Appendix E - Part 1

Noise and vibration technical report

Prepared for
Transport for NSW
ABN: 18 804 239 602

Noise and vibration technical report

Westlink M7 Widening

28-Jul-2022
Westlink M7 Widening
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Noise and vibration technical report

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Client: Transport for NSW

ABN: 18 804 239 602

Prepared by

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Glossary of terms and abbreviations

Term	Definition
Sound power level	The total sound emitted by a source.
Sound pressure level	The amount of sound at a specified point.
Decibel [dB]	The measurement unit of sound.
A Weighted decibels [dB(A)]	The A weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1 kHz and 4 kHz) which the human ear is most sensitive to, and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A).
Decibel scale	The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB(A) increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB(A) increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows: 0 dB(A) Threshold of human hearing 30 dB(A) A quiet country park 40 dB(A) Whisper in a library 50 dB(A) Open office space 70 dB(A) Inside a car on a freeway 80 dB(A) Outboard motor 90 dB(A) Heavy truck pass-by 100 dB(A) Jack hammer / subway train 110 dB(A) Rock concert 115 dB(A) Limit of sound permitted in industry 120 dB(A) 747 take off at 250 metres
Frequency [f]	The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high pitched sound and a low frequency to a low pitched sound.
Equivalent continuous sound level [Leq]	The constant sound level which, when occurring over the same period of time, would result in the receiver experiencing the same amount of sound energy.
Insertion loss	Reduction in noise by inserting a barrier between the source and receiver.
L_{max}	The maximum sound pressure level measured over the measurement period.
L_{min}	The minimum sound pressure level measured over the measurement period.
L_{10}	The sound pressure level exceeded for 10% of the measurement period. For 10% of the measurement period it was louder than the L_{10}.
L_{90}	The sound pressure level exceeded for 90% of the measurement period. For 90% of the measurement period it was louder than the L_{90}.
Ambient noise	The all-encompassing noise at a point composed of sound from all sources near and far.

Term	Definition
Background noise	The underlying level of noise present in the ambient noise when extraneous noise (such as transient traffic and dogs barking) is removed. The L_{90} sound pressure level is used to quantify background noise.
Traffic noise	The total noise resulting from road traffic. The L_{eq} sound pressure level is used to quantify traffic noise.
Day	Construction noise: The period from 0700 to 1800 h Monday to Saturday and 0800 to 1800 h Sundays and Public Holidays. Road traffic noise: The period from 0700 to 2200 h every day of the week.
Evening	Construction noise: The period from 1800 to 2200 h Monday to Sunday and Public Holidays. Road traffic noise: Not applicable.
Night	Construction noise: The period from 2200 to 0700 h Monday to Saturday and 2200 to 0800 h Sundays and Public Holidays. Road traffic noise: The period from 2200 to 0700 h every day of the week.
Assessment background level [ABL]	The overall background level for each day, evening and night period for each day of the noise monitoring.
Rating background level [RBL]	The overall background level for each day, evening and night period for the entire length of noise monitoring.
Noise management level [NML]	The level which represents the point above which there may be some community reaction to noise.

Executive Summary

The Westlink M7 (formerly called the Western Sydney Orbital) is an existing 39-kilometre-long toll road connecting the M5 Motorway at Prestons, the M4 Motorway at Eastern Creek and The Hills M2 Motorway at Baulkham Hills (the approved project). Transport for NSW (Transport) is seeking a modification to the approved project to widen part of the Westlink M7 into the existing median. This is proposed in response to recent and forecast traffic growth, to improve motorway efficiency, travel time performance and safety.

The proposed modification would enable the construction and operation of an additional lane in both directions within the existing median of the Westlink M7, for approximately 26 kilometres from about 140 metres south of the Kurrajong Road overhead bridge at Prestons to the Westlink M7 bridge at Richmond Road in the suburbs of Oakhurst and Glendenning, excluding widening through the Westlink M7/M4 Motorway (Light Horse) Interchange.

This technical paper provides a detailed report assessing potential noise and vibration impacts from both the construction and operational phases of the project. Relevant guidelines and assessment procedures have been followed to ensure all applicable state requirements have been considered. The project's Secretary's Environmental Assessment Requirements (SEARs) have also been referenced in the assessment to ensure that all potential impacts have been adequately considered.

A survey has been undertaken of the existing conditions throughout the area surrounding the proposed modification. Buildings throughout the study area have been visually inspected (from the outside) to identify their likely use and the number of storeys. Background noise levels have been monitored at a total of 17 locations to identify the existing noise environment throughout the study area. The existing noise environment allows this assessment to define appropriate noise criteria and validate the operational road noise model.

A construction noise assessment has been conducted in accordance with the *Interim Construction Noise Guideline* and *Construction Noise and Vibration Guideline*. Reasonable worst case construction scenarios have been assessed. Construction of the project is likely to primarily occur outside of standard construction hours to minimise impacts to the road network.

The assessment of noise associated with the construction of the proposed modification indicates some exceedances of the *Interim Construction Noise Guideline* noise management levels at the most affected sensitive receivers. The magnitude and number of exceedances are detailed in **Chapter 6.0**. Exceedances of the noise management levels occur during the day and night at the most affected sensitive receivers during certain activities. The magnitude of these impacts is consistent with other major works projects and highlights the need for effective noise mitigation and management planning.

Measures have been recommended to mitigate the construction noise impact at adjacent sensitive receivers. The implemented measures would ultimately be selected by the contractor and be largely dependent on the construction strategy and work undertaken. Specific noise management and mitigation measures would be detailed in the contractor's Construction Noise and Vibration Management Plan. The recommended management and mitigation measures which would be considered in the plan include:

- Effective community consultation
- Training of construction site workers
- Use of noise walls
- Noise monitoring
- Appropriate selection and maintenance of equipment
- Scheduling of work for less sensitive time periods
- Situating plant in less noise sensitive locations
- Construction traffic management
- Respite periods.

Minimum working distances for vibration intensive construction works have been presented. Equipment size would be selected by the contractor taking into account the minimum working distances and the distance between the area of construction and the most affected sensitive receiver. If works need to be undertaken within minimum working distances, vibration monitoring would be undertaken.

Construction traffic would increase road traffic noise level in some areas, but increases would be less than 2 dB(A) during the daytime and night-time periods. An increase of 2 dB(A) or less is compliant with the traffic noise increase criterion in the *Road Noise Policy*.

Cumulative construction noise impacts may occur as a result of construction works for the modification occurring simultaneously and other major projects, such as the M12 Motorway occurring within proximity to the project. Consultation would be undertaken between the projects to minimise potential impacts where feasible and reasonable.

An operational road traffic noise assessment has been completed in accordance with the Environment Protection Authority's *NSW Road Noise Policy* and Roads and Maritime's *Noise Criteria Guideline* and *Noise Mitigation Guideline*.

Exceedances of the applicable noise criteria have been identified. The majority of these exceedances are exceedances of the acute noise limit. These exceedances are generated by existing high noise levels throughout the study area due to operation of the existing Westlink M7 motorway. Appropriate noise mitigation has been recommended to minimise adverse impacts on the community by the project, in accordance with the *Noise Mitigation Guideline* and the draft *At-Receiver Noise Treatment Guideline*.

Noise mitigation in the form of noise walls or noise wall adjustments, and architectural treatments have been considered to protect the community. Some recommendations have been made for adjustments to existing noise walls and for new noise walls. At-receiver architectural treatment has also been recommended at a number of sensitive receivers that were found eligible for the consideration of noise mitigation. These requirements would be clarified at the detailed design phase when more information would be available.

Operational traffic noise would be monitored at sensitive receivers between six months and one year after opening. If the traffic noise levels are above the levels as predicted during detailed design, consideration of additional feasible and reasonable mitigation measures would be undertaken.

1.0 Introduction

The Westlink M7 is an existing 39-kilometre-long toll road connecting the M5 Motorway at Prestons, the M4 Motorway at Eastern Creek and The Hills M2 Motorway at Baulkham Hills (the approved project). Transport for NSW (Transport) is seeking a modification to the approved project to widen part of the Westlink M7 in response to current and forecast traffic growth, and to improve motorway efficiency, travel time performance and safety ('the proposed modification').

1.1 Overview of proposed modification

Transport, as the proponent for the proposed modification, is requesting that the Minister for Planning and Homes modify the planning approval for the Western Sydney Orbital (now referred to as Westlink M7) under section 5.25 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The original approval (DPE reference number SSI-663) was for the construction and operation of the four-traffic lane motorway. The proposed modification would provide an additional trafficable lane in both directions within the existing median of the Westlink M7. The motorway would be widened from about 140 metres south of the Kurrajong Road bridge at Prestons (southern end) to the intersection with Richmond Road in Oakhurst/Glendenning (northern end), excluding at the M4 Motorway/Westlink M7 Motorway (Light Horse) interchange. The extent of the approved project and the proposed modification is shown in **Figure 1**.

This report includes:

- An overview of the proposed modification
- An assessment of the potential noise and vibration impacts of the proposed modification
- Identification of additional noise mitigation measures required by the proposed modification.

The assessment of potential environmental impacts has been undertaken to meet the Secretary's Environmental Assessment Requirements (SEARs) issued for the proposed modification.

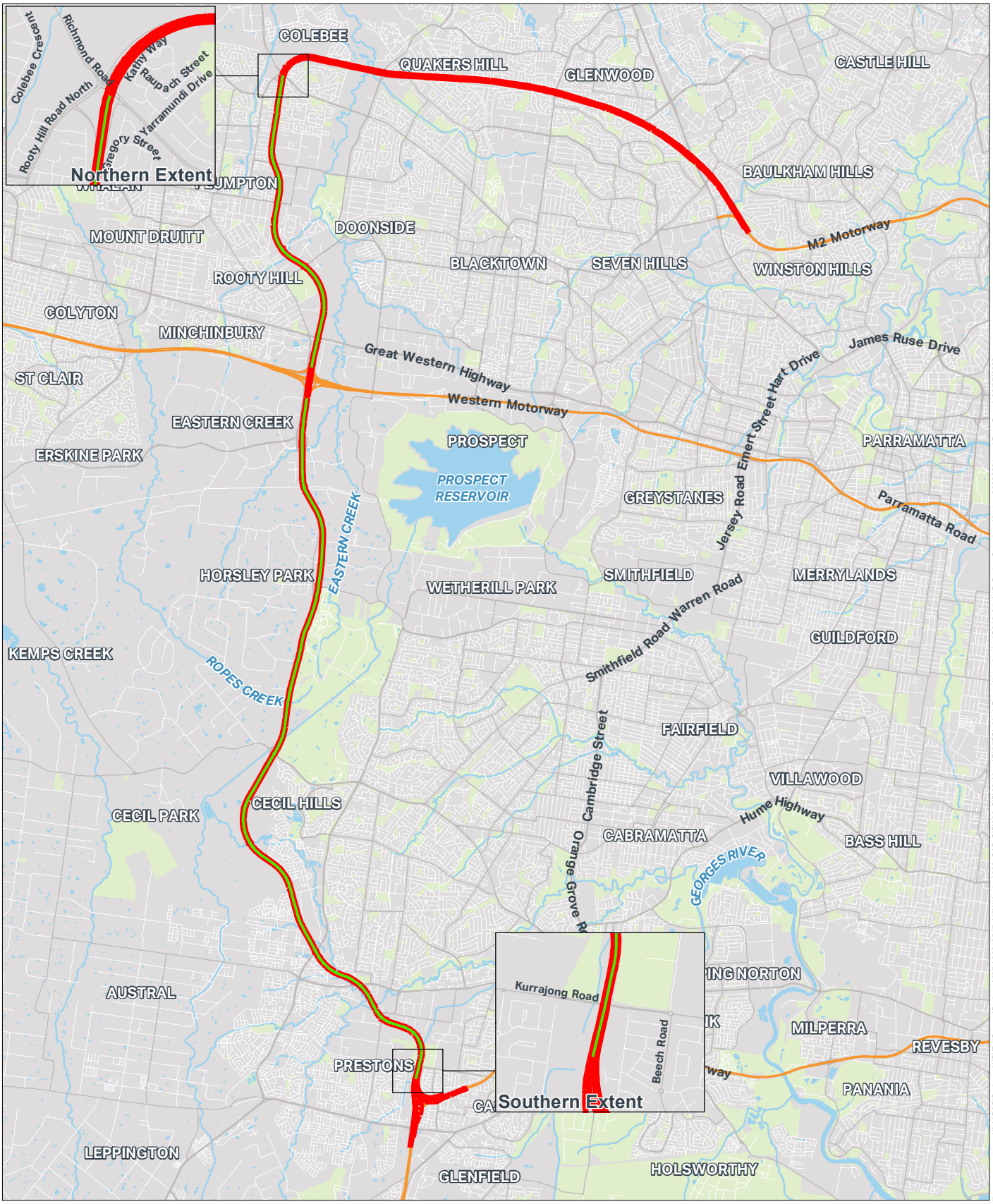

FIGURE 1: EXTENT OF THE APPROVED PROJECT AND THE PROPOSED MODIFICATION

N

0 2 4 km

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Legend

- Proposed modification
- Approved project
- Motorway
- Primary road

Source:

1.2 The proposed modification

The proposed modification would permit the addition of a trafficable lane in both directions within the existing median of the Westlink M7. A full description of the construction activities and operational features are provided in detail in **Chapter 4** (Proposed modification) of the Modification Report.

The proposed modification to the approval for the Westlink M7 would include the following key operational components:

- Widening of the motorway into the existing median for a length of about 26 kilometres along the Westlink M7 from about 140 metres south of the Kurrajong Road overhead bridge at Prestons (southern end) to Richmond Road interchange in Oakhurst/Glendenning (northern end), excluding at the M4 Motorway/Westlink M7 (Light Horse) Interchange

  Widening the exit from the Westlink M7 northbound onto the M4 Motorway westbound from one lane to two lanes
- Widening of 43 existing northbound and southbound bridges on the Westlink M7 at 23 locations within the centre median, and widening on the outside of the bridges on the approach to the M4 Motorway from Old Wallgrove Road
- Upgrades, additions, and modifications to noise walls
- Utility works and upgrades to drainage
- Intelligent Transport System (ITS) installations, adjustments, and relocations to cover the new lane configurations.

Existing operational features affected by the proposed modification would include:

- Main road alignment, including median and bridge areas
- Interchanges, tie-ins and entry/exit ramps
- Fill embankments and cuttings
- Culverts and drainage structures
- Water quality control measures, including basins
- Landscaping
- Existing public art and landscaping at the M4 (Light Horse) Interchange
- Maintenance access
- Security fencing
- Noise walls
- Shared path
- Other associated elements required during operation (for example, ITS, utilities and variable message signs (VMS)).

The following activities would be required to facilitate construction of the proposed modification:

- Establishment of several construction ancillary facilities within and adjacent to the Westlink M7 and the M12 Motorway construction area. These would be used for stockpiling, construction support at bridge and median widening locations, project offices and compounds. The precise number and location of construction ancillary facilities would be determined by the construction contractor in accordance with the environmental approval
- Vegetation clearing within the median/widening areas and construction ancillary facilities (including for construction access)
- Demolition of existing structures and infrastructure within the widening areas

- Provision of temporary water management infrastructure including the maintenance of stormwater drainage and establishment of waterway crossings and diversions
- Utility works within Westlink M7 and adjoining roads, particularly around existing motorway bridge substructures
- Earthworks for bridge and road widening within the existing median, and placement and compaction of fill material, with a likely net volume of spoil material
- Bridge widening including establishment of substructures such as piles, abutments, piers and headstocks and superstructures including beams, girders, decks and barriers
- Pavement widening works within the road median
- Finishing works including asphalting the carriageway surface, line marking, signage, permanent barriers and median infill, adjustments to noise walls, installation of communications infrastructure and landscaping treatments.

Temporary road network changes would be required including a reduction in speed limits along the Westlink M7, temporary traffic diversions and lane closures. Two lanes in each direction on the Westlink M7 would be maintained during peak traffic periods. Temporary lane and full local road closures, as well as temporary off-motorway detour routes, would be required to support the construction of widened bridges. Construction access and haulage routes would primarily utilise the Westlink M7, however would also include roads adjacent to the Westlink M7. The existing Westlink M7 shared path would also be closed in places, however appropriate detours would be provided to maintain full north-south connectivity.

Construction would likely commence in 2023 and continue through to the end of 2025. The construction program for the M12 Motorway, and how this interfaces with the Westlink M7, has been considered in the development of this program. It is proposed to construct the proposed modification at this interchange at the same time as the M12 Motorway project works to minimise disruption and achieve efficiencies during construction.

1.3 Purpose of this report

This working paper provides a noise and vibration impact assessment of the project and has been prepared to support the Modification Report. The construction and operational phases of the report have been assessed using the applicable noise and vibration guidelines.

1.4 Secretary's Environmental Assessment Requirements

The Secretary's Environmental Assessment requirements (SEARs) which relate to noise and vibration are presented in **Table 1-1**.

Table 1-1 SEARs – Noise and vibration

Desired Performance Outcome	Assessment requirements	Where addressed in this report
2. Noise and Vibration – Amenity Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimise adverse impacts on acoustic amenity, and adverse impacts on the structural integrity of buildings and items including Aboriginal places and environmental heritage. Increases in noise emissions and vibration affecting nearby properties and other sensitive receivers during operation of the project are effectively managed to protect the amenity and well-being of the community. Increases in noise emissions and vibration affecting environmental heritage as defined in the Heritage Act 1977 during operation of the project are effectively managed.	1. The Proponent must assess construction and operational noise and vibration impacts in accordance with relevant NSW noise and vibration guidelines and policies, including how the measures in the guidelines will be implemented and their effect on reducing the level and impact of noise and vibration. The assessment must take into consideration and address the redistribution of traffic (including on local feeder roads), operational plant and equipment, and the characteristics of noise and vibration (for example, low frequency noise). It must consider the impacts to sensitive receivers, including sleep disturbance (in terms of noise levels and number of noise-awakening events).	
	2. The assessment of construction noise and vibration must be undertaken in accordance with the *Interim Construction Noise Guideline* (DECC 2009) (ICNG) relevant guidelines, and must:	Section 4.0
	a. describe the nature of construction activities and related noise characteristics (including annoying activities described in the ICNG) using typical and worst-case scenarios and identify high noise generating activities;	Section 4.1
	b. detail the intensity and duration of noise (both air and ground borne) and vibration impacts. This must include consideration of high noise generating activities and extended construction impacts associated with ancillary facilities (and the like) and construction fatigue;	Section 4.2
	c. identify the nature and location of sensitive receivers;	Section 2.2
	d. describe the nature and level of the impact and the sensitivity of receivers, including for out of hours works; (NOTE: subjective and qualitative language must not be used to describe or group noise impacts. Eg terms such as "negligible" and "low" should be avoided);	Section 4.2.1, Section 4.2.2
	e. identify factors that may influence the timing and duration of noisy and vibration generating construction activities;	Section 4.2.1, Section 4.2.2

Desired Performance Outcome	Assessment requirements	Where addressed in this report
	f. identify and document the potential for works outside standard construction hours (including utility works and works associated with the proposed development including those undertaken under another assessment and approval pathway, including but not limited to: - justification for the activity(ies) in terms of the *Interim Construction Noise Guideline* (DECCW, 2009) - location of the activity(ies) - predicted noise and vibration levels, and exceedances - number of potentially affected receivers, and - timing and duration of the activity(ies).	Section 4.2, Section 4.2.1
	g. include a cumulative noise and vibration assessment inclusive of impacts from the project (including concurrent project construction activities) and the construction of other relevant development in the vicinity of the project;	Section 4.2.3
	h. assess the potential for sleep disturbance (including the number of noise-awakening events);	Section 4.2.4
	i. provide details and analysis of the predicted effectiveness of temporary or permanent mitigation measures to adequately manage identified impacts,	Section 6.2.6
	j. describe any potential residual noise and vibration impacts following application of mitigation measures; and	Section 6.2.5
	k. include a description of how receiver feedback received during the preparation of the EIS has been taken into account (and would be taken into account post exhibition of the EIS) in the design of mitigation measures, including any tailored mitigation, management and communication strategies for sensitive receivers.	Consultation would be considered in mitigation as described in Sections 4.2.1, 6.1.2, 6.2.6
	3. The assessment of construction traffic and operational traffic noise undertaken in accordance with the NSW *Road Noise Policy* (DECCW) must include:	
	a. justification for the model used in accordance with the *Road Noise Policy* Appendix B4 and B5;	Section 5.1.1
	b. consideration of how the potential for maximum noise levels to cause sleep disturbance has informed the mitigation measures;	Section 5.1.1
	c. consideration of the effects of road gradient on road emissions and speed of vehicles; and	Section 5.1.1

Desired Performance Outcome	Assessment requirements	Where addressed in this report
	d. consider meteorological conditions by noting any wind or temperature inversion conditions that are characteristic of the area and discuss the effects on traffic noise from the project according to the NSW *Road Noise Policy* *Note: Consideration of changes to traffic volumes as a result of recent strategic and project land use change in the project's road catchment must be considered in the noise assessment*	Section 5.1.1
	4. The process for community engagement should be included or referenced in the noise and vibration assessment as part of the mitigation strategy and assessment.	Section 6.1.2

1.5 Structure of this report

This report is structured as follows:

- **Chapter 1 – Introduction**. This chapter introduces the proposed modification and describes the operational area
- **Chapter 2 – Existing environment**. This chapter provides a description of the existing noise environment within the study area
- **Chapter 3 – Assessment methodology**. This chapter summarises the assessment criteria that applies to this assessment
- **Chapter 4 – Assessment of construction noise and vibration impacts**. The chapter provides the results of the construction noise and vibration impact assessment
- **Chapter 5 – Assessment of operational noise impacts**. This chapter provides the results of the operational noise impact assessment for road traffic noise
- **Chapter 6 – Management of impacts**. The chapter outlines the recommended mitigation and management measures for potential construction and operational noise, subject to detailed design
- **Chapter 7 – Conclusion**. This chapter presents the conclusion to the report.

2.0 Existing Environment

2.1 Overview

The proposed modification covers several suburbs surrounding the Westlink M7, from about 140 metres south of the Kurrajong Road overhead bridge at Prestons to the Westlink M7 bridge at Richmond Road in the suburbs of Oakhurst and Glendenning.

The noise and vibration impact assessment has considered two study areas.:

- Construction noise assessment study area which comprises a number of noise catchment areas (NCA) as detailed in **Section 3.2.1.**
- Operational road traffic noise study area which extends to where noise levels are dominated by other roads that are not being assessed as part of this proposal, as detailed in the *Noise Criteria Guideline*. This is up to a maximum distance of 600 metres from the centre line of the outermost traffic lane on each side of the road under consideration.

The study areas include a mixture of receivers sensitive to noise and vibration such as, residential properties, educational establishments, hospitals, recreational areas, commercial and industrial properties.

Existing key sources of noise within the study area include transport infrastructure, such as the existing Westlink M7, M5 Motorway, M4 Motorway, M2 Motorway, the arterial road network, North Shore and Western railway line and industrial/commercial properties.

2.2 Noise sensitive receivers

Receivers surrounding the M7 corridor are mostly single or double storey residential dwellings. There are also a few industrial and commercial receivers in Glendenning, Rooty Hill, Eastern Creek and Hoxton Park. Several active recreational receivers, including Blacktown Sports Park and Sydney International Equestrian Centre, are also located in close proximity to the Westlink M7. All residential receivers included in the assessment are identified in **Appendix A**.

Noise catchment areas (NCA) have been determined for the construction noise and vibration assessment (as detailed in **Section 3.2.1**). NCAs are areas where receivers have a similar land use and ambient noise environment. They are used to group receivers affected by the same works to assist with assessment, consultation and mitigation. The NCAs are identified in **Appendix A**.

Noise sensitive receivers other than residential receivers are listed in **Table 2-1** and shown in the figures in **Appendix A**.

Table 2-1 Notable sensitive receivers within the study area (non-residential)

Receiver	Receiver Type
Amity College, Prestons campus	School
Good Shepherd Catholic Primary School	School
Good Samaritan Catholic College	School
Hoxton Park High School	School
Middleton Grange Public School	School
Thomas Hassall Anglican College	School
Horsley Park Public School	School
Eastern Creek Public School	School
St Agnes Catholic High School	School
Rooty Hill Public School	School
Plumpton High School	School

Receiver	Receiver Type
Glendenning Public School	School
St Clare's Catholic High School	School
Bilal Mosque	Place of Worship
Inspire Church & Childcare Centre	Place of Worship
Saint Zaia Cathedral	Place of Worship
Our Lady of Victories	Place of Worship
Solo En Cristo Hay Salvacion	Place of Worship
Our Lady of Consolation	Place of Worship
MBM Rooty Hill	Place of Worship
Plumpton Community Church	Place of Worship
Oakhurst Anglican Church	Place of Worship
Western Sydney Parklands	Passive & Active Recreation Area
Sydney International Equestrian Centre	Active Recreation Area
Sydney Zoo	Passive Recreation Area
Western Sydney Wanderers FC	Active Recreation Area
Blacktown International Sports Park	Active Recreation Area

2.3 Ambient noise monitoring

Ambient noise monitoring was undertaken at 19 locations as listed in **Table 2-2** between 23 February and 11 March 2021.

Concurrent traffic counts were undertaken during the monitoring period. This data has been used to validate the operational road traffic noise model. Results from the monitoring period have been used to establish construction noise management levels.

The locations for the unattended noise loggers were determined through examination of aerial photography and site inspections. Attended noise measurements were also undertaken to determine the nature of the local noise environment and confirm road traffic as the controlling noise source (for the validation of the operational noise model).

The noise logging locations are shown in **Appendix A.** The noise logging results are provided graphically in **Appendix B.**

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 levels 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.

The results of the noise monitoring have been processed in accordance with the procedures contained in the *NSW Road Noise Policy* and the *Noise Policy for Industry*. Weather data recorded during the noise monitoring survey periods was obtained from the Bureau of Meteorology weather station, located at Horsley Park (ID067119). Periods which were affected by noise from extraneous wind and rain were omitted from the results, as indicated in **Appendix B**.

Details of each noise logging location and the purpose of each noise logger are provided in **Table 2-2** below. As the study areas include receivers up to 600 metres from the alignment of roads, noise loggers have been located at varying distances from the existing road alignments. This allows the accuracy of the model to be confirmed over the extent of the proposal.

Table 2-2 Noise logging locations

Location ID[1]	Address	Purpose		Measurement period
		Construction	Operational	
NL1	79 Armitage Drive, Glendenning	✓	-	26 Feb to 5 March 2021
NL2	20 Ridgeview Place, Oakhurst	✓	-	26 Feb to 4 March 2021
NL3	Lot 2, DP1033513, Glendenning	✓	✓	25 Feb to 11 March 2021
NL4	Lot 671, DP740870, Glendenning	✓	✓	26 Feb to 6 March 2021
NL5	Lot 5, DP1042577, Rooty Hill	-	✓	25 Feb to 11 March 2021
NL6	Lot 8, DP1042004, Horsley Park	✓	✓	23 Feb to 6 March 2021
NL8	Lot 30, DP1022008, Horsley Park	✓	✓	25 Feb to 11 March 2021
NL9	Lot 35, DP1021940, Cecil Park	✓	✓	23 Feb to 3 March 2021
NL10	Lot 24, DP1042996, Cecil Park	-	✓	25 Feb to 10 March 2021
NL11	20 Toulouse Street, Cecil Hills	✓	-	26 Feb to 4 March 2021
NL12	Lot 24, DP1042996, Elizabeth Hills	✓	✓	25 Feb to 11 March 2021
NL13	23 Lightning Ridge Road, Hinchinbrook	✓	-	26 Feb to 8 March 2021
NL14	53 Hemsworth Avenue, Middleton Grange	✓	✓	25 Feb to 8 March 2021
NL15	Lot 28, DP1123873, Prestons	✓	✓	23 Feb to 1 March 2021
NL17	11 Skipton Lane, Prestons	✓	✓	25 Feb to 3 March 2021
NL18	1A Burley Road, Horsley Park	✓	-	26 Feb to 3 March 2021
NL19	Lot 13, DP1040948, Eastern Creek	✓	✓	23 Feb to 5 March 2021

Notes:

1. *Noise loggers were placed at two additional locations (NL7 and NL16) however one appeared to have been tampered with and another failed after a short period of time.*

2.4 Unattended background noise monitoring results

The background noise monitoring results are provided in **Table 2-3**. These noise levels were used to define the appropriate construction noise management levels, consistent with the *Interim Construction Noise Guideline* (ICNG).

The assessment background levels (ABL) were established by determining the lowest tenth-percentile level of the L_{A90} noise data acquired over each assessment period of interest. The background noise level or rating background levels (RBL) representing the day, evening and night-time assessment periods were based on the median of individual ABLs determined over the entire monitoring duration.

Table 2-3 also presents the ambient L_{Aeq} levels at each monitoring location. The L_{Aeq} level is the equivalent continuous sound level and has the same sound energy over the sample period as the actual noise environment with fluctuating sound levels.

The noise levels presented in **Table 2-3** indicate that the noise environment at the measurement locations are typical of those located along major transport corridors in suburban/urban noise areas, where daytime and evening background levels are high due to heavy and continuous traffic flows. The night-time background levels tend to decrease as a result of reduced traffic flows.

Table 2-3 Ambient and background noise measurements

Noise logger	Ambient noise level dB(A)			RBL[1], dB(A)		
	Day (7am to 6pm) $L_{Aeq,15\ hour}$	Evening (6pm to 10pm) $L_{Aeq,4\ hour}$	Night (10pm to 7am) $L_{Aeq,9\ hour}$	Day (7am to 6pm) $L_{A90,15\ min}$	Evening (6pm to 10pm) $L_{A90,15\ min}$	Night (10pm to 7am) $L_{A90,15\ min}$
NL1	60	57	55	50	46	40
NL2	60	61	48	44	41	38
NL3	73	71	69	66	56	42
NL4	74	71	70	66	57	49
NL5	76	73	71	65	60	56
NL6	67	64	63	60	56	47
NL8	78	75	74	67	60	45
NL9	70	67	66	65	57	45
NL10	66	64	63	59	54	45
NL11	56	51	50	44	43	39
NL12	70	65	63	57	53	45
NL13	57	56	49	46	45	39
NL14	61	60	58	54	51	41
NL15	57	56	53	47	53[2]	42
NL17	59	58	58	49	54[2]	48
NL18	55	60	60	47	51[2]	51[2]
NL19	73	70	69	63	55	47

Notes:

1 *Rating Background Level*

2 *Application notes to the Noise Policy for Industry indicate that the community generally expects a greater control of noise during the evening and night as compared to the daytime. Therefore the rating background level for the evening is set to no more than that for the daytime and the night-time to no more than the evening.*

2.5 Short term attended measurements

Short term attended noise measurements were undertaken to establish the existing ambient noise environment at potentially affected receivers around the Project. The acoustic instrumentation employed during attended noise measurements comply with the requirements of *AS IEC 61672.1-2019 Electroacoustics – Sound level meters Specifications* and were within their current National Association of Testing Authorities, Australia (NATA) certified in-calibration period (i.e. calibration in the last two years).

Due to road corridor access time restrictions it was not possible to complete attended measurements at all the logger locations. Attended noise measurements were conducted at ten unattended noise

monitoring locations on 3-5 February 2021. The measurements were conducted over 15 minute periods. Weather conditions were sunny on the days of monitoring, with no wind.

Attended noise measurements were conducted using a Brüel & Kjær Type 2250 sound level meter. The sound level meter used is designated as a Class 1 instrument and has accuracy suitable for laboratory and field use. The sound level meter was calibrated before and after the measurements with no drift in calibration exceeding ±0.5 dB(A).

The results of the 15 minute attended noise monitoring are presented in **Table 2-4**.

Table 2-4 Attended noise measurements

Location	Date	Time	L_{Aeq} dB(A)	L_{A90} dB(A)	Comments
NL1	04/02/2021	16:50	59	50	Road traffic noise on Westlink M7 audible 57 dB(A). Local traffic noise on Armitage Drive, 69 dB(A).
NL2	03/02/2021	10:51	47	42	Background noise dominated by Road traffic on Westlink M7, 51 dB(A).Cicadas audible, birds chirping nearby, 56 dB(A). Sunny weather.
NL7	03/02/2021	12:07	68	63	Background dominated by Road traffic noise on Westlink M7, 68 dB(A). Sunny weather.
NL11	04/02/2021	14:41	56	50	Noise dominated by cicadas. Road traffic noise 54 dB(A). Sunny weather. Bird calls audible. Helicopter fly by 64 dB(A). Car pass by on Toulouse street 66 dB(A).
NL12	05/02/2021	11:10	65	58	Dominated by Road traffic noise on Westlink M7 61 dB(A).truck 71 dB(A). Cicadas and bird calls audible.
NL13	03/02/2021	13:27	53	49	Background dominated by Road traffic noise on Westlink M7, 56 dB(A). Birds chirping 51 dB(A). Sunny weather.
NL16	04/02/2021	11:09	60	56	Cicadas dominate noise environment. Road traffic noise on Westlink M7 audible, 59 dB(A). Sunny weather.
NL17	03/02/2021	15:51	56	46	Cicadas audible. Birds chirping. Sunny weather. Background dominated by Road traffic noise on Westlink M7, 46 dB(A). Car on Skipton Lane, 60.8 dB(A). Truck on Skipton Lane, 78 dB(A).
NL18	04/02/2021	15:28	54	52	Dominated by Road traffic noise on Westlink M7 and Wallgrove road, 54 dB(A). Neighbour using drill, 63 dB(A). Bird calls and insects audible. Sunny weather.
NL19	05/02/2021	13:58	73	65	Dominated by Road traffic noise on Westlink M7 76 dB(A). Truck near lane 80 dB(A). Sunny weather. Cicadas audible.

3.0 Assessment methodology

3.1 Relevant guidelines and policies

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

- Construction noise:
  - *Construction Noise and Vibration Guideline* (CNVG) (Roads and Maritime 2016)
  - *Interim Construction Noise Guideline* (ICNG) (DECC 2009)
  - *Construction Noise and Vibration Strategy* (CNVS) (Transport for NSW 2019)
  - *Draft Construction Noise guideline* (CNG) (EPA 2021)
- 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)
- Operational traffic noise:
  - *NSW Road Noise Policy* (RNP) (DECCW 2011)
  - *Noise Criteria Guideline* (NCG) (Roads and Maritime 2015a)
  - *Noise Mitigation Guideline* (NMG) (Roads and Maritime 2015b)
  - *Noise Model Validation Guideline* (Roads and Maritime 2016)
  - *Application Notes – Noise Criteria Guideline* (Roads and Maritime 2015a)
  - *Environmental Noise Management Manual* (Roads and Maritime 2001)
  - *Procedure for Preparing an Operational Noise and Vibration Assessment* (Roads and Maritime 2011b)
  - *Draft At-Receiver Noise Treatment Guideline (ANTG) (Roads and Maritime 2017)*
- Sleep disturbance during construction and operation:
  - *NSW Road Noise Policy* (RNP) (DECCW 2011)
  - *Noise Policy for Industry* (NPfI) (NSW Environment Protection Authority (NSW EPA) 2017).

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

3.2 Construction noise

The potential risk of adverse impact of construction noise on a receiver is determined by the extent of its emergence above the existing background noise level, the duration of the event and the characteristics of the noise.

The *Interim Construction Noise Guideline* is a NSW Government document that identifies ways to manage impacts of construction noise on residences and other sensitive land uses. It is the principal guideline for the assessment and management of construction noise in NSW and is used to establish construction noise management levels (NML).

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 ‘reasonable’ worst case construction scenarios, has been carried out for these works. Noise levels resulting from

construction activities are predicted at nearby noise sensitive receivers using environmental noise modelling software and compared to the noise management levels, derived in accordance with the *Interim Construction Noise Guideline*.

Where an exceedance of the noise management 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 impacted residents of the nature of the works to be carried out, the expected noise level and duration, as well as provide contact details to facilitate feedback from affected residents during construction.

Where construction noise levels at a 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 *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.

Additionally the *Interim Construction Noise Guideline* notes that strong justification is required for work that is proposed outside of standard working hours.

Noise management levels for the project for residential receivers are derived using the information in **Table 3-1**.

Table 3-1 Construction noise management levels – Residential receivers (from the *Interim Construction Noise Guideline*)

Time of day	Construction noise management level $L_{Aeq,15min}$	How to apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected RBL + 10 dB(A)	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, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 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)	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate 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 metres above ground level. If the property boundary is more than 30 metres from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 metres of the residence. Noise levels may be higher at upper floors of the noise affected residence.

3.2.1 Noise catchment areas

The study area has been divided into 34 distinct noise catchment areas (NCAs). The noise environment at each of the sensitive receivers within a noise catchment area is considered to have a similar noise environment to the unattended monitoring location within that NCA. Where an NCA does not have an unattended monitoring location within it, it is associated with a monitoring location most similar to it based on site observations. As such each of these sensitive receivers within an NCA is assigned the same background noise level and noise management level. The location of each NCA is provided graphically in **Appendix A**. Details of the construction noise management levels in each NCA are provided in **Table 3-2.**

Table 3-2 Noise catchment areas and construction noise management levels

NCA	Representative logger	Period	Rating background level, dB(A)	Construction noise management level (NML)[2,3,4]
NCA01	13	Day	46	56 (51)
		Evening	45	50
		Night	39	44
NCA02	17	Day	49	59 (54)
		Evening	49[1]	54
		Night	48	53
NCA03	13	Day	46	56 (51)
		Evening	45	50
		Night	39	44
NCA04	13	Day	46	56 (51)
		Evening	45	50
		Night	39	44
NCA05	13	Day	46	56 (51)
		Evening	45	50
		Night	39	44
NCA06	17	Day	49	59 (54)
		Evening	49[1]	54
		Night	48	53
NCA07	15	Day	47	57 (52)
		Evening	47[1]	52
		Night	42	47
NCA08	13	Day	46	56 (51)
		Evening	45	50
		Night	39	44
NCA09	13	Day	46	56 (51)
		Evening	45	50
		Night	39	44
NCA10	14	Day	54	64 (59)
		Evening	51	56
		Night	41	46
NCA11	11	Day	44	54 (49)
		Evening	43	48
		Night	39	44

NCA	Representative logger	Period	Rating background level, dB(A)	Construction noise management level (NML)[2,3,4]
NCA12	13	Day	46	56 (51)
		Evening	45	50
		Night	39	44
NCA13	12	Day	59	69 (64)
		Evening	52	57
		Night	45	50
NCA14	11	Day	44	54 (49)
		Evening	43	48
		Night	39	44
NCA15	11	Day	44	54 (49)
		Evening	43	48
		Night	39	44
NCA16	11	Day	44	54 (49)
		Evening	43	48
		Night	39	44
NCA17	9	Day	65	75 (70)
		Evening	57	62
		Night	45	50
NCA18	18	Day	47	57 (52)
		Evening	47[1]	52
		Night	47[1]	52
NCA19	18	Day	47	57 (52)
		Evening	47[1]	52
		Night	47[1]	52
NCA20	8	Day	67	77 (72)
		Evening	60	65
		Night	45	50
NCA21	6	Day	60	70 (65)
		Evening	56	61
		Night	47	52
NCA22	19	Day	63	73 (68)
		Evening	55	60
		Night	47	52
NCA23	2	Day	44	54 (49)
		Evening	41	46
		Night	38	43

NCA	Representative logger	Period	Rating background level, dB(A)	Construction noise management level (NML)[2,3,4]
NCA24	2	Day	44	54 (49)
		Evening	41	46
		Night	38	43
NCA25	2	Day	44	54 (49)
		Evening	41	46
		Night	38	43
NCA26	3	Day	66	76 (71)
		Evening	56	61
		Night	42	47
NCA27	1	Day	50	60 (55)
		Evening	46	51
		Night	40	45
NCA28	4	Day	66	76 (71)
		Evening	57	62
		Night	49	54
NCA29	2	Day	44	54 (49)
		Evening	41	46
		Night	38	43
NCA30	2	Day	44	54 (49)
		Evening	41	46
		Night	38	43
NCA31	3	Day	66	76 (71)
		Evening	56	61
		Night	42	47
NCA32	1	Day	50	60 (55)
		Evening	46	51
		Night	40	45
NCA33	2	Day	44	54 (49)
		Evening	41	46
		Night	38	43
NCA34	2	Day	44	54 (49)
		Evening	41	46
		Night	38	43

Notes:

1 *Application notes to the Industrial Noise Policy indicate that the community generally expects a greater control of noise during the evening and night as compared to the daytime. Therefore the rating background level for the evening is set to no more than that for the daytime and the night-time to no more than the evening.*

2 *Day noise management levels = RBL + 10 dB(A)*

3 *Evening/night noise management levels = RBL + 5 dB(A)*

4 Day Out of Hours Management level given in brackets

3.2.2 Non-residential criteria

Noise management levels recommended by the *Interim Construction Noise Guideline* for non-residential sensitive land uses, such as schools, hospitals or places of worship are provided in **Table 3-3**. Noise management levels for commercial and industrial premises are provided in **Table 3-4**.

Table 3-3 Construction noise management levels – non-residential sensitive land uses

Land use	Management level, $L_{Aeq(15\ min)}$
Classrooms at schools and other educational institutions	Internal noise level 45 dB(A)
Hospital wards and operating theatres	Internal noise level 45 dB(A)
Places of worship	Internal noise level 45 dB(A)
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dB(A)
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dB(A)
Community centres	Depends on the intended use of the centre. Refer to the recommended “maximum” internal levels in AS2107 for specific uses.

Table 3-4 Construction noise management levels – Commercial and industrial land uses

Land use	Management level, $L_{Aeq(15min)}$
Industrial premises	External noise level 75 dB(A)
Offices, retail outlets	External noise level 70 dB(A)

3.2.3 Sleep disturbance

The *Interim Construction Noise Guideline* requires a sleep disturbance assessment to be undertaken where construction works are planned to extend over more than two consecutive nights. The *Interim Construction Noise Guideline* makes reference to the EPA’s NSW *Environment Criteria for Road Traffic Noise* (ECRTN), now superseded by the NSW *Road Noise Policy*, for assessment of sleep disturbance. The *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 undertaken 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 having considered the results of research to date that, ‘Maximum internal noise levels below 50-55 dB(A) are

unlikely to cause awakening reactions'. Therefore, given that an open window provides around 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 3-5 presents the sleep disturbance screening and sleep disturbance awakening reaction criteria.

Table 3-5 Construction noise sleep disturbance criteria

NCA	Rating background level, dB(A)	Sleep disturbance screening $L_{A1(1min)}$ criteria, dB(A)	Sleep disturbance awakening reaction $L_{A1(1min)}$ criteria, dB(A)
NCA01	39	54	65
NCA02	48	63	65
NCA03	39	54	65
NCA04	39	54	65
NCA05	39	54	65
NCA06	48	63	65
NCA07	42	57	65
NCA08	39	54	65
NCA09	39	54	65
NCA10	41	56	65
NCA11	39	54	65
NCA12	39	54	65
NCA13	45	60	65
NCA14	39	54	65
NCA15	39	54	65
NCA16	39	54	65
NCA17	45	60	65
NCA18	47	62	65
NCA19	47	62	65
NCA20	45	60	65
NCA21	47	62	65
NCA22	47	62	65
NCA23	38	53	65
NCA24	38	53	65
NCA25	38	53	65
NCA26	42	57	65
NCA27	40	55	65
NCA28	49	64	65
NCA29	38	53	65
NCA30	38	53	65
NCA31	42	57	65
NCA32	40	55	65

NCA	Rating background level, dB(A)	Sleep disturbance screening $L_{A1(1min)}$ criteria, dB(A)	Sleep disturbance awakening reaction $L_{A1(1min)}$ criteria, dB(A)
NCA33	38	53	65
NCA34	38	53	65

3.2.4 Construction road traffic noise

Noise from construction traffic on public roads is not covered by the *Interim Construction Noise Guideline*. However the *Interim Construction Noise Guideline* does refer to the *Environmental Criteria for Road Traffic Noise*, which is now superseded by the *Road Noise Policy*, for the assessment of noise arising from construction traffic on public roads.

To assess noise impacts from construction traffic, an initial screening test has been undertaken by evaluating whether existing road traffic noise levels would increase by more than 2 dB(A) as a result of the proposed modification. Where the predicted noise increase is 2 dB(A) or less, then no further assessment is required. However, where the predicted noise level increase is greater than 2 dB(A), and the predicted road traffic noise level exceeds the road category specific criterion, then noise mitigation should be considered for those receivers affected. The *Road Noise Policy* does not require assessment of noise impact to commercial or industrial receivers.

3.3 Construction vibration criteria

The relevant standards/guidelines for the assessment of construction vibration are summarised in **Table 3-6**.

Table 3-6 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 continuous, impulsive or intermittent as follows:

- Continuous vibration continues uninterrupted for a defined period and includes sources such as machinery and continuous construction activities for example, a tunnel boring machine
- 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.

3.3.1 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 3-7** and **Table 3-8**. 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 3-7 Structural damage safe criteria (DIN 4150) for building vibration (Peak particle velocity)

Group	Type of structure	At foundation – Less than 10 Hz	At foundation – 10 Hz to 50 Hz	At foundation – 50 Hz to 100 Hz[1]	Vibration at the horizontal plane of the highest floor for all frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20 mm/s	20 to 40 mm/s	40 to 50 mm/s	40 mm/s
2	Dwellings and buildings of similar design and/or use	5 mm/s	5 to 15 mm/s	15 to 20 mm/s	15 mm/s
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order/heritage listed)	3 mm/s	3 to 8 mm/s	8 to 10 mm/s	8 mm/s

Notes:

1. At frequencies above 100 Hz, the values given in this column may be used as minimum values

Table 3-8 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 Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

3.3.2 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.

3.3.2.1 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 3-9** . 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 3-9 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.*

3.3.2.2 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 3-10**.

There is low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values in **Table 3-10**. 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 3-10** may be dealt with through negotiation with the regulator of the affected community.

Table 3-10 Peak particle velocity for continuous and impulsive vibration (mm/s)

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
Workshops	When in use	1.10	2.20
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
Workshops	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.*

3.4 Ground-borne noise

Vibration generated by activities such as the use of vibratory rollers may enter buildings via the ground. This may cause the floors, walls and ceilings to vibrate and to radiate noise. This noise is commonly referred to as ground-borne noise. Ground-borne noise is typically low frequency and if audible, is perceived as a 'rumble'.

In general, ground-borne noise level values are relevant only where they are higher than the airborne noise. Ground-borne noise from construction would typically be masked by airborne noise associated with surface construction activities and/or traffic.

The ground-borne noise management levels as outlined in the *Interim Construction Noise Guideline* were adopted for this project and are presented in **Table 3-11**. These levels are applicable during the evening and night-time periods only in residential properties, as the objective is to protect the amenity and sleep of people when they are at home.

Table 3-11 Recommended ground–borne noise goals for construction activities

Time	Ground-borne noise goals
Evening (6pm to 10pm)	40 dB(A) $L_{Aeq(15\ min)}$
Night-time (10pm to 7am)	35 dB(A) $L_{Aeq(15\ min)}$

3.5 Operational road traffic noise criteria

Noise criteria are assigned to sensitive receivers using the Roads and Maritime's *Noise Criteria Guideline*. The *Noise Criteria Guideline* provides guidance on how to apply the *Road Noise Policy*.

The *Road Noise Policy* requires the consideration of two scenarios, the 'do minimum' option (without the proposal) and the design option (with the proposal). The 'do minimum' option represents the scenario if the proposal was not to proceed. The design option represents the scenario if the proposal

was to proceed. Each of these scenarios must be considered at two points in time, the year of opening and the design year, typically ten years after opening. For this proposal, the year 2026 has been assessed as the year of opening, and 2036 has been assessed as the design year.

The operational road traffic noise study area extends to where noise levels are dominated by other roads that are not being assessed as part of this proposal, as detailed in the *Noise Criteria Guideline*. For suburban areas this is up to a maximum distance of 600 metres from the proposal works. Residential receivers may be assigned new, redeveloped, transition zone or relative increase criteria.

Receivers identified for assessment have been assigned receiver numbers for the purposes of this assessment.

Criteria are based on the road development type which is affecting the residential receiver. In this case only the redeveloped criteria apply. For each façade of a residential receiver the most stringent applicable criteria are used in the assessment. **Table 3-12** presents the applicable road traffic criteria.

Table 3-12 Operational road traffic noise assessment criteria for residential land use

Road category	Type of proposal/land use	Assessment criteria dB(A)	
		Day (7am – 10pm)	Night (10pm – 7am)
Freeway/ arterial/sub-arterial	Existing residences affected by operational noise from redevelopment of existing freeways/arterial/sub-arterial roads	$L_{Aeq(15\ hr)}$ 60 (external)	$L_{Aeq(9\ hr)}$ 55 (external)

3.5.1 Operational road traffic noise criteria – Non-residential sensitive receivers

The criteria for other sensitive receivers are presented in **Table 3-13**. For schools, places of worship and childcare facilities, the *Noise Criteria Guideline* criteria are based on internal noise levels. A conservative minimum outside-to-inside attenuation of 10 dB(A), on the basis of open windows for natural ventilation, has been assumed to allow for an external noise assessment at the other sensitive receivers. As details are not currently available to allow the building-specific façade noise reduction to be identified it is recommended that this should be investigated further at detailed design.

The noise model predicts noise levels for $L_{Aeq(15\ hr)}$ and $L_{Aeq(9\ hr)}$ periods for day and night-time respectively.

Table 3-13 Road traffic noise assessment criteria for non-residential land use

Existing sensitive land use	Assessment criteria		Additional considerations
	Day (7am – 10pm)	Night (10pm – 7am)	
1. School classrooms	$L_{Aeq(1\ hr)}$ 40 (internal)	-	In the case of buildings used for education or health care, noise level criteria for spaces other than classrooms and wards may be obtained by interpolation from the 'maximum' levels shown in Australian Standard 2107:2000 (Standards Australia 2000)
3. Places of worship	$L_{Aeq(1\ hr)}$ 40 (internal)	$L_{Aeq(1\ hr)}$ 40 (internal)	The criteria are internal, i.e. the inside of a church. Areas outside the place of worship, such as a churchyard or cemetery, may also be a place of worship. Therefore, in determining appropriate criteria for such external areas, it should be established what in these areas may be affected by road traffic noise. For example, if there is a church car park between a church and the road, compliance with the internal criteria inside the church may be sufficient. If, however, there are areas between the church and the road where outdoor services may take place such as weddings and funerals, external criteria for these areas are appropriate. As issues such as speech intelligibility may be a consideration in these cases, the passive recreation criteria (see row 5 Open space (passive use) of this table) may be applied.
4. Open space (active use)	$L_{Aeq(15\ hr)}$ 60 (external)	-	Active recreation is characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion. Passive recreation is characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, e.g. playing chess, reading. In determining whether areas are used for active or passive recreation, the type of activity that occurs in that area and its sensitivity to noise intrusion should be established. For areas where there may be a mix of passive and active recreation, e.g. school playgrounds, the more stringent criteria apply. Open space may also be used as a buffer zone for more sensitive land uses.

Existing sensitive land use	Assessment criteria		Additional considerations
	Day (7am – 10pm)	Night (10pm – 7am)	
8. Childcare facilities	Sleeping rooms $L_{Aeq(1\ hr)}$ 35 (internal) Indoor play areas $L_{Aeq(1\ hr)}$ 40 (internal) Outdoor play areas $L_{Aeq(1\ hr)}$ 55 (external)		Multi-purpose spaces, e.g. shared indoor play/sleeping rooms should meet the lower of the respective criteria. Measurements for sleeping rooms should be taken during designated sleeping times for the facility, or if these are not known, during the highest hourly traffic noise level during the opening hours of the facility.

3.5.2 Guidance for the evaluation of feasible and reasonable noise mitigation measures

Where the *Noise Criteria Guideline* criteria are exceeded, the Roads and Maritime's *Noise Mitigation Guideline* provides guidance where the provision of additional controls, such as noise walls, architectural treatments and quieter pavements, would be considered 'feasible and reasonable'. It should be acknowledged that these considerations apply only if it can be demonstrated that all 'feasible and reasonable' traffic management and other road design opportunities for reduction of traffic noise at the source have been exhausted. It is noted that a 'quiet' road pavement is to be used in this proposed modification.

The *Noise Mitigation Guideline* provides guidance on managing and controlling road traffic generated noise and describes the principles to be applied when reviewing noise mitigation options. The *Noise Mitigation Guideline* recognises that the criteria recommended by the *Noise Criteria Guideline* are not always practicable and that is it not always feasible and/or reasonable to expect that they should be achieved.

The *Noise Mitigation Guideline* provides three triggers where a receiver may qualify for consideration of noise mitigation (beyond the adoption of road design and traffic management measures). These are:

- The predicted design noise level exceeds the *Noise Criteria Guideline* controlling criterion and the noise level increase due to the proposal (i.e. the noise predictions for the design minus the 'do minimum') is greater than 2.0 dB(A), or
- The predicted design noise level is 5 dB(A) or more above the criteria (meets or exceeds the cumulative limit) and the receiver is significantly influenced by road noise, regardless of the incremental impact of the proposal. The cumulative limit is 5 dB(A) above the *Noise Criteria Guideline* criteria. The purpose of the cumulative limit is to prevent a receiver with an existing high noise level from remaining well above the criterion if the noise level did not increase significantly relative to the 'do minimum' scenario, or
- The predicted design noise level increase due to the proposal (i.e. the noise predictions for the Design minus the 'Do Minimum') is 12.0 dB(A) or more.

In addition, if the noise level contribution from the road proposal is acute (daytime $L_{Aeq(15\ hr)}$ 65 dB(A) or higher, night-time $L_{Aeq(9\ hr)}$ 60 dB(A) or higher) then it qualifies for consideration of noise mitigation even if noise levels are dominated by another road.

For receivers that qualify for consideration of additional noise mitigation measures, potential noise mitigation measures include:

- Quieter pavement surfaces
- Noise mounds

- Noise walls
- At-receiver treatments.

Where quieter pavement surfaces and noise mounds or walls are shown not to be feasible or reasonable then at-receiver treatments can be considered.

3.5.3 Maximum noise levels

Maximum noise levels generated by road traffic noise have the potential to cause disturbance to sleep. Although maximum noise goals are not provided in the *Road Noise Policy*, it does include a review of internal sleep arousal research. It concludes that there appears to be insufficient evidence to set new indicators for potential sleep disturbance due to road traffic noise. Nevertheless, Transport recognises the potential impacts and requires an assessment of maximum noise levels be made where impacts may occur during the night.

Guidance for assessing maximum noise levels are provided in Practice Note iii of the *Environmental Noise Management Manual*. The maximum noise assessment should be used as a tool to help prioritise and rank mitigation strategies, but should not be used as a decisive criterion in itself and should not be used to aid in designing the degree of mitigation required.

The assessment considers the following:

- Calculation of maximum noise levels
- The extent to which the maximum noise levels for individual vehicle pass-bys exceed the L_{Aeq} noise level for each hour of the night (i.e. L_{Amax} noise levels greater than 65 dB(A) where $L_{Amax} – L_{Aeq(1hr)} \geq 15$ dB(A))
- The number of times the maximum noise levels for individual vehicle pass-bys exceed the L_{Aeq} noise level for each hour of the night.

4.0 Construction noise and vibration impact assessment

4.1 Construction scenarios and equipment

The following works would be undertaken along the length of the proposed alignment:

- Site establishment works
- Utility works
- Earthworks
- Bridge works
- Drainage works
- Pavement works
- Noise wall works
- Finishing works including asphalting, line marking and signage and street furniture installation.

The construction scenarios have been taken from the Construction Noise and Vibration Guideline. Where the *Construction Noise and Vibration Guideline* does not specify an activity total L_{A1} sound power level, this has been calculated based on experience with other projects where L_{A1} sound power levels are typically up to 8 dB(A) above L_{Aeq} sound power levels.

All utility works would be undertaken during standard hours only, would be of low intensity (cable pulling between pits, with no saw cutting or rock breaking), within the M7 corridor and around existing bridge piers. Therefore they are considered to be low impact and conservatively represented by the bridgeworks scenario and have not been modelled separately.

The equipment and associated sound power levels (SWL) for the seven construction phases are shown in **Table 4-1**.

Table 4-1 Assessed construction components and equipment

Construction component	Activities	Assigned CNVG activity	CNVG L_{Aeq} SWL, dB(A)	CNVG L_{A1} SWL, dB(A)
Site establishment and enabling works	• Site investigations (environmental and utilities as required) • Installation of site offices and crib rooms • Vegetation clearing and removal • Traffic management measures • Potential temporary diversions to property access • Installation of safety and environmental controls • Installation of site fencing and hoarding • Establishment of temporary noise attenuation measures • Temporary removal of some areas of the Light Horse Interchange artwork • Establishment of construction ancillary facilities and access • Supply of utilities to construction ancillary facilities as required • Establishment of temporary pedestrian and cyclist diversions as required • Temporary adjustments to controlled access fencing along the Westlink M7 • Demolition of existing buildings and structures, where required. This may also be undertaken in subsequent construction stages, subject to detailed construction planning	Mobilisation and site establishment	115	116
Utility works	• Site investigations to identify and mark up utilities requiring relocation and protection • Utility relocation and protection	Utility, property, service adjustment	111	111
Earthworks	• Top soil stripping • Excavation of cut areas and placement to fill areas • Construction of required retaining structures • Establishment and stabilisation of new ground levels	Bulk earthworks	123	130[1]
Bridge works	• Construction of piers and abutments • Installation of girders/beams • Construction of bridge decks, slabs and associated barriers	Bridge works	120	124

Construction component	Activities	Assigned CNVG activity	CNVG L_{Aeq} SWL, dB(A)	CNVG L_{A1} SWL, dB(A)
Drainage works	• Construction of new pits and pipes where required along road carriageway • Connection of new drainage to existing network • Adjustments to existing drainage infrastructure to tie into new drainage infrastructure • Demolition and removal of redundant drainage	Drainage infrastructure	115	116
Pavement works	• Placement of selected material zone and pavement layers • Installation of road pavement surfacing • Construction of pavement drainage	Paving/ asphalting (inc concrete sawing)	118	130
Finishing works	• Line markings on new road surfaces • Erection of directional and other signage and other roadside furniture • Carry out earthworks at disturbed areas to establish the finished landform • Carry out landscape reinstatement, including plantings • Reinstatement of Light Horse Interchange artwork • Construction of new noise walls and adjustments to existing noise walls • Reinstatement of cyclist and pedestrian facilities, property access and fencing • Site demobilisation and rehabilitation and preparation of the site for a future use.	Road furniture installation	110	116
		Retaining walls/noise walls	119	130

Notes:

1. *Reduced from SWL presented in the Construction Noise and Vibration Guideline as concrete saw and pneumatic hammer would not be required*

Construction is scheduled to be undertaken outside of standard construction hours, with the majority of construction scheduled for night-time for safety reasons and to minimise the effect on traffic. Any out of hours work would require justification, assessment and more detailed management.

Table 4-2 Relevant construction activities, equipment and sound power levels from CNVG Table F.1

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	Truck (medium rigid)	103	115	116
	Road truck	108		
	Scissor Lift	98		
	Franna crane 20t	98		
Utility, property, service adjustment	Excavator (tracked) 35t	110	111	111
	Dump truck	110		
	Franna crane 20t	98		
	Vacuum truck	109		
	Backhoe	111		
	Power generator	103		
Bulk earthworks	Bulldozer D9	116	123	130[1]
	Scraper 651	110		
	Excavator (tracked) 35t	110		
	As above + hydraulic hammer	122		
	Grader	113		
	Dump truck	110		
	Compactor	106		
	Roller (large pad foot)	109		
	Water cart	107		
Drainage infrastructure	Backhoe	110	115	116
	Franna crane 20t	98		
	Excavator (tracked) 35t	110		
	Concrete truck	109		
	Truck compressor	75		
	Vibratory roller	109		
	Road truck	108		

Activity	Indicative plant/equipment	L_{Aeq}, SWL	Activity total L_{Aeq} SWL, dB(A)	Activity total L_{A1} SWL, dB(A)
Bridge works	Franna crane 20t	98	120	124
	Piling rig - driven	116		
	Piling rig - bored	112		
	Power generator	100		
	Concrete pump	102		
	Concrete truck	109		
	Air Compressor	109		
	Pneumatic hammer	115		
	Welding equipment	105		
Retaining walls/ noise walls	Piling rig - bored	112	119	130
	Power generator	103		
	Mobile crane	113		
	Concrete vibrator	113		
	Concrete pump	109		
	Welding equipment	105		
	Excavator (tracked) 35t	112		
	Air track drill	124		
Paving/ asphalting (inc concrete sawing)	Pavement laying machine	114	118	130
	Dump truck	110		
	Asphalt truck & sprayer	103		
	Concrete truck	109		
	Smooth drum roller	107		
	Concrete saw	118		
Road furniture installation	Road truck	108	110	116
	Scissor lift	98		
	Franna crane 20t	98		
	Line marking truck	108		

Notes

1. *Not recommended of OOHW in CNVG. 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*

4.2 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 includes 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.

There are five categories of work that typically may be required to be carried out outside the standard construction hours:

- The delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads
- Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- Maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard construction hours
- Public infrastructure works that shorten the length of the project and are supported by the affected community
- Works where a proponent demonstrates and justifies a need to operate outside the recommended standard construction hours.

The above categories would apply to specific stages of the construction of the project works for various reasons. For example, the works within the existing road network would need to be carried out outside standard construction hours in order to limit impacts on the traffic network during peak periods and for both worker and road user safety. This would also likely be the case where a Road Occupancy Licence is required to undertake the construction works on major roads. This would apply extensively as part of the Westlink M7 widening works due to the critical nature of this road to the Sydney road network.

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.

4.2.1 Residential receivers

Table 4-3 presents the construction noise modelling results for residential properties and shows the number of properties where the NMLs are likely to be exceeded during the day and night-time. The tables also present the number of receivers who are predicted to exceed the highly affected level (75 dB(A)) for each NCA.

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 road alignment, rather than works located at a construction ancillary facility) 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 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 C**. 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 6.1.1**)

Table 4-3 Number of residential buildings where noise levels may exceed NMLs for all construction scenarios

Scenario	Number of residential buildings where noise levels may exceed NML across the study area							
	Standard construction hours			Outside of standard construction hours (night)				Highly affected > 75 dB(A)
	1-10 dB	11-20 dB	> 20 dB	1-5 dB	6-15 dB	16-25 dB	> 25 dB	
NCA1								
Site establishment and enabling works	0	0	0	11	10	0	0	0
Earthworks	13	0	0	15	27	4	0	0
Bridge works	0	0	0	0	0	0	0	0
Drainage works	0	0	0	3	0	0	0	0
Pavement works	0	0	0	11	13	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	0	0	7	0	0	0	0
NCA2								
Site establishment and enabling works	0	0	0	0	0	0	0	0
Earthworks	0	0	0	0	0	0	0	0
Bridge works	0	0	0	0	0	0	0	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	0	0	0	0	0	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	0	0	0	0	0	0	0
NCA3								
Site establishment and enabling works	0	0	0	0	0	0	0	0
Earthworks	0	0	0	0	0	0	0	0
Bridge works	0	0	0	0	0	0	0	0

Scenario	Number of residential buildings where noise levels may exceed NML across the study area							
	Standard construction hours			Outside of standard construction hours (night)				Highly affected > 75 dB(A)
	1-10 dB	11-20 dB	> 20 dB	1-5 dB	6-15 dB	16-25 dB	> 25 dB	
Drainage works	0	0	0	0	0	0	0	0
Pavement works	0	0	0	0	0	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	0	0	0	0	0	0	0
NCA4								
Site establishment and enabling works	0	0	0	0	0	0	0	0
Earthworks	0	0	0	0	0	0	0	0
Bridge works	0	0	0	0	0	0	0	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	0	0	0	0	0	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	0	0	0	0	0	0	0
NCA5								
Site establishment and enabling works	8	0	0	25	46	3	0	0
Earthworks	43	3	0	25	49	28	0	0
Bridge works	0	0	0	0	0	0	0	0
Drainage works	0	0	0	5	2	0	0	0
Pavement works	4	0	0	29	37	1	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	0	0	30	13	0	0	0

Scenario	Number of residential buildings where noise levels may exceed NML across the study area							
	Standard construction hours			Outside of standard construction hours (night)				Highly affected > 75 dB(A)
	1-10 dB	11-20 dB	> 20 dB	1-5 dB	6-15 dB	16-25 dB	> 25 dB	
NCA6								
Site establishment and enabling works	6	0	0	6	7	1	0	0
Earthworks	20	5	0	14	26	5	0	1
Bridge works	0	0	0	0	0	0	0	0
Drainage works	1	0	0	1	1	0	0	0
Pavement works	5	0	0	7	7	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	4	0	0	2	4	0	0	0
NCA7								
Site establishment and enabling works	43	17	6	0	28	36	8	7
Earthworks	25	42	1	0	15	47	10	2
Bridge works	42	2	0	8	41	22	0	0
Drainage works	5	0	0	21	31	0	0	0
Pavement works	28	0	0	16	48	4	0	0
Noise walls	2	0	0	3	5	0	0	0
Finishing works	33	8	0	3	45	17	6	2
NCA8								
Site establishment and enabling works	143	13	0	70	302	92	4	0
Earthworks	306	66	0	8	212	248	28	0
Bridge works	119	2	0	29	279	57	0	0
Drainage works	4	0	0	130	78	0	0	0
Pavement works	25	0	0	141	165	10	0	0
Noise walls	24	0	0	20	63	14	0	0
Finishing works	58	1	0	147	204	29	0	0

Scenario	Number of residential buildings where noise levels may exceed NML across the study area							
	Standard construction hours			Outside of standard construction hours (night)				Highly affected > 75 dB(A)
	1-10 dB	11-20 dB	> 20 dB	1-5 dB	6-15 dB	16-25 dB	> 25 dB	
NCA9								
Site establishment and enabling works	60	32	13	109	237	44	35	14
Earthworks	101	1	0	17	201	39	0	0
Bridge works	9	0	0	72	157	3	0	0
Drainage works	0	0	0	61	7	0	0	0
Pavement works	2	0	0	43	44	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	32	16	10	160	94	32	17	11
NCA10								
Site establishment and enabling works	27	6	0	0	8	24	19	2
Earthworks	18	29	0	1	1	16	34	27
Bridge works	9	4	0	1	10	9	7	3
Drainage works	7	0	0	2	26	20	1	0
Pavement works	21	0	0	2	18	27	4	0
Noise walls	20	14	0	0	10	18	23	10
Finishing works	21	0	0	3	16	32	0	0
NCA11								
Site establishment and enabling works	71	13	0	69	115	40	0	0
Earthworks	127	62	3	23	117	93	30	2
Bridge works	58	8	0	9	74	26	2	0
Drainage works	11	0	0	65	35	3	0	0
Pavement works	37	2	0	93	81	16	0	0
Noise walls	62	14	0	71	105	41	1	0
Finishing works	37	0	0	57	77	13	0	0

Scenario	Number of residential buildings where noise levels may exceed NML across the study area							
	Standard construction hours			Outside of standard construction hours (night)				Highly affected > 75 dB(A)
	1-10 dB	11-20 dB	> 20 dB	1-5 dB	6-15 dB	16-25 dB	> 25 dB	
NCA12								
Site establishment and enabling works	0	0	0	0	0	0	0	0
Earthworks	0	0	0	0	0	0	0	0
Bridge works	0	0	0	0	0	0	0	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	0	0	0	0	0	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	0	0	0	0	0	0	0
NCA13								
Site establishment and enabling works	17	0	0	17	14	17	5	5
Earthworks	16	6	0	0	28	10	17	17
Bridge works	0	0	0	2	17	3	0	0
Drainage works	0	0	0	6	15	6	0	0
Pavement works	10	0	0	21	10	17	0	0
Noise walls	14	4	0	5	28	5	17	17
Finishing works	6	0	0	10	7	17	0	0

Scenario	Number of residential buildings where noise levels may exceed NML across the study area							
	Standard construction hours			Outside of standard construction hours (night)				Highly affected > 75 dB(A)
	1-10 dB	11-20 dB	> 20 dB	1-5 dB	6-15 dB	16-25 dB	> 25 dB	
NCA14								
Site establishment and enabling works	49	10	0	83	119	28	2	0
Earthworks	140	28	3	92	168	88	13	3
Bridge works	69	3	0	24	84	33	0	0
Drainage works	8	0	0	63	27	0	0	0
Pavement works	16	3	0	89	78	6	0	0
Noise walls	52	4	0	78	113	17	0	0
Finishing works	26	2	0	69	60	10	0	0
NCA15								
Site establishment and enabling works	0	0	0	0	0	0	0	0
Earthworks	0	0	0	0	0	0	0	0
Bridge works	0	0	0	0	0	0	0	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	0	0	0	0	0	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	0	0	0	0	0	0	0

Scenario	Number of residential buildings where noise levels may exceed NML across the study area							
	Standard construction hours			Outside of standard construction hours (night)				Highly affected > 75 dB(A)
	1-10 dB	11-20 dB	> 20 dB	1-5 dB	6-15 dB	16-25 dB	> 25 dB	
NCA16								
Site establishment and enabling works	31	1	0	24	58	14	0	0
Earthworks	61	18	0	8	32	51	3	0
Bridge works	54	7	0	2	40	34	0	0
Drainage works	0	0	0	38	11	0	0	0
Pavement works	2	0	0	36	43	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	10	0	0	34	33	1	0	0
NCA17								
Site establishment and enabling works	0	1	3	1	12	8	4	4
Earthworks	3	0	0	0	6	16	4	4
Bridge works	0	0	0	1	5	5	0	0
Drainage works	0	0	0	6	10	2	0	0
Pavement works	0	0	0	5	15	2	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	2	2	6	11	1	4	4

Scenario	Number of residential buildings where noise levels may exceed NML across the study area							
	Standard construction hours			Outside of standard construction hours (night)				Highly affected > 75 dB(A)
	1-10 dB	11-20 dB	> 20 dB	1-5 dB	6-15 dB	16-25 dB	> 25 dB	
NCA18								
Site establishment and enabling works	47	2	0	35	52	2	0	0
Earthworks	80	25	0	20	82	25	0	0
Bridge works	30	5	0	16	38	5	0	0
Drainage works	1	0	0	24	2	0	0	0
Pavement works	12	0	0	40	20	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	16	0	0	33	16	0	0	0
NCA19								
Site establishment and enabling works	0	0	0	2	0	0	0	0
Earthworks	4	0	0	2	4	0	0	0
Bridge works	1	0	0	0	1	0	0	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	0	0	0	1	0	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	0	0	0	0	0	0	0

Scenario	Number of residential buildings where noise levels may exceed NML across the study area							
	Standard construction hours			Outside of standard construction hours (night)				Highly affected > 75 dB(A)
	1-10 dB	11-20 dB	> 20 dB	1-5 dB	6-15 dB	16-25 dB	> 25 dB	
NCA20								
Site establishment and enabling works	0	0	0	1	6	24	0	0
Earthworks	4	0	0	1	3	20	9	10
Bridge works	0	0	0	2	5	7	0	0
Drainage works	0	0	0	3	21	2	0	0
Pavement works	0	0	0	1	25	5	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	0	0	1	22	7	0	0
NCA21								
Site establishment and enabling works	0	0	0	4	3	0	0	0
Earthworks	1	0	0	0	7	1	0	0
Bridge works	0	0	0	0	0	0	0	0
Drainage works	0	0	0	1	0	0	0	0
Pavement works	0	0	0	1	1	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	0	0	1	1	0	0	0

Scenario	Number of residential buildings where noise levels may exceed NML across the study area							
	Standard construction hours			Outside of standard construction hours (night)				Highly affected > 75 dB(A)
	1-10 dB	11-20 dB	> 20 dB	1-5 dB	6-15 dB	16-25 dB	> 25 dB	
NCA22								
Site establishment and enabling works	0	0	0	0	0	0	0	0
Earthworks	0	0	0	1	1	0	0	0
Bridge works	0	0	0	0	0	0	0	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	0	0	0	0	0	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	0	0	0	0	0	0	0
NCA23								
Site establishment and enabling works	1	0	0	1	8	0	0	0
Earthworks	10	0	0	1	3	7	0	0
Bridge works	5	0	0	1	2	4	0	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	0	0	0	1	10	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	0	0	6	2	0	0	0
NCA24								
Site establishment and enabling works	0	0	0	0	0	0	0	0
Earthworks	0	0	0	0	0	0	0	0
Bridge works	0	0	0	0	0	0	0	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	0	0	0	0	0	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	0	0	0	0	0	0	0

Scenario	Number of residential buildings where noise levels may exceed NML across the study area							
	Standard construction hours			Outside of standard construction hours (night)				Highly affected > 75 dB(A)
	1-10 dB	11-20 dB	> 20 dB	1-5 dB	6-15 dB	16-25 dB	> 25 dB	
NCA25								
Site establishment and enabling works	173	38	2	79	291	111	11	2
Earthworks	273	143	6	13	141	258	77	3
Bridge works	181	33	0	5	138	122	5	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	42	0	0	152	217	9	0	0
Noise walls	91	13	3	96	169	50	9	2
Finishing works	83	6	1	147	206	46	3	1
NCA26								
Site establishment and enabling works	1	2	0	0	6	21	9	4
Earthworks	10	0	0	0	2	17	19	13
Bridge works	0	0	0	1	6	14	0	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	0	0	0	6	21	7	1	0
Noise walls	9	0	0	3	11	7	14	13
Finishing works	2	0	0	2	15	16	3	2
NCA27								
Site establishment and enabling works	0	0	0	0	0	0	0	0
Earthworks	0	0	0	0	0	0	0	0
Bridge works	0	0	0	0	0	0	0	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	0	0	0	0	0	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	0	0	0	0	0	0	0

Scenario	Number of residential buildings where noise levels may exceed NML across the study area							
	Standard construction hours			Outside of standard construction hours (night)				Highly affected > 75 dB(A)
	1-10 dB	11-20 dB	> 20 dB	1-5 dB	6-15 dB	16-25 dB	> 25 dB	
NCA28								
Site establishment and enabling works	0	0	0	3	15	16	0	0
Earthworks	6	0	0	2	7	27	1	7
Bridge works	0	0	0	5	16	0	0	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	0	0	0	11	15	0	0	0
Noise walls	3	5	2	4	3	3	8	10
Finishing works	0	0	0	7	23	1	0	0
NCA29								
Site establishment and enabling works	0	0	0	0	0	0	0	0
Earthworks	0	0	0	0	0	0	0	0
Bridge works	0	0	0	0	0	0	0	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	0	0	0	0	0	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	0	0	0	0	0	0	0
NCA30								
Site establishment and enabling works	229	34	3	141	387	141	15	1
Earthworks	337	229	34	80	320	338	140	31
Bridge works	194	20	0	41	209	125	2	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	97	9	1	205	280	40	5	1
Noise walls	38	19	2	78	106	23	15	1
Finishing works	100	14	0	190	291	39	7	0

Scenario	Number of residential buildings where noise levels may exceed NML across the study area							
	Standard construction hours			Outside of standard construction hours (night)				Highly affected > 75 dB(A)
	1-10 dB	11-20 dB	> 20 dB	1-5 dB	6-15 dB	16-25 dB	> 25 dB	
NCA31								
Site establishment and enabling works	23	1	0	5	56	93	32	28
Earthworks	25	13	4	4	16	86	89	50
Bridge works	0	0	0	5	50	68	2	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	5	1	0	9	120	41	10	8
Noise walls	3	9	0	20	11	7	15	13
Finishing works	13	0	0	12	97	50	22	16
NCA32								
Site establishment and enabling works	90	1	0	128	265	100	1	0
Earthworks	241	58	0	47	225	257	58	9
Bridge works	85	12	0	96	195	104	12	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	3	0	0	160	199	5	0	0
Noise walls	0	0	0	11	5	0	0	0
Finishing works	23	0	0	136	189	28	0	0
NCA33								
Site establishment and enabling works	0	0	0	18	0	0	0	0
Earthworks	0	0	0	0	0	0	0	0
Bridge works	0	0	0	0	0	0	0	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	0	0	0	0	0	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	0	0	0	0	0	0	0

Scenario	Number of residential buildings where noise levels may exceed NML across the study area							
	Standard construction hours			Outside of standard construction hours (night)				Highly affected > 75 dB(A)
	1-10 dB	11-20 dB	> 20 dB	1-5 dB	6-15 dB	16-25 dB	> 25 dB	
NCA34								
Site establishment and enabling works	0	0	0	0	0	0	0	0
Earthworks	0	0	0	0	0	0	0	0
Bridge works	0	0	0	0	0	0	0	0
Drainage works	0	0	0	0	0	0	0	0
Pavement works	0	0	0	0	0	0	0	0
Noise walls	0	0	0	0	0	0	0	0
Finishing works	0	0	0	0	0	0	0	0

Site establishment and enabling works

Site establishment and enabling 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 1,220 receivers during works in standard construction hours and 3,840 receivers during works outside of standard construction hours across the study area may experience noise levels above the associated noise management levels. 67 receivers may be highly noise affected.

Noise levels would be moderately intrusive at up to 198 receivers across the study area in the daytime. Night-time mitigation measures would be required for approximately 3,005 receivers with perceptions ranging from ‘clearly audible’ to ‘highly intrusive’. Approximately 832 receivers would require notification of night-time works, at these receivers construction noise may be ‘noticeable’.

Earthworks

Earthworks are predicted to generate the greatest number of exceedances of the daytime noise management level across the study area. Approximately 2,640 receivers during works in standard construction hours and 4,280 receivers during works outside of standard construction hours across the study area may experience noise levels above the noise management levels. 179 receivers may be highly noise affected.

