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NSW GOVERNMENT

M12 Motorway Environmental Impact Statement

Appendix K Noise and Vibration Assessment Report

Roads and Maritime Services | October 2019

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Glossary of terms and abbreviations

Term	Meaning
Acute noise level	A level of road traffic noise of 65 dBA or more for the day period of 7 am to 10 pm or 60 dBA or more for the night period of 10 pm to 7 am and measured as an equivalent continuous noise level (L_{Aeq}) 1 metre from the building facade.
AF	Ancillary facility
Airport access road	Part of the M12 Motorway connecting the Western Sydney Airport interchange with the Western Sydney Airport.
Arterial	Supports major regional and inter-regional traffic movement and carry traffic directly from one region to another. For noise assessment this term also includes freeways and motorways.
At-property treatments	Includes building treatments and courtyard walls. Building treatments may include but are not limited to ventilation, glazing, window and door seals, sealing of vents and underfloor areas.
At-receiver treatments	Includes building treatments and courtyard walls. Building treatments may include but are not limited to ventilation, glazing, window and door seals, sealing of vents and underfloor areas.
CEMP	Construction Environmental Management Plan
Construction footprint	The construction footprint is the area required to build the project. This includes the area required for temporary work such as sedimentation basins, drainage lines, access roads, construction ancillary facilities.
CNVMP	Construction Noise and Vibration Management Plan
Closely spaced group of residences	Residences are generally considered closely spaced where the facades are separated by less than 20 metres.
Collector road	Connects the sub-arterial roads to the local road system in developed areas. May support sub-arterial roads during peak periods. May have been designed as local streets but can serve major traffic-generating developments or support non-local traffic. Note not all networks are large enough to have both collector and sub-arterial roads. The Road Noise Policy does not provide separate noise criteria for collector roads. Roads and Maritime applies sub-arterial noise criteria to collector roads and still considers collector roads and sub-arterial roads to be different functional classes.
Controlling criterion	Whichever of the day or night time L_{Aeq} criteria (*Noise Criteria Guideline*) is exceeded by the greatest amount.
Cumulative limit	A total noise level that is 5 dBA or more above the *Noise Criteria Guideline* criteria in the build year – discussed further in **Section 4.2.8**.
dBA	Decibel, A-weighted – discussed further in **Annexure A**
DEC	Department of Environment and Conservation (now EPA)
DECC	Department of Environment and Climate Change (now EPA)
DECCW	Department of Environment, Climate Change and Water (now EPA)
Design barrier	Barrier where two-thirds of receivers that qualify for consideration of noise mitigation and receive benefit from the noise barrier no longer need at-property treatments. In some instances, the height may be increased where the points weighting curve has a minimum value.
DP	Deposited plan
DPE	Department of Planning and Environment (now DPIE)
DPIE	Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
Equitable	Receivers and communities exposed to road project noise receive consistent outcomes.

Term	Meaning
Exclusion zones	Exclusion zones are areas of environmental importance (eg threatened vegetation or heritage items) that need to be protected. Exclusion zones are shown on figures throughout this EIS where relevant. These exclusion zones are defined as no-go areas and are to be protected for the duration of construction in that particular footprint area.
Existing road corridor	A corridor of land that is zoned for road purposes in relevant environmental planning instruments such as LEPs and contains an existing formed and dedicated public or classified road within the road reserve. Note that lots subsequently purchased and owned by Roads and Maritime that are adjacent to the existing road reserve do not form part of the existing corridor.
Feasibility	Relates to engineering considerations (what can be practically built). These engineering considerations may include: • The inherent limitations of different techniques to reduce noise emissions from road traffic noise sources • Safety issues such as restrictions on road vision • Road corridor site constraints such as space limitations • Floodway and stormwater flow obstruction • Access requirements • Maintenance requirements • The suitability of building conditions for at receiver treatments.
Grade separated interchange	An interchange that is separated vertically (at different heights) involving bridges, underpasses and/or overpasses.
Highly sensitive receiver	Receiver where standard annoyance and human comfort criteria do not provide sufficient guidance on the impact. Some examples include buildings with sensitive equipment, recording studios and cinemas.
HNA	Highly Noise Affected
ICNG	Interim Construction Noise Guideline
INP	*Industrial Noise Policy*
ISCA	Infrastructure Sustainability Council of Australia
Isolated single residences and isolated groups of closely spaced residences	Single residences or closely spaced groups of residences in numbers of three or less are considered isolated where they are separated from other residences by more than 100 metres. Where residences are separated by between 20 metres and 100 metres they may be considered isolated, but this depends on examining surrounding development more broadly. If for example the low-density development comprises regular placement of residences at 20 metres to 100 metres separation, then the residences are not considered isolated.
LAeq	The average noise level over a measurement period, such as the daytime or night-time – discussed further in **Annexure A**
LAmax	The maximum noise level – discussed further in **Annexure A**
LEP	Local Environmental Plan
LGA	Local government area
Local road	Provide vehicular access to abutting property and surrounding streets. They are the subdivisional roads within a particular developed area.
Low noise pavement	Low noise pavement is pavement that has an emission level 2 dBA lower or more than dense graded asphalt.
M12 Motorway	The proposed M12 Motorway which is the subject of this document (also known as 'the project')
M7 Motorway	The M7 Motorway is a major connecting road on Sydney's orbital motorway network. It runs for 40 km and links the M5 Motorway with the M4 Motorway and the M2 Motorway.
Maximum barrier design	The barrier height where there are no receivers behind the barrier that need at-property noise treatment other than those that are influenced by barrier end effects or noise from other non-project roads.

Term	Meaning
Modelling allowance	A decibel amount added to predicted noise levels to artificially increase them. This may be used to provide conservatism to predictions where there is uncertainty in modelling input parameters. In engineering design this is commonly referred to as a safety factor. The modelling allowance should be applied to both the build and no build cases so that it does not affect the difference in noise levels between them.
NATA	National Association of Testing Authorities
New road	See Section 5.2 the *Noise Criteria Guideline* for clarification.
NCA	Noise Catchment Area
NML	Noise Management Level
NPfI	*Noise Policy for Industry*
NSW	New South Wales
OOH	Out of Hours
OOHW	Out of Hours Work
Operational footprint	Generally includes the M12 Motorway and additional areas required for operation and maintenance of the project
Operational study area	The study area for the operational noise assessment extends to a distance of 600 metres on each side of the project roads (measured from the centreline of the outermost traffic lanes), as defined in the RNP and NCG. This distance is based on the limit of accuracy of currently approved road traffic noise models. The operational study area is hard cut at the project extents, as per Roads and Maritime's application of the NCG.
OSO	The Outer Sydney Orbital is a future transport corridor being investigated by the NSW Government which will provide for a connection between Box Hill in the north and the Hume Motorway near Menangle in the south. The OSO will provide for a major transport link (motorway and/or freight rail line) between western Sydney's growth areas, connecting with the planned Western Sydney Airport and future employment lands.
Reasonable	Selecting reasonable measures from those that are feasible involves judging whether the overall noise benefits provide significant social, economic or environmental benefits. The factors to be considered are: • The noise reduction provided and the overall number of people that benefit from the mitigation. • Existing and future noise levels, including changes in noise levels in the build and design year and the extent of any exceedance of the noise criteria. • Potential for a mitigation measure to reduce noise during construction as well as from road traffic after the project is complete. • The cost of mitigation, including the cost of noise mitigation measures as a per centage of the total project cost and the ongoing maintenance and operational costs. • Community views and preferences (typically gathered during the community consultation process following the noise assessment). • Visual impacts for the community surrounding the road project and for road users. These are typically identified in the Environmental Assessment. • The wider community benefits arising from noise mitigation of the proposed road or road redevelopment. • Relative weighting of treatments with respect to protection of outdoor areas or only internal living spaces.
RBL	Rating Background Level – discussed further in **Annexure A**
Receiver	A noise sensitive receiver includes the following: residences, schools, child care centres, places of worship, health care institutions.
Redeveloped road	Please see Section 5.3 of *Noise Criteria Guideline* for clarification.
RNP	*Road Noise Policy*

Term	Meaning
Roads and Maritime	Roads and Maritime Services
ROL	Road Occupancy Licence
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State environmental planning policy
Site law	The site specific vibration attenuation with distance. This is determined by measuring vibration at numerous distances from a source to determine the rate of attenuation with distance for that specific location.
SLR	SLR Consulting Australia Pty Ltd
Study area	The area around the project has been summarised using ten Noise Catchment Areas (NCAs) which collectively make up the study area – discussed further in **Chapter 2**.
Sub-arterial road	Connects arterials to regions of development and carry traffic from one part of a region to another. Provide connection between arterial roads and local roads. May support arterial roads during peak periods. A road that collects local traffic leaving a locality and connects to another local road, sub-arterial or arterial. Note not all networks are large enough to have both sub-arterial and collector roads.
The project	M12 Motorway
Transition zone	The 'transition zone' is the area either side of the physical transition point between road functional classes (eg arterial versus local) or road development types (eg new versus redeveloped road project). See Section 5.4 of the *Noise Criteria Guideline*.
Triggered receiver	A noise sensitive receiver which is predicted to exceed any of the operational road traffic noise triggers for consideration of noise mitigation.
VC	Vibration Criterion
VDV	Vibration Dose Value
VMS	Variable Messaging Signs
Western Sydney Aerotropolis	As defined in the Western Sydney Aerotropolis Stage 1 Plan, the Aerotropolis surrounds the Western Sydney Airport site at Badgerys Creek and will comprise industrial, commercial and residential development.
WSA	The future Western Sydney Airport at Badgerys Creek

Executive summary

Background

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to construct and operate the M12 Motorway project to provide direct access between the Western Sydney Airport at Badgerys Creek and Sydney's motorway network (the project). The project has been determined to be a controlled action under Section 75 of the Environment *Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act) (EPBC 2018/8286) for significant impact to threatened species and communities (Section 18 and Section 18A of the EPBC Act). As such, the project requires assessment and approval from the Commonwealth Government.

The M12 Motorway would run between the M7 Motorway at Cecil Hills and The Northern Road at Luddenham for a distance of about 16 kilometres and would be opened to traffic prior to opening of the Western Sydney Airport.

Purpose of this report

This report has been prepared to support the environmental impact statement (EIS) for the M12 Motorway project. The EIS has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) for the project (SSI 9364) and to enable the Minister for Planning and Public Spaces and the Commonwealth Minister for the Environment to make a determination on whether the project can proceed. The report presents an assessment of the construction and operational activities for the project that have the potential to produce noise and vibration impacts.

Overview of potential impacts

Construction noise and vibration assessment

As the nearest receivers are relatively distant and sparsely distributed in many areas of the project, the construction noise impacts across the project are relatively low. However, consistent with most major infrastructure projects, noise impacts during certain stages of construction are predicted to be 'high', particularly when noise intensive equipment such as rock-breakers or concrete saws are in use near to receivers.

Consistent with the requirements of the Interim Construction Noise Guideline, the construction noise impacts in this report are based on a realistic worst-case assessment. There would frequently be periods when construction noise levels are much lower than the worst-case levels presented and there would be many times when no equipment is in use and there are no impacts.

Residential receivers

The construction noise impacts at residential receivers are generally limited to catchments where receivers are located close to the construction footprint. This includes east of the M7 Motorway and north of Elizabeth Drive in noise catchment area (NCA)01, north of Elizabeth Drive near Salisbury Ave in NCA06 and near Clifton Avenue in the north of the construction footprint in NCA07. Receivers in these catchments are however generally sparsely distributed, meaning the number of receivers with the highest impacts is relatively low.

Seven receivers in total may be subject to construction noise levels above the Highly Noise Affected threshold and these receivers are located in:

- NCA01, to the east of the M7 Motorway
- NCA04, to the west of Wallgrove Road
- NCA06, on Salisbury Road
- NCA07, to the north of the project on Clifton Avenue.

‘Other’ sensitive receivers

The construction noise impacts at ‘other’ sensitive receivers (educational facilities, places of worship, childcare centres etc) are predicted to generally be minor, with moderate impacts predicted at the closest school (Irfan College) located in NCA04 when noise intensive equipment is in use. Noise levels and exceedances during the typical works, when no noise intensive equipment is being used, are significantly lower and mostly compliant with the management levels.

Commercial receivers

The construction noise impacts at commercial receivers are predicted to be minor when noise intensive equipment is in use. Noise levels and exceedances during the typical works, when no noise intensive equipment is being used, are predicted to be compliant with the management levels.

Construction vibration

The main potential sources of vibration during construction are from vibratory rollers, rock-breakers and bored piling which may be required in close proximity to the Upper Canal System (Pheasants Nest Weir to Prospect Reservoir) and gas supply pipelines which will need a detailed assessment to be carried out in consultation with the respective owners of those assets. The distance between the construction works and the nearest sensitive receivers is generally sufficient for most buildings to be unlikely to suffer cosmetic damage from construction vibration. The assessment shows that approximately 19 structures are identified as being within the minimum working distances for cosmetic damage, ie these structures have the potential to be impacted by vibration from construction of the project.

A number of heritage items are identified as being within the minimum working distances for sensitive structures, with these items to be reviewed on a case by case basis during detailed design.

Construction traffic

The assessment shows that the proposed construction traffic routes and forecast redistribution of traffic is unlikely to result in a noticeable increase in noise levels.

Cumulative and consecutive impacts

Cumulative and consecutive construction impacts may occur near the Western Sydney Airport site, Sydney Metro Greater West, and The Northern Road due to the construction of these projects in the same area.

Approximately five residential receivers (primarily in NCA08) eight residential receivers (located in NCA10) may be influenced by simultaneous works occurring at the Western Sydney Airport, The Northern Road and the M12 Motorway project. The likely impact of cumulative works on the project would be an increase in the number of 15-minute periods where noise impacts are apparent.

Operational road traffic noise assessment

The operational noise assessment compares road traffic noise levels predicted due to the project in 2026 (modelled as the year ‘at opening’) and 2036 (modelled as 10 years after opening) with those predicted without the project. Impacts associated with the project are accounted for by assessing the ‘Build’ traffic scenario, while impacts without the project are accounted for by assessing the ‘No Build’ traffic scenario.

Predicted road traffic noise levels

The change in road traffic noise exposure is generally predicted to be less than 2 dBA in areas adjacent to the existing major roads such as the M7 Motorway, Elizabeth Drive and The Northern Road. This change in road traffic noise exposure is considered by the EPA to be barely perceptible.

In other areas, road traffic noise exposure is predicted to increase by over 5 dBA at the receivers nearest to the project. This is generally due to the project affecting houses that are not affected by existing road traffic noise. Mitigation measures would therefore need to be considered to mitigate operational road traffic noise impacts.

The ‘Build’ scenario assessment identifies a total of 183 sensitive receiver buildings (262 individual floors) that qualify for consideration of additional noise mitigation under the assessment guidelines. This includes buildings triggered in either the 2026 and/or 2036 timeframes. The majority of these receivers are predicted to have an increase of more than 2 dB due to the project and high levels of equivalent continuous road traffic noise 5 dBA or more above the noise criterion.

Maximum noise level assessment

The maximum noise level assessments for the project identify that the change in maximum noise levels is predicted to be negligible at residential receivers closest to existing major roads such as Elizabeth Drive and The Northern Road.

An increase in maximum noise levels of over 10 dBA is predicted at residential receivers in NCA02 adjacent to the proposed new M7 Motorway southbound on ramp from the M12 Motorway which are not directly exposed to existing roads.

In NCA07 where receivers are not affected by existing road traffic noise, maximum noise levels are predicted to increase by over 10 dBA due to the project.

Maximum noise levels in other NCAs are predicted to increase by up to 10 dB at receivers closest to the project where the most-affected facades are not dominated by existing roads.

Summary of environmental management measures

Construction noise and vibration

The project would apply all feasible and reasonable work practices to reduce the potential impacts. Specific strategies will be determined as the project progresses and would be detailed in the Construction Environmental Management Plan (CEMP) for the project. Site specific Construction Noise and Vibration Management Plans (CNVMP) and Construction Noise and Vibration Impact Statements (CNVIS) will also be developed before any works begin. These plans would provide a detailed assessment of the potential impacts from the work (including re-modelling of construction noise impacts) and would define the site-specific environmental management measures to be used to control the impacts, particularly where evening or night-time works are required.

Residual noise impacts would be managed in accordance with the recommended environmental management measures outlined in this report, relevant guidelines, and contractor procedures. In addition to standard environmental management measures detailed in the assessment guidelines, the following measures have been recommended, where practicable:

- When works are near to receivers, schedule operation of noise intensive equipment to less sensitive periods, such as during the daytime
- Detailed noise assessments will be carried out prior to construction for all ancillary facilities (including batching plant operations) required for construction
- Use hoarding at ancillary facilities or fixed long term works areas where receivers are nearby
- Monitoring will be carried out at the commencement of new noise and vibration intensive activities
- Where vibration intensive works are required within the minimum working distances, vibration monitoring should be completed to determine the risk of exceeding the vibration thresholds
- Building condition surveys should be completed before and after the works where buildings or structures are within the minimum working distances for vibration intensive equipment
- Prior to works occurring in the vicinity of the Upper Canal System and gas supply pipelines, a detailed assessment will be carried out in consultation with the owners of the assets
- Detailed surveys of heritage items in close proximity to the project site to determine their sensitivity and to define appropriate criteria. Vibration monitoring should be carried out when new vibration intensive tasks are occurring in close proximity to these structures

- The likelihood of cumulative construction noise impacts should be reviewed during detailed design when detailed construction schedules are available. Construction associated with the M12 Motorway, The Northern Road, Sydney Metro Greater West, and Western Sydney Airport should be scheduled with the aim of minimising concurrent works near to sensitive receivers where possible.
- Consecutive construction impacts, or 'construction fatigue', may occur near the Western Sydney Airport site, Sydney Metro Greater West, and The Northern Road due to the construction of these projects in the same area. While each project would apply environmental management measures that are suitable for controlling impacts from one project in isolation, the measures may not be sufficient due to the extended nature of the work in these areas. Specific additional management and environmental management measures designed to address potential consecutive impacts would be developed and used to minimise the impacts as far as practicable, in consultation with the affected community.

Operational road traffic noise

The operational assessment has identified the potential noise benefits associated with the use of different types of noise treatment including quieter noise pavement, noise barriers and at-property treatment.

The investigated quieter noise pavements are predicted to provide a minor benefit to triggered receivers and should be considered in conjunction with other mitigation options during detailed design, where feasible and reasonable.

Where noise barriers have been considered, the assessment has found that four barrier locations would potentially be reasonable based on the predicted noise benefit.

Other factors would be considered before determining whether these barriers are likely to be feasible and/or reasonable. These factors may include cost to benefit ratio, constructability, and the required overhead power line clearance, along with the community's concerns and preferences. In making this determination, the noise barriers identified as potentially reasonable should be considered in conjunction with other potentially reasonable mitigation measures during the detailed design stage of the project, in terms of their feasibility.

A preferred noise mitigation option (low noise pavement, noise barrier, architectural treatments, a combination or other) would be determined during detailed design taking into account whole-of-life engineering considerations and the overall social, economic and environmental benefits. The preference will be given to noise mitigation measures that reduce outdoor noise levels and the number of at-property treatments required.

1. Introduction

1.1 Background

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to construct and operate the M12 Motorway project to provide direct access between the Western Sydney Airport at Badgerys Creek and Sydney's motorway network (the project). In addition, the project has been determined to be a controlled action under Section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act) (EPBC 2018/8286) for significant impact to threatened species and communities (Section 18 and Section 18A of the EPBC Act). As such, the project requires assessment and approval from the Commonwealth Government.

The project would commence about 30 kilometres west of the Sydney central business district, at its connection with the M7 Motorway. The project traverses the local government areas of Fairfield, Liverpool and Penrith. The suburbs of Cecil Park and Cecil Hills are found to the east of the M12 Motorway, with Luddenham to the west.

The project is predominately located in greenfield areas. The topography in and around the project comprises rolling hills and small valleys between generally north–south ridge lines. The existing land uses are semi-rural residential, recreational, agricultural, commercial and industrial. The main residential areas are Kemps Creek, Mount Vernon and Cecil Hills.

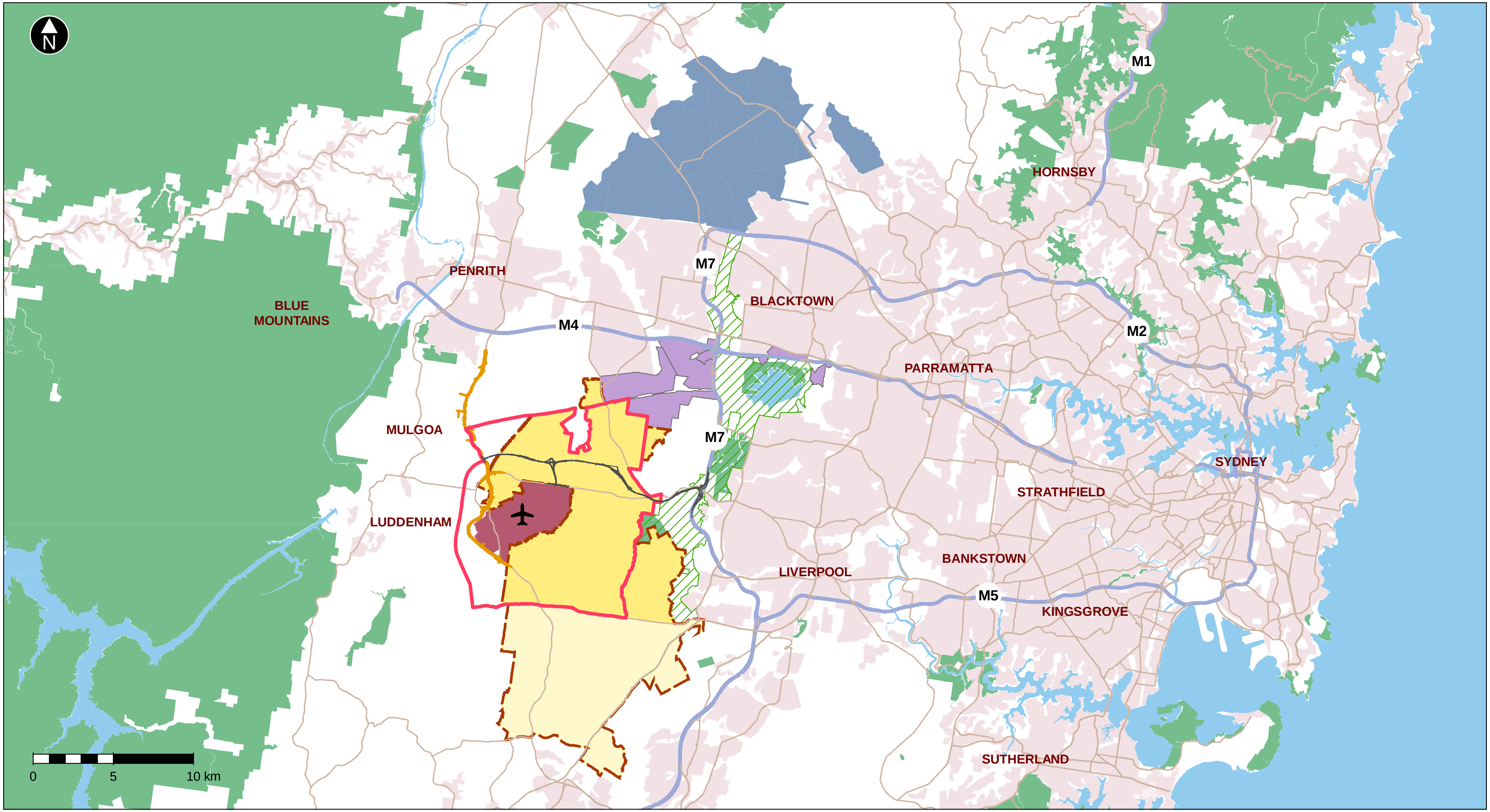
The project is required to support the opening of the Western Sydney Airport by connecting Sydney's motorway network to the airport. The project would also serve and facilitate the growth and development of the Western Sydney which is expected to undergo significant development and land use change over the coming decades. The motorway would provide increased road capacity and reduce congestion and travel times in the future and would also improve the movement of freight in and through western Sydney.

The project location is shown in **Figure 1-1** in relation to its regional context.

1.2 Project overview

The project would include the following key features:

- A new dual-carriageway motorway between the M7 Motorway and The Northern Road with two lanes in each direction with a central median allowing future expansion to six lanes
- Motorway access via three interchanges/intersections:
  - A motorway-to-motorway interchange at the M7 Motorway and associated works (extending about four kilometres within the existing M7 Motorway corridor)
  - A grade-separated interchange referred to as the Western Sydney Airport interchange, including a dual-carriageway four-lane airport access road (two lanes in each direction for about 1.5 kilometres) connecting with the Western Sydney Airport Main Access Road
  - A signalised intersection at The Northern Road with provision for grade separation in the future
- Bridge structures across Ropes Creek, Kemps Creek, South Creek, Badgerys Creek and Cosgroves Creek
- A bridge structure across the M12 Motorway into Western Sydney Parklands to maintain access to the existing water tower and mobile telephone/other service towers on the ridgeline in the vicinity of Cecil Hills, to the west of the M7 Motorway
- Bridge structures at interchanges and at Clifton Avenue, Elizabeth Drive, Luddenham Road and other local roads to maintain local access and connectivity



- The project
- Motorways
- Existing main roads
- The Northern Road upgrade (currently under construction)
- Western Sydney Parklands
- NPWS estate / reserve
- Urban areas
- Main waterbodies

Growth areas

- Western Sydney Priority Growth Area
- South West Priority Growth Area
- South West Growth Area
- Western Sydney Airport
- Western Sydney Aerotropolis
- Western Sydney Employment Area
- North West Growth Area

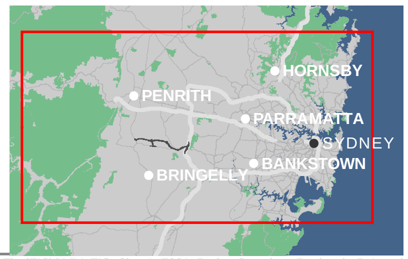


Figure 1-1 Project location (regional context)

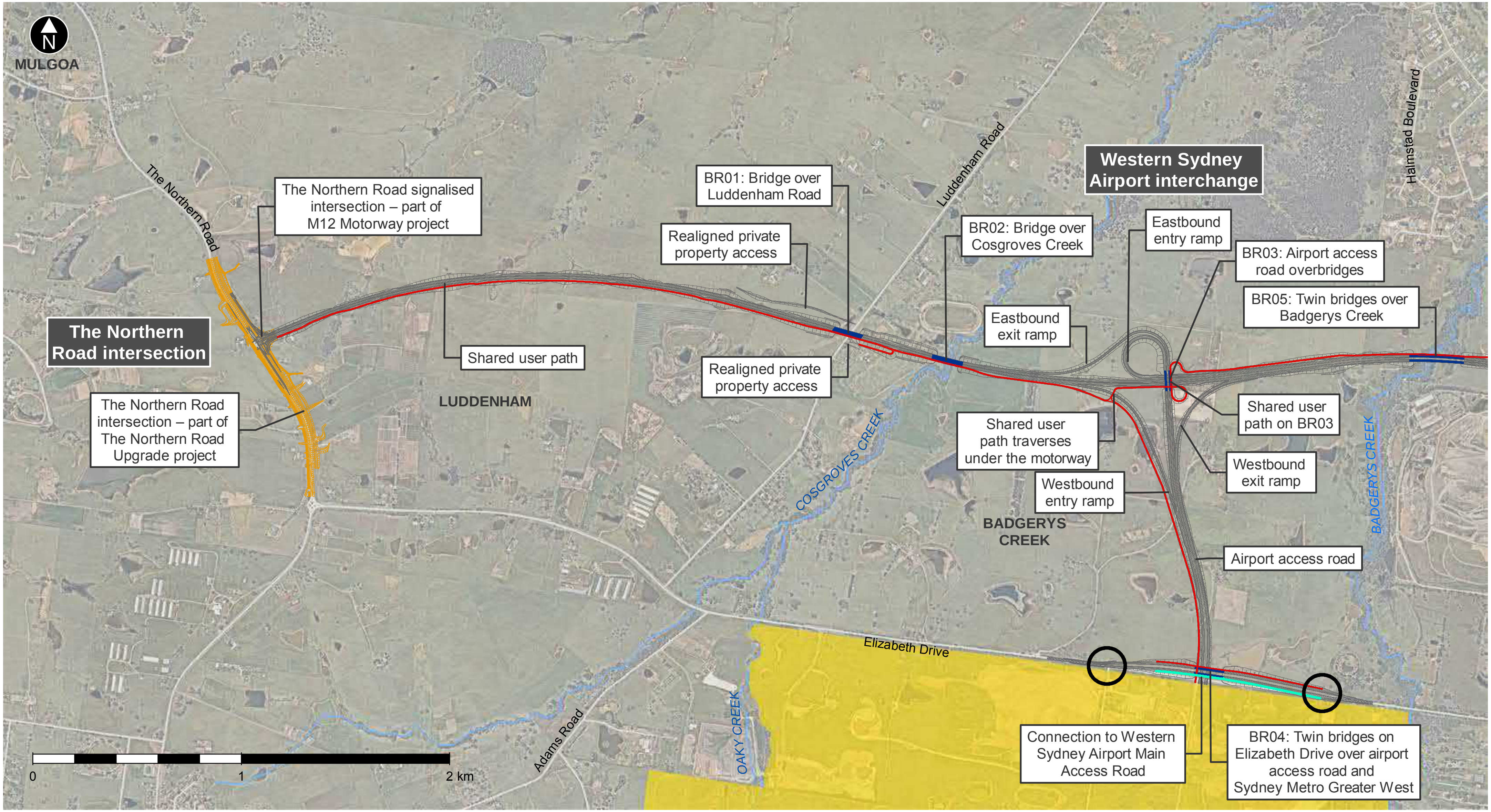
- Inclusion of active transport (pedestrian and cyclist) facilities through provision of pedestrian bridges and an off-road shared user path including connections to existing and future shared user path networks
- Modifications to the local road network, as required, to facilitate connections across and around the M12 Motorway including:
  - Realignment of Elizabeth Drive at the Western Sydney Airport, with Elizabeth Drive bridging over the airport access road and future passenger rail line to the airport
  - Realignment of Clifton Avenue over the M12 Motorway, with associated adjustments to nearby property access
  - Relocation of Salisbury Avenue cul-de-sac, on the southern side of the M12 Motorway
  - Realignment of Wallgrove Road north of its intersection with Elizabeth Drive to accommodate the M7 Motorway northbound entry ramp
- Adjustment, protection or relocation of existing utilities
- Ancillary facilities to support motorway operations, smart motorways operation in the future and the existing M7 Motorway operation, including gantries, electronic signage and ramp metering
- Other roadside furniture including safety barriers, signage and street lighting
- Adjustments of waterways, where required, including Kemps Creek, South Creek and Badgerys Creek
- Permanent water quality management measures including swales and basins
- Establishment and use of temporary ancillary facilities, temporary construction sedimentation basins, access tracks and haul roads during construction
- Permanent and temporary property adjustments and property access refinements as required.

The project overview presented in this document represents the proposed design as described in the EIS. If the project is approved, a further detailed design process would follow, which may include variations to the design as described in the EIS. Flexibility has been provided in the design as described in the EIS to allow for refinement of the project during detailed design, in response to any submissions received following the exhibition of the environmental impact statement (EIS), or if opportunities arise to further minimise potential environmental impacts.

The key features of the project are shown on **Figure 1-2**.

1.3 Purpose and scope of this report

This report has been prepared to support the EIS for the project. The EIS has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) for the project (SSI 9364), as well as the Australian Government assessment requirements under the EPBC Act. The EIS for the project provides sufficient information to enable the NSW Minister for Planning and Public Spaces and the Commonwealth Minister for the Environment to make a determination on whether the project can proceed. The report presents an assessment of the construction and operational activities for the project that have the potential to produce noise and vibration impacts.



The project

Part of The Northern Road upgrade project

Shared user path

Future shared user path (by others)

Existing roads

Waterways

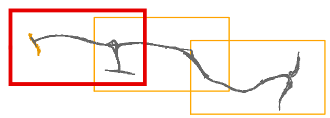
Bridges

Western Sydney Airport

Note. The roads within this zone are being removed as part of airport construction.

Potential future intersections (by others)

Note: Locations to be confirmed



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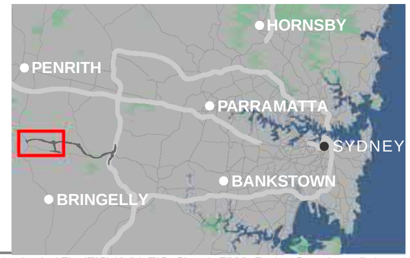

Figure 1-2 Key features of the project

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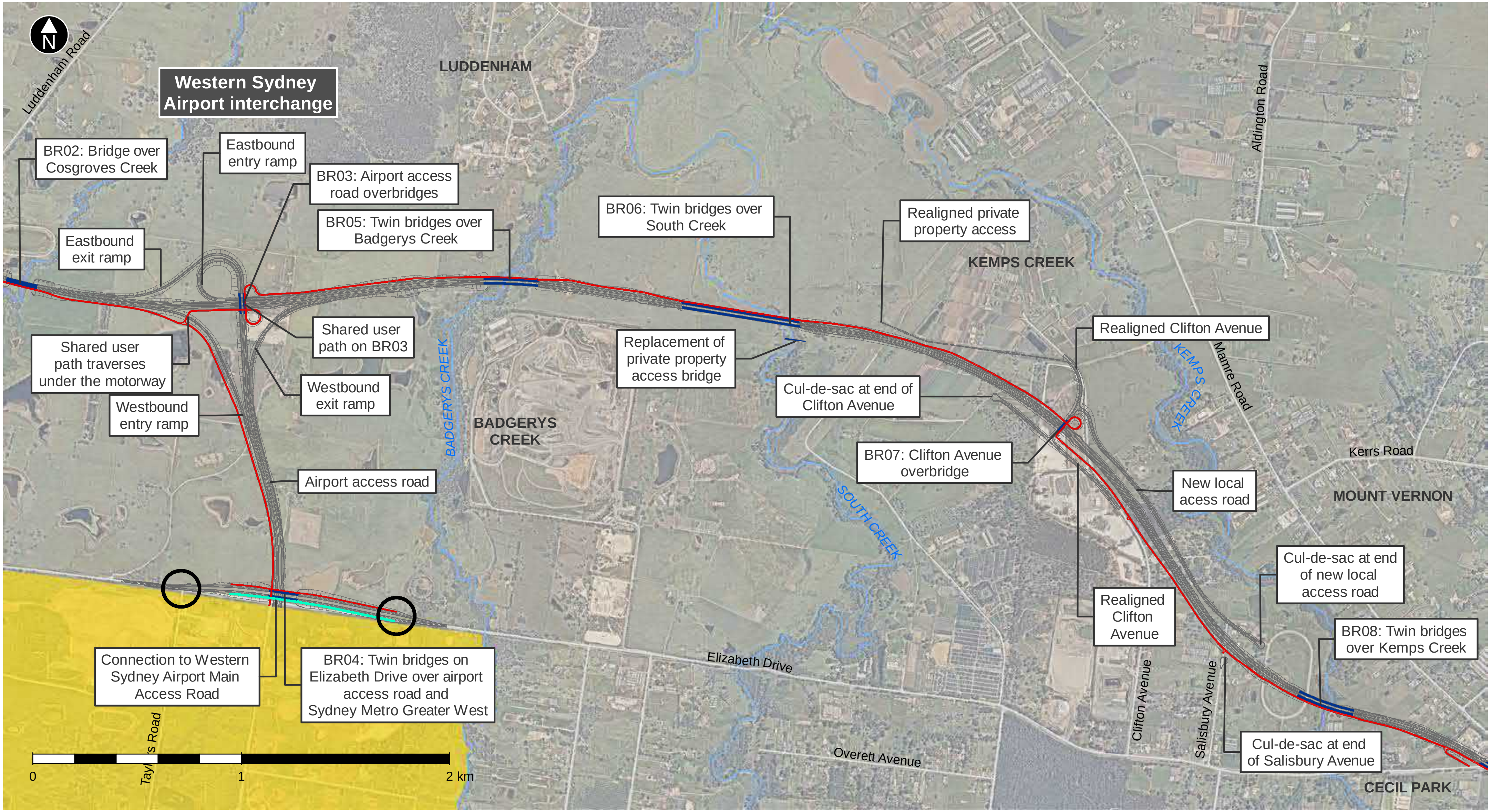
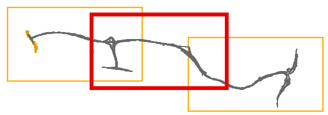


- The project
- Part of The Northern Road upgrade project
- Shared user path
- Future shared user path (by others)
- Existing roads
- Waterways
- Bridges
- Western Sydney Airport
  Note. The roads within this zone are being removed as part of airport construction.
- Potential future intersections (by others)
  Note: Locations to be confirmed



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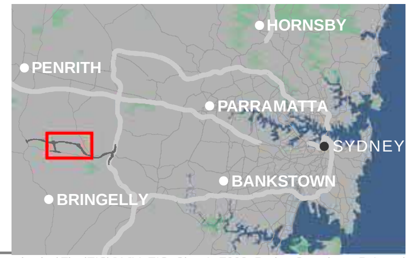

Figure 1-2 Key features of the project

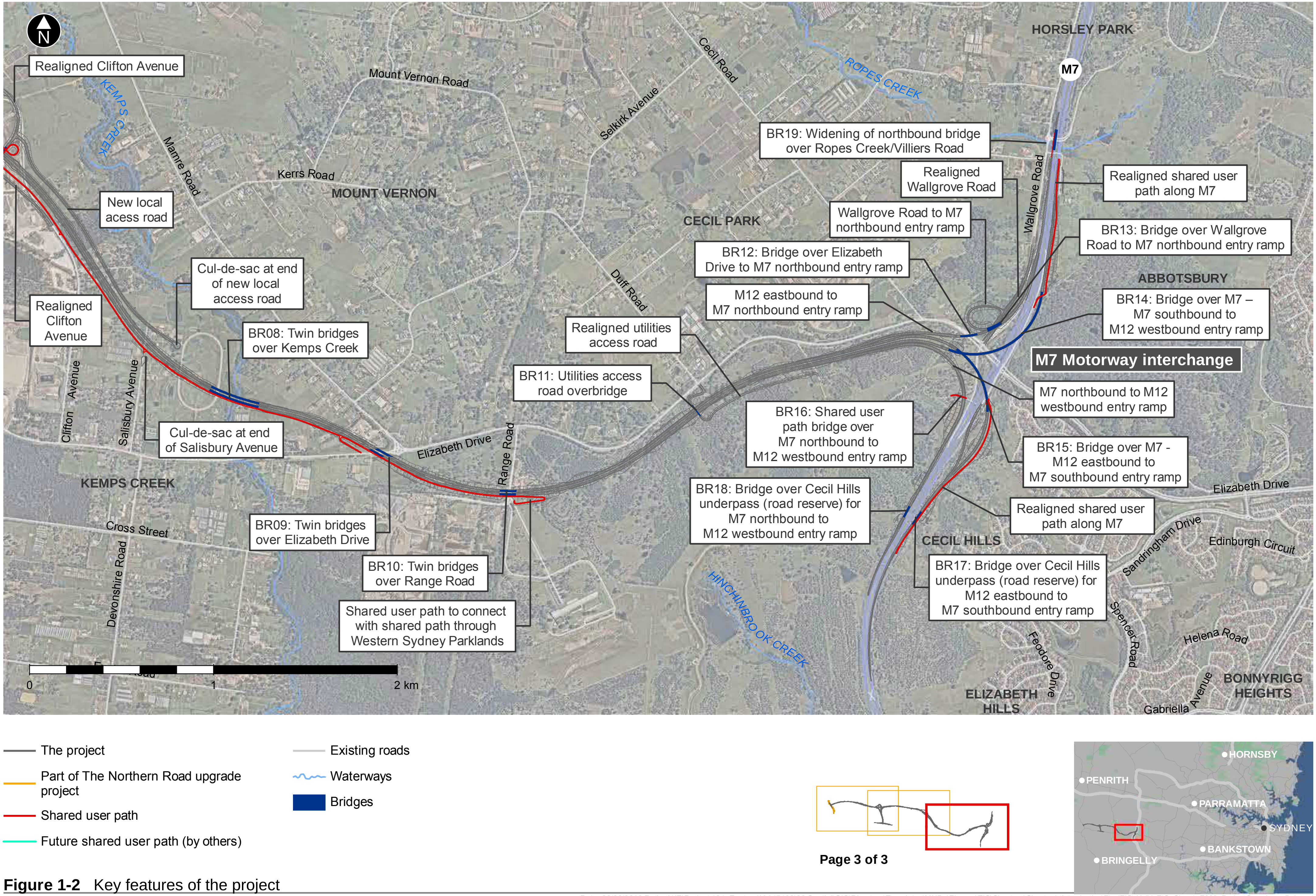

Figure 1-2 Key features of the project

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1.4 SEARs

On 18 June 2018, the Secretary of the NSW Department of Planning and Environment issued Roads and Maritime the draft Secretary's environmental assessment requirements (SEARs) for the M12 Motorway EIS. The SEARS were finalised and reissued on 12 July 2018. The project was then determined to be a controlled action under the EPBC Act, and updated SEARs were issued on 30 October 2018 that include the Commonwealth assessment requirements under the EPBC Act. **Table 1-1** lists those requirements relating specifically to the assessment of the project's potential impacts on noise and vibration, with a reference to the chapter or section of this report where each requirement is addressed.

Table 1-1 SEARs (noise and vibration)

Secretary's requirement	Where addressed
6. Noise and vibration - Amenity	
1. The Proponent must assess construction and operational noise and vibration impacts in accordance with relevant NSW noise and vibration guidelines. The assessment must cover typical and realistic construction and operation activities. The assessment must include consideration of:	Construction and operational noise and vibration criteria – refer to **Chapter 3**. Construction and operational noise and vibration assessment methodology – refer to **Chapter 4**. Construction noise and vibration assessment - refer to **Chapter 5**. Operational road traffic noise assessment - refer to **Chapter 6**. Construction and operational noise and vibration environmental management measures – refer to **Chapter 7**.
a) Impacts to sensitive receivers including small businesses;	Where small businesses have been identified within the study area they have been included as commercial receivers. Sensitive receiver uses have been identified in **Chapter 2**.
b) Noise impacts of out-of-hours works including proposed activities including utility works, justification for these activities, estimation of the number of out-of-hours activities required and timeframes for these activities;	Identification and justification of out-of-hours works are provided in **Section 4.1.1**. Assessment of out-of-hours works impacts – refer to **Chapter 5**.
c) Sleep disturbance;	Sleep disturbance impacts are discussed in **Section 5.6**.
d) The characteristics of noise and vibration, as relevant (for example, low-frequency noise); and	Characteristics of noise and vibration are typically brought into consideration for fixed operational facilities which may require modifying factors to be applied to account for low frequency or impulsiveness. This project does not have any fixed facilities. Construction noise impacts include penalties in the source in the source noise levels for equipment with annoying characteristics – refer to **Annexure C – Construction equipment**.
e) How noise and vibration mitigation measures act to mitigate the effects of consecutive and cumulative construction impacts.	Construction and operational noise and vibration environmental management measures are discussed in **Chapter 7**.
2. The Proponent must demonstrate that blast impacts are capable of complying with the current guidelines, if blasting is required.	Blasting is not proposed to be undertaken as part of the project.

Secretary's requirement	Where addressed
7. Noise and vibration - Structural	
1. The Proponent must assess construction and operation noise and vibration impacts in accordance with relevant NSW noise and vibration guidelines. The assessment must include consideration of impacts to the structural integrity and heritage significance of items (including Aboriginal places and items of environmental heritage).	Construction and operational noise and vibration criteria – refer to **Chapter 3**. Construction and operational noise and vibration assessment methodology – refer to **Chapter 4**. Construction noise and vibration assessment - refer to **Chapter 5**. Operational road traffic noise assessment - refer to **Chapter 6**. Construction and operational noise and vibration environmental management measures – refer to **Chapter 7**. Assessment of vibration impacts on heritage items - refer to **Section 5.7.3**.
2. The Proponent must demonstrate that blast impacts are capable of complying with the current guidelines, if blasting is required.	Blasting is not proposed to be undertaken as part of the project.

2. Existing environment

The project traverses the local government areas of Penrith to the north and Liverpool to the south. The suburbs of Cecil Park and Cecil Hills are found to the east of the M12 Motorway, with Luddenham to the west. The project is close to a number of major existing road corridors, including the M7 Motorway, Elizabeth Drive, Mamre Road, Luddenham Road, and The Northern Road. The future Western Sydney Airport (WSA) is located to the south of the project.

The area around the project has been summarised using ten Noise Catchment Areas (NCAs) which collectively make up the study area. The NCAs were selected to be representative of the varying land uses and noise environment of sensitive receiver locations around the project. The NCAs are shown in **Figure 2-1** and described in **Table 2-1**.

The study area includes a mix of rural and suburban areas. Cecil Hills, Abbotsbury (suburban areas), Cecil Park and Mount Vernon (small-lot rural residential areas) are located in the eastern section of the project near to the M7 Motorway and Elizabeth Drive. Kemps Creek, Badgerys Creek and Luddenham are in the western section of the project are sparsely populated and consist primarily of large rural lots.

The noise environment within the suburban areas is generally influenced by sources of road traffic noise from the M7 Motorway and Elizabeth Drive, particularly during the daytime period. During the evening and night-time periods, ambient noise levels typically decrease due to a reduction in the volume of road traffic on Elizabeth Drive and the M7 Motorway. The noise environment in the rural locations is generally influenced by environmental noises such as wind and insects.

Detailed figures showing the receiver types throughout the NCAs are provided in **Annexure B**.

Table 2-1 Noise catchment areas and surrounding land uses

NCA	Minimum distance[1]	Description
NCA01	40 m	This catchment area is located along Wallgrove Road and to the east of the M7 Motorway and extends south to Elizabeth Drive. Receivers in this catchment are largely residential with the nearest receiver located to the east of the project, however Western Sydney Parklands (passive recreation) covers a large portion to the catchment to the east of the M7 Motorway. Saints Peter and Paul Assyrian Church of the East are located in the west of the catchment. This catchment represents receivers adjacent to the M7 Motorway and in the suburban area of Abbotsbury where the noise environment is dominated by road traffic noise from the M7 Motorway and/or Elizabeth Drive.
NCA02	85 m	This catchment area is located to the south of Elizabeth Drive and east of the M7 Motorway. It is primarily suburban residential with the nearest receivers located to the east of the project. Cecil Hills Public School is located in the north of the catchment and Cecil Hills High School in the south of the catchment. Head Start Long Day Care is located in the north of the catchment. An area of commercial use is located near Sandringham Drive and Feodore Drive. This catchment represents receivers in the suburban areas of Cecil Hills and Elizabeth Hills where the noise environment is dominated by road traffic noise from the M7 Motorway and/or Elizabeth Drive.
NCA03	440 m	This catchment area is located to the north of Elizabeth Drive and west of the M7 Motorway, extending to the west of Mamre Road. It is set back from Elizabeth Drive and the M7 to represent receivers which are not adjacent to the existing major roads. The nearest receivers are located north of the project on Mamre Road. Do Re Mi Child Care Centre is located in the southwest of the catchment. This catchment represents receivers further from the project where the noise environment is likely to be dominated by road traffic noise from Mamre Road and/or distant road traffic noise from the M7 Motorway and Elizabeth Drive.

NCA	Minimum distance[1]	Description
NCA04	90 m	This catchment area is located to the north of Elizabeth Drive and west of the M7 Motorway and extends west to the intersection of Devonshire Road and Cross Street. It represents receivers along the eastern section of Elizabeth Drive and is primarily residential with the nearest receivers located adjacent the project on the north of Elizabeth Drive. Irfan College is located in the centre of the catchment adjacent to Elizabeth Drive. This catchment represents receivers close to the project where the noise environment is dominated by road traffic noise from Elizabeth Drive.
NCA05	60 m	This catchment area is located to the south of Elizabeth Drive and west of the M7 Motorway and extends west to Kemps Creek. It primarily consists of the Western Sydney Parklands with no residential receivers. The Sydney International Shooting centre is located in the centre of the catchment.
NCA06	70 m	This catchment area is located to the west of Kemps Creek and east of South Creek and extends to the north and south of Elizabeth Drive. It primarily consists of rural residential receivers. Kemps Creek Children's Cottage is located in the centre of the catchment. This catchment represents receivers close to the project where the noise environment is dominated by Elizabeth Drive, and those further from the project where the primary source of road traffic noise is likely to be the same section of Elizabeth Drive.
NCA07	100 m	This catchment area is located to the west of Kemps Creek, east of Cosgrove Creek, and north of Elizabeth Drive. It is set back from Elizabeth Drive to represent receivers which are not adjacent to the existing major roads. This catchment primarily consists of rural residential receivers and a cluster of residential dwellings 500 metres to the north of the project. This catchment represents rural receivers where there is likely to be minimal influence on the noise environment from existing road traffic noise sources.
NCA08	420 m	This catchment area is located along the western section of Elizabeth Drive to the west of South Creek and east of The Northern Road. This catchment is primarily rural residential. Part of this catchment is within the footprint of the future Western Sydney Airport. This catchment represents rural receivers where the primary source of road traffic noise is likely to be the western section of Elizabeth Drive.
NCA09	90 m	This catchment area is located to the west of Cosgrove Creek, east of The Northern Road, and north of Elizabeth Drive. It is set back from Elizabeth Drive and The Northern Road to represent receivers which are not adjacent to the existing major roads. This catchment is primarily rural residential with the nearest receivers located adjacent to the project on the east of Luddenham Road. This catchment represents rural receivers where the primary source of road traffic noise is likely to be Luddenham Road.
NCA10	160 m	This catchment area is located along The Northern Road. It is primarily rural residential with the nearest receivers located opposite the west end of the project to the west of The Northern Road. This catchment represents rural receivers where the primary source of road traffic noise is likely to be The Northern Road.

Note 1: Approximate minimum horizontal distance from the project to the nearest sensitive receiver.

2.1 Noise and vibration sensitive receivers

Receivers potentially sensitive to noise and vibration have been categorised as residential dwellings, commercial/industrial buildings (including small businesses), or 'other' sensitive land uses which includes educational institutions, childcare centres, medical facilities, places of worship, etc. Receiver types are shown in **Annexure B**.

The 'other' sensitive non-residential receivers identified in the study area are shown in **Table 2-2**.

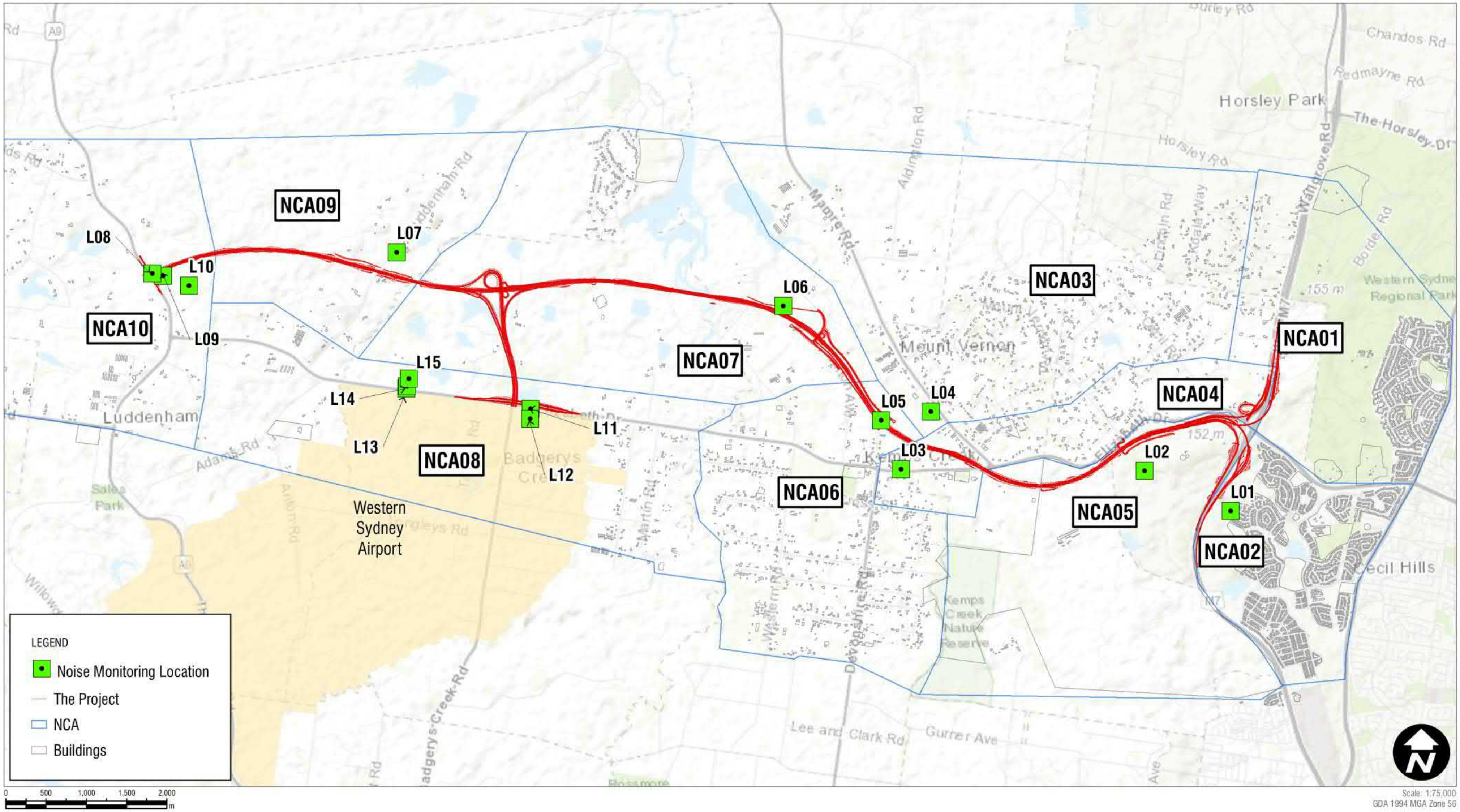


Figure 2-1 Site plan, receivers and noise monitoring locations

Table 2-2 'Other' sensitive receivers within the study area (non-residential)

NCA	Description	Address	Type
NCA01	Sydney International Equestrian Centre	Saxony Road, Horsley Park	Active recreation
	Saints Peter and Paul Assyrian Church of the East	32-40 Kosovich Place, Cecil Park	Place of worship
	Plough and Harrow West	901-919 Elizabeth Drive, Abbotsbury	Active recreation
	Amoretti's	745-899 Elizabeth Drive, Abbotsbury	Café/bar
	Plough and Harrow East	745-899 Elizabeth Drive, Abbotsbury	Active recreation
	Western Sydney Parklands	31-39 Border Road, Horsley Park	Passive recreation
	Bancroft Road Reserve	31 Bancroft Road, Abbotsbury	Active recreation
	Province Park	41-43 Falmer Street, Abbotsbury	Active recreation
	Stockdale Crescent Reserve	526-540 Cowpasture Road, Abbotsbury	Active recreation
	Heysen Park	16 Roony Avenue, Abbotsbury	Active recreation
NCA02	Head Start Long Day Care	87-89 Balmoral Circuit, Cecil Hills	Childcare
	Cecil Hills Public School	Leopold Place, Cecil Hills	Educational
	Cecil Hills High School	50 Spencer Road, Cecil Hills	Educational
	Woolway Park	Frederick Road, Cecil Hills,	Passive recreation
	Dunumbral Park	9-21 Inverness Circuit, Cecil Hills	Active recreation
	Pye Hill Reserve	7 Sandringham Drive, Cecil Hills	Passive recreation
	Yarraman Park	880 Elizabeth Drive, Cecil Hills	Passive recreation
	Community Hall	5 Sandringham Drive, Cecil Hills	Public building
	Nature Reserve	11 Edmund Place, Cecil Hills	Passive recreation
	Longfields Park	28-52 Anjou Circuit, Cecil Hills	Passive recreation
NCA03	Do Re Mi Childcare Centre	162 Kerrs Road, Mt Vernon	Childcare
NCA04	Kemps Creek Sporting and Bowling Club	1309-1319 Elizabeth Drive, Cecil Park	Active recreation
	Macarthur Park	316-318 Mount Vernon Road, Mt Vernon	Passive recreation
	Irfan College	2089-2109 Elizabeth Drive, Cecil Park	Educational
NCA05	Sydney International Shooting Centre	Range Road, Cecil Park	Active recreation
	Western Sydney Parklands	Off Elizabeth Drive, Kemps Creek	Passive recreation
NCA06	Kemps Creek Christadelphian Ecclesia	110 Cross Street, Kemps Creek	Educational
	Bill Anderson Park	1650 Elizabeth Drive, Kemps Creek	Active recreation
	Kemps Creek Children's Cottage	35 Floribunda Road, Kemps Creek	Childcare
NCA07	Twin Creeks Golf & Country Club	2-8 Twin Creeks Drive, Luddenham	Active recreation
NCA08	Badgerys Creek Park	638-642 Badgerys Creek Road, Badgerys Creek	Active recreation
	Workers Hubertus Country Club	205 Adams Road, Luddenham	Passive recreation
NCA10	Luddenham Showground	442-452 Park Road, Luddenham	Active recreation

2.2 Ambient noise surveys and monitoring locations

Unattended noise monitoring was completed in the study area in June and July 2017 at 15 locations. The measured noise levels have been used to determine the existing noise environment and to set criteria to assess the potential impacts from the project.

The monitoring equipment was generally located at receivers which would have line-of-sight to the project or to existing major roads, within constraints such as accessibility, security and permission of land owners.

The measured existing noise levels are representative of receivers that would likely be most affected by the construction and operation of the project in each NCA. Where NCAs are likely to have a similar noise environment and noise levels it is not necessary to measure noise levels in every NCA provided representative noise monitoring is carried out in similar location. This is discussed further in **Section 3.1.1**.

The noise monitoring equipment continuously measured existing noise levels in 15-minute periods during the daytime, evening and night-time periods for the survey period. All equipment carried current National Association of Testing Authorities (NATA) or manufacturer calibration certificates and the calibration was checked before and after each measurement.

The results of the noise monitoring have been processed with reference to the NSW EPA *Noise Policy for Industry* (NPfI) and *Road Noise Policy* (RNP) to exclude noise from extraneous events and/or data affected by adverse weather conditions, such as strong wind or rain, to establish representative existing noise levels for each NCA. Weather conditions recorded during the monitoring period were obtained from the Bureau of Meteorology (BoM) Automated Weather Station (AWS) located at Badgerys Creek, around 2.5 kilometres south of the study area.

The noise monitoring locations are shown in **Figure 2-1** and the results are summarised in **Table 2-3**. Details of each monitoring location together with graphs of the measured daily noise levels are in **Annexure B**.

Table 2-3 Summary of unattended noise monitoring results

ID	Address	Measured noise level (dBA)						
		Background noise (RBL) – Periods based on extended construction hours[1]					Average noise level L_{Aeq} (period) – Periods based on Road Noise Policy[2]	
		Morning shoulder	Day	Evening	Evening shoulder	Night	Day 15 hour	Night 9 hour
L01	Adjacent to Toulouse Street, Cecil Hills	51	45	44	46	40	52	51
L02	Western Sydney Parklands, Cecil Hills	47	36	39	41	34	46	45
L03	1383 Elizabeth Drive, Kemps Creek	60	54	48	56	37	66	63
L04	1219 Mamre Road, Kemps Creek	54	48	46	52	37	57	55
L05	12-20 Salisbury Avenue, Kemps Creek	49	39	42	45	35	49	48
L06	203 Clifton Avenue, Kemps Creek	43	34	35	39	31	53	44
L07	740 Luddenham Road, Luddenham	46	40	36	42	31	56	52
L08	45 m east of Northern Rd - 2828 The Northern Rd, Luddenham	58	46	50	57	34	60	59

ID	Address	Measured noise level (dBA)						
		Background noise (RBL) – Periods based on extended construction hours[1]					Average noise level L_{Aeq} (period) – Periods based on Road Noise Policy[2]	
		Morning shoulder	Day	Evening	Evening shoulder	Night	Day 15 hour	Night 9 hour
L09	140 m east of Northern Rd - 2828 The Northern Rd, Luddenham	56	44	48	54	36	56	55
L10	340 m east of Northern Rd - 2828 The Northern Rd, Luddenham	51	40	44	49	37	51	49
L11	15 m south of Elizabeth Dr - 2300 Elizabeth Drive, Badgerys Creek	57	46	40	51	31	69	66
L12	145 m south of Elizabeth Dr - 2300 Elizabeth Drive, Badgerys Creek	50	40	37	44	30	49	48
L13	20 m north of Elizabeth Dr - 1953-2109 Elizabeth Drive, Badgerys Creek	50	42	38	48	33	64	60
L14	50 m north of Elizabeth Dr - 1953-2109 Elizabeth Drive, Badgerys Creek	50	42	39	48	33	55	52
L15	150 m north of Elizabeth Dr - 1953-2109 Elizabeth Drive, Badgerys Creek	50	39	40	47	34	52	49

Note 1: RBL periods are based on the extended construction hours discussed in **Section 4.1.1**: Morning shoulder is 6:00 am to 7:00 am Monday to Friday; Daytime is 7:00 am to 6:00 pm Monday to Saturday and 8:00 am to 6:00 pm Sunday and Public Holidays; Evening is 7:00 pm to 10:00 pm Monday to Friday and 6:00 pm to 10:00 pm Saturday, Sunday and Public Holidays; Evening shoulder is 6:00 pm to 7:00 pm Monday to Friday; Night-time is 10:00 pm to 6:00 am Monday to Friday, 10:00 pm to 7:00 am Saturday and 10:00 pm to 8:00 am Sunday and Public Holidays.

Note 2: L_{Aeq} periods are based on the *Road Noise Policy*: Daytime is 7:00 am to 10:00 pm; Night-time is 10:00 pm to 7:00 am.

Short-term attended noise monitoring was completed at each monitoring location. The attended measurements allow the contributions of the various noise sources at each location to be determined. Detailed observations from the attended measurements are provided in **Annexure B**.

The attended measurements were generally found to be consistent with the results of the unattended noise monitoring and show that existing noise levels are typically dominated by road traffic noise at locations in the vicinity of major roads, and general environmental noise (such as wind and insects) in the more rural locations.

3. Policy and planning setting

3.1 Construction noise and vibration guidelines

The guidelines used to assess the construction impacts from the project are listed in **Table 3-1**. The guidelines aim to protect the community and environment from excessive noise and vibration impacts that may result from construction of the project.

Table 3-1 Construction noise and vibration guidelines

Guideline/policy name	Where guideline used
Interim Construction Noise Guideline (ICNG), DECC, 2009	Assessment of airborne noise and ground-borne noise impacts on sensitive receivers.
Construction Noise and Vibration Guideline (CNVG), Roads and Maritime, 2016	Assessment and management protocols for airborne noise and vibration impacts of Roads and Maritime road infrastructure projects
Assessing Vibration: a technical guideline, DEC, 2006	Assessment of vibration impacts on sensitive receivers.
AS2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors	Provides recommended design sound levels for internal areas of occupied spaces.
Road Noise Policy (RNP), DECCW, 2011	Assessment of construction traffic impacts.
BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2, BSI, 1993	Assessment of vibration impacts (structural damage) to non-heritage sensitive structures.
DIN 4150: Part 3-2016 Structural vibration – Effects of vibration on structures, Deutsches Institute fur Normung, 2016	Screening assessment of vibration impacts (structural damage) to heritage sensitive structures, where the structure is found to be unsound.

3.1.1 Interim construction noise guideline

The NSW *Interim Construction Noise Guideline* (ICNG) is used to assess and manage impacts from construction noise on residences and 'other' sensitive land uses in NSW. The ICNG contains procedures for determining project specific Noise Management Levels (NMLs) for sensitive receivers based on the existing background noise in the area.

The NMLs are not mandatory limits, however where construction noise levels are predicted or measured to be above the NMLs, feasible and reasonable work practices to minimise noise emissions are to be investigated.

Residential receivers

The approach provided in the ICNG for determining NMLs for a project at residential receivers is presented in **Table 3-2**.

More stringent requirements are placed on works that are completed outside of Standard Construction Hours which reflects the greater sensitivity of communities to noise impacts during these periods.

Table 3-2 Determining construction noise management levels for residential receivers (from ICNG)

Time of day	NML - L_{Aeq} (15minute)	How to apply
Recommended standard hours Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured L_{Aeq} (15minute) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practises 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 dBA	The highly noise affected (HNA) 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 restructuring the hours that the very noisy activities can occur, taking into account: - Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools or mid-morning or mid-afternoon for works near residences. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	• A strong justification would 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 practises have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1: The RBL is the Rating Background Level. The ICNG refers to the calculation procedures in the NSW Industrial Noise Policy (INP). The INP has been superseded by the NSW EPA *Noise Policy for Industry*.

Note 2: 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.

Sleep disturbance

Major infrastructure projects often require certain works to be completed during the night-time. Where night works are located close to residential receivers there is potential for sleep disturbance impacts.

The ICNG lists five categories of works that may be required to be carried out outside the recommended standard hours:

- The delivery of oversized equipment or structures that require special arrangements to transport on 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 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 hours.

Justification for Out of Hours Work (OOHW) in relation to the last two categories are provided in **Table 4-4**.

Where construction works are planned to extend over more than two consecutive nights, the ICNG recommends that an assessment of sleep disturbance impacts be completed. The ICNG references the *NSW Environmental Criteria for Road Traffic Noise* (ECRTN) (EPA 1999) for guidance relating to sleep disturbance. The ECRTN has since been superseded by the *NSW Road Noise Policy* (RNP).

RNP guidance for assessing the potential for sleep disturbance outlines a screening level of the prevailing background level (RBL) plus 15 dB. The screening level indicates a noise level that is intended as a guide to identify the likelihood of sleep disturbance. It is not a firm criterion to be met, however where the screening level is met sleep disturbance is considered to be unlikely. When the screening levelling is not met, a more detailed analysis is required.

Summary of residential NMLs

The residential NMLs for the project have been determined using the background noise monitoring and are shown in **Table 3-3**. Each NCA has been assigned the RBL background noise levels from the noise logger most representative of the noise environment in that NCA. As noted in **Section 2.2**, it is not necessary to measure noise levels in every NCA provided representative noise monitoring is carried out in a similar location. For this reason L01 has been selected as the representative location for both NCA01 and NCA02, and L05 has been selected as the representative location for both NCA03 and NCA06.

Table 3-3 Residential receiver construction NMLs

NCA	Representative background monitoring location	NML (L_{Aeq} (15minute) – dBA)						Sleep disturbance screening criteria (RBL +15 dB)
		Standard construction (RBL +10 dB)	Out of hours (RBL +5 dB)					
		Daytime[1]	Morning shoulder[2]	Daytime[3]	Evening[4]	Evening shoulder[5]	Night-time[6]	
NCA01	L01	55	50	50	49	49	45	55
NCA02	L01	55	50	50	49	49	45	55
NCA03	L05	49	44	44	44	44	40	50
NCA04	L03	64	59	59	53	53	42	52
NCA05	L02	46	41	41	41	41	39	49
NCA06	L05	49	44	44	44	44	40	50
NCA07	L06	44	39	39	39	39	36	46
NCA08	L14	52	47	47	44	44	38	48
NCA09	L07	50	45	45	41	41	36	46
NCA10	L09	54	49	49	49	49	41	51

Note 1: Daytime period is the standard construction hours of 7:00 am to 6:00 pm Monday to Friday and 8:00 am to 1:00 pm Saturday.

Note 2: Morning shoulder period is 6:00 am to 7:00 am Monday to Friday. Where the morning shoulder RBL is higher than the daytime RBL, the daytime RBL has been adopted.

Note 3: Daytime OOH period is 7:00 am to 8:00 am and 1:00 pm to 6:00 pm Saturday, and 8:00 am to 6:00 pm Sunday and Public Holidays.

Note 4: Evening period is 7:00 pm to 10:00 pm Monday to Friday and 6:00 pm to 10:00 pm Saturday, Sunday and Public Holidays. Where the evening RBL is higher than the daytime RBL, the daytime RBL has been adopted.

Note 5: Evening shoulder period is 6:00 pm to 7:00 pm Monday to Friday. Where the evening shoulder RBL is higher than the evening RBL, the evening RBL has been adopted.

Note 6: Night-time period is 10:00 pm to 6:00 am Monday to Friday, 10:00 pm to 7:00 am Saturday and 10:00 pm to 8:00 am Sunday and Public Holidays.

'Other' sensitive land uses and commercial receivers

A number of non-residential land uses have been identified in the study area. These include 'other' sensitive land uses, such as educational institutes, places of worship, medical facilities and outdoor recreational areas, and commercial and industrial properties. The NMLs recommended in the ICNG for 'other' sensitive receivers are shown in **Table 3-4**.

Table 3-4 ICNG NMLs for 'other' sensitive receivers

Land use	NML L_{Aeq} (15minute) (Applied when the property is in use)
Classrooms at schools and other education institutions	Internal noise level 45 dBA[1]
Places of worship	Internal noise level 45 dBA[1]
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants)	External noise level 65 dBA
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion)	External noise level 60 dBA
Commercial	External noise level 70 dBA
Industrial	External noise level 75 dBA

Note 1: The criterion is specified as an internal noise level for this receiver category. As the noise model predicts external noise levels, it has been conservatively assumed that all schools and places of worship have openable windows and external noise levels are therefore 10 dB higher than the corresponding internal level, which is generally considered representative of windows being partially open for ventilation.

The ICNG references AS 2107 for criteria for 'other' sensitive receivers which are not listed in the guideline. The AS2107 NMLs for 'other' sensitive receivers are shown in **Table 3-5**.

Table 3-5 AS2107 NMLs for 'other' sensitive receivers

Use	Period	AS2107 classification	Noise management level L_{Aeq} (15minute)
Public building	When in use	Public space	Internal noise level 50 dBA[1]
Café	When in use	Coffee bar	Internal noise level 50 dBA[1]

Note 1: It has been conservatively assumed that these receivers have openable windows and external noise levels are therefore 10 dB higher than the corresponding internal level.

3.1.2 Construction road traffic noise guidelines

The potential impacts from construction traffic on public roads are assessed under the NSW EPA *Road Noise Policy* (RNP) and Roads and Maritime Construction Noise and Vibration Guideline (CNVG).

To assess noise impacts that may result from construction traffic, an initial screening test is first applied to evaluate if existing road traffic noise levels are expected to increase by more than 2 dB with the addition of construction traffic at nearby residential and 'other' sensitive receivers. Where this is considered likely further assessment is required using the RNP base criteria shown in **Table 3-6**. Where the RNP criteria is exceeded, feasible and reasonable noise environmental management measures should be considered using the guidance provided in the CNVG. It is noted that since noise from construction traffic is not permanent, guidance to feasible and reasonable mitigation differs from operational traffic noise. Refer to Chapter 7 for the environmental management measures for the project.

Table 3-6 RNP criteria for assessing construction traffic on public roads

Road category	Type of project/land use	Assessment criteria (dBA)	
		Daytime (7 am – 10 pm)	Night-time (10 pm – 7 am)
Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	L_{Aeq} (15hour) 60 (external)	L_{Aeq} (9hour) 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	L_{Aeq} (1hour) 55 (external)	L_{Aeq} (1hour) 50 (external)

3.1.3 Construction ground-borne noise guidelines

Construction works can cause ground-borne noise impacts in nearby buildings when vibration generating equipment is in use. Vibration can be transmitted through the ground and into the structure of nearby buildings, which can then create audible noise impacts inside buildings. The ICNG provides evening and night-time ground-borne noise NMLs for residences to protect the amenity and sleep of residents. The ICNG ground-borne noise NMLs are:

- Evening L_{Aeq} (15minute) 40 dBA
- Night-time L_{Aeq} (15minute) 35 dBA

The NMLs only apply where internal ground-borne noise levels are higher than noise transmitted through the air. This situation can occur where buildings near to construction works have high performing facades which attenuate the airborne component or where sensitive internal areas do not have facades which face the construction works.

3.1.4 Construction vibration guidelines

The effects of vibration from construction works can be divided into three categories:

- Those in which the occupants of buildings are disturbed (human comfort)
- Those where building contents may be affected (building contents)
- Those where the integrity of the building may be compromised (structural or cosmetic damage).

Human comfort vibration

Humans can perceive vibration impacts when vibration generating construction works are located close to occupied buildings.

Vibration from construction works tends to be intermittent in nature and the EPA's *Assessing Vibration: a technical guideline* (2006) provides criteria for intermittent vibration based on the Vibration Dose Value (VDV). The 'preferred' and 'maximum' VDVs for human comfort impacts are shown in **Table 3-7**. Vibration generating activities should be designed to achieve the preferred values where an area is not already exposed to vibration. Where all feasible and reasonable measures have been applied, values up to the maximum may be used.

Table 3-7 Vibration dose values for intermittent vibration

Building types	Assessment period	Vibration dose value[1] ($m/s^{1.75}$)	
		Preferred	Preferred
Critical working areas[2] (eg operating theatres or precision laboratories where sensitive operations are occurring)	Day or night-time	0.10	0.20
Residential	Daytime	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	Day or night-time	0.40	0.80
Workshops	Day or night-time	0.80	1.60

Note 1: The VDV accumulates vibration energy over the daytime and night-time assessment periods and is dependent on the level of vibration as well as the duration.

Note 2 No critical working areas have been identified in the study area. This should be confirmed during the detailed design stage.

While the construction activities for this project are not expected to result in continuous or impulsive vibration impacts, it is noted that the construction activities are subject to refinement during detailed design and therefore the Assessing Vibration guidelines have been included in **Table 3-8** to guide these activities should they be required at a later date. .

Table 3-8 Preferred and maximum weighted root mean square values for continuous and impulsive vibration acceleration *m/s^2) 1-80 Hz

Building types	Assessment period	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration					
Critical working areas[1] (eg operating theatres or precision laboratories where sensitive operations are occurring)	Day or night-time	0.0050	0.0036	0.010	0.0072
Residential	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night-time	0.020	0.014	0.040	0.028
Workshops	Day or night-time	0.04	0.029	0.080	0.058
Impulsive vibration					
Critical working areas[1] (eg operating theatres or precision laboratories where sensitive operations are occurring)	Day or night-time	0.0050	0.0036	0.010	0.0072
Residential	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-time	0.64	0.46	1.28	0.92

Note 1 No critical working areas have been identified in the study area. This should be confirmed during the detailed design stage.

Effects on building contents

Humans perceive vibration at levels well below those likely to cause damage to building contents. For most receivers, the human comfort vibration criteria are the most stringent and it is generally not necessary to set separate criteria for vibration effects on typical building contents.

Exceptions to this can occur when vibration sensitive equipment, such as electron microscopes which can have more stringent vibration requirements than those for human comfort, are located in buildings near to construction works. No such receivers have been identified in the study area.

Structural and cosmetic damage vibration

If vibration from construction works is high enough it can cause damage to structural elements of affected buildings. The levels of vibration required to cause cosmetic damage tend to be at least an order of magnitude (10 times) higher than those at which people can perceive vibration. Examples of damage that can occur includes cracks or loosening of drywall surfaces, cracks in supporting columns and loosening of joints.

Structural damage vibration limits are contained in British Standard BS 7385 and German Standard DIN 4150.

BS 7385

British Standard BS 7385 recommends vibration limits for transient vibration which are judged to give a minimal risk of vibration induced damage to effected buildings. The limits for residential and industrial buildings are shown in **Table 3-9**.

Table 3-9 Transient vibration values for minimal risk of 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	0.20
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

Note 1: Where the dynamic loading caused by continuous vibration may give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values may need to be reduced by up to 50%.

For heritage buildings, the standard states that *"a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive".*

DIN 4150

German Standard DIN 4150 also provides guideline vibration limits for different buildings and buried pipework. Damage is not expected to occur where the values are complied with and the values are generally recognised to be conservative. **Table 3-10** provides the values appropriate for different structure types and **Table 3-11** provides the values appropriate for buried pipework.

Table 3-10 DIN 4150 guideline values for short-term vibration on structures

Group	Type of structure	Guideline values – vibration velocity (mm/s)				
		Foundation, all directions at a frequency of			Topmost floor, horizontal	Floor slabs, vertical
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz	All frequencies	All frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40	20
2	Residential buildings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15	20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified as Group 1 or 2 **and** are of great intrinsic value (eg listed buildings)	3	3 to 8	8 to 10	8	20[1]

Table 3-11 DIN 4150 guideline values for short-term vibration on buried pipework

Line	Pipe material	Vibration velocity at the pipe (mm/s)
1	Steel, welded	100
2	Vitrified clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80
3	Masonry, plastics	50

Adopting the criteria for masonry/plastic may be appropriate for the gas supply pipelines located around Elizabeth drive and M7 Intersection, however specific criteria would be adopted in consultation with the owners of the assets once the pipe materials and conditions are known.

Heritage items

Heritage buildings and structures would be considered on a case-by-case basis but as noted in BS 7285 should not be assumed to be more sensitive to vibration unless structurally unsound. Where a heritage building is deemed to be sensitive, the more stringent DIN 4150 Group 3 guideline values in **Table 3-10** can be applied. Refer to Chapter 7 for the environmental management measures for the project including consideration of vibration monitoring.

Minimum working distances for vibration intensive works

Minimum working distances for typical vibration intensive construction equipment are provided in the CNVG and are summarised in **Table 3-12**. The minimum working distances are for both cosmetic damage (from BS 7358 and DIN 4150) and human comfort (from the NSW EPA Vibration Guideline) and are based on empirical data which suggests that where works are further from receivers than the quoted minimum distances then impacts are not considered likely.

Table 3-12 Recommended minimum working distances from vibration intensive equipment

Plant item	Rating/description	Minimum distance		
		Cosmetic damage		Human response (NSW EPA Guideline)[1]
		Residential and light commercial (BS 7385)[1]	Heritage items (DIN4150, Group 3)[2]	
Vibratory roller	< 50 kN (typically 1-2t)	5 m	11 m	15 m to 20 m
	< 100 kN (typically 2-4t)	6 m	13 m	20 m
	< 200 kN (typically 4-6t)	12 m	15 m	40 m
	< 300 kN (typically 7-13t)	15 m	31 m	100 m
	> 300 kN (typically 13-18t)	20 m	40 m	100 m
	> 300 kN (typically > 18t)	25 m	50 m	100 m
Small hydraulic hammer	300 kg - 5 to 12t excavator	2 m	5 m	7 m
Medium hydraulic hammer	900 kg - 12 to 18t excavator	7 m	15 m	23 m
Large hydraulic hammer	1600 kg - 18 to 34t excavator	22 m	44 m	73 m
Vibratory pile driver	Sheet piles	2 m to 20 m	5 m to 40 m	20 m
Pile boring	≤ 800 mm	2 m (nominal)	5 m	4 m
Jackhammer	Hand held	1 m (nominal)	3 m	2 m

Note 1: Criteria reference from Roads and Maritime CNVG

Note 2: Criteria reference from DIN4150

The minimum working distances are indicative and will vary depending on the particular item of equipment and local geotechnical conditions. The distances apply to cosmetic damage of typical buildings under typical geotechnical conditions.

3.2 Operational road traffic noise and vibration guidelines

The guidelines used for assessing operational road traffic impacts are listed in **Table 3-13**. The guidelines aim to protect the community and environment from excessive noise and vibration impacts from the long-term operation of the project.

Table 3-13 Operational road traffic noise and vibration guidelines

Guideline/policy name	When guideline is used
Road Noise Policy (RNP), NSW EPA, 2011	Operational road traffic noise assessment
Noise Criteria Guideline (NCG), Roads and Maritime, 2014 (including application notes)	Defines Roads and Maritime's interpretation of the RNP and details how criteria are applied to sensitive receivers
Noise Mitigation Guideline (NMG), Roads and Maritime, 2014	Details how additional mitigation measures are to be applied to Roads and Maritime projects
Model Validation Guideline, Roads and Maritime, 2016	Contains procedures for validating operational road traffic noise models
Environmental Noise Management Manual (ENMM), Roads and Traffic Authority, 2001	Additional information for operational road traffic noise assessment Maximum noise level assessment

Guideline/policy name	When guideline is used
Preparing an Operational Noise and Vibration Assessment, Roads and Maritime, 2011	Maximum noise level assessment
AS2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors	Provides recommended design sound levels for internal areas of occupied spaces
At-Receiver Noise Treatment Guideline, Roads and Maritime, 2017	Provides an overview and discussion of feasible and reasonable at-receiver noise mitigation measures

3.2.1 Operational airborne noise – Road Noise Policy and Noise Criteria Guideline

The NSW *Road Noise Policy* (RNP) is used to assess and manage potential airborne noise impact from new and redeveloped road projects.

This assessment is carried out with guidance from the *Noise Criteria Guideline* (NCG) which is Roads and Maritime's interpretation of the RNP and provides a consistent approach to identifying road noise criteria for Roads and Maritime projects.

The RNP and NCG provide non-mandatory criteria for residential and 'other' sensitive land uses. Where a project results in road traffic noise levels which are predicted to be above the criteria, the project should investigate feasible and reasonable noise mitigation measures to minimise the impacts.

The RNP and NCG use the following terms to describe and assess the impacts from road projects:

- '**No Build**' – the assessment scenario used to predict noise levels if the project were not to go ahead.
- '**Build**' – the assessment scenario used to predict noise levels with the project.

The RNP and NCG require noise to be assessed at project opening and for a future design year which is typically ten years after opening. For this project, the at-opening year is 2026 and a design year is 2036.

Residential receivers

The project is defined as a mixture of both redeveloped roads and new roads. A road is redeveloped where works are in an existing road corridor and the existing road is not substantially realigned. Roads are classed as new where the road construction is in an undeveloped corridor or where the functional class of a road changes. Refer to **Section 4.2** for further details on new and redeveloped roads.

The location of new and redeveloped roads is shown in **Annexure D**. The NCG requires transition zones to be applied at the point where road categories change to provide a smooth transition in noise criteria. Transition zones are also shown in **Annexure D**.

The relevant noise criteria for residential receivers are shown in **Table 3-14**. The assessment criteria are lower for the night-time due to the greater sensitivity of communities to noise impacts during this period.

Table 3-14 NCG road traffic noise assessment criteria for residential land use

Road category	Type of project/land use	Assessment criteria (dBA)	Road category
		Daytime (7 am - 10 pm)	Night-time (10 pm - 7 am)
Freeway/ arterial/ sub-arterial roads	1. Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors	LAeq (15 hour) 55 (external)	LAeq (9 hour) 50 (external)
	2. Existing residences affected by noise from **redevelopment** of existing freeway/arterial/sub-arterial roads	LAeq (15 hour) 60 (external)	LAeq (9 hour) 55 (external)
	4. Existing residences affected by both new roads and the redevelopment of existing freeway/arterial/sub-arterial roads in a **Transition Zone**[1]	Between LAeq (15 hour) 55-60 (external)	Between LAeq (9 hour) 50-55 (external)
	5. Existing residences affected by increases in traffic noise of 12 dB or more from new of existing freeway/arterial/sub-arterial roads[2]	Between LAeq (15 hour) 42-55 (external)	Between LAeq (9 hour) 42-50 (external)
	6. Existing residences affected by increases in traffic noise of 12 dB or more from redevelopment of existing freeway/arterial/sub-arterial roads[2]	Between LAeq (15 hour) 42-60 (external)	Between LAeq (9 hour) 42-55 (external)

Note 1: The criteria assigned to the entire residence depend on the proportion of noise coming from the new and redeveloped road, as per the procedures in the Roads and Maritime NCG.

Note 2: The criteria at each facade are determined from the existing traffic noise level plus 12 dB.

'Other' sensitive land uses

A number of 'other' sensitive non-residential land uses have been identified in the operational study area. The noise criteria for these receivers are shown in **Table 3-15**. The NCG does not consider commercial and industrial receivers as being sensitive to operational airborne road traffic noise impacts.

Table 3-15 NCG criteria for 'other' sensitive receivers

Existing sensitive land use	Assessment criteria (dB)		Additional considerations
	Daytime (7 am - 10 pm)	Night-time (10 pm - 7 am)	
1. School classrooms	LAeq (1 hour) 40 (internal)[1]	-	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).
2. Hospital wards	LAeq (1 hour) 35 (internal)[1]	LAeq (1 hour) 35 (internal)[1]	
3. Places of worship	LAeq (1 hour) 40 (internal)[1]	LAeq (1 hour) 40 (internal)[1]	The criteria are internal, ie 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 is in these areas that may be affected by road traffic noise.
4. Open space (active use	LAeq (15 hour) 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.

Existing sensitive land use	Assessment criteria (dB)		Additional considerations
	Daytime (7 am - 10 pm)	Night-time (10 pm - 7 am)	
5. Open space (passive use)	L_{Aeq} (15 hour) 55 (external)	-	Passive recreation is characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion (eg playing chess, reading).
6. Child care facilities	Sleeping rooms L_{Aeq} (1 hour) 35 (internal)[1] Indoor play areas L_{Aeq} (1 hour) 40 (internal)[1] Outdoor play areas L_{Aeq} (1 hour) 55 (internal)[1]	-	Multipurpose spaces (eg 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.
7. Aged care facilities	-	-	The criteria for residential land uses should be applied to these facilities.

Note 1: The criteria are specified as an internal noise level for this receiver category. As the noise model predicts external noise levels, it has been conservatively assumed that all schools and places of worship have openable windows and external noise levels are therefore 10 dB higher than the corresponding internal level, which is generally considered representative of windows being partially open for ventilation. Hospital wards are assumed to have fixed windows with 20 dB higher external levels.

Potential road traffic noise impacts on the surrounding road network

Where a project results in traffic redistribution, noise impacts can occur on the surrounding road network due to additional vehicles using certain routes after the project is complete. The NCG criteria are therefore to be applied to the surrounding road network where a road project generates an increase in road traffic noise of more than 2 dB on these routes.

3.2.2 Operational vibration

Vehicles operating on roadways are unlikely to cause vibration impacts at adjacent receivers unless there are significant road irregularities, such as can occur at poorly maintained bridge joints. As the new and upgraded roads in the operational study area would be designed and constructed to avoid irregularities, impacts from operational vibration are not expected and have not been assessed any further in this report.

4. Assessment methodology

4.1 Construction noise and vibration assessment methodology

4.1.1 Construction scenarios

Representative scenarios have been developed to assess the likely impacts from the main construction phases of the project. These scenarios are described in **Table 4-1** together with a high-level description of each works activity. The location of the various work scenarios is shown in **Figure 4-1**.

The assessment uses ‘realistic worst-case’ scenarios to determine the impacts from the noisiest 15-minute period that is likely to occur for each work scenario, as required by the ICNG.

The scenarios have been categorised into ‘Peak impact’ and ‘Typical impact’ works. An example of ‘Peak impact’ work includes the use of noise intensive equipment like rock-breakers or concrete saws for some scenarios. While ‘Peak impact’ works would be required at certain times in most locations, the noisiest works would only last for relatively short periods throughout the overall works duration. The ‘Typical impact’ works represent typical noise emissions from the project when noise intensive equipment is not in use. ‘Peak impact’ and ‘Typical impact’ works are discussed further in **Section 5.1**.

Construction works would not occur continuously at each site and it is expected that there would be relatively long periods where construction noise levels are much lower than the worst-case levels presented in this assessment. There would also be many instances when no noisy works are occurring.

Table 4-1 Construction scenario descriptions

<table>
<tr><th>ID</th><th>Scenario</th><th>Description</th></tr>
<tr><td>1a</td><td>Ancillary facility establishment/ decommissioning – Peak impact</td><td rowspan="2">Before construction commences, the ancillary facilities would need to be prepared to allow construction works to occur. The works would vary depending on location and the existing conditions but could include:
- Minor clearing
- Minor earthworks
- Installation of office accommodation
- Utilities
- Amenities
- Secure perimeter fencing, including visual screening of construction ancillary facilities where necessary
High noise impact works would be required at certain times and would include the use of excavators and front end loaders.</td></tr>
<tr><td>1b</td><td>Ancillary facility establishment/ decommissioning – Typical impact</td></tr>
<tr><td>2a</td><td>Ancillary facilities – Operation</td><td rowspan="2">The ancillary facilities would generally comprise:
- Temporary buildings (generally prefabricated) including offices and meeting rooms, amenities and first aid facilities (the size and number of office facilities at the main ancillary facilities would be greater than at the secondary ancillary facilities)</td></tr>
<tr><td>2b</td><td>Ancillary facilities – Stockpiling</td></tr>
</table>

ID	Scenario	Description
2c	Ancillary facilities – Batching plant	- Hardstand parking areas with sufficient space to accommodate the numbers of construction workers expected at any site - Materials laydown, storage and handling areas, including purpose-built temporary structures as required - Batching plants are currently proposed to be located at AF2 and AF3. The location of the batching plant has been assumed to be in the middle of each ancillary facility. The location is considered indicative and would be confirmed as the project progresses. - Bridge construction support areas - Workshops with appropriate safety and environmental controls for servicing plant and equipment.
3a	Utilities and drainage - including relocation of existing - Peak impact	The project would require the construction of new drainage infrastructure and alterations to existing drainage. Construction of drainage works would involve localised excavation, compaction and installation of drainage pipes and pits, and construction of table drains and temporary construction sediment basins. High noise impact works would be required at certain times and would include the use of rock-breakers.
3b	Utilities and drainage - including relocation of existing - Typical impact	
4a	Demolition - bridges and buildings (including breaker)	Certain buildings and structures within the construction footprint would require demolition and removal where they are not proposed to be used as ancillary facilities during construction. This includes: - Buildings, sheds or farm infrastructure that fall within the construction footprint. - A bridge crossing South Creek on private property. Peak noise impact works would be required at certain times and would include the use of rock-breakers.
4b	Demolition - bridges and buildings (no breaker)	
5a	Clearing - Peak impact	Prior to earthworks being undertaken, vegetation and topsoil would be stripped. This is likely to involve: - Removal of vegetation - Topsoil stripping Peak noise impact works would be required at certain times and would include the use of chainsaws and chippers.
5b	Clearing - Typical impact	
6a	Earthworks - Peak impact	Earthworks would be required along the entire length of the project for: - Areas of new cut and fill along the construction footprint, including at all interchanges - Construction of retaining walls - Cut and fill or preparation of site for construction of all bridges Peak noise impact works would be required at certain times and would include the use of dozers or graders.
6b	Earthworks - Typical impact	
6c	Earthworks - onsite truck haulage	Onsite haulage would be required to move spoil between areas of the site as required. These activities have the potential to cause impacts as the truck travel between the various sites within the construction footprint.
7a	Bridge works - Peak impact (including piling)	Construction of the bridges would generally involve: - Construction of foundations (piling) - Construction of bridge piers - Construction of bridge abutments and spill-throughs where required
7b	Bridge works - Typical impact	

ID	Scenario	Description
7c	Bridge works - concrete works	- Installation of pre-cast concrete planks/girders and barriers - Installation of the deck - Installation of throw screens where required. For the proposed bridge lifts occurring over existing roads, it is likely that these activities would be required to occur outside of standard hours to minimise traffic disruption.
7d	Bridge works - girder lifts over existing roads	
8a	Road works - concrete works	Road works would generally include the surfacing and concrete/asphalt works associated with the construction of the road surface. Road works involving the tie-in works to existing roads at M7 Interchange, Elizabeth Drive at Airport Road, Wallgrove Road would likely be required to occur outside of standard hours. Additionally, works around the private access road along Luddenham Road, bike path connection into Elizabeth Drive near Mamre Road and utility access road would likely be required to occur outside of standard hours. Peak noise impact works would be required at certain times and would include the use of concrete saws.
8b	Road works - Typical impact	
8c	Road works - tie-in works to existing roads	
9a	Signage, lighting and landscaping - installation & finishing works	Finishing works are required to complete the project and include activities such as line marking, installing signs, etc. Installation and finishing work generally have no requirement for peak noise impact equipment.

Note 1: Equipment lists for each scenario and sound power level data are provided in **Annexure C**.

Working hours

Where feasible and reasonable, construction activities would be carried out during the standard construction hours as shown in **Table 4-2**.

Extended construction hours are proposed for the project which include an extra hour at the start and end of each day Monday to Friday and an extra four hours on a Saturday afternoon, as shown in **Table 4-3** highlighted in yellow.

Where possible, less noisy activities would be completed in the extended working hours such as refuelling, light vehicle movements and briefing of the workforce (toolbox talks). Noisy activities, such as starting noisy machinery, would be done in standard construction hours where feasible and reasonable.

The nature of the works means evening and night-time work would also be required at certain times to minimise impacts on road traffic and for safety reasons.

Out of Hours Works would be required to:

- Minimise unacceptable traffic impacts on and disruptions to the road network
- Minimise disturbance to surrounding landowners and commercial properties
- Ensure the safety of the construction workers, motorists and the general public.

It is anticipated that the activities listed in **Table 4-4** would be required to be completed out-of-hours.

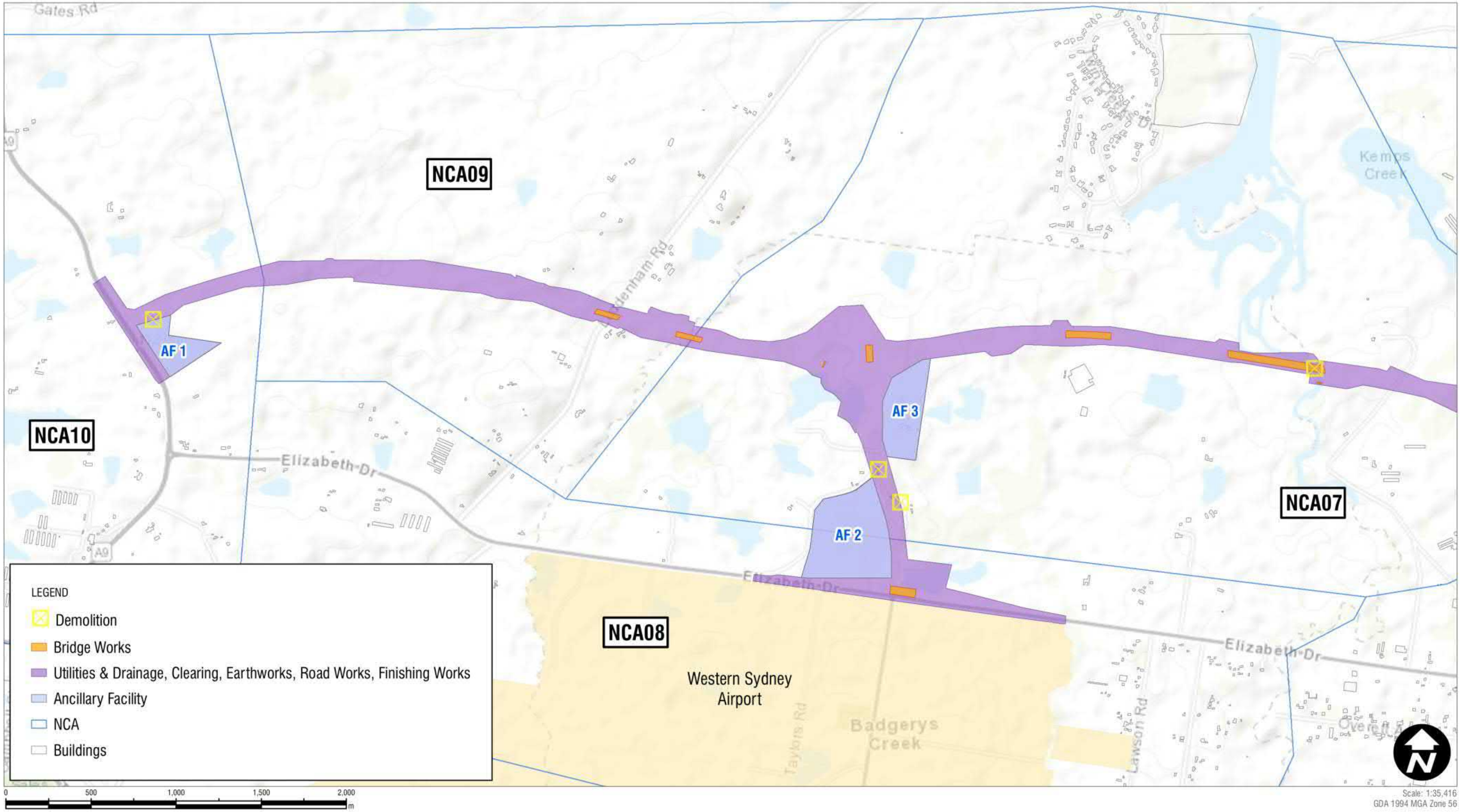


Figure 4-1 Construction works locations

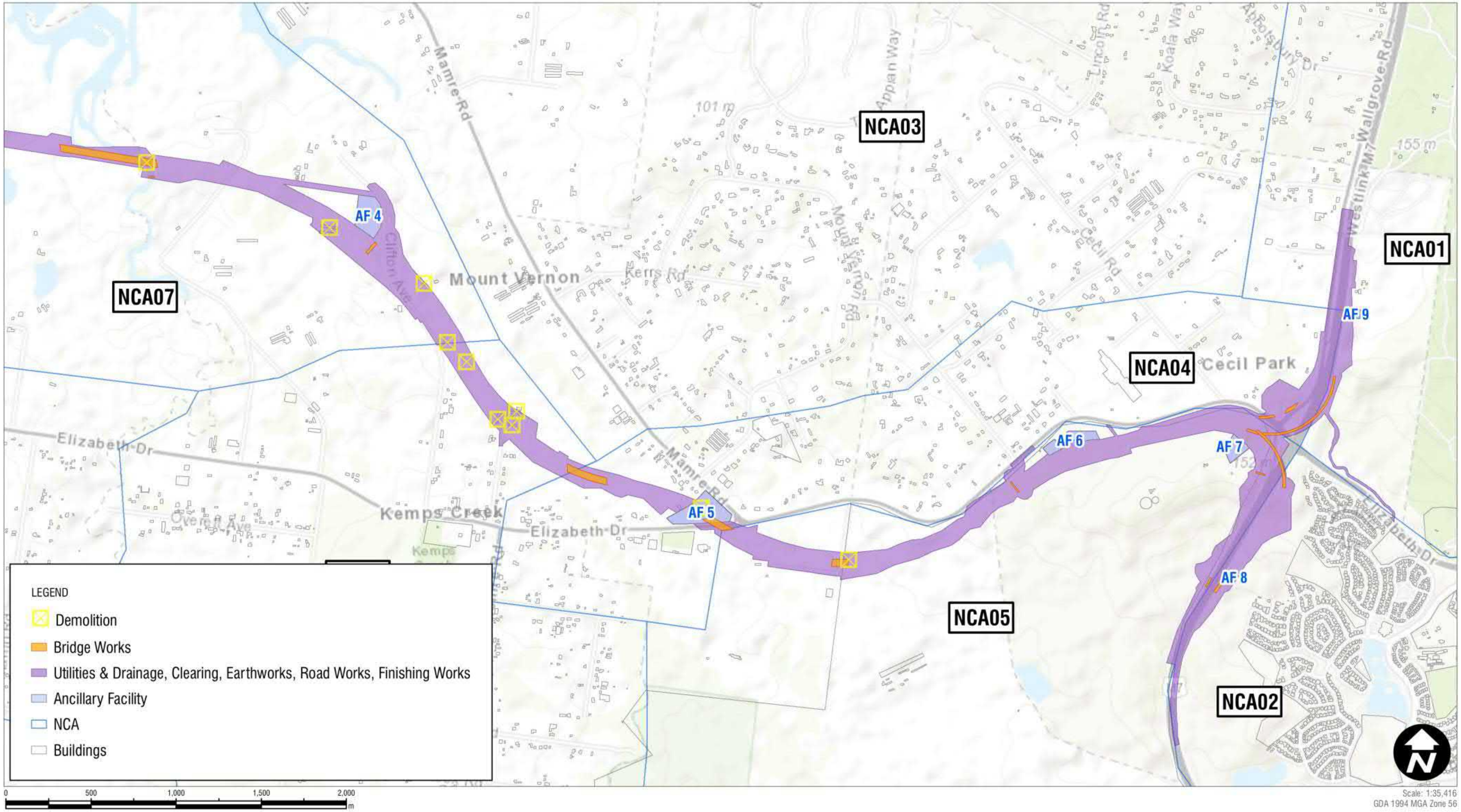


Figure 4-1 Construction works locations

Table 4-2 Standard construction hours and out of hours work periods under a normal project scenario

Hour commencing	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM
Monday																								
Tuesday																								
Wednesday													**Standard Day**							**OOHW Evening**				
Thursday				**OOHW**									**Construction Hours**							**Period 1**				
Friday				**Period 2**																				
Saturday																								
Sunday													**OOHW Day**								**OOHW**			
Public Holiday													**Period 1**								**Period 2**			

Note 1: Referenced from the Roads and Maritime Construction Noise and Vibration Guideline.

Note 2: Standard construction hours are defined as: Monday to Friday 7:00 am to 6:00 pm and Saturdays from 8:00 am to 1:00 pm.

Table 4-3 Extended and standard construction hours and out of hours work periods under an approved 'extended hours' project scenario

Hour commencing	12 AM	1 AM	2 AM	3 AM	4 AM	5 AM	6 AM	7 AM	8 AM	9 AM	10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM
Monday																								
Tuesday																								
Wednesday													**Standard Day**								**OOHW Evening**			
Thursday				**OOHW**									**Construction Hours**								**Period 1**			
Friday				**Period 2**																				
Saturday															**Extended Hours**									
Sunday													**OOHW Day**								**OOHW**			
Public Holiday													**Period 1**								**Period 2**			

Note 1: Extended construction hours shown in yellow: 6:00 am to 7:00 am Monday to Friday, 6:00 pm to 7:00 pm Monday to Friday, and 1:00 pm to 5:00 pm Saturday.

Table 4-4 Proposed out of hours works

Activity	Justification for out of hours activities
Maintenance	Maintenance for plant and equipment may be on call for breakdowns and emergencies
Road tie-in works, temporary diversions and traffic switches	Completing or installing these items at night when traffic flows are low would minimise disruption to traffic and minimise any potential safety conflict between construction personnel and traffic. This includes works interfacing with the M7 Motorway and construction of overbridge piers for the M12 entry and exit ramps with the M7 Motorway
Craneage of bridge beams and precast deck units	Craneage of bridge beams over existing roads including Luddenham Road, Elizabeth Drive, Range Road and the M7 Motorway, for activities such as installing bridge girders, concrete decking, barriers. In some areas the crane would need to be established on the road.
Pavement works, temporary medians and line marking	These works require lane closures and, in some cases, total closure of roads to safely carry out the works. This means that pavement works cannot be carried out during periods of high traffic volumes and would occur during evening and night-time periods.
Use of construction ancillary facilities to support out-of-hours works	Some activities at construction ancillary facilities would be required to support out-of-hours works. Where possible, activities would be kept to a minimum with only those required to support the works to be used
Delivery of oversized material, plant and equipment	Delivery of some materials and equipment may require oversized loads. Such activities would be carried out in line with NSW Police, NSW Traffic Management Centre and Roads and Maritime requirements, which may include out-of-hours movements when vehicle numbers on the network are lower
Utility relocation	Some utilities would cross major and local roads. They would be closed or partially closed to facilitate this work. This work would be carried out in accordance with Roads and Maritime and local council requirements. Where the utility authority only allows works to be carried out during a shutdown period, works would be coordinated with the utility authority.
Other works	Can be demonstrated that these works would have unacceptable amenity impacts to local sensitive receivers

Night-time construction activities would be supported by out-of-hours operation of temporary ancillary facilities. The exact timing of out-of-hours work would depend on construction activities, construction techniques and working with the affected communities or authorities such as utility authorities or North West Roads (M7 Motorway) and would be subject to the requirements of the construction contractor.

The periods in which the construction works are expected to be required are shown in **Table 4-5**. At this early stage in the project, Out of Hours Works (OOHW) have been included in a number of construction scenarios that would likely need to occur outside of daytime hours at some point in the construction. The anticipated duration of each activity is also provided in the table, noting that noisy activities would not occur at full capacity for the entire duration and would not be carried out every day.

Activities which represent ‘Peak impact’ and ‘Typical Impact’ works have been used in the assessment. The ‘Peak impact’ activities include noise intensive equipment such as rock-breakers and concrete saws, and these works are generally only required for relatively short periods of the full project duration. The ‘Typical Impact’ works represent typical noise emissions when noise intensive equipment is not in use.

Table 4-5 Construction scenarios – working hours and indicative durations

ID	Scenario	Activity	Indicative duration (weeks)	Hours of works					
				Normal works					
				Morning shoulder	Day	Day OOH[1]	Evening	Evening shoulder	Night-time
1a	Ancillary facility establishment/decommissioning	Peak impact	6	✓	✓	-	-	✓	-
1b		Typical impact	12	✓	✓	✓	✓	✓	✓
2a	Ancillary facilities	Operation	192	✓	✓	✓	✓	✓	✓
2b		Stockpiling	144	✓	✓	✓	✓	✓	✓
2c		Batching plant	120	✓	✓	✓	✓	✓	✓
3a	Utilities and drainage - including relocation of existing	Peak impact	35	✓	✓	-	-	✓	-
3b		Typical impact	132	✓	✓	-	-	✓	-
4a	Demolition	Bridges and buildings (inc breaker)	36	✓	✓	-	-	✓	-
4b		Bridges and buildings (no breaker)	36	✓	✓	-	-	✓	-
5a	Clearing	Peak impact	20	✓	✓	-	-	✓	-
5b		Typical impact	36	✓	✓	-	-	✓	-
6a	Earthworks	Peak impact	80	✓	✓	-	-	✓	-
6b		Typical impact	144	✓	✓	-	-	✓	-
6c		Onsite truck haulage	144	✓	✓	-	-	✓	-
7a	Bridge works	Peak impact (inc piling)	48	✓	✓	✓	✓	✓	✓
7b		Typical impact	144	✓	✓	✓	✓	✓	✓
7c		Concrete works	48	✓	✓	✓	✓	✓	✓
7d		Girder lifts over existing roads	50	✓	✓	✓	✓	✓	✓
8a	Road works	Concrete works	30	✓	✓	✓	✓	✓	✓
8b		Typical impact	144	✓	✓	-	-	✓	-
8c		Tie-in works to existing roads	48	✓	✓	✓	✓	✓	✓
9a	Signage, lighting and landscaping	Installation & finishing works	36	✓	✓	-	-	✓	-

Note 1: OOH = out of hours.

Works schedule

Construction of the project would start in the second quarter of 2022, with completion expected by end of the first quarter of 2026. The indicative construction program for the project is shown in **Table 4-6**.

Table 4-6 Indicative construction schedule

Work phase	2022				2023				2024				2025				2026			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
Ancillary facility establishment/ decommissioning																				
Ancillary facilities																				
Utilities and drainage - including relocation of existing																				
Demolition																				
Clearing																				
Earthworks																				
Bridge works																				
Road works																				
Signage, lighting and landscaping																				

4.1.2 Overview of construction noise modelling

A noise model of the study area has been used to predict noise levels from the construction works to all surrounding receivers. The model uses ISO 9613 algorithms in SoundPLAN software.

Local terrain, receiver buildings and structures were digitised in the noise model to develop a three-dimensional representation of the construction sites and surrounding areas.

4.1.3 Overview of construction road traffic

Construction traffic volumes during the peak construction period (around 2024) have been compared to the forecast traffic volumes during the same period.

The construction road traffic noise calculations were carried out using *Calculation of Road Traffic Noise* (CoRTN) (UK Department of Transport, 1988) calculations to predict the change in road traffic noise levels due to construction traffic. As outlined in **Section 3.1.2**, where the predicted increase is greater than 2 dB, the predicted noise level is compared to the RNP road traffic noise criteria.

Construction road traffic would access the construction footprint via the ancillary facilities. Traffic accessing each ancillary facility is likely to follow the following routes to the site location:

- AF1, AF2/AF3 and AF4 would be accessed via The Northern Road, Elizabeth Drive
- AF5 would be accessed via The Northern Road, Elizabeth Drive and Mamre Road

- Range Road, AF6, Wallgrove Road and AF9 would be accessed via the M7 Motorway and Elizabeth Drive.

The construction traffic volumes provided assume that 50 per cent of the construction traffic will be travelling from the north and 50 per cent from the south (along the M7 Motorway and The Northern Road).

The baseline traffic volumes for the construction period and proposed construction traffic volumes are detailed in **Annexure C**.

4.2 Operational noise assessment methodology

4.2.1 Key features of the project as related to operational noise impacts

The key features of the project that have the potential to change operational road traffic noise impacts in the study area include:

- A new dual-carriageway motorway with two lanes in each direction
- Motorway access via interchanges/intersections at The Northern Road, the Western Sydney Airport and the M7 Motorway
- Bridge structures across a number of creeks and existing roads
- Realignment of Elizabeth Drive at the Western Sydney Airport, with Elizabeth Drive bridging over the WSA access road
- Realignment of Wallgrove Road to the north of Elizabeth Drive and modification to the Wallgrove Road and Elizabeth Drive entries to the M7 Motorway.

The key features of the project are shown in **Figure 4-2**.

The study area for the operational noise assessment extends to a distance of 600 metres on each side of the project roads (measured from the centreline of the outermost traffic lanes), as defined in the RNP and NCG. This distance is based on the limit of accuracy of currently approved road traffic noise models. The operational study area is hard cut at the project extents, as per Roads and Maritime’s application of the NCG.

4.2.2 Noise model

A noise model of the operational study area has been used to predict noise levels from the operation of the project to all surrounding receivers. The model uses *Calculation of Road Traffic Noise* (CoRTN) (UK Department of Transport, 1988) algorithms in SoundPLAN software.

Local terrain, receiver buildings and structures were digitised in the noise model to develop a three-dimensional representation of the road corridor and surrounding areas.

The ‘No Build’ scenarios use the existing road alignment geometry, with existing structures such as noise barriers and features within the road corridor being included.

The ‘Build’ scenarios use the proposed design of the project which includes all new roads, widening works, proposed modifications to the access ramps and changes to existing ground levels such as cuttings and embankments.

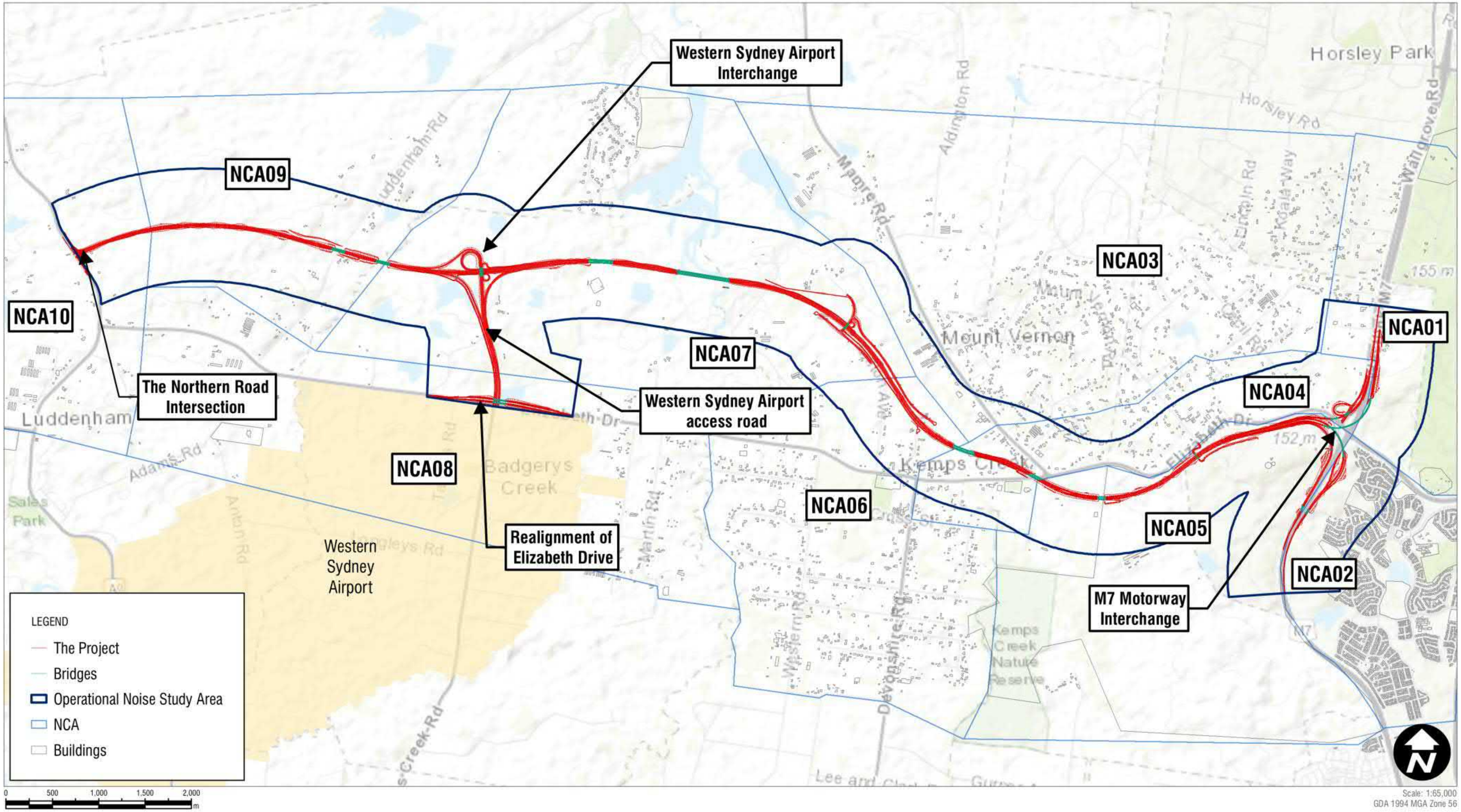


Figure 4-2 Key operational features of the project

4.2.3 Project and non-project roads

Roads where design or engineering changes are proposed as part of the project are considered as 'project' roads. Roads with no works are considered 'non-project'.

All major roads in the operational study area have been modelled together with major roads on the surrounding road network to determine the contributions from 'project' and 'non-project' existing roads at individual sensitive receivers, as required by the NCG.

'Project' and 'non-project' roads are shown in **Annexure D**.

4.2.4 Road types

The NCG classifies project roads as either 'new' or 'redeveloped'. The road classifications used in the assessment are shown in **Annexure D**.

4.2.5 Traffic data

The project has a number of related key projects which influence traffic volumes in the operational study area. Some of these projects would be operational at the opening of the M12, while others would open within 10 years of the M12 opening.

The projects which have been included in the various assessment scenarios are shown in **Table 4-7**. The traffic scenarios are:

- **No Build** (ie without the project) – this scenario represents the existing road network in the operational study area in the absence of the project.
- **Build** (ie with the project) – this scenario assumes that the project goes ahead.

Table 4-7 Traffic scenarios and interfacing projects

Project	No Build		Build	
	2026 At Opening	2036 Future	2026 At Opening	2036 Future
Land use				
LU14 adjusted version 4 (TPA)	✓	✓	✓	✓
Western Sydney Airport and business park (adjusted)	✓	✓	✓	✓
Roads				
M12 Motorway			✓	✓
Old Wallgrove Road	✓	✓	✓	✓
Archbold Road	✓	✓	✓	✓
Southern Link Road	✓	✓	✓	✓
NorthConnex	✓	✓	✓	✓
WestConnex (all stages)	✓	✓	✓	✓
Western Harbour Tunnel	✓	✓	✓	✓

Project	No Build		Build	
	2026 At Opening	2036 Future	2026 At Opening	2036 Future
Beaches Link	✓	✓	✓	✓
The Northern Road upgrade	✓	✓	✓	✓
Bringelly Road upgrade	✓	✓	✓	✓
Werrington Arterial Road	✓	✓	✓	✓
Elizabeth Drive upgrade (M7 to Devonshire Road, 4 lanes divided)	-	✓	-	✓
Elizabeth Drive upgrade (Devonshire Road to The Northern Road, 4 lanes divided)	-	✓	-	✓
Mamre Road upgrade (M4 to Bakers Lane)	✓	✓	✓	✓
Mamre Road upgrade (Bakers Lane to Kerrs Road)	-	✓	-	✓
Schofields Road	✓	✓	✓	✓
Richmond Road	✓	✓	✓	✓
Denmark Link Road	✓	✓	✓	✓
Bandon Road	-	✓	-	✓
Garfield Road	-	✓	-	✓
Mulgoa Road upgrade	-	✓	-	✓
M4 SMART Motorway upgrades	✓	✓	✓	✓

4.2.6 Noise modelling parameters

The noise modelling parameters used in the assessment are detailed in **Table 4-8**, overleaf.

4.2.7 Noise model validation

To validate the operational road traffic noise model, the 2018 existing scenario was modelled and compared to existing noise measurements in the operational study area (refer to **Chapter 2**). The validation measurement sites are shown in **Figure 2-1** and a summary of the noise model validation is provided in **Table 4-9**, overleaf. Only noise monitoring locations which were used for model validation purposes are shown.

The Roads and Maritime Environmental Noise Management Manual (ENMM) notes that “it should be recognised that noise prediction modelling has some accuracy limitations and will commonly produce acceptable errors of around 2 dBA”.

Table 4-8 Summary of operational noise model inputs and parameters

Input parameter	Source of data
Ground topography	The noise model includes a 'digital ground model' which is an accurate 3D representation of the terrain in the operational study area. The ground model was made from a combination of surveyed road corridor data and LIDAR point cloud data.
Buildings, receiver locations and floors	Buildings can provide screening to more distant locations of the operational study area which is dependent on the building height. The buildings were generated from a combination of LIDAR, aerial photography and site inspections. The heights of buildings were determined from LIDAR point cloud data. The model predicts noise to every facade of every identified receiver in the operational study area, using the following heights: • Ground floor[1] 1.5 m • First floor[1] 4.5 m All floors of multi-storey receivers are included in the assessment.
Study area	The operational study area extends to a distance of 600 metres from the centreline of the outermost traffic lane on each side of the project roads. The operational study area is hard cut at the project extents, as per the RNP.
Assessment timeframes	The project is assessed 'At Opening' in 2026 and in the 'Future Design' year in 2036, as per the RNP.
Traffic volumes	Existing traffic volumes were counted at the same time as the ambient noise monitoring was completed. This data was used to model the existing situation and validate the operational road traffic noise model. The predicted traffic volumes for the 2026 and 2036 assessment years were provided by the project team. All major roads near the project were included in the noise model.
Vehicle speed	Existing vehicle speeds were measured during the baseline survey and used to validate the noise model. Existing and future posted vehicle speeds were used in the operational assessment.
Source heights and source correction	Vehicles generally emit road traffic noise at four source heights. These are represented in the noise model by the following: • Cars (at 0.5 m height with a source correction of 0.0 dBA) • Truck tyres (at 0.5 m height with a source correction of -5.4 dBA) • Truck engines (at 1.5 m height with a source correction of -2.4 dBA) • Truck exhausts (at 3.6 m height with a source correction of -8.5 dBA)
Road surface corrections	The road surface in the operational study area is generally dense graded asphalt (DGA). The proposed surface of the M12 main carriageway is a concrete pavement. The project ramps and bridges are proposed to be surfaced with DGA. The source corrections for these surfaces are: • Dense graded asphalt +0.0 dBA • Concrete pavement +3.0 dBA
Noise barriers	No existing noise barriers were identified near the project.
Ground absorption	Noise levels at receivers can be influenced by the type of ground between the source of noise and the receiver. Soft ground such as vegetation can reduce noise to a greater degree than hard ground such as concrete or road surfaces. A ground absorption factor of 0.75 has been used in the noise model.
General corrections	The model also includes the following corrections: • Facade reflections +2.5 dB • L_{A10} to L_{Aeq} -3 dB

Note 1: These are typical heights above ground level, the height of some receivers was adjusted according to site survey information.

Table 4-9 Comparison of measured and predicted road traffic noise levels

Location[1]	Noise level (dBA)[2]					
	Daytime LAeq (15hour)			Night-time LAeq (9hour)		
	Measured	Predicted	Difference[3]	Measured	Predicted	Difference[3]
L03	67.2	67.6	0.4	63.5	64.2	0.7
L04	57.5	57.2	-0.3	53.5	53.4	-0.1
L05	48.0	47.1	-0.9	44.4	43.3	-1.1
L07	56.3	56.6	0.3	52.3	52.9	0.6
L08	60.4	61.8	1.4	58.7	58.2	-0.5
L09	56.0	55.5	-0.5	55.7	51.8	-3.9[4]
L10	50.8	50.5	-0.3	49.3	46.8	-2.5[4]
L11	70.0	69.4	-0.6	66.4	65.1	-1.3
L12	48.6	51.7	3.1[4]	45.3	47.6	2.3[4]
L13	64.7	65.7	1.0	60.9	61.8	0.9
L14	55.9	58.9	3.0[4]	52.7	54.9	2.2[4]
L15	51.6	54.1	2.5[4]	49.5	50.1	0.6
	Median		**-0.3**	**Median**		**0.3**

Note 1: L01, L02 and L06 were excluded from the validation due to their distance from roads where traffic counting was undertaken. The purpose of these locations was to determine background noise levels for use in the construction assessment.

Note 2: Validation of the noise model was done using data from 26 to 30 June 2017. This period excluded weekends which tend to have lower and intermittent traffic volumes.

Note 3: Difference is Predicted minus Measured. A negative difference indicates the predicted level of road traffic noise is lower than the measured data, a positive difference indicates the predicted level is higher.

Note 4: These values have been excluded from the calculation of the median value. This is discussed in the paragraphs following this table.

The noise model predictions are within the accepted tolerances (+/- 2 dBA) at all logger locations except L09, L10, L12, L14 and L15. These locations are located at distances greater than 100 m from the road and are likely to be influenced by noise levels not related to road traffic. This feature can be most apparent during the night time, where low volumes of existing road traffic result in noise levels at the monitoring locations being controlled by environmental noise sources such as wind, birds and insects.

At locations where the model is overpredicting (L12, L14, and L15), it is likely that localised shielding from ground terrain is influencing the line of sight between the monitoring locations and the nearest road. While the noise model incorporates 3D LIDAR ground contours, small changes in ground elevation over large distances can result in differences between the predicted and measured levels.

Given the model correlates well with measured locations which are dominated by road traffic noise, it is considered suitable for use.

4.2.8 Noise mitigation

The Roads and Maritime Noise Mitigation Guideline (NMG) provides guidance in managing and controlling road traffic noise and describes the principles to be applied when reviewing noise mitigation. The NMG recognises that the NCG criteria are not always practicable and that it is not always feasible or reasonable to expect that they are achieved.

When evaluating if a receiver qualifies for consideration of additional noise mitigation the NMG considers how far above the criterion the noise level is and also how much the noise level has increased by. These considerations provide a feasible and reasonable approach to identifying qualifying receivers.

The NMG provides three triggers where a receiver may qualify for consideration of noise mitigation (beyond the use of 'integrated noise reduction measures' such as road design and traffic management). These are:

- **Trigger 1** – the predicted 'Build' noise level exceeds the NCG controlling criterion and the noise level increase due to the project (ie the noise predictions for the 'Build' minus the 'No Build') is greater than 2.0 dB.
- **Trigger 2** – the predicted Build noise level is 5.0 dB or more above the NCG controlling criterion (ie exceeds the cumulative limit) and the receiver is significantly influenced by project road noise, regardless of the incremental impact of the project.
- **Trigger 3 –** the noise level contribution from the road project is acute (daytime L_{Aeq} (15hour) 65 dBA or higher, or night-time L_{Aeq} (9hour) 60 dBA or higher) even if noise levels are dominated by a non-project road.

The eligibility of receivers for consideration of additional noise mitigation is determined before the benefit of additional noise mitigation (low noise pavement and noise barriers) is included. The requirement for the project is to provide feasible and reasonable additional mitigation to eligible receivers with the aim of meeting the NCG controlling criterion.

For receivers that qualify for consideration of additional noise mitigation, potential noise mitigation measures are to be considered in the following descending order of preference:

- Quieter road pavement surfaces
- Noise mounds
- Noise barriers
- At-property treatments.

4.2.9 Maximum noise levels

Maximum noise levels near to roads are generally controlled by noise from trucks during braking. Where roads are located close to residential receivers there is potential for sleep disturbance impacts from maximum noise level events.

The RNP and ENMM both state that while a maximum noise level assessment is required to be carried out for new and upgraded road infrastructure projects, it should only be used as a tool to help prioritise and rank mitigation strategies and should not be applied as a decisive criterion.

The purpose of a maximum noise level assessment is to determine where maximum noise levels are likely to change as a result of a project.

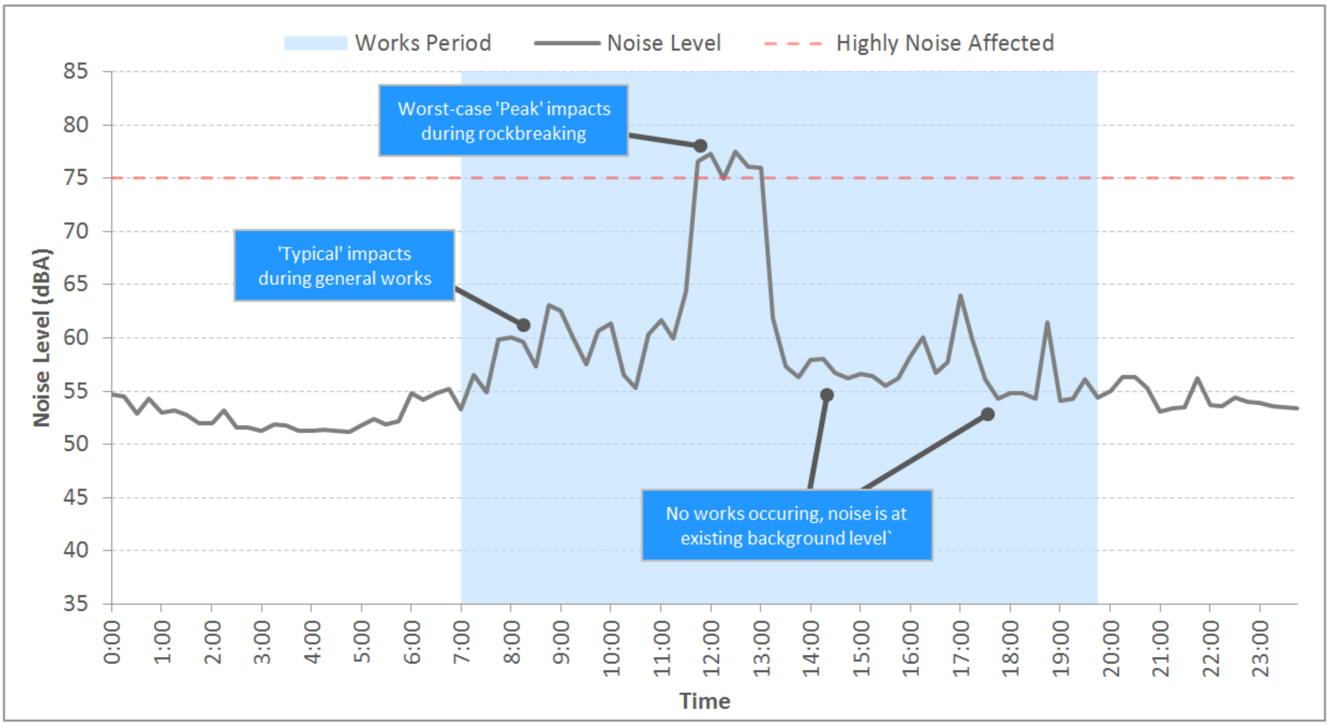
The maximum noise level assessment includes an evaluation of the number and distribution of night-time events in accordance with the ENMM. A maximum noise level event is defined as being any pass by where:

- The maximum noise level of the event is greater than 65 dBA L_{AFmax}; and
- The L_{AFmax} – L_{Aeq} (1hour) is greater than or equal to 15 dB.

5. Construction noise and vibration assessment

5.1 Predicted worst-case noise impacts – project overview

The following summary is based on the predicted noise impacts at the most affected receivers in each NCA and is representative of the worst-case situation where construction equipment is at the closest point to each receiver. For most works, the construction noise impacts would frequently be lower than predicted as the worst-case situation is typically only apparent for a relatively short period when noisy equipment is in use. This concept is illustrated in **Figure 5-1**, which shows noise levels measured next to major construction works during a period of 'peak impact' rock-breaking and shows how construction noise levels vary over the works period.



Note 1: The measurement location was about 40 metres away from the works.

Figure 5-1 Example of indicative construction noise levels during rock-breaking

In the above example, while the worst-case noise levels result in highly noise affected impacts, they only last for part of the works period and the noise levels during 'Typical Impacts' are much lower. There are also periods when no works are occurring, and noise levels are at the existing background level (eg road traffic and general urban hum).

The following assessment shows the predicted noise impacts based on the exceedance of the NML, as per the three categories in **Table 5-1**. The likely subjective response of people affected by the impacts is also shown.

Table 5-1 NML exceedance bands and corresponding qualitative response to impacts

Exceedance of NML	Symbol	Likely subjective response
No exceedance	·	n/a
1 dB to 10 dB	●	Marginal to minor
11 dB to 20 dB	◆	Moderate
>20 dB	■	High

The predicted construction noise impacts are presented for the most affected receivers. Receivers which are further away from the works and/or shielded from view would have substantially lower noise impacts.

A summary of the predicted construction noise impacts in each NCA for residential receivers is shown in **Table 5-2** to **Table 5-6** for each assessment period. Detailed noise level predictions and summaries of the number of receivers predicted to have ‘minor’, ‘moderate’ and ‘high’ impacts in each NCA are provided in **Annexure C**.

Where impacts are predicted, the methods for controlling the impacts through the use of environmental management measures are discussed in more detail in **Section 7.1**.

Table 5-2 Predicted construction noise exceedances morning shoulder – residential receivers

Period	ID	Scenario	Activity	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	NCA10
Morning Shoulder	1a	Ancillary facility establishment	Peak impact	♦	●	●	●	·	●	■	·	·	♦
	1b		Typical impact	●	●	·	●	·	·	■	·	·	●
	2a	Ancillary facility operations	Operation	●	·	·	·	·	·	■	·	·	●
	2b		Stockpiling	●	●	·	●	·	·	■	·	·	●
	2c		Batching plant	·	·	·	·	·	·	♦	·	·	·
	3a	Utilities and drainage	Peak impact	■	♦	♦	♦	·	■	■	♦	■	♦
	3b		Typical impact	♦	●	·	●	·	■	■	●	●	●
	4a	Demolition	Peak impact	·	·	♦	♦	·	■	■	●	●	♦
	4b		Typical impact	·	·	·	●	·	♦	■	·	·	●
	5a	Clearing	Peak impact	■	♦	♦	♦	·	■	■	♦	♦	♦
	5b		Typical impact	♦	●	·	●	·	■	■	●	●	●
	6a	Earthworks	Peak impact	■	♦	♦	♦	·	■	■	♦	♦	♦
	6b		Typical impact	♦	●	·	●	·	■	■	●	●	●
	6c		Onsite truck haulage	·	·	·	·	·	·	●	·	·	·
	7a	Bridge works	Peak impact	·	●	●	●	·	●	♦	·	●	·
	7b		Typical impact	·	●	·	·	·	·	●	·	·	·
	7c		Concrete works	·	●	·	·	·	●	●	·	●	·
	7d		Girder lifts	·	●	·	·	·	·	·	·	·	·
	8a	Road works	Concrete works	♦	●	·	●	·	■	■	·	●	●
	8b		Typical works	♦	●	·	·	·	■	■	·	●	●
	8c		Tie-in works	■	♦	●	♦	·	●	♦	♦	♦	·
	9a	Signage, lighting and landscaping		♦	●	●	●	·	■	■	●	♦	●

Key to impacts: · No exceedance ● Marginal to minor (1 dB to 10 dB) ♦ Moderate (11 dB to 20 dB) ■ High (>20 dB)

Table 5-3 Predicted construction noise exceedances standard daytime – residential receivers

Period	ID	Scenario	Activity	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	NCA10
Standard Daytime	1a	Ancillary facility establishment	Peak impact	●	●	●	●	·	·	■	·	·	●
	1b		Typical impact	●	·	·	·	·	·	■	·	·	●
	2a	Ancillary facility operations	Operation	·	·	·	·	·	·	♦	·	·	·
	2b		Stockpiling	●	·	·	·	·	·	■	·	·	●
	2c		Batching plant	·	·	·	·	·	·	♦	·	·	·
	3a	Utilities and drainage	Peak impact	■	♦	●	♦	·	■	■	♦	♦	♦
	3b		Typical impact	●	·	·	·	·	♦	■	·	●	·
	4a	Demolition	Peak impact	·	·	●	●	·	■	■	·	·	♦
	4b		Typical impact	·	·	·	·	·	●	♦	·	·	·
	5a	Clearing	Peak impact	■	♦	●	♦	·	■	■	●	♦	●
	5b		Typical impact	●	·	·	·	·	♦	■	·	●	·
	6a	Earthworks	Peak impact	♦	♦	●	●	·	■	■	●	♦	●
	6b		Typical impact	●	·	·	·	·	♦	■	·	●	·
	6c		Onsite truck haulage	·	·	·	·	·	·	·	·	·	·
	7a	Bridge works	Peak impact	·	●	·	·	·	●	●	·	●	·
	7b		Typical impact	·	·	·	·	·	·	·	·	·	·
	7c		Concrete works	·	·	·	·	·	·	·	·	·	·
	7d		Girder lifts	·	·	·	·	·	·	·	·	·	·
	8a	Road works	Concrete works	●	●	·	·	·	♦	■	·	●	·
	8b		Typical works	●	●	·	·	·	♦	■	·	●	·
	8c		Tie-in works	♦	●	●	♦	·	·	●	●	●	·
	9a	Signage, lighting and landscaping		♦	●	·	●	·	♦	■	·	●	·

Key to impacts: · No exceedance ● Marginal to minor (1 dB to 10 dB) ♦ Moderate (11 dB to 20 dB) ■ High (>20 dB)

Table 5-4 Predicted construction noise exceedances evening shoulder – residential receivers

Period	ID	Scenario	Activity	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	NCA10
Evening Shoulder	1a	Ancillary facility establishment	Peak impact	♦	♦	●	♦	·	●	■	●	●	♦
	1b		Typical impact	●	●	·	●	·	·	■	·	·	●
	2a	Ancillary facility operations	Operation	●	·	·	●	·	·	■	·	·	●
	2b		Stockpiling	●	●	·	●	·	·	■	·	·	●
	2c		Batching plant	·	·	·	·	·	·	♦	·	·	·
	3a	Utilities and drainage	Peak impact	■	■	♦	■	·	■	■	♦	■	♦
	3b		Typical impact	♦	●	·	●	·	■	■	●	♦	●
	4a	Demolition	Peak impact	·	·	♦	♦	·	■	■	●	●	♦
	4b		Typical impact	·	·	·	●	·	♦	■	·	·	●
	5a	Clearing	Peak impact	■	♦	♦	■	·	■	■	♦	■	♦
	5b		Typical impact	♦	●	·	●	·	■	■	●	♦	●
	6a	Earthworks	Peak impact	■	♦	♦	■	·	■	■	♦	■	♦
	6b		Typical impact	♦	●	·	●	·	■	■	●	♦	●
	6c		Onsite truck haulage	●	·	·	·	·	·	●	·	·	·
	7a	Bridge works	Peak impact	·	♦	●	●	·	●	♦	·	♦	·
	7b		Typical impact	·	●	·	·	·	·	●	·	●	·
	7c		Concrete works	·	●	·	●	·	●	●	·	●	·
	7d		Girder lifts	·	●	·	·	·	·	·	·	●	·
	8a	Road works	Concrete works	♦	●	·	●	·	■	■	●	♦	●
	8b		Typical works	♦	●	·	●	·	■	■	·	♦	●
	8c		Tie-in works	■	♦	●	■	·	●	♦	♦	♦	·
	9a	Signage, lighting and landscaping		♦	♦	♦	●	♦	·	■	■	●	♦

Key to impacts: · No exceedance ● Marginal to minor (1 dB to 10 dB) ♦ Moderate (11 dB to 20 dB) ■ High (>20 dB)

Table 5-5 Predicted construction noise exceedances evening – residential receivers

Period	ID	Scenario	Activity	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	NCA10
Evening	1a	Ancillary facility establishment	Peak impact	·	·	·	·	·	·	·	·	·	·
	1b		Typical impact	●	●	·	●	·	·	■	·	·	●
	2a	Ancillary facility operations	Operation	●	·	·	●	·	·	■	·	·	●
	2b		Stockpiling	●	●	·	●	·	·	■	·	·	●
	2c		Batching plant	·	·	·	·	·	·	♦	·	·	·
	3a	Utilities and drainage	Peak impact	·	·	·	·	·	·	·	·	·	·
	3b		Typical impact	·	·	·	·	·	·	·	·	·	·
	4a	Demolition	Peak impact	·	·	·	·	·	·	·	·	·	·
	4b		Typical impact	·	·	·	·	·	·	·	·	·	·
	5a	Clearing	Peak impact	·	·	·	·	·	·	·	·	·	·
	5b		Typical impact	·	·	·	·	·	·	·	·	·	·
	6a	Earthworks	Peak impact	·	·	·	·	·	·	·	·	·	·
	6b		Typical impact	·	·	·	·	·	·	·	·	·	·
	6c		Onsite truck haulage	·	·	·	·	·	·	·	·	·	·
	7a	Bridge works	Peak impact	·	♦	●	●	·	●	♦	·	♦	·
	7b		Typical impact	·	●	·	·	·	·	●	·	●	·
	7c		Concrete works	·	●	·	●	·	●	●	·	●	·
	7d		Girder lifts	·	●	·	·	·	·	·	·	●	·
	8a	Road works	Concrete works	♦	●	·	●	·	■	■	●	♦	●
	8b		Typical works	·	·	·	·	·	·	·	·	·	·
	8c		Tie-in works	■	♦	●	■	·	●	♦	♦	♦	·
	9a	Signage, lighting and landscaping		·	·	·	·	·	·	·	·	·	·

Key to impacts: · No exceedance ● Marginal to minor (1 dB to 10 dB) ♦ Moderate (11 dB to 20 dB) ■ High (>20 dB)

Table 5-6 Predicted construction noise exceedances night-time – residential receivers

Period	ID	Scenario	Activity	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	NCA10
Night-time	1a	Ancillary facility establishment	Peak impact	·	·	·	·	·	·	·	·	·	·
	1b		Typical impact	♦	●	●	♦	·	·	■	·	·	♦
	2a	Ancillary facility operations	Operation	●	●	·	♦	·	·	■	·	·	●
	2b		Stockpiling	♦	●	●	♦	·	·	■	·	·	♦
	2c		Batching plant	·	·	·	·	·	·	♦	●	●	·
	3a	Utilities and drainage	Peak impact	·	·	·	·	·	·	·	·	·	·
	3b		Typical impact	·	·	·	·	·	·	·	·	·	·
	4a	Demolition	Peak impact	·	·	·	·	·	·	·	·	·	·
	4b		Typical impact	·	·	·	·	·	·	·	·	·	·
	5a	Clearing	Peak impact	·	·	·	·	·	·	·	·	·	·
	5b		Typical impact	·	·	·	·	·	·	·	·	·	·
	6a	Earthworks	Peak impact	·	·	·	·	·	·	·	·	·	·
	6b		Typical impact	·	·	·	·	·	·	·	·	·	·
	6c		Onsite truck haulage	●	·	·	●	·	●	●	·	·	·
	7a	Bridge works	Peak impact	·	♦	●	♦	·	♦	♦	●	♦	·
	7b		Typical impact	·	●	·	●	·	●	●	·	●	·
	7c		Concrete works	·	●	●	♦	·	●	●	·	●	·
	7d		Girder lifts	·	●	·	●	·	·	●	·	●	·
	8a	Road works	Concrete works	♦	♦	●	♦	·	■	■	●	♦	●
	8b		Typical works	·	·	·	·	·	·	·	·	·	·
	8c		Tie-in works	■	♦	♦	■	·	●	♦	■	■	·
	9a	Signage, lighting and landscaping		·	·	·	·	·	·	·	·	·	·

Key to impacts: · No exceedance ● Marginal to minor (1 dB to 10 dB) ♦ Moderate (11 dB to 20 dB) ■ High (>20 dB)

The above assessment for residential receivers shows that:

- The highest impacts are generally seen in the ‘Peak Impact’ scenarios, which is due to the use of noise intensive equipment such as rock-breakers or concrete saws. For most scenarios, the ‘Peak Impact’ works would however only be required for a relatively short period. Noise levels and impacts during the ‘Typical Impact’ works are lower and affect fewer receivers.
- The highest impacts at residential receivers are generally in catchments where receivers are located close to the construction footprint. This includes east of the M7 Motorway and north of Elizabeth Drive in NCA01, north of Elizabeth Drive near Salisbury Ave in NCA06 and near Clifton Avenue in the north of the construction footprint in NCA07. Receivers in these catchments are however generally sparsely distributed, meaning the number of receivers with the highest impacts is typically relatively low.
- During the morning shoulder period, ‘Peak’ impacts are seen for certain scenarios at the nearest receivers in NCA01, NCA06 and NCA07. ‘Moderate’ impacts are also predicted for a relatively large number of receivers to the east of the M7 Motorway and south of Elizabeth Drive in NCA02. Receivers in the rest of study area are generally further from the project and are therefore less affected.
  - As noted previously, works completed in the morning shoulder period are likely to be limited to relatively low noise impact works, with full construction generally being completed during standard daytime hours. In this case the impacts would be lower than predicted.
- During the standard daytime period, ‘Peak’ impacts are predicted in NCA01, NCA06 and NCA07 at the same receivers as for the morning shoulder period. A relatively small number of receivers are predicted to have ‘moderate’ impacts in the remaining areas where receivers are in close proximity to the construction footprint, such as east of the M7 Motorway and South of Elizabeth Drive in NCA02.
- During the night-time, construction works are only proposed in certain parts of the construction footprint (associated with bridges, road works and ancillary facilities – refer to **Section 4.1.1**), meaning only a small number of receivers are predicted to have ‘Peak’ impacts. The receivers are generally around Clifton Avenue and Salisbury Avenue in NCA06 and NCA07, due to the proximity of receivers to the construction footprint. ‘Moderate’ impacts are predicted east of the M7 Motorway in NCA02, along Elizabeth Drive in NCA04 and NCA06, and for receivers near to Luddenham Road in NCA09. Compliant noise levels or ‘minor’ impacts are predicted for the rest of the study area.
- Batching plants have been assessed as being in the middle of AF2 and AF3 which are both located adjacent the Western Sydney Airport access road. Noise levels are predicted to result in ‘moderate’ impacts at the nearest residential receivers to north of Elizabeth Drive in NCA07 during all periods. The locations of and activities within the batching plants are considered indicative and would be further assessed as part of detailed design.
- Stockpiling activities are predicted to have higher impacts than the batching plants, as the assessment assumes the works would occur across the entire ancillary facility and therefore maybe closer to the nearest some receivers.
- The worst-case impacts are typically in the following scenarios:
  - Scenario 3a, Utilities and drainage – peak impact
  - Scenario 4a, Demolition – peak impact
  - Scenario 5a, Clearing – peak impact
  - Scenario 6a, Earthworks – peak impact
  - Scenario 8a, Road works – concrete works
  - Scenario 8c, Road works – tie-in to existing roads
- Works that do not require highly intensive noise generating items of equipment generally result in considerably lower impacts.
- Given the location of the nearest receivers to the project, it is likely that there are several areas of the project where construction can occur with little or no impact to residential receivers due to the separation distances between the works and receiver.

Comments regarding the use of highly noise intensive equipment in the construction scenarios with the peak impacts are provided in **Table 5-7**.

Table 5-7 Peak noise impact works

ID	Scenario	Activity	Indicative duration (weeks)	Comments on Peak noise activities
3a	Utilities and drainage	Peak impact (inc breaker)	35	Rock-breakers and/or concrete saws would be used during extended working hours, where required for relatively short durations.
4a	Demolition	Peak impact (inc breaker)	36	Rock-breakers would be used during extended working hours only as required at specific locations identified in **Figure 4-1** for relatively short durations.
5a	Clearing	Peak impact	20	Chainsaws and chippers would be used during extended working hours only as required for relatively short durations.
6a	Earthworks	Peak impact	80	Peak noise generating equipment such as dozers would be required to move spoil during extended working hours only as required.
8a	Road works	Concrete works	30	Concrete truck and concrete pump will be used for any concrete works required for the road and may be carried out during the night-time period as required.
8c	Road Works	Tie in works	48	Concrete saws would be used at night-time only when works cannot take place during the daytime, eg during closure of surrounding roads. Concrete saws would be used for relatively short durations at a time.

5.2 Predicted impacts

The predicted construction noise impacts from work scenarios in each NCA are provided in the assessment tables and maps in **Annexure C**. The following section provides further detail on the scenarios which either result in impacts to the most number of receivers or are representative of the works with the longest duration. The scenarios are:

- *Utilities and drainage*, which is the scenario with the predicted **worst-case impacts during standard daytime hours** (ie the highest predicted NML exceedances and most number of receivers affected).
- *Road works – Tie in works* which is the scenario with the predicted **worst-case impacts during the night-time period** (ie the highest predicted NML exceedances and most number of receivers affected).
- Earthworks and ancillary facility operations (Stockpiling) which are the two scenarios with the **longest duration**.

5.2.1 Worst-case scenarios

Utilities and drainage – all locations

The worst-case construction impacts are predicted during *Utilities and drainage* when noise intensive equipment like concrete saws or rock-breakers are in use. The predicted daytime impacts during *Utilities and drainage* are show in:

- **Figure 5-2** – Scenario 3a, *Utilities and drainage – Peak impact*, when noise intensive equipment is being used as part of these works.

- **Figure 5-3** – Scenario 3b, *Utilities and drainage – Typical impact*. For works when typical activities are being completed that do not require noise intensive equipment.

Utilities and drainage works are anticipated to last for 132 weeks, however within that, the 'peak impact' works are indicatively scheduled to take 35 weeks.

Noise intensive equipment would be required for the 'peak impact' works with rock-breakers and concrete saws being used as required.

The above assessment shows that for 'Peak impact' works, certain receivers are predicted to have 'high' impacts during standard daytime hours, which is due to noise intensive equipment such as rock-breakers or concrete saws being required during stages of the works. The most affected locations are:

- Two receivers to the east of the M7 Motorway in NCA01, which are predicted to have 'high' worst-case impacts.
- Densely clustered receivers to the south of Elizabeth Drive in NCA02, where 'moderate' worst-case impacts are predicted.
- Receivers to the south of the construction footprint in NCA06, around Salisbury Avenue located between the project and Elizabeth Drive, where two receivers are predicted to have 'high' impacts with several more having 'moderate' impacts.
- Receivers to the north of the construction footprint in NCA07 where six receivers have 'high' impacts, with more distant receivers having 'moderate' and 'minor' impacts, depending on their distance from the project.

During 'Typical impact' works, when noise intensive equipment is not being used, the noise levels would be substantially lower which much fewer receivers affected. The worst-case impacts are generally reduced to 'moderate' at the most affected front row receivers, with many of the previously exceeding receivers now being compliant.

The impacts presented above are based on all equipment working in each assessed scenario. There would frequently be periods when construction noise levels are much lower than worst-case and there would be times when no equipment is in use and there are no impacts.

Road Works – Tie-in works

The worst-case construction impacts are predicted during *Road works – Tie in works* when noise intensive equipment like concrete saws are in use. The predicted night-time impacts during *Road works – Tie in works* are shown in **Figure 5-5**. These works maybe required to be carried out outside of standard construction hours to minimise impacts to local traffic and to ensure the safety of the workers and nearby pedestrians.

Road works – Tie in works are anticipated to last for 48 weeks however would occur in discrete locations. These areas include works around the Elizabeth Drive - M7 Motorway interchange, Elizabeth Drive at the Airport Access Road and Wallgrove Road. Works around the private access road along Luddenham Road, bike path connection into Elizabeth Drive near Mamre Road and the utility access road off Elizabeth Drive have the potential to require construction works outside of standard hours.

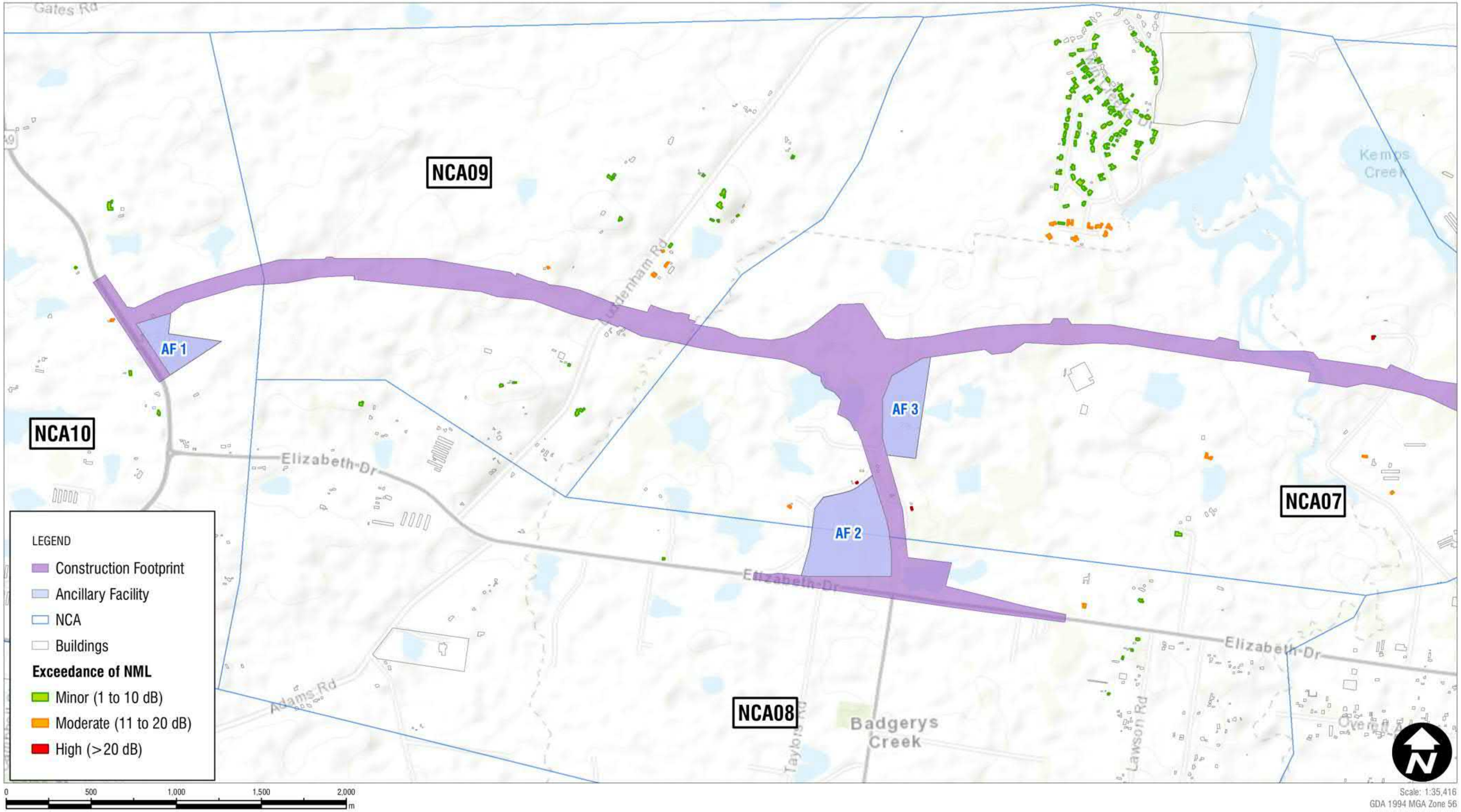


Figure 5-2 Predicted impacts '*scenario 3a, Utilities and drainage - peak impact'* in all locations (daytime)

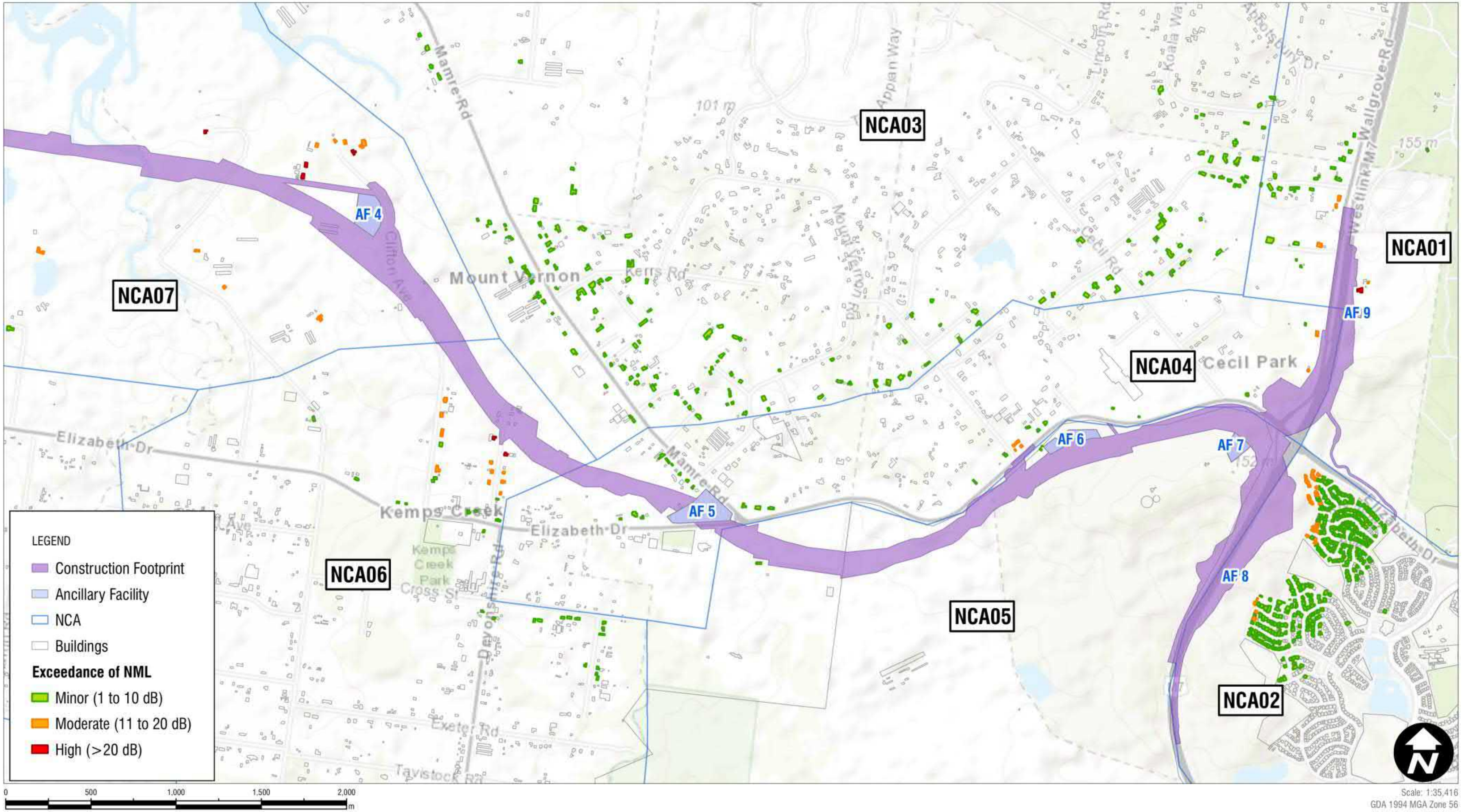


Figure 5-2 Predicted impacts '*scenario 3a, Utilities and drainage - peak impact'* in all locations (daytime)

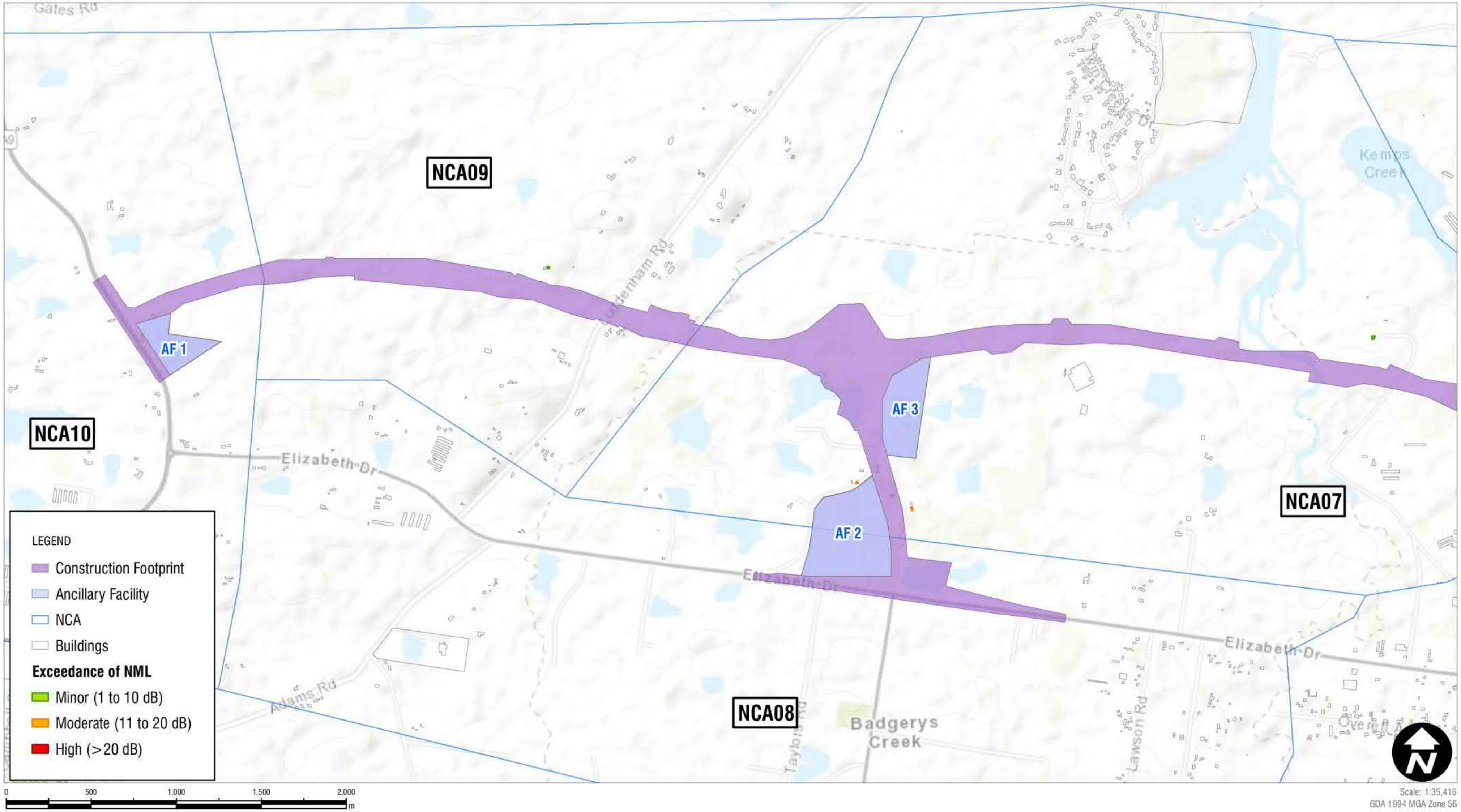


Figure 5-3 Predicted impacts 'scenario 3b, Utilities and drainage, typical impact' in all locations (daytime)

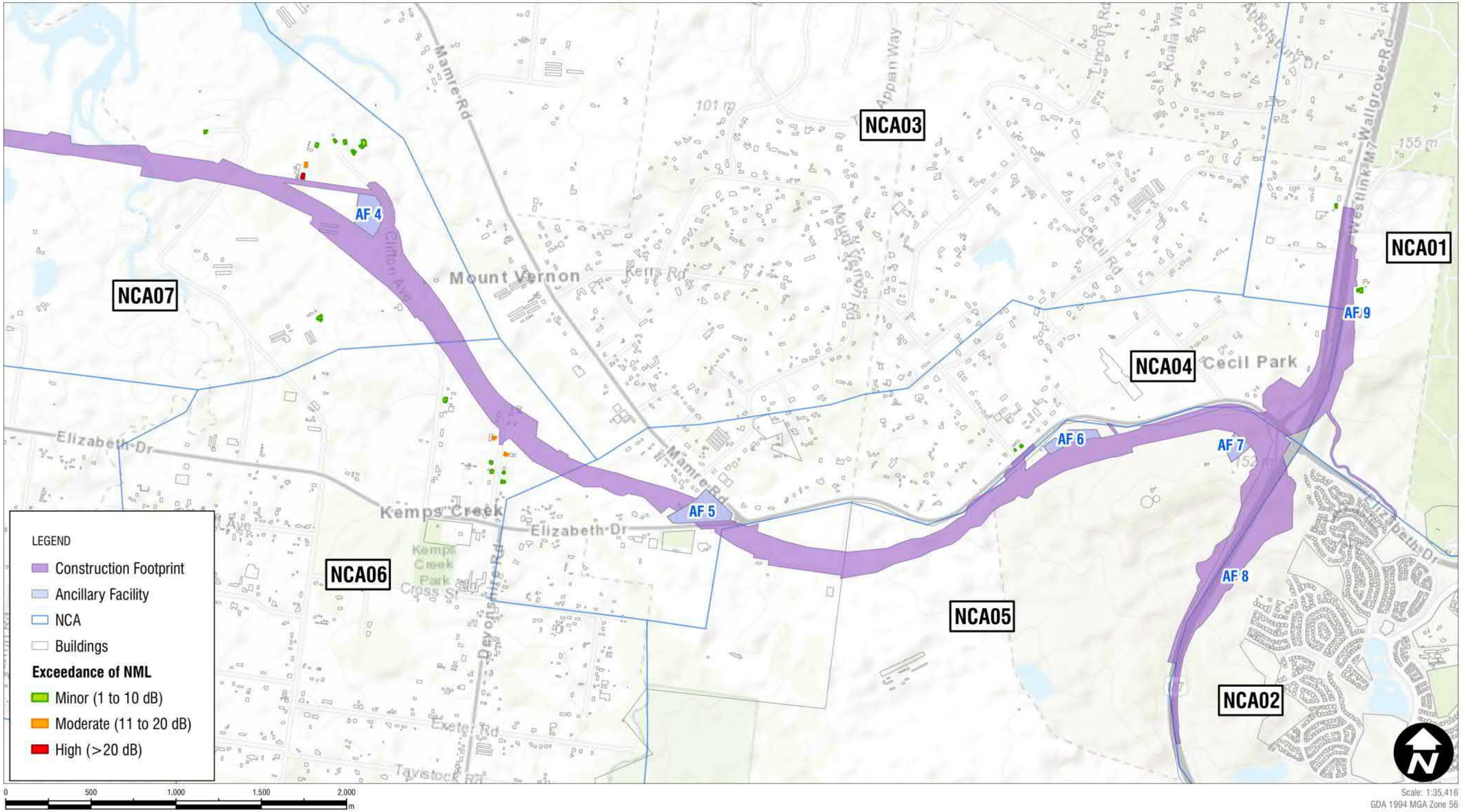


Figure 5-3 Predicted impacts ‘scenario 3b, Utilities and drainage, typical impact’ in all locations (daytime)

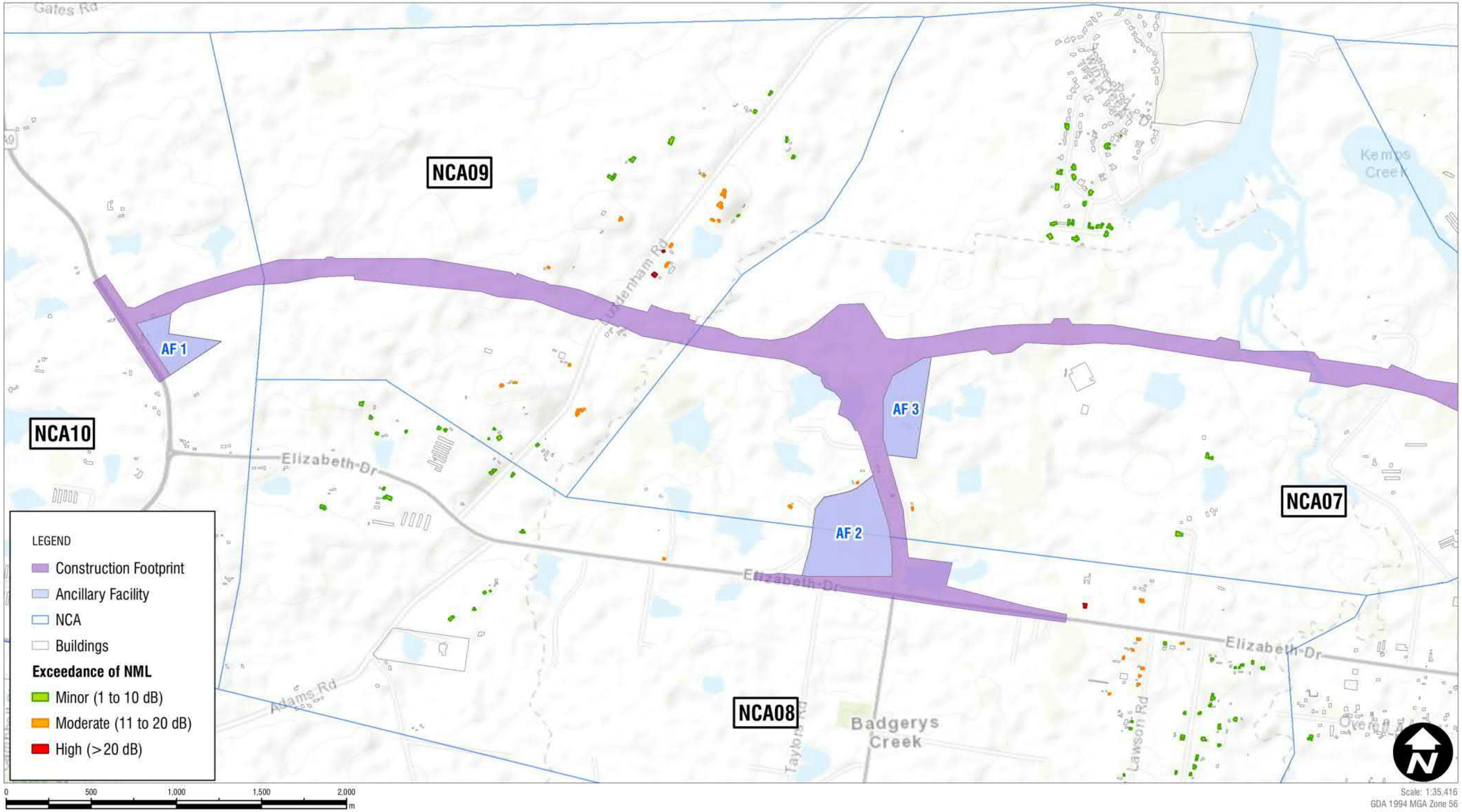


Figure 5-4 Predicted impacts '*scenario 8c, Road works – Tie-in works* in all locations (night-time)

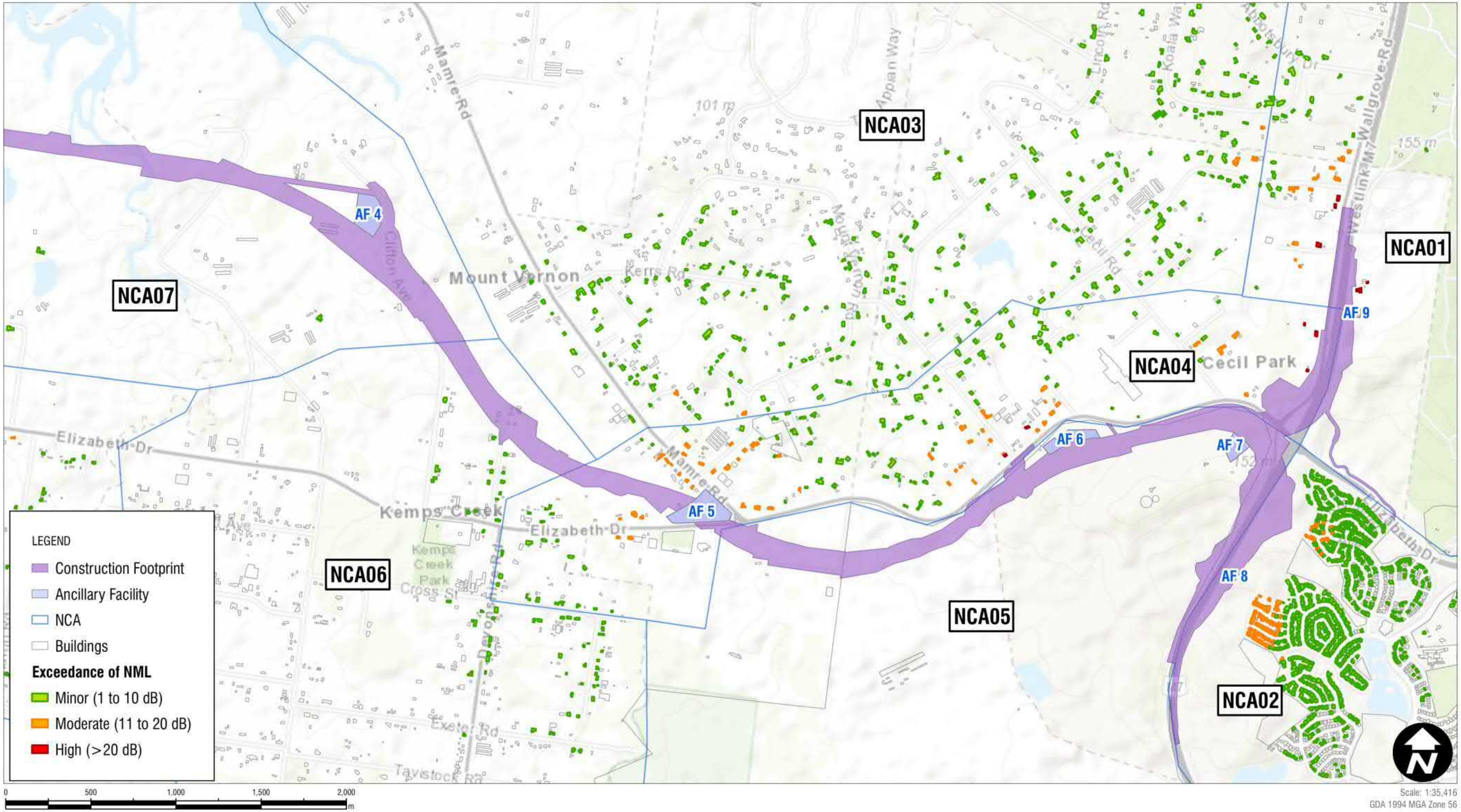


Figure 5-4 Predicted impacts ‘scenario 8c, Road works – Tie-in works in all locations (night-time)

The above assessment shows that for *Road works – Tie in works*, certain receivers are predicted to have 'high' impacts during the night-time period, which is due to noise intensive equipment such as a concrete saws being required during stages of the works. The most affected locations are:

- Nine receivers to the north of Elizabeth Drive around the M7 Motorway in NCA01 and NCA04, which are predicted to have 'high' worst-case impacts.
- To the south of Elizabeth Drive in NCA02, where receivers are densely clustered and 'moderate' worst-case impacts are predicted at 68 receivers and a greater number to experience 'minor' worst-case impacts.
- Two receivers to the north of the construction footprint adjacent to the utility access road in NCA04 are predicted to have 'high' worst-case impacts with more distant receivers between Mamre Road and Wallgrove Road having 'moderate' and 'minor' impacts depending on the distance from the tie-in works.
- One receiver in NCA08 adjacent to the Elizabeth Drive works over the Airport Access Road is predicted to have 'high' worst-case impacts with several more receivers surrounding Lawson Road having 'moderate' impacts.
- Two receivers along Luddenham Road and adjacent to the private access road tie-in works are predicted to have 'high' worst-case impacts and several more predicted to have 'moderate' and 'minor' impacts depending on the distance from the works.

The impacts presented above are based on all equipment working simultaneously. When the concrete saw is not being used, the noise levels would generally be 10 dB lower and thus have a much lesser impact. There would frequently be periods when construction noise levels are much lower than worst-case and there would be times when no equipment is in use and there are no impacts.

5.2.2 Longest duration scenario

The longest duration works scenario is *earthworks* and *ancillary facility operations (Stockpiling).*

Earthworks are generally required along the entire construction footprint including importing and exporting of spoil. Peak noise impact works would be required at certain times and would include the use of dozers and other noise intensive equipment.

Stockpiling would generally be required at each of the ancillary facilities identified in **Figure 4-1** and would occur for the full duration of the project.

Earthworks

The predicted daytime impacts are shown in:

- **Figure 5-5** – Scenario *6a Earthworks - peak impact,* where noise intensive equipment is being used as part of these works.
- **Figure 5-6** – *Scenario 6b Earthworks, typical impact.* For works when general works are being completed.

Earthworks works are anticipated to last for 144 weeks, however within that the 'peak impact' works are scheduled to indicatively take 80 weeks across the whole project.

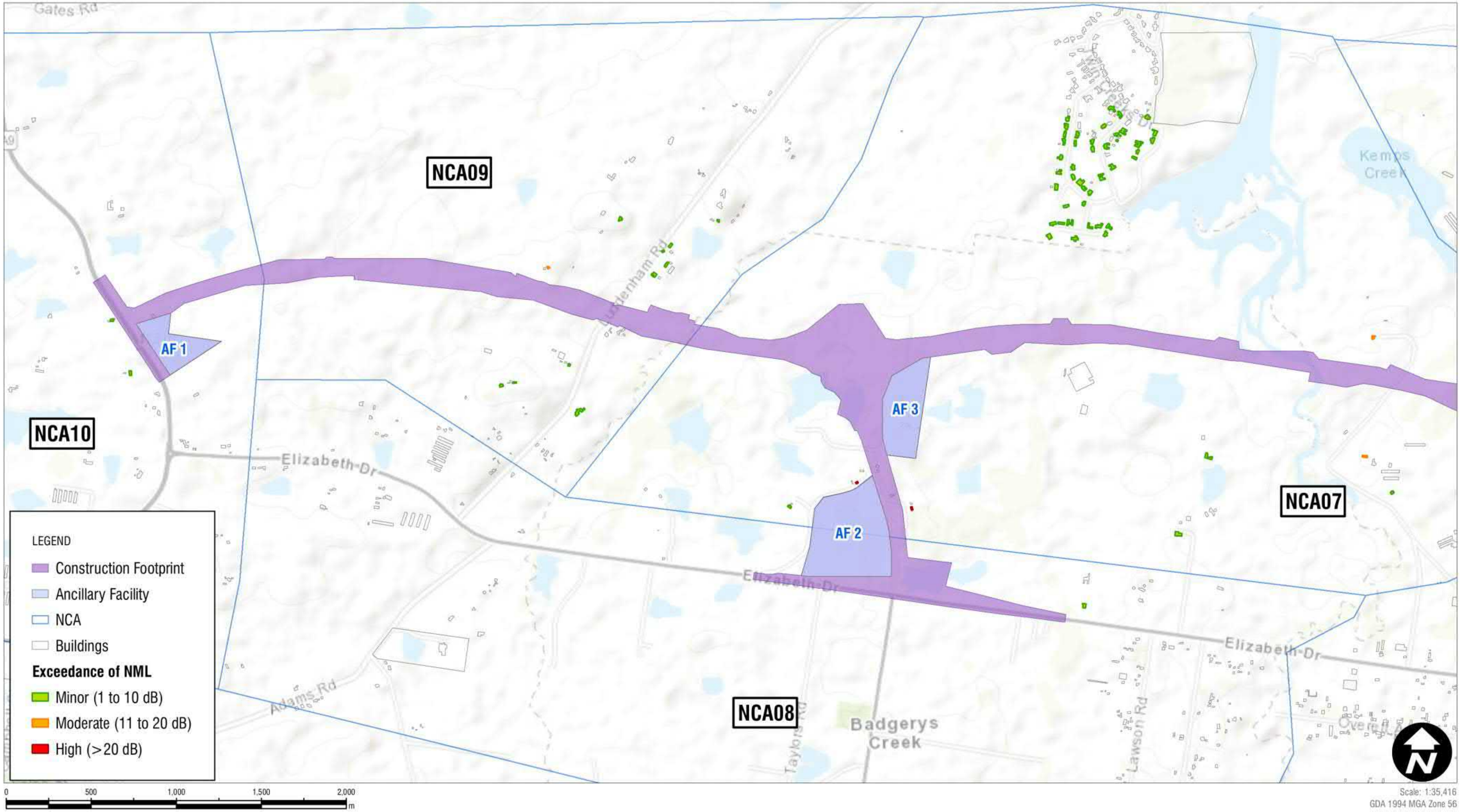


Figure 5-5 Predicted impacts *'scenario 6a, earthworks - peak impact'* in all locations (daytime)

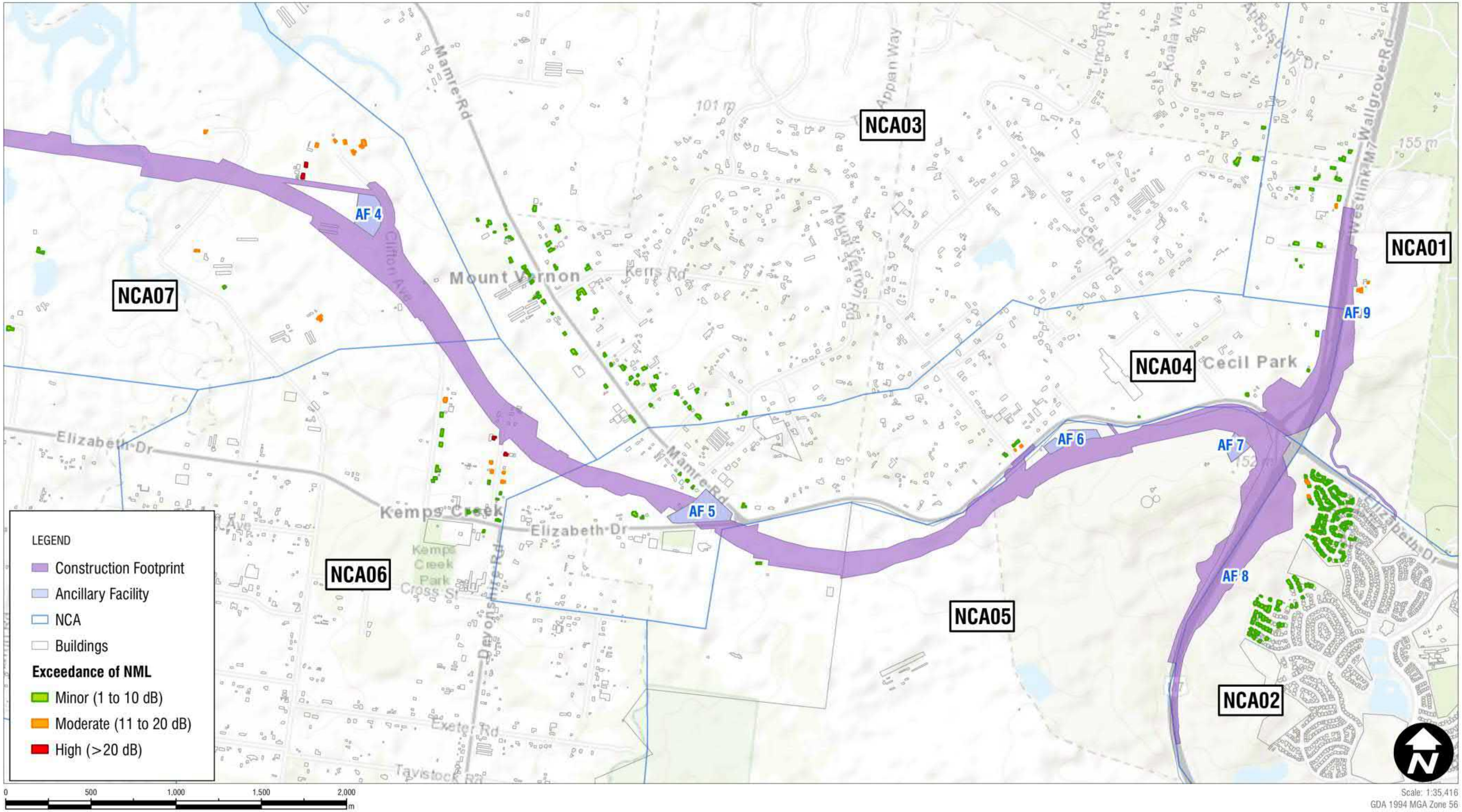


Figure 5-5 Predicted impacts *'scenario 6a, earthworks - peak impact'* in all locations (daytime)

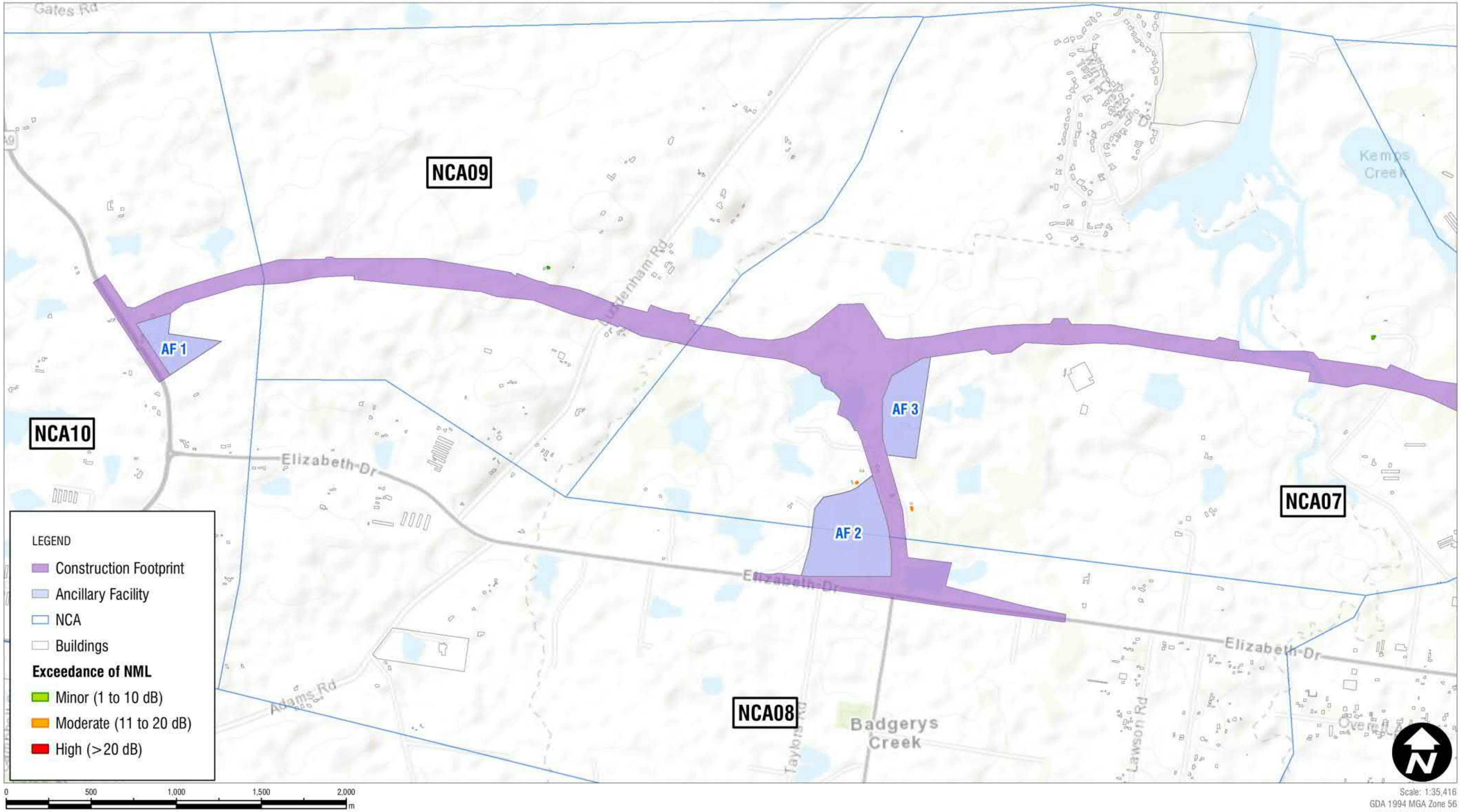


Figure 5-6 Predicted impacts *'scenario 6b, earthworks - typical impact'* in all locations (daytime)

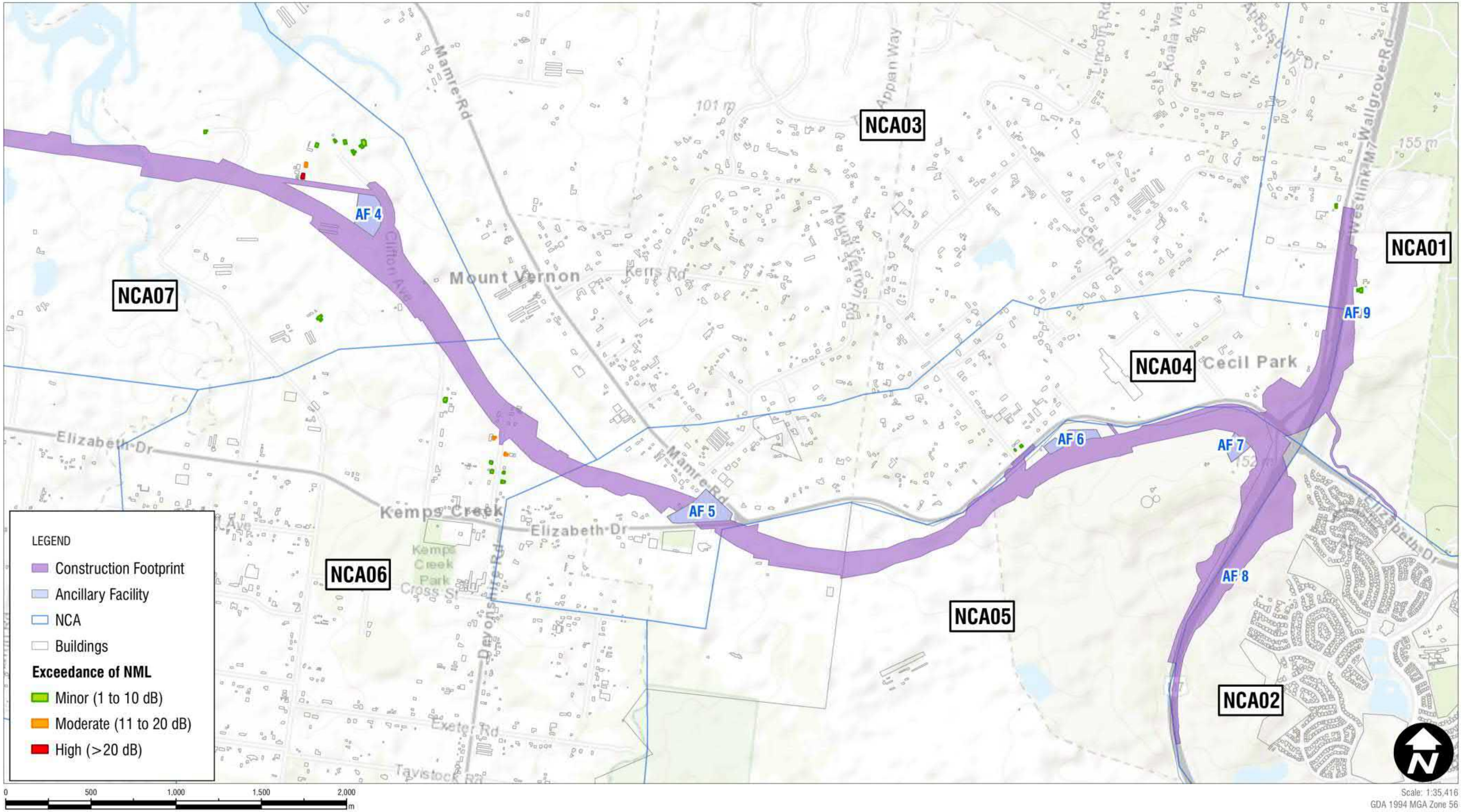


Figure 5-6 Predicted impacts *'scenario 6b, earthworks - typical impact'* in all locations (daytime)

The above shows that for ‘Peak impact’ *works*, receivers are predicted to have ‘high’ impacts due to noise intensive works such as dozers being required during stages of these works. The most affected locations are:

- Receivers to the south of the construction footprint in NCA06, around Salisbury Avenue and between the project and Elizabeth Drive, where two receivers are predicted to have ‘high’ impacts with several more having ‘moderate’ impacts.
- Receivers to the north of the construction footprint in NCA07 where four receivers have ‘high’ impacts, with more distant receivers having ‘moderate’ and ‘minor’ impacts, depending on their distance from the project.

During ‘typical impact’ works, when noise intensive equipment is not being used, the noise levels would be substantially lower with much fewer receivers affected. The worst-case impacts are reduced to ‘moderate’ and ‘minor’ at the most affected front row receivers except for one receiver off Clifton Avenue in NCA07 which is still predicted to have ‘peak impacts’ due to the proximity to the works.

The impacts presented above are based on all equipment working in each assessed scenario. There would frequently be periods when construction noise levels are much lower than worst-case levels and there would be times when no equipment is in use and the impacts are much lower.

Ancillary facility operations (stockpiling)

The predicted night-time impacts during *Ancillary facility operations (stockpiling)* are shown in:

- Figure 5-7 – *Scenario 2b Ancillary facilities (stockpiling)*

Stockpiling at the ancillary facilities is anticipated to occur for the duration of the project, and cannot be ruled out as a night-time activity.

The figure shows that during stockpiling works at each ancillary facility, ‘high impacts’ are predicted at the closest receivers to AF2 near the airport access road in NCA07 during the night time period due to their proximity.

‘Moderate impacts’ are predicted at the closets receivers east of the M7 in NCA01, receivers along Elizabeth Drive in NCA04 and receivers along The Northern Road in NCA10. ‘Minor’ or no impacts are predicted at receivers in the remaining study area during the night-time period.

The impacts presented above are based on all equipment working in each assessed scenario. There would frequently be periods when construction noise levels are much lower than worst-case levels and there would be times when no equipment is in use and there are no impacts.

5.2.3 Works in one location

The above assessments present the impacts from the various construction scenarios assuming works are occurring at the closest location to each receiver. In reality, works would occur at discrete locations and move around the construction footprint, which would limit the potential impacts to receivers which are near to each individual work site. This shows that individual receivers may be affected by varying levels of noise over the duration of the project, not the worst-case predicted noise levels for the whole duration of the project.

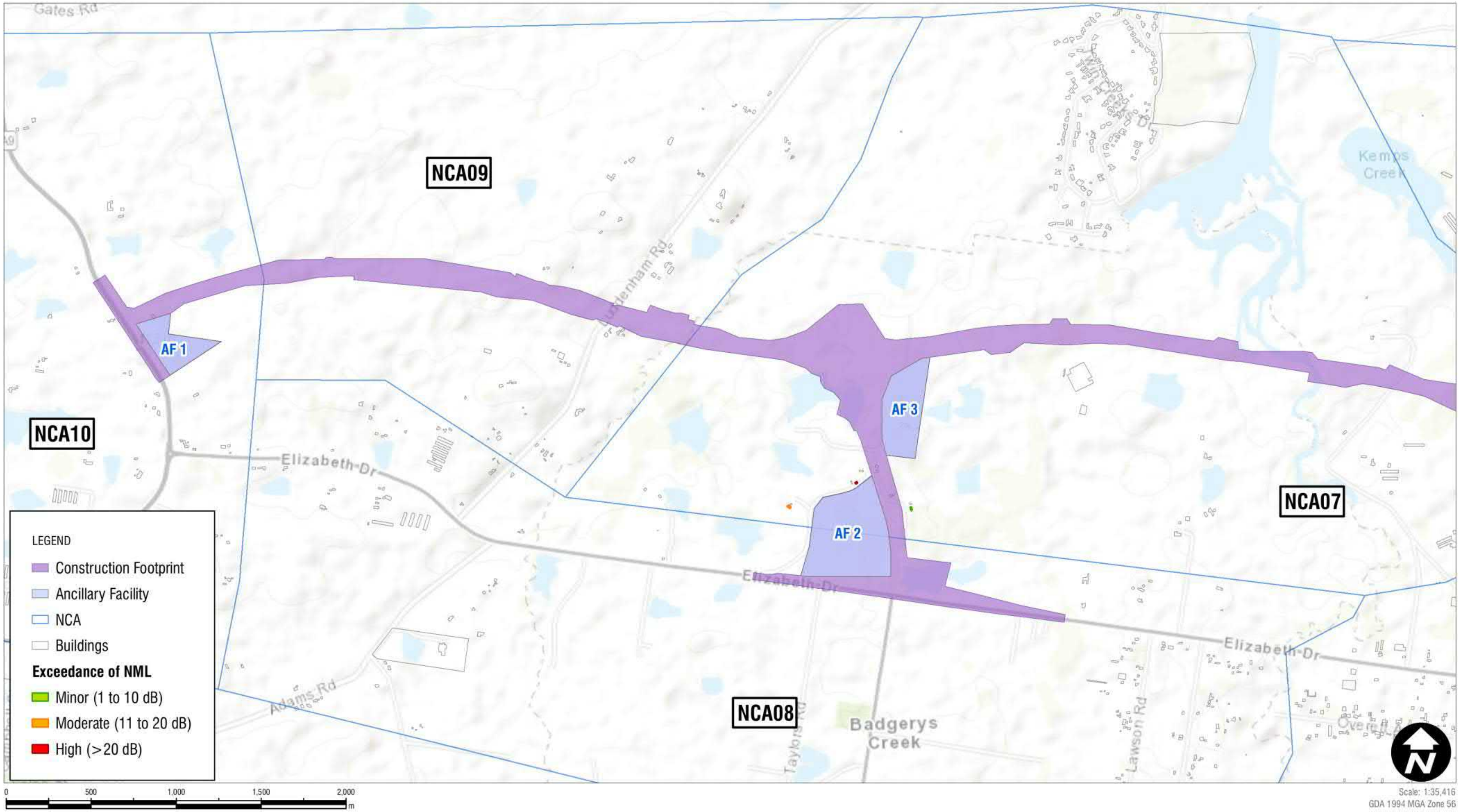


Figure 5-7 Predicted Impacts 'Scenario 2b, Ancillary facilities (stockpiling)' in All Locations (Night-time)

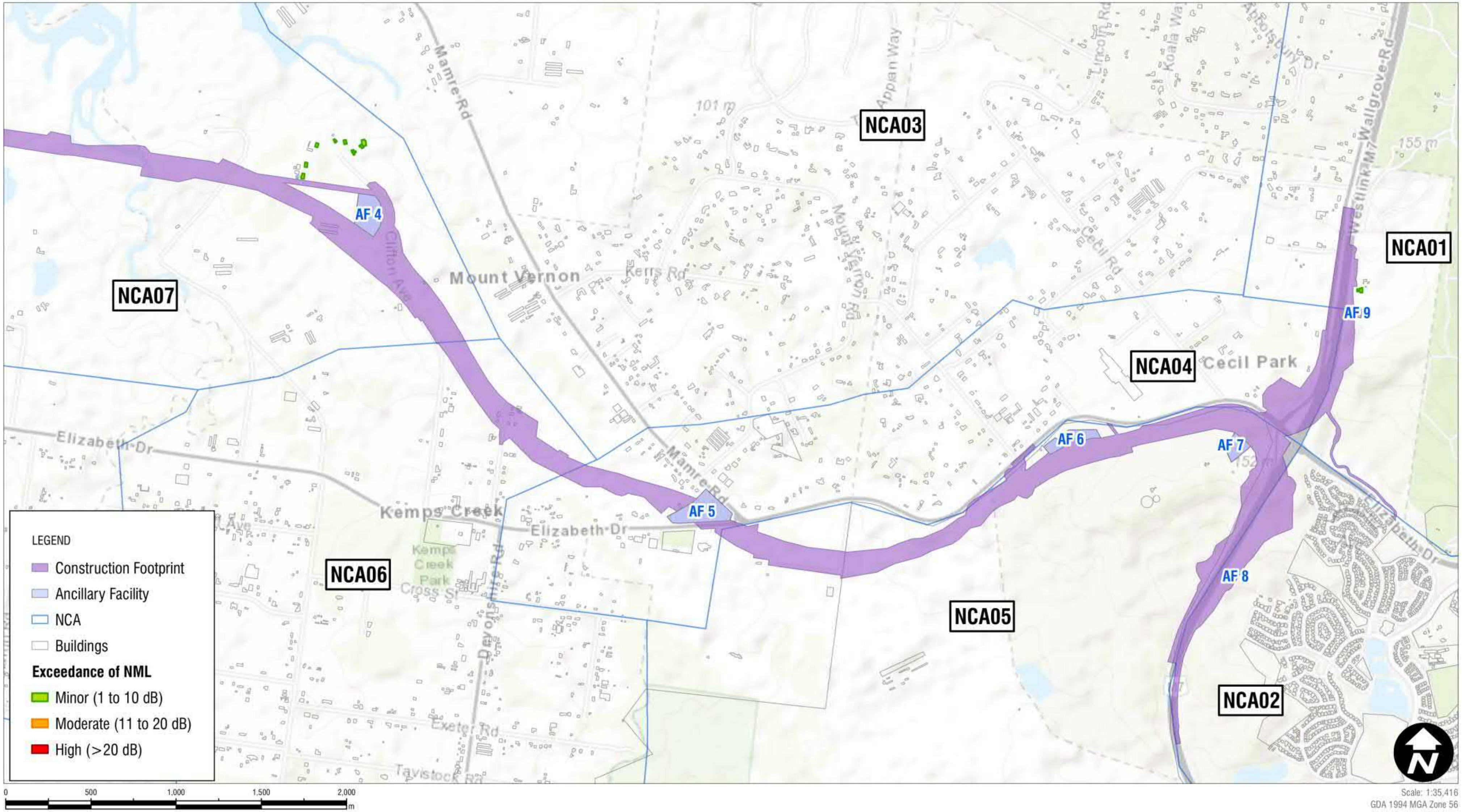


Figure 5-7 Predicted Impacts ‘Scenario 2b, Ancillary facilities (stockpiling)’ in All Locations (Night-time)

The potential impacts when works are distant from the nearest receivers have been simulated by modelling the *'Earthworks -peak impact'* scenario occurring in one location. The works have been modelled at a single location to the north of Elizabeth Drive and West of Mamre Road on the border of NCA06 and NCA07.

