CHATSWOOD TO SYDENHAM

ENVIRONMENTAL IMPACT STATEMENT

MAY 2016

TECHNICAL PAPER 2: NOISE AND VIBRATION

Sydney Metro Chatswood to Sydenham

Technical Paper 2: Noise and Vibration

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Executive Summary

Sydney Metro is a new standalone rail network identified in Sydney's Rail Future. The Sydney Metro network consists of Sydney Metro City & Southwest and Sydney Metro Northwest.

The proposed Sydney Metro City & Southwest comprises two core components:

- The Chatswood to Sydenham project (the project), the subject of this technical paper, would involve construction and operation of an underground rail line between Chatswood and Sydenham
- The Sydenham to Bankstown upgrade would involve the conversion of the 13.5 kilometre Bankstown line to metro standards and upgrade of existing stations between Sydenham and Bankstown.

The Sydenham to Bankstown upgrade will be subject to a separate environmental impact assessment.

Investigations have started on the possible extension of Sydney Metro from Bankstown to Liverpool. The potential extension would support growth in Sydney's south west by connecting communities, businesses, jobs and services as well as improving access between the south west and Sydney's CBD. It would also reduce growth pressure on road infrastructure and the rail network, including the potential to relieve crowding on the T1 Western Line, T2 South Line and T2 Airport Line.

The Sydney Metro Chatswood to Sydenham project (the project) involves the construction and operation of a metro rail line. The project would be mainly located underground in twin tunnels extending from Chatswood on Sydney's north shore, crossing under Sydney Harbour, and continue to Sydenham.

The key components of the project would include:

- About 15.5 kilometres of twin rail tunnels (that is, two tunnels located side-by-side) between Mowbray Road, Chatswood and north of Sydenham Station (near Bedwin Road, Marrickville).
- Realignment of the existing T1 North Shore Line surface track within the existing rail corridor between Chatswood Station and in the vicinity of Brand Street, Artarmon, including a new bridge for a section of the 'down' (northbound) track to pass over the proposed northern dive structure.
- About 250 metres of aboveground metro tracks between Chatswood Station and the Chatswood dive structure.
- A dive structure (about 400 metres long) and tunnel portal south of Chatswood Station and north of Mowbray Road, Chatswood (the Chatswood dive structure).
- A substation (for traction power supply) at Artarmon.
- Metro stations at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street and Waterloo; and new underground platforms at Central Station.
- A dive structure (about 400 metres long) and tunnel portal between Sydenham Station and Bedwin Road, Marrickville (the Marrickville dive structure).
- A services facility (for traction power supply and an operational water treatment plant) adjacent to the Marrickville dive structure.

The project would also include a number of ancillary components, including new overhead wiring and alterations to existing overhead wiring, signalling, access tracks / paths, rail corridor fencing, noise walls, fresh air ventilation equipment, temporary and permanent alterations to the road network, facilities for pedestrians, and other construction related works.

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Identification of Sensitive Receivers

The sensitivity of building occupants to noise and vibration varies according to the nature of the occupancy and activities within the affected premises. Site inspections were undertaken within a corridor extending approximately 100 m either side of the proposed alignment and typically 200 m from the construction sites to identify the sensitivity of each nearby receiver (building occupancy). Receivers beyond 200 m are unlikely to receive any appreciable impacts. Receivers were classified as commercial, educational, industrial, residential, worship or other sensitivity to assist in determining appropriate noise and vibration management levels.

Ambient Noise Monitoring

In order to characterise the existing ambient noise environment across the project area, environmental noise monitoring was performed at 25 representative locations during June 2015 and September 2015. This information has been supplemented with ambient noise data collated for other recent projects, resulting in an ambient noise database for a total of 29 representative locations across the project area.

The purpose of the noise monitoring was to quantify the existing noise environment and to determine the existing L_{Aeq}, L_{A90} and other relevant statistical noise levels during the daytime, evening and night-time periods. These results were used to assist in determining the appropriate noise management levels (NMLs) as a basis for assessing the potential noise impacts during construction.

Construction Noise Guidelines

The Interim Construction Noise Guideline (ICNG) was adopted to determine the NMLs for residential receivers as follows:

- Daytime (7:00 am to 6:00 pm) Rating Background Level +10 dB
- Evening (6:00 pm to 10:00 pm) Rating Background Level + 5 dB
- Night-time (10:00 pm to 7:00 am) Rating Background Level + 5 dB

At commercial receivers, the recommended NML is 70 dBA (external). Construction NMLs have also been established for other sensitive receivers such as schools, childcare centres and places of worship, and are discussed in the relevant sections of the report.

The ICNG provides residential NMLs for ground-borne noise, which are applicable when ground-borne noise levels are higher than the corresponding airborne noise levels. NMLs of 40 dBA and 35 dBA are applicable for the evening and night-time periods respectively. Additionally for project environmental impact assessment purposes two interim daytime NMLs have been adopted, a residential NML of 45 dBA, and commercial receiver NML of 50 dBA.

Construction Noise and Vibration Strategy

A Sydney Metro City & Southwest Construction Noise and Vibration Strategy (Sydney Metro CNVS – refer to Appendix E of the Environmental Impact Statement) has been developed by the project design team and will be adopted by all contractors to manage construction noise and vibration emissions across the various construction sites. In preparing this strategy, consideration has been given to several guideline documents including the Interim Construction Noise Guideline, Transport Construction Authority's Construction Noise Strategy, Australian Standard AS 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites and the Road Noise Policy (EPA 2011).

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Daytime Construction Works

At all sites, following site establishment and earthworks, construction activities are likely to occur over a period of several years. The potential noise and vibration impacts would be highest during any demolition works (if required), earthworks and during excavation works. These works would primarily be undertaken during daytime periods (7:00 am to 6:00 pm Monday to Friday and 8:00 am to 1:00 pm on Saturdays) using conventional methods. Construction noise and vibration levels during these stages would be similar to those occurring at many other building sites across the Sydney metropolitan area.

Out of Hours Works

Several of the sites support the operation of tunnel boring machines (TBMs) and roadheaders, which operate underground on a 24 hour per day basis and up to 7 days per week. Furthermore at most of the station sites it is required to excavate the shafts on a 24 hour per day basis and up to 7 days per week as this work is required to be completed prior to the TBM arrival. At these construction sites, mitigation measures are likely to involve the construction of acoustic enclosures and/or noise barriers to contain noise emissions. Prior to undertaking significant “out of hours” works, noise mitigation and management measures would be implemented (where required) to minimise the potential noise and vibration impacts at nearby sensitive receivers.

Construction Sites

At this early stage in the planning process of the project, detailed information in relation to the proposed construction works, equipment and site layouts is not available. The construction noise and vibration assessments have therefore been based on preliminary information and previous project experience, and would be reviewed in more detail as the project progresses and the future land-uses in the vicinity of the proposed construction sites are either established and/or become better understood.

At all the sites, the land-use in the immediate surrounding area is mostly commercial or residential, with schools, childcare centres, places of worship and performance venues located near some station sites.

Consistent with the requirements of the Interim Construction Noise Guideline, the construction noise impacts are based on a realistic worst-case assessment. For most construction activities, it is expected that the construction noise levels will be lower than predicted in this report.

At the TBM support and underground station sites, predictions indicate that there would be exceedances of more than 20 dB of the NMLs at the nearest surrounding receivers during site establishment and excavation, occurring during the daytime construction period. These are a direct result of the relative close proximity of receivers to the construction activities and the absence of any appreciable shielding between sites and receivers. Where spoil handling and station box/shaft excavation is required during the night-time, an acoustic shed has been included to reduce exceedances of the NMLs. Three metre perimeter hoarding has been included in the modelling to reduce impacts.

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Careful management of the noise and vibration impacts will be required at all construction sites. To mitigate impacts, feasible mitigation measures are likely to include the use of 3 m to 6 m high perimeter noise walls or full enclosures of the noise-producing areas of the worksites (for night-time activities), noting that noise walls are effective for receivers at or near ground level (e.g. outdoor recreation areas and single story dwellings) and not so effective for higher receivers overlooking the sites. The indicative enclosure construction would consist of metal cladding with internal insulation faced with perforated steel sheet or aluminium foil on the walls and roof. Where increased noise insulation is required for the acoustic enclosures, this can be achieved by upgrading the enclosure elements by using, for example, double metal-skin-cladding or masonry construction. The reasonableness of the identified feasible mitigation measures would be assessed during the construction planning and site establishment phases of the project. This assessment will include aspects such as the cost of mitigation, the noise benefit received, the number of receivers protected, the time of day and the duration of the noise emissions.

Having considered all feasible and reasonable noise mitigation as part of the design, the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement) would be implemented to manage the potential noise impacts.

A summary of the recommended site specific noise and vibration mitigation measures to reduce the potential impacts at sensitive receivers is provided in **Table 106**.

Construction Ground-borne Noise

Potential ground-borne noise impacts are likely to be highest at sensitive receiver locations close to the underground stations and the main tunnel alignments. At the station construction sites, shaft and station excavation by rockbreaker, and cavern excavation by roadheaders, are anticipated to operate during the daytime and night-time periods.

Ground-borne noise levels from rockbreakers would exceed the NML by up to and more than 30 dB at the nearest commercial and residential receivers for many of the stations sites where shaft excavations occur. The duration of the excavation of each shaft varies; however, these impacts can be expected for up to six to twelve months at the worst affected properties. These exceedances at night-time would trigger alternative accommodation in accordance with the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement). Where these exceedances are predicted at residential and commercial receivers during the daytime for prolonged durations it has been recommended that alternative accommodation be considered as a mitigation option. A potential alternative to continuous rock breaking for the station shaft excavations is through the use of controlled blasting. When blasting is feasible (at a safe depth) the effective duration of rock breakers required for the station shaft excavations would be significantly reduced.

Roadheaders, which are used to excavate the station caverns, create far less ground borne noise and are unlikely to exceed the NMLs even when the roadheader is located close to sensitive receivers.

The rail tunnels are proposed to be excavated using TBMs. Tunnelling activities are anticipated to occur on 24 hour per day basis, up to 7 days per week. At any particular receiver, the potential ground-borne noise impact from tunnelling is anticipated to occur only for short periods of time when each TBM passes by. Given the progression rate of the TBM (around 20 m per day), it is anticipated that the worst-case ground-borne noise impacts along the majority of the alignment would only be apparent for a relatively short period of time (ie up to approximately four days for each TBM) whilst the tunnelling works are directly beneath a particular receiver. For roadheaders, the rate of progress would be less than for the tunnel boring machines (around 4 m per day), but the overall ground-borne noise levels would be lower.

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Where exceedances of the NMLs are predicted, these would need to be managed or mitigated in accordance with the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement).

Construction Vibration

The effects of vibration in buildings can be divided into three main categories:

- Those in which the occupants or users of the building are inconvenienced or possibly disturbed (human perception or human comfort vibration).
- Those where the building contents may be affected.
- Those in which the integrity of building elements or the structure itself may be prejudiced.

A conservative vibration damage screening (trigger) level of 25 mm/s for reinforced or framed structures (industrial and heavy commercial buildings) and 7.5 mm/s for unreinforced or light framed structures (residential or light commercial type buildings) has been adopted for the project and has been established with reference to the minor cosmetic damage criteria in British Standard BS 7385 Part 2-1993. The vibration levels specified in this standard are designed to minimise the risk of threshold or cosmetic surface cracks, and are set well below the levels that have potential to cause damage to the main structure. The recommended unreinforced structure screening level of 7.5 mm/s is also applicable to heritage structures.

Buildings that are potentially at risk of threshold or cosmetic damage would be identified by the contractor prior to the commencement of construction works. At these locations, impacts will be managed in accordance with the procedures outlined in the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement), which may require building condition surveys to be conducted before the commencement of construction activities and after construction is completed.

Where buildings are located close to vibration generating activities, attended vibration measurements would be undertaken under carefully controlled equipment testing regimes at the commencement of the works to establish environmentally safe operating distances. At some sites, long-term monitoring systems may be required to ensure that vibration levels remain within the established limits.

Buildings are generally far more resistance to vibration than is commonly realised. Humans are far more sensitive to vibration than is commonly realised and can perceive vibration at very low levels and would generally be very uncomfortable at vibration levels well below those that present any risk of structural damage. Human comfort vibration management levels have been established on the basis of the Assessing Vibration - a technical guideline (DEC 2006). During construction, the potential impact of vibration on building occupants will be managed in accordance with the procedures outlined in the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement), which may involve the observance of respite periods, alternative construction methods or attended monitoring.

Blasting is assessed as an option for the excavation works, as noise and vibration impacts are significantly shorter in duration than conventional excavation techniques. Guidance in relation to acceptable overpressure and vibration from blasting is based on recent NSW infrastructure project approvals resulting in a vibration limit of 25 mm/s and overpressure limit of 125 dBL for the project.

A more detailed assessment of the realistic worst-case noise and vibration levels from blasting would need to be undertaken and compared with noise and vibration criteria. Alternative construction methods such as penetrating cone fracture would need to be considered if the predicted noise and vibration levels from blasting exceed the criteria.

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Construction Traffic

The proposed traffic access routes to construction sites is via arterial, sub-arterial or local roads which all have significant daytime flows. The additional daytime construction traffic is not predicted to result in a noticeable change in traffic noise levels on these access routes.

Night-time spoil removal may be required at some sites, however as access is generally via arterial and sub-arterial roads with moderate night-time flows, the additional heavy vehicles movements result in a minor increase in traffic noise levels on the public road network. Whilst the maximum noise levels associated with truck movements exceed the background + 15 dB sleep disturbance screening criterion at most locations, the maximum noise levels will be similar to other heavy vehicles using the public road network. At Chatswood, Crows Nest, and Victoria Cross, site access is via a local road with low night-time flows and a resultant sleep disturbance risk. Unless compliance with the road traffic noise criteria can be achieved, night-time heavy vehicles movements on local roads at these sites would be restricted.

The maximum noise levels associated with on site truck movements can potentially cause awakening reactions (or sleep disturbance) at nearby residences. At each of the TBM and underground station sites, it is anticipated that truck movements would be required during night-time periods. At these sites, with the exception of those in the CBD, maximum noise levels from on site truck movements are predicted to exceed the background + 15 dB sleep disturbance screening criterion at the nearest residences.

Operational Airborne Noise - Surface Tracks

Airborne noise created by train operations on surface track requires the assessment of noise impacts against the noise trigger levels defined in the NSW EPA Rail Infrastructure Noise Guideline (2013). If these trigger levels are exceeded, consideration of noise mitigation for existing sensitive receivers, both at opening and at an indicative time in the future (taken to be 10 years after opening), is required.

The introduction of the new rail lines associated with the project would result in rail tracks being closer to the adjacent receivers than the existing case in some areas. Furthermore, the project would also result in a considerable increase in the total number of trains operating within the rail corridor. In the opening 2024 timeframe the project would more than double the number of trains operating, whilst in the future 2034 timeframe the project would result in an increase of over 108%.

The project proposes to include several noise abatement elements in the base case design. The base case noise mitigation options include rail dampers and deck absorption on slab track in the region of the Chatswood Dive, and increasing the height of existing noise barriers on the up and down sides of the rail corridor at several locations between Nelson Street, Chatswood and Albert Avenue, Chatswood

With the inclusion of the base case mitigation options, noise modelling indicates the potential for exceedances of the noise trigger levels at one sensitive receiver building adjacent the proposed surface track at Chatswood. No exceedances of noise trigger levels are predicted for sensitive receivers surrounding the Marrickville dive structure.

Residual impacts at the multistorey residential apartment building at Chatswood may require consideration of property treatments if detailed design studies determine alternative controls are not feasible and reasonable.

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Operational Ground-borne Vibration

The potential impacts of ground-borne vibration in buildings fall into three main categories: human comfort (disturbance); impacts on building contents; and structural damage. A fourth effect is ground-borne noise generated within buildings as a result of the vibration.

For this project, no potential ground-borne vibration impacts would occur to receivers located beyond an approximate 50 m wide corridor above the centreline of the proposed tunnels (dependent upon the local depth of the tunnel). Ground-borne vibration impacts at sensitive receivers adjacent to the surface track sections associated with the project would typically be limited to less than 10 to 15 m from the surface track, depending on speed.

People can perceive floor vibration at levels well below those likely to cause damage to building contents or affect the operation of typical equipment. The controlling vibration design objectives during operations are therefore the human comfort goals. Ground-borne noise goals tend to result in still more stringent vibration requirements than the human vibration comfort goals, so vibration mitigation measures are normally determined by the ground-borne noise assessment.

Compliance with the ground-borne vibration objectives is predicted for all residential receivers and other sensitive receiver locations above or near to the proposed project alignment.

Operational Ground-borne Noise

Train noise in buildings adjacent to rail tunnels is predominantly caused by the transmission of ground-borne vibration rather than the direct transmission of noise through the air. After entering a building, this vibration may cause the walls and floors to vibrate faintly and hence to radiate noise, which is commonly termed ground-borne or regenerated noise.

Ground-borne noise levels are relevant only where they are higher than the airborne noise from railways, such as when the railway is underground. Therefore, the surface track sections at Chatswood and Marrickville are not prone to ground-borne noise impacts. Some especially sensitive spaces and activities, such as theatres, cinemas, studios and sleeping areas are more prone to disturbance from ground-borne noise than others.

Predictions of ground-borne noise levels have been made for all buildings located above or close to the proposed rail alignments. These predictions consider a range of resilient rail fasteners that can be incorporated in the track design to reduce ground-borne vibration and noise, providing different levels of attenuation. Specific locations are identified where High or Very High Attenuation track instead of the Standard Attenuation track may be required to achieve compliance with the ground-borne noise design objectives.

With the proposed track forms as outlined in **Table 84** ground-borne noise levels are predicted to comply with the design objectives at all residential and other sensitive receiver locations.

Operational Airborne Noise from Stations and Ancillary Facilities

The potential operational noise impacts from stations and ancillary equipment such as substations and ventilation systems have been assessed. The detailed design of these facilities and details of equipment to be used are not available at this stage, and the locations of shafts and service buildings may change during the detailed design stage. The approach to the assessment was therefore to determine allowable noise emissions from stations and ancillary equipment, to inform the detailed design of the project and to provide an early indication on whether the noise criteria are able to be achieved by reasonable and feasible means.

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Mitigation measures are likely to be required for some station and tunnel ventilation equipment in order to comply with the project noise design criteria. Mitigation measures that may need to be considered at some locations include appropriate “quiet” equipment selection, in-duct attenuators, acoustic enclosures and the strategic positioning and direction of ventilation discharges away from sensitive receivers.

Train noise break-out through the draught relief shafts from trains operating within the tunnels is not expected to exceed the noise design criteria. To achieve this outcome, all tunnel exhaust shafts and draught relief shafts near sensitive receivers will require mitigation measures (typically in-duct noise attenuation).

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GLOSSARY

Item	Description / Definition
AADT	Annual Average Daily Traffic (AADT) is the total yearly traffic volume in both directions divided by the number of days in the year
CNS	Construction Noise Strategy
CORTN	Calculation of Road Traffic Noise
DEC	Department of Environment and Conservation (now OEH / EPA)
DECC	Department of Environment and Climate Change (now OEH / EPA)
DECCW	Department of Environment, Climate Change and Water (now OEH / EPA)
DP&I	Department of Planning and Infrastructure
ECRL	Epping to Chatswood Rail Line
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
FEL	Front End Loader
ICNG	Interim Construction Noise Guideline
INP	Industrial Noise Policy
Lidar	Light Detection and Ranging
NML	Noise Management Level
NSW	New South Wales
RBL	Rating Background Level
RING	Rail Infrastructure Noise Guideline
RMS	Root Mean Square
RNP	Road Noise Policy
SEAR	Secretary's Environmental Assessment Requirement
SLR	SLR Consulting Australia Pty Ltd
Sydney Metro CNVS	*Sydney Metro City & Southwest Construction Noise and Vibration Strategy (draft)*
SWL	Sound Power Level
TBM	Tunnel Boring Machine
TfNSW	Transport for NSW

1 INTRODUCTION

1.1 Project Background

Sydney Metro is a new standalone rail network identified in Sydney's Rail Future. The Sydney Metro network consists of Sydney Metro City & Southwest and Sydney Metro Northwest.

The proposed Sydney Metro City & Southwest comprises two core components:

- The Chatswood to Sydenham project (the project), the subject of this technical paper, would involve construction and operation of an underground rail line between Chatswood and Sydenham.
- The Sydenham to Bankstown upgrade would involve the conversion of the 13.5 kilometre Bankstown line to metro standards and upgrade of existing stations between Sydenham and Bankstown.

Both components are subject to assessment by the Department of Planning and Environment and approval by the Minister for Planning under Part 5.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The Sydenham to Bankstown upgrade will be subject to a separate environmental impact assessment.

Sydney Metro Northwest (formerly the North West Rail Link) is currently under construction, services will start in the first half of 2019. This includes a new metro rail line between Rouse Hill and Epping and conversion of the existing rail line between Epping and Chatswood to metro standards.

Investigations have started on the possible extension of Sydney Metro from Bankstown to Liverpool. The potential extension would support growth in Sydney's south west by connecting communities, businesses, jobs and services as well as improving access between the south west and Sydney's CBD. It would also reduce growth pressure on road infrastructure and the rail network, including the potential to relieve crowding on the T1 Western Line, T2 South Line and T2 Airport Line.

The Sydney Metro Delivery Office has been established as part of Transport for NSW to manage the planning, procurement and delivery of the Sydney Metro network.

The Sydney Metro rail network is shown in **Figure 1**.

1.2 The Sydney Metro network

The customer experience underpins how Sydney Metro is being planned and designed. The customer experience incorporates all aspects of travel associated with the transport network, service and project including:

- The decision on how to travel.
- The travel information available.
- The speed and comfort of the journey.
- The range and quantity of services available at stations, interchanges and within station precincts.

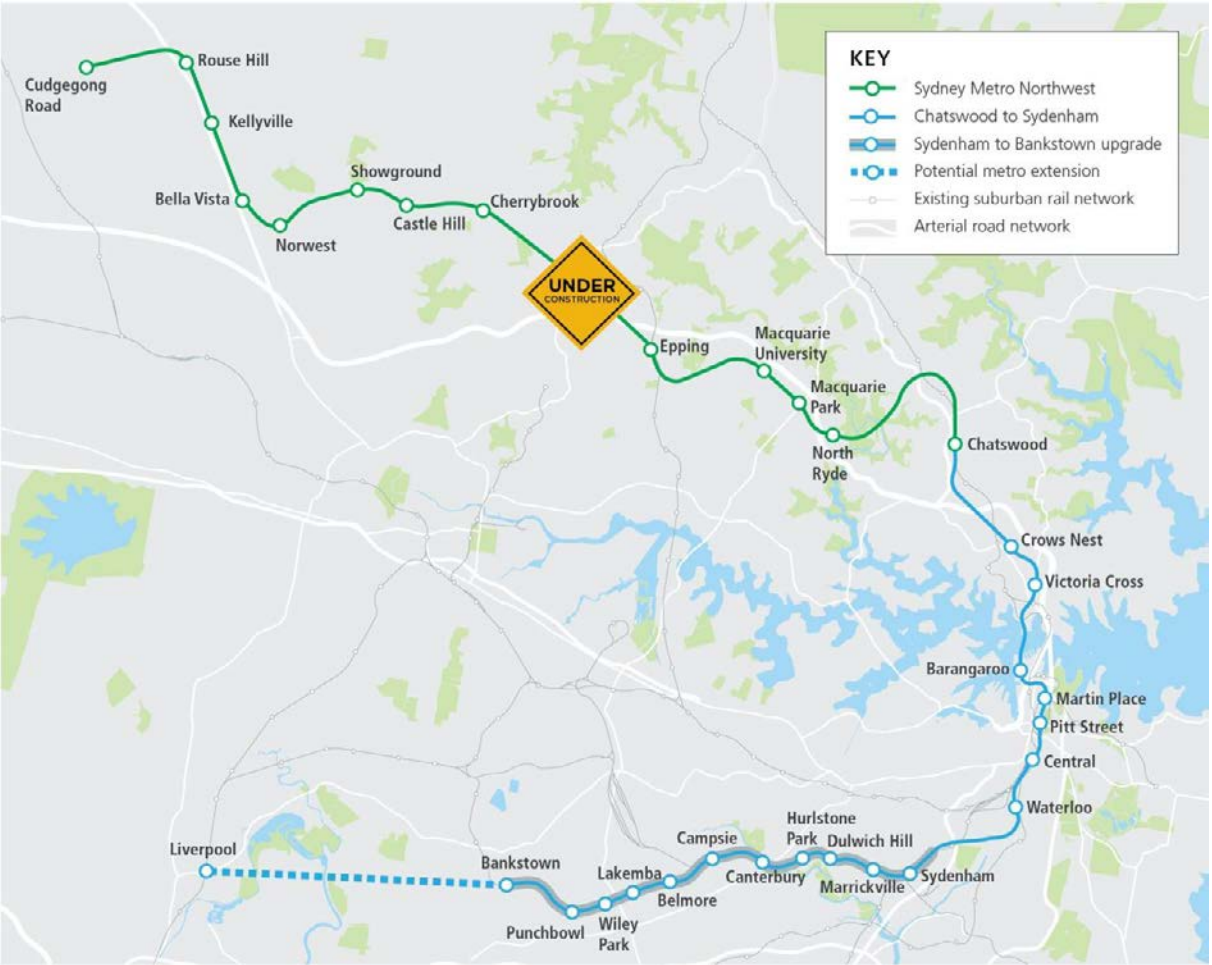
A high quality 'door to door' transport product is critical to attract and retain customers and also to meet broader transport and land use objectives. This includes providing a system that is inherently safe for customers on trains, at stations and at the interface with the public domain; providing direct, comfortable, legible and safe routes for customers between transport modes; and provide a clean, pleasant and comfortable environment for customers at stations and on trains.

Key features of the metro product include:

- Comfortable carriages with space for customers to sit or stand.
- A 'turn-up-and-go' service, with high frequency trains Reduced journey times with faster trains, and new underground routes through the Sydney CBD.
- Increased capacity to safely and reliably carry more customers per hour due to the increased frequency of trains.
- Reduced dwell times at stations as each carriage would be single-deck with three doors, allowing customers to board and alight more quickly than they can with double-deck carriages.

The Chatswood to Sydenham project would have the capacity to run up to 30 trains per hour through the Sydney CBD in each direction, which would provide the foundation for delivering a 60 per cent increase in the number of trains operating in peak periods, and cater for an extra 100,000 customers per hour.

Figure 1 The Sydney Metro network



1.3 Overview of the Project

1.3.1 Location

The Sydney Metro Chatswood to Sydenham project (the project) involves the construction and operation of a metro rail line. The project would be mainly located underground in twin tunnels extending from Chatswood on Sydney's north shore, crossing under Sydney Harbour, and continue to Sydenham.

1.3.2 Key Features

The proposed alignment and key operational features of the project are shown **Figure 2** and would include:

- Realignment of T1 North Shore Line surface track within the existing rail corridor between Chatswood Station and Brand Street, Artarmon, including a new bridge for a section of the 'down' (northbound) track to pass over the proposed northern dive structure.
- About 250 metres of aboveground metro tracks between Chatswood Station and the Chatswood dive structure.
- A dive structure (about 400 metres long) and tunnel portal south of Chatswood Station and north of Mowbray Road, Chatswood (the Chatswood dive structure).
- About 15.5 kilometres of twin rail tunnels (that is, two tunnels located side-by-side) between Mowbray Road, Chatswood and Bedwin Road, Marrickville. The tunnel corridor would extend about 30 metres either side of each tunnel centre line and around all stations.
- A substation (for traction power supply) in Artarmon, next to the Gore Hill Freeway, between the proposed Crows Nest Station and the Chatswood tunnel portal.
- Metro stations at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street and Waterloo; and new underground platforms at Central Station.
- A dive structure (about 400 metres long) and tunnel portal between Sydenham Station and Bedwin Road, Marrickville (the Marrickville dive structure).
- A services facility beside the Marrickville dive structure and tunnel portal, including a tunnel water treatment plant and a substation (for traction power supply).

The project would also include:

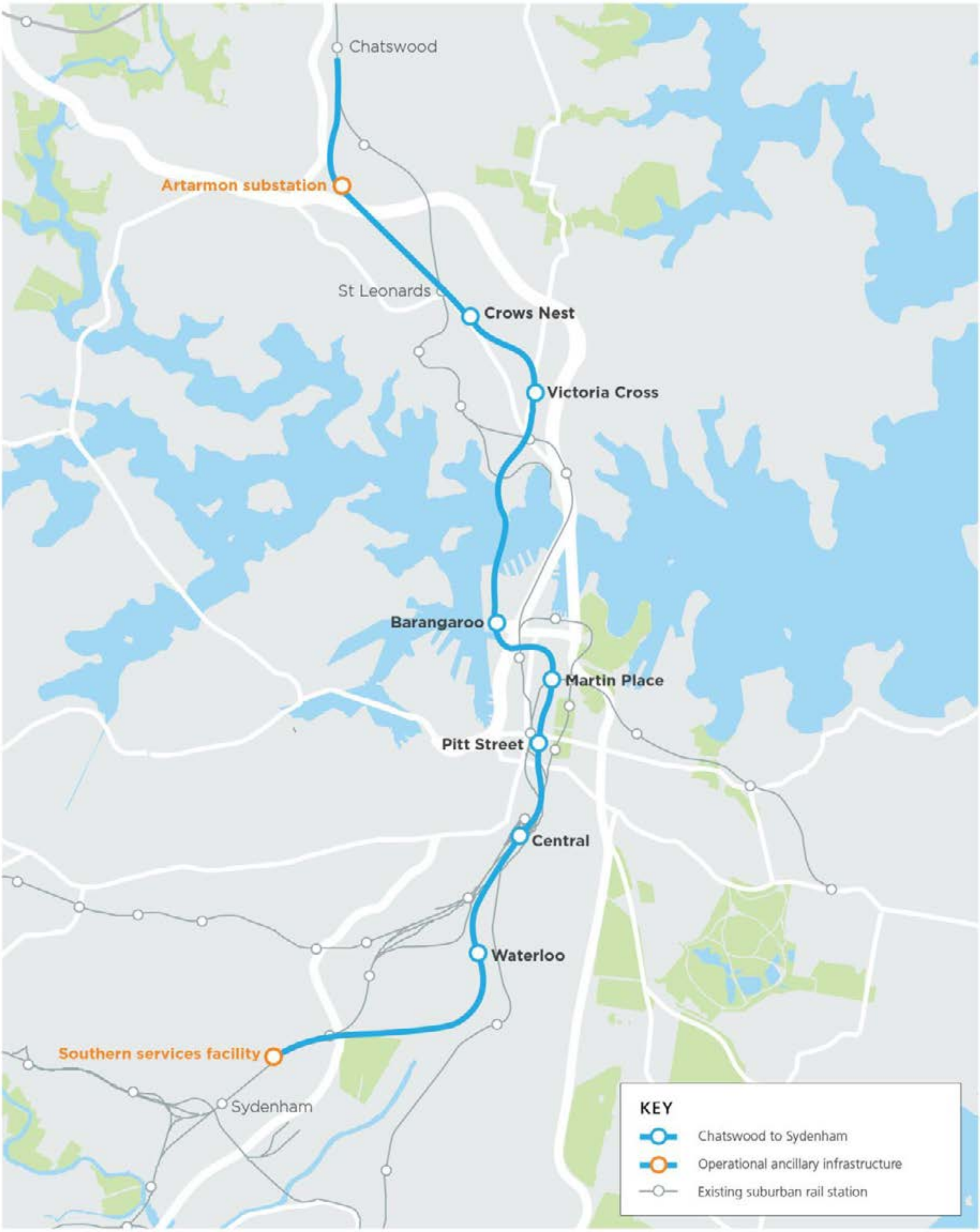
- Permanent closure of the road bridge at Nelson Street, Chatswood, and provision of an all vehicle right-turn movement from the Pacific Highway (southbound) into Mowbray Road (westbound).
- Changes to arrangements for maintenance access from Hopetoun Avenue and Albert Avenue, Chatswood as well as a new access point from Brand Street, Artarmon.
- Underground pedestrian links at some stations and connections to other modes of transport (such as the existing suburban rail network) and surrounding land uses.
- Alterations to pedestrian and traffic arrangements and public transport infrastructure (where required) around the new stations and surrounding Central Station.
- Installation and modification of existing Sydney Trains rail systems including overhead wiring, signalling, rail corridor fencing and noise walls, within surface sections at the northern end of the project.
- Noise barriers (where required) and other environmental protection measures.

The proposed construction activities for the project broadly include:

- Demolishing buildings and structures at the station sites and other construction sites.
- Constructing tunnels, dive structures and tunnel portals.
- Excavating, constructing and fitting out metro stations
- Fitting out tunnel rail systems and testing and commissioning of stations, tunnels, ancillary infrastructure, rail systems and trains.
- Excavating shafts, carrying out structural work and fitting out ancillary infrastructure at Artarmon
- Carrying out structural work and fitting out ancillary infrastructure at Marrickville.

A number of construction sites would be required to construct the project. These include locations for tunnel equipment and tunnel boring machine support at Chatswood, Barangaroo and Marrickville as well as at station sites; a casting yard and segment storage facility at Marrickville and a temporary tunnel boring machine retrieval site at Blues Point.

Figure 2 Project Overview



1.4 Purpose and Scope of this Report

The project has been declared State significant infrastructure and critical State significant infrastructure and therefore is subject to assessment by the Department of Planning and Environment and approval by the Minister for Planning under Part 5.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

This technical paper, *Technical Paper 2: Noise and Vibration* is one of a number of technical documents that forms part of the Environmental Impact Statement. The purpose of this technical paper is to identify and assess the noise and vibration impacts of the project during both construction and operation. In doing so it responds directly to the Secretary's environmental assessment requirements outlined in **Section 1.4.1**.

This technical paper considers the construction and operational noise and vibration impacts on the surrounding noise and vibration sensitive receives.

The assessment of noise and vibration has included:

- Ambient noise and vibration surveys to determine the existing noise and vibration environment within the surrounding environment of the proposal.
- Identification of receivers along the alignment and major construction sites potentially sensitive to noise and vibration.
- Prediction of noise and vibration from the construction and operation of the metro service, including stations and ancillary facilities.
- Assessment of potential noise and vibration impacts in accordance with relevant legislation and guidelines.
- Identification of potential improvement to existing noise environments as a result of the proposal.
- Identification of management and mitigation measures to reduce and control potential impacts where noise and vibration levels are predicted to be above the relevant assessment criteria.

1.4.1 Secretary's Environmental Assessment Requirements

The Secretary's environmental assessment requirements relating to noise and vibration, and where these requirements are addressed in this technical paper, are outlined in **Table 1**.

Table 1 Secretary's Environmental Assessment Requirements - *Noise and Vibration*

Secretary's environmental assessment requirements	Where addressed
8. Noise and Vibration - Amenity Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimise adverse impacts on acoustic amenity. Increases in noise emissions and vibration affecting nearby properties and other sensitive receivers during operation of the project are effectively managed to protect the amenity and well-being of the community. 1. The Proponent must assess construction and operational noise and vibration impacts in accordance with relevant NSW noise and vibration guidelines. The assessment must include consideration of impacts to sensitive receivers including commercial premises, and include consideration of sleep disturbance and, as relevant, the characteristics of noise and vibration (for example, low frequency noise). 2. If blasting is required, the relevant requirements of the Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC 1990) are to be assessed.	Applicable guidelines outlined in **Sections 3.1, 4.2.3, 4.3.3,** and **4.4.2**. Assessment throughout **Sections 3** and **4**. Blasting guideline values are outlined in **Section 3.1.12,** and a consideration and assessment of blasting at each relevant construction site is provided in **Section 3**.
9. Noise and Vibration - Structural Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimise adverse impacts on the structural integrity of buildings and items including Aboriginal places and environmental heritage. Increases in noise emissions and vibration affecting environmental heritage as defined in the *Heritage Act 1977* during operation of the project are effectively managed. 1. The Proponent must assess construction and 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). 2. The Proponent must demonstrate that blast impacts are capable of complying with the current guidelines, if blasting is required.	Applicable guidelines outlined in **Sections 3.1** and **4.1.2**. Assessment throughout **Sections 3** and **4**. Blasting guideline values are outlined in **Section 3.1.12,** and a consideration and assessment of blasting at each relevant construction site is provided in **Section 3**.

1.5 Relevant Guidelines

Noise from the operation of the rail line has been assessed in accordance with guidance provided by the NSW Environment Protection Authority (EPA) in the *Rail Infrastructure Noise Guideline* (RING), NSW EPA, 2013[i].

Noise from mechanical plant at stations and ancillary facilities has been assessed in accordance with the NSW *Industrial Noise Policy* (INP), NSW EPA, 2000[ii], with guidance on sleep disturbance criteria taken from the online Application Notes to the INP.

Construction noise has been assessed in accordance with the *Interim Construction Noise Guideline* (ICNG), DECC, 2009[iii]. Construction road traffic noise has been assessed in accordance with the NSW *Road Noise Policy* (RNP), NSW EPA, 2011[iv].

Vibration from operation and construction has been assessed in accordance with *Assessing Vibration: A technical guideline*, DEC, 2006[v].

1.6 Terminology

The assessment has used specific acoustic terminology; an explanation of common terms is included as **Appendix A**.

Consistent with normal rail terminology, track chainages for the main alignment are referenced to 0 km at Central Station. Down and Up directions refer to trains travelling away from and towards Central Station, respectively consistent with standard transport terminology.

2 DESCRIPTION OF EXISTING ACOUSTIC ENVIRONMENT

The existing noise environment varies along the length of the proposed alignment, as would be expected from the wide range of commercial, urban, residential and industrial land uses within the project area (within approximately 100 m on either side of the alignment and within 200 m of the proposed construction sites).

2.1 Sensitive Receivers

The sensitivity of occupants to noise and vibration varies according to the nature of the occupancy and the activities performed within the affected premises. For example, recording studios are more sensitive to vibration and ground-borne noise than residential premises, which in turn are more sensitive than typical commercial premises.

The sensitivity may also depend on the existing noise and vibration environment. For example, the INP (EPA 2000) and Australian / New Zealand Standard AS/NZS 2107:2000 *'Recommended Design Sound Levels and Reverberation Times for Building Interiors*[vi] (AS 2107) recommend higher acceptable noise levels in urban areas compared with suburban areas. Guidelines produced by the American Public Transit Association (APTA) also nominate higher ground-borne noise goals for multi-family dwellings than for single-family dwellings.

2.2 Sensitive Receiver Categories

The existing and proposed land use within a corridor extending approximately 100 m either side of the proposed rail alignment and typically 200 m from the construction sites was reviewed. This information was collated from a combination of site inspections, street-level imagery and review of aerial photography. Each building was classified into one of the following receiver categories:

1. Commercial
2. Educational
3. Industrial
4. Mixed commercial/residential
5. Residential
6. Place of Worship
7. Child care
8. Special Sensitive (eg hospital, precision laboratories, recording studios)

The noise and vibration assessment presented in this report considers all residential receivers, educational receivers, places of worship, theatres, etc to be of a sensitive nature. Commercial receivers are generally considered to be less sensitive to noise and vibration compared to residential and similar sensitive receivers.

The project area has been divided into multiple Noise Catchment Areas (NCAs). These NCAs reflect the changing land uses and ambient noise environments adjacent to the project. The NCAs and sensitive receivers are illustrated in Appendix C Project Site Plan.

A more detailed description of the nearest sensitive receivers to each major works site is provided in **Section 3.1.2** of this report.

2.3 Ambient Noise Surveys and Monitoring Locations

In order to characterise the existing ambient noise environment across the project area and to establish ambient noise levels on which to base the construction noise management levels, environmental noise monitoring was performed at 25 representative locations during June to July and August to September 2015. This information has been supplemented with ambient noise data collated during the now abandoned CBD Metro project and other recent projects, resulting in a database for a total of 29 representative locations across the project area. The previous ambient noise surveys were conducted in 2009, 2013 and 2014, and whilst the 2009 survey is dated a review of the data and comparison to other Sydney CBD results have indicated valid results.

Noise monitoring locations were selected based on a detailed inspection of all the potentially affected areas and considering the following:

- Other noise sources which may influence the recordings
- Security issues for the noise monitoring devices
- Gaining permission for access to the location from the resident or landowner.

The "potentially most affected" receiver locations near each construction site have been chosen in accordance with the guidelines in Section 3.1.2 of the INP, which is reproduced in part below:

> *"NSW Industrial Noise Policy 3.1.2*
>
> *Most affected location(s) – locations that are most affected (or that will be most affected) by noise from the source under consideration as per Note 2 in Section 2.2.1. In determining these locations, the following need to be considered: existing background levels, noise source location/s, distance from source/s (or proposed source/s) to receiver, and any shielding (for example, building, barrier) between source and receiver. Often several locations will be affected by noise from the development. In these cases, locations that can be considered representative of the various affected areas should be monitored."*

Table 2 lists the various monitoring locations, whilst **Appendix B** illustrates the locations graphically as well as the noise monitoring results.

Table 2 Ambient Noise Monitoring Locations

Location	Address	Project Area	Monitoring Period	Year Collated
B.01	104 Unwins Bridge Road, St Peters	Marrickville dive site	19 June 2015 to 2 July 2015	2015
B.02	322 Edgeware Road, Newtown	Marrickville dive site	31 August 2015 to 3 September 2015	2015
B.03	1B Leicester Street, Marrickville	Marrickville dive site	19 June 2015 to 2 July 2015	2015
B.04	46 Dickson Street, Newtown	Above alignment just north of Marrickville tunnel portal	19 June 2015 to 2 July 2015	2015
B.06	122 Wellington Street, Waterloo	Waterloo Station	31 August 2015 to 13 September 2015	2015
B.09	101 Chalmers Street, Chippendale (Railway Institute)	Central Station	4 September 2015 to 17 September 2015	2015
B.10	8/10 Lee Street, Sydney (YHA Railway Square)	Central Station	19 June 2015 to 2 July 2015	2015
B.11	1 Hoskings Place, Sydney	Martin Place Station	19 June 2015 to 2 July 2015	2015

Location	Address	Project Area	Monitoring Period	Year Collated
B.12	26A High Street, Millers Point (Barangaroo)	Barangaroo Station	1 September 2015 to 13 September 2015	2015
B.13	2-60 Cumberland Street, The Rocks	Sydney Harbour ground improvement works	19 June 2015 to 2 July 2015	2015
B.14	20/30 Blues Point Road, McMahons Point	Blues Point temporary site	31 August 2015 to 15 September 2015	2015
B.15	23 Queens Avenue, McMahons Point	Above alignment south of Victoria Cross Station	19 June 2015 to 1 July 2015	2015
B.16	Unit 3004 / 77-81 Berry Street, North Sydney	Victoria Cross Station	1 September 2015 to 14 September 2015	2015
B.17	12-16 Berry Street, North Sydney	Victoria Cross Station	22 June 2015 to 1 July 2015	2015
B.18	237 Miller Street, North Sydney	Victoria Cross Station	1 September 2015 to 12 September 2015	2015
B.19	420 Pacific Highway, Crows Nest	Crows Nest Station	19 June 2015 to 2 July 2015	2015
B.20	7 Francis Street, Naremburn	Artarmon substation	19 June 2015 to 2 July 2015	2015
B.21	6 Milner Road, Artarmon	Artarmon Substation	1 September 2015 to 12 September 2015	2015
B.22	14 Raleigh Street, Artarmon	Chatswood dive site	31 August 2015 to 13 September 2015	2015
B.23	518 Pacific Highway, Lane Cove North (Chatswood South Uniting Church)	Chatswood dive site	1 September 2015 to 12 September 2015	2015
B.24	14 Nelson Street, Chatswood (Ausgrid)	Chatswood dive site	3 September 2015 to 12 September 2015	2015
B.25	13 Hopetoun Avenue, Chatswood	Surface track south of Chatswood Station	27 August 2015 to 6 September 2015	2015
B.26[1]	812 George Street, Sydney (Christ Church St Laurence)	Central Station	16 April 2009 to 28 April 2009	2009
B.27[1]	260 Pitt Street (Criterion Hotel)	Pitt Street Station	15 April 2009 to 29 April 2009	2009
B.28[1]	56A Pirrama Road, Pyrmont (Wharf 8)	Barangaroo Station	26 August 2014 to 9 September 2014	2014
B.29[1]	Goat Island	Barangaroo Station	18 January 2013 to 4 February 2013	2013

Note 1: Noise monitoring data were taken from SLR's database.

2.3.1 Methodology for Unattended Noise Monitoring

The purpose of the unattended noise monitoring is to determine the existing L_{Aeq}, L_{A90} and other relevant statistical noise levels during the daytime, evening and night-time periods. These were used to assist in determining the appropriate noise management levels for the proposed construction works.

Unattended noise loggers were deployed adjacent to sensitive receivers over a minimum period of one week in order to measure the prevailing levels of ambient noise. The measurements were generally conducted at a height of 1.5 m above the local ground level.

All noise measurement instrumentation used in the surveys was designed to comply with the requirements of Australian Standard AS 1259.2-1990 *'Acoustics - Sound Level Meters. Part 2: Integrating - Averaging*[vii] (AS1259.2) and carried appropriate and current NATA calibration certificates. All noise loggers were fitted with microphone wind shields.

The equipment utilised for the continuous unattended noise surveys are outlined in **Table 3** below.

Table 3 Noise Survey Instrumentation

Location	Equipment	Serial Number
Unattended Noise Monitoring Instrumentation		
B.01	ARL Type 316 environmental noise loggers	16-207-046
B.02	SVANTEK Type 957 noise logger	23816
B.03	SVANTEK Type 957 noise logger	27580
B.04	ARL Type 316 environmental noise loggers	16-306-047
B.06	SVANTEK Type 957 noise logger	23245
B.09	SVANTEK Type 957 noise logger	23244
B.10	SVANTEK Type 957 noise logger	20667
B.11	SVANTEK Type 957 noise logger	23245
B.12	SVANTEK Type 957 noise logger	27578
B.13	SVANTEK Type 957 noise logger	23243
B.14	SVANTEK Type 957 noise logger	20670
B.15	SVANTEK Type 957 noise logger	23816
B.16	SVANTEK Type 957 noise logger	20667
B.17	SVANTEK Type 957 noise logger	23241
B.18	ARL Type 316 environmental noise loggers	16-306-047
B.19	SVANTEK Type 957 noise logger	23241
B.20	SVANTEK Type 957 noise logger	23241
B.21	ARL Type 316 environmental noise loggers	16-306-039
B.22	SVANTEK Type 957 noise logger	20674
B.23	ARL Type 316 environmental noise loggers	16-306-041
B.24	SVANTEK Type 957 noise logger	21884
B.25	SVANTEK Type 957 noise logger	23815
B.26 (2009)	ARL Type 215 environmental noise loggers	193410
B.27 (2009)	ARL Type 316 environmental noise loggers	16-207-048
B.28 (2014)	SVANTEK Type 957 noise logger	23243
B.29 (2013)	SVANTEK Type 957 noise logger	23815
Operator Attended Noise Monitoring Instrumentation		
Various	Brüel & Kjær Type 2270L Sound Level Meter	3004635
Various	Brüel & Kjær Type 2260 Sound Level Meter	2414604
Various	Brüel & Kjær Type 2260 Sound Level Meter	3004636
Various	SVANTEK Type 957 Sound Level Meter	21884
Various	Brüel & Kjær Type 2260 Sound Level Meter	3003632

Location	Equipment	Serial Number
Various	Brüel & Kjær Type 4231 Acoustic Calibrator	2218228
Various	Brüel & Kjær Type 4231 Acoustic Calibrator	2482669
Various	SVANTEK SV30A Acoustic Calibrator	24614

Note: ARL - Australian Research Laboratories.

The calibration of the loggers was checked before and after each measurement survey, and the variation in calibration at all locations was found to be within acceptable limits at all times.

All noise loggers were set to record statistical noise descriptors in continuous 15 minute sampling periods for the duration of their deployment.

The results of the noise monitoring have been processed in accordance with the procedures contained in the INP so as to establish representative sensitive receiver background noise levels.

Weather data recorded during the noise monitoring survey periods by the Sydney Bureau of Meteorology (at Observatory Hill Weather Station for city centre and north of the harbour, and Sydney Airport Weather Station for locations beyond Central station to the south) was used to assist in identifying potentially adverse weather conditions, such as excessively windy or rainy periods, so that weather affected data could be discarded. Based on the meteorological results, rain and wind affected results have been excluded from the results.

2.3.2 Unattended Noise Monitoring Results

The results of the unattended ambient noise surveys are presented in **Table 4**, with the 24 hour average noise level plots for each monitoring location being shown graphically in **Appendix B**.

Representative Rating Background Levels (RBL's) and L_{Aeq} (energy averaged) noise levels during the standard daytime, evening and night-time hours, are shown in **Table 4**.

Table 4 Summary of Unattended Noise Monitoring Results

Location	Noise Level (dBA)[1, 2]					
	Daytime 7:00 am to 6:00 pm		Evening 6:00 pm to 10:00 pm		Night-time 10:00 pm to 7:00 am	
	RBL	LAeq	RBL	LAeq	RBL	LAeq
B.01	59	71	53	69	41	65
B.02	58	69	52	66	38	62
B.03	52	66	43	64	38	58
B.04	47	61	47	59	47	53
B.06	54	65	47	62	39	58
B.09	56	68	53	66	45	64
B.10	51	65	50	64	49	62
B.11	61	66	56	62	52	63
B.12	50	61	45	64	40	51
B.13	62	66	62	65	52	63
B.14	51	62	49	61	40	54
B.15	38	51	38	47	36	45
B.16	65	68	63	65	52	62
B.17	55	61	50	55	44	51

Location	Noise Level (dBA)[1, 2]					
	Daytime 7:00 am to 6:00 pm		Evening 6:00 pm to 10:00 pm		Night-time 10:00 pm to 7:00 am	
	RBL	LAeq	RBL	LAeq	RBL	LAeq
B.18	65	74	57	71	51	66
B.19	59	68	55	67	50	62
B.20	45	56	45 (46)[3]	54	38	50
B.21	49	55	46	50	41	48
B.22	42	55	41	50	34	48
B.23	63	71	60	70	45	67
B.24	50	59	47	58	39	55
B.25	41	54	40	53	35	49
B.26 (2009)	58	70	56	69	52	66
B.27 (2009)	66	71	64	70	61	68
B.28 (2014)	51	56	46	52	41	47
B.29 (2013)	49	55	49	55	41	49

Note 1: The RBL and LAeq noise levels have been obtained using the calculation procedures documented in the INP.
Note 2: In accordance with the INP, where the RBL is found to be less than 30 dBA, then it is set to 30 dBA.
Note 3: Evening RBL reduced to equal daytime RBL in accordance with INP application notes.

2.4 Operator Attended Train Passby Measurements

The train passby noise measurements were carried out on 27 October 2014, and on 24 November 2015 at two representative locations in the project area.

The train passby vibration measurements were carried out on 16 October 2014, 27 October 2014 and on 24 November 2015 at three representative locations in the project area.

The operator attended measurements were undertaken at each location for up to four hours. All train passby events during the attended measurements were passenger trains.

The instrumentation used for the attended passby measurements comprised of calibrated Brüel & Kjær Type 2260 and 2250L Sound Level Meters and one Brüel & Kjær Type 4231 Acoustic Calibrator. Calibration of the sound level meters was carried out before, during and after the measurements at each location and no significant calibration drift was noted.

2.4.1 Attended Passby Noise Measurements

The noise measurements captured A-weighted, fast response L_{Amax} and L_{AE} (sound exposure level). One third octave L_{max} measurements were also obtained for each train passby event. The L_{max} values are the maximum levels occurring in each 1/3 octave band during the train passby, and are therefore not necessarily time coincident.

The L_{AE} measurements were commenced as the train noise rose significantly above the background level and were terminated as the train noise approached the background level. In the event that noise from other sources significantly affected the measurement results, the measurement was discarded.

2.4.2 Train Passby Noise Measurement Locations

The attended passby measurements (free-field) were conducted at the locations described in **Table 5**.

Table 5 Train Passby Measurements - Noise Locations

Reference	Line	Chainage (km)	Measurement Dates	Distance to Near Track (m)	Description
N1	T1 North Shore Line	10.740	27/10/2014	7.5	Adjacent to the end of Hawkins Street, Artarmon. Up side of corridor.
N2	T4 Illawarra Line	4.460	24/11/2015	15	Corridor access gate at the end of Murray Street, Marrickville. Up side of corridor.

2.4.3 Attended Passby Noise Levels

Table 6 presents a summary of the measured noise levels at each location. For each track, the average noise levels (L_{AE} and L_{Amax}) have been determined, along with the 95th percentile L_{Amax} levels recorded during the attended measurements. Results for individual train types are not shown in **Table 6**, it is noted that the majority of trains were newer generation trainsets (T, M or A sets), with very few older S, K or C sets.

The passenger train speeds observed during the attended measurements at each location for each track are included in **Table 6**. These speeds were estimated by measuring the passby time with a stopwatch, and observing the number of carriages and the typical carriage lengths. At both locations, typical passenger train speeds are between 55 km/h and 67 km/h.

Table 6 Summary of Attended Measured Noise Levels and Average Train Speeds

Location	Track	Distance from track centre (m)	Number of Trains	Average Speed (km/h)	Average L_{AE} (dBA)[1]	Average L_{Amax} (dBA)	95th Percentile L_{Amax} (dBA)
N1	T1 Main Up	7.5	10	55	88	81	85
	T1 Main Down	11.5	8	58	88	83	84
N2	Local Up	15	9	63	82	76	77
	Local Down	19	6	63	78	70	71
	Main Up	23	21	67	76	69	73
	Main Down	27	21	66	75	66	71

Note 1: Logarithmic average.

The NSW Rail Noise Database Stage III Measurements and Analysis - January 2015 (SLR Consulting Report 610.14035-R1) provides a summary of measured noise levels for rolling stock operating in the Sydney network under standard reference conditions. The noise levels shown in **Table 6** have been adjusted to match the reference conditions of 80 km/h speed and 15 m distance, following the guidance provided in the Rail Noise Database. The resulting measured levels are compared with the Rail Noise Database levels in **Table 7**.

Table 7 Comparison of Measured Levels with Rail Noise Database Reference Levels[1]

Location	Track	Measured LAE (dBA)[1]	Measured 95th Percentile LAmax (dBA)	Reference LAE (dBA)	Reference 95th Percentile LAmax (dBA)
N1	T1 Main Up	88	82	S, K, C Sets: 88 T, G Sets: 85 M Sets: 86 A Sets: 84	S, K, C Sets: 85 T, G Sets: 83 M Sets: 86 A Sets: 80
	T1 Main Down	90	84		
N2	Local Up	84	80		
	Local Down	81	77		
	Main Up	79	80		
	Main Down	79	80		

Note 1: All levels have been adjusted to the reference conditions of 80 km/h train speed and 15 m measurement distance.

It can be seen from **Table 7** that the measured LAE noise levels at Location N1 are 2 to 6 dB above the Rail Noise Database levels for newer generation train sets. Measured LAmax noise levels at this location were broadly consistent with the Rail Noise Database.

At location N2, both LAE and LAmax noise levels from trains on the two Local tracks were equal to or less than the reference levels for A set trains, which are the quietest rolling stock type on the network. On the Main tracks at this location the measured LAmax noise levels were also consistent with the reference levels for A Set trains, and the measured LAE noise levels were 5 dB less than the quietest reference levels.

2.4.3.1 Attended Passby Location N1

Measurement Location N1 was 7.5 m from the near (Up) track at approximate chainage 10.740 km. The track in the area was observed to be in good condition (free from audible defects or rail joints).

The rail tracks are located at the top of a ballast mound which is approximately 0.8 m higher than the average cess elevation. The track in this location had an approximate radius of curvature of 1255 m.

Varying levels of flanging was observed on passenger trains travelling in the Down direction with flanging contributing to LAmax levels of up to 84 dBA. Minor wheel flats were observed on some of the trains but were typically not considered to significantly increase the overall passby noise levels.

The duration and level of the flanging events also influenced the LAE noise levels particularly from the Down track. Overall, similar noise levels were observed from trains on both tracks, even though the Down track was further away from the measurement position.

The contribution of flanging noise alone is not thought to be the sole reason for the elevated measured LAE noise levels relative to the rail noise database reference at this location. Rail roughness above the reference levels may also be a contributing factor.

2.4.3.2 Attended Passby Location N2

Measurement Location N2 was 15 m from the near (Up Local) track at approximate chainage 9.710 km. The track condition in the area was observed to be acceptable for acoustic measurements, free from audible defects or rail joints.

Noise levels from passenger train passbys on the Local tracks were observed to be at the lower end of typical levels around the greater Sydney heavy rail network. Noise levels from passenger train movements on the Main tracks were observed to be less than typically observed elsewhere. This indicates that the track condition (rail roughness) for the Up and Down main track in this region is likely to be very good acoustically, compared with typical Sydney passenger heavy rail track.

The observed rail speeds were typically lower than the 80 km/h line speed on all tracks.

The bulk of the rail services were observed to utilise the Main tracks which carried approximately 74% of all train movements. Because the majority of services use the slightly quieter mainline, the L_{Aeq} wayside noise levels in this area are potentially lower than might be expected from the Rail Noise Database reference levels.

L_{Amax} noise levels were generated by wheel flats and occasional flanging. These L_{Amax} events are more typical of operations on the broader network.

2.4.4 Attended Surface Track Passby Vibration Measurements

Attended passby vibration measurements were conducted at two locations adjacent the existing T1 North Shore Line and T4 Illawarra Line.

Measurements undertaken at measurement location V1 were within the T1 North Shore Line rail corridor at the end of Hawkins Street, Artarmon. The track at this location was ballast track with 60 kg/m rail on concrete sleepers.

Measurements undertaken at measurement location V2 were on the boundary of the T4 Illawarra Line rail corridor at the end of Murray Street, Marrickville. The track at this location was ballast track with 60 kg/m rail on concrete sleepers.

The attended passby vibration measurements locations are described in **Table 8**.

Measurements were undertaken at two distances from the track at location V1 (9.7 m and 12.7 m from the near track) and at one location at measurement location V2 (15 m from the near track). Vibration transducers were fixed to hardwood stakes by use of magnetic bases. The stakes were driven into the raw earth to a minimum depth of 200 mm. The measurements were conducted with a Brüel & Kjær Type 2260 vibration level meter and a B&K Type 4370 accelerometers. Calibration of the measurement system was checked before and after each set of measurements and no significant measurement drift was observed.

Table 8 Train Passby Measurements - Vibration Locations

Reference	Chainage (km)	Measurement Date	Distance to Near Track (m)
V1	10.740	27/10/2014	9.7 and 12.7
V2	9.710	24/11/2015	15

2.4.5 Attended Surface Track Passby Vibration Levels

Table 9 presents a summary of the measured vibration levels at each location. For each train type, the average vibration levels (L_{eq} and L_{max}) have been determined. The maximum L_{max} levels recorded during the attended measurements are also shown. Maximum results presented in **Table 9** are unweighted slow-response maximum vibration levels.

Table 9 Summary of Measured Vibration Levels

Location	Distance to track		Train Type	Number of Trains		Average Leq (dB)[1]		Average Lmax (dB)		Maximum Lmax (dB)	
	Up	Down		Up	Down	Up	Down	Up	Down	Up	Down
V1	9.7	13.5	A-Set	7	8	93	90	102	98	105	101
			T-Set	2	1	89	89	98	96	98	96
	12.7	16.5	A-Set	7	8	91	88	99	96	102	101
			T-Set	2	1	88	87	95	93	96	93
V2	15	18.7	A-Set	3	4	100	95	102	101	109	104
			M-Set	2	2	98	96	108	103	110	106
			D-Set	4	-	95	-	101	-	102	-
	22.8	26.4	H-Set	4	4	87	88	94	94	100	94
			M-Set	3	3	88	84	93	91	96	92
			T-Set	14	14	95	93	101	97	104	104

Note 1: Logarithmic average.

3 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

3.1 Construction Noise and Vibration Goals

The ICNG and the TfNSW *Sydney Metro City & Southwest Construction Noise and Vibration Strategy (draft)* (Sydney Metro CNVS)*,* TfNSW, 2015[viii], contain goals for construction noise that are applicable for this proposal.

The following sections outline the noise and vibration goals applicable to the construction of the project.

3.1.1 Construction Noise Metrics

The three primary noise metrics used to describe construction noise emissions in the modelling and assessments are:

$L_{A1(1minute)}$ The typical 'maximum noise level for an event', used in the assessment of potential sleep disturbance during night-time periods. Alternatively, an assessment may be conducted using the L_{Amax} or maximum noise level

$L_{Aeq(15minute)}$ The 'energy average noise level' evaluated over a 15-minute period. This parameter is used to assess potential construction noise impacts.

L_{A90} The 'background noise level' in the absence of construction activities. This parameter represents the average minimum noise level during the daytime, evening and night-time periods respectively. The $L_{Aeq(15minute)}$ construction noise management levels are based on the L_{A90} background noise levels.

The subscript 'A' indicates that the noise levels are filtered to match normal hearing characteristics (A-weighted).

3.1.2 Noise Management Levels for Surface Construction Activities

The ICNG contains a quantitative assessment method which is applicable to new infrastructure projects. Guidance levels are given for airborne noise at residential receivers and other sensitive land uses, including commercial and industrial premises. For residential receivers, guidance in relation to ground-borne noise and sleep disturbance is also provided.

The quantitative assessment method involves predicting noise levels at sensitive receivers and comparing them with the guidance, or management levels. The ICNG sets out a quantitative assessment method involving predicting noise levels at sensitive receivers and comparing them with the proposal specific Noise Management Levels (NMLs) to be established for noise affected receivers. In the event construction noise levels are predicted to be above the NMLs, all feasible and reasonable mitigation and work practices are investigated to minimise noise emissions.

3.1.2.1 Residential Receivers

The ICNG provides an approach for determining $L_{Aeq(15minute)}$ NMLs at residential receivers along the alignment applying the measured $L_{A90(15minute)}$ background noise levels, as described in **Table 10**.

Table 10 Determination of NMLs for Residential Receivers

Time of Day	NML $L_{Aeq(15minute)}$	How to Apply
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	RBL + 10 dBA	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 practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by 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	RBL + 5 dBA	• 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 practice have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1 Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or

predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Note 2 The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Industrial Noise Policy.

Adopting the measured background noise levels in **Table 4**, the NMLs derived for the project are detailed in **Table 11.**

Table 11 Residential Receiver NMLs for Construction

Precinct	NCA	Monitoring Location	$L_{Aeq(15minute)}$ Construction NMLs (dBA)			
			Daytime[1]	Daytime OOH[2]	Evening[3]	Night[3]
Chatswood dive site	NCA01	B.25	51	46	45	40
	NCA02	B.25	51	46	45	40
	NCA03	B.24	60	55	52	44
	NCA05	B.23	73	68	65	50
	NCA04	B.22	52	47	46	39
Artarmon substation	NCA06	B.21	59	54	51	46
	NCA07	B.20	55	50	50	43
	NCA08	B.20	55	50	50	43
	NCA09	B.20	55	50	50	43
Crows Nest Station	NCA10	B.19	69	64	60	55
	NCA11	B.19	69	64	60	55
	NCA12	B.19	69	64	60	55
Victoria Cross Station	NCA13	B.18	75	70	62	56
	NCA14	B.17	65	60	55	49
	NCA15	B.16	75	70	68	57
	NCA16	B.17	65	60	55	49
Blues Point temporary site	NCA17	B.15	48	43	43	41
	NCA18	B.14	61	56	54	45
Sydney Harbour ground improvement work	NCA18	B.14	61	56	54	45
	NCA19	B.29	59	54	54	46
	NCA20	B.12	60	55	50	45
Barangaroo Station	NCA19	B.29	59	54	54	46
	NCA20	B.12	60	55	50	45
	NCA21	B.13	72	67	67	57
	NCA22	B 28	61	56	51	46
Martin Place Station	NCA23	B.11	71	66	61	57
Pitt Street Station	NCA24	B.27	76	71	69	66
Central Station	NCA25	B.26	68	63	61	57
	NCA26	B.09	66	61	58	50
Waterloo Station	NCA29	B.06	64	59	52	44
	NCA31	B.06	64	59	52	44
Marrickville dive site	NCA32	B.02	68	63	57	43
	NCA33	B.03	62	57	48	43
	NCA34	B.01	69	64	58	46

Note 1: Standard construction Daytime is Monday to Friday between 7:00 am and 6:00 pm, Saturday between 8:00 am to 1:00 pm.

Note 2: Out of hours Daytime (DOOH) is Saturday between 1pm and 6pm, and Sunday 8:00 am to 6:00 pm.

Note 3: Evening is between 6:00 pm and 10:00 pm and night-time is between 10:00 pm and 7:00 am.

Where construction would be undertaken during the night-time period the potential for sleep disturbance should be assessed. Sleep disturbance noise goals are discussed in **Section 3.1.5**.

At construction sites where spoil removal and or excavation anticipated to be undertaken during night-time periods, tunnel ventilation fans and other fixed plant are likely to be required to support the TBM or roadheader operations. Diesel generators may also be used to support roadheader operations. At these sites, noise mitigation treatments for the ventilation equipment and other fixed plant such as diesel generators and water treatment plant would be designed to meet the RBLs at the nearest residences.

3.1.2.2 Other sensitive Land Uses

The proposal specific $L_{Aeq(15minute)}$ NMLs for other non-residential noise sensitive receivers from the ICNG are provided in **Table 12**.

Table 12 Noise Management Levels 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
Hospital wards and operating theatres	Internal noise level 45 dBA
Places of Worship	Internal noise level 45 dBA
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dBA
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, e.g. reading, meditation)	External noise level 60 dBA
Community centres	Depends on the intended use of the centre. Refer to the recommended 'maximum' internal levels in AS 2107 for specific uses.

For sensitive receivers such as schools, hospitals and places of worship, the NMLs presented in **Table 12** are based on internal noise levels. For the purpose of this assessment, it is conservatively assumed that all schools, hospitals and places of worship have openable windows. On the basis that external noise levels are typically 10 dB higher than internal noise levels when windows are open, an external $L_{Aeq(15minute)}$ NML of 55 dBA has been adopted.

Other noise-sensitive businesses require separate proposal specific noise goals and it is suggested in the ICNG that the internal construction noise levels at these premises are to be referenced to the 'maximum' internal levels presented in AS 2107. Recommended 'maximum' internal noise levels from AS 2107 are reproduced in **Table 13** for other sensitive receiver types identified within the proposal area.

The ICNG and AS 2107 do not provide specific guideline noise levels for childcare centres. Childcare centres generally have internal play areas and sleep areas. The Association of Australian Acoustical Consultants *Technical Guideline Child Care Centre Noise Assessment* provides criteria for road, rail traffic and industry. The guideline recommends a $L_{Aeq\ (1hour)}$ of 55 dBA for external play areas and $L_{Aeq\ (1hour)}$ of 40 dBA for indoor play areas and sleeping areas. For internal play areas an internal NML of $L_{Aeq(15minute)}$ 55 dBA has been adopted and for sleeping areas, an internal NML of $L_{Aeq(15minute)}$ 40 dBA (when in use) has been adopted.

On the assumption that windows and doors of childcare centres may be opened, an external NML of $L_{Aeq(15minute)}$ 65 dBA for play areas has been applied at the facade and would also be applicable to external play areas. For sleeping areas on the assumption that windows are open, the external NML is $L_{Aeq(15minute)}$ 50 dBA.

Table 13 AS 2107 Recommended Maximum Internal Noise Levels

Description	Time Period	AS 2107 Classification	Recommended "Maximum" Internal L_{Aeq} (dBA)[1]
Hotel	Daytime & Evening	*Bars and Lounges*	50[2,3]
	Night-time	*Sleeping Areas*: - Hotels near major roads	40[4]
Café	When in use	*Coffee bar*	50[2,3]
Bar/Restaurant	When in use	*Bars and Lounges / Restaurant*	50[2,3]
Library	When in use	*Reading Areas*	45[5]
Recording Studio	When in use	*Music Recording Studios*	25[6]
Theatre / Auditorium	When in use	*Drama Theatres*	30[6]

Note 1: Design noise levels specified in AS 2107 internal noise levels

Note 2: Where no external seating has been identified, fixed window glazing and air conditioning is assumed to mitigate high existing ambient noise levels (refer to **Section 1**) and/or control internal noise break-out. A minimum outside-to-inside attenuation of 20 dB is assumed. The internal ICNG noise goal then corresponds to a facade level of 70 dBA.

Note 3: Where an open frontage or outdoor seating area has been identified, the external noise goal is taken as 60 dBA.

Note 4: Hotels (sleeping areas during the night-time) are assumed to have fixed window glazing and air conditioning in order to mitigate high existing ambient noise levels (refer to **Section 1**). In this case, a minimum (conservative) outside-to-inside attenuation of 20 dB can be assumed, meaning that the internal ICNG noise goal criterion would correspond to an external noise level at the building facade of 70 dBA. Hotels outside the City Centre Precinct are conservatively assumed to have open windows with an ICNG noise goal criterion corresponding to an external noise level at the building facade of 60 dBA.

Note 5: Receiver conservatively assumed to have open windows with an ICNG noise goal criterion corresponding to an external noise level at the building facade of 55 dBA.

Note 6: These receivers are typically well insulated from external noise break-in. For the purpose of this assessment, a minimum (conservative) outside-to-inside attenuation of 20 dB can be assumed, meaning that the internal ICNG noise goal criterion would correspond to an external noise level at the building facade of (internal +20) dBA

3.1.2.3 Commercial and Industrial Premises

For commercial premises, including offices, retail outlets and small commercial premises an external NML of $L_{Aeq(15minute)}$ 70 dBA has been adopted. An external NML of $L_{Aeq(15minute)}$ 75 dBA has been adopted for industrial premises. In both land uses, the external noise levels should be assessed at the most affected occupied point on the premises.

3.1.3 Construction Traffic Noise

When trucks and other vehicles are operating within the boundaries of the various construction sites, road vehicle noise contributions are included in the overall predicted $L_{Aeq(15minute)}$ construction site noise emissions. When construction related traffic moves onto the public road network a different noise assessment methodology is appropriate, as vehicle movements would be regarded as "additional road traffic" rather than as part of the construction site.

The ICNG does not provide specific guidance in relation to acceptable noise levels associated with construction traffic. For assessment purposes, guidance is taken from the *NSW Road Noise Policy*[ix] (RNP), DECCW, 2011.

One of the objectives of the RNP is to protect sensitive residential receivers against excessive decreases in amenity as the result of a project by first comparing traffic noise levels with the development, with the following road traffic noise criteria in the RNP:

- Existing freeway / arterial / sub-arterial roads — $L_{Aeq(15hour)}$ 60 dBA day and $L_{Aeq(9hour)}$ 55 dBA night.
- Existing local roads — $L_{Aeq(1hour)}$ 55 dBA day and $L_{Aeq(1hour)}$ 50 dBA night.

Where traffic noise levels from the existing traffic plus the additional traffic generated by the development exceeds the above criteria, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.

In considering feasible and reasonable mitigation measures where the relevant noise increase is greater than 2 dB, consideration would also be given to the actual noise levels associated with construction traffic.

Construction traffic noise impacts on public roads are assessed in **Section 3.4** to **Section 3.15**.

3.1.4 Ground-borne Noise Management Levels

The ICNG provides residential NMLs for ground-borne noise, which are applicable when ground-borne noise levels are higher than the corresponding airborne noise levels. The ICNG provides ground-borne noise levels at residential receivers for evening and night-time periods only, as the objectives are to protect the amenity and sleep of people when they are at home. The following ground-borne noise levels are applicable for residential receivers:

- Daytime $L_{Aeq(15minute)}$ 45 dBA
- Evening $L_{Aeq(15minute)}$ 40 dBA
- Night-time $L_{Aeq(15minute)}$ 35 dBA.

For other sensitive receivers such as education institutions, hospital wards and operating theatres and place of worship the internal the ICNG does not provide guidance in relation to acceptable ground-borne noise levels. However, the internal NML's provided in the ICNG for these receivers have been adopted in order to assist in identifying potential impacts.

For commercial receivers such as offices and retail areas, the ICNG does not provide guidance in relation to acceptable ground-borne noise levels. An internal NML of $L_{Aeq(15minute)}$ 50 dBA has been adopted in order to assist in identifying potential impacts. The NML has been based on the ICNG external NML of 70 dBA, and that commercial premises have windows closed and would provide typically 20 dB of noise reduction from outside to inside. The internal ground-borne NML of $L_{Aeq(15minute)}$ 50 dBA thus equals the expected internal noise level resulting from the external airborne NML of $L_{Aeq(15minute)}$ 70 dBA.

These NMLs are applicable to residential receivers, other sensitive receivers and commercial receivers located above TBM and roadheader works, and also apply to other construction activities such as rock breaking where ground-borne noise levels are higher than airborne noise levels. This situation may occur at construction sites where airborne noise levels are shielded by noise barriers or other structures, or sensitive areas within residential or commercial buildings which are removed from the airborne noise source.

3.1.5 Sleep Disturbance and Maximum Noise Level Events

The EPA's most recent policy considers sleep disturbance as the emergence of the maximum level ($L_{A1(1minute)}$ or L_{Amax}) above the $L_{A90(15minute)}$ background level at the time. The appropriate screening criterion for sleep disturbance is determined to be a maximum level 15 dB above the RBL, normally during the night-time period (10:00 pm to 7:00 am).

The EPA reviewed research on sleep disturbance in the *NSW Environmental Criteria for Road Traffic Noise*[x] (ECRTN), EPA, 1999, and in the RNP. EPA's most recent publication, the RNP notes "*despite intensive research, the triggers for and effects of sleep disturbance have not yet been conclusively determined*".

The EPA notes in its Application Notes of the INP that the current sleep disturbance screening criterion is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, EPA continues to use it as a guide to identify the likelihood of sleep disturbance. This means that where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.

Some guidance on possible impacts is contained in the RNP which contains a section on sleep disturbance that includes a summary of current literature. This indicates that the main noise characteristics that influence sleep disturbance are the number of noisy events heard distinctly above the background level, the emergence of these events above the background level and the highest (maximum) noise level event.

Notwithstanding, the RNP concludes from the research to date that:

- Maximum internal noise levels below 50 dBA to 55 dBA are unlikely to cause awakening reactions
- One or two events per night, with maximum internal noise levels of 65 dBA to 70 dBA, are not likely to affect health and wellbeing significantly

On the basis of the above guidance, an external sleep disturbance screening criterion of RBL + 15 dB and sleep disturbance NML of L_{Amax} 55 dBA (internal) have been adopted – the latter equates to an external NML of 65 dBA (assuming open windows).

3.1.6 Categories of Construction Vibration

The effects of vibration in buildings can be divided into three main categories; those in which the occupants or users of the building are inconvenienced or possibly disturbed, those where the building contents may be affected and those in which the integrity of the building or the structure itself may be compromised.

3.1.7 Human Comfort Vibration

The EPAs *"Assessing Vibration: a technical guideline"* (DEC, 2006) recommends the use of BS 6472-1992 for the purpose of assessing vibration in relation to human comfort.

British Standard BS 6472-1992 *Guide to evaluation of human exposure to vibration in building*[xi] (BS6472-1992) nominates guideline values for various categories of disturbance, the most stringent of which are the levels of building vibration associated with a "low probability of adverse comment" from occupants.

BS 6472-1992 provides guideline values for continuous, transient and intermittent events that are based on a Vibration Dose Value (VDV), rather than a continuous vibration level. The vibration dose value is dependent on the level and duration of the short-term vibration event, as well as the number of events occurring during the daytime or night-time period.

The vibration dose values recommended in BS 6472-1992 for which various levels of adverse comment from occupants may be expected are presented in **Table 14**.

Table 14 Vibration Dose Value Ranges which Might Result in Various Probabilities of Adverse Comment Within Residential Buildings

Place and Time	Low Probability of Adverse Comment ($m/s^{1.75}$)	Adverse Comment Possible ($m/s^{1.75}$)	Adverse Comment Probable ($m/s^{1.75}$)
Residential buildings 16 hr day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hr night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Note: For offices and workshops, multiplying factors of 2 and 4 respectively should be applied to the above vibration dose value ranges for a 16 hr day.

3.1.8 Structural Damage Vibration

Most commonly specified 'safe' structural vibration limits are designed to minimise the risk of cosmetic damage such as surface cracks, and are set well below the levels that have potential to cause structural damage. Cosmetic damage is very minor in nature, is readily repairable and does not affect the structural integrity of the building.

In terms of the most recent relevant vibration damage goals, AS 2187: Part 2-2006 *'Explosives - Storage and Use - Part 2: Use of Explosives'* [xii] recommends the frequency dependent guideline values and assessment methods given in British Standard BS 7385 Part 2-1993 *'Evaluation and measurement for vibration in buildings Part 2'* [xiii] as they "are applicable to Australian conditions".

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

Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (eg compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

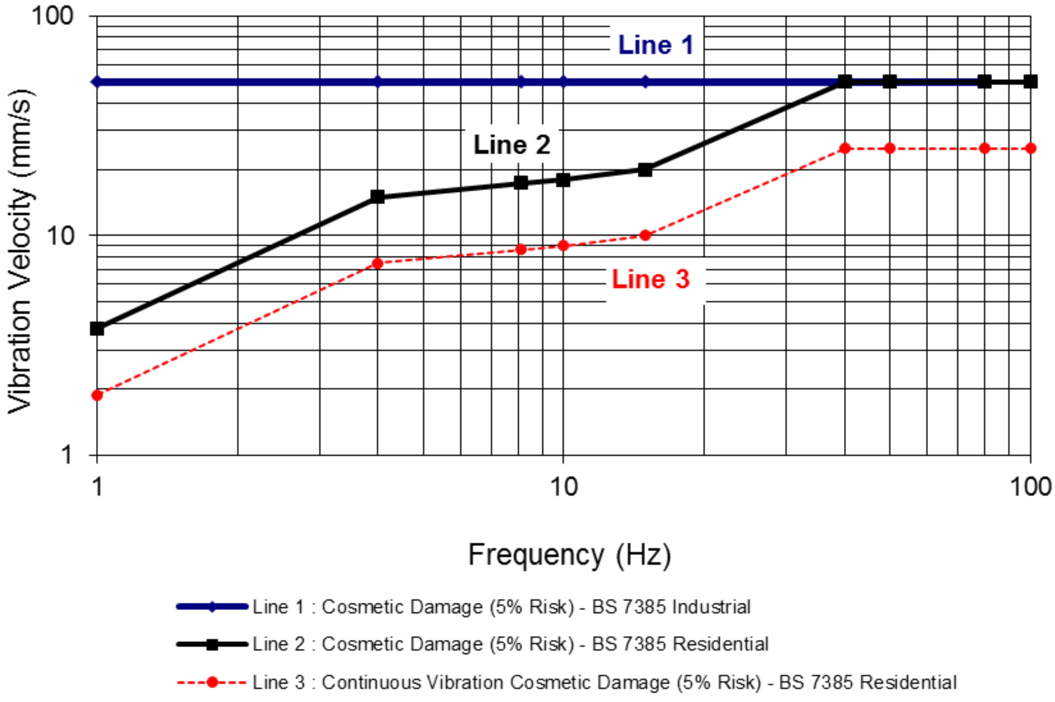
3.1.9 Cosmetic Damage Vibration

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in **Table 15** and graphically in **Figure 3**.

Table 15 Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage

Line	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Figure 3 Graph of Transient Vibration Guide Values for Cosmetic Damage



The Standard goes on to state that cosmetic damage is possible at vibration magnitudes which are greater than twice those given in **Table 15**, and damage to a building structure may occur at values greater than four times the tabulated values.

Fatigue considerations are also addressed in the Standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the guide values in **Table 15** should not be reduced for fatigue considerations.

In order to assess the likelihood of cosmetic damage due to vibration, AS 2187 specifies that vibration measured should be undertaken at the base of the building and the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) should be compared with the guidance curves presented in **Figure 3**.

It is noteworthy that extra to the guide values nominated in **Table 15**, the British Standard states that:

> *"Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. This is not inconsistent with an extensive review of the case history information available in the UK."*

Also that:

> *"A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive."*

3.1.9.1 General Vibration Screening Criterion

The Standard states that the guide values in **Table 15** relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings.

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 in **Table 15** may need to be reduced by up to 50%.

Rockbreaking / hammering and sheet piling activities are considered to have the potential to cause dynamic loading in some structures (eg residences) and it is therefore appropriate to reduce the transient values by 50%.

For construction activities involving intermittent vibration sources such as rockbreakers, piling rigs, vibratory rollers, excavators and the like, the predominant vibration energy occurs at frequencies greater than 4 Hz (and usually in the 10 Hz to 100 Hz range). On this basis, a conservative vibration damage screening level per receiver type is given below:

- Reinforced or framed structures: **25.0 mm/s**
- Unreinforced or light framed structures: **7.5 mm/s**.

At locations where the predicted and/or measured vibration levels are greater than shown above (peak component particle velocity) monitoring should be performed during construction. At these locations a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure would be undertaken to determine the applicable safe vibration level.

3.1.9.2 Heritage

Heritage buildings are to be considered on a case by case bases, as a heritage listed structure may not (unless it is structurally unsound) be assumed to be more sensitive to vibration resulting in application of the 7.5 mm/s screening criterion. Where a historic building is deemed to be sensitive to damage from vibration (following inspection), more conservative superficial cosmetic damage criterion of 2.5 mm/s peak component particle velocity (from DIN 4150) should be considered.

3.1.10 Sensitive Scientific and Medical Equipment

Some scientific equipment (eg electron microscopes and microelectronics manufacturing equipment) can require more stringent objectives than those applicable to human comfort.

Where it has been identified that vibration sensitive scientific and/or medical instruments are likely to be in use inside the premises of an identified vibration sensitive receiver, objectives for the satisfactory operation of the instrument should be sourced from manufacturer's data. Where manufacturer's data is not available, generic vibration criterion (VC) curves as published by the Society of Photo-Optical Instrumentation Engineers (Colin G. Gordon - 28 September 1999) may be adopted as vibration goals. These generic VC curves are presented below in **Table 16** and **Figure 4**.

Table 16 Application and Interpretation of the Generic Vibration Criterion (VC) Curves (as shown in Figure 4)

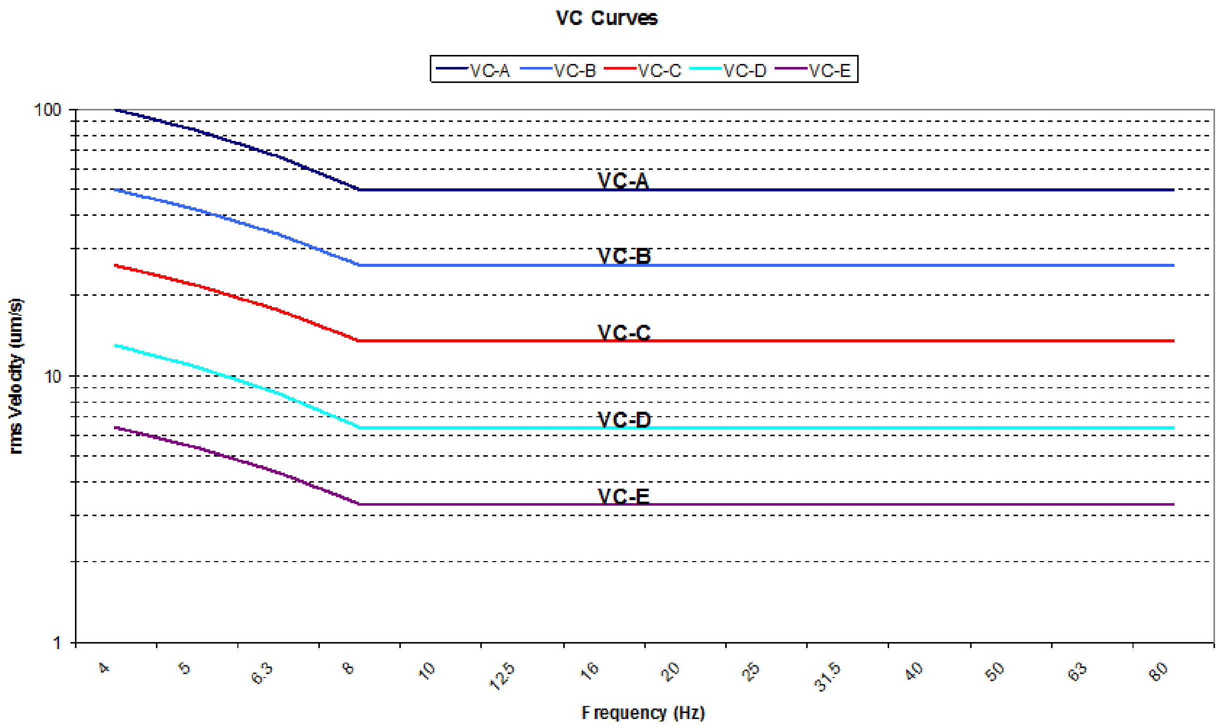
Criterion Curve	Max Level (µm/sec, rms)[1]	Detail Size (microns)[2]	Description of Use
VC-A	50	8	Adequate in most instances for optical microscopes to 400X, microbalances, optical balances, proximity and projection aligners, etc.
VC-B	25	3	An appropriate standard for optical microscopes to 1000X, inspection and lithography equipment (including steppers) to 3 micron line widths.
VC-C	12.5	1	A good standard for most lithography and inspection equipment to 1 micron detail size.
VC-D	6	0.3	Suitable in most instances for the most demanding equipment including electron microscopes (TEMs and SEMs) and E-Beam systems, operating to the limits of their capability.
VC-E	3	0.1	A difficult criterion to achieve in most instances. Assumed to be adequate for the most demanding of sensitive systems including long path, laser-based, small target systems and other systems requiring extraordinary dynamic stability.

Note 1: As measured in one-third octave bands of frequency over the frequency range 8 to 100 Hz.

Note 2: The detail size refers to the line widths for microelectronics fabrication, the particle (cell) size for medical and pharmaceutical research, etc. The values given take into account the observation requirements of many items depend upon the detail size of the process.

Note 3: See Table 46 of Chapter 47 from ASHRAE Sound and Vibration Control Manual for additional equipment items with respect to the VC curves

Figure 4 Vibration Criterion (VC) Curves



3.1.11 Utilities and Other Vibration Sensitive Structures

Where structures and utilities are encountered which may be considered to be particularly sensitive to vibration, a vibration goal which is more stringent than structural damage goals presented in **Section 3.1.6** may need to be adopted. Examples of such structures and utilities include:

- Tunnels
- Gas pipelines
- Fibre optic cables
- Sydney Water retention basin

Specific vibration goals should be determined on a case-by-case basis by an acoustic consultant. The acoustic consultant would be engaged by the construction contractor and would liaise with the structure or utility's owner in order to determine acceptable vibration levels.

3.1.12 Vibration and Overpressure from Blasting

The ICNG recommends that vibration and overpressure from blasting be assessed against the levels presented in the Australian and New Zealand Environment Council's (ANZECC) *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration*[xiv], ANZECC, 1990. This standard is also referenced in the SEARs as per **Section 1.3.2**.

However, the criteria set by the ANZECC standard are targeted for operations that occur for long periods of time such as those at mining sites. Therefore the ANZECC criteria are targeted to protect human comfort from vibration. As a result the vibration levels are conservative and can introduce unnecessary constraints when applied to construction projects, which typically occur for much shorter time periods.

Recent NSW infrastructure project approvals (eg Northconnex) have recognised the restrictive nature of the ANZECC blasting criteria when applied to construction projects and have therefore allowed the following vibration and overpressure limits:

- Vibration (PPV): **25 mm/s**
- Overpressure: **125 dBL**

These upper limits to vibration and overpressure are intended to target the protection of building structures from cosmetic damage rather than human comfort criteria as construction works are considered short-term. Since these criteria are analogous to the cosmetic damage screening criteria it is appropriate to add an additional criteria which is specific to heritage buildings, which are potentially more sensitive to vibration. A vibration (PPV) of 7.5 mm/s would be used to screen potential vibration impacts at heritage buildings.

3.1.12.1 Times and Frequency of Blasting

The recommended hours for blasting are provided in the ICNG and are as follows:

- Monday to Friday (9:00 am to 5:00 pm)
- Saturday (9:00 am to 1:00 pm)
- No blasting on Sundays or public holidays

As part of the detailed construction planning for blasting, an assessment of the realistic worst-case noise and vibration levels would be undertaken and compared with the above noise and vibration criteria. The hours for blasting would be determined based on reducing impacts to receivers and consideration of what is feasible and reasonable, noting in commercial districts for example blasting outside office hours may be preferred. Should the predicted levels exceed the noise or vibration criteria, alternative construction methods may need to be utilised such as penetrating cone fracture.

Penetrating cone fracture involves the energy efficient breakage of rock using a high-pressure gas pulse. The rock is fractured by the introduction of a gas pulse at the base of a short drill hole (usually less than 1.5 m). This technique has been utilised successfully on a number of construction sites in Sydney, including at the Westfield site in Bondi Junction. Penetrating cone fracture potentially offers the ability to conduct excavation works with a reduced impact on the surrounding area when compared to more conventional techniques such as rock breaking.

3.2 Proposed Construction Activities

3.2.1 Overview of Potential Noise and Vibration Impacts during Construction

Construction often requires the use of heavy machinery which can generate high noise and vibration levels at nearby buildings and receivers. For some equipment, there is limited opportunity to mitigate the noise and vibration levels in a cost-effective manner and hence the potential impacts should be minimised by using feasible and reasonable management techniques.

At any particular location, the potential impacts can vary greatly depending on factors such as the relative proximity of sensitive receivers, the overall duration of the construction works, the intensity of the noise and vibration levels, the time at which the construction works are undertaken and the character of the noise or vibration emissions.

3.2.2 Enabling Works

Enabling works are required at construction sites to demolish existing buildings and structures, clear or protect trees, establish a means of heavy vehicle access and provide perimeter site hoarding. In addition, it may be necessary to relocate any above ground and underground services or third party assets. In particular, the provision of high voltage power supplies for the operation of heavy excavation equipment, roadheaders and TBMs is required to be procured early in the project program in readiness for the major tunnel contractor(s).

3.2.3 TBM Launch and Support Sites

TBMs are proposed to be launched at the sites near the tunnel portals at Chatswood and Marrickville as well as from the Barangaroo Station construction site. At each of these sites, TBM support activities would be required to provide tunnel ventilation, supply high voltage (HV) power and extract/stockpile spoil to be removed on the surface via road trucks. TBMs would be retrieved at Barangaroo for the Marrickville launch site, Blues Point for the Chatswood launch site and Blues Point for the Barangaroo launch site.

The highest noise and vibration impacts would take place during the site establishment, demolition and excavation stages. The initial site establishment proposed to occur during standard (daytime) construction hours, however once mitigation measures are in place then works would occur up to 24 hours per day and up to 7 days per week.

When excavation works are being undertaken below ground, the potential noise and vibration impacts would be dependent on the distance between the works, the sensitivity of the receiver type (eg residential, commercial, etc), the times and durations when the noise and vibration occurs and the proposed mitigation and management measures.

Once the TBMs are operational, spoil handling and removal activities would occur up to 24 hours per day and up to 7 days per week. The potential noise emissions from such activities are generated by sources including heavy vehicles, spoil conveyors, loading activities, tunnel ventilation fans, dust collectors, and materials and equipment deliveries. Potential noise impacts may therefore occur at the spoil extraction points where sensitive receivers are located nearby.

For the construction activities that are required to be undertaken outside normal daytime periods, careful attention would be required to manage and mitigate the potential noise and vibration impacts. These are documented in later sections of this report.

At the TBM launch sites the following general activities are proposed:

- Establishment of a site compound
- Excavation of the TBM launch area
- Construction of tunnel construction water treatment plant and water tanks
- Supply of electrical power for TBMs
- Tunnel air ventilation supply and extraction plant
- Assembly and launching of TBMs
- Spoil storage and disposal by road
- Tunnel pre-cast segment lining delivery and storage
- Tunnel grout batching plant

3.2.4 Stations

The Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street and Waterloo stations, and the Central Station metro platforms, would be underground. Following site establishment, the demolition of existing structures and excavation and construction works are proposed to occur up to 24 hours per day and up to 7 days per week. The highest noise and vibration impacts are likely to take place during the initial site demolition and surface excavation works.

For the station sites, construction noise and vibration levels would be similar to those experienced next to typical building sites in the Sydney CBD.

As with the TBM launch sites, when excavation works are being undertaken below ground, the potential noise and vibration impacts would be dependent on the distance between the works, the sensitivity of the receiver type (eg residential, commercial, etc), the times and durations when the noise and vibration occurs and the proposed mitigation and management measures.

Nearby receivers may also be affected by materials and equipment deliveries, spoil removal (if required) and general construction of the station entry points.

At the underground stations, the following general activities are proposed:

- Establishment of a site compound
- Demolition of existing structures
- Excavation of the station and vertical transport shafts
- Spoil storage and disposal by road
- Station construction

Excavation of the station and station shafts is a time critical element of the Metro construction project. Excavation of the stations need to be complete to allow free passage of the TBM machines in order to meet the construction programme.

3.2.4.1 Station Shaft Excavation using Rock Breakers

The worst case scenario for noise and vibration associated with the excavation of the station shafts is when large rock breakers are assumed to be the principal construction activity for excavation. It is highly likely that, no matter which construction approach is finally selected, rock breakers will be required, at least in part, for the excavation of these shafts.

The noise and vibration impacts from rock breakers would vary significantly at each receiver depending on the horizontal and vertical offset distances between the rock breaker and the receiver. However, the worst case noise vibration impacts would always occur when the horizontal and vertical offset distances are at their shortest. For any rock breaking activities during construction this report assesses the worst-case offset distances (shortest) between the rock breaker and receivers.

With respect to rock breaking activities where exceedances of the ground-borne NMLs and human comfort vibration criteria are found, it is the duration of those exceedances that need to be considered when determining the appropriate level of noise mitigation for affected receivers, given the time critical nature of this element of the construction.

The depths at which rock breaking activities will be necessary (due to hardness / strength) of rock are given in **Table 17** below.

Table 17 Approximate Depth of Rock

Station Shaft	Approx Depth of Rock (m)
Crows Nest	15
Victoria Cross - North	0
Victoria Cross - South	0
Barangaroo	5
Martin Place - North	4
Martin Place - South	0
Pitt Street - North	5
Pitt Street - South	5
Waterloo	9

3.2.4.2 Station Shaft Excavation using Blasting

A potential alternative to continuous rock breaking (to reduce ground-borne noise and human comfort vibration exceedances) is to use controlled blasting. However, the blasting criteria (screening for cosmetic damage) as per **Section 3.1.12** means that blasting would only commence at the indicative depths shown in **Table 18** assuming initial charge sizes of 1 MIC (kg) or smaller. As the shafts become deeper (increased offset distances to the receivers) then the charge sizes can be increased while still satisfying the blast criteria.

Table 18 Approximate Initial Depth of Blasting

Station Shaft	Approx Initial Depth of Blasting (m)
Crows Nest	25
Victoria Cross - North	15
Victoria Cross - South	15
Barangaroo	15
Martin Place - North	4
Martin Place - South	15
Pitt Street - North	15
Pitt Street - South	15
Waterloo	15

In all cases blast charges would be carefully monitored to ensure the vibration and blast over-pressure criteria are always satisfied.

The duration and timing of any ground-borne noise and human comfort vibration impacts would be minimal due to blast events. The durations are virtually instantaneous meaning insignificant disturbance from either noise or vibration. Additionally, the events are only expected to occur, at most, once a day, but more likely 2-3 times a week.

In order to excavate the shafts to a depth suitable for blasting, rock breaking would be required. Therefore, using blasting as a potential alternative to rock breaking would not completely eliminate the need for rock breaking. However, the duration of the impacts due to rock breaking would be reduced.

This report provides the worst-case noise and vibration impacts due to rock breaking and discusses the reduction in duration of these impacts through the use of blasting (from the depths identified in **Table 18**).

3.2.4.3 Station Shaft Excavation using Alternative Methodologies

Traditionally, excavation of the stations would be carried out through the use of excavators and rock hammers. Due to the anticipated magnitude and duration of impacts associated with this excavation method, a number of contemporary alternatives were explored. This includes blasting, track sawing, wire cutting, rock bursting / splitting and penetrative cone fracture; or a combination of methods.

Based on the preliminary construction planning carried out for the project, it is unlikely that track sawing, wire cutting, rock bursting / splitting or penetrative cone fracture would be able to achieve the necessary excavation rates in isolation. However, there is potential they could be used to supplement other excavation methods in order to reduce overall construction noise and vibration impacts.

Blasting is likely to result in an overall improvement in the excavation rate and a reduction in the duration, and associated impacts, of rock hammering. In order to achieve compliance with the relevant criteria for blasting, the use of rock hammers would still be necessary until appropriate offset depths are reached.

Based on the above analysis, the preferred excavation method for the stations is a combination of rock hammers, use of excavators and blasting. Due to the location of the metro platforms at Central Station, there are limited residential and commercial receivers which could be impacted by rock hammering works. Additionally, the site is located within a busy transport interchange and heritage precinct. As a result, the preferred excavation method is the traditional use of rock hammers and excavators for this station site.

3.2.5 Concrete Batch Plant and Pre-cast Facility

At the concrete batch plant site the following general activities are proposed:

- Establishment of a site compound
- Construction of batch plant facility
- Operation of batch plant facility

3.2.6 Operational Ancillary Facilities

The proposed ancillary facilities are:

- A traction substation at Artarmon, just north of the Gore Hill Freeway.
- A traction substation and water treatment works adjacent to the Marrickville tunnel portal, which would form part of the construction works at that site.

For the Artarmon facility the proposed construction works would include:

- Mobilisation and earthworks
- Vertical shaft excavation using rock breakers
- Concreting
- Traction substation construction

Works at the ancillary facility sites would be conducted during standard working hours, except for those activities required out of hours, such as the delivery of oversize equipment, etc.

3.2.7 Tunnels

3.2.7.1 Excavation and Construction

Ground-borne (or regenerated) noise in buildings is caused by the transmission of ground-borne vibration rather than the direct transmission of noise through air. For underground excavation works from activities such as rock breaking, TBM and roadheaders, the soil and rock between the construction activities and sensitive receivers does not permit the transmission of airborne noise. Vibration from these sources can however travel through the ground and into nearby buildings and structures. After entering a building, this vibration can cause the walls and floors to vibrate faintly and hence to radiate noise. For some activities such as rock breaking, ground-borne noise may be heard in buildings located around 50 m to 100 m from the tunnelling works.

Whether or not the ground-borne noise levels are intrusive is dependent on a number of factors including the source vibration levels, distance, ground conditions, time of day, the ambient noise levels, duration of the construction works, and the activities undertaken within the building.

As the tunnelling construction works are proposed to occur on a 24 hour per day basis and up to 7 days per week, the ground-borne noise and vibration levels from tunnelling may exceed the management levels at residential receiver locations during the evening and night-time period when people are resting or sleeping. The vibration caused by underground tunnelling equipment can also impact on sensitive equipment such as electron microscopes and precision balancing equipment.

Depending on the rate of the tunnelling progress, the potential impacts of noise and vibration on sensitive receiver are however likely to prevail for only relatively short periods at most locations.

At this stage, TBMs are proposed to be used for the majority of the proposed twin tunnel alignment, with roadheaders and rock breakers proposed to be at stations, stub tunnels and cross passages.

Spoil from underground tunnelling would be required to be brought to the surface and transported to disposal sites via heavy vehicles.

3.2.7.2 Work Trains

The TBMs require regular and frequent deliveries of material and labour to the workface. This could be achieved through the use of work trains, or with conveyor systems and special purpose rubber tyred vehicles. For the purpose of this assessment, the use of works trains has been assumed as it would result in a worst-case noise and vibration assessment.

Work trains are small, specialised locomotive trains on a temporary narrow gauge rail which is laid in the sections of the tunnel leading up to the workface.

Each work train would be required to transport construction related equipment and items such as:

- Construction personnel in a dedicated car
- Service pipes and other consumables on a flat car
- Precast segmental lining (if required) in specialised segment cars

The work trains would be loaded at the TBM launch and unloaded with specialised lifting equipment once they reach the TBM location.

The operating speed of work trains is likely to be up to 10 km/h. Work trains would be required on a 24 hour per day, up to 7 days per week basis to support the underground tunnelling activities. For a particular location, it is anticipated that there would be a maximum of one work train passing by during the worst-case 15 minute period.

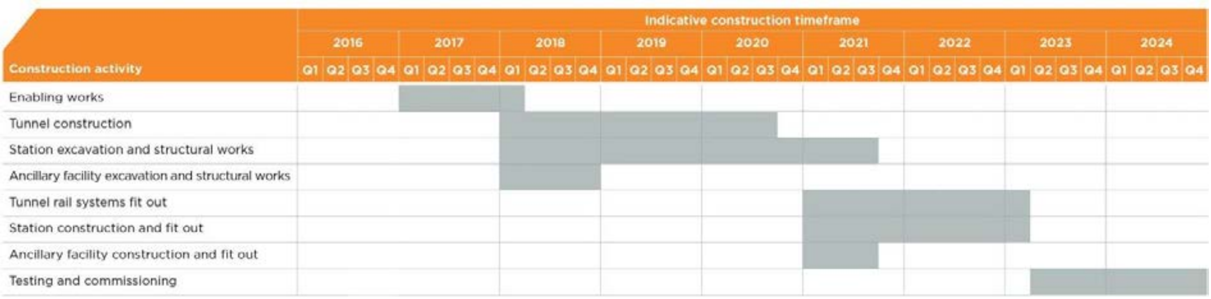
3.2.8 Spoil Transport

Spoil transport would be required from the TBM launch and support sites at Marrickville, Chatswood and Barangaroo. In addition, spoil transport would also be required from the station sites and ancillary sites.

3.2.9 Indicative Construction Program

Enabling works (preliminary construction activities required to facilitate substantial construction) would likely commence in early 2017, with substantial construction of the project planned to commence in early 2018. The total period for major construction would be about seven years, with the project expected to be opened to the public in late 2024. An indicative construction program is shown in **Figure 5**.

Figure 5 Indicative Construction Program



3.2.10 Construction Hours

In accordance with the ICNG standard construction hours are 7:00 am - 6:00 pm Monday to Friday, and 8am to 1pm on Saturdays, with no works on Sundays or Public Holidays.

In addition to standard construction hours, the daytime periods from 1:00 pm to 6:00 pm on Saturday, and Sundays 8:00 am to 6:00 pm are referred to as daytime out of hours (DOOH). Evening is 6:00 pm to 10:00 pm and night-time 10:00 pm to 8:00 am. These time periods correlate to the NMLs developed in accordance with the ICNG.

The proposed construction hours are shown in **Table 19**. These hours have been developed based on a balanced consideration of the construction program and minimising noise and traffic related impacts. As the tunnel boring machines operate continuously, the tunnelling works and associated support activities would need to be carried out up to 24 hours per day and seven days per week. The majority of the station fit-out and other aboveground construction activities would be carried out during the ICNG standard construction hours.

Table 19 Proposed construction hours

Activity	Construction hours	Comments or exceptions
Aboveground construction activities		
Demolition works Station and ancillary facility fit-out and construction (surface works)	ICNG standard construction hours	Surface works supporting underground construction activities (eg concrete pumping, truck loading) would be expected to be required 24 hours per day, up to seven days per-week where noise impact management measures have been established. Non-disruptive preparatory work, repairs or maintenance may be carried out on Saturday afternoons between 1:00 pm and 5:00 pm or Sundays between 8:00 am and 5:00 pm. Activities requiring the temporary possession of roads or to accommodate road network requirements may need to be carried out outside the standard daytime construction hours during periods of low demand to minimise safety impacts and inconvenience to commuters. Activities requiring rail possessions may need to be carried out outside the standard construction hours up to 24 hours per day, seven days per week.
Construction traffic for material supply to and spoil removal from tunnelling and underground excavation (station and ancillary facility sites)	24 hours per day, seven days per week	Restrictions would be in place during peak hours and during special events. At locations where night-time sensitive noise receivers are close to construction sites, significant construction vehicle movements are likely to be restricted during evening and night-time periods.
Underground construction activities		
Tunnelling works	24 hours per day, seven days per week	Activities that support tunnelling may need to occur 24 hours per day, up to seven days per week. Rock hammering in the tunnel between 10:00 pm and 7:00 am would be precluded except where noise impact management measures have been established. Drill and blast, if required, would be carried out during periods anticipated to have the least impact on receivers.

Activity	Construction hours	Comments or exceptions
Underground excavation at station and ancillary sites	24 hours per day, seven days per week	May need to occur outside standard daytime construction hours provided appropriate airborne acoustic mitigation is in place. Drill and blast would be carried out during periods anticipated to have the least impact on receivers.
Tunnel and station fit-out (underground)	24 hours per day, seven days per week	Activities that support tunnel and station fit-out may need to occur 24 hours per day, up to seven days per week.

3.3 Overview of Construction Noise and Vibration Modelling

3.3.1 Construction Airborne Noise Modelling

In order to quantify the likely construction noise emissions, a three-dimensional computer noise model was prepared for each major construction site.

Airborne noise modelling was undertaken using the CONCAWE industrial noise algorithm as implemented in the SoundPLAN Version 7 acoustic modelling software. The model for these sites includes source noise emission levels, ground topography, location of sources and receivers, acoustic shielding provided by intervening ground topography, air absorption, ground effects and the duration of equipment usage within the assessment period. The noise modelling algorithms are consistent with the noise prediction process recommended in Australian Standard AS 2436-2010 *'Guide to noise and vibration control on construction, demolition and maintenance sites'*[xv].

Light Detection and Ranging (Lidar) data was utilised to develop ground topography throughout the project area. Construction site layouts were provided by Transport for NSW.

L_{Amax} sound power levels for equipment assumed in the modelling are presented in **Table 20**. The sound power levels given are maximum noise emission levels of plant that would or may be used on this project in typical operation.

In order to apply the construction NMLs for the project, it is necessary to convert these maximum power levels to equivalent $L_{Aeq(15minute)}$ sound pressure levels.

From numerous field studies on large construction projects, the measured difference values between the L_{Amax} and $L_{Aeq(15minute)}$ noise levels have been found to be up to 10 dB depending on the mixture of the plant, intensity of operation and location of the plant relative to the receiver.

In the present study, where the equipment is generally confined to the TBM launch sites or station construction sites and the receivers are relatively close, typical adjustments of 2 dB to 5 dB have been applied during conversion of the L_{Amax} power levels shown in **Table 20** to $L_{Aeq(15minute)}$ sound pressure levels for comparison with the construction NMLs.

The proposed equipment used at the station sites would be a subset of that presented in **Table 20**, with the station noise models using sound power levels (SWLs) per activity and plant operating loads and cycles, based on the maximum noise levels presented in **Table 20**.

Table 20 Summary of Maximum Sound Power Levels used for Demolition, Excavation and Construction Equipment

Plant Item	LAmax Sound Power Level (dBA)	LAmax Sound Pressure Level @ 7 m (dBA)
Excavator Hammer	122	97
Dump Truck	108	83
Excavator (approximately 20 tonnes)	105	80
Excavator (approximately 30 tonnes)	110	85
Excavator (approximately 40 tonnes)	115	90
Bulldozer (equivalent to D9)	120	95
Front End Loader	111	86
Compactor	105	80
Scraper	110	85
Grader	110	85
Water Cart	108	83
Concrete Saw	118	93
Jackhammer	113	88
Mobile Crane	110	85
Generator	104	79
Bored Piling Rig	110	85
Concrete Pump	109	84
Compressor	105	80
Vibratory Roller	114	89
Water Pump	108	83

Note 1: The sound power levels presented are based on the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement).

Note 2: In accordance with the *Interim Construction Noise Guideline* for activities identified as particularly annoying (such as jack hammering, rock breaking and power saw operation), a 5dB "penalty" is added to the source sound power level when predicting noise using the quantitative method.

3.3.1.1 Modelling of Construction Sites

At the TBM launch sites a large range of activities is likely to occur over the life of the project. Nevertheless, scenarios representative of activities for significant stages producing the typical noise emissions during the project have been modelled. The equipment modelled in each scenario is a subset of that presented in **Table 20,** and based on the indicative plant and equipment lists provided by Transport for NSW.

At the TBM sites, activities representative of the typical noise emissions expected to occur during the project are:

- Enabling works
  Demolition of existing buildings and structures, vegetation clearing, noise wall construction/relocation, site establishment including buildings, spoil handling facilities.
- Surface track works
  Corridor widening, track slewing lifting and re-alignment, bridge removal.
- Earthworks
  Initial excavation, tunnel dive piling, tunnel dive excavation, tunnel dive lining, laying tunnel dive track, TBM assemble and launch, tunnelling support.
- Acoustic shed construction.

- Tunnelling and excavation with shed.
- Spoil removal by heavy vehicle.
- Fitout and /or reinstatement works.
- Precast factory included as part of the Marrickville dive site.

At the station sites, activities representative of the typical noise emissions expected to occur during the project are:

- Enabling works
  Demolition of existing buildings and structures, vegetation clearing, noise wall construction/relocation, site establishment including buildings, spoil handling facilities.
- Earthworks
  Initial excavation, piling works.
- Acoustic shed construction.
- Excavation of the station shafts using excavators, bulldozers, rock breakers and other construction plant.
- Excavation of the station cavities using roadheaders, bulldozers, rock breakers and other construction plant.
- Spoil removal by heavy vehicle.
- Station construction
  Including concrete trucks, concrete pumps and concrete vibrators.

At the ancillary sites, activities representative of the typical noise emissions expected to occur during the project are:

- Enabling works
  Demolition of existing buildings and structures, vegetation clearing, noise wall construction/relocation, site establishment including buildings, spoil handling facilities.
- Earthworks
  Initial excavation, piling works.
- Excavation using excavators, rock breakers and other construction plant.
- Spoil removal by heavy vehicle.
- Building construction, including concrete trucks, concrete pumps and concrete vibrators.

At the Sydney Harbour ground improvement site, activities representative of the typical noise emissions expected to occur during the project are:

- Grout barge.

During most construction activities on the construction sites, for any given receiver the received noise level would depend on the location of the equipment. For example, during site establishment, noise levels would be higher when earthmoving equipment is operating on the nearest part of the site, and lower when the equipment is operating on the far side of the site.

Consistent with the requirements of the ICNG, the construction noise impacts are based on a worst-case assessment corresponding to equipment operating on the nearest part of the site. The guideline recommends that the realistic worst-case or conservative noise levels from the source should be predicted for assessment locations representing the most noise-exposed residential receivers or other sensitive land uses. For each construction site, residential receivers and other sensitive receivers have been grouped together into receiver areas or 'catchments', which comprise those receivers which would experience a similar level of construction noise. For each receiver area the noise levels are predicted at the most noise-exposed location, which would usually be the closest receiver.

For most construction activities, it is expected that the construction noise levels would be lower than predicted at the most-exposed receiver - as the noise levels presented in this report are based on a realistic worst-case assessment.

Furthermore, other receivers within each receiver area would generally experience lower noise levels compared with the most noise-exposed location. To provide an indication of the likely reduction in construction noise levels, the following can be assumed:

- A doubling of the distance between the source and receiver would provide an approximate 6 dB reduction in noise level. For example the sound pressure levels presented in **Table 20** would decrease by typically 6 dB as the distance increases to 15 m and by 12 dB as the distance increases to 30 m.
- Buildings and other solid structures located between the construction noise source and sensitive receivers would act as a barrier and typically reduce the noise level by up to 15 dB. For example in a residential area adjoining a construction site the first row of houses would provide an effective shield to the second and subsequent rows with resulting noise levels up to 10 dB lower than experienced in the first row due to screening effects.

3.3.2 Noise Mitigation

3.3.2.1 Barriers

For the TBM and station sites there are negligible existing barriers between the proposed sites and noise sensitive receivers, therefore it is anticipated that the construction of minor to major noise barriers would result in the following reductions in noise levels:

- Minor barrier (hoarding indicative height ~ 3 m) 5 dB to 10 dB reduction
- Moderate barrier (hoarding indicative height ~ 6 m) 10 dB to 15 dB reduction
- Major barrier (enclosure or acoustic shed) 15 dB to 25 dB reduction.

Correctly designed and constructed barriers (of solid construction using appropriate materials, such as 25 mm timber without gaps) would be expected to result in reductions at the upper end of the range provided. For the calculations at nearby receivers "mid-range" noise reductions of 8 dB, 13 dB and 20 dB have been assumed for the minor, moderate and major barriers, respectively.

The (hoarding) noise barriers are effective for receivers at or near ground level (e.g. single storey dwellings) - they would however not attenuate noise at elevated receivers "overlooking" the construction sites. The use of noise barriers, and in particular site enclosures, is often not feasible prior to completion of the demolition phase of the works.

For all sites operating on a 24 hour per day basis, and/or where residential receivers are close to rockbreaker excavation a 'default' three metre site perimeter solid timber fence has been assumed in the calculations. However, in practice the same noise outcome at the receivers could be achieved through a range of mitigation measures and barrier heights.

3.3.2.2 Acoustic Sheds

Spoil removal would be required during the night at sites supporting TBMs and roadheaders, and acoustic sheds have been assumed. Typically the activities modelled inside the sheds include spoil transport using either a gantry bucket system or conveyor with a front end loader used to organise spoil in the shed. The front end loader would also be used to load trucks via a roller door or similar, which would be kept closed during night-time loading.

For all the station sites (except Central due to the complexity of constructing an effective acoustic shed over the works) acoustic sheds have been assumed as 24/7 station excavation may be required. However, the same noise outcome may be achieved through alternative means, such as acoustic panels over the station excavations. The specific noise mitigation measures would be determined during detailed construction planning taking into account construction program, construction working hours and construction traffic management in accordance with the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement)

The indicative acoustic shed construction would consist of metal cladding with internal insulation faced with perforated steel sheet or aluminium foil on the internal walls and under the roof. Doors that do not compromise performance would be required with no gaps when closed. All ventilation would be required to be designed to maintain the integrity of the shed, which indicatively would require attenuators for supply and return air systems.

Where increased noise insulation is required, this can be achieved by upgrading the enclosure elements by using, for example, a double skin construction with insulation, or masonry construction.

3.3.3 Construction Ground-borne Noise and Vibration Modelling

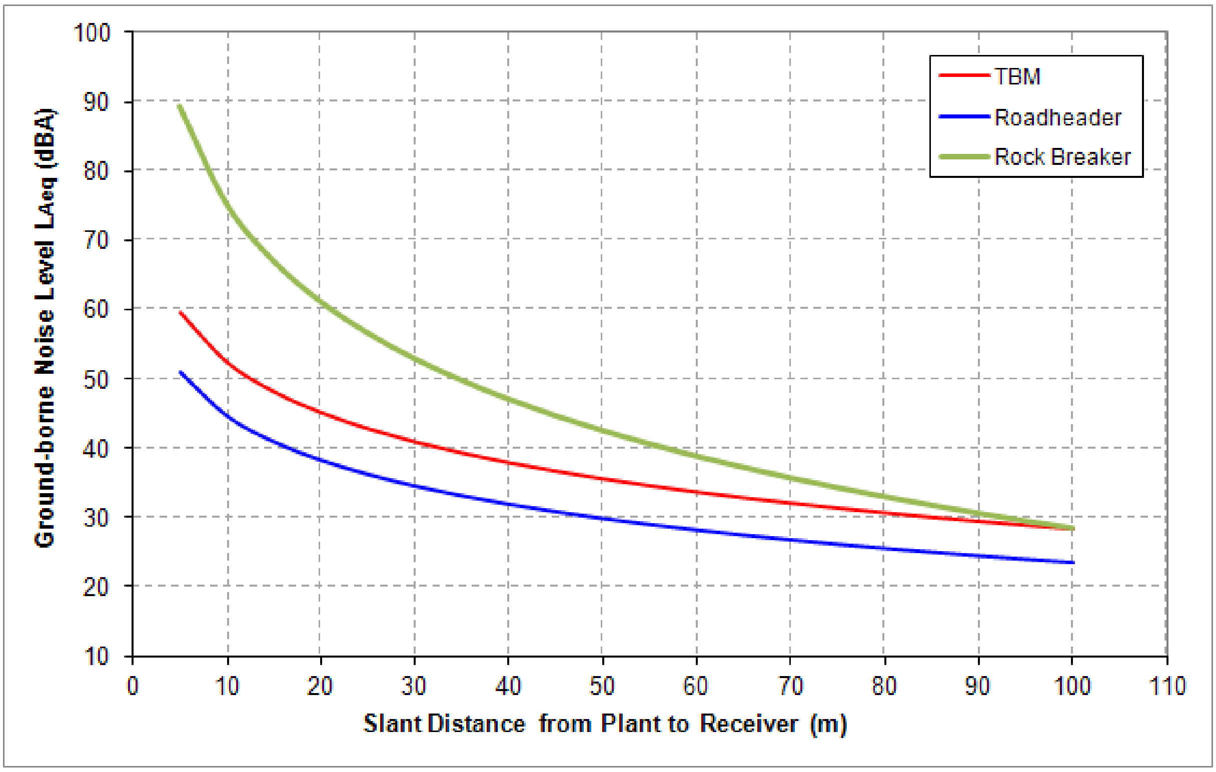
Humans are more sensitive to ground-borne noise than to vibration – in other words humans tend to *hear* vibration before they *feel* vibration. This means that if the ground-borne noise criteria are exceeded then the human comfort criteria for vibration would also be exceeded. This report has taken a conservative approach by assessing ground-borne noise impacts to determine exceedances of the NMLs and therefore any requirements for mitigation.

Ground-borne noise and vibration impacts at the various sensitive receivers near to the proposed tunnelling works and construction sites have been predicted using a three-dimensional model which uses the receiver location and elevation data together with the horizontal and vertical information supplied for the project alignment.

Figure 6 presents indicative ground-borne noise levels for TBMs, roadheaders and rock breakers as measured on other Sydney tunnelling projects. As the figure demonstrates, ground-borne noise levels reduce as the distance between plant and the receiver increases. SLR database vibration attenuation with distance curves have also been used to calculate ground vibrations due to these sources.

Underground works and station excavations would be typically conducted 24 hours per day; seven days per week, including in-tunnel rail fitout works.

Figure 6 Indicative Ground-borne Noise Levels from TBMs, Roadheaders and Rock Breakers



Note 1. The rockbreaker ground-borne noise curve is for a 'heavy' rockbreaker.

Source: TBM and roadheader data is from *Australian Acoustical Society Technical Meeting – Tunnelling Noise and Vibration Management*, Wilkinson Murray, December 2003. Rock breaker data was obtained from SLR Consulting's noise database.