Noise levels would be moderately intrusive at up to 779 receivers across the study area during standard construction hours. Night-time mitigation measures would be required for approximately 3,906 receivers with perceptions ranging from ‘clearly audible’ to ‘highly intrusive’. Approximately 374 receivers would require notification of night-time works, at these receivers construction noise may be ‘noticeable’. As earthworks are expected to be staged and therefore the actual number of affected receivers would be limited at any single point in time.

Bridge works

Approximately 960 receivers during works in standard construction hours and 2,360 receivers during works outside of standard construction hours across the study area may experience noise levels above the noise management level during bridge works. Three receivers may be highly noise affected.

Noise levels would be moderately intrusive at up to 96 receivers across the study area during standard construction hours. Night-time mitigation measures would be required for approximately 2,038 receivers

with perceptions ranging from ‘clearly audible’ to ‘highly intrusive’. Approximately 320 receivers would require notification of night-time works, at these receivers construction noise may be ‘noticeable’. Bridge works are in discrete areas and are expected to be staged, therefore the actual number of affected receivers would be limited at any single point in time.

Drainage works

Approximately 40 receivers during works in standard construction hours and 730 receivers during works outside of standard construction hours across the study area may experience noise levels above the associated noise management level during drainage works. No receivers are expected to be highly noise affected.

The drainage works are located in close proximity to some receivers due to the nature of works potentially located outside of the M7 corridor.

Noise levels would be noticeable at up to 37 receivers across the study area in the daytime with no additional mitigation measures required at these receivers during standard construction hours. Night-time mitigation measures would be required for approximately 300 receivers with perceptions ranging from ‘clearly audible’ to only one receiver predicted to be affected by noise levels considered ‘highly intrusive’. Approximately 429 receivers would require notification of night-time works, at these receivers construction noise may be ‘noticeable’.

As the works relate to discrete locations, they are expected to be staged and not occur all at once, therefore the actual number of affected receivers may differ than those reported above.

Pavement works

Approximately 330 receivers during works in standard construction hours and 2,760 receivers during works outside of standard construction hours across the study area may experience noise levels above the associated noise management level during pavement works. Nine receivers may be highly noise affected. The pavement works would be progressive, moving along the alignment and therefore the actual number of affected receivers would be limited at any single point in time.

Noise levels would be moderately intrusive at up to 16 receivers across the study area during standard construction hours. Night-time mitigation measures would be required for approximately 1,677 receivers with perceptions ranging from ‘clearly audible’ to ‘highly intrusive’. Approximately 1,080 receivers would require notification of night-time works, at these receivers construction noise may be ‘noticeable’.

Noise wall works

Approximately 410 receivers during works in standard construction hours and 1,310 receivers during works outside of standard construction hours across the study area may experience noise levels above the associated noise management level during noise wall works. 66 receivers may be highly noise affected. The high number of highly noise affected receivers is due to the nature of the noise wall works, as they are, at times, located in close proximity to some receivers.

Noise levels would be moderately intrusive at up to 89 receivers across the study area during standard construction hours. Night-time mitigation measures would be required for approximately 916 receivers with perceptions ranging from ‘clearly audible’ to ‘highly intrusive’. Approximately 389 receivers would require notification of night-time works, at these receivers construction noise may be ‘noticeable’. As the works relate to discrete locations and that they are expected to occur staged and not all at once, the actual number of affected receivers at any single point in time would be lower than what is reported above.

Finishing works

Receivers near to the finishing works would experience elevated noise levels during these works. Approximately 530 receivers during works in standard construction hours and 2,890 receivers during works outside of standard construction hours across the study area may experience noise levels above the associated noise management levels. 36 receivers may be highly noise affected.

Noise levels would be moderately intrusive at up to 62 receivers across the study area in the daytime. Night-time mitigation measures would be required for approximately 1,827 receivers with perceptions ranging from ‘clearly audible’ to ‘highly intrusive’. Approximately 1,063 receivers would require notification of night-time works, at these receivers construction noise may be ‘noticeable’. As finishing

works would commence following the completion of pavement and bridge works which are expected to be progressive and staged, respectively, the actual number of affected receivers at any single point in time would be minimal.

4.2.2 Other receivers

Table 4-4 presents the construction noise modelling results for non-residential properties which shows the number of properties where the NMLs are likely to be exceeded during their hours of use. 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 receiver location. The activities associated with the construction components for the Project are expected to exceed the noise management levels at some non-residential receivers during the day. A small number of receivers are expected to experience moderately intrusive (17) and highly intrusive noise levels (10) across the entire project footprint. These exceedances include education, childcare, commercial, industrial, active recreation and place of worship receivers.

Table 4-4 Number of non-residential buildings where noise levels may exceed NMLs

Phase	Exceedance of NML		
	1-10 dB	11-20 dB	> 20 dB
Site establishment and enabling works	22	2	3
Earthworks	60	4	2
Bridge works	28	2	1
Drainage works	0	2	0
Pavement works	1	2	0
Noise walls	6	0	0
Finishing works	8	4	0

4.2.3 Cumulative construction noise impacts

4.2.3.1 Project construction stages

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). This may increase the number of receivers where noise levels would be greater than 20 dB(A) above the NMLs.

Noise from use of the construction ancillary facility areas 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.

4.2.4 Other construction projects

A review of surrounding projects has been undertaken in **Chapter 7** of the modification report. Proposed projects (approved and under construction) identified in the vicinity of the Project include:

- M12 Motorway: Dual carriage motorway proposed to directly connect the M7 Motorway with the Western Sydney Airport and The Northern Road. The M12 Motorway will directly intersect the M7 with construction and operation occurring concurrently with the proposed modification. The M12 Motorway will intersect the Project near Cecil Hills. Development approval was granted on 23 April 2021.

- Light Horse Interchange Business Hub Eastern Creek: Construction of a 165,000 m^2 of gross floor area (GFA) business hub for general and light industrial, warehouse and distribution and ancillary offices. The site is directly adjacent to the proposed modification area. Development approval was granted on August 2020.
- Saint Peter and Paul Assyrian Primary School: Construction and operation of a new school, Saints Peter and Paul Assyrian School, for a maximum of 630 students from Kindergarten to Year 6. The site is approximately 300 metres to the west of the proposed modification area. Development approval was granted on February 2021.
- Gazcorp Industrial Estate: Construction of a new industrial estate including 16 warehouse building envelopes, landscaping, and associated infrastructure. The site adjoins the proposed modification area directly to the west. Development approval for the latest consent modification was granted on 11 November 2019 and the estate is currently under construction.
- Prestons Waste Treatment Facility: Construction and operation of a new waste treatment facility with capacity to process and store up to 270,000 tonnes of soil, sediment, sludges and liquid waste. The Proposal is not yet approved and is currently in the submissions phase. The site is to be located 500 metres east of the proposed modification area. SEARs were issued on 14 October, 2020.
- Horsley Drive Upgrade: Upgrade of the Horsley Drive between the Project and Cowpasture Road to a four lane divided road. The upgrade is to include an option for six lanes in the future. Horsley Drive currently intersects the proposed modification area at Horsley Park. No SEARs are available at this stage.
- Sydney International Speedway: Construction and operation of a new speedway as a part of the Eastern Creek Motor Sports Precinct. Directly adjoining the existing Sydney Dragway and Sydney Motorsports Park, the development will include a new clay-based racetrack. The site is approximately 900 metres from the proposed modification area. Approval was granted in December, 2020.
- Other major land releases include:
    - Western Sydney Aerotropolis
    - South West Growth Area
    - Western Sydney Employment Area
    - Future strategic government projects.

While most construction activities are expected to occur at separate times and locations, it is possible that noisy construction activities for the proposed modification may occur at the same time in close proximity to each other. In these cases, it is possible that predicted noise levels may increase by up to 3 dB(A) and there is potential that this would increase the number of receivers where noise levels would be greater than 20 dB above the NMLs. Although 3 dB(A) is generally considered just discernible, the cumulative impact of noise would be managed as far as possible by the contractor by the measures described in **Section 6.1** to ensure that the potential for adverse impacts at sensitive receivers is minimised.

4.2.5 Sleep disturbance assessment

To ensure worker safety and to minimise traffic disruptions, most of the 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 4-5** with the number of residential buildings where noise levels are predicted to exceed the sleep disturbance screening criteria and the awakening reaction criteria.

A large number of exceedances of the sleep disturbance screening criteria have been predicted due to the night-time construction works associated with the proposal. 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 proposal. 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.

As the majority of constructions would take place outside of standard hours, an effective communication plan and noise management measures would need to be developed during detailed design to minimise the impacts upon affected sensitive receivers.

Table 4-5 Number of residential buildings where noise levels may exceed sleep disturbance criteria for night works

Scenario	Number of residential buildings where noise levels may exceed the sleep disturbance screening level and/or the awakening reaction level	
	Sleep disturbance screening level $L_{A1(1\ minute)}$, dB(A)	Awakening reaction level $L_{A1(1\ minute)}$, dB(A)
NCA1		
Site establishment and enabling works	1	0
Earthworks	37	6
Bridge works	0	0
Drainage works	0	0
Pavement works	29	1
Noise walls	0	0
Finishing works	1	0
NCA2		
Site establishment and enabling works	0	0
Earthworks	0	0
Bridge works	0	0
Drainage works	0	0
Pavement works	0	0
Noise walls	0	0
Finishing works	0	0
NCA3		
Site establishment and enabling works	0	0
Earthworks	0	0
Bridge works	0	0
Drainage works	0	0
Pavement works	0	0
Noise walls	0	0

Scenario	Number of residential buildings where noise levels may exceed the sleep disturbance screening level and/or the awakening reaction level	
	Sleep disturbance screening level $L_{A1(1\ minute)}$, dB(A)	Awakening reaction level $L_{A1(1\ minute)}$, dB(A)
Finishing works	0	0
NCA4		
Site establishment and enabling works	0	0
Earthworks	0	0
Bridge works	0	0
Drainage works	0	0
Pavement works	0	0
Noise walls	0	0
Finishing works	0	0
NCA5		
Site establishment and enabling works	14	0
Earthworks	82	37
Bridge works	0	0
Drainage works	0	0
Pavement works	73	10
Noise walls	0	0
Finishing works	14	0
NCA6		
Site establishment and enabling works	4	4
Earthworks	36	31
Bridge works	0	0
Drainage works	0	0
Pavement works	26	16
Noise walls	0	0
Finishing works	4	4

Scenario	Number of residential buildings where noise levels may exceed the sleep disturbance screening level and/or the awakening reaction level	
	Sleep disturbance screening level $L_{A1(1\ minute)}$, dB(A)	Awakening reaction level $L_{A1(1\ minute)}$, dB(A)
NCA7		
Site establishment and enabling works	69	36
Earthworks	72	67
Bridge works	61	23
Drainage works	8	0
Pavement works	70	49
Noise walls	8	3
Finishing works	69	36
NCA8		
Site establishment and enabling works	252	29
Earthworks	491	318
Bridge works	313	34
Drainage works	11	0
Pavement works	374	78
Noise walls	102	35
Finishing works	252	29
NCA9		
Site establishment and enabling works	155	49
Earthworks	252	68
Bridge works	127	1
Drainage works	0	0
Pavement works	134	10
Noise walls	0	0
Finishing works	155	49

Scenario	Number of residential buildings where noise levels may exceed the sleep disturbance screening level and/or the awakening reaction level	
	Sleep disturbance screening level $L_{A1(1\ minute)}$, dB(A)	Awakening reaction level $L_{A1(1\ minute)}$, dB(A)
NCA10		
Site establishment and enabling works	48	34
Earthworks	46	39
Bridge works	52	51
Drainage works	26	16
Pavement works	34	8
Noise walls	51	49
Finishing works	51	49
NCA11		
Site establishment and enabling works	96	13
Earthworks	245	141
Bridge works	93	18
Drainage works	14	0
Pavement works	209	53
Noise walls	227	82
Finishing works	96	13
NCA12		
Site establishment and enabling works	0	0
Earthworks	0	0
Bridge works	0	0
Drainage works	0	0
Pavement works	0	0
Noise walls	0	0
Finishing works	0	0

Scenario	Number of residential buildings where noise levels may exceed the sleep disturbance screening level and/or the awakening reaction level	
	Sleep disturbance screening level $L_{A1(1\ minute)}$, dB(A)	Awakening reaction level $L_{A1(1\ minute)}$, dB(A)
NCA13		
Site establishment and enabling works	24	22
Earthworks	34	23
Bridge works	55	52
Drainage works	17	9
Pavement works	17	9
Noise walls	51	34
Finishing works	55	52
NCA14		
Site establishment and enabling works	76	10
Earthworks	302	118
Bridge works	112	16
Drainage works	9	0
Pavement works	206	28
Noise walls	232	66
Finishing works	76	10
NCA15		
Site establishment and enabling works	0	0
Earthworks	0	0
Bridge works	0	0
Drainage works	0	0
Pavement works	0	0
Noise walls	0	0
Finishing works	0	0

Scenario	Number of residential buildings where noise levels may exceed the sleep disturbance screening level and/or the awakening reaction level	
	Sleep disturbance screening level $L_{A1(1\ minute)}$, dB(A)	Awakening reaction level $L_{A1(1\ minute)}$, dB(A)
NCA16		
Site establishment and enabling works	39	1
Earthworks	90	61
Bridge works	72	17
Drainage works	0	0
Pavement works	84	9
Noise walls	0	0
Finishing works	39	1
NCA17		
Site establishment and enabling works	17	16
Earthworks	26	26
Bridge works	10	7
Drainage works	5	2
Pavement works	22	20
Noise walls	0	0
Finishing works	17	16
NCA18		
Site establishment and enabling works	18	11
Earthworks	116	103
Bridge works	32	18
Drainage works	0	0
Pavement works	85	57
Noise walls	0	0
Finishing works	18	11

Scenario	Number of residential buildings where noise levels may exceed the sleep disturbance screening level and/or the awakening reaction level	
	Sleep disturbance screening level $L_{A1(1\ minute)}$, dB(A)	Awakening reaction level $L_{A1(1\ minute)}$, dB(A)
NCA19		
Site establishment and enabling works	0	0
Earthworks	4	3
Bridge works	0	0
Drainage works	0	0
Pavement works	3	1
Noise walls	0	0
Finishing works	0	0
NCA20		
Site establishment and enabling works	29	28
Earthworks	33	31
Bridge works	11	8
Drainage works	7	3
Pavement works	31	31
Noise walls	0	0
Finishing works	29	28
NCA21		
Site establishment and enabling works	1	1
Earthworks	8	7
Bridge works	0	0
Drainage works	0	0
Pavement works	4	1
Noise walls	0	0
Finishing works	1	1

Scenario	Number of residential buildings where noise levels may exceed the sleep disturbance screening level and/or the awakening reaction level	
	Sleep disturbance screening level $L_{A1(1\ minute)}$, dB(A)	Awakening reaction level $L_{A1(1\ minute)}$, dB(A)
NCA22		
Site establishment and enabling works	0	0
Earthworks	2	1
Bridge works	0	0
Drainage works	0	0
Pavement works	1	0
Noise walls	0	0
Finishing works	0	0
NCA23		
Site establishment and enabling works	3	0
Earthworks	10	7
Bridge works	6	0
Drainage works	0	0
Pavement works	11	1
Noise walls	0	0
Finishing works	3	0
NCA24		
Site establishment and enabling works	0	0
Earthworks	0	0
Bridge works	0	0
Drainage works	0	0
Pavement works	0	0
Noise walls	0	0
Finishing works	0	0

Scenario	Number of residential buildings where noise levels may exceed the sleep disturbance screening level and/or the awakening reaction level	
	Sleep disturbance screening level $L_{A1(1\ minute)}$, dB(A)	Awakening reaction level $L_{A1(1\ minute)}$, dB(A)
NCA25		
Site establishment and enabling works	276	42
Earthworks	482	337
Bridge works	259	65
Drainage works	0	0
Pavement works	420	80
Noise walls	343	115
Finishing works	276	42
NCA26		
Site establishment and enabling works	34	25
Earthworks	38	36
Bridge works	20	15
Drainage works	0	0
Pavement works	36	27
Noise walls	35	32
Finishing works	34	25
NCA27		
Site establishment and enabling works	0	0
Earthworks	0	0
Bridge works	0	0
Drainage works	0	0
Pavement works	0	0
Noise walls	0	0
Finishing works	0	0

Scenario	Number of residential buildings where noise levels may exceed the sleep disturbance screening level and/or the awakening reaction level	
	Sleep disturbance screening level $L_{A1(1\ minute)}$, dB(A)	Awakening reaction level $L_{A1(1\ minute)}$, dB(A)
NCA28		
Site establishment and enabling works	26	25
Earthworks	37	37
Bridge works	15	15
Drainage works	0	0
Pavement works	32	32
Noise walls	21	20
Finishing works	26	25
NCA29		
Site establishment and enabling works	0	0
Earthworks	0	0
Bridge works	0	0
Drainage works	0	0
Pavement works	0	0
Noise walls	0	0
Finishing works	0	0
NCA30		
Site establishment and enabling works	353	38
Earthworks	834	479
Bridge works	308	60
Drainage works	0	0
Pavement works	619	147
Noise walls	242	64
Finishing works	353	38

Scenario	Number of residential buildings where noise levels may exceed the sleep disturbance screening level and/or the awakening reaction level	
	Sleep disturbance screening level $L_{A1(1\ minute)}$, dB(A)	Awakening reaction level $L_{A1(1\ minute)}$, dB(A)
NCA31		
Site establishment and enabling works	170	98
Earthworks	191	182
Bridge works	118	74
Drainage works	0	0
Pavement works	186	169
Noise walls	54	28
Finishing works	170	98
NCA32		
Site establishment and enabling works	231	42
Earthworks	559	373
Bridge works	283	89
Drainage works	0	0
Pavement works	418	110
Noise walls	19	1
Finishing works	231	42
NCA33		
Site establishment and enabling works	0	0
Earthworks	0	0
Bridge works	0	0
Drainage works	0	0
Pavement works	0	0
Noise walls	0	0
Finishing works	0	0
NCA34		
Site establishment and enabling works	0	0
Earthworks	0	0
Bridge works	0	0
Drainage works	0	0
Pavement works	0	0
Noise walls	0	0
Finishing works	0	0

Site establishment and enabling works

Noise levels at approximately 1,936 residential receivers in total for the project are predicted to exceed the sleep disturbance screening level for the site establishment and enabling works during the construction period. 524 awakening reactions may be expected to occur in total across the entire project footprint. The large number of exceedances are due to the close proximity of the works to receivers.

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 truck movements. These impacts are expected at receivers within NCAs 1, 5-11, 13, 14, 16-18, 20-21, 23, 25-26, 28 and 30-32.

Earthworks

Noise levels at approximately 4,054 residential receivers in total for the project are predicted to exceed the sleep disturbance screening level for the earthworks during the construction period. 2,572 awakening reactions may be expected to occur in total across the entire project footprint. 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. These impacts are expected at receivers within all NCAs with the exception of 2-4, 12, 15, 24, 27, 29, 33 and 34. The large number of exceedances are due to the close proximity of the works and the high L_{A1} sound power level of hammering activities.

Bridge works

Noise levels at approximately 1,883 residential receivers in total for the project (along the entire project footprint) are predicted to exceed the sleep disturbance screening level for the bridge works during the construction period. 485 awakening reactions may be expected to occur in total across the entire project footprint. As the works are expected to be in discrete locations, the number of affected residential receivers at any one time would be limited. The highest impacts are expected during piling works. These impacts are expected at receivers within NCAs 7-11, 13, 14, 16-18, 20, 23, 25, 26, 28, 30-32.

Drainage works

Noise levels at approximately 105 residential receivers in total for the project are predicted to exceed the sleep disturbance screening level for drainage works during the construction period. 22 awakening reactions may be expected to occur in total across the entire project footprint. 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 truck movements. These impacts are expected at receivers within NCAs 7, 8, 10,11, 13, 14, 17 and 20.

Pavement works

Noise levels at approximately 3,175 residential receivers in total for the project (along the entire project footprint) are predicted to exceed the sleep disturbance screening level for the pavement works during the construction period. 1,013 awakening reactions may be expected to occur in total across the entire project footprint. As the works are expected to be progressive, the number of affected residential receivers at any one time would be limited. The highest impacts are expected during concrete sawing activities. These impacts are expected at receivers within all NCAs within1, 5-11, 13, 14, 16-23, 25, 26, 28 and 30-32. The large number of exceedances are due to the close proximity of the works and the high L_{A1} sound power level of saw cutting activities.

Noise wall works

Noise levels at approximately 1,389 residential receivers in total for the project (along the entire project footprint) are predicted to exceed the sleep disturbance screening level for the noise wall works during the construction period. 547 awakening reactions may be expected to occur in total across the entire project footprint. As the works are expected to be in discrete locations, the number of affected residential receivers at any one time would be limited. The highest impacts are expected during drilling works. These impacts are expected at receivers within NCAs 7, 8, 10, 11, 13, 14, 25, 26, 28, 30-32.

Finishing works

Noise levels at approximately 1,936 residential receivers in total for the project (along the entire project footprint) are predicted to exceed the sleep disturbance screening level for the site establishment and enabling works during the construction period. 524 awakening reactions may be expected to occur in total across the entire project footprint. The large number of exceedances are due to the close proximity of the works to receivers.

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 truck movements. These impacts are expected at receivers within NCAs 1, 5- 11, 13, 14, 16-18, 20, 21, 23, 25, 26, 28 and 30-32.

4.3 Construction vibration

4.3.1 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 4-6**.

Table 4-6 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	(1600 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 TfNSW *Construction Noise and Vibration Strategy* (CNVS) 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 6.2.6**.

4.3.2 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.

4.3.3 Cosmetic damage

Table 4-6 presents minimum working distances to minimise the likelihood of cosmetic damage on buildings and structures, including heritage items. The non-Aboriginal Heritage assessment prepared for the proposed modification identified the Upper Nepean Canal System, which is listed on the State Heritage Register as the “Upper Canal System” under the *Heritage Act 1977* (NSW). This includes the entire length and area of the Upper Canal corridor and all related water supply components. The Cecil Hills Tunnel passes beneath the M7 travelling south west to north east. A concrete air shaft entrance is located in the median of the Westlink M7.

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.

4.4 Construction road traffic noise

4.4.1 Site access and traffic movements

Access for heavy vehicles would be required throughout the study area. The standard of access along the project footprint would be sufficient to permit passage of excavators, spoil haulage trucks, concrete trucks, low loaders and mobile cranes. The estimated vehicle movements required for construction is outlined in **Table 4-7**. The numbers outlined would be typical for median construction and bridge abutment and pier construction including road widening, noting that there would be higher frequencies of movements during specific construction activities. Construction is expected to result in about 4,400 light vehicles and 1,300 heavy vehicles per day, during peak construction periods. The final number of work crews, materials and vehicle movements would be determined during detailed design and construction planning.

Table 4-7 Anticipated vehicle movements at ancillary sites (by type)

Estimated vehicle movements per site	No. of sites	Assumptions
Construction site ancillary facilities		
Facilities for motorway widening works, abutment construction and bridge construction support **Light vehicles:** **Up to 40 movements per hour** **Up to 320 movements per day**	47	• Use: major civil work compound/laydown/parking • Duration: 36 months • Parking: 15-25 spaces (some parking required on local roads) • Most of the civil works staff and workforce would park at construction zone ancillary facilities • Mostly night works pavement construction, asphalting, tie-ins, traffic barriers, traffic switching and miscellaneous works • A large concrete pour at night

Estimated vehicle movements per site	No. of sites	Assumptions
Heavy vehicles: **Up to 10 movements per hour** **Up to 160 movements per day**		• Up to about 5,000 cubic metres of spoil would be disposed
Facilities for bridge piling and pier construction support (3-5 span) **Light vehicles:** **Up to 30 movements per hour** **Up to 180 movements per day** **Heavy vehicles:** **Up to 2 vehicles per hour** **Up to 50 vehicles per day**	12	
Facilities for bridge piling and pier construction support (6-8 span) **Light vehicles:** **Up to 40 movements per hour** **Up to 300 movements per day** **Heavy vehicles:** **Up to 10 vehicles per hour** **Up to 80 vehicles per day**	8	
Zone construction ancillary facility		
Light vehicles: **Up to 70 movements per hour** **Up to 490 movements per day** **Heavy vehicles:** **Up to 20 movements per hour** **Up to120 movements per day**	9	• Most civil works staff and workforce would park at zone construction ancillary facilities • Use: major civil work compound/laydown/parking • Duration: 36 months • Parking: 20-30 spaces • Mostly night works pavement construction, asphalting, tie-ins, traffic barriers, traffic switching and miscellaneous works • All vehicles are assumed to access site from local roads

Estimated vehicle movements per site	No. of sites	Assumptions
Project management head office		
Light vehicles: **Up to 110 movements per hour** **Up to 490 movements per day** **Heavy vehicles:** **Up to 1 movements per hour** **2 movements per day**	1	• Use: Central Project Office, assumed to be in existing office complex within proximity of the project works • Duration: duration of construction • Parking: 25-35 spaces (some parking required on local roads) • Most civil works staff and workforce would be at the other compounds

Construction road traffic noise would be generated by vehicles associated with the construction of the project, including heavy vehicles transporting spoil and light vehicle movements generated by construction workers.

The construction traffic volumes are presented in **Table 4-7**.

In order for construction traffic to generate an increase in noise levels of greater than 2 dB, existing traffic levels along construction traffic routes would need to increase by around 60%.

All construction ancillary facilities with proposed access from the M7 are expected to generate an increase in noise levels less than 2 dB due to high existing traffic flows, therefore they have not been assessed.

It is noted that construction traffic for some construction ancillary facilities with proposed access from shared paths may travel on residential streets. In these cases, given the low existing traffic volumes, it is not expected that the *Road Noise Policy* noise criteria would be exceeded. In addition generally there are no truck movements proposed between midnight and 6:00 am.

4.4.2 Daytime movements

Table 4-8 presents a summary of the existing, forecasted additional traffic flow and the resultant noise increases for the most affected hour of the daytime. The most affected hour is considered to be the hour with the greatest predicted relative increase in traffic noise levels.

Table 4-8 Construction road traffic noise during most affected hour - daytime

Route	Compounds	Most Affected Hour	Existing traffic (hourly)		Approximate additional traffic (hourly)		Relative increase, dB(A)
			Light	Heavy	Light	Heavy	
Hoxton Park Road	C2@B9829/30 C3@B9829/30 C4@B9829/30 Zone A-1 Zone D-2	7:00 am to 8:00 am	1,622	142	165	42	0.7
Cowpasture Road South	C2@B9839/40 C2@B9841/42 Zone A-2 Zone A-3	4:00 pm to 5:00 pm	3,549	383	228	30	0.3
Cowpasture Road North	C2@B9839/40 C2@B9841/42 Zone A-2 Zone A-3	4:00 pm to 5:00 pm	3,444	257	228	30	0.4
Elizabeth Drive	AF8 Zone B AF17 AF18	7:00 am to 8:00 am	2,050	225	292	51	0.7
Wallgrove Road	C2@B9861/62 C2@B9873/74 Zone C-3	4:00 pm to 5:00 pm	1,087	130	125	18	0.5
Great Western Highway	C2@B9893/94	9:00 pm to 10:00 pm	696	75	7	2	0.1
Woodstock Avenue	C2@B9902/03 C3@B9902/03 C4@B9902/03	9:00 pm to 10:00 pm	259	17	7	2	0.3

4.4.3 Night-time movements

Table 4-9 presents a summary of the existing, forecasted additional traffic flow and the resultant noise increases for the most affected hour of the night-time. The most affected hour is considered to be the hour with the greatest predicted relative increase in traffic noise levels..

Table 4-9 Construction road traffic noise during most affected hour – night-time

Route	Compounds	Most Affected Hour	Existing traffic (hourly)		Approximate additional traffic (hourly)		Relative increase, dB(A)
			Light	Heavy	Light	Heavy	
Hoxton Park Road	C2@B9829/30 C3@B9829/30 C4@B9829/30 Zone A-1 Zone D-2	1:00 am to 2:00 am	123	12	59	0	1.0
Cowpasture Road South	C2@B9839/40 C2@B9841/42 Zone A-2 Zone A-3	1:00 am to 2:00 am	262	27	42	0	0.4
Cowpasture Road North	C2@B9839/40 C2@B9841/42 Zone A-2 Zone A-3	1:00 am to 2:00 am	270	27	42	0	0.4
Elizabeth Drive	AF8 Zone B AF17 AF18	6:00 am to 7:00 am	1,811	239	277	46	0.7
Wallgrove Road	C2@B9861/62 C2@B9873/74 Zone C-3	11:00 pm to 12 midnight	191	14	26	4	0.7
Great Western Highway	C2@B9893/94	1:00 am to 2:00 am	158	23	11	0	0.1
Woodstock Avenue	C2@B9902/03 C3@B9902/03 C4@B9902/03	11:00 pm to 12:00 midnight	178	13	11	2	0.4

No increases in road traffic noise of greater than 2 dB(A) have been identified at any of the proposed access roads.

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.

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

- Existing traffic volumes have been determined based on the 6-day average (Monday to Saturday) hourly traffic movements
- All ancillary 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)
- The existing traffic flows were based on traffic count data collected in 2021

As a result, this assessment has assumed a worst case scenario.

4.5 Detour road traffic noise

Bridge widening works would require temporary lane closures on the Westlink M7 and traffic detours. These traffic detours would only occur at night-time to allow critical construction activities that cannot otherwise be practically carried out without road or lane closures.

Detour road traffic noise would be generated by vehicles diverted from the M7 along roads in the surrounding area.

In order for detour traffic to generate an increase in noise levels of greater than 2 dB, existing traffic levels along detour routes would need to increase by around 60%.

Table 4-10 and **Table 4-11** present a summary of the existing, forecasted additional traffic flow and the resultant noise increases for 9pm to 10pm and 10pm to 11pm respectively.

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

- Existing traffic volumes have been determined based on the 6-day average (Monday to Saturday) hourly traffic movements
- The existing traffic flows were based on traffic count data collected in 2021
- Northbound and southbound detours will not occur simultaneously.

Table 4-10 Detour road traffic noise 9pm to 10pm

Detour	Direction of detour traffic	Road	Existing traffic (hourly)[1]		Approximate additional traffic (hourly)		Relative increase, dB(A)
			Light	Heavy	Light	Heavy	
Between M5 Motorway and Bernera Road	North	Kurrajong Road	594	12	500	180	6.1
	South	Kurrajong Road	594	12	440	180	6.0
Between Bernera Road and Cowpasture Road	North	Hoxton Park Road, East of M7 Overpass	999	44	520	170	3.8
		Hoxton Park Road, West of Wilson Road	1,046	53	520	170	3.6
		Cowpasture Road	1,943	122	520	170	2.2
	South	Hoxton Park Road, East of M7 Overpass	999	44	450	160	3.6
		Hoxton Park Road, West of Wilson Road	1,046	53	450	160	3.4
		Cowpasture Road	1,943	122	450	160	2.0
Between Cowpasture Road and Elizabeth Drive	North	Cowpasture Road	1,819	93	490	180	2.5
		Elizabeth Drive	801	48	490	180	4.2
	South	Cowpasture Road	1,819	93	480	160	2.3
		Elizabeth Drive	801	48	480	160	4.0
Elizabeth Drive at the Westlink M7	North	Nil residential receiver along detour route					
	South	Elizabeth Drive	801	48	520	170	4.1

Detour	Direction of detour traffic	Road	Existing traffic (hourly)[1]		Approximate additional traffic (hourly)		Relative increase, dB(A)
			Light	Heavy	Light	Heavy	
Between Elizabeth Drive and The Horsley Drive	North	Wallgrove Road	327	28	510	180	6.5
	South	Wallgrove Road	327	28	500	170	6.3
Between The Horsley Drive and Old Wallgrove Road	North	Wallgrove Road	327	28	540	170	6.4
	South	Wallgrove Road	327	28	530	160	6.2
Between Old Wallgrove Road and Great Western Highway	North	Nil residential receiver along detour route					
Between Old Wallgrove Road and Power Street	North	Rooty Hill Road	1,150	47	510	160	3.5
		Francis Road	745	12	510	160	5.2
		Power Street	359	7	510	160	7.6
	South	Rooty Hill Road	1,150	47	490	120	3.0
		Francis Road	745	12	490	120	4.6
		Power Street	359	7	490	120	6.8
Between Woodstock Avenue and Power Street	South	Rooty Hill Road	1,150	47	340	80	2.3
		Power Street	359	7	340	80	5.5
Between Woodstock Avenue and Richmond Road	North	Rooty Hill Road	1,150	47	450	110	2.9
	South	Rooty Hill Road	1,150	47	360	90	2.4

Notes

1. Includes traffic movements in both directions

Table 4-11 Detour road traffic noise 10pm to 11pm

Detour	Direction of detour traffic	Road	Existing traffic (hourly)[1]		Approximate additional traffic (hourly)		Relative increase, dB(A)
			Light	Heavy	Light	Heavy	
Between M5 Motorway and Bernera Road	North	Kurrajong Road	540	10	350	170	6.1
	South	Kurrajong Road	540	10	290	170	6.0
Between Bernera Road and Cowpasture Road	North	Hoxton Park Road, East of M7 Overpass	856	37	350	160	3.9
		Hoxton Park Road, West of Wilson Road	876	45	350	160	3.7
		Cowpasture Road	1,725	111	350	160	2.1
	South	Hoxton Park Road, East of M7 Overpass	856	37	300	160	3.8
		Hoxton Park Road, West of Wilson Road	876	45	300	160	3.6
		Cowpasture Road	1,725	111	300	160	2.1
Between Cowpasture Road and Elizabeth Drive	North	Cowpasture Road	1,615	91	330	160	2.3
		Elizabeth Drive	750	40	330	160	4.0
	South	Cowpasture Road	1,615	91	320	160	2.3
		Elizabeth Drive	750	40	320	160	4.0
Elizabeth Drive at the Westlink M7	North	Nil residential receiver along detour route					
	South	Elizabeth Drive	750	40	330	170	4.1
Between Elizabeth Drive and The Horsley Drive	North	Wallgrove Road	311	24	350	160	6.1
	South	Wallgrove Road	311	24	330	170	6.3
Between The Horsley Drive and Old Wallgrove Road	North	Wallgrove Road	311	24	370	150	6.0
	South	Wallgrove Road	311	24	350	160	6.1
Between Old Wallgrove Road and Great Western Highway	North	Nil residential receiver along detour route					

Detour	Direction of detour traffic	Road	Existing traffic (hourly)[1]		Approximate additional traffic (hourly)		Relative increase, dB(A)
			Light	Heavy	Light	Heavy	
Between Old Wallgrove Road and Power Street	North	Rooty Hill Road	1,021	32	340	130	3.4
		Francis Road	686	14	340	130	4.6
		Power Street	335	7	340	130	6.9
	South	Rooty Hill Road	1,021	32	310	130	3.3
		Francis Road	686	14	310	130	4.6
		Power Street	335	7	310	130	6.8
Between Woodstock Avenue and Power Street	South	Rooty Hill Road	1,021	32	200	90	2.5
		Power Street	335	7	200	90	5.6
Between Woodstock Avenue and Richmond Road	North	Rooty Hill Road	1,021	32	260	70	2.3
	South	Rooty Hill Road	1,021	32	220	90	2.6

Notes

1. Includes traffic movements in both directions

Increases in road traffic noise of greater than 2 dB(A) have been identified along some detour routes. It is noted that, whilst the relative increase in noise levels from the roads on the detour route is significant, in many cases, the receivers located on these roads are currently impacted by traffic noise from M7 vehicle movements, particularly Wallgrove Road. It is also noted that construction activities would be temporary in nature and regulated by the EPA under an Environment Protection Licence that would limit the number and duration of out of hours work nights. Unless approved by the EPA under the project Environment Protection Licence, to minimise the traffic noise impact from the diversions, works requiring diversions would be limited as follows:

- No more than 2 consecutive evenings and/or nights
- No more than 3 evenings and/or night per week
- No more than 10 evenings and/or night per month.

The Contractor must conduct a detailed construction noise and vibration assessment and implement reasonable and feasible mitigation measures in accordance with the *Construction Noise and Vibration Guideline* (Roads and Maritime, 2016). Mitigation measures that may be implemented include the following:

- Traffic diversions limited in duration as noted above
- Notification (letterbox drop or equivalent)
- Specific notifications
- Individual briefings and/or community consultations.

5.0 Assessment of operational noise impacts

5.1 Road traffic noise assessment

The assessment of road traffic noise has been completed in accordance with the *Road Noise Policy*, the *Noise Criteria Guideline* and the *Noise Mitigation Guideline*. The *Noise Criteria Guideline* and the *Noise Mitigation Guideline* provide details of the practical application of the criteria presented in the *Road Noise Policy*.

To assess the potential impact of the proposal on noise sensitive receivers, the following steps have been completed:

- Existing road traffic noise levels have been modelled with existing (2021) road traffic volumes. This model has been validated with noise measurements and concurrent road traffic surveys. This is discussed further in **Section 5.1.3**
- Future road traffic noise levels have been modelled for the 'do minimum' (without the proposal), design scenarios for the design year (2036). This is discussed further in **Section 5.2** and results are presented in **Section 5.3**.

5.1.1 Road traffic noise modelling methodology

Road traffic noise levels were calculated using SoundPLAN v8.0 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 and has been found to consistently model noise predictions for all Transport road projects.

CoRTN is the most widely used algorithm for the prediction of road traffic noise within Australia and is an accepted algorithm under the EPA's *Road Noise Policy* (Appendix B4). It is the only algorithm at this point in time which has been evaluated under Australian conditions. Recently in NSW, adjustments have been used to CoRTN predictions to improve accuracy. This includes the use of three source heights for trucks (Tyres, engines and exhausts) and the application of a heavy vehicle mix correction to account for the larger heavy vehicle fleet in Australia compared with the UK, where CoRTN was developed.

Where road gradients affect road emissions and speed of vehicles, posted speeds are modelled within CoRTN which are higher than actual speeds on the road gradient and provide a conservative approach. Given that this is a motorway project with optimised grades, there are no locations where grades of significance have any bearing on predicted noise levels.

Meteorology in the area surrounding the Westlink M7 corridor is affected by several factors such as terrain and land use. Wind speed and direction are affected by topography and land use at the local scale (typically on a scale of a few meters to 150 km. The proposed modification covers a 26-kilometre-long stretch and as such local meteorological conditions are likely to be influenced by varying topography and land use characteristics along the alignment at the local scale.

The Modification report - Technical working paper: Air Quality provides details of ten years of meteorological data at the BoM Horsley Park Station (closest BOM station to the Westlink M7) which was analysed between 2010 and 2019. On an annual basis, the dominant wind direction is from the south-southwest to southwest with an annual average wind speed of 2.2 m/s. Calm conditions (defined as wind speeds less than 0.5 m/s) occur approximately 17.8 % of the time.

On a seasonal basis average wind speeds were found to be similar ranging from 1.9 m/s in the autumn to 2.4 m/s in the summer. A high proportion of calm conditions was observed across all seasons ranging from 16% to 20%. General seasonal trends observed show that temperature declines heading into and during the winter months with a gradual increase leading into the summer period. The hottest month January with an average maximum temperature of 29°C and the coldest month is July with an average minimum temperature of approximately 7°C.

The potential for temperature inversions in the area surrounding the Westlink M7 can be determined through the examination of wind speed conditions and stability class occurrences. Calm wind conditions (wind speed less than 0.5 m/s) and very stable, Class F stability classes have been determined as part

of the air quality impact assessment. The calm wind speeds showed an occurrence of about 18% during the year with Class F condition occurring about 46% of the time. When these condition combine there is the potential for inversion to form. Along the length of the Westlink M7 (considering meteorology at Liverpool, Horsley Park and St Marys), Class F conditions occur at the same time as calm condition about 15% of the time, suggesting the potential for inversions to occur at the same frequency. It should be noted that the potential for inversions would change depending on time of year where winter conditions are more conducive to the formation of inversions.

Whilst road traffic noise levels at receivers may vary at times due to changes in weather conditions such as wind speed and direction and temperature inversions, it is noted that the *Road Noise Policy* does not require road traffic noise criteria to be met under adverse meteorological conditions.

As noted in the *Model Validation Guideline* the objective of model validation is to demonstrate that the noise model is an accurate representation of the real world within the limitations of the algorithm. Validation of the existing noise model is presented in **Section 5.1.3.**

The modelling parameters which are included in the model are detailed in **Table 5-1**.

Table 5-1 Modelling noise parameters

<table>
<tr><th>Parameter</th><th>Comment</th></tr>
<tr><td>Calculation search radius</td><td>2,000 metres</td></tr>
<tr><td>Assessment area</td><td>600 metres</td></tr>
<tr><td>Traffic volumes and mix</td><td>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.
For model validation, the traffic counting carried out at the time of the noise monitoring was used.
Predicted traffic volumes for the design year (2036) for the ‘do minimum’ and design scenarios were provided by Transurban and are presented in Appendix D.
In accordance with the Austroads vehicle classification, light vehicles are considered to be Class 1 and 2 and Heavy vehicles are Class 3 through to 12.</td></tr>
<tr><td>Traffic speeds</td><td>An increase in speed generally causes an increase in road traffic noise. For model validation, the speed measured during the traffic counting at the time of the noise monitoring was used. For the design scenarios traffic speeds have been based on posted road speeds for existing roads (100 km/h) and proposed speeds for the main carriageways (100 km/h).</td></tr>
<tr><td>Traffic noise source heights</td><td>Four noise source heights were used in the model as follows:
<table>
<tr><th>Source</th><th>Height (m)</th><th>Correction (dB)</th></tr>
<tr><td>Light vehicles engine and tyres</td><td>0.5</td><td>0.0</td></tr>
<tr><td>Heavy vehicles tyres</td><td>0.5</td><td>-5.4</td></tr>
<tr><td>Heavy vehicles engine</td><td>1.5</td><td>-2.4</td></tr>
<tr><td>Heavy vehicles exhaust</td><td>3.6</td><td>-8.5</td></tr>
</table></td></tr>
<tr><td>Existing road alignment</td><td>The existing roads were modelled using satellite imagery.</td></tr>
<tr><td>Roadway gradient</td><td>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</td></tr>
</table>

<table>
<tr><th>Parameter</th><th colspan="2">Comment</th></tr>
<tr><td></td><td colspan="2">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 for NSW estimate 95% of trucks are) the noise levels predicted by CoRTN are considered to adequately represent typical road traffic noise levels.

It is also noted that the design of the Westlink M7 generally does not necessitate use of sudden truck deceleration.</td></tr>
<tr><td rowspan="4">Road surface</td><td colspan="2">Road surface characteristics would determine the level of road/tyre interfacial noise created.
Open graded asphalt (OGA) surfaces were modelled for the main alignment and on/off ramps. All other roads were modelled as dense graded asphalt (DGA). The following corrections were used.</td></tr>
<tr><td>Surface</td><td>Correction</td></tr>
<tr><td>DGA</td><td>0 dB</td></tr>
<tr><td>OGA</td><td>-2 dB</td></tr>
<tr><td>Ground absorption</td><td colspan="2">Road traffic noise levels reduce with increasing distance from the noise source along the ground.
A ground absorption factor of 0.75 was used for soft ground areas, 1.0 was used in areas of dense vegetation and 0.0 for areas of water.</td></tr>
<tr><td>Terrain</td><td colspan="2">Natural topographical features such as hills and valleys can shield sensitive receivers from road traffic noise. Two metre interval data was included up to 1 kilometre either side of the project.</td></tr>
<tr><td>Buildings</td><td colspan="2">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 the use of LiDAR data and a virtual ground-truthing exercise. The heights were then included in the road traffic noise model.</td></tr>
<tr><td>Noise walls</td><td colspan="2">Existing noise walls along Westlink M7 alignment have been incorporated into the noise model based on as-built noise wall drawings.</td></tr>
<tr><td>façade reflections</td><td colspan="2">A correction of 2.5 dB(A) was added to all road traffic noise levels to take account of façade reflection effects in accordance with the NSW Road Noise Policy.
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.</td></tr>
<tr><td>Receiver heights</td><td colspan="2">1.5 metres for single storey and 4.5 metres for double storey.</td></tr>
<tr><td>Receiver locations</td><td colspan="2">1 metre from the façade of receivers.</td></tr>
<tr><td>Standard corrections</td><td colspan="2">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.</td></tr>
<tr><td>Temperature and vehicle classification</td><td colspan="2">Corrections were applied to account for the vehicle classification and temperature in accordance with Peng et al. 2017, Evaluation of Calculation of Road Traffic Noise in Australia.</td></tr>
<tr><td>Noise sensitive receivers</td><td colspan="2">In accordance with the Road Noise Policy this includes residences, school classrooms, hospital wards, places of worship, open space (active and passive use), mixed use development, childcare facilities and aged facilities. In this preliminary assessment only residential properties were considered.</td></tr>
</table>

5.1.2 Operational noise study area

The *Road Noise Policy* defines the study areas as comprising locations within a distance of 600 metres from the centre line of the outermost traffic lane on each side of each road under consideration. However in highly urban areas such as around the Westlink M7, a boundary width either side of the project of 600 metres may include other significant roads with noise levels that dominate at nearby receivers. In accordance with the *Noise Criteria Guideline* the width of the study area has been reduced to where the noise levels from the project contribute slightly less than half of the total noise level. This is considered to be where the project adds no more than 2.0 dB(A) to the total noise level.

The operational noise study area boundary has been individually assessed for each receiver and each scenario based on the highly urban principle. Receivers that have been found to be outside the study area are not considered for treatment. These receivers have an existing high exposure to noise, are not expected to increase in the future as a result of the project, and are not located adjacent to any major roadworks associated with the project.

5.1.3 Validation noise model

An existing road traffic noise model was developed incorporating the existing traffic flows and alignment for validation with road traffic noise measurements. The traffic flows used in the model were provided by tube counts that were deployed concurrently with noise logging for the project. Noise logging charts are provided in **Appendix B**. Road traffic volumes are presented in **Appendix D**.

If it can be proven that the predicted road traffic noise levels are accurate at discrete locations across the extent of a project, then it is reasonable to assume that the road traffic noise levels are accurate at all modelled receivers.

Furthermore, it can be assumed that if the same road traffic noise model is updated to include the project design model parameters (e.g. including alignment, traffic flow etc), then the design noise model would predict to the same level of accuracy.

The CoRTN algorithm was utilised to calculate road traffic noise. For a project corridor of 600 metres either side of the road, this algorithm has a well-documented accuracy of ±2 dB(A). If the differences between measured and predicted road traffic noise levels fall within this margin, then the model is considered to have a suitable level of accuracy for that location. Attention should be given to noise measurements that fall outside this range. Common reasons for poor validation of road traffic noise models include extraneous noise sources and poor logger placement. Although the aim during logger deployment was to minimise these issues, they may still occur.

The model was validated in accordance with the *Model Validation Guideline*. The *Model Validation Guideline* (MVG) provides guidance and procedures for validating operational road traffic noise models. The guideline discusses error, which is the difference between measured and predicted noise levels, principles to be applied when completing monitoring and modelling to minimise error and use of calibration adjustments. A correction factor of -3 during the daytime and night-time periods was found to provide the best median differences, whilst maintaining a conservative model. A summary of the noise logger validation results are provided in **Table 5-2**.

Table 5-2 Noise logger validation

Noise logger	Daytime			Night-time		
	Modelled L_{Aeq} (dB(A))	Measured L_{Aeq} (dB(A))	Difference[1]	Modelled L_{Aeq} (dB(A))	Measured L_{Aeq} (dB(A))	Difference[1]
NL3	73.7	72.8	0.9	70.3	68.7	1.6
NL4	73.5	73.6	-0.1	70.2	69.6	0.6
NL5	74.3	75.0	-0.7	70.9	71.3	-0.4
NL6	67.2	66.2	1.0	64.4	63.4	1.0
NL8	73.6	77.1	**-3.5**	70.7	73.6	**-2.9**
NL9	70.8	69.2	1.6	67.9	66.0	1.9
NL10	66.6	65.3	1.3	63.8	62.5	1.3
NL12	69.2	68.9	0.3	66.4	63.3	**3.1**
NL14	63.3	60.2	**3.1**	60.5	57.7	**2.8**
NL15	62.4	57.2	**5.2**	58.7	53.2	**5.5**
NL17	59.7	59.1	0.6	56.8	58.4	-1.6
NL19	72.9	72.3	0.6	69.8	68.7	1.1
Mean			0.9			1.2
Median			0.8			1.2

Notes:

1. *Bolded numbers indicate that the difference between measured and modelled is outside the ±2 dB margin.*
2. *Note 1: A positive difference indicates that the road traffic noise model over-predicted the noise level compared with the measured noise level whilst a negative difference indicates that the road traffic noise model under-predicted the noise level compared with the measured noise level*

At nine locations the differences between measured and predicted noise levels were within ± 2 dB with a correction factor of -3 dB.

It is noted that at NL8 the noise model was underpredicting, this logger was within 10 m of the road edge due to site constraints and it is likely that this close proximity led to the underprediction. The noise model was found to be overpredicting by more than 2 dB at N12, NL14 and NL15.

The NL14 modelled noise levels are slightly higher than 2 dB above the measured levels, this logger was behind a noise wall of around 3 m (not part of Westlink M7 therefore exact barrier heights were not available and the barrier may have been slightly higher than modelled). Modelled noise levels at NL12 were also slightly higher than 2 dB above the measured levels in the night-time although the daytime levels validated well. The NL15 modelled noise levels are higher than the measured levels, this was consistent for the daytime and the night-time periods. At this location the logger was behind a barrier and at a lower level than the road, this may have contributed to the discrepancies between the modelled and measured level.

It is noted that whilst existing traffic volumes along the Westlink M7 were available at every gantry, vehicle classifications were estimated based on weight information available at a single location at the northern end of the existing Westlink M7. The vehicle classification and speed estimations may have led to slightly inaccurate vehicle classification adjustment factors.

Given that good validation was achieved at nine logger locations and the discussion provided for the other three locations the road noise model is considered to be validated. It is generally preferable to have a slightly conservative noise model as this means noise mitigation measures are unlikely to be underestimated. This approach has been implemented successfully across other projects throughout NSW ensuring a greater degree of modelling accuracy.

5.2 Noise modelling scenarios

As previously noted the *Road Noise Policy* requires the assessment of road traffic noise at the year of opening and at the design year. To determine the appropriate noise mitigation, results from the more stringent year (Design year) have been discussed within this report.

Noise levels for both the daytime and night-time periods have been assessed, however the night-time was found to be the controlling period. The assessed situations are:

- **Do Minimum –**This scenario is assessed for the design year (2036) and incorporates the existing alignment and traffic flows for the applicable year. All major existing arterial roads have been included in the noise modelling. It represents the design if the project was not to be built. The *Road Noise Policy*, *Noise Criteria Guideline*, and *Noise Mitigation Guideline* refer to this as the 'No Build' scenario.

  It is called Do Minimum rather than 'Do Nothing' as it assumes that ongoing improvements would be made to the broader road and public transport network including some new infrastructure and intersection improvements to improve capacity and cater for traffic growth.

- **Do Something** – This scenario incorporates the project design alignment, including ramps and all existing major arterial roads. The *Road Noise Policy*, *Noise Criteria Guideline*, and *Noise Mitigation Guideline* refer to this as the Build scenario.

5.2.1 Project impact

Noise sensitive receivers within the study area of the project are currently affected by appreciable levels of road traffic noise. This project is only required to mitigate noise impacts resulting from and directly associated with this project. Existing noise issues outside the extent of the project, such as residential receivers exposed to noise levels exceeding acute noise levels ($L_{Aeq(15\ hr)}$ ≥65 dB(A) or $L_{Aeq(9\ hr)}$ ≥60 dB(A)), are addressed through the Transport for NSW noise abatement program (NAP).

Considering the impacts in Year 2036 during the daytime and night-time periods with the existing noise walls as detailed above constructed the anticipated impacts are summarised as follows:

- Road traffic noise levels are predicted to exceed the L_{Aeq} noise criterion at a total of 1,060 residential receivers
- Of these 1,060 noise sensitive receivers:
  - Noise levels are predicted to increase by more than 2 dB(A) at 4 noise sensitive receiver
  - Noise levels are predicted to exceed the cumulative limit at 108 sensitive receivers. (i.e. ≥ $L_{Aeq(15\ hr)}$ or $L_{Aeq(9\ hr)}$ noise criterion + 5 dB(A))
  - Noise levels are predicted to exceed the acute noise limit at 309 sensitive receivers. (i.e. ≥ $L_{Aeq(15\ hr)}$ 65 dB(A) or $L_{Aeq(9\ hr)}$ 60 dB(A))
- 329 sensitive receivers are considered to be eligible for the consideration of feasible and reasonable noise mitigation measures.

As discussed in **Section 3.5.2**, a sensitive receiver would be considered eligible for the consideration of noise mitigation where:

- The predicted design noise level exceeds the *Noise Criteria Guideline* controlling criterion and the noise level increase due to the proposal (i.e. the noise predictions for the 'Design' minus the 'Do Minimum') is greater than 2.0 dB(A), or
- The predicted 'Design' noise level is 5 dB(A) or more above the criteria (exceeds the cumulative limit) and the receiver is significantly influenced by road noise, regardless of the incremental impact of the proposal, or
- The noise level contribution from the road proposal is acute (daytime $L_{Aeq(15\ hr)}$ 65 dB(A) or higher, or night-time $L_{Aeq(9\ hr)}$ 60 dB(A) or higher) then it qualifies for consideration of noise mitigation even if noise levels are dominated by another road.

Generally, exceedances would occur at receivers directly adjacent to the Westlink M7 corridor. Residential receivers where the noise levels are exceeding the criteria fall within three main categories, these are detailed in the following sections.

5.2.2 Residential areas with existing Westlink M7 Motorway noise wall

There are a number of receivers within the suburbs of Hoxton Park, Hinchinbrook, Rooty Hill, Plumpton, Oakhurst and Glendenning which have been identified as being eligible for consideration of additional mitigation. These receivers are located behind existing Westlink M7 Motorway noise walls.

Initial noise wall analysis has shown that increasing the height of these barriers may be considered reasonable to reduce road traffic noise levels in these areas. In NSW noise walls up to eight metres in height should be considered in a noise wall analysis. Increasing the height or length of the following existing noise walls has been considered in **Section 5.3**:

- NW14A
- NW18 (new extension)
- NW29
- NW32A
- NW33
- NW35.

5.2.3 Residential areas within Elizabeth Hills and Middleton Grange residential subdivisions

There are a number of receivers within the suburbs of Middleton Grange and Elizabeth Hills where noise levels would exceed the cumulative and/or acute noise limit. These receivers were not identified within the Western Sydney Orbital Environmental Impact Statement (WSO EIS) prepared as part of the approved project and were likely constructed after the Westlink M7 Motorway became operational.

The *Liverpool Development Control Plan 2008 Part 2.14 Land Subdivision and Development in Elizabeth Hills* required a 4 m high noise wall to be constructed within the residential development site and ‘acoustic treatment’ to be included in the design of residential buildings in the adjacent to the Westlink M7 corridor. Details of the ‘acoustic treatment’ are unknown at this stage.

A noise wall (around 4 m high) was also constructed to the east of the residential buildings along Hemsworth Avenue within the Middleton Grange residential land subdivision. Some of these receivers may include at-receiver noise mitigation measures, however this is unknown at this stage.

Consideration may be given to increasing the height of the existing barriers or providing at-receiver noise mitigation measures where the cumulative noise limit is exceeded and receivers do not have sufficient noise mitigation measures already installed.

5.2.4 Residential areas without noise walls

There are a number of receivers scattered throughout the suburb of Horsley Park where noise levels would exceed the cumulative and/or noise limits. For these receivers, noise walls are unlikely to be reasonable given that the receivers are not located in groups of four or more, in accordance with the *Noise Mitigation Guideline*. It noted that some of these receivers may have had at-receiver noise mitigation installed when the Westlink M7 Motorway was initially constructed, however these details are not available in the WSO EIS. Consideration of at-receiver noise mitigation may be required for these receivers where sufficient noise mitigation measures are not already installed. There are also a number of receivers around Skipton Lane, Prestons where noise levels would exceed the cumulative and/or acute noise levels. These receivers are located in groups of four or more and a barrier has been considered for this area. It is noted that some of these receivers may have had ‘acoustic treatment’ installed when they were constructed, however details of the ‘acoustic treatment’ are unknown at this stage.

5.3 Noise wall assessment

As noted above there are 329 noise sensitive receivers considered to be eligible for the consideration of feasible and reasonable noise mitigation measures. Seven schools, seven places of worship and one

childcare centre have also been identified as being eligible for the consideration of feasible and reasonable noise mitigation measures. The *Noise Mitigation Guideline* advises that noise walls should be considered where there are four or more closely spaced receivers. Residences are generally considered closely spaced where the facades are separated by less than 20 metres.

A combination of noise wall and at-property treatment can provide the most reasonable overall noise reduction for an affected community when consideration is given to cost, urban design, shadowing and engineering construction with the maximum height barrier. The *Noise Mitigation Guideline* presents a process for determining the most effective combination of noise wall height and at-property treatment and considers:

- The additional benefit of noise walls in reducing external noise levels
- Noise reductions that occur to the broader community beyond only those receivers affected by traffic noise above the *Noise Criteria Guideline* noise criteria.

5.3.1 Basis of noise wall assessment

To determine the design barrier height, a points rating assessment is undertaken as detailed in the *Noise Mitigation Guideline*. The points system allows the most reasonable noise wall height to be selected in a consistent manner. The assessment takes into account the size of the noise wall, the exceedance above the criteria at each property and the exceedance above the World Health Organisation guidelines[1] at each property ($L_{Aeq(15hr)}$ 50 dB(A) and $L_{Aeq(9hr)}$) 45 dB(A)). The assessment considers a number of barriers:

- Maximum barrier height - the barrier height that results in the noise criteria being met at all receivers. Barrier heights above 8 m are not to be considered. In the situation where the noise criteria cannot be met at all receivers the maximum barrier height is the height that would result in the lowest noise levels that can be feasibly achieved, taking account of limitations to barrier length or traffic noise from other roads which are not part of the proposal.
- Initial design barrier height - the height at which two thirds of noise affected receivers that could meet the criteria with the maximum barrier, no longer need at-property treatment.
- Design barrier height - the height that is used in combination with the at-property treatment to give the most reasonable noise benefits.

For a noise wall to be considered reasonable, a minimum insertion loss must be obtained for at least one sensitive receiver. A noise wall less than five metres high must have a minimum insertion loss of around 5 dB. A noise wall equal to or greater than five metres high must have a minimum insertion loss of around 10 dB to be considered reasonable.

Where noise walls already exist the noise wall assessment is completed as for a new barrier. However, if the outcome of the assessment is that a higher barrier than the existing is recommended then the additional noise reduction provided by the higher barrier must be greater than 2.0 dB(A). Otherwise, the increase in barrier height is not considered reasonable, as it would not provide a noticeable change in noise level.

5.3.2 Results of noise wall assessment

The assessment has been undertaken for the design year 2036 and considered the night-time assessment period, as this was the most stringent assessment period. The calculations include noise wall heights from 0 metres to eight metres in 0.5 metre increments. A summary of the noise wall assessment is presented in **Appendix E**.

The barriers listed in **Table 5-3** were assessed as noise sensitive receivers behind these barriers were identified as being eligible for consideration of additional mitigation. The resultant design noise wall heights for each of the five noise walls found to be reasonable are shown below in **Table 5-3**.

[1] *Guidelines for Community Noise*, 1999, World Health Organisation and *Night Noise Guidelines for Europe*, 2009, World Health Organisation

Table 5-3 Design noise wall heights

Precinct	Existing	Design height (m)
NW 18 extension	Yes	4 m
NW 33	Yes	6 m
NW Elizabeth Hills	Yes (non Westlink)	7 m
NW Middleton Grange	Yes (non Westlink)	6 m
NW Skipton Lane	No	5 m

5.4 Noise modelling results with design barriers

The Year 2036 design scenarios have been reassessed including the design noise walls presented in **Table 5-3**. Noise levels have been predicted across the extent of the proposal and are presented in **Appendix F**. Road traffic noise maps are presented in **Appendix G**.

- Road traffic noise levels are predicted to exceed the L_{Aeq} noise criteria, presented in **Table 3-12** at a total of 996 residential receivers
- Of these 996 noise sensitive receivers:
  - Noise levels are predicted to increase by more than 2 dB(A) at 4 noise sensitive receivers
  - Noise levels are predicted to exceed the cumulative limit at 95 sensitive receivers. (i.e. ≥ $L_{Aeq(15\ hr)}$ or $L_{Aeq(9\ hr)}$ noise criterion + 5 dB(A))
  - Noise levels are predicted to exceed the acute noise limit at 229 sensitive receivers. (i.e. ≥ $L_{Aeq(15\ hr)}$ 65 dB(A) or $L_{Aeq(9\ hr)}$ 60 dB(A))
- 250 sensitive receivers are considered to be eligible for the consideration of feasible and reasonable noise mitigation measures.

5.4.1 Noise sensitive receivers eligible for consideration of additional noise mitigation

Provided below in **Table 5-4** is a summary of all sensitive receivers where road traffic noise levels exceed the applicable noise criteria, assuming the noise walls detailed in **Section 5.3.2** are constructed. These receivers are also identified in the maps in **Appendix G**. Recommended noise mitigation measures for sensitive receivers are considered further in **Section 6.4**. Unless otherwise noted the noise levels presented are for the most affected façade.

Additional mitigation installed will reduce L_{Aeq} road traffic noise levels and will also reduce maximum noise levels at receivers.

Table 5-4 Receivers eligible for consideration of additional feasible and reasonable noise mitigation measures

ID	Use	Criteria		Predicted noise levels $L_{Aeq(period)}$, dB(A) - Year 2036								Equal or exceed controlling criteria with an increase in noise level ≥ 2dB	Equal or exceed the cumulative limit with the project roads adding ≥ 2dB to the total noise levels	Is the contribution from the project road Acute?	Eligible for mitigation
				Do minimum		Design		Project only		Change					
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night				
1761470	RS	60	55	63	61	64	61	64	61	0.4	0.4	No	Yes	Yes	Yes
1761786	RS	60	55	64	61	64	62	64	62	0.4	0.5	No	No	Yes	Yes
1761834	RS	60	55	65	62	65	62	65	62	0.5	0.4	No	Yes	Yes	Yes
1761910	RS	60	55	64	61	64	62	64	62	0.5	0.4	No	No	Yes	Yes
1762296	RS	60	55	66	61	66	61	59	56	0.0	0.1	No	Yes	No	Yes
1762347	RS	60	55	63	60	64	61	64	61	0.8	0.7	No	No	Yes	Yes
1762477	RS	60	55	65	62	66	63	65	63	0.8	0.9	No	Yes	Yes	Yes
1762619	RS	60	55	63	60	63	60	63	60	0.7	0.7	No	No	Yes	Yes
1763248	RS	60	55	62	59	63	60	63	60	0.8	0.7	No	No	Yes	Yes
1763579	RS	60	55	63	60	64	61	64	61	0.8	0.8	No	Yes	Yes	Yes
1763689	RS	60	55	63	60	63	60	63	60	0.6	0.6	No	No	Yes	Yes
1763731	RS	60	55	65	60	65	61	60	57	0.2	0.2	No	Yes	No	Yes
1763751	RS	60	55	67	62	67	62	62	59	0.1	0.4	No	Yes	No	Yes
1763886	RS	60	55	62	59	63	60	63	60	0.7	0.7	No	No	Yes	Yes
1763926	RS	60	55	63	60	63	60	63	60	0.6	0.7	No	Yes	Yes	Yes
1764101	RS	60	55	64	61	65	62	63	60	0.6	1.3	No	Yes	Yes	Yes
1764122	RS	60	55	62	59	62	60	62	60	0.7	0.7	No	No	Yes	Yes
1764238	RS	60	55	62	60	63	60	63	60	0.7	0.7	No	No	Yes	Yes
1764445	RS	60	55	63	60	64	60	63	60	0.5	0.5	No	Yes	Yes	Yes
1764721	RS	60	55	62	59	63	60	63	60	0.7	0.8	No	No	Yes	Yes
1764732	RS	60	55	62	59	63	60	63	60	0.6	0.6	No	No	Yes	Yes
1765019	RS	60	55	64	61	64	61	64	61	0.7	0.7	No	No	Yes	Yes
1765257	RS	60	55	66	60	66	61	61	59	0.1	0.4	No	Yes	No	Yes
1765296	RS	60	55	63	60	64	61	64	61	0.7	0.7	No	No	Yes	Yes

ID	Use	Criteria		Predicted noise levels $L_{Aeq(period)}$, dB(A) - Year 2036								Equal or exceed controlling criteria with an increase in noise level ≥ 2dB	Equal or exceed the cumulative limit with the project roads adding ≥ 2dB to the total noise levels	Is the contribution from the project road Acute?	Eligible for mitigation
				Do minimum		Design		Project only		Change					
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night				
1765372	RS	60	55	63	60	64	61	64	61	0.7	0.6	No	No	Yes	Yes
1765860	RS	60	55	67	64	68	65	68	65	0.8	0.7	No	No	Yes	Yes
1765863	RS	60	55	62	59	63	61	61	58	0.8	1.6	No	Yes	No	Yes
1766631	RS	60	55	63	60	64	61	64	61	0.8	0.9	No	Yes	Yes	Yes
1767375	RS	60	55	69	63	69	64	63	60	-0.1	0.3	No	Yes	Yes	Yes
1767564	RS	60	55	64	61	64	61	64	61	0.7	0.7	No	Yes	Yes	Yes
1767705	RS	60	55	62	60	63	60	63	60	0.7	0.6	No	No	Yes	Yes
1767881	RS	60	55	62	59	63	60	62	60	0.7	0.7	No	Yes	Yes	Yes
1768351	RS	60	55	64	61	64	61	64	61	0.6	0.6	No	Yes	Yes	Yes
1768670	RS	60	55	63	60	64	61	64	61	0.8	0.8	No	No	Yes	Yes
1768673	RS	60	55	68	65	69	66	69	66	0.8	0.8	No	Yes	Yes	Yes
1769269	RS	60	55	62	59	63	60	62	60	0.7	0.7	No	No	Yes	Yes
1769421	RS	60	55	62	60	63	60	63	60	0.6	0.6	No	No	Yes	Yes
1769617	RS	60	55	67	64	68	66	67	64	0.9	1.9	No	Yes	Yes	Yes
1769829	RS	60	55	65	63	66	63	66	63	0.8	0.7	No	No	Yes	Yes
1770053	RS	60	55	63	60	64	61	64	61	0.8	0.7	No	No	Yes	Yes
1770071	RS	60	55	62	59	63	60	63	60	0.7	0.6	No	No	Yes	Yes
1770432	RS	60	55	69	64	69	65	65	62	0.1	0.4	No	Yes	Yes	Yes
1770502	RS	60	55	62	60	63	60	63	60	0.9	0.8	No	No	Yes	Yes
1770642	RS	60	55	63	60	63	61	63	61	0.7	0.7	No	No	Yes	Yes
1770743	RS	60	55	64	61	65	62	65	62	0.8	0.7	No	No	Yes	Yes
1770810	RS	60	55	64	61	65	62	64	62	0.8	1.0	No	Yes	Yes	Yes
1771038	RS	60	55	62	59	63	60	63	60	0.7	0.8	No	No	Yes	Yes
1771056	RS	60	55	67	62	67	62	62	60	0.0	0.3	No	Yes	Yes	Yes
1771220	RS	60	55	62	59	63	60	62	60	0.7	0.7	No	No	Yes	Yes

ID	Use	Criteria		Predicted noise levels $L_{Aeq(period)}$, dB(A) - Year 2036								Equal or exceed controlling criteria with an increase in noise level ≥ 2dB	Equal or exceed the cumulative limit with the project roads adding ≥ 2dB to the total noise levels	Is the contribution from the project road Acute?	Eligible for mitigation
				Do minimum		Design		Project only		Change					
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night				
1771282	RS	60	55	68	63	68	63	64	61	0.1	0.4	No	Yes	Yes	Yes
1771326	RS	60	55	64	60	65	60	61	58	0.2	0.5	No	Yes	No	Yes
1771370	RS	60	55	63	60	64	62	62	59	0.8	1.9	No	Yes	No	Yes
1771478	RS	60	55	63	60	63	61	63	61	0.7	0.7	No	No	Yes	Yes
1771503	RS	60	55	66	63	67	66	63	61	1.0	3.0	Yes	Yes	Yes	Yes
1771518	RS	60	55	62	59	63	60	62	59	0.5	0.6	No	Yes	No	Yes
1771840	RS	60	55	64	61	65	63	63	60	0.9	2.1	Yes	Yes	Yes	Yes
1771894	RS	60	55	63	60	64	61	62	59	0.6	1.1	No	Yes	No	Yes
1772355	RS	60	55	64	61	65	62	65	62	0.8	0.8	No	No	Yes	Yes
1772477	RS	60	55	63	60	64	61	62	60	0.9	1.4	No	Yes	Yes	Yes
1772942	RS	60	55	64	61	64	62	64	62	0.8	0.8	No	No	Yes	Yes
1773124	RS	60	55	63	60	64	61	64	61	0.8	0.7	No	No	Yes	Yes
1773166	RS	60	55	64	61	65	62	65	62	0.6	0.6	No	No	Yes	Yes
1773199	RS	60	55	63	60	64	61	64	61	0.8	0.8	No	Yes	Yes	Yes
1773410	RS	60	55	63	60	64	61	62	59	0.5	1.2	No	Yes	No	Yes
1773451	RS	60	55	62	60	63	60	63	60	0.8	0.7	No	No	Yes	Yes
1773705	RS	60	55	61	59	62	60	61	58	0.9	1.7	No	Yes	No	Yes
1773935	RS	60	55	63	60	63	60	63	60	0.6	0.6	No	No	Yes	Yes
1775175	RS	60	55	64	61	65	63	64	62	0.8	1.4	No	Yes	Yes	Yes
1775395	RS	60	55	64	61	64	62	64	62	0.7	0.7	No	No	Yes	Yes
1775756	RS	60	55	65	62	65	63	65	63	0.8	0.7	No	No	Yes	Yes
1775960	RS	60	55	67	64	68	65	67	65	0.8	1.0	No	Yes	Yes	Yes
1775977	RS	60	55	63	60	63	61	63	61	0.8	0.8	No	Yes	Yes	Yes
1776409	RS	60	55	64	61	64	62	64	61	0.6	0.6	No	Yes	Yes	Yes
1776424	RS	60	55	62	59	62	60	62	59	0.7	0.7	No	Yes	No	Yes

ID	Use	Criteria		Predicted noise levels $L_{Aeq(period)}$, dB(A) - Year 2036								Equal or exceed controlling criteria with an increase in noise level ≥ 2dB	Equal or exceed the cumulative limit with the project roads adding ≥ 2dB to the total noise levels	Is the contribution from the project road Acute?	Eligible for mitigation
				Do minimum		Design		Project only		Change					
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night				
1776451	RS	60	55	64	61	64	61	64	61	0.7	0.7	No	No	Yes	Yes
1776488	RS	60	55	63	60	64	61	63	61	0.8	1.0	No	Yes	Yes	Yes
1776687	RS	60	55	69	64	69	64	64	61	0.0	0.3	No	Yes	Yes	Yes
1777035	RS	60	55	63	60	64	61	64	61	0.6	0.6	No	No	Yes	Yes
1777214	RS	60	55	63	60	64	61	64	61	0.8	0.8	No	No	Yes	Yes
1777246	RS	60	55	63	60	63	60	62	59	0.5	0.7	No	Yes	No	Yes
1777424	RS	60	55	63	60	63	61	63	61	0.6	0.6	No	No	Yes	Yes
1777588	RS	60	55	67	62	67	63	63	60	0.0	0.4	No	Yes	Yes	Yes
1777635	RS	60	55	62	59	63	60	63	60	0.7	0.8	No	No	Yes	Yes
1777705	RS	60	55	62	60	63	60	63	60	0.7	0.7	No	Yes	Yes	Yes
1777822	RS	60	55	62	59	62	60	62	59	0.8	0.8	No	Yes	No	Yes
1777860	RS	60	55	64	61	65	61	62	60	0.6	0.7	No	Yes	Yes	Yes
1777980	RS	60	55	64	60	64	60	61	58	-0.1	0.2	No	Yes	No	Yes
1777984	RS	60	55	70	64	70	65	64	61	0.0	0.3	No	Yes	Yes	Yes
1778200	RS	60	55	62	59	62	60	62	60	0.9	0.8	No	No	Yes	Yes
1778624	RS	60	55	63	60	63	60	63	60	0.7	0.7	No	No	Yes	Yes
1778751	RS	60	55	63	61	64	61	64	61	0.5	0.4	No	No	Yes	Yes
1778763	RS	60	55	66	61	66	61	59	56	0.0	0.1	No	Yes	No	Yes
1778770	RS	60	55	62	59	63	60	63	60	0.7	0.7	No	No	Yes	Yes
1779707	RS	60	55	65	60	65	60	60	58	0.0	0.2	No	Yes	No	Yes
1779823	RS	60	55	62	59	62	60	62	60	0.5	0.5	No	No	Yes	Yes
1779828	RS	60	55	65	63	66	63	66	63	0.8	0.8	No	No	Yes	Yes
1779833	RS	60	55	63	60	63	60	63	60	0.6	0.6	No	No	Yes	Yes
1779836	RS	60	55	66	63	67	64	67	64	0.7	0.7	No	No	Yes	Yes
1779848	RS	60	55	64	61	64	61	64	61	0.5	0.5	No	No	Yes	Yes

ID	Use	Criteria		Predicted noise levels $L_{Aeq(period)}$, dB(A) - Year 2036								Equal or exceed controlling criteria with an increase in noise level ≥ 2dB	Equal or exceed the cumulative limit with the project roads adding ≥ 2dB to the total noise levels	Is the contribution from the project road Acute?	Eligible for mitigation
				Do minimum		Design		Project only		Change					
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night				
1779855	RS	60	55	65	62	65	63	65	62	0.8	0.8	No	Yes	Yes	Yes
1779858	RS	60	55	62	59	63	60	63	60	0.5	0.5	No	No	Yes	Yes
1779870	RS	60	55	63	60	63	60	63	60	0.5	0.5	No	No	Yes	Yes
1779879	RS	60	55	67	64	68	65	67	64	0.5	0.9	No	Yes	Yes	Yes
1779886	RS	60	55	62	59	63	60	63	60	0.8	0.7	No	No	Yes	Yes
1779888	RS	60	55	67	62	67	63	65	62	0.3	0.4	No	Yes	Yes	Yes
1779904	RS	60	55	66	63	67	64	67	64	0.6	0.6	No	No	Yes	Yes
1779910	RS	60	55	62	59	63	60	63	60	0.8	0.8	No	No	Yes	Yes
1779911	RS	60	55	62	59	63	60	63	60	0.7	0.7	No	No	Yes	Yes
1779914	RS	60	55	67	64	68	65	68	65	0.7	0.7	No	No	Yes	Yes
1779916	RS	60	55	66	63	67	64	67	64	0.9	0.9	No	No	Yes	Yes
1779922	RS	60	55	69	66	70	67	70	67	0.8	0.8	No	No	Yes	Yes
1779925	RS	60	55	66	63	66	63	66	63	0.7	0.7	No	No	Yes	Yes
1779926	RS	60	55	65	62	66	63	66	63	0.6	0.6	No	No	Yes	Yes
1779927	RS	60	55	64	61	64	62	64	62	0.7	0.7	No	No	Yes	Yes
1779928	RS	60	55	65	62	66	63	66	63	0.7	0.7	No	No	Yes	Yes
1779930	RS	60	55	64	61	65	62	65	62	0.9	0.9	No	No	Yes	Yes
1779933	RS	60	55	63	60	64	61	64	61	0.9	0.8	No	No	Yes	Yes
1779934	RS	60	55	67	64	68	65	68	65	0.9	0.9	No	No	Yes	Yes
1779936	RS	60	55	66	63	67	64	67	64	0.7	0.6	No	Yes	Yes	Yes
1779938	RS	60	55	66	63	67	64	67	64	0.5	0.5	No	Yes	Yes	Yes
1779947	RS	60	55	63	60	63	60	63	60	0.5	0.5	No	No	Yes	Yes
1779953	RS	60	55	67	65	68	65	68	65	0.5	0.5	No	Yes	Yes	Yes
1779960	RS	60	55	66	63	67	64	67	64	0.6	0.5	No	No	Yes	Yes
1779969	RS	60	55	65	62	66	63	66	63	0.7	0.7	No	No	Yes	Yes