Figure 5-8 shows the predicted noise levels over the study area for works occurring over the whole construction footprint, while **Figure 5-9** shows the predicted noise levels over the study area for works occurring in a single location.

Figure 5-8 and **Figure 5-9** show that when highly noise intensive works are occurring in a single location, the impacts are limited to receivers within 800 metres of the works. Receivers in the rest of the study area are predicted to be compliant with the noise management levels.

The potential impacts during *'Earthworks -Typical impact'*, which generates much lower noise levels, would be less than the example shown above.

5.3 Highly noise affected residential receivers

Residential receivers that are subject to noise levels of 75 dBA or greater are considered highly noise affected. Receivers can be highly noise affected when noise intensive equipment is being used close to residents.

The receivers which have potential to be highly noise affected during the worst-case impacts from the project are summarised in **Table 5-8** and shown in **Figure 5-10**.

The predictions assume the worst-case scenarios are occurring at the closet location to each receiver and therefore present all highly noise affected receivers in one assessment. In reality, work would occur in isolated locations and the number of highly noise affected receivers during any single works period would be less than shown.

The majority of residential receivers are predicted not to be highly noise affected during the construction works. Seven receivers in total may be subject to construction noise levels above the highly noise affected threshold and these receivers are located in:

- NCA01, to the east of the M7
- NCA04, to the west of Wallgrove Road
- NCA06, on Salisbury Road
- NCA07, to the north of the project on Clifton Avenue.

Highly noise affected impacts may occur during works associated with *Utilities and drainage*, *Clearing*, *Earthworks* and *Road works*.

Impacted receivers are typically dwellings which are close to the project and have direct line-of-sight to the nearest works. While certain receivers are predicted to be highly noise affected, this would only occur when peak noise generating works are being carried out near to particular residential receivers and would only be apparent for relatively short periods.

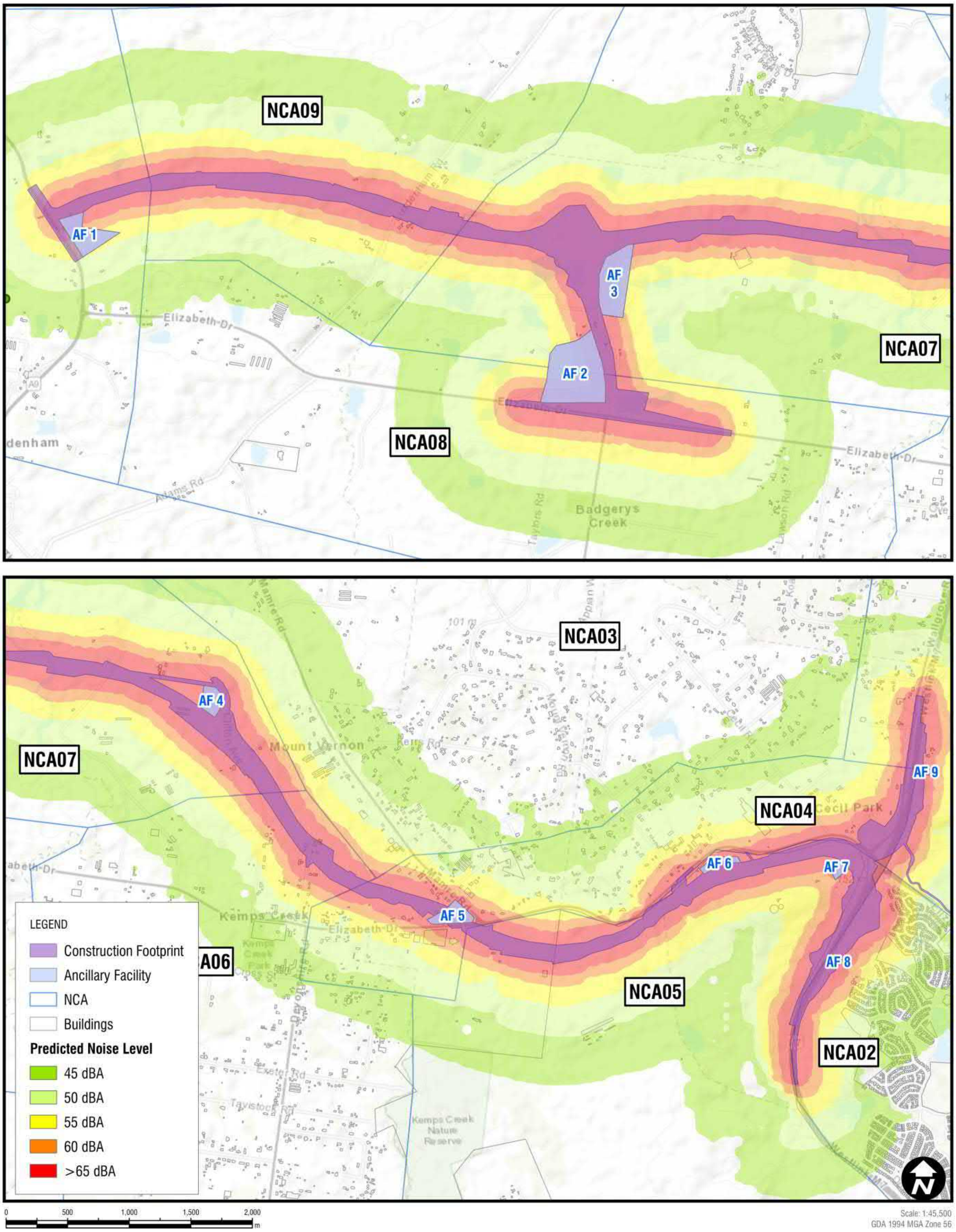


Figure 5-8 Predicted noise Contours, 'Scenario 7a, earthworks – Peak impact – whole project

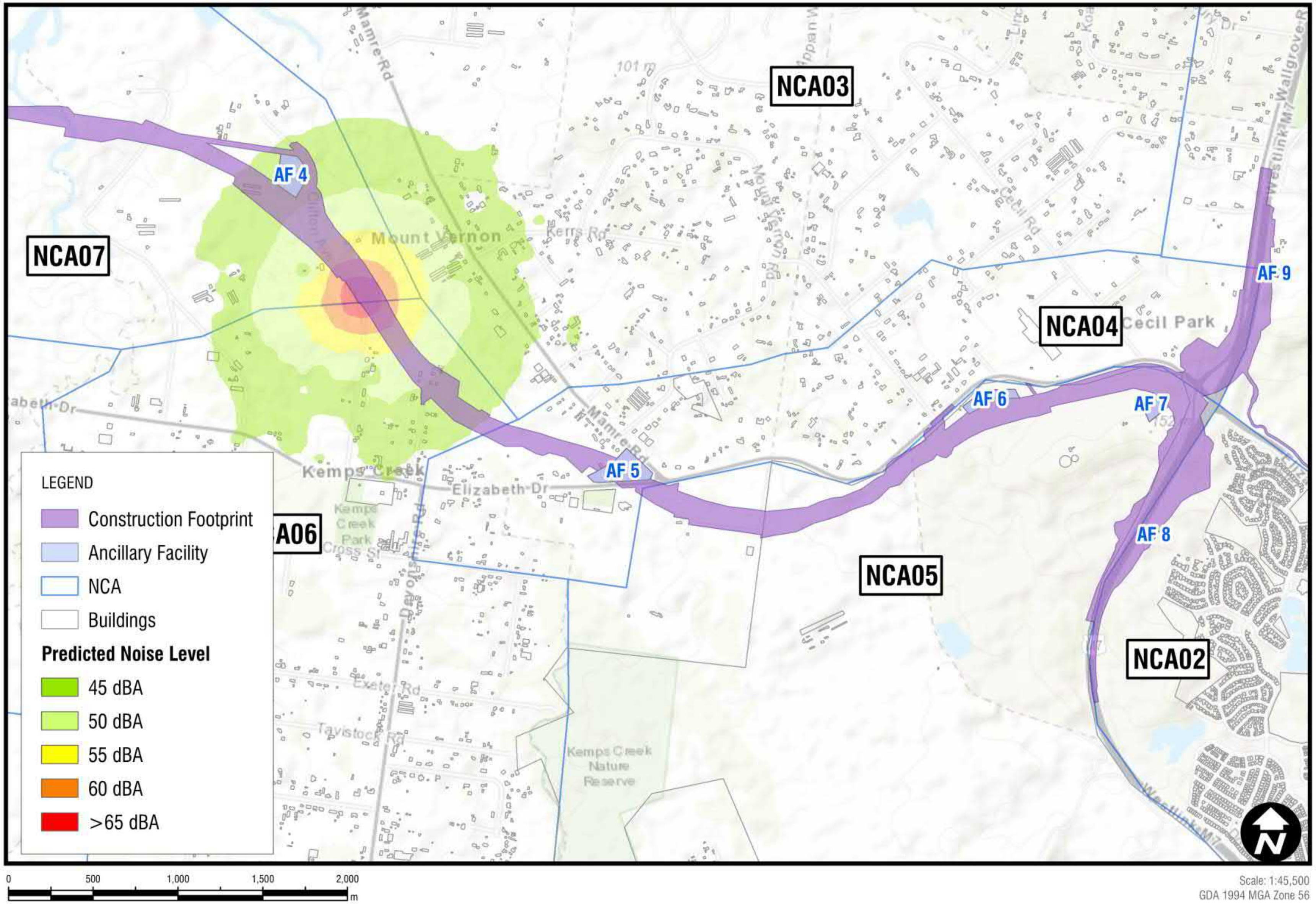


Figure 5-9 Predicted noise contours, ‘Scenario 7a, earthworks – Peak impact – single location

Table 5-8 Number of predicted highly noise affected residential receivers

ID	Scenario	Activity	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	NCA10
1a	Ancillary facility establishment	Peak impact	-	-	-	-	-	-	-	-	-	-
1b		Typical impact	-	-	-	-	-	-	-	-	-	-
2a	Ancillary facilities	Operation	-	-	-	-	-	-	-	-	-	-
2b		Stockpiling	-	-	-	-	-	-	-	-	-	-
2c		Batching plant	-	-	-	-	-	-	-	-	-	-
3a	Utilities and drainage	Peak impact	2	-	-	2	-	2	1	-	-	-
3b		Typical impact	-	-	-	-	-	-	-	-	-	-
4a	Demolition	Peak impact	-	-	-	-	-	-	-	-	-	-
4b		Typical impact	-	-	-	-	-	-	-	-	-	-
5a	Clearing	Peak impact	1	-	-	1	-	1	1	-	-	-
5b		Typical impact	-	-	-	-	-	-	-	-	-	-
6a	Earthworks	Peak impact	1	-	-	-	-	1	1	-	-	-
6b		Typical impact	-	-	-	-	-	-	-	-	-	-
6c		Onsite truck haulage	-	-	-	-	-	-	-	-	-	-
7a	Bridge works	Peak impact	-	-	-	-	-	-	-	-	-	-
7b		Typical impact	-	-	-	-	-	-	-	-	-	-
7c		Concrete works	-	-	-	-	-	-	-	-	-	-
7d		Girder lifts	-	-	-	-	-	-	-	-	-	-
8a	Road works	Concrete works	-	-	-	-	-	-	-	-	-	-
8b		Typical works	-	-	-	-	-	-	-	-	-	-
8c		Tie-in works	1	-	-	1	-	-	-	-	-	-
9a	Signage, lighting and landscaping		-	-		-		-	-	-	-	-

5.4 'Other' sensitive receivers

There are several categories of 'other' sensitive receivers in the study area, including educational facilities, places of worship and outdoor areas.

The predicted NML exceedances for 'other' sensitive receivers are summarised in **Table 5-9**. The summary is for all NCAs on the project and shows the impacts in bands of 10 dB above the corresponding NML, separately by receiver type. The predicted worst-case impacts at 'other' sensitive receivers in the study area is shown in **Figure 5-11**.

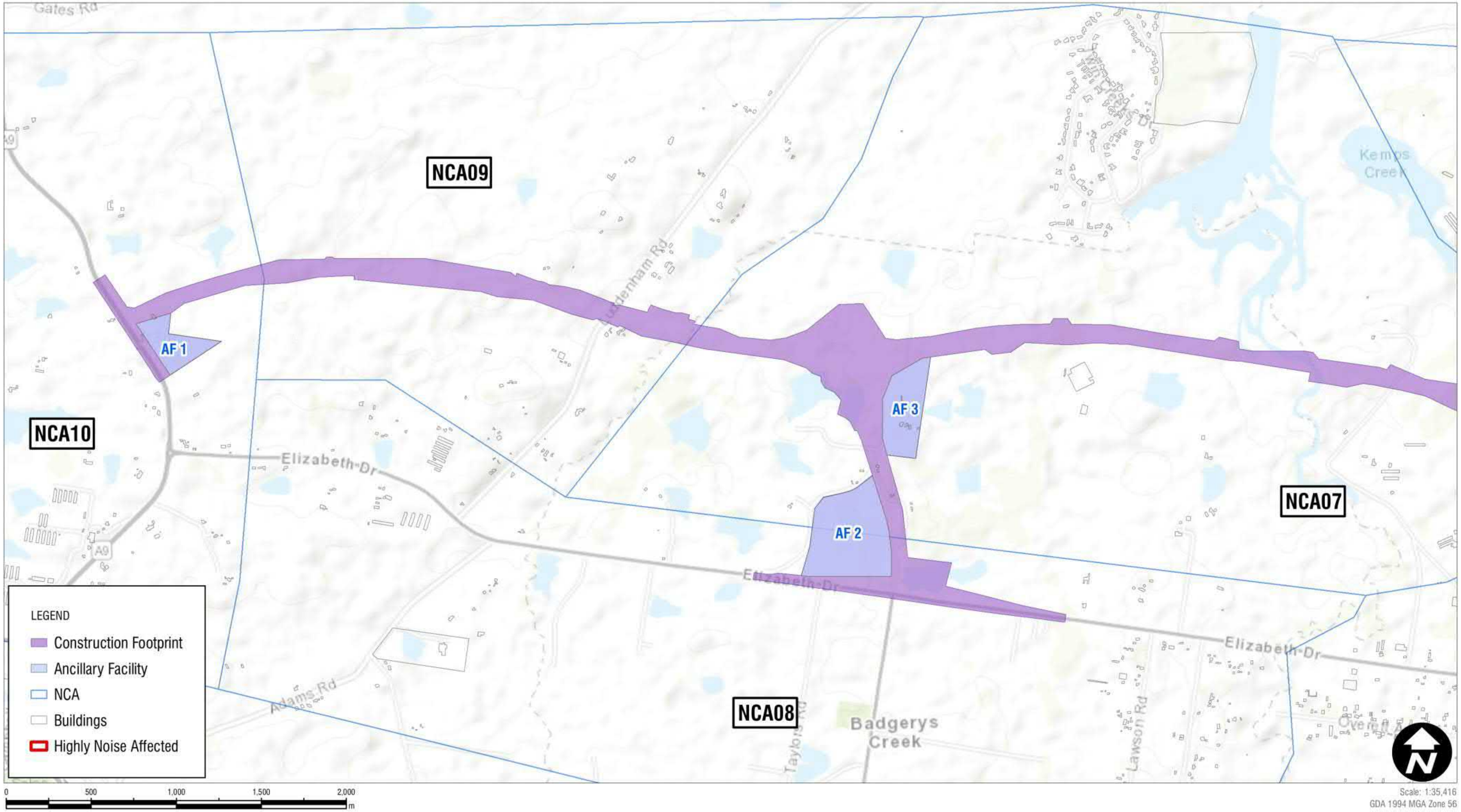


Figure 5-10 Highly noise affected residential receivers (all works)

Figure 5-10 Highly noise affected residential receivers (all works)

Table 5-9 Overview of 'Other' Sensitive Receiver NML Exceedances

ID	Scenario	Activity	Educational			Child care centre			Place of worship			Remaining[1]		
			Daytime			Daytime			Daytime			Daytime		
			1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
1a	Ancillary facility establishment	Peak impact	5	-	-	-	-	-	-	-	-	-	-	-
1b		Typical impact	-	-	-	-	-	-	-	-	-	-	-	-
2a	Ancillary facilities	Operation	-	-	-	-	-	-	-	-	-	-	-	-
2b		Stockpiling	-	-	-	-	-	-	-	-	-	-	-	-
2c		Batching plant	-	-	-	-	-	-	-	-	-	-	-	-
3a	Utilities and drainage	Peak impact	-	5	-	1	-	-	1	-	-	2	-	-
3b		Typical impact	2	-	-	-	-	-	-	-	-	-	-	-
4a	Demolition	Peak impact	-	-	-	-	-	-	-	-	-	-	-	-
4b		Typical impact	-	-	-	-	-	-	-	-	-	-	-	-
5a	Clearing	Peak impact	1	4	-	-	-	-	-	-	-	1	-	-
5b		Typical impact	2	-	-	-	-	-	-	-	-	-	-	-
6a	Earthworks	Peak impact	3	2	-	-	-	-	-	-	-	1	-	-
6b		Typical impact	2	-	-	-	-	-	-	-	-	-	-	-
6c		Onsite truck haulage	-	-	-	-	-	-	-	-	-	-	-	-
7a	Bridge works	Peak impact	1	-	-	-	-	-	-	-	-	-	-	-
7b		Typical impact	-	-	-	-	-	-	-	-	-	-	-	-
7c		Concrete works	-	-	-	-	-	-	-	-	-	-	-	-
7d		Girder lifts	-	-	-	-	-	-	-	-	-	-	-	-
8a	Road works	Concrete works	1	-	-	-	-	-	-	-	-	-	-	-
8b		Typical works	-	-	-	-	-	-	-	-	-	-	-	-
8c		Tie-in works	1	4	-	-	-	-	-	-	-	-	-	-
9a	Signage, lighting and landscaping		5	-	-	-	-	-	-	-	-	-	-	-

Note 1: Remaining refers to outdoor active recreational areas and outdoor passive recreational areas.

Note 2: Cell shading indicates highest predicted exceedance of NML for worst-case proposed operating period; green = minor (less than 10 dB), orange = moderate (11-20 dB), red = high (greater than 20 dB)

Note 3: The number of exceedances refers to individual buildings.

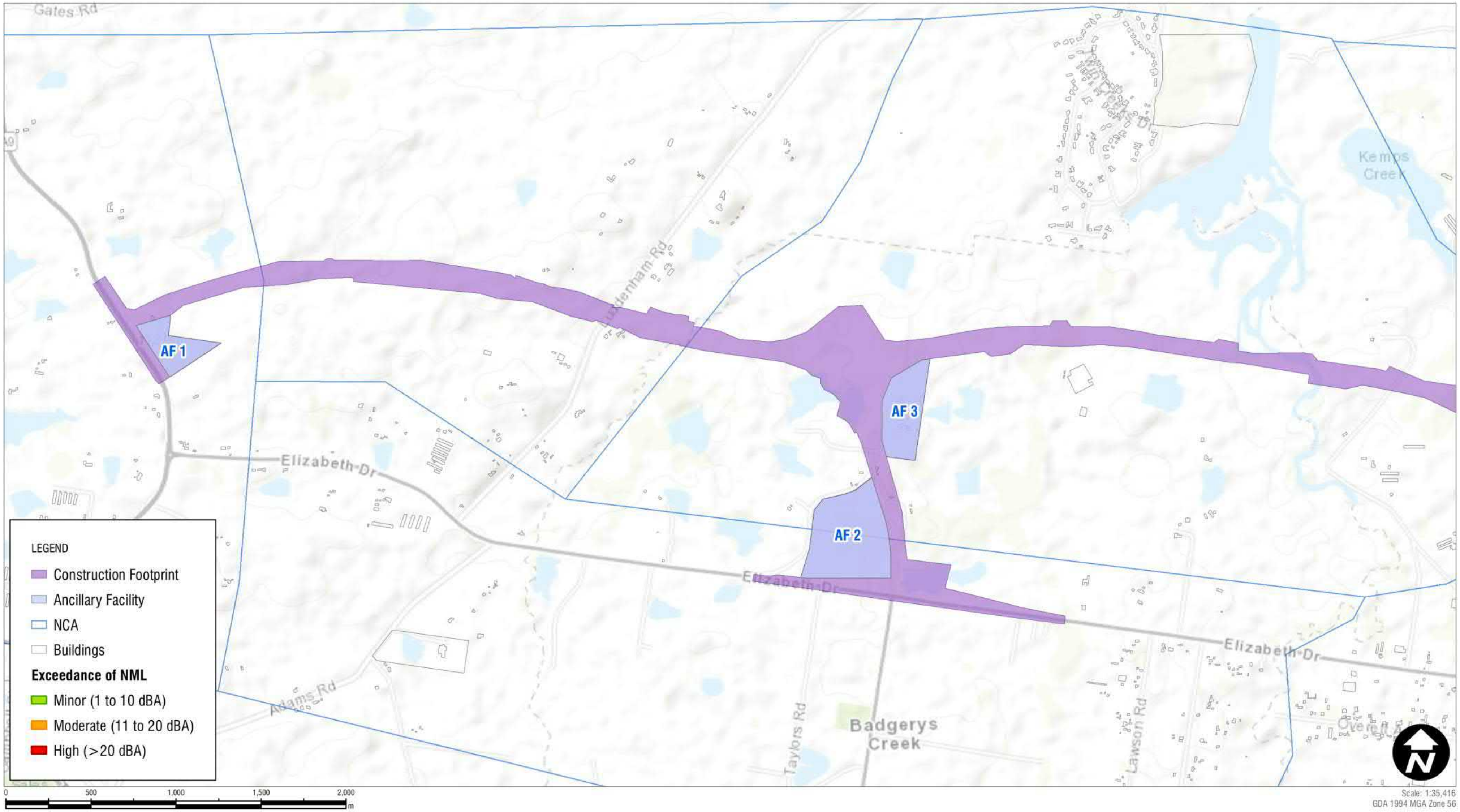


Figure 5-11 Predicted impacts – ‘other’ sensitive receivers

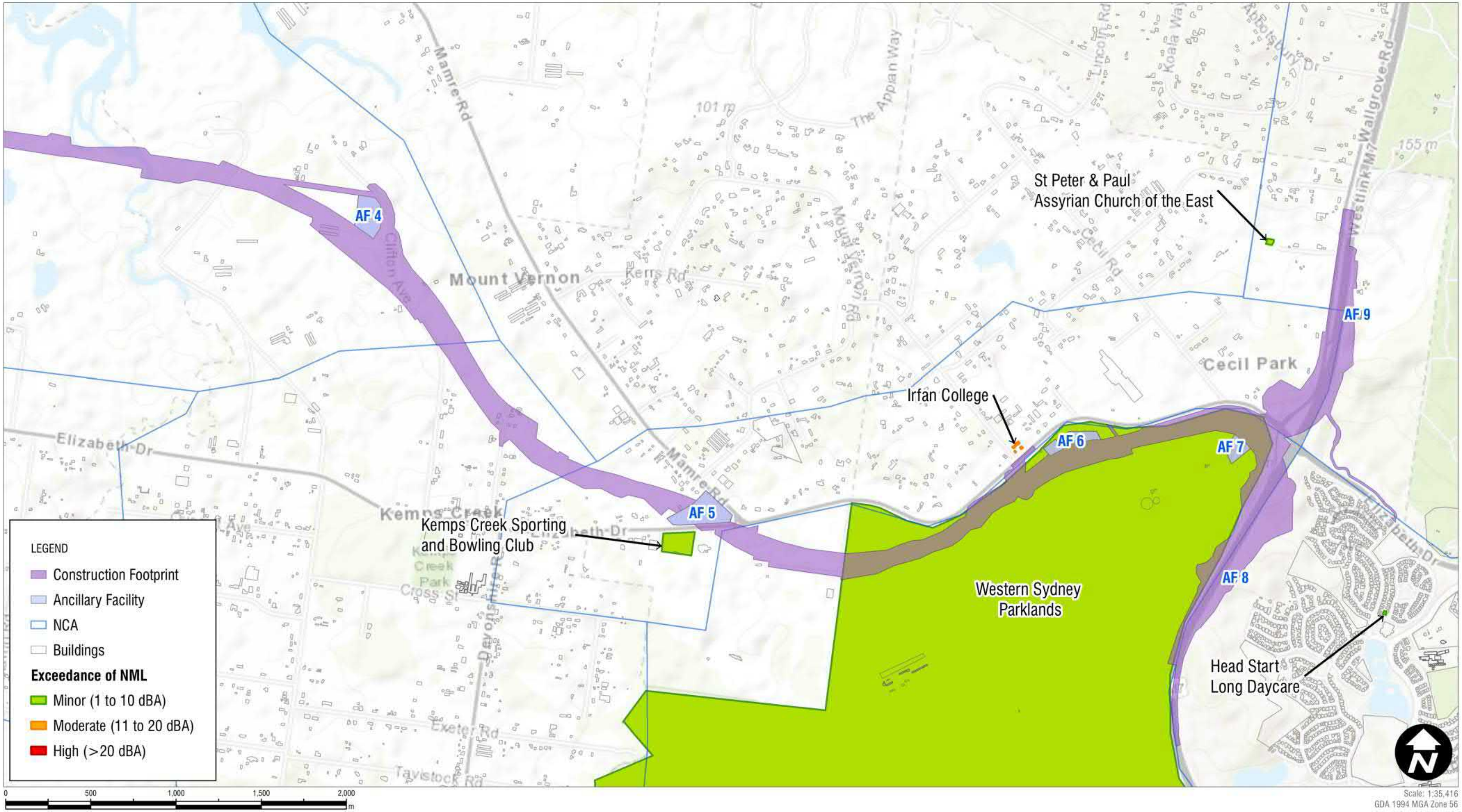


Figure 5-11 Predicted impacts – ‘other’ sensitive receivers

The above shows the following:

- Exceedances at 'other' sensitive receivers are limited to receivers in NCA01, NCA02, NCA04 and NCA05.
- The closest School (Irfan College) located in NCA04 is likely to be subject to 'moderate' impacts during worst-case scenarios when noise intensive equipment is being used.
- A Minor 1 dB exceedance is predicted at Saints Peter and Paul Assyrian Church of the East located in NCA01 and at the Head Start Long Day Care Centre in Cecil Hills, located in NCA02.
- Minor exceedances of up to 6 dB are predicted at two out-door sensitive receiver areas (Kemps Creek Sporting and Bowling Club and Western Sydney Parklands) adjacent to the project in NCA04 and NCA05.
- 'Other' sensitive receivers in the study area are not expected to be impacted by construction of the project.

The worst-case noise levels and the impacts on 'other' sensitive receivers would only be apparent for relatively short durations of the works.

5.5 Commercial receivers

A summary of the predicted construction noise impacts in each NCA for commercial receivers (including small businesses) is presented in **Table 5-10**.

The table shows that for commercial receivers:

- Minor impacts are seen in NCA05 during the 'Peak impact' scenarios for *Ancillary facility establishment*, *Utilities and drainage*, *Clearing* and *Earthworks*
- The worst-case impacts are seen in the 'Peak impact' scenarios, which is due to the use of noise intensive equipment. Noise levels and exceedances during the 'Typical impact' works do not exceed the noise management levels
- Other NCAs either have no commercial receivers or they are sufficiently distant from the construction footprint to be compliant with the noise goals
- No commercial receivers are predicted to have moderate or peak impacts.

5.6 Sleep disturbance

A sleep disturbance screening assessment has been carried out for the construction works and a summary is provided in the assessment tables in **Annexure C**. Review of the predictions shows that the sleep disturbance screening criterion is likely to be exceeded when night works are occurring near to residential receivers.

The need for night-time works on consecutive nights is not fully understood at this stage of the project. Where night-time work is located close to residential receivers, a detailed assessment of the potential noise impacts would be carried out prior to the works being carried out and site-specific environmental management measures to control the impacts would be developed.

The requirements for night-time works would be determined as the project progresses. Sleep disturbance impacts are dependent on a number of factors including the existing facade performance of affected residential receiver buildings. The likelihood of sleep disturbance impacts would be reviewed during detailed design. Construction environmental management measures are discussed further in **Section 7.1**.

Table 5-10 Predicted construction noise exceedances – commercial receivers

Period	ID	Scenario	Activity	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	NCA10
When in use	1a	Ancillary facility establishment	Peak impact	·	·	·	·	●	·	·	·	·	·
	1b		Typical impact	·	·	·	·	·	·	·	·	·	·
	2a	Ancillary facility operations	Operation	·	·	·	·	·	·	·	·	·	·
	2b		Stockpiling	·	·	·	·	·	·	·	·	·	·
	2c		Batching plant	·	·	·	·	·	·	·	·	·	·
	3a	Utilities and drainage	Peak impact	·	·	·	·	●	·	·	·	·	·
	3b		Typical impact	·	·	·	·	·	·	·	·	·	·
	4a	Demolition	Peak impact	·	·	·	·	·	·	·	·	·	·
	4b		Typical impact	·	·	·	·	·	·	·	·	·	·
	5a	Clearing	Peak impact	·	·	·	·	●	·	·	·	·	·
	5b		Typical impact	·	·	·	·	·	·	·	·	·	·
	6a	Earthworks	Peak impact	·	·	·	·	●	·	·	·	·	·
	6b		Typical impact	·	·	·	·	·	·	·	·	·	·
	6c		Onsite truck haulage	·	·	·	·	·	·	·	·	·	·
	7a	Bridge works	Peak impact	·	·	·	·	·	·	·	·	·	·
	7b		Typical impact	·	·	·	·	·	·	·	·	·	·
	7c		Concrete works	·	·	·	·	·	·	·	·	·	·
	7d		Girder lifts	·	·	·	·	·	·	·	·	·	·
	8a	Road works	Concrete works	·	·	·	·	·	·	·	·	·	·
	8b		Typical works	·	·	·	·	·	·	·	·	·	·
	8c		Tie-in works	·	·	·	·	·	·	·	·	·	·
	9a	Signage, lighting and landscaping		·	·	·	·	·	·	·	·	·	·

Key to impacts: · No exceedance ● Marginal to minor (1 dB to 10 dB) ♦ Moderate (11 dB to 20 dB) ■ High (>20 dB)

5.7 Construction vibration assessment

The main sources of vibration from construction works within the study area are vibratory rollers and rock-breakers.

- Vibratory rolling maybe required in discrete locations during the following scenarios:
  - Scenario 1a, Ancillary facility and establishment – Peak impact
  - Scenario 1b, Ancillary facility and establishment – Typical impact
  - Scenario 3a, Utilities and drainage – Peak impact
  - Scenario 6a, Earthworks – Peak impact
  - Scenario 8a, Road works – tie-in to existing roads
- Rock-breaking may be required in discrete locations during the following scenarios:
  - Scenario 3a, Utilities and drainage - Peak impact
  - Scenario 4a, Demolition – bridges and buildings (including rock-breaker)

A large vibratory roller produces a significant amount of vibration and is likely to be used throughout the construction of the project. Vibration offset distances are based on the recommended minimum working distances for cosmetic damage and human response in **Table 3-12**. The assessment assumes that a vibratory roller is required across the study area and the assessment is summarised in **Figure 5-12**.

5.7.1 Cosmetic damage assessment summary

The above shows that the distance between the construction works and the nearest sensitive receivers is generally sufficient for most buildings to be unlikely to suffer cosmetic damage. Approximately 19 structures are however located within the recommended minimum working distance spread across NCA01, NCA04, NCA05, NCA06, NCA07 and NCA10 where receivers are located close to the works.

Where works are within the minimum working distances and considered likely to exceed the cosmetic damage objectives, construction works would not proceed unless:

- A different construction method with lower source vibration levels is used, where feasible.
- Attended vibration measurements are carried out at the start of the works to determine the risk of exceeding of the vibration objectives.

Where buildings are potentially affected by vibration, building condition surveys would be completed before and after works.

5.7.2 Human comfort vibration assessment

Certain receivers which are near to the construction areas are within the human comfort minimum working distance and occupants of affected buildings may be able to perceive vibration impacts at times when vibration generating equipment is in use.

Where impacts are perceptible, they would likely only be apparent for relatively short durations when equipment such as rock-breakers or vibratory rollers are in use nearby.

The requirement for vibration intensive works and associated potential for impacts on human comfort would be reviewed during detailed design once finalised details of the works are available.

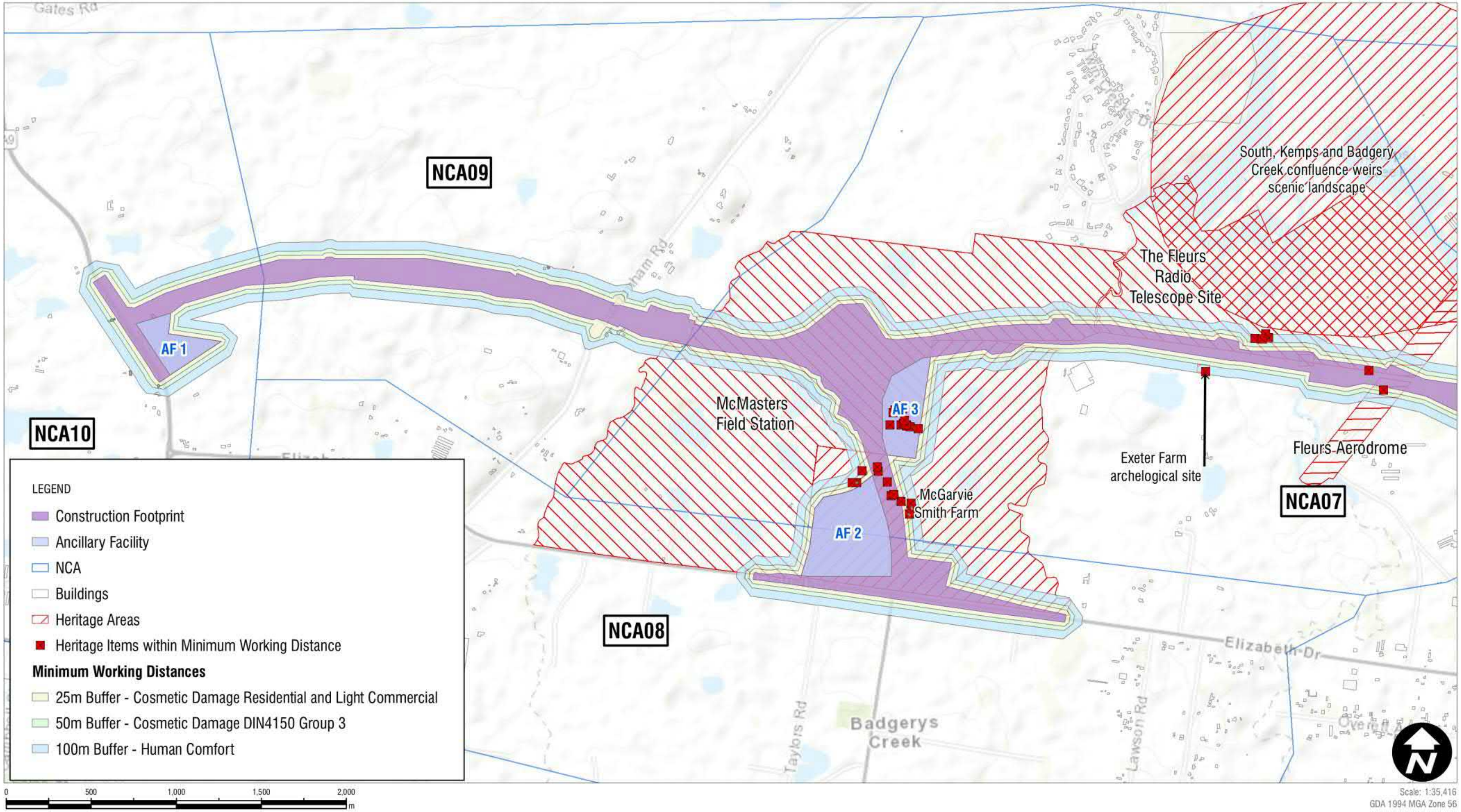


Figure 5-12 Construction vibration assessment

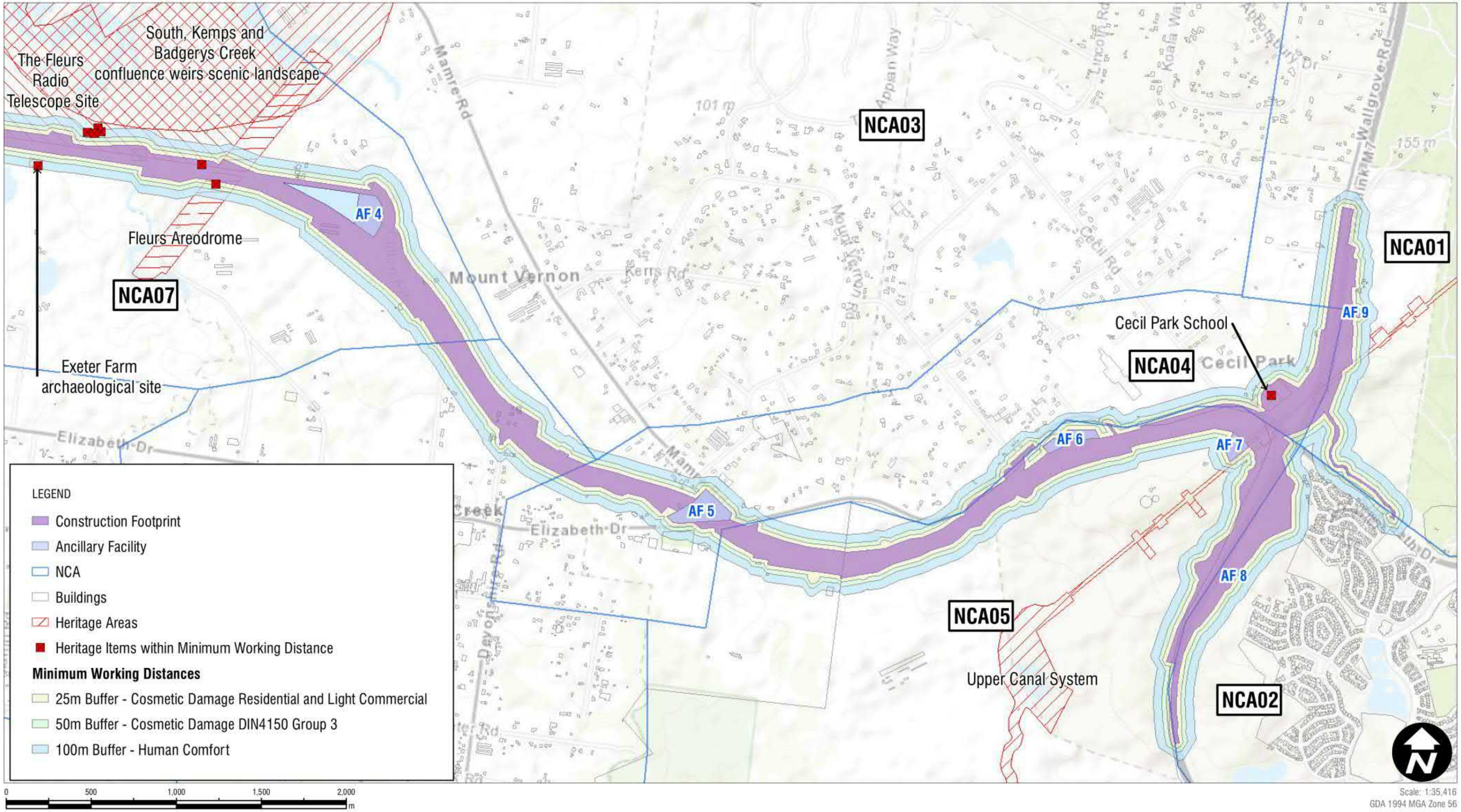


Figure 5-12 Construction vibration assessment

5.7.3 Heritage structures

The *non-Aboriginal heritage assessment* for the project (presented in Appendix J of the EIS) has identified a number of non-Aboriginal heritage items that are located in the study area. Items that have been deemed to be of heritage significance in the heritage report and are near to the construction footprint are shown in **Figure 5-12** and listed in **Table 5-11**.

The *Aboriginal heritage assessment* for the project (presented in Appendix I of the EIS) has found that there are artefacts throughout the landscape within the study area. However, that assessment did not identify any Aboriginal heritage structures or items near the project construction footprint that would be susceptible to vibration impacts.

Table 5-11 Heritage items identified within close proximity to the construction footprint

Heritage item[1]	NCA	Item	Location
Item 1	NCA07	McGarvie Smith farm	Badgerys Creek, Lot 62/DP1087838, Lot 63/DP1087838
Item 2	NCA07	Fleurs radio telescope site	Kemps Creek, Lot 21/DP258414, Lot 1/DP74574, Lot 1/DP88836, Lot 2/DP88836
Item 4	NCA05	Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)	Elizabeth Drive, Cecil Hills
Item 6	NCA07	McMasters field station	Kemps Creek, Lot 101/DP848215
Item 7	NCA07	Fleurs aerodrome	Kemps Creek, Lot 2/DP88836
Item 8	NCA04	Cecil Park school, post office and church site	Cecil Park, Lot 1/DP724970
Item 10	NCA07	Exeter farm archaeological site	Kemps Creek, Lot 1 DP74574
Item 12	NCA07	South, Kemps and Badgerys Creek confluence weirs scenic landscape	Lot 21/DP258414

Note 1: Heritage item number specified in the *non-Aboriginal heritage report* for the project.

BS 7385 states that “a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive” and therefore buildings or structures should not be assumed to be sensitive to vibration on the basis of being classed a heritage item.

Heritage buildings are to be considered on a case by case basis and further investigation would be carried out during detailed design for all potentially affected structures. Where buildings or structures are considered sensitive to vibration, appropriate vibration criteria would be determined after detailed inspections have been completed.

Item 1: McGarvie Smith farm

The heritage report identifies 12 structures (excluding sheds and silos) that are located on the site. Of these 12 structures, six are proposed to be demolished as part of the project, three are located on the eastern side of the construction footprint and three are located on the western side of the construction footprint.

Of the buildings that are located on the eastern side of the construction footprint, the closest building is located approximately 37 metres from the construction footprint and approximately 60 meters from the alignment. These structures are likely to be outside the minimum working distances for heritage items as outlined in **Table 3-12**.

Of the buildings that are located on the western side of the construction footprint, the closest building is approximately 40 meters from the construction footprint and approximately 60 meters from the alignment.

These three buildings are also located adjacent to an ancillary facility (AF2), approximately 20 meters, 30 meters and 50 meters respectively from the boundary. Depending on the location of vibration works carried out within AF2, there is potential to be within the minimum working distances for heritage items as outlined in **Table 3-12**.

The structures should be inspected prior to the commencement of nearby vibration intensive works. A dilapidation survey should be carried out to confirm the sensitivity of the item to vibration induced damage and the appropriate criteria applied. It is noted that the heritage report states that there are a number of buildings which appear to be constructed recently and therefore not likely to be sensitive to vibration.

Item 2: The Fleurs radio telescope site

The heritage report identifies that one element of the shain cross is within the construction footprint. It is noted that parts or all of the shain cross will be demolished as part of this project. All other structures including the dish are greater than 50 metres from the construction footprint and are outside the minimum working distances for heritage items. The structures should be inspected prior to the commencement of nearby vibration intensive works. A dilapidation survey should be carried out to confirm the sensitivity of the item to vibration induced damage and the appropriate criteria applied.

Item 4: Upper Canal System

Refer to **Section 5.7.4** for details regarding the vibration impacts.

Item 6: McMasters field station

The non-Aboriginal heritage report identifies a cluster of 13 buildings which are within the boundary of ancillary facility (AF3). The heritage report states that an exclusion zone should be established around these buildings to minimise any potential damage. As works have the potential to occur in close proximity to these structures, the structures should be inspected prior to the commencement of nearby vibration intensive works. A dilapidation survey should be carried out to confirm the sensitivity of the item to vibration induced damage and the appropriate criteria applied. Where vibration intensive activities are proposed to occur within the minimum working distances, appropriate environmental management measures will need to be implemented as outlined in **Section 7.1.**

Item 7: Fleurs aerodrome

The heritage report only identifies a metal structure located approximately 13 meters from the construction footprint, and approximately 44 meters from the alignment. The structures should be inspected prior to the commencement of vibration intensive works and a dilapidation survey carried out to confirm its sensitivity to vibration induced damage and the appropriate criteria applied.

Item 8: Cecil Park school, post office and school church

The heritage report states that no physical structures at the site would be impacted by vibration as the archaeological deposits would be salvaged prior to construction commencing.

Item 10: Exeter farm archaeological site

The heritage report states that no physical structures are located within the vibration offset distances. Further investigation will be required during detailed design.

Item 12: South, Kemps and Badgerys Creek confluence weirs scenic landscape

The heritage report states that no physical structures are located within the vibration offset distances. Further investigation will be required during detailed design.

Item 13: Former Cecil Park public hall

The heritage report states that the only structures still standing in situ on the site are the brick piers, timbers and a set of concrete stairs. There is abundant material strewn around the site, comprising timbers, bricks and brick fragments and corrugated iron. The structures should be inspected prior to the commencement of vibration intensive works and a dilapidation survey carried out to confirm its sensitivity to vibration induced damage and the appropriate criteria applied.

5.7.4 Water NSW – Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)

The Upper Canal System bisects the study area in the southwestern and northeast corner of the Elizabeth Drive and M7 Motorway interchange and is listed on the state heritage register. While the canal itself is underground at the location where it crosses the study area, Tunnel Shaft 4 is located at the surface within the study area and can be observed from the M7 Motorway. Vibration intensive activities may occur near to the canal tunnel including the construction of the bridge support piles crossing over the M7 Motorway, potential excavation of rock to make way for the M12 Motorway ramps, and vibratory rolling.

A review of available information suggests that the canal is of sandstone and brick construction. Based on this a vibration criterion of 50 mm/s has been used as per the recommendations in DIN 4150.3 for buried masonry pipework (see **Table 3-11**).

A dilapidation survey has been conducted by Roads and Maritime. A reduction of the above vibration criteria by half to a peak particle velocity (PPV) of 25 mm/s is recommended. The condition of the canal will be confirmed by Roads and Maritime during or prior to the detailed design stage of the project in order to determine appropriate vibration criteria.

The proposed construction methodology would use bored piles. Vibration from bored piles is comparatively low and it is unlikely that vibration would exceed the recommended criteria of 25 mm/s.

Rock-breaking, and vibratory rolling has the potential to exceed the recommended criteria of 25 mm/s and would require a more detailed assessment taking into account the actual distance from the vibration intensive activities to the canal as well as the ground conditions. In-situ monitoring would be used to establish site laws to confirm the site-specific vibration propagation to assess the impact of vibration.

5.7.5 Gas supply pipelines

The Eastern Gas Pipeline and the Wilton to Horsley trunk main are located in the vicinity of the M7 Motorway and Elizabeth Drive Intersection. Vibration intensive activities could occur near the gas supply pipelines including the bridge support piles crossing over the M7 Motorway, potential excavation of rock to make way for the M12 Motorway ramps, and vibratory rolling.

The Eastern Gas Pipeline is steel with a plastic coating. A vibration criterion of 50 mm/s has been used as per the recommendations from DIN 4150.3 for buried masonry pipework. A reduction of this vibration criterion by half to a PPV of 25 mm/s is recommended.

Similar to the Upper Canal System, bored piling is unlikely to result in vibration levels that exceed the recommended project criteria.

Rock-breaking and vibratory rolling has the potential to exceed the recommended criteria of 25 mm/s and would require a more detailed assessment taking into account the actual distance from the vibration intensive activities to the gas supply pipelines as well as the ground conditions. In-situ monitoring would be used to establish site laws to confirm the site-specific vibration propagation to assess the impact of vibration.

5.7.6 Vibration environmental management measures

The requirement for works which use vibration intensive equipment near to vibration sensitive buildings, structures and assets would be reviewed during detailed design. It is expected that vibration impacts would be able to be controlled to avoid cosmetic damage to all structures.

Where works are within the minimum working distances, detailed review of the required construction methods would be completed and attended vibration measurements would be required at the start of the works to determine the risk of exceeding of the vibration objectives.

Construction environmental management measures are discussed in more detail in **Section 7.1**.

5.8 Construction ground-borne noise

Construction works can cause ground-borne noise impacts in nearby buildings when vibration generating equipment is in use. Ground-borne noise impacts should be considered where the ground-borne noise levels are higher than noise transmitted through the air, such as where buildings near to construction works have high performing facades which attenuate the airborne component.

The majority of receivers are sufficiently distant from the works for ground-borne noise impacts to be minimal. Where residential receivers are located near to construction works, airborne noise levels would typically be dominant over the ground-borne component.

5.9 Construction traffic noise assessment

Construction related traffic has the potential to temporarily increase road traffic noise levels at receivers which are located near to the construction routes.

A comparison of the proposed construction traffic volumes to the forecast traffic volumes during the construction period has been used to determine where increases in road traffic noise (ie a greater than 2.0 dB increase over the existing noise level) may be likely to occur.

The baseline traffic volumes for the construction period and proposed construction traffic volumes are detailed in **Annexure C**.

The predicted increase in traffic noise due to additional construction traffic is outlined in **Table 5-12**.

The assessment is summarised for the daytime period in **Figure 5-13** and for the night-time period in **Figure 5-14**.

The figure shows that construction traffic is unlikely to result in a noticeable increase in noise levels where vehicles use major roads. This is because of the high volumes of traffic that already use these routes.

Based on the proposed construction traffic routes and the forecast redistribution of traffic during construction, no noticeable increases in road traffic noise are predicted.

Table 5-12 Predicted road traffic noise increase due to construction traffic

Road	Section	Predicted Construction Traffic Noise Increase (dB)	
		Day	Night
M7 Motorway	South of M7 Interchange	<0.5	<0.5
	Btwn On/Off Ramps to Elizabeth Dr & Wallgrove Rd	<0.5	<0.5
	North of M7 Interchange	<0.5	<0.5
M7 Motorway – Elizabeth Drive Interchange	NB Off Ramp to Elizabeth Dr	0.5	0.5
	NB On Ramp from Wallgrove Rd	1.0	0.6
	SB Off Ramp to Elizabeth Dr	0.8	1.2
	SB On Ramp from Elizabeth Dr	1.3	0.8
Elizabeth Drive	East of M7 Interchange	<0.5	<0.5
	Btwn M7 Interchange Rd & Cecil Rd	<0.5	<0.5
	Btwn Cecil Rd & Duff Rd	<0.5	<0.5
	Btwn Duff Rd & Mamre Rd	0.5	<0.5
	Btwn Mamre Rd & Devonshire Rd	<0.5	<0.5
	Btwn Devonshire Rd & Clifton Ave	<0.5	<0.5
	Btwn Clifton Ave & Western Rd	0.5	<0.5
	Btwn Western Rd & Martin Rd	0.7	0.5
	Btwn Martin Rd & WSA Business Park East Access	0.6	0.5
	Btwn WSA Business Park East Access & WSA Business Park West Access	0.7	0.7
	Btwn WSA Business Park West Access & Adams Rd	0.7	0.6
	Btwn Adams Rd & Luddenham Rd	0.9	0.8
	Btwn Luddenham Rd & The Northern Road	1.0	0.9
Wallgrove Road	Btwn Elizabeth Dr & M7 NB On Ramp	1.1	1.0
	North of M7 NB On Ramp	0.6	<0.5
Clifton Avenue	North of Elizabeth Dr	<0.5	<0.5
The Northern Road	South of Elizabeth Dr	1.3	1.0
	Btwn Elizabeth Dr & M12	0.5	0.5
	North of M12	0.5	<0.5

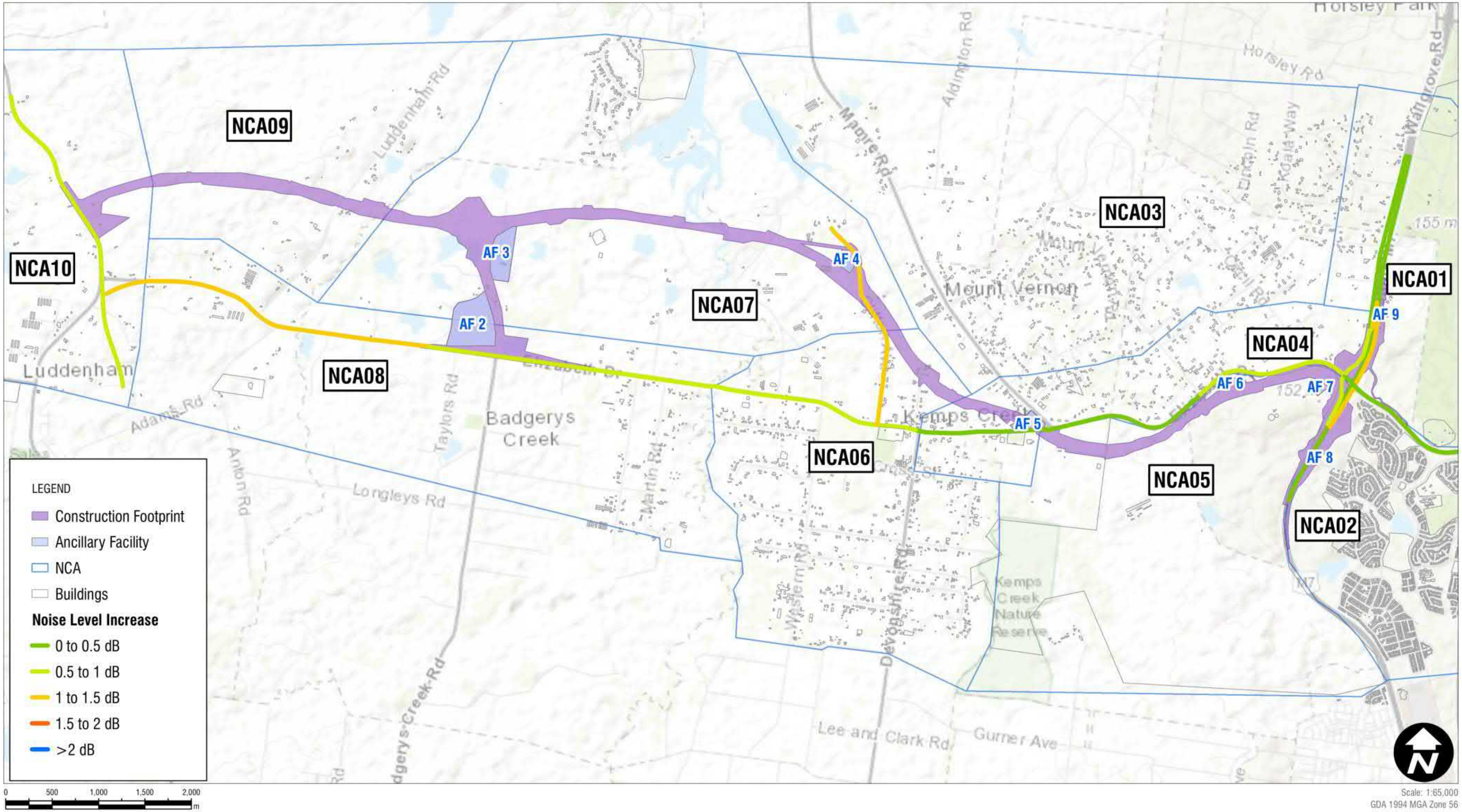


Figure 5-13 Predicted road traffic noise increase due to construction traffic - Daytime

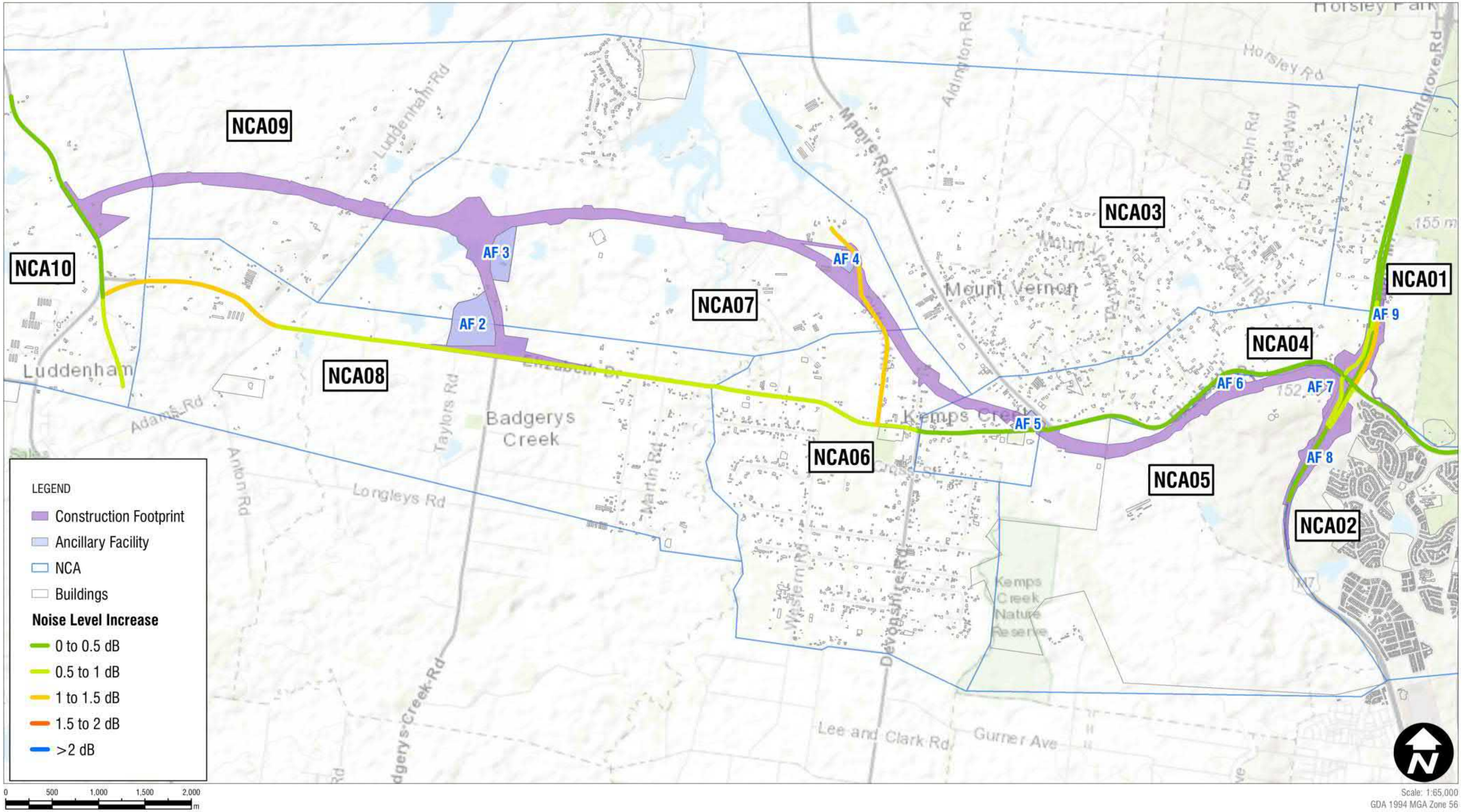


Figure 5-14 Predicted road traffic noise increase due to construction traffic – Night-time

5.10 Cumulative construction noise impacts

Cumulative construction noise impacts may arise from the interaction of construction activities of the project and other approved or proposed projects in the area. When considered in isolation, specific project impacts may be considered minor. These minor impacts may be more substantial, however, when the impact of multiple projects on the same receivers is considered. As such, the construction noise impacts discussed in **Section 5** above were assessed in consideration of the following recently completed, ongoing and proposed projects:

- Western Sydney Airport
- Sydney Metro Greater West
- The Northern Road Upgrade
  - Stage 5 (Littlefields Road to Glenmore Park)
  - Stage 6 (Littlefields Road to Eaton Road)
- Other existing road network upgrades and potential road projects including:
  - Elizabeth Drive Upgrade
  - Mamre Road Upgrade
- Major land releases, including:
  - Western Sydney Aerotropolis
  - South West Growth Area
  - Western Sydney Employment Area.

The above projects are in varying stages of delivery and planning. This chapter provides an assessment of cumulative construction noise impacts based on the most current and publicly available information on the above. In many instances this is a high-level qualitative discussion.

Projects which have been assessed quantitatively are The Northern Road Upgrade and Western Sydney Airport, as these are approved projects with construction timeframes which would overlap with the construction of the M12 Motorway.

5.10.1 Cumulative airborne noise assessment

The following provides an assessment of cumulative impacts from the construction of The Northern Road Upgrade and Western Sydney Airport. These projects in relation to the proposed M12 Motorway are shown in **Figure 5-15**.

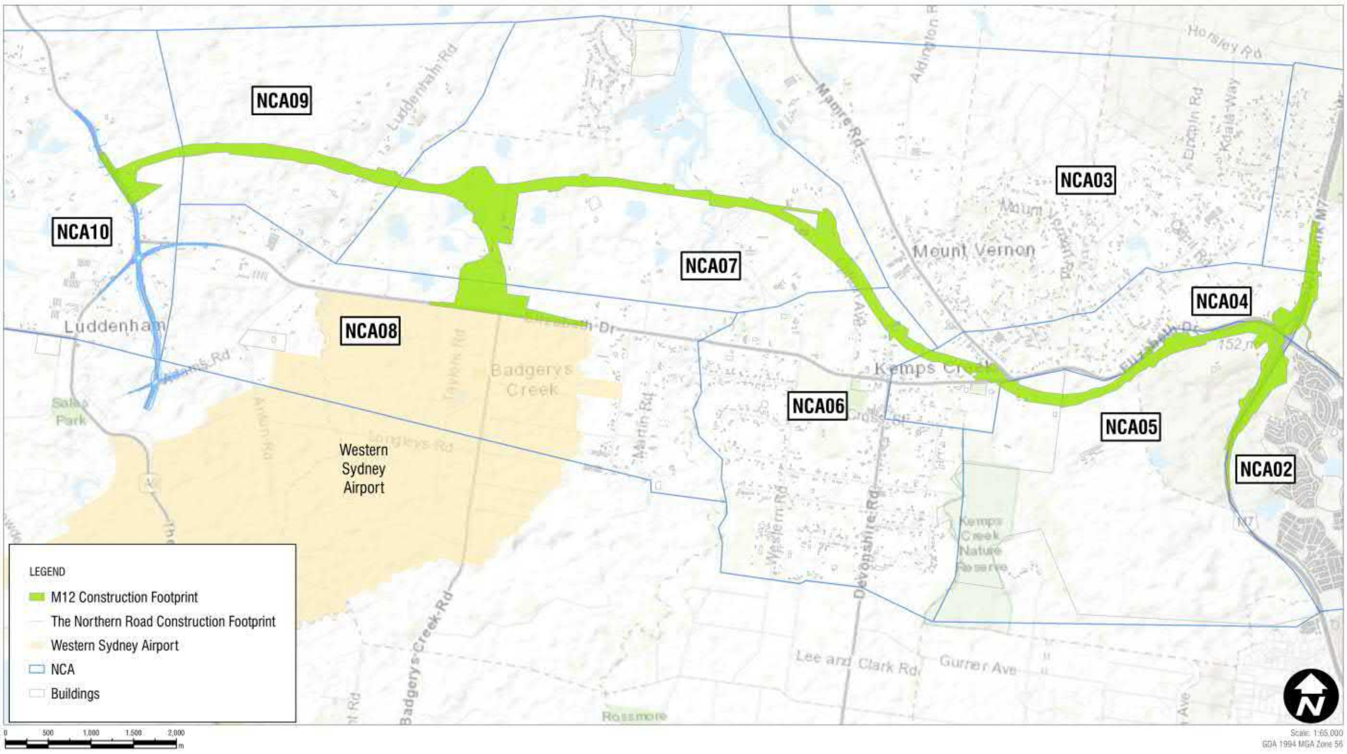


Figure 5-15 Major construction projects in vicinity of the M12 Motorway

The indicative construction schedule for the nearby approved major projects in comparison to the M12 Motorway is outlined in **Table 5-13**

Table 5-13 Indicative construction schedule for major projects in vicinity of the M12 Motorway

Work phase	2020				2021				2022				2023				2024				2025				2026			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
M12 Motorway																												
Western Sydney Airport																												
The Northern Road Upgrade																												

Cumulative construction noise impacts can occur where multiple works are being completed near to a particular receiver at the same time. The indicative construction program in **Table 4-6** shows a number of overlapping work phases meaning cumulative impacts may happen at certain times during construction of the M12 Motorway.

Since the construction scenarios generally require similar items of equipment, concurrent construction works could theoretically increase the worst-case noise levels in this report by around 3 dB where works are a similar distance from a particular receiver, however the likelihood of worst-case noise levels being generated by two sets of works at the same time is considered low.

The likely impact of concurrent works on the project would be an increase in the number of 15-minute periods where noise impacts are apparent. In practice, construction noise levels in any one location would vary and would be frequently much lower due to construction phasing moving works around and, in many cases, only a few items of equipment being used at any one time.

The potential cumulative impacts from construction of the M12 Motorway and other nearby major projects have been evaluated by determining locations where noise levels from the individual projects (ie the M12 Motorway project, The Northern Road Upgrade and Western Sydney Airport) are likely to be above the standard daytime NML.

Figure 5-16 shows the areas where cumulative noise impacts may occur. These are indicated by the areas where the indicative noise levels (transparent shading) overlap. The impact areas are based on the construction noise impact assessments prepared for each project, combined with the worst-case predicted impacts from the M12 project.

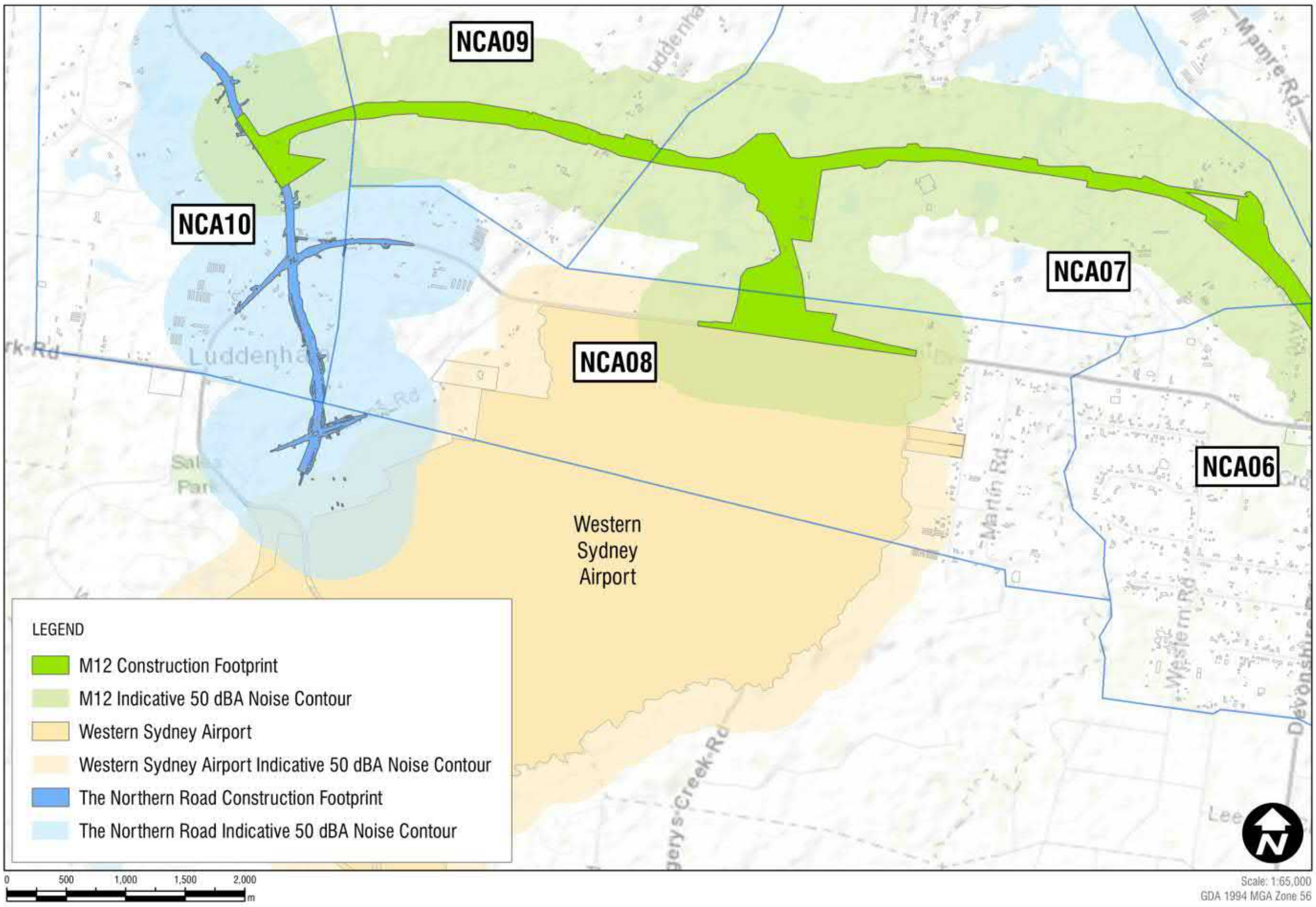


Figure 5-16 Areas of potential cumulative and consecutive impacts

Western Sydney Airport

Based on a review of the potential impacts from the construction of Western Sydney Airport (refer to the *Western Sydney Airport EIS – Assessment of Ground-Based Noise*, prepared by Wilkinson Murray Pty Ltd dated August 2016), the receivers in the vicinity surrounding the site are predicted to experience noise levels up to 40-45 dBA. Noise impacts are due to the bulk earthworks carried out in the East Sector (the closest area of works to Elizabeth Drive) during the daytime period. Noise levels would depend on the exact location of the works within the site and would vary due to the size of the works areas.

Approximately five residential receivers (primarily in NCA08) located to the east of the Western Sydney Airport access road have the potential to be influenced by simultaneous works occurring at the Western Sydney Airport and the M12 Motorway project as identified in **Figure 5-16**.

For receivers in close proximity to the M12 Motorway, noise levels would generally be dominated by construction activities from this project, with worst-case noise levels predicted to be up to 63 dBA compared to 40-45 dBA from bulk earthworks associated with the Western Sydney Airport. In these circumstances, the environmental management measures used to control construction noise from the M12 Motorway would be considered sufficient to control the cumulative noise impacts from the M12 Motorway and the Western Sydney Airport.

Where receivers are further away from the M12 Motorway and closer to the Western Sydney Airport, noise levels may be influenced by the bulk earthworks at Western Sydney Airport and potentially have an increase of worst-case noise levels by up to around 3 dB for concurrent works from the M12 Motorway.

The Northern Road

It is likely that this section of The Northern Road upgrade will be completed by the time construction commences on the M12 Motorway project. An assessment has been included to account for any potential changes or delays in project timing.

Based on a review of the potential impacts from the construction noise assessment carried out for The Northern Road upgrade (refer to *The Northern Road Upgrade EIS*, prepared by Jacobs dated 15 May 2017), the receivers along The Northern Road between Elizabeth Drive and Littlefields Road are predicted to experience noise levels up to 70 dBA depending on their setback from these works.

Approximately eight residential receivers (located in NCA10) may be potentially impacted by cumulative construction activities if works occur within the same area as identified in in **Figure 5-16**.

Where works simultaneously occur, the construction activities associated with The Northern Road are likely to dominate the construction noise levels, as the worst affected receivers are generally closer to The Northern Road.

Where receivers are further from The Northern Road and closer to the M12 Motorway, construction noise levels are likely to be dominated by the M12 Motorway construction activities. In these circumstances, the environmental management measures used to control noise from the project would be sufficient to control noise at these receivers.

Where receivers are set back from both The Northern Road and the M12 Motorway, a theoretical increase of noise levels up to around 3 dB for concurrent works could occur, although would be considered to be a worst-case scenario.

5.10.2 Construction traffic

Construction related traffic from the construction of The Northern Road Upgrade, Western Sydney Airport and the M12 Motorway has the potential to temporarily increase road traffic noise levels at receivers due to the use of same roads for construction traffic.

The existing and forecasted construction traffic volumes from the project as well as the construction traffic reported in the Western Sydney Airport EIS and The Northern Road EIS has been used to determine where potentially noticeable increases in cumulative road traffic noise (ie a greater than 2.0 dB increase over the existing noise level) are likely to occur.

It has been assumed that construction traffic from nearby projects would access Elizabeth Drive via the M7 Motorway. The traffic has been divided with an equal split of vehicles travelling northbound and southbound on the M7 Motorway. It has been assumed that construction traffic would travel along Elizabeth Drive until reaching the respective project areas.

The construction traffic volumes associated with each project have been detailed in **Table 5-14** and the cumulative construction traffic assessment is summarised for the daytime period in **Figure 5-17** and for the night-time period in **Figure 5-18**.

Table 5-14 Predicted road traffic noise increase due to construction traffic – Cumulative impacts with other major projects

Road	Section	Predicted Construction Traffic Noise Increase (dB)	
		Day	Night
M7 Motorway	South of M7 Interchange	<0.5	<0.5
	Btwn On/Off Ramps to Elizabeth Dr & Wallgrove Rd	<0.5	<0.5
	North of M7 Interchange	<0.5	<0.5
M7 Motorway – Elizabeth Drive Interchange	NB Off Ramp to Elizabeth Dr	0.8	0.8
	NB On Ramp from Wallgrove Rd	1.5	0.9
	SB Off Ramp to Elizabeth Dr	1.2	1.6
	SB On Ramp from Elizabeth Dr	1.6	1.1
Elizabeth Drive	East of M7 Interchange	<0.5	<0.5
	Btwn M7 Interchange Rd & Cecil Rd	0.7	0.6
	Btwn Cecil Rd & Duff Rd	0.8	0.5
	Btwn Duff Rd & Mamre Rd	0.6	<0.5
	Btwn Mamre Rd & Devonshire Rd	0.7	0.5
	Btwn Devonshire Rd & Clifton Ave	1.0	0.9
	Btwn Clifton Ave & Western Rd	1.1	1.0
	Btwn Western Rd & Martin Rd	1.1	1.0
	Btwn Martin Rd & WSA Business Park East Access	1.2	1.2
	Btwn WSA Business Park East Access & WSA Business Park West Access	1.1	1.2
	Btwn WSA Business Park West Access & Adams Rd	0.9	0.8
	Btwn Adams Rd & Luddenham Rd	1.0	0.9
	Btwn Luddenham Rd & The Northern Road	1.1	1.0
Wallgrove Road	Btwn Elizabeth Dr & M7 NB On Ramp	0.7	0.6
	North of M7 NB On Ramp	<0.5	<0.5
Clifton Avenue	North of Elizabeth Dr	1.3	1.0
The Northern Road	South of Elizabeth Dr	0.8	0.7
	Btwn Elizabeth Dr & M12	0.7	0.5
	North of M12	0.7	0.5

The cumulative construction traffic assessment is summarised for the daytime period in **Figure 5-17** and for the night-time period in **Figure 5-18**.

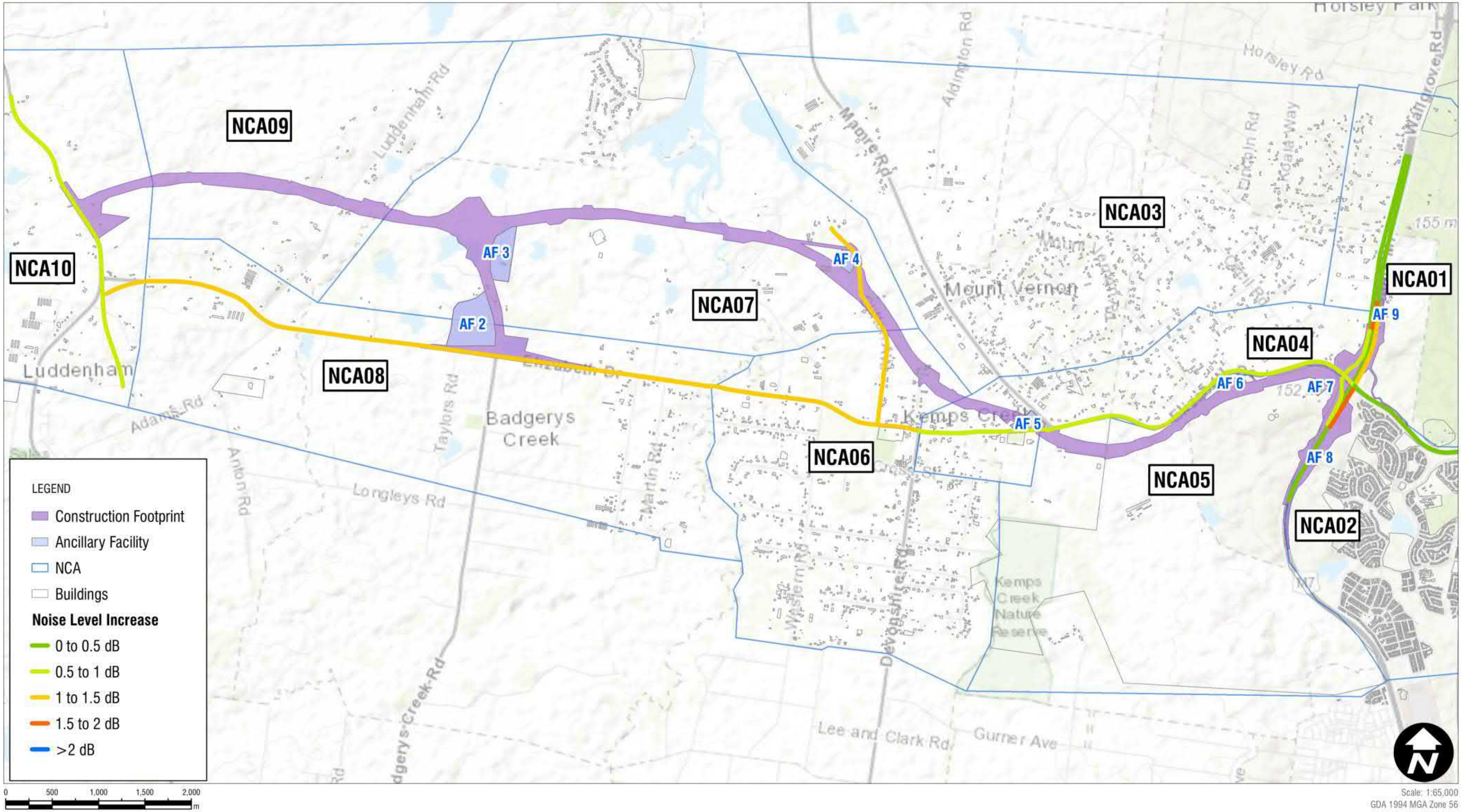


Figure 5-17 Predicted road traffic noise increase due to construction traffic – Cumulative impacts with other major projects - Daytime

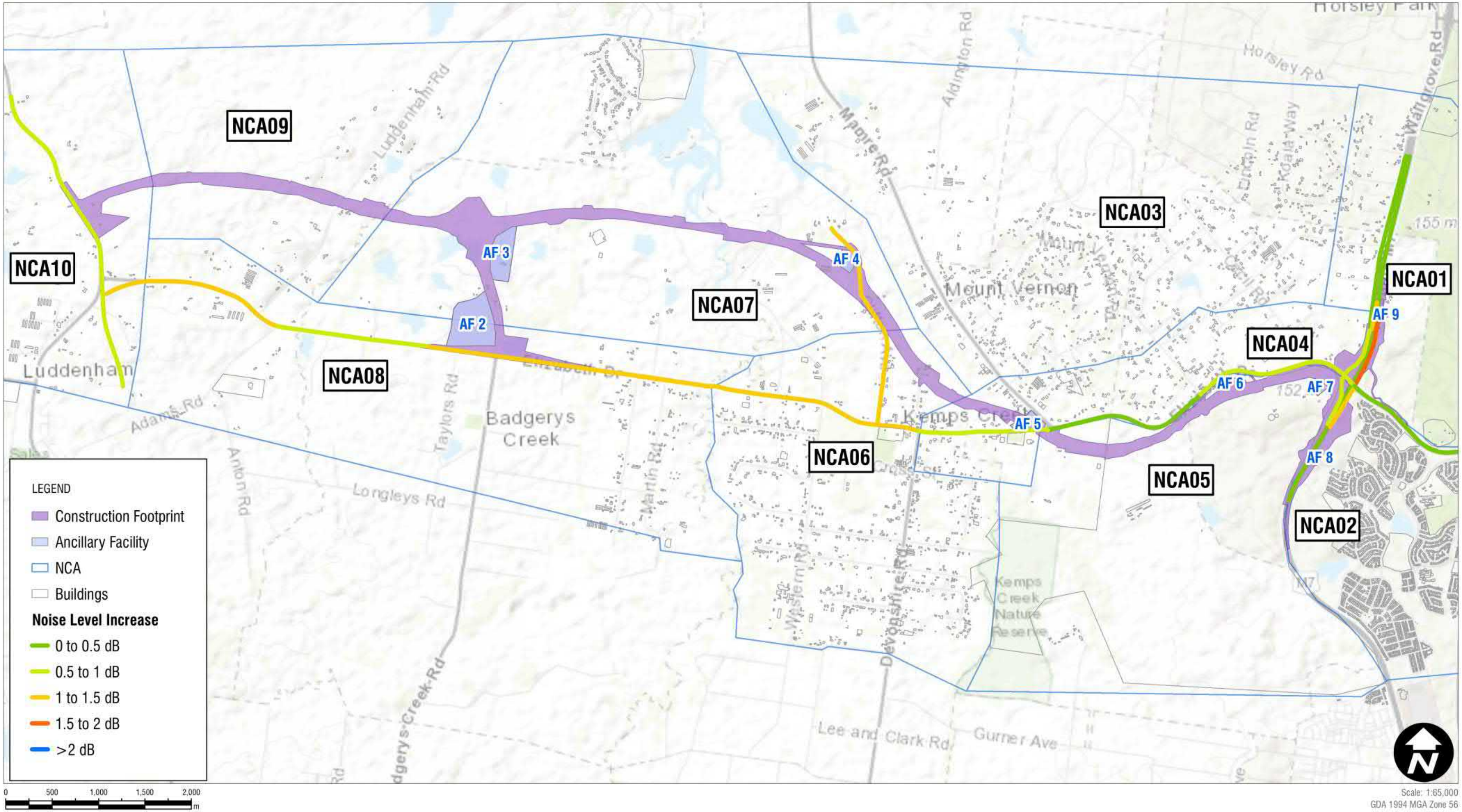


Figure 5-18 Predicted road traffic noise increase due to construction traffic – Cumulative impacts with other major projects – Night-time

The figures above show that the cumulative construction traffic is unlikely to result in a noticeable increase in noise levels along the proposed haulage routes. This is due to the high volumes of traffic that currently use these routes.

Potential road traffic noise increases of up to 1.6 dB during the night-time are predicted for the access ramps to the M7 Motorway. It should however be noted that the traffic volumes on Wallgrove Road and the M7 Motorway would be higher and would likely be the dominate source in the area, masking any potential increase in noise from these ramps.

Based on the proposed construction traffic routes and the forecast redistribution of traffic during construction, no noticeable increases in road traffic noise are predicted.

5.10.3 Cumulative impacts from other projects

The following provides an overview of other projects which have the potential to result in cumulative impacts. These projects are currently at varying stages of planning and no design or environmental assessment information is currently publicly available. A qualitative discussion for each project is provided below.

Sydney Metro Greater West

Transport for NSW recently identified recommended corridors for a rail option to provide a major transport link between the North West Growth Area, Western Sydney Airport, and the South West and Greater MacArthur Growth Area. This rail option would connect the existing Main South Line (T8) near Macarthur Station to the existing Main Western Line (T1) near St Marys Station, via the Western Sydney Airport.

This railway servicing the new Western Sydney Airport will be developed and delivered by Sydney Metro. It is referred to as Sydney Metro Greater West. Planning for this project is currently underway and as such, environmental assessment results are not yet available.

Construction timeframes for the Sydney Metro Greater West are likely to have some overlap with the construction of the project. During any timeframes where construction activities are concurrent, increased construction noise impacts may be likely.

Cumulative impacts associated with the construction of the project and the Sydney Metro Greater West would be considered in the environmental assessment prepared for the Sydney Metro Greater West.

Other road network upgrades

There are a number of other planned and potential road upgrade projects in the western Sydney area that may contribute to cumulative noise impacts. These potential projects include:

- Elizabeth Drive upgrade – Roads and Maritime has started site investigations, including preliminary engineering, preliminary/strategic designs, environmental field investigations, and strategic modelling. These investigations are expected to be completed during 2019
- Mamre Road upgrade – the NSW Government has started early planning for a future upgrade of a 10 kilometre section of Mamre Road, between the M4 Motorway and Kerrs Road to support economic and residential growth in the area.

These projects are currently at varying stages of planning and no design or environmental assessment information is currently publicly available.

The timing for construction of the above projects has not yet been announced. However, there is potential for overlaps in construction timing between the project and some of these road upgrade works. Should this occur the cumulative impacts would be dependent on the timing, type and location of simultaneous construction activities. An assessment of cumulative noise impacts would be undertaken during the site-specific environmental impact assessments for each project. The assessment would outline the process for managing construction schedules across the various projects to ensure adequate respite periods are provided to affected receivers.

Growth Areas

Western Sydney is the focus of a number of plans and policies to promote changes in land use and to increase employment opportunities, in particular within the following defined areas:

- Western Sydney Aerotropolis – The area surrounding the Western Sydney Airport that was previously known as the Western Sydney Airport Growth Area. The Aerotropolis would establish a new high-skill jobs hub across aerospace and defence, manufacturing, healthcare, freight and logistics, agribusiness, education and research industries, and is expected to contribute to establishing 200,000 new jobs for Western Sydney (DPE, 2018)
- South West Growth Area – The area south-east of the Western Sydney Aerotropolis. This will guide new infrastructure investment, identify new homes and jobs close to transport, and coordinate services in the area. The NSW Government is currently at the early stages of investigations
- Western Sydney Employment Area – The area north-east of the Western Sydney Aerotropolis. Established by the NSW Government to be a new employment space, providing opportunities for local people to work closer to home.

The land within the areas above will be developed by individual developers at varying timeframes. Each will be subject to their own environmental assessments, based on the scale and potential impact of each project. There are currently no defined plans available for the individual developments within these growth areas.

The project would traverse the South West Growth Area and service the Western Sydney Aerotropolis, and indirectly, the Western Sydney Employment Area. The project would serve and facilitate the growth by providing increased road capacity and reducing congestion and travel times in the area.

The timing for the construction of developments within the above-mentioned growth areas has not yet been announced. There is potential of overlaps in construction timing between some developments and the project. Should this occur, the cumulative impacts would be dependent on the timing, type and location of simultaneous construction activities. An assessment of cumulative noise impacts would be undertaken during the site-specific environmental impact's assessments for each project.

5.11 Consecutive construction impacts

Environmental management measures aimed at short-term construction works may be less effective where receivers are affected by longer term impacts. If several projects occur in the same area consecutively, there may be a combined effect due to the increased duration of impacts on nearby receivers. This effect is termed 'construction fatigue'.

Where receivers are affected by extended impacts from more than one project, it may be necessary to consider additional environmental management measures to minimise the impacts.

As identified in **Table 5-13** the Western Sydney Airport and The Northern Road Upgrade are identified as occurring consecutively, with crossover periods. The construction of the Sydney Metro Greater West is expected to commence in 2021.

The potential consecutive impacts from the M12 Motorway and other major projects in the area would be investigated further as the project progresses when detailed construction planning is developed. For example, construction works in the western area of the M12 Motorway have the potential to occur after the works along The Northern Road have been completed and therefore potentially extending the duration of impacts at the most affected receivers to construction noise.

Specific additional management measures designed to address potential consecutive impacts would be developed and used to minimise the impacts as far as practicable, in consultation with the affected community. This may include adjustments to the environmental management measures to ensure receivers which are impacted by long-term construction works receive additional mitigation measures, where appropriate.

6. Operational road traffic noise assessment

6.1 Predicted operational road traffic noise levels without mitigation

Operational noise impacts have been predicted to all sensitive receivers in the operational study area. The operational impacts are discussed in the following sections.

As discussed in **Section 4.2.5**, the forecast traffic data used in the operational noise assessment takes into account numerous current and future road projects and land use changes. This has therefore allowed for consideration of cumulative operational road traffic noise impacts from the project along with other sources of road traffic in the area.

6.1.1 Operational road noise predictions without mitigation

Operational noise impacts in the operational study area have been predicted 'without mitigation' and compared to the NCG criteria (see **Table 3-14** and **Table 3-15**). The predicted operational road noise levels at residential receivers are summarised in **Table 6-1** for the 2026 at-opening and 2036 future design scenarios. The table summarises the worst-case change in noise levels in each NCA, which is typically receivers which are nearest to the project. Predicted noise levels for the assessed scenarios are included in **Annexure D**.

The 'without mitigation' noise predictions are used to identify receivers which qualify for consideration of additional noise mitigation, noting that receivers which are above the NCG criteria do not necessarily qualify for additional noise mitigation (see **Section 6.1.2**).

Table 6-1 Predicted worst-case changes in road traffic noise level in each NCA without mitigation (triggered residential receivers only)

NCA	Predicted noise level (dBA) for residential receivers who exceed the NCG criteria											
	At-Opening 2026						Future Design 2036					
	No Build		Build		Change		No Build		Build		Change	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
NCA01	62	58	67	63	5	5	63	59	69	64	5	5
NCA02	52	47	53	50	2	2	53	49	55	52	1	2
NCA03	49	44	59	55	11	11	49	45	60	56	11	11
NCA04	54	53	66	65	12	12	53	51	66	64	12	12
NCA05	-	-	-	-	-	-	-	-	-	-	-	-
NCA06	51	47	67	63	16	16	53	49	67	63	14	14
NCA07	33	28	53	48	20	20	36	31	55	51	19	20
NCA08	-	-	-	-	-	-	-	-	-	-	-	-
NCA09	44	40	57	53	13	13	45	41	59	55	14	15
NCA10	53	49	55	51	2	1	54	50	57	53	3	3

Note 1: Results based on receiver predicted to experience the greatest change in noise between the build and no build scenarios and may not represent the highest predicted noise level within each NCA.

These results show that increases in road traffic noise levels are predicted at receivers within most NCAs across the operational study area. In NCA01, NCA03, NCA04 and NCA06, increases result from the alignment of the project being relatively close to receivers with the project impacting facades of houses which were previously not affected by road traffic noise. In NCA07 and NCA09 the project is being constructed in an area which has low existing road traffic noise levels and affects receivers which were previously not affected. Increases in NCA02 and NCA10 are minor due to these receivers proximity to existing roads. There are no residential receivers within the operational study area in NCA05 and NCA08.

Figure 6-1 and **Figure 6-2** illustrate the predicted change in noise levels (ie the Build minus No Build) and the predicted Build night-time noise levels for the 2036 timeframe.

The time period in which the project is predicted to have the highest number of impacted receivers is the 2036 night-time scenario. The following maps present the impacts for the controlling 2036 night-time scenario, while maps for the other time periods are included in **Annexure D**.

6.1.2 Receivers considered for additional noise mitigation

Where road traffic noise levels at receivers are predicted to be above the NCG criteria, the requirement for additional noise mitigation is determined using guidance from the Roads and Maritime NMG (see **Section 4.2.8**). The NMG recognises that the NCG criteria are not always practicable and that it is not always feasible or reasonable to expect that they are achieved.

When evaluating if a receiver qualifies for consideration of additional noise mitigation the NMG considers how far above the criterion the noise level is and by how much the noise level has increased. These considerations provide a feasible and reasonable approach to identifying qualifying receivers.

The receivers which have been identified as eligible for consideration of additional noise mitigation are detailed in **Table 6-2**.

Table 6-2 Receivers considered for additional noise mitigation

NCA	Receiver type	Triggered floors (buildings)	Comments
NCA01	Residential	3 (2)	Triggers are limited to two residential buildings situated east of the M7 Motorway. Receivers are triggered due to road traffic noise increases as a result of the new M7 southbound off ramp to the M12.
	Other	0 (0)	
NCA02	Residential	3 (2)	Triggered receivers are situated to the east of the new M7 southbound on ramp from the M12. Receivers are triggered due to road traffic noise increases as a result of the project.
	Other	0 (0)	
NCA03	Residential	39 (28)	Triggered receivers are situated in the western portion of the NCA. Receivers are triggered due to an increase in road traffic noise levels as a result of the project.
	Other	0 (0)	
NCA04	Residential	139 (96)	NCA adjacent to the M12. Receivers are triggered due to an increase in road traffic noise levels as a result of the project.
	Other	7 (7)	
NCA05	Residential	0 (0)	Triggers are limited to the passive recreation area (Western Sydney Parklands).
	Other	4 (1)	
NCA06	Residential	27 (18)	Triggered receivers are situated in the north eastern portion of the NCA. Receivers are triggered due to an increase as a result of the project being in close vicinity.
	Other	0 (0)	
NCA07	Residential	25 (18)	Triggered receivers are generally located in three groups - around the

NCA	Receiver type	Triggered floors (buildings)	Comments
	Other	0 (0)	northern end of Clifton Avenue, around the Airport access road, and in the Twin Creeks development area. Receivers are triggered due to an increase in road traffic noise levels as a result of the M12.
NCA08	Residential	0 (0)	No sensitive receivers are located within the operational study area in this NCA.
	Other	0 (0)	
NCA09	Residential	14 (10)	Triggered receivers are situated across the NCA. Receivers are triggered due to road traffic noise increases as a result of the project.
	Other	0 (0)	
NCA10	Residential	1 (1)	Triggered receiver is situated adjacent to The Northern Rd. Receiver is triggered due to road traffic noise increases as a result of the project.
	Other	0 (0)	
ALL	**Residential**	**251 (175)**	
	Other	**11 (8)**	
	TOTAL	**262 (183)**	

In summary, the above table shows that a total of 262 receivers (183 individual buildings) are predicted to have exceedances of the operational road traffic noise criteria for the project and are therefore considered eligible for consideration of additional noise mitigation.

These exceedances fall into the categories shown in **Table 6-3**.

Table 6-3 Trigger receiver exceedance categories

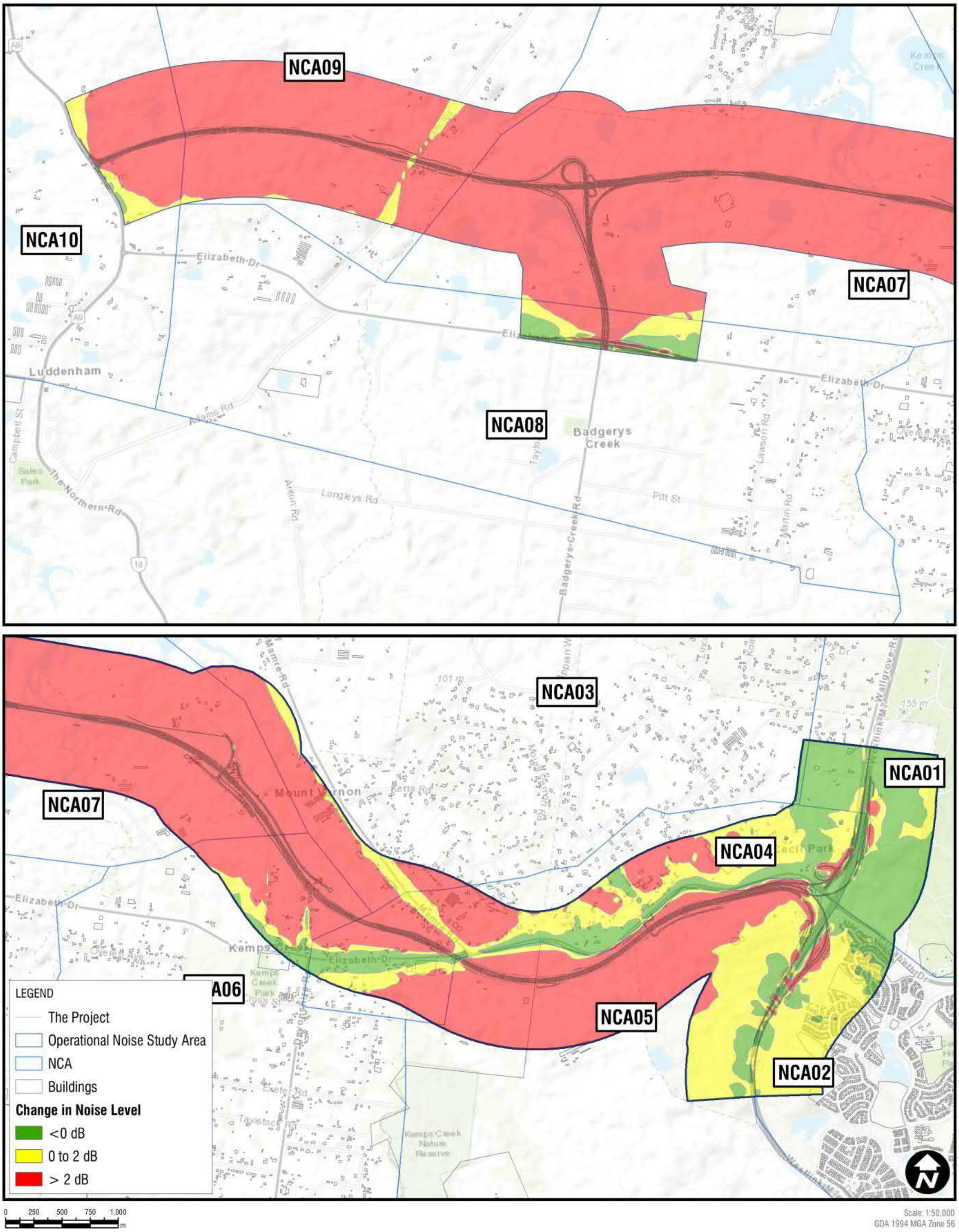
Trigger category[1]	Number of triggers[2]	
	Floors	Buildings
Trigger 1 (greater than 2 dB increase)	218	151
Trigger 2 (exceeds cumulative limit)	228	162
Trigger 3 (acute)	50	36
TOTAL	**262**	**183**

Note 1: The Relative Increase Criteria is included in the assessment of Trigger 1 and Trigger 2 as it adjusts the RNP base criteria for each receiver where existing road traffic noise levels are more than 12 dB below the RNP criteria.

Note 2: The total number of triggers may be lower than the sum of each type of trigger as individual receivers can trigger multiple types.

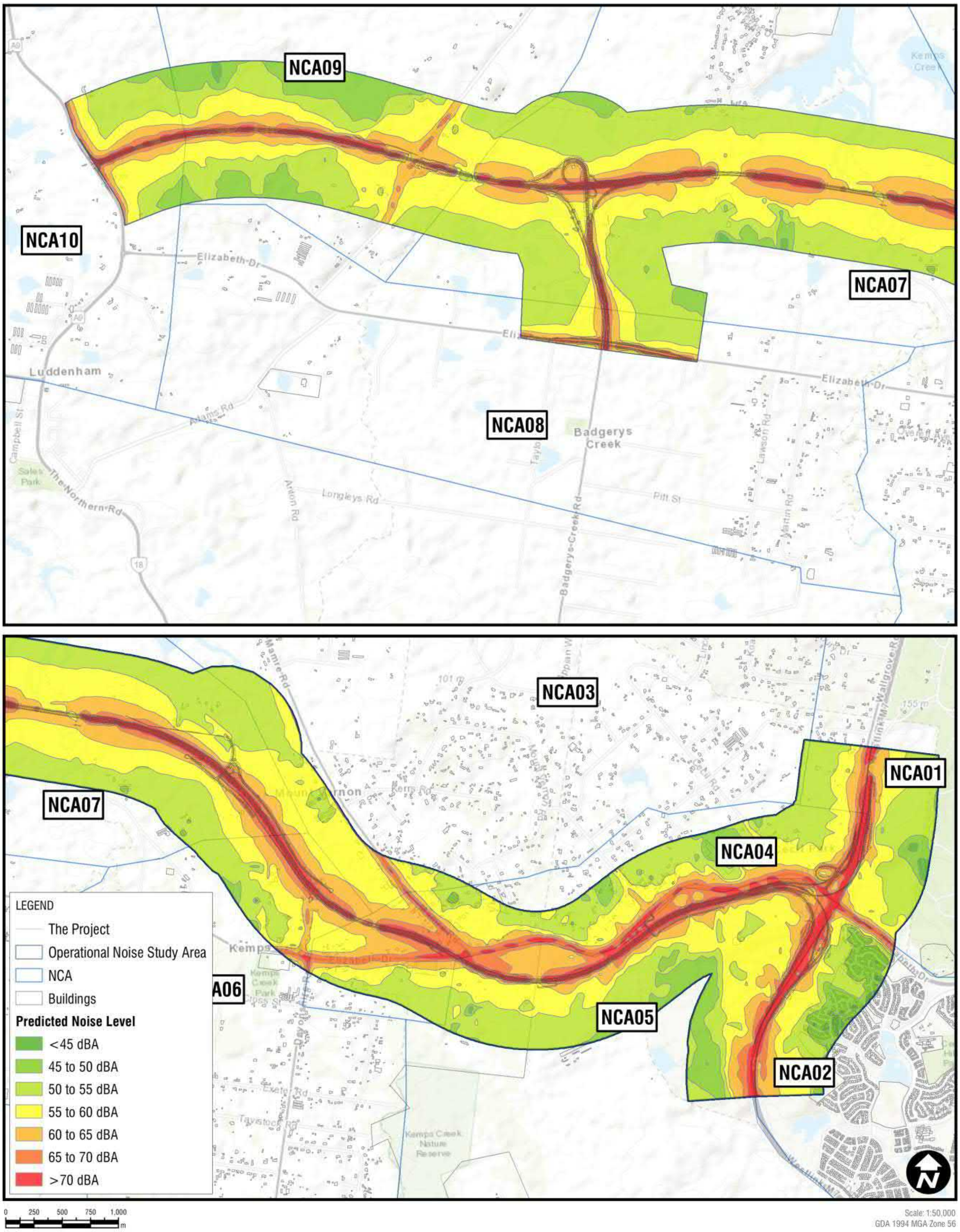
The receivers which have been identified as eligible for consideration of additional noise mitigation are shown in **Figure 6-3**.

Operational noise mitigation measures are discussed in **Section 7.2**.



Note 1: Predicted change in noise levels (Build minus No Build) are for 2036 night-time scenario at a height of 1.5 metres above local ground (ground floor level).

Figure 6-1 Predicted change in operational noise without mitigation – 2036 Night-time



Note 1: Predicted free field noise levels are for Build 2036 night-time scenario at a height of 1.5 metres above local ground (ground floor level).

Figure 6-2 Predicted Build operational noise levels without mitigation – L_{Aeq} (9hour) – 2036 Night-time

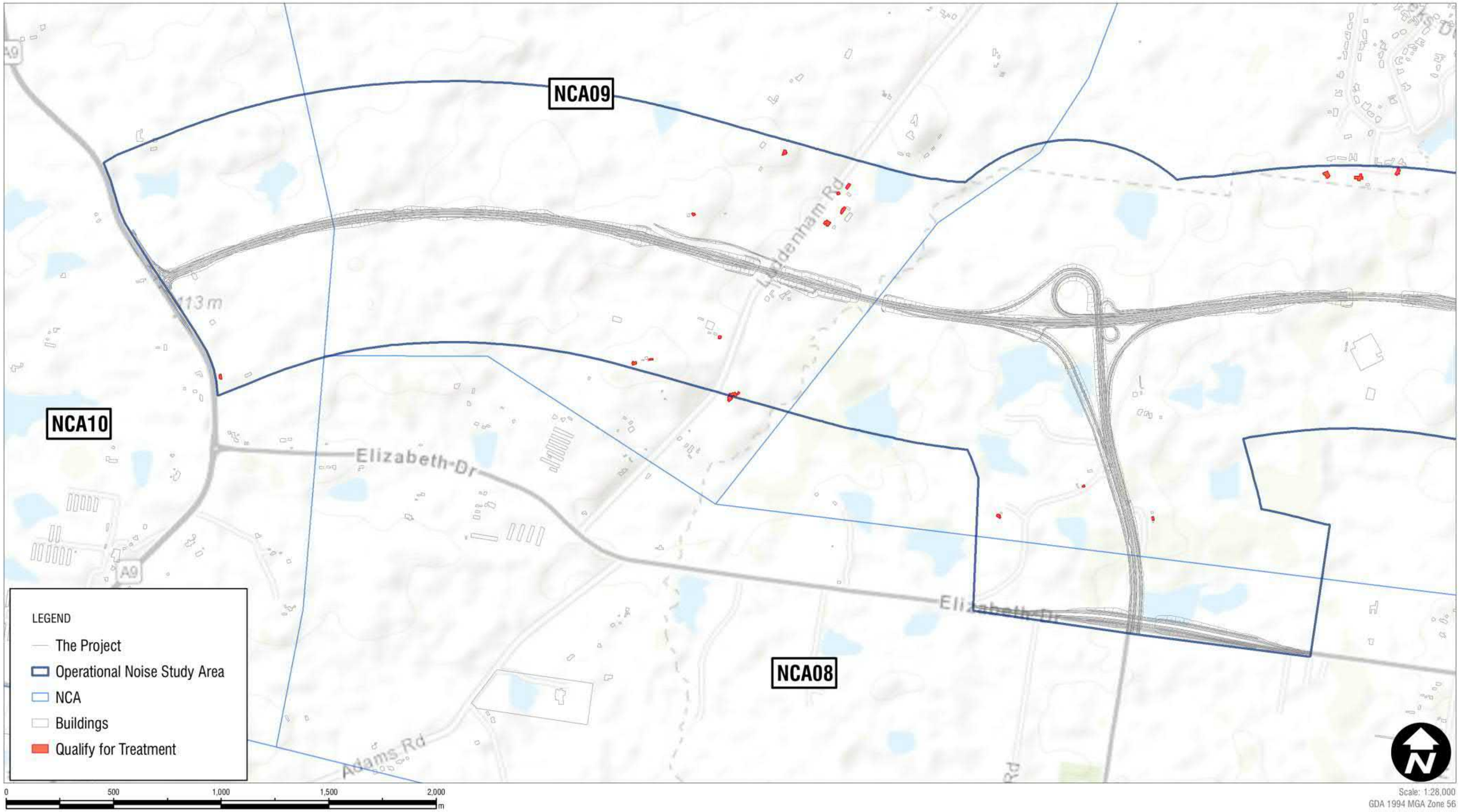


Figure 6-3 Receivers identified as eligible for consideration of additional mitigation

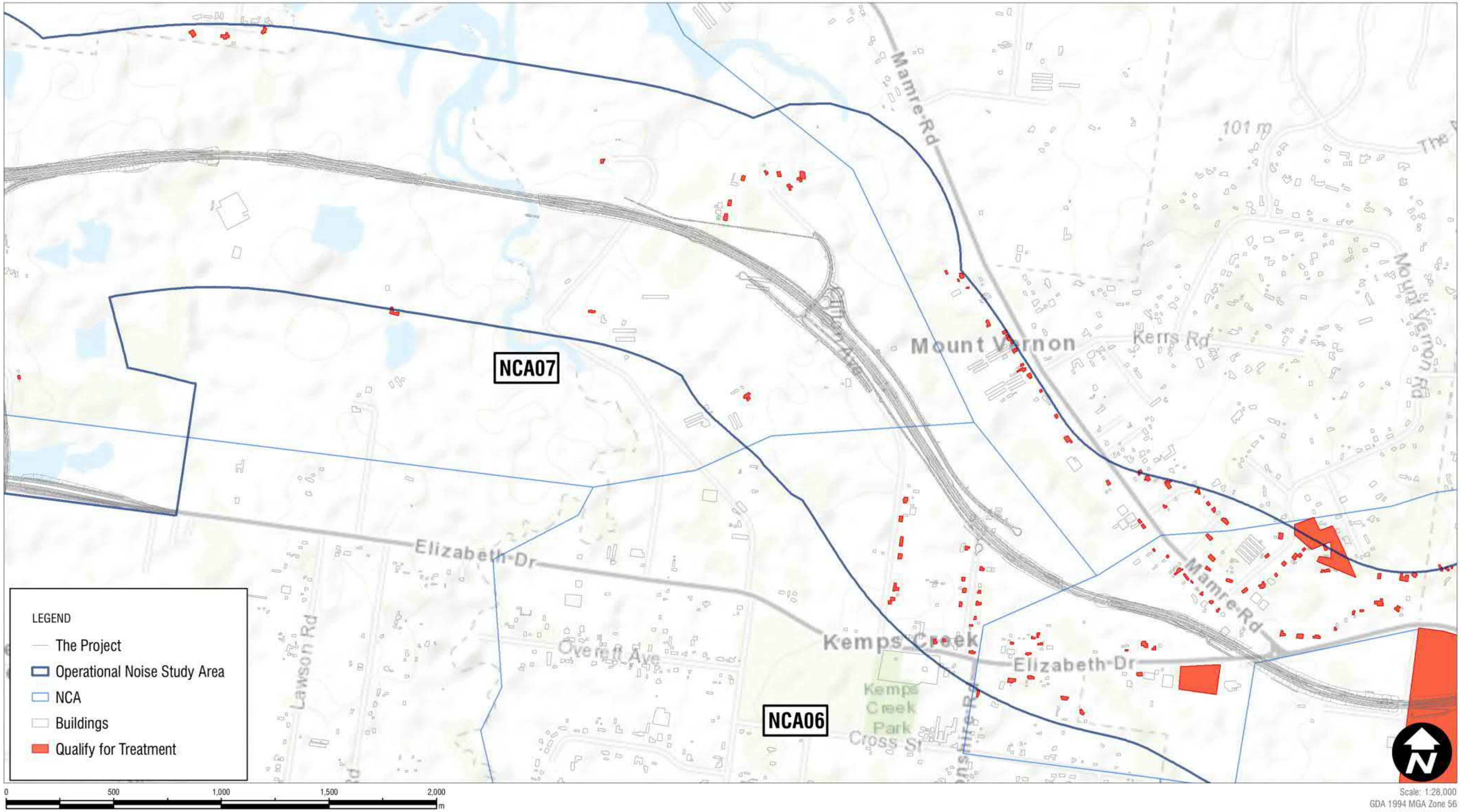


Figure 6-3 Receivers identified as eligible for consideration of additional mitigation

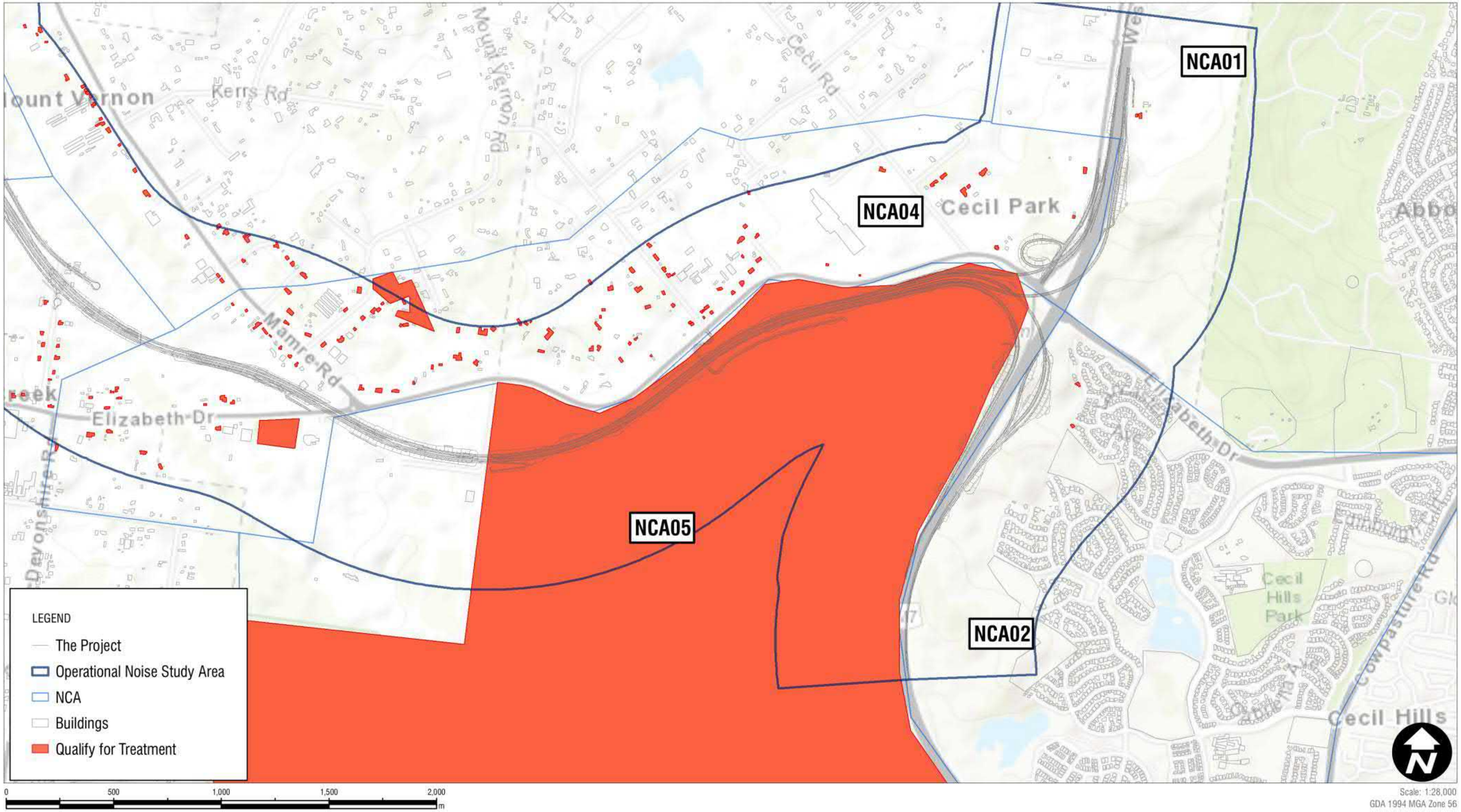


Figure 6-3 Receivers identified as eligible for consideration of additional mitigation

6.2 Sensitivity analysis

A sensitivity analysis of the operational road traffic noise assessment and noise modelling methodology has been carried out. This indicates how sensitive the mitigation requirements for this project are to a change in predicted noise levels. The likely change in the predicted number of receivers that are considered eligible for consideration of property treatment has been determined by applying a correction factor to the noise model predictions in 1 dBA increments. The sensitivity of the total number of at-property treatments to the modelling predictions is shown in **Figure 6-4**.

Figure 6-4 indicates that an additional 15 receivers would be eligible for consideration of property treatment if a +1 dBA correction were to be added to the noise model predictions. A reduction of 19 receivers would be apparent if 1 dBA was subtracted from the noise model predictions.

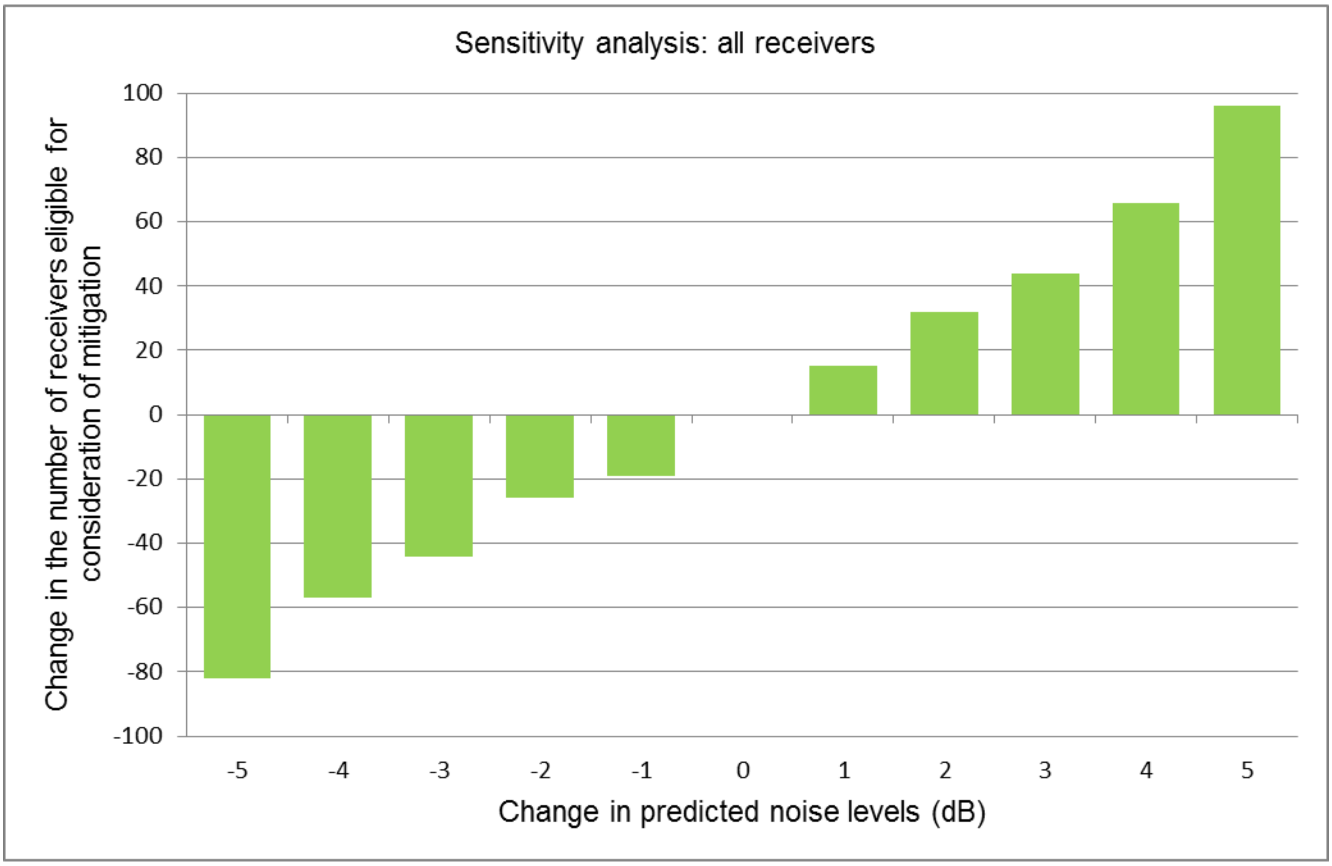


Figure 6-4 Noise model sensitivity analysis

6.3 Maximum noise level assessment

The representative results of the maximum noise level monitoring is provided in **Annexure D** which includes the maximum noise level range for the passby events in the existing situation during the period of monitoring (2017). A summary of the maximum noise level assessment is presented in **Table 6-4**.

Indicative increases in maximum noise levels have been predicted in the noise model using a source height corresponding to the approximate height of a truck exhaust.

Table 6-4 Measured maximum noise level events

Monitoring location	Monitoring dates	Total night-time events within the monitoring period	Measured maximum noise level (dBA L_{AFmax})	
			Range	Average
L03	23/06/17 – 03/07/17	729	69-86	75
L04	23/06/17 – 04/07/17	59	65-81	68
L05	23/06/17 – 04/07/17	63	65-76	68
L07	23/06/17 – 04/07/17	284	65-77	67
L08	23/06/17 – 04/07/17	149	66-78	70
L09	23/06/17 – 04/07/17	71	65-73	67
L10	24/06/17 – 02/07/17	12	65-70	66
L11	20/06/17 – 29/06/17	918	71-95	78
L12	20/06/17 – 01/07/17	14	65-68	66

It can be seen in **Table 6-4** that existing maximum noise level events typically range from 65 dBA to around 80 dBA L_{AFmax} at the monitoring locations within the operational study area. Higher levels were measured at L03 and L11 due to their proximity to the nearest road. Locations immediately adjacent to Elizabeth Drive, Mamre Road and The Northern Road were observed to have higher existing maximum noise levels as a result of the relatively short setback distances and no intervening screening.

Maximum noise level events towards the upper end of the range presented in **Table 6-4** are likely to be from heavy vehicle passbys, with light vehicles tending towards the lower end of the range.

Changes in the number of maximum noise events would be in line with general changes in traffic volumes forecast for the project.

A summary of the predicted change in road traffic maximum noise levels due to the project is presented in **Table 6-5**, overleaf.

Some of the receivers identified in the table may be eligible for consideration of additional noise mitigation based on the predicted L_{Aeq} road traffic noise levels (refer to **Section 6.1.2**). Operational noise management measures are discussed in **Section 7.2**. While receivers are not triggered for consideration of additional noise mitigation by maximum noise levels alone, selection of feasible and reasonable mitigation measures during the detailed design stage would take the change in maximum noise levels into consideration where a receiver qualifies for consideration of additional mitigation.

Table 6-5 Predicted change in maximum noise levels

NCA	Highest predicted change in maximum noise level (dB) – most-affected receiver	Discussion
NCA01	6	Maximum noise levels at two receivers in this NCA which are adjacent to the M7 southbound off ramp are predicted to increase by up to 6 dB due to the increased line of sight to the motorway and new ramp due to a change in the cutting in this area. Negligible change in maximum noise levels is predicted at other receivers in this NCA.
NCA02	16	Maximum noise levels are predicted to increase by up to 16 dB due to increased line of sight to the M7 southbound on ramp from the M12. Negligible change in maximum noise level is predicted at receivers closer to Elizabeth Drive or the M7 Motorway south of the new on ramp.

NCA	Highest predicted change in maximum noise level (dB) – most-affected receiver	Discussion
NCA03	2	Maximum noise levels at receivers in this NCA on the west of Mamre Road are predicted to increase by up to 2 dB. This is due to the project affecting the opposite side of the dwelling to existing maximum noise levels from Mamre Road. Negligible change in maximum noise levels is predicted at other receivers in this NCA.
NCA04	10	Maximum noise levels at receivers to the west of Mamre Road are predicted to increase by up to 10 dB. This is generally due to the project affecting facades of houses that are not affected by existing road traffic noise from Mamre Road or Elizabeth Drive. Maximum noise levels at receivers adjacent to the new M7 northbound on ramp from Wallgrove Road are predicted to increase by up to 8 dB due the change in alignment. Negligible change in maximum noise levels is predicted at other receivers in this NCA.
NCA05	-	No residential receivers are located within the operational study area in this NCA.
NCA06	5	Maximum noise levels are predicted to increase by up to 5 dB. This is generally due to the project affecting facades of houses that are not affected by existing road traffic noise from Elizabeth Drive. Negligible change in maximum noise levels is predicted at other receivers in this NCA.
NCA07	16	Maximum noise levels are predicted to increase by up to 16 dB. This is due to the project being located closer to existing dwellings when compared to the existing road network.
NCA08	-	No residential receivers are located within the operational study area in this NCA.
NCA09	9	Maximum noise levels are predicted to increase by up to 9 dB. This is generally due to the project affecting facades of houses that are not affected by existing road traffic from Luddenham Road.
NCA10	0	Negligible change in maximum noise levels is predicted at receivers in this NCA due to their proximity to The Northern Road.

7. Environmental management measures

7.1 Construction noise and vibration management measures

A Construction Noise and Vibration Management Sub-plan (CNVMP) which forms part of the Construction Environmental Management Plan (CEMP) will be prepared prior to the commencement of construction

This CNVMP will be prepared to address the requirements of the Minister's Conditions of Approval (CoA) and will include the specific environmental management measures outlined below.

7.1.1 Project specific construction noise and vibration measures

Project specific environmental management measures to avoid, minimise or manage noise and vibration impacts as a result of construction are detailed in **Table 7-1**. Items where further investigation is recommended at later stages of the project are also listed below.

Table 7-1 Environment management measures (construction noise and vibration)

Impact	Reference	Environmental management measure	Responsibility	Timing
General construction noise and vibration	NV01	A Construction noise and vibration management plan (CNVMP) will be prepared for the project to mitigate and manage noise and vibration impacts during construction. The CNVMP will be implemented for the duration of construction of the project and will: • Identify nearby sensitive receivers • Include a description of the construction activities equipment and working hours • Identify relevant noise and vibration performance criteria for the project and license and approval conditions. • Include modelling results showing construction noise impacts based on detailed design information • Outline standard and additional mitigation measures from the Construction Noise and Vibration Guideline (CNVG) (Roads and Maritime 2016) and information about when each will be applied • Outline requirements for the development and implementation of an Out of Hours Work Protocol • Outline requirements for noise and vibration monitoring that will be undertaken to monitor project performance associated with the noise and vibration criteria • Describe community consultation and complaints handling procedures in accordance with the Community Communication Strategy to be developed for the project • Outline measures to manage noise impacts associated with heavy vehicle movements both on and offsite • Outline measures to minimise cumulative construction impacts and the likelihood for 'construction fatigue' from concurrent and consecutive projects in the area	Contractor	Prior to construction and during construction

Impact	Reference	Environmental management measure	Responsibility	Timing
		• Outline requirements to minimise and manage construction fatigue, in consultation with the community.		
	NV02	Measures to minimise and manage construction fatigue are to be investigated through the planning of construction staging	Contractor	Detailed design, prior to construction and during construction
	NV03	Detailed noise assessments will be carried out for ancillary facilities with the potential to involve high noise generating activities (including batching plant operations). The assessments will consider the proposed site layouts and noise generating activities that will occur at the facilities and assess predicted noise levels against the relevant noise management criteria. The assessments will also consider the requirement for appropriate noise mitigation within ancillary facilities and adjacent to construction works, depending on the predicted noise levels. Any mitigation measures required will be implemented prior to the commencement of activities that generate noise and vibration impacts.	Contractor	Prior to construction
	NV04	Monitoring will be carried out at the commencement of high noise and vibration activities to confirm that actual noise and vibration levels are consistent with the noise and vibration impact predictions. Where mitigation measures have been included, measurements will be carried out to confirm the effectiveness. Where the monitoring identifies higher levels of noise and vibration compared to predicted levels, or where mitigation is shown to be ineffective against measured noise and vibration levels, additional mitigation measures will be identified and implemented to appropriately manage impacts where feasible and reasonable.	Contractor	Construction
	NV05	Where reasonable and feasible, receivers identified as requiring at-property treatment for operational noise mitigation will be identified and offered treatment before construction activities commence that are likely to impact them.	Roads and Maritime / Contractor	Prior to construction
Vibration impacts	NV06	Activities that generate vibration will be managed to avoid impacts on structures and sensitive receivers. This includes implementing appropriate safe working distances where practicable.	Contractor	Prior to construction and during construction
	NV07	The use of alternatives to vibration generating equipment will be considered where vibration impacts are predicted.	Contractor	During construction
	NV08	Where works are within the minimum working distances and considered likely to exceed the cosmetic damage objectives (see **Figure 7-**3), construction works will not proceed unless: • A different construction method with lower source vibration levels is used, where feasible	Contractor	During construction

Impact	Reference	Environmental management measure	Responsibility	Timing
		• Attended vibration measurements are carried out at the start of the works to determine the risk of exceeding the vibration objectives.		
	NV09	Building Condition Surveys will be offered in writing to property owners prior to construction where there is a potential for construction activities to cause structural or cosmetic damage. A comprehensive report will be prepared by a suitably qualified professional before the relevant works commence and will comprise a written and photographic condition.	Contractor	Prior to construction
Vibrations impacts on the Upper Canal System and Gas Pipelines	NV10	Surveys will be undertaken to confirm the existing condition of the Water NSW Upper Canal System and Jemena high pressure gas pipelines to determine appropriate vibration criteria. This will also include consideration of distances from the vibration intensive activity (piling, rock-breaking and vibratory rolling), as well as ground conditions. A vibration criterion of a peak particle velocity (PPV) will be determined in consultation with the relevant utility/service providers. In-situ monitoring will be undertaken to confirm the vibration levels and assess the impact of vibration. Where the monitoring identifies exceedances in the relevant criteria, or where impacts are identified, additional mitigation measures will be identified and implemented to appropriately manage impacts.	Roads and Maritime / Contractor	Detailed design and during construction
Vibration impacts on heritage structures	NV11	The following structures have the potential to be within the safe working distances for sensitive structures (Group 3 from DIN 4150): • Item 1: McGarvie Smith Farm • Item 2: Fleurs Radio Telescope Site • Item 4: Upper Canal System • Item 6: McMaster Field Station • Item 7: Fleurs Aerodrome A detailed survey will be completed to determine the potential for vibration impacts and to define appropriate criteria for each heritage item. Vibration monitoring will be undertaken when vibration intensive tasks are occurring within the minimum working distances to heritage structures. Where the monitoring identifies exceedances in the relevant criteria, or where impacts are identified, additional mitigation measures will be identified and implemented to appropriately manage impacts.	Contractor	Prior to construction and during construction
Construction traffic noise	NV12	Construction vehicle movements (both on and offsite) will be managed to minimise noise impacts. Where feasible, this will include (but not be limited to): • Establishment and use of internal haul routes, or existing major roads where this is not feasible • Restriction of heavy vehicle movements to standard construction hours • Locating traffic marshalling areas away from residences to minimise noise impacts from idling vehicles	Contractor	During construction

Impact	Reference	Environmental management measure	Responsibility	Timing
		• Instructing workers on the operation of heavy vehicles entering and exiting the site to minimise noise		
Cumulative construction impacts	NV13	The likelihood of cumulative construction noise impacts will be considered during detailed design when detailed construction schedules of other projects are available. Construction works will be scheduled with the aim of minimising concurrent works near sensitive receivers where possible in consultation with managers of other nearby projects that are likely to result in a cumulative impact. This will include the coordination of respite between the various construction projects where receivers are likely to experience concurrent construction impacts where feasible. Coordination between project teams would be undertaken throughout construction.	Contractor	Prior to construction and during construction

7.1.2 Standard construction noise and vibration management measures

The Roads and Maritime Construction Noise and Vibration Guideline (CNVG) contains standard measures for mitigating and managing construction impacts on infrastructure projects.

The measures are shown in **Table 7-2** and will be applied where feasible and reasonable to minimise the impacts from the works.

Table 7-2 Recommended standard environmental management measures

Action required	Applies to	Details
Management measures		
Implementation of any project specific mitigation measures required.	Airborne noise	Implementation of any project specific mitigation measures required (see **Section 7.1.1**).
Implement community consultation or notification measures.	Airborne noise Ground-borne noise & vibration	Notification detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night time period, any operational noise benefits from the works (where applicable) and contact telephone number. Notification will be a minimum of seven calendar days prior to the start of works. For projects other than maintenance works more advanced consultation or notification may be required. Please contact Roads and Maritime Communication and Stakeholder Engagement for guidance. Website (If required) Contact telephone number for community Email distribution list (if required) Community drop in session (if required by approval conditions).
Site inductions	Airborne noise Ground-borne noise & vibration	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: • All project specific and relevant standard noise and vibration mitigation measures

Action required	Applies to	Details
		• Relevant licence and approval conditions • Permissible hours of work • Any limitations on Peak noise generating activities • Location of nearest sensitive receivers • Construction employee parking areas • Designated loading/unloading areas and procedures • Site opening/closing times (including deliveries) • Environmental incident procedures.
Behavioural practices	Airborne noise	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.
Verification	Airborne noise Ground-borne noise & vibration	Where specified under Appendix C of the CNVG a noise verification program is to be carried out for the duration of the works in accordance with the Construction Noise and Vibration Management Plan and any approval and licence conditions.
Attended vibration measurements	Ground-borne vibration	Where required attended vibration measurements will be carried out at the commencement of vibration generating activities to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage.
Update Construction Environmental Management Plans	Airborne noise Ground-borne noise & vibration	The CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies.
Building condition surveys	Vibration	Undertake building dilapidation surveys on all buildings located within the buffer zone prior to commencement of activities with the potential to cause property damage
Source controls		
Construction hours and scheduling.	Airborne noise Ground-borne noise & vibration	Where feasible and reasonable, construction will be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels will be scheduled during less sensitive time periods.
Construction respite period during normal hours and out-of-hours work	Ground-borne noise & vibration Airborne noise	See Appendix C of the CNVG for more details on the following respite measures: • Respite Offers (RO) • Respite Period 1 (R1) • Respite Period 2 (R2) • Duration Respite (DR)
Equipment selection.	Airborne noise Ground-borne noise & vibration	Use quieter and less vibration emitting construction methods where feasible and reasonable. For example, when piling is required, bored piles rather than impact-driven piles will minimise noise and vibration impacts. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, will have significant noise and vibration benefits. Ensure plant including the silencer is well maintained.
Plant noise levels.	Airborne-noise	The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the criteria in Appendix H of the CNVG. Implement a noise monitoring audit program to ensure equipment remains within the more stringent of the

Action required	Applies to	Details
		manufacturer's specifications or Appendix H of the CNVG.
Rental plant and equipment.	Airborne-noise	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the criteria in Table 2 of the CNVG.
Use and siting of plant.	Airborne-noise	The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away from sensitive receivers. Only have necessary equipment on site.
Plan worksites and activities to minimise noise and vibration.	Airborne noise Ground-borne vibration	Locate compounds away from sensitive receivers and discourage access from local roads. Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site. Where additional activities or plant may only result in a marginal noise increase and speed up works, consider limiting duration of impact by concentrating noisy activities at one location and move to another as quickly as possible. Very noise activities will be scheduled for normal working hours. If the work cannot be carried out during the day, it will be completed before 11:00 pm. Where practicable, work will be scheduled to avoid major student examination periods when students are studying for examinations such as before or during Higher School Certificate and at the end of higher education semesters. If programmed night work is postponed the work will be re-programmed and the approaches in this guideline apply again.
Reduced equipment power	Airborne noise Ground-borne vibration	Use only the necessary size and power
Non-tonal and ambient sensitive reversing alarms	Airborne noise	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work. Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level.
Minimise disturbance arising from delivery of goods to construction sites.	Airborne noise	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible. Avoid or minimise these out of hours movements where possible.
Engine compression brakes	Construction vehicles	Limit the use of engine compression brakes at night and in residential areas.

Action required	Applies to	Details
		Ensure vehicles are fitted with a maintained Original Equipment Manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's 'In-service test procedure' and standard.
Path controls		
Shield stationary noise sources such as pumps, compressors, fans etc.	Airborne noise	Stationary noise sources will be enclosed or shielded where feasible and reasonable while ensuring that the occupational health and safety of workers is maintained. Appendix D of AS 2436:2010 lists materials suitable for shielding.
Shield sensitive receivers from noisy activities.	Airborne noise	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.
Receptor control		
Structural surveys and vibration monitoring	Ground-borne vibration	Pre-construction surveys of the structural integrity of vibration sensitive buildings may be warranted. At locations where there are high-risk receptors, vibration monitoring will be conducted during the activities causing vibration.
See Appendix C of the CNVG for additional measures	Airborne noise Ground-borne vibration	In some instances, additional mitigation measures may be required.

7.1.3 Additional construction noise and vibration management measures

Airborne noise

Where noise impacts still exist after the use of the standard environmental management measures shown above, the CNVG requires additional mitigation measures to be applied where feasible and reasonable. The additional environmental management measures are shown in **Table 7-3**.

Table 7-3 CNVG additional environmental management measures

Additional mitigation measure	Description
Notification (letterbox drop or equivalent)	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 will occur, impacts and mitigation measures. Notification should be a minimum of five working days prior to the start of works.
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.
Phone calls (PC)	Phone calls detailing relevant information made to 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.

Additional mitigation measure	Description
Individual briefings (IB)	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Project representatives will 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.
Respite offers (RO)	Respite offers will be considered where there are high noise and vibration generating activities near receivers. As a guide, work will be carried out in continuous blocks that do not exceed three hours each, with a minimum respite period of one hour between each block. The actual duration of each block of work and respite will 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’ will 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 will be separated by not less than one week and no more than six evenings per month.
Respite period 2 (R2)	Night time construction noise in ‘out of hours period 2’ will be limited to two consecutive nights except for where there is a duration respite. For night work these periods of work will be separated by not less than one week and six nights per month. Where possible, high noise generating works shall be completed before 11 pm.
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 will engage with the community where noise levels are expected to exceed the NML to demonstrate support for duration respite.
Alternative accommodation (AA)	Alternative accommodation 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 will 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 of construction noise and vibration levels will occur to ensure the actual impacts are consistent with the predicted levels. Appendix F of the CNVG contains further details about verification of Noise and Vibration levels as part of routine checks of noise levels or following reasonable complaints.

The process for determining how additional environmental management measures are applied to airborne noise impacts is summarised in **Table 7-4**.

Table 7-4 specifies the different categories of perception for construction noise impacts, ie noticeable, clearly audible, moderately intrusive, or highly intrusive. **Table 7-4** identifies specific additional mitigation measures applicable for each perception category during each construction period, ie standard hours, OOHW Period 1 and OOHW Period 2, along with measures for highly noise affected receivers which are applicable during all periods. **Table 7-4** also specifies the noise levels at which the additional mitigation measures for each perception category are applicable.

Table 7-4 CNVG additional environmental management measures – airborne noise

Predicted LAeq (15minute) airborne noise level at receiver			Additional mitigation measures type	Noise level at which additional mitigation measures are applicable
Perception	dBA above RBL	dBA above NML		
All hours				
75 dBA or greater (highly noise affected)			N, V, PC, RO	HNA
Standard hours: Mon – Fri (7 am – 6 pm), Sat (8 am – 1 pm), Sun/Public Holiday (Nil)				
Noticeable	5 to 10	0	-	NML
Clearly Audible	10 to 20	<10	-	NML
Moderately Intrusive	20 to 30	10 to 20	N, V	NML+10
Highly Intrusive	>30	>20	N, V	NML+20
OOHW Period 1: Mon – Fri (6 pm – 10 pm), Sat (7 am – 8 am & 1 pm – 10 pm), Sun/Public Holiday (8 am – 6 pm)				
Noticeable	5 to 10	<5	-	NML
Clearly Audible	10 to 20	5 to 15	N, R1, DR	NML+5
Moderately Intrusive	20 to 30	15 to 25	V, N, R1, DR	NML+15
Highly Intrusive	>30	>25	V, IB, N, R1, DR, PC, SN	NML+25
OOHW Period 2: Mon – Fri (10 pm – 7 am), Sat (10 pm – 8 am), Sun/Public Holiday (6 pm – 7 am)				
Noticeable	5 to 10	<5	N	NML
Clearly Audible	10 to 20	5 to 15	V, N, R2, DR	NML+5
Moderately Intrusive	20 to 30	15 to 25	V, IB, N, PC, SN, R2, DR	NML+15
Highly Intrusive	>30	>25	AA, V, IB, N, PC, SN, R2, DR	NML+25

Note 1: N = Notification, SN = Specific Notification, PC = Phone Calls, IB = Individual Briefings, R1 = Respite Period 1, R2 = Respite Period 2, DR = Duration Respite, AA = Alternative Accommodation, V = Verification.

Note 2: NML = Noise Management Level, HNA = Highly Noise Affected (ie 75 dBA or greater for residential receivers).

The requirement for additional environmental management measures for airborne noise impacts will be determined during later stages of the project when specific information regarding the construction works is known.

The potential impacts from construction works, particularly where evening or night-time works are required, will be assessed in Construction Noise and Vibration Impact Statements (CNVIS) before any works begin. These CNVIS's provide a detailed assessment of the potential impacts and define the site-specific environmental management measures to be used to control the impacts.

The indicative additional mitigation perception categories for the proposed construction works are shown in **Figure 7-1** for works during standard construction hours, and in **Figure 7-2** for out of hours works. These figures identify where the additional environmental management measures outlined in **Table 7-4** would be applicable.

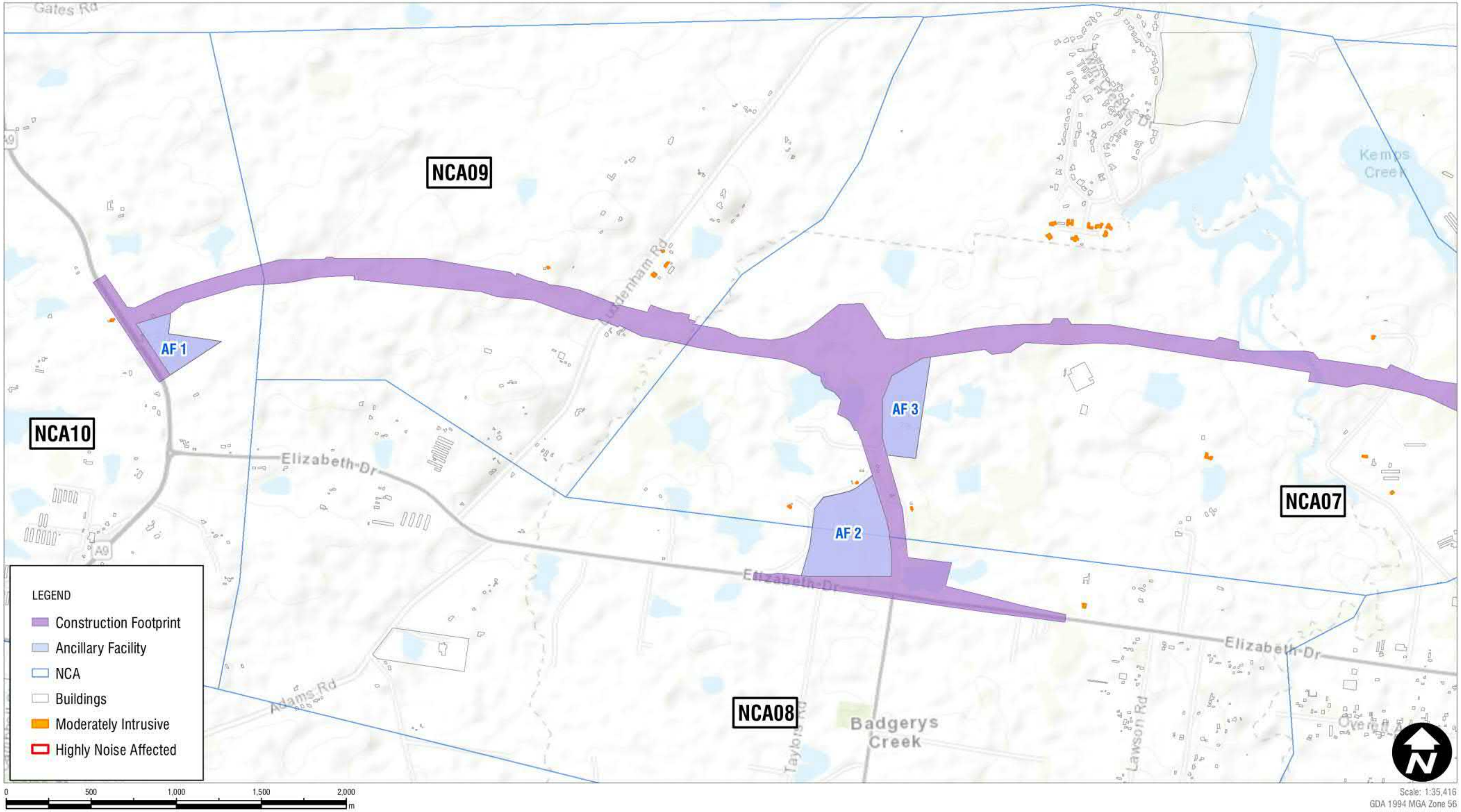


Figure 7-1 Indicative additional mitigation perception categories for all construction works – standard daytime period

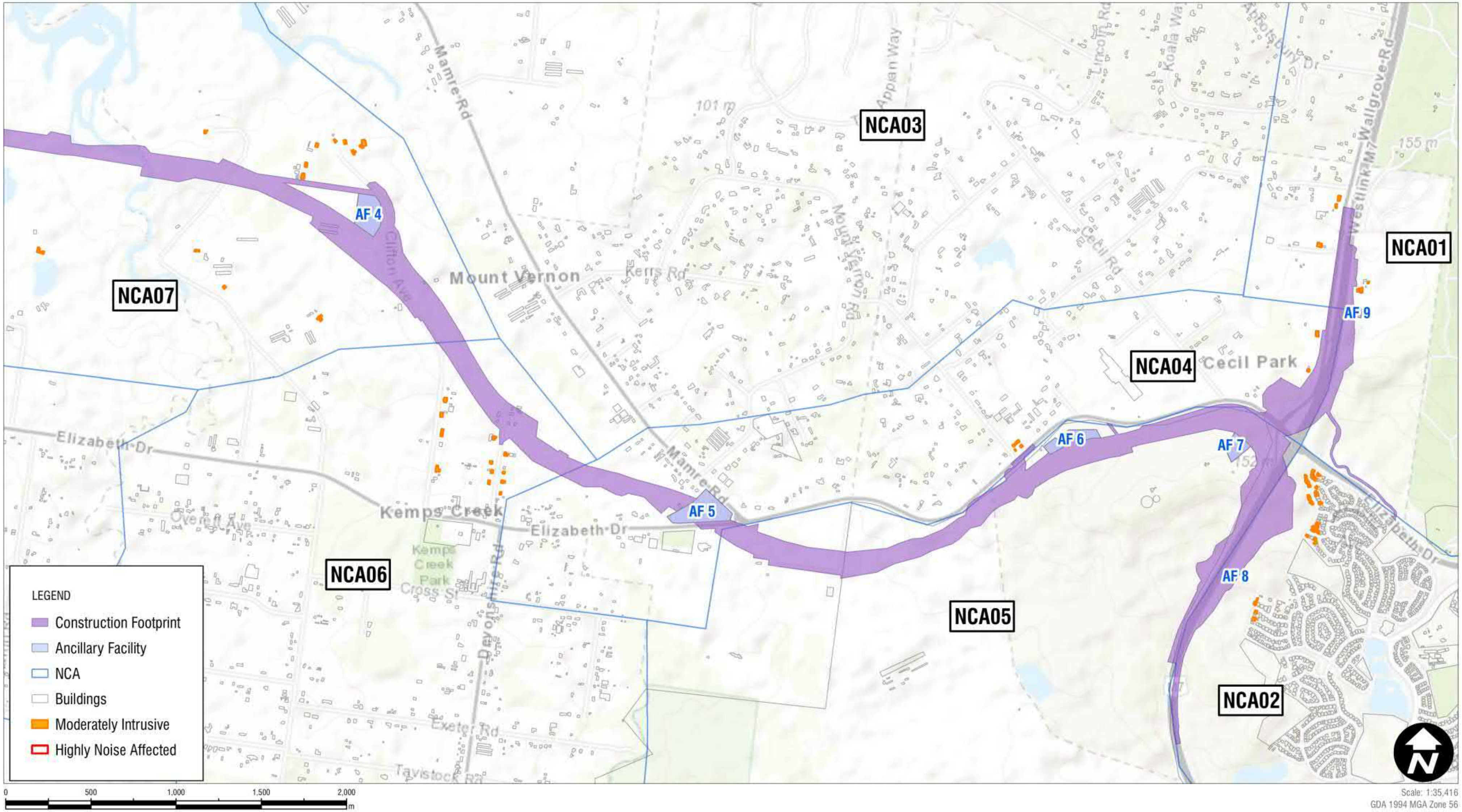


Figure 7-1 Indicative additional mitigation perception categories for all construction works – standard daytime period

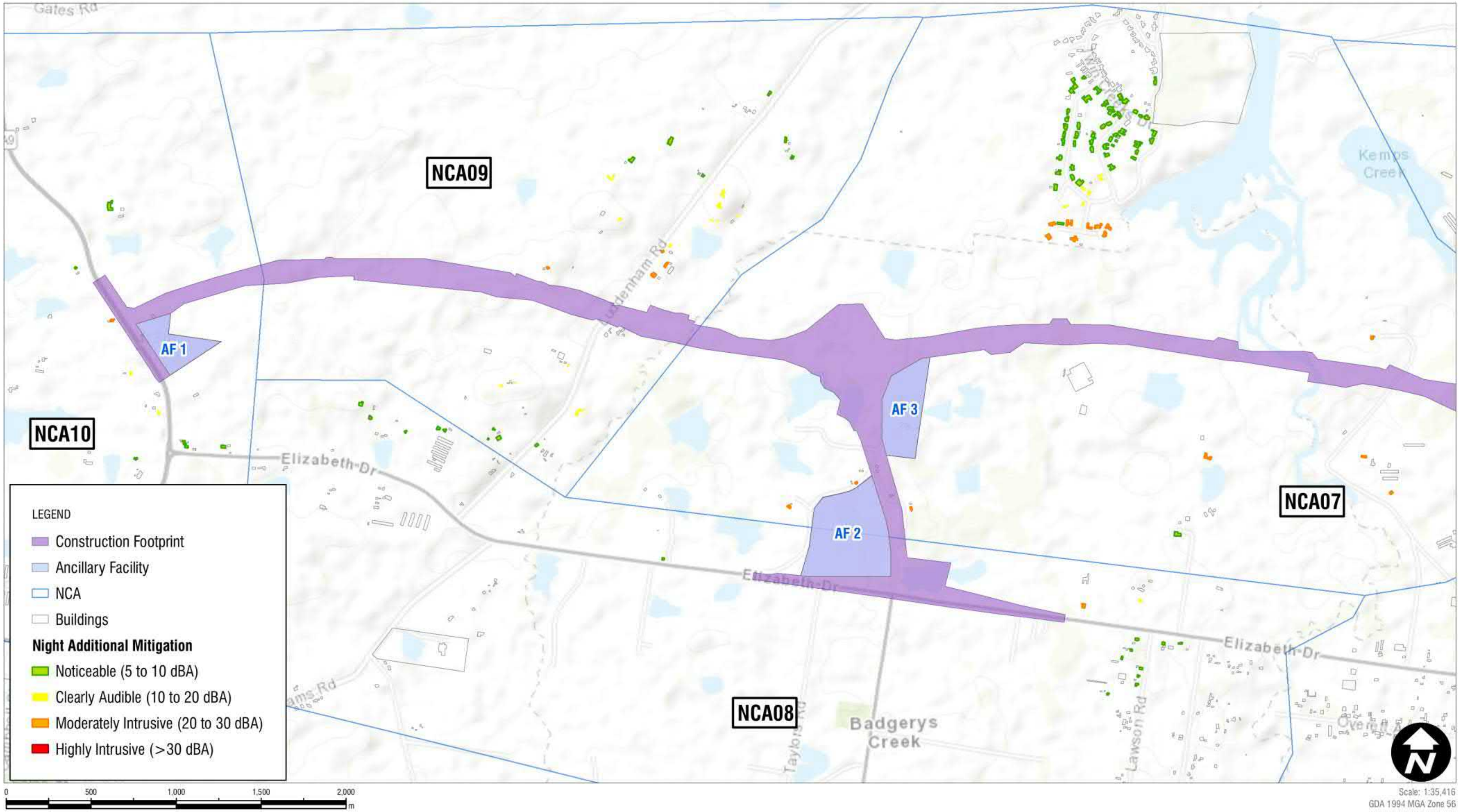


Figure 7-2 Indicative additional mitigation perception categories for all construction works – out of hours periods

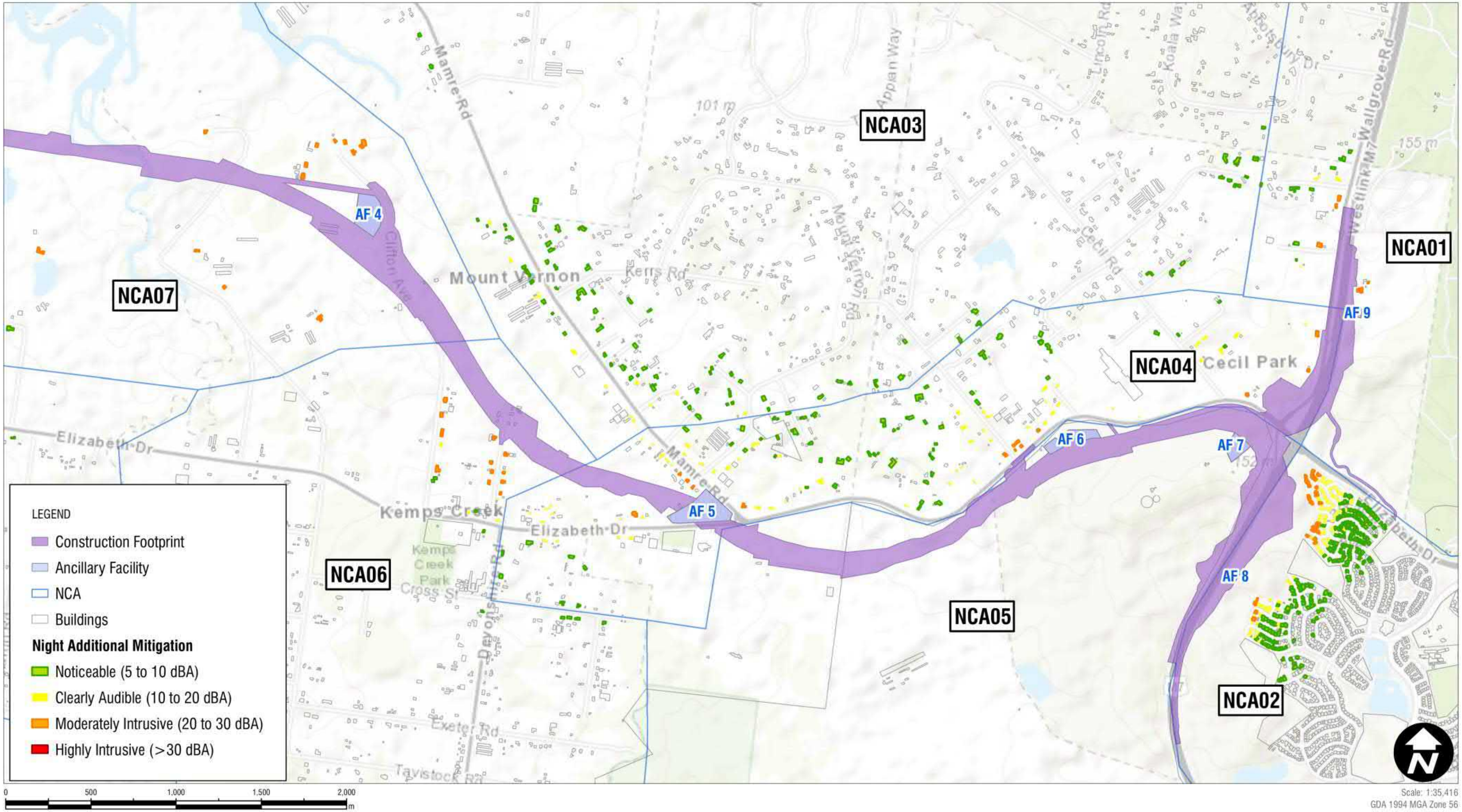


Figure 7-2 Indicative additional mitigation perception categories for all construction works – out of hours periods

Vibration

The process for determining how additional environmental management measures are applied to vibration impacts is summarised in **Table 7-5**.

Table 7-5 CNVG additional environmental management measures – vibration

Predicted vibration level at receiver	Additional mitigation measures	
	Type[1:]	Apply to[2]:
Standard hours: Mon - Fri (7 am – 6 pm), Sat (8 am – 1 pm), Sun/Pub Hol (Nil)		
Predicted vibration exceeds maximum human comfort levels	V, N, RP	All
OOHW period 1: Mon - Fri (6 pm – 10 pm), Sat (7 am – 8 am & 1 pm – 10 pm), Sun/Pub Hol (8 am – 6 pm)		
Predicted vibration exceeds maximum human comfort levels	V, IB, N, RO, PC, RP, SN	All
OOHW period 2: Mon - Fri (10 pm – 7 am), Sat (10 pm – 8 am), Sun/Pub Hol (6 pm – 7 am)		
Predicted vibration exceeds maximum human comfort levels	AA, V, IB, N, PC, RP, SN	All

Note 1: The following abbreviations are used: Alternative Accommodation (AA), Validation of predicted vibration levels (V), Individual Briefings (IB), Notification drops (N), Project specific respite offer (RO), Phone Calls (PC), Specific Notifications (SN).

Note 2: All affected receivers

Figure 7-3 below identifies receivers that fall within the vibration offset distances as per the recommended minimum working distances outlined in **Table 3-12**. The buildings that fall within these offset distances are likely to require additional environmental management measures as per the above table based on the time of day the vibration intensive activity is occurring.

In addition to this, **Figure 7-3** also identifies only the heritage structures which have the potential to be within the minimum working distances, and/or are close to the construction footprint (eg Fleurs Dish). Further investigation is required to confirm its sensitivity as noted in the non-Aboriginal heritage report.

7.2 Operational noise management measures

Road traffic noise levels from infrastructure projects should be reduced to meet the NCG noise criteria through the use of feasible and reasonable mitigation. An Operation Noise and Vibration Review (ONVR) will be prepared as part of the construction of the project. The ONVR will detail the specific mitigation measures for eligible receivers to be applied across the project.

EMMs applicable to the operational noise impacts are detailed in **Table 7-6**.

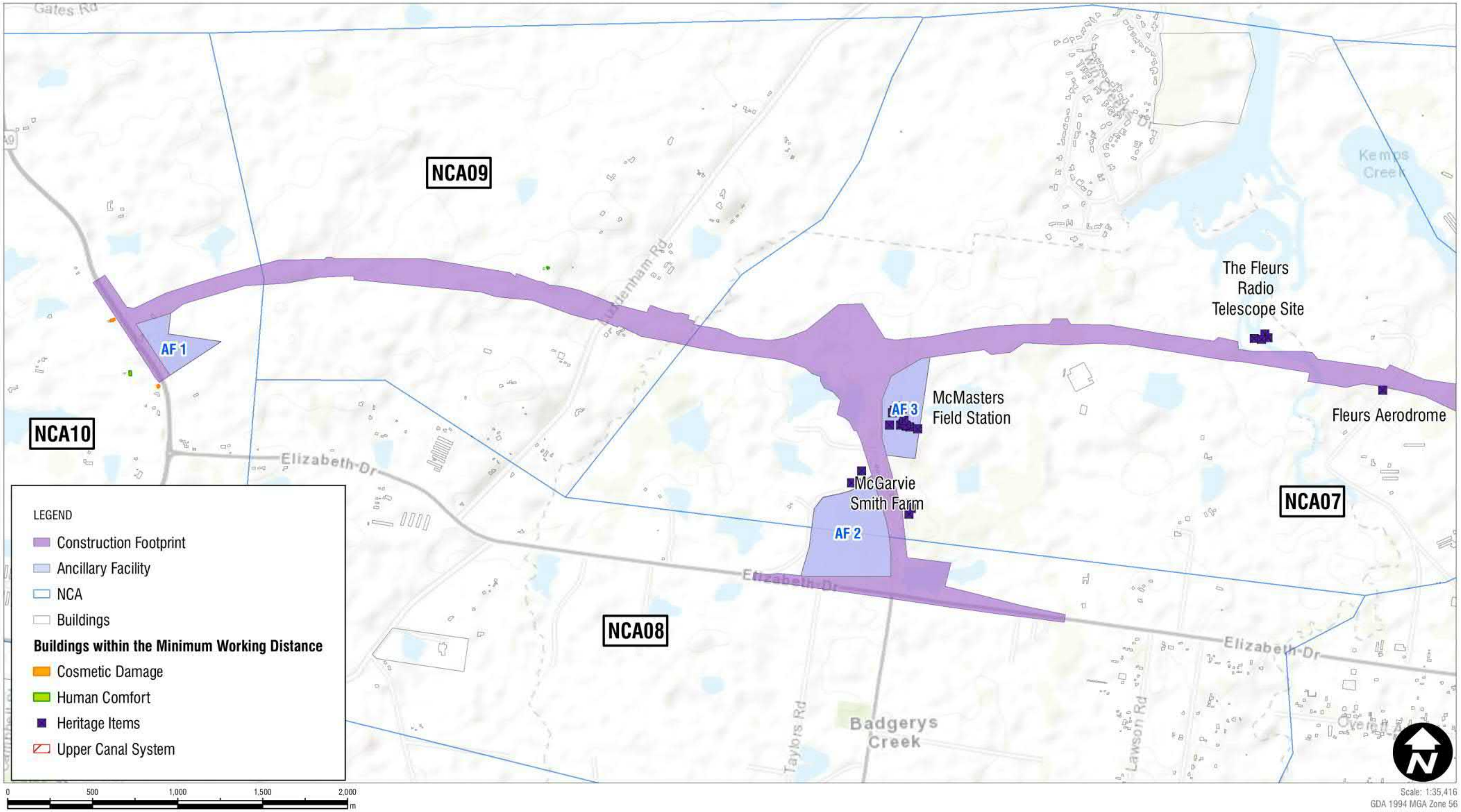


Figure 7-3 Indicative additional vibration environmental management measures categories for all activities

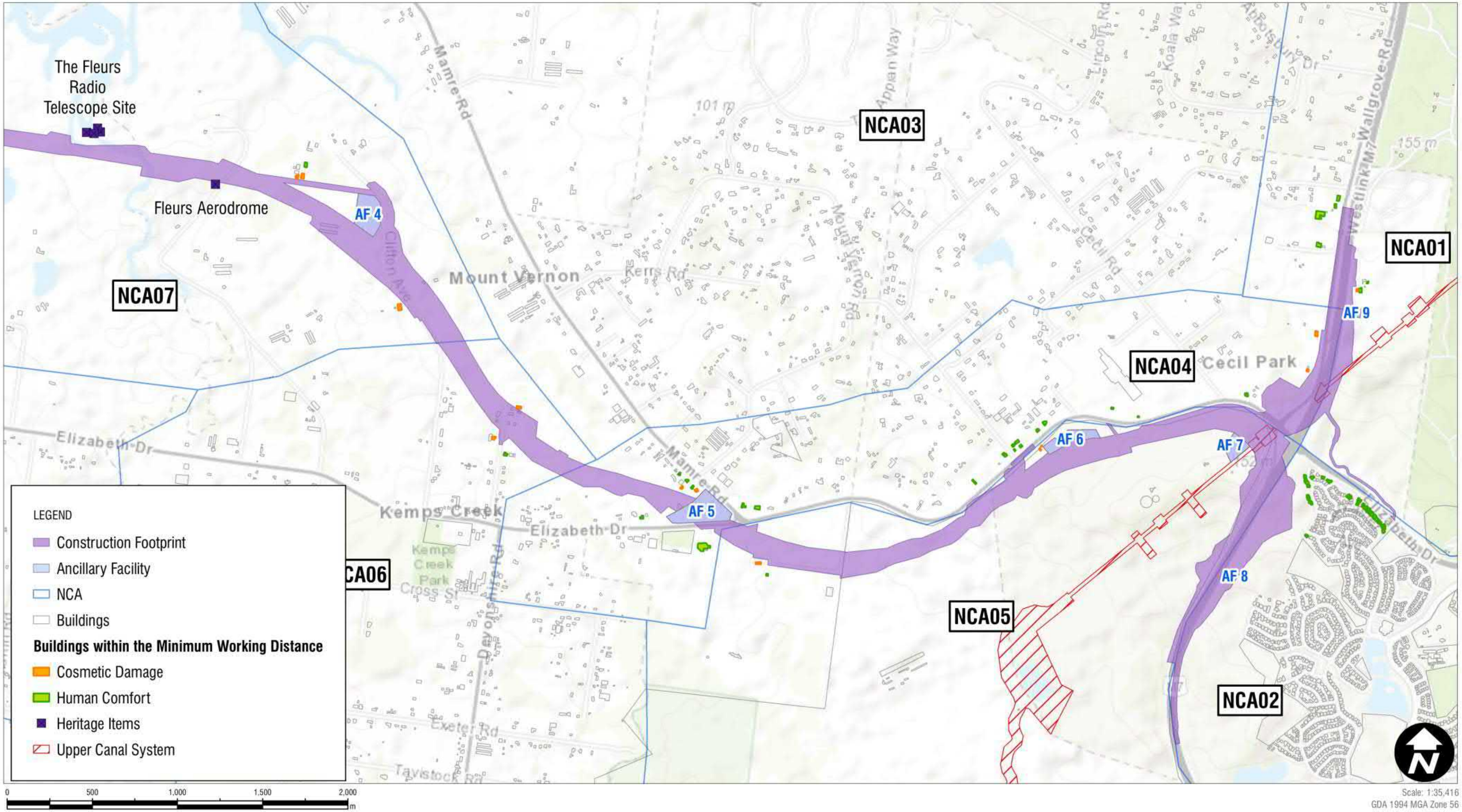


Figure 7-3 Indicative additional vibration environmental management measures categories for all activities

Table 7-6 Environment management measures (operational noise and vibration)

Impact	Reference	Environmental management measure	Responsibility	Timing
Operational noise and vibration	NV14	Operational noise and vibration mitigation measures will be identified in an Operational Noise and Vibration Review (ONVR). Requirements for mitigation measures, including quieter noise pavements, noise barriers, and at-property treatments, will be reviewed as part of the ONVR and as the detailed design progresses. The implementation of treatments will be undertaken in accordance with Roads and Maritime Noise Mitigation guidelines (2015).	Contractor / Roads and Maritime	Detailed design, during construction and prior to operation
	NV15	Within 12 months of commencement of operation of the project, actual operational noise performance will be compared to predicted operational noise performance. The need for additional mitigation or management measures to address identified operational performance issues and meet relevant operational noise criteria will be assessed and implemented where feasible and reasonable.	Roads and Maritime	During operation

For receivers that qualify for consideration of additional noise mitigation (refer to **Section 6.1.2**), potential noise mitigation measures include (in order of preference outlined in the RNP):

- Quieter road pavement surfaces
- Noise mounds
- Noise barriers
- At-property treatments.

The selection and specification of noise mitigation also requires the consideration of a range of safety, engineering, cost, social, and environmental factors. These factors are considered in determining whether a mitigation option is feasible and reasonable to implement.

The terms 'feasible' and 'reasonable', with respect to noise mitigation, are outlined in the NMG as follows.

Feasibility – Relates to engineering considerations (what can practically be built). These engineering considerations include:

- The inherent limitations of different techniques to reduce noise emissions from road traffic noise sources
- Safety issues such as restrictions on road vision
- Road corridor site constraints such as space limitations
- Floodway and stormwater flow obstruction
- Access requirements
- Maintenance requirements
- The suitability of building conditions for at receiver treatments.

Reasonable – Selecting reasonable measures from those that are feasible involves judging whether the overall noise benefits provide significant social, economic or environmental benefits. The factors to be considered are:

- The noise reduction provided and the overall number of people that benefit from the mitigation
- Existing and future noise levels, including changes in noise levels, and the extent of any exceedance of the noise criteria
- Potential for a mitigation measure to reduce noise during construction as well as from road traffic after the project is complete
- The cost of mitigation, including the cost of noise mitigation measures as a per centage of the total project cost and the ongoing maintenance and operational costs
- Community views and preferences (typically gathered during the community consultation process following the noise assessment)
- Visual impacts for the community surrounding the road project and for road users (identified in Appendix G of the EIS)
- The wider community benefits arising from noise mitigation of the road
- Relative weighting of treatments with respect to protection of outdoor areas or only internal living spaces.

The following assessment of operational mitigation measures forms a preliminary feasible and reasonable assessment to inform the detailed design stage of the project.

7.2.1 At-source mitigation – low noise pavements

The type of road surface can affect road traffic noise levels at receivers. Concrete pavements tend to be the noisiest with low noise pavements such as open graded asphalt (OGA) being the quietest.

In accordance with the hierarchy of mitigation (outlined in **Section 7.2**), at source controls are the first form of operational noise mitigation considered. Low noise pavements are therefore the first form of noise mitigation as they reduce source noise levels and provide protection to both outside areas and internal spaces at affected properties. Low noise pavements have no associated visual impact and are also likely to provide noise benefits to receivers at greater distances than noise barriers.

The choice of road pavement surfaces and textures must meet a number of criteria besides noise performance including structural integrity, skid resistance, water shedding, maintenance requirements and design life.

Low noise pavements should be considered where there is a group of four or more receivers that exceed the NCG criteria.

As noted in the operational road traffic noise assessment, the main carriageway is proposed to be constructed with a concrete surface (+3 dB surface correction), with dense graded asphalt (DGA) on the bridges and ramps (+0 dB surface correction).

To investigate the potential benefit that quieter road surfaces could provide to the project the following scenarios have been assessed:

- DGA on the main carriageway and bridges/ramps (with a +0 dB surface correction).
- Open graded asphalt (OGA) on the main carriageway (with a -2 dB surface correction) and DGA on the bridges/ramps.

A comparison of the number of receivers which are triggered in the two quieter pavement options with the original concrete surface (see **Table 6-2**) is shown in **Table 7-7**.

Table 7-7 Comparison of receivers considered for additional noise mitigation – low noise pavement

NCA	Receiver type	Triggered floors (buildings)		
		Concrete carriageway (+3 dB)	DGA carriageway (+0 dB)	OGA carriageway (-2 dB)
NCA01	Residential	3 (2)	3 (2)	3 (2)
	Other	0 (0)	0 (0)	0 (0)
NCA02	Residential	3 (2)	3 (2)	3 (2)
	Other	0 (0)	0 (0)	0 (0)
NCA03	Residential	39 (28)	39 (28)	39 (28)
	Other	0 (0)	0 (0)	0 (0)
NCA04	Residential	139 (96)	135 (95)	134 (94)
	Other	7 (7)	7 (7)	7 (7)
NCA05	Residential	0 (0)	0 (0)	0 (0)
	Other	4 (1)	4 (1)	4 (1)
NCA06	Residential	27 (18)	27 (18)	27 (18)
	Other	0 (0)	0 (0)	0 (0)
NCA07	Residential	25 (18)	24 (18)	20 (15)
	Other	0 (0)	0 (0)	0 (0)
NCA08	Residential	0 (0)	0 (0)	0 (0)
	Other	0 (0)	0 (0)	0 (0)
NCA09	Residential	14 (10)	14 (10)	14 (10)
	Other	0 (0)	0 (0)	0 (0)
NCA10	Residential	1 (1)	1 (1)	1 (1)
	Other	0 (0)	0 (0)	0 (0)
ALL	**Residential**	**251 (175)**	**246 (174)**	**241 (170)**
	Other	**11 (8)**	**11 (8)**	**11 (8)**
	TOTAL	**262 (183)**	**257 (182)**	**252 (178)**

In summary, the above shows that quieter pavements are predicted to reduce the number of triggered buildings by the following:

- DGA results in one less buildings (from 183 to 182)
- OGA results in five less buildings (from 183 to 178).

While the inclusion of quieter pavements only marginally reduces the number of triggered receivers, the use of quieter pavement types would provide a reduction in operational noise levels across the study area. Quieter pavements will be considered in conjunction with other mitigation options during detailed design, subject to feasible and reasonable considerations.

7.2.2 In-corridor mitigation – noise barriers

Noise barriers (in the form of walls or mounds) can provide noise reductions and also reduce both external and internal noise levels. Where space allows, raised earth mounds can be used as noise barriers and can be enhanced by placing a low wall on top. Noise walls are often more feasible than a mound as the footprint is much smaller. These methods are shown below in **Figure 7-4.**

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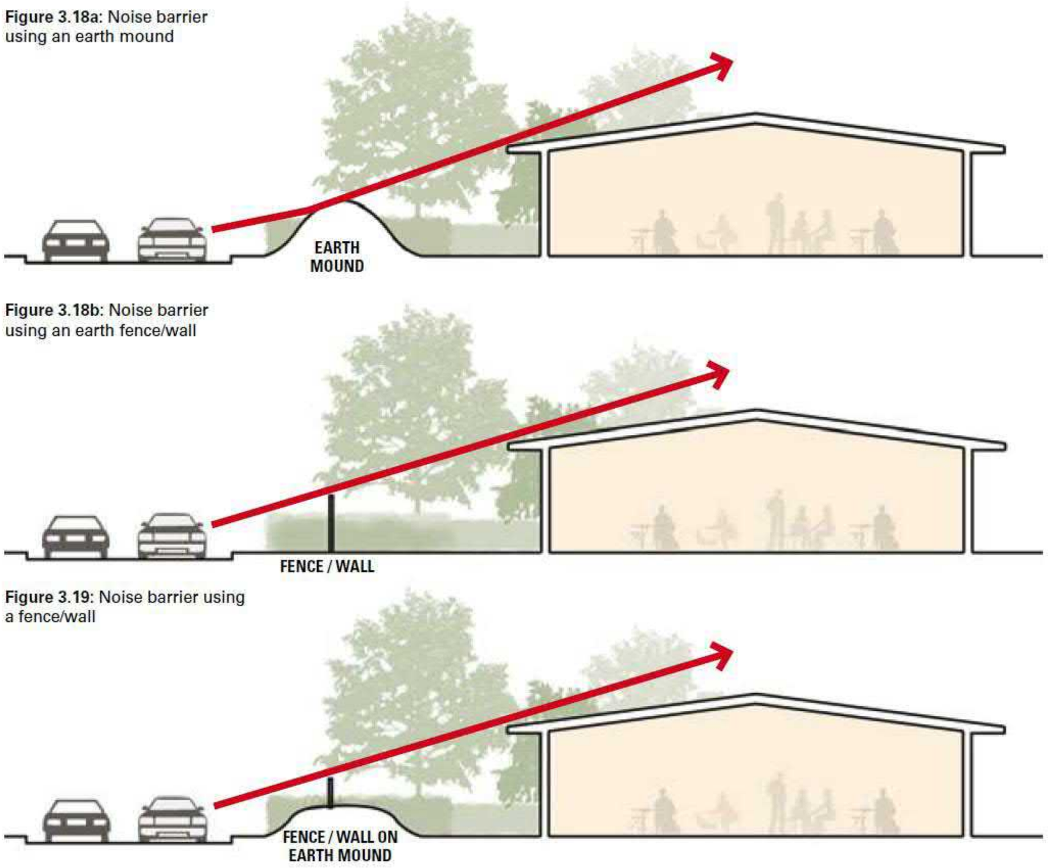

Note 1: Taken from DP&I *Development near Rail Corridors and Busy Roads – Interim Guideline*.

Figure 7-4 Noise barrier and mounds

Noise barriers can however introduce a number of potential negative aspects, including changes to property access, aesthetic impacts, overshadowing, drainage, increased opportunities for graffiti, restriction of line-of-sight and views, maintenance access and safety concerns.

Noise barriers are typically most efficient when receivers are located at ground floor level. As the height of a receiver increases, the noise reduction from barriers is seen to reduce due to line-of-sight over the top of the barrier. It is therefore not uncommon for upper floors of multi-storey buildings to see little to no reduction in noise levels from nearby barriers because of their elevation. As a result, the process of determining reasonable barrier heights would generally be less likely to result in noise barriers being considered a reasonable option if upper floors formed part of the analysis. With consideration of this, the assessment and optimisation of noise barriers for the project makes use of noise predictions at ground and first floor only, with architectural treatments to be investigated for higher floors.

Assessment of noise barriers

The process for considering the use of noise barriers is described in the Roads and Maritime NMG. Noise barriers are to be considered where there are four or more closely spaced triggered receivers. The locations of the exceeding receivers are shown for the Build scenario exceedance maps in **Annexure D**.

The NMG approach involves identifying the number of receivers that would be considered for at-property treatment versus barrier height (noting that a two storey residence is counted as two receivers) to establish an initial design height and then conducts a weighted analysis to find the optimal mix of barrier height and at-property treatments. This prioritises at-road mitigation and minimises the use of at-property treatments, as per the intent of the RNP.

The NMG approach first identifies the maximum barrier height (up to eight metres) where no receivers require at-property treatment. The initial design height is then established by identifying the height where, of the receivers that benefit from the noise barrier, two thirds no longer require at-property treatment. A value of two thirds is defined in the NMG as further increases in barrier height have been shown to have diminishing benefits.

The approach then applies weightings which consider the cost and the overall noise benefits the barrier provides to the wider community. A low point in the weighting curve between the initial design height and the maximum barrier height corresponds to the most reasonable barrier height in terms of community benefit and weighted cost. The practicability of the design and maximum barrier heights are then reviewed taking into account engineering considerations as well as social, economic and environmental benefits.

As a guide, noise barriers are considered to be a reasonable noise mitigation option where they are capable of providing a noise attenuation benefit (referred to as an insertion loss) of:

- 5 dBA at representative receivers for barrier heights of up to 5 metres.
- 10 dBA at representative receivers for barrier heights above 5 metres high and up to 8 metres high.

In certain situations the requirements for the barrier cannot always be met. In this case further feasible and reasonable considerations are undertaken.

At this early stage in the project, the barrier analysis has used the predicted noise levels from the concrete road surface scenario, as this results in the highest road traffic noise levels and represents a worst-case assessment.

The detailed noise barrier optimisation results are provided in **Annexure D**. A summary of the assessment is provided in **Table 7-8**. The barriers should be regarded as indicative and will be finalised during detailed design.

The noise barrier analysis identifies that, of the noise barriers assessed, NW.02, NW.03, NW.04 and NW.06 may potentially provide a reasonable noise benefit.

However other design factors such as cost to benefit ratio, constructability, and overhead power line clearance may result in these barriers being considered unfeasible and/or unreasonable. In addition, other considerations from a community perspective may include:

- Potential visual or urban design impacts
- Potential overshadowing impacts
- Potential community safety/crime prevention considerations such as isolated walkways
- Form of future development in the area
- Preferences of the local community as identified during community consultation.

The noise barriers identified as potentially reasonable should be considered in conjunction with other mitigation measures for their feasibility and reasonability during the detailed design stage of the project.

Table 7-8 Indicative noise barriers

Barrier ID	Indicative location	Noise barrier details						Comments
		Type	Length (m)	Height (m)[1]	Triggered receivers		Reasonable?	
					No barrier	With barrier		
NW.01	Along the northern boundary of the project west of Luddenham Road to the Western Sydney Airport interchange	New	2,019	8.0	9	9	No	• Barrier does not meet the insertion loss requirements at the initial design height of 8.0 m. • Barrier does not provide the required insertion loss to at least one triggered receiver at a height of 5.0 m. • Barrier has not been considered further.
NW.02	Along the northern boundary of the project, east of South Creek to Clifton Avenue overbridge	New	923	6.0	12	6	Potentially at 5.0 m height	• Barrier does not meet the insertion loss requirements at the initial design height of 6.0 m. • Barrier provides the required insertion loss to at least one triggered receiver at a height of 5.0 m. • 8 of the 12 triggered receivers would remain triggered with a wall height of 5.0 m. • Subject to feasible and reasonable considerations.
NW.03	Along the northern boundary of the project, from Clifton Avenue overbridge to Kemps Creek	New	1,978	7.0	31	26	Potentially at 5.0 m height	• Barrier does not meet the insertion loss requirements at the initial design height of 7.0 m. • Barrier provides the required insertion loss to at least one triggered receiver at a height of 5.0 m. • 31 of the 31 triggered receivers would remain triggered with a wall height of 5.0 m. • Subject to feasible and reasonable considerations.

Barrier ID	Indicative location	Noise barrier details						Comments
		Type	Length (m)	Height (m)[1]	Triggered receivers		Reasonable?	
					No barrier	With barrier		
NW.04	Along the northern boundary of the project, from Kemps Creek to Western Sydney Parklands	New	1,907	7.0	77	76	Potentially at 7.0 m height	• Barrier provides the required insertion loss to at least one triggered receiver at the initial design height of 7.0 m. • Subject to feasible and reasonable considerations.
NW.05	Along the northern boundary of the project, within the Western Sydney Parklands	New	809	4.0	47	44	No	• Barrier does not meet the insertion loss requirements at the initial design height of 4.0 m. • Barrier has not been considered further.
NW.06	Along the southern boundary of the project, between Clifton Avenue overbridge and Elizabeth Drive	New	2,552	5.5	45	44	Potentially at 5.0 m height	• Barrier does not meet the insertion loss requirements at the initial design height of 5.5 m. • Barrier provides the required insertion loss to at least one triggered receiver at a height of 5.0 m. • 45 of the 45 triggered receivers would remain triggered with a wall height of 5.0 m. • Subject to feasible and reasonable considerations.

Note 1: Recommended height is subject to further considerations during detailed design such as construction limitations, overshadowing, urban design and community preference.

7.2.3 At-property mitigation – architectural treatment

Where residual impacts remain after the use of at-source and in-corridor mitigation, the final approach is to use at-property mitigation. This typically involves using architectural treatments such as thicker glazing and doors or upgraded facade constructions to achieve appropriate internal noise levels.

At-property mitigation can potentially be used in place of at-source and in-corridor mitigation, such as where receivers are not grouped together or based on community preference. These treatments are generally limited to architectural treatment of building elements and the installation of acoustic screen walls (generally located within the property boundary) close to the receiver where they also protect outdoor living spaces.

Architectural treatments are more effective when they are applied to masonry buildings than lightly clad timber frames structures, and caution should be taken before providing treatments to buildings in a poor state as they may not be effective.

Selection of feasible and reasonable at-property mitigation will be made in accordance with the Roads and Maritime At-Receiver Noise Treatment Guideline (2017).

The architectural treatments provided by Roads and Maritime are typically limited to:

- Fresh air ventilation systems that meet the Building Code of Australia requirements with the windows and doors shut
- Upgraded windows and glazing and solid core doors on the exposed facades of the substantial structures only (eg masonry or insulated weather board cladding with sealed underfloor)
- Upgrading window or door seals and appropriately treating sub-floor ventilation
- The sealing of wall vents
- The sealing of the underfloor below the bearers and appropriately treating sub-floors ventilation
- Roof insulation
- The sealing of eaves.

Alternative at-property mitigation can include:

- The installation of acoustic screen walls that break line-of-sight between the affected facade window and the road where they are feasible and reasonable and are preferred by the owner.

The operational noise mitigation strategy selected will be determined as the project progresses and may use a combination of the approaches discussed in this report (ie low noise pavements, noise barriers and at-property architectural treatment).

Identification of residual noise impacts and receivers eligible for consideration of at-receiver noise treatments will be carried out during the detailed design stage after consideration of any at-source and in-corridor mitigation measures.

Selection of feasible and reasonable at-property mitigation will be made in accordance with the Roads and Maritime At-Receiver Noise Treatment Guideline (2017).

8. Conclusion

Summary of the key findings - construction noise and vibration

- The worst-case construction noise impacts at residential receivers are limited to catchments where receivers are close to the construction footprint. This includes east of the M7 Motorway and north of Elizabeth Drive in NCA01, north of Elizabeth Drive near Salisbury Ave in NCA06 and near Clifton Avenue in NCA07. Receivers in these catchments are however generally sparsely distributed, meaning the number of receivers with the highest impacts are relatively low.
- While impacts across the project as a whole are relatively low, 'high' impacts are likely at the nearest receivers to the project when noise intensive equipment such as rock-breakers or concrete saws are in use. Noise intensive equipment would however generally only be required for relatively short periods and noise levels and impacts during typical works generally result in either compliant noise levels or 'minor' impacts.
- During the night-time period, 'high' impacts are predicted at residential receivers in close proximity to the construction footprint, primarily around Clifton Avenue and Salisbury Avenue in NCA06 and NCA07. 'Moderate' impacts are predicted at receivers east of the M7 Motorway in NCA02, along Elizabeth Drive in NCA04 and NCA06, and receivers around Luddenham Road in NCA09. Compliant noise levels or 'minor' impacts are predicted for the rest of the study area.
- Seven receivers located in NCA01, NCA04, NCA06 and NCA07 are predicted to be Highly Noise Affected during the noisiest works scenarios nearby and when rock-breakers and concrete saws are in use.
- The construction noise impacts at other sensitive receivers are generally predicted to be minor, with moderate impacts predicted at the closest school (Irfan College) located in NCA04 when noise intensive equipment is in use.
- 'Minor' worst-case impacts are predicted at the nearest commercial receivers when noise intensive equipment is in use.
- The distance between the construction works and the nearest sensitive receivers is generally sufficient for most buildings to be unlikely to suffer cosmetic damage from construction vibration. Approximately 19 buildings are identified as being within the minimum working distance for cosmetic damage (ie these structures have the potential to be impacted by vibration during construction).
- A number of heritage items are identified as potentially being within the minimum working distances for sensitive structures.
- The Upper Canal System tunnel (listed on the State Heritage Register) and gas supply pipelines are identified as being within the construction footprint and potentially sensitive to vibration impacts. A detailed assessment in consultation with the relevant asset owners will be required during detailed design when more information is known.

Summary of the key findings- operational road traffic noise

- The change in road traffic noise levels due to the project is generally predicted to be less than 2 dBA in areas adjacent to existing major roads such as the M7 Motorway, Elizabeth Drive and The Northern Road.
- In other areas road traffic noise levels are predicted to increase by over 5 dBA at the receivers nearest to the project. This is generally due to the project affecting facades of these houses that are not currently affected by existing road traffic noise. Mitigation measures would be required to be considered to mitigate operational road traffic noise impacts.
- The change in maximum noise levels is predicted to be negligible at residential receivers closest to existing major roads such as the M7 Motorway, Elizabeth Drive and The Northern Road.

- An increase in maximum noise levels of over 10 dB is predicted at some residential receivers in NCA02 adjacent to the new M7 southbound on ramp from the M12. These properties are currently not directly exposed to existing road traffic noise.
- In NCA07 where receivers are currently not affected by existing road traffic noise, maximum noise levels are predicted to increase by over 10 dB due to the project.
- Maximum noise levels in other NCAs are predicted to increase by up to 10 dB at receivers closest to the project where the most-affected facades are not affected by existing road traffic noise.
- Quieter noise pavements are predicted to provide a minor benefit to triggered receivers and should be considered in conjunction with other mitigation options during detailed design, subject to feasible and reasonable considerations.
- Where noise barriers have been considered, the assessment has found that four barrier locations would potentially be reasonable based on the predicted noise benefit.
- Other design factors such as cost to benefit ratio, constructability, and overhead power line clearance may result in these barriers being considered unfeasible and/or unreasonable. The noise barriers identified as potentially reasonable should be considered in conjunction with other mitigation measures for their feasibility and reasonability during the detailed design stage of the project.
- A preferred noise mitigation option (low noise pavement, noise barriers, architectural treatments, or a combination of these) will be determined during detailed design taking into account whole-of-life engineering considerations and the overall social, economic and environmental benefits. The preference will be given to noise mitigation measures that reduce outdoor noise levels and the number of at-property treatments.

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Annexure A Acoustic terminology

1 Sound Level or Noise Level

The terms ‘sound’ and ‘noise’ are almost interchangeable, except that in common usage ‘noise’ is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or L_P are commonly used to represent Sound Pressure Level. The symbol L_A represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2 x 10^{-5} Pa.

2 ‘A’ Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an ‘A-weighting’ filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People’s hearing is most sensitive to sounds at mid frequencies (500 Hz to 4,000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels.

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as ‘linear’, and the units are expressed as dB(lin) or dB.

3 Sound Power Level

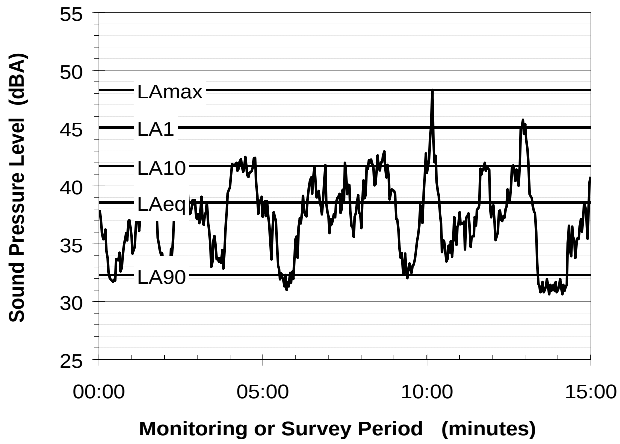
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or L_W, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels L_{AN}, where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

L_{A1} The noise level exceeded for 1% of the 15 minute interval.

L_{A10} The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

L_{A90} The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

L_{Aeq} The A-weighted equivalent noise level (basically, the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the ‘repeatable minimum’ L_{A90} noise level over the daytime and night-time measurement periods, as required by the EPA. In addition, the method produces mean or ‘average’ levels representative of the other descriptors (L_{Aeq}, L_{A10}, etc).

5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than ‘broad band’ noise.

6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7 Frequency Analysis

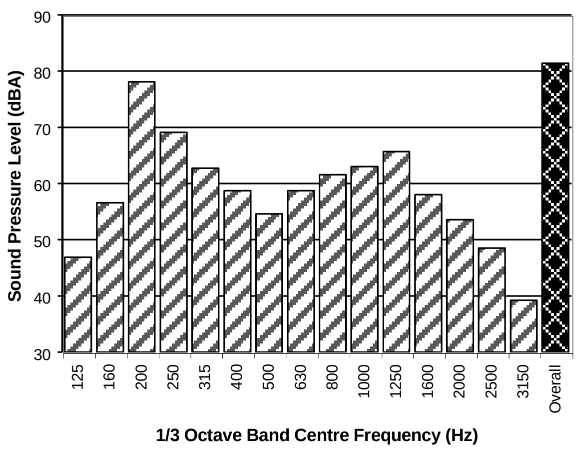
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of 'peak' velocity or 'rms' velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/V_o), where V_o is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used by some organisations.