The ground-borne noise and vibration model calculates the three-dimensional slant distance from the works to each sensitive receiver situated above the project alignment. An additional offset distance of 5.8 m from the mean rail height to the tunnel crown has been incorporated into the model for the ground-borne noise calculations for TBMs and roadheaders.

3.3.4 Construction Traffic Noise Modelling

The calculation of traffic noise on public roads for comparison with the criteria presented in **Section 3.1.3** has been performed using two modelling methods. The models used are Calculation of Road Traffic Noise (CORTN), which has the advantage of having been specifically validated under Australian conditions, and the L_{Aeq} calculation based on the US Environmental Protection Agency - Report 550/9-74-004 (1974). The L_{Aeq} calculation has also been used as it is recognised that the CORTN algorithms are not valid for low traffic flows. The models predict traffic noise levels at the receiver based on traffic volumes, percentage of heavy vehicles, vehicle speed and distance to the receiver.

3.4 Chatswood Dive Site and Northern Surface works

3.4.1 Site Layout and Proposed Construction Works

An aerial photograph of the proposed Chatswood dive site and the surrounding receiver areas is provided in **Figure 7** with the nearest noise sensitive receivers identified in **Table 21**.

Figure 7 Chatswood Dive Site and Receiver Areas

Table 21 Nearest Noise Sensitive Receivers - Chatswood Dive Site

Receiver Area	Location Relative to Works (m)[1]
A - Church to the south west on the Pacific Highway	83
B - Residential receivers to the west on the Pacific Highway	18
B - Commercial receivers to the west on the Pacific Highway	20
C –- Residential receivers to the north on Nelson Street	10
C - Commercial receivers to the north on Nelson Street	8
C - Active Recreation to the north, west of the railway line	12
D - Active Recreation to the north, east of the railway line	34
D - Residential receivers to the east, east of the railway line	6
E - Residential receivers to the east, east of the railway line	24
F - Residential receivers to the south on Mowbray Road	12
F - Commercial receivers to the south on Mowbray Road	111
F - Industrial receivers to the south on Mowbray Road	67

Note 1: The relative distance to works shown is that from the nearest sensitive receiver to the closest location of construction activity.

3.4.2 Site Specific Construction Noise Management Levels

With reference to the ambient noise survey results summarised in **Table 4**, the site specific construction NMLs are presented in **Table 22**.

Table 22 Chatswood Dive Site Noise Management Levels

Receiver Area	Receiver Type	Relevant Monitoring Location	$L_{Aeq(15minute)}$ Construction NMLs (dBA)			
			Daytime	Daytime OOH	Evening	Night-time
A	Church	B.23	55	55	n/a	n/a
B	Residential	B.23	73	68	65	50
B	Commercial	B.23	70	70	n/a	n/a
C	Residential	B.25	51	46	45	40
C	Commercial	B.25	70	70	n/a	n/a
C	Active Recreation	B.25	65	65	n/a	n/a
D	Active Recreation	B.25	65	65	n/a	n/a
D	Residential	B.25	51	46	45	40
E	Residential	B.22	52	47	46	39
F	Residential	B.23	73	68	65	50
F	Commercial	B.23	70	70	n/a	n/a
F	Industrial	B.23	75	75	n/a	n/a

3.4.3 Airborne Noise Assessment at the Nearest Noise Sensitive Receivers

Scenarios were developed for the daytime, evening and night-time periods, to be representative of activities having potentially the greatest noise impact on the surrounding receivers. These scenarios have been developed to be a subset of those discussed in **Section 3.3.1.1**, and are:

- Enabling works including mobilisation and demolition (12 months)
- Track works (periodic over about four and a half years)
- Earthworks which consist of initial excavation, tunnel dive piling, tunnel dive excavation, tunnel dive lining, laying tunnel dive track (12 months)
- Acoustic shed construction (one month)
- Tunnelling and excavation with shed (18 months)
- Fitout (18 months)

Calculations of the typical $L_{Aeq(15minute)}$ noise level exceedances of the NMLs at the nearest noise sensitive receivers are provided in **Appendix D** and are summarised in **Table 23**. The 'sleep' column of the table provides the predicted exceedance of the sleep disturbance screening noise level.

Note that for night-time construction, preliminary modelling indicated that an acoustic shed would be required and was included in the tunnelling and fitout scenarios.

Table 23 Predicted Noise Level Exceedances at Chatswood Dive Site

Receiver Area	Scenario													
	Enabling Works	Track Works	Earthworks	Acoustic Shed Construction	Tunnelling with Shed					Fitout				
	Day	Day	Day	OOHD	Day	OOHD	Eve	Night	Sleep	Day	OOHD	Eve	Night	Sleep
A – Church to the south west on the Pacific Highway	2	2	1	0	1	0	0	0	0	0	0	0	0	0
B – Residential receivers to the west on the Pacific Highway	2	0	0	0	0	0	0	1	0	0	0	0	0	0
B – Commercial receivers to the west on the Pacific Hwy.	2	0	0	0	0	0	0	0	0	0	0	0	0	0
C – Residential receivers to the north on Nelson Street	3	3	3	1	3	1	1	2	1	0	0	0	1	0
C – Commercial receivers to the north on Nelson Street	3	3	2	0	1	0	0	0	0	0	0	0	0	0
C – Active Recreation to the north, west of the railway line	3	3	2	0	1	0	0	0	0	0	0	0	0	0
D – Active Recreation to the north, east of the railway line	1	2	1	0	0	0	0	0	0	0	0	0	0	0
D – Residential receivers to the east, east of the railway line	3	3	3	1	3	0	1	2	0	0	0	0	0	0
E – Residential receivers to the east, east of the railway line	3	3	3	1	2	1	1	2	1	0	0	0	1	0
F – Residential receivers to the south on Mowbray Road	3	3	3	1	3	2	2	2	1	0	1	1	1	0
F – Commercial receivers to the south on Mowbray Road	1	1	0	0	0	0	0	0	0	0	0	0	0	0
F – Industrial receivers to the south on Mowbray Road	1	1	1	0	0	0	0	0	0	0	0	0	0	0

Legend

Category 0	Category 1	Category 2	Category 3
NML Compliance	NML exceedance of less than 10 dB	NML exceedance of between 10 dB and 20 dB	NML exceedance of more than 20 dB

Discussion

The preliminary findings of the construction noise impact assessment at Chatswood indicate:

- The predicted noise levels for enabling works indicate high exceedances of more than 20 dB of the NMLs at residential receivers in Area C, D, E and F and at the commercial receivers and active recreation of in Area C. Moderate exceedances of more than 10 dB are predicted for the church in Area A, and at the residential and commercial receivers in Area B. Minor exceedances are predicted at the active recreation Area D. These are a direct result of the relative close proximity of receivers to the construction activities and the absence of any appreciable shielding between sites and receivers.
- During track works predicted noise levels indicate high exceedances of more than 20 dB of the NMLs at residential receivers in Area C, D, E and F and at the commercial receivers and active recreation of Area C. Moderate exceedances of more than 10 dB are at the church and at the active recreation Area D.

- During earthworks predicted noise levels indicate high exceedances of more than 20 dB of the NMLs at residential receivers in Area C, D, E and F. Moderate exceedances of more than 10 dB are at the commercial receivers in Area C and at the active recreation Area C.
- Minor exceedances of less than 10 dB are predicted during acoustic shed construction.
- During tunnelling with an acoustic shed there is a high exceedance of the NMLs by more than 20 dB at the residential receivers in Area C, D, and F, and a moderate exceedance in Area E during the daytime, from activities outside the shed. During the night-time there are moderate exceedances of more than 10 dB at the residential receivers in Area C, D, E, and F, and minor exceedances in Area B. An acoustic shed with higher noise insulation would be required to reduce night-time non compliance.
- During fitout compliance is predicted during daytime and evening, with minor exceedances at residences in Areas C and F.

On Site Night-Time L_{Amax} Truck Noise

The maximum noise levels associated with on-site truck movements, deliveries by semitrailer and other activities on site can potentially cause awakening reactions (or sleep disturbance) at nearby residential receivers. The L_{Amax} noise levels associated with these events exceed the sleep disturbance screening level during tunnelling with an acoustic shed. During the detailed design night-time ‘on site’ traffic routes and activities should be reviewed and/or additional mitigation considered, such as increased site perimeter hoarding height.

3.4.4 Ground-borne Noise and Human Comfort Vibration Assessment

Where ground-borne noise exceedances are identified then human comfort vibration exceedances would also be present. **Appendix F** illustrates the potential ground borne noise impacts due to vibration intensive construction activities (rock breaking) in this area. In summary the analysis for daytime (no track works are proposed for night-time) indicates:

- Three (3) residences, located to the east of the dive structure, have exceedances of the NML of 20 dB to 25 dB.
- A further seven (7) residences, located to the east and west of the dive structure, have moderate exceedances of the NML of 10 dB to 20 dB. This includes Mowbray House which would form part of the construction site but be retained.
- Minor exceedances of up to 10 dB are predicted at nine (9) residences, located to the east and south of the dive structure.
- A single commercial receiver, located to the west of the dive structure, has a moderate exceedance of 10 dB to 20 dB during the day time.

These exceedances are a direct result of the relative close proximity of receivers to the construction activities and the use of large rock breakers.

3.4.5 Vibration Cosmetic Damage Assessment

During construction of the proposed shafts vibration levels are anticipated to remain well below the vibration screening levels associated with minor cosmetic building damage at locations surrounding the works, except for Mowbray House. **Appendix G** illustrates the potential cosmetic damage vibration impacts due to construction activities in this area.

The heritage listed Mowbray House is located on the construction site, and predicted vibration levels for excavation works exceed the 7.5 mm/s vibration screening level. A more detailed assessment of the structure and attended vibration monitoring would be carried out to ensure vibration levels remain below appropriate limits for that structure.

3.4.6 Traffic Noise Assessment

Traffic noise levels have been predicted for residential receivers located on the proposed access route to the Chatswood construction site. In this instance the access to the site is via the Pacific Highway, Mowbray Road and Nelson Street. The Pacific Highway and Mowbray Roads are arterial roads with significant daytime flows, whilst Nelson Street is a local road. The RNP base criteria, predicted $L_{Aeq(15hr)}$ daytime and $L_{Aeq(9hr)}$ nighttime noise levels with the development, and the L_{Aeq} increase and sleep disturbance noise levels have been assessed in **Table 24**.

Table 24 Chatswood Dive Site - Construction Traffic on Public Roads

Access Road	Base Criteria Day/Night ($L_{Aeq(15hr/9hr)}$)	Predicted Road Traffic Noise Day/Night	Predicted Road Traffic Noise Increase (dB)	RBL + 15 dB Screening Criterion (dBA)	External LAmax NML Level (dBA)	Predicted L_{Amax} Noise Level (dBA)
Pacific Hwy	60/55	74/68	0.1/0.2	65	65	74
Mowbray Rd	60/55	73/67	0.1/0.2	65	65	75
Nelson St	55/50	58/52	n/a[1]	54	65	70

Note 1: Existing flows are not available for Nelson Street.

Table 24 indicates that whilst at the Pacific Highway and at Mowbray Road the base criteria are exceeded, the predicted noise level increase (L_{Aeq}) associated with construction traffic complies with the 2 dB allowance, therefore sensitive receivers are not likely to notice an increase in the average road traffic noise levels during construction. Nelson Street would be closed, with negligible existing movements as the street would have access at the western end only, and baseline noise levels of daytime 58 dBA and night-time of 52 dBA have been predicted. These levels exceed the RNP baseline criteria of 55 dBA daytime and 50 dBA night-time for local roads.

There are expected to be up to 8 heavy vehicle and 30 light vehicles movements or events per hour during the night and whilst there is an exceedance of the sleep disturbance screening criterion (of up to 10 dB) and external sleep disturbance NML of 65 dBA (by up to 10 dB), the L_{Amax} levels would be similar to other heavy vehicles using the Pacific Highway and Mowbray Road.

At Nelson Street there is an exceedance of the sleep disturbance screening criterion (of up to 16 dB) and external sleep disturbance NML of 65 dBA (by up to 5 dB) resulting in a sleep disturbance risk. Unless compliance with the base road traffic noise criteria can be achieved on Nelson Street, night time heavy vehicle movements at the Chatswood dive site would be restricted to the Pacific Highway and Mowbray Road.

3.5 Artarmon Substation Construction Site

3.5.1 Site Layout and Proposed Construction Works

An aerial photograph of the proposed Artarmon Substation construction site and the surrounding receiver areas is provided in **Figure 8** with the nearest noise sensitive receivers identified in **Table 25**.

Figure 8 Artarmon Substation Construction Site and Receiver Areas

Table 25 Nearest Noise Sensitive Receivers - Artarmon Substation Construction Site

Receiver Area	Location Relative to Works (m)[1]
A - Residential receivers to the north on Butchers Lane	15
B - Residential receivers to the north east on Reserve Road	14
C - Residential receivers to the east on Barton Road	103
D - Commercial receivers to the south on Hotham Parade	94

Note 1: The relative distance to works shown is that from the nearest sensitive receiver to the closest location of construction activity.

3.5.2 Site Specific Construction Noise Management Levels

With reference to the ambient noise survey results summarised in **Table 4**, the site specific construction NMLs are presented in **Table 26**.

Table 26 Artarmon Substation Construction Site Noise Management Levels

Receiver Area	Receiver Type	Relevant Monitoring Location	$L_{Aeq(15minute)}$ Construction NMLs (dBA)			
			Daytime	Daytime OOH	Evening	Night-time
A	Residential	B.21	59	54	51	46
B	Residential	B.21	59	54	51	46
C	Residential	B.21	59	54	51	46
D	Commercial	B.21	70	70	n/a	n/a

3.5.3 Airborne Noise Assessment at the Nearest Noise Sensitive Receivers

Scenarios were developed for the daytime, evening and night-time periods, to be representative of activities having potentially the greatest noise impact on the surrounding receivers. These scenarios have been developed to be a subset of those discussed in **Section 3.3.1.1**, and are:

- Enabling works including mobilisation and demolition (one month)
- Earthworks (one month)
- Excavation (nine months)
- Building construction works (12 months)

Calculations of the typical $L_{Aeq(15minute)}$ noise level exceedances of the NMLs at the nearest noise sensitive receivers are provided in **Appendix D** and are summarised in **Table 27**.

Table 27 Predicted noise level exceedances at Artarmon Substation Construction Site

Receiver Area	Scenario			
	Enabling Works	Earthworks	Excavation	Construction
	Day	Day	Day	Day
A - Residential receivers to the north on Butchers Lane	3	3	3	2
B - Residential receivers to the north east on Reserve Road	3	2	2	2
C - Residential receivers to the east on Barton Road	2	1	1	1
D – Commercial receivers to the south on Hotham Parade	1	1	1	0

Legend

Category 0	Category 1	Category 2	Category 3
NML Compliance	NML exceedance of less than 10 dB	NML exceedance of between 10 dB and 20 dB	NML exceedance of more than 20 dB

Discussion

The preliminary findings of the construction noise impact assessment at Artarmon Substation indicate:

- The predicted noise levels for enabling works indicate high exceedances of more than 20 dB of the NMLs at residential receivers in area A and B, and moderate exceedances of more than 10 dB in Area C. These are a direct result of the relative close proximity of receivers to the construction activities and the absence of any appreciable shielding between sites and receivers.
- During earthworks and shaft excavation high exceedances of more than 20 dB at the Area A residential receivers and moderate exceedances of more than 10 dB at the area B residential receivers are predicted during the daytime. There are minor exceedances at the residential receivers in Area C and at the commercial receivers in Area D.
- During construction moderate exceedances of more than 10 dB at the area A and B and minor exceedances in Area C. At the commercial receivers compliance is predicted.

3.5.4 Ground-borne Noise and Human Comfort Vibration Assessment

Where ground-borne noise exceedances are identified then human comfort vibration exceedances would also be present. **Appendix F** illustrates the potential ground borne noise impacts due to vibration intensive construction activities (rock breaking) in this area. In summary the analysis for daytime indicates:

- At the nearest residences a minor exceedances of the NML of up 10 dB, and compliance in all other areas.

The potential ground-borne noise impacts associated with the excavation of the tunnels is discussed in **Section 3.16.1**.

3.5.5 Vibration Assessment

During rock breaker activities at the Artarmon substation construction site, vibration levels may be perceptible at the nearest residential receivers. On the basis that the nearest buildings are approximately 25 m from the proposed shaft, vibration levels are anticipated to remain well below the vibration screening levels associated with minor cosmetic building damage. **Appendix G** illustrates the potential cosmetic damage vibration impacts due to construction activities in this area.

3.5.6 Traffic Noise Assessment

Traffic noise levels have been predicted for residential receivers located on the proposed access routes to the Artarmon substation construction site. In this instance the access to the site is via Reserve Road and Barton Road, which are sub arterial and local roads respectively. Reserve Road has significant daytime flows, and the predicted traffic noise increase is 0.2 dB, complying with the 2 dB allowance criteria.

Barton Road is a cul-de-sac, and does not provide access to residences and as such has negligible existing flows. Therefore traffic noise levels from site only traffic movements have been predicted for comparison with the RNP baseline criteria and are presented in **Table 28**

Table 28 Artarmon Substation Construction Site - Construction Traffic on Public Roads

Site	Access Road	Base Criteria Daytime	Predicted Project Daytime Traffic noise
Artarmon	Barton Rd	55	51

Table 28 shows traffic noise levels from the project comply with the baseline criteria on Barton Road. No night-time activities are proposed at this site.

3.6 Crows Nest Station Construction Site

3.6.1 Site Layout and Proposed Construction Works

An aerial photograph of the proposed Crows Nest Station construction site and the surrounding receiver areas is provided in **Figure 9**, with the nearest noise sensitive receivers identified in **Table 29**.

Figure 9 Crows Nest Station Construction Site and Receiver Areas

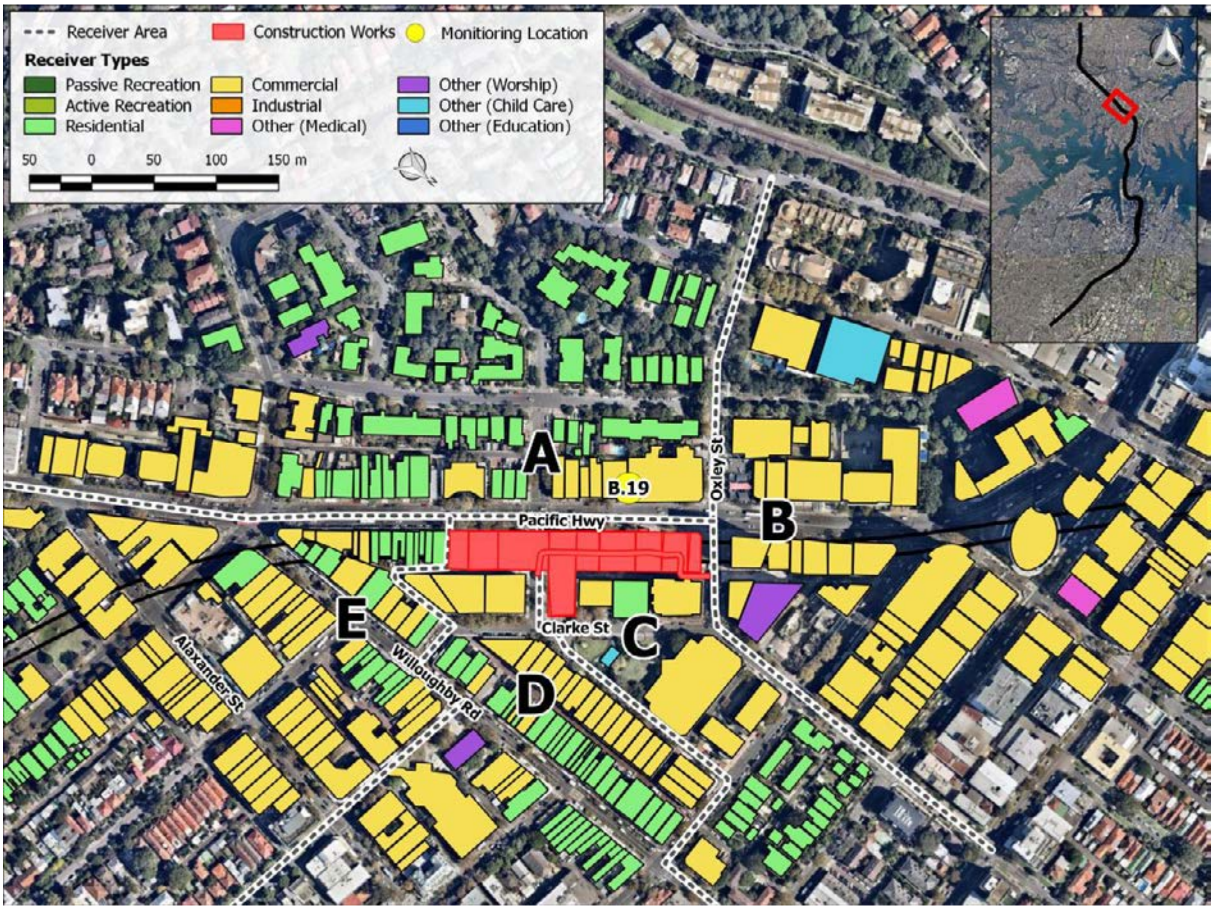


Table 29 Nearest Noise Sensitive Receivers - Crows Nest Station Construction Site

Receiver Area	Location Relative to Works (m)[1]
A - Residential receivers to the west on the Pacific Highway	33
A - Commercial receivers to the west on the Pacific Highway	28
B - Commercial receivers to the north of Oxley Street	29
B – North Side Community Church to the north on Oxley St.	51
C - Residential receivers to the north east on Clarke Street	5
C - Commercial receivers to the north east on Clarke Street	2
C - Active recreation receiver to north on Hume Street	60
D - Residential receivers to the north east on Clarke Street	69

Receiver Area	Location Relative to Works (m)[1]
D - Commercial receivers to the north east on Clarke Street	5
E - Residential receivers to the south on the Pacific Highway	4
E - Commercial receivers to the south on the Pacific Highway	42

Note 1: The relative distance to works shown is that from the nearest sensitive receiver to the closest location of construction activity.

3.6.2 Site Specific Construction Noise Management Levels

With reference to the ambient noise survey results summarised in **Table 4**, the site specific construction NMLs are presented in **Table 30**.

Table 30 Crows Nest Station Construction Site Noise Management Levels

Receiver Area	Receiver Type	Relevant Monitoring Location	$L_{Aeq(15minute)}$ Construction NMLs (dBA)			
			Daytime	Daytime OOH	Evening	Night-time
A	Residential	B.19	69	64	60	55
A	Commercial	B.19	70	70	n/a	n/a
B	Commercial	B.19	70	70	n/a	n/a
B	Church	B.19	55	55	n/a	n/a
C	Residential	B.19	69	64	60	55
C	Commercial	B.19	70	70	n/a	n/a
C	Active Recreation	B.19	65	65	n/a	n/a
D	Residential	B.19	69	64	60	55
D	Commercial	B.19	70	70	n/a	n/a
E	Residential	B.19	69	64	60	55
E	Commercial	B.19	70	70	n/a	n/a

3.6.3 Airborne Noise Assessment at the Nearest Noise Sensitive Receivers

Scenarios were developed for the daytime, evening and night-time periods, to be representative of activities having potentially the greatest noise impact on the surrounding receivers. These scenarios have been developed to be a subset of those discussed in **Section 3.3.1.1**, and are:

- Enabling works including mobilisation and demolition (12 months)
- Earthworks (two months)
- Acoustic shed construction (one month)
- Excavation (three years)
- Station construction (18 months)

Calculations of the typical $L_{Aeq(15minute)}$ noise level exceedances of the NMLs at the nearest noise sensitive receivers are provided in **Appendix D** and are summarised in **Table 31**. The ‘sleep’ column of the table provides the predicted exceedance of the sleep disturbance screening noise level.

Note that for night-time construction, preliminary modelling indicated that an acoustic shed would be required and was included for the station excavation scenario.

Table 31 Predicted noise level exceedances at Crows Nest Station Construction Site

Receiver Area	Scenario								
	Enabling Works	Earthworks	Acoustic Shed Construction	Excavation with Shed					Construction
	Day	Day	Day	Day	OOHD	Even	Night	Sleep	Day
A – Residential receivers to the west on the Pacific Highway	2	1	0	0	0	0	1	0	1
A – Commercial receivers to the west on the Pacific Highway	2	2	0	0	0	0	0	0	1
B – Commercial receivers to the north of Oxley Street	2	2	0	0	0	0	0	0	1
B – North Side Community Church to the north on Oxley St.	2	2	1	1	1	0	0	0	2
C – Residential receivers to the north east on Clarke Street	3	3	1	0	1	1	2	1	2
C – Commercial receivers to the north east on Clarke Street	3	3	2	1	1	0	0	0	2
C – Active recreation receiver to north on Hume Street	2	2	0	0	0	0	0	0	1
D – Residential receivers to the north east on Clarke Street	1	1	0	0	0	0	0	0	0
D – Commercial receivers to the north east on Clarke Street	3	3	1	0	0	0	0	0	2
E – Residential receivers to the south on the Pacific Highway	3	2	0	0	0	0	0	0	2
E – Commercial receivers to the south on the Pacific Highway	1	0	0	0	0	0	0	0	0

Legend

Category 0	Category 1	Category 2	Category 3
NML Compliance	NML exceedance of less than 10 dB	NML exceedance of between 10 dB and 20 dB	NML exceedance of more than 20 dB

Discussion

The preliminary findings of the construction noise impact assessment at Crows Nest Station indicate:

- The predicted noise levels for enabling works (including mobilisation/demolition) indicate high exceedances of more than 20 dB of the NMLs at residential receivers in Area C and E. Moderate exceedances of more than 10 dB are predicted at residential receivers in Areas A, at the church in Area in B and the active recreation in Area C. At residential receivers in Area D minor exceedances are predicted.

  At the nearest commercial receivers in Areas C and D high exceedances of more than 20 dB of the NMLs are predicted, and at commercial receivers in Areas A and B moderate exceedances of more than 10 dB. Minor exceedances are predicted at commercial receivers in Area E.

- The predicted noise levels for earthworks indicate high exceedances of more than 20 dB of the NMLs at the residential receivers in Area C. Moderate exceedances are predicted at the church in receiver Area B, and the residential receivers in Area E and the active recreation in Area C. Minor exceedances are predicted at the residential receivers in Area A and D.

  At the nearest commercial receivers in Areas C and D high exceedances of more than 20 dB of the NMLs are predicted, and at commercial receivers in Areas A and B moderate exceedances of more than 10 dB.
- During acoustic shed construction moderate exceedances at commercial receivers in Area C, and minor exceedances are predicted at the church in Area B, the residential in Area C and the commercial in Area D.
- During station excavation and structural works minor exceedances of up to 10 dB of the NMLs are predicted at the commercial receivers in Area C, and the church during daytime. With night-time excavation there is a moderate exceedance at residences in Area C, and minor exceedance at residences in Area A. An acoustic shed with higher noise insulation would be required to reduce night-time non compliance.
- During station construction moderate exceedances of more than 10 dB of the NMLs are predicted at the residential receivers in Area C and E, commercial receivers at Area C and D, and at the church in Area B. Minor exceedances are predicted at residential receivers in Area A, and at commercial receivers in Area A and B and the active recreation in Area C.

On Site Night-Time L_{Amax} Truck Noise

The maximum noise levels associated with on-site truck movements, deliveries by semitrailer and other activities on site can potentially cause awakening reactions (or sleep disturbance) at nearby residential receivers. The L_{Amax} noise levels associated with these events exceed the sleep disturbance screening level by up to 10 dB during excavation with an acoustic shed. During the detailed design night-time ‘on site’ traffic routes and activities should be reviewed and/or additional mitigation such as increased site perimeter hoarding height.

3.6.4 Ground-borne Noise and Human Comfort Vibration Assessment

Where ground-borne noise exceedances are identified then human comfort vibration exceedances would also be present. **Appendix F** illustrates the potential ground-borne noise impacts due to vibration intensive construction activities (rock breaking) in this area. In summary the analysis indicates:

- During the day seven (7) buildings (four commercial buildings located to the east of the site, one residential building located to the east of the site and two residential buildings located to the south of the site) have ground-borne noise levels potentially higher than 75 dBA for several floors in each building. Where receivers experience day-time internal noise levels greater than 75 dBA more detailed site specific ground borne noise investigation is required. If this investigation finds ground borne noise levels are likely to exceed 75 dBA for extended periods then alternative accommodation would be considered as a mitigation measure.
- During night-time works the analysis shows fifteen (15) residential buildings, located to the east of the site, have regenerated noise levels potentially higher than 45 dBA on one or more floors. Where residential receivers have night-time internal noise levels greater than 45 dBA they would be considered eligible for alternative accommodation (the highest level mitigation measure) as per the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement).

3.6.4.1 Blasting

The use of blasting in the excavation of the station shafts effectively reduces the duration of noise and vibration impacts due to the use of rock breakers, which must be used to some extent before blasting can occur. **Table 32** illustrates the effective reduction in duration of the ground-borne noise (and human comfort vibration) NML exceedances when blasting is used as an alternative excavation methodology. This table also illustrates the effective reduction in duration of these exceedances when blasting is combined with medium rock breakers instead of large rock breakers.

The values in this table represent all exceedances of the NMLs (even those as low as 1 dB to 5 dB). Therefore, the actual requirement for high level mitigation measures is not represented. The information is presented to indicate the benefits in terms of duration of impacts between different excavation methodologies.

Table 32 No. of Periods Above the NMLs Due to Alternative Construction Methodologies

Site	Number of Periods Above NMLs											
	Residential									Commercial		
	Day			Evening			Night			Day		
	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB
Crows Nest	80	30	15	136	45	29	185	60	49	67	27	8

Note: B- = No Blasting, B+ = With Blasting, Lrg RB = Large Rock Breakers, Med RB = Medium Rock Breakers

The duration of the impacts can be summarised as follows:

Residential Day: The use of large rock breakers with no blasting generates 80 daytime periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 30 daytime periods. The inclusion of blasting combined with medium rock breakers reduces the duration of impacts to 15 daytime periods.

Residential Evening: The use of large rock breakers with no blasting generates 136 evening periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 45 evening periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts even further to 29 evening periods. Blasting therefore significantly reduces the impacts during the evening.

Residential Night: The use of large rock breakers with no blasting generates 185 night-time periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 60 night-time periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts even further to 49 night-time periods. Blasting therefore significantly reduces the impacts during the night.

Commercial Day: The use of large rock breakers with no blasting generates 67 daytime periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 27 daytime periods. The inclusion of blasting combined with medium rock breakers reduces the duration of impacts to 8 daytime periods.

With careful planning and positioning of the rock breakers it may be possible to avoid consecutive periods of NML exceedances ie respite periods for receivers could be planned in the construction program through careful rock breaker locations. For any residual exceedances of the NMLs, the processes and mitigation measures identified in the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement) would be implemented.

The potential ground-borne noise impacts associated with the excavation of the tunnels are discussed in **Section 3.16.1**.

3.6.5 Vibration Assessment

During construction of the proposed shaft vibration levels are anticipated to exceed the vibration screening levels associated with minor cosmetic building damage. The analysis shows three (3) buildings adjacent to the shaft excavation site (one building located to the east on Clarke Street and two building located to the south of the Pacific Highway) where the screening criteria for cosmetic damage may be exceeded. A more detailed assessment of the structure and attended vibration monitoring would be carried out to ensure vibration levels remain below appropriate limits for those structures. **Appendix G** illustrates the potential cosmetic damage vibration impacts due to construction activities in this area.

3.6.6 Traffic Noise Assessment

Traffic noise levels have been predicted for residential receivers located on the proposed access route to the Crows Nest Station sites. In this instance the access to the site is via the Pacific Highway, Oxley Street, Clarke Street and Hume Street. The Pacific Highway is an arterial road with significant daytime flows, and Clarke Street is a local road. No sensitive receivers are located on the sections of Oxley Street and Hume Street proposed to be used as haul routes. Given that traffic movements are proposed during the night-time period, the L_{Aeq} increase and sleep disturbance noise levels have been assessed in **Table 33**.

Table 33 Crows Nest Station Construction Site - Construction Traffic on Public Roads

Access Road	Base Criteria Day/Night ($L_{Aeq(15hr/9hr)}$)	Predicted Road Traffic Noise Day/Night	Predicted Road Traffic Noise Increase (dB)	RBL + 15 dB Screening Criterion (dBA)	External L_{Amax} NML Level (dBA)	Predicted L_{Amax} Noise Level (dBA)
Pacific Hwy	60/55	75/68	0.2/0.5	65	65	79
Clarke St	55/50	59/56	n/a[1]	66	65	75

Note 1: Existing traffic flows are not available for Clarke Street

Table 33 indicates that whilst at the Pacific Highway the base criteria are exceeded, the predicted noise level increase (L_{Aeq}) associated with construction traffic complies with the 2 dB allowance, therefore sensitive receivers are not likely to notice an increase in the average road traffic noise levels during construction. At Clarke Street the existing movements are not available and baseline noise levels of daytime 59 dBA and night-time of 56 dBA have been predicted. These levels exceed the RNP baseline criteria of 55 dBA daytime and 50 dBA night-time for local roads.

There are expected to be up to 6 heavy vehicle and 2 light vehicles movements or events per hour during the night on the Pacific Highway and whilst there is an exceedance of the sleep disturbance screening criterion (of up to 14 dB) and external sleep disturbance NML of 65 dBA (by up to 14 dB), the L_{Amax} levels would be similar to other heavy vehicles using the Pacific Highway.

At Clarke Street there is an exceedance of the sleep disturbance screening criterion (of up to 9 dB) and external sleep disturbance NML of 65 dBA (by up to 10 dB) with limited existing heavy vehicles expected, resulting in a sleep disturbance risk. Unless compliance with the base road traffic noise criteria can be achieved on Clarke Street, night time heavy vehicle movements at the Crows Nest Station construction site would be restricted to the Pacific Highway, Hume Street and Oxley Street.

3.7 Victoria Cross Station Construction Site

3.7.1 Site Layout and Proposed Construction Works

An aerial photograph of the proposed Victoria Cross Station construction site and the surrounding receiver areas is provided in **Figure 10**, with the nearest noise sensitive receivers identified in **Table 34**.

Figure 10 Victoria Cross Station Construction Site and Receiver Areas

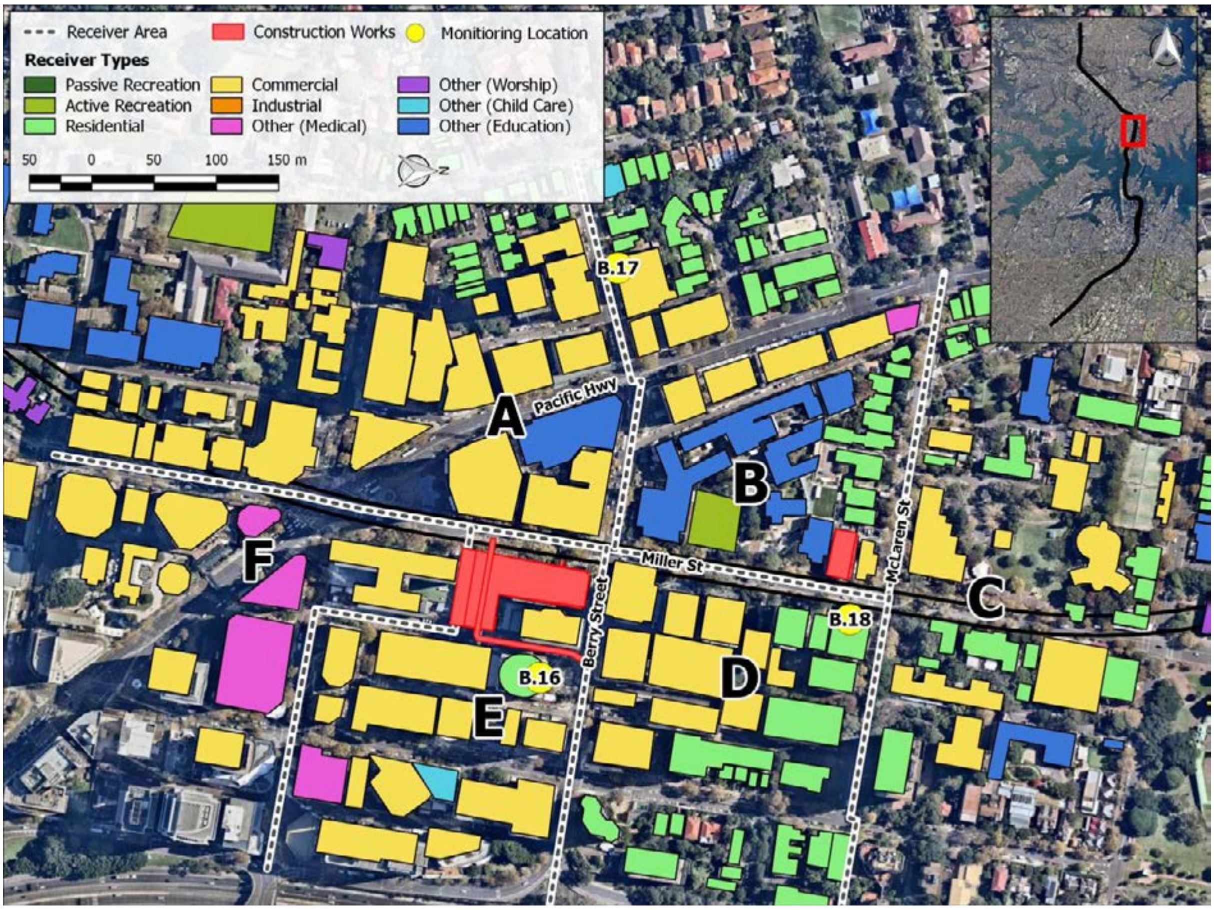


Table 34 Nearest Noise Sensitive Receivers - Victoria Cross Station Construction Site

Receiver Area	Location Relative to Works (m)[1]
A - Commercial receivers to the west on Miller Street	35
A - Educational receivers to the west on the Pacific Highway	89
B - Commercial receivers to the west on Miller Street	3
B - Residential receivers to the west on McLaren Street	11
B - Educational receivers to the west on the Miller Street	32
C - Residential receivers to the north on McLaren Street	89
C - Commercial receivers to the north on McLaren Street	56
D - Residential receivers to the east on Miller Street	38
D - Commercial receivers to the east on Miller Street	20
E - Residential receivers to the east on Miller Street	31
E - Commercial receivers to the east on Miller Street	7
F - Commercial receivers adjacent to the south	2

Note 1: The relative distance to works shown is that from the nearest sensitive receiver to the closest location of construction activity.

3.7.2 Site Specific Construction Noise Management Levels

With reference to the ambient noise survey results summarised in **Table 4**, the site specific construction NMLs are presented in **Table 35**.

Table 35 Victoria Cross Station Construction Site Noise Management Levels

Receiver Area	Receiver Type	Relevant Monitoring Location	$L_{Aeq(15minute)}$ Construction NMLs (dBA)			
			Daytime	Daytime OOH	Evening	Night-time
A	Commercial	B.17	70	70	n/a	n/a
A	Educational	B.17	55	n/a	n/a	n/a
B	Commercial	B.18	70	70	n/a	n/a
B	Residential	B.18	75	70	62	56
B	Educational	B.18	55	n/a	n/a	n/a
C	Residential	B.18	75	70	62	56
C	Commercial	B.18	70	70	n/a	n/a
D	Residential	B.18	75	70	62	56
D	Commercial	B.18	70	70	n/a	n/a
E	Residential	B.16	75	70	68	57
E	Commercial	B.16	70	70	n/a	n/a
F	Commercial	B.16	70	70	n/a	n/a

3.7.3 Airborne Noise Assessment at the Nearest Noise Sensitive Receivers

Scenarios were developed for the daytime, evening and night-time periods, to be representative of activities having potentially the greatest noise impact on the surrounding receivers. These scenarios have been developed to be a subset of those discussed in **Section 3.3.1.1**, and are:

- Enabling works including mobilisation and demolition (12 months)
- Earthworks (two months)
- Acoustic shed construction (one month)
- Excavation (three years)
- Station construction (18 months)

Calculations of the typical $L_{Aeq(15minute)}$ noise level exceedances of the NMLs at the nearest noise sensitive receivers are provided in **Appendix D** and are summarised in **Table 36**. The 'sleep' column of the table provides the predicted exceedance of the sleep disturbance screening noise level.

Note that for night-time construction, preliminary modelling indicated that an acoustic shed would be required and was included for the station excavation scenario.

Table 36 Predicted noise level exceedances at Victoria Cross Station Construction Site

Receiver Area	Scenario								
	Enabling Works	Earthworks	Acoustic Shed Construction	Excavation with Shed					Construction
	Day	Day	Day	Day	DOOH	Even	Night	Sleep	Day
A – Commercial receivers to the west on Miller Street	2	1	0	0	0	0	0	0	1
A – Educational receivers to the west on the Pacific Hwy	2	2	0	0	0	0	0	0	1
B – Commercial receivers to the west on Miller Street	3	2	1	0	0	0	0	0	2
B – Residential receivers to the west on McLaren Street	2	2	0	0	0	1	2	1	1
B – Educational receivers to the west on the Miller Street	3	3	3	2	1	0	0	0	3
C – Residential receivers to the north on McLaren Street	0	0	0	0	0	0	0	0	0
C – Commercial receivers to the north on McLaren Street	1	0	0	0	0	0	0	0	0
D – Residential receivers to the east on Miller Street	1	1	0	0	0	0	1	0	1
D – Commercial receivers to the east on Miller Street	2	2	1	0	0	0	0	0	1
E – Residential receivers to the east on Miller Street	1	1	0	0	0	0	1	0	0
E – Commercial receivers to the east on Miller Street	3	3	2	0	0	0	0	0	2
F – Commercial receivers adjacent to the south	3	3	2	0	0	0	0	0	1

Legend			
Category 0	Category 1	Category 2	Category 3
NML Compliance	NML exceedance of less than 10 dB	NML exceedance of between 10 dB and 20 dB	NML exceedance of more than 20 dB

Discussion

The preliminary findings of the construction noise impact assessment at Victoria Cross Station indicate:

- The predicted noise levels for enabling works indicate high exceedances of more than 20 dB of the NMLs at educational receivers in Area B and at the commercial receivers in Area B, E and F. Moderate exceedances of more than 10 dB are predicted at commercial receivers in Area A and D, at residential receivers in Area B and educational receivers in Area in A. At residential receivers in Area D and E and commercial receivers in Area C minor exceedances are predicted.
- The predicted noise levels for earthworks indicate high exceedances of more than 20 dB of the NMLs at the educational receivers in Area B and commercial receivers in Area E and F. At the educational receivers in Area A, and the commercial receivers in Area B and D moderate exceedances are predicted.

  At the nearest residential receivers moderate exceedances are predicted in Area B and low exceedances are predicted in Area D and E.

- During acoustic shed construction high exceedances of more than 20 dB are predicted educational receivers in Area B and moderate exceedances of more than 10 dB at commercial receivers in Area E and F.
- During excavation with an acoustic shed there are moderate exceedances at the educational receivers in Area B. For night-time works there is a moderate exceedances at residential receivers in Area B and a minor exceedance is predicted at residential receivers in Area d and E. An acoustic shed with higher noise insulation would be required to reduce night-time non compliance.
- During station construction high exceedances of more than 20 dB are predicted at the educational receivers in Area B, and moderate exceedances of more than 10 dB of the NMLs are predicted at the commercial receivers at Area B and E. Minor exceedances are predicted at residential receivers in Areas B and D, educational receivers in Area A and at commercial receivers in Area A, D and F.

On Site Night-Time L_{Amax} Truck Noise

The maximum noise levels associated with on-site truck movements, deliveries by semitrailer and other activities on site can potentially cause awakening reactions (or sleep disturbance) at nearby residential receivers. The L_{Amax} noise levels associated with these events exceed the sleep disturbance screening level during station excavation with an acoustic shed. During the detailed design night-time 'on site' traffic routes and activities should be reviewed and/or additional mitigation such as increased site perimeter hoarding height.

3.7.4 Ground-borne Noise and Human Comfort Vibration Assessment

Where ground-borne noise exceedances are identified then human comfort vibration exceedances would also be present. **Appendix F** illustrates the potential ground borne noise impacts due to vibration intensive construction activities (rock breaking) in this area. In summary the analysis indicates:

- During the daytime three (3) buildings immediately adjacent to the at the northern shaft (to the south, west and north) and one (1) building to the east of the southern shaft have regenerated noise levels potentially higher than 75 dBA on several floors in each building. Where receivers experience day-time internal noise levels greater than 75 dBA more detailed site specific ground borne noise investigation is required. If this investigation finds ground borne noise levels are likely to exceed 75 dBA for extended periods then alternative accommodation would be considered as a mitigation measure
- During night-time works the analysis shows five (5) residential buildings at the northern site (to the east and west) and one (1) residential building to the east of the southern site have regenerated noise levels potentially higher than 45 dBA on several floors. Where residential receivers have night-time internal noise levels greater than 45 dBA they would be considered eligible for alternative accommodation (the highest level mitigation measure) as per the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement).

3.7.4.1 Blasting

The use of blasting in the excavation of the station shafts effectively reduces the duration of noise and vibration impacts due to the use of rock breakers which must be used to some extent before blasting can occur. **Table 37** illustrates the effective reduction in duration of the ground-borne noise (and human comfort vibration) exceedances when blasting is used as an alternative excavation methodology. This table also illustrates the effective reduction in duration of these exceedances when blasting is combined with medium rock breakers instead of large rock breakers.

The values in this table represent all exceedances of the NMLs (even those as low as 1 dB to 5 dB). Therefore, the actual requirement for high level mitigation measures is not represented. The information is presented to indicate the benefits in terms of duration of impacts between different excavation methodologies.

Table 37 No. of Periods Above the NMLs Due to Alternative Construction Methodologies

Site	Number of Periods Above NMLs											
	Residential									Commercial		
	Day			Evening			Night			Day		
	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB
Victoria Cross - North	62	32	9	172	71	31	268	101	77	283	131	111
Victoria Cross - South	0	0	0	16	8	0	55	22	7	37	22	8

Note: B- = No Blasting, B+ = With Blasting, Lrg RB = Large Rock Breakers, Med RB = Medium Rock Breakers

The duration of the impacts can be summarised as follows:

Residential Day: The use of large rock breakers with no blasting generates 62 daytime periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 32 daytime periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts even further to 9 daytime periods. Blasting coupled with medium rock breaker therefore significantly reduces the impacts during the day.

Residential Evening: The use of large rock breakers with no blasting generates 192 evening periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 79 evening periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts even further to 31 evening periods. Blasting therefore significantly reduces the impacts during the evening.

Residential Night: The use of large rock breakers with no blasting generates 323 night-time periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 123 night-time periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts even further to 84 night-time periods. Blasting therefore significantly reduces the impacts during the night.

Commercial Day: The use of large rock breakers with no blasting generates 324 daytime periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 153 daytime periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts even further to 119 daytime periods. Blasting coupled with medium rock breaker therefore significantly reduces the impacts during the day.

With careful planning and positioning of the rock breakers it may be possible to avoid consecutive periods of NML exceedances ie respite periods for receivers could be planned in the construction program through careful rock breaker locations. For any residual exceedances of the NMLs, the processes and mitigation measures identified in the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement) would be implemented.

The potential ground-borne noise impacts associated with the excavation of the tunnels are discussed in **Section 3.16.1**.

3.7.5 Vibration Assessment

During construction of the proposed shafts vibration levels are anticipated to remain well below the vibration screening levels associated with minor cosmetic building damage at all buildings except for three (3) buildings immediately adjacent to the northern site to the south, west and north. The analysis also shows one (1) commercial building to the east of the southern site where the screening criteria for cosmetic damage may be exceeded. Dilapidation surveys, vibration monitoring and more detailed site vibration investigation are therefore recommended for these buildings as a precautionary measure during construction. **Appendix G** illustrates the potential cosmetic damage vibration impacts due to construction activities in this area.

The use of road headers to excavate a low level pedestrian walkway between the northern and southern shafts are not predicted to generate significant vibration levels and will remain below the screening levels associated with minor cosmetic building damage.

3.7.6 Traffic Noise Assessment

Traffic noise levels have been predicted for residential receivers located on the proposed access route to the Victoria Cross Station sites. In this instance the access to the site is via McLaren Street, Miller Street and Berry Street which are sub-arterial roads with significant daytime flows, and Denison Street which is a local road. The RNP base criteria, predicted $L_{Aeq(15hr)}$ daytime and $L_{Aeq(9hr)}$ nighttime noise levels with the development, and the L_{Aeq} increase and sleep disturbance noise levels have been assessed in **Table 38**.

Table 38 Victoria Cross Station Construction Site - Construction Traffic on Public Roads

Access Road	Base Criteria Day/Night ($L_{Aeq(15hr/9hr)}$)	Predicted Road Traffic Noise Day/Night	Predicted Road Traffic Noise Increase (dB)	RBL + 15 dB Screening Criterion (dBA)	External L_{Amax} NML Level (dBA)	Predicted L_{Amax} Noise Level (dBA)
McLaren St	60/55	66/62	0.6/0.8	66	65	76
Miller St	60/55	66/59	0.3/0.7	66	65	72
Berry St	60/55	69/62	0.3/0.8	67	65	76
Denison St	55/50	54/50	n/a[1]	67	65	72

Note 1: Existing flows are not available for Denison Street

Table 38 indicates that whilst at McLaren Street, Miller Street and at Berry Street the base criteria are exceeded,the predicted noise level increase (L_{Aeq}) associated with construction traffic complies with the 2 dB allowance, therefore sensitive receivers are not likely to notice an increase in the average road traffic noise levels during construction. At Denison Street there are negligible existing movements, and baseline noise levels of daytime 54 dBA and night-time of 50 dBA have been predicted. These levels comply with the RNP baseline criteria for local roads.

There are expected to be up to 6 heavy vehicle and 2 light vehicles movements or events per hour during the night and whilst there is an exceedance of the sleep disturbance screening criterion (of up to 10 dB) and external sleep disturbance NML of 65 dBA (by up to 11 dB), the L_{Amax} levels would be similar to other heavy vehicles using McLaren Street, Miller Street and Berry Street. At Denison Street there are limited existing heavy vehicles resulting in a sleep disturbance risk. Unless compliance with the base road traffic noise criteria can be achieved on Denison Street, night time heavy vehicle movements at the Victoria Cross Station construction site would be restricted to McLaren Street, Miller Street and Berry Street.

3.8 Blues Point Temporary Site

3.8.1 Site Layout and Proposed Works

An aerial photograph of the proposed Blues Point temporary site and the surrounding receiver areas is provided in **Figure 11**, with the nearest noise sensitive receivers identified in **Table 39**.

Figure 11 Blues Point Temporary Site and Receiver Areas

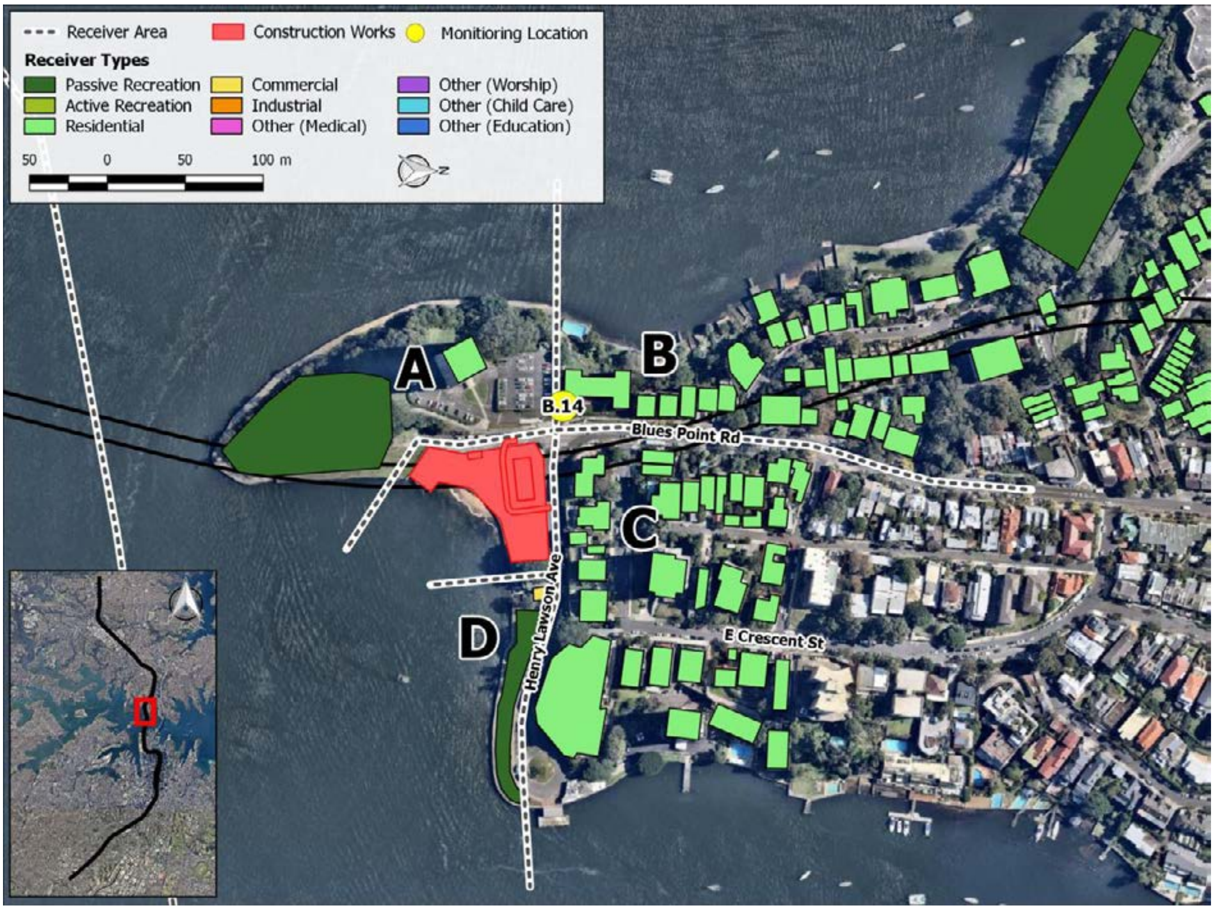


Table 39 Nearest Noise Sensitive Receivers - Blues Point Temporary Site

Receiver Area	Location Relative to Works (m)[1]
A - Residential receivers to the west in Blue's Point Tower	54
A - Passive recreation to the south west	23
B - Residential receivers to the north, east of Blues Point Road	36
C - Residential receivers to the north of Henry Lawson Avenue	22
D - Commercial receiver to the east of Henry Lawson Avenue	18
D - Passive recreation to the east	37

Note 1: The relative distance to works shown is that from the nearest sensitive receiver to the closest location of construction activity.

3.8.2 Site Specific Construction Noise Management Levels

With reference to the ambient noise survey results summarised in **Table 4**, the site specific construction NMLs are presented in **Table 40**.

Table 40 Blues Point Temporary Site Noise Management Levels

Receiver Area	Receiver Type	Relevant Monitoring Location	$L_{Aeq(15minute)}$ Construction NMLs (dBA)			
			Daytime	Daytime OOH	Evening	Night-time
A	Residential	B.14	61	56	54	45
A	Recreation	B.14	60	60	n/a	n/a
B	Residential	B.14	61	56	54	45
C	Residential	B.14	61	56	54	45
D	Commercial	B.14	70	70	n/a	n/a
D	Recreation	B.14	60	60	n/a	n/a

3.8.3 Noise Assessment at the Nearest Noise Sensitive Receivers

Scenarios were developed for the daytime, evening and night-time periods, to be representative of activities having potentially the greatest noise impact on the surrounding receivers. These scenarios have been developed to be a subset of those discussed in **Section 3.3.1.1**, and are:

- Enabling works including mobilisation and demolition (one month)
- Earthworks (one month)
- Shaft excavation (12 months)
- Site reinstatement (6 months)

At this site, site reinstatement works are proposed to reinstate the park land, jetty, and bus shelter.

Calculations of the typical $L_{Aeq(15minute)}$ noise level exceedances of the NMLs at the nearest noise sensitive receivers are provided in **Appendix D** and are summarised in **Table 41**.

Table 41 Predicted noise level exceedances at Blues Point Temporary Site

Receiver Area	Scenario			
	Enabling works	Earthworks	Excavation	Site reinstatement
	Day	Day	Day	Day
A – Residential receivers to the west in Blue's Point Tower	2	2	2	1
A – Passive recreation to the south west	2	1	1	1
B – Residential receivers to the north, east of Blues Point Road	2	2	2	1
C – Residential receivers to the north on Henry Lawson Avenue	3	3	3	2
D – Commercial receiver to the east Henry Lawson Avenue	2	1	1	0
D – Passive recreation to the east	2	1	1	1

Legend

Category 0	Category 1	Category 2	Category 3
NML Compliance	NML exceedance of less than 10 dB	NML exceedance of between 10 dB and 20 dB	NML exceedance of more than 20 dB

Discussion

The preliminary findings of the construction noise impact assessment at Blues Point indicate:

- The predicted noise levels for enabling works indicate high exceedances of more than 20 dB of the NMLs at residential receivers in Area C, and moderate exceedances of more than 10 dB in Area A, B, and D. A moderate exceedance is also predicted in the passive recreation Area A and D, and at the commercial receiver in Area D. These are a direct result of the relative close proximity of receivers to the construction activities and the absence of any appreciable shielding between sites and receivers.
- During earthworks and shaft excavation there are high exceedances of more than 20 dB at the Area C residential receivers, a moderate exceedance at residences in Area A and B and minor exceedances of less than 10 dB at the passive recreation receivers in Area A and D, and the commercial receiver in Area D.
- During site reinstatement moderate exceedances of more than 10 dB are predicted at the residential receivers in Area C. There are minor exceedances in the residential Areas A and B and the passive recreation Areas A and D.

On Site Night-Time L_{Amax} Truck Noise

The maximum noise levels associated with on-site truck movements, deliveries by semitrailer and other activities on site can potentially cause awakening reactions (or sleep disturbance) at nearby residential receivers. No night-time activities are proposed with the exception of the four TBM retrieval events.

3.8.4 Ground-borne Noise Assessment

Where ground-borne noise exceedances are identified then human comfort vibration exceedances will also be present. **Appendix F** illustrates the potential ground borne noise impacts due to vibration intensive construction activities (rock breaking) in this area. In summary the analysis for daytime (no works are proposed for night-time) indicates:

- At the nearest residences, located on Warung Street, the analysis shows one (1) high exceedance of the NML between 20 dB to 25 dB, and three (3) moderate exceedances of up to 10 dB.

The potential ground-borne noise impacts associated with the excavation of the tunnels are discussed in **Section 3.16.1**.

3.8.5 Vibration Assessment

During construction of the proposed shafts vibration levels are anticipated to remain well below the vibration screening levels associated with minor cosmetic building damage. The analysis shows the heritage listed bus stop adjacent to the shaft excavation site where the screening criteria for cosmetic damage may be exceeded. However, this bus stop would be temporarily removed during the construction works. **Appendix G** illustrates the potential cosmetic damage vibration impacts due to construction activities in this area.

3.8.6 Traffic Noise Assessment

Traffic noise levels have been predicted for residential receivers located on the proposed access routes to the Blues Point construction site. In this instance the access to the site is via Blues Point Road and Henry Lawson Avenue, which are local roads with low existing daytime flows. Therefore traffic noise levels from site only traffic movements have been predicted for comparison with the RNP baseline criteria and are presented in **Table 42**.

Table 42 Blues Point Temporary Site - Construction Traffic on Public Roads

Site	Access Road	Base Criteria Daytime	Predicted Project Daytime Traffic noise
Blues Point	Blues Point Rd	55	56
	Henry Lawson Avenue	55	52

Table 42 shows traffic noise levels from the project comply with the baseline criteria on Henry Lawson Avenue and exceed by 1 dB on Blues Point Road. No night-time activities are proposed at this site, with the exception of the four TBM retrieval events.

3.9 Sydney Harbour ground improvements work

3.9.1 Site Layout and Proposed Construction Works

An aerial photograph of the proposed Sydney Harbour ground improvement works and the surrounding receiver areas is provided in **Figure 12**, with the nearest noise sensitive receivers identified in **Table 43**.

Figure 12 Sydney Harbour ground improvement works and Receiver Areas

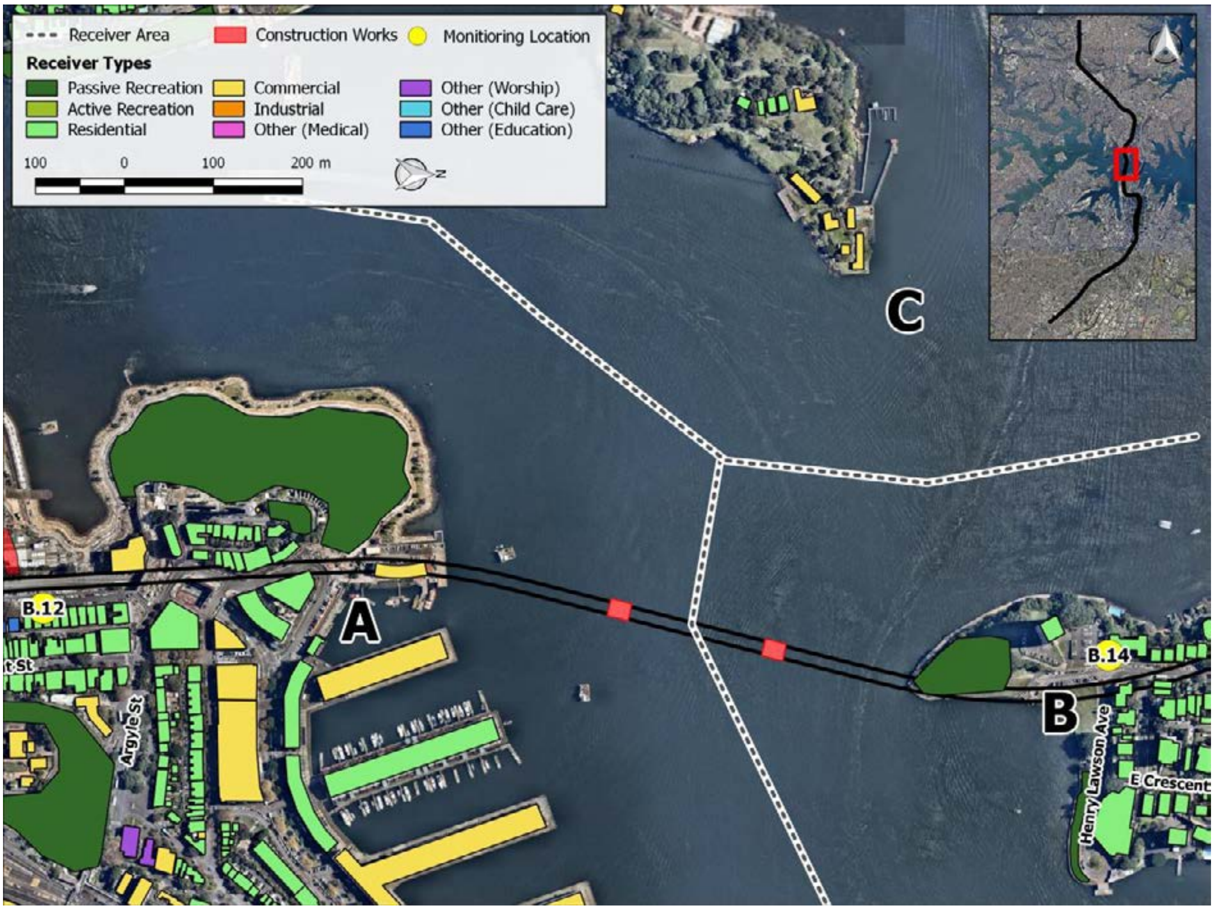


Table 43 Nearest Noise Sensitive Receivers - Sydney Harbour ground improvement works

Receiver Area	Location Relative to Works (m)[1]
A - Commercial receivers to the south in Port Authority of NSW building	240
A - Residential receivers to the south, Hickson Road	220
A - Passive recreation area receivers to the south in Barangaroo Reserve	310
B - Passive recreation area receivers south of Blue's point tower	190
B - Residential receivers to the north in Blue's Point Tower	350
C - Residential receivers on Goat Island	680
C - Commercial receivers on Goat Island	510

Note 1: The relative distance to works shown is that from the nearest sensitive receiver to the closest location of construction activity.

3.9.2 Site Specific Construction Noise Management Levels

With reference to the ambient noise survey results summarised in **Table 4**, the site specific construction NMLs are presented in **Table 44**.

Table 44 Sydney Harbour Ground Improvement Works Noise Management Levels

Receiver Area	Receiver Type	Relevant Monitoring Location	$L_{Aeq(15minute)}$ Construction NMLs (dBA)			
			Daytime	Daytime OOH	Evening	Night-time
A	Residential	B.12	60	55	50	45
A	Commercial	B.12	70	70	n/a	n/a
A	Recreation	B.12	60	60	n/a	n/a
B	Recreation	B.14	60	60	n/a	n/a
B	Residential	B.14	61	56	54	45
C	Residential	B.29	59	54	54	46
C	Commercial	B.29	70	70	n/a	n/a

3.9.3 Airborne Noise Assessment at the Nearest Noise Sensitive Receivers

Scenarios were developed for the daytime, evening and night-time periods, to be representative of activities having potentially the greatest noise impact on the surrounding receivers. These scenarios have been developed to be a subset of those discussed in **Section 3.3.1.1**, and are:

- Grout barge

Calculations of the typical $L_{Aeq(15minute)}$ noise level exceedances of the NMLs at the nearest noise sensitive receivers are provided in **Appendix D** and are summarised in **Table 45**. The 'sleep' column of the table provides the predicted exceedance of the sleep disturbance screening noise level.

Table 45 Predicted noise level exceedances at Harbor Crossing Ground Improvement works

Receiver Area	Scenario: Grout Barge				
	Day	DOOH	Even	Night	Sleep
A - Commercial receivers to the south in Port Authority of NSW building	0	0	0	0	0
A - Residential receivers to the south, Hickson Road	0	0	0	1	0
A - Passive recreation area receivers to the south in Barangaroo Reserve	0	0	0	0	0
B - Passive recreation area receivers south of Blue's Point tower	0	0	0	0	0
B - Residential receivers to the north in Blue's Point Tower	0	0	0	0	0
C - Residential receivers on Goat Island	0	0	0	0	0
C – Commercial receivers on Goat Island	0	0	0	0	0

Legend

Category 0	Category 1	Category 2	Category 3
NML Compliance	NML exceedance of less than 10 dB	NML exceedance of between 10 dB and 20 dB	NML exceedance of more than 20 dB

Discussion

The preliminary findings of the construction noise impact assessment of the Sydney Harbour Crossing construction site ground improvement works indicates:

- Compliance for the daytime at evening periods at all receiver areas. During night-time there is a minor exceedance of up to 10 dB at residential receivers in Area A.

3.9.4 Ground-borne Noise and Human Comfort Vibration Assessment

No ground-borne noise impacts are predicted due to construction activities at this site.

3.9.5 Vibration Assessment

No vibration impacts are predicted due to construction activities at this site.

3.10 Barangaroo Station Construction Site

3.10.1 Site Layout and Proposed Construction Works

An aerial photograph of the proposed Barangaroo Station construction site and the surrounding receiver areas is provided in **Figure 13**, with the nearest noise sensitive receivers identified in **Table 46**.

Figure 13 Barangaroo Station Construction Site and Receiver Areas

Table 46 Nearest Noise Sensitive Receivers - Barangaroo Station Construction Site

Receiver Area	Location Relative to Works (m)[1]
A - Commercial receivers to the west (to be constructed)	2
A - Residential receivers to the west and south (to be constructed)	18
B - Residential receivers to the north on Bettington Street	75
B - Passive recreation area receivers to the north in Barangaroo Reserve	101
C - Residential receivers to the east on High Street	10
D - Residential receivers to the south on High Street	12
D - Commercial receivers to the south on Hickson Road	61
E - Residential receivers to the west in Balmain East	500

Note 1: The relative distance to works shown is that from the nearest sensitive receiver to the closest location of construction activity.

3.10.2 Site Specific Construction Noise Management Levels

With reference to the ambient noise survey results summarised in **Table 4**, the site specific construction NMLs are presented in **Table 47**.

Table 47 Barangaroo Station Construction Site Noise Management Levels

Receiver Area	Receiver Type	Relevant Monitoring Location	$L_{Aeq(15minute)}$ Construction NMLs (dBA)			
			Daytime	Daytime OOH	Evening	Night-time
A	Commercial	B.12	70	70	n/a	n/a
A	Residential	B.12	60	55	50	45
B	Residential	B.12	60	55	50	45
B	Recreation	B.12	60	60	n/a	n/a
C	Residential	B.12	60	55	50	45
C	Residential	B.12	60	55	50	45
D	Commercial	B.12	70	70	n/a	n/a
E	Residential	B.29	59	54	54	46

3.10.3 Airborne Noise Assessment at the Nearest Noise Sensitive Receivers

Scenarios were developed for the daytime, evening and night-time periods, to be representative of activities having potentially the greatest noise impact on the surrounding receivers. These scenarios have been developed to be a subset of those discussed in **Section 3.3.1.1**, and are:

- Enabling works including mobilisation and demolition (12 months)
- Earthworks which consists of initial excavation (2 months)
- Acoustic shed construction (one month)
- Excavation and tunnelling with shed (12 months for station excavation, and 18 months for tunnelling)
- Station construction and fitout (18 months)

Calculations of the typical $L_{Aeq(15minute)}$ noise levels at the nearest noise sensitive receivers (at ground floor level) are provided in **Appendix D** and the predicted noise level exceedances are summarised in **Table 48**. The ‘sleep’ column of the table provides the predicted exceedance of the sleep disturbance screening noise level.

For night-time construction, preliminary modelling indicated that an acoustic shed would be required and was included for the excavation and tunnelling scenarios.

Table 48 Predicted noise level exceedances at Barangaroo Station Construction Site

Receiver Area	Scenario								
	Enabling Works	Earthworks	Acoustic Shed Construction	Excavation with Shed					Construction
	Day	Day	Day	Day	OOHD	Eve	Night	Sleep	Day
A – Commercial receivers to the east (to be constructed)	3	1	0	0	0	0	0	0	1
A – Residential receivers to the west and south (to be constructed)	1	1	0	0	0	1	1	0	1
B – Residential receivers to the north on Bettington Street	2	1	0	1	0	1	1	0	1
B – Passive recreation area receivers to the north in Barangaroo Reserve	1	1	0	0	0	0	0	0	1
C – Residential receivers to the east on High Street	3	2	1	2	1	2	2	1	2
D – Residential receivers to the south on High Street	2	2	1	1	1	2	2	1	2
D – Commercial receivers to the south on Hickson Road	1	1	0	0	0	0	0	0	0
E – Residential receivers to the west in Balmain East	0	0	0	0	0	0	0	0	0

Legend

Category 0	Category 1	Category 2	Category 3
NML Compliance	NML exceedance of less than 10 dB	NML exceedance of between 10 dB and 20 dB	NML exceedance of more than 20 dB

Discussion

The preliminary findings of the construction noise impact assessment at Barangaroo Station indicate:

- The predicted noise levels for enabling works indicate high exceedances of more than 20 dB of the NMLs at residential receivers in Area C and commercial receivers in Area A. Moderate exceedances of more than 10 dB are predicted at residential receivers in Area B and D. Minor exceedances are predicted at residential receivers in Area A, commercial receivers in Area D and passive recreation in Area B. These are a direct result of the relative close proximity of receivers to the construction activities and the absence of any appreciable shielding between sites and receivers.
- During earthworks there is a moderate exceedance at residential receivers in Area C and D. Minor exceedances are predicted at residential receivers in Area A, B, commercial receivers in Areas A and D and passive recreation in Area B.
- During construction of the acoustic shed there are minor exceedances at the residential receivers in Areas C and D.

- During excavation with the acoustic shed there is a moderate exceedance of more than 10 dB at residences in Area C, and a minor exceedance of up to 10 dB at residential receivers in Areas B and D. For operations outside standard construction hours there are moderate exceedances at residential receivers in Area C and D and minor exceedances in Area A and B. An acoustic shed with increased noise insulation is required for night-time compliance.
- During construction there are moderate exceedances at residential receivers in Area C and D and minor exceedances at residences in Area A and B, commercial receivers in Area A and passive recreation in Area B.

On Site Night-Time L_{Amax} Noise

The maximum noise levels associated with on-site truck movements, deliveries by semitrailer and other activities on site can potentially cause awakening reactions (or sleep disturbance) at nearby residential receivers. The L_{Amax} noise levels associated with these events exceed the sleep disturbance screening level by up to 10 dB during excavation with an acoustic shed at residential receivers in Area C and D. During the detailed design night-time ‘on site’ traffic routes and activities should be reviewed and/or additional mitigation such as increased site perimeter hoarding height.

3.10.4 Ground-borne Noise and Human Comfort Vibration Assessment

Where ground-borne noise exceedances are identified then human comfort vibration exceedances would also be present. **Appendix F** illustrates the potential ground borne noise impacts due to vibration intensive construction activities (rock breaking) in this area. In summary the analysis indicates:

- During the day one (1) commercial building, located on Hickson Road to the north of the site is predicted to have high exceedances of the NML of 20 dB to 25 dB. The remaining commercial and residential buildings show a moderate exceedance of the NML of 10 dB to 20 dB.
- During night-time fourteen (14) residential buildings, located on High Street and Kent Street to the east of the excavation site, have regenerated noise levels potentially higher than 45 dBA on several floors. Where residential receivers have night-time internal noise levels greater than 45 dBA they should be considered eligible for Alternative Accommodation (the highest level mitigation measure) as per the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement).

3.10.4.1 Blasting

The use of blasting in the excavation of the station shafts effectively reduces the duration of noise and vibration impacts due to the use of rock breakers which must be used to some extent before blasting can occur. **Table 49** illustrates the effective reduction in duration of the ground-borne noise (and human comfort vibration) exceedances when blasting is used as an alternative excavation methodology. This table also illustrates the effective reduction in duration of these exceedances when blasting is combined with medium rock breakers instead of large rock breakers.

The values in this table represent all exceedances of the NMLs (even those as low as 1 dB to 5 dB). Therefore, the actual requirement for high level mitigation measures is not represented. The information is presented to indicate the benefits in terms of duration of impacts between different excavation methodologies.

Table 49 No. of Periods Above the NMLs Due to Alternative Construction Methodologies

Site	Number of Periods Above NMLs											
	Residential									Commercial		
	Day			Evening			Night			Day		
	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB
Barangaroo	358	171	63	>365	277	174	>365	>365	295	9	6	1

Note: B- = No Blasting, B+ = With Blasting, Lrg RB = Large Rock Breakers, Med RB = Medium Rock Breakers

The duration of the impacts can be summarised as follows:

Residential Day: The use of large rock breakers with no blasting generates 358 daytime periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 171 daytime periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts even further to 63 daytime periods. Blasting coupled with medium rock breaker therefore significantly reduces the impacts during the day.

Residential Evening: The use of large rock breakers with no blasting generates greater than 365 evening periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 277 evening periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts even further to 174 evening periods. Blasting therefore significantly reduces the impacts during the evening.

Residential Night: The use of large rock breakers with no blasting generates greater than 365 night-time periods with exceedances of the NMLs. The inclusion of blasting still results in the duration of impacts being greater than 365 night-time periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts to 295 night-time periods.

Commercial Day: The use of large rock breakers with no blasting generates 9 daytime periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 6 daytime periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts even further to 1 daytime period. Blasting coupled with medium rock breaker therefore reduces the impacts during the day.

With careful planning and positioning of the rock breakers it may be possible to avoid consecutive periods of NML exceedances ie respite periods for receivers could be planned in the construction program through careful rock breaker locations. For any residual exceedances of the NMLs, the processes and mitigation measures identified in the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement) would be implemented.

The potential ground-borne noise impacts associated with the excavation of the tunnels are discussed in **Section 3.16.1**.

3.10.5 Vibration Assessment

During construction of the proposed shafts vibration levels are anticipated to remain well below the vibration screening levels associated with minor cosmetic building damage at all buildings except for one (1) commercial building adjacent to the north of the site on Hickson Road. A more detailed assessment of the structure and attended vibration monitoring would be carried out to ensure vibration levels remain below appropriate limits for this structure. **Appendix G** illustrates the potential cosmetic damage vibration impacts due to construction activities in this area.

3.10.6 Traffic Noise Assessment

Traffic noise levels have been predicted for residential receivers located on the proposed access route to the Barangaroo Station site. In this instance the access to the site is via Hickson Road which is a sub-arterial road with significant daytime flows. The RNP base criteria, predicted $L_{Aeq(15hr)}$ daytime and $L_{Aeq(9hr)}$ nighttime noise levels with the development, and the L_{Aeq} increase and sleep disturbance noise levels have been assessed in **Table 50**.

Table 50 Barangaroo Station Construction Site - Construction Traffic on Public Roads

Access Road	Base Criteria Day/Night ($L_{Aeq(15hr/9hr)}$)	Predicted Road Traffic Noise Day/Night	Predicted Road Traffic Noise Increase (dB) day/night	RBL + 15 dB Screening Criterion (dBA)	External LAmax NML Level (dBA)	Predicted L_{Amax} Noise Level (dBA)
Hickson Rd	60/55	70/64	0.6/1.2	55	65	77

Table 50 indicates that whilst at Hickson Road the base criteria are exceeded, the predicted noise level increase (L_{Aeq}) associated with construction traffic complies with the 2 dB allowance, therefore sensitive receivers are not likely to notice an increase in the average road traffic noise levels during construction. There are expected to be up to 6 heavy vehicle and 2 light vehicles movements or events per hour during the night and whilst there is an exceedance of the sleep disturbance screening criterion (of up to 22 dB) and external sleep disturbance NML of 65 dBA (by up to 12 dB), the L_{Amax} levels would be similar to other heavy vehicles using Hickson Road.

3.11 Martin Place Station Construction Site

3.11.1 Site Layout and Proposed Construction Works

An aerial photograph of the proposed Martin Place Station construction site and the surrounding receiver areas is provided in **Figure 14**, with the nearest noise sensitive receivers identified in **Table 51**.

Figure 14 Martin Place Station Construction Site and Receiver Areas

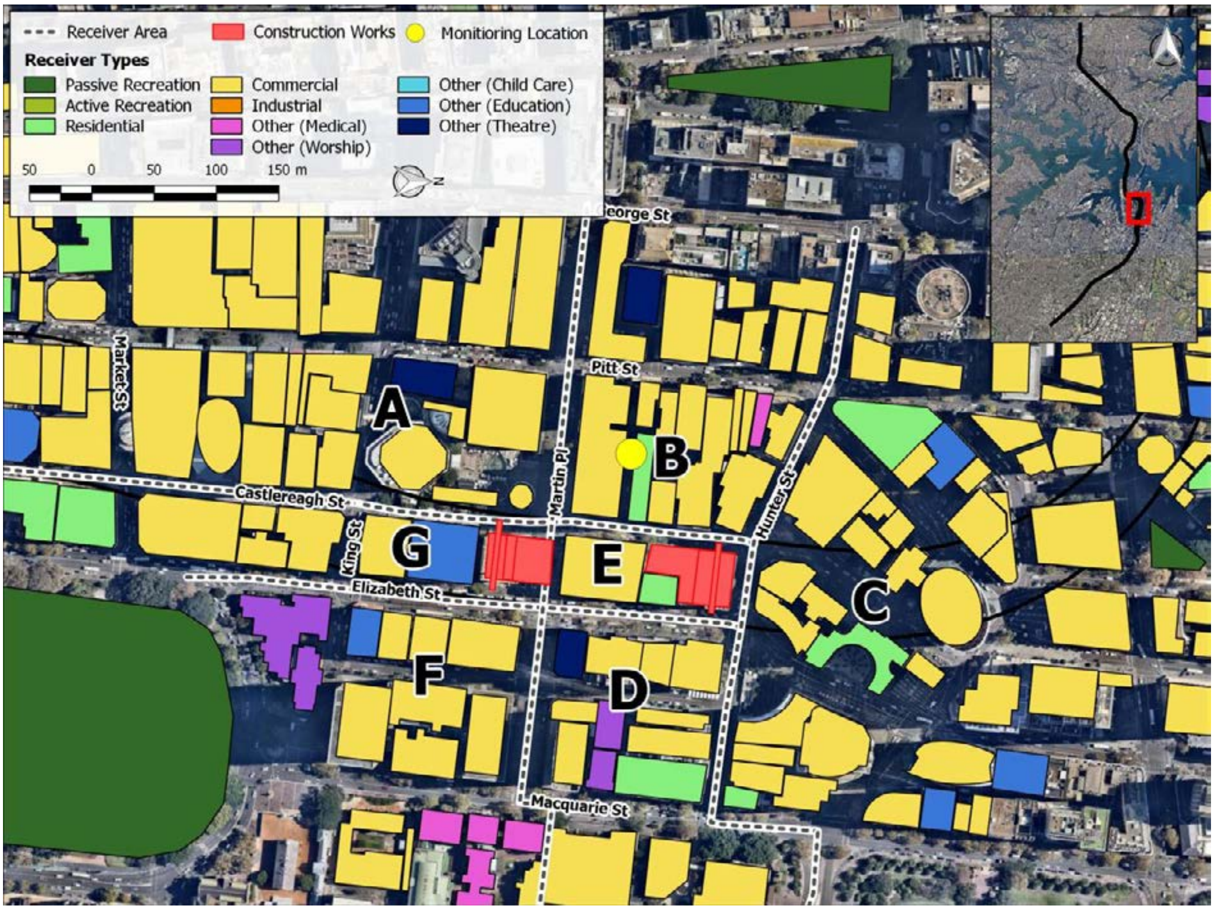


Table 51 Nearest Noise Sensitive Receivers - Martin Place Station Construction Site

Receiver Area	Location Relative to Works (m)[1]
A - Commercial receivers to the west, west of Castlereagh Street and south of Martin Place	27
A - Theatre Royal to the west, west of Castlereagh Street and south of Martin Place	79
B - Residential receivers to the west, west of Castlereagh Street and north of Martin Place.	21
B - Commercial receivers to the west, west of Castlereagh Street and north of Martin Place.	21
C - Residential receivers to the north, north of Hunter Street	
C - Commercial receivers to the north, north of Hunter Street.	25
D - Residential receivers to the east, between Hunter Street and Martin Place	87
D - Commercial receivers to the east, between Hunter Street and Martin Place	35
E - Residential receivers between the two construction sites	3
E - Commercial receivers between the two construction sites	3
F - Commercial receivers to the east, between King Street and Martin Place.	42

Receiver Area	Location Relative to Works (m)[1]
F - Educational to the east, between King Street and Martin Place	105
G - Educational receivers to the south, between Castlereagh Street and Elizabeth Street	10
G - Commercial receivers to the south, between Castlereagh Street and Elizabeth Street	77

Note 1: The relative distance to works shown is that from the nearest sensitive receiver to the closest location of construction activity.

3.11.2 Site Specific Construction Noise Management Levels

With reference to the ambient noise survey results summarised in **Table 4**, the site specific construction NMLs are presented in **Table 52**.

Table 52 Martin Place Station Construction Site Noise Management Levels

Receiver Area	Receiver Type	Relevant Monitoring Location	$L_{Aeq(15minute)}$ Construction NMLs (dBA)			
			Daytime	Daytime OOH	Evening	Night-time
A	Commercial	B.11	70	70	n/a	n/a
A	Special	B.11	50	50	50	n/a
B	Residential	B.11	71	66	61	57
B	Commercial	B.11	70	70	n/a	n/a
C	Residential	B.11	71	66	61	57
C	Commercial	B.11	70	70	n/a	n/a
D	Residential	B.11	71	66	61	57
D	Commercial	B.11	70	70	n/a	n/a
E	Residential	B.11	71	66	61	57
E	Commercial	B.11	70	70	n/a	n/a
F	Commercial	B.11	70	70	n/a	n/a
F	Educational	B.11	55	n/a	n/a	n/a
G	Educational	B.11	55	n/a	n/a	n/a
G	Commercial	B.11	70	70	n/a	n/a

3.11.3 Airborne Noise Assessment at the Nearest Noise Sensitive Receivers

Scenarios were developed for the daytime, evening and night-time periods, to be representative of activities having potentially the greatest noise impact on the surrounding receivers. These scenarios have been developed to be a subset of those discussed in **Section 3.3.1.1**, and are:

- Enabling works including mobilisation and demolition (12 months)
- Earthworks (two months)
- Acoustic shed construction (one month)
- Excavation (three years)
- Station construction (18 months)

Calculations of the typical $L_{Aeq(15minute)}$ noise level exceedances of the NMLs at the nearest noise sensitive receivers are provided in **Appendix D** and are summarised in **Table 53**. The 'sleep' column of the table provides the predicted exceedance of the sleep disturbance screening noise level.

For night-time construction, preliminary modelling indicated that an acoustic shed would be required and was included for the station excavation scenario.

Table 53 Predicted noise level exceedances at Martin Place Station Construction Site

Receiver Area	Scenario: Enabling Works	Earthworks	Acoustic Shed Construction	Excavation with Shed					Construction
	Day	Day	Day	Day	DOOH	Even	Night	Sleep	Day
A - Commercial receivers to the west, west of Castlereagh Street & south of Martin Place	2	2	0	0	0	0	0	0	1
B - Residential receivers to the west, west of Castlereagh Street & north of Martin Place.	2	1	0	0	0	0	1	0	1
B - Commercial receivers to the west, west of Castlereagh Street & north of Martin Place.	2	2	1	0	0	0	0	0	1
C - Residential receivers to the north, north of Hunter Street	1	1	0	0	0	0	0	0	0
C - Commercial receivers to the north, north of Hunter Street.	2	2	0	0	0	0	0	0	1
D - Residential receivers to the east, between Hunter Street and Martin Place	0	0	0	0	0	0	0	0	0
D - Commercial receivers to the east, between Hunter Street and Martin Place	2	2	0	0	0	0	0	0	1
E - Residential receivers between the two construction sites	3	2	1	0	0	1	1	0	2
E - Commercial receivers between the two construction sites	3	2	0	0	0	0	0	0	2
F - Commercial receivers to the east, between King Street and Martin Place.	1	1	0	0	0	0	0	0	1
F - Educational to the east, between King Street and Martin Place	2	2	1	0	0	0	0	0	1
G - Educational receivers to the south, between Castlereagh Street and Elizabeth Street	3	3	2	2	0	0	0	0	3
G - Commercial receivers to the south, between Castlereagh Street and Elizabeth Street	0	0	0	0	0	0	0	0	0

Legend

Category 0	Category 1	Category 2	Category 3
NML Compliance	NML exceedance of less than 10 dB	NML exceedance of between 10 dB and 20 dB	NML exceedance of more than 20 dB

Discussion

The preliminary findings of the construction noise impact assessment at Martin Place Station indicate:

- The predicted noise levels for enabling works (including mobilisation/demolition) indicate high exceedances of more than 20 dB of the NMLs at educational receivers in Area G and the residential receivers in Area E. Moderate exceedances of more than 10 dB are predicted at residential receivers in Areas B and educational receivers in Area F. At residential receivers in area C minor exceedances of less than 10 dB are predicted.

At the nearest commercial receivers in Area E high exceedances of more than 20 dB of the NMLs are predicted, and at commercial receivers in Areas A, B, C and D moderate exceedances of more than 10 dB. Minor exceedances are predicted at commercial receivers in Area F.

- The predicted noise levels for earthworks indicate high exceedances of more than 20 dB of the NMLs at the educational receivers in Area G. At the educational receivers in Area F and residences in Area E moderate exceedances are predicted. At residences in Area B and C minor exceedances of the NMLs are predicted.

  At the nearest commercial receivers in Areas A, B, C, D and E moderate exceedances of the NMLs are predicted, with minor exceedances in Area F.

- During the acoustic shed construction a moderate exceedance is predicted at educational receivers in Area G and minor exceedances at educational receivers in Area F, the residential receivers in Area E, and commercial receivers in Area B.
- During excavation with an acoustic shed a moderate exceedance of more than 10 dB is predicted the educational receivers in Area G, and compliance at all other receivers during daytime. For night-time there are minor exceedances at residences in Area B and E.
- During station construction major exceedances are predicted at the educational receivers in Area G and moderate exceedances at residences in Area E and commercial receivers at Area E. Minor exceedances are predicted at educational receivers in Area F, at residential receivers in Area B and at commercial receivers in Area A, B, C, D and F.
- At the Channel Seven studio on Martin Place noise levels are predicted to be up to 79 dBA, and at the Theatre Royal up to 69 dBA. At both locations these levels would be similar to external noise levels from heavy vehicles on Castlereagh Street, and Pitt Street respectively, and general city noise. The building external to internal noise reduction would therefore adequately attenuate noise from the works to the news room and theatre respectively.

On Site Night-Time L_{Amax} Truck Noise

The maximum noise levels associated with on-site truck movements, deliveries by semitrailer and other activities on site can potentially cause awakening reactions (or sleep disturbance) at nearby residential receivers. The L_{Amax} noise levels associated with these events comply with the sleep disturbance screening level.

3.11.4 Ground-borne Noise and Human Comfort Vibration Assessment

Where ground-borne noise exceedances are identified then human comfort vibration exceedances would also be present. **Appendix F** illustrates the potential ground borne noise impacts due to vibration intensive construction activities (rockbreaking) in this area. In summary the analysis indicates:

- During the day two (2) commercial buildings (one to the south of the northern site and one to the south of the southern site) are predicted to have ground-borne noise levels potentially higher than 75 dBA for several floors, this correlates to very high NML exceedances of greater than 25 dB.

  A further five (5) commercial buildings, located to the west of both sites, show high exceedances of the NML of 20 dB to 25 dB. The nearest residential receiver, located to the west on Castlereagh Street between Hunter Street and Martin Place, shows a moderate exceedance of the NML of 10 dB to 20 dB. Where receivers experience day-time internal noise levels greater than 75 dBA more detailed site specific ground borne noise investigation is required. If this investigation finds ground borne noise levels are likely to exceed 75 dBA for extended periods then alternative accommodation would be considered as a mitigation measure.

- During night-time one (1) residential building to the west on Castlereagh Street between Hunter Street and Martin Place has regenerated noise levels potentially higher than 45 dBA on one or more floors. Where residential receivers have night-time internal noise levels greater than 45 dBA they should be considered eligible for Alternative Accommodation (the highest level mitigation measure) as per the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement).

The Theatre Royal (theatre) is located approximately 100 m from the proposed station excavation works. The ground-borne noise levels would be up to $L_{Aeq(15minute)}$ 30 dBA within the theatre during rock breaker works, assuming that a large rock breaker would be utilised, which complies with the 30 dBA criteria.

3.11.4.1 Blasting

The use of blasting in the excavation of the station shafts effectively reduces the duration of noise and vibration impacts due to the use of rock breakers which must be used to some extent before blasting can occur. **Table 54** illustrates the effective reduction in duration of the ground-borne noise (and human comfort vibration) exceedances when blasting is used as an alternative excavation methodology. This table also illustrates the effective reduction in duration of these exceedances when blasting is combined with medium rock breakers instead of large rock breakers.

The values in this table represent all exceedances of the NMLs (even those as low as 1 dB to 5 dB). Therefore, the actual requirement for high level mitigation measures is not represented. The information is presented to indicate the benefits in terms of duration of impacts between different excavation methodologies.

Table 54 No. of Periods Above the NMLs Due to Alternative Construction Methodologies

Site	Number of Periods Above NMLs											
	Residential									Commercial		
	Day			Evening			Night			Day		
	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB
Martin Place - North	2	0	0	5	1	0	9	1	1	225	42	22
Martin Place - South	0	0	0	0	0	0	0	0	0	32	18	9

Note: B- = No Blasting, B+ = With Blasting, Lrg RB = Large Rock Breakers, Med RB = Medium Rock Breakers

The duration of the impacts can be summarised as follows:

Residential Day: The use of large rock breakers with no blasting generates 2 daytime periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to zero (0) daytime periods.

Residential Evening: the use of large rock breakers with no blasting generates 5 evening periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 1 evening period.

Residential Night: The use of large rock breakers with no blasting generates 9 night-time periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 1 night-time period.

Commercial Day: The use of large rock breakers with no blasting generates 257 daytime periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 60 daytime periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts even further to 31 daytime periods. Blasting coupled with medium rock breaker therefore significantly reduces the impacts during the day.

With careful planning and positioning of the rock breakers it may be possible to avoid consecutive periods of NML exceedances ie respite periods for receivers could be planned in the construction program through careful rock breaker locations. For any residual exceedances of the NMLs, the processes and mitigation measures identified in the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement) would be implemented.

The potential ground-borne noise impacts associated with the excavation of the tunnels are discussed in **Section 3.16.1**.

3.11.5 Vibration Assessment

During construction of the proposed shafts vibration levels are anticipated to remain well below the vibration screening levels associated with minor cosmetic building damage for all the surrounding buildings except for one (1) commercial building located immediately to the south of the southern shaft. A more detailed assessment of the structure and attended vibration monitoring would be carried out to ensure vibration levels remain below appropriate limits for this structure.**Appendix G** illustrates the potential cosmetic damage vibration impacts due to construction activities in this area.

No exceedance of the 7.5 mm/s screening criteria is predicted at the Commonwealth Bank building which is listed as a heritage building. Despite this finding, as a further precaution a dilapidation survey, vibration monitoring and more detailed site vibration investigation are recommended for the Commonwealth Bank building.

3.11.6 Traffic Noise Assessment

Traffic noise levels have been predicted for residential receivers located on the proposed access route to the Martin Place Station site. In this instance the access to the site is via Hunter Street, Castlereagh Street and Elizabeth Street which are sub-arterial roads with significant daytime flows. The RNP base criteria, predicted LAeq(15hr) daytime and LAeq(9hr) nighttime noise levels with the development, and the L_{Aeq} increase and sleep disturbance noise levels have been assessed in **Table 55**.

Table 55 Martin Place Station Construction Site - Construction Traffic on Public Roads

Access Road	Base Criteria Day/Night (LAeq(15hr/9hr)	Predicted Road Traffic Noise Day/Night	Predicted Road Traffic Noise Increase (dB) day/night	RBL + 15 dB Screening Criterion (dBA)	External LAmax NML Level (dBA)	Predicted LAmax Noise Level (dBA)
Hunter St	60/55	70/66	0.3/0.4	67	65	78
Castlereagh St	60/55	69/64	0.4/0.6	67	65	78
Elizabeth St	60/55	73/69	0.2/0.2	67	65	78

Table 55 indicates that whilst at Hunter Street, Castlereagh Street and at Elizabeth Street the base criteria are exceeded, the predicted noise level increase (LAeq) associated with construction traffic complies with the 2 dB allowance, therefore sensitive receivers are not likely to notice an increase in the average road traffic noise levels during construction. There are expected to be up to 6 heavy vehicle and 2 light vehicles movements or events per hour during the night and whilst there is an exceedance of the sleep disturbance screening criterion (of up to 11 dB) and external sleep disturbance NML of 65 dBA (by up to 13 dB), the LAmax levels would be similar to other heavy vehicles using Hunter Street, Castlereagh Street and Elizabeth Street.

3.12 Pitt Street Station Construction Site

3.12.1 Site Layout and Proposed Construction Works

An aerial photograph of the proposed Pitt Street Station construction site and the surrounding receiver areas is provided in **Figure 15**, with the nearest noise sensitive receivers identified in **Table 56**.

Figure 15 Pitt Street Station Construction Site and Receiver Areas

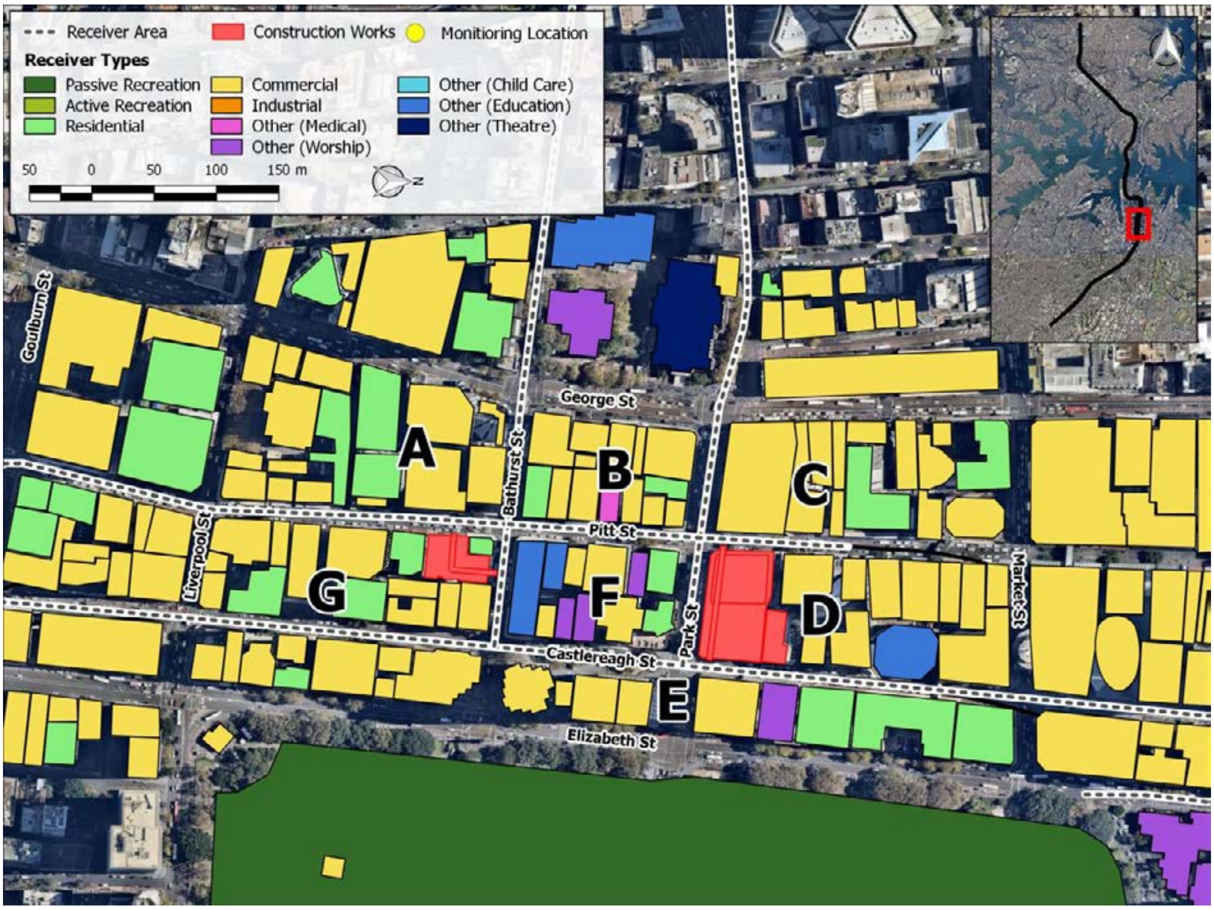


Table 56 Nearest Noise Sensitive Receivers - Pitt Street Station Construction Site

Receiver Area	Location Relative to Works (m)[1]
A - Residential receivers to the west, west of Pitt Street and south of Bathurst Street	45
A - Commercial receivers to the west, west of Pitt Street and south of Bathurst Street	25
B - Residential receivers to the west, west of Pitt Street and north of Bathurst Street.	45
B - Commercial receivers to the west, west of Pitt Street and north of Bathurst Street.	55
C - Residential receivers to the west, west of Pitt Street and north of Park Street.	76
C - Commercial receivers to the west, west of Pitt Street and north of Park Street.	19

Receiver Area	Location Relative to Works (m)[1]
D - Commercial receivers to the north, between Pitt Street and Castlereagh Street	2
E - Residential receivers to the east	50
E - Commercial receivers to the east	20
F – Residential receivers between Park Street and Bathurst Street.	24
F - Commercial receivers between Park Street and Bathurst Street.	58
F - Educational receivers between Park Street and Bathurst Street.	26
G - Residential receivers to the north and south, between Pitt Street and Castlereagh Street	2
G - Commercial receivers to the south, between Pitt Street and Castlereagh Street	2

Note 1: The relative distance to works shown is that from the nearest sensitive receiver to the closest location of construction activity.

3.12.2 Site Specific Construction Noise Management Levels

With reference to the ambient noise survey results summarised in **Table 4**, the site specific construction NMLs are presented in **Table 57**.

Table 57 Pitt Street Station Construction Site Noise Management Levels

Receiver Area	Receiver Type	Relevant Monitoring Location	$L_{Aeq(15minute)}$ Construction NMLs (dBA)			
			Daytime	Daytime OOH	Evening	Night-time
A	Residential	B.27	76	71	69	66
A	Commercial	B.27	70	70	n/a	n/a
B	Residential	B.27	76	71	69	66
B	Commercial	B.27	70	70	n/a	n/a
C	Residential	B.27	76	71	69	66
C	Commercial	B.27	70	70	n/a	n/a
D	Commercial	B.27	70	70	n/a	n/a
E	Residential	B.27	76	71	69	66
E	Commercial	B.27	70	70	n/a	n/a
F	Residential	B.27	76	71	69	66
F	Commercial	B.27	70	70	n/a	n/a
F	Educational	B.27	55	n/a	n/a	n/a
G	Residential	B.27	76	71	69	66
G	Commercial	B.27	70	70	n/a	n/a

3.12.3 Airborne Noise Assessment at the Nearest Noise Sensitive Receivers

Scenarios were developed for the daytime, evening and night-time periods, to be representative of activities having potentially the greatest noise impact on the surrounding receivers.

These scenarios have been developed to be a subset of those discussed in **Section 3.3.1.1**, and are:

- Enabling works including mobilisation and demolition (12 months)
- Earthworks (two months)
- Acoustic shed construction (one month)
- Excavation (three years)
- Station construction (18 months)

Calculations of the typical $L_{Aeq(15minute)}$ noise level exceedances of the NMLs at the nearest noise sensitive receivers are provided in **Appendix D** and are summarised in **Table 58**. The 'sleep' column of the table provides the predicted exceedance of the sleep disturbance screening noise level.

For night-time construction, preliminary modelling indicated that an acoustic shed would be required and was included for the station excavation scenario.

Table 58 Predicted noise level exceedances at Pitt Street Station Construction Site

Receiver Area	Scenario								
	Enabling Works	Earthworks	Acoustic Shed Construction	Excavation with Shed					Construction
	Day	Day	Day	Day	DOOH	Even	Night	Sleep	Day
A – Residential receivers to the west, west of Pitt Street and south of Bathurst Street	0	0	0	0	0	0	0	0	0
A – Commercial receivers to the west, west of Pitt Street and south of Bathurst Street	2	2	0	0	0	0	0	0	1
B – Residential receivers to the west, west of Pitt Street and north of Bathurst Street.	1	1	0	0	0	0	0	0	0
B – Commercial receivers to the west, west of Pitt Street and north of Bathurst Street.	1	1	0	0	0	0	0	0	1
C – Residential receivers to the west, west of Pitt Street and north of Park Street.	0	0	0	0	0	0	0	0	0
C – Commercial receivers to the west, west of Pitt Street and north of Park Street.	2	2	1	0	0	0	0	0	1
D – Commercial receivers to the north, between Pitt Street and Castlereagh Street	3	2	1	0	0	0	0	0	2
E – Residential receivers to the east	0	0	0	0	0	0	0	0	0
E – Commercial receivers to the east	2	2	0	0	0	0	0	0	1
F – Residential receivers between Park Street and Bathurst Street.	1	1	0	0	0	0	0	0	1
F – Commercial receivers between Park Street and Bathurst Street.	1	1	0	0	0	0	0	0	1
F – Educational receivers between Park Street and Bathurst Street.	3	3	2	1	0	0	0	0	3
G – Residential receivers to the south, between Pitt Street and Castlereagh Street	3	2	1	0	0	0	1	0	3
G – Commercial receivers to the south, between Pitt Street and Castlereagh Street.	3	3	2	0	0	0	0	0	3

Legend

Category 0	Category 1	Category 2	Category 3
NML Compliance	NML exceedance of less than 10 dB	NML exceedance of between 10 dB and 20 dB	NML exceedance of more than 20 dB

Discussion

The preliminary findings of the construction noise impact assessment at Pitt Street Station indicate:

- The predicted noise levels for enabling works) indicate high exceedances of more than 20 dB of the NMLs at the residential receivers in Area G and at educational receivers in Area F. At residential receivers in area B and F, minor exceedances are predicted.

  At the nearest commercial receivers in Areas D, and G high exceedances of more than 20 dB of the NMLs are predicted, and at commercial receivers in Areas A, C and E moderate exceedances of more than 10 dB. Minor exceedances are predicted at commercial receivers in Areas B and F.

- The predicted noise levels for earthworks indicate high exceedances of more than 20 dB of the NMLs at the educational receivers in Area F. Minor exceedances of more than 10 dB are predicted at residential receivers in Area G.

  At the nearest commercial receivers in Area G high exceedances of more than 20 dB of the NMLs are predicted, and at commercial receivers in Areas A, C, D and E moderate exceedances of more than 10 dB. Minor exceedances are predicted at commercial receivers in Areas B, and F. During the acoustic shed construction a moderate exceedance is predicted at educational receivers in Area F and commercial receivers in Area G. Minor exceedances at residential receivers in Area G and commercial receivers in Area C and D are predicted.

- During excavation with an acoustic shed a minor exceedance of less than 10 dB is predicted at educational receivers in Area F during the daytime.

- During station construction major exceedances are predicted at residential receivers in Area G, the educational receivers in Area F and the commercial receivers in Area G. Moderate exceedances at commercial receivers at Area D. Minor exceedances are predicted at the residential receivers in Area F, and at commercial receivers in Area A, B, C, E and F.

- At Town Hall external noise levels are predicted to be up to 68 dBA. These levels will be similar to existing noise from heavy vehicles on George Street and other city noise. The buildings external to internal noise reduction will be expected to attenuate noise from the works to levels similar to those from heavy vehicles on George Street to the performance space.

On Site Night-Time L_{Amax} Noise

The maximum noise levels associated with on-site truck movements, deliveries by semitrailer and other activities on site can potentially cause awakening reactions (or sleep disturbance) at nearby residential receivers. The L_{Amax} noise levels associated with these events comply with the sleep disturbance screening level during excavation with an acoustic shed.

3.12.4 Ground-borne Noise and Human Comfort Vibration Assessment

Where ground-borne noise exceedances are identified then human comfort vibration exceedances would also be present. **Appendix F** illustrates the potential ground borne noise impacts due to vibration intensive construction activities (rock breaking) in this area. In summary the analysis indicates:

- During the day one (1) building adjacent to the northern shaft (to the north on Pitt Street) and the four (4) buildings immediately adjacent to the southern shaft have regenerated noise levels potentially higher than 75 dBA on several floors in each building. Where receivers experience day-time internal noise levels greater than 75 dBA more detailed site specific ground borne noise investigation is required. If this investigation finds ground borne noise levels are likely to exceed 75 dBA for extended periods then alternative accommodation would be considered as a mitigation measure.

- During night-time works the analysis shows three (3) residential buildings at the northern shaft (one to the north on Pitt Street, and two to the south on Park Street) and four (4) residential buildings at the southern shaft (one to the south on Pitt Street, one to the south on Castlereagh Street and two to the west on Pitt Street) have regenerated noise levels potentially higher than 45 dBA on several floors in each building. Where residential receivers have night-time internal noise levels greater than 45 dBA they would be considered eligible for alternative accommodation (the highest level mitigation measure) as per the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement).

3.12.4.1 Blasting

The use of blasting in the excavation of the station shafts effectively reduces the duration of noise and vibration impacts due to the use of rock breakers which must be used to some extent before blasting can occur. **Table 59** illustrates the effective reduction in duration of the ground-borne noise (and human comfort vibration) exceedances when blasting is used as an alternative excavation methodology. This table also illustrates the effective reduction in duration of these exceedances when blasting is combined with medium rock breakers instead of large rock breakers.

The values in this table represent all exceedances of the NMLs (even those as low as 1 dB to 5 dB). Therefore, the actual requirement for high level mitigation measures is not represented. The information is presented to indicate the benefits in terms of duration of impacts between different excavation methodologies.

Table 59 No. of Periods Above the NMLs Due to Alternative Construction Methodologies

Site	Number of Periods Above NMLs											
	Residential									Commercial		
	Day			Evening			Night			Day		
	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB
Pitt Street - North	48	25	4	123	52	24	181	69	54	41	22	12
Pitt Street - South	76	33	23	129	53	35	212	83	56	116	60	36

Note: B- = No Blasting, B+ = With Blasting, Lrg RB = Large Rock Breakers, Med RB = Medium Rock Breakers

The duration of the impacts can be summarised as follows:

Residential Day: The use of large rock breakers with no blasting generates 124 daytime periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 58 daytime periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts even further to 27 daytime periods. Blasting coupled with medium rock breaker therefore significantly reduces the impacts during the day.

Residential Evening: The use of large rock breakers with no blasting generates 252 evening periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 105 evening periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts even further to 59 evening periods. Blasting therefore significantly reduces the impacts during the evening.

Residential Night: The use of large rock breakers with no blasting generates greater than 365 night-time periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 152 night-time periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts even further to 60 night-time periods.

Commercial Day: The use of large rock breakers with no blasting generates 157 daytime periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 82 daytime periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts even further to 48 daytime periods. Blasting coupled with medium rock breaker therefore significantly reduces the impacts during the day.

With careful planning and positioning of the rock breakers it may be possible to avoid consecutive periods of NML exceedances ie respite periods for receivers could be planned in the construction program through careful rock breaker locations. For any residual exceedances of the NMLs, the processes and mitigation measures identified in the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement) would be implemented.

The potential ground-borne noise impacts associated with the excavation of the tunnels are discussed in **Section 3.16.1**.

3.12.5 Vibration Assessment

During construction of the proposed shafts vibration levels are anticipated to exceed the vibration screening levels associated with minor cosmetic building damage. The analysis shows five (5) buildings at the southern site (the buildings immediately adjacent on Bathurst, Pitt and Castlereagh streets) and one (1) building adjacent to the northern site (to the north on Pitt Street) where the screening criteria for cosmetic damage may be exceeded. A more detailed assessment of the structure and attended vibration monitoring would be carried out to ensure vibration levels remain below appropriate limits for these structures. **Appendix G** illustrates the potential cosmetic damage vibration impacts due to construction activities in this area.

3.12.6 Traffic Noise Assessment

Traffic noise levels have been predicted for residential receivers located on the proposed access route to the Pitt Street Station site. In this instance the access to the site is via Pitt Street north and south of the site, Castlereagh Street and Bathurst Street which are sub-arterial roads with significant daytime flows. The RNP base criteria, predicted $L_{Aeq(15hr)}$ daytime and $L_{Aeq(9hr)}$ nighttime noise levels with the development, and the L_{Aeq} increase and sleep disturbance noise levels have been assessed in **Table 60**.

Table 60 Pitt Street Station Construction Site - Construction Traffic on Public Roads

Access Road	Base Criteria Day/Night ($L_{Aeq(15hr/9hr)}$)	Predicted Road Traffic Noise Day/Night	Predicted Road Traffic Noise Increase (dB) day/night	RBL + 15 dB Screening Criterion (dBA)	External LAmax NML Level (dBA)	Predicted LAmax Noise Level (dBA)
Pitt St South	60/55	67/62	0.5/0.7	76	65	76
Pitt St North	60/55	65/61	0.5/0.4	76	65	76
Castlereagh St	60/55	67/61	0.2/0.4	76	65	76
Bathurst St	60/55	70/67	0.2/0.2	76	65	76

Table 60 indicates that whilst at Pitt Street, Castlereagh Street and at Bathurst Street the base criteria are exceeded, the the predicted noise level increase (L_{Aeq}) associated with construction traffic complies with the 2 dB allowance, therefore sensitive receivers are not likely to notice an increase in the average road traffic noise levels during construction. There are expected to be up to 6 heavy vehicle and 2 light vehicles movements or events per hour during the night and whilst there is compliance with the sleep disturbance screening criterion, there is an exceedance of the external sleep disturbance NML of 65 dBA (by up to 11 dB). The L_{Amax} levels would however, be similar to other heavy vehicles using Pitt Street, Castlereagh Street and Bathurst Street.

3.13 Central Station Construction Site

3.13.1 Site Layout and Proposed Construction Works

An aerial photograph of the proposed Central Station construction site and the surrounding receiver areas is provided in **Figure 16**, with the nearest noise sensitive receivers identified in **Table 61**.

Figure 16 Central Station Construction Site and Receiver Areas

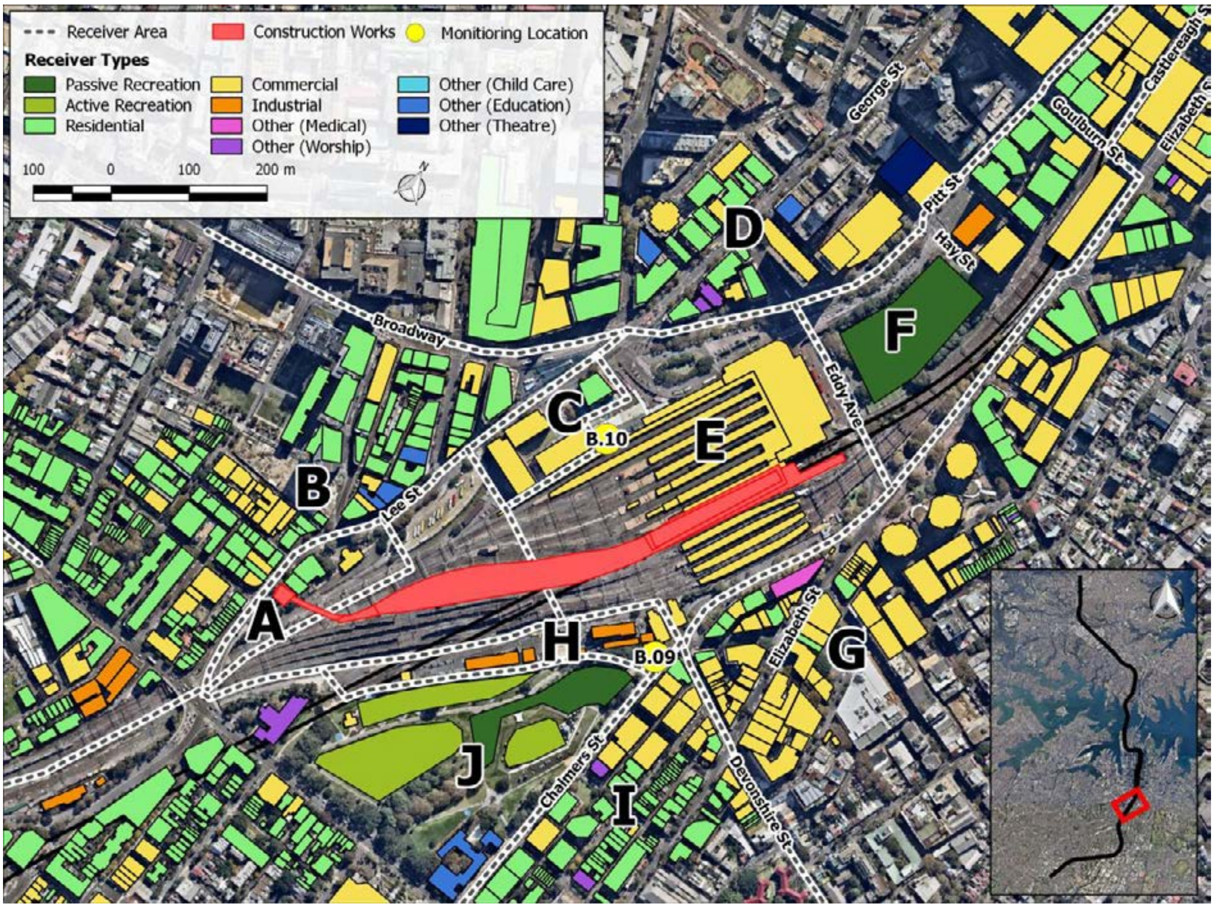


Table 61 Nearest Noise Sensitive Receivers – Central Station Construction Site

Receiver Area	Location Relative to Works (m)[1]
A - Residential receivers to the west, east of Regent Street.	5
B - Residential receivers to the east, west of Regent Street	20
B - Commercial receivers to the west, east of Lee Street	20
C - Residential receivers to the east, east of Regent Street	170
C - Commercial receivers to the east, east of Regent Street	110
D - Residential receivers to the west, west of Pitt Street	210
D - Church to the west, west of Pitt Street	210
E - Commercial receivers surrounding at Central Station	5
F - Belmore Park to the north	60
G - Residential receivers to the east, east of Chalmers Street	95
G – Sydney Dental Hospital to the east, east of Chalmers St.	95

Receiver Area	Location Relative to Works (m)[1]
H - Commercial receivers to the east, west of Prince Alfred Pk.	65
I - Residential receivers to the east, south of Devonshire St.	125
I - Commercial receivers to the east, south of Devonshire St.	140
J - Prince Alfred Park	110

Note 1: The relative distance to works shown is that from the nearest sensitive receiver to the closest location of construction activity.

3.13.2 Site Specific Construction Noise Management Levelss

With reference to the ambient noise survey results summarised in **Table 4**, the site specific construction NMLs are presented in **Table 62**.

Table 62 Central Station Construction Site Noise Management Levels

Receiver Area	Receiver Type	Relevant Monitoring Location	$L_{Aeq(15minute)}$ Construction NMLs (dBA)			
			Daytime	Daytime OOH	Evening	Night-time
A	Residential	B.26	68	63	61	57
B	Residential	B.26	68	63	61	57
B	Commercial	B.26	70	70	n/a	n/a
C	Residential	B.26	68	63	61	57
D	Residential	B.26	68	63	61	57
D	Church	B.26	55	55	n/a	n/a
E	Commercial	B.26	70	70	n/a	n/a
F	Recreation	B.26	60	60	n/a	n/a
G	Residential	B.09	66	61	58	50
G	Medical	B.09	55	55	n/a	n/a
H	Commercial	B.09	70	70	n/a	n/a
I	Residential	B.09	66	61	58	50
I	Commercial	B.09	70	70	n/a	n/a
J	Recreation	B.09	60	60	n/a	n/a

3.13.3 Airborne Noise Assessment at the Nearest Noise Sensitive Receivers

Scenarios were developed for the daytime, evening and night-time periods, to be representative of activities having potentially the greatest noise impact on the surrounding receivers. These scenarios have been developed to be a subset of those discussed in **Section 3.3.1.1**, and are:

- Enabling works including mobilisation and demolition (18 months)
- Earthworks (two months)
- Excavation (three and a half years)
- Station construction (12 months)

Calculations of the typical $L_{Aeq(15minute)}$ noise level exceedances of the NMLs at the nearest noise sensitive receivers are provided in **Appendix D** and are summarised in **Table 63**. The ‘sleep’ column of the table provides the predicted exceedance of the sleep disturbance screening noise level.