ID	Use	Criteria		Predicted noise levels $L_{Aeq(period)}$, dB(A) - Year 2036								Equal or exceed controlling criteria with an increase in noise level ≥ 2dB	Equal or exceed the cumulative limit with the project roads adding ≥ 2dB to the total noise levels	Is the contribution from the project road Acute?	Eligible for mitigation
				Do minimum		Design		Project only		Change					
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night				
1779972	RS	60	55	69	66	70	68	69	66	1.2	1.7	No	Yes	Yes	Yes
1779975	RS	60	55	65	62	66	63	66	63	0.7	0.7	No	Yes	Yes	Yes
1779980	RS	60	55	63	60	64	61	64	61	0.8	0.7	No	No	Yes	Yes
1779981	RS	60	55	65	62	65	62	65	62	0.7	0.8	No	Yes	Yes	Yes
1779985	RS	60	55	66	63	67	64	67	64	0.7	0.7	No	No	Yes	Yes
1779990	RS	60	55	66	63	67	64	67	64	0.6	0.6	No	No	Yes	Yes
1779998	RS	60	55	63	60	64	61	63	60	0.6	0.5	No	Yes	Yes	Yes
1780010	RS	60	55	70	67	71	69	69	67	1.2	2.1	Yes	Yes	Yes	Yes
1780012	RS	60	55	63	60	64	61	64	61	0.8	0.7	No	No	Yes	Yes
1780015	RS	60	55	64	61	65	63	64	61	0.9	1.5	No	Yes	Yes	Yes
1780018	RS	60	55	63	60	64	61	64	61	0.5	0.4	No	Yes	Yes	Yes
1780019	RS	60	55	69	66	69	66	69	66	0.5	0.5	No	No	Yes	Yes
1780024	RS	60	55	65	62	66	63	66	63	0.6	0.5	No	No	Yes	Yes
1780027	RS	60	55	62	60	63	60	63	60	0.6	0.5	No	No	Yes	Yes
1780029	RS	60	55	62	59	63	60	63	60	0.8	0.7	No	No	Yes	Yes
1780030	RS	60	55	72	69	73	71	72	70	1.1	1.4	No	Yes	Yes	Yes
1780033	RS	60	55	67	64	68	65	68	65	0.8	0.7	No	No	Yes	Yes
1780035	RS	60	55	62	60	63	60	63	60	0.3	0.4	No	Yes	Yes	Yes
1780037	RS	60	55	62	59	63	60	63	60	0.8	0.8	No	No	Yes	Yes
1780046	RS	60	55	67	64	67	65	66	63	0.9	1.8	No	Yes	Yes	Yes
1780047	RS	60	55	62	59	62	60	62	60	0.9	0.9	No	No	Yes	Yes
1780062	RS	60	55	62	59	62	60	62	60	0.4	0.5	No	No	Yes	Yes
1780074	RS	60	55	63	60	63	60	63	60	0.6	0.5	No	No	Yes	Yes
1780080	RS	60	55	68	64	68	66	65	62	0.4	2.4	Yes	Yes	Yes	Yes
1780081	RS	60	55	63	60	64	61	64	61	0.6	0.6	No	No	Yes	Yes

ID	Use	Criteria		Predicted noise levels $L_{Aeq(period)}$, dB(A) - Year 2036								Equal or exceed controlling criteria with an increase in noise level ≥ 2dB	Equal or exceed the cumulative limit with the project roads adding ≥ 2dB to the total noise levels	Is the contribution from the project road Acute?	Eligible for mitigation
				Do minimum		Design		Project only		Change					
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night				
1780085	RS	60	55	62	59	62	60	62	60	0.8	0.8	No	Yes	Yes	Yes
1780091	RS	60	55	66	63	67	64	67	64	0.9	0.9	No	No	Yes	Yes
1780095	RS	60	55	67	64	68	65	68	65	0.5	0.5	No	Yes	Yes	Yes
1780096	RS	60	55	63	60	64	61	64	61	0.8	0.8	No	Yes	Yes	Yes
1780098	RS	60	55	63	60	63	60	63	60	-0.2	-0.2	No	No	Yes	Yes
1780103	RS	60	55	62	59	62	60	62	60	0.9	0.9	No	No	Yes	Yes
1780104	RS	60	55	66	63	66	63	66	63	0.7	0.7	No	No	Yes	Yes
1780110	RS	60	55	69	63	70	63	62	59	0.7	-0.4	No	Yes	No	Yes
1780111	RS	60	55	66	63	67	64	67	64	0.8	0.8	No	No	Yes	Yes
1780114	RS	60	55	67	64	68	66	67	65	1.0	1.6	No	Yes	Yes	Yes
1780124	RS	60	55	63	60	64	61	64	61	0.7	0.7	No	No	Yes	Yes
1780128	RS	60	55	62	60	63	60	63	60	0.8	0.8	No	No	Yes	Yes
1780136	RS	60	55	72	69	72	69	72	69	0.5	0.5	No	No	Yes	Yes
1780139	RS	60	55	67	61	67	61	61	58	0.1	0.2	No	Yes	No	Yes
1780144	RS	60	55	64	61	64	61	64	61	0.6	0.5	No	No	Yes	Yes
1780148	RS	60	55	62	60	63	60	63	60	0.8	0.7	No	No	Yes	Yes
1780149	RS	60	55	65	62	66	63	66	63	0.7	0.7	No	No	Yes	Yes
1780154	RS	60	55	65	63	66	63	66	63	0.7	0.7	No	No	Yes	Yes
1780156	RS	60	55	63	60	63	61	63	60	0.7	0.8	No	Yes	Yes	Yes
1780164	RS	60	55	62	60	63	60	63	60	0.7	0.7	No	No	Yes	Yes
1780165	RS	60	55	62	59	63	60	63	60	0.7	0.7	No	No	Yes	Yes
1780167	RS	60	55	63	60	64	61	64	61	0.5	0.5	No	No	Yes	Yes
1780170	RS	60	55	63	60	64	61	64	61	0.8	0.8	No	No	Yes	Yes
1780178	RS	60	55	68	65	68	66	68	66	0.7	0.7	No	No	Yes	Yes
1780182	RS	60	55	66	64	67	65	66	63	1.0	1.8	No	Yes	Yes	Yes

ID	Use	Criteria		Predicted noise levels $L_{Aeq(period)}$, dB(A) - Year 2036								Equal or exceed controlling criteria with an increase in noise level ≥ 2dB	Equal or exceed the cumulative limit with the project roads adding ≥ 2dB to the total noise levels	Is the contribution from the project road Acute?	Eligible for mitigation
				Do minimum		Design		Project only		Change					
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night				
1780185	RS	60	55	62	59	63	60	63	60	0.6	0.6	No	No	Yes	Yes
1780213	RS	60	55	70	66	71	66	68	65	0.6	0.2	No	Yes	Yes	Yes
1780215	RS	60	55	68	65	69	66	69	66	0.6	0.5	No	No	Yes	Yes
1780238	RS	60	55	62	59	63	60	63	60	0.7	0.6	No	No	Yes	Yes
1780243	RS	60	55	65	62	66	63	66	63	0.8	0.7	No	No	Yes	Yes
1780244	RS	60	55	62	59	63	60	63	60	0.5	0.5	No	Yes	Yes	Yes
1780260	RS	60	55	71	68	71	69	70	67	0.9	1.6	No	Yes	Yes	Yes
1780263	RS	60	55	66	63	66	64	66	64	0.8	0.8	No	No	Yes	Yes
1780290	RS	60	55	65	62	66	63	65	62	0.8	1.2	No	Yes	Yes	Yes
1780294	RS	60	55	62	59	62	60	62	60	0.8	0.8	No	No	Yes	Yes
1780296	RS	60	55	64	61	64	61	64	61	0.6	0.6	No	No	Yes	Yes
1780300	RS	60	55	62	59	63	60	62	60	0.8	0.7	No	No	Yes	Yes
1780302	RS	60	55	66	63	67	65	66	63	1.0	1.8	No	Yes	Yes	Yes
1780304	RS	60	55	67	64	68	65	68	65	0.7	0.8	No	No	Yes	Yes
1780308	RS	60	55	62	60	63	60	63	60	0.9	0.8	No	No	Yes	Yes
1780311	RS	60	55	64	61	65	62	65	62	0.6	0.6	No	No	Yes	Yes
1780312	RS	60	55	63	60	63	60	63	60	-0.3	-0.3	No	No	Yes	Yes
1780315	RS	60	55	67	64	67	65	67	65	0.7	0.7	No	No	Yes	Yes
1780317	RS	60	55	67	64	67	65	67	65	0.5	0.5	No	No	Yes	Yes
1780322	RS	60	55	63	60	64	61	64	61	0.7	0.7	No	No	Yes	Yes
1780325	RS	60	55	67	64	68	65	67	64	0.8	1.2	No	Yes	Yes	Yes
1780326	RS	60	55	68	66	69	67	69	66	1.0	1.5	No	Yes	Yes	Yes
1780328	RS	60	55	62	59	63	60	63	60	0.7	0.7	No	No	Yes	Yes
1780334	RS	60	55	67	61	67	61	63	60	0.2	0.7	No	Yes	Yes	Yes
1780341	RS	60	55	62	60	63	60	63	60	0.9	0.8	No	No	Yes	Yes

ID	Use	Criteria		Predicted noise levels $L_{Aeq(period)}$, dB(A) - Year 2036								Equal or exceed controlling criteria with an increase in noise level ≥ 2dB	Equal or exceed the cumulative limit with the project roads adding ≥ 2dB to the total noise levels	Is the contribution from the project road Acute?	Eligible for mitigation
				Do minimum		Design		Project only		Change					
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night				
1780345	RS	60	55	66	63	67	64	66	63	0.6	1.0	No	Yes	Yes	Yes
1780348	RS	60	55	65	62	65	62	65	62	0.7	0.8	No	No	Yes	Yes
1780350	RS	60	55	64	61	65	62	65	62	0.6	0.6	No	Yes	Yes	Yes
1780352	RS	60	55	62	59	63	60	63	60	0.7	0.6	No	No	Yes	Yes
1780364	RS	60	55	62	59	63	60	63	60	0.8	0.8	No	No	Yes	Yes
1780374	RS	60	55	66	64	67	64	67	64	0.8	0.8	No	Yes	Yes	Yes
1780375	RS	60	55	63	60	64	61	64	61	0.9	0.8	No	No	Yes	Yes
1780377	RS	60	55	62	60	63	60	63	60	0.8	0.7	No	No	Yes	Yes
1780380	RS	60	55	62	59	63	60	63	60	0.5	0.5	No	No	Yes	Yes
1780381	RS	60	55	63	60	63	60	62	60	-0.2	-0.2	No	No	Yes	Yes
1780382	RS	60	55	63	60	64	61	64	61	0.8	0.9	No	No	Yes	Yes
1780387	RS	60	55	67	61	67	61	62	59	0.2	0.3	No	Yes	No	Yes
1780389	RS	60	55	63	60	63	61	63	61	0.6	0.5	No	No	Yes	Yes
1780392	RS	60	55	71	68	72	70	71	68	0.9	1.4	No	Yes	Yes	Yes
1780395	RS	60	55	65	62	65	62	65	62	0.7	0.7	No	No	Yes	Yes
1780400	RS	60	55	67	65	68	65	68	65	0.6	0.6	No	No	Yes	Yes
1780403	RS	60	55	67	61	67	61	64	61	0.2	0.4	No	Yes	Yes	Yes
1780412	RS	60	55	65	62	65	62	65	62	0.4	0.5	No	No	Yes	Yes
1780413	RS	60	55	66	63	67	65	66	63	1.0	1.7	No	Yes	Yes	Yes
1780414	RS	60	55	62	59	63	60	63	60	0.6	0.6	No	No	Yes	Yes
1780415	RS	60	55	62	59	63	61	62	59	1.0	1.6	No	Yes	No	Yes
1780416	RS	60	55	70	67	70	68	70	68	0.6	0.6	No	No	Yes	Yes
1780423	RS	60	55	71	65	71	65	63	60	0.0	0.1	No	No	Yes	Yes
1780425	RS	60	55	66	63	67	64	67	64	0.8	0.7	No	No	Yes	Yes
1780432	RS	60	55	64	61	65	62	65	62	0.6	0.6	No	No	Yes	Yes

ID	Use	Criteria		Predicted noise levels $L_{Aeq(period)}$, dB(A) - Year 2036								Equal or exceed controlling criteria with an increase in noise level ≥ 2dB	Equal or exceed the cumulative limit with the project roads adding ≥ 2dB to the total noise levels	Is the contribution from the project road Acute?	Eligible for mitigation
				Do minimum		Design		Project only		Change					
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night				
1780436	RS	60	55	63	60	64	61	64	61	0.7	0.7	No	No	Yes	Yes
1780450	RS	60	55	67	64	67	65	67	65	0.4	0.4	No	No	Yes	Yes
1780456	RS	60	55	62	59	63	60	63	60	0.5	0.5	No	No	Yes	Yes
1780458	RS	60	55	62	59	63	60	63	60	0.8	0.7	No	No	Yes	Yes
1780468	RS	60	55	63	60	64	61	64	61	0.6	0.6	No	No	Yes	Yes
1780473	RS	60	55	62	59	63	60	63	60	0.8	0.8	No	No	Yes	Yes
1780478	RS	60	55	66	63	67	64	67	64	0.4	0.4	No	No	Yes	Yes
1780480	RS	60	55	63	60	63	61	63	61	0.7	0.8	No	No	Yes	Yes
1780484	RS	60	55	62	59	63	60	63	60	0.7	0.7	No	No	Yes	Yes
1780487	RS	60	55	63	60	63	60	63	60	0.7	0.6	No	No	Yes	Yes
1780495	RS	60	55	64	61	65	62	64	61	0.6	1.1	No	Yes	Yes	Yes
1780496	RS	60	55	64	60	64	60	63	60	0.4	0.4	No	Yes	Yes	Yes
1780497	RS	60	55	63	60	64	61	64	61	0.6	0.6	No	Yes	Yes	Yes
1780505	RS	60	55	63	60	64	61	64	61	0.8	0.8	No	No	Yes	Yes
1780512	RS	60	55	64	61	65	62	65	62	0.7	0.7	No	Yes	Yes	Yes
1780519	RS	60	55	69	66	70	67	70	67	0.8	0.7	No	No	Yes	Yes
1780527	RS	60	55	65	63	66	63	66	63	0.7	0.7	No	Yes	Yes	Yes
1780535	RS	60	55	65	62	64	61	64	61	-0.4	-0.4	No	No	Yes	Yes
1780539	RS	60	55	62	59	63	60	63	60	0.7	0.8	No	No	Yes	Yes
1780540	RS	60	55	68	65	68	65	68	65	0.4	0.4	No	No	Yes	Yes
1780543	RS	60	55	62	59	62	60	62	60	0.7	0.7	No	No	Yes	Yes
1780544	RS	60	55	64	62	65	62	65	62	0.7	0.7	No	No	Yes	Yes
1780552	RS	60	55	62	59	63	60	63	60	0.9	0.8	No	No	Yes	Yes
1780553	RS	60	55	62	59	63	60	63	60	0.9	0.9	No	No	Yes	Yes
1780575	RS	60	55	66	63	67	64	67	64	0.4	0.4	No	No	Yes	Yes

ID	Use	Criteria		Predicted noise levels $L_{Aeq(period)}$, dB(A) - Year 2036								Equal or exceed controlling criteria with an increase in noise level ≥ 2dB	Equal or exceed the cumulative limit with the project roads adding ≥ 2dB to the total noise levels	Is the contribution from the project road Acute?	Eligible for mitigation
				Do minimum		Design		Project only		Change					
		Day	Night	Day	Night	Day	Night	Day	Night	Day	Night				
1780581	RS	60	55	68	66	69	66	69	66	0.4	0.3	No	No	Yes	Yes

A summary of the non-residential receivers eligible for consideration of additional noise mitigation measures are presented in **Table 5-5**.

Table 5-5 Non-residential receivers eligible for consideration of additional feasible and reasonable noise mitigation measures

ID	Use	Criteria	Scenario	Predicted Noise Level $L_{Aeq,15hr}$ dB(A) – Year 2036			Reason for eligibility
				Do Minimum	Design	Change	
1761268	SCH	50	DY Day	53	54	1761268	Potentially exceeds internal level
1761270	SCH	50	DY Day	61	62	1761270	Potentially exceeds internal level
1761274	SCH	50	DY Day	59	60	1761274	Potentially exceeds internal level
1761277	SCH	50	DY Day	54	54	1761277	Potentially exceeds internal level
1761278	SCH	50	DY Day	56	57	1761278	Potentially exceeds internal level
1761287	SCH	50	DY Day	61	61	1761287	Potentially exceeds internal level
1761289	SCH	50	DY Day	58	58	1761289	Potentially exceeds internal level
1761651	SCH	50	DY Day	60	61	1761651	Potentially exceeds internal level
1761669	SCH	50	DY Day	61	61	1761669	Potentially exceeds internal level
1761691	SCH	50	DY Day	63	63	1761691	Potentially exceeds internal level
1761756	SCH	50	DY Day	62	63	1761756	Potentially exceeds internal level
1761772	SCH	50	DY Day	59	60	1761772	Potentially exceeds internal level
1761788	SCH	50	DY Day	57	58	1761788	Potentially exceeds internal level
1761792	SCH	50	DY Day	64	64	1761792	Potentially exceeds internal level
1761801	SCH	50	DY Day	54	55	1761801	Potentially exceeds internal level
1761803	SCH	50	DY Day	54	55	1761803	Potentially exceeds internal level
1761805	SCH	50	DY Day	55	56	1761805	Potentially exceeds internal level
1761816	SCH	50	DY Day	60	60	1761816	Potentially exceeds internal level
1761833	SCH	50	DY Day	57	58	1761833	Potentially exceeds internal level
1761839	SCH	50	DY Day	60	61	1761839	Potentially exceeds internal level
1761846	SCH	50	DY Day	60	61	1761846	Potentially exceeds internal level
1761851	SCH	50	DY Day	72	73	1761851	Potentially exceeds internal level
1761852	SCH	50	DY Day	51	52	1761852	Potentially exceeds internal level
1761860	SCH	50	DY Day	61	62	1761860	Potentially exceeds internal level
1761862	SCH	50	DY Day	54	54	1761862	Potentially exceeds internal level
1761878	SCH	50	DY Day	70	70	1761878	Potentially exceeds internal level
1761895	SCH	50	DY Day	56	57	1761895	Potentially exceeds internal level
1761906	SCH	50	DY Day	63	63	1761906	Potentially exceeds internal level
1761911	SCH	50	DY Day	60	61	1761911	Potentially exceeds internal level
1761913	SCH	50	DY Day	56	56	1761913	Potentially exceeds internal level
1761914	SCH	50	DY Day	55	56	1761914	Potentially exceeds internal level
1761924	SCH	50	DY Day	57	58	1761924	Potentially exceeds internal level
1761925	SCH	50	DY Day	55	56	1761925	Potentially exceeds internal level
1761926	SCH	50	DY Day	72	73	1761926	Potentially exceeds internal level
1761942	SCH	50	DY Day	59	59	1761942	Potentially exceeds internal level
1761959	SCH	50	DY Day	62	62	1761959	Potentially exceeds internal level
1761990	SCH	50	DY Day	60	61	1761990	Potentially exceeds internal level
1761996	SCH	50	DY Day	57	58	1761996	Potentially exceeds internal level
1762005	SCH	50	DY Day	52	52	1762005	Potentially exceeds internal level
1762009	SCH	50	DY Day	59	60	1762009	Potentially exceeds internal level
1762011	SCH	50	DY Day	57	57	1762011	Potentially exceeds internal level
1762018	SCH	50	DY Day	58	59	1762018	Potentially exceeds internal level
1763585	SCH	50	DY Day	55	55	1763585	Potentially exceeds internal level

ID	Use	Criteria	Scenario	Predicted Noise Level $L_{Aeq,15hr}$ dB(A) – Year 2036			Reason for eligibility
				Do Minimum	Design	Change	
1767145	SCH	50	DY Day	53	54	1767145	Potentially exceeds internal level
1768700	SCH	50	DY Day	55	55	1768700	Potentially exceeds internal level
1775383	SCH	50	DY Day	54	55	1775383	Potentially exceeds internal level
1779672	SCH	50	DY Day	61	61	1779672	Potentially exceeds internal level
1779673	SCH	50	DY Day	62	62	1779673	Potentially exceeds internal level
1779674	SCH	50	DY Day	63	63	1779674	Potentially exceeds internal level
1779675	SCH	50	DY Day	62	62	1779675	Potentially exceeds internal level
1761569	POW	50	DY Day	61	62	1761569	Potentially exceeds internal level
1761963	POW	50	DY Day	56	56	1761963	Potentially exceeds internal level
1770370	POW	50	DY Day	62	62	1770370	Potentially exceeds internal level
1770904	POW	50	DY Day	56	57	1770904	Potentially exceeds internal level
1771299	POW	50	DY Day	59	59	1771299	Potentially exceeds internal level
1776051	POW	50	DY Day	54	54	1776051	Potentially exceeds internal level
1778761	POW	50	DY Day	61	61	1778761	Potentially exceeds internal level
1780077	POW	50	DY Day	69	69	1780077	Potentially exceeds internal level
1780109	POW	50	DY Day	70	70	1780109	Potentially exceeds internal level
1780554	POW	50	DY Day	66	66	1780554	Potentially exceeds internal level

The buildings listed in Table 5-5 are located within seven schools, seven places of worship and one childcare centre.

5.5 Maximum noise levels

The overall level associated with maximum noise events is driven by the type of truck, and speed to a lesser degree. Given the proposed modification will introduce traffic lanes in the existing central median, some maximum noise events may occur further away from residential receivers compared with the existing situation, leading to slightly reduced L_{Amax} levels. Currently some congestion occurs on the Westlink M7 during morning and afternoon peak periods. The proposed modification would reduce this congestion and therefore this would likely reduce the number of maximum noise events as less sudden braking and acceleration from slow speeds would occur.

Transport do not provide any requirements to provide noise mitigation options on the basis of the maximum noise level assessment. Rather, maximum noise level assessments can be used to prioritise the application of noise mitigation measures. Transport have long term strategies which are being employed to ensure noise levels from trucks are reduced across the entire network.

6.0 Management of impacts

6.1 Management of construction impacts

The construction noise and vibration assessment presented in **Section 4.0** detailed a number of exceedances of the associated noise management levels in this project. Exceedances of the noise management levels were predicted across the entire project footprint for each construction component. The exceedances varied between being perceived as 'noticeable' to 'highly intrusive'. Additionally, a number of receivers were predicted to be 'highly noise affected'. It should be noted that the construction noise impact assessment is considered to be conservative and for significant periods of time during the construction period noise levels would be lower than presented in this report. Nonetheless, as a result of the exceedances, and potential exceedances of vibration criteria, the following generic and receiver specific mitigation measures have been identified.

6.1.1 Construction noise and vibration management plan

A Construction Noise and Vibration Management Plan (CNVMP) would be prepared. The CNVMP would include the following:

- Identify relevant performance criteria in relation to noise and vibration
- Identify noise and vibration sensitive receptors and features in the vicinity of the project
- Include standard and additional mitigation measures from the *Construction Noise and Vibration Guideline* (CNVG) (Roads and Maritime 2016) and details about when each will be applied
- Describe the process(es) that will be adopted for carrying out location and activity specific noise and vibration impact assessments to assist with the selection of appropriate mitigation measures
- Consider cumulative construction noise impacts and construction noise fatigue
- Include protocols that will be adopted to manage works required outside standard construction hours, in accordance with relevant guidelines including for management of respite periods
- Detailed monitoring that will be carried out to confirm project performance in relation to noise and vibration performance criteria.

The CNVMP should include consideration of the following issues:

- Cumulative construction noise impacts
- Construction noise fatigue.

The cumulative noise impacts of any nearby major projects should be further considered by the contractor when a detailed construction schedule becomes available for the project. Consultation should be undertaken with the relevant contractors to manage cumulative impacts on sensitive receivers within common areas. Feasible and reasonable mitigation measures should be detailed in the CNVMP.

Feasible and reasonable mitigation measures would be detailed within the CNVMP to manage predicted noise levels at sensitive receivers and areas where construction fatigue could occur. Consultation with the affected community would also occur prior to and during construction.

6.1.2 Community consultation and complaints handling

All residents affected by noise from the project which are expected to experience an exceedance of the construction NMLs should be consulted about the project prior to the commencement of the particular activity, with the highest consideration given to those that are predicted to be most affected as a result of the works.

The information provided to the residents should include:

- Programmed times and locations of construction work
- The hours of the project works

- Construction noise and vibration impact predictions
- Construction noise and vibration mitigation measures being implemented on site.

Community consultation regarding construction noise and vibration would be detailed in the Community and Stakeholder Engagement Plan for the construction of the project and would include a 24 hour hotline and complaints management process.

Consultation would also be undertaken with all schools likely to be affected.

For out of hours works, consultation would take place with consideration to the *Construction Noise and Vibration Guideline* and Strategy 2 of the *Interim Construction Noise Guideline*.

6.1.3 Work practices

Induction and training would be provided to relevant staff and sub-contractors outlining their responsibilities with regard to noise and vibration.

6.1.4 Construction hours and work scheduling

Details of all out of hours work required would form part of the CNVMP.

Noisy work would be scheduled to be undertaken during the standard hours as far as possible. Noisy activities that cannot be undertaken during standard construction hours are to be scheduled as early as possible during the evening and/or night-time periods.

Particularly noisy activities such as the use of impact piling rigs, road and concrete saws, rock hammers, should be scheduled where feasible and reasonable around times of high background noise to provide masking.

Deliveries would be carried out during standard construction hours where feasible and reasonable.

Respite measures are to be implemented for noisy work and vibration intensive activities in a manner consistent with EPL and Transport guideline requirements.

6.1.5 Respite

A protocol would be developed to identify the need for and provision of respite measures for residential receivers in accordance with the ICNG. Respite measures may include the restriction to the hours of construction activities resulting in impulsive or tonal noise (such as rock hammering, pile driving), or other appropriate measures agreed between the contractor and residential receiver such as alternative accommodation.

The protocol would form part of the Construction Noise and Vibration Management Plan.

6.1.6 Early installation of architectural treatments

Where properties have been identified for architectural treatment and these properties would be impacted by noise from construction works, Transport would consult with those property owners on the early installation of treatments to provide noise mitigation during the construction of the project. This approach would assist in managing noise through all phases of the project. Treatments provided by Transport would be accordance with the draft *At-receiver Noise Treatment Guideline* where feasible and reasonable.

6.1.7 Standard mitigation measures

Appendix B of the Roads and Maritime's *Construction Noise and Vibration Guideline* (CNVG) Version 1.0 dated August 2016 lists a number of standard actions and mitigation measures which should be implemented on all construction projects. The strategies are centred on management, training and the attenuation of noise at the source.

6.2 Construction noise

6.2.1 Construction traffic

The following measures would be implemented to reduce and manage noise and vibration impacts:

- Truck drivers would be advised of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (i.e. minimising the use of engine brakes, and no extended periods of engine idling). Vehicle routes should be reviewed and final selections should consider noise impacts on noise sensitive receivers.
- Site access and egress points would be located away from residences and other sensitive land uses, where feasible and reasonable
- Deliveries and spoil removal would be planned to avoid queuing of trucks on or around the construction ancillary facilities
- Construction sites would be arranged to limit the need for reversing associated with regular / repeatable movements (e.g. trucks transporting spoil) to minimise the use of reversing alarms
- Where feasible and reasonable, non-tonal reversing alarms would be used, taking into account the requirements of the Workplace Health and Safety legislation.

Spoil would be moved during the day where practical, and feasible and reasonable management strategies would be investigated in consultation with the NSW EPA to minimise the volume of heavy vehicle movements at night. Mitigation measures for vehicle movements outside of standard construction hours would be included in the CNVMP.

6.2.2 Construction ancillary facilities

The noise associated with the operation of construction ancillary facilities would primarily result from the operation of fixed and mobile plant and truck movements. Consideration would be given to the layout of the site in order to maximise distance and shielding to nearby receivers.

6.2.3 Plant and equipment selection and location

The selection of plant and equipment can have a significant impact on construction noise levels. Appropriate plant would be selected for each task to minimise the noise contributions.

Alternative works methods such as use of hydraulic or electric-controlled units in place of diesel units would be considered and implemented where feasible and reasonable. The use of alternative machines that perform the same function (such as rubber wheeled plant) would be considered in place of steel tracked plant.

Equipment would be regularly inspected and maintained to ensure it is in good working order.

Plant should be located on site with as much distance as possible between the plant and noise sensitive receivers. Noisy equipment would be orientated away from residential receivers where feasible and reasonable.

6.2.4 Noise walls

Detailed noise assessments will be carried out for all ancillary facilities required for construction of the project. The requirement for temporary noise walls within ancillary facilities and adjacent to construction works, and the requirement for other appropriate noise management measures, is to be assessed and implemented prior to the commencement of activities which have the potential to cause noise or vibration impacts.

6.2.5 Additional mitigation measures

Additional mitigation measures are provided in Appendix C of the CNVG Version 1.0, dated August 2016. These measures are applied after standard noise mitigation measures (Appendix B of the above mentioned document) have been applied and where the noise levels are still exceeding the noise management levels. The guideline recommends following the approach in Table C.1 where reasonable and feasible.

Table 6-1 Triggers for Additional Mitigation Measures – Airborne Noise (Construction noise and Vibration Guideline

Perception	dB(A) above NML	Additional mitigation measures type[1, 2]
All hours		
> 75 dB(A)	-	N, V, PC, RO
Standard hours[3]		
Noticeable	0	-
Clearly audible	1 - 10	-
Moderately intrusive	11 – 20	N,V
Highly intrusive	> 20	N,V
OOHW Period 1[4]		
Noticeable	1 - 5	-
Clearly audible	6 - 15	N, R1, DR
Moderately intrusive	16 – 25	V, N, R1, DR
Highly intrusive	> 25	V, IB, N, R1, DR, PC, SN
OOHW Period 2[5]		
Noticeable	1 - 5	N
Clearly audible	6 - 15	V, N, R2, DR
Moderately intrusive	16 – 25	V, IB, N, PC, SN, R2, DR
Highly intrusive	> 25	AA, V, IB, N, PC, SN, R2, DR

Notes:
1. *Refer to section below for detailed descriptions of the mitigation types*
2. *These additional mitigation measures are applicable to the number of exceedances of the NMLs presented in the construction noise prediction tables in section 3.5*
3. *Standard Hours refers to Monday – Friday (7am – 6pm), Sat (8am – 1pm)*
4. *OOHW Period 1 refers to Monday – Friday (6pm – 10pm), Saturday (7am – 8am and 1pm – 10pm), Sunday /public holiday (8am – 6pm)*
5. *OOHW Period 2 refers to Monday – Friday (10pm – 7am), Saturday (10pm – 8am), Sunday /public holiday (6am – 7am)*

Overview of additional mitigation measures

Notification (letterbox drop or equivalent) (N)

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

Specific notifications (SN)

Specific notifications are letterbox dropped (or equivalent) to identified stakeholders no later than seven calendar days ahead of construction activities that are likely to exceed the noise objectives. The specific notification provides additional information when relevant and informative to more highly affected receivers than covered in general letterbox drops. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

Phone calls (PC)

Phone calls detailing relevant information made to identified/affected stakeholders within seven calendar days of proposed work. Phone calls provide affected stakeholders with personalised contact

and tailored advice, with the opportunity to provide comments on the proposed work and specific needs. Where the resident cannot be telephoned then an alternative form of engagement should be used.

Individual briefings (IB)

Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that would be implemented. Project representatives would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project. Where the resident cannot be met with individually then an alternative form of engagement should be used.

Respite Offers (RO)

Respite Offers should be considered made where there are high noise and vibration generating activities near receivers. As a guide work should be carried out in continuous blocks that do not exceed 3 hours each, with a minimum respite period of one hour between each block. The actual duration of each block of work and respite should be flexible to accommodate the usage of and amenity at nearby receivers. The purpose of such an offer is to provide residents with respite from an ongoing impact. This measure is evaluated on a project-by-project basis, and may not be applicable to all projects.

Respite Period 1 (R1)

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

Respite Period 2 (R2)

Night-time construction noise in out of hours period 2 shall be limited to two consecutive nights except for where there is a Duration Respite. For night work these periods of work should be separated by not less than one week and 6 nights per month. Where possible, high noise generating works would be completed before 11pm.

Duration Respite (DR)

Respite offers and respite periods 1 and 2 may be counterproductive in reducing the impact on the community for longer duration projects. In this instance and where it can be strongly justified it may be beneficial to increase the work duration, number of evenings or nights worked through Duration Respite so that the project can be completed more quickly. The project team should engage with the community where noise levels are expected to exceed the NML to demonstrate support for Duration Respite. Where there are few receivers above the NML each of these receivers should be visited to discuss the project to gain support for Duration Respite.

Alternative Accommodation (AA)

Alternative accommodation options may be offered to residents living in close proximity to construction works that are likely to experience highly intrusive noise levels. The specifics of the offer would be identified on a project-by-project basis. Additional aspects for consideration shall include whether the highly intrusive activities occur throughout the night or before midnight.

Verification (V)

Verification should include measurement of the background noise level and construction noise. A noise monitoring program would be implemented to assist in confirming and controlling the site specific potential for disturbance at particularly sensitive localities at the commencement of activities and periodically during the construction program as the works progress. The results would be reviewed to determine if additional mitigation measures are required. All measurements would be undertaken in accordance with Australian Standard 1055.1-1997 – Acoustics – Description and measurement of environmental noise, Part 1: General procedures.

A noise monitoring program would be presented in the CNVMP.

If ground-borne noise is reported to be a problem during vibration intensive works, attended and/or unattended noise measurements would be undertaken in the relevant building spaces to determine the level of ground-borne noise.

6.2.6 Effect of mitigation measures

Additional mitigation measures would be implemented as necessary based on the noise levels as indicated in Section 4.0. Factors which may affect the implementation include the following:

- Availability of suitable equipment
- Outcomes of community consultation.

The indicative effect of the proposed noise mitigation measures is provided in Table 18 below.

Table 18 Effect of mitigation measures

Mitigation measure	Nominal noise reduction
Screening, location of site sheds, construction compound boundary fencing	5-10 dB nominal noise reduction
Good site layouts/Distance	About 6 dB per each doubling of distance
Construction scheduling	Provision of periods of respite
Plant and equipment selection and location Substitution of equipment of methodologies eg rubber wheeled excavators	5-15 dB nominal noise reduction
Monitoring	Confirmation construction noise predictions, identification of unnecessarily noisy pieces of equipment or methodology and alternative/additional methods of mitigation.
Community consultation/notification	Construction would not occur unexpectedly. Residents can plan to minimise disruption. Residents would be aware of the complaint management process.

6.3 Construction vibration

In some circumstances, construction activity within the minimum working distance cannot be avoided due to the work required and the prevalent geological site conditions. These conditions may not be fully understood until work has commenced. For vibration intensive activities that occur within the minimum working distances, management methods to mitigate should include:

- Equipment selection and maintenance
- Construction scheduling
- Building condition surveys
- Supplementary vibration monitoring.

6.3.1 Building condition surveys

Prior to the commencement of vibration intensive work at each site, existing condition surveys would be undertaken on all properties and structures within 50 metres from these works.

6.3.2 Equipment selection and maintenance

Equipment size would be selected taking into account the minimum working distances and the distance between the area of construction and the most affected sensitive receiver.

The use of less vibration intensive methods of construction or equipment would be considered where feasible and reasonable when working in proximity to existing structures.

Equipment would be maintained and operated in an efficient manner, in accordance with manufacturer's specifications, to reduce the potential for adverse vibration impacts.

6.3.3 Works scheduling

Wherever reasonable and reasonable, vibration intensive works should be limited to the least sensitive times of the day.

6.3.4 Supplementary vibration monitoring

If the use of vibration intensive plant cannot be avoided within the minimum working distance for cosmetic damage the following procedure would occur as a minimum:

- Notification of the works to the affected residents and community.
- Works would not proceed until attended vibration measurements are undertaken. Vibration monitors are to provide real-time notification of exceedances of levels approaching cosmetic damage criteria.

If ongoing works are required a temporary relocatable vibration monitoring system would be installed, to warn operators (via flashing light, audible alarm, short message service (SMS) etc) when vibration levels are approaching the cosmetic damage objective.

6.3.5 Heritage and other sensitive structures

A detailed survey would be undertaken prior to vibration intensive construction commencing to identify all nearby vibration sensitive buildings. Applicable vibration criteria and construction strategies would need to be included in the CNVMP for each of the identified locations, ensuring that the works' impacts would be appropriately controlled.

6.4 Management of operational impacts

Where feasible and reasonable, road traffic noise levels from the operation of redeveloped and new roads should be reduced to meet the noise criteria in accordance with Transport for NSW procedures. In many instances this may be achievable only through long-term strategies such as improved planning, design and construction of adjoining land-use developments, reduced vehicle emission levels through new vehicle standards and regulation of in-service vehicles, greater use of public transport, and alternative methods of freight haulage.

The *Road Noise Policy* hierarchy of noise mitigation is firstly to consider at-source noise mitigation measures such as road design and traffic management, then the use of quieter pavements. A quieter pavement, open graded asphalt, would be used in the proposed modification. Since there would be exceedances even with this quieter pavement, the use of 'in corridor' mitigation measures would be considered, which are generally noise walls and mounds. Finally, as the applicable noise criteria cannot be met by using a combination of all these methods, at-receiver mitigation measures would be considered such as architectural treatments and property boundary walls during detailed design.

7.0 Conclusion

The Westlink M7 (formerly called the Western Sydney Orbital) is an existing 39-kilometre-long toll road connecting the M5 Motorway at Prestons, the M4 Motorway at Eastern Creek and the Hills M2 Motorway at Baulkham Hills (the approved project). A modification to the approval granted for the Westlink M7 (SSD-663) is being sought under the *Environmental, Planning and Assessment Act 1979* (NSW) (EP&A Act).

This modification would enable widening part of the motorway in response to current and projected future traffic growth, and to address reduced motorway efficiency, travel time performance and enhance safety. The proposed modification would enable the construction and operation of an additional lane in both directions within the existing median of the Westlink M7, for approximately 27 kilometres from about 140 metres south of the Kurrajong Road overhead bridge at Prestons to the Westlink M7 bridge at Richmond Road in the suburbs of Oakhurst and Glendenning, excluding widening through the Light Horse (M4 Motorway) Interchange.

Construction Impacts

A construction noise assessment has been conducted in accordance with the *Interim Construction Noise Guideline* and *Construction Noise and Vibration Guideline*. Reasonable worst case construction scenarios have been assessed. Construction of the project is likely to primarily occur outside of standard construction hours to minimise impacts to the road network.

The assessment of noise associated with the construction of the project indicates some exceedances of the *Interim Construction Noise Guideline* noise management levels at the most affected sensitive receivers. The magnitude and number of exceedances are detailed in **Chapter 6.0**. Exceedances of the noise management levels occur during the day and night at the most affected sensitive receivers during certain activities.

Earthworks are predicted to result in the greatest number of exceedances of the daytime and night-time NMLs. Effective noise mitigation and management measures would need to be developed by the contractor to minimise the potential noise impacts from the works. The magnitude of these impacts is consistent with other major works projects and highlights the need for effective noise mitigation and management planning.

Measures have been recommended to mitigate construction noise impacts upon nearby sensitive receivers. The final number, degree and nature of these measures would ultimately be selected by the contractor and be largely dependent on the construction strategy and work undertaken. Specific noise management and mitigation measures would be detailed in the contractor's Construction Noise and Vibration Management Plan. The recommended management and mitigation measures which would be considered in the plan include:

- Effective community consultation
- Training of construction site workers
- Use of noise walls
- Noise monitoring
- Appropriate selection and maintenance of equipment
- Scheduling of work for less sensitive time periods
- Situating plant in less noise sensitive locations
- Construction traffic management
- Respite periods.
- Minimum working distances for vibration intensive construction works have been presented. Equipment size would be selected by the contractor taking into account the minimum working distances and the distance between the area of construction and the most affected sensitive receiver. If works need to be undertaken within minimum working distances, vibration monitoring would be undertaken.

Construction traffic would increase road traffic noise level in some areas, but increases would be less than 2 dB(A) during the daytime and night-time periods. An increase of 2 dB(A) or less is compliant with the traffic noise increase criterion in the *Road Noise Policy*.

Cumulative construction noise impacts may occur as a result of construction works for the modification occurring simultaneously and other major projects, such as the M12 Motorway occurring within proximity to the project. Consultation would be undertaken between the projects to minimise potential impacts where feasible and reasonable.

Operational Impacts

An operational road traffic noise assessment has been completed in accordance with the Environment Protection Authority's *NSW Road Noise Policy* and Roads and Maritime's *Noise Criteria Guideline* and *Noise Mitigation Guideline*.

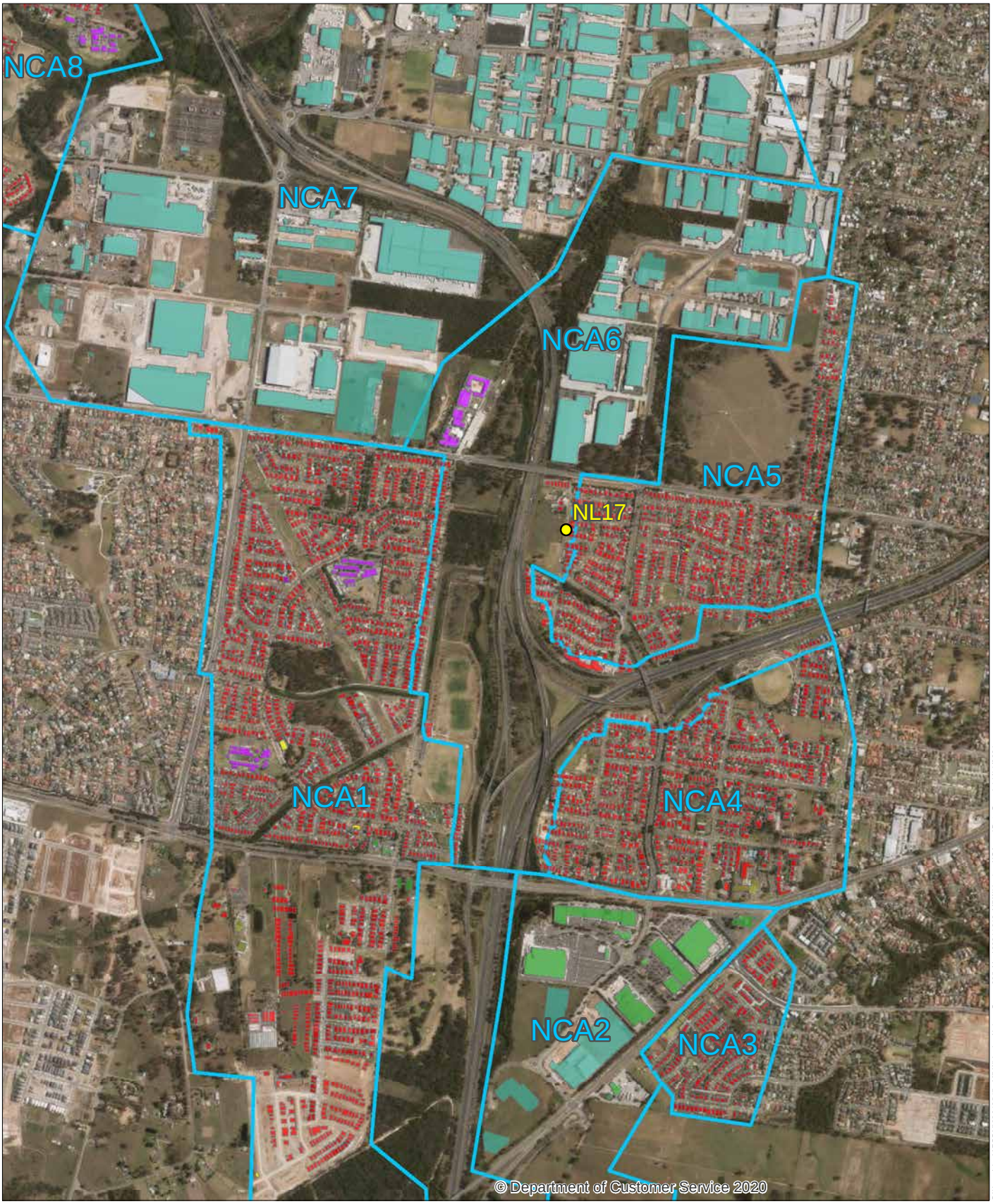
Exceedances of the applicable noise criteria have been identified. The majority of these exceedances are exceedances of the acute noise limit. These exceedances are generated by existing high noise levels throughout the study area. Appropriate noise mitigation has been recommended to minimise adverse impacts on the community by the project, in accordance with the *Noise Mitigation Guideline* and the draft *At-Receiver Noise Treatment Guideline*.

Noise mitigation in the form of noise walls or noise wall adjustments, and architectural treatments have been considered to protect the community. Some recommendations have been made for adjustments to existing noise walls and for new noise walls. At-receiver architectural treatment has also been recommended at a number of sensitive receivers that were found eligible for the consideration of noise mitigation. These requirements would be clarified at the detailed design phase when more information would be available.

Operational traffic noise would be monitored at sensitive receivers between six months and one year after opening. If the traffic noise levels are above the levels as predicted during detailed design, consideration of additional feasible and reasonable mitigation measures would be undertaken.

Appendix A

Receiver and logging locations



Westlink M7 Proposed Modification NCA and noise logger map - 1

N

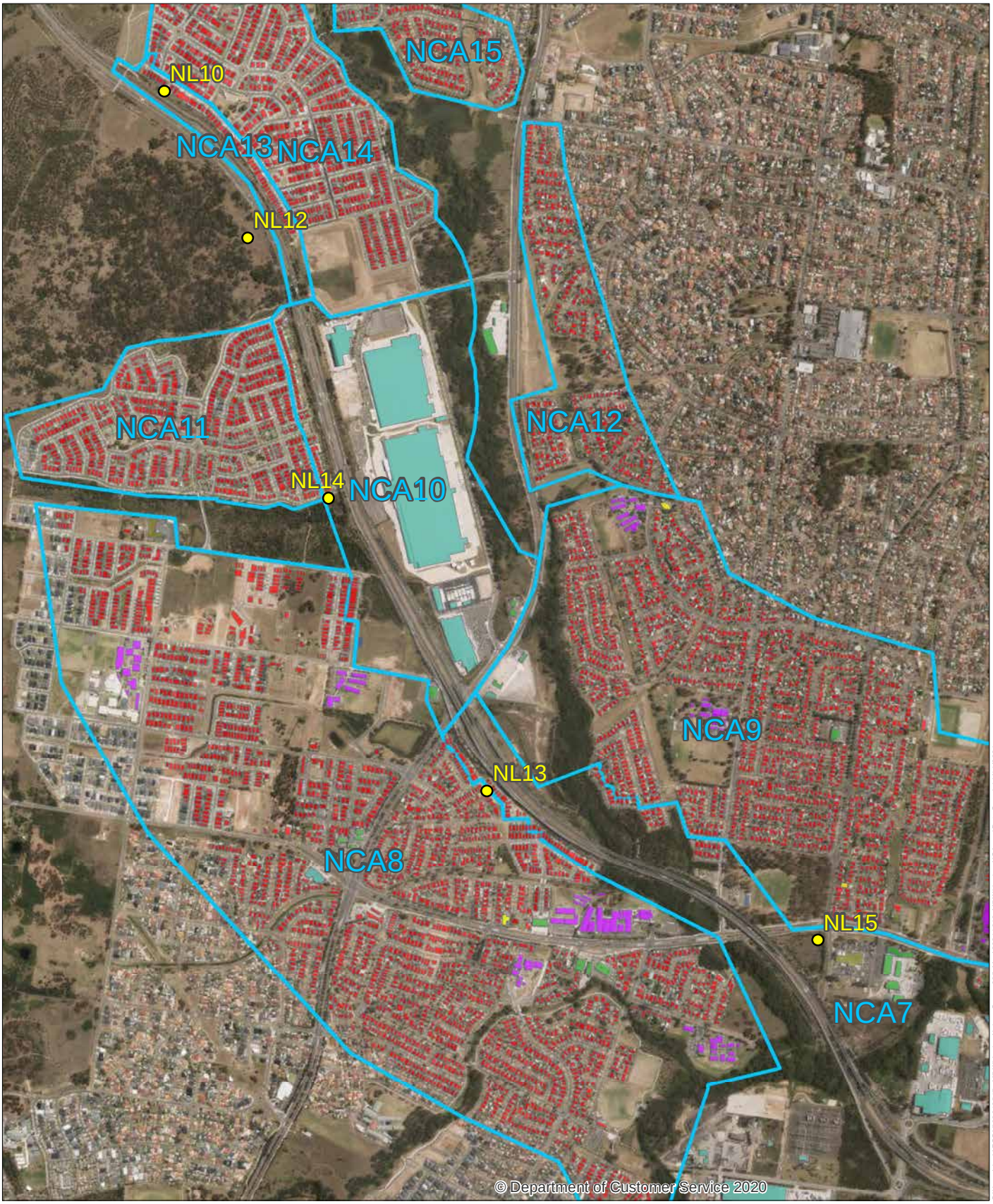
0 0.3 0.6 km

AECOM

Legend

- Active recreation
- Childcare
- Commercial
- Community
- Education
- Industrial
- Office
- Place of worship
- Residential

Source:



Westlink M7 Proposed Modification NCA and noise logger map - 2

N

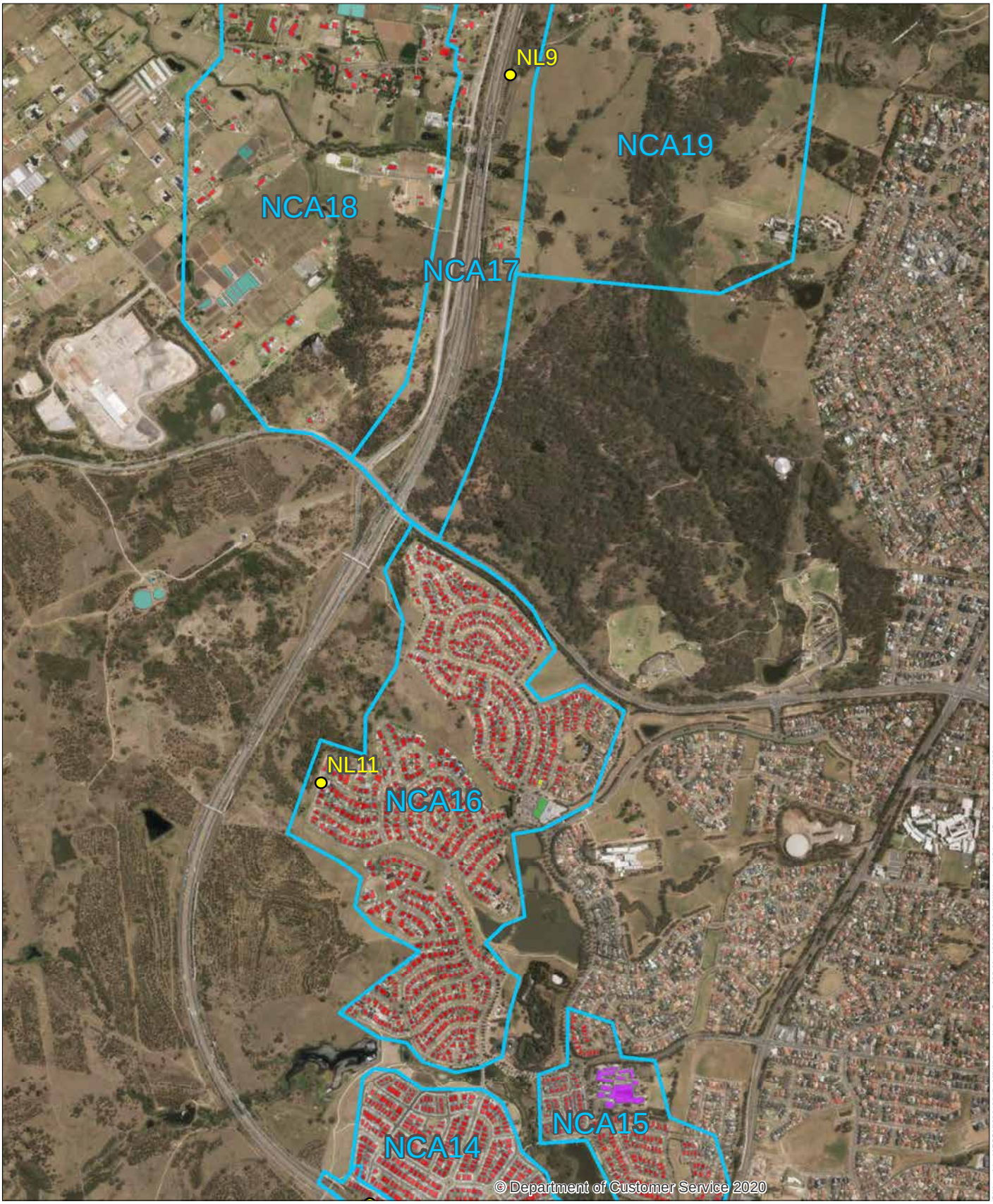
0 0.3 0.6 km

AECOM

Legend

- Active recreation
- Childcare
- Commercial
- Community
- Education
- Industrial
- Office
- Place of worship
- Residential

Source:



Westlink M7 Proposed Modification NCA and noise logger map - 3

N

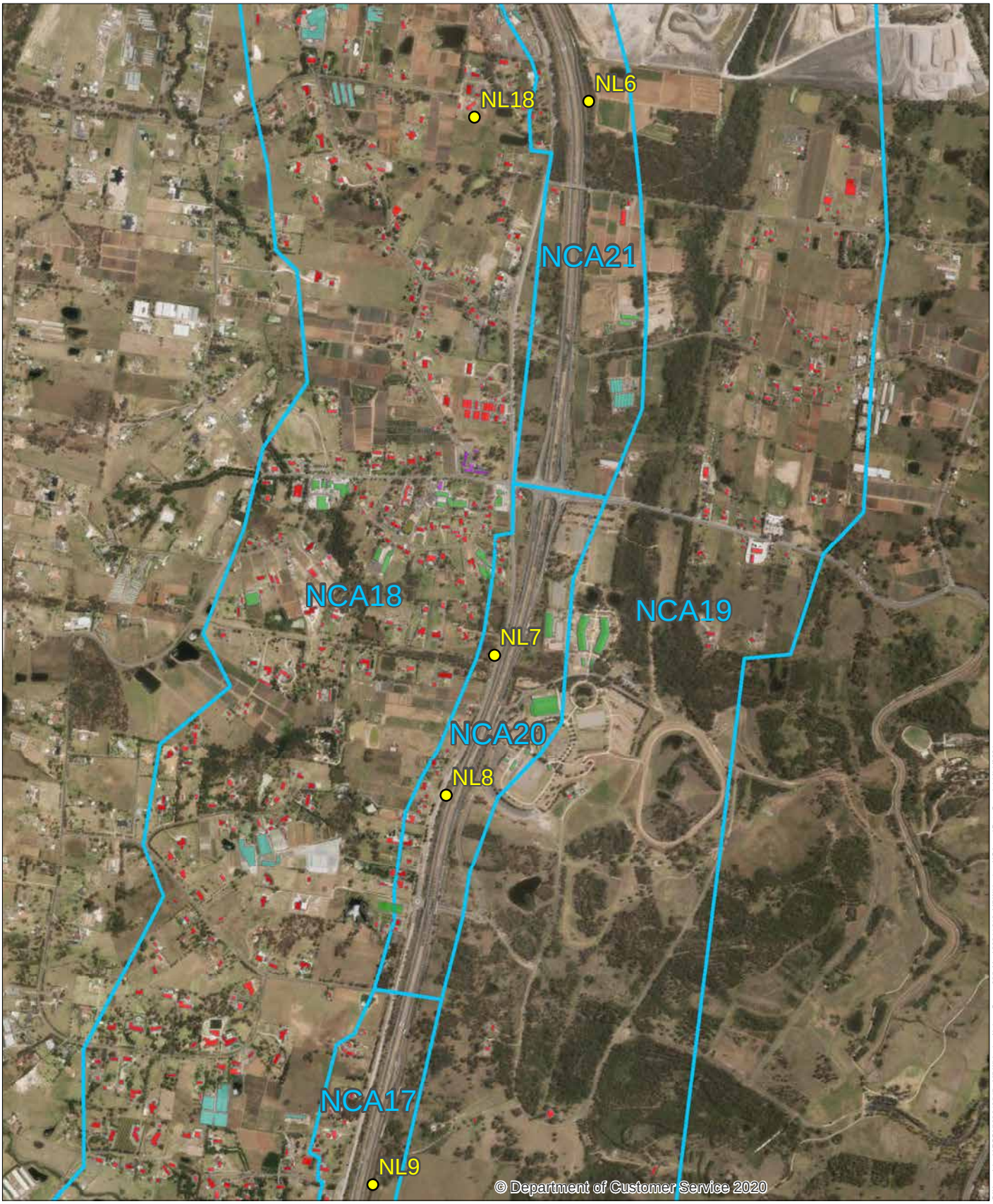
0 0.3 0.6 km

AECOM

Legend

- Active recreation
- Childcare
- Commercial
- Community
- Education
- Industrial
- Office
- Place of worship
- Residential

Source:



Westlink M7 Proposed Modification NCA and noise logger map - 4

N

0 0.3 0.6 km

AECOM

Legend

- Active recreation
- Childcare
- Commercial
- Community
- Education
- Industrial
- Office
- Place of worship
- Residential

Source:

Westlink M7 Proposed Modification NCA and noise logger map - 5

N

0 0.3 0.6 km

AECOM

Legend

- Active recreation
- Childcare
- Commercial
- Community
- Education
- Industrial
- Office
- Place of worship
- Residential

Source:

Westlink M7 Proposed Modification NCA and noise logger map - 6

N

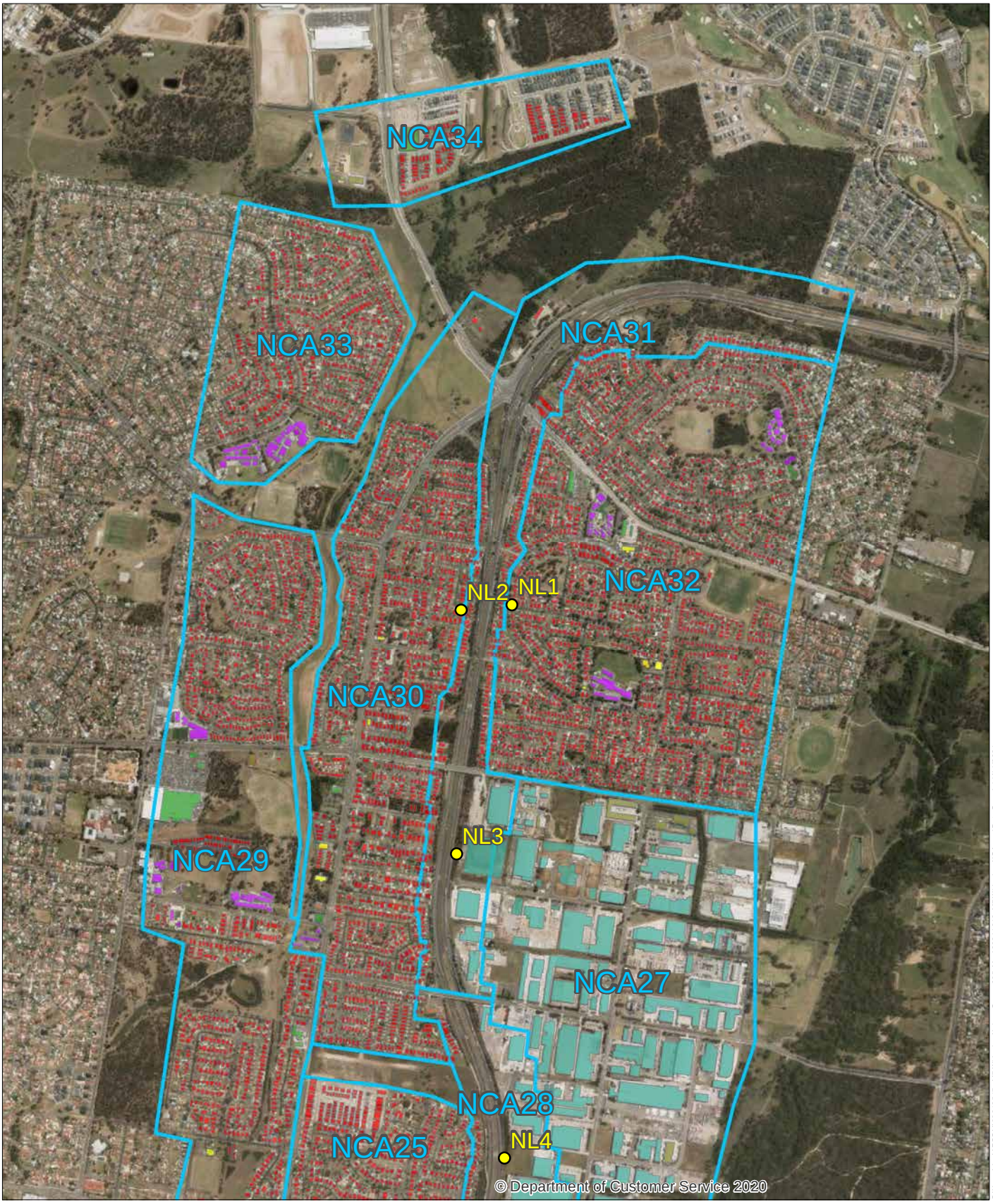
0 0.3 0.6 km

AECOM

Legend

- Active recreation
- Childcare
- Commercial
- Community
- Education
- Industrial
- Office
- Place of worship
- Residential

Source:



Westlink M7 Proposed Modification NCA and noise logger map - 7

N

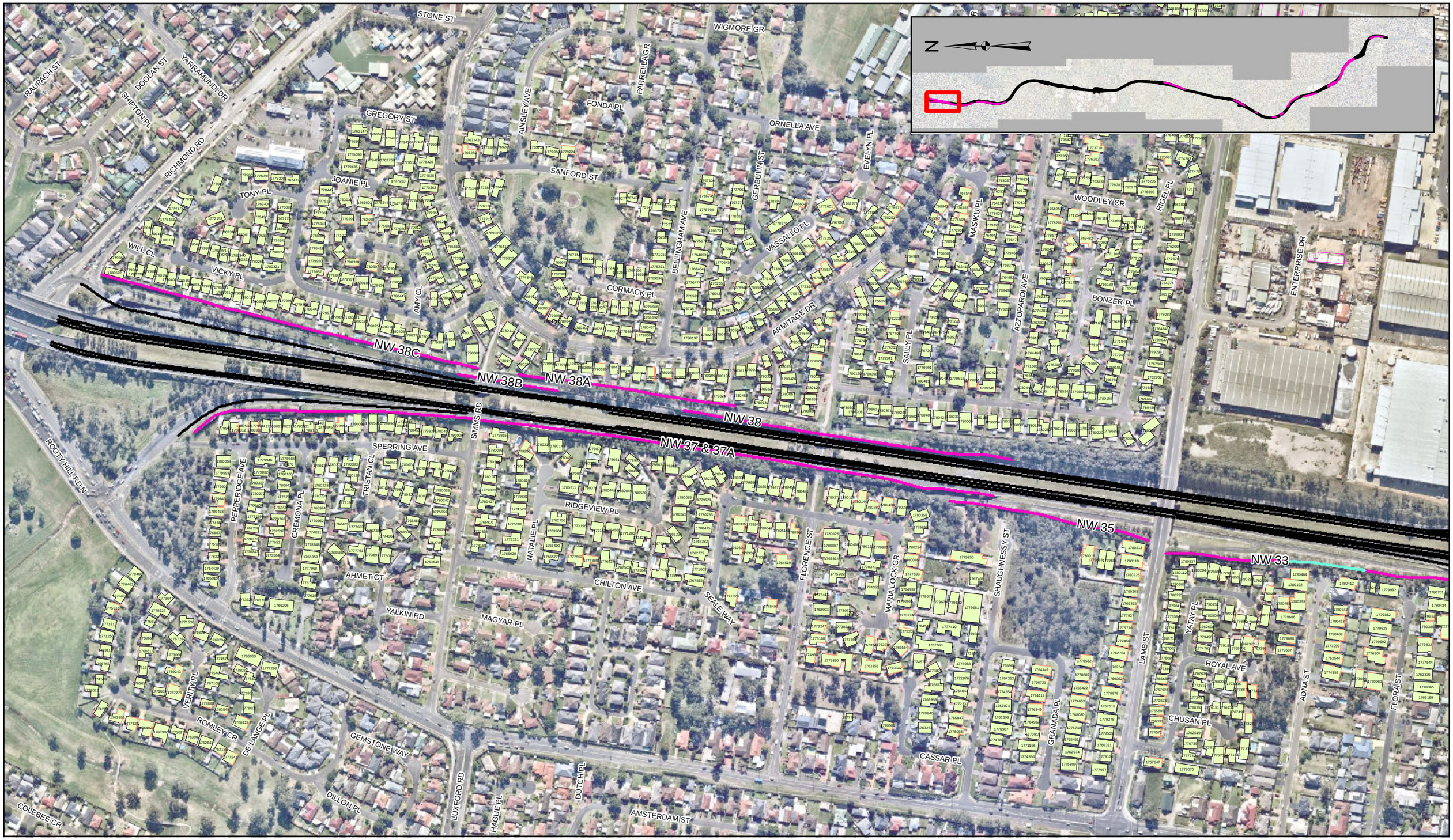
0 0.3 0.6 km

AECOM

Legend

- Active recreation
- Childcare
- Commercial
- Community
- Education
- Industrial
- Office
- Place of worship
- Residential

Source:



Transurban AECOM

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 40 80 160

metres

1:4,000 (when printed at A3)

LEGEND

- Residential Buildings
- Multiple Story Buildings
- School
- Place of Worship
- Future Road Alignment
- Noise Barrier Upgrades/Additions
- Existing Noise Barriers

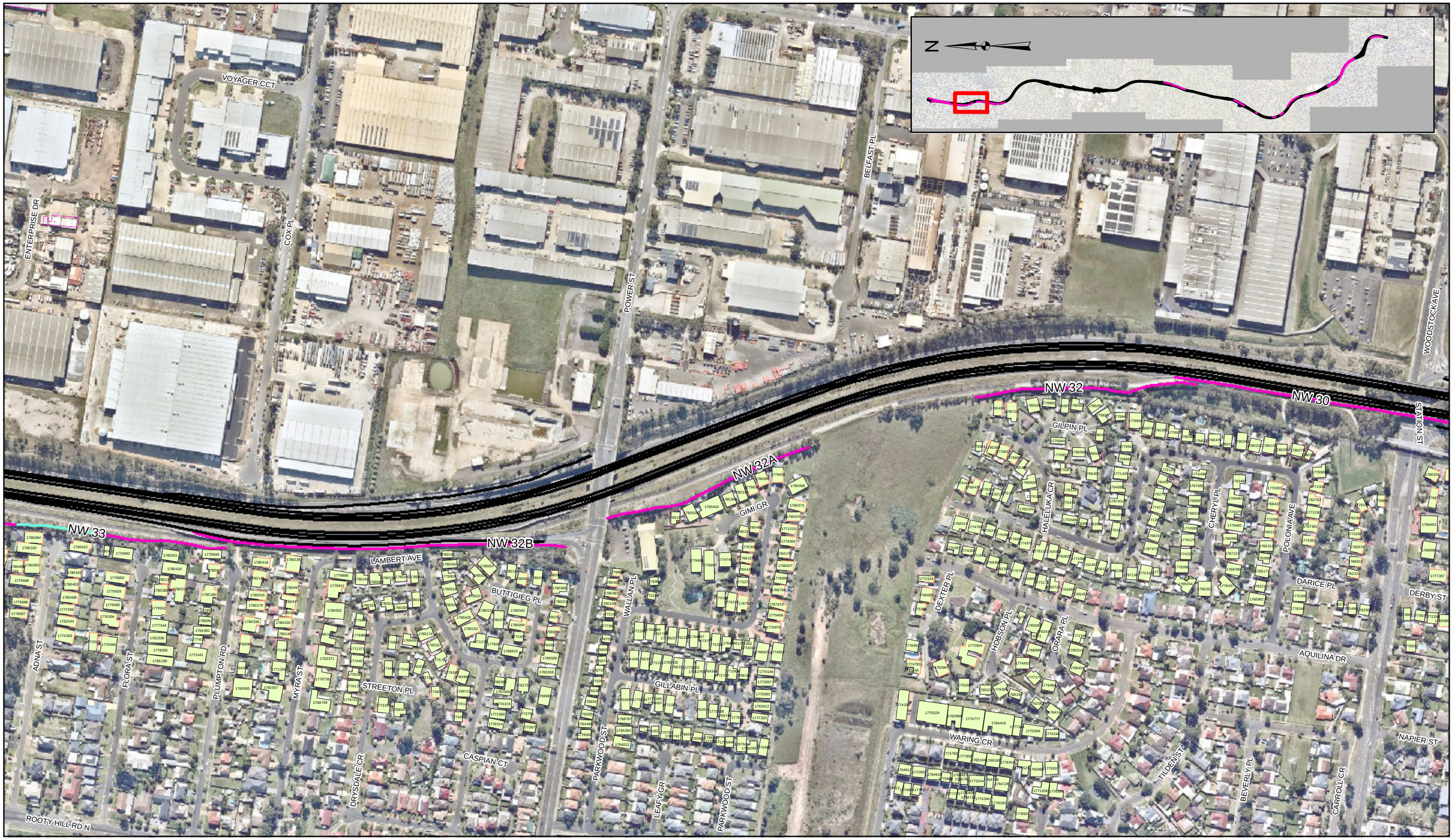
M7 Widening
Operational Assessment
Noise Affected Buildings

House IDs

PROJECT ID	60603874
CREATED BY	JZ
LAST MODIFIED	20 June 2022

Figure 1-1

A3 size



Transurban AECOM

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 40 80 160

metres

N

1:4,000 (when printed at A3)

LEGEND

- Residential Buildings
- Multiple Story Buildings
- School
- Place of Worship
- Future Road Alignment
- Noise Barrier Upgrades/Additions
- Existing Noise Barriers

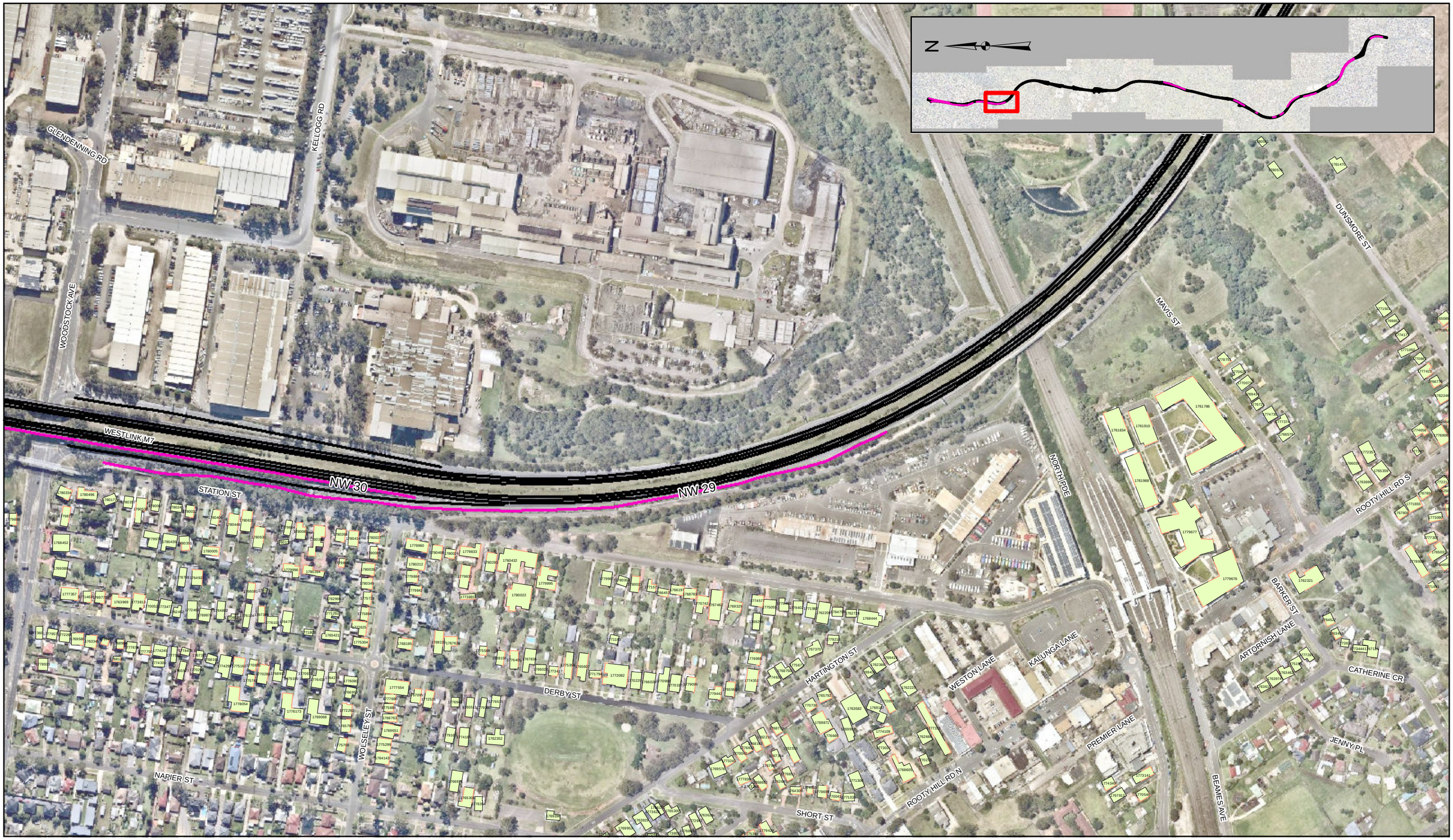
M7 Widening
Operational Assessment
Noise Affected Buildings

House IDs

PROJECT ID	60603874
CREATED BY	JZ
LAST MODIFIED	20 June 2022

Figure
1-2

A3 size



Transurban AECOM

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 40 80 160
metres

1:4,000 (when printed at A3)

LEGEND

- Residential Buildings
- Multiple Story Buildings
- School
- Place of Worship
- Future Road Alignment
- Noise Barrier Upgrades/Additions
- Existing Noise Barriers

M7 Widening
Operational Assessment
Noise Affected Buildings

House IDs

PROJECT ID	60603874
CREATED BY	JZ
LAST MODIFIED	20 June 2022

Figure
1-3

A3 size

Transurban AECOM

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 40 80 160

metres

N

1:4,000 (when printed at A3)

LEGEND

- Residential Buildings
- Multiple Story Buildings
- School
- Place of Worship
- Future Road Alignment
- Noise Barrier Upgrades/Additions
- Existing Noise Barriers

M7 Widening
Operational Assessment
Noise Affected Buildings

House IDs

PROJECT ID	60603874
CREATED BY	JZ
LAST MODIFIED	20 June 2022

Figure
1-4

A3 size

Transurban AECOM

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 40 80 160

metres

N

1:4,000 (when printed at A3)

LEGEND

- Residential Buildings
- Multiple Story Buildings
- School
- Place of Worship
- Future Road Alignment
- Noise Barrier Upgrades/Additions
- Existing Noise Barriers

M7 Widening
Operational Assessment
Noise Affected Buildings

House IDs

PROJECT ID	60603874
CREATED BY	JZ
LAST MODIFIED	20 June 2022

Figure
1-5

A3 size

Transurban AECOM

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 40 80 160

metres

1:4,000 (when printed at A3)

LEGEND

- Residential Buildings
- Multiple Story Buildings
- School
- Place of Worship
- Future Road Alignment
- Noise Barrier Upgrades/Additions
- Existing Noise Barriers

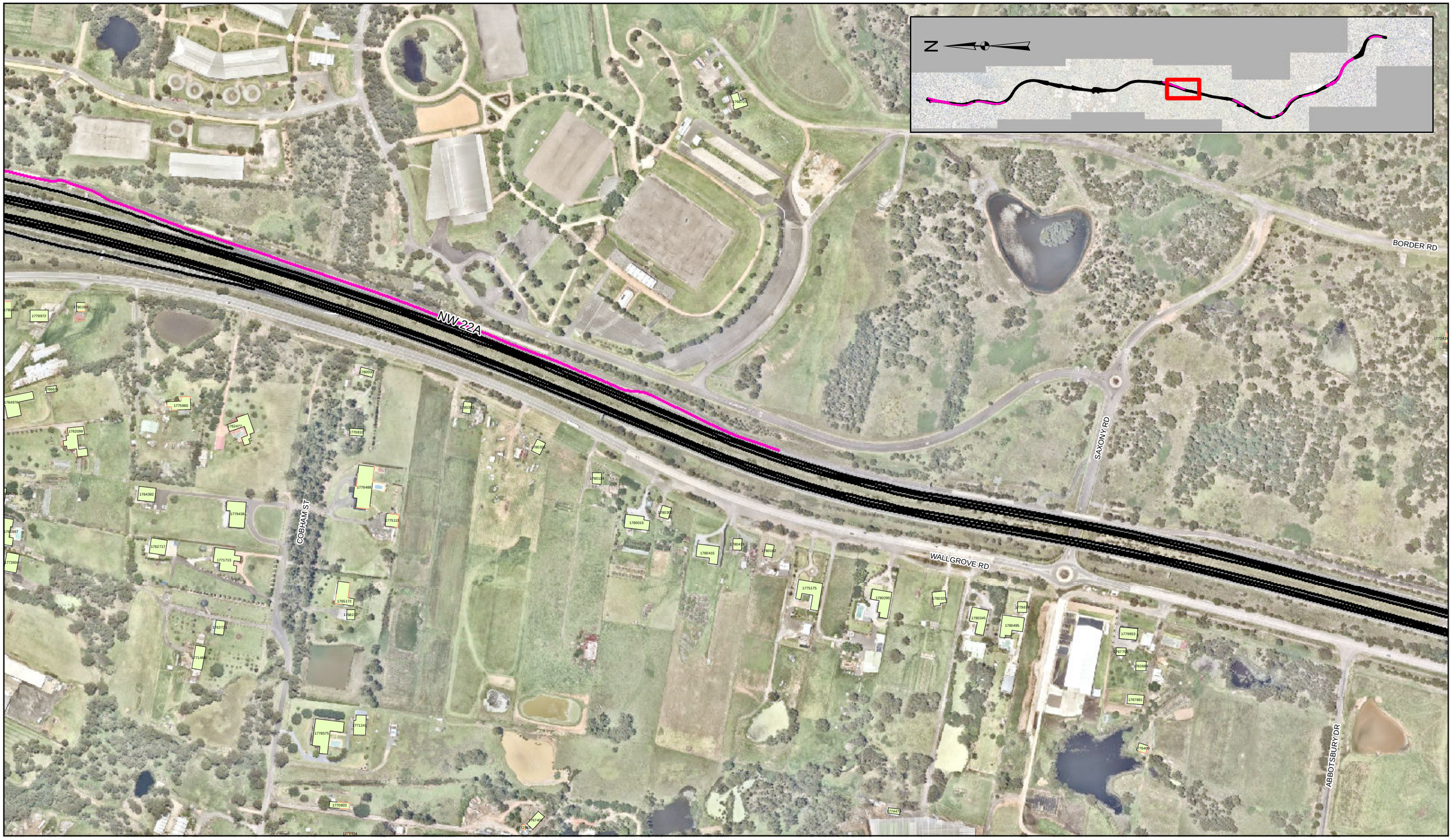
M7 Widening
Operational Assessment
Noise Affected Buildings