9 Human Perception of Vibration

People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

10 Over-Pressure

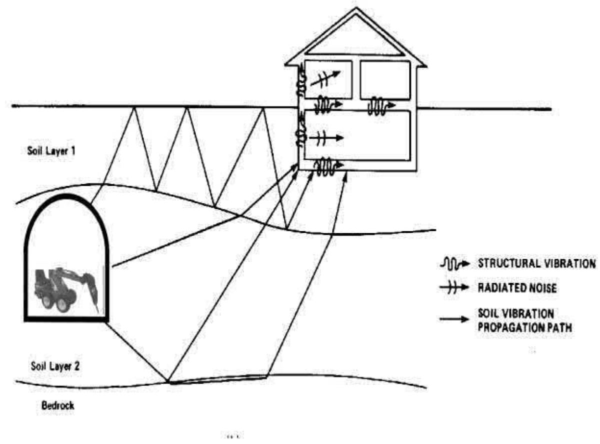
The term 'over-pressure' is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

11 Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

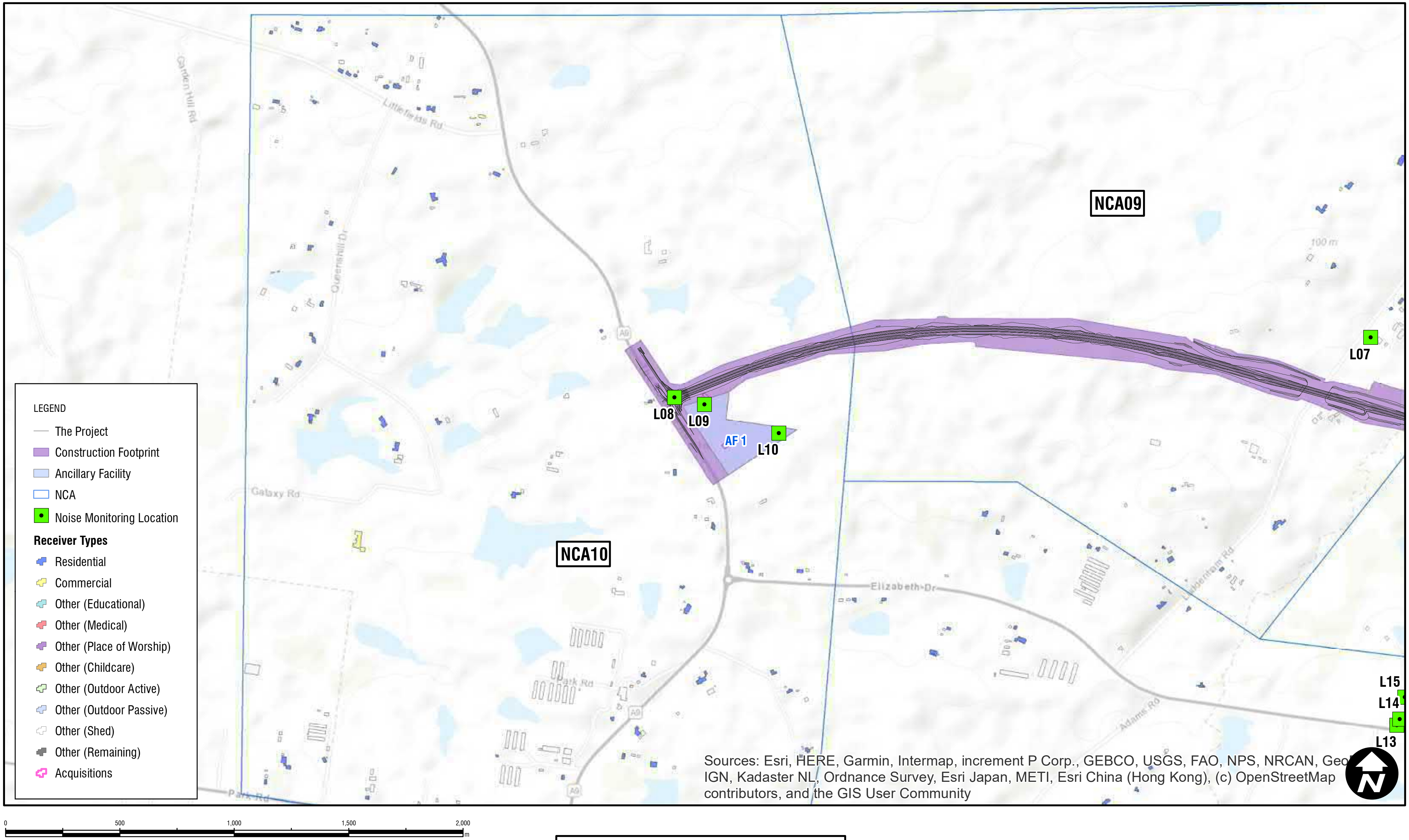
The following figure presents an example of the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



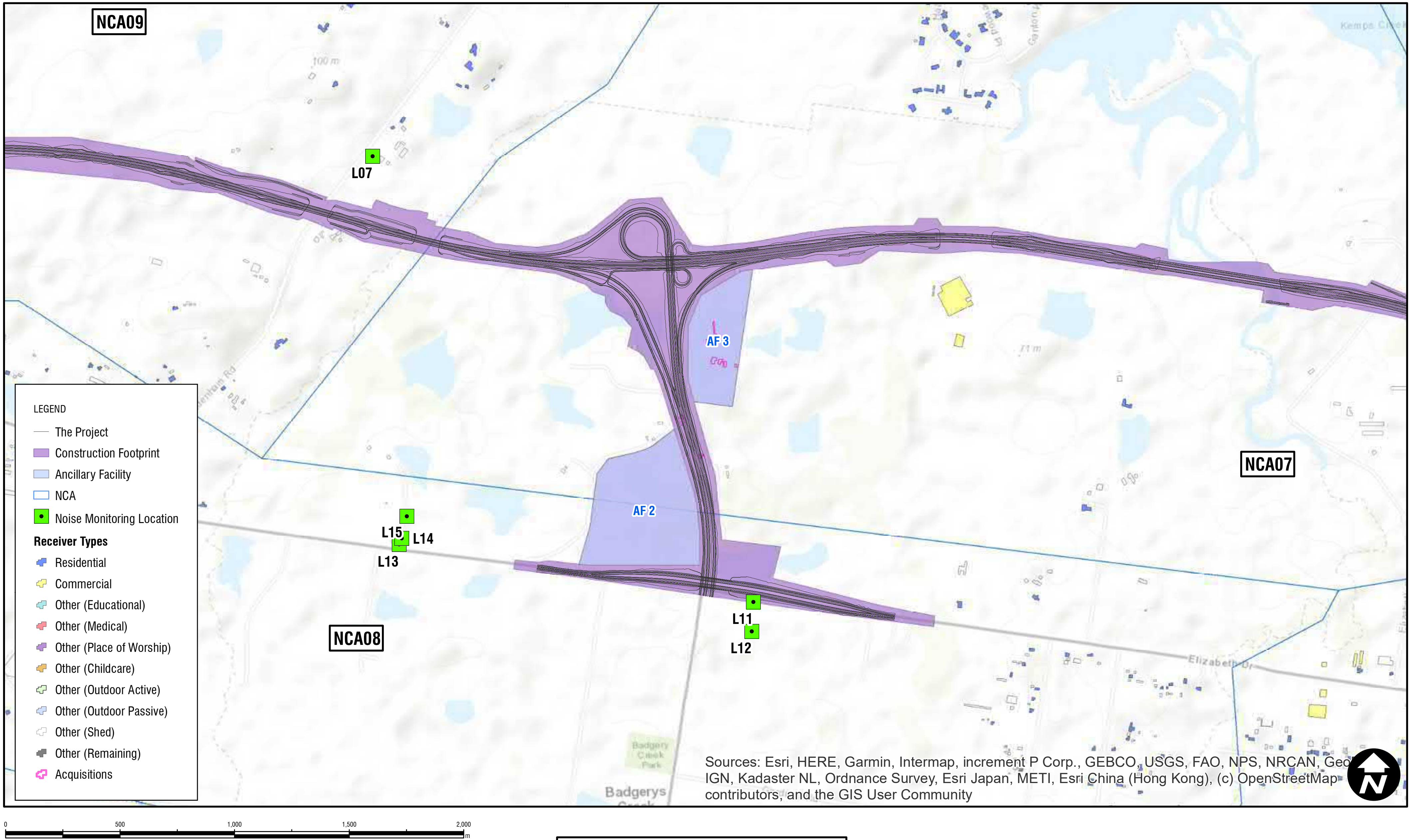
The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise

Annexure B Existing environment

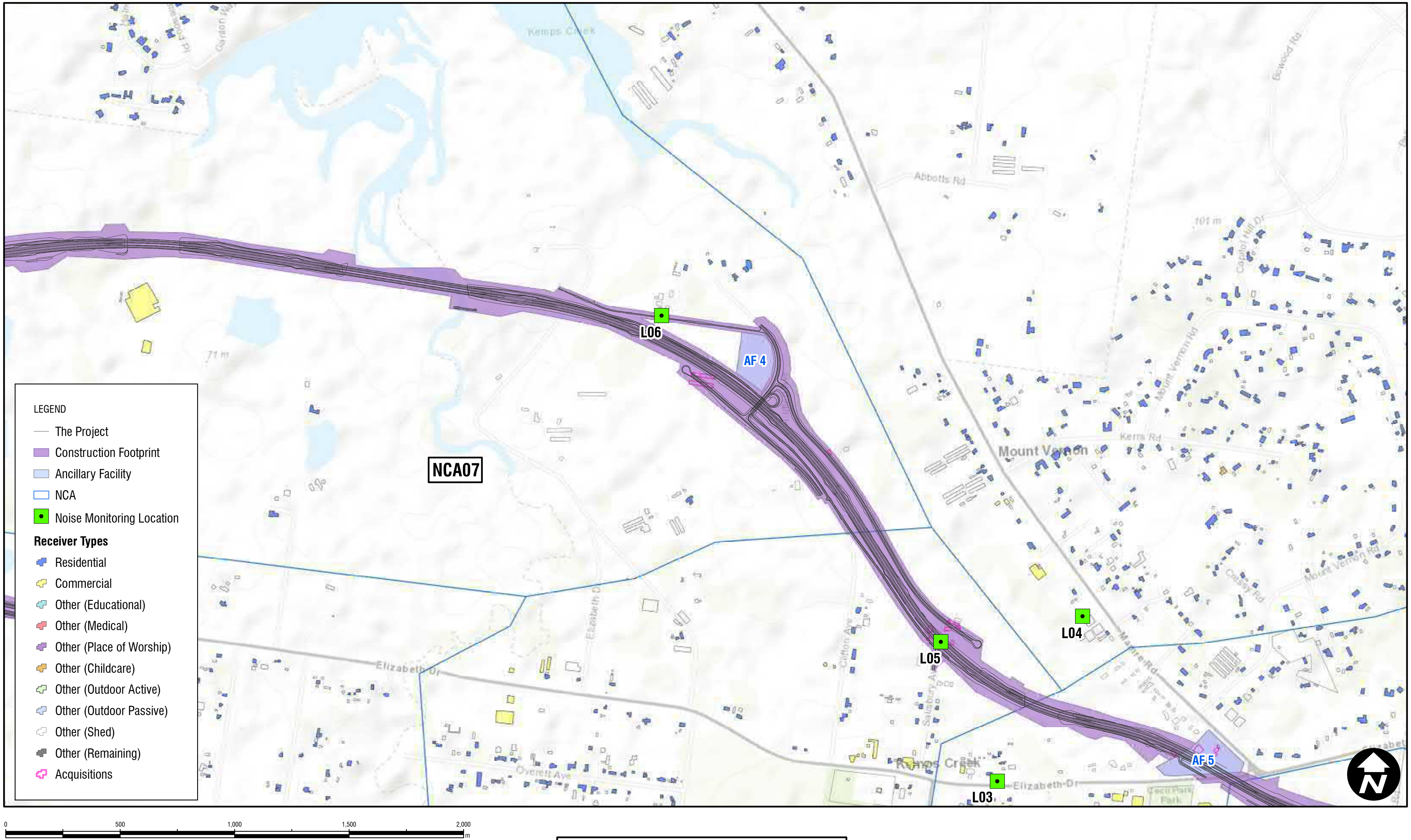
SITE PLAN AND SENSITIVE RECEIVERS



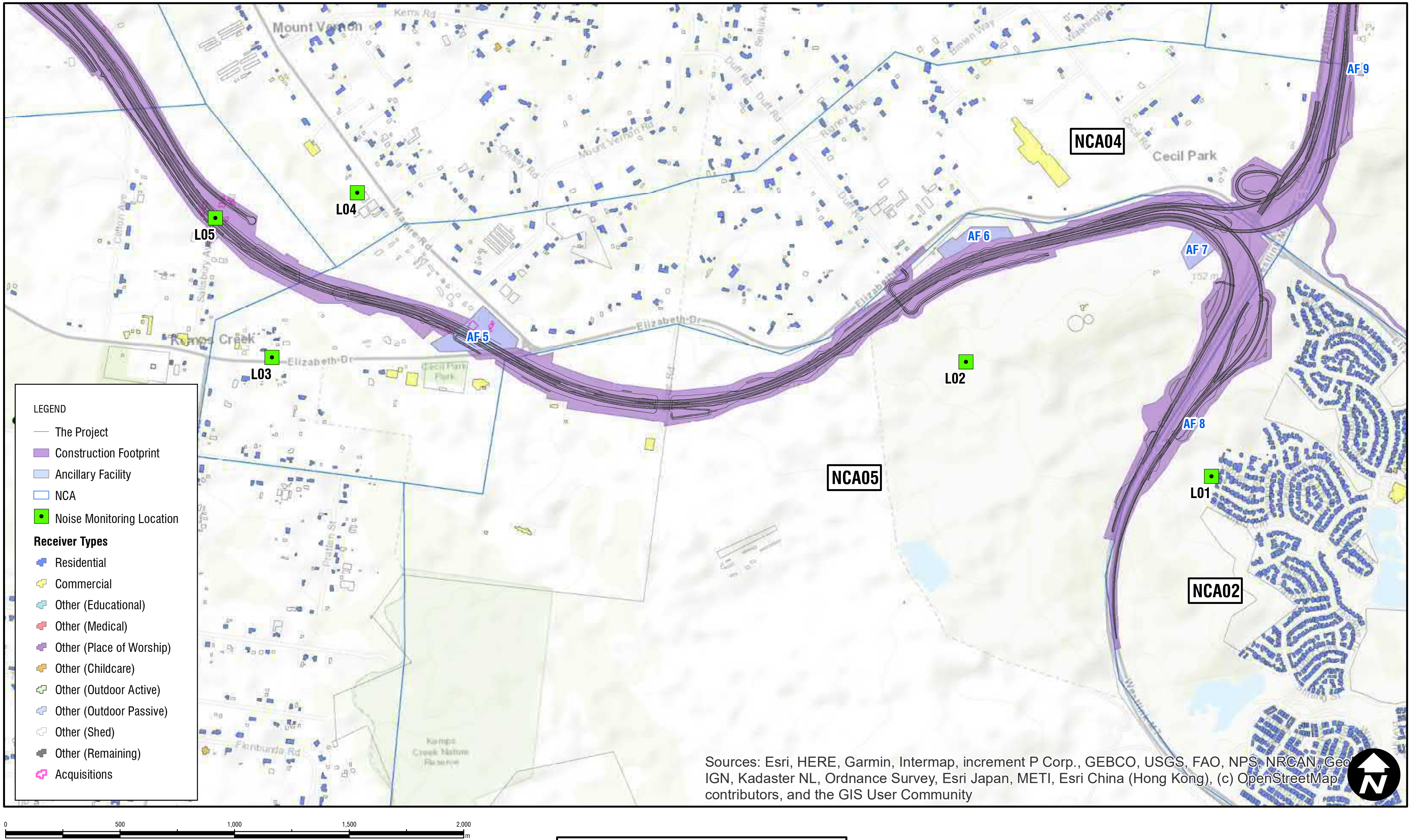
Site Plan and Sensitive Receivers



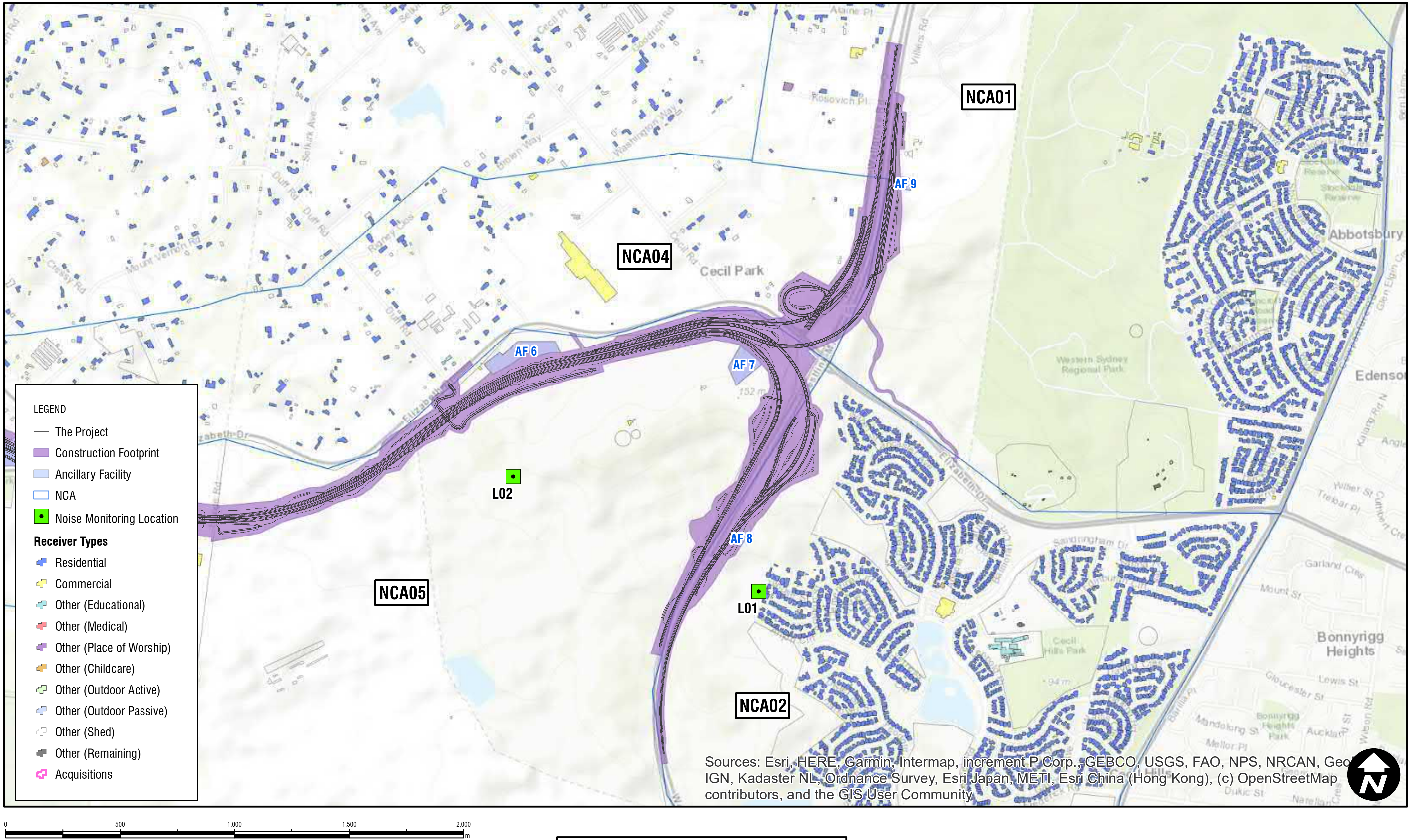
Site Plan and Sensitive Receivers



Site Plan and Sensitive Receivers



Site Plan and Sensitive Receivers



Site Plan and Sensitive Receivers

NOISE MONITORING RESULTS

Noise Monitoring Location	L.01
Noise Monitoring Address	**Adjacent to Toulouse Street, Cecil Hills**

Logger Device Type: Svantek 957, Logger Serial No: 23294

Sound Level Meter Device Type: Brüel and Kjær 2260i, Sound Level Meter Serial No: 2414605

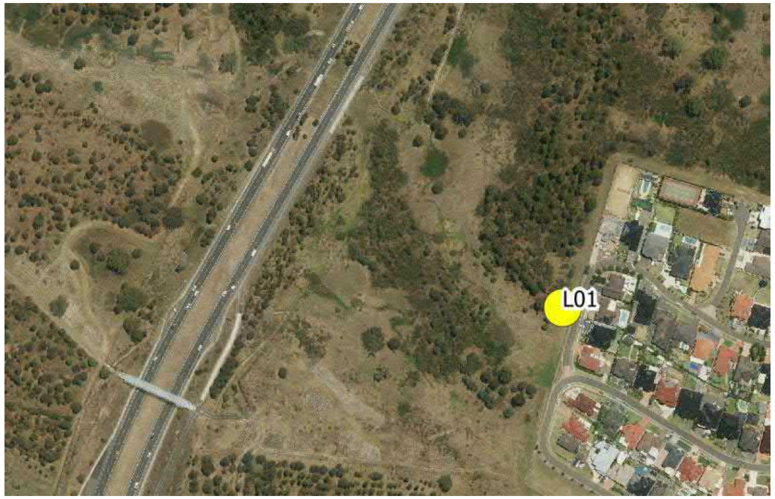
Ambient noise logger deployed adjacent to Toulousse Street, Cecil Hills. Logger located in open bushland adjacent to residential area approximately 12 m west of Toulousse Street and 245 m southeast of M7 Motorway.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from M7 Motorway. Noise from general neighbourhood activities and wildlife also contributes to the LAeq at this location.

Recorded Noise Levels: (LAmax):

19/06/2017: Road traffic (M7): 45-55 dBA, Heavy-vehicle exhausts (M7): 62-66 dBA, Birds: 40-52 dBA

Map of Noise Monitoring Location



Ambient Noise Logging Results – Construction Periods[1]

RBL Noise Level (dBA)				
Morning Shoulder	**Day**	**Evening**	**Evening Shoulder**	**Night**
51	45	44	46	40

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	52	56
Night-time (10pm-7am)	51	56

Attended Noise Measurement Results

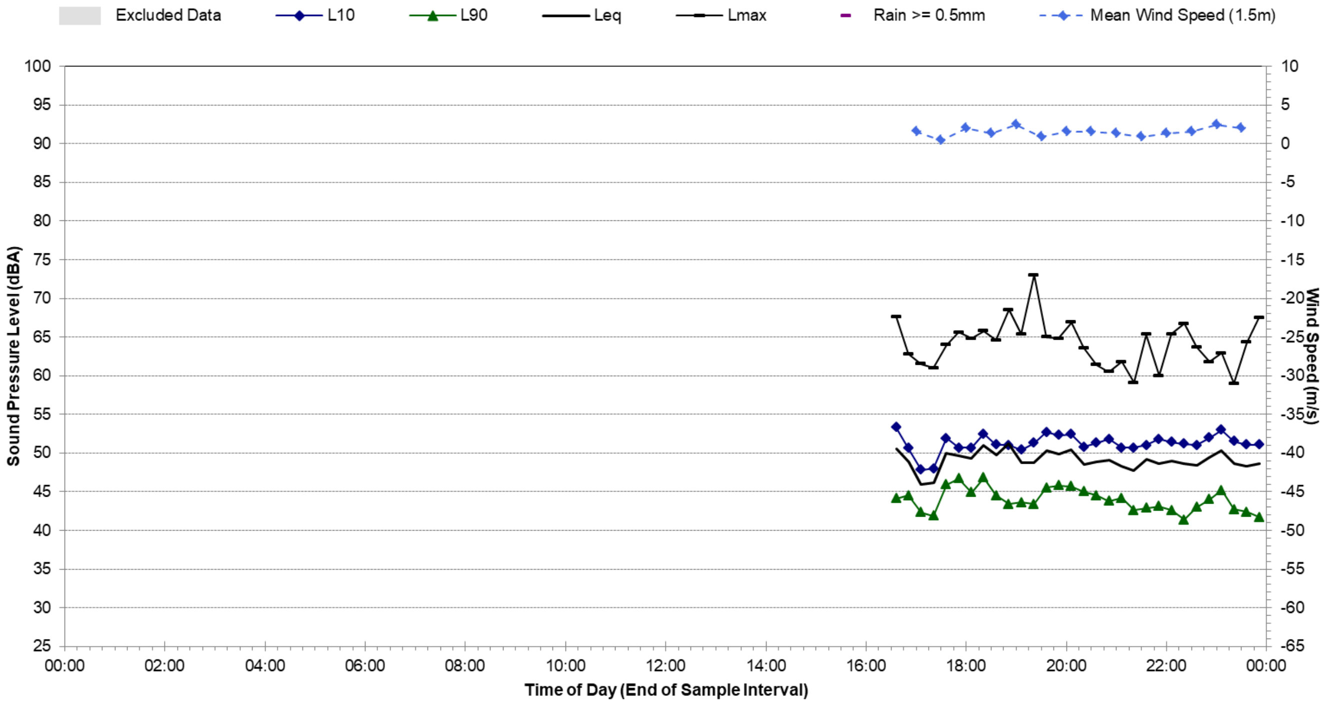
Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
19/06/2017	16:40	45	49	66

Photo of Noise Monitoring Location

Note 1: Morning shoulder is 6 am to 7 am Monday to Friday; Daytime is 7 am to 6 pm Monday to Saturday & 8 am to 6 pm Sunday & Public Holidays; Evening is 7 pm to 10 pm Monday to Friday & 6 pm to 10 pm Saturday, Sunday & Public Holidays; Evening shoulder is 6 pm to 7 pm Monday to Friday; Night-time is 10 pm to 6 am Monday to Friday, 10 pm to 7 am Saturday & 10 pm to 8 am Sunday and Public Holidays.

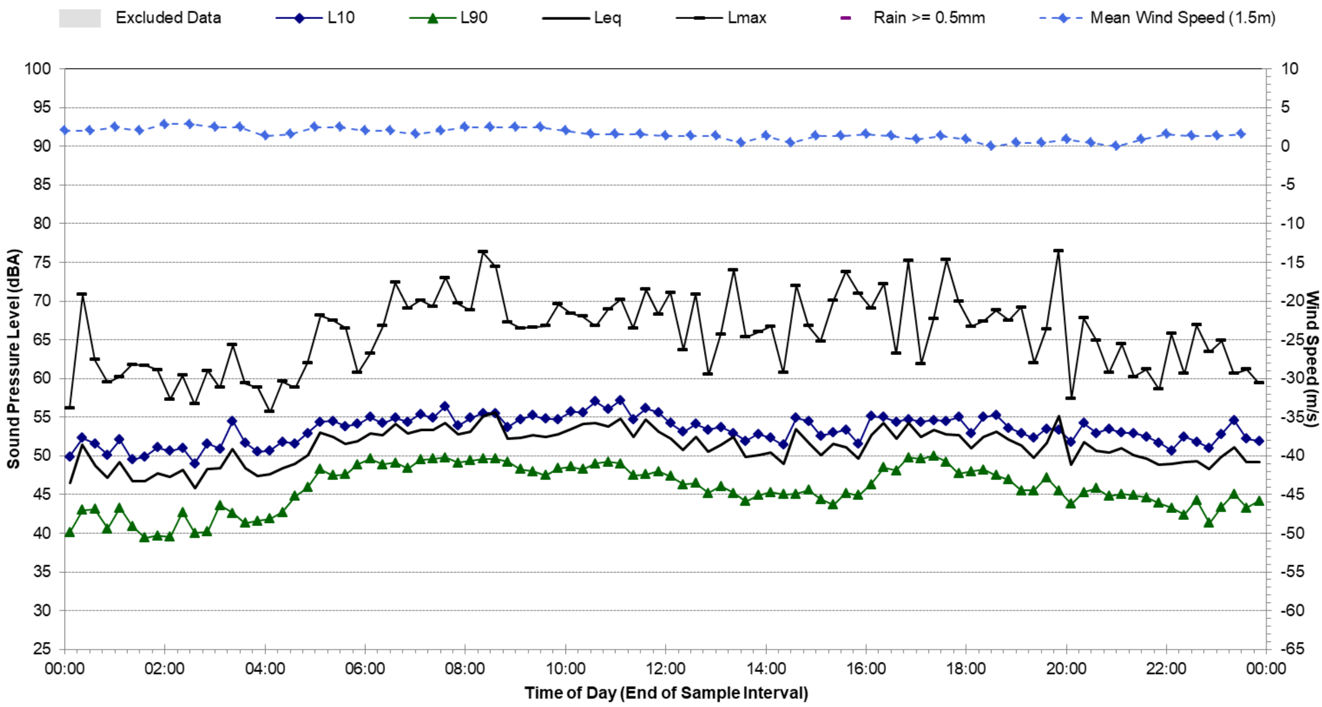
Statistical Ambient Noise Levels

L.01 Adjacent to Toulouse Street, Cecil Hills - Monday, 19 June 2017



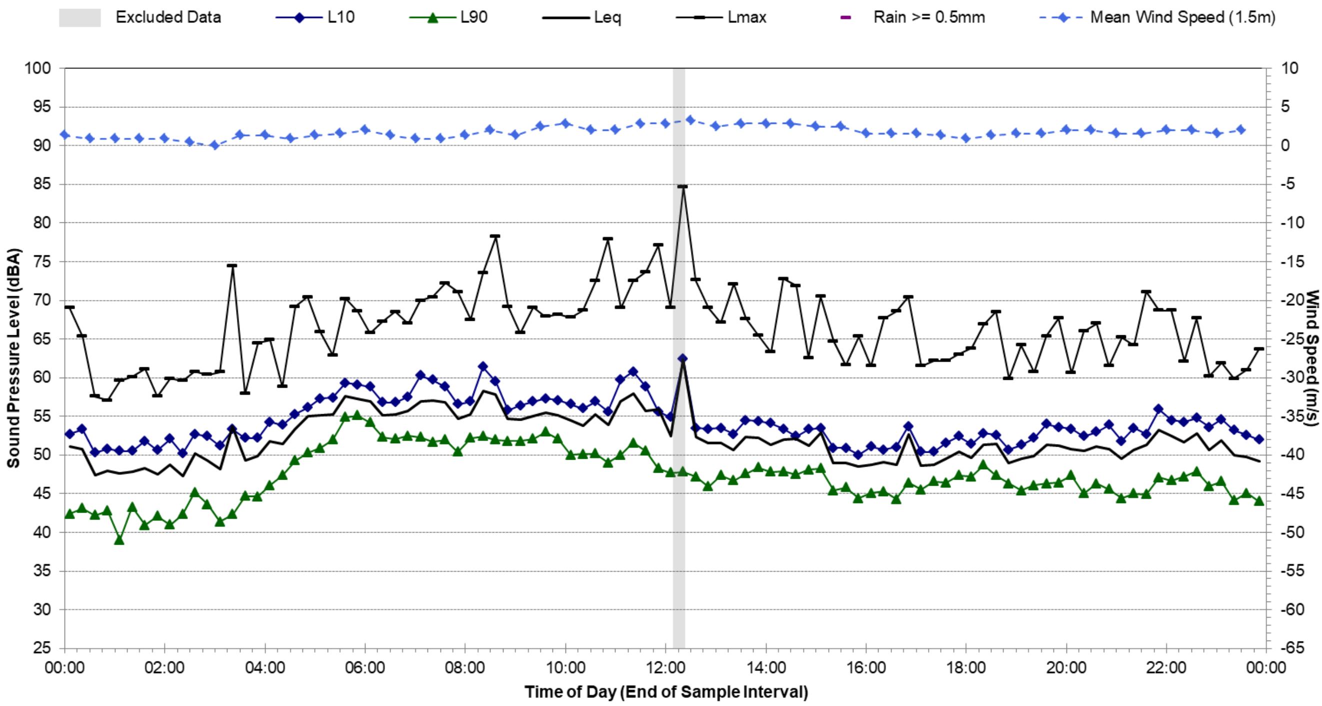
Statistical Ambient Noise Levels

L.01 Adjacent to Toulouse Street, Cecil Hills - Tuesday, 20 June 2017



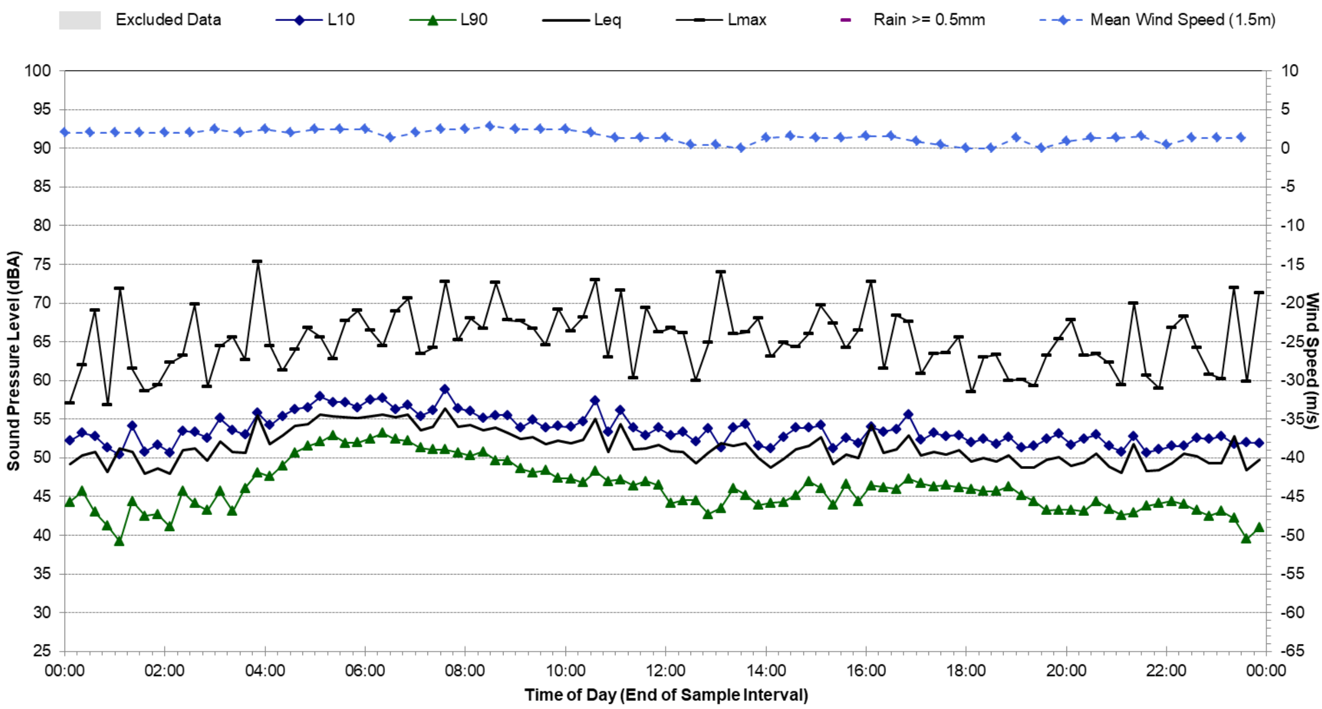
Statistical Ambient Noise Levels

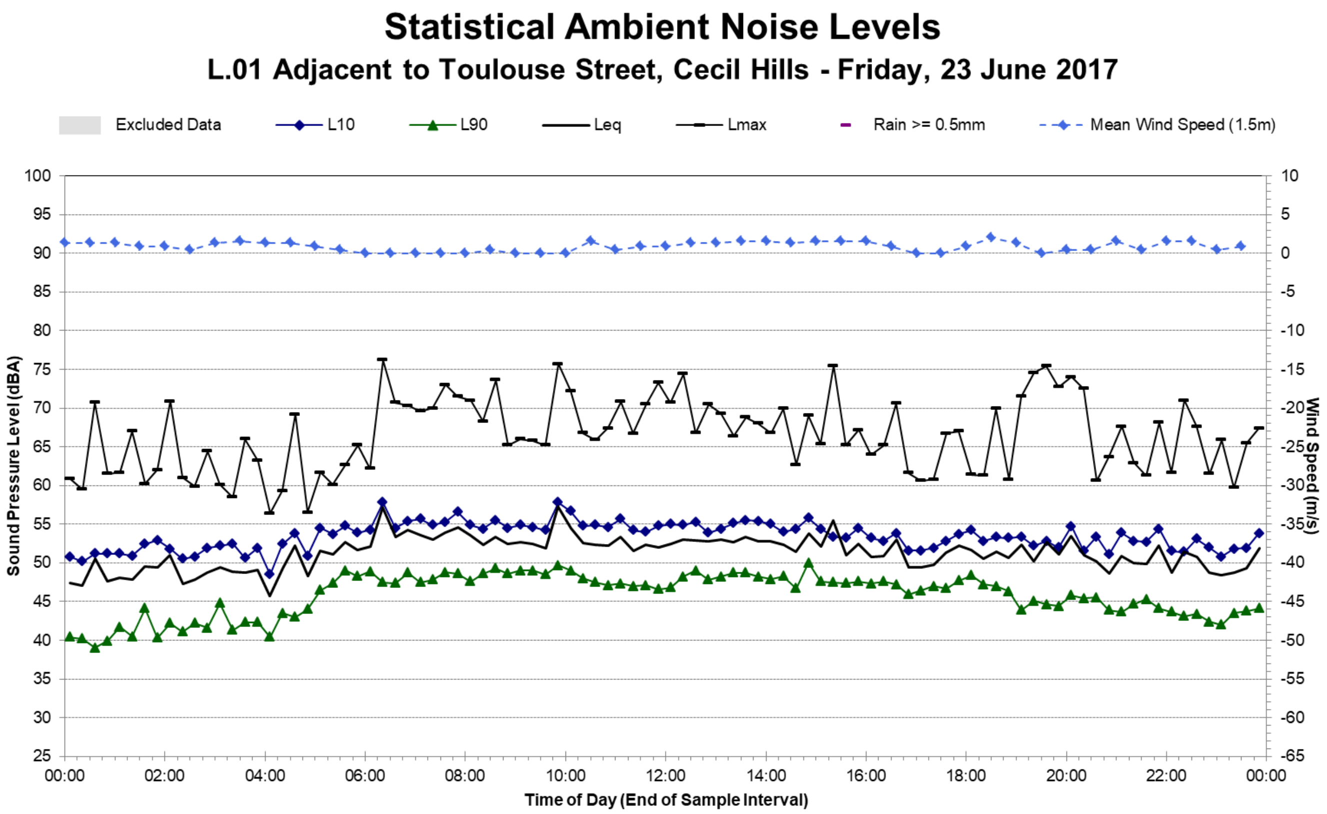
L.01 Adjacent to Toulouse Street, Cecil Hills - Wednesday, 21 June 2017

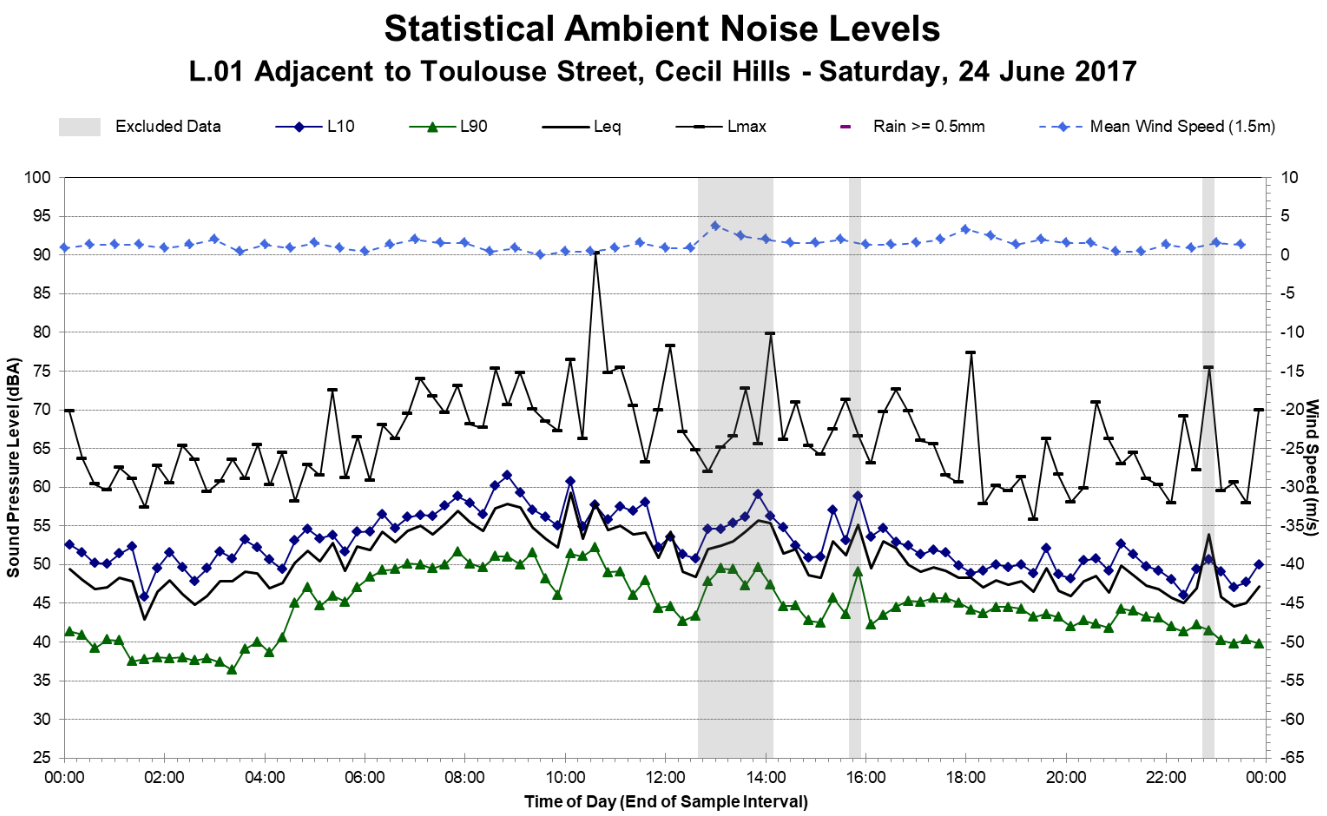


Statistical Ambient Noise Levels

L.01 Adjacent to Toulouse Street, Cecil Hills - Thursday, 22 June 2017

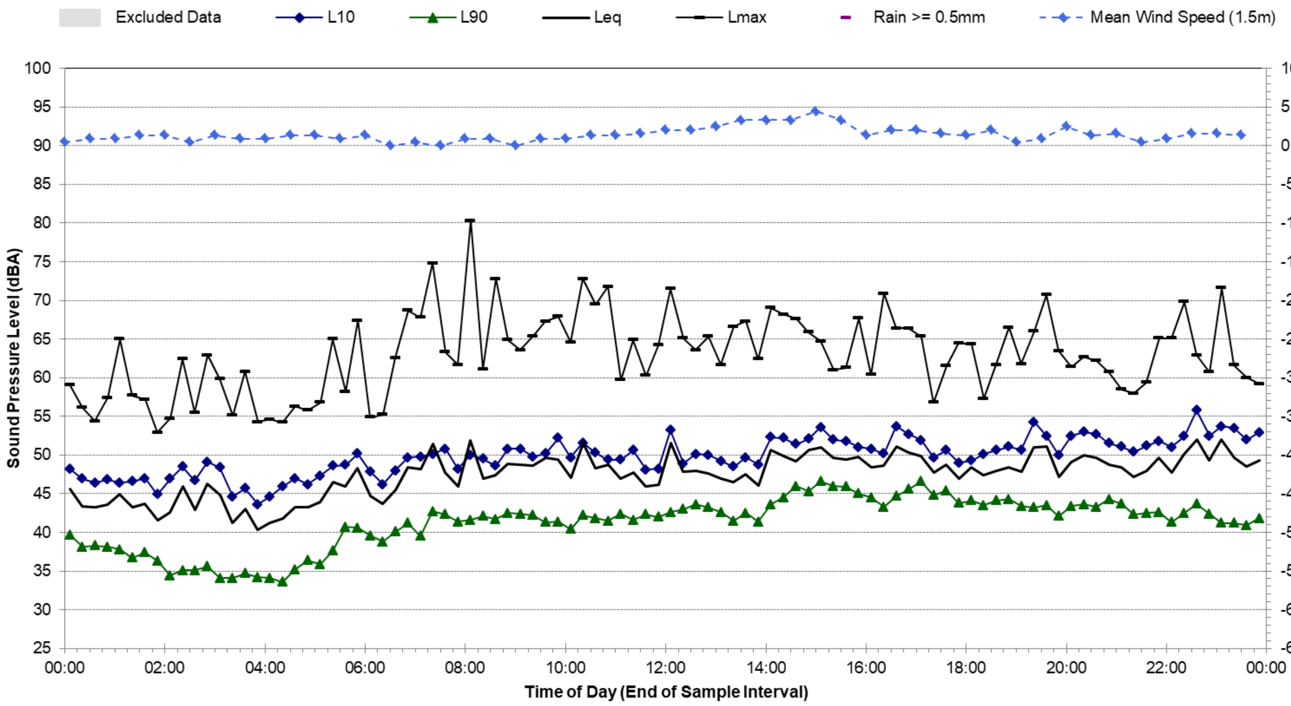



Statistical Ambient Noise Levels
L.01 Adjacent to Toulouse Street, Cecil Hills - Friday, 23 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.01 Adjacent to Toulouse Street, Cecil Hills - Saturday, 24 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

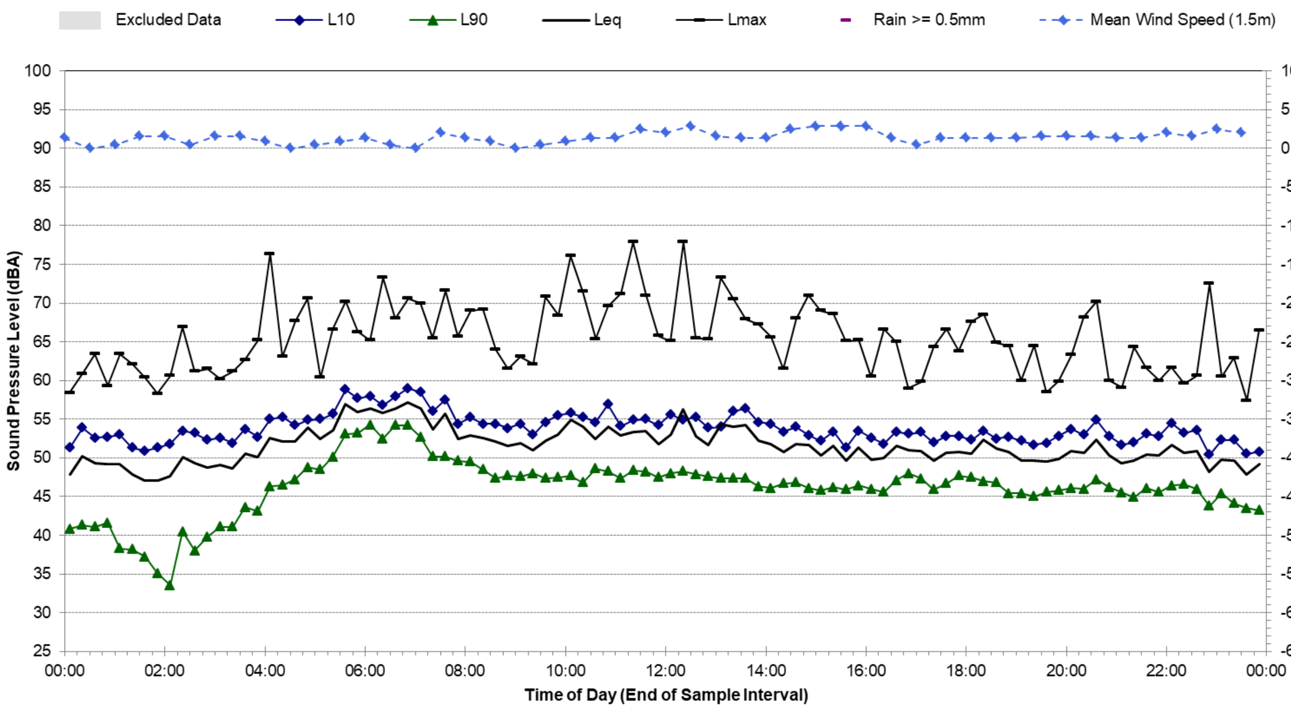
Statistical Ambient Noise Levels

L.01 Adjacent to Toulouse Street, Cecil Hills - Sunday, 25 June 2017



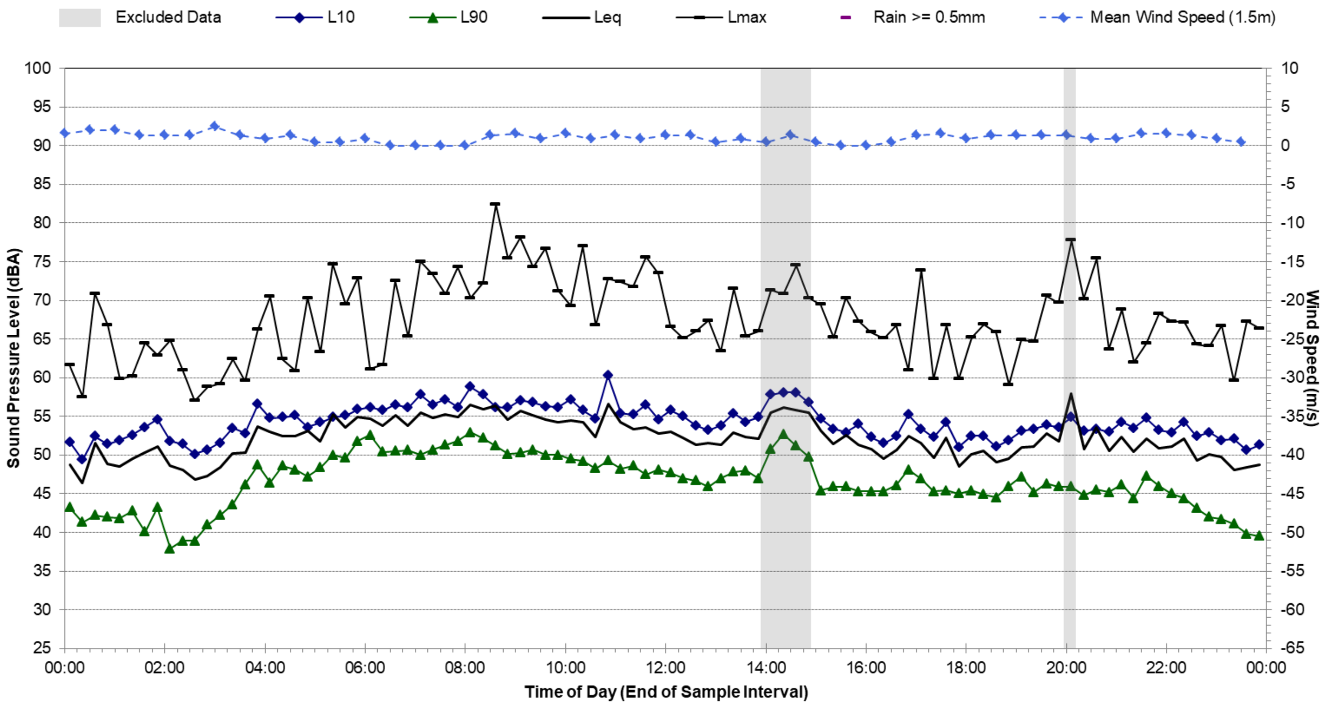
Statistical Ambient Noise Levels

L.01 Adjacent to Toulouse Street, Cecil Hills - Monday, 26 June 2017



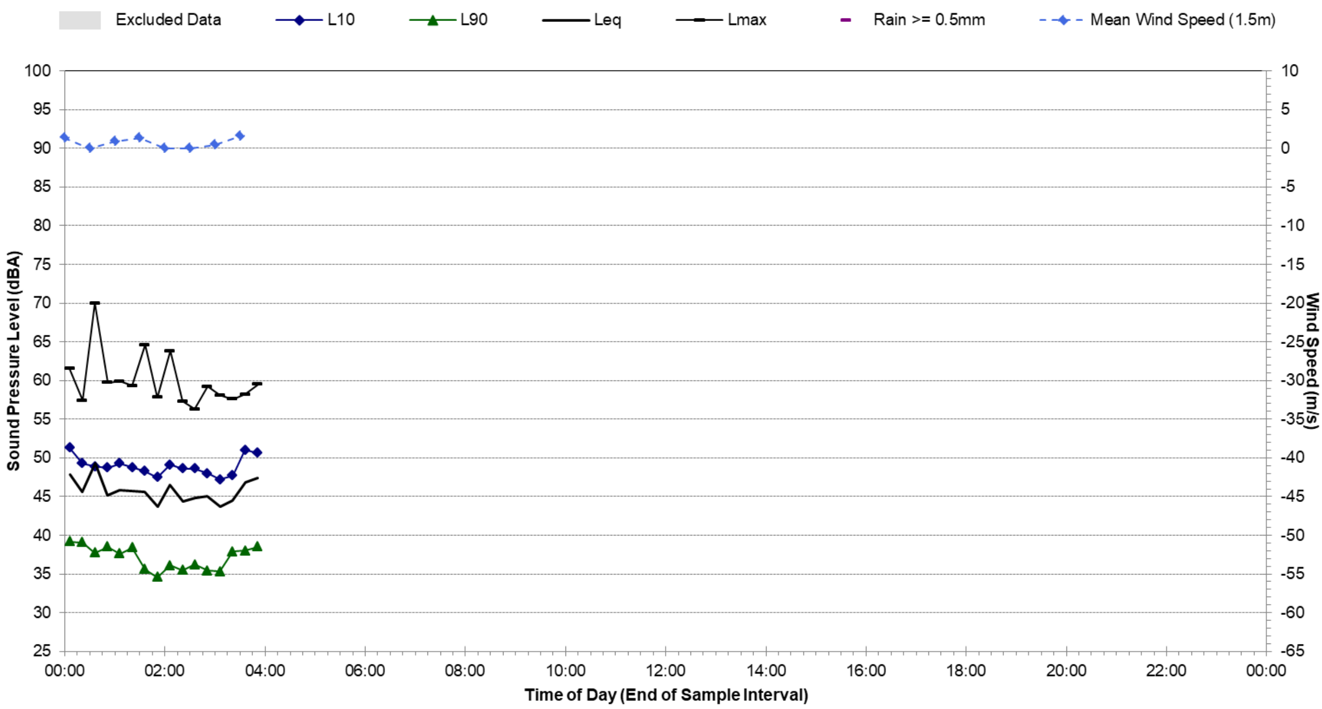
Statistical Ambient Noise Levels

L.01 Adjacent to Toulouse Street, Cecil Hills - Tuesday, 27 June 2017



Statistical Ambient Noise Levels

L.01 Adjacent to Toulouse Street, Cecil Hills - Wednesday, 28 June 2017



Noise Monitoring Location	L.02
Noise Monitoring Address	Western Sydney Parklands, Cecil Hills

Logger Device Type: Svantek 957, Logger Serial No: 27552

Sound Level Meter Device Type: Brüel and Kjær 2260i, Sound Level Meter Serial No: 2414605

Ambient noise logger deployed in the Western Sydney Parklands, Cecil Hills. Logger located in open grassland approximately 500 m southeast of Elizabeth Drive.

Attended noise measurements indicate the ambient noise environment at this location is dominated by noise from local wildlife (birds etc). Noise from light aircraft and road traffic from Elizabeth Drive and M7 Motorway also contributes to the LAeq at this location.

Recorded Noise Levels: (LAmax):

22/06/2017: Birds: 40-60 dBA, Light aircraft: up to 48 dBA,
Ambient noise (including distant road traffic noise): 37-41 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – Construction Periods[1]

RBL Noise Level (dBA)				
Morning Shoulder	**Day**	**Evening**	**Evening Shoulder**	**Night**
47	36	39	41	34

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	46	49
Night-time (10pm-7am)	45	52

Attended Noise Measurement Results

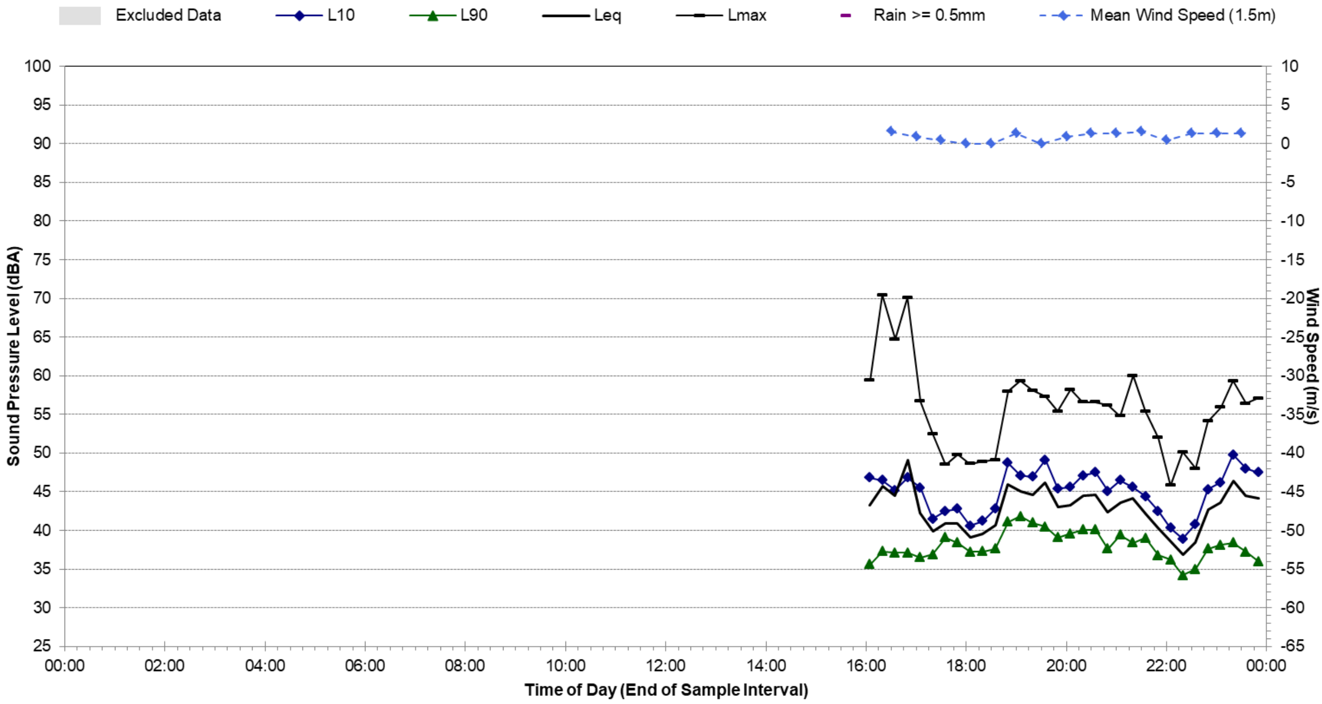
Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
22/06/2017	15:13	37	43	60

Photo of Noise Monitoring Location

Note 1: Morning shoulder is 6 am to 7 am Monday to Friday; Daytime is 7 am to 6 pm Monday to Saturday & 8 am to 6 pm Sunday & Public Holidays; Evening is 7 pm to 10 pm Monday to Friday & 6 pm to 10 pm Saturday, Sunday & Public Holidays; Evening shoulder is 6 pm to 7 pm Monday to Friday; Night-time is 10 pm to 6 am Monday to Friday, 10 pm to 7 am Saturday & 10 pm to 8 am Sunday and Public Holidays.

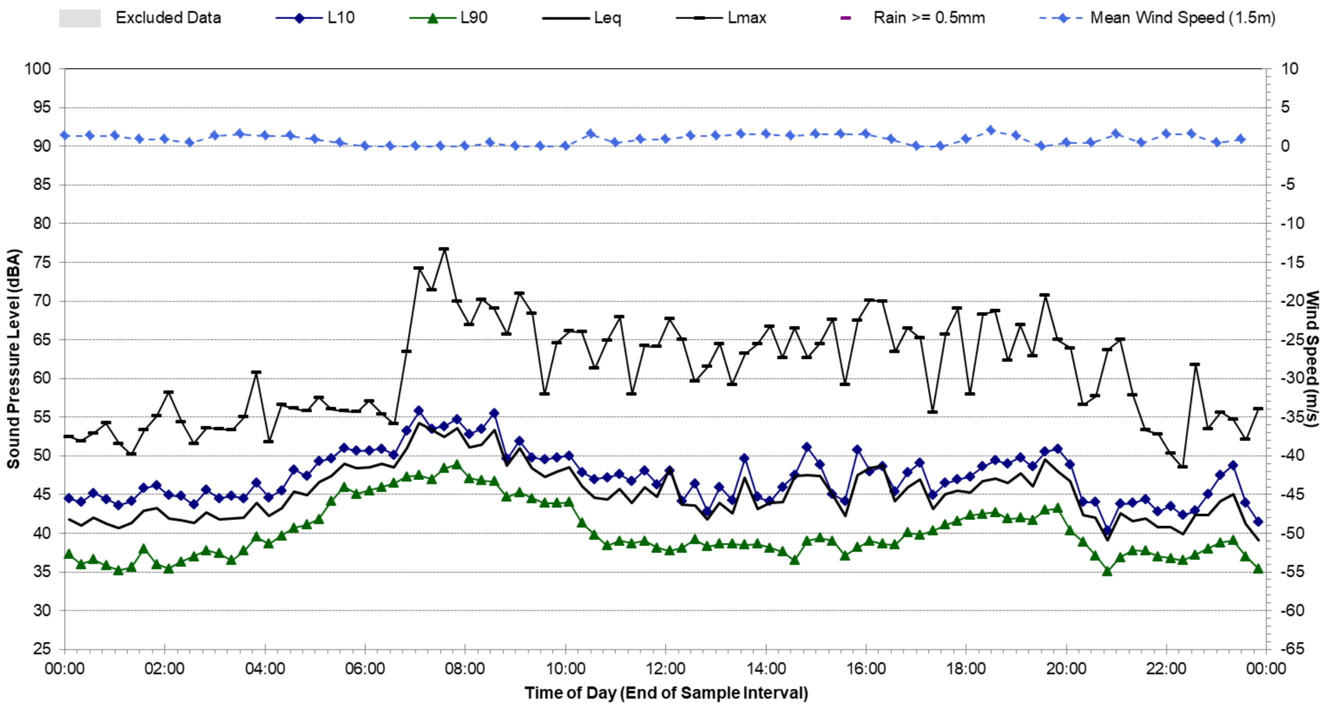
Statistical Ambient Noise Levels

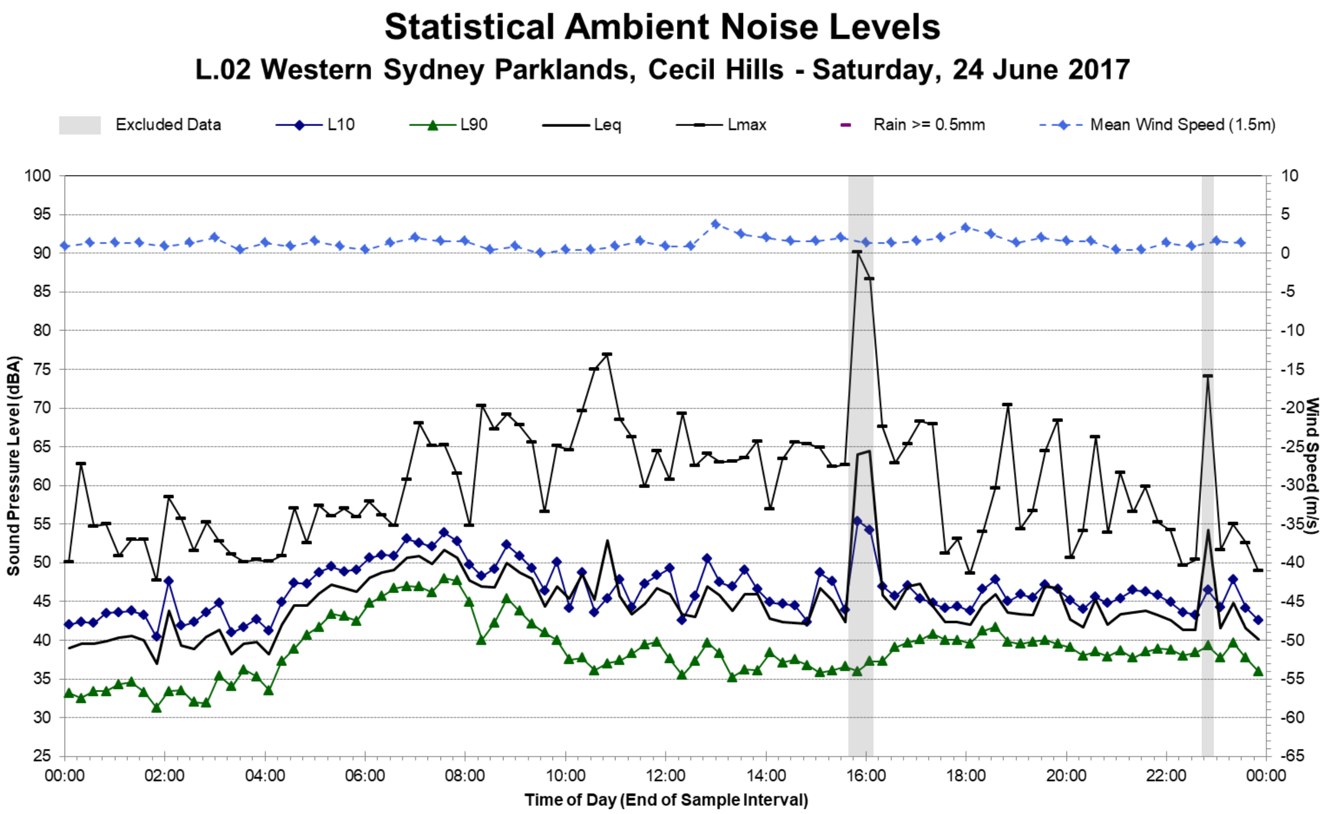
L.02 Western Sydney Parklands, Cecil Hills - Thursday, 22 June 2017

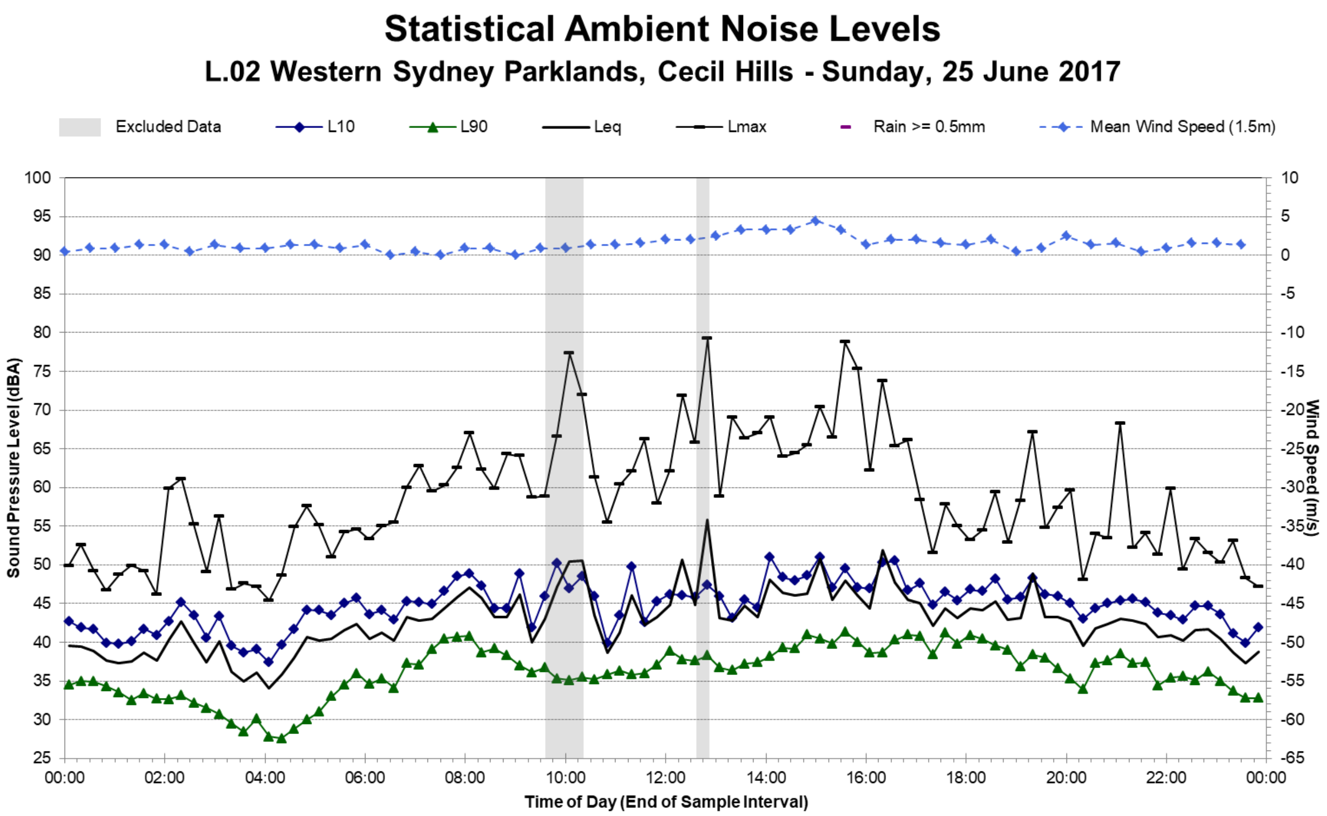


Statistical Ambient Noise Levels

L.02 Western Sydney Parklands, Cecil Hills - Friday, 23 June 2017

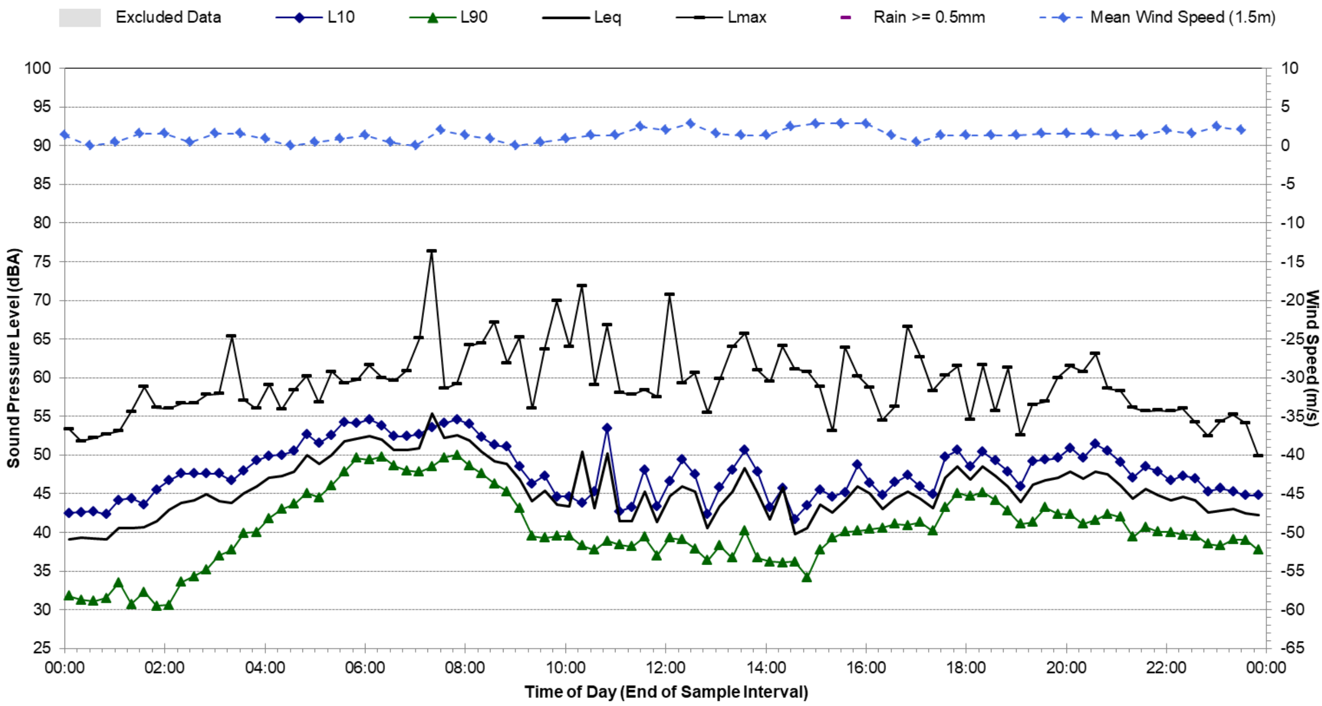



Statistical Ambient Noise Levels
L.02 Western Sydney Parklands, Cecil Hills - Saturday, 24 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.02 Western Sydney Parklands, Cecil Hills - Sunday, 25 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

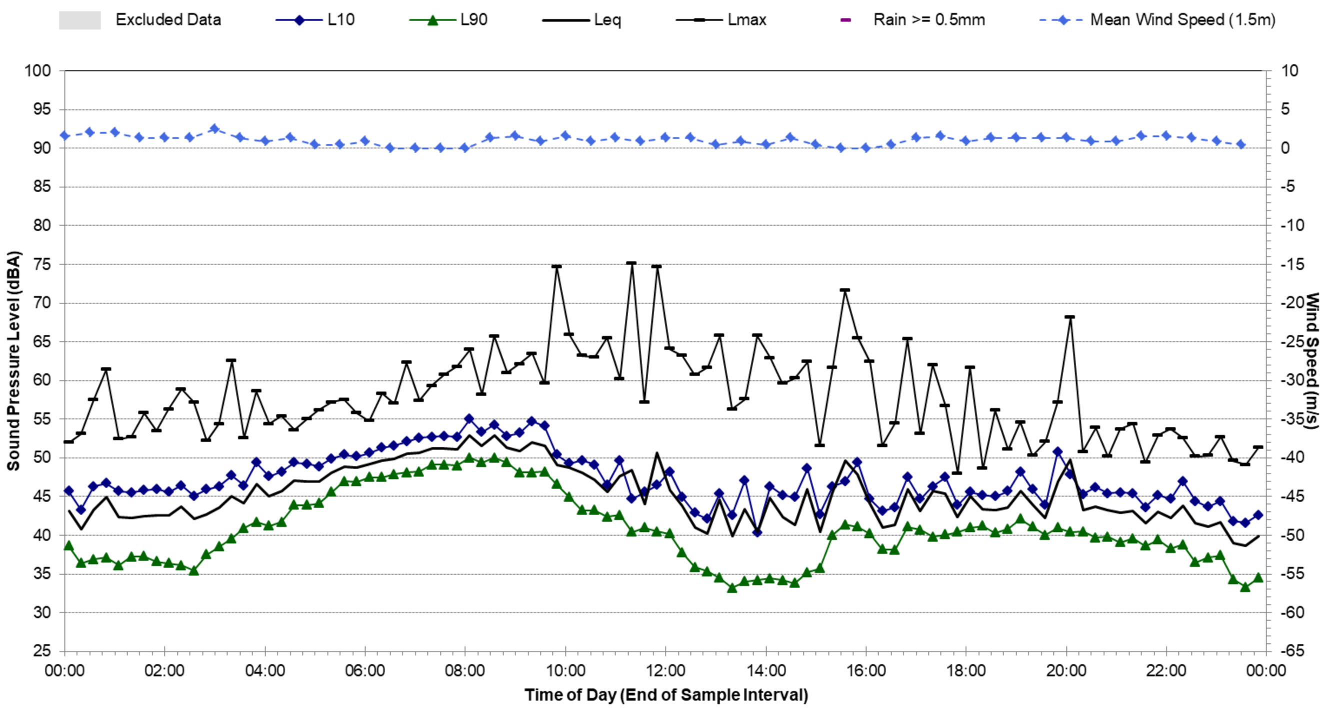
Statistical Ambient Noise Levels

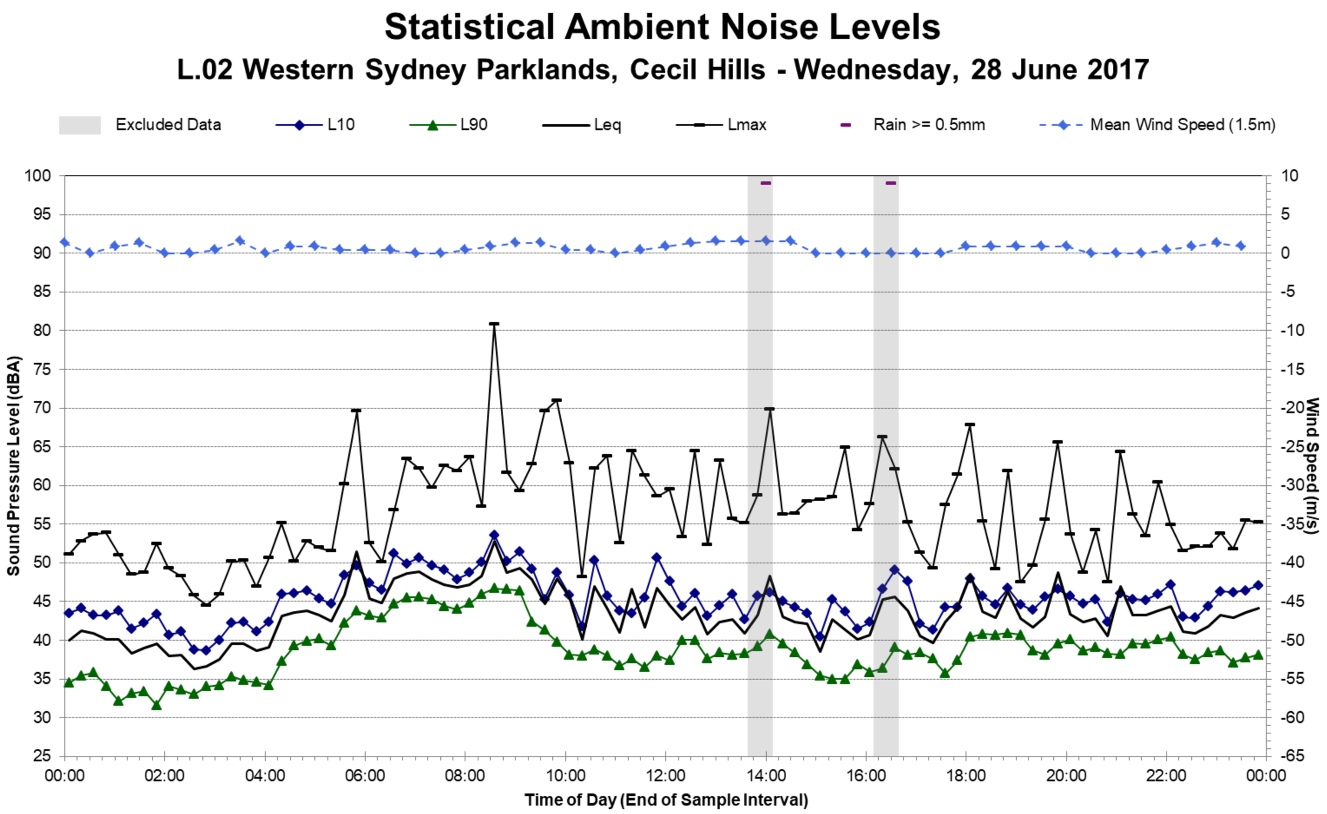
L.02 Western Sydney Parklands, Cecil Hills - Monday, 26 June 2017

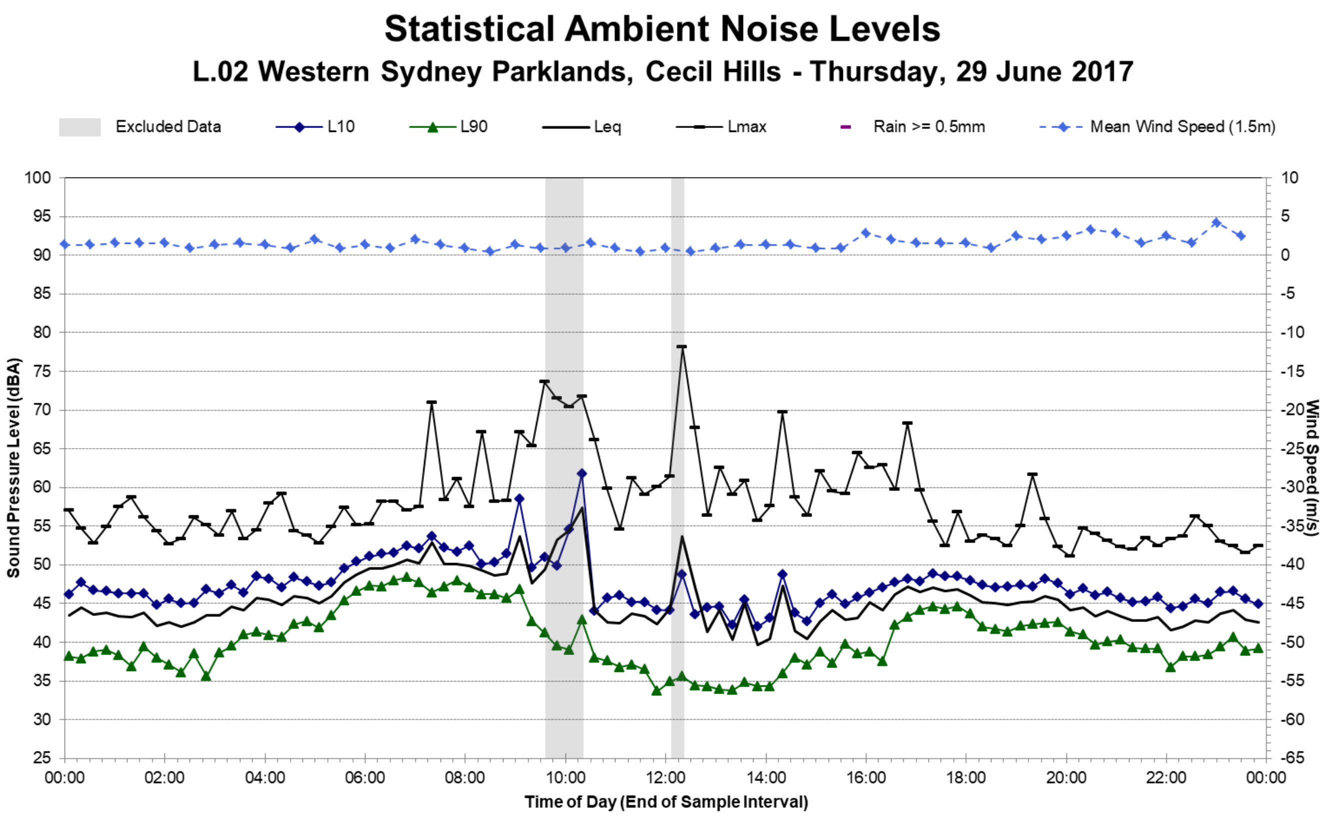


Statistical Ambient Noise Levels

L.02 Western Sydney Parklands, Cecil Hills - Tuesday, 27 June 2017

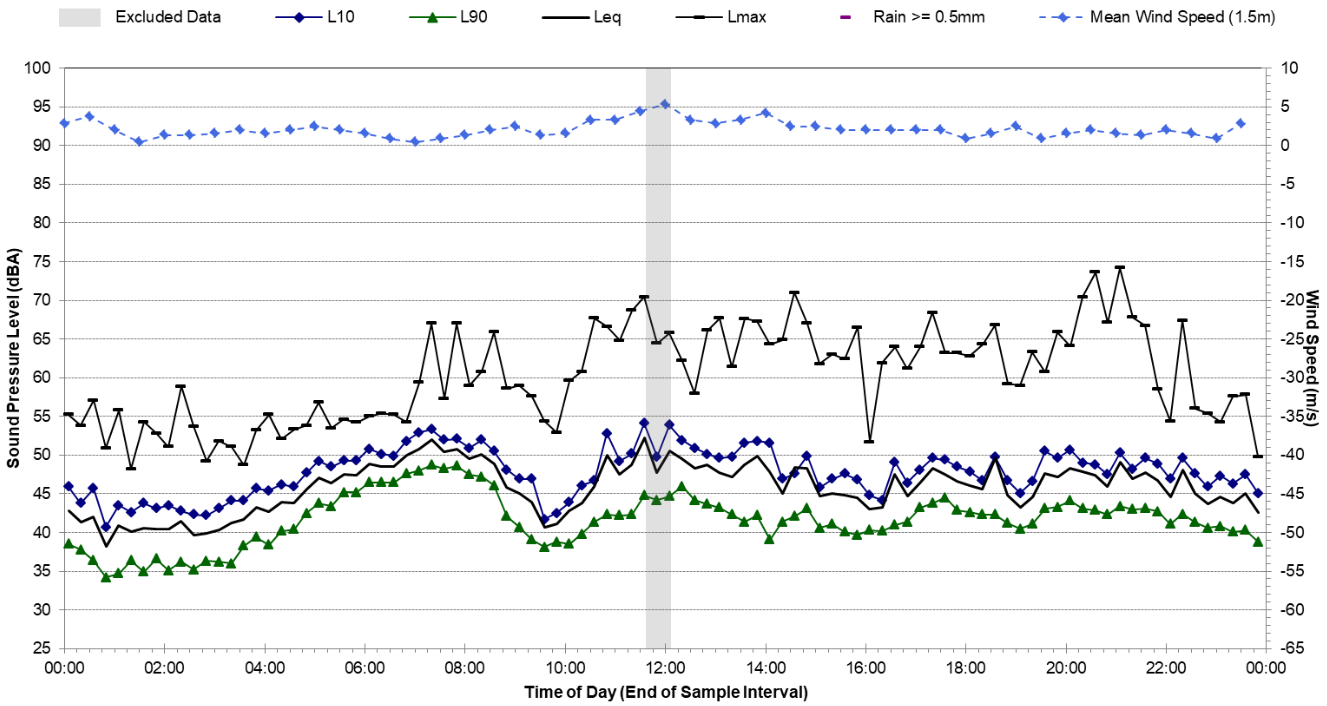



Statistical Ambient Noise Levels
L.02 Western Sydney Parklands, Cecil Hills - Wednesday, 28 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.02 Western Sydney Parklands, Cecil Hills - Thursday, 29 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

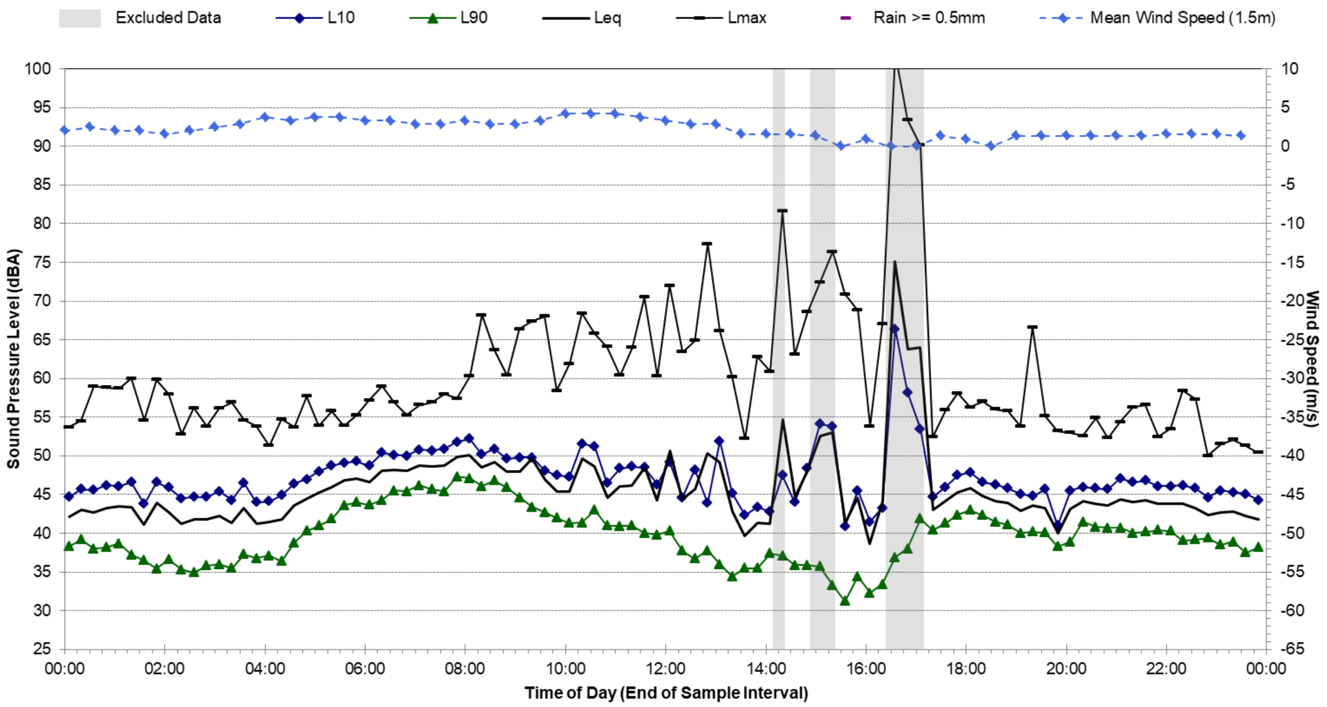
Statistical Ambient Noise Levels

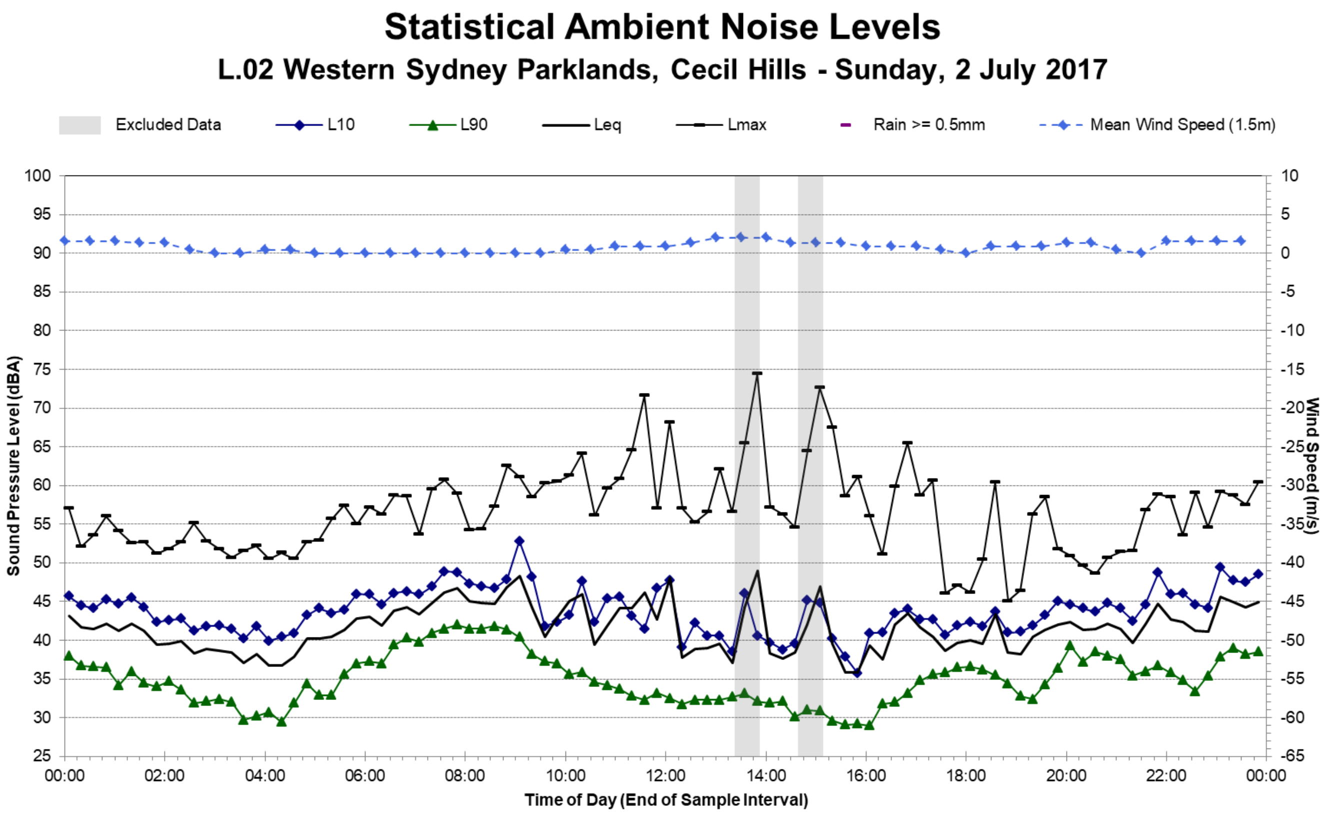
L.02 Western Sydney Parklands, Cecil Hills - Friday, 30 June 2017

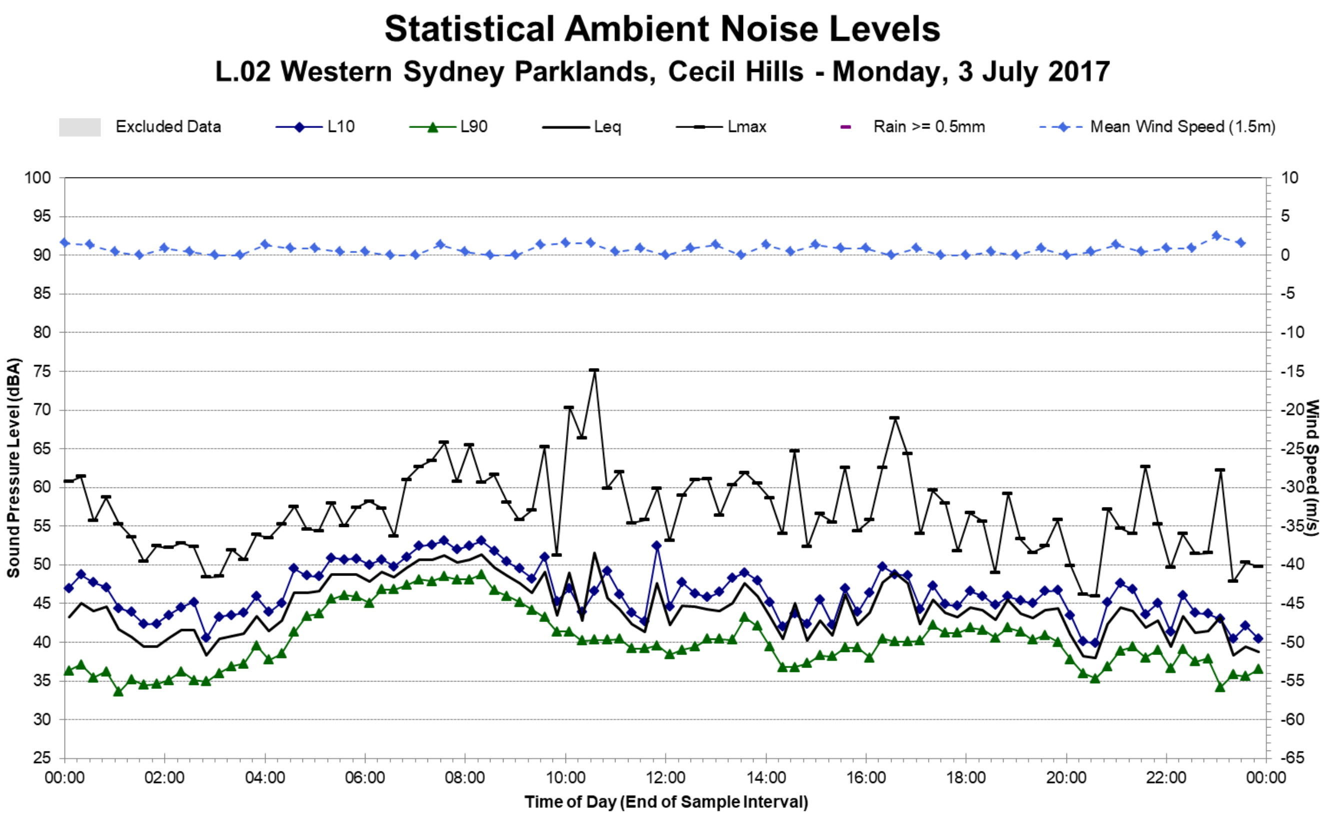


Statistical Ambient Noise Levels

L.02 Western Sydney Parklands, Cecil Hills - Saturday, 1 July 2017




Statistical Ambient Noise Levels
L.02 Western Sydney Parklands, Cecil Hills - Sunday, 2 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00


Statistical Ambient Noise Levels
L.02 Western Sydney Parklands, Cecil Hills - Monday, 3 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
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00:00
02:00
04:00
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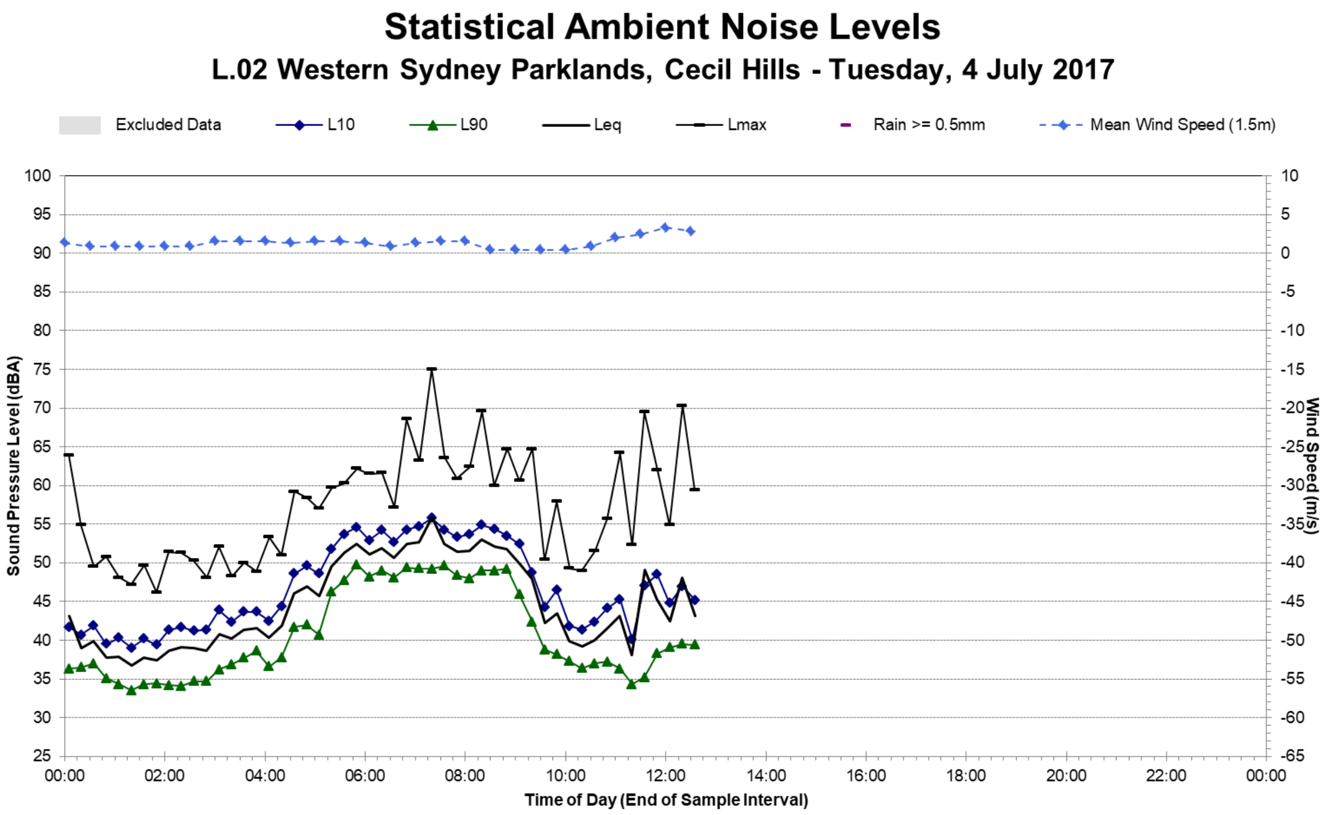
20:00
22:00
00:00



Statistical Ambient Noise Levels
L.02 Western Sydney Parklands, Cecil Hills - Tuesday, 4 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
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-60
-65
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

Noise Monitoring Location	L.03
Noise Monitoring Address	1383 Elizabeth Drive, Kemps Creek

Logger Device Type: Svantek 979, Logger Serial No: 35873

Sound Level Meter Device Type: Brüel and Kjær 2260i, Sound Level Meter Serial No: 2414604

Ambient noise logger deployed at residential address 1383 Elizabeth Drive, Kemps Creek. Logger located approximately 18 m north of Elizabeth Drive.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from Elizabeth Drive. Road traffic noise at this location is a mixture of frequent light and heavy vehicle passbys.

Recorded Noise Levels: (LAmax):

22/06/2017: Light vehicles (Elizabeth Dr): 65-72 dBA, Heavy vehicles (Elizabeth Dr): 68-80 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – Construction Periods[1]

RBL Noise Level (dBA)				
Morning Shoulder	Day	Evening	Evening Shoulder	Night
60	54	48	56	37

Ambient Noise Logging Results – RNP Defined Time Periods

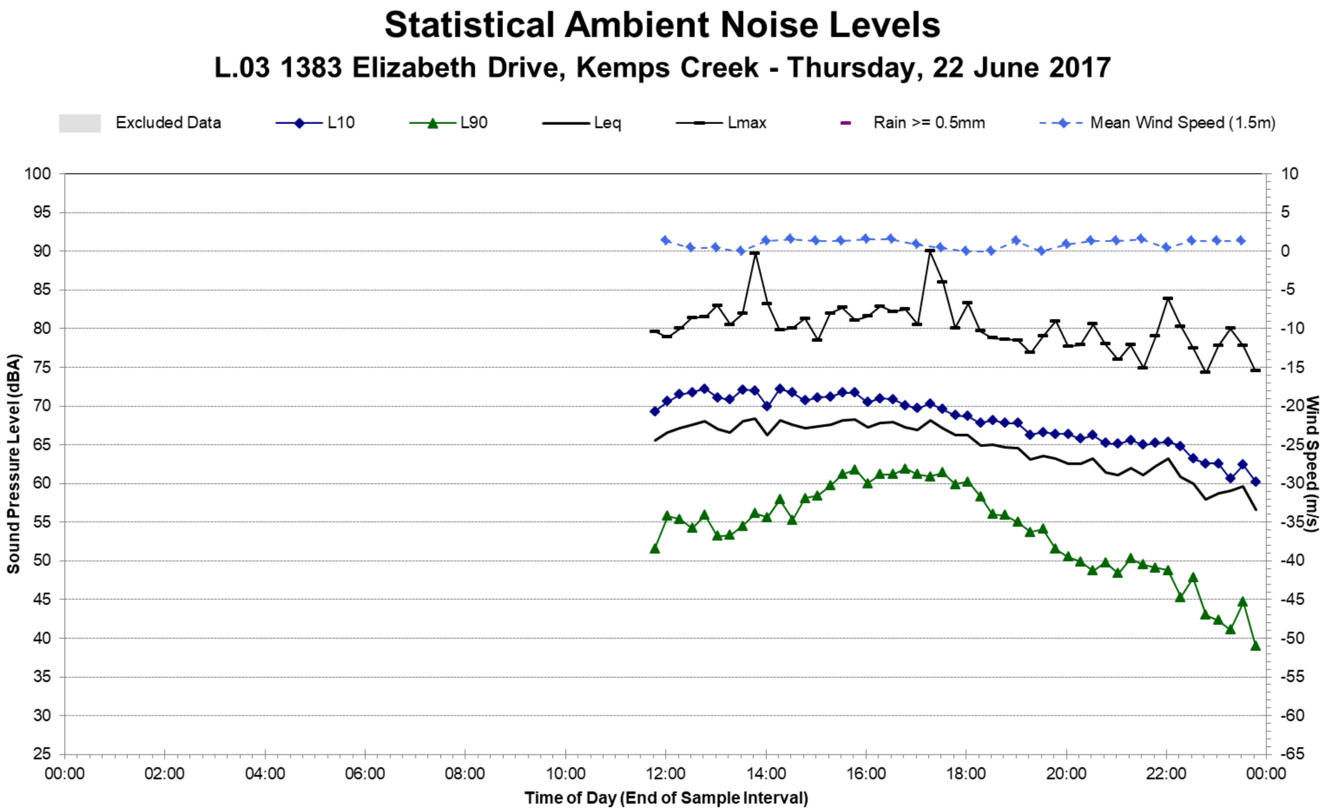
Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	66	69
Night-time (10pm-7am)	63	69

Attended Noise Measurement Results

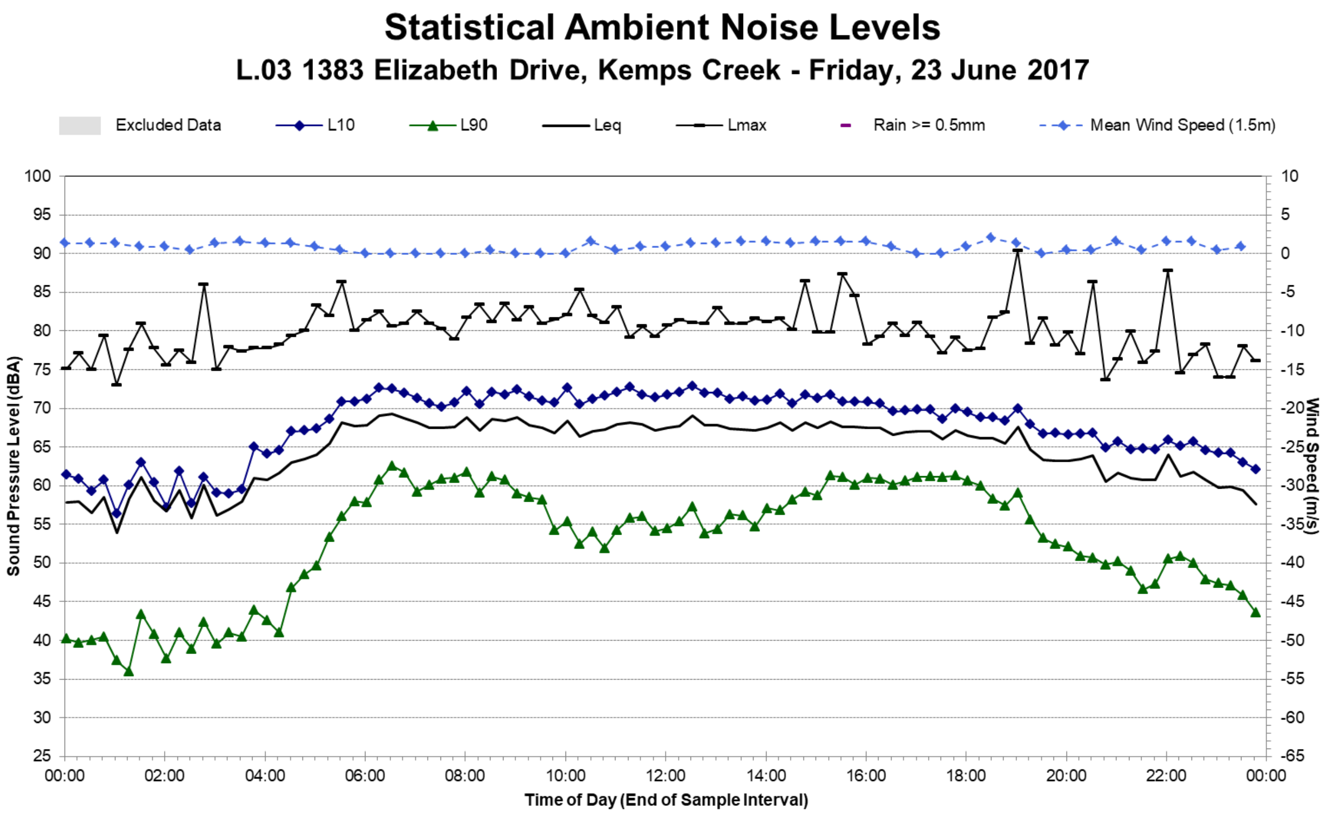
Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
22/06/2017	11:04	54	66	80

Photo of Noise Monitoring Location

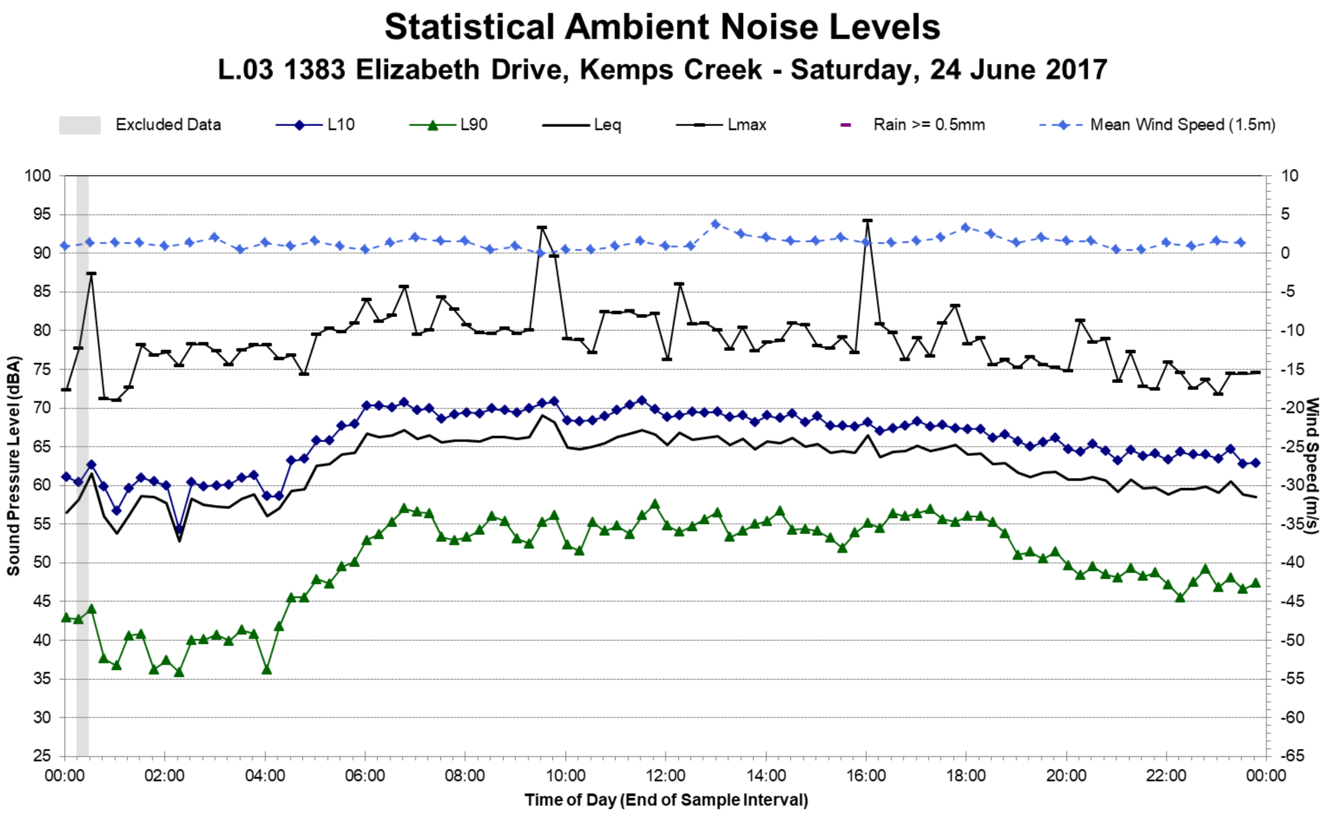
Note 1: Morning shoulder is 6 am to 7 am Monday to Friday; Daytime is 7 am to 6 pm Monday to Saturday & 8 am to 6 pm Sunday & Public Holidays; Evening is 7 pm to 10 pm Monday to Friday & 6 pm to 10 pm Saturday, Sunday & Public Holidays; Evening shoulder is 6 pm to 7 pm Monday to Friday; Night-time is 10 pm to 6 am Monday to Friday, 10 pm to 7 am Saturday & 10 pm to 8 am Sunday and Public Holidays.

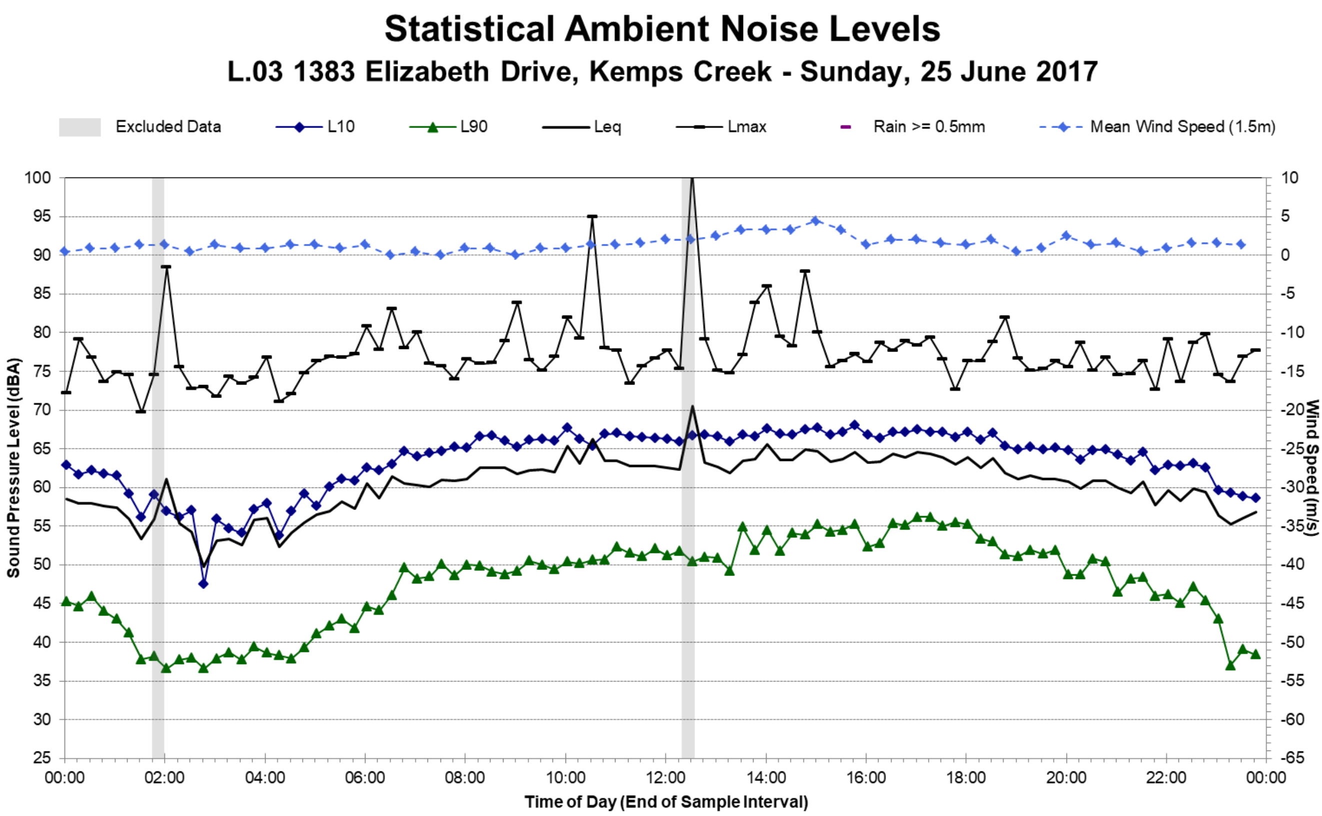


Statistical Ambient Noise Levels
L.03 1383 Elizabeth Drive, Kemps Creek - Thursday, 22 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



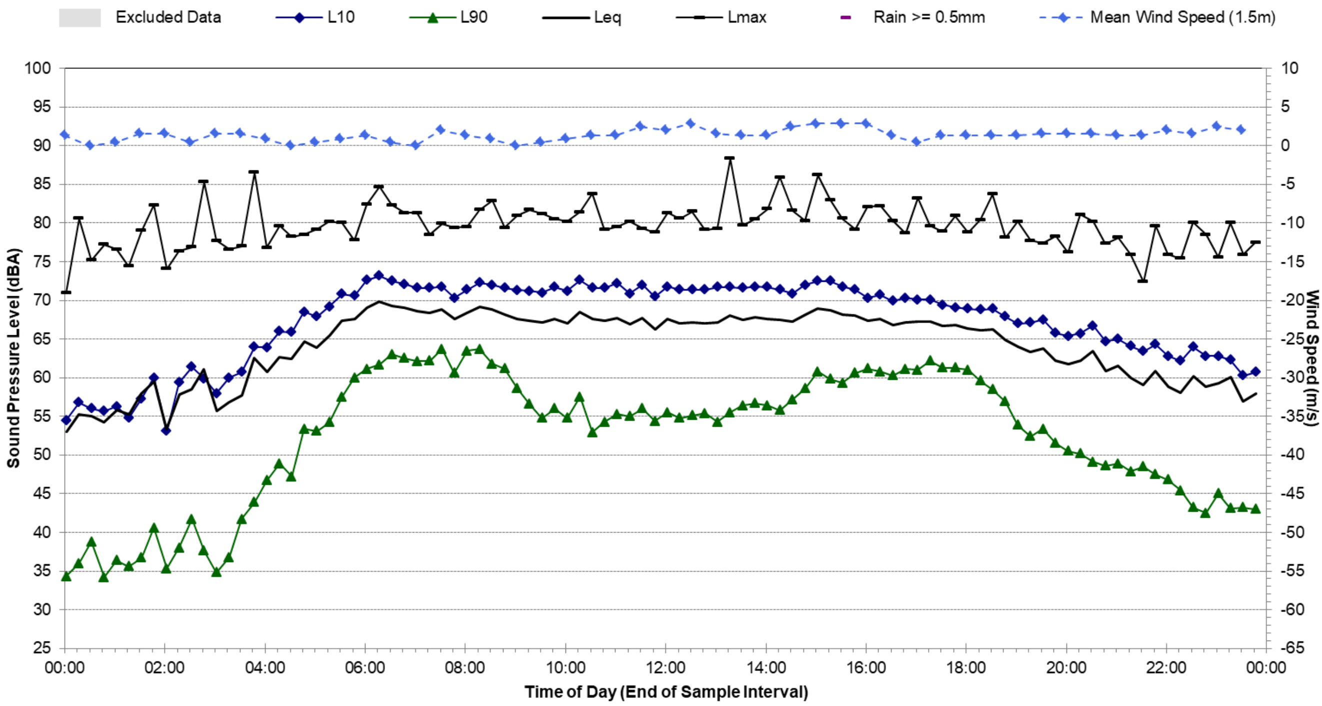
Statistical Ambient Noise Levels
L.03 1383 Elizabeth Drive, Kemps Creek - Friday, 23 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.03 1383 Elizabeth Drive, Kemps Creek - Saturday, 24 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.03 1383 Elizabeth Drive, Kemps Creek - Sunday, 25 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

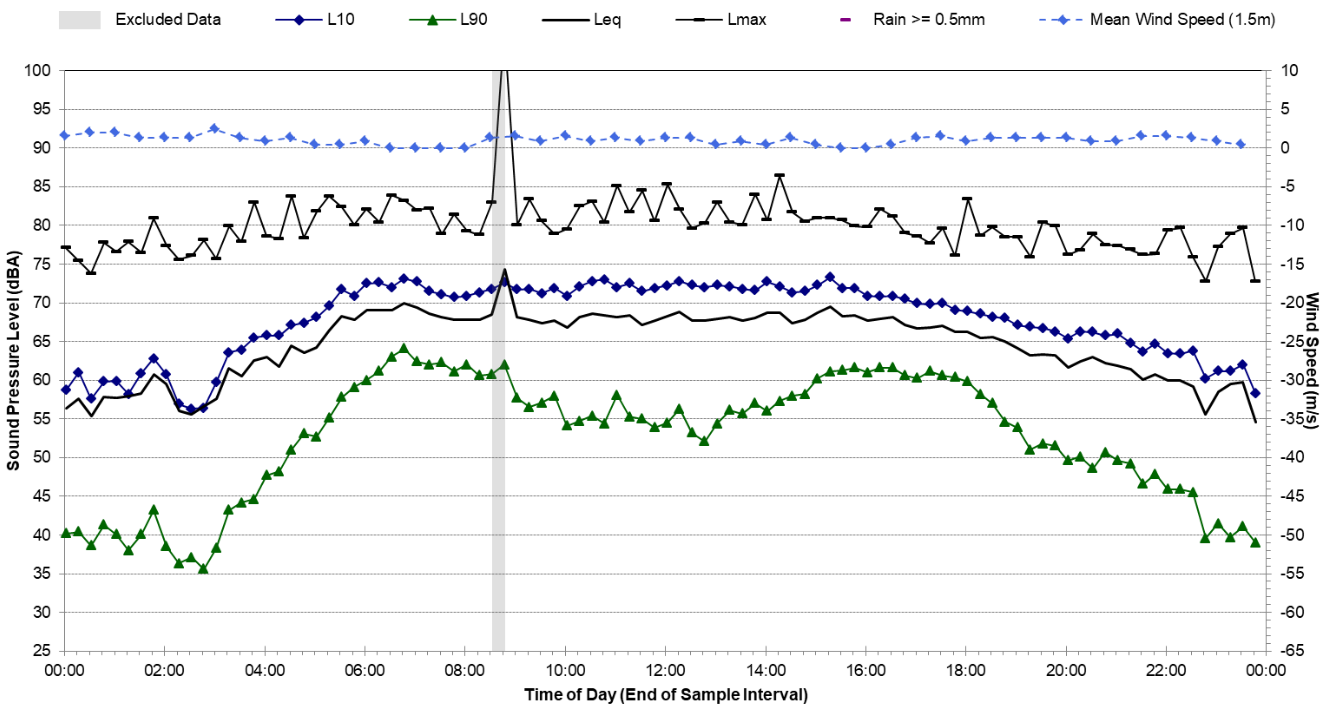
Statistical Ambient Noise Levels

L.03 1383 Elizabeth Drive, Kemps Creek - Monday, 26 June 2017



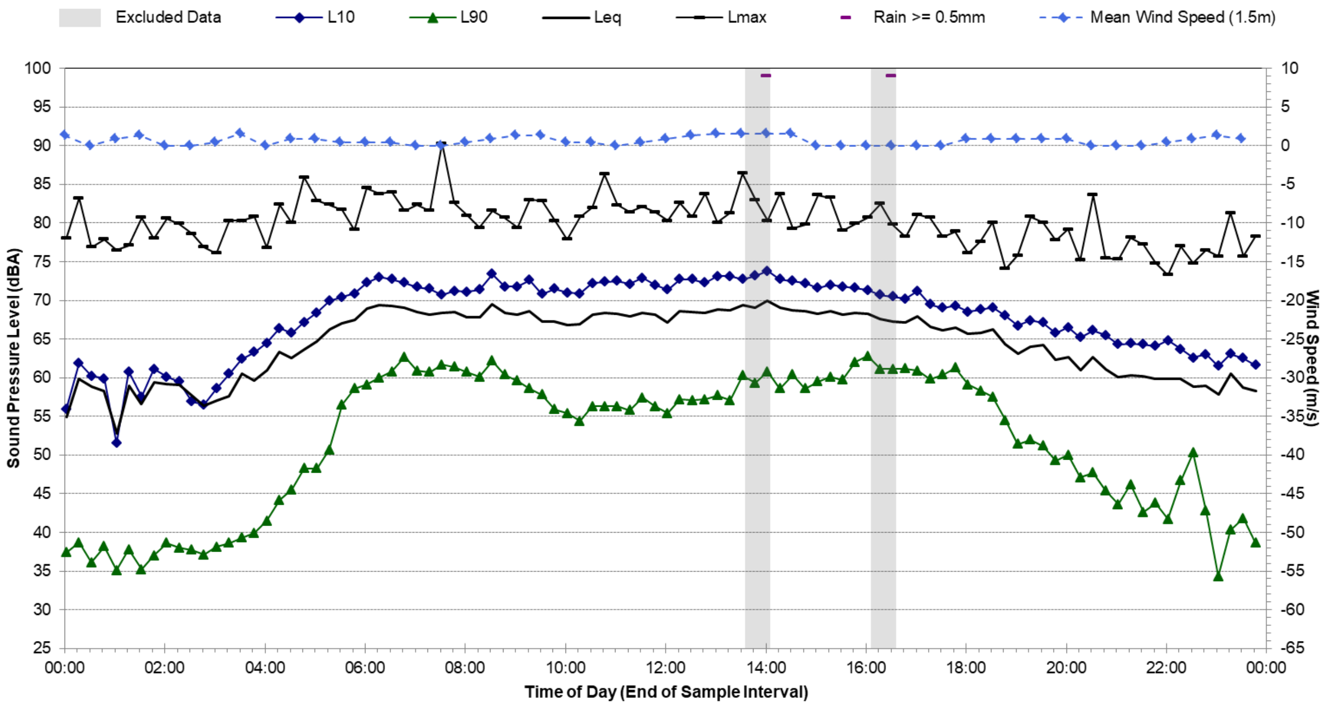
Statistical Ambient Noise Levels

L.03 1383 Elizabeth Drive, Kemps Creek - Tuesday, 27 June 2017



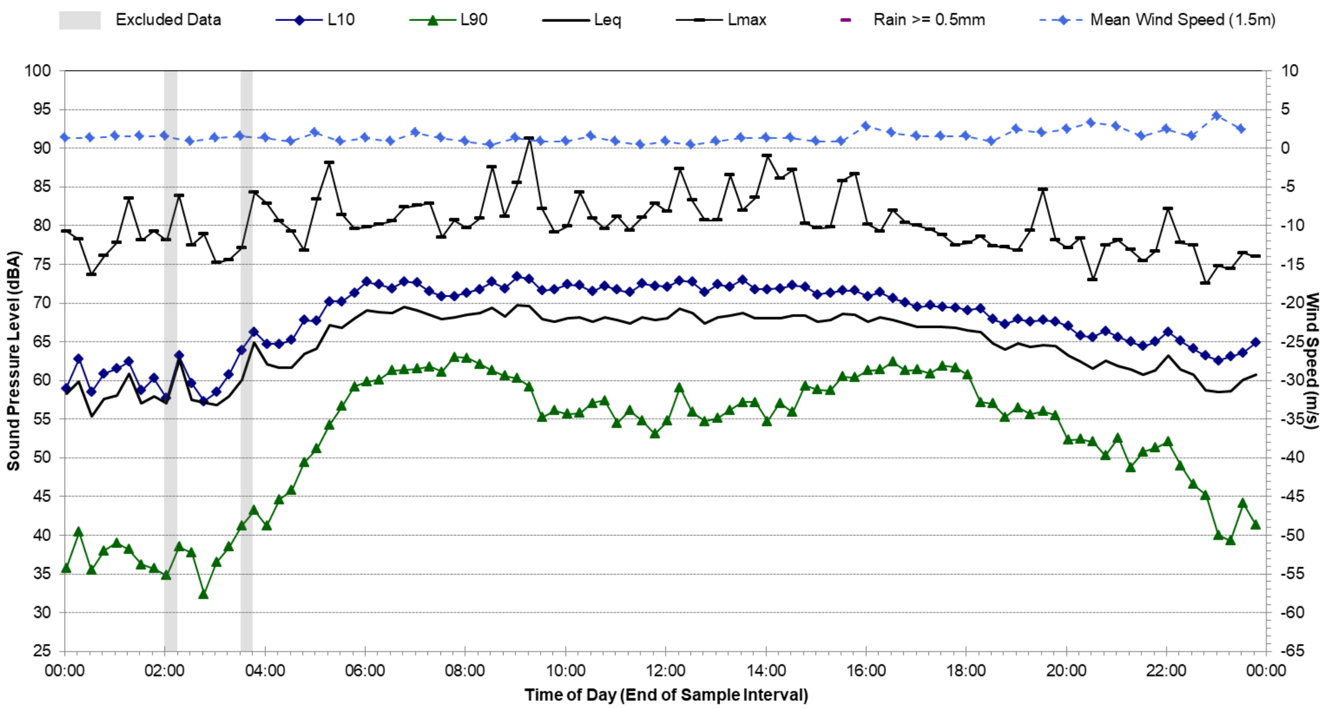
Statistical Ambient Noise Levels

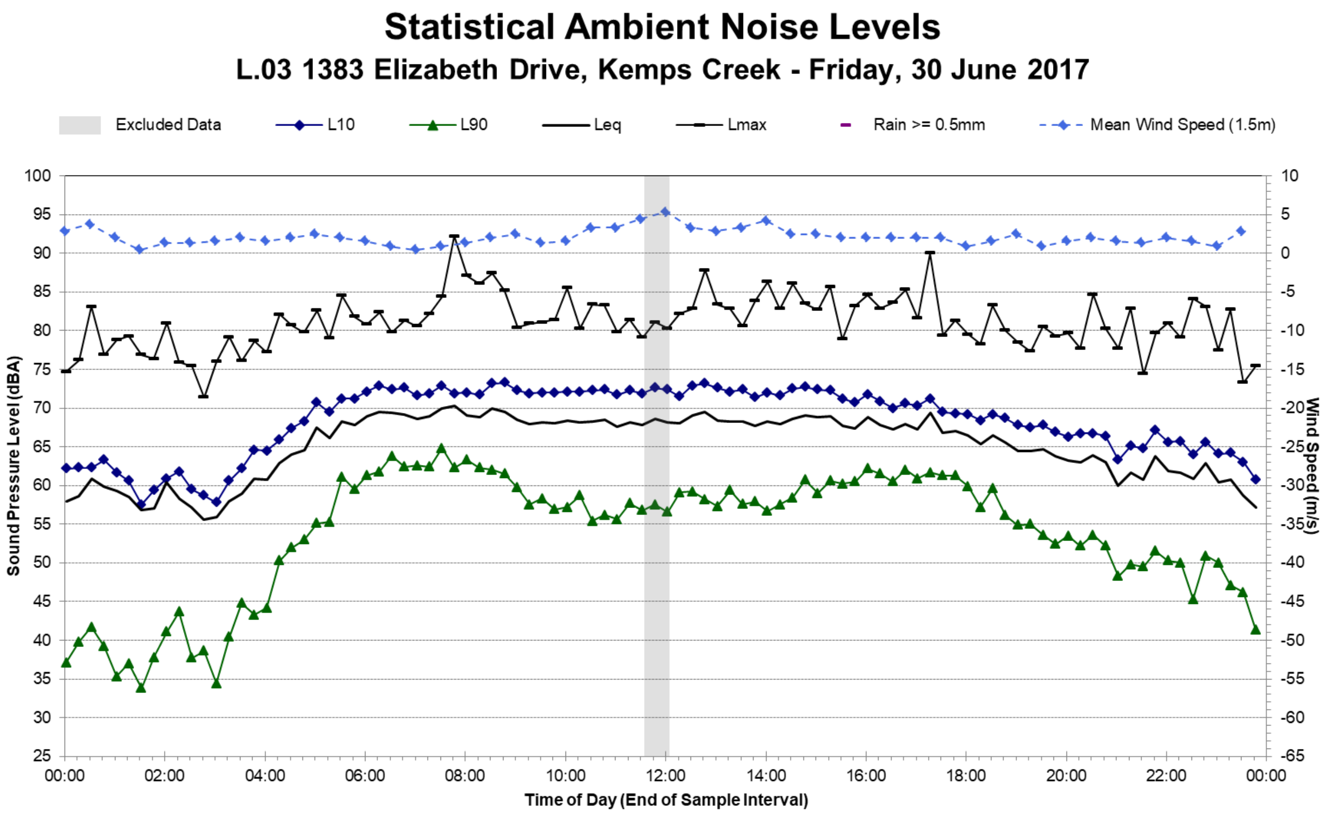
L.03 1383 Elizabeth Drive, Kemps Creek - Wednesday, 28 June 2017

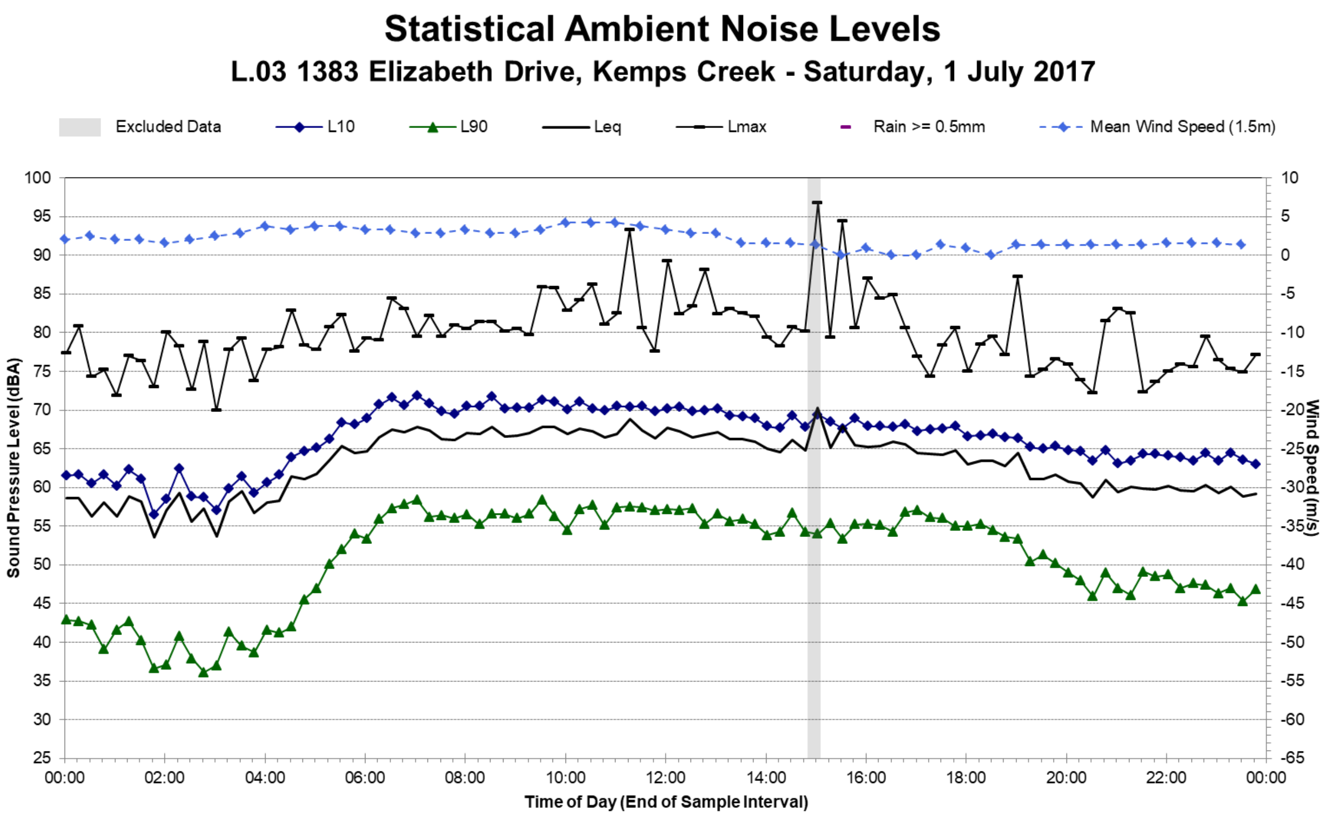


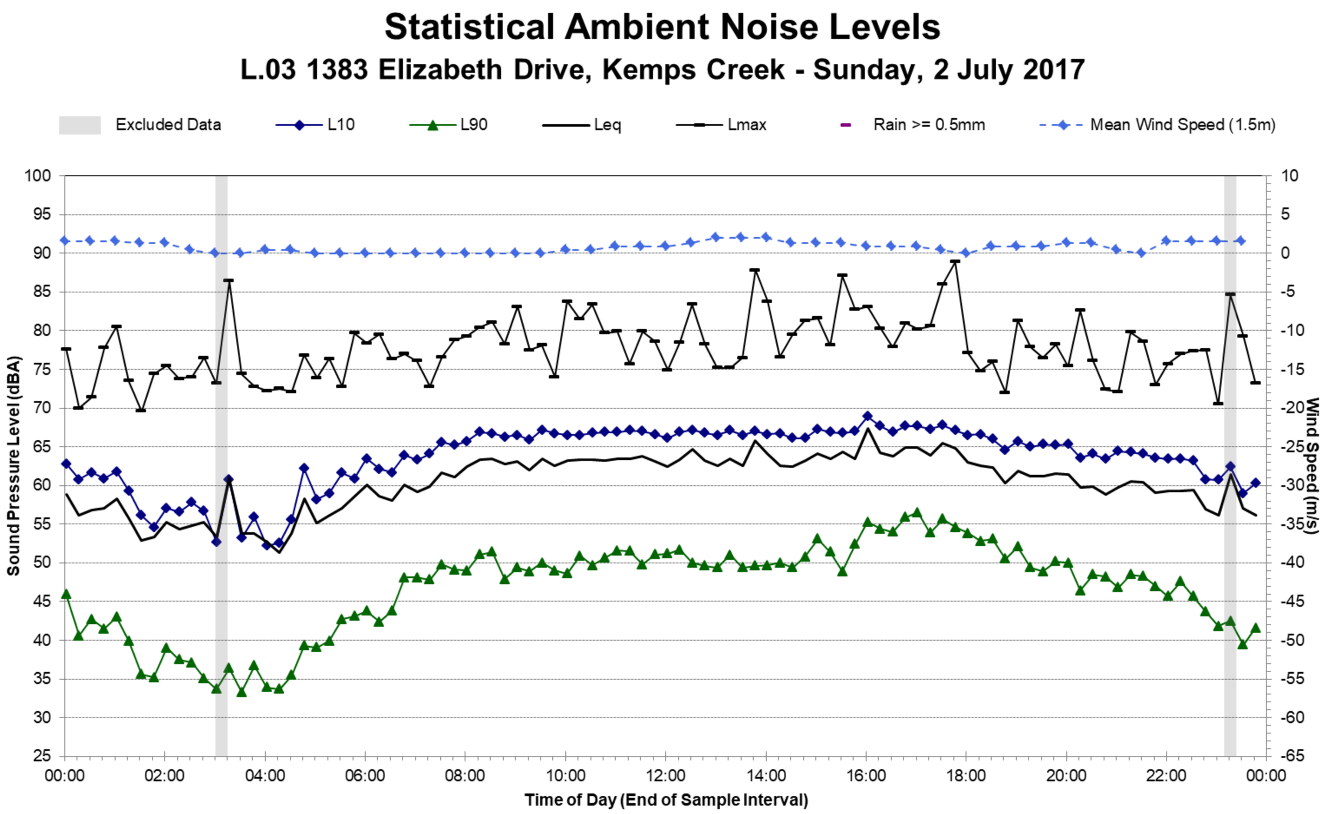
Statistical Ambient Noise Levels

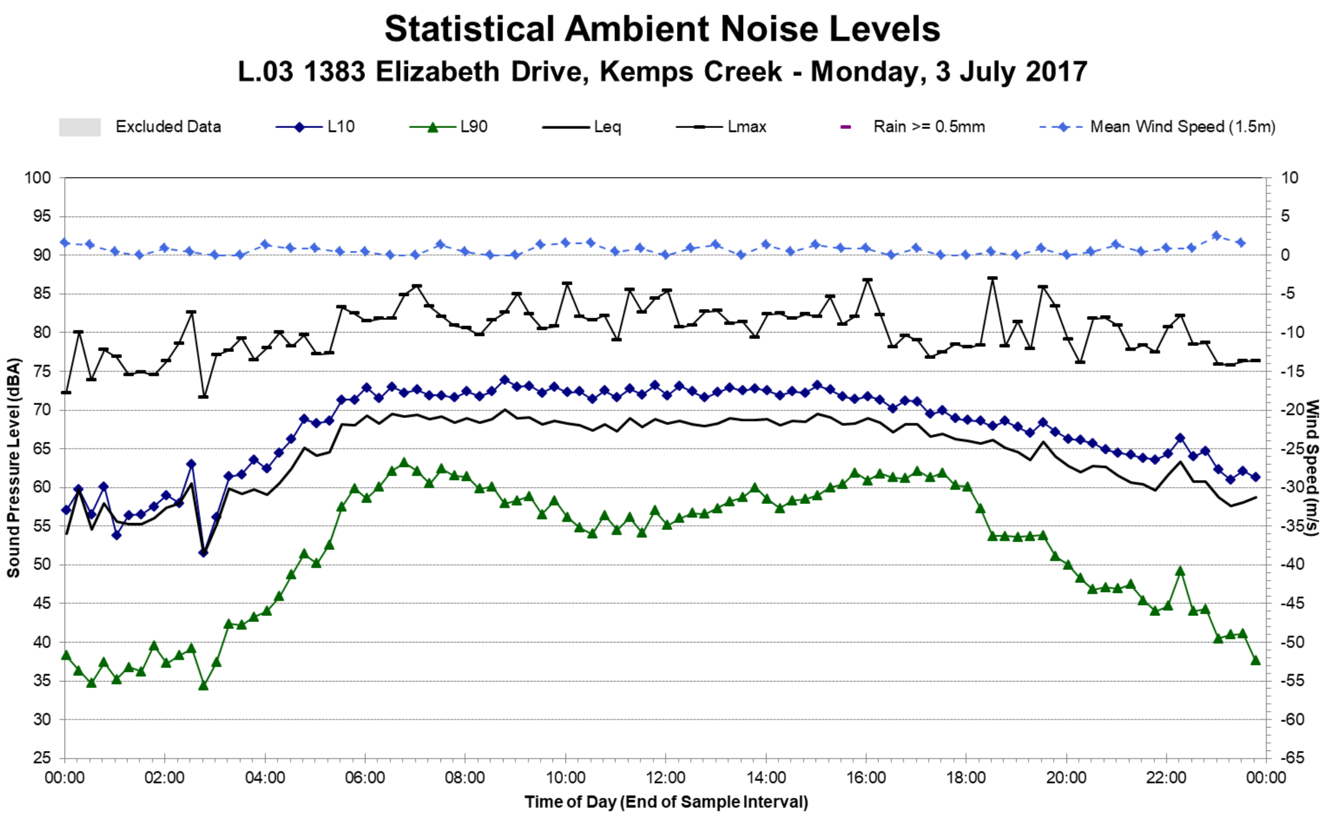
L.03 1383 Elizabeth Drive, Kemps Creek - Thursday, 29 June 2017

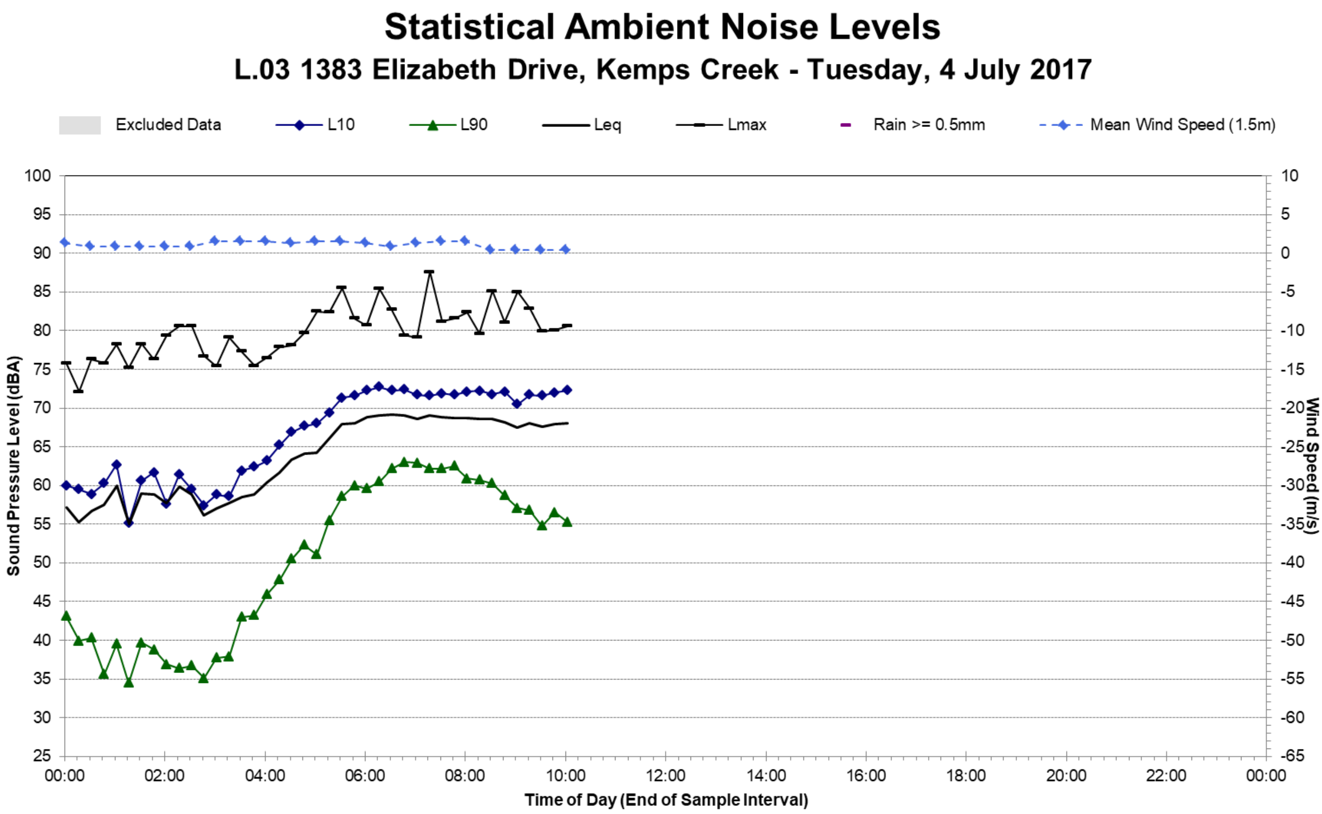



Statistical Ambient Noise Levels
L.03 1383 Elizabeth Drive, Kemps Creek - Friday, 30 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.03 1383 Elizabeth Drive, Kemps Creek - Saturday, 1 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.03 1383 Elizabeth Drive, Kemps Creek - Sunday, 2 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.03 1383 Elizabeth Drive, Kemps Creek - Monday, 3 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.03 1383 Elizabeth Drive, Kemps Creek - Tuesday, 4 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

Noise Monitoring Location	L.04
Noise Monitoring Address	1219 Mamre Road, Kemps Creek

Logger Device Type: Svantek 977, Logger Serial No: 59804

Sound Level Meter Device Type: Brüel and Kjær 2260i, Sound Level Meter Serial No: 2414604

Ambient noise logger deployed at 1219 Mamre Road, Kemps Creek. Logger located approximately 80 m southwest of Mamre Road.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from Mamre Road. Road traffic noise at this location is a mixture of frequent light and heavy vehicle passbys. Noise from light aircraft and wildlife (ie birds) also contributes to the LAeq at this location.

Recorded Noise Levels: (LAmax):

22/06/2017: Road traffic (Mamre Rd): 55-65 dBA, Light aircraft: 58-60 dBA, Birds: 50-70 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – Construction Periods[1]

RBL Noise Level (dBA)				
Morning Shoulder	Day	Evening	Evening Shoulder	Night
54	48	46	52	37

Ambient Noise Logging Results – RNP Defined Time Periods

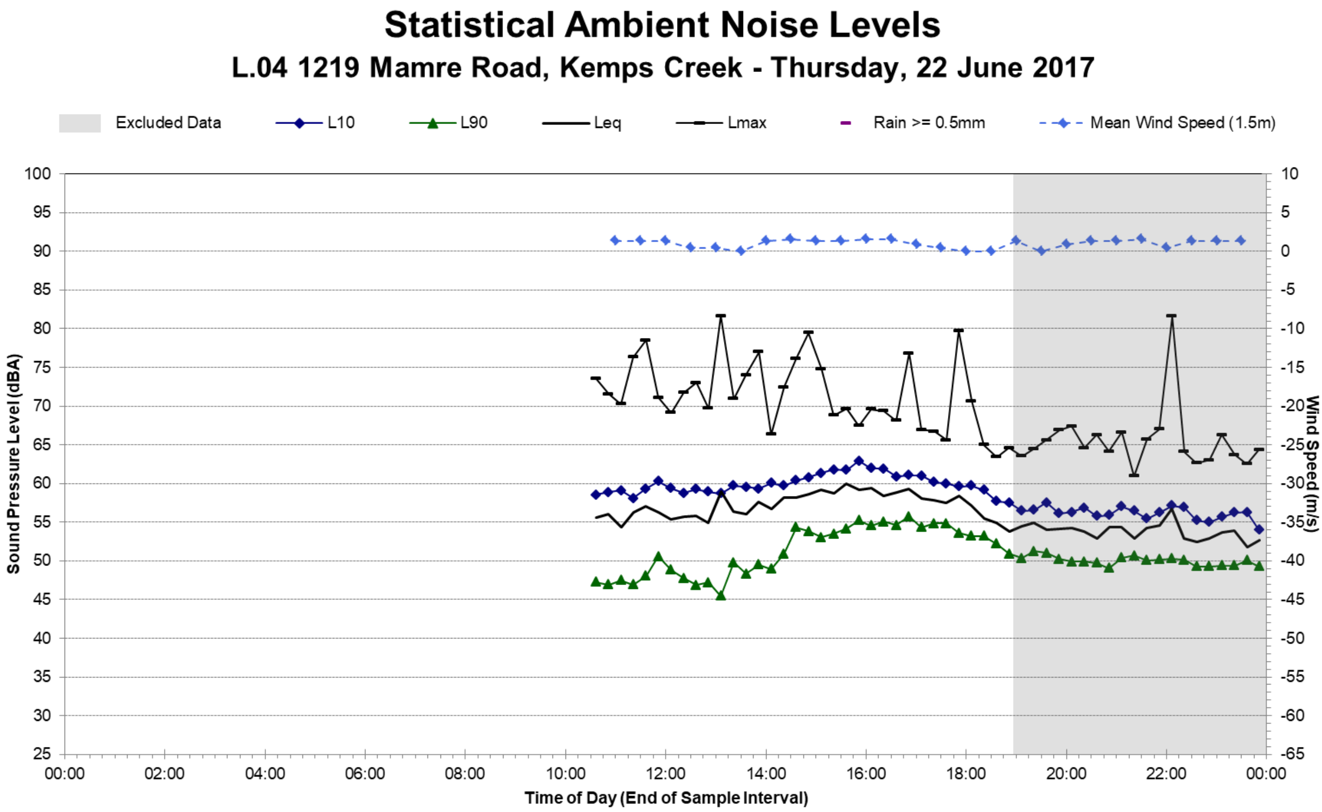
Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	57	59
Night-time (10pm-7am)	55	58

Attended Noise Measurement Results

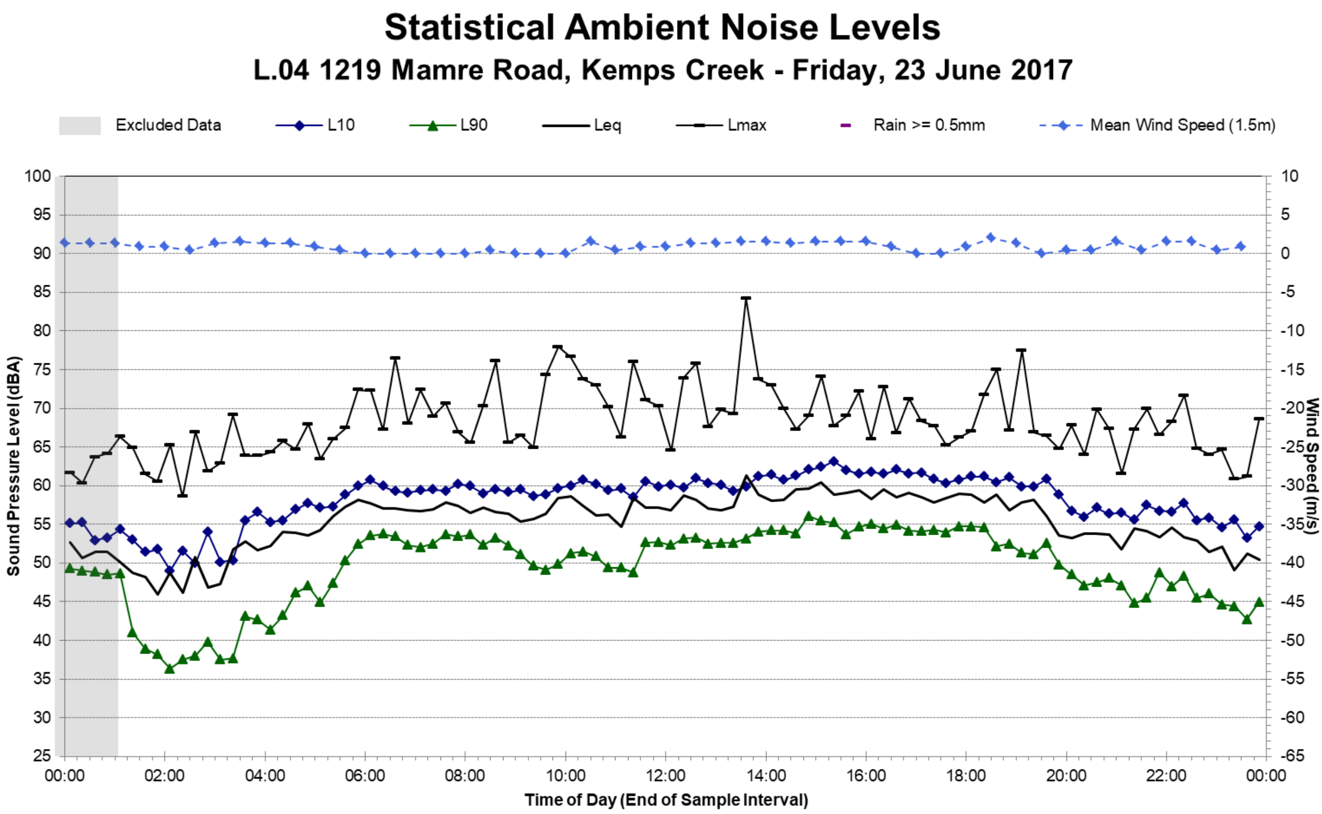
Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
22/06/2017	10:12	47	55	70

Photo of Noise Monitoring Location

Note 1: Morning shoulder is 6 am to 7 am Monday to Friday; Daytime is 7 am to 6 pm Monday to Saturday & 8 am to 6 pm Sunday & Public Holidays; Evening is 7 pm to 10 pm Monday to Friday & 6 pm to 10 pm Saturday, Sunday & Public Holidays; Evening shoulder is 6 pm to 7 pm Monday to Friday; Night-time is 10 pm to 6 am Monday to Friday, 10 pm to 7 am Saturday & 10 pm to 8 am Sunday and Public Holidays.

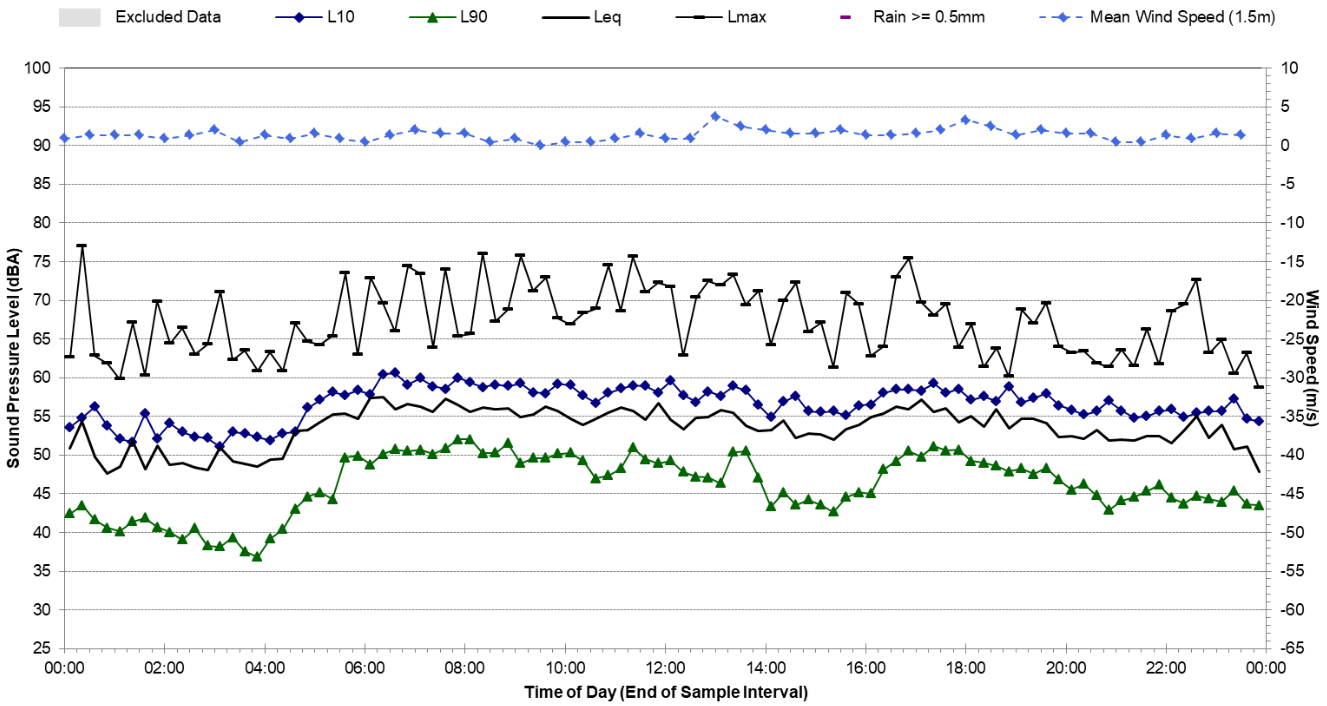


Statistical Ambient Noise Levels
L.04 1219 Mamre Road, Kemps Creek - Thursday, 22 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

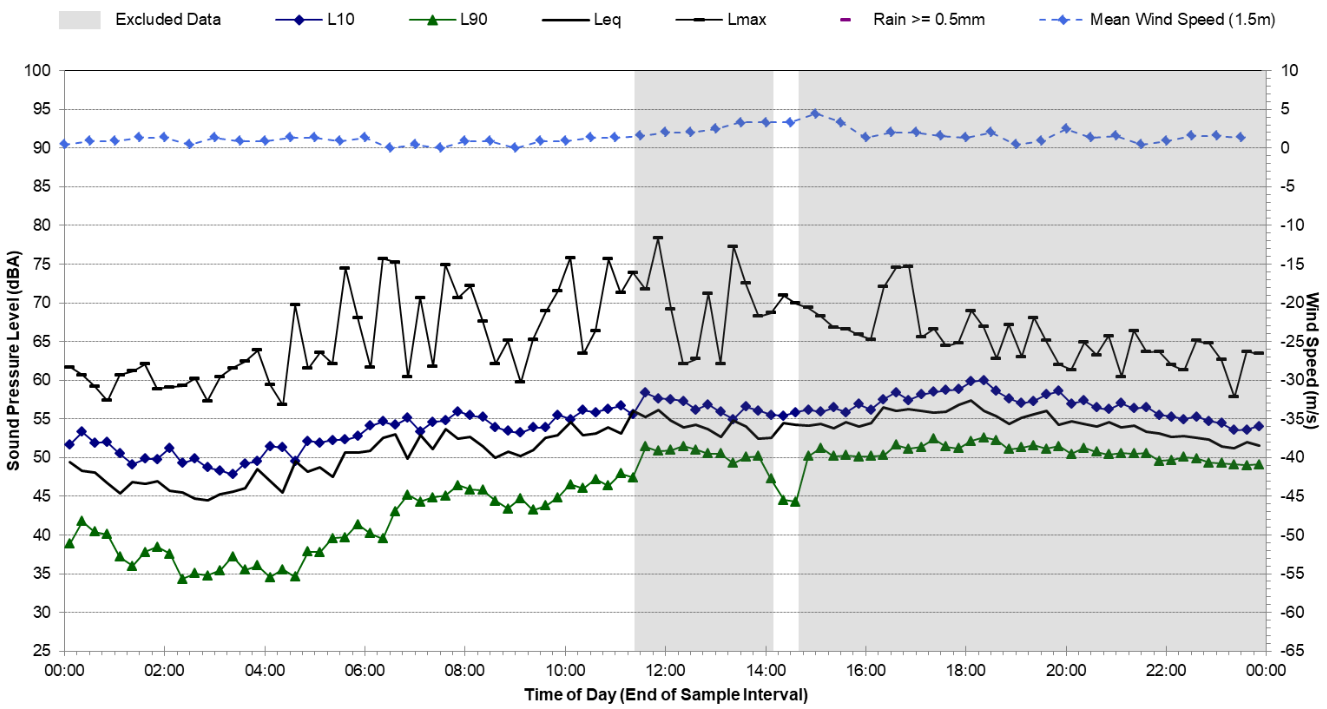


Statistical Ambient Noise Levels
L.04 1219 Mamre Road, Kemps Creek - Friday, 23 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Statistical Ambient Noise Levels
L.04 1219 Mamre Road, Kemps Creek - Saturday, 24 June 2017

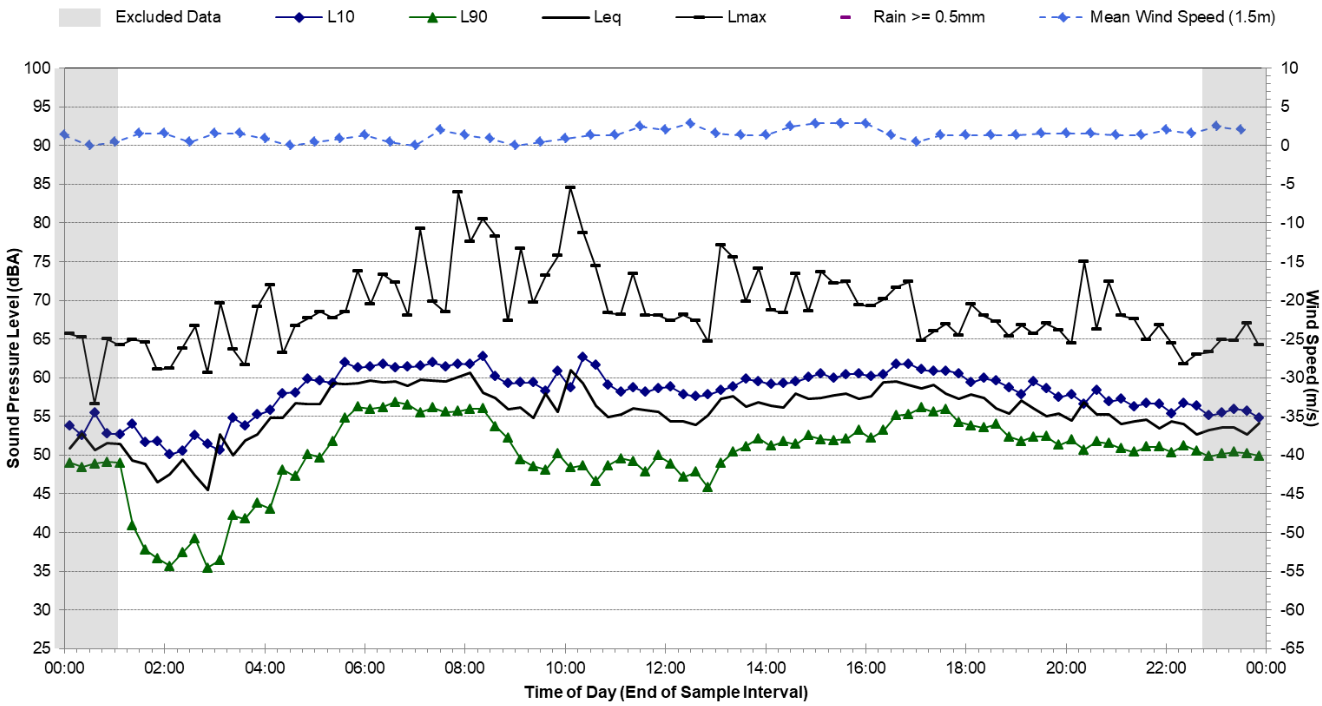


Statistical Ambient Noise Levels
L.04 1219 Mamre Road, Kemps Creek - Sunday, 25 June 2017



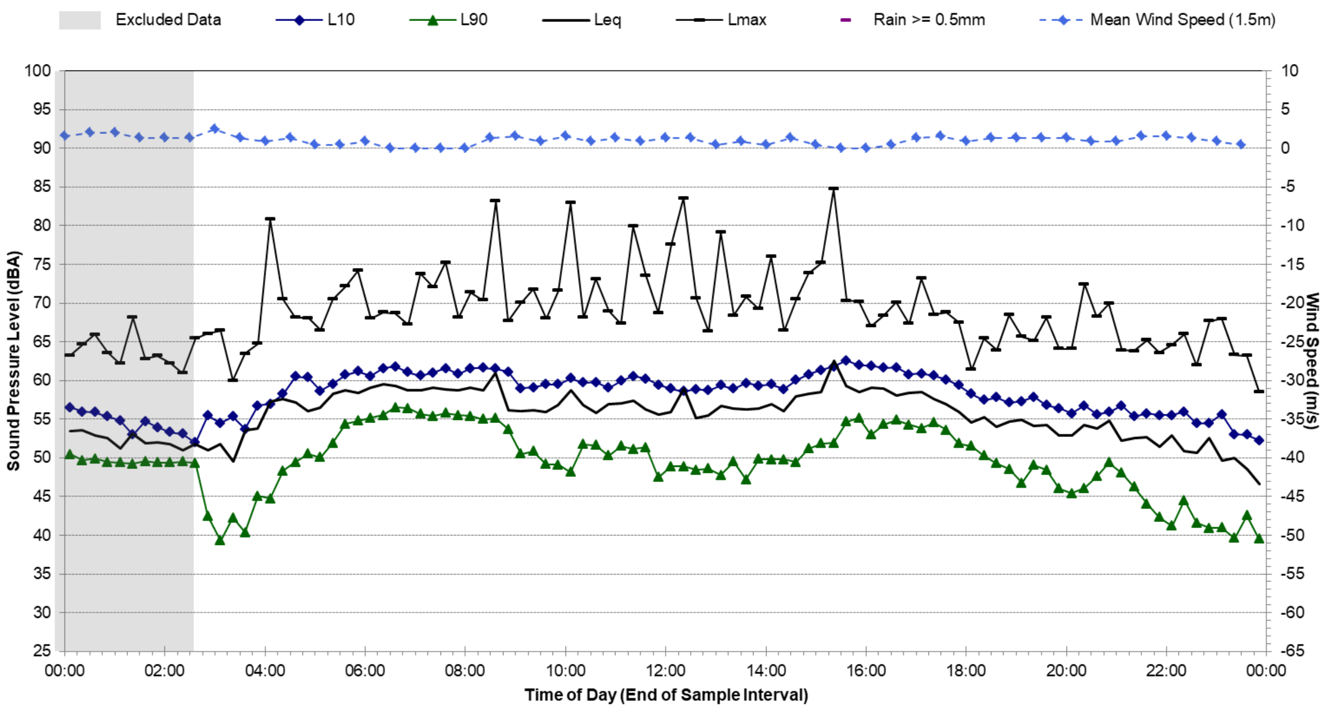
Statistical Ambient Noise Levels

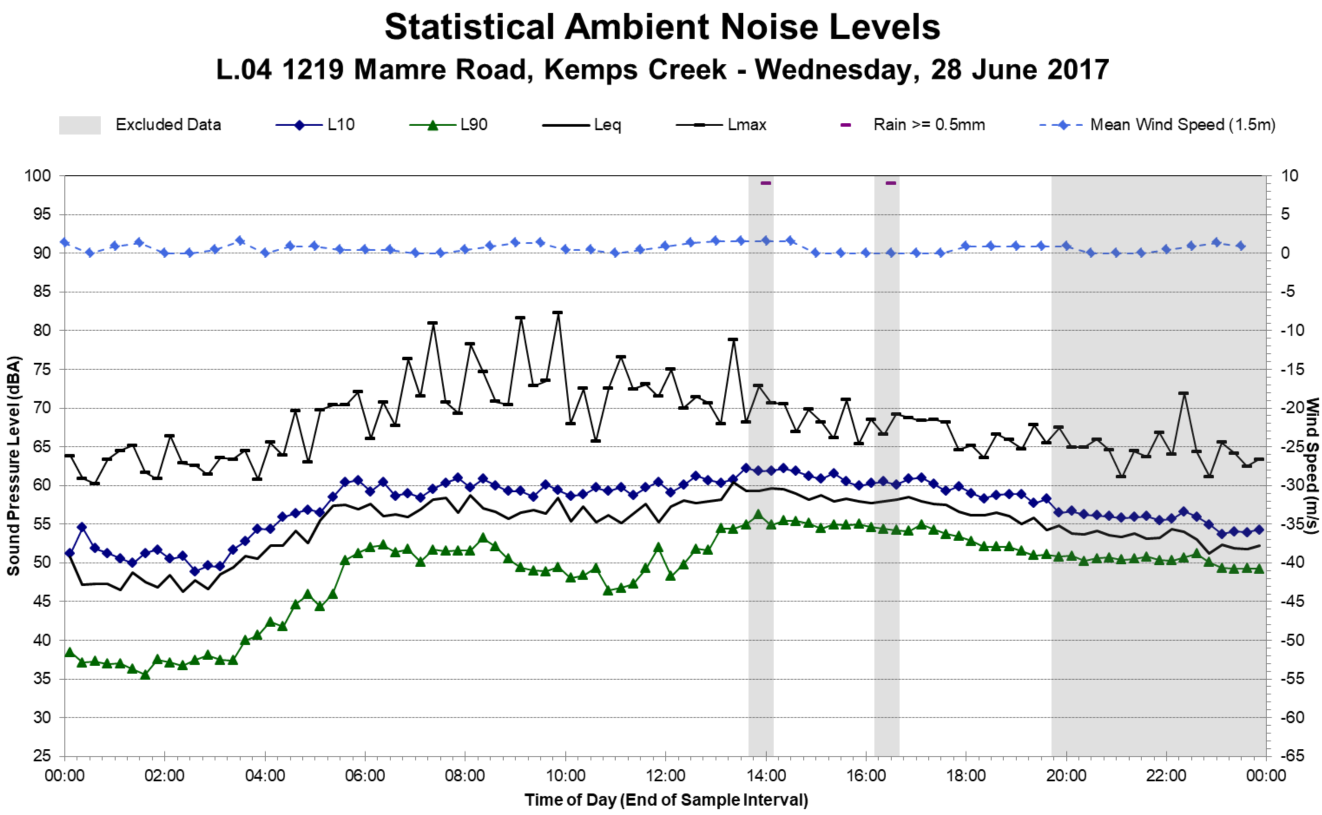
L.04 1219 Mamre Road, Kemps Creek - Monday, 26 June 2017

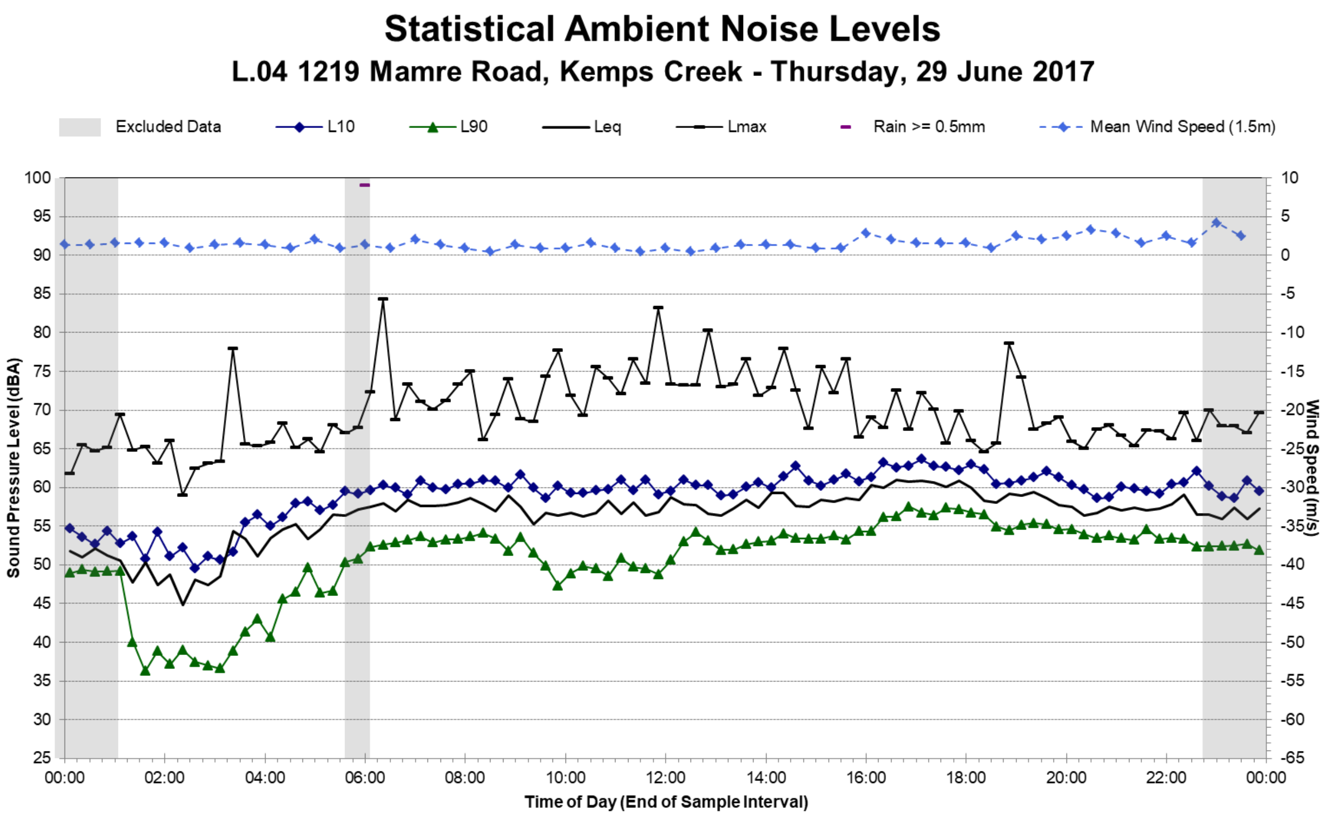


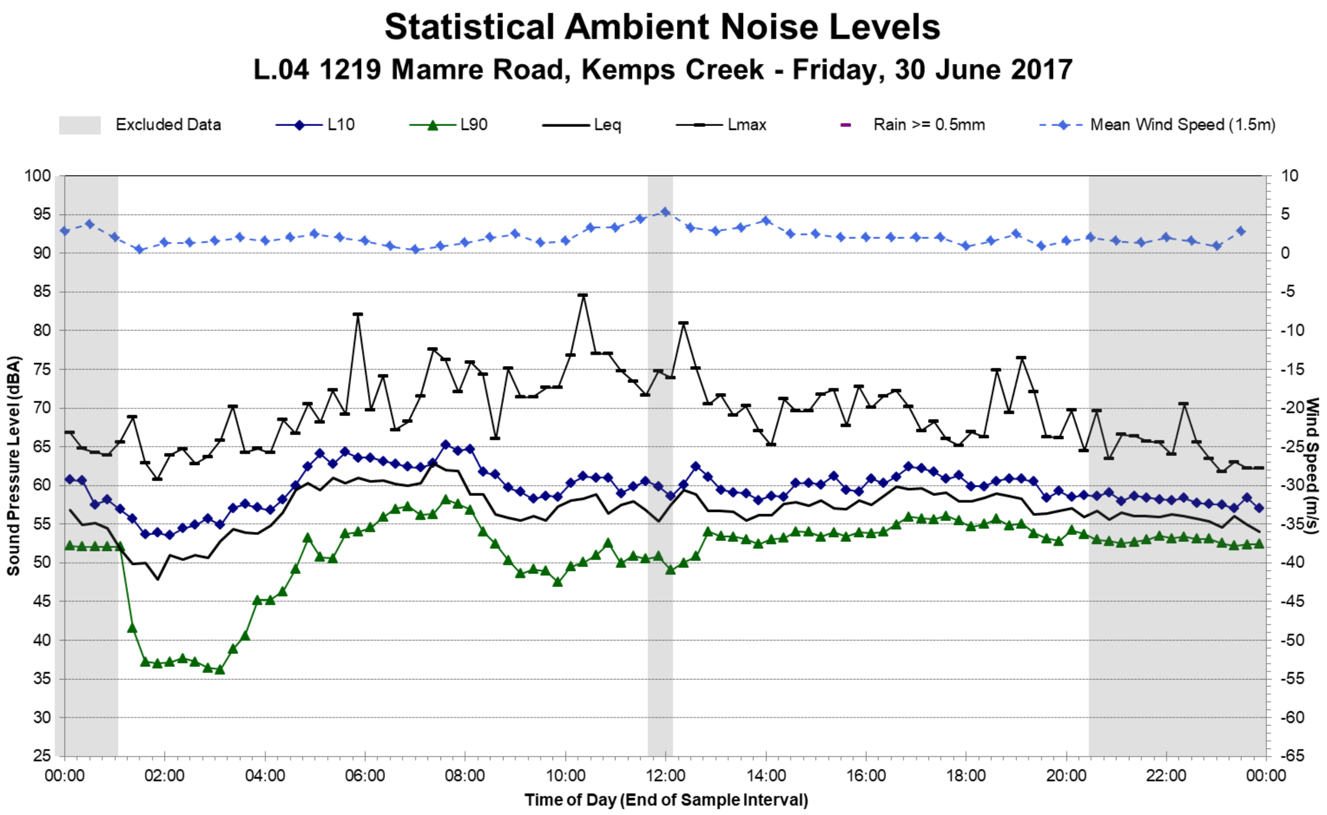
Statistical Ambient Noise Levels

L.04 1219 Mamre Road, Kemps Creek - Tuesday, 27 June 2017

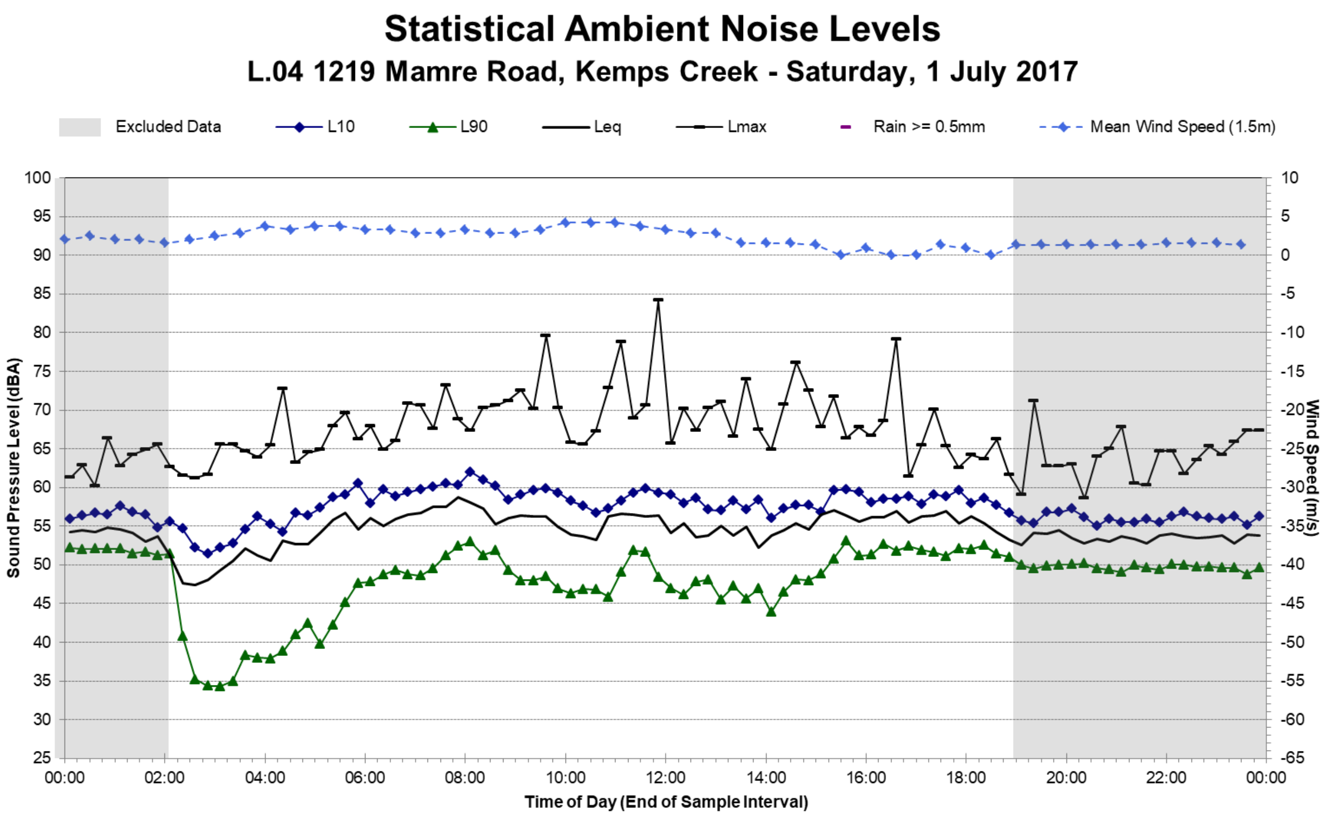



Statistical Ambient Noise Levels
L.04 1219 Mamre Road, Kemps Creek - Wednesday, 28 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

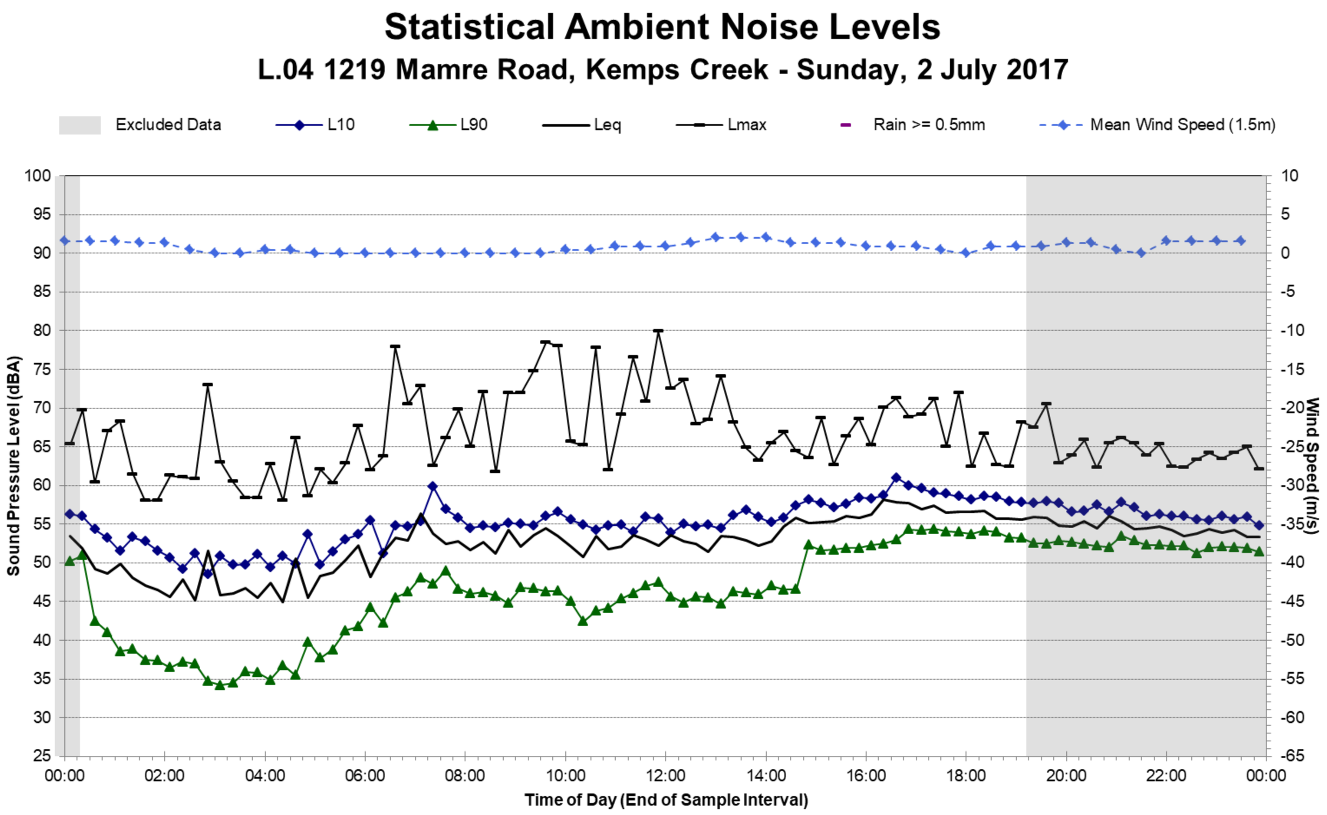

Statistical Ambient Noise Levels
L.04 1219 Mamre Road, Kemps Creek - Thursday, 29 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



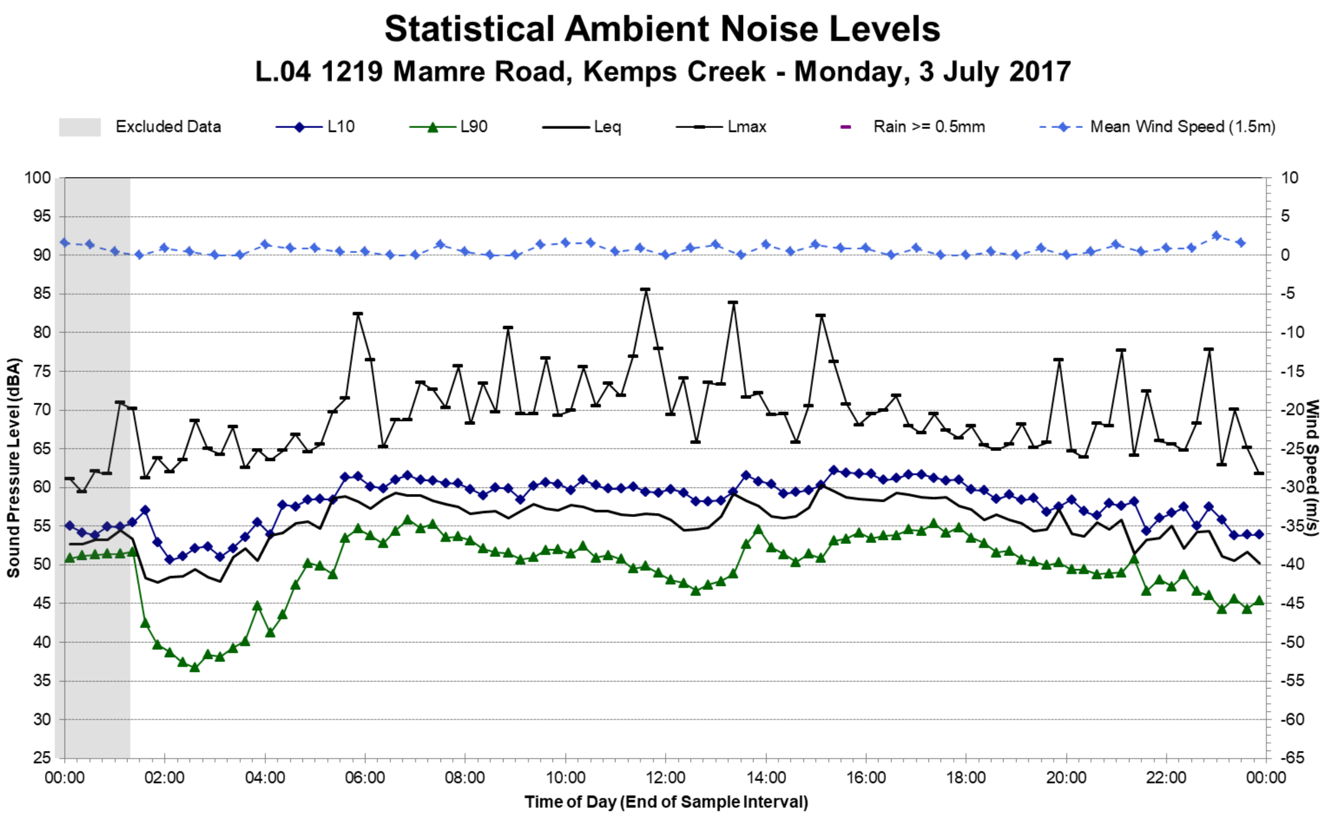
Statistical Ambient Noise Levels
L.04 1219 Mamre Road, Kemps Creek - Friday, 30 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



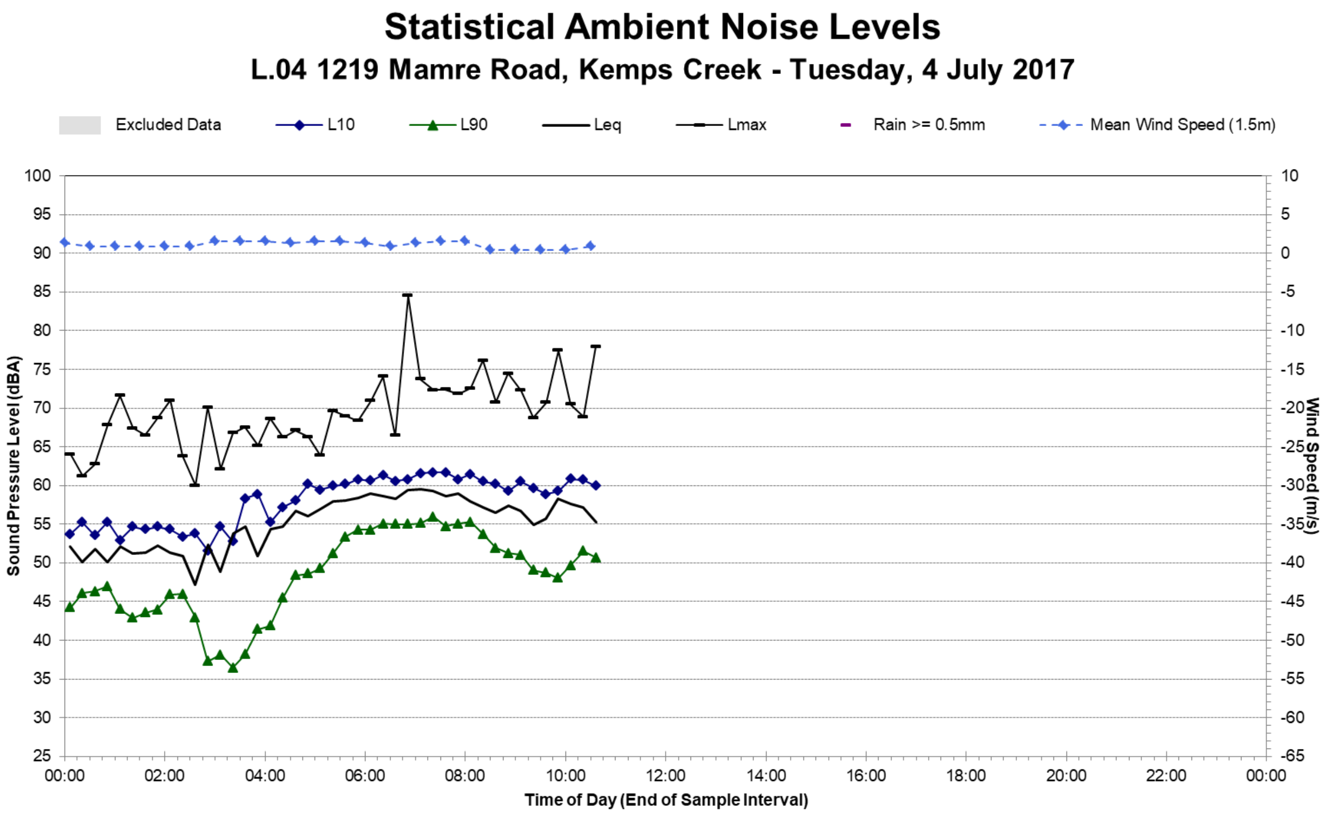
Statistical Ambient Noise Levels
L.04 1219 Mamre Road, Kemps Creek - Saturday, 1 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
L.04 1219 Mamre Road, Kemps Creek - Sunday, 2 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
L.04 1219 Mamre Road, Kemps Creek - Monday, 3 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.04 1219 Mamre Road, Kemps Creek - Tuesday, 4 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
-60
-65
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

Noise Monitoring Location	L.05
Noise Monitoring Address	12-20 Salisbury Avenue, Kemps Creek

Logger Device Type: Svantek 977, Logger Serial No: 59805

Sound Level Meter Device Type: Brüel and Kjær 2260i, Sound Level Meter Serial No: 2414604

Ambient noise logger deployed at residential address 12-20 Salisbury Avenue, Kemps Creek. Logger located approximately 600 m north of Elizabeth Drive, 400 m east of Clifton Avenue and 650 m southwest of Mamre Road.

Attended noise measurements indicate the ambient noise environment at this location is dominated by distant traffic noise from Mamre Road and Elizabeth Drive. Noise from wildlife and light aircraft also contributes to the LAeq at this location.

Recorded Noise Levels: (LAmax):

04/07/2017: Distant road traffic (Elizabeth Dr & Mamre Rd): 46-52 dBA, Light aircraft: 56-60 dBA, Birds and insects: 48-72 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – Construction Periods[1]

RBL Noise Level (dBA)				
Morning Shoulder	Day	Evening	Evening Shoulder	Night
49	39	42	45	35

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	49	52
Night-time (10pm-7am)	48	54

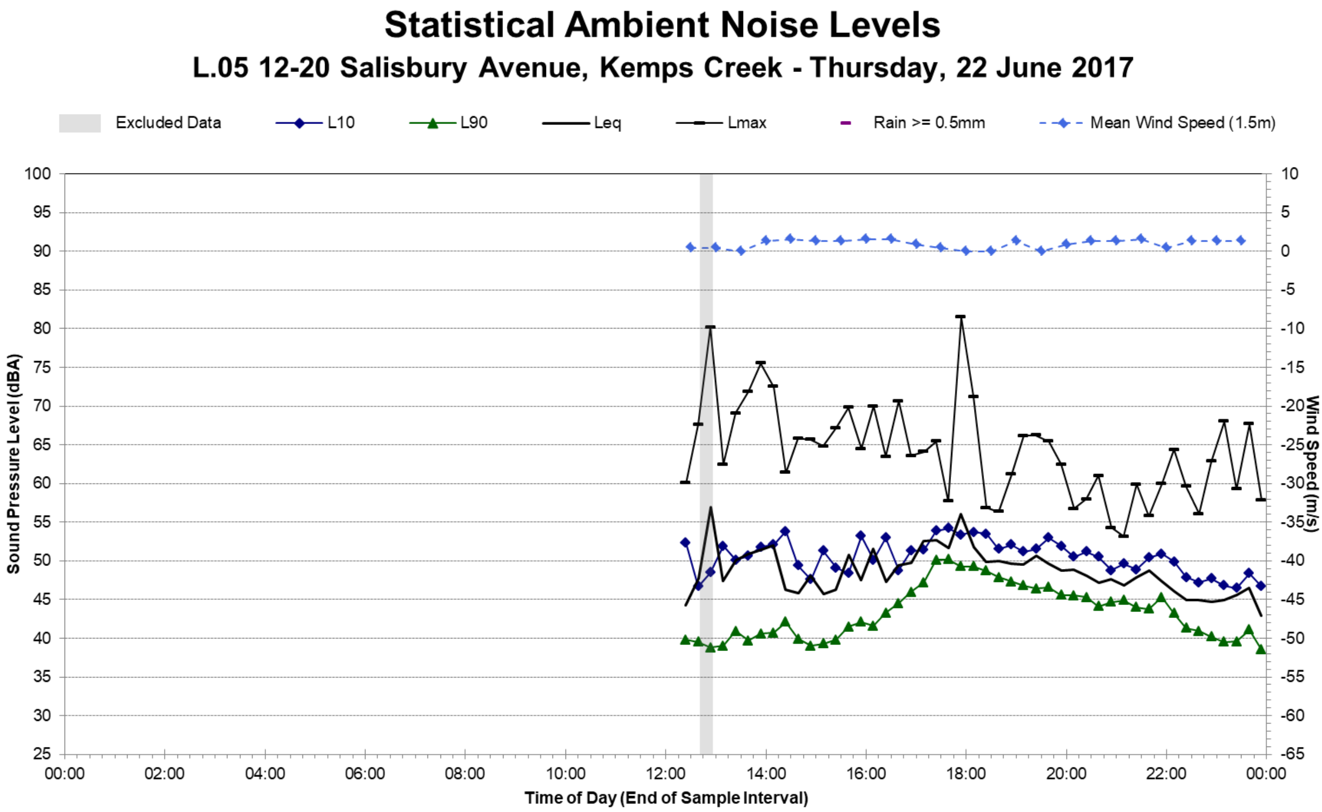
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
04/07/2017	11:36	43	50	79

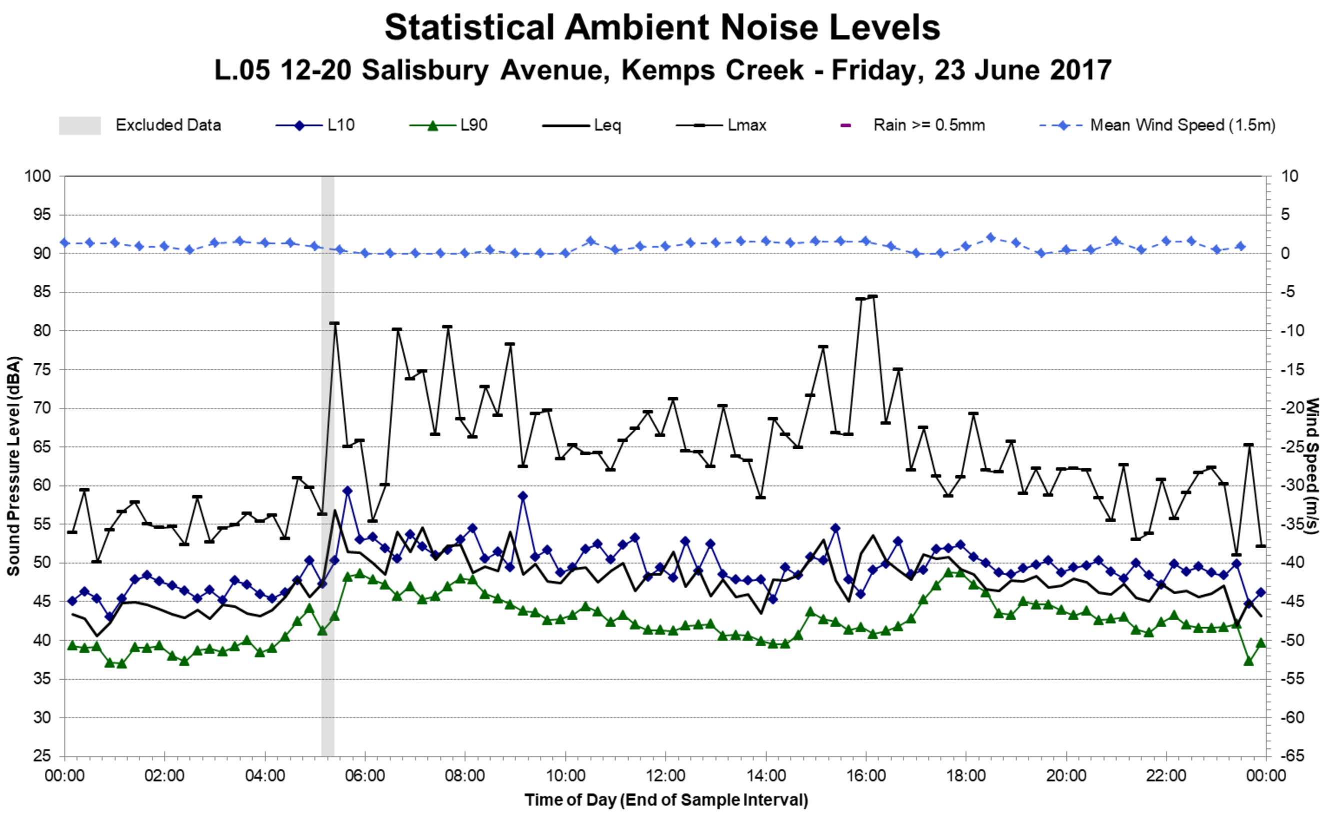
Photo of Noise Monitoring Location

Photo unavailable

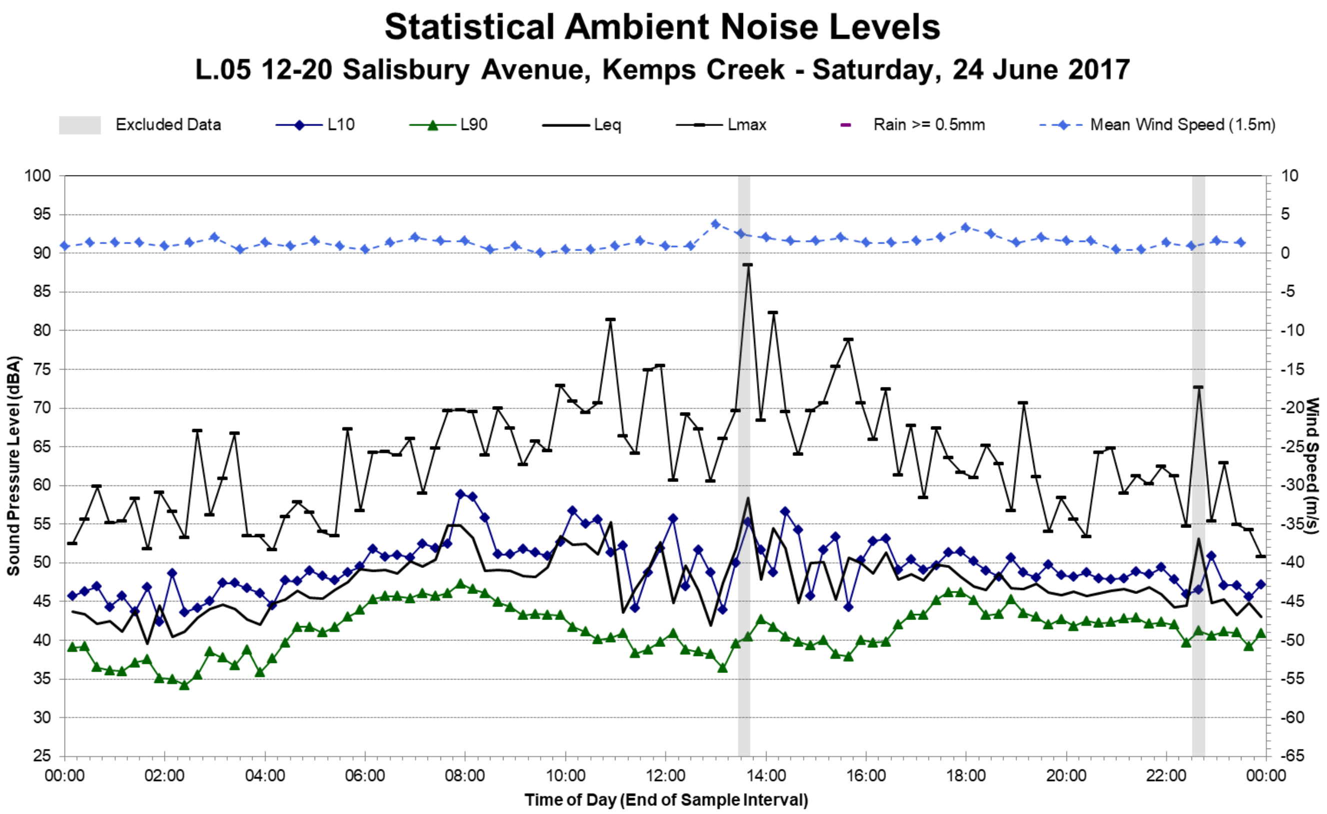
Note 1: Morning shoulder is 6 am to 7 am Monday to Friday; Daytime is 7 am to 6 pm Monday to Saturday & 8 am to 6 pm Sunday & Public Holidays; Evening is 7 pm to 10 pm Monday to Friday & 6 pm to 10 pm Saturday, Sunday & Public Holidays; Evening shoulder is 6 pm to 7 pm Monday to Friday; Night-time is 10 pm to 6 am Monday to Friday, 10 pm to 7 am Saturday & 10 pm to 8 am Sunday and Public Holidays.