Table 63 Predicted noise level exceedances at Central Station Construction Site

Receiver Area	Scenario							
	Enabling Works	Earthworks	Excavation					Construction
	Day	Day	Day	OOH	Even	Night	Sleep	Day
A - Residential receivers to the west, east of Regent Street.	3	3	0	0	0	1	0	0
B - Residential receivers to the east, west of Regent Street	2	1	0	0	0	0	0	0
B - Commercial receivers to the west, east of Lee Street	2	1	0	0	0	0	0	0
C - Residential receivers to the east, east of Regent Street	0	0	0	0	0	1	0	0
C - Commercial receivers to the east, east of Regent Street	0	0	0	0	0	0	0	0
D - Residential receivers to the west, west of Pitt Street	0	0	0	0	0	0	0	0
D - Church to the west, west of Pitt Street	1	0	0	0	0	0	0	0
E - Commercial receivers surrounding at Central Station	3	3	2	2	0	0	0	3
F - Belmore Park to the north	2	1	0	0	0	0	0	0
G - Residential receivers to the east, east of Chalmers Street	1	1	0	1	1	2	1	0
G - Sydney Dental Hospital to the east, east of Chalmers St.	2	2	1	1	0	0	0	1
H - Commercial receivers to the east, west of Prince Alfred Pk.	1	1	0	0	0	0	0	0
I - Residential receivers to the east, south of Devonshire St.	1	0	0	0	1	2	1	0
I - Commercial receivers to the east, south of Devonshire St.	0	0	0	0	0	0	0	0
J - Prince Alfred Park	1	0	0	0	0	0	0	0

Legend

Exceedance Category 0	Exceedance Category 1	Exceedance Category 2	Exceedance Category 3
NML Compliance	NML exceedance of less than 10 dB	NML exceedance of between 10 dB and 20 dB	NML exceedance of more than 20 dB

Discussion

The preliminary findings of the construction noise impact assessment at Central Station indicate:

- The predicted noise levels for enabling works (including mobilisation/demolition/earthworks) indicate high exceedances of more than 20 dB of the NMLs at the residential receivers in Area A. Moderate exceedances of more than 10 dB are predicted at residential receivers in Area B, at the Sydney Dental Hospital and at Belmore Park. At residential receivers in area G and I, at the Church in Area D and at Prince Alfred Park minor exceedances are predicted.

  At the nearest commercial receivers in Area E high exceedances of more than 20 dB of the NMLs are predicted. At commercial receivers in Area B moderate exceedances of more than 10 dB are predicted. Minor exceedances are predicted at commercial Areas H.
- The predicted noise levels for earthworks indicate high exceedances of more than 20 dB of the NMLs at the residential receivers in Area A. At residential receivers in Areas B and G, at the Sydney Dental Hospital and at Belmore Park minor exceedances are predicted.

At the nearest commercial receivers in Area E high exceedances of more than 20 dB of the NMLs are predicted. Minor exceedances are predicted at commercial receivers in Areas B, and H.

Compliance during earthworks is predicted at residential receivers in Areas C, D and I, at the Church and at commercial receivers in Areas C, and I.

- During excavation during daytime there is a moderate exceedance of more than 10 dB at commercial receivers in Area E, a minor exceedance at the Sydney Dental Hospital and compliance at all other locations. For excavation during DOOH and evenings there is a minor exceedance of up to 10 dB for residences in Area G, and during DOOH a minor exceedance at the Sydney Dental Hospital

  For night-time excavation works there are moderate exceedances of more than 10 dB at residences in area G and I and minor exceedances of up to 10 dB at residences in area A and C.

- During construction there is a major exceedance at commercial receivers in Area E, a minor exceedance at the Sydney Dental Hospital and compliance at all other areas.

On Site Night-Time L_{Amax} Noise

The maximum noise levels associated with on-site truck movements, deliveries by semitrailer and other activities on site can potentially cause awakening reactions (or sleep disturbance) at nearby residential receivers. The L_{Amax} noise levels associated with these events exceed the sleep disturbance screening level during the construction phase. During the detailed design night-time 'on site' traffic routes and activities should be reviewed and/or additional mitigation such as increased site perimeter hoarding height.

3.13.4 Ground-borne Noise and Human Comfort Vibration Assessment

Appendix F illustrates the potential ground borne noise impacts due to vibration intensive construction activities (rock breaking) in this area. In summary the analysis indicates:

- During the day ground borne noise levels inside the adjacent station buildings and on platforms has the potential to exceed 75 dBA during rock breaking activities. However, no mitigation measures are likely to be required for this site because of the existing ambient noise levels from normal operation of the station.
- During the day three (3) commercial buildings, located to the east around the northern corner of Prince Alfred Park, are predicted to have regenerated noise levels potentially higher than 75 dBA on several floors in each building. Where receivers experience day-time internal noise levels greater than 75 dBA more detailed site specific ground borne noise investigation is required. If this investigation finds ground borne noise levels are likely to exceed 75 dBA for extended periods then alternative accommodation would be considered as a mitigation measure.
- During night-time works the analysis shows one (1) residential building, located on the corner of Devonshire and Chalmers streets, has regenerated noise levels potentially higher than 45 dBA on several floors. Where residential receivers have night-time internal noise levels greater than 45 dBA they would be considered eligible for alternative accommodation (the highest level mitigation measure) as per the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement). Other potential mitigation measures would include alternative excavation techniques such as blasting and penetrative cone fracture (PCF).

The potential ground-borne noise impacts associated with the excavation of the tunnels are discussed in **Section 3.16.1**.

3.13.5 Vibration Assessment

During construction of the proposed excavation vibration levels are anticipated to exceed the vibration screening levels associated with minor cosmetic building damage. The analysis shows two (2) station platforms where the screening criteria for cosmetic damage may be exceeded. A further three (3) commercial buildings (located to the east around the northern corner of Prince Alfred Park) are predicted to exceed the screening criterion. A more detailed assessment of the structure and attended vibration monitoring would be carried out to ensure vibration levels remain below appropriate limits for these structures. **Appendix G** illustrates the potential cosmetic damage vibration impacts due to construction activities in this area.

3.13.6 Traffic Noise Assessment

Traffic noise levels have been predicted for residential receivers located on the proposed access route to the Central Station site. In this instance the access to the site is via Regent Street and Chalmers Street which are sub-arterial roads with significant daytime flows. The RNP base criteria, predicted $L_{Aeq(15hr)}$ daytime and $L_{Aeq(9hr)}$ nighttime noise levels with the development, and the L_{Aeq} increase and sleep disturbance noise levels have been assessed in **Table 64**.

Table 64 Central Station Construction Site - Construction Traffic on Public Roads

Access Road	Base Criteria Day/Night ($L_{Aeq(15hr/9hr)}$)	Predicted Road Traffic Noise Day/Night	Predicted Road Traffic Noise Increase (dB)	RBL + 15 dB Screening Criterion (dBA)	External LAmax NML Level (dBA)	Predicted L_{Amax} Noise Level (dBA)
Regent Street	60/55	74/70	0.1/0.2	67	65	78
Chalmers Street	60/55	72/67	0.2/0.3	60	65	78

Table 64 indicates that whilst at Regent Street and at Chalmers Street the base criteria are exceeded, the the predicted noise level increase (L_{Aeq}) associated with construction traffic complies with the 2 dB allowance, therefore sensitive receivers are not likely to notice an increase in the average road traffic noise levels during construction. There are expected to be up to 6 heavy vehicle and 2 light vehicles movements or events per hour during the night and whilst there is an exceedance of the sleep disturbance screening criterion (of up to 18 dB) and external sleep disturbance NML of 65 dBA (by up to 13 dB), the L_{Amax} levels would be similar to other heavy vehicles using Regent Street and Chalmers Street.

3.14 Waterloo Station Construction Site

3.14.1 Site Layout and Proposed Construction Works

An aerial photograph of the proposed Waterloo Street Station construction site and the surrounding receiver areas is provided in **Figure 17**, with the nearest noise sensitive receivers identified in **Table 65**.

Figure 17 Waterloo Station Construction Site and Receiver Areas

Table 65 Nearest Noise Sensitive Receivers – Waterloo Station Construction Site

Receiver Area	Location Relative to Works (m)[1]
A - Residential receivers north of Raglan Street	16
B - Residential receivers east of Cope Street	25
C - Residential receivers south of Buckland Street	18
C - Commercial receivers south of Buckland Street	18
D - Residential receivers west of Botany Road	23
D - Place of worship receivers west of Botany Road	16
D - Commercial receivers east of Botany Road	43

Note 1: The relative distance to works shown is that from the nearest sensitive receiver to the closest location of construction activity.

3.14.2 Site Specific Construction Noise Management Levels

With reference to the ambient noise survey results summarised in **Table 4**, the site specific construction NMLs are presented in **Table 66**.

Table 66 Waterloo Station Construction Site Noise Management Levels

Receiver Area	Receiver Type	Relevant Monitoring Location	$L_{Aeq(15minute)}$ Construction NMLs (dBA)			
			Daytime	Daytime OOH	Evening	Night-time
A	Residential	B.06	64	59	52	44
B	Residential	B.06	64	59	52	44
C	Residential	B.06	64	59	52	44
C	Commercial	B.06	70	70	n/a	n/a
D	Residential	B.06	64	59	52	44
D	Place of Worship	B.06	70	70	n/a	n/a
D	Commercial	B.06	70	70	n/a	n/a

3.14.3 Airborne Noise Assessment at the Nearest Noise Sensitive Receivers

Scenarios were developed for the daytime, evening and night-time periods, to be representative of activities having potentially the greatest noise impact on the surrounding receivers. These scenarios have been developed to be a subset of those discussed in **Section 3.3.1.1**, and are:

- Enabling works including mobilisation and demolition (12 months)
- Earthworks (two months)
- Acoustic shed construction (one month)
- Excavation (three years)
- Station construction (18 months)

Calculations of the typical $L_{Aeq(15minute)}$ noise level exceedances of the NMLs at the nearest noise sensitive receivers are provided in **Appendix D** and are summarised in

Table 67. The 'sleep' column of the table provides the predicted exceedance of the sleep disturbance screening noise level.

Note that for night-time construction, preliminary modelling indicated that an acoustic shed would be required and was included for the station excavation scenario.

Table 67 Predicted noise level exceedances at Waterloo Station Construction Site

Receiver Area	Scenario								
	Enabling Works	Earthworks	Acoustic Shed Construction	Excavation with Shed					Construction
	Day	Day	Day	Day	DOOH	Even	Night	Sleep	Day
A - Residential receivers north of Raglan Street	3	2	1	0	1	1	2	1	1
B - Residential receivers east of Cope Street	2	2	1	0	1	1	2	1	2
C - Residential receivers south of Buckland Street	2	2	1	0	0	1	2	1	2
C - Commercial receivers south of Buckland Street	1	1	0	0	0	0	0	0	1
D - Residential receivers west of Botany Road	3	2	1	0	1	1	2	1	1
D - Place of worship receivers west of Botany Road	3	3	2	1	1	0	0	0	3
D – Commercial receivers east of Botany Road	2	1	0	0	0	0	0	0	1

Legend

Category 0	Category 1	Category 2	Category 3
NML Compliance	NML exceedance of less than 10 dB	NML exceedance of between 10 dB and 20 dB	NML exceedance of more than 20 dB

Discussion

The preliminary findings of the construction noise impact assessment at Waterloo Street Station indicate:

- The predicted noise levels for enabling works indicate high exceedances of more than 20 dB of the NMLs at the residential receivers in Area A and D, and at place of worship in Area D. Moderate exceedances of more than 10 dB are predicted at residential receivers in Areas B and D.

  At the nearest commercial receivers in Area D, moderate exceedances of more than 10 dB of the NMLs are predicted. Minor exceedances of less than 10 dB are predicted at commercial receivers in Area C.

- The predicted noise levels for earthworks works indicate high exceedances of more than 20 dB of the NMLs at the place of worship in Area D. Moderate exceedances of more than 10 dB are predicted at residential receivers in Areas A, B, C and D.

  At the nearest commercial receivers in Areas C and D, minor exceedances of less than 10 dB of the NMLs are predicted.

- During the acoustic shed construction a moderate exceedance is predicted at the place of worship in Area D. There are minor exceedances at residential receivers in Area A, B, C and D.

- During daytime excavation with an acoustic shed a minor exceedance of less than 10 dB is predicted at the place of worship in Area D. For night-time excavation there are moderate exceedances for residences in Area A, B, C and D. Potential mitigation would be to increase the acoustic shed noise insulation performance, however this would not reduce ground-borne noise at the impacted receivers.
- During station construction high exceedances are predicted at the place of worship in Area D. Moderate exceedances are predicted at residential receivers at Areas B and C. Minor exceedances are predicted at residences in Area A and D, and at commercial receivers in Area C and D.

On Site Night-Time LAmax Noise

The maximum noise levels associated with on-site truck movements, deliveries by semitrailer and other activities on site can potentially cause awakening reactions (or sleep disturbance) at nearby residential receivers. The LAmax noise levels associated with these events exceed the sleep disturbance screening level during excavation by up to 10 dB in area A, B, C and D. During the detailed design night-time 'on site' traffic routes and activities should be reviewed and/or additional mitigation such as increased site perimeter hoarding height.

3.14.4 Ground-borne Noise and Human Comfort Vibration Assessment

Where ground-borne noise exceedances are identified then human comfort vibration exceedances would also be present**. Appendix F** illustrates the potential ground borne noise impacts due to vibration intensive construction activities (rock breaking) in this area. In summary the analysis indicates:

- Moderate (or less) exceedances of the NMLs (10 to 20 dB) are predicted at the nearby commercial and residential receivers.
- During night-time works the analysis shows ten (10) residential buildings have regenerated noise levels potentially higher than 45 dBA on several floors in each building. Where residential receivers have night-time internal noise levels greater than 45 dBA they would be considered eligible for alternative accommodation (the highest level mitigation measure) as per the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement).

3.14.4.1 Blasting

The use of blasting in the excavation of the station shafts effectively reduces the duration of noise and vibration impacts due to the use of rock breakers which must be used to some extent before blasting can occur. **Table 68** illustrates the effective reduction in duration of the ground-borne noise (and human comfort vibration) exceedances when blasting is used as an alternative excavation methodology. This table also illustrates the effective reduction in duration of these exceedances when blasting is combined with medium rock breakers instead of large rock breakers.

The values in this table represent all exceedances of the NMLs (even those as low as 1 dB to 5 dB). Therefore, the actual requirement for high level mitigation measures is not represented. The information is presented to indicate the benefits in terms of duration of impacts between different excavation methodologies.

Table 68 No. of Periods Above the NMLs Due to Alternative Construction Methodologies

Site	Number of Periods Above NMLs											
	Residential									Commercial		
	Day			Evening			Night			Day		
	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB	B- Lrg RB	B+ Lrg RB	B+ Med RB
Waterloo	251	139	13	>365	275	131	>365	>365	294	14	8	3

Note: B- = No Blasting, B+ = With Blasting, Lrg RB = Large Rock Breakers, Med RB = Medium Rock Breakers

The duration of the impacts can be summarised as follows:

Residential Day: The use of large rock breakers with no blasting generates 251 daytime periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 139 daytime periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts even further to 13 daytime periods. Blasting coupled with medium rock breaker therefore significantly reduces the impacts during the day.

Residential Evening: The use of large rock breakers with no blasting generates greater than 365 evening periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 275 evening periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts even further to 131 evening periods. Blasting and the use of medium rock breakers significantly reduces the impacts during the evening.

Residential Night: The use of large rock breakers with no blasting generates greater than 365 night-time periods with exceedances of the NMLs. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts 294 night-time periods.

Commercial Day: The use of large rock breakers with no blasting generates 14 daytime periods with exceedances of the NMLs. The inclusion of blasting reduces the duration of impacts to 8 daytime periods. The inclusion of blasting and the use of medium rock breakers reduces the duration of impacts even further to 3 daytime periods. Blasting coupled with medium rock breaker therefore reduces the impacts during the day.

With careful planning and positioning of the rock breakers it may be possible to avoid consecutive periods of NML exceedances ie respite periods for receivers could be planned in the construction program through careful rock breaker locations. For any residual exceedances of the NMLs, the processes and mitigation measures identified in the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement) would be implemented.

The potential ground-borne noise impacts associated with the excavation of the tunnels are discussed in **Section 3.16.1**.

3.14.5 Vibration Assessment

During construction of the proposed shaft vibration levels are anticipated to remain well below the vibration screening levels associated with minor cosmetic building damage. **Appendix G** illustrates the potential cosmetic damage vibration impacts due to construction activities in this area.

3.14.6 Traffic Noise Assessment

Traffic noise levels have been predicted for residential receivers located on the proposed access route to the Waterloo Station site. In this instance the access to the site is via Botany Road and Henderson Road which are sub-arterial roads with significant daytime flows. The RNP base criteria, predicted $L_{Aeq(15hr)}$ daytime and $L_{Aeq(9hr)}$ nighttime noise levels with the development, and the L_{Aeq} increase and sleep disturbance noise levels have been assessed in **Table 69**.

Table 69 Waterloo Station Construction Site - Construction Traffic on Public Roads

Access Road	Base Criteria Day/Night (LAeq(15hr/9hr))	Predicted Road Traffic Noise Day/Night	Predicted Road Traffic Noise Increase (dB)	RBL + 15 dB Screening Criterion (dBA)	External LAmax NML Level (dBA)	Predicted LAmax Noise Level (dBA)
Botany Rd	60/55	73/68	0.1/0.2	54	65	78
Henderson Rd	60/55	72/66	0.1/0.3	54	65	76

Table 69 indicates that whilst at Botany Road and at Henderson Road the base criteria are exceeded, the predicted noise level increase (LAeq) associated with construction traffic complies with the 2 dB allowance, therefore sensitive receivers are not likely to notice an increase in the average road traffic noise levels during construction.

There are expected to be up to 6 heavy vehicle and 2 light vehicles movements or events per hour during the night and whilst there is an exceedance of the sleep disturbance screening criterion (of up to 24 dB) and external sleep disturbance NML of 65 dBA (by up to 13 dB), the LAmax levels would be similar to other heavy vehicles using Botany Road and Henderson Road.

3.15 Marrickville Dive Site

3.15.1 Site Layout and Proposed Construction Works

An aerial photograph of the proposed Marrickville dive site and the surrounding receiver areas is provided in **Figure 18**, with the nearest noise sensitive receivers identified in **Table 70**.

Figure 18 Marrickville Dive Site and Receiver Areas

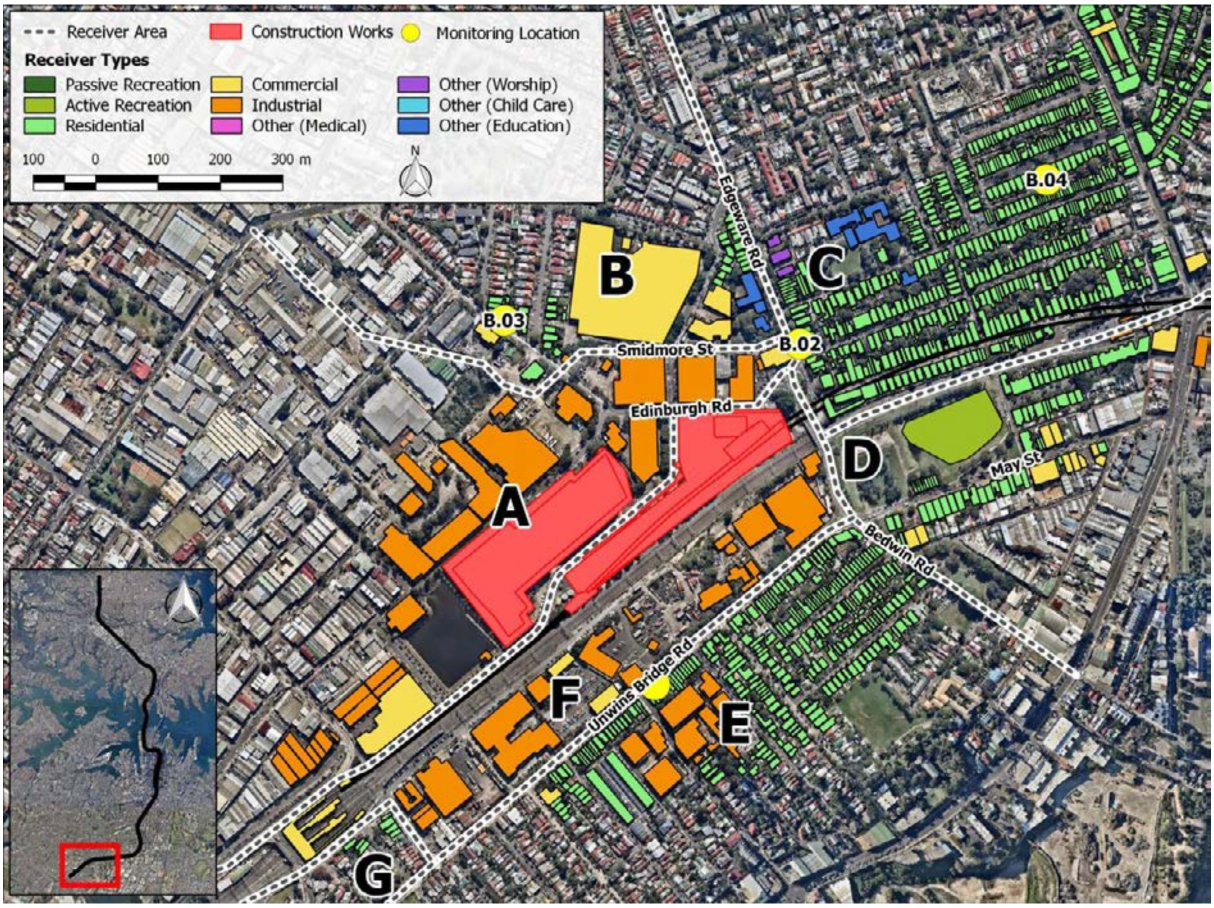


Table 70 Nearest Noise Sensitive Receivers - Marrickville Dive Site

Receiver Area	Location Relative to Works (m)[1]
A - Industrial Area to the north	20
B - Commercial receivers to the north	160
B - Educational receiver to north	124
B - Residential receivers to the north on Edinburgh Road	110
C - Residential receivers to the north, east of Edgeware Road	65
D - Recreation to the east at Camdenville Park	70
D - Residential receivers to the east, north and south of May Street	190
E - Residential receivers to the south–east on Unwins Bridge Road	160
F - Industrial receivers to the south –east	45
G - Residential receivers to the south–east on Burrows Avenue	510

Note 1: The relative distance to works shown is that from the nearest sensitive receiver to the closest location of construction activity.

3.15.2 Site Specific Construction Noise Management Levels

With reference to the ambient noise survey results summarised in **Table 4**, the site specific construction NMLs are presented in **Table 71**.

Table 71 Marrickville Dive Site Noise Management Levels

Receiver Area	Receiver Type	Relevant Monitoring Location	$L_{Aeq(15minute)}$ Construction NMLs (dBA)		
			Daytime	Evening	Night-time
A	Industrial	B02	75	n/a	n/a
B	Commercial	B03	70	n/a	n/a
B	Educational	B03	55	n/a	n/a
B	Residential	B03	62	48	43
C	Residential	B02	68	57	43
D	Active recreational (field)	B02	65	n/a	n/a
D	Residential	B02	68	57	43
E	Residential	B01	69	58	46
F	Industrial	B01	75	n/a	n/a
G	Residential	B01	69	58	46

3.15.3 Airborne Noise Assessment at the Nearest Noise Sensitive Receivers

Scenarios were developed for the daytime, evening and night-time periods, to be representative of activities having potentially the greatest noise impact on the surrounding receivers.

These scenarios have been developed to be a subset of those discussed in **Section 3.3.1.1**, and are detailed as follows:

- Enabling works including mobilisation and demolition (12 months)
- Track works which consists of construction works to the south of the dive site (12 months)
- Earthworks which consist of initial excavation, tunnel dive piling, tunnel dive excavation, tunnel dive lining, laying tunnel dive track (six months)
- Acoustic shed construction (one month)
- Tunnelling and excavation with shed, including the precast factory (18 months)
- Fitout (18 months)

Calculations of the typical $L_{Aeq(15minute)}$ noise level exceedances of the NMLs at the nearest noise sensitive receivers are provided in **Appendix D** and are summarised in **Table 72**. The 'sleep' column of the table provides the predicted exceedance of the sleep disturbance screening noise level.

For night-time construction, preliminary modelling indicates that an acoustic shed would be required and was included for the tunnelling and precast scenarios.

Table 72 Predicted noise level exceedances at the Marrickville Dive Site

Receiver Area	Scenario													
	Enabling Works	Track Works	Earthworks	Acoustic Shed Construction	Tunnelling with Shed and Precast Factory					Fitout				
	Day	Day	Day	Day	Day	OOH	Eve	Night	Sleep	Day	OOH	Eve	Night	Sleep
A – Industrial Area to the north	2	0	0	0	0	0	0	0	0	0	0	0	0	0
B – Commercial receivers to the north	1	0	0	0	0	0	0	0	0	0	0	0	0	0
B – Educational receiver to north	2	2	2	0	1	0	0	0	0	0	0	0	0	0
B – Residential receivers to the north on Edinburgh Road	1	0	0	0	0	0	1	1	0	0	0	0	0	0
C – Residential receivers to the north, east of Edgeware Road	1	1	1	0	0	0	0	1	0	0	0	0	0	0
D – Camdenville Park to the east	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D – Residential receivers to the east, north and south of May Street	0	0	0	0	0	0	0	1	0	0	0	0	0	0
E – Residential receivers to the south–east on Unwins Bridge Road	0	0	0	0	0	0	0	1	0	0	0	0	0	0
F – Industrial receivers to the south –east	1	1	1	0	0	0	0	0	0	0	0	0	0	0
G – Residential receivers to the south–east on Burrows Avenue	0	0	0	0	0	0	0	1	0	0	0	0	0	0

Legend

Category 0	Category 1	Category 2	Category 3
NML Compliance	NML exceedance of less than 10 dB	NML exceedance of between 10 dB and 20 dB	NML exceedance of more than 20 dB

Discussion

The preliminary findings of the construction noise impact assessment at the Marrickville construction site indicate:

- The predicted noise levels for enabling works indicate moderate exceedances of between 10 dB to 20 dB of the NMLs at the educational receiver in Area B and industrial receivers in Area A. Minor exceedances are predicted at Residential receivers in Area B and C, and commercial and industrial receivers in Area B and F. These are a direct result of the relative close proximity of receivers to the construction activities and the absence of any appreciable shielding between sites and receivers. Enabling works duration is approximately 10 months.
- During track works and earthworks there is a moderate exceedance of between 10 dB to 20 dB of the NML at the educational receiver in Area B. At residential receivers there is a minor exceedance at receivers in Area C.

  At commercial and industrial receivers there is a minor exceedance of up to 10 dB at the industrial area to the south east and compliance elsewhere. Earthworks duration is approximately 6 months.
- During acoustic shed construction compliance is predicted. . Acoustic shed construction duration is approximately 2 months.
- During tunnelling and precast factory operation there is a minor exceedance at educational receiver in Area B, and at the residential receivers in Area B, C, D, E and G during night-time. Tunnelling and precast duration is approximately 22 months.
- During fitout compliance is predicted. Fitout duration is approximately 14 months.

On Site Night-Time L_{Amax} Noise

The maximum noise levels associated with on-site truck movements, deliveries by semitrailer and other activities on site can potentially cause awakening reactions (or sleep disturbance) at nearby residential receivers. The L_{Amax} noise levels associated with these events comply with screening level during tunnelling with the precast factory and fitout.

3.15.4 Ground-borne Noise and Human Comfort Vibration Assessment

Where ground-borne noise exceedances are identified then human comfort vibration exceedances would also be present**. Appendix F** illustrates the potential ground borne noise impacts due to vibration intensive construction activities (rockbreaking) in this area. The ground-borne noise assessment indicated all receivers would comply with the ground-borne noise NMLs. Dive excavation works at this site are expected to occur during the daytime period only.

The potential ground-borne noise impacts associated with the excavation of the tunnels are discussed in **Section 3.16.1**.

3.15.5 Vibration Assessment

During construction of the proposed excavation vibration levels are anticipated to remain well below the vibration screening levels associated with minor cosmetic building damage. **Appendix G** illustrates the potential cosmetic damage vibration impacts due to construction activities in this area.

3.15.6 Traffic Noise Assessment

Traffic noise levels have been predicted for residential receivers located on the proposed access route to the Marrickville dive site. In this instance the access to the site is via the Bedwin Road, and May Street which are sub-arterial roads with significant daytime flows. The RNP base criteria, predicted $L_{Aeq(15hr)}$ daytime and $L_{Aeq(9hr)}$ nighttime noise levels with the development, and the L_{Aeq} increase and sleep disturbance noise levels have been assessed in **Table 73**.

Table 73 Marrickville Dive Site - Construction Traffic on Public Roads

Access Road	Base Criteria Day/Night ($L_{Aeq(15hr/9hr)}$)	Predicted Road Traffic Noise Day/Night	Predicted Road Traffic Noise Increase (dB)	RBL + 15 dB Screening Criterion (dBA)	External L_{Amax} NML Level (dBA)	Predicted L_{Amax} Noise Level (dBA)
Bedwin Rd	60/55	68/62	0.5/1.8	53	65	69
May St	60/55	72/68	0.9/2.4	56	65	79

Table 73 indicates that whilst at Bedwin Road and at May Street the base criteria are exceeded, the the predicted noise level increase (L_{Aeq}) associated with construction traffic complies with the 2 dB allowance during the daytime. During the night-time on Bedwin Road the predicted traffic increase complies with the 2 dB allowance, and on May Street is marginally exceeded by 0.4 dB.

There are expected to be up to 18 heavy vehicle and 90 light vehicles movements or events per hour during the night and whilst there is an exceedance of the sleep disturbance screening criterion (of up to 23 dB) and external sleep disturbance NML of 65 dBA (by up to 14 dB), the L_{Amax} levels would be similar to other heavy vehicles using Bedwin Road and May Street.

3.16 TBM Tunnel Excavation

Two 15.5 km tunnels would be excavated for the project using Tunnel Boring Machines (TBMs). It is expected that the stations would be excavated concurrently using conventional breakers, excavators and roadheaders.

In addition to the twin tunnels and station excavations, the following underground features would also be excavated using roadheaders:

- Cross passages between the two tunnels would be provided at intervals of about 240 metres to allow for emergency access.
- Stub tunnels from the twin tunnels near Victoria Cross Station and Sydenham to allow for future extensions to the metro network.

It is anticipated that the tunnel boring machines works would occur from three sites incorporating a total of five TBMs. These sites are:

- A tunnel boring machine launch and support site in Chatswood (to the south of Chatswood Station and north of Mowbray Road), referred to as the Chatswood dive site.
- A tunnel boring machine launch and support site north of Sydenham Station (south of Bedwin Road), referred to as the Marrickville dive site.
- A tunnel boring machine launch and support site at the proposed Barangaroo Station construction site for the crossing of Sydney Harbour.

TBM retrieval sites would be at Blues Point for the south going TBMs from Chatswood and for the north going TBMs from Barangaroo and at Barangaroo for the north going TBMs from Marrickville.

The TBMs are proposed to be travelling approximately 20 m per day on a 24 hour per day basis.

3.16.1 Ground-borne Noise from Tunnelling

The potential ground-borne noise impacts associated with the construction of the underground tunnels and caverns have been assessed. The assessment includes the excavation of the twin rail tunnels and the underground works associated with the stations, cross passages and stub tunnels.

The assessment is based on available basement information provided by the project team at the time of assessment. It is noted that this is not a complete survey of all existing basements and a survey should be completed at the detailed design stage to confirm that all buildings with basements have been accurately included in the assessment.

3.16.1.1 Excavation of Main Tunnels

Figure 19 provides an overview chart showing the proposed tunnel depth for the entire alignment and illustrates that the tunnel depth varies from approximately 20 m to 60 m at the shallowest and deepest points respectively.

In the following assessment, where the depth of the alignment is discussed, the distance is noted as being from the existing ground surface height (ground elevation) to the track height (track elevation).

The ground-borne noise assessment is based on the worst-case predicted L_{Aeq} internal ground-borne noise level when the tunnelling works are directly below each receiver and the tunnelling works are at their closest point.

Given the progression rate of the TBM (around 20 m per day), it is anticipated that the worst-case ground-borne noise impacts along the majority of the alignment would only be apparent for a relatively short period of time (ie a few days for each TBM) whilst the tunnelling works are directly beneath a particular receiver.

As the works progress and move away, a particular receiver's exposure to ground-borne noise would notably reduce. This concept is illustrated in **Figure 20**, which shows the likely internal ground-borne noise levels from TBM excavation works as it progresses past a particular location. The figure indicates that the night-time NML of $L_{Aeq(15minute)}$ 35 dBA is likely to be exceeded for up to four days as each TBM passes residential receivers within a slant distance of approximately 40 m from the tunnels.

The progress rate of roadheading is notably less (around 4 m per day), however, the vast majority of the alignment is proposed to be excavated using TBMs and roadheading only at stations, cross passages and stub tunnels.

Figure 19 Proposed Tunnel Depth and Existing Ground Elevation

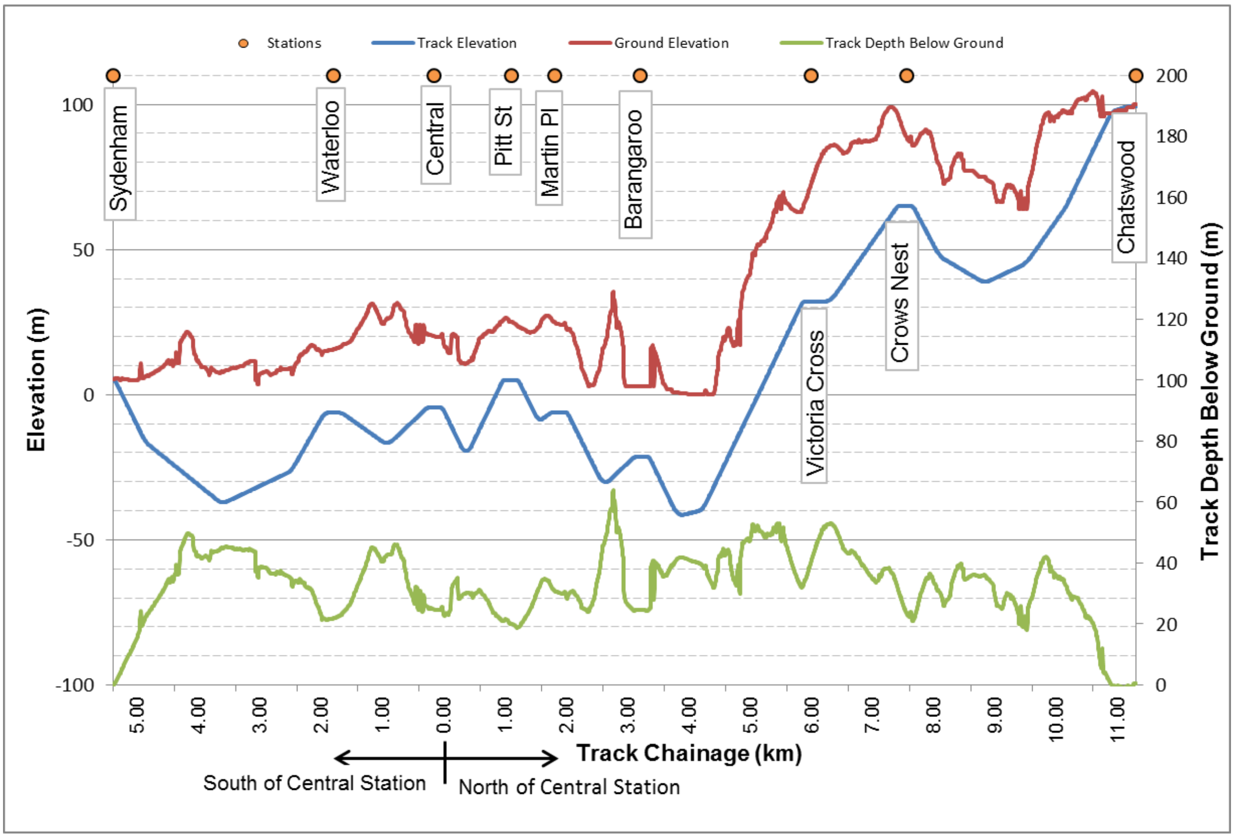
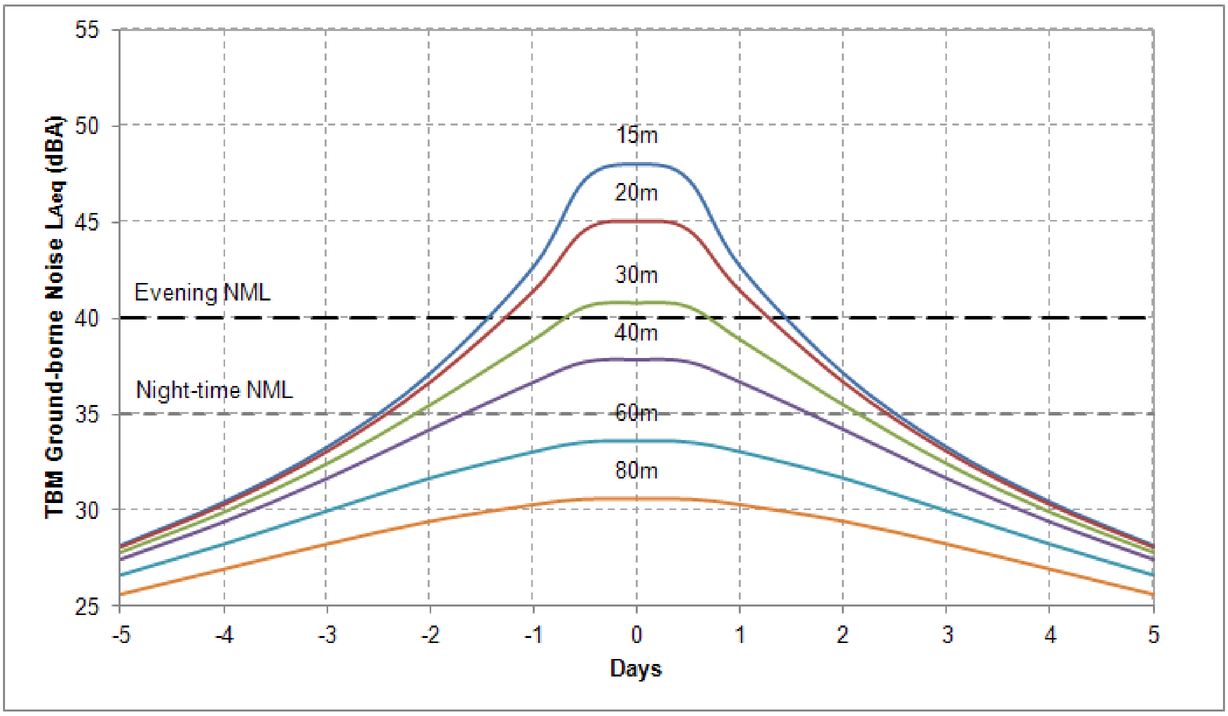


Figure 20 Ground-borne Noise Levels at Slant Distances from TBM (Progress = 20m/day)

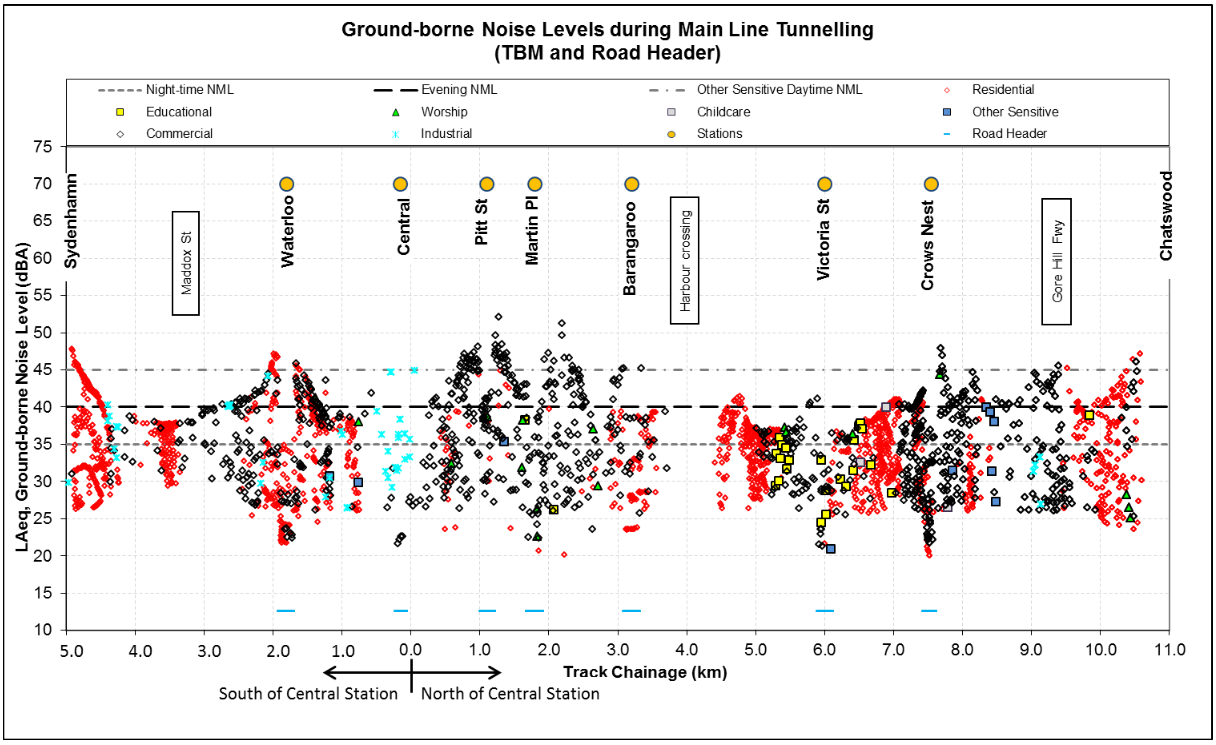


A summary graph showing the maximum predicted ground-borne noise levels from TBM excavation works is presented in **Figure 21**. The predicted maximum ground-borne noise levels from TBM excavation works are also presented on maps in **Appendix E**.

At residential locations greater than a slant distance of approximately 50 m from the nearest tunnel (ie taking into account the tunnel depth and the horizontal offset distance), exceedances of the ground-borne NML of $L_{Aeq(15minute)}$ 35 dBA during night-time periods are unlikely. At several locations, the tunnel depth at receivers directly above the proposed alignment is less than 50 m. The following sections discuss the predicted maximum ground-borne noise levels from TBM excavation works and potential impacts.

At all of the locations, the ground-borne noise predictions are based on the nearest sensitive receivers and most exposed floor (ie ground floor for commercial and lowest habitable floor for residential) above or adjacent to the proposed tunnel alignment. The ground-borne noise impacts would reduce for sensitive receivers further away from the alignment or on floor levels higher up within buildings.

Figure 21 Ground-borne Noise from Tunnelling

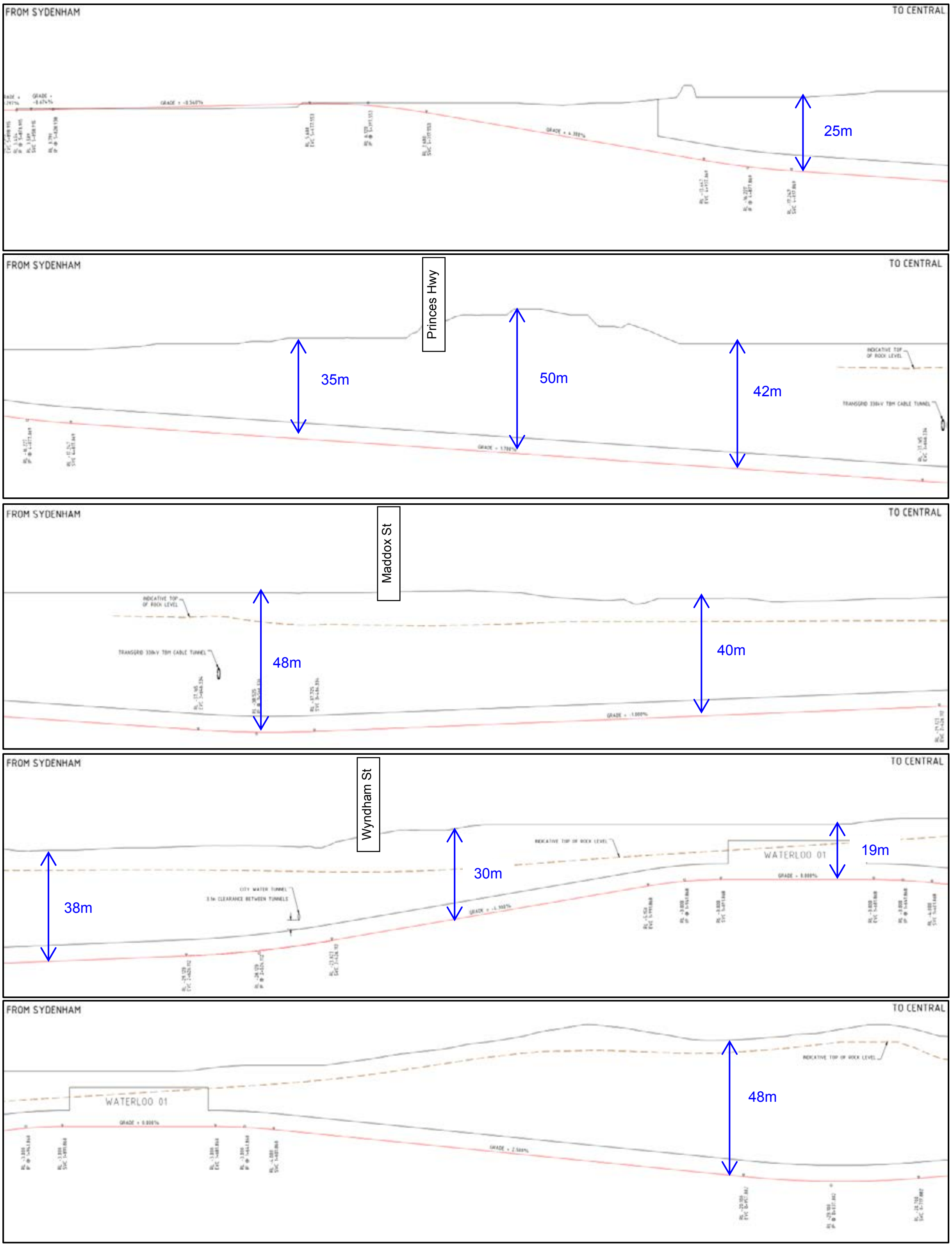


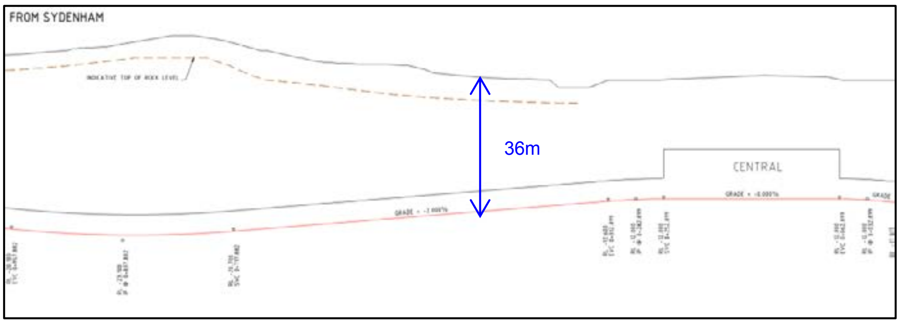
Note: The predictions are for the most exposed floor (ie ground floor for commercial and lowest habitable floor for residential) and would reduce with approximately 2 dB per floor level for higher floors.

3.16.1.1.1 Marrickville Tunnel Portal to Central Station

The long sections for tunnels between the Marrickville portal and Central Station are provided in **Figure 22**.

Figure 22 Proposed Long Sections for Tunnels – Marrickville Tunnel Portal to Central Station





Reference to **Figure 22** indicates that the tunnel depth between the Marrickville tunnel portal and Central Station varies from a minimum depth of 19 m at Waterloo Station to a maximum depth of 50 m just west of Princess Highway.

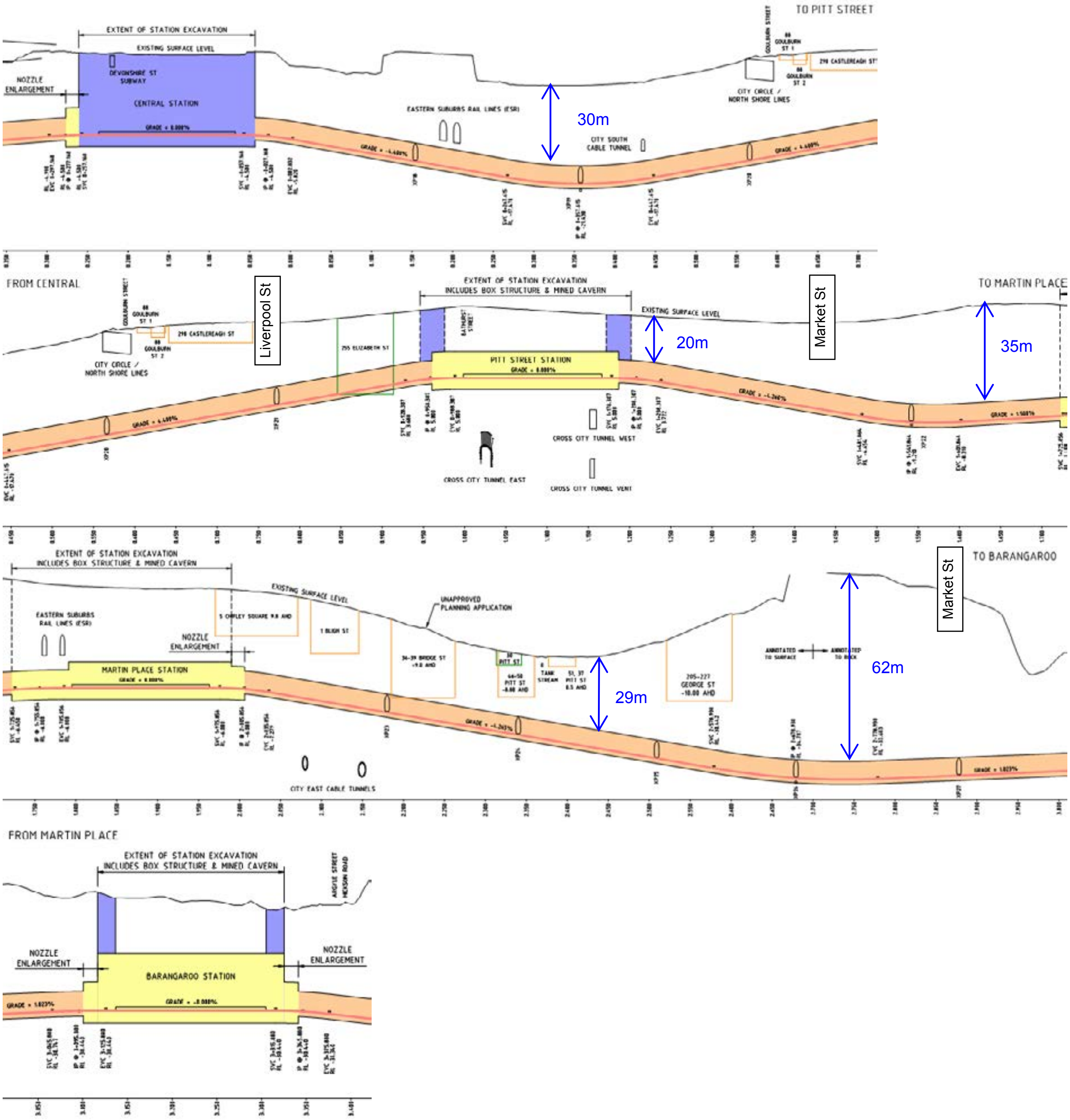
The predicted maximum ground-borne noise levels (refer **Figure 21**) and potential impacts at sensitive receiver locations are discussed below:

- Portal to Princes Highway. This is the initial low depth tunnel just after the portal under a large residential area, with a large number of potentially affected residential receivers. Worst-case exceedances of the $L_{Aeq(15minute)}$ night-time NML of more than 10 dB are predicted during TBM excavation near the portal, where the depth of the alignment is at its shallowest point. It should be noted that these receivers are located adjacent the existing rail line and exposed to high existing background noise levels.
- Princes Highway to Maddox Street. The alignment passes beneath a commercial and residential area at a tunnel depth of approximately 45 m. There are several potentially affected residential receivers. However, the worst-case predicted night-time exceedances are generally less than 3 dB.
- Maddox Street to Wyndham Street. The alignment passes beneath a commercial area with no predicted exceedances.
- Wyndham Street to Waterloo Station. The alignment passes beneath an area of commercial, mixed use and residential receivers. Just south of Waterloo Station the tunnel depth drops to close to 20 m and there are a few potentially affected residential receivers. Worst-case exceedances of the $L_{Aeq(15minute)}$ night-time NML of more than 10 dB are predicted during TBM excavation.
- Waterloo Station to Central Station. The alignment passes beneath an area of commercial, mixed use and residential receivers. Just north of Waterloo Station the tunnel depth is approximately 25 m, however, the depth quickly increase to close to 50 m before entering beneath the existing rail corridor. There are a few potentially affected residential receivers north of Waterloo Station with worst-case exceedances of the $L_{Aeq(15minute)}$ night-time NML of up to 10 dB predicted during TBM excavation.

3.16.1.1.2 Sydney CBD (Central Station to Barangaroo Station)

The long sections for tunnels between the Central Station and Barangaroo Station are provided in **Figure 23**.

Figure 23 Proposed Long Sections for Tunnels - Sydney CBD (Central Station to Barangaroo Station)



Reference to **Figure 23** indicates that the tunnel depth for the alignment through Sydney CBD between the Central Station and Barangaroo Station varies from a minimum depth of 20 m around Pitt Street and Barangaroo Stations to a maximum depth of 62 m just south of Kent Street.

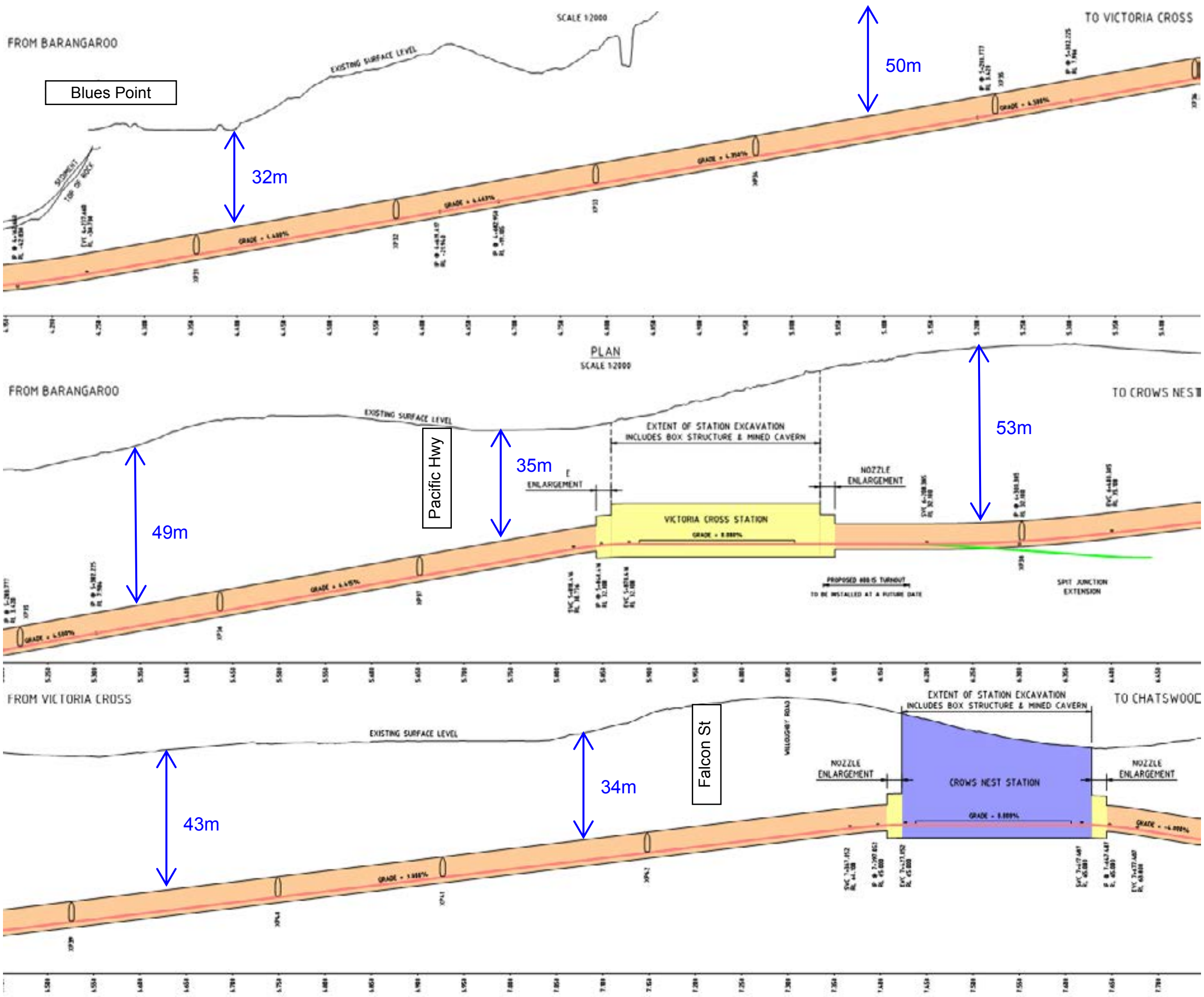
The predicted maximum ground-borne noise levels (refer **Figure 21**) and potential impacts at sensitive receiver locations are discussed below:

- Pitt Street Station and Martin Place Station. The alignment passes beneath mostly commercial and some mixed use receivers (ie commercial or retail on ground floor with residential higher up in the building) at depth of approximately 30 m. A few residential receivers (Hilton Hotel amongst these) have predicted worst-case exceedances of the $L_{Aeq(15minute)}$ night-time NML of up to 10 dB during TBM excavation near Pitt Street Station. There are also a large number of commercial receivers, with predicted ground-borne noise that would be audible. However, only one receiver is predicted to exceed the $L_{Aeq(15minute)}$ daytime NML of 50 dBA, due to the close proximity to the alignment and having 5 basement levels.
- Just north of Martin Place Station. The alignment passes beneath mostly commercial receivers at depth of between 25 m and 30 m. There are several buildings with identified basements in this area which increases the ground-borne noise transmitted into the buildings. There is one residential receiver (the Sofitel Sydney Wentworth Hotel) with predicted worst-case exceedances of the $L_{Aeq(15minute)}$ night-time NML of up to 5 dB during TBM excavation near Martin Place Station. There are several commercial receivers, with predicted ground-borne noise that would be audible. However, only one receiver is predicted to exceed the $L_{Aeq(15minute)}$ daytime NML of 50 dBA, due to the close proximity to the alignment and having 6 basement levels.
- Barangaroo Station. The alignment passes beneath a few residential receivers just before and after the Barangaroo Station at depth of approximately 20 m. There are worst-case exceedances of the $L_{Aeq(15minute)}$ night-time NML of up to 5 dB during TBM excavation.

3.16.1.1.3 North Sydney (Blues Point to Crows Nest Station)

The long sections for tunnels between Blues Point and Crows Nest Station are provided in **Figure 24**.

Figure 24 Proposed Long Sections for Tunnels - North Sydney (Blues Point to Crows Nest Station)



Reference to **Figure 24** indicates that the tunnel depth for the alignment through North Sydney between the Blues Point and Crows Nest Station varies from a minimum depth of 32 m near the North Shore to a maximum depth of 53 m just north of Victoria Cross Station.

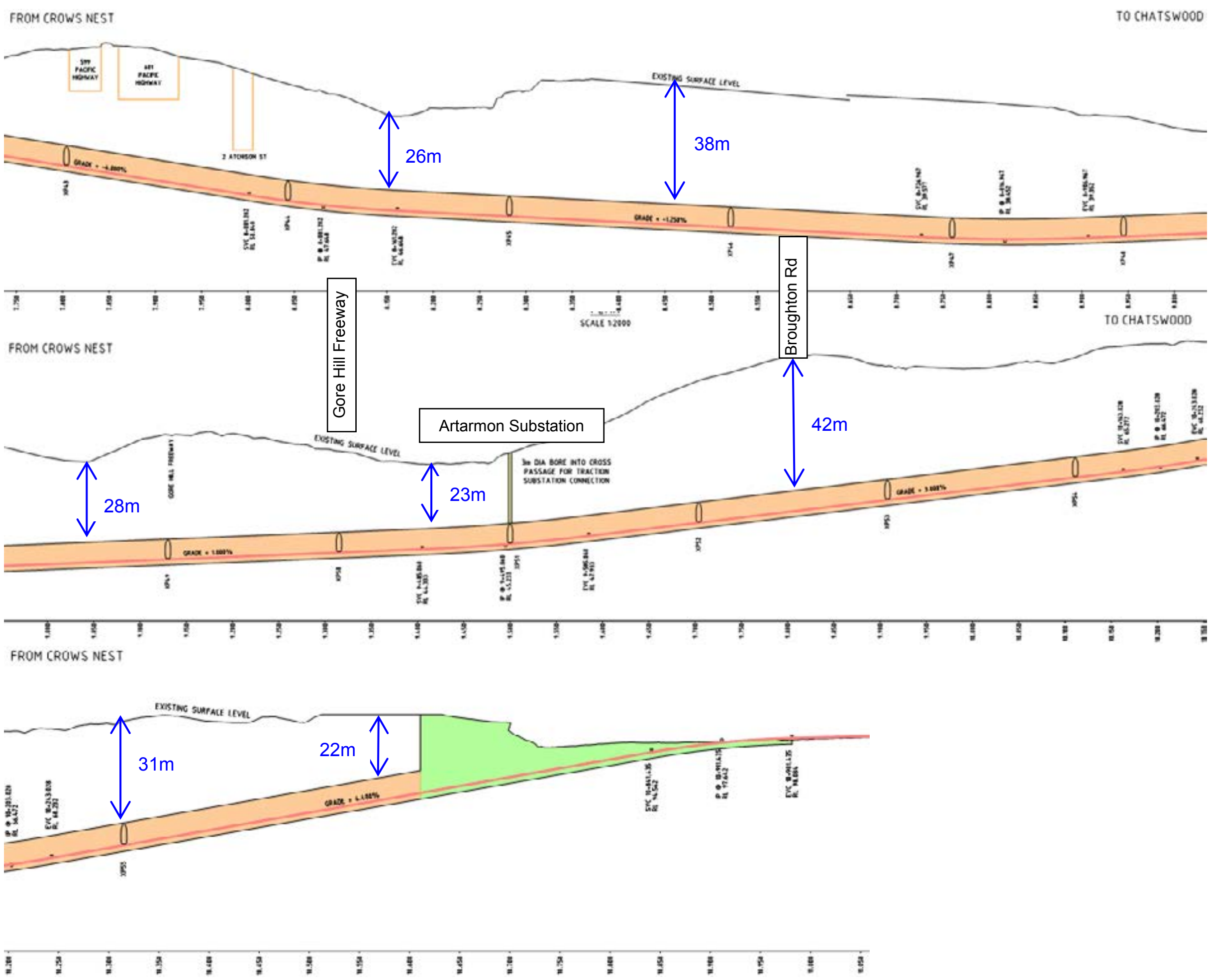
The predicted maximum ground-borne noise levels (refer **Figure 21**) and potential impacts at sensitive receiver locations are discussed below:

- Blues Point. The alignment passes beneath a residential area at depth of between 32 m and 52 m. There are a few number of residential receivers with predicted worst-case exceedances of the $L_{Aeq(15minute)}$ night-time NML of up to 8 dB close to the north shore before chainage 4.8 km (south of Princess Street). From Princess Street to just after the existing North Sydney Station there are a large number of residential receivers with a marginal predicted worst-case exceedances of the $L_{Aeq(15minute)}$ night-time NML of up to 3 dB.
- Victoria Cross Station to Crows Nest Station. The alignment passes beneath a large residential area with some educational and a place of worship at depth of between 34 m and 53 m. There are a large number of residential receivers with predicted worst-case exceedances of the $L_{Aeq(15minute)}$ night-time NML of up to 5 dB. The educational receivers and place of worship is below the $L_{Aeq(15minute)}$ NML (other sensitive receivers).

3.16.1.1.4 Connection to Chatswood (Crows Nest Station to Chatswood tunnel portal)

The long sections for tunnels between Crows Nest Station and the Chatswood portal just south of Chatswood are provided in **Figure 25**.

Figure 25 Proposed Long Sections for Tunnels - Connection to Chatswood (Crows Nest Station to Chatswood tunnel portal)



Reference to **Figure 25** indicates that the tunnel depth for the alignment through the northern suburbs of Sydney between the Crows Nest Station to the Chatswood tunnel portal just south of Chatswood varies from a minimum depth of 23 m around the Artarmon Substation to a maximum depth of 42 m at Broughton Road.

The predicted maximum ground-borne noise levels (refer **Figure 21**) and potential impacts at sensitive receiver locations are discussed below:

- Crows Nest Station to Gore Hill Freeway. The alignment passes beneath mostly commercial receivers with a few residential receivers and the Royal North Shore Hospital at depth of between 32 m and 52 m. There are commercial receivers just north of Crows Nest Station with predicted ground-borne noise levels that would be audible, but not exceeding the $L_{Aeq(15minute)}$ daytime NML of 60 dBA. There are a few number of residential receivers with predicted worst-case exceedances of the $L_{Aeq(15minute)}$ night-time NML of up to 6 dB. The Royal North Shore Hospital is below the $L_{Aeq(15minute)}$ NML (other sensitive receivers).

- Gore Hill Freeway to Chatswood tunnel portal. The alignment passes beneath a residential area with one educational receiver at depth of between 30 m and 42 m (decreasing to 22 m just before the portal). There are a large number of residential receivers with predicted worst-case exceedances of the $L_{Aeq(15minute)}$ night-time NML of up to 10 dB. The educational receiver is below the $L_{Aeq(15minute)}$ daytime NML (other sensitive receivers).

3.16.1.2 Cross Passages

Cross passages between tunnels would be spaced at regular intervals of approximately 240 m and are proposed to be excavated with roadheaders, with niches and rooms by hydraulic rock breaker.

The anticipated duration of the excavation works is 80 working days for each cross passage. During the excavation works, the potential ground-borne noise impacts would be dependent on the tunnel depth and potential basement levels for adjacent buildings. The $L_{Aeq(15minute)}$ night-time NML of 35 dBA is predicted to be exceeded at slant distances of less than approximately 30 m (which generally occurs near the tunnel portals and around Crows Nest Station, Barangaroo Station, Martin Place Station, Pitt Street Station, Central Station and Waterloo Station) for roadheading and 70 m (which would be the case for the majority of the tunnel alignment) for rock hammering. Rock hammering for cross passages and niches between 10:00 pm and 7:00 am would be precluded except where there would be no exceedances of the applicable noise management level at sensitive receivers.

3.16.1.3 Stub Tunnels

Short sections of stub tunnels would be excavated adjacent to the main tunnels, located adjacent to Darley and Wells Street north of the Marrickville tunnel portal and just north of Victoria Cross Station.

The stub tunnels are expected to be excavated by roadheaders. During the excavation works for the stub tunnels, lower ground-borne noise levels compared to those during the main tunnel excavation by TBM is expected. If excavation with rock breakers is required, rock hammering for the stub tunnels between 10:00 pm and 7:00 am would be precluded except where there would be no exceedances of the applicable noise management level at sensitive receivers.

3.16.1.4 Use of Rock Breakers

Rock breakers may be required at each of the above sites in situations where hard rock is encountered. Rock hammering within the tunnels between 10:00 pm and 7:00 am would be precluded except where there would be no exceedances of the applicable noise management level at sensitive receivers. If out of hours works are required, approval would need to be sought on a case by case basis with noise and vibration management mitigation measures being managed in accordance with the procedures in the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement).

3.16.2 Ground-borne Vibration from Tunnelling

During tunnelling works, construction related vibration levels at sensitive receivers from TBM and roadheaders would be much lower than the 7.5 mm/s screening level (relating to the threshold where minor cosmetic damage may occur).

Vibration levels may, however, be noticeable within surface buildings which are located close to the main tunnel alignment. The impacts at these locations would only be apparent for a relatively limited period (ie one or two days) as the TBMs pass by a particular location. Human comfort vibration impacts from tunnelling works would be managed in accordance with the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement).

3.16.3 Ground-borne Noise from Construction Work Trains

As discussed in **Section 3.2.7**, it is currently assumed that work trains would be required during construction to transport labour and materials between the TBM support sites and the work front within the tunnels.

Whilst the speed of these work trains is typically limited to approximately 10 km/h (for safety reasons), the temporary nature of the activities does not facilitate the installation of a low noise and vibration track design consistent with the requirements for passenger train operations.

On the basis that work trains are anticipated to operate during the night-time period and would have similar characteristics to train operations (in terms of the temporal characteristics), it is considered appropriate to compare the ground-borne noise levels with the operational noise trigger levels in the RING. For train operations, the following noise trigger levels are provided for residential receivers:

- Daytime (7:00 am to 10:00 pm) 40 dBA L_{Amax}, (slow)
- Night-time (10:00 pm to 7:00 am) 35 dBA L_{Amax}, (slow)

For schools, educational institutions and places of worship, the ground-borne noise trigger levels are 40 dBA to 45 dBA LAmax, (slow), when in use.

Consistent with the requirements in RING, feasible and reasonable mitigation measures would be considered at locations where there is a risk that the ground-borne noise and / or vibration trigger levels would be exceeded. Such measures are only likely to be required at locations where the tunnel depth is relatively shallow, and may include the following:

- Use of rubber-tyred vehicles in lieu of work trains.
- Slowing down work trains at locations where the ground-borne noise and vibration trigger levels are exceeded.
- Installation of resilient layer between the track and tunnel formation (either in the form of resilient rail fasteners or ballast mat, rubber pads or similar materials placed below the sleepers).
- Grinding of uneven joints in the rail sections.

At this stage in the assessment process, there is insufficient information to undertake a thorough assessment of the potential ground-borne noise and vibration impacts associated with work train movements within the tunnels. An assessment of the potential impacts associated with the proposed construction technique would be undertaken as part of the construction environmental management documentation.

3.16.4 Tunnelling Ground-borne Noise Management and Mitigation Measures

Tunnelling activities are anticipated to occur on 24 hour per day basis and up to 7 days per week. At any particular receiver location, the potential ground borne noise impacts from tunnelling are anticipated to occur only for short periods of time (up to approximately 4 nights) when each TBM passes by.

There are multi storey residences and hotels in the Sydney CBD that exceed the night-time NML, however the noise predictions are for the lowest habitable floor and the noise level would be lower higher up in the buildings. As a guide, ground-borne noise levels attenuate by approximately 2 dB per floor for the first 4 floors and by approximately 1 dB per floor thereafter.

The following management strategies would be implemented where feasible and reasonable to minimise the impact of the TBM tunnelling works:

- Ground-borne noise and vibration monitoring to be undertaken at the commencement of tunnelling to refine the source data utilised for this assessment.
- Comprehensive advance notice as well as educating the public of intended tunnelling activities in the localities near the tunnel alignment. Part of the consultation process should include information regarding the monitoring program. A thorough education program will assist to allay fears of the tunnelling process.
- Slow down the progress rate of the TBM during night-time to generate less ground-borne noise levels.

Further details of management and mitigation measures are outlined in the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement).

3.16.5 Noise from construction of power supply routes

The ICNG suggests a qualitative noise assessment method for works which are unlikely to affect an individual or sensitive land use for more than three weeks in total. As the construction work associated with the power supply routes are not expected to affect any individual receivers for more than 3 weeks, and these receivers would be minimally impacted by the long term works of the project, a qualitative noise assessment has been carried out for these works.

Work along the power supply routes would take place generally within the road corridor and therefore would be close to receivers. In some cases the closest residential receiver would be within 10 metres of the proposed works. The following sections provide a qualitative discussion in relation to the types of activities and potential noise impacts.

3.16.5.1 Trenching

Receivers along the power supply route are expected to experience elevated noise levels during periods when the trenching work is in their vicinity. The initial phase of trenching is likely to involve the use of a concrete saw to remove road pavement. This would be followed by excavation using a small excavator or bobcat.

During these works, especially during the use of concrete saws, the closest receivers could experience noise levels in excess of 75 dB(A). Additionally, as the works are located within road reserves, a substantial portion of the works may be required to be carried out outside of standard daytime construction hours. The excavation work is anticipated to progress at about 30 metres per day and it is likely that a receiver would be affected for up to two consecutive days at most.

Due to these potential high noise levels, feasible and reasonable mitigation measures would be implemented to minimise impacts to receivers. This would include:

- Carrying out works during the daytime period when in the vicinity of residential receivers, where feasible and reasonable
- Where out of hours works are required, scheduling the noisiest activities to occur in the evening period (up to 10 pm)
- Use of portable noise barriers around particularly noisy equipment such as concrete saws
- Provision of additional mitigation measures in accordance with the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement).

3.16.5.2 Under-boring

Where works cross major roads or other infrastructure under-boring may be used instead of trenching. Drilling equipment would typically result in elevated noise levels which, at some receivers, could exceed 75 dB(A). It is anticipated that under boring would generally be restricted to daytime works and would be carried out for up to two weeks in any single location.

3.16.5.3 Cable installation

Cable installation work is expected to be carried out during standard daytime construction hours and is not expected to cause significant noise impacts. The estimated work rate is around 500 metres per day and therefore any single receivers would only be affected for about one day.

3.16.5.4 Road and footpath re-instatement

Road and footpath re-instatement works have the potential to cause elevated noise levels in the vicinity of sensitive receivers. Additionally, these works are likely to occur outside of standard daytime construction hours to minimise traffic impacts. Re-instatement works are expected to progress at about 30 metres per day and therefore any single receiver would likely be affected for up to about two days.

4 OPERATIONAL NOISE AND VIBRATION ASSESSMENT

This section covers the operational noise and vibration assessment. An overview of the assessed operational noise and vibration sources is as follows:

- Ground-borne noise and vibration from trains operating within the project tunnels.
- Airborne noise from metro trains operating between the Chatswood tunnel portal and just south of Chatswood Station, suburban and intercity trains operating between Brand Street, Atarmon and just south of Chatswood Station, and metro trains operating immediately outside the Marrickville tunnel portal
- Airborne noise from mechanical plant and tunnel ventilation systems at stations and other ancillary facilities.

4.1 Ground-borne Vibration - Train Operations

4.1.1 Introduction

Rail vibration is generated by dynamic forces at the wheel-rail interface and occurs, to some degree, even with continuously welded rail and smooth wheel and rail surfaces (due to the moving loads, finite roughness and elastic deformation of the surfaces). Higher vibration levels occur in the presence of rail and wheel surface irregularities.

This vibration propagates via the rail mounts into the ground or track support structures. It then travels through the ground or structures and in some circumstances may sometimes be felt as tactile vibration by the occupants of buildings. If the levels of vibration are sufficiently high (ie in buildings very close to rail tracks), then rattling or visible movement of loose objects (crockery, plants, etc) may also sometimes occur.

The effects of vibration in buildings can be divided into three main categories:

- Those in which the occupants or users of the building are inconvenienced or disturbed - termed human perception or human comfort vibration.
- Those where the building contents may be affected.
- Those in which the integrity of the building or the structure itself may be prejudiced.

A fourth effect is an audible ‘rumbling’ noise generated within buildings as a result of the vibration. This is termed ground-borne or regenerated noise and is discussed further in **Section 4.2**.

4.1.2 Ground-borne Vibration Goals

4.1.2.1 Human Perception of Vibration

Humans are far more sensitive to vibration than is commonly realised. They can detect vibration levels well below those required to cause any risk of damage to a building or its contents.

The actual perception of motion or vibration may not in itself be disturbing or annoying. An individual’s response to that perception and whether the vibration is ‘normal’ or ‘abnormal’ 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. The vibration caused in a home by a child running across a timber floor may be acceptable to most people, but similar vibration caused by nearby road construction may be considered unacceptable.

The thresholds of perception for continuous whole-body vibration vary widely among individuals. Approximately half the people in a typical population, when standing or seated, can perceive a vertical weighted peak acceleration of 0.015 m/s^2 as stated in Annex C of AS 2670.1:2001 '*Evaluation of human exposure to whole-body vibration - Part 1: General requirements*[xvi] (AS2670.1). Converted to vibration velocity, the perception threshold is approximately 0.1 mm/s Root Mean Square (RMS).

The *Assessing Vibration: a technical guideline* (DEC, 2006) notes that:

> *"vibration in buildings can be caused by many different external sources, including industrial, construction and transportation activities. The vibration may be continuous (with magnitudes varying or remaining constant with time), impulsive (such as in shocks) or intermittent (with the magnitude of each event being either constant or varying with time)."*

Examples of continuous vibration include generators, compressors and other continuous operating plant. Examples of impulsive vibration events include the vibration generated by blasting, or dropping of heavy equipment. Examples of intermittent vibration events include vibration generated by train passbys, vibratory roller passbys, drilling and materials handling.

Where vibration is intermittent or impulsive in character, the DEC vibration guideline (and other similar guidelines) recognises that higher vibration levels are tolerable to building occupants than is the case for continuous vibration. As such, higher vibration goals are usually applicable for short term, intermittent and impulsive vibration activities than for continuous sources.

Although people are able to perceive relatively low vibration levels, it is not appropriate to set vibration emission limits requiring 'no vibration' since there will always be some measurable vibration in any environment. Realistic design objectives should therefore be set to minimise disturbance and adverse impacts on occupants' amenity. The recommended approach is discussed in **Section 4.1.3**.

4.1.2.2 Effects on Building Contents

People can perceive floor vibration at levels well below those likely to cause damage to building contents or affect the operation of typical equipment. As such, the controlling vibration design objectives are the human comfort goals. It is therefore not necessary to set separate design objectives for this environmental impact statement in relation to the effect of rail vibration on common building contents.

Some scientific equipment (eg electron microscopes and microelectronics manufacturing equipment) can however require more stringent design goals than those applicable to human comfort. In such cases, vibration design objectives should be obtained from the specific equipment manufacturers or if unavailable, from generic vibration criteria within commonly referenced sources in the literature[1].

4.1.2.3 Effects of Vibration on Structures

The levels of vibration required to cause damage to buildings tend to be at least an order of magnitude (10 times) higher than those at which people may consider the vibration to be intrusive or disturbing. It is therefore also not necessary to set separate design objectives for this project in relation to building damage from rail vibration, as compliance with the human comfort design objectives would ensure compliance with any criteria related to potential structural damage.

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[1] *ANC Guidelines - Measurement and Assessment of Ground-borne Noise & Vibration,* Association of Noise Consultants (2012) and *Vibration Control Design of High Technology Facilities*, Journal of S & V, Ungar, Sturtz & Amick (1990).

4.1.3 Ground-borne Vibration Design Objectives

On the basis of the above discussion, the vibration design objectives adopted for this project are based on human comfort considerations, rather than the less stringent building damage risk criteria or potential effects on building contents. There are several sources from which vibration design objectives may be drawn, including:

- Australian Standard AS 2670.2 1990 - *Evaluation of Human Exposure to Whole Body Vibration - Part 2: Continuous and Shock Induced Vibration in Buildings (1 Hz to 80 Hz)*
- The United States Federal Transit Administration (FTA) guideline *Transit Noise and Vibration Impact Assessment* (2006)[xvii]
- British Standard BS 6472-1992 - *Evaluation of Human Exposure Vibration in Buildings (1 Hz to 80 Hz)*[xviii]
- *Assessing Vibration: A Technical Guideline* (DEC, 2006)[xix].

The following discussion expresses root mean square (RMS) vibration velocity levels in terms of decibels (dB_V re 10^{-9} m/s). A level of 100 dB corresponds to 0.1 mm/s RMS and a level of 120 dB corresponds to 1 mm/s RMS.

AS 2670.2 has been withdrawn, however there is no new replacement and it has still been referred to due to the long history of application on Australian projects. The AS 2670.2 provides recommended vibration levels corresponding to 106 dB_V (0.2 mm/s) to 112 dB_V (0.4 mm/s) for residential buildings during the daytime, reducing to 103 dB_V (0.14 mm/s) during the night-time. These levels apply to both continuous and intermittent vibration. For office and industrial buildings, the recommended vibration levels are 112 dB_V (0.4 mm/s) and 118 dB_V (0.8 mm/s) respectively, when in use, independent of the time of day. Much higher vibration levels are permitted for transient events with only a few occurrences per day.

For residential buildings, the US FTA guideline recommends a vibration level of 100 dB_V (0.1 mm/s) for frequent events (ie more than 70 per day), 103 dB_V (0.14 mm/s) for occasional events (ie between 30 and 70 per day) and 108 dB_V (0.25 mm/s) for infrequent events (ie less than 30 per day). For schools, churches, quiet offices, etc, the recommended vibration levels are 3 dB higher than residential receivers.

BS 6472 has similar vibration level objectives for continuous vibration, but also includes a vibration dose relationship for intermittent events such as trains, which for a "low probability of adverse comment" would permit vibration levels of up to approximately 110 dB_V (0.32 mm/s) on the basis of the frequent nature of the proposed project operations.

Assessing Vibration: A Technical Guideline is based on the guidelines contained in BS 6472. For vibration associated with train passbys, the guideline indicates that vibration levels should be assessed on the basis of the vibration dose value. This would correspond to a maximum level of approximately 110 dB_V for each train passby as discussed above for BS 6472.

4.1.3.1 Proposed Vibration Design Objectives

The proposed project vibration design objectives for residential receivers are in line with those applied for the Sydney Metro Northwest and are based on the continuous vibration levels in AS 2670 and *Assessing Vibration: A Technical Guideline*.

The proposed design objectives for residential and other sensitive receiver categories are listed in **Table 74**. For design purposes, these objectives may be regarded as applicable to the maximum 1 second RMS vibration level not to be exceeded for 95% of rail passby events.

Table 74 Human Comfort Vibration Design Objectives

Receiver Type	Period	Vibration Design Objective[1]
Residential	Day	106 dB_V (0.2 mm/s)
	Night	103 dB_V (0.14 mm/s)
Commercial (including offices, schools and places of worship)	When in use	112 dB_V (0.4 mm/s)
Industrial	When in use	118 dB_V (0.8 mm/s)
Theatres	When in use	106 dB_V (0.2 mm/s)
Critical working areas[2]	Any time	100 dB_V (0.1 mm/s)

Note 1: The vibration design objectives are based on the maximum 1 second rms vibration level not exceeded for 95% of train passbys

Note 2: Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring

In the case of rail tunnels, the ground-borne noise trigger levels presented in **Section 4.2.3** almost always require lower vibration levels than the vibration objectives indicated in **Table 74**. Hence other than at specific specialist facilities with particularly high sensitivity to vibration, compliance with the ground-borne noise trigger levels would ensure that the vibration design objectives is achieved.

The generic vibration criterion curve C (Colin G. Gordon - 28 September 1999) is used as a trigger level for further investigation for identified receivers likely to have highly vibration sensitive equipment. The VC-C curve specifies a design objective of 82 dB_V per 1/3 octave band for frequencies between 8 Hz and 80 Hz and is appropriate for most lithography and inspection equipment down to 1 micron detail size (refer further discussion in **Section 3.1.10**).

4.1.4 Ground-borne Noise and Vibration Modelling Methodology

International Standard ISO 14837-1 2005 *Mechanical vibration - Ground-borne noise and vibration arising from rail systems - Part 1: General Guidance*[xx] provides relevant guidance in relation to the extent of assessment that is normally required for new rail systems. A brief description of the modelling options from this document is provided below.

> *"A single model may be used for all stages with appropriate selection of input parameters (e.g. worst case for scoping assessment). Otherwise, three types of ground-borne vibration and/or ground-borne noise prediction model should be considered, as follows.*
>
> *a)* ***Scoping model****: to be used at the very earliest stages of development of a rail system to identify whether ground-borne vibration and/or ground-borne noise is an issue and, if so, where the "hot spots" along the length of the system's alignment are located. This type of model should be used to generate input to either environmental comparative frameworks (as part of the selection of a mode of transport) or the scoping stage of an environmental assessment.*
>
> *b)* ***Environmental assessment model****: to be used to quantify more accurately the location and severity of ground-borne vibration and/or ground-borne noise effects for a rail system and the generic form and extent of mitigation required to reduce or to remove the effects. This type of model should form part of the planning process for a scheme, developing the environmental statement where required and supporting preliminary design.*
>
> *c)* ***Detailed design model****: to be used to support the detailed design and specification of the generic mitigation identified as being required by the environmental assessment model. This type of model should form part of the design and construction stages of a scheme, with particular focus on the rolling stock and permanent-way design."*

At this stage of the project, a combined environmental assessment/detailed design model has been adopted to assess the potential impacts from ground-borne noise and vibration levels and identify the extent of the likely in-principle mitigation measures.

In accordance with the ISO standard, the model considers all of the parameters that are critical in determining the absolute levels of ground-borne noise and vibration, and the benefits (or otherwise) of different design and mitigation options.

The key parameters of the project modelling algorithms are described in the following section under the headings:

- **Source** - route alignment, rolling stock design, rail type, track form design, tunnel design, turnouts, construction tolerances, operations and maintenance
- **Propagation Path** - ground type and vibration propagation wave types
- **Receivers** - building construction.

4.1.4.1 Modelling Approach

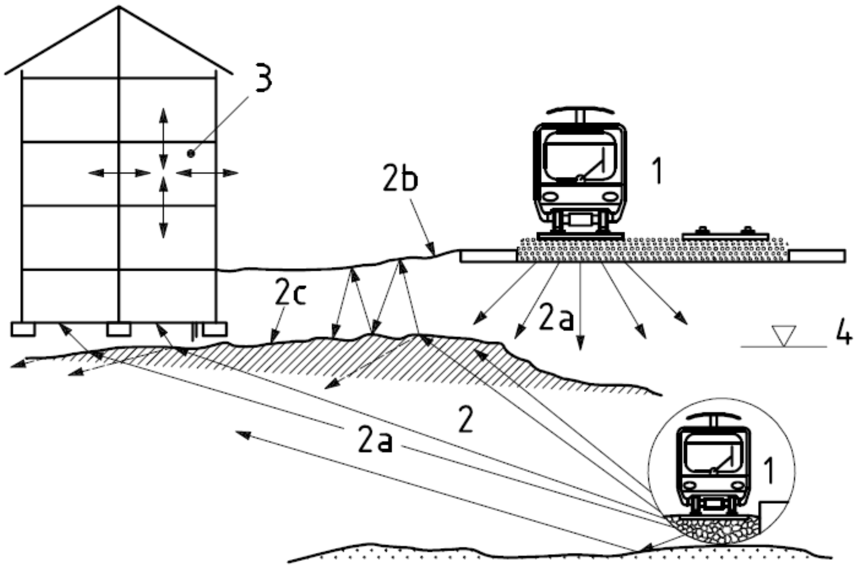
The prediction of ground-borne noise and vibration from rail systems is a complex and developing technical field. Whilst much research has been undertaken into various aspects associated with ground-borne impacts from rail systems, there are currently no commercially available modelling software packages.

The modelling for the project was therefore carried out using a modelling process for the core calculations developed by SLR. The algorithms incorporated into the SLR model are well documented in authoritative references and are widely used within the acoustical consulting profession, both in Australia and internationally.

Furthermore, as part of the Epping to Chatswood Railway Line (ECRL) project, ground-borne noise and vibration measurements were undertaken by SLR whilst a test train was operating in the tunnel under controlled conditions. As part of this testing, SLR undertook ground-borne noise and vibration measurements on the surface and within the tunnel at a number of locations. The results from this testing have been used to validate and refine the ground-borne noise and vibration modelling algorithms for the project assessment.

An overview of the ground-borne noise and vibration modelling approach is illustrated in **Figure 26**. The figure shows that the model takes into account the source vibration levels (1), the vibration propagation between the tunnel and nearby building foundations (2), and the propagation of vibration within the building elements (3).

Figure 26 Example of Source, Propagation and Receiver System (ISO 14837)



Key

1 source

2 propagation:
- 2 a body waves (compression, shear)
- 2 b surface waves (e.g. Rayleigh, Love)
- 2 c interface waves (e.g. Stoneley)

3 receiver (vibration, re-radiated noise)

4 water table

NOTE The components of the system comprising source, propagation and receiver are interdependent.

4.1.4.2 Source Vibration Levels

Source vibration levels within tunnels are dependent on a number of factors including the track design, train type, train speed, wheel condition, ground conditions and tunnel design.

Given the expected similarities of the project to the ECRL (in terms of tunnel diameter, geology, concrete lining, slab track design, etc), the source vibration levels for the new fleet of single deck, metro trains for use in the ground-borne noise and vibration modelling have been determined from historical measurements of the ECRL conducted by SLR Consulting between 2009 and 2011.

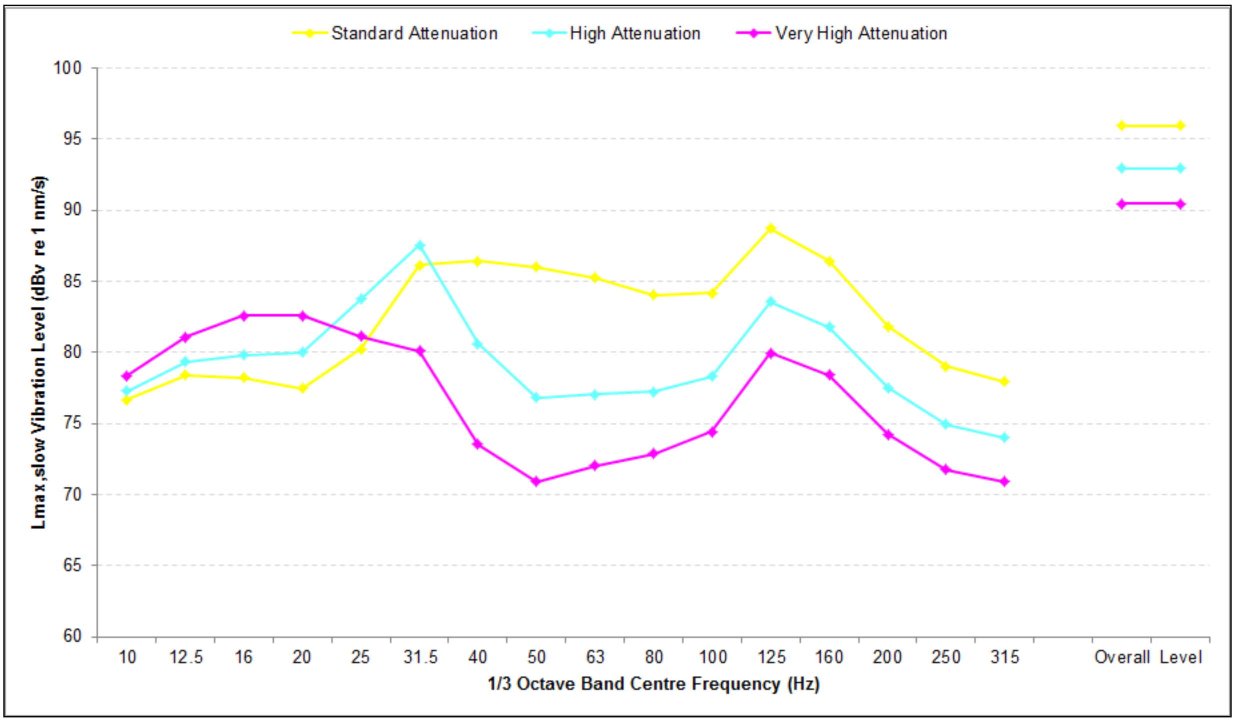
In the absence of specific measured data relating to the proposed single-deck trains, source vibration levels have been assumed to be equivalent to A-Set (Waratah) trains, which are the most modern trains currently operating on the Sydney rail network. This assumption is considered to be slightly conservative on the basis that the proposed single-deck passenger trains are likely to have reduced axle loads and unsprung mass compared with A-Set trains, resulting in marginally lower source vibration levels.

A summary of the reference vibration levels for three forms of slab track are provided in **Table 75** and **Figure 27**. These track forms are project-specific, taking into account the relevant design factors described below under the Track Form Design heading.

Table 75 Reference Source Vibration Levels (Tunnel Wall at 80 km/h Reference Speed)

Track Type	Vibration Levels (dB_V re 1 nm/s) in 1/3 Octave Bands (Hz) – $L_{max,slow,95\%}$																Overall Level
	10 Hz	12 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	
Standard Attenuation	77	78	78	77	80	86	86	86	85	84	84	89	86	82	79	78	96
High Attenuation	77	79	80	80	84	88	81	77	77	77	78	84	82	78	75	74	93
Very High Attenuation	78	81	83	83	81	80	74	71	72	73	74	80	78	74	72	71	90

Figure 27 Reference Source Vibration Levels (Tunnel Wall at 80 km/h) - Lmax,slow,95%



4.1.4.2.1 Route Alignment

The proposed tunnel alignment was guided primarily by the general location of metro stations. However, in order to reduce proximity to sensitive receivers, the project alignment has, where practicable, been located below or near to major roads and existing surface rail corridors including the Pacific Highway, Miller Street, Castlereagh Street and Pitt Street.

From a ground-borne noise and vibration perspective this is advantageous because the nearest sensitive receivers have existing noise exposure from road and rail traffic (which often masks the effects of ground-borne noise) or are commercial or industrial in nature and therefore less susceptible to ground-borne noise and vibration emissions. In other sections, the proposed alignment runs beneath suburban residential areas not directly adjacent to major roads where the ambient noise level environment is typically quieter - the potential sensitivity to train passbys is increased at these locations.

On curved track, wear patterns and vehicle steering characteristics can affect the source vibration emissions at the wheel rail interface. The risk of poor rail condition (such as corrugation) is also greater on curves than on straight track, as is the risk of other effects such as heavy flanging.

For track radii less than approximately 600 m, measurements undertaken by SLR on the Singapore Circle Line indicated that there is a general increase in source vibration levels of approximately 5 dB. On this basis, 5 dB has been added to the source vibration levels at the locations identified in **Table 76**.

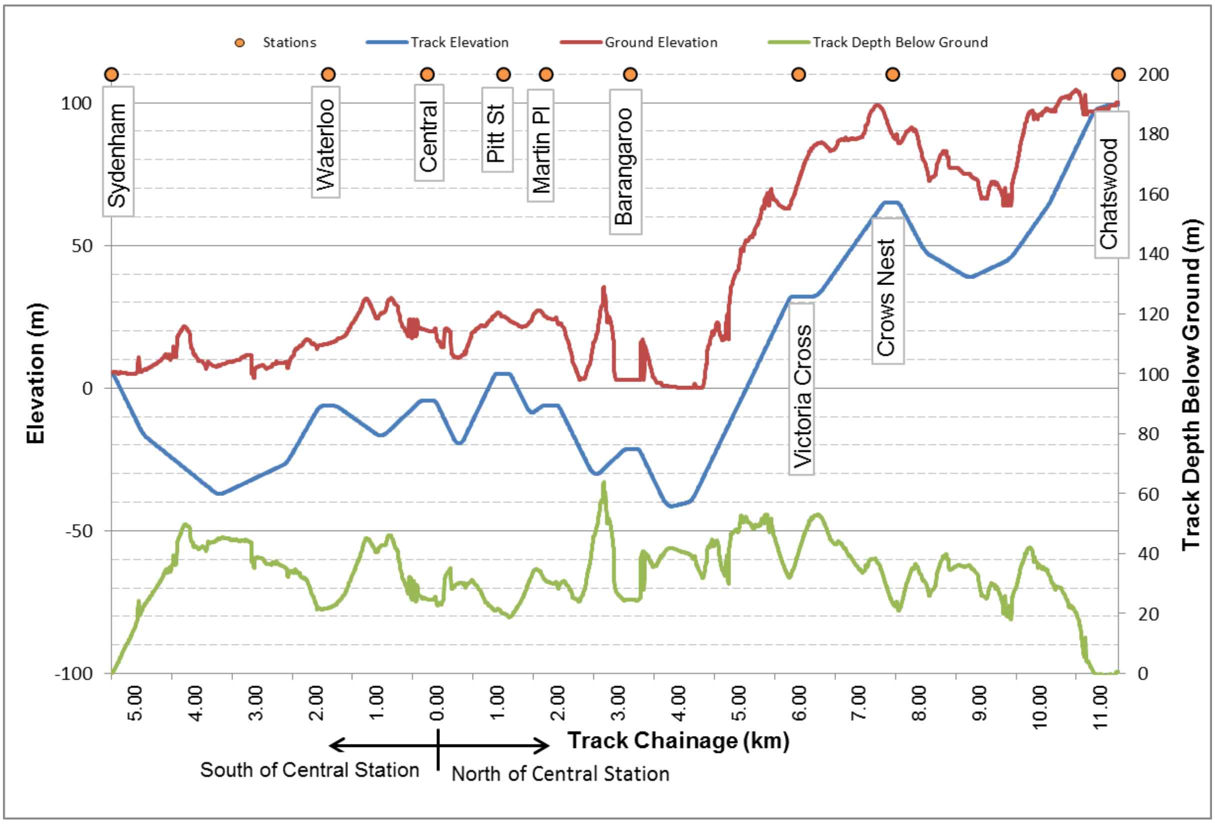
Table 76 Location of Curve Radii Less than 600 m

Chainage (m)		Curve Radius (m)	Chainage (m)		Curve Radius (m)
Start of Curve	**End of Curve**		**Start of Curve**	**End of Curve**	
North of Central Station					
Up Track (Southbound)			**Down Track (Northbound)**		
1,370	1,440	600	170	600	550
1,630	1,690	600	760	860	400
2,050	2,515	280	1,365	1,450	250
2,675	3,060	260	1,550	1,760	575
3,640	3,740	600	2,070	2,470	250
4,790	5,105	400	2,615	3,020	274
6,270	6,840	514	4,220	4,490	600
7,175	7,315	500	4,740	5,075	414
9,805	10,355	600	6,220	6,780	500
			7,120	7,260	500
South of Central Station					
Down Track (Southbound)			**Up Track (Northbound)**		
			2,020	2,990	600

Note: The chainage is defined as increasing away from Central Station. Tracks traveling away from Central Station are called Down Track and tracks traveling to Central Station are called Up Track.

The tunnel depth (i.e. rail track level) along the project alignment is shown in **Figure 28**. It can be seen that the rail tracks under the Sydney CBD (chainage 0 m to 3,600 m) are between 20 m and 40 m underground. There are no tunnel sections with the rail tracks less than 20 m below ground.

Figure 28 The Project Tunnel Depth vs Chainage



Note: The chainage is defined as increasing away from Central Station. Tracks traveling away from Central Station are called Down Track and tracks traveling to Central Station are called Up Track.

4.1.4.2.2 Rolling Stock Design

The proposed rolling stock to be utilised on the project would comprise modern, single-deck, metro trains. The trains would be approximately 160 m to 170 m long in an 8-car configuration (6-car trains would be used at opening and increased to 8-car trains as demand increases). These proposed trains are likely to incorporate dynamic brakes, friction disc brakes (at low speeds) and anti-skid systems to ensure that the wheel running profile remains smooth.

4.1.4.2.3 Rail Type

The proposed rail type for the project is 60 kg/m rail.

4.1.4.2.4 Track Form Design

The track form design (and its interaction with the operational rolling stock) is one of the primary ways in which ground-borne noise and vibration can be minimised on new underground rail lines.

The broad principles of vibration isolation for rail lines consist of a reduction in the dynamic stiffness of the track support and an increase in the mass of elements above the resilient track support. In general, the lower the natural frequency of the track support system, the better the vibration isolation. Low natural frequency is achieved by increased mass above the resilient support layer and reduced dynamic stiffness of the resilient support.[2]

[2] *ANC Guidelines - Measurement and Assessment of Ground-borne Noise & Vibration,* Association of Noise Consultants (2012), Page209.

Mitigation of ground-borne noise and vibration levels in buildings near rail lines is usually achieved through the insertion of a resilient layer between the rail and tunnel floor, either in the form of a resilient rail fastener, booted sleeper, floating track slab or a combination of approaches. The resilience is usually in the form of elastic/resilient pads or mats (or moulded rubber elements in the resilient baseplates/fasteners).

Figure 29 presents the principal features of generic designs for slab tracks and the location of the resilient components in each case, whilst examples of moderately resilient and highly resilient baseplates from two manufacturers (Delkor and Pandrol) are provided in **Figure 30**.

Resilient baseplates are available from a range of suppliers including ATP, CDM, Delkor, Getzner, Hilti, Lord, Pandrol, Schwihag and Vossloh. The dynamic stiffness of resilient baseplates varies significantly, ranging from around 5 kN/mm to 40 kN/mm.

The final track form design and associated mitigation measures would be addressed in the detailed design to be undertaken by the successful contractor. The track form design assessed as part of this environmental impact statement identifies one option for achieving the ground-borne noise and vibration objectives.

Figure 29 Generic Track Forms to Mitigate Ground-borne Noise and Vibration on Slab Track

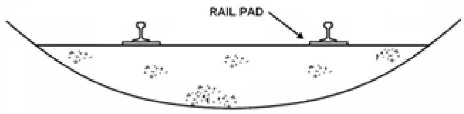
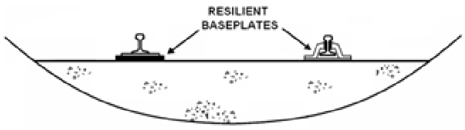
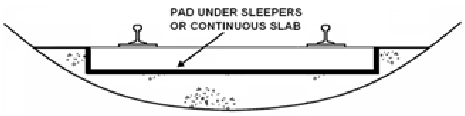
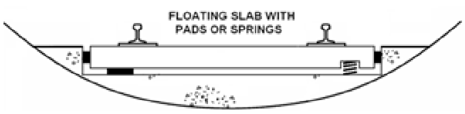
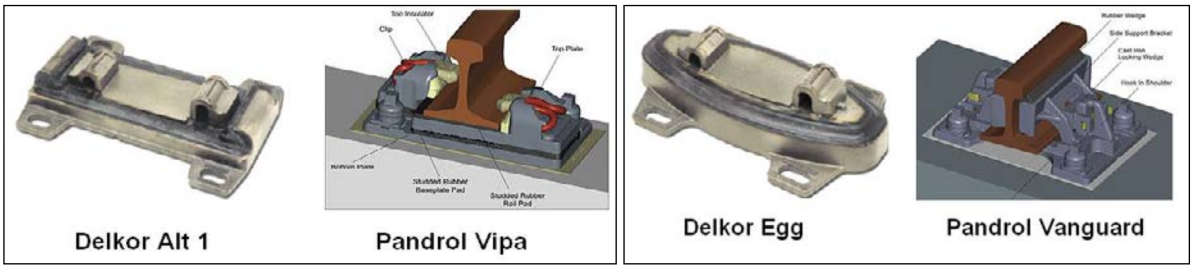
Generic Track Form Layouts	***Acoustic Performance***	***Description***
		*Direct fixation with standard rail foot pads (eg HDPE)*
	***Increasing Ground-borne Noise and Vibration Reduction***	*'Hard' resilient baseplates (eg, Delkor Alt 1, Pandrol Vipa, Pandrol Double Fastclip)*
		'Soft' resilient baseplates (eg, Delkor Egg or Pandrol Vanguard)
		*Resiliently supported sleepers/blocks or continuously supported slabs (eg slab on ballast mat)*
		*Floating Slab Track (FST) systems using short, long or continuous slabs with rubber or spring elements*

Figure 30 Hard Resilient Baseplates (left) and Soft Resilient Baseplates (right)



For the purpose of this assessment, generic performance data have been obtained for the Delkor fasteners (used on the ECRL) and the Pandrol fasteners (used on the Perth Metro). The stiffness properties for a number of different track forms are provided in **Table 77**.

Table 77 Properties of Delkor and Pandrol Rail Fasteners

Fastener Type	Static Stiffness[1,2]	Dynamic Stiffness[1,2]	Dyn/Stat Ratio	Comments
Standard Rail Fasteners				
ECRL Delkor Alt 1	20 kN/mm	28 kN/mm	1.4	As installed on ECRL
Delkor Alt 1	12 - 30 kN/mm	17 - 42 kN/mm	1.4	Stiffness options can be varied to suit
Pandrol Vipa	17 - 20 kN/mm	17 - 21 kN/mm	1.05	-
High Attenuation Rail Fasteners				
ECRL Delkor Egg	10 kN/mm	12 kN/mm	1.2	As installed on ECRL
Delkor Egg	6 - 15 kN/mm	8 - 20 kN/mm	1.3	Stiffness options can be varied to suit
Very High Attenuation Rail Fasteners				
Pandrol Vanguard	3 - 5 kN/mm	5 - 7.5 kN/mm	1.5	Assume dynamic stiffness of 6 kN/mm
Low Profile Delkor Egg	6 kN/mm	7.2 kN/mm	1.2	Stiffness options can be varied to suit

Note 1: The Static and Dynamic stiffness values have been obtained from product brochures (for Delkor and Pandrol products) and from the ECRL 100% Design Report (for the ECRL Alt 1 and Egg products).

Note 2: Various testing methods are employed in order to calculate the static and dynamic stiffness values of different systems. This makes a direct like for like comparison of the different systems difficult.

For the current assessment, the vibration performance of the ECRL Delkor Egg has been used as a starting point (based on tunnel wall measurement data within ECRL), with adjustments to the source levels being made for Delkor Alt 1 and Pandrol Vanguard fasteners based on the typical Dynamic Stiffness values. In practice, the vibration attenuation performance would also be affected by other parameters including the loss factor (damping), mass and dynamic interaction with the tunnel and rolling stock. Furthermore, various testing methods are employed in order to calculate the static and dynamic stiffness values of different systems which make a direct like-for-like comparison difficult. These other factors may require further investigation as part of the detailed design stage of the project.

Other important factors related to the use of softer baseplates which should be noted for consideration during detailed design are listed below:

- Care needs to be exercised to ensure that a low stiffness track design does not give rise to excessive passenger discomfort vibration levels or unacceptable reliability, availability, maintainability and safety implications.
- Careful attention is needed to ensure that the loaded natural frequency of the resilient rail fastener does not coincide with other frequencies associated with the fastener spacing, wheel diameter, bogie passing frequency, etc. If this occurs, the performance of the system would be impaired.
- An increase in the fastener spacing and decrease in the static stiffness of the resilient rail fasteners will increase the maximum rail deflection (and rail stress).

4.1.4.2.5 Track Forms

For the Delkor Alt 1 and Pandrol Vanguard fastening system, the relative performance (compared with the ECRL Delkor Egg) has been evaluated using a Single Degree of Freedom (SDoF) analysis including the unsprung axle mass of the rolling stock and rail pad stiffness per track metre. The project design assumes a rail fastener spacing of 700 mm for all track form options.

In the project ground-borne noise and vibration assessment, the following three track form options have been evaluated:

- **Standard Attenuation Track** - ground-borne noise performance of Delkor Alt 1, or equivalent from other suppliers/systems. Assumed dynamic stiffness of 28 kN/mm.
- **High Attenuation Track** - ground-borne noise performance of ECRL Delkor Egg or equivalent from other suppliers/systems. Assumed dynamic stiffness of 12 kN/mm.
- **Very High Attenuation Track** - ground-borne noise performance of Pandrol Vanguard Direct Fix Track System or equivalent from other suppliers/systems. Assumed dynamic stiffness of 6 kN/mm.

Standard attenuation track is proposed as the base case in the design process with higher attenuation or very high attenuation track being required in more sensitive areas where the standard attenuation design is not sufficient to achieve the ground-borne noise and vibration design objectives. The source vibration levels for the above three track forms are provided in **Table 75** and **Figure 27**.

4.1.4.2.6 Turnouts

There are no proposed turnouts or crossovers within the tunnels. There are however two future potential tunnel extensions and associated turnouts south of Central Station and just north of Victoria Cross Station.

As there is a discontinuity in the rail running surface at these turnouts, vibration levels would be higher than on smooth continuous track. References such as the US FTA *Transit Noise and Vibration Impact Assessment* indicate that vibration levels are typically 10 dB higher adjacent to conventional turnouts, which is in accordance with SLR's experience on previous projects.

The potential increase in ground-borne vibration and noise from the future turnouts would be designed and mitigated as part of these future projects. If required, mitigation could include specification of alternative turnouts (such as swingnose) and/or higher attenuation track form fasteners for a section adjacent to the turnouts.

4.1.4.2.7 Tunnel Design

The design properties of the tunnel including the diameter, wall thickness and material properties influence the vibration energy transmitted into the surrounding ground. An internal tunnel diameter of approximately 6 m has been evaluated for the project design.

4.1.4.2.8 Construction Tolerances

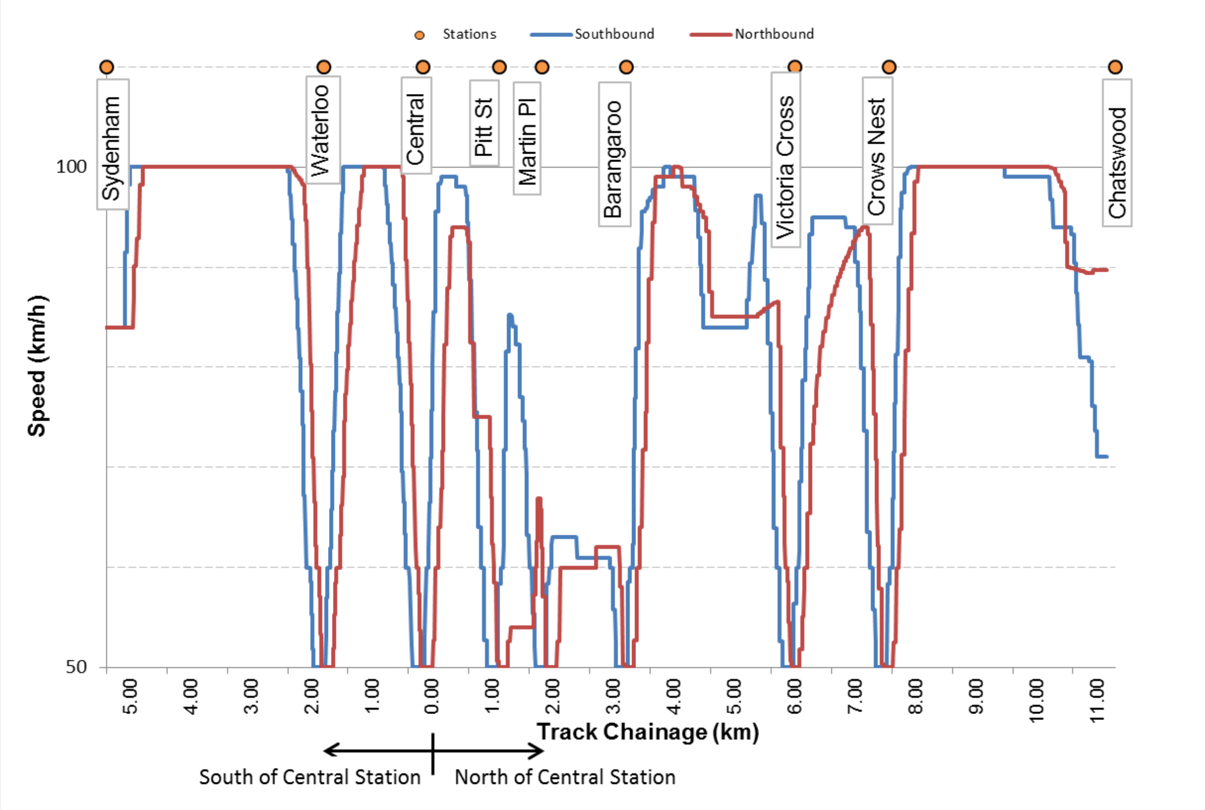
Construction tolerances refer to factors such as the variation in stiffness values between rail fasteners, the quality of the track construction and any change in stiffness values with time.

The potential effect of construction tolerances has not been evaluated as part of the assessment and will be required to be addressed in the detailed design and procurement processes. Control of these effects is anticipated to be feasible, and therefore construction tolerances are not considered further in this assessment.

4.1.4.2.9 Operations

The main factors associated with operational patterns are the train speeds and timetabling. The speed profiles for both the down and up track used for the modelling are provided in **Figure 31**. For the purpose of the ground-borne noise and vibration modelling, a minimum speed of 50 km/h has been assumed at the stations.

Figure 31 Speed Profile



For train operations in tunnels, the vibration levels typically increase by 6 dB for each doubling of train speed. This relationship has been observed by SLR on other projects (including ECRL) and has therefore been adopted for the modelling.

The reference vibration levels adopted in the modelling process are for a train speed of 80 km/h (refer to **Table 75**). The maximum train speeds proposed for the project is 100 km/h. **Figure 31** shows the trains speeds which have been adopted for the noise and vibration modelling. Speed adjustment of the 80 km/h reference vibration level has therefore been made using the following formula on a 1/3 octave frequency basis:

$$V(speed\_adjusted) = V(reference) + 20\log_{10}\left(\frac{speed}{80}\right)$$

The potential impact of simultaneously passing trains at particular receiver locations on a regular basis has not been evaluated in detail as part of the assessment. The maximum increase in vibration levels in the event of two trains passing at the same time is 3 dB. In practice, this situation would occur infrequently and since ground-borne noise and vibration levels from trains are variable, any increase in noise levels would likely be limited to 1 dB or 2 dB and is not likely to be noticeable.

4.1.4.2.10 Maintenance

The maintenance of the track and rolling stock can have a significant influence on the ground-borne noise and vibration levels. The source vibration levels which form the starting point of the modelling assume that the track is maintained in a reasonable condition consistent with what has been observed and measured on ECRL. In the case of poor track condition, it is assumed that rail grinding would be undertaken if the surface roughness values of the track are outside the permitted tolerances. Furthermore, it is also assumed that the condition of the track would be monitored on a regular basis using on-car or hand-held monitoring equipment. Additional information on rail roughness management as applied to the ECRL may be found in Vegh et. al. *Acoustic rail grinding - measures of long term effectiveness: Epping to Chatswood Rail Link case study*[xxi].

The source vibration levels are also based on the 95th percentile (highest 5%) of train vibration levels observed, as required by the RING. The project would include wheel condition monitoring systems and a wheel lathe at the Sydney Metro Trains Facility (part of Sydney Metro Northwest). On this basis, it is reasonable to assume that the condition of the wheels would remain steady over time.

In the case of poor wheel condition, it is assumed that the potential for wheel flats would be minimised through incorporation of anti-skid braking systems in the design. If wheel flats or other wheel defects do occur, it is assumed that these would be identified by a permanent monitoring station and rectified using the wheel lathe or other measures to return the wheel condition to an acceptable degree of smoothness.

4.1.4.2.11 Safety Factor

The modelling process incorporates a +5 dB safety factor to the predictions of ground-borne noise and vibration to accommodate for site specific factors such as atypical ground conditions and/or abnormal building construction methods which could lead to higher than anticipated levels.

4.1.4.3 Propagation Path

The propagation of vibration through the ground is a complex phenomenon. Even for a simple source, the received vibration at any point includes the combined effects of several different wave types, plus reflections and other effects caused by changes in ground conditions along the propagation path.

Attenuation with distance occurs due to the geometric spreading of the wave front and due to other losses within the ground material known as ‘damping’. The attenuation due to geometric spreading occurs equally for all frequencies, whereas the damping component is frequency dependent, with greater loss per metre occurring at high frequencies than at low frequencies.

4.1.4.3.1 Vibration Attenuation due to Geometric Spreading

For geometric spreading, a 160 m long train was modelled as a cylindrical line source based on the tunnel wall vibration levels at a distance of 2 m from the track centreline. For this project, the trains were represented by point sources spaced at 5 m intervals, with the distance attenuation from each point calculated according to the following formula:

$$V(spreading) = 10\log_{10}\left(\frac{2}{\mathrm{Distance}}\right)$$

where: *V(spreading)* is the change in vibration level (in dB), Distance is the slant distance between the point source and the receiver location.

4.1.4.3.2 Vibration Attenuation due to Material Damping

The indicated ground geology along the proposed alignment is predominantly Hawkesbury sandstone and Ashfield shale.

The excess attenuation due to material damping for the project was based on bore hole vibration testing undertaken by SLR as part of the Sydney Metro Northwest project and the now abandoned West Metro proposal. The measurement results are consistent with the force transmissibility measurements undertaken by Wilkinson Murray Pty Ltd as part of the ECRL project.