House IDs

PROJECT ID	60603874
CREATED BY	JZ
LAST MODIFIED	20 June 2022

Figure
1-6

A3 size



Transurban AECOM

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 40 80 160

metres

N

1:4,000 (when printed at A3)

LEGEND

- Residential Buildings
- Multiple Story Buildings
- School
- Place of Worship
- Future Road Alignment
- Noise Barrier Upgrades/Additions
- Existing Noise Barriers

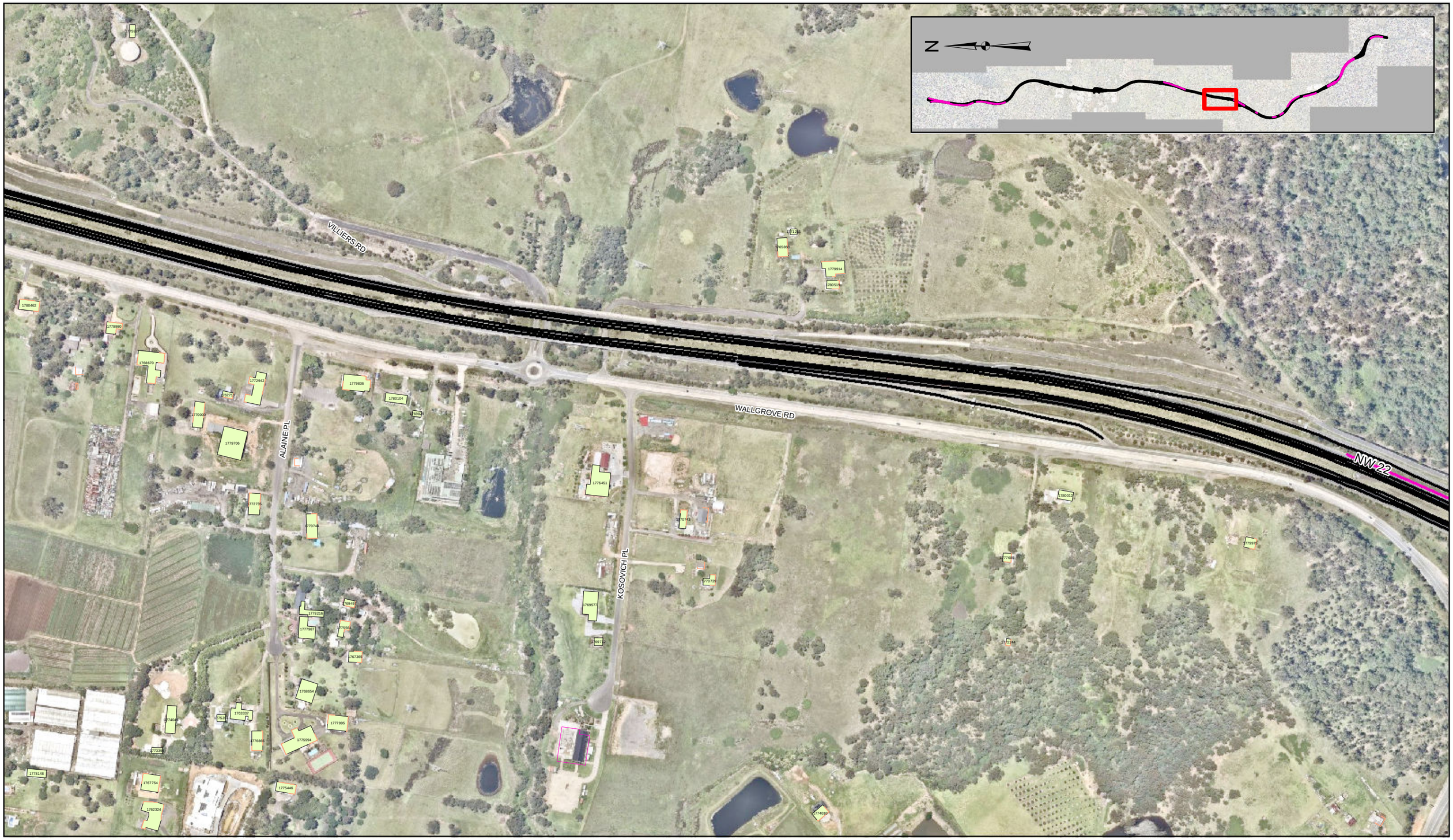
M7 Widening
Operational Assessment
Noise Affected Buildings

House IDs

PROJECT ID	60603874
CREATED BY	JZ
LAST MODIFIED	20 June 2022

Figure
1-7

A3 size



Transurban AECOM

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 40 80 160

metres

N

1:4,000 (when printed at A3)

LEGEND

- Residential Buildings
- Multiple Story Buildings
- School
- Place of Worship
- Future Road Alignment
- Noise Barrier Upgrades/Additions
- Existing Noise Barriers

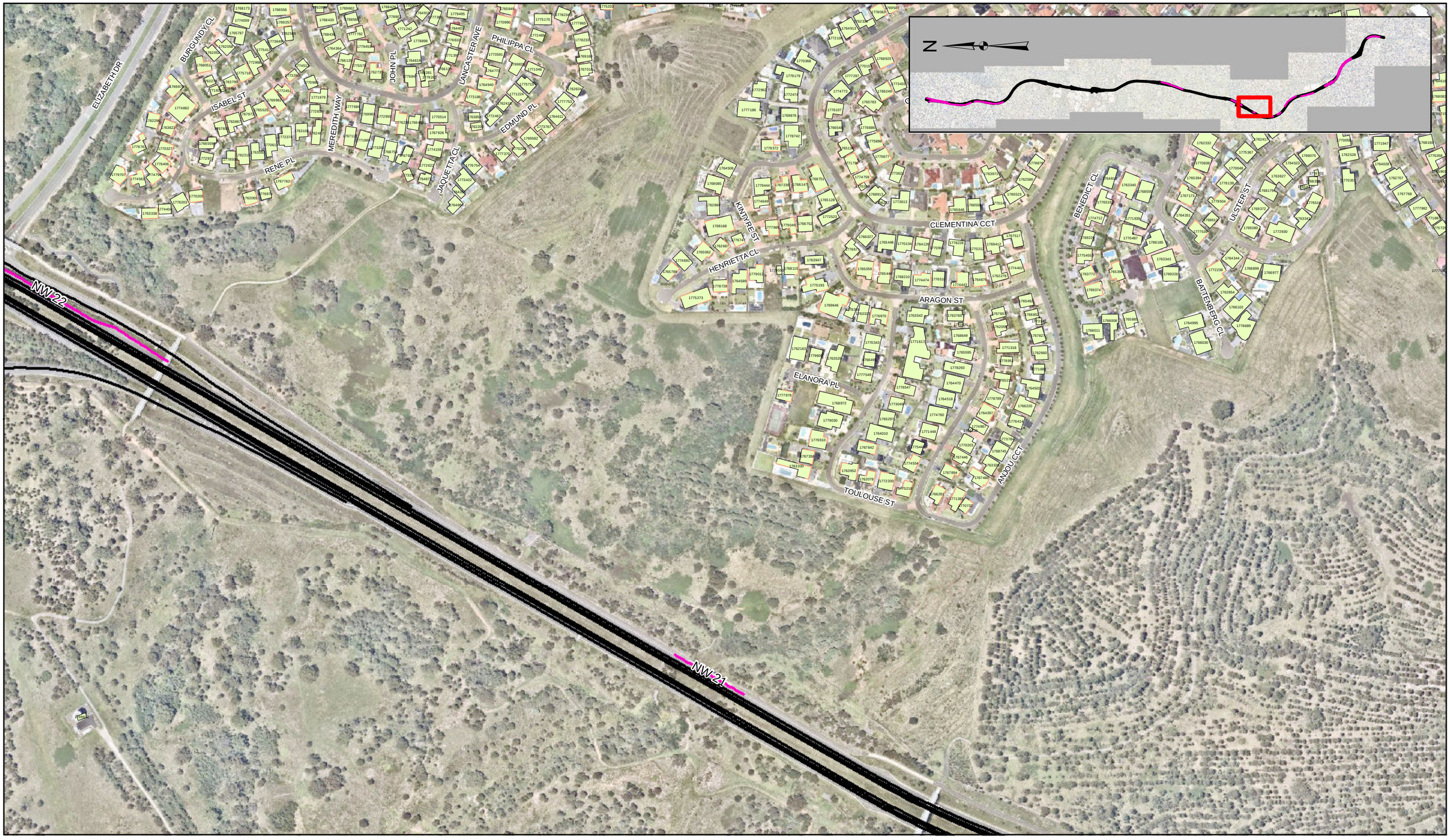
M7 Widening
Operational Assessment
Noise Affected Buildings

House IDs

PROJECT ID	60603874
CREATED BY	JZ
LAST MODIFIED	20 June 2022

Figure
1-8

A3 size



Transurban AECOM

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 40 80 160

metres

1:4,000 (when printed at A3)

LEGEND

- Residential Buildings
- Multiple Story Buildings
- School
- Place of Worship
- Future Road Alignment
- Noise Barrier Upgrades/Additions
- Existing Noise Barriers

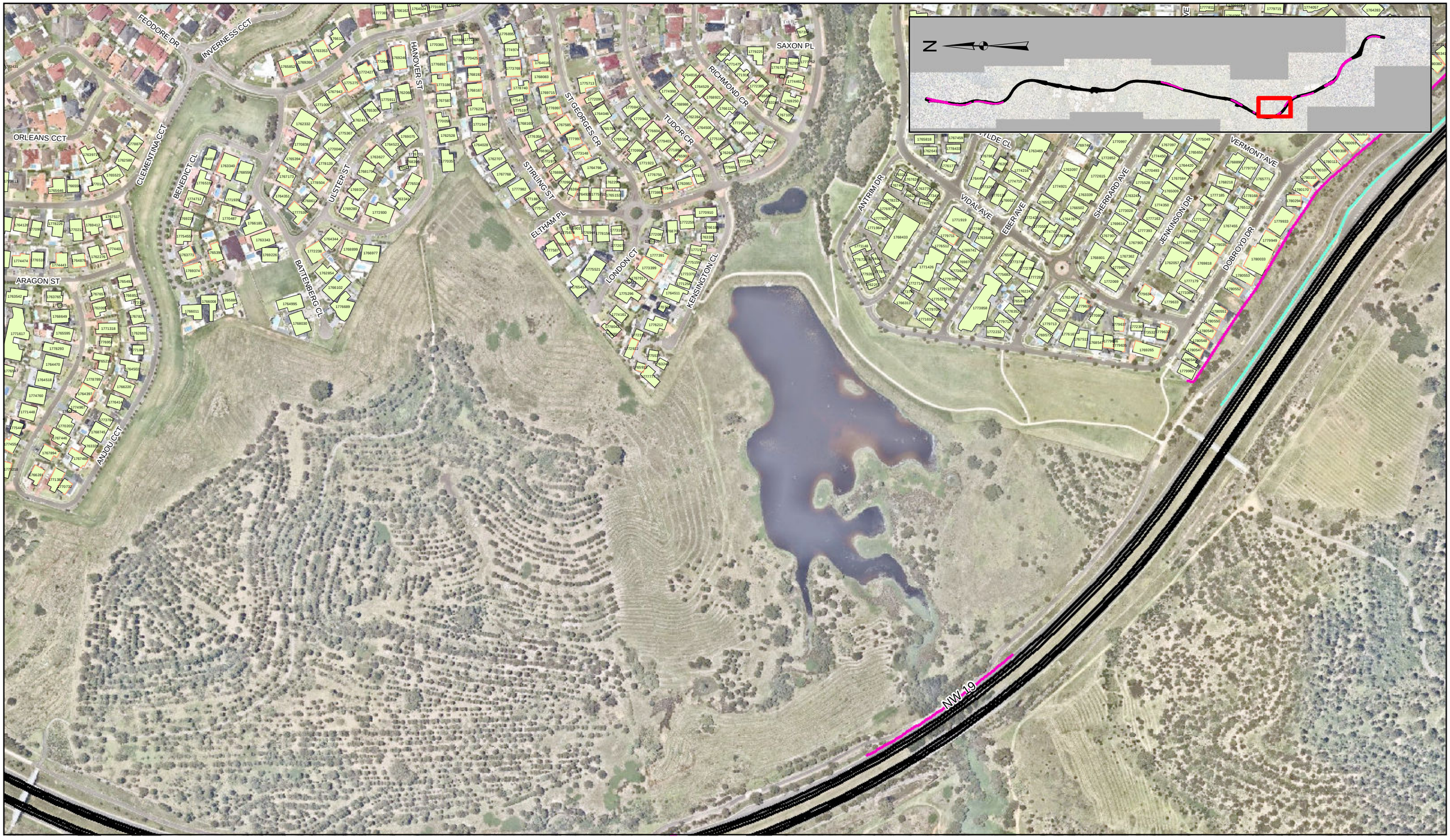
M7 Widening
Operational Assessment
Noise Affected Buildings

House IDs

PROJECT ID	60603874
CREATED BY	JZ
LAST MODIFIED	20 June 2022

Figure
1-9

A3 size



Transurban AECOM

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 40 80 160

metres

N

1:4,000 (when printed at A3)

LEGEND

- Residential Buildings
- Multiple Story Buildings
- School
- Place of Worship
- Future Road Alignment
- Noise Barrier Upgrades/Additions
- Existing Noise Barriers

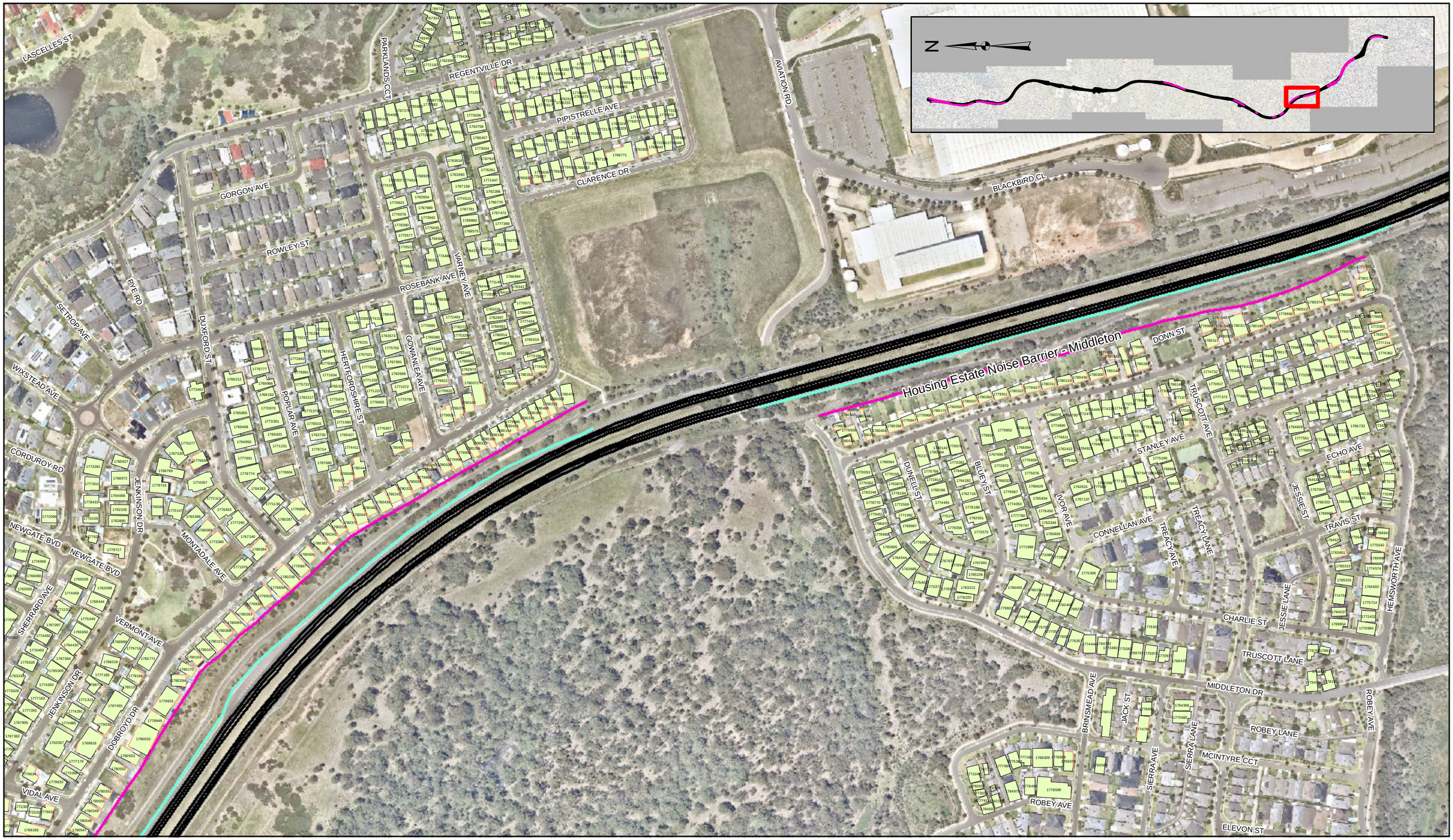
M7 Widening
Operational Assessment
Noise Affected Buildings

House IDs

PROJECT ID	60603874
CREATED BY	JZ
LAST MODIFIED	20 June 2022

Figure
1-10

A3 size



Transurban AECOM

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 40 80 160

metres

N

1:4,000 (when printed at A3)

LEGEND

- Residential Buildings
- Multiple Story Buildings
- School
- Place of Worship
- Future Road Alignment
- Noise Barrier Upgrades/Additions
- Existing Noise Barriers

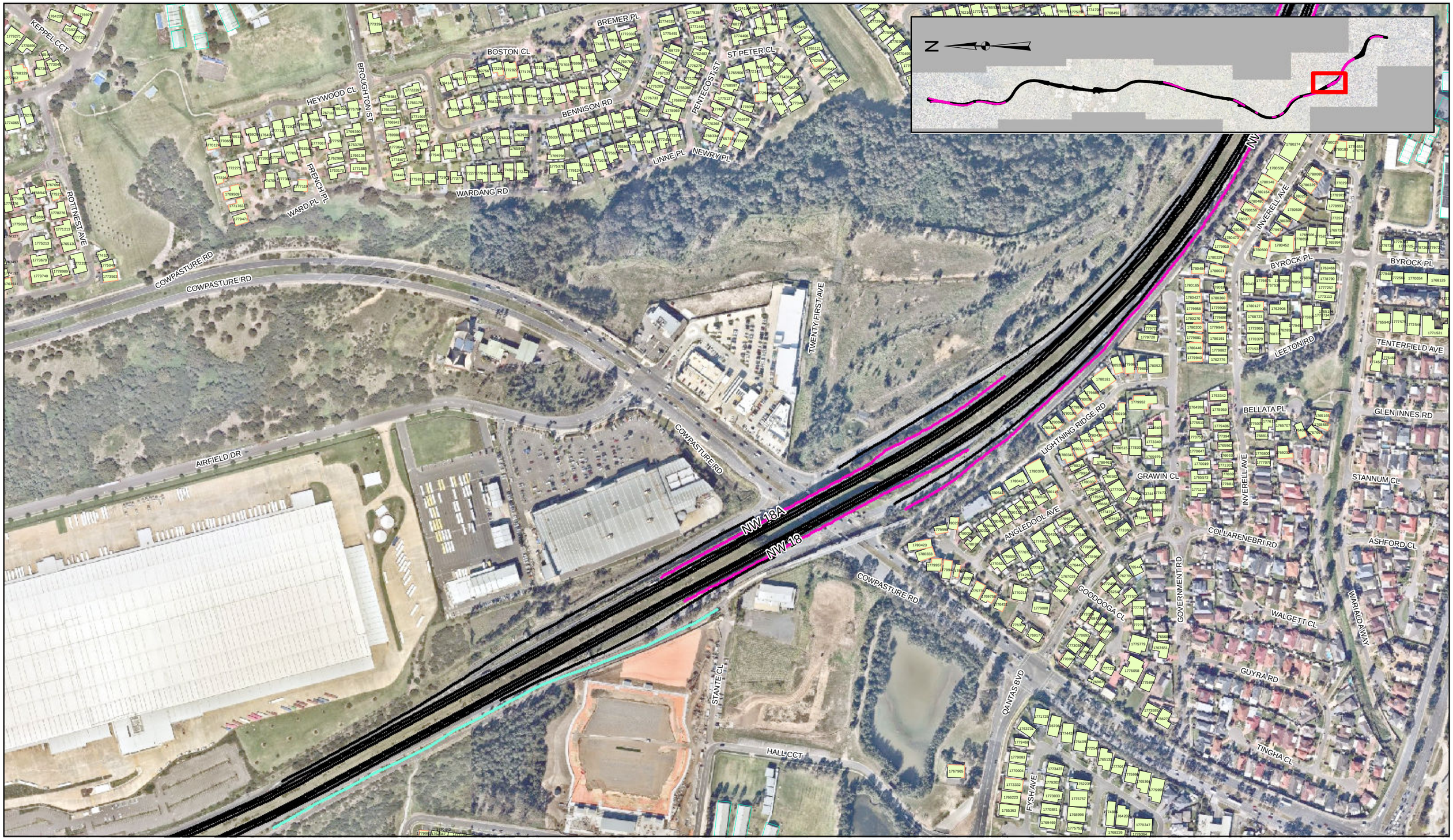
M7 Widening
Operational Assessment
Noise Affected Buildings

House IDs

PROJECT ID	60603874
CREATED BY	JZ
LAST MODIFIED	20 June 2022

Figure
1-11

A3 size



Transurban AECOM

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 40 80 160

metres

N

1:4,000 (when printed at A3)

LEGEND

- Residential Buildings
- Multiple Story Buildings
- School
- Place of Worship
- Future Road Alignment
- Noise Barrier Upgrades/Additions
- Existing Noise Barriers

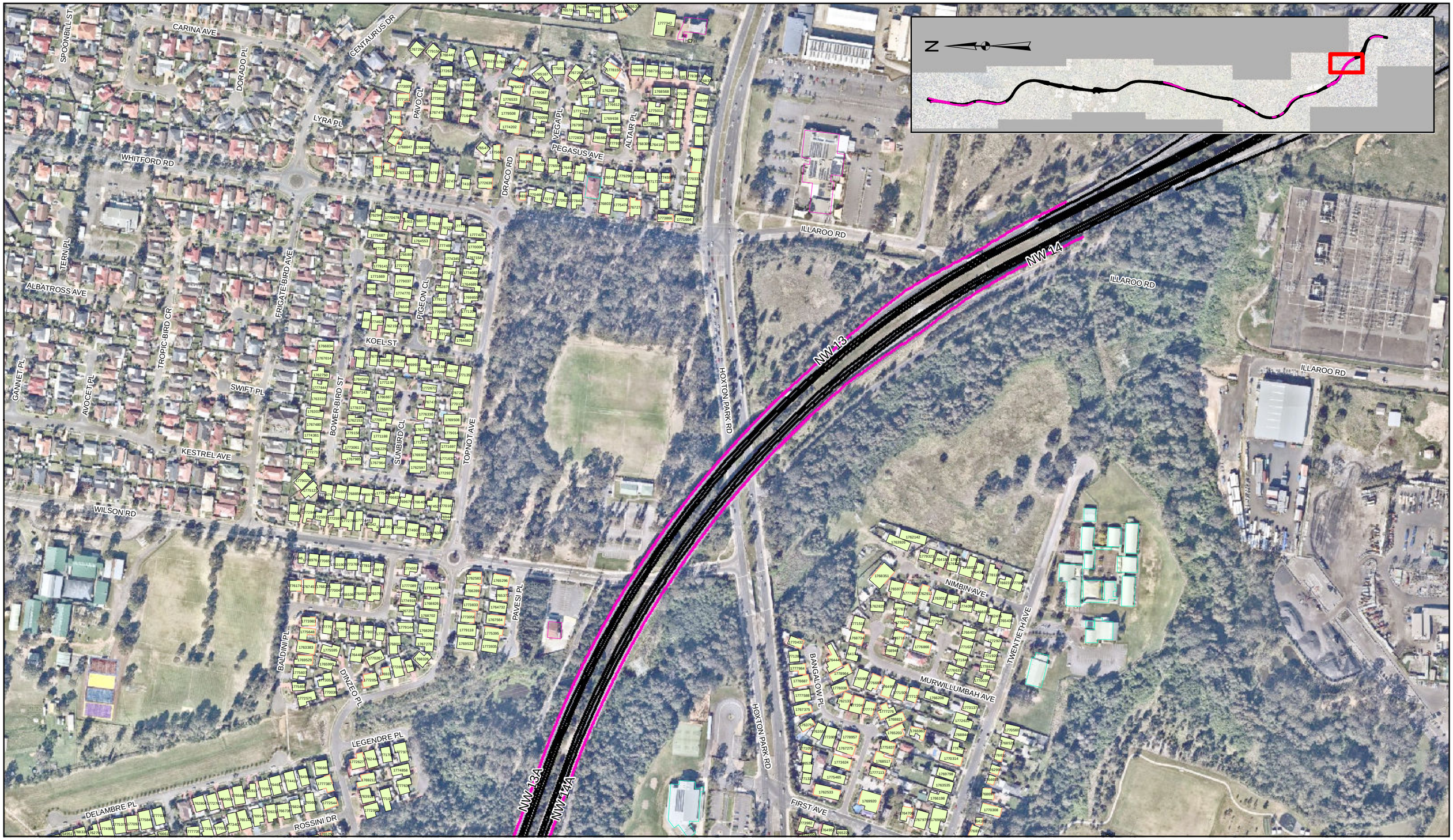
M7 Widening
Operational Assessment
Noise Affected Buildings

House IDs

PROJECT ID	60603874
CREATED BY	JZ
LAST MODIFIED	20 June 2022

Figure
1-12

A3 size



Transurban AECOM

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 40 80 160

metres

N

1:4,000 (when printed at A3)

LEGEND

- Residential Buildings
- Multiple Story Buildings
- School
- Place of Worship
- Future Road Alignment
- Noise Barrier Upgrades/Additions
- Existing Noise Barriers

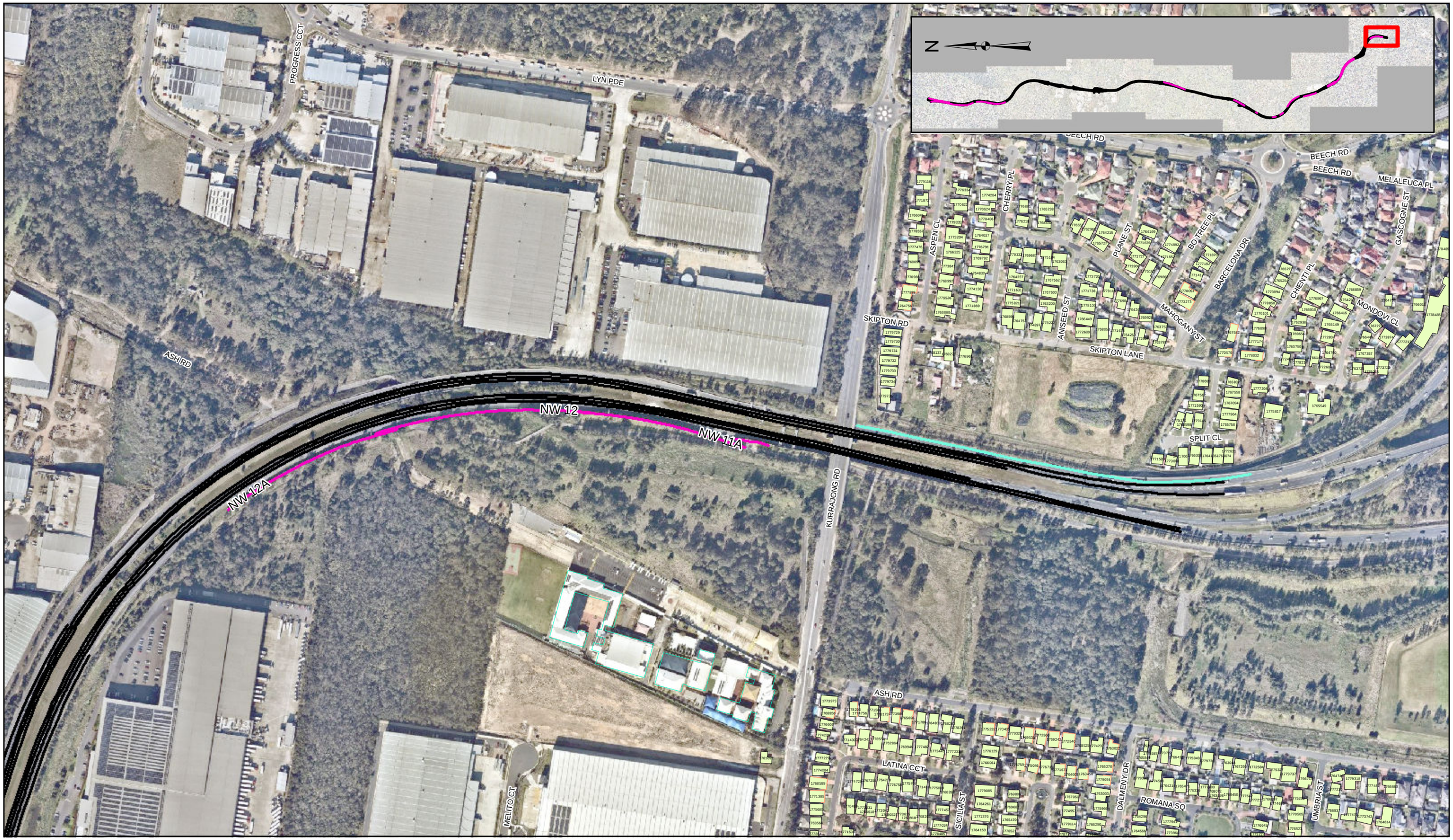
M7 Widening
Operational Assessment
Noise Affected Buildings

House IDs

PROJECT ID	60603874
CREATED BY	JZ
LAST MODIFIED	20 June 2022

Figure
1-13

A3 size



Transurban AECOM

DATUM GDA 1994, PROJECTION MGA ZONE 50

0 40 80 160

metres

N

1:4,000 (when printed at A3)

LEGEND

- Residential Buildings
- Multiple Story Buildings
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- Future Road Alignment
- Noise Barrier Upgrades/Additions
- Existing Noise Barriers

M7 Widening
Operational Assessment
Noise Affected Buildings

House IDs

PROJECT ID	60603874
CREATED BY	JZ
LAST MODIFIED	20 June 2022

Figure
1-14

A3 size

Appendix B

Noise logging results

Noise Logger Report

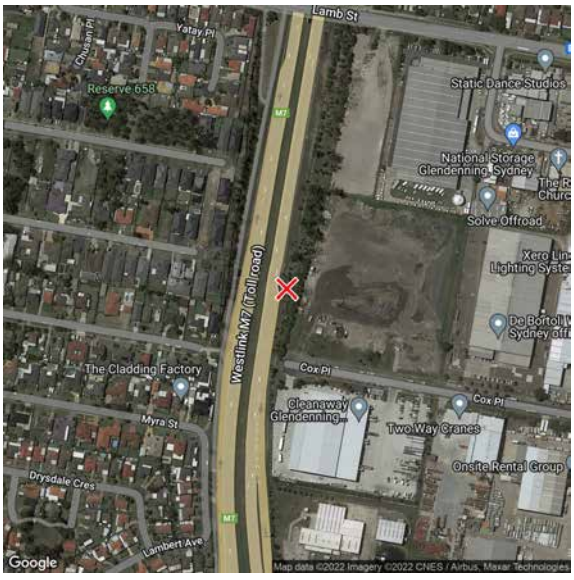
NL3 - Lot 2, DP1033513, Glendenning

Item	Information
Logger Type	NGARA
Serial number	878007
Address	NL3 - Lot 2, DP1033513, Glendenning
Location	NL3 - Lot 2, DP1033513, Glendenning
Facade / Free Field	Free field
Environment	Background dominated by road traffic noise on the M7

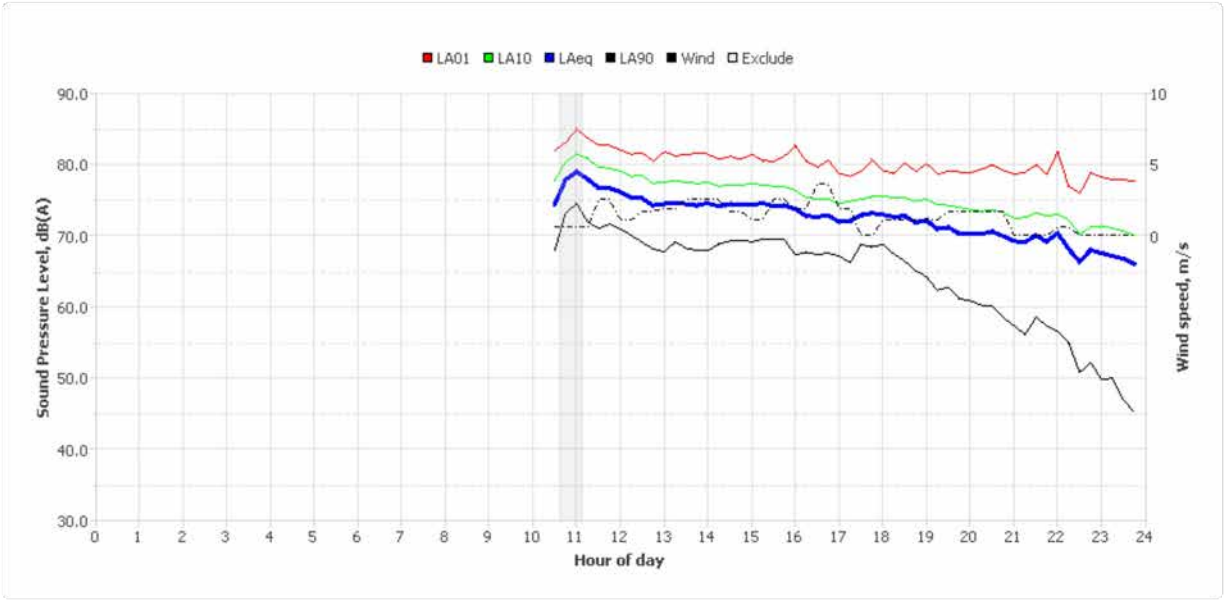
Measured noise levels

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 Feb 25 2021	75	71	68	-	57	-	74	68
Fri Feb 26 2021	74	71	70	-	58	44	74	70
Sat Feb 27 2021	72	68	67	64	56	39	71	67
Sun Feb 28 2021	71	70	64	58	56	42	71	64
Mon Mar 1 2021	74	71	69	68	55	40	73	69
Tue Mar 2 2021	74	71	70	-	55	44	73	70
Wed Mar 3 2021	74	71	70	67	56	39	73	70
Thu Mar 4 2021	74	71	70	67	57	41	73	70
Fri Mar 5 2021	73	70	70	-	58	45	73	70
Sat Mar 6 2021	72	69	67	64	56	40	71	67
Sun Mar 7 2021	71	70	65	58	55	-	71	65
Mon Mar 8 2021	74	72	69	67	56	41	73	69
Tue Mar 9 2021	74	71	70	-	56	46	74	70
Wed Mar 10 2021	74	71	70	-	55	44	73	70
Thu Mar 11 2021	74	-	70	-	-	-	74	70
Summary	**73**	**71**	**69**	**66**	**56**	**42**	**73**	**69**

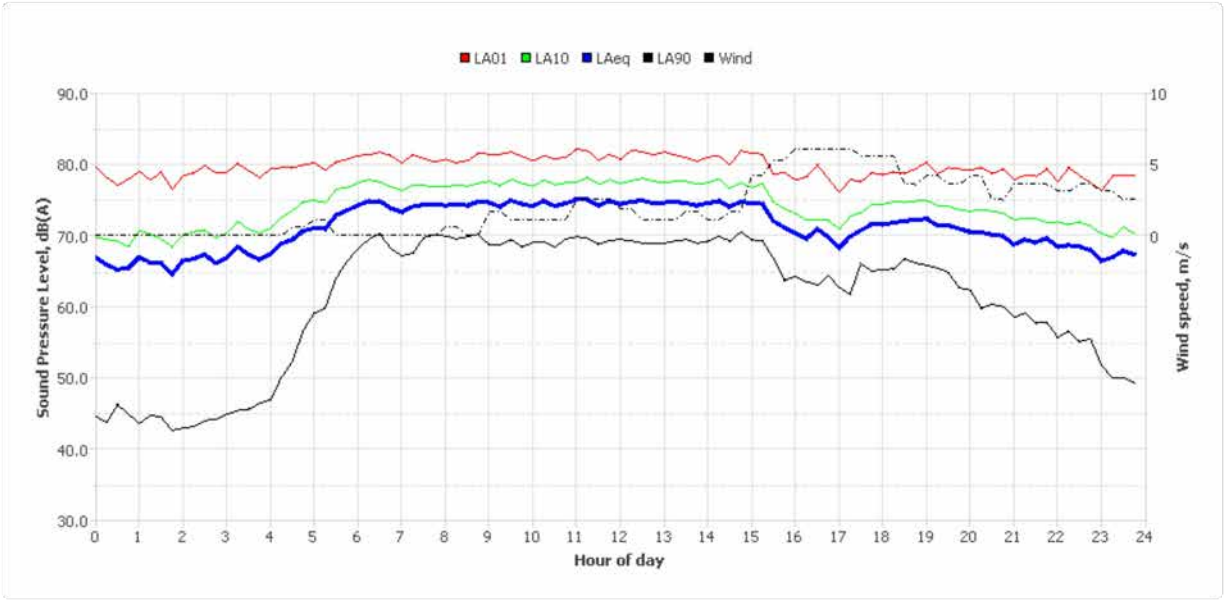
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location	Logger Deployment Photo
	

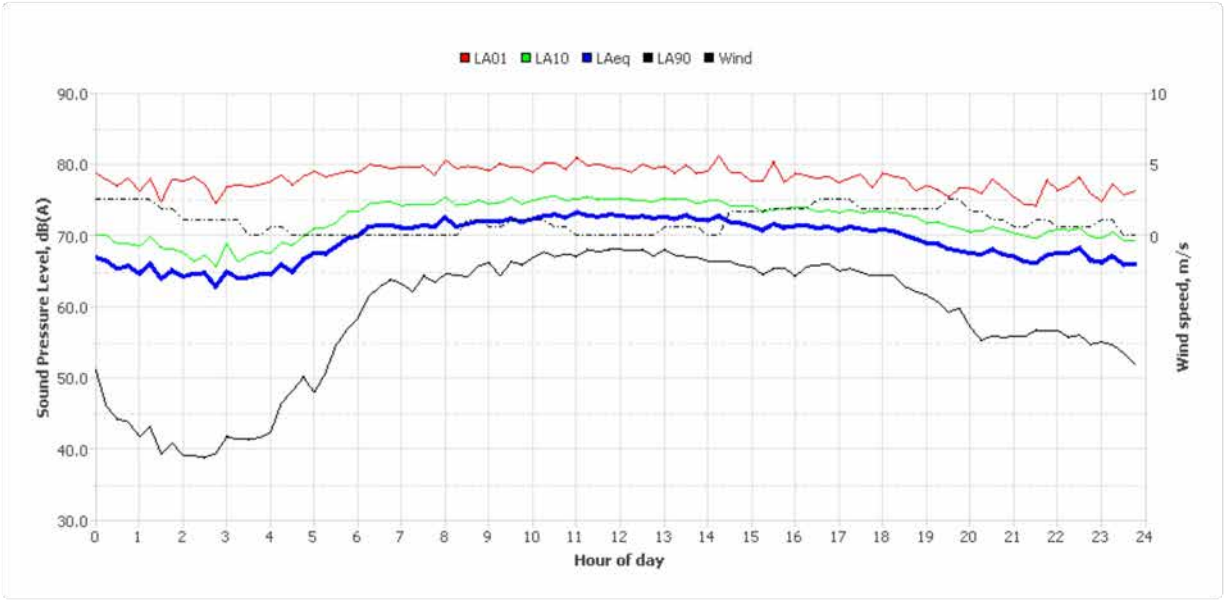
Thursday, 25 Feb 2021



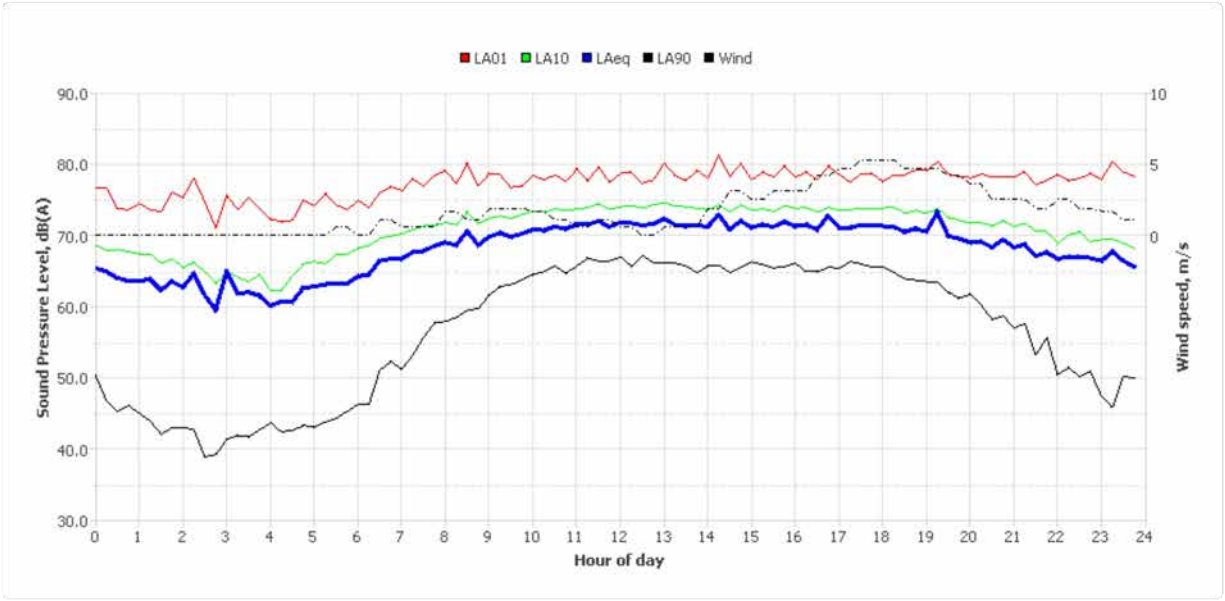
Friday, 26 Feb 2021



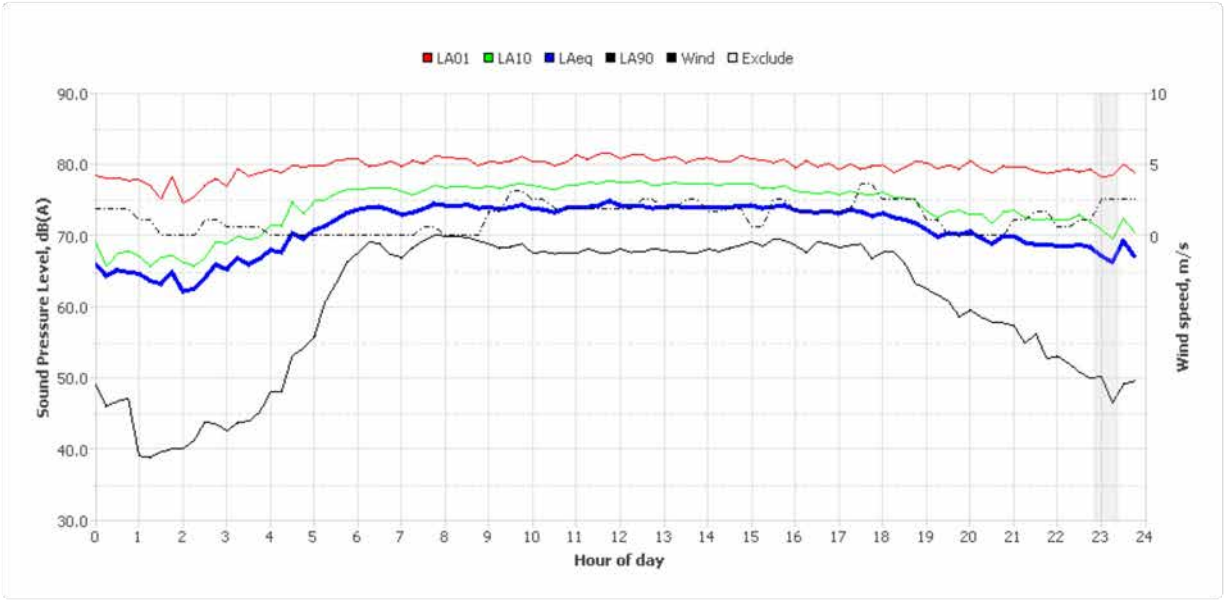
Saturday, 27 Feb 2021



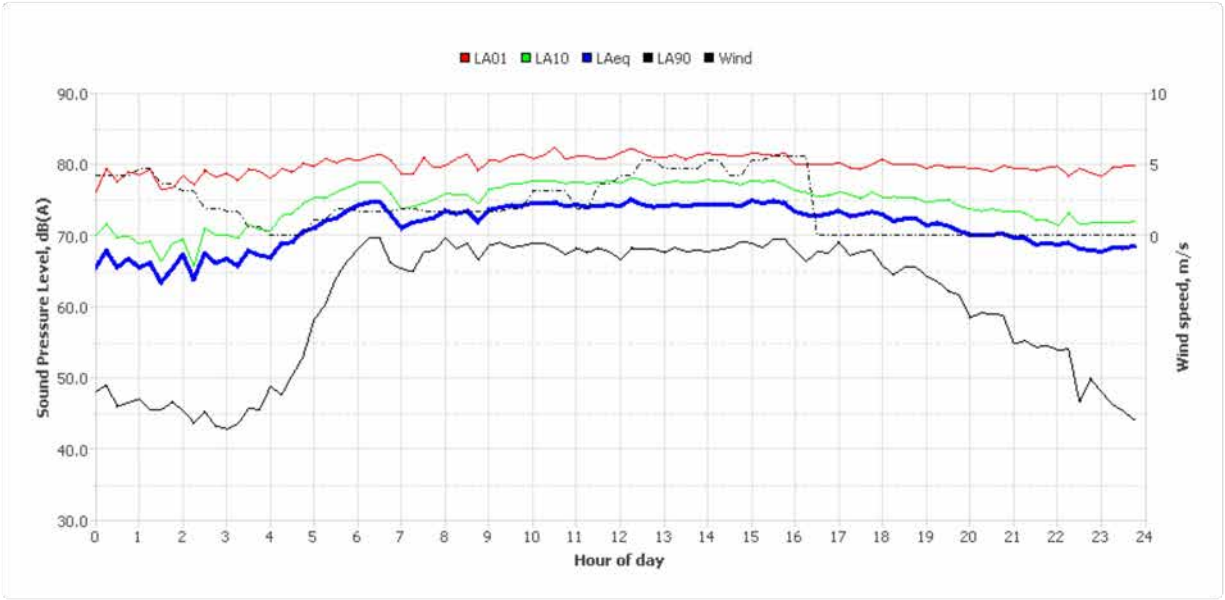
Sunday, 28 Feb 2021



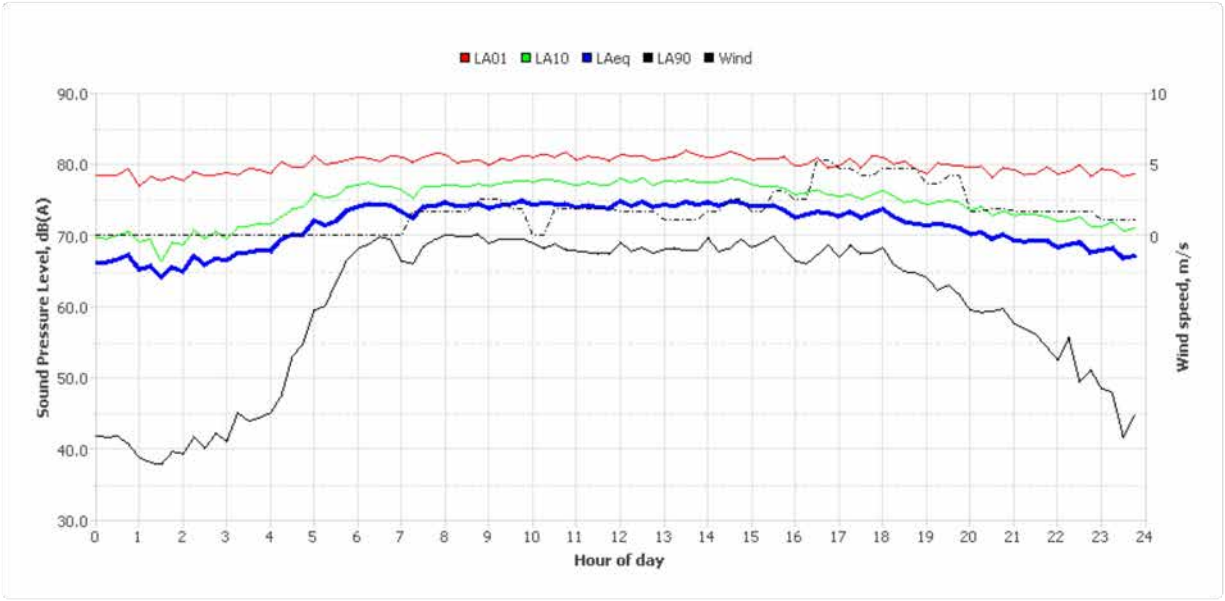
Monday, 01 Mar 2021



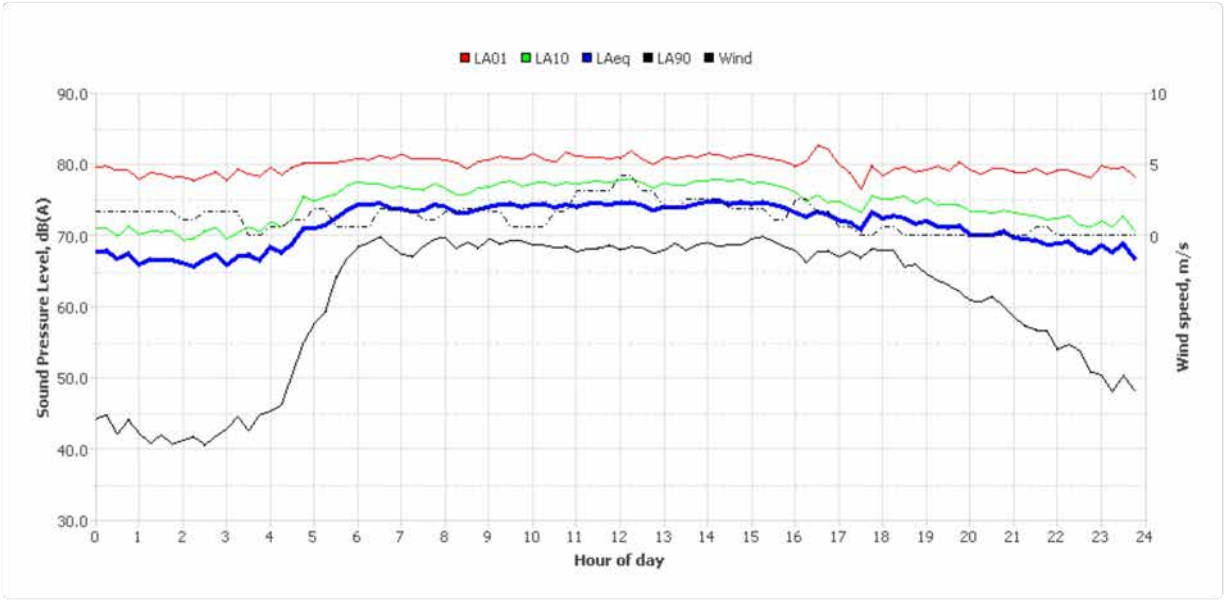
Tuesday, 02 Mar 2021



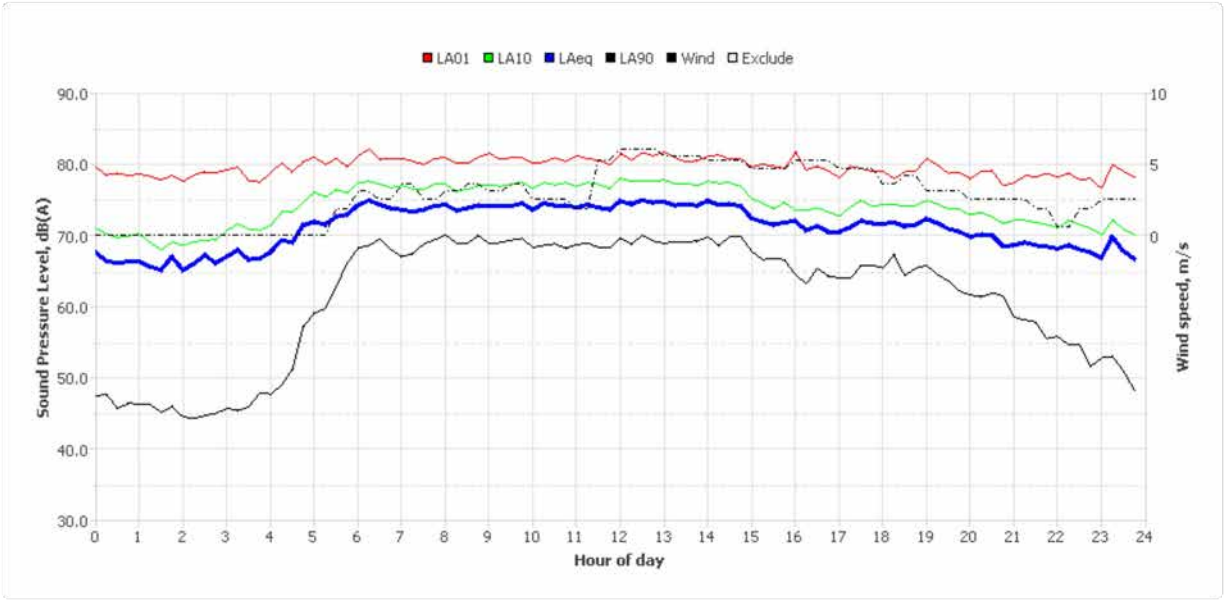
Wednesday, 03 Mar 2021



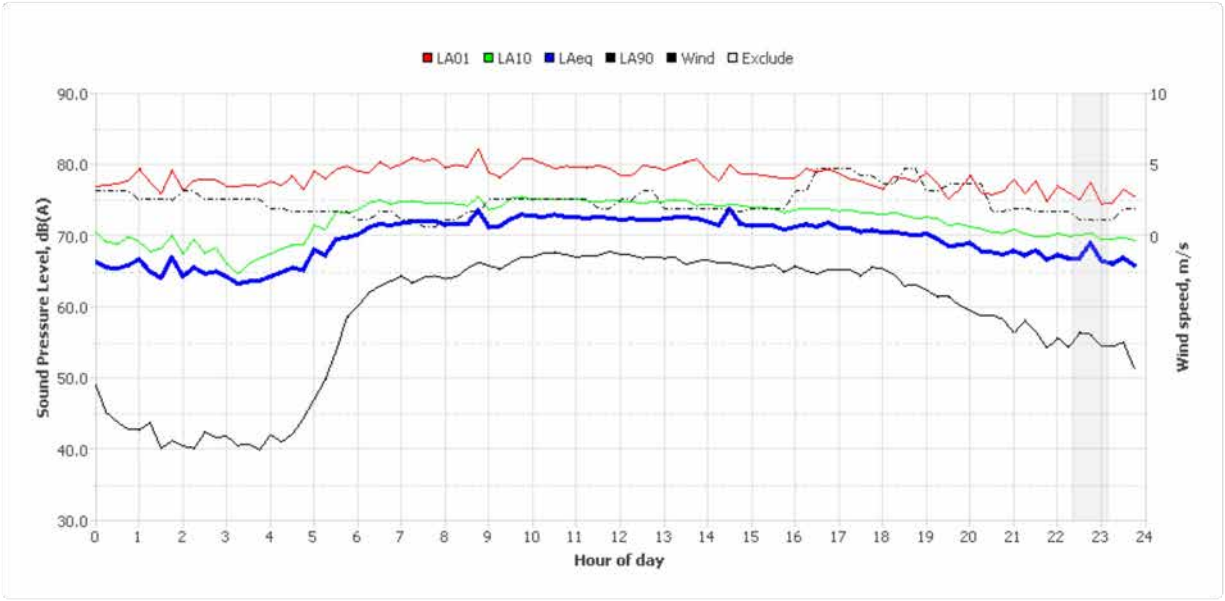
Thursday, 04 Mar 2021



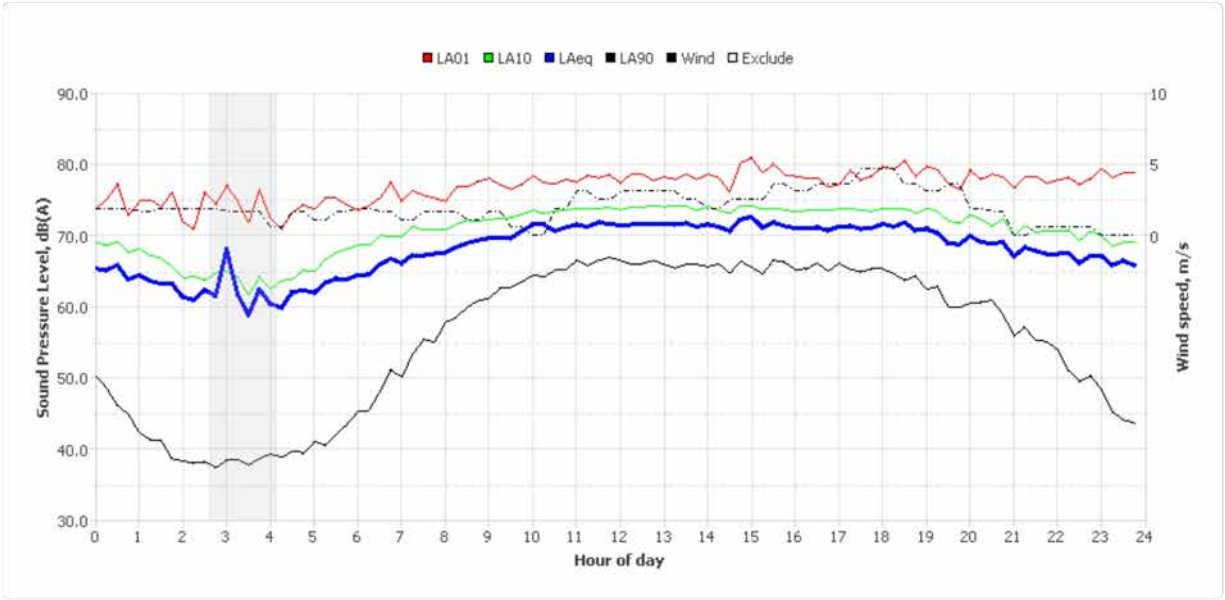
Friday, 05 Mar 2021



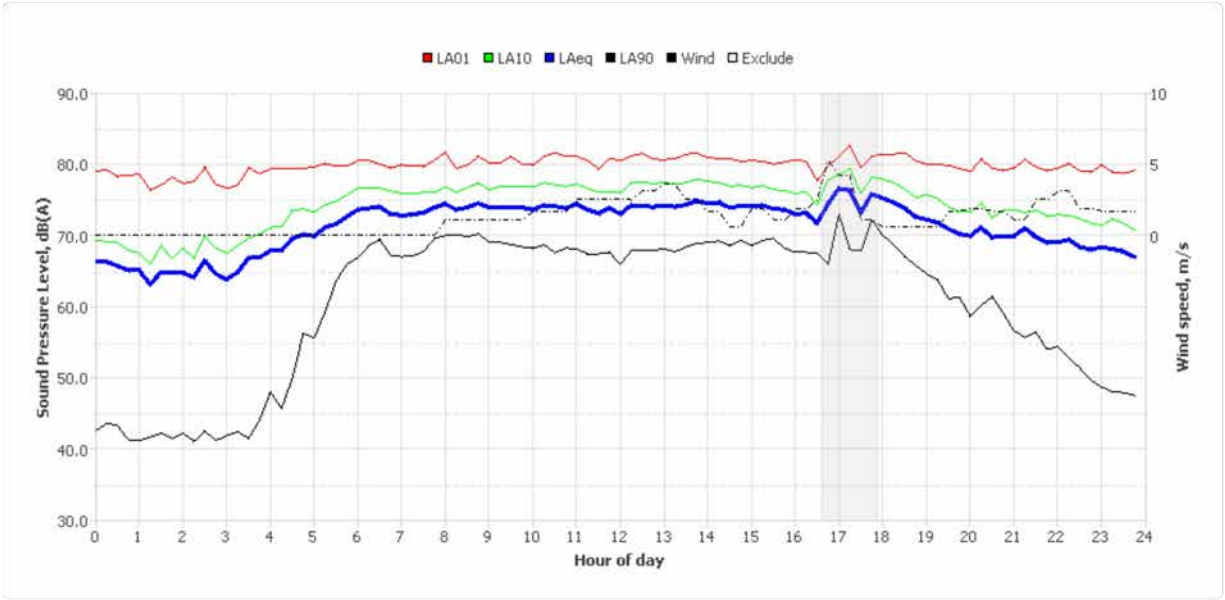
Saturday, 06 Mar 2021



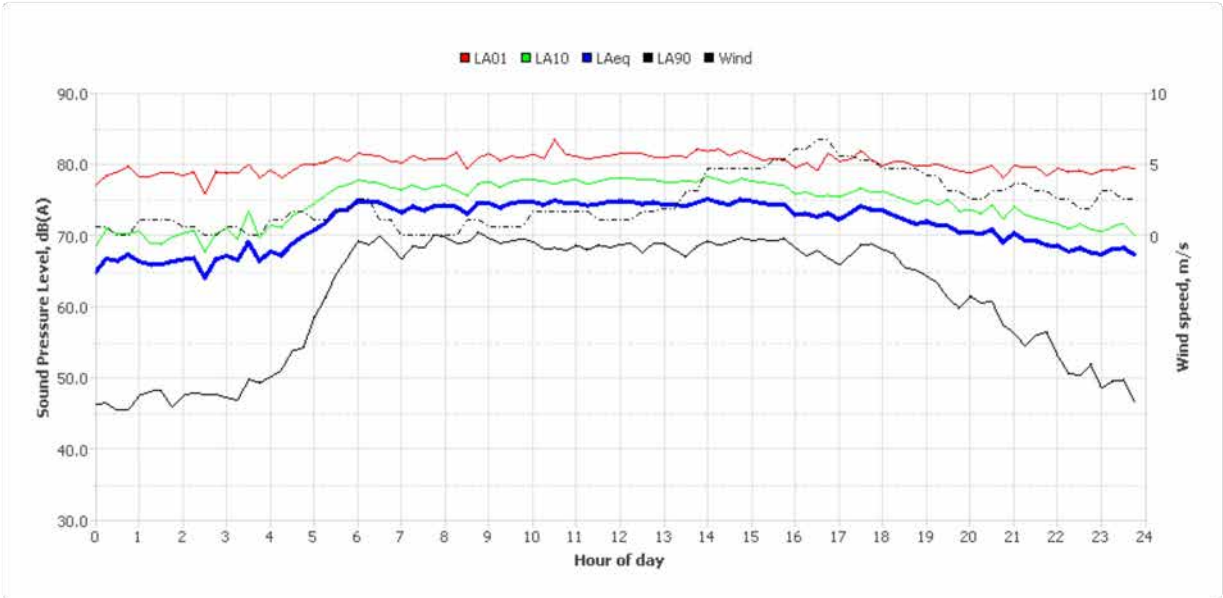
Sunday, 07 Mar 2021



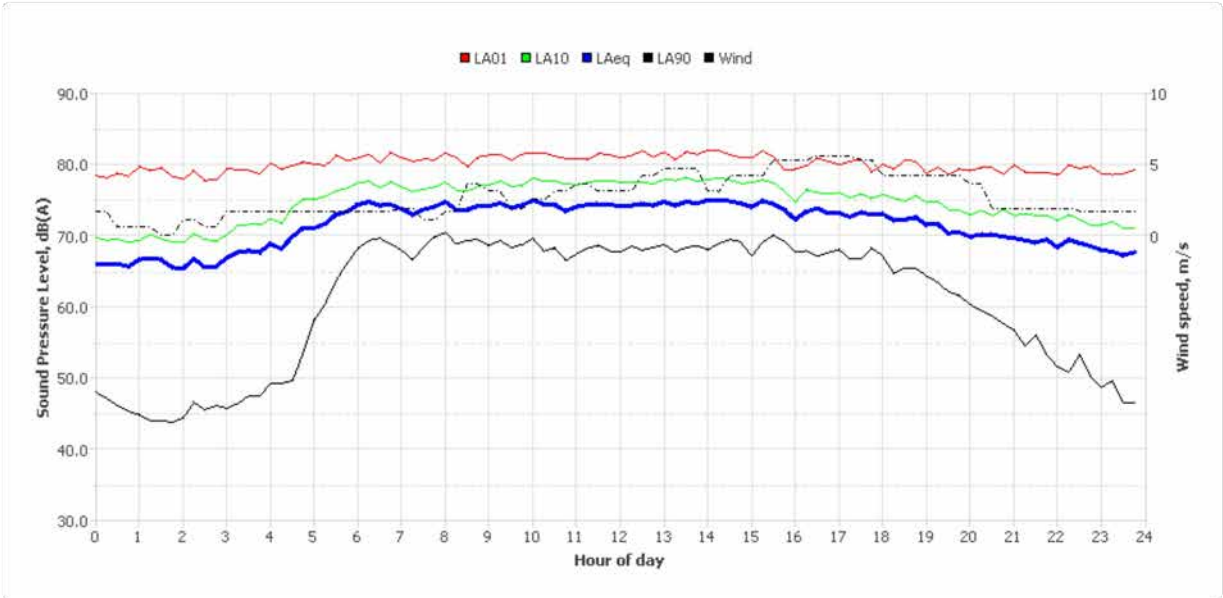
Monday, 08 Mar 2021



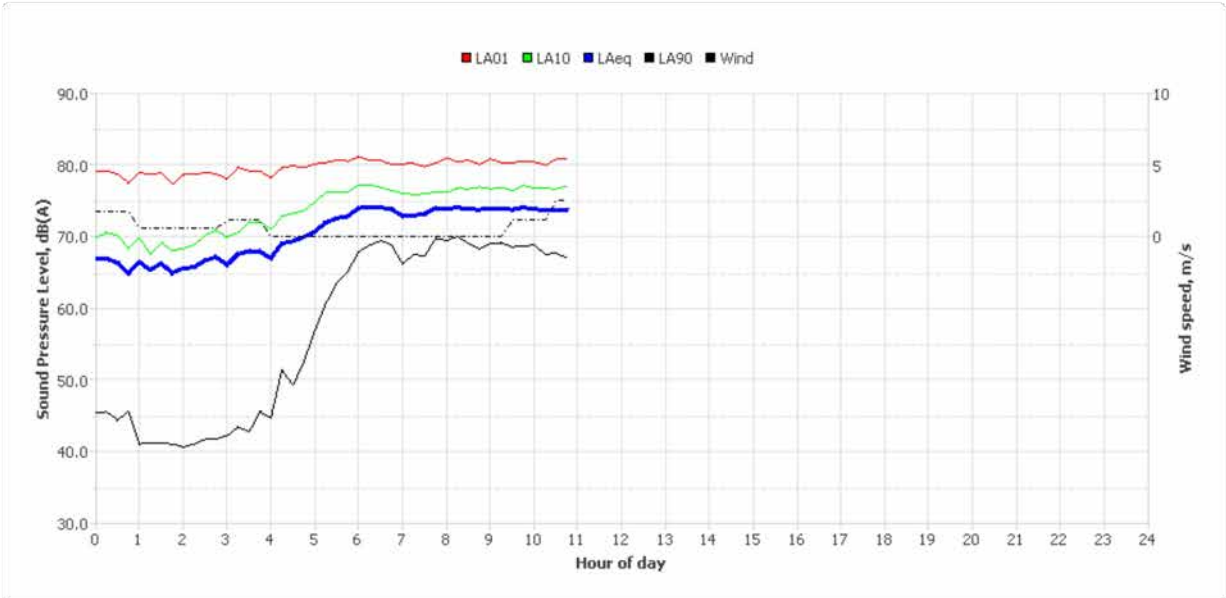
Tuesday, 09 Mar 2021



Wednesday, 10 Mar 2021



Thursday, 11 Mar 2021



Noise Logger Report

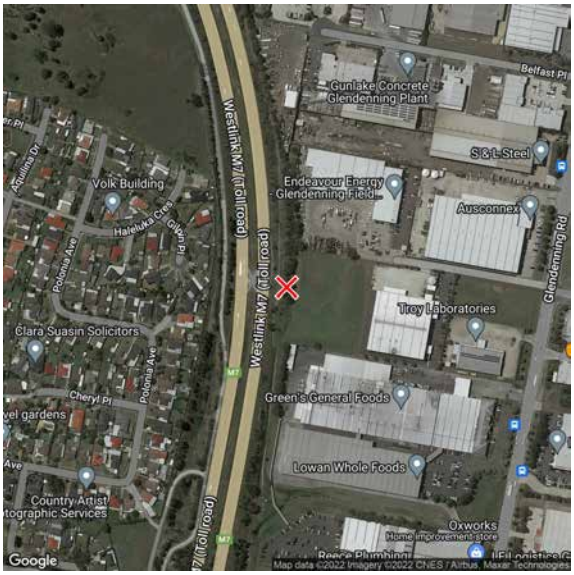
NL4 - Lot 671, DP740870, Glendenning

Item	Information
Logger Type	NGARA
Serial number	87802E
Address	NL4 - Lot 671, DP740870, Glendenning
Location	NL4 - Lot 671, DP740870, Glendenning
Facade / Free Field	Free Field
Environment	Background dominated by road traffic noise on the M7

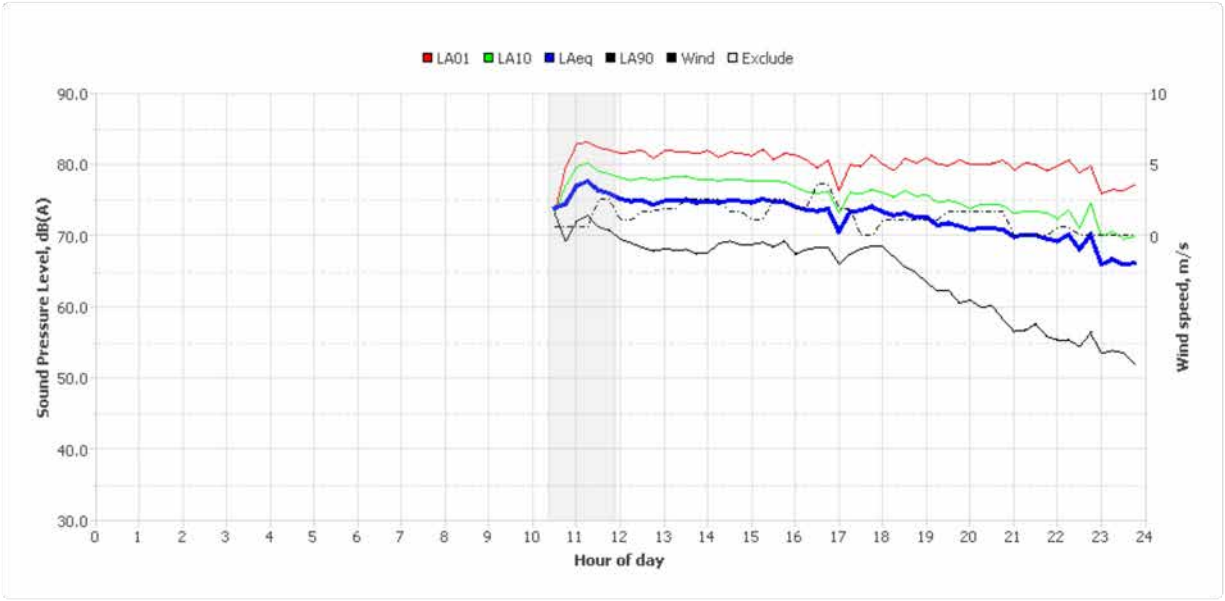
Measured noise levels

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 Feb 25 2021	74	72	68	-	57	-	73	68
Fri Feb 26 2021	75	71	70	-	58	50	74	70
Sat Feb 27 2021	73	70	68	64	55	47	72	68
Sun Feb 28 2021	72	70	66	58	55	48	72	66
Mon Mar 1 2021	75	72	70	68	56	48	74	70
Tue Mar 2 2021	74	72	71	-	56	50	74	71
Wed Mar 3 2021	75	72	71	67	57	48	74	71
Thu Mar 4 2021	75	72	71	66	59	50	74	71
Fri Mar 5 2021	74	72	71	-	58	50	74	71
Sat Mar 6 2021	-	-	67	-	-	-	-	67
Summary	**74**	**71**	**70**	**66**	**57**	**49**	**74**	**70**

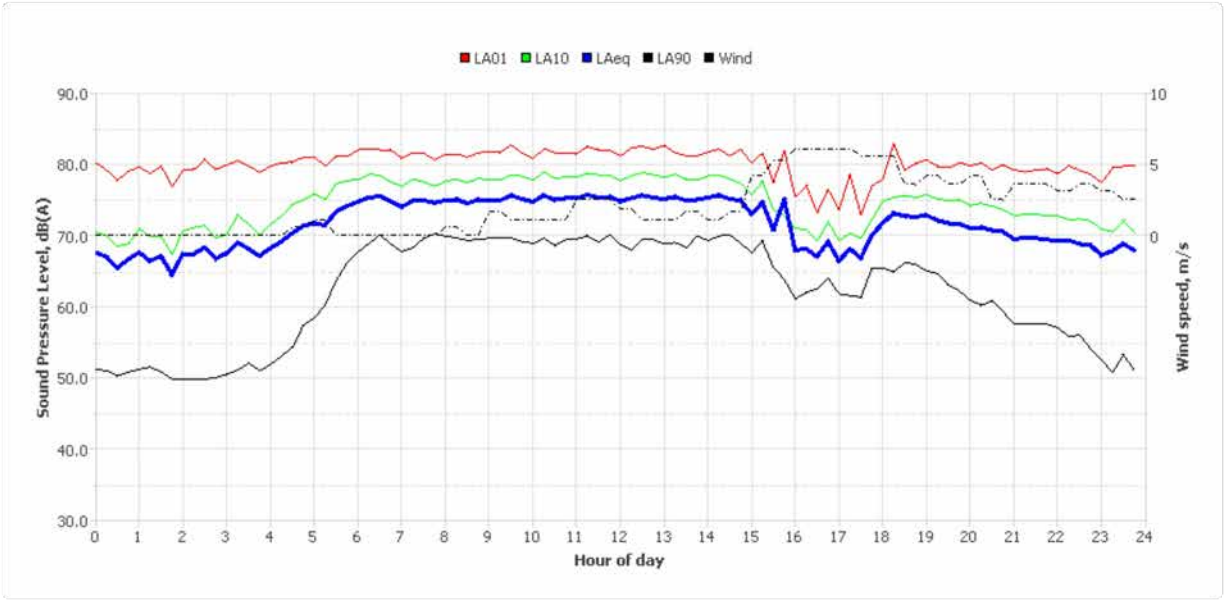
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location	Logger Deployment Photo
	