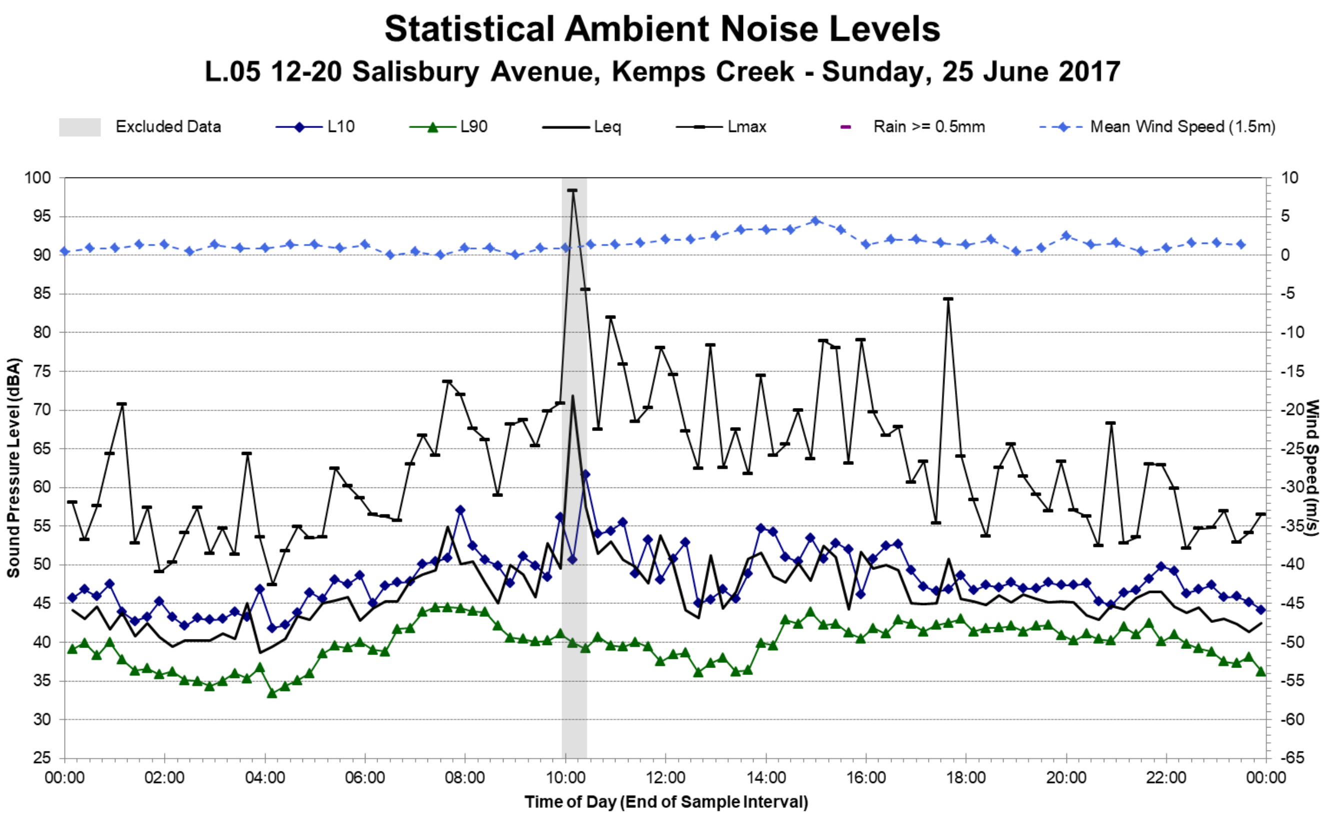
Statistical Ambient Noise Levels
L.05 12-20 Salisbury Avenue, Kemps Creek - Thursday, 22 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



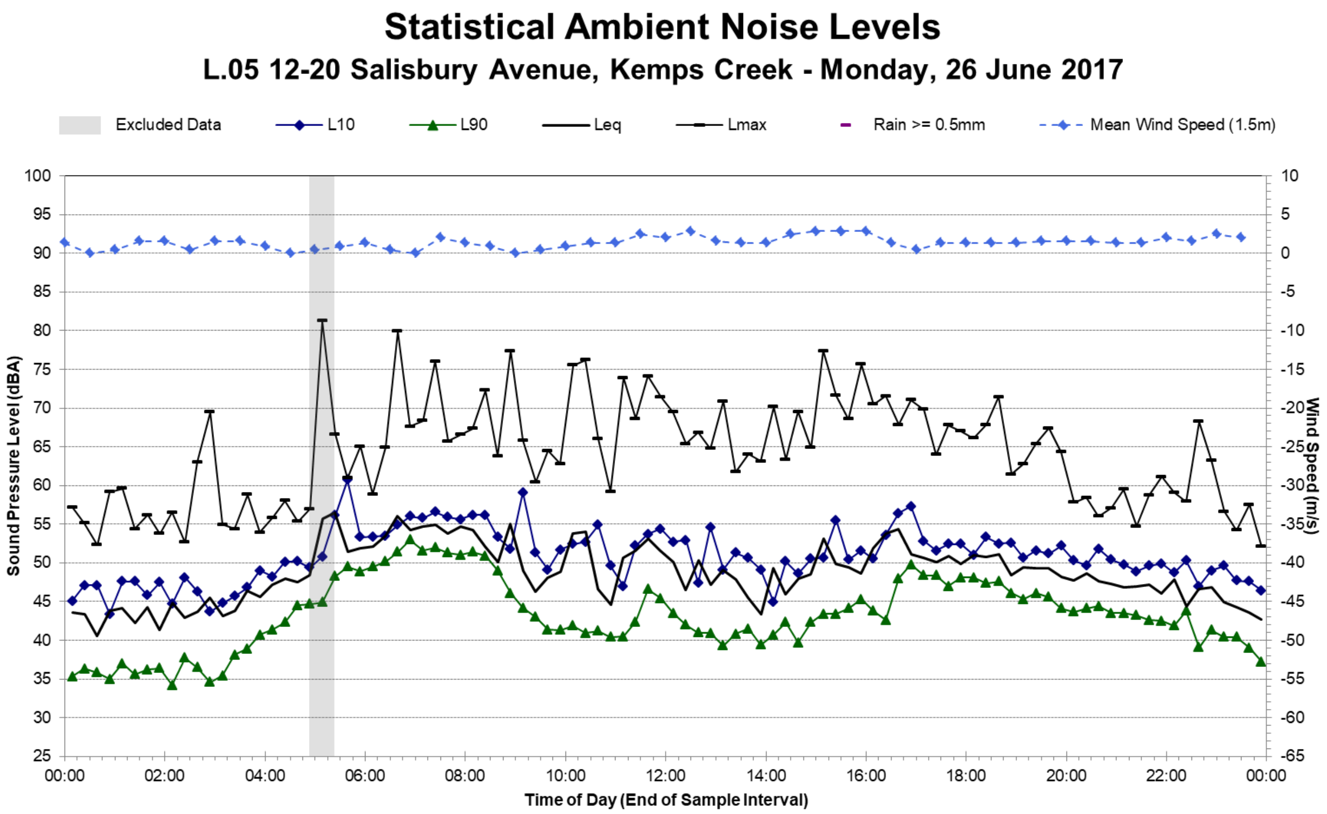
Statistical Ambient Noise Levels
L.05 12-20 Salisbury Avenue, Kemps Creek - Friday, 23 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



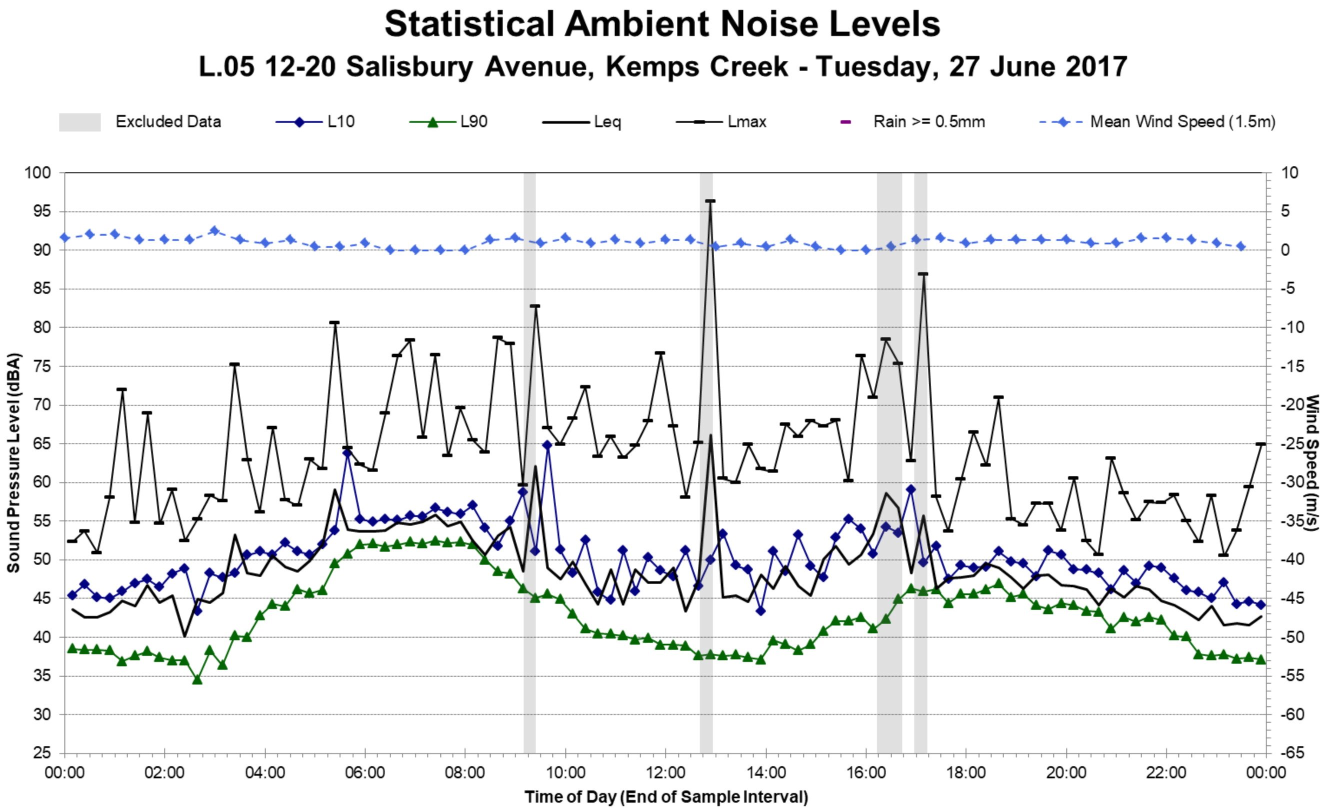
Statistical Ambient Noise Levels
L.05 12-20 Salisbury Avenue, Kemps Creek - Saturday, 24 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



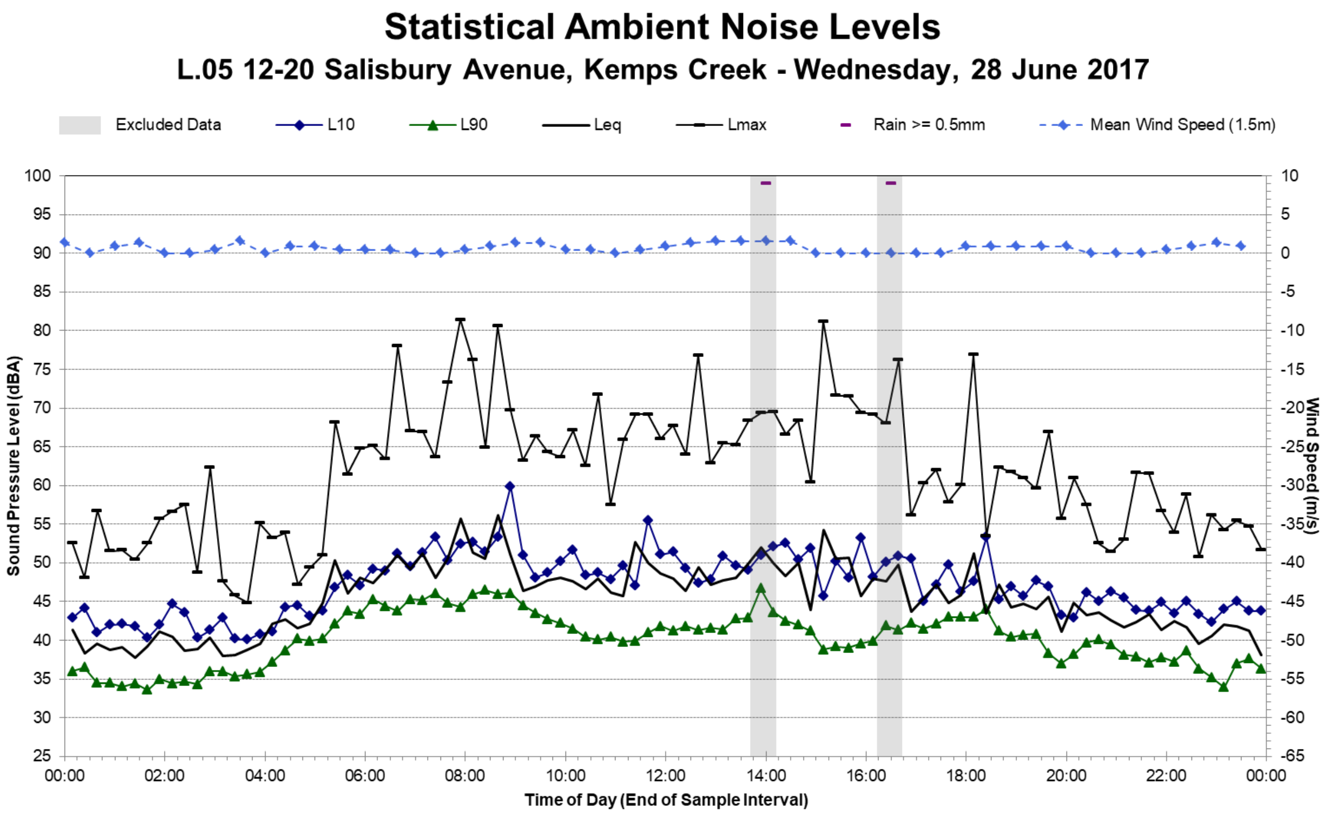
Statistical Ambient Noise Levels
L.05 12-20 Salisbury Avenue, Kemps Creek - Sunday, 25 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

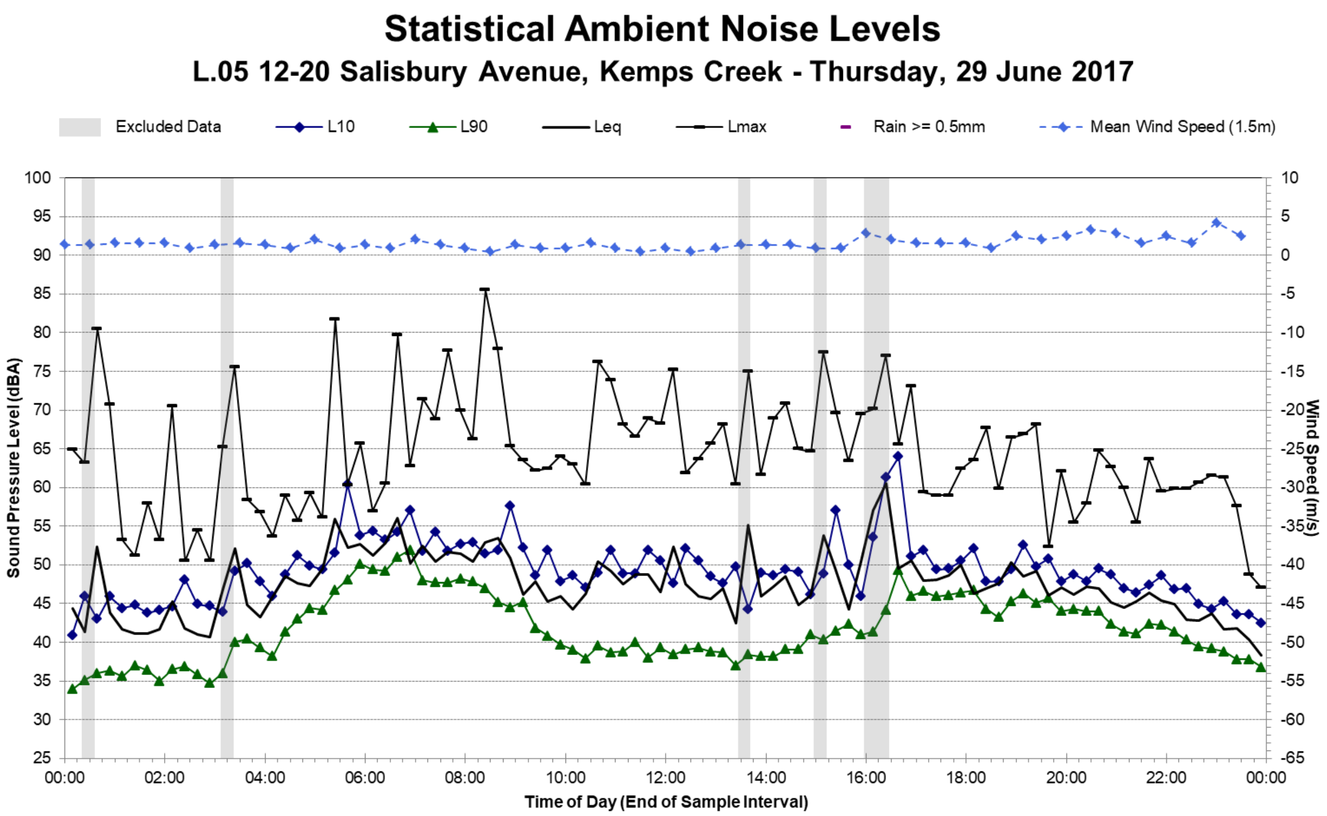


Statistical Ambient Noise Levels
L.05 12-20 Salisbury Avenue, Kemps Creek - Monday, 26 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



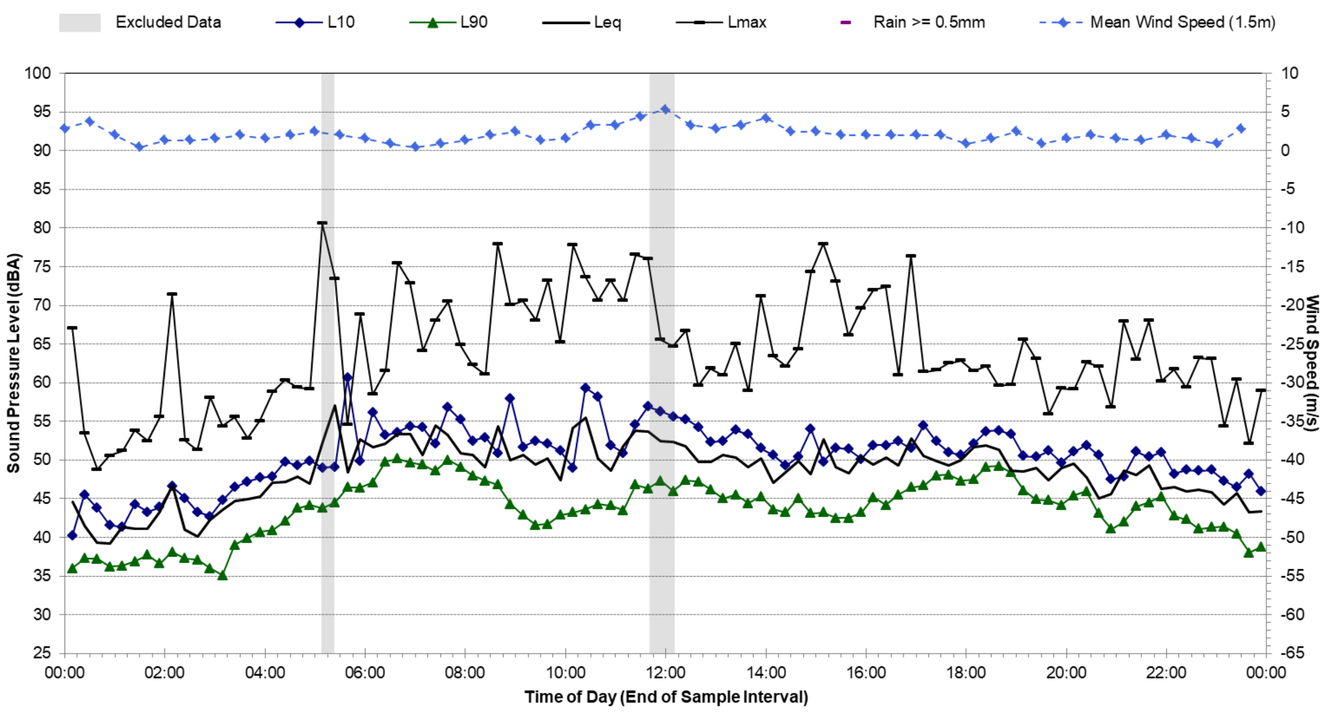
Statistical Ambient Noise Levels
L.05 12-20 Salisbury Avenue, Kemps Creek - Tuesday, 27 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.05 12-20 Salisbury Avenue, Kemps Creek - Wednesday, 28 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.05 12-20 Salisbury Avenue, Kemps Creek - Thursday, 29 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

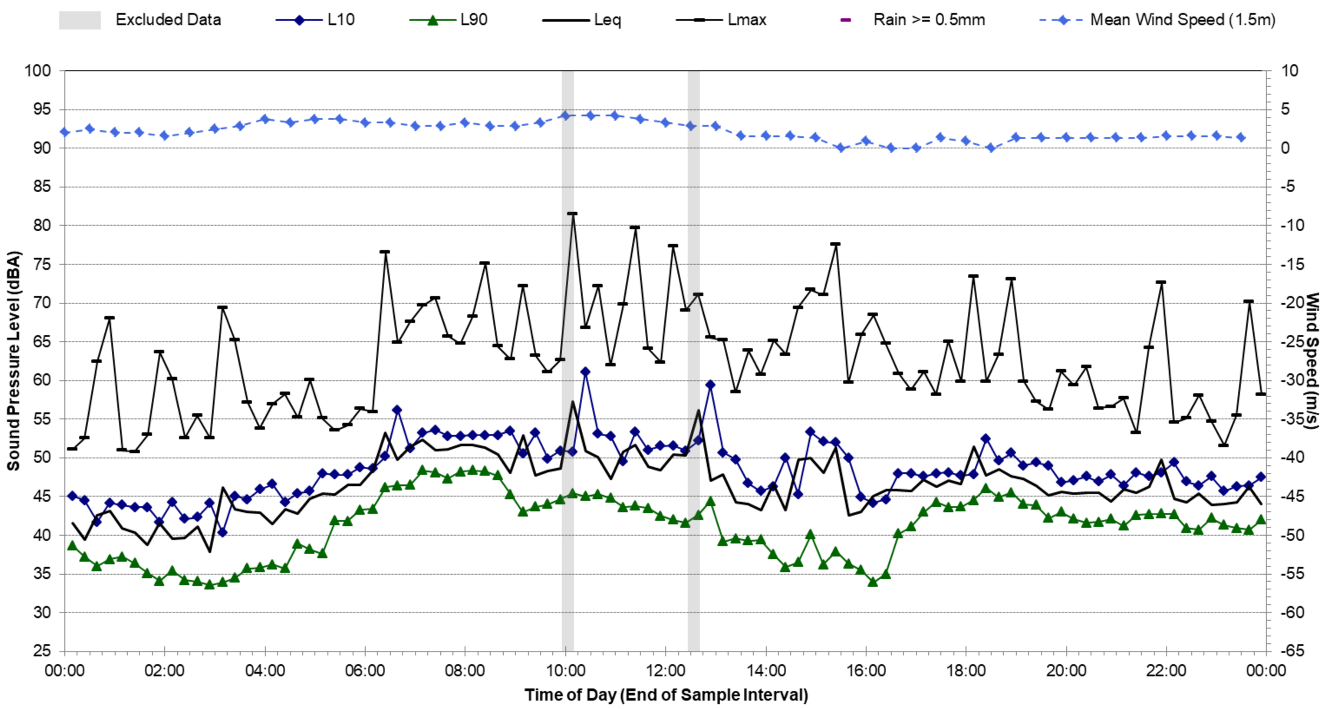
Statistical Ambient Noise Levels

L.05 12-20 Salisbury Avenue, Kemps Creek - Friday, 30 June 2017

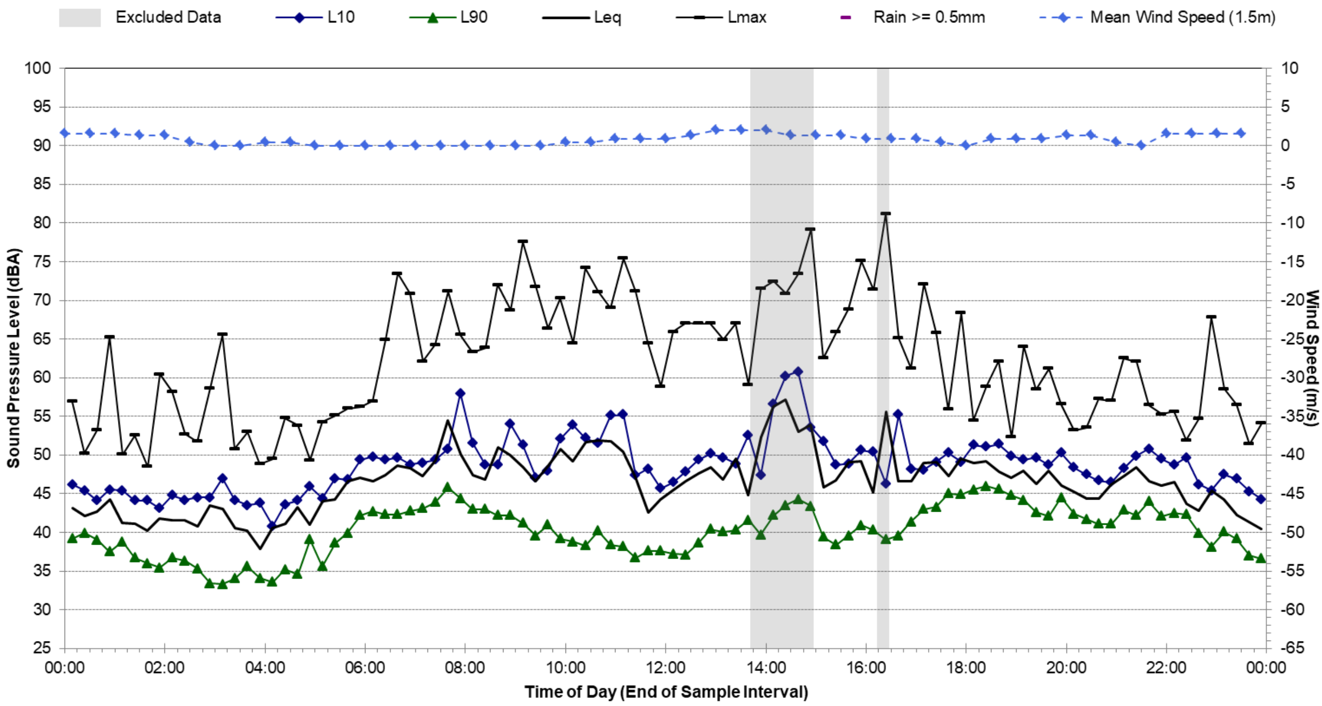


Statistical Ambient Noise Levels

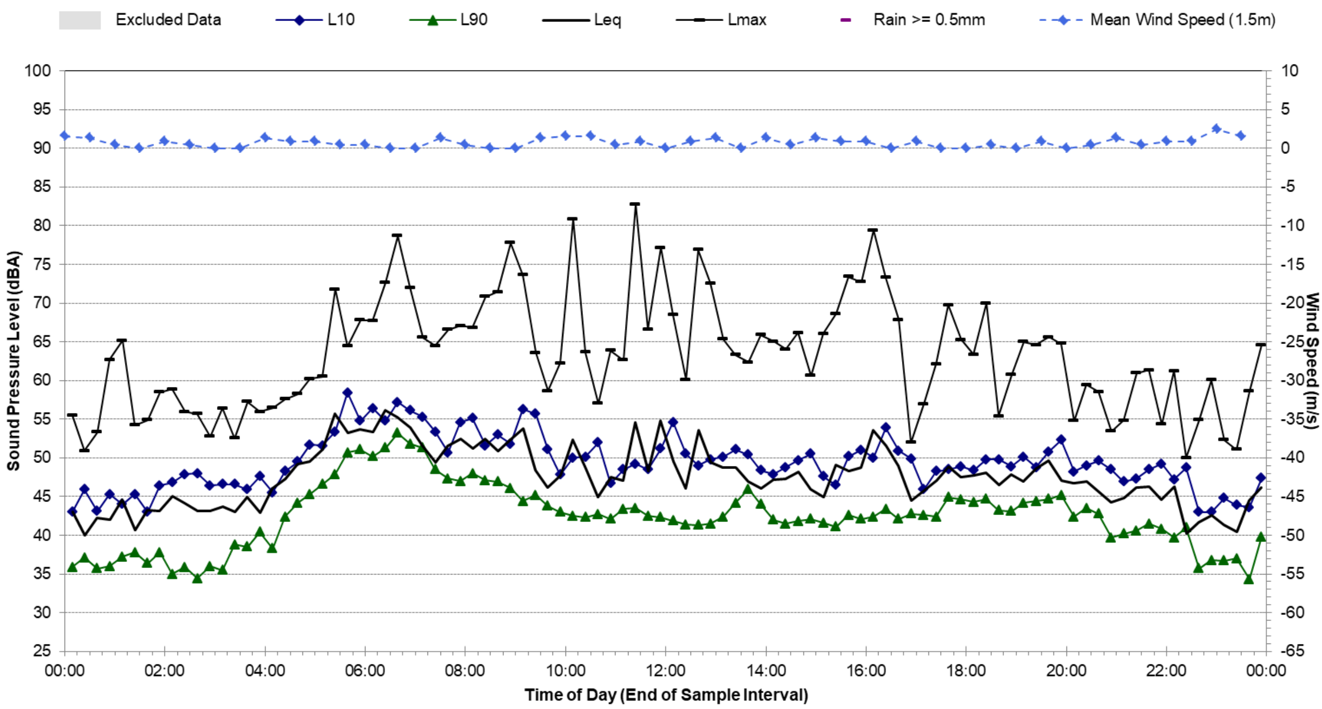
L.05 12-20 Salisbury Avenue, Kemps Creek - Saturday, 1 July 2017

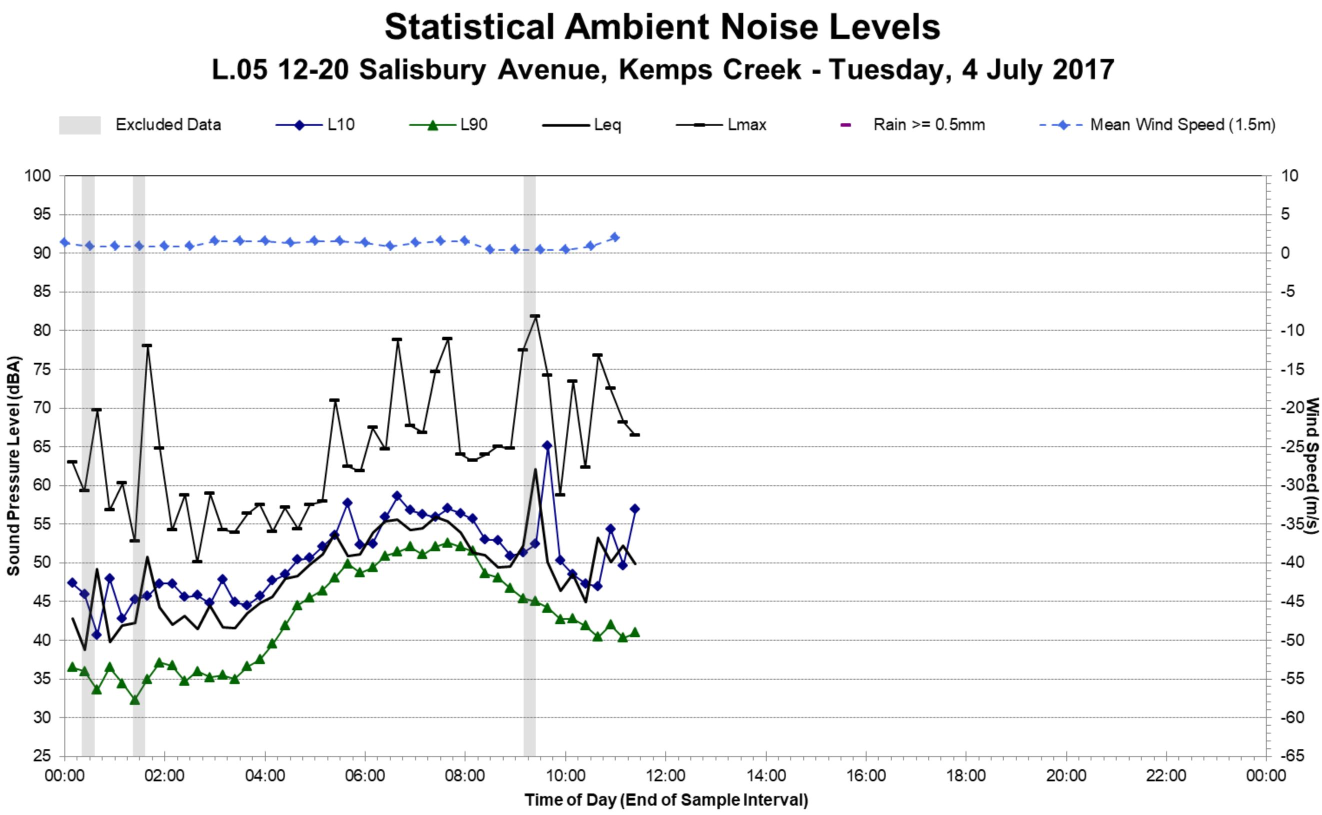


Statistical Ambient Noise Levels
L.05 12-20 Salisbury Avenue, Kemps Creek - Sunday, 2 July 2017



Statistical Ambient Noise Levels
L.05 12-20 Salisbury Avenue, Kemps Creek - Monday, 3 July 2017





Statistical Ambient Noise Levels
L.05 12-20 Salisbury Avenue, Kemps Creek - Tuesday, 4 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Noise Monitoring Location	L.06
Noise Monitoring Address	203 Clifton Avenue, Kemps Creek

Logger Device Type: Svantek 979, Logger Serial No: 35839

Sound Level Meter Device Type: Brüel and Kjær 2260i, Sound Level Meter Serial No: 2414604

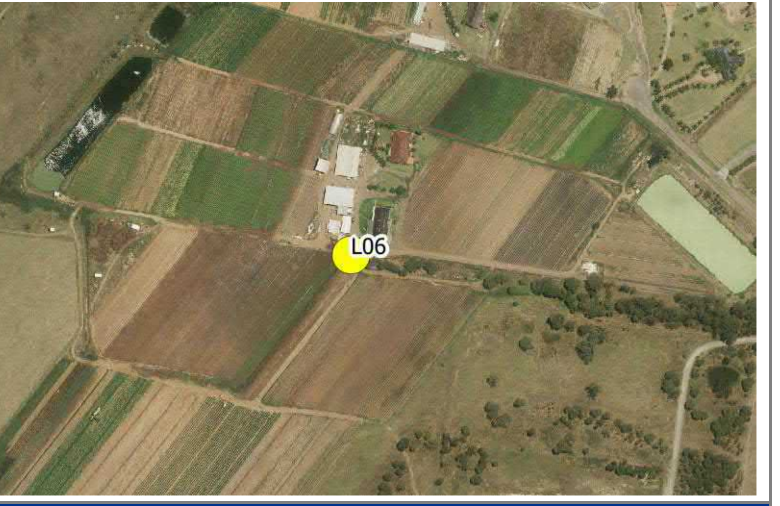
Ambient noise logger deployed at residential address 203 Clifton Avenue, Kemps Creek. Logger located in open farmland approximately 275 m southwest of Clifton Avenue.

Attended noise measurements indicate the ambient noise environment at this location is dominated by noise from wildlife (ie farm animals and birds). Noise from light aircraft also contributes to the LAeq at this location.

Recorded Noise Levels: (LAmax):

22/06/2017: Animals and birds): 38-64 dBA, Distant road traffic (intermittent) 38-41 dBA, Light aircraft: 39-48 dBA

Map of Noise Monitoring Location



Ambient Noise Logging Results – Construction Periods[1]

RBL Noise Level (dBA)				
Morning Shoulder	**Day**	**Evening**	**Evening Shoulder**	**Night**
43	34	35	39	31

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	53	57
Night-time (10pm-7am)	44	50

Attended Noise Measurement Results

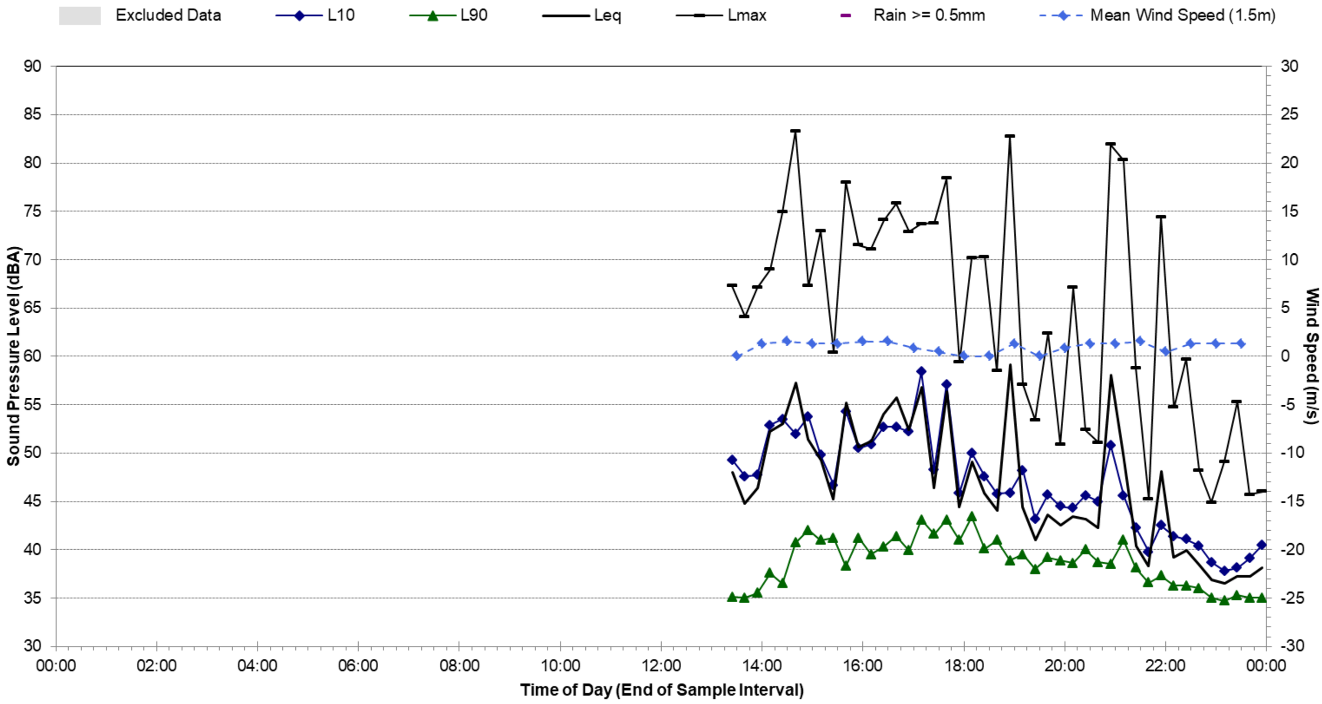
Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
22/06/2017	12:42	34	42	64

Photo of Noise Monitoring Location

Note 1: Morning shoulder is 6 am to 7 am Monday to Friday; Daytime is 7 am to 6 pm Monday to Saturday & 8 am to 6 pm Sunday & Public Holidays; Evening is 7 pm to 10 pm Monday to Friday & 6 pm to 10 pm Saturday, Sunday & Public Holidays; Evening shoulder is 6 pm to 7 pm Monday to Friday; Night-time is 10 pm to 6 am Monday to Friday, 10 pm to 7 am Saturday & 10 pm to 8 am Sunday and Public Holidays.

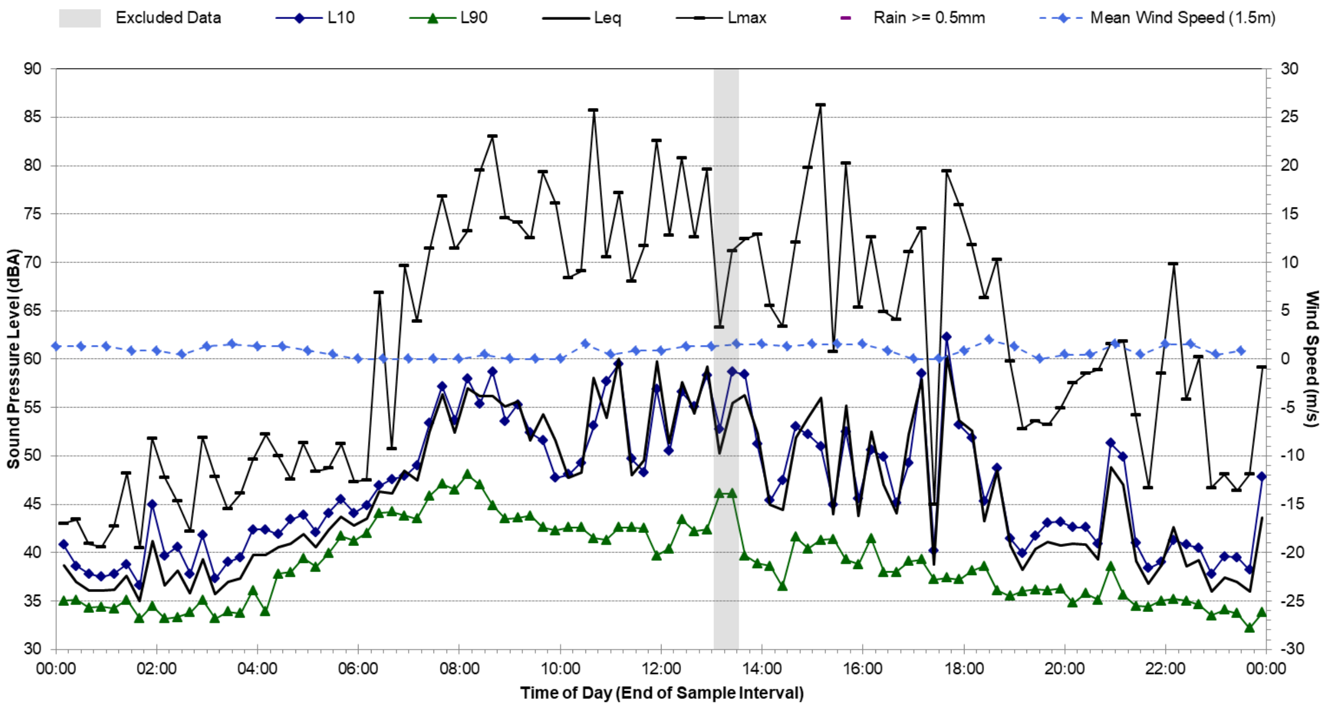
Statistical Ambient Noise Levels

L.06 203 Clifton Avenue, Kemps Creek - Thursday, 22 June 2017

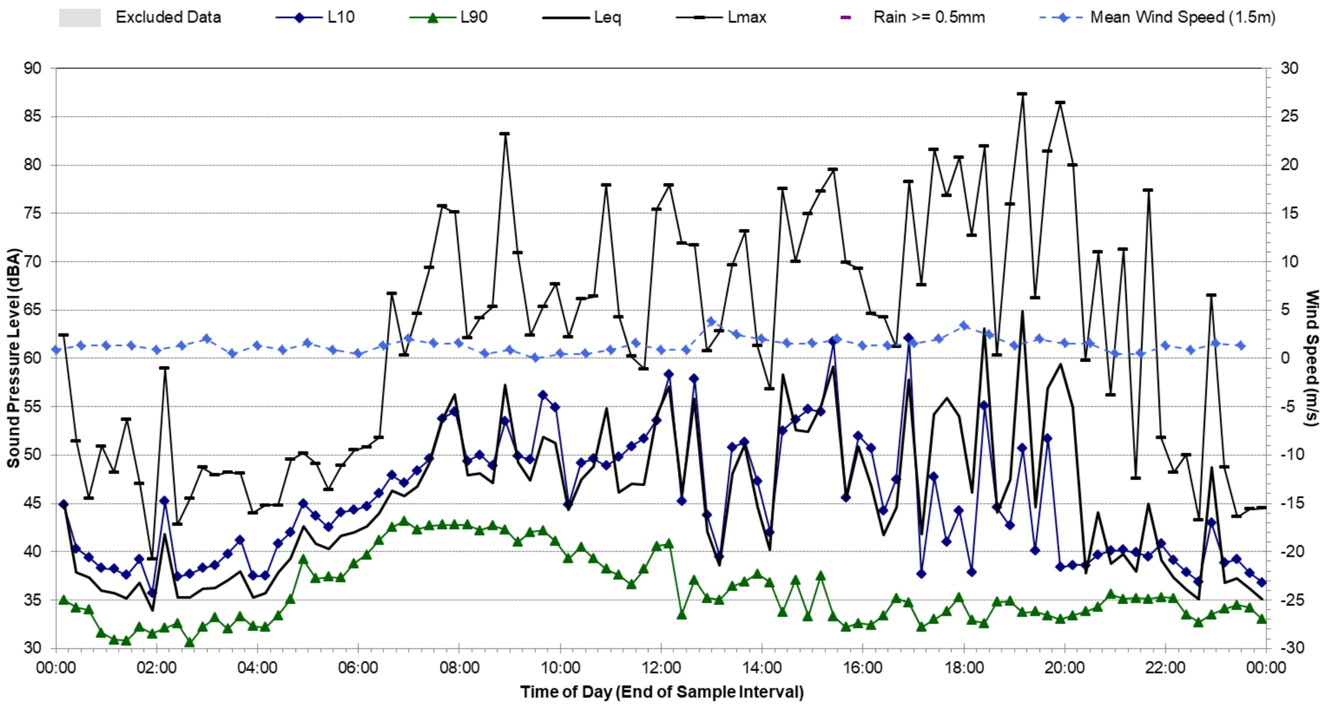


Statistical Ambient Noise Levels

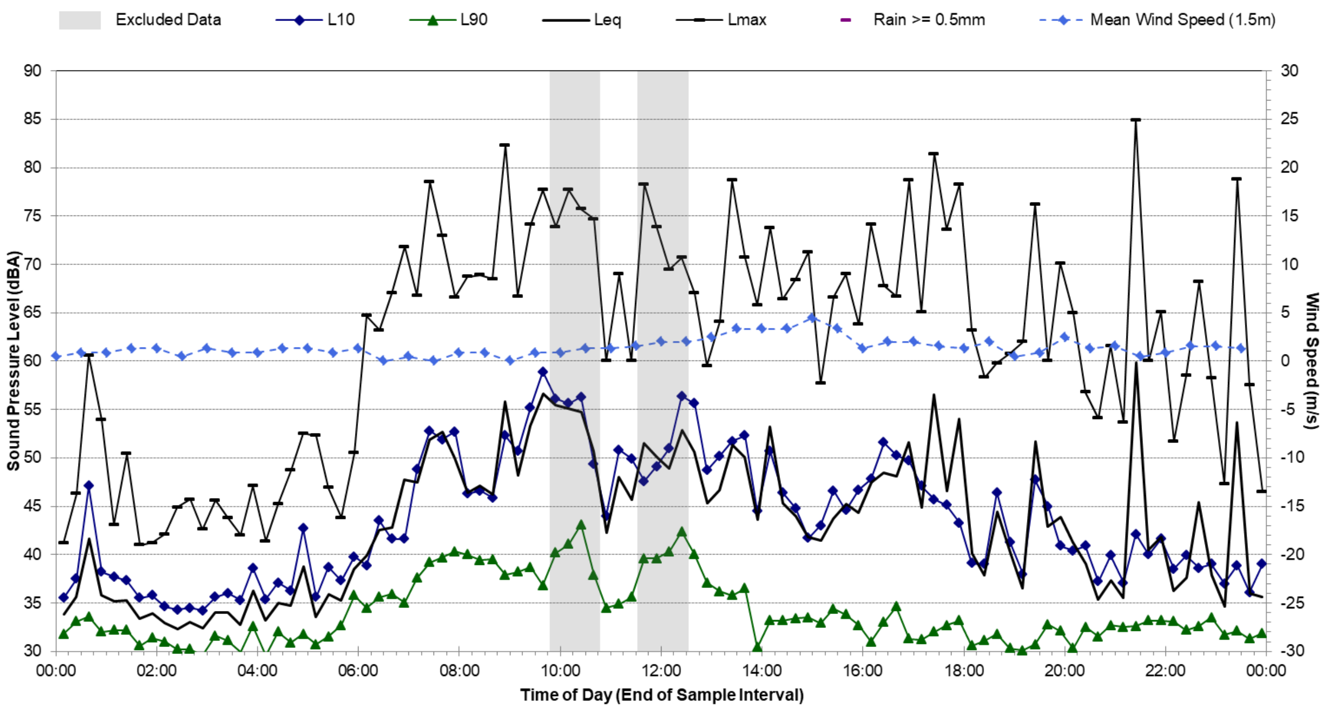
L.06 203 Clifton Avenue, Kemps Creek - Friday, 23 June 2017



Statistical Ambient Noise Levels
L.06 203 Clifton Avenue, Kemps Creek - Saturday, 24 June 2017

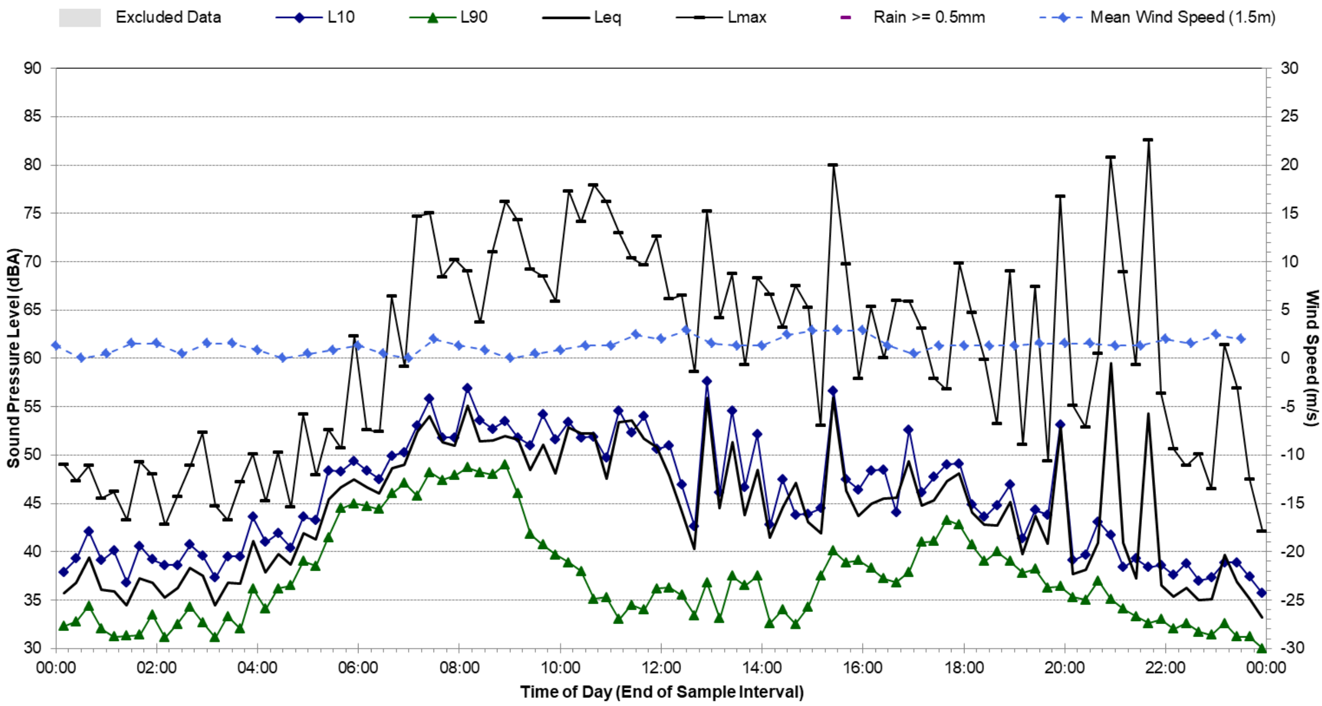


Statistical Ambient Noise Levels
L.06 203 Clifton Avenue, Kemps Creek - Sunday, 25 June 2017



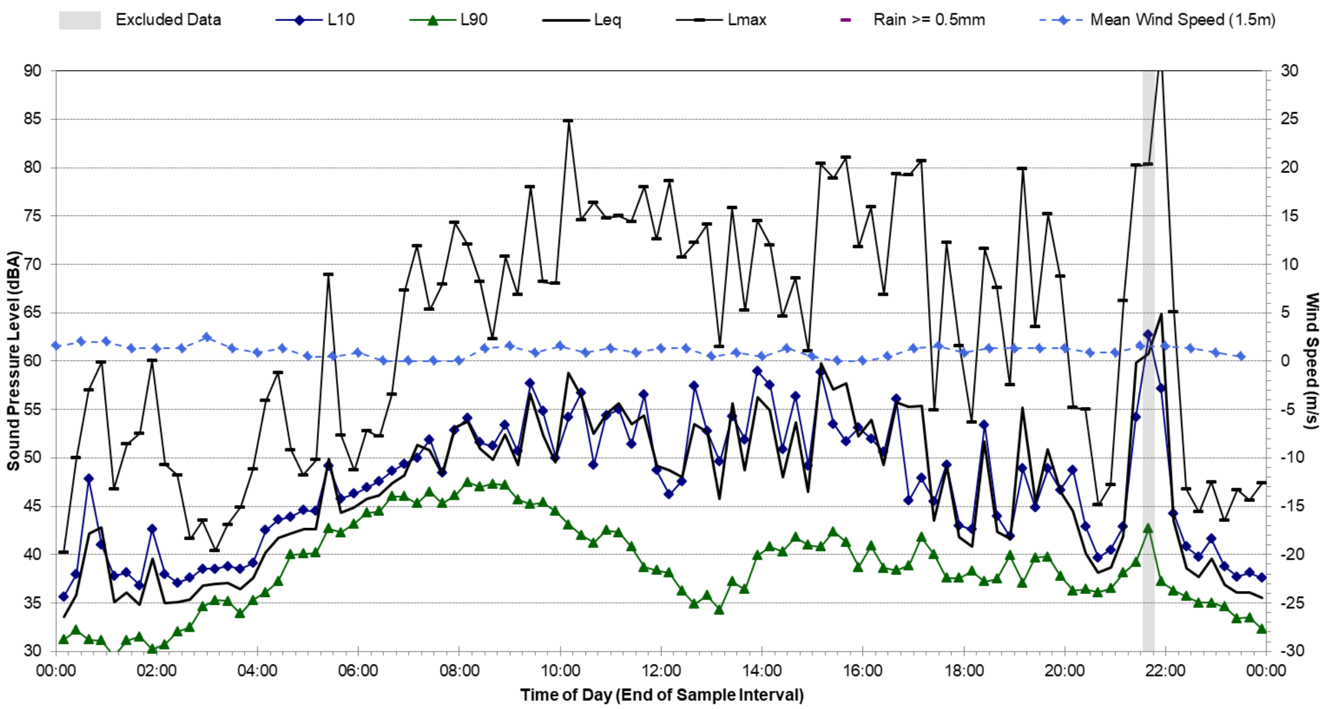
Statistical Ambient Noise Levels

L.06 203 Clifton Avenue, Kemps Creek - Monday, 26 June 2017



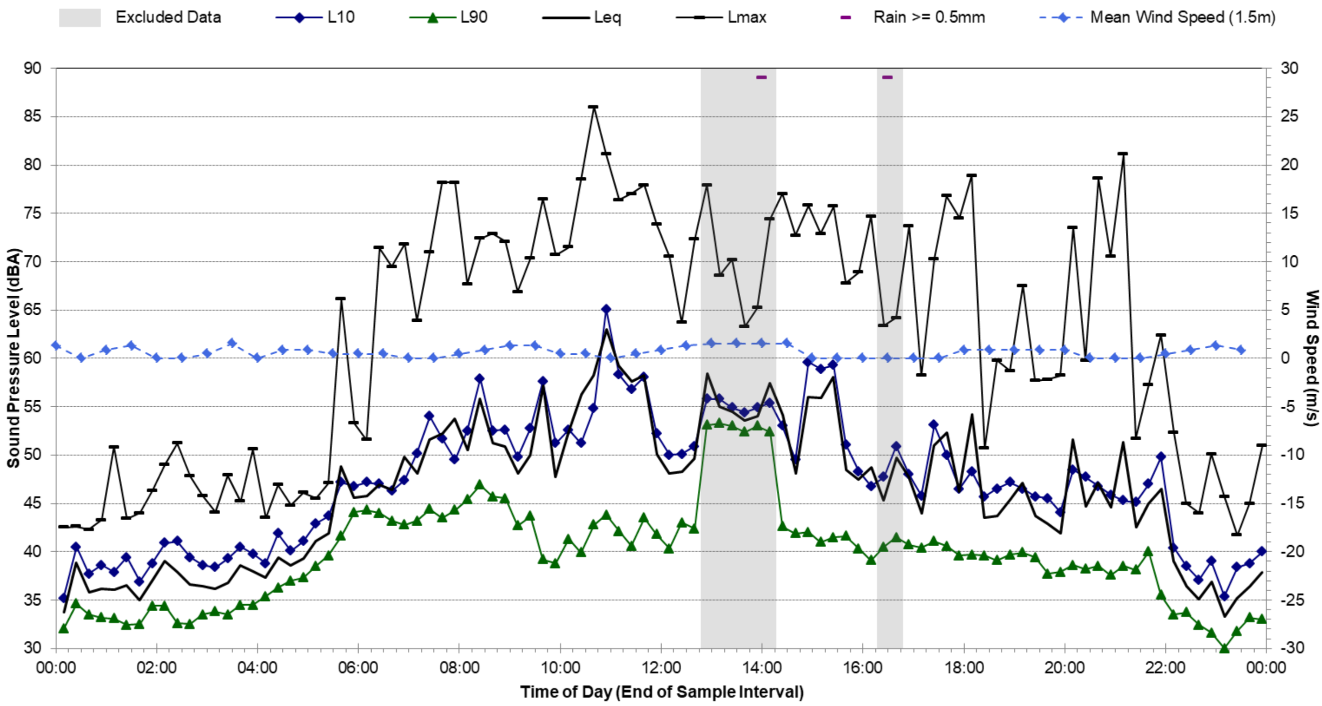
Statistical Ambient Noise Levels

L.06 203 Clifton Avenue, Kemps Creek - Tuesday, 27 June 2017



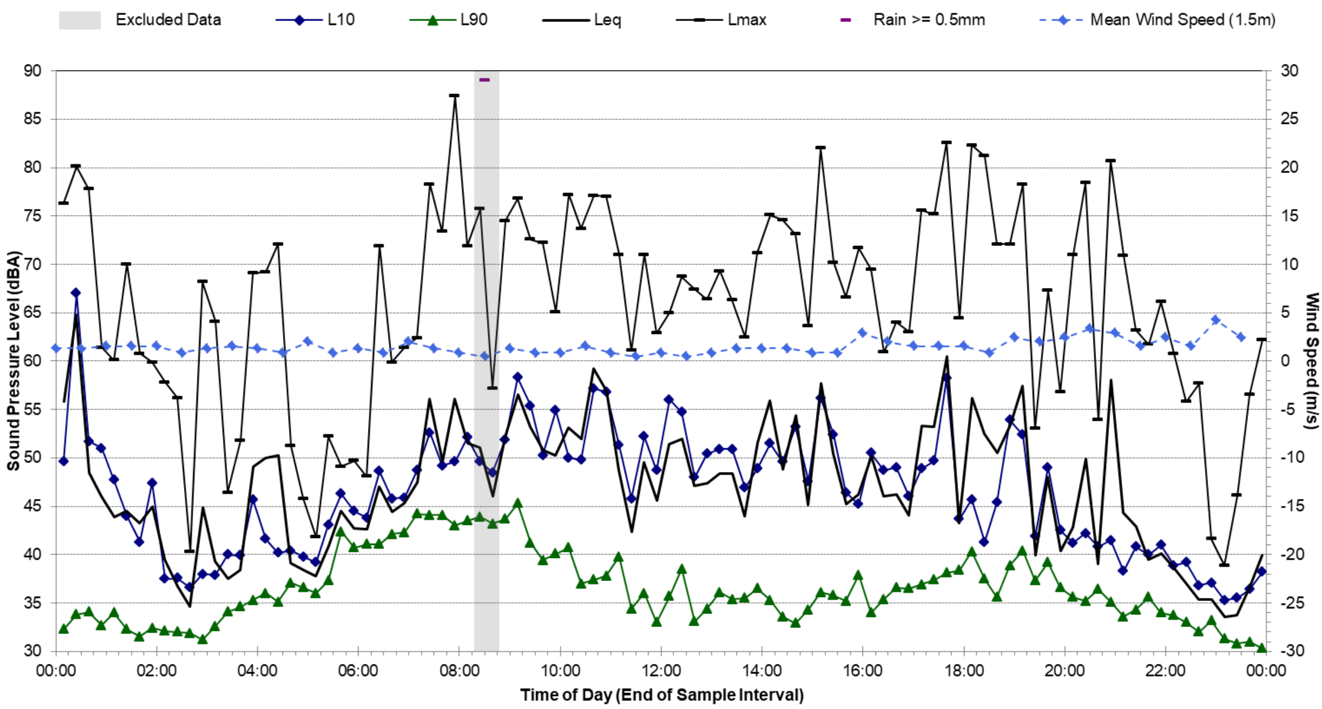
Statistical Ambient Noise Levels

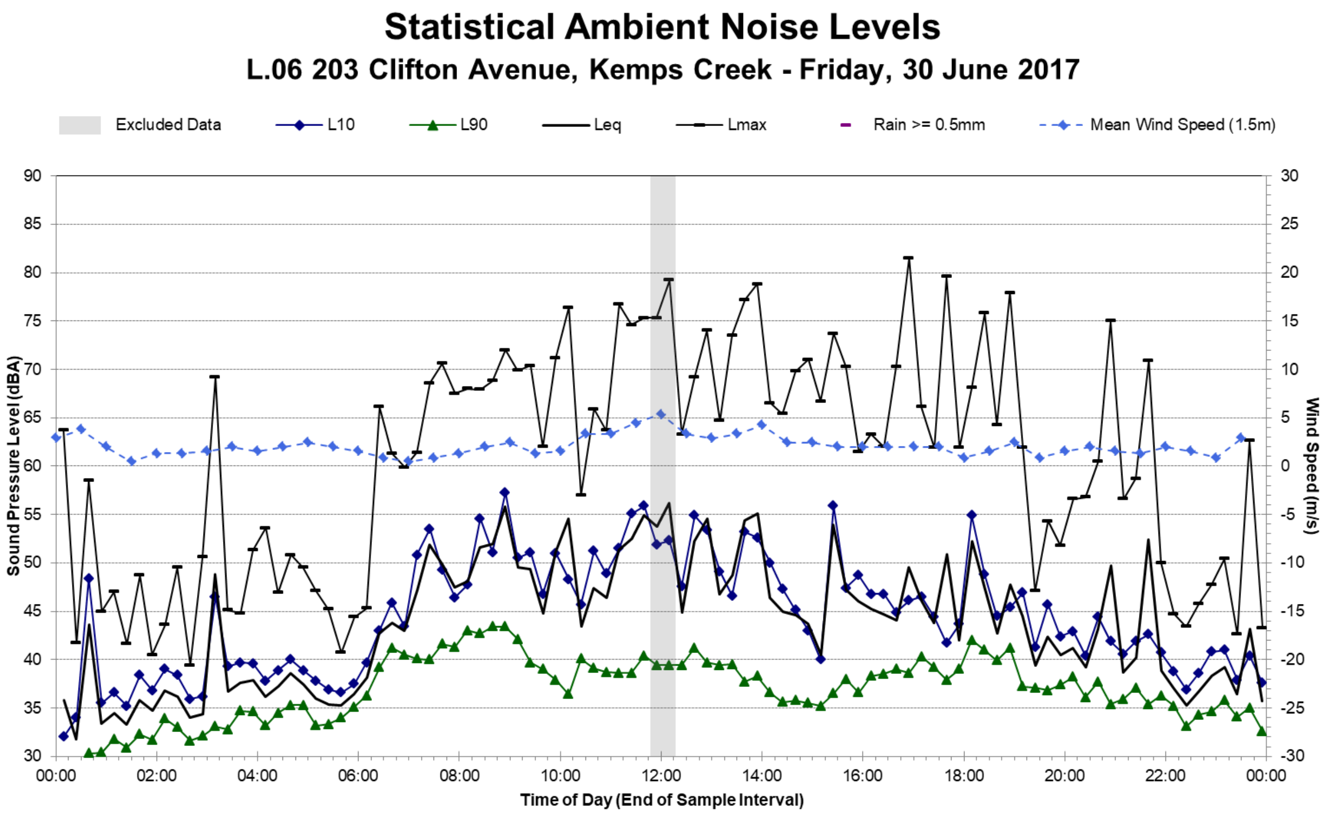
L.06 203 Clifton Avenue, Kemps Creek - Wednesday, 28 June 2017

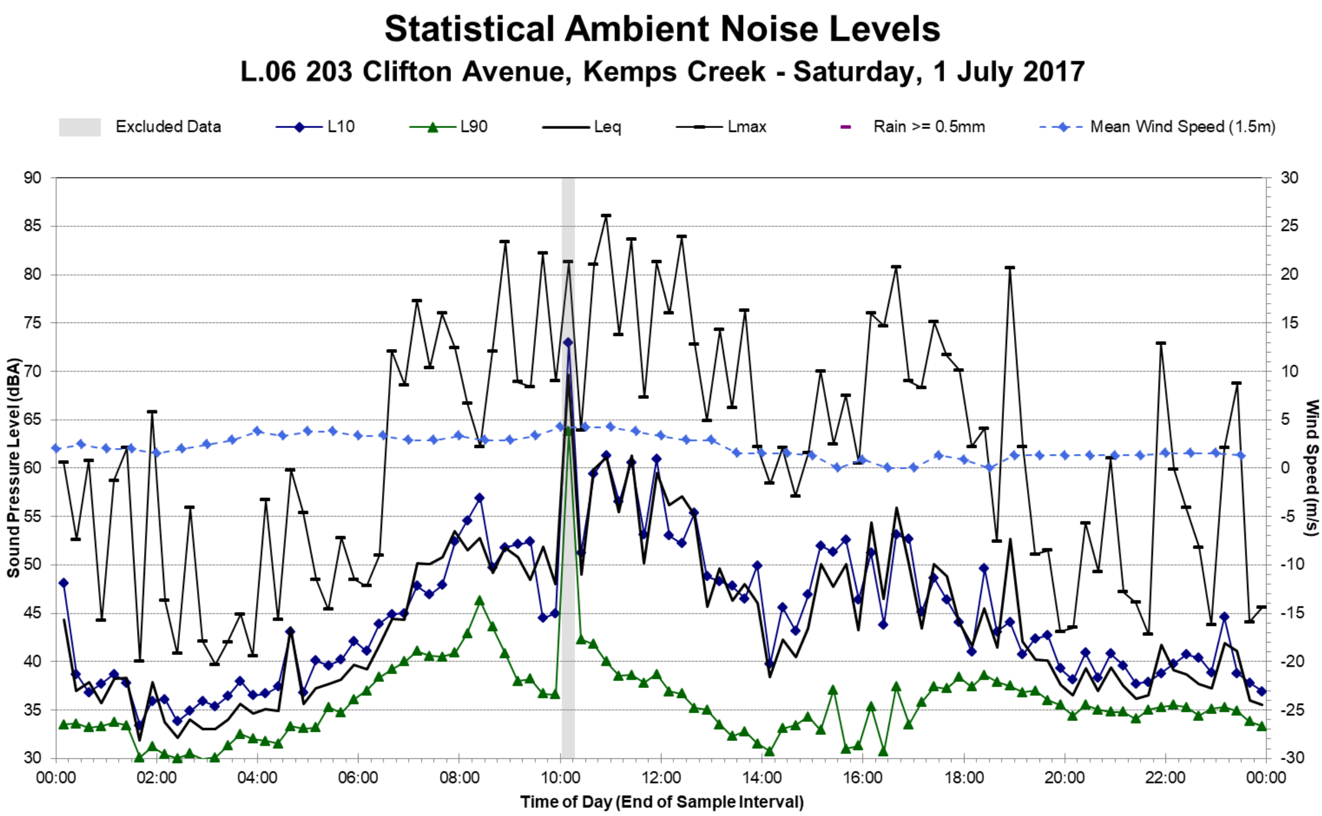


Statistical Ambient Noise Levels

L.06 203 Clifton Avenue, Kemps Creek - Thursday, 29 June 2017

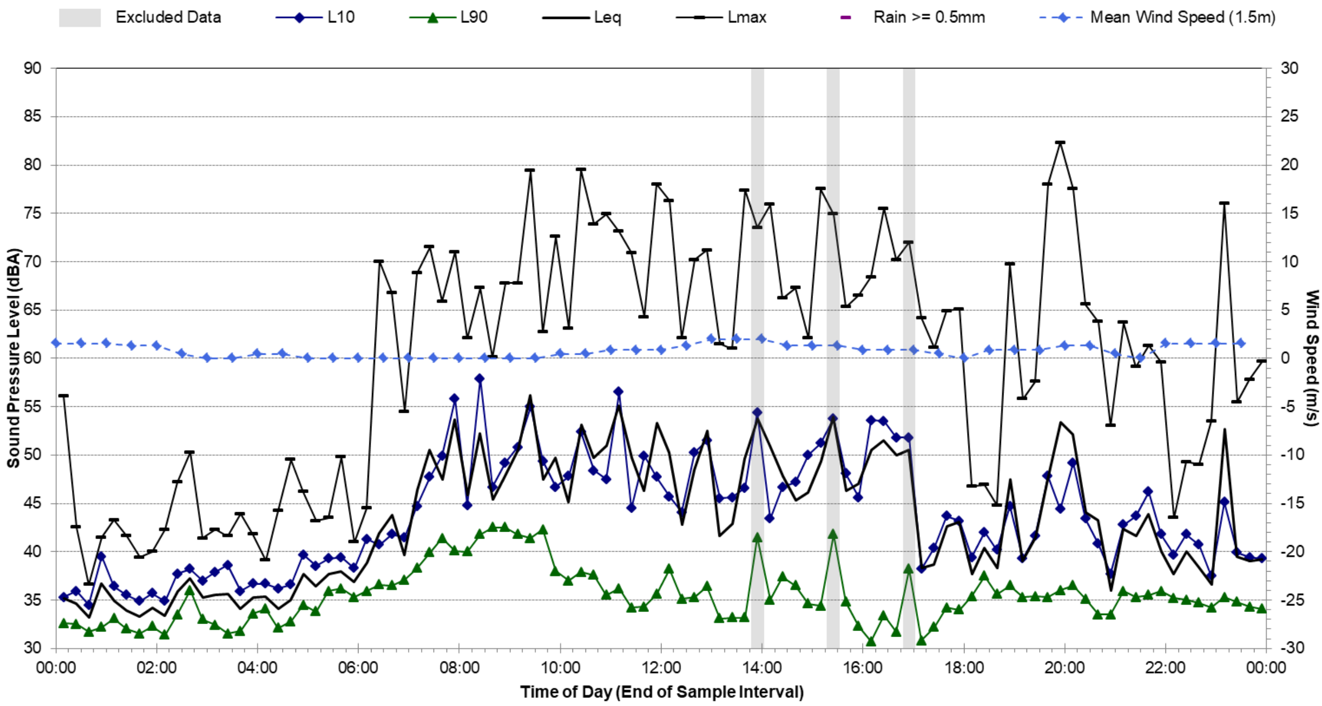



Statistical Ambient Noise Levels
L.06 203 Clifton Avenue, Kemps Creek - Friday, 30 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.06 203 Clifton Avenue, Kemps Creek - Saturday, 1 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

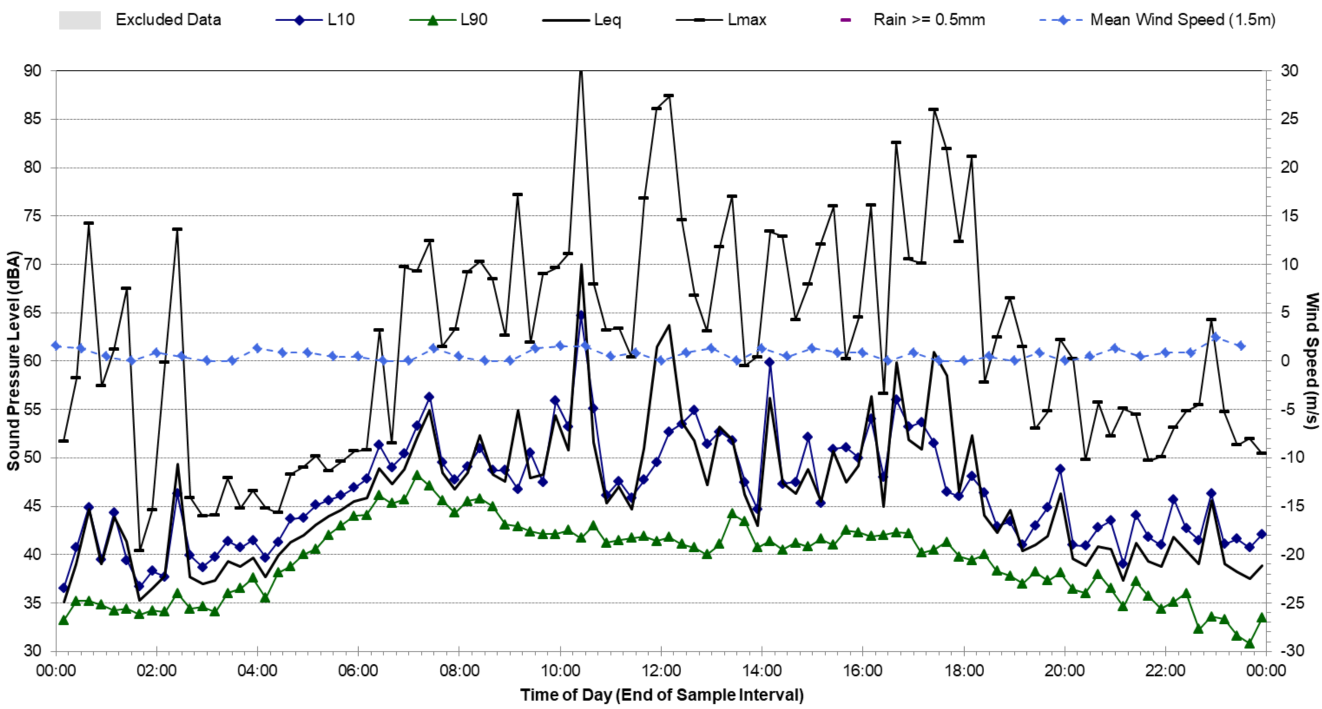
Statistical Ambient Noise Levels

L.06 203 Clifton Avenue, Kemps Creek - Sunday, 2 July 2017



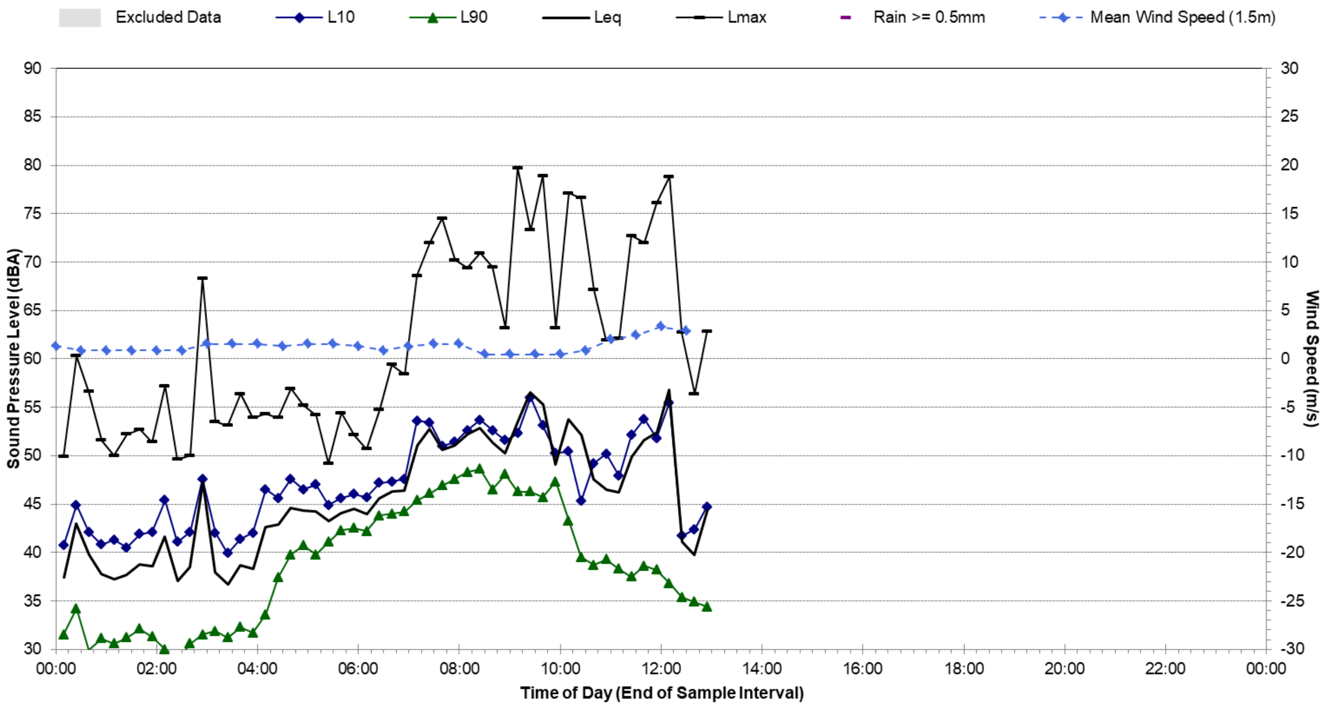
Statistical Ambient Noise Levels

L.06 203 Clifton Avenue, Kemps Creek - Monday, 3 July 2017



Statistical Ambient Noise Levels

L.06 203 Clifton Avenue, Kemps Creek - Tuesday, 4 July 2017



Noise Monitoring Location	L.07
Noise Monitoring Address	740 Luddenham Road, Luddenham

Logger Device Type: Svantek 958, Logger Serial No: 14295

Sound Level Meter Device Type: Brüel and Kjær 2260i, Sound Level Meter Serial No: 2414605

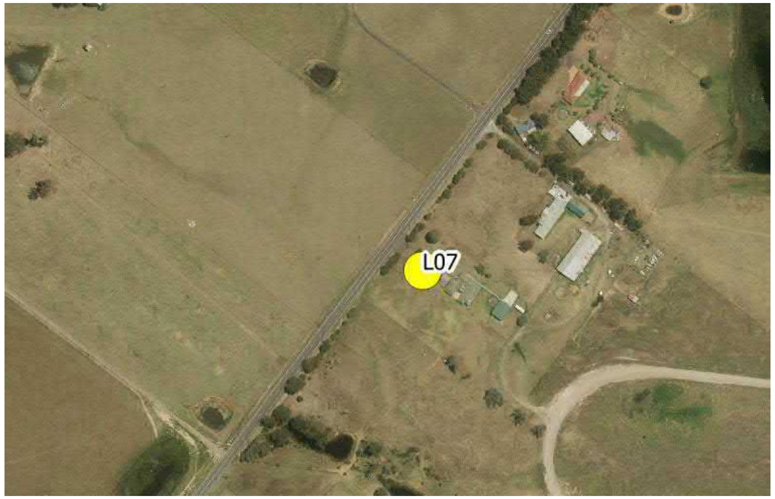
Ambient noise logger deployed at residential address 740 Luddenham Road, Luddenham. Logger located approximately 35 m southeast of Luddenham Road.

Attended noise measurements indicate the ambient noise environment at this location is dominated by wildlife (ie birds) and intermittent road traffic noise from Luddenham Road. Noise from light aircraft also contributes to the LAeq at this location.

Recorded Noise Levels: (LAmax):

22/06/2017: Road traffic (Luddenham Rd) 58-65 dBA, Light aircraft: 54-57 dBA, Birds: 50-73 dBA, Ambient noise (distant road traffic & wildlife): 38-41 dBA

Map of Noise Monitoring Location



Ambient Noise Logging Results – Construction Periods[1]

RBL Noise Level (dBA)				
Morning Shoulder	Day	Evening	Evening Shoulder	Night
46	40	36	42	31

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	56	59
Night-time (10pm-7am)	52	59

Attended Noise Measurement Results

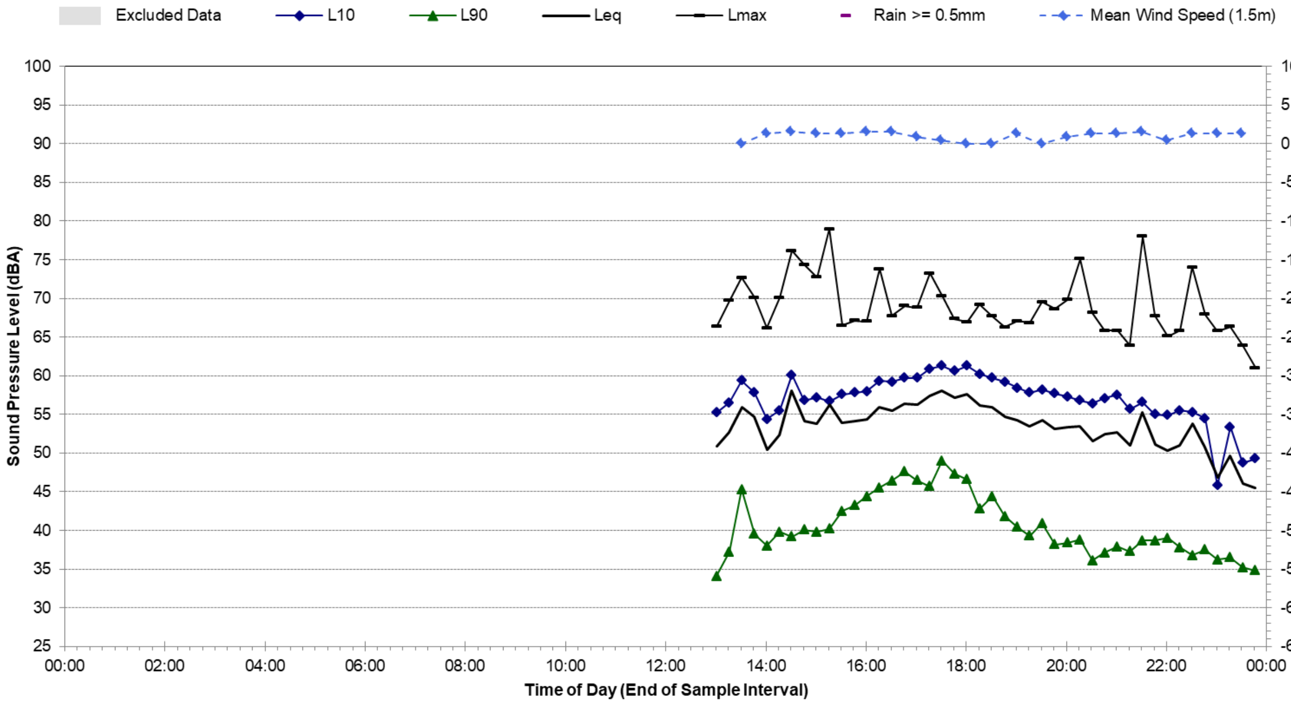
Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
22/06/2017	12:09	38	53	73

Photo of Noise Monitoring Location

Note 1: Morning shoulder is 6 am to 7 am Monday to Friday; Daytime is 7 am to 6 pm Monday to Saturday & 8 am to 6 pm Sunday & Public Holidays; Evening is 7 pm to 10 pm Monday to Friday & 6 pm to 10 pm Saturday, Sunday & Public Holidays; Evening shoulder is 6 pm to 7 pm Monday to Friday; Night-time is 10 pm to 6 am Monday to Friday, 10 pm to 7 am Saturday & 10 pm to 8 am Sunday and Public Holidays.

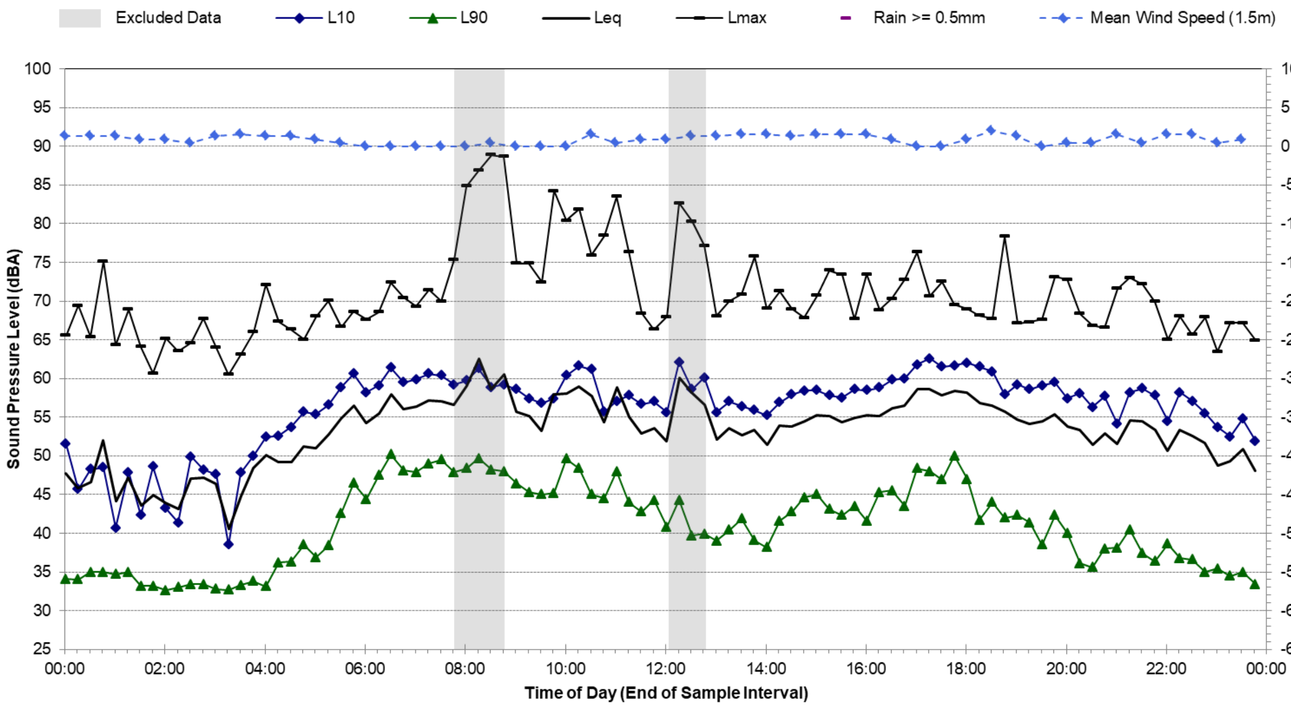
Statistical Ambient Noise Levels

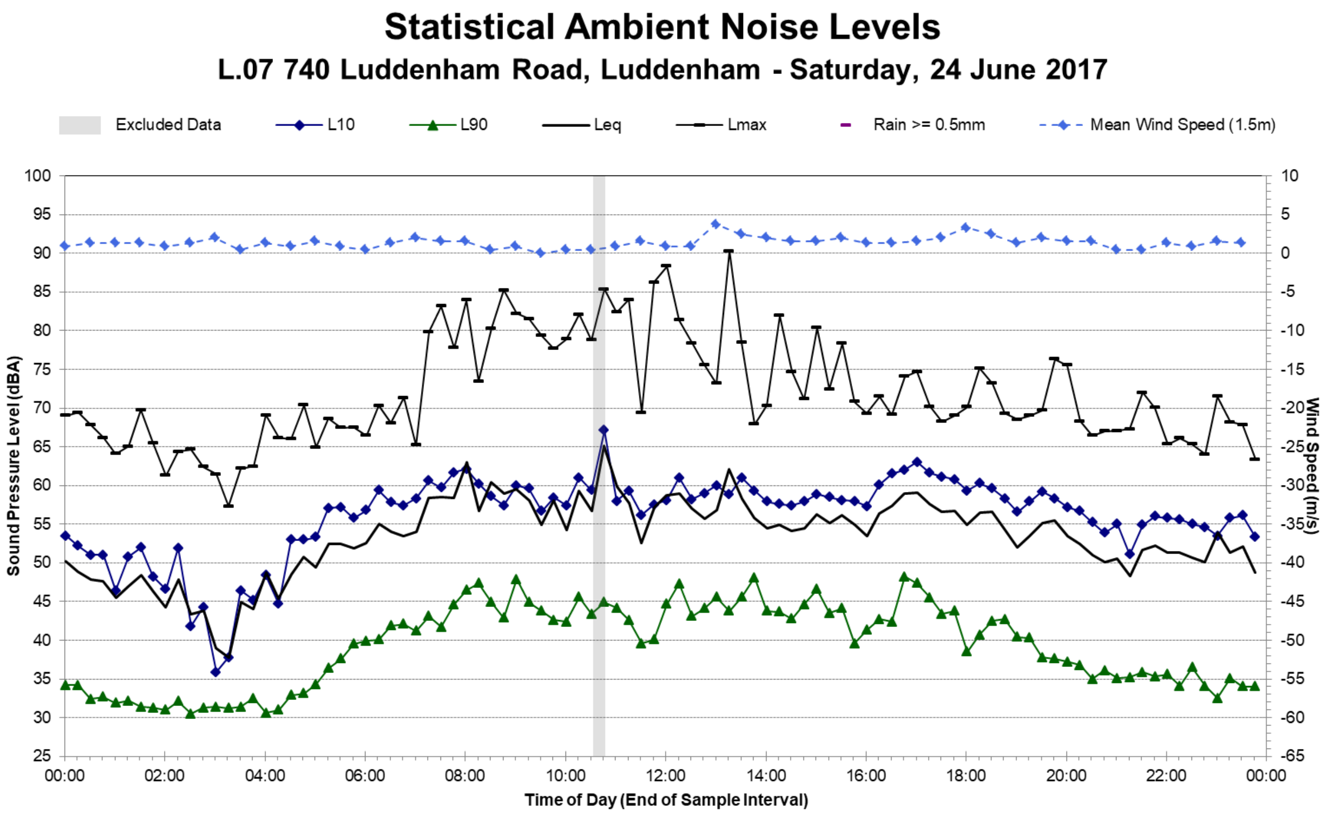
L.07 740 Luddenham Road, Luddenham - Thursday, 22 June 2017



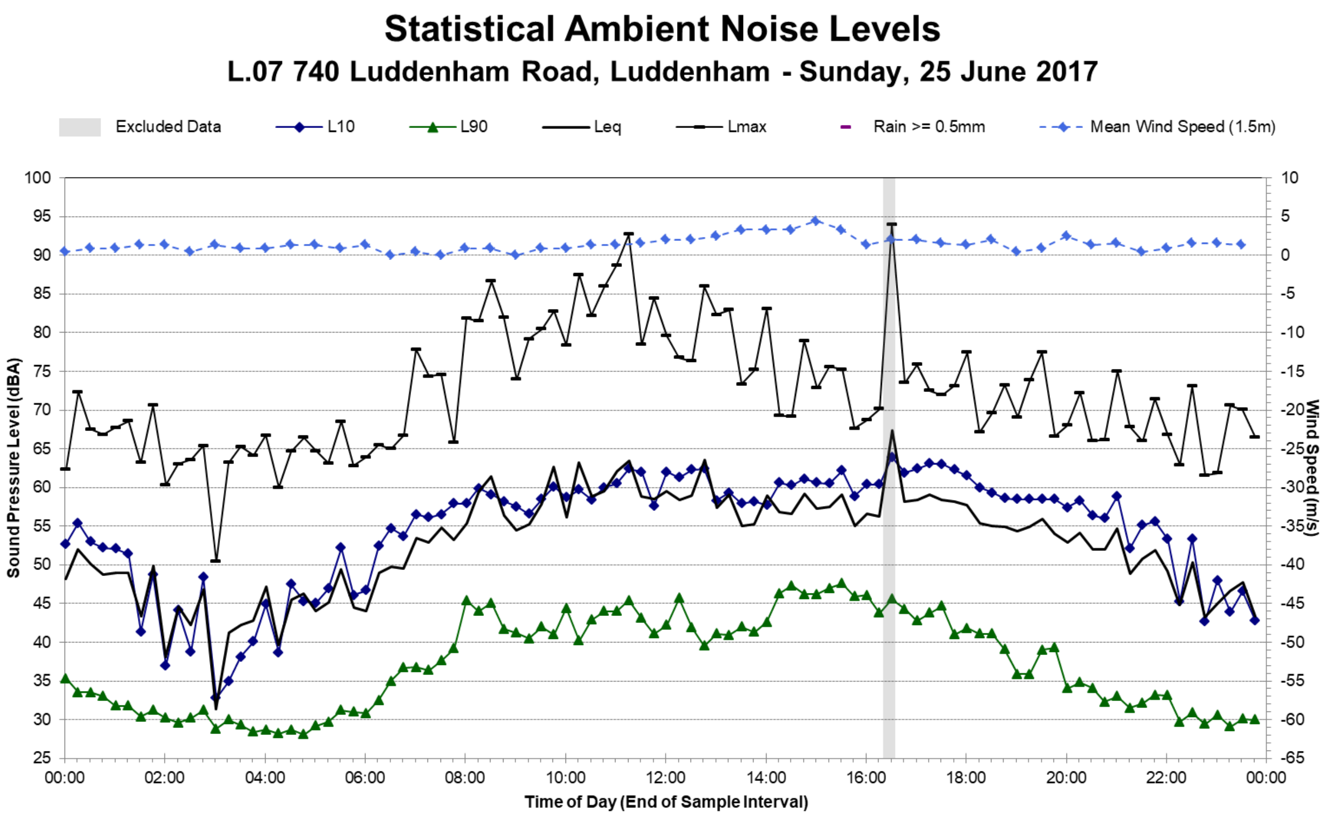
Statistical Ambient Noise Levels

L.07 740 Luddenham Road, Luddenham - Friday, 23 June 2017





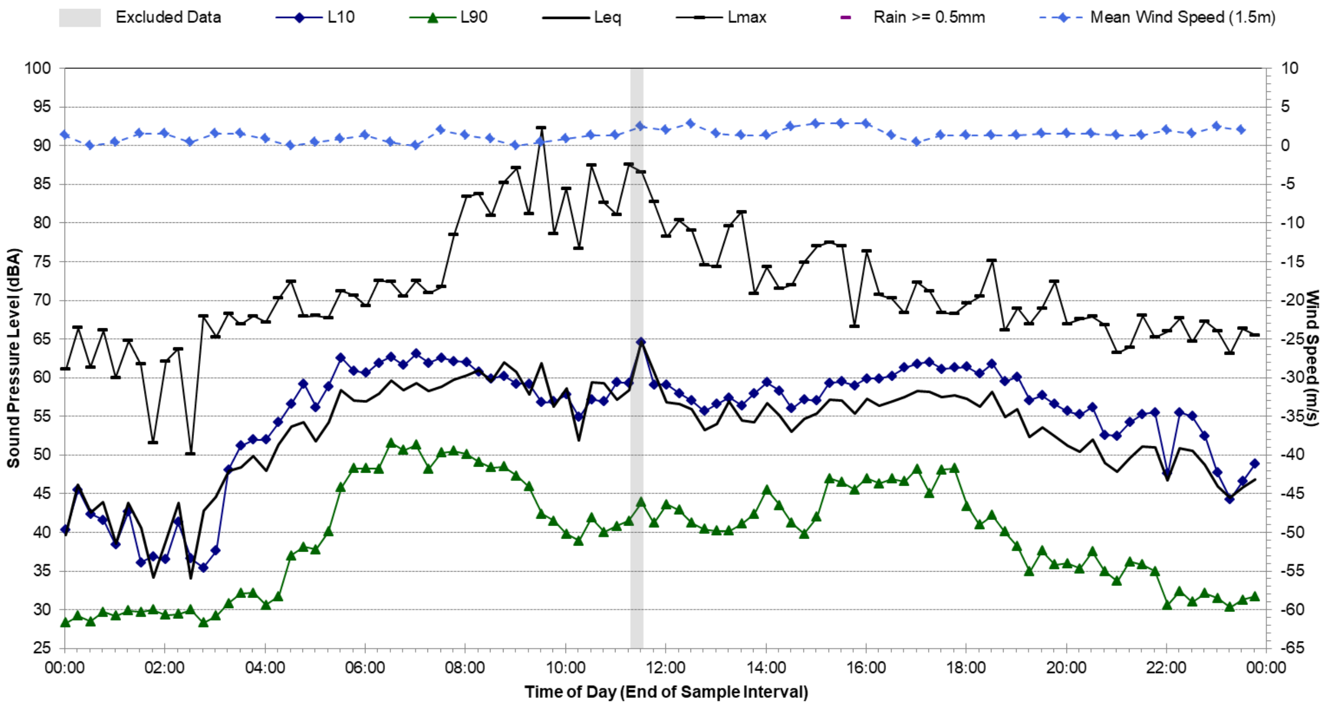
Statistical Ambient Noise Levels
L.07 740 Luddenham Road, Luddenham - Saturday, 24 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
L.07 740 Luddenham Road, Luddenham - Sunday, 25 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

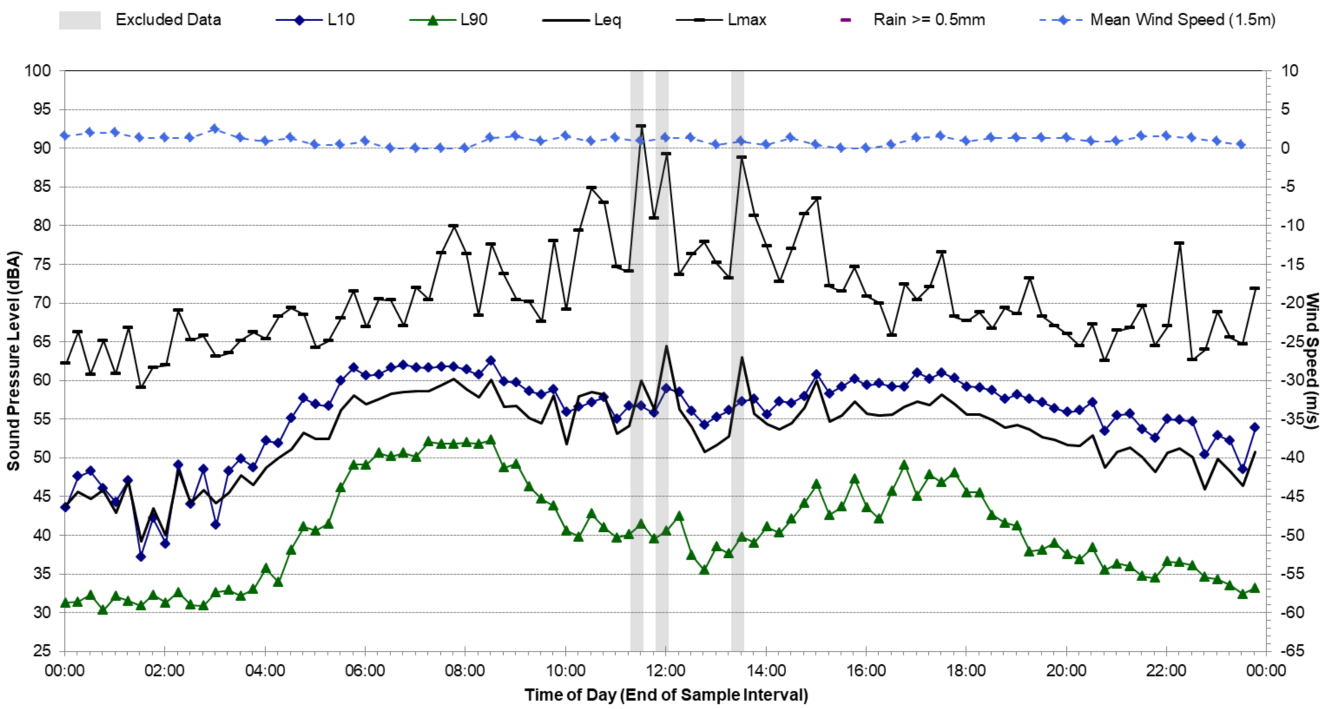
Statistical Ambient Noise Levels

L.07 740 Luddenham Road, Luddenham - Monday, 26 June 2017

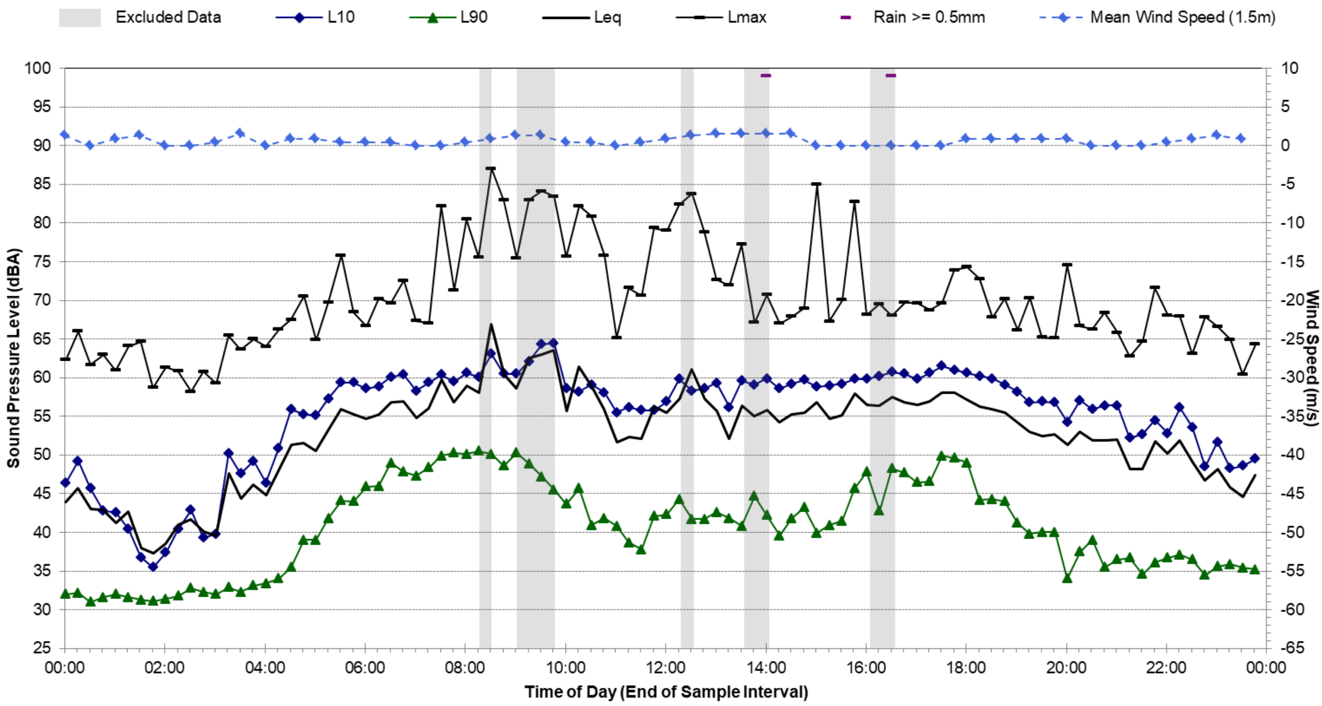


Statistical Ambient Noise Levels

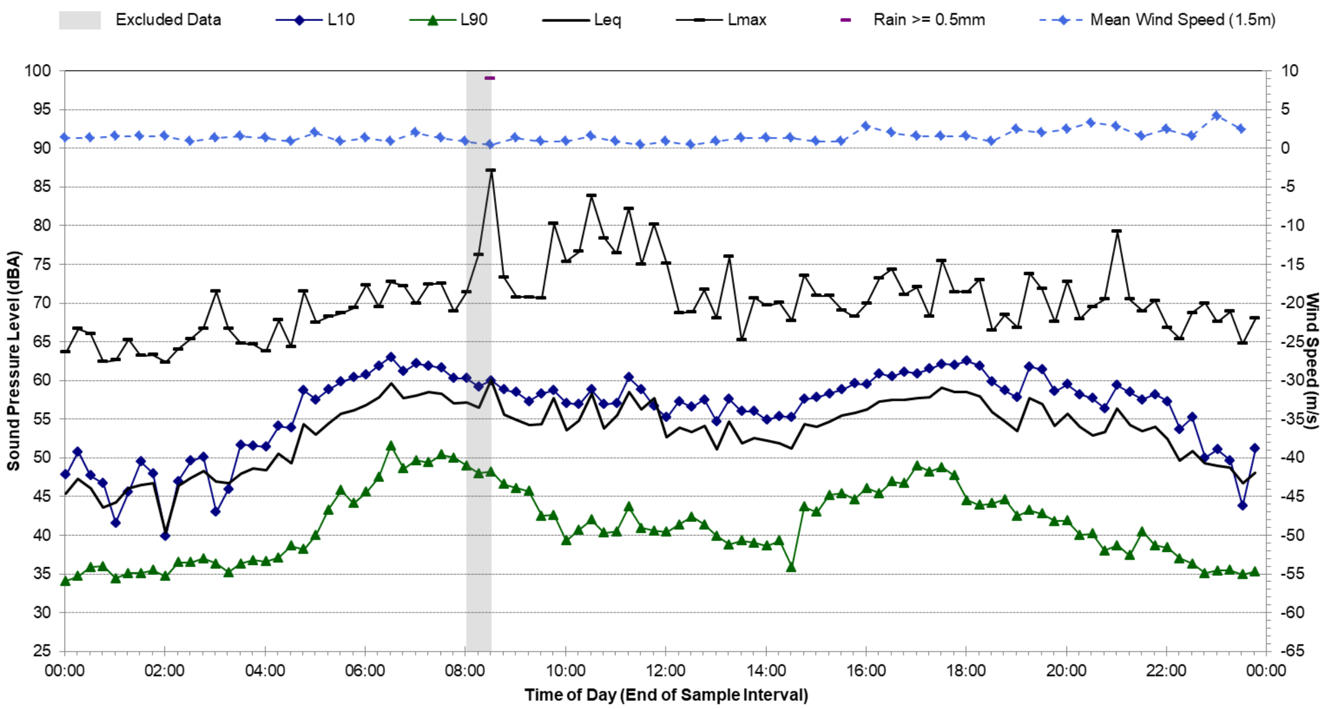
L.07 740 Luddenham Road, Luddenham - Tuesday, 27 June 2017

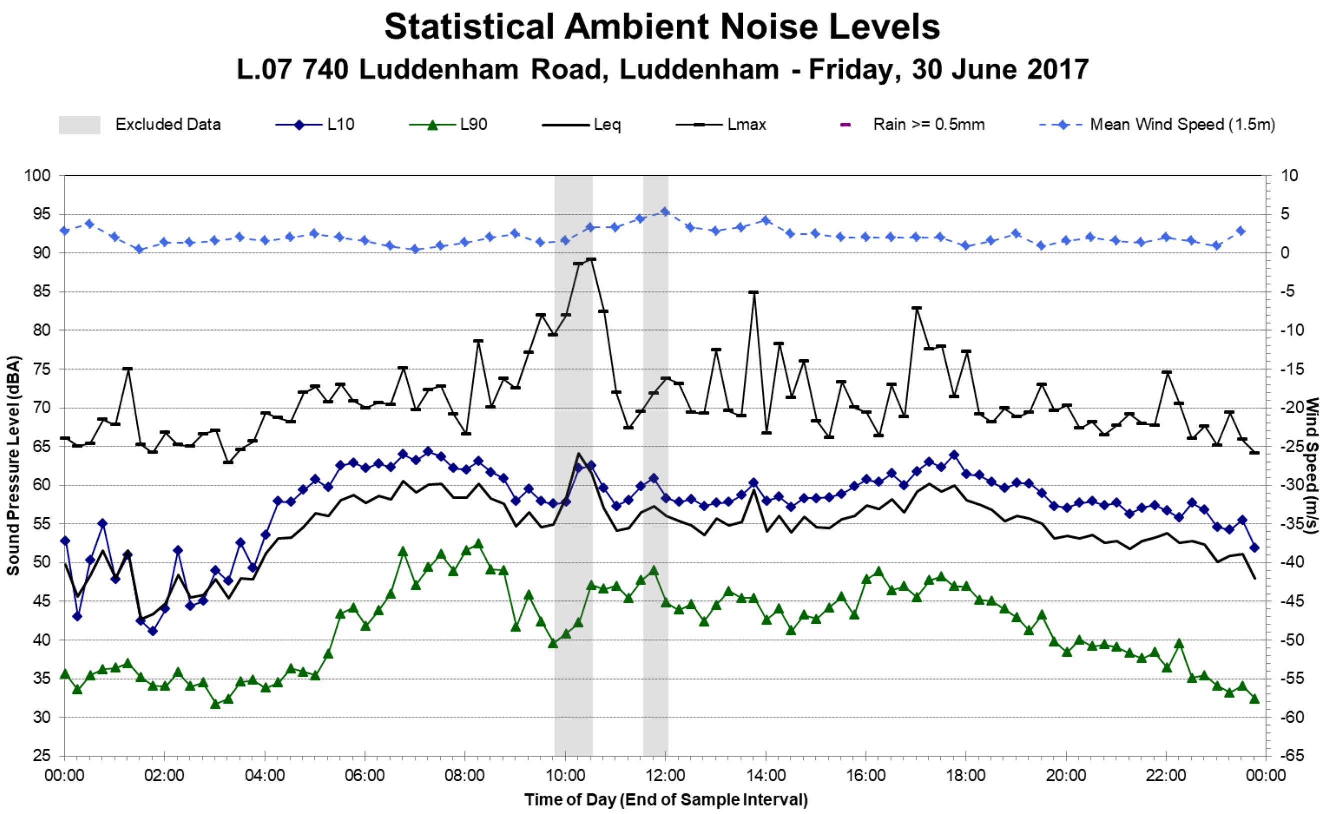


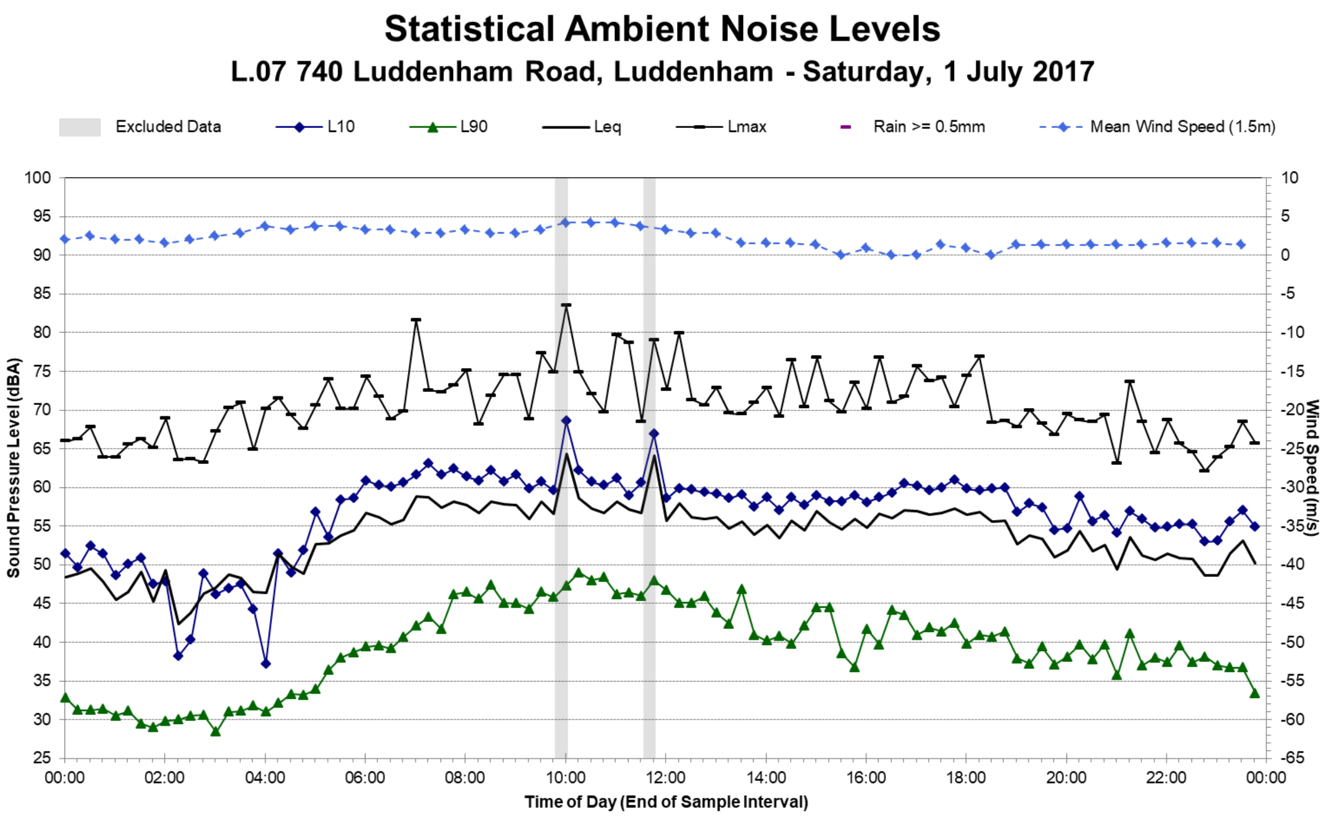
Statistical Ambient Noise Levels
L.07 740 Luddenham Road, Luddenham - Wednesday, 28 June 2017



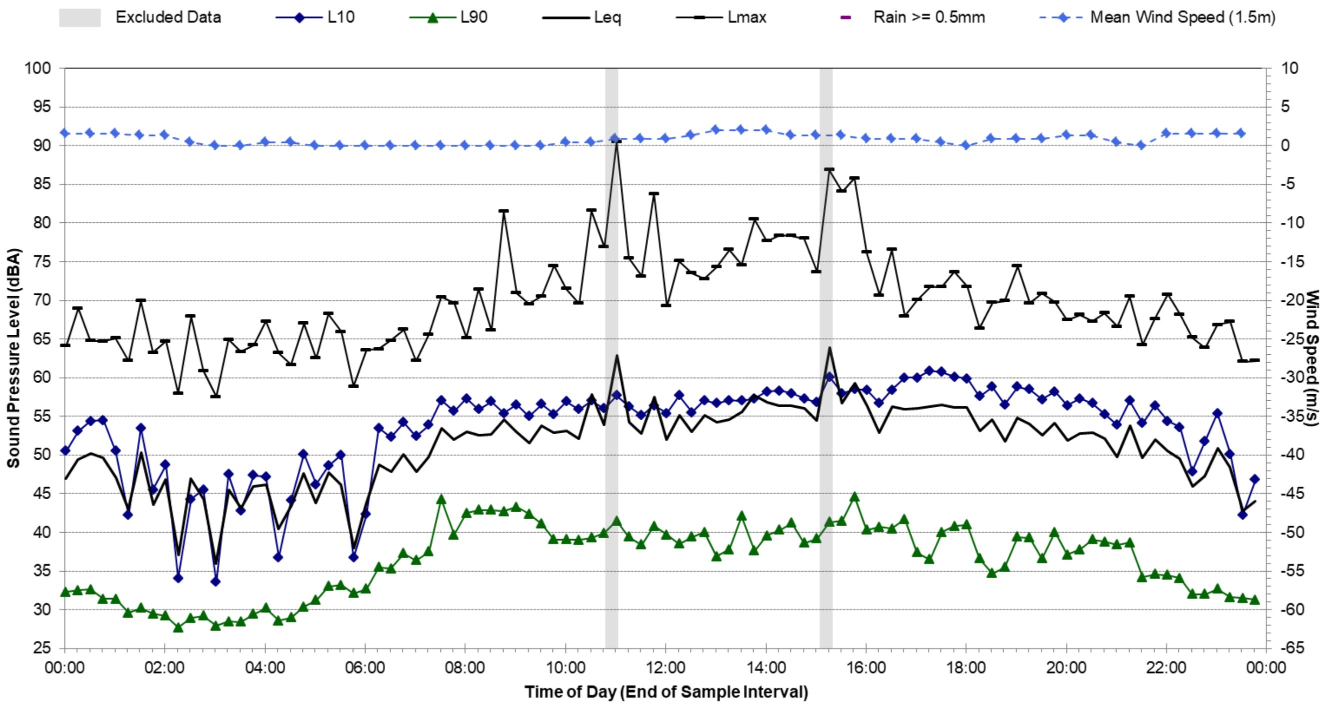
Statistical Ambient Noise Levels
L.07 740 Luddenham Road, Luddenham - Thursday, 29 June 2017



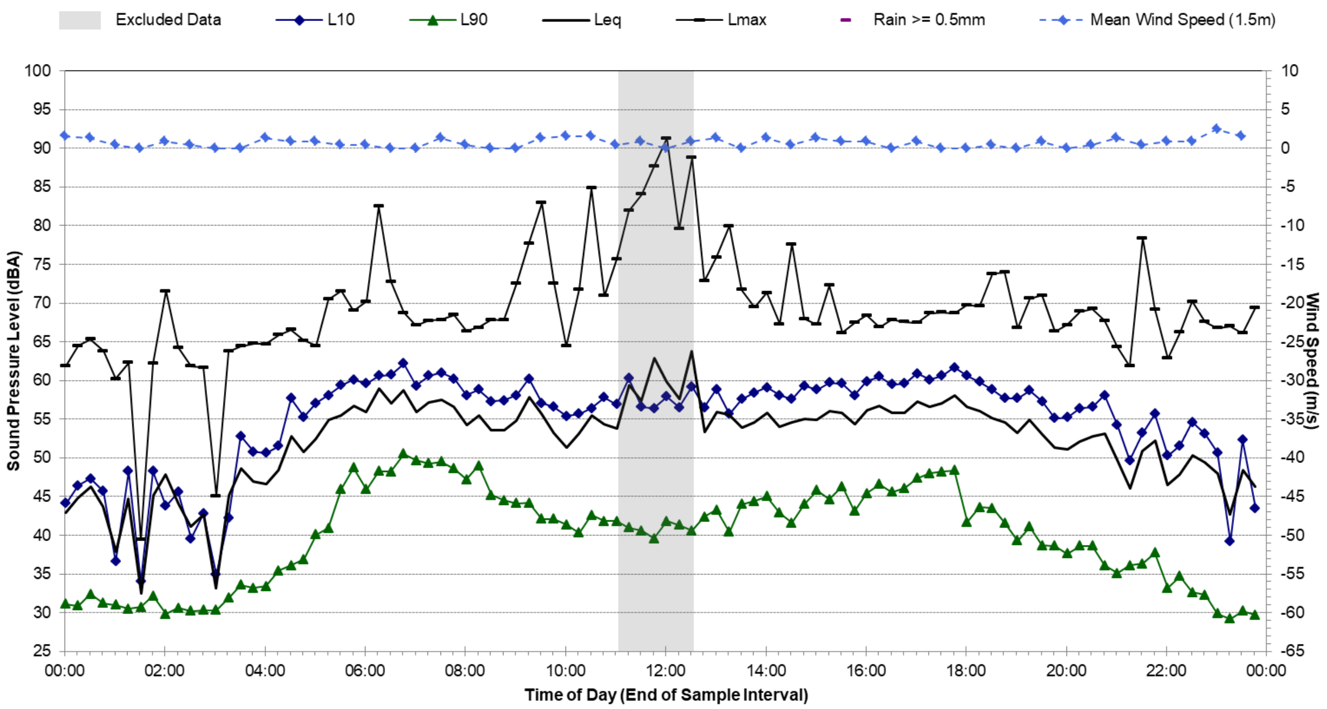

Statistical Ambient Noise Levels
L.07 740 Luddenham Road, Luddenham - Friday, 30 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

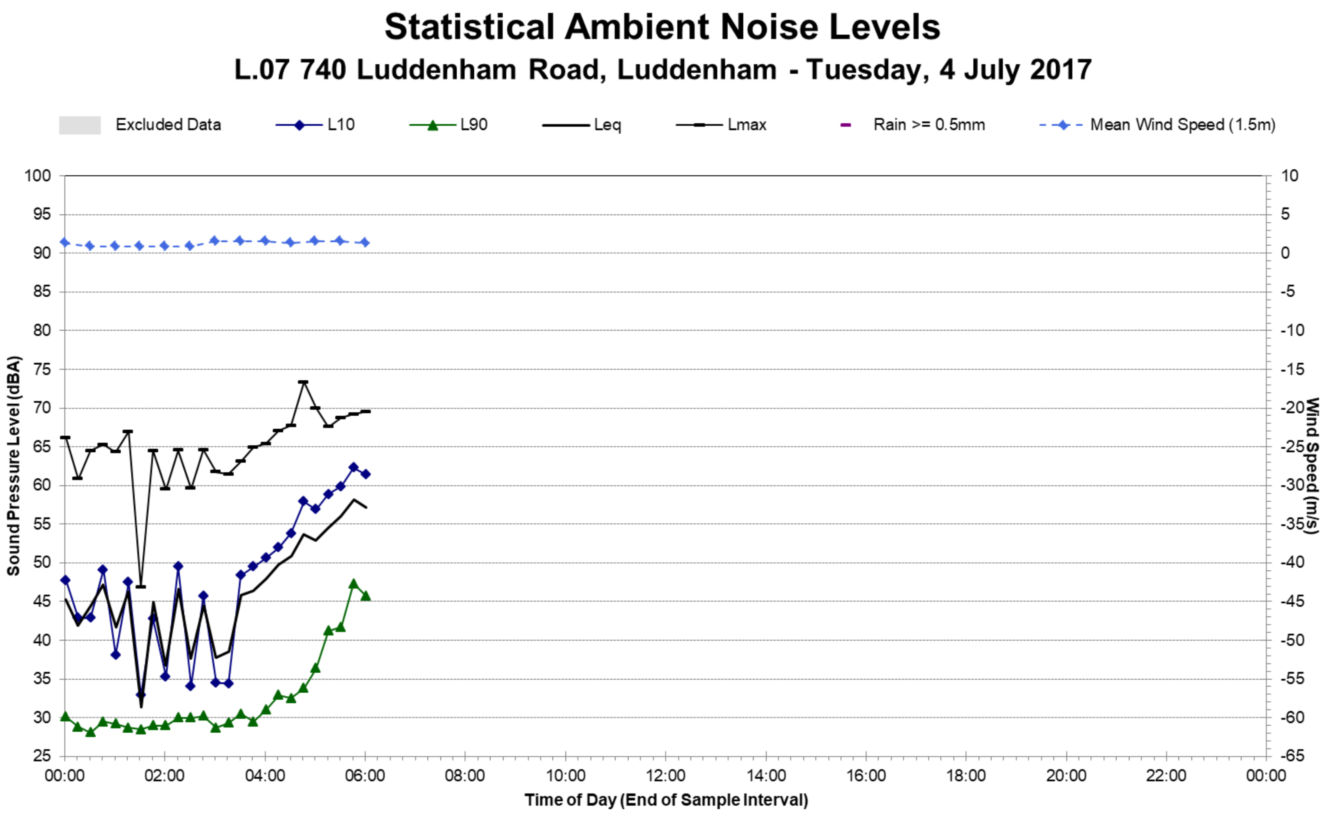

Statistical Ambient Noise Levels
L.07 740 Luddenham Road, Luddenham - Saturday, 1 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Statistical Ambient Noise Levels
L.07 740 Luddenham Road, Luddenham - Sunday, 2 July 2017



Statistical Ambient Noise Levels
L.07 740 Luddenham Road, Luddenham - Monday, 3 July 2017





Statistical Ambient Noise Levels
L.07 740 Luddenham Road, Luddenham - Tuesday, 4 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Noise Monitoring Location	L.08
Noise Monitoring Address	45m E of Northern Rd - 2828 The Northern Rd, Luddenham

Logger Device Type: Svantek 959, Logger Serial No: 11225
Sound Level Meter Device Type: Brüel and Kjær 2260i, Sound Level Meter Serial No: 2414605

Ambient noise logger deployed at residential address 2828 The Northern Road, Luddenham. Logger located approximately 45 m east of The Northern Road.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from The Northern Road. Noise from light aircraft and wildlife (ie birds) also contributes to the LAeq at this location.

Recorded Noise Levels: (LAmax):
22/06/2017: Road traffic (The Northern Rd) 55-74 dBA, Light aircraft: 51-59 dBA, Birds: 45-48 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – Construction Periods[1]

RBL Noise Level (dBA)				
Morning Shoulder	**Day**	**Evening**	**Evening Shoulder**	**Night**
58	46	50	57	34

Ambient Noise Logging Results – RNP Defined Time Periods

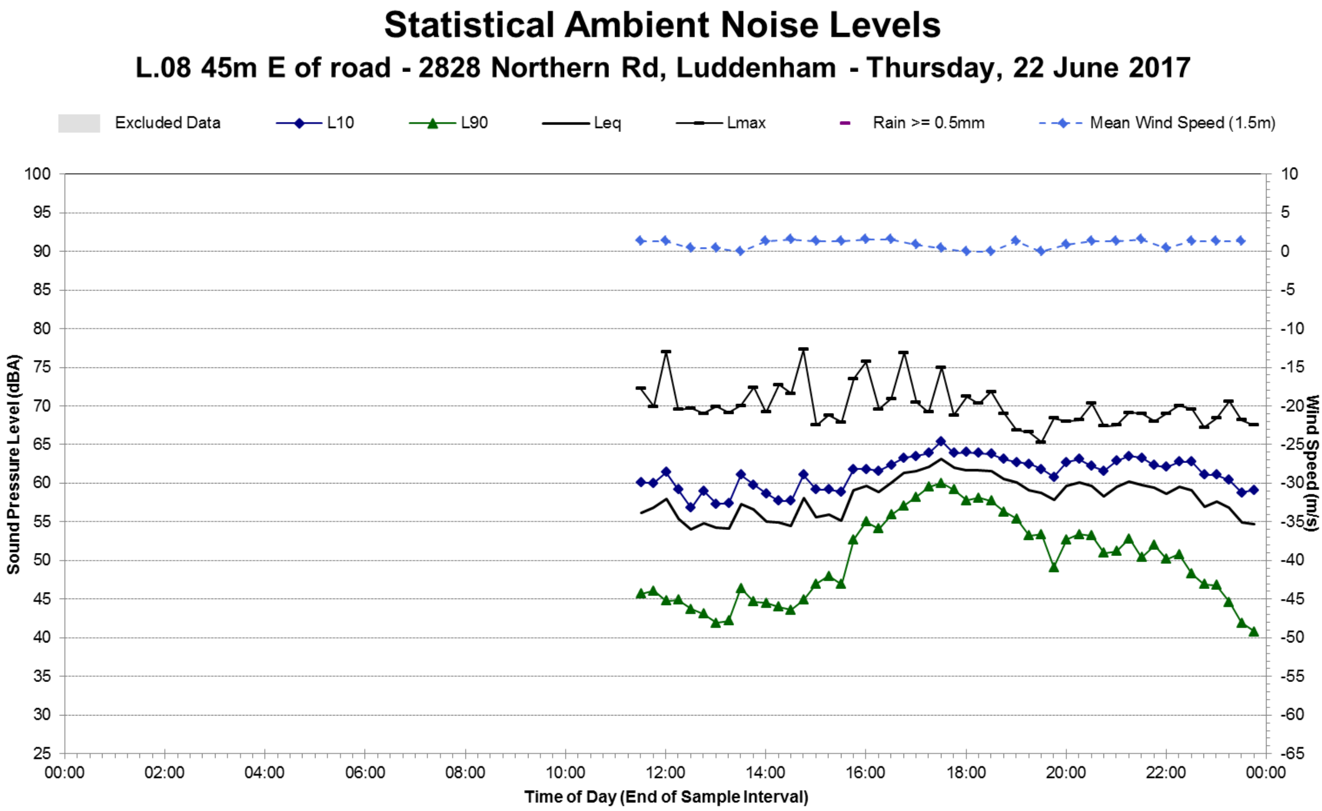
Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	60	63
Night-time (10pm-7am)	59	64

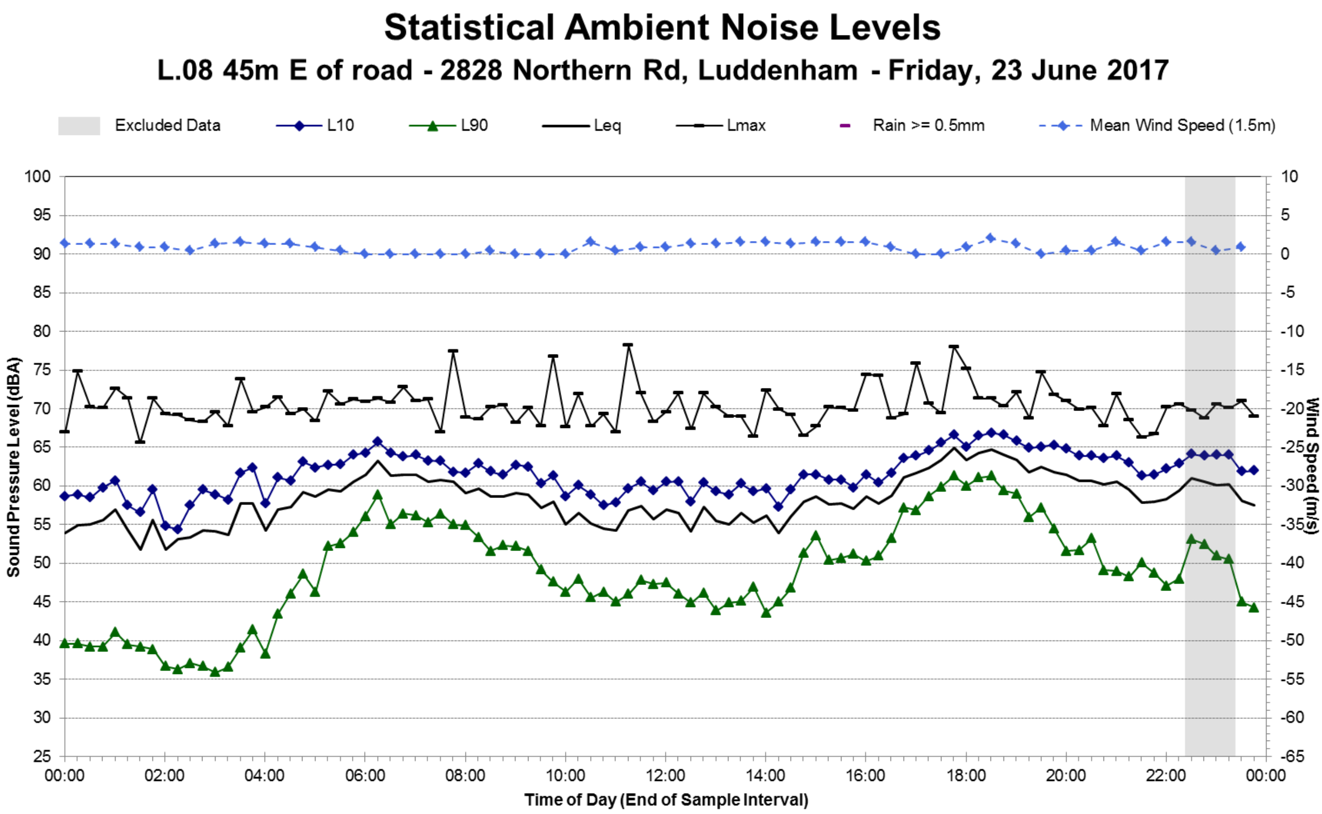
Attended Noise Measurement Results

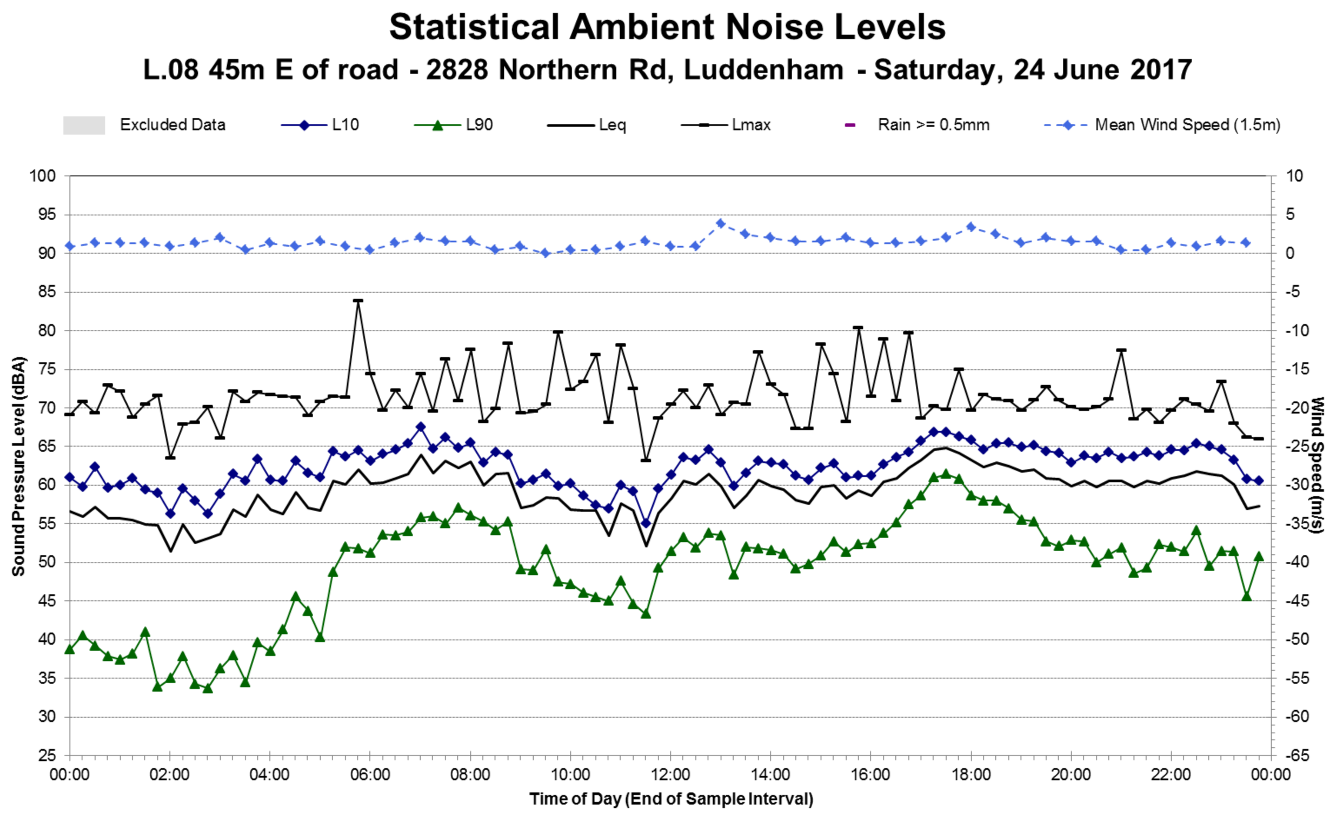
Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
22/06/2017	10:23	49	58	74

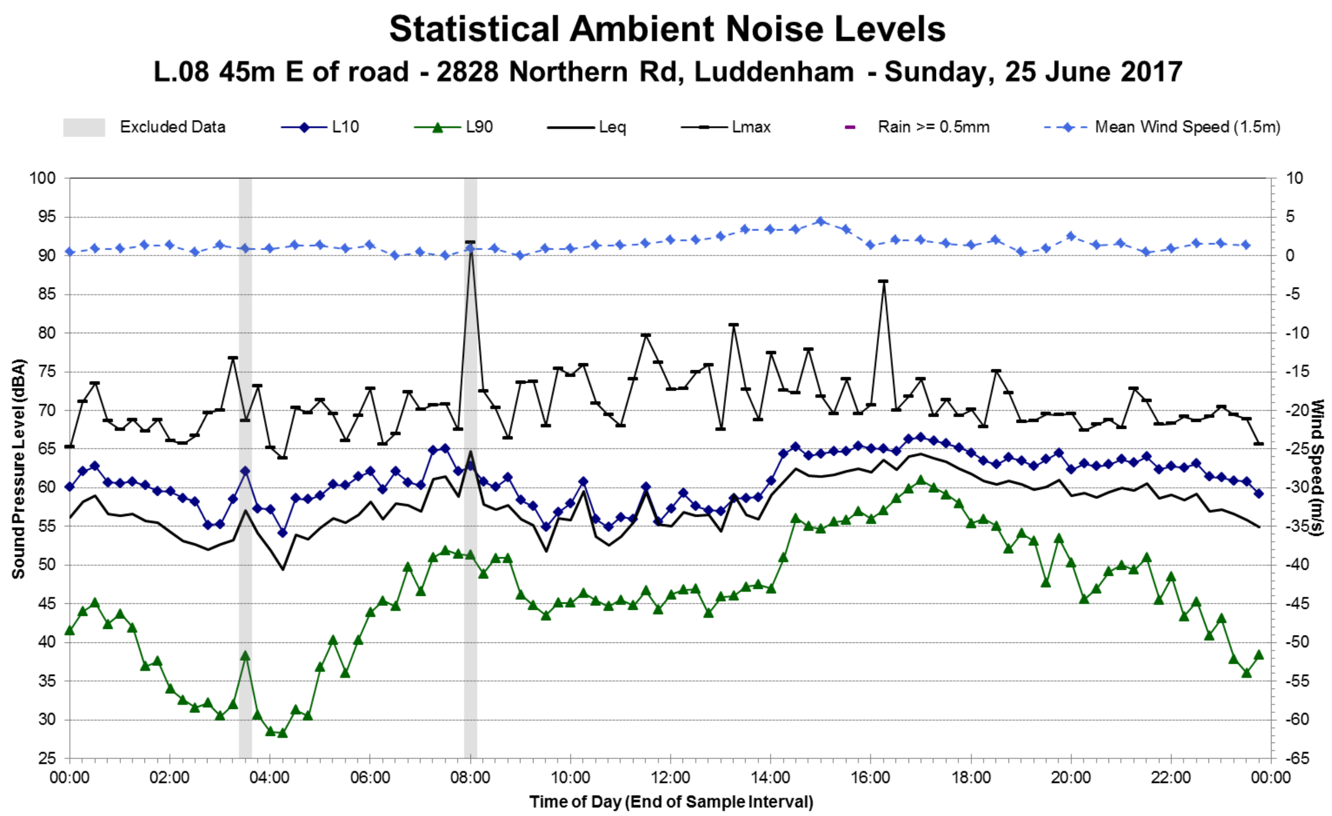
Photo of Noise Monitoring Location

Note 1: Morning shoulder is 6 am to 7 am Monday to Friday; Daytime is 7 am to 6 pm Monday to Saturday & 8 am to 6 pm Sunday & Public Holidays; Evening is 7 pm to 10 pm Monday to Friday & 6 pm to 10 pm Saturday, Sunday & Public Holidays; Evening shoulder is 6 pm to 7 pm Monday to Friday; Night-time is 10 pm to 6 am Monday to Friday, 10 pm to 7 am Saturday & 10 pm to 8 am Sunday and Public Holidays.


Statistical Ambient Noise Levels
L.08 45m E of road - 2828 Northern Rd, Luddenham - Thursday, 22 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

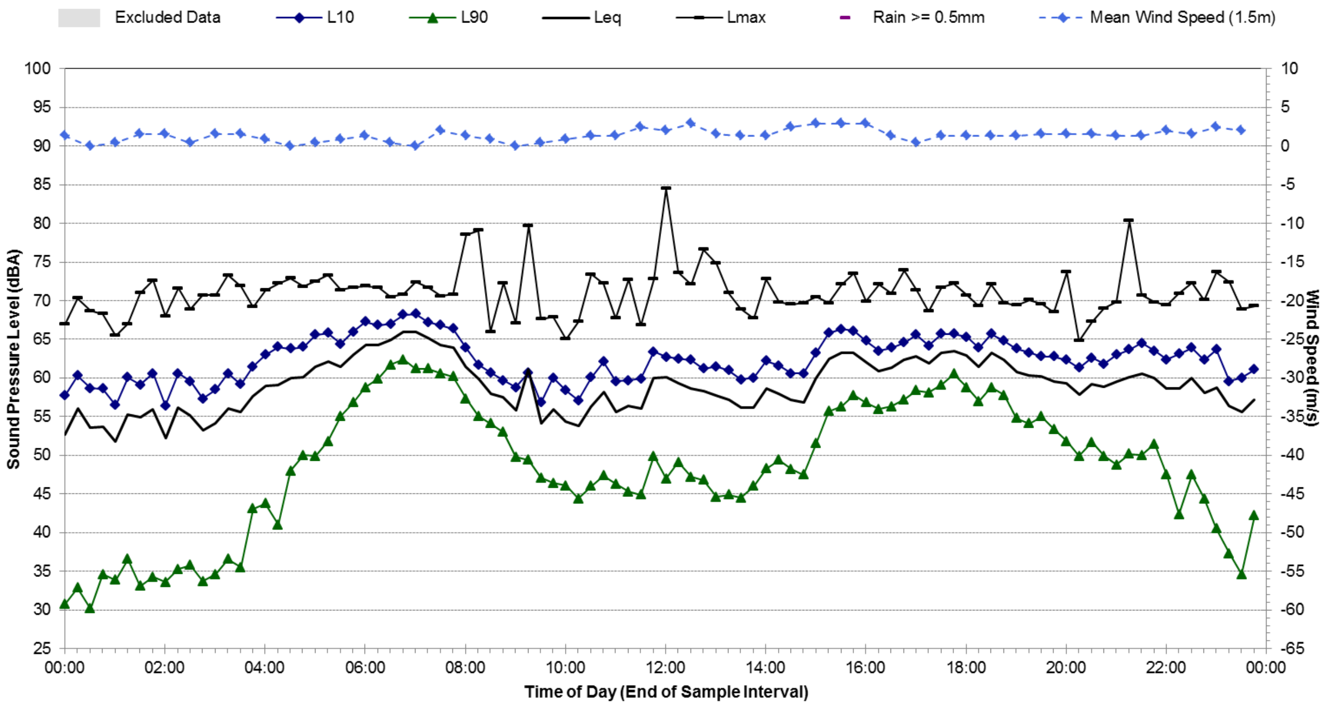

Statistical Ambient Noise Levels
L.08 45m E of road - 2828 Northern Rd, Luddenham - Friday, 23 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.08 45m E of road - 2828 Northern Rd, Luddenham - Saturday, 24 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.08 45m E of road - 2828 Northern Rd, Luddenham - Sunday, 25 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

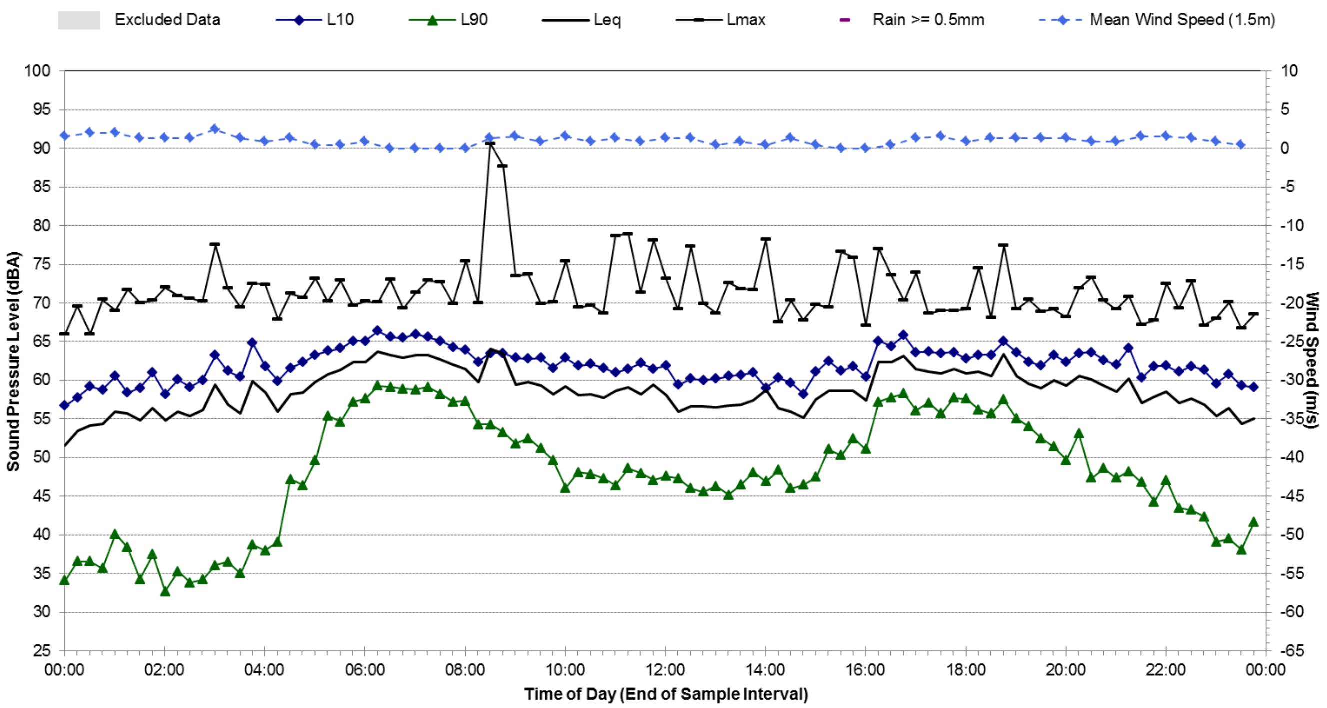
Statistical Ambient Noise Levels

L.08 45m E of road - 2828 Northern Rd, Luddenham - Monday, 26 June 2017



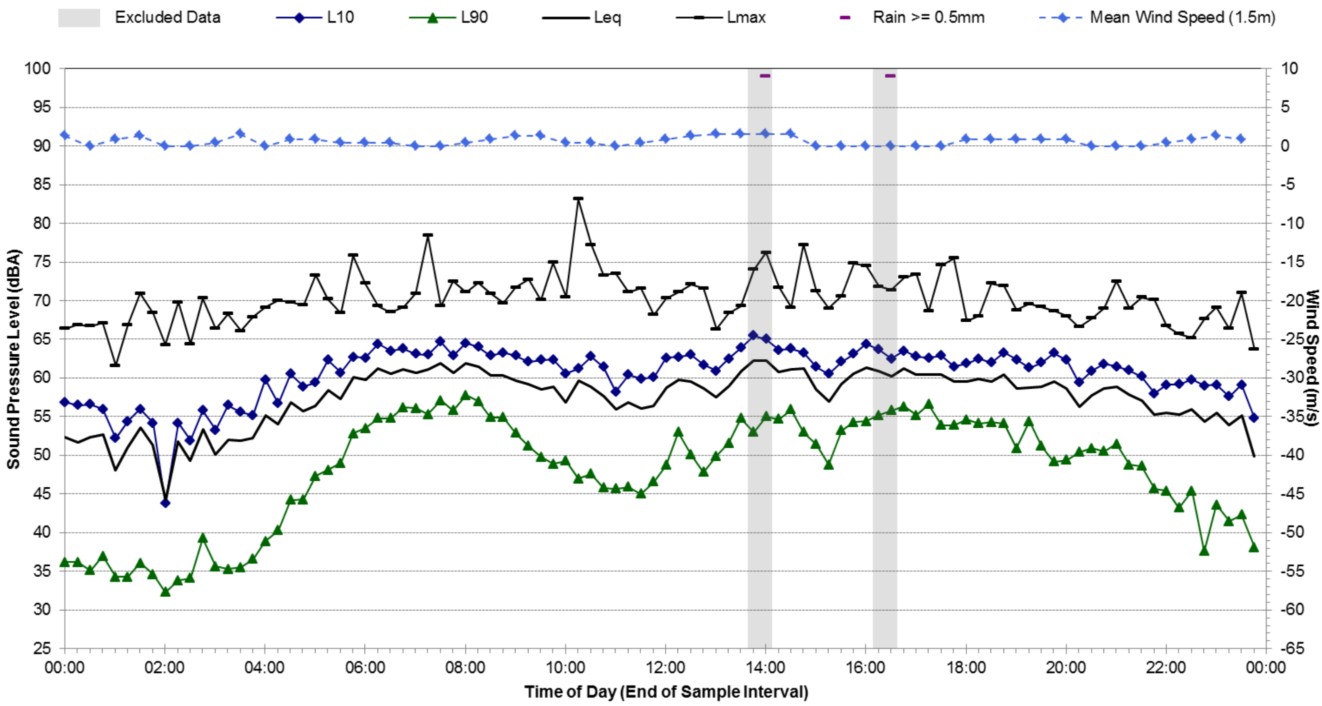
Statistical Ambient Noise Levels

L.08 45m E of road - 2828 Northern Rd, Luddenham - Tuesday, 27 June 2017



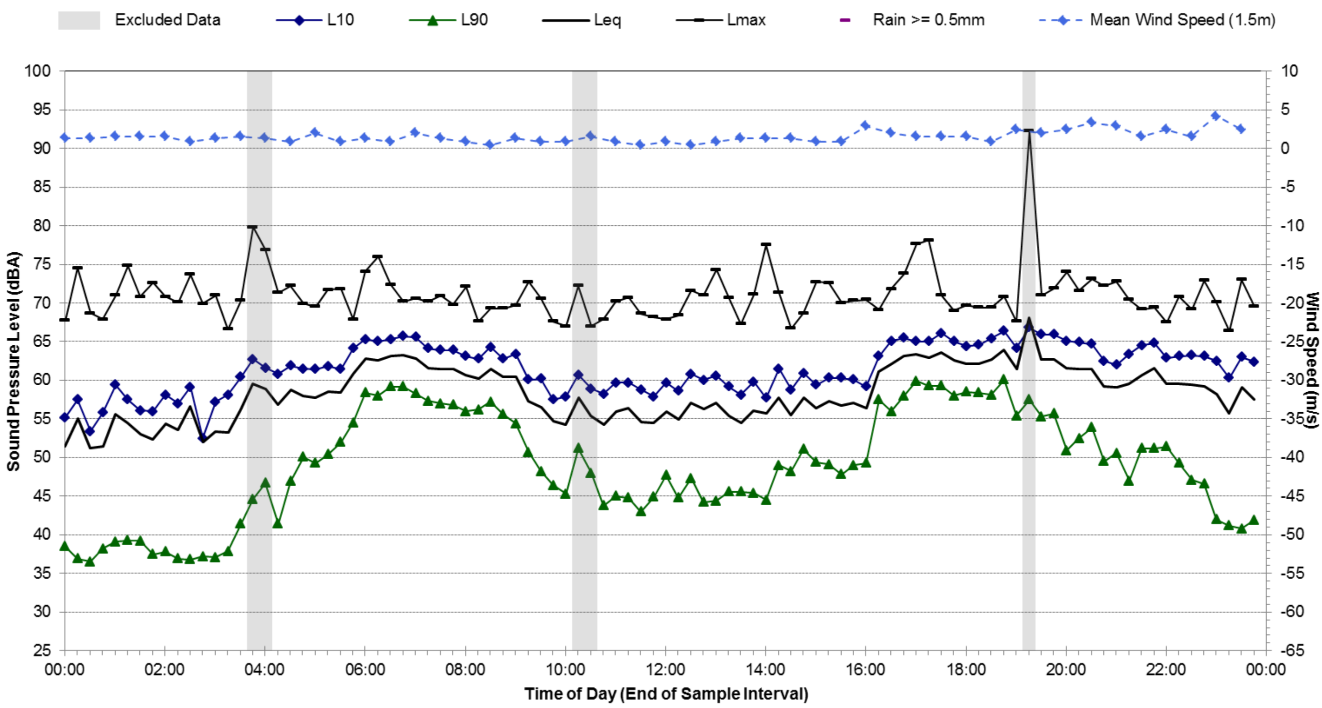
Statistical Ambient Noise Levels

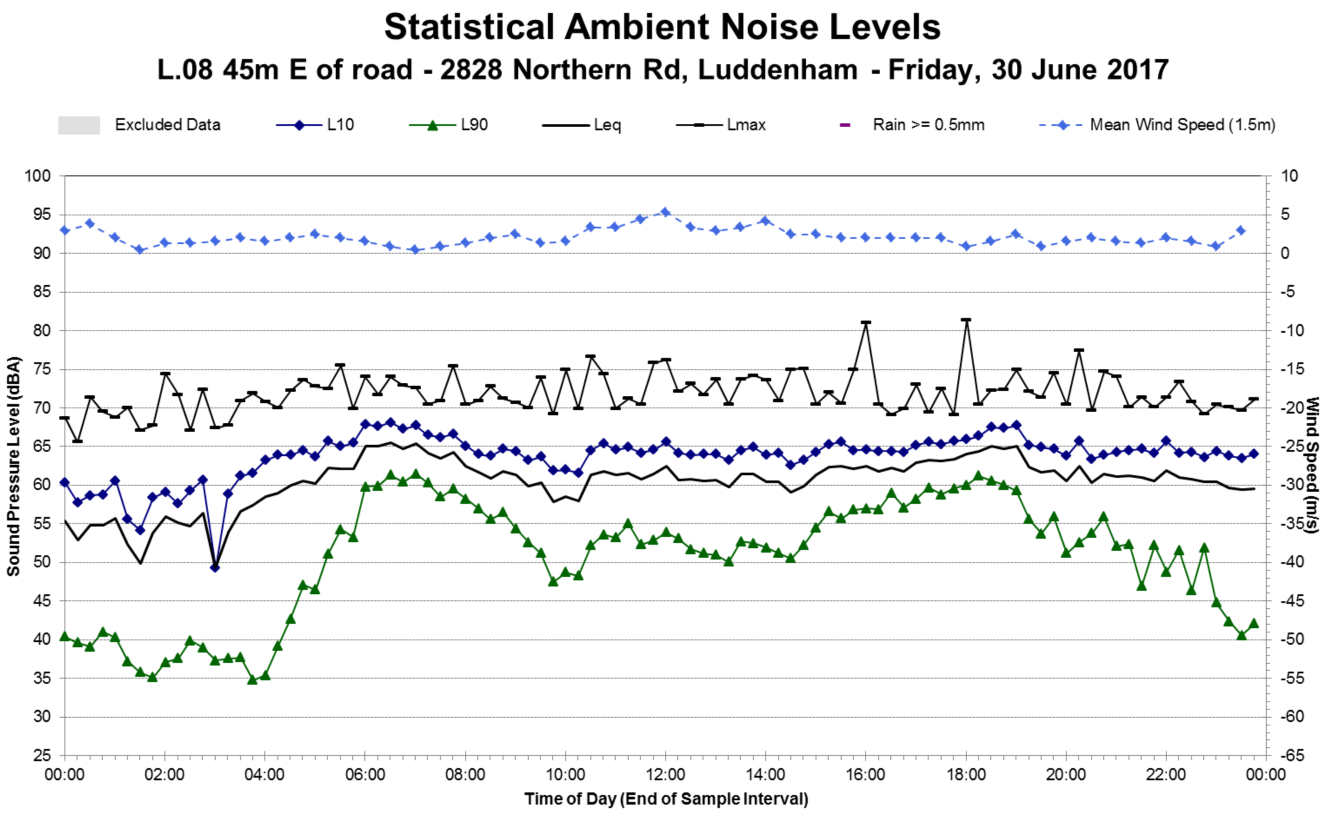
L.08 45m E of road - 2828 Northern Rd, Luddenham - Wednesday, 28 June 2017

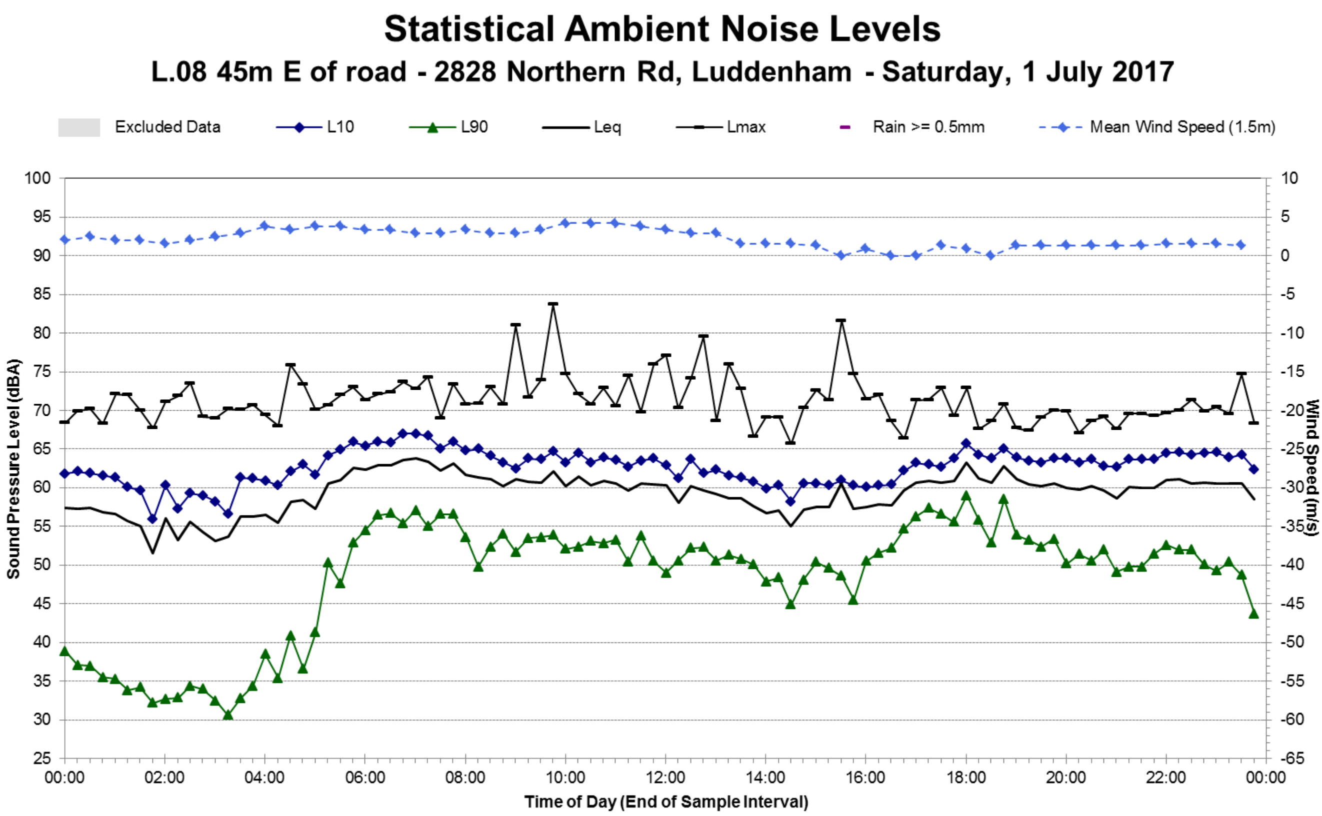


Statistical Ambient Noise Levels

L.08 45m E of road - 2828 Northern Rd, Luddenham - Thursday, 29 June 2017

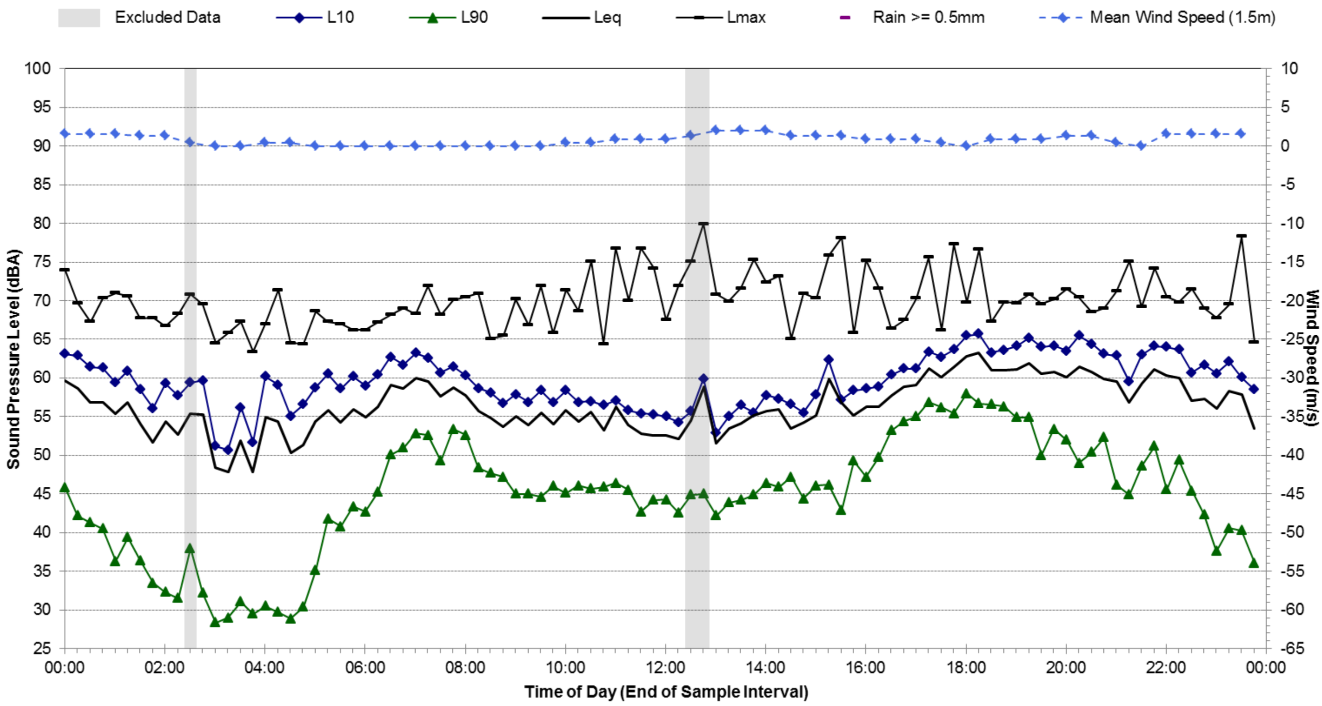



Statistical Ambient Noise Levels
L.08 45m E of road - 2828 Northern Rd, Luddenham - Friday, 30 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.08 45m E of road - 2828 Northern Rd, Luddenham - Saturday, 1 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

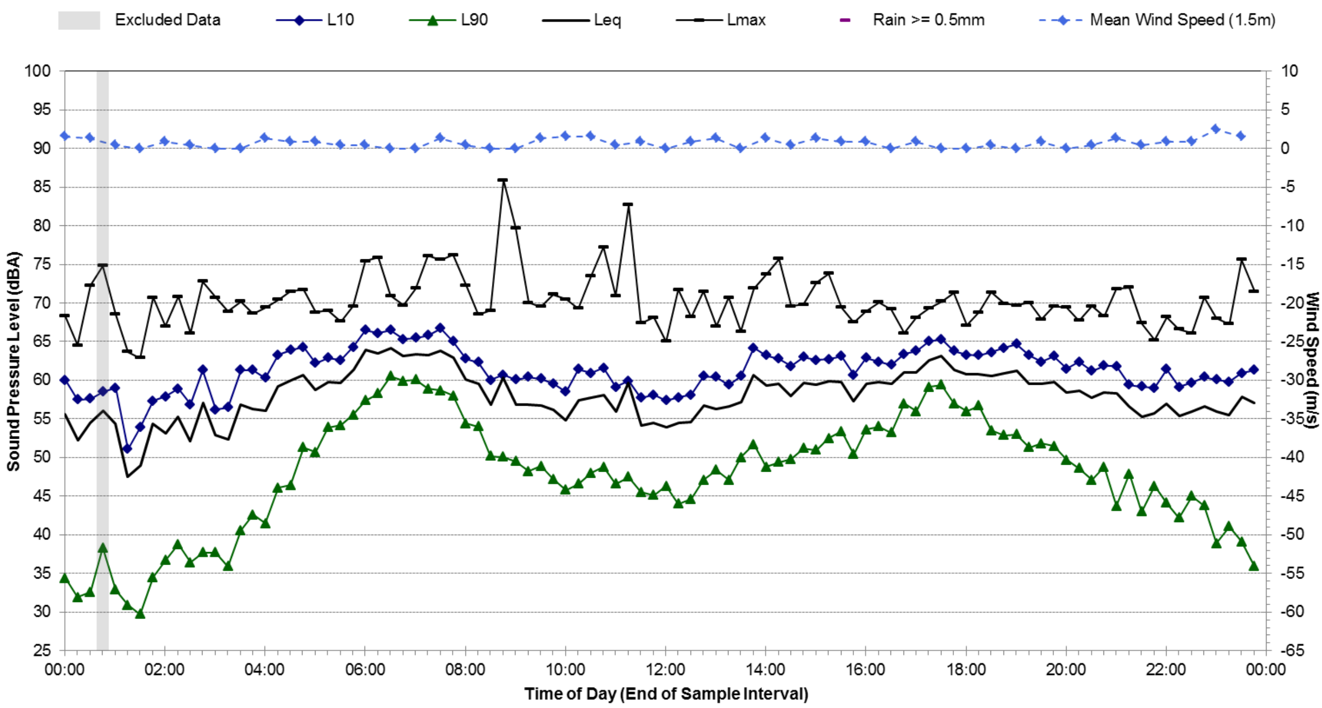
Statistical Ambient Noise Levels

L.08 45m E of road - 2828 Northern Rd, Luddenham - Sunday, 2 July 2017



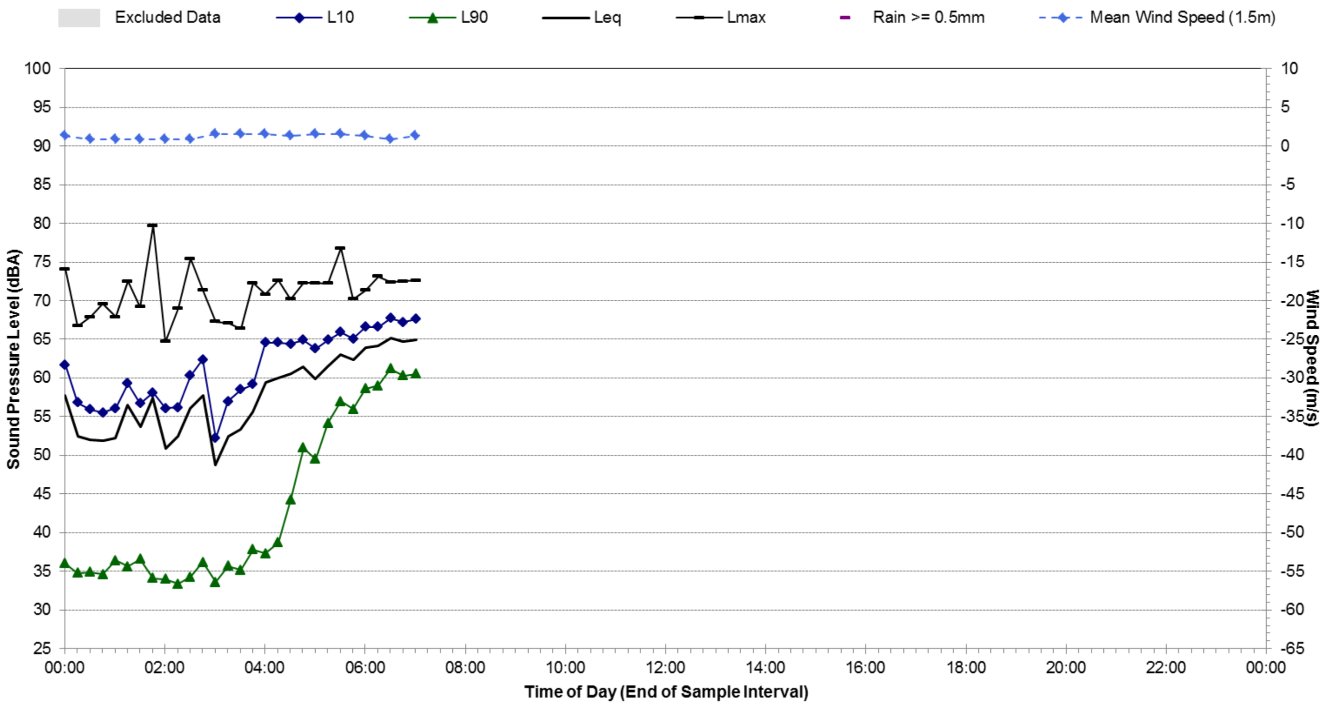
Statistical Ambient Noise Levels

L.08 45m E of road - 2828 Northern Rd, Luddenham - Monday, 3 July 2017



Statistical Ambient Noise Levels

L.08 45m E of road - 2828 Northern Rd, Luddenham - Tuesday, 4 July 2017



Noise Monitoring Location	L.09
Noise Monitoring Address	**140m E of Northern Rd - 2828 The Northern Rd, Luddenham**

Logger Device Type: Svantek 959, Logger Serial No: 21293

Sound Level Meter Device Type: Brüel and Kjær 2260i, Sound Level Meter Serial No: 2414605

Ambient noise logger deployed at residential address 2828 The Northern Road, Luddenham. Logger located approximately 140 m east of The Northern Road.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from The Northern Road. Noise from light aircraft and wildlife (ie birds) also contributes to the LAeq at this location.

Recorded Noise Levels: (LAmax):

22/06/2017: Road traffic (The Northern Rd) 50-63 dBA, Light aircraft: 55-59 dBA, Birds: 56 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – Construction Periods[1]

RBL Noise Level (dBA)				
Morning Shoulder	**Day**	**Evening**	**Evening Shoulder**	**Night**
56	44	48	54	36

Ambient Noise Logging Results – RNP Defined Time Periods

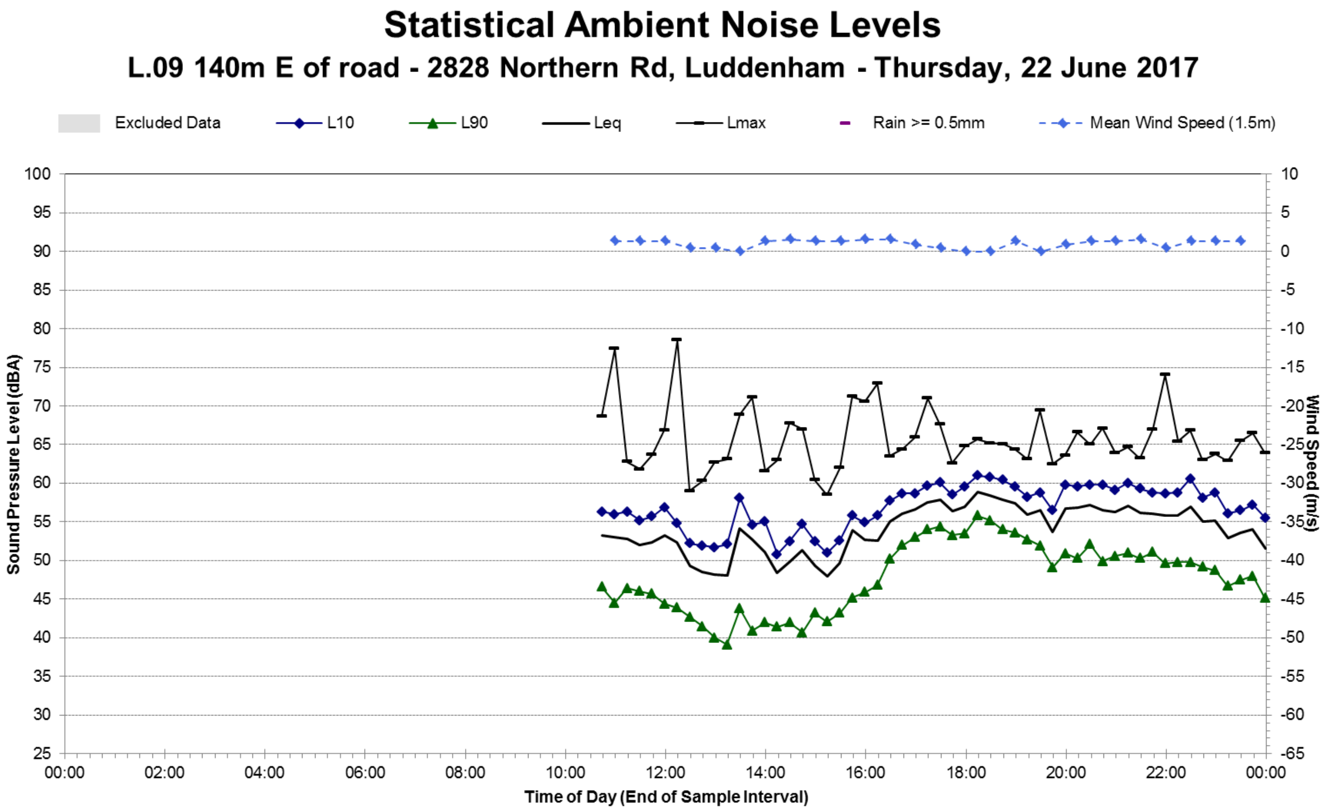
Monitoring Period	Noise Level (dBA)	
	LAeq(period)	**LAeq(1hour)**
Daytime (7am-10pm)	56	59
Night-time (10pm-7am)	55	60

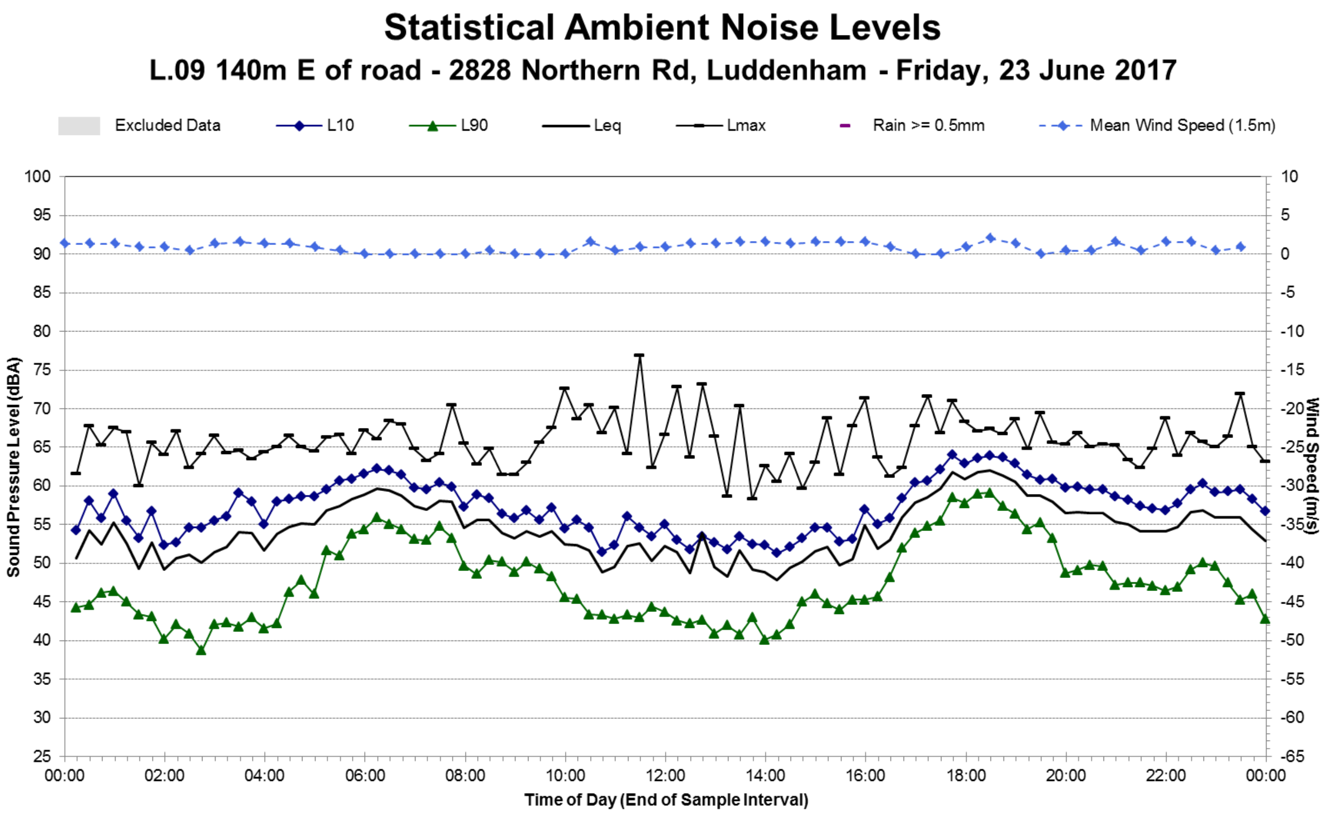
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	**LAeq**	**LAmax**
22/06/2017	09:48	48	54	63

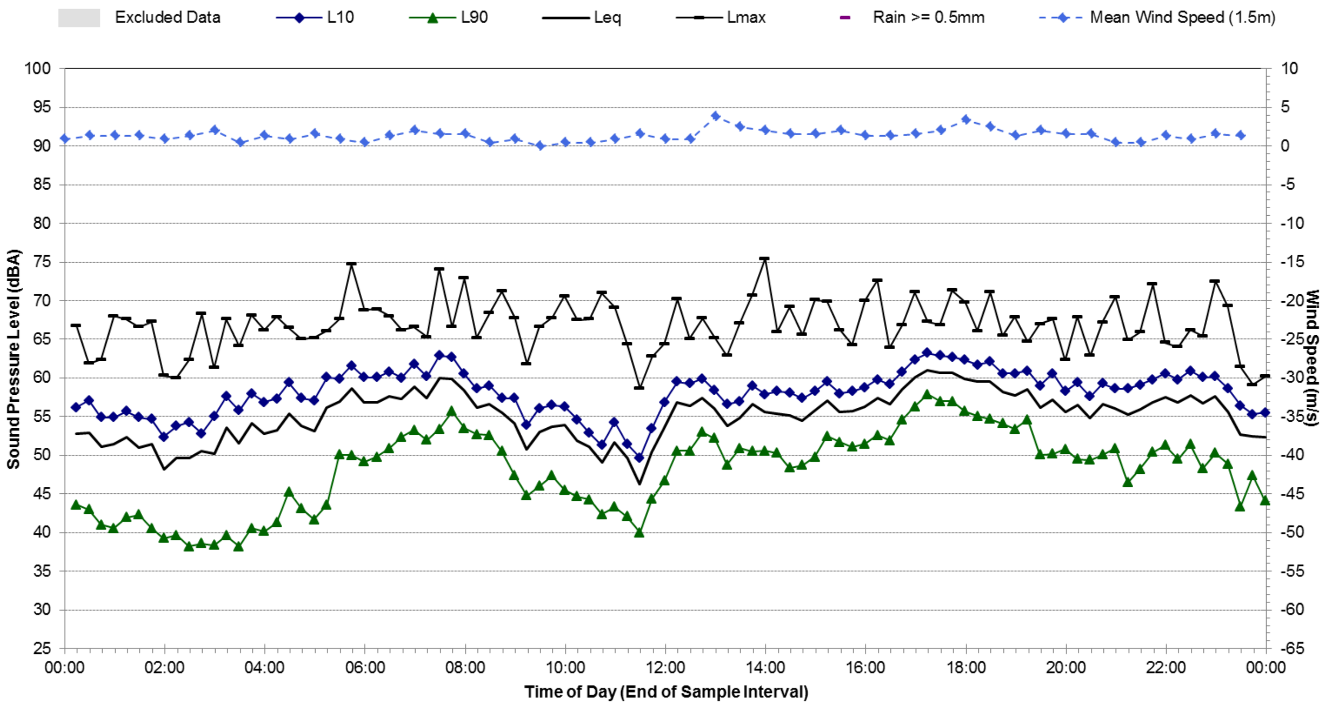
Photo of Noise Monitoring Location

Note 1: Morning shoulder is 6 am to 7 am Monday to Friday; Daytime is 7 am to 6 pm Monday to Saturday & 8 am to 6 pm Sunday & Public Holidays; Evening is 7 pm to 10 pm Monday to Friday & 6 pm to 10 pm Saturday, Sunday & Public Holidays; Evening shoulder is 6 pm to 7 pm Monday to Friday; Night-time is 10 pm to 6 am Monday to Friday, 10 pm to 7 am Saturday & 10 pm to 8 am Sunday and Public Holidays.