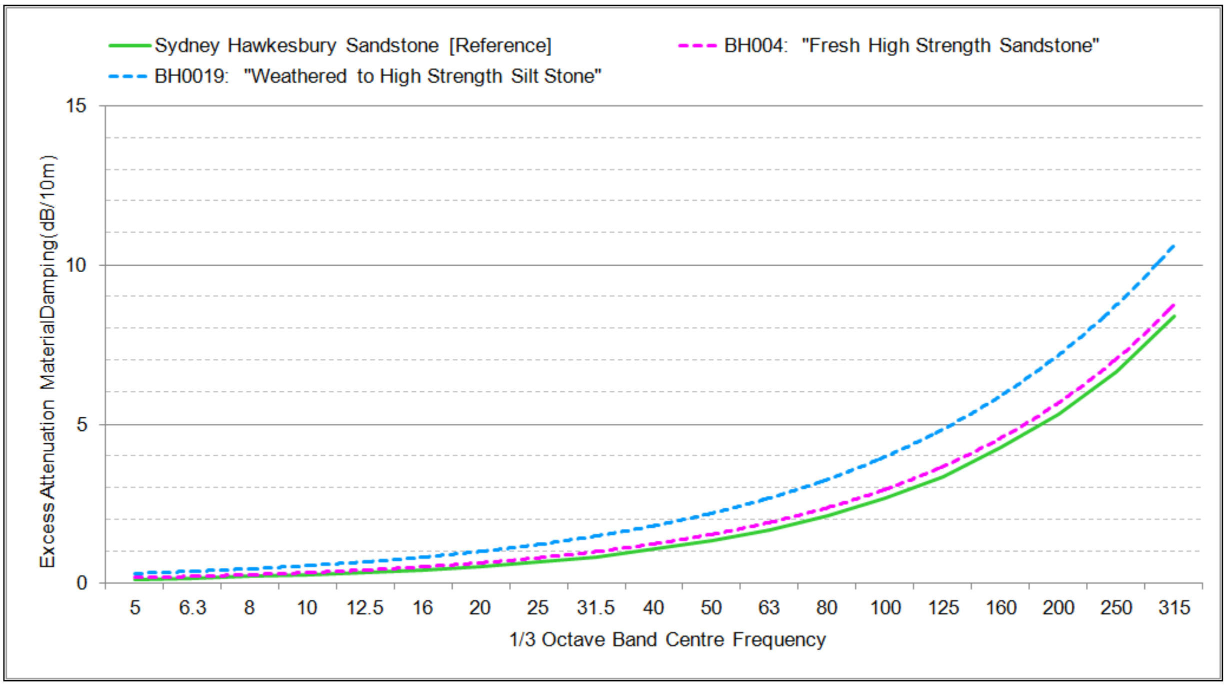
These excess attenuation levels (shown by the green line in **Figure 32**) were adopted on the basis that they provided a good conservative estimate of the measured damping properties for Hawkesbury sandstone and Ashfield shale, which are the predominant ground types through which the project alignment passes.

The measured excess attenuation due to material damping for Hawkesbury sandstone (pink dashed line in **Figure 32**) was found to be consistent with previous measurement data for this ground type. The measurements for Ashfield shale (blue dashed line in **Figure 32**) found slightly higher excess attenuation values compared to Hawkesbury sandstone.

A conservative estimate of the excess attenuation according to values presented in **Figure 32** has therefore been implemented for the length of the project alignment.

This conservative estimate for the excess attenuation due to material damping may result in a slight over-prediction of the ground-borne noise and vibration levels at some locations. Since it is not possible to know exactly what ground conditions exist at all locations, a conservative approach is required at this stage in the assessment process to provide confidence that the design objectives are achievable along the whole alignment.

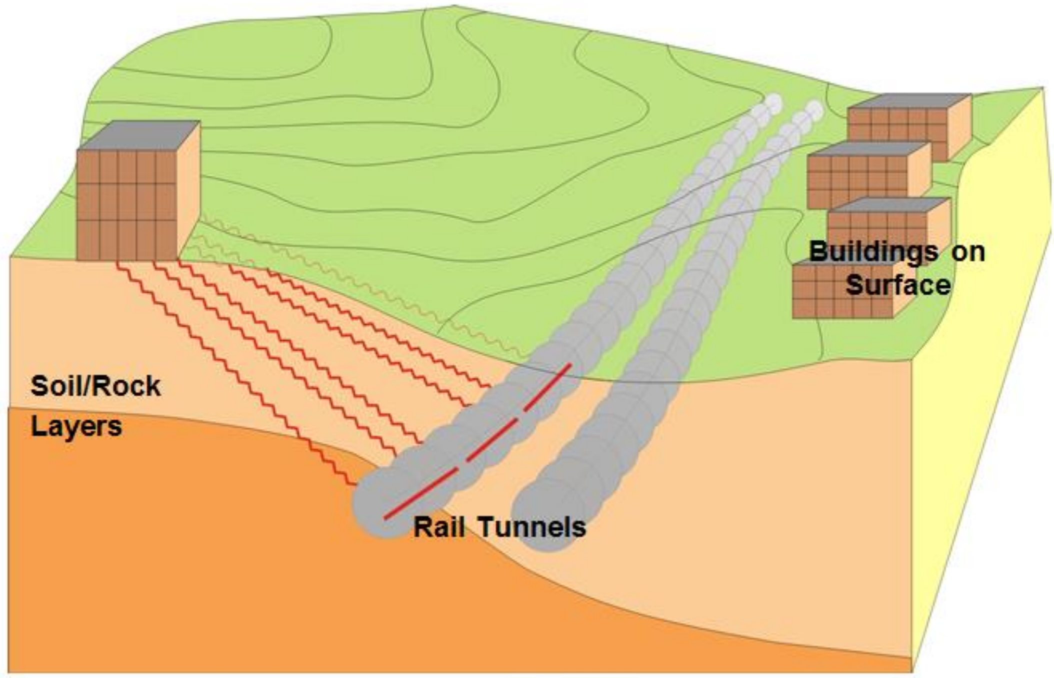
Figure 32 Excess Attenuation Due to Material Damping



4.1.4.3.3 Three-Dimensional Modelling

The importance of undertaking three-dimensional modelling is illustrated in **Figure 33**. For a 160 m long train vibration source, changes in track form or train speed, crossovers, curves and other local characteristics can result in variations in vibration emissions within the zone of influence of a given building. Hence, it is desirable for modelling to represent the train over its full length. Therefore it is necessary to model the tunnel in three dimensions, rather than as a simple cross section.

Figure 33 Possible Propagation Paths from Train in Tunnel to Surface Buildings



4.1.4.4 Receivers

4.1.4.4.1 Propagation of Vibration into Buildings

With many types of building, a coupling loss occurs at the ground/footing interface, resulting in lower levels of vibration in the building's footings than in the surrounding ground. The ground-borne vibration and noise model permits assessment with a variety of coupling loss categories, representative of several different building constructions.

For many buildings situated near to the project alignment, it is likely that the building footings will be founded in the underlying bedrock. On this basis, a conservative coupling loss midway between zero and that for a single level building has been assumed in the model for all buildings. This is detailed in **Table 78** together with typical coupling loss data for common building structures.

At this stage of the project only limited information regarding basements is available and modelling would be refined during the detailed design to incorporate all basement levels for potentially impacted buildings.

Table 78 Coupling Loss Values (dB)

Type	Coupling Loss (dB) in 1/3 Octave Bands (Hz)																		
	5	6.3	8	10	12	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315
Values adopted for the project	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2
Large Masonry on Piles	6	6	6	6	7	7	7	8	9	10	11	12	13	13	14	14	15	15	15
Large Masonry on Spread Footings	11	11	11	11	12	13	14	14	15	15	15	15	14	14	14	14	13	12	11
2-4 Storey Masonry on Spread Footings	5	6	6	7	9	11	11	12	13	13	13	13	13	12	12	11	10	9	8
1-2 Storey Commercial	4	5	5	6	7	8	8	9	9	9	9	9	9	8	8	8	7	6	5
Single Residential	3	3	4	4	5	5	6	6	6	6	6	6	6	5	5	5	4	4	4

Note: Coupling loss values have been obtained from Nelson[3] and have been extrapolated to include frequency bands below 16 Hz.

4.1.4.4.2 Propagation of Vibration within Buildings

Losses also occur with the transfer of vibration from floor-to-floor within buildings. The model incorporates the losses listed in **Table 79**, which are also based on data presented by Nelson (1987), extrapolated to include frequency bands below 16 Hz. The ground-borne noise and vibration levels attenuate by approximately 2 dB per floor for the first four floors and by approximately 1 dB per floor thereafter.

Table 79 Floor-to-Floor Loss Values

Floor Level Above Grade	Floor-to-Floor Loss (dB) in 1/3 Octave Bands																		
	5	6.3	8	10	12	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315
1	1	1	1	1	1.5	1.5	1.5	2	2	2	3	3	3	2	2	2	3	3	3
2	1	1	1	1	1.5	1.5	1.5	2	2	2	2	2	2	3	3	3	3	3	3

Note: The floor to floor losses in this table are additive (ie for assessment on the second level above ground, the loss at 50 Hz would be 5 dB).

3 *Transportation Noise Reference Book*, Nelson, J (1987).

Low frequency vibration can be amplified within buildings by resonances in floors and walls. On the basis of data presented by Nelson, the amplification spectrum presented in **Table 80** has been adopted. Nelson indicates that amplification values found in practice are typically within ±3 dB of these values. Slightly lower values are assumed for the ground-borne noise calculations as the use of the full floor amplification values can result in over-estimation of the resultant noise[4]. The values below have been adopted in the project model for all receivers.

Table 80 Amplification within Buildings Values

Floor Level Above Grade	Floor-to-Floor Amplification (dB) in 1/3 Octave Bands																		
	5	6.3	8	10	12	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315
Floor Vibration	10	10	10	10	10	10	10	11	11	11	10	9	9	-	-	-	-	-	-
Ground-borne Noise	-	-	-	-	-	-	6	7	7	7	6	6	5	5	4	3	2	1	1

Note: Note that the frequency range used for vibration assessment is 5 Hz to 80 Hz and the frequency range for ground-borne noise assessment is 20 Hz to 315 Hz.

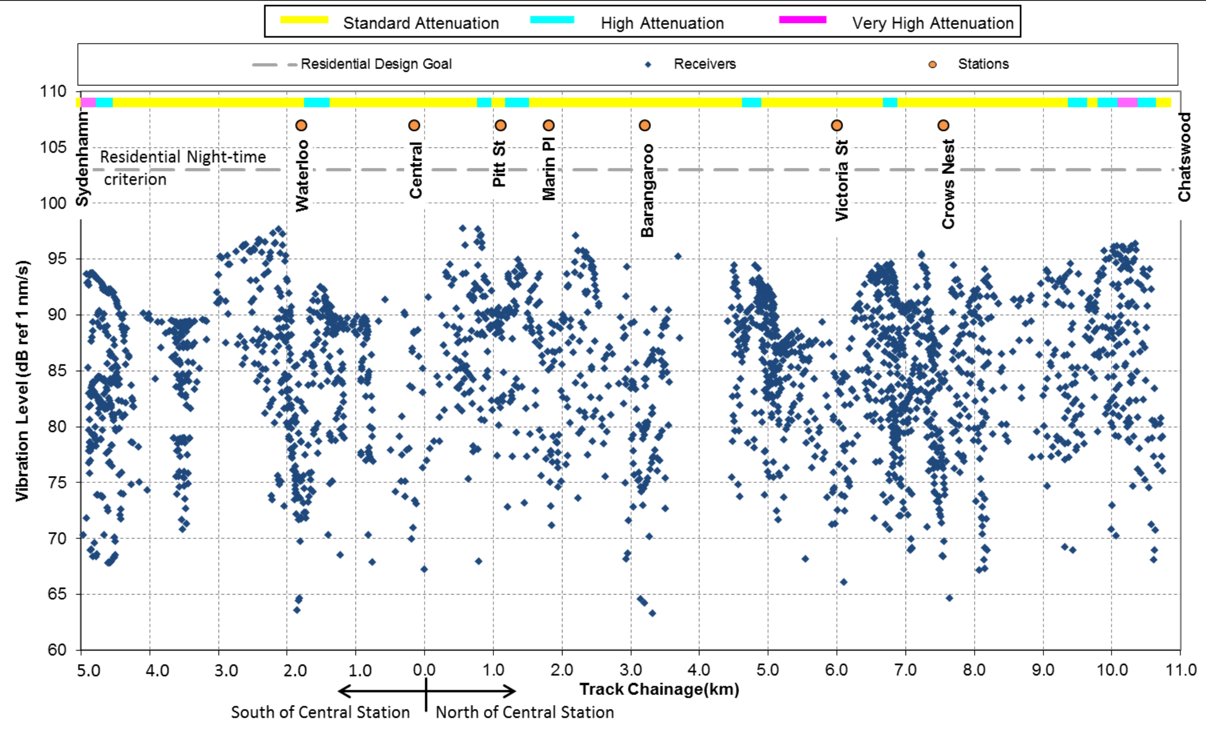
4.1.5 Ground-borne Vibration Predictions

Figure 34 presents a summary of the predicted ground-borne vibration levels for buildings located above or near the proposed rail alignment.

The predicted ground-borne vibration levels are for the proposed track design to meet the ground-borne noise levels (refer **Section 4.2.7**) and represent the maximum mid-floor vibration levels within multi-storey buildings.

[4] *ANC Guidelines - Measurement and Assessment of Ground-borne Noise & Vibration,* Association of Noise Consultants (2012).

Figure 34 Predicted Ground-borne Vibration Levels (Proposed Track Form)



4.1.5.1 Special Receivers Which May Contain Highly Vibration Sensitive Equipment

At this stage, it is not known whether any commercial facilities contain highly sensitive measurement or fabrication equipment. For preliminary assessment purposes, it is assumed that all nearby (within approximately 150 m of the alignment) medical (with MRI or imaging facilities) and special research facilities may contain highly sensitive equipment such as lithography or optical/electronic inspection equipment with high resolution (down to 1 micron). **Table 81** presents predicted ground-borne vibration levels for special facilities that are located in proximity to the proposed alignment.

Table 81 Special Receivers which may contain Highly Vibration Sensitive Equipment

Receiver	Chainage (km)	Maximum 1/3 Octave Band Vibration Level (dB ref 1 nm/s)[1]	
		Design Objective	Predicted
Royal North Shore Hospital	8.46	82	**74**
Health Care Imaging Services	1.00		**75**

4.1.6 Surface Track Ground-borne Vibration Predictions

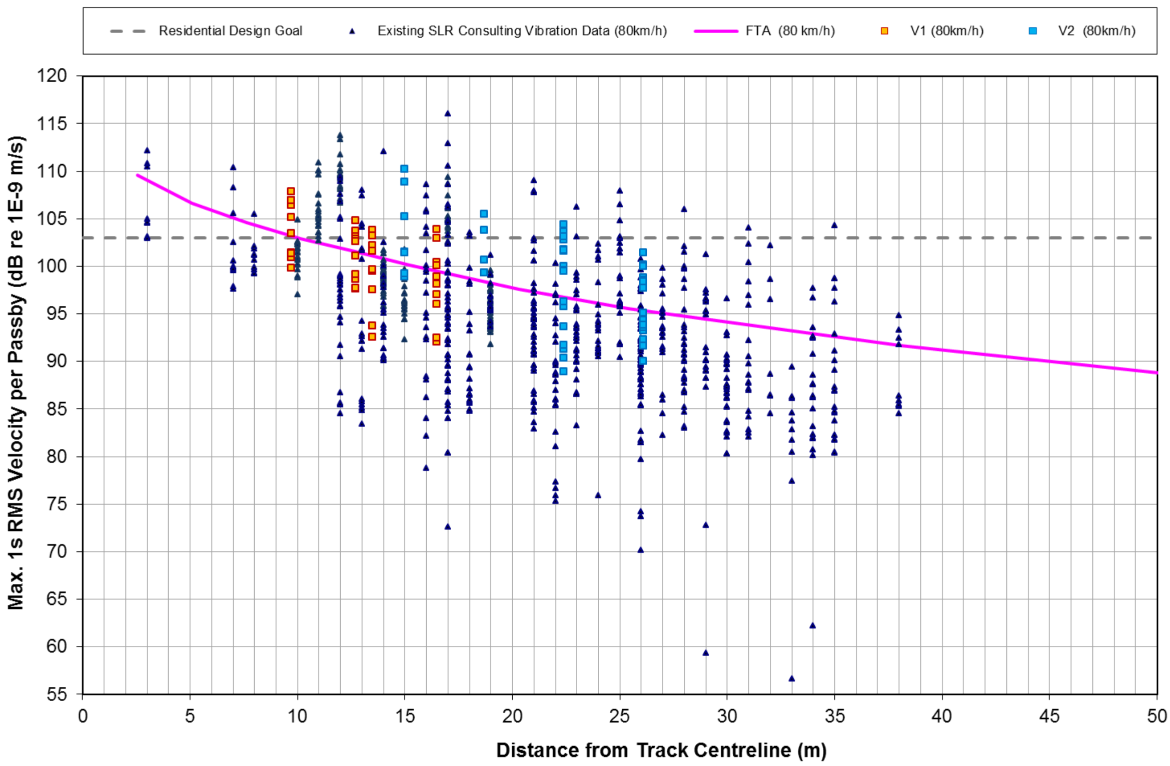
Vibration measurements of passenger train passbys on surface track were undertaken in the Sydney Metro project area at two locations (as described is **Section 2.4.4**).

Vibration propagation characteristics can be highly variable depending on the ground conditions at a given location. The US Federal Transit Administration's (FTA's) Transit Noise and Vibration Impact Assessment report provides indicative vibration levels versus distance for a variety of transport systems, including metro style rail systems. The base curve, shown in **Figure 35** shows the typical ground surface vibration levels assuming rolling stock and rail in good condition and a train speed of 80 km/h. At other speeds, the change in vibration level is approximately proportional to 20 x log(speed/80 km/h), however the manual notes that sometimes the speed relationship has been observed to be as low as 10 to 15 x log(speed/80 km/h).

The vibration measurement results for passenger train passbys in the Sydney Metro project area are presented in **Figure 35** for comparison with the FTA vibration vs distance base curve (adjusted for speed to represent the 80 km/h reference).

Vibration measurements undertaken adjacent to the Sydney metropolitan network on other projects undertaken by SLR Consulting are also included in **Figure 35** to demonstrate the variability of results according to train and location characteristics. The vibration levels are expressed in terms of the RMS vibration velocity level in dB (re 10-9 m/s). The measurement data obtained as part of the current study represent the maximum vibration levels observed during each train passby.

Figure 35 Ground Surface Vibration Levels Versus Distance (adapted from Figure 10-1 in FTA's Transit Noise and Vibration Impact Assessment Report)



From the measurement results taken within the Sydney Metro project area it is evident that the vibration levels at locations V1 and V2 are typically consistent with that predicted by the FTA base curve with some measurements higher on average and others lower on average. The variation in measured vibration levels from the FTA base curve is likely to be due to the local ground conditions at the measurement locations and the propagation path from the tracks into the ground.

Section B2.3 of the DECC vibration guideline indicates that the threshold of perception for most people is approximately 103 dB RMS (0.14 mm/s). From the measurement results presented in **Figure 35**, it is anticipated that for some train passbys, vibration levels may be perceptible at times where buildings are located within approximately 20 m from the nearest track. It is noted that the observed average train speeds for Sydney Trains operations on the T1 North Shore Line in the vicinity of the Chatswood dive are approximately 20 km/h lower than the 80 km/h line speeds for this region. Therefore the average vibration impacts are likely to be approximately 2.5 dB lower than the FTA base curve displayed in **Figure 35**.

Some residential buildings located immediately adjacent the surface rail track in the vicinity of the Chatswood dive may experience an increase in train passby vibration levels. Residential receivers located on the eastern side of the surface rail corridor in between Mowbray Road and Gordon Avenue, Chatswood are located approximately 11 m (horizontally) from the nearest existing rail track (T1 North Shore Line Up track). As a result of the track realignment associated with the project, the nearest track would be located approximately 8 m (horizontally) from the nearest residential receiver. According to the FTA base curve displayed in **Figure 35**, this change in track to receiver distance equates to a change in vibration level of approximately 2 dB. This level of change in vibration level is expected to be barely perceptible to most people.

Train passby vibration levels may exceed the night-time 103 dB_V vibration criteria at residential receivers located within 10 m of the design alignment. This includes four residential receivers located on the Up side of the surface rail corridor between Mowbray Road and Gordon Avenue, Chatswood.

However, the maximum predicted VDV value is 0.1 $m/s^{1.75}$ during the day and 0.07 $m/s^{1.75}$ during the night, which is well below the VDV criterion of 0.2 $m/s^{1.75}$ during the day and 0.1 $m/s^{1.75}$ during the night in accordance with BS 6472.

When taking into account the above levels and the duration and frequency of train passbys adjacent to the realigned T1 North Shore Line Up track, no adverse vibration impacts are anticipated adjacent to the project surface rail sections.

4.1.7 Summary of Ground-borne Vibration Assessment

As discussed in **Section 4.1.2**, the human comfort (perception) objectives for ground-borne vibration are more stringent than other possible design limits relating to building damage risk or the potential effects on building contents.

On the basis of the input data and modelling assumptions described in the previous sections, compliance with the ground-borne vibration objectives (the human comfort vibration criteria from *Assessing Vibration: A Technical Guideline*) is predicted for all residential receivers and other sensitive receiver locations above or near to the proposed project alignments.

There are no anticipated vibration impacts adjacent to project related surface rail tracks.

4.2 Ground-borne Noise Train Operations

4.2.1 Introduction

Train noise in buildings adjacent to rail tunnels is predominantly caused by the transmission of ground-borne vibration rather than the direct transmission of noise through the air. After entering a building, this vibration may cause the walls and floors to vibrate faintly and hence to radiate audible noise, which is commonly termed ground-borne or regenerated noise.

If it is of sufficient magnitude to be audible, this noise has a low frequency rumbling character, which increases and decreases in level as a train approaches and then departs the site. This type of noise can be experienced in buildings adjacent to many urban underground rail systems, including several buildings close to the existing Sydney Trains tunnels in the Sydney CBD.

In some CBD buildings where no precautions have been taken in the tunnel or building design to limit ground-borne noise and vibration effects, the rumbling noise can sometimes be heard several storeys above ground level.

For most new rail lines, the track design incorporates resilient rail fasteners to reduce the transmission of dynamic forces that occur at the wheel-rail interface. This resilience also serves to provide some isolation of ground-borne vibration, which in turn reduces the ground-borne noise levels in buildings near the rail tunnel.

Some especially sensitive spaces and activities, such as theatres, cinemas, studios and sleeping areas are more prone to disturbance from ground-borne noise than others, such as shopping areas, office spaces or industrial premises.

Ground-borne noise levels are relevant only where they are higher than the airborne noise, such as when the rail line is underground.

4.2.2 Ground-borne Noise Metrics

The primary noise metric used to describe railway ground-borne noise emissions in the modelling and assessments is:

$L_{Amax(slow),95\%}$ The *"typical maximum noise level"* for a train passby event. For operational rail noise, $L_{Amax(slow)}$ refers to the maximum noise level not exceeded for 95% of rail passby events measured using the 'slow' response setting on a sound level meter.

The subscript 'A' indicates that the noise levels are filtered to match normal human hearing characteristics (ie A-weighted). On the basis of guidance in International Standard ISO 14837-1 2005 *Mechanical vibration - Ground-borne noise and vibration arising from rail systems - Part 1: General Guidance*, ground-borne noise levels are evaluated over the 20 Hz to 315 Hz frequency range.

4.2.3 Operational Ground-borne Noise Objectives

The ground-borne noise and vibration assessment is required to be undertaken in accordance with the RING. The noise design objectives contained within this guideline are expressed as non-mandatory "trigger levels" which, if exceeded, require the consideration of feasible and reasonable mitigation measures.

The ground-borne noise trigger levels for residential and other sensitive receiver locations are provided in **Table 82**.

Table 82 Ground-borne Noise Trigger Levels (Internal)

Receiver	Time of Day	Noise Trigger Levels (dBA)
		Development increases existing rail noise levels by 3.0 dB or more AND resulting rail noise levels exceed:
Residential	Day (7:00 am to 10:00 pm)	40 $L_{Amax(slow)}$
	Night (10:00 pm to 7:00 am)	35 $L_{Amax(slow)}$
Schools, educational institutions, places of worship	When in use	40-45 $L_{Amax(slow)}$

The ground-borne noise levels in **Table 82** refer to noise caused by the proposed rail operations only and do not include ambient noise from other sources such as major roads and industry. The train noise levels are evaluated inside buildings at the centre of the most affected habitable room (kitchens, bathrooms, laundries and the like are not considered "habitable").

"Residential" typically means any residential premises located in a zone as defined in a planning instrument that permits new residential land use as a primary use. The $L_{Amax,95\%}$ noise level refers to the noise levels not to be exceeded by 95% of train passby events (ie 5% of train passbys are permitted to exceed the trigger levels). The absolute maximum event is not used for design, as it cannot be precisely defined and would be a highly infrequent event. The ground-borne noise level of the "average" or median train event would typically be between 5 dB and 10 dB lower than the 95th percentile event.

For new rail projects, the noise trigger levels apply immediately after operations commence and for projected traffic volumes over an indicative period into the future.

For schools, educational institutions and places of worship, the lower value of the range is most applicable where low internal ambient noise levels are expected, such as in areas assigned to studying, listening and praying.

The guideline also states:

> *"It appears reasonable to conclude that ground-borne noise at or below 30 dB L_{Amax} will not result in adverse reactions, even where the source of noise is new and occurs in areas with low ambient noise levels. Levels of 35–40 L_{Amax} are more typically applied and likely to be sufficient for most urban residential situations, even where there are large numbers of noisy events.*
>
> *…the noise trigger levels in Table 4 … They are necessarily set to the lower end of the range of possible trigger values so that potential impacts on quieter suburban locations are addressed. In practice, higher levels of ground-borne noise than the trigger level for assessing impacts may be suitable for urban areas where background noise levels are relatively high."*

As the project represents a new rail infrastructure project, the noise trigger levels have been adopted as design objectives which are to be achieved at all locations, where feasible and reasonable.

For residential receivers, this results in a ground-borne noise design objective of 40 dBA $L_{Amax,slow,95\%}$ during the daytime and 35 dBA $L_{Amax,slow,95\%}$ during the night-time. For schools, educational institutions and places of worship, this results in a ground-borne noise design objective of 40 dBA to 45 dBA $L_{Amax,slow,95\%}$. Even though the guideline does not include specific criteria for medical institutions, it has for this assessment been assumed that the ground-borne noise design objective of 40 dBA to 45 dBA $L_{Amax,slow,95\%}$ is also applicable to medical institutions (except patient wards that are assessed as residential).

For commercial receivers, shopping centres and industrial buildings, RING does not provide guidance on acceptable levels. On other projects including Sydney Metro Northwest, SLR has applied ground-borne noise objective of 45 dBA for general office areas and 50 dBA to 55 dBA for retail areas depending on the particular sensitivity of the receiver. A ground-borne noise design objective of 40 dBA is desirable for commercial receivers with private offices or conference rooms.

Provided in **Table 83** is a summary of the proposed ground-borne noise design objectives for the project for these other receiver types.

Table 83 Ground-borne Noise Design Objectives for Other Sensitive Receivers

Receiver	Time of Day	Noise Trigger Level (dBA)[1]
Residential	Day (7:00 am to 10:00 pm)	40 dBA
	Night (10:00 pm to 7:00 am)	35 dBA
Medical institutions	When in use	40 dBA to 45 dBA[2]
Retail Areas	When in use	50 dBA
General Office Areas	When in use	45 dBA
Private Offices and Conference Rooms	When in use	40 dBA
Cinemas, Public Halls and Lecture Theatres	When in use	35 dBA
Drama Theatres	When in use	NR 25[3]
Film/Television Studios and Sound Recording Studios	When in use	NR 15[3]
Workshops / Industrial Buildings	-	N/A

Note 1: The ground-borne noise design objectives are based on the maximum $L_{Amax(slow)}$ noise level, not to be exceeded for 95% of train passbys over any 24 hour period.

Note 2: The lower value of the range is most applicable where low internal noise levels are expected, such as in areas assigned to studying, listening and praying. Note that patient wards are assessed as residential receivers.

Note 3: NR curves are used for rating noise levels and are a set of octave band curves which provide limiting sound pressure level values. NR 15 is equivalent to approximately 20 dBA and NR 25 is approximately 30 dBA.

4.2.4 Ground-borne Noise Modelling Methodology

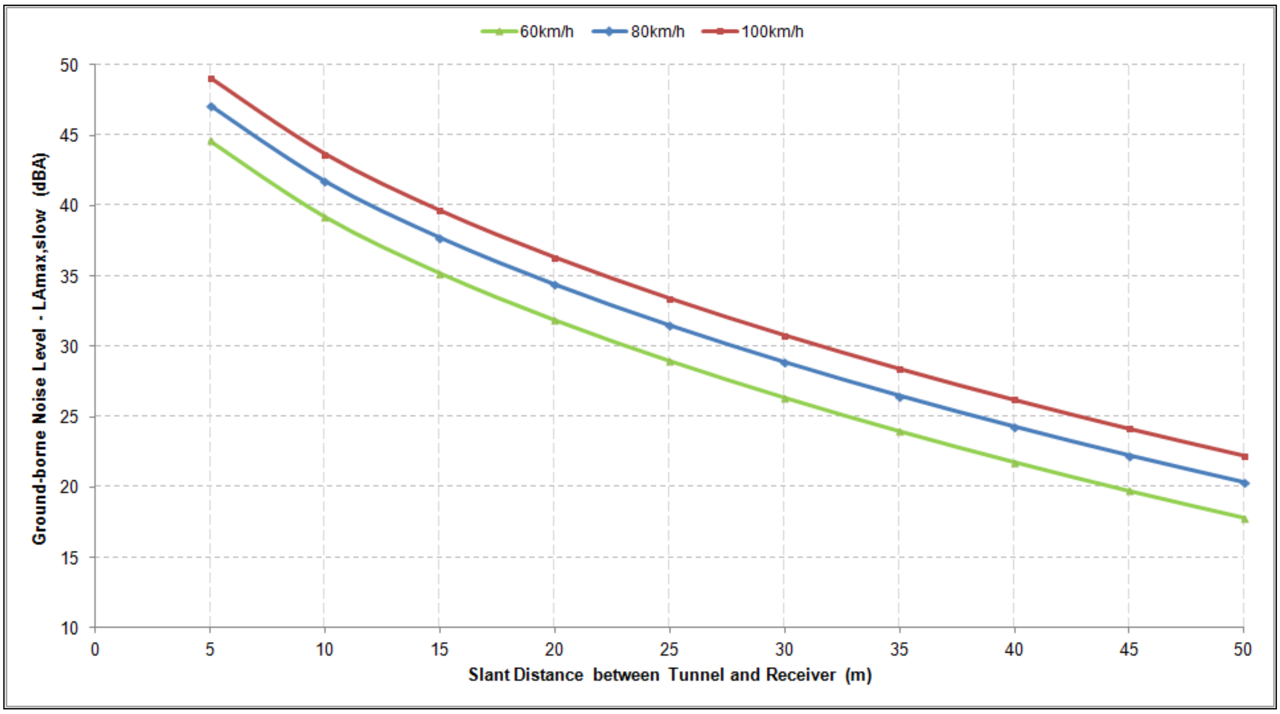
The ground-borne noise and vibration modelling methodology is discussed in **Section 4.1.4**, with the addition of two final steps to account for the conversion of surface vibration into noise.

In accordance with Nelson (1987) and the ANC Guidelines (2001), an adjustment of -27 dB was used in the model to convert each 1/3 octave band vibration level (dB_V re 1 nm/s) to a sound pressure level (dB re 20 µPa). The 1/3 octave band sound pressure levels were then A-weighted and logarithmically summed to provide the overall $L_{Amax(slow)}$ noise level predictions. The employed relationship is conservative and the latest version of the ANC guideline (2012) has moved to recommend a conversion factor of -32 (rather than -27).

4.2.5 Ground-borne Noise Prediction Curve

On the basis of the ground-borne noise and vibration modelling assumptions discussed in **Section 4.1.4** and **Section 4.2.4**, **Figure 36** presents a summary of the indicative ground-borne noise levels at various distances from the proposed rail tunnels for train speeds of 60 km/h, 80 km/h and 100 km/h, assuming a Standard Attenuation track form design.

Figure 36 Ground-borne Noise Level vs. Slant Distance (Illustrative Only)



Note: The distance refers to the slant distance between the receiver location (on the surface) and the track (within the tunnel). For example, if the track is located 30 m below ground and the receiver is located 40 m to the side of the tunnel, the receiver would be located at a slant distance of 50 m from the track.

4.2.6 Ground-borne Noise Mitigation Options

The potential ground-borne noise mitigation options for a new railway line include the following:

- Operational measures such as reduced train speeds or allowing system access only to trains with wheels in ‘good’ condition (or modern trains)
- Avoiding tight curves (less than approximately 600 m radius) and optimising the vertical alignment (maximising tunnel depth) where possible
- Track design measures including the provision of resilient rail fasteners, booted sleepers or floating slab track to reduce the vibration energy transferred to the tunnel footing, foundation, surrounding ground and nearby buildings (refer to **Section 4.1.4.2.4** for more detail on track from mitigation options)
- Track maintenance / rolling stock measures such as maintenance to ensure rail and wheel roughness is kept within required tolerances, maintaining existing rolling stock to ensure “good” wheel condition and / or implementing long-term measures to improve wheel condition over time
- Receiver controls at existing or proposed developments such as full or partial vibration isolation of the building using springs or rubber bearings
- Planning measures such as locating sensitive developments at an acceptable distance from the tunnel alignment

The alignment has been designed to avoid major buildings insofar as possible by running the route in-line with existing roads and rail lines. This approach also minimises the extent to which the rail alignment is below residential areas where background noise levels from road traffic are inherently lower.

Further approaches to mitigation therefore focus on operational measures, track design, maintenance regimes and source control measures. These options are likely to be more cost effective than receiver controls such as full or partial vibration isolation of buildings above the rail tunnel (which are also usually impracticable for most existing buildings).

Operational measures such as improved wheel and rail condition would provide ground-borne noise and vibration benefits across the whole project area, whilst track design measures and a reduction in train speeds could provide benefits in specific areas. New single-deck trains are proposed to operate on the project with modern braking systems to minimise the risk of wheel defects forming. The source vibration levels are conservatively assumed to be equivalent to A-set (Waratah) trains.

As previously discussed, for the ground-borne noise and vibration modelling, it has been assumed that the condition of the wheels and rails would be maintained within specified limits, using similar processes to those that have been implemented successfully on ECRL. Additional information on rail roughness management as applied to the ECRL may be found in Vegh et. al. *Acoustic rail grinding – measures of long term effectiveness: Epping to Chatswood Rail Link case study.*

In order to reduce the potential for ground-borne noise impacts at sensitive receivers without impacting operations via speed reductions, mitigation measures would need to focus on improving the vibration isolation characteristics of the track.

4.2.7 Ground-borne Noise Predictions

On the basis of the speed profile for the project (shown in **Figure 31**), the proposed alignment and the modelling assumptions described in the previous sections, predictions of ground-borne noise levels for buildings located above or close to the proposed rail alignments have been undertaken. These calculations have been made for the standard, high and very high attenuation track forms, as outlined in **Section 4.1.4.2.5**.

On the basis of the predicted ground-borne noise levels for the different track forms, **Table 84** provides a summary of the likely extent of the various track forms in each tunnel that are required to achieve compliance with the ground-borne noise design objectives at all sensitive receiver locations. The extents of the proposed track forms are illustrated in **Figure 37**.

The final track form design and associated mitigation measures would form part of the detailed design. The track form design assessed as part of this Environmental Impact Statement forms part of the Concept Design and identifies one option on how the ground-borne noise and vibration objectives can be achieved.

The current assessment (refer **Table 84**) identifies that 91 percent and 93 percent of the southbound and northbound tracks respectively would achieve the ground-borne noise design objectives with the standard attenuation track form. 9 percent and 7 percent of the southbound and northbound tracks respectively would require high attenuation track form to achieve the ground-borne noise design objectives. Only two short sections of the southbound track and two short section of the northbound track were predicted to require the very high attenuation track form to achieve the ground-borne noise design objectives.

The assessment currently assumes that the ground-borne noise objectives can be achieved with a slab track design incorporating direct fixation baseplates. Where required the baseplates need to be a soft resilient type such as Delkor Egg and Pandrol Vanguard. Other systems could also be adopted as part of detailed design to achieve the same outcomes with baseplate designs from other suppliers or via various floating slab track designs.

Table 84 Proposed[1] Track form Extent

Southbound Track [2]			Northbound Track [3]		
Chainage (km)	**Extent (m)**	**Track form**	**Chainage (km)**	**Extent (m)**	**Track form**
North of Central Station					
10.935 - 10.58	345	Standard	10.90 - 10.535	365	Standard
10.58 - 10.315	275	High	10.535 - 10.49	45	High
10.315 - 10.16	155	Very High	10.49 - 10.325	165	Standard
10.16 - 9.87	290	High	10.325 - 10.12	205	High
9.87 - 9.585	285	Standard	10.12 - 9.485	635	Standard
9.585 - 9.495	90	High	9.485 - 9.44	45	High
9.495 - 6.82	2,675	Standard	9.44 - 4.835	4,605	Standard
6.82 - 6.75	70	High	4.835 - 4.69	145	High
6.75 - 1.455	5,295	Standard	4.69 - 0.915	3,775	Standard
1.455 - 1.25	205	High	0.915 - 0.84	75	High
1.25 - 0	1,250	Standard	0.84 - 0	840	Standard
South of Central Station					
0 - 1.445	1,445	Standard	0 – 1.915	1,915	Standard
1.445 - 1.680	235	High	1.915 - 1.995	80	High
1.680 - 4.595	2,915	Standard	1.995 - 2.050	55	Very High
4.595 - 4.845	250	High	2.050 - 2.120	70	High
4.845 - 4.930	85	Very High	2.120 - 2.245	125	Standard
4.930 - 5.400	470	Standard	2.245 - 2.370	125	High
			2.370 - 4.565	2,195	Standard
			4.565 - 4.875	310	High
			4.875 - 4.920	45	Very High
			4.920 - 5.400	480	Standard
Total	16,335			16,300	
Track form Percentages	14,835 (91%)	Standard		15,100 (93%)	Standard
	1,415 (9%)	High		1,100 (7%)	High
	240 (1.5%)	Very High		100 (0.6%)	Very High

Note 1: Concept design proposed track form, subject to detailed design investigations. The standard, high and very high attenuation track forms are specified in **Section 4.1.4.2.5**.

Note 2: Southbound track is Up Track north of Central Station and Down Track south of Central Station.

Note 3: Northbound track is Down Track north of Central Station and Up Track south of Central Station.

Figure 37 Extent of Proposed Track Forms - Crows Nest Station to Chatswood Tunnel Portal

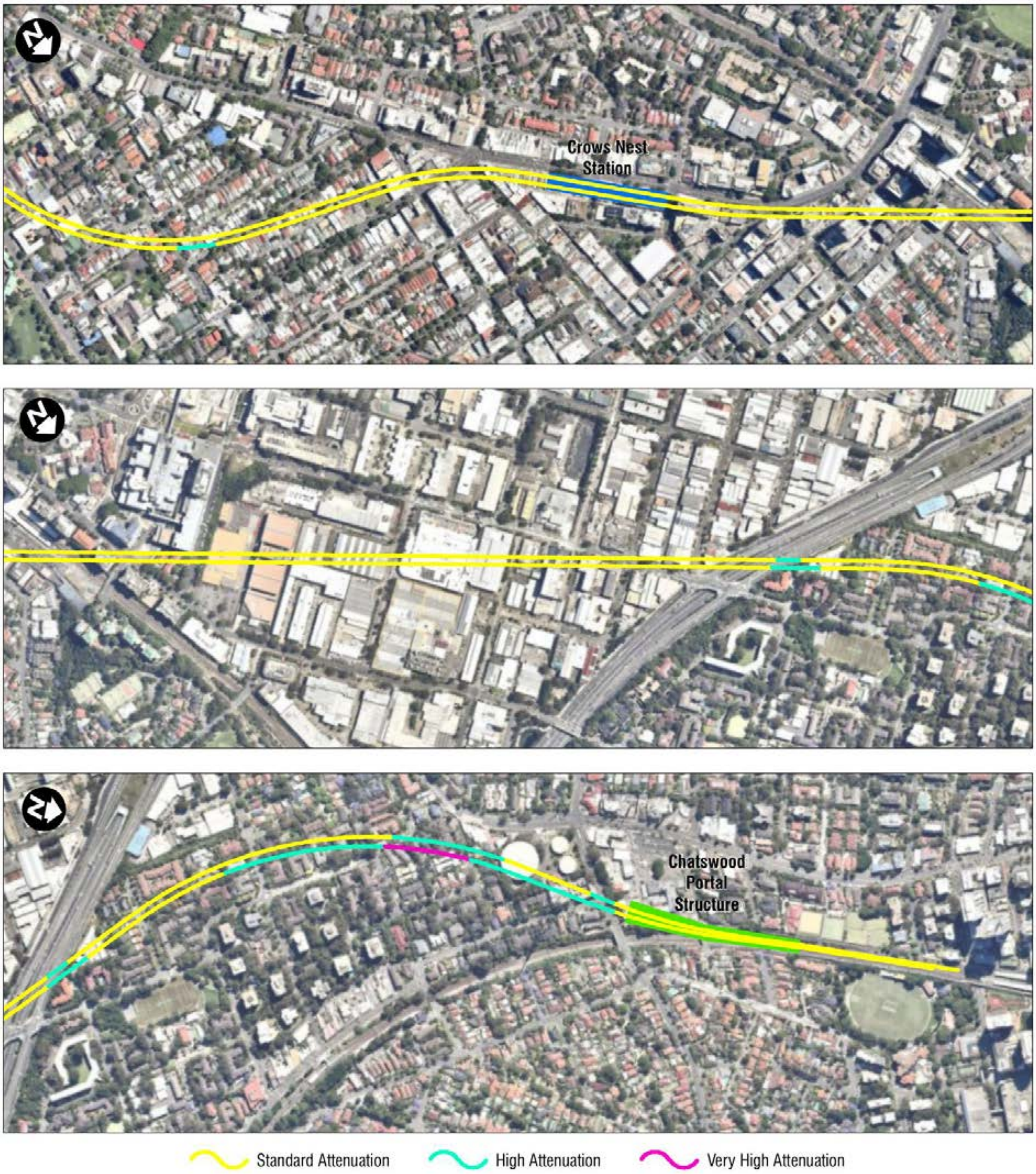


Figure 38 Extent of Proposed Track Forms - Pitt Street Station to Victoria Cross Station

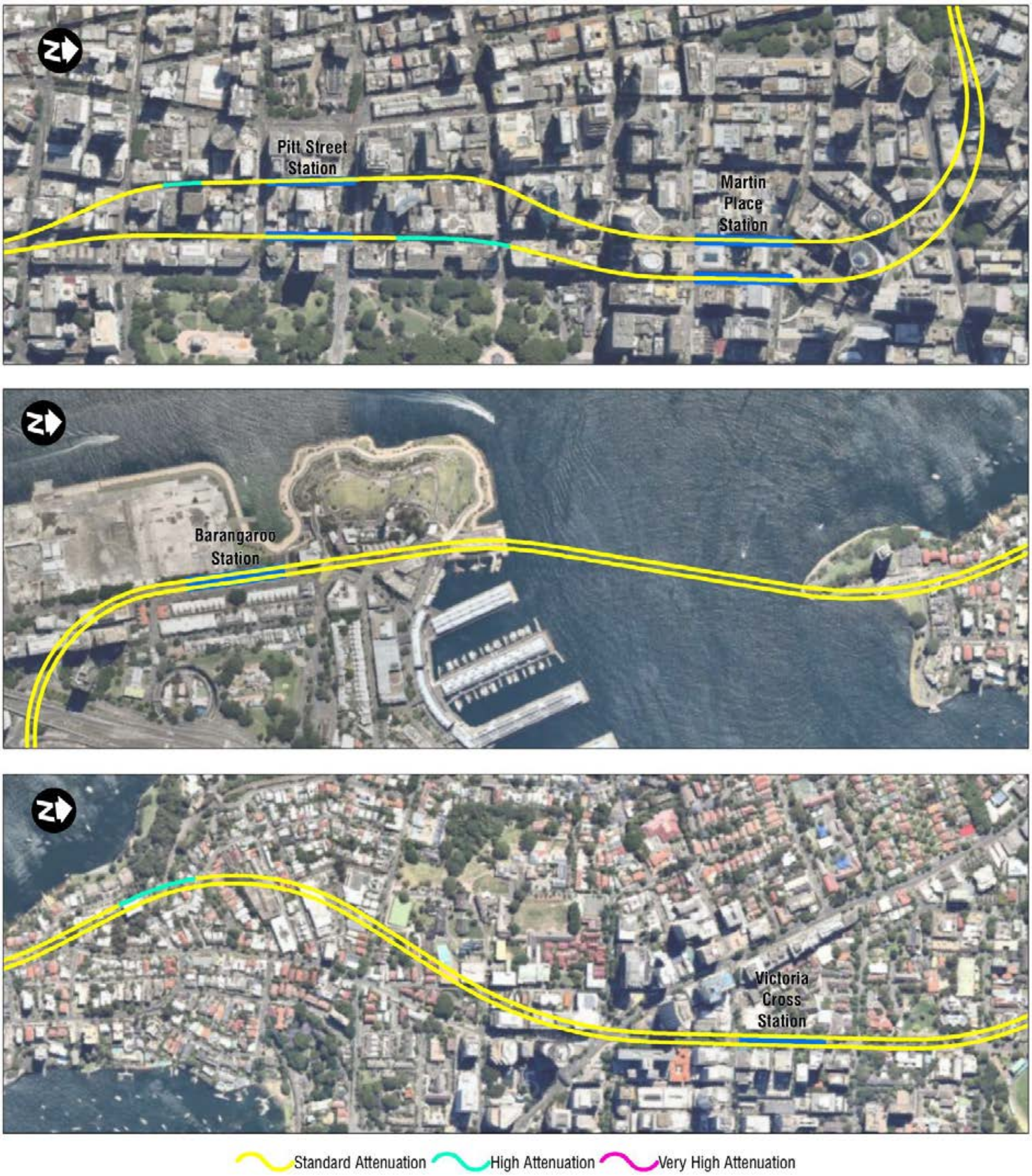
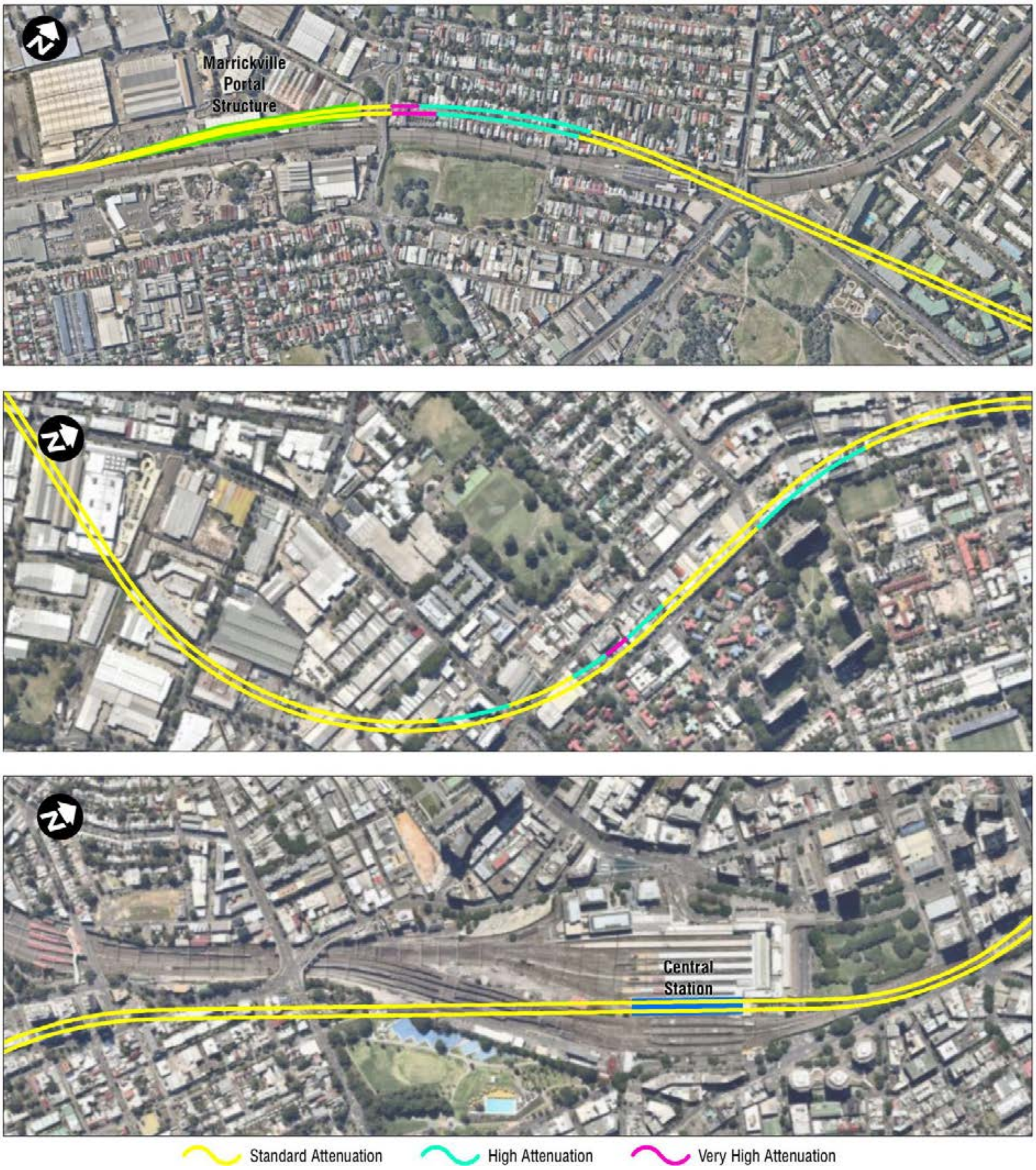


Figure 39 Extent of Proposed Track Forms - Marrickville Tunnel Portal to Central Station

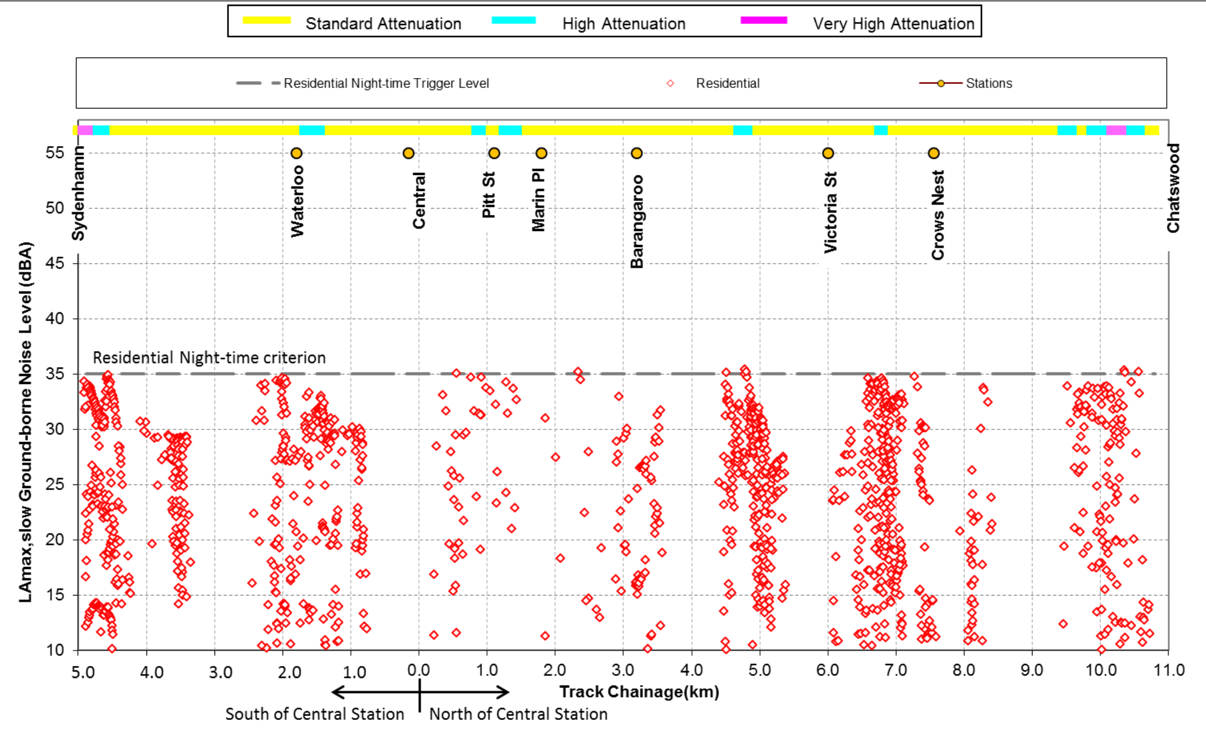


4.2.7.1 Residential Receivers

The ground-borne noise predictions for the residential receivers along the alignment (with the above proposed track form) are provided in **Figure 40**. The predicted ground-borne noise levels for residential receivers are also shown on maps in **Appendix E**.

The track is designed to meet the noise objectives at the nearest receivers to the alignment. The predictions are based on a 'best estimate' plus a 5 dB safety factor. On average, the predicted ground-borne noise levels (for the highest 1 in 20 trains) at the nearest locations would be 30 dBA. At most locations the noise levels would be much lower.

Figure 40 Predicted Ground-borne Noise Levels - Residential Receivers



4.2.7.2 Other Sensitive Receivers

The assessment of ground-borne noise for other sensitive receivers near to the project alignment is presented in **Figure 41**. A summary of the ground-borne noise predictions at non-residential sensitive receivers are provided in **Table 85**. The predicted ground-borne noise levels for commercial and other sensitive receivers are also shown on maps in **Appendix E**.

Figure 41 Predicted Ground-borne Noise Levels - Commercial and Other Sensitive Receivers

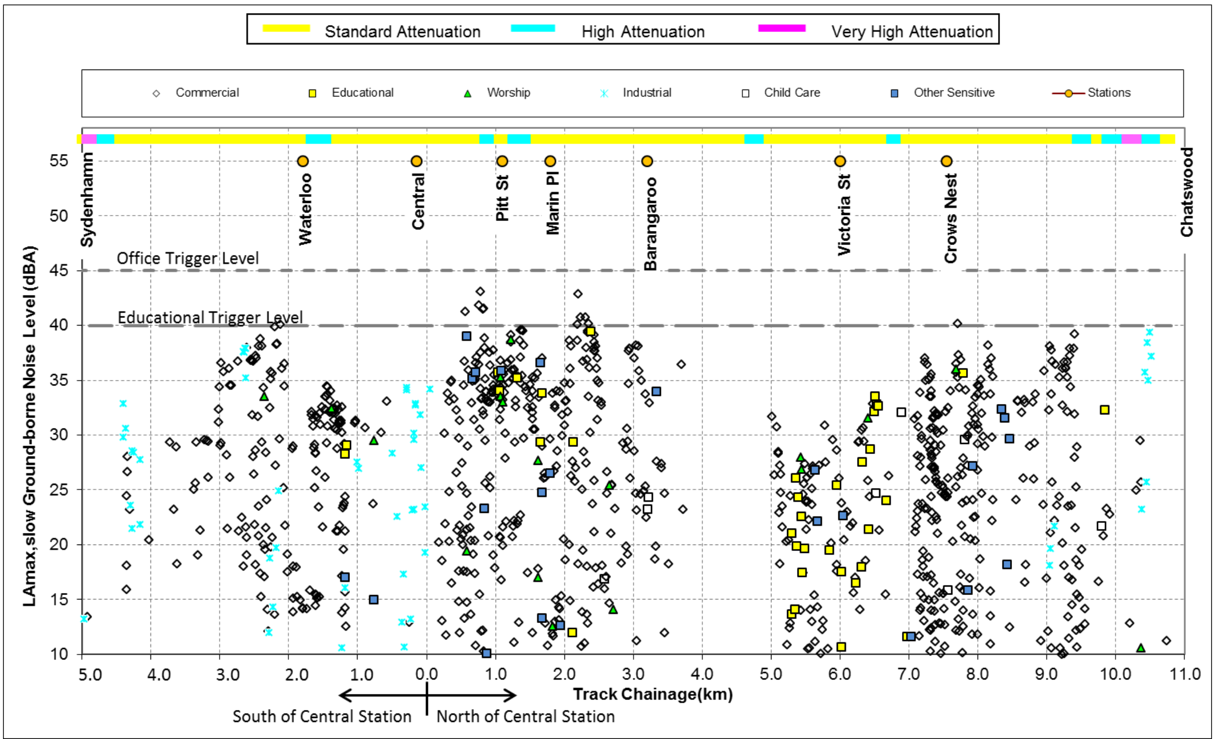


Table 85 Predicted Ground-borne Noise Levels - Other Sensitive Receivers

Receiver	North of Central Station Chainage (km)	Ground-borne Noise Level - LAmax,slow,95% (dBA)	
		Design Objective	Predicted
Educational			
Jansen Newman Institute	7.79	40 to 45	36
Public Reserve And Recreation	6.68		24
North Sydney Girls High School	6.98		Less than 20
Marist College North Shore	6.51		34
Williams Business College	6.33		28
Wenona School	6.24		Less than 20
Monte Sant' Angelo Mercy College	5.96		25
School of Physiotherapy Australian Catholic University	5.85		20
Raffles College of Design and Commerce	5.68		Less than 20
Shore-Sydney Church of England Grammar School	5.4		26
Macquarie Graduate School of Management	2.39		40
ELS Universal English College	2.14		29
Sydney Mechanics' School of Arts	1.06		34
Child Care			
Willoughby Lane Cove Family Day Care	9.85	40 to 45	33

Receiver	North of Central Station Chainage (km)	Ground-borne Noise Level - $L_{Amax,slow,95\%}$ (dBA)	
		Design Objective	Predicted
Nicky's Kids Town	9.8		22
Goodstart Early Learning St Leonards Pacific Highway	7.81		30
Kelly's Place Children's Centre	7.57		Less than 20
Crows Nest Kindergarten	6.9		32
Jacaranda Cottage	6.53		25
KU Lance Preschool and Children's Centre	3.23		24
Sydney Cove Children's Centre	2.58		Less than 20
Cheeky Monkey Corporation	1.89		34
Worship			
Northside Community Church Sydney	7.68	40 to 45	36
St Mary's North Sydney	6.41		32
St Peter's Presbyterian Church	5.43		28
St Philips Church	2.71		Less than 20
St Patricks Catholic Church	2.66		25
St Stephens Church	1.84		Less than 20
St James Church	1.62		28
Great Synagogue	1.23		39
Uniting Church	1.12		38
Church Of Scientology	1.08		35
Martin Luther Church	0.59		Less than 20
Medical			
Royal North Shore Hospital	8.46	40 to 45	32
Crows Nest Medical Practice and The Exercise Clinic	7.04		Less than 20
Miller Street Medical Practices	6.05		23
Sydney Premier Medical & Health Centre	1.09		36
Other Sensitive			
City Recital Hall - Angel Place	1.9	35	Less than 20
Channel 7	1.8	NR 25[5]	Less than NR 23
Theatre Royal	1.68	35	25

[5] SLR was involved in the design of the Channel 7 TV studios. The studio was designed to NR 25.

Receiver	South of Central Station Chainage (km)	Ground-borne Noise Level – $L_{Amax,slow,95\%}$ (dBA)	
		Design Objective	**Predicted**
Educational			
Redfern Primary School	1.54	40 to 45	Less than 20
Worship			
Yiu Ming Temple	2.4	40 to 45	34
Waterloo Congregational Church	1.83		32
St Luke's Presbyterian Church	1.38		32
Cathedral of The Annunciation of our Lady	0.76		30
Medical			
Sydney Dental Hospital	0.025	40 to 45	Less than 20
Other Sensitive			
Sydney Film School	1.56	40 to 45	33
Cleveland Street Theatre	0.76	NR25	Less than NR15

4.2.8 Summary of Ground-borne Noise Assessment

On the basis of the proposed alignments, the modelling assumptions described in the previous sections and the proposed track form in **Table 84**, ground-borne noise levels are predicted to comply with the ground-borne noise design objectives at all residential and other sensitive receiver locations.

4.3 Airborne Noise - Rail Operations

4.3.1 Introduction

The primary source of airborne noise from rail operations is the wheel-rail interface, as a result of surface irregularities on the wheel and/or rail running surfaces and interaction forces. During a train passby the wheel, bogies, rail and rail support system vibrate and transfer this energy to the surrounding environment as airborne noise.

The key influencers of airborne noise are the train speed, the condition of the wheel and rail, the train length, number of train passby events and the design of the train and track. The level of airborne noise experienced at a receiver is dependent upon the distance to the track and the presence of natural or man-made barriers between the rail and the receiver which can impede the propagation of noise.

4.3.2 Operational Noise Metrics

The primary noise metrics used to describe airborne railway noise emissions in the modelling and assessments are:

$L_{Amax,95\%}$ The *"typical maximum noise level"* for a train passby event. In RING, L_{Amax} refers to the maximum noise level not exceeded for 95% of rail passby events and is measured using the 'fast' response setting on a sound level meter.

$L_{Aeq(24hour)}$ The *"energy average noise level"* evaluated over a 24 hour period. The $L_{Aeq(24hour)}$ represents the cumulative effects of all the train noise events occurring in one day.

$L_{Aeq(15hour)}$ The $L_{Aeq(15hour)}$ represents the cumulative effects of all the train noise events occurring in the daytime period from 7:00 am to 10:00 pm.

$L_{Aeq(9hour)}$ The $L_{Aeq(9hour)}$ represents the cumulative effects of all the train noise events occurring in the night-time period from 10:00 pm to 7:00 am.

$L_{Aeq(1hour)}$ The busiest 1-hour "*energy average noise level*" The $L_{Aeq(1hour)}$ represents the typical L_{Aeq} noise level from all the train noise events during the busiest 1-hour of the assessment period.

L_{AE} The "*Sound Exposure Level*", which is used to indicate the total acoustic energy of an individual noise event. This parameter is used in the calculation of L_{Aeq} values from individual noise events.

The subscript "A" indicates that the noise levels are filtered to match normal human hearing characteristics (ie A-weighted).

4.3.3 Operational Noise Trigger Levels

The NSW EPA provides guidance for the assessment and management of potential airborne noise from rail lines in the *Rail Infrastructure Noise Guideline* (RING). To assess and manage potential noise from rail projects the guideline provides non-mandatory airborne noise trigger levels for residential and other sensitive receivers. Where rail noise levels are above the noise triggers the noise assessment is to identify feasible and reasonable mitigation to achieve a desired objective of airborne noise within the trigger levels.

The RING requires noise to be assessed at proposal opening and for a future design year, typically ten years after opening. For this proposal the two timeframes assessed are the at-opening scenario in 2024 and a future scenario based on forecasts for operations in 2034.

The project related surface track sections are categorised as a redevelopment of an existing rail line as described by the RING according to the following classification:

> *"Redevelopment of a heavy rail line occurs where any rail infrastructure project is to be developed on land that:*
>
> - *Is located within an existing and operational rail corridor is or has been operational; or*
> - *Is immediately adjacent to an existing operational rail line which may result in widening of an existing rail corridor."*

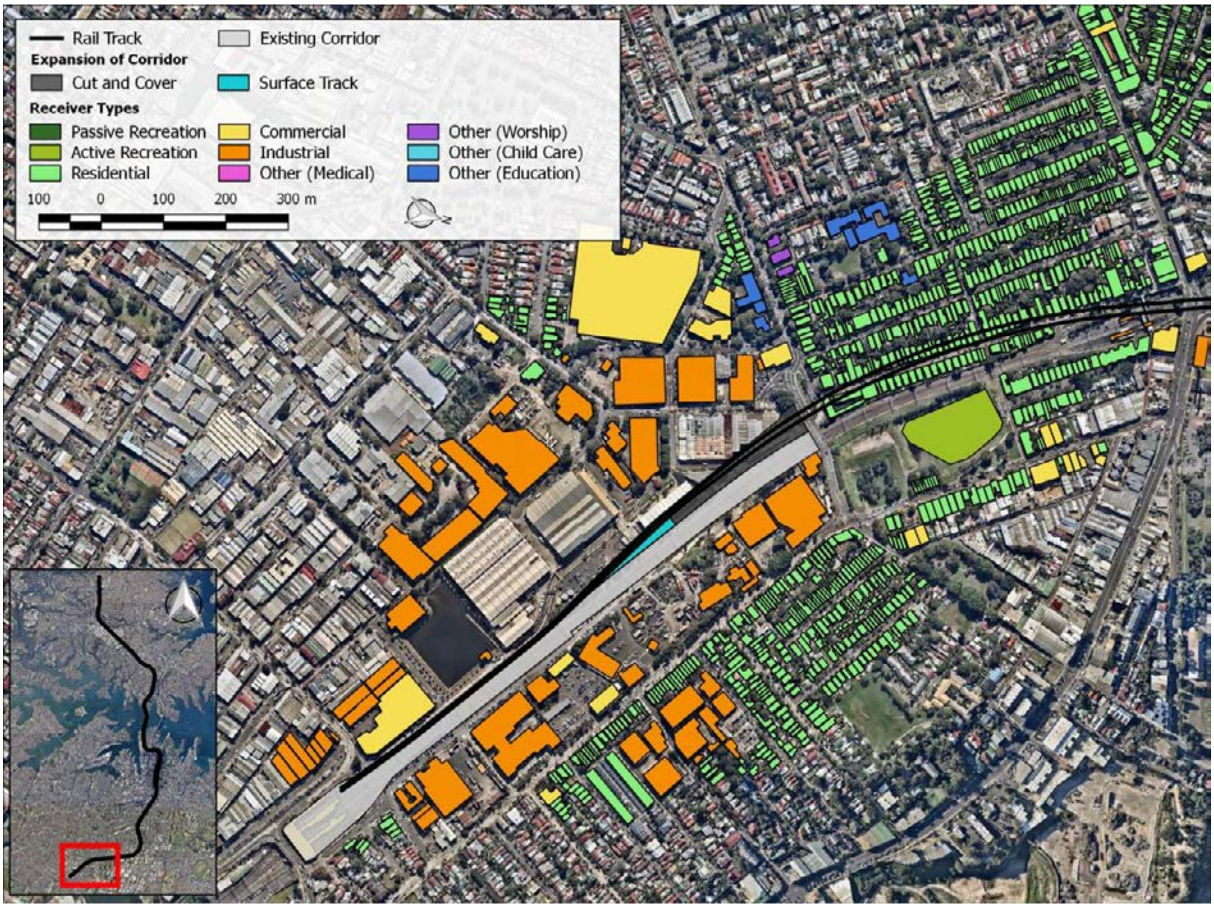
The RING identifies that where the track is moved sufficiently outside the existing corridor to allow new noise mitigation options to be considered that would not have been considered feasible otherwise, the realigned track section should be categorised as 'New' rather than "Redeveloped".

The northern surface track works are generally contained within the confines of the existing T1 North Shore Line rail corridor. Some limited widening of the corridor boundary in the vicinity of the tunnel portal is proposed as displayed in **Figure 42**. The expansion of the rail corridor in this locality is completely comprised of cut and cover tunnel track. Receivers located immediately adjacent the rail noise sources in this area are positioned directly adjacent the existing rail corridor, and closer to the existing rail lines than the new rail lines. No new opportunities for noise mitigation are anticipated to be provided by the limited widening proposed in this area. Therefore, the realigned track section is categorised as a redevelopment under the RING.

Figure 42 Corridor Widening Near Chatswood Tunnel Portal

The Marrickville dive structure is situated directly parallel to existing surface track. The project involve new metro rail tracks within the Marrickville dive structure located on the Up-side (north-western side) of the existing corridor from Bedwin Road and extending approximately 450 m south west as displayed in **Figure 43**. The expansion of the rail corridor in the area of the alignment closest to sensitive receivers (Bedwin Road) is comprised of cut and cover tunnel track which is not anticipated to generate airborne operational rail noise. All residential receivers located nearest the surface track sections within the Marrickville dive are located on the Down-side of the rail corridor (south-eastern side) which is the opposite side of the corridor to the widening works, so new opportunities for noise mitigation are not anticipated to be provided by the corridor widening in this area, and works in this area remain categorised as a redevelopment under the RING.

Figure 43 Corridor Widening Near Marrickville Tunnel Portal



In summary, the expansion of the surface rail corridors at both the northern and southern extremities of the project area are considered to be "redevelopments" under the RING. The relevant airborne noise trigger levels for residential land uses surrounding the proposed surface track are presented in **Table 86**.

Table 86 Airborne Rail Noise Triggers for Residential Land Use

Sensitive Land Use	Noise Trigger Level (dBA)	
	Day time 7:00 am to 10:00 pm	**Night-time 10:00 pm to 7:00 am**
Redevelopment of existing rail line	Development increases existing $L_{Aeq(period)}$[1] rail noise levels by 2 dB or more, or existing L_{Amax}[2] rail noise levels by 3 dB or more AND Resulting rail noise levels exceed:	
	65 $L_{Aeq(15hour)}$ and 85 L_{Amax}	60 $L_{Aeq(9hour)}$ and 85 L_{Amax}

Note 1: $L_{Aeq(period)}$ means $L_{Aeq(15hour)}$ for the day-time period and $L_{Aeq(9h)}$ for the night-time period

Note 2: L_{Amax} refers to the maximum noise level not exceeded for 95 per cent of rail pass-by events and is measured using the 'fast' response setting on a sound level meter.

The RING noise triggers for non-residential sensitive receivers in **Table 87** are applicable when the building or premise is in use. All noise trigger levels are external levels except where otherwise stated. Commercial receivers are not considered sensitive to operational airborne noise impacts.

Table 87 Airborne Rail Noise Triggers for Sensitive Land Uses Other than Residential

Sensitive Land Use	Noise Trigger Level dBA (when in use)
	Development increases existing rail noise levels by 2.0 dB or more in L_{Aeq} in any hour AND Resulting rail noise levels exceed:
Schools, educational institutions and child care centres	45 $L_{Aeq(1hour)}$ Internal
Places of worship	45 $L_{Aeq(1hour)}$ Internal
Hospital wards	40 $L_{Aeq(1hour)}$ Internal
Hospital other uses	65 $L_{Aeq(1hour)}$
Open space – passive use (e.g. parkland, bush reserves)	65 $L_{Aeq(15hour)}$
Open space – active use (e.g. sports field, golf course)	65 $L_{Aeq(15hour)}$

In assessing noise levels emitted by the project at residential receiver locations, the outdoor noise level to be addressed is that prevailing at a location 1 m in front of the most affected building facade. A facade reflection correction is included for all external noise levels, except the “Open space” in **Table 87** which is assessed as free field.

For sensitive receivers such as schools, child care centres and places of worship, the trigger levels presented in **Table 87** are based on internal noise levels. Any “internal noise level” refers to the noise level at the centre of the habitable room that is most exposed to the noise source. Depending on the location and existing noise sources in the area (ie road, rail, commercial or industry), the building may be fitted with ventilation or air-conditioning to allow for closed windows and indoor acoustic amenity. In other situations open windows may be relied upon to provide adequate ventilation. Depending on building facade and openings, the outside-to-inside attenuation would typically be between 10 and 20 dB, but could also be significantly more.

4.3.4 Operational Noise Modelling

4.3.4.1 Introduction to Noise Modelling

SoundPLAN Version 7.1 has been used to calculate rail noise emission levels for this project. Of the train noise prediction models available within SoundPLAN, the Nordic Rail Traffic Noise Prediction Method (Kilde 1984) has been used.

Noise emissions from suburban electric passenger trains on surface track are predominantly caused by the rolling contact of steel wheels on steel rails. Even under ideal conditions with “smooth” rail and wheels, noise would occur as a result of the elastic deformation at the rolling contact point and due to the finite residual roughness of typical wheel and rail running surfaces. Other noise sources on electric passenger trains (such as air-conditioning plant and air compressors) are generally insignificant in noise level when compared with the wheel rail interaction, unless the train is travelling at very low speed or is stationary. Where track is located on bridges or viaducts, vibration is transmitted to the structure resulting in structure-radiated noise in addition to the direct rolling noise from the track and wheels of the trains.

Predicted noise levels in previous rail modelling projects have shown good correlation with the values measured at the completion of the projects, once operations began.

4.3.4.2 Source Noise Levels

The future track forms in above ground sections consist primarily of ballast track on concrete sleepers. The only sections of track that are not expected to be ballasted are the Sydney Metro dive structures and the T1 North Shore Line bridge over the Chatswood dive structure. These sections would have a slab track with direct fixation rail fasteners.

The *Handbook of Railway Vehicle Dynamics*[6] states that slab tracks *"are generally found to be noisier than conventional ballasted track, typically by 3 to 5 dB. This can be attributed to two features of such tracks. Firstly, they tend to be fitted with softer rail fasteners in order to introduce the resilience normally given by the ballast. Second, they have a hard sound-reflecting surface, whereas ballast has an absorptive effect. The latter affects the overall noise by 1 to 2 dB."*

The increase in noise emissions resulting from softer rail fasteners can be controlled by the addition of tuned absorbers (rail dampers). The noise reduction that can be achieved by rail dampers in any situation depends on the starting noise level. Measurements on the ECRL (on similar track to that proposed for the Sydney Metro) found a benefit of 4 dB from the installation of rail dampers[7].

The reference noise levels used for the noise modelling are shown in **Table 88**. These levels are consistent with the source noise levels applied for modern passenger trains by SLR Consulting on other Sydney Metro projects, with the following adjustments to account for the higher noise emissions from slab track compared to ballasted track.

- While noise emissions from the rail would be approximately 4 dB higher with slab track as the result of softer rail fasteners and less damping, this increase in noise could potentially be controlled where required by application of source mitigation in the form of rail dampers, potentially providing a net change of 0 dB in both L_{AE} and L_{Amax} compared to ballast track.
- An increase of 2 dB in L_{AE} and L_{Amax} is included, to account for increased reflection (reduced absorption) from slab track compared to ballast track.

The source noise levels used in the noise modelling are at the upper end of the range of noise levels in the NSW rail noise database for existing double-deck Sydney trains. This approach is considered conservative, since at this stage the rail roughness in the project area is unknown; there is no measured noise data is available for the new Sydney Metro single-deck trains; and the mix of rolling stock on the existing lines may vary. In the event that the new Sydney Metro rolling stock has lower noise emissions than assumed here, the impacts of the project would be less than predicted in this report (both the overall wayside noise levels, and the increase due to the project).

Table 88 Rolling Stock Reference Noise Levels (8-car trains)

Train Types	Track form	Source Mitigation	Reference Conditions	$L_{Amax,95\%}$	L_{AE}
Double-deck Sydney Trains	Ballast	None	15 m, 80 km/h	85 dBA	88 dBA
Single-deck Sydney Metro Trains	Ballast	None	15 m, 80 km/h	85 dBA	88 dBA
Single-deck Sydney Metro Trains	Slab Track	Rail Damper Mitigation	15 m, 80 km/h	87 dBA	90 dBA
Single-deck Sydney Metro Trains	Slab Track	Without Rail Dampers	15 m, 80 km/h	91 dBA	94 dBA

[6] S. Iwnicki (Editor) *Handbook of Railway Vehicle Dynamics*, Taylor and Francis 2006

[7] C.M. Weber and D. Sburlati, *Source Noise Control to Mitigate Airborne Noise at High Rise Developments – Epping to Chatswood Rail Link*. Proceedings of 20th International Congress on Acoustics 2010.

4.3.4.3 Track Feature Corrections

Impact noise from rail discontinuities such as turnouts, crossovers, expansion joints or rail defects increase the level of wheel-rail noise as each wheel of the train passes over the discontinuity. **Table 89** identifies the locations of the crossovers in the future alignment designs.

Table 89 Rail Track Crossovers

Line	Track	Chainage
T1 North Shore Line	Main Down	11.340 km
	Main Up	11.330 km
	ECRL Down	11.470 km
	ECRL Up	11.380 km
		11.450 km
T3 Bankstown Line	Main Up	5.450 km
	Main Down	5.480 km
		5.530 km
T4 Illawarra Line	Local Up	5.010 km
		5.120 km
		5.160 km
		5.550 km
		5.640 km
		5.760 km
	Local Down	4.990 km
		5.020 km
		5.140 km
		5.670 km
		5.730 km
		5.760 km
	Main Up	4.960 km
		4.990 km
		5.690 km
		5.720 km
	Main Down	4.960 km
		5.690 km

The modelling includes allowances for localised increases in noise emission from turnouts. A correction of +6 dB for turnouts has been applied in the noise model over a 20 m track distance.

In areas where there are tight radius curves, flanging noise or curve squeal may also increase the levels of noise emission. No surface track sections within the project area have curves of less than 500 m radius, and therefore no corrections for squeal or flanging have been included in the airborne noise predictions.

4.3.4.4 Bridge Noise

Structure-radiated noise from some types of rail bridges (especially open-transom steel bridges) may also increase the overall levels of track noise. The form of the new Sydney Metro rail bridges are currently proposed to comprise concrete beams with concrete deck, which are inherently quieter than steel or composite constructions. Concrete bridges that incorporate solid parapets or side screens are typically quieter than standard (reference) ballasted track at grade, due to the shielding provided by the parapets.

A rail bridge is proposed to carry the T1 North Shore Down-track across the metro rail lines in the vicinity of the Chatswood dive. For modelling purposes, there is no change to the L_{Amax} and L_{AE} noise emissions for a concrete span bridge with ballasted track and no side screens compared to at grade noise emissions from ballasted track.

Corrections applied to rail bridges within the project area are listed in **Table 90**.

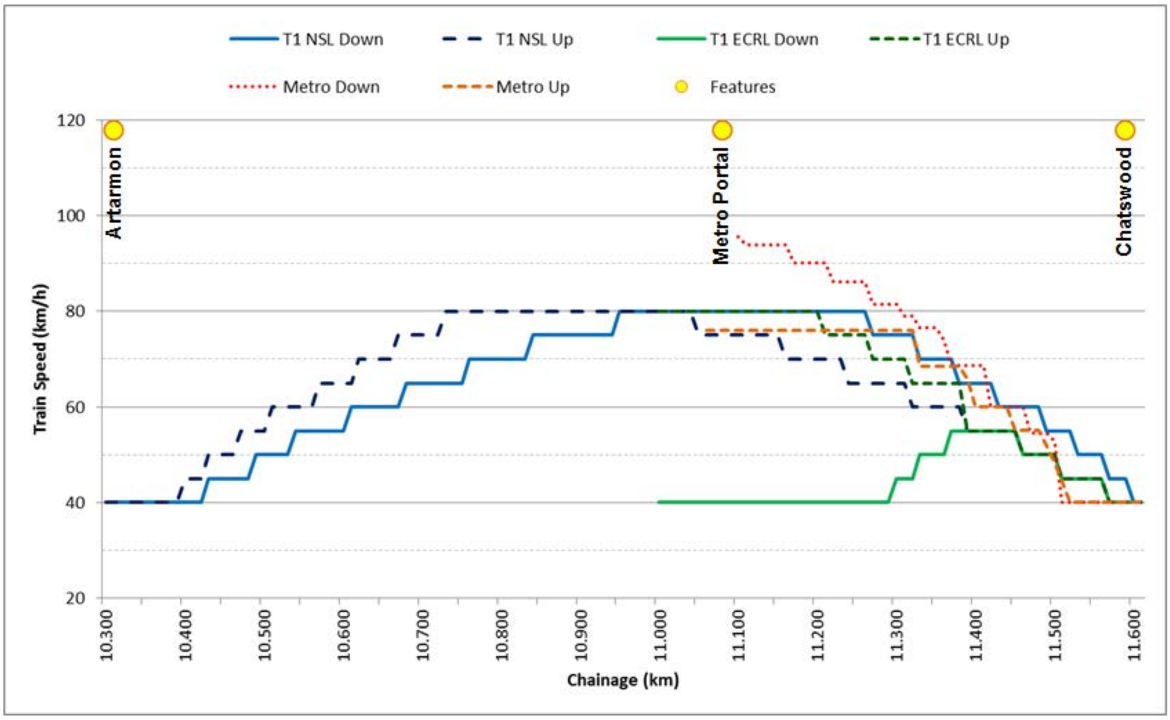
Table 90 Rail Bridge Corrections

Bridge	Approx. Chainage	Existing Bridge		Proposed Bridge	
		Construction Description	Correction	Construction Description	Correction
Albert Avenue	10.540 - 10.570 km	Concrete trackbed, concrete box girder, with side screens	-2 dB	Concrete trackbed, concrete box girder, with side screens	-2 dB
Chatswood Dive bridge	10.990 - 11.070 km	None	-	Concrete trackbed, concrete box girder	0 dB

4.3.4.5 Speed Profile

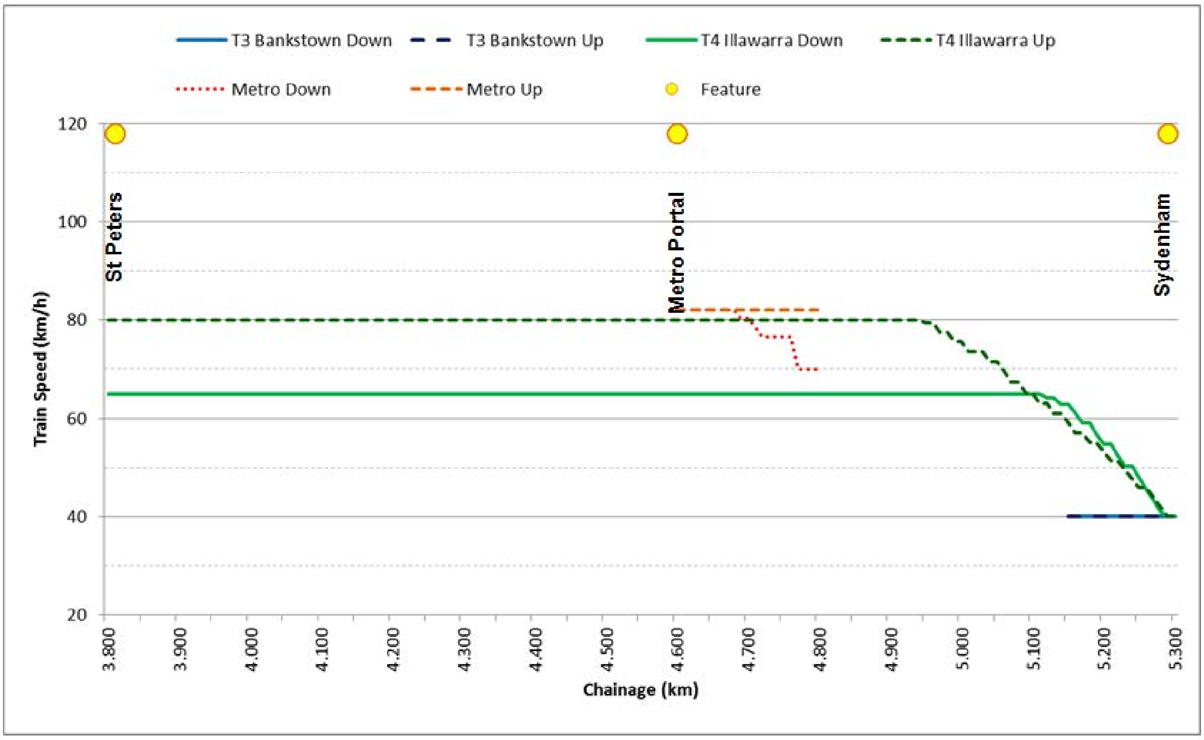
The speed profiles for noise and vibration assessment purposes through the future surface track sections are shown in **Figure 44** and **Figure 45** for the Chatswood and Marrickville dives respectively.

Figure 44 Sydney Metro Speed Profile for Noise and Vibration Assessment - Chatswood Dive



Note: "T1 NSL" represents T1 North Shore Line
Note: "T1 ECRL" represents T1 Epping to Chatswood Rail Line

Figure 45 Sydney Metro Speed Profile for Noise and Vibration Assessment - Marrickville Dive



As shown in **Figure 44** and **Figure 45**, the minimum modelled train speed through stations is 40 km/h.

4.3.4.6 Track Alignment and Ground Terrain

The track alignments for the project were provided by the project team in the form of 3 dimensional track strings in AutoCAD format.

The ground terrain was based on LiDAR data of the project area, modified to incorporate the project alignments and realignment of existing tracks, including cuttings or embankments where necessary.

4.3.4.7 Rail Traffic Data

The RING specifies that the noise trigger levels apply both immediately after operations commence and for projected traffic volumes at an indicative period into the future to represent the expected typical maximum level of train usage. In order to support the noise modelling predictions, estimated train numbers for the after opening and 10-years after opening operating scenarios have been provided.

The rail traffic estimates used in the modelling scenarios are summarised in **Table 91**. The train numbers in **Table 91** are indicative only, with consideration given to the estimated passenger demand, minimum service levels and the upper design limit of Sydney Metro service frequencies for future peak times.

Table 91 Rail Traffic Scenarios for Noise Assessment Purposes

Rail Line	Scenario	Train Type	Trains Per Weekday Period			
			Day 7:00 am to 10:00 pm		Night 10:00 pm to 7:00 am	
			Up	Down	Up	Down
T1 North Shore Line including future Metro Services	Existing 2015	A/H/M/T-Set	186	190	44	47
	Prior to Opening 2024	A/H/M/T-Set	186	190	44	47
	After Opening 2024	A/H/M/T-Set	186	190	44	47
		Metro Train	202	202	27	27
	Future 2034	A/H/M/T-Set	186	190	44	47
		Metro Train	222	222	30	30
	Future 2034 Without Project (‘no build option’)	A/H/M/T-Set	186	190	44	47
		Metro Train	0	0	0	0
T2 Airport Line	Existing 2015	A/H/M/T-Set	6	8	0	1
	Prior to Opening 2024	A/H/M/T-Set	6	8	0	1
	After Opening 2024	A/H/M/T-Set	6	8	0	1
	Future 2034	A/H/M/T-Set	6	8	0	1
	Future 2034 Without Project (‘no build option’)	A/H/M/T-Set	6	8	0	1
T3 Bankstown Line including future Metro Services	Existing 2015	A/H/M/T-Set	78	84	17	20
	Prior to Opening 2024	A/H/M/T-Set	78	84	17	20
	After Opening 2024	A/H/M/T-Set	78	84	17	20
		Metro Train	184	184	27	27
	Future 2034	A/H/M/T-Set	78	84	17	20
		Metro Train	202	202	30	30
	Future 2034 Without Project (‘no build option’)	A/H/M/T-Set	78	84	17	20
		Metro Train	0	0	0	0

Rail Line	Scenario	Train Type	Trains Per Weekday Period			
			Day 7:00 am to 10:00 pm		Night 10:00 pm to 7:00 am	
			Up	Down	Up	Down
T4 Eastern Suburbs and Illawarra Line	Existing 2015	A/H/M/T-Set	96	85	26	23
		C/K/S/R-Set	9	8	2	2
	Prior to Opening 2024	A/H/M/T-Set	105	93	28	25
	After Opening 2024	A/H/M/T-Set	105	93	28	25
	Future 2034	A/H/M/T-Set	105	93	28	25
	Future 2034 Without Project ('no build option')	A/H/M/T-Set	105	93	28	25

4.3.4.8 Noise Modelling Outputs and Assessment Parameters

The operational noise model predicts facade noise levels at each floor for each receiver building. The most exposed floor is commonly the upper storey, for buildings with two or more levels, as lower floors receive more shielding from the intervening terrain. Where exceedances of the noise trigger levels are identified for an individual receiver at any floor level, the predicted noise levels are described in this report.

In terms of the $L_{Amax,95\%}$ assessment parameter, the noise emission trigger levels at residential receiver locations are the same during the daytime and night-time periods. This is on the basis that the maximum train speeds are the same during the daytime and night-time periods.

The $L_{Aeq(period)}$ noise parameter is determined by the number of trains during the relevant daytime or night-time period. The night-time $L_{Aeq(9hour)}$ noise trigger levels are 5 dB lower (ie more stringent) than the daytime $L_{Aeq(15hour)}$ noise trigger levels.

For other receivers with noise trigger levels defined on the basis of the $L_{Aeq(1hour)}$ assessment parameter, the maximum number of services per hour within the project area has been used to calculate the $L_{Aeq(1hour)}$ using the values in **Table 92**. Service frequencies in **Table 92** represent the combination of both Up and Down rail traffic per line.

Table 92 Maximum Service Frequencies - Trains per Hour

Line	2024 Maximum Trains Per Hour		2034 Maximum Trains Per Hour	
	Day	Night	Day	Night
T1 Epping to Chatswood Line Main	13	5	13	5
T1 North Shore Line Main	37	17	37	17
T3 Bankstown Line Main	17	9	17	9
T4 Illawarra Line Local	4	3	4	3
T4 Illawarra Line Main	14	11	14	11
Sydney Metro Marrickville Dive	40	12	44	13
Sydney Metro Chatswood Dive	40	12	44	13

4.3.4.9 Potentially Reasonable and Feasible Base Case Noise Mitigation Options

The project proposes to include several noise abatement elements in the base case design. Base case noise mitigation elements are described below.

4.3.4.9.1 Rail Dampers on Slab Track

Concrete slab track typically requires softer rail supports than ballasted track. As a consequence, the track decay rate is lower and more noise is radiated by the rails. This increase in noise due to softer rail supports may be countered through the use of rail dampers.

Where slab track is to be constructed in surface track sections (Chatswood and Marrickville dives) the L_{Aeq} and L_{Amax} noise levels from the surface track in these regions is anticipated to be approximately 6 dB higher than for typical ballast track with concrete sleepers.

Measurements on the ECRL (on similar track to that proposed for the Sydney Metro) found a benefit of 4 dB from the installation of rail dampers[8]. Slab track regions with rail dampers would therefore have L_{Aeq} and L_{Amax} noise levels approximately 2 dB higher than typical ballast track.

The proposed Chatswood dive track alignment is located adjacent several existing multi-storey residential buildings. Rail dampers are included in this assessment as a base case noise mitigation option to address slab track noise emission levels within the Chatswood dive.

4.3.4.9.2 Deck Absorption

Generally slab track is constructed with a concrete deck spanning between the rails (4-foot), and extending between the tracks (6-foot), and also to the edges of the dive. This concrete deck provides less noise absorption compared to typical ballast track, and can increase noise in areas of slab track such as the dive structures.

The installation of noise absorptive material to the 4-foot would likely provide approximately 2 dB of attenuation and potentially more if the area of absorptive material can be increased, for example by application to the dive walls and/or 6-foot.

The combination of rail dampers and deck absorption is expected to reduce the noise emissions from slab track to approximately match the emissions from typical ballast track.

Deck absorption is included in this assessment along with rail dampers as a base case noise mitigation option to address slab track noise emission levels within the Chatswood dive.

4.3.4.9.3 Conventional Noise Barriers

Increasing the height of several existing noise barriers on the up and down sides of the Chatswood dive track has been identified as being likely to be feasible and reasonable in the course of this study. Increased barrier height has therefore been included in the base case design at several locations where noise modelling indicates the project noise goals may exceed the RING noise trigger levels in the absence of mitigation.

The existing 3 m high noise barriers between Nelson Street and Chapman Avenue on the Up side of the corridor would be increased in height by 1 m as part of the base case noise mitigation design. The increase in wall height in this region (NCA02 and NCA03) is likely be considered feasible as the existing wall is planned to be relocated as part of the project scope, therefore providing an opportunity to reconstruct the noise barrier at a greater height.

[8] C.M. Weber and D. Sburlati, *Source Noise Control to Mitigate Airborne Noise at High Rise Developments – Epping to Chatswood Rail Link*. Proceedings of 20th International Congress on Acoustics 2010.

The existing 3 m high noise barriers between Nelson Street and Gordon Avenue on the Down side of the corridor would be increased in height by 1 m as part of the base case noise mitigation design. While this height of noise barrier would generally be considered reasonable, the feasibility of increasing the height of the existing barrier would require an assessment of constructability constraints. Further consideration of the feasibility of noise barriers in this location should be made during the detailed design stage of the project.

The existing 3 m high noise barriers between the Frank Channon Walk pedestrian underpass and Albert Avenue on the Down side of the corridor would be increased in height by 1 m as part of the base case noise mitigation design. This would require modifications to the barrier over a length of approximately 160 m.

A new 2 m high conventional noise barrier located at the edge of the retaining wall on the Down side of the rail corridor in NCA04 is included in the base case noise mitigation design. The feasibility of this mitigation option is dependent on the detailed design of the civil works in this area. Feasibility and effectiveness of the proposed base case conventional noise barriers in this area would be confirmed when more detailed information pertaining to the civil designs in this area is available.

A summary of the conventional noise barrier modifications included in the base case noise mitigation design is presented in **Table 93**.

Table 93 Base Case Noise Mitigation Design - Conventional Noise Barriers

Area	Side	Mitigation	Description
NCA02	Up	Increase height of relocated noise barrier to 4 m between Chapman Avenue and Nelson Street.	Noise barrier relocation included as part of the proposed design. Exact height and design of relocated noise barriers to be determined during the detailed design stage of the project when detailed civil designs are available.
	Down	Increase existing noise barriers by 1 m between Frank Channon Walk pedestrian underpass and Albert Avenue	Increase existing 3 m high noise barriers by 1 m. Exact height and design of noise barriers to be determined during the detailed design stage of the project when detailed civil designs are available.
NCA03	Up	Increase height of relocated noise barrier to 4 m between Chapman Avenue and Nelson Street.	Noise barrier relocation included as part of the proposed design. Increase existing 3 m high noise barriers by 1 m. Exact height and design of relocated noise barriers to be determined during the detailed design stage of the project when detailed civil designs are available.
	Down	Increase existing noise barriers by 1 m between Nelson Street and Gordon Avenue.	Increase existing 3 m high noise barriers by 1 m. Exact height and design of relocated noise barriers to be determined during the detailed design stage of the project when detailed civil designs are available.
NCA04	Down	2m noise barrier at edge of cutting	2 m high conventional noise barrier located at the edge of the retaining wall. Feasibility and effectiveness of conventional noise barrier in this area would be confirmed when more detailed information pertaining to the civil designs in this area is available.

4.3.5 Noise Model Validation

To validate the noise model, receiver points representing the measurement locations described in **Section 2.4.3** were established in the model. The model was then used to calculate noise levels at these locations. **Table 94** presents the comparison between the model results and the attended noise measurements at the two locations described in **Section 2.4**.

Noise model validation outputs include L_{Aeq} noise levels and L_{Amax} noise levels. The L_{Aeq} noise levels provide a validation of the assumed L_{AE} train source levels and the number of trains assumed for a given period. The L_{Amax} noise levels provide a validation of the assumed maximum train source levels.

Table 94 Modelling Predictions and Measured Noise Levels

Location	Noise Level (dBA)					
	$L_{Aeq(24hour)}$			L_{Amax}		
	Measured	Modelled	Difference	Measured	Modelled	Difference
Attended N1	64	64	-0.6	85	85	+0.6
Attended N2	55	57	+2.6	77	78	+1.1

The agreement between the model results and the measurements is within 2 dB at location N1 for $L_{Aeq(24hour)}$ and L_{Amax} noise levels, and at location N2 for L_{Amax} noise levels. At location N2, the model results in a slight over prediction of $L_{Aeq(24hour)}$ relative to the attended measurements.

As discussed in **Section 2.4.3.2** the measured noise levels on the Illawarra Up and Down Main tracks at location N2 were less than expected from typical track, and less than observed on the Local tracks at the same location. Approximately 77% of the rail movements at this location use the Illawarra Up and Down Main tracks. As a result, the $L_{Aeq(24hour)}$ noise levels derived from measurements at this location are lower than noise levels typically observed across the wider network, and lower than the modelled noise levels since the same source levels were used for both sets of tracks. Rail roughness levels at this location have not been investigated in detail at this stage, but it is possible that the measured Main track noise levels may increase over time with a change in rail roughness. For example, maintenance track grinding can increase the roughness and hence rail noise in the area. For this reason, the modelled $L_{Aeq(24hour)}$ noise levels are considered acceptable, with the slight over prediction of 2.6 dB representing a reasonable degree of conservatism.

Overall the model is considered to be suitable for predicting the rail noise levels from the project.

The modelling process inherently requires a number of assumptions to be made. Whilst every effort has been made to correlate predicted noise levels with measured noise data, it is important to regard the overall absolute predicted noise levels within the generally accepted modelling accuracy of +/- 2 dB.

4.3.6 Predicted Operational Airborne Noise Levels

To assist the interpretation of operational noise impacts, noise level contours have been calculated with a grid spacing of 10 m. The contour plots for the daytime, night-time and maximum noise levels are calculated for the 2034 with project scenario, at a height of 4.5 m above the local ground level, over a grid spaced at 10 m intervals (see **Appendix I**).

The second floor noise levels are representative of the typically most exposed floor level for the majority of existing receivers. Noise levels at single-storey buildings would typically be lower than shown in the noise contour plots. Noise levels at the upper floors of buildings with three or more storeys may be higher than shown in the noise contour plots.

Contours are shown for the 2034 scenario only as this scenario is representative of the future noise levels with the maximum forecast train numbers.

4.3.6.1 Predicted Operational Airborne Noise Levels - Chatswood Dive

Operational airborne noise predictions undertaken for the Chatswood surface track include the noise modelling inputs reviewed in **Section 4.3.4** and base case noise mitigation design discussed in **Section 4.3.4.9**.

4.3.6.1.1 Residential Receivers

A summary of the highest residential rail noise levels for the 2024 and 2034 scenarios are presented in **Table 95** for receivers with a predicted exceedance of the RING noise trigger levels. The results are shown as the worst-case prediction for the receiver potentially most affected by the project in each NCA within the areas surrounding the Chatswood dive. Where exceedance of the RING trigger levels was not predicted within a NCA, the highest overall residential rail noise levels are displayed for non-triggered residential receivers.

Table 95 Summary of Most Potentially Project Affected Residences - Chatswood Dive

NCA	Side	Worst-case Predicted Noise Level (dBA)																	
		Scenario Year 2024									Scenario Year 2034								
		Without Project			With Project			Noise Level Increase		RING Triggers	Without Project			With Project			Noise Level Increase		RING Triggers
		LAeq(15h)	LAeq(9h)	LAmax	LAeq(15h)	LAeq(9h)	LAmax	LAeq	LAmax		LAeq(15h)	LAeq(9h)	LAmax	LAeq(15h)	LAeq(9h)	LAmax	LAeq	LAmax	
NCA01	Up	50	46	68	52	47	68	1.3	-0.1	0	50	46	68	52	47	68	1.6	-0.1	0
	Down	61	58	80	62	58	81	1.0	0.5	0	61	58	80	63	58	81	1.2	0.5	0
NCA02	Up	**68**	64	**86**	**70**	**65**	**86**	1.6	-0.3	0	**68**	64	**86**	**70**	**65**	**86**	1.9	-0.3	0
	Down	64	62	84	**67**	**63**	**85**	3.3	1.3	1	64	60	84	**67**	**62**	**85**	3.5	1.3	1
NCA03	Up	**67**	63	**86**	**68**	**64**	**87**	0.6	0.8	0	**67**	63	**86**	**68**	**64**	**87**	0.7	0.8	0
	Down	63	59	81	64	60	81	1.6	0.7	0	63	59	81	65	60	81	1.8	0.7	0
NCA04	Up	**69**	65	**87**	**69**	**65**	**87**	0.3	0.0	0	**69**	65	**87**	**69**	**65**	**87**	0.3	0.0	0
	Down	**68**	64	**85**	**68**	**64**	**85**	0.1	0.0	0	**68**	64	**85**	**68**	**64**	**85**	0.1	0.0	0

Note1: **Red bold** indicates exceedances of the RING absolute noise trigger levels.

Note 2: "RING Triggers" refers to the number of locations where the RING noise trigger levels are predicted to be exceeded. For reference, the RING noise trigger levels are: development increases existing LAeq(period) rail noise levels by 2 dB or more, or existing LAmax rail noise levels by 3 dB or more ***and*** predicted rail noise levels exceed: daytime: 65 LAeq(15hour) or 85 LAmax, night-time: 60 LAeq(9hour) or 85 LAmax.

The results presented in **Table 95** for residential receivers surrounding the Chatswood dive indicate that operational noise levels in 2024 and 2034 without the project are generally already close to, or exceeding, the RING L_{Aeq} and L_{Amax} overall noise trigger levels due to the existing rail operations within the rail corridor.

Comparing the 'with project' and 'without project' highest residential L_{Aeq} noise levels within each assessment timeframe in **Table 95**, the 'with project' noise levels are approximately the same as the 'without project' noise levels in the 2024 and 2034 scenarios. This is primarily due to the noise abatement provided by the base case noise mitigation described in **Section 4.3.4.9**.

Reference to the 'without project' predictions shows that there is essentially no change in impacts between the 2024 and 2034 timeframes. This is because the 'without project' scenarios only consider Sydney Trains related noise impacts. These impacts are not anticipated to change over time as these lines are already operating at capacity (refer **Section 4.3.4.7**).

A detailed presentation of the residential airborne noise predictions is provided by NCA in Sections **4.3.6.2.1** through **4.3.6.2.4**.

4.3.6.1.2 Other Sensitive Receivers

A summary of the highest overall rail noise levels for the 2024 and 2034 scenarios are presented in **Table 96** for other sensitive receivers where a noise level increase trigger is predicted. The results are shown as the worst-case prediction in each NCA within the areas surrounding the Chatswood dive. Where an exceedance of the RING trigger levels is not predicted within a NCA, the highest overall rail noise levels are displayed for non-triggered other sensitive receivers.

Table 96 Summary of Highest Other Sensitive Noise Triggers - Chatswood Dive

NCA	Side	Worst-case Predicted Noise Level (dBA)											
		Scenario Year 2024						Scenario Year 2034					
		Without Project		With Project		Noise Level Increase	RING Triggers	Without Project		With Project		Noise Level Increase	RING Triggers
		LAeq(1h) Day	LAeq(1h) Night	LAeq(1h) Day	LAeq(1h) Night	LAeq(1h)		LAeq(1h) Day	LAeq(1h) Night	LAeq(1h) Day	LAeq(1h) Night	LAeq(1h)	
NCA01	Up	59	55	61	56	1.9	0	59	55	61	56	2.2	0
	Down	61	58	62	58	1.0	0	61	58	62	58	1.2	0
NCA02	Up	-	-	-	-	-	0	-	-	-	-	-	0
	Down	66	62	69	63	3.0	0	66	62	69	63	3.2	0
NCA03	Up	-	-	-	-	-	0	-	-	-	-	-	0
	Down	63	59	64	60	1.6	0	63	59	64	60	1.8	0
NCA04	Up	-	-	-	-	-	0	-	-	-	-	-	0
	Down	68	64	68	64	0.1	0	68	64	68	64	0.1	0

Note 1: Noise predictions are external. A conservative outside-to-inside attenuation of 10 dB has been applied.

Note 2: “RING Triggers” refers to the number of locations where the RING noise trigger levels are predicted to be exceeded.

The results presented in **Table 96** indicate that there are no exceedances of the RING trigger levels for other sensitive receivers in the vicinity of the Chatswood dive.

4.3.6.2 Predicted Base Case Noise Impacts by Noise Catchment Area - Chatswood Dive

In the following sections, the predicted base case overall rail noise levels are discussed for each of the NCAs adjacent the Chatswood Dive. Tables showing the noise level predictions at all sensitive receivers are provided in **Appendix J**.

In each figure below, receiver buildings with red or orange fill indicates that the property is predicted to exceed the RING trigger levels based on either the 2024 or 2034 modelling scenario.

Where exceedances of the noise trigger levels are apparent, the RING requires additional noise mitigation to be considered. Noise mitigation options are discussed in **Section 4.3.7**.

4.3.6.2.1 Predicted Noise Impacts NCA01

There are no exceedances of the operational noise trigger levels in NCA01 and hence no requirement to consider additional noise mitigation in this catchment. This results from rail operations in the vicinity of NCA01 being relatively slow in speed as services approach, stop, and depart Chatswood Station.

4.3.6.2.2 Predicted Noise Impacts NCA02

Many of the most potentially affected receivers in NCA02 receive noise abatement in the ‘with project’ scenarios through the inclusion of the base case noise mitigation design. This includes the installation of rail dampers and deck absorption within the Chatswood dive structure, and an increase in the height of the existing noise barriers by 1 m.

The remaining sensitive receivers in NCA02 that are triggered for consideration of noise mitigation are shown in **Figure 46**.

Figure 46 NCA02 Locations Triggered for Consideration of Noise Mitigation

Exceedances of the noise trigger levels are predicted at one residential receiver building situated on the Down side of the alignment at address 1-3 Gordon Avenue, Chatswood. This residential receiver is a multi-storey apartment building and would consist of several dwellings. The upper floors of this receiver would have an unobstructed view of the rail tracks over the noise barrier, even with the proposed increase in barrier height. To break line of sight at the triggered receivers on the upper floor of this building would require a noise barrier in excess of 6 m high. Noise barriers of this height are unlikely to be considered reasonable and may not be feasible, particularly since the barrier would need to be located in close proximity to the building facade. .

4.3.6.2.3 Predicted Noise Impacts NCA03

The most potentially affected receivers in NCA03 would benefit from the base case noise mitigation design, in the form of dive track source noise mitigation and the increased height of existing noise barriers. As a result, no exceedances of the operational noise trigger levels are predicted in NCA03 and there is no requirement to consider additional noise mitigation in this catchment.

4.3.6.2.4 Predicted Noise Impacts NCA04

The most affected receivers in NCA04 would benefit from the proposed base case noise mitigation measures. These measures include the installation of a 2 m noise barrier at the edge of the cutting on the Up side of the corridor. As a result, there are no predicted exceedances of the operational noise trigger levels in NCA04 and hence no requirement to consider additional noise mitigation in this catchment.

4.3.6.3 Potential Noise Impacts - Proposed Developments Adjacent Chatswood Dive

Commercial receivers located between Nelson Street and Mowbray Road in NCA03 are proposed to be acquired as part of the project. Detailed plans for future land use for this site are not currently available. However, potential future land uses on this site may include several multi-storey residential developments overlooking the rail corridor.

These developments may be exposed to levels of operational airborne rail noise in excess of the RING absolute noise level criteria. Accordingly any future developments on this site should adequately address the noise criteria in the Infrastructure State Environment Planning Policy (SEPP).

4.3.6.4 Predicted Operational Airborne Noise Levels – Marrickville Dive

4.3.6.4.1 Residential Receivers

A summary of the highest residential rail noise levels for the 2024 and 2034 scenarios are presented in **Table 97** for receivers where a RING noise level trigger is predicted. The results are shown as the worst-case prediction for the receiver potentially most affected by the project in each NCA within the areas surrounding the Marrickville dive. Where a RING trigger is not predicted within a NCA, the highest overall residential rail noise levels are displayed for non-triggered residential receivers.

Table 97 Summary of Most Potentially Project Affected Residences - Marrickville Dive

NCA	Side	Worst-case Predicted Noise Level (dBA)																	
		Scenario Year 2024									Scenario Year 2034								
		Without Project			With Project			Noise Level Increase		RING Triggers	Without Project			With Project			Noise Level Increase		RING Triggers
		LAeq(15h)	LAeq(9h)	LAmax	LAeq(15h)	LAeq(9h)	LAmax	LAeq	LAmax		LAeq(15h)	LAeq(9h)	LAmax	LAeq(15h)	LAeq(9h)	LAmax	LAeq	LAmax	
NCA32	Up	**67**	63	**99**	**67**	**63**	**99**	0.0	0.0	0	**67**	63	**99**	**67**	**63**	**99**	0.0	0.0	0
	Down	**68**	64	**93**	**68**	**64**	**93**	0.0	0.0	0	**68**	64	**93**	**68**	**64**	**93**	0.0	0.0	0
NCA33	Up	41	38	55	50	44	68	9.1	13.5	0	41	37	55	50	45	68	9.5	13.5	0
	Down	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
NCA34	Up	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
	Down	58	54	76	58	54	76	0.0	0.0	0	58	54	76	58	54	76	0.0	0.0	0

Note1: **Red bold** indicates exceedances of the RING absolute criteria levels.

Note 2: Note 2: “RING Triggers” refers to the number of locations where the RING noise trigger levels are predicted to be exceeded.

For reference, the RING trigger levels are “development increases existing LAeq(period) rail noise levels by 2 dB or more, or existing LAmax rail noise levels by 3 dB or more ***and*** predicted rail noise levels exceed: daytime: 65 LAeq(15hour) or 85 LAmax, night-time: 60 LAeq(9hour) or 85 LAmax.

The results presented in **Table 97** for residential receivers surrounding the Marrickville dive indicate that residential noise levels in NCA32 for design years 2024 and 2034 without the project are generally already close to or above, the RING L_{Aeq} and L_{Amax} noise criteria levels.

Comparing the 'with project' and 'without project' highest residential L_{Aeq} noise levels within each assessment timeframe in **Table 97**, the 'with project' noise levels are generally the same for the 2024 and 2034 scenario. Project noise level increases are more evident in NCA33 on the up side of the corridor, and NCA04 on the down side of the corridor where the distance to the dive tracks is shortest. However the predicted noise levels in these areas are below the RING absolute noise level criteria.

Reference to the 'without project' predictions shows that there is essentially no change in impacts between the 2024 and 2034 timeframes. This is because the 'without project' scenarios only consider Sydney Trains related noise impacts which would not change over time since the lines are already at capacity (refer **Section 4.3.4.7**).

From the results presented in in **Table 97** it can be seen that there are no exceedances of the RING noise trigger levels for residential receivers surrounding the Marrickville dive for design years 2024 or 2034.

4.3.6.4.2 Other Sensitive Receivers

A summary of the highest overall rail noise levels for the 2024 and 2034 scenarios are presented in **Table 98** for other sensitive receivers where a noise level increase trigger is predicted. The results are shown as the worst-case prediction in each NCA within the areas surrounding the Marrickville dive. Where a RING trigger is not predicted within a NCA, the highest overall rail noise levels are displayed for non-triggered other sensitive receivers.

Table 98 Summary of Highest Other Sensitive Noise Levels - Marrickville Dive

NCA	Side	Worst-case Predicted Noise Level (dBA)											
		Scenario Year 2024						Scenario Year 2034					
		Without Project		With Project		Noise Level Increase	RING Triggers	Without Project		With Project		Noise Level Increase	RING Triggers
		LAeq(1h) Day	LAeq(1h) Night	LAeq(1h) Day	LAeq(1h) Night	LAeq(1h)		LAeq(1h) Day	LAeq(1h) Night	LAeq(1h) Day	LAeq(1h) Night	LAeq(1h)	
NCA32	Up	67	63	67	63	0.0	0	67	63	67	63	0.0	0
	Down	68	64	68	64	0.0	0	68	64	68	64	0.0	0
NCA33	Up	51	49	55	51	4.6	0	51	49	55	51	4.8	0
	Down	0	0	0	0	0.0	0	0	0	0	0	0.0	0
NCA34	Up	69	64	69	64	0.0	0	69	64	69	64	0.0	0
	Down	68	64	68	64	0.0	0	68	64	68	64	0.0	0

Note 1: Noise predictions are external. An outside-to-inside attenuation of 10 dB has been applied.

Note 2: “RING Triggers” refers to the number of locations where the RING noise trigger levels are predicted to be exceeded.

The results presented in **Table 98** indicate that consideration of noise mitigation for other sensitive receivers in the vicinity of the Marrickville dive is not triggered in either the 2024 or 2034 scenarios.

4.3.6.5 Potential Noise Impacts - Proposed Developments Adjacent to Marrickville Dive

Commercial receivers located on the Up side of the corridor in NCA34 are proposed to be acquired as part of the project. Detailed plans for future land use for this site are not currently available. Potential future land uses on this site are likely to comprise commercial and industrial developments. If residential developments are considered for this site, such developments should adequately address the noise criteria in the Infrastructure State Environment Planning Policy (SEPP).

4.3.6.6 Summary of Locations Triggered for Consideration of Noise Mitigation

Table 99 provides a summary of the locations where residual exceedances of the RING trigger levels are predicted.

Table 99 Summary of Locations Triggered for Consideration of Noise Mitigation

Project Zone	NCA	SIDE	Number of Exceedances of RING Trigger Levels[1]				Comments
			Residential Receivers		Other Sensitive Receivers		
			2024	2034	2024	2034	
Chatswood Dive	NCA01	Up	0	0	0	0	n/a
		Down	0	0	0	0	n/a
	NCA02	Up	0	0	0	0	n/a
		Down	1	1	0	0	Multistorey residential apartment building.
	NCA03	Up	0	0	0	0	n/a
		Down	0	0	0	0	n/a
	NCA04	Up	0	0	0	0	n/a
		Down	0	0	0	0	n/a
Marrickville Dive	NCA32	Up	0	0	0	0	n/a
		Down	0	0	0	0	n/a
	NCA33	Up	0	0	0	0	n/a
		Down	0	0	0	0	n/a
	NCA34	Up	0	0	0	0	n/a
		Down	0	0	0	0	n/a
	TOTAL		**1**	**1**	**0**	**0**	

Note 1: The number of locations triggered counts buildings once only, in the event that more than one facade or floor of the building is triggered. This number may be less than the number of individual dwellings triggered, for example where buildings contain multiple apartments.

4.3.7 Airborne Noise Mitigation Options

The noise modelling results indicate that future rail noise levels exceed the RING trigger levels at existing receivers in one residential building in Chatswood. It is therefore appropriate to assess additional feasible and reasonable noise mitigation measures for this location.

Appendix 6 of the RING provides the following guidance in relation to determining feasible and reasonable mitigation measures:

> *"A **feasible** mitigation measure is a noise-abatement measure that can be engineered and is practical to build, given proposal constraints such as safety, maintenance and reliability requirements. It may also include options such as amending operational practices (e.g. changing timetable schedules) to achieve noise reduction.*
>
> *Selecting **reasonable** measures from those that are feasible involves judging whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the abatement measure. To make such a judgement, consider the following.*
>
> - *Noise impacts*
> - *Noise mitigation benefits*
> - *Cost effectiveness of noise mitigation*
> - *Community views"*

A summary of potential airborne operational noise mitigation options along the proposal corridor is provided in **Table 100**, along with comments on their feasibility and reasonableness.

Source control measures are typically more cost effective to implement in terms of the resulting noise benefit compared with path and receivers controls respectively. On this basis, the hierarchy of noise control is to give preference to source control measures, then to path control measures and finally receiver controls.

Table 100 Summary of Additional Operational Noise Mitigation Options

Description	Estimated Noise Reduction	Comments on Feasibility and Reasonableness
Source Control Measures		
Reduce speeds	A 20% reduction in maximum speed would reduce L_{Amax} noise levels by 2.5 dB and L_{Aeq} noise levels by 1.5 dB	The speeds as proposed are required to meet service frequency demands during peak periods. Potentially feasible and reasonable outside of peak periods, for example at night.
Reduce overall number of train passbys	No change in L_{Amax} 1 dB in L_{Aeq} for 20% reduction 2 dB in L_{Aeq} for 35% reduction	Not feasible as train numbers are required to meet service frequency demands.
Reduce train lengths	Negligible change in L_{Amax} 1.3 dB reduction in L_{Aeq} for 6-car trains in lieu of 8-car trains 3 dB reduction in L_{Aeq} for 4-car trains in lieu of 8-car trains	Not feasible as train lengths are required to meet capacity demand.

Description	Estimated Noise Reduction	Comments on Feasibility and Reasonableness
Minimise wheel and rail roughness	Limited by whether rail roughness or wheel roughness dominates the combined system	The specifications for the Sydney Metro operations include requirements for maintaining the rail surface (via rail grinding) and train wheel condition (via wheel lathe) in accordance with defined acceptance standards.
Minimise train source noise levels via specifications	N/A	Trains are locked in as specified for the Sydney Metro Northwest, and this assessment assumes similar source levels. Additional source noise reduction is not an option for this project.
Track design measures - rail dampers	Rail dampers provide 4 dB reduction to LAeq and LAmax for typical slab track. No benefit on ballast track.	Only applicable to slab track in the dives and tunnels. Included on Chatswood Dive slab track as base case noise mitigation. No significant benefit for ballast track.
Deck Absorption	Provides 2 dB reduction to LAeq and LAmax for typical slab track. No benefit on ballast track.	Absorption located in between the rails and directly adjacent the rails. Benefit to LAmax noise levels depends on origin of maximum noise. Included on Chatswood Dive slab track as base case noise mitigation.
Exclude "noisy" individual trains from Sydney Metro	Negligible	The operation of the Sydney Metro will include a maintenance strategy to identify and repair noisy trains.
Path Control Measures		
Noise barriers - conventional at rail corridor boundary	Significant noise reduction possible (ie >5 dB) where source to receiver line-of-sight is broken by barrier.	Existing and relocated noise barriers along existing rail tracks adjacent to Chatswood Dive. Existing noise barrier increased in height as base case noise mitigation. Effectiveness limited by multi-storey dwellings.
Noise barriers - low profile "platform barriers"	Up to 8 dB reduction in L_{Aeq} and L_{Amax} over unmitigated case. Benefit depends on the gap remaining between the low barrier and the train. Little benefit to tracks other than the immediately adjacent track.	Could result in high noise reduction with low visual impact. Design would need to consider rolling stock loading gauge and track maintenance requirements including safe access. Feasibility at locations with multiple tracks may be limited.
Receiver Control Options		
Ventilation in accordance with Building Code requirements to allow windows to be closed (if desired)	10 dB to 15 dB reduction in internal noise levels compared with windows open for standard glazing. Higher noise reductions possible for laminated and double glazing with acoustic seals. No benefit for outdoor areas or if windows are opened.	This option could be applicable as a final measure for existing residences predicted to exceed the trigger levels. Several receivers triggered for mitigation are modern constructions which likely include ventilation and facades with high acoustic performance in line with the requirements of the SEPP.

4.3.8 Potentially Reasonable and Feasible Mitigation Options

Of the additional noise mitigation options listed in **Table 100**, those which may be feasible and reasonable for reducing the impact of operational noise at the existing receivers with identified exceedances of the trigger levels are discussed below.

4.3.8.1 Low Profile Noise Barriers

Even with the inclusion of base case noise mitigation in the form of rail dampers, deck absorption, and increased noise barrier heights, it is anticipated that receivers on the down side of the corridor adjacent to the Chatswood dive would experience residual operational airborne noise impacts.

Noise from the wheel-rail interface is dominant in the region of the Chatswood dive and can be targeted directly by screening in close proximity to the source through use of low profile noise barriers. Low-profile barriers would need to be installed as close as possible to the tracks, but outside the zone in which there is the potential for them to be struck by a train or by maintenance equipment such as automated ballast cleaning machines.

There are many potential designs for low-height barriers in various situations. “Platform” profile barriers have been in use at Woollahra cutting on the Eastern Suburbs rail line since the 1970’s. Other examples of low height barrier designs are shown in **Figure 47**. The low barrier examples in **Figure 47** are installed on only one side of the tracks in most cases. The example with another barrier on the far side incorporates gaps in the low concrete barrier to permit a refuge or egress point. From an acoustic perspective, a barrier with an absorptive facing is preferred.