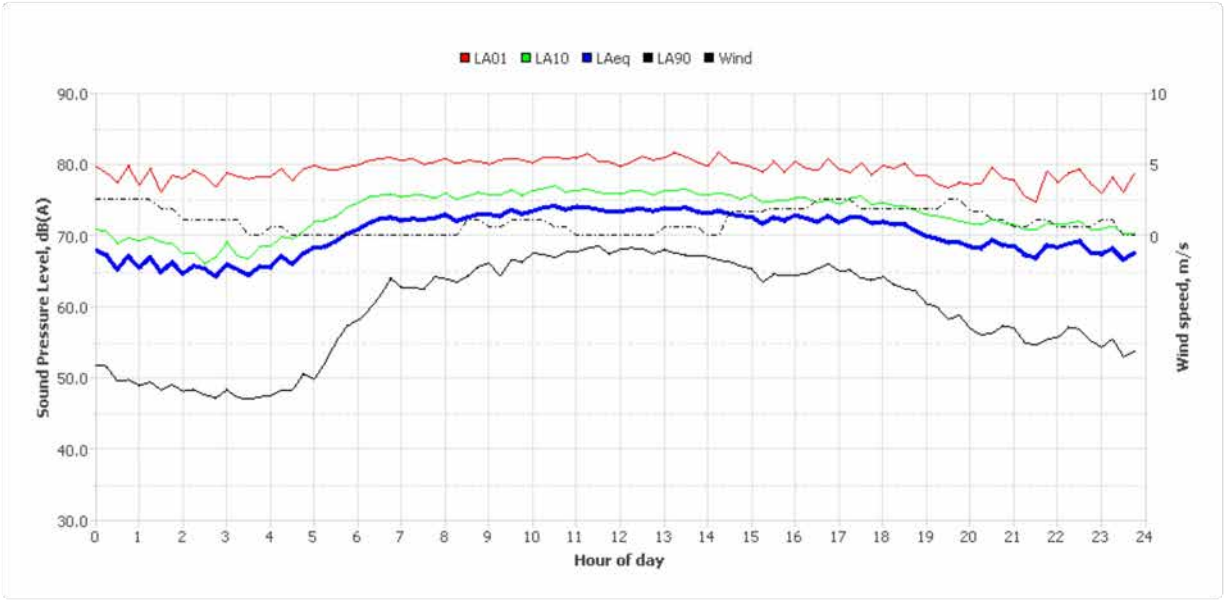
Thursday, 25 Feb 2021



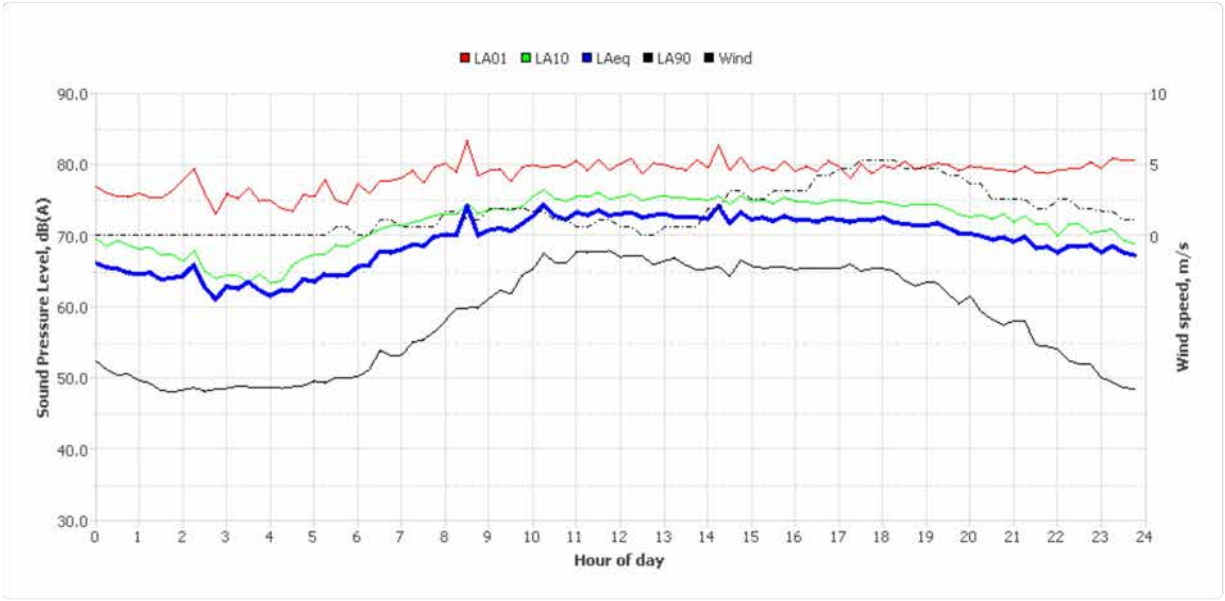
Friday, 26 Feb 2021



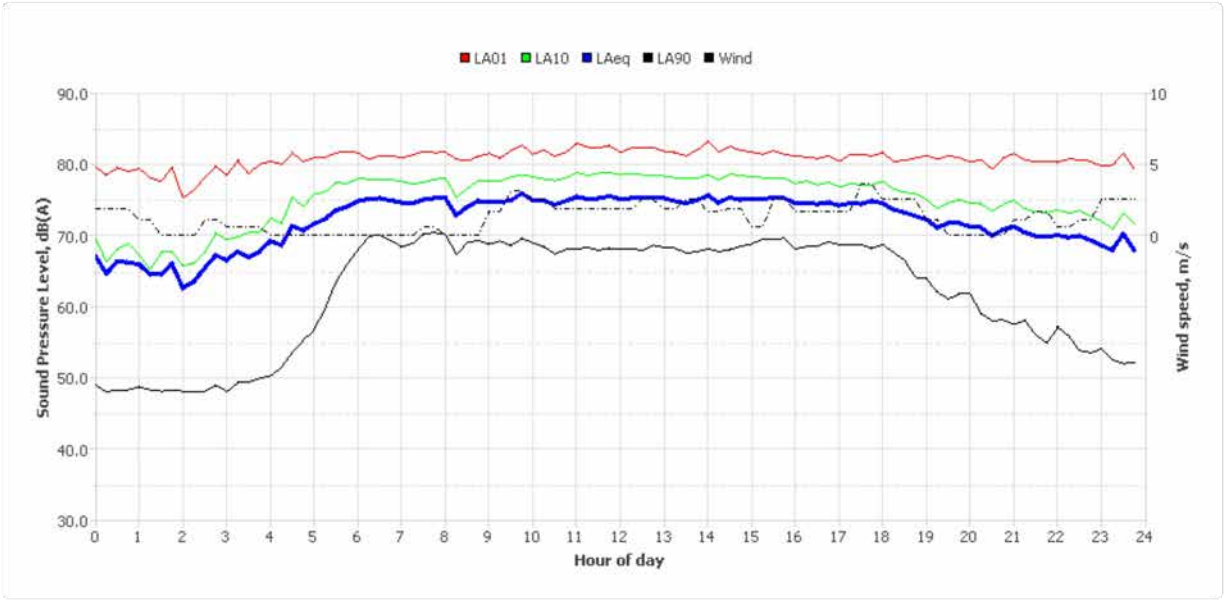
Saturday, 27 Feb 2021



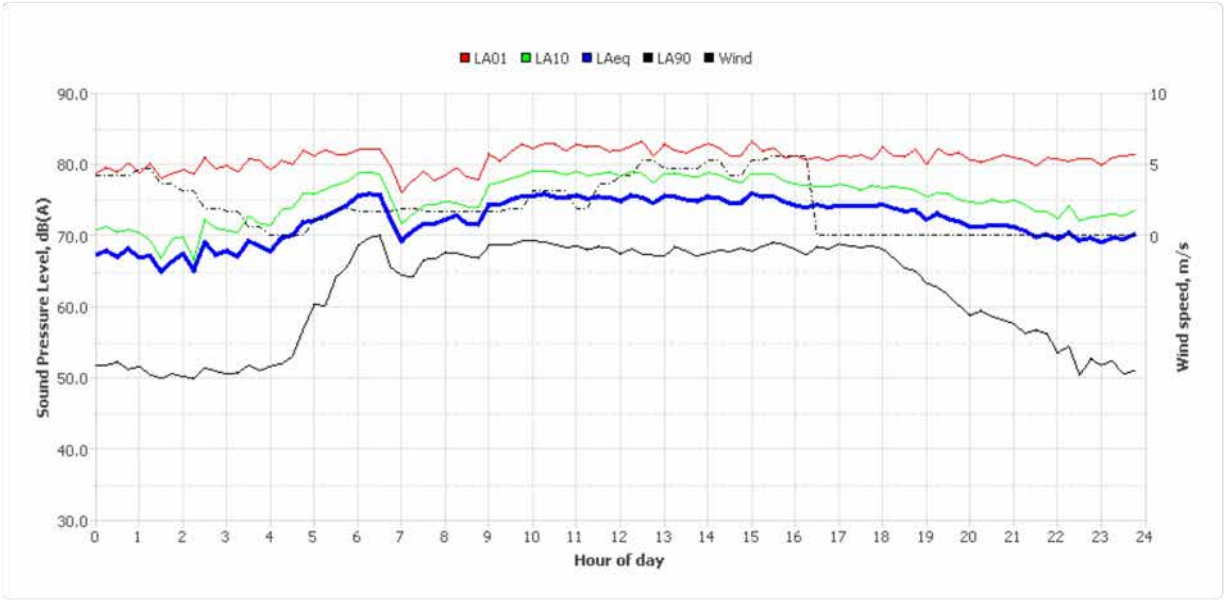
Sunday, 28 Feb 2021



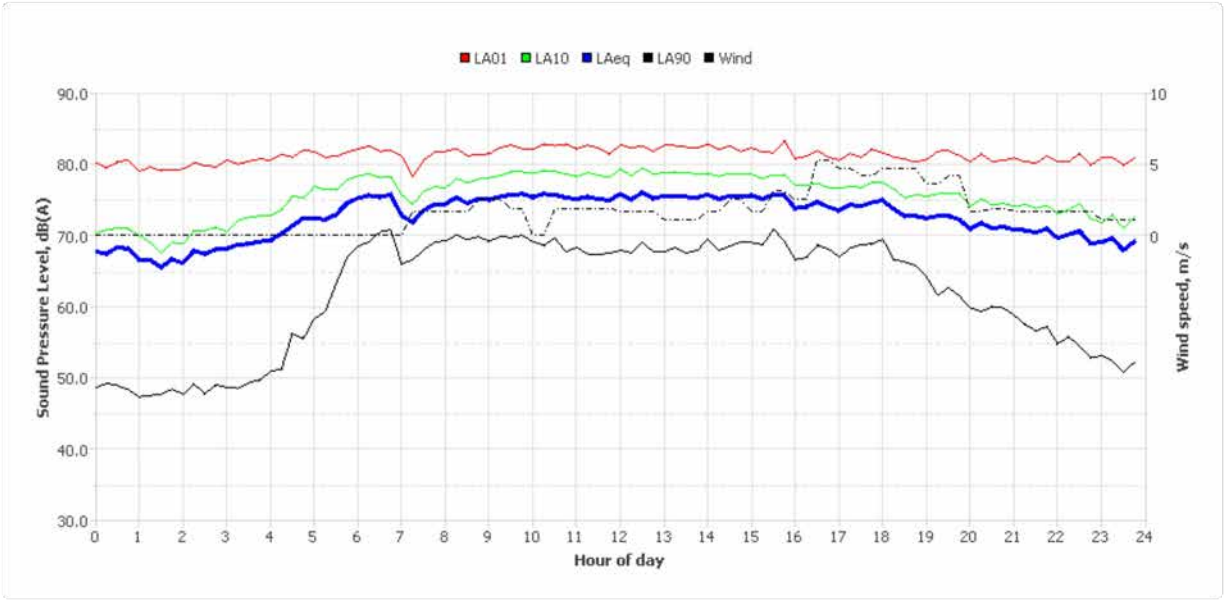
Monday, 01 Mar 2021



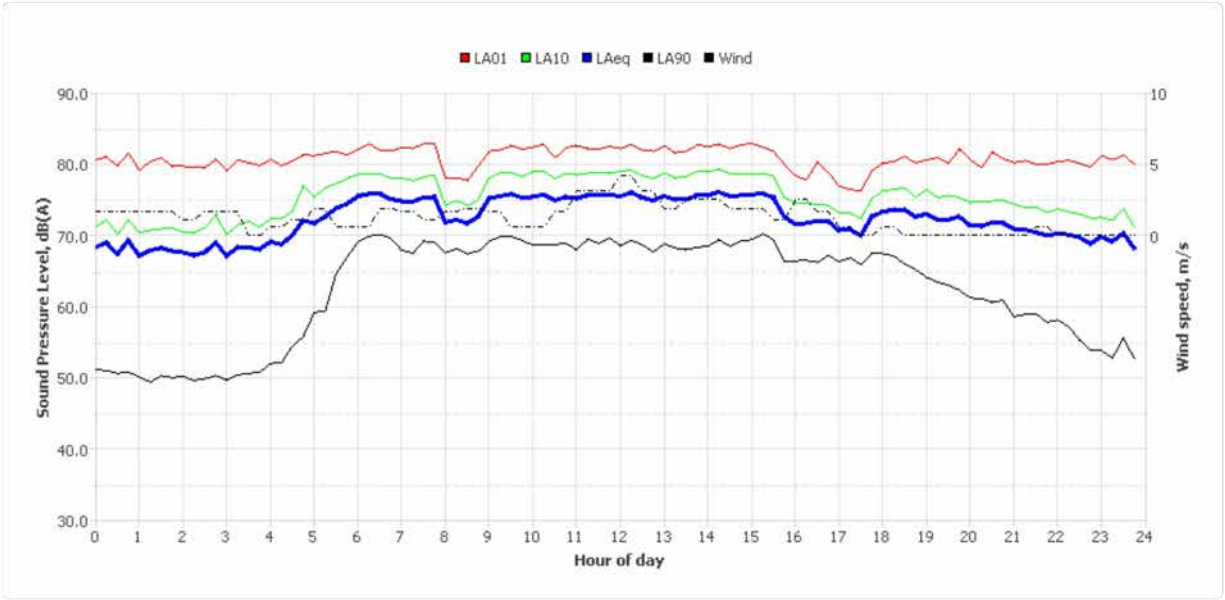
Tuesday, 02 Mar 2021



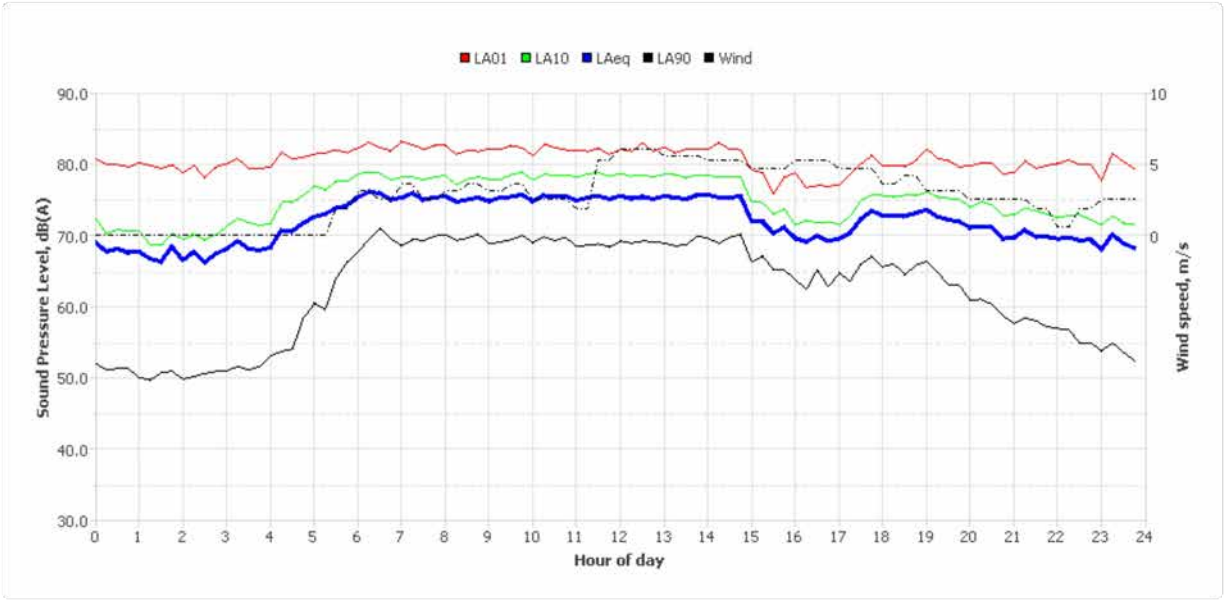
Wednesday, 03 Mar 2021



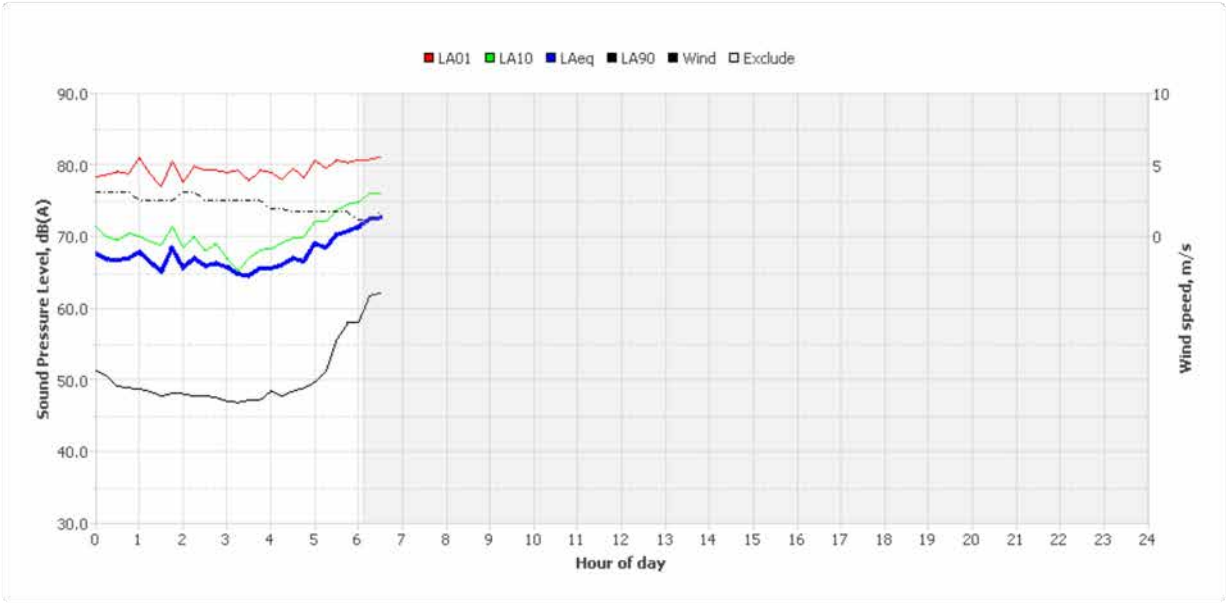
Thursday, 04 Mar 2021



Friday, 05 Mar 2021



Saturday, 06 Mar 2021



Noise Logger Report

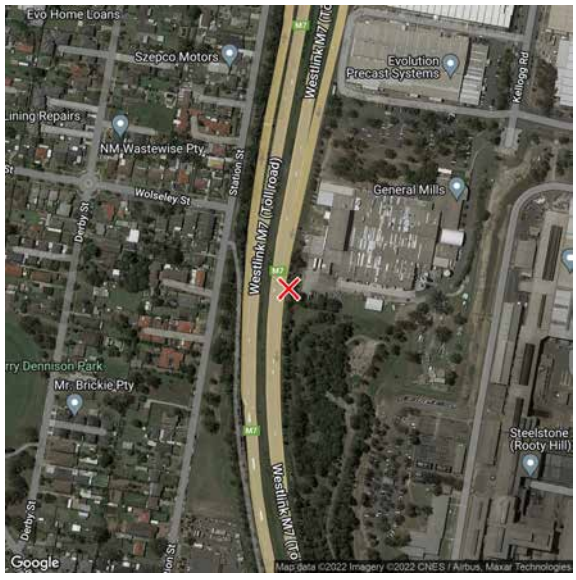
NL5 - Lot 5, DP1042577, Rooty Hill

Item	Information
Logger Type	NGARA
Serial number	8780B0
Address	NL5 - Lot 5, DP1042577, Rooty Hill
Location	NL5 - Lot 5, DP1042577, Rooty Hill
Facade / Free Field	Free field
Environment	Background dominated by road traffic noise on the M7

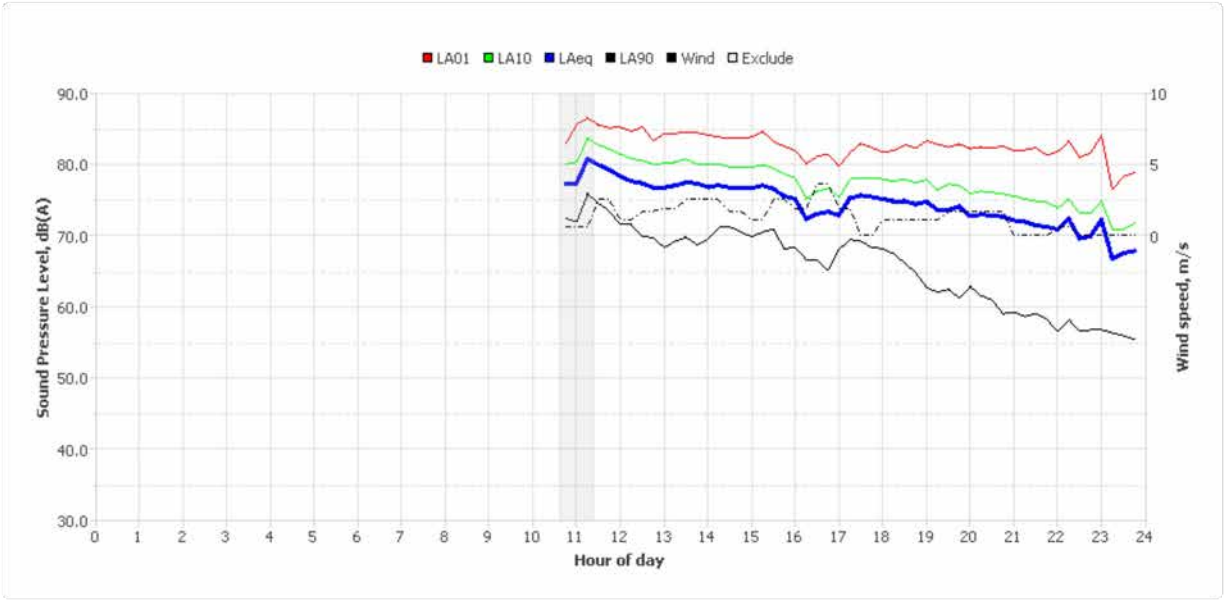
Measured noise levels

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 Feb 25 2021	77	73	70	-	59	-	76	70
Fri Feb 26 2021	77	73	72	-	61	55	76	72
Sat Feb 27 2021	74	71	70	64	59	54	74	70
Sun Feb 28 2021	73	72	68	59	61	55	73	68
Mon Mar 1 2021	76	73	72	68	62	58	75	72
Tue Mar 2 2021	76	73	72	-	59	56	75	72
Wed Mar 3 2021	76	73	72	68	59	55	75	72
Thu Mar 4 2021	75	73	72	66	58	55	75	72
Fri Mar 5 2021	75	73	72	-	60	56	75	72
Sat Mar 6 2021	74	71	69	64	59	56	74	69
Sun Mar 7 2021	73	72	67	59	61	56	73	67
Mon Mar 8 2021	76	75	72	67	61	57	75	72
Tue Mar 9 2021	77	73	73	-	60	57	76	73
Wed Mar 10 2021	77	73	72	-	62	57	76	72
Thu Mar 11 2021	76	-	73	-	-	-	76	73
Summary	**76**	**73**	**71**	**65**	**60**	**56**	**75**	**71**

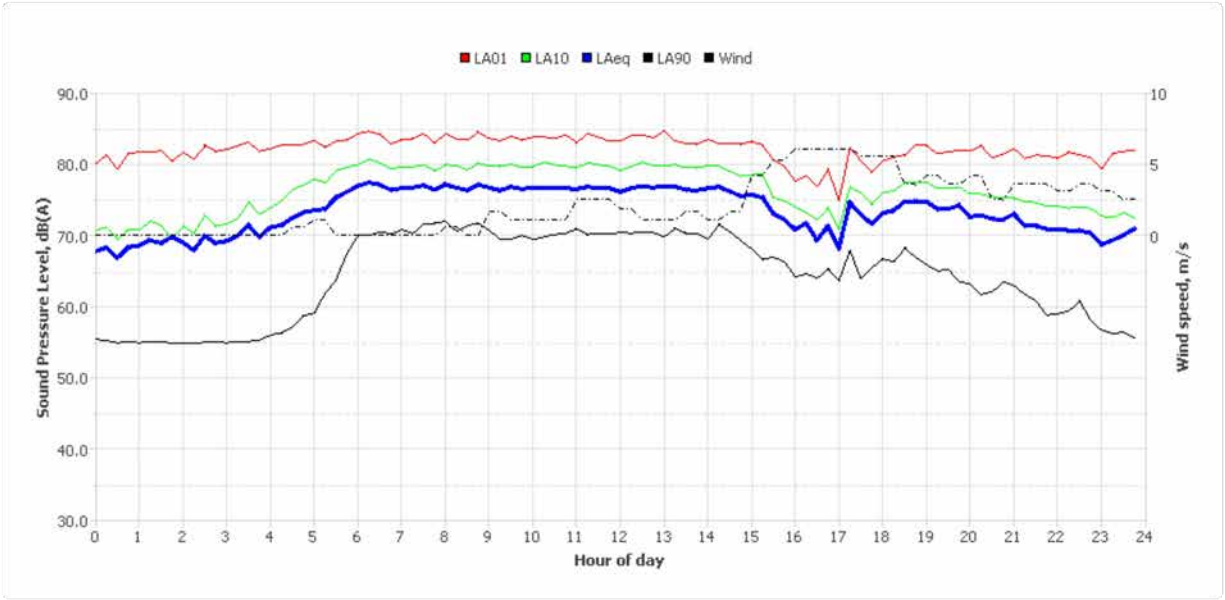
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location	Logger Deployment Photo
	

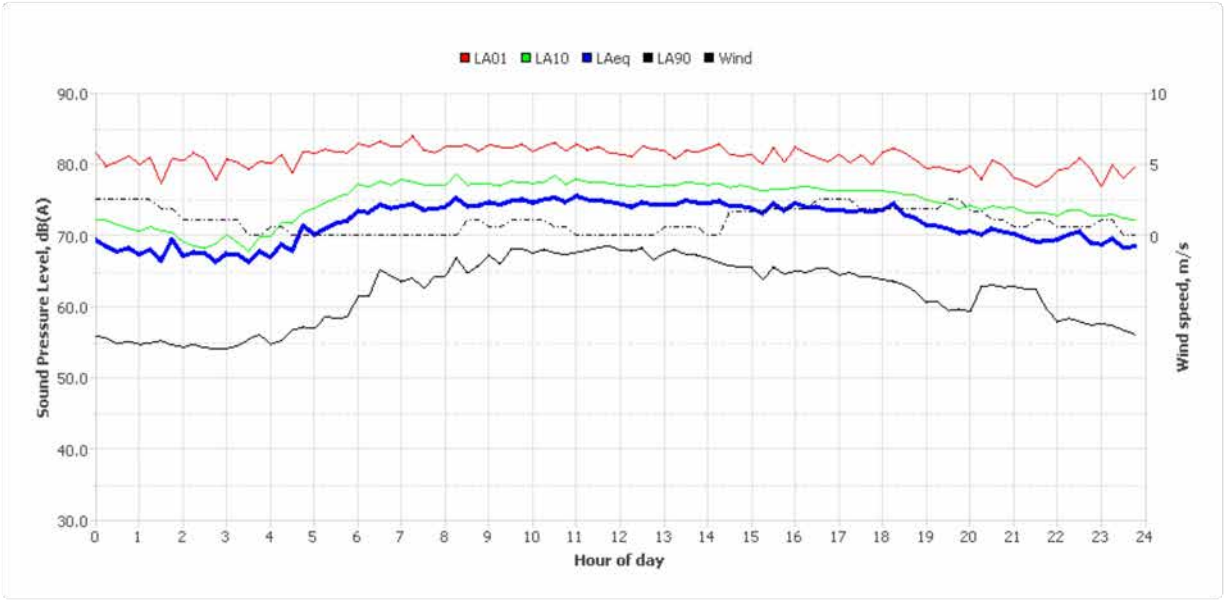
Thursday, 25 Feb 2021



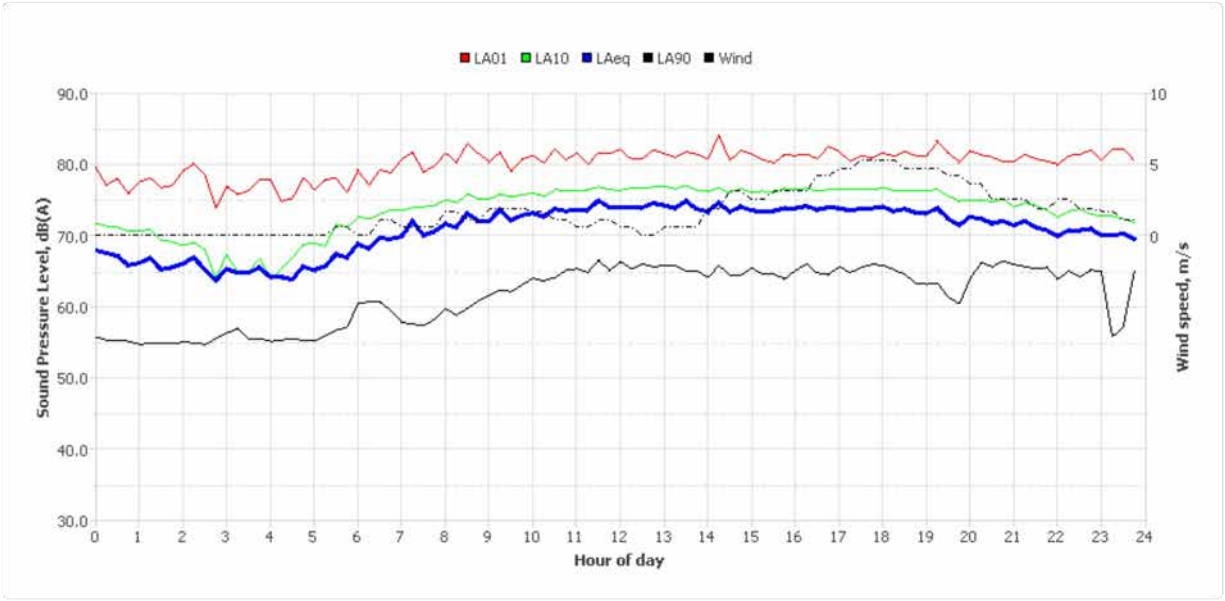
Friday, 26 Feb 2021



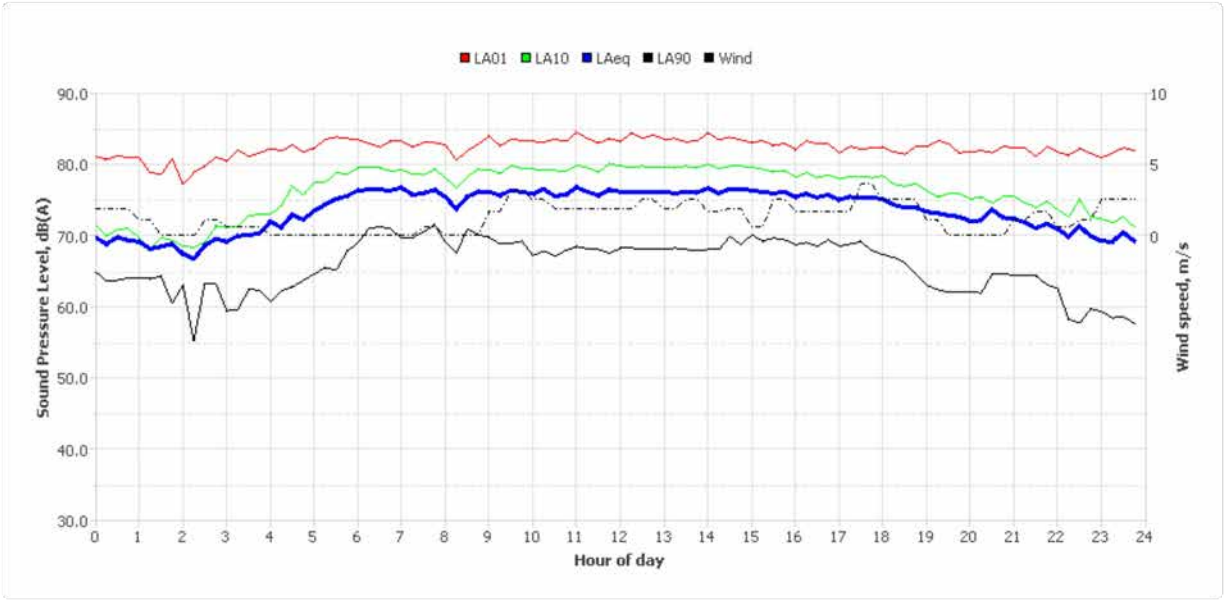
Saturday, 27 Feb 2021



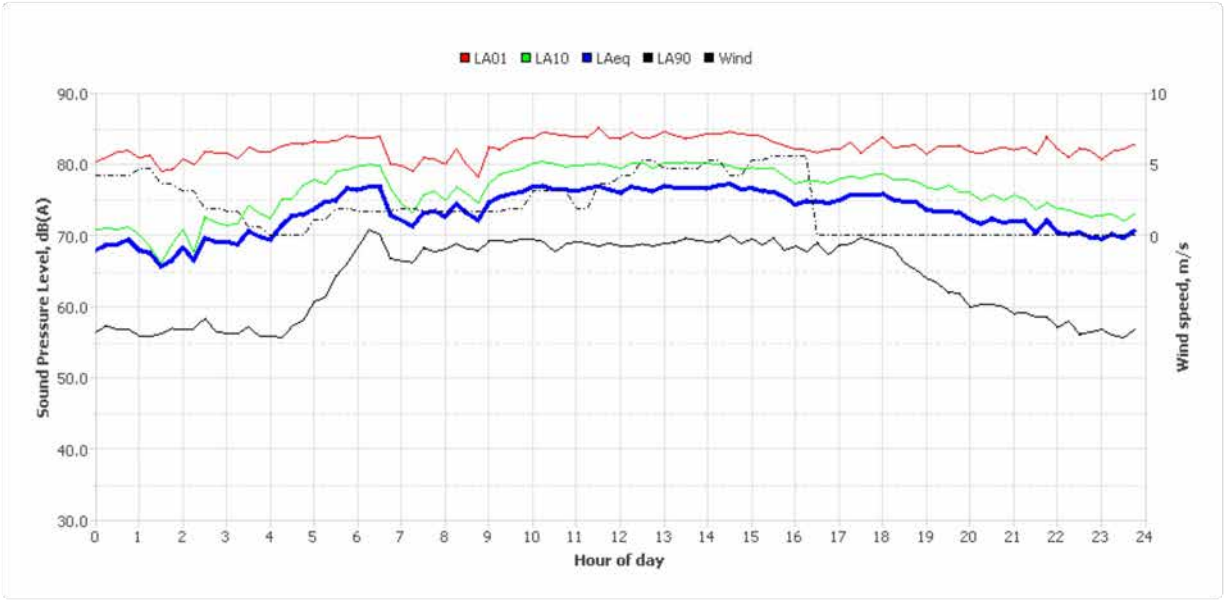
Sunday, 28 Feb 2021



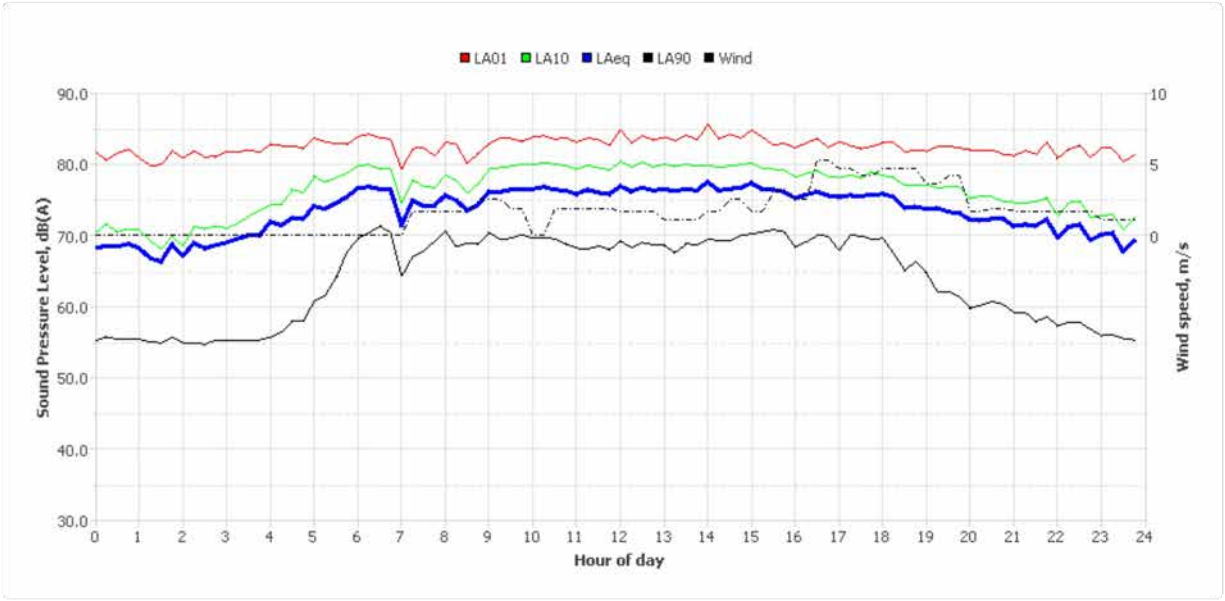
Monday, 01 Mar 2021



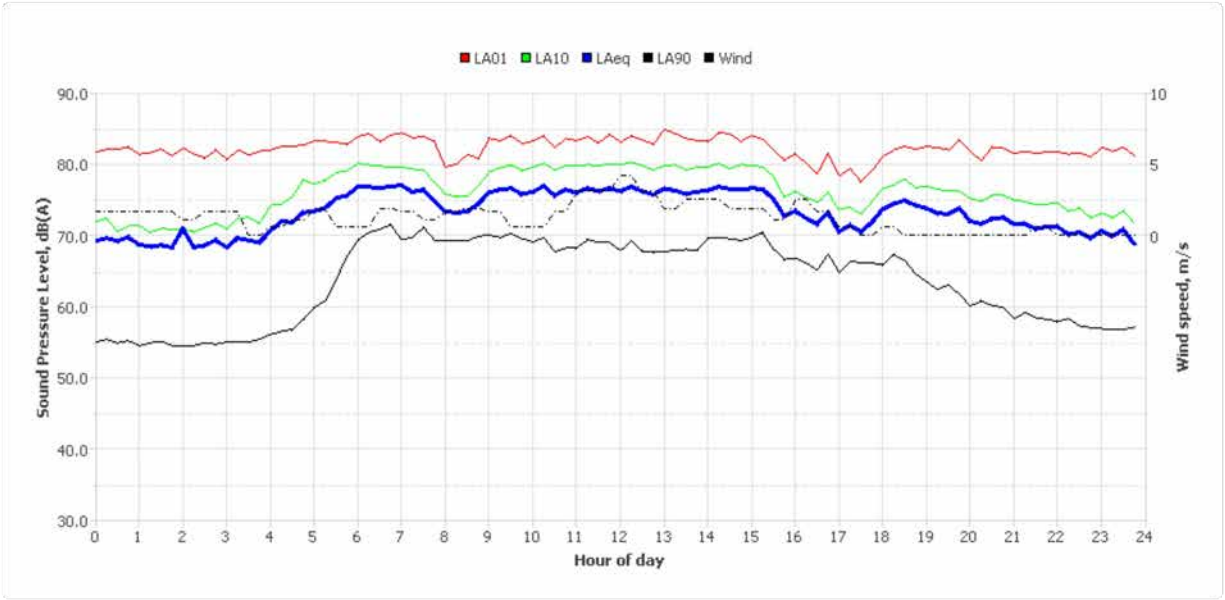
Tuesday, 02 Mar 2021



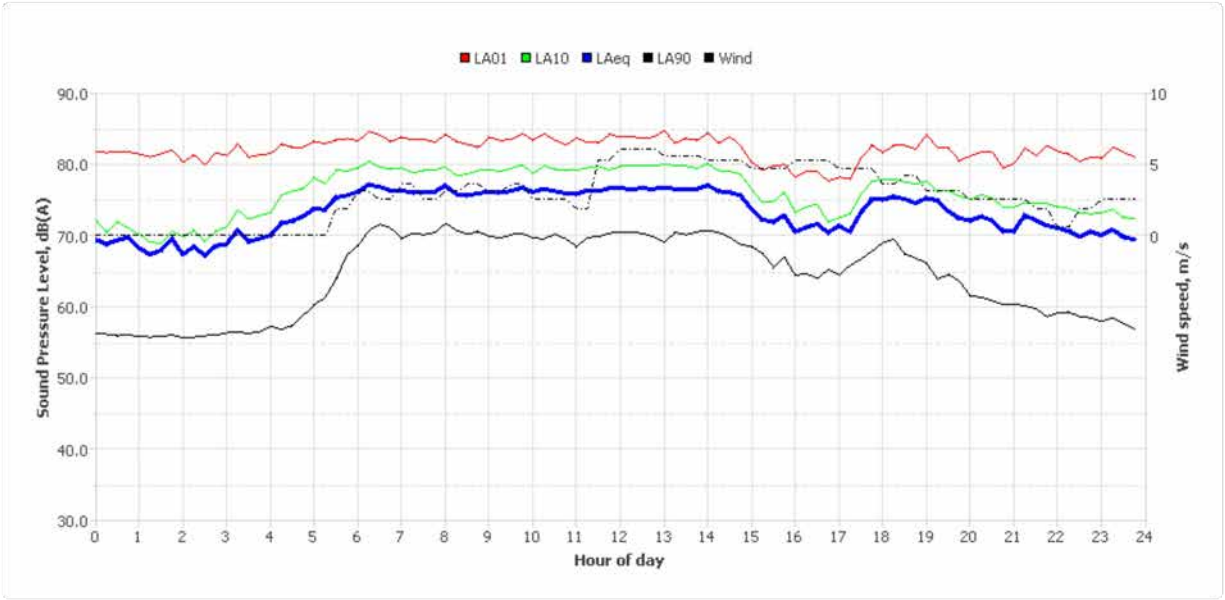
Wednesday, 03 Mar 2021



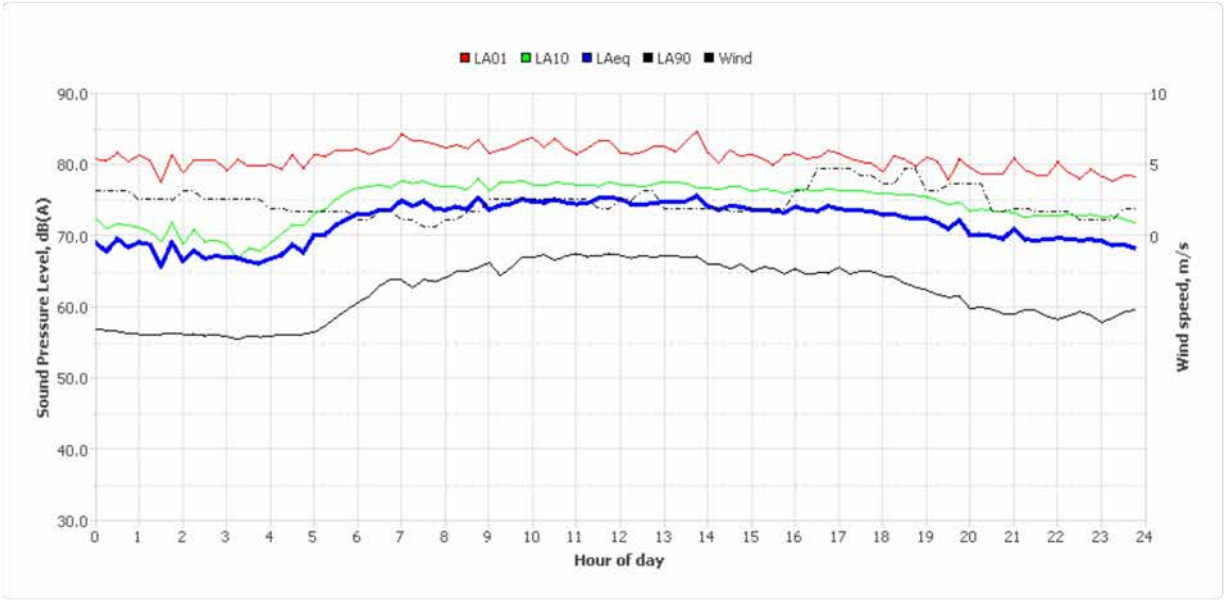
Thursday, 04 Mar 2021



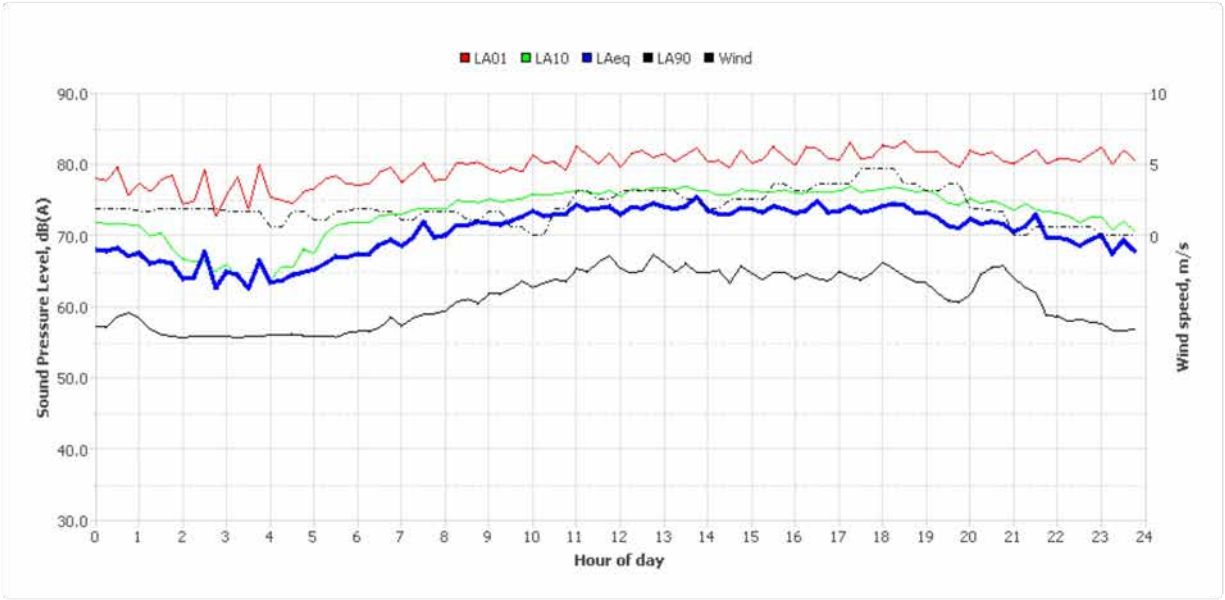
Friday, 05 Mar 2021



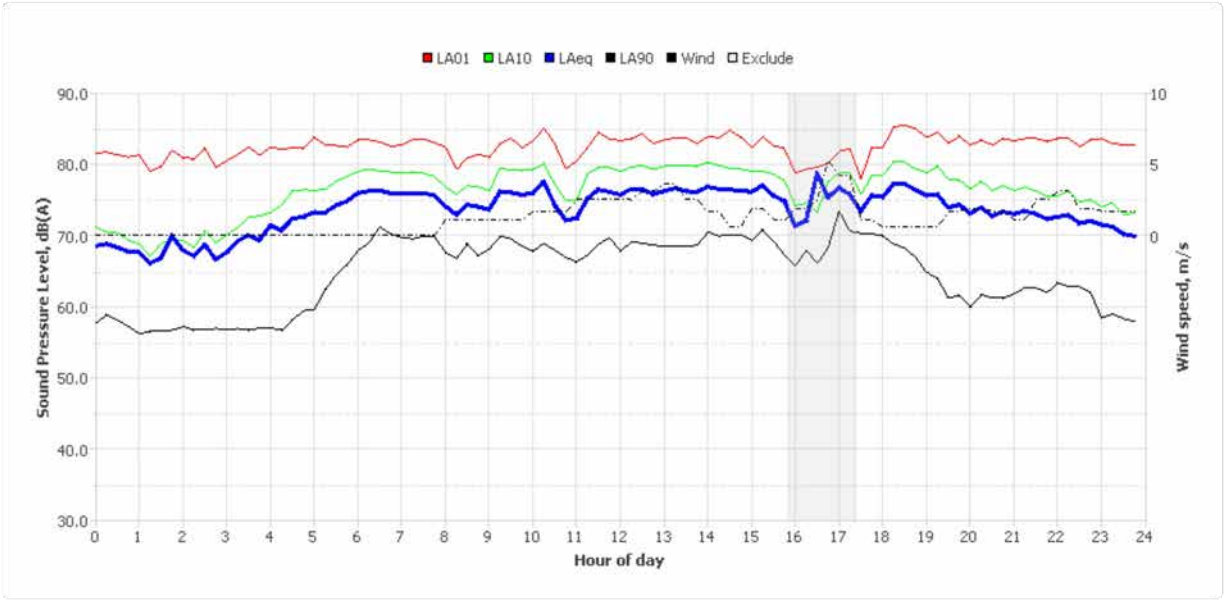
Saturday, 06 Mar 2021



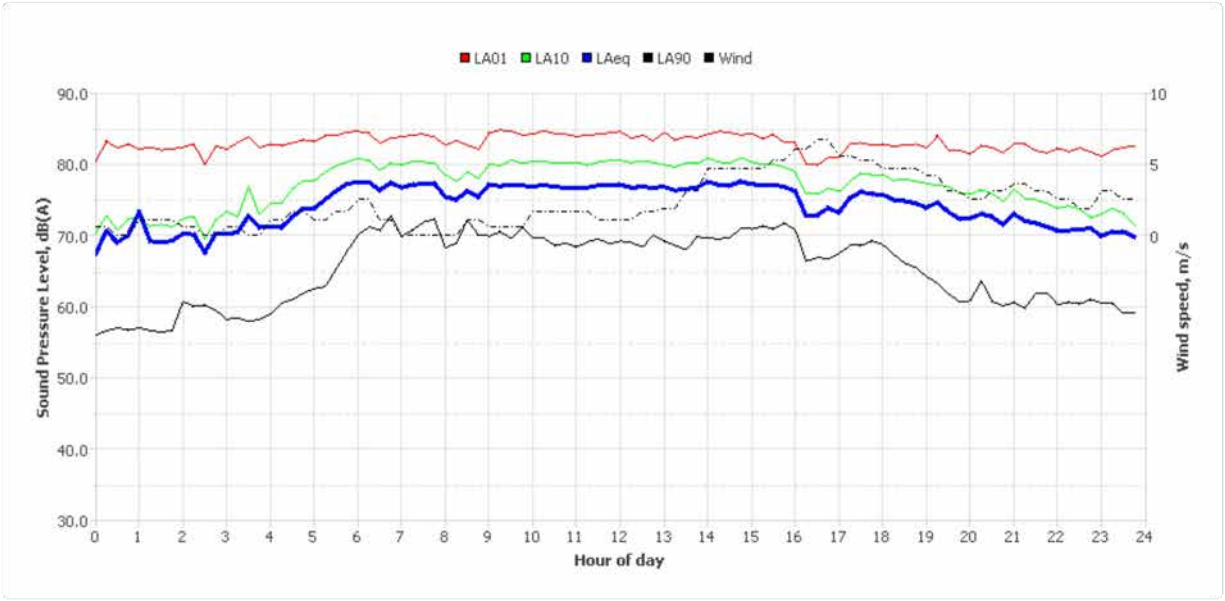
Sunday, 07 Mar 2021



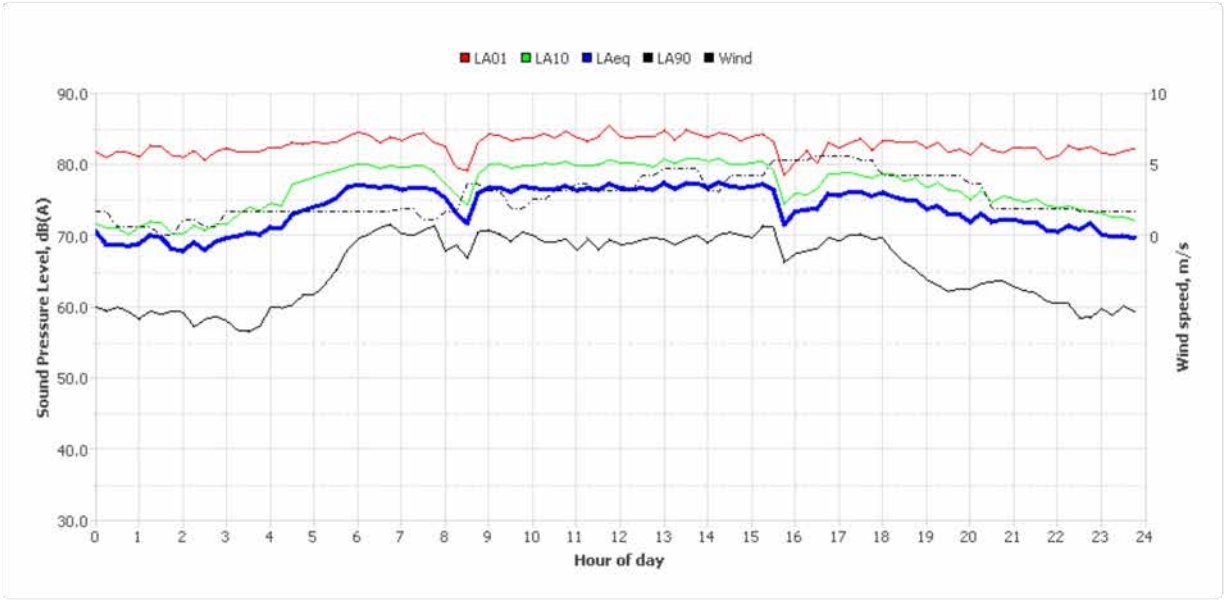
Monday, 08 Mar 2021



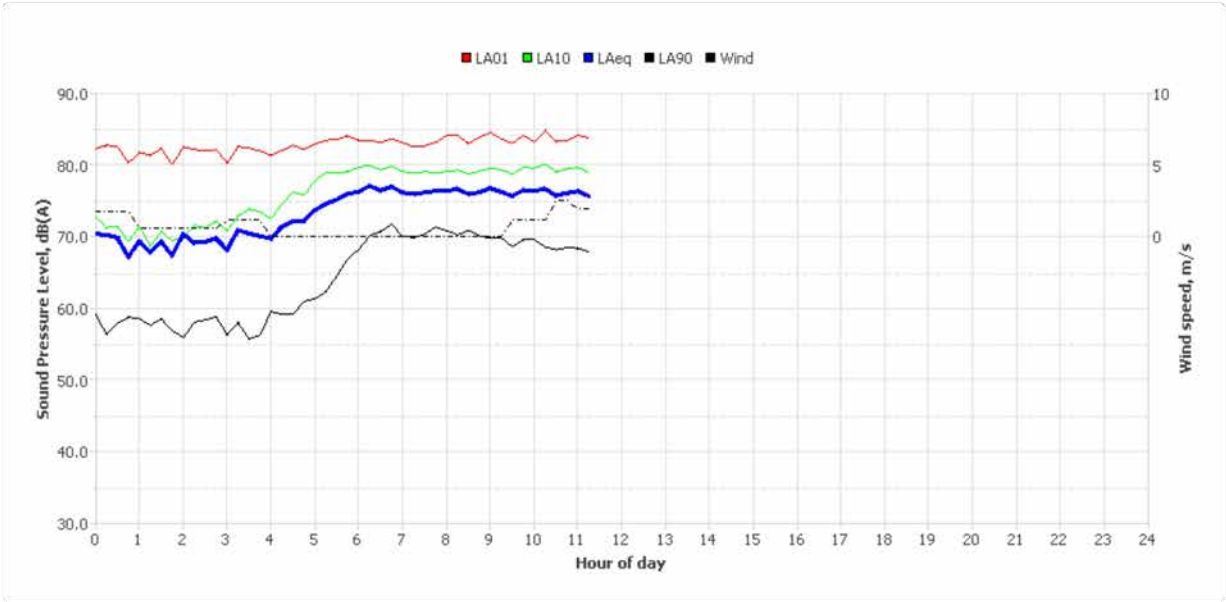
Tuesday, 09 Mar 2021



Wednesday, 10 Mar 2021



Thursday, 11 Mar 2021



Noise Logger Report

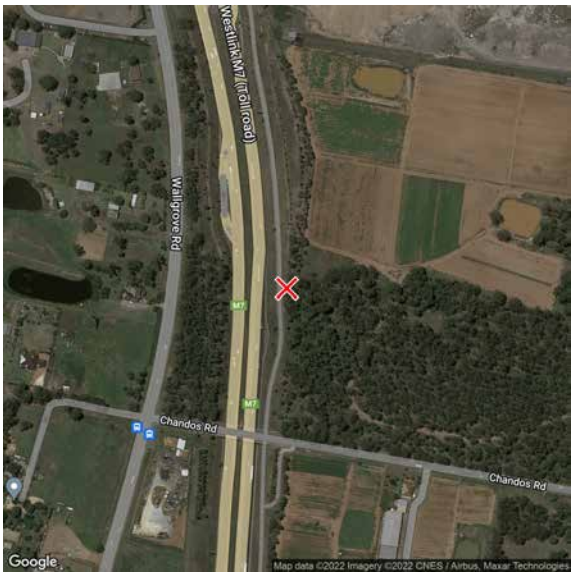
NL6 - Lot 8, DP1042004, Horsley Park

Item	Information
Logger Type	NGARA
Serial number	8780A2
Address	NL6 - Lot 8, DP1042004, Horsley Park
Location	NL6 - Lot 8, DP1042004, Horsley Park
Facade / Free Field	Free Field
Environment	Background dominated by road traffic noise on the M7

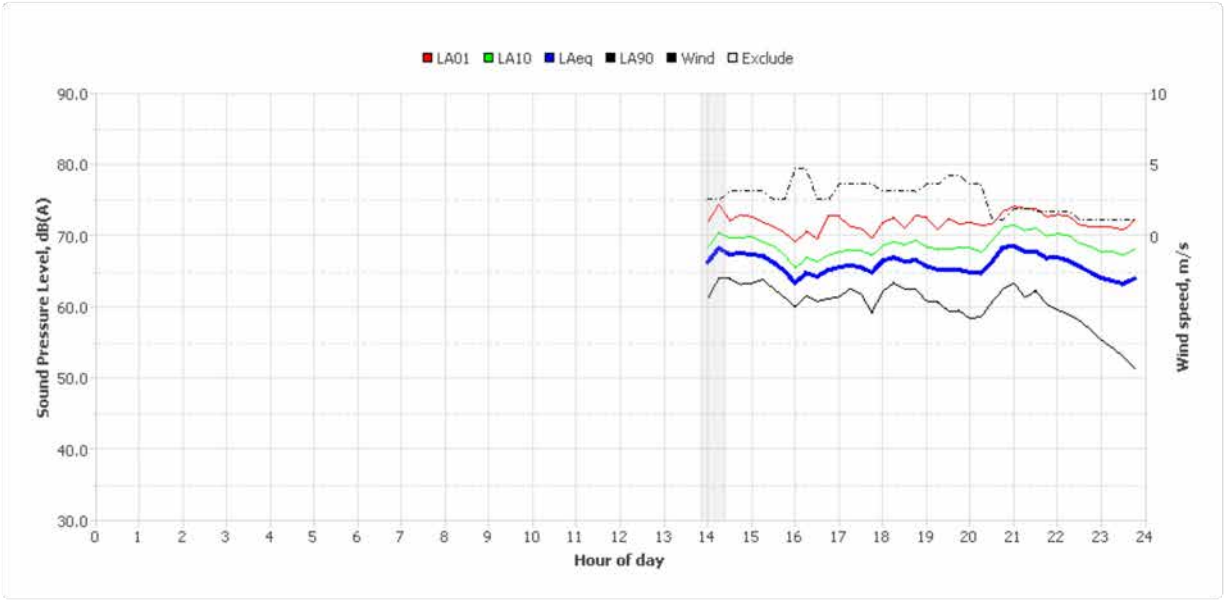
Measured noise levels

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 Feb 23 2021	66	67	65	-	59	-	66	65
Wed Feb 24 2021	67	64	64	61	56	49	67	64
Thu Feb 25 2021	67	65	64	63	58	47	67	64
Fri Feb 26 2021	68	64	64	-	56	51	67	64
Sat Feb 27 2021	65	62	61	60	56	45	65	61
Sun Feb 28 2021	64	63	59	56	55	44	64	59
Mon Mar 1 2021	67	64	63	60	56	47	66	63
Tue Mar 2 2021	67	64	64	-	56	48	66	64
Wed Mar 3 2021	67	64	64	61	57	47	67	64
Thu Mar 4 2021	67	65	64	60	57	48	66	64
Fri Mar 5 2021	67	64	64	-	56	50	66	64
Sat Mar 6 2021	-	-	61	-	-	-	-	61
Summary	**67**	**64**	**63**	**60**	**56**	**47**	**66**	**63**

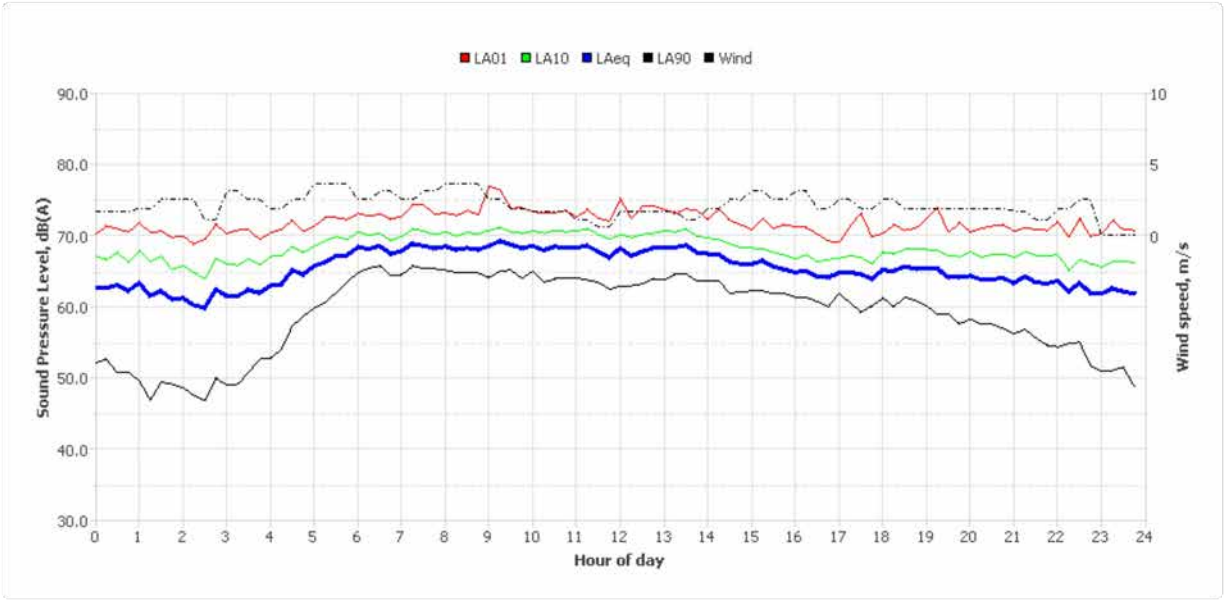
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location	Logger Deployment Photo
	

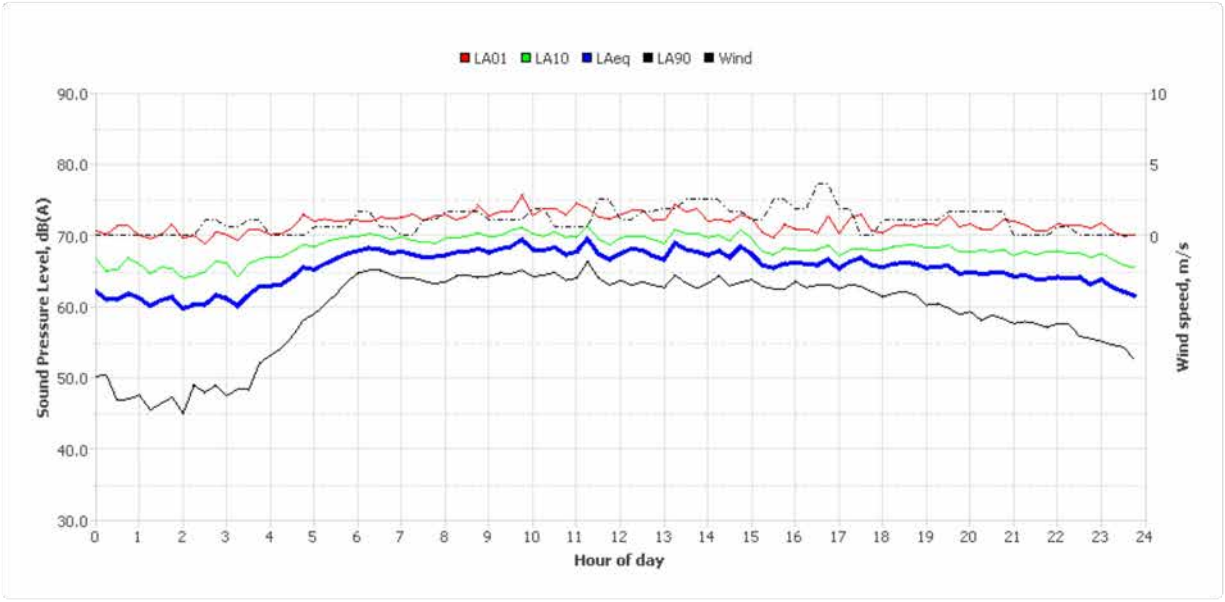
Tuesday, 23 Feb 2021



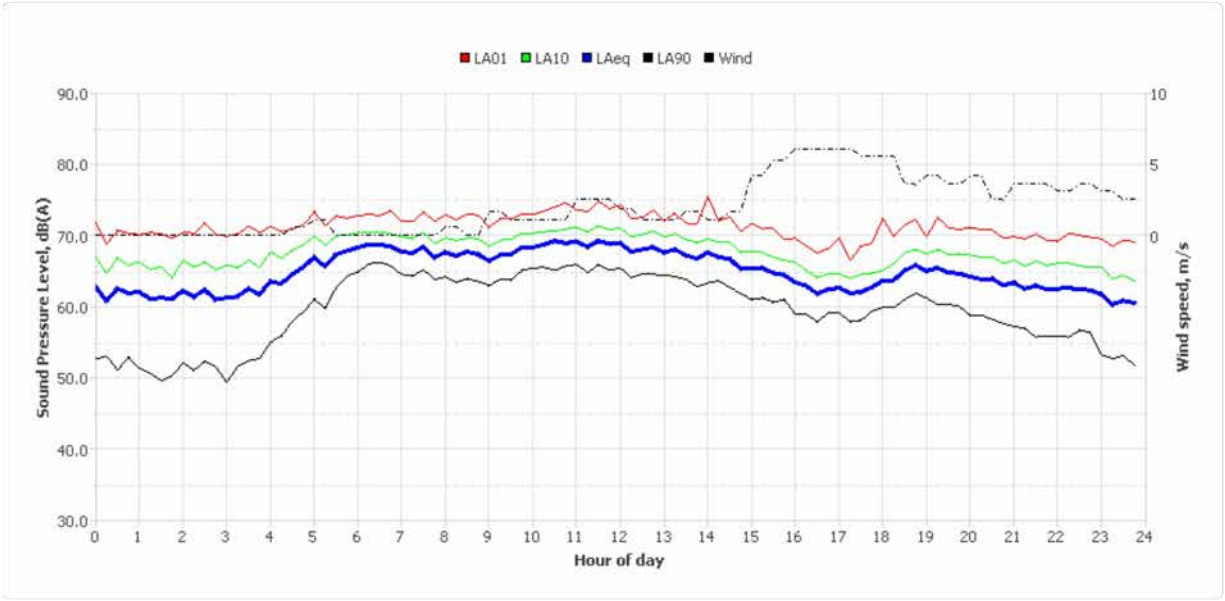
Wednesday, 24 Feb 2021



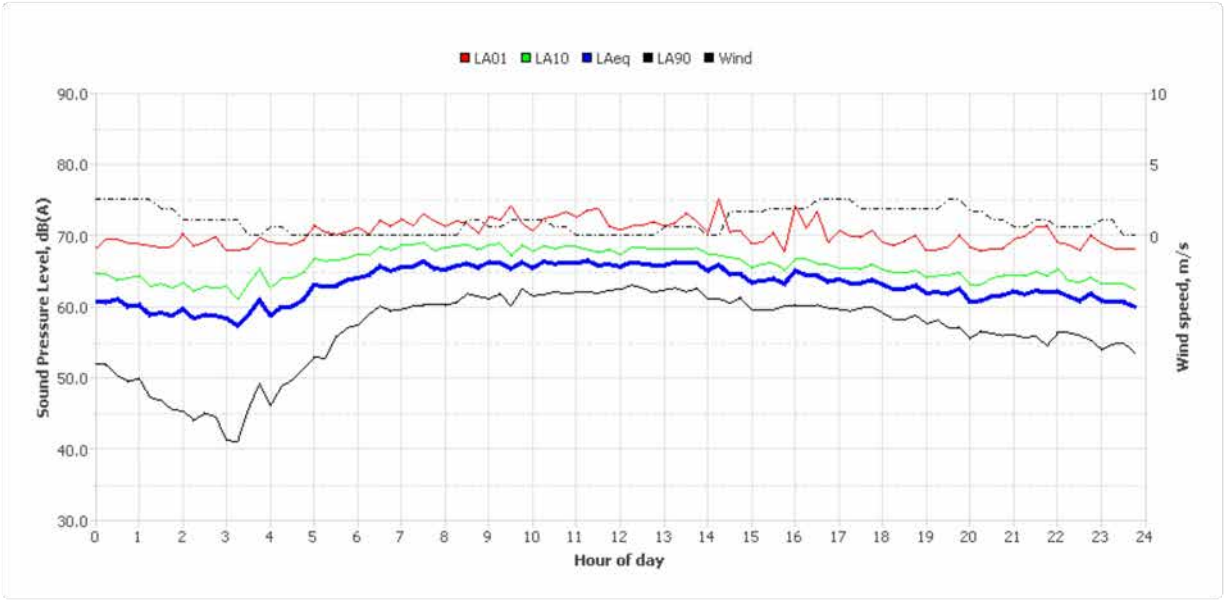
Thursday, 25 Feb 2021



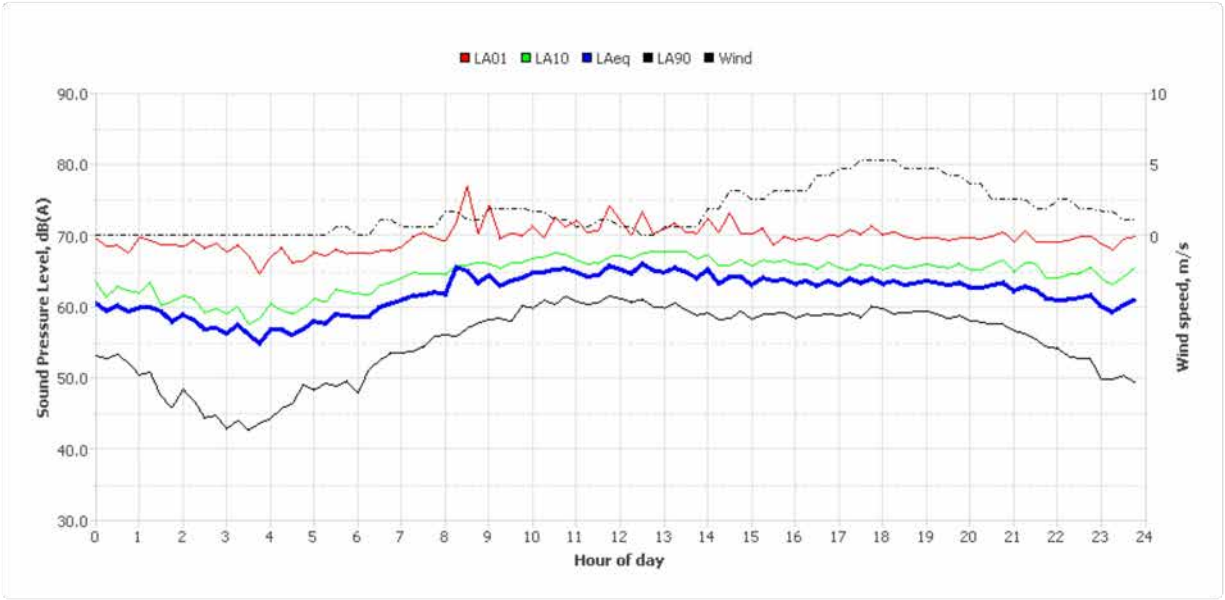
Friday, 26 Feb 2021



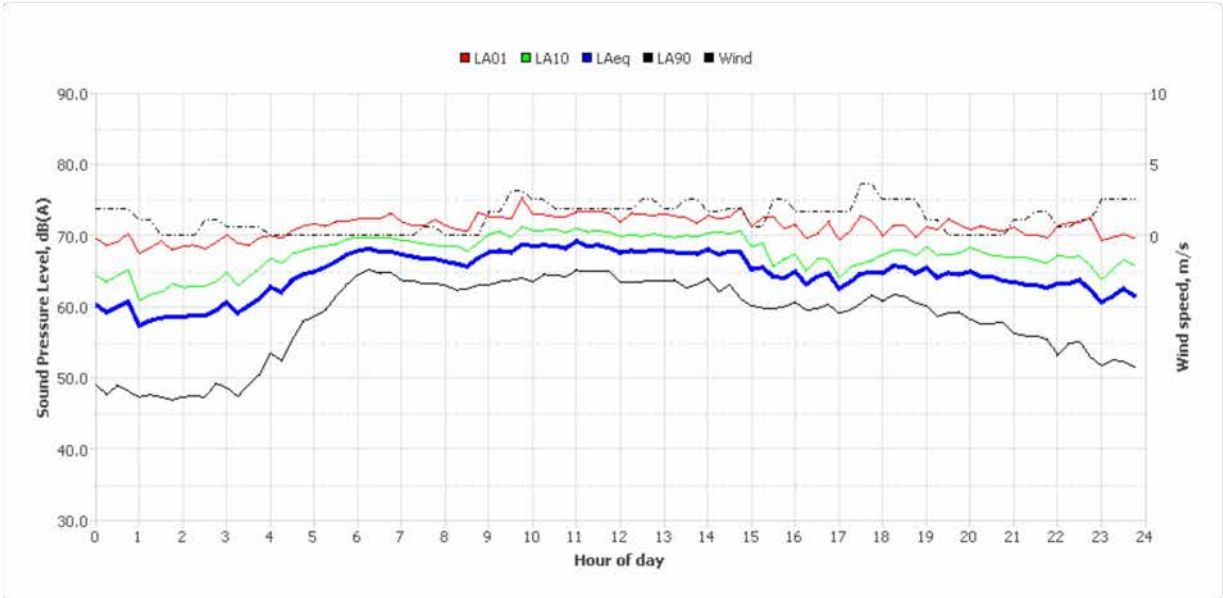
Saturday, 27 Feb 2021



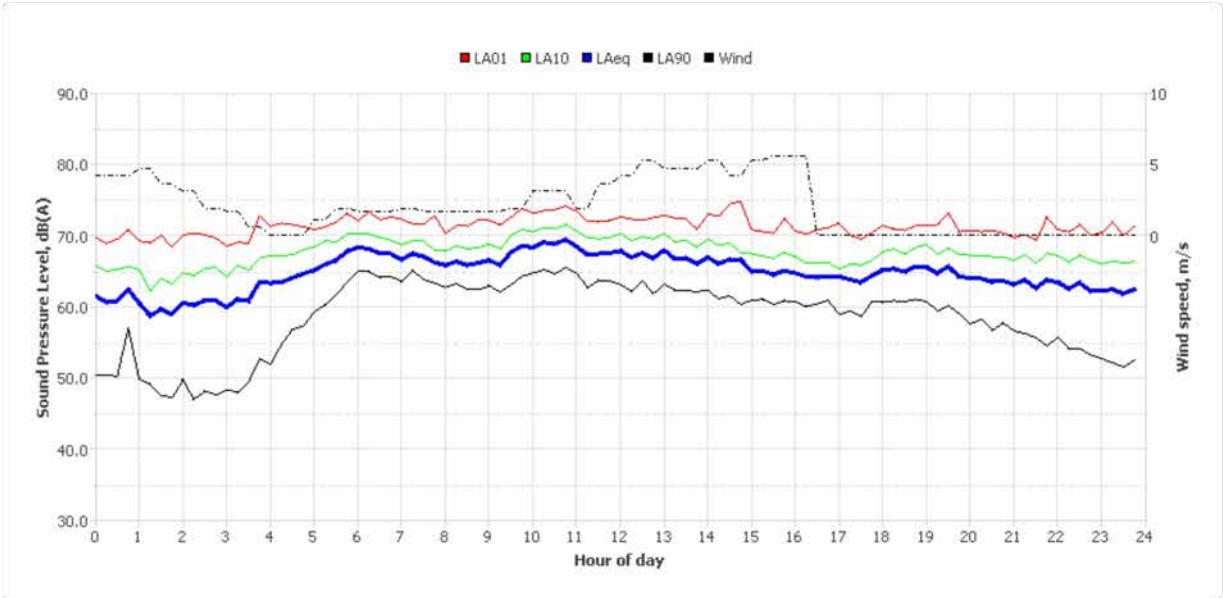
Sunday, 28 Feb 2021



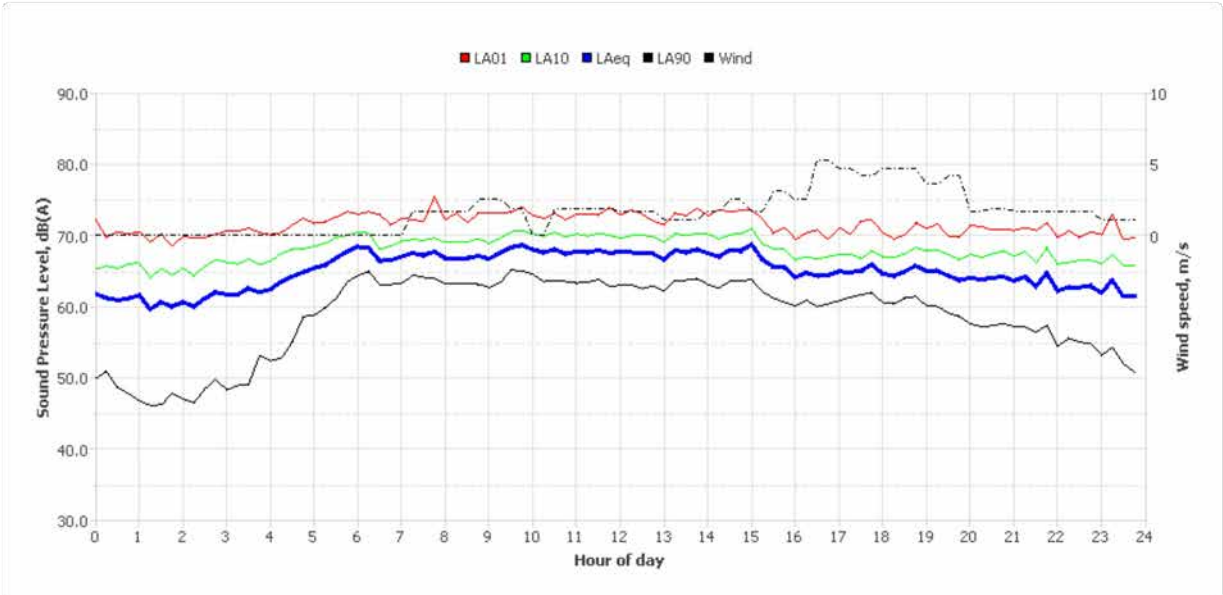
Monday, 01 Mar 2021



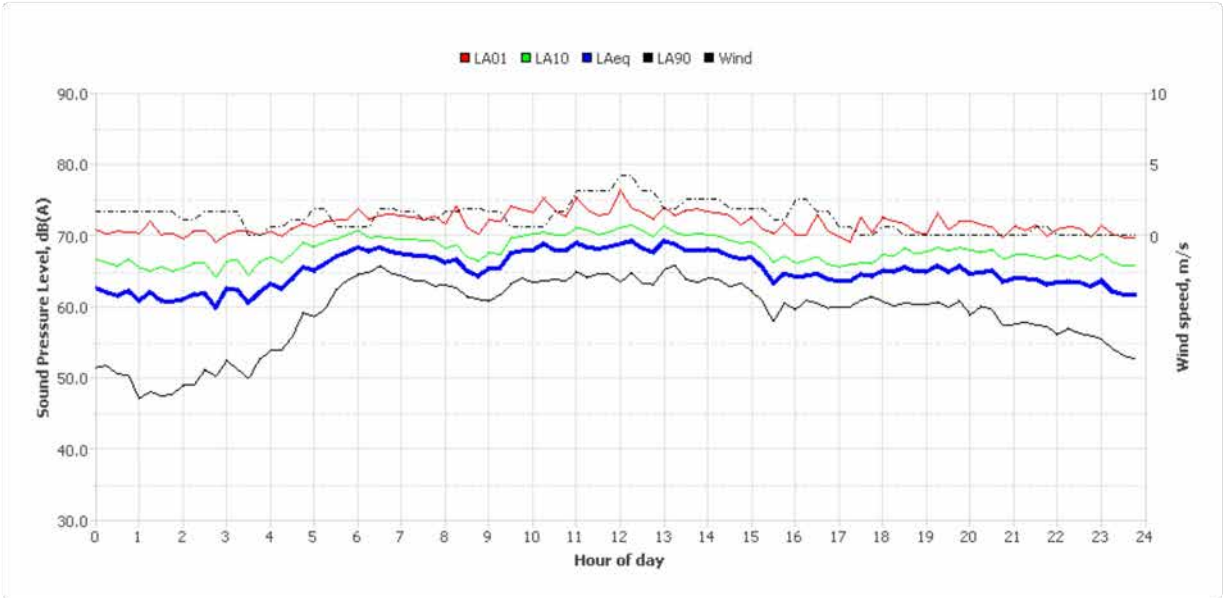
Tuesday, 02 Mar 2021



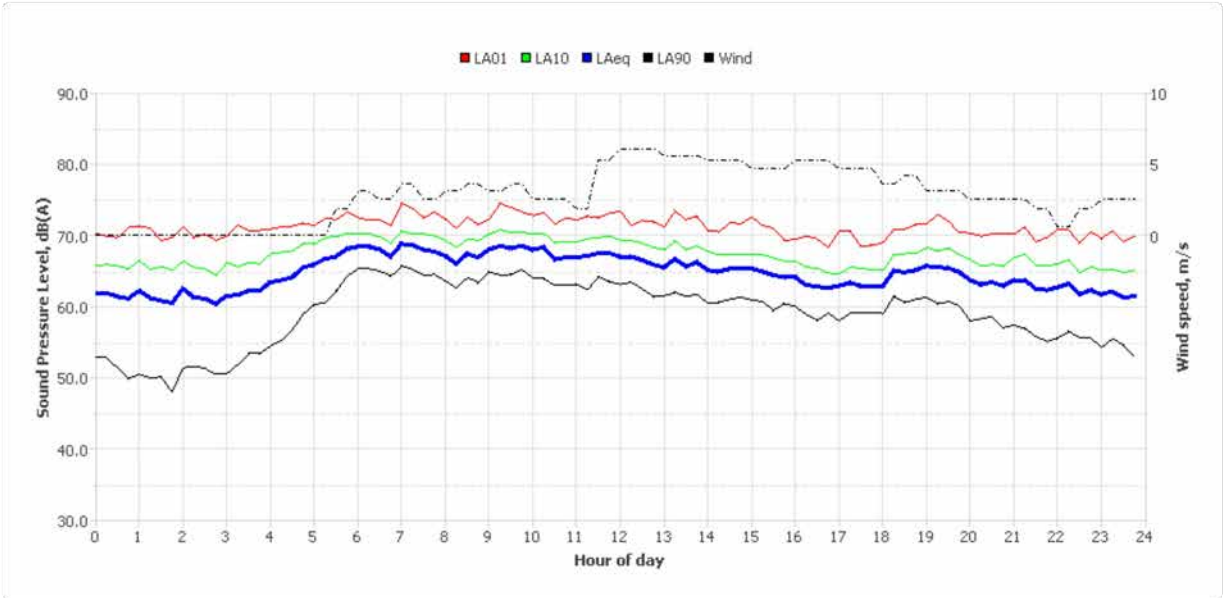
Wednesday, 03 Mar 2021



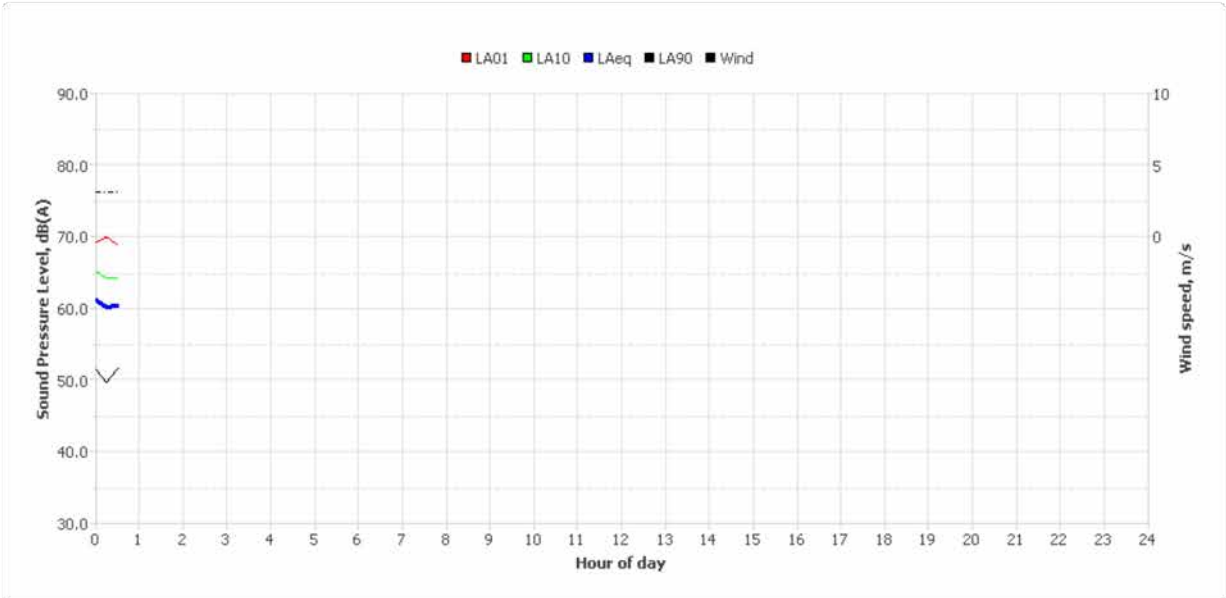
Thursday, 04 Mar 2021



Friday, 05 Mar 2021



Saturday, 06 Mar 2021



Noise Logger Report

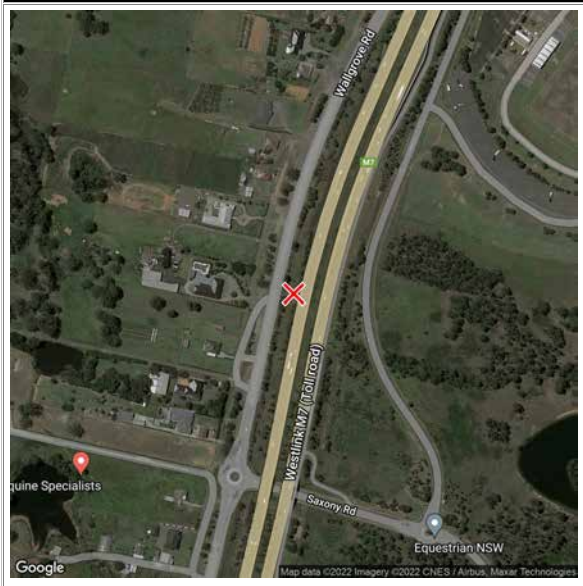
NL8 - Lot30, DP1022008, Horsley Park

Item	Information
Logger Type	NGARA
Serial number	878012
Address	NL8 - Lot30, DP1022008, Horsley Park
Location	NL8 - Lot30, DP1022008, Horsley Park
Facade / Free Field	Free field
Environment	Background dominated by road traffic noise on the M7