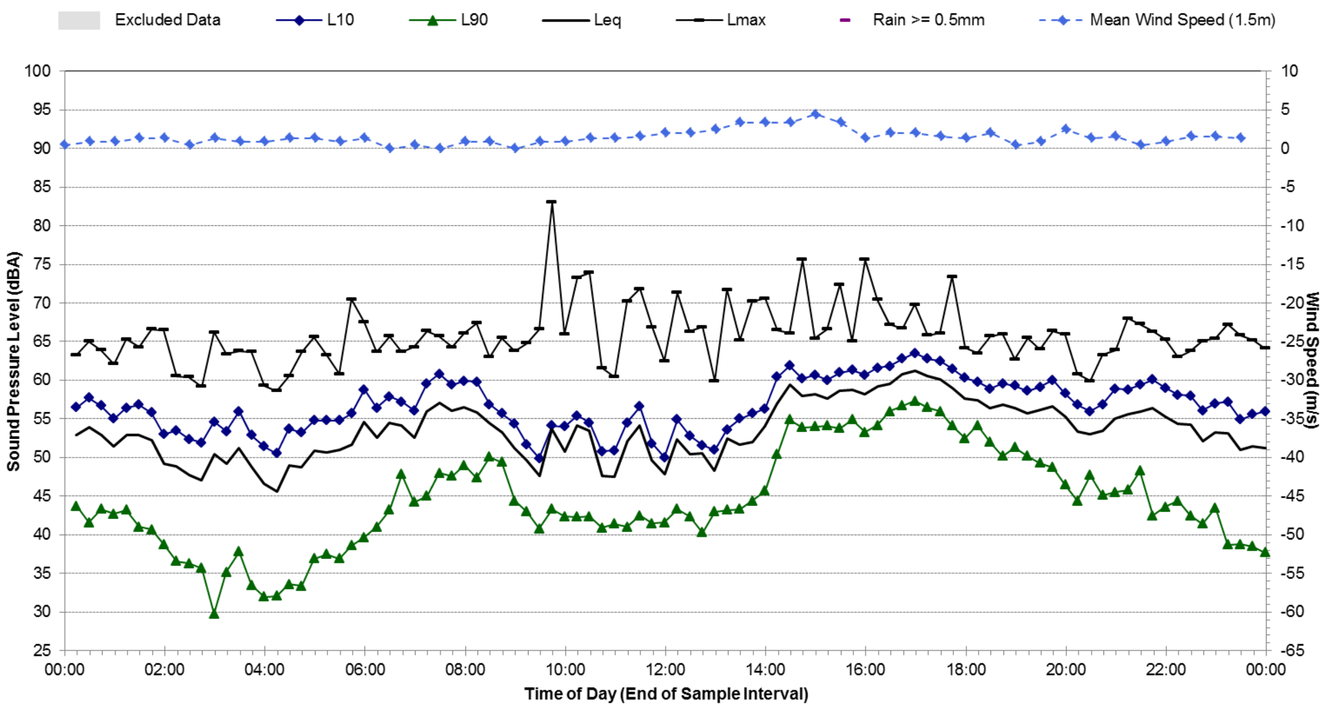

Statistical Ambient Noise Levels
L.09 140m E of road - 2828 Northern Rd, Luddenham - Thursday, 22 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

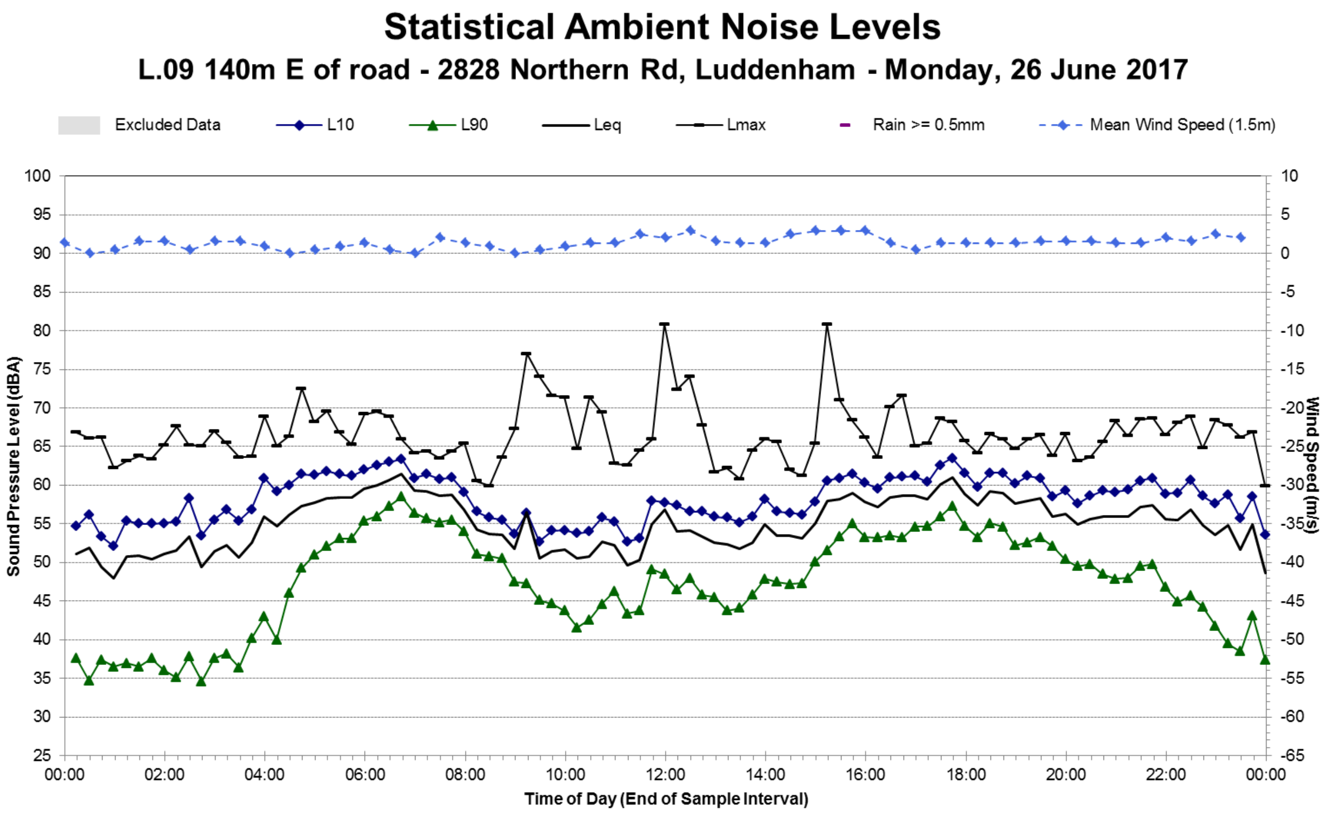

Statistical Ambient Noise Levels
L.09 140m E of road - 2828 Northern Rd, Luddenham - Friday, 23 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

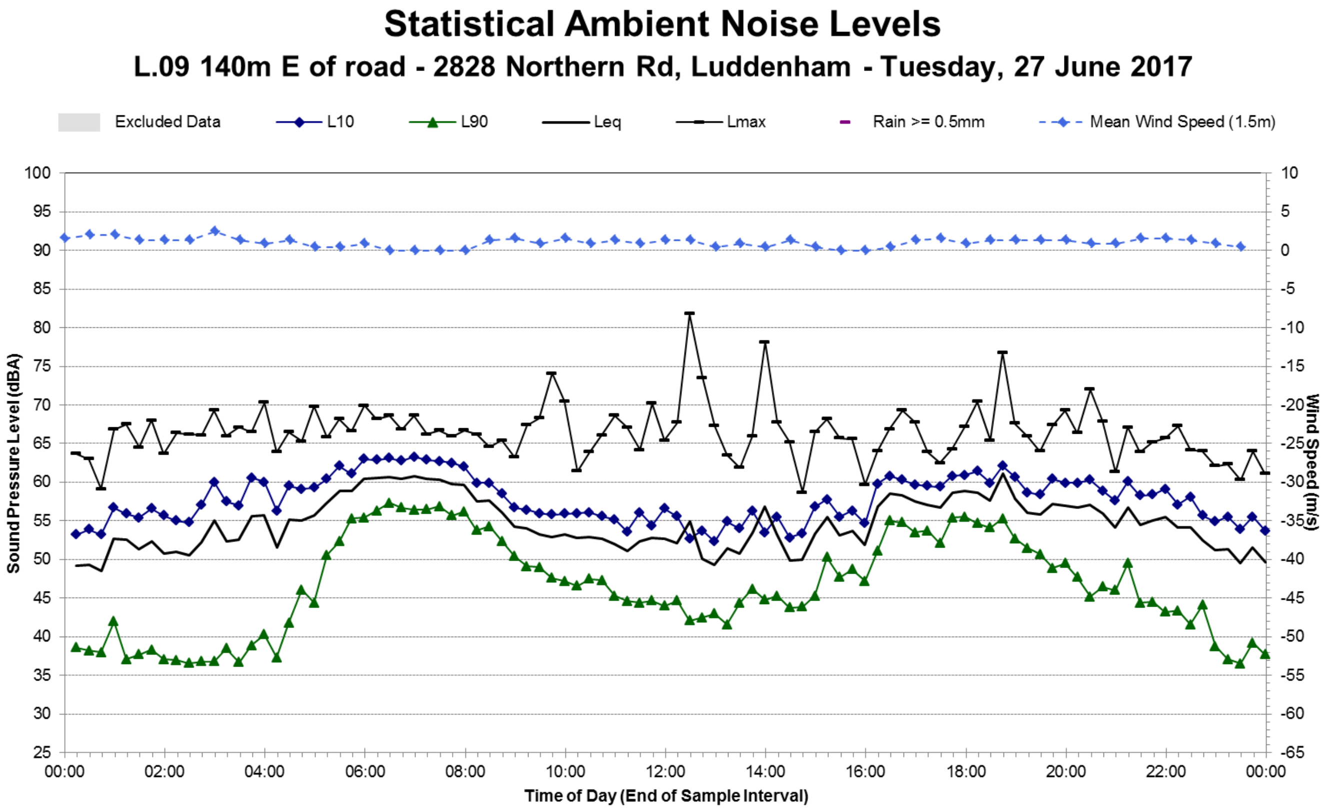
Statistical Ambient Noise Levels
L.09 140m E of road - 2828 Northern Rd, Luddenham - Saturday, 24 June 2017

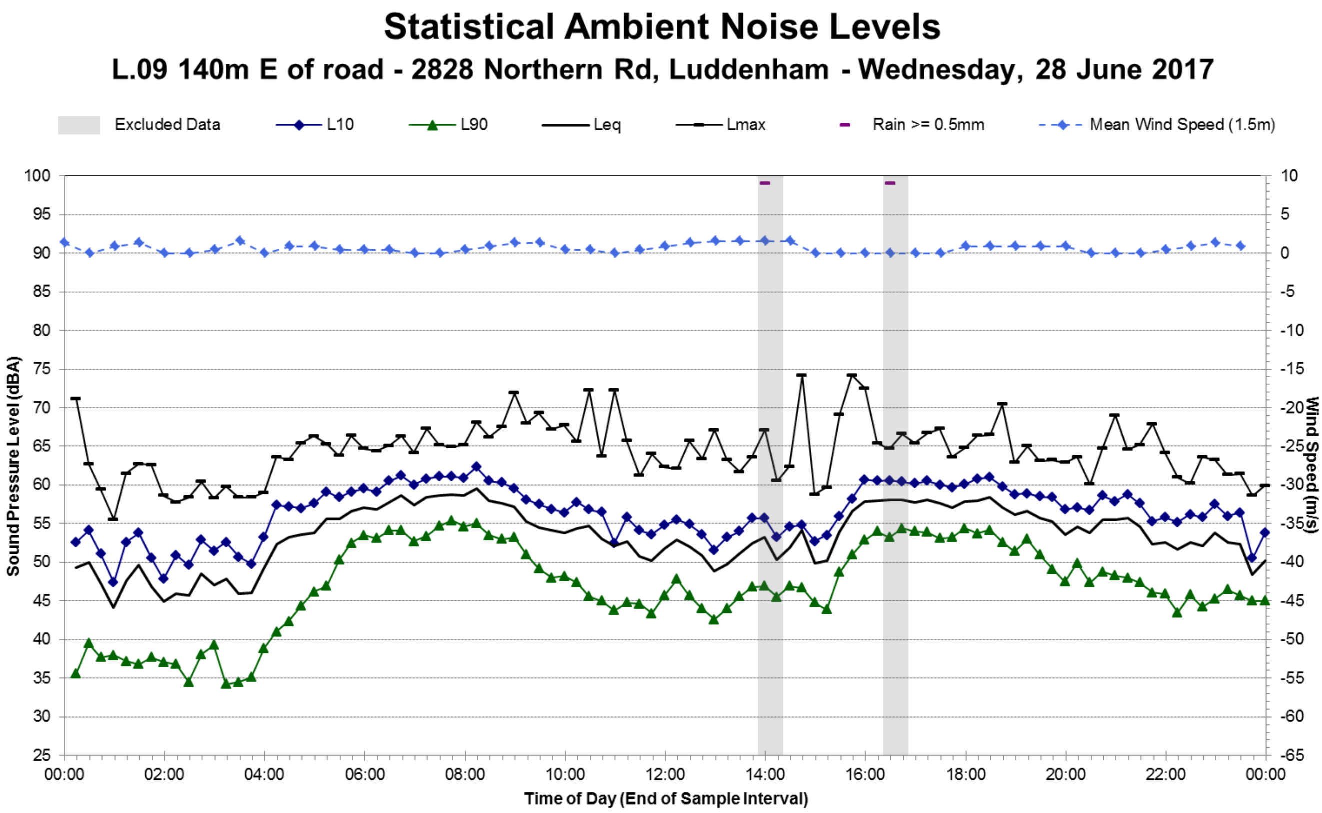


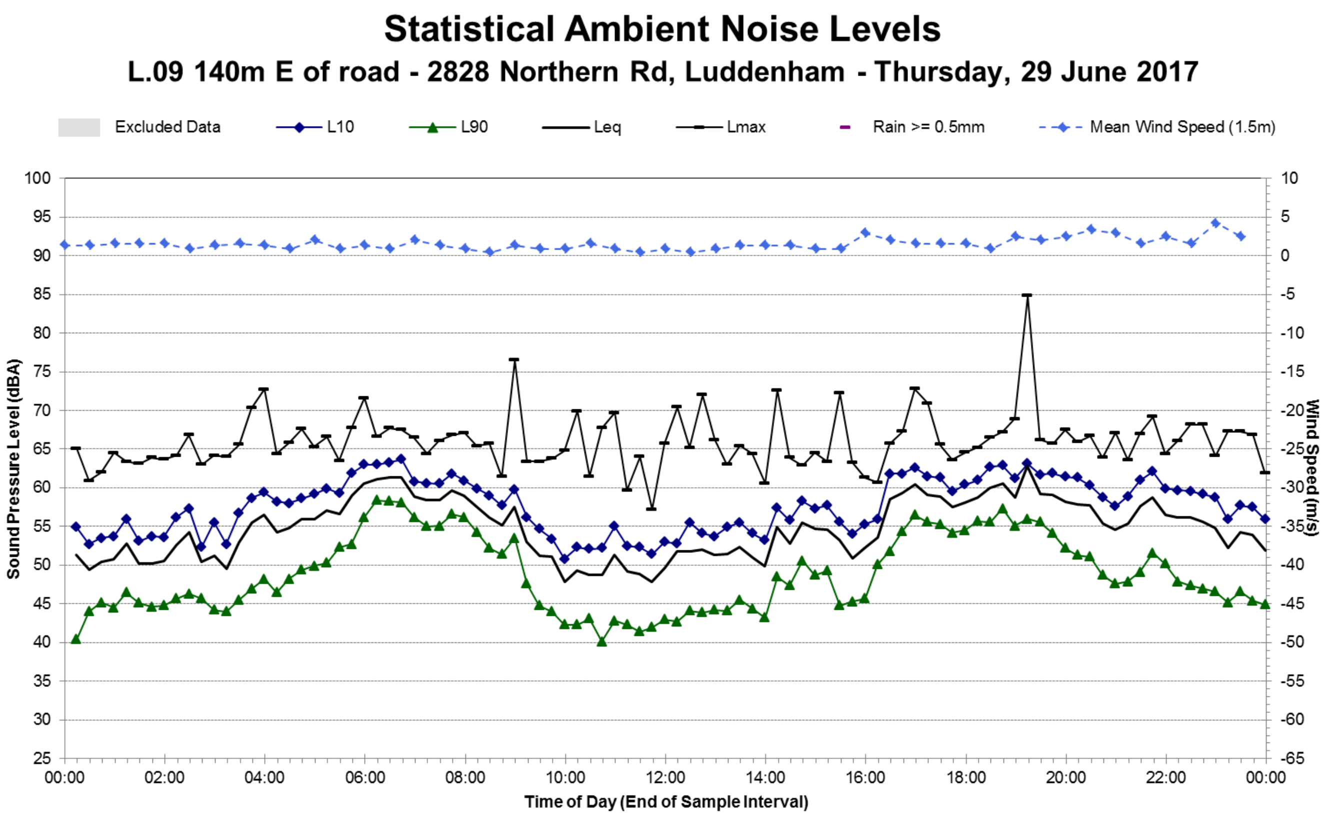
Statistical Ambient Noise Levels
L.09 140m E of road - 2828 Northern Rd, Luddenham - Sunday, 25 June 2017

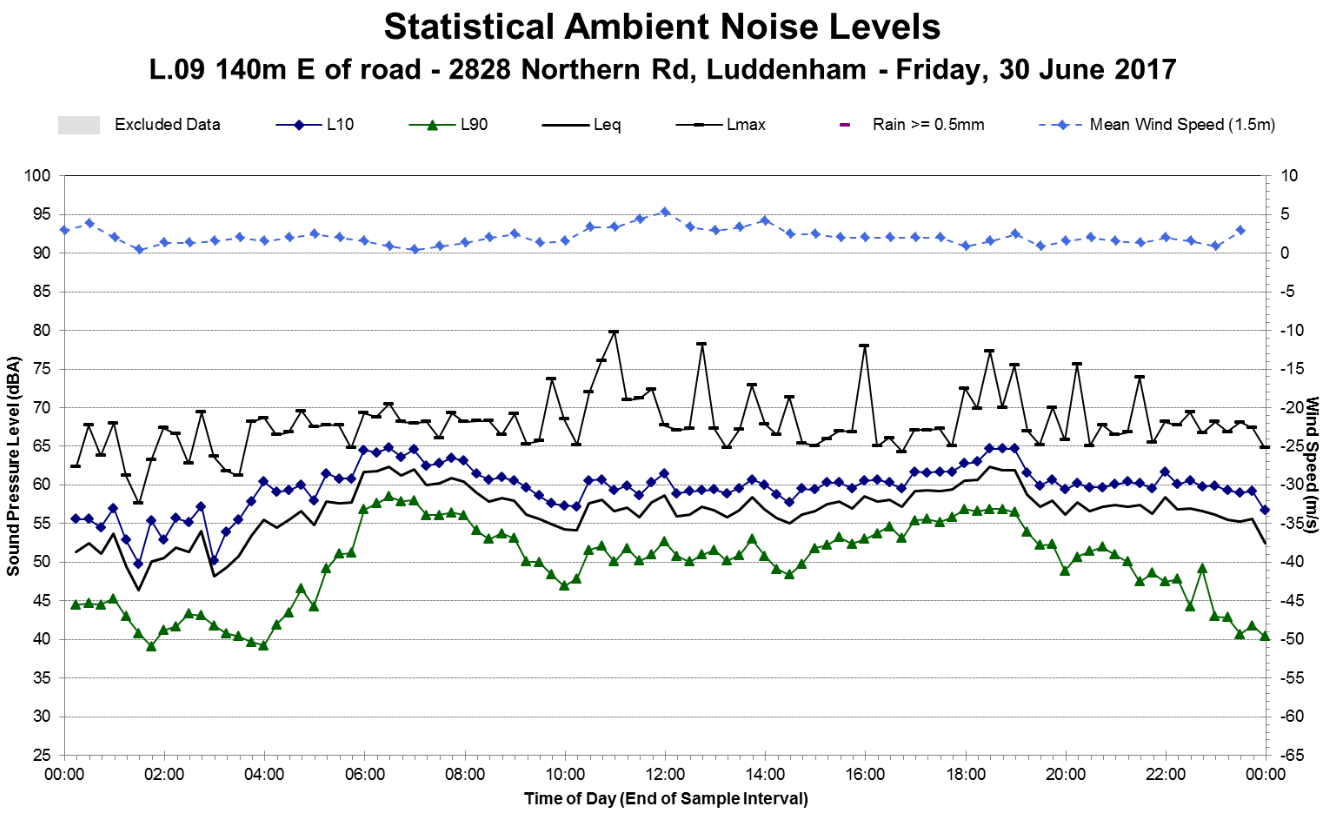


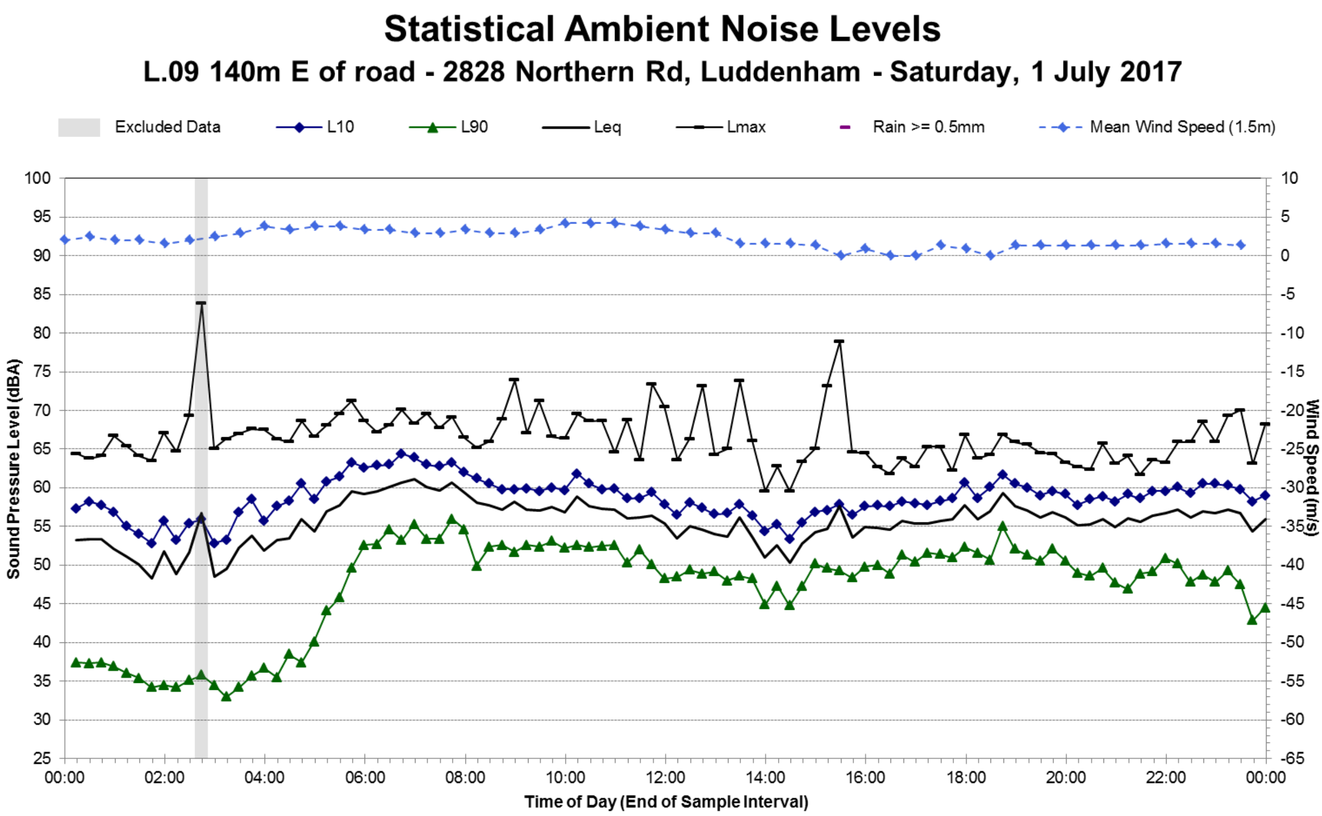

Statistical Ambient Noise Levels
L.09 140m E of road - 2828 Northern Rd, Luddenham - Monday, 26 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

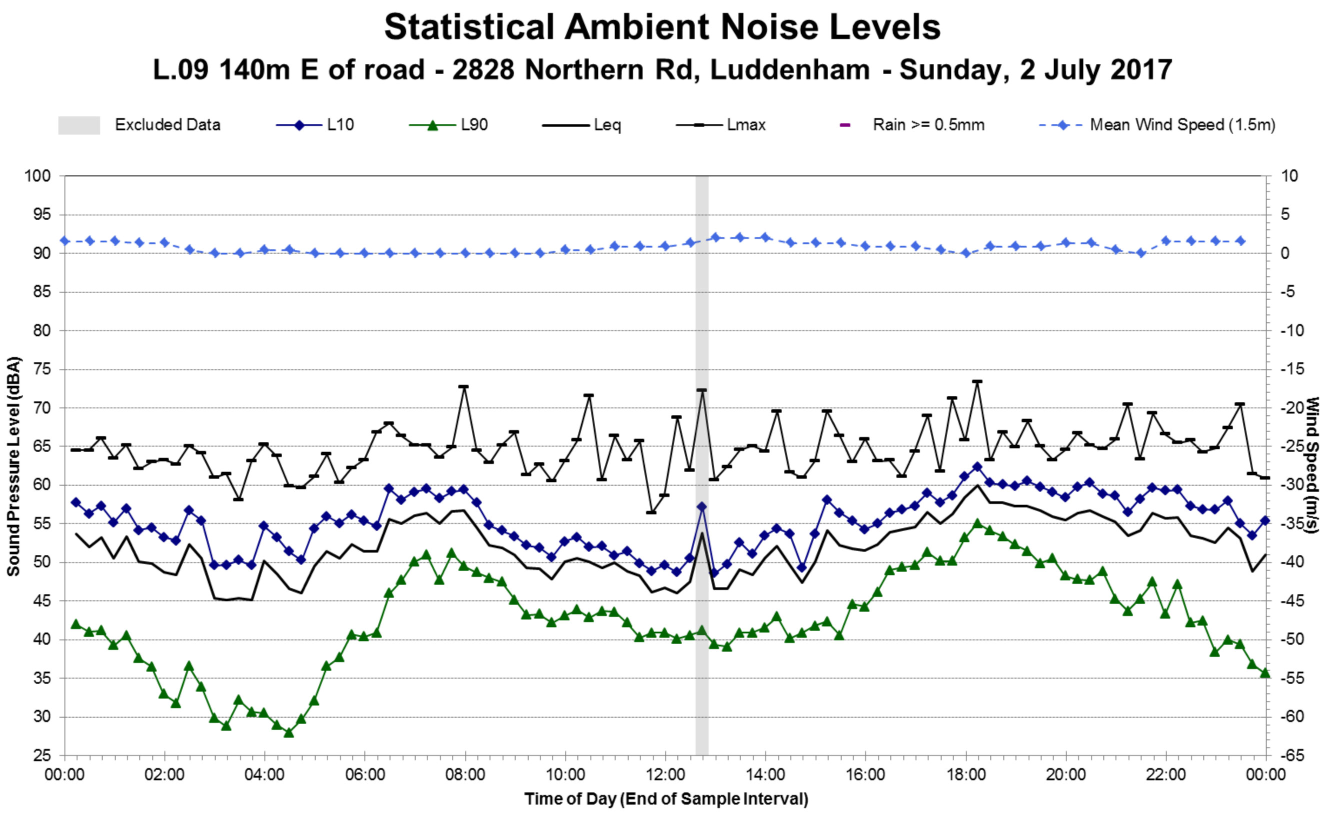

Statistical Ambient Noise Levels
L.09 140m E of road - 2828 Northern Rd, Luddenham - Tuesday, 27 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.09 140m E of road - 2828 Northern Rd, Luddenham - Wednesday, 28 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

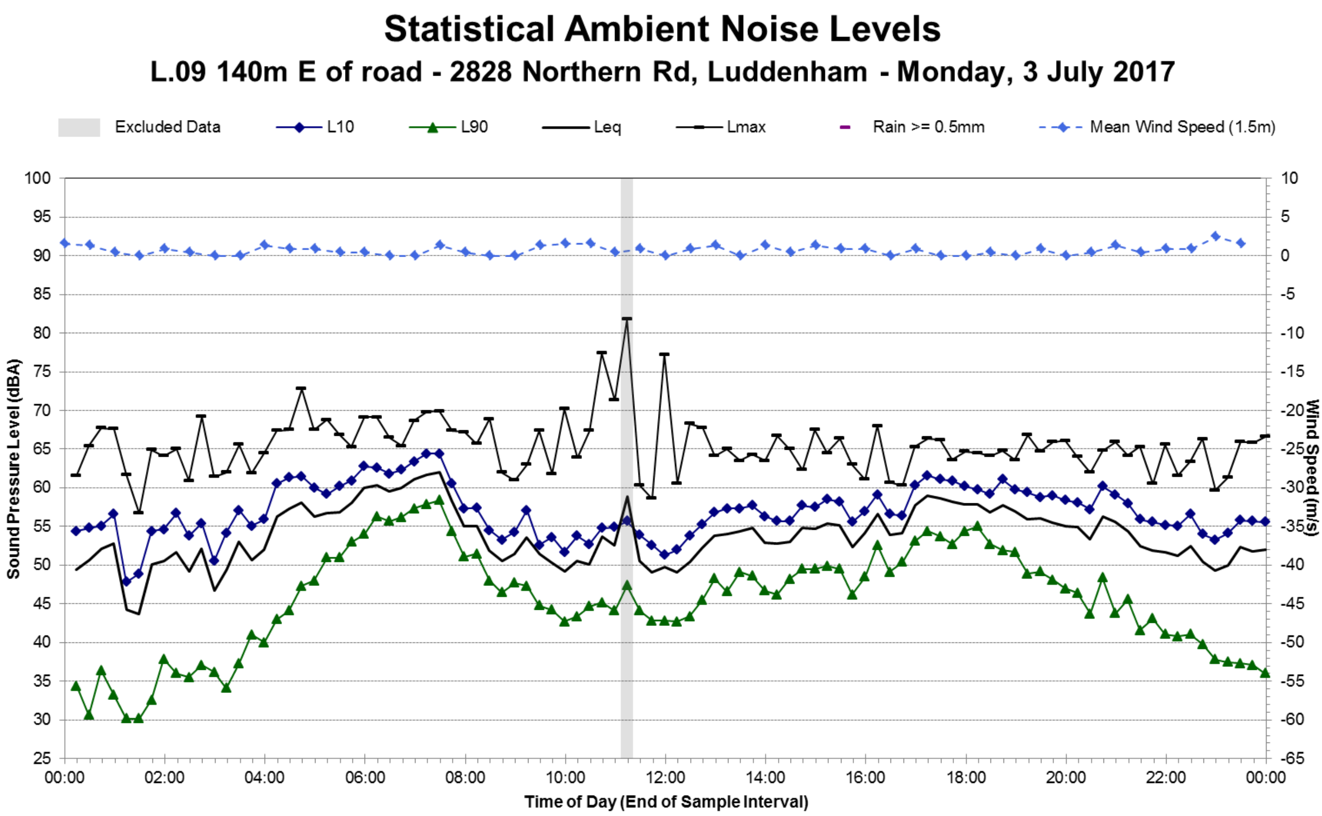

Statistical Ambient Noise Levels
L.09 140m E of road - 2828 Northern Rd, Luddenham - Thursday, 29 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.09 140m E of road - 2828 Northern Rd, Luddenham - Friday, 30 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

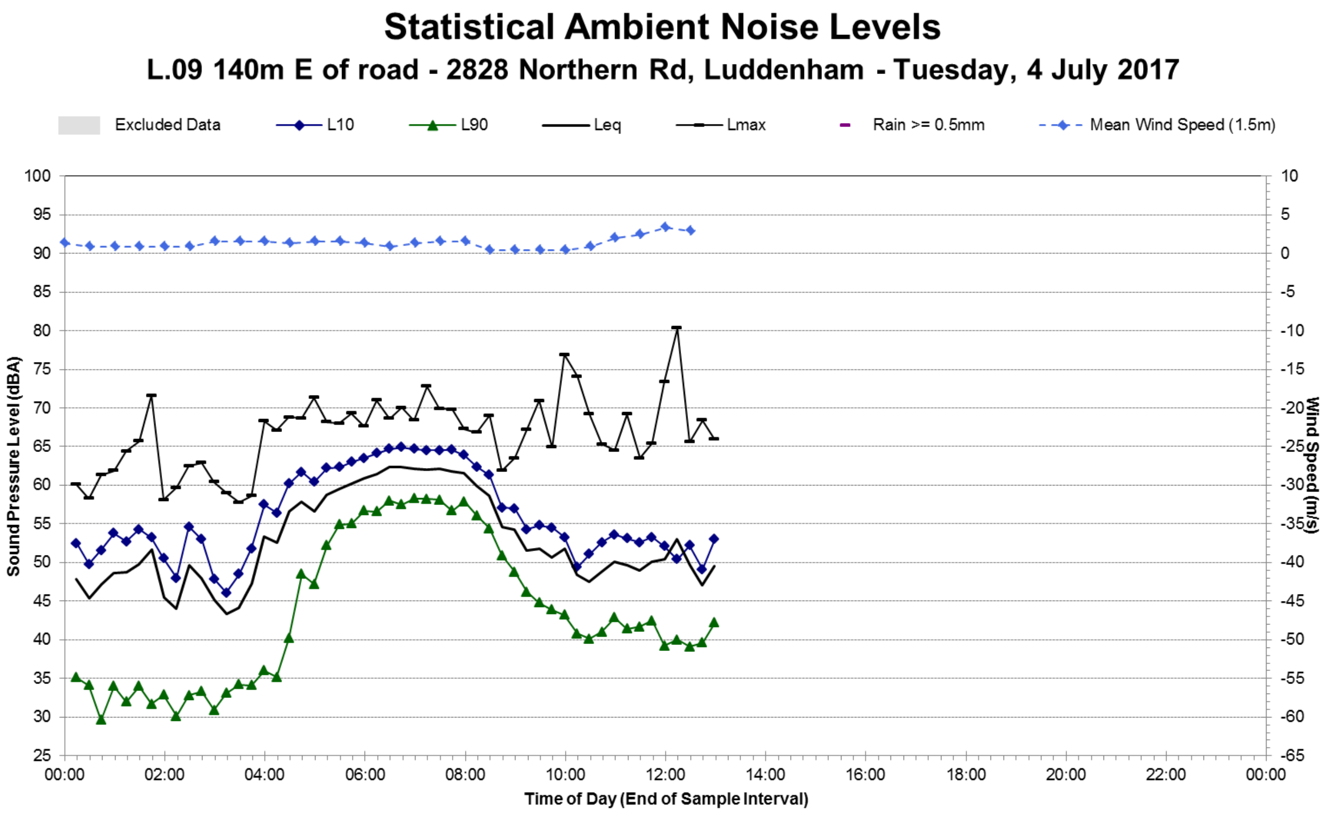

Statistical Ambient Noise Levels
L.09 140m E of road - 2828 Northern Rd, Luddenham - Saturday, 1 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
L.09 140m E of road - 2828 Northern Rd, Luddenham - Sunday, 2 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
L.09 140m E of road - 2828 Northern Rd, Luddenham - Monday, 3 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
L.09 140m E of road - 2828 Northern Rd, Luddenham - Tuesday, 4 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Noise Monitoring Location	L.10
Noise Monitoring Address	**340m E of Northern Rd - 2828 The Northern Rd, Luddenham**

Logger Device Type: Svantek 957, Logger Serial No: 23241

Sound Level Meter Device Type: Brüel and Kjær 2260i, Sound Level Meter Serial No: 2414605

Ambient noise logger deployed at residential address 2828 The Northern Road, Luddenham. Logger located approximately 340 m east of The Northern Road.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from The Northern Road. Noise from light aircraft and wildlife (ie birds) also contributes to the LAeq at this location.

Recorded Noise Levels: (LAmax):

22/06/2017: Light vehicles (The Northern Rd): 40-43 dBA, Heavy vehicles (The Northern Rd): 48-49 dBA, Light aircraft: 55 dBA, Ambient noise (wind, grass, insects, frogs) 41-46 dBA.

Map of Noise Monitoring Location

Ambient Noise Logging Results – Construction Periods[1]

RBL Noise Level (dBA)				
Morning Shoulder	**Day**	**Evening**	**Evening Shoulder**	**Night**
51	40	44	49	37

Ambient Noise Logging Results – RNP Defined Time Periods

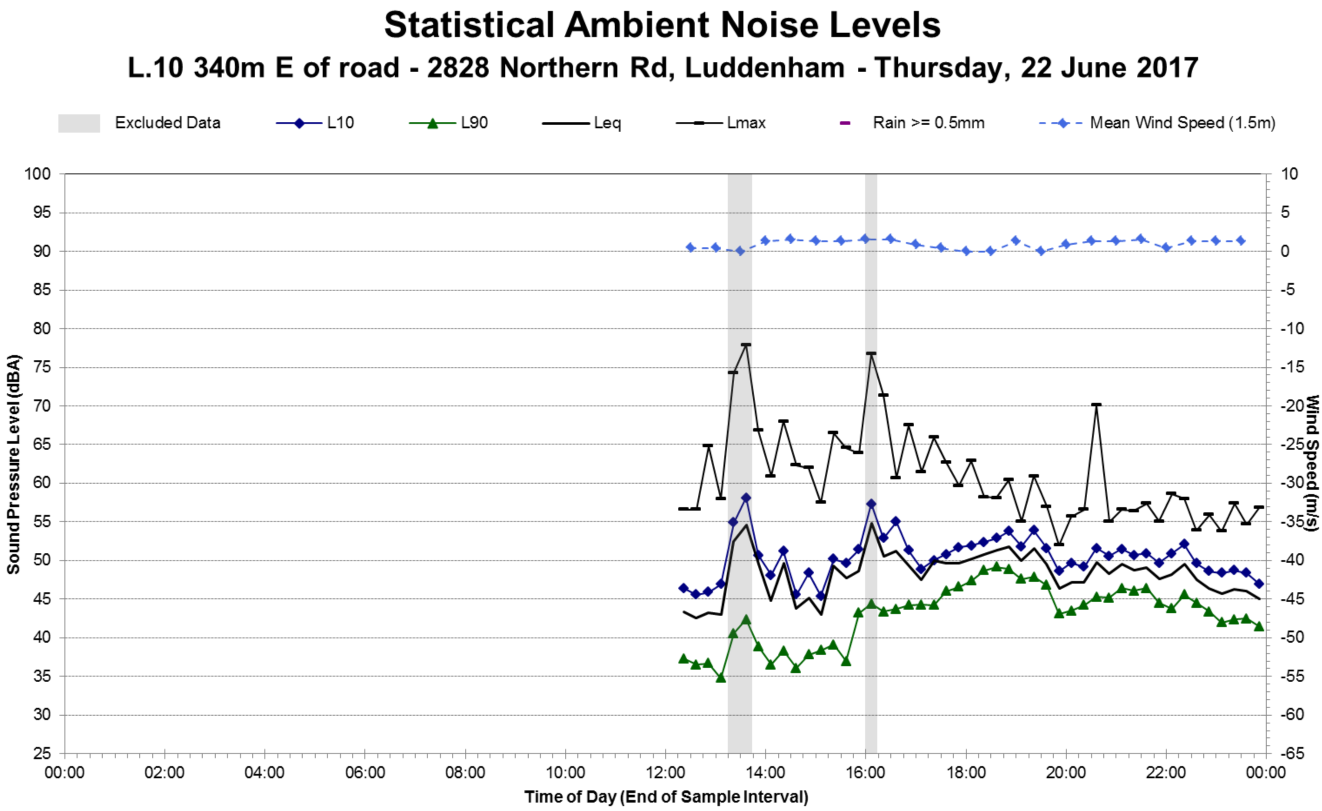
Monitoring Period	Noise Level (dBA)	
	LAeq(period)	**LAeq(1hour)**
Daytime (7am-10pm)	51	53
Night-time (10pm-7am)	49	55

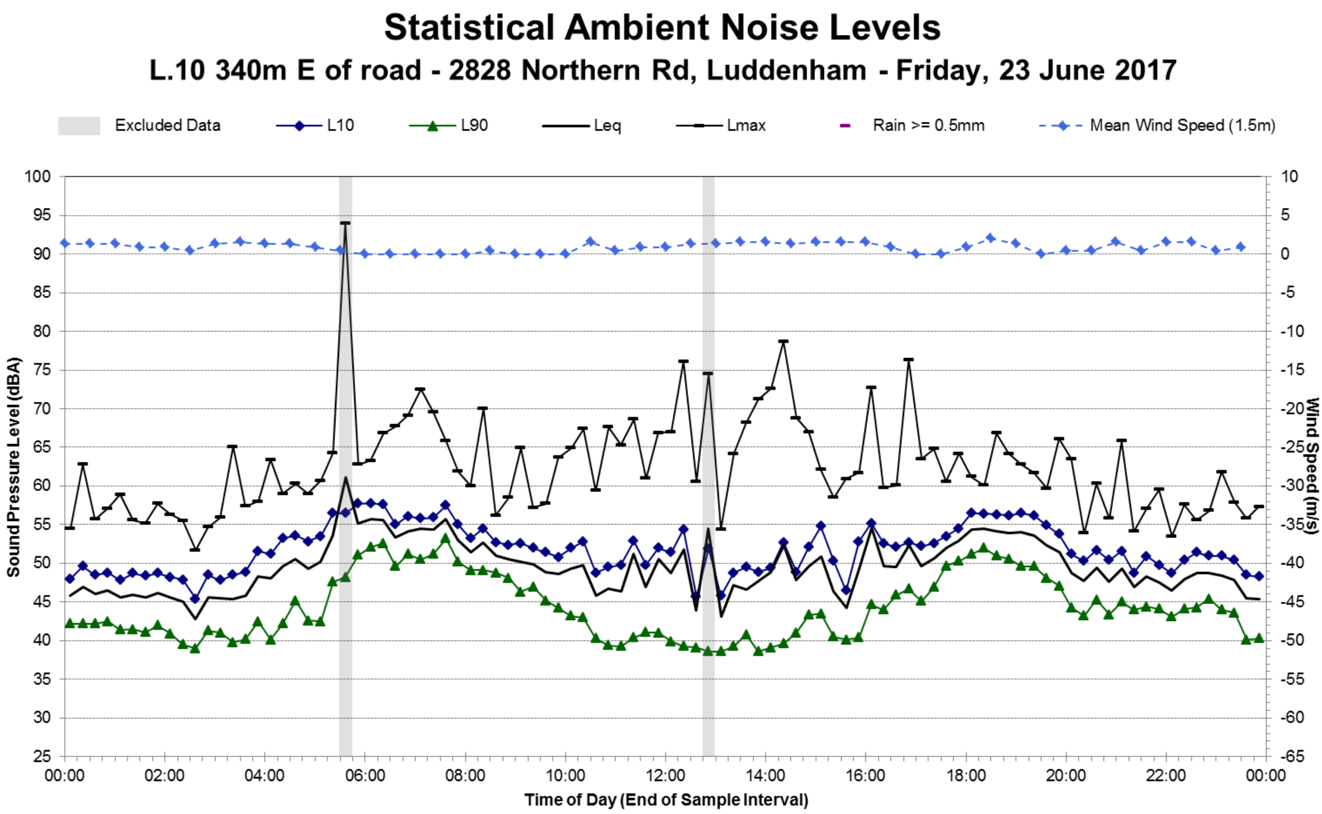
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	**LAeq**	**LAmax**
22/06/2017	11:15	41	45	55

Photo of Noise Monitoring Location

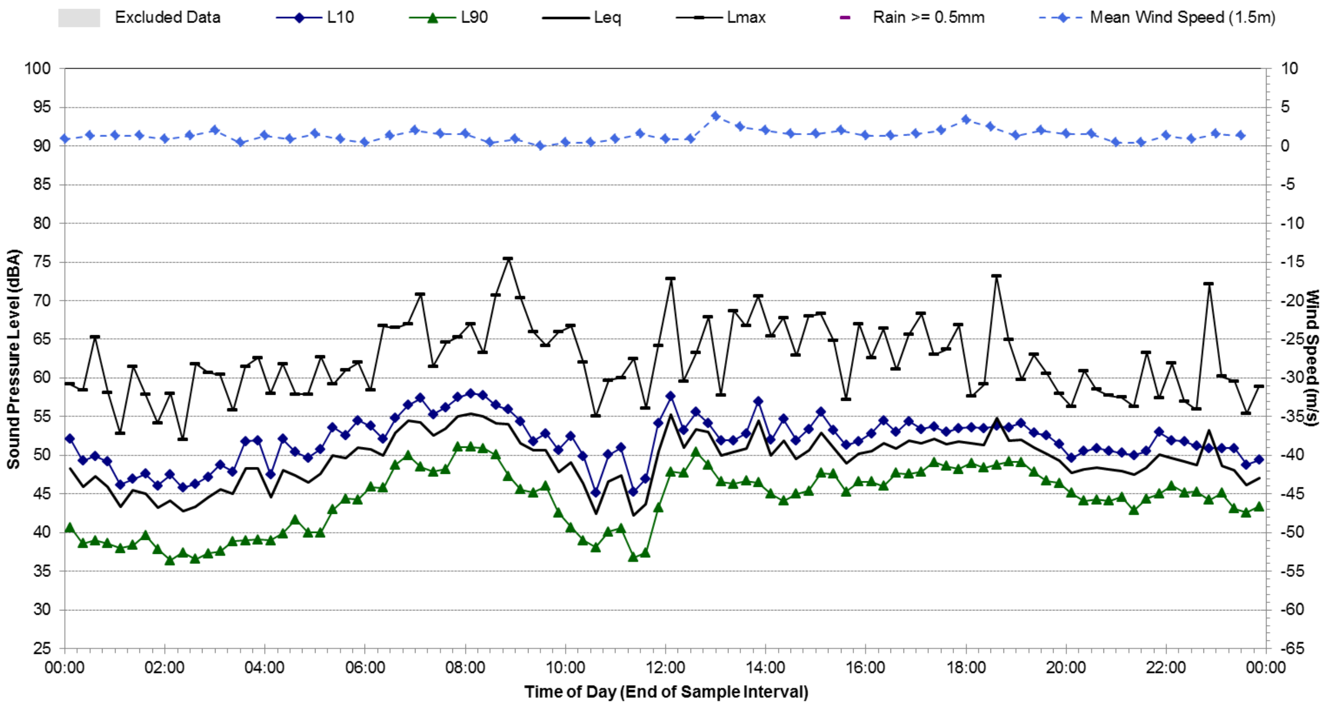
Note 1: Morning shoulder is 6 am to 7 am Monday to Friday; Daytime is 7 am to 6 pm Monday to Saturday & 8 am to 6 pm Sunday & Public Holidays; Evening is 7 pm to 10 pm Monday to Friday & 6 pm to 10 pm Saturday, Sunday & Public Holidays; Evening shoulder is 6 pm to 7 pm Monday to Friday; Night-time is 10 pm to 6 am Monday to Friday, 10 pm to 7 am Saturday & 10 pm to 8 am Sunday and Public Holidays.


Statistical Ambient Noise Levels
L.10 340m E of road - 2828 Northern Rd, Luddenham - Thursday, 22 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.10 340m E of road - 2828 Northern Rd, Luddenham - Friday, 23 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

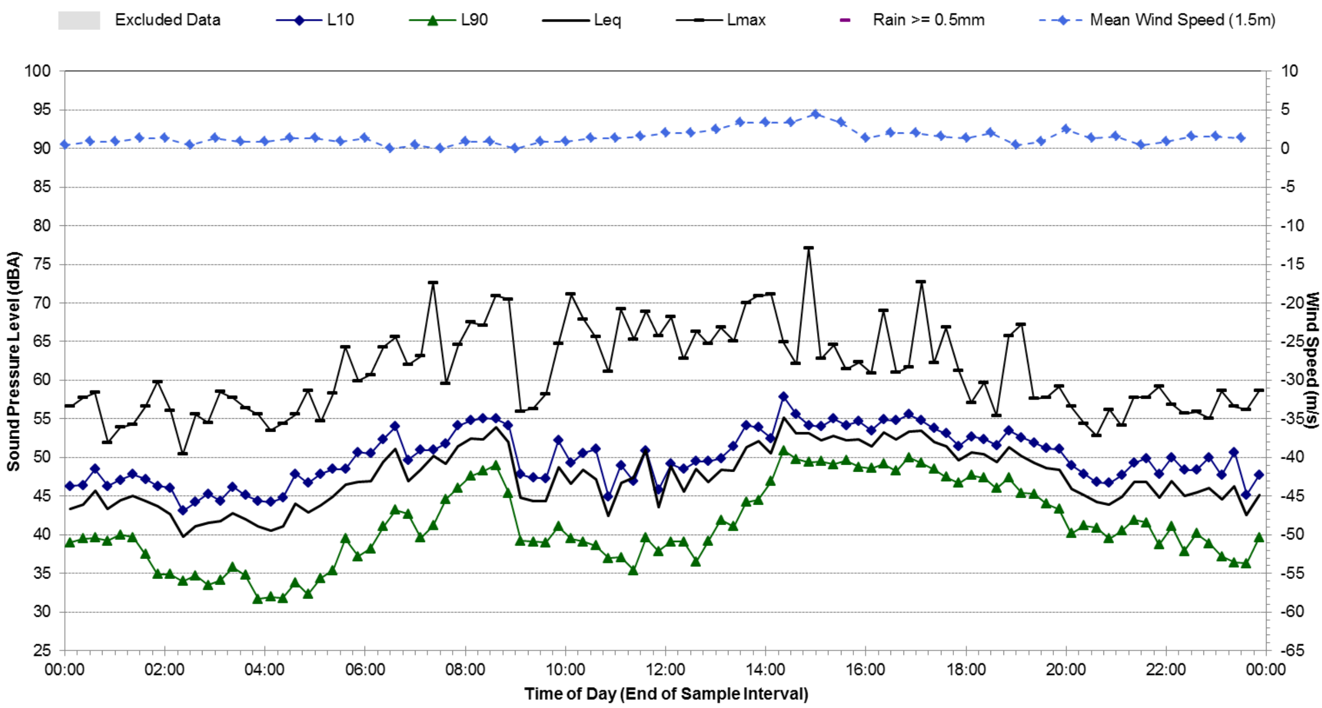
Statistical Ambient Noise Levels

L.10 340m E of road - 2828 Northern Rd, Luddenham - Saturday, 24 June 2017



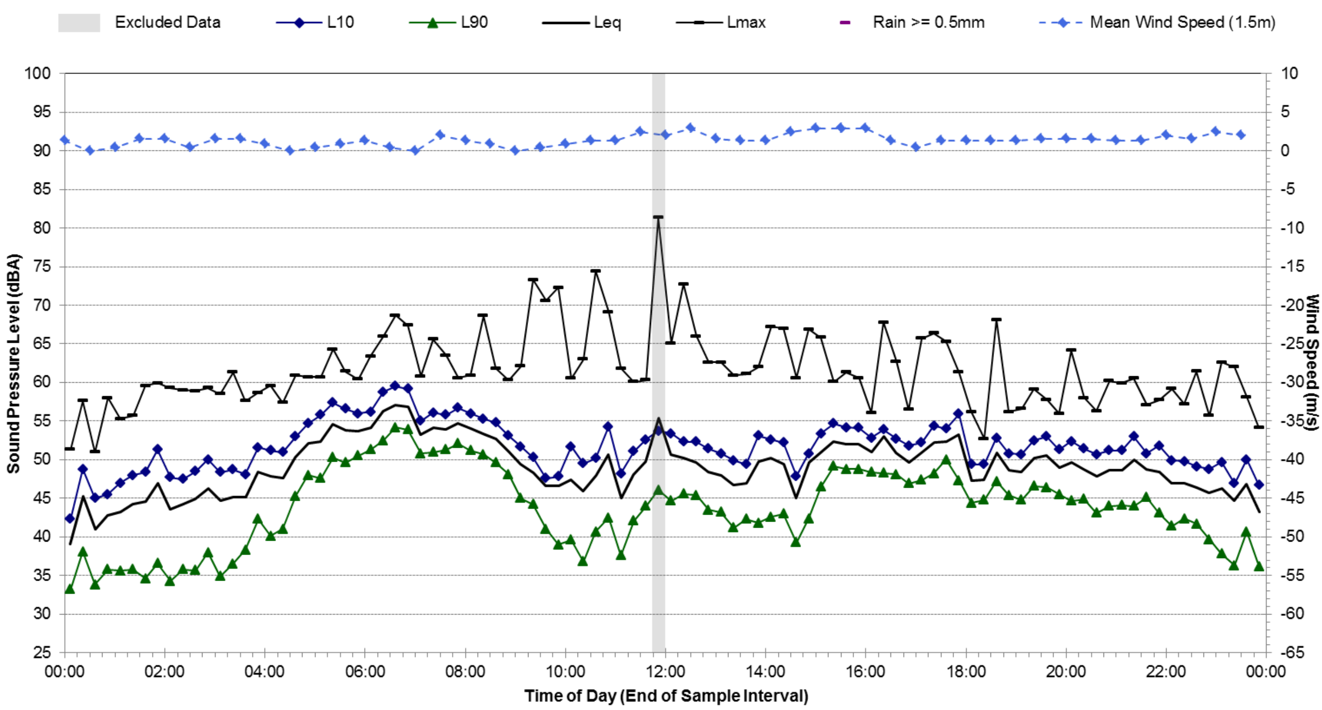
Statistical Ambient Noise Levels

L.10 340m E of road - 2828 Northern Rd, Luddenham - Sunday, 25 June 2017



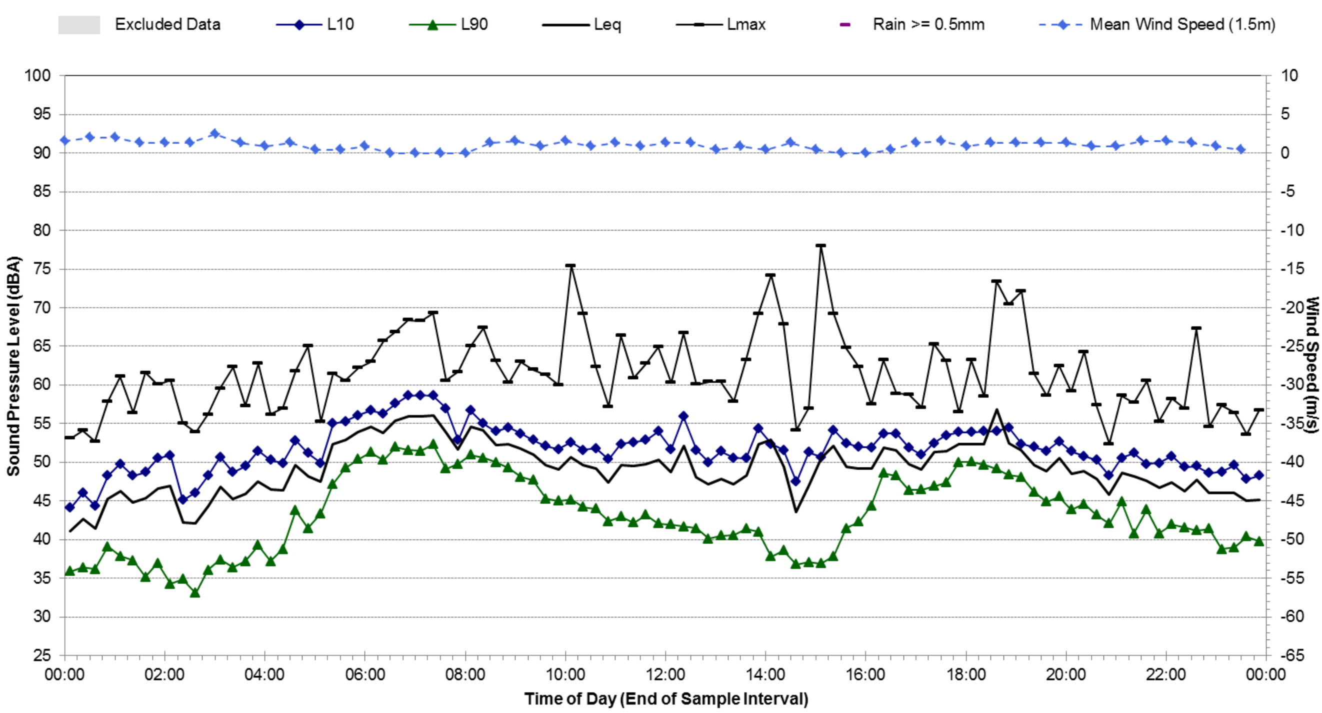
Statistical Ambient Noise Levels

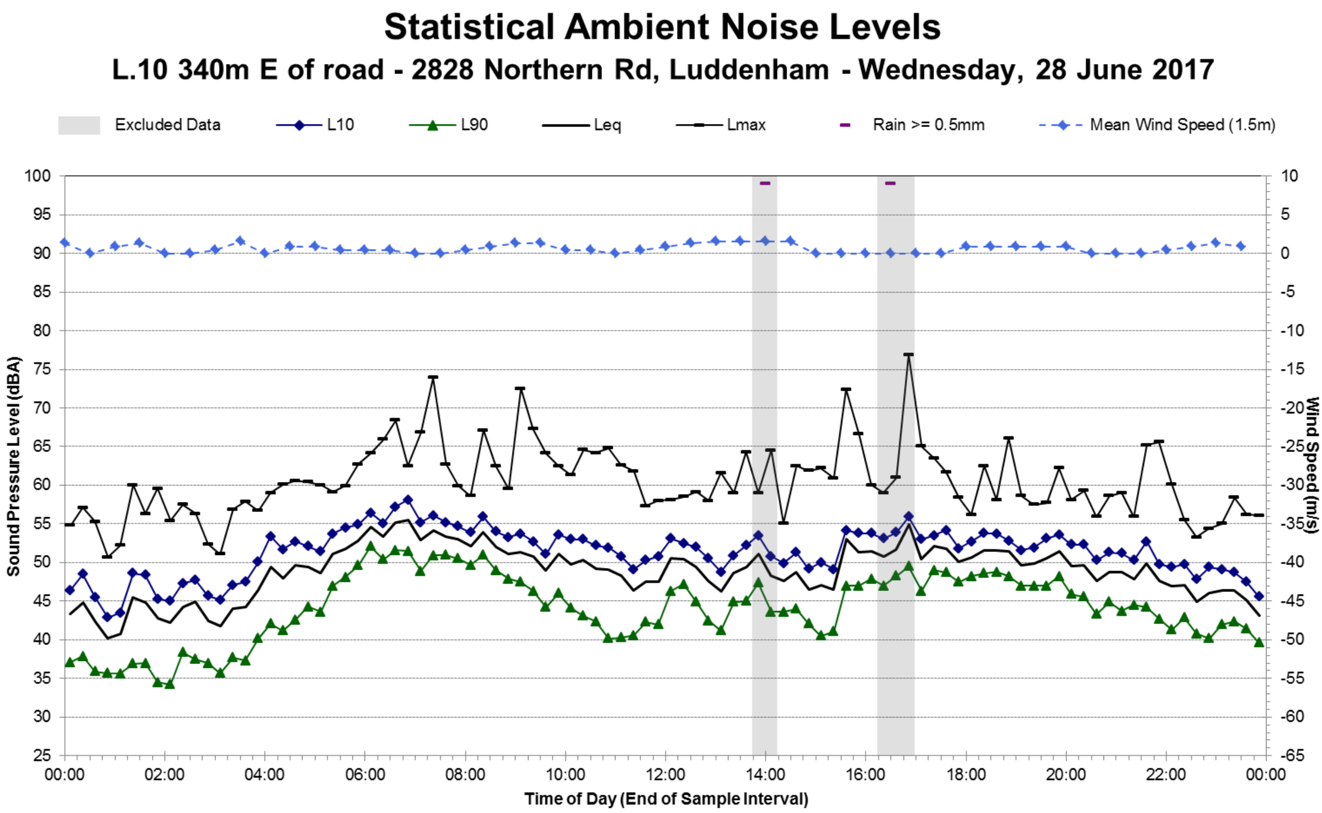
L.10 340m E of road - 2828 Northern Rd, Luddenham - Monday, 26 June 2017

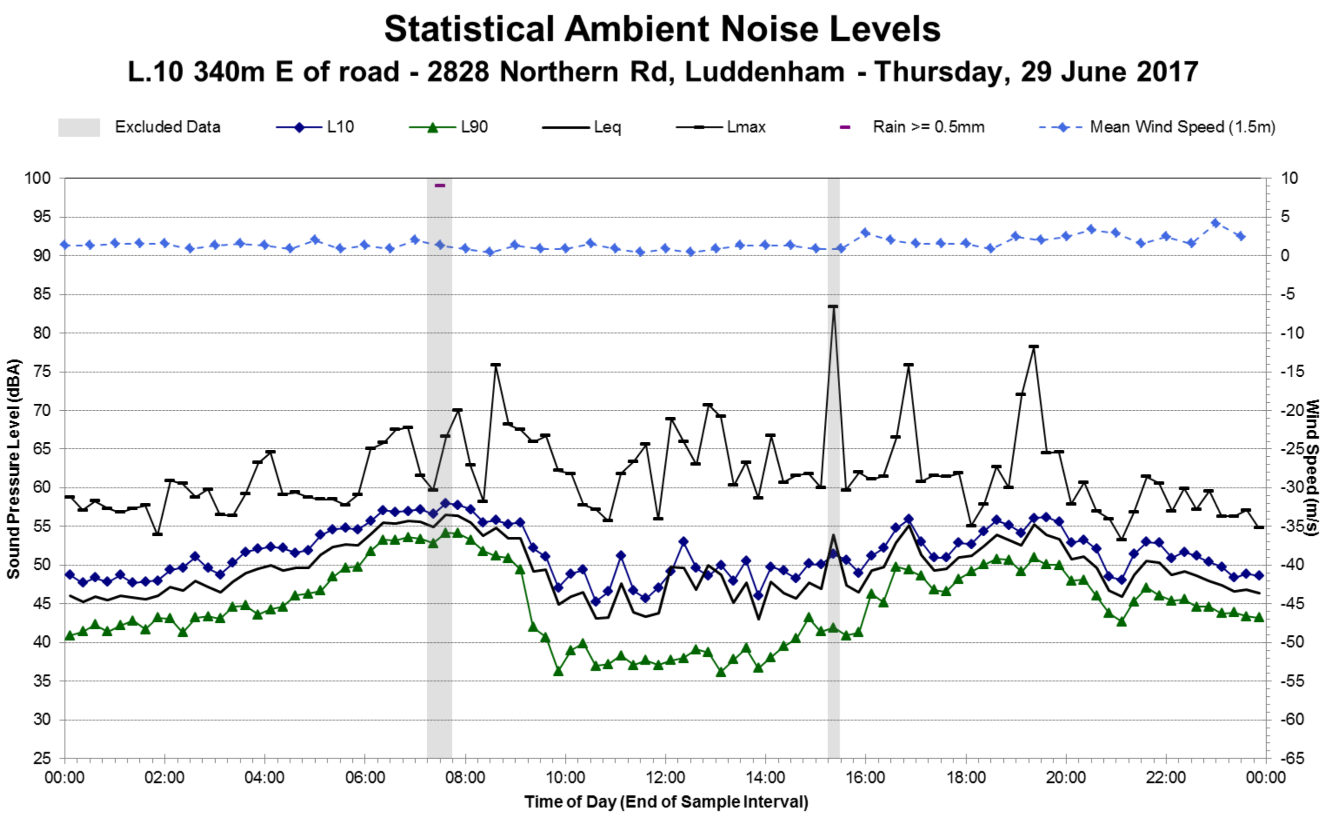


Statistical Ambient Noise Levels

L.10 340m E of road - 2828 Northern Rd, Luddenham - Tuesday, 27 June 2017

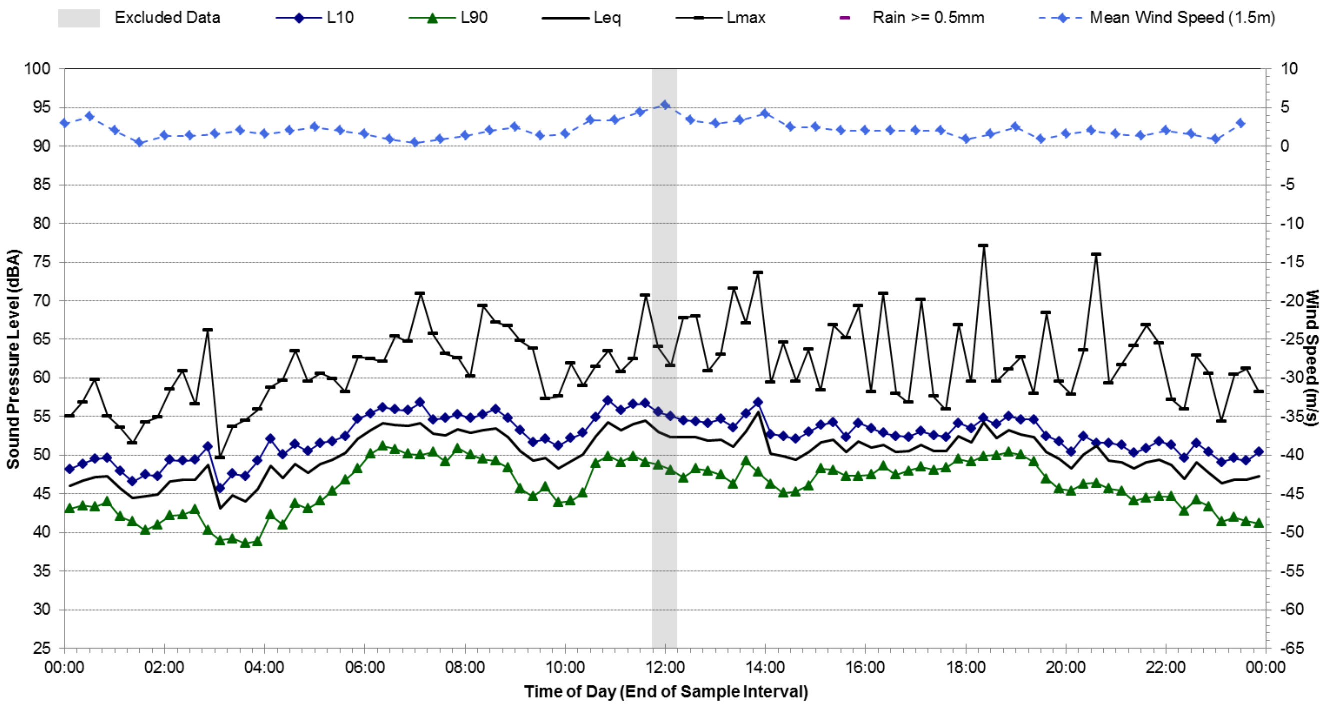



Statistical Ambient Noise Levels
L.10 340m E of road - 2828 Northern Rd, Luddenham - Wednesday, 28 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.10 340m E of road - 2828 Northern Rd, Luddenham - Thursday, 29 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

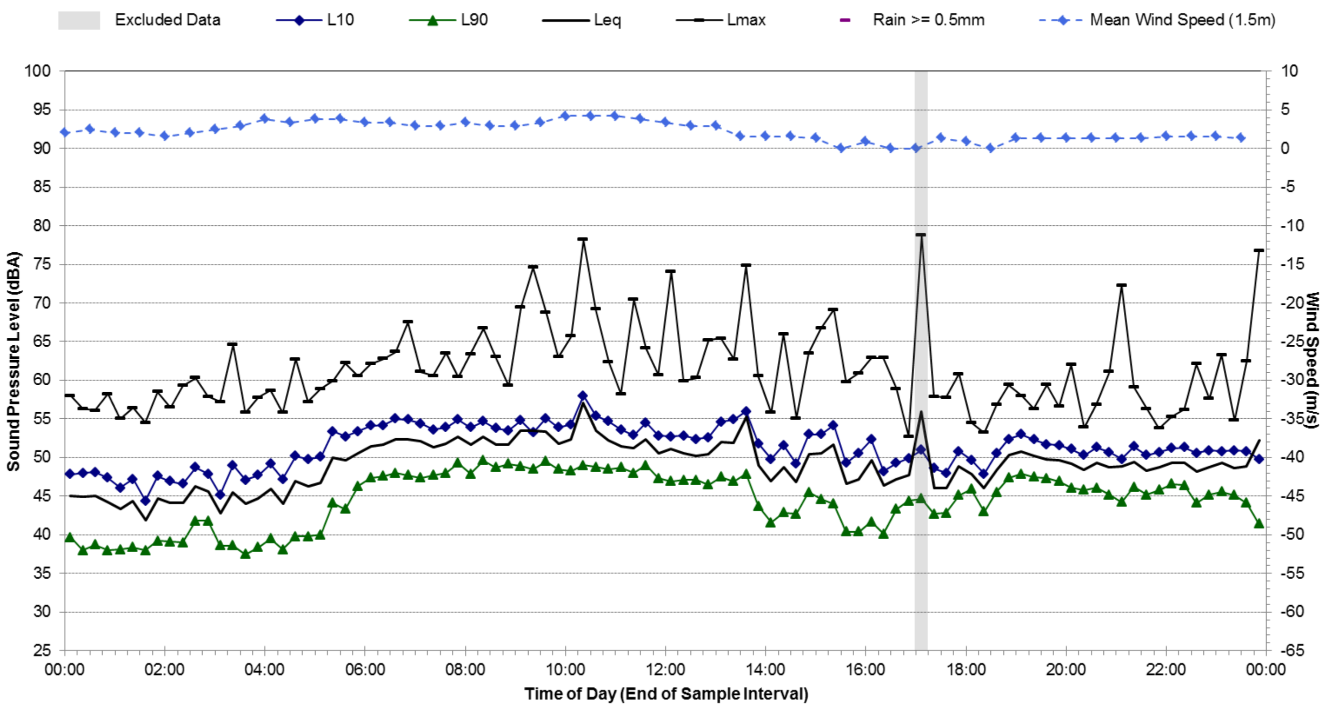
Statistical Ambient Noise Levels

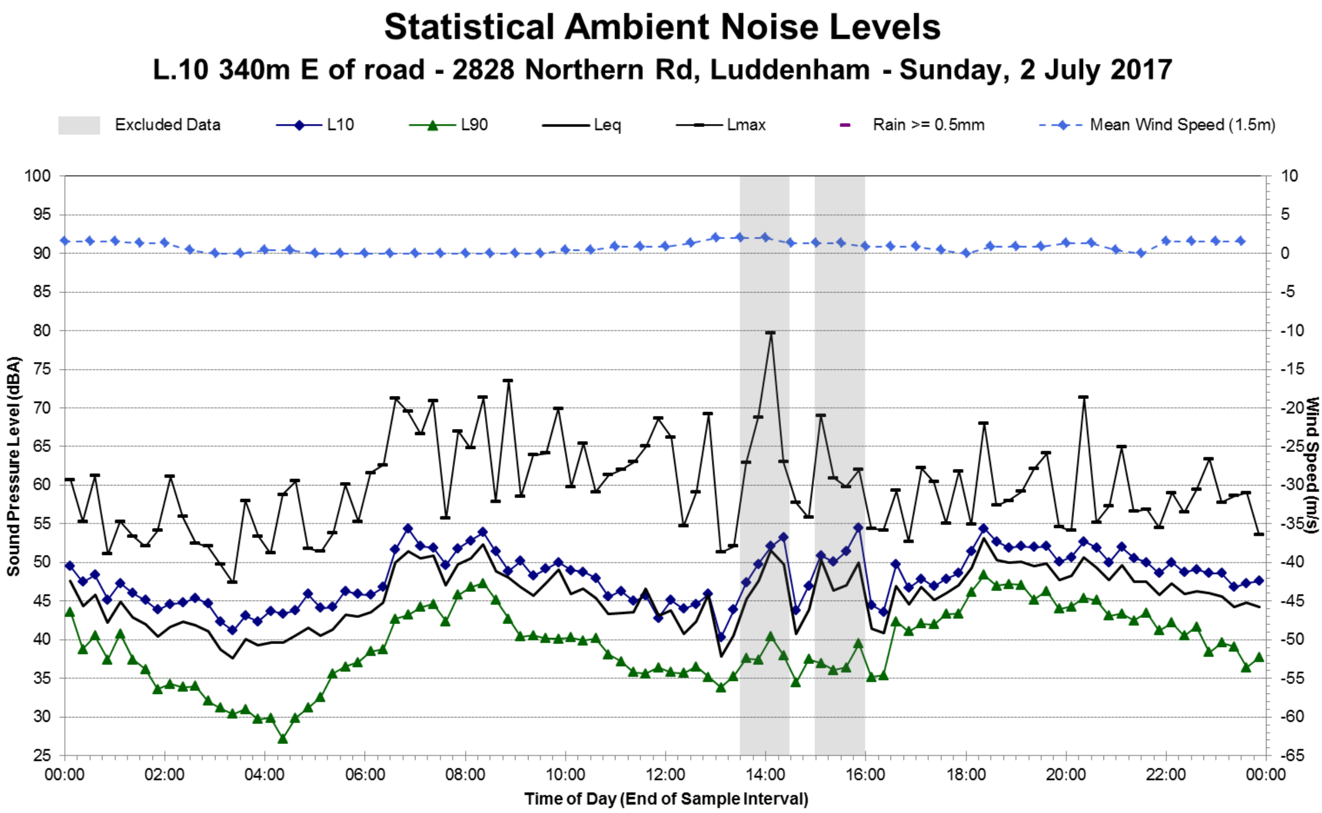
L.10 340m E of road - 2828 Northern Rd, Luddenham - Friday, 30 June 2017



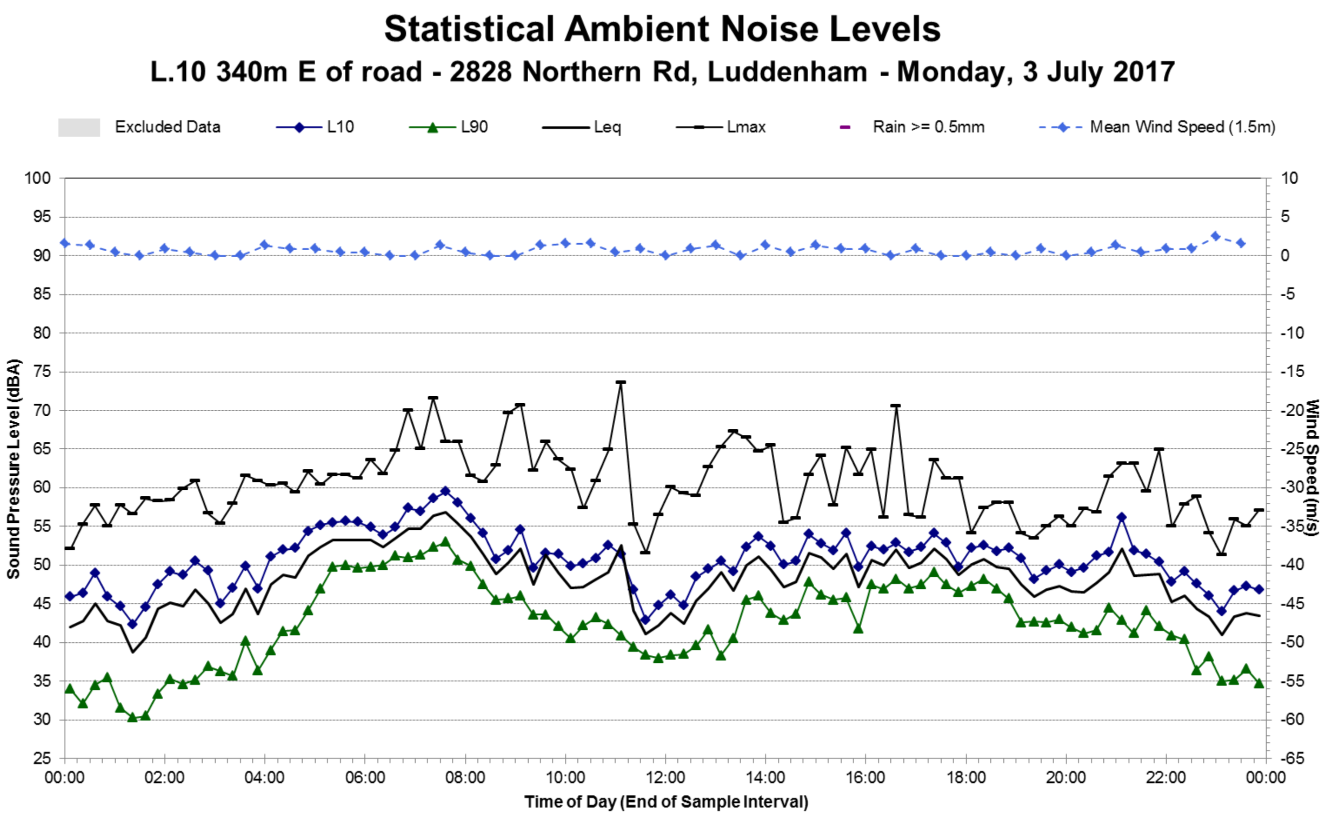
Statistical Ambient Noise Levels

L.10 340m E of road - 2828 Northern Rd, Luddenham - Saturday, 1 July 2017

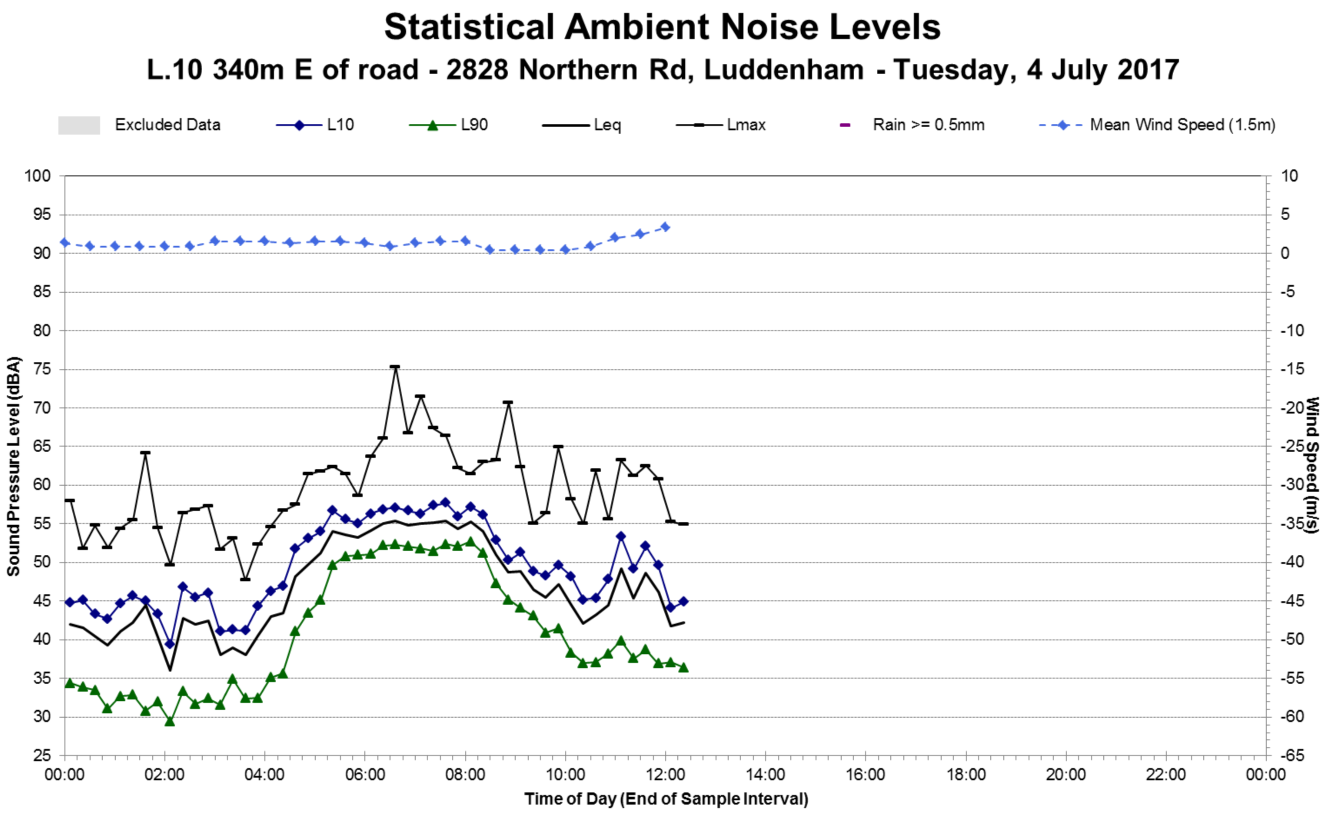




Statistical Ambient Noise Levels
L.10 340m E of road - 2828 Northern Rd, Luddenham - Sunday, 2 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
L.10 340m E of road - 2828 Northern Rd, Luddenham - Monday, 3 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
L.10 340m E of road - 2828 Northern Rd, Luddenham - Tuesday, 4 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00

Noise Monitoring Location	L.11
Noise Monitoring Address	15m S of Elizabeth Dr - 2300 Elizabeth Drive, Badgerys Creek

Logger Device Type: Svantek 957, Logger Serial No: 15395

Sound Level Meter Device Type: Brüel and Kjær 2260i, Sound Level Meter Serial No: 2414604

Ambient noise logger deployed at residential address 2300 Elizabeth Drive, Badgerys Creek. Logger located approximately 15 m south of Elizabeth Drive.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from Elizabeth Drive. Noise from light aircraft and heavy vehicles on Badgerys Creek Road to the west also contributes to the LAeq at this location.

Recorded Noise Levels: (LAmax):

19/06/2017: Light vehicles (Elizabeth Dr): 60-72 dBA, Heavy vehicles (Elizabeth Dr): 76-89 dBA, Heavy vehicles (Badgerys Creek Rd): 45-55 dBA, Light aircraft: 60-72 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – Construction Periods[1]

RBL Noise Level (dBA)				
Morning Shoulder	**Day**	**Evening**	**Evening Shoulder**	**Night**
57	46	40	51	31

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	69	71
Night-time (10pm-7am)	66	72

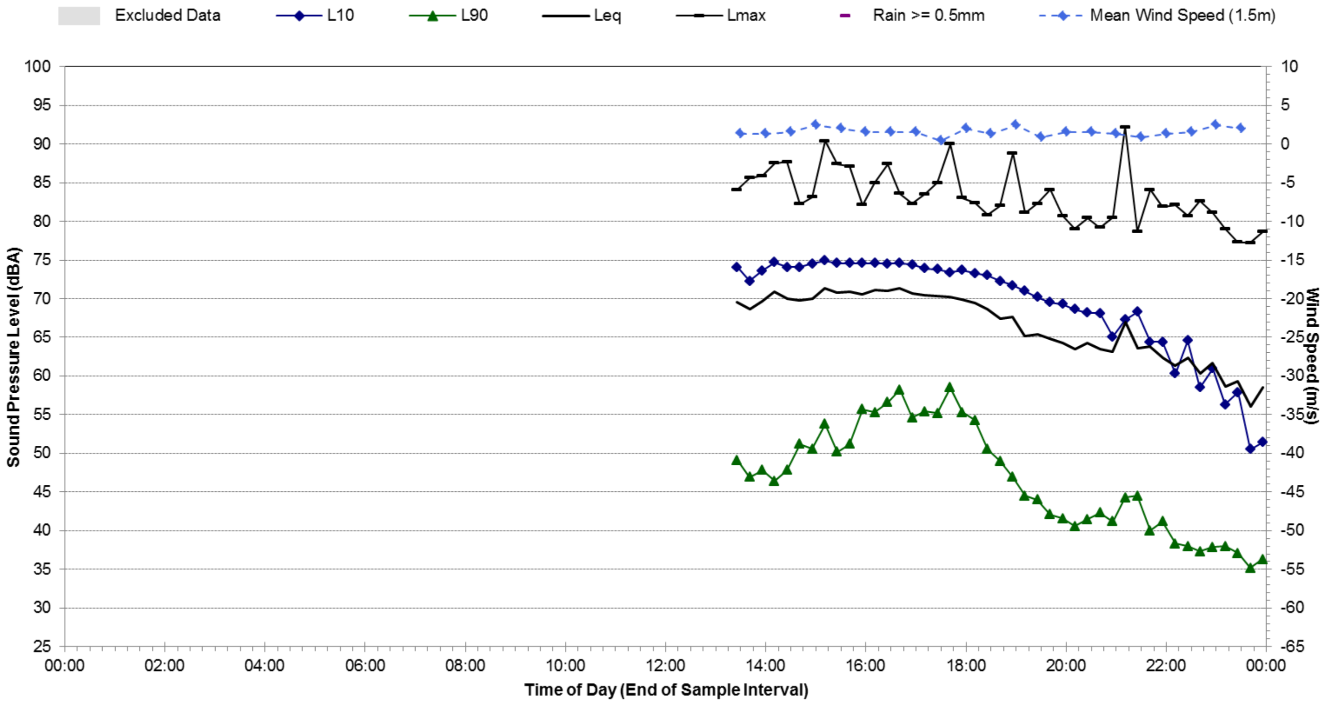
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
19/06/2017	12:42	47	70	89

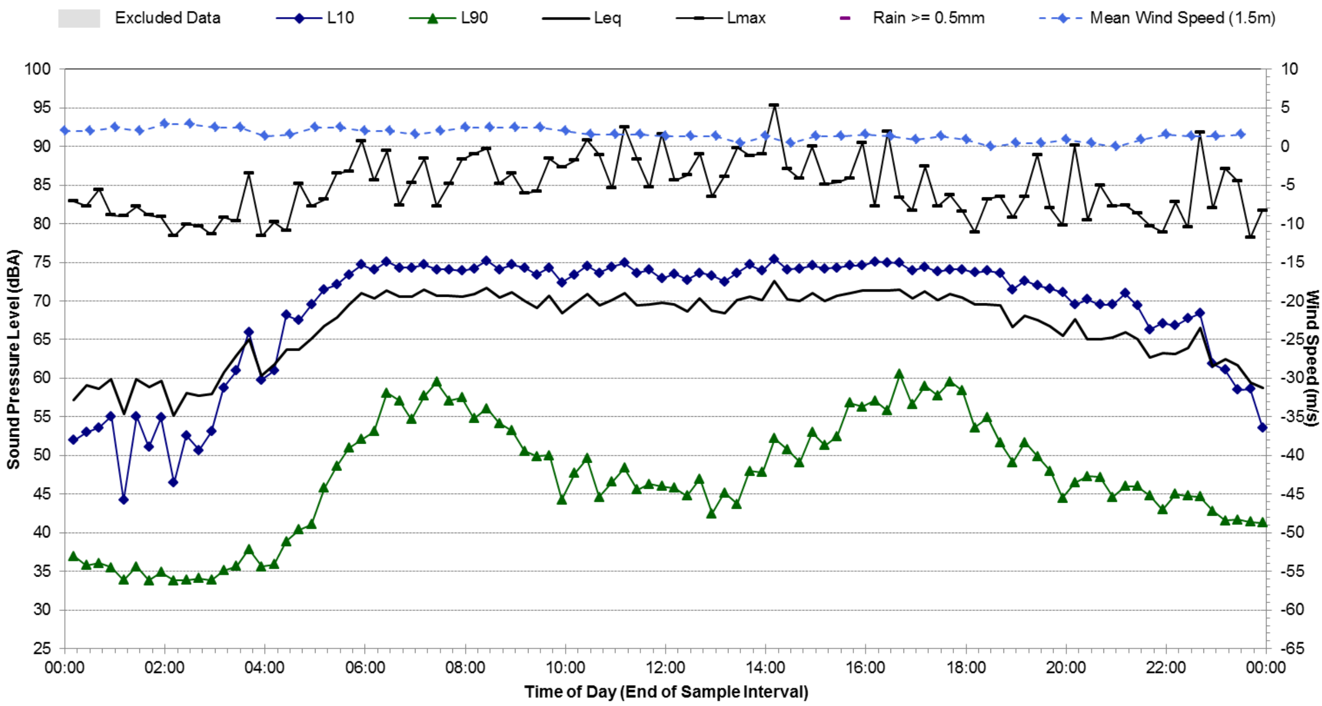
Photo of Noise Monitoring Location

Note 1: Morning shoulder is 6 am to 7 am Monday to Friday; Daytime is 7 am to 6 pm Monday to Saturday & 8 am to 6 pm Sunday & Public Holidays; Evening is 7 pm to 10 pm Monday to Friday & 6 pm to 10 pm Saturday, Sunday & Public Holidays; Evening shoulder is 6 pm to 7 pm Monday to Friday; Night-time is 10 pm to 6 am Monday to Friday, 10 pm to 7 am Saturday & 10 pm to 8 am Sunday and Public Holidays.

Statistical Ambient Noise Levels
L.11 15m S of road - 2300 Elizabeth Dr, Badgerys Creek - Monday, 19 June 2017

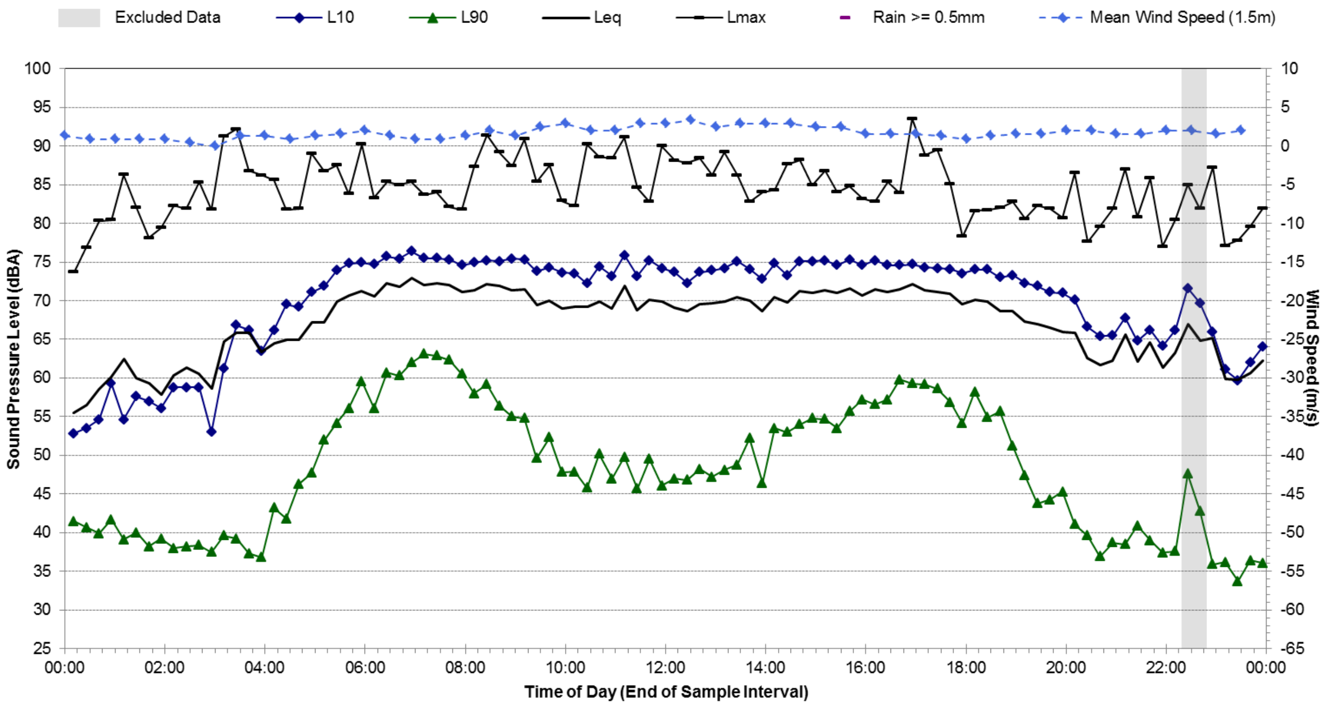


Statistical Ambient Noise Levels
L.11 15m S of road - 2300 Elizabeth Dr, Badgerys Creek - Tuesday, 20 June 2017



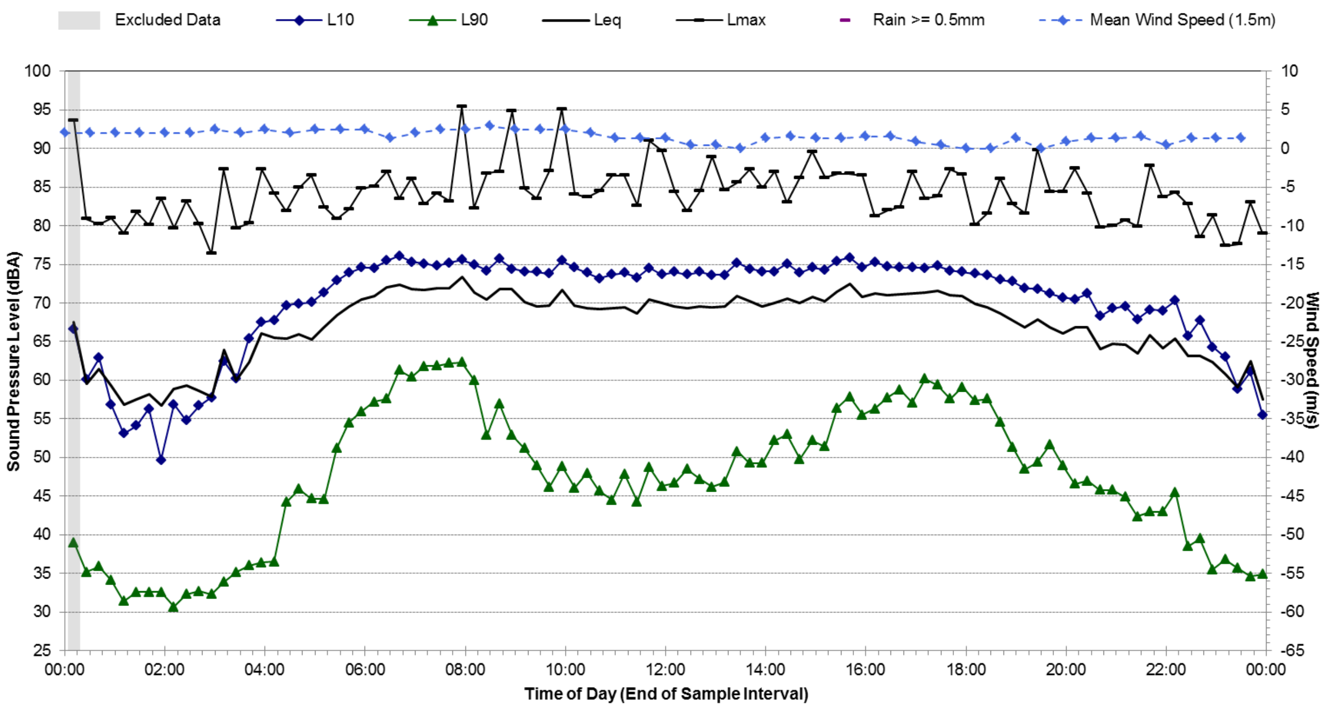
Statistical Ambient Noise Levels

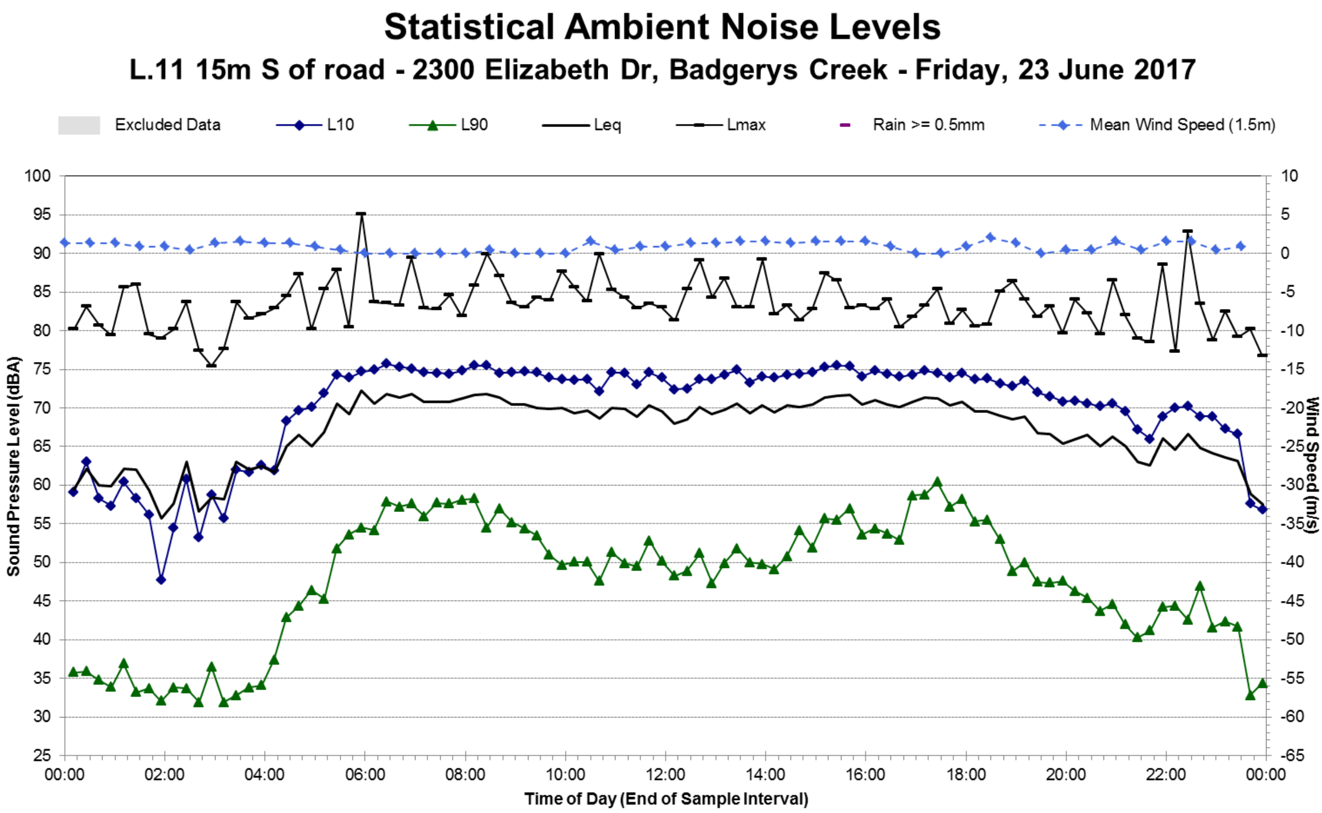
L.11 15m S of road - 2300 Elizabeth Dr, Badgerys Creek - Wednesday, 21 June 2017

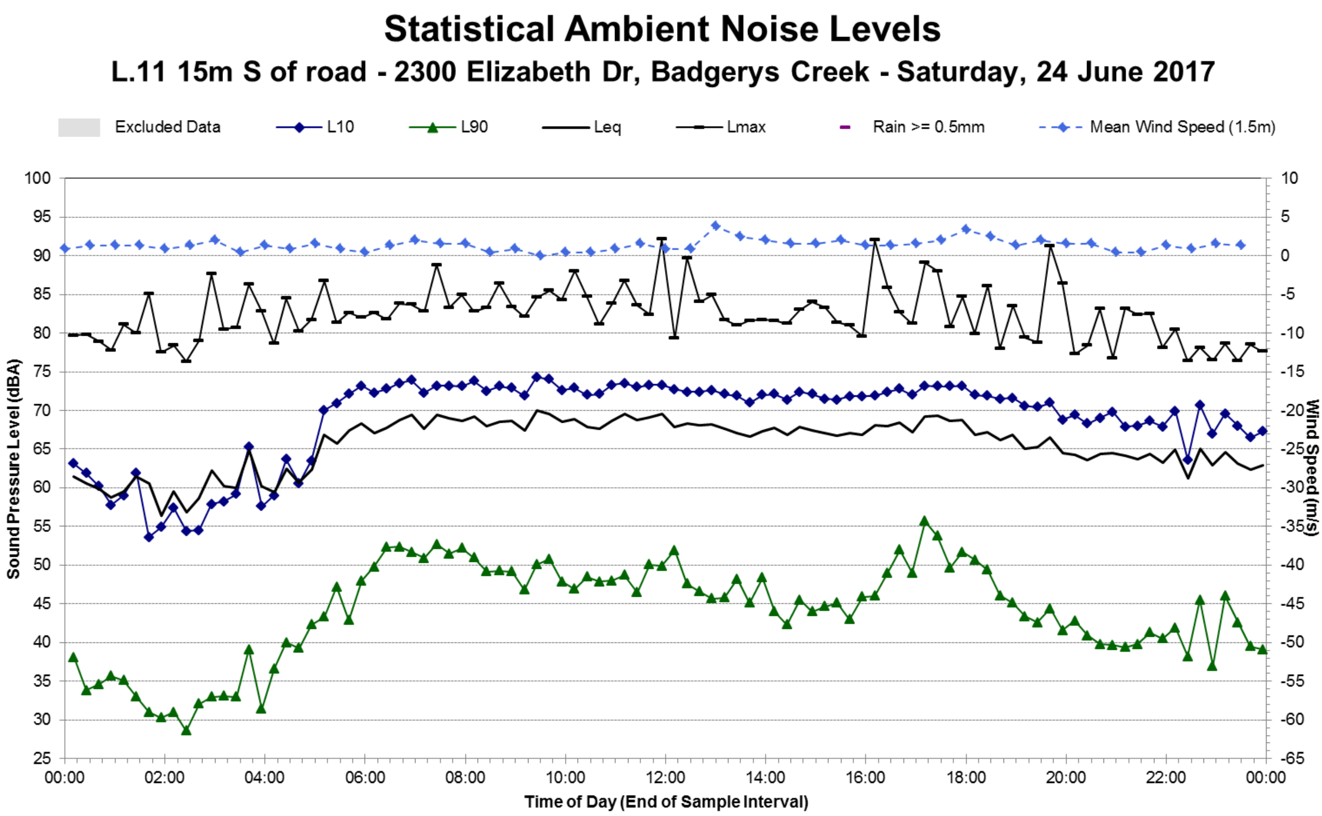


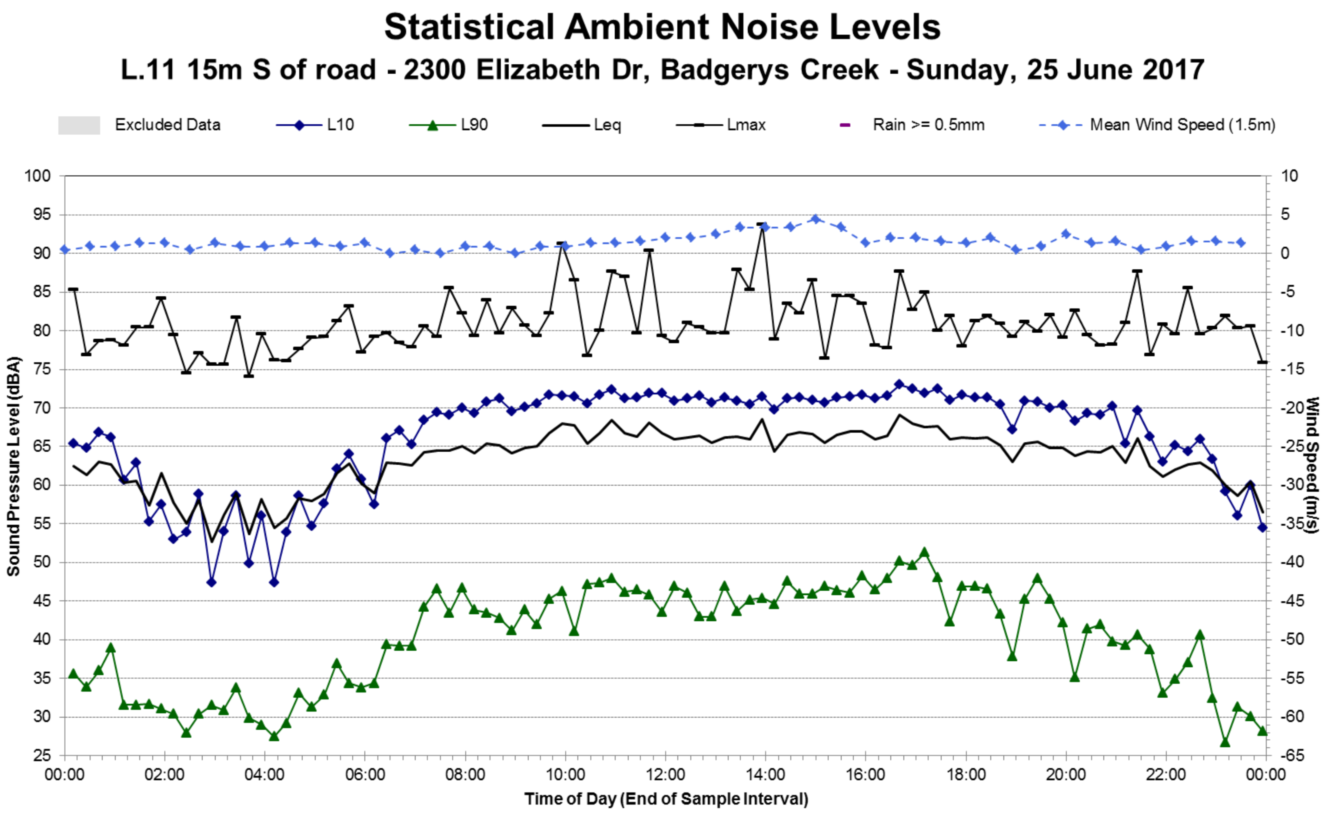
Statistical Ambient Noise Levels

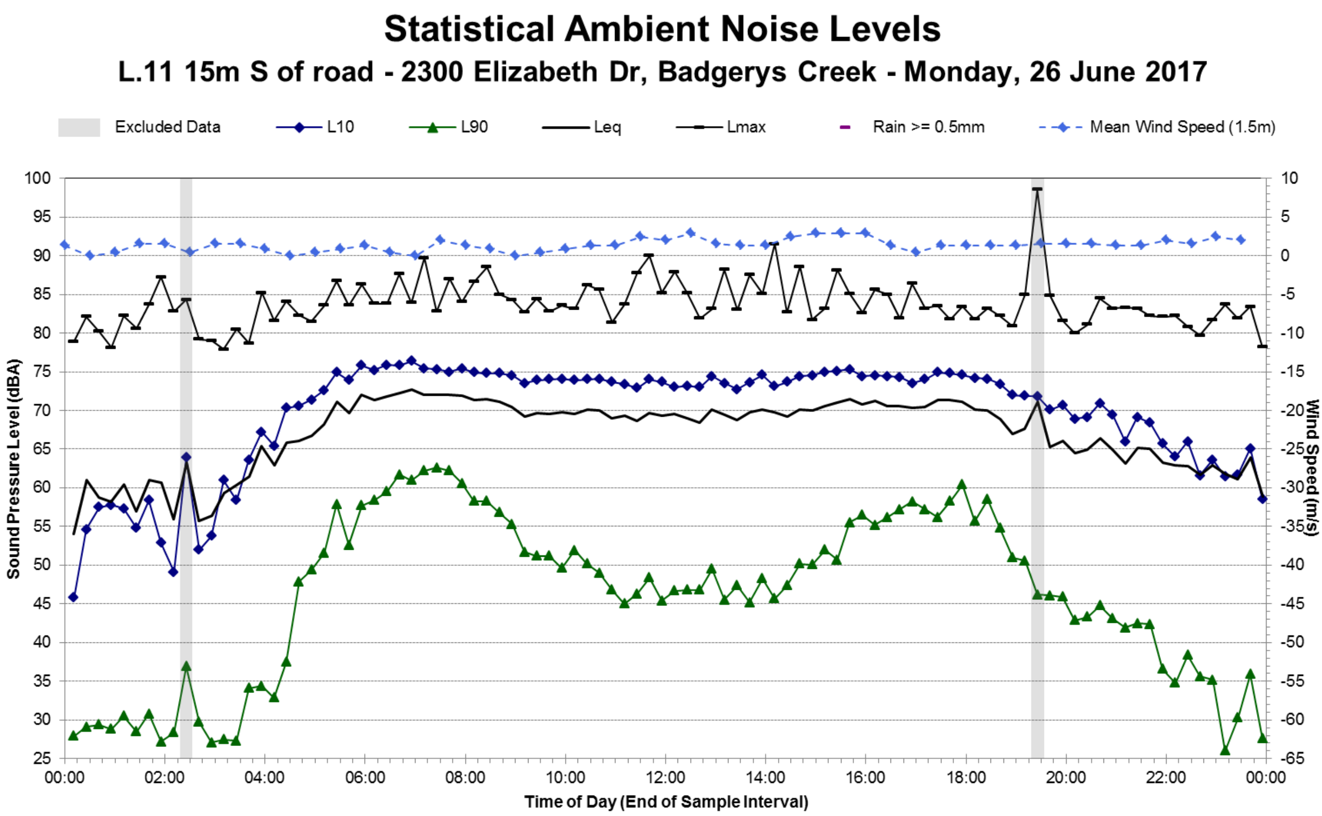
L.11 15m S of road - 2300 Elizabeth Dr, Badgerys Creek - Thursday, 22 June 2017




Statistical Ambient Noise Levels
L.11 15m S of road - 2300 Elizabeth Dr, Badgerys Creek - Friday, 23 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

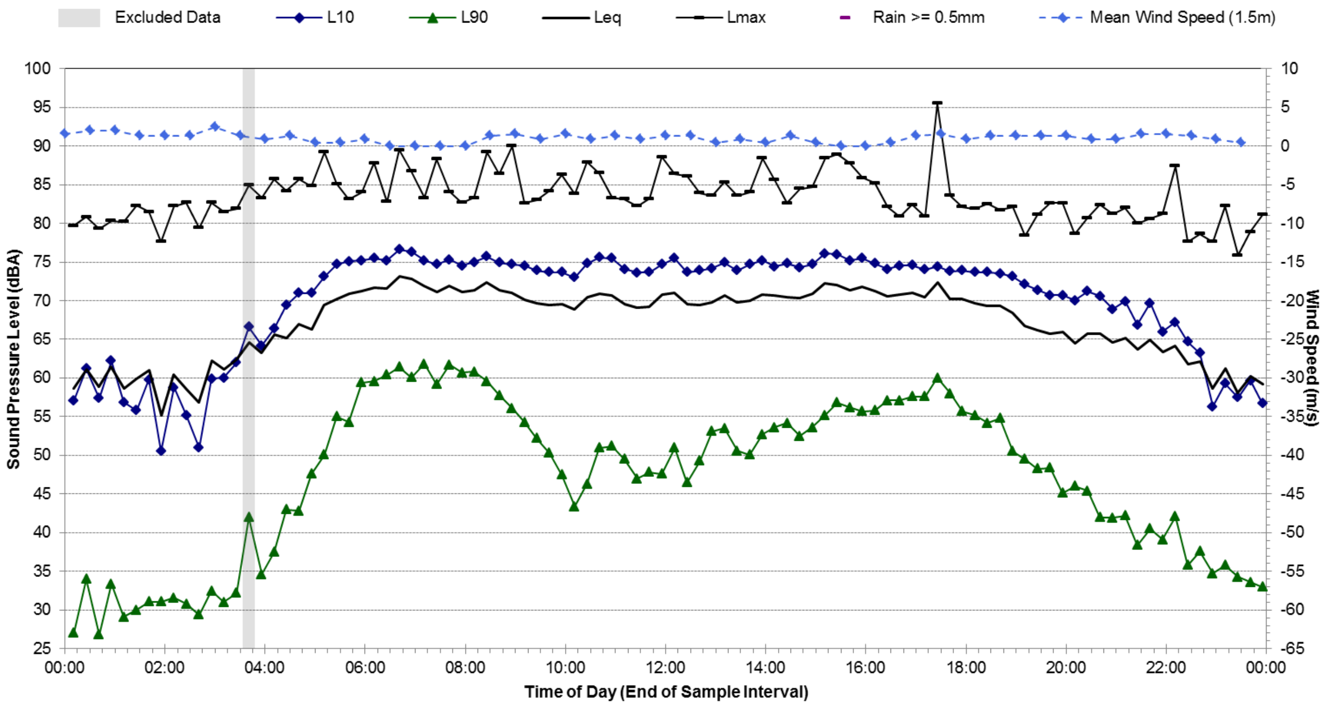

Statistical Ambient Noise Levels
L.11 15m S of road - 2300 Elizabeth Dr, Badgerys Creek - Saturday, 24 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.11 15m S of road - 2300 Elizabeth Dr, Badgerys Creek - Sunday, 25 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.11 15m S of road - 2300 Elizabeth Dr, Badgerys Creek - Monday, 26 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

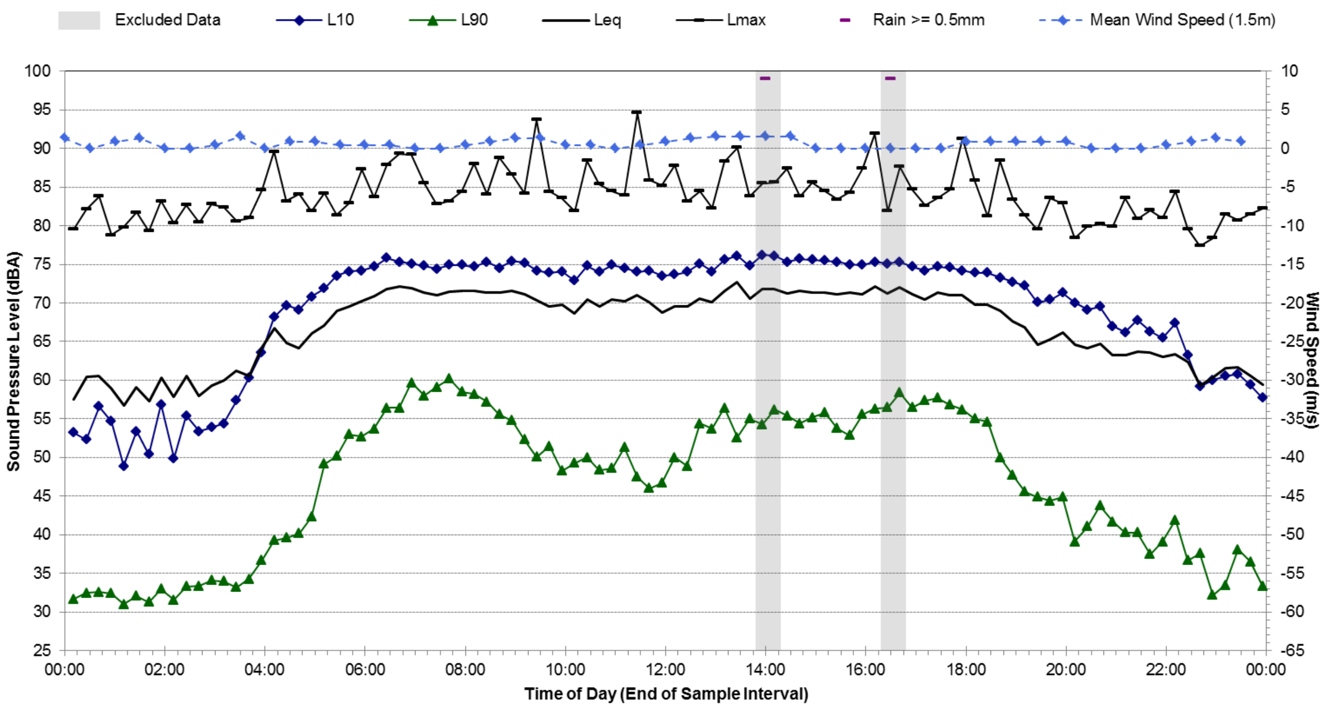
Statistical Ambient Noise Levels

L.11 15m S of road - 2300 Elizabeth Dr, Badgerys Creek - Tuesday, 27 June 2017



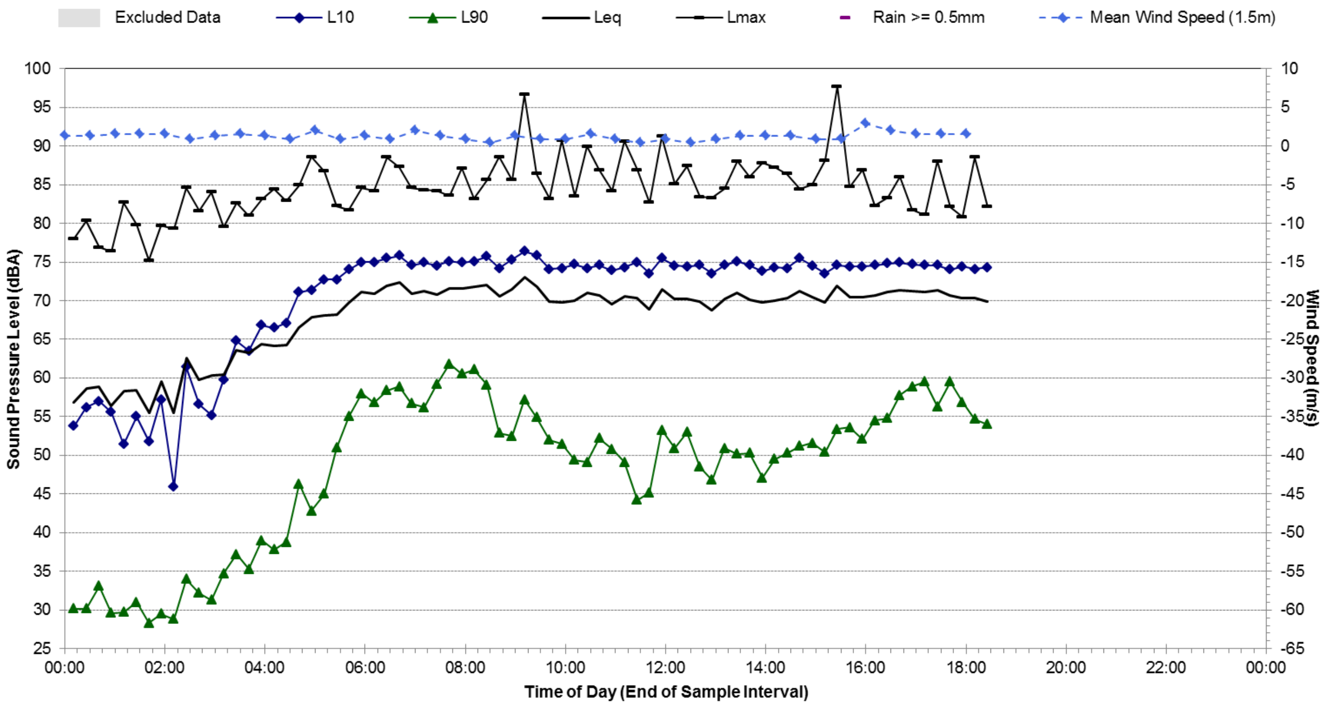
Statistical Ambient Noise Levels

L.11 15m S of road - 2300 Elizabeth Dr, Badgerys Creek - Wednesday, 28 June 2017



Statistical Ambient Noise Levels

L.11 15m S of road - 2300 Elizabeth Dr, Badgerys Creek - Thursday, 29 June 2017



Noise Monitoring Location	L.12
Noise Monitoring Address	145m S of Elizabeth Dr - 2300 Elizabeth Drive, Badgerys Creek

Logger Device Type: Svantek 957, Logger Serial No: 28048

Sound Level Meter Device Type: Brüel and Kjær 2260i, Sound Level Meter Serial No: 2414604

Ambient noise logger deployed at residential address 2300 Elizabeth Drive, Badgerys Creek. Logger located approximately 145 m south of Elizabeth Drive.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from Elizabeth Drive. Noise from light aircraft and wildlife (ie birds) also contributes to the LAeq at this location.

Recorded Noise Levels: (LAmax):

19/06/2017: Road traffic (Elizabeth Dr): 55-59 dBA, Light aircraft: 58-66 dBA, Wildlife (insects, frogs, birds): 42-50 dBA.

Map of Noise Monitoring Location

Ambient Noise Logging Results – Construction Periods[1]

RBL Noise Level (dBA)				
Morning Shoulder	Day	Evening	Evening Shoulder	Night
50	40	37	44	30

Ambient Noise Logging Results – RNP Defined Time Periods

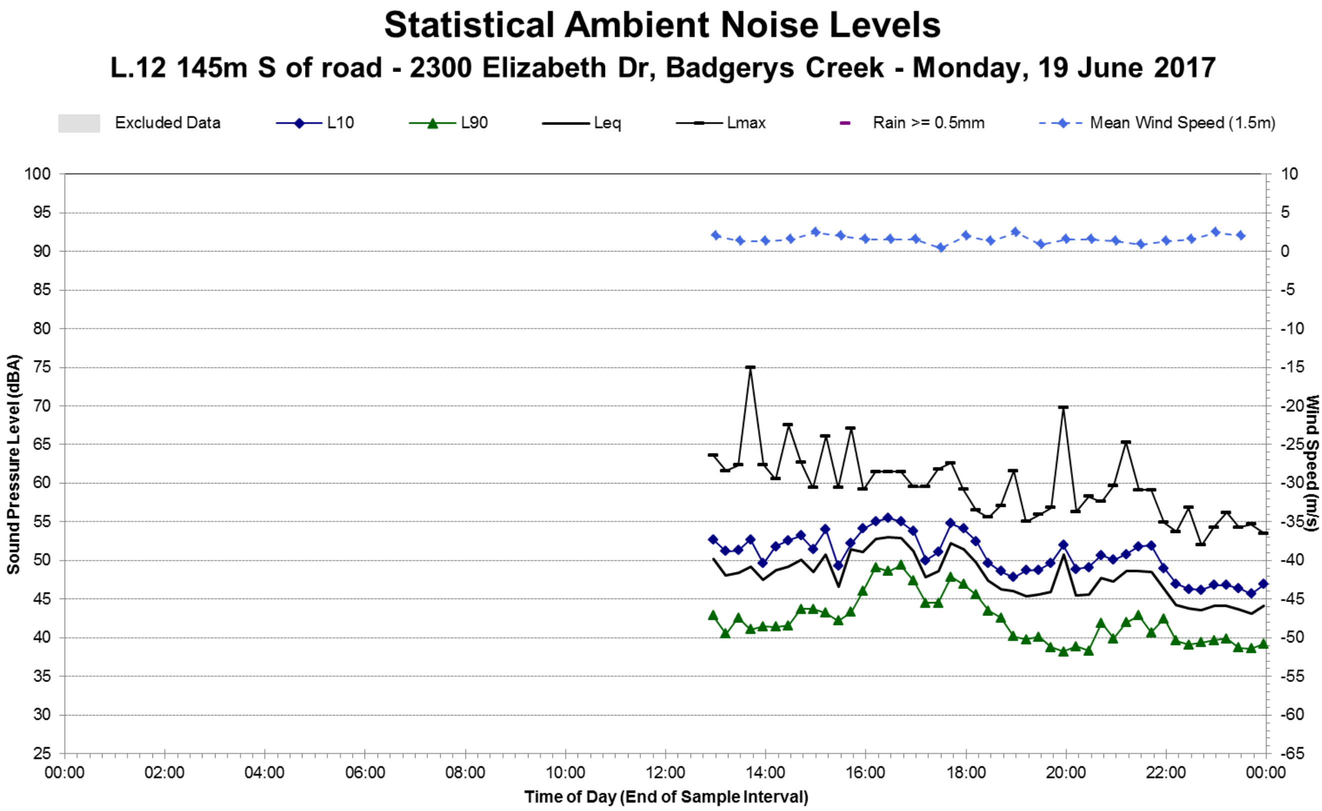
Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	49	53
Night-time (10pm-7am)	48	56

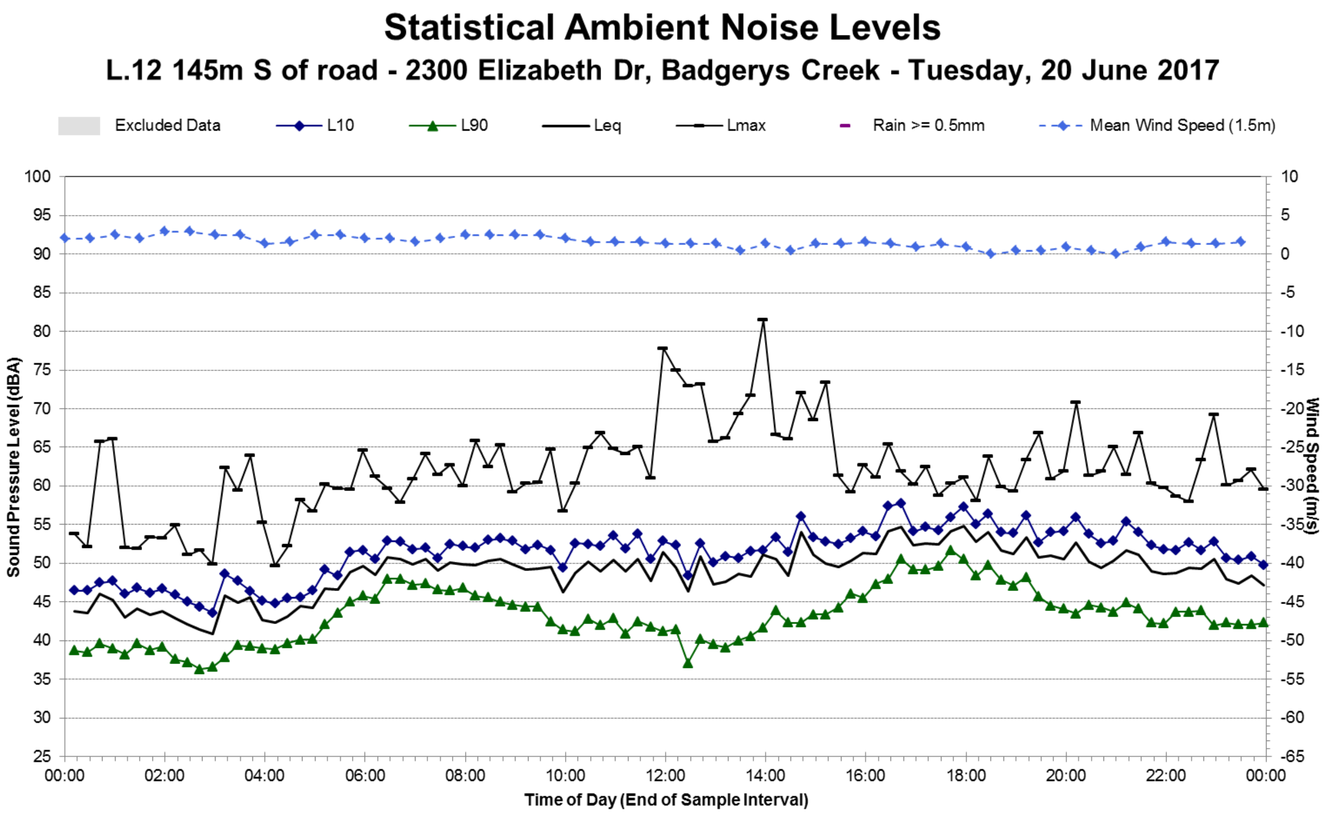
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
19/06/2017	12:13	42	49	66

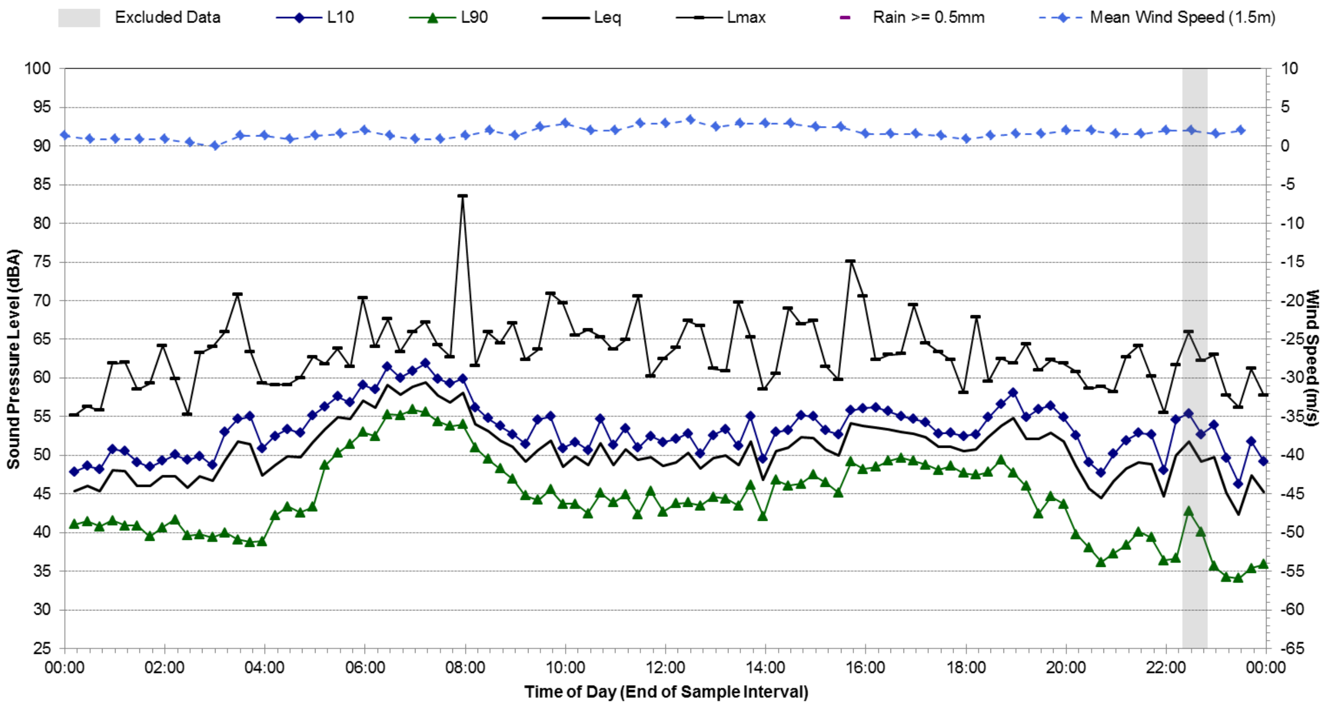
Photo of Noise Monitoring Location

Note 1: Morning shoulder is 6 am to 7 am Monday to Friday; Daytime is 7 am to 6 pm Monday to Saturday & 8 am to 6 pm Sunday & Public Holidays; Evening is 7 pm to 10 pm Monday to Friday & 6 pm to 10 pm Saturday, Sunday & Public Holidays; Evening shoulder is 6 pm to 7 pm Monday to Friday; Night-time is 10 pm to 6 am Monday to Friday, 10 pm to 7 am Saturday & 10 pm to 8 am Sunday and Public Holidays.

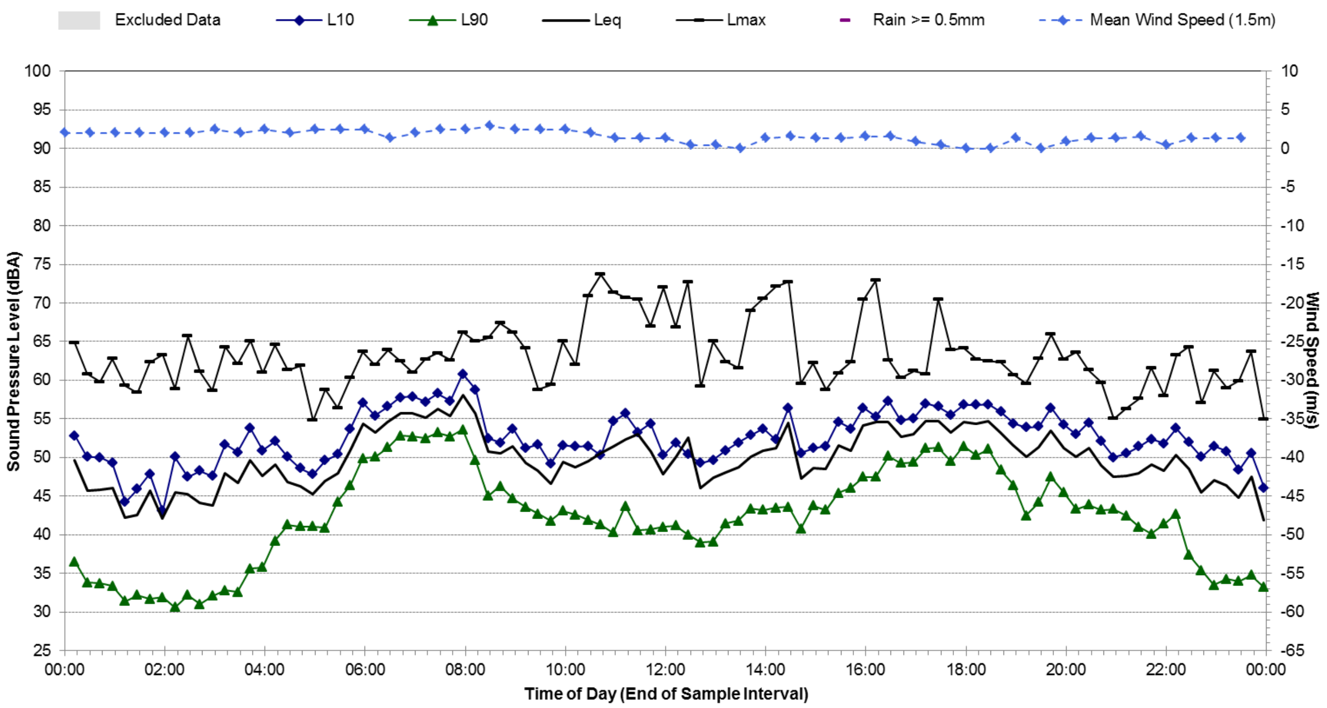

Statistical Ambient Noise Levels
L.12 145m S of road - 2300 Elizabeth Dr, Badgerys Creek - Monday, 19 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.12 145m S of road - 2300 Elizabeth Dr, Badgerys Creek - Tuesday, 20 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Statistical Ambient Noise Levels
L.12 145m S of road - 2300 Elizabeth Dr, Badgerys Creek - Wednesday, 21 June 2017

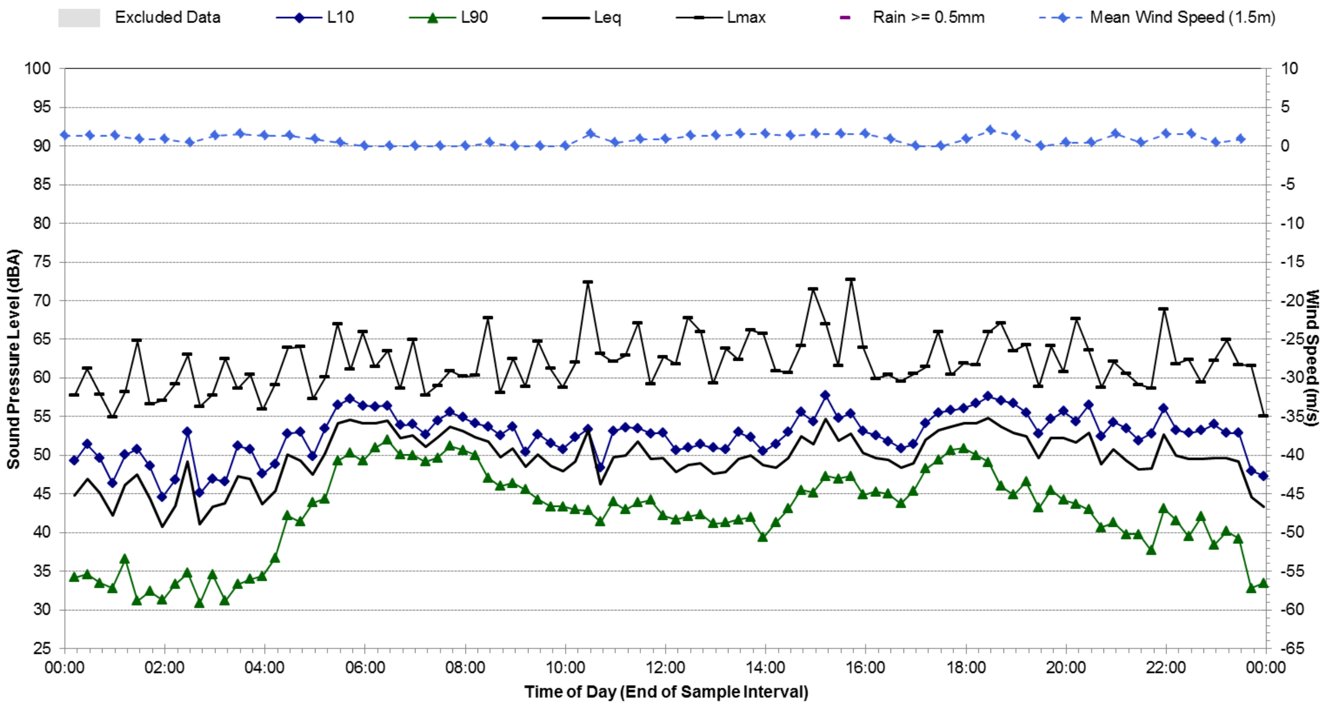


Statistical Ambient Noise Levels
L.12 145m S of road - 2300 Elizabeth Dr, Badgerys Creek - Thursday, 22 June 2017



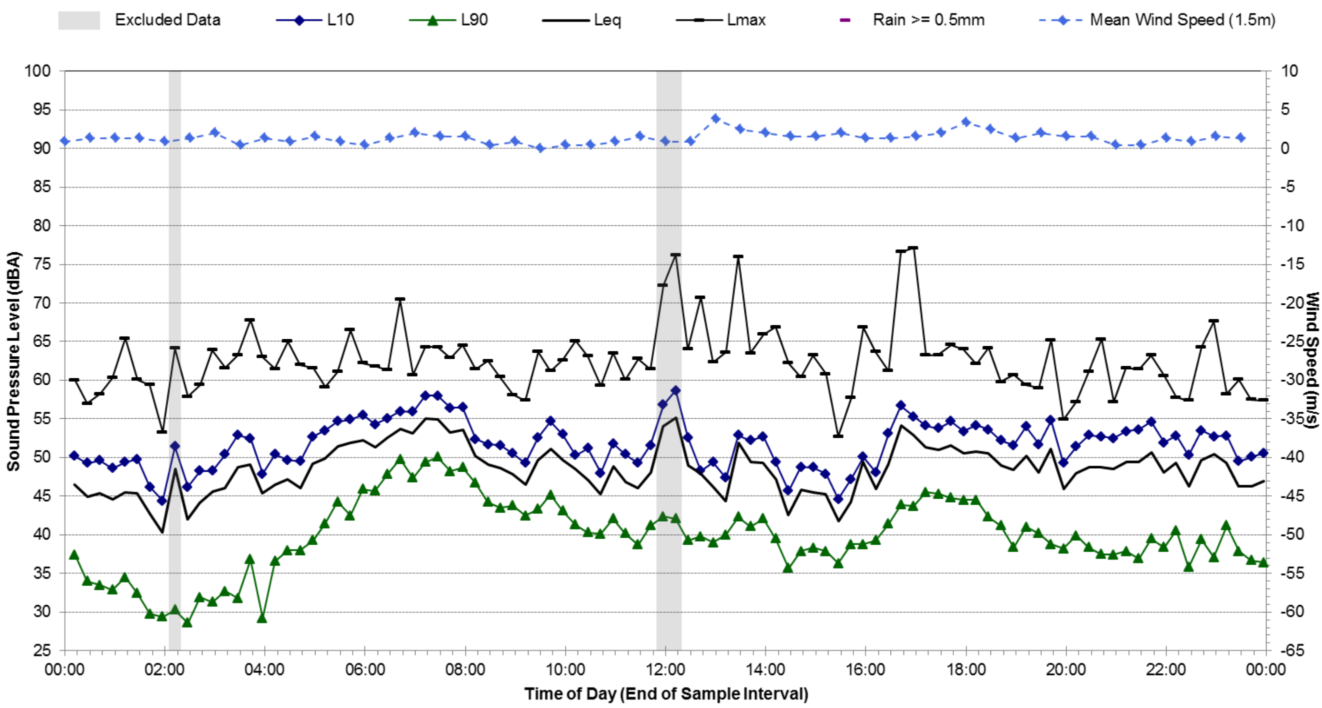
Statistical Ambient Noise Levels

L.12 145m S of road - 2300 Elizabeth Dr, Badgerys Creek - Friday, 23 June 2017



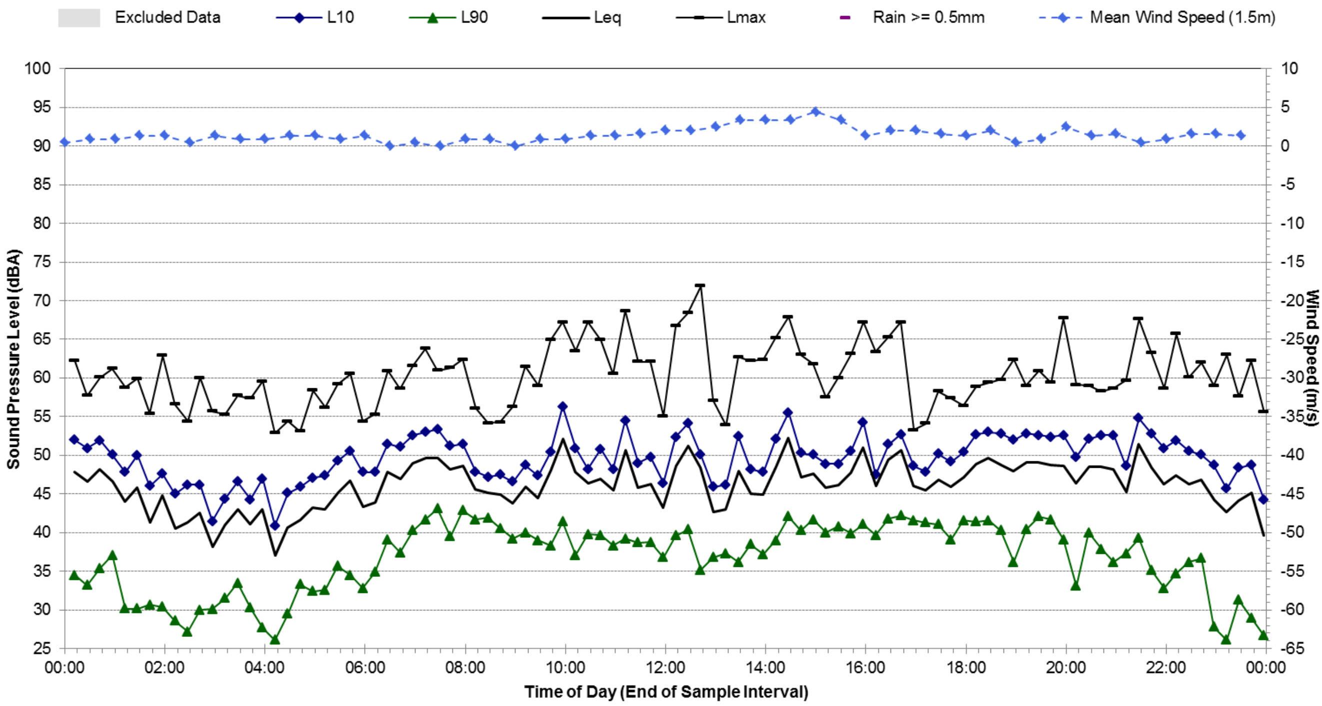
Statistical Ambient Noise Levels

L.12 145m S of road - 2300 Elizabeth Dr, Badgerys Creek - Saturday, 24 June 2017



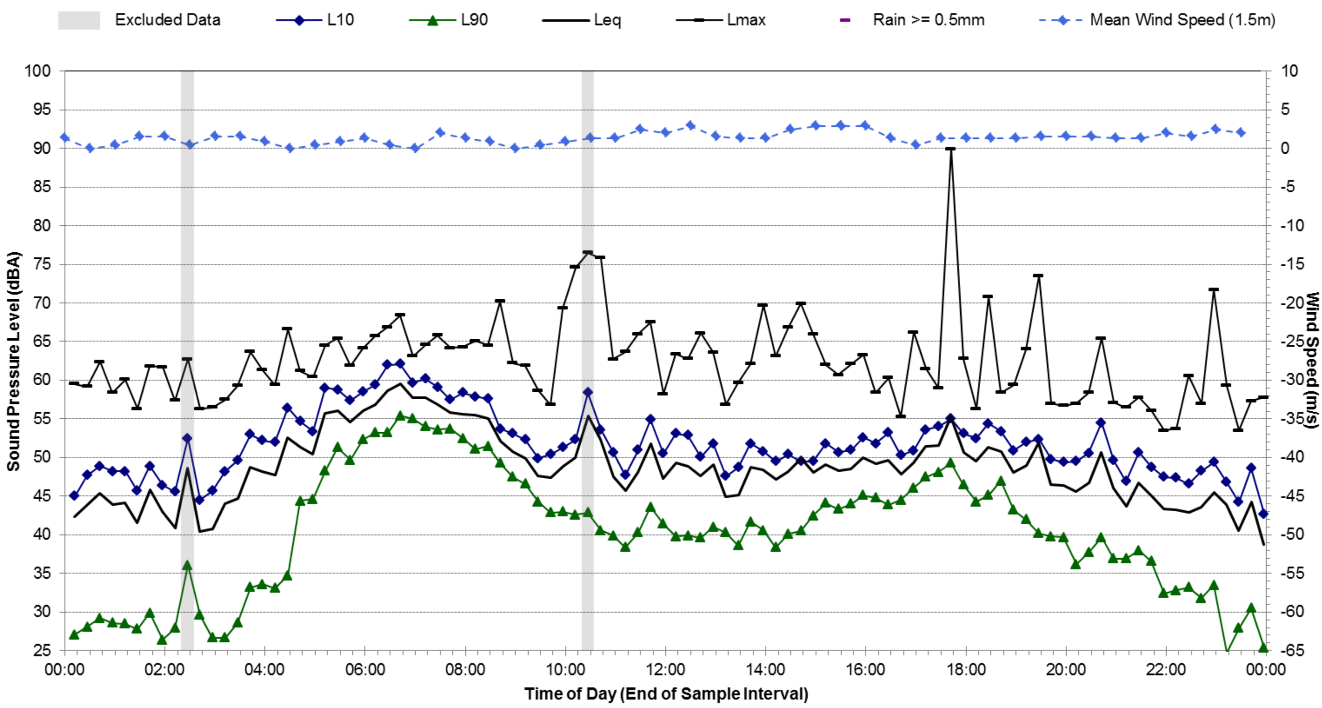
Statistical Ambient Noise Levels

L.12 145m S of road - 2300 Elizabeth Dr, Badgerys Creek - Sunday, 25 June 2017



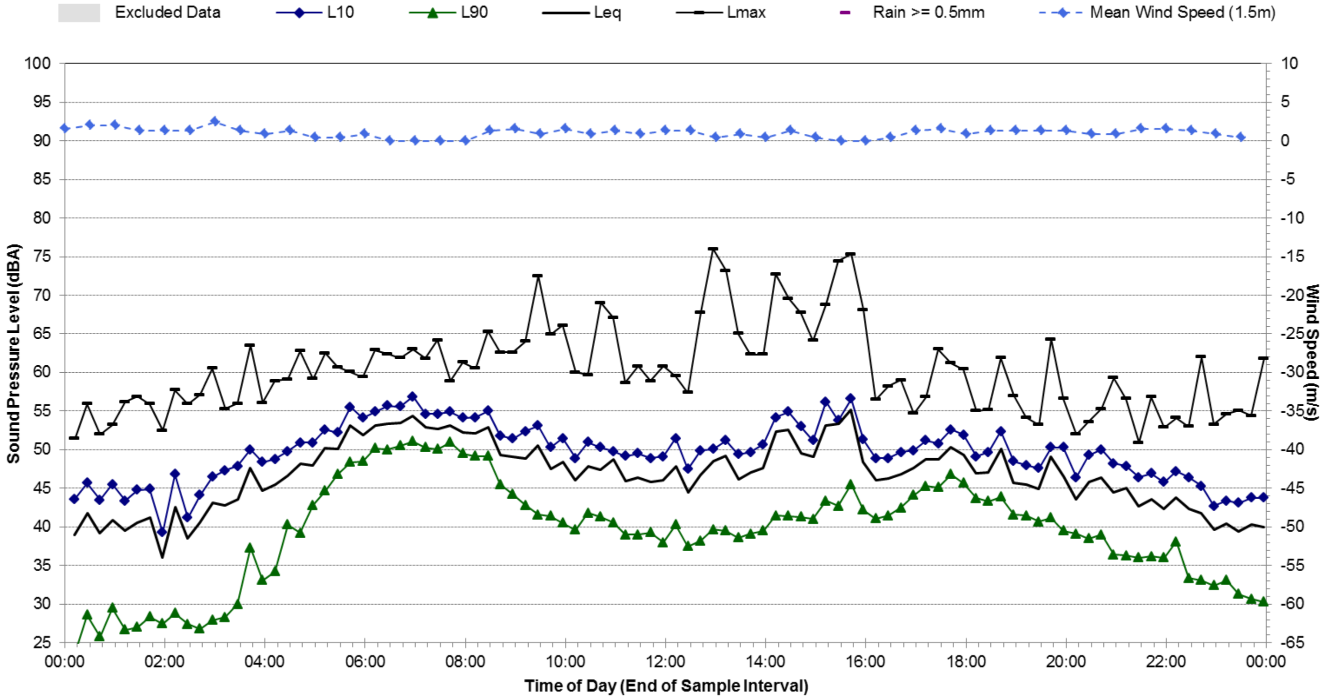
Statistical Ambient Noise Levels

L.12 145m S of road - 2300 Elizabeth Dr, Badgerys Creek - Monday, 26 June 2017



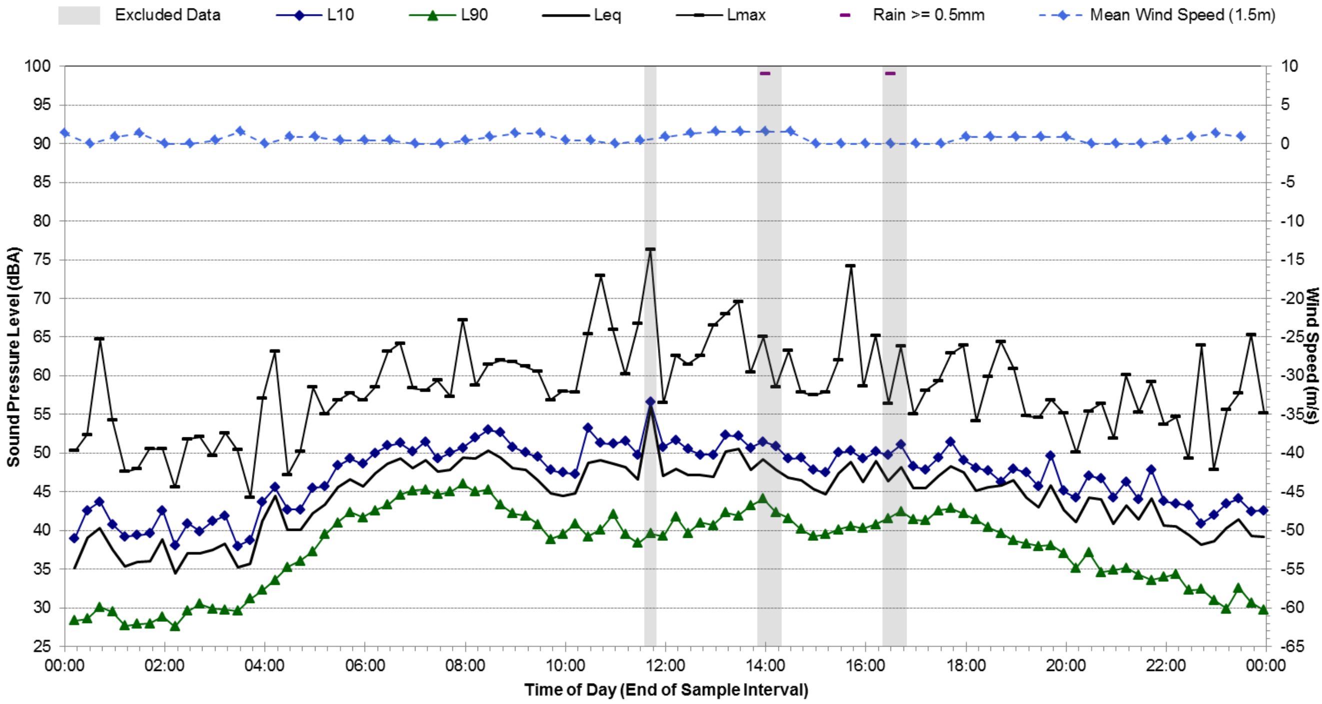
Statistical Ambient Noise Levels

L.12 145m S of road - 2300 Elizabeth Dr, Badgerys Creek - Tuesday, 27 June 2017



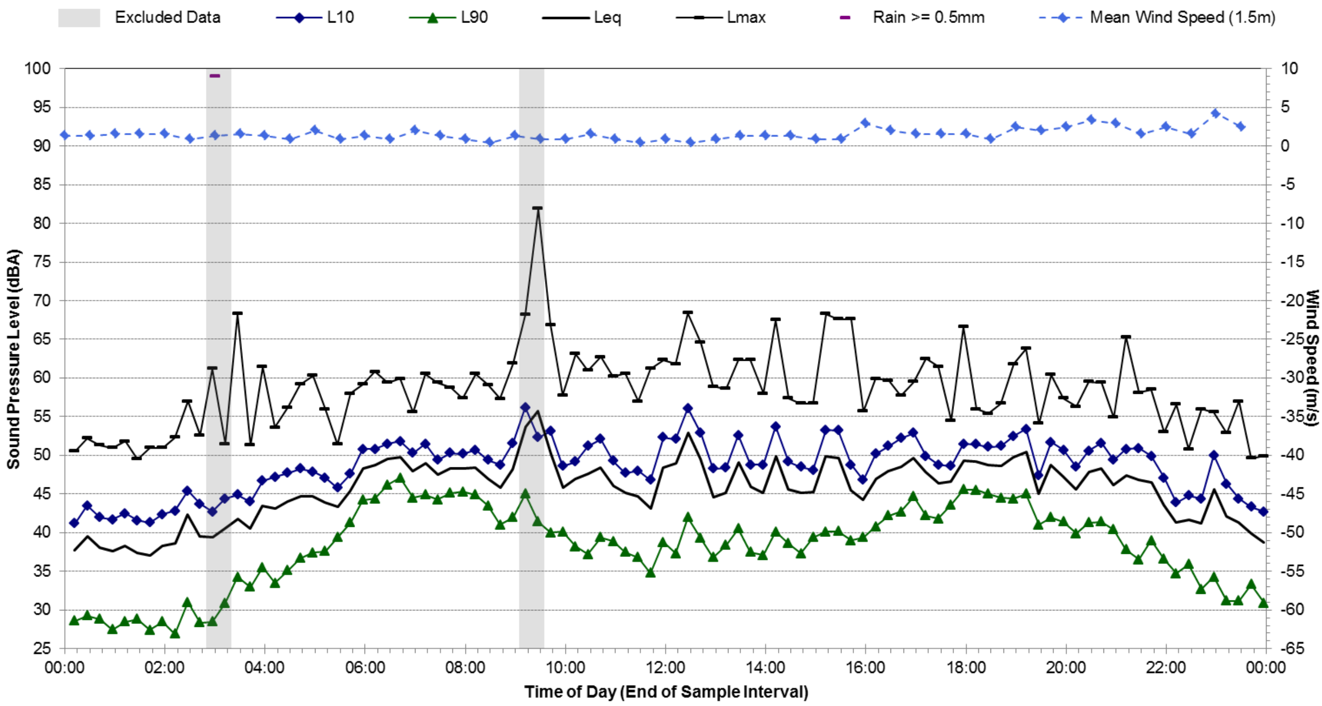
Statistical Ambient Noise Levels

L.12 145m S of road - 2300 Elizabeth Dr, Badgerys Creek - Wednesday, 28 June 2017



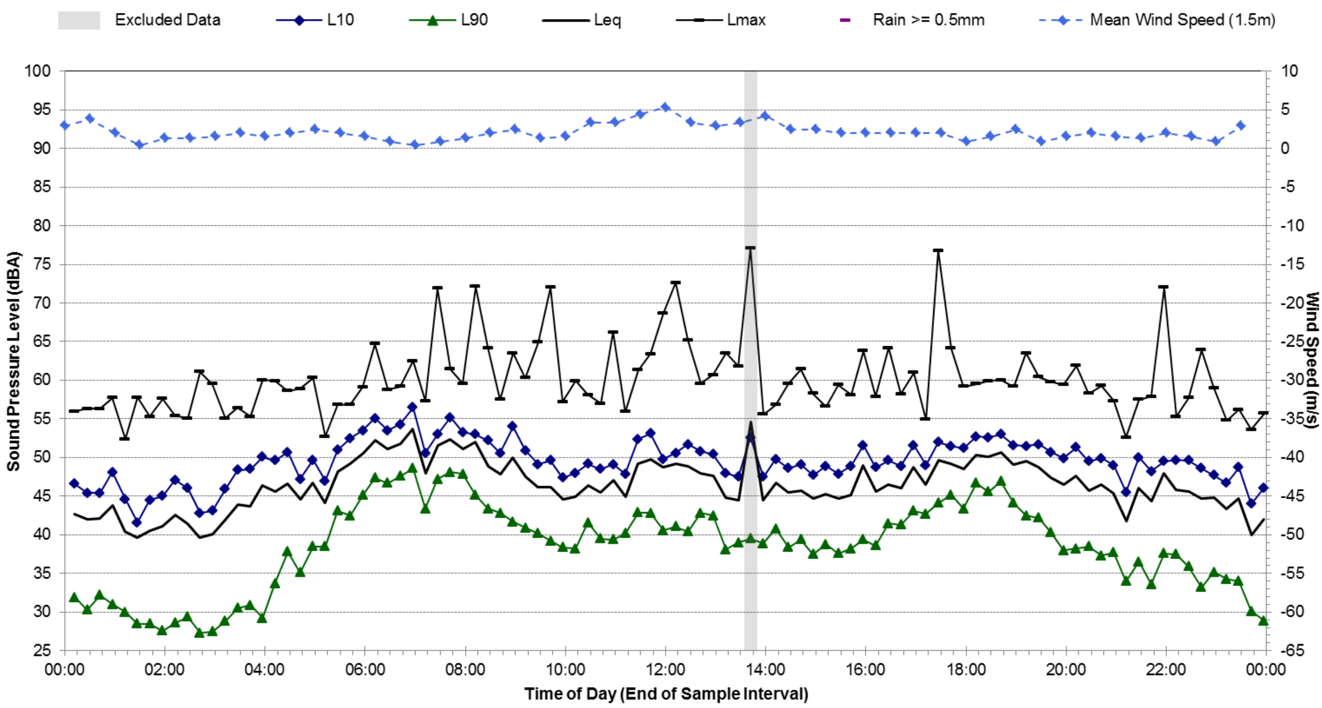
Statistical Ambient Noise Levels

L.12 145m S of road - 2300 Elizabeth Dr, Badgerys Creek - Thursday, 29 June 2017



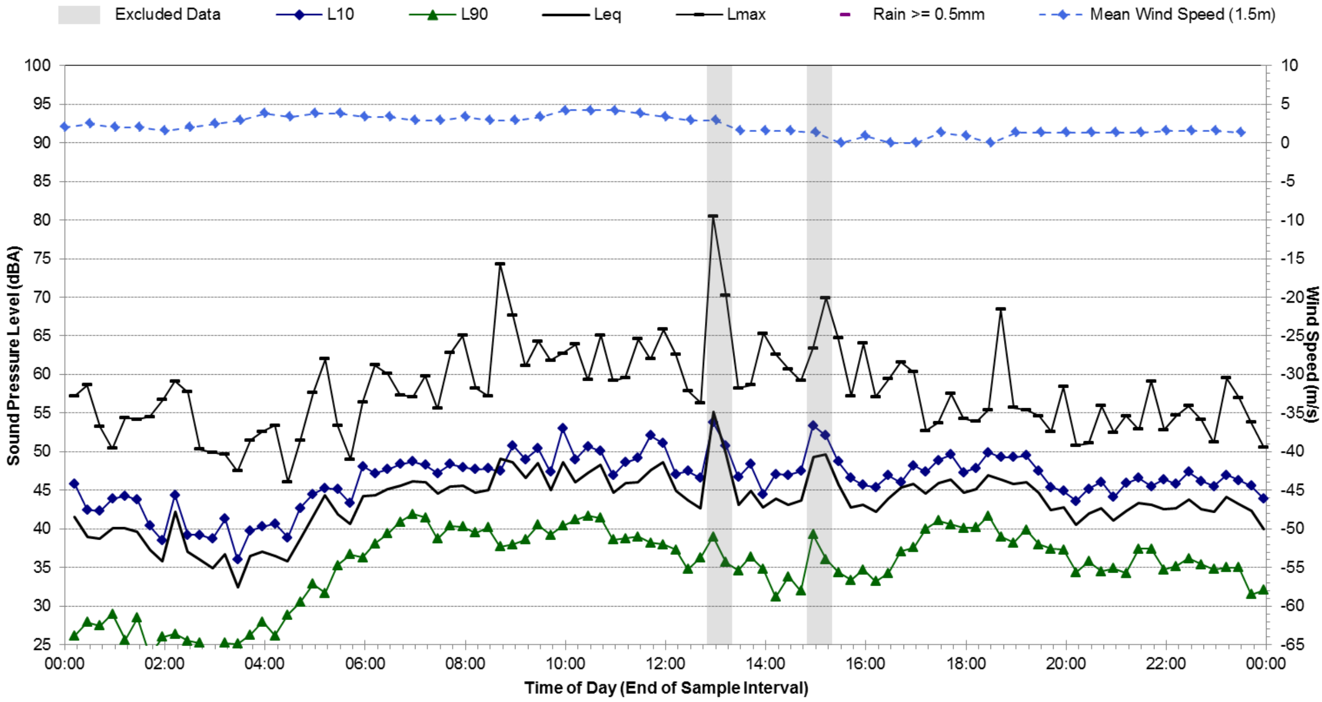
Statistical Ambient Noise Levels

L.12 145m S of road - 2300 Elizabeth Dr, Badgerys Creek - Friday, 30 June 2017



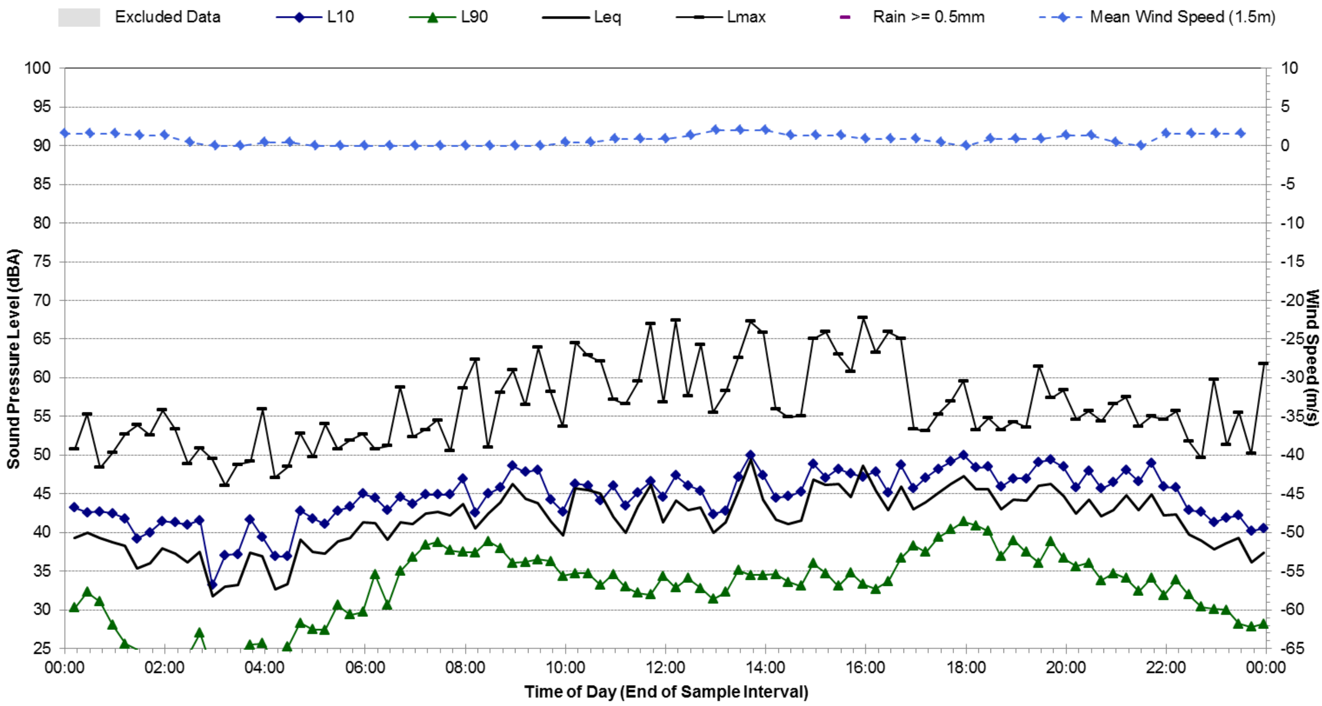
Statistical Ambient Noise Levels

L.12 145m S of road - 2300 Elizabeth Dr, Badgerys Creek - Saturday, 1 July 2017



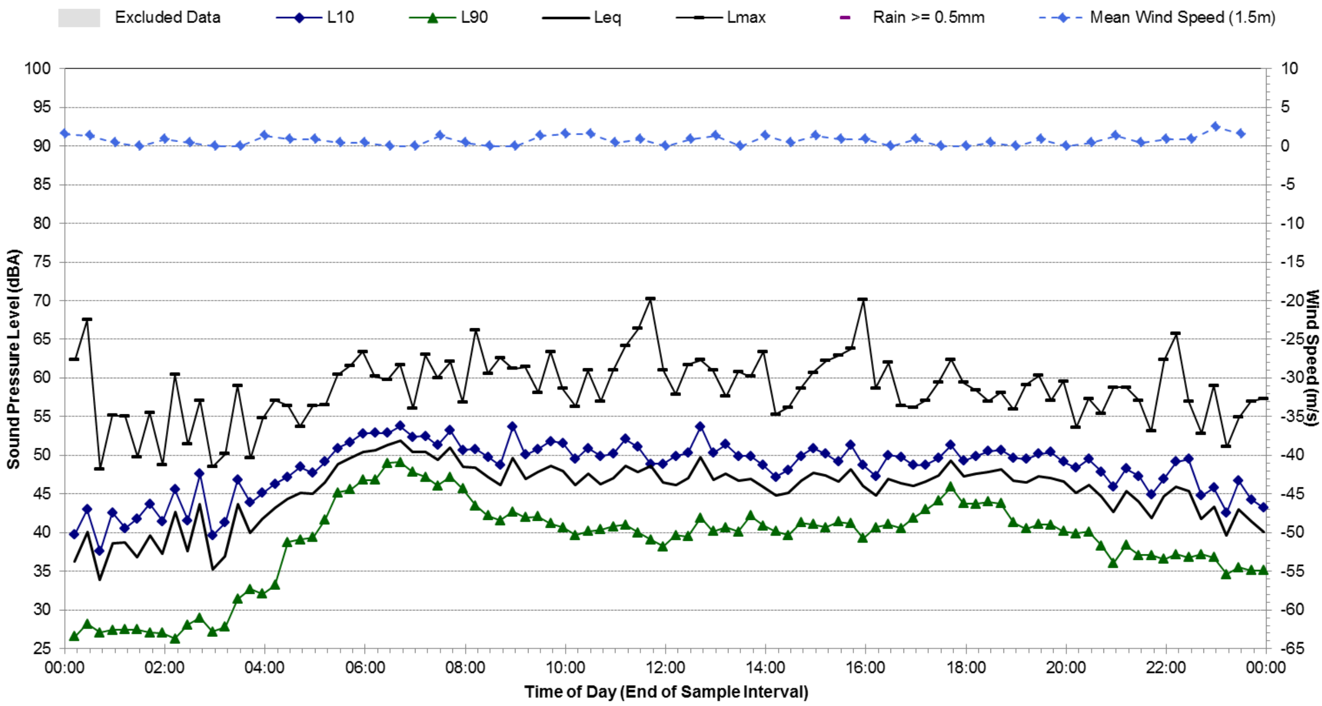
Statistical Ambient Noise Levels

L.12 145m S of road - 2300 Elizabeth Dr, Badgerys Creek - Sunday, 2 July 2017



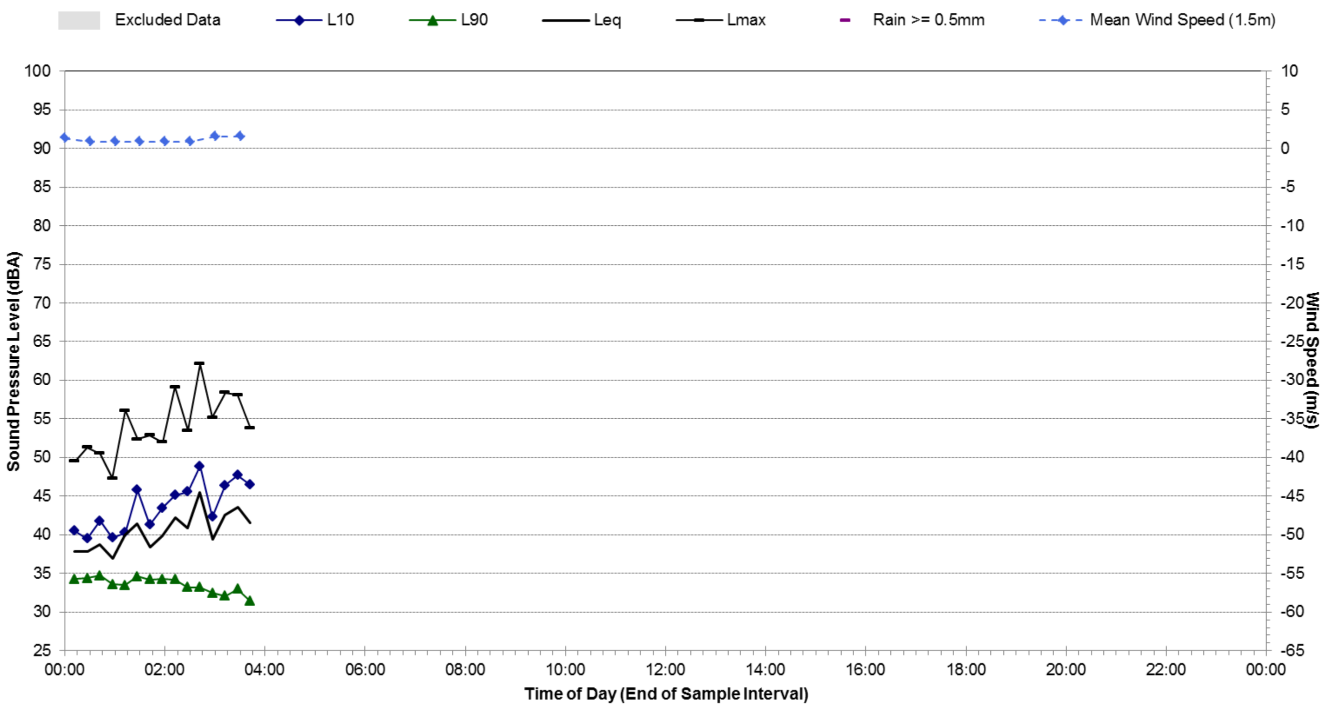
Statistical Ambient Noise Levels

L.12 145m S of road - 2300 Elizabeth Dr, Badgerys Creek - Monday, 3 July 2017



Statistical Ambient Noise Levels

L.12 145m S of road - 2300 Elizabeth Dr, Badgerys Creek - Tuesday, 4 July 2017



Noise Monitoring Location	L.13
Noise Monitoring Address	20m N of Elizabeth Dr - 1953-2109 Elizabeth Drive, Badgerys Creek

Logger Device Type: ARL EL-316, Logger Serial No: 16-203-524

Sound Level Meter Device Type: Brüel and Kjær 2260i, Sound Level Meter Serial No: 2414605

Ambient noise logger deployed at residential address 1953-2109 Elizabeth Drive, Badgerys Creek. Logger located approximately 20 m north of Elizabeth Drive.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from Elizabeth Drive. Noise from wildlife (ie birds) also contributes to the LAeq at this location.

Recorded Noise Levels: (LAmax):

19/06/2017: Road traffic (Elizabeth Dr): 68-83 dBA, Birds: 39-41 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – Construction Periods[1]

RBL Noise Level (dBA)				
Morning Shoulder	Day	Evening	Evening Shoulder	Night
50	42	38	48	33

Ambient Noise Logging Results – RNP Defined Time Periods

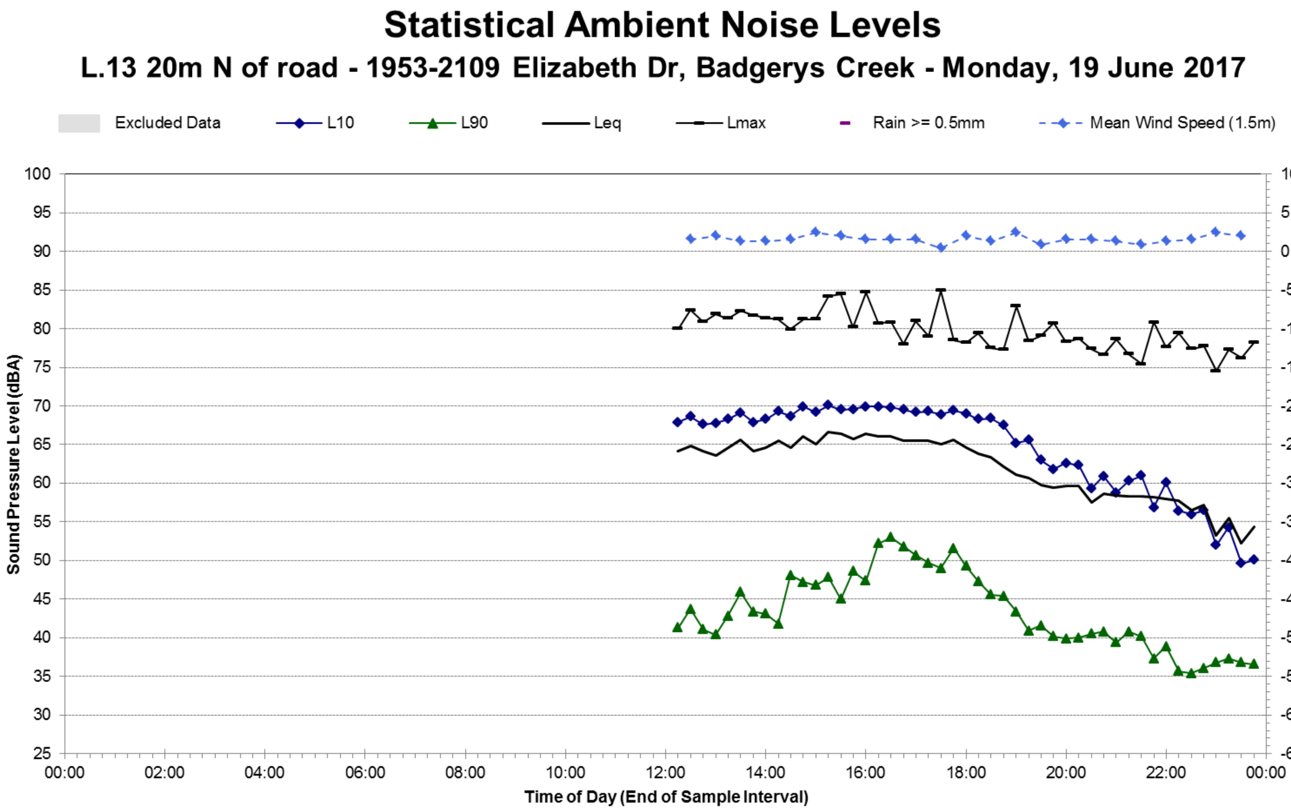
Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	64	67
Night-time (10pm-7am)	60	67

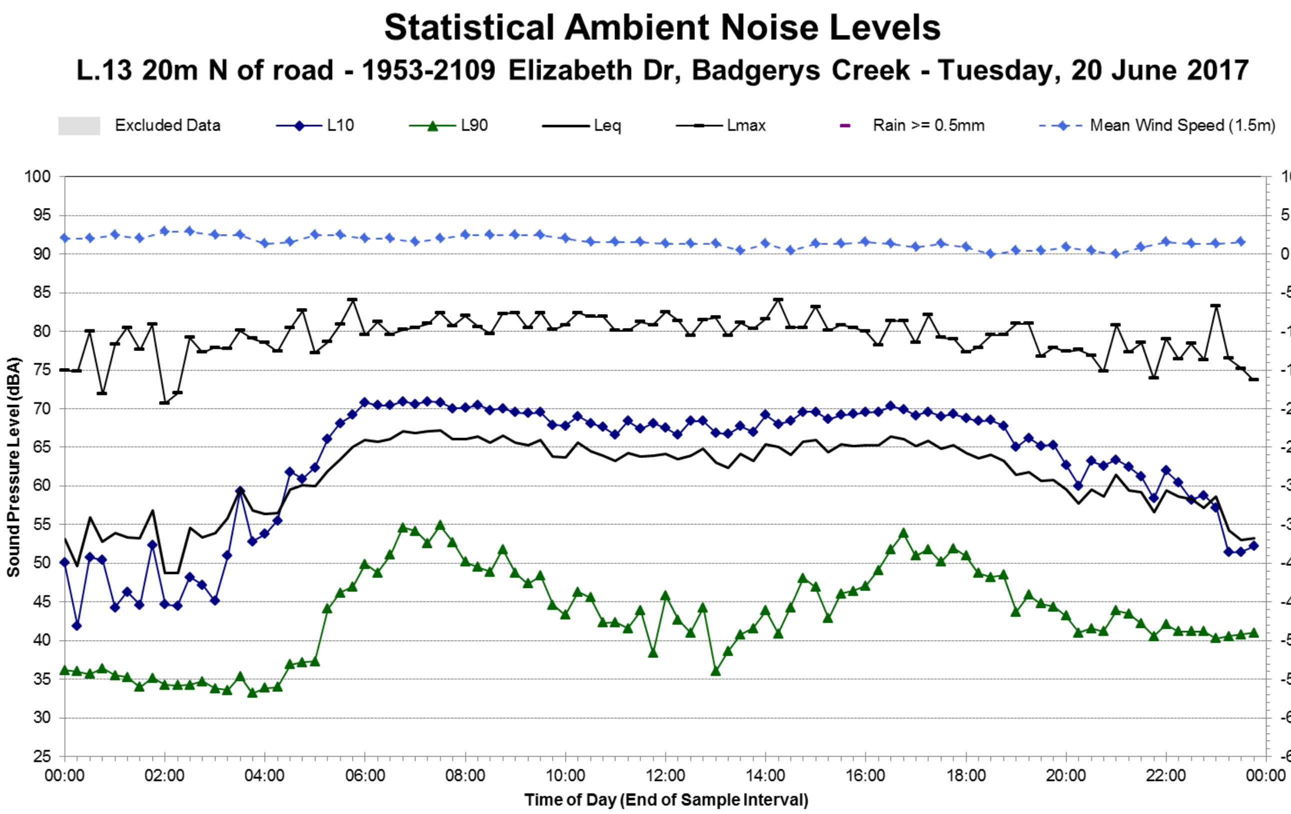
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
19/06/2017	12:29	41	65	83

Photo of Noise Monitoring Location

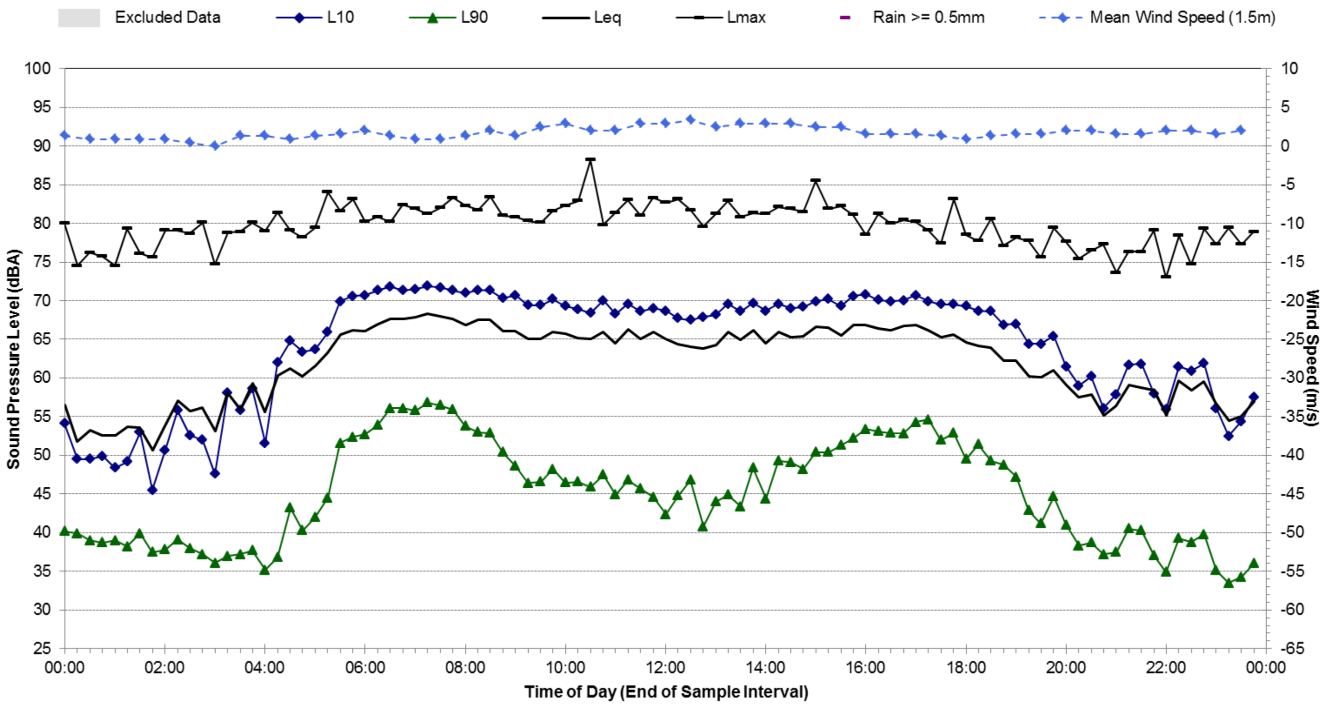
Note 1: Morning shoulder is 6 am to 7 am Monday to Friday; Daytime is 7 am to 6 pm Monday to Saturday & 8 am to 6 pm Sunday & Public Holidays; Evening is 7 pm to 10 pm Monday to Friday & 6 pm to 10 pm Saturday, Sunday & Public Holidays; Evening shoulder is 6 pm to 7 pm Monday to Friday; Night-time is 10 pm to 6 am Monday to Friday, 10 pm to 7 am Saturday & 10 pm to 8 am Sunday and Public Holidays.


Statistical Ambient Noise Levels
L.13 20m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Monday, 19 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.13 20m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Tuesday, 20 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

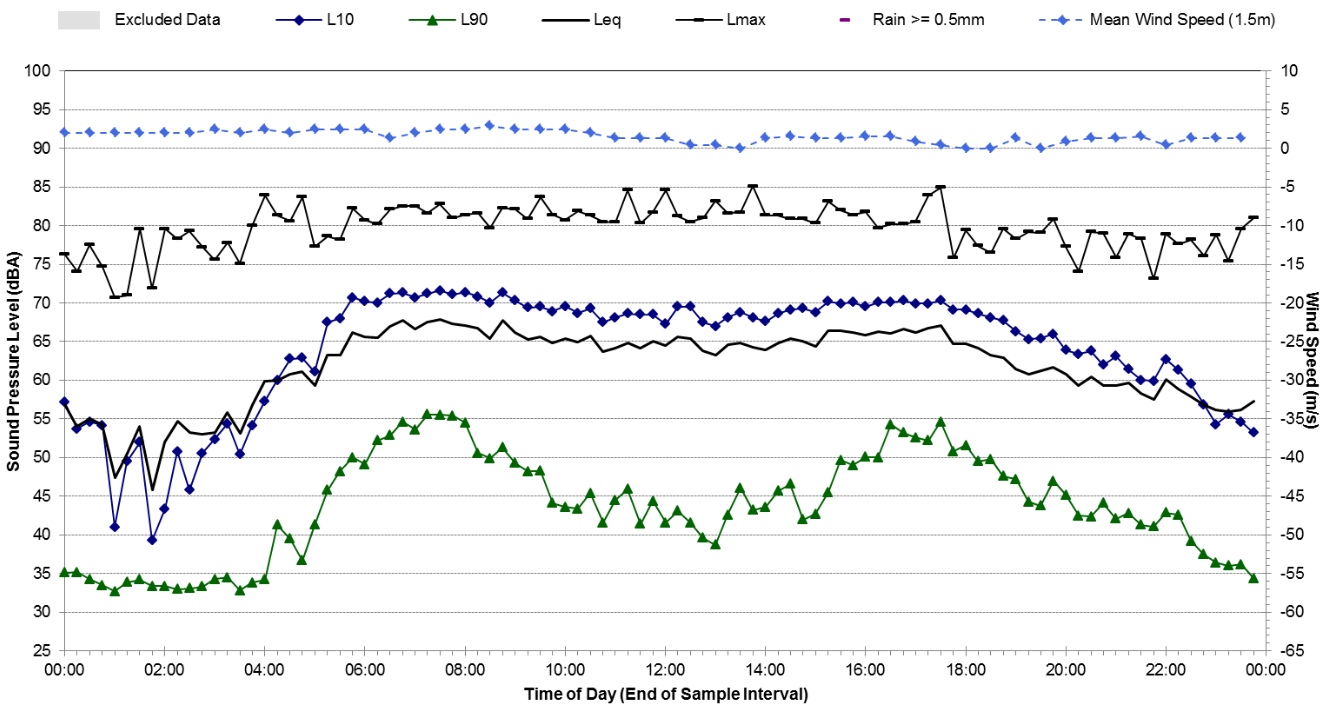
Statistical Ambient Noise Levels

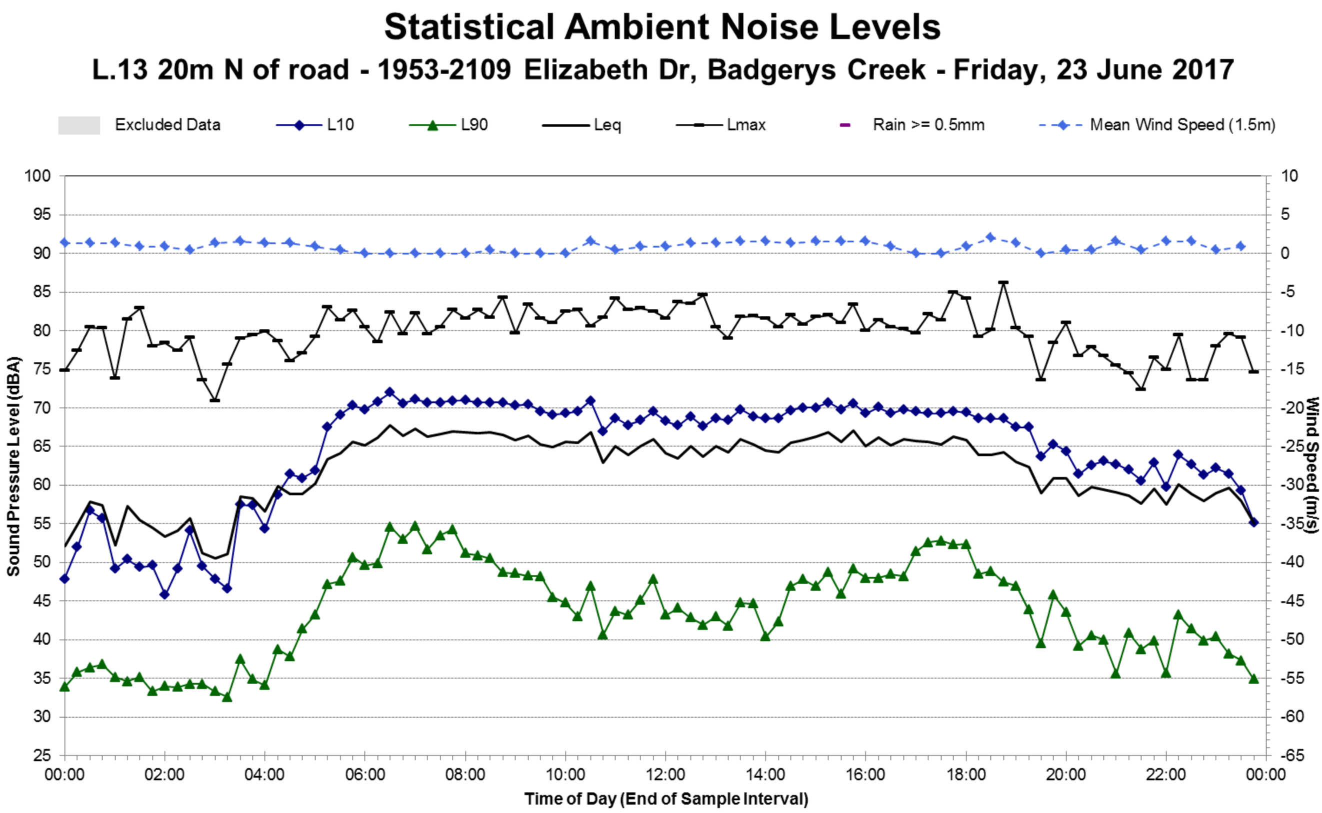
L.13 20m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Wednesday, 21 June 2017

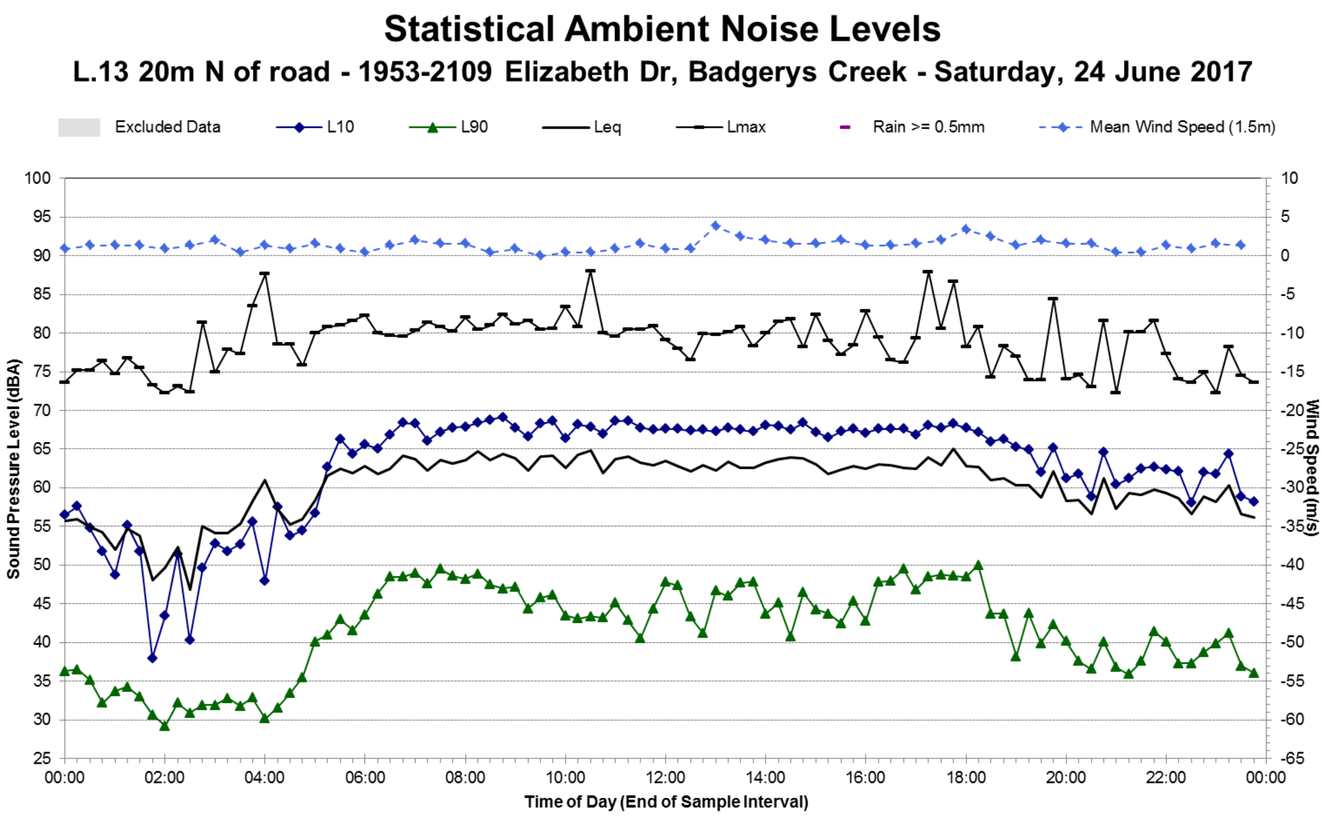


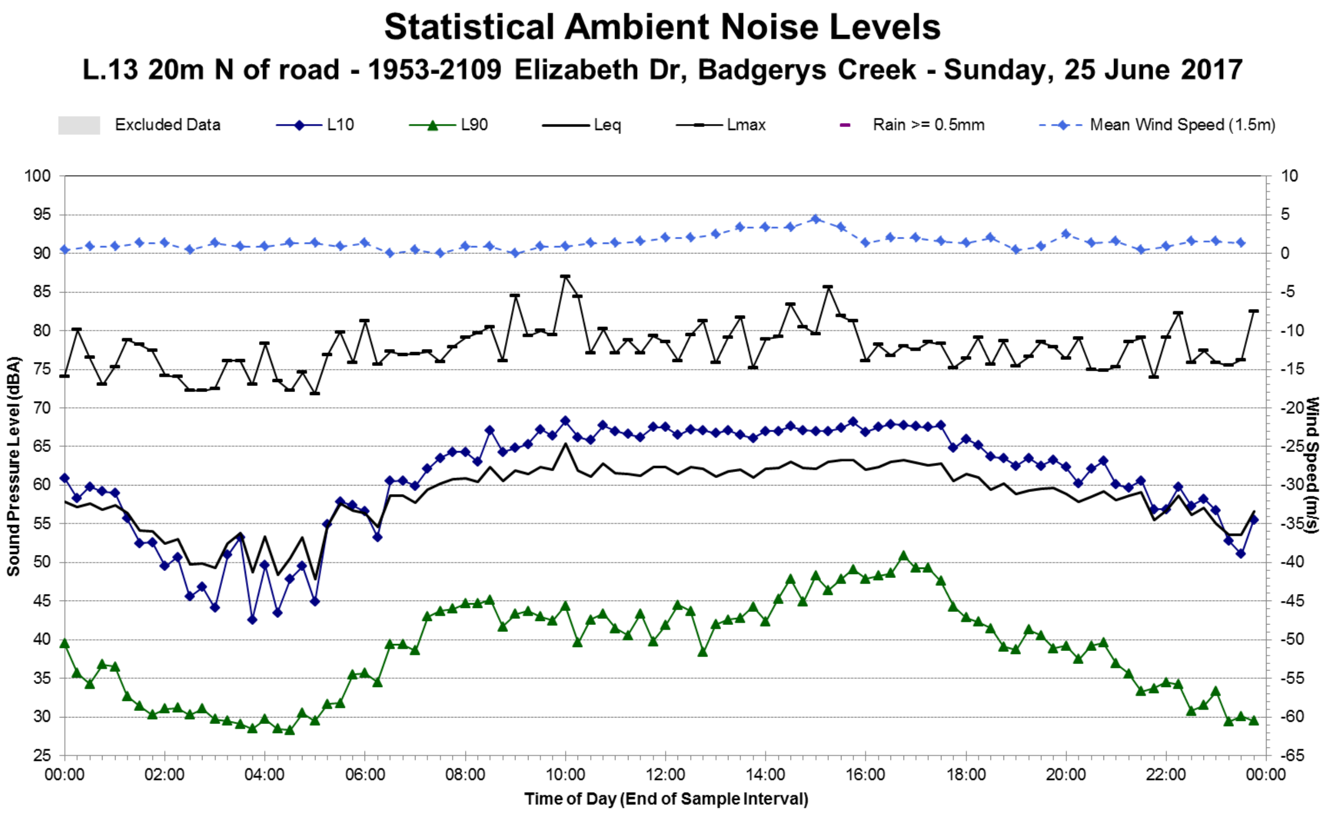
Statistical Ambient Noise Levels

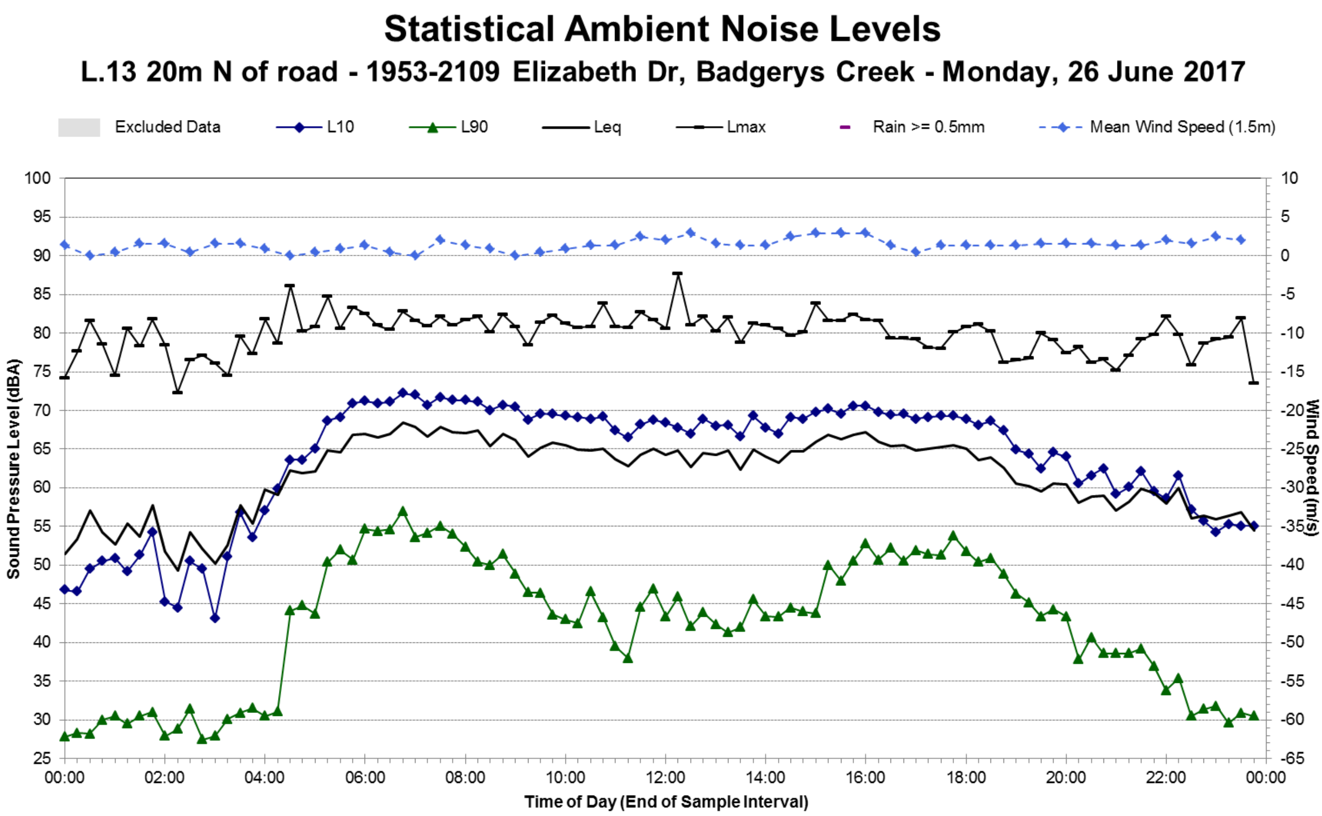
L.13 20m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Thursday, 22 June 2017

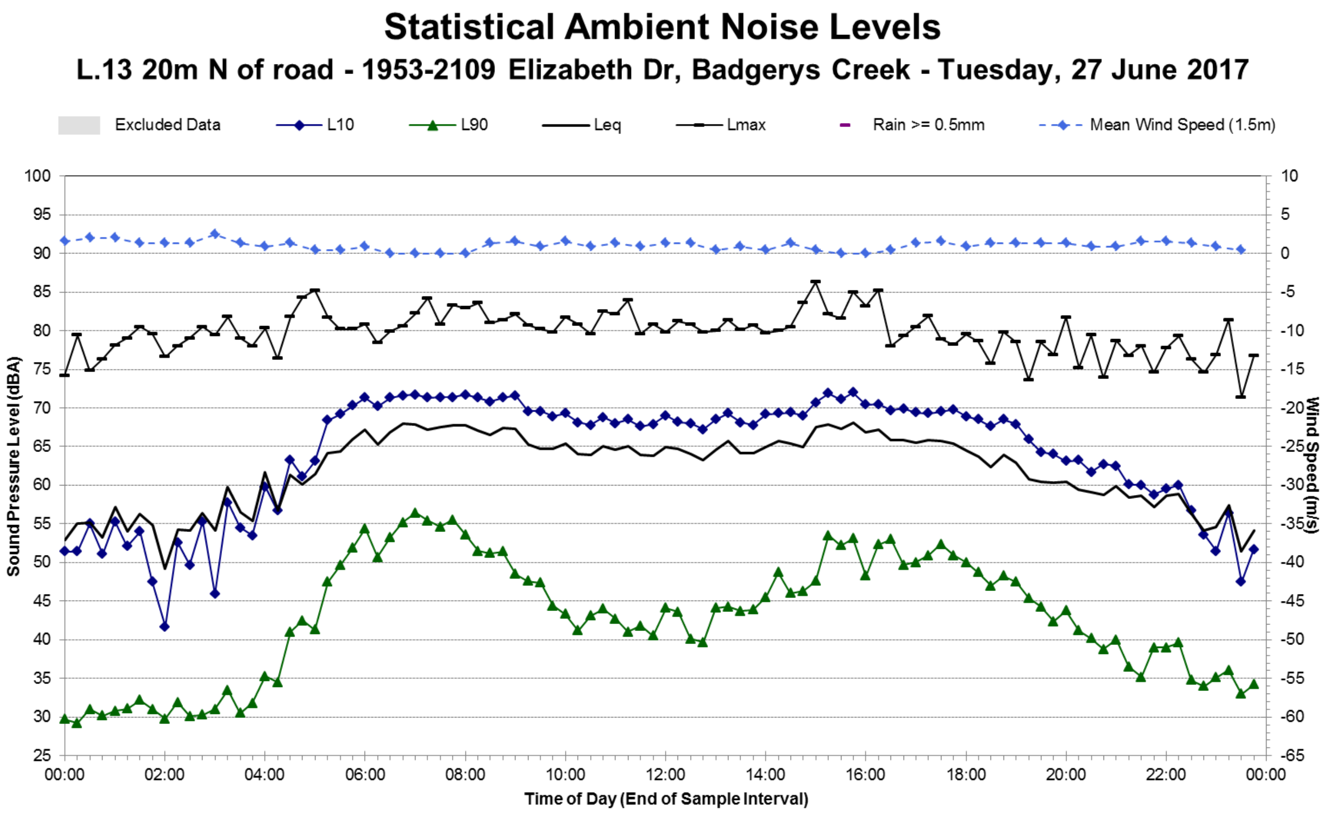


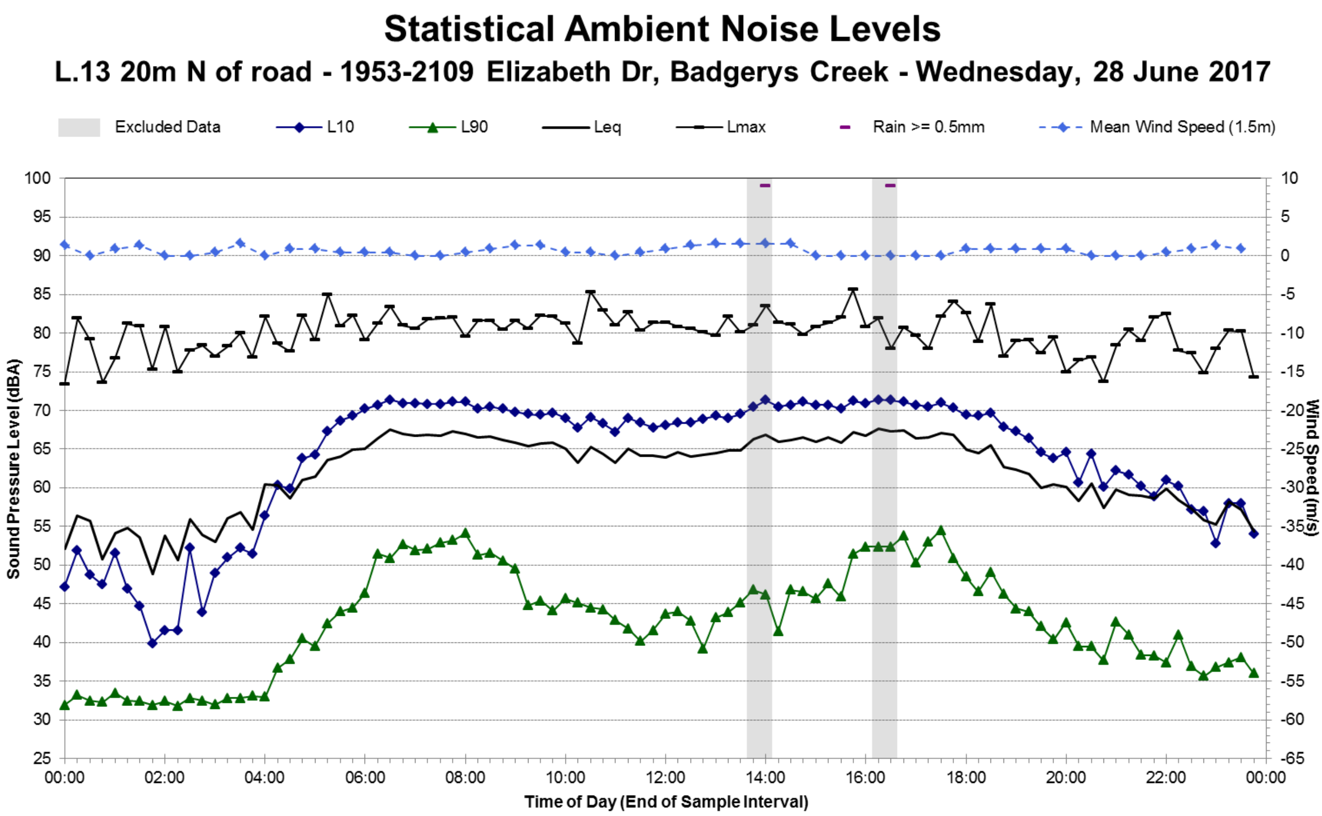

Statistical Ambient Noise Levels
L.13 20m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Friday, 23 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.13 20m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Saturday, 24 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.13 20m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Sunday, 25 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

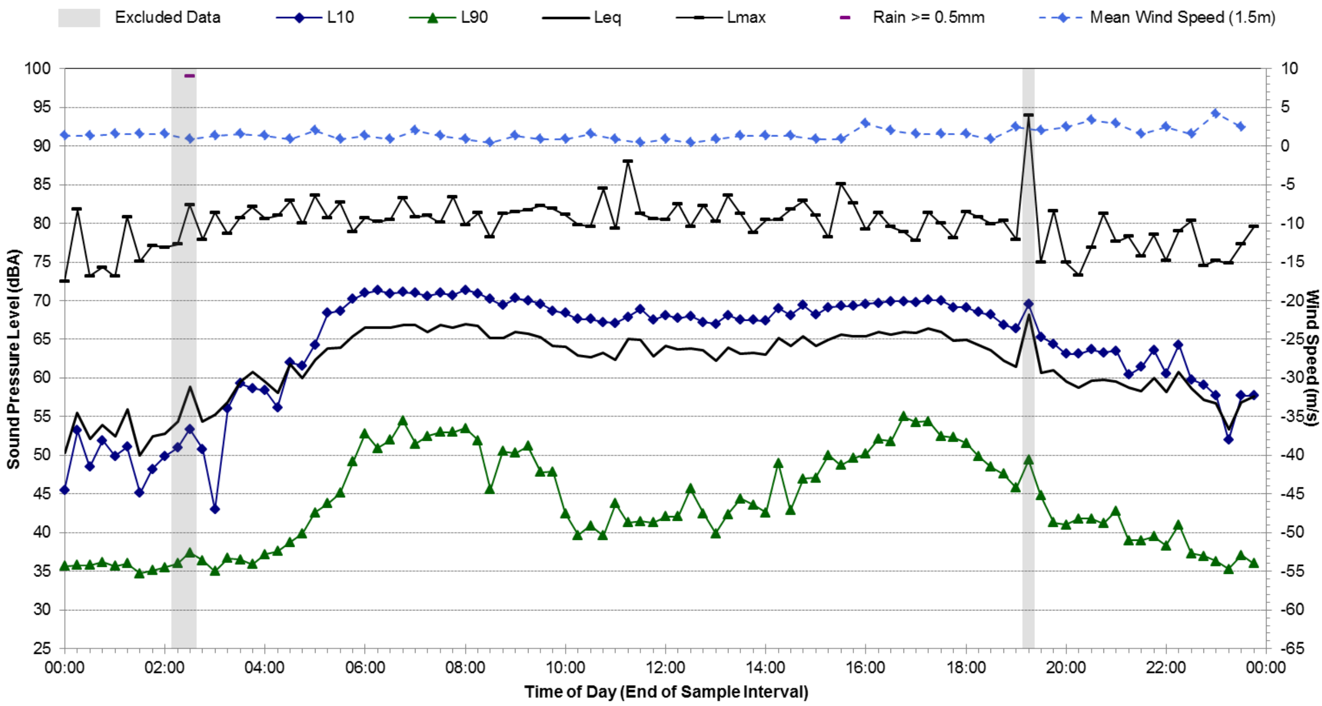

Statistical Ambient Noise Levels
L.13 20m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Monday, 26 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.13 20m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Tuesday, 27 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.13 20m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Wednesday, 28 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

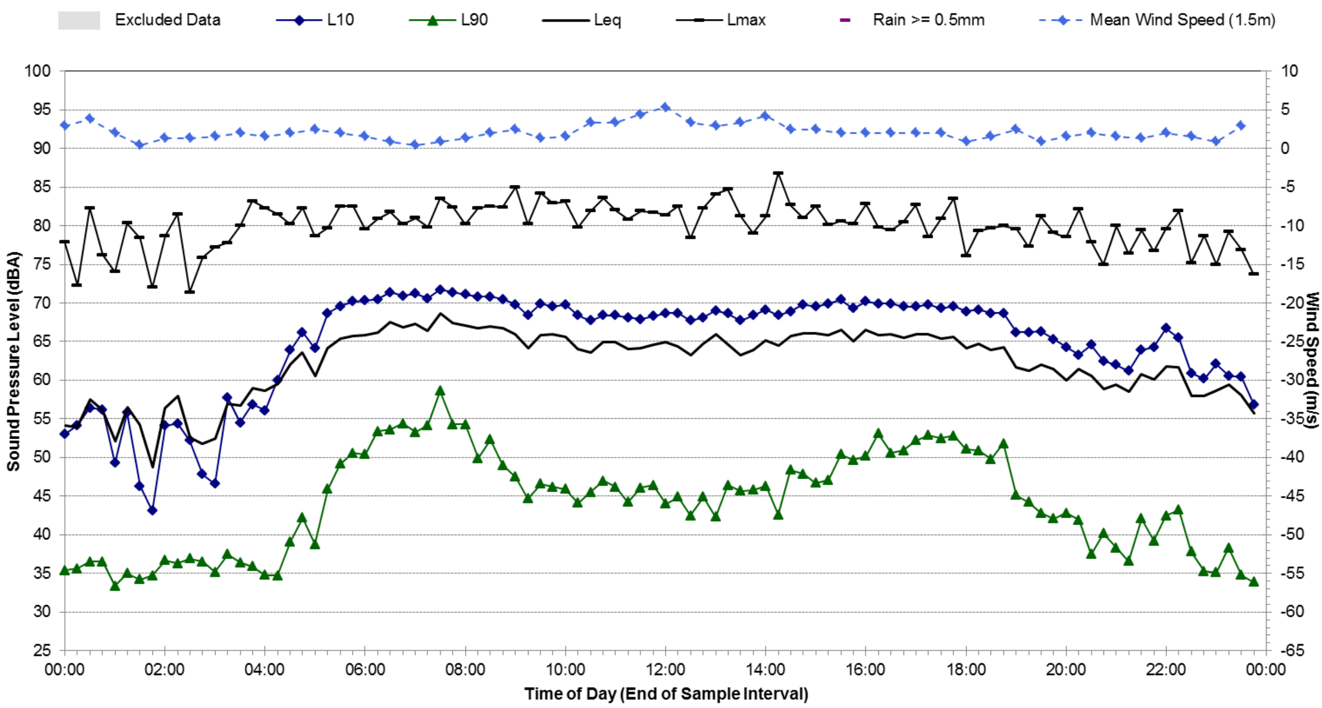
Statistical Ambient Noise Levels

L.13 20m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Thursday, 29 June 2017



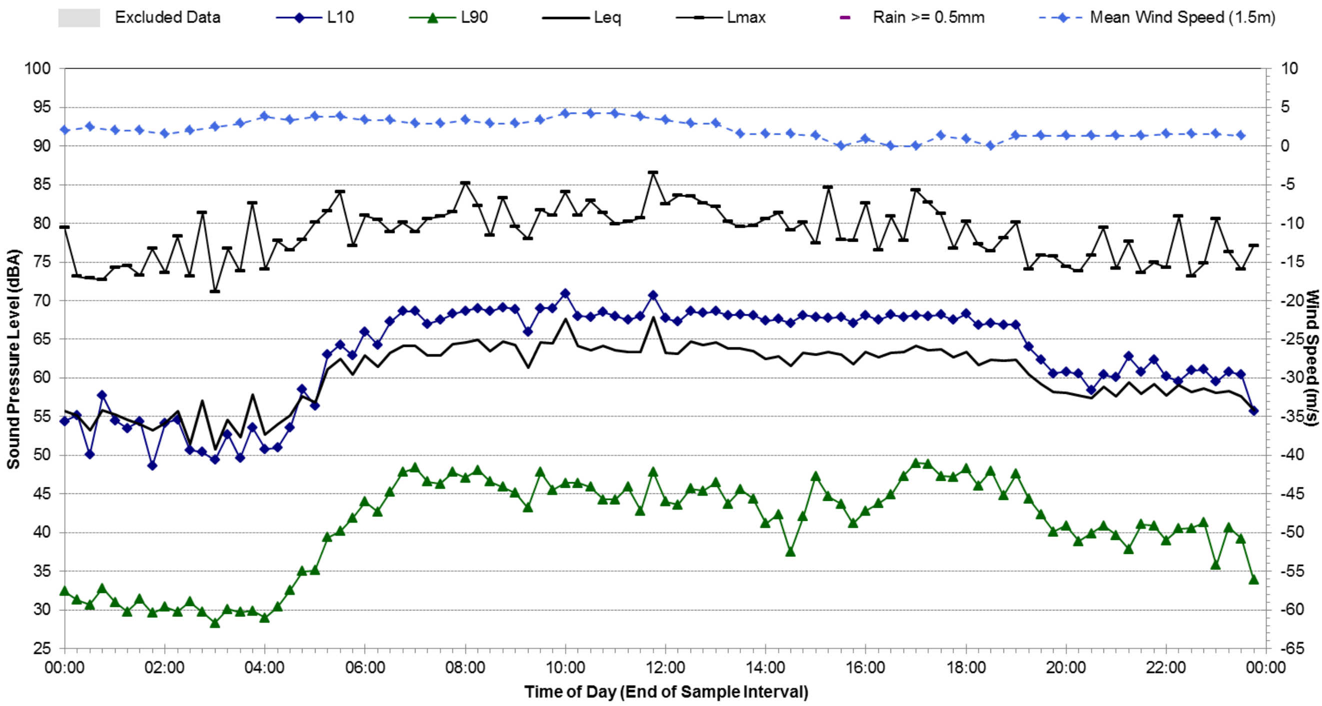
Statistical Ambient Noise Levels

L.13 20m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Friday, 30 June 2017



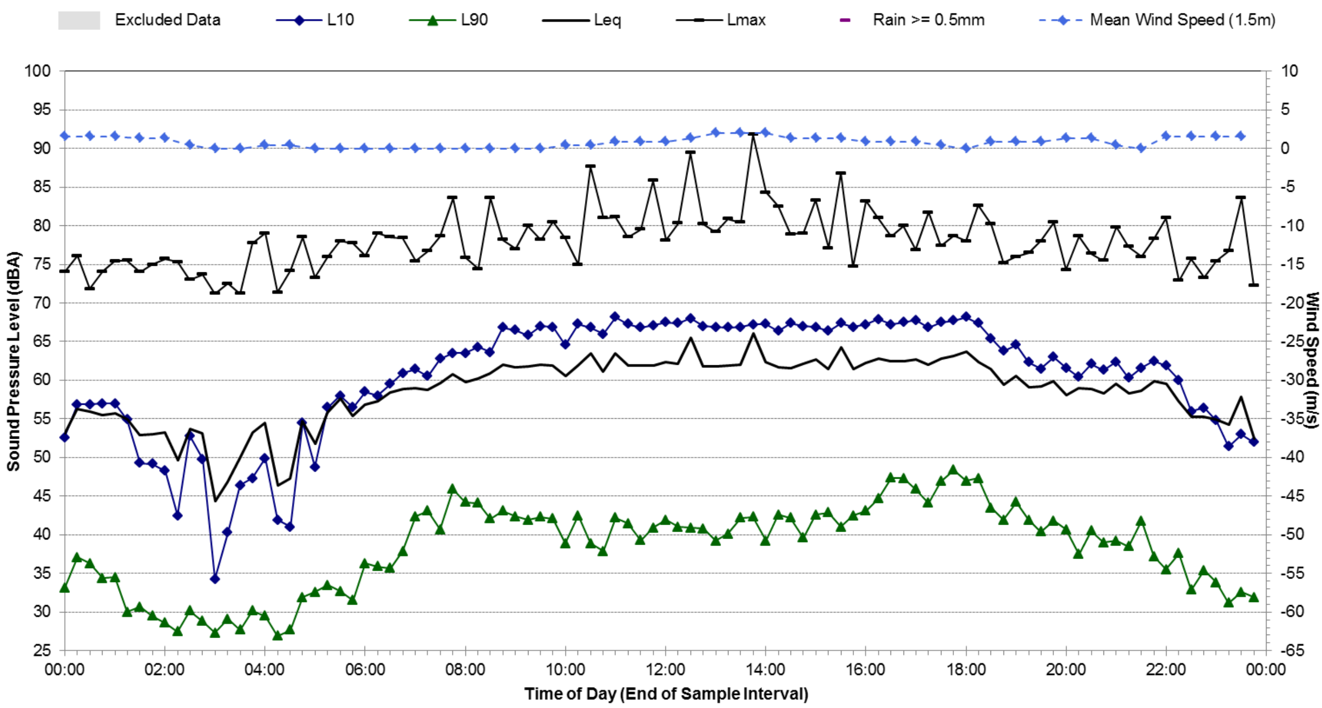
Statistical Ambient Noise Levels

L.13 20m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Saturday, 1 July 2017



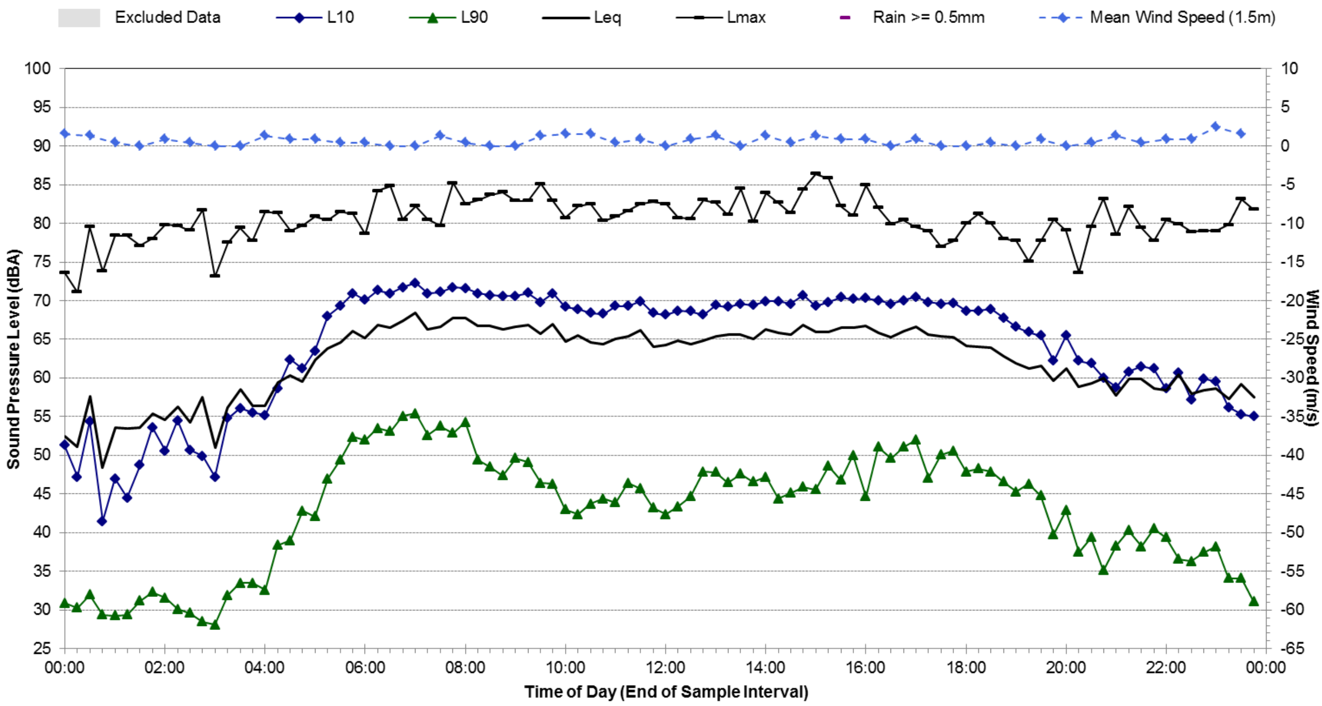
Statistical Ambient Noise Levels

L.13 20m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Sunday, 2 July 2017



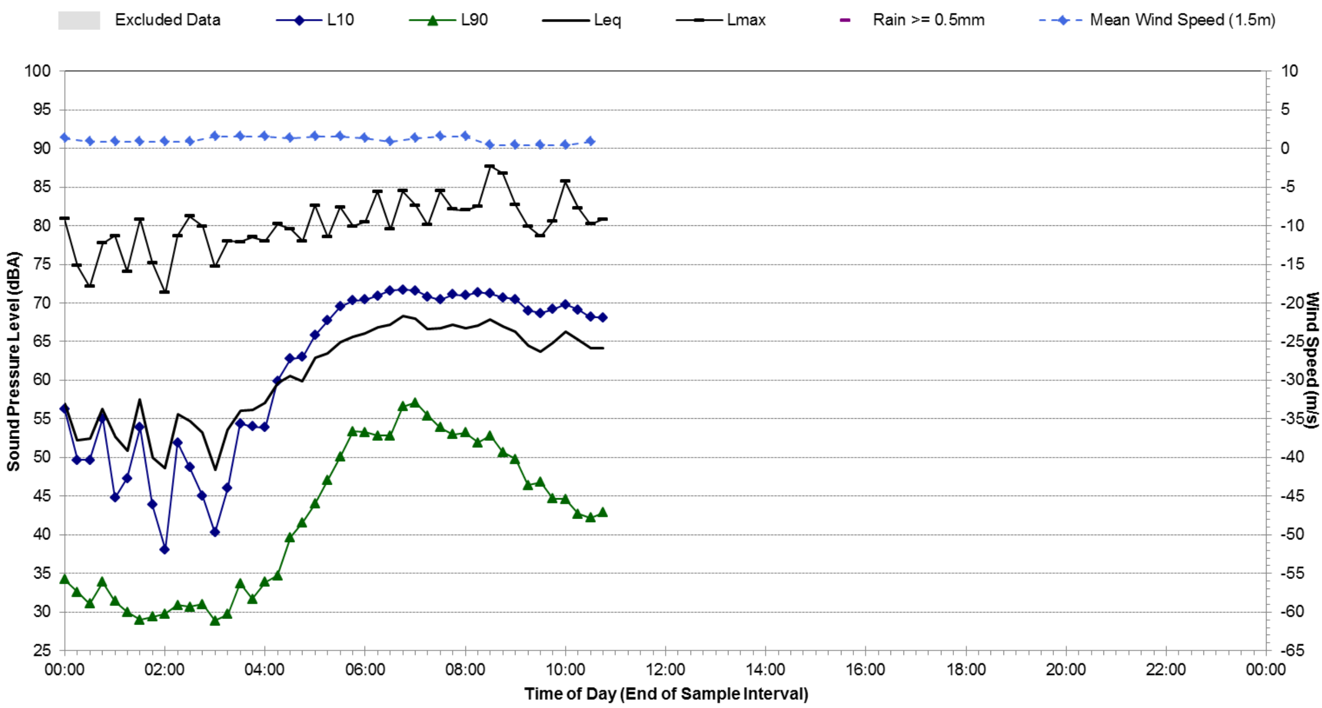
Statistical Ambient Noise Levels

L.13 20m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Monday, 3 July 2017



Statistical Ambient Noise Levels

L.13 20m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Tuesday, 4 July 2017



Noise Monitoring Location	L.14
Noise Monitoring Address	50m N of Elizabeth Dr - 1953-2109 Elizabeth Drive, Badgerys Creek

Logger Device Type: ARL EL-316, Logger Serial No: 16-203-525

Sound Level Meter Device Type: Brüel and Kjær 2260i, Sound Level Meter Serial No: 2414605

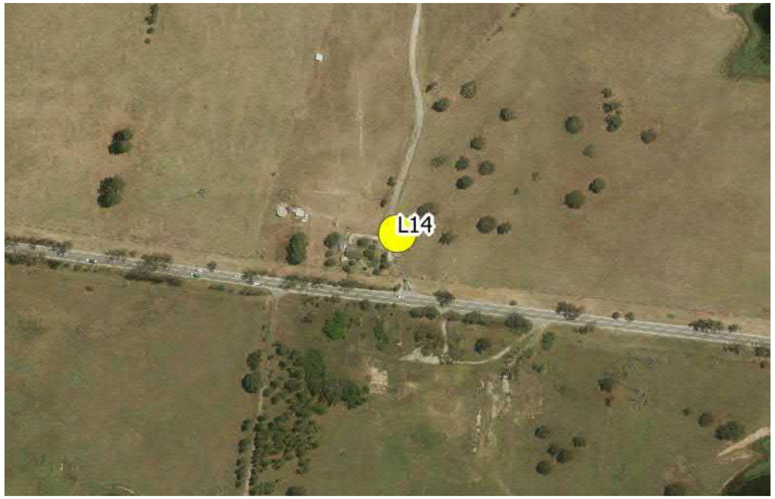
Ambient noise logger deployed at residential address 1953-2109 Elizabeth Drive, Badgerys Creek. Logger located approximately 50 m north of Elizabeth Drive.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from Elizabeth Drive. Noise from light aircraft and wildlife (ie birds) also contributes to the LAeq at this location.