Safety and maintenance considerations control the detail of the design of a low-height barrier close to the track. Safety and maintenance risks can affect the feasibility of low profile noise barriers and would be considered in greater detail during the detailed design stage of the project.

Low profile noise barriers would potentially reduce noise from metro services at adjacent receivers by up to 8 dB to 10 dB. The actual benefit that can be achieved depends on the geometry of the barrier relative to the train, and the size of the residual gap. If installed on the metro tracks, low profile barriers would be unlikely to effectively address noise from the existing tracks. This mitigation option therefore would not address the total noise from all rail noise services in the corridor.

Figure 47 Examples of Low-Height Barriers

4.3.8.2 Conventional Noise Barriers

Unlike low profile noise barriers which only mitigate noise from directly adjacent rail track sources, well designed conventional noise barriers can potentially mitigate noise emissions originating from all sources within the rail corridor.

Conventional noise barriers are generally only considered where more than three closely grouped properties require noise mitigation. In circumstances with multi-unit dwellings, the density of individual dwellings is considered when judging the potential suitability of noise barriers.

A benefit of noise barriers (both conventional and low profile) is that they maximise the noise mitigation benefits to all residents in the area, including those that have noise impacts below the RING trigger levels. Barriers also improve external amenity for all receiver types, including parks and playing fields. Conventional barriers can be constructed to greater heights than low barriers close to the tracks.

Conventional noise barriers do not necessarily satisfy all expectations. Residents may also possibly be affected by negative aspects of conventional barriers such as:

- Loss of open aspect and breezes
- Potential for vandalism and need for graffiti removal
- Reduction in visual amenity of urban landscape and potential for overshadowing
- Loss of views and vistas
- Removal of vegetation

In some cases, transparent barriers have been used in an attempt to reduce overshadowing and loss of visual amenity, but have also attracted vandalism including etching which is difficult to remove.

Conventional noise barriers are typically well suited to mitigating the mid to high frequency noise generated by steel wheels rolling on steel rails.

The primary acoustic limitation of conventional noise barriers is the requirement to break the line of sight between the noise source and receiver. In the case of the multi-storey residential receivers directly adjacent the Chatswood dive rail corridor boundary, this would require a substantial increase in existing noise barrier height.

Residual impacts at the multi-storey residential receiver building at 1-3 Gordon Avenue, Chatswood would persist even if the existing 3 m high noise barrier height were increased to 6 m. This illustrates the limited capability of noise barriers to provide effective mitigation when line of site to the rail source cannot be obstructed. Increasing the existing noise barrier height in the region of this receiver to higher than that included in the base case noise mitigation design is not likely to be a feasible mitigation option.

4.3.8.3 Property Treatments

Treatments to building facades usually involve higher performance windows, doors and seals to keep noise out. Facade treatments effectively require occupants to keep their windows and doors closed and hence alternative ventilation is usually required to maintain adequate air flow.

Building treatments are generally considered as a noise mitigation option only as a final measure. If windows are closed as a noise mitigation measure, the resulting noise reductions are likely to be clearly beneficial from a quantitative and subjective perspective. If heavier glazing, laminated glazing or double glazing is provided, the additional noise benefit (quantitative and subjective) could be beneficial in some circumstances, depending on the overall facade construction of individual dwellings.

The scope and suitability of property facade treatments would depend on the existing conditions at each property and consultation with the affected receivers.

4.3.9 Recommended Airborne Noise Mitigation

Base case noise mitigation in the form of rail dampers, deck absorption, and increased noise barrier heights has been included in this assessment. Residual operational airborne noise impacts have been identified at one multi-storey residential receiver on the down side of the corridor adjacent to the Chatswood dive. Airborne noise levels are dominated by wheel rail noise from rail operations.

Noise barriers are unlikely to be effective at the multi-storey residential receiver located immediately adjacent the rail corridor in NCA02 on the Down side of the corridor since the line of sight from the receiver to the tracks cannot be obstructed by a conventional noise barrier.

Low profile noise barriers would potentially be effective in reducing noise from metro services at adjacent receivers but are unlikely to effectively address noise from the neighbouring T1 North Shore Line tracks. The ability of low profile noise barriers to significantly reduce noise emissions from targeted wheel-rail sources may be investigated further during the detailed design stage of the project, with consideration of the safety and maintenance risks.

Residual impacts at the multistorey residential apartment building may therefore require consideration of property treatments if detailed design studies determine the above controls are not sufficient.

4.4 Operational Noise from Stations and Ancillary Facilities

This section provides an assessment of the potential operational noise impacts associated with the project stations and ancillary facilities.

4.4.1 Nearest Receivers and Unattended Noise Monitoring Results

To determine the existing ambient noise climate within the project area, unattended ambient noise measurements were undertaken (this process is described in detail in **Chapter 1**). Measurements were performed in the vicinity of all proposed stations.

4.4.2 Noise Criteria

The Industrial Noise Policy (INP) sets two separate noise criteria to meet environmental noise objectives: one to account for intrusive noise and the other to protect the amenity of particular land uses. These criteria are to be met at the most-affected boundary of the receiver property. The more stringent of these two criteria usually defines the proposal specific noise levels. For both amenity and intrusiveness, night-time criteria are more stringent than daytime or evening criteria.

In addition to intrusiveness and amenity, the risk of sleep disturbance must be assessed. Sleep disturbance is assessed in accordance with the screening criterion described in the online Application Notes to the INP and the more detailed review of sleep disturbance contained in the Road Noise Policy (RNP).

Public Address system announcements at the underground stations are not anticipated to generate any audible noise emissions at sensitive receivers above ground.

4.4.2.1 Industrial Noise Policy Criteria for Intrusive Noise

To provide for protection against intrusive noise, the INP states that the L_{Aeq} noise level of the source, measured over a period of 15 minutes, should not be more than 5 dB above the ambient (background) L_{A90} noise level (or RBL), measured during the daytime, evening and night-time periods at the nearest sensitive residential receivers. In this case, the intrusiveness criteria are determined from the RBLs in **Table 4** at sensitive receiver locations nearest to the facilities.

4.4.2.2 Industrial Noise Policy Criteria for Amenity

To provide protection against impacts on amenity, the INP specifies suitable maximum noise levels for particular land uses and activities during the daytime, evening and night-time periods. For this assessment, the existing residences in the vicinity of the stations and ancillary facilities are considered to be ‘Urban’. According to the INP, an ‘Urban’ area is characterised by an acoustic environment dominated by ‘urban hum’ or industrial source noise, through traffic with characteristically heavy and continuous traffic flows during peak hours, located near commercial districts or industrial districts.

According to the INP, where existing transportation L_{Aeq} noise levels exceed the 'Acceptable' noise level by 10 dB or more, and the existing noise level is unlikely to decrease in future, the noise criteria should be taken to be the existing noise level minus 10 dB. This approach is also applicable to areas with high traffic noise.

The relevant INP external amenity noise criteria are presented in **Table 101**.

Table 101 Industrial Noise Policy Amenity Noise Levels

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level (dBA)	
			Acceptable	Recommended Maximum
Residence	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
Residence	Urban	Day	60	65
		Evening	50	55
		Night	45	50
Commercial	All	when in use	65	70
Active recreation area	All	when in use	55	60
Educational	All	when in use	55[1]	60[1]
Place of worship	All	when in use	60[1]	65[1]

Note 1: External levels, based on the internal levels specified in the INP plus 20 dB (assuming open windows).

4.4.2.3 Modifying Factor Adjustments

Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other less-obtrusive noise sources at the same level. To account for this additional annoyance, the INP describes modifying factors to be applied when assessing amenity and intrusiveness. No modifying factors have been assumed applicable for the stations and ancillary facilities.

4.4.2.4 Sleep Disturbance

The current approach to assessing potential sleep disturbance is to apply an initial screening criterion of background plus 15 dB (as described in the Application Notes to the INP), and to undertake further analysis if the screening criterion cannot be achieved. The sleep disturbance screening criterion applies outside bedroom windows during the night-time period. Where the screening criterion cannot be met, the additional analysis should consider the level of exceedance as well as factors such as:

- How often high noise events would occur
- The time of day (normally between 10:00 pm and 7:00 am)
- Whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).

Other guidelines that contain additional advice relating to potential sleep disturbance impacts should also be considered, including the RNP. The RNP provides a review of research into sleep disturbance. From the research to date, the RNP concludes that:

- Maximum internal noise levels below 50 dBA to 55 dBA are unlikely to awaken people from sleep
- One or two events per night, with maximum internal noise levels of 65 dBA to 70 dBA, are not likely to affect health and wellbeing significantly.

It is generally accepted that internal noise levels in a dwelling, with the windows open are 10 dB lower than external noise levels. Based on a worst case minimum attenuation, with windows open, of 10 dB, the first conclusion above suggests that short term external noises of 60 dBA to 65 dBA are unlikely to cause awakening reactions. The second conclusion suggests that one or two noise events per night with maximum external noise levels of 75 dBA to 80 dBA are not likely to affect health and wellbeing significantly.

4.4.2.5 Noise Criteria for Draught Relief Shafts

For residential and commercial receivers, train passby noise emitted from draught relief shafts (at underground stations) has been examined against the L_{Amax} (fast) noise criteria in **Table 102**.

Table 102 Noise Criteria for Draught Relief Shafts

Usage	Noise Criteria, L_{Amax} (dBA)
Residential	55
Commercial	65

The L_{Amax} noise level refers to the 95th percentile train passby event (ie 95% of train passby events are not permitted to exceed these levels). The absolute maximum event is not used for design, as it cannot be precisely defined and would occur infrequently.

These noise criteria are comparable with the design criteria adopted for the Sydney Metro Northwest, Epping to Chatswood Rail Line (ECRL) and Sydney Airport Rail Line.

4.4.3 Noise Goal Summary Mechanical and Electrical Services and Stations

Noise emissions from mechanical and electrical services are normally of a continuous nature and do not change unless operational conditions vary. As a result of the general reduction in existing ambient noise levels during the latter periods of the day, the night-time INP intrusive noise criteria are in general the most stringent for residential receivers and are therefore the controlling design criteria at most residential locations.

“Commercial” and “active recreation area” receivers have acceptable amenity noise levels of 65 dBA and 55 dBA L_{Aeq} respectively (when in use).

The locations of sensitive receivers at each station and ancillary facility and their corresponding industrial noise criteria, determined using the procedures defined within the INP (refer **Section 4.4.2**), are presented in **Table 103**.

The operational noise criteria at the nearest sensitive receivers at each station and ancillary facility, determined using the procedures defined within the INP, are presented in **Table 103**.

Table 103 Noise Criteria for Sensitive Receivers near Stations and Ancillary Facilities

Location	Operational Noise Source	Nearest Receiver Type	Address	Distance to Nearest Boundary or Facade	Reference[2]	External Noise Criteria (dBA)[1]
Artarmon Substation	Traction substation	Residential	12-14 Millner Rd, Artarmon	25 m	B21	45
Crows Nest Station	N Service building	Commercial	22-28 Clarke Street, Crows Nest	10 m	N/A	65
	S Service building	Commercial	6-8 Clarke Street, Crows Nest	10 m	N/A	65

Location	Operational Noise Source	Nearest Receiver Type	Address	Distance to Nearest Boundary or Facade	Reference[2]	External Noise Criteria (dBA)[1]
Victoria Cross Station	N Service building	Residential	31 Mclaren Street, North Sydney	40 m	B18	56
		Commercial	194 Miller Street, North Sydney	20 m	N/A	65
	S Service building (incl Traction substation)	Commercial	65 Berry Street, North Sydney	<10 m	N/A	65
Barangaroo Station	N Service building and ventilation risers	Residential	14-16 High St, Millers Point	20 m	B12	45
	S Service building and ventilation risers	Residential	66 High St, Millers Point	20 m	B12	45
	Traction Substation and minor ventilation risers	Residential	New proposed developments	10 m	B12	45
Martin Place Station	N Service building	Commercial	Macquarie Bank; 48 Castlereagh St, Sydney	<10 m	N/A	65
		Commercial	15 Castlereagh St, Sydney	20 m	N/A	65
	S Service building	Commercial	43 Castlereagh St Sydney	25 m	N/A	65
Pitt Street Station	N Service building	Hotel (Residential)	Park8 Hotel Sydney; 256 Pitt St, Sydney	<10 m	B27	58
		Commercial	50 Park St, Sydney	20 m	N/A	65
	S Service building (incl Traction substation)	Commercial	120 Bathurst St, Sydney	25 m	N/A	65
Central Station	Service Building	Hotel (Residential)	Central Hotel; 17 Randle Street, Surry Hills	135 m	B09	50
		Commercial	101 Chalmers Street, Chippendale	70 m	N/A	65
Waterloo Station	N Service building (incl Traction substation)	Residential to the west	69-83 Botany Rd, Waterloo	25 m	B06	44
		Residential to the east	209 Cope St, Waterloo	30 m	B06	44
	S Service building	Residential	219 Cope St, Waterloo	30 m	B06	44
		Worship	103 Botany Rd, Waterloo	20 m	N/A	60

Location	Operational Noise Source	Nearest Receiver Type	Address	Distance to Nearest Boundary or Facade	Reference[2]	External Noise Criteria (dBA)[1]
Southern services facility	Water Treatment Plant	Residential	80 Unwins Bridge Road, St Peters	220 m	B01	46
		Commercial	15 Unwins Bridge Road, St Peters	130 m	N/A	65
	Traction substation	Residential	80 Unwins Bridge Road, St Peters	220 m	B01	46
		Commercial	15 Unwins Bridge Road, St Peters	160 m	N/A	65

Note 1: As discussed in **Section 4.4.3**, the night-time intrusive noise criteria are adopted for the design criteria presented in this table. The criteria for commercial and recreational premises are absolute levels and are not relative to existing background noise levels in accordance with the INP.

Note 2: The reference location refers to the nearest unattended noise logging location in **Table 4**.

4.4.4 Predicted Noise Levels - Stations and Ancillary Facilities

4.4.4.1 Noise Modelling Methodology

The modelling of the mechanical and electrical services airborne noise presented in this assessment is based on the shaft and service building locations forming part of the current project design.

The approach to the assessment of noise impacts presented here is to calculate the maximum total allowable emitted sound power level (SWL) at each location, thus specifying the acoustic emission limit for all equipment (combined operation) at each location. In some cases, plant and equipment associated with the ECRL project have been considered as representative to provide an early indication of whether the noise criteria are able to be achieved.

The noise sources have been assumed to operate without noticeable tonal, impulsive or intermittent components, unless otherwise stated, and the assessment therefore does not require the application of modifying factors, as defined in the INP.

4.4.4.2 Assessment of Mechanical and Electrical Plant and Ventilation Systems

The maximum allowable sound power levels emitted by industrial-type noise sources have been predicted for each location in order to meet the amenity and intrusive noise criteria at nearby sensitive receivers, where applicable. The predicted maximum allowable levels apply to the combined sound power level of all equipment at a specified location and not to an individual noise source. The results are presented in **Table 104**.

Table 104 Maximum Acceptable Noise Emissions from Station Services

Site Location	Ancillary Locations	Maximum Acceptable Sound Power Level (dBA)
Artarmon Substation	Traction substation	78
Crows Nest Station	N Service building	90
	S Service building	90
Victoria Cross Station	N Service building	93
	S Service building (incl Traction substation)	90

Site Location	Ancillary Locations	Maximum Acceptable Sound Power Level (dBA)
Barangaroo Station	N Service building	76
	S Service building	76
	Traction substation	70
Martin Place Station	N Service building	90
	S Service building	98
Pitt Street Station	N Service building	83
	S Service building(incl Traction substation)	98
Central Station	Service building	98
Waterloo Station	N Service building (incl Traction substation)	77
	S Service building	79
Southern services facility	Water Treatment Plant	98
	Traction Substation	98

Note: Mechanical services located underground at stations and not anticipated to contribute to above ground noise emissions.

The design of station mechanical and electrical services is yet to be finalised and plant and equipment selection is subject to change. Notwithstanding this, maximum allowable sound power levels (SWLs) provided in **Table 104** have been compared to plant and equipment selections associated with the ECRL project to determine the feasibility of achieving the project noise criteria.

4.4.4.2.1 Traction Substations

Traction substations are proposed at Artarmon (next to the Gore Hill Freeway), southern services facility, Victoria Cross Station, Pitt Street Station, Barangaroo Station and Waterloo Station.

The substations would generally be 30 m to 50 m long and 10 m to 20 m wide and would be enclosed on all sides with a removable roof to allow installation, maintenance and repair works when required. The facade of the substations would generally be masonry with acoustic louvres if required for noise reduction purposes.

Acoustically significant plant and equipment associated with ECRL project traction substations include a reactor transformer and traction reactor with a combined SWL of 81 dBA.

It is expected that with appropriate noise attenuation measures in place such as those afforded by the enclosure, installing acoustic louvres, and directing louvres away from nearest receivers, noise from traction substations can be reduced to levels below the maximum levels provided in **Table 104**.

4.4.4.2.2 Ventilation Systems

The ventilation systems include the tunnel and track way ventilation systems. Tunnel ventilation systems supply fresh ambient air to the tunnels and include tunnel ventilation fans and draught relief shafts. The track way ventilation system captures heat from the air conditioning exhausts and brakes of trains stopped at stations. Over track way and under platform exhausts are connected via ductwork to the track way exhaust fans. The draught relief shafts also provide a path for make-up air from the track way exhaust system.

A draught relief shaft and two 120 m^3/s tunnel ventilation fans with associated tunnel ventilation shafts are proposed to be located at each station end. The tunnel ventilation fans are mainly for congested and emergency operating modes when air flow generated by train movement is insufficient. However, they may operate at part load at strategic stations to maintain temperatures below 40˚C during normal operations in peak summer periods. Three 40 m^3/s track way exhaust fans are proposed to be installed at each end of the underground stations. However, only two of the three fans are expected to be operating under normal conditions.

Overhead tunnel impulse fans are also proposed to be mounted in each tunnel at the two portal locations.

Typical tunnel ventilation fan selection for the ECRL project was specified with an SWL of 80 dBA (including 3 m attenuator and 50 % open area). Similar fan and attenuator selection was assumed for the Sydney Metro Northwest and is also likely be used for this project. The tunnel ventilation fans may however have an increased duty and SWL to those used for the ECRL project and an increased allowance for a 5 m attenuator has been made.

For assessment purposes, it has been assumed that a sound power level of 80 dBA could be achieved from a tunnel ventilation fan with a 5 m attenuator on the surface side. The proposed track way exhaust fans have a lower capacity and are expected to have a sound power level approximately 7 dB less than a tunnel ventilation fan. Allowance has been made for 3 m attenuators and the SWL of each track way exhaust fan with a 3 m attenuator installed is likely to be similar to a tunnel ventilation fan with a 5 m attenuator.

Tunnel ventilation fans would typically operate only during times of congestion or in response to emergency events. Congestion in both tunnels between two of the stations is considered to be an unlikely and infrequent event, particularly during the night-time period. For the purpose of this assessment it has been assumed that one tunnel ventilation fan and two track way exhaust fans are operating at each end of the station.

On this basis, the total SWL from the ventilation buildings is predicted to be in the order of 85 dBA at the stations.

Careful design consideration would be required at Barangaroo, Pitt Street and Waterloo stations to minimise noise at the nearest residences.

It is envisaged that with attenuation measures in place such as appropriate attenuator selection, directing ventilation discharges away from the nearest sensitive receivers and acoustically lining plenums and ductwork, acoustic louvers on ventilation discharges that noise emission from fans can be mitigated to comply with the design criteria. Such measures would be developed in the detailed design stage of the project.

4.4.4.3 Assessment of Train Noise Breakout from Draught Relief Shafts

Although the proposed rail line would operate underground, noise generated during train passbys has the potential to escape from the tunnels via the draught relief shafts. The in-tunnel maximum reverberant noise levels used for predictions of the train noise break-out are presented in **Table 105**, based on noise measurements undertaken within the ECRL tunnels for a train speed of 80 km/h.

Table 105 In-tunnel Reverberant Noise Levels

Maximum Noise Levels, L_{max} (fast) (dB)										
Octave Band Centre Frequency (Hz)	**31.5**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**Overall (dBA)**
In-tunnel Noise Levels	89	83	81	88	96	92	87	85	78	102

Note: A 5 dB reduction in noise is included in the above levels from the measured levels at 80 km/h to compensate for the lower speeds near the draught relief shafts.

The draught relief shafts are typically of 20 m^2 cross section located at each end of the station. The shafts are typically lined with concrete which is a highly reflective material with practically no absorptive characteristics. As such, reduction losses as noise propagates to the surface through the shafts would be negligible.

It has been assumed that the ventilation system design includes a 3 m long attenuator in each draught relief shaft. The insertion loss provided by these attenuators (assuming 50% open area) would decrease the train noise (L_{Amax}) to approximately 55 dBA at 10 m from the surface discharge of the draught relief shafts.

Noise breakout from ventilation shafts is not expected to exceed the nominated noise criteria (L_{Amax} of 55 dBA for residential receivers) at any receiver surrounding the proposed stations, with appropriate attenuator selection in place.

4.4.5 Summary of Impacts and Mitigation Measures

The maximum allowable mechanical and electrical services sound power levels emitted at each station and ancillary facility have for detailed design purposes been calculated and range from 70 dBA to 98 dBA.

Mitigation measures are likely to be required for some station and tunnel ventilation equipment / locations in order to comply with the project noise design criteria. Mitigation measures that may need to be considered at some locations include appropriate equipment selection, in-duct attenuators, acoustic enclosures and the strategic positioning of critical plant and vent discharges away from sensitive receivers.

5 SUMMARY OF NOISE AND VIBRATION MITIGATION MEASURES

5.1 Construction

The NSW EPA's ICNG sets out ways to deal with the impacts of construction noise on residential receivers and other sensitive land uses. It does this by presenting assessment approaches that are tailored to the scale of construction projects.

A portion of the main objectives from Section 1.3 of the ICNG which is consistent with the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement) are presented below:

- Promote a clear understanding of ways to identify and minimise noise from construction works.
- Focus on applying all "feasible" and "reasonable" work practices to minimise construction noise impacts.
- Encourage construction to be undertaken only during the recommended standard hours unless approval is given for works that cannot be undertaken during these hours.
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage.
- Provide flexibility in selecting site-specific feasible and reasonable work practices in order to minimise noise impacts.

Table 106 provides a summary of the site specific noise mitigation measures to be implemented as part of the project.

Table 106 Summary of Site Specific Construction Noise and Vibration Mitigation Measures

Reference	Mitigation measure	Applicable sites[1]
NV1	The Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement) would be implemented with the aim of achieving the noise management levels where feasible and reasonable. This would include the following example standard mitigation measures where feasible and reasonable: • Provision of noise barriers around each construction site • Provision of acoustic sheds at Chatswood dive site, Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street, Waterloo and Marrickville dive site • The coincidence of noisy plant working simultaneously close together would be avoided • Offset distances between noisy plant and sensitive receivers would be increased • Residential grade mufflers would be fitted to all mobile plant • Dampened rock hammers would be used • Non-tonal reversing alarms would be fitted to all permanent mobile plant • High noise generating activities would be scheduled for less sensitive periods considering the nearby receivers • The layout of construction sites would consider opportunities to shield receivers from noise.	All
NV2	Unless compliance with the relevant traffic noise criteria can be achieved, night time heavy vehicle movements at the Chatswood dive site, Crows Nest Station and Victoria Cross Station sites would be restricted to: • The Pacific Highway and Mowbray Road at the Chatswood dive site • The Pacific Highway, Hume Street and Oxley Street at the Crows Nest Station construction site • McLaren Street, Miller Street and Berry Street at the Victoria Cross station construction site.	CDS, CN, VC
NV3	Where vibration levels are predicted to exceed the screening criteria, a more detailed assessment of the structure and attended vibration monitoring would be carried out to ensure vibration levels remain below appropriate limits for that structure. For heritage items, the more detailed assessment would specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed.	All except metro rail tunnels
NV4	Feasible and reasonable measures would be implemented to minimise ground-borne noise where exceedences are predicted.	All
NV5	Feasible and reasonable mitigation measures would be implemented where power supply works would result in elevated noise levels at receivers. This would include: • Carrying out works during the daytime period when in the vicinity of residential receivers • Where out of hours works are required, scheduling the noisiest activities to occur in the evening period (up to 10 pm) • Use of portable noise barriers around particularly noisy equipment such as concrete saws.	PSR

[1] STW: Surface track works; CDS: Chatswood dive site; AS: Artarmon substation; CN: Crows Nest Station; VC: Victoria Cross Station; BP: Blues Point temporary site; GI: Ground improvement works; BN: Barangaroo Station; MP: Martin Place Station; PS: Pitt Street Station; CS: Central Station; WS: Waterloo Station; MDS: Marrickville dive site; Metro rail tunnels: Tunnel not related to other sites (eg TBM works); PSR: Power supply routes.

In addition to the above measures, the following sections provide information on control measures and strategies, consistent with the Sydney Metro CNVS (refer to Appendix E of the Environmental Impact Statement), which also provides the process to develop site specific construction noise impact statements.

5.1.1.1 Source Noise Control

Source control measures should be adopted and these include:

- The minimising of noise emissions from mobile plant by fitting residential grade mufflers on all mobile plant utilised on Sydney Metro construction projects.
- The use of damped hammers is recommended such as the ‘City’ model Rammer hammers. These reduce the ‘ringing’ of the rock pick, cylinder and excavator arm that is commonly associated with rock breaking works.
- Air brake silencers should be installed and fully operational for any heavy vehicle that uses any Sydney Metro construction site.
- Heavy vehicle vehicles using the sites should have RMS compliant mufflers to control engine breaking noise.
- Non-tonal reversing alarms should be used for all permanent mobile plant operating on Sydney Metro construction projects. Whilst the use of non-tonal reversing alarms is suggested to ensure noise impacts are minimised, it is noted that OH&S requirements must also be fully satisfied.
- Regular maintenance of all plant and machinery used for the project will assist in minimising noise emissions, including the reporting of the results.
- Acoustic enclosure of plant items, if required, as identified during compliance monitoring.

5.1.1.2 Noise Management Strategies

- Construction hours should be in accordance with the ICNG, and project approvals, except where otherwise specified in an approved noise management plan.
- When working adjacent to schools, medical facilities and childcare centres, particularly noisy activities should be scheduled outside normal working hours, where feasible and reasonable.
- When working adjacent to churches and places of worship particularly noisy activities should be scheduled outside services, where feasible and reasonable.
- Avoiding the coincidence of noisy plant working simultaneously close together and adjacent to sensitive receivers will result in reduced noise emissions.
- Where feasible and reasonable, the offset distance between noisy plant items and nearby noise sensitive receivers should be as great as possible.
- Regular compliance checks on the noise emissions of all plant and machinery used for the project would indicate whether noise emissions from plant items were higher than predicted. This also identifies defective silencing equipment on the items of plant.
- Ongoing noise monitoring during construction at sensitive receivers during critical periods (ie times when noise emissions are expected to be at their highest - eg piling and hammering) to identify and assist in managing high risk noise events.
- Where feasible and reasonable heavy vehicle movements should be limited to daytime hours.
- Provide training and induction for employees, contractors and subcontractors on standard mitigation measures, permissible hours of work and other aspects of the project to minimise impacts.
- Engage community consultation and the maintenance of positive, cooperative relationships with schools, local residents and building owners and occupiers assists in managing impacts from noisier operations.

5.1.1.3 Vibration Management Strategies

Attended vibration measurements are required at the commencement of vibration generating activities to confirm that vibration levels satisfy the criteria for that vibration generating activity. Where there is potential for exceedances of the criteria further vibration site law investigations should be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms should be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the applicable safe-working distances.

5.1.1.4 Blasting Management Strategies

Attended vibration and overpressure measurements are required at the commencement of any blasting activities to confirm that vibration levels satisfy the blasting criteria. Regular vibration site law investigations would be undertaken to determine the site-specific offset distances and maximum instantaneous charge sizes to satisfy the blasting criteria at various horizontal and vertical offset distances as excavation progresses. Blasting would be planned during hours which would cause the least disruption and disturbance to the nearest sensitive receivers. For example, at sites with commercial receivers, the most appropriate period may not be the daytime period. Notification protocols prior to blasting for the nearest sensitive receivers would be established as part of environmental management documentation.

5.2 Operation

Table 107 provides a summary of the site specific noise mitigation measures to be implemented as part of the project.

Table 107 Summary of Operational Noise and Vibration Mitigation Measures

Reference	Mitigation measure	Applicable sites[1]
OpNV1	The height and extent of noise barriers adjacent to the northern surface track works would be confirmed during detailed design with the aim of not exceeding trigger levels from the *Rail Infrastructure Noise Guidelines* (Environment Protection Authority, 2013). At property treatments would be offered where there are residual exceedances of the trigger levels.	STW
OpNV2	Track form would be confirmed during the detailed design process in order to meet the relevant ground-borne noise and vibration criteria from the *Rail Infrastructure Noise Guidelines* (EPA, 2013) and the *Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects* (DECC, 2007).	Metro rail tunnels
OpNV3	Stations and ancillary facilities including train breakout noise from draught relief shafts would be designed to meet the applicable noise criteria derived from the *Industrial Noise Policy* (EPA, 2000).	All except metro rail tunnels

[1] *STW: Surface track works; CDS: Chatswood dive site; AS: Artarmon substation; CN: Crows Nest Station; VC: Victoria Cross Station; BP: Blues Point temporary site; GI: Ground improvement works; BN: Barangaroo Station; MP: Martin Place Station; PS: Pitt Street Station; CS: Central Station; WS: Waterloo Station; MDS: Marrickville dive site; Metro rail tunnels: Tunnel not related to other sites (eg TBM works); PSR: Power supply routes.*

6 REFERENCES

[i] Rail Infrastructure Noise Guideline, NSW EPA, 2013

[ii] Industrial Noise Policy, NSW EPA, 2000

[iii] Interim Construction Noise Guideline, DECC, 2009

[iv] Road Noise Policy, NSW EPA, 2011

[v] Assessing Vibration: a technical guideline, DEC, 2006

[vi] Recommended Design Sound Levels and Reverberation Times for Building Interiors, AS 2107, 2000

[vii] Acoustics - Sound Level Meters. Part 2: Integrating - Averaging*,* AS 1259.2, 1990

[viii] Sydney Metro City & Southwest Construction Noise and Vibration Strategy (draft)*,* TfNSW, 2015

[ix] NSW Road Noise Policy, DECCW, 2011

[x] NSW Environmental Criteria for Road Traffic Noise, EPA, 1999

[xi] *Guide to evaluation of human exposure to vibration in building,* BS 6472, 1992

[xii] *Explosives - Storage and Use - Part 2: Use of Explosives,* AS 2187: Part 2, 2006

[xiii] *Evaluation and measurement for vibration in buildings Part 2,* BS 7385 Part 2, 1993

[xiv] *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration,* Australian and New Zealand Environment Council's, 1990

[xv] Guide to noise and vibration control on construction, demolition and maintenance sites, AS 2436, 2010

[xvi] *Evaluation of human exposure to whole-body vibration - Part 1: General requirements*, AS2670.1, 2001

[xvii] *Guideline Transit Noise and Vibration Impact Assessment,* The United States Federal Transit Administration, 2006

[xviii] *Evaluation of Human Exposure Vibration in Buildings (1 Hz to 80 Hz)*, BS 6472, 1992

[xix] *Assessing Vibration: A Technical Guideline*, NSW Department of Environment and Conservation, 2006

[xx] *Mechanical vibration - Ground-borne noise and vibration arising from rail systems - Part 1: General Guidance*, International Standard ISO 14837-1, 2005

[xxi] S. Vegh, R. Kochanowski, B. Croft *Acoustic rail grinding - measures of long term effectiveness: Epping to Chatswood Rail Link case study*. Proceedings of Internoise 2014, available online at http://www.acoustics.asn.au/conference_proceedings/INTERNOISE2014/papers/p438.pdf

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 4000 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 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA 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

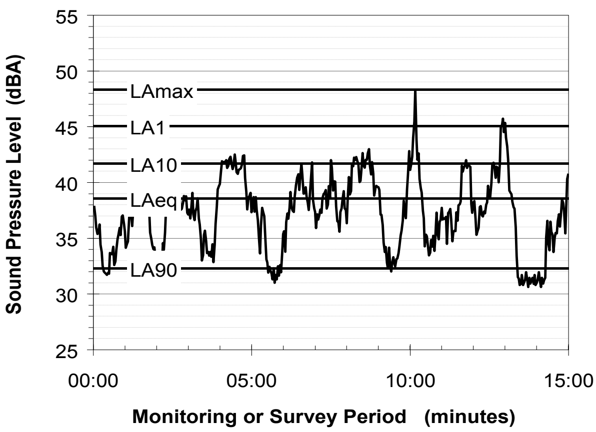
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or L_W, or by the reference unit 10^{-12} W.

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 exceed 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

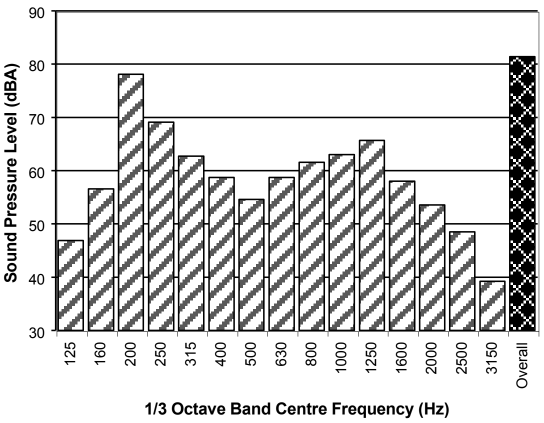
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

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 organizations.

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

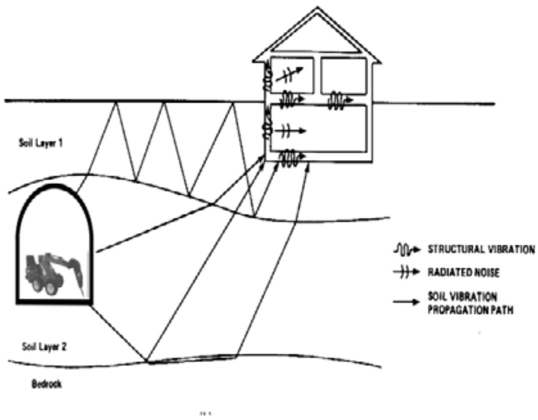
The term 'over-pressure' is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

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 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

INDEX

Background Noise Monitoring Results – B.01

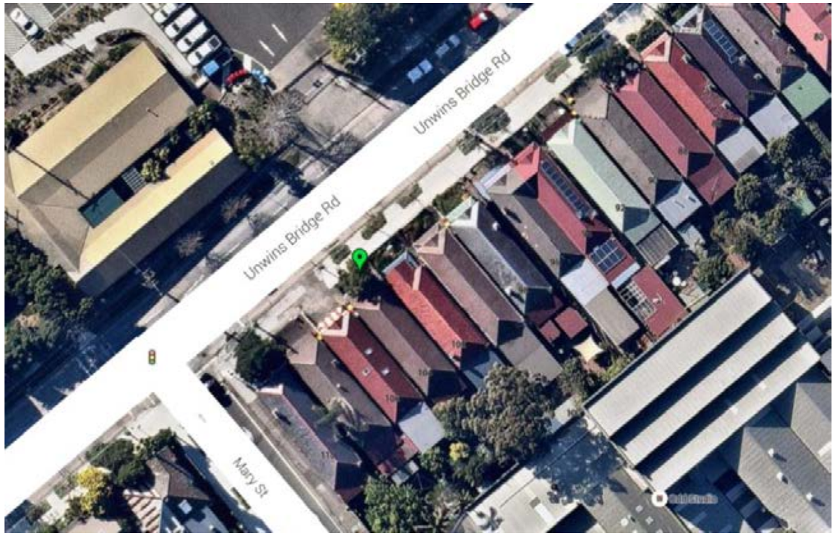
Noise Monitoring Location:	**B.01**
Noise Monitoring Address:	**104 Unwins Bridge Road, St Peters 2044**

Logger Device Type: ARL-EL316
Logger Serial No: 16-207-046

Ambient noise logger deployed on the front garden of residential address 104 Unwins Bridge Road, St Peters. Logger located next to a tree on the north western boundary of the property.

Attended noise measurements indicate that the ambient noise environment at this location is dominated by road traffic noise from Unwins Bridge Road and general traffic noise in the area in the daytime. Medium to high traffic noise levels occur several times per minute at this location from Unwins Bridge Road with continuous traffic noise levels from distant vehicle movements. Aircraft noise also influences the ambient noise environment.

Map of Noise Monitoring Location



Ambient Noise Logging Results – INP Defined Time Periods

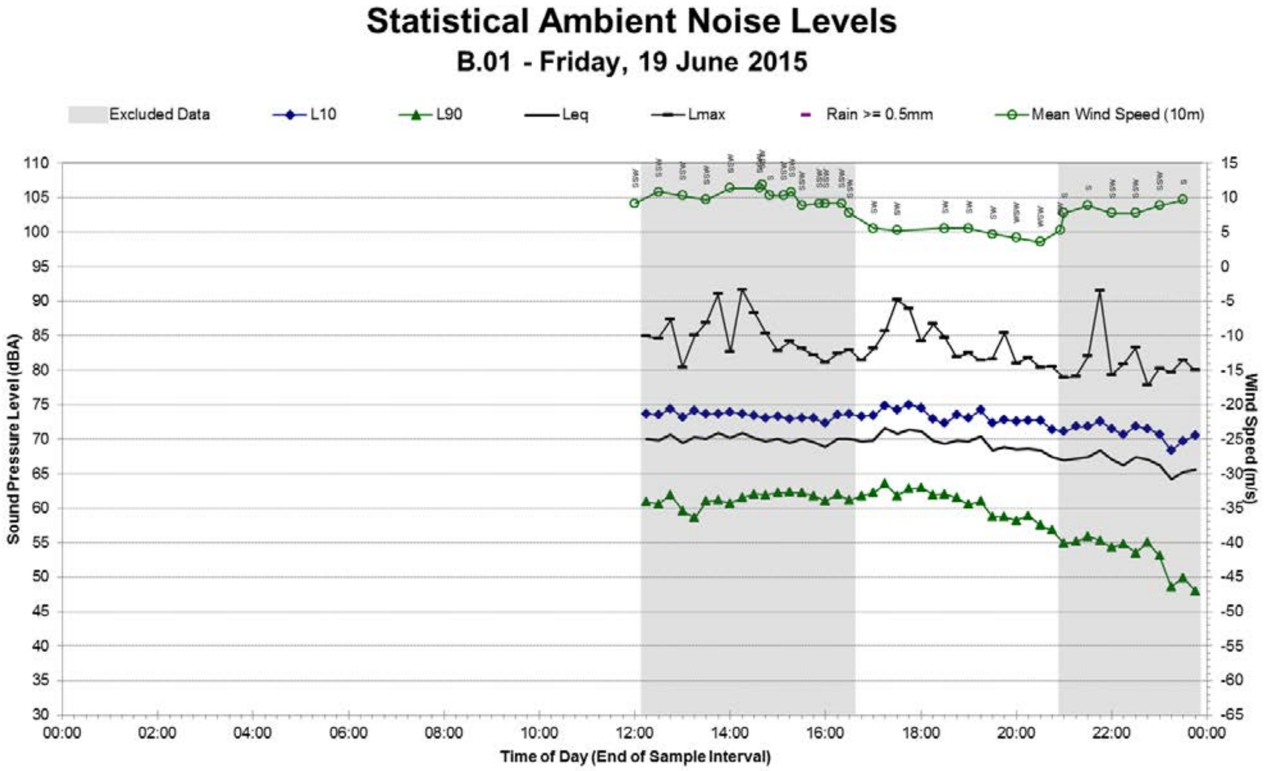
Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	59	71	74	79
Evening	53	69	73	78
Night-time	41	65	66	75

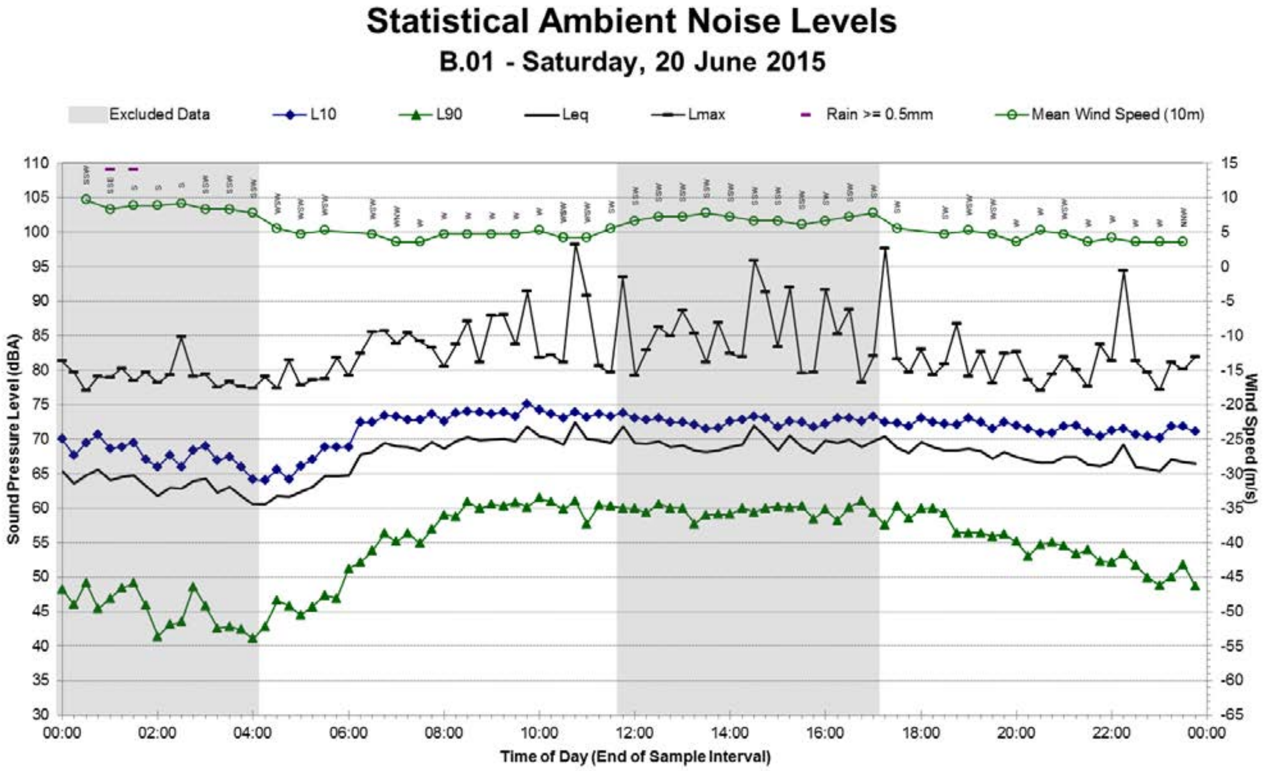
Attended Noise Measurement Results

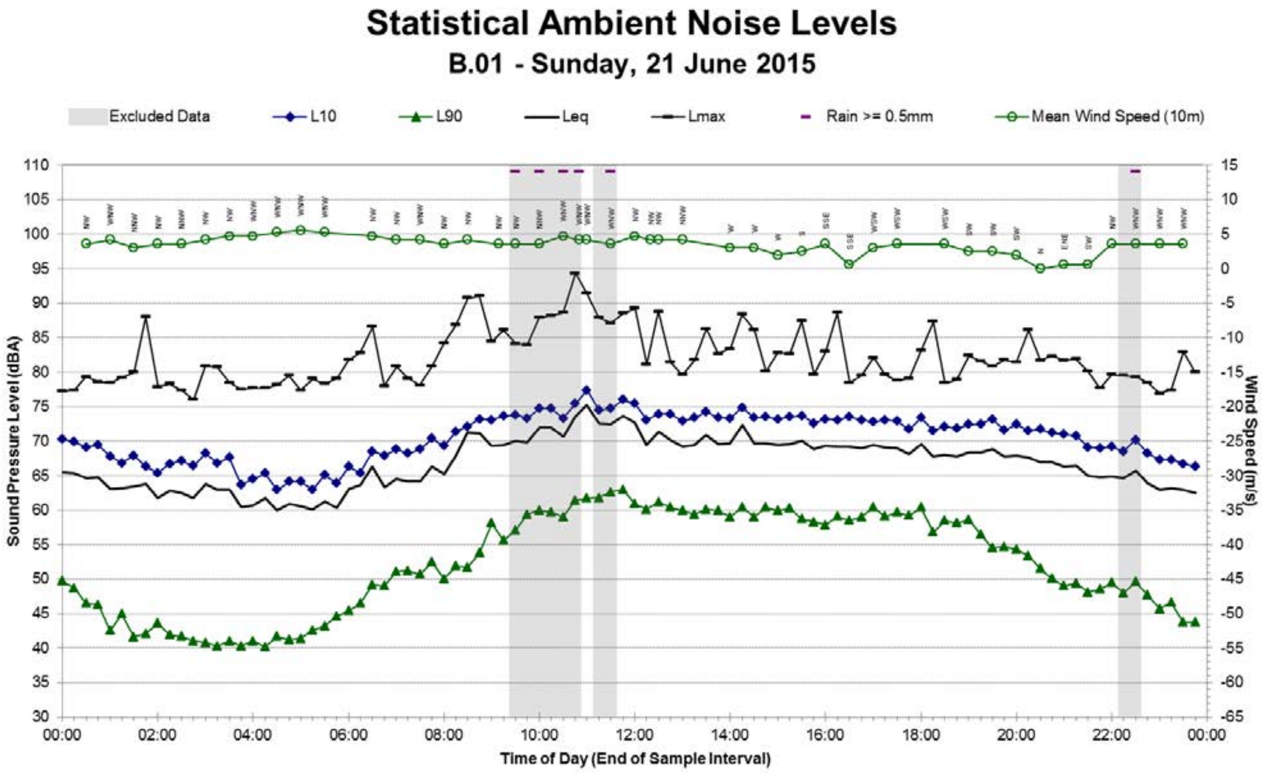
Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
19/06/2015	11:59:53	61	71	82

Photo of Noise Monitoring Location

Background Noise Monitoring Results – B.01






Statistical Ambient Noise Levels
B.01 - Sunday, 21 June 2015
Excluded Data
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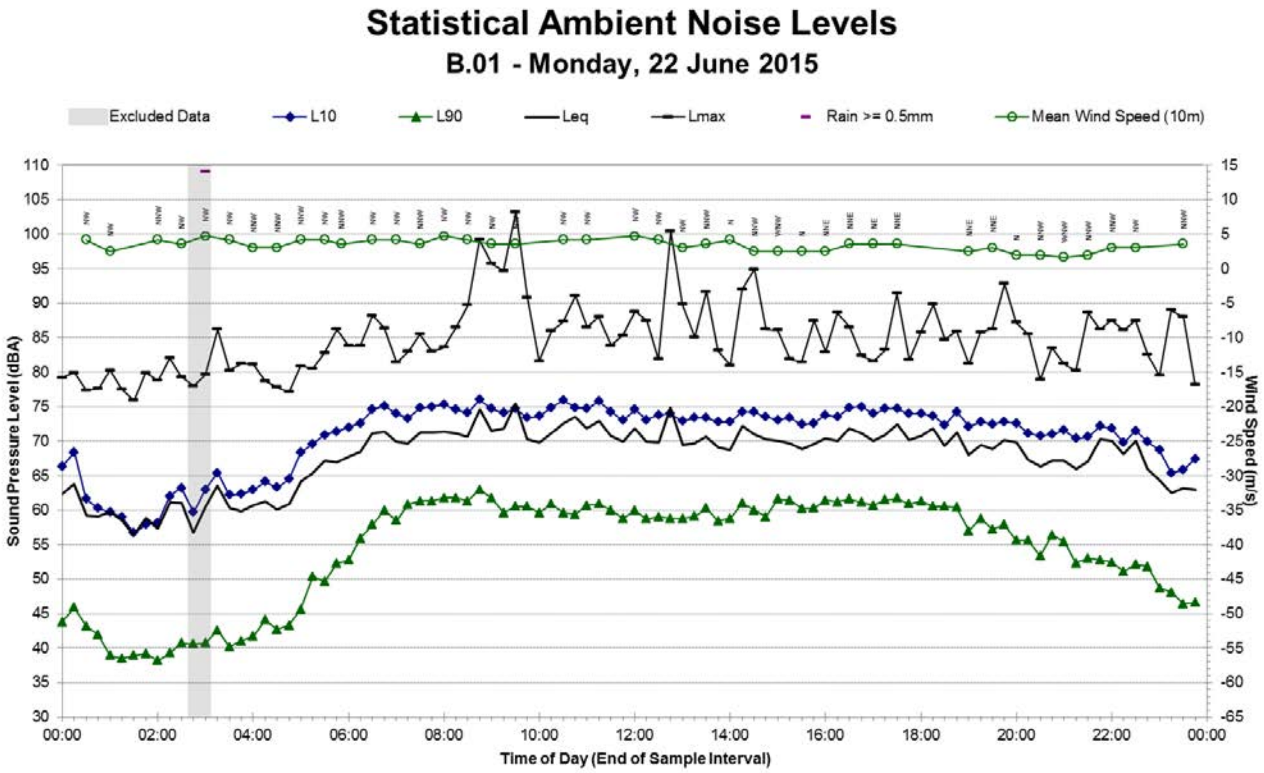
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
B.01 - Monday, 22 June 2015
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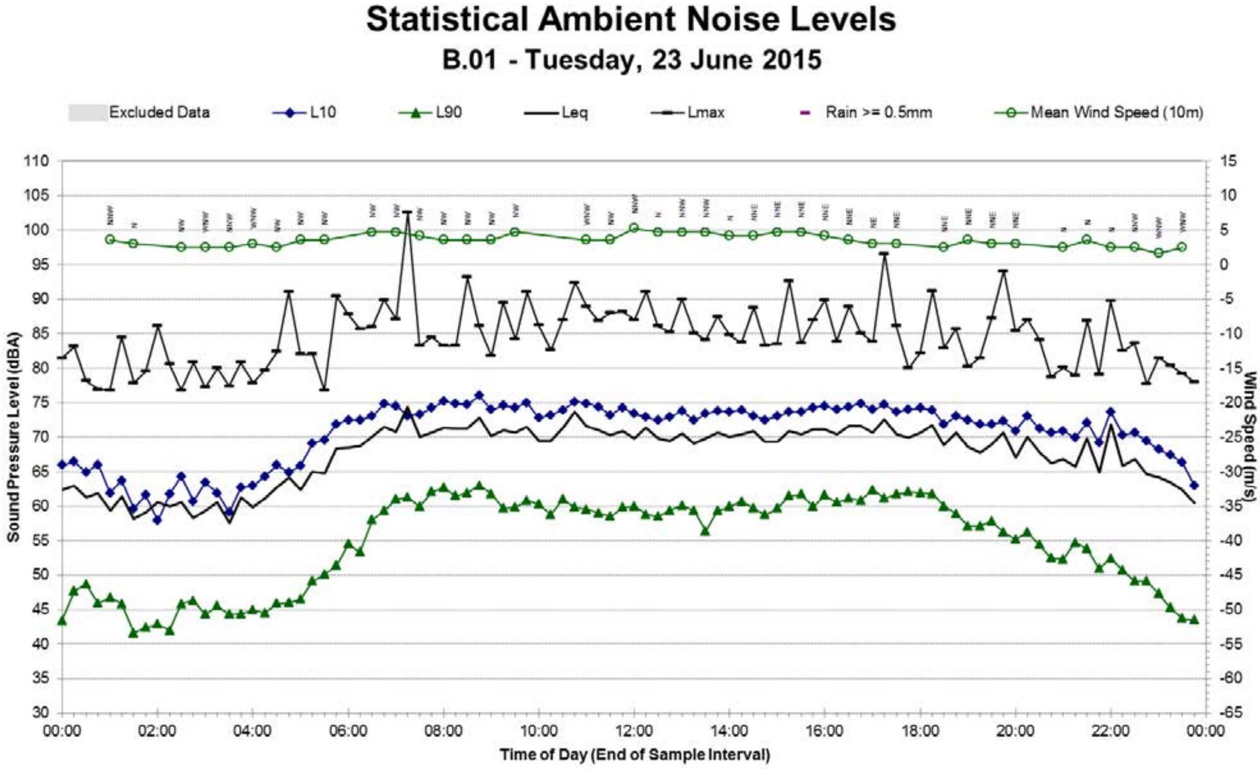
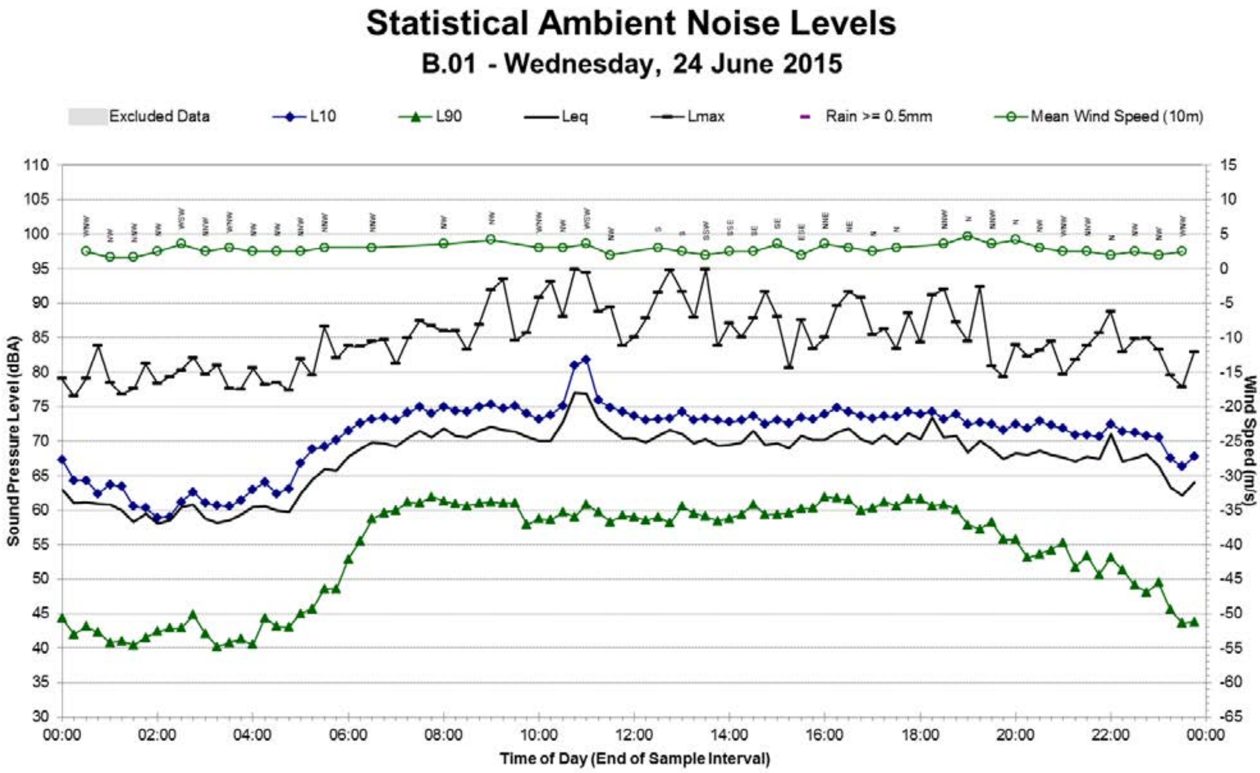
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

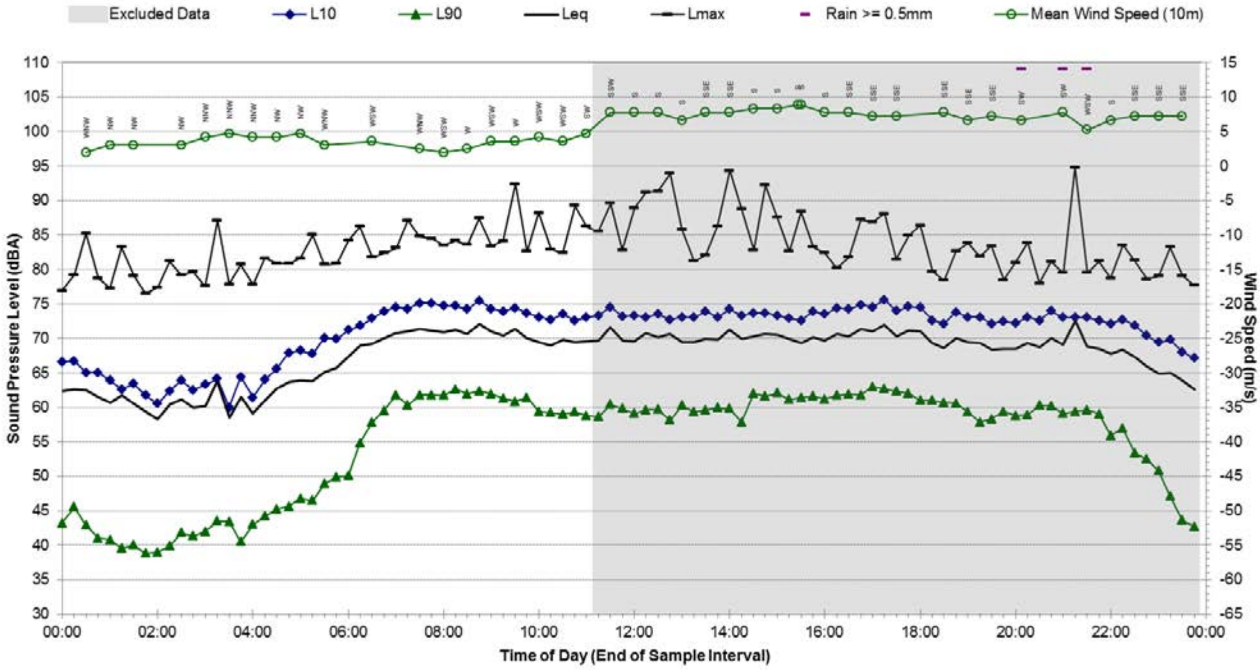
Background Noise Monitoring Results – B.01



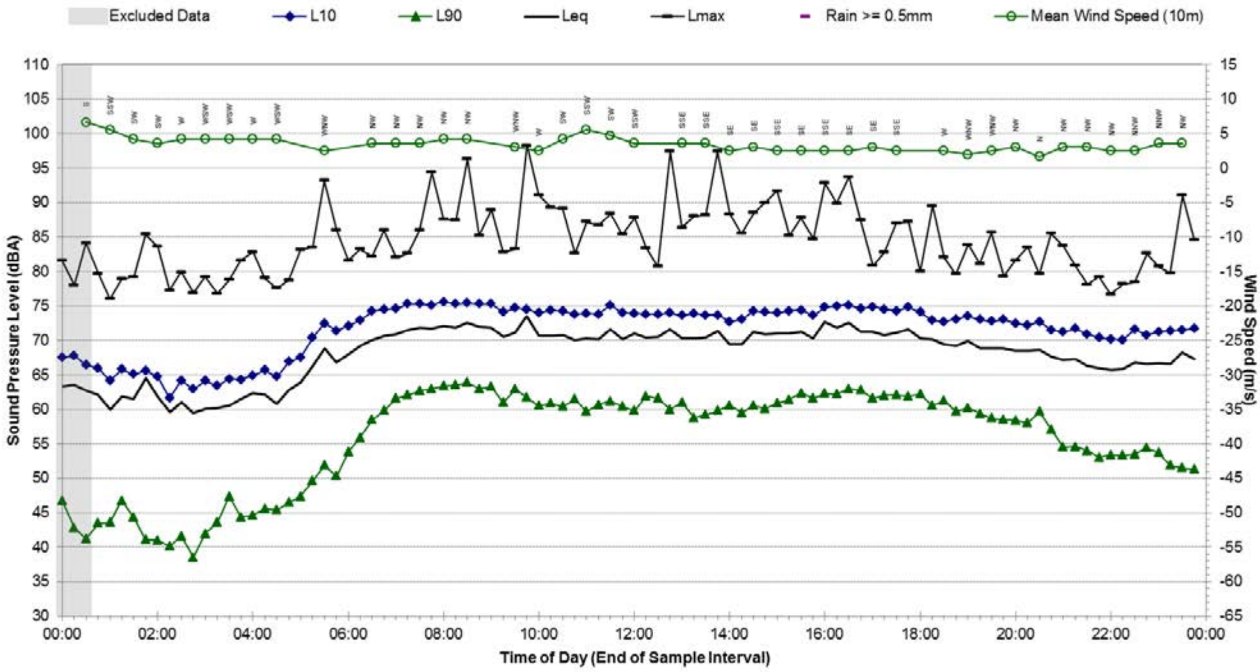


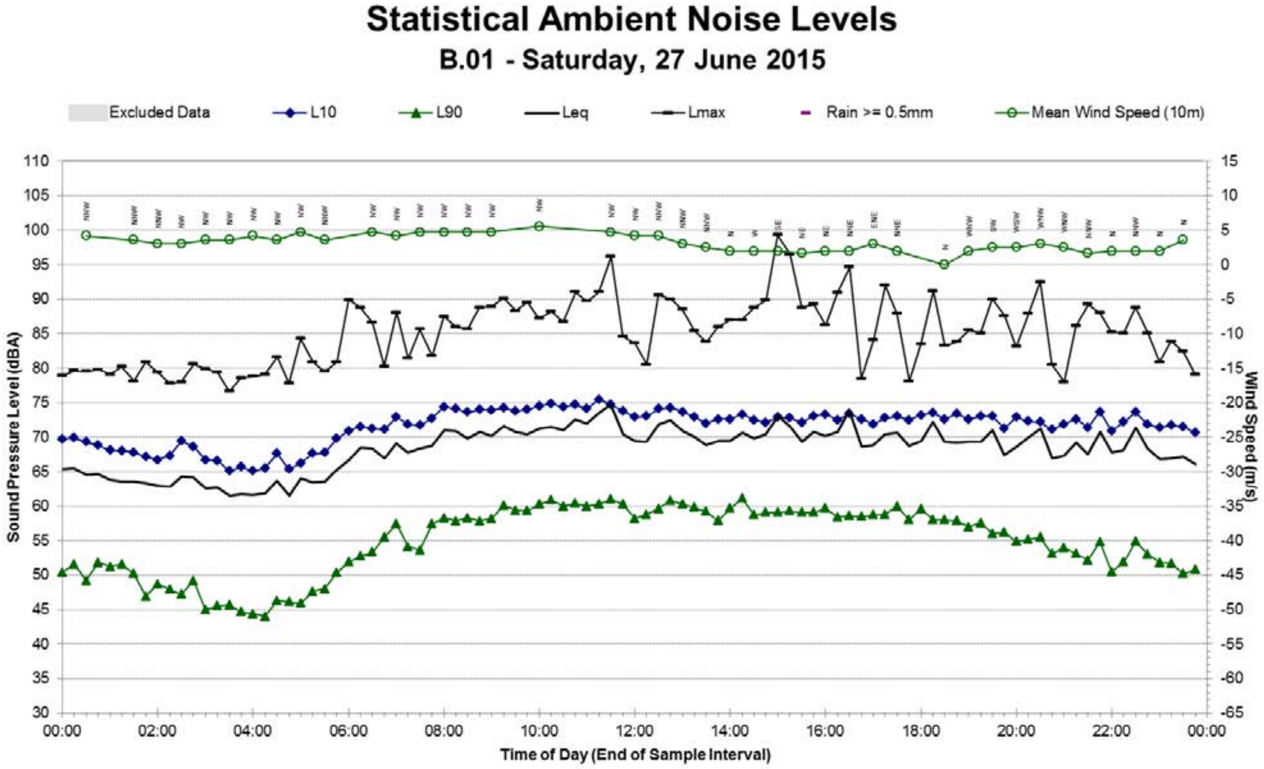
Background Noise Monitoring Results – B.01

Statistical Ambient Noise Levels
B.01 - Thursday, 25 June 2015



Statistical Ambient Noise Levels
B.01 - Friday, 26 June 2015




Statistical Ambient Noise Levels
B.01 - Saturday, 27 June 2015
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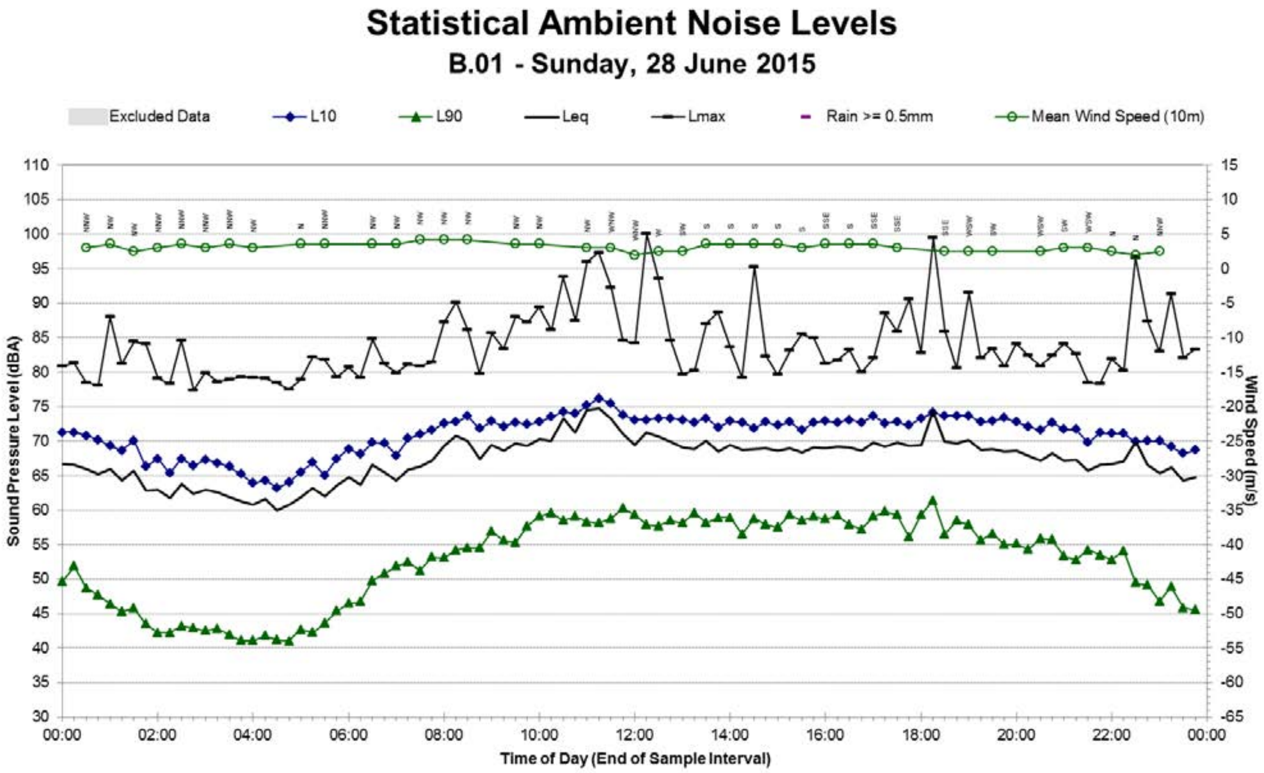
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
B.01 - Sunday, 28 June 2015
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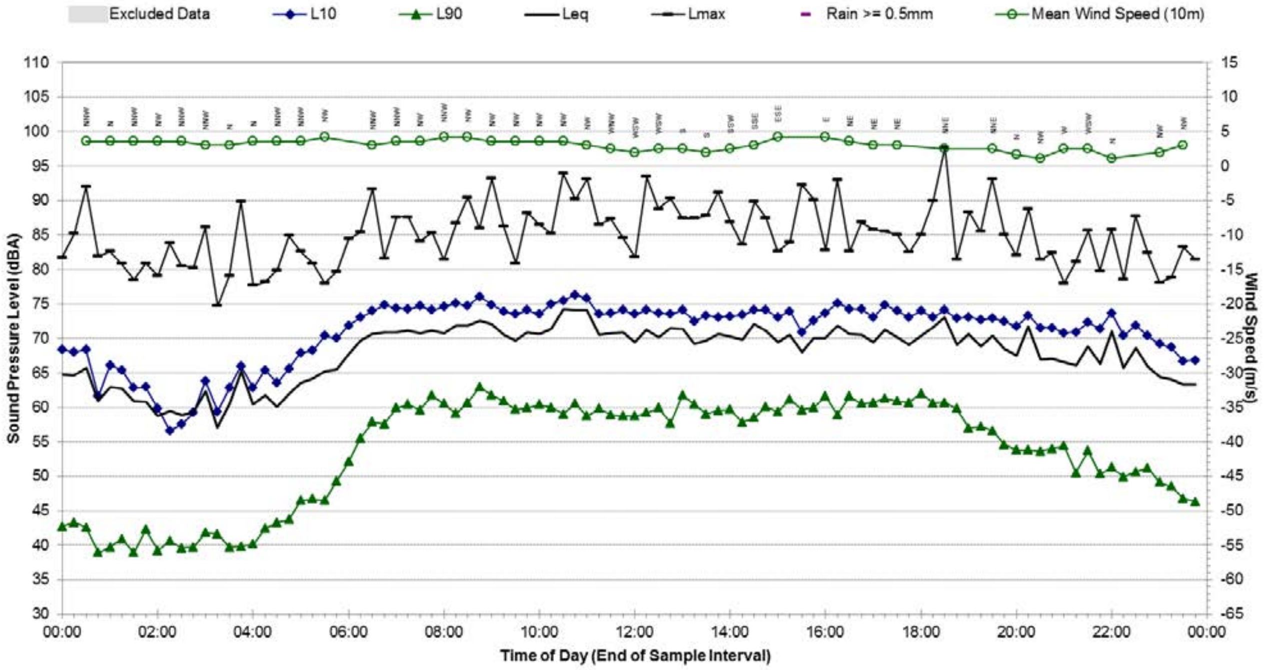
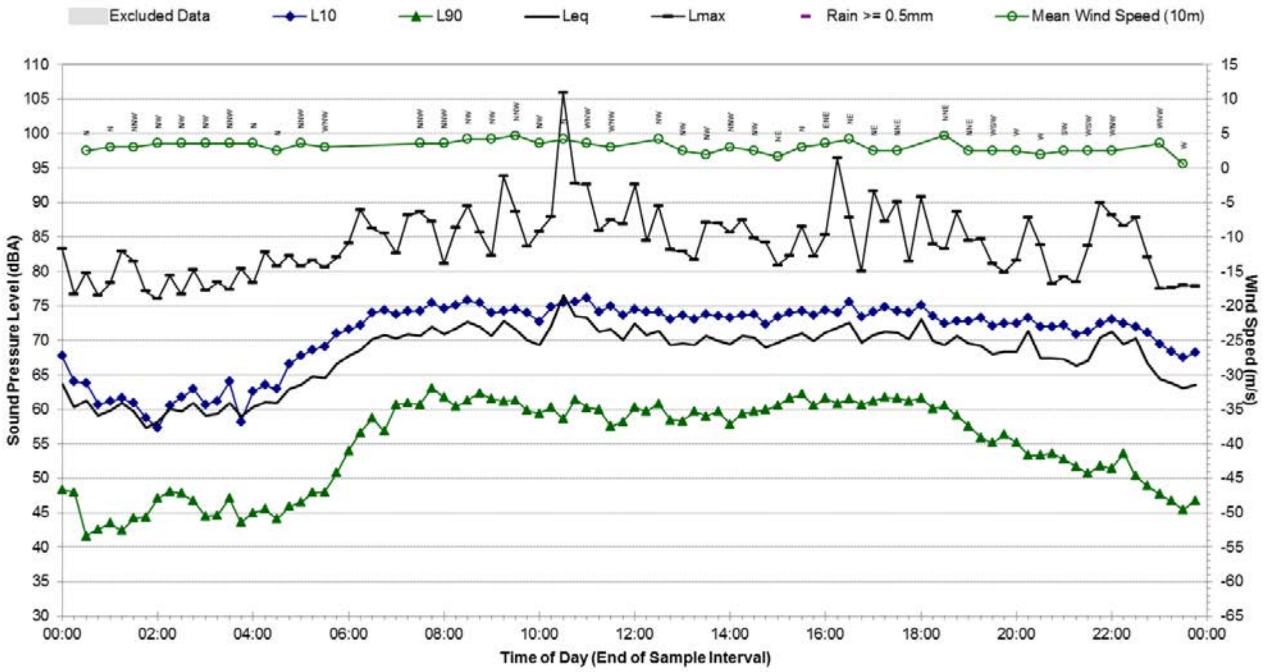
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Background Noise Monitoring Results – B.01

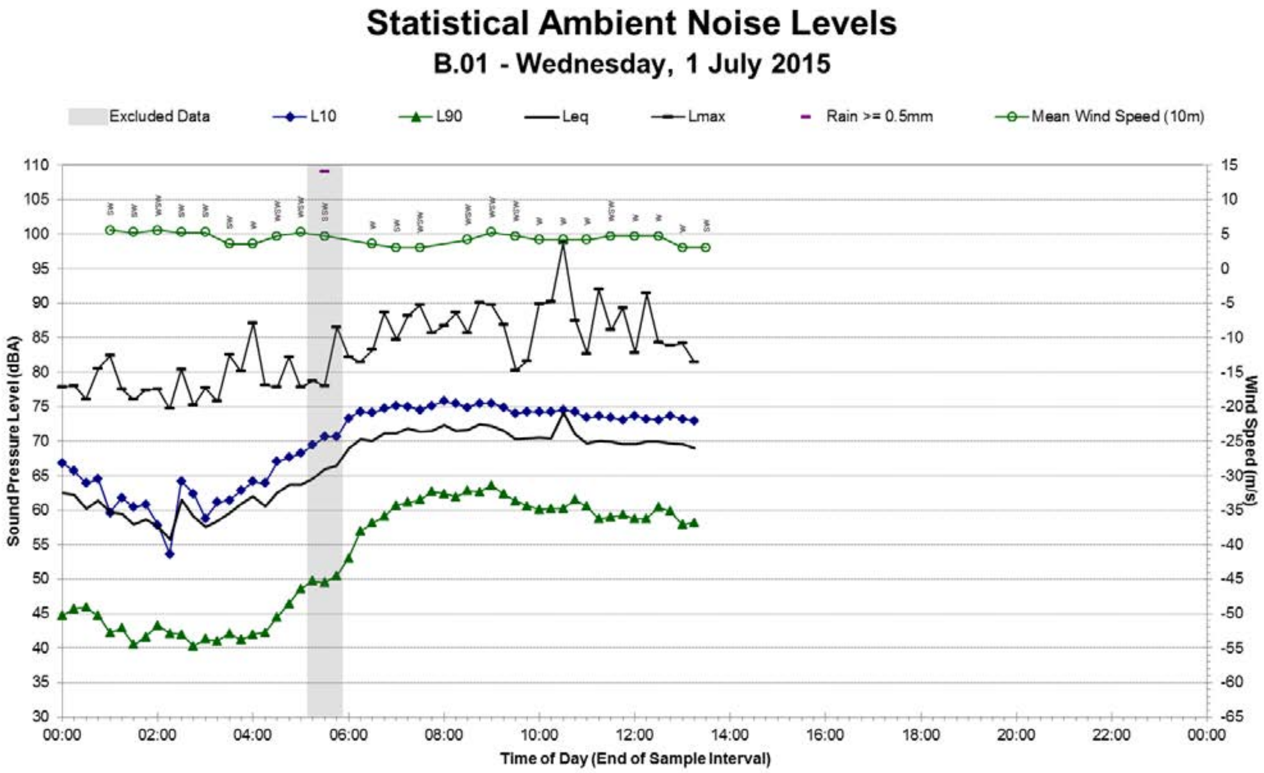
Statistical Ambient Noise Levels
B.01 - Monday, 29 June 2015



Statistical Ambient Noise Levels
B.01 - Tuesday, 30 June 2015



Background Noise Monitoring Results – B.01



Background Noise Monitoring Results – B.02

Noise Monitoring Location:	**B.02**
Noise Monitoring Address:	**322 Edgeware Road, Newtown 2065**

Logger Device Type: Svantek 957
Logger Serial No: 23816

Ambient noise logger deployed at residential address 322 Edgeware Road, Newtown. Logger located on the front balcony of the property.

Attended noise measurements indicate that the ambient noise environment at this location is dominated by road traffic noise from Edgeware Road to the west during the daytime. Constant tyre-pavement/engine noise from light-vehicle traffic on Edgeware Road can be heard at this location along with noise from vehicles breaking into the right hand bend. Discrete traffic noise level peaks from heavy vehicle movements often occur several times per minute.

Map of Noise Monitoring Location

Ambient Noise Logging Results – INP Defined Time Periods

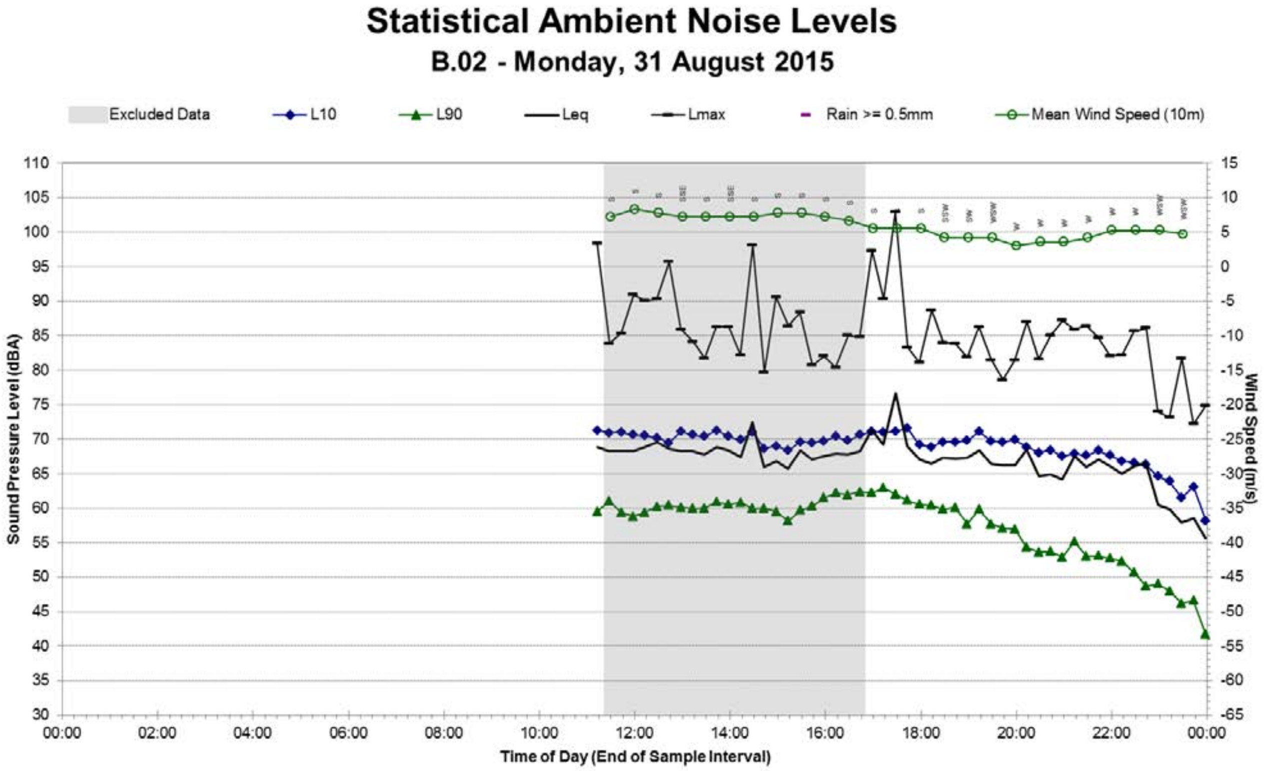
Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	58	69	71	79
Evening	52	66	68	75
Night-time	38	62	63	69

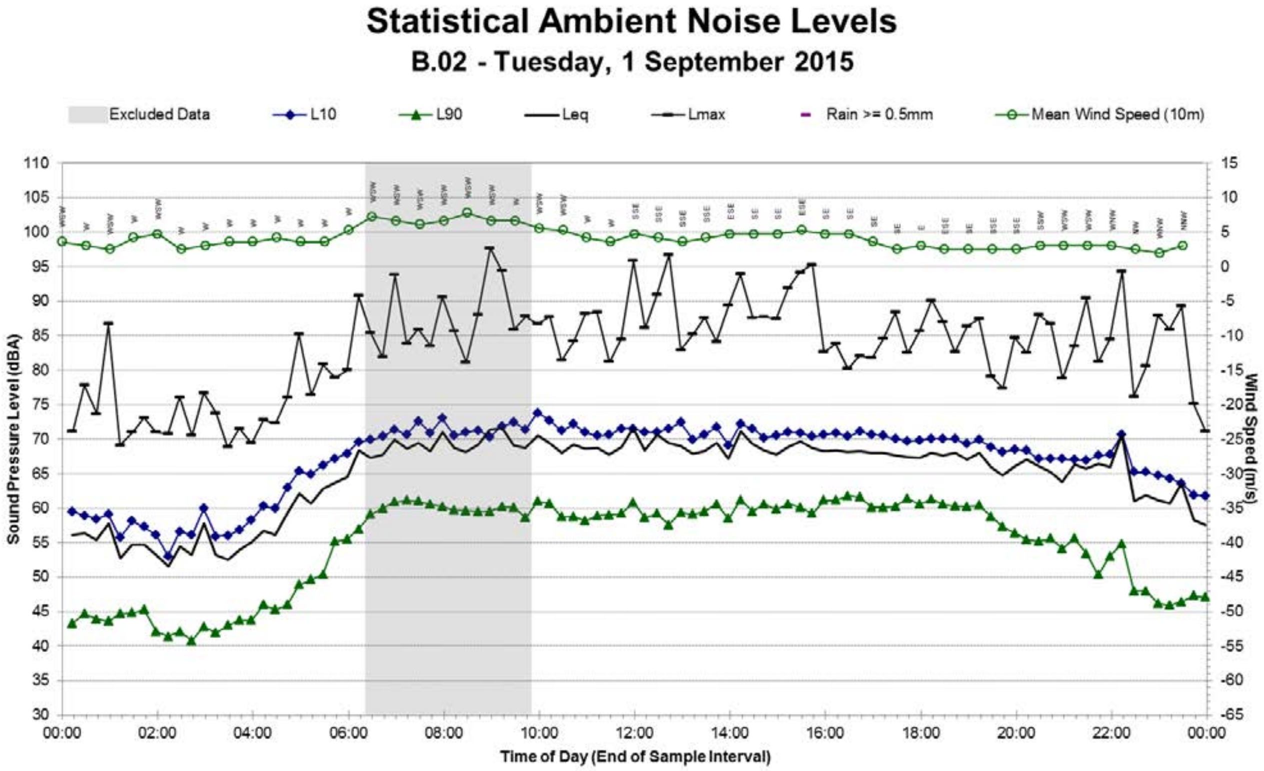
Attended Noise Measurement Results

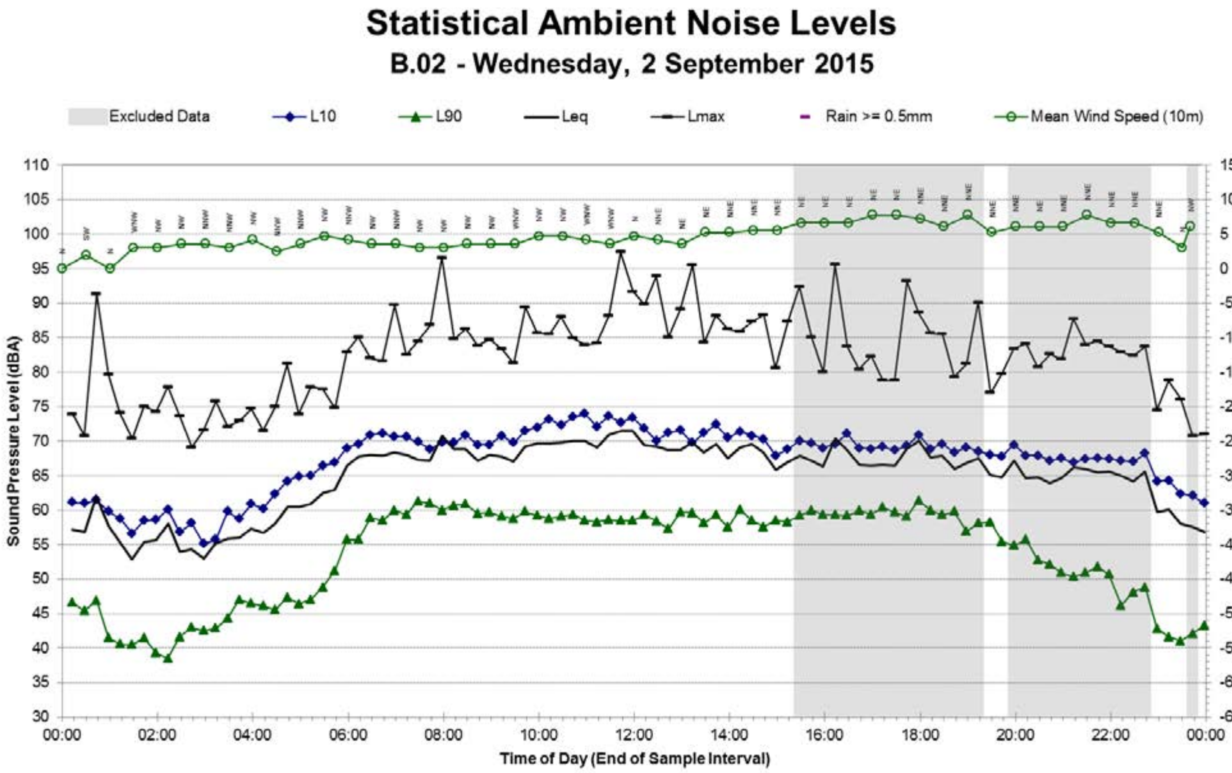
Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
31/08/2015	11:02:07	61	68	84

Photo of Noise Monitoring Location

Background Noise Monitoring Results – B.02



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B.02 - Wednesday, 2 September 2015
Excluded Data
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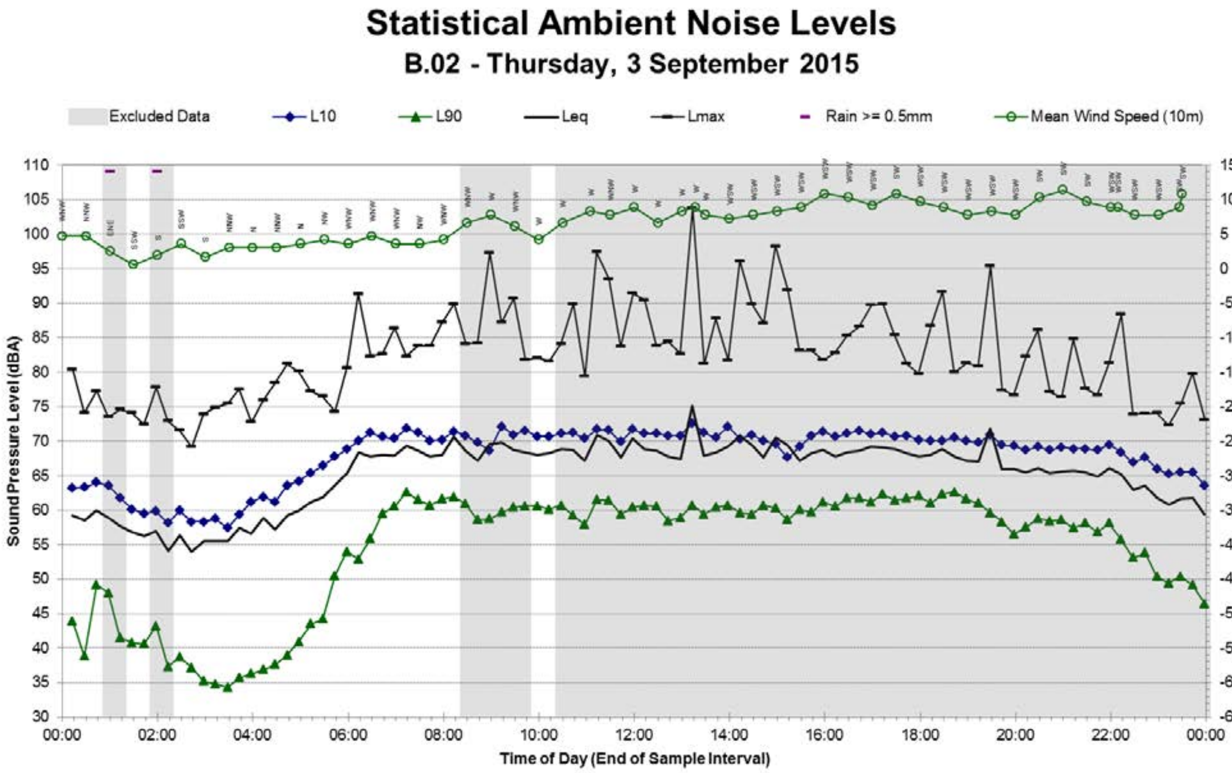
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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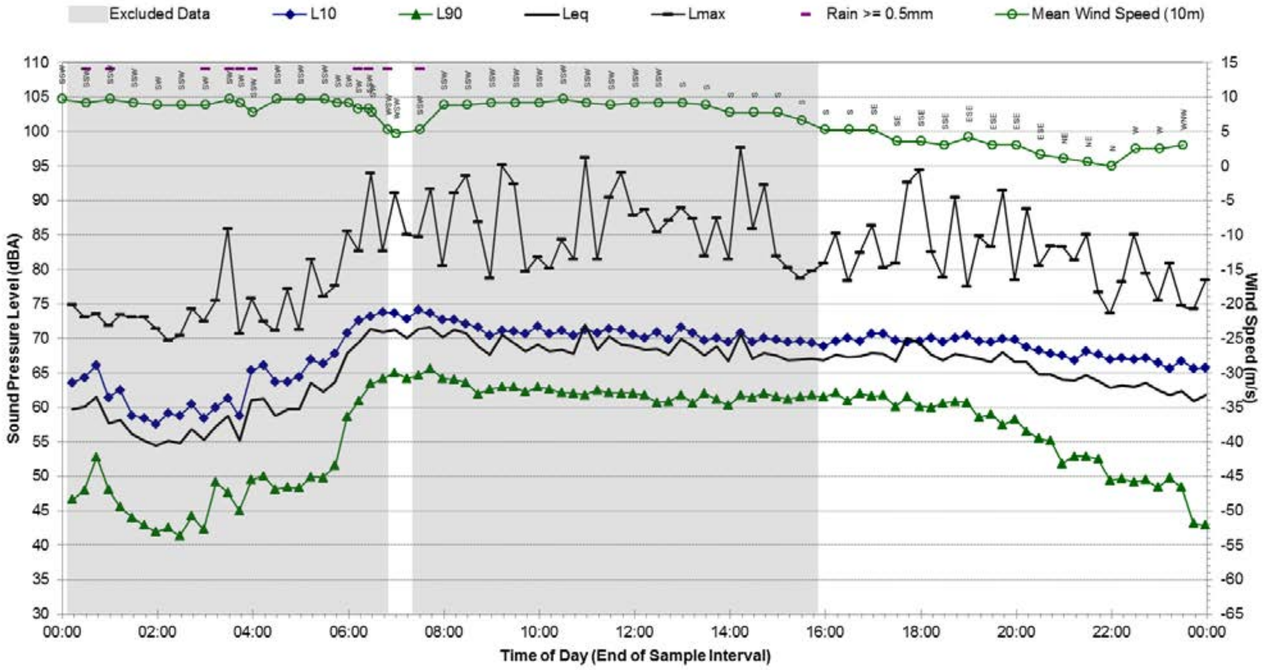
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Background Noise Monitoring Results – B.02

Statistical Ambient Noise Levels
B.02 - Friday, 4 September 2015



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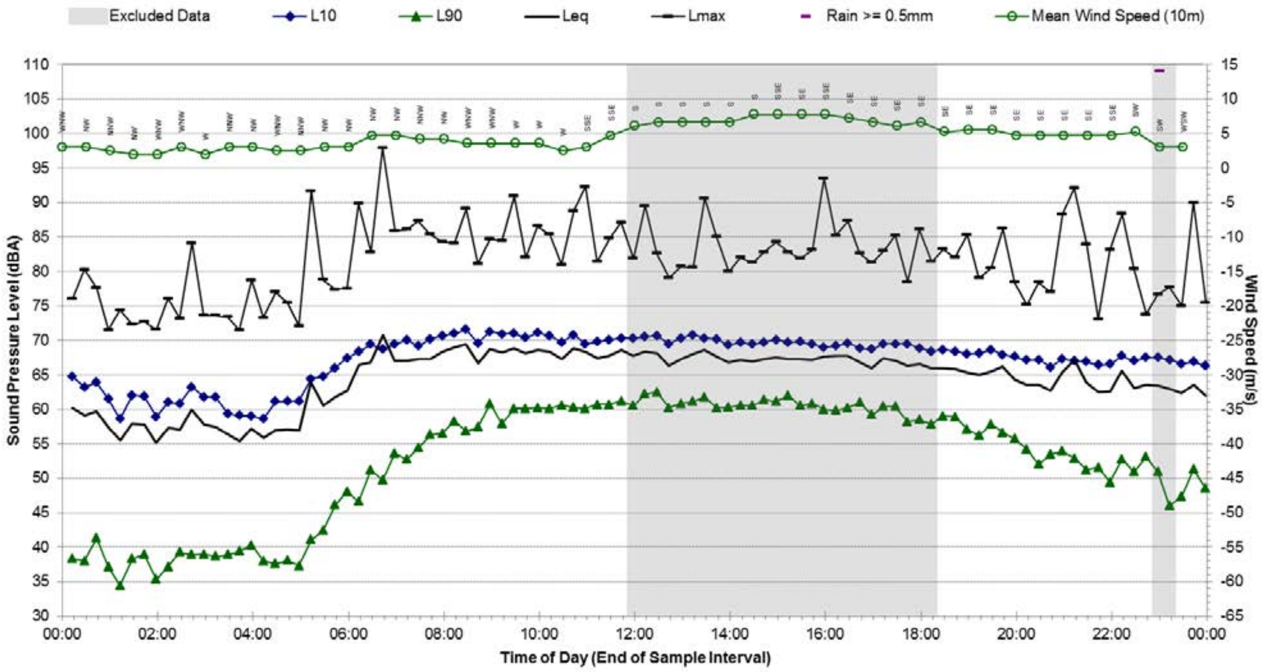
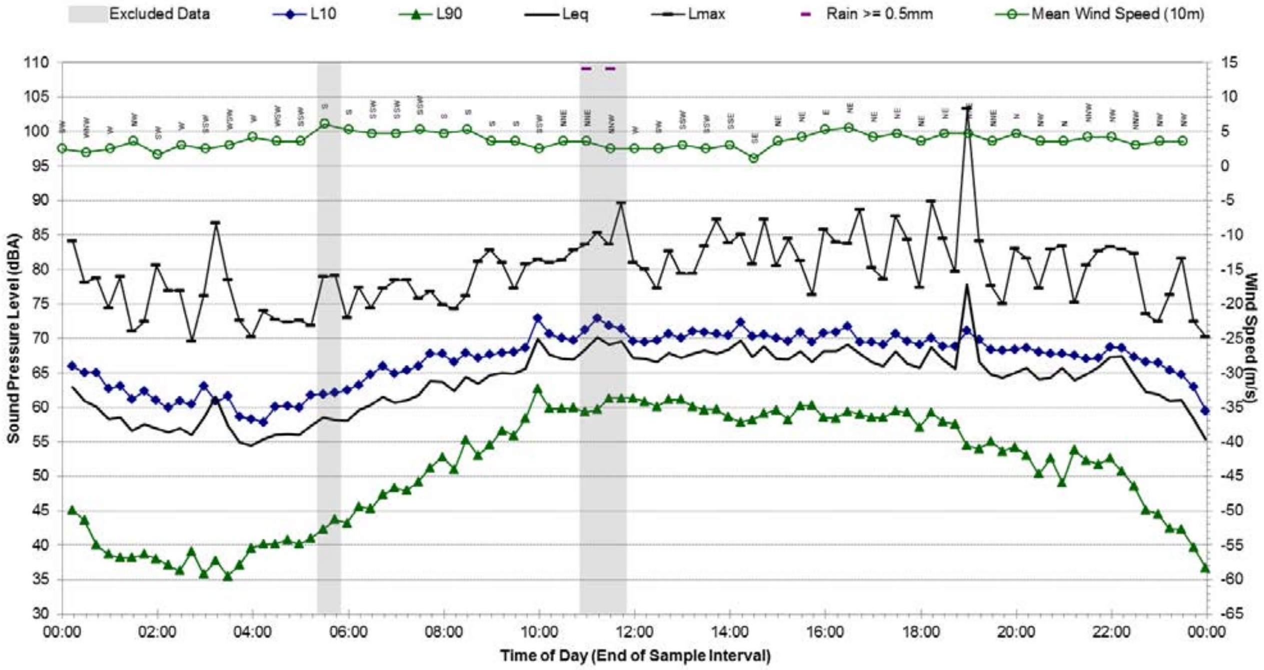
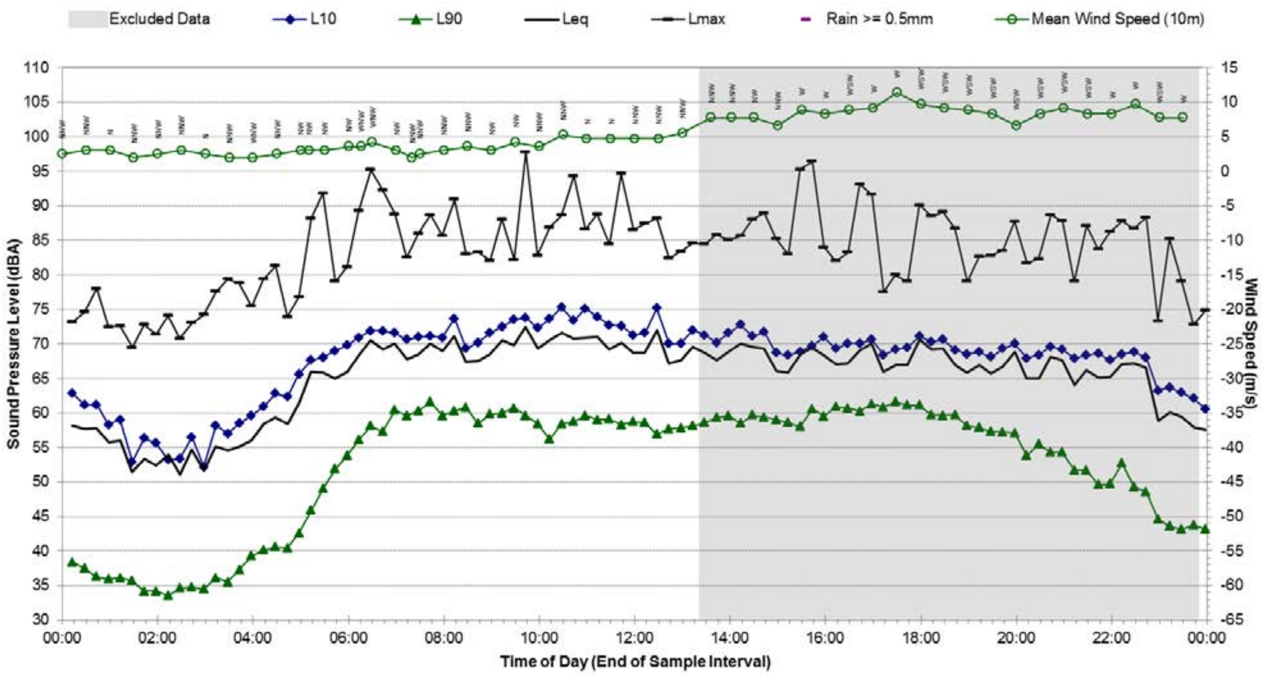


Background Noise Monitoring Results – B.02

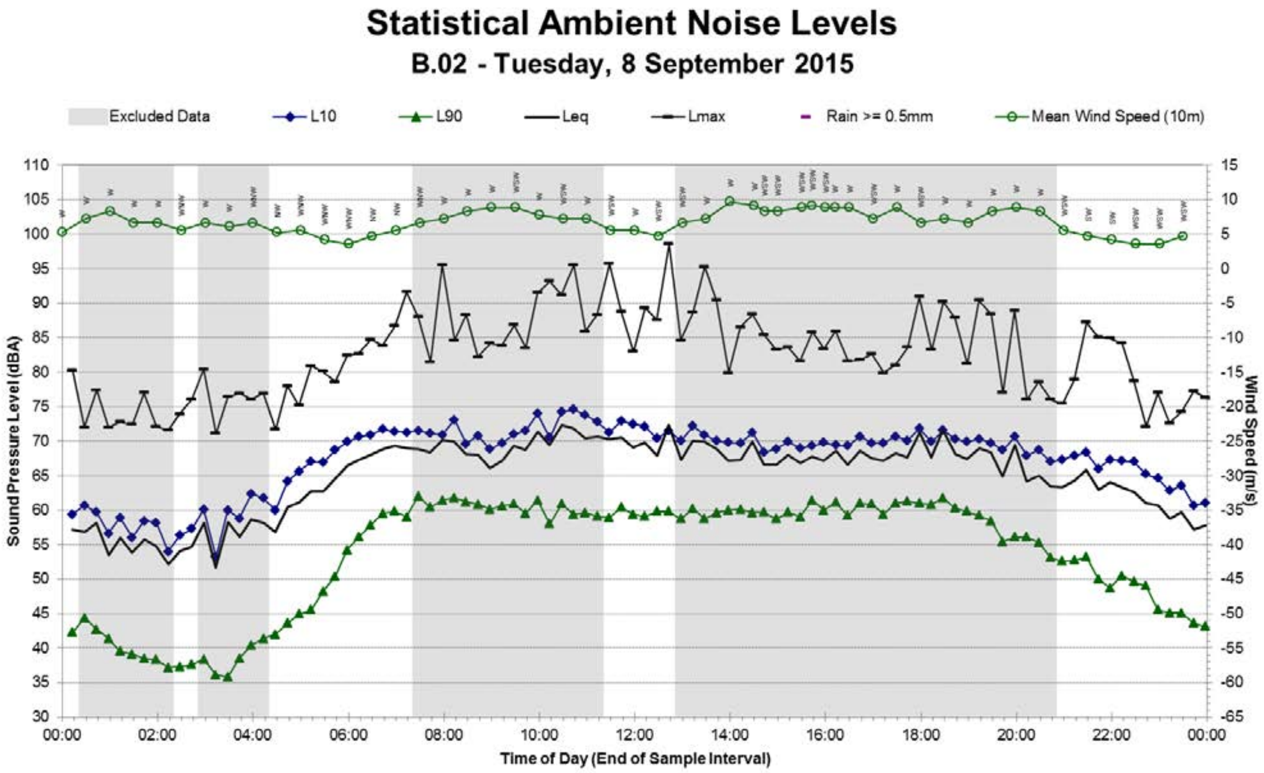
Statistical Ambient Noise Levels
B.02 - Sunday, 6 September 2015

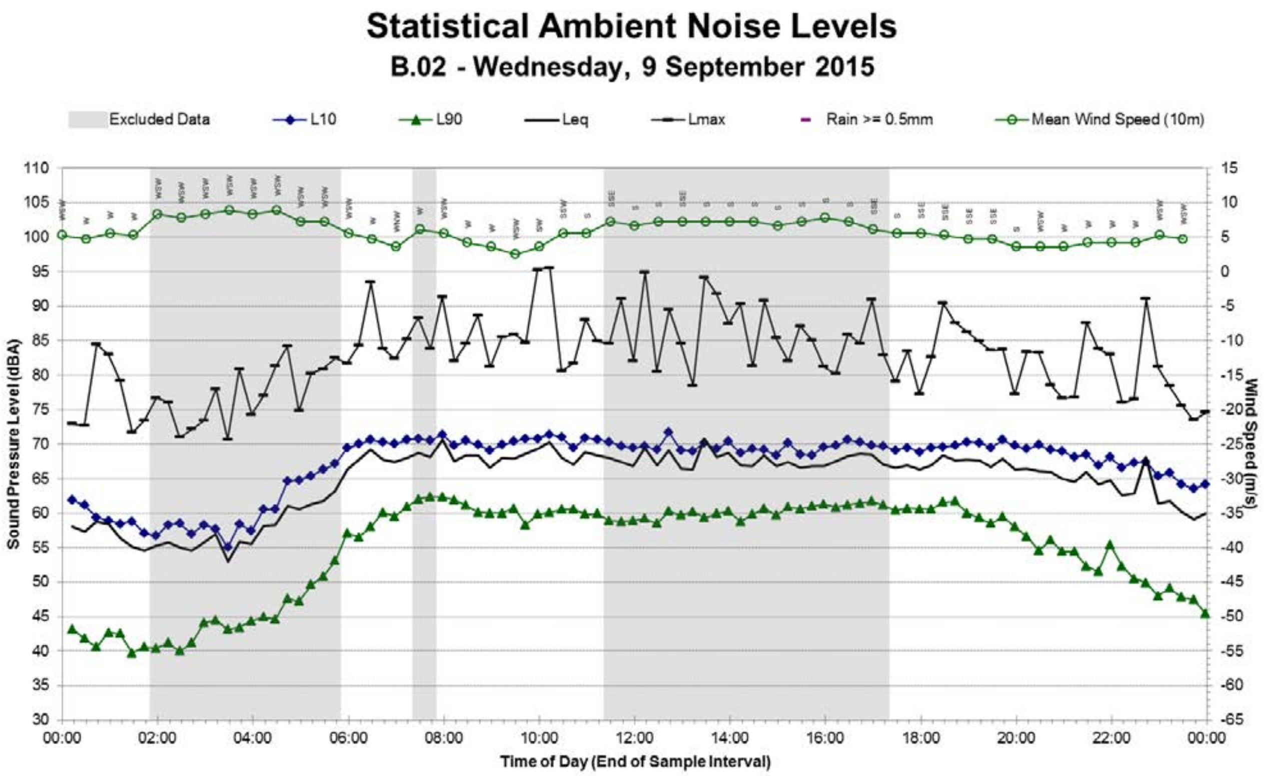


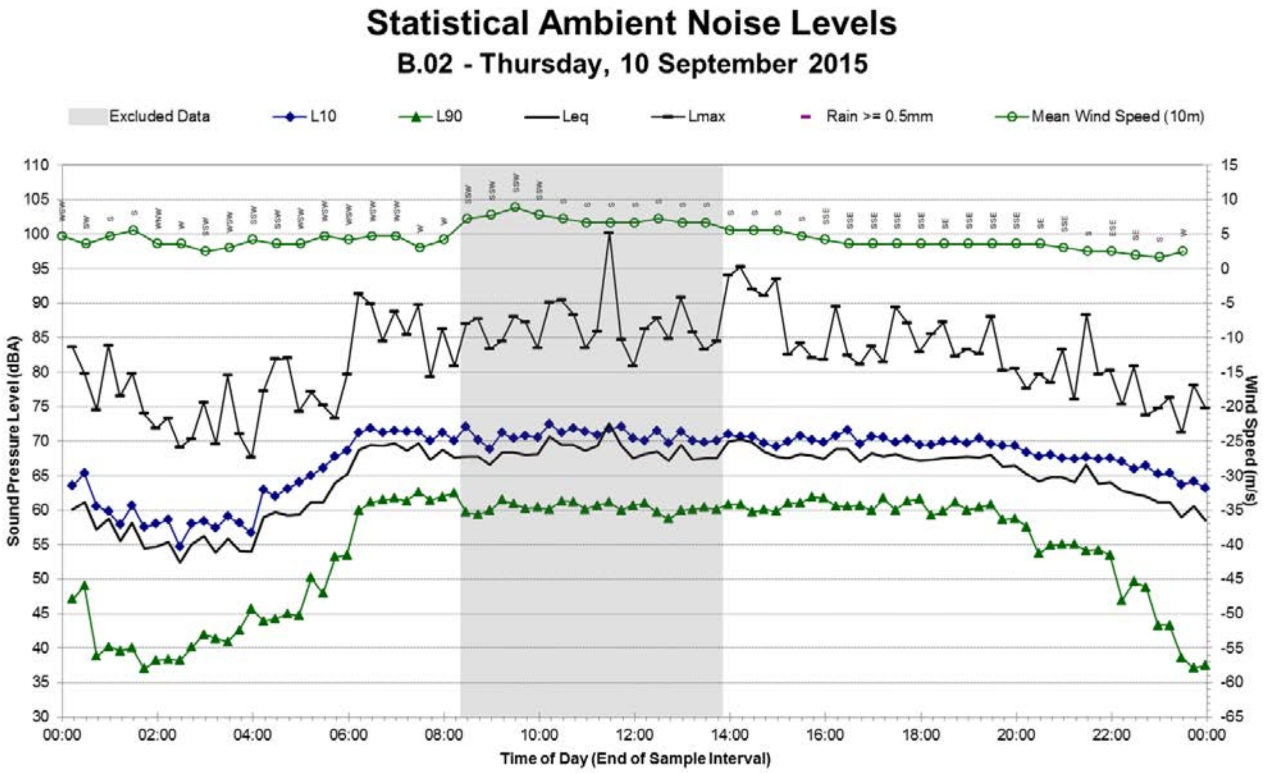
Statistical Ambient Noise Levels
B.02 - Monday, 7 September 2015



Background Noise Monitoring Results – B.02






Statistical Ambient Noise Levels
B.02 - Thursday, 10 September 2015
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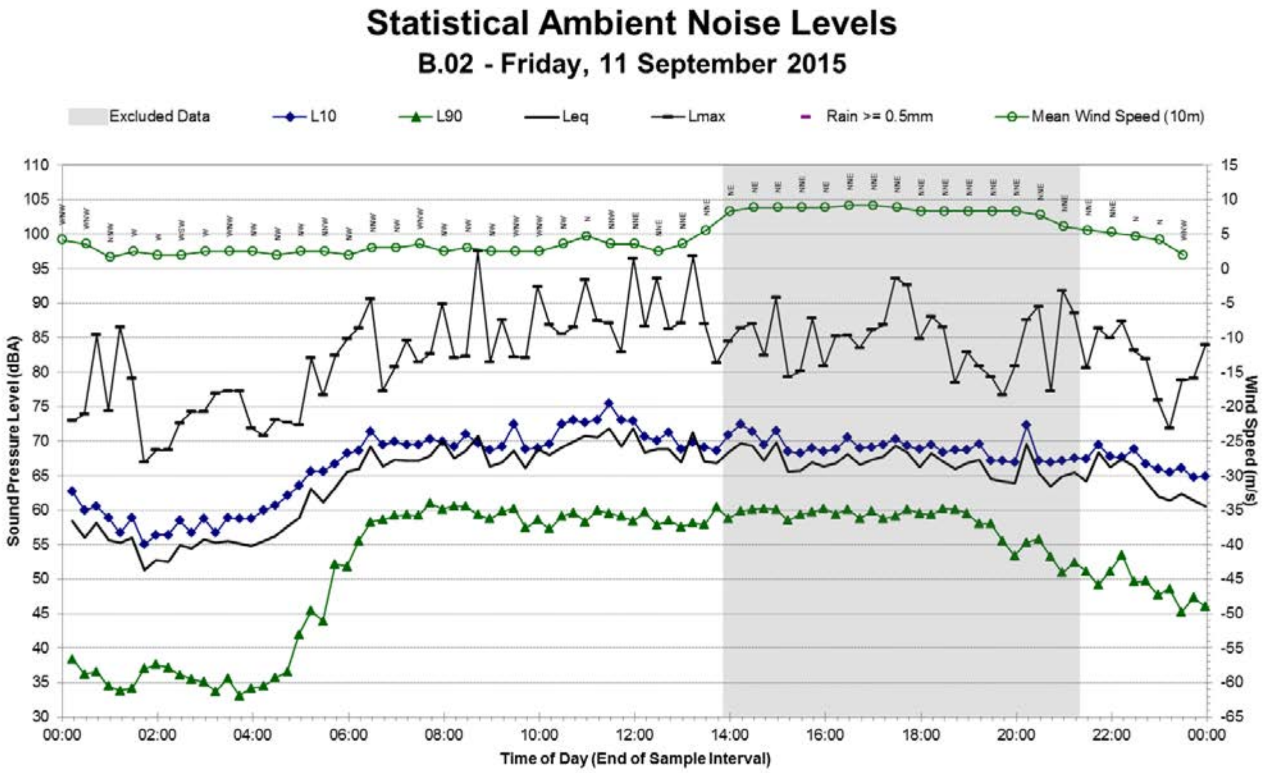
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
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Excluded Data
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Leq
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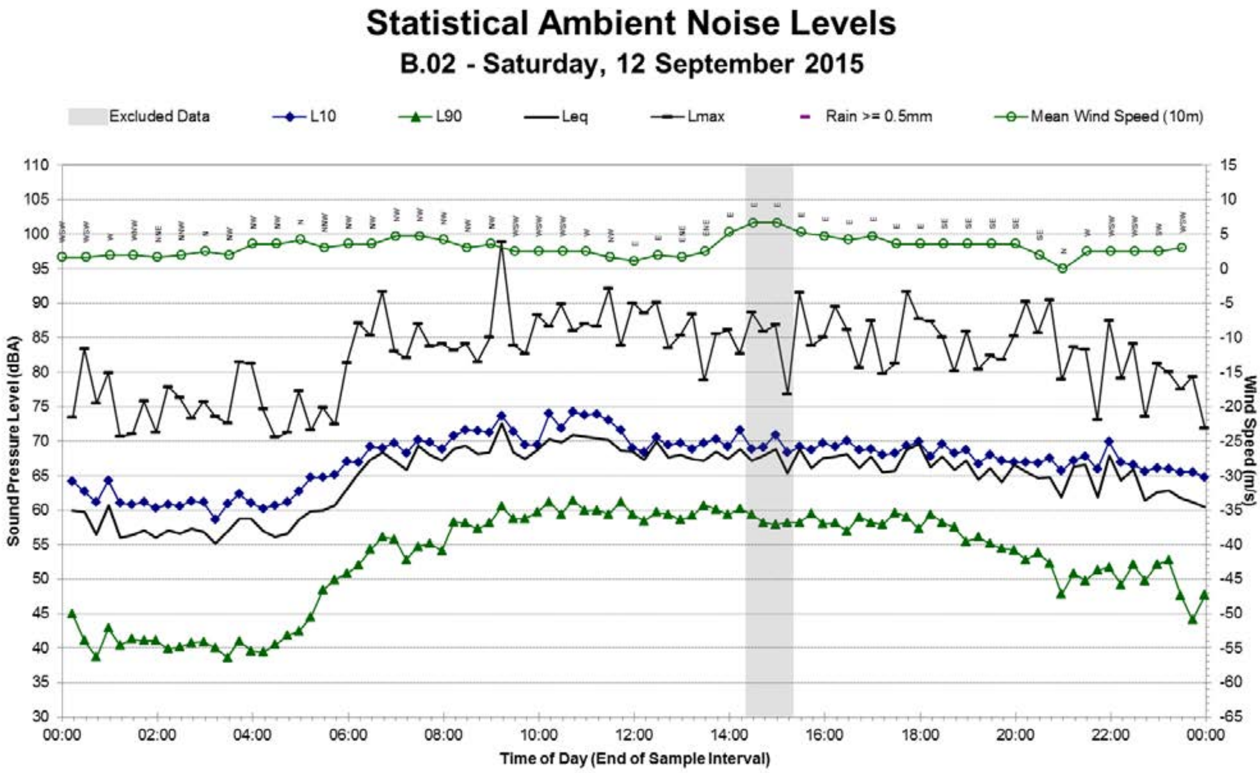
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
B.02 - Saturday, 12 September 2015
Excluded Data
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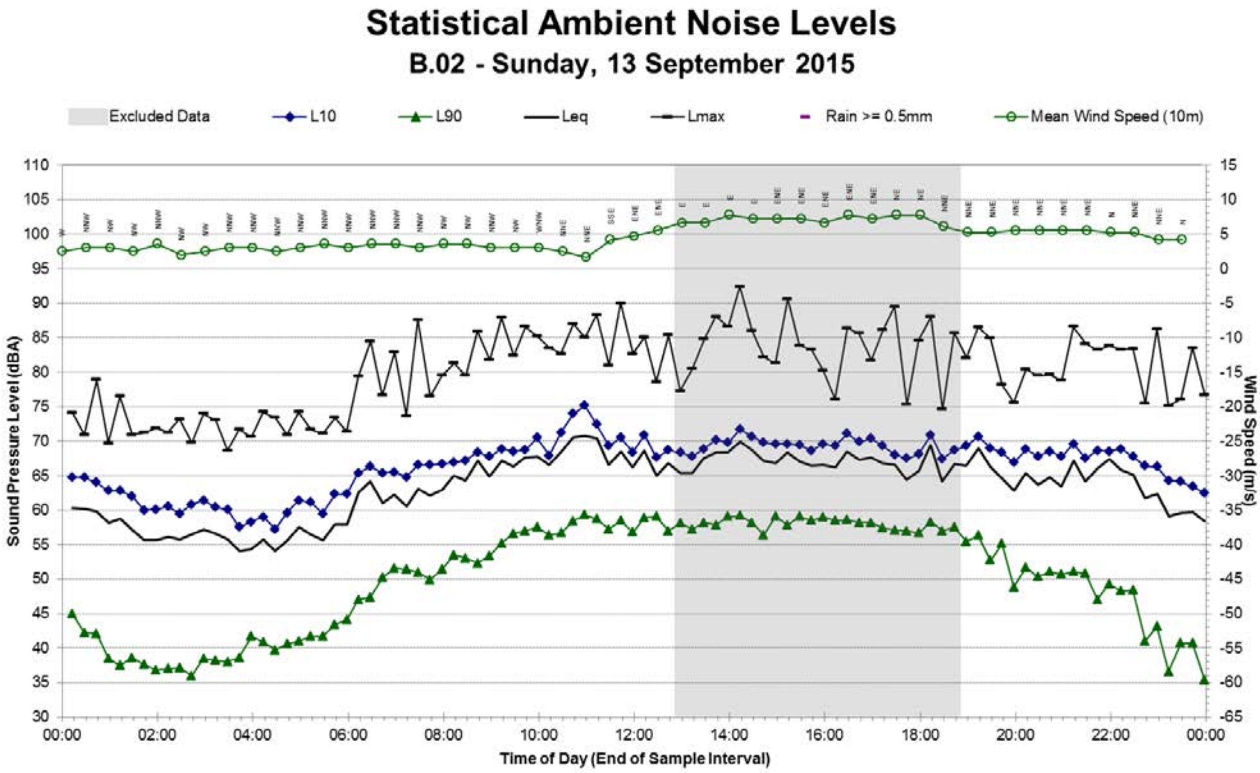
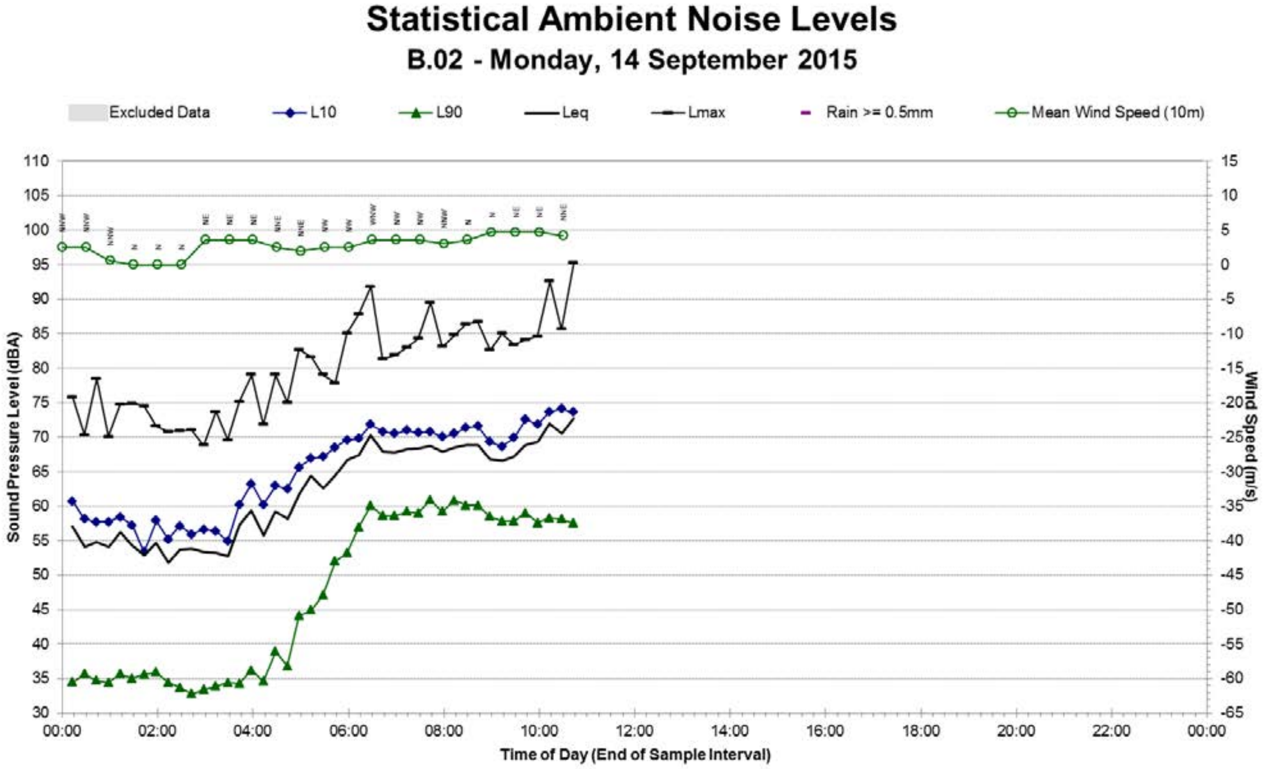
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
B.02 - Sunday, 13 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Background Noise Monitoring Results – B.02



Background Noise Monitoring Results – B.03

Noise Monitoring Location:	**B.03**
Noise Monitoring Address:	**1B Leicester Street, Marrickville 2204**

Logger Device Type: Svantek 957
Logger Serial No: 27580

Ambient noise logger deployed at the front of residential address 1B Leicester Street, Marrickville. Logger located on the driveway in the south eastern corner of the property.