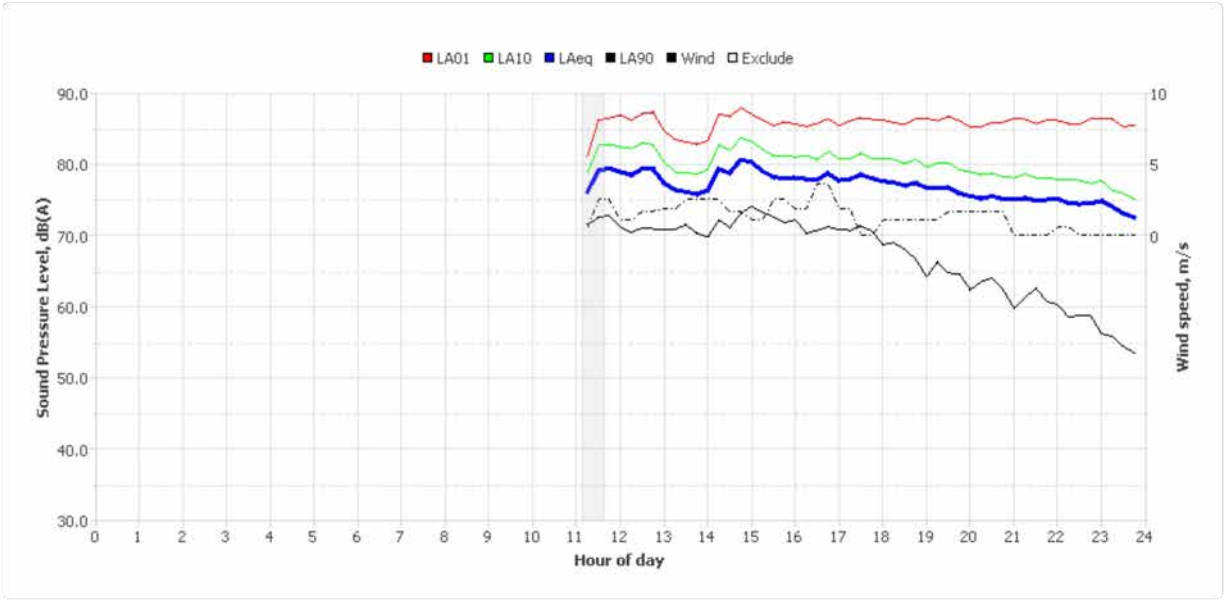
Measured noise levels

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 Feb 25 2021	78	76	74	-	61	-	78	74
Fri Feb 26 2021	79	76	75	-	60	49	78	75
Sat Feb 27 2021	77	74	73	66	-	43	76	73
Sun Feb 28 2021	76	75	70	59	60	42	75	70
Mon Mar 1 2021	78	74	74	67	57	43	77	74
Tue Mar 2 2021	78	76	75	-	58	48	77	75
Wed Mar 3 2021	79	76	74	70	61	-	78	74
Thu Mar 4 2021	78	76	75	69	61	48	77	75
Fri Mar 5 2021	78	76	75	-	61	49	77	75
Sat Mar 6 2021	76	74	72	65	59	45	76	72
Sun Mar 7 2021	75	74	70	59	59	41	75	70
Mon Mar 8 2021	78	76	74	69	60	45	78	74
Summary	**78**	**75**	**74**	**67**	**60**	**45**	**77**	**74**

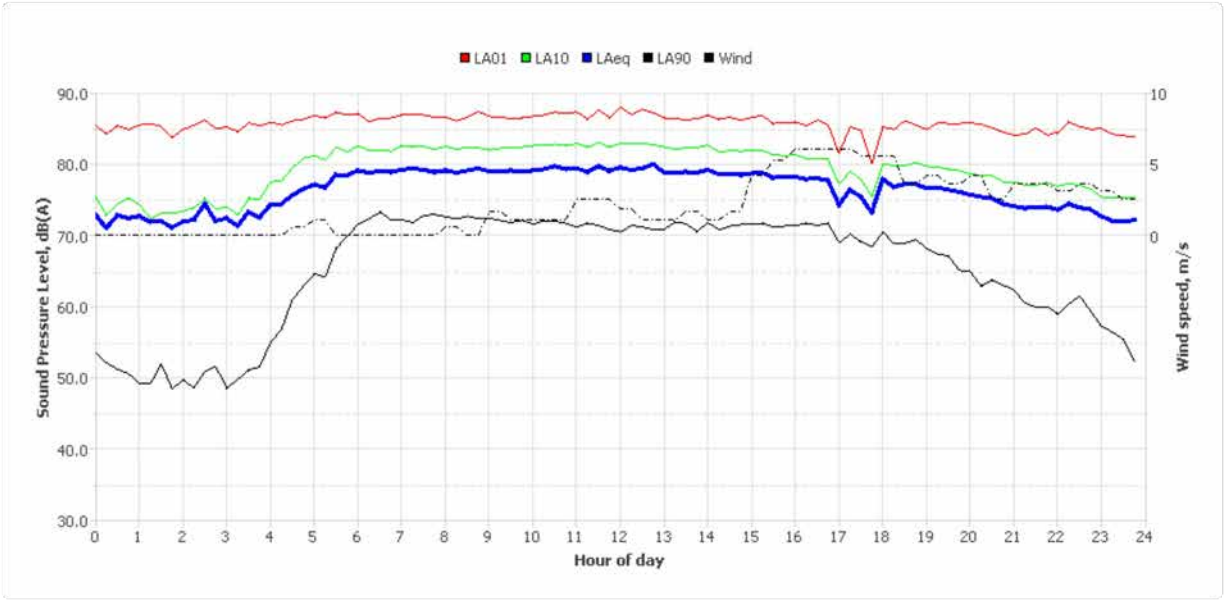
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location	Logger Deployment Photo
	

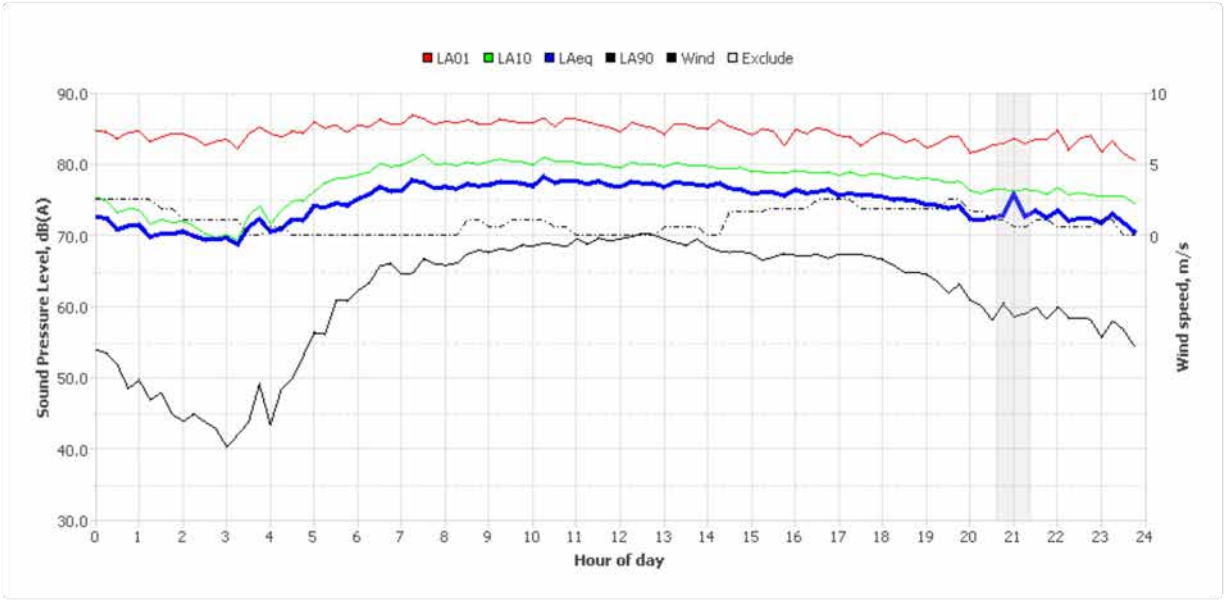
Thursday, 25 Feb 2021



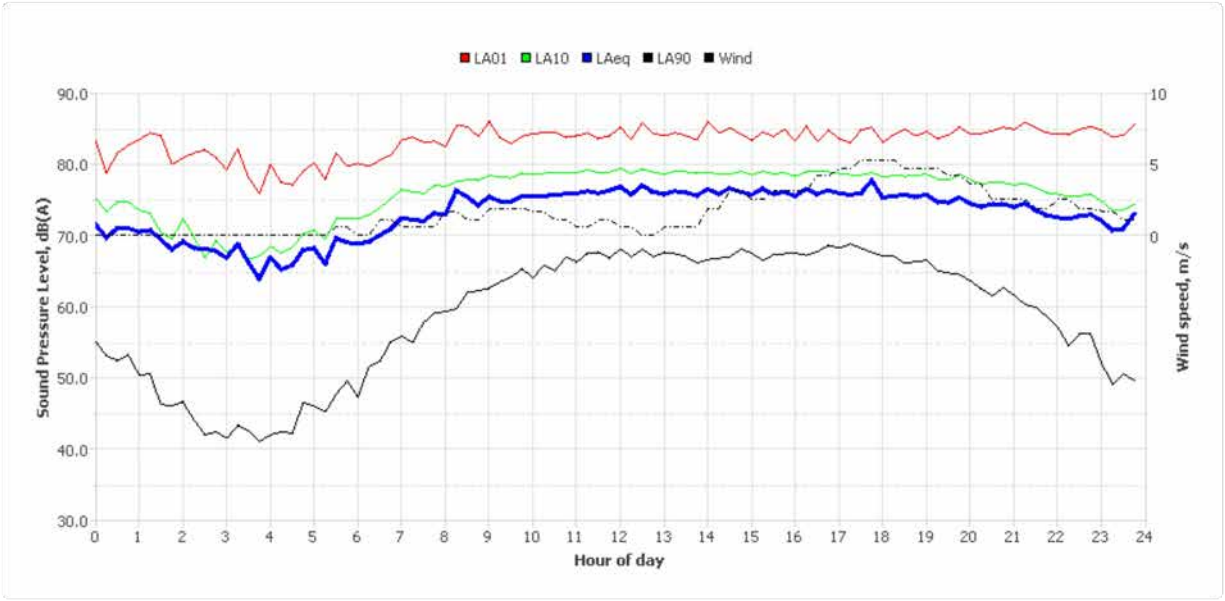
Friday, 26 Feb 2021



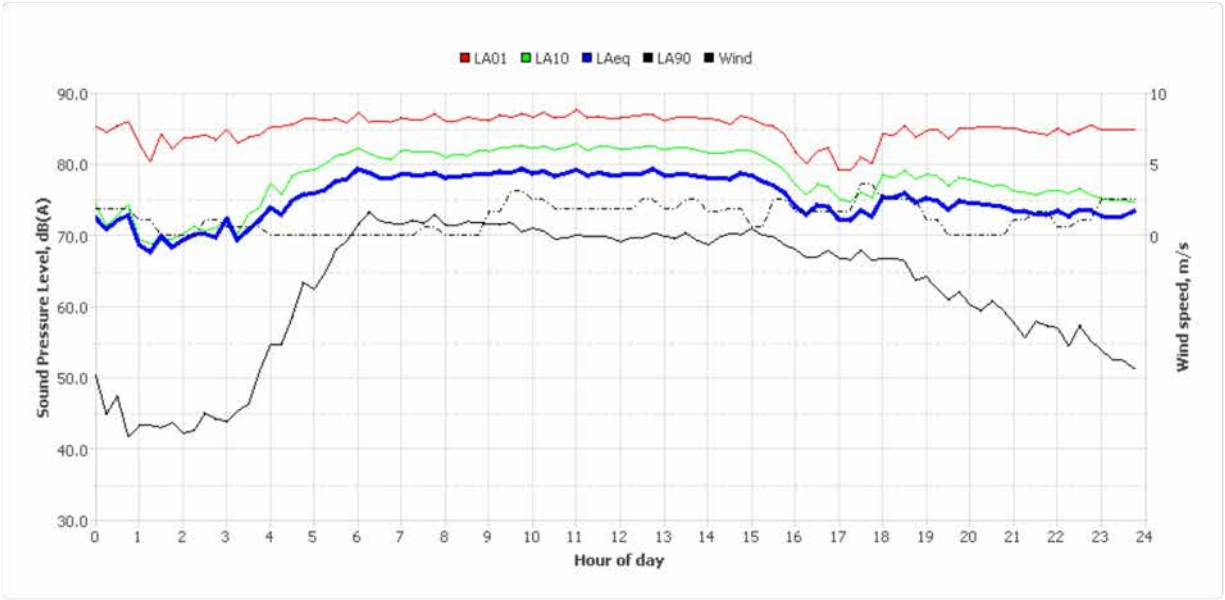
Saturday, 27 Feb 2021



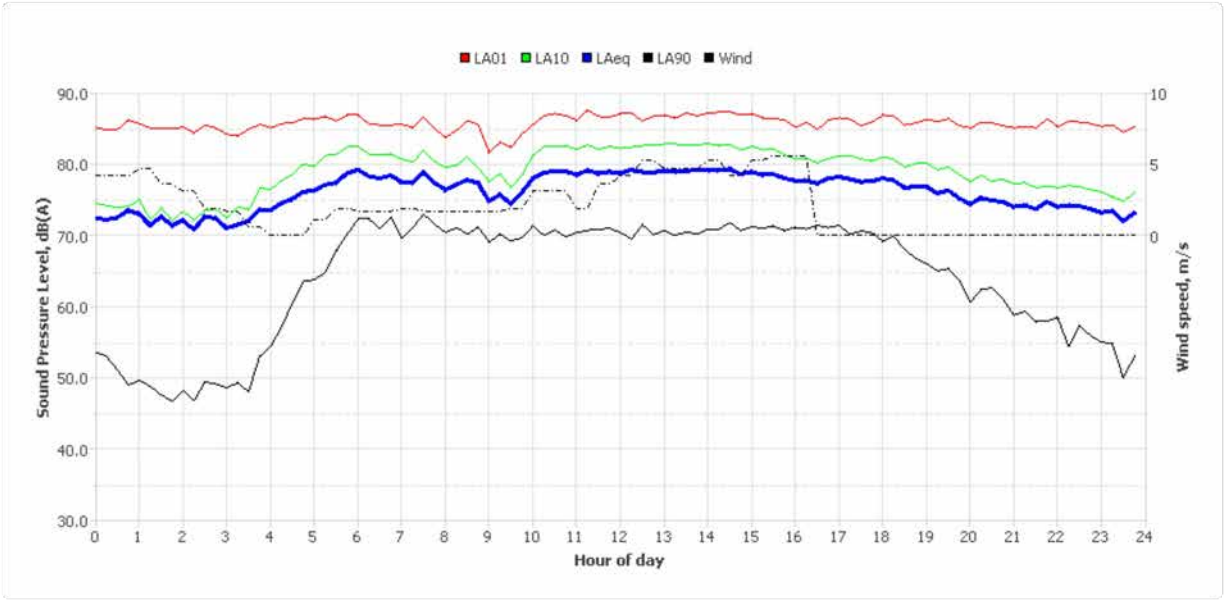
Sunday, 28 Feb 2021



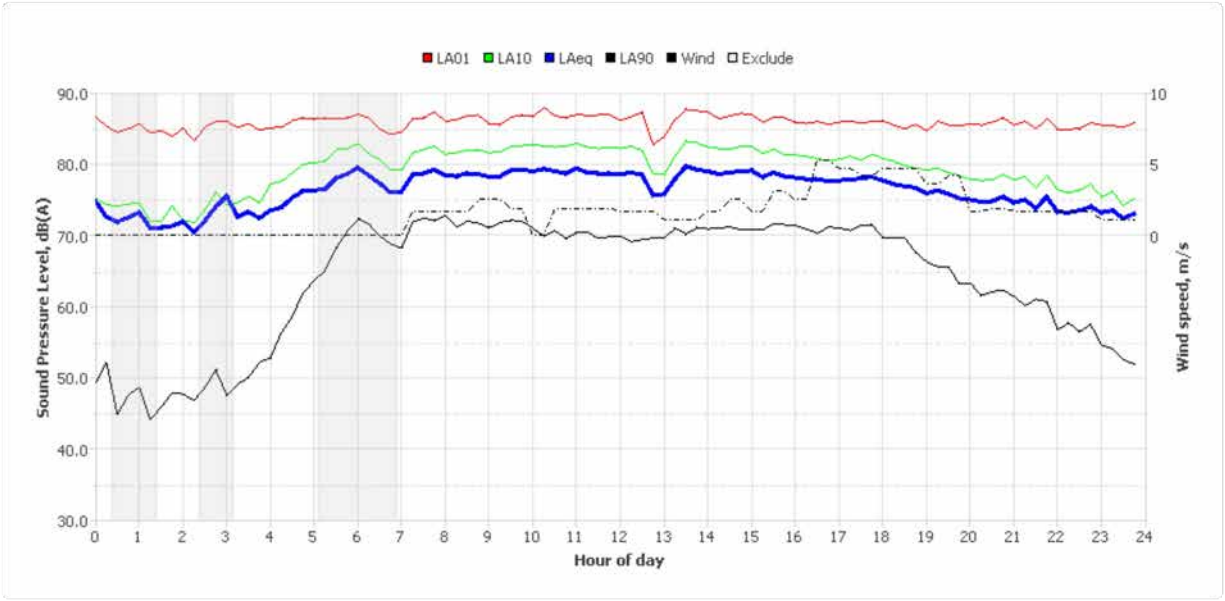
Monday, 01 Mar 2021



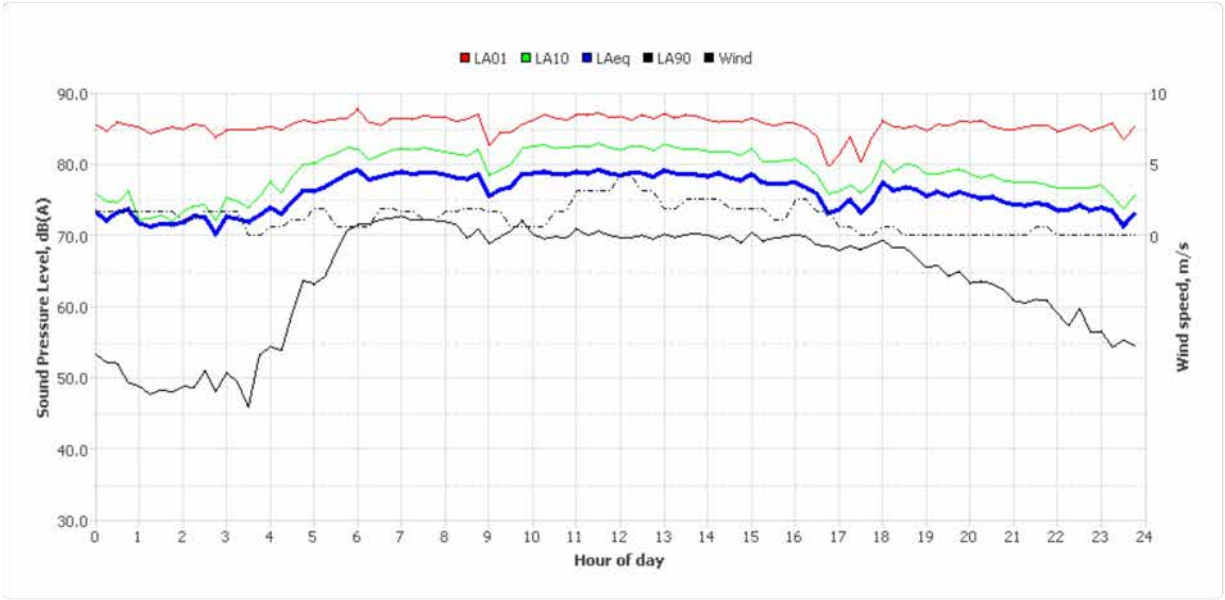
Tuesday, 02 Mar 2021



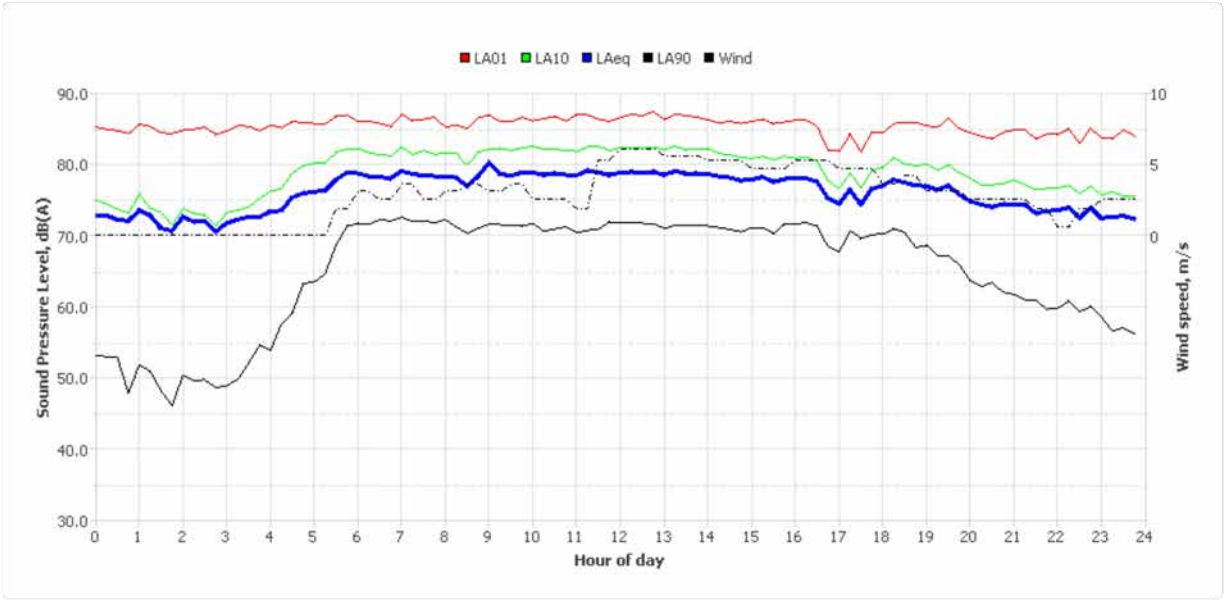
Wednesday, 03 Mar 2021



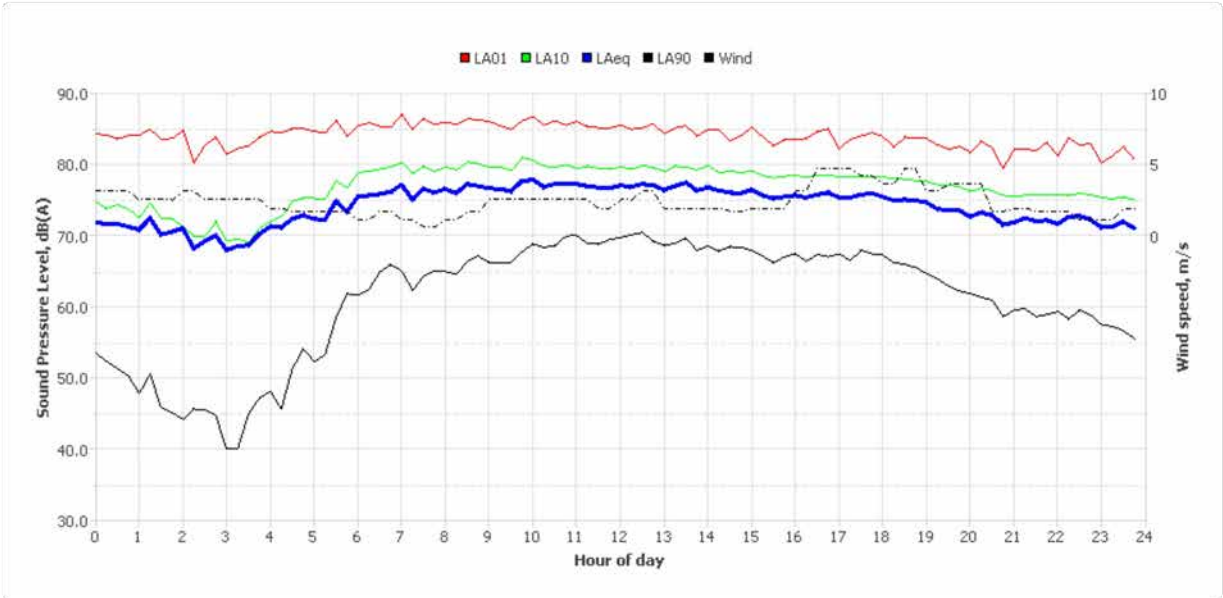
Thursday, 04 Mar 2021



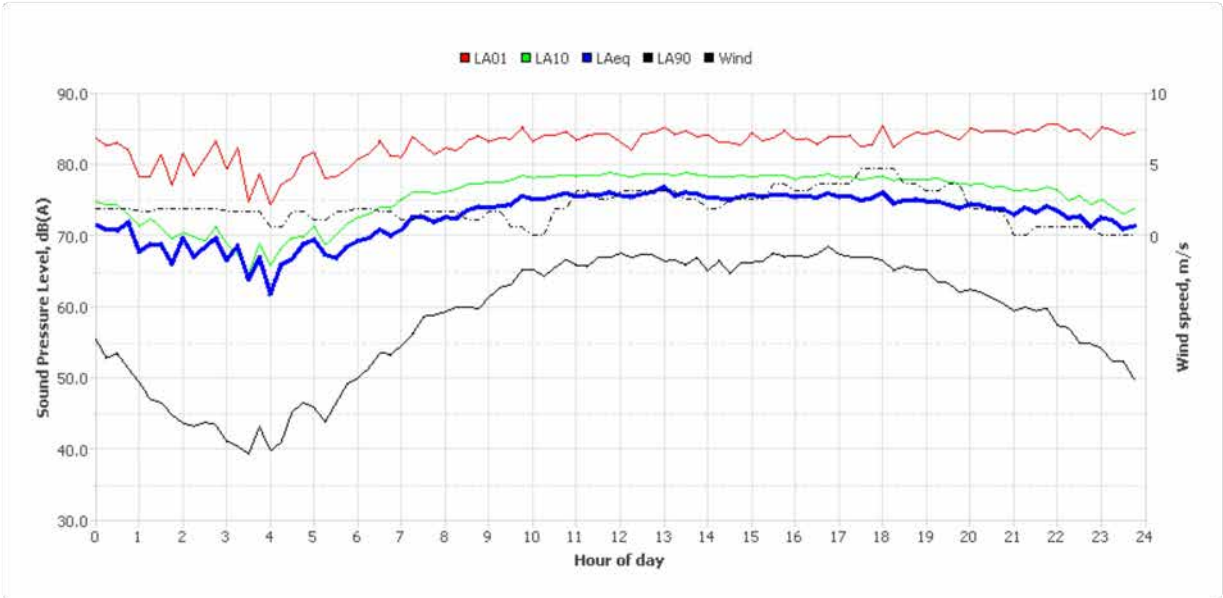
Friday, 05 Mar 2021



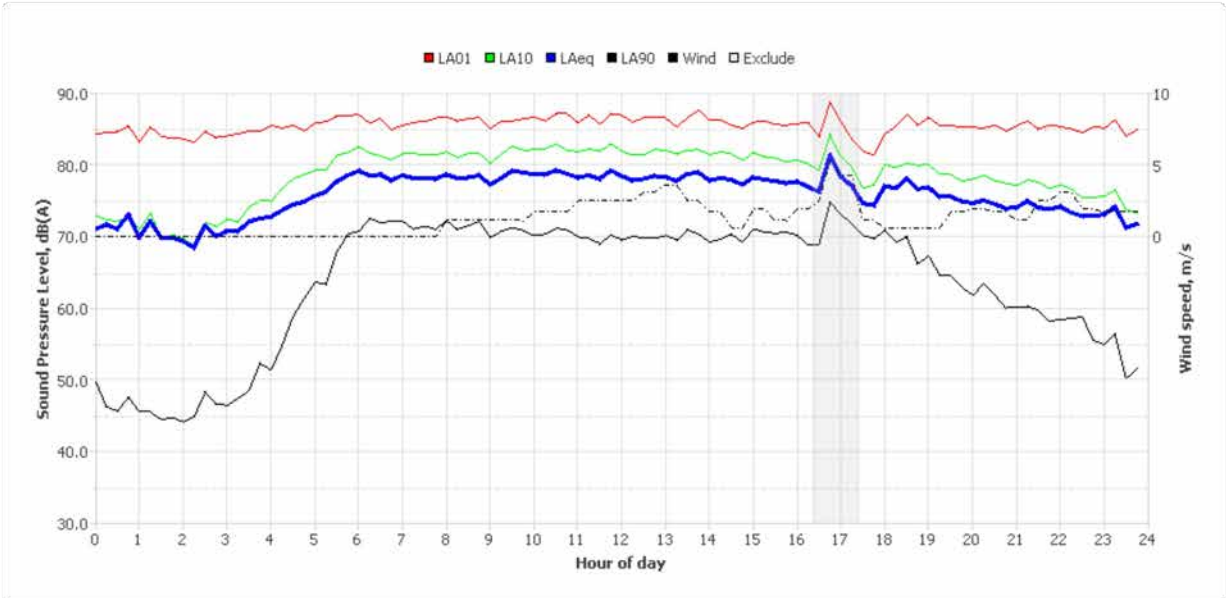
Saturday, 06 Mar 2021



Sunday, 07 Mar 2021



Monday, 08 Mar 2021



Noise Logger Report

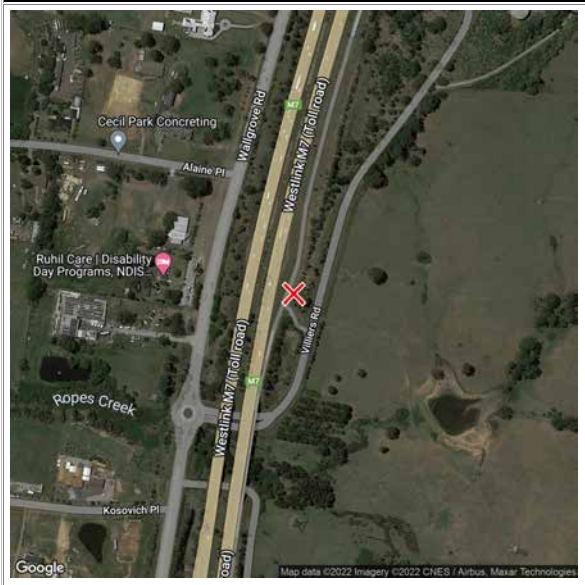
NL9 - Lot 35, DP1021940, Cecil Park

Item	Information
Logger Type	NGARA
Serial number	8780EA
Address	NL9 - Lot 35, DP1021940, Cecil Park
Location	NL9 - Lot 35, DP1021940, Cecil Park
Facade / Free Field	Free Field
Environment	Background dominated by road traffic noise on the M7

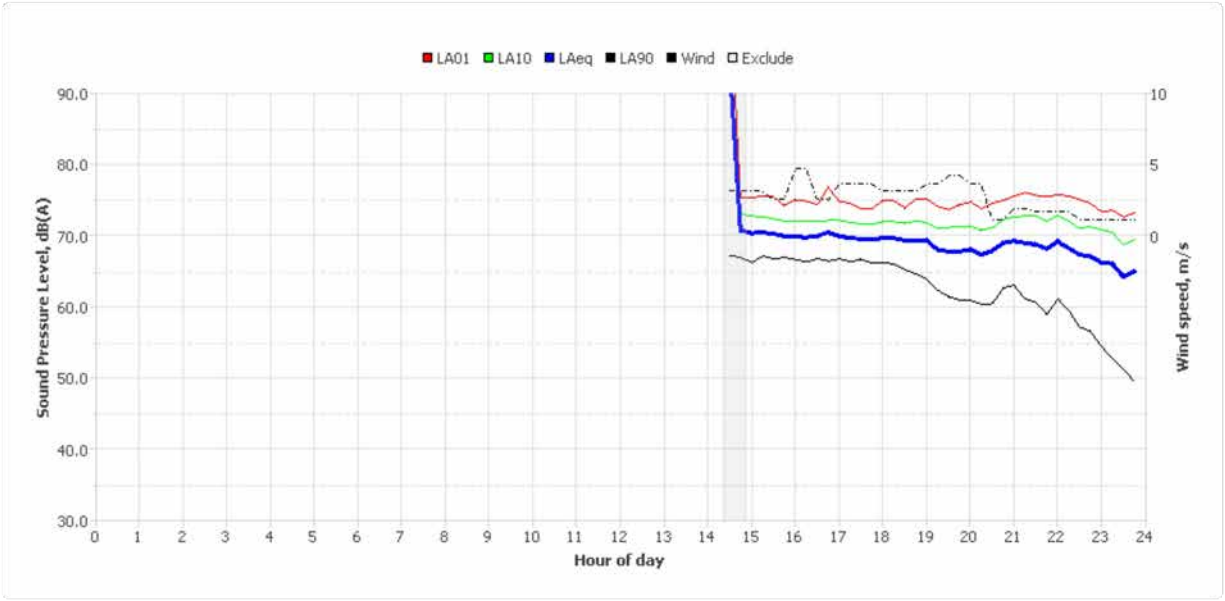
Measured noise levels

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 Feb 23 2021	70	69	67	-	60	-	69	67
Wed Feb 24 2021	71	68	67	66	57	47	70	67
Thu Feb 25 2021	70	68	67	65	58	45	70	67
Fri Feb 26 2021	71	67	67	-	58	47	70	67
Sat Feb 27 2021	68	65	64	63	56	43	68	64
Sun Feb 28 2021	67	66	62	57	57	40	67	62
Mon Mar 1 2021	70	68	66	65	57	42	70	66
Tue Mar 2 2021	70	68	66	-	56	47	69	66
Wed Mar 3 2021	-	-	67	-	-	-	-	67
Summary	**70**	**67**	**66**	**65**	**57**	**45**	**69**	**66**

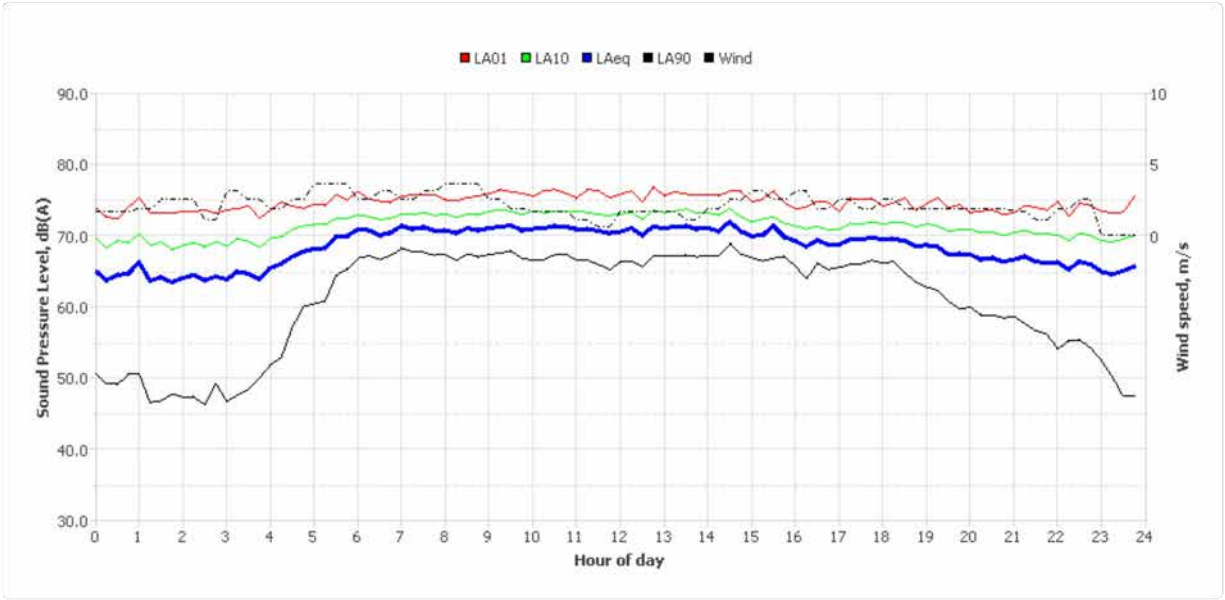
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location	Logger Deployment Photo
	

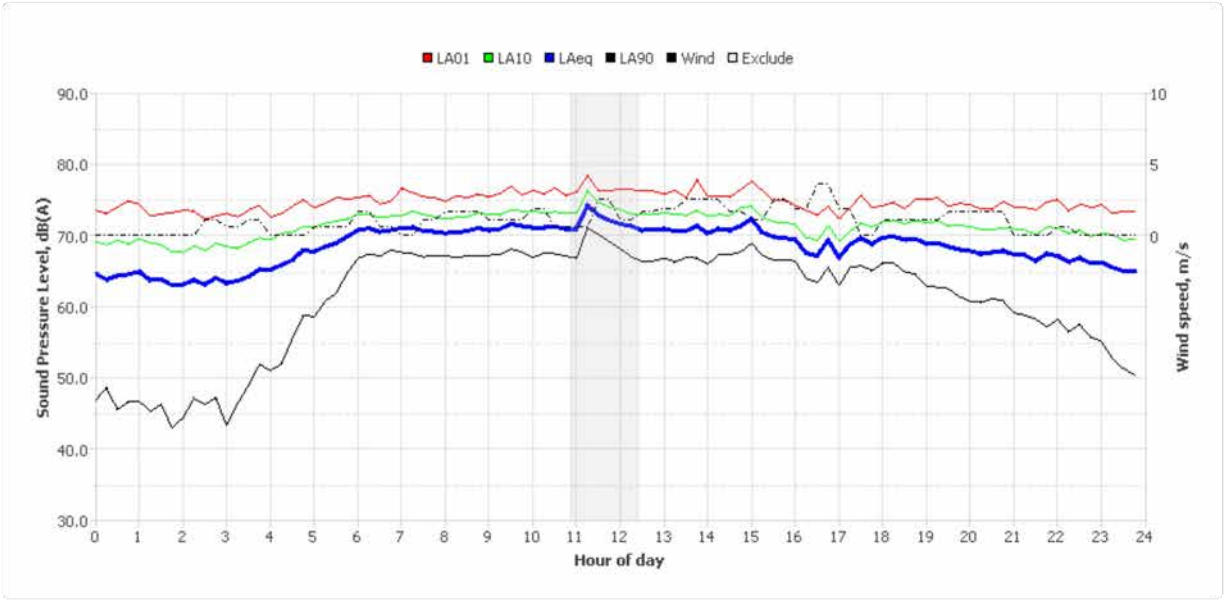
Tuesday, 23 Feb 2021



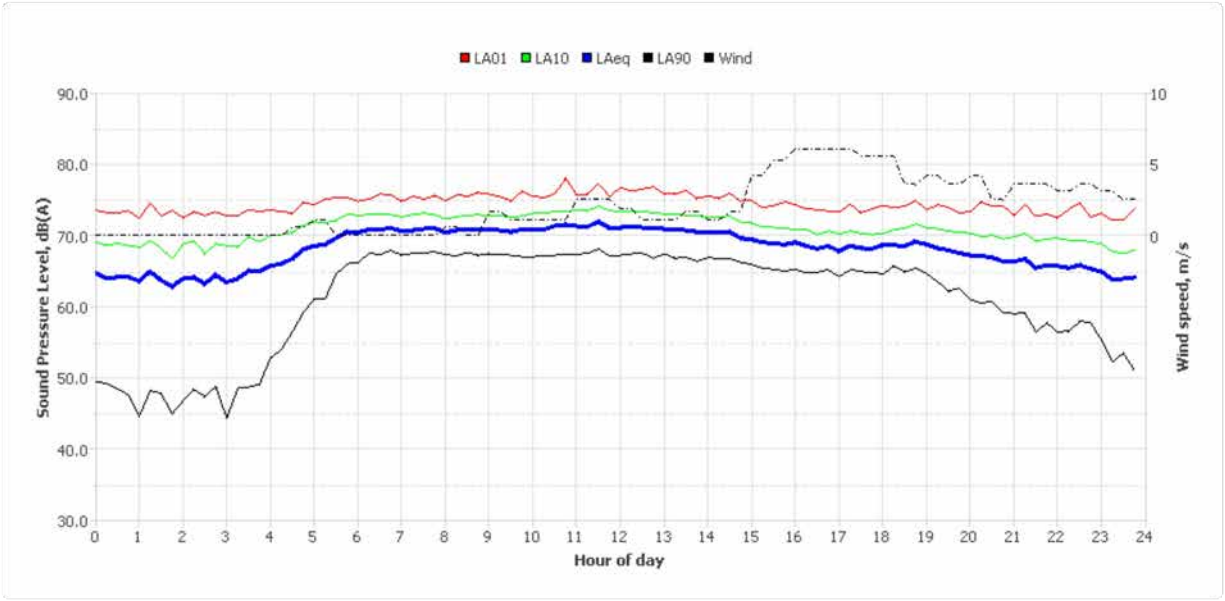
Wednesday, 24 Feb 2021



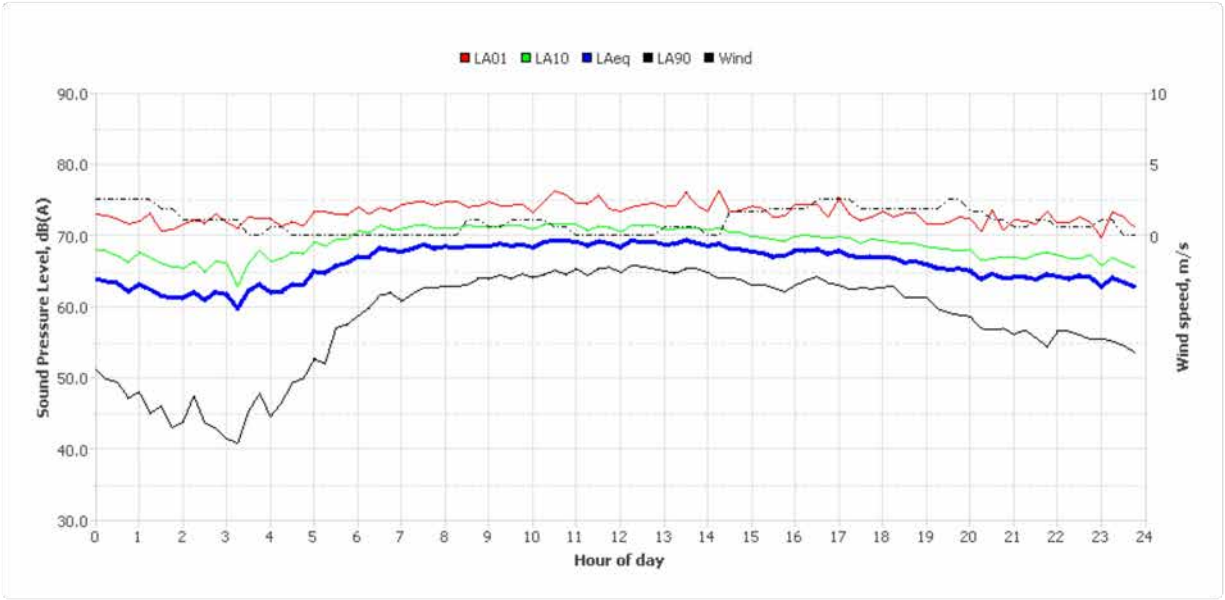
Thursday, 25 Feb 2021



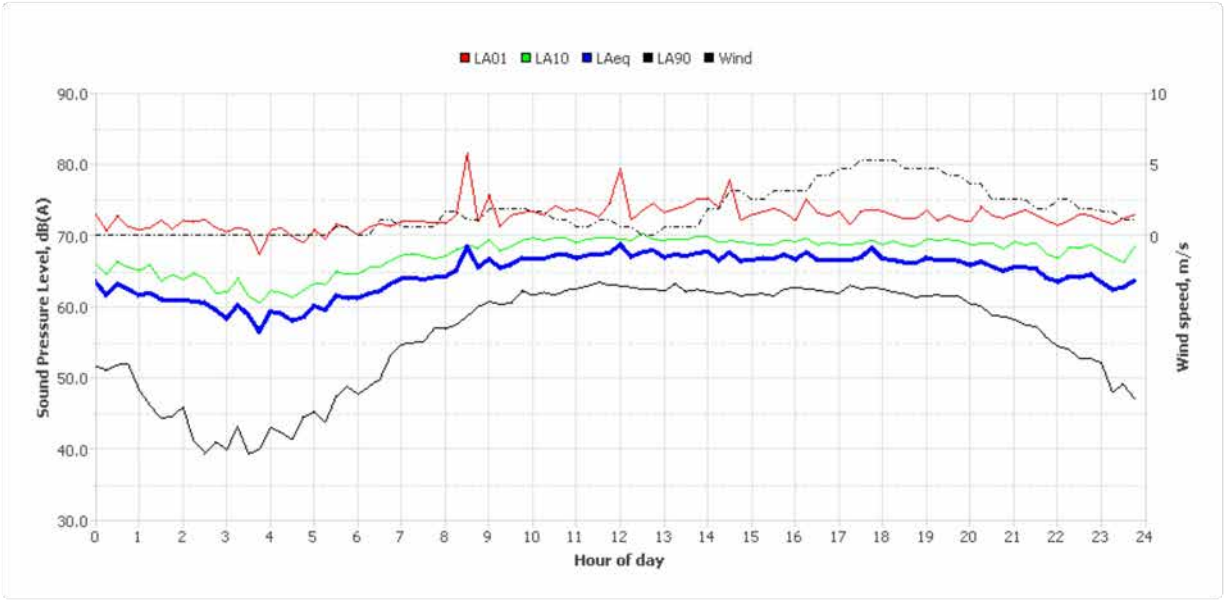
Friday, 26 Feb 2021



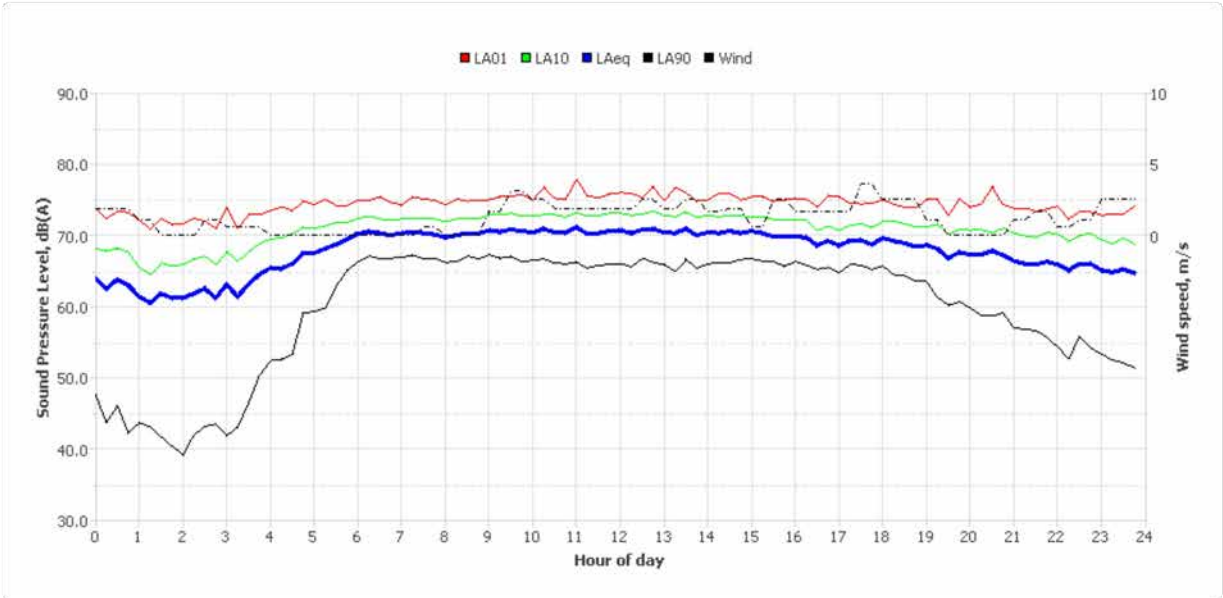
Saturday, 27 Feb 2021



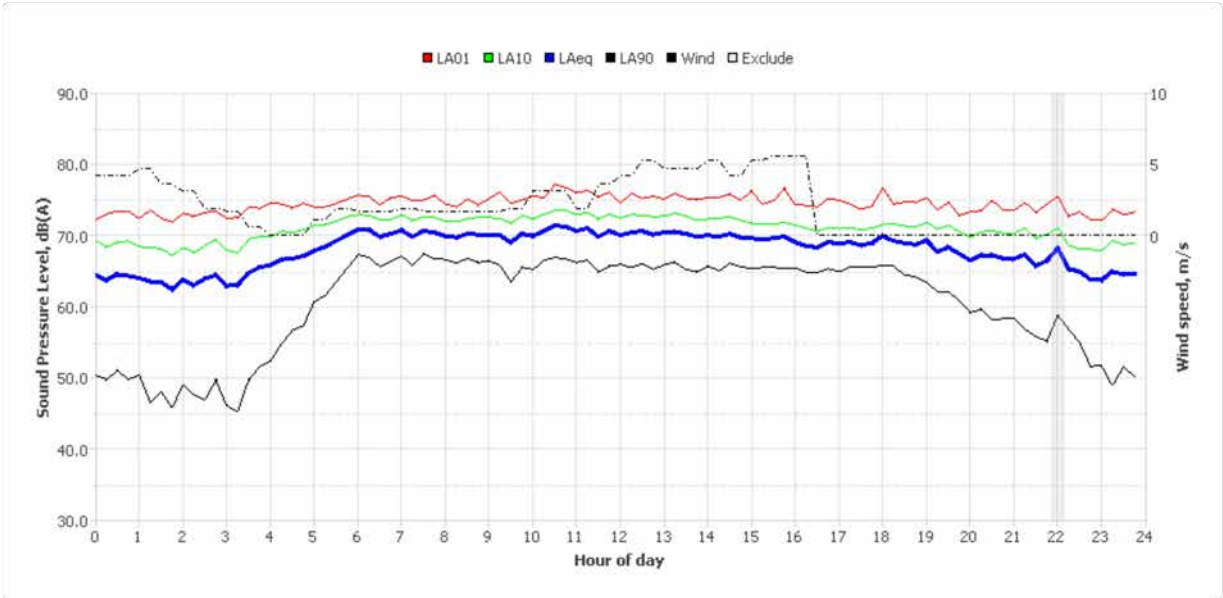
Sunday, 28 Feb 2021



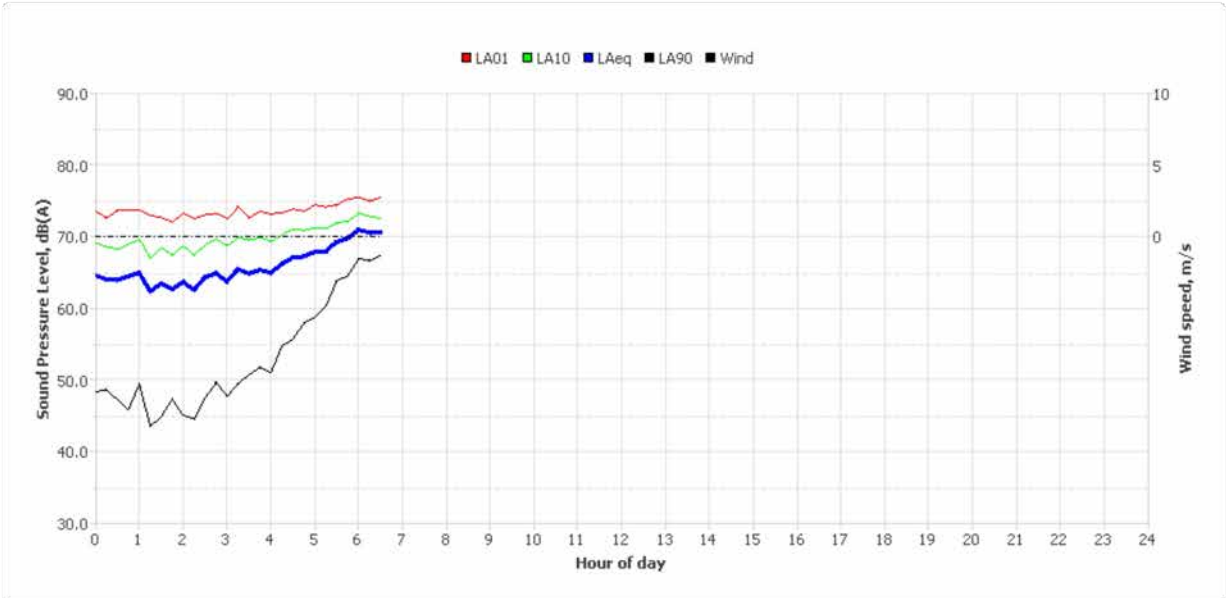
Monday, 01 Mar 2021



Tuesday, 02 Mar 2021



Wednesday, 03 Mar 2021



Noise Logger Report

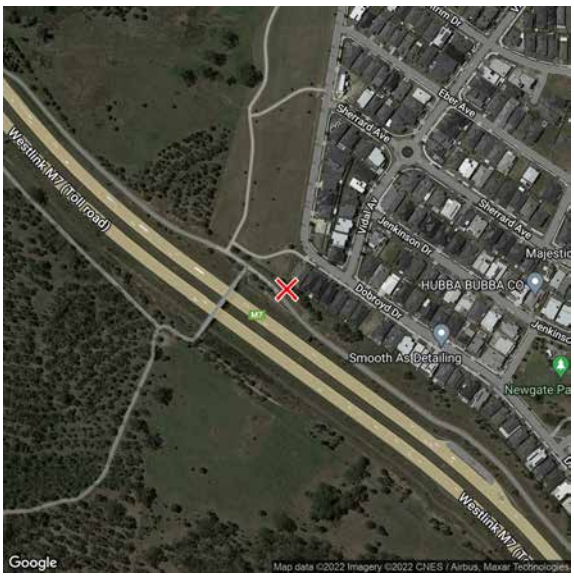
NL10 - Lot 24, DP1042996, Cecil Park

Item	Information
Logger Type	NGARA
Serial number	87809F
Address	NL10 - Lot 24, DP1042996, Cecil Park
Location	NL10 - Lot 24, DP1042996, Cecil Park
Facade / Free Field	Free field
Environment	M7 traffic dominant 66 dB(A) constant. Truck 78 dB(A). Light insect noise and bird noise just audible but not contributing to measurement

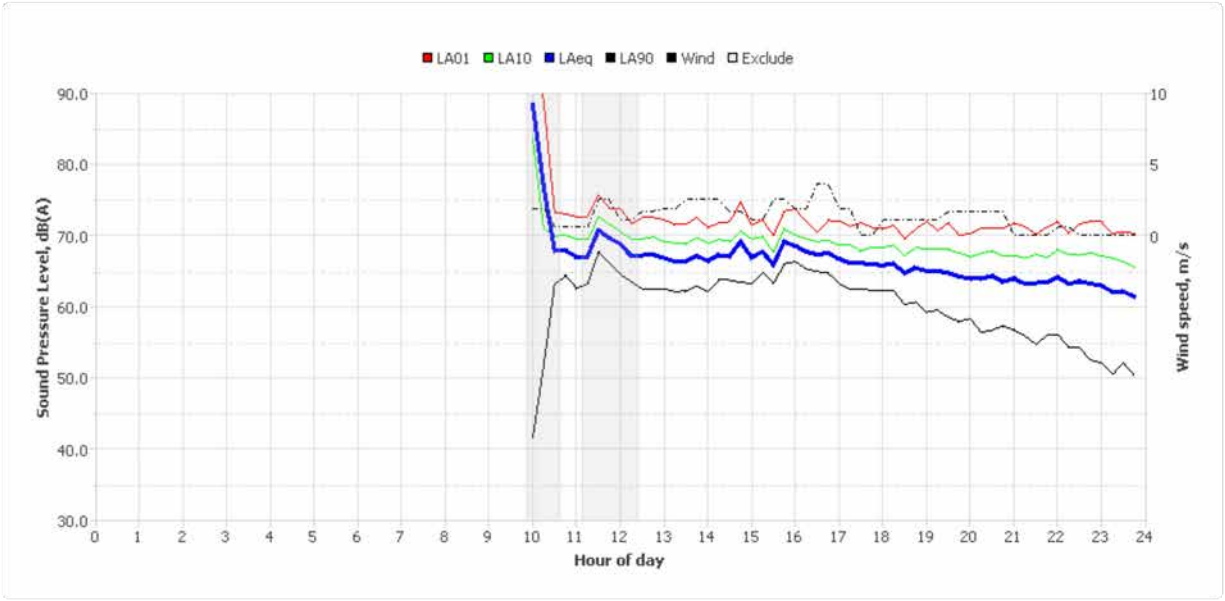
Measured noise levels

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 Feb 25 2021	67	64	63	-	56	-	66	63
Fri Feb 26 2021	67	64	63	-	55	47	67	63
Sat Feb 27 2021	65	61	61	58	52	43	64	61
Sun Feb 28 2021	63	63	59	54	54	44	63	59
Mon Mar 1 2021	65	64	63	60	54	47	65	63
Tue Mar 2 2021	67	65	64	-	53	44	66	64
Wed Mar 3 2021	66	64	63	61	53	43	66	63
Thu Mar 4 2021	66	65	64	61	56	46	65	64
Fri Mar 5 2021	66	64	64	-	54	48	65	64
Sat Mar 6 2021	65	62	61	59	53	42	64	61
Sun Mar 7 2021	62	62	58	55	54	40	62	58
Mon Mar 8 2021	66	64	63	61	54	46	66	63
Tue Mar 9 2021	67	64	63	-	54	47	66	63
Wed Mar 10 2021	65	-	64	-	-	-	65	64
Summary	**66**	**64**	**63**	**59**	**54**	**45**	**65**	**63**

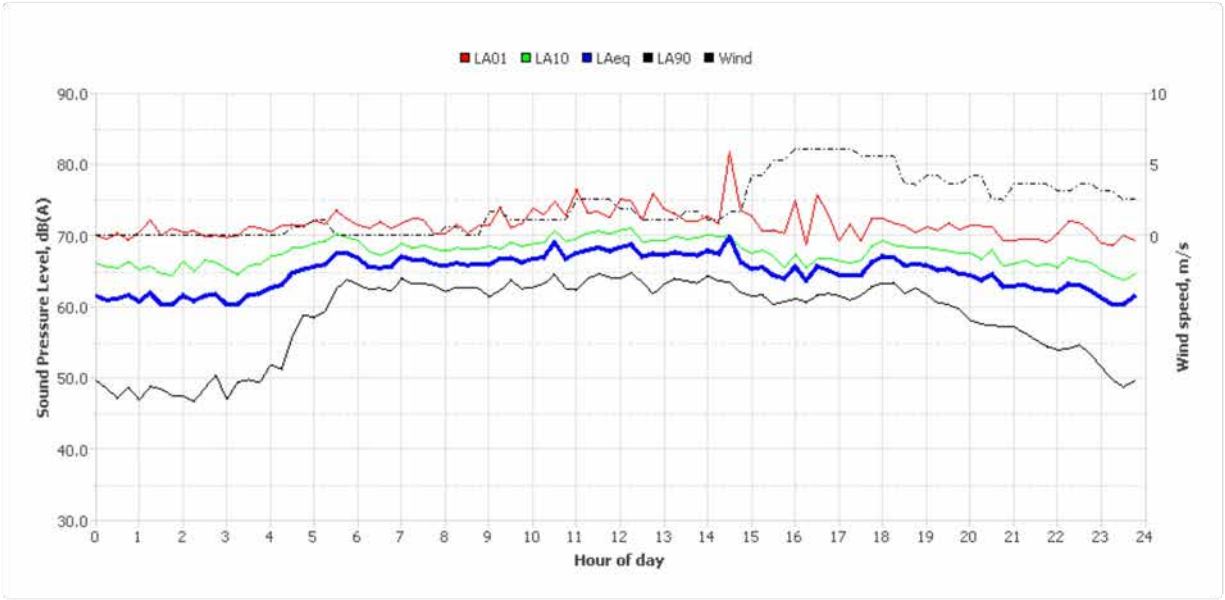
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location	Logger Deployment Photo
	