Recorded Noise Levels: (LAmax):

19/06/2017: Road traffic: 50-70 dBA, Light aircraft: 50-55 dBA

Map of Noise Monitoring Location



Ambient Noise Logging Results – Construction Periods[1]

RBL Noise Level (dBA)				
Morning Shoulder	Day	Evening	Evening Shoulder	Night
50	42	39	48	33

Ambient Noise Logging Results – RNP Defined Time Periods

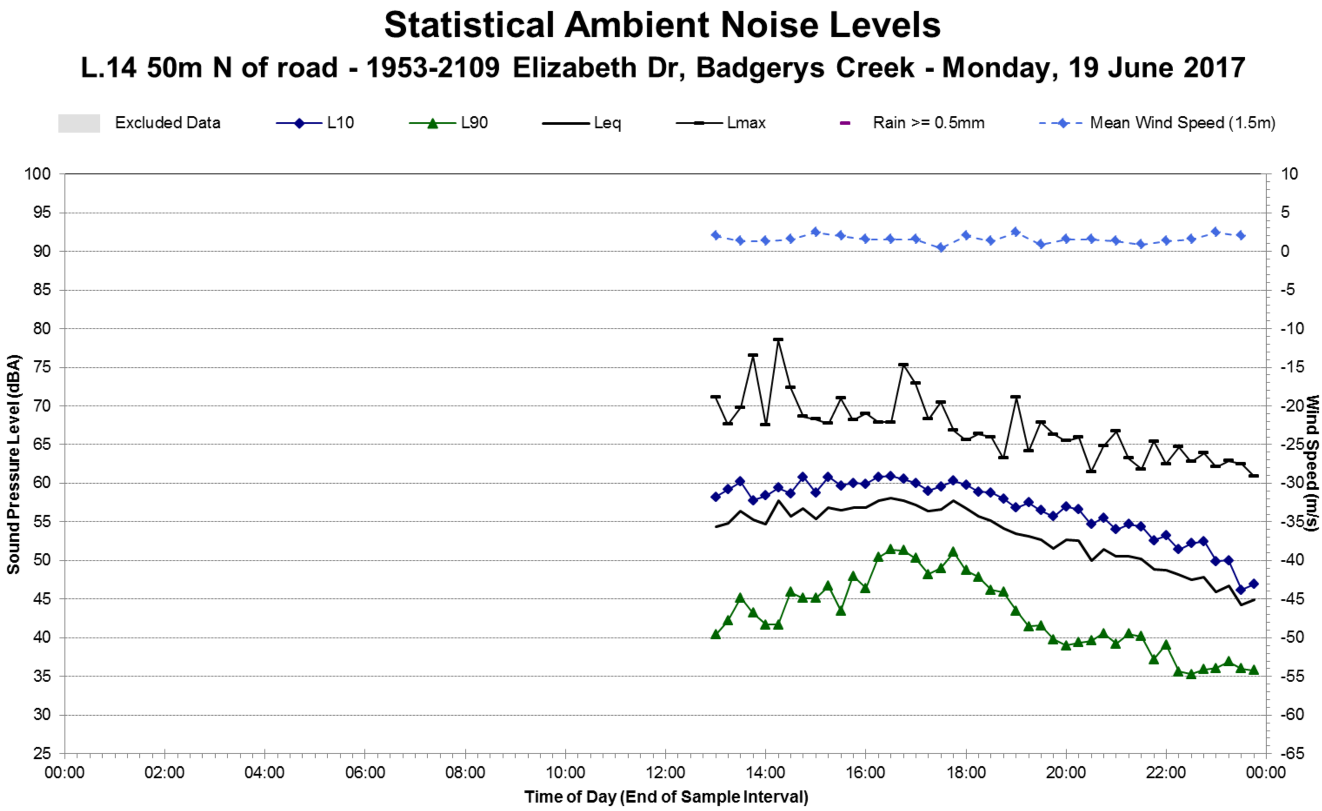
Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	55	58
Night-time (10pm-7am)	52	60

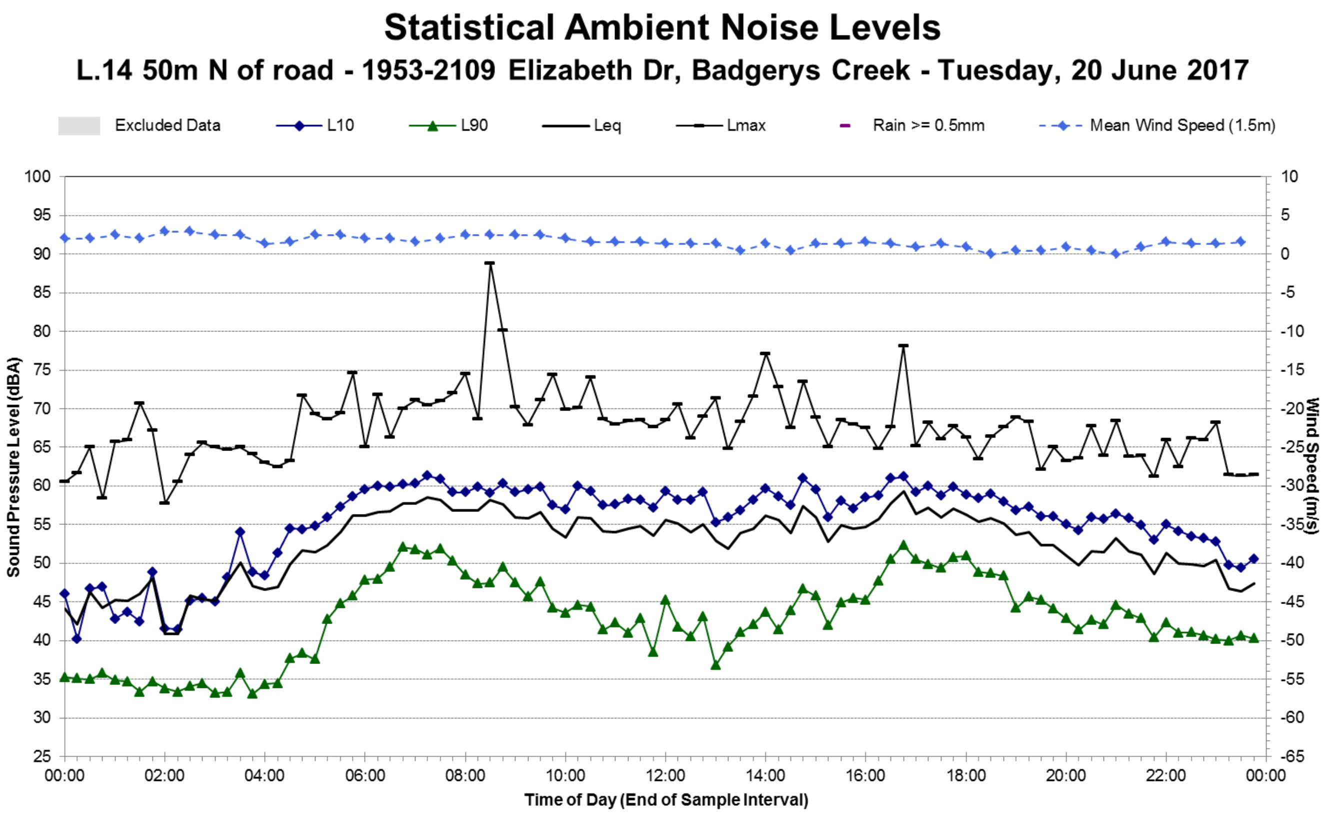
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
19/06/2017	13:08	42	55	70

Photo of Noise Monitoring Location

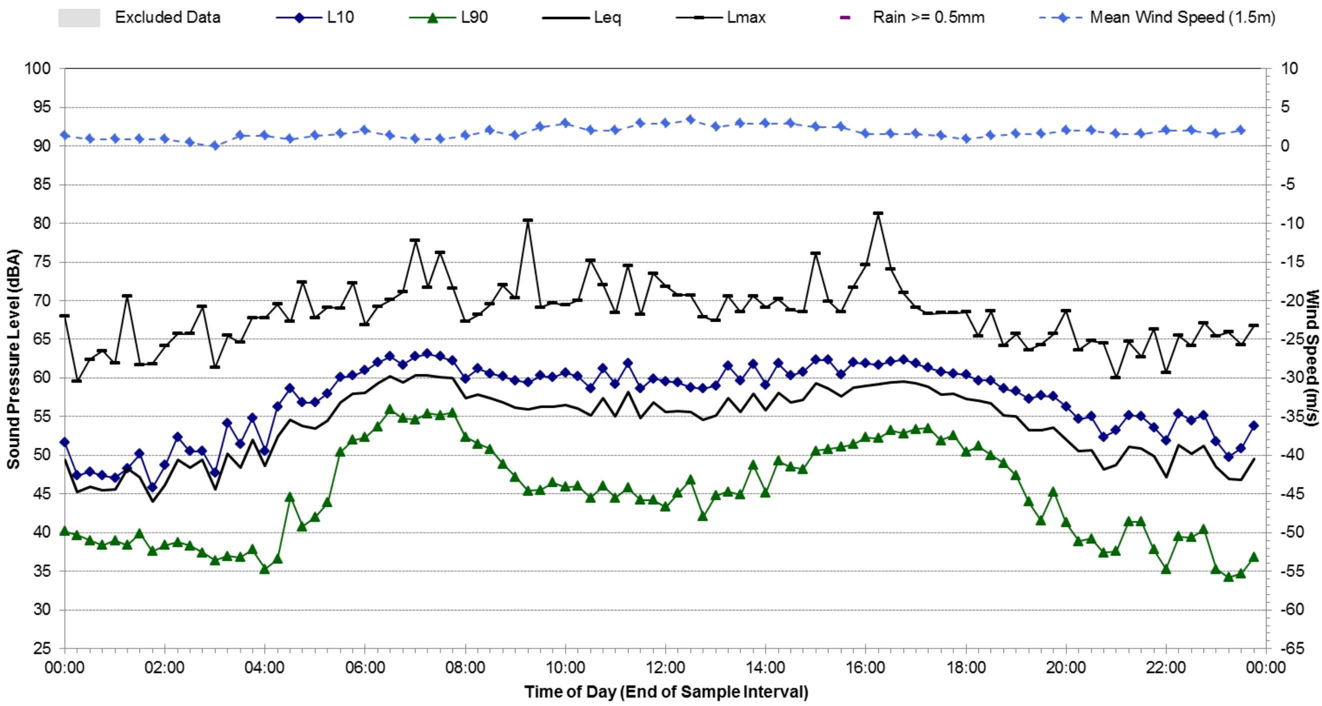
Note 1: Morning shoulder is 6 am to 7 am Monday to Friday; Daytime is 7 am to 6 pm Monday to Saturday & 8 am to 6 pm Sunday & Public Holidays; Evening is 7 pm to 10 pm Monday to Friday & 6 pm to 10 pm Saturday, Sunday & Public Holidays; Evening shoulder is 6 pm to 7 pm Monday to Friday; Night-time is 10 pm to 6 am Monday to Friday, 10 pm to 7 am Saturday & 10 pm to 8 am Sunday and Public Holidays.


Statistical Ambient Noise Levels
L.14 50m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Monday, 19 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.14 50m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Tuesday, 20 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

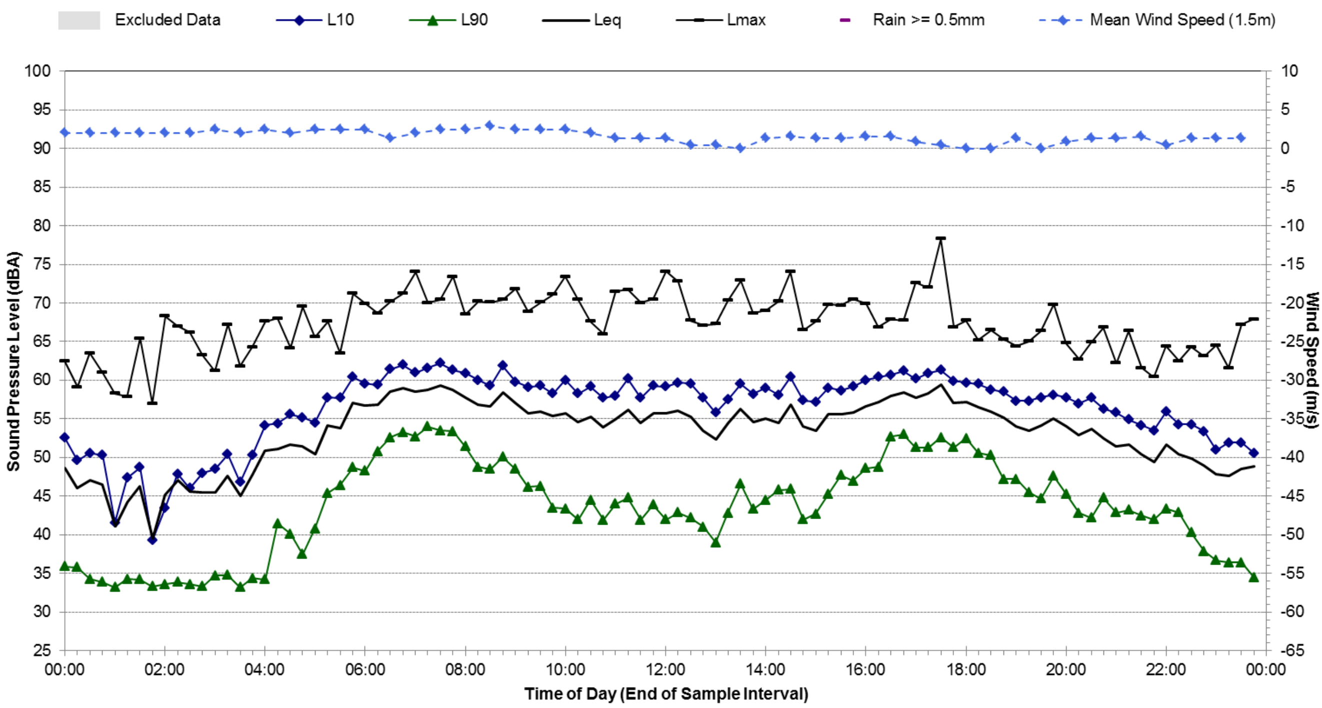
Statistical Ambient Noise Levels

L.14 50m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Wednesday, 21 June 2017



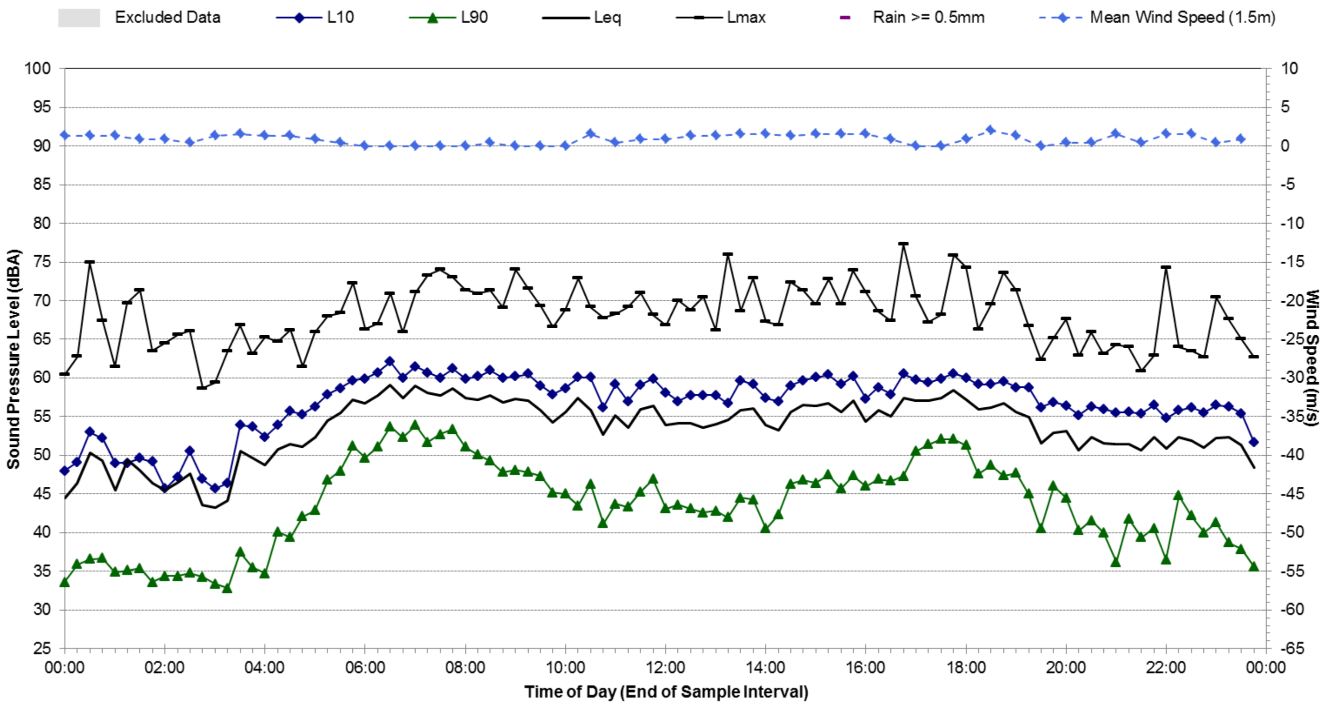
Statistical Ambient Noise Levels

L.14 50m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Thursday, 22 June 2017



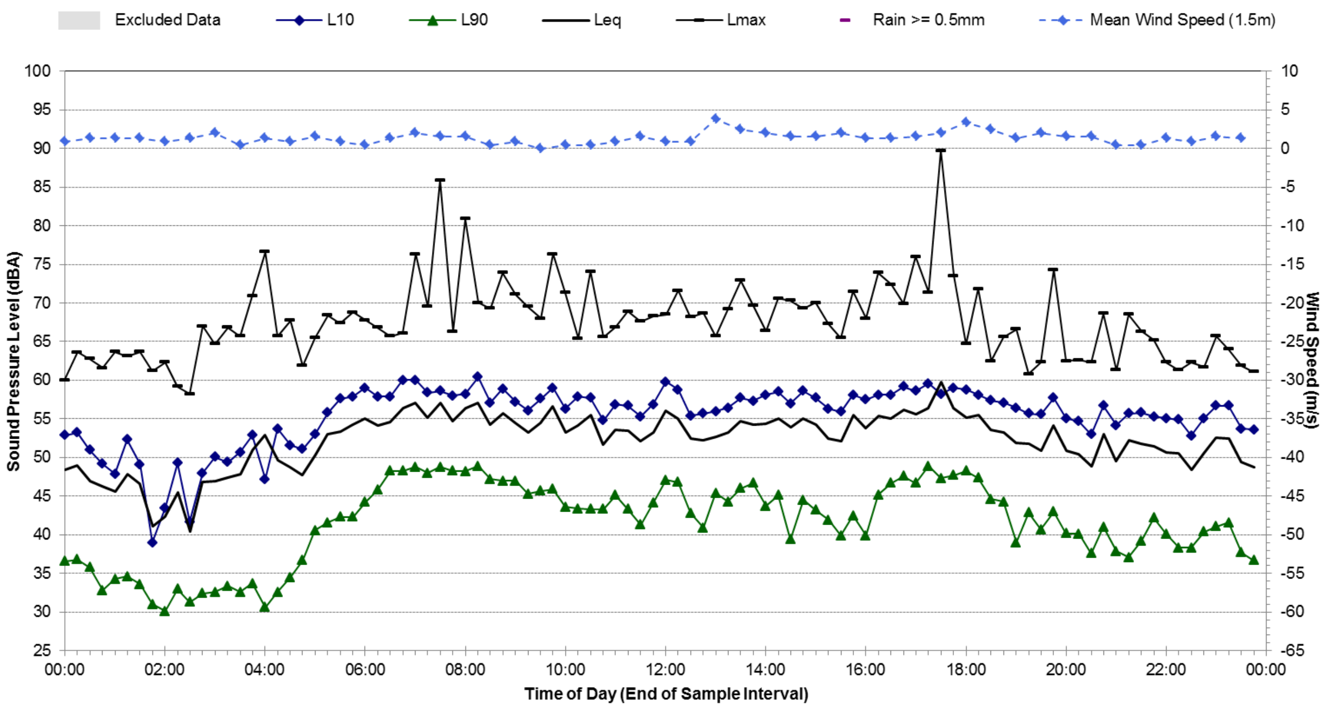
Statistical Ambient Noise Levels

L.14 50m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Friday, 23 June 2017



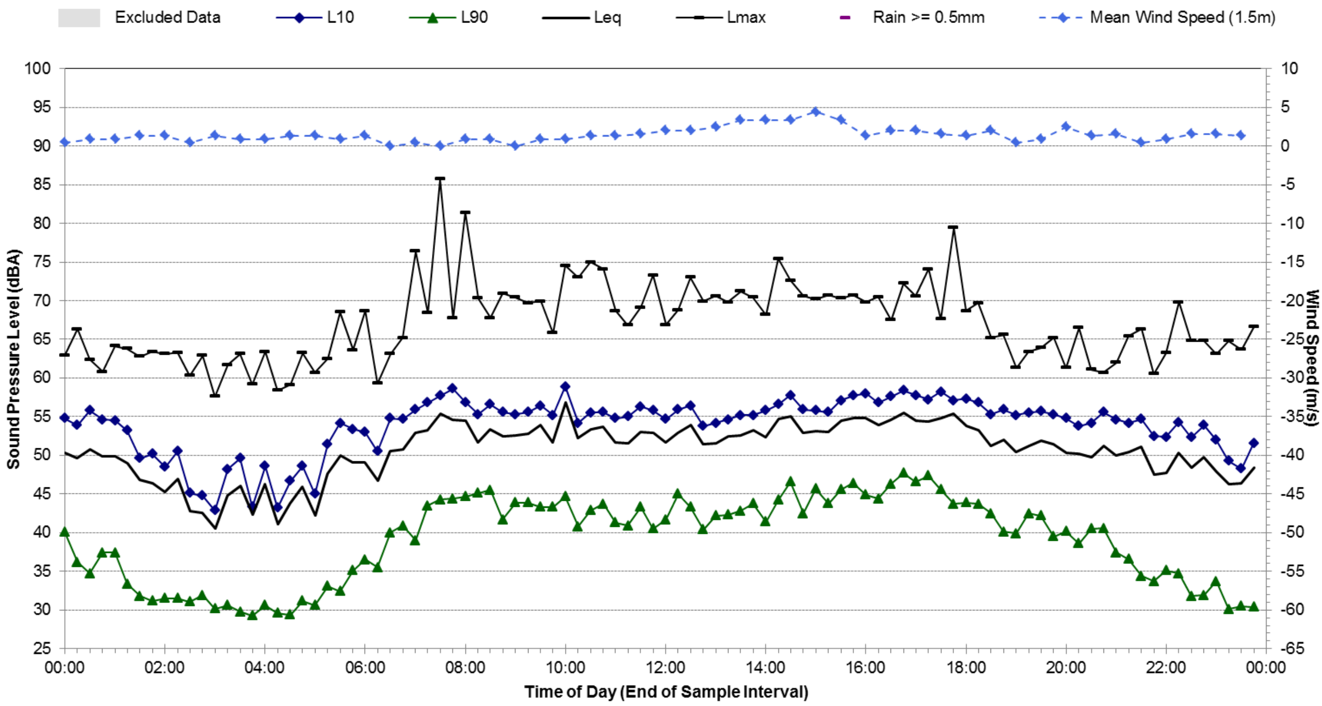
Statistical Ambient Noise Levels

L.14 50m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Saturday, 24 June 2017



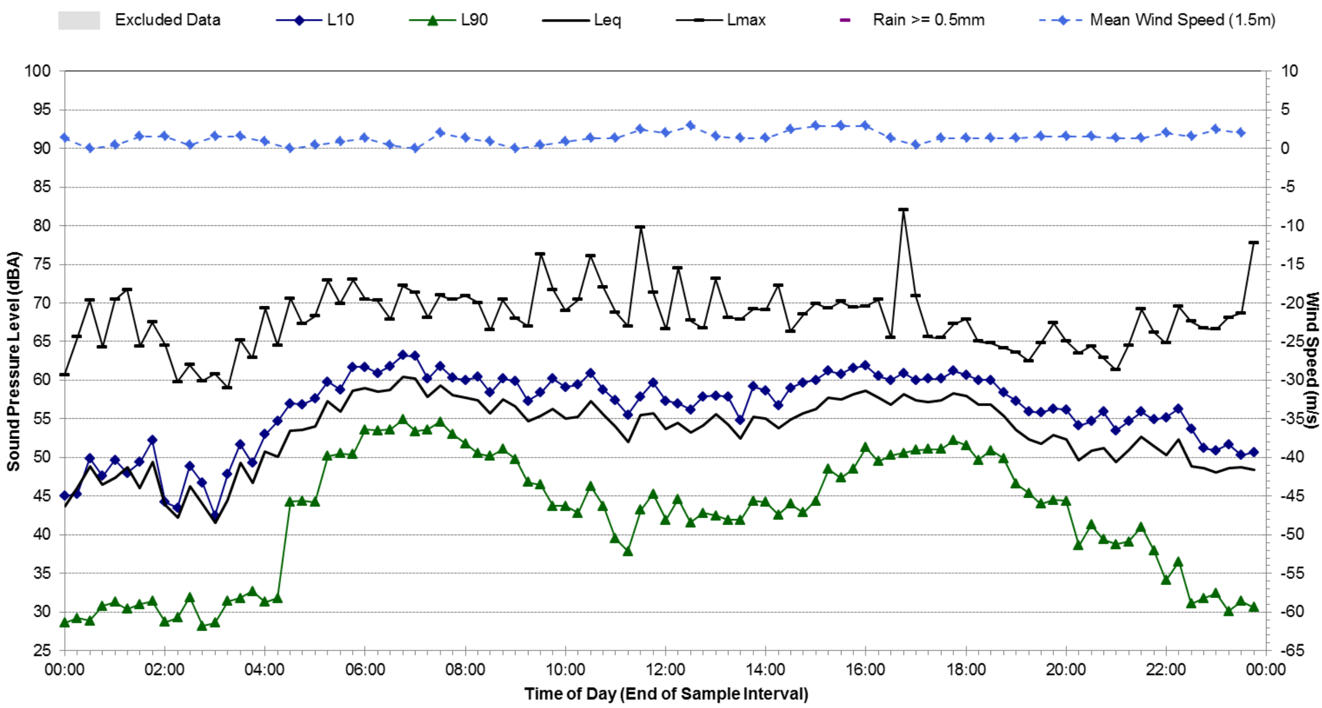
Statistical Ambient Noise Levels

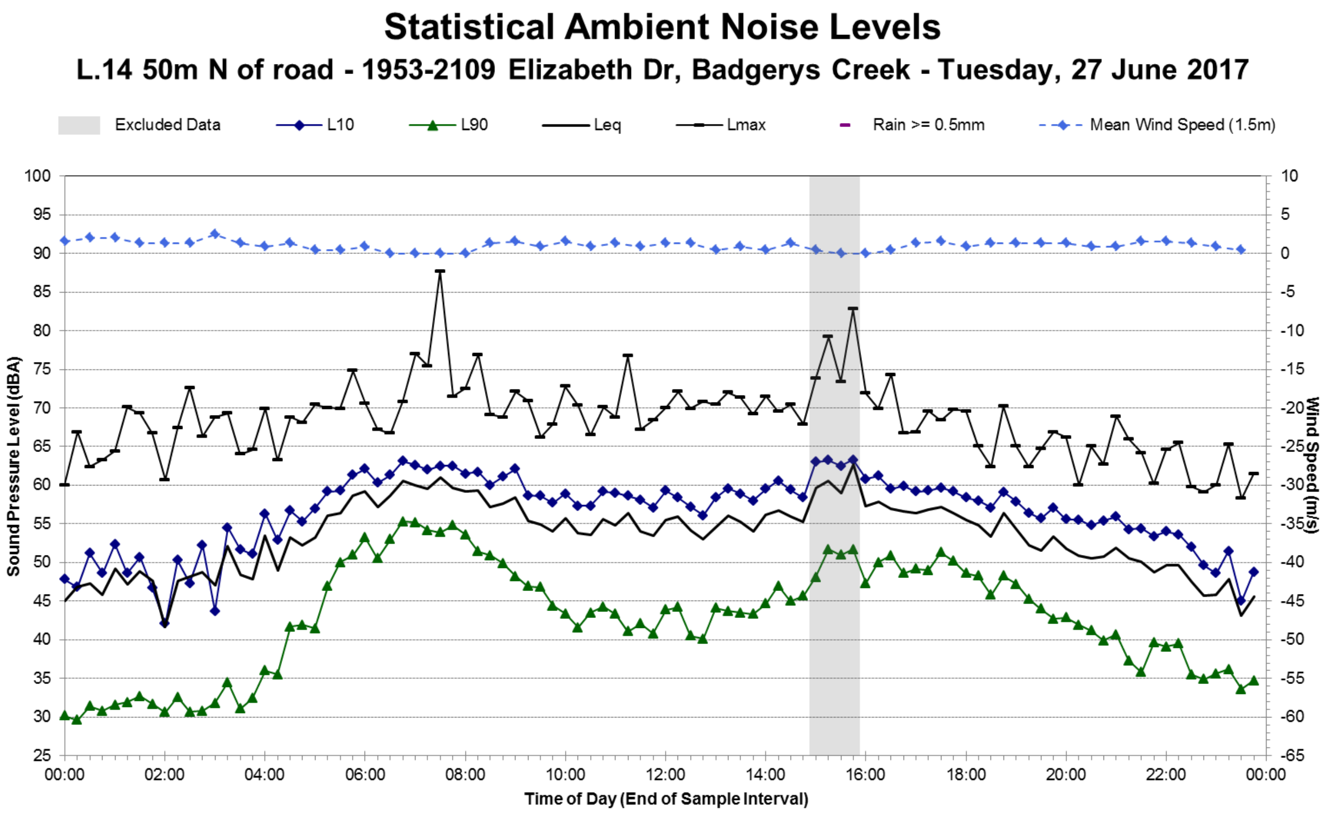
L.14 50m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Sunday, 25 June 2017

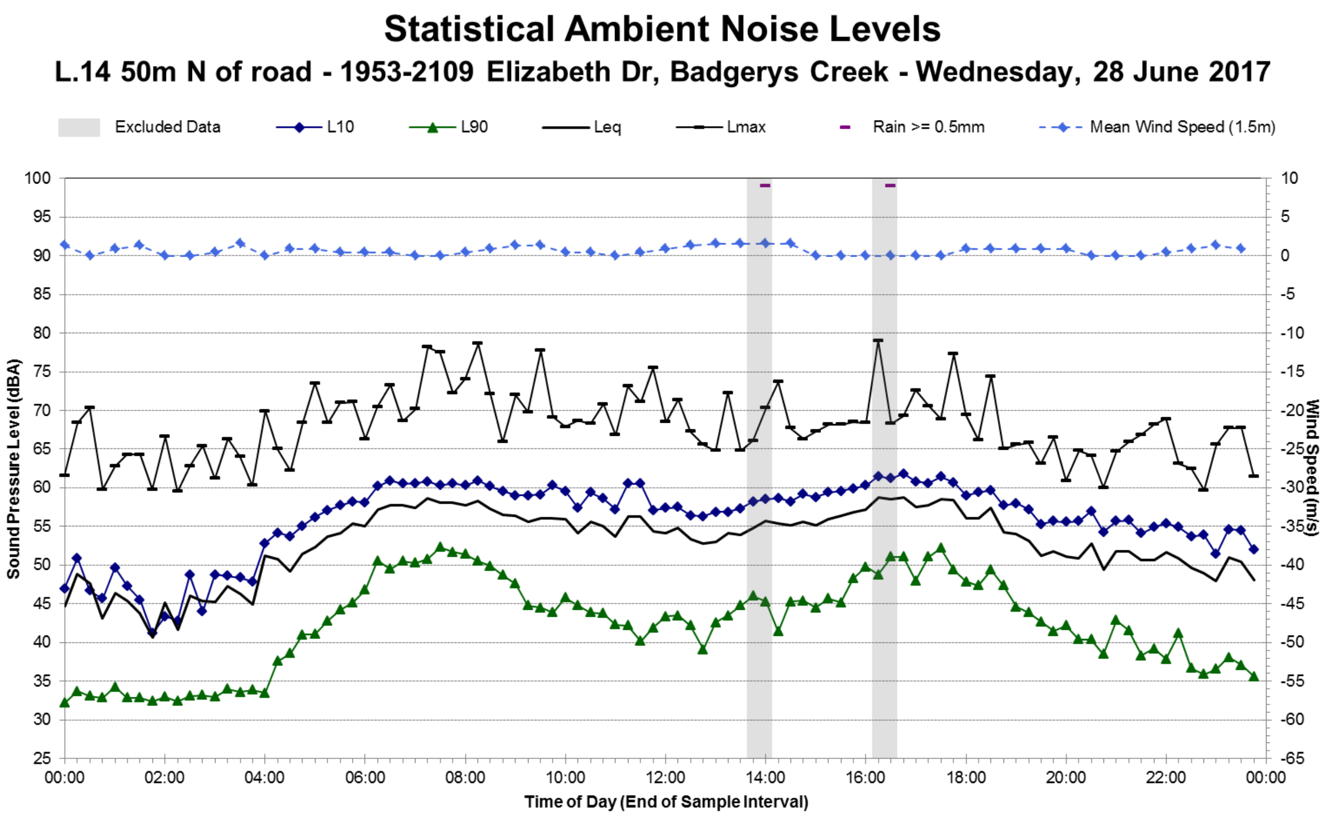


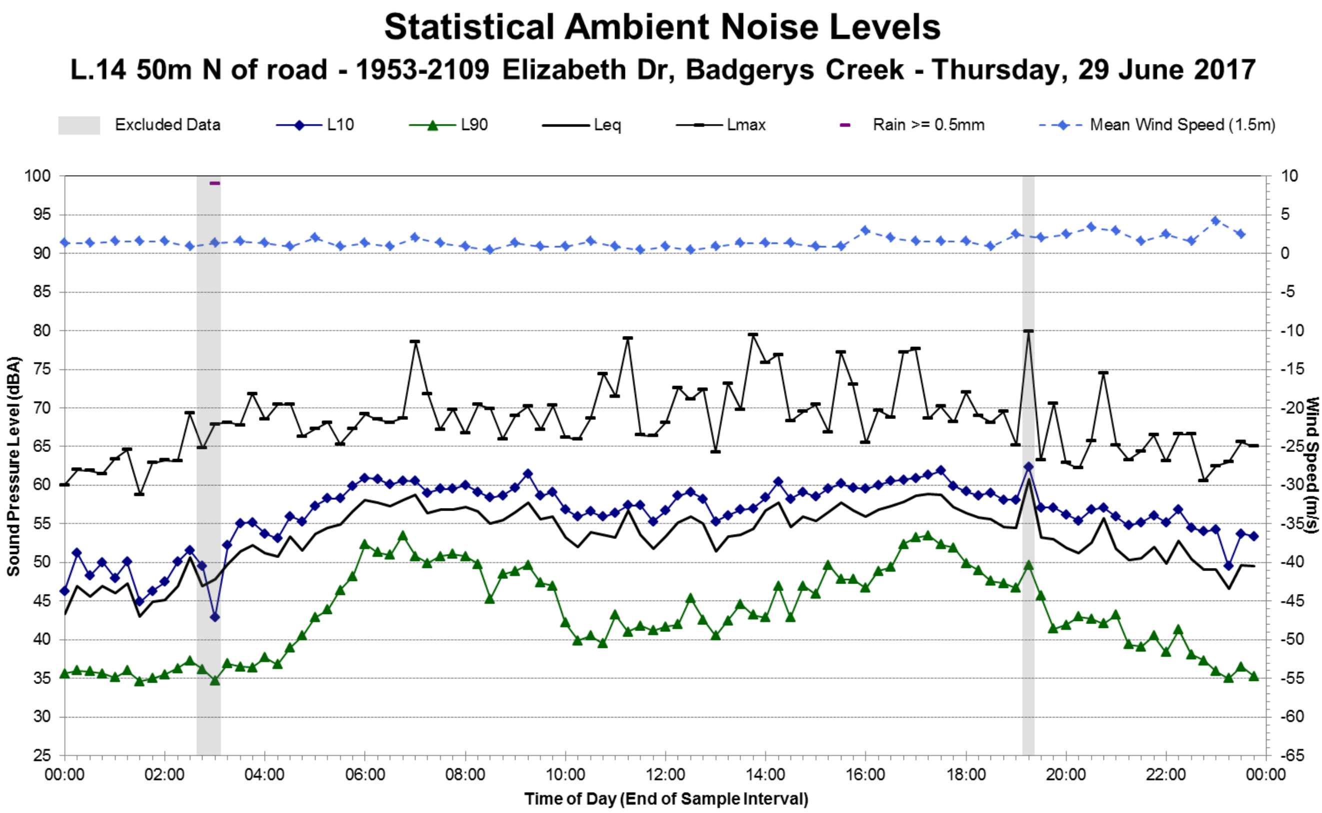
Statistical Ambient Noise Levels

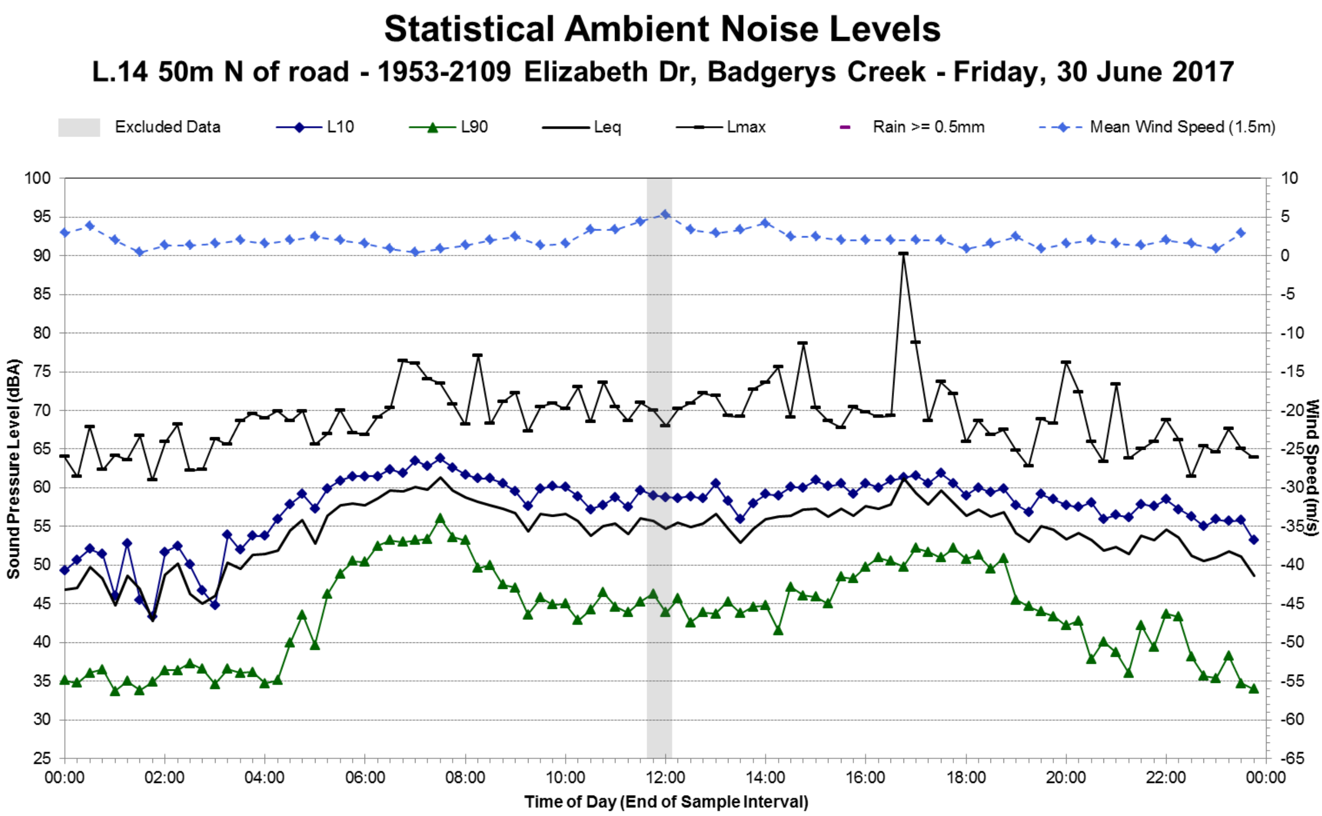
L.14 50m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Monday, 26 June 2017

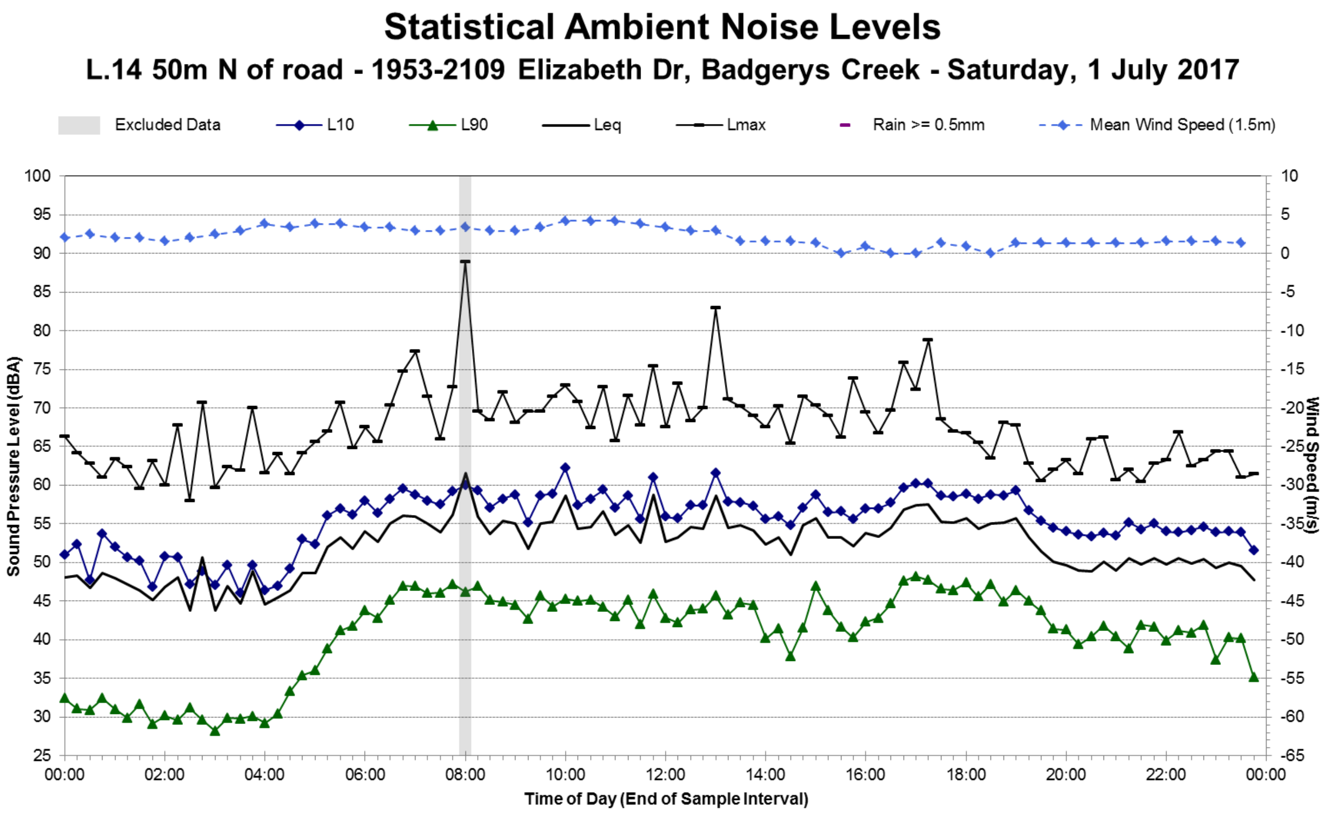


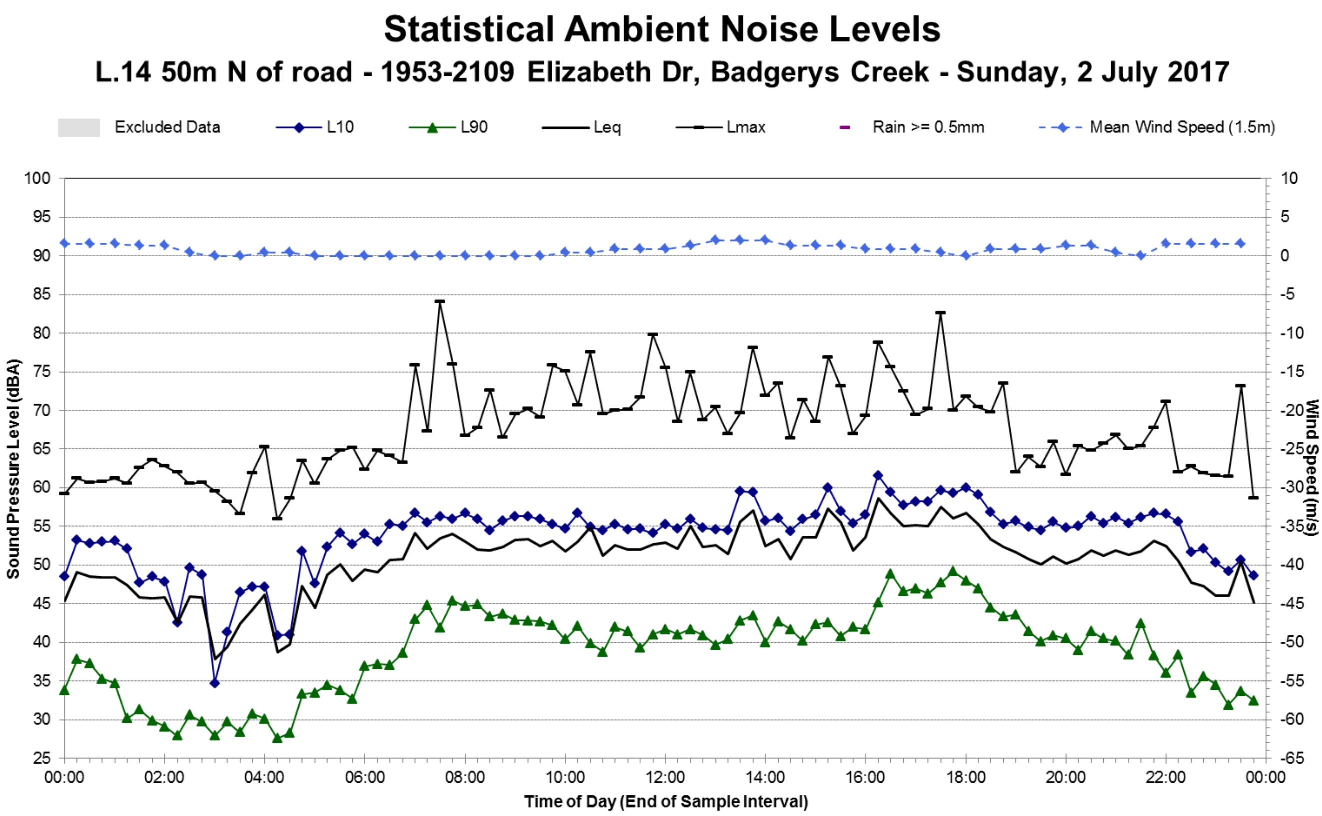

Statistical Ambient Noise Levels
L.14 50m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Tuesday, 27 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

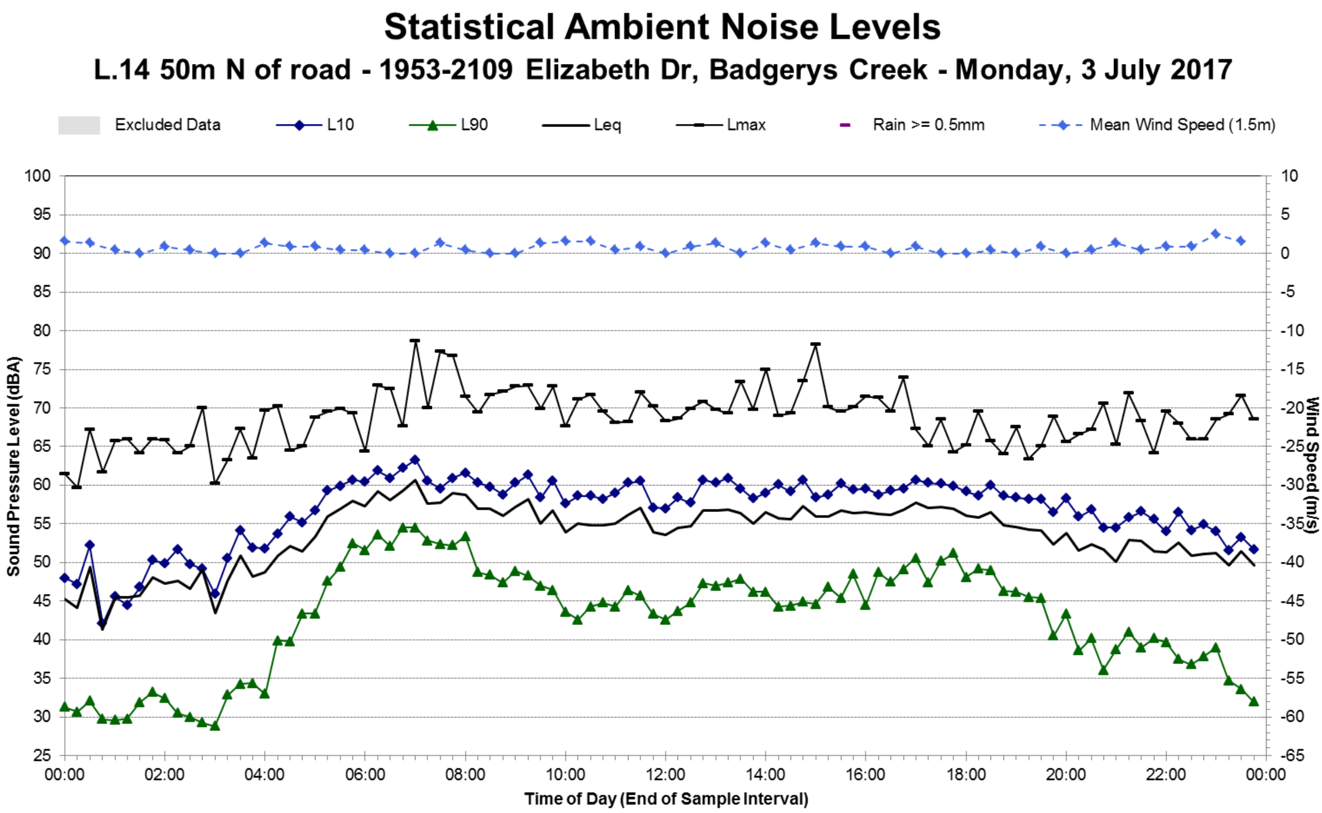

Statistical Ambient Noise Levels
L.14 50m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Wednesday, 28 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.14 50m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Thursday, 29 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

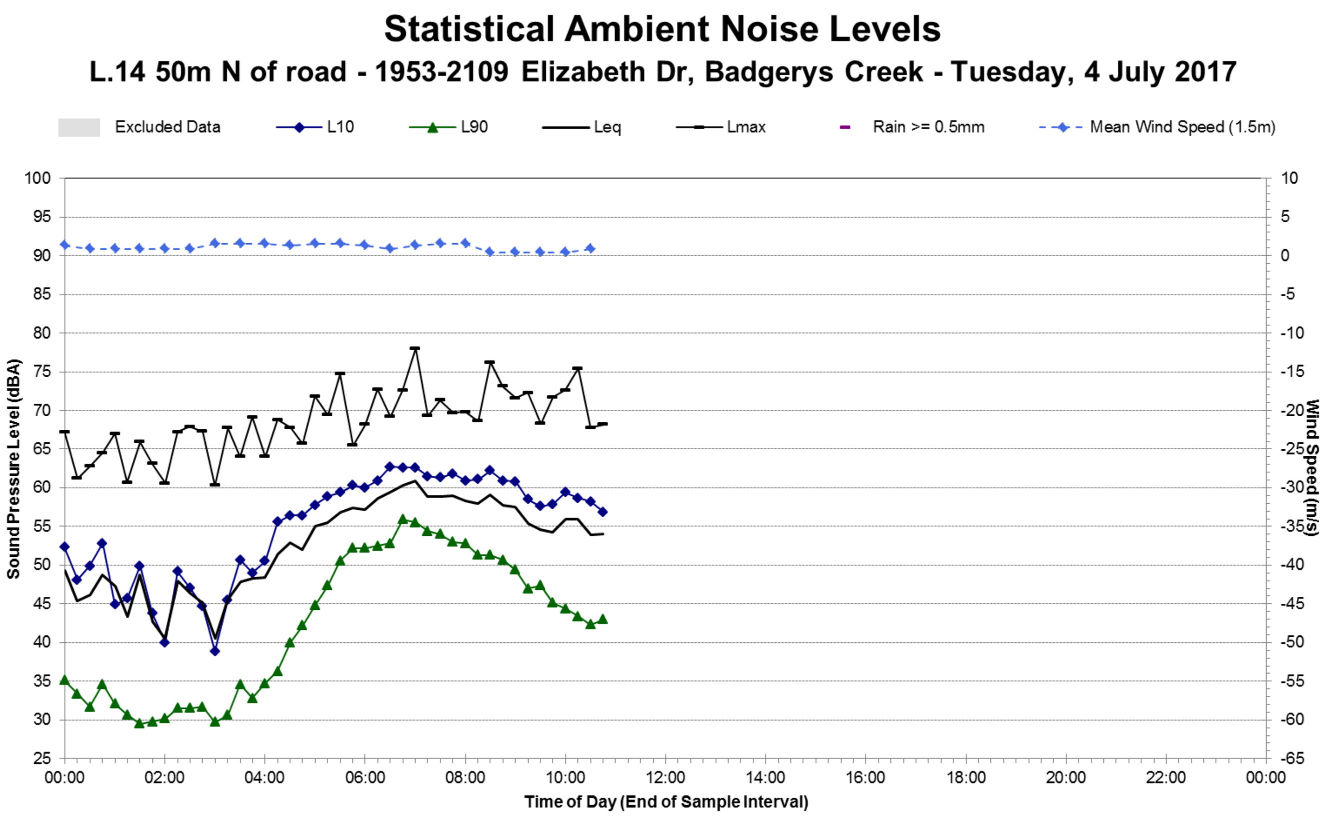

Statistical Ambient Noise Levels
L.14 50m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Friday, 30 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.14 50m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Saturday, 1 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.14 50m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Sunday, 2 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
L.14 50m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Monday, 3 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
L.14 50m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Tuesday, 4 July 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Noise Monitoring Location	L.15
Noise Monitoring Address	150m N of Elizabeth Dr - 1953-2109 Elizabeth Drive, Badgerys Creek

Logger Device Type: ARL EL-316, Logger Serial No: 16-207-044

Sound Level Meter Device Type: Brüel and Kjær 2260i, Sound Level Meter Serial No: 2414605

Ambient noise logger deployed at residential address 1953-2109 Elizabeth Drive, Badgerys Creek. Logger located approximately 150 m north of Elizabeth Drive.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from Elizabeth Drive. Noise from light aircraft and wildlife (ie birds) also contributes to the LAeq at this location.

Recorded Noise Levels: (LAmax):

19/06/2017: Road traffic: 48-62 dBA, Light aircraft: 43-57 dBA, Birds: 43-51 dBA

Map of Noise Monitoring Location

Ambient Noise Logging Results – Construction Periods[1]

RBL Noise Level (dBA)				
Morning Shoulder	**Day**	**Evening**	**Evening Shoulder**	**Night**
50	39	40	47	34

Ambient Noise Logging Results – RNP Defined Time Periods

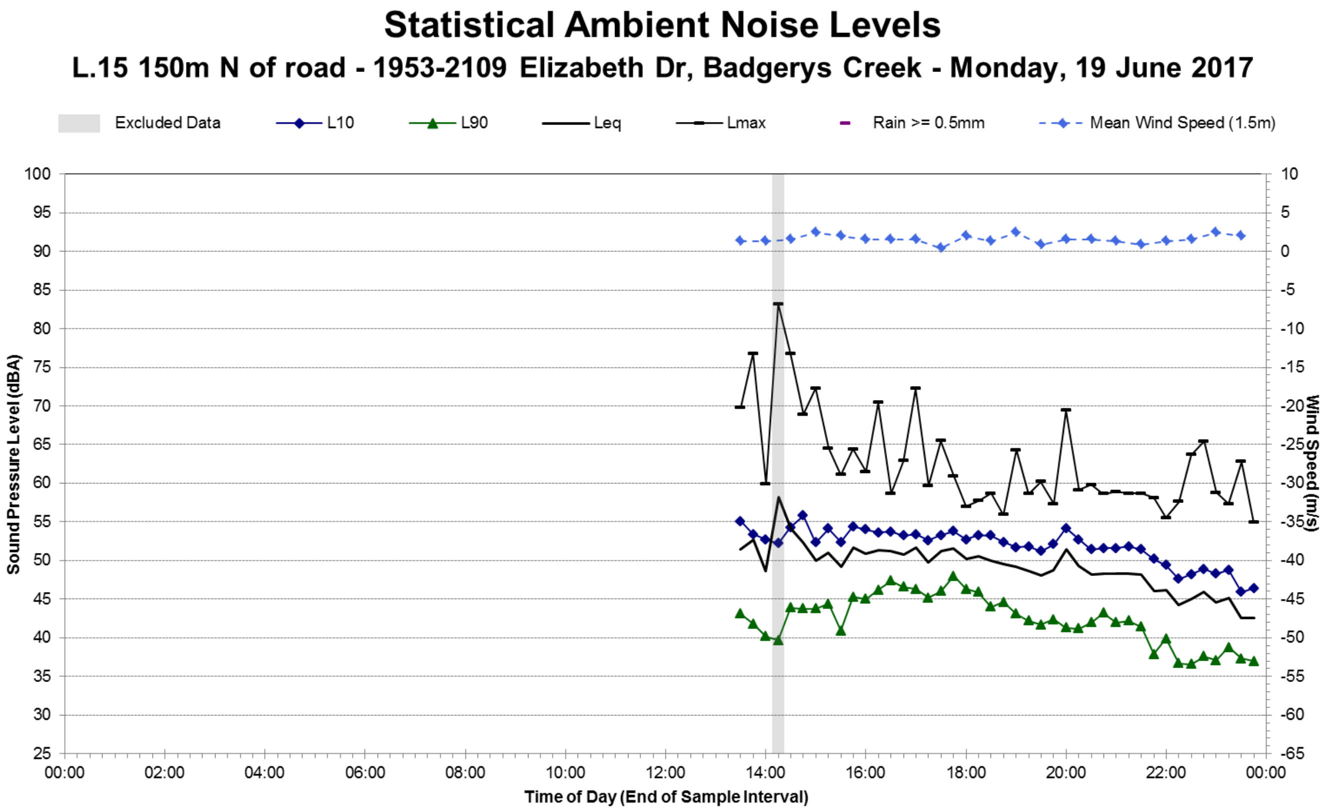
Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	52	54
Night-time (10pm-7am)	49	56

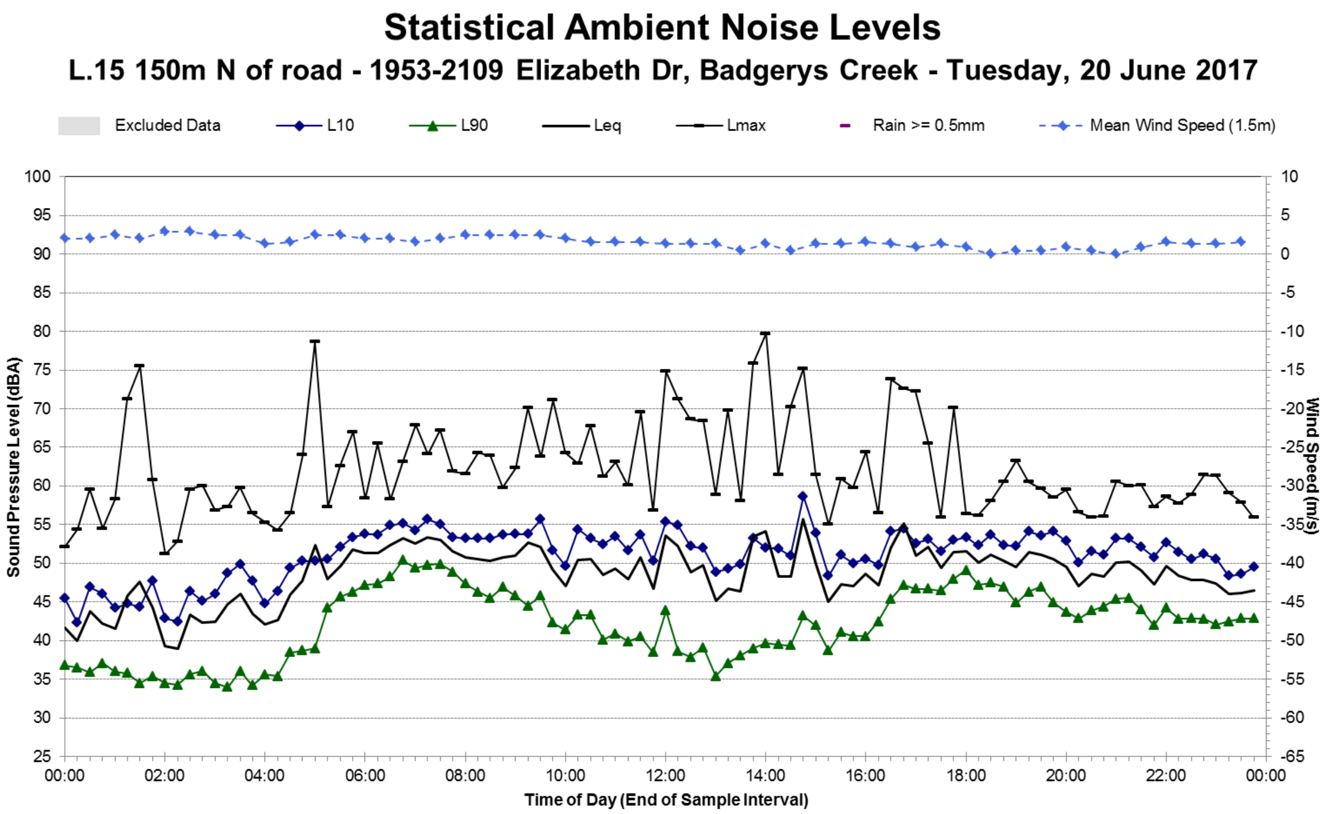
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
19/06/2017	13:41	39	48	62

Photo of Noise Monitoring Location

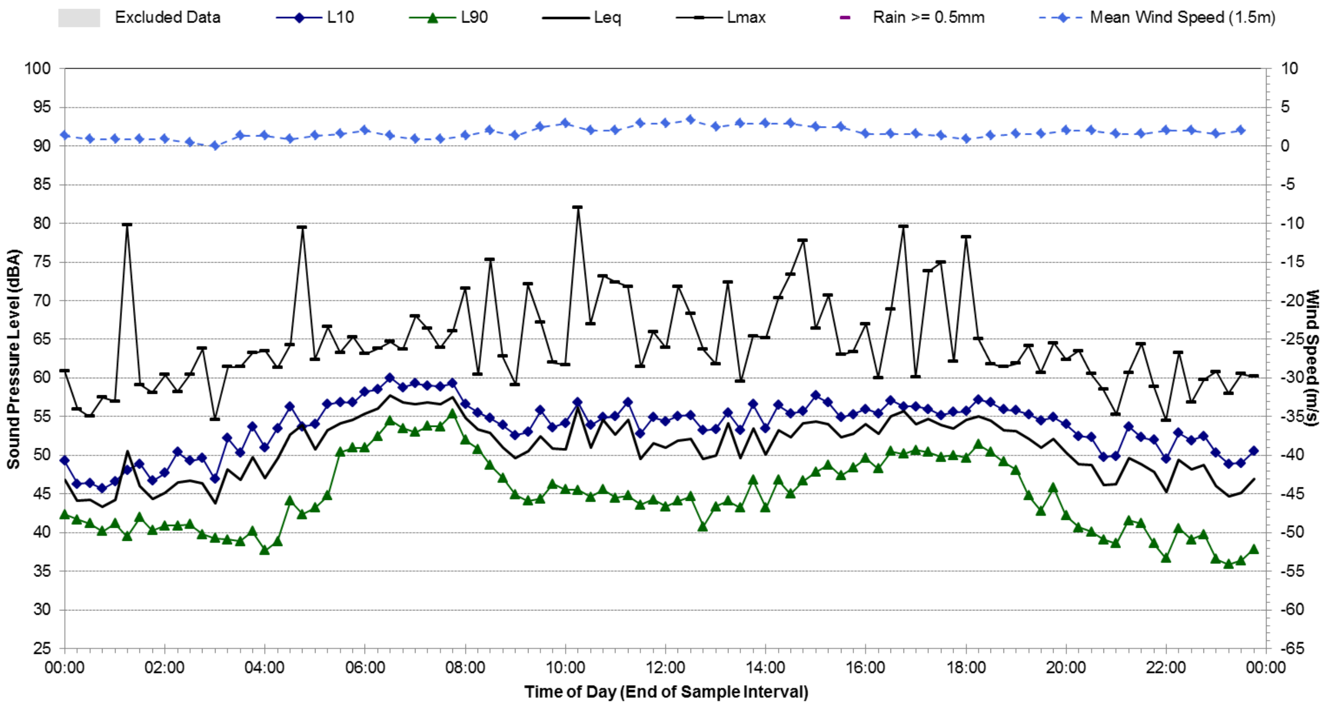
Note 1: Morning shoulder is 6 am to 7 am Monday to Friday; Daytime is 7 am to 6 pm Monday to Saturday & 8 am to 6 pm Sunday & Public Holidays; Evening is 7 pm to 10 pm Monday to Friday & 6 pm to 10 pm Saturday, Sunday & Public Holidays; Evening shoulder is 6 pm to 7 pm Monday to Friday; Night-time is 10 pm to 6 am Monday to Friday, 10 pm to 7 am Saturday & 10 pm to 8 am Sunday and Public Holidays.


Statistical Ambient Noise Levels
L.15 150m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Monday, 19 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.15 150m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Tuesday, 20 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

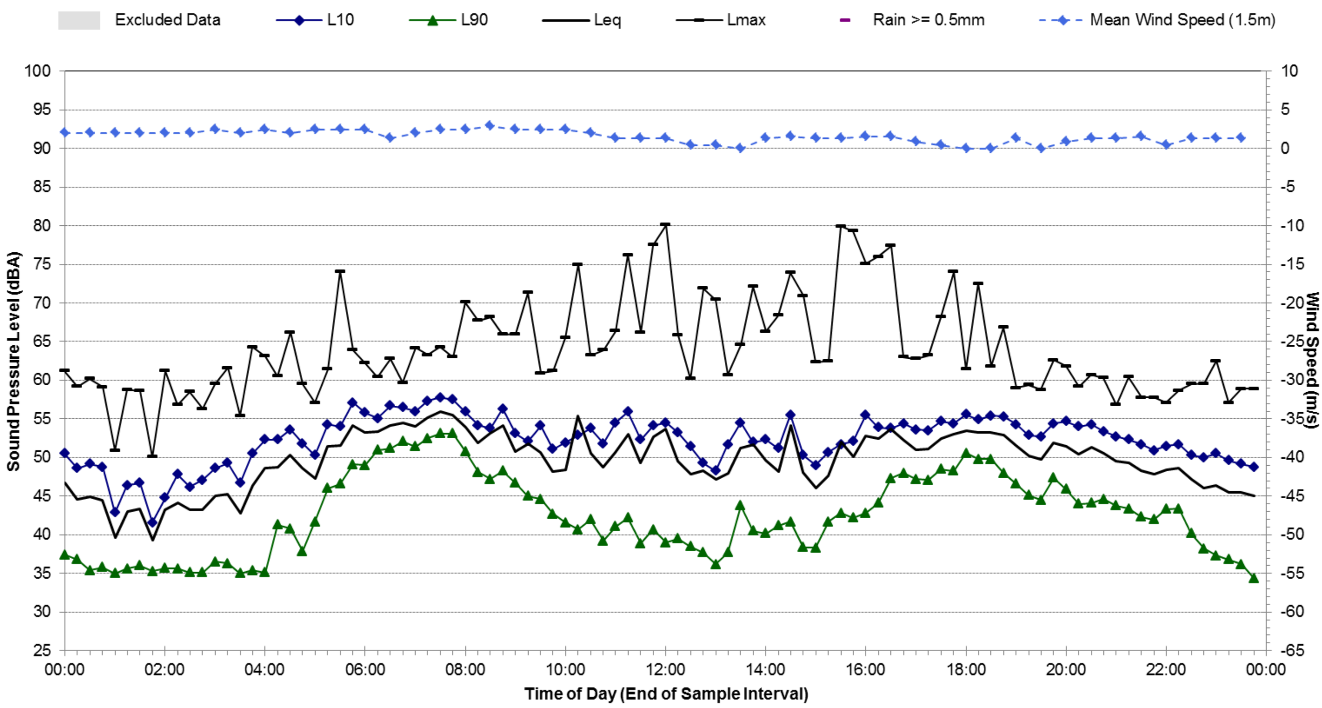
Statistical Ambient Noise Levels

L.15 150m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Wednesday, 21 June 2017

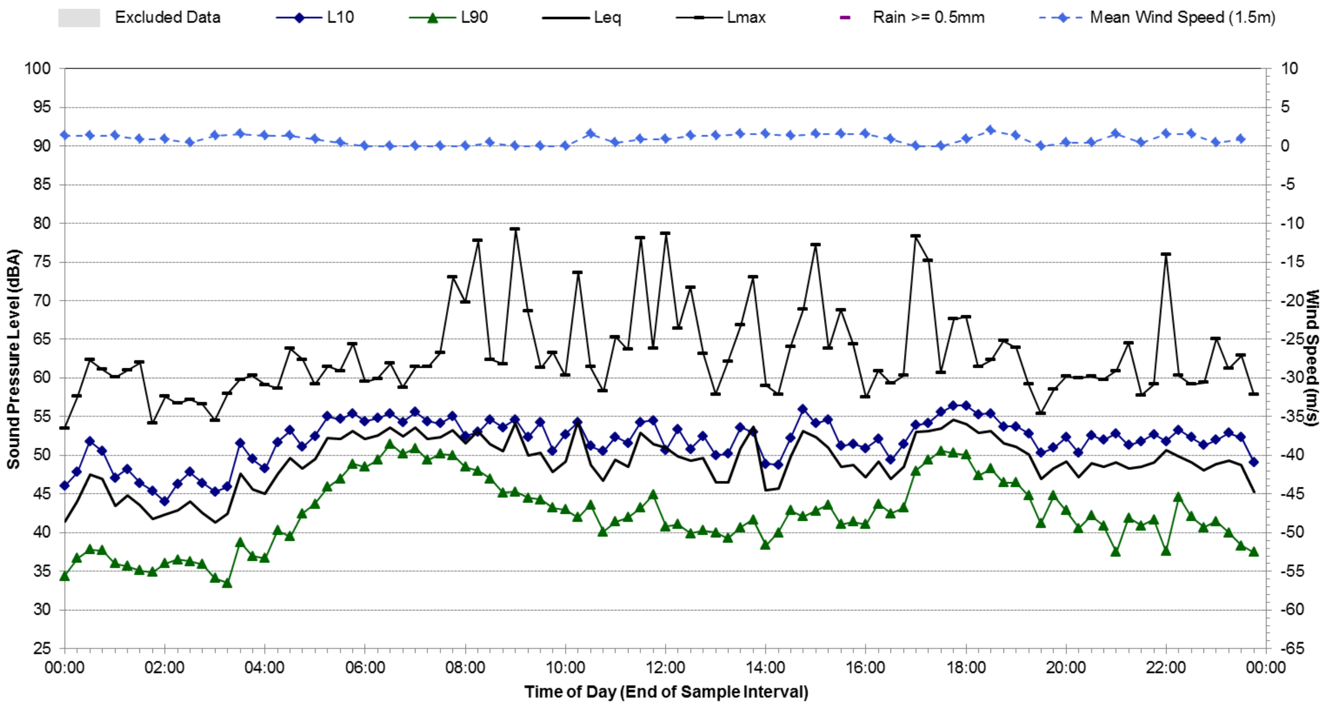


Statistical Ambient Noise Levels

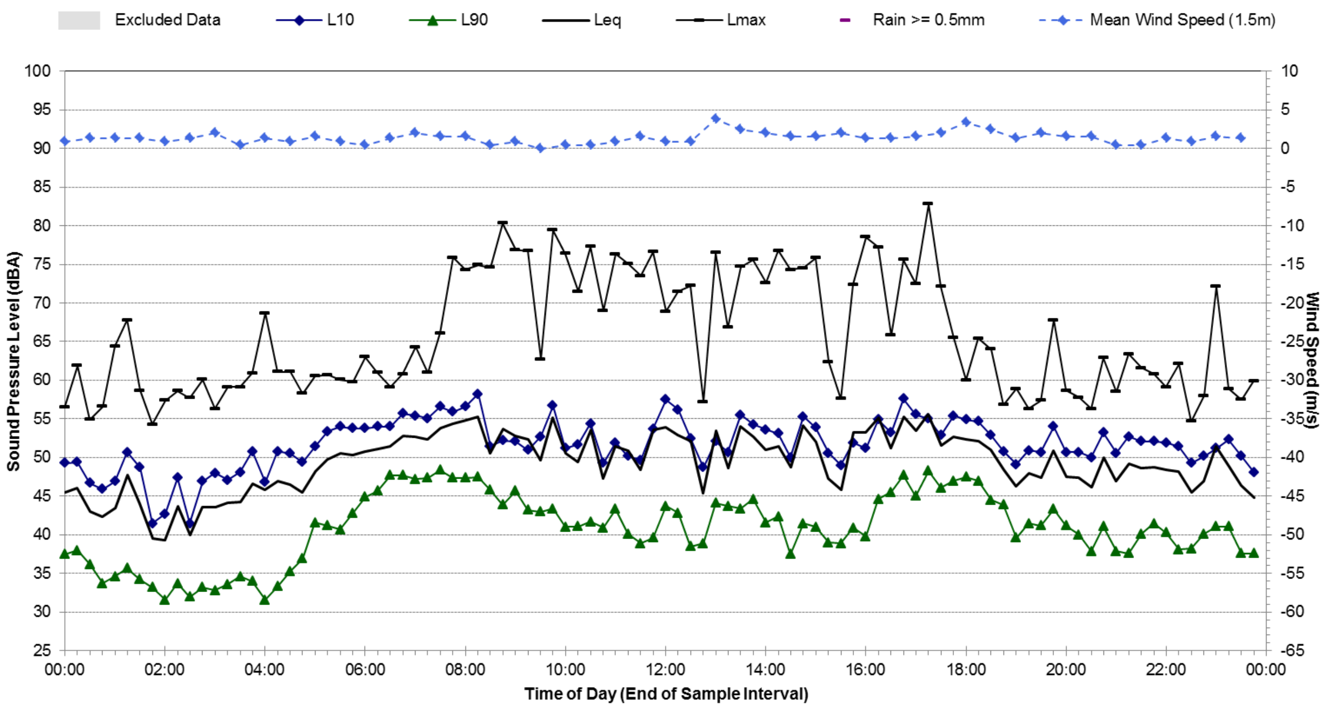
L.15 150m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Thursday, 22 June 2017



Statistical Ambient Noise Levels
L.15 150m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Friday, 23 June 2017

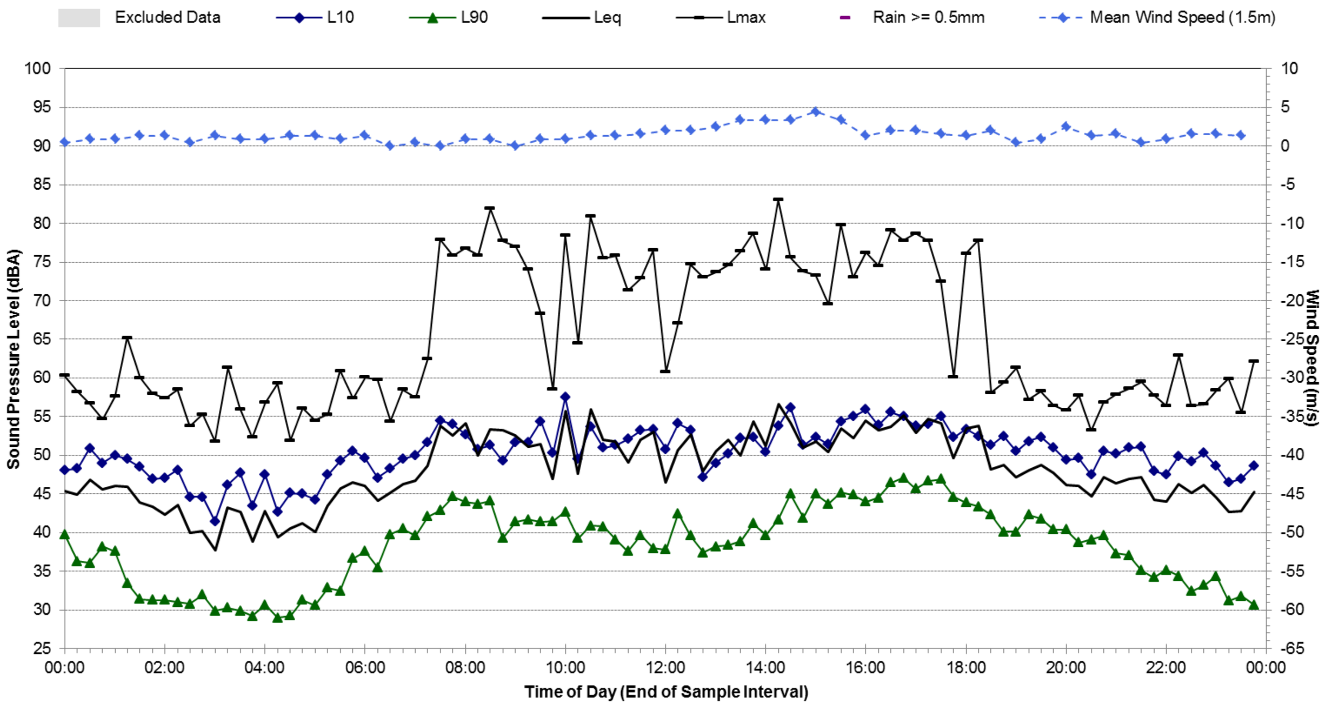


Statistical Ambient Noise Levels
L.15 150m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Saturday, 24 June 2017



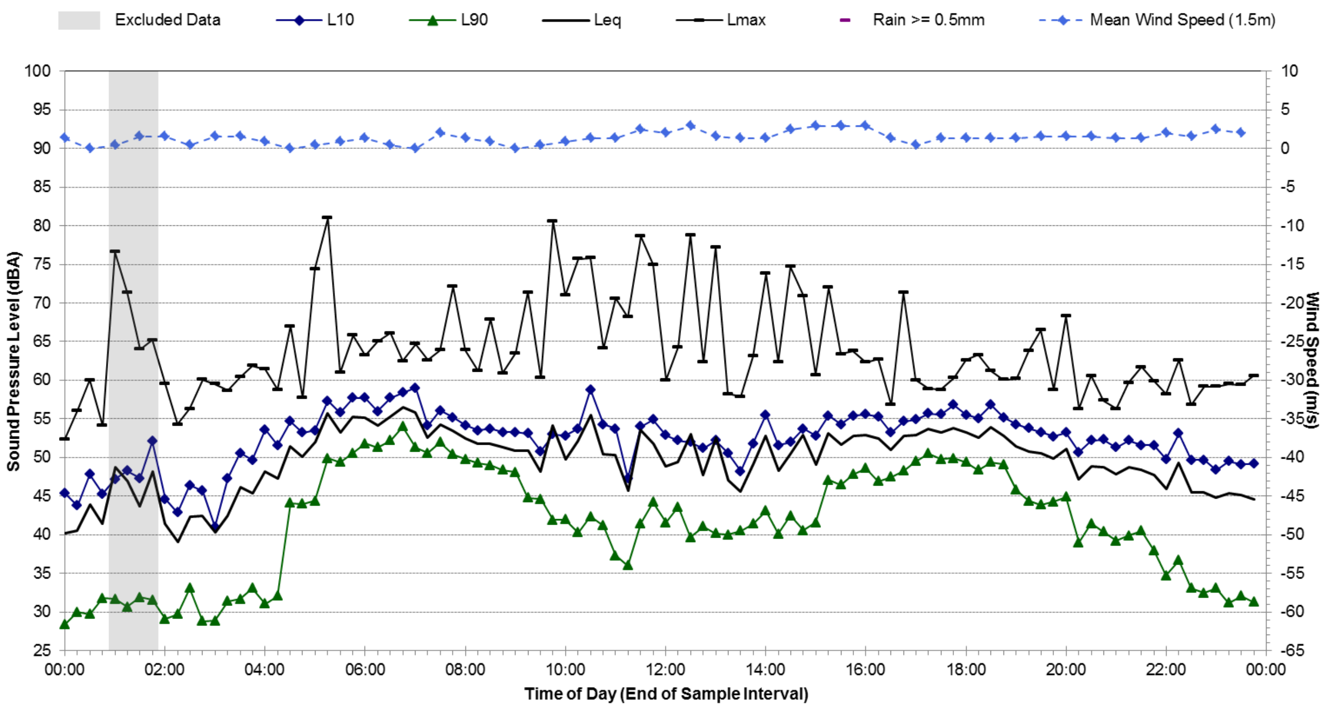
Statistical Ambient Noise Levels

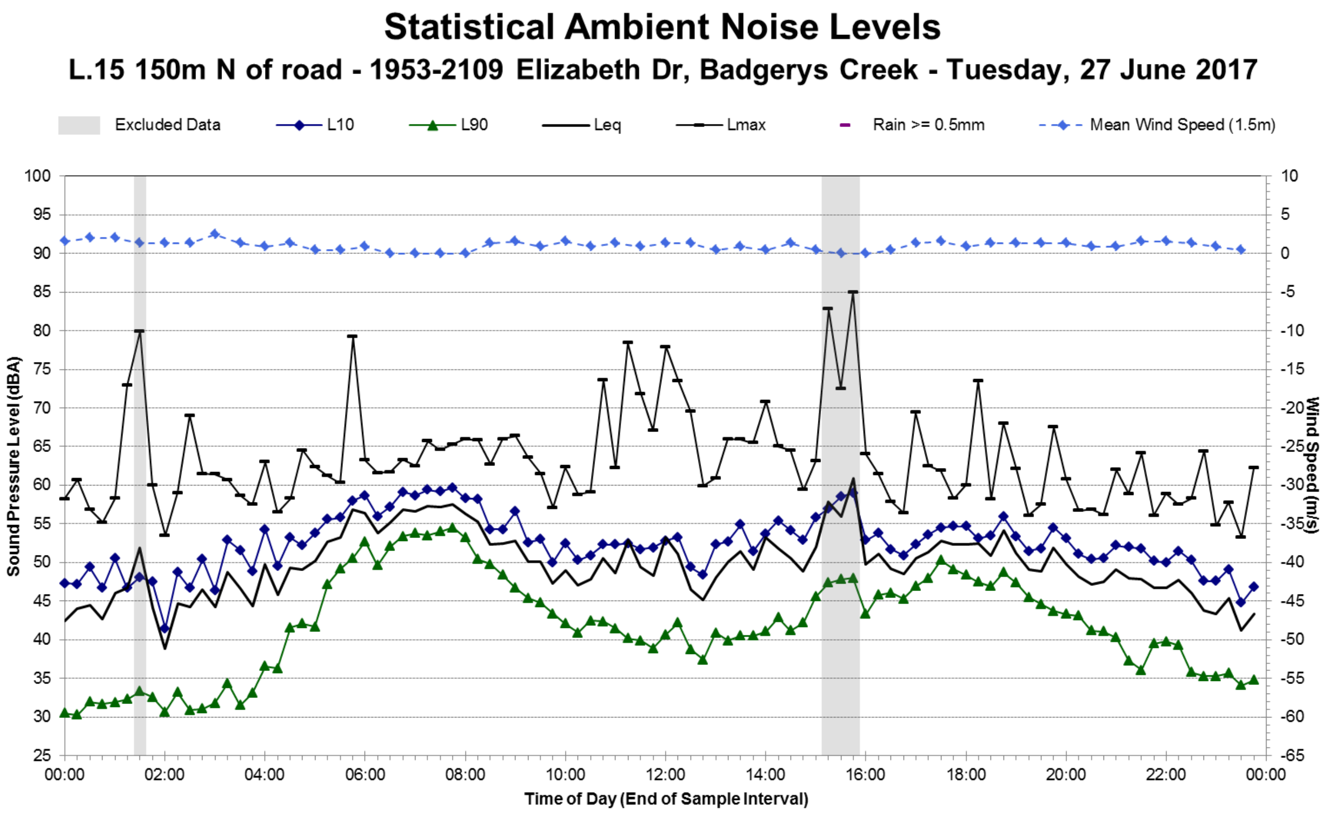
L.15 150m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Sunday, 25 June 2017

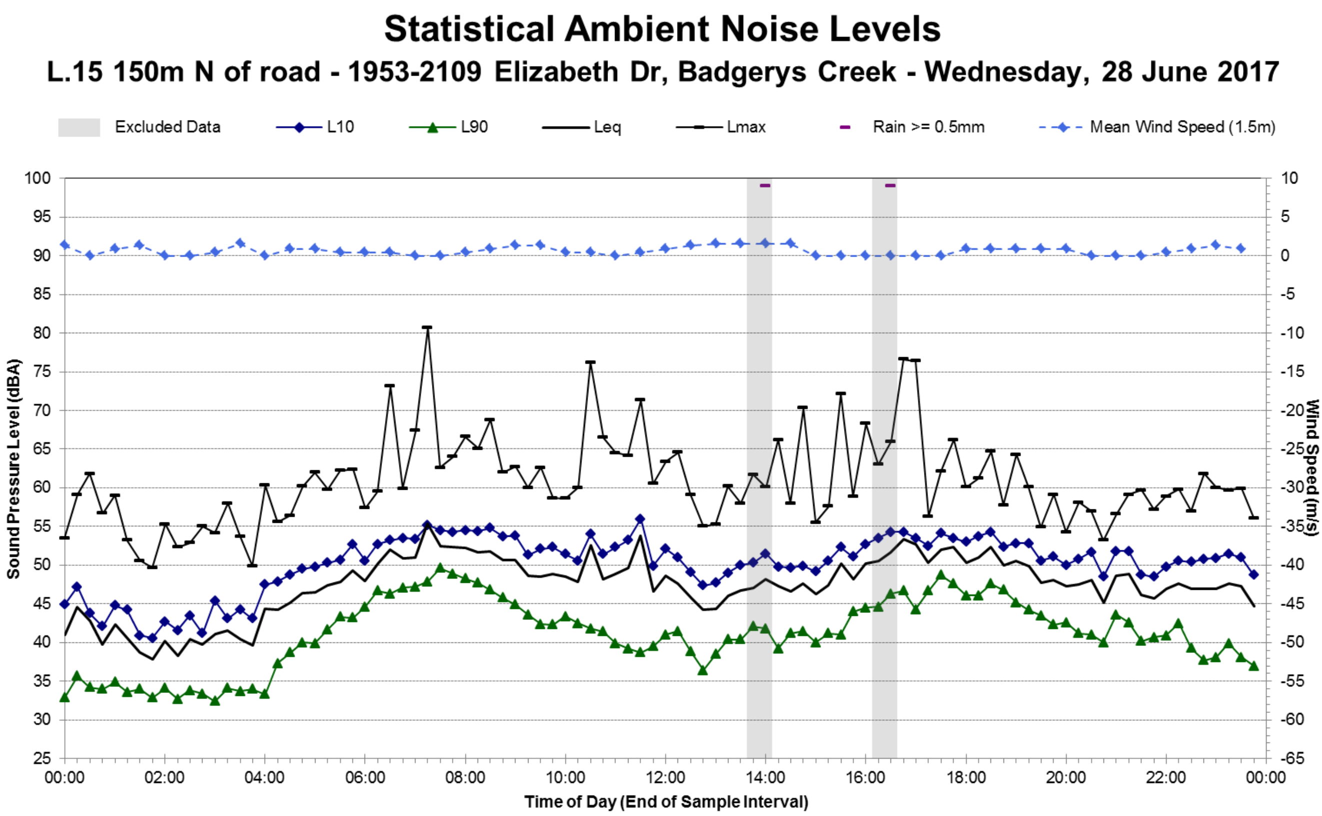


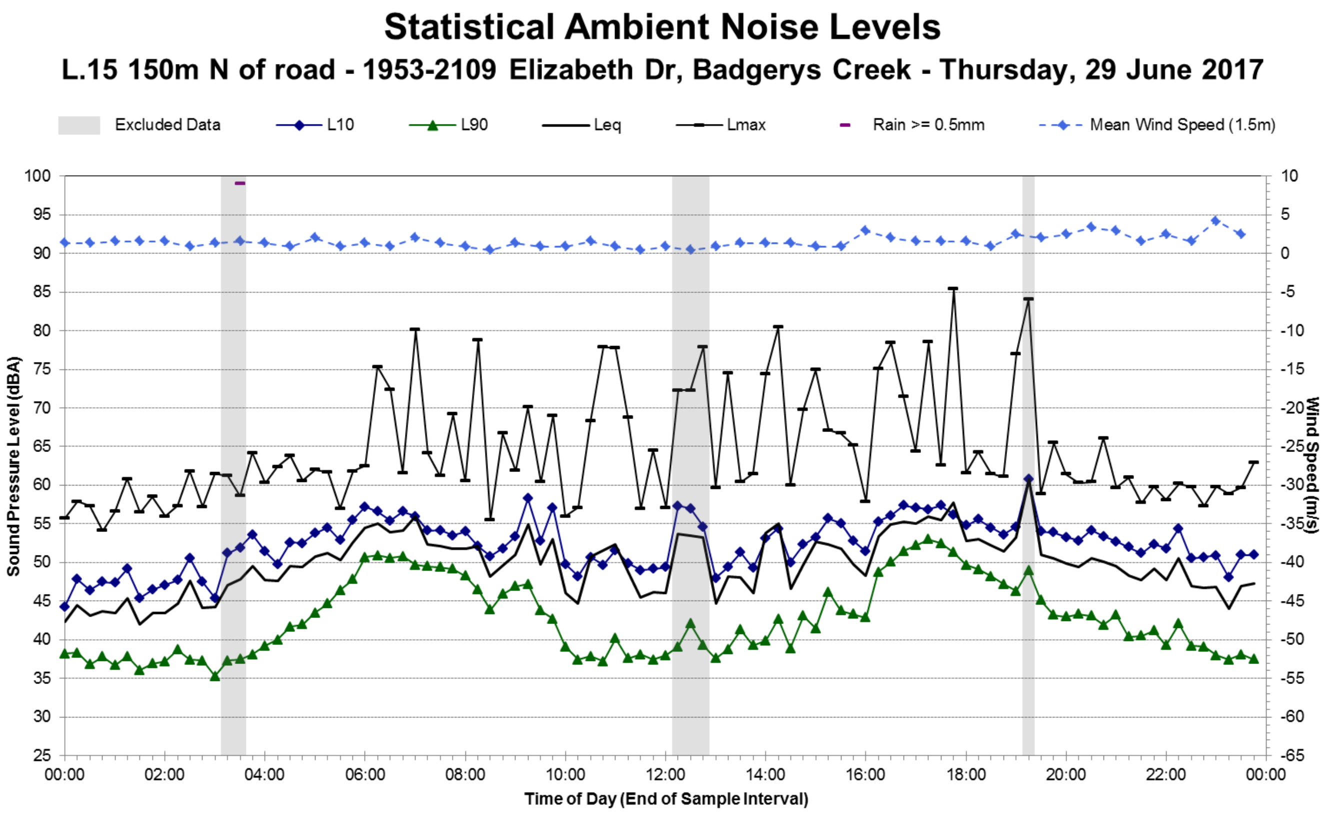
Statistical Ambient Noise Levels

L.15 150m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Monday, 26 June 2017

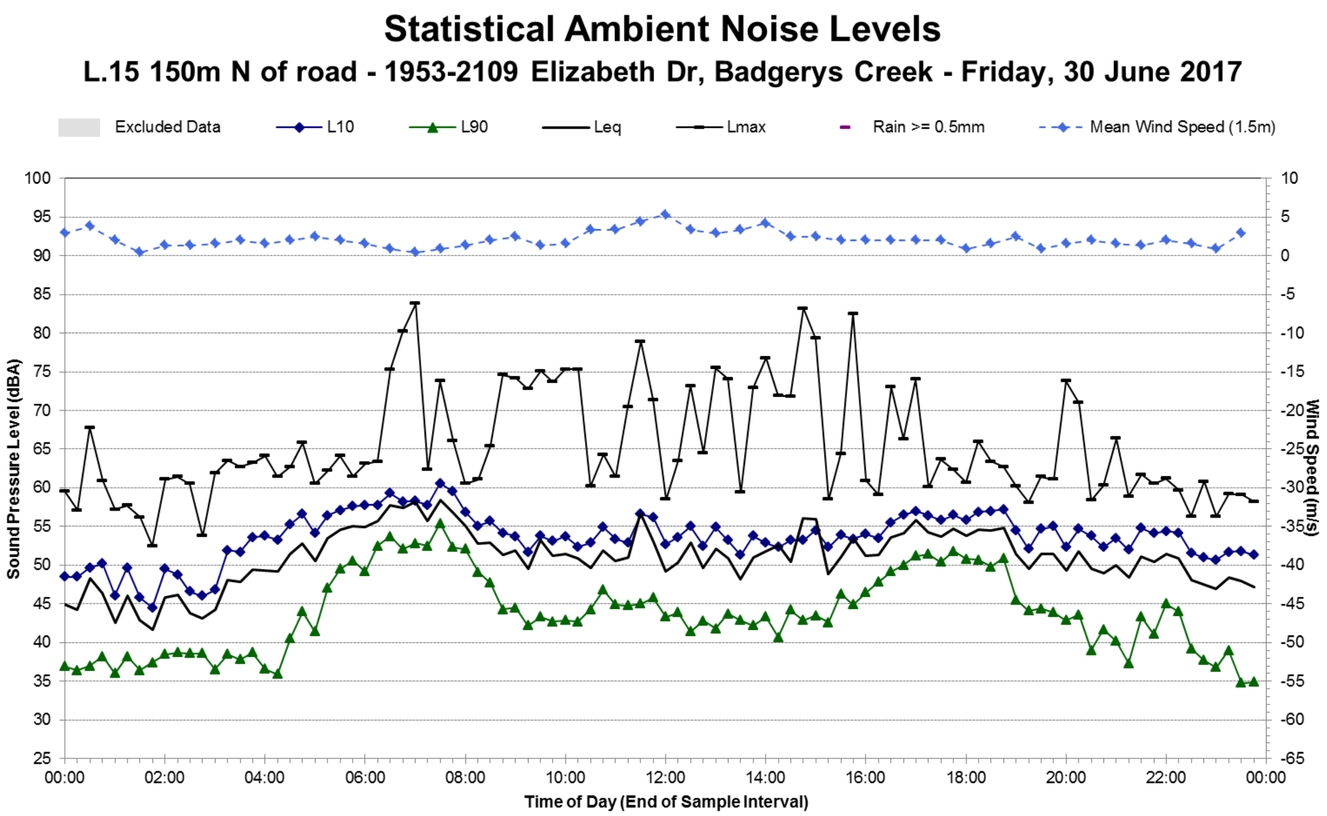



Statistical Ambient Noise Levels
L.15 150m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Tuesday, 27 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L.15 150m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Wednesday, 28 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



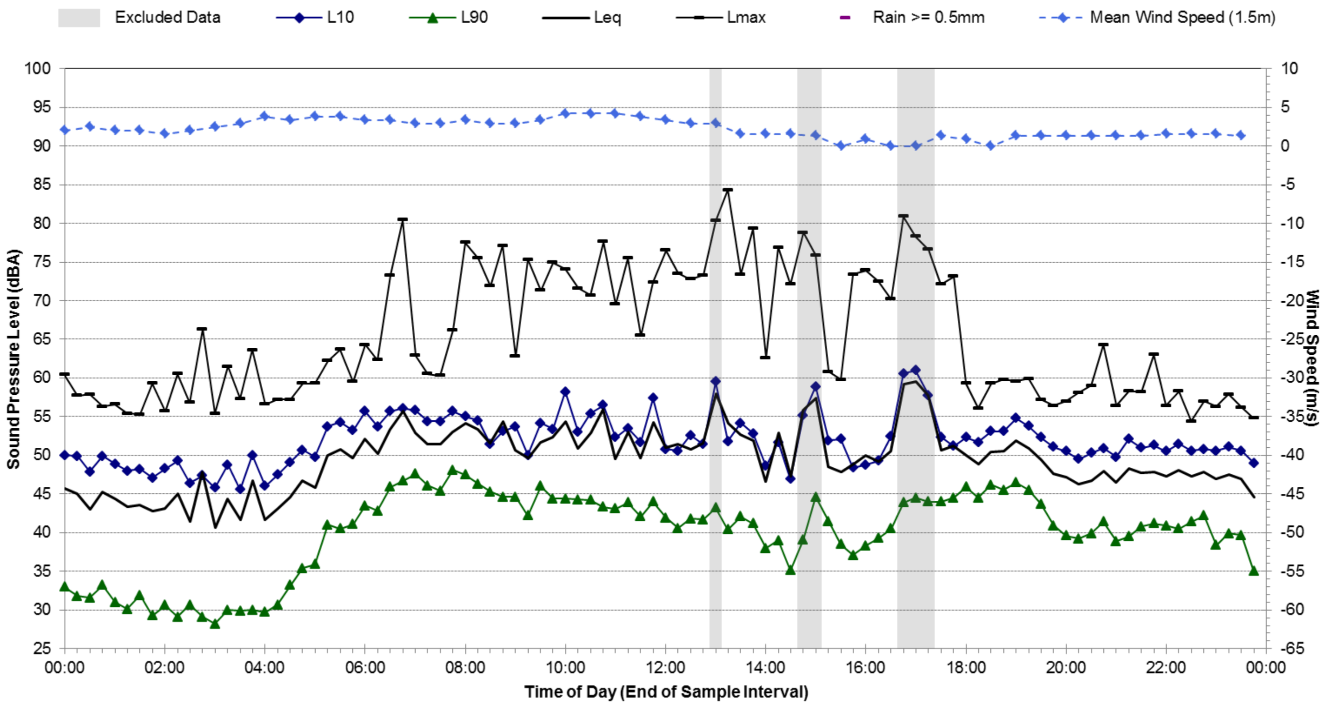
Statistical Ambient Noise Levels
L.15 150m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Thursday, 29 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
L.15 150m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Friday, 30 June 2017
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

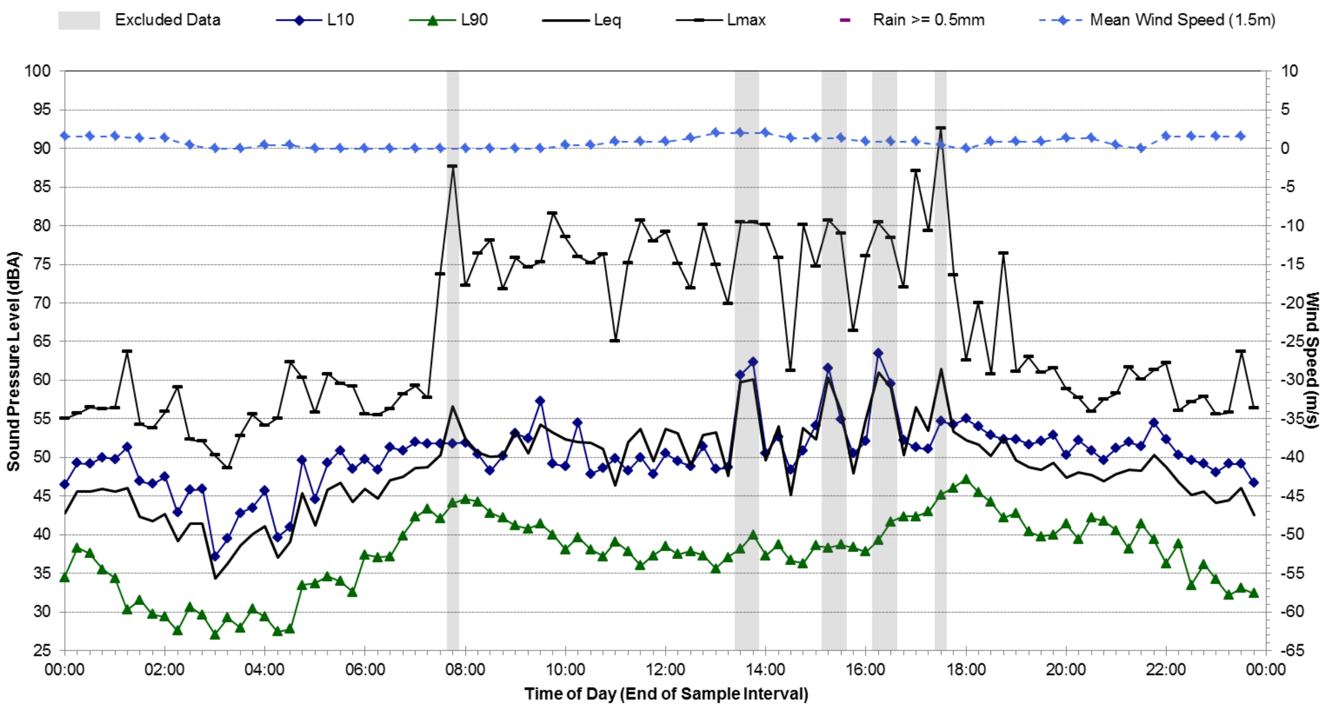
Statistical Ambient Noise Levels

L.15 150m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Saturday, 1 July 2017



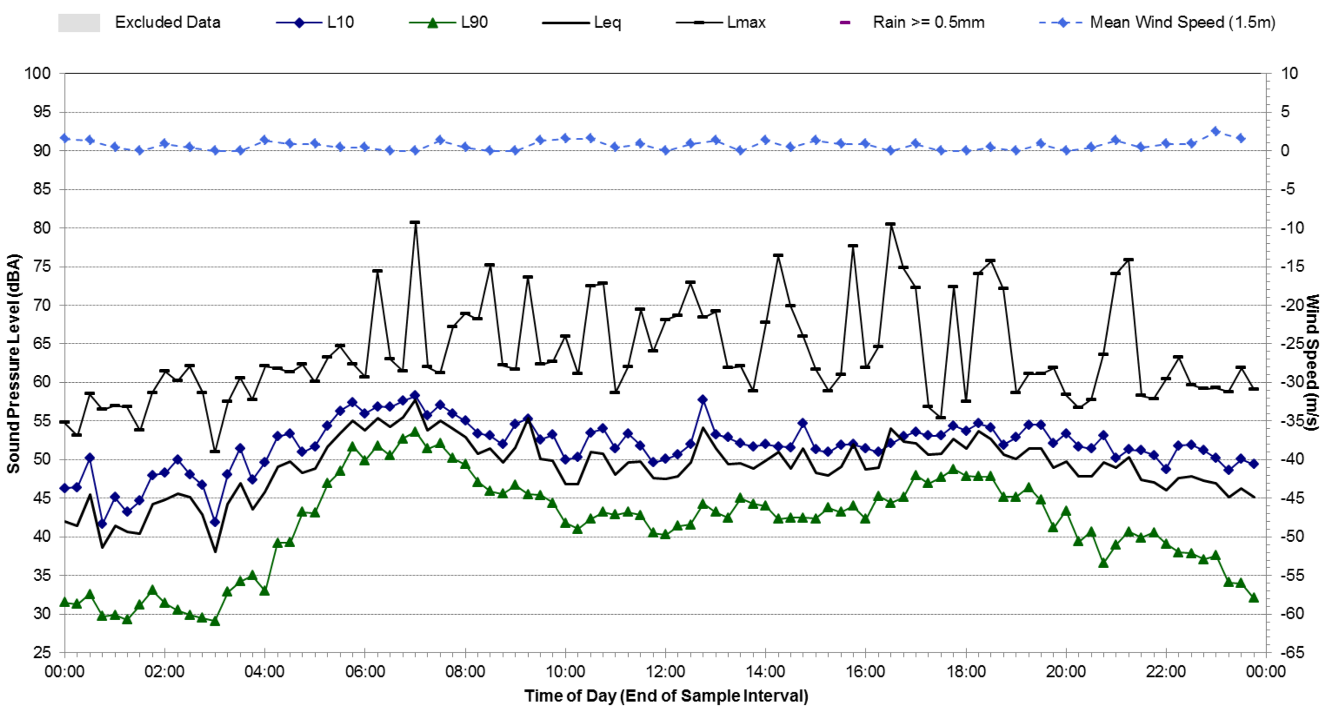
Statistical Ambient Noise Levels

L.15 150m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Sunday, 2 July 2017



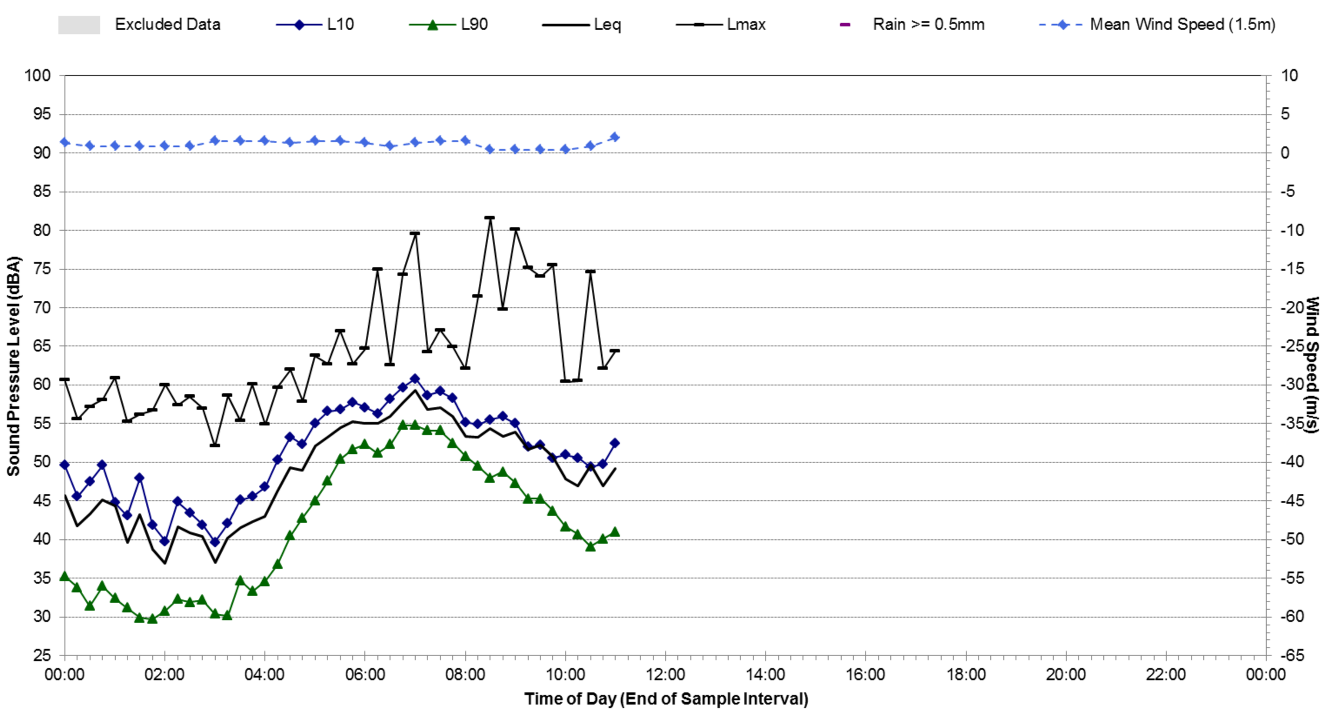
Statistical Ambient Noise Levels

L.15 150m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Monday, 3 July 2017



Statistical Ambient Noise Levels

L.15 150m N of road - 1953-2109 Elizabeth Dr, Badgerys Creek - Tuesday, 4 July 2017



Annexure C Construction information

CONSTRUCTION EQUIPMENT

Table 1 Construction equipment

Ref	Scenario	Activity	Bobcat	Chainsaw[1]	Chipper	Compactor	Concrete mixer truck	Concrete pump	Concrete saw[1]	Dozer	Dump truck (approx. 15 tonne)	Excavator - breaker[1]	Excavator (35 tonne)	Flatbed truck	Front end loader	Grader	Hand tools (electric)	Line marking plant	Mobile crane - franna	Mobile crane (100 tonne)	Mobile crane (35 tonne)	Paving machine	Piling - bored	Roller - vibratory (12 tonne)[1]	Vehicle (light coommercial e.g. 4WD)	Water tanker (8000 litre)	Batching plant
		SWL LAeq(15min)	104	114	116	106	103	108	124	116	107	121	109	103	108	114	96	108	98	100	98	105	111	109	103	107	118
Ref	**Scenario**	**Activity**																									
1a	Ancillary facility establishment / decommissioning	Peak impact									X		X		X		X							X	X		
1b		Typical impact	X											X			X				X			X	X		
2a	Ancillary facility	Operation												X			X		X						X	X	
2b		Stockpiling									X		X		X										X	X	
2c		Batching plant					X							X	X		X								X		X
3a	Utilitiies and drainage - including relocation of existing	Peak impact					X					X	X	X			X			X			X	X			
3b		Typical impact											X	X			X			X							
4a	Demolition	Bridges and buildings (inc breaker)									X	X	X		X		X								X		
4b		Bridges and buildings (no breaker)									X		X		X		X			X					X		
5a	Clearing	Peak impact		X	X					X	X		X				X								X		
5b		Typical impact									X		X				X								X		
6a	Earthworks	Peak impact				X				X	X		X		X	X								X	X	X	
6b		Typical impact									X		X												X	X	
6c		Onsite truck haulage									X																
7a	Bridge works	Peak impact (inc piling)											X	X			X			X			X		X		
7b		Typical impact												X			X			X					X		
7c		Concrete works					X	X									X		X								
7d		Girder lifts over existing roads												X			X		X	X					X		
8a	Road works	Concrete works					X	X									X		X								
8b		Typical impact												X			X		X			X			X		
8c		Tie-in works to existing roads							X					X			X					X		X	X		
9a	Signage, lighting and landscaping	Installation & finishing works	X											X			X	X		X					X		

Note 1: The ICNG requires that activities identified as particularly annoying (such as jackhammering, rockbreaking and power saw operation) have a 5 dB 'penalty' added to predicted noise levels when using the quantitative method.

PREDICTED CONSTRUCTION NOISE LEVELS

Table 1 Predicted construction noise levels morning shoulder – $L_{Aeq(15minute)}$ – residential receivers

Period	ID	Scenario	Activity	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	NCA10
Morning Shoulder	1a	Ancillary facility establishment	Peak impact	64	60	51	69	-	46	73	45	42	64
	1b		Typical impact	56	52	43	61	-	38	65	37	34	56
	2a	Ancillary facilities	Operation	51	47	38	56	-	33	60	32	<30	51
	2b		Stockpiling	57	53	44	62	-	39	66	38	35	57
	2c		Batching plant	<30	<30	30	<30	-	34	55	42	41	30
	3a	Utilities and drainage	Peak impact	79	70	59	78	-	81	85	63	68	66
	3b		Typical impact	64	55	44	63	-	66	70	48	53	51
	4a	Demolition	Peak impact	35	42	57	73	-	71	74	50	46	65
	4b		Typical impact	<30	<30	44	60	-	58	61	37	33	52
	5a	Clearing	Peak impact	76	67	56	75	-	78	82	60	65	63
	5b		Typical impact	64	55	44	63	-	66	70	48	53	51
	6a	Earthworks	Peak impact	75	66	55	74	-	77	81	59	64	62
	6b		Typical impact	64	55	44	63	-	66	70	48	53	51
	6c		Onsite truck haulage	50	41	30	49	-	44	42	<30	36	37
	7a	Bridge works	Peak impact	44	60	49	60	-	51	50	41	52	30
	7b		Typical impact	35	51	40	51	-	42	41	32	43	<30
	7c		Concrete works	38	54	43	54	-	45	44	35	46	<30
	7d		Girder lifts	36	53	39	51	-	33	39	34	45	<30
	8a	Road works	Concrete works	63	56	43	62	-	65	69	47	52	50
	8b		Typical works	63	56	43	57	-	65	69	37	52	50
	8c		Tie-in works	75	63	54	75	-	48	54	60	59	36
	9a	Signage, lighting and landscaping		67	60	47	66	-	69	73	51	56	54

Table 2 Predicted construction noise levels standard daytime – $L_{Aeq(15minute)}$ – residential receivers

Period	ID	Scenario	Activity	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	NCA10
Standard Daytime	1a	Ancillary facility establishment	Peak impact	64	60	51	69	-	46	73	45	42	64
	1b		Typical impact	56	52	43	61	-	38	65	37	34	56
	2a	Ancillary facilities	Operation	51	47	38	56	-	33	60	32	<30	51
	2b		Stockpiling	57	53	44	62	-	39	66	38	35	57
	2c		Batching plant	<30	<30	30	<30	-	34	55	42	41	30
	3a	Utilities and drainage	Peak impact	79	70	59	78	-	81	85	63	68	66
	3b		Typical impact	64	55	44	63	-	66	70	48	53	51
	4a	Demolition	Peak impact	35	42	57	73	-	71	74	50	46	65
	4b		Typical impact	<30	<30	44	60	-	58	61	37	33	52
	5a	Clearing	Peak impact	76	67	56	75	-	78	82	60	65	63
	5b		Typical impact	64	55	44	63	-	66	70	48	53	51
	6a	Earthworks	Peak impact	75	66	55	74	-	77	81	59	64	62
	6b		Typical impact	64	55	44	63	-	66	70	48	53	51
	6c		Onsite truck haulage	50	41	30	49	-	44	42	<30	36	37
	7a	Bridge works	Peak impact	44	60	49	60	-	51	50	41	52	30
	7b		Typical impact	35	51	40	51	-	42	41	32	43	<30
	7c		Concrete works	38	54	43	54	-	45	44	35	46	<30
	7d		Girder lifts	36	53	39	51	-	33	39	34	45	<30
	8a	Road works	Concrete works	63	56	43	62	-	65	69	47	52	50
	8b		Typical works	63	56	43	57	-	65	69	37	52	50
	8c		Tie-in works	75	63	54	75	-	48	54	60	59	36
	9a	Signage, lighting and landscaping		67	60	47	66	-	69	73	51	56	54

Table 3 Predicted construction noise levels evening shoulder – $L_{Aeq(15minute)}$ – residential receivers

Period	ID	Scenario	Activity	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	NCA10
Evening Shoulder	1a	Ancillary facility establishment	Peak impact	64	60	51	69	-	46	73	45	42	64
	1b		Typical impact	56	52	43	61	-	38	65	37	34	56
	2a	Ancillary facilities	Operation	51	47	38	56	-	33	60	32	<30	51
	2b		Stockpiling	57	53	44	62	-	39	66	38	35	57
	2c		Batching plant	<30	<30	30	<30	-	34	55	42	41	<30
	3a	Utilities and drainage	Peak impact	79	70	59	78	-	81	85	63	68	79
	3b		Typical impact	64	55	44	63	-	66	70	48	53	64
	4a	Demolition	Peak impact	35	42	57	73	-	71	74	50	46	35
	4b		Typical impact	<30	<30	44	60	-	58	61	37	33	<30
	5a	Clearing	Peak impact	76	67	56	75	-	78	82	60	65	76
	5b		Typical impact	64	55	44	63	-	66	70	48	53	64
	6a	Earthworks	Peak impact	75	66	55	74	-	77	81	59	64	75
	6b		Typical impact	64	55	44	63	-	66	70	48	53	64
	6c		Onsite truck haulage	50	41	30	49	-	44	42	<30	36	50
	7a	Bridge works	Peak impact	44	60	49	60	-	51	50	41	52	44
	7b		Typical impact	35	51	40	51	-	42	41	32	43	35
	7c		Concrete works	38	54	43	54	-	45	44	35	46	38
	7d		Girder lifts	36	53	39	51	-	33	39	34	45	36
	8a	Road works	Concrete works	63	56	43	62	-	65	69	47	52	63
	8b		Typical works	63	56	43	57	-	65	69	37	52	63
	8c		Tie-in works	75	63	54	75	-	48	54	60	59	75
	9a	Signage, lighting and landscaping		67	60	47	66	-	69	73	51	56	67

Table 4 Predicted construction noise levels evening – $L_{Aeq(15minute)}$ – residential receivers

Period	ID	Scenario	Activity	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	NCA10
Evening	1a	Ancillary facility establishment	Peak impact	-	-	-	-	-	-	-	-	-	-
	1b		Typical impact	56	52	43	61	-	38	65	37	34	56
	2a	Ancillary facilities	Operation	51	47	38	56	-	33	60	32	<30	51
	2b		Stockpiling	57	53	44	62	-	39	66	38	35	57
	2c		Batching plant	<30	<30	30	<30	-	34	55	42	41	30
	3a	Utilities and drainage	Peak impact	-	-	-	-	-	-	-	-	-	-
	3b		Typical impact	-	-	-	-	-	-	-	-	-	-
	4a	Demolition	Peak impact	-	-	-	-	-	-	-	-	-	-
	4b		Typical impact	-	-	-	-	-	-	-	-	-	-
	5a	Clearing	Peak impact	-	-	-	-	-	-	-	-	-	-
	5b		Typical impact	-	-	-	-	-	-	-	-	-	-
	6a	Earthworks	Peak impact	-	-	-	-	-	-	-	-	-	-
	6b		Typical impact	-	-	-	-	-	-	-	-	-	-
	6c		Onsite truck haulage	-	-	-	-	-	-	-	-	-	-
	7a	Bridge works	Peak impact	44	60	49	60	-	51	50	41	52	30
	7b		Typical impact	35	51	40	51	-	42	41	32	43	<30
	7c		Concrete works	38	54	43	54	-	45	44	35	46	<30
	7d		Girder lifts	36	53	39	51	-	33	39	34	45	<30
	8a	Road works	Concrete works	63	56	43	62	-	65	69	47	52	50
	8b		Typical works	-	-	-	-	-	-	-	-	-	-
	8c		Tie-in works	75	63	54	75	-	48	54	60	59	36
	9a	Signage, lighting and landscaping		-	-	-	-	-	-	-	-	-	-

Table 5 Predicted construction noise levels night-time – $L_{Aeq(15minute)}$ – residential receivers

Period	ID	Scenario	Activity	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	NCA10
Night-time	1a	Ancillary facility establishment	Peak impact	-	-	-	-	-	-	-	-	-	-
	1b		Typical impact	56	52	43	61	-	38	65	37	34	56
	2a	Ancillary facilities	Operation	51	47	38	56	-	33	60	32	<30	51
	2b		Stockpiling	57	53	44	62	-	39	66	38	35	57
	2c		Batching plant	<30	<30	30	<30	-	34	55	42	41	30
	3a	Utilities and drainage	Peak impact	-	-	-	-	-	-	-	-	-	-
	3b		Typical impact	-	-	-	-	-	-	-	-	-	-
	4a	Demolition	Peak impact	-	-	-	-	-	-	-	-	-	-
	4b		Typical impact	-	-	-	-	-	-	-	-	-	-
	5a	Clearing	Peak impact	-	-	-	-	-	-	-	-	-	-
	5b		Typical impact	-	-	-	-	-	-	-	-	-	-
	6a	Earthworks	Peak impact	-	-	-	-	-	-	-	-	-	-
	6b		Typical impact	-	-	-	-	-	-	-	-	-	-
	6c		Onsite truck haulage	-	-	-	-	-	-	-	-	-	-
	7a	Bridge works	Peak impact	44	60	49	60	-	51	50	41	52	30
	7b		Typical impact	35	51	40	51	-	42	41	32	43	<30
	7c		Concrete works	38	54	43	54	-	45	44	35	46	<30
	7d		Girder lifts	36	53	39	51	-	33	39	34	45	<30
	8a	Road works	Concrete works	63	56	43	62	-	65	69	47	52	50
	8b		Typical works	-	-	-	-	-	-	-	-	-	-
	8c		Tie-in works	75	63	54	75	-	48	54	60	59	36
	9a	Signage, lighting and landscaping		-	-	-	-	-	-	-	-	-	-

Table 6 Predicted construction noise levels – $L_{Aeq(15minute)}$ – commercial receivers

Period	ID	Scenario	Activity	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	NCA10
When in Use	1a	Ancillary facility establishment	Peak impact	50	42	46	63	77	44	47	37	37	37
	1b		Typical impact	42	34	38	55	69	36	39	<30	<30	<30
	2a	Ancillary facilities	Operation	37	<30	33	50	64	31	34	<30	<30	<30
	2b		Stockpiling	43	35	39	56	70	37	40	30	30	30
	2c		Batching plant	<30	<30	<30	<30	<30	30	46	35	33	<30
	3a	Utilities and drainage	Peak impact	67	53	58	69	77	59	67	43	59	44
	3b		Typical impact	52	38	43	54	62	44	52	<30	44	<30
	4a	Demolition	Peak impact	33	35	57	65	65	58	51	42	41	43
	4b		Typical impact	<30	<30	44	52	52	45	38	<30	<30	30
	5a	Clearing	Peak impact	64	50	55	66	74	56	64	40	56	41
	5b		Typical impact	52	38	43	54	62	44	52	<30	44	<30
	6a	Earthworks	Peak impact	63	49	54	65	73	55	63	39	55	40
	6b		Typical impact	52	38	43	54	62	44	52	<30	44	<30
	6c		Onsite truck haulage	38	<30	<30	40	48	30	38	<30	30	<30
	7a	Bridge works	Peak impact	40	41	45	59	59	48	57	32	43	<30
	7b		Typical impact	31	32	36	50	50	39	48	<30	34	<30
	7c		Concrete works	34	35	39	53	53	42	51	<30	37	<30
	7d		Girder lifts	33	34	33	52	50	32	<30	<30	36	<30
	8a	Road works	Concrete works	51	36	42	53	55	43	51	<30	41	<30
	8b		Typical works	46	36	42	53	55	43	51	<30	41	<30
	8c		Tie-in works	64	48	47	66	65	46	43	40	49	<30
	9a	Signage, lighting and landscaping		55	41	46	57	59	47	55	31	45	32

Table 7 Predicted construction noise levels – $L_{Aeq(15minute)}$ – other sensitive receivers

Period	ID	Scenario	Activity	NCA01	NCA02	NCA03	NCA04	NCA05	NCA06	NCA07	NCA08	NCA09	NCA10
When in Use	1a	Ancillary facility establishment	Peak impact	47	47	38	63	42	42	33	44	-	35
	1b		Typical impact	39	39	30	55	34	34	<30	36	-	<30
	2a	Ancillary facilities	Operation	34	34	<30	50	<30	<30	<30	31	-	<30
	2b		Stockpiling	40	40	31	56	35	35	<30	37	-	<30
	2c		Batching plant	<30	<30	<30	<30	<30	<30	33	43	-	<30
	3a	Utilities and drainage	Peak impact	57	59	48	73	66	54	44	52	-	39
	3b		Typical impact	42	44	33	58	51	39	<30	37	-	<30
	4a	Demolition	Peak impact	34	35	47	63	55	53	41	46	-	40
	4b		Typical impact	<30	<30	34	50	42	40	<30	33	-	<30
	5a	Clearing	Peak impact	54	56	45	70	63	51	41	49	-	36
	5b		Typical impact	42	44	33	58	51	39	<30	37	-	<30
	6a	Earthworks	Peak impact	53	55	44	69	62	50	40	48	-	35
	6b		Typical impact	42	44	33	58	51	39	<30	37	-	<30
	6c		Onsite truck haulage	<30	<30	<30	38	37	<30	<30	<30	-	<30
	7a	Bridge works	Peak impact	41	46	38	57	45	44	34	41	-	<30
	7b		Typical impact	32	37	29	48	36	35	<30	32	-	<30
	7c		Concrete works	35	40	32	51	39	38	<30	35	-	<30
	7d		Girder lifts	33	38	27	47	37	30	<30	34	-	<30
	8a	Road works	Concrete works	41	42	32	57	49	38	<30	35	-	<30
	8b		Typical works	39	42	32	53	49	38	<30	34	-	<30
	8c		Tie-in works	54	53	40	70	44	44	31	48	-	<30
	9a	Signage, lighting and landscaping		45	47	36	61	53	42	32	39	-	<30

PREDICTED CONSTRUCTION NML EXCEEDANCES

Table 1 Predicted NML exceedances – all receiver types – NCA01

ID	Scenario	Activity	No. weeks[1]	Number of receivers																						
				Total	HNA[2]	With NML exceedance[3]																				
						Standard daytime			Out of hours works[4]																	
									Morning shoulde			Daytime OOH			Evening shoulder			Evening			Night-time			Sleep disturbance		
						1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
1a	Ancillary facility establishment	Peak impact	6	1457	-	3	-	-	2	3	-	2	3	-	3	3	-	-	-	-	-	-	-	-	-	-
1b		Typical impact	12	1457	-	1	-	-	3	-	-	3	-	-	3	-	-	3	-	-	2	1	-	3	-	-
2a	Ancillary facilities	Operation	192	1457	-	-	-	-	1	-	-	1	-	-	2	-	-	2	-	-	3	-	-	2	-	-
2b		Stockpiling	144	1457	-	2	-	-	3	-	-	3	-	-	3	-	-	3	-	-	1	2	-	3	-	-
2c		Batching plant	120	1457	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3a	Utilities and drainage	Peak impact	35	1457	2	20	4	2	24	12	3	24	12	3	23	13	4	-	-	-	-	-	-	-	-	-
3b		Typical impact	132	1457	-	3	-	-	4	2	-	4	2	-	4	2	-	-	-	-	-	-	-	-	-	-
4a	Demolition	Peak impact	36	1457	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4b		Typical impact	36	1457	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5a	Clearing	Peak impact	20	1457	1	12	5	1	23	5	2	23	5	2	22	8	2	-	-	-	-	-	-	-	-	-
5b		Typical impact	36	1457	-	3	-	-	4	2	-	4	2	-	4	2	-	-	-	-	-	-	-	-	-	-
6a	Earthworks	Peak impact	80	1457	1	13	4	-	23	4	2	23	4	2	23	5	2	-	-	-	-	-	-	-	-	-
6b		Typical impact	144	1457	-	3	-	-	4	2	-	4	2	-	4	2	-	-	-	-	-	-	-	-	-	-
6c		Onsite haulage	144	1457	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
7a	Bridge works	Peak impact	48	1457	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7b		Typical impact	144	1457	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7c		Concrete works	48	1457	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7d		Girder lifts	50	1457	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8a	Road works	Concrete works	30	1457	-	2	-	-	4	2	-	4	2	-	4	2	-	4	2	-	9	2	-	4	2	-
8b		Typical works	144	1457	-	2	-	-	1	2	-	1	2	-	1	2	-	-	-	-	-	-	-	-	-	-
8c		Tie-in works	48	1457	1	12	6	-	23	5	2	23	5	2	22	8	2	22	8	2	23	12	6	24	9	2
9a	Signage, lighting and landscaping		36	1457	-	4	2	-	8	2	-	8	2	-	9	2	-	-	-	-	-	-	-	-	-	-

Note 1: Durations should be regarded as indicative and represent typical works. The duration of the worst-case impacts would be less than the overall duration, and depends on the rate of progress.
Note 2: Highly Noise Affected, based on ICNG definition (ie predicted noise level at residential receiver is 75 dBA or greater).
Note 3: Based on worst-case predicted noise levels.
Note 4: OOH = Out of hours.

Table 2 Predicted NML exceedances – all receiver types – NCA02

ID	Scenario	Activity	No. weeks[1]	Number of receivers																						
				Total	HNA[2]	With NML exceedance[3]																				
						Standard daytime			Out of hours works[4]																	
									Morning shoulder			Daytime OOH			Evening shoulder			Evening			Night-time			Sleep disturbance		
						1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
1a	Ancillary facility establishment	Peak impact	6	2912	-	10	-	-	33	-	-	33	-	-	42	2	-	-	-	-	-	-	-	-	-	-
1b		Typical impact	12	2912	-	-	-	-	2	-	-	2	-	-	4	-	-	4	-	-	19	-	-	10	-	-
2a	Ancillary facilities	Operation	192	2912	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
2b		Stockpiling	144	2912	-	-	-	-	4	-	-	4	-	-	7	-	-	7	-	-	23	-	-	10	-	-
2c		Batching plant	120	2912	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3a	Utilities and drainage	Peak impact	35	2912	-	330	28	-	641	144	-	641	144	-	739	169	4	-	-	-	-	-	-	-	-	-
3b		Typical impact	132	2912	-	-	-	-	28	-	-	28	-	-	43	-	-	-	-	-	-	-	-	-	-	-
4a	Demolition	Peak impact	36	2912	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4b		Typical impact	36	2912	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5a	Clearing	Peak impact	20	2912	-	217	5	-	408	61	-	408	61	-	487	84	-	-	-	-	-	-	-	-	-	-
5b		Typical impact	36	2912	-	-	-	-	28	-	-	28	-	-	43	-	-	-	-	-	-	-	-	-	-	-
6a	Earthworks	Peak impact	80	2912	-	169	4	-	374	43	-	374	43	-	408	61	-	-	-	-	-	-	-	-	-	-
6b		Typical impact	144	2912	-	-	-	-	28	-	-	28	-	-	43	-	-	-	-	-	-	-	-	-	-	-
6c		Onsite haulage	144	2912	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7a	Bridge works	Peak impact	48	2912	-	17	-	-	96	-	-	96	-	-	129	3	-	129	3	-	277	17	-	96	-	-
7b		Typical impact	144	2912	-	-	-	-	3	-	-	3	-	-	4	-	-	4	-	-	26	-	-	10	-	-
7c		Concrete works	48	2912	-	-	-	-	14	-	-	14	-	-	17	-	-	17	-	-	71	-	-	14	-	-
7d		Girder lifts	50	2912	-	-	-	-	5	-	-	5	-	-	6	-	-	6	-	-	35	-	-	5	-	-
8a	Road works	Concrete works	30	2912	-	1	-	-	16	-	-	16	-	-	25	-	-	25	-	-	108	1	-	16	-	-
8b		Typical works	144	2912	-	1	-	-	16	-	-	16	-	-	24	-	-	-	-	-	-	-	-	-	-	-
8c		Tie-in works	48	2912	-	68	-	-	300	10	-	300	10	-	386	16	-	386	16	-	866	68	-	463	24	-
9a	Signage, lighting and landscaping		36	2912	-	17	-	-	97	-	-	97	-	-	117	1	-	-	-	-	-	-	-	-	-	-

Note 1: Durations should be regarded as indicative and represent typical works. The duration of the worst-case impacts would be less than the overall duration, and depends on the rate of progress.
Note 2: Highly Noise Affected, based on ICNG definition (ie predicted noise level at residential receiver is 75 dBA or greater).
Note 3: Based on worst-case predicted noise levels.
Note 4: OOH = Out of hours.

Table 3 Predicted NML exceedances – all receiver types – NCA03

ID	Scenario	Activity	No. weeks[1]	Number of receivers																						
				Total	HNA[2]	With NML exceedance[3]																				
						Standard daytime			Out of hours works[4]																	
									Morning shoulder			Daytime OOH			Evening shoulder			Evening			Night-time			Sleep disturbance		
						1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
1a	Ancillary facility establishment	Peak impact	6	955	-	5	-	-	60	-	-	60	-	-	60	-	-	-	-	-	-	-	-	-	-	-
1b		Typical impact	12	955	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-	-	2	-	-
2a	Ancillary facilities	Operation	192	955	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2b		Stockpiling	144	955	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	-	-	2	-	-
2c		Batching plant	120	955	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3a	Utilities and drainage	Peak impact	35	955	-	156	-	-	349	38	-	349	38	-	349	38	-	-	-	-	-	-	-	-	-	-
3b		Typical impact	132	955	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4a	Demolition	Peak impact	36	955	-	87	-	-	187	22	-	187	22	-	187	22	-	-	-	-	-	-	-	-	-	-
4b		Typical impact	36	955	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5a	Clearing	Peak impact	20	955	-	76	-	-	229	8	-	229	8	-	229	8	-	-	-	-	-	-	-	-	-	-
5b		Typical impact	36	955	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6a	Earthworks	Peak impact	80	955	-	53	-	-	189	4	-	189	4	-	189	4	-	-	-	-	-	-	-	-	-	-
6b		Typical impact	144	955	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6c		Onsite haulage	144	955	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7a	Bridge works	Peak impact	48	955	-	-	-	-	12	-	-	12	-	-	12	-	-	12	-	-	70	-	-	7	-	-
7b		Typical impact	144	955	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7c		Concrete works	48	955	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
7d		Girder lifts	50	955	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8a	Road works	Concrete works	30	955	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	-	-	-	-	-
8b		Typical works	144	955	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8c		Tie-in works	48	955	-	18	-	-	123	-	-	123	-	-	123	-	-	123	-	-	309	5	-	168	1	-
9a	Signage, lighting and landscaping		36	955	-	-	-	-	17	-	-	17	-	-	17	-	-	-	-	-	-	-	-	-	-	-

Note 1: Durations should be regarded as indicative and represent typical works. The duration of the worst-case impacts would be less than the overall duration, and depends on the rate of progress.
Note 2: Highly Noise Affected, based on ICNG definition (ie predicted noise level at residential receiver is 75 dBA or greater).
Note 3: Based on worst-case predicted noise levels.
Note 4: OOH = Out of hours.

Table 4 Predicted NML exceedances – all receiver types – NCA04

ID	Scenario	Activity	No. weeks[1]	Number of receivers: Total	HNA[2]	With NML exceedance[3]: Standard daytime 1-10 dB	Standard daytime 11-20 dB	Standard daytime >20 dB	Out of hours works[4]: Morning shoulder 1-10 dB	Morning shoulder 11-20 dB	Morning shoulder >20 dB	Daytime OOH 1-10 dB	Daytime OOH 11-20 dB	Daytime OOH >20 dB	Evening shoulder 1-10 dB	Evening shoulder 11-20 dB	Evening shoulder >20 dB	Evening 1-10 dB	Evening 11-20 dB	Evening >20 dB	Night-time 1-10 dB	Night-time 11-20 dB	Night-time >20 dB	Sleep disturbance 1-10 dB	Sleep disturbance 11-20 dB	Sleep disturbance >20 dB
1a	Ancillary facility establishment	Peak impact	6	351	-	8	-	-	17	-	-	17	-	-	32	4	-	-	-	-	-	-	-	-	-	-
1b		Typical impact	12	351	-	-	-	-	1	-	-	1	-	-	8	-	-	8	-	-	48	11	-	38	6	-
2a	Ancillary facilities	Operation	192	351	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-	22	2	-	14	1	-
2b		Stockpiling	144	351	-	-	-	-	2	-	-	2	-	-	11	-	-	11	-	-	58	12	-	38	6	-
2c		Batching plant	120	351	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3a	Utilities and drainage	Peak impact	35	351	2	24	7	-	50	15	-	50	15	-	109	27	2	-	-	-	-	-	-	-	-	-
3b		Typical impact	132	351	-	2	-	-	4	-	-	4	-	-	12	-	-	-	-	-	-	-	-	-	-	-
4a	Demolition	Peak impact	36	351	-	7	-	-	12	2	-	12	2	-	47	8	-	-	-	-	-	-	-	-	-	-
4b		Typical impact	36	351	-	-	-	-	1	-	-	1	-	-	3	-	-	-	-	-	-	-	-	-	-	-
5a	Clearing	Peak impact	20	351	1	13	5	-	36	7	-	36	7	-	75	15	1	-	-	-	-	-	-	-	-	-
5b		Typical impact	36	351	-	2	-	-	4	-	-	4	-	-	12	-	-	-	-	-	-	-	-	-	-	-
6a	Earthworks	Peak impact	80	351	-	15	2	-	30	4	-	30	4	-	68	12	1	-	-	-	-	-	-	-	-	-
6b		Typical impact	144	351	-	2	-	-	4	-	-	4	-	-	12	-	-	-	-	-	-	-	-	-	-	-
6c		Onsite haulage	144	351	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7a	Bridge works	Peak impact	48	351	-	1	-	-	2	-	-	2	-	-	15	-	-	15	-	-	105	19	-	53	3	-
7b		Typical impact	144	351	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	-	-	7	-	-
7c		Concrete works	48	351	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	45	1	-	15	-	-
7d		Girder lifts	50	351	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	-	-	3	-	-
8a	Road works	Concrete works	30	351	-	1	-	-	2	-	-	2	-	-	9	-	-	9	-	-	56	10	-	26	2	-
8b		Typical works	144	351	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-
8c		Tie-in works	48	351	1	3	5	-	11	6	-	11	6	-	38	3	1	38	3	1	112	50	5	118	30	3
9a	Signage, lighting and landscaping		36	351	-	6	-	-	10	-	-	10	-	-	15	1	-	-	-	-	-	-	-	-	-	-

Note 1: Durations should be regarded as indicative and represent typical works. The duration of the worst-case impacts would be less than the overall duration, and depends on the rate of progress.
Note 2: Highly Noise Affected, based on ICNG definition (ie predicted noise level at residential receiver is 75 dBA or greater).
Note 3: Based on worst-case predicted noise levels.
Note 4: OOH = Out of hours.

Table 5 Predicted NML exceedances – all Receiver types – NCA05

ID	Scenario	Activity	No. weeks[1]	Number of receivers																							
				Total	HNA[2]	With NML exceedance[3]																				
						Standard daytime			Out of hours works[4]																	
									Morning shoulder			Daytime OOH			Evening shoulder			Evening			Night-time			Sleep disturbance		
						1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
1a	Ancillary facility establishment	Peak impact	6	50	-	2	-	-	2	-	-	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-
1b		Typical impact	12	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2a	Ancillary facilities	Operation	192	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2b		Stockpiling	144	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2c		Batching plant	120	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3a	Utilities and drainage	Peak impact	35	50	-	4	-	-	4	-	-	4	-	-	4	-	-	-	-	-	-	-	-	-	-	-
3b		Typical impact	132	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4a	Demolition	Peak impact	36	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4b		Typical impact	36	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5a	Clearing	Peak impact	20	50	-	2	-	-	2	-	-	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-
5b		Typical impact	36	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6a	Earthworks	Peak impact	80	50	-	2	-	-	2	-	-	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-
6b		Typical impact	144	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6c		Onsite haulage	144	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7a	Bridge works	Peak impact	48	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7b		Typical impact	144	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7c		Concrete works	48	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7d		Girder lifts	50	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8a	Road works	Concrete works	30	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8b		Typical works	144	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8c		Tie-in works	48	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9a	Signage, lighting and landscaping		36	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note 1: Durations should be regarded as indicative and represent typical works. The duration of the worst-case impacts would be less than the overall duration, and depends on the rate of progress.
Note 2: Highly Noise Affected, based on ICNG definition (ie predicted noise level at residential receiver is 75 dBA or greater).
Note 3: Based on worst-case predicted noise levels.
Note 4: OOH = Out of hours.

Table 6 Predicted NML exceedances – all receiver types – NCA06

ID	Scenario	Activity	No. weeks[1]	Number of receivers																						
				Total	HNA[2]				With NML exceedance[3]																	
						Standard daytime			Out of hours works[4]																	
									Morning shoulder			Daytime OOH			Evening shoulder			Evening			Night-time			Sleep disturbance		
						1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
1a	Ancillary facility establishment	Peak impact	6	803	-	-	-	-	10	-	-	10	-	-	10	-	-	-	-	-	-	-	-	-	-	-
1b		Typical impact	12	803	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2a	Ancillary facilities	Operation	192	803	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2b		Stockpiling	144	803	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2c		Batching plant	120	803	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3a	Utilities and drainage	Peak impact	35	803	2	25	10	2	88	12	7	88	12	7	88	12	7	-	-	-	-	-	-	-	-	-
3b		Typical impact	132	803	-	5	2	-	10	1	1	10	1	1	10	1	1	-	-	-	-	-	-	-	-	-
4a	Demolition	Peak impact	36	803	-	23	7	1	75	17	2	75	17	2	75	17	2	-	-	-	-	-	-	-	-	-
4b		Typical impact	36	803	-	5	-	-	11	2	-	11	2	-	11	2	-	-	-	-	-	-	-	-	-	-
5a	Clearing	Peak impact	20	803	1	13	5	2	48	13	3	48	13	3	48	13	3	-	-	-	-	-	-	-	-	-
5b		Typical impact	36	803	-	5	2	-	10	1	1	10	1	1	10	1	1	-	-	-	-	-	-	-	-	-
6a	Earthworks	Peak impact	80	803	1	12	5	2	31	14	2	31	14	2	31	14	2	-	-	-	-	-	-	-	-	-
6b		Typical impact	144	803	-	5	2	-	10	1	1	10	1	1	10	1	1	-	-	-	-	-	-	-	-	-
6c		Onsite haulage	144	803	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7a	Bridge works	Peak impact	48	803	-	2	-	-	10	-	-	10	-	-	10	-	-	10	-	-	23	1	-	10	-	-
7b		Typical impact	144	803	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
7c		Concrete works	48	803	-	-	-	-	1	-	-	1	-	-	1	-	-	1	-	-	10	-	-	-	-	-
7d		Girder lifts	50	803	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8a	Road works	Concrete works	30	803	-	2	2	-	8	1	1	8	1	1	8	1	1	8	1	1	13	3	1	7	2	-
8b		Typical works	144	803	-	2	2	-	8	1	1	8	1	1	8	1	1	-	-	-	-	-	-	-	-	-
8c		Tie-in works	48	803	-	-	-	-	21	-	-	21	-	-	21	-	-	21	-	-	61	-	-	33	-	-
9a	Signage, lighting and landscaping		36	803	-	7	2	-	13	3	1	13	3	1	13	3	1	-	-	-	-	-	-	-	-	-

Note 1: Durations should be regarded as indicative and represent typical works. The duration of the worst-case impacts would be less than the overall duration, and depends on the rate of progress.
Note 2: Highly Noise Affected, based on ICNG definition (ie predicted noise level at residential receiver is 75 dBA or greater).
Note 3: Based on worst-case predicted noise levels.
Note 4: OOH = Out of hours.

Table 7 Predicted NML exceedances – all receiver types – NCA07

ID	Scenario	Activity	No. weeks[1]	Number of receivers																							
				Total	HNA[2]				With NML exceedance[3]																	
						Standard daytime			Out of hours works[4]																	
									Morning shoulder			Daytime OOH			Evening shoulder			Evening			Night-time			Sleep disturbance		
						1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
1a	Ancillary facility establishment	Peak impact	6	192	-	8	5	1	31	10	2	31	10	2	31	10	2	-	-	-	-	-	-	-	-	-
1b		Typical impact	12	192	-	7	1	1	9	2	1	9	2	1	9	2	1	9	2	1	8	5	1	7	4	1
2a	Ancillary facilities	Operation	192	192	-	2	1	-	7	1	1	7	1	1	7	1	1	7	1	1	10	1	1	7	1	1
2b		Stockpiling	144	192	-	9	1	1	7	4	1	7	4	1	7	4	1	7	4	1	10	6	1	7	4	1
2c		Batching plant	120	192	-	2	1	-	16	3	-	16	3	-	16	3	-	16	3	-	58	3	-	28	3	-
3a	Utilities and drainage	Peak impact	35	192	1	80	18	6	76	37	12	76	37	12	76	37	12	-	-	-	-	-	-	-	-	-
3b		Typical impact	132	192	-	8	3	1	18	5	1	18	5	1	18	5	1	-	-	-	-	-	-	-	-	-
4a	Demolition	Peak impact	36	192	-	28	12	2	104	12	4	104	12	4	104	12	4	-	-	-	-	-	-	-	-	-
4b		Typical impact	36	192	-	6	2	-	14	1	1	14	1	1	14	1	1	-	-	-	-	-	-	-	-	-
5a	Clearing	Peak impact	20	192	1	57	9	4	94	20	9	94	20	9	94	20	9	-	-	-	-	-	-	-	-	-
5b		Typical impact	36	192	-	8	3	1	18	5	1	18	5	1	18	5	1	-	-	-	-	-	-	-	-	-
6a	Earthworks	Peak impact	80	192	1	47	9	4	94	18	7	94	18	7	94	18	7	-	-	-	-	-	-	-	-	-
6b		Typical impact	144	192	-	8	3	1	18	5	1	18	5	1	18	5	1	-	-	-	-	-	-	-	-	-
6c		Onsite haulage	144	192	-	-	-	-	3	-	-	3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
7a	Bridge works	Peak impact	48	192	-	15	-	-	44	1	-	44	1	-	44	1	-	44	1	-	68	6	-	29	-	-
7b		Typical impact	144	192	-	-	-	-	2	-	-	2	-	-	2	-	-	2	-	-	12	-	-	2	-	-
7c		Concrete works	48	192	-	-	-	-	12	-	-	12	-	-	12	-	-	12	-	-	27	-	-	2	-	-
7d		Girder lifts	50	192	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
8a	Road works	Concrete works	30	192	-	10	-	1	16	4	1	16	4	1	16	4	1	16	4	1	19	8	1	11	1	1
8b		Typical works	144	192	-	10	-	1	16	4	1	16	4	1	16	4	1	-	-	-	-	-	-	-	-	-
8c		Tie-in works	48	192	-	4	-	-	2	3	-	2	3	-	2	3	-	2	3	-	20	3	-	2	3	-
9a	Signage, lighting and landscaping		36	192	-	14	3	1	22	8	1	22	8	1	22	8	1	-	-	-	-	-	-	-	-	-

Note 1: Durations should be regarded as indicative and represent typical works. The duration of the worst-case impacts would be less than the overall duration, and depends on the rate of progress.
Note 2: Highly Noise Affected, based on ICNG definition (ie predicted noise level at residential receiver is 75 dBA or greater).
Note 3: Based on worst-case predicted noise levels.
Note 4: OOH = Out of hours.

Table 8 Predicted NML exceedances – all receiver types – NCA08

ID	Scenario	Activity	No. weeks[1]	Number of receivers																						
				Total	HNA[2]	With NML exceedance[3]																				
						Standard daytime			Out of hours works[4]																	
									Morning shoulder			Daytime OOH			Evening shoulder			Evening			Night-time			Sleep disturbance		
						1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
1a	Ancillary facility establishment	Peak impact	6	269	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
1b		Typical impact	12	269	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2a	Ancillary facilities	Operation	192	269	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2b		Stockpiling	144	269	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2c		Batching plant	120	269	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	1	-	-
3a	Utilities and drainage	Peak impact	35	269	-	7	1	-	34	1	-	34	1	-	59	2	-	-	-	-	-	-	-	-	-	-
3b		Typical impact	132	269	-	-	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
4a	Demolition	Peak impact	36	269	-	-	-	-	2	-	-	2	-	-	13	-	-	-	-	-	-	-	-	-	-	-
4b		Typical impact	36	269	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5a	Clearing	Peak impact	20	269	-	2	-	-	16	1	-	16	1	-	34	1	-	-	-	-	-	-	-	-	-	-
5b		Typical impact	36	269	-	-	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
6a	Earthworks	Peak impact	80	269	-	1	-	-	14	1	-	14	1	-	25	1	-	-	-	-	-	-	-	-	-	-
6b		Typical impact	144	269	-	-	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
6c		Onsite haulage	144	269	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7a	Bridge works	Peak impact	48	269	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
7b		Typical impact	144	269	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7c		Concrete works	48	269	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7d		Girder lifts	50	269	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8a	Road works	Concrete works	30	269	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	2	-	-	1	-	-
8b		Typical works	144	269	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8c		Tie-in works	48	269	-	2	-	-	11	1	-	11	1	-	22	1	-	22	1	-	62	10	1	49	2	-
9a	Signage, lighting and landscaping		36	269	-	-	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-

Note 1: Durations should be regarded as indicative and represent typical works. The duration of the worst-case impacts would be less than the overall duration, and depends on the rate of progress.
Note 2: Highly Noise Affected, based on ICNG definition (ie predicted noise level at residential receiver is 75 dBA or greater).
Note 3: Based on worst-case predicted noise levels.
Note 4: OOH = Out of hours.

Table 9 Predicted NML exceedances – all receiver types – NCA09

ID	Scenario	Activity	No. weeks[1]	Number of receivers																						
				Total	HNA[2]	With NML exceedance[3]																				
						Standard daytime			Out of hours works[4]																	
									Morning shoulder			Daytime OOH			Evening shoulder			Evening			Night-time			Sleep disturbance		
						1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
1a	Ancillary facility establishment	Peak impact	6	71	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
1b		Typical impact	12	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2a	Ancillary facilities	Operation	192	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2b		Stockpiling	144	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2c		Batching plant	120	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	-	-	8	-	-
3a	Utilities and drainage	Peak impact	35	71	-	14	4	-	17	9	1	17	9	1	10	15	2	-	-	-	-	-	-	-	-	-
3b		Typical impact	132	71	-	1	-	-	4	-	-	4	-	-	9	1	-	-	-	-	-	-	-	-	-	-
4a	Demolition	Peak impact	36	71	-	-	-	-	4	-	-	4	-	-	17	-	-	-	-	-	-	-	-	-	-	-
4b		Typical impact	36	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5a	Clearing	Peak impact	20	71	-	10	2	-	17	6	-	17	6	-	16	10	1	-	-	-	-	-	-	-	-	-
5b		Typical impact	36	71	-	1	-	-	4	-	-	4	-	-	9	1	-	-	-	-	-	-	-	-	-	-
6a	Earthworks	Peak impact	80	71	-	10	1	-	15	5	-	15	5	-	17	9	1	-	-	-	-	-	-	-	-	-
6b		Typical impact	144	71	-	1	-	-	4	-	-	4	-	-	9	1	-	-	-	-	-	-	-	-	-	-
6c		Onsite haulage	144	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7a	Bridge works	Peak impact	48	71	-	1	-	-	8	-	-	8	-	-	15	1	-	15	1	-	18	7	-	15	1	-
7b		Typical impact	144	71	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	8	-	-	5	-	-
7c		Concrete works	48	71	-	-	-	-	1	-	-	1	-	-	6	-	-	6	-	-	13	-	-	6	-	-
7d		Girder lifts	50	71	-	-	-	-	-	-	-	-	-	-	5	-	-	5	-	-	10	-	-	5	-	-
8a	Road works	Concrete works	30	71	-	1	-	-	2	-	-	2	-	-	7	1	-	7	1	-	12	2	-	7	1	-
8b		Typical works	144	71	-	1	-	-	2	-	-	2	-	-	7	1	-	-	-	-	-	-	-	-	-	-
8c		Tie-in works	48	71	-	9	-	-	14	4	-	14	4	-	17	9	-	17	9	-	12	13	2	15	12	-
9a	Signage, lighting and landscaping		36	71	-	2	-	-	7	1	-	7	1	-	10	2	-	-	-	-	-	-	-	-	-	-

Note 1: Durations should be regarded as indicative and represent typical works. The duration of the worst-case impacts would be less than the overall duration, and depends on the rate of progress.
Note 2: Highly Noise Affected, based on ICNG definition (ie predicted noise level at residential receiver is 75 dBA or greater).
Note 3: Based on worst-case predicted noise levels.
Note 4: OOH = Out of hours.

Table 10 Predicted NML exceedances – all receiver types – NCA10

ID	Scenario	Activity	No. weeks[1]	Number of receivers																						
				Total	HNA[2]	With NML exceedance[3]																				
						Standard daytime			Out of hours works[4]																	
									Morning shoulder			Daytime OOH			Evening shoulder			Evening			Night-time			Sleep disturbance		
						1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
1a	Ancillary facility establishment	Peak impact	6	234	-	5	-	-	5	3	-	5	3	-	5	3	-	-	-	-	-	-	-	-	-	-
1b		Typical impact	12	234	-	2	-	-	5	-	-	5	-	-	5	-	-	5	-	-	5	3	-	5	2	-
2a	Ancillary facilities	Operation	192	234	-	-	-	-	2	-	-	2	-	-	2	-	-	2	-	-	5	-	-	5	-	-
2b		Stockpiling	144	234	-	2	-	-	5	-	-	5	-	-	5	-	-	5	-	-	7	3	-	5	2	-
2c		Batching plant	120	234	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3a	Utilities and drainage	Peak impact	35	234	-	6	1	-	14	1	-	14	1	-	14	1	-	-	-	-	-	-	-	-	-	-
3b		Typical impact	132	234	-	-	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
4a	Demolition	Peak impact	36	234	-	8	1	-	14	5	-	14	5	-	14	5	-	-	-	-	-	-	-	-	-	-
4b		Typical impact	36	234	-	-	-	-	3	-	-	3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
5a	Clearing	Peak impact	20	234	-	3	-	-	8	1	-	8	1	-	8	1	-	-	-	-	-	-	-	-	-	-
5b		Typical impact	36	234	-	-	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
6a	Earthworks	Peak impact	80	234	-	2	-	-	7	1	-	7	1	-	7	1	-	-	-	-	-	-	-	-	-	-
6b		Typical impact	144	234	-	-	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
6c		Onsite haulage	144	234	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7a	Bridge works	Peak impact	48	234	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7b		Typical impact	144	234	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7c		Concrete works	48	234	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7d		Girder lifts	50	234	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8a	Road works	Concrete works	30	234	-	-	-	-	1	-	-	1	-	-	1	-	-	1	-	-	2	-	-	1	-	-
8b		Typical works	144	234	-	-	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
8c		Tie-in works	48	234	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9a	Signage, lighting and landscaping		36	234	-	-	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-

Note 1: Durations should be regarded as indicative and represent typical works. The duration of the worst-case impacts would be less than the overall duration, and depends on the rate of progress.
Note 2: Highly Noise Affected, based on ICNG definition (ie predicted noise level at residential receiver is 75 dBA or greater).
Note 3: Based on worst-case predicted noise levels.
Note 4: OOH = Out of hours.