Attended noise measurements indicate that the ambient noise environment at this location is dominated by road traffic noise from Edgeware Road located to the south during the daytime.

Map of Noise Monitoring Location

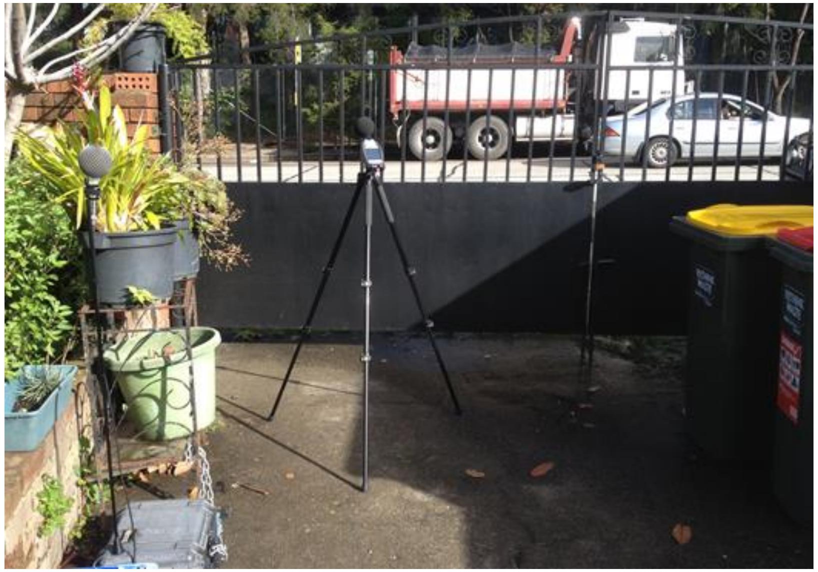
Ambient Noise Logging Results – INP Defined Time Periods

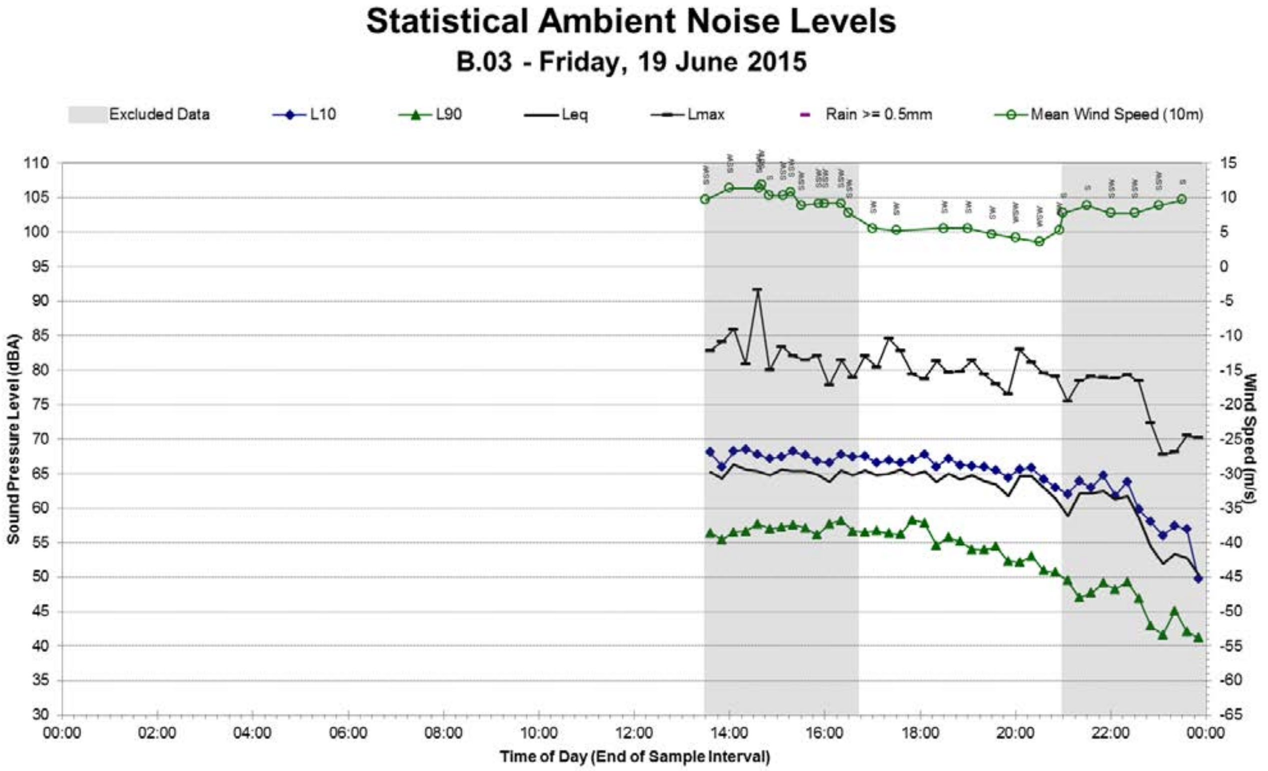
Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	52	66	67	76
Evening	43	64	64	75
Night-time	38	58	55	66

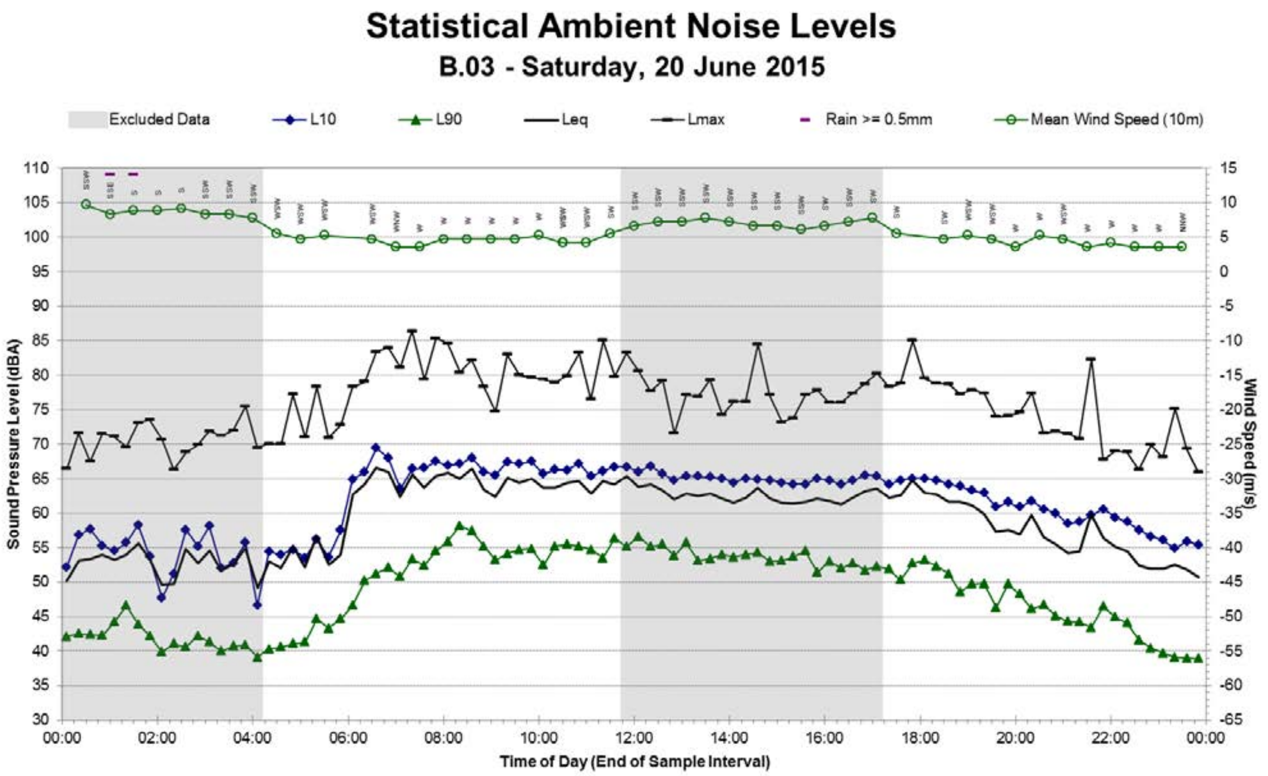
Attended Noise Measurement Results

Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
19/06/2015	13:07:41	58	66	81

Photo of Noise Monitoring Location

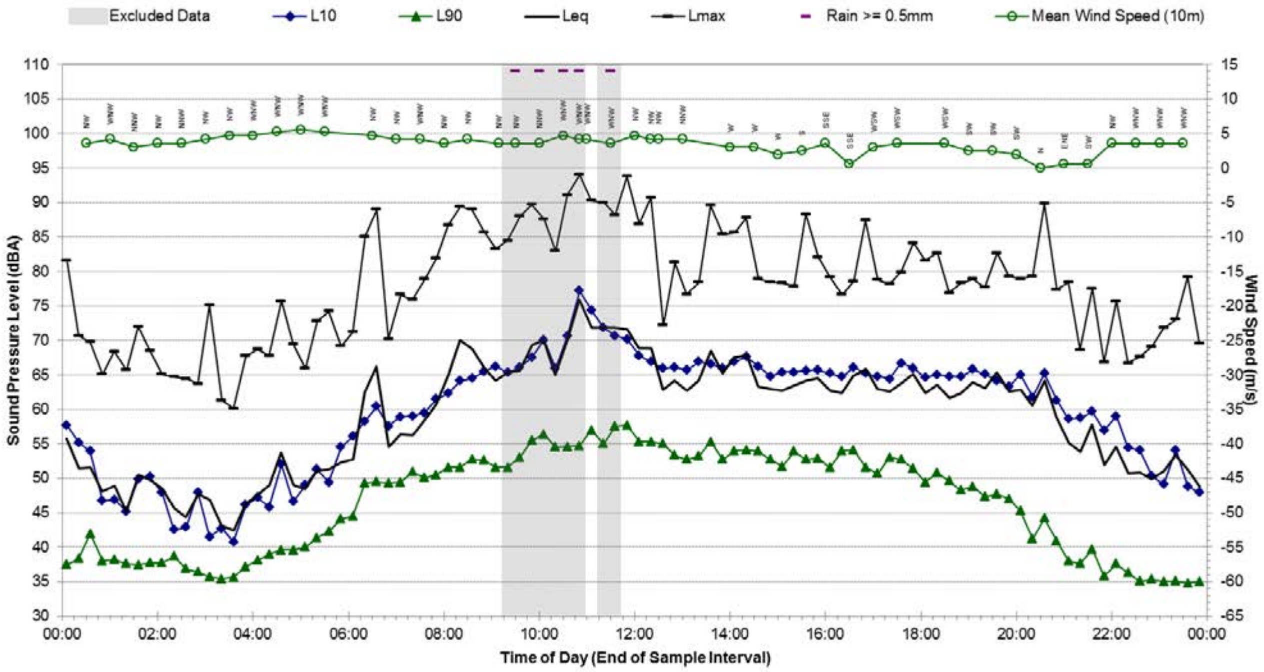



Statistical Ambient Noise Levels
B.03 - Friday, 19 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

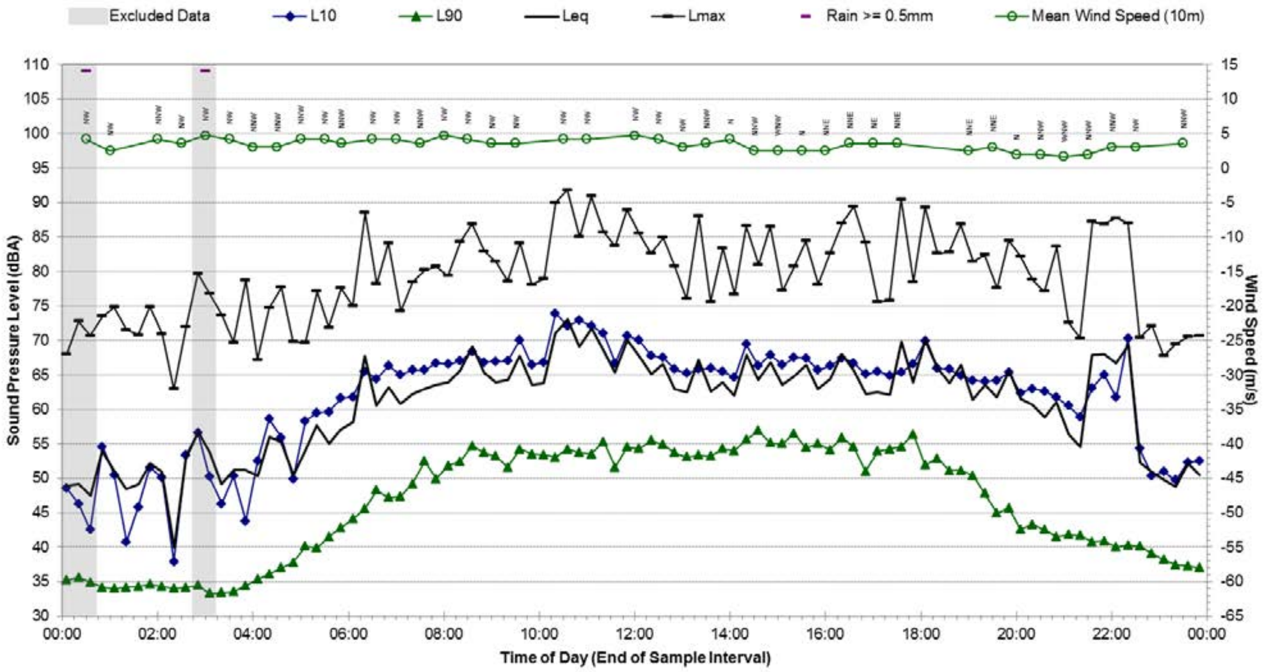

Statistical Ambient Noise Levels
B.03 - Saturday, 20 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Background Noise Monitoring Results – B.03

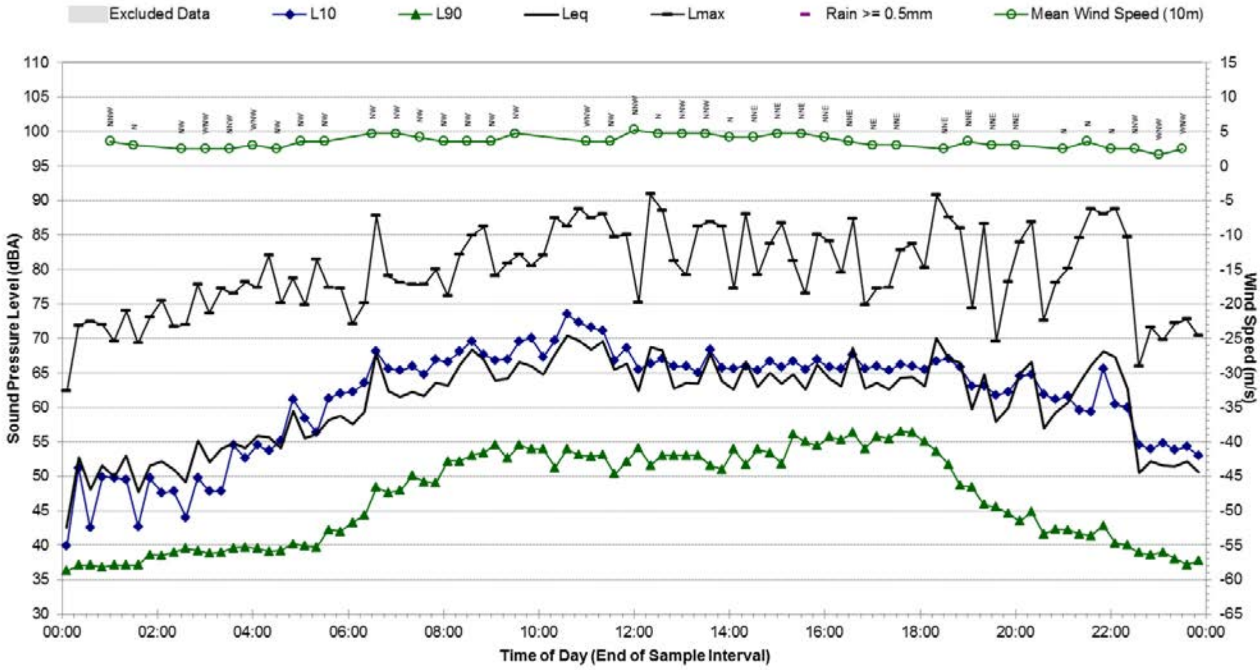
Statistical Ambient Noise Levels
B.03 - Sunday, 21 June 2015



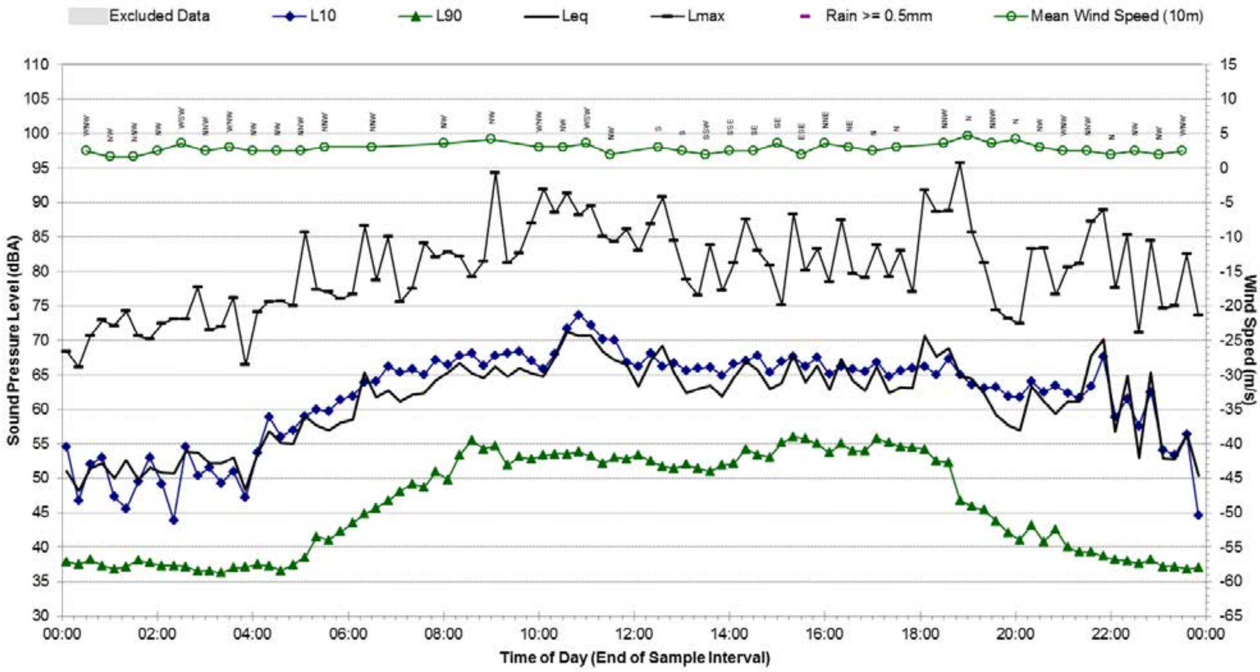
Statistical Ambient Noise Levels
B.03 - Monday, 22 June 2015



Statistical Ambient Noise Levels
B.03 - Tuesday, 23 June 2015

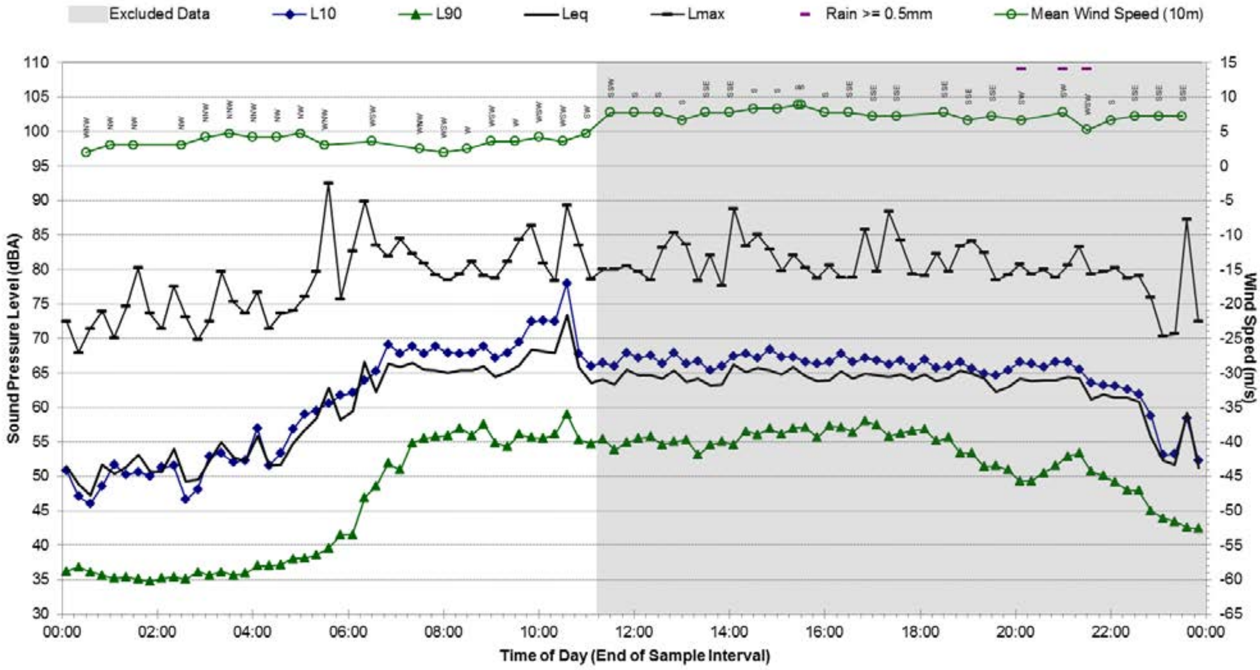


Statistical Ambient Noise Levels
B.03 - Wednesday, 24 June 2015

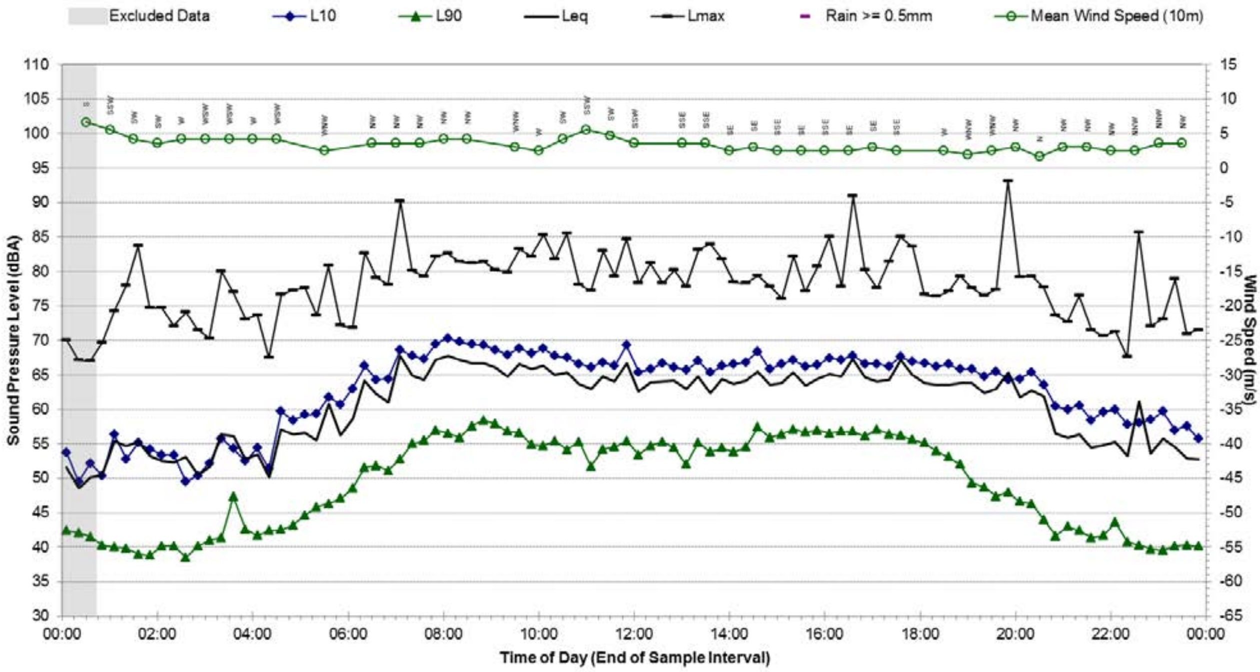


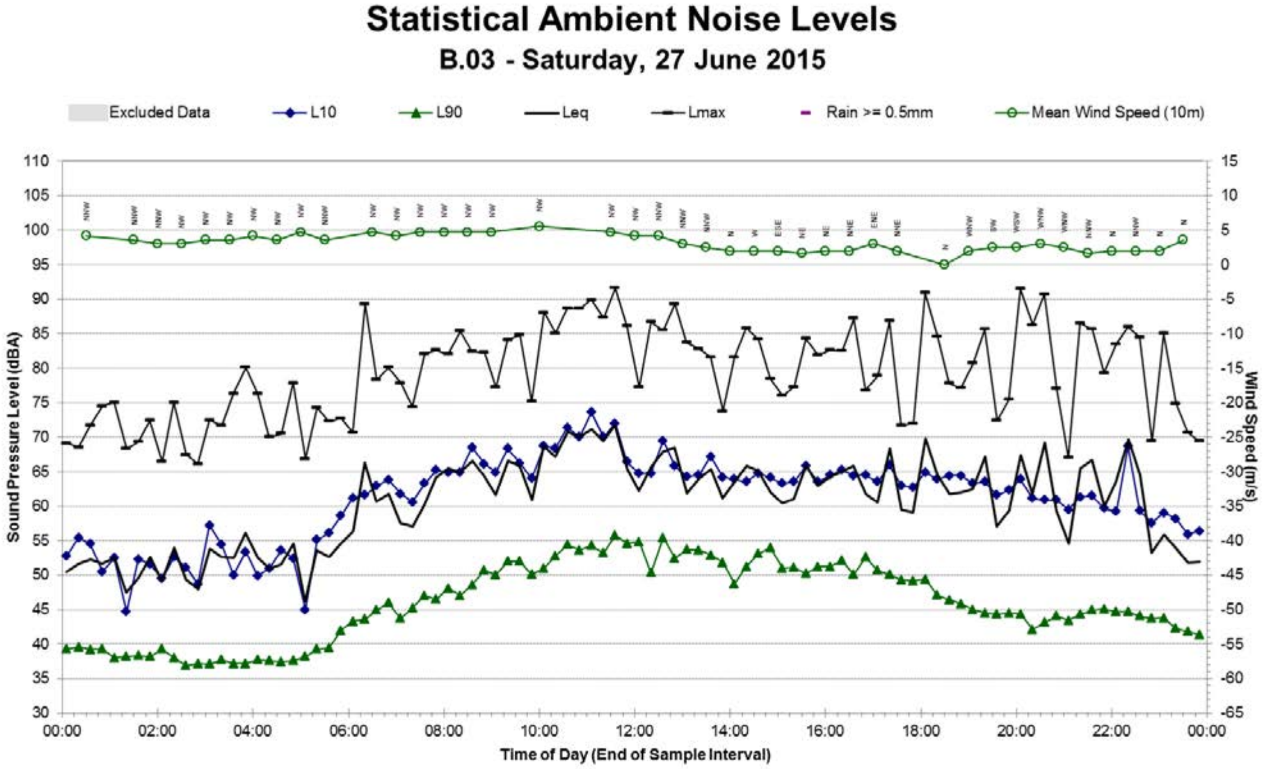
Background Noise Monitoring Results – B.03

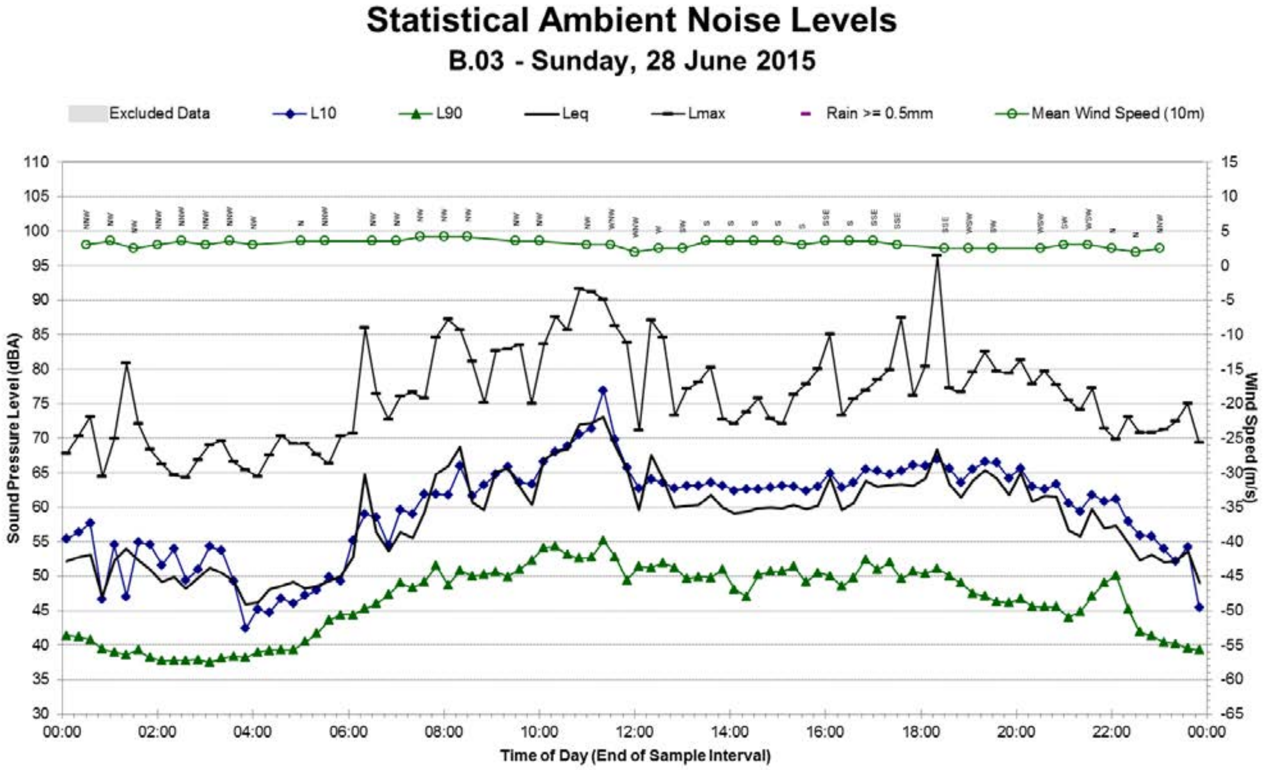
Statistical Ambient Noise Levels
B.03 - Thursday, 25 June 2015

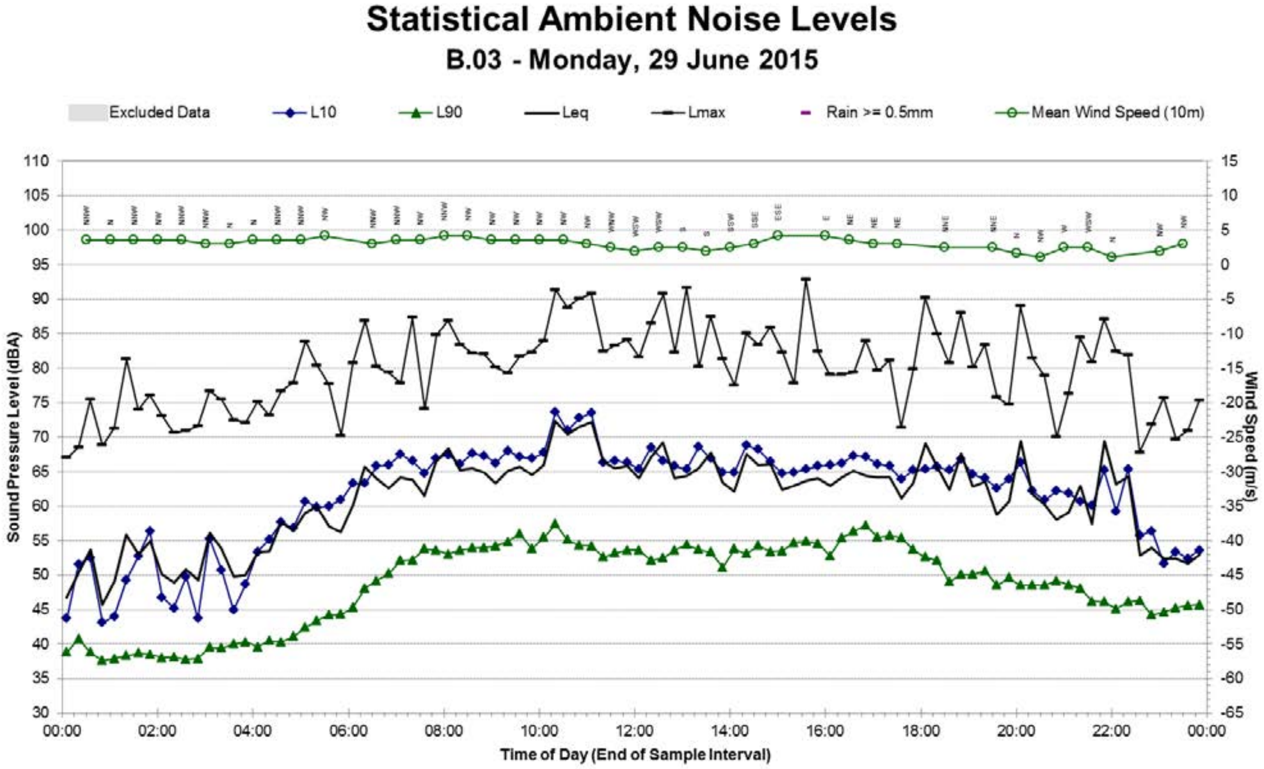


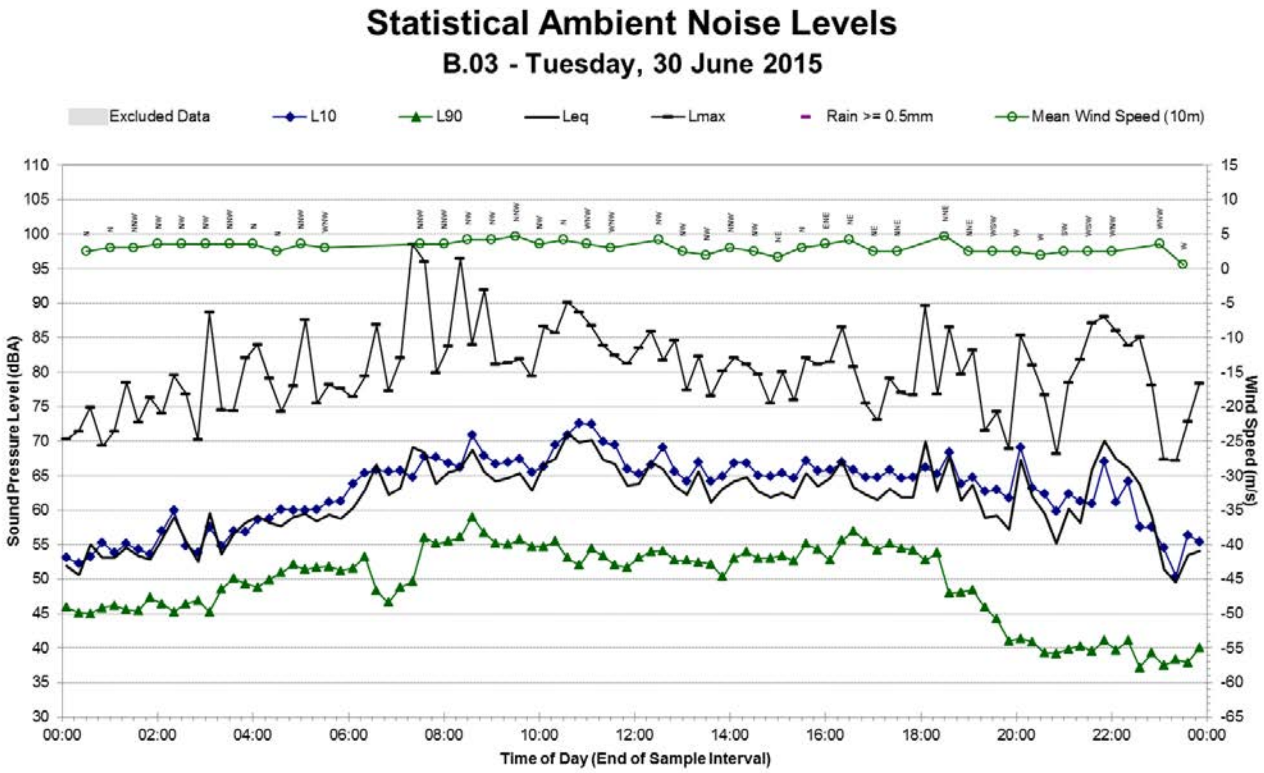
Statistical Ambient Noise Levels
B.03 - Friday, 26 June 2015




Statistical Ambient Noise Levels
B.03 - Saturday, 27 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

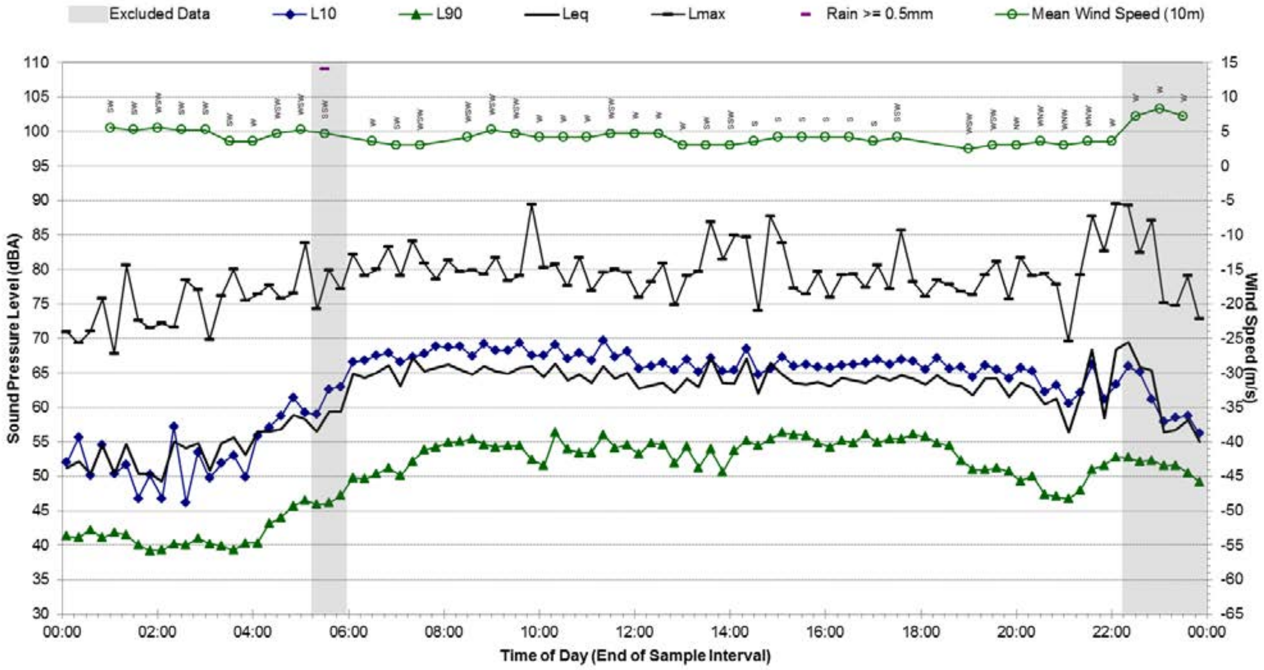

Statistical Ambient Noise Levels
B.03 - Sunday, 28 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
B.03 - Monday, 29 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

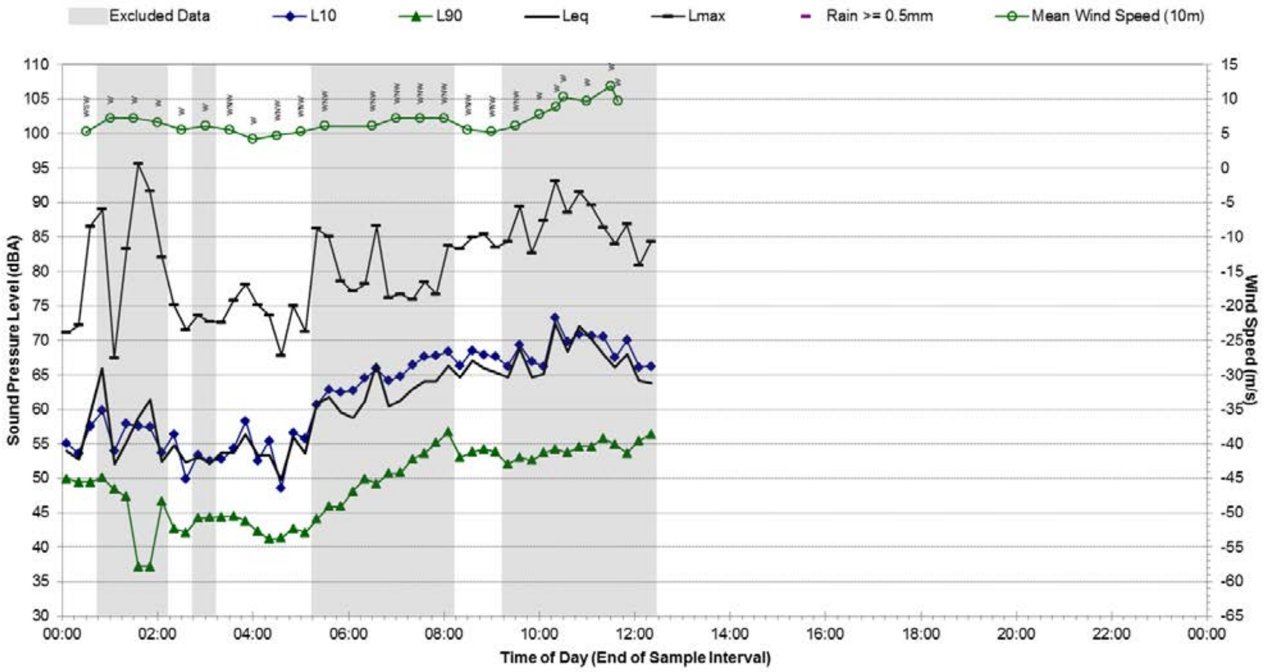

Statistical Ambient Noise Levels
B.03 - Tuesday, 30 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Background Noise Monitoring Results – B.03

Statistical Ambient Noise Levels
B.03 - Wednesday, 1 July 2015



Statistical Ambient Noise Levels
B.03 - Thursday, 2 July 2015



Background Noise Monitoring Results – B.04

Noise Monitoring Location:	**B.04**
Noise Monitoring Address:	**46 Dickson Street, Newtown 2065**

Logger Device Type: ARL-EL316
Logger Serial No: 16-306-047

Ambient noise logger deployed at rear of residential address 46 Dickson Street, Newtown. Logger located in south eastern corner of the back yard which fronts Dickson Lane.

Attended noise measurements indicate that the ambient noise environment at this location is dominated by light road traffic noise. LA90 (background) levels were influenced by surrounding mechanical plant.

Map of Noise Monitoring Location

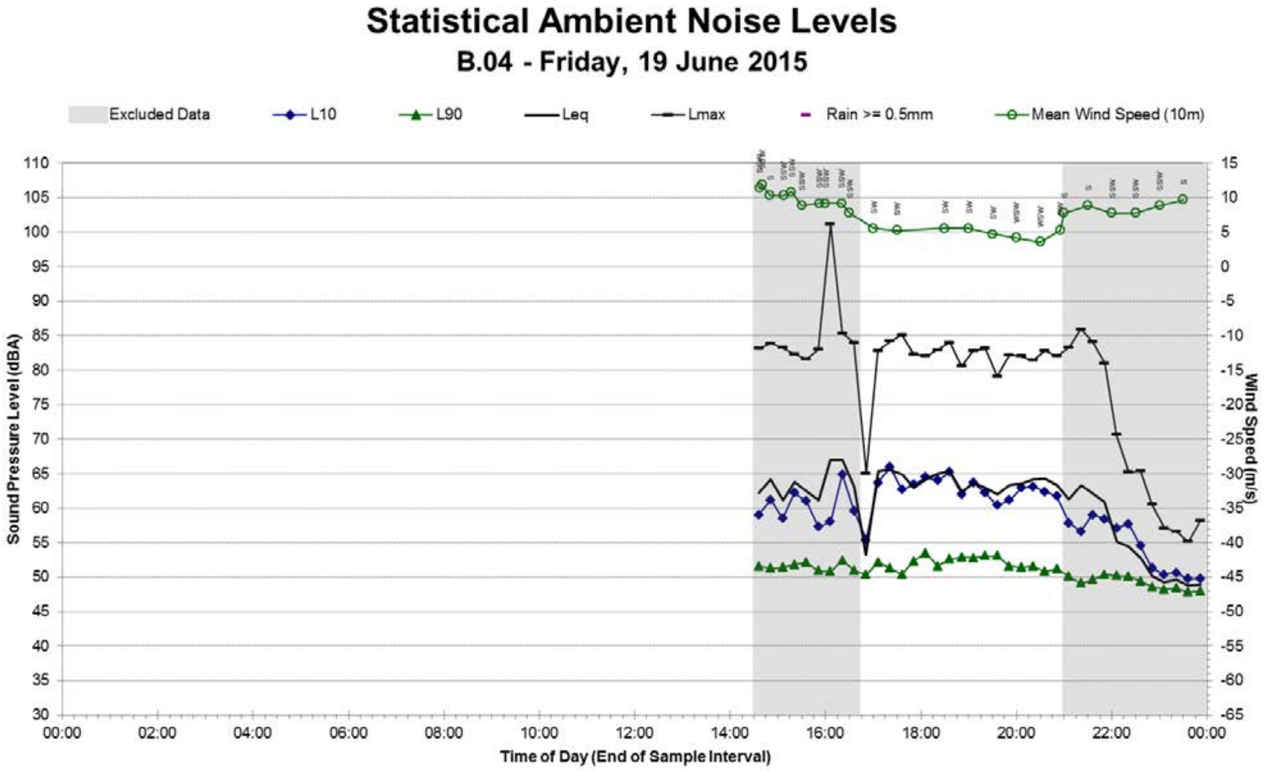
Ambient Noise Logging Results – INP Defined Time Periods

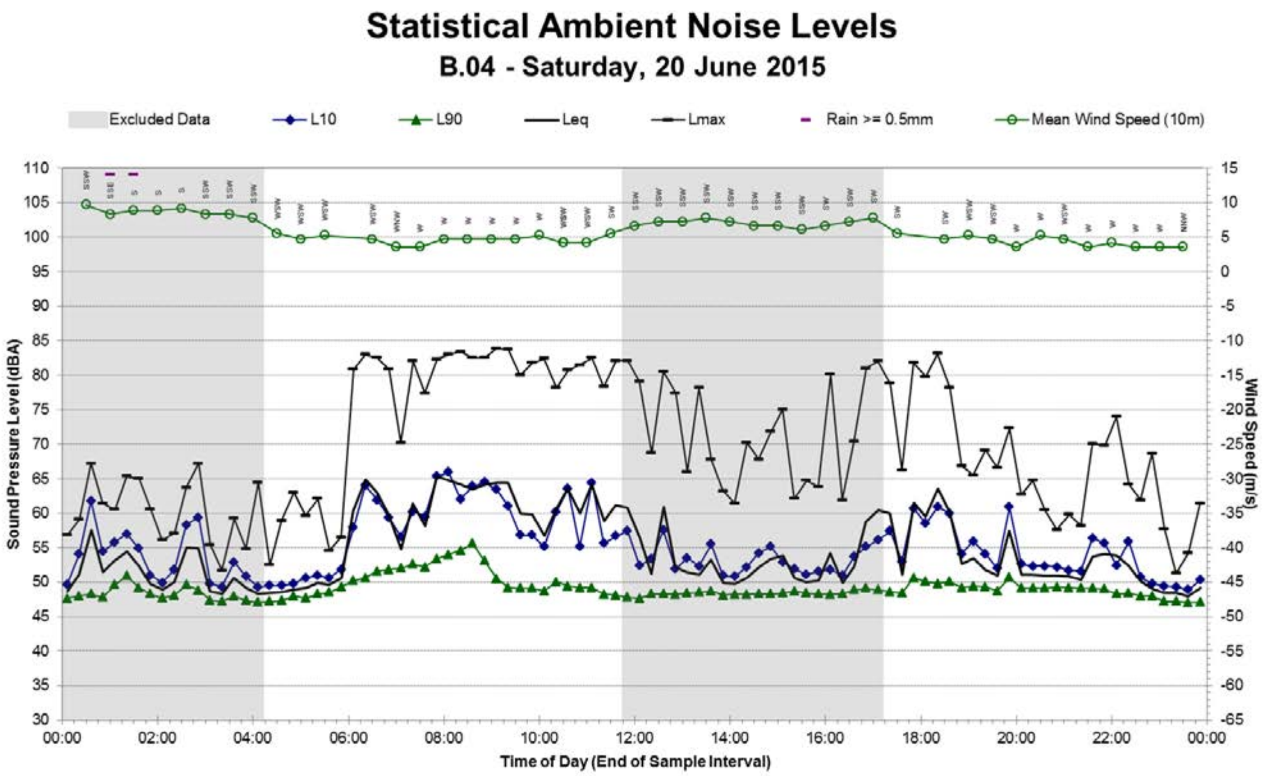
Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	47	61	58	71
Evening	47	59	55	69
Night-time	47	53	50	51

Attended Noise Measurement Results

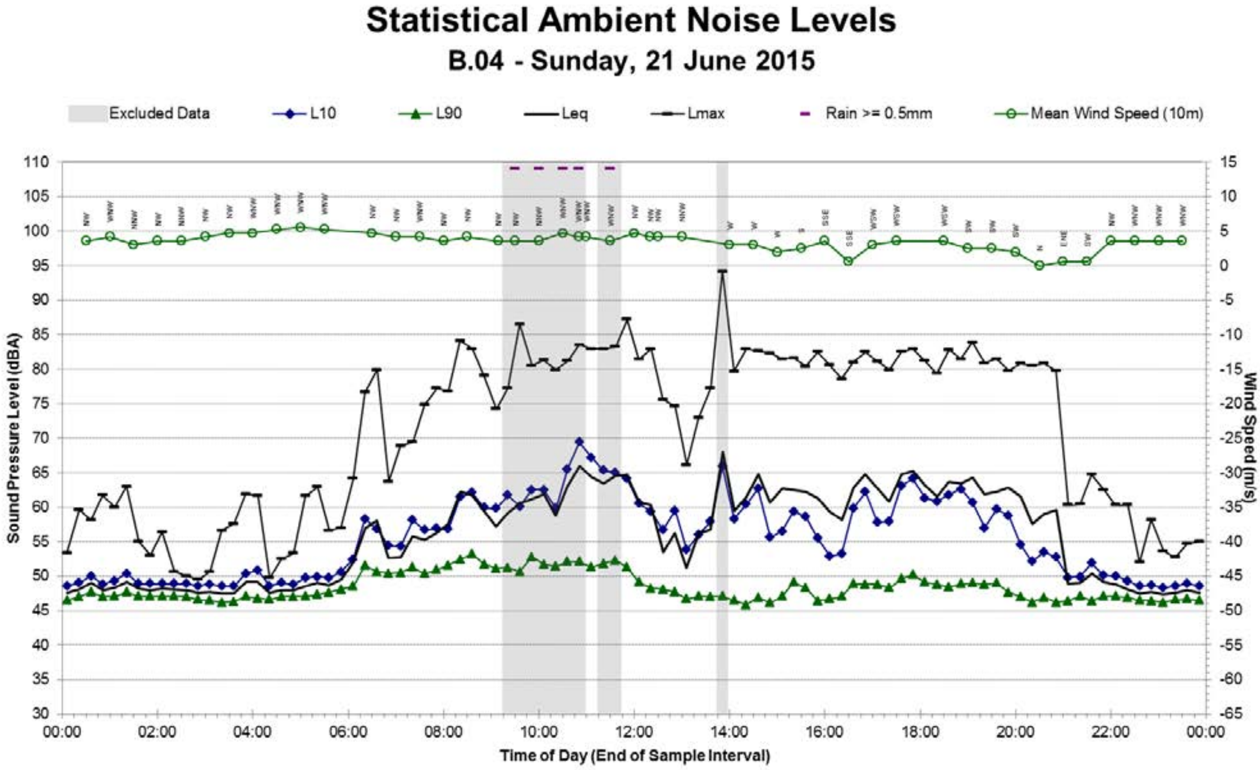
Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
19/06/2015	14:15:08	51	59	79

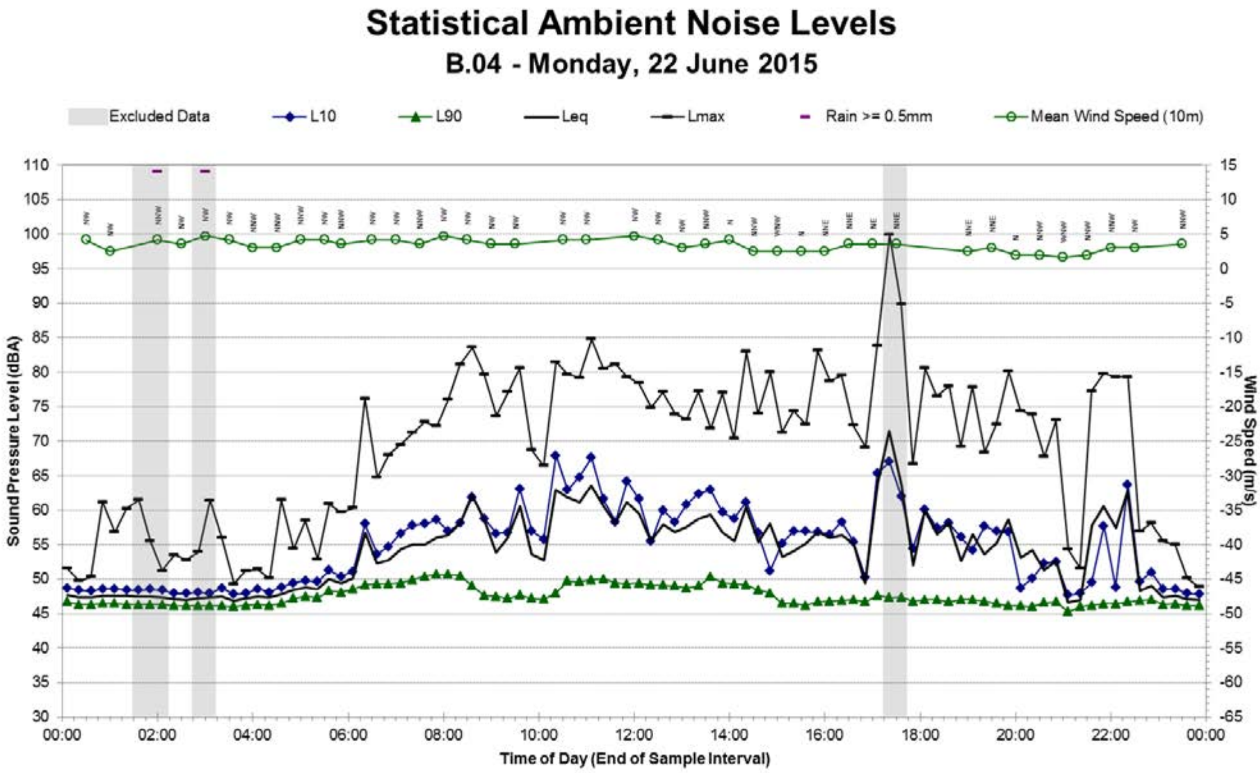
Photo of Noise Monitoring Location


Statistical Ambient Noise Levels
B.04 - Friday, 19 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

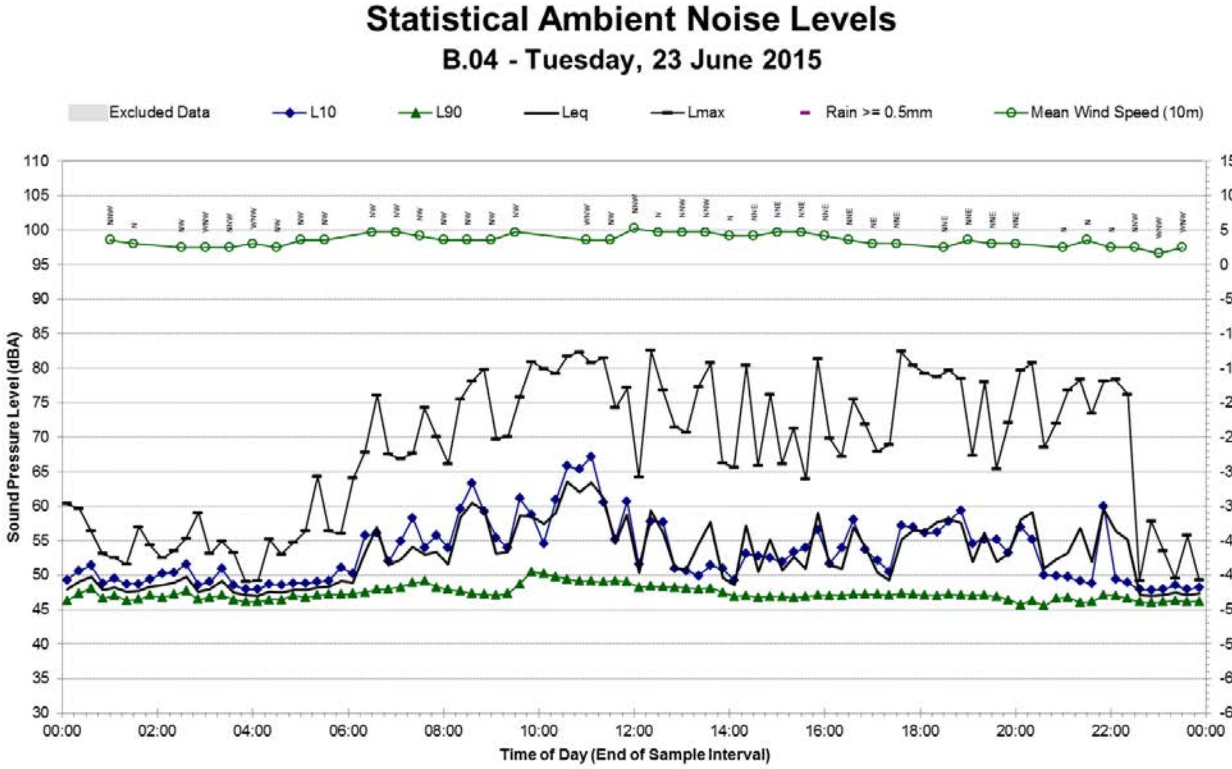

Statistical Ambient Noise Levels
B.04 - Saturday, 20 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

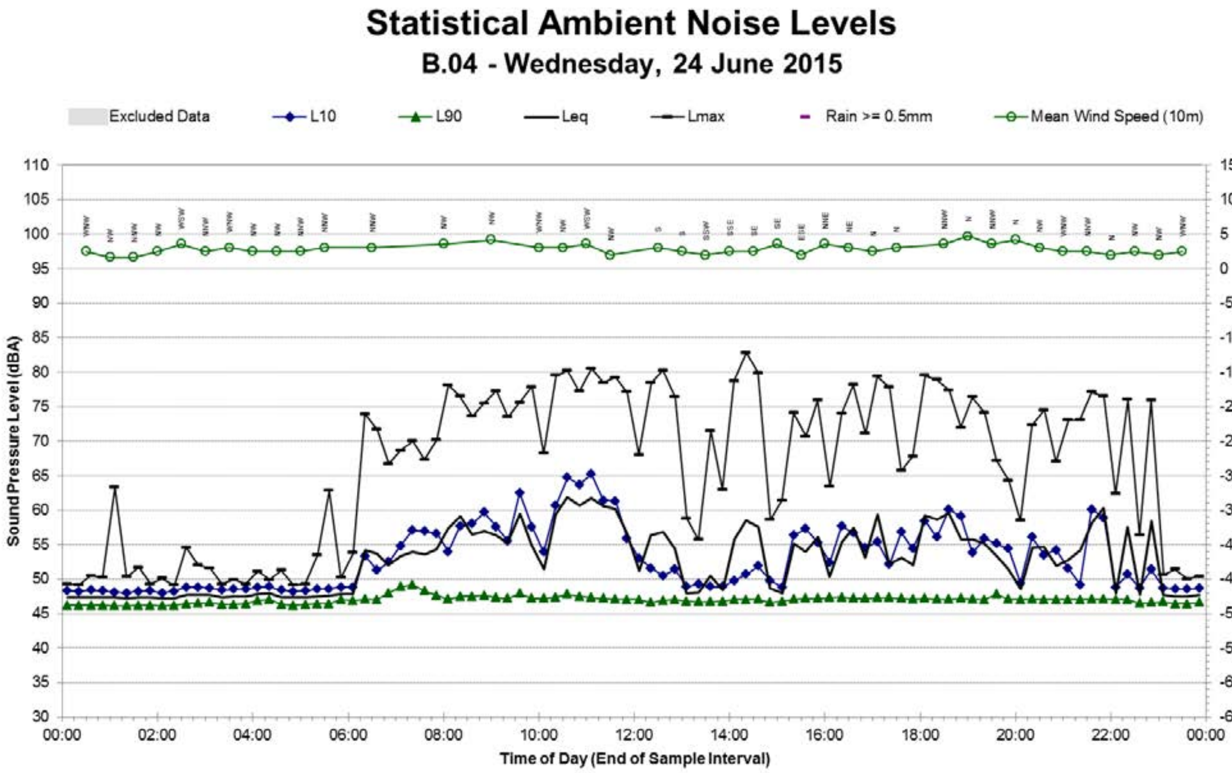
Background Noise Monitoring Results – B.04



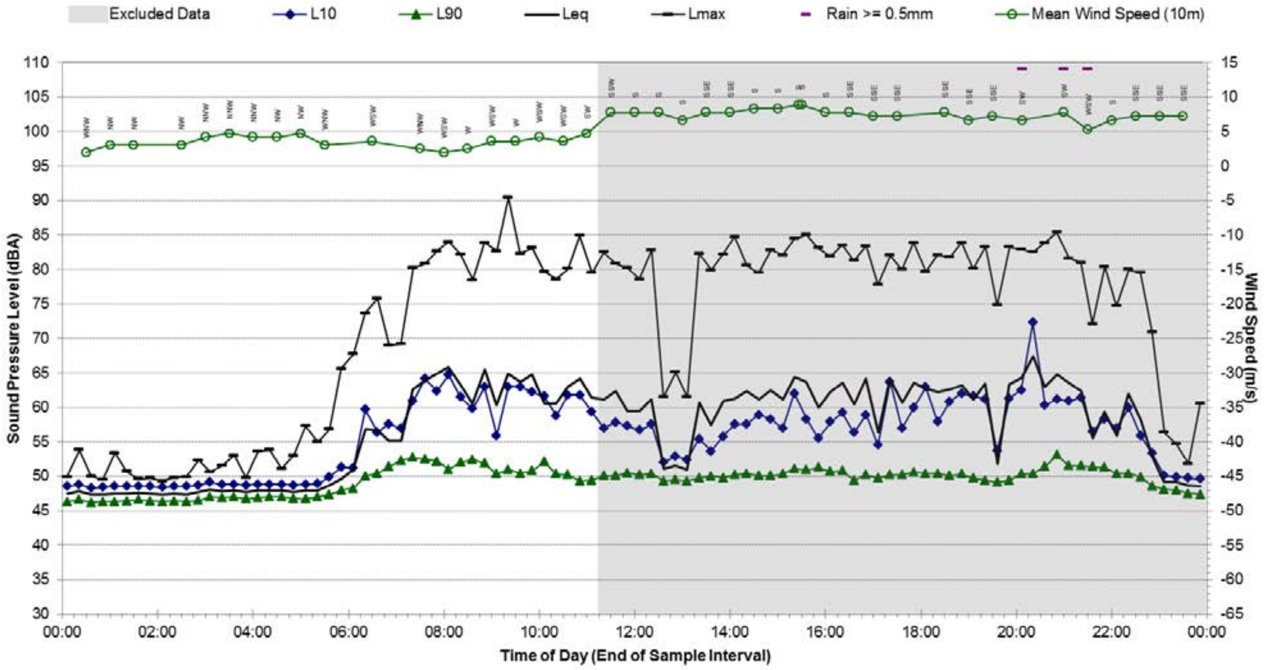


Background Noise Monitoring Results – B.04

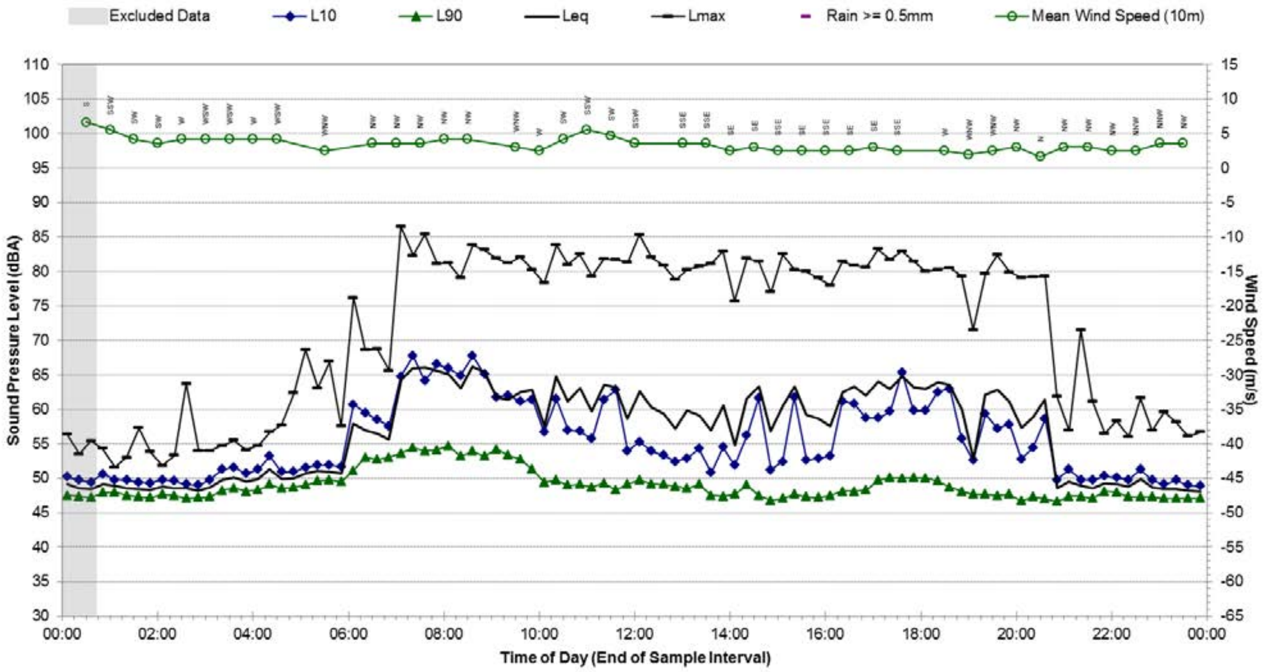


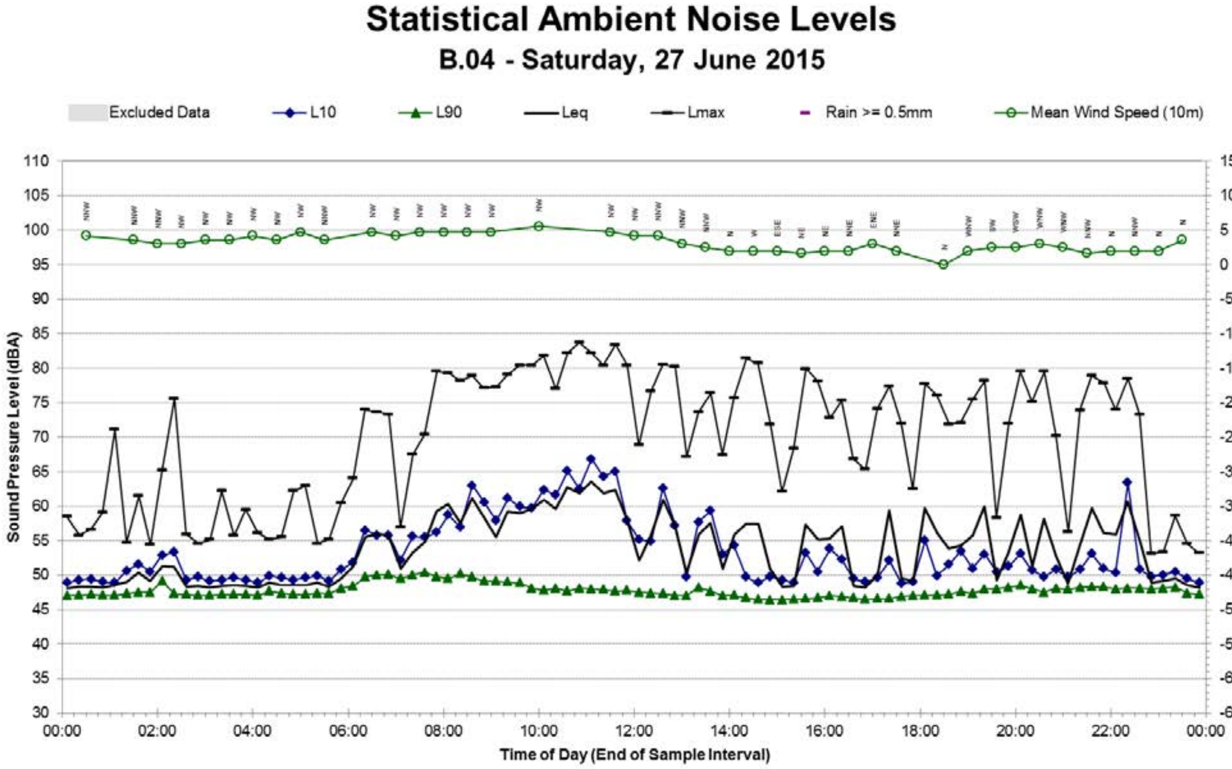


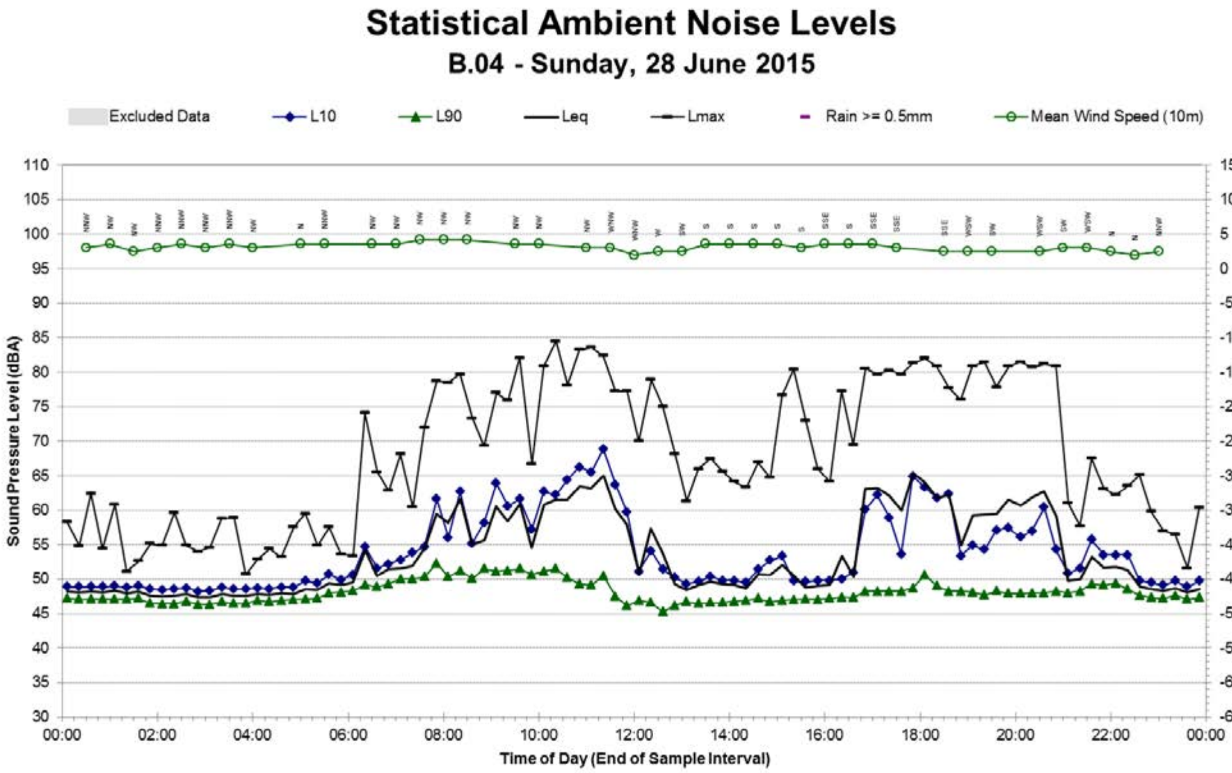
Statistical Ambient Noise Levels
B.04 - Thursday, 25 June 2015



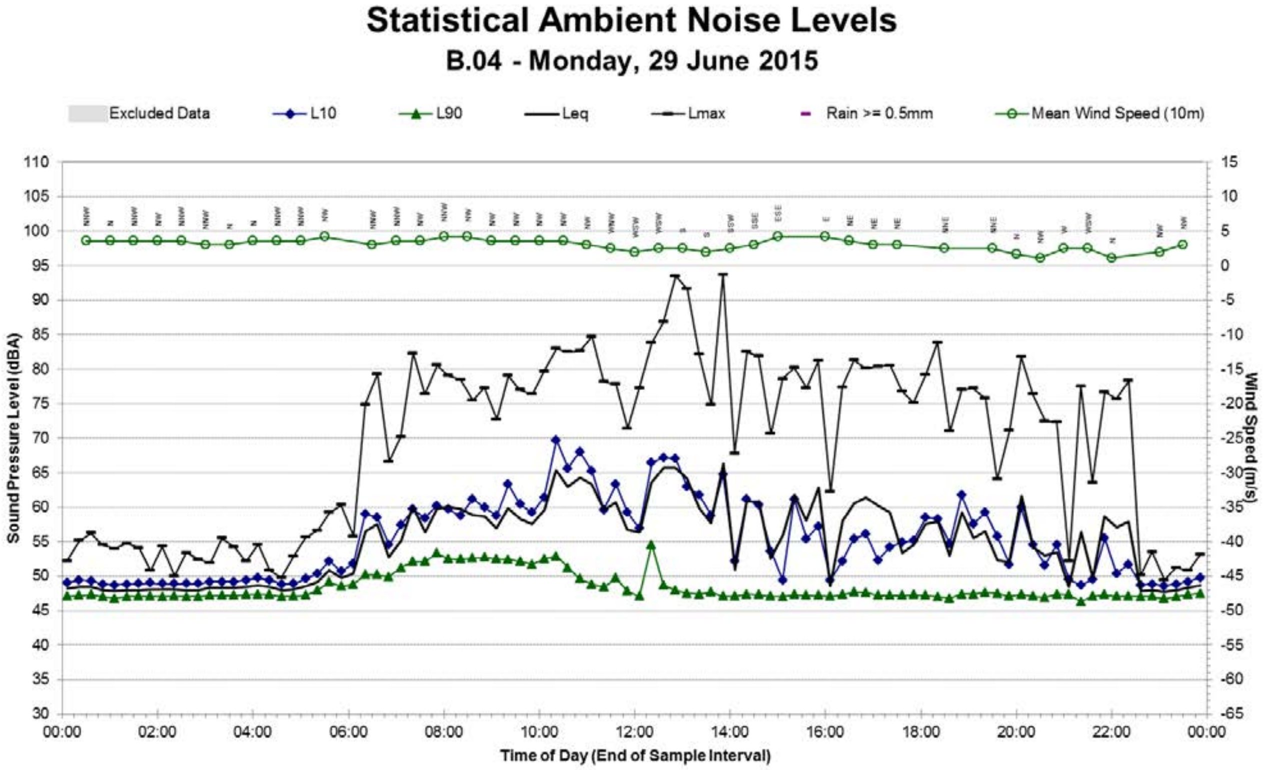
Statistical Ambient Noise Levels
B.04 - Friday, 26 June 2015

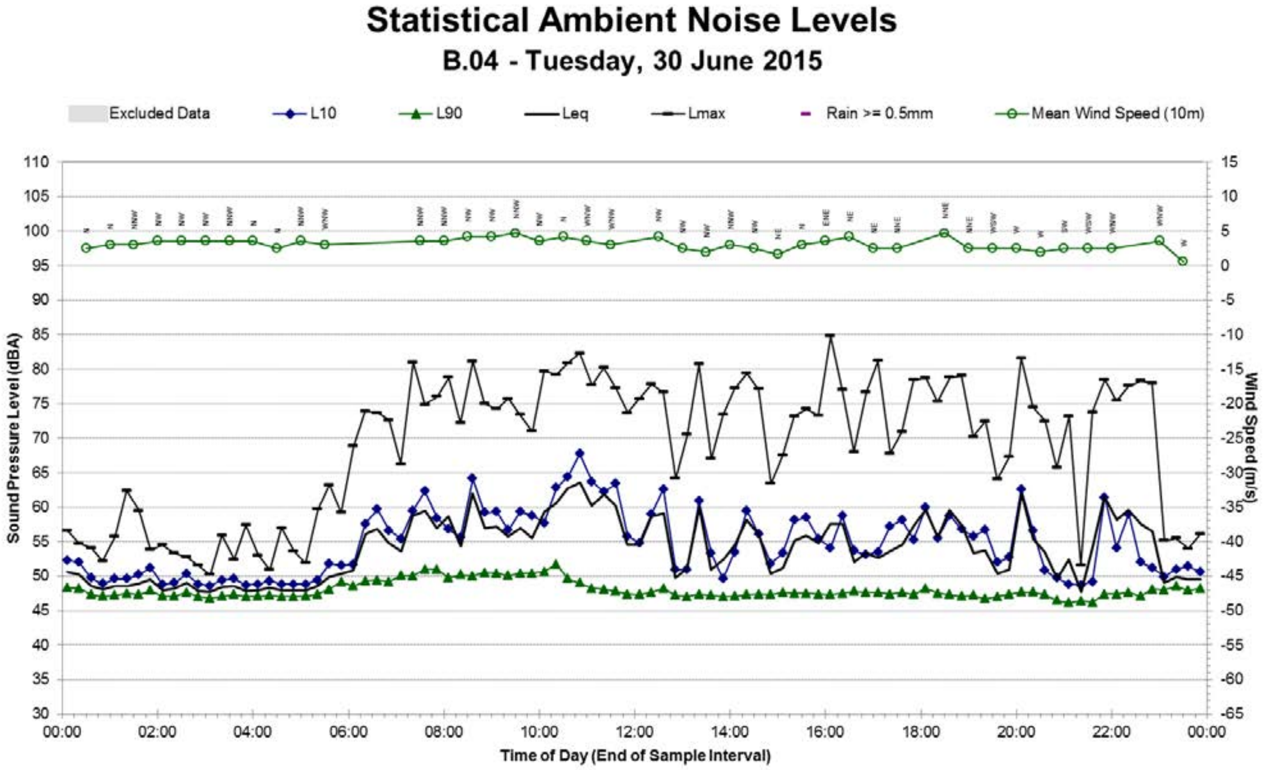



Statistical Ambient Noise Levels
B.04 - Saturday, 27 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

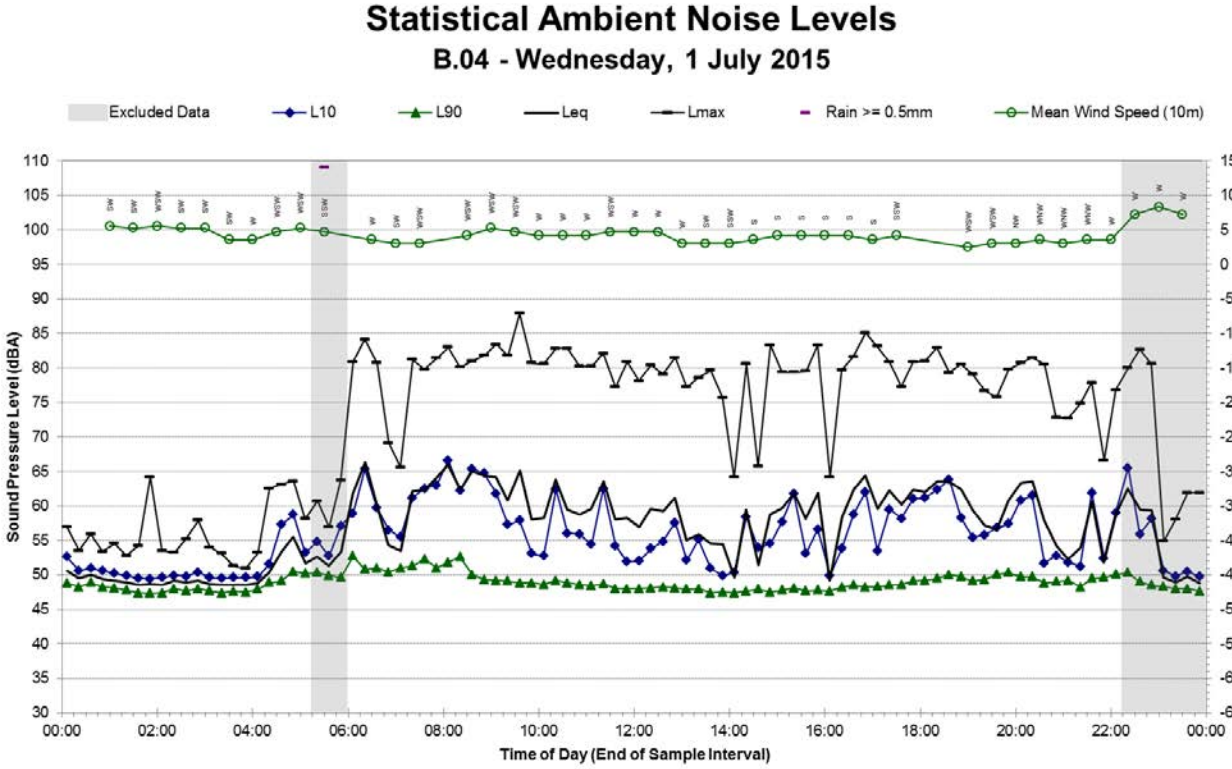

Statistical Ambient Noise Levels
B.04 - Sunday, 28 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

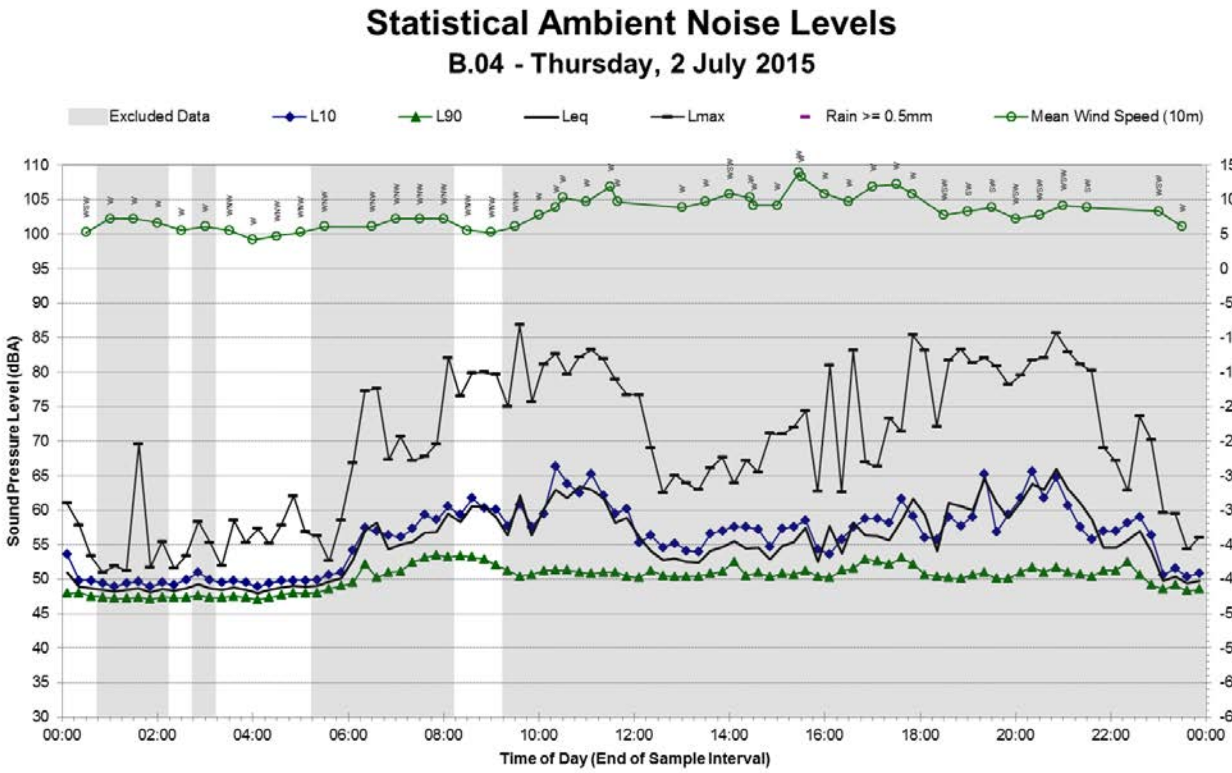
Background Noise Monitoring Results – B.04



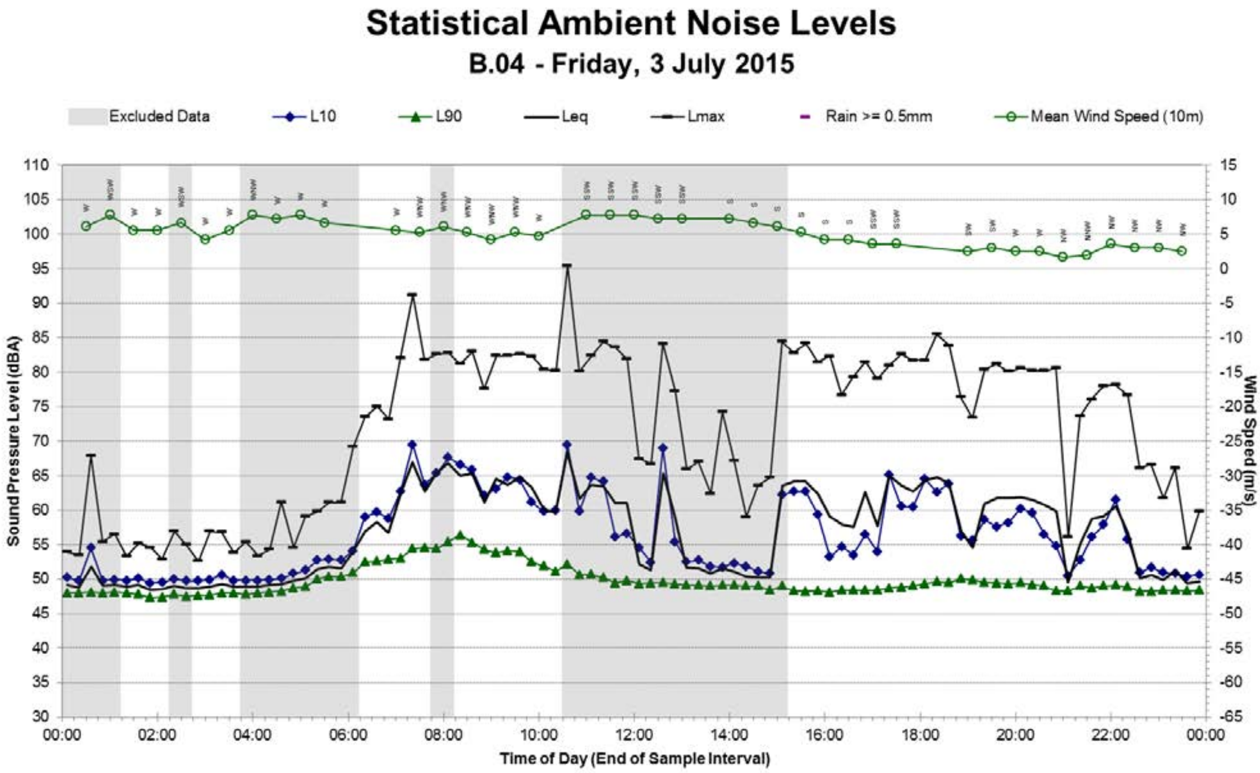


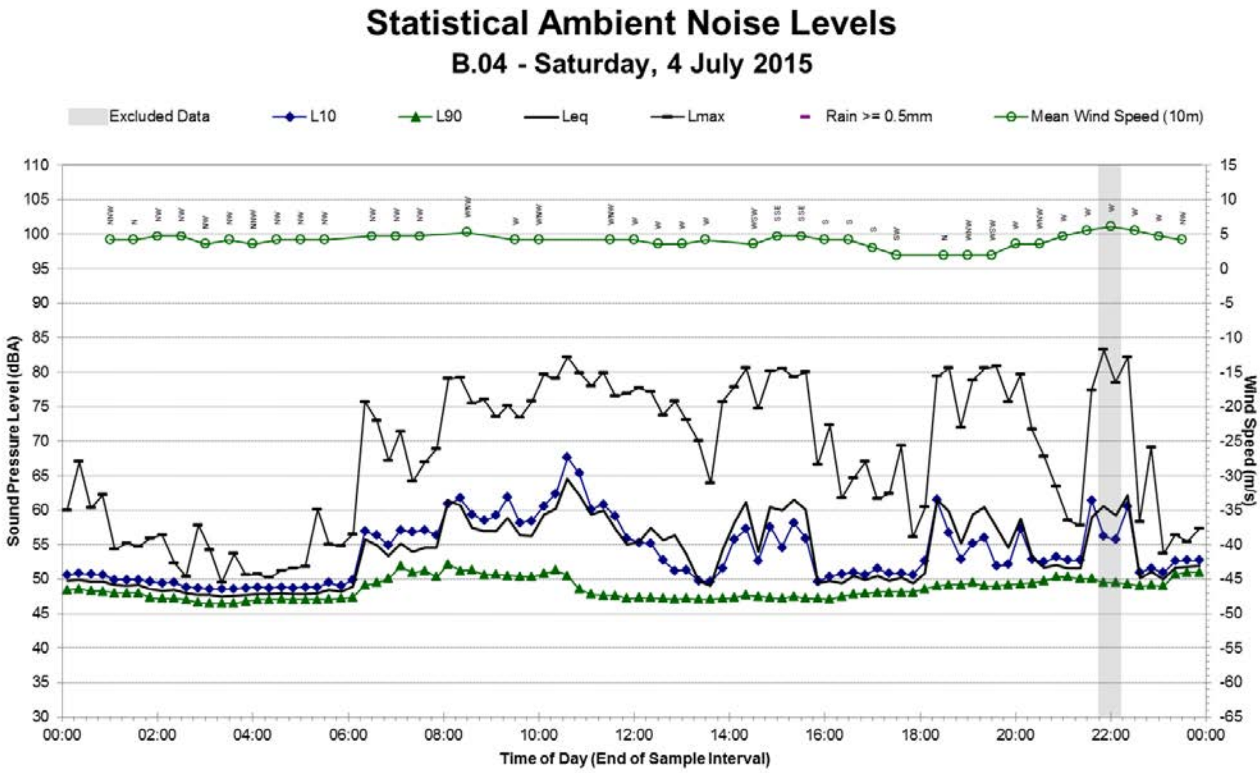
Background Noise Monitoring Results – B.04

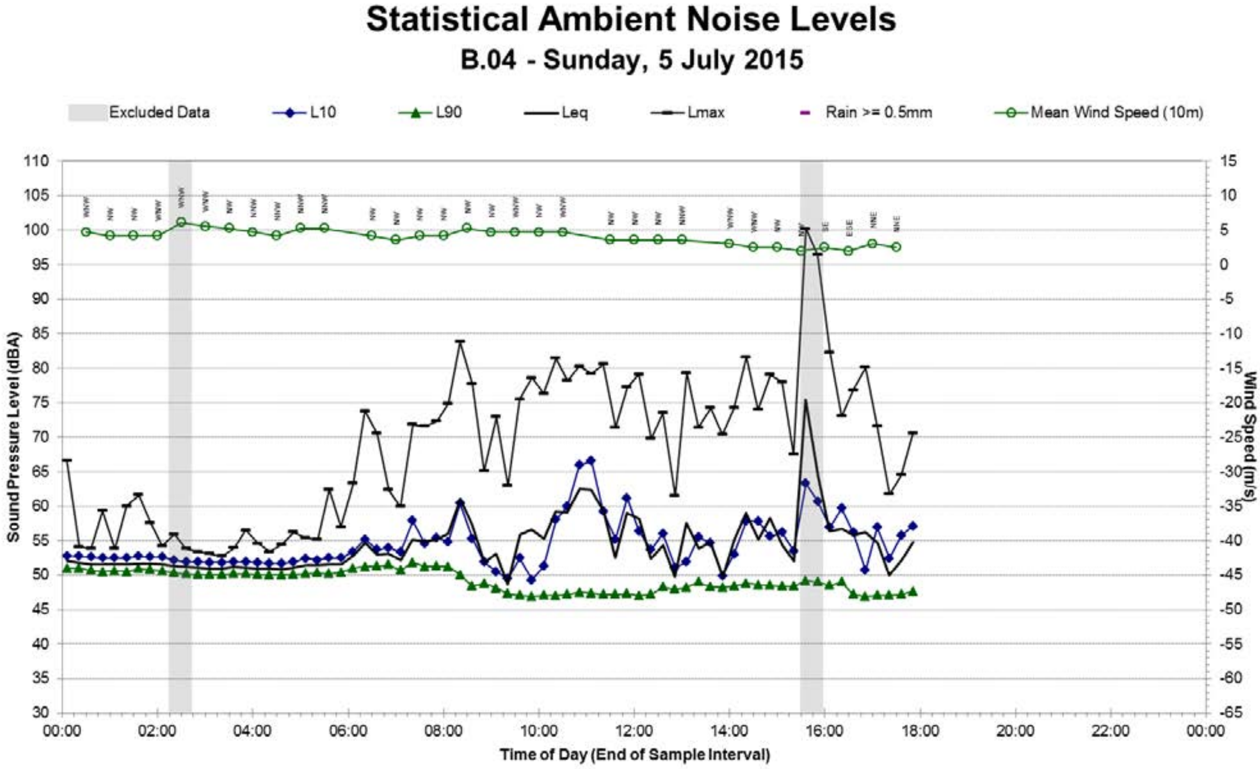




Background Noise Monitoring Results – B.04






Statistical Ambient Noise Levels
B.04 - Sunday, 5 July 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Background Noise Monitoring Results – B.05

Noise Monitoring Location:	**B.05**
Noise Monitoring Address:	**43 Burren Street, Erskineville 2043**

Logger Device Type: ARL-EL316
Logger Serial No: 16-306-047

Ambient noise logger deployed at rear of residential address 43 Burren Street, Erskineville. Logger located in north eastern corner of back yard.

Attended noise measurements indicate that the ambient noise environment at this location is dominated by rail traffic noise from the Homebush line to the north and the Liverpool line to the south.

Map of Noise Monitoring Location

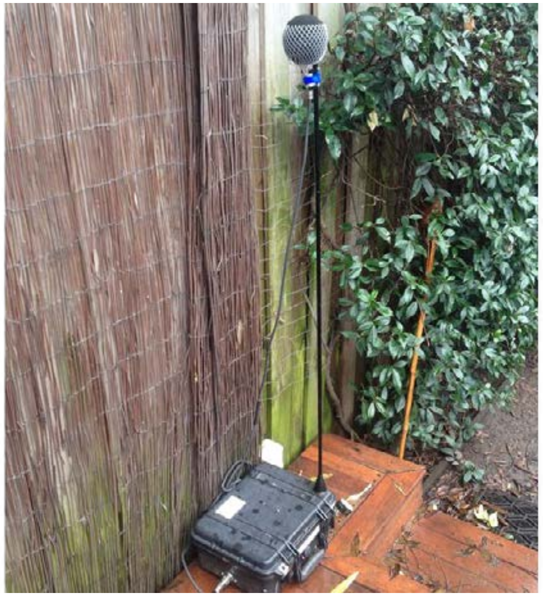
Ambient Noise Logging Results – INP Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	46	65	64	69
Evening	42	64	52	58
Night-time	39	50	44	52

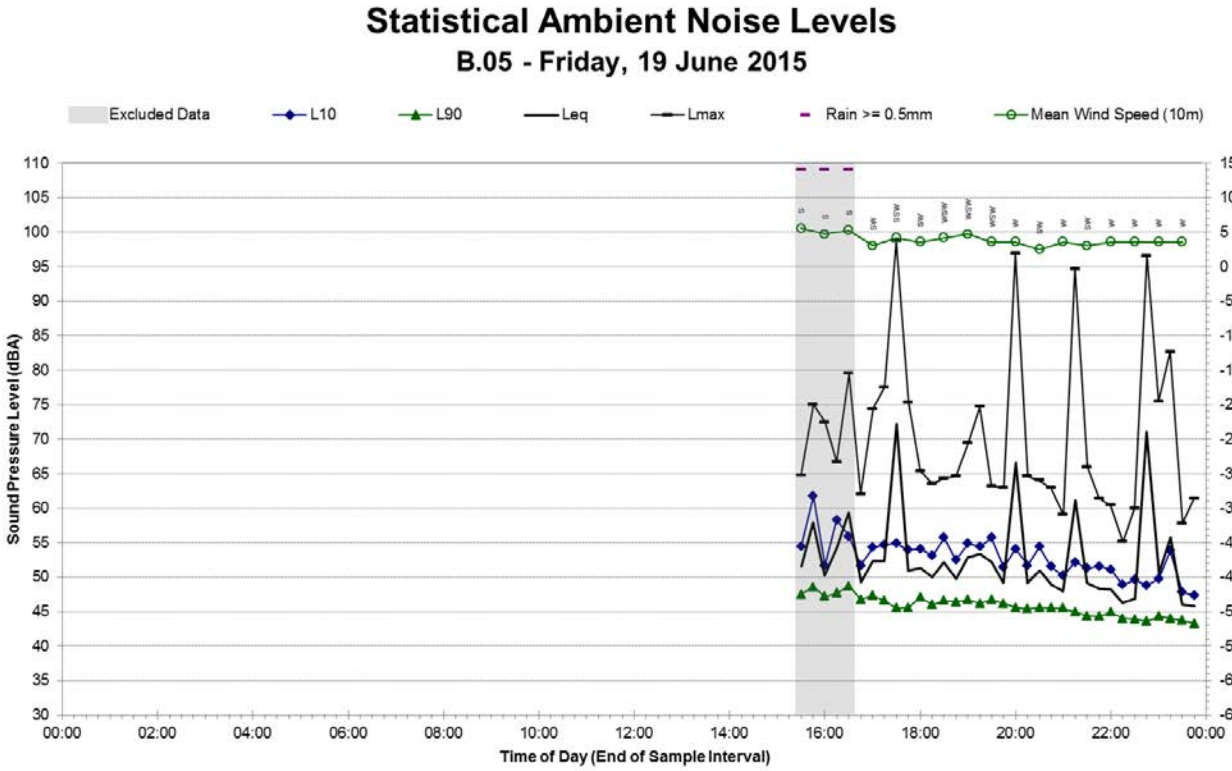
Attended Noise Measurement Results

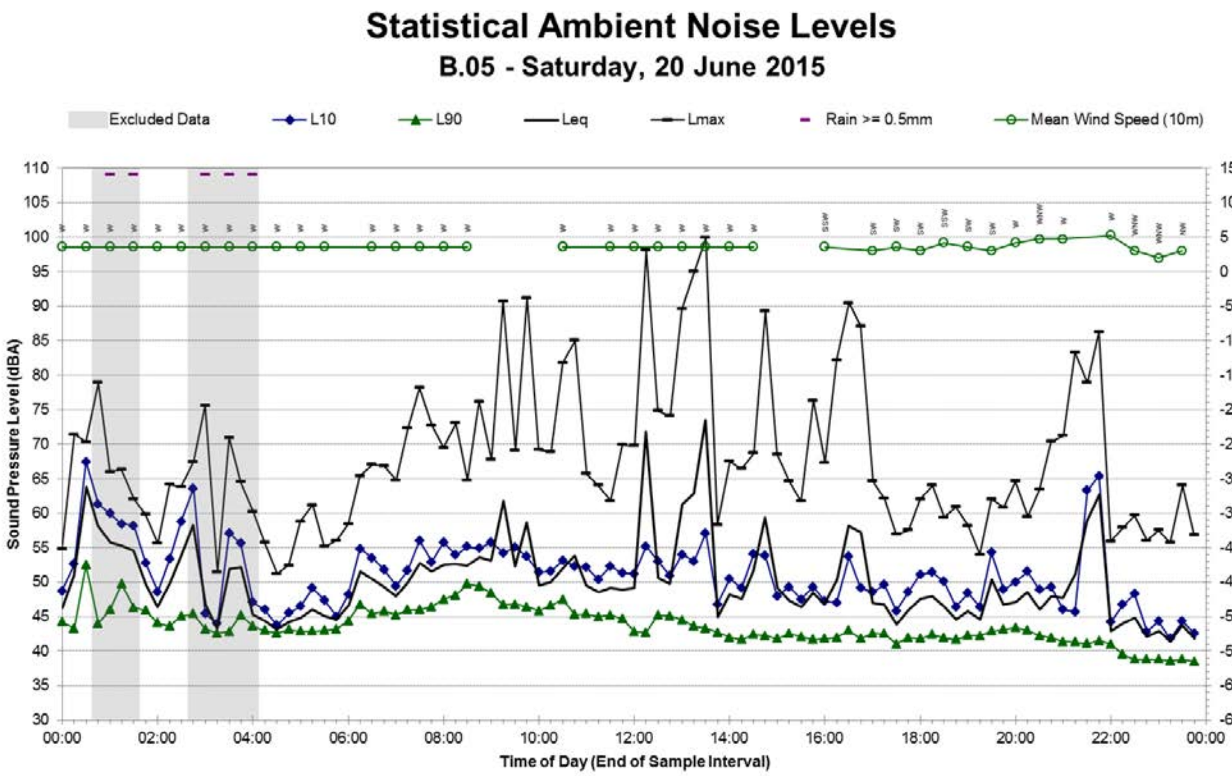
Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
19/06/2015	15:16:26	49	52	64

Photo of Noise Monitoring Location

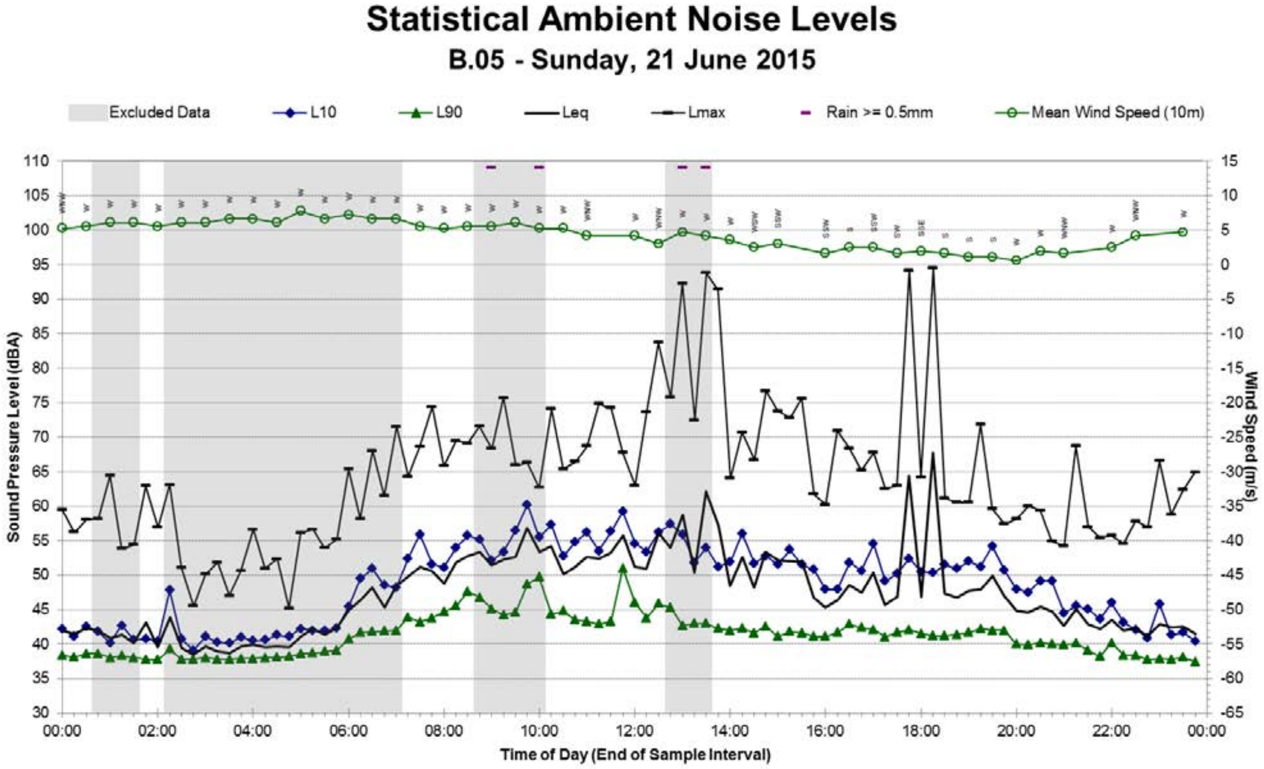


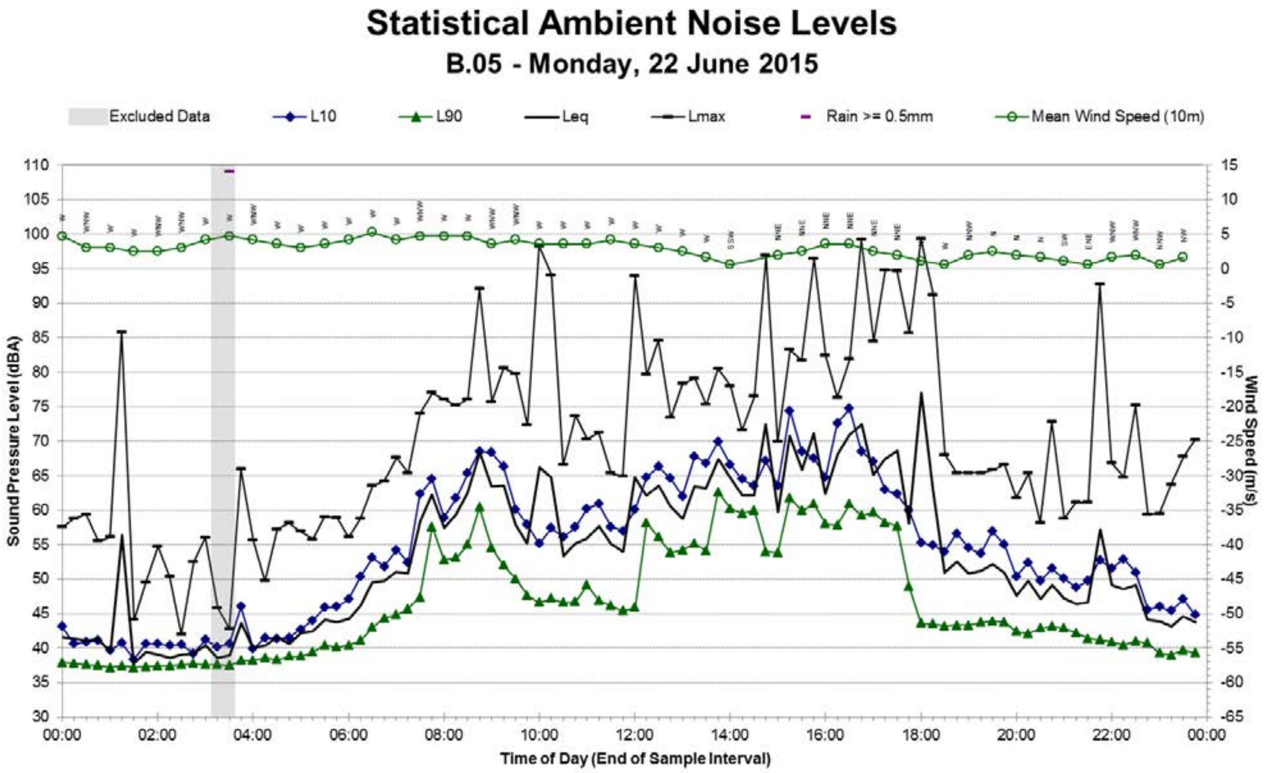
Background Noise Monitoring Results – B.05