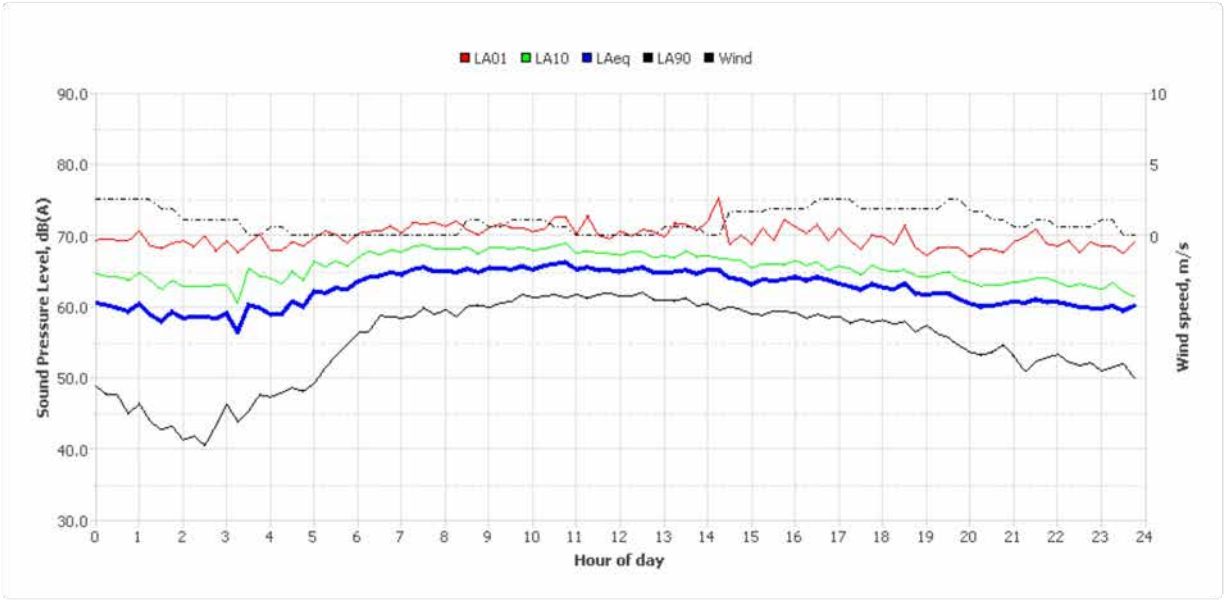
Thursday, 25 Feb 2021



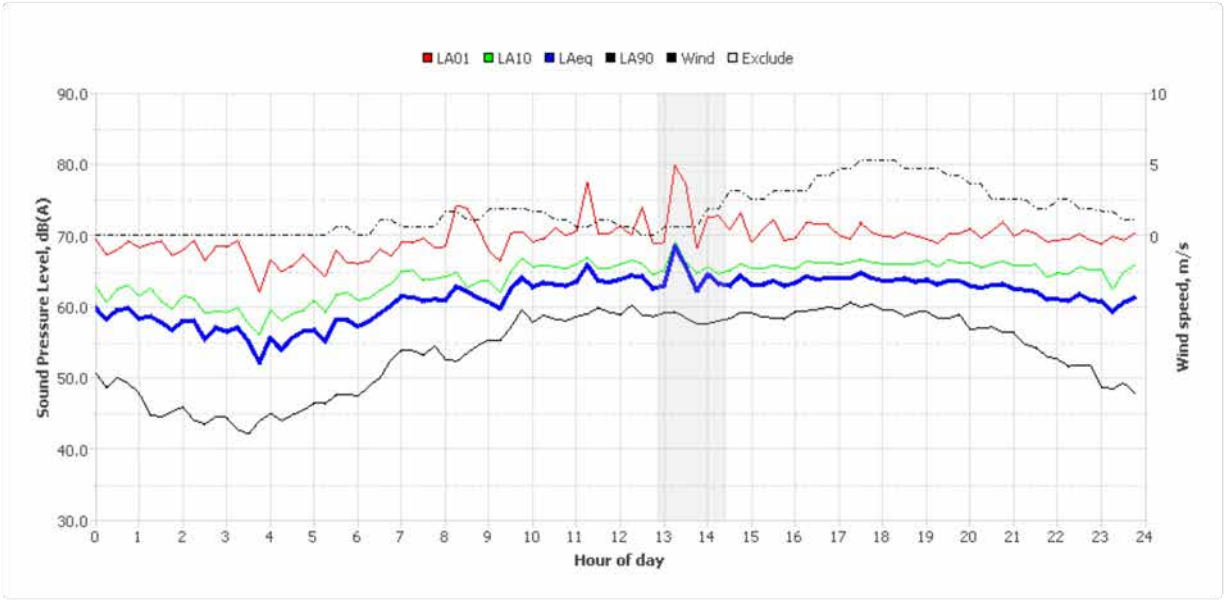
Friday, 26 Feb 2021



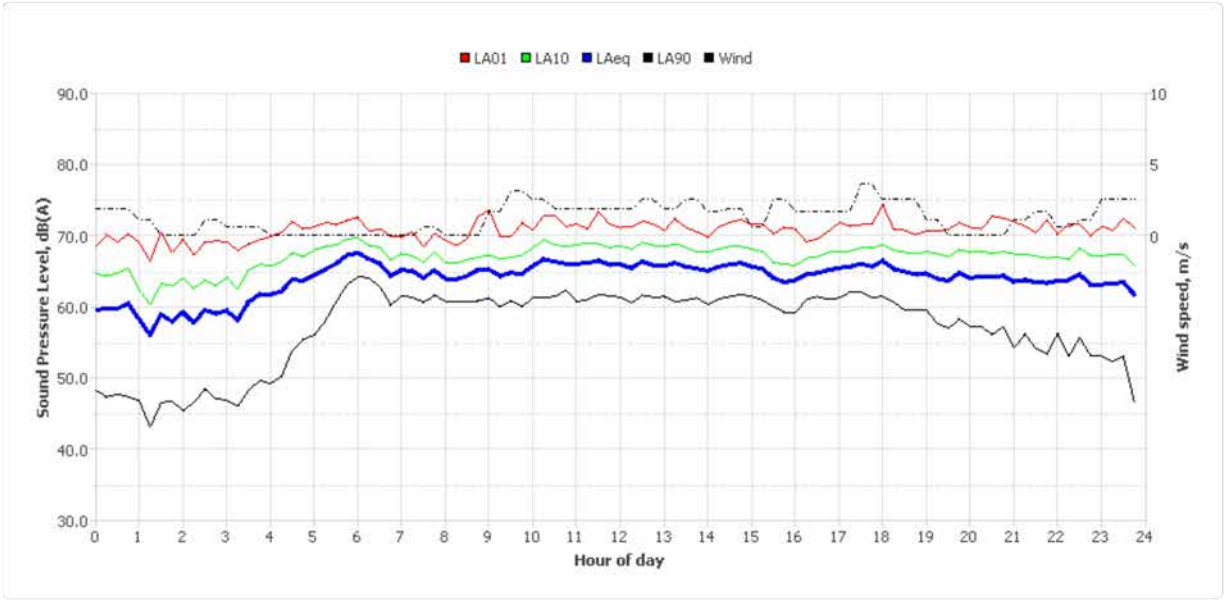
Saturday, 27 Feb 2021



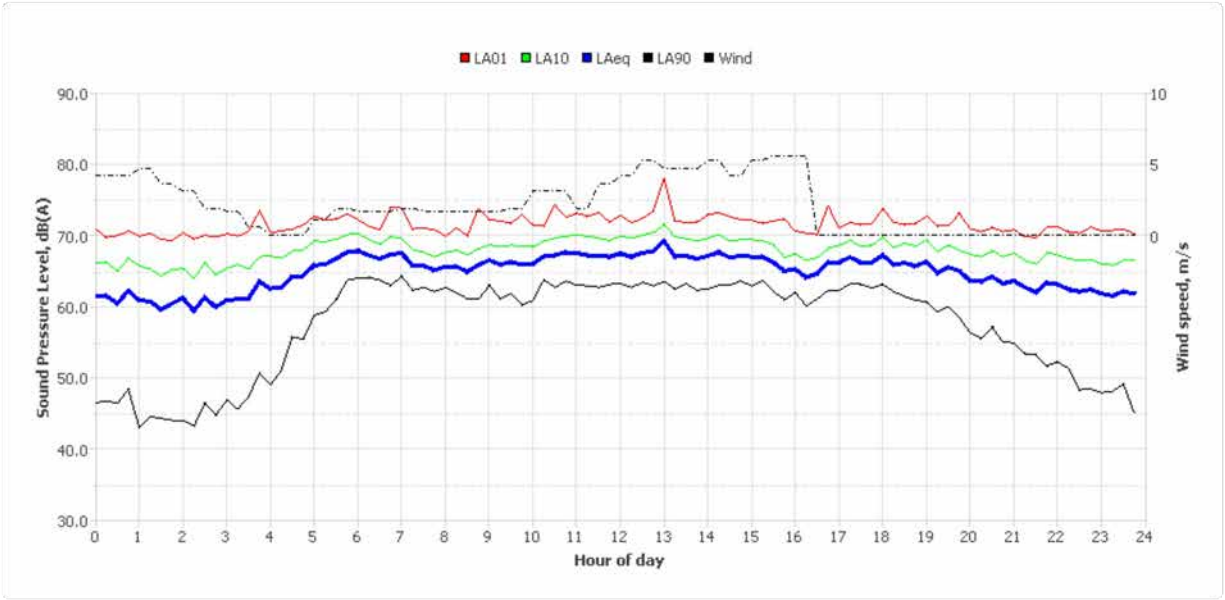
Sunday, 28 Feb 2021



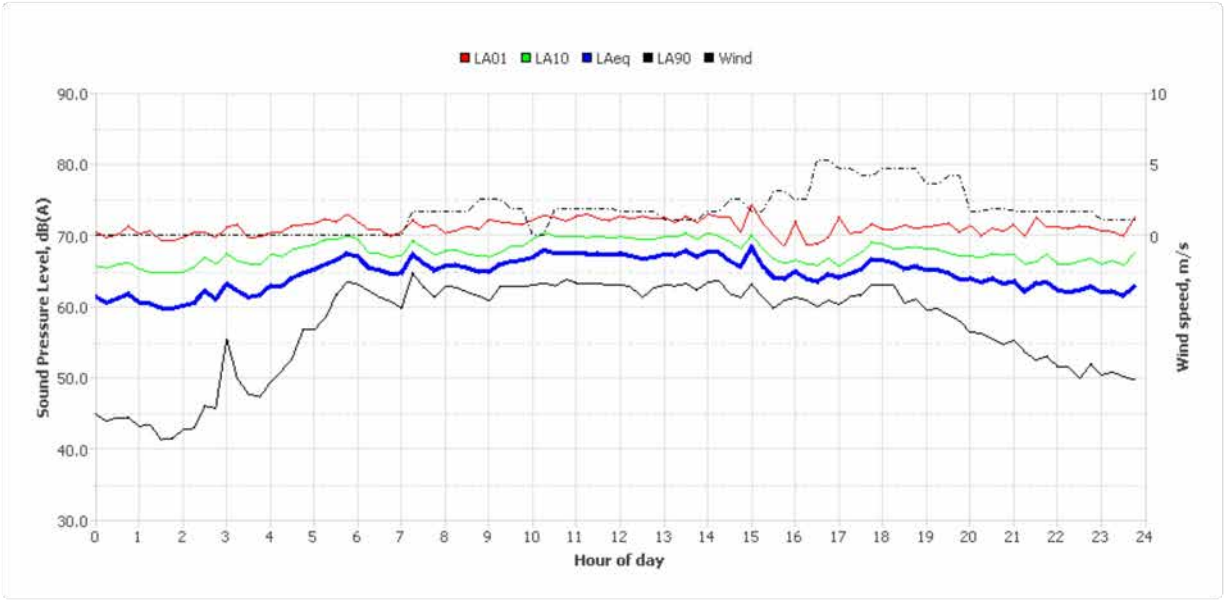
Monday, 01 Mar 2021



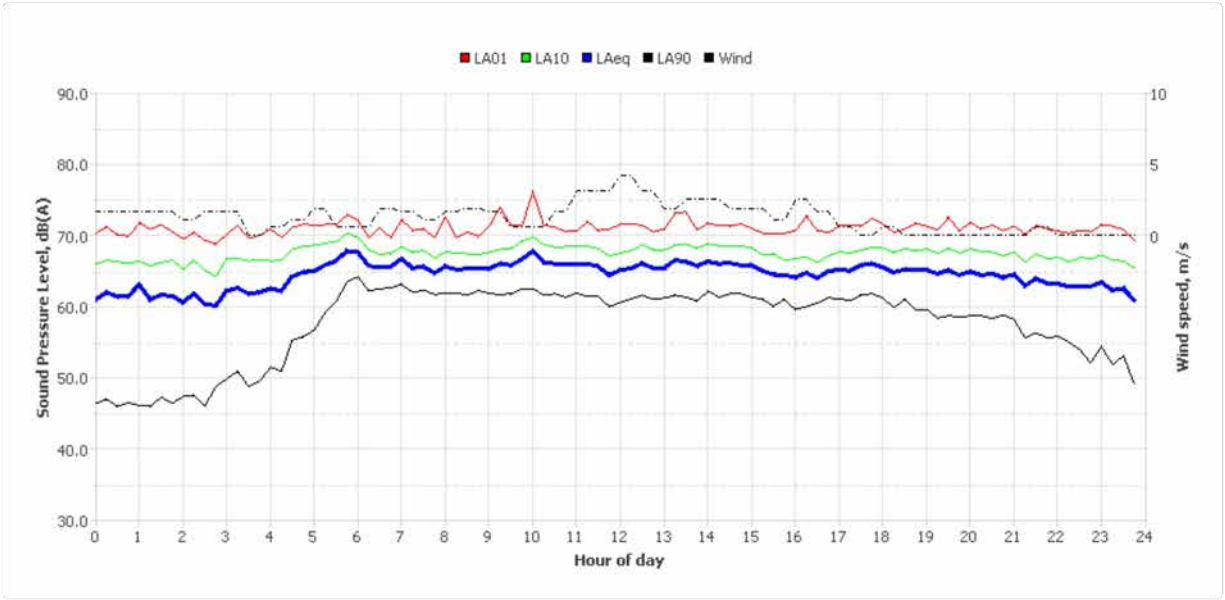
Tuesday, 02 Mar 2021



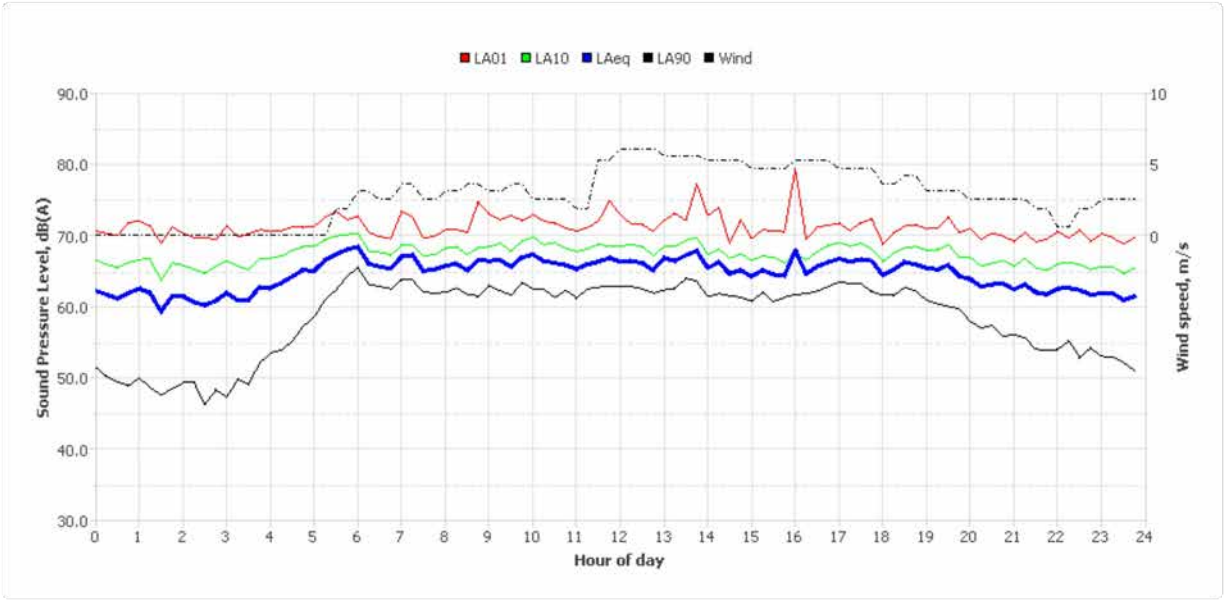
Wednesday, 03 Mar 2021



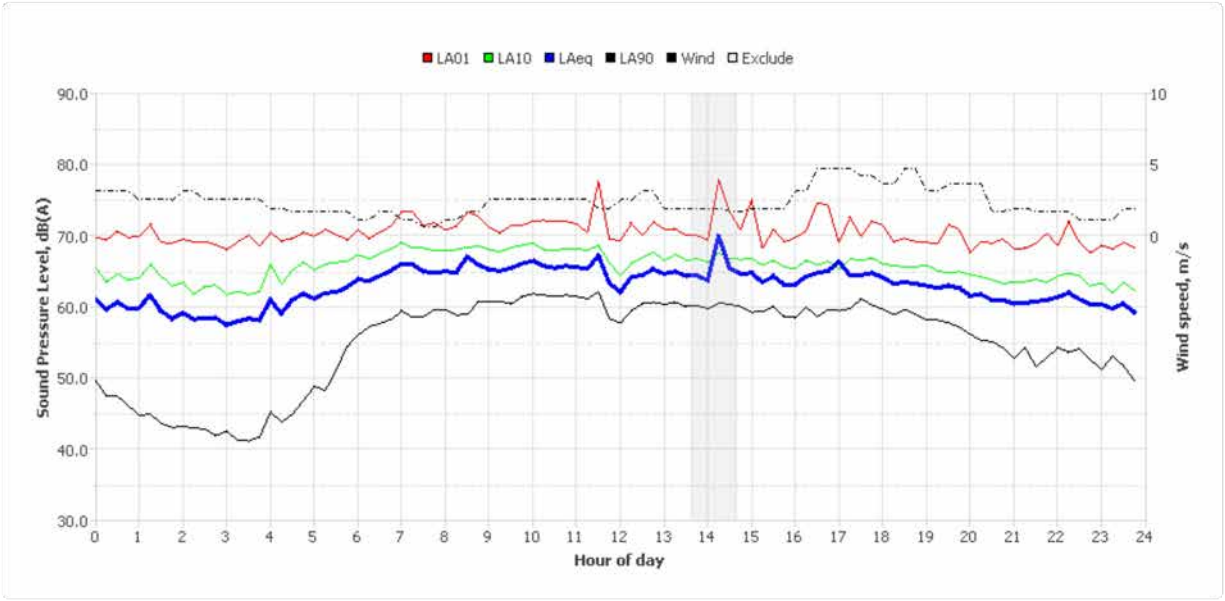
Thursday, 04 Mar 2021



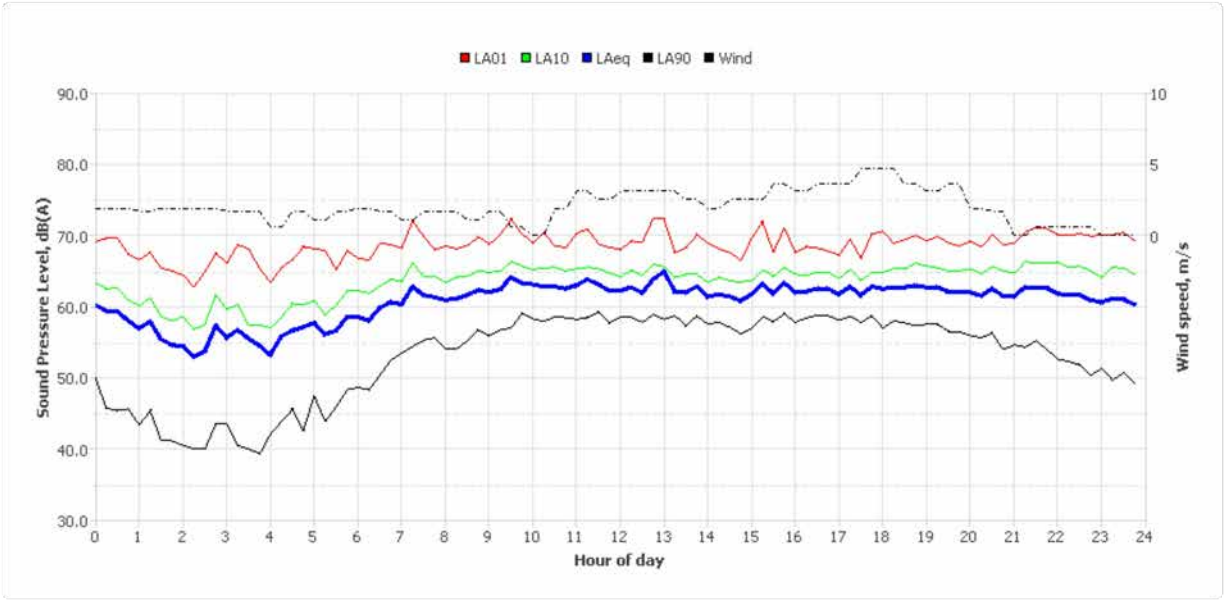
Friday, 05 Mar 2021



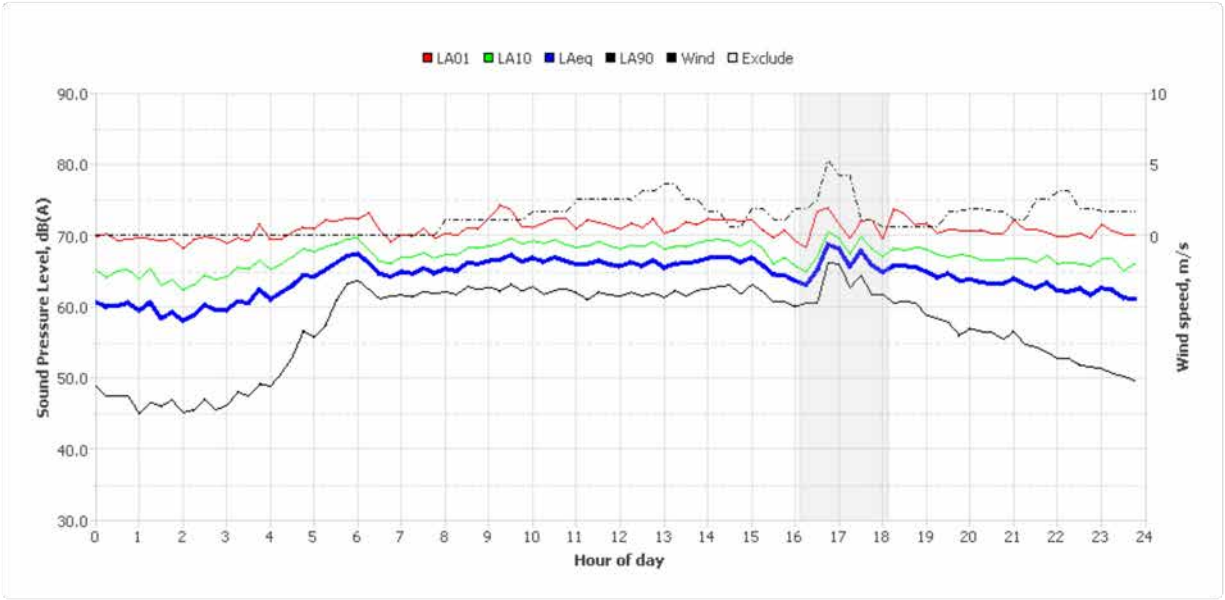
Saturday, 06 Mar 2021



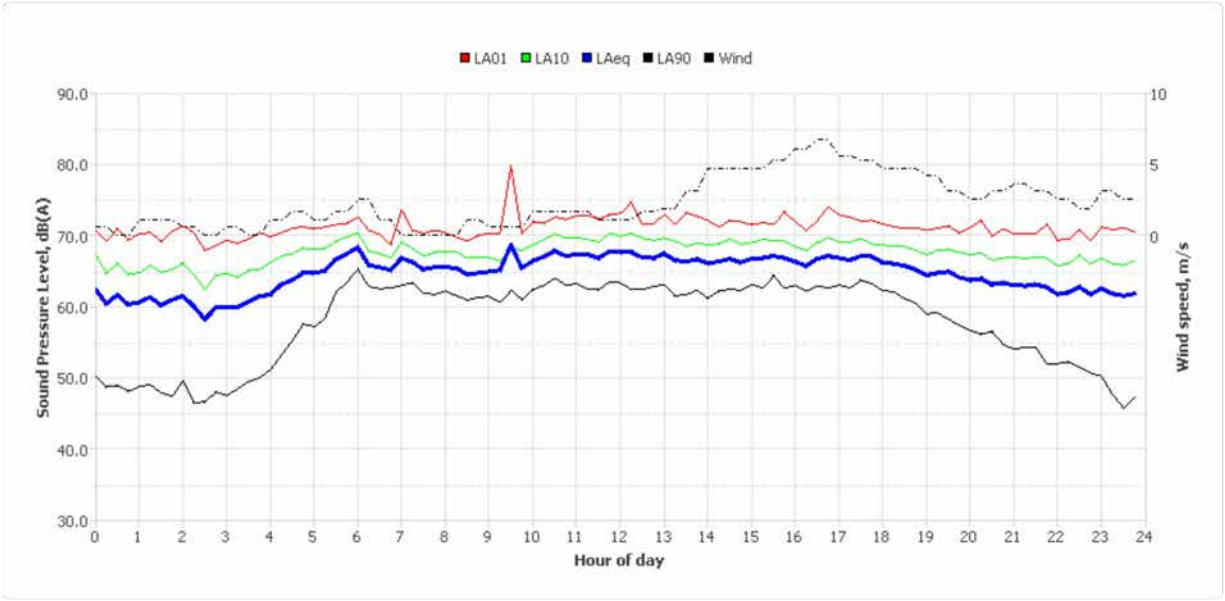
Sunday, 07 Mar 2021



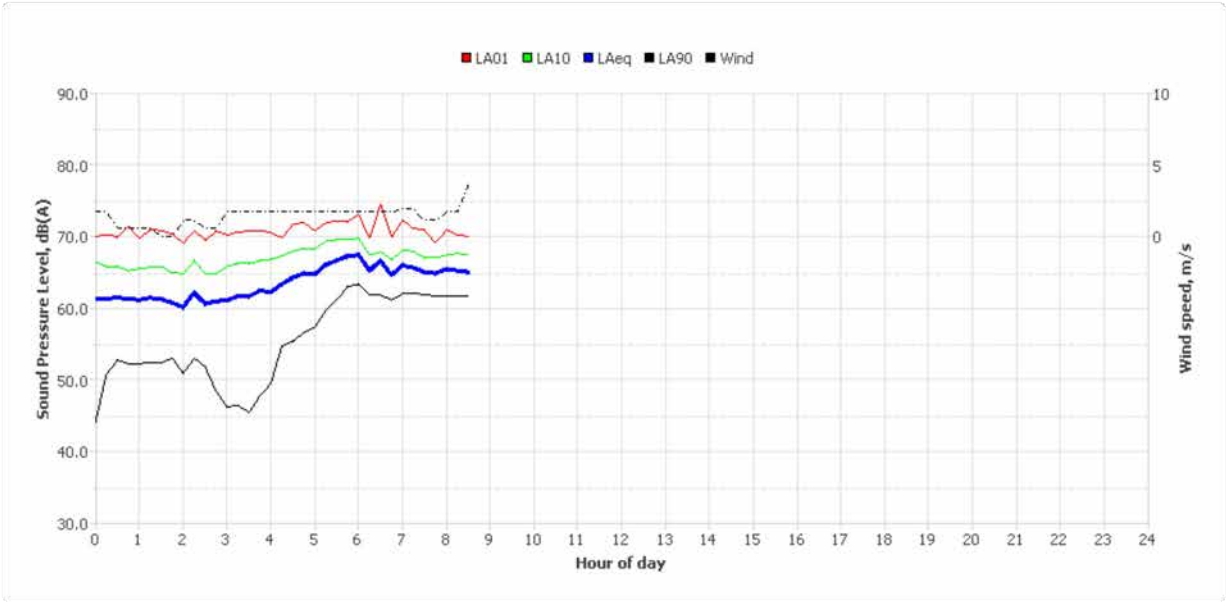
Monday, 08 Mar 2021



Tuesday, 09 Mar 2021



Wednesday, 10 Mar 2021



Noise Logger Report

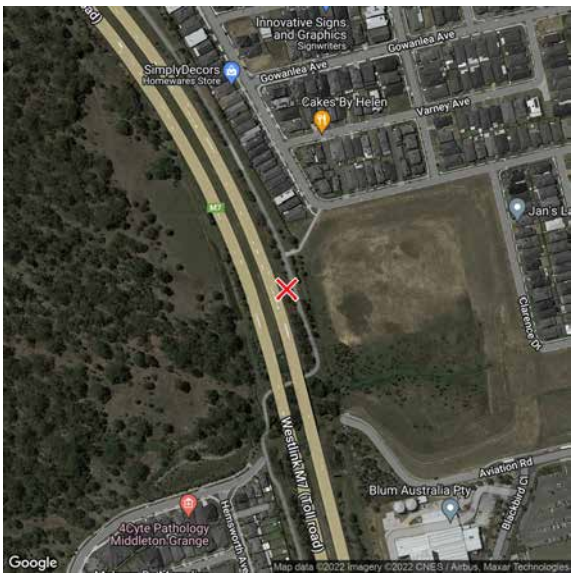
NL12 - Lot 24, DP1042996, Elizabeth Hills

Item	Information
Logger Type	NGARA
Serial number	8780C7
Address	NL12 - Lot 24, DP1042996, Elizabeth Hills
Location	NL12 - Lot 24, DP1042996, Elizabeth Hills
Facade / Free Field	Free field
Environment	Dominated by Road traffic noise on m7 61 dB(A).truck 71.4 dB(A). Cicadas And bird calls audible.

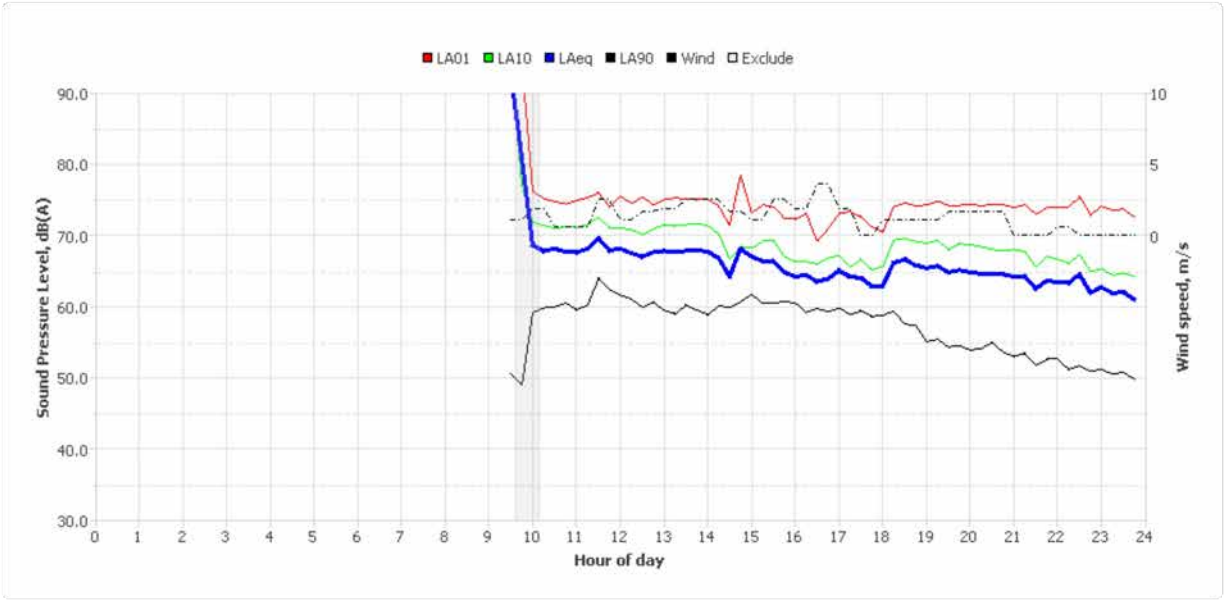
Measured noise levels

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
Thu Feb 25 2021	78	65	63	-	53	-	77	63
Fri Feb 26 2021	68	65	64	-	53	46	68	64
Sat Feb 27 2021	65	62	61	55	49	44	65	61
Sun Feb 28 2021	65	64	59	50	51	44	64	59
Mon Mar 1 2021	68	66	64	59	53	44	68	64
Tue Mar 2 2021	68	66	64	-	51	47	68	64
Wed Mar 3 2021	69	66	64	60	-	44	68	64
Thu Mar 4 2021	68	66	64	59	53	45	68	64
Fri Mar 5 2021	68	66	64	-	53	46	68	64
Sat Mar 6 2021	66	63	62	55	50	43	66	62
Sun Mar 7 2021	64	63	59	50	51	39	64	59
Mon Mar 8 2021	68	66	64	59	53	45	68	64
Tue Mar 9 2021	69	66	64	-	53	46	68	64
Wed Mar 10 2021	68	66	64	-	50	45	68	64
Thu Mar 11 2021	69	-	65	-	-	-	69	65
Summary	**70**	**65**	**63**	**57**	**53**	**45**	**69**	**63**

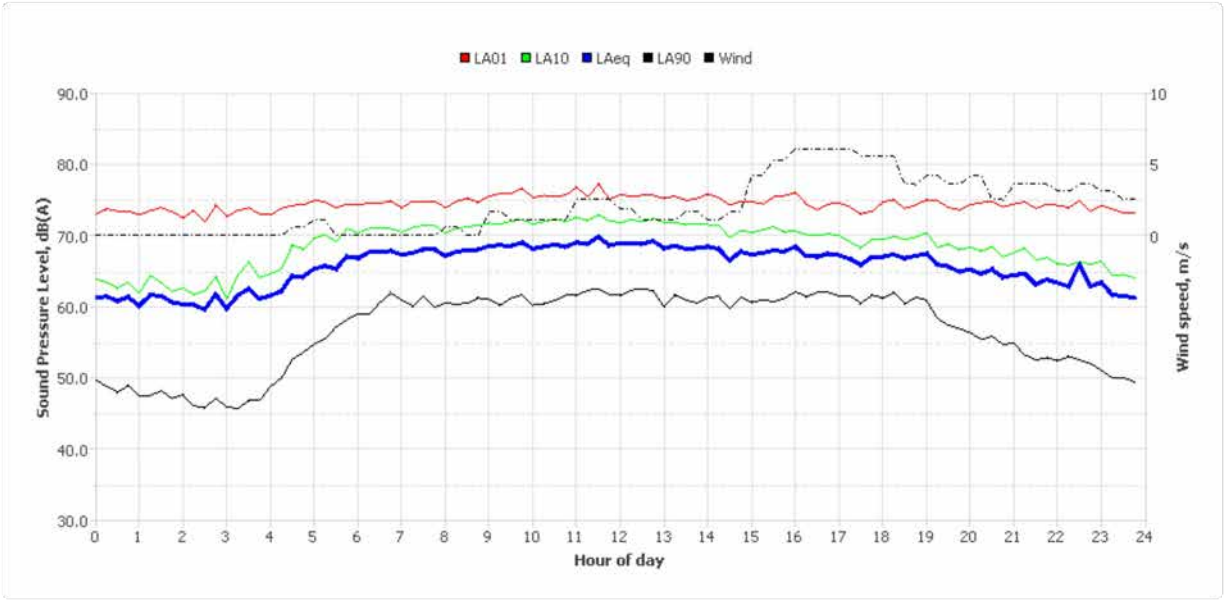
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location	Logger Deployment Photo
	

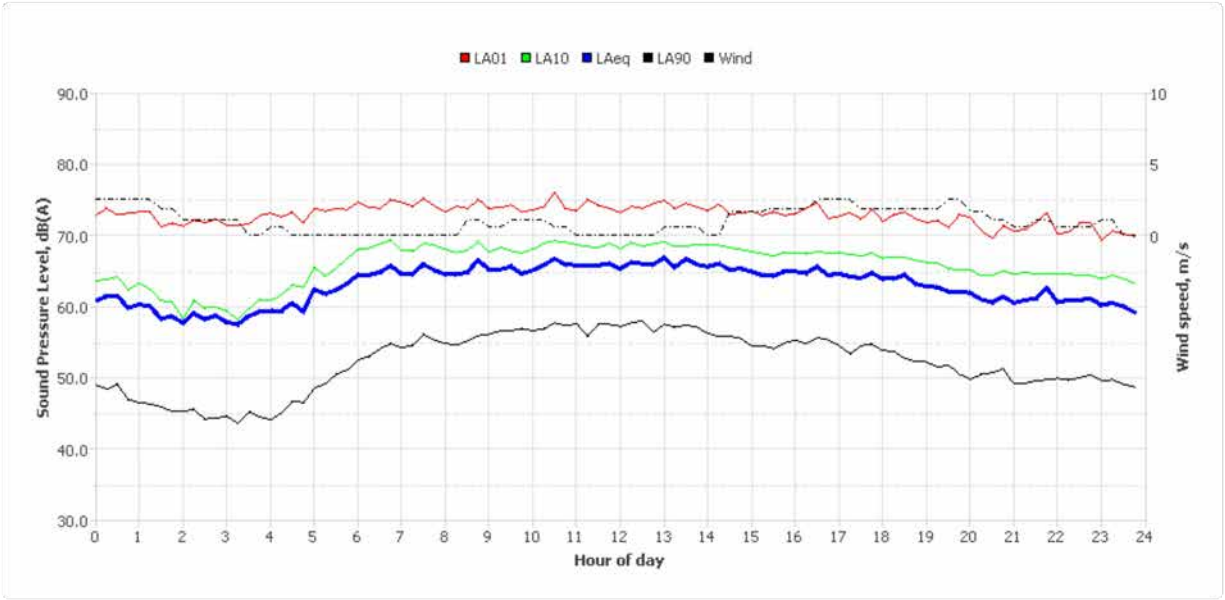
Thursday, 25 Feb 2021



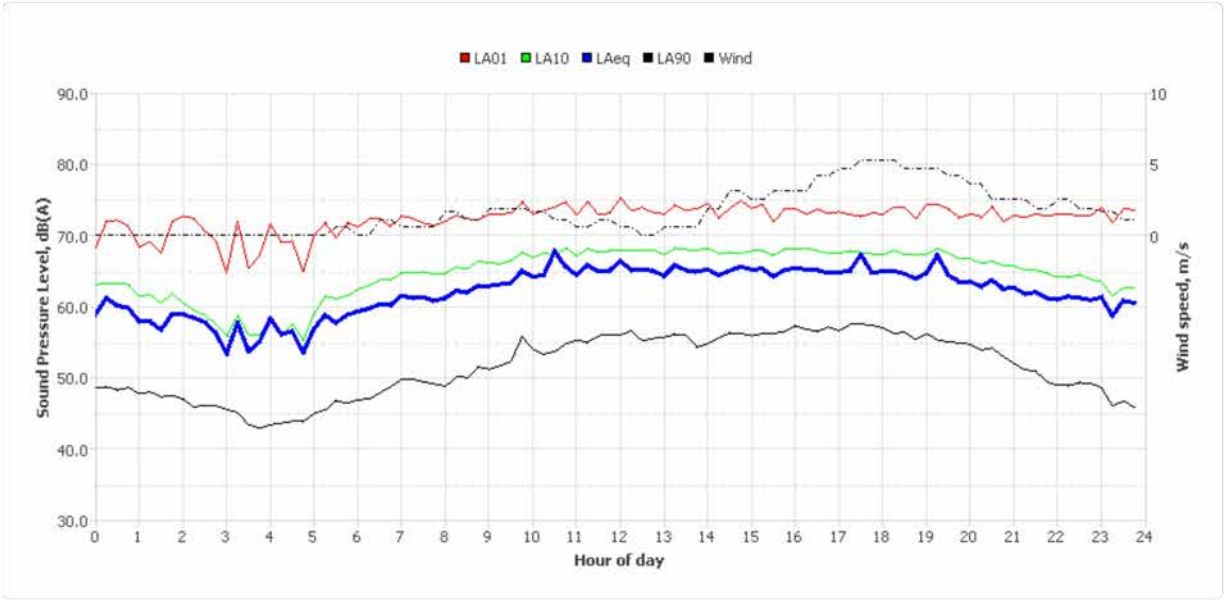
Friday, 26 Feb 2021



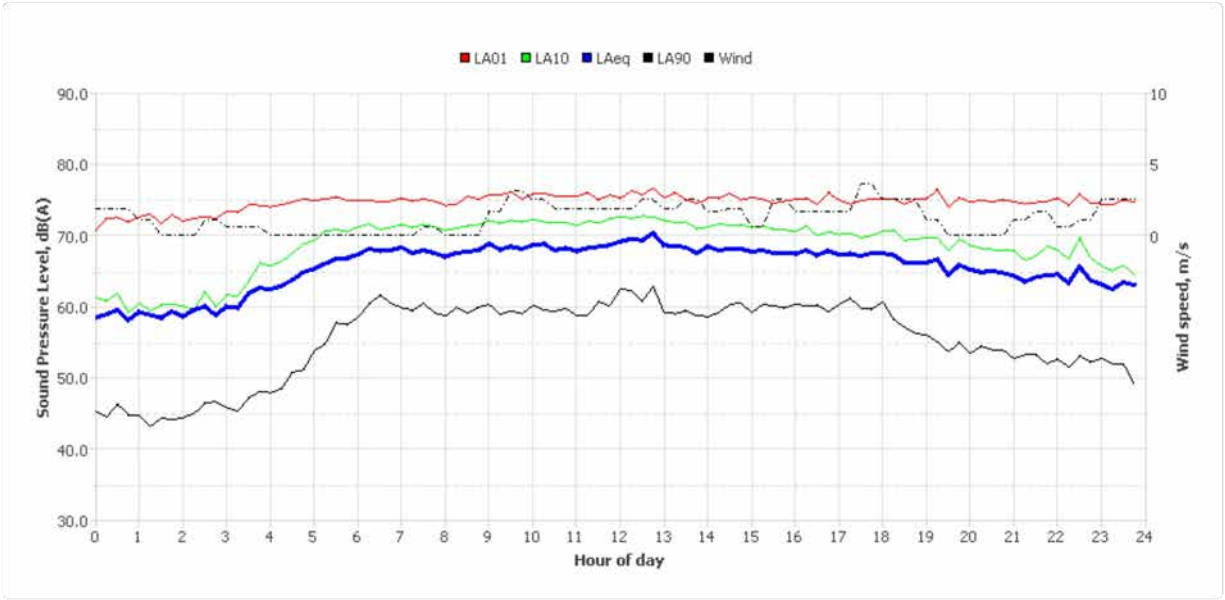
Saturday, 27 Feb 2021



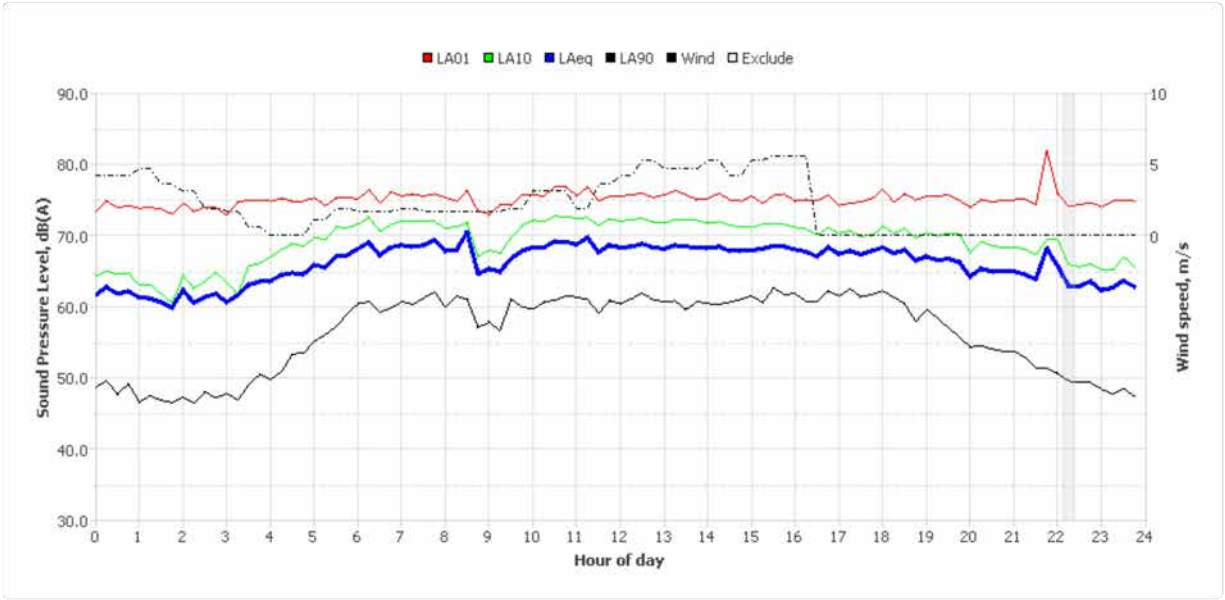
Sunday, 28 Feb 2021



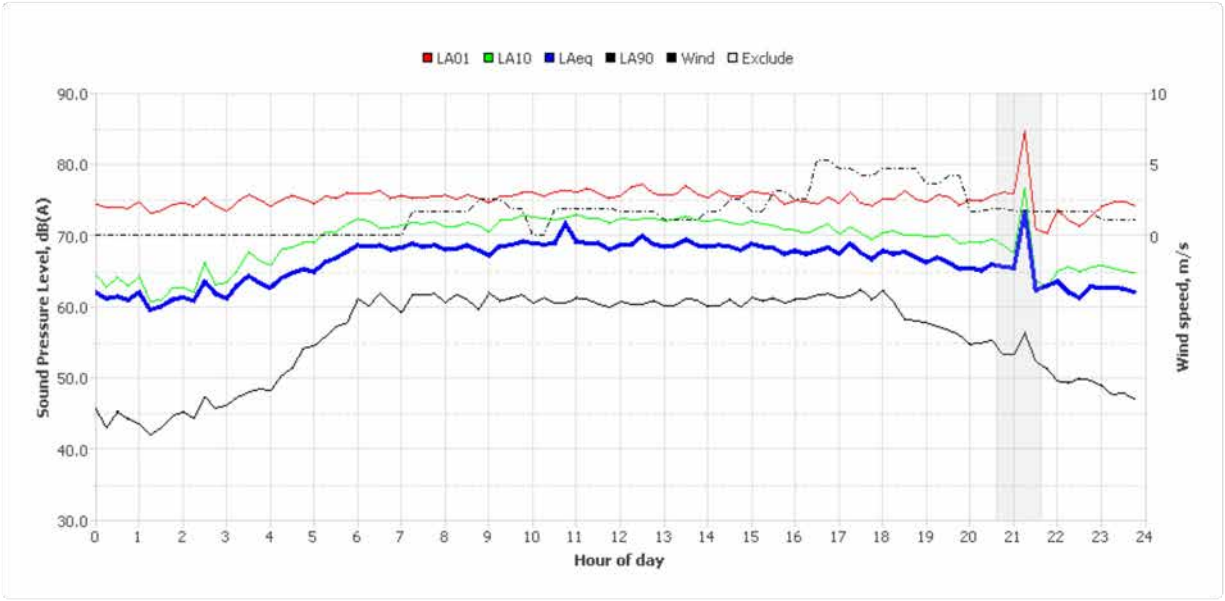
Monday, 01 Mar 2021



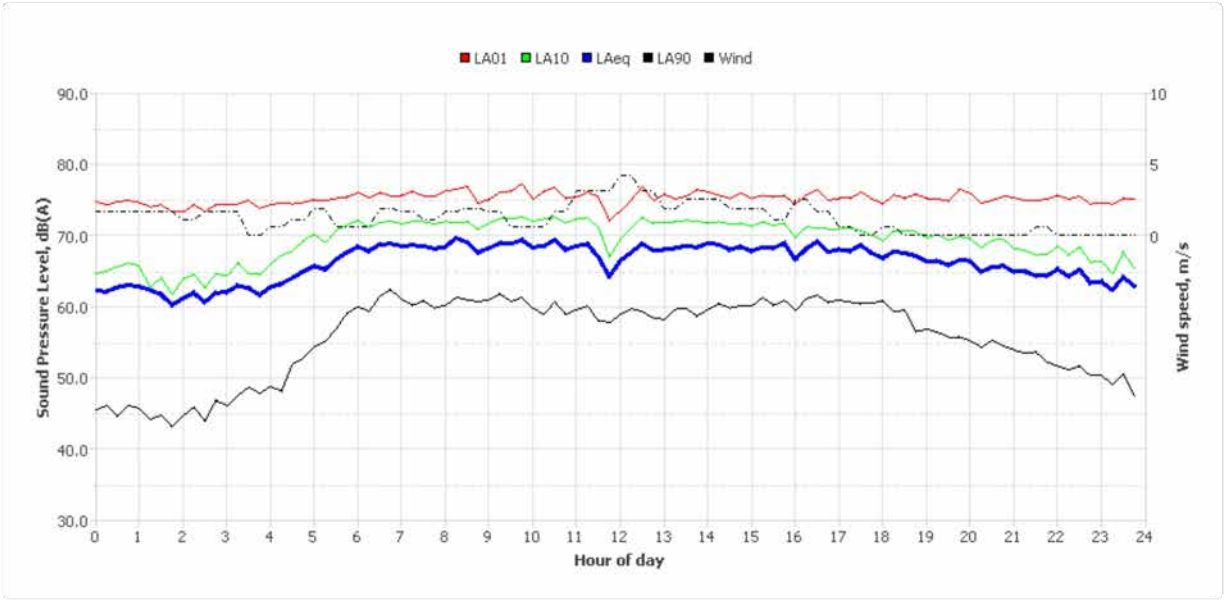
Tuesday, 02 Mar 2021



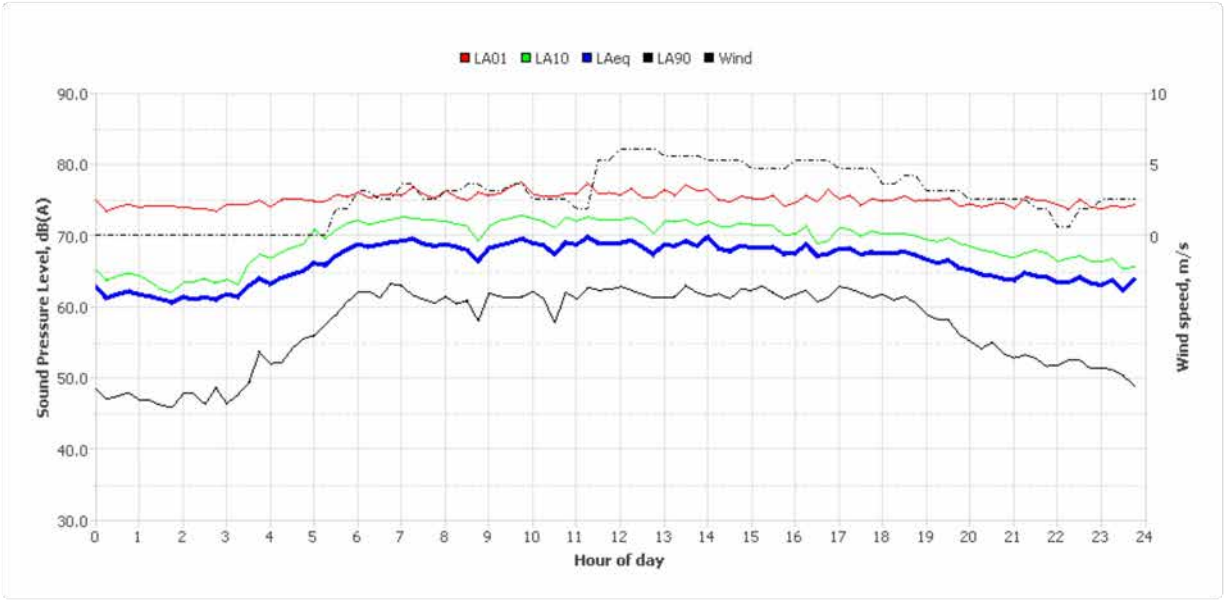
Wednesday, 03 Mar 2021



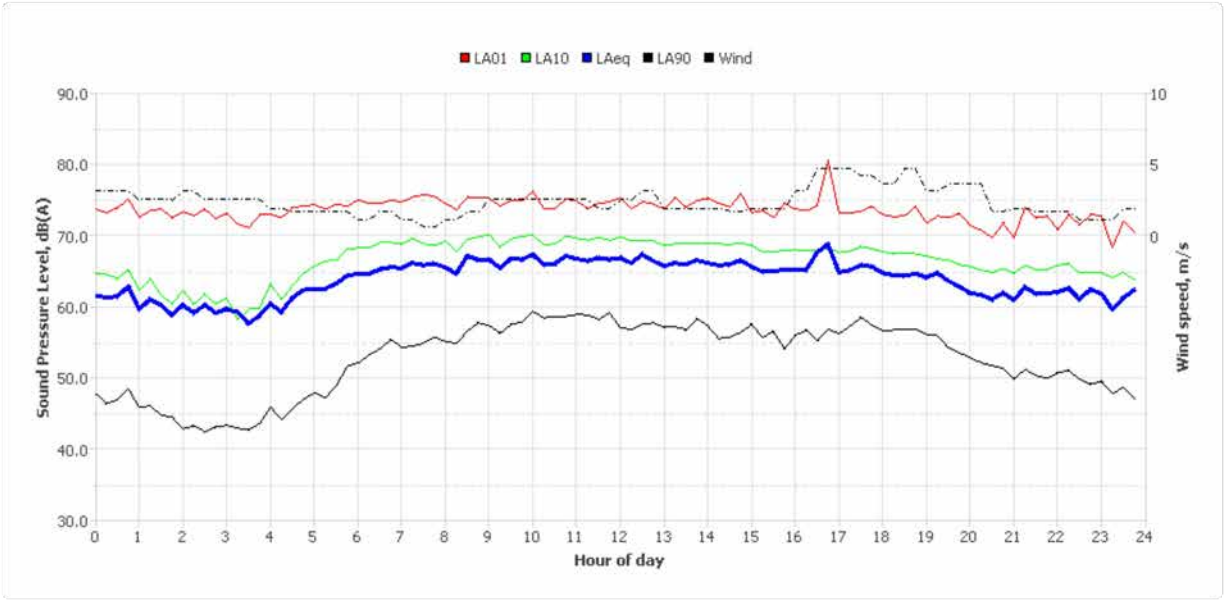
Thursday, 04 Mar 2021



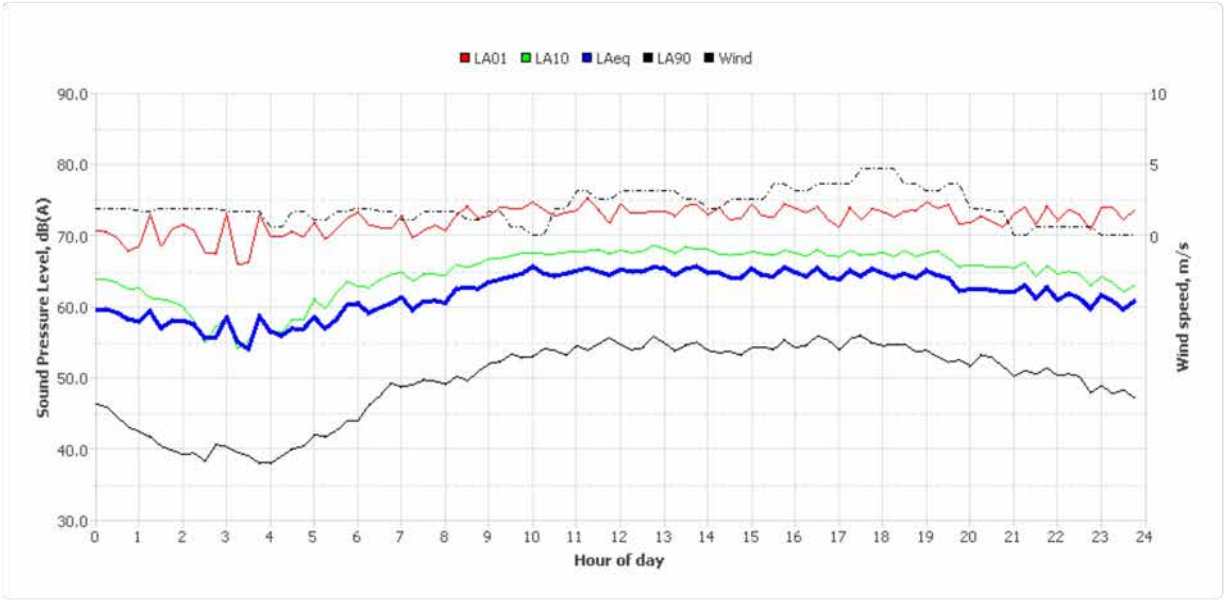
Friday, 05 Mar 2021



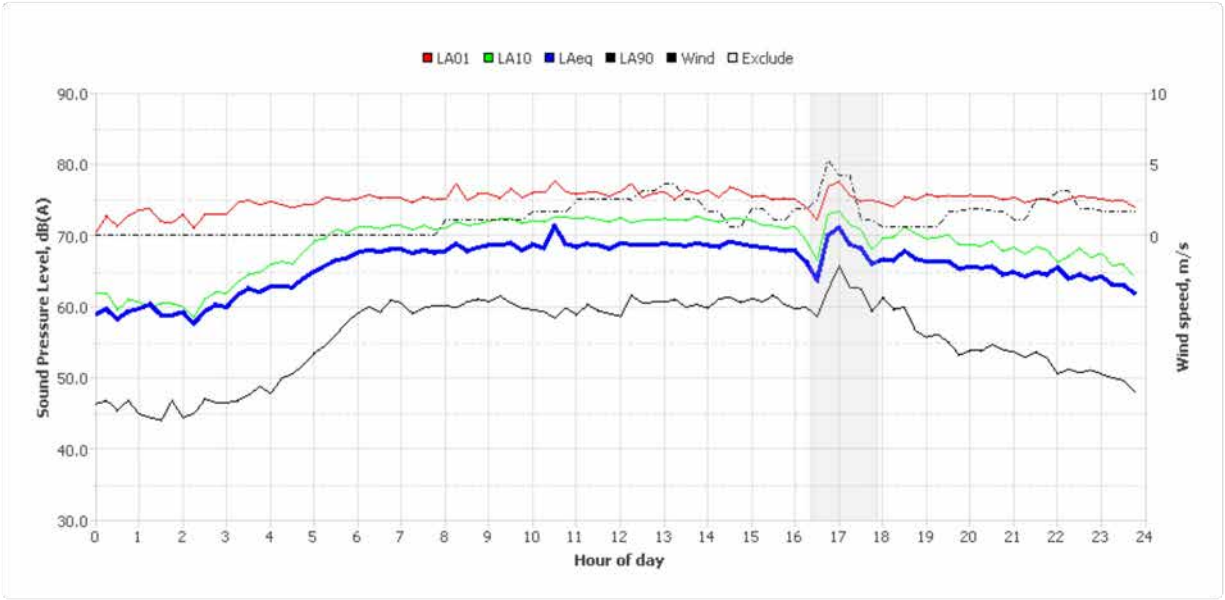
Saturday, 06 Mar 2021



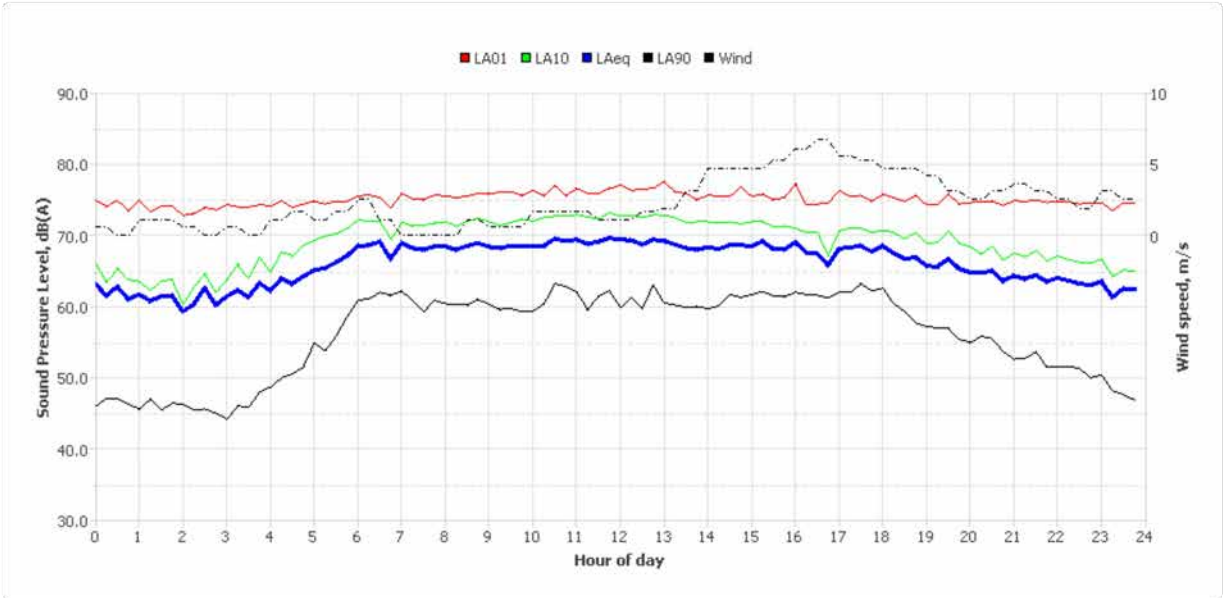
Sunday, 07 Mar 2021



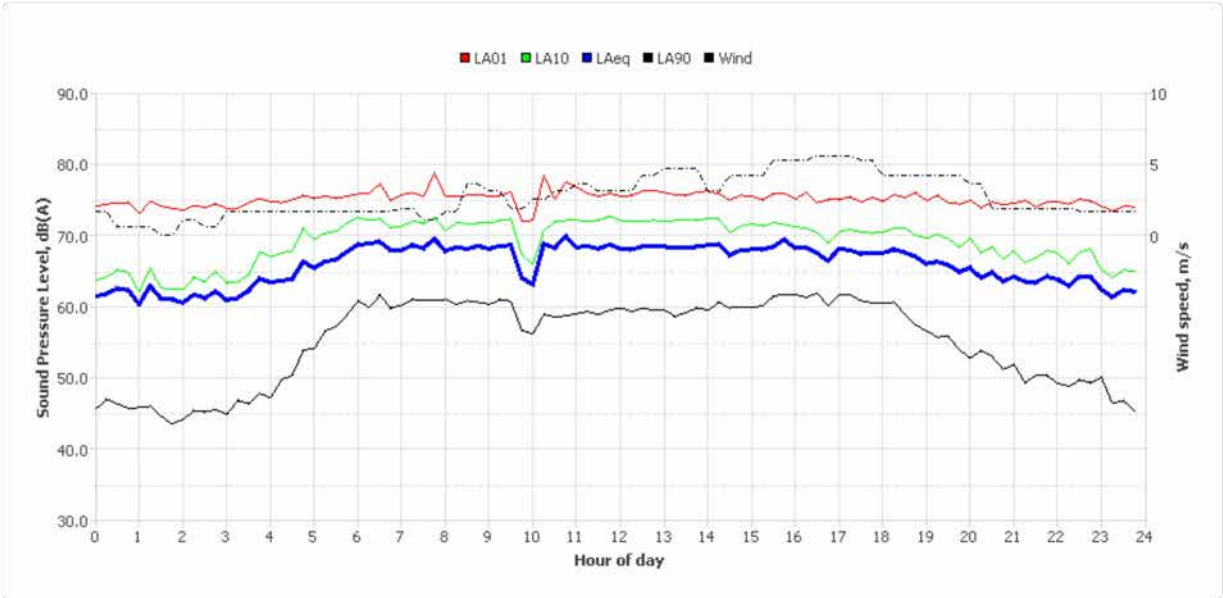
Monday, 08 Mar 2021



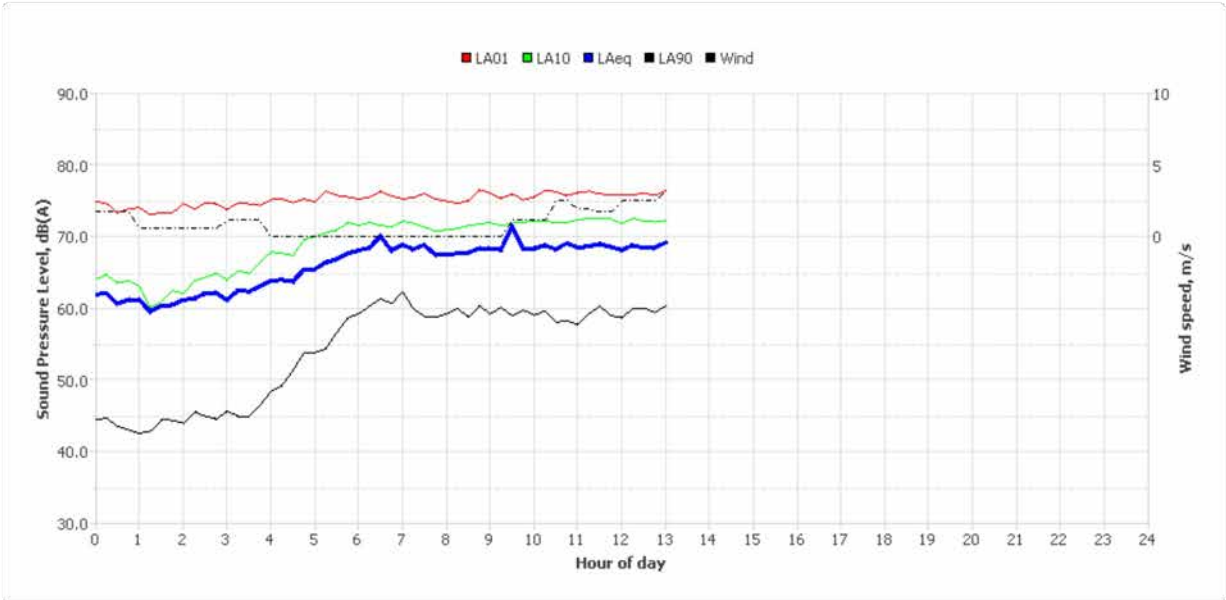
Tuesday, 09 Mar 2021



Wednesday, 10 Mar 2021



Thursday, 11 Mar 2021



Noise Logger Report

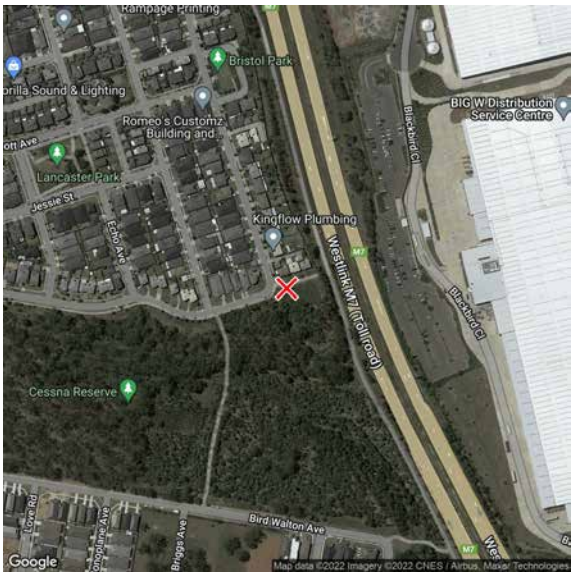
NL14 - 53 Hemsworth Avenue, Middleton Grange

Item	Information
Logger Type	NGARA
Serial number	878002
Address	NL14 - 53 Hemsworth Avenue, Middleton Grange
Location	53 Hemsworth Avenue, Middleton Grange
Facade / Free Field	Free field
Environment	Noise environment dominated by road traffic noise from highway and cicadas 63-65 dB(A) constant.

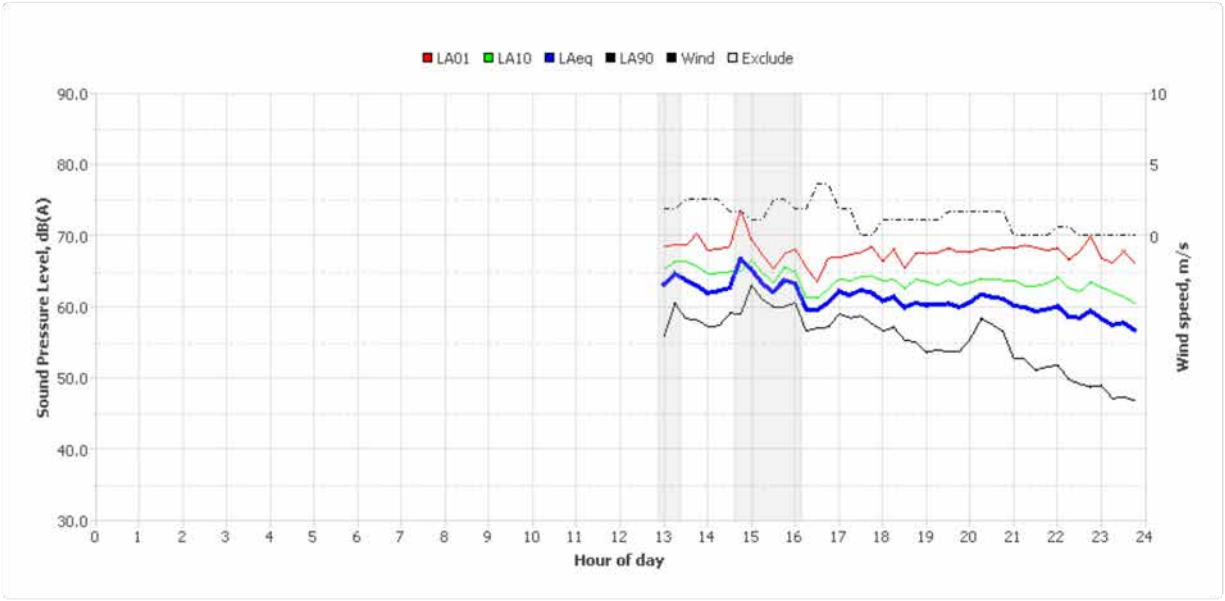
Measured noise levels

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 Feb 25 2021	62	60	58	-	52	-	61	58
Fri Feb 26 2021	62	60	59	-	52	43	62	59
Sat Feb 27 2021	60	57	56	53	-	39	59	56
Sun Feb 28 2021	59	59	54	-	50	38	59	54
Mon Mar 1 2021	61	59	58	55	50	40	60	58
Tue Mar 2 2021	61	60	59	-	-	44	61	59
Wed Mar 3 2021	61	60	58	55	51	42	61	58
Thu Mar 4 2021	61	60	59	54	50	41	60	59
Fri Mar 5 2021	61	61	59	-	57	42	61	59
Sat Mar 6 2021	59	58	56	52	51	44	59	56
Sun Mar 7 2021	57	58	54	49	50	37	57	54
Mon Mar 8 2021	60	-	58	-	-	-	60	58
Summary	**61**	**59**	**58**	**54**	**51**	**41**	**60**	**58**

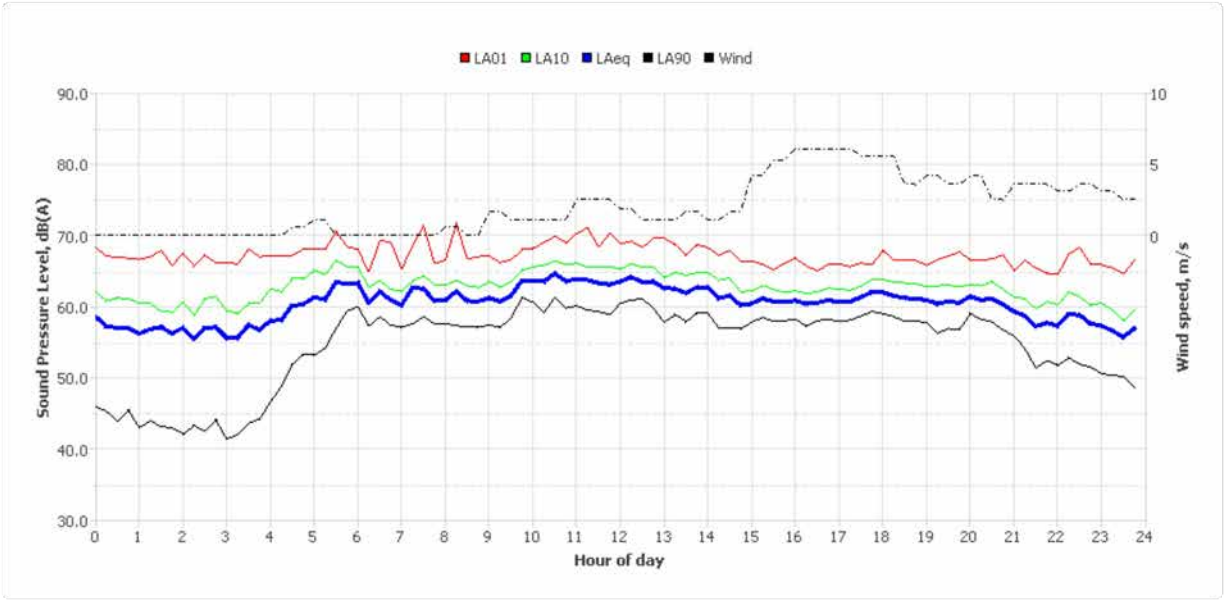
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location	Logger Deployment Photo
	