CONSTRUCTION TRAFFIC VOLUMES

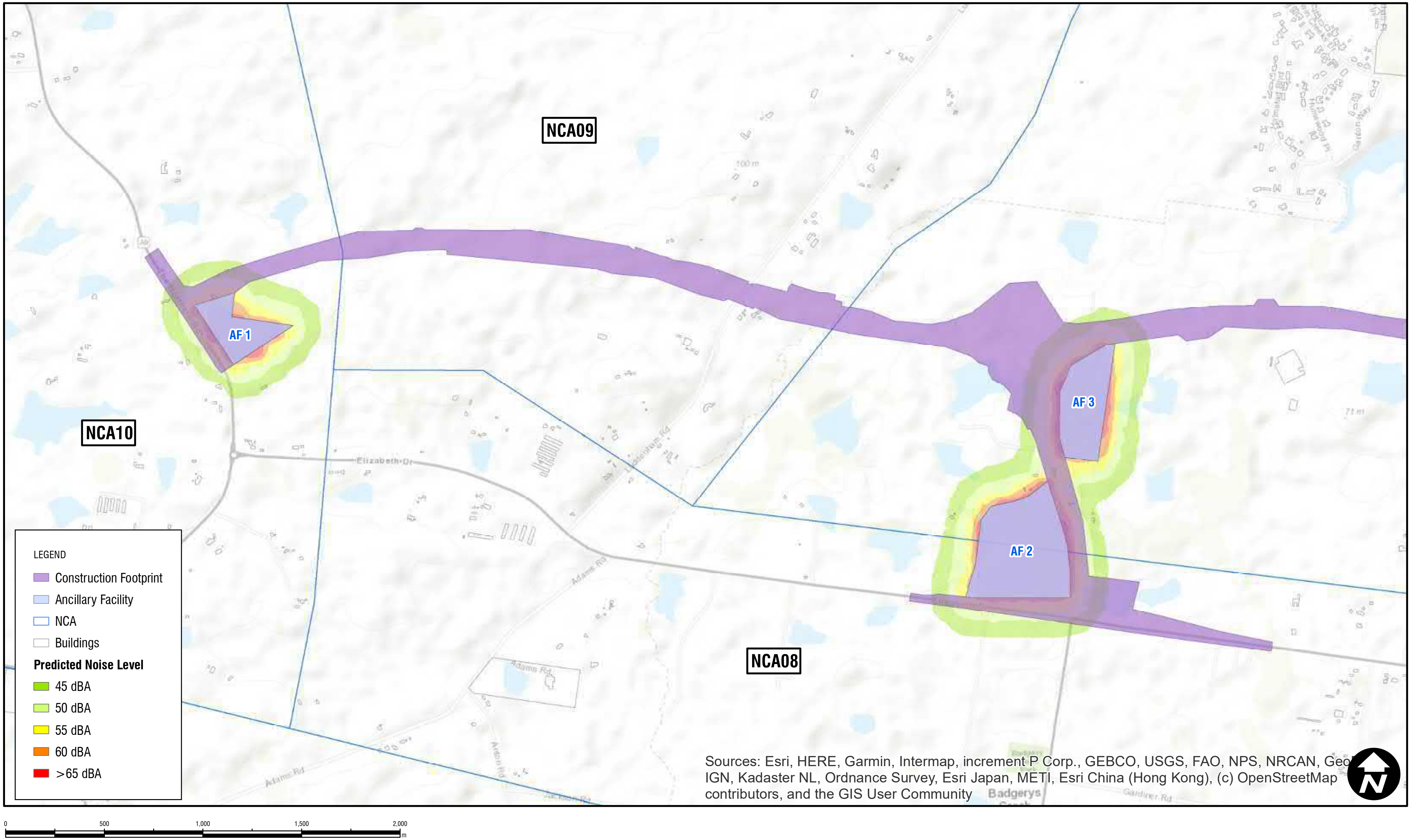
Table 1 Project Construction Traffic Volumes

Road	Section	Baseline traffic volumes - 2024				Proposed construction traffic			
		Day (15 Hour)		Night (9 Hour)		Day (15 Hour)		Night (9 Hour)	
		Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy
M7 Motorway	South of M7 Interchange	52,195	9,991	10,530	2,108	1,742	415	69	94
	Btwn On/Off Ramps to Elizabeth Dr & Wallgrove Rd	44,309	8,263	9,090	1,673	150	0	6	0
	North of M7 Interchange	52,150	8,808	10,781	1,809	571	354	19	83
M7 Motorway – Elizabeth Drive Interchange	NB Off Ramp to Elizabeth Dr	4,288	1,001	851	232	0	205	0	46
	NB On Ramp from Wallgrove Rd	3,069	345	804	124	425	151	14	34
	SB Off Ramp to Elizabeth Dr	5,169	258	930	26	0	203	0	49
	SB On Ramp from Elizabeth Dr	3,381	703	563	203	1,527	203	61	48
Elizabeth Drive	East of M7 Interchange	27,353	2,669	5,812	549	0	0	0	0
	Btwn M7 Interchange & Cecil Rd	21,846	3,839	5,005	722	1,786	489	82	104
	Btwn Cecil Rd & Duff Rd	20,405	3,635	4,804	688	2,780	467	127	80
	Btwn Duff Rd & Mamre Rd	18,943	3,267	4,407	592	2,037	108	93	22
	Btwn Mamre Rd & Devonshire Rd	19,770	2,815	4,153	473	2,479	148	95	36
	Btwn Devonshire Rd & Clifton Ave	13,205	1,865	2,866	223	1,538	272	49	53
	Btwn Clifton Ave & Western Rd	12,520	1,779	2,681	212	1,845	355	59	69
	Btwn Western Rd & Martin Rd	13,299	1,821	2,863	219	1,751	346	65	74
	Btwn Martin Rd & WSA Business Park East Access	12,534	1,580	2,580	145	1,732	333	60	75
	Btwn WSA Business Park East Access & WSA Business Park West Access	12,777	1,618	2,624	150	1,731	333	59	74
	Btwn WSA Business Park West Access & Adams Rd	14,391	958	3,277	129	2,083	407	72	101
	Btwn Adams Rd & Luddenham Rd	13,411	984	3,018	139	1,949	458	72	113
	Btwn Luddenham Rd & The Northern Road	12,430	1,009	2,759	149	1,816	510	72	124
Wallgrove Road	Btwn Elizabeth Dr & M7 NB On Ramp	10,393	1,953	2,233	479	885	342	29	79
	North of M7 NB On Ramp	7,080	1,561	1,429	355	283	136	8	32
Clifton Avenue	North of Elizabeth Dr	1,615	263	431	57	338	120	12	30
The Northern Road	South of Elizabeth Dr	12,109	1,044	2,104	429	36	352	3	81
	Btwn Elizabeth Dr & M12	24,113	1,630	4,529	539	2,213	358	81	81
	North of M12	24,113	1,630	4,529	539	2,213	358	81	81

Table 2 Construction Traffic Volumes – Major Projects

Road	Section	M12 construction traffic				The Northern Road Upgrade construction traffic				Western Sydney Airport construction traffic			
		Day (15 Hour)		Night (9 Hour)		Day (15 Hour)		Night (9 Hour)		Day (15 Hour)		Night (9 Hour)	
		Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy
M7 Motorway	South of M7 Interchange	1,742	415	69	94	22	20	10	5	754	321	126	53
	Btwn On/Off Ramps to Elizabeth Dr & Wallgrove Rd	150	0	6	0	22	20	10	5	754	321	126	53
	North of M7 Interchange	571	354	19	83	22	20	10	5	754	321	126	53
M7 Motorway – Elizabeth Drive Interchange	NB Off Ramp to Elizabeth Dr	0	205	0	46	11	10	5	2.5	189	80	31	13
	NB On Ramp from Wallgrove Rd	425	151	14	34	11	10	5	2.5	189	80	31	13
	SB Off Ramp to Elizabeth Dr	0	203	0	49	11	10	5	2.5	189	80	31	13
	SB On Ramp from Elizabeth Dr	1,527	203	61	48	11	10	5	2.5	189	80	31	13
Elizabeth Drive	East of M7 Interchange	0	0	0	0	22	20	10	5	754	321	126	53
	Btwn M7 Interchange & Cecil Rd	1,786	489	82	104	22	20	10	5	754	321	126	53
	Btwn Cecil Rd & Duff Rd	2,780	467	127	80	22	20	10	5	754	321	126	53
	Btwn Duff Rd & Mamre Rd	2,037	108	93	22	22	20	10	5	754	321	126	53
	Btwn Mamre Rd & Devonshire Rd	2,479	148	95	36	22	20	10	5	754	321	126	53
	Btwn Devonshire Rd & Clifton Ave	1,538	272	49	53	22	20	10	5	754	321	126	53
	Btwn Clifton Ave & Western Rd	1,845	355	59	69	22	20	10	5	754	321	126	53
	Btwn Western Rd & Martin Rd	1,751	346	65	74	22	20	10	5	754	321	126	53
	Btwn Martin Rd & WSA Business Park East Access	1,732	333	60	75	22	20	10	5	754	321	126	53
	Btwn WSA Business Park East Access & WSA Business Park West Access	1,731	333	59	74	22	20	10	5	754	321	126	53
	Btwn WSA Business Park West Access & Adams Rd	2,083	407	72	101	22	20	10	5	0	0	0	0
	Btwn Adams Rd & Luddenham Rd	1,949	458	72	113	22	20	10	5	0	0	0	0
	Btwn Luddenham Rd & The Northern Road	1,816	510	72	124	22	20	10	5	0	0	0	0
Wallgrove Road	Btwn Elizabeth Dr & M7 NB On Ramp	885	342	29	79	22	20	10	5	189	80	31	13
	North of M7 NB On Ramp	283	136	8	32	0	0	0	0	0	0	0	0
Clifton Avenue	North of Elizabeth Dr	338	120	12	30	0	0	0	0	0	0	0	0
The Northern Road	South of Elizabeth Dr	36	352	3	81	197	176	10	49	0	0	0	0
	Btwn Elizabeth Dr & M12	2,213	358	81	81	197	176	10	49	0	0	0	0
	North of M12	2,213	358	81	81	197	176	10	49	0	0	0	0

CONSTRUCTION NOISE CONTOURS
SCENARIO 2A, ANCILLARY FACILITIES – GENERAL OPERATION



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AF 1
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Elizabeth Dr
Adams Rd
LEGEND
Construction Footprint
Ancillary Facility
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Buildings
Predicted Noise Level
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>65 dBA
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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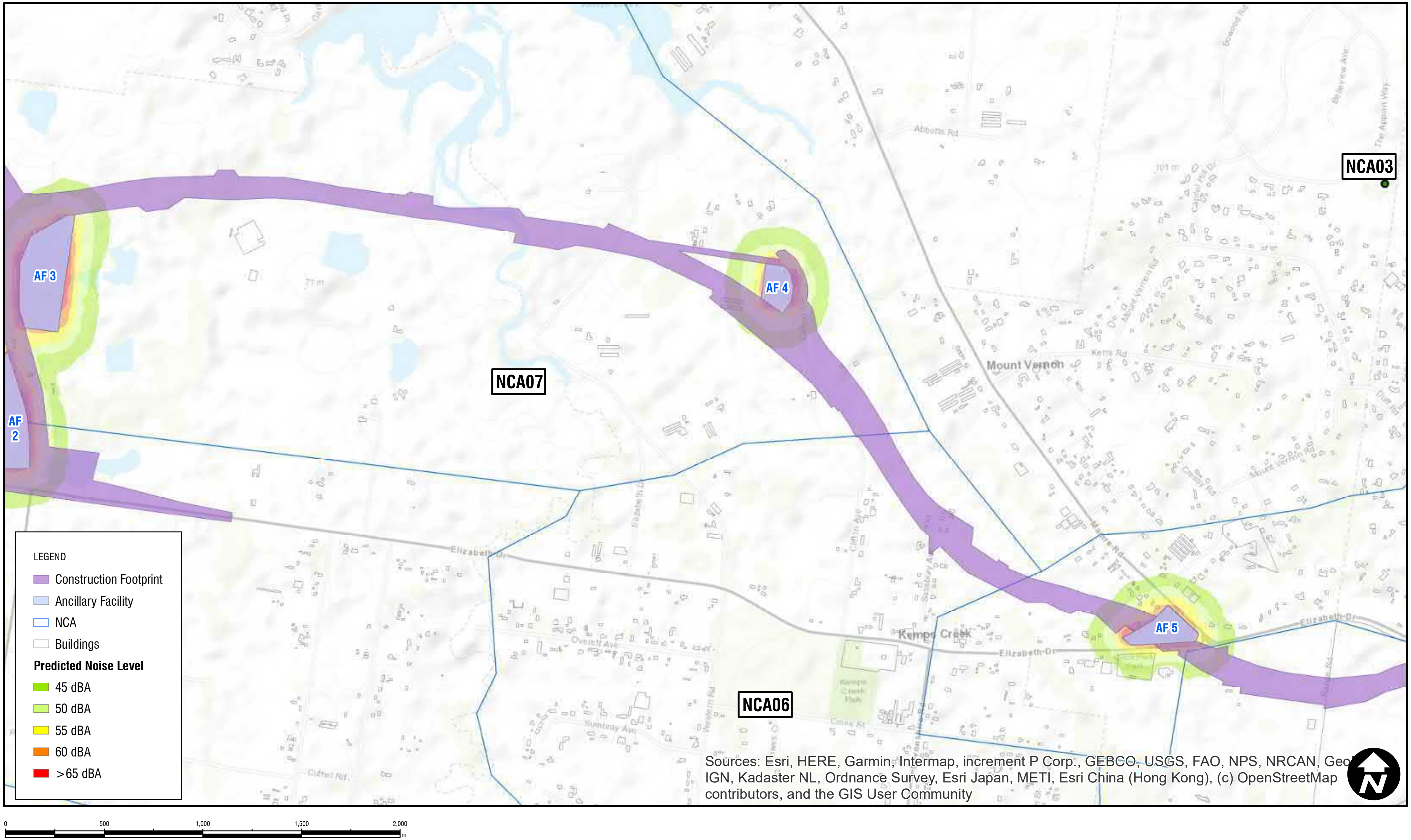
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Construction Footprint
Ancillary Facility
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Buildings
Predicted Noise Level
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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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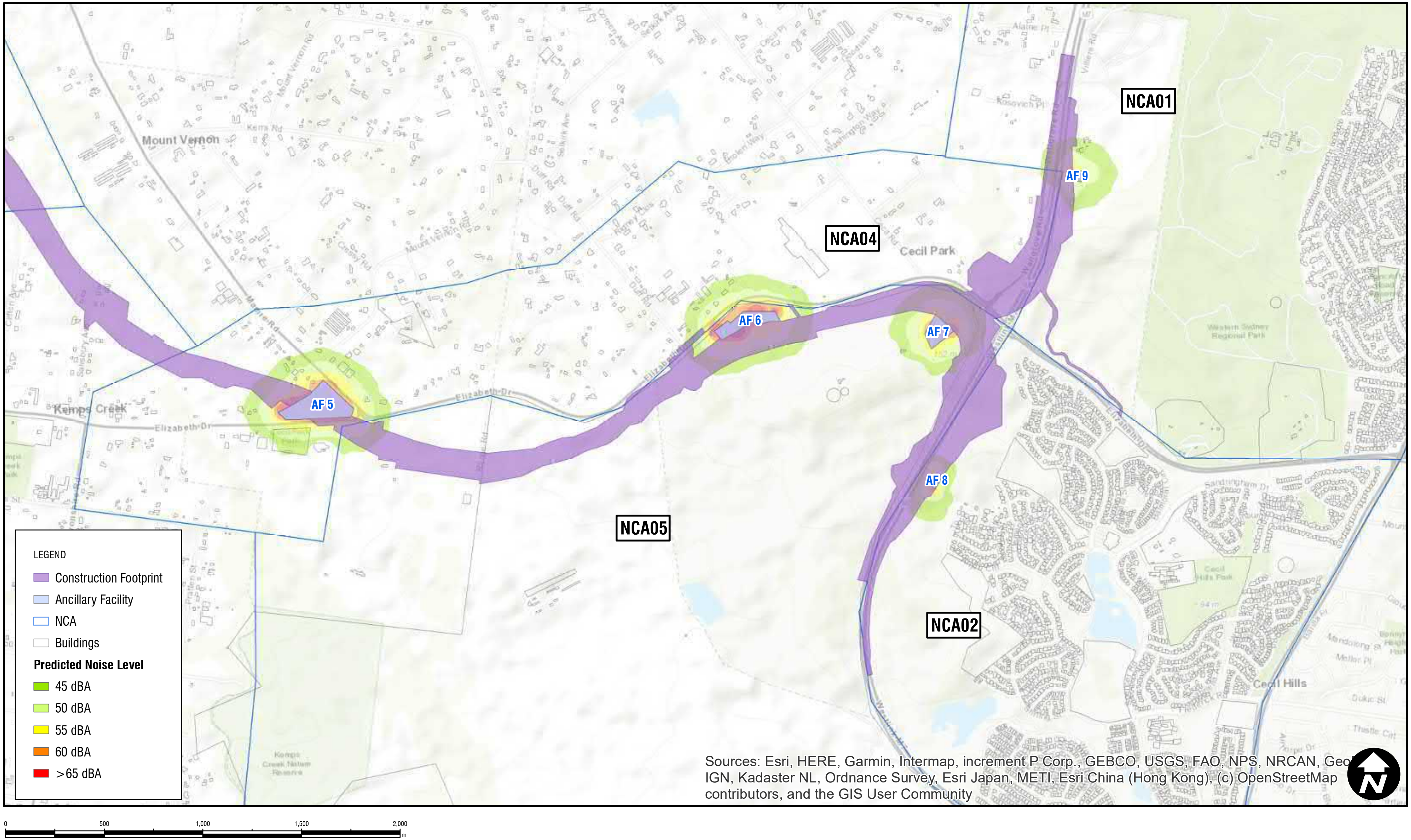
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Elizabeth Dr
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Construction Footprint
Ancillary Facility
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Buildings
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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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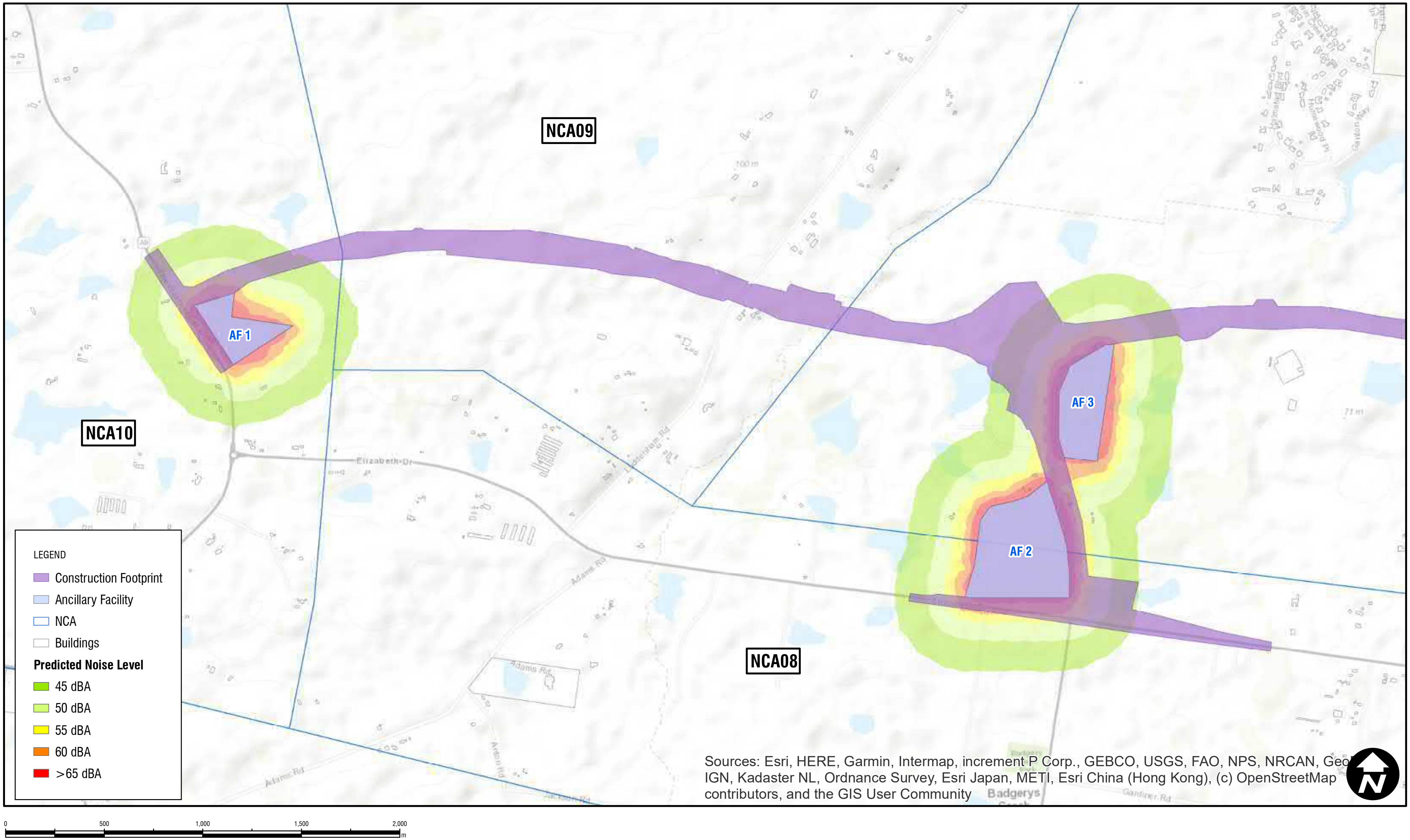
CONSTRUCTION NOISE CONTOURS
SCENARIO 2B, ANCILLARY FACILITIES – STOCKPILING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Buildings
Predicted Noise Level
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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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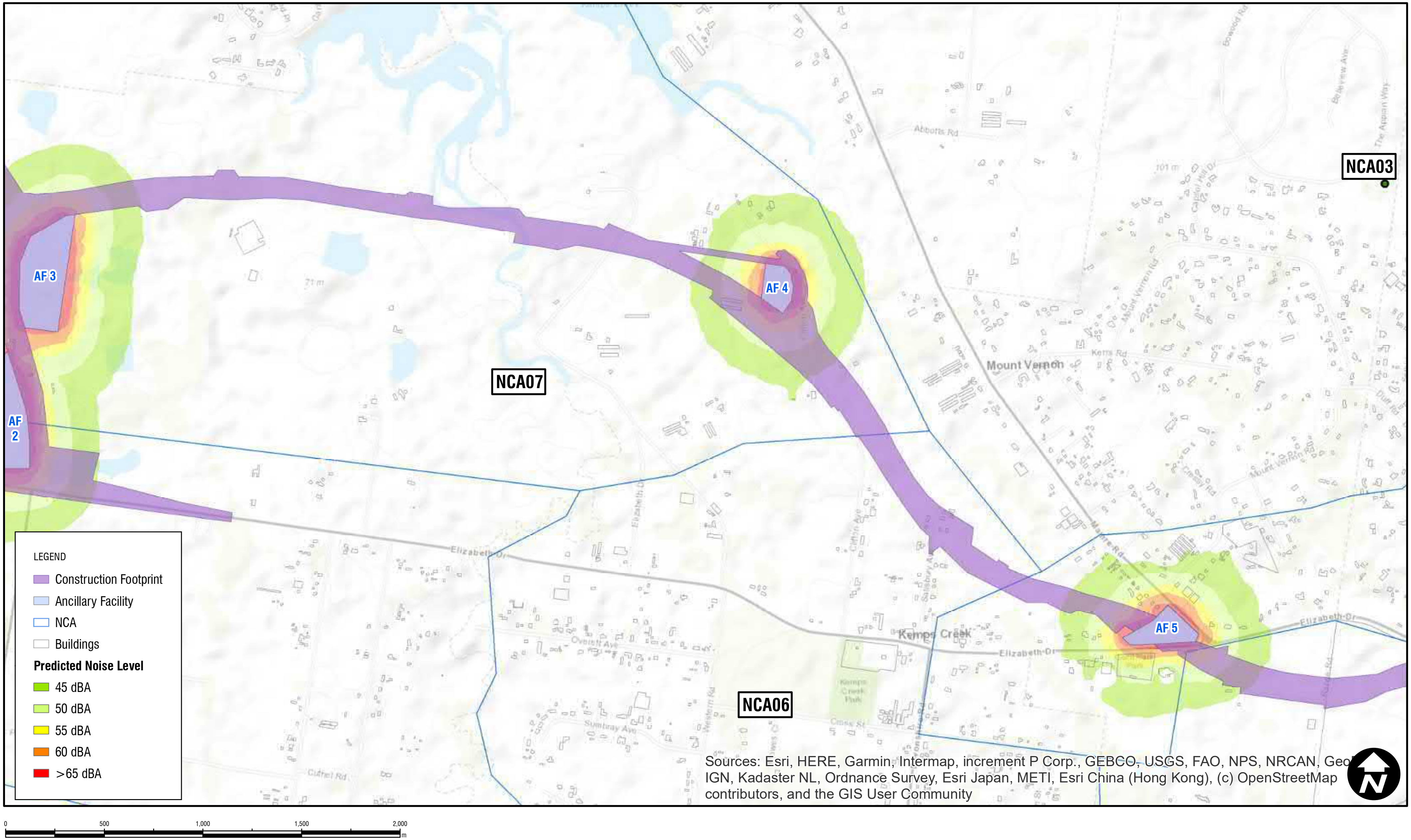
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Construction Footprint
Ancillary Facility
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Buildings
Predicted Noise Level
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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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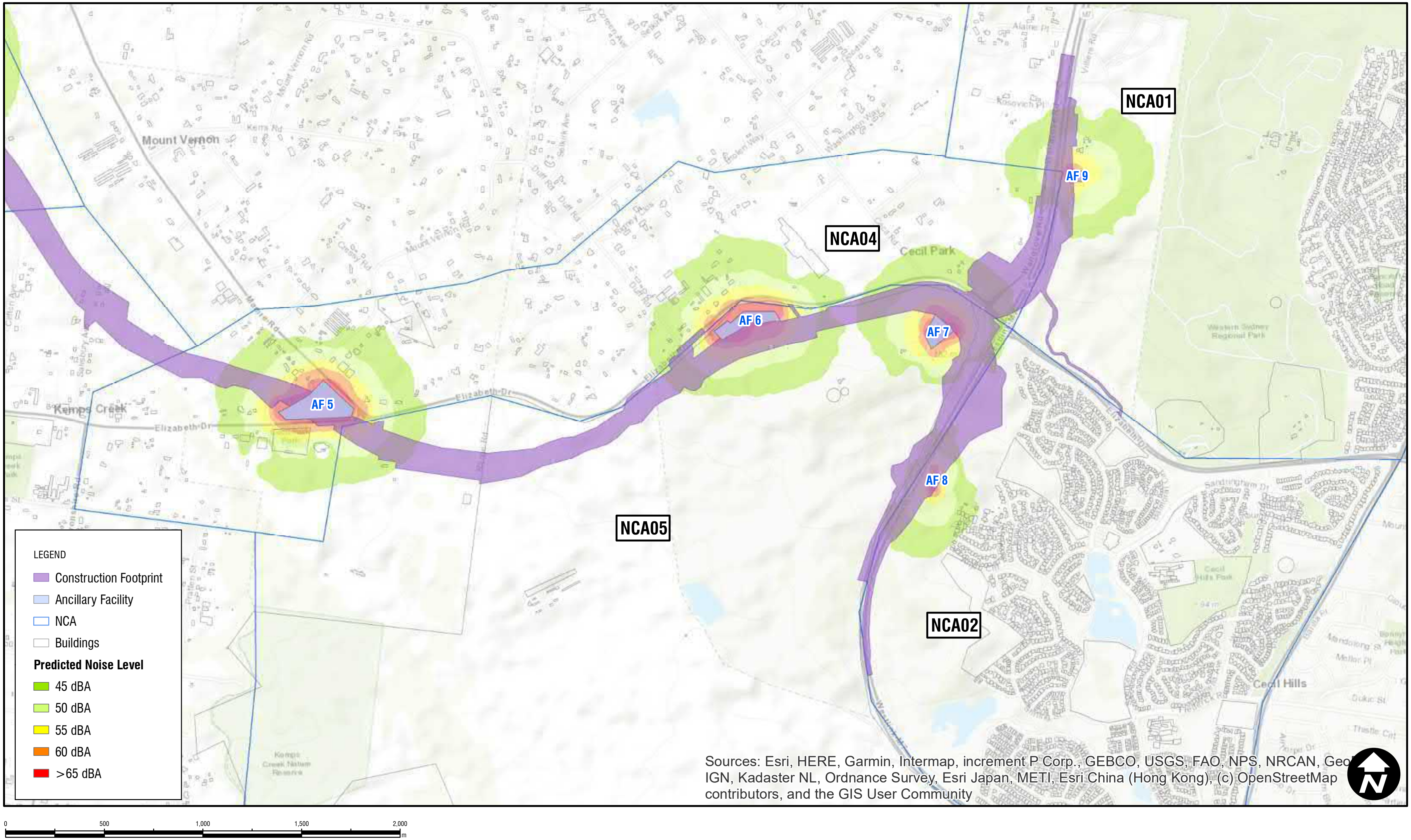

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Elizabeth Dr
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Construction Footprint
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Buildings
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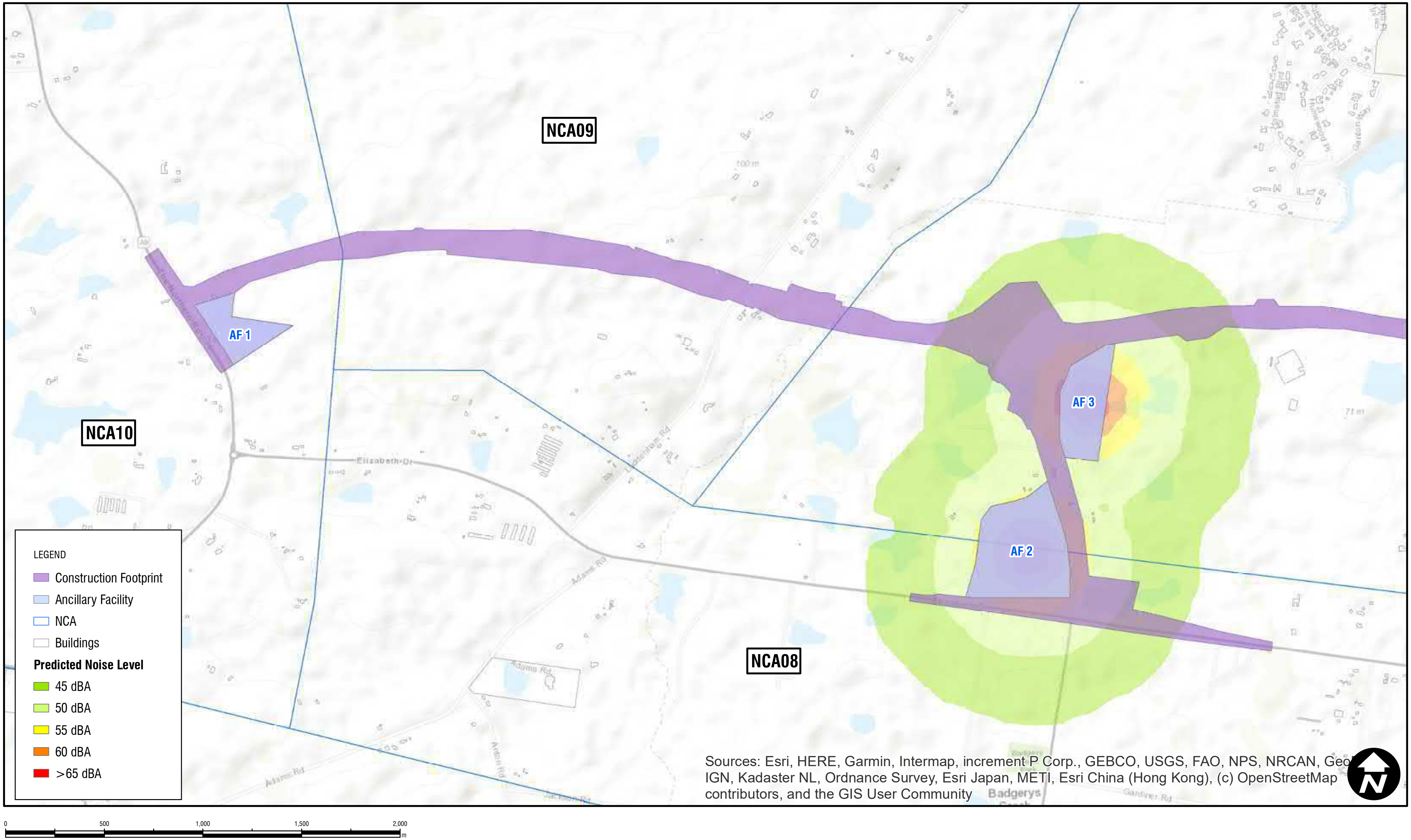
CONSTRUCTION NOISE CONTOURS
SCENARIO 2C, ANCILLARY FACILITIES – BATCHING PLANT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Construction Footprint
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Buildings
Predicted Noise Level
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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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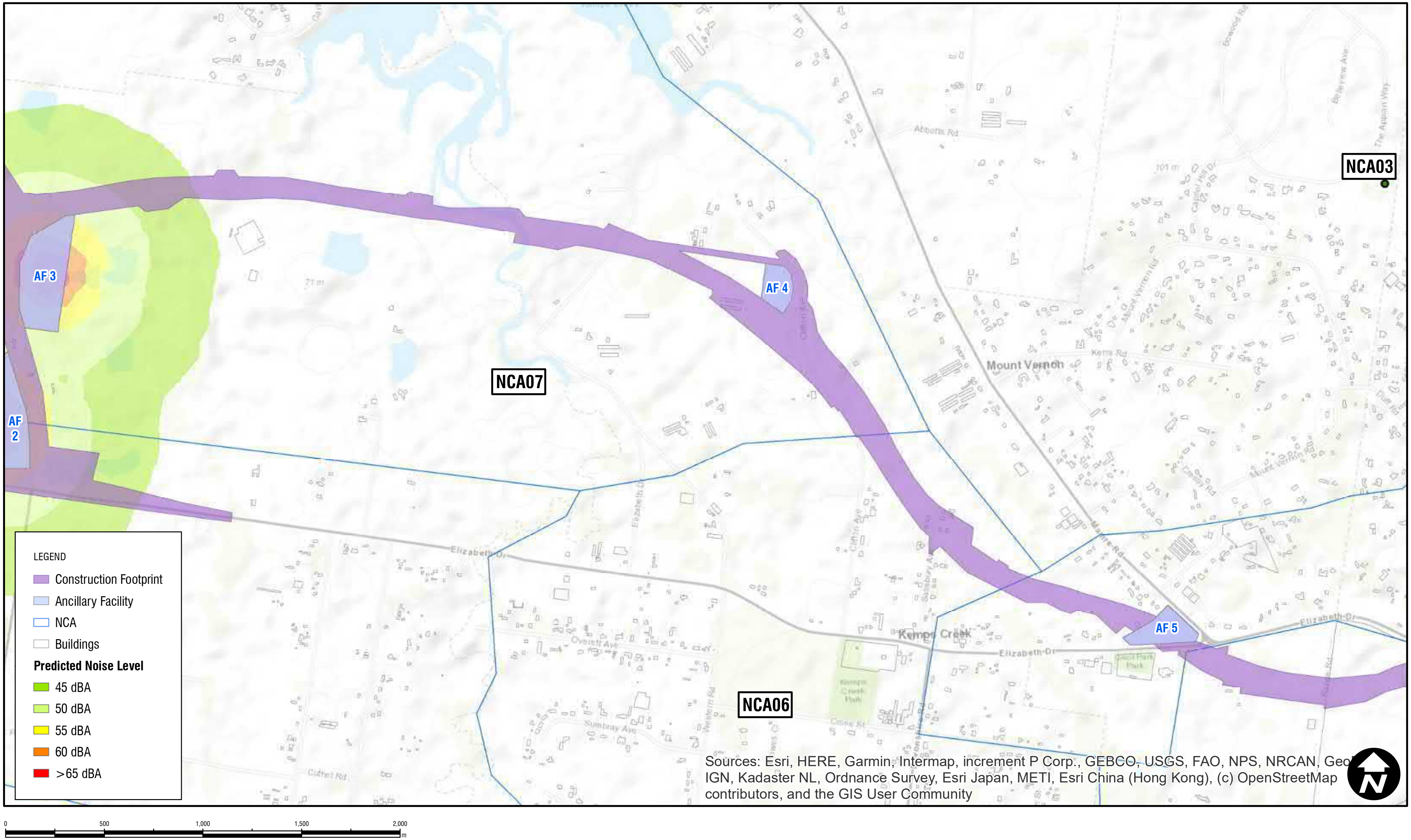
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Buildings
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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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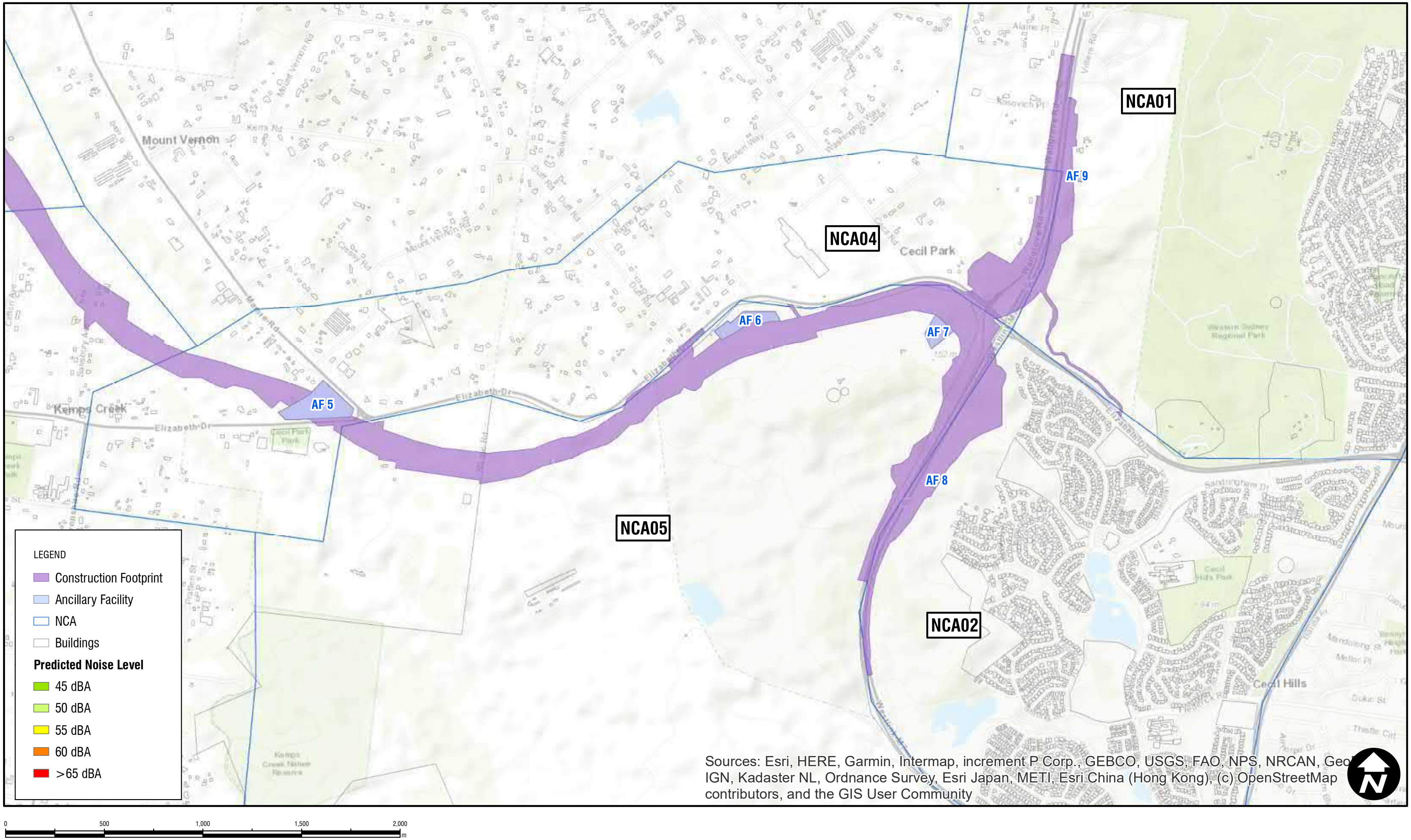
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Buildings
Predicted Noise Level
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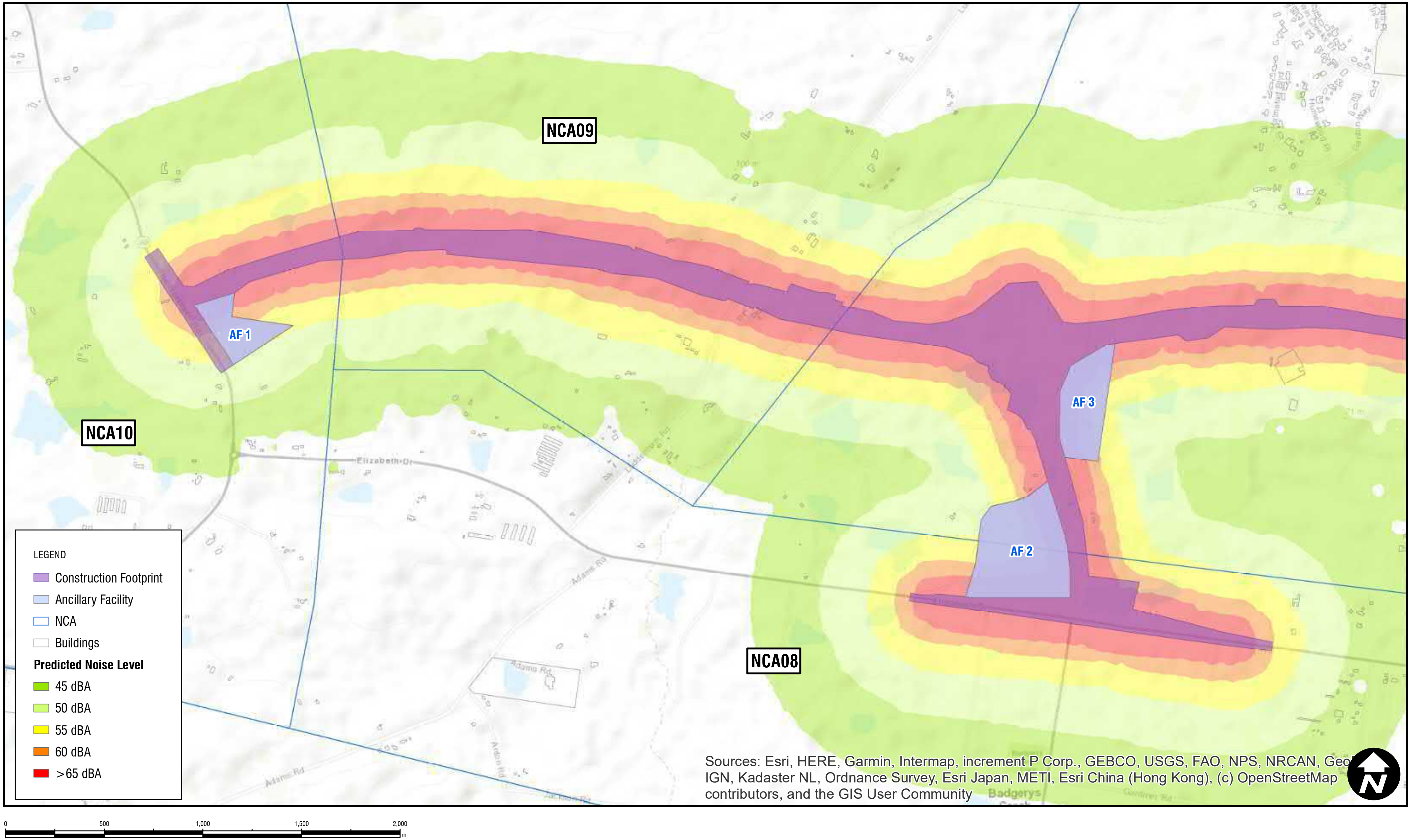
CONSTRUCTION NOISE CONTOURS
SCENARIO 6A, EARTHWORKS – PEAK IMPACT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Predicted Noise Level
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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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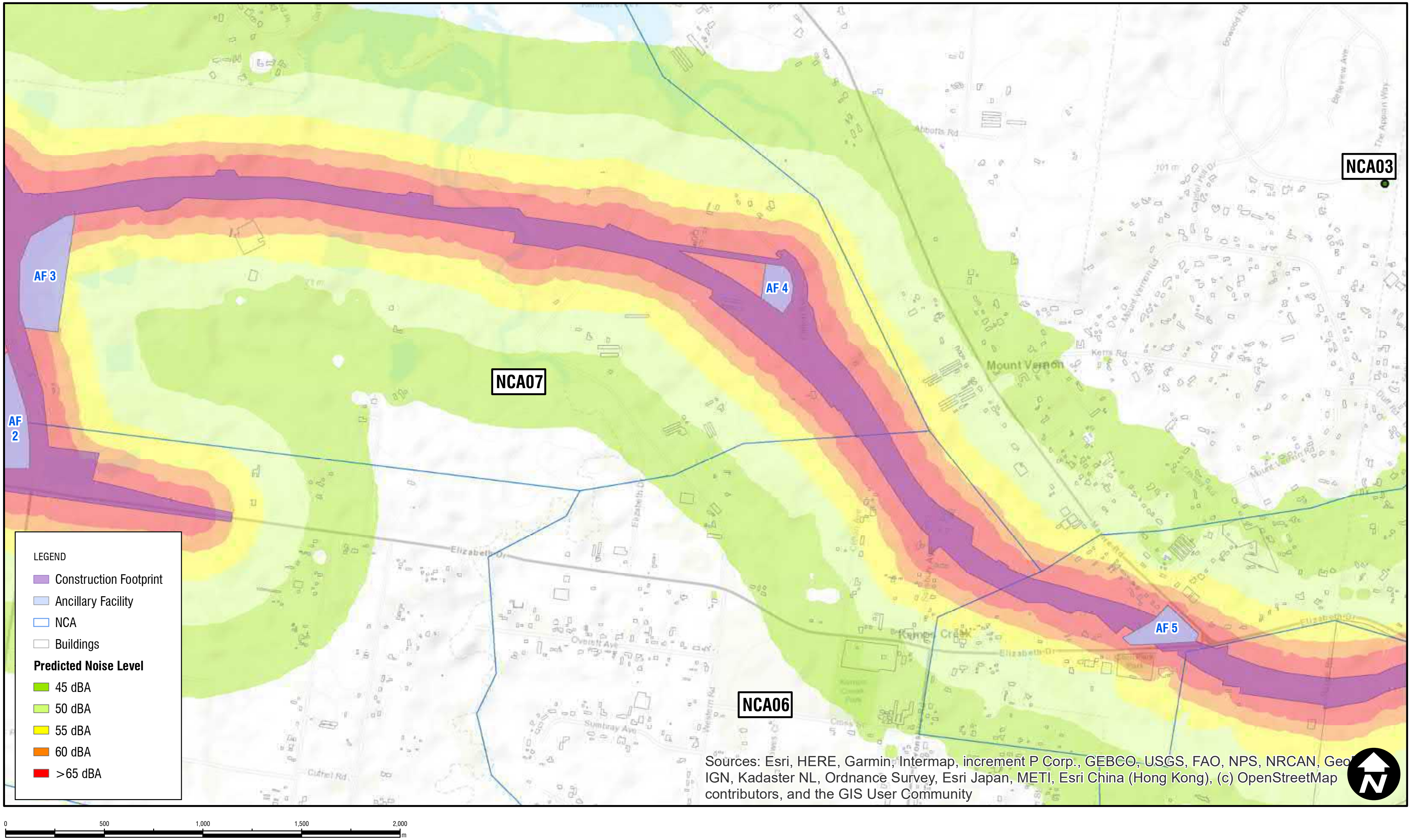
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Construction Footprint
Ancillary Facility
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Buildings
Predicted Noise Level
45 dBA
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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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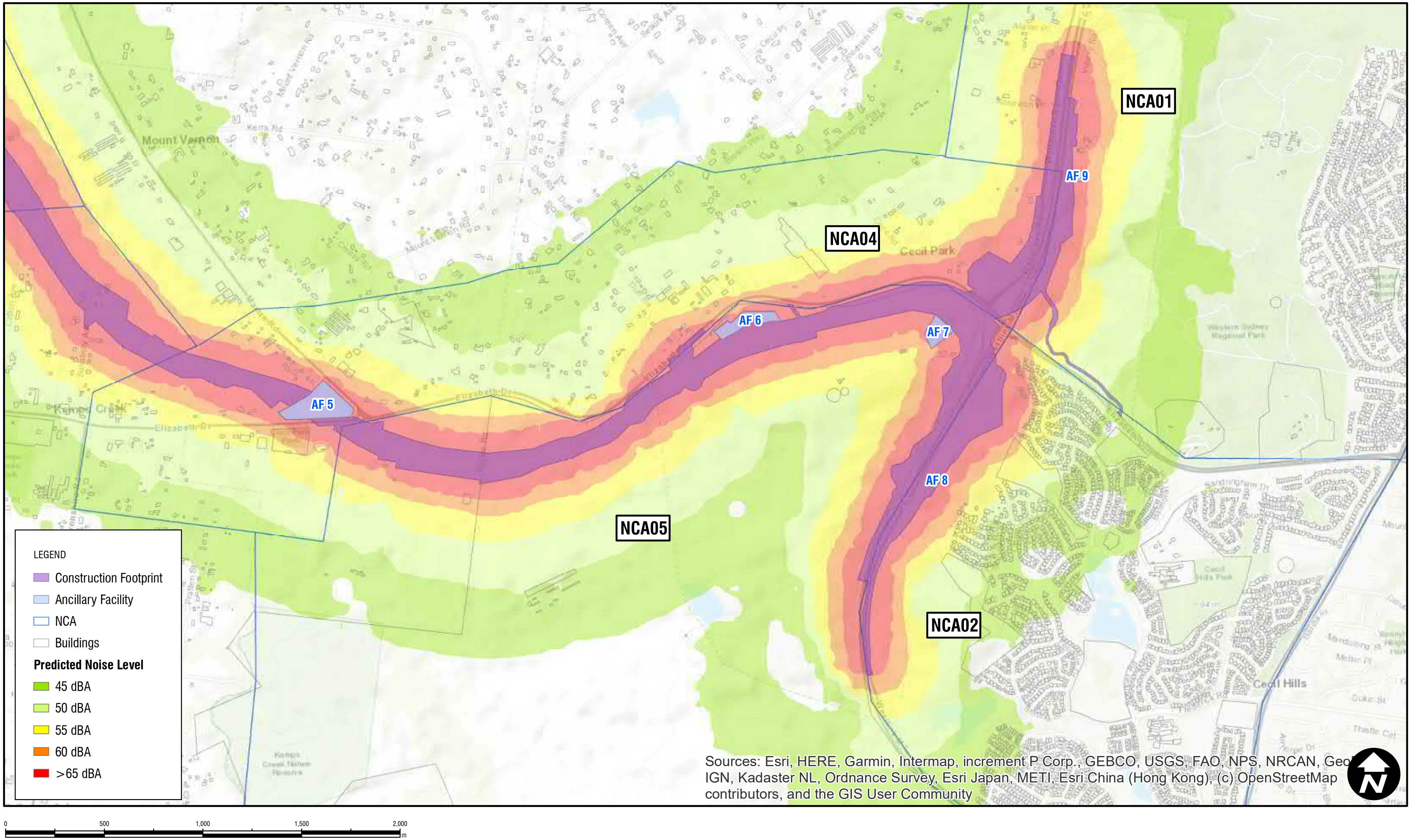

NCA01
NCA02
NCA04
NCA05
AF 5
AF 6
AF 7
AF 8
AF 9
Mount Vernon
Cecil Park
Kemps Creek
Cecil Hills
LEGEND
Construction Footprint
Ancillary Facility
NCA
Buildings
Predicted Noise Level
45 dBA
50 dBA
55 dBA
60 dBA
>65 dBA
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
0
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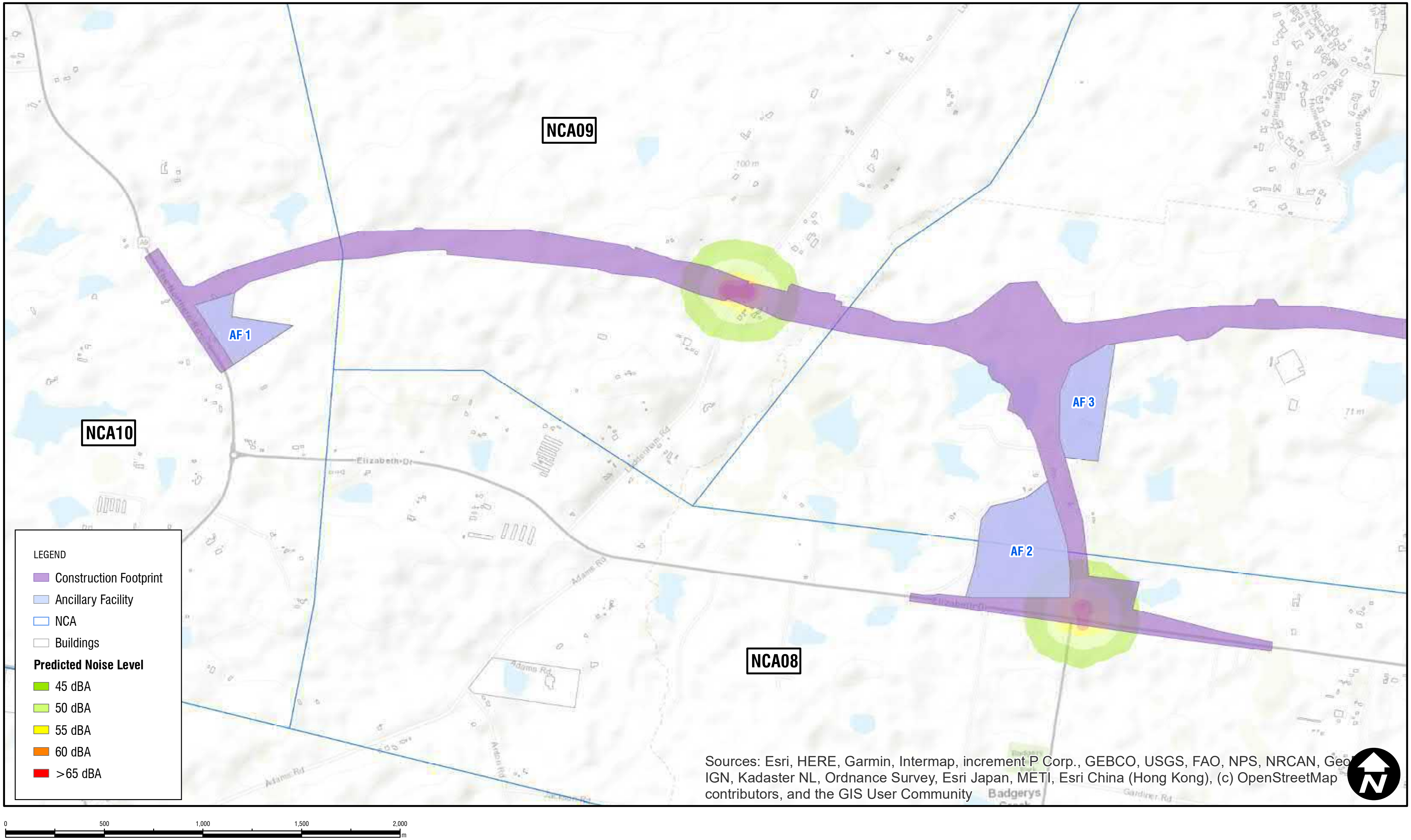
1,000
1,500
2,000
m

CONSTRUCTION NOISE CONTOURS
SCENARIO 7D, BRIDGE WORKS – GIRDER LIFTS OVER EXISTING ROADS



NCA09
NCA10
NCA08
AF 1
AF 2
AF 3
Elizabeth Dr
Adams Rd
LEGEND
Construction Footprint
Ancillary Facility
NCA
Buildings
Predicted Noise Level
45 dBA
50 dBA
55 dBA
60 dBA
>65 dBA
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Badgerys Creek
0
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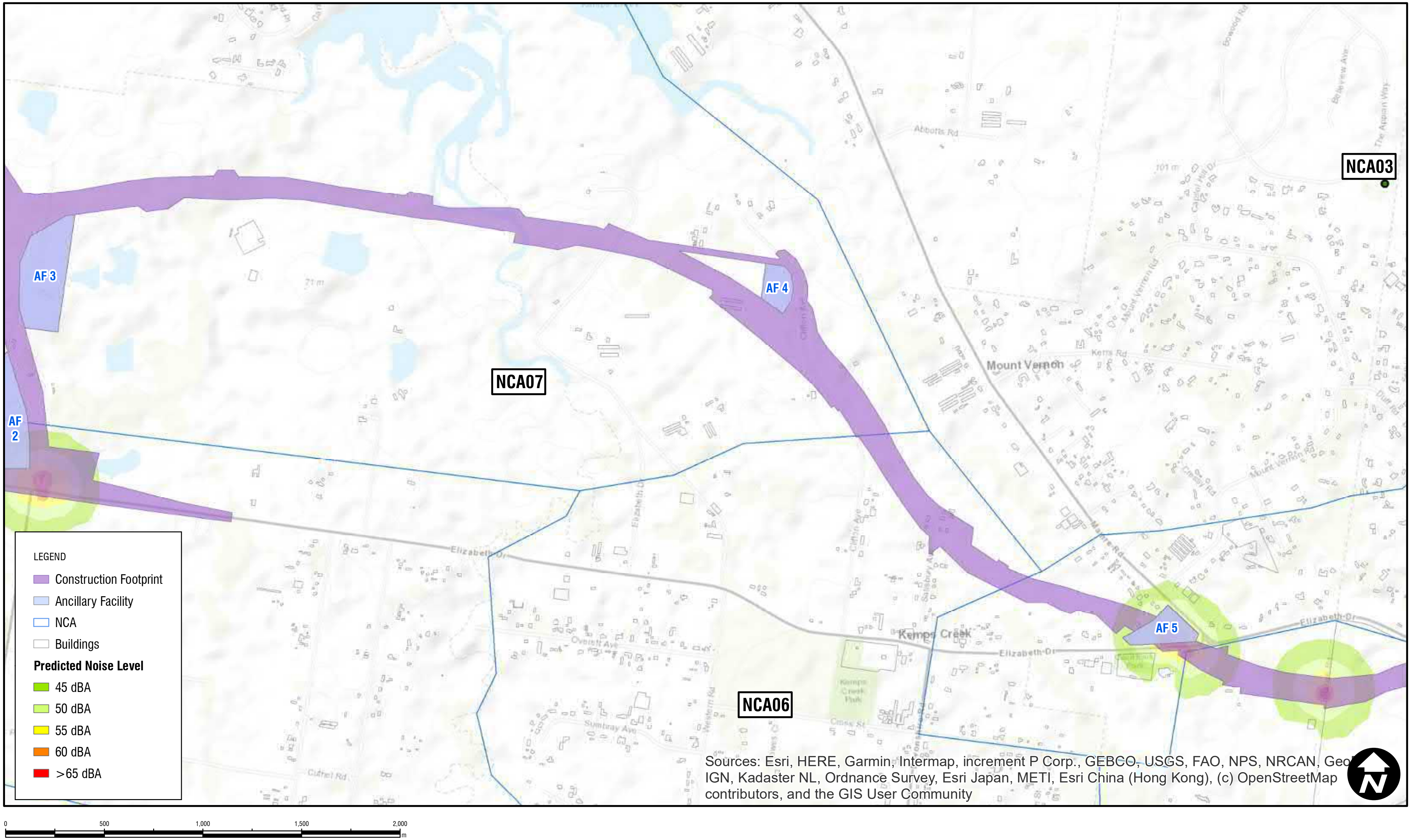
1,000
1,500
2,000
m


NCA03
NCA07
NCA06
AF 3
AF 4
AF 2
AF 5
Mount Vernon
Kemps Creek
Elizabeth Dr
Abbotts Rd
Kerrs Rd
Mamre Rd
Mount Vernon Rd
LEGEND
Construction Footprint
Ancillary Facility
NCA
Buildings
Predicted Noise Level
45 dBA
50 dBA
55 dBA
60 dBA
>65 dBA
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
0
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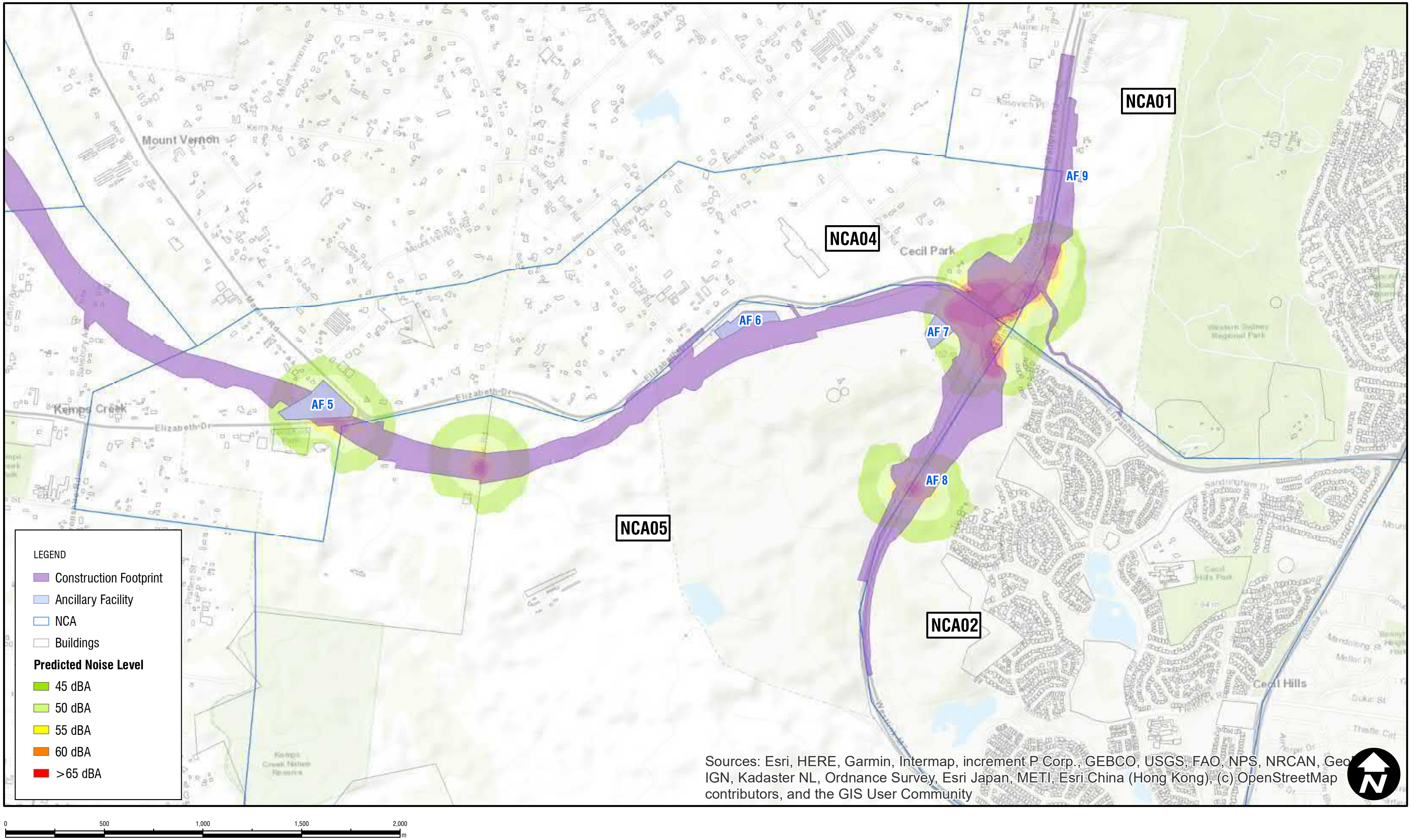

NCA01
NCA04
NCA05
NCA02
AF 5
AF 6
AF 7
AF 8
AF 9
Mount Vernon
Kemps Creek
Cecil Park
Cecil Hills
Elizabeth Dr
LEGEND
Construction Footprint
Ancillary Facility
NCA
Buildings
Predicted Noise Level
45 dBA
50 dBA
55 dBA
60 dBA
>65 dBA
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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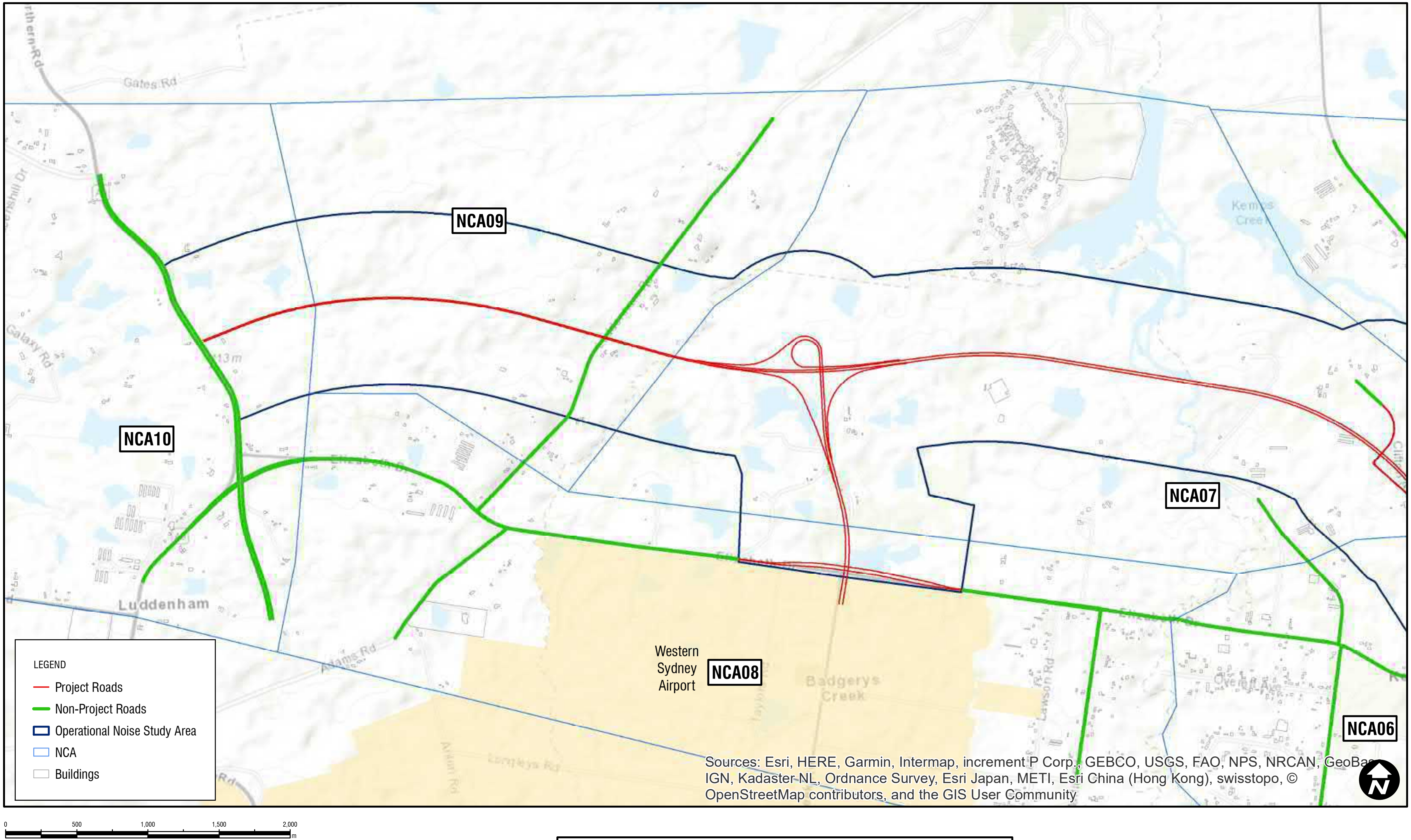
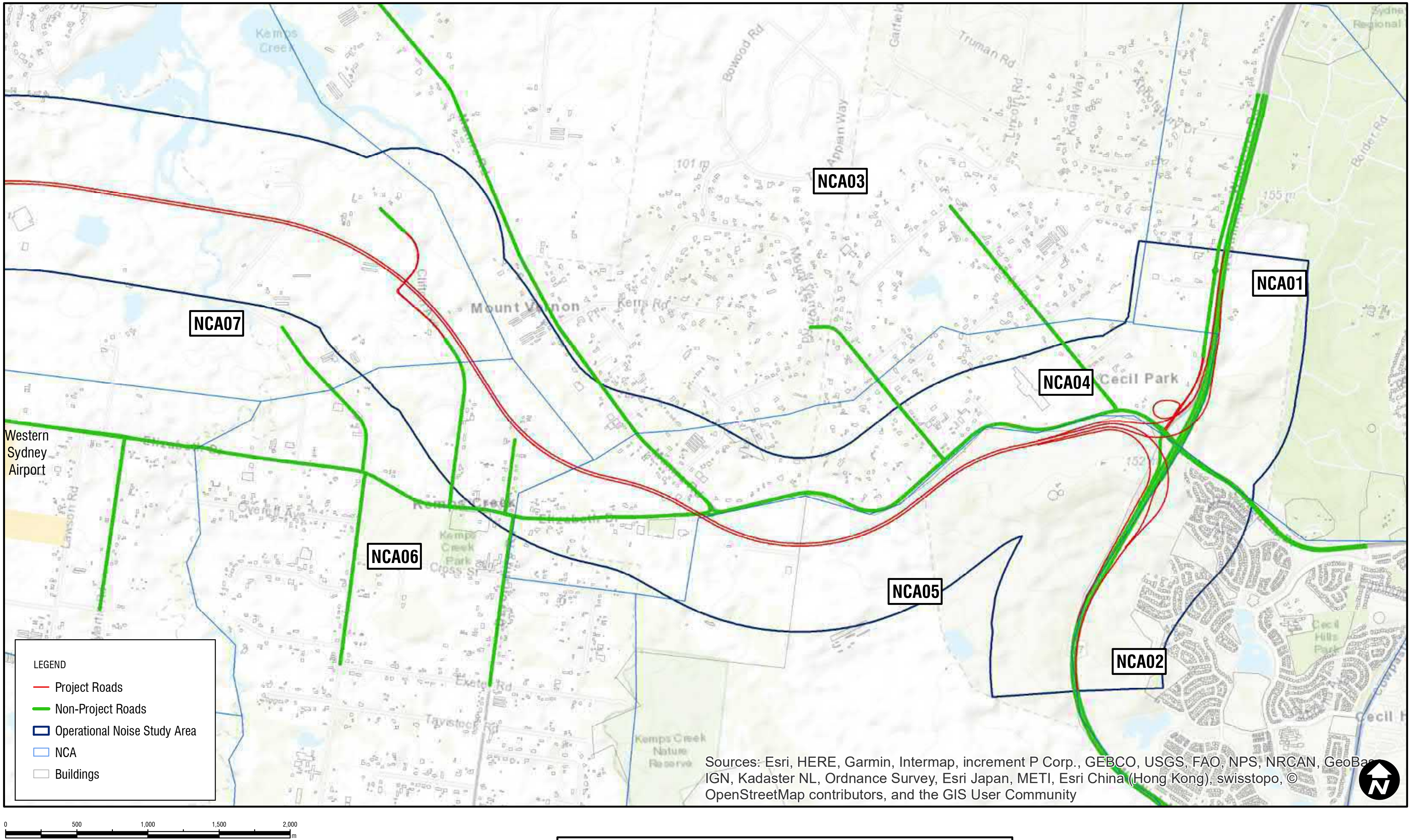
Annexure D Operational information

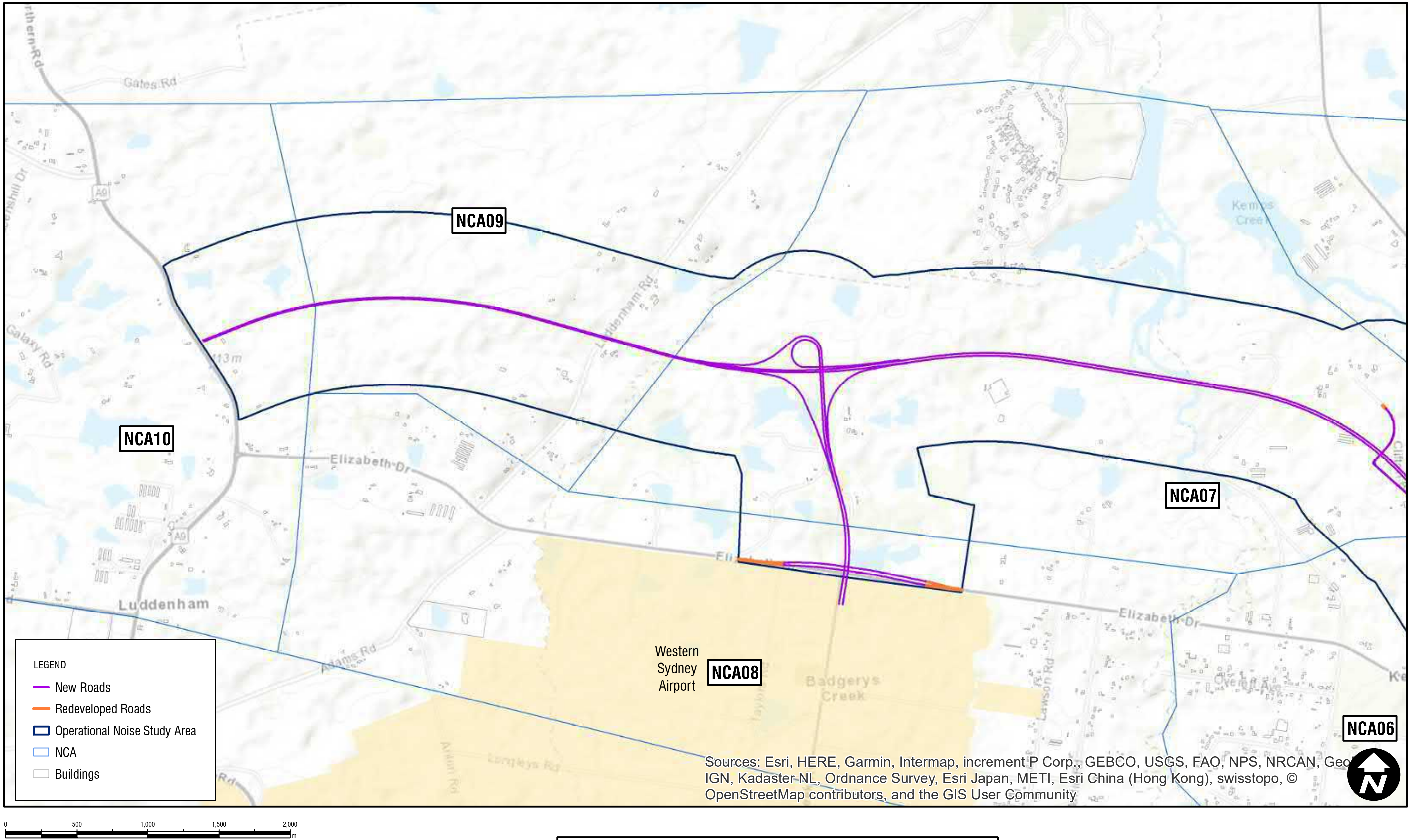
NOISE CRITERIA GUIDELINE REQUIREMENTS



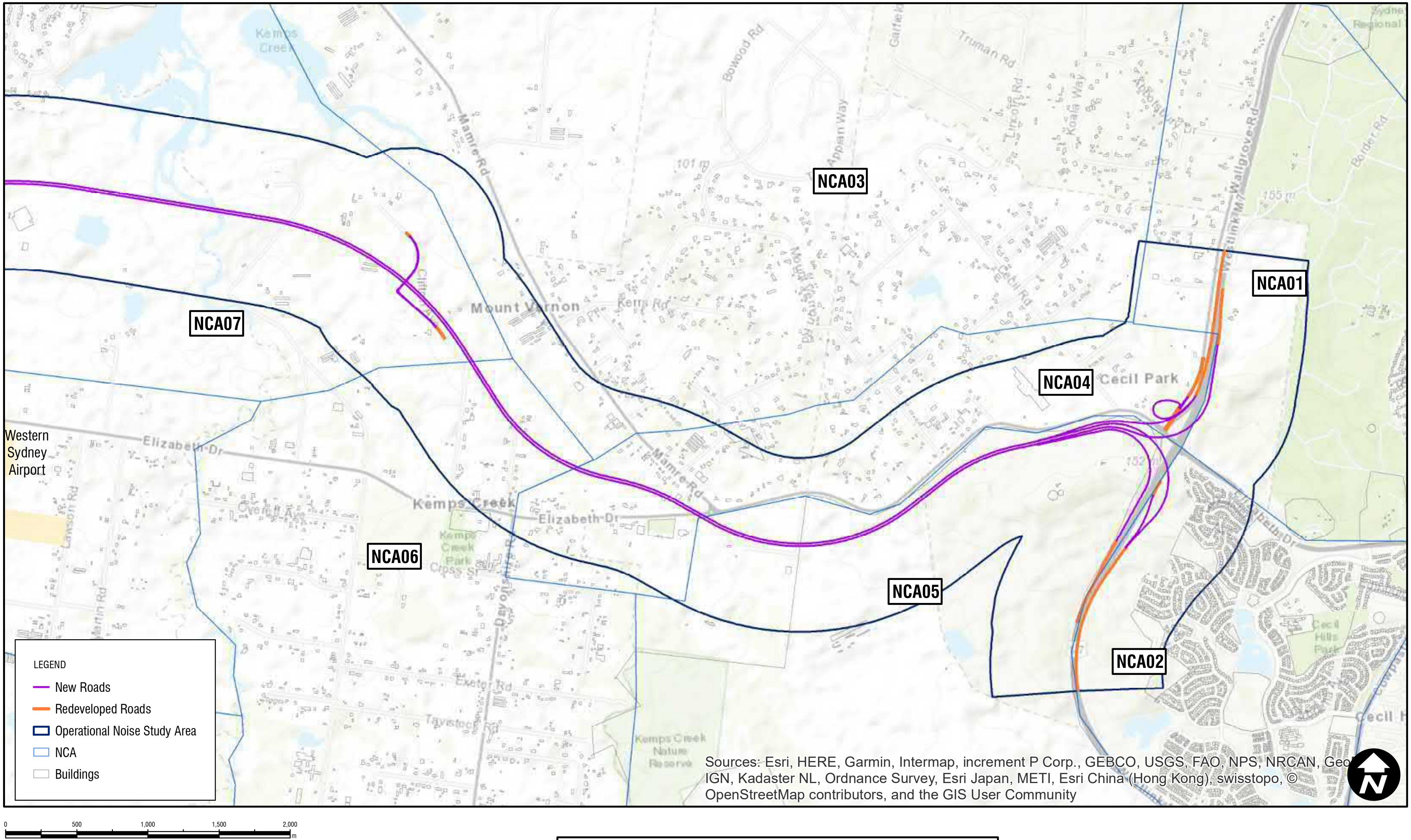
Road Classifications - Project and Non-Project Roads
BUILD



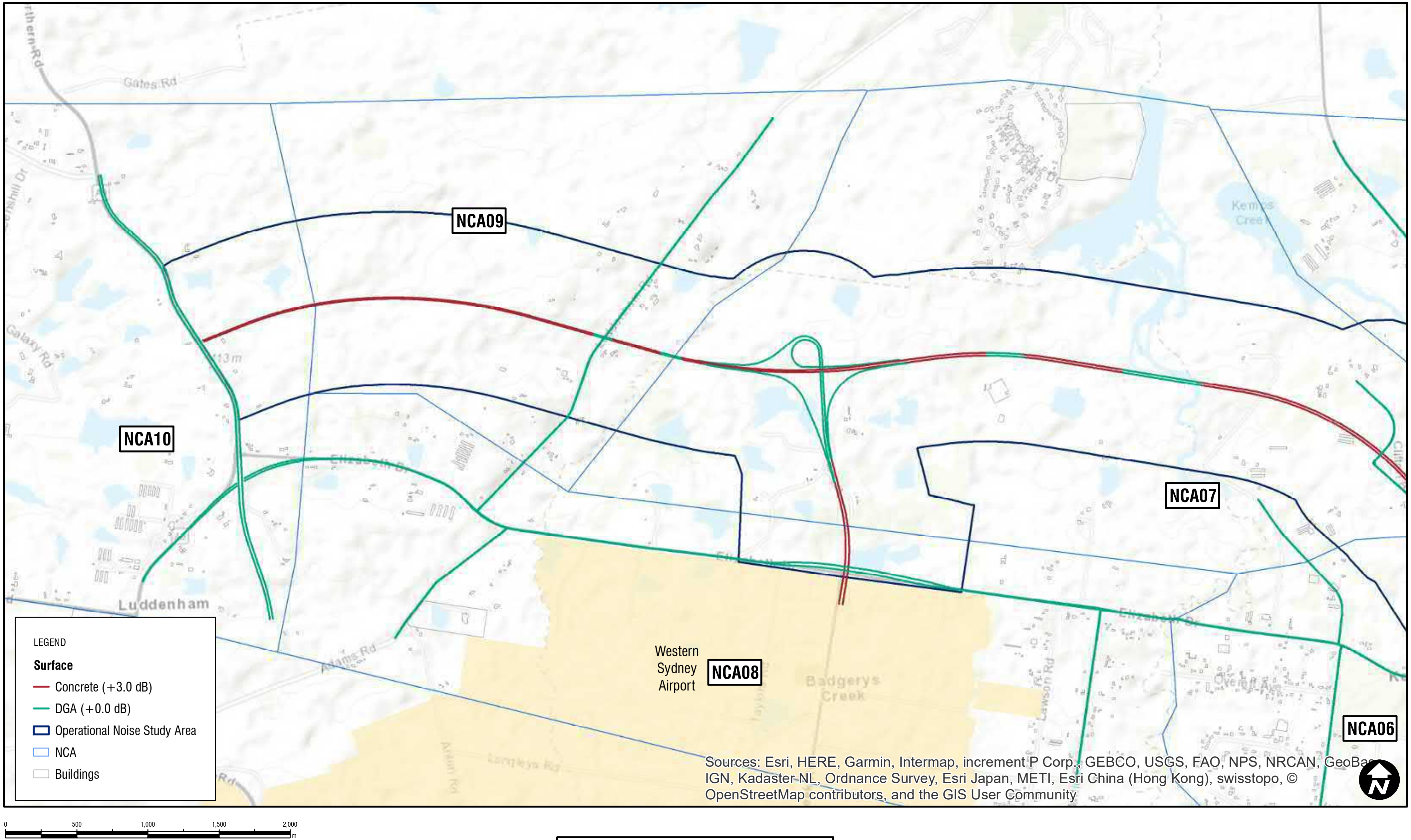
Road Classifications - Project and Non-Project Roads
BUILD



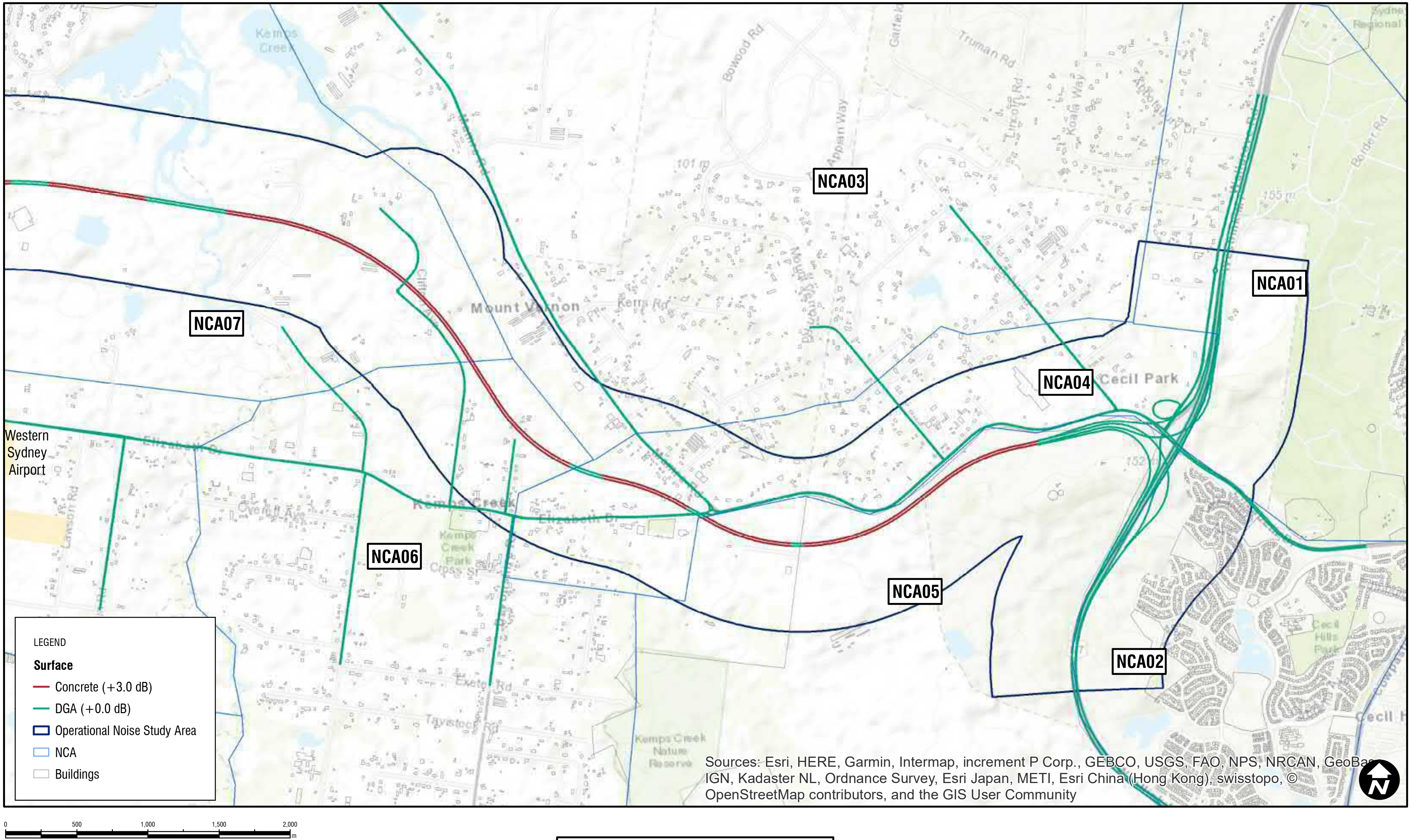
Road Classifications - New and Redeveloped Roads
BUILD



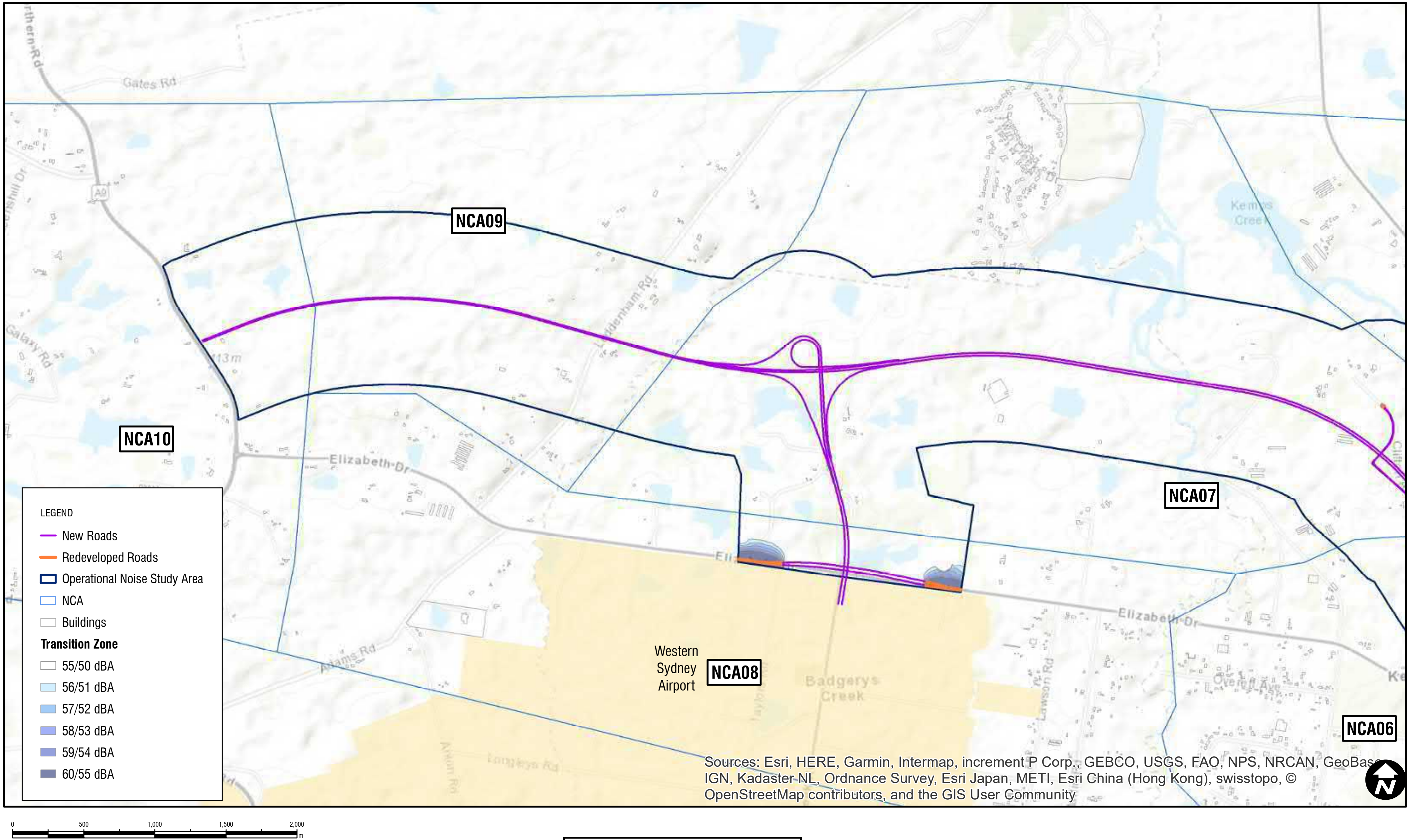
Road Classifications - New and Redeveloped Roads
BUILD



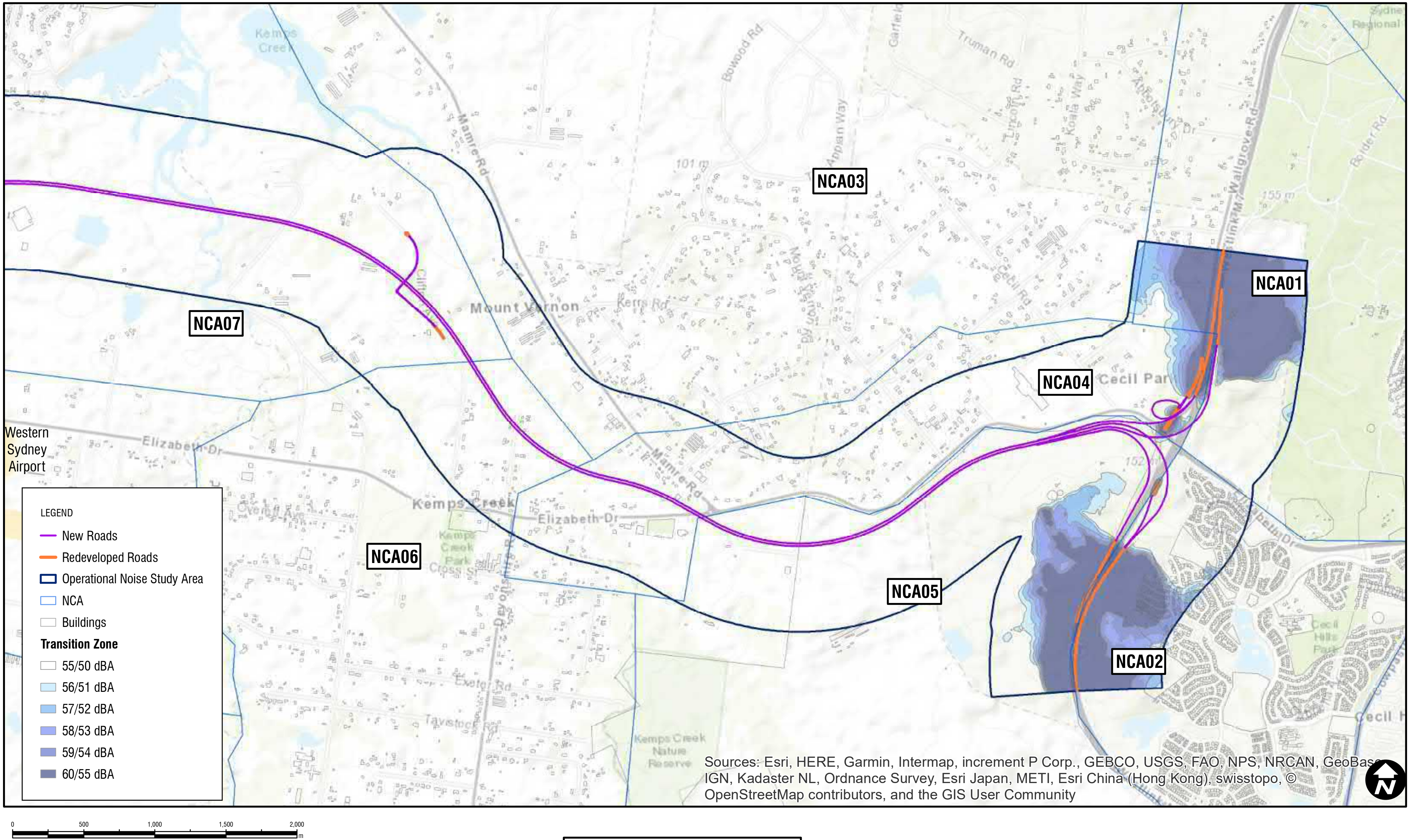
Operational Surface Corrections
BUILD



Operational Surface Corrections
BUILD



Operational Transition Zone
BUILD



Operational Transition Zone
BUILD

TRAFFIC DATA – VALIDATION 2017

	Measured Traffic Volumes - 2017					
	Day (15 Hour)			Night (9 Hour)		
	Light	Heavy	Speed km/h	Light	Heavy	Speed km/h
The Northern Road - Southbound						
North of Elizabeth Dr	5,957	843	67	1,310	277	67
The Northern Road - Northbound						
North of Elizabeth Dr	6,420	872	73	980	160	74
Luddenham Road - Southbound						
North of Elizabeth Dr	2,198	182	61	341	28	63
Luddenham Road - Northbound						
North of Elizabeth Dr	1,949	118	61	541	40	62
Mamre Road - Southbound						
North of Elizabeth Dr	6,854	1,096	63	1,528	225	67
Mamre Road - Northbound						
North of Elizabeth Dr	6,153	1,098	62	1,688	176	65
Elizabeth Drive - Eastbound						
Btwn The Northern Rd & Luddenham Rd	3,148	474	81	1,029	201	82
Btwn Luddenham Rd & Devonshire Rd	4,282	1,168	76	1,198	339	78
Btwn Devonshire Rd & Mamre Rd	7,321	1,396	58	1,917	458	62
East of Mamre Rd	8,228	1,694	73	1,982	540	75
Elizabeth Drive - Westbound						
East of Mamre Rd	8,562	2,313	66	1,656	321	71
Btwn Mamre Rd & Devonshire Rd	8,725	1,446	61	1,498	181	67
Btwn Devonshire Rd & Luddenham Rd	4,995	1,235	75	699	149	75
Btwn Luddenham Rd & The Northern Rd	3,776	544	78	469	70	78

TRAFFIC DATA – 2026

	No Build - 2026				Build - 2026			
	Day (15 Hour)		Night (9 Hour)		Day (15 Hour)		Night (9 Hour)	
	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy
M7 Motorway - Northbound								
South of Off Ramp to M12	28,212	5,699	6,239	1,273	30,150	5,940	6,683	1,287
Btwn Off Ramp to M12 & Off Ramp to Elizabeth Dr	28,212	5,699	6,239	1,273	23,601	4,734	5,696	1,139
Btwn M7 Ramp to Elizabeth Dr & On Ramp from M12/Wallgrove Rd	23,914	4,793	5,401	1,060	21,187	3,851	4,887	923
North of On Ramp from M12/Wallgrove Rd	27,235	5,188	6,327	1,193	32,166	4,520	7,231	1,112
M7 Motorway - Southbound								
North of Off Ramp to M12	28,418	4,122	5,284	725	27,615	3,642	4,995	596
Btwn Off Ramp to M12 & Off Ramp to Elizabeth Dr	28,418	4,122	5,284	725	25,563	3,429	4,554	535
Btwn Off Ramp to Elizabeth Dr & On Ramp from Elizabeth Dr	22,981	3,929	4,250	706	20,340	3,359	3,710	521
Btwn On Ramp from Elizabeth Dr & On Ramp from M12	27,663	4,783	4,994	943	20,340	3,359	3,710	521
South of On Ramp from M12	27,663	4,783	4,994	943	32,726	5,057	6,348	1,070
M7 Interchange								
M7 NB Off Ramp to M12	-	-	-	-	6,943	1,308	1,094	176
M7 NB Off Ramp to Elizabeth Dr	5,041	1,081	976	248	2,784	955	914	229
M7 NB On Ramp from M12	-	-	-	-	6,934	247	1,428	80
New M7 NB On Ramp from Wallgrove Rd	-	-	-	-	3,147	296	717	85
Existing M7 NB On Ramp from Wallgrove Rd	3,213	395	900	133	-	-	-	-
M7 SB Off Ramp to M12	-	-	-	-	2,252	227	480	65
M7 SB Off Ramp to Elizabeth Dr	6,211	331	1,131	32	5,658	148	911	26
M7 SB On Ramp from Elizabeth Dr	4,103	744	642	210	2,336	506	455	171
M7 SB On Ramp from M12	-	-	-	-	9,073	1,024	2,016	343
M12 Motorway – Westbound								
Btwn M7 Interchange & Off Ramp to WSA Access Rd	-	-	-	-	10,095	1,675	1,721	259
Btwn Off Ramp to WSA Access Rd & On Ramp from WSA Access Rd	-	-	-	-	5,918	1,418	777	193
Btwn On Ramp from WSA Access Rd & The Northern Road	-	-	-	-	7,539	1,514	1,145	206
M12 Motorway – Eastbound								
Btwn The Northern Road & Off Ramp to WSA Access Rd	-	-	-	-	8,866	1,082	2,059	340
Btwn Off Ramp to WSA Access Rd & On Ramp from WSA Access Rd	-	-	-	-	8,001	1,020	1,849	340
Btwn On Ramp from WSA Access Rd & M7 Interchange	-	-	-	-	15,809	1,257	3,393	418

	No Build - 2026				Build - 2026			
	Day (15 Hour)		Night (9 Hour)		Day (15 Hour)		Night (9 Hour)	
	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy
WSA Interchange								
M12 WB Off Ramp to WSA Access Rd	-	-	-	-	4,284	263	959	66
M12 WB On Ramp from WSA Access Rd	-	-	-	-	1,400	52	332	3
M12 EB Off Ramp to WSA Access Rd	-	-	-	-	1,004	69	240	4
M12 EB On Ramp from WSA Access Rd	-	-	-	-	6,511	147	1,277	49
WSA Access Road - Southbound								
South of Airport Interchange	-	-	-	-	5,319	336	1,209	72
WSA Access Road - Northbound								
South of Airport Interchange	-	-	-	-	7,722	199	1,574	52
Elizabeth Drive - Westbound								
East of M7 Interchange	12,543	1,486	3,136	264	11,529	1,340	2,872	233
Btwn M7 Interchange & Cecil Rd	13,984	2,509	2,842	367	9,917	2,158	2,226	325
Btwn Cecil Rd & Duff Rd	14,435	2,564	2,974	377	10,251	2,197	2,304	331
Btwn Duff Rd & Mamre Rd	13,470	2,302	2,789	327	10,218	2,123	2,294	312
Btwn Mamre Rd & Devonshire Rd	13,345	2,300	2,289	304	10,738	1,884	1,895	265
Btwn Devonshire Rd & Clifton Ave	10,614	1,826	1,869	195	7,731	1,343	1,470	152
Btwn Clifton Ave & Western Rd	10,701	1,860	1,880	195	7,810	1,358	1,490	156
Btwn Western Rd & Martin Rd	11,275	1,768	2,014	194	7,357	1,233	1,313	135
Btwn Martin Rd & WSA Business Park East Access	11,333	1,759	1,903	182	7,309	1,205	1,240	134
Btwn WSA Business Park East Access & WSA Business Park West Access	7,848	858	1,051	80	4,695	405	645	20
Btwn WSA Business Park West Access & Adams Rd	11,399	888	1,802	92	5,556	426	747	24
Btwn Adams Rd & Luddenham Rd	11,266	894	1,647	99	6,122	466	779	30
Btwn Luddenham Rd & The Northern Road	11,132	899	1,492	105	6,688	505	811	36
Elizabeth Drive - Eastbound								
Btwn The Northern Road & Luddenham Rd	5,379	178	1,861	54	4,386	180	1,454	25
Btwn Luddenham Rd & Adams Rd	6,460	176	2,114	51	4,767	169	1,545	27
Btwn Adams Rd & WSA Business Park West Access	7,541	173	2,366	47	5,148	158	1,635	28
Btwn WSA Business Park West Access & WSA Business Park East Access	5,786	207	1,772	65	3,367	131	935	22
Btwn WSA Business Park East Access & Martin Rd	8,000	281	2,014	83	5,270	199	1,423	41
Btwn Martin Rd & Western Rd	8,650	474	2,197	144	5,987	394	1,622	89
Btwn Western Rd & Clifton Ave	8,642	494	2,157	166	5,806	387	1,562	99
Btwn Clifton Ave & Devonshire Rd	9,797	632	2,450	194	6,665	480	1,763	116

	No Build - 2026				Build - 2026			
	Day (15 Hour)		Night (9 Hour)		Day (15 Hour)		Night (9 Hour)	
	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy
Btwn Devonshire Rd & Mamre Rd	13,052	791	3,231	268	11,003	673	2,795	182
Btwn Mamre Rd & Duff Rd	11,389	1,403	2,890	375	9,340	1,121	2,283	298
Btwn Duff Rd & Cecil Rd	11,807	1,564	2,991	420	9,691	1,286	2,423	337
Btwn Cecil Rd & M7 Interchange	13,631	1,806	3,252	461	11,496	1,428	2,687	353
East of M7 Interchange	19,359	1,419	3,561	357	18,257	1,475	3,294	313
Wallgrove Road - Northbound								
Btwn Elizabeth Dr & New M7 On Ramp	6,627	1,212	2,087	328	6,233	876	1,925	256
Btwn New M7 On Ramp & Existing M7 On Ramp	6,627	1,212	2,087	328	3,115	590	1,218	173
North of Existing M7 On Ramp	3,475	826	1,213	197	3,115	590	1,218	173
Wallgrove Road - Southbound								
North of Existing M7 On Ramp	5,151	1,047	425	229	4,295	1,036	341	212
Btwn Existing M7 On Ramp & Elizabeth Dr	5,339	1,063	435	231	4,295	1,036	341	212
Cecil Road - Northbound								
North of Elizabeth Dr	6	0	4	0	0	0	0	0
Cecil Road - Southbound								
North of Elizabeth Dr	1,700	232	249	39	1,632	118	238	15
Duff Road - Northbound								
North of Elizabeth Dr	1,498	308	344	53	344	105	72	17
Duff Road - Southbound								
North of Elizabeth Dr	666	198	222	44	371	153	154	39
Mamre Road - Northbound								
North of Elizabeth Dr	10,448	604	2,688	139	9,751	823	2,732	155
Mamre Road - Southbound								
North of Elizabeth Dr	7,685	1,078	1,528	204	7,804	927	1,556	193
Devonshire Road - Northbound								
South of Elizabeth Dr	4,373	263	935	49	4,835	221	1,102	43
Devonshire Road - Southbound								
South of Elizabeth Dr	4,627	560	841	83	4,231	588	735	84
Salisbury Road - Northbound								
North of Elizabeth Dr	6	0	3	0	3	0	2	0
Salisbury Road - Southbound								
North of Elizabeth Dr	0	0	0	0	0	0	0	0
Clifton Avenue - Northbound								
North of Elizabeth Dr	14	4	5	2	25	0	5	0
Clifton Avenue - Southbound								
North of Elizabeth Dr	1,016	128	265	26	876	93	204	17

	No Build - 2026				Build - 2026			
	Day (15 Hour)		Night (9 Hour)		Day (15 Hour)		Night (9 Hour)	
	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy
Western Road - Northbound								
South of Elizabeth Dr	2,387	329	423	64	122	62	24	11
North of Elizabeth Dr	1,133	127	272	10	1,247	141	353	24
Western Road - Southbound								
North of Elizabeth Dr	287	17	33	0	331	10	43	2
South of Elizabeth Dr	1,419	323	179	46	170	102	26	3
Martin Road - Northbound								
South of Elizabeth Dr	618	170	141	50	780	188	188	48
Martin Road - Southbound								
South of Elizabeth Dr	772	145	234	26	671	120	183	20
Adams Road - Northbound								
South of Elizabeth Dr	1,084	8	174	2	1,418	29	185	2
Adams Road - Southbound								
South of Elizabeth Dr	986	31	168	1	1,028	26	170	0
Luddenham Road - Northbound								
North of Elizabeth Dr	4,962	92	1,177	12	4,540	82	1,001	7
Luddenham Road - Southbound								
North of Elizabeth Dr	6,178	113	1,205	13	5,735	118	1,144	13
The Northern Road - Northbound								
South of Elizabeth Dr	9,245	726	1,302	229	8,275	475	1,099	128
Btwn Elizabeth Dr & M12	20,063	1,290	3,000	319	15,401	795	2,240	169
North of M12	20,063	1,290	3,000	319	18,696	1,761	2,752	326
The Northern Road - Southbound								
North of M12	9,023	675	2,154	304	12,277	1,263	3,047	509
Btwn M12 & Elizabeth Dr	9,023	675	2,154	304	8,417	917	1,858	275
South of Elizabeth Dr	4,085	577	947	261	3,392	538	801	252
The Old Northern Road - Northbound								
West of Elizabeth Dr	2,842	46	968	3	3,349	78	1,035	12
The Old Northern Road - Southbound								
West of Elizabeth Dr	3,956	385	399	33	4,097	475	504	35

TRAFFIC DATA – 2036

	No Build - 2036				Build - 2036			
	Day (15 Hour)		Night (9 Hour)		Day (15 Hour)		Night (9 Hour)	
	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy
M7 Motorway - Northbound								
South of Off Ramp to M12	44,206	8,372	9,175	1,985	46,275	8,295	9,758	2,037
Btwn Off Ramp to M12 & Off Ramp to Elizabeth Dr	44,206	8,372	9,175	1,985	33,193	7,052	7,478	1,721
Btwn M7 Ramp to Elizabeth Dr & On Ramp from M12/Wallgrove Rd	36,758	7,760	7,760	1,902	29,929	6,105	6,542	1,500
North of On Ramp from M12/Wallgrove Rd	41,073	8,295	8,751	2,074	46,647	7,063	9,770	1,764
M7 Motorway - Southbound								
North of Off Ramp to M12	38,124	6,513	6,728	1,426	36,930	5,331	6,650	1,099
Btwn Off Ramp to M12 & Off Ramp to Elizabeth Dr	38,124	6,513	6,728	1,426	31,406	5,082	5,565	1,081
Btwn Off Ramp to Elizabeth Dr & On Ramp from Elizabeth Dr	31,562	6,315	5,323	1,422	26,396	4,960	4,609	1,063
Btwn On Ramp from Elizabeth Dr & On Ramp from M12	43,591	7,415	7,652	1,812	26,396	4,960	4,609	1,063
South of On Ramp from M12	43,591	7,415	7,652	1,812	50,405	7,268	9,157	1,887
M7 Interchange								
M7 NB Off Ramp to M12	-	-	-	-	13,621	1,392	2,381	353
M7 NB Off Ramp to Elizabeth Dr	8,362	796	1,599	136	3,690	1,024	1,042	239
M7 NB On Ramp from M12	-	-	-	-	11,922	425	2,179	117
New M7 NB On Ramp from Wallgrove Rd	-	-	-	-	3,533	360	790	99
Existing M7 NB On Ramp from Wallgrove Rd	4,222	507	970	165	-	-	-	-
M7 SB Off Ramp to M12	-	-	-	-	5,844	263	1,141	22
M7 SB Off Ramp to Elizabeth Dr	7,761	390	1,617	40	5,622	176	1,065	29
M7 SB On Ramp from Elizabeth Dr	11,240	909	2,191	336	5,878	828	1,013	282
M7 SB On Ramp from M12	-	-	-	-	16,916	1,295	3,302	494
M12 Motorway - Westbound								
Btwn M7 Interchange & Off Ramp to WSA Access Rd	-	-	-	-	21,239	1,853	3,853	417
Btwn Off Ramp to WSA Access Rd & On Ramp from WSA Access Rd	-	-	-	-	12,064	1,724	1,346	406
Btwn On Ramp from WSA Access Rd & The Northern Road	-	-	-	-	13,965	1,846	1,891	423
M12 Motorway - Eastbound								
Btwn The Northern Road & Off Ramp to WSA Access Rd	-	-	-	-	19,582	1,564	4,469	527
Btwn Off Ramp to WSA Access Rd & On Ramp from WSA Access Rd	-	-	-	-	16,193	1,435	3,114	522
Btwn On Ramp from WSA Access Rd & M7 Interchange	-	-	-	-	28,472	1,707	5,413	607

	No Build - 2036				Build - 2036			
	Day (15 Hour)		Night (9 Hour)		Day (15 Hour)		Night (9 Hour)	
	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy
WSA Interchange								
M12 WB Off Ramp to WSA Access Rd	-	-	-	-	9,459	142	2,551	16
M12 WB On Ramp from WSA Access Rd	-	-	-	-	1,444	75	489	4
M12 EB Off Ramp to WSA Access Rd	-	-	-	-	3,732	140	1,415	11
M12 EB On Ramp from WSA Access Rd	-	-	-	-	9,715	143	1,831	36
WSA Access Road - Southbound								
South of Airport Interchange	-	-	-	-	13,287	286	4,003	29
WSA Access Road - Northbound								
South of Airport Interchange	-	-	-	-	10,956	218	2,279	40
Elizabeth Drive - Westbound								
East of M7 Interchange	17,151	1,700	4,382	333	12,948	1,416	3,702	260
Btwn M7 Interchange & Cecil Rd	24,561	3,092	5,487	425	13,243	2,253	3,272	317
Btwn Cecil Rd & Duff Rd	25,040	3,163	5,620	439	13,487	2,306	3,326	321
Btwn Duff Rd & Mamre Rd	23,701	2,830	5,367	377	13,596	2,241	3,398	307
Btwn Mamre Rd & Devonshire Rd	21,567	2,855	3,925	365	10,212	2,033	1,940	255
Btwn Devonshire Rd & Clifton Ave	24,821	2,399	4,767	213	12,526	1,792	2,531	210
Btwn Clifton Ave & Western Rd	25,194	2,417	4,829	213	12,748	1,803	2,576	212
Btwn Western Rd & Martin Rd	26,190	1,860	5,086	151	12,664	1,691	2,481	197
Btwn Martin Rd & WSA Business Park East Access	26,391	1,587	5,048	108	12,798	1,586	2,436	153
Btwn WSA Business Park East Access & WSA Business Park West Access	18,117	1,036	2,724	90	9,648	1,059	1,586	144
Btwn WSA Business Park West Access & Adams Rd	20,175	977	2,757	90	10,825	1,004	1,326	137
Btwn Adams Rd & Luddenham Rd	19,293	1,000	2,528	92	10,682	1,045	1,296	139
Btwn Luddenham Rd & The Northern Road	18,411	1,022	2,299	93	10,538	1,086	1,266	140
Elizabeth Drive - Eastbound								
Btwn The Northern Road & Luddenham Rd	15,649	542	4,496	182	8,126	382	2,140	102
Btwn Luddenham Rd & Adams Rd	17,118	529	4,840	178	9,703	366	2,275	98
Btwn Adams Rd & WSA Business Park West Access	18,587	516	5,184	173	11,279	349	2,410	93
Btwn WSA Business Park West Access & WSA Business Park East Access	18,686	592	4,320	175	11,216	372	2,047	87
Btwn WSA Business Park East Access & Martin Rd	25,064	746	5,086	197	13,819	455	2,566	102
Btwn Martin Rd & Western Rd	26,711	1,057	5,406	279	14,845	715	2,764	165
Btwn Western Rd & Clifton Ave	26,204	1,257	5,129	353	14,816	690	2,724	167
Btwn Clifton Ave & Devonshire Rd	27,766	1,388	5,463	383	15,828	807	2,957	192

	No Build - 2036				Build - 2036			
	Day (15 Hour)		Night (9 Hour)		Day (15 Hour)		Night (9 Hour)	
	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy
Btwn Devonshire Rd & Mamre Rd	26,210	1,913	6,045	593	20,298	1,242	4,393	310
Btwn Mamre Rd & Duff Rd	27,117	1,718	6,076	550	20,261	1,729	4,365	460
Btwn Duff Rd & Cecil Rd	28,399	1,926	6,315	609	20,619	1,850	4,485	500
Btwn Cecil Rd & M7 Interchange	29,833	2,472	6,585	668	22,726	2,056	4,816	542
East of M7 Interchange	24,785	1,092	4,828	264	23,741	1,232	4,644	336
Wallgrove Road - Northbound								
Btwn Elizabeth Dr & New M7 On Ramp	8,668	966	2,338	296	7,097	1,221	2,171	303
Btwn New M7 On Ramp & Existing M7 On Ramp	8,668	966	2,338	296	3,611	884	1,406	211
North of Existing M7 On Ramp	4,492	460	1,386	131	3,611	884	1,406	211
Wallgrove Road - Southbound								
North of Existing M7 On Ramp	4,747	765	411	121	4,006	857	283	148
Btwn Existing M7 On Ramp & Elizabeth Dr	4,906	792	422	124	4,006	857	283	148
Cecil Road - Northbound								
North of Elizabeth Dr	6	0	0	0	6	0	0	0
Cecil Road - Southbound								
North of Elizabeth Dr	1,101	526	199	52	1,800	199	267	42
Duff Road - Northbound								
North of Elizabeth Dr	1,746	353	369	58	341	116	70	19
Duff Road - Southbound								
North of Elizabeth Dr	1,251	267	239	60	351	143	143	45
Mamre Road - Northbound								
North of Elizabeth Dr	7,035	1,164	2,764	241	11,076	748	3,179	119
Mamre Road - Southbound								
North of Elizabeth Dr	4,389	770	749	198	6,615	854	1,161	200
Devonshire Road - Northbound								
South of Elizabeth Dr	13,583	548	2,171	119	12,146	512	2,191	77
Devonshire Road - Southbound								
South of Elizabeth Dr	5,661	663	945	111	5,918	667	1,030	105
Salisbury Road - Northbound								
North of Elizabeth Dr	16,793	39	2,190	3	7,647	0	1,034	0
Salisbury Road - Southbound								
North of Elizabeth Dr	9,079	218	1,911	13	6,261	306	1,390	82
Clifton Avenue - Northbound								
North of Elizabeth Dr	23	0	7	0	72	11	14	0
Clifton Avenue - Southbound								
North of Elizabeth Dr	966	103	217	19	906	97	217	19

	No Build - 2036				Build - 2036			
	Day (15 Hour)		Night (9 Hour)		Day (15 Hour)		Night (9 Hour)	
	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy
Western Road - Northbound								
South of Elizabeth Dr	5,076	274	914	85	127	43	25	5
North of Elizabeth Dr	1,296	147	350	24	1,232	129	345	24
Western Road - Southbound								
North of Elizabeth Dr	301	16	48	2	340	11	55	0
South of Elizabeth Dr	4,605	582	867	68	164	96	26	3
Martin Road - Northbound								
South of Elizabeth Dr	1,095	306	183	82	1,010	318	177	72
Martin Road - Southbound								
South of Elizabeth Dr	929	341	244	54	859	333	228	66
Adams Road - Northbound								
South of Elizabeth Dr	4,524	21	1,051	0	4,588	50	979	3
Adams Road - Southbound								
South of Elizabeth Dr	5,089	21	730	0	3,769	26	612	0
Luddenham Road - Northbound								
North of Elizabeth Dr	6,395	73	1,712	10	5,859	111	1,592	15
Luddenham Road - Southbound								
North of Elizabeth Dr	7,086	86	1,330	3	7,284	117	1,312	4
The Northern Road - Northbound								
South of Elizabeth Dr	16,841	340	2,819	185	17,497	361	3,102	197
Btwn Elizabeth Dr & M12	25,738	432	4,125	145	27,079	878	4,288	231
North of M12	25,738	432	4,125	145	22,739	1,385	3,639	381
The Northern Road - Southbound								
North of M12	13,226	515	3,422	141	16,241	1,044	3,822	381
Btwn M12 & Elizabeth Dr	13,226	515	3,422	141	15,842	947	2,317	171
South of Elizabeth Dr	6,877	659	1,052	117	9,305	718	1,169	155
The Old Northern Road - Northbound								
West of Elizabeth Dr	4,481	148	1,236	26	6,087	257	1,324	33
The Old Northern Road - Southbound								
West of Elizabeth Dr	6,653	448	604	43	6,314	675	651	75

PREDICTED OPERATIONAL ROAD TRAFFIC NOISE LEVELS

NO MITIGATION SCENARIO - (TRIGGERED RECEIVERS ONLY)

Name	NCA	Floor	Easting	Northing	Land Use	Address	NCG Criteria		Period	Predicted noise level (dBA)								> 2 dBA Increase		Cumulative Limit		Project Acute		Eligible for consideration of mitigation
										At Opening (2026)				Future Design (2036)										
										No Build		Build		No Build		Build								
							D	N		D	N	D	N	D	N	D	N	D	N	D	N	D	N	
NCA01.RES.3969.01	NCA01	1	300913	6250280	Residential	112 - 128 Wallgrove Road, Cecil Park 2178	60	55	P	62	58	66	62	63	59	68	64	Y	Y	-	-	-	-	Y
NCA01.RES.3969.01	NCA01	2	300913	6250280	Residential	112 - 128 Wallgrove Road, Cecil Park 2178	60	55	P	65	61	69	64	67	63	70	66	Y	Y	-	-	-	-	Y
NCA01.RES.3970.01	NCA01	1	300895	6250280	Residential	112 - 128 Wallgrove Road, Cecil Park 2178	60	55	P	68	64	71	67	70	66	72	68	Y	Y	-	-	-	-	Y
NCA02.RES.1997.01	NCA02	1	300622	6249032	Residential	11 Rene Place, Cecil Hills 2171	55	50	P	51	47	53	50	53	49	55	51	-	Y	-	-	-	-	Y
NCA02.RES.1997.01	NCA02	2	300622	6249032	Residential	11 Rene Place, Cecil Hills 2171	55	50	P	56	52	57	53	58	54	58	55	-	Y	-	Y	-	-	Y
NCA02.RES.1943.01	NCA02	1	300597	6248838	Residential	12 Jaquetta Close, Cecil Hills 2171	55	50	P	51	47	53	50	53	49	55	51	-	Y	-	-	-	-	Y
NCA03.RES.4799.01	NCA03	1	295799	6250678	Residential	1097 - 1099 Mamre Road, Kemps Creek 2178	55	50	P	56	52	58	54	56	53	59	55	Y	Y	-	Y	-	-	Y
NCA03.RES.4799.01	NCA03	2	295799	6250678	Residential	1097 - 1099 Mamre Road, Kemps Creek 2178	55	50	P	58	54	60	56	58	54	61	58	Y	Y	Y	Y	-	-	Y
NCA03.RES.4800.01	NCA03	1	295729	6250694	Residential	1097 - 1099 Mamre Road, Kemps Creek 2178	55	50	P	48	44	58	54	49	45	60	56	Y	Y	Y	Y	-	-	Y
NCA03.RES.4801.01	NCA03	1	295785	6250657	Residential	1097 - 1099 Mamre Road, Kemps Creek 2178	55	50	P	55	51	58	54	55	52	60	56	Y	Y	Y	Y	-	-	Y
NCA03.RES.4802.01	NCA03	1	295829	6250622	Residential	1101 - 1105 Mamre Road, Kemps Creek 2178	55	50	P	56	52	59	55	56	52	60	56	Y	Y	Y	Y	-	-	Y
NCA03.RES.4806.01	NCA03	1	295923	6250457	Residential	1117 Mamre Road, Kemps Creek 2178	55	50	P	58	54	60	56	57	54	60	57	Y	Y	Y	Y	-	-	Y
NCA03.RES.4807.01	NCA03	1	296000	6250417	Residential	1127 - 1133 Mamre Road, Kemps Creek 2178	55	50	P	51	47	58	54	51	47	59	55	Y	Y	-	Y	-	-	Y
NCA03.RES.4808.01	NCA03	1	296012	6250399	Residential	1127 - 1133 Mamre Road, Kemps Creek 2178	55	50	P	60	56	61	57	59	56	61	58	Y	Y	-	Y	-	-	Y
NCA03.RES.4809.01	NCA03	1	296020	6250385	Residential	1127 - 1133 Mamre Road, Kemps Creek 2178	55	50	P	51	47	57	53	51	47	59	55	Y	Y	-	Y	-	-	Y
NCA03.RES.4810.01	NCA03	1	296033	6250369	Residential	1135 - 1141 Mamre Road, Kemps Creek 2178	55	50	P	52	49	57	53	52	49	58	54	Y	Y	-	-	-	-	Y
NCA03.RES.4811.01	NCA03	1	296047	6250330	Residential	1135 - 1141 Mamre Road, Kemps Creek 2178	55	50	P	61	57	62	58	61	57	63	59	Y	Y	-	-	-	-	Y
NCA03.RES.0813.01	NCA03	1	296081	6250264	Residential	1143 - 1147 Mamre Road, Kemps Creek 2178	55	50	P	53	49	57	53	53	50	59	55	Y	Y	-	Y	-	-	Y
NCA03.RES.4812.01	NCA03	1	296081	6250241	Residential	1149 - 1155 Mamre Road, Kemps Creek 2178	55	50	P	50	46	57	53	50	46	59	55	Y	Y	-	Y	-	-	Y
NCA03.RES.4813.01	NCA03	1	296116	6250212	Residential	1149 - 1155 Mamre Road, Kemps Creek 2178	55	50	P	61	58	62	59	61	58	63	59	Y	Y	Y	Y	-	-	Y
NCA03.RES.4813.01	NCA03	2	296116	6250212	Residential	1149 - 1155 Mamre Road, Kemps Creek 2178	55	50	P	54	50	60	56	54	51	62	58	Y	Y	Y	Y	-	-	Y
NCA03.RES.4814.01	NCA03	1	296168	6250143	Residential	1157 - 1161 Mamre Road, Kemps Creek 2178	55	50	P	51	46	58	54	51	47	60	56	Y	Y	Y	Y	-	-	Y
NCA03.RES.4815.01	NCA03	1	296240	6250026	Residential	1169 - 1177 Mamre Road, Kemps Creek 2178	55	50	P	61	57	62	58	60	57	63	59	Y	Y	Y	Y	-	-	Y
NCA03.RES.4706.01	NCA03	1	296293	6249918	Residential	1179 - 1189 Mamre Road, Kemps Creek 2178	55	50	P	61	57	62	59	61	58	63	59	Y	Y	Y	Y	-	-	Y
NCA03.RES.4706.01	NCA03	2	296293	6249918	Residential	1179 - 1189 Mamre Road, Kemps Creek 2178	55	50	P	62	59	64	60	62	59	64	60	Y	Y	Y	Y	-	-	Y
NCA03.RES.4693.01	NCA03	1	296481	6249716	Residential	1205 - 1217 Mamre Road, Kemps Creek 2178	55	50	P	56	52	60	56	56	52	62	58	Y	Y	Y	Y	-	-	Y
NCA03.RES.4685.01	NCA03	1	296629	6249765	Residential	1210-1216 Mamre Road, Mount Vernon 2178	55	50	P	63	59	64	60	62	59	65	61	Y	Y	Y	Y	-	-	Y
NCA03.RES.4685.01	NCA03	2	296629	6249765	Residential	1210-1216 Mamre Road, Mount Vernon 2178	55	50	P	64	60	65	62	64	60	66	62	Y	-	Y	Y	-	-	Y
NCA03.RES.4686.01	NCA03	1	296663	6249737	Residential	1218-1224 Mamre Road, Mount Vernon 2178	55	50	P	63	59	64	61	63	59	65	61	Y	Y	Y	Y	-	-	Y
NCA03.RES.4686.01	NCA03	2	296663	6249737	Residential	1218-1224 Mamre Road, Mount Vernon 2178	55	50	P	64	60	65	62	64	60	66	62	Y	Y	Y	Y	-	-	Y
NCA03.RES.4691.01	NCA03	1	296761	6249708	Residential	1226 - 1232 Mamre Road, Mount Vernon 2178	55	50	P	60	56	62	58	60	56	63	59	Y	Y	Y	Y	-	-	Y
NCA03.RES.4691.01	NCA03	2	296761	6249708	Residential	1226 - 1232 Mamre Road, Mount Vernon 2178	55	50	P	61	57	63	59	61	57	64	60	Y	Y	Y	Y	-	-	Y
NCA03.RES.4692.01	NCA03	1	296750	6249721	Residential	1226 - 1232 Mamre Road, Mount Vernon 2178	55	50	P	59	55	62	58	59	56	63	59	Y	Y	Y	Y	-	-	Y
NCA03.RES.4610.01	NCA03	1	296627	6249537	Residential	1233 - 1237 Mamre Road, Kemps Creek 2178	55	50	P	52	48	58	54	53	49	60	56	Y	Y	Y	Y	-	-	Y
NCA03.RES.4619.01	NCA03	1	296898	6249676	Residential	1234 Mamre Road, Mount Vernon 2178	55	50	P	57	53	60	56	57	54	62	58	Y	Y	Y	Y	-	-	Y
NCA03.RES.4619.01	NCA03	2	296898	6249676	Residential	1234 Mamre Road, Mount Vernon 2178	55	50	P	58	54	61	57	58	54	62	58	Y	Y	Y	Y	-	-	Y
NCA03.RES.4689.01	NCA03	1	296744	6249605	Residential	1236 - 1240 Mamre Road, Mount Vernon 2178	55	50	P	63	59	64	60	62	59	65	61	Y	Y	Y	Y	-	-	Y
NCA03.RES.4609.01	NCA03	1	296644	6249514	Residential	1239 - 1245 Mamre Road, Kemps Creek 2178	55	50	P	52	47	60	56	54	49	62	58	Y	Y	Y	Y	-	-	Y
NCA03.RES.4609.01	NCA03	2	296644	6249514	Residential	1239 - 1245 Mamre Road, Kemps Creek 2178	55	50	P	54	49	61	57	55	51	63	59	Y	Y	Y	Y	-	-	Y
NCA03.RES.4615.01	NCA03	1	296972	6249591	Residential	1242 - 1256 Mamre Road, Mount Vernon 2178	55	50	P	58	54	61	57	58	54	63	59	Y	Y	Y	Y	-	-	Y
NCA03.RES.4615.01	NCA03	2	296972	6249591	Residential	1242 - 1256 Mamre Road, Mount Vernon 2178	55	50	P	58	54	62	58	59	55	63	59	Y	Y	Y	Y	-	-	Y
NCA03.RES.4616.01	NCA03	1	296947	6249619	Residential	1242 - 1256 Mamre Road, Mount Vernon 2178	55	50	P	58	54	61	57	58	54	62	59	Y	Y	Y	Y	-	-	Y
NCA03.RES.4616.01	NCA03	2	296947	6249619	Residential	1242 - 1256 Mamre Road, Mount Vernon 2178	55	50	P	59	55	62	58	59	55	63	59	Y	Y	Y	Y	-	-	Y
NCA03.RES.4614.01	NCA03	1	297024	6249538	Residential	1258 Mamre Road, Mount Vernon 2178	55	50	P	57	53	60	56	57	53	62	58	Y	Y	Y	Y	-	-	Y
NCA03.RES.4614.01	NCA03	2	297024	6249538	Residential	1258 Mamre Road, Mount Vernon 2178	55	50	P	58	54	61	57	58	54	63	59	Y	Y	Y	Y	-	-	Y
NCA04.OED.4272.01	NCA04	1	298897	6249389	Other (Educational)	2089 - 2109 Elizabeth Drive, Cecil Park 2178	50	-	H	67	67	68	68	69	69	70	69	-	-	Y	-	-	-	Y
NCA04.OED.4273.01	NCA04	1	298882	6249375	Other (Educational)	2089 - 2109 Elizabeth Drive, Cecil Park 2178	50	-	H	67	67	68	68	69	69	70	70	Y	-	Y	-	-	-	Y
NCA04.OED.4274.01	NCA04	1	298873	6249368	Other (Educational)	2089 - 2109 Elizabeth Drive, Cecil Park 2178	50	-	H	68	67	69	68	69	69	70	70	-	-	Y	-	-	-	Y
NCA04.OED.4275.01	NCA04	1	298919	6249365	Other (Educational)	2089 - 2109 Elizabeth Drive, Cecil Park 2178	50	-	H	72	72	73	72	74	74	74	74	-	-	Y	-	Y	-	Y
NCA04.OED.4276.01	NCA04	1	298883	6249342	Other (Educational)	2089 - 2109 Elizabeth Drive, Cecil Park 2178	50	-	H	72	72	72	72	74	74	74	74	-	-	-	-	Y	-	Y
NCA04.OOA.8012.01	NCA04	1	296908	6248806	Other (Outdoor Active)	1490 Elizabeth Drive Cecil Park 2178	60	-	P	62	57	63	59	64	60	65	61	-	-	Y	-	-	-	Y
NCA04.OOP.8013.01	NCA04	1	297485	6249429	Other (Outdoor Passive)	316-318 Mount Vernon Road Mount Vernon 2178	55	-	P	53	49	57	53	55	52	59	55	Y	-	-	-	-	-	Y
NCA04.RES.4277.01	NCA04	1	298819	6249318	Residential	1 - 7 Duff Road, Cecil Park 2178	55	50	P	65	61	65	61	66	62	66	63	-	-	Y	Y	-	-	Y
NCA04.RES.4278.01	NCA04	1	298829	6249311	Residential	1 - 7 Duff Road, Cecil Park 2178	55	50	P	68	63	68	64	70	66	70	66	-	-	Y	Y	Y	Y	Y
NCA04.RES.4278.01	NCA04	2	298829	6249311	Residential	1 - 7 Duff Road, Cecil Park 2178	55	50	P	69	65	70	66	71	67	71	67	-	-	-	-	Y	Y	Y
NCA04.RES.3864.01	NCA04	1	300245	6249667	Residential	1111 - 1141 Elizabeth Drive, Cecil Park 2178	55	50	P	59	54	59	55	60	56	60	56	-	-	-	Y	-	-	Y
NCA04.RES.3864.01	NCA04	2	300245	6249667	Residential	1111 - 1141 Elizabeth Drive, Cecil Park 2178	55	50	P	60	56	61	57	62	58	62	58	-	-	-	Y	-	-	Y
NCA04.RES.0161.01	NCA04	1	299075	6249765	Residential	1183-1185 Elizabeth Drive Cecil Park 2178	55	50	P	54	50	57	53	56	52	59	55	Y	Y	-	Y	-	-	Y
NCA04.RES.0461.01	NCA04	1	299131	6249722	Residential	1183-1185 Elizabeth Drive Cecil Park 2178	55	50	P	58	54	60	56	60	56	61	58	Y	Y	Y	Y	-	-	Y
NCA04.RES.3880.01	NCA04	1	299457	6249587	Residential	1183-1185 Elizabeth Drive Cecil Park 2178	55	50	P	67	63	68	64	70	66	70	66	-	-	Y	Y	Y	Y	Y
NCA04.RES.3881.01	NCA04	1	299610	6249537	Residential	1183-1185 Elizabeth Drive Cecil Park 2178	55	50	P	67	63	68	64	69	65	70	66	-	-	-	Y	Y	Y	Y
NCA04.RES.4417.01	NCA04	1	297905	6249289	Residential	1227 - 1229 Elizabeth Drive, Mount Vernon 2178	55	50	P	57	53	59	55	59	56	61	57	-	-	Y	Y	-	-	Y
NCA04.RES.4417.01	NCA04	2	297905	6249289	Residential	1227 - 1229 Elizabeth Drive, Mount Vernon 2178	55	50	P	58	54	61	57	60	57	62	59	Y	Y	Y	Y	-	-	Y
NCA04.RES.4421.01	NCA04	1	297825	6249131	Residential	1231 - 1237 Elizabeth Drive, Mount Vernon 2178	55	50	P	60	56	61	57	62	58	63	59	-	-	Y	Y	-	-	Y
NCA04.RES.4418.01	NCA04	1	297856	6249274	Residential	1231A Elizabeth Drive, Mount Vernon 2178	55	50	P	57	53	59	55	59	56	61	57	Y	Y	Y	Y	-	-	Y
NCA04.RES.4418.01	NCA04	2	297856	6249274	Residential	1231A Elizabeth Drive, Mount Vernon 2178	55	50	P	58	54	60	56	60	57	62	58	Y	Y	Y	Y	-	-	Y
NCA04.RES.4419.01	NCA04	1	297742	6249282	Residential	1239 - 1245 Elizabeth Drive, Mount Vernon 2178	55	50	P	55	51	57	53	57	53	59	55	Y	Y	-	Y	-	-	Y
NCA04.RES.4422.01	NCA04	1	297742	6249158	Residential	1239 - 1245 Elizabeth Drive, Mount Vernon 2178	55	50	P	64	60	65	61	66	62	67	63	Y	Y	Y	Y	-	-	Y
NCA04.RES.4422.01	NCA04	2	297742	6249158	Residential	1239 - 1245 Elizabeth Drive, Mount Vernon 2178	55	50	P	62	58	64	60	64	61	66	62	Y	Y	Y	Y	-	-	Y
NCA04.RES.4423.01	NCA04	1	297660	6249122	Residential	1247 - 1253 Elizabeth Drive, Mount Vernon 2178	55	50	P	64	60	65	61	66	62	67	63	Y	Y	Y	Y	-	-	Y
NCA04.RES.4423.01	NCA04	2	297660	6249122	Residential	1247 - 1253 Elizabeth Drive, Mount Vernon 2178	55	50	P	65	61	66	62	67	63	68	64	Y	Y	Y	Y	-	Y	Y
NCA04.RES.4608.01	NCA04	1	296694	6249403	Residential	1247 Mamre Road, Kemps Creek 2178	55	50	P	61	58	63	59	61	58	64	60	Y	Y	Y	Y	-	-	Y
NCA04.RES.4424.01	NCA04	1	297622	6249111	Residential	1255 - 1261 Elizabeth Drive, Mount Vernon 2178	55	50	P	62	58	64	60	65	61	66	62	Y	Y	Y	Y	-	-	Y

Note: The results in this table are based on the highest noise level of the triggered facades, per floor. If no facades are triggered, then the highest noise level of all facades is presented for each floor.
It is noted that a single receiver may be triggered on multiple facades and for some receivers where a >2 dB increase is shown, this may be on a different facade from where the highest noise level is predicted.

Name	NCA	Floor	Easting	Northing	Land Use	Address	NCG Criteria		Period	Predicted noise level (dBA)								> 2 dBA Increase		Cumulative Limit		Project Acute		Eligible for consideration of mitigation
										At Opening (2026)				Future Design (2036)										
										No Build		Build		No Build		Build								
							D	N		D	N	D	N	D	N	D	N	D	N	D	N	D	N	
NCA04.RES.4424.01	NCA04	2	297622	6249111	Residential	1255 - 1261 Elizabeth Drive, Mount Vernon 2178	55	50	P	65	61	67	63	67	63	68	64	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4603.01	NCA04	1	296757	6249374	Residential	1255-1259 Mamre Road, Kemps Creek 2178	55	50	P	63	59	64	60	62	59	65	61	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.4613.01	NCA04	1	296950	6249464	Residential	1260 - 1264 Mamre Road, Mount Vernon 2178	55	50	P	60	56	62	58	59	56	63	59	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.4613.01	NCA04	2	296950	6249464	Residential	1260 - 1264 Mamre Road, Mount Vernon 2178	55	50	P	61	57	63	59	60	57	64	60	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.4602.01	NCA04	1	296807	6249306	Residential	1261 - 1267 Mamre Road, Kemps Creek 2178	55	50	P	54	50	64	60	56	52	66	62	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4434.01	NCA04	1	297536	6249037	Residential	1263 - 1269 Elizabeth Drive, Mount Vernon 2178	55	50	P	67	63	68	64	69	65	70	66	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4611.01	NCA04	1	296943	6249318	Residential	1266-1272 Mamre Road, Mount Vernon 2178	55	50	P	54	50	56	52	54	51	57	53	Y	Y	-	-	-	-	**Y**
NCA04.RES.4612.01	NCA04	1	296962	6249367	Residential	1266-1272 Mamre Road, Mount Vernon 2178	55	50	P	63	59	64	60	62	59	65	61	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.4612.01	NCA04	2	296962	6249367	Residential	1266-1272 Mamre Road, Mount Vernon 2178	55	50	P	64	60	65	61	64	60	66	62	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.4600.01	NCA04	1	296869	6249256	Residential	1269 - 1275 Mamre Road, Kemps Creek 2178	55	50	P	64	60	65	61	63	60	66	62	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4601.01	NCA04	1	296843	6249279	Residential	1269 - 1275 Mamre Road, Kemps Creek 2178	55	50	P	63	59	64	60	63	59	65	61	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4435.01	NCA04	1	297451	6249000	Residential	1271 - 1277 Elizabeth Drive, Mount Vernon 2178	55	50	P	69	65	70	66	71	67	71	68	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4599.01	NCA04	1	296915	6249201	Residential	1277 - 1283 Mamre Road, Kemps Creek 2178	55	50	P	61	57	64	60	61	58	66	62	Y	Y	Y	Y	-	Y	**Y**
NCA04.RES.4599.01	NCA04	2	296915	6249201	Residential	1277 - 1283 Mamre Road, Kemps Creek 2178	55	50	P	63	59	66	62	63	60	67	63	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4585.01	NCA04	1	297373	6249003	Residential	1279 Elizabeth Drive, Mount Vernon 2178	55	50	P	67	63	69	65	69	65	71	67	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4585.01	NCA04	2	297373	6249003	Residential	1279 Elizabeth Drive, Mount Vernon 2178	55	50	P	68	64	70	66	70	66	72	68	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4596.01	NCA04	1	296960	6249162	Residential	1285 - 1291 Mamre Road, Kemps Creek 2178	55	50	P	55	51	66	62	57	53	68	64	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4596.01	NCA04	2	296960	6249162	Residential	1285 - 1291 Mamre Road, Kemps Creek 2178	55	50	P	58	53	68	64	60	56	70	66	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4598.01	NCA04	1	296990	6249123	Residential	1293A Mamre Road, Kemps Creek 2178	55	50	P	57	53	68	65	59	55	71	67	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4598.01	NCA04	2	296990	6249123	Residential	1293A Mamre Road, Kemps Creek 2178	55	50	P	59	55	70	66	61	57	72	68	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4584.01	NCA04	1	297291	6249014	Residential	1306 Mamre Road, Mount Vernon 2178	55	50	P	67	63	70	66	69	65	71	67	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4584.01	NCA04	2	297291	6249014	Residential	1306 Mamre Road, Mount Vernon 2178	55	50	P	69	65	71	67	70	66	72	68	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4695.01	NCA04	1	296695	6248946	Residential	1341 - 1347 Elizabeth Drive, Kemps Creek 2178	55	50	P	54	50	65	61	55	52	67	63	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4695.01	NCA04	2	296695	6248946	Residential	1341 - 1347 Elizabeth Drive, Kemps Creek 2178	55	50	P	57	53	66	62	59	55	68	64	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4696.01	NCA04	1	296651	6248965	Residential	1349 - 1355 Elizabeth Drive, Kemps Creek 2178	55	50	P	54	50	66	62	55	51	68	64	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4696.01	NCA04	2	296651	6248965	Residential	1349 - 1355 Elizabeth Drive, Kemps Creek 2178	55	50	P	55	51	67	63	57	53	69	65	Y	Y	Y	Y	Y	Y	**Y**
NCA04.RES.4698.01	NCA04	1	296567	6248937	Residential	1357 - 1371 Elizabeth Drive, Kemps Creek 2178	55	50	P	57	53	62	58	60	55	64	60	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.0219.01	NCA04	1	296155	6249009	Residential	1383 - 1411 Elizabeth Drive, Kemps Creek 2178	55	50	P	53	48	62	58	55	51	64	60	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.5570.01	NCA04	1	296110	6248921	Residential	1383 - 1411 Elizabeth Drive, Kemps Creek 2178	55	50	P	56	52	61	57	58	54	63	59	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.5571.01	NCA04	1	296166	6248967	Residential	1383 - 1411 Elizabeth Drive, Kemps Creek 2178	55	50	P	60	55	62	57	62	58	63	59	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.5572.01	NCA04	1	296133	6248995	Residential	1383 - 1411 Elizabeth Drive, Kemps Creek 2178	55	50	P	54	50	61	56	56	52	63	59	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.1484.01	NCA04	1	296034	6248971	Residential	1413 - 1415 Elizabeth Drive, Kemps Creek 2178	55	50	P	61	56	62	58	63	59	64	60	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.4320.01	NCA04	1	298450	6249477	Residential	15 - 20 Warana Road, Cecil Park 2178	55	50	P	50	46	53	49	52	48	55	51	-	Y	-	-	-	-	**Y**
NCA04.RES.4320.01	NCA04	2	298450	6249477	Residential	15 - 20 Warana Road, Cecil Park 2178	55	50	P	51	47	54	50	53	49	56	52	Y	Y	-	-	-	-	**Y**
NCA04.RES.4701.01	NCA04	2	296628	6248826	Residential	1560 Elizabeth Drive, Cecil Park 2178	55	50	P	70	65	70	65	72	68	71	67	-	-	-	Y	-	Y	**Y**
NCA04.RES.5586.01	NCA04	1	296358	6248650	Residential	1572 Elizabeth Drive, Cecil Park 2178	55	50	P	58	54	60	56	60	56	62	58	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.5586.01	NCA04	2	296358	6248650	Residential	1572 Elizabeth Drive, Cecil Park 2178	55	50	P	59	55	61	57	61	57	63	59	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.5579.01	NCA04	1	296278	6248715	Residential	1590 Elizabeth Drive, Kemps Creek 2178	55	50	P	61	57	63	58	64	59	64	60	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.5579.01	NCA04	2	296278	6248715	Residential	1590 Elizabeth Drive, Kemps Creek 2178	55	50	P	63	58	64	59	65	61	65	61	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.5577.01	NCA04	2	296121	6248811	Residential	1610 Elizabeth Drive, Kemps Creek 2178	55	50	P	51	47	54	49	54	49	56	51	-	Y	-	-	-	-	**Y**
NCA04.RES.5576.01	NCA04	2	296032	6248797	Residential	1630 Elizabeth Drive, Kemps Creek 2178	55	50	P	57	52	58	54	59	55	60	55	-	-	Y	Y	-	-	**Y**
NCA04.RES.1180.01	NCA04	2	300114	6249951	Residential	18 Cecil Road, Cecil Park 2178	55	50	P	57	53	57	53	59	55	59	55	-	-	-	Y	-	-	**Y**
NCA04.RES.3865.01	NCA04	1	300093	6249925	Residential	18 Cecil Road, Cecil Park 2178	55	50	P	58	54	59	55	60	56	61	57	-	-	Y	Y	-	-	**Y**
NCA04.RES.3865.01	NCA04	2	300093	6249925	Residential	18 Cecil Road, Cecil Park 2178	55	50	P	59	54	60	56	61	56	61	57	-	-	Y	Y	-	-	**Y**
NCA04.RES.4280.01	NCA04	1	298696	6249457	Residential	19 - 27 Duff Road, Cecil Park 2178	55	50	P	63	58	63	59	64	60	64	60	-	-	Y	Y	-	-	**Y**
NCA04.RES.4280.01	NCA04	2	298696	6249457	Residential	19 - 27 Duff Road, Cecil Park 2178	55	50	P	64	60	63	60	65	61	65	61	-	-	Y	Y	-	-	**Y**
NCA04.RES.3871.01	NCA04	2	300182	6250017	Residential	20 - 22 Cecil Road, Cecil Park 2178	55	50	P	56	52	57	53	58	54	59	55	-	-	-	Y	-	-	**Y**
NCA04.RES.4287.01	NCA04	1	298720	6249538	Residential	20 - 38 Duff Road, Cecil Park 2178	55	50	P	62	57	62	58	63	59	64	60	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.4288.01	NCA04	1	298743	6249542	Residential	20 - 38 Duff Road, Cecil Park 2178	55	50	P	59	55	61	57	61	57	63	59	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.4265.01	NCA04	1	299138	6249610	Residential	2055 - 2059 Elizabeth Drive, Cecil Park 2178	55	50	P	60	56	61	57	62	58	63	59	-	-	Y	Y	-	-	**Y**
NCA04.RES.4265.01	NCA04	2	299138	6249610	Residential	2055 - 2059 Elizabeth Drive, Cecil Park 2178	55	50	P	61	57	63	59	63	59	64	60	-	-	Y	Y	-	-	**Y**
NCA04.RES.4264.01	NCA04	1	299055	6249703	Residential	2061 - 2063 Elizabeth Drive, Cecil Park 2178	55	50	P	57	53	59	55	59	55	61	57	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.4266.01	NCA04	1	299064	6249625	Residential	2065 - 2071 Elizabeth Drive, Cecil Park 2178	55	50	P	58	53	60	56	60	56	62	58	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.4267.01	NCA04	1	299103	6249559	Residential	2065 - 2071 Elizabeth Drive, Cecil Park 2178	55	50	P	63	59	64	60	65	61	65	62	-	-	Y	Y	-	-	**Y**
NCA04.RES.4267.01	NCA04	2	299103	6249559	Residential	2065 - 2071 Elizabeth Drive, Cecil Park 2178	55	50	P	67	63	68	64	69	66	69	65	-	-	-	-	-	Y	**Y**
NCA04.RES.4268.01	NCA04	1	299060	6249501	Residential	2073 - 2081 Elizabeth Drive, Cecil Park 2178	55	50	P	68	64	68	64	70	66	70	66	-	-	-	-	-	Y	**Y**
NCA04.RES.4269.01	NCA04	1	299019	6249457	Residential	2073 - 2081 Elizabeth Drive, Cecil Park 2178	55	50	P	69	65	69	65	71	67	71	67	-	-	-	-	Y	Y	**Y**
NCA04.RES.4269.01	NCA04	2	299019	6249457	Residential	2073 - 2081 Elizabeth Drive, Cecil Park 2178	55	50	P	71	67	71	67	73	69	72	69	-	-	-	-	Y	Y	**Y**
NCA04.RES.4270.01	NCA04	1	298958	6249475	Residential	2083 - 2087 Elizabeth Drive, Cecil Park 2178	55	50	P	62	58	64	60	64	60	66	62	-	-	Y	Y	-	-	**Y**
NCA04.RES.4296.01	NCA04	1	298568	6249243	Residential	2131 Elizabeth Drive, Cecil Park 2178	55	50	P	62	58	64	60	64	60	65	62	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.4300.01	NCA04	1	298639	6249163	Residential	2131 Elizabeth Drive, Cecil Park 2178	55	50	P	63	59	64	60	65	61	66	62	-	-	Y	Y	-	-	**Y**
NCA04.RES.4318.01	NCA04	1	298403	6249344	Residential	2149 Elizabeth Drive, Cecil Park 2178	55	50	P	53	49	56	52	55	51	58	54	Y	Y	-	-	-	-	**Y**
NCA04.RES.4318.01	NCA04	2	298403	6249344	Residential	2149 Elizabeth Drive, Cecil Park 2178	55	50	P	55	51	58	54	57	54	60	56	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.4319.01	NCA04	1	298418	6249377	Residential	2149 Elizabeth Drive, Cecil Park 2178	55	50	P	53	49	56	52	55	51	58	54	Y	Y	-	-	-	-	**Y**
NCA04.RES.4316.01	NCA04	1	298392	6249302	Residential	2159 Elizabeth Drive, Cecil Park 2178	55	50	P	58	54	59	55	60	56	61	57	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.4316.01	NCA04	2	298392	6249302	Residential	2159 Elizabeth Drive, Cecil Park 2178	55	50	P	59	55	60	56	61	57	62	58	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.4299.01	NCA04	1	298539	6249221	Residential	2169 - 2177 Elizabeth Drive, Cecil Park 2178	55	50	P	62	58	64	60	64	61	66	62	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.4299.01	NCA04	2	298539	6249221	Residential	2169 - 2177 Elizabeth Drive, Cecil Park 2178	55	50	P	63	59	64	60	65	61	66	62	Y	Y	Y	Y	-	-	**Y**
NCA04.RES.4302.01	NCA04	2	298498	6249145	Residential	2179 Elizabeth Drive, Cecil Park 2178	55	50	P	56	52	58	54	58	54	59	55	-	-	-	Y	-	-	**Y**
NCA04.RES.4314.01	NCA04	1	298395	6249200	Residential	2197 - 2201 Elizabeth Drive, Cecil Park 2178	55	50	P	58	54	59	55	60	56	61	57	-	-	Y	Y	-	-	**Y**
NCA04.RES.4313.01	NCA04	1	298362	6249195	Residential	2219 Elizabeth Drive, Cecil Park 2178	55	50	P	53	48	55	51	55	51	57	53	Y	Y	-	-	-	-	**Y**
NCA04.RES.4332.01	NCA04	1	298127	6249185	Residential	2245 - 2249 Elizabeth Drive, Cecil Park 2178	55	50	P	56	52	57	53	58	54	59	55	-	-	-	Y	-	-	**Y**
NCA04.RES.4335.01	NCA04	1	298164	6249266	Residential	2251 - 2253 Elizabeth Drive, Cecil Park 2178	55	50	P	55	51	58	54	57	54	60	56	Y	Y	Y	Y	-	-	**Y**

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It is noted that a single receiver may be triggered on multiple facades and for some receivers where a >2 dB increase is shown, this may be on a different facade from where the highest noise level is predicted.

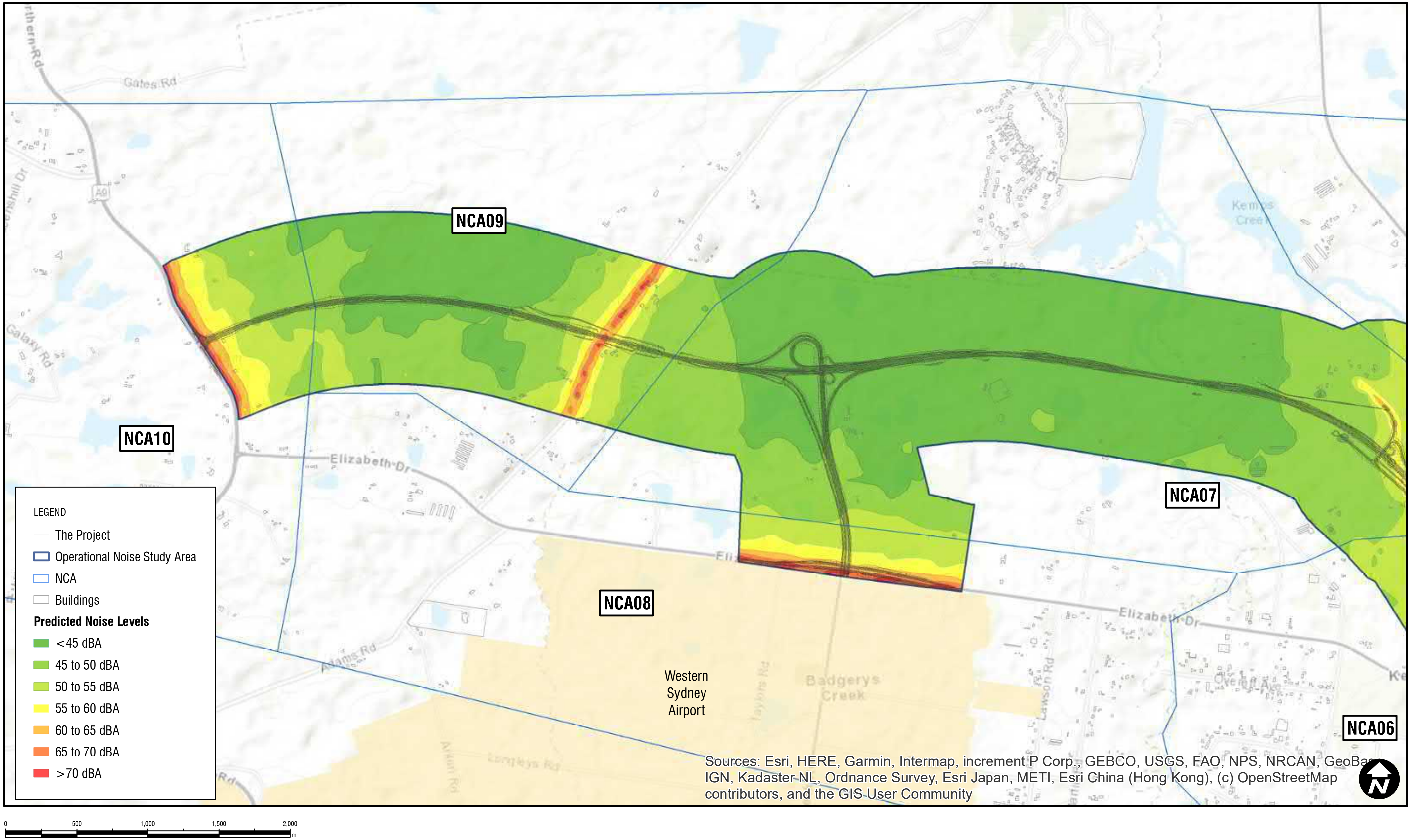
Name	NCA	Floor	Easting	Northing	Land Use	Address	NCG Criteria		Period	Predicted noise level (dBA)								> 2 dBA Increase		Cumulative Limit		Project Acute		Eligible for consideration of mitigation
										At Opening (2026)				Future Design (2036)										
										No Build		Build		No Build		Build								
							D	N		D	N	D	N	D	N	D	N	D	N	D	N	D	N	
NCA04.RES.4335.01	NCA04	2	298164	6249266	Residential	2251 - 2253 Elizabeth Drive, Cecil Park 2178	55	50	P	57	53	59	55	59	55	61	57	-	-	Y	Y	-	-	Y
NCA04.RES.4337.01	NCA04	1	298057	6249315	Residential	2255-22771 Elizabeth Drive, Cecil Park 2178	55	50	P	60	56	61	57	62	58	63	59	Y	Y	Y	Y	-	-	Y
NCA04.RES.4337.01	NCA04	2	298057	6249315	Residential	2255-22771 Elizabeth Drive, Cecil Park 2178	55	50	P	60	56	62	58	62	59	64	60	Y	Y	Y	Y	-	-	Y
NCA04.RES.4338.01	NCA04	1	298079	6249322	Residential	2255-22771 Elizabeth Drive, Cecil Park 2178	55	50	P	58	54	59	55	60	56	61	57	-	Y	Y	Y	-	-	Y
NCA04.RES.4339.01	NCA04	1	298027	6249320	Residential	2265-22771 Elizabeth Drive, Cecil Park 2178	55	50	P	60	56	62	58	62	58	64	60	-	-	Y	Y	-	-	Y
NCA04.RES.4321.01	NCA04	1	298355	6249505	Residential	25 - 27 Warana Road, Cecil Park 2178	55	50	P	53	49	55	51	55	51	57	53	-	Y	-	-	-	-	Y
NCA04.RES.4281.01	NCA04	1	298623	6249392	Residential	29 - 35 Duff Road, Cecil Park 2178	55	50	P	60	55	62	58	62	58	64	60	Y	Y	Y	Y	-	-	Y
NCA04.RES.3868.01	NCA04	1	299952	6249965	Residential	30-36 Cecil Road, Cecil Park 2178	55	50	P	59	54	59	55	60	56	61	57	-	-	Y	Y	-	-	Y
NCA04.RES.3868.01	NCA04	2	299952	6249965	Residential	30-36 Cecil Road, Cecil Park 2178	55	50	P	60	55	60	56	61	57	62	58	-	-	Y	Y	-	-	Y
NCA04.RES.4575.01	NCA04	1	297283	6249469	Residential	309 - 319 Mount Vernon Road, Mount Vernon 2178	55	50	P	56	51	60	56	57	53	61	57	Y	Y	Y	Y	-	-	Y
NCA04.RES.4438.01	NCA04	1	297489	6249415	Residential	316 Mount Vernon Road, Mount Vernon 2178	55	50	P	58	54	61	57	60	56	63	59	Y	Y	Y	Y	-	-	Y
NCA04.RES.4438.01	NCA04	2	297489	6249415	Residential	316 Mount Vernon Road, Mount Vernon 2178	55	50	P	57	52	61	57	58	54	63	59	Y	Y	Y	Y	-	-	Y
NCA04.RES.4577.01	NCA04	1	297390	6249406	Residential	316 Mount Vernon Road, Mount Vernon 2178	55	50	P	54	50	59	55	55	51	61	57	Y	Y	Y	Y	-	-	Y
NCA04.RES.4436.01	NCA04	1	297498	6249308	Residential	320 Mount Vernon Road, Mount Vernon 2178	55	50	P	57	53	61	57	59	55	63	59	Y	Y	Y	Y	-	-	Y
NCA04.RES.4437.01	NCA04	1	297475	6249305	Residential	320 Mount Vernon Road, Mount Vernon 2178	55	50	P	57	53	61	57	58	55	63	59	Y	Y	Y	Y	-	-	Y
NCA04.RES.4594.01	NCA04	1	297218	6249377	Residential	321 - 333 Mount Vernon Road, Mount Vernon 2178	55	50	P	55	51	59	55	56	52	61	57	Y	Y	Y	Y	-	-	Y
NCA04.RES.4578.01	NCA04	1	297357	6249375	Residential	324 Mount Vernon Road, Mount Vernon 2178	55	50	P	56	52	60	56	58	54	62	58	Y	Y	Y	Y	-	-	Y
NCA04.RES.4579.01	NCA04	1	297298	6249340	Residential	326 - 332 Mount Vernon Road, Mount Vernon 2178	55	50	P	57	53	62	58	58	55	63	60	Y	Y	Y	Y	-	-	Y
NCA04.RES.4579.01	NCA04	2	297298	6249340	Residential	326 - 332 Mount Vernon Road, Mount Vernon 2178	55	50	P	58	54	62	58	59	55	64	60	Y	Y	Y	Y	-	-	Y
NCA04.RES.4580.01	NCA04	1	297262	6249288	Residential	334 - 338 Mount Vernon Road, Mount Vernon 2178	55	50	P	56	52	61	57	57	53	63	59	Y	Y	Y	Y	-	-	Y
NCA04.RES.4580.01	NCA04	2	297262	6249288	Residential	334 - 338 Mount Vernon Road, Mount Vernon 2178	55	50	P	57	53	62	58	58	55	64	60	Y	Y	Y	Y	-	-	Y
NCA04.RES.4582.01	NCA04	1	297197	6249239	Residential	340 - 344 Mount Vernon Road, Mount Vernon 2178	55	50	P	59	55	63	59	60	56	65	61	Y	Y	Y	Y	-	Y	Y
NCA04.RES.4582.01	NCA04	2	297197	6249239	Residential	340 - 344 Mount Vernon Road, Mount Vernon 2178	55	50	P	61	57	65	61	62	58	66	62	Y	Y	Y	Y	Y	Y	Y
NCA04.RES.4588.01	NCA04	1	297044	6249262	Residential	343 Mount Vernon Road, Mount Vernon 2178	55	50	P	63	59	64	60	62	59	65	61	Y	Y	Y	Y	-	-	Y
NCA04.RES.4588.01	NCA04	2	297044	6249262	Residential	343 Mount Vernon Road, Mount Vernon 2178	55	50	P	65	61	67	63	64	61	67	64	Y	Y	Y	Y	-	Y	Y
NCA04.RES.4583.01	NCA04	1	297116	6249216	Residential	346 - 356 Mount Vernon Road, Mount Vernon 2178	55	50	P	64	60	66	63	64	60	68	64	Y	Y	Y	Y	Y	Y	Y
NCA04.RES.4583.01	NCA04	2	297116	6249216	Residential	346 - 356 Mount Vernon Road, Mount Vernon 2178	55	50	P	65	61	67	64	65	62	69	65	Y	Y	Y	Y	Y	Y	Y
NCA04.RES.4282.01	NCA04	1	298579	6249473	Residential	37 - 45 Duff Road, Cecil Park 2178	55	50	P	50	46	53	49	52	48	55	51	-	Y	-	-	-	-	Y
NCA04.RES.4282.01	NCA04	2	298579	6249473	Residential	37 - 45 Duff Road, Cecil Park 2178	55	50	P	56	52	57	53	58	54	58	55	Y	Y	-	Y	-	-	Y
NCA04.RES.3882.01	NCA04	1	300604	6249809	Residential	37 - 73 Wallgrove Road, Cecil Park 2178	60	55	P	68	64	69	65	69	65	70	66	-	-	Y	Y	Y	Y	Y
NCA04.RES.3869.01	NCA04	1	299997	6249999	Residential	38 - 42 Cecil Road, Cecil Park 2178	55	50	P	56	52	57	53	58	54	59	55	-	-	-	Y	-	-	Y
NCA04.RES.3869.01	NCA04	2	299997	6249999	Residential	38 - 42 Cecil Road, Cecil Park 2178	55	50	P	57	53	58	54	59	55	60	56	-	-	Y	Y	-	-	Y
NCA04.RES.4289.01	NCA04	1	298699	6249566	Residential	40-46 Duff Road, Cecil Park 2178	55	50	P	55	51	58	54	57	53	60	56	Y	Y	Y	Y	-	-	Y
NCA04.RES.4289.01	NCA04	2	298699	6249566	Residential	40-46 Duff Road, Cecil Park 2178	55	50	P	60	56	60	57	62	58	62	58	Y	Y	Y	Y	-	-	Y
NCA04.RES.4193.01	NCA04	1	299093	6249922	Residential	47 - 49 Brolen Way, Cecil Park 2178	55	50	P	54	50	57	53	56	52	59	55	Y	Y	-	Y	-	-	Y
NCA04.RES.4285.01	NCA04	2	298549	6249562	Residential	47 - 55 Duff Road, Cecil Park 2178	55	50	P	50	46	53	49	52	48	55	51	-	Y	-	-	-	-	Y
NCA04.RES.4291.01	NCA04	1	298662	6249622	Residential	48-56 Duff Road, Cecil Park 2178	55	50	P	56	52	58	54	58	54	59	55	Y	Y	-	Y	-	-	Y
NCA04.RES.4291.01	NCA04	2	298662	6249622	Residential	48-56 Duff Road, Cecil Park 2178	55	50	P	58	54	59	55	60	56	61	57	Y	Y	Y	Y	-	-	Y
NCA04.RES.4292.01	NCA04	1	298630	6249677	Residential	58 - 76 Duff Road, Cecil Park 2178	55	50	P	56	52	57	53	58	53	59	55	Y	Y	-	Y	-	-	Y
NCA04.RES.4292.01	NCA04	2	298630	6249677	Residential	58 - 76 Duff Road, Cecil Park 2178	55	50	P	57	53	58	55	59	55	60	56	Y	Y	Y	Y	-	-	Y
NCA04.RES.3975.01	NCA04	1	300655	6250025	Residential	87 - 95 Wallgrove Road, Cecil Park 2178	60	55	P	63	59	64	60	64	60	65	61	-	-	Y	Y	-	-	Y
NCA04.RES.4279.01	NCA04	1	298741	6249398	Residential	9 - 17 Duff Road, Cecil Park 2178	55	50	P	62	58	63	59	64	60	65	61	-	-	Y	Y	-	-	Y
NCA04.RES.4279.01	NCA04	2	298741	6249398	Residential	9 - 17 Duff Road, Cecil Park 2178	55	50	P	63	59	64	60	65	61	66	62	-	-	Y	Y	-	-	Y
NCA04.RES.3876.01	NCA04	1	299712	6250029	Residential	99 - 117 Cecil Road, Cecil Park 2178	55	50	P	52	47	54	49	54	49	56	52	-	Y	-	-	-	-	Y
NCA04.RES.3876.01	NCA04	2	299712	6250029	Residential	99 - 117 Cecil Road, Cecil Park 2178	55	50	P	55	51	57	53	57	53	59	55	-	Y	-	Y	-	-	Y
NCA05.OOP.8011.01	NCA05	1	298815	6247596	Other (Outdoor Passive)	Western Sydney Parklands, Cecil Hills 2171	55	-	P	55	51	62	58	57	53	64	60	Y	-	Y	-	-	-	Y
NCA05.OOP.8011.01	NCA05	1	298815	6247596	Other (Outdoor Passive)	Western Sydney Parklands, Cecil Hills 2171	55	-	P	55	51	62	58	57	53	64	60	Y	-	Y	-	-	-	Y
NCA05.OOP.8011.01	NCA05	1	298815	6247596	Other (Outdoor Passive)	Western Sydney Parklands, Cecil Hills 2171	55	-	P	55	51	62	58	57	53	64	60	Y	-	Y	-	-	-	Y
NCA05.OOP.8011.01	NCA05	1	298815	6247596	Other (Outdoor Passive)	Western Sydney Parklands, Cecil Hills 2171	55	-	P	55	51	62	58	57	53	64	60	Y	-	Y	-	-	-	Y
NCA06.RES.5559.01	NCA06	1	295825	6249413	Residential	13 - 23 Salisbury Avenue, Kemps Creek 2178	55	50	P	54	49	68	63	64	59	70	66	Y	Y	Y	Y	Y	Y	Y
NCA06.RES.5544.01	NCA06	1	295849	6248929	Residential	1431 - 1433 Elizabeth Drive, Kemps Creek 2178	55	50	P	60	56	61	57	64	59	64	60	Y	Y	Y	Y	-	-	Y
NCA06.RES.5544.01	NCA06	2	295849	6248929	Residential	1431 - 1433 Elizabeth Drive, Kemps Creek 2178	55	50	P	62	58	63	59	66	62	66	62	Y	Y	Y	Y	-	-	Y
NCA06.RES.5569.01	NCA06	1	295844	6249053	Residential	1431 - 1433 Elizabeth Drive, Kemps Creek 2178	55	50	P	54	49	56	52	72	67	70	66	Y	Y	Y	Y	-	-	Y
NCA06.RES.5569.01	NCA06	2	295844	6249053	Residential	1431 - 1433 Elizabeth Drive, Kemps Creek 2178	55	50	P	56	51	58	54	73	68	71	67	Y	Y	Y	Y	-	-	Y
NCA06.RES.5564.01	NCA06	1	295893	6249316	Residential	26 - 32 Salisbury Avenue, Kemps Creek 2178	55	50	P	50	46	65	61	58	53	68	64	Y	Y	Y	Y	Y	Y	Y
NCA06.RES.5563.01	NCA06	1	295808	6249269	Residential	33-39 Salisbury Avenue, Kemps Creek 2178	55	50	P	54	49	63	59	65	60	67	63	Y	Y	Y	Y	Y	Y	Y
NCA06.RES.5563.01	NCA06	2	295808	6249269	Residential	33-39 Salisbury Avenue, Kemps Creek 2178	55	50	P	55	51	63	59	66	61	68	64	Y	Y	Y	Y	Y	Y	Y
NCA06.RES.5566.01	NCA06	1	295882	6249209	Residential	34-42 Salisbury Avenue, Kemps Creek 2178	55	50	P	49	45	56	52	66	60	65	60	Y	Y	Y	Y	-	Y	Y
NCA06.RES.5566.01	NCA06	2	295882	6249209	Residential	34-42 Salisbury Avenue, Kemps Creek 2178	55	50	P	51	47	58	54	68	62	67	62	Y	Y	Y	Y	Y	Y	Y
NCA06.RES.5553.01	NCA06	1	295517	6249549	Residential	395 - 409 Clifton Avenue, Kemps Creek 2178	55	50	P	51	47	59	55	53	49	61	57	Y	Y	Y	Y	-	-	Y
NCA06.RES.5553.01	NCA06	2	295517	6249549	Residential	395 - 409 Clifton Avenue, Kemps Creek 2178	55	50	P	53	49	61	57	55	50	63	59	Y	Y	Y	Y	-	-	Y
NCA06.RES.5556.01	NCA06	1	295539	6249636	Residential	395 - 409 Clifton Avenue, Kemps Creek 2178	55	50	P	54	50	62	58	53	49	64	60	Y	Y	Y	Y	-	Y	Y
NCA06.RES.5560.01	NCA06	1	295795	6249152	Residential	41 - 49 Salisbury Avenue, Kemps Creek 2178	55	50	P	55	51	60	56	66	61	66	61	Y	Y	Y	Y	-	-	Y
NCA06.RES.5560.01	NCA06	2	295795	6249152	Residential	41 - 49 Salisbury Avenue, Kemps Creek 2178	55	50	P	56	52	62	57	67	62	67	63	Y	Y	Y	Y	-	-	Y
NCA06.RES.5561.01	NCA06	1	295813	6249216	Residential	41 - 49 Salisbury Avenue, Kemps Creek 2178	55	50	P	55	50	61	57	68	63	67	63	Y	Y	Y	Y	-	-	Y
NCA06.RES.5552.01	NCA06	1	295520	6249443	Residential	410 Clifton Avenue, Kemps Creek 2178	55	50	P	52	48	59	55	54	50	61	57	Y	Y	Y	Y	-	-	Y
NCA06.RES.5551.01	NCA06	1	295513	6249375	Residential	422-433 Clifton Avenue, Kemps Creek 2178	55	50	P	51	47	57	53	54	49	59	55	Y	Y	-	Y	-	-	Y
NCA06.RES.5551.01	NCA06	2	295513	6249375	Residential	422-433 Clifton Avenue, Kemps Creek 2178	55	50	P	53	49	60	56	55	51	62	58	Y	Y	Y	Y	-	-	Y
NCA06.RES.5550.01	NCA06	1	295493	6249229	Residential	434-441 Clifton Avenue, Kemps Creek 2178	55	50	P	53	50	57	53	54	50	59	55	Y	Y	-	Y	-	-	Y
NCA06.RES.5567.01	NCA06	1	295877	6249155	Residential	44 - 56 Salisbury Avenue, Kemps Creek 2178	55	50	P	51	47	61	57	63	58	65	61	Y	Y	Y	Y	-	-	Y
NCA06.RES.5568.01	NCA06	1	295863	6249087	Residential	44 - 56 Salisbury Avenue, Kemps Creek 2178	55	50	P	51	47	56	52	66	61	65	60	Y	Y	Y	Y	-	-	Y
NCA06.RES.5548.01	NCA06	1	295474	6249169	Residential	442-449 Clifton Avenue, Kemps Creek 2178	55	50	P	54	50	56	52	55	51	58	54	Y	Y	-	-	-	-	Y
NCA06.RES.5548.01	NCA06	2	295474	6249169	Residential	442-449 Clifton Avenue, Kemps Creek 2178	55	50	P	56	52	59	54	58	53	60	56	Y	Y	Y	Y	-	-	Y

Note: The results in this table are based on the highest noise level of the triggered facades, per floor. If no facades are triggered, then the highest noise level of all facades is presented for each floor.
It is noted that a single receiver may be triggered on multiple facades and for some receivers where a >2 dB increase is shown, this may be on a different facade from where the highest noise level is predicted.

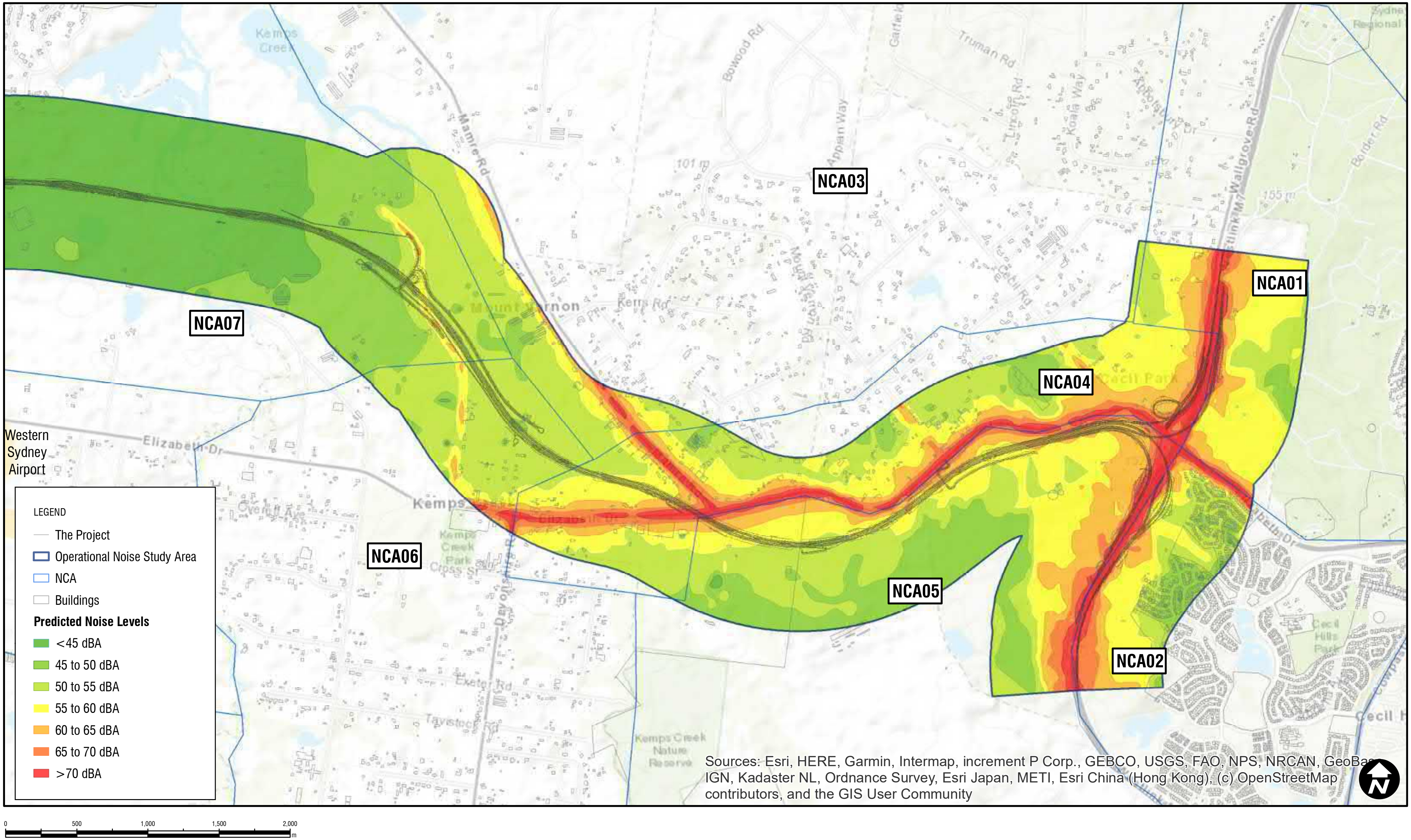
Name	NCA	Floor	Easting	Northing	Land Use	Address	NCG Criteria		Period	Predicted noise level (dBA)								> 2 dBA Increase		Cumulative Limit		Project Acute		Eligible for consideration of mitigation
										At Opening (2026)				Future Design (2036)										
										No Build		Build		No Build		Build								
							D	N		D	N	D	N	D	N	D	N	D	N	D	N	D	N	
NCA06.RES.5546.01	NCA06	1	295719	6248984	Residential	51 Salisbury Avenue, Kemps Creek 2178	55	50	P	50	45	57	53	55	50	59	55	Y	Y	-	Y	-	-	**Y**
NCA06.RES.5546.01	NCA06	2	295719	6248984	Residential	51 Salisbury Avenue, Kemps Creek 2178	55	50	P	52	48	58	54	57	53	61	57	Y	Y	Y	Y	-	-	**Y**
NCA06.RES.5547.01	NCA06	1	295676	6248977	Residential	51 Salisbury Avenue, Kemps Creek 2178	55	50	P	59	54	60	55	62	57	62	57	Y	Y	-	Y	-	-	**Y**
NCA07.RES.6034.01	NCA07	1	292558	6251818	Residential	11 Farmingdale Court Luddenham 2745	51	47	P	39	35	57	53	42	37	59	55	Y	Y	Y	Y	-	-	**Y**
NCA07.RES.4831.01	NCA07	1	294082	6250512	Residential	146 Clifton Avenue, Kemps Creek 2178	54	50	P	42	38	59	55	42	38	61	57	Y	Y	Y	Y	-	-	**Y**
NCA07.RES.4831.01	NCA07	2	294082	6250512	Residential	146 Clifton Avenue, Kemps Creek 2178	55	50	P	43	39	59	55	44	40	62	58	Y	Y	Y	Y	-	-	**Y**
NCA07.RES.4835.01	NCA07	1	294803	6250117	Residential	1541A Elizabeth Drive, Kemps Creek 2178	55	50	P	46	42	57	53	47	43	59	55	Y	Y	-	Y	-	-	**Y**
NCA07.RES.6026.01	NCA07	1	292227	6251805	Residential	16 Farmingdale Court Luddenham 2745	53	49	P	41	37	56	52	44	39	58	54	Y	Y	Y	Y	-	-	**Y**
NCA07.RES.5170.01	NCA07	1	293161	6250509	Residential	1669 Elizabeth Drive, Badgerys Creek 2555	53	49	P	41	37	56	52	41	37	58	54	Y	Y	Y	Y	-	-	**Y**
NCA07.RES.5170.01	NCA07	2	293161	6250509	Residential	1669 Elizabeth Drive, Badgerys Creek 2555	53	49	P	41	37	57	53	42	38	59	55	Y	Y	Y	Y	-	-	**Y**
NCA07.RES.4833.01	NCA07	1	294703	6250950	Residential	203 - 229 Clifton Avenue, Kemps Creek 2178	55	50	P	46	41	63	59	48	44	65	61	Y	Y	Y	Y	Y	Y	**Y**
NCA07.RES.4833.01	NCA07	2	294703	6250950	Residential	203 - 229 Clifton Avenue, Kemps Creek 2178	55	50	P	47	42	65	61	49	45	67	63	Y	Y	Y	Y	Y	Y	**Y**
NCA07.RES.4834.01	NCA07	1	294721	6251017	Residential	203 - 229 Clifton Avenue, Kemps Creek 2178	55	50	P	46	42	59	55	47	43	61	57	Y	Y	Y	Y	-	-	**Y**
NCA07.RES.4834.01	NCA07	2	294721	6251017	Residential	203 - 229 Clifton Avenue, Kemps Creek 2178	55	50	P	47	43	60	56	48	44	62	59	Y	Y	Y	Y	-	-	**Y**
NCA07.RES.6027.01	NCA07	1	292378	6251791	Residential	22 Farmingdale Court Luddenham 2745	53	48	P	41	36	56	52	43	39	59	55	Y	Y	Y	Y	-	-	**Y**
NCA07.RES.4837.01	NCA07	1	294785	6251132	Residential	230 - 234 Clifton Avenue, Kemps Creek 2178	55	50	P	46	42	56	52	47	43	58	55	Y	Y	-	Y	-	-	**Y**
NCA07.RES.4838.01	NCA07	1	294892	6251157	Residential	230 - 234 Clifton Avenue, Kemps Creek 2178	55	50	P	45	41	56	52	46	42	58	54	Y	Y	-	-	-	-	**Y**
NCA07.RES.4840.01	NCA07	1	294951	6251150	Residential	235 - 245 Clifton Avenue, Kemps Creek 2178	55	50	P	48	44	56	52	49	45	58	54	Y	Y	-	-	-	-	**Y**
NCA07.RES.4841.01	NCA07	1	295061	6251145	Residential	235 - 245 Clifton Avenue, Kemps Creek 2178	55	50	P	49	45	55	51	49	45	56	53	Y	Y	-	-	-	-	**Y**
NCA07.RES.4841.01	NCA07	2	295061	6251145	Residential	235 - 245 Clifton Avenue, Kemps Creek 2178	55	50	P	50	46	57	53	50	47	59	55	Y	Y	-	Y	-	-	**Y**
NCA07.RES.4842.01	NCA07	1	295047	6251126	Residential	235 - 245 Clifton Avenue, Kemps Creek 2178	55	50	P	51	47	56	52	51	47	58	54	Y	Y	-	-	-	-	**Y**
NCA07.RES.4843.01	NCA07	1	295000	6251091	Residential	235 - 245 Clifton Avenue, Kemps Creek 2178	55	50	P	48	44	56	52	49	44	58	54	Y	Y	-	-	-	-	**Y**
NCA07.RES.4843.01	NCA07	2	295000	6251091	Residential	235 - 245 Clifton Avenue, Kemps Creek 2178	55	50	P	50	46	57	53	50	46	59	55	Y	Y	-	Y	-	-	**Y**
NCA07.RES.4844.01	NCA07	1	294131	6251211	Residential	885A Mamre Road, Kemps Creek 2178	55	50	P	45	41	64	60	47	43	66	62	Y	Y	Y	Y	Y	Y	**Y**
NCA07.RES.5149.01	NCA07	1	291097	6250357	Residential	1793 - 1951 Elizabeth Drive, Badgerys Creek 2555	55	50	P	48	43	59	55	51	46	61	57	Y	Y	Y	Y	-	-	**Y**
NCA07.RES.5167.01	NCA07	1	291419	6250206	Residential	1793 - 1951 Elizabeth Drive, Badgerys Creek 2555	55	50	P	50	45	61	57	53	48	63	59	Y	Y	Y	Y	-	-	**Y**
NCA07.RES.5153.01	NCA07	1	290701	6250217	Residential	Unit 15, 1953 Elizabeth Drive, Badgerys Creek 2555	55	50	P	50	46	55	50	53	49	57	53	Y	Y	-	-	-	-	**Y**
NCA07.RES.5153.01	NCA07	2	290701	6250217	Residential	Unit 15, 1953 Elizabeth Drive, Badgerys Creek 2555	55	50	P	51	47	55	51	54	49	58	54	Y	Y	-	Y	-	-	**Y**
NCA09.RES.4887.01	NCA09	1	289957	6251717	Residential	710 - 732 Luddenham Road, Luddenham 2745	55	50	P	58	53	61	57	58	54	63	59	Y	Y	Y	Y	-	-	**Y**
NCA09.RES.4887.01	NCA09	2	289957	6251717	Residential	710 - 732 Luddenham Road, Luddenham 2745	55	50	P	60	55	62	58	60	56	64	60	Y	Y	Y	Y	-	-	**Y**
NCA09.RES.4889.01	NCA09	1	290001	6251751	Residential	710 - 732 Luddenham Road, Luddenham 2745	55	50	P	58	54	60	56	59	55	62	58	Y	Y	Y	Y	-	-	**Y**
NCA09.RES.4916.01	NCA09	1	289706	6251907	Residential	713 - 733 Luddenham Road, Luddenham 2745	55	50	P	54	49	60	55	54	50	62	58	Y	Y	Y	Y	-	-	**Y**
NCA09.RES.4916.01	NCA09	2	289706	6251907	Residential	713 - 733 Luddenham Road, Luddenham 2745	55	50	P	54	50	60	56	55	51	62	58	Y	Y	Y	Y	-	-	**Y**
NCA09.RES.4882.01	NCA09	1	289904	6251579	Residential	734 Luddenham Road, Luddenham 2745	55	50	P	57	53	63	58	58	54	65	61	Y	Y	Y	Y	-	Y	**Y**
NCA09.RES.4884.01	NCA09	1	289977	6251640	Residential	734 Luddenham Road, Luddenham 2745	55	50	P	55	51	60	56	56	52	62	59	Y	Y	Y	Y	-	-	**Y**
NCA09.RES.4884.01	NCA09	2	289977	6251640	Residential	734 Luddenham Road, Luddenham 2745	55	50	P	57	53	62	57	58	54	63	60	Y	Y	Y	Y	-	-	**Y**
NCA09.RES.4918.01	NCA09	1	289282	6251621	Residential	765 Luddenham Road, Luddenham 2745	55	50	P	52	48	64	60	53	49	66	63	Y	Y	Y	Y	Y	Y	**Y**
NCA09.RES.5765.01	NCA09	1	289405	6251049	Residential	777 - 819 Luddenham Road, Luddenham 2745	55	50	P	60	56	62	58	61	57	64	60	Y	Y	Y	Y	-	-	**Y**
NCA09.RES.5137.01	NCA09	1	289463	6250776	Residential	812 - 844 Luddenham Road, Luddenham 2745	55	50	P	57	53	59	54	58	54	60	56	Y	Y	Y	Y	-	-	**Y**
NCA09.RES.5129.01	NCA09	1	289085	6250946	Residential	821-849 Luddenham Road, Luddenham 2745	55	50	P	49	45	59	54	50	46	61	57	Y	Y	Y	Y	-	-	**Y**
NCA09.RES.5129.01	NCA09	2	289085	6250946	Residential	821-849 Luddenham Road, Luddenham 2745	55	50	P	55	50	60	55	56	52	62	58	Y	Y	Y	Y	-	-	**Y**
NCA09.RES.5128.01	NCA09	1	289006	6250929	Residential	851 Luddenham Road, Luddenham 2745	55	50	P	49	45	56	52	50	46	58	54	Y	Y	-	-	-	-	**Y**
NCA10.RES.5067.01	NCA10	1	287082	6250865	Residential	2830 - 2844 The Northern Road, Luddenham 2745	55	50	P	53	49	55	51	54	50	57	53	Y	Y	-	-	-	-	**Y**

Note: The results in this table are based on the highest noise level of the triggered facades, per floor. If no facades are triggered, then the highest noise level of all facades is presented for each floor.
It is noted that a single receiver may be triggered on multiple facades and for some receivers where a >2 dB increase is shown, this may be on a different facade from where the highest noise level is predicted.

PREDICTED OPERATIONAL ROAD TRAFFIC NOISE LEVELS WITHOUT MITIGATION – NO BUILD 2026 DAYTIME (FREE FIELD NOISE CONTOURS)

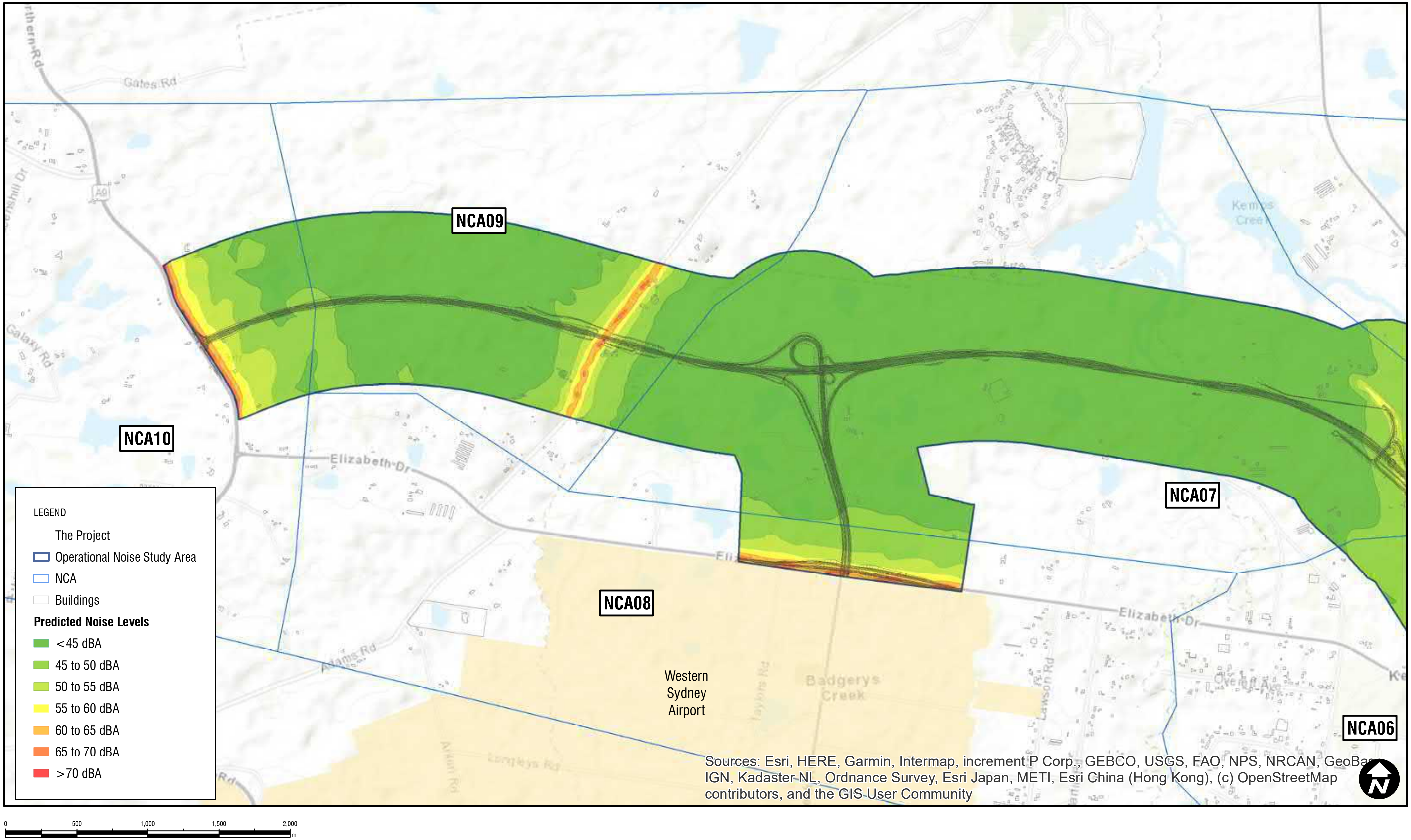


Predicted noise levels without mitigation - No Build 2026 Daytime LAeq (15 hour)

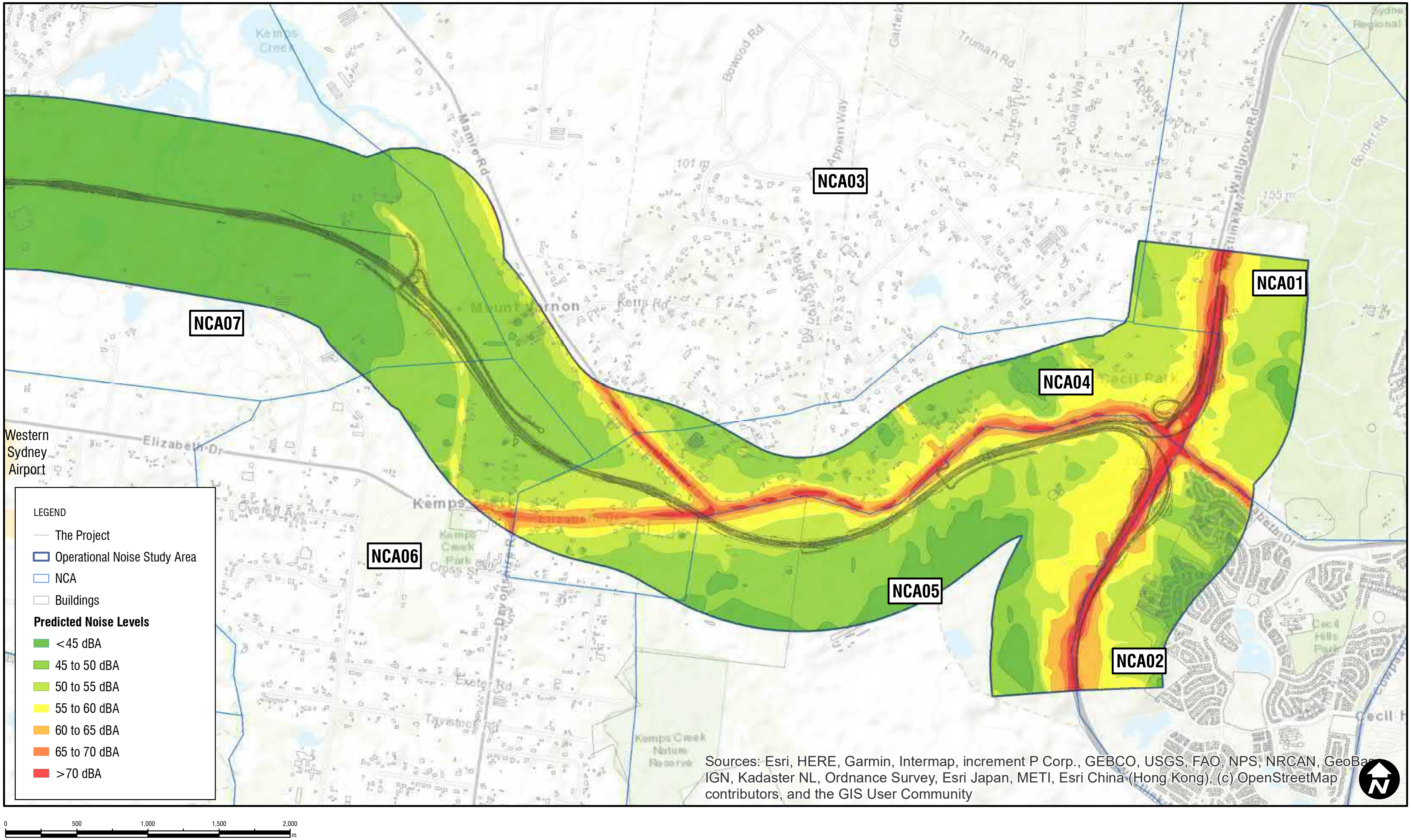


Predicted noise levels without mitigation - No Build 2026 Daytime LAeq (15 hour)

PREDICTED OPERATIONAL ROAD TRAFFIC NOISE LEVELS WITHOUT MITIGATION – NO BUILD 2026 NIGHT-TIME (FREE FIELD NOISE CONTOURS)

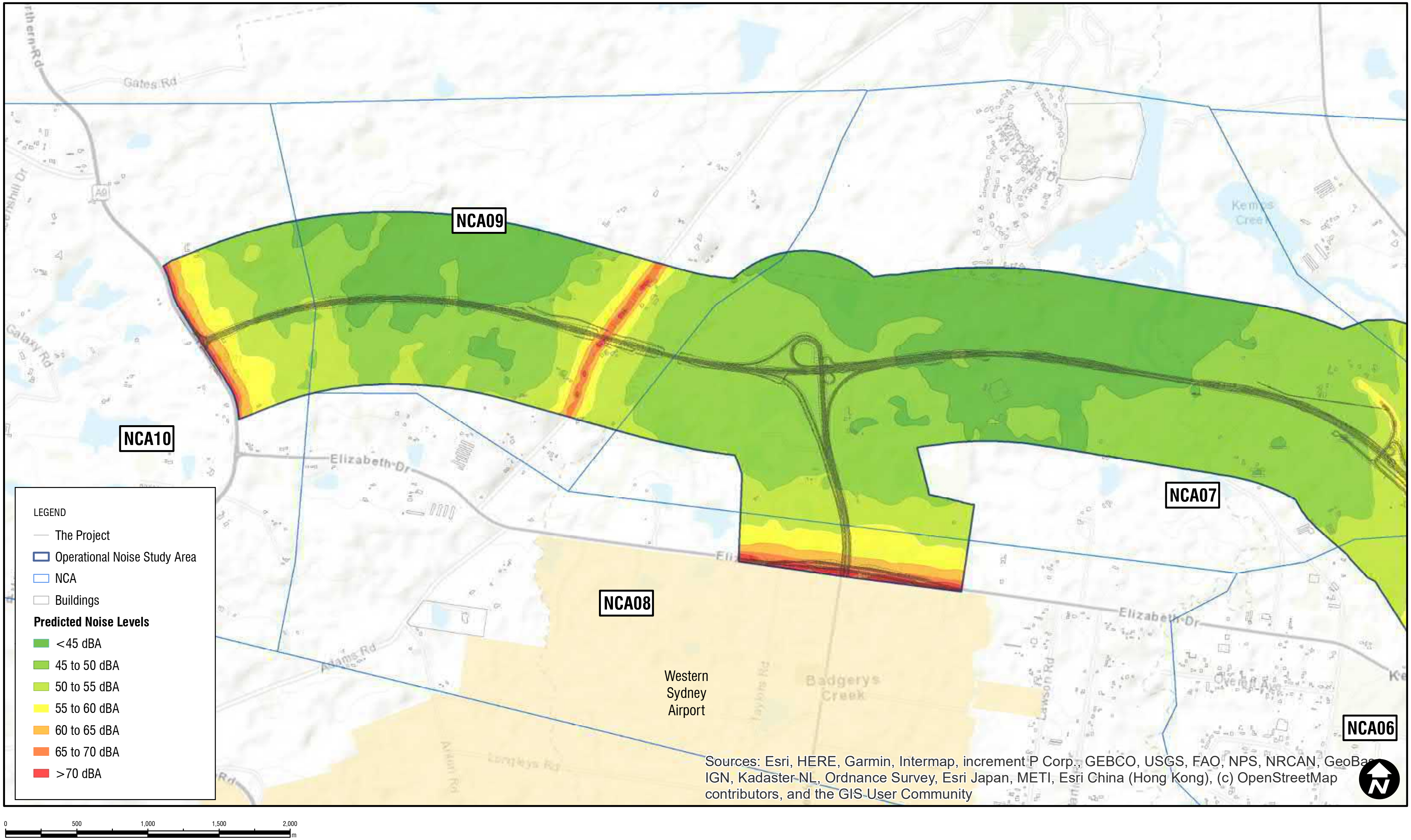


Predicted noise levels without mitigation - No Build 2026 Night-time LAeq (9 hour)

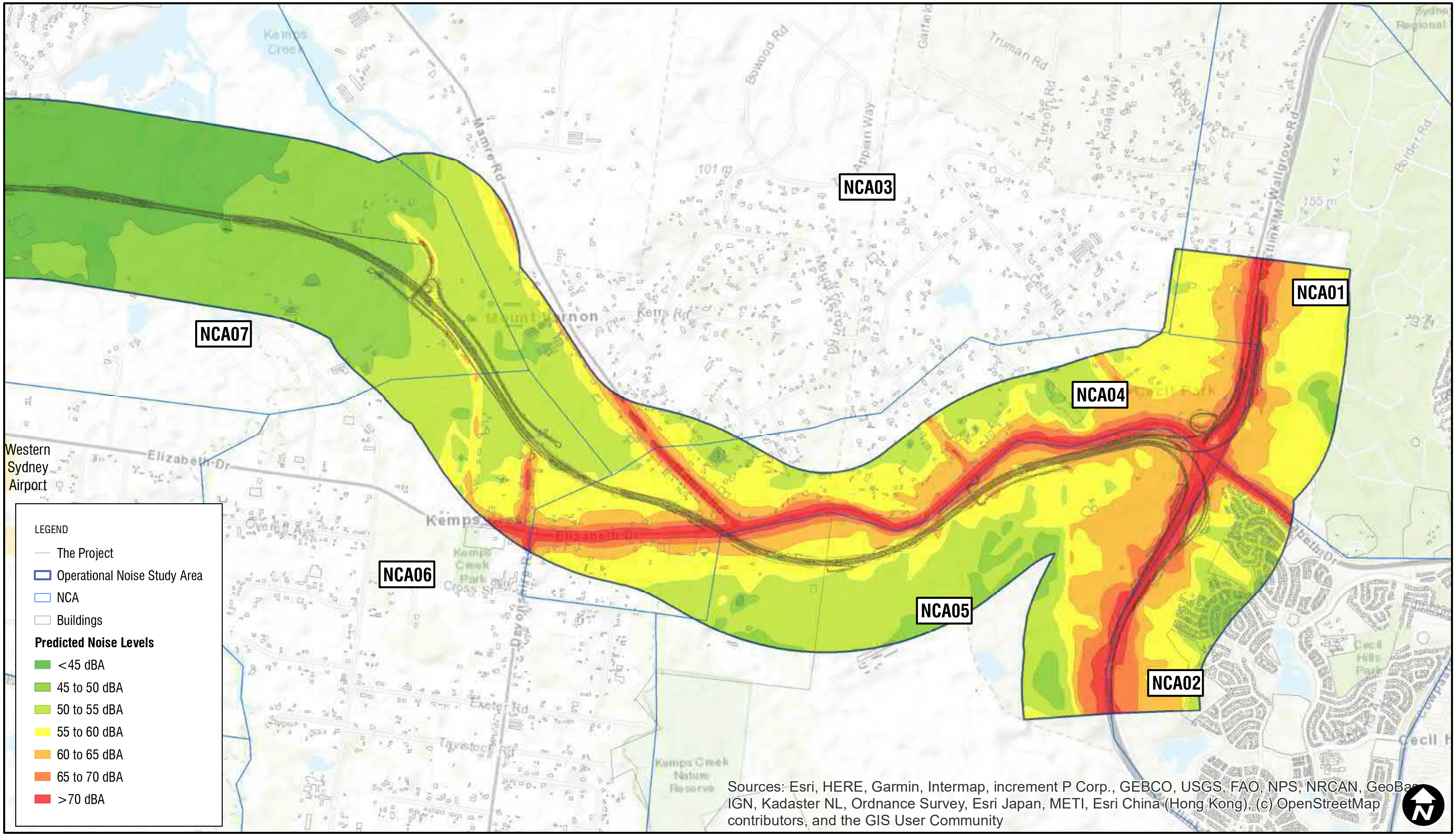


Predicted noise levels without mitigation - No Build 2026 Night-time LAeq (9 hour)

PREDICTED OPERATIONAL ROAD TRAFFIC NOISE LEVELS WITHOUT MITIGATION – NO BUILD 2036 DAYTIME (FREE FIELD NOISE CONTOURS)



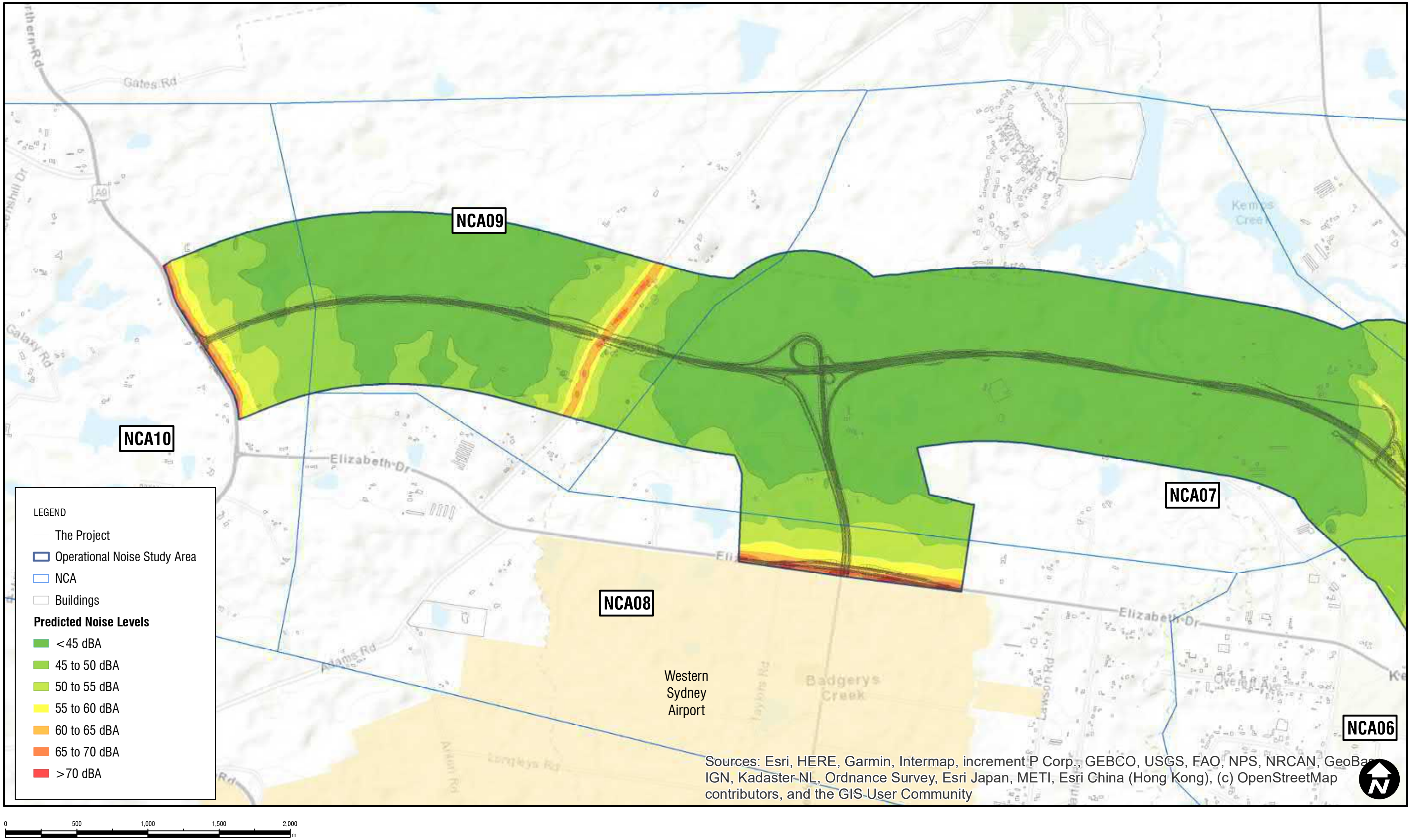
Predicted noise levels without mitigation - No Build 2036 Daytime LAeq (15 hour)



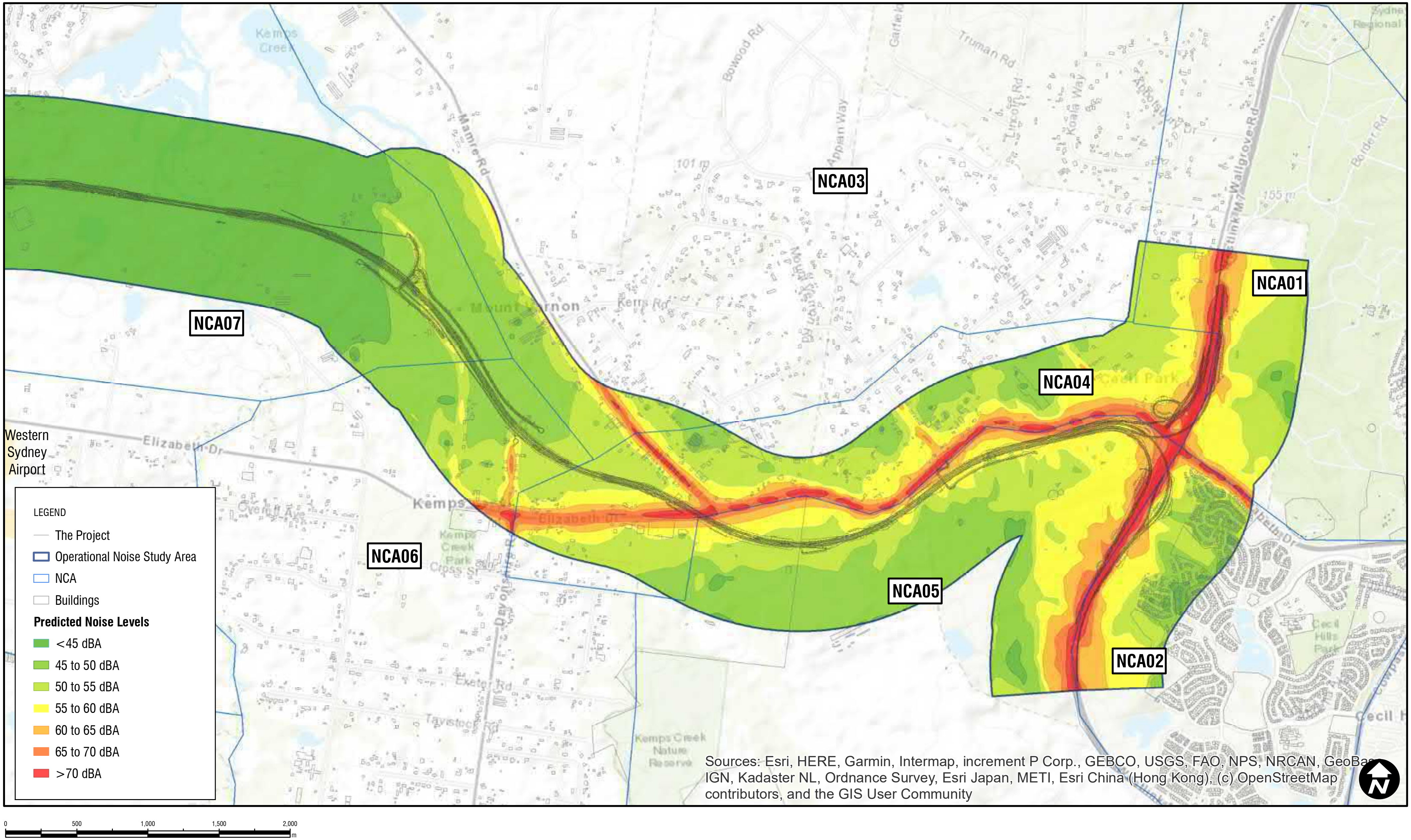
0 500 1,000 1,500 2,000 m

Predicted noise levels without mitigation - No Build 2036 Daytime LAeq (15 hour)

PREDICTED OPERATIONAL ROAD TRAFFIC NOISE LEVELS WITHOUT MITIGATION – NO BUILD 2036 NIGHT-TIME (FREE FIELD NOISE CONTOURS)

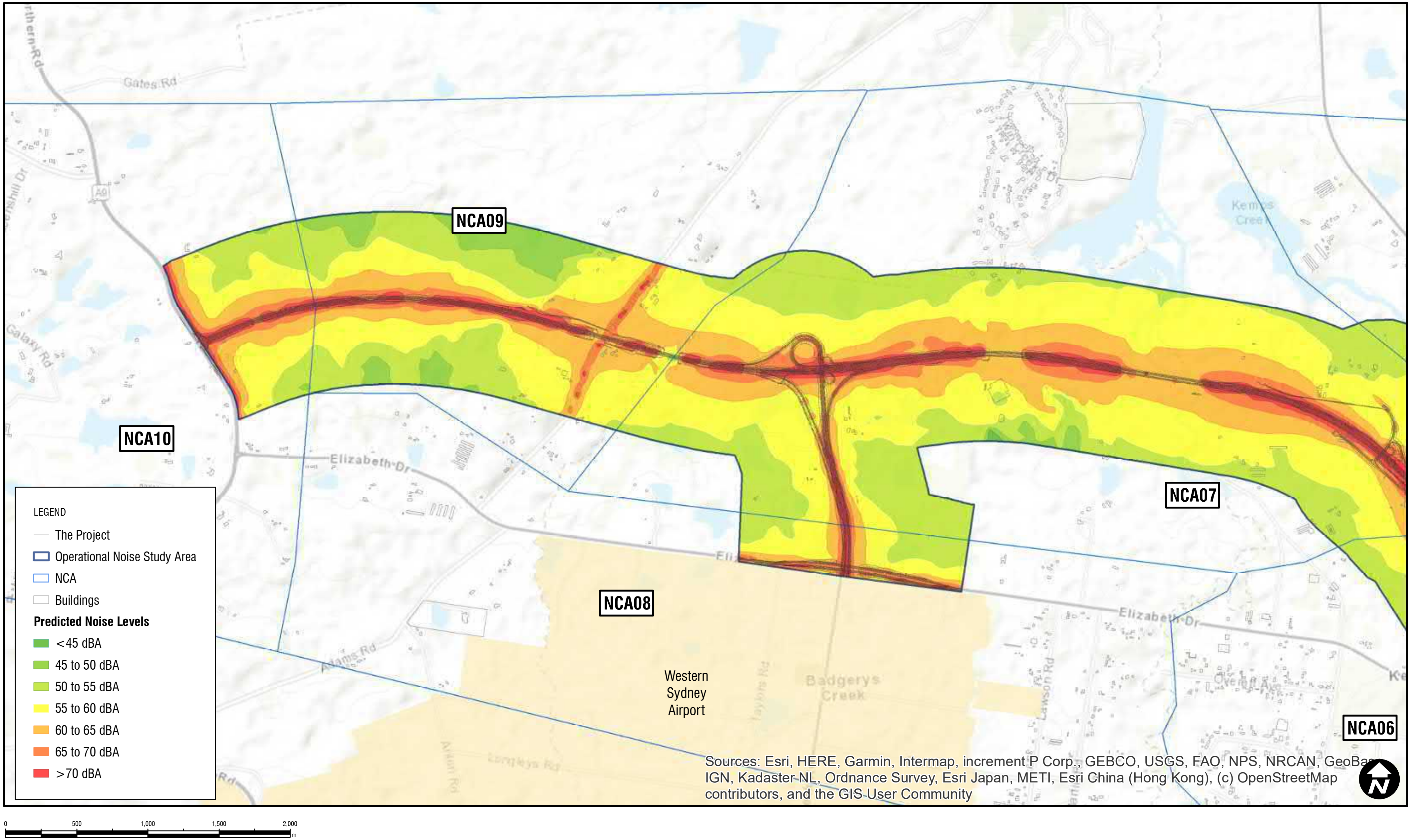


Predicted noise levels without mitigation - No Build 2036 Night-time LAeq (9 hour)

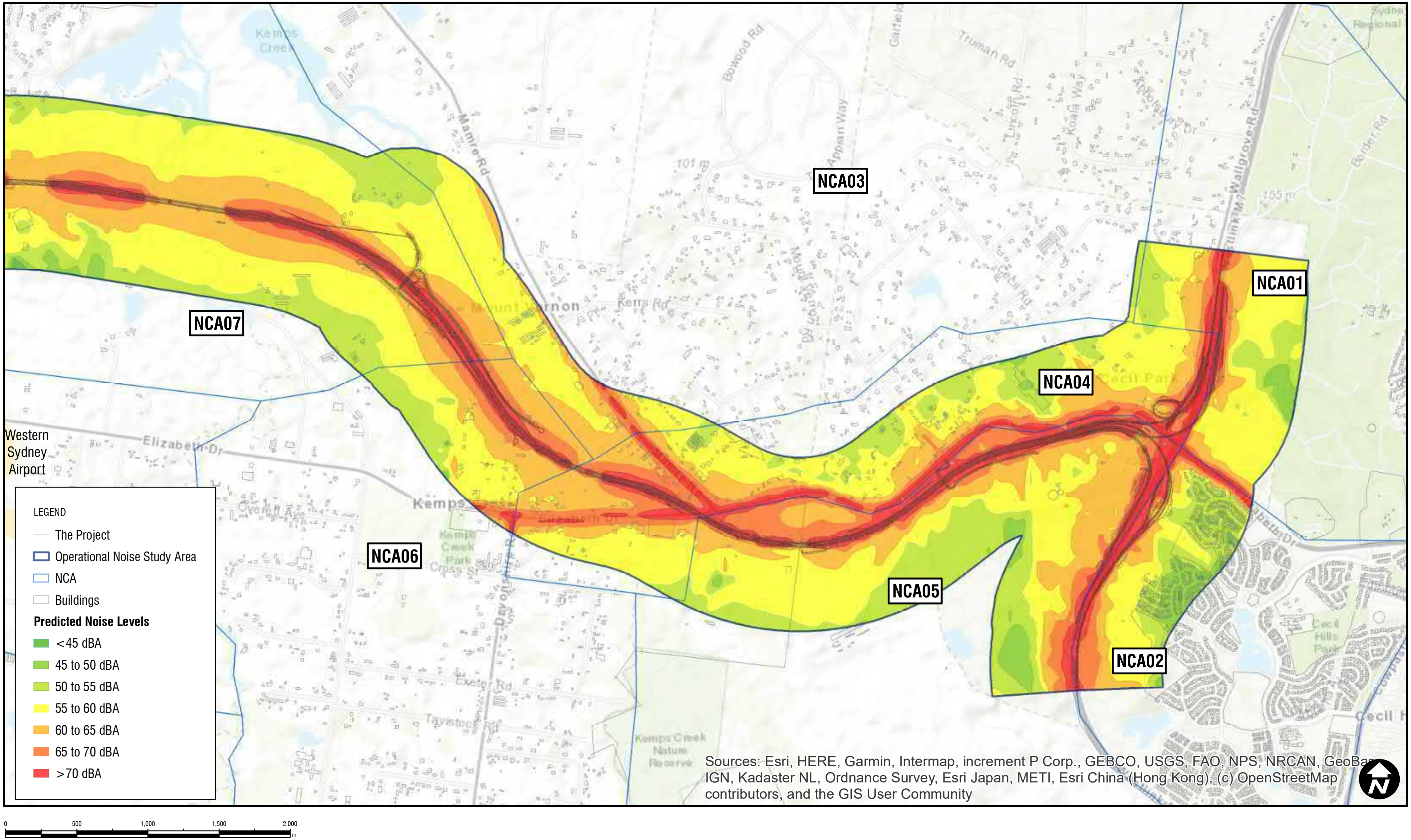


Predicted noise levels without mitigation - No Build 2036 Night-time LAeq (9 hour)