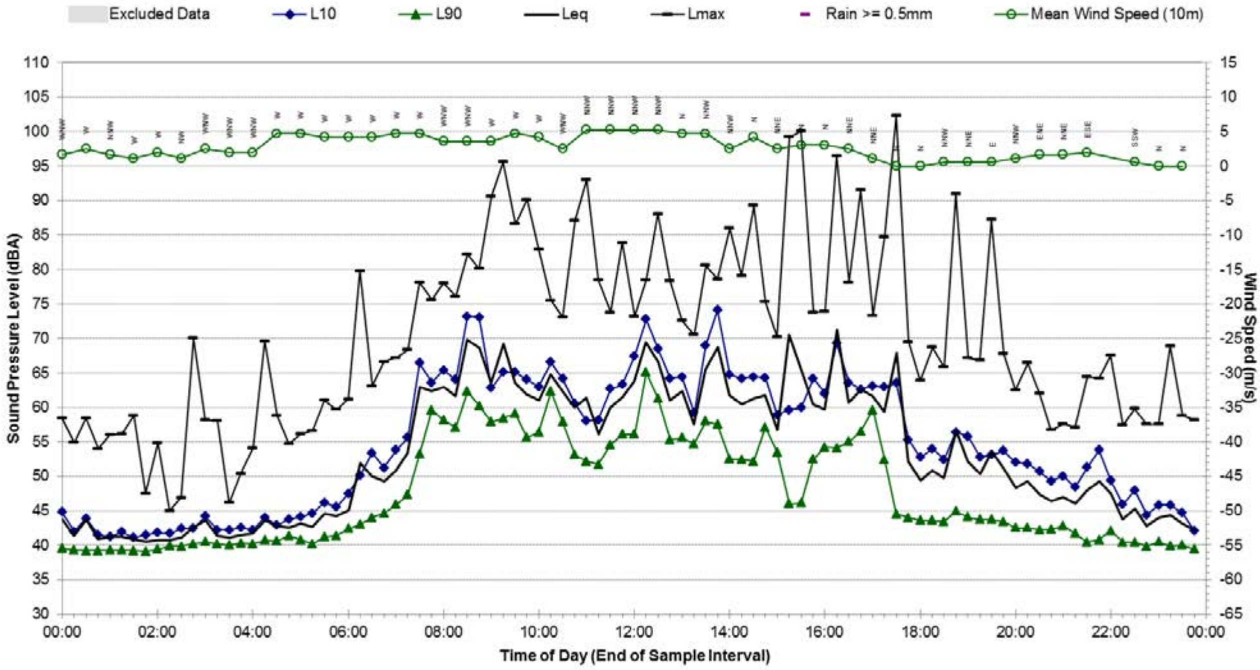


Background Noise Monitoring Results – B.05

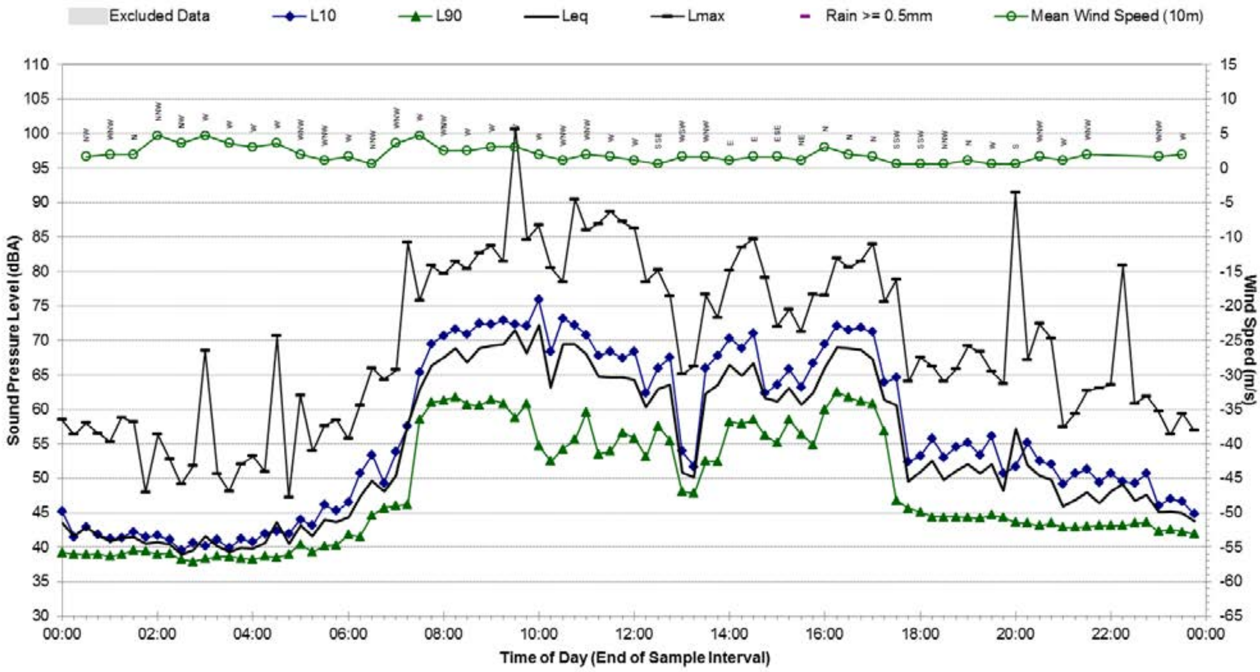




Statistical Ambient Noise Levels
B.05 - Tuesday, 23 June 2015

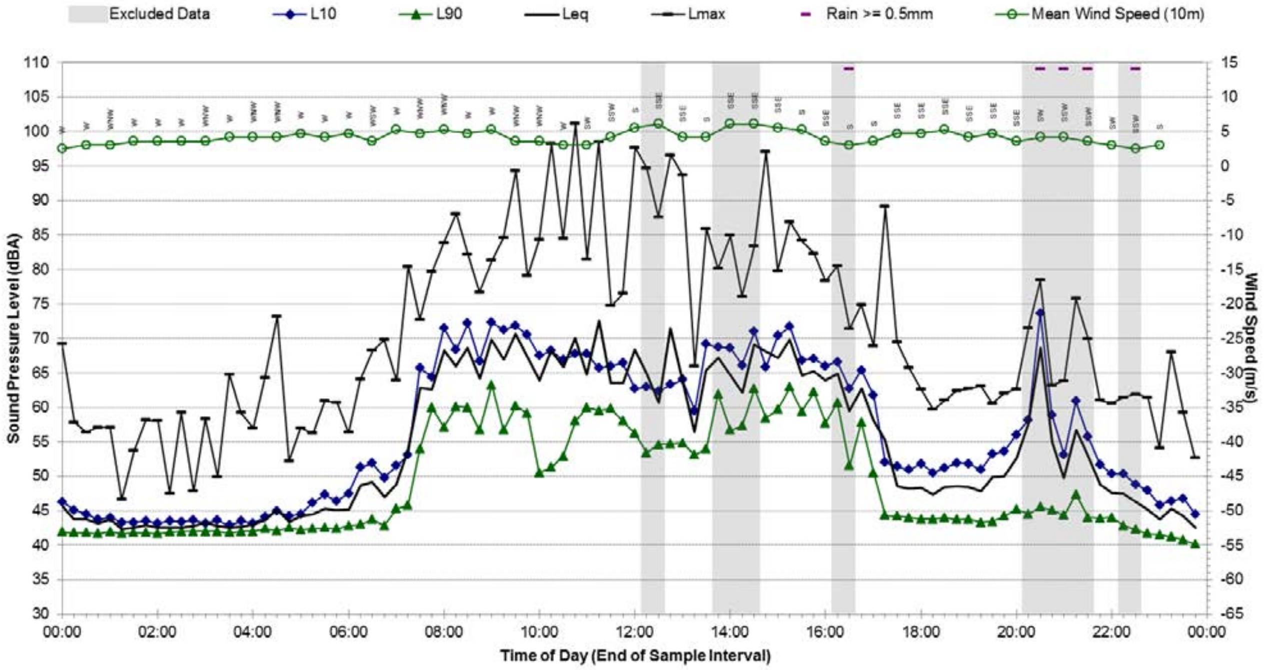


Statistical Ambient Noise Levels
B.05 - Wednesday, 24 June 2015

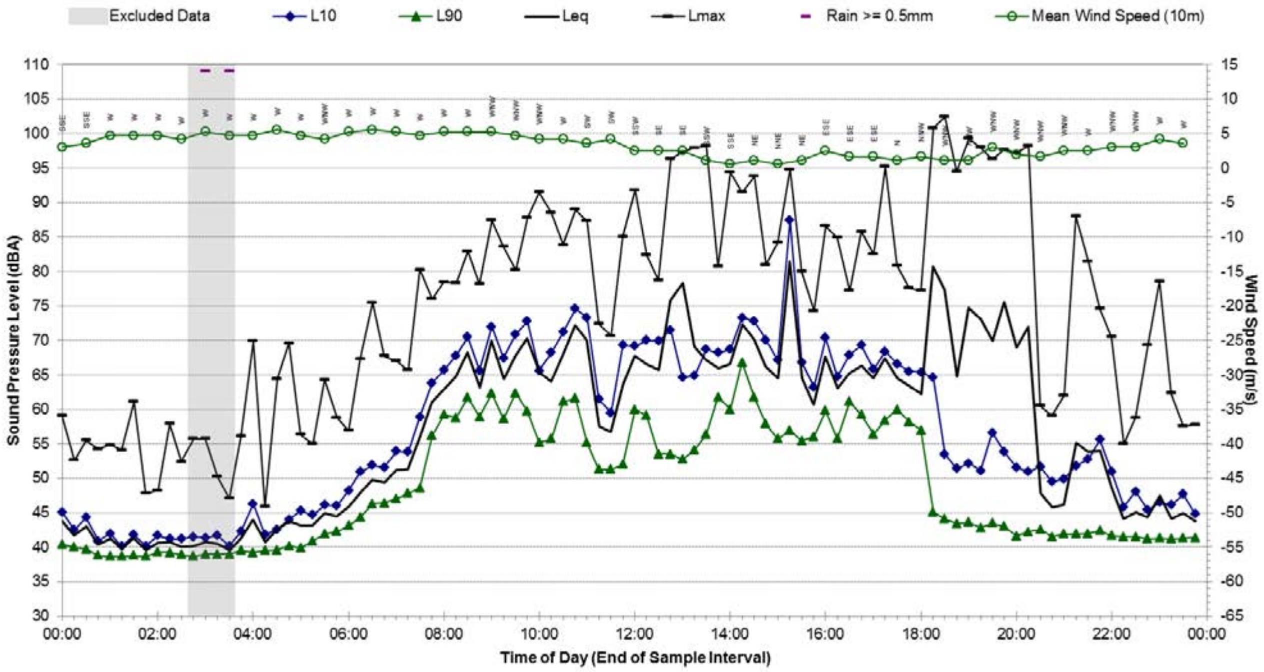


Background Noise Monitoring Results – B.05

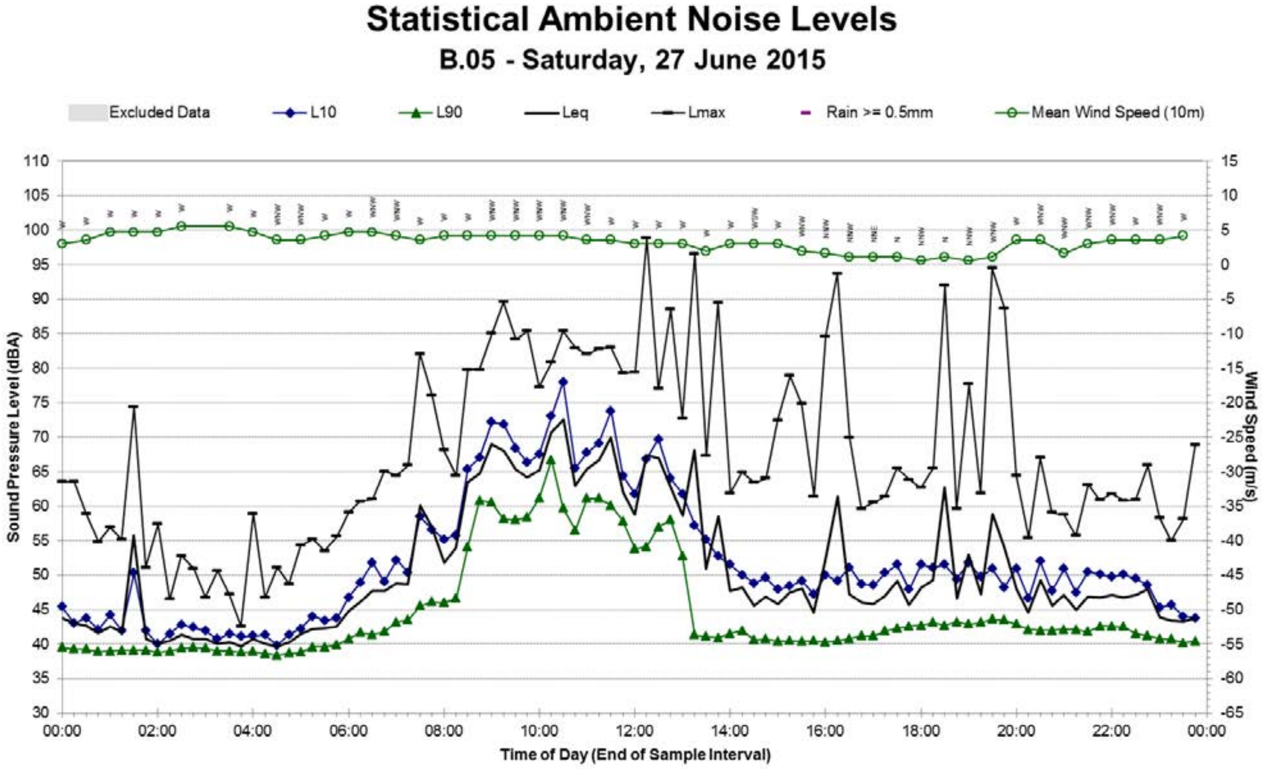
Statistical Ambient Noise Levels
B.05 - Thursday, 25 June 2015

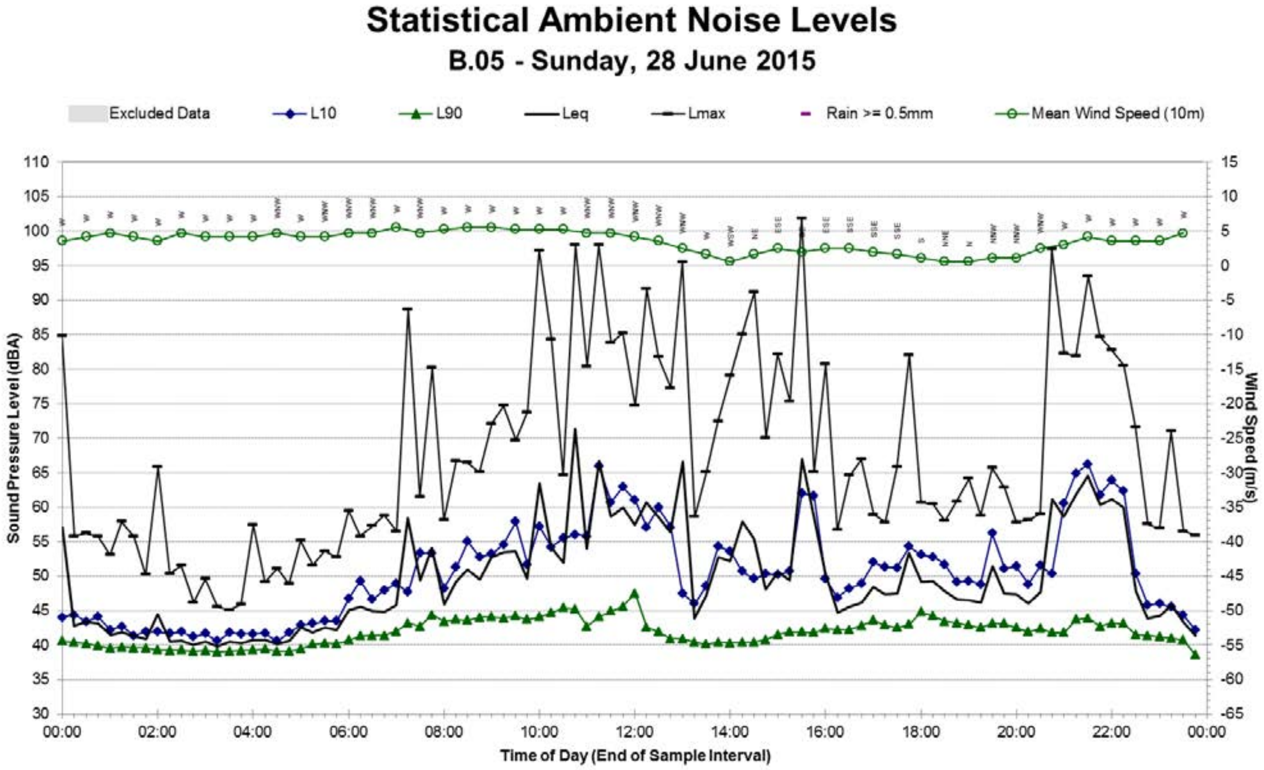


Statistical Ambient Noise Levels
B.05 - Friday, 26 June 2015

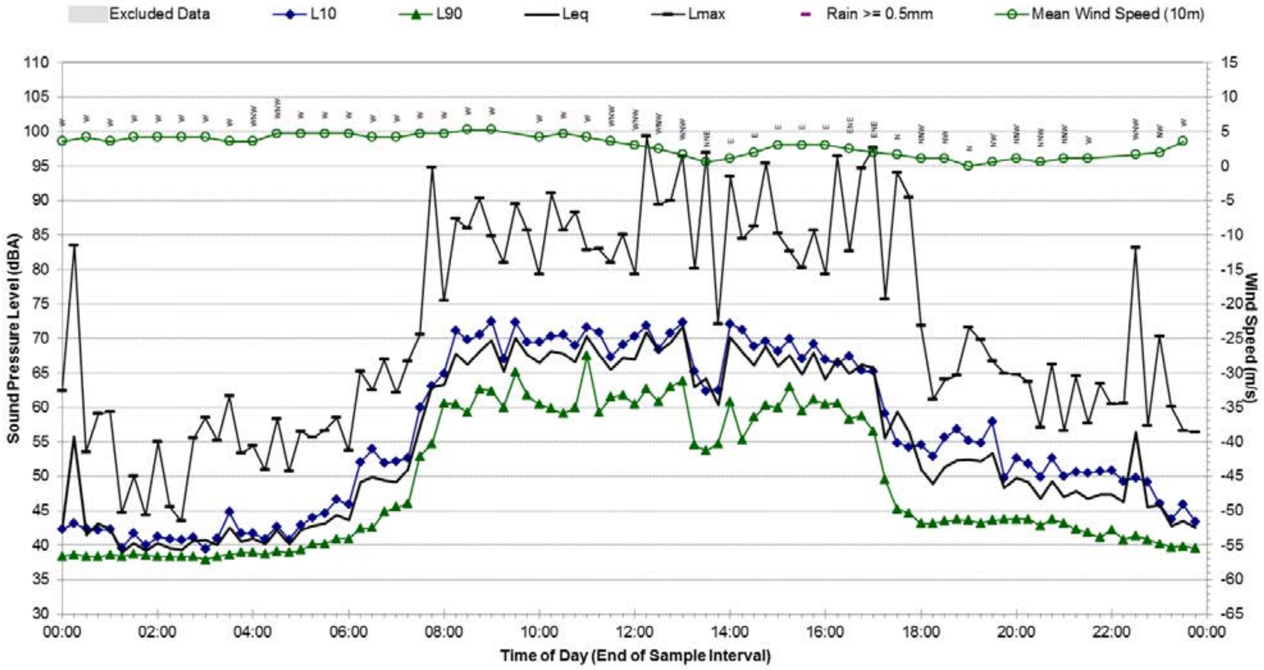


Background Noise Monitoring Results – B.05

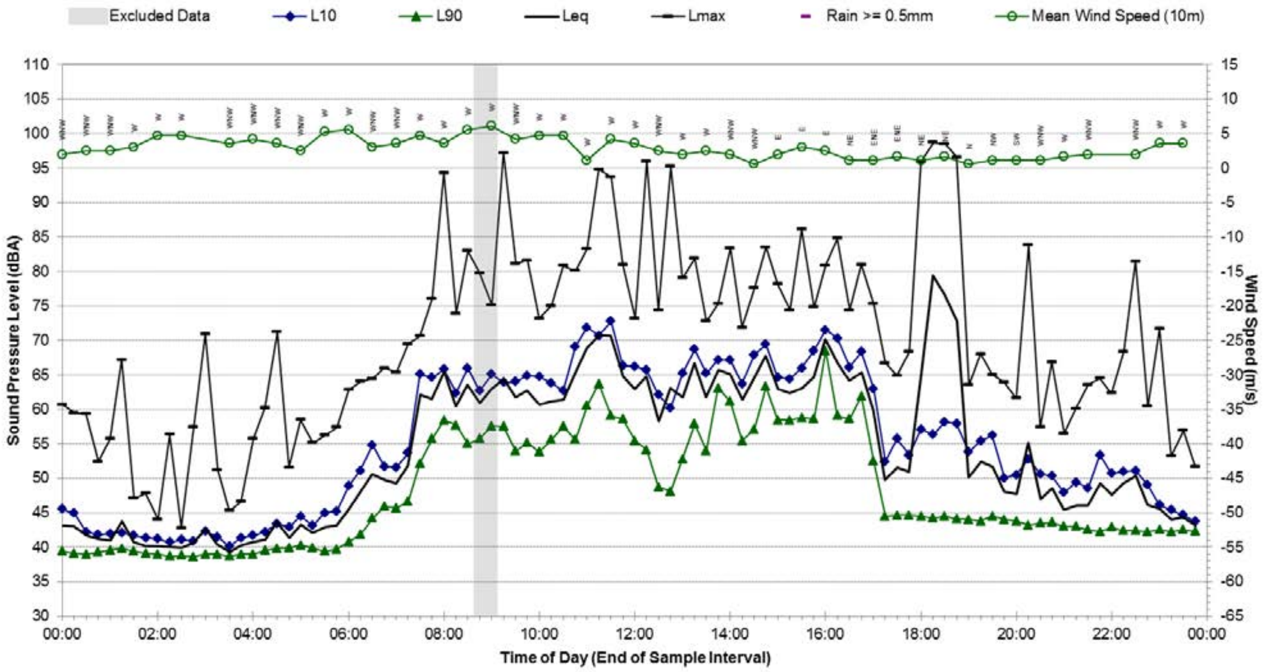




Statistical Ambient Noise Levels
B.05 - Monday, 29 June 2015

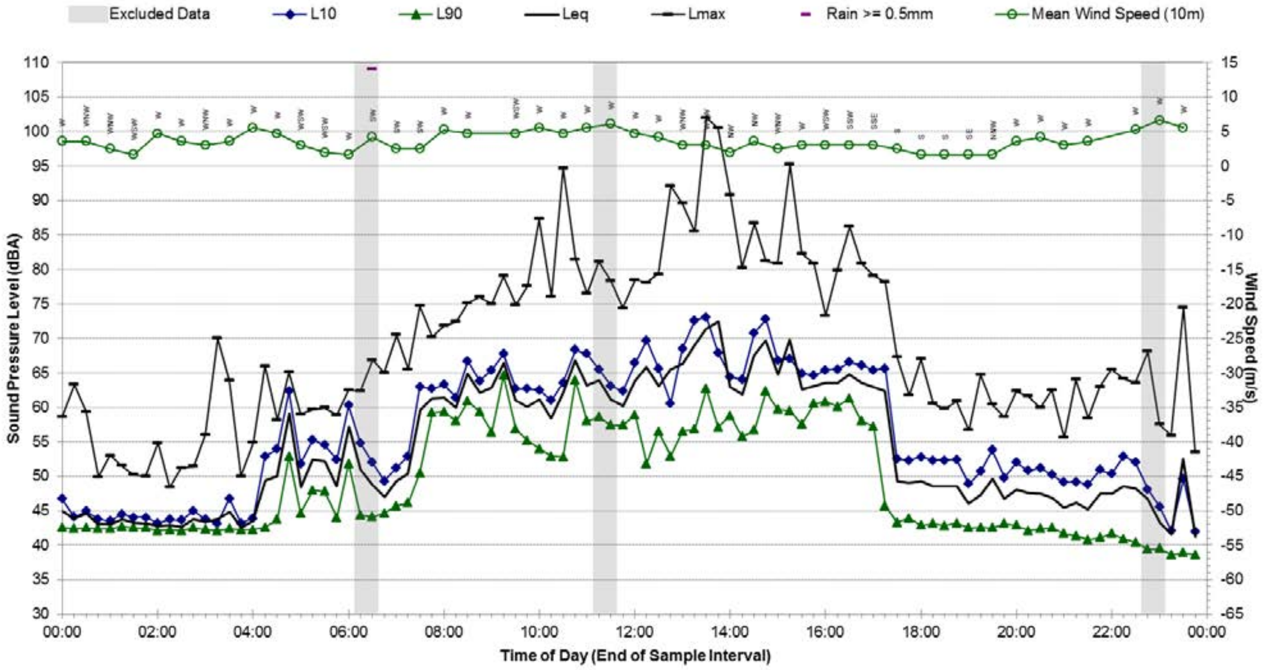


Statistical Ambient Noise Levels
B.05 - Tuesday, 30 June 2015

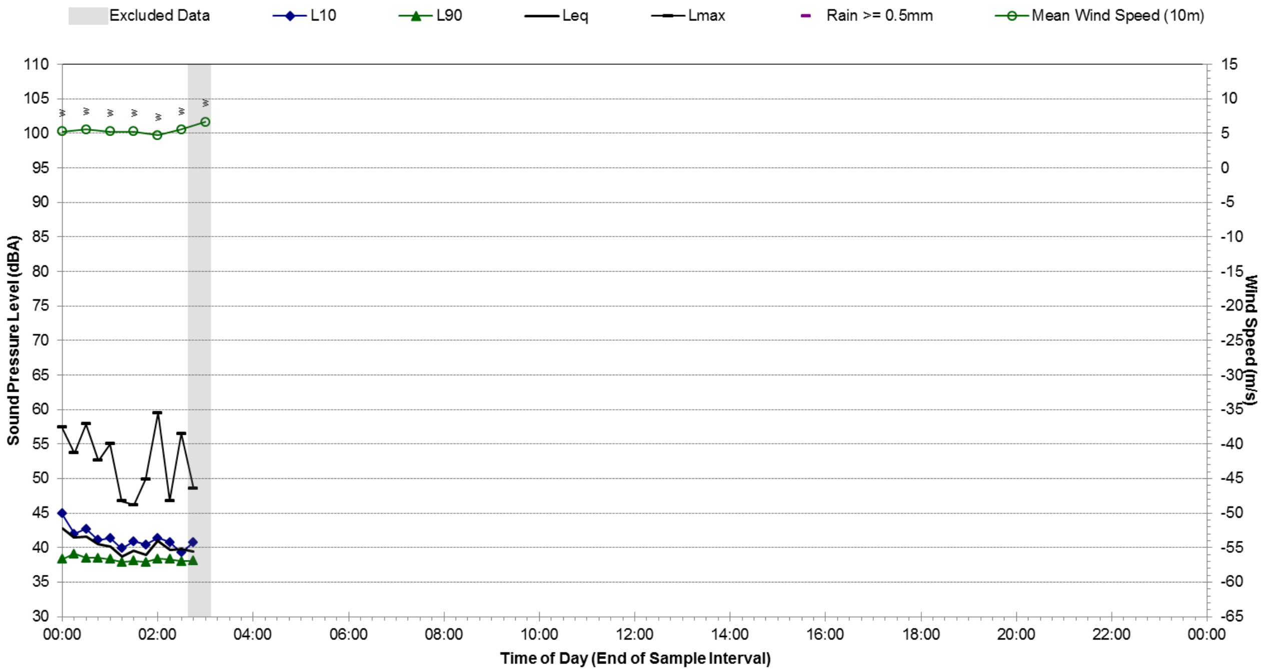


Background Noise Monitoring Results – B.05

Statistical Ambient Noise Levels
B.05 - Wednesday, 1 July 2015



Statistical Ambient Noise Levels
B.05 - Thursday, 2 July 2015



Background Noise Monitoring Results – B.06

Noise Monitoring Location:	**B.06**
Noise Monitoring Address:	**122 Wellington Street, Waterloo 2017**

Logger Device Type: Svantek 957
Logger Serial No: 23245

Ambient noise logger deployed at the front of residential address 122 Wellington Street, Waterloo. Logger located on the balcony of the second floor overlooking the intersection of Cope Street and Wellington Street.

Attended noise measurements indicate that the ambient noise environment at this location is dominated by road traffic noise from the intersection during the daytime. Constant tyre-pavement/engine noise from light-vehicle traffic on surrounding roads can be heard at this location. Discrete traffic noise level peaks from heavy vehicle movements on Botany Road to the west were also frequently noted.

Map of Noise Monitoring Location

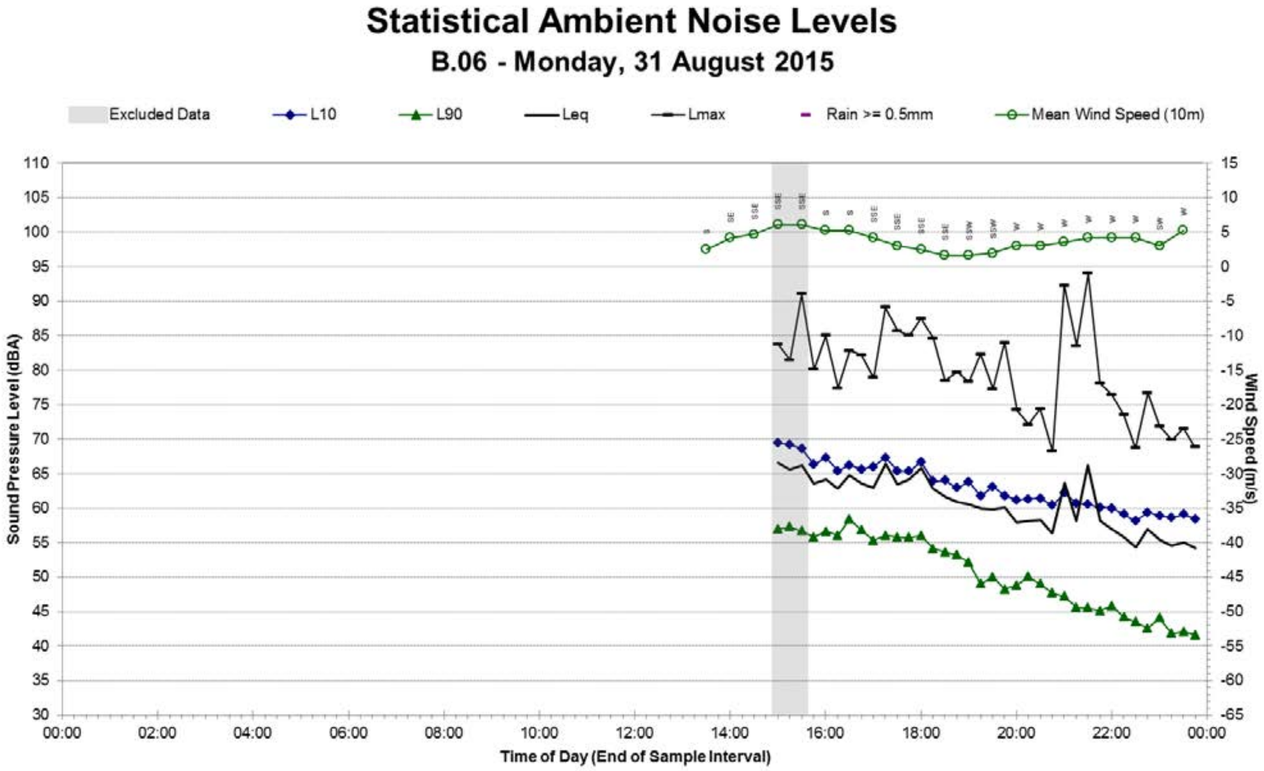
Ambient Noise Logging Results – INP Defined Time Periods

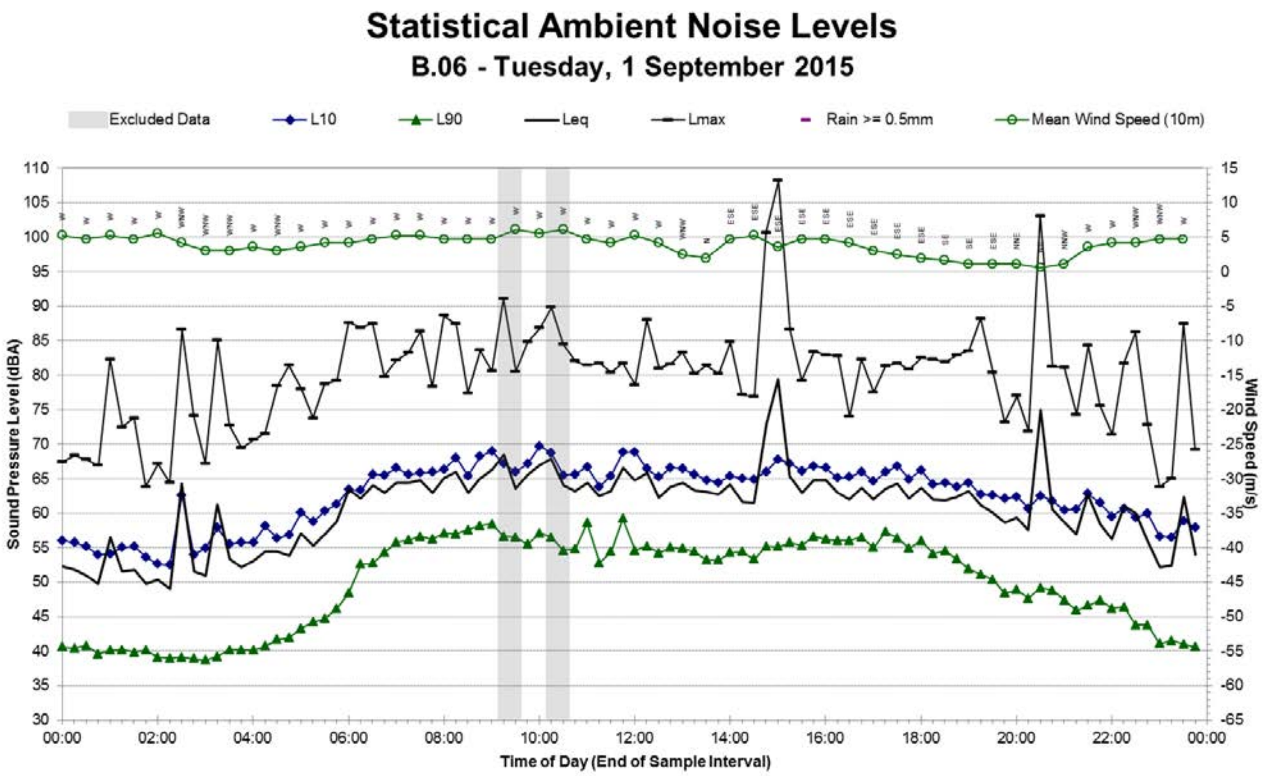
Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	54	65	66	73
Evening	47	62	62	69
Night-time	39	58	58	65

Attended Noise Measurement Results

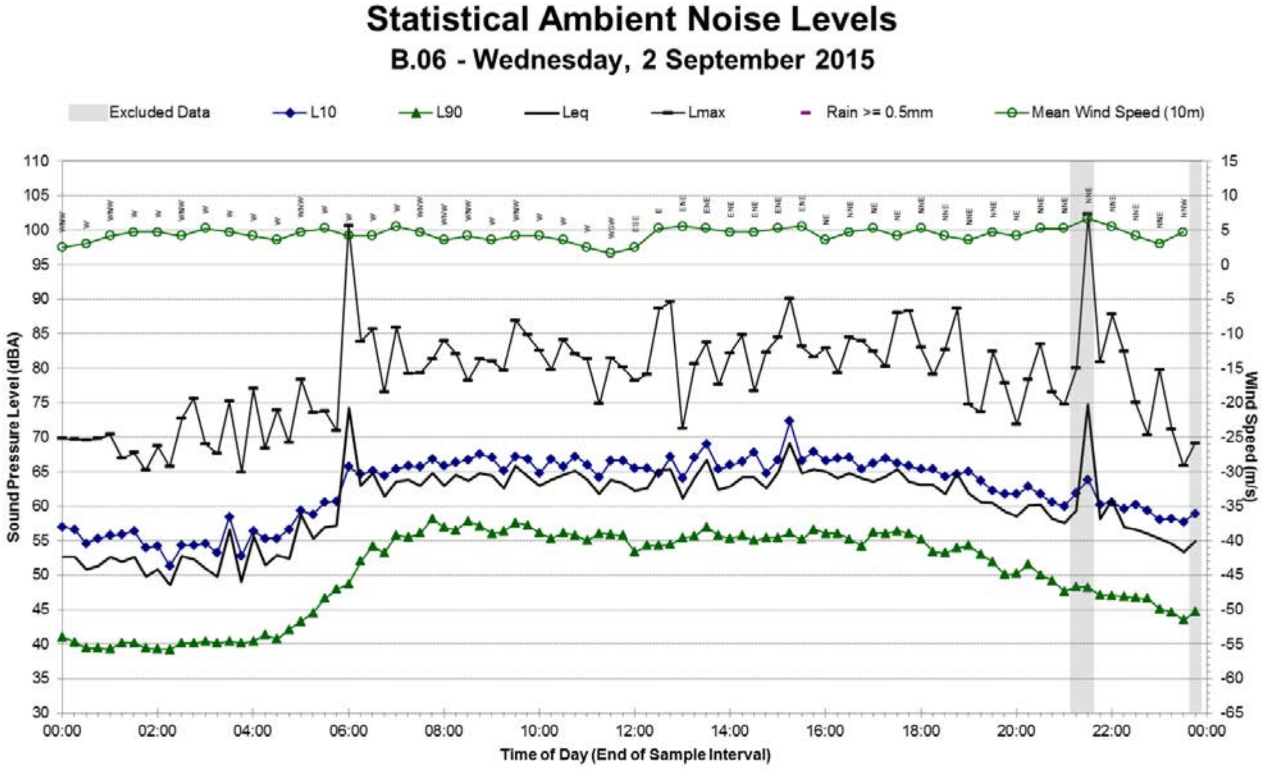
Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
14/09/2015	09:46:17	55	63	83

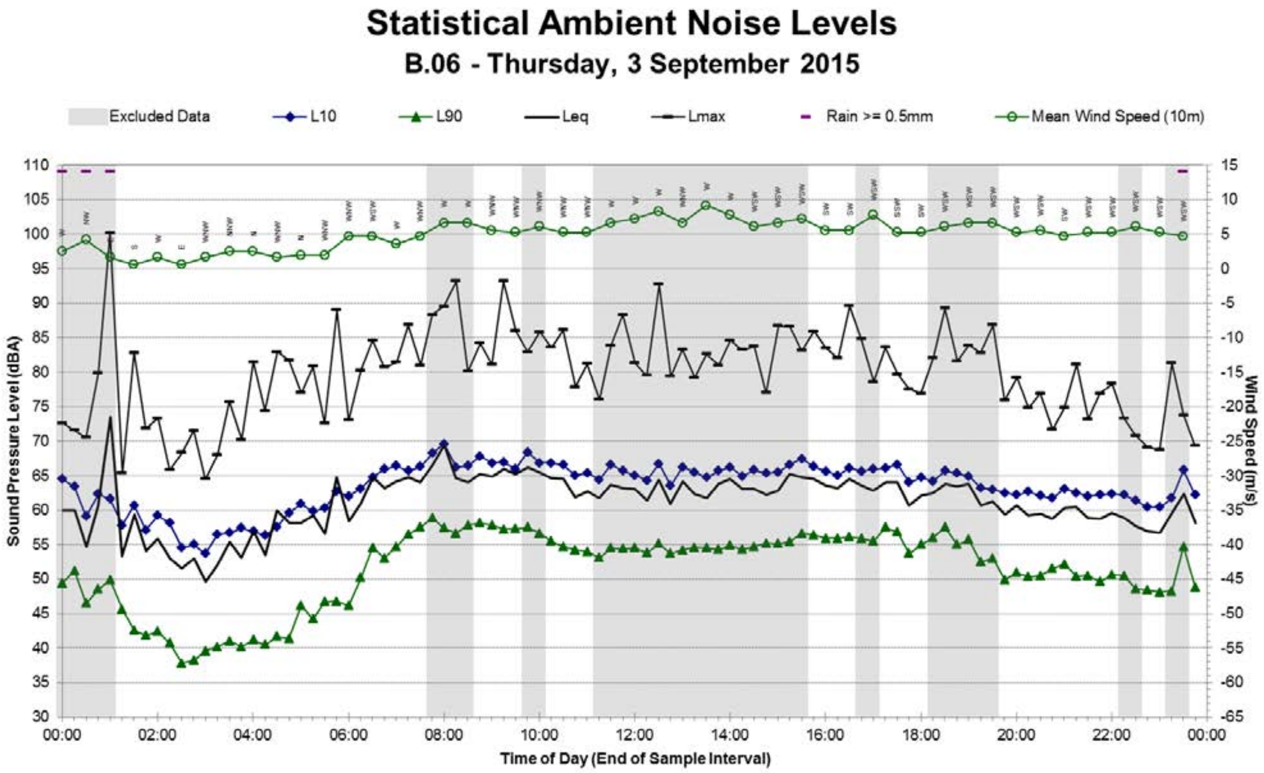
Photo of Noise Monitoring Location


Statistical Ambient Noise Levels
B.06 - Monday, 31 August 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
B.06 - Tuesday, 1 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

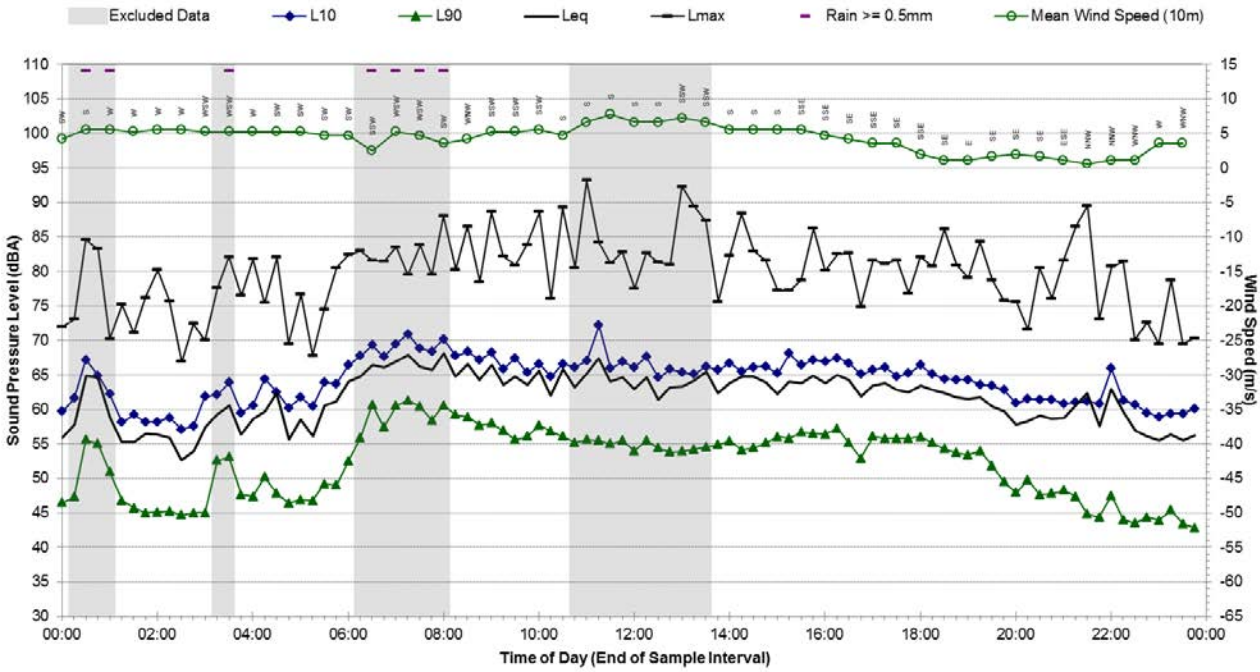
Background Noise Monitoring Results – B.06



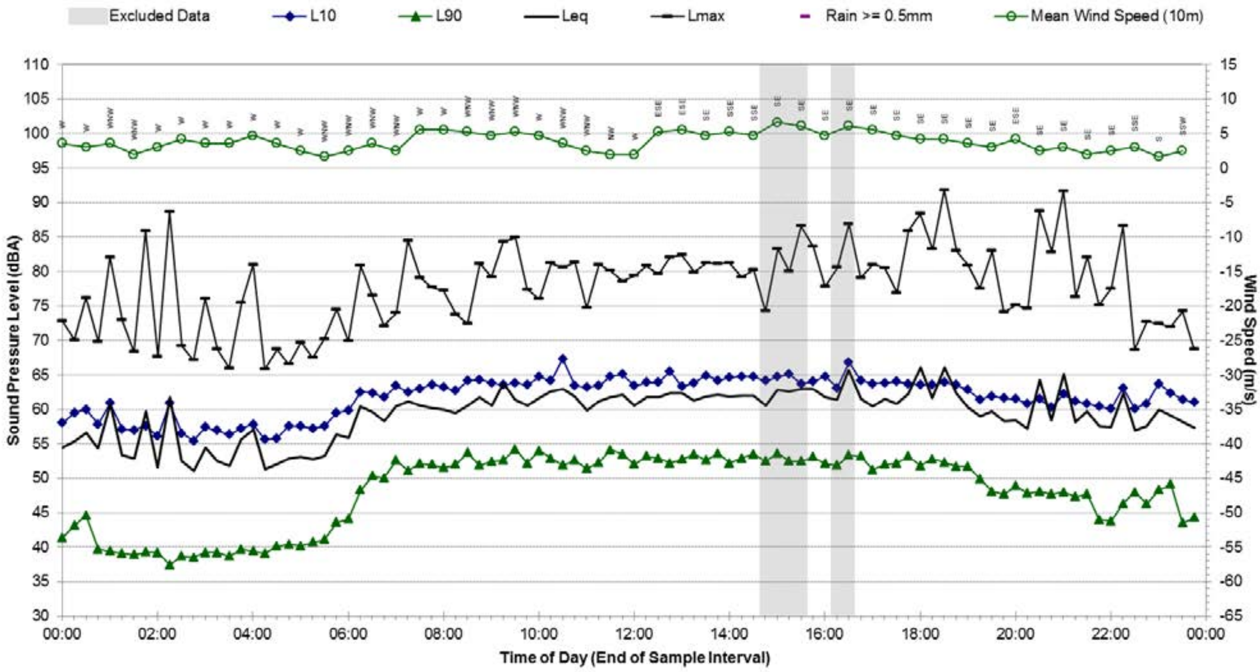


Background Noise Monitoring Results – B.06

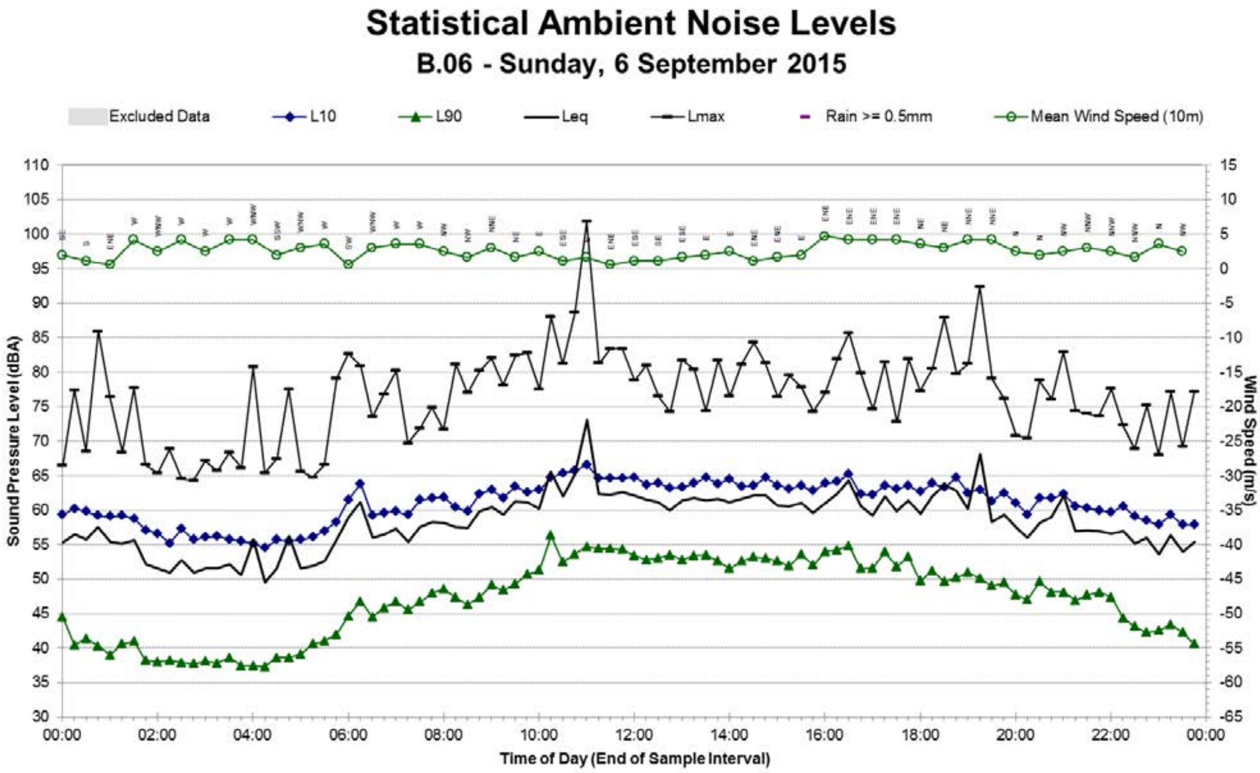
Statistical Ambient Noise Levels
B.06 - Friday, 4 September 2015

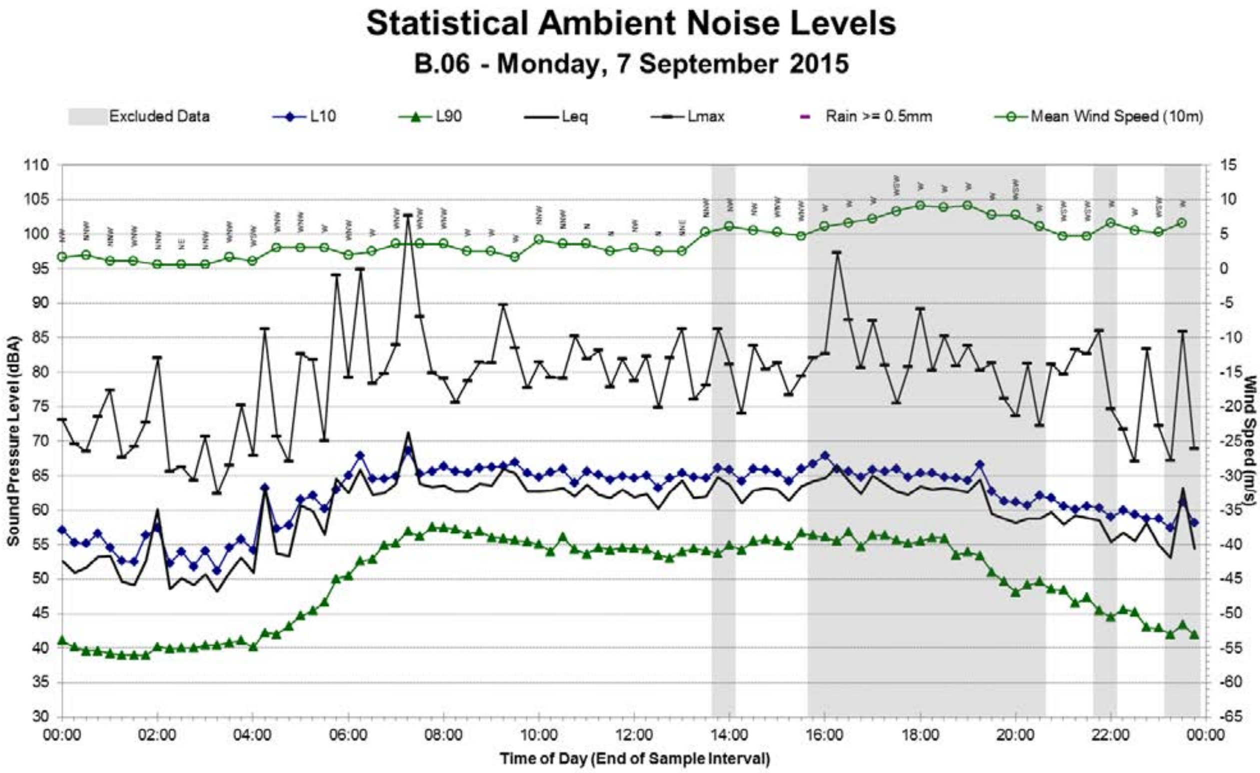


Statistical Ambient Noise Levels
B.06 - Saturday, 5 September 2015

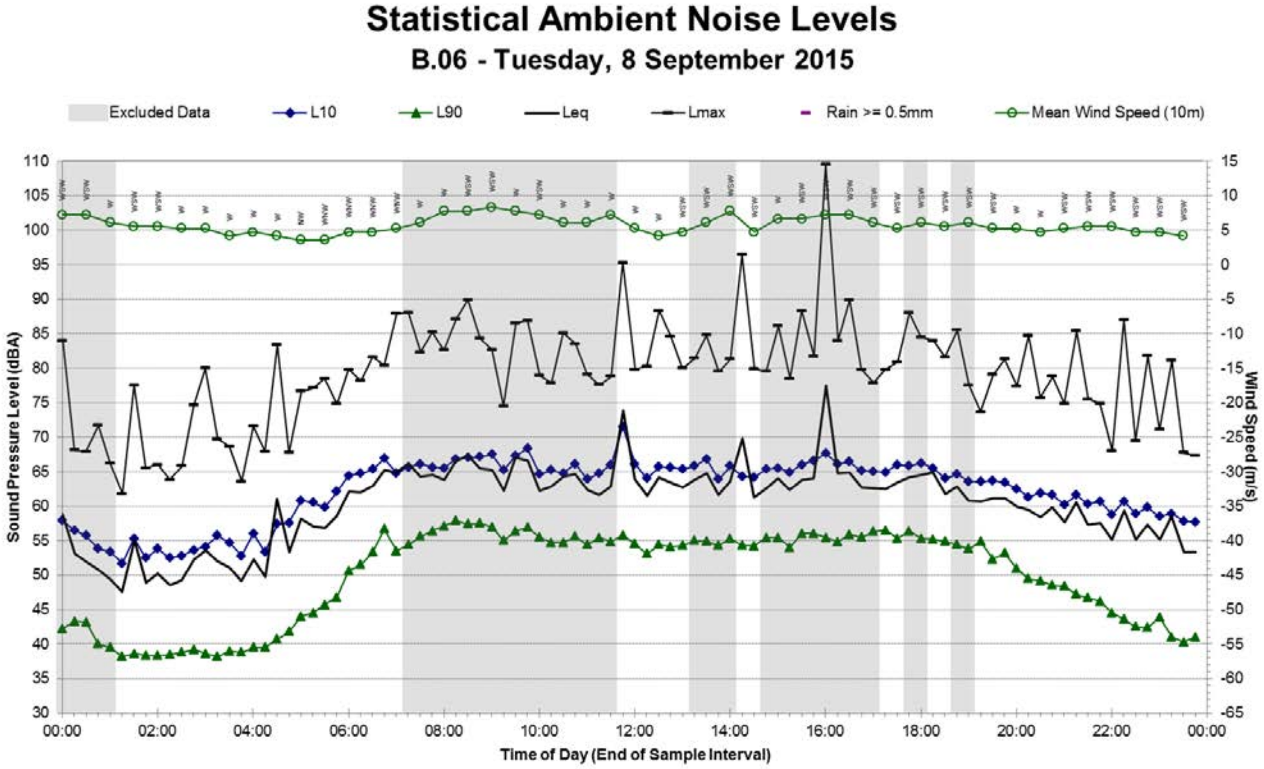


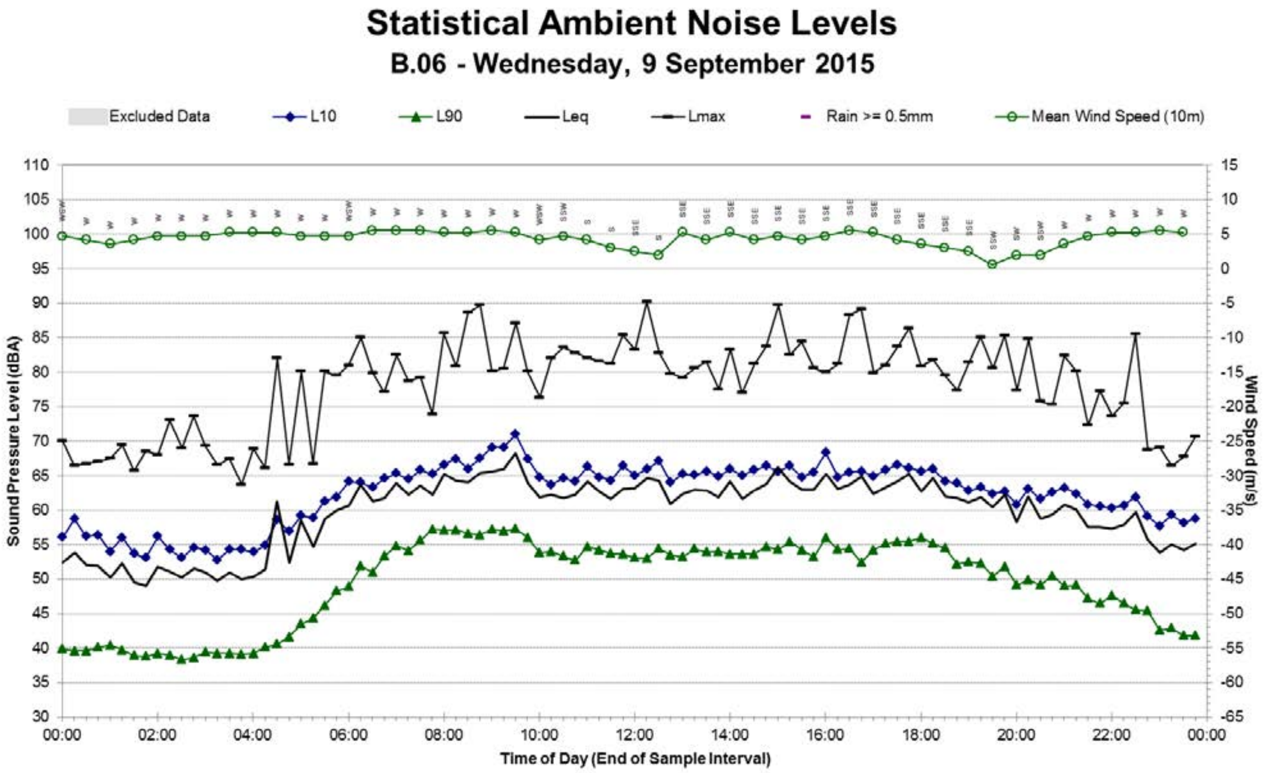
Background Noise Monitoring Results – B.06



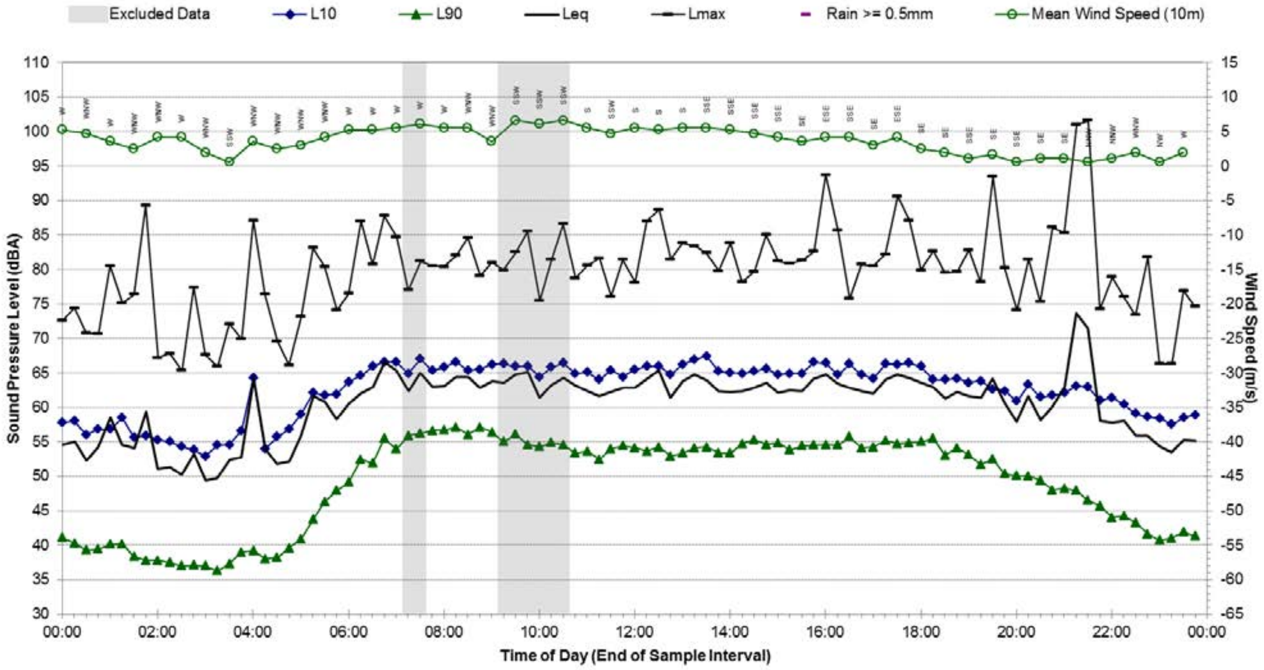


Background Noise Monitoring Results – B.06

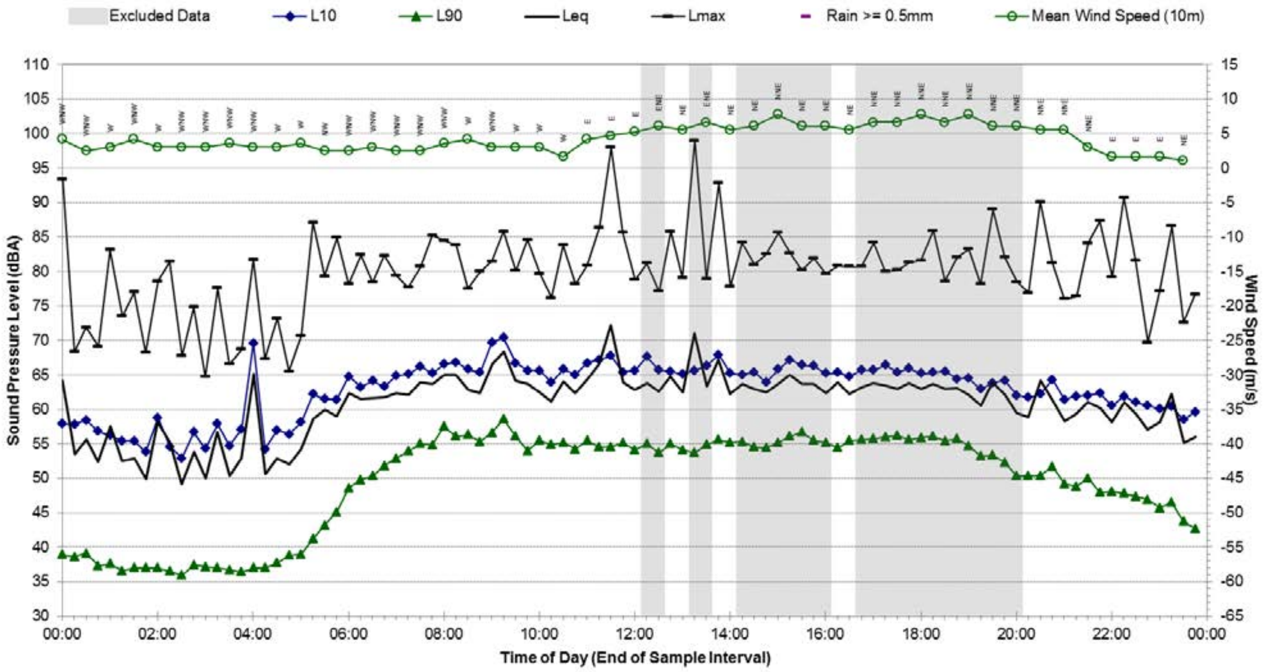




Statistical Ambient Noise Levels
B.06 - Thursday, 10 September 2015

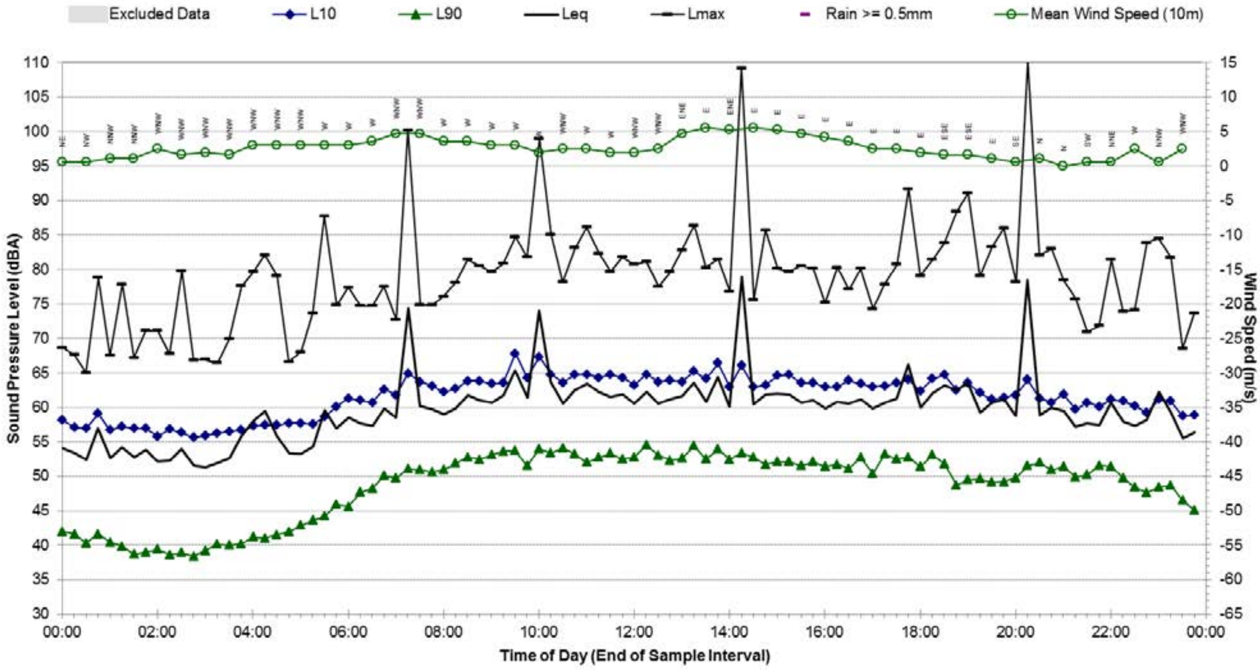


Statistical Ambient Noise Levels
B.06 - Friday, 11 September 2015

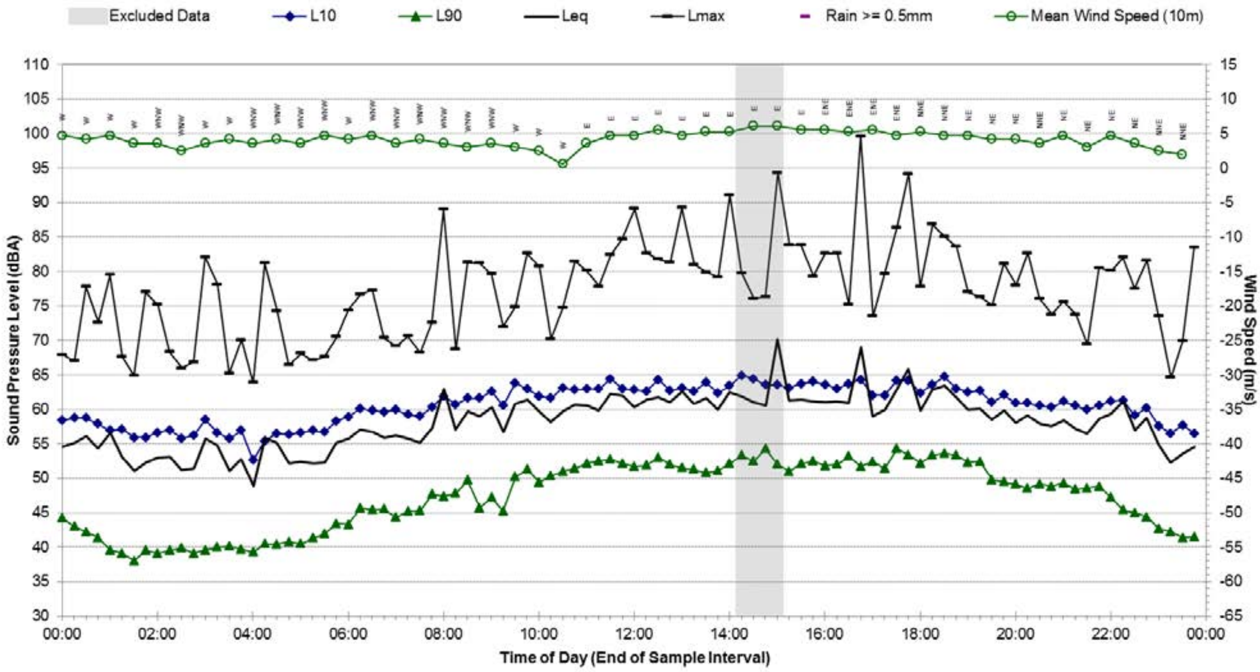


Background Noise Monitoring Results – B.06

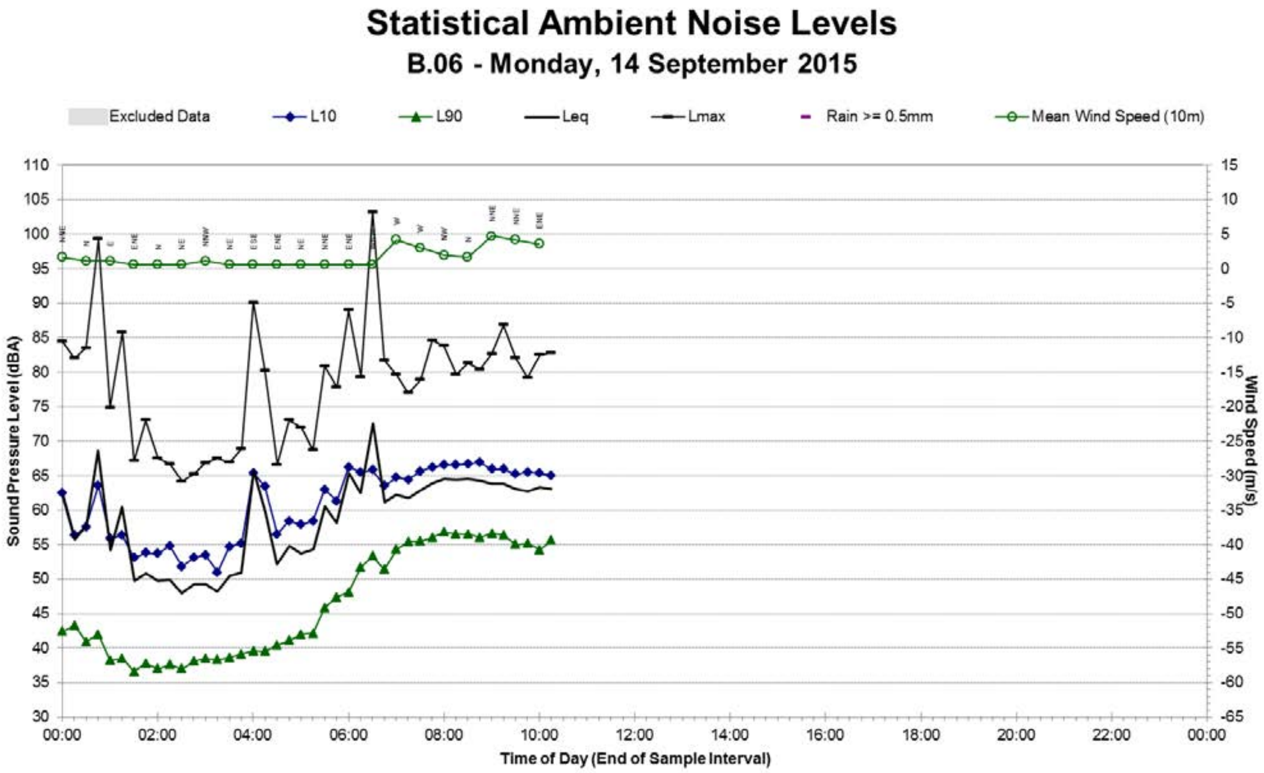
Statistical Ambient Noise Levels
B.06 - Saturday, 12 September 2015



Statistical Ambient Noise Levels
B.06 - Sunday, 13 September 2015



Background Noise Monitoring Results – B.06



Background Noise Monitoring Results – B.07

Noise Monitoring Location:	**B.07**
Noise Monitoring Address:	**87 Darlington Road, Darlington 2008**

Logger Device Type: Svantek 957
Logger Serial No: 23243

Ambient noise logger deployed at the front of residential address 87 Darlington Road, Darlington. Logger located on the northern front porch.

Attended noise measurements indicate that the ambient noise environment at this location is dominated by frequent medium-level road noise from Darlington Road and Codrington Street during the daytime.

Map of Noise Monitoring Location

Ambient Noise Logging Results – INP Defined Time Periods

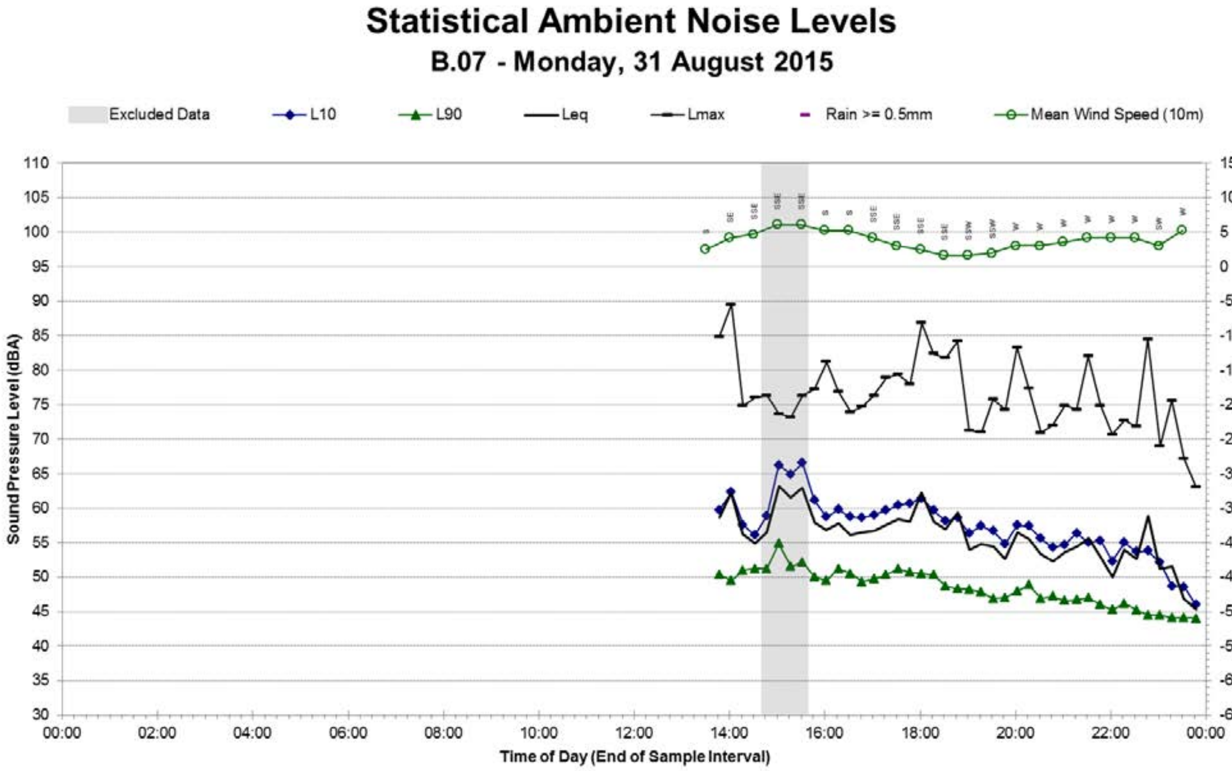
Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	49	63	60	68
Evening	47	57	57	66
Night-time	43	53	50	59

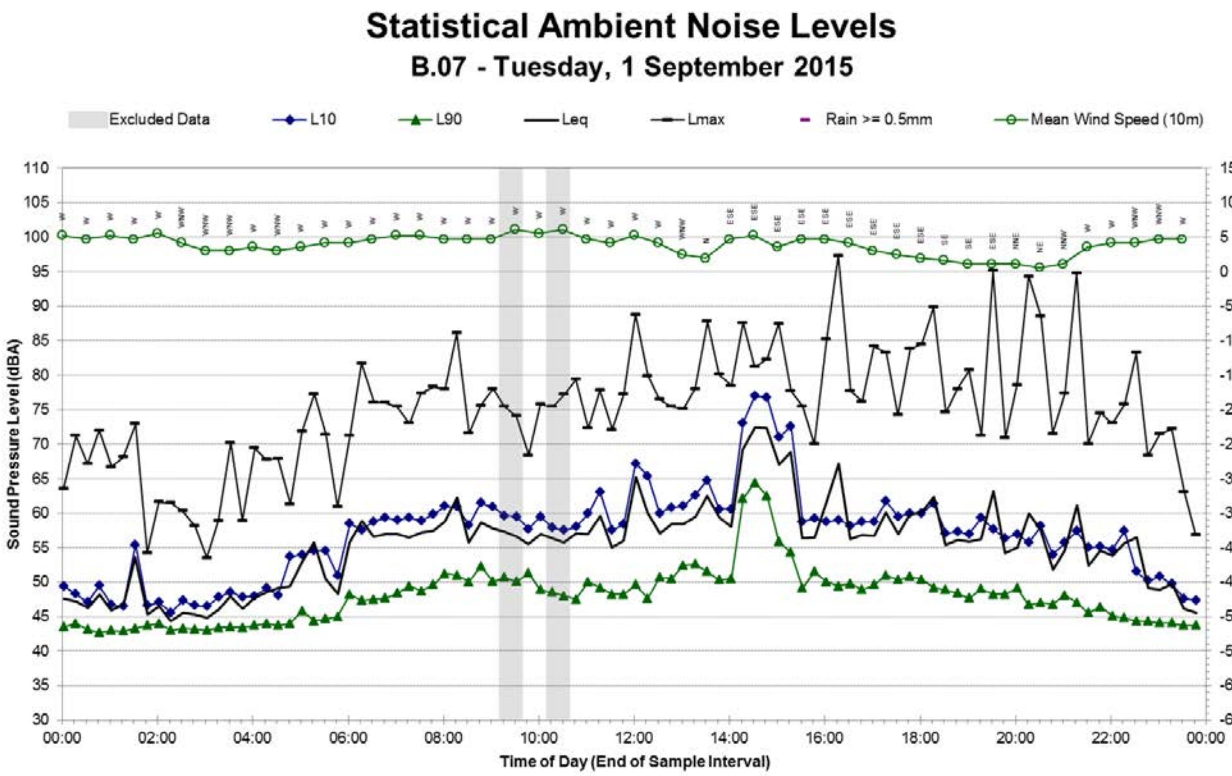
Attended Noise Measurement Results

Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
31/08/2015	13:19:59	51	60	85

Photo of Noise Monitoring Location

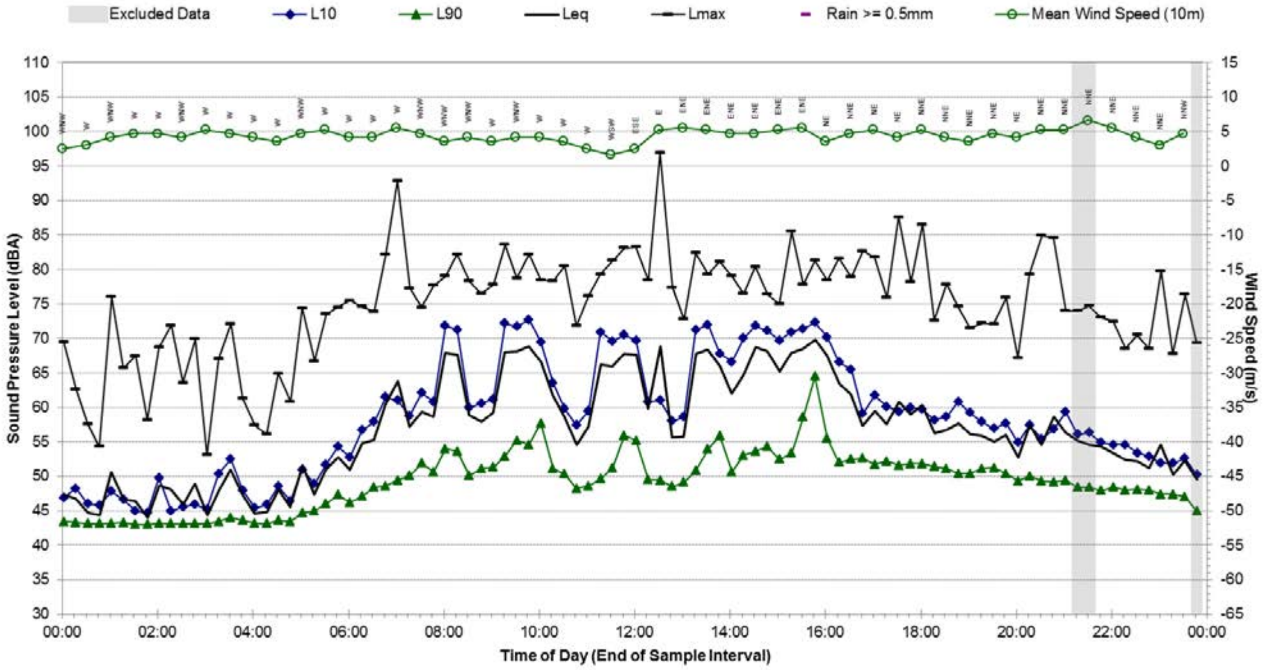
Background Noise Monitoring Results – B.07



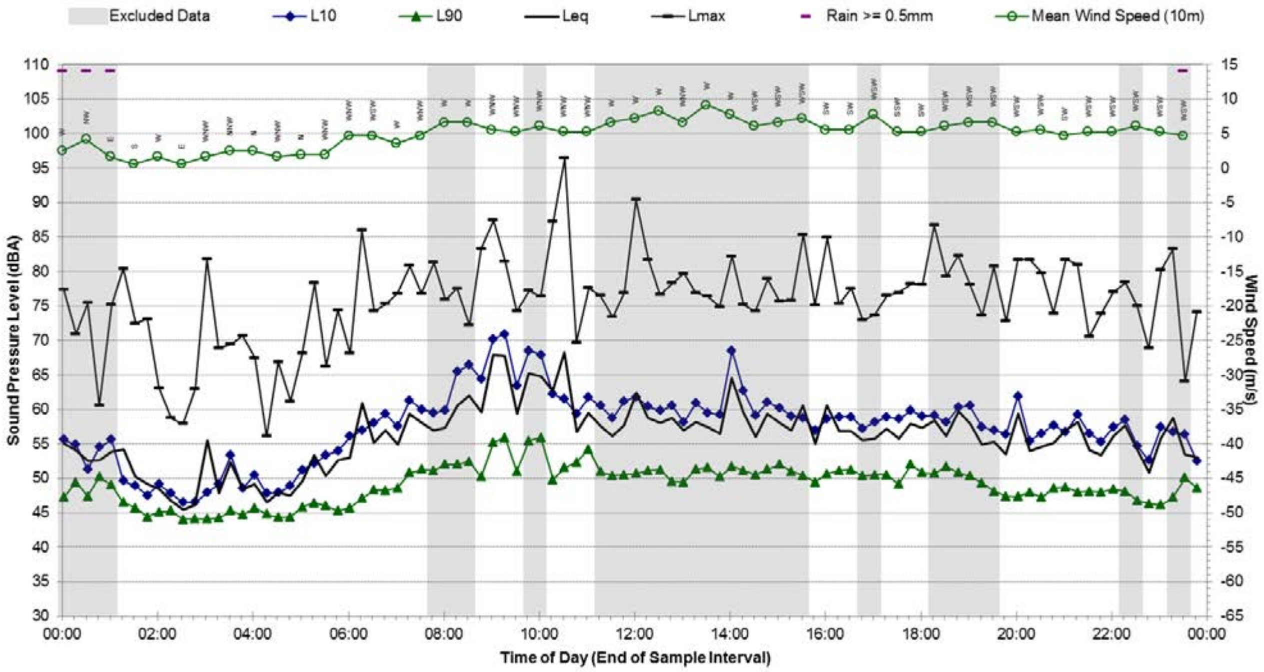


Background Noise Monitoring Results – B.07

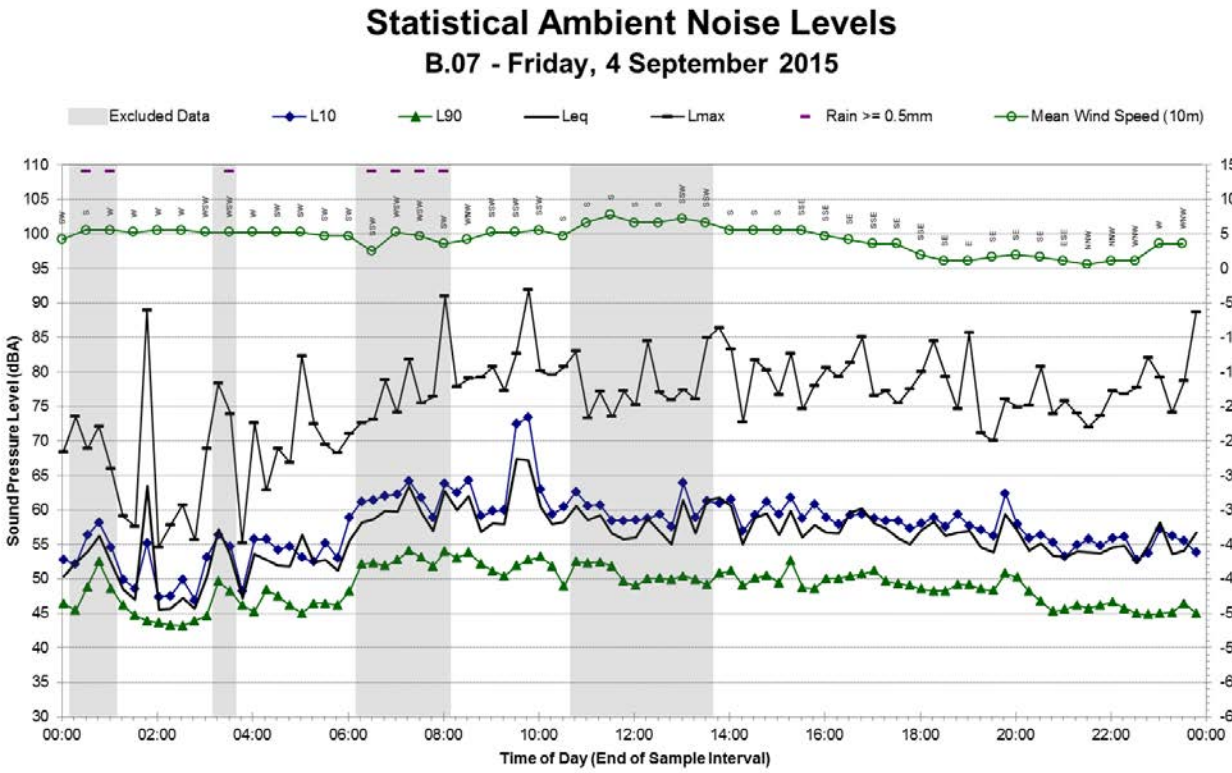
Statistical Ambient Noise Levels
B.07 - Wednesday, 2 September 2015

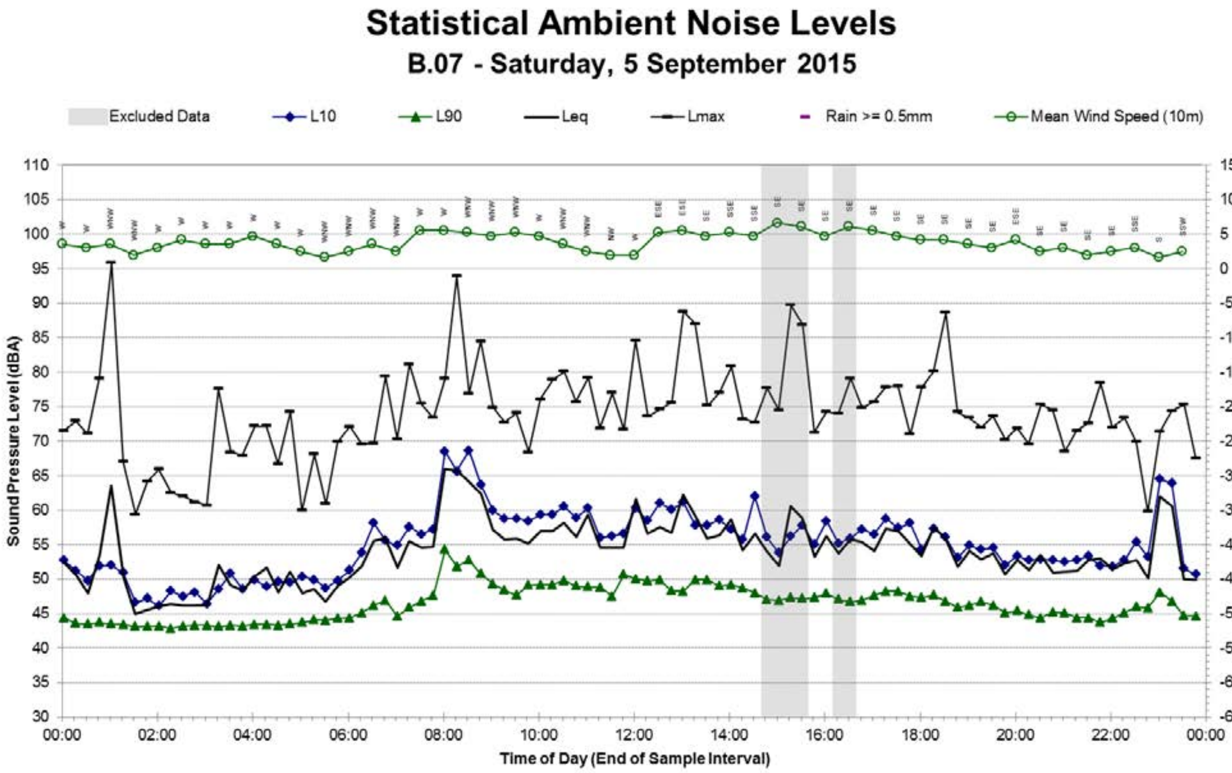


Statistical Ambient Noise Levels
B.07 - Thursday, 3 September 2015

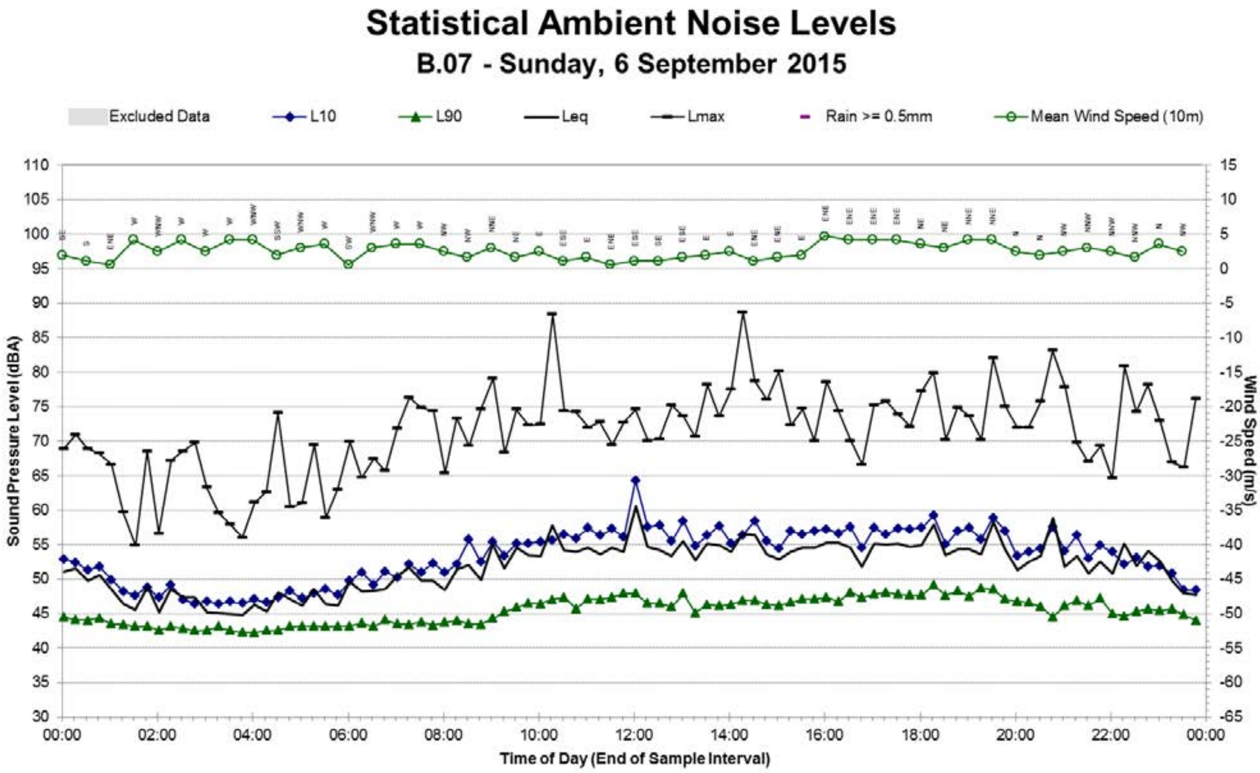


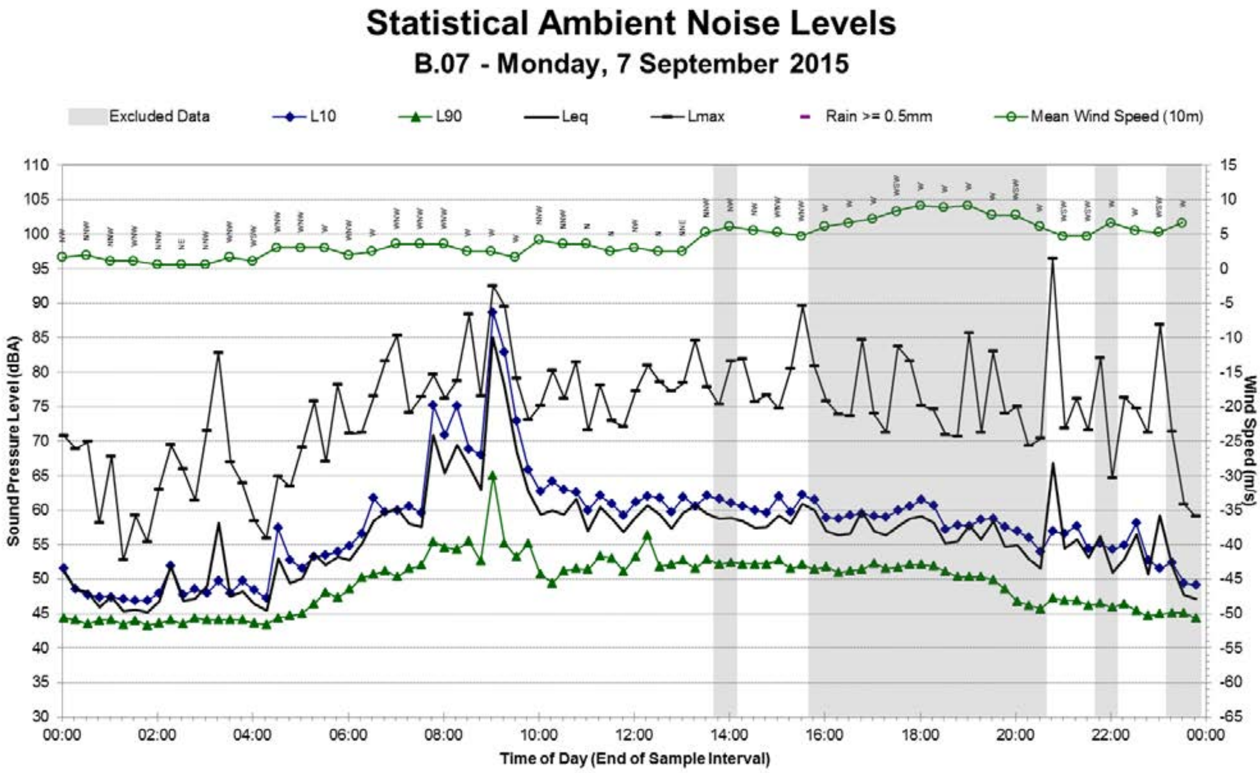
Background Noise Monitoring Results – B.07



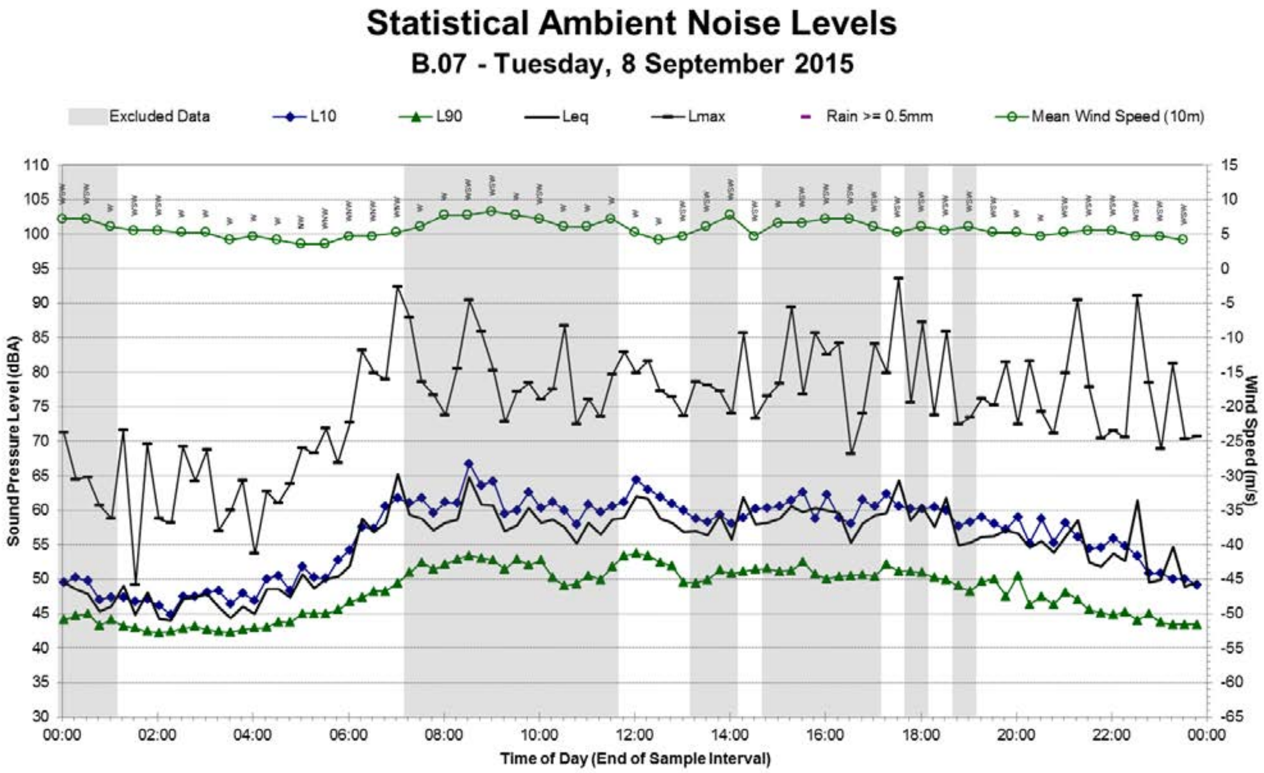


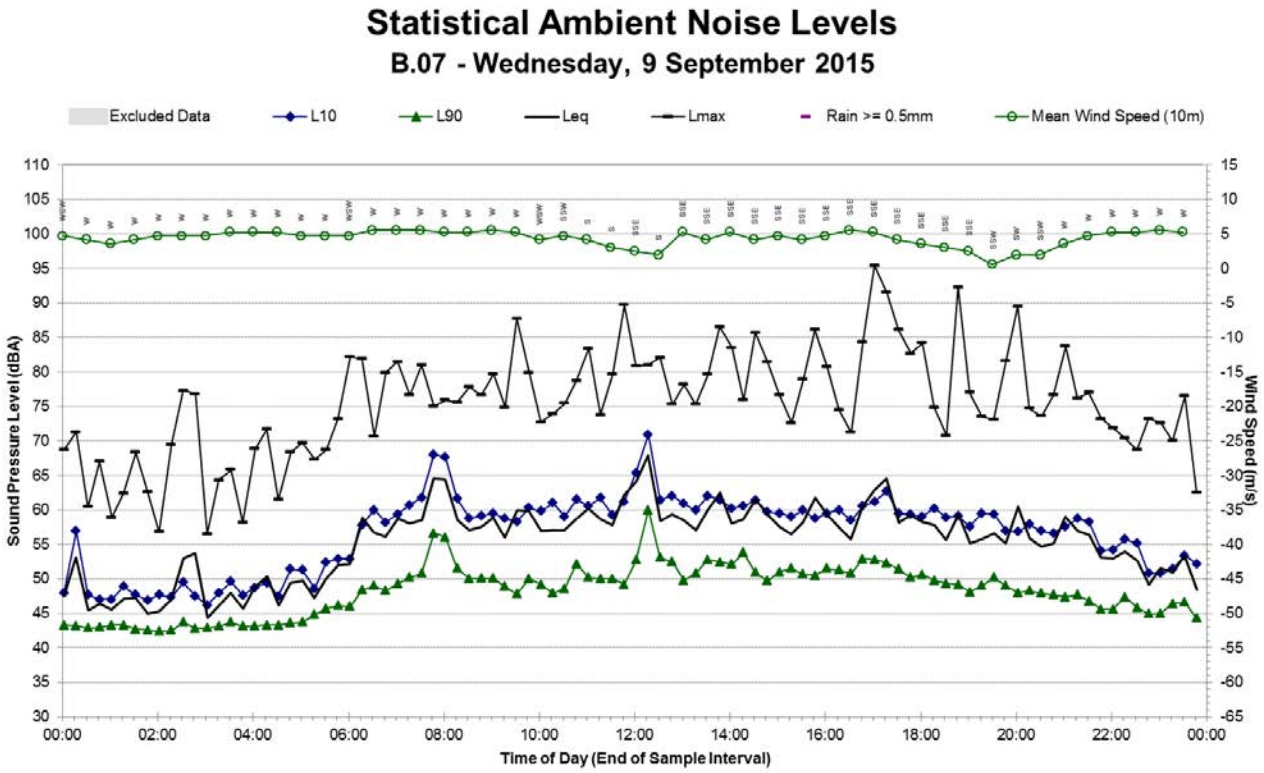
Background Noise Monitoring Results – B.07

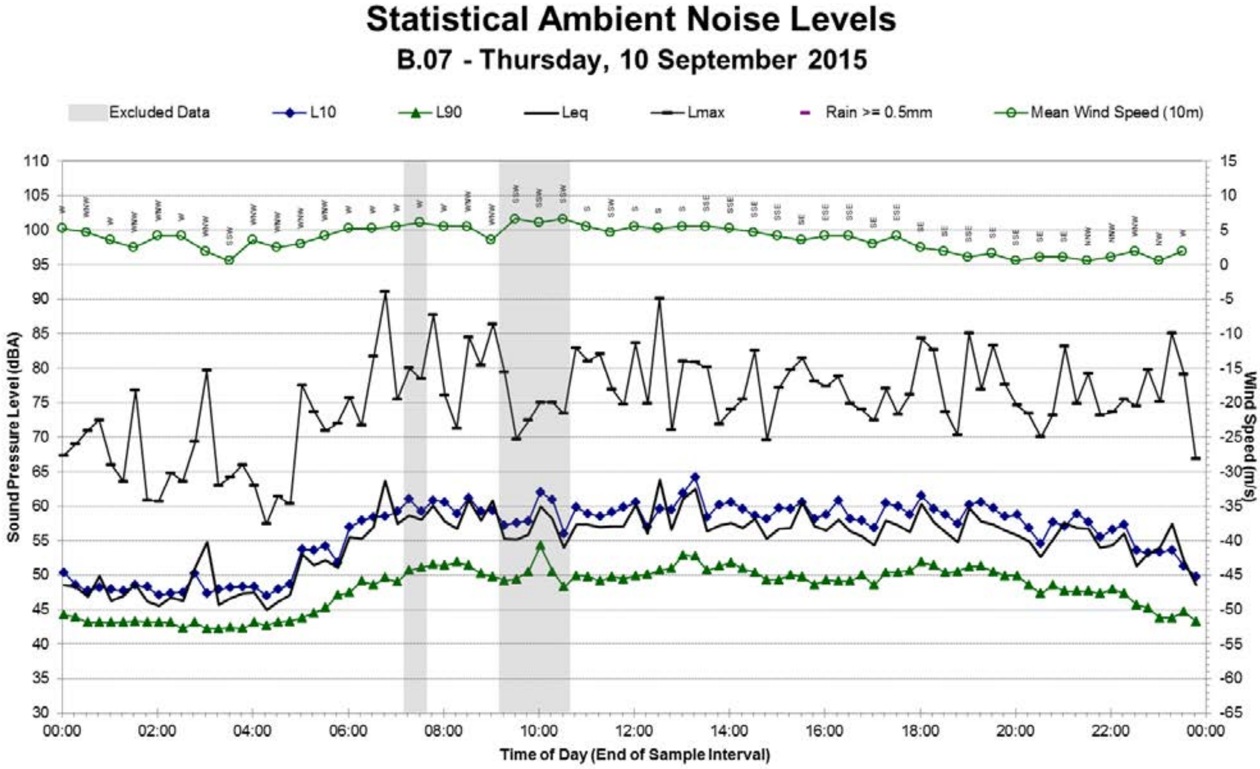




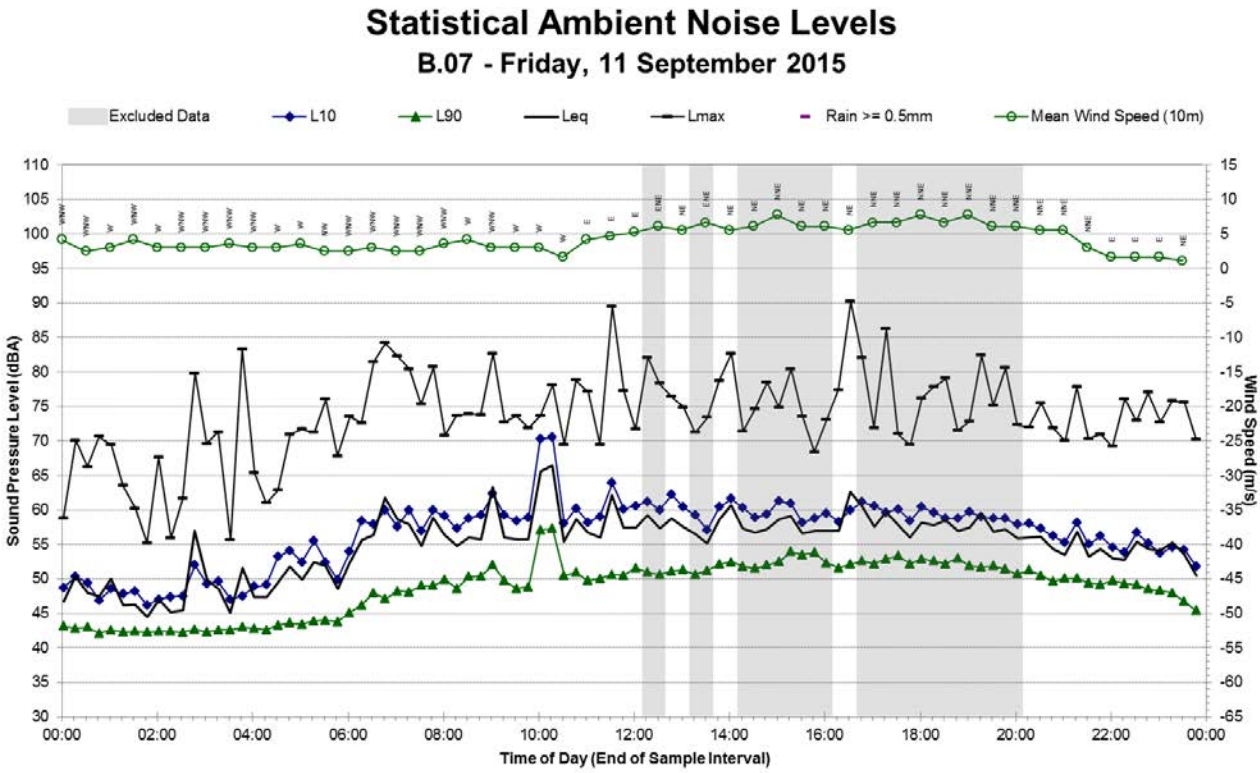
Background Noise Monitoring Results – B.07





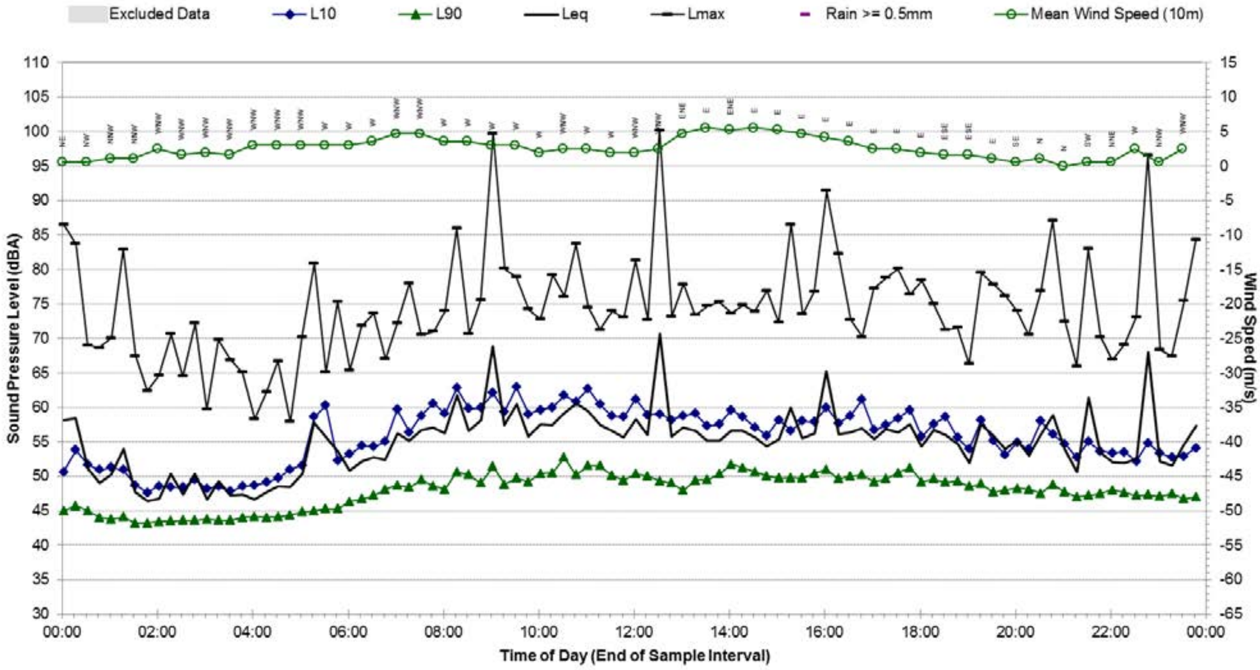


Statistical Ambient Noise Levels
B.07 - Thursday, 10 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

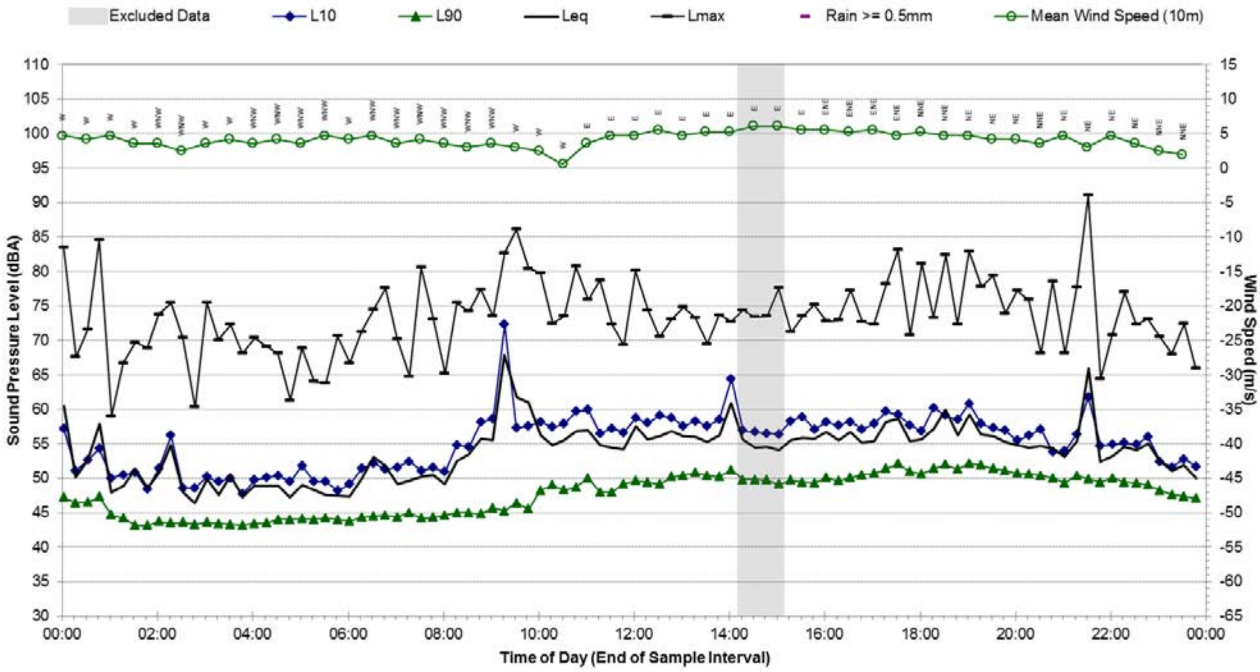


Statistical Ambient Noise Levels
B.07 - Friday, 11 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

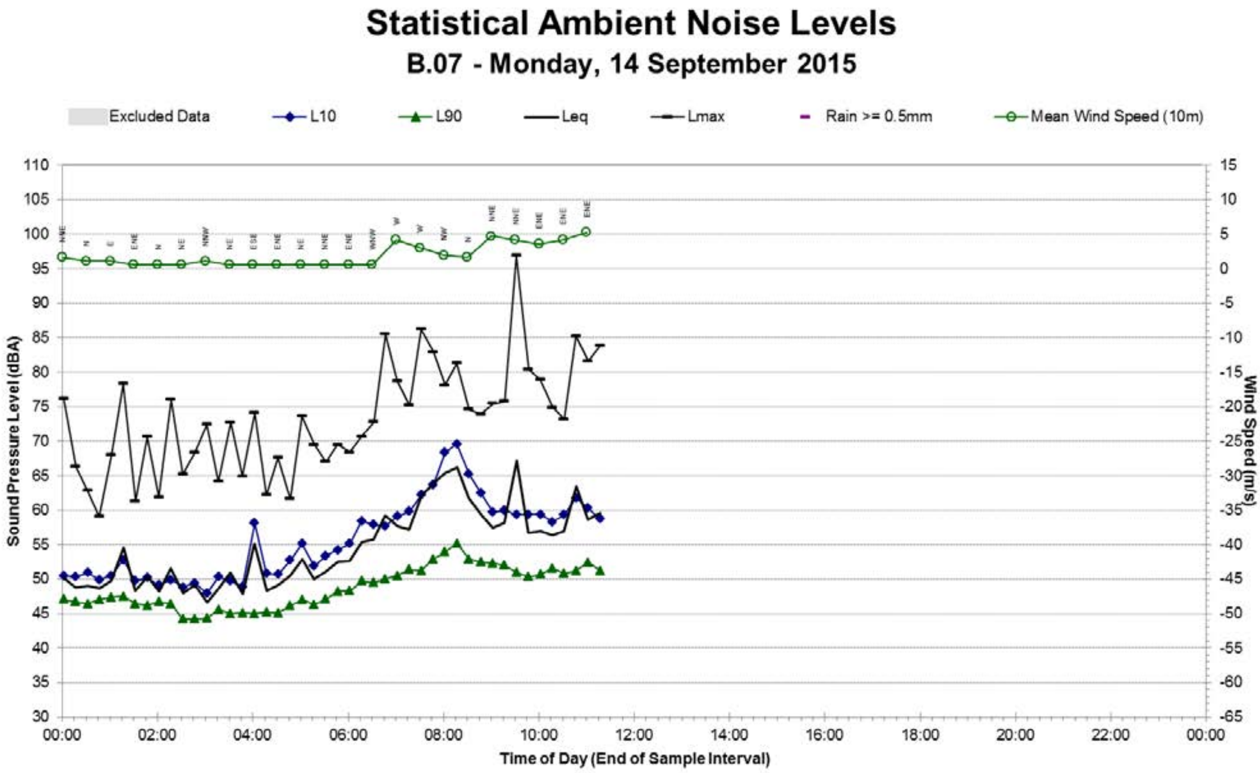
Statistical Ambient Noise Levels
B.07 - Saturday, 12 September 2015



Statistical Ambient Noise Levels
B.07 - Sunday, 13 September 2015



Background Noise Monitoring Results – B.07



Background Noise Monitoring Results – B.08

Noise Monitoring Location:	**B.08**
Noise Monitoring Address:	**96-148 City Road, Darlington 2008**

Logger Device Type: Svantek 957
Logger Serial No: 20674

Ambient noise logger deployed on the roof of the Seymour Centre building at 96-148 City Road, Darlington.

Attended noise measurements indicate that the ambient noise environment at this location is contributed to by various distant road traffic noise sources from both within the university grounds and main roads Cleveland Street and City Road. University students and Seymour Centre patrons in the grounds can also be heard at this location at infrequent intervals.