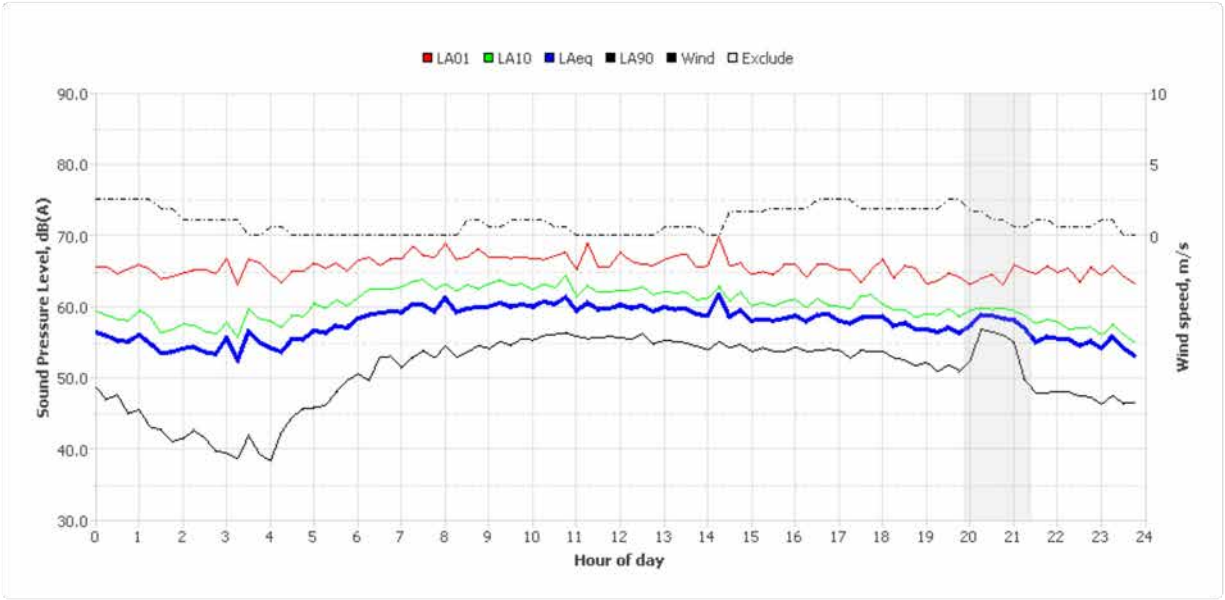
Thursday, 25 Feb 2021



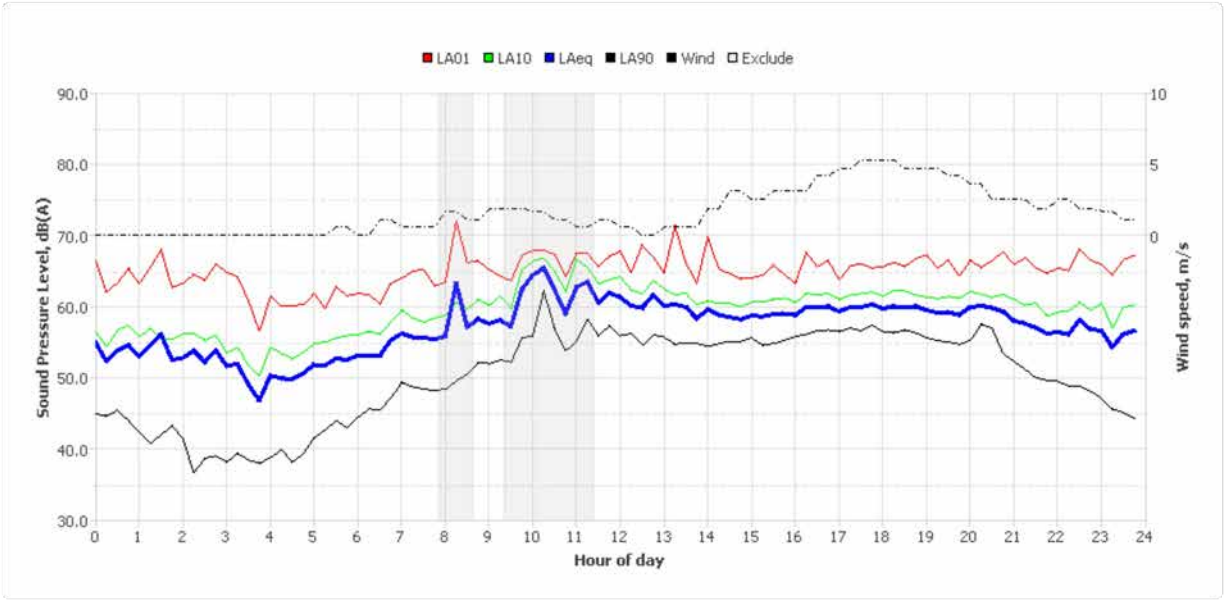
Friday, 26 Feb 2021



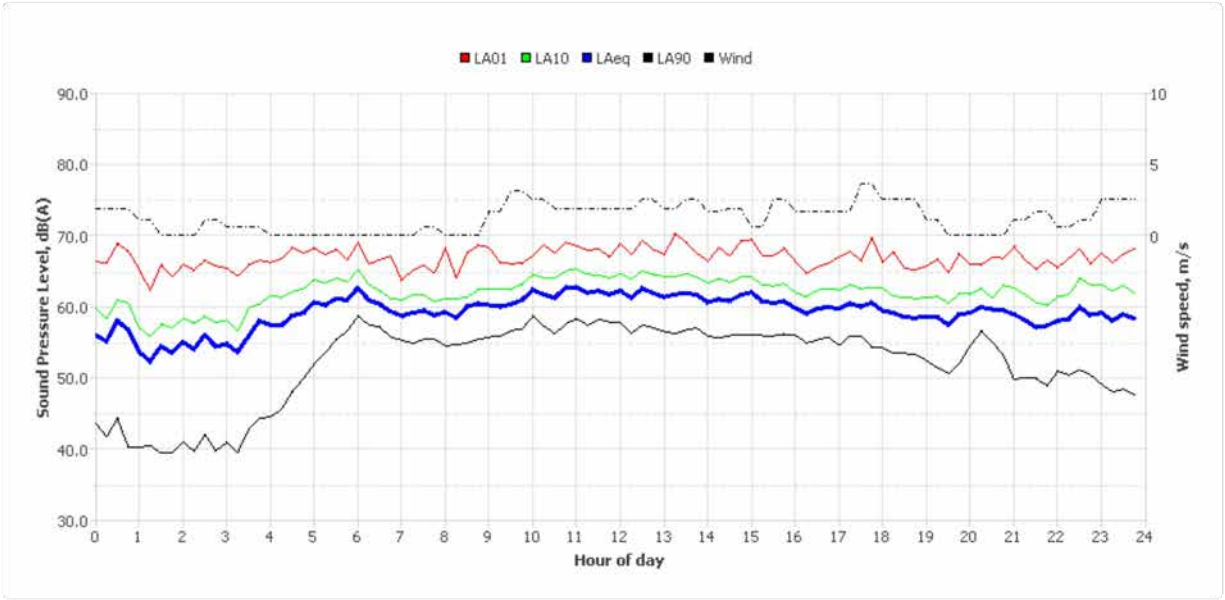
Saturday, 27 Feb 2021



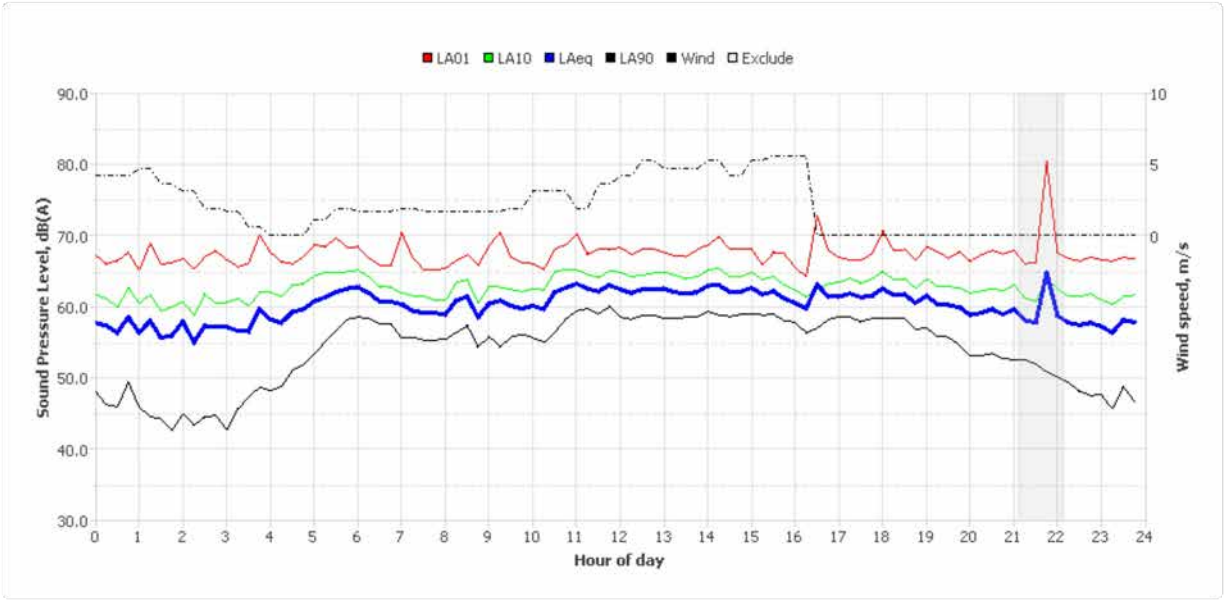
Sunday, 28 Feb 2021



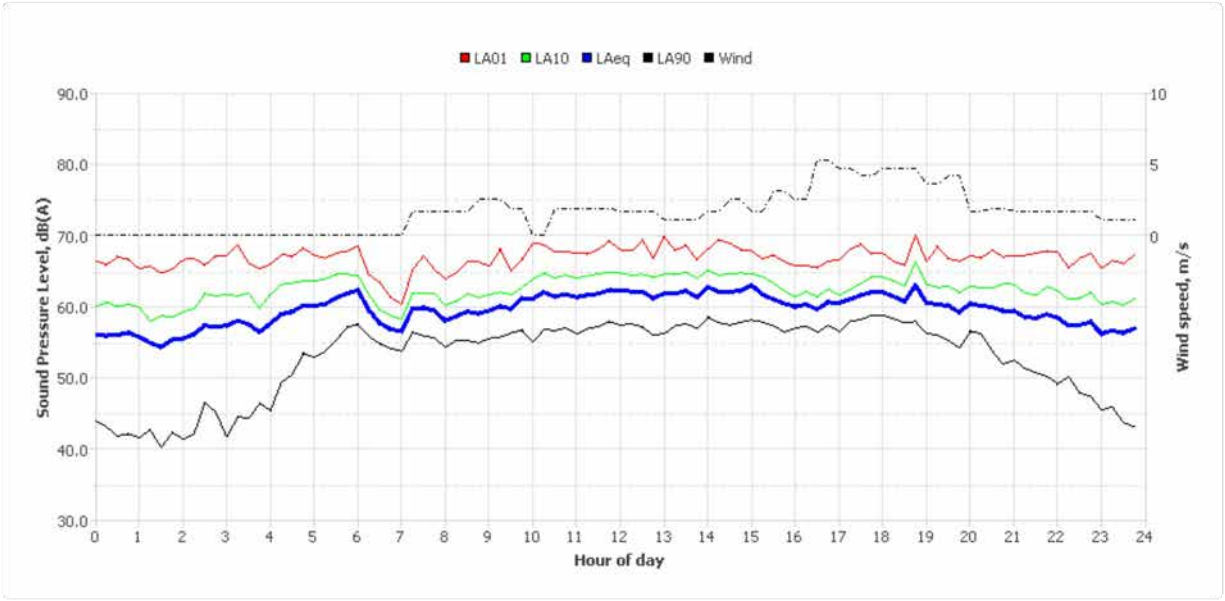
Monday, 01 Mar 2021



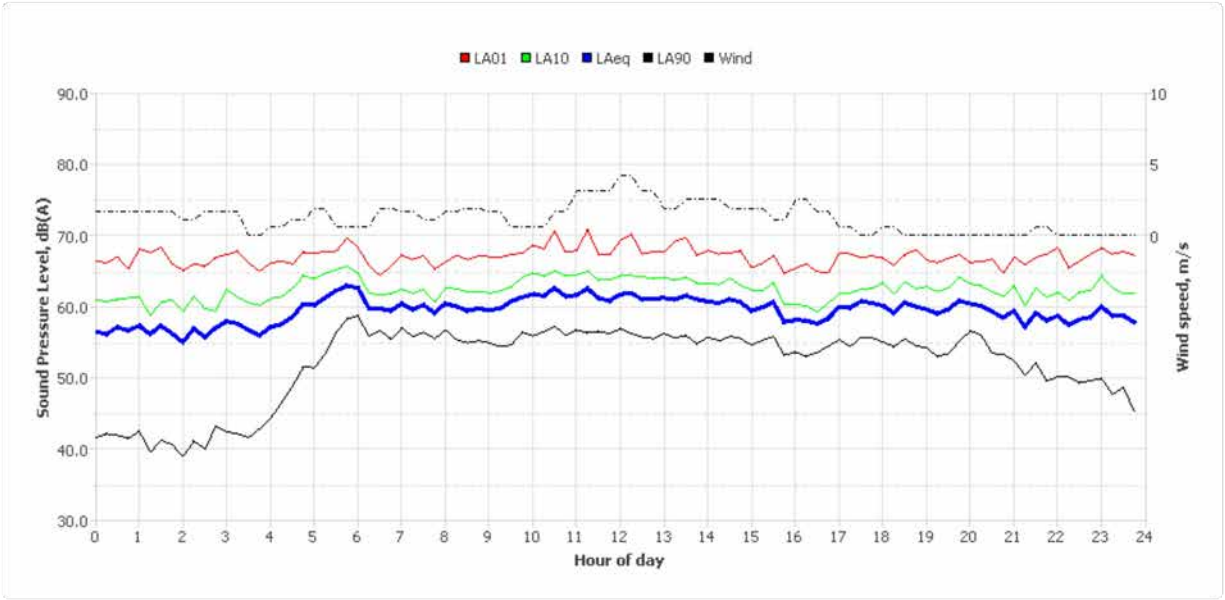
Tuesday, 02 Mar 2021



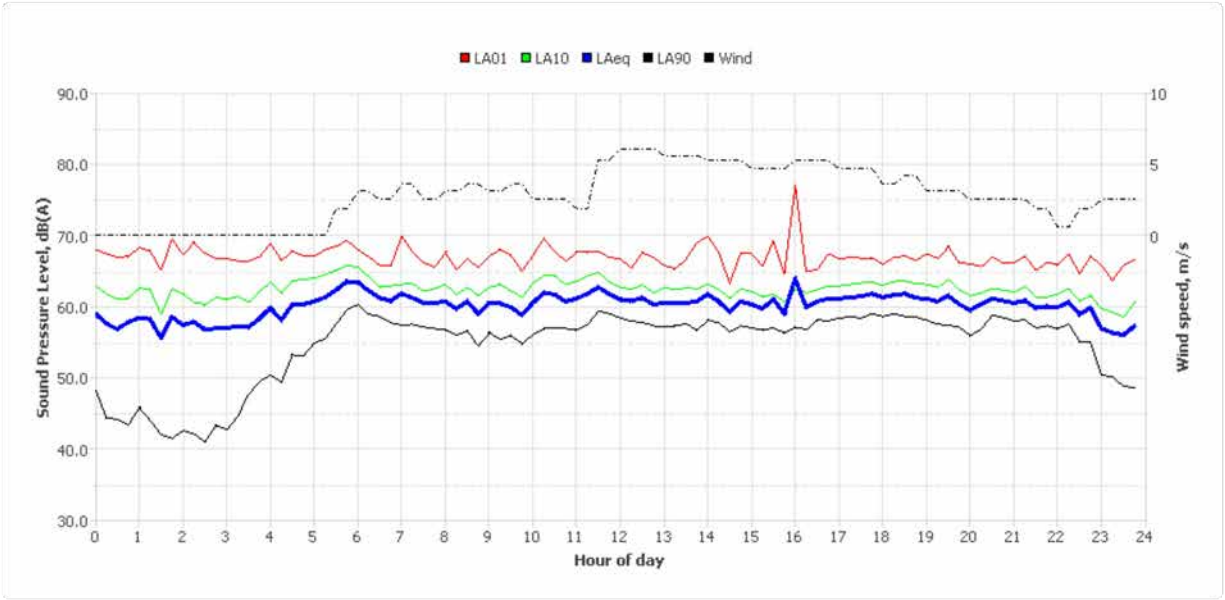
Wednesday, 03 Mar 2021



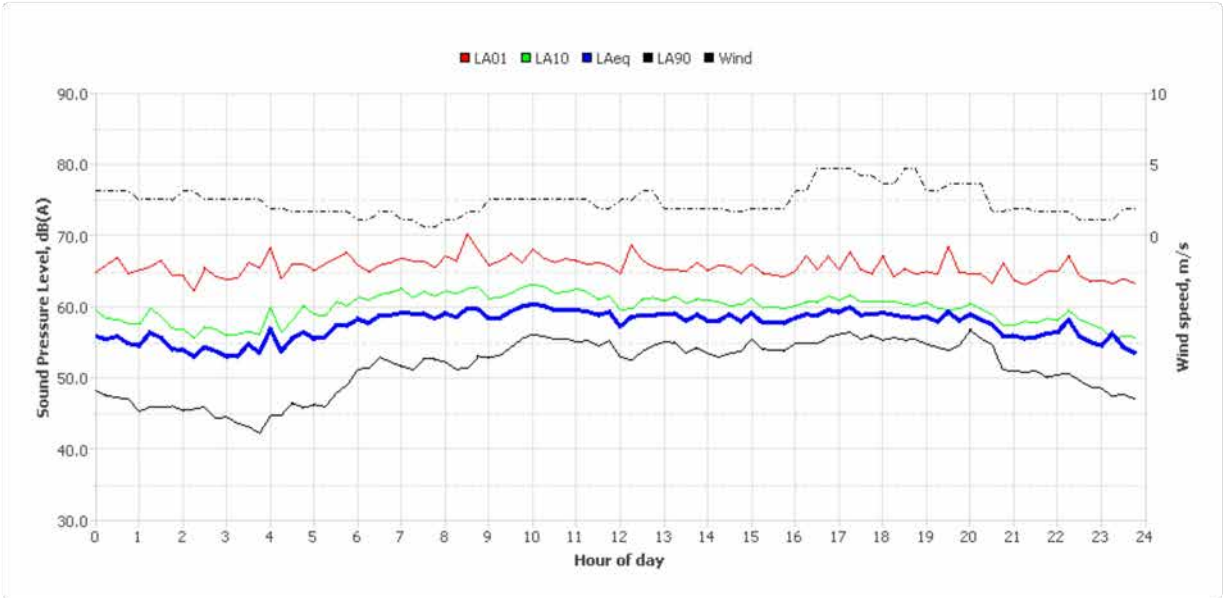
Thursday, 04 Mar 2021



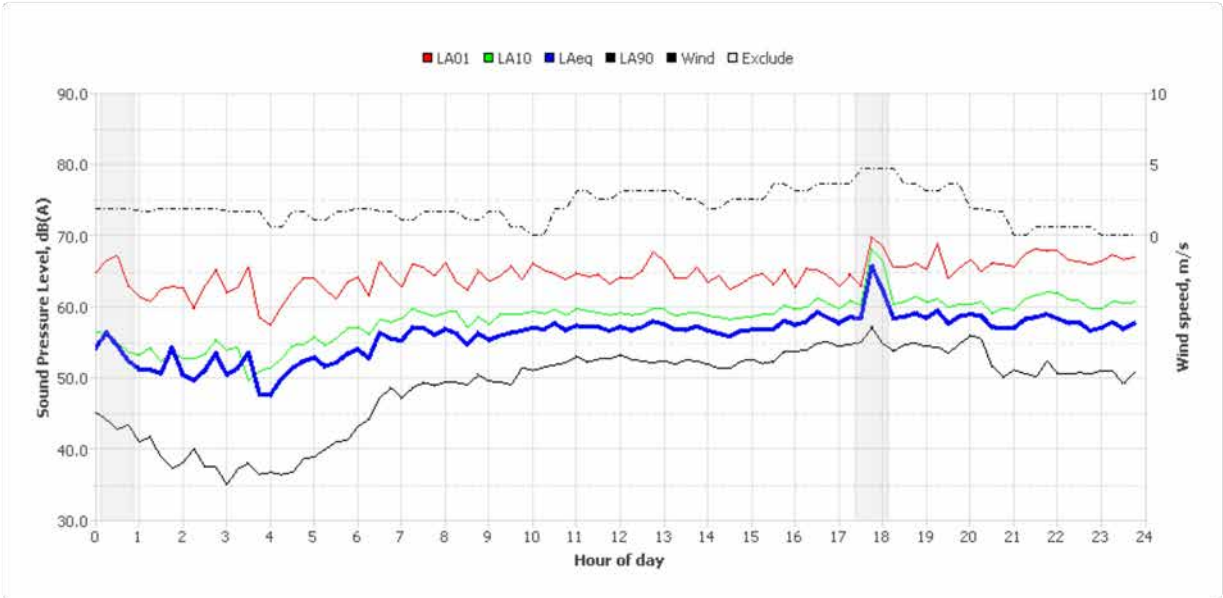
Friday, 05 Mar 2021



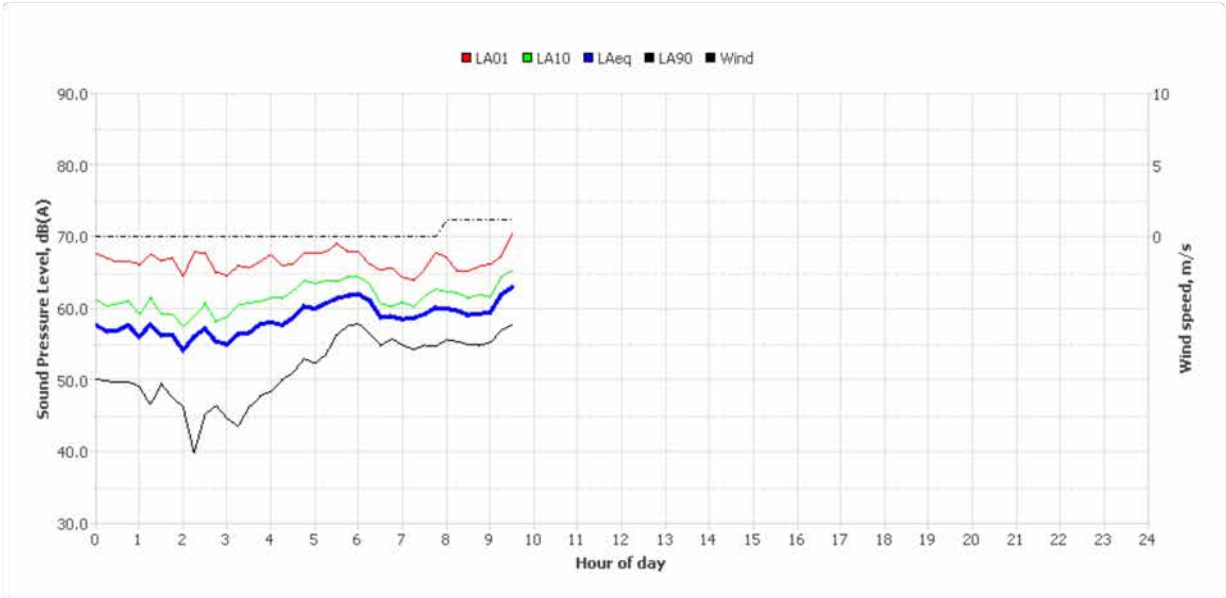
Saturday, 06 Mar 2021



Sunday, 07 Mar 2021



Monday, 08 Mar 2021



Noise Logger Report

NL15 - Lot 28, DP1123873, Prestons

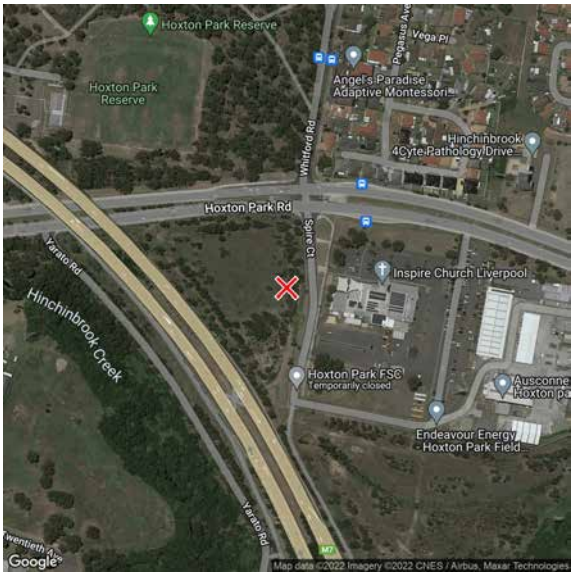
Item	Information
Logger Type	NGARA
Serial number	8780D3
Address	NL15 - Lot 28, DP1123873, Prestons
Location	NL15 - Lot 28, DP1123873, Prestons
Facade / Free Field	Free field
Environment	Noise environment mostly cicada noise 55-65 dB(A). Hoxton park road same or slightly more dominant than M7 which is behind noise wall. Truck engine brake 70 dB(A) from M7

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 Feb 16 2021	-	57	58	-	53	-	57	58
Wed Feb 17 2021	54	56	55	-	-	-	54	55
Thu Feb 18 2021	55	-	55	42	-	48	55	55
Fri Feb 19 2021	55	57	55	-	-	47	55	55
Sat Feb 20 2021	52	55	54	41	49	45	53	54
Sun Feb 21 2021	51	53	53	-	-	45	51	53
Mon Feb 22 2021	55	58	52	43	-	-	56	52
Summary	**54**	**56**	**55**	**42**	**51**	**46**	**55**	**55**

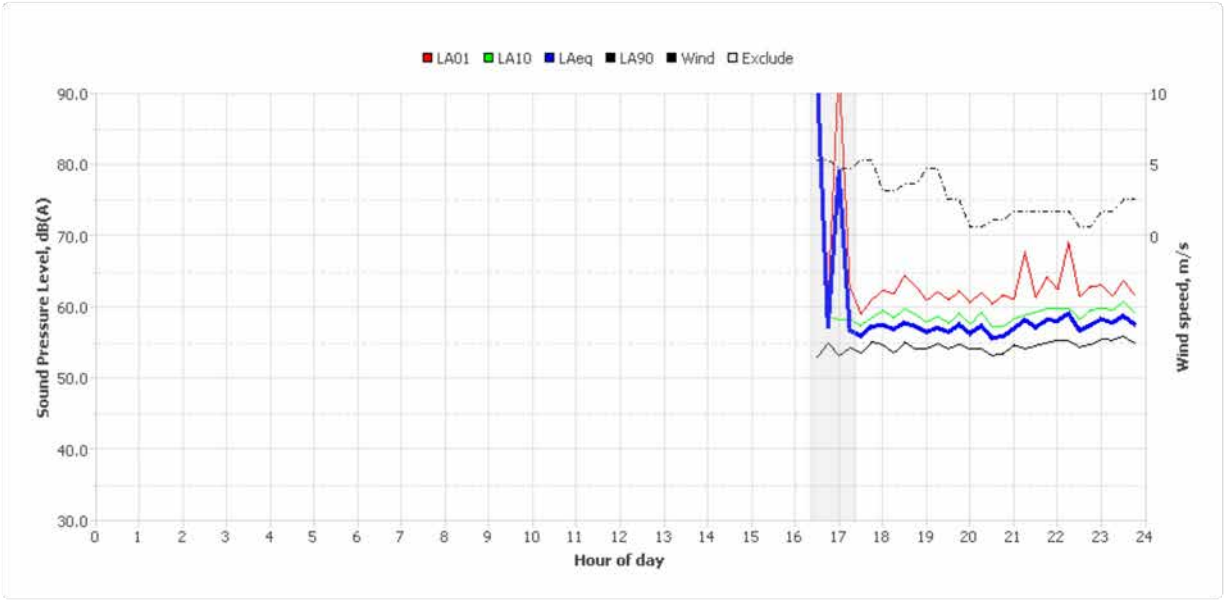
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location

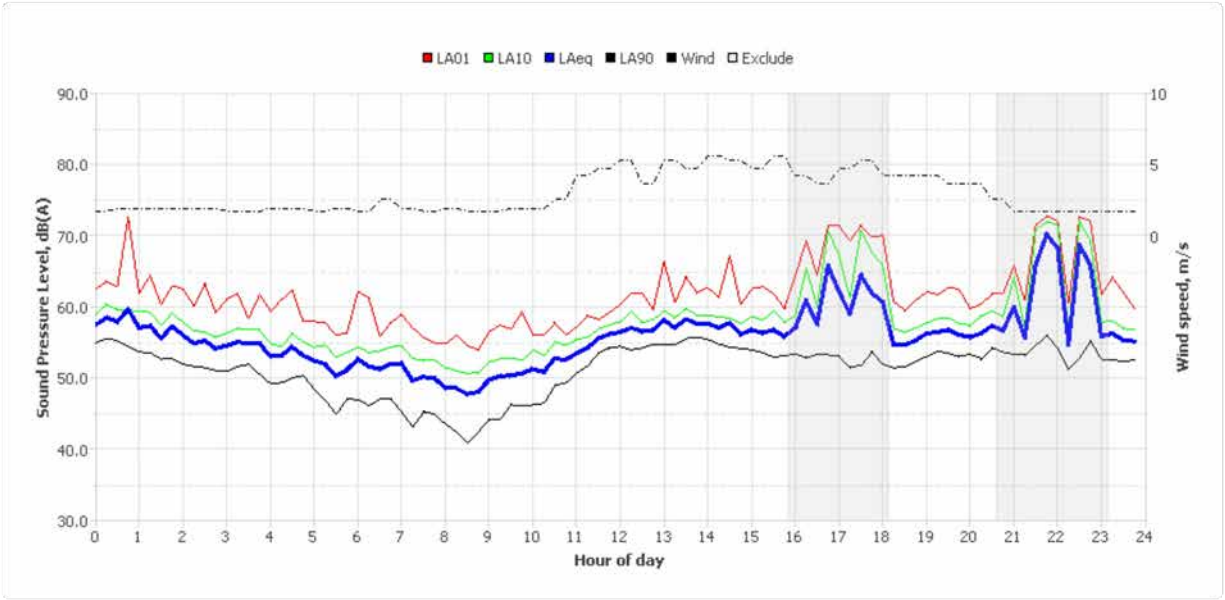


Logger Deployment Photo

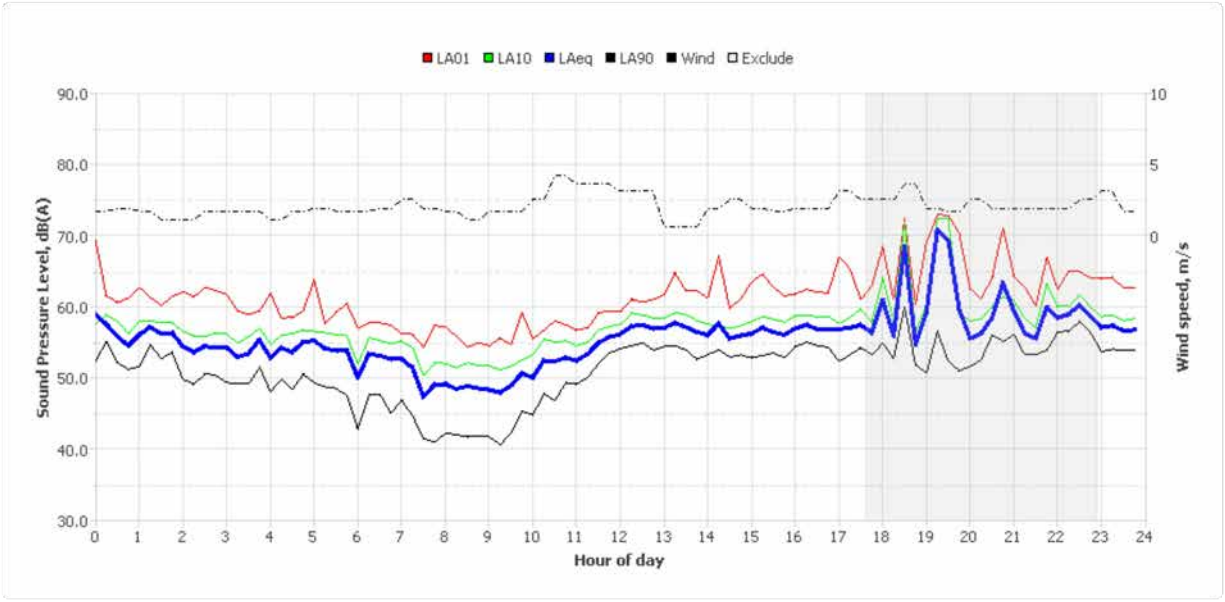
Tuesday, 16 Feb 2021



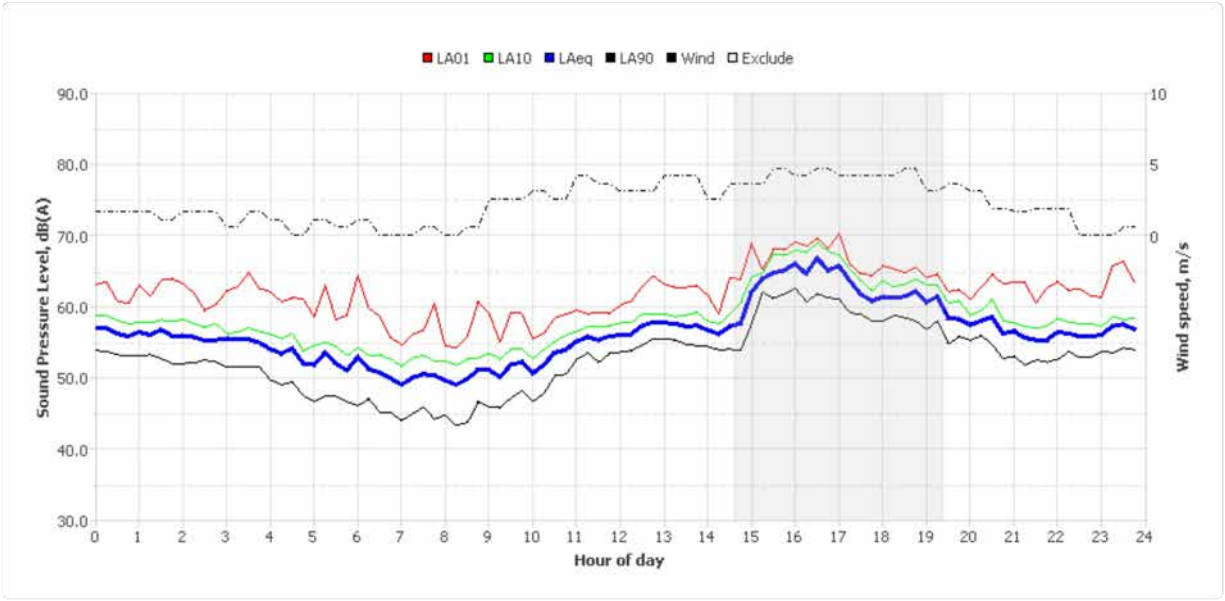
Wednesday, 17 Feb 2021



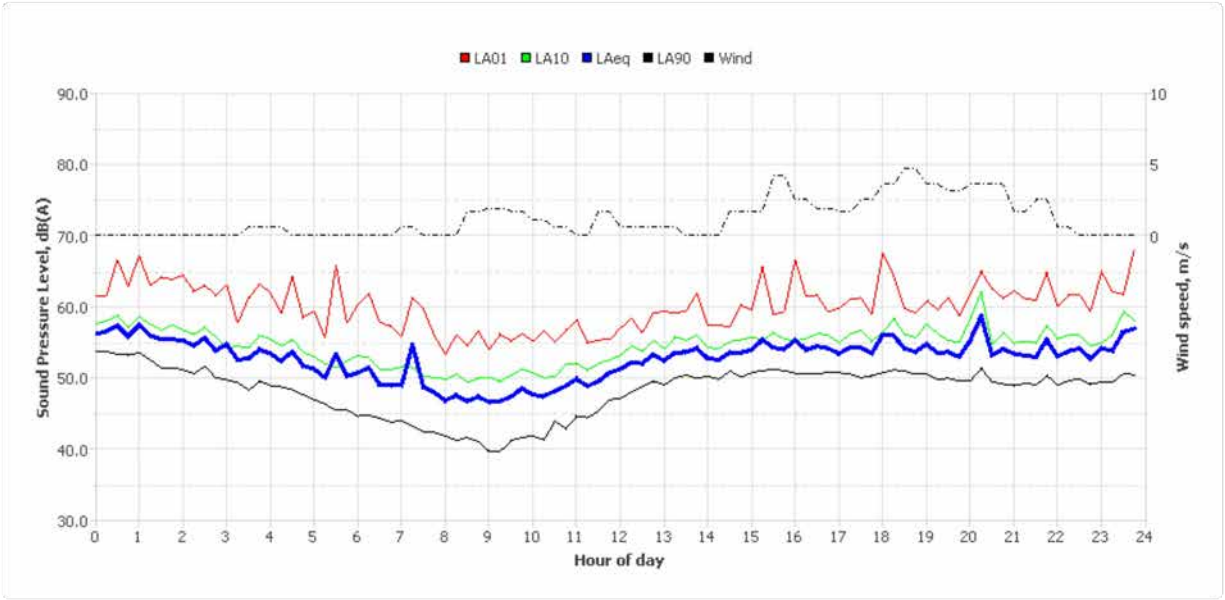
Thursday, 18 Feb 2021



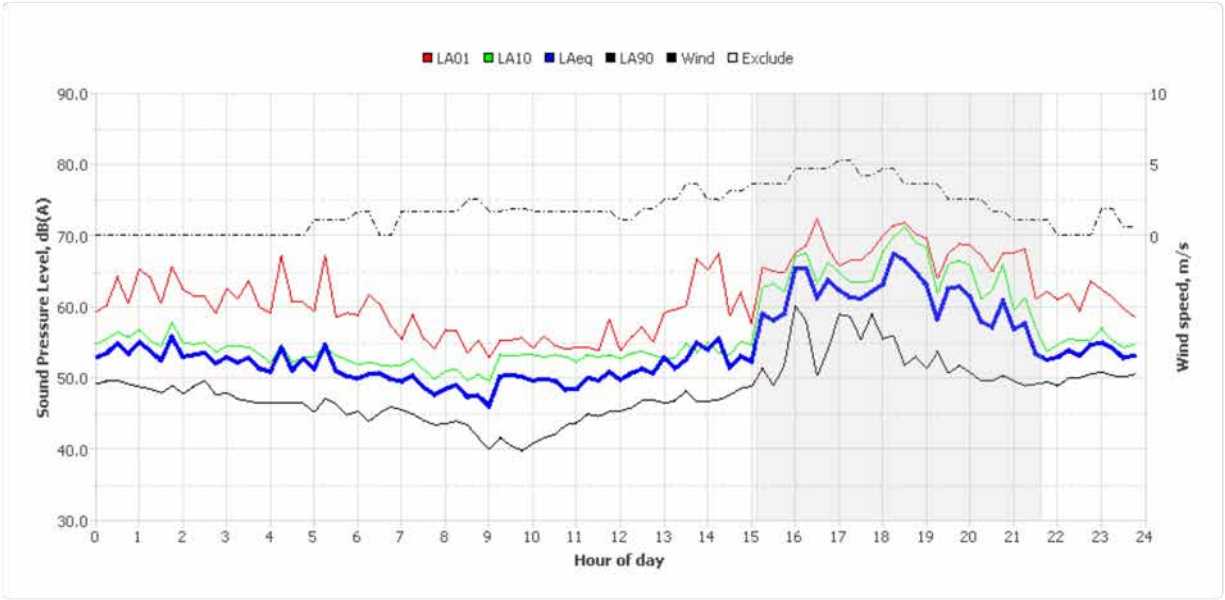
Friday, 19 Feb 2021



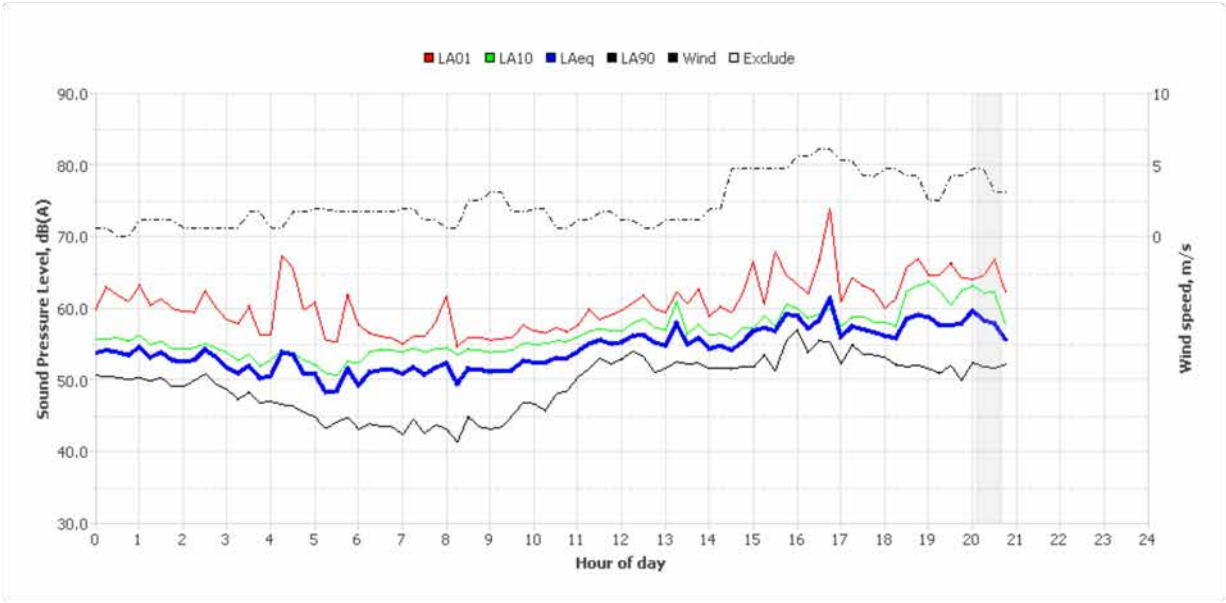
Saturday, 20 Feb 2021



Sunday, 21 Feb 2021



Monday, 22 Feb 2021



Noise Logger Report

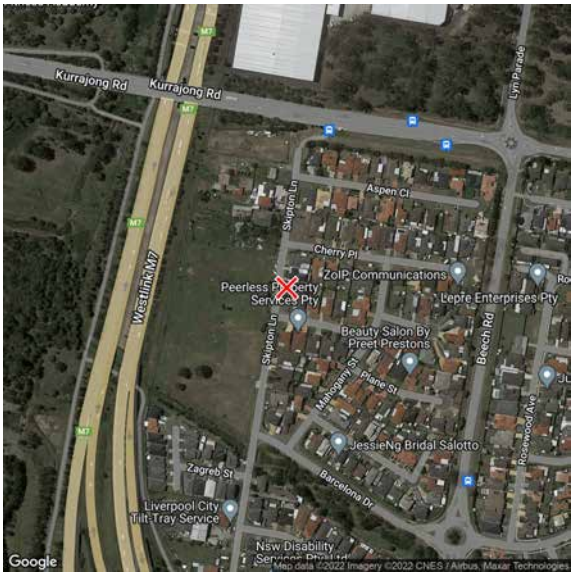
NL17 - 11 Skipton Lane, Prestons

Item	Information
Logger Type	NGARA
Serial number	878079
Address	NL17 - 11 Skipton Lane, Prestons
Location	NL17 - 11 Skipton Lane, Prestons
Facade / Free Field	Free field
Environment	Cicadas audible. Birds chirping. Sunny weather. Background dominated by Road traffic noise on M7 (45.8 dB(A)). Car on Skipton Lane (60.8 dB(A)). Truck on Skipton Lane (78 dB(A)).

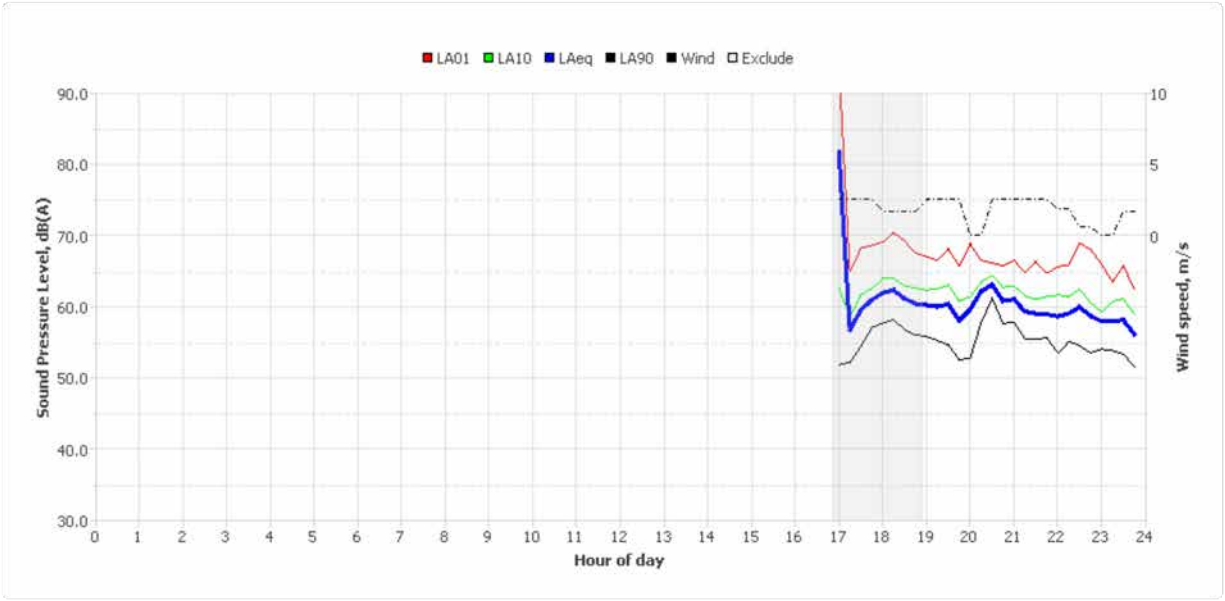
Measured noise levels

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 Feb 25 2021	-	60	58	-	-	-	60	58
Fri Feb 26 2021	61	-	58	-	-	48	61	58
Sat Feb 27 2021	56	54	57	46	-	-	56	57
Sun Feb 28 2021	53	54	59	-	-	-	53	59
Mon Mar 1 2021	60	61	58	52	54	-	61	58
Tue Mar 2 2021	60	56	60	-	-	-	59	60
Wed Mar 3 2021	-	-	58	-	-	-	-	58
Summary	**59**	**58**	**58**	**49**	**54**	**48**	**59**	**58**

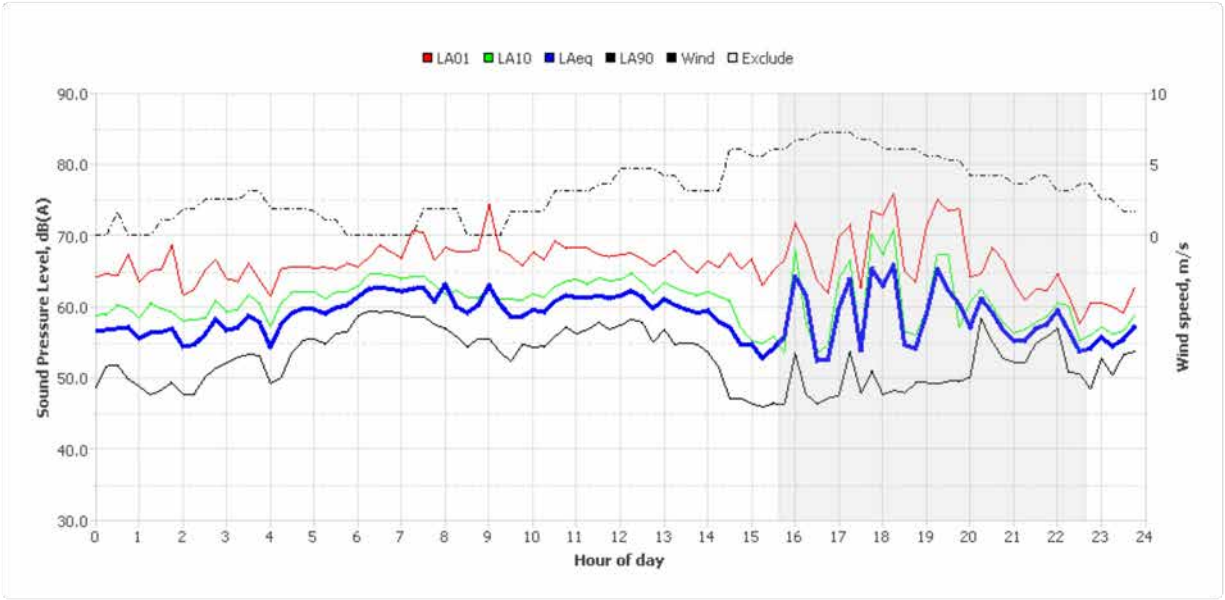
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location	Logger Deployment Photo
	

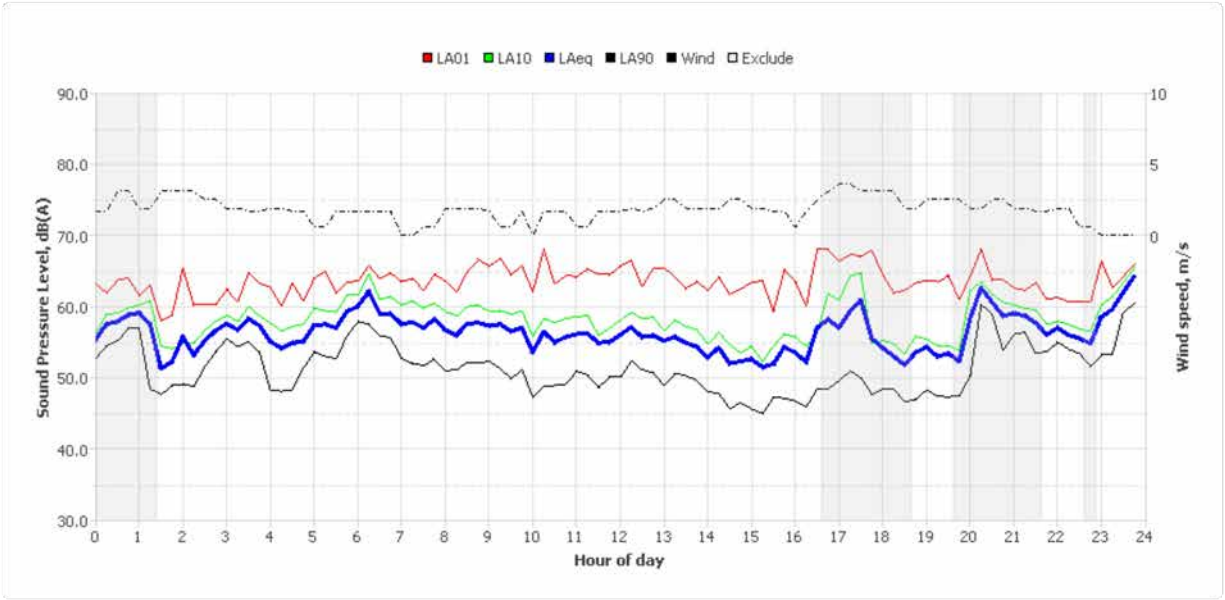
Thursday, 25 Feb 2021



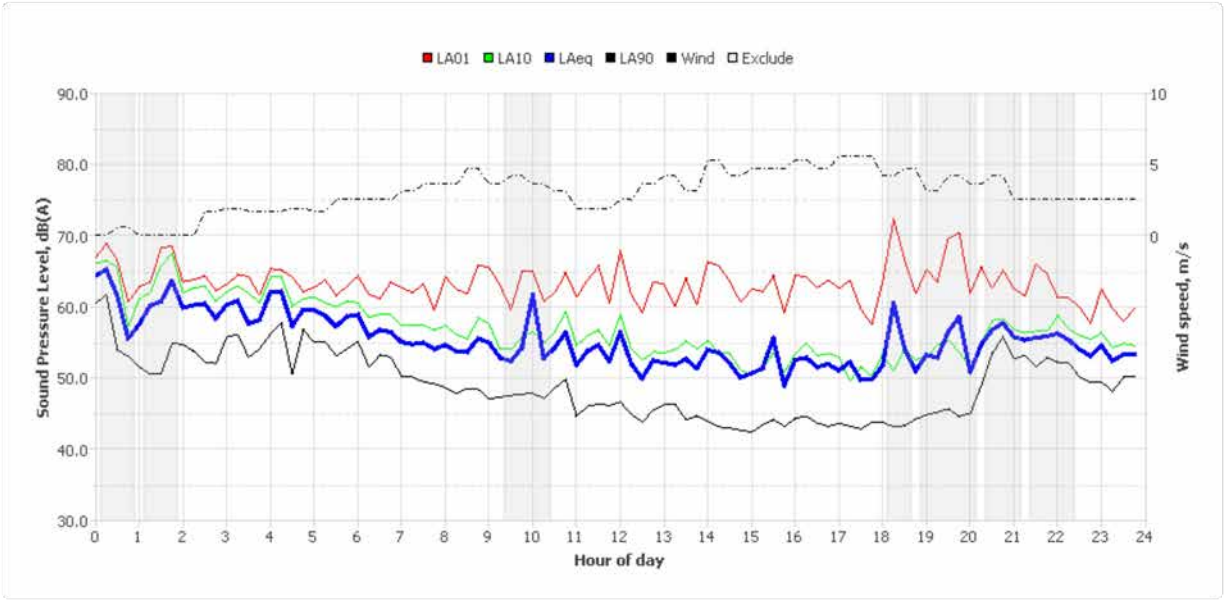
Friday, 26 Feb 2021



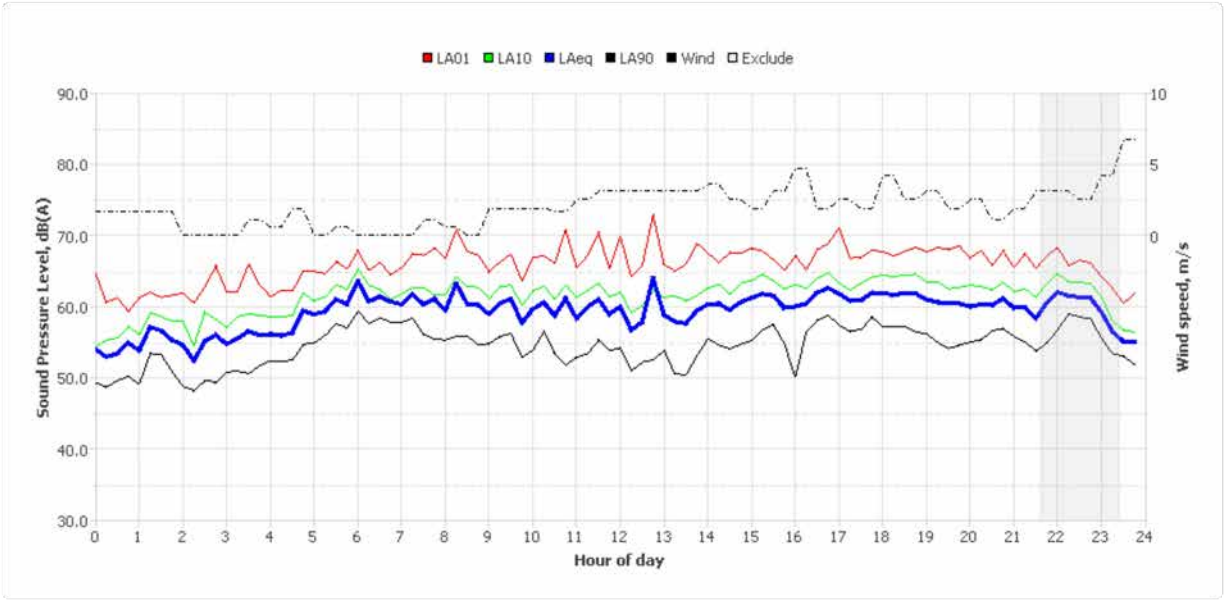
Saturday, 27 Feb 2021



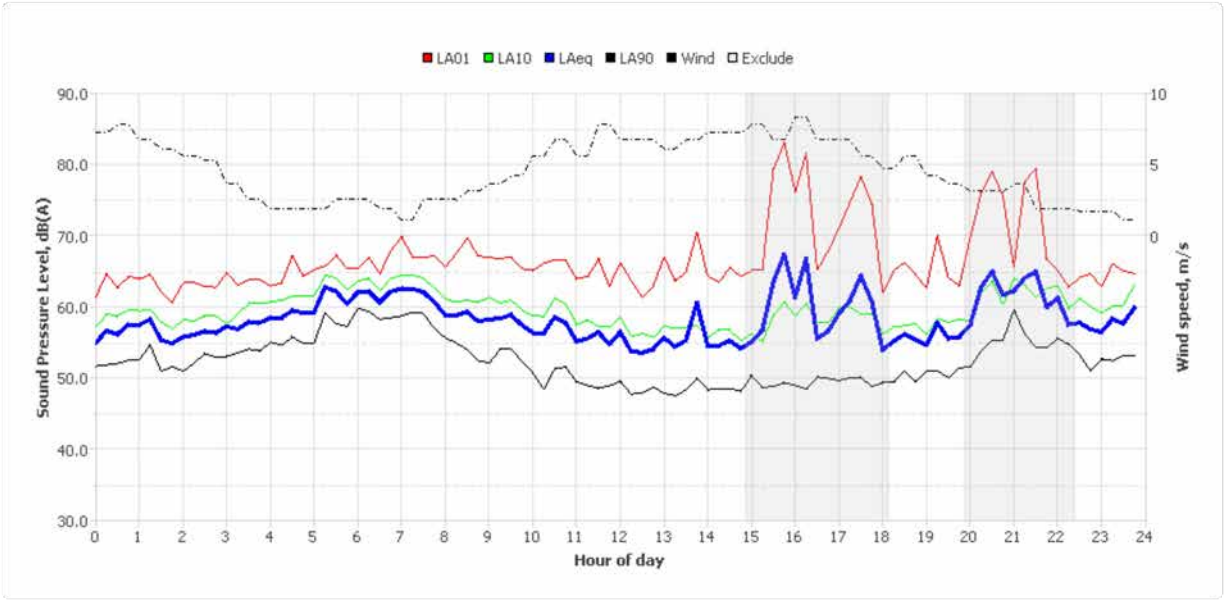
Sunday, 28 Feb 2021



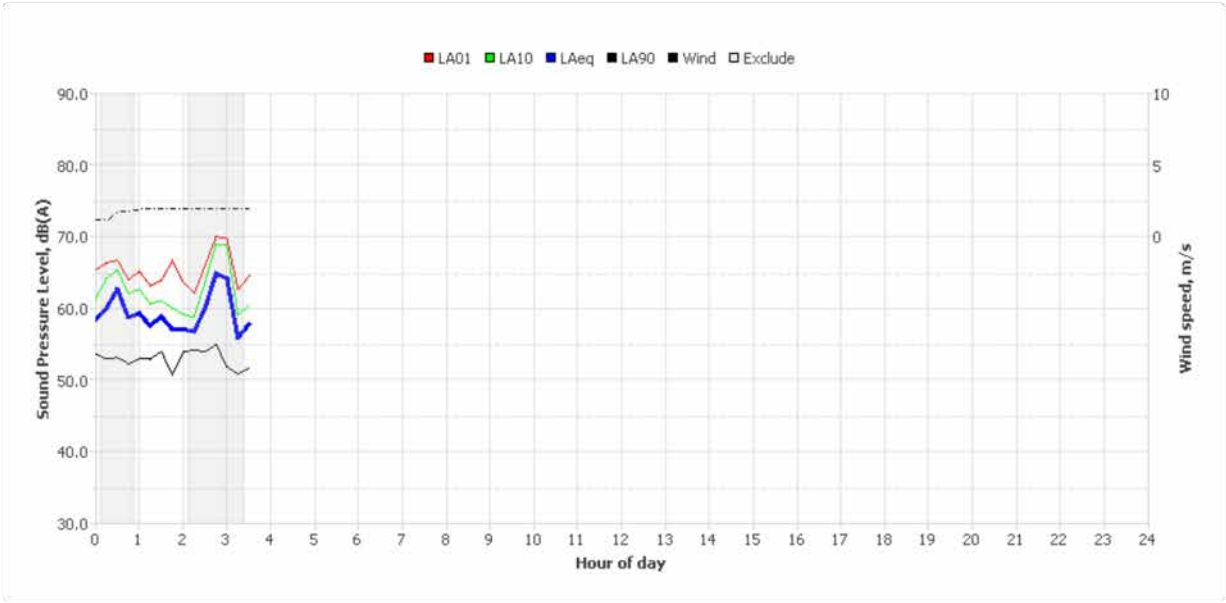
Monday, 01 Mar 2021



Tuesday, 02 Mar 2021



Wednesday, 03 Mar 2021



Noise Logger Report

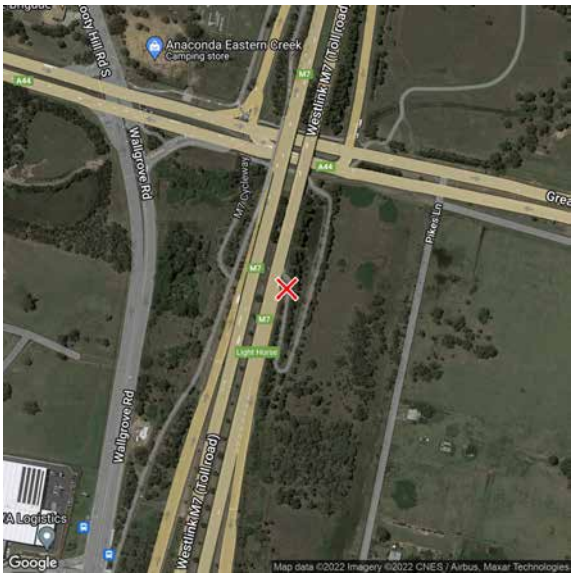
NL19 - Lot 13, DP1040948, Eastern Creek

Item	Information
Logger Type	NGARA
Serial number	87807B
Address	NL19 - Lot 13, DP1040948, Eastern Creek
Location	NL19 - Lot 13, DP1040948, Eastern Creek
Facade / Free Field	Free field
Environment	Dominated by Road traffic noise on M7 76.1 dB(A). Truck near lane 80.4 dB(A). Sunny weather. Cicadas audible

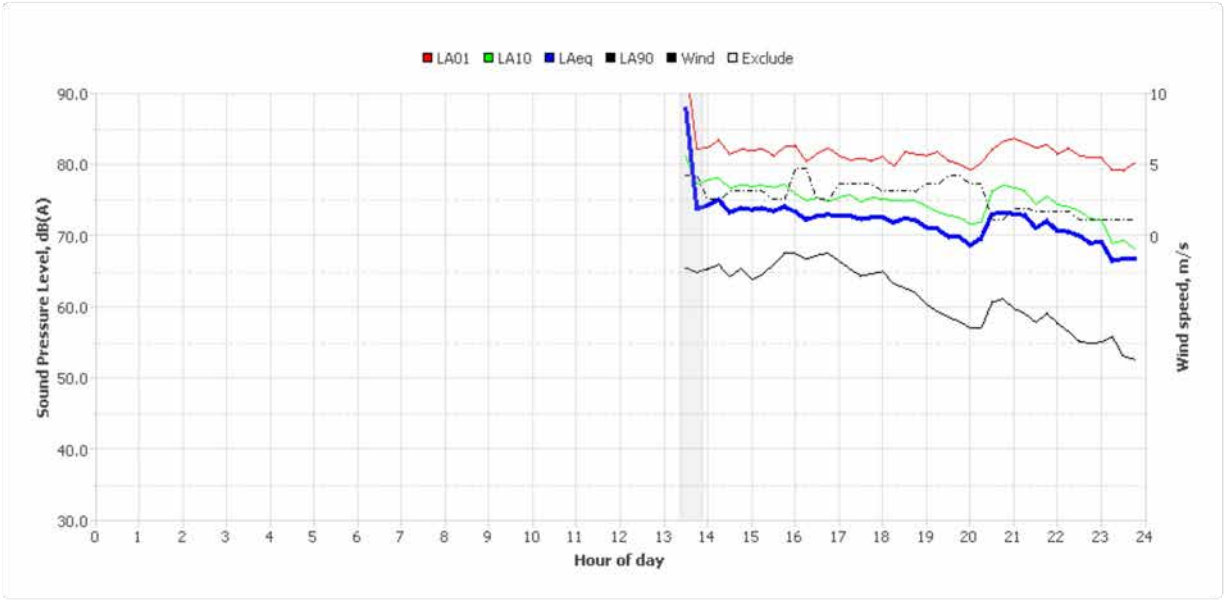
Measured noise levels

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
Tue Feb 23 2021	73	72	69	-	57	-	73	69
Wed Feb 24 2021	73	70	70	63	54	49	73	70
Thu Feb 25 2021	74	70	69	64	56	47	73	69
Fri Feb 26 2021	74	70	70	-	55	49	73	70
Sat Feb 27 2021	71	68	66	59	54	44	71	66
Sun Feb 28 2021	70	68	64	55	53	45	69	64
Mon Mar 1 2021	73	69	69	62	56	44	72	69
Tue Mar 2 2021	73	70	69	-	54	48	72	69
Wed Mar 3 2021	73	70	69	63	56	47	72	69
Thu Mar 4 2021	73	69	69	63	55	48	72	69
Fri Mar 5 2021	73	-	70	-	-	-	73	70
Summary	**73**	**70**	**69**	**63**	**55**	**47**	**72**	**69**

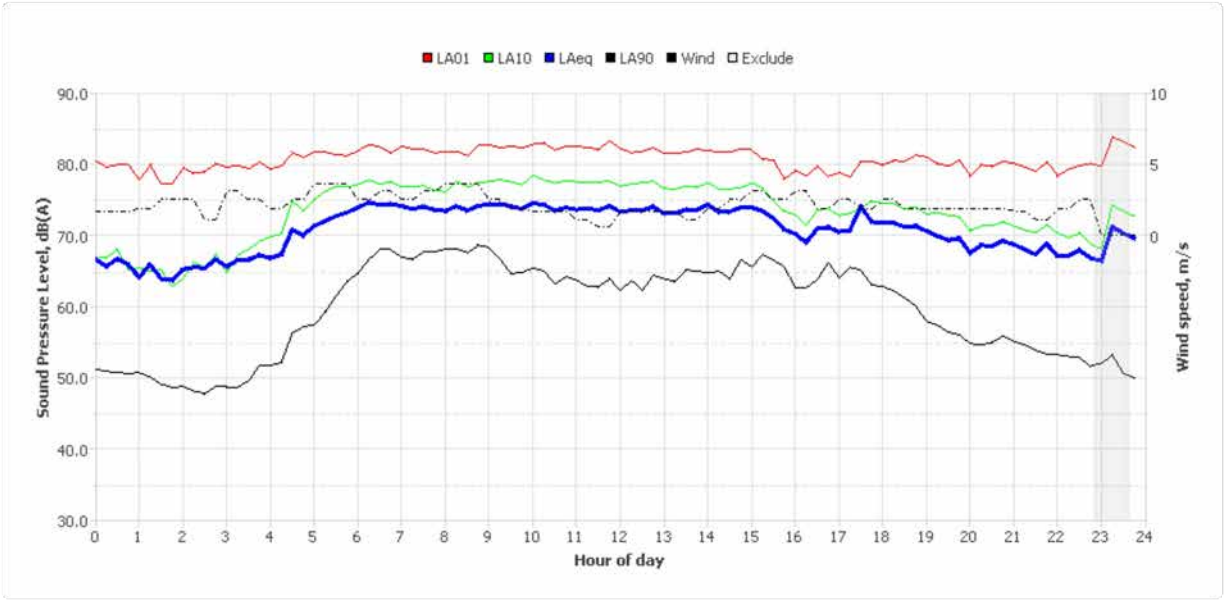
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location	Logger Deployment Photo
	

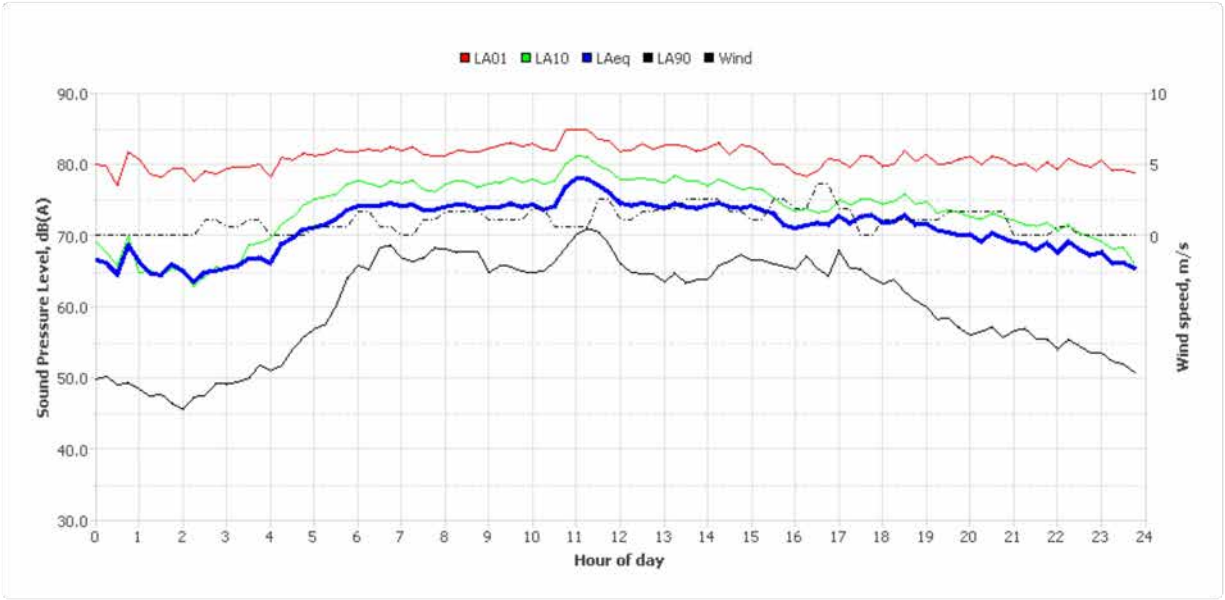
Tuesday, 23 Feb 2021



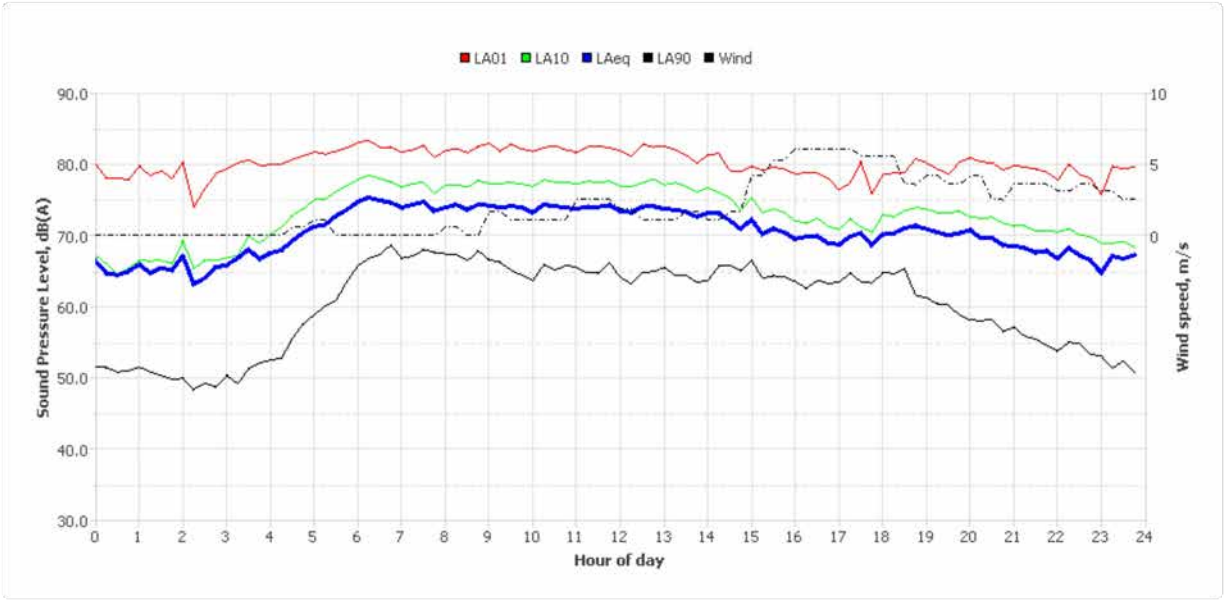
Wednesday, 24 Feb 2021



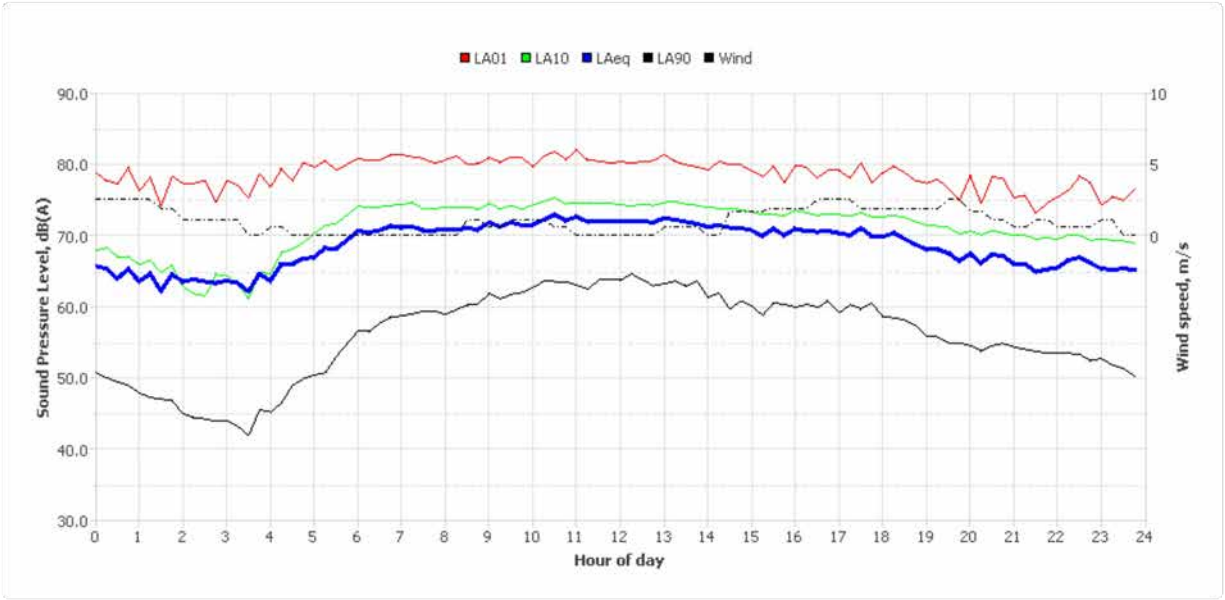
Thursday, 25 Feb 2021



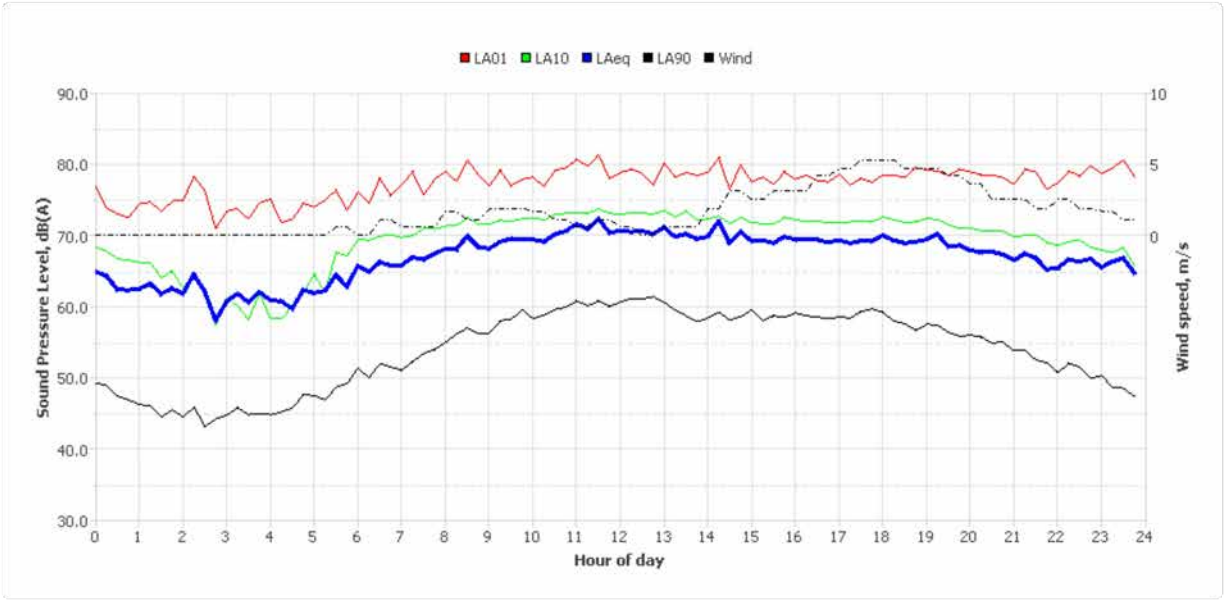
Friday, 26 Feb 2021



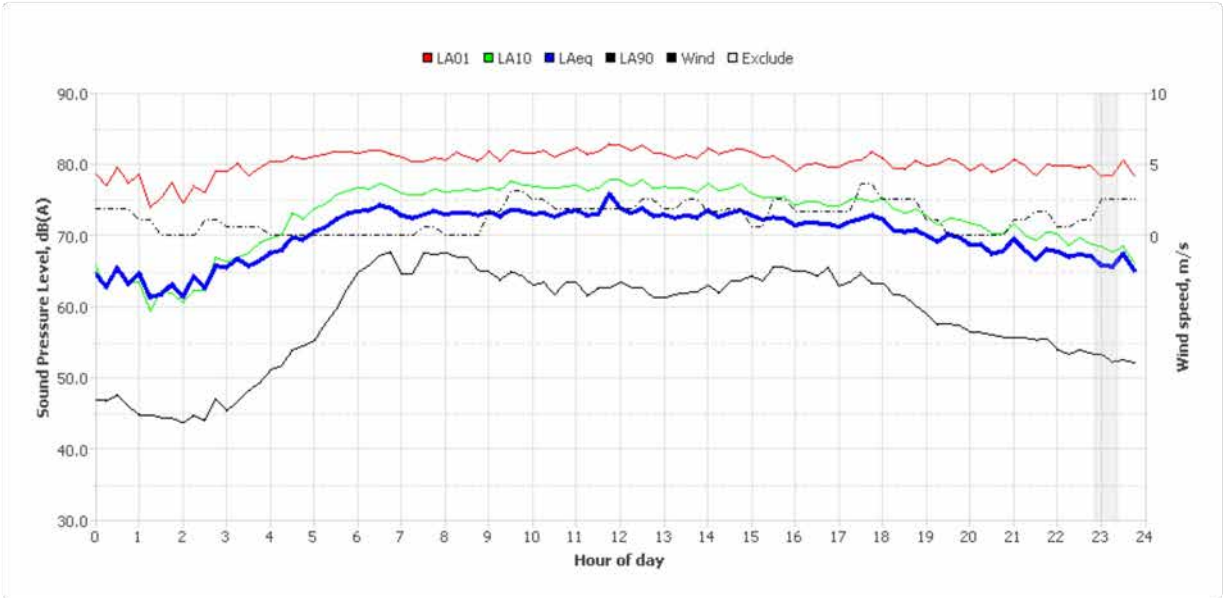
Saturday, 27 Feb 2021



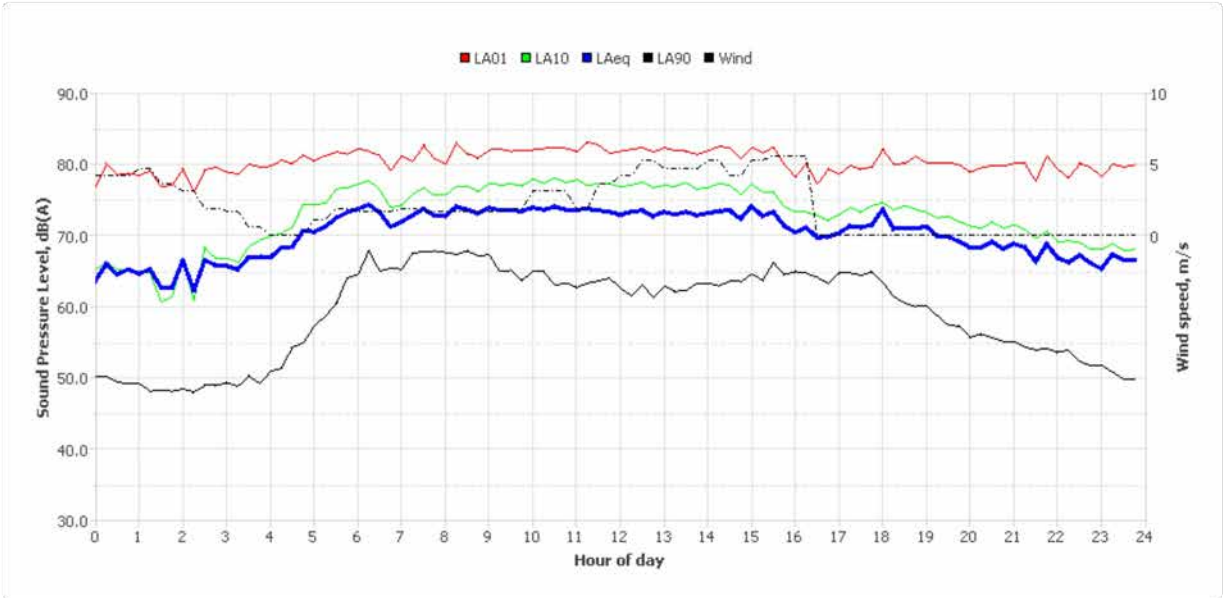
Sunday, 28 Feb 2021



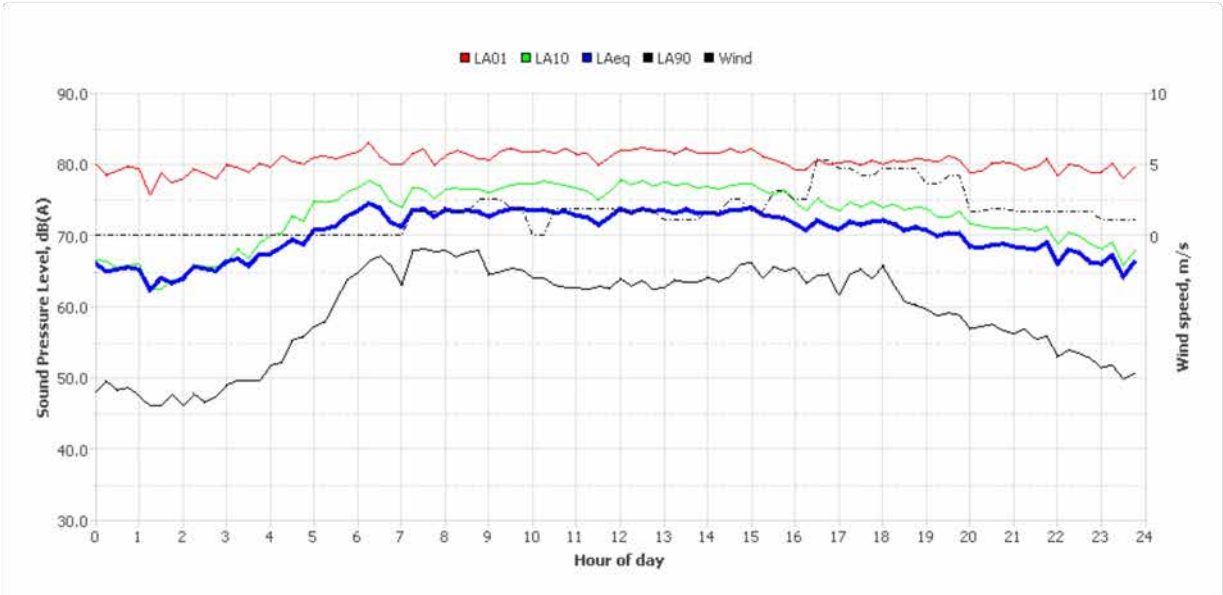
Monday, 01 Mar 2021



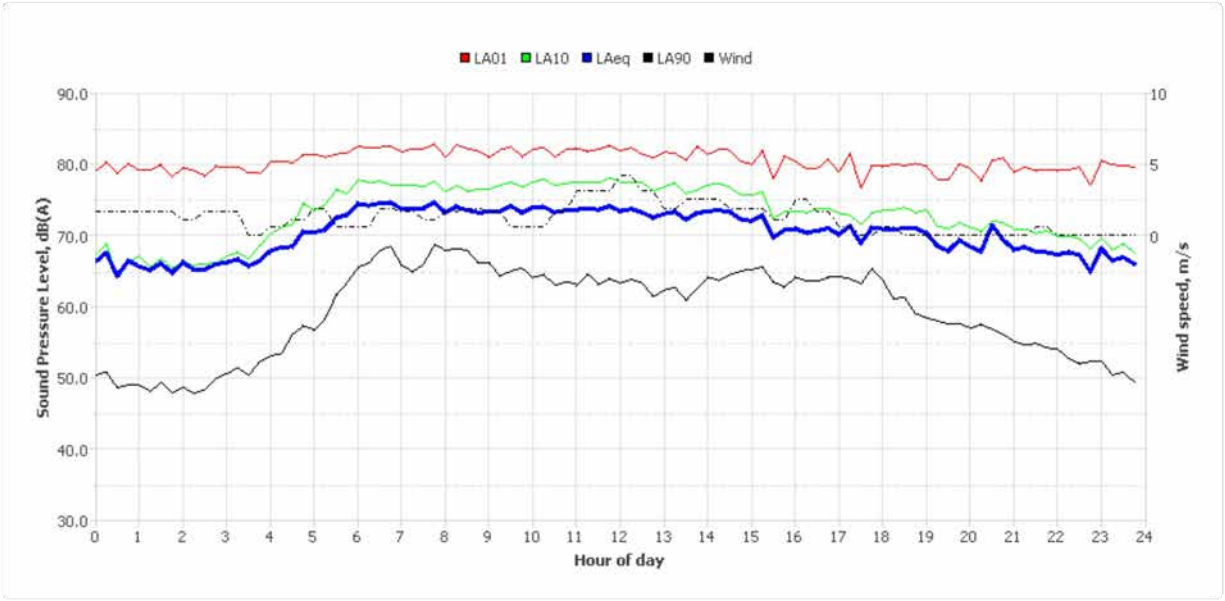
Tuesday, 02 Mar 2021



Wednesday, 03 Mar 2021



Thursday, 04 Mar 2021



Friday, 05 Mar 2021