PREDICTED OPERATIONAL ROAD TRAFFIC NOISE LEVELS WITHOUT MITIGATION – BUILD 2026 DAYTIME (FREE FIELD NOISE CONTOURS)

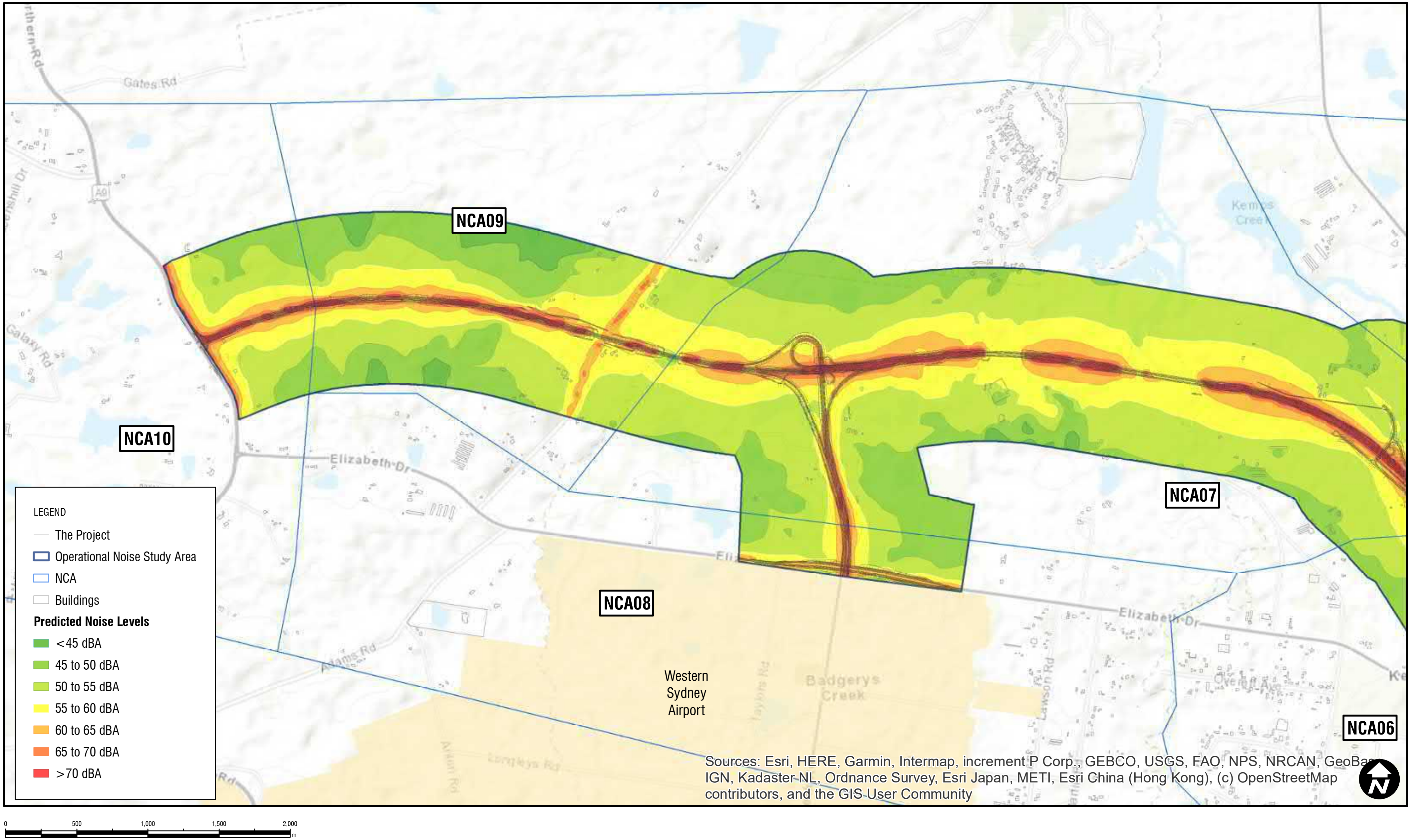


Predicted noise levels without mitigation - Build 2026 Daytime LAeq (15 hour)

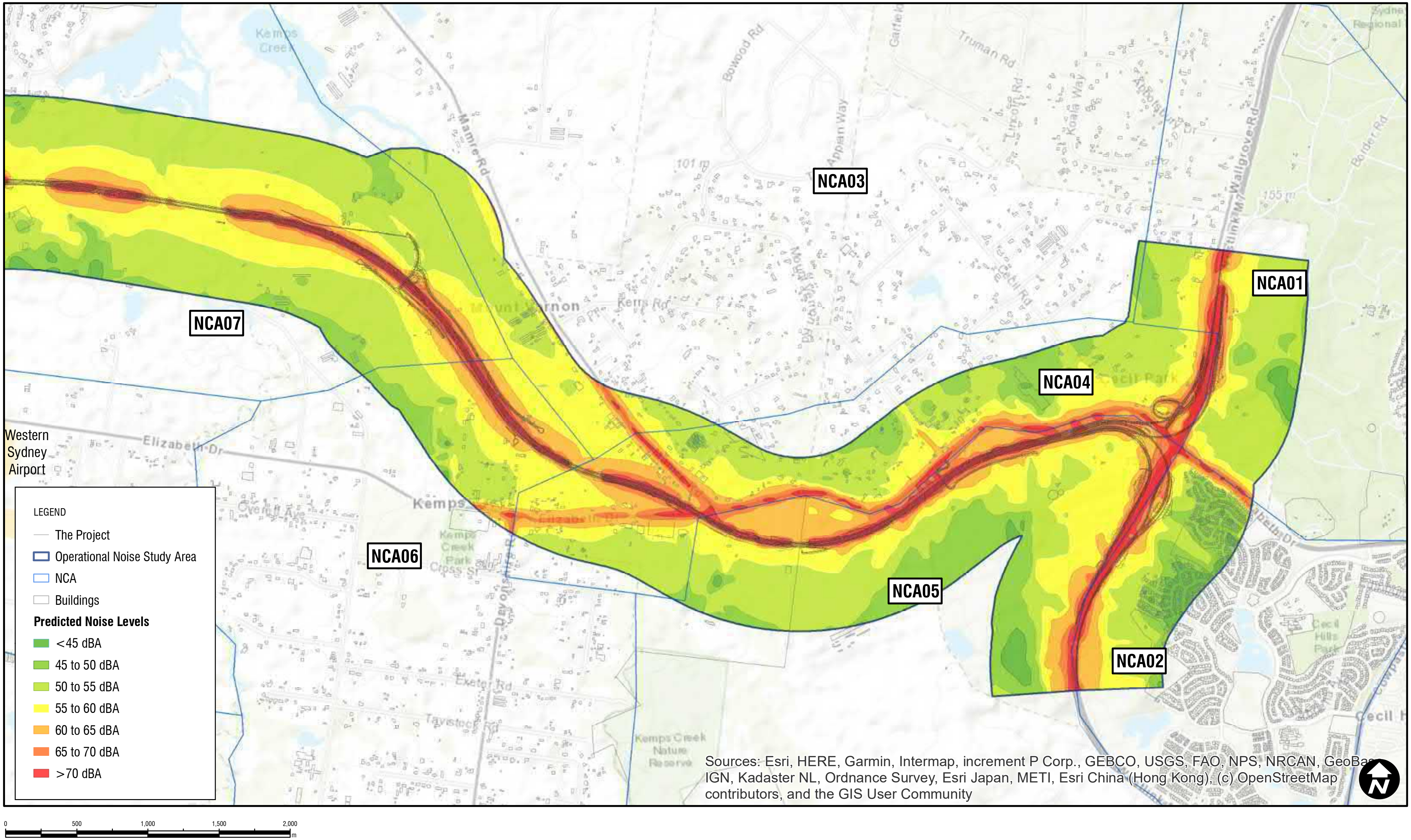


Predicted noise levels without mitigation - Build 2026 Daytime LAeq (15 hour)

PREDICTED OPERATIONAL ROAD TRAFFIC NOISE LEVELS WITHOUT MITIGATION – BUILD 2026 NIGHT-TIME (FREE FIELD NOISE CONTOURS)

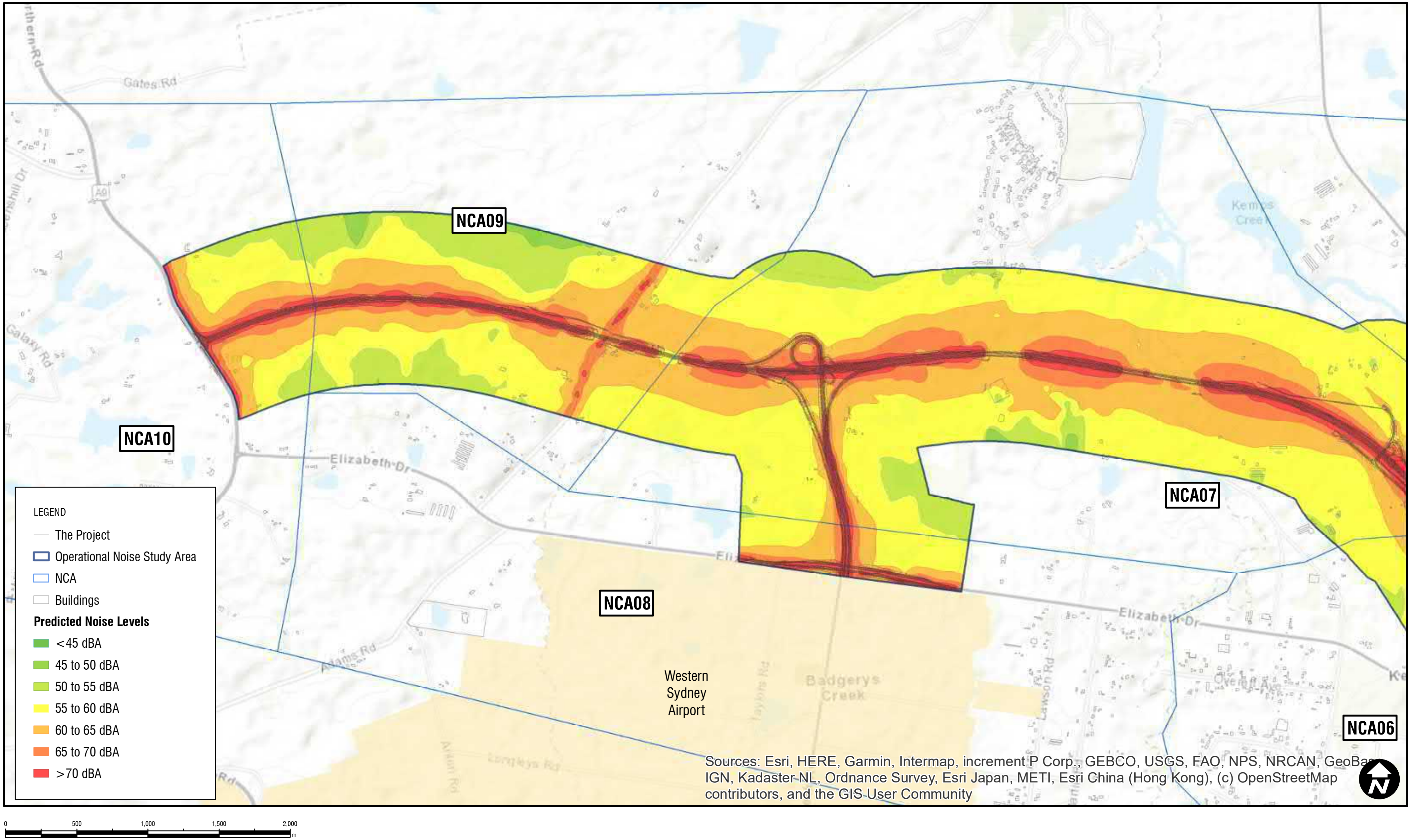


Predicted noise levels without mitigation - Build 2026 Night-time LAeq (9 hour)

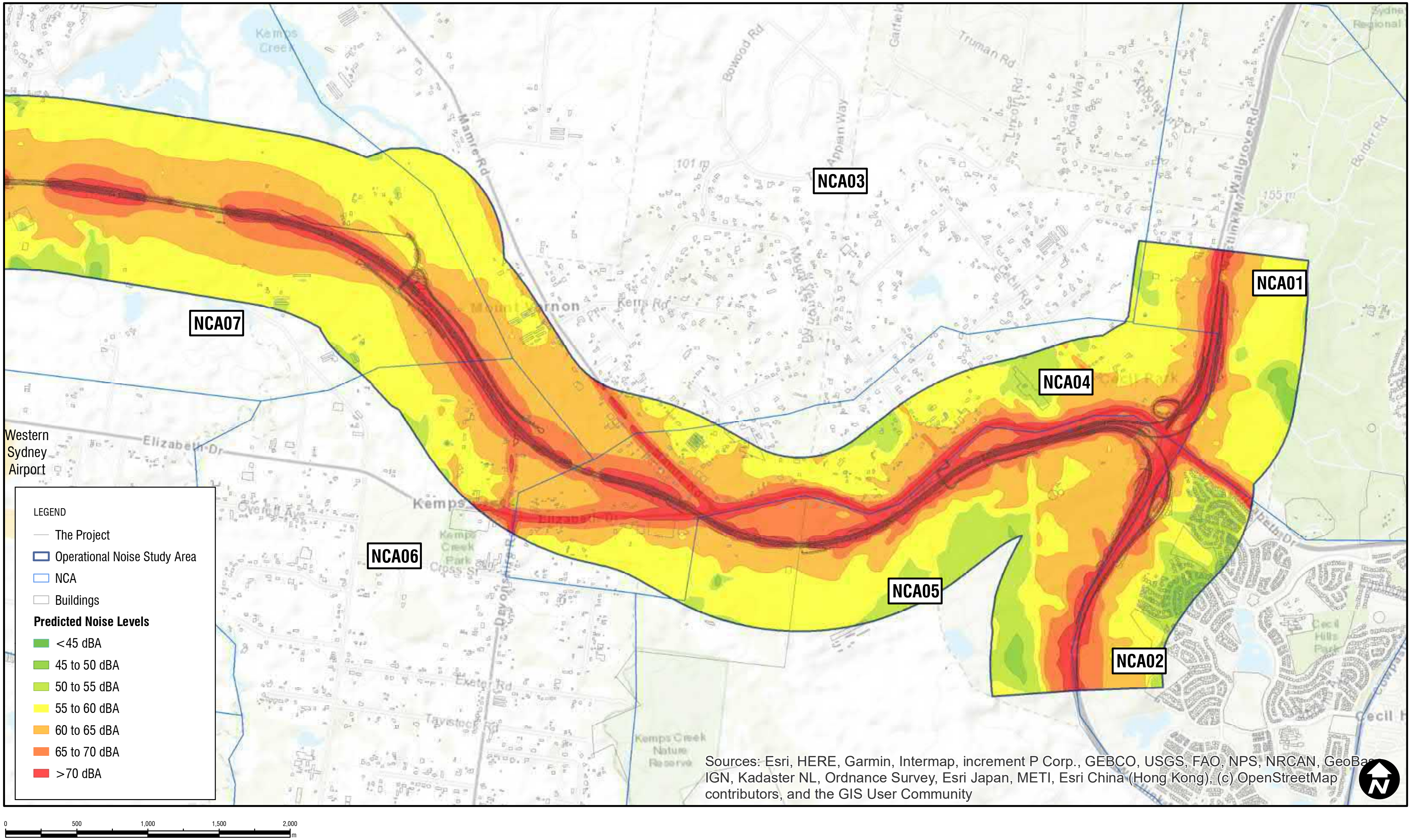


Predicted noise levels without mitigation - Build 2026 Night-time LAeq (9 hour)

PREDICTED OPERATIONAL ROAD TRAFFIC NOISE LEVELS WITHOUT MITIGATION – BUILD 2036 DAYTIME (FREE FIELD NOISE CONTOURS)

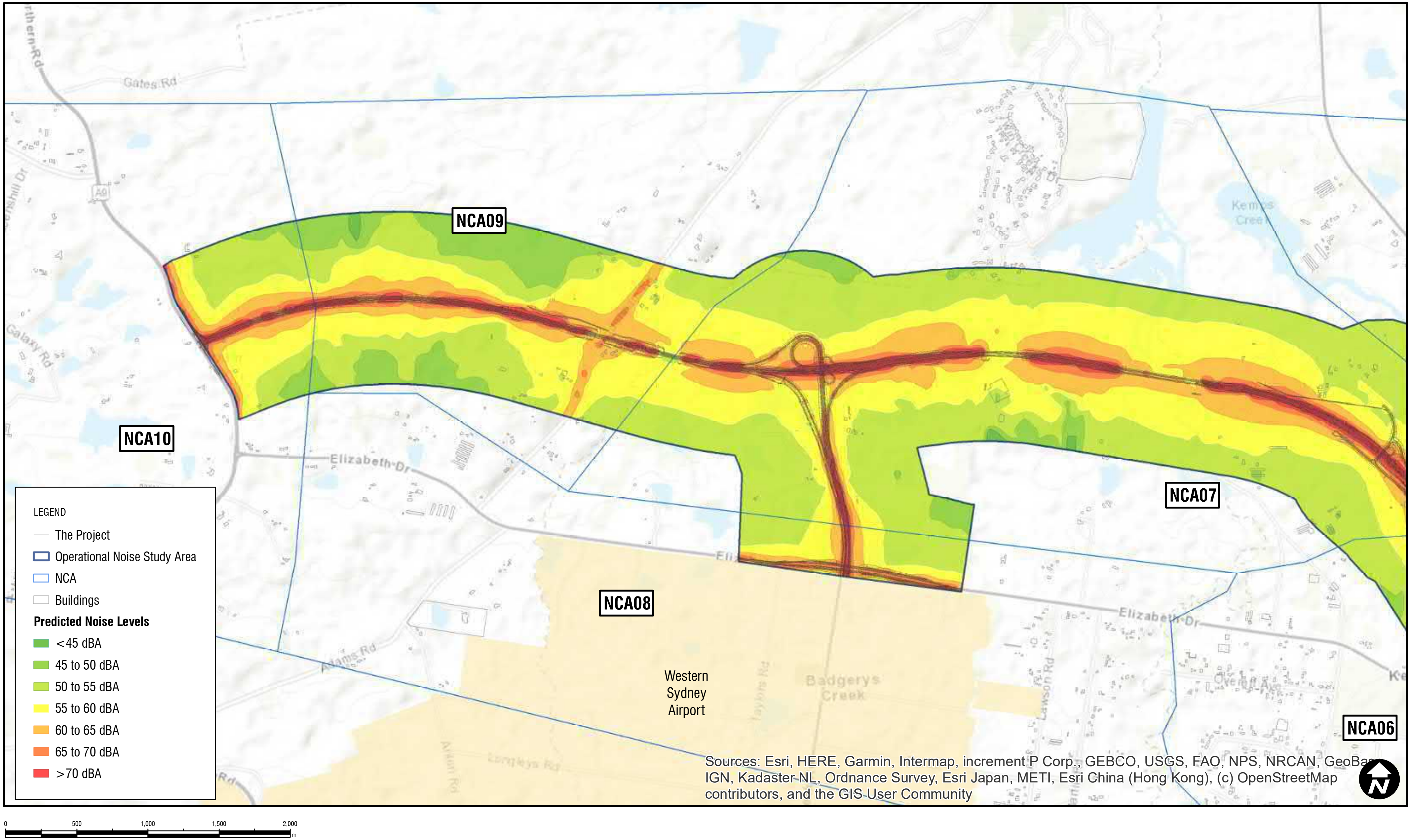


Predicted noise levels without mitigation - Build 2036 Daytime LAeq (15 hour)

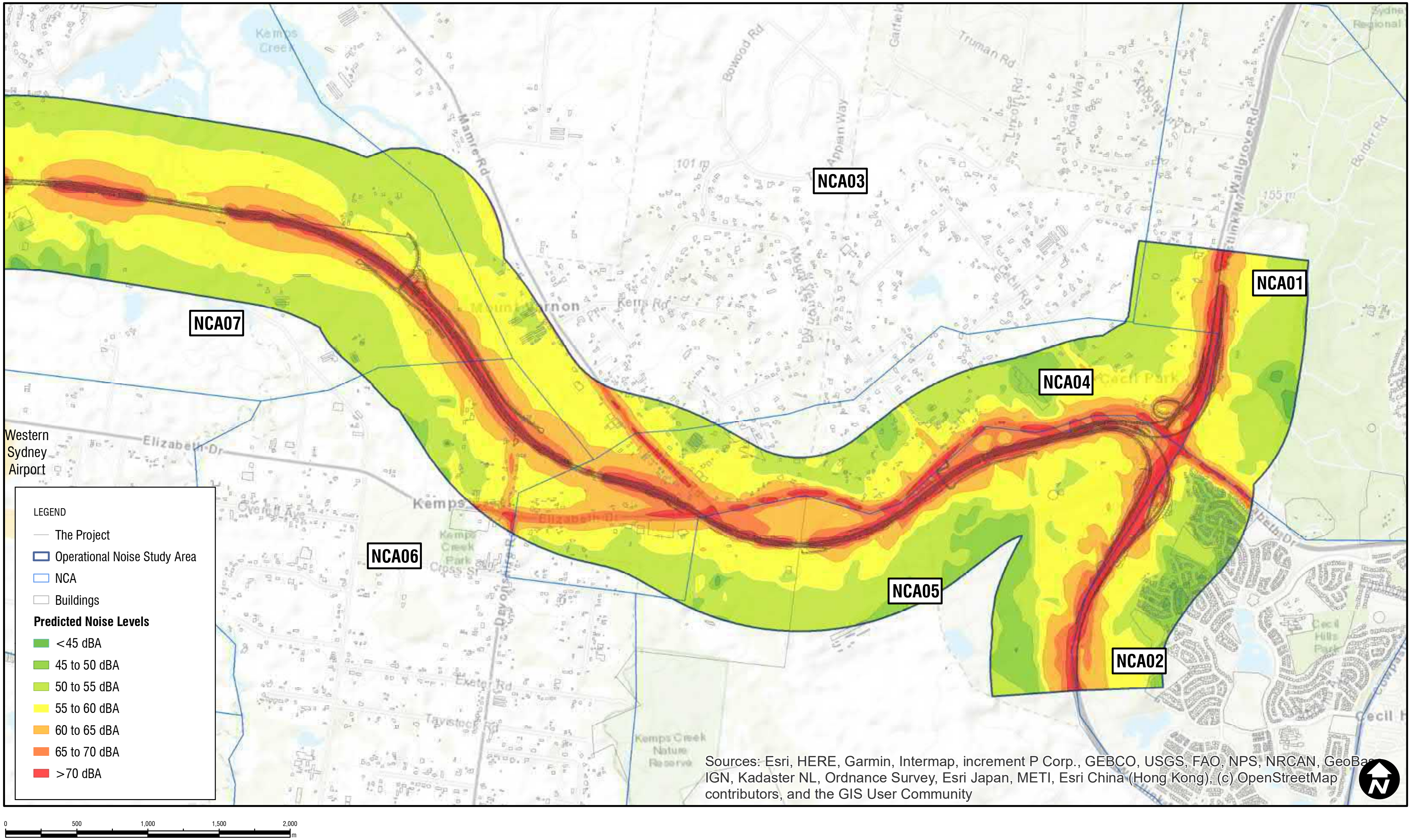


Predicted noise levels without mitigation - Build 2036 Daytime LAeq (15 hour)

PREDICTED OPERATIONAL ROAD TRAFFIC NOISE LEVELS WITHOUT MITIGATION – BUILD 2036 NIGHT-TIME (FREE FIELD NOISE CONTOURS)

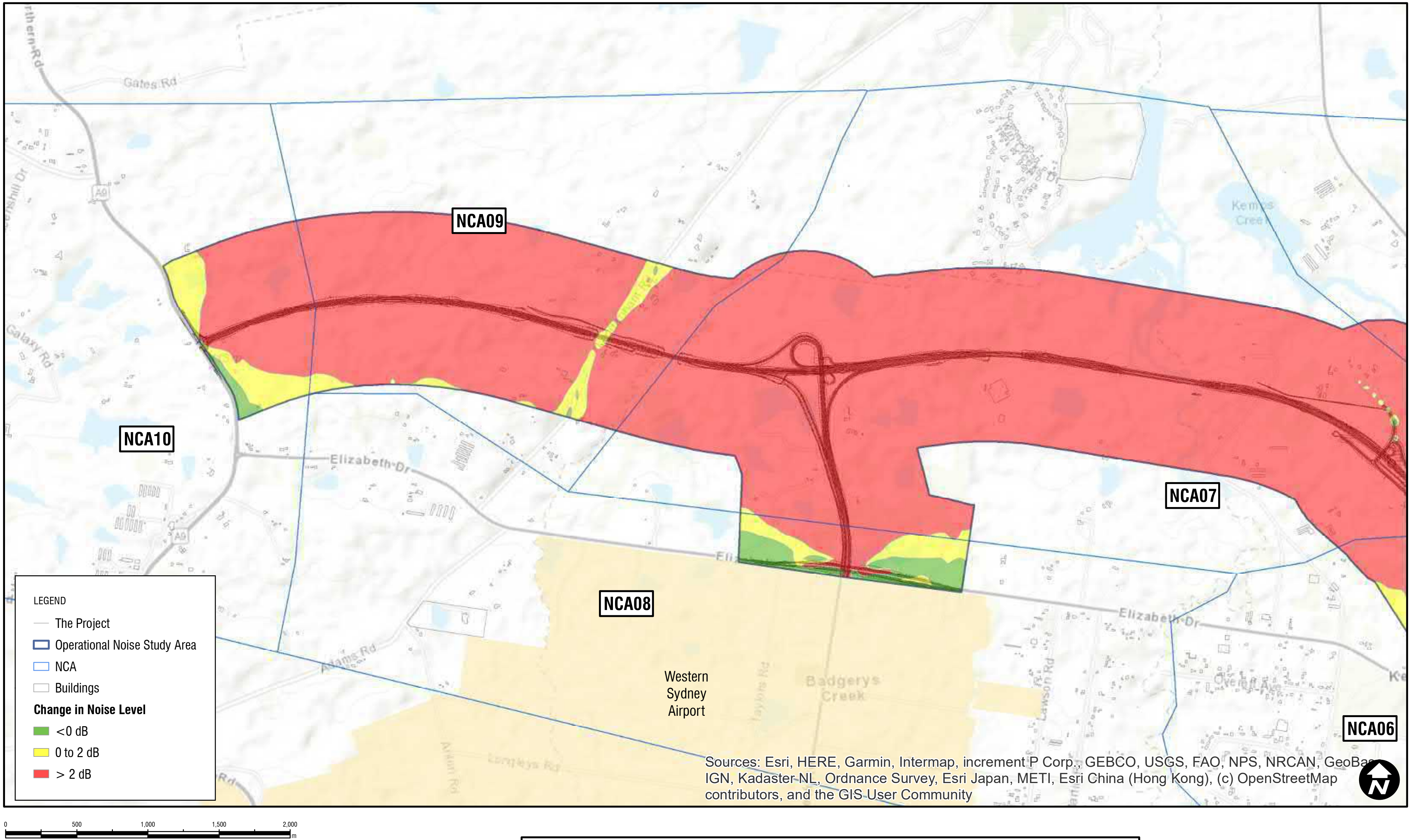


Predicted noise levels without mitigation - Build 2036 Night-time LAeq (9 hour)

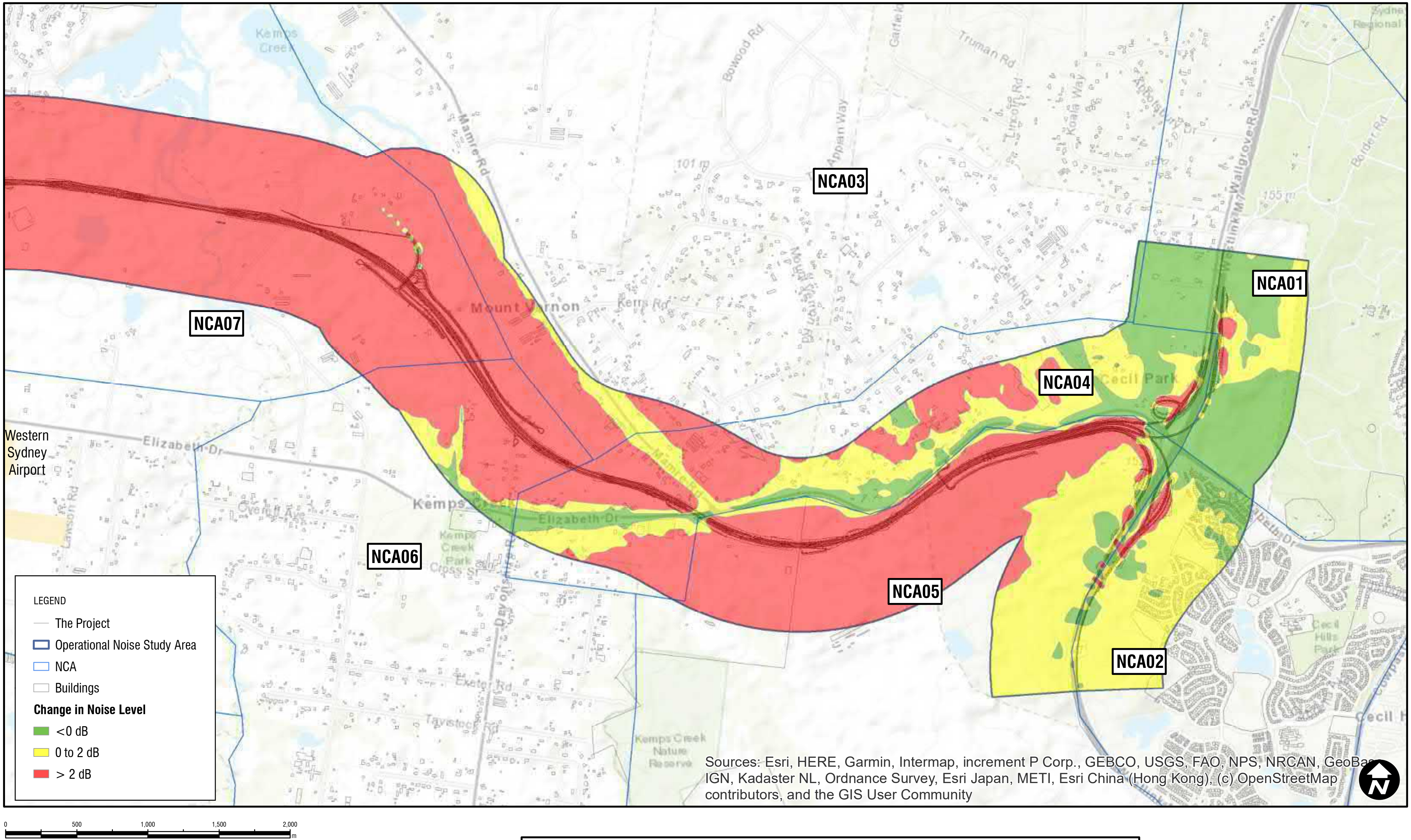


Predicted noise levels without mitigation - Build 2036 Night-time LAeq (9 hour)

PREDICTED CHANGE IN OPERATIONAL NOISE LEVELS WITHOUT MITIGATION – BUILD MINUS NO BUILD 2026 DAYTIME

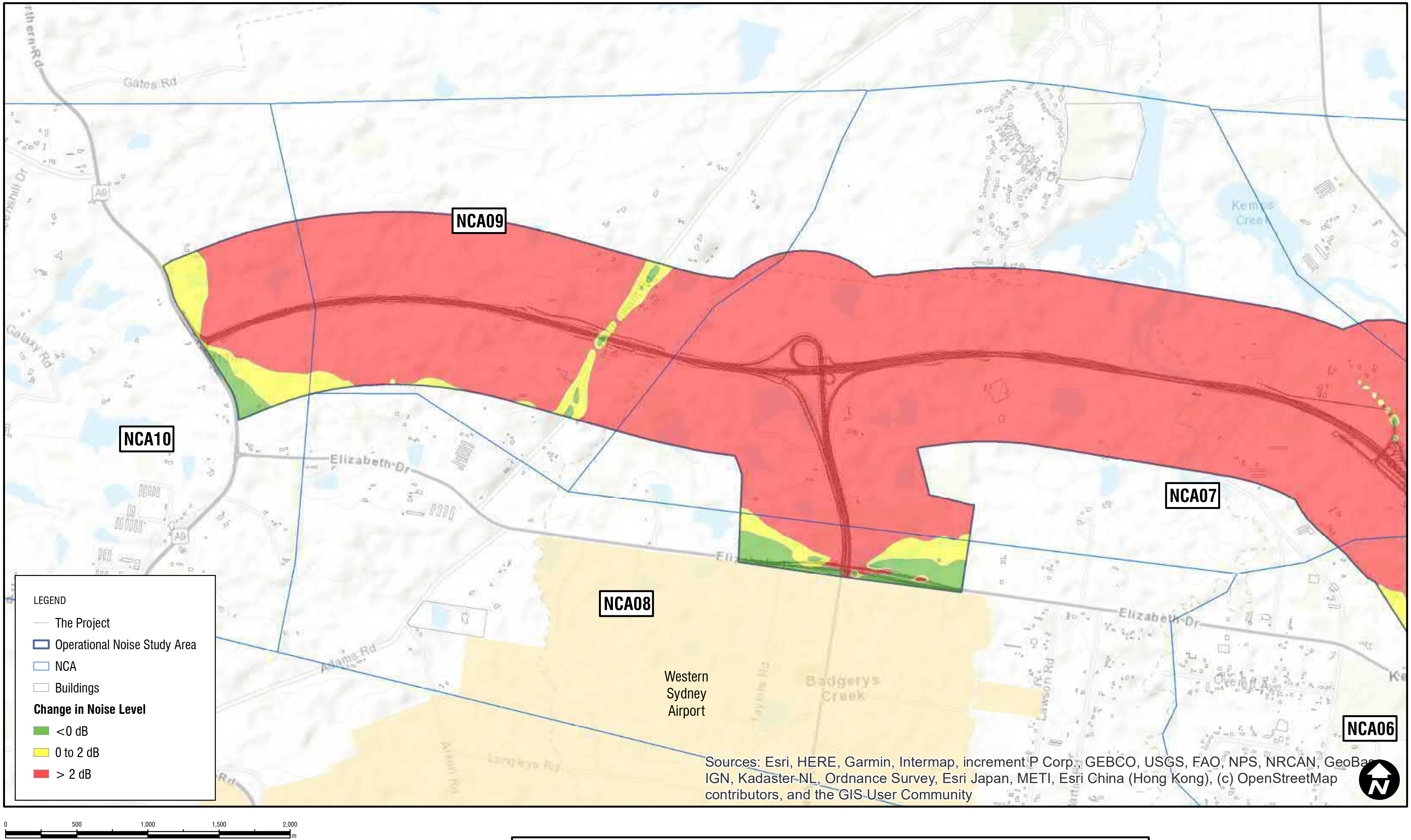


Predicted change in noise levels without mitigation - Build 2026 Daytime

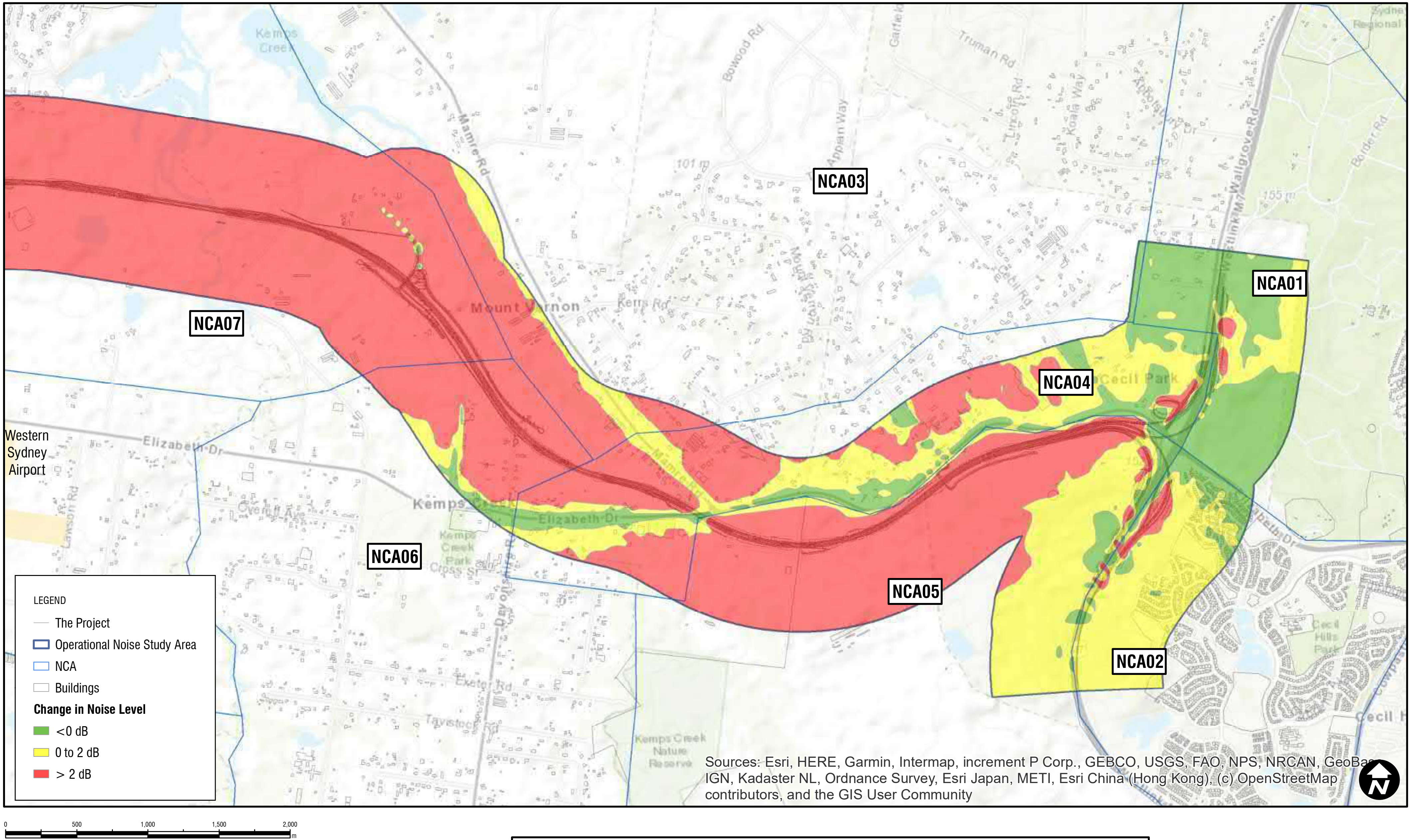


Predicted change in noise levels without mitigation - Build 2026 Daytime

PREDICTED CHANGE IN OPERATIONAL NOISE LEVELS WITHOUT MITIGATION – BUILD MINUS NO BUILD 2026 NIGHT-TIME

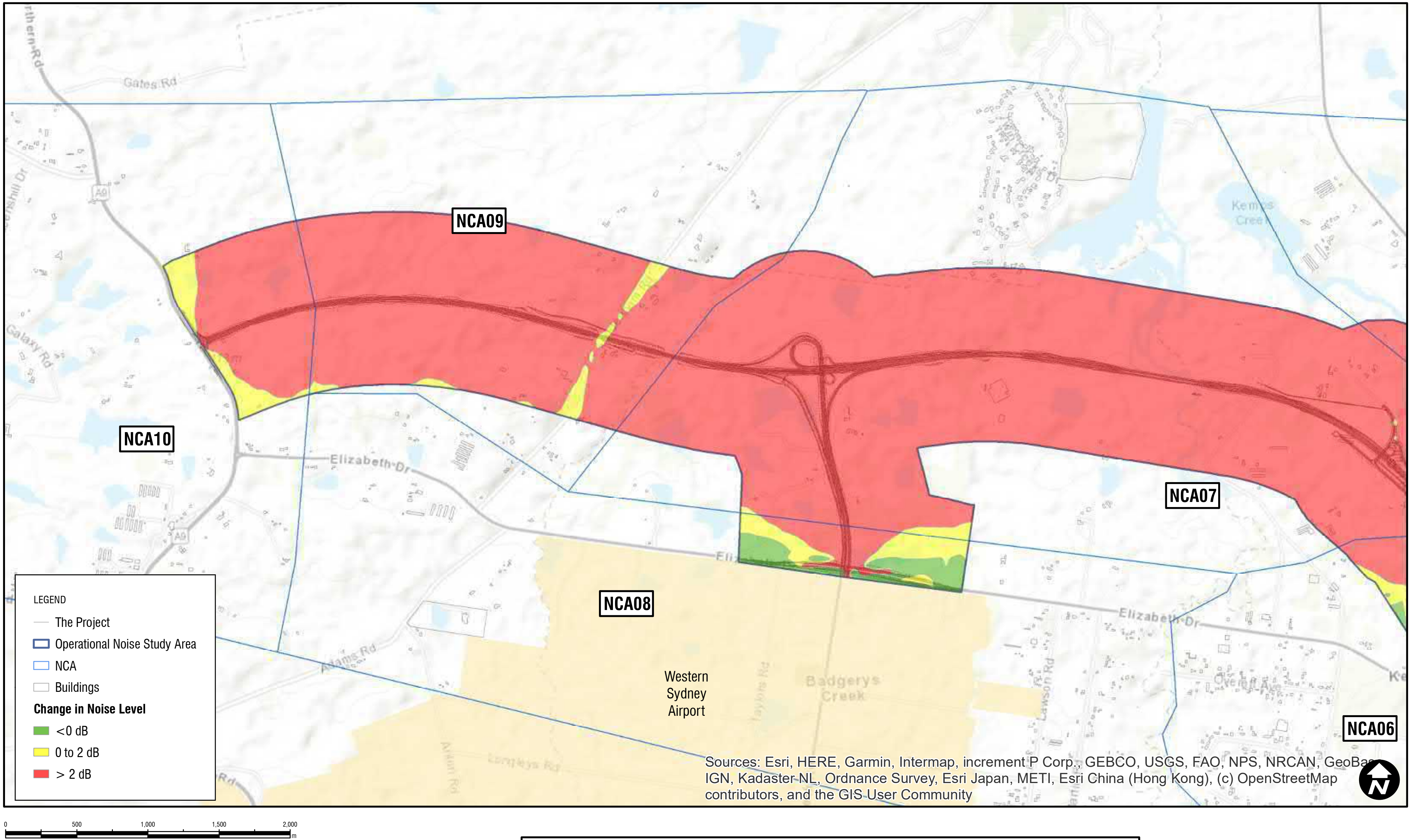


Predicted change in noise levels without mitigation - Build 2026 Night-time

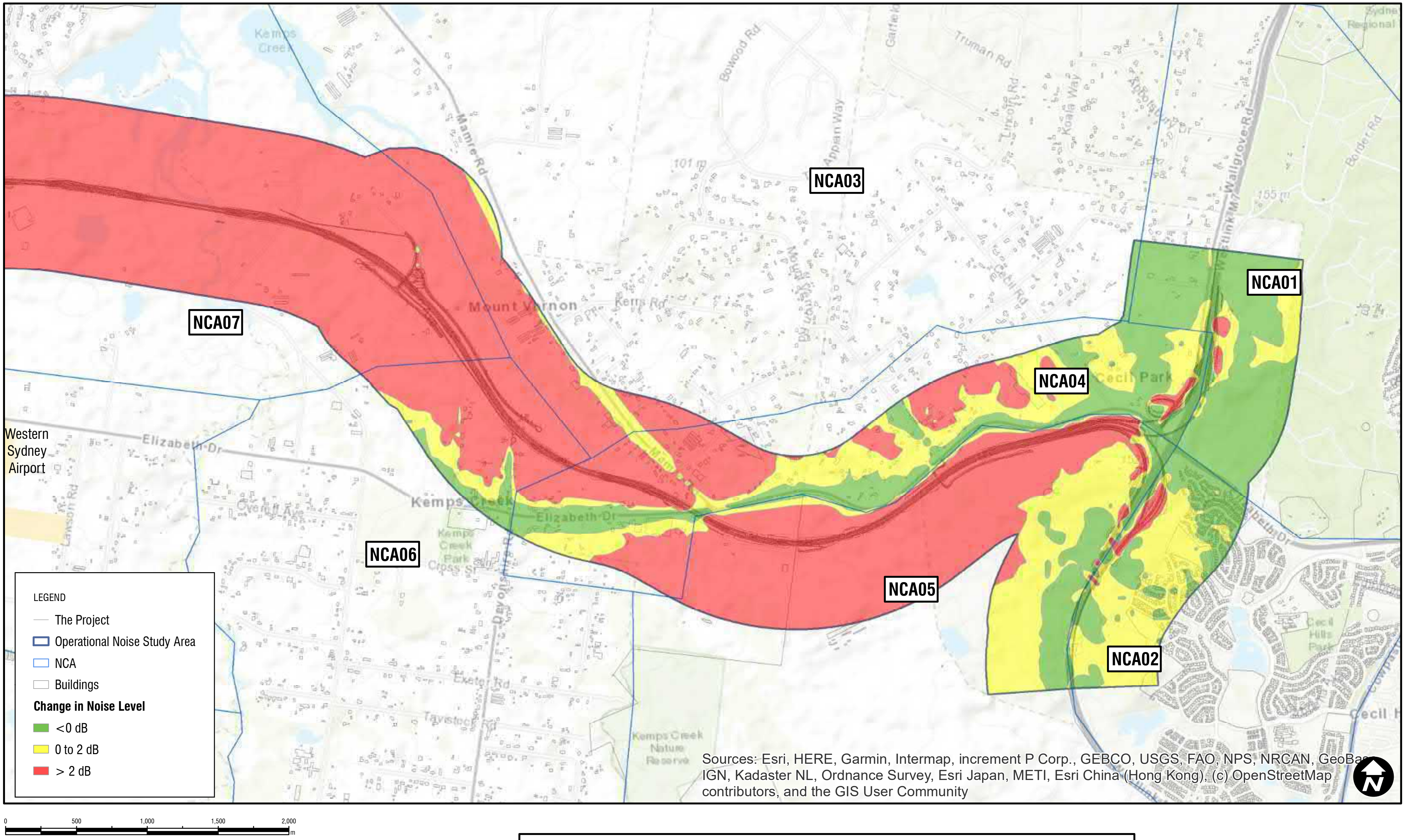


Predicted change in noise levels without mitigation - Build 2026 Night-time

PREDICTED CHANGE IN OPERATIONAL NOISE LEVELS WITHOUT MITIGATION – BUILD MINUS NO BUILD 2036 DAYTIME

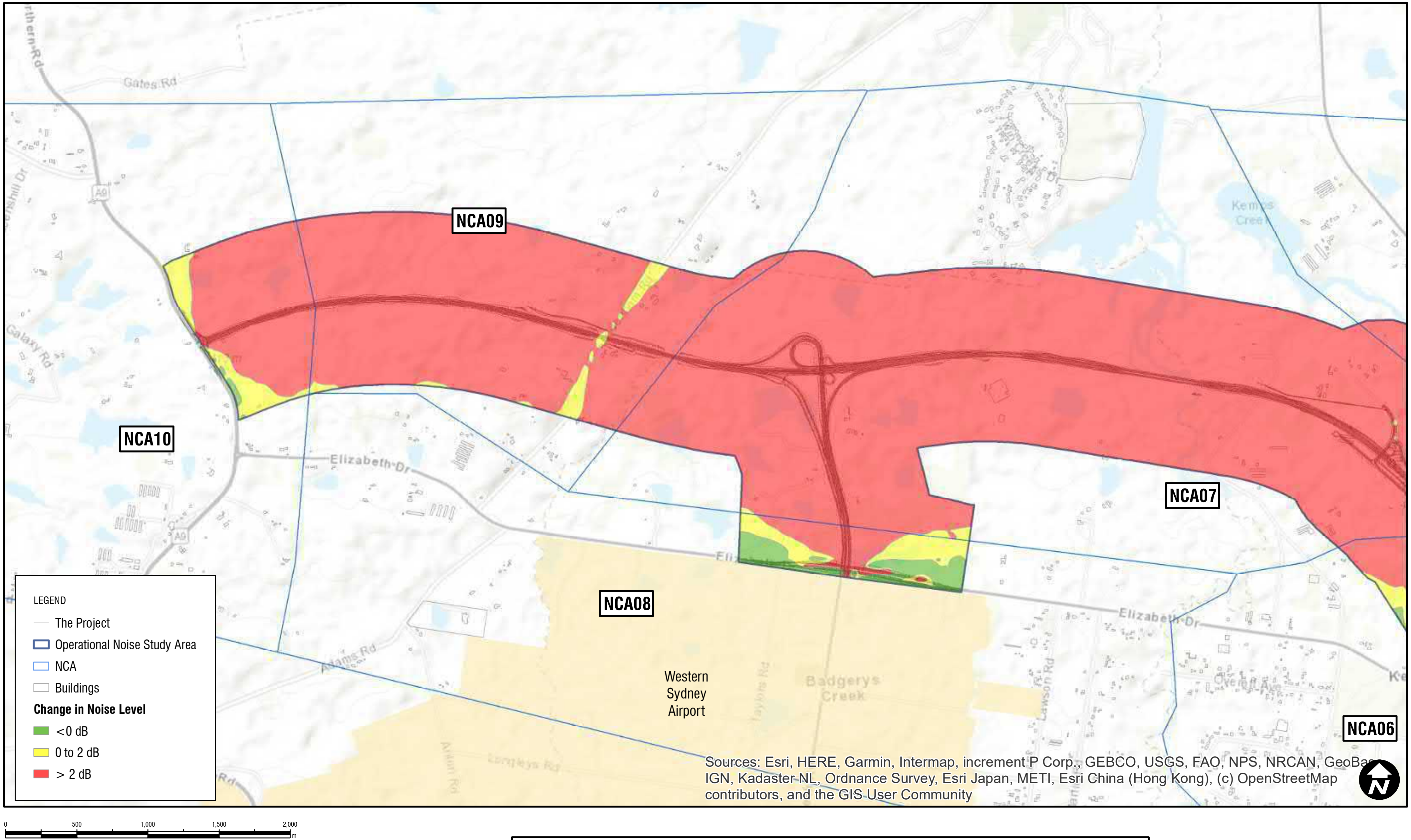


Predicted change in noise levels without mitigation - Build 2036 Daytime

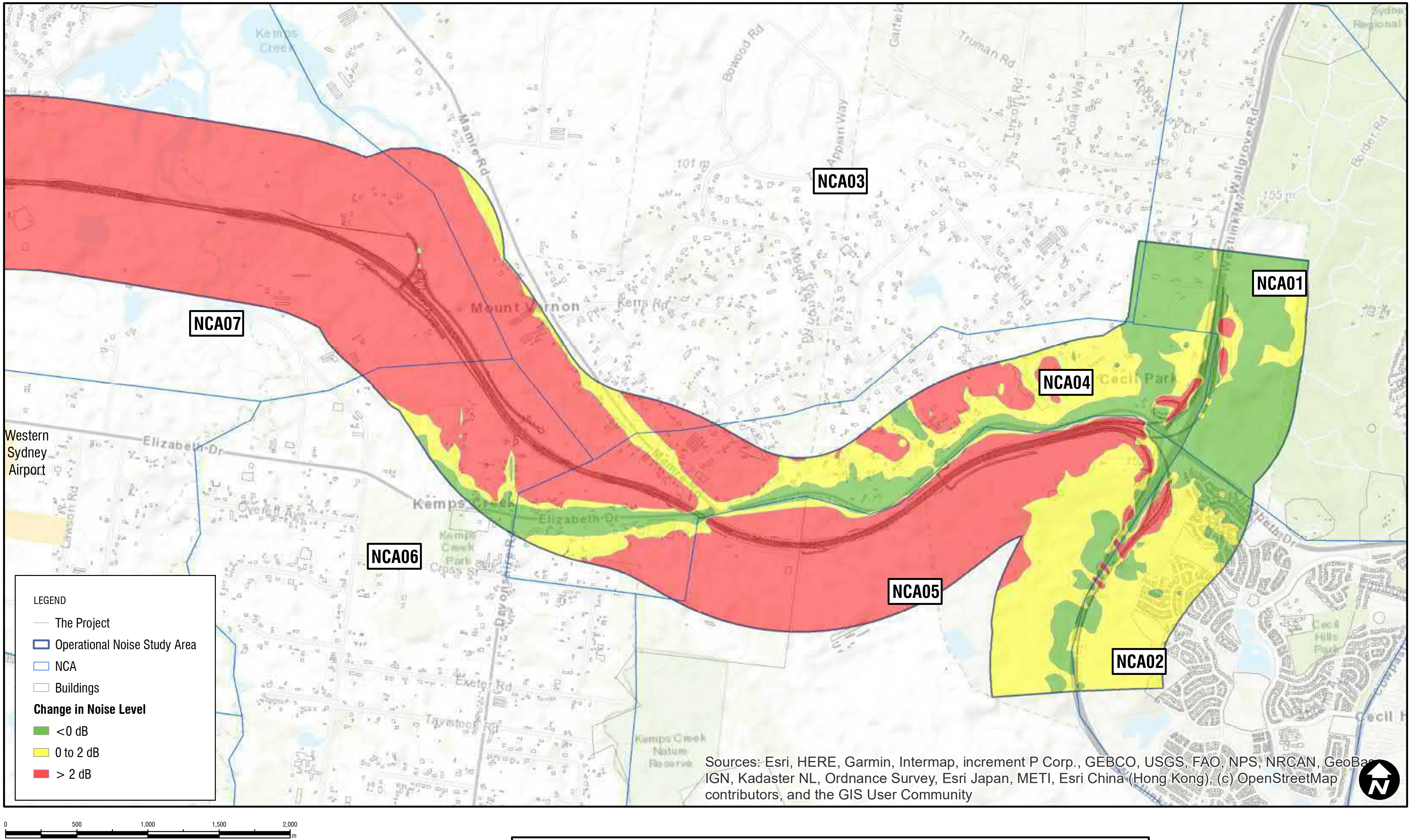


Predicted change in noise levels without mitigation - Build 2036 Daytime

PREDICTED CHANGE IN OPERATIONAL NOISE LEVELS WITHOUT MITIGATION – BUILD MINUS NO BUILD 2036 NIGHT-TIME



Predicted change in noise levels without mitigation - Build 2036 Night-time



Predicted change in noise levels without mitigation - Build 2036 Night-time

MAXIMUM NOISE LEVELS ASSESSMENT

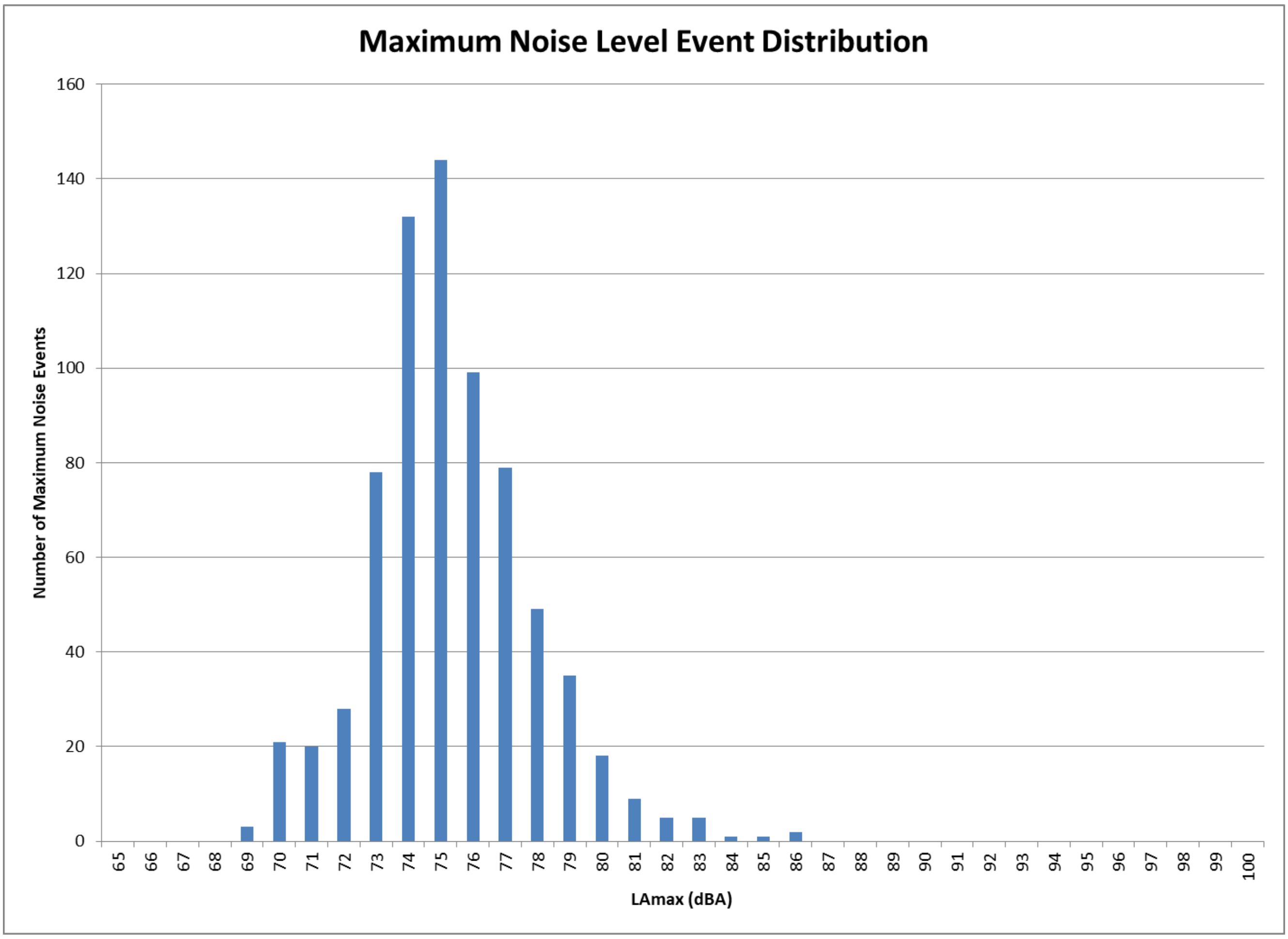
L.03 1383 Elizabeth Drive, Kemps Creek

Table 1 L.03 maximum noise level events

Monitoring date	Number of maximum noise events per hour (LAmax noise levels, dBA)									
	00:00-01:00	01:00-02:00	02:00-03:00	03:00-04:00	04:00-05:00	05:00-06:00	06:00-07:00	22:00-23:00	23:00-00:00	Total/ (Range)
22-Jun-17	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	5 (75-80)	10 (74-76)	15 (74-80)
23-Jun-17	12 (72-78)	17 (74-78)	11 (73-77)	11 (74-78)	6 (78-80)	1 (86)	-	2 (77-78)	5 (74-77)	65 (72-86)
24-Jun-17	3 (74-78)	10 (73-78)	8 (73-78)	11 (73-77)	7 (75-79)	4 (80-81)	1 (82)	-	4 (74-75)	48 (73-82)
25-Jun-17	5 (73-75)	3 (73-75)	13 (69-73)	11 (70-77)	7 (70-72)	6 (74-77)	6 (76-80)	6 (74-80)	7 (71-78)	64 (69-80)
26-Jun-17	13 (70-77)	12 (72-79)	7 (74-77)	6 (75-79)	2 (79)	-	1 (85)	7 (75-79)	7 (74-80)	55 (70-85)
27-Jun-17	13 (72-78)	14 (74-81)	14 (72-78)	9 (77-79)	4 (79-82)	1 (84)	-	5 (76-80)	10 (74-79)	70 (72-84)
28-Jun-17	14 (73-77)	16 (74-81)	15 (73-79)	9 (75-77)	5 (79-83)	-	-	8 (74-77)	11 (74-81)	78 (73-83)
29-Jun-17	8 (73-76)	14 (74-78)	5 (75-78)	2 (77)	4 (78-81)	-	-	5 (75-78)	8 (74-76)	46 (73-81)
30-Jun-17	10 (75-81)	12 (73-79)	12 (72-76)	7 (76-79)	4 (80-82)	-	-	3 (78-83)	5 (74-80)	53 (72-83)
1-Jul-17	7 (73-76)	9 (73-77)	9 (72-77)	17 (73-79)	10 (76-78)	2 (80-81)	1 (83)	5 (75-79)	4 (74-78)	64 (72-83)
2-Jul-17	-	7 (70-74)	13 (70-74)	3 (72-73)	8 (70-74)	5 (74-78)	4 (75-76)	4 (75-77)	3 (73-76)	47 (70-78)
3-Jul-17	12 (73-80)	14 (71-76)	11 (73-79)	13 (75-79)	2 (79-80)	2 (83)	1 (86)	9 (77-82)	11 (73-76)	75 (71-86)
4-Jul-17	9 (73-75)	14 (73-79)	13 (73-81)	12 (74-78)	1 (80)	-	-	n/a[1]	n/a[1]	49 (73-81)

Note 1: This period was outside of the period of unattended noise logging.

Figure 1 L.03 maximum noise level event distribution over monitoring period



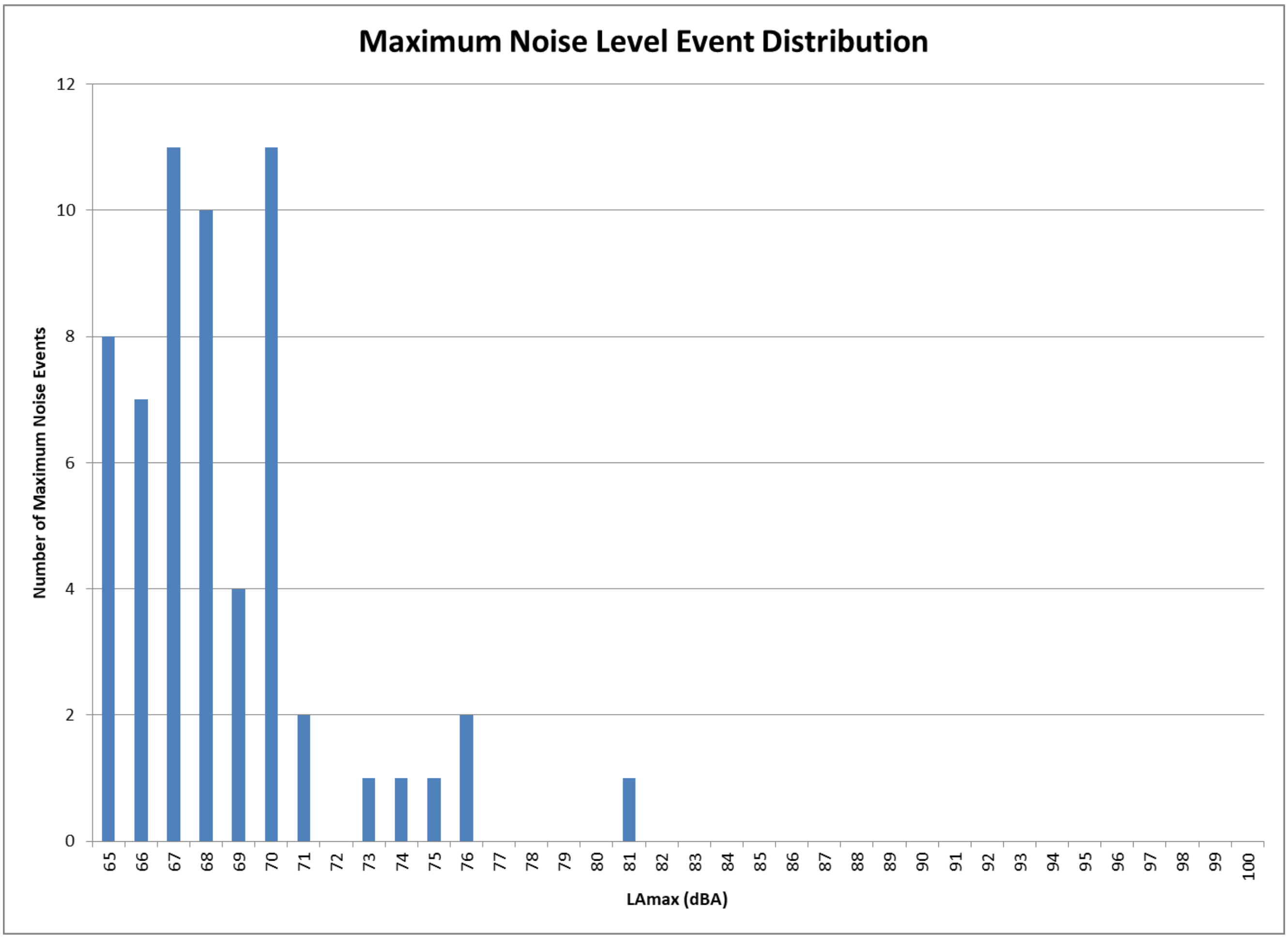
L.04 1219 Mamre Road, Kemps Creek

Table 2 L.04 maximum noise level events

Monitoring date	Number of maximum noise events per hour (LAmax noise levels, dBA)									
	00:00-01:00	01:00-02:00	02:00-03:00	03:00-04:00	04:00-05:00	05:00-06:00	06:00-07:00	22:00-23:00	23:00-00:00	Total/ (Range)
22-Jun-17	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	-	-	-
23-Jun-17	-	1 (66)	2 (65-67)	-	-	-	-	1 (69)	-	4 (65-69)
24-Jun-17	1 (76)	3 (65-67)	3 (65-70)	1 (66)	1 (67)	-	-	4 (68-71)	-	13 (65-76)
25-Jun-17	-	-	-	-	1 (70)	2 (68)	2 (69-70)	-	-	5 (68-70)
26-Jun-17	-	-	1 (65)	1 (68)	-	-	-	-	-	2 (65-68)
27-Jun-17	-	-	-	-	1 (81)	-	-	1 (67)	1 (67)	3 (67-81)
28-Jun-17	-	1 (65)	1 (65)	-	1 (70)	-	-	-	-	3 (65-70)
29-Jun-17	-	2 (65-66)	-	2 (68-76)	-	-	-	-	-	4 (65-76)
30-Jun-17	-	1 (69)	-	2 (70)	-	-	-	-	-	3 (69-70)
1-Jul-17	-	-	-	-	1 (73)	-	-	-	-	1 (73)
2-Jul-17	1 (70)	1 (65)	-	1 (65)	1 (66)	-	1 (67)	-	-	5 (65-70)
3-Jul-17	-	-	-	1 (68)	-	-	1 (75)	-	3 (68-70)	5 (68-75)
4-Jul-17	1 (67)	5 (66-68)	3 (67-71)	1 (68)	-	-	1 (74)	n/a[1]	n/a[1]	11 (66-74)

Note 1: This period was outside of the period of unattended noise logging.

Figure 2 L.04 maximum noise level event distribution over monitoring period



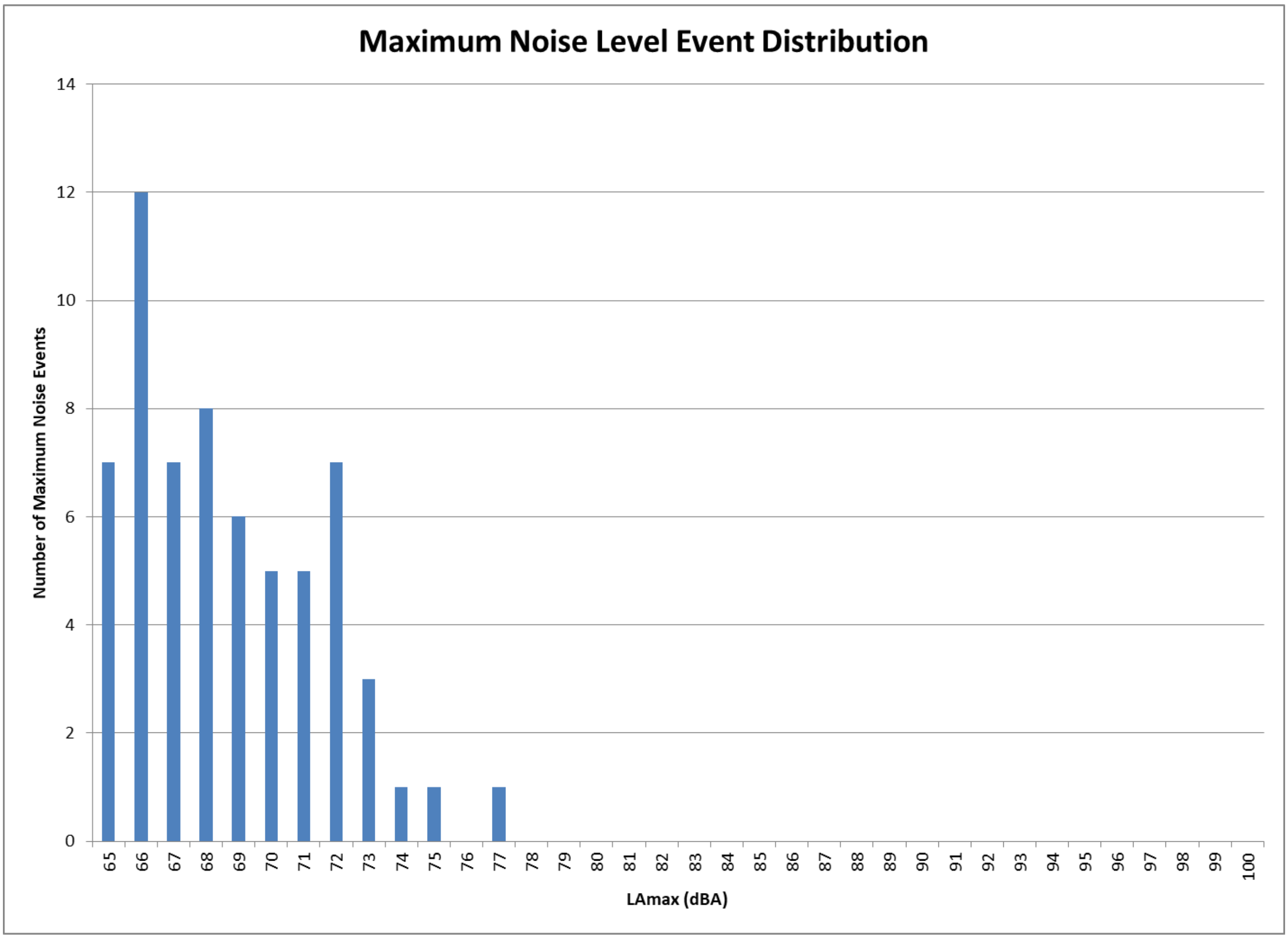
L.05 12-20 Salisbury Avenue, Kemps Creek

Table 3 L.05 maximum noise level events

Monitoring date	Number of maximum noise events per hour (LAmax noise levels, dBA)									
	00:00-01:00	01:00-02:00	02:00-03:00	03:00-04:00	04:00-05:00	05:00-06:00	06:00-07:00	22:00-23:00	23:00-00:00	Total/ (Range)
22-Jun-17	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	-	1 (68)	1 (68)
23-Jun-17	-	-	-	-	-	2 (69-70)	3 (69-72)	-	-	5 (69-72)
24-Jun-17	-	-	-	-	-	-	-	3 (67-72)	-	3 (67-72)
25-Jun-17	-	1 (68)	-	-	-	-	-	-	-	1 (68)
26-Jun-17	-	-	-	2 (66-69)	-	-	1 (71)	-	-	3 (66-71)
27-Jun-17	-	2 (66)	-	10 (65-75)	1 (66)	-	-	-	-	13 (65-75)
28-Jun-17	-	-	-	-	-	2 (66-67)	1 (68)	-	-	3 (66-68)
29-Jun-17	5 (65-76)	-	-	2 (65-66)	-	2 (68-72)	-	-	-	9 (65-76)
30-Jun-17	-	-	1 (68)	-	-	1 (73)	1 (68)	-	-	3 (68-73)
1-Jul-17	-	-	-	2 (65-66)	-	-	3 (66-67)	2 (65-73)	-	7 (65-73)
2-Jul-17	-	-	-	1 (65)	-	-	-	-	-	1 (65)
3-Jul-17	-	1 (65)	-	-	-	1 (71)	2 (71-72)	-	-	4 (65-72)
4-Jul-17	3 (67-70)	6 (65-74)	-	-	-	1 (69)	-	n/a[1]	n/a[1]	10 (65-74)

Note 1: This period was outside of the period of unattended noise logging.

Figure 3 L.05 maximum noise level event distribution over monitoring period



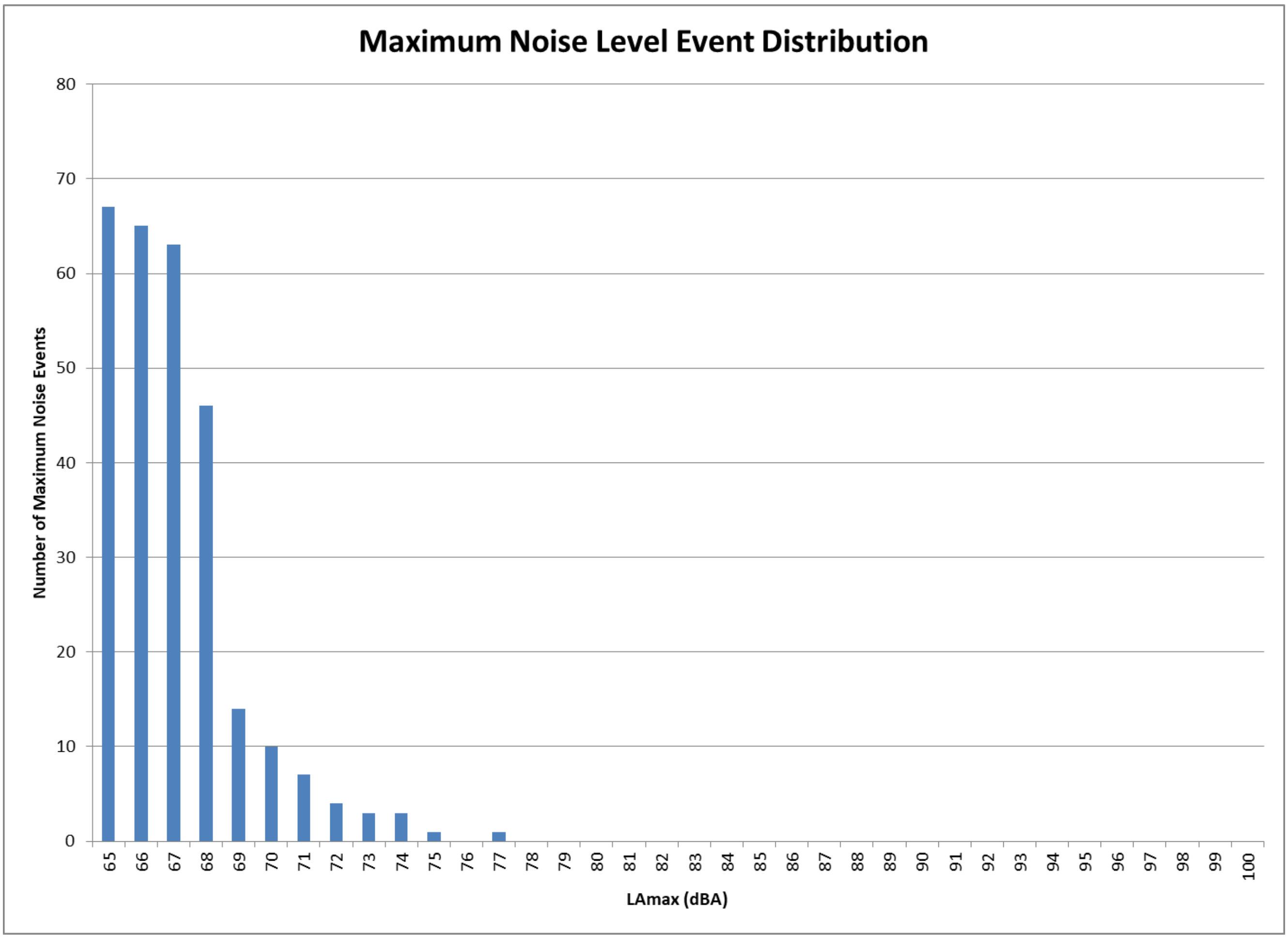
L.07 740 Luddenham Road, Luddenham

Table 4 L.07 maximum noise level events

Monitoring date	Number of maximum noise events per hour (LAmax noise levels, dBA)									
	00:00-01:00	01:00-02:00	02:00-03:00	03:00-04:00	04:00-05:00	05:00-06:00	06:00-07:00	22:00-23:00	23:00-00:00	Total/ (Range)
22-Jun-17	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	5 (67-74)	2 (66)	7 (66-74)
23-Jun-17	3 (67-71)	2 (65)	1 (68)	4 (65-67)	3 (66-68)	1 (70)	-	2 (68)	8 (65-68)	24 (65-71)
24-Jun-17	5 (66-68)	2 (66-67)	-	1 (69)	6 (65-68)	4 (68-69)	1 (70)	4 (68-71)	6 (66-68)	29 (65-71)
25-Jun-17	7 (65-68)	4 (65-68)	2 (65)	3 (65-67)	1 (65)	3 (65-68)	3 (67-69)	2 (67-69)	5 (65-70)	30 (65-70)
26-Jun-17	2 (66)	-	2 (65-68)	5 (65-68)	6 (68-70)	-	-	4 (65-67)	3 (66)	22 (65-70)
27-Jun-17	-	1 (66)	4 (65-68)	3 (65-66)	3 (67-69)	1 (72)	-	3 (65-67)	5 (65-67)	20 (65-72)
28-Jun-17	1 (66)	-	-	1 (65)	3 (66-67)	1 (74)	1 (73)	4 (66-67)	-	11 (65-74)
29-Jun-17	2 (66)	1 (65)	5 (65)	1 (67)	2 (67-68)	1 (72)	-	7 (65-68)	4 (66-67)	23 (65-72)
30-Jun-17	8 (65-68)	4 (65-68)	5 (65-67)	4 (66-69)	5 (70-72)	1 (73)	1 (75)	5 (67-68)	6 (65-69)	39 (65-75)
1-Jul-17	7 (65-67)	7 (65-68)	2 (65-67)	4 (65-67)	12 (66-71)	5 (70-74)	1 (73)	-	3 (66-68)	41 (65-74)
2-Jul-17	3 (65-69)	2 (65)	1 (65)	1 (65)	1 (67)	2 (66-68)	1 (66)	5 (65-68)	2 (66-67)	18 (65-69)
3-Jul-17	-	1 (69)	-	-	1 (67)	1 (72)	1 (77)	6 (65-68)	3 (66-67)	13 (65-77)
4-Jul-17	1 (65)	1 (65)	-	1 (65)	4 (68-69)	-	-	n/a[1]	n/a[1]	7 (65-69)

Note 1: This period was outside of the period of unattended noise logging.

Figure 4 L.07 maximum noise level event distribution over monitoring period



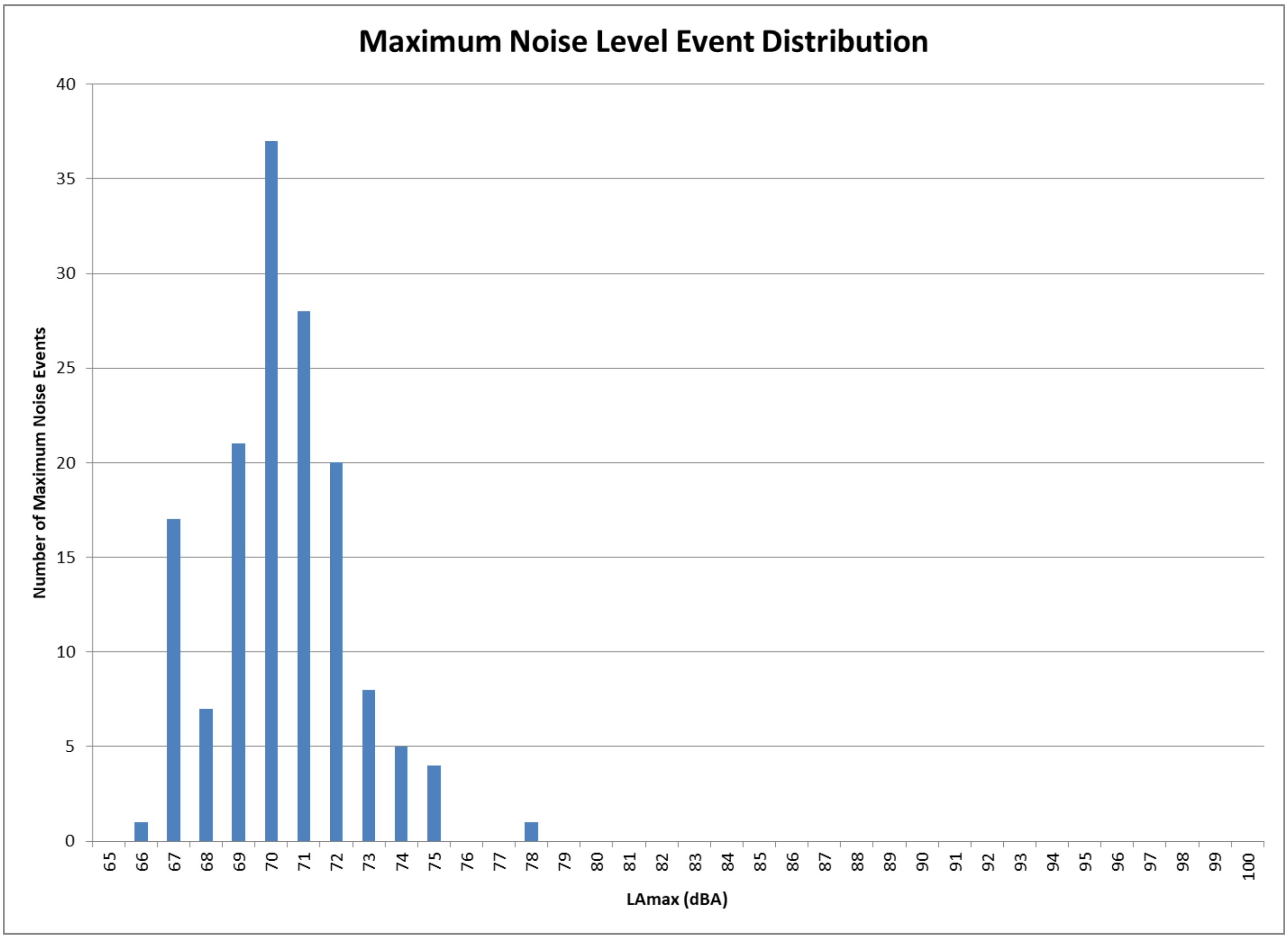
L.08 45m E of road - 2828 Northern Rd, Luddenham

Table 5 L.08 maximum noise level events

Monitoring date	Number of maximum noise events per hour (LAmax noise levels, dBA)									
	00:00-01:00	01:00-02:00	02:00-03:00	03:00-04:00	04:00-05:00	05:00-06:00	06:00-07:00	22:00-23:00	23:00-00:00	Total/ (Range)
22-Jun-17	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	-	1 (71)	1 (71)
23-Jun-17	2 (71-72)	6 (69-70)	3 (69)	1 (72)	-	-	-	-	-	12 (69-72)
24-Jun-17	2 (72-73)	1 (70)	2 (69)	1 (72)	-	1 (78)	-	-	-	7 (69-78)
25-Jun-17	-	-	5 (68-69)	1 (73)	4 (69-70)	1 (73)	1 (72)	-	-	12 (68-73)
26-Jun-17	2 (69-70)	2 (70-72)	4 (70-72)	1 (73)	-	-	-	-	3 (72-73)	12 (69-73)
27-Jun-17	2 (70)	2 (71-72)	3 (72-75)	-	-	-	-	1 (72)	1 (70)	9 (70-75)
28-Jun-17	4 (67)	6 (67)	5 (66-70)	2 (69)	-	1 (74)	-	-	1 (71)	19 (66-74)
29-Jun-17	4 (69-71)	5 (69-75)	7 (70-71)	-	-	-	-	-	1 (73)	17 (69-75)
30-Jun-17	1 (71)	5 (70-71)	4 (71-72)	1 (72)	-	-	-	-	-	11 (70-72)
1-Jul-17	-	3 (70-72)	3 (70-72)	-	2 (73-75)	-	-	-	-	8 (70-75)
2-Jul-17	-	2 (70-71)	2 (70)	2 (67)	3 (69-71)	-	-	-	2 (72-74)	11 (67-74)
3-Jul-17	1 (70)	3 (67-70)	7 (70-72)	-	-	-	-	-	2 (73-74)	13 (67-74)
4-Jul-17	4 (67-69)	5 (71-74)	6 (70-75)	2 (71-72)	-	-	-	n/a[1]	n/a[1]	17 (67-75)

Note 1: This period was outside of the period of unattended noise logging.

Figure 5 L.08 maximum noise level event distribution over monitoring period



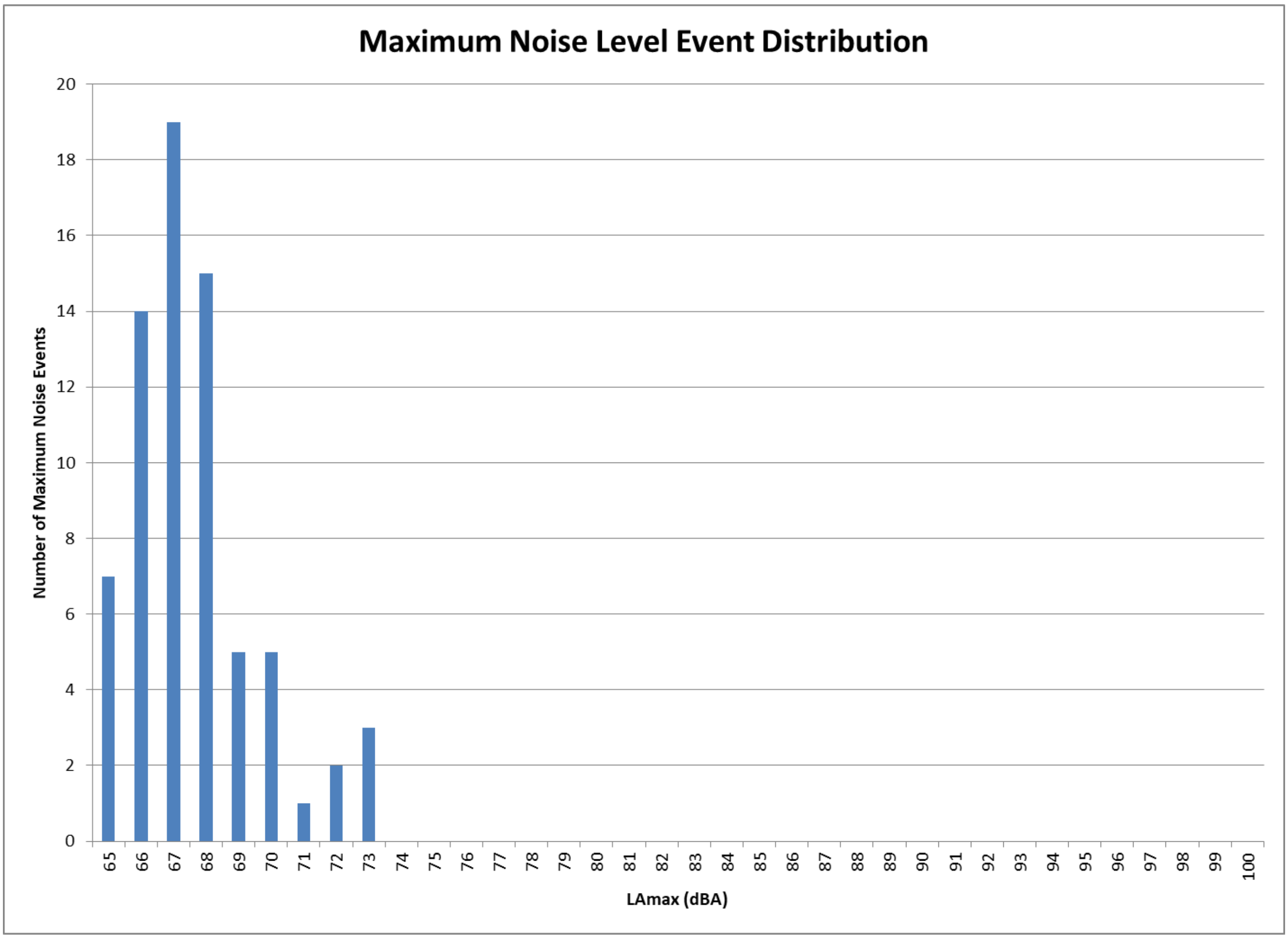
L.09 140m E of road - 2828 Northern Rd, Luddenham

Table 6 L.09 maximum noise level events

Monitoring date	Number of maximum noise events per hour (LAmax noise levels, dBA)									
	00:00-01:00	01:00-02:00	02:00-03:00	03:00-04:00	04:00-05:00	05:00-06:00	06:00-07:00	22:00-23:00	23:00-00:00	Total/ (Range)
22-Jun-17	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	-	-	-
23-Jun-17	-	1 (67)	2 (66-67)	-	-	-	-	-	1 (72)	4 (66-72)
24-Jun-17	1 (67)	2 (67-68)	3 (65-67)	-	-	1 (73)	-	1 (73)	1 (69)	9 (65-73)
25-Jun-17	-	-	1 (65)	-	1 (66)	2 (68-70)	-	-	1 (67)	5 (65-70)
26-Jun-17	3 (66)	-	3 (67)	1 (69)	-	-	-	-	-	7 (66-69)
27-Jun-17	1 (66)	3 (67-68)	2 (68)	1 (70)	-	-	-	-	-	7 (66-70)
28-Jun-17	2 (66-71)	-	-	-	-	-	-	-	-	2 (66-71)
29-Jun-17	-	-	-	3 (70)	-	-	-	-	-	3 (70)
30-Jun-17	2 (68)	2 (65-67)	3 (67-69)	2 (68-69)	-	-	-	-	-	9 (65-69)
1-Jul-17	-	2 (65-66)	3 (68)	2 (68)	-	-	-	-	-	7 (65-68)
2-Jul-17	-	-	1 (65)	1 (65)	-	-	-	-	2 (68-69)	4 (65-69)
3-Jul-17	2 (67)	-	2 (66)	-	1 (73)	-	-	1 (66)	1 (67)	7 (66-73)
4-Jul-17	-	4 (65-72)	-	3 (66-68)	-	-	-	n/a[1]	n/a[1]	7 (65-72)

Note 1: This period was outside of the period of unattended noise logging.

Figure 6 L.09 maximum noise level event distribution over monitoring period



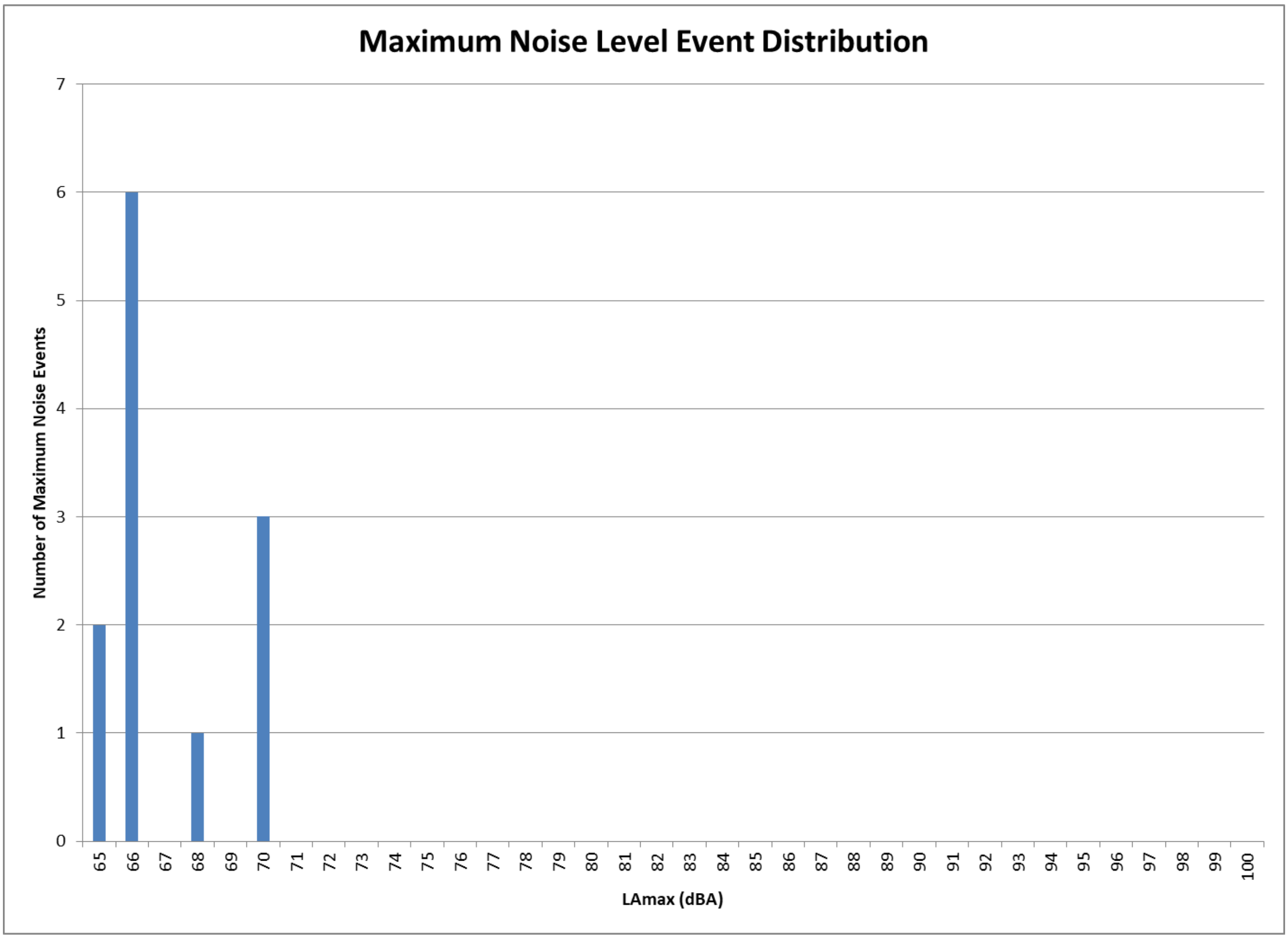
L.10 340m E of road - 2828 Northern Rd, Luddenham

Table 7 L.10 maximum noise level events

Monitoring date	Number of maximum noise events per hour (LAmax noise levels, dBA)									
	00:00-01:00	01:00-02:00	02:00-03:00	03:00-04:00	04:00-05:00	05:00-06:00	06:00-07:00	22:00-23:00	23:00-00:00	Total/ (Range)
22-Jun-17	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	-	-	-
23-Jun-17	-	-	-	-	-	-	-	-	-	-
24-Jun-17	1 (65)	-	-	-	-	-	-	4 (66-70)	-	5 (65-70)
25-Jun-17	-	-	-	-	-	-	1 (66)	-	-	1 (66)
26-Jun-17	-	-	-	-	-	-	-	-	-	-
27-Jun-17	-	-	-	-	-	-	-	1 (66)	-	1 (66)
28-Jun-17	-	-	-	-	-	-	-	-	-	-
29-Jun-17	-	-	-	-	-	-	-	-	-	-
30-Jun-17	-	-	2 (65-66)	-	-	-	-	-	-	2 (65-66)
1-Jul-17	-	-	-	-	-	-	-	-	2 (66-68)	2 (66-68)
2-Jul-17	-	-	-	-	-	-	1 (66)	-	-	1 (66)
3-Jul-17	-	-	-	-	-	-	-	-	-	-
4-Jul-17	-	-	-	-	-	-	-	n/a[1]	n/a[1]	-

Note 1: This period was outside of the period of unattended noise logging.

Figure 7 L.10 maximum noise level event distribution over monitoring period



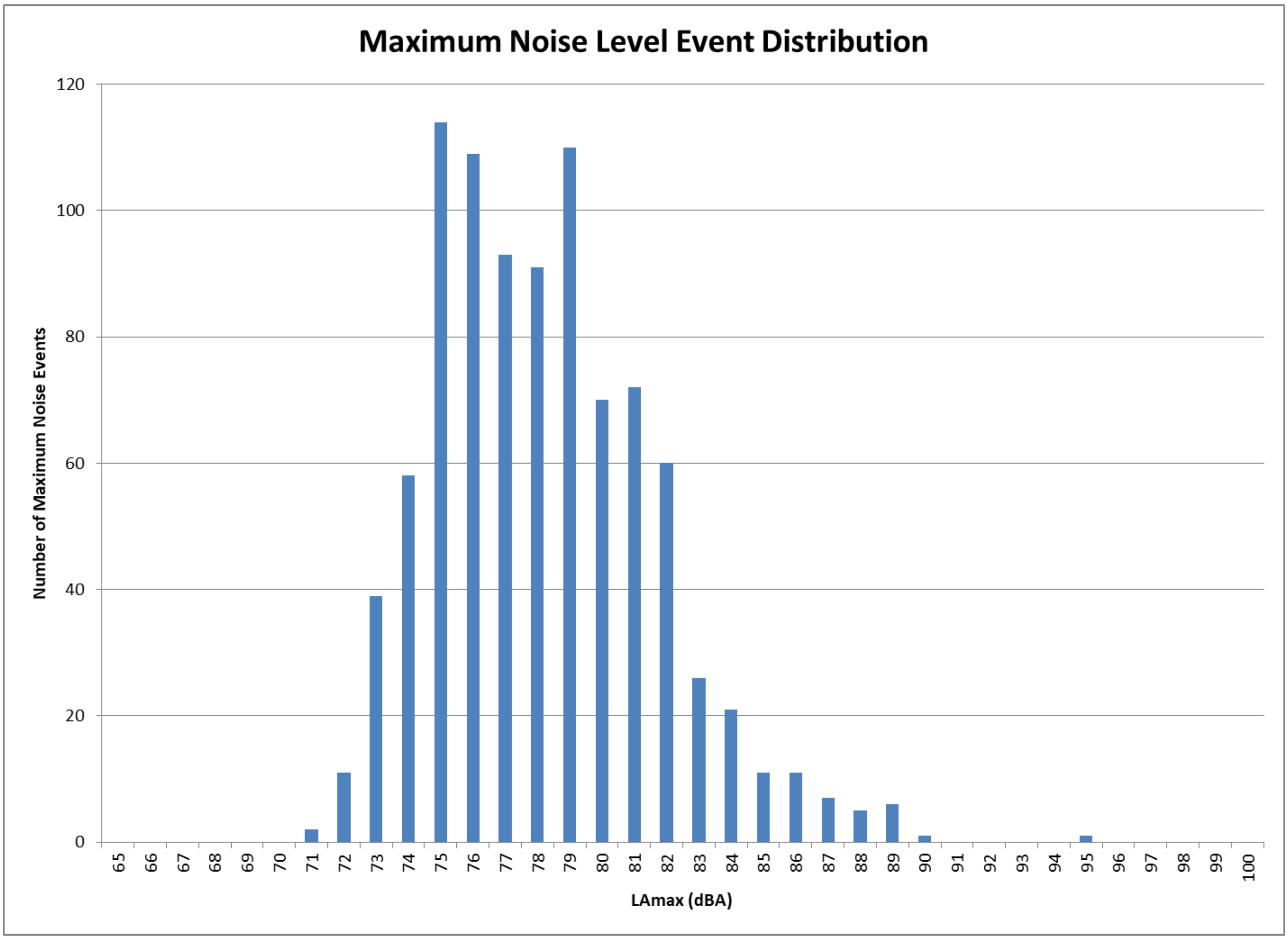
L.11 15m S of road - 2300 Elizabeth Dr, Badgerys Creek

Table 8 L.11 maximum noise level events

Monitoring date	Number of maximum noise events per hour (LAmax noise levels, dBA)									
	00:00-01:00	01:00-02:00	02:00-03:00	03:00-04:00	04:00-05:00	05:00-06:00	06:00-07:00	22:00-23:00	23:00-00:00	Total/ (Range)
19-Jun-17	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	11 (77-82)	20 (74-83)	31 (74-83)
20-Jun-17	15 (74-81)	17 (73-82)	18 (72-80)	17 (78-81)	7 (79-85)	4 (85-87)	1 (88)	5 (79-85)	15 (75-83)	99 (72-88)
21-Jun-17	18 (73-80)	16 (76-86)	13 (77-85)	10 (80-86)	6 (81-89)	1 (86)	-	4 (80-82)	9 (76-80)	77 (73-89)
22-Jun-17	5 (78-81)	16 (73-84)	22 (73-83)	11 (79-81)	10 (81-85)	2 (85)	-	11 (78-84)	17 (75-83)	94 (73-85)
23-Jun-17	12 (76-83)	15 (75-84)	13 (74-83)	16 (77-82)	5 (81-84)	3 (87-95)	1 (89)	3 (82-83)	11 (77-83)	79 (74-95)
24-Jun-17	16 (75-79)	12 (75-80)	12 (75-83)	15 (77-86)	11 (78-87)	3 (82-83)	1 (84)	-	2 (79)	72 (75-87)
25-Jun-17	2 (78)	13 (75-84)	24 (71-79)	21 (72-82)	21 (72-79)	11 (77-81)	5 (78-79)	7 (77-86)	19 (74-82)	123 (71-86)
26-Jun-17	15 (75-81)	12 (75-84)	10 (74-78)	16 (78-83)	4 (81-84)	2 (86)	1 (87)	8 (78-82)	14 (76-83)	82 (74-87)
27-Jun-17	16 (75-81)	14 (74-82)	18 (75-83)	12 (79-83)	6 (82-89)	1 (88)	2 (88-90)	11 (77-81)	11 (75-82)	91 (74-90)
28-Jun-17	12 (75-84)	17 (74-83)	16 (75-82)	14 (78-85)	6 (81-84)	2 (84-87)	3 (88-89)	9 (77-84)	12 (76-82)	91 (74-89)
29-Jun-17	24 (73-78)	17 (73-83)	15 (75-85)	17 (79-84)	4 (82-85)	-	2 (87-89)	n/a[1]	n/a[1]	79 (73-89)

Note 1: This period was outside of the period of unattended noise logging.

Figure 8 L.11 maximum noise level event distribution over monitoring period



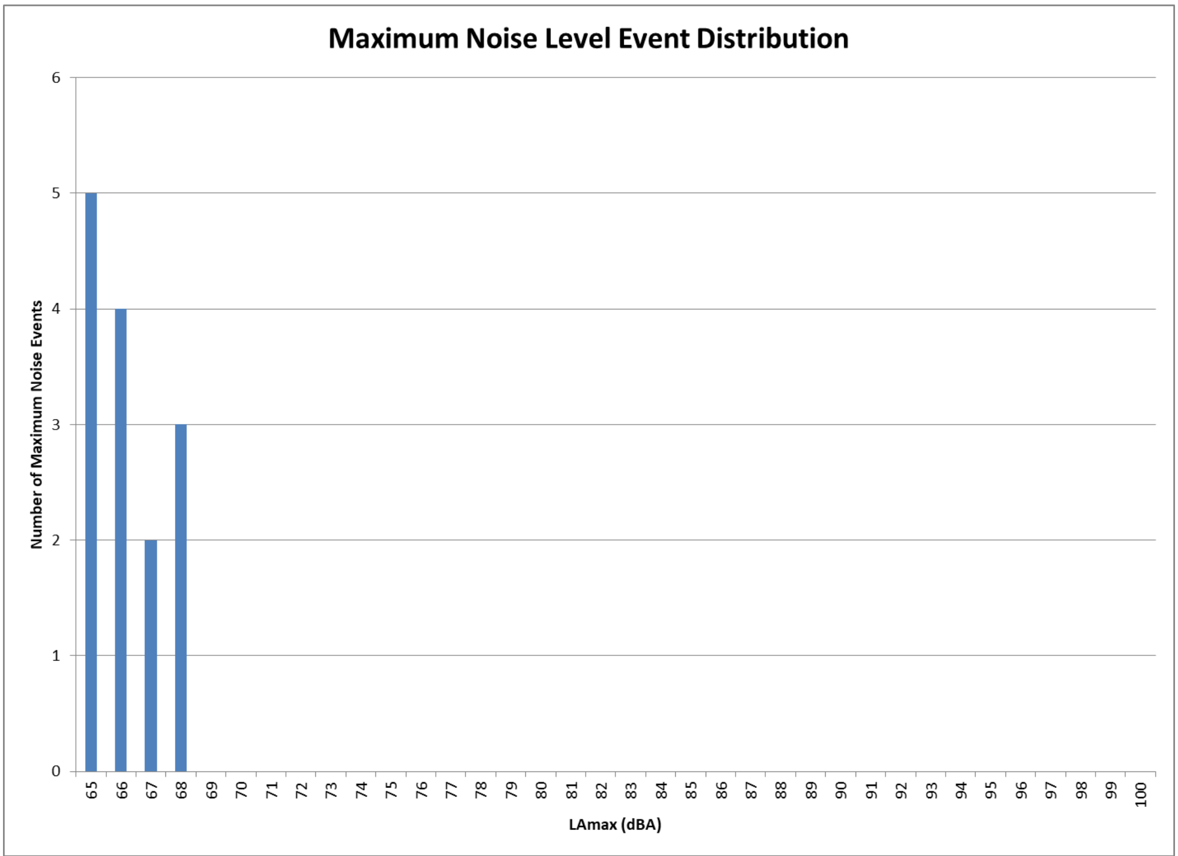
L.12 145m S of road - 2300 Elizabeth Dr, Badgerys Creek

Table 9 L.12 maximum noise level events

Monitoring date	Number of maximum noise events per hour (LAmax noise levels, dBA)									
	00:00-01:00	01:00-02:00	02:00-03:00	03:00-04:00	04:00-05:00	05:00-06:00	06:00-07:00	22:00-23:00	23:00-00:00	Total/ (Range)
19-Jun-17	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	-	-	-
20-Jun-17	2 (65-66)	-	-	-	-	-	-	2 (65-68)	-	4 (65-68)
21-Jun-17	-	-	-	3 (66-68)	-	-	-	-	-	3 (66-68)
22-Jun-17	-	-	1 (66)	1 (65)	-	-	-	-	-	2 (65-66)
23-Jun-17	-	-	-	-	-	-	-	-	-	-
24-Jun-17	-	-	-	1 (66)	1 (65)	-	-	1 (68)	-	3 (65-68)
25-Jun-17	-	-	-	-	-	-	-	-	-	-
26-Jun-17	-	-	-	-	1 (67)	-	-	-	-	1 (67)
27-Jun-17	-	-	-	-	-	-	-	-	-	-
28-Jun-17	-	-	-	-	-	-	-	-	-	-
29-Jun-17	-	-	-	-	-	-	-	-	-	-
30-Jun-17	-	-	-	-	-	-	-	-	-	-
1-Jul-17	-	-	-	-	-	-	-	-	-	-
2-Jul-17	-	-	-	-	-	-	-	-	-	-
3-Jul-17	-	-	-	-	-	-	-	1 (65)	-	1 (65)
4-Jul-17	-	-	-	-	n/a[1]	n/a[1]	n/a[1]	n/a[1]	n/a[1]	-

Note 1: This period was outside of the period of unattended noise logging.

Figure 9 L.12 maximum noise level event distribution over monitoring period



Noise barriers are typically most efficient when receivers are located at ground floor level. As the height above ground of a receiver increases, the noise reduction due to the barrier is usually seen to reduce due to the increased line-of-sight over the top of the barrier to the road corridor (ie reduced path length difference).

It is not uncommon for upper floors of multi-storey buildings to see little to no reduction in noise levels from nearby barriers because of their elevation. The process of determining reasonable barrier heights would therefore generally be less likely to result in noise barriers being considered a reasonable option if upper floors formed part of the analysis. With consideration of this, the assessment and optimisation of noise barriers for the project makes use of noise predictions at ground and first floor only, with architectural treatments to be investigated for higher floors.

The NMG approach identifies the number of receivers (noting that a two storey residence is counted as two receivers) that receive at-residence treatment versus barrier height to establish an initial design height and then conducts a weighted analysis to find the optimal mix of barrier height and at-property treatments. This prioritises at-road mitigation and minimises the use of at-property treatments, as per the intent of the RNP.

The NMG approach to barrier optimisation is presented in **Figure 1** and **Figure 2** and described as follows:

- Step 1-3: The approach is to first identify the maximum barrier height (up to eight metres) where no receivers require at-property treatment. The initial design height is then established by identifying the height where, of the receivers that benefit from the noise barrier, two thirds no longer require at-property treatment. A value of two thirds is defined in the NMG as further increases in barrier height have been shown to have diminishing benefits with respect to increasing barrier heights.
- Step 4: Weightings are then applied which consider the cost and the overall noise benefits the barrier provides to the wider community. The total points weighting at each barrier height is the sum of the weightings for barrier area, number of at-property treatments and exceedances of 50 dBA $L_{Aeq(15hour)}$ daytime or 45 dBA $L_{Aeq(9hour)}$ night-time noise levels (based on the World Health Organisation (WHO) criteria).
- Step 5: A low point in the weighting curve between the initial design height and the maximum barrier height corresponds to the most reasonable barrier height in terms of community benefit and weighted cost. The practicability of the design and maximum barrier heights are then reviewed taking into account engineering considerations as well as social, economic and environmental benefits.

As a guide, noise barriers are considered to be a reasonable noise mitigation option where they are capable of providing a noise attenuation benefit (referred to as an insertion loss) of:

- 5 dBA at representative receivers for barrier heights of up to 5 metres
- 10 dBA at representative receivers for barrier heights above 5 metres high and up to 8 metres high.

In certain situations the requirements for the barrier cannot always be met. In this case further feasible and reasonable considerations are undertaken in consultation with Roads and Maritime.

Where an existing barrier is relocated as part of the works, the top of noise wall height of the replacement section of the noise barrier is kept consistent with the existing height unless the optimised barrier height is greater.

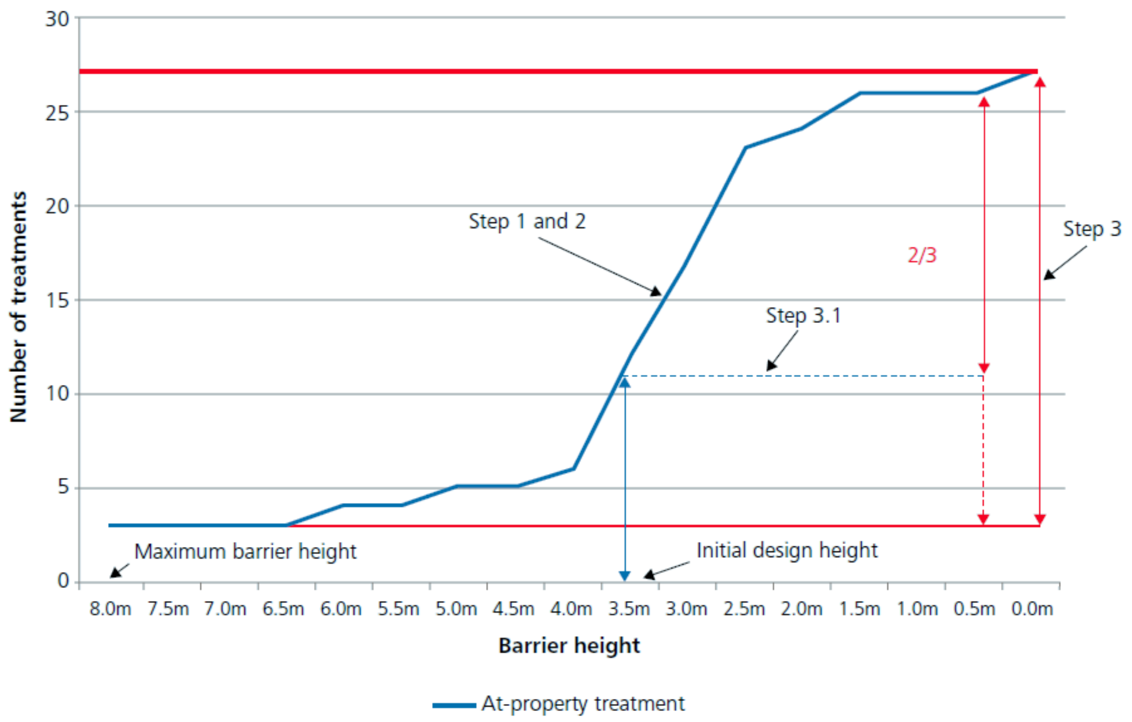


Figure 1 NMG optimisation process – Steps 1-3

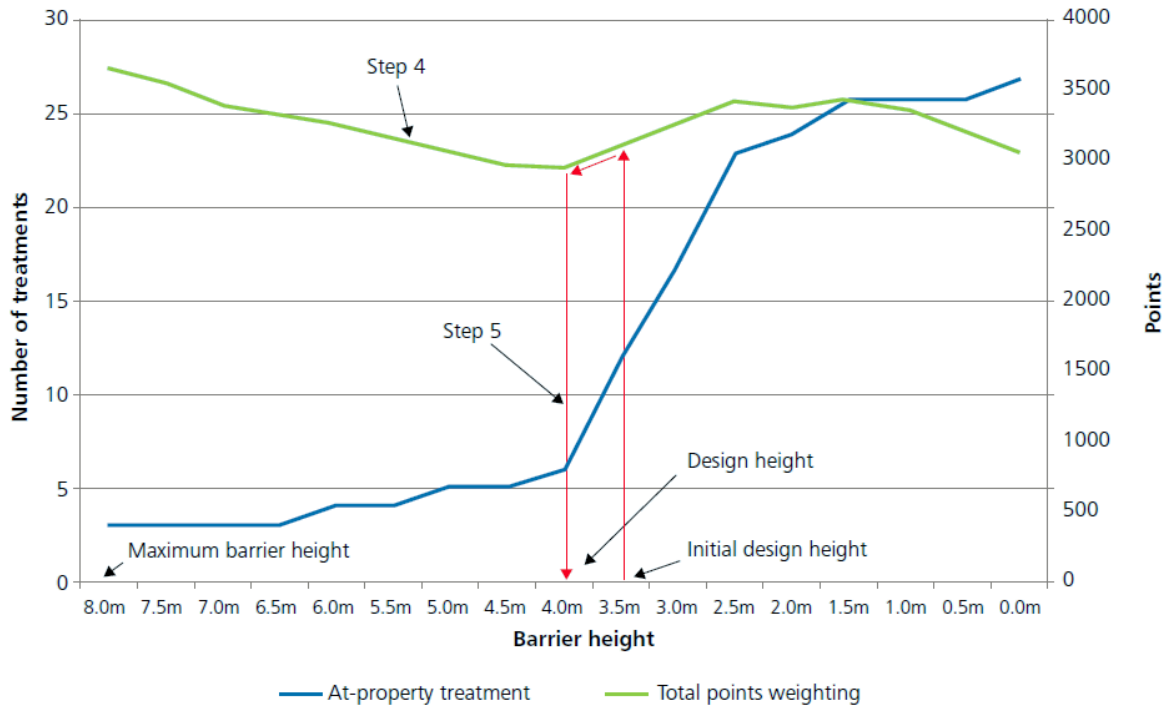
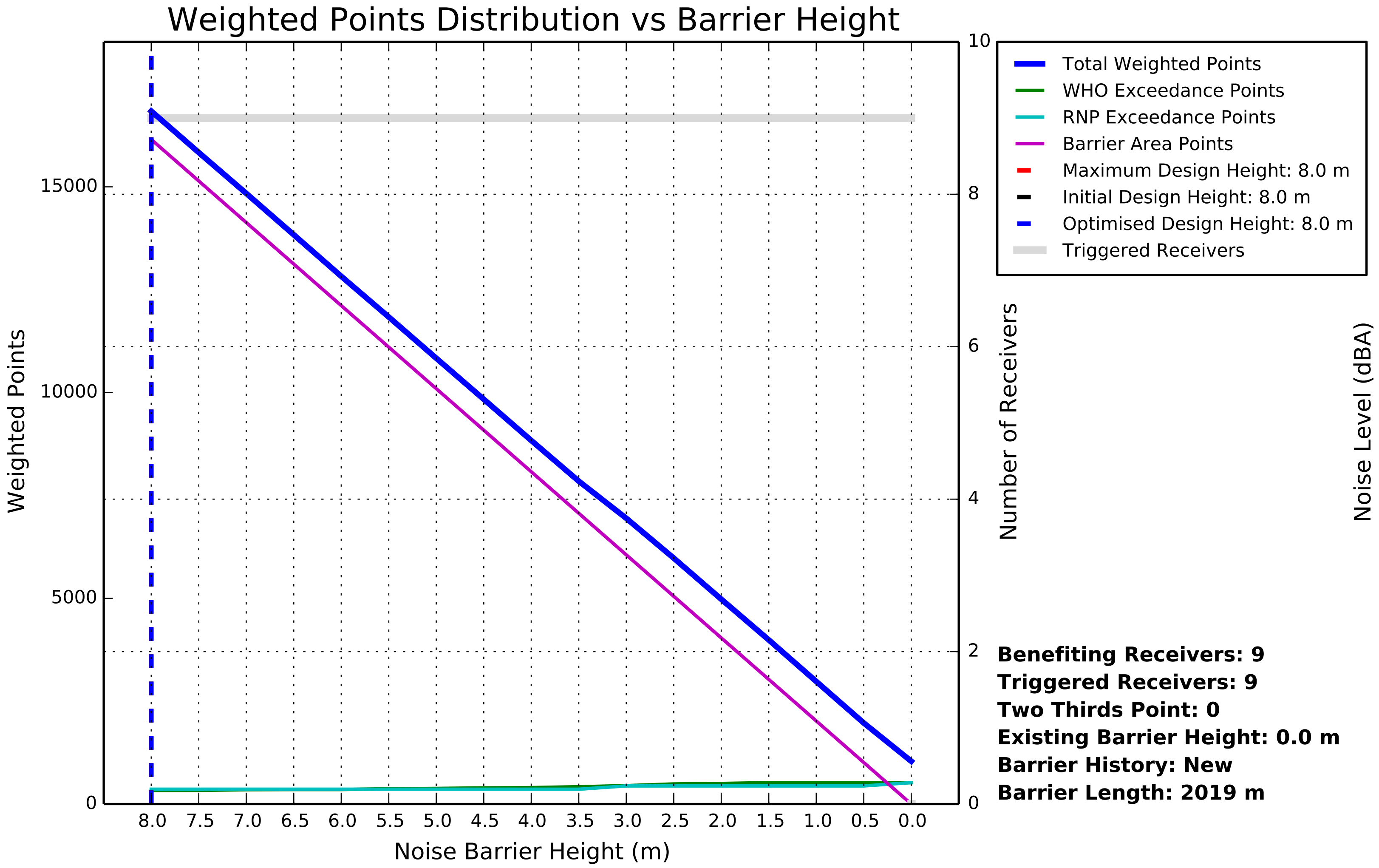
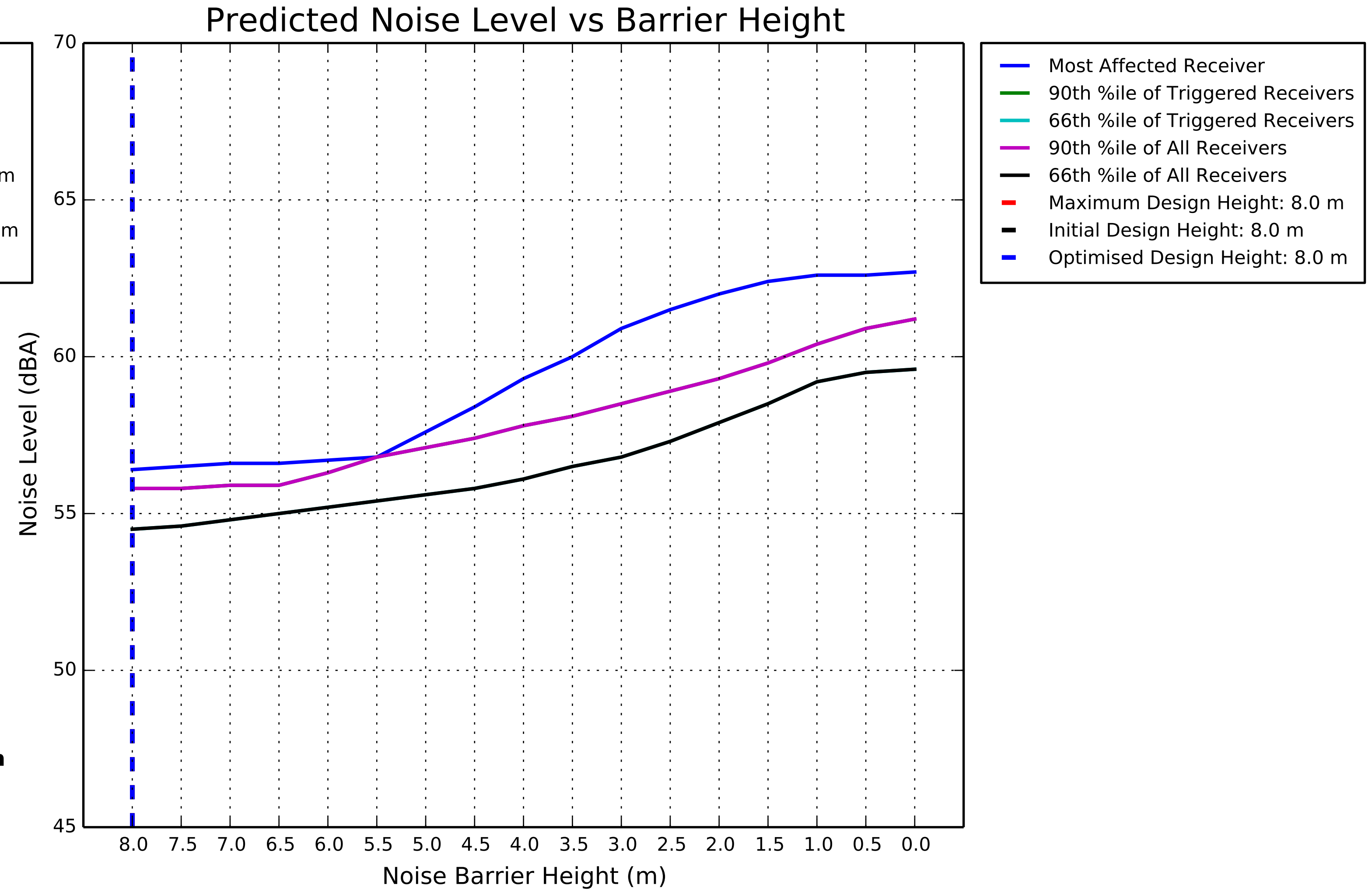
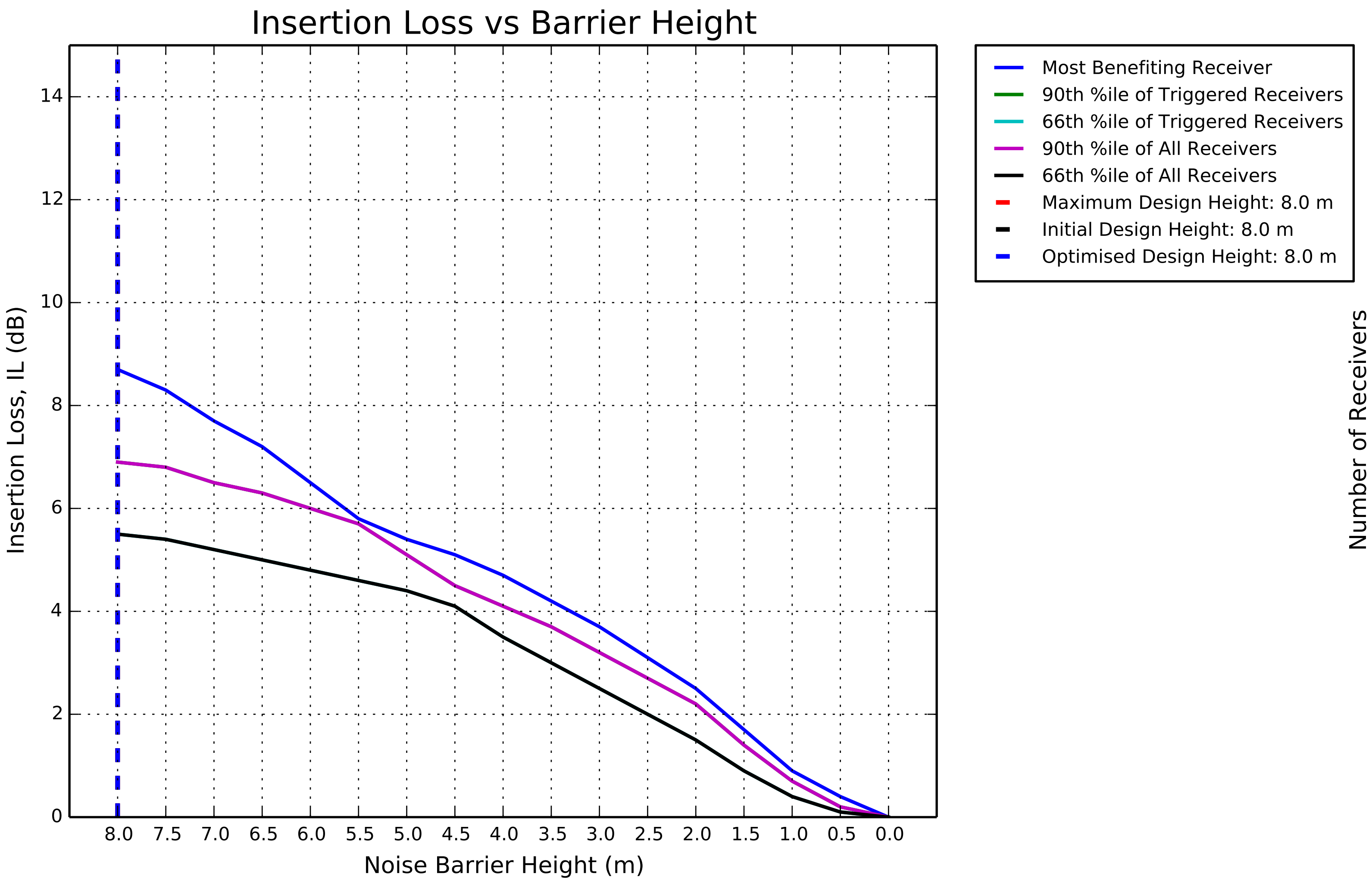


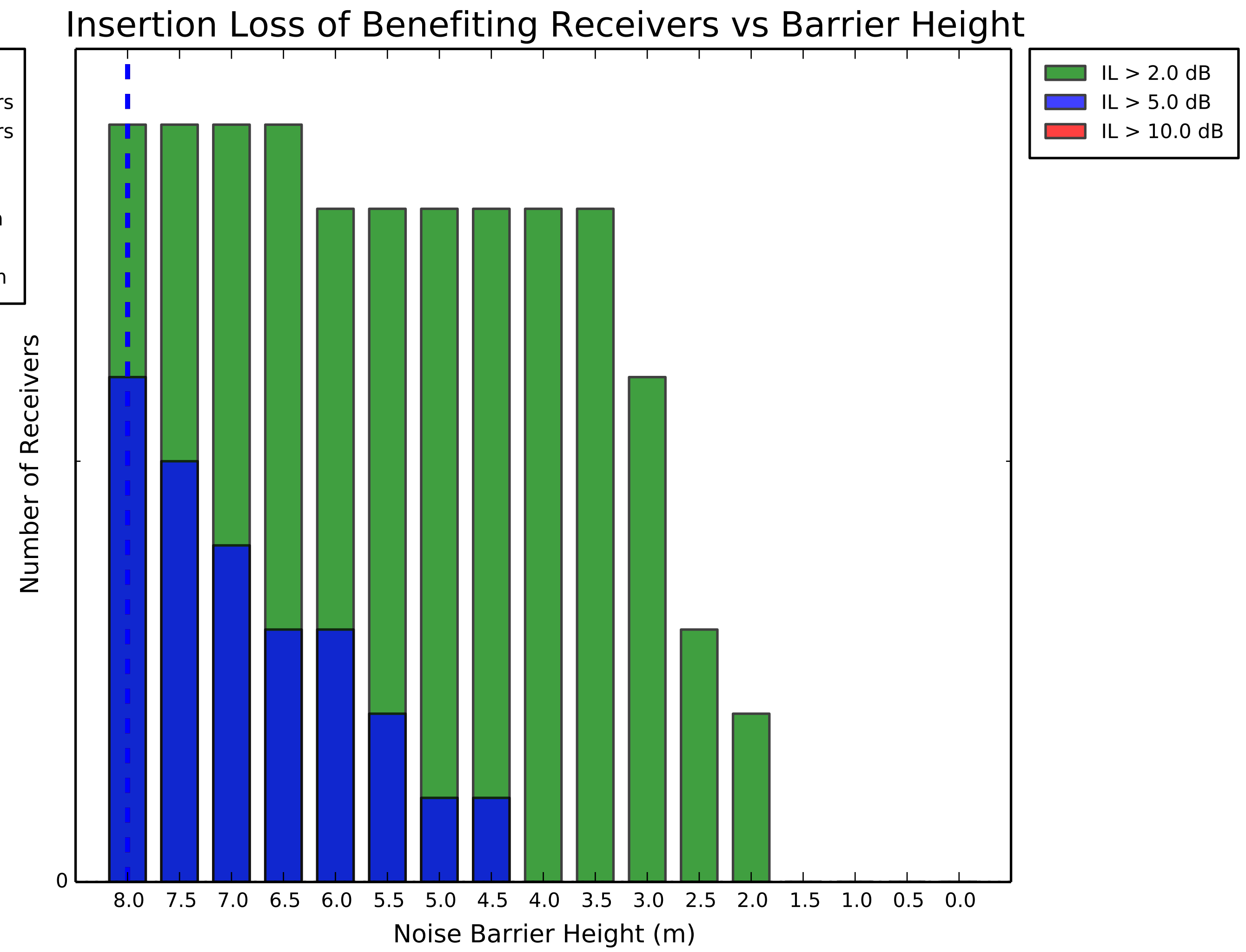
Figure 2 NMG optimisation process – Steps 4-5

Noise Barrier Optimisation: NW.01



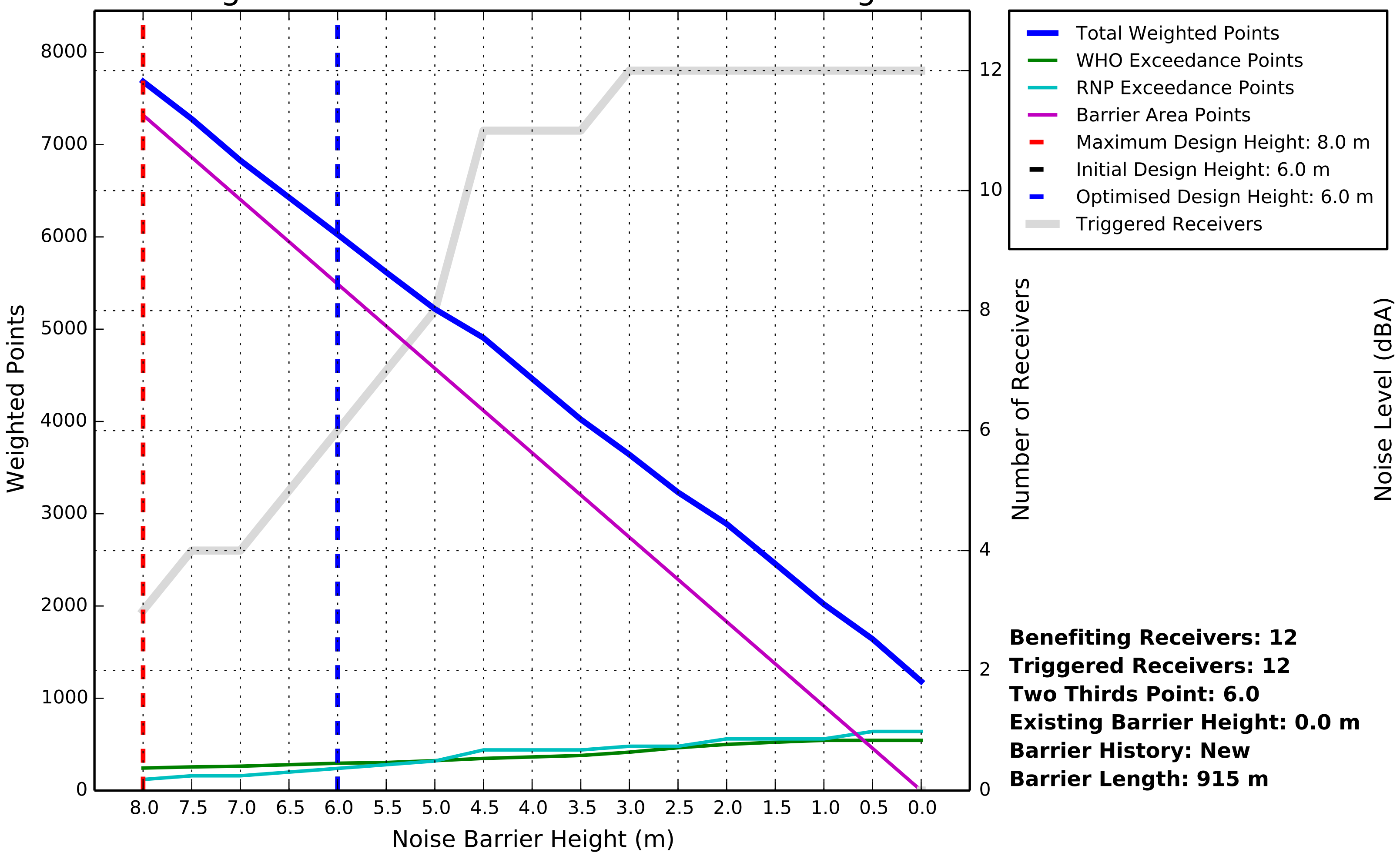






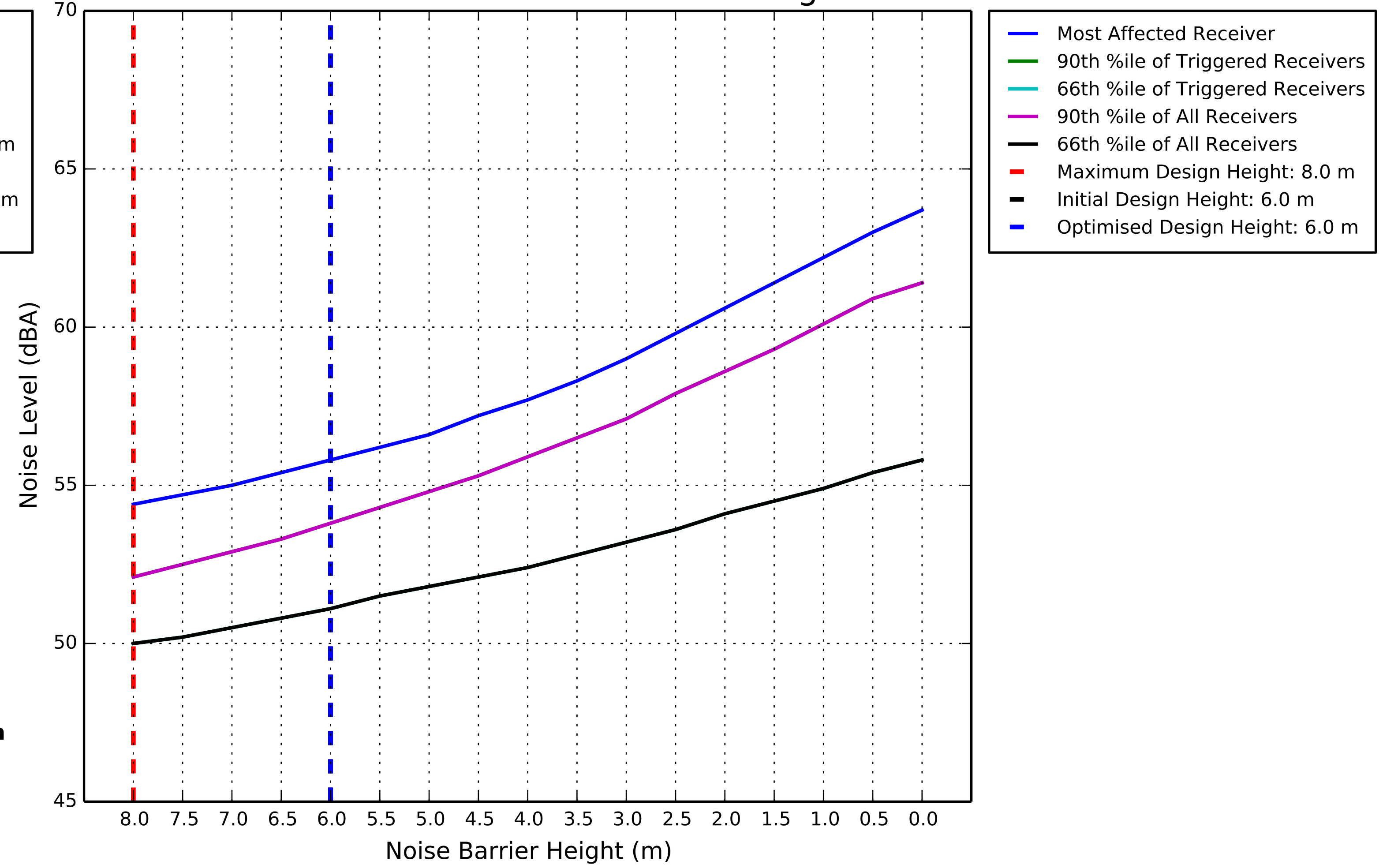
Noise Barrier Optimisation: NW.02

Weighted Points Distribution vs Barrier Height

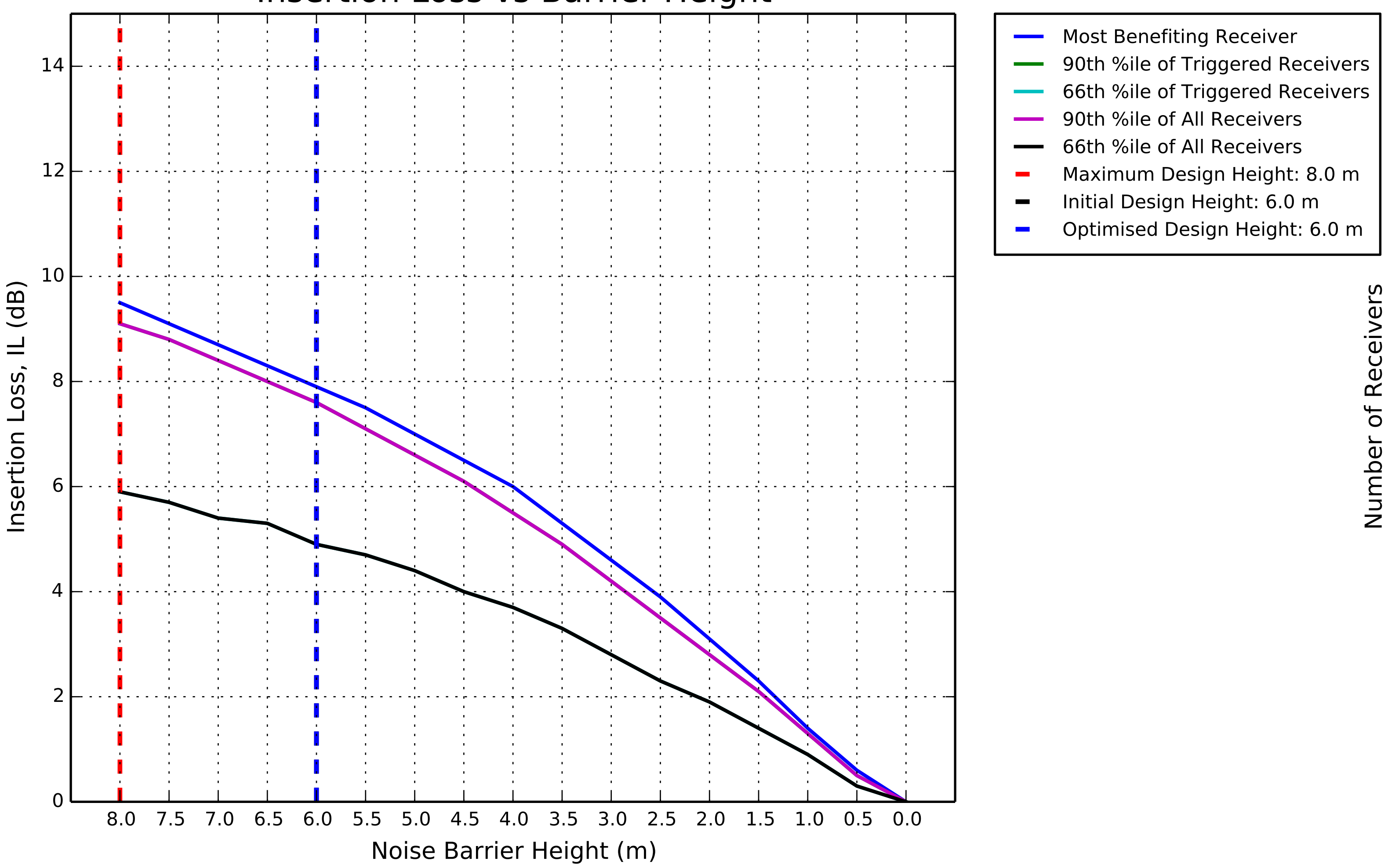


Benefiting Receivers: 12
Triggered Receivers: 12
Two Thirds Point: 6.0
Existing Barrier Height: 0.0 m
Barrier History: New
Barrier Length: 915 m

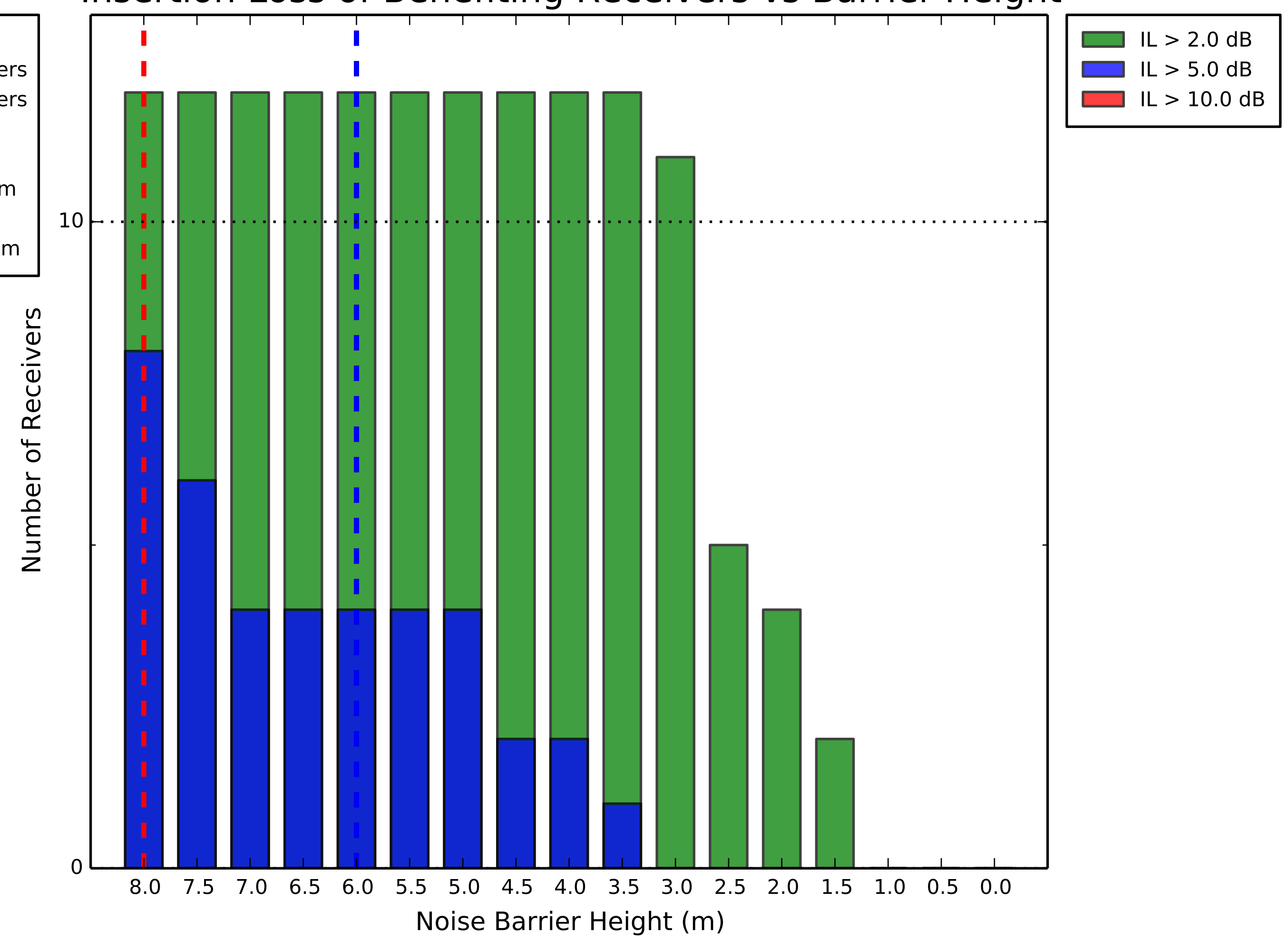
Predicted Noise Level vs Barrier Height



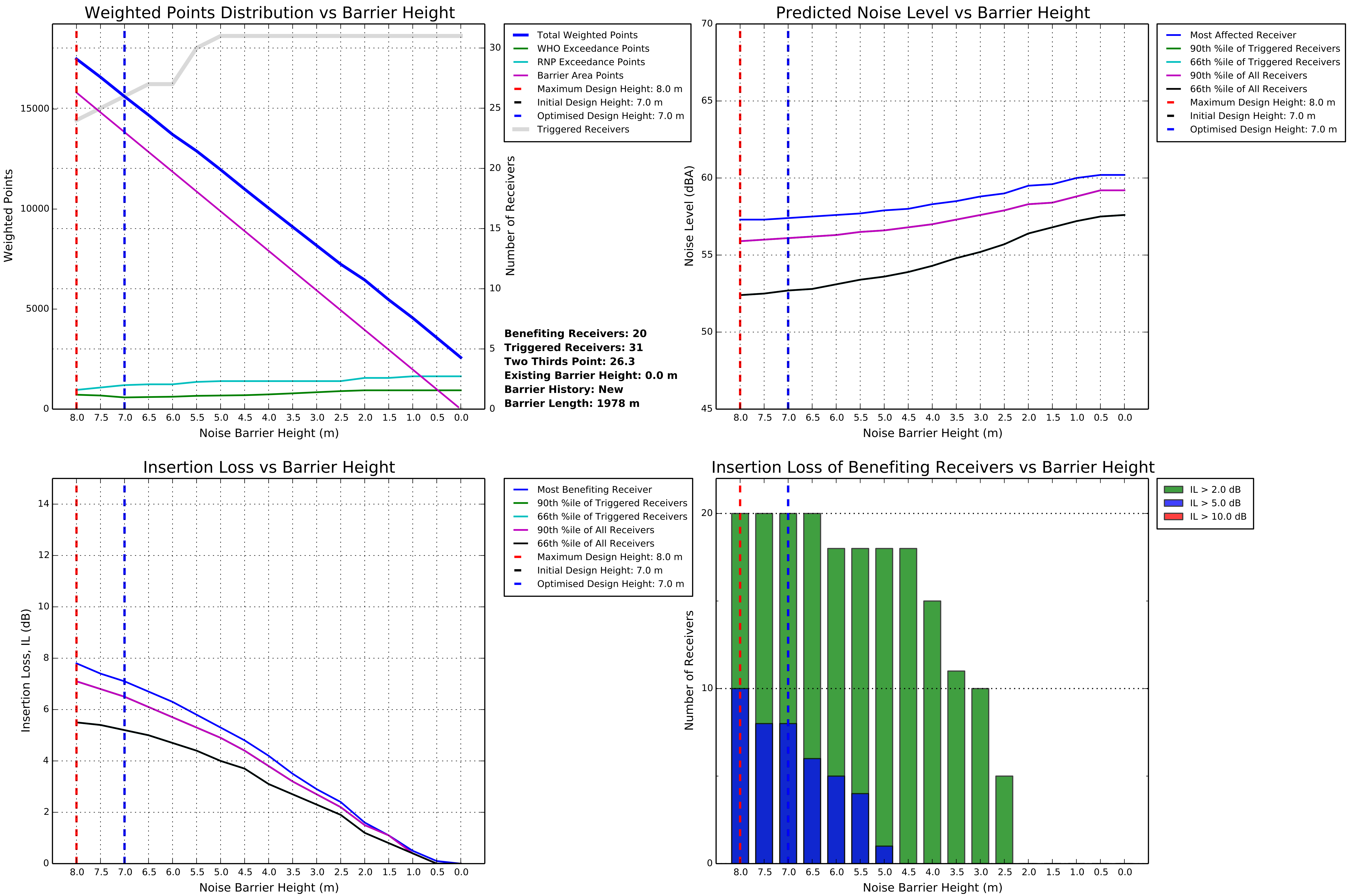
Insertion Loss vs Barrier Height



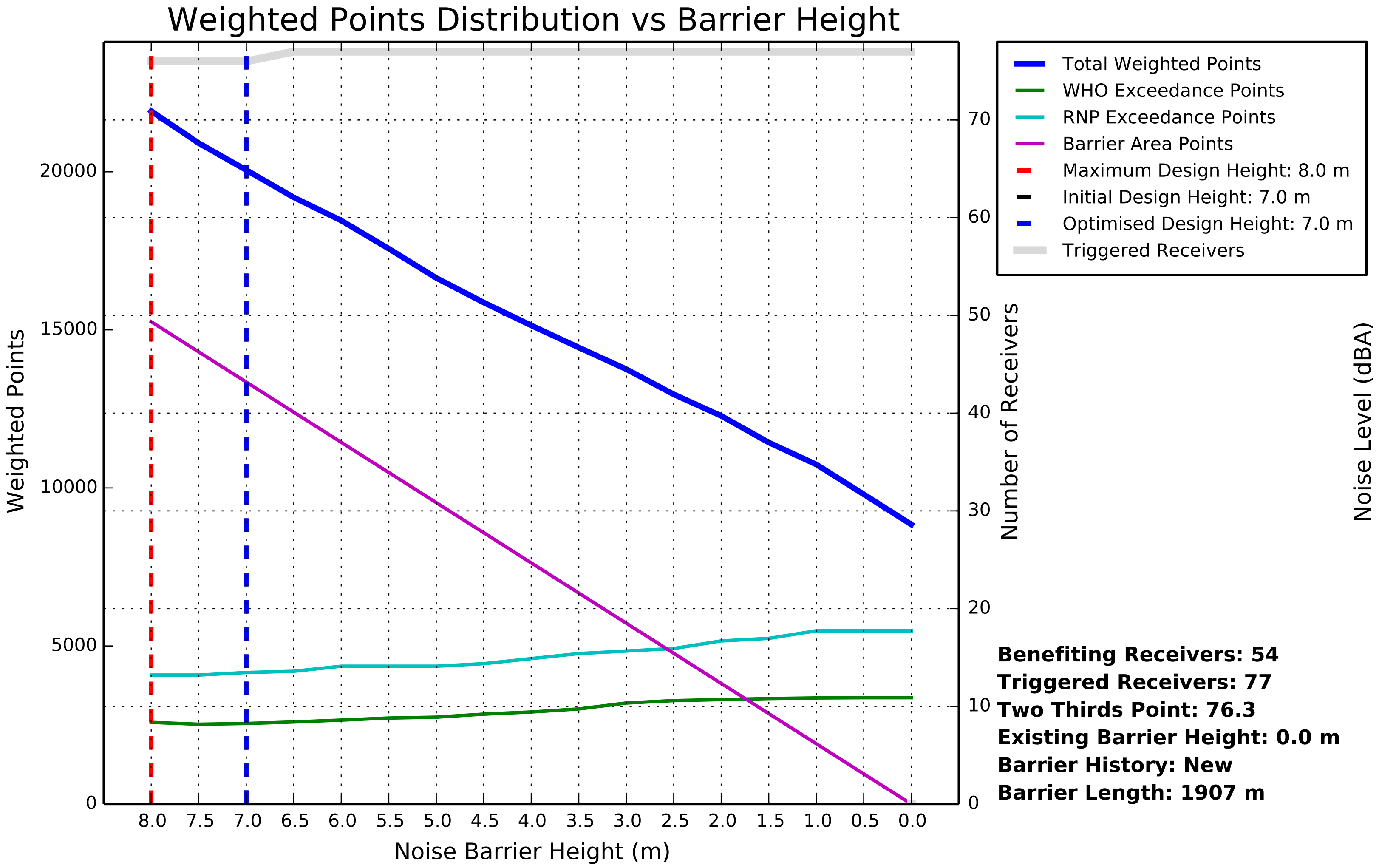
Insertion Loss of Benefiting Receivers vs Barrier Height



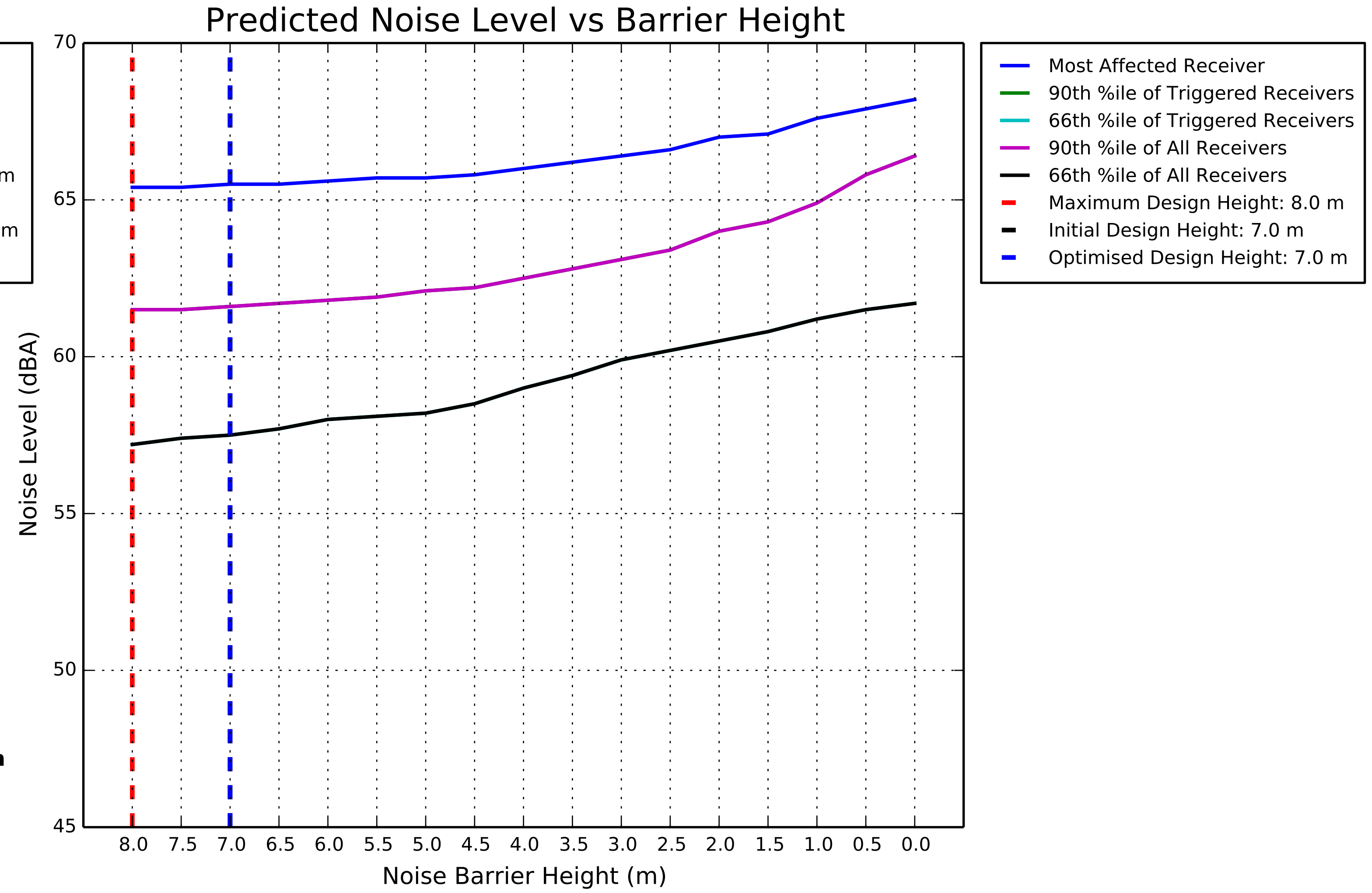
Noise Barrier Optimisation: NW.03

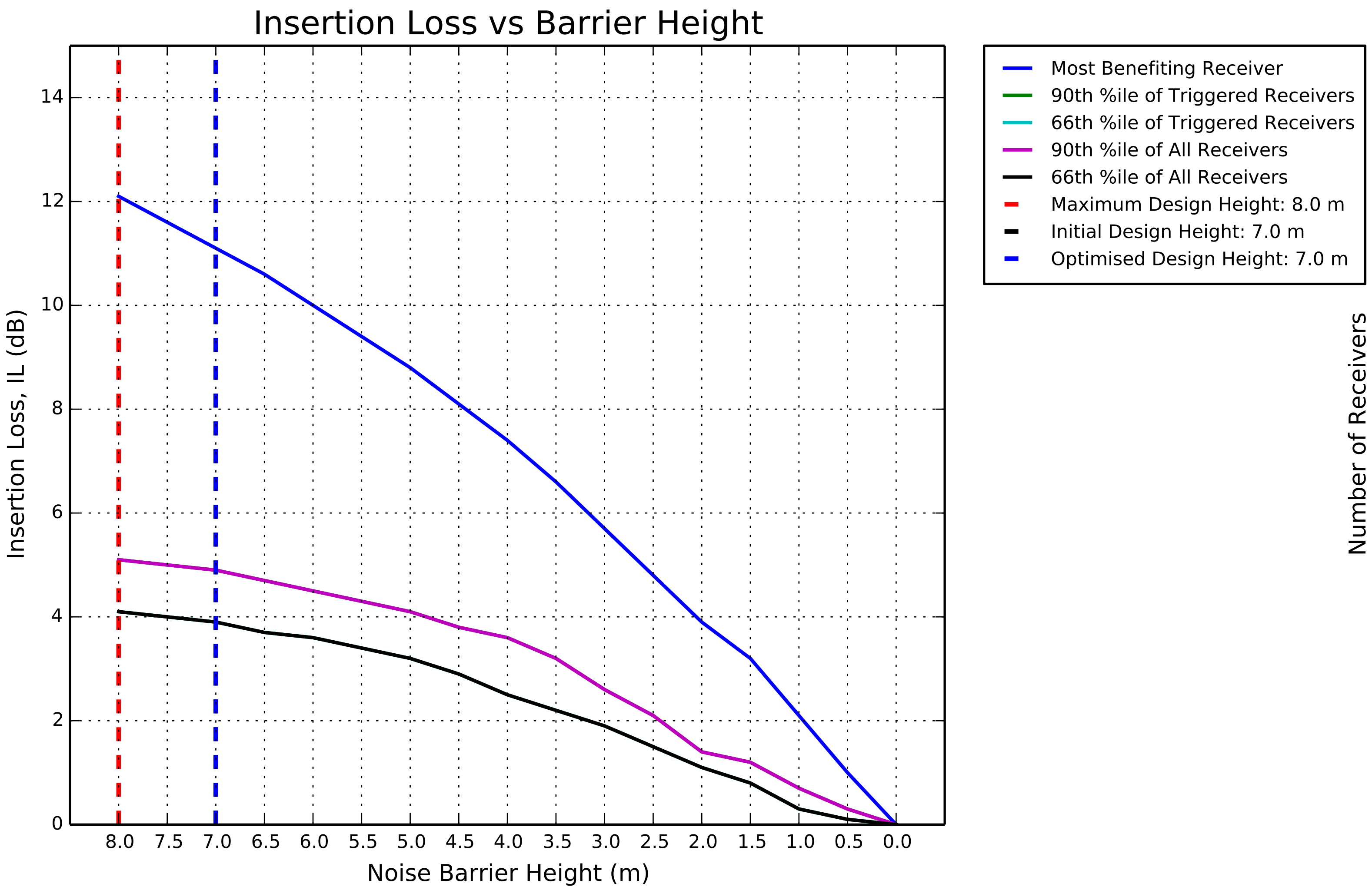


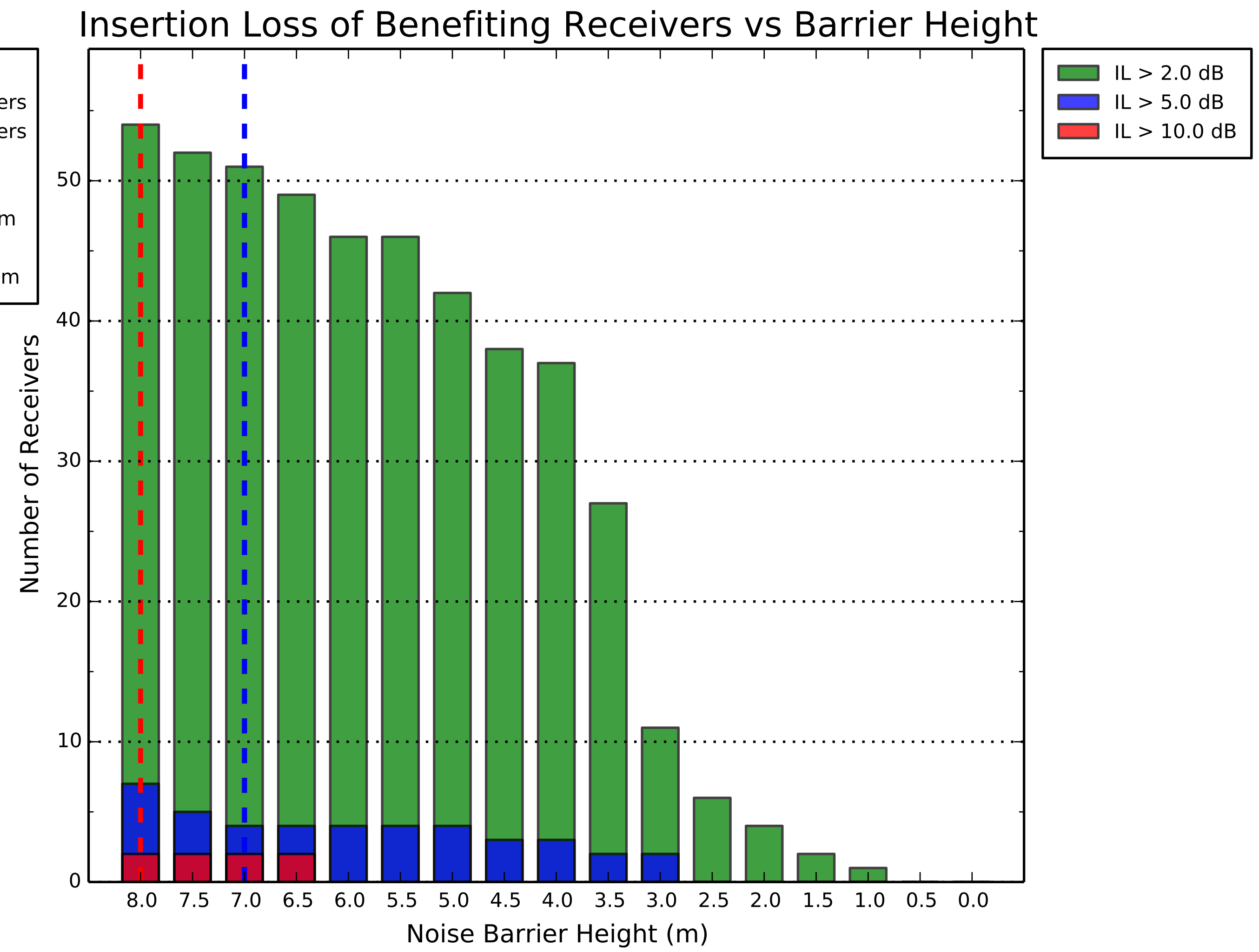
Noise Barrier Optimisation: NW.04



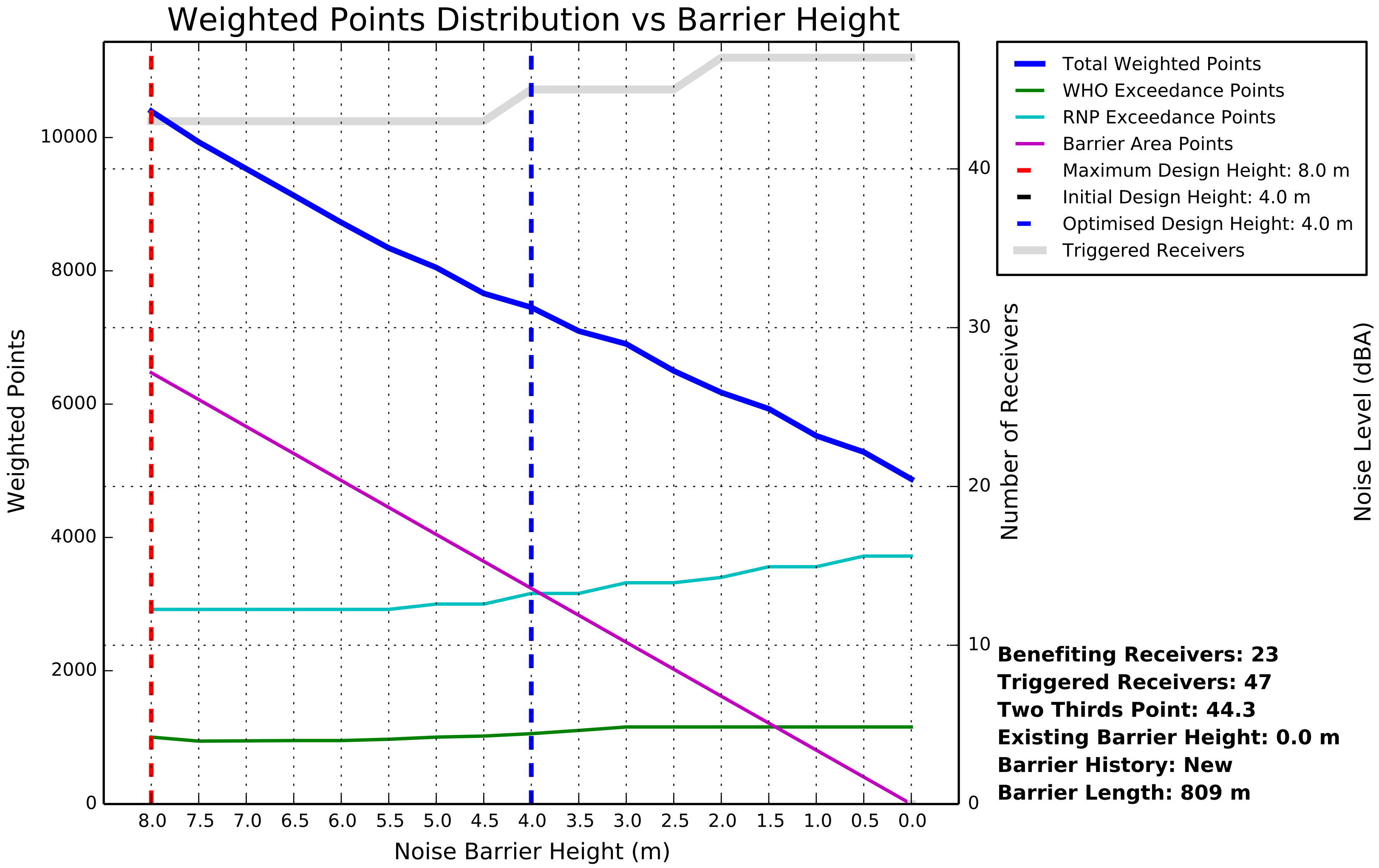
Benefiting Receivers: 54
Triggered Receivers: 77
Two Thirds Point: 76.3
Existing Barrier Height: 0.0 m
Barrier History: New
Barrier Length: 1907 m



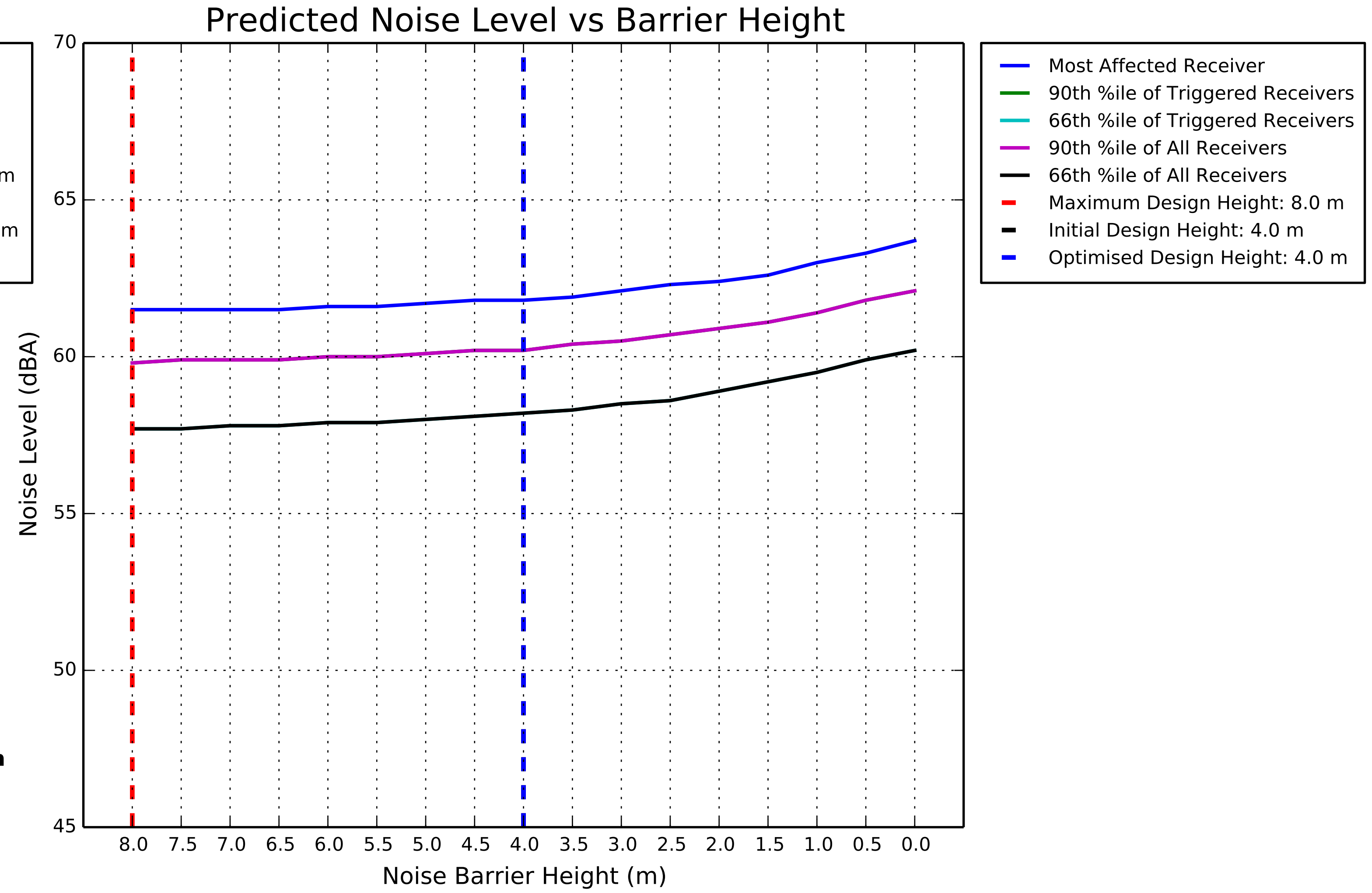


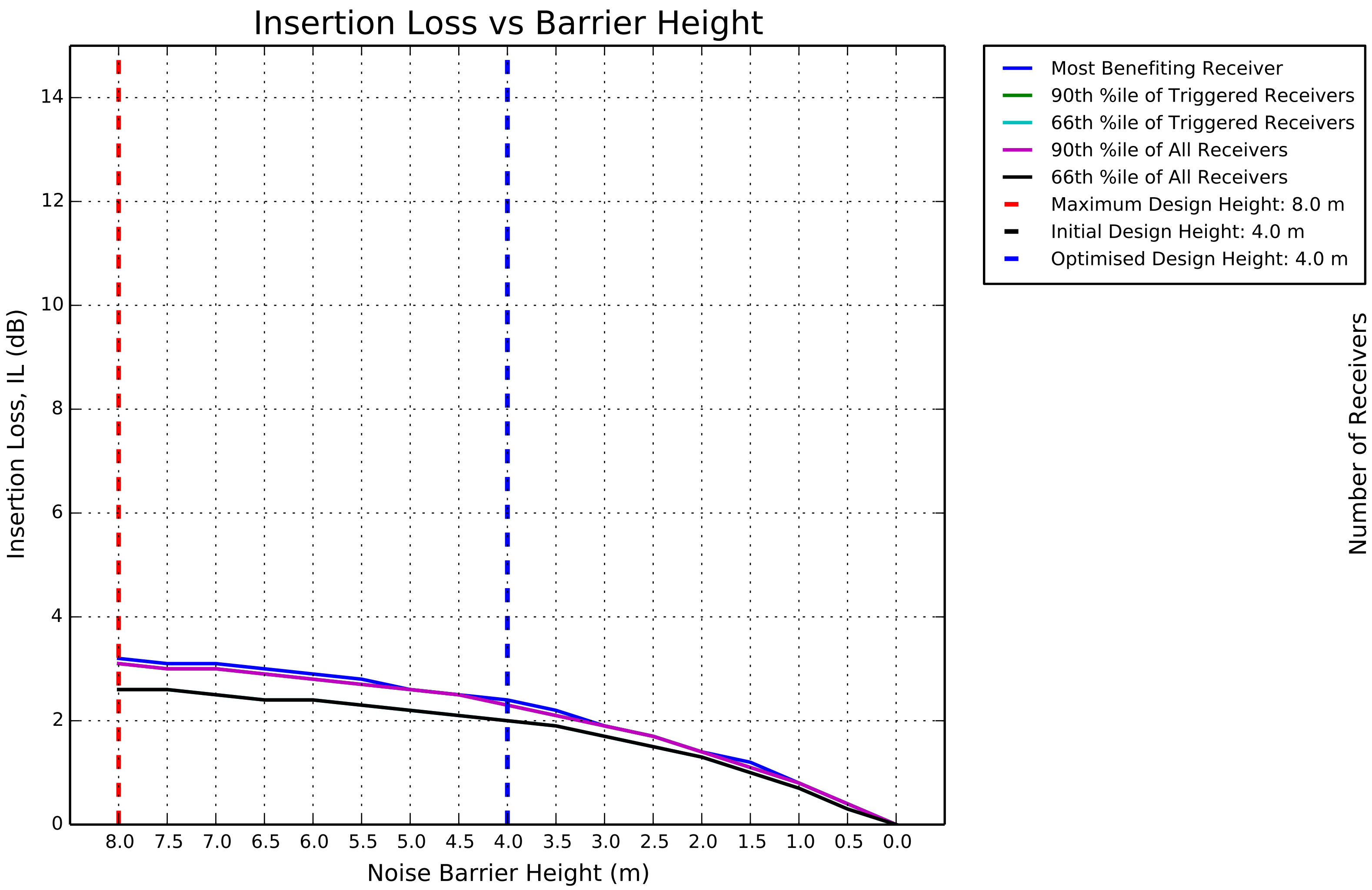


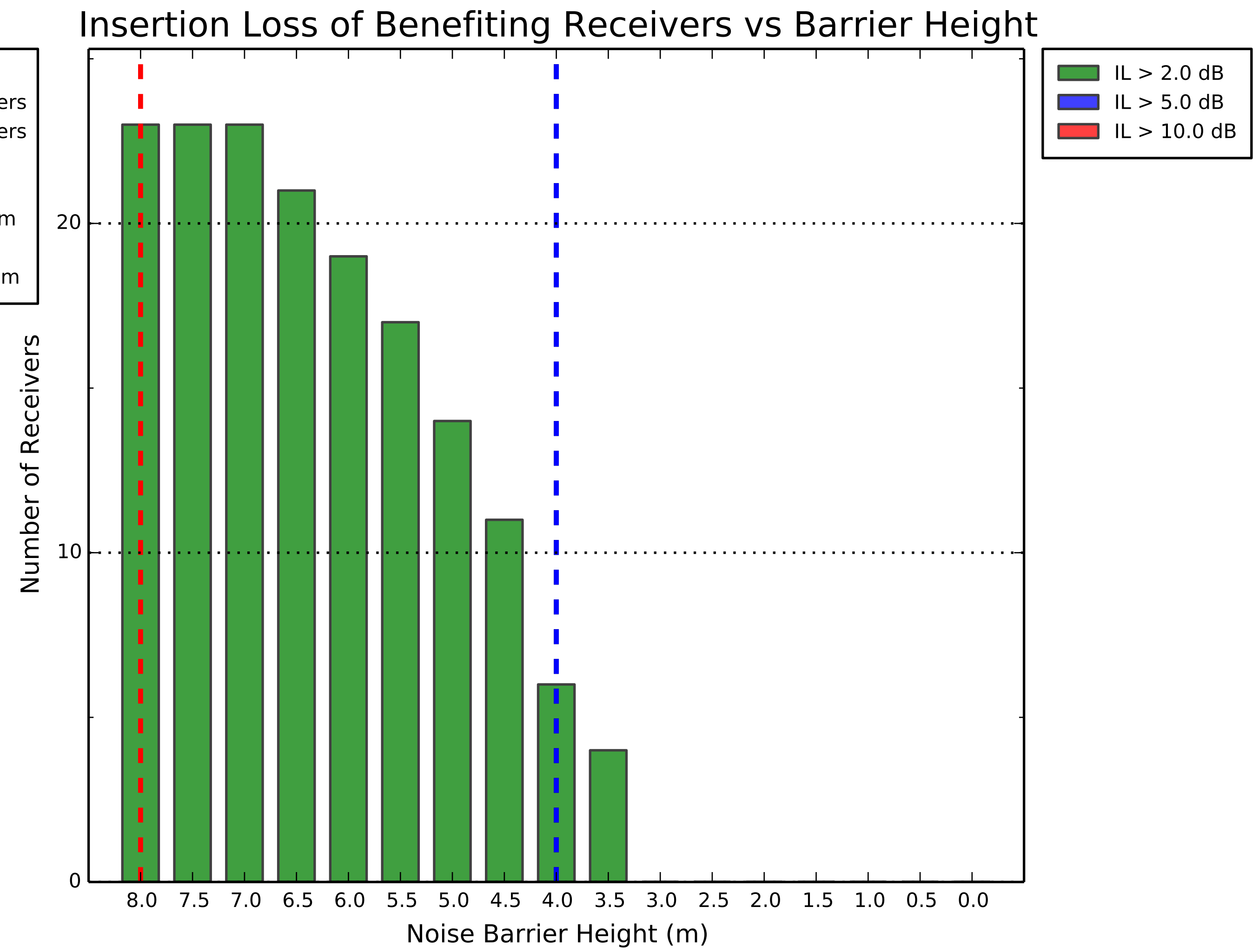
Noise Barrier Optimisation: NW.05



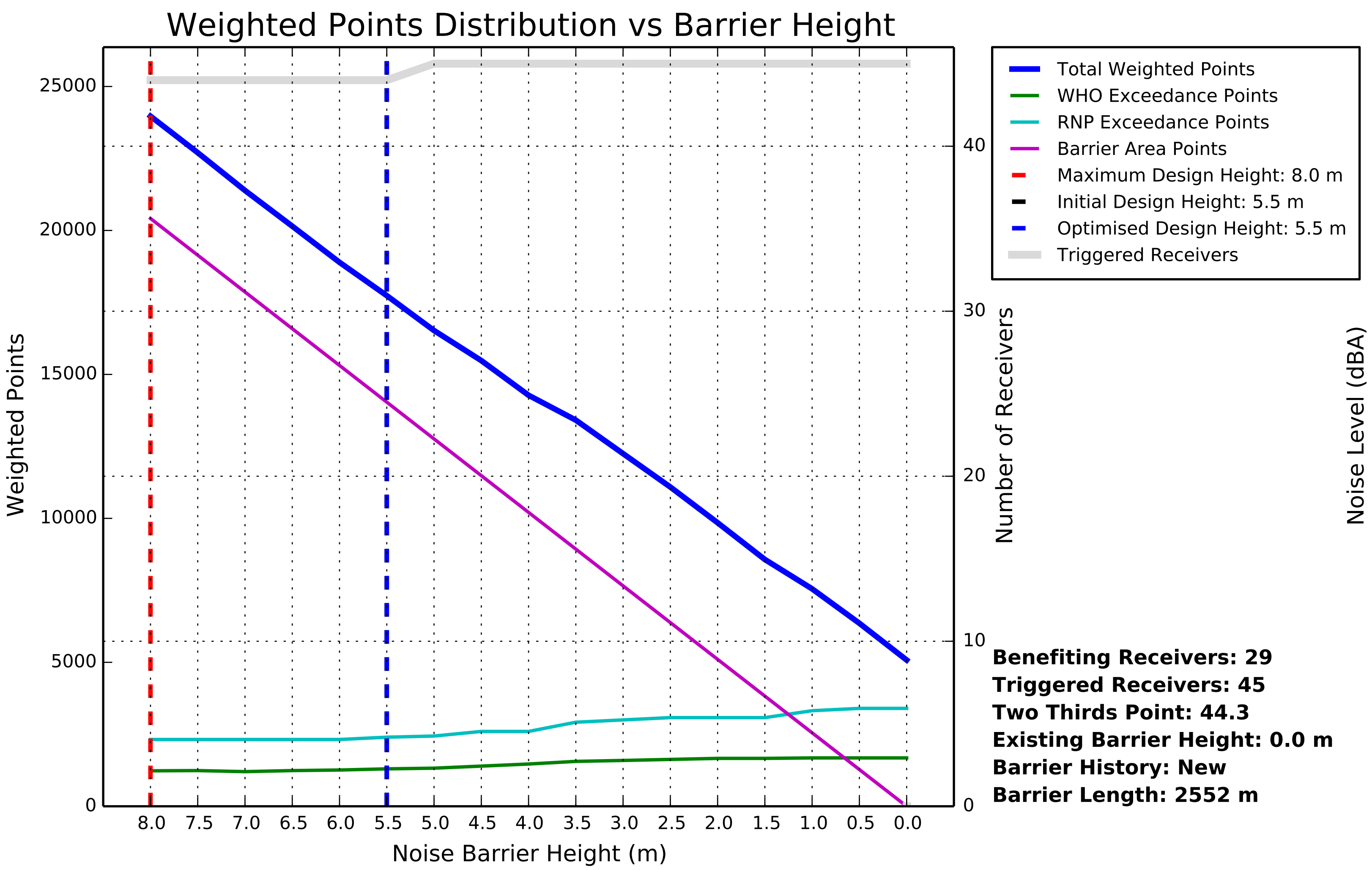
Benefiting Receivers: 23
Triggered Receivers: 47
Two Thirds Point: 44.3
Existing Barrier Height: 0.0 m
Barrier History: New
Barrier Length: 809 m

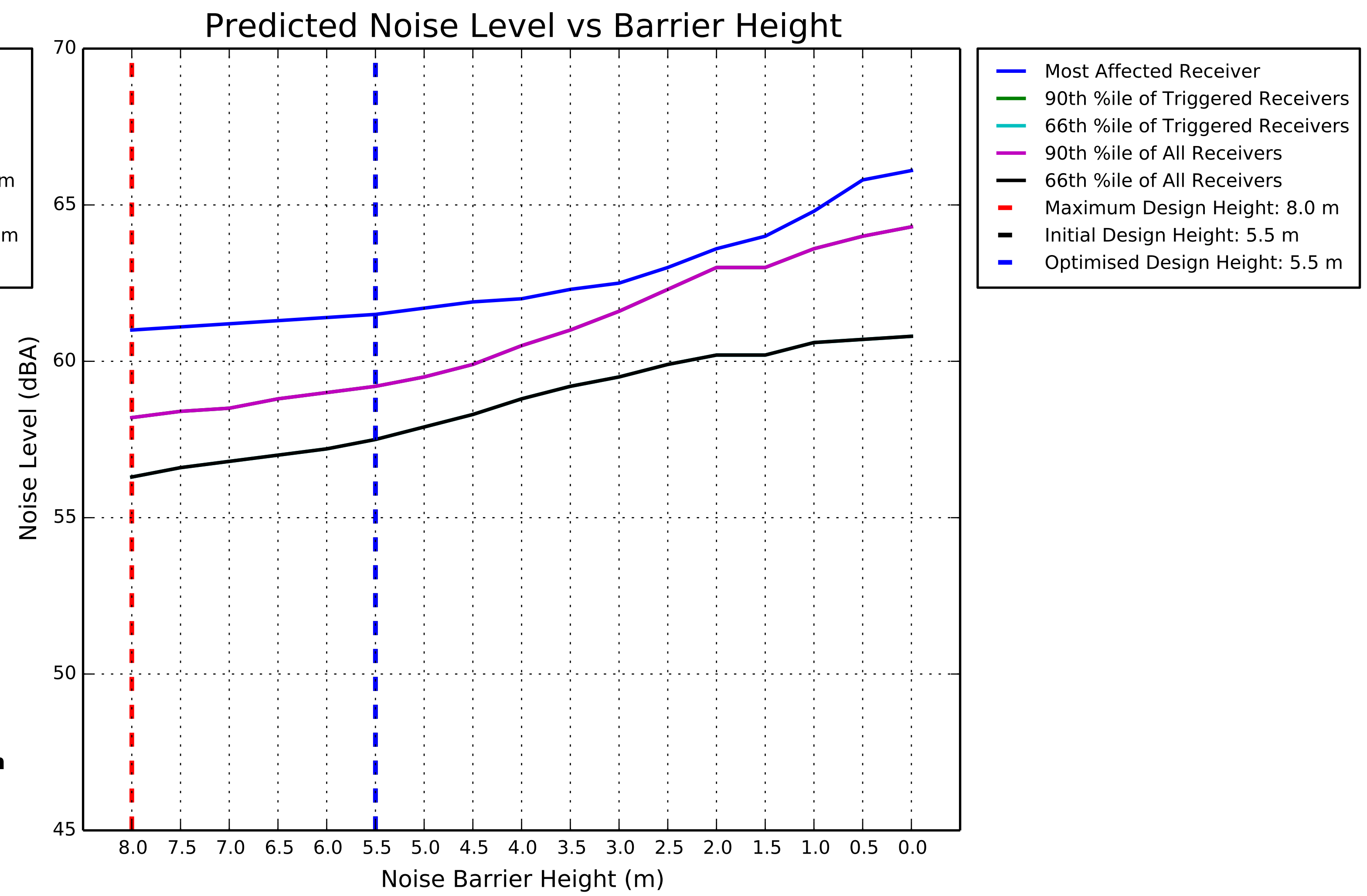


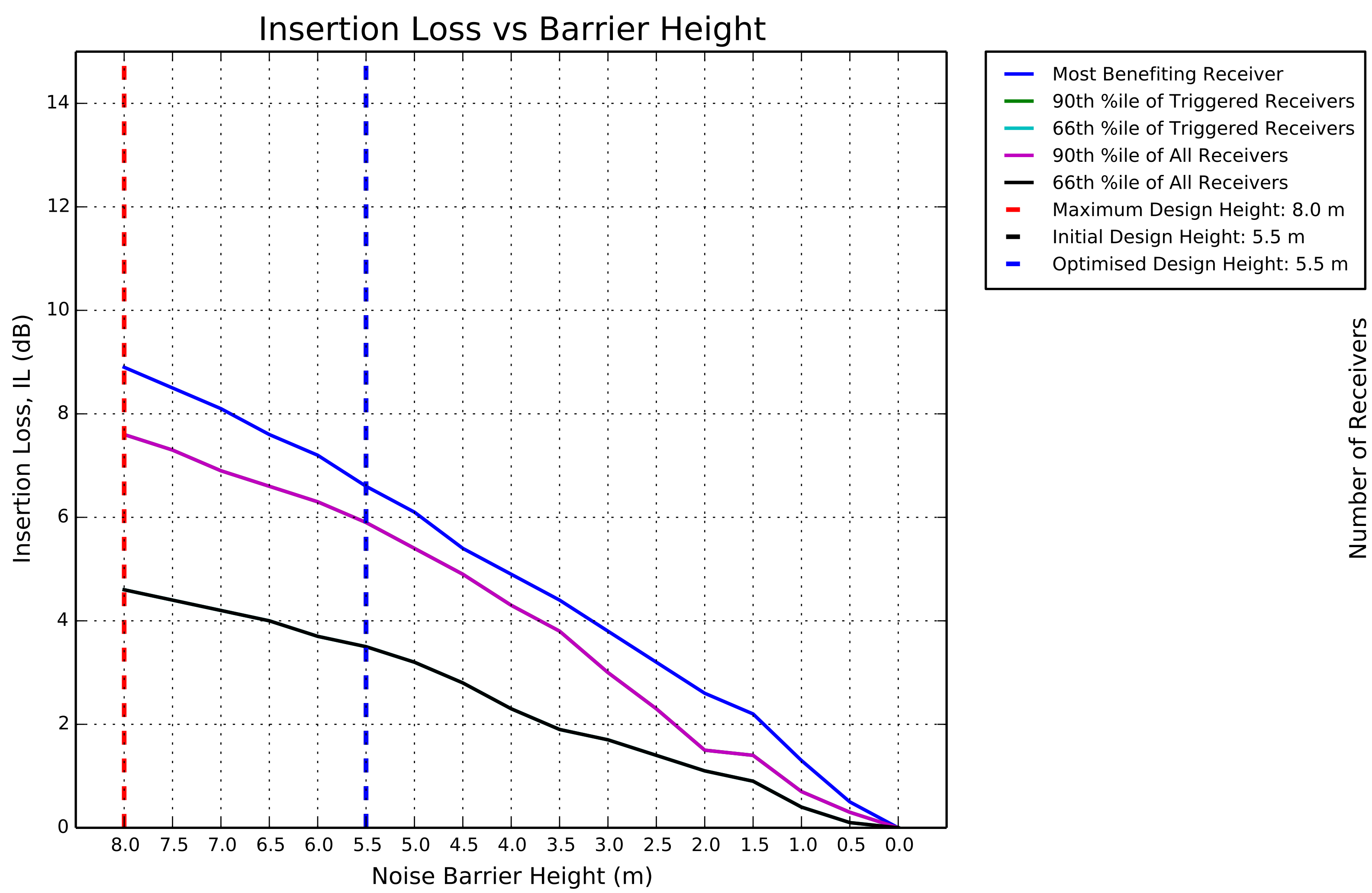


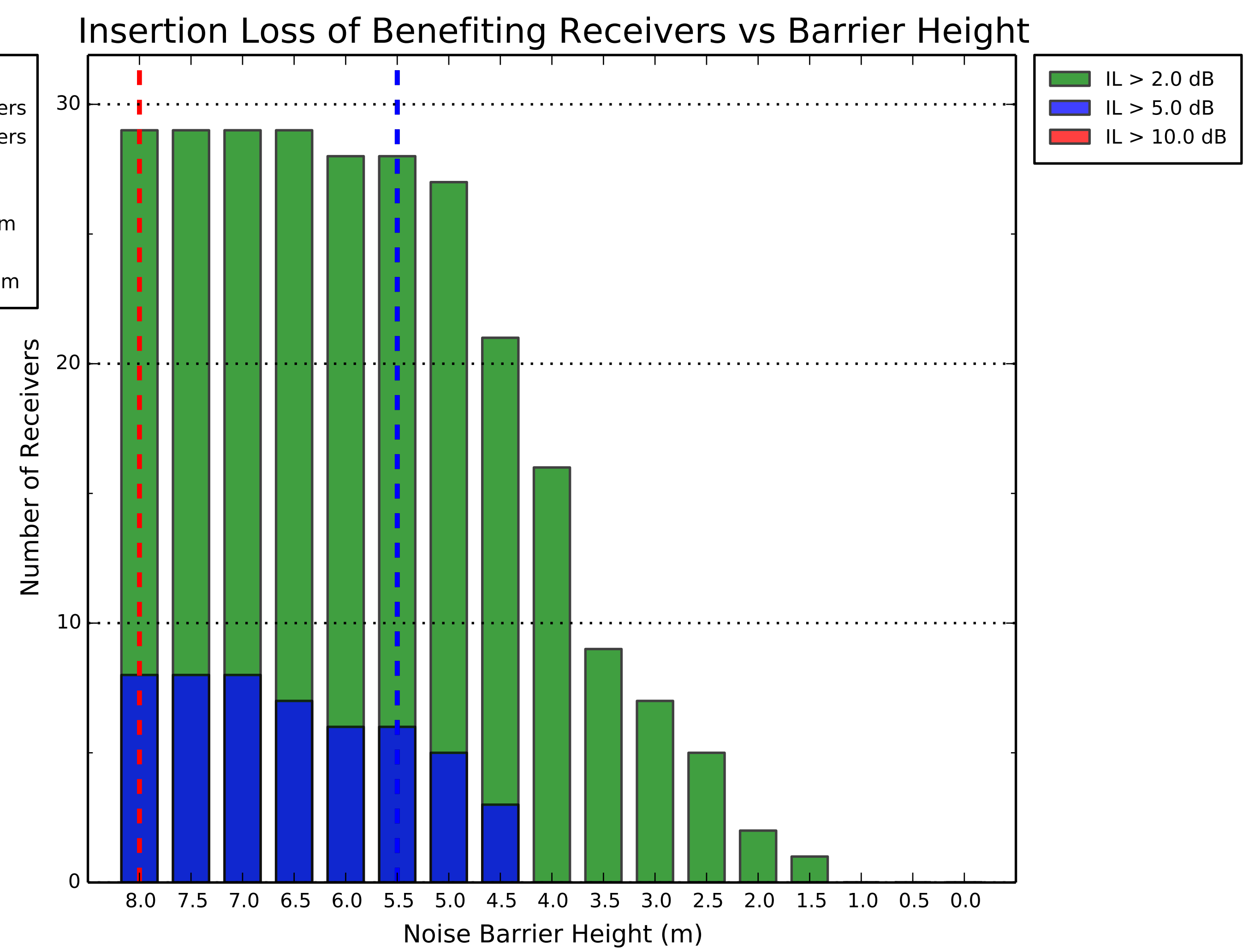


Noise Barrier Optimisation: NW.06









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