Map of Noise Monitoring Location

Ambient Noise Logging Results – INP Defined Time Periods

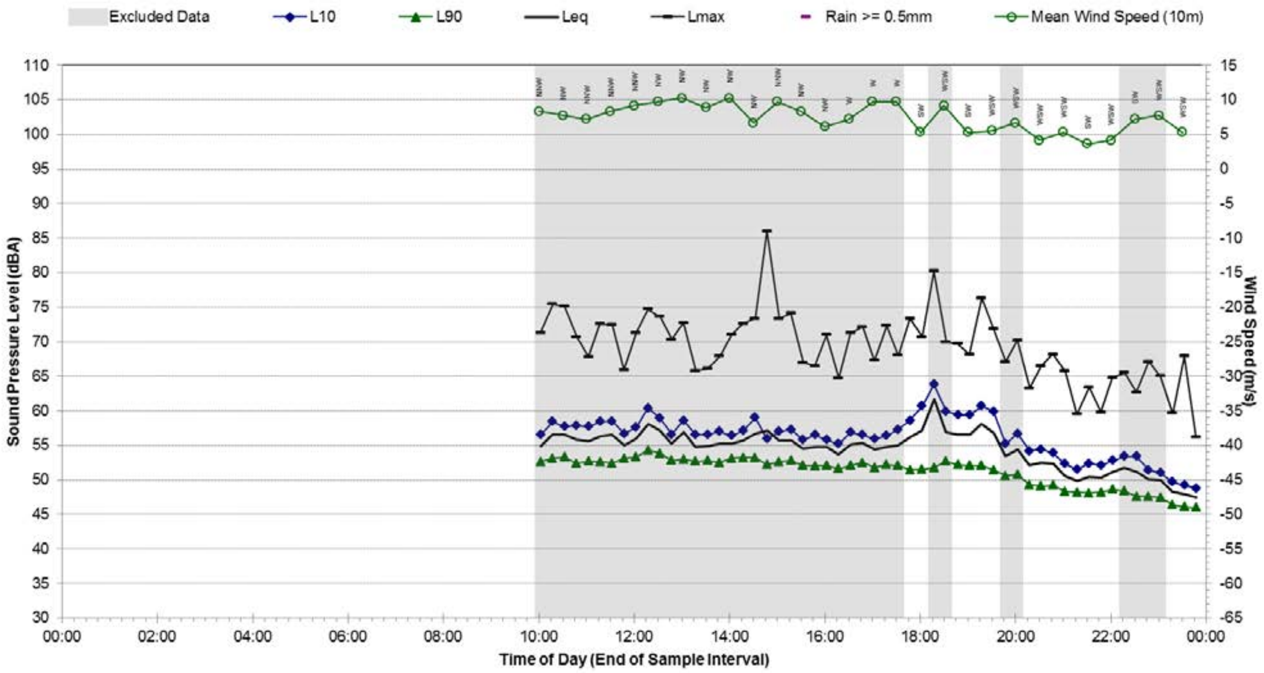
Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	50	61	56	61
Evening	48	60	54	59
Night-time	46	58	51	55

Attended Noise Measurement Results

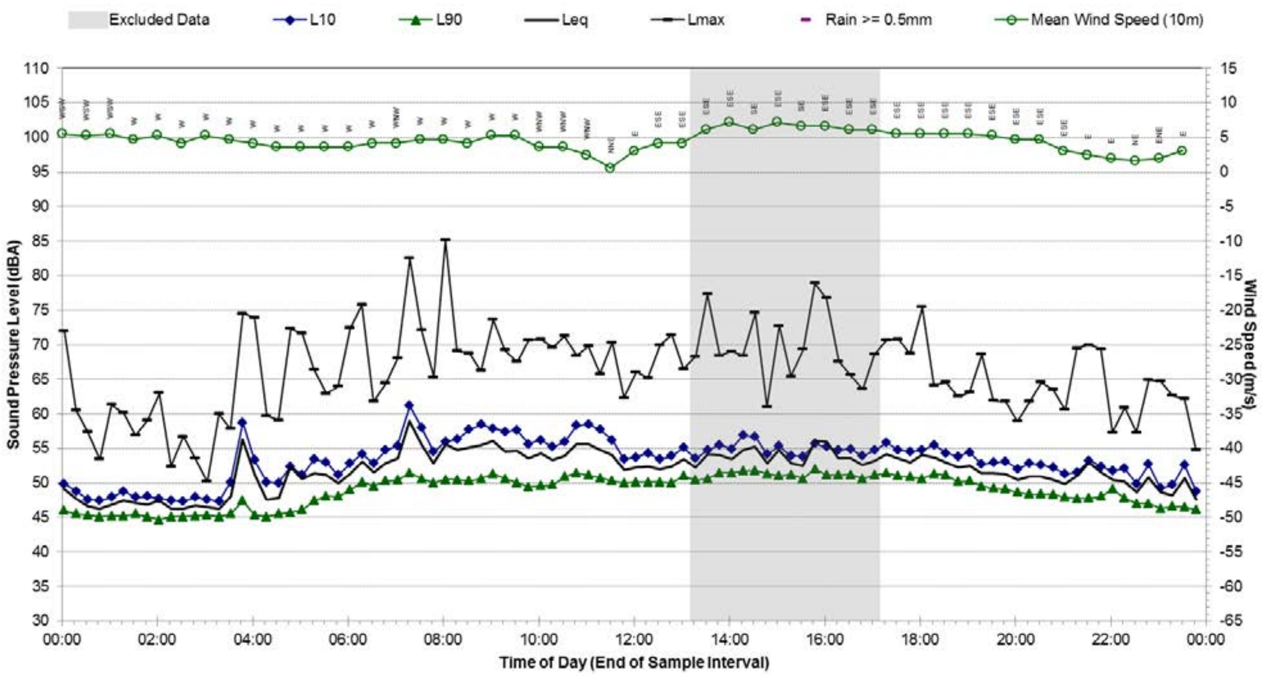
Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
14/09/2015	13:23:35	52	54	66

Photo of Noise Monitoring Location

Statistical Ambient Noise Levels
B.08 - Tuesday, 15 September 2015

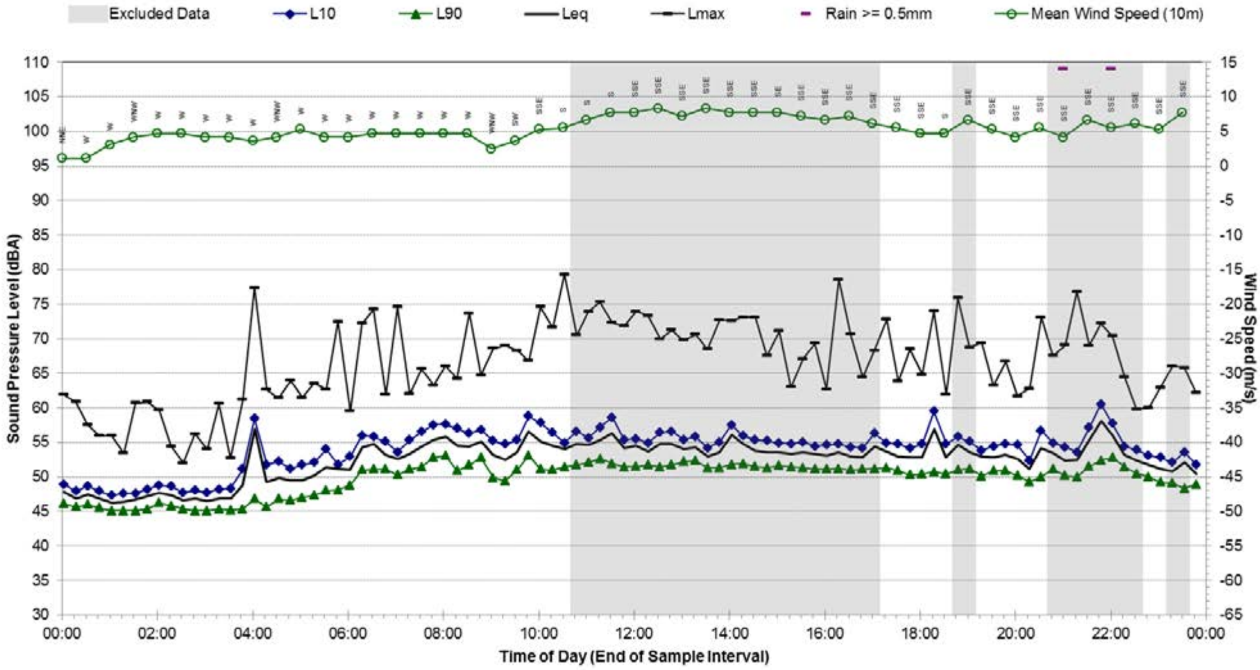


Statistical Ambient Noise Levels
B.08 - Wednesday, 16 September 2015

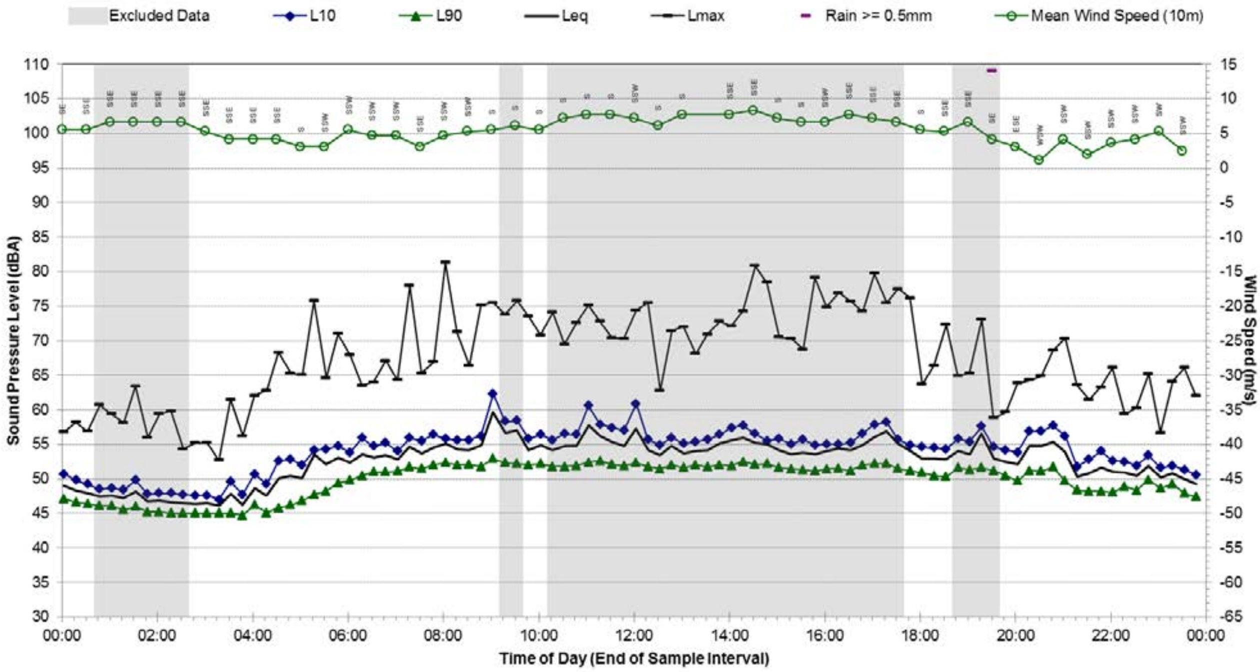


Background Noise Monitoring Results – B.08

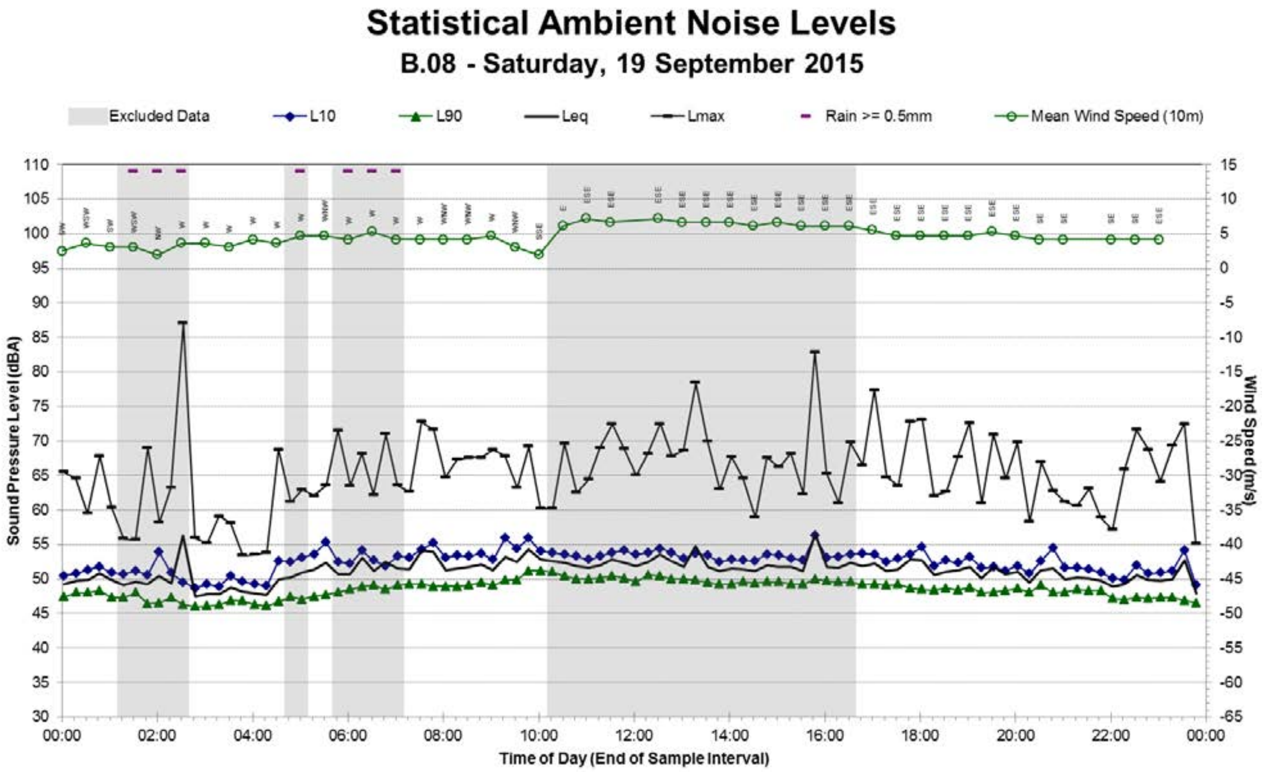
Statistical Ambient Noise Levels
B.08 - Thursday, 17 September 2015

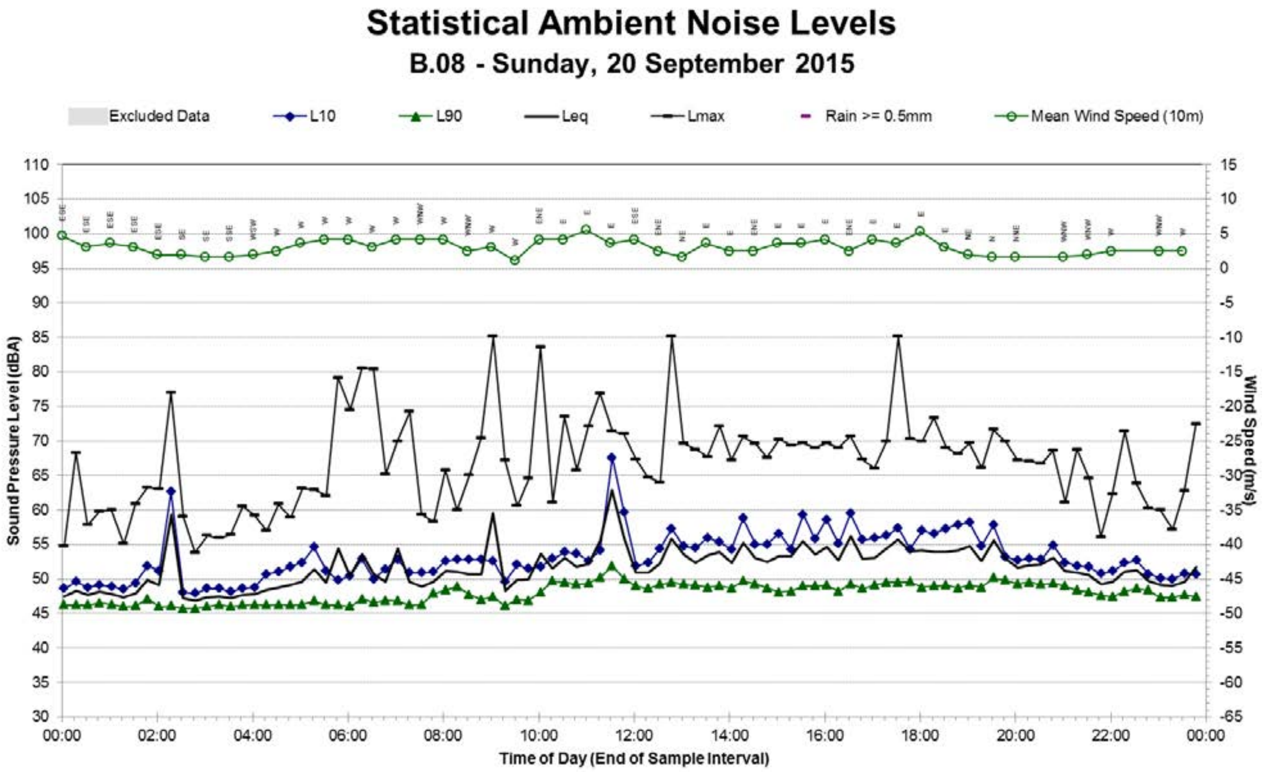


Statistical Ambient Noise Levels
B.08 - Friday, 18 September 2015

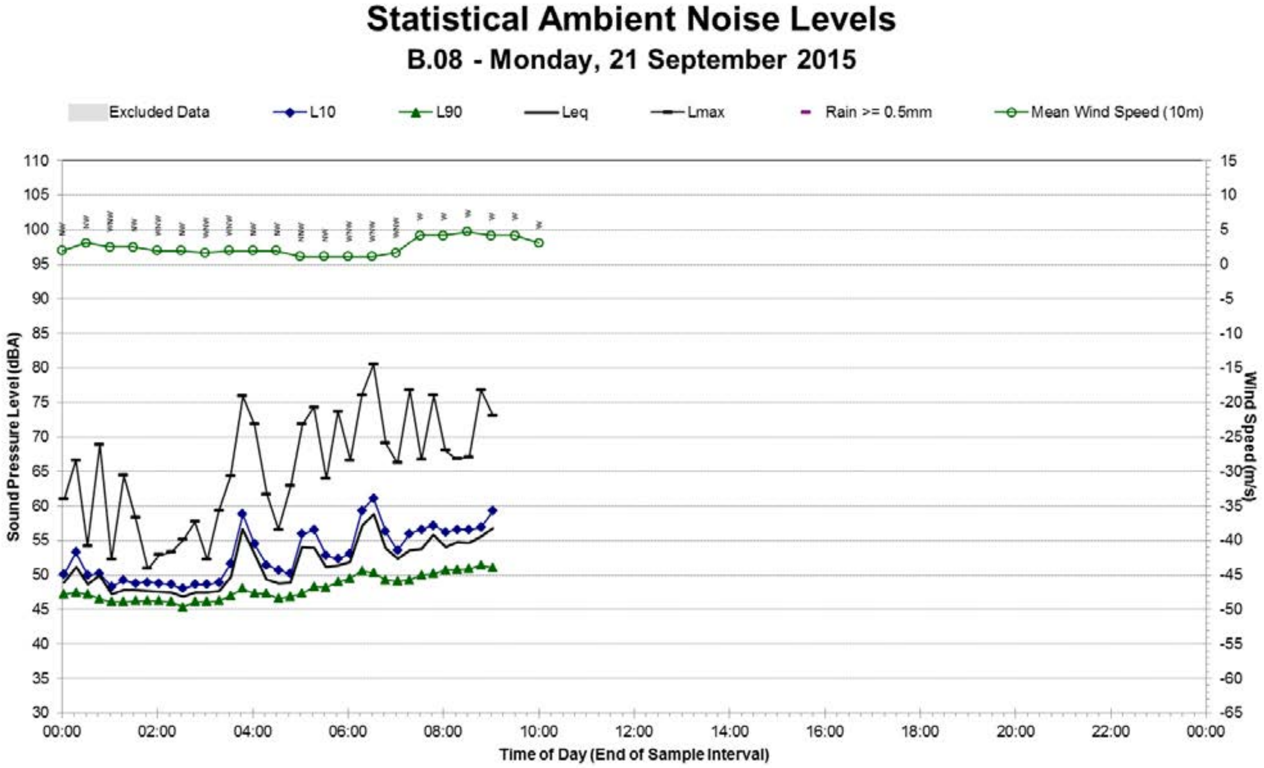


Background Noise Monitoring Results – B.08





Background Noise Monitoring Results – B.08



Background Noise Monitoring Results – B.09

Noise Monitoring Location:	**B.09**
Noise Monitoring Address:	**101 Chalmers Street, Chippendale 2008 (Railway Institute)**

Logger Device Type: Svantek 957
Logger Serial No: 23244

Ambient noise logger deployed at the front of the Railway Institute at 101 Chalmers Street, Chippendale. Logger located beside a tree and a small carpark.

Attended noise measurements indicate that the ambient noise environment at this location is significantly dominated by road traffic noise from Chalmers Street with a bus stop approximately 10 meters from the location. Passing pedestrians and rail traffic noise from Central Station also include regular contribution to the noise levels captured at this location. The LA90 background noise levels result from the observed "city hum" which is a feature of the Sydney CBD.

Map of Noise Monitoring Location

Ambient Noise Logging Results – INP Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	56	68	71	77
Evening	53	66	69	75
Night-time	45	64	67	72

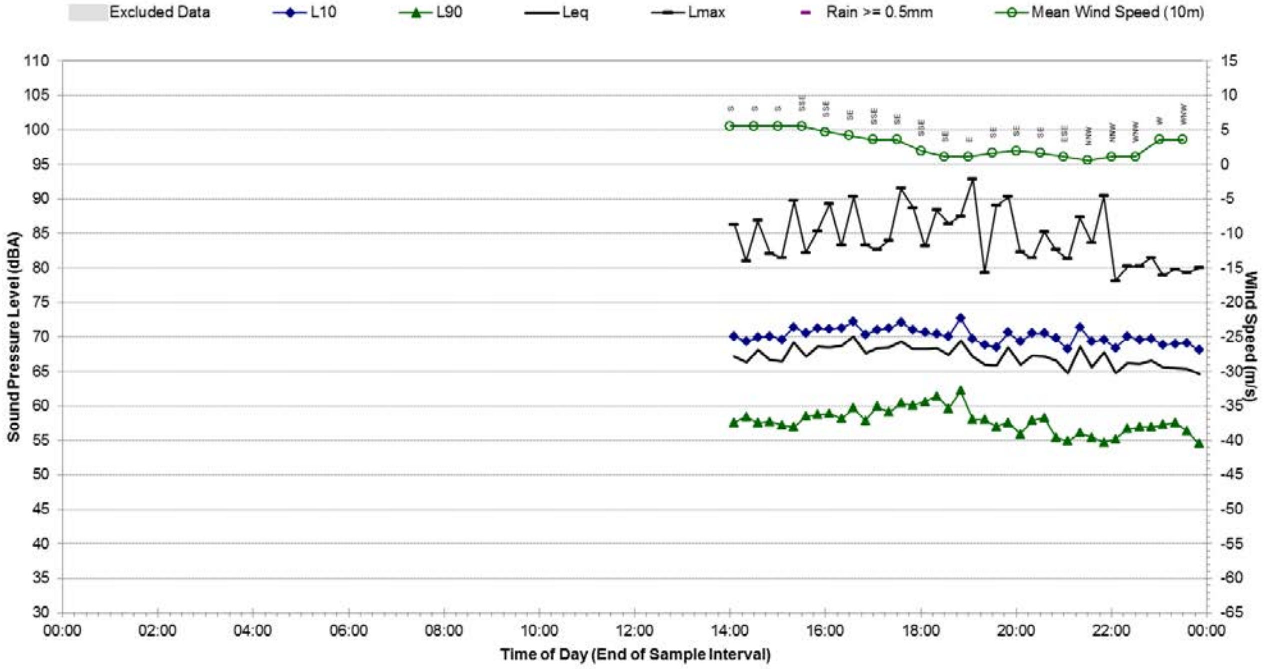
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
18/09/2015	10:52:48	65	71	87

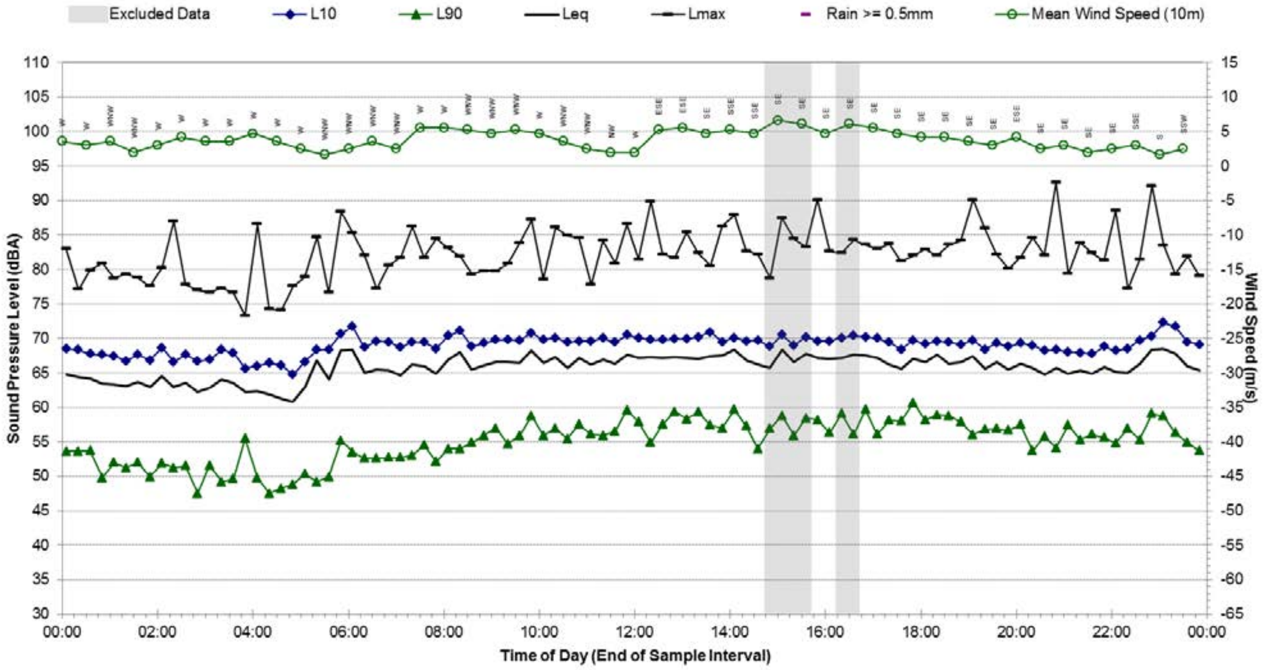
Photo of Noise Monitoring Location

Background Noise Monitoring Results – B.09

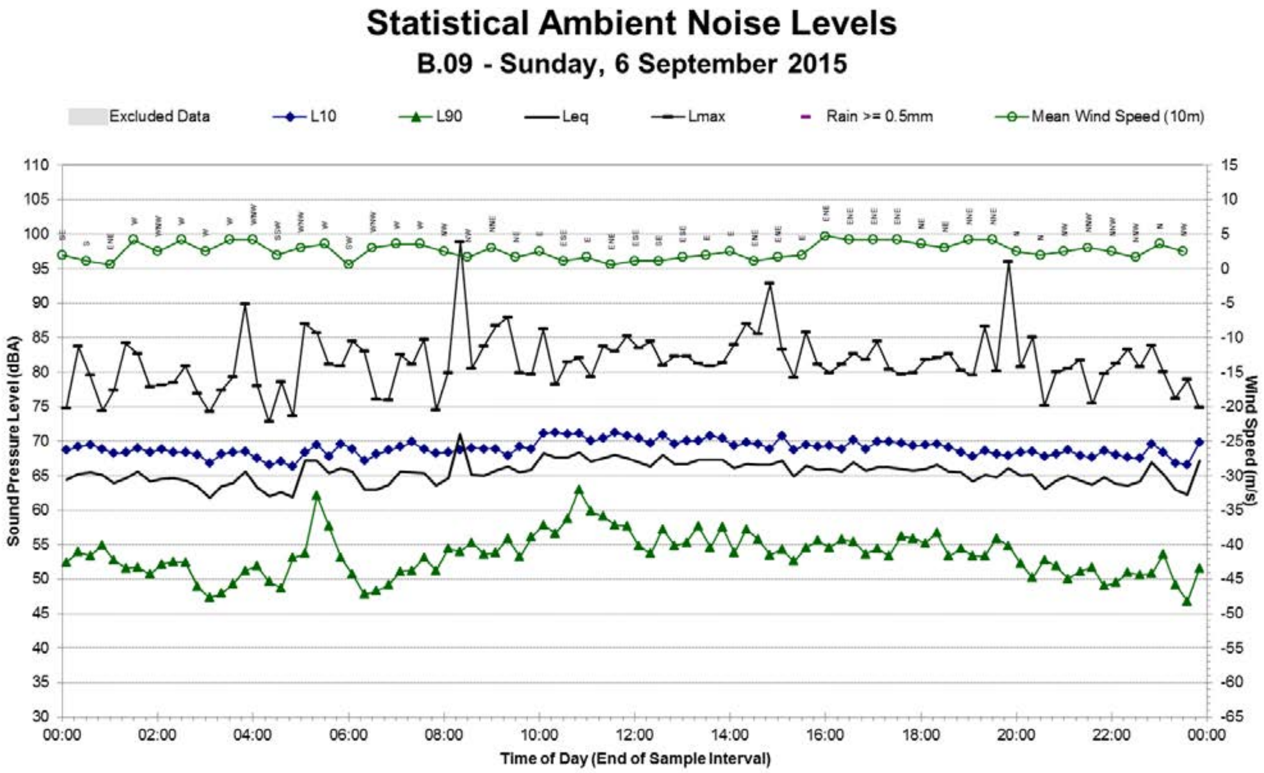
Statistical Ambient Noise Levels
B.09 - Friday, 4 September 2015

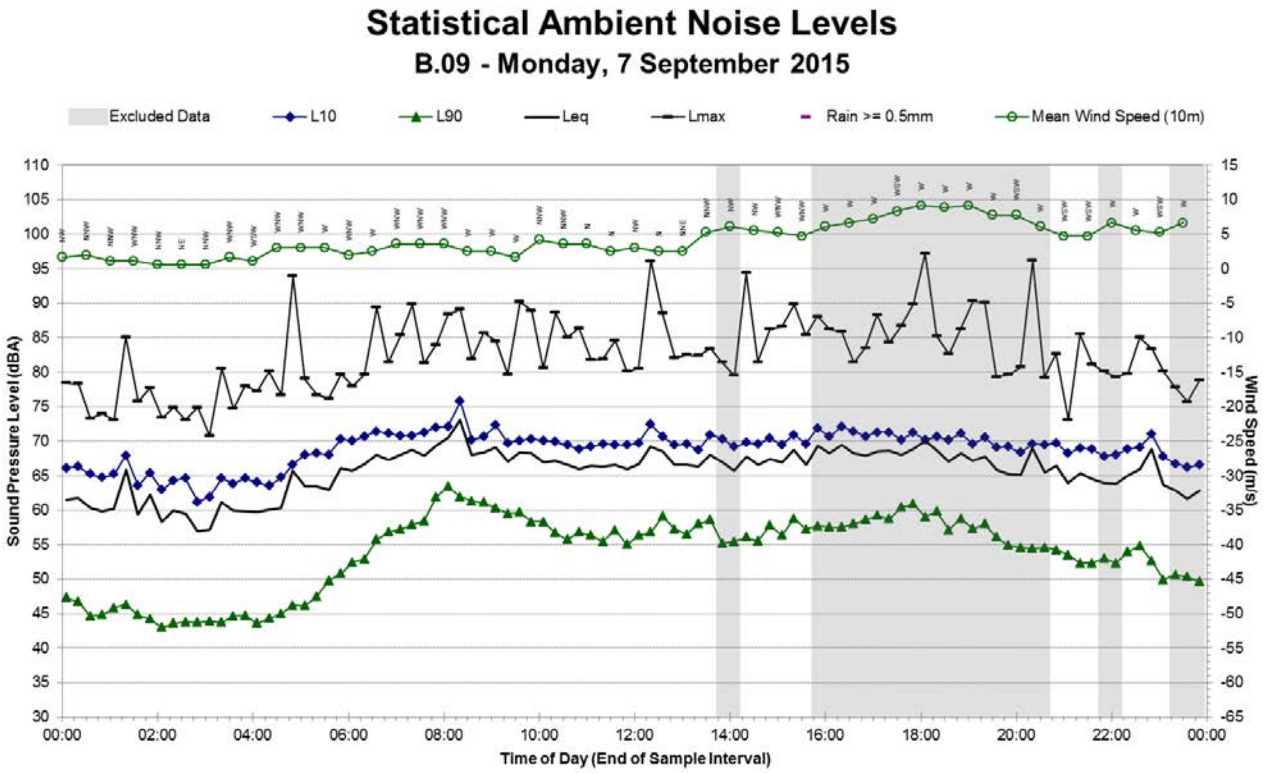


Statistical Ambient Noise Levels
B.09 - Saturday, 5 September 2015

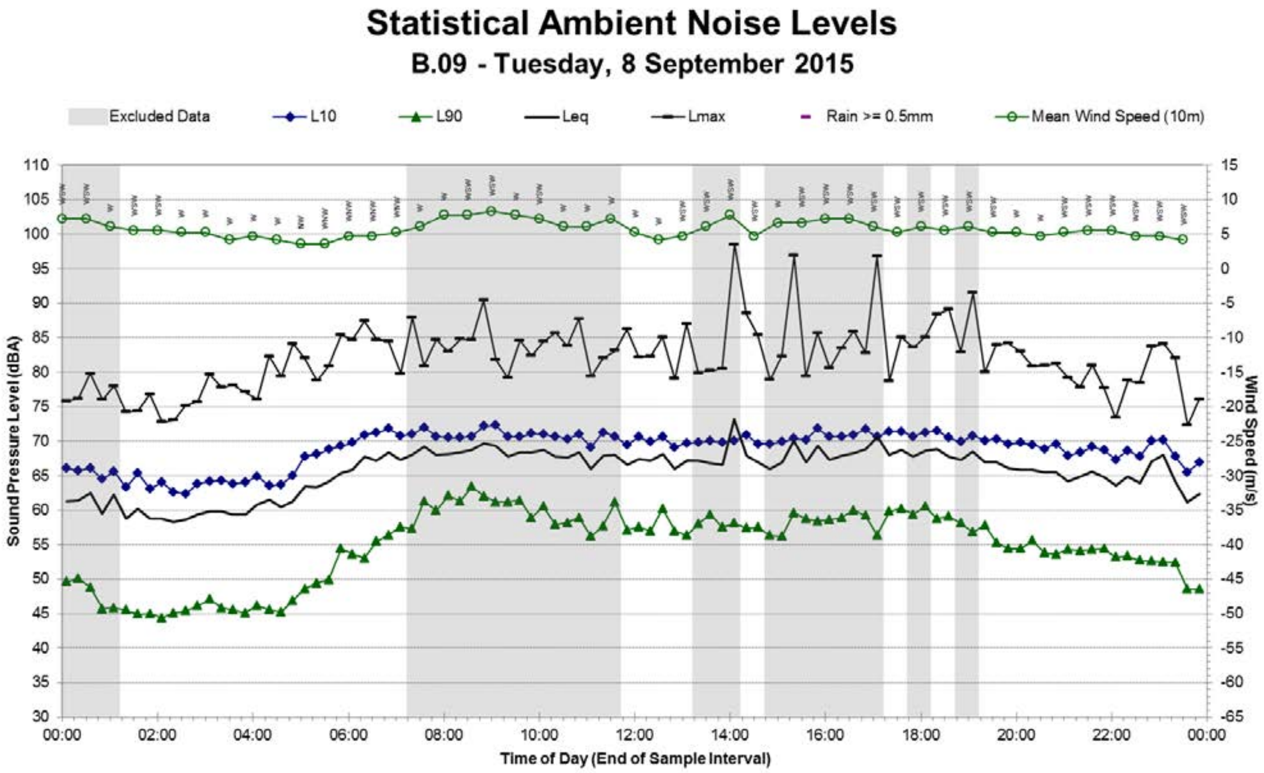


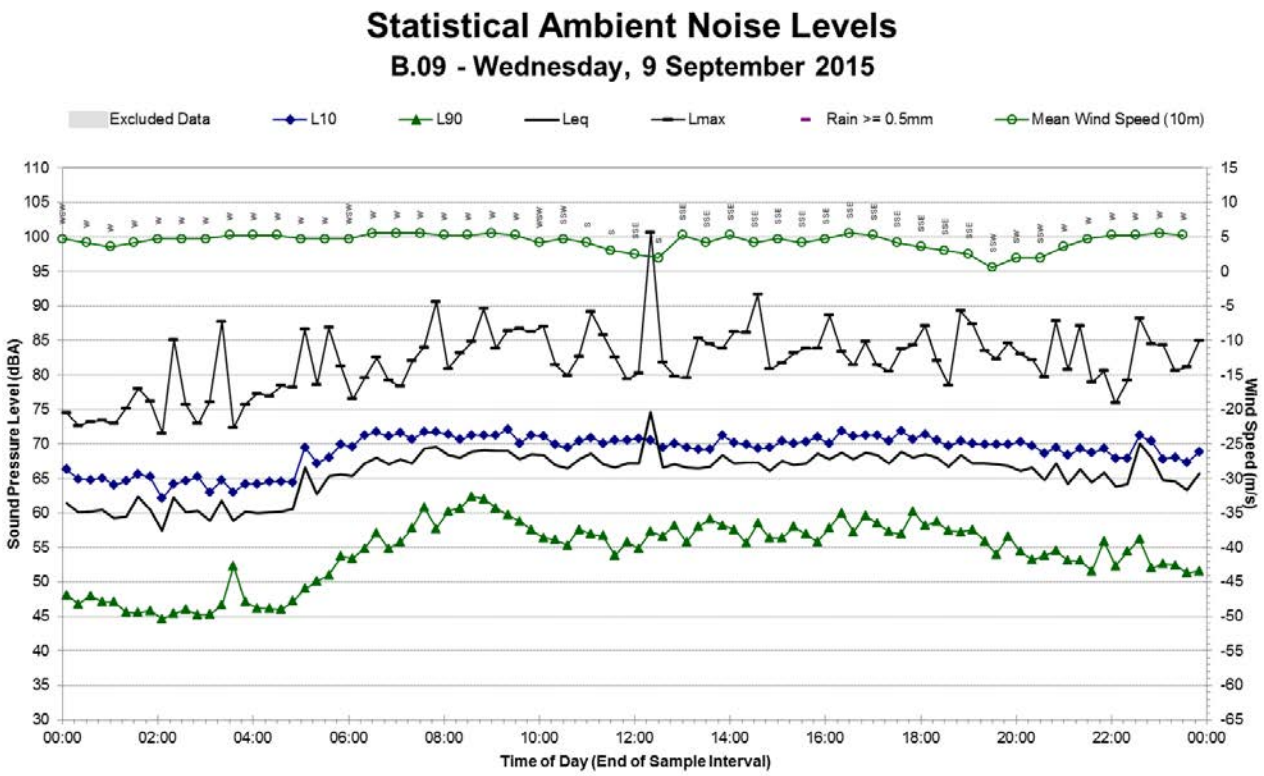
Background Noise Monitoring Results – B.09



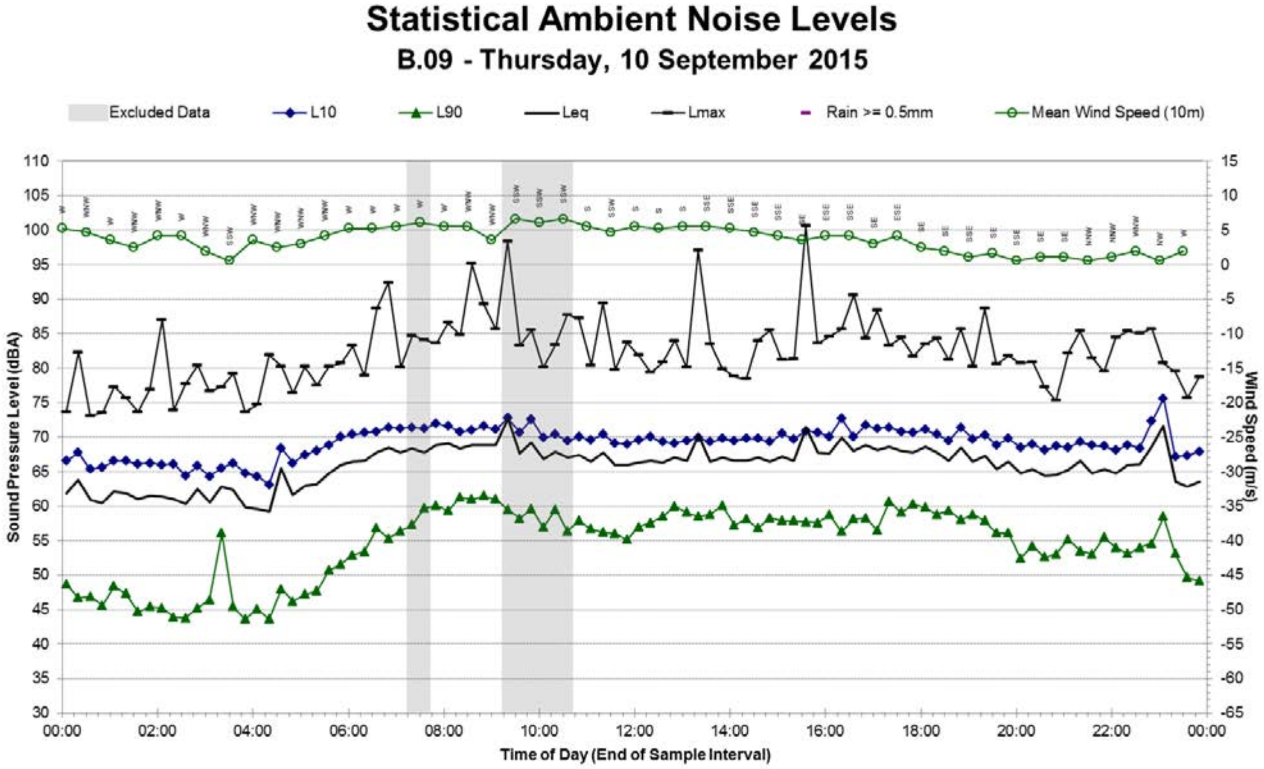


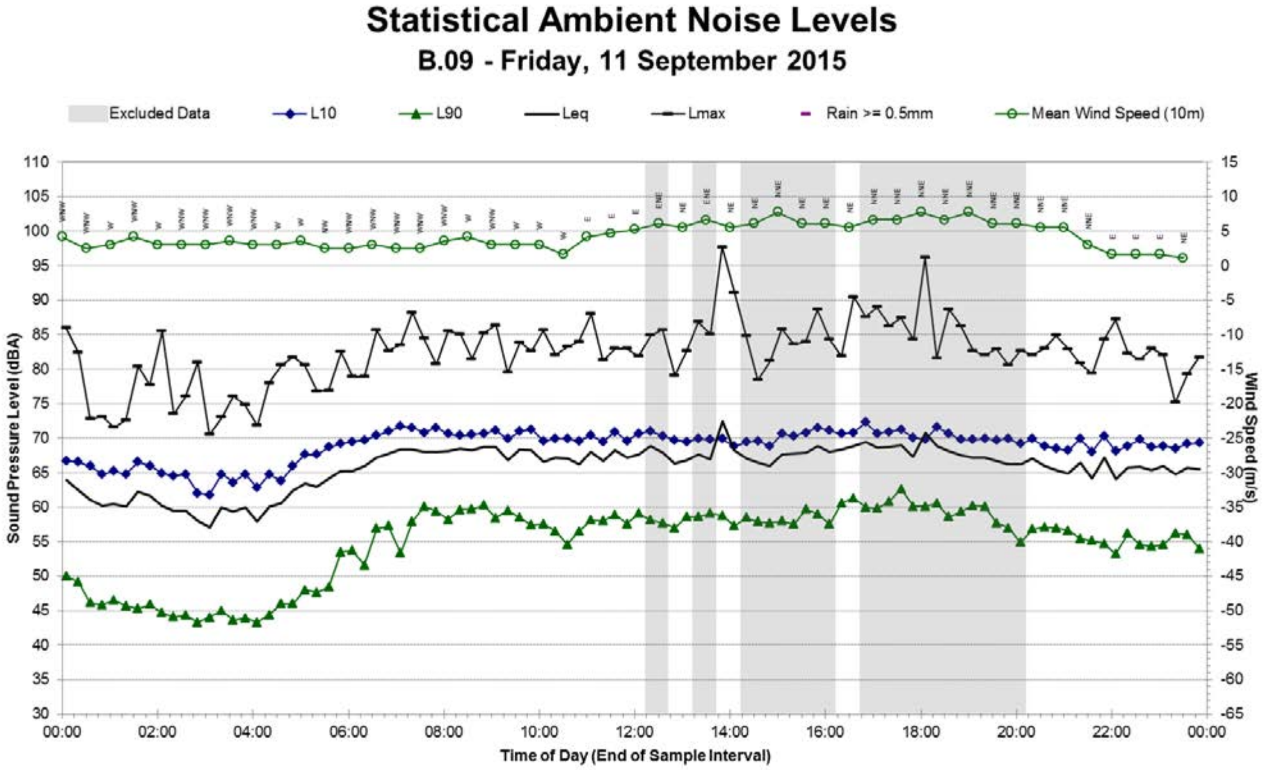
Background Noise Monitoring Results – B.09



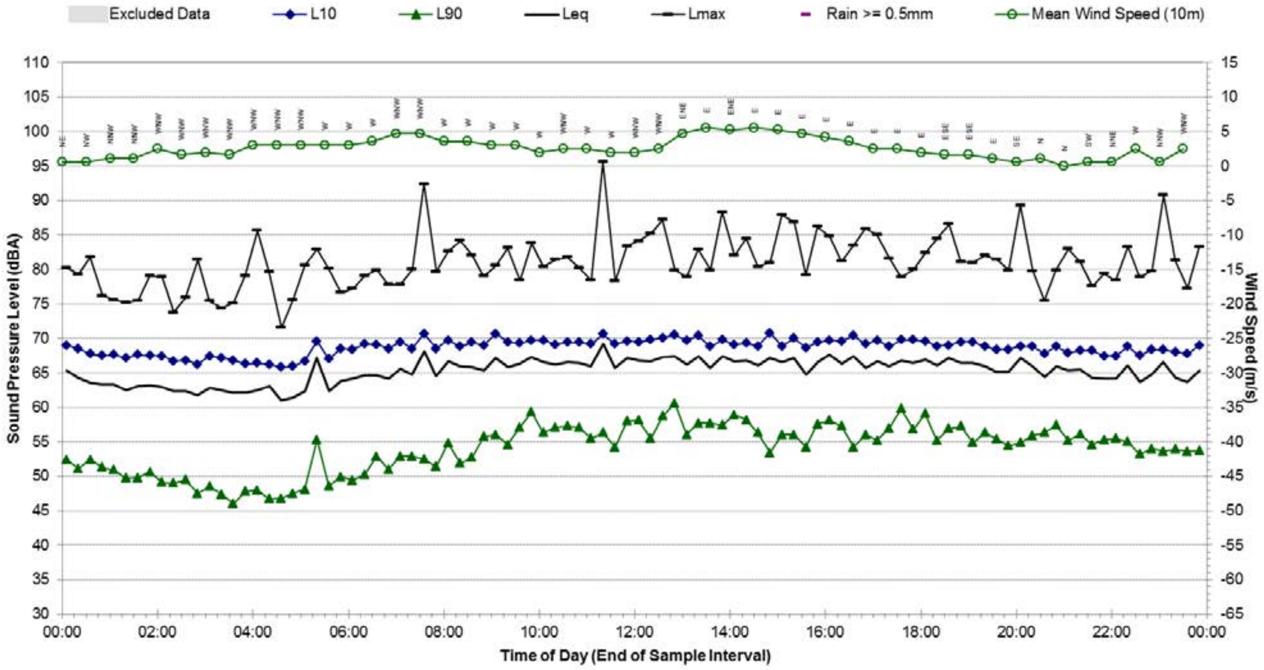


Background Noise Monitoring Results – B.09

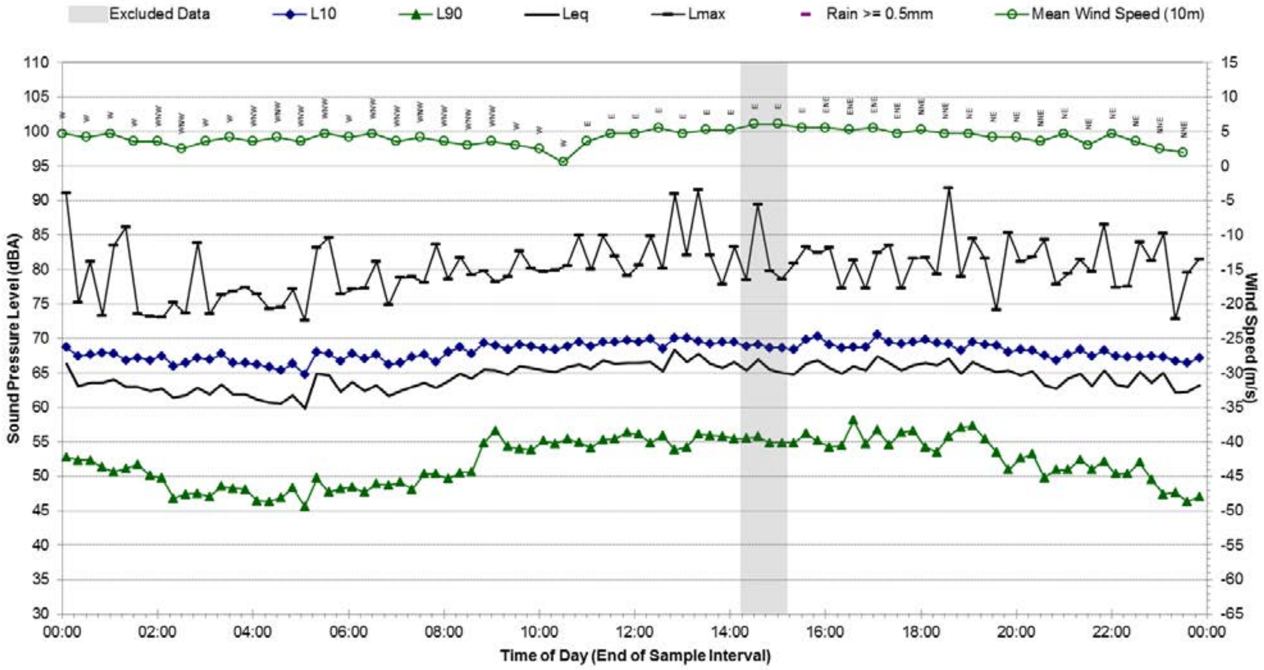




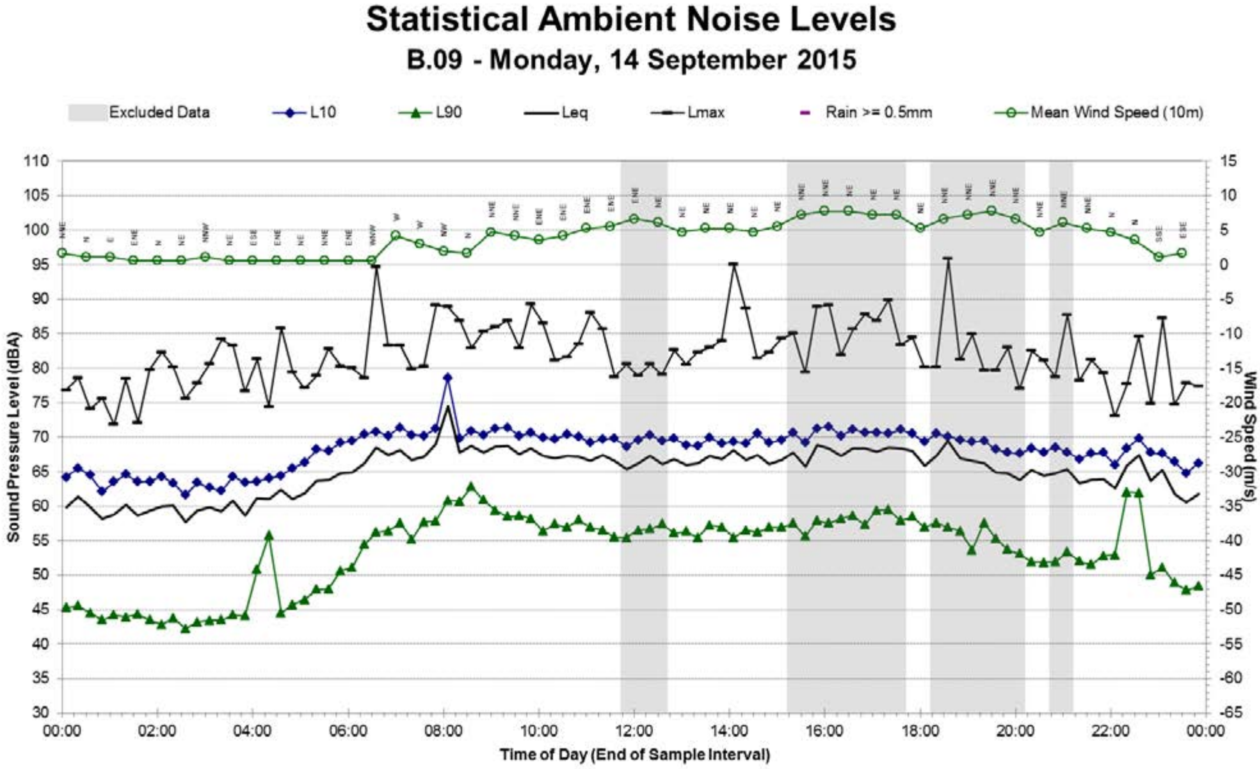
Statistical Ambient Noise Levels
B.09 - Saturday, 12 September 2015

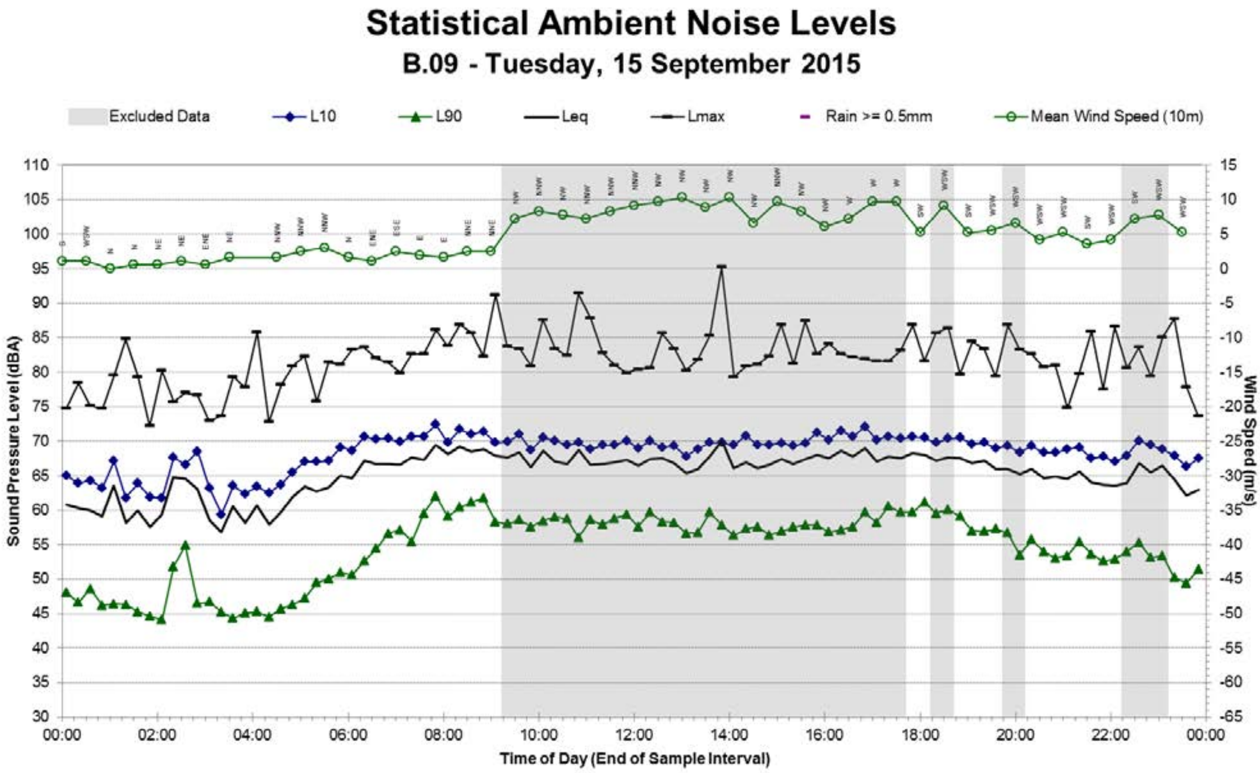


Statistical Ambient Noise Levels
B.09 - Sunday, 13 September 2015

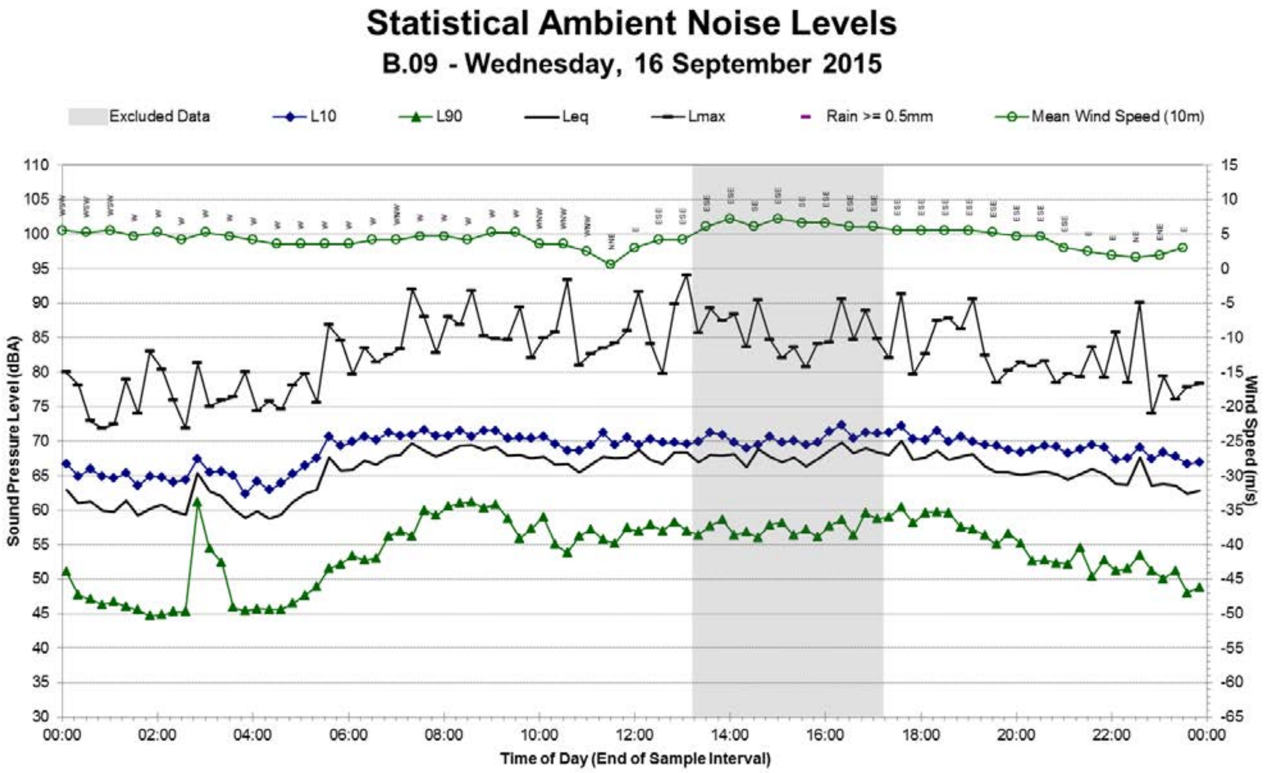


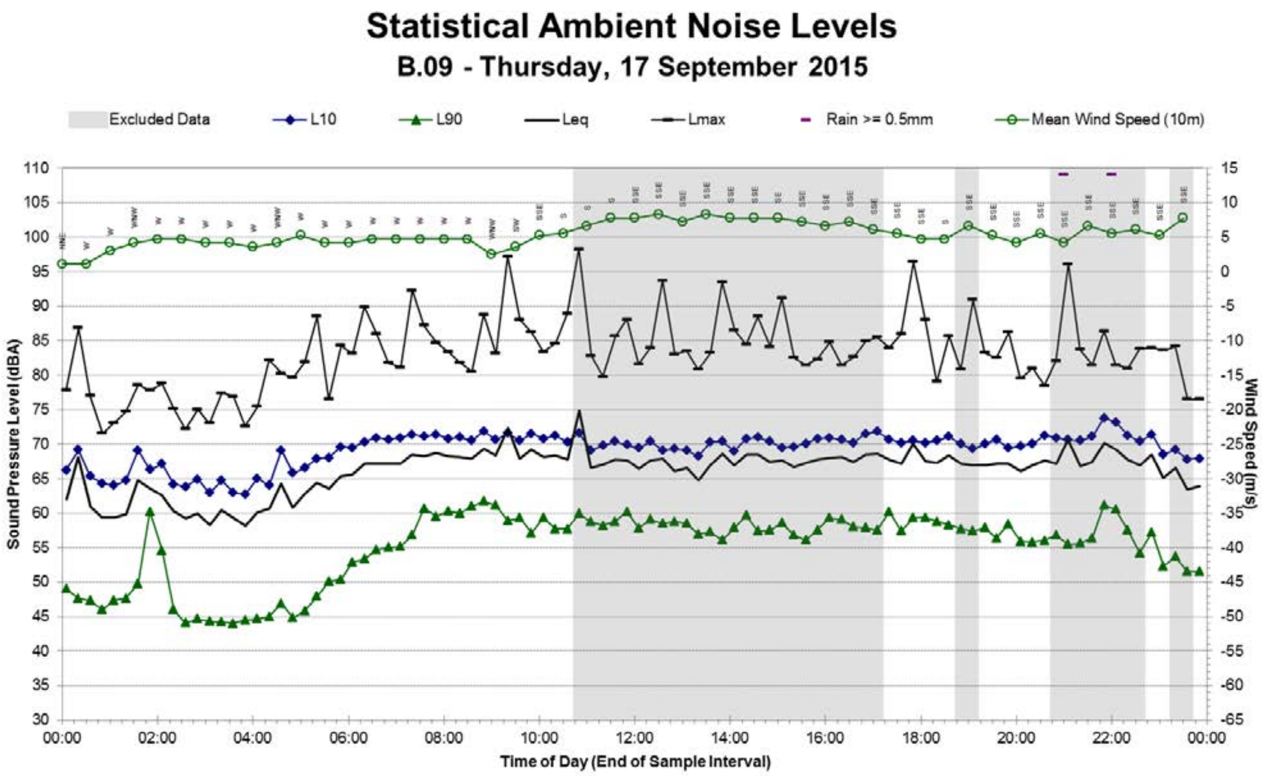
Background Noise Monitoring Results – B.09

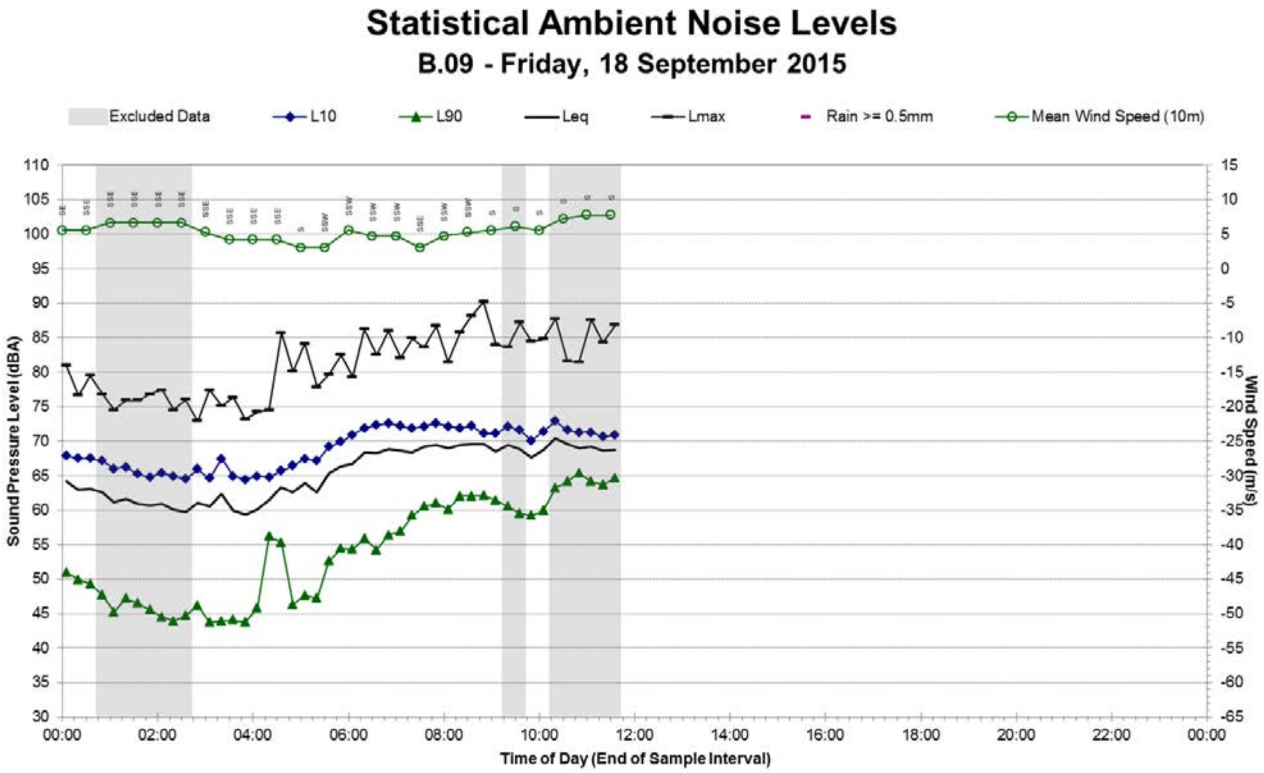




Background Noise Monitoring Results – B.09






Statistical Ambient Noise Levels
B.09 - Friday, 18 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
15
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
Time of Day (End of Sample Interval)

Background Noise Monitoring Results – B.10

Noise Monitoring Location:	**B.10**
Noise Monitoring Address:	**8/10 Lee Street, Sydney 2000 (YHA Railway Square)**

Logger Device Type: Svantek 957
Logger Serial No: 20667

Ambient noise logger deployed beside the YHA Railway Square dormitories which lie directly adjacent to the Central Station railway tracks. Logger positioned away from hostel patrons on top of lockers, and this location offers a direct line of sight to neighbouring railway tracks.

Attended noise measurements at this location and its surrounds indicate that the ambient noise environment at this location is significantly dominated by rail traffic noise from inbound and outbound trains, particularly the CountryLink trains that service the nearest track. Marginal increase in both LA90 (background) and LAeq are noted during these events. Passing hostel patrons also contributioned to the LAeq and LAmax noise levels captured at this location. The overall LA90 background results are attributed to an observed “city hum” which is a feature of the Sydney CBD.

Map of Noise Monitoring Location

Ambient Noise Logging Results – INP Defined Time Periods

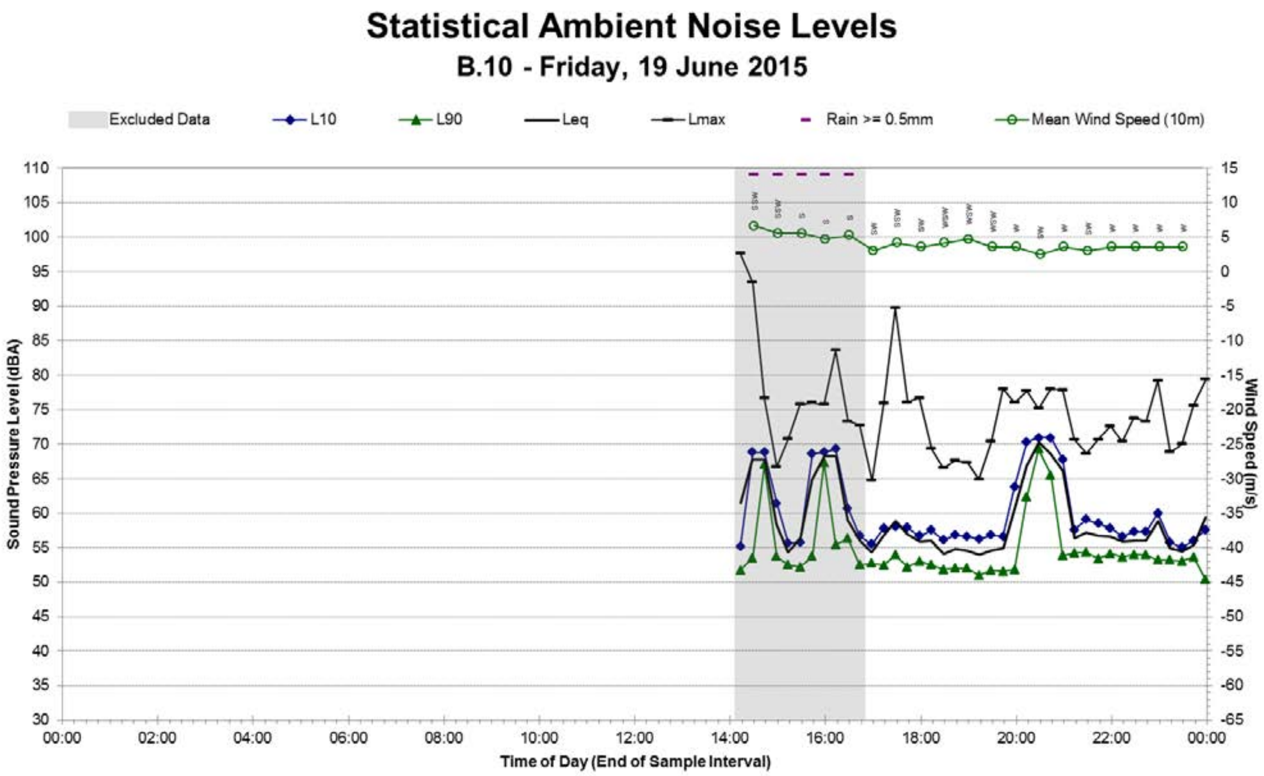
Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	51	65	58	66
Evening	50	64	58	64
Night-time	49	62	53	61

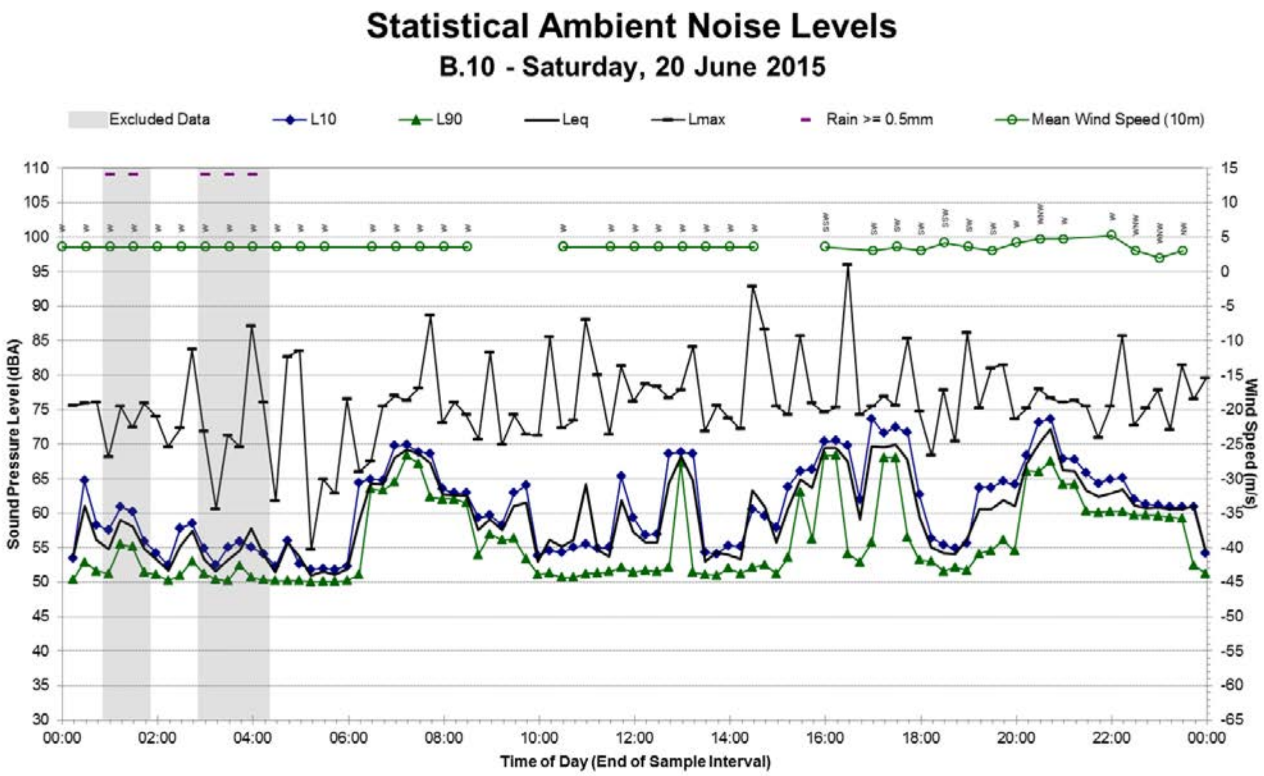
Attended Noise Measurement Results

Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
19/06/2015	14:01:41	52	55	76

Photo of Noise Monitoring Location

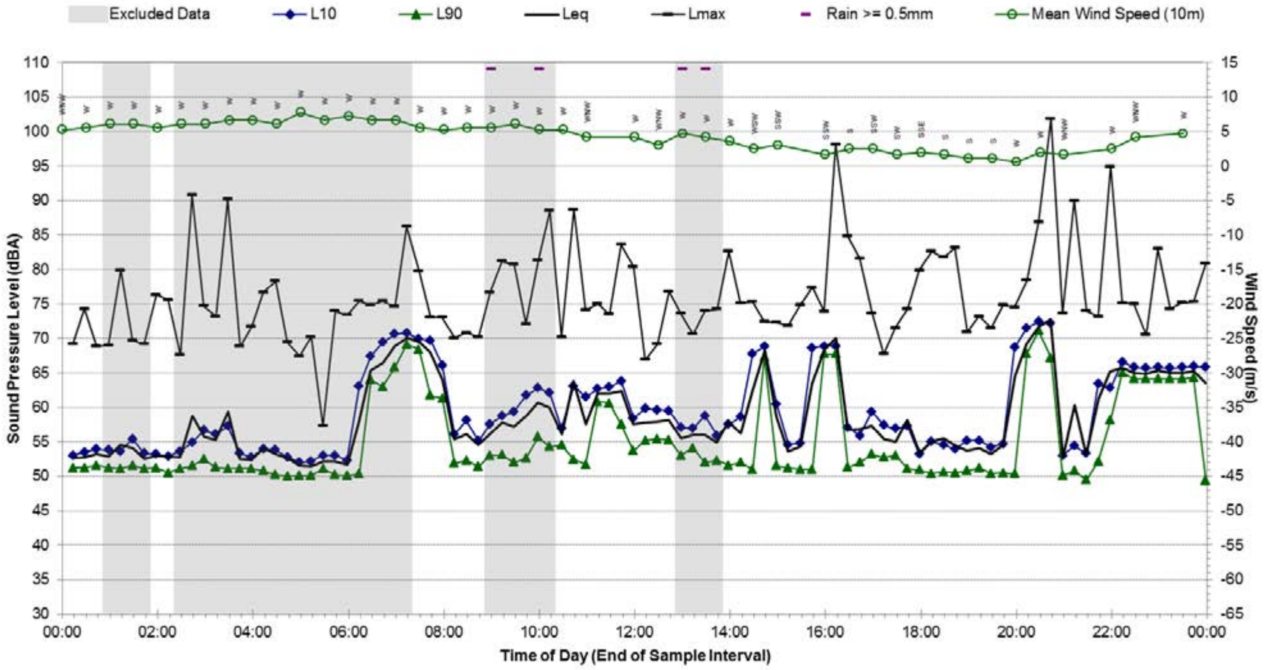
Background Noise Monitoring Results – B.10



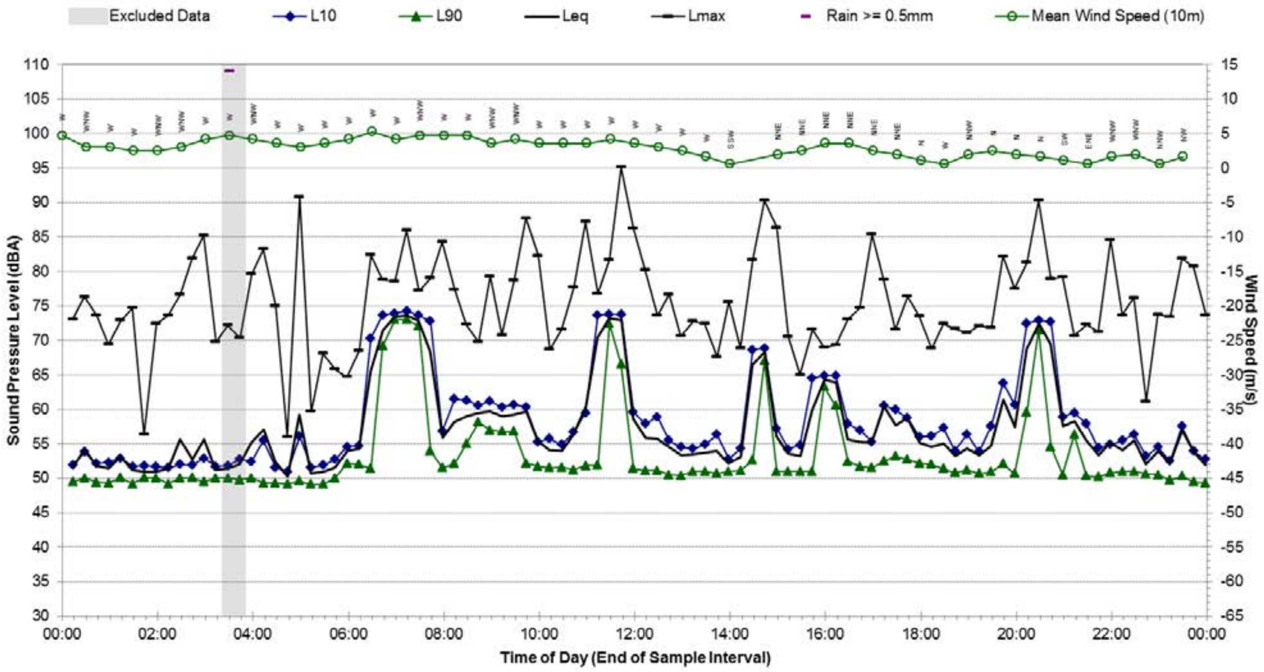


Background Noise Monitoring Results – B.10

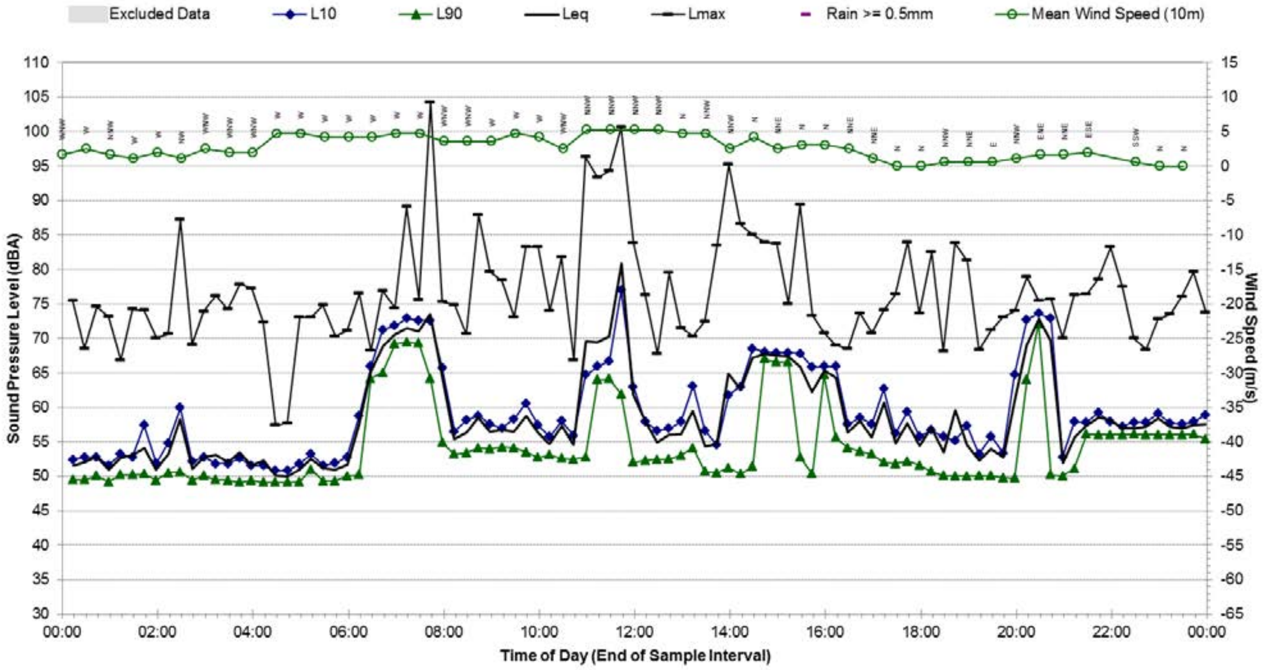
Statistical Ambient Noise Levels
B.10 - Sunday, 21 June 2015



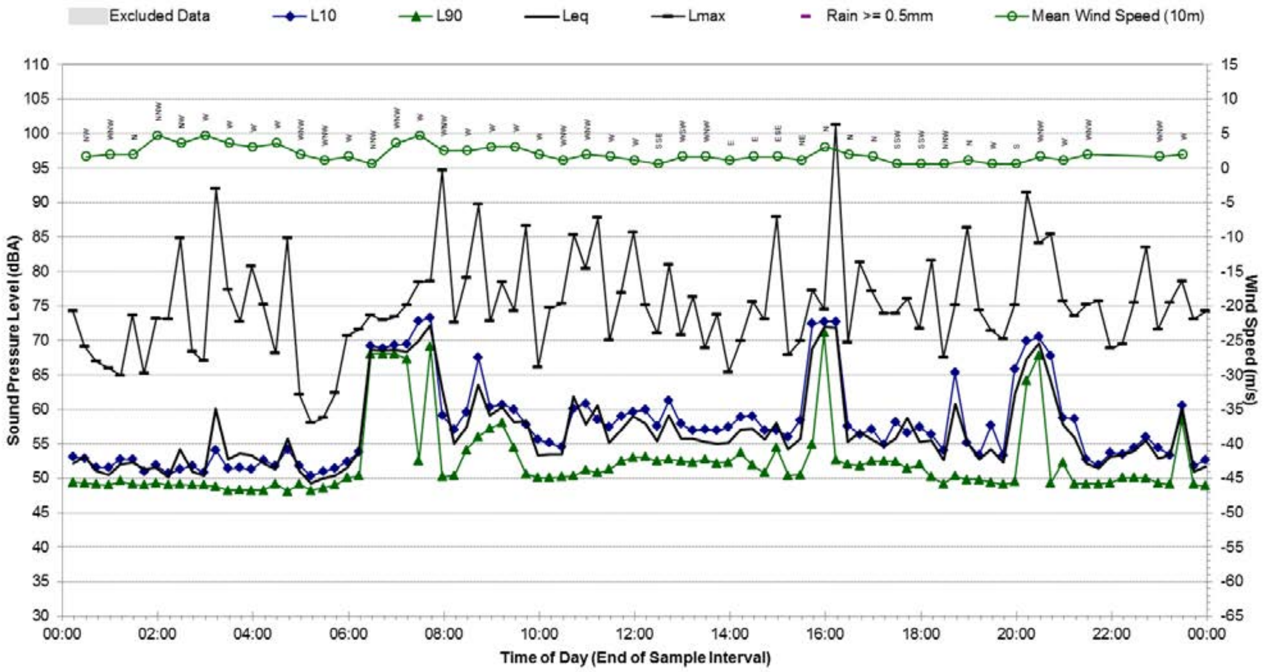
Statistical Ambient Noise Levels
B.10 - Monday, 22 June 2015

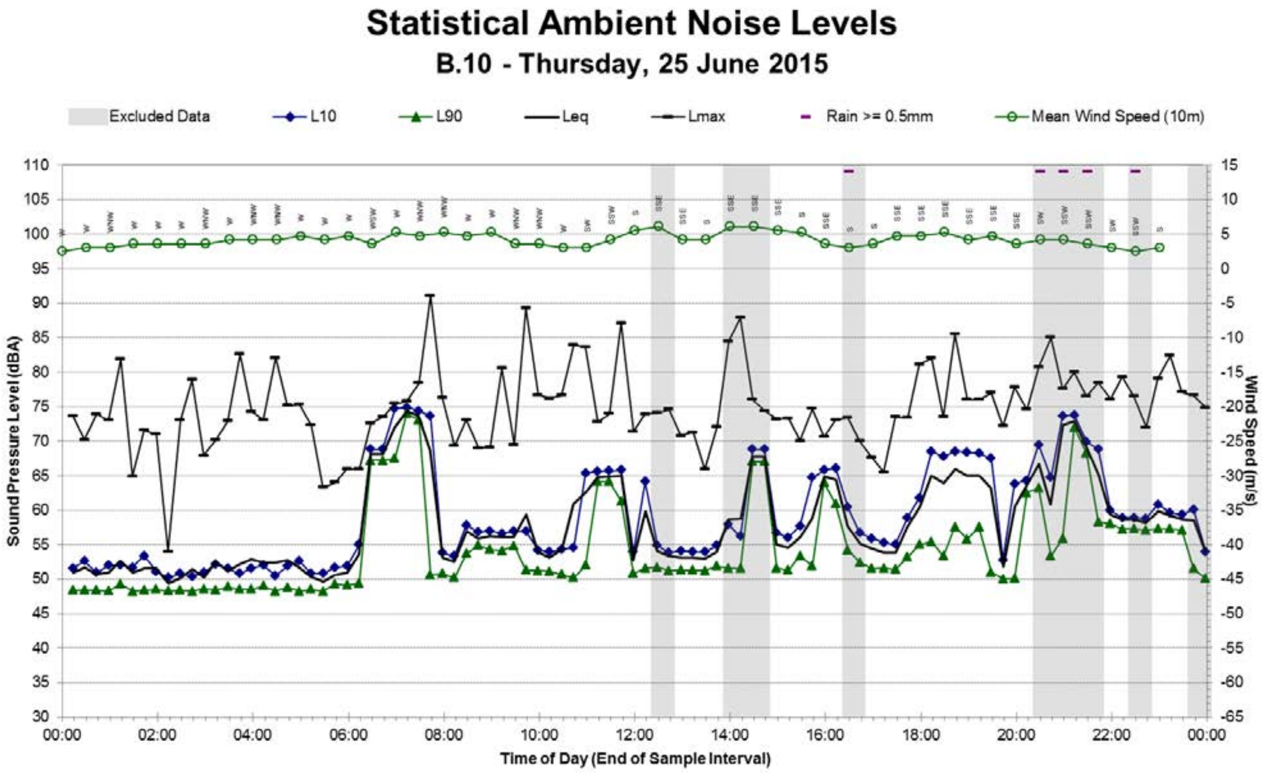


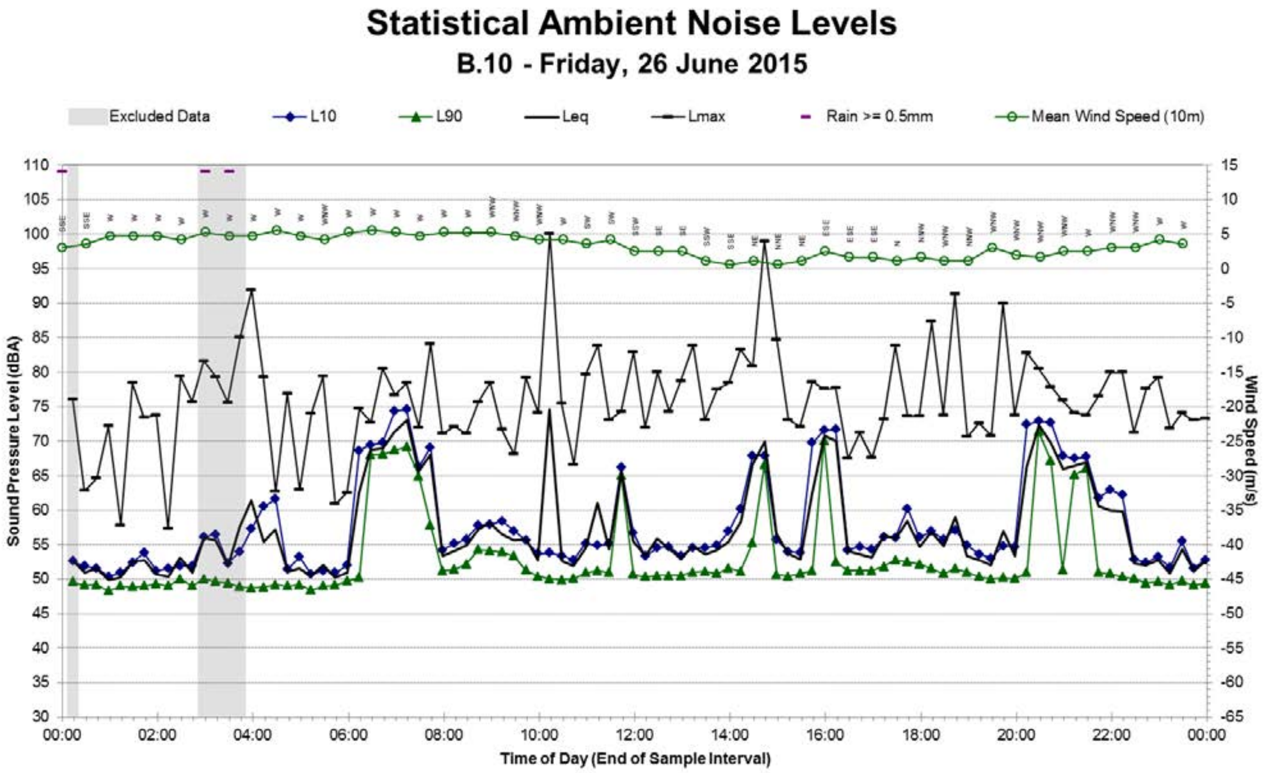
Statistical Ambient Noise Levels
B.10 - Tuesday, 23 June 2015



Statistical Ambient Noise Levels
B.10 - Wednesday, 24 June 2015

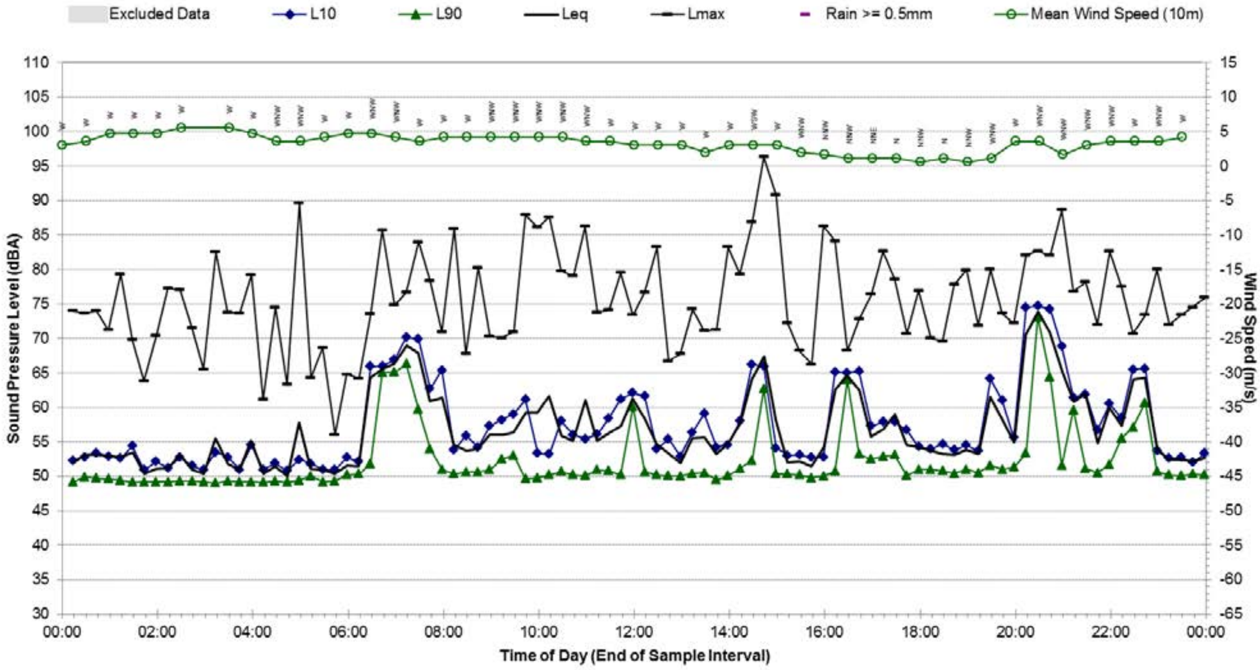



Statistical Ambient Noise Levels
B.10 - Thursday, 25 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

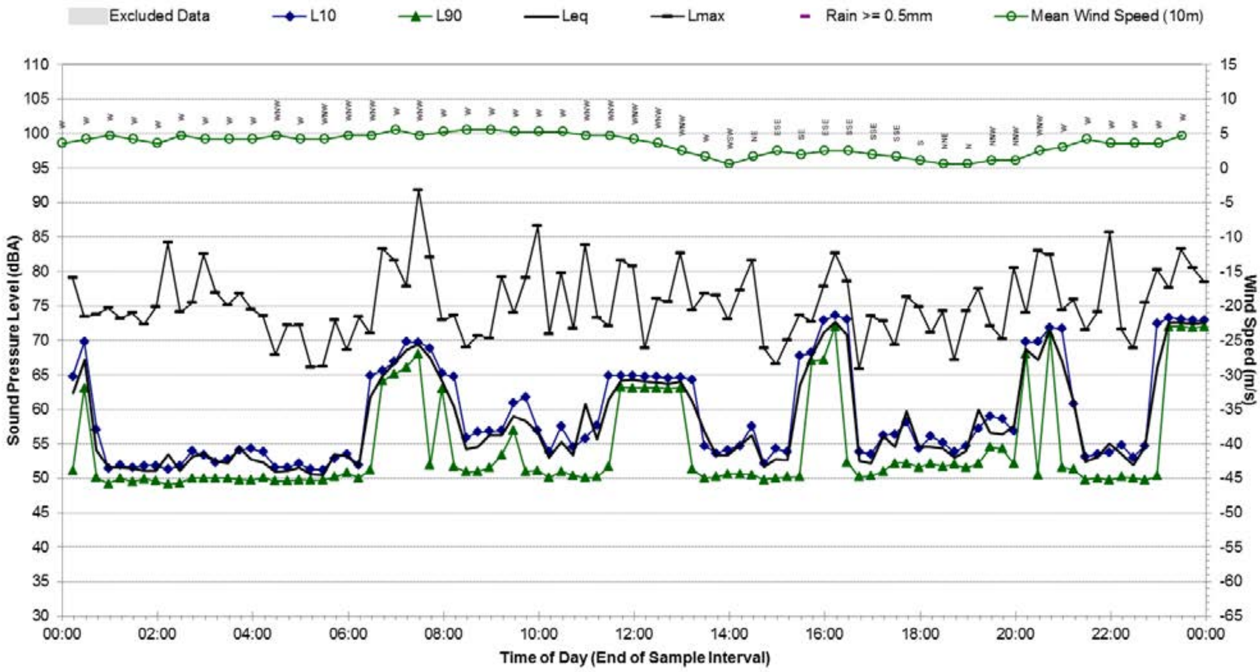

Statistical Ambient Noise Levels
B.10 - Friday, 26 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Background Noise Monitoring Results – B.10

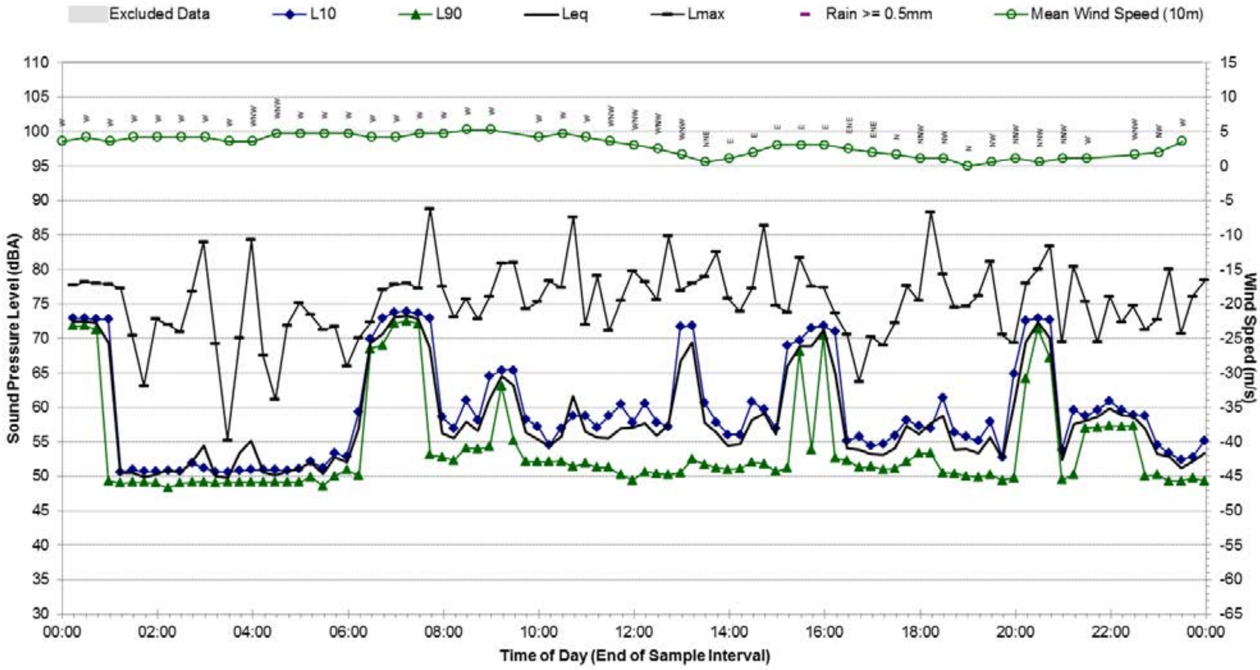
Statistical Ambient Noise Levels
B.10 - Saturday, 27 June 2015



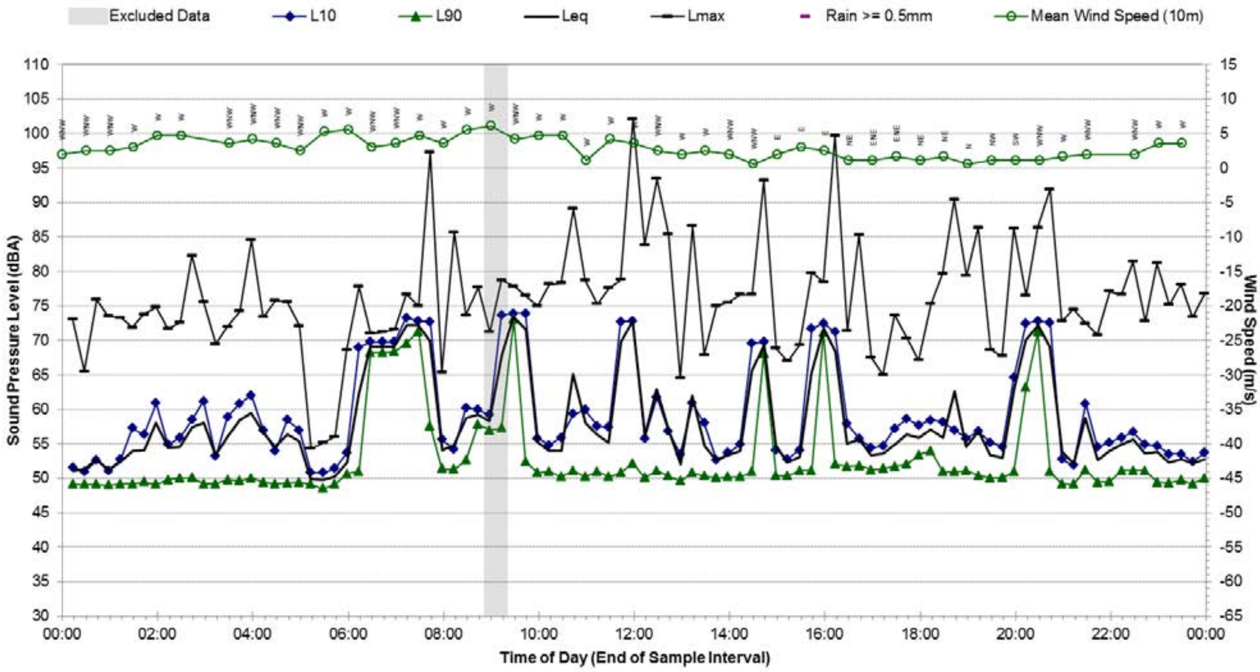
Statistical Ambient Noise Levels
B.10 - Sunday, 28 June 2015



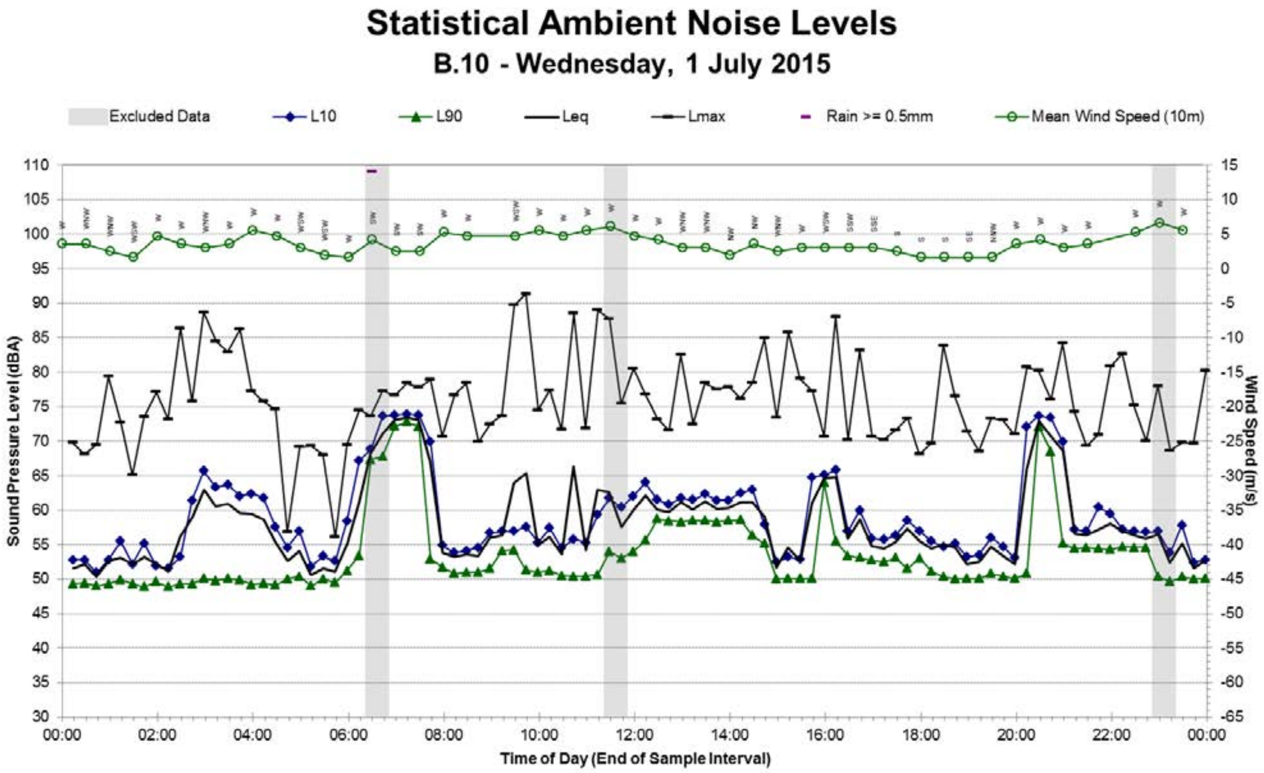
Statistical Ambient Noise Levels
B.10 - Monday, 29 June 2015

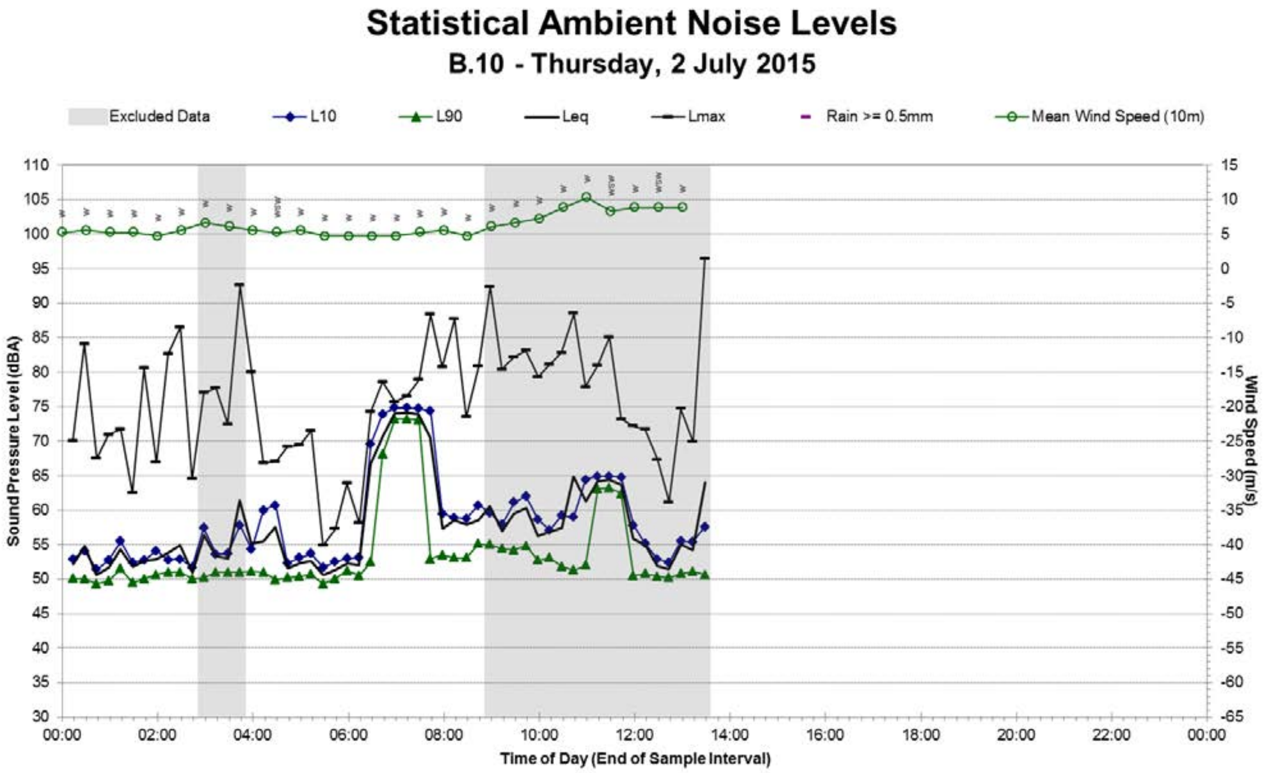


Statistical Ambient Noise Levels
B.10 - Tuesday, 30 June 2015



Background Noise Monitoring Results – B.10





Background Noise Monitoring Results – B.11

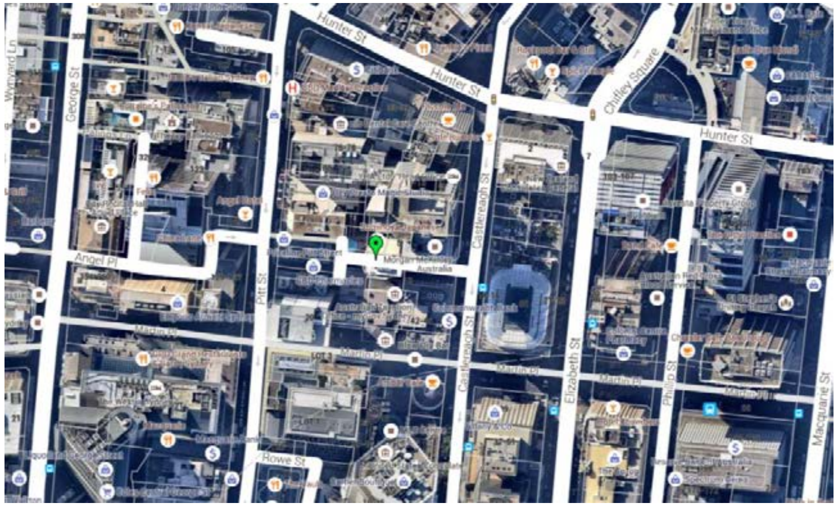
Noise Monitoring Location:	**B.11**
Noise Monitoring Address:	**1 Hoskings Place, Sydney 2000**

Logger Device Type: Svantek 957
Logger Serial No: 23245

Ambient noise logger deployed on the balcony of apartment 403 of Medina Serviced Apartments, Martin Place at 1 Hoskings Place, Sydney. Logger located four levels up with noise catchment over Hoskings Place.

Attended noise measurements indicate that the ambient noise environment at this location is significantly dominated by mechanical plant from neighbouring buildings, building maintenance work and road traffic noise from both Castlereagh Street and Hoskings Place. The LA90 (background) noise level was from surrounding mechanical plant and the observed "city hum" which is constant in the Sydney CBD.

Map of Noise Monitoring Location



Ambient Noise Logging Results – INP Defined Time Periods

Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	61	66	66	71
Evening	56	62	63	68
Night-time	52	63	59	66

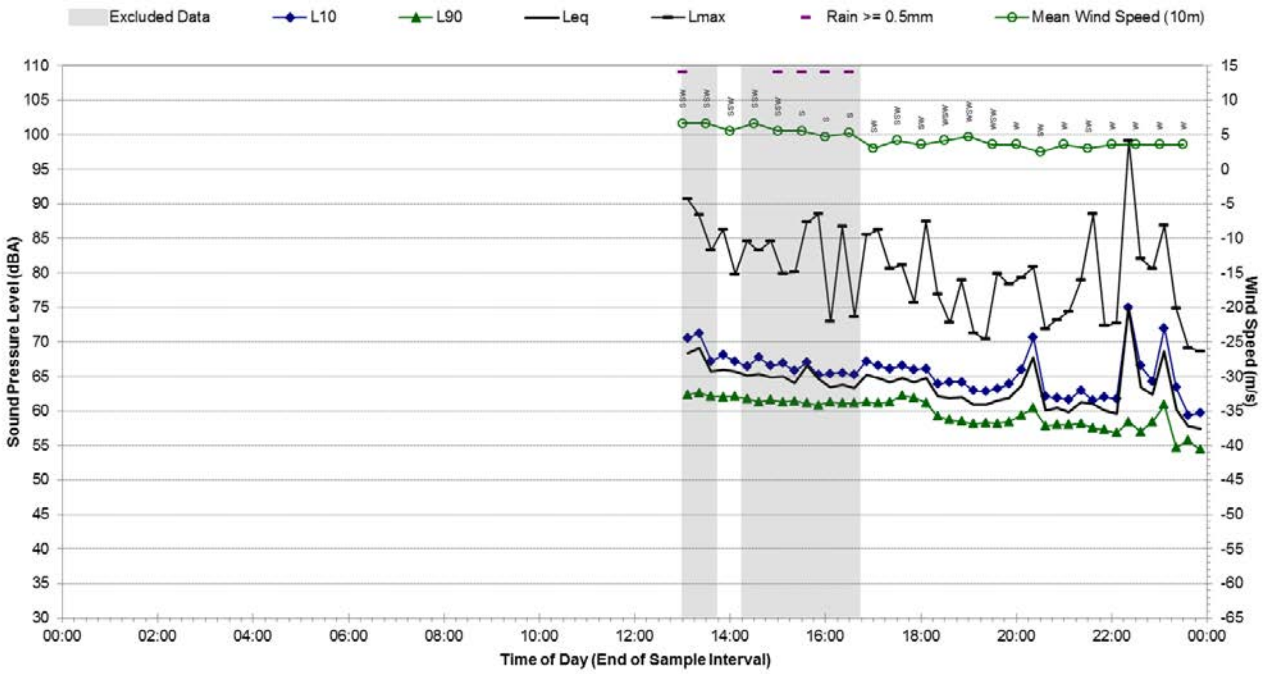
Attended Noise Measurement Results

Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
19/06/2015	12:44:34	62	68	85

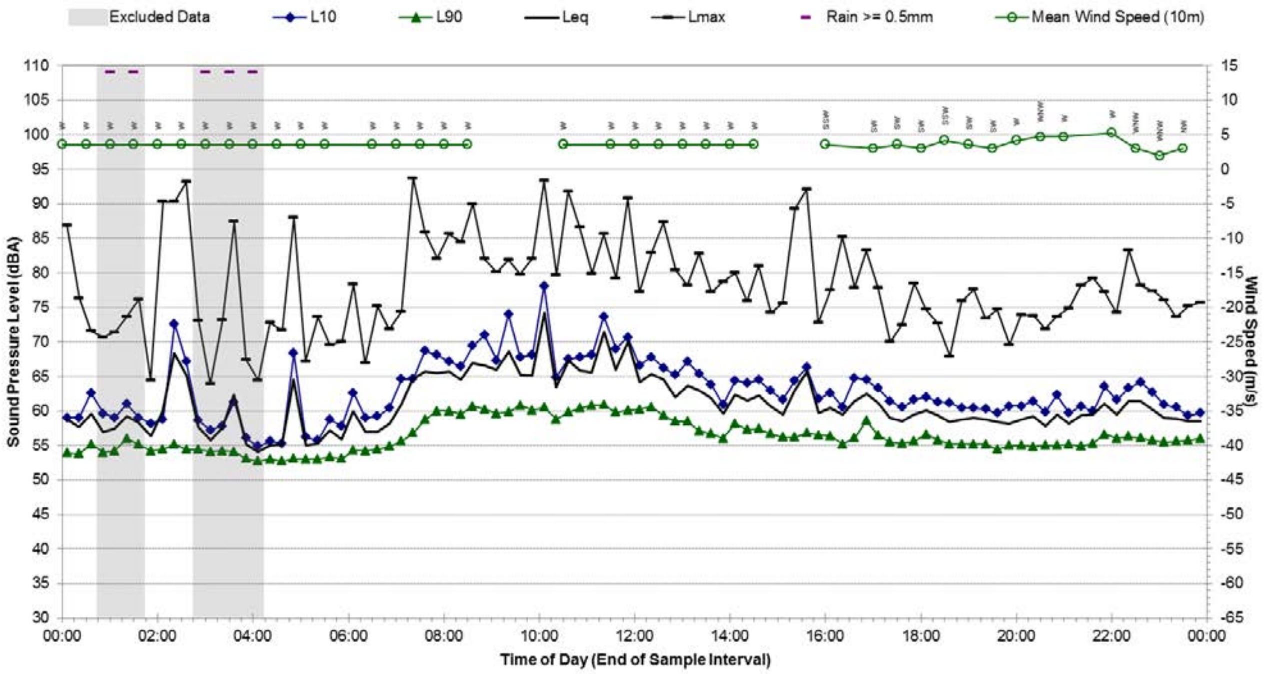
Photo of Noise Monitoring Location

Background Noise Monitoring Results – B.11

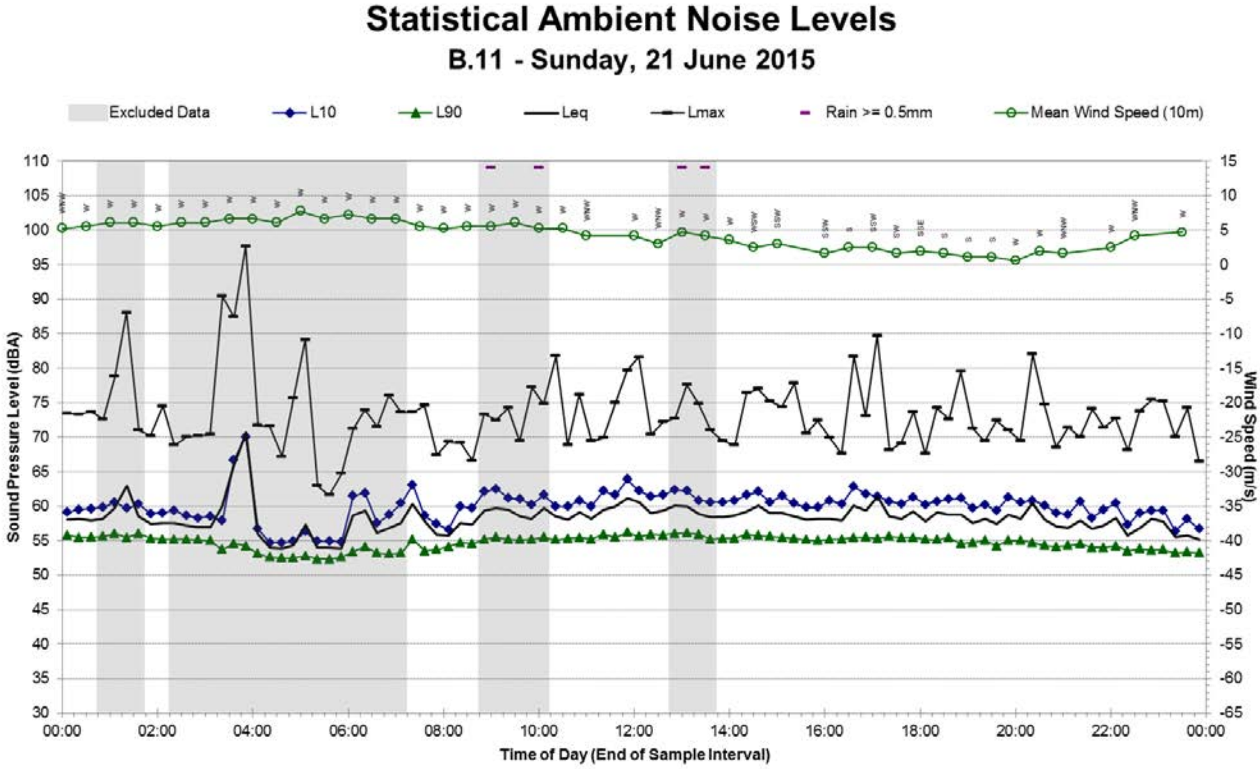
Statistical Ambient Noise Levels
B.11 - Friday, 19 June 2015

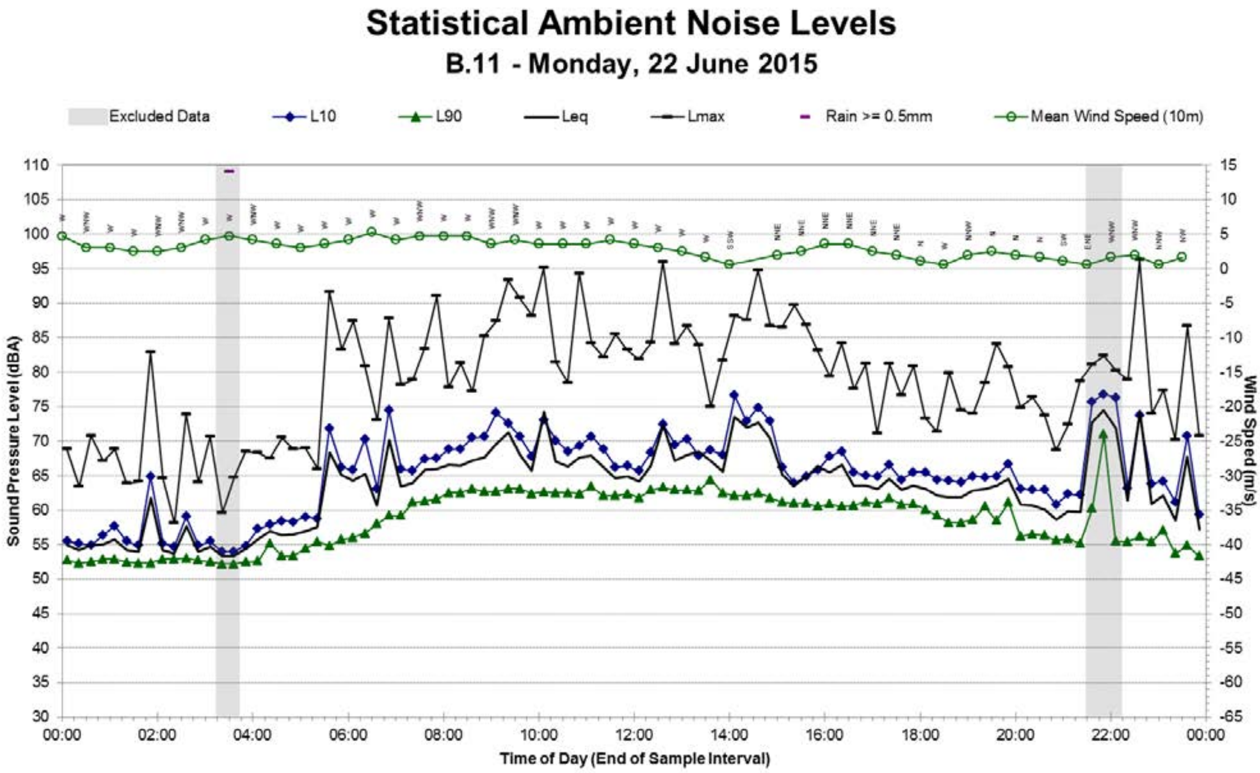


Statistical Ambient Noise Levels
B.11 - Saturday, 20 June 2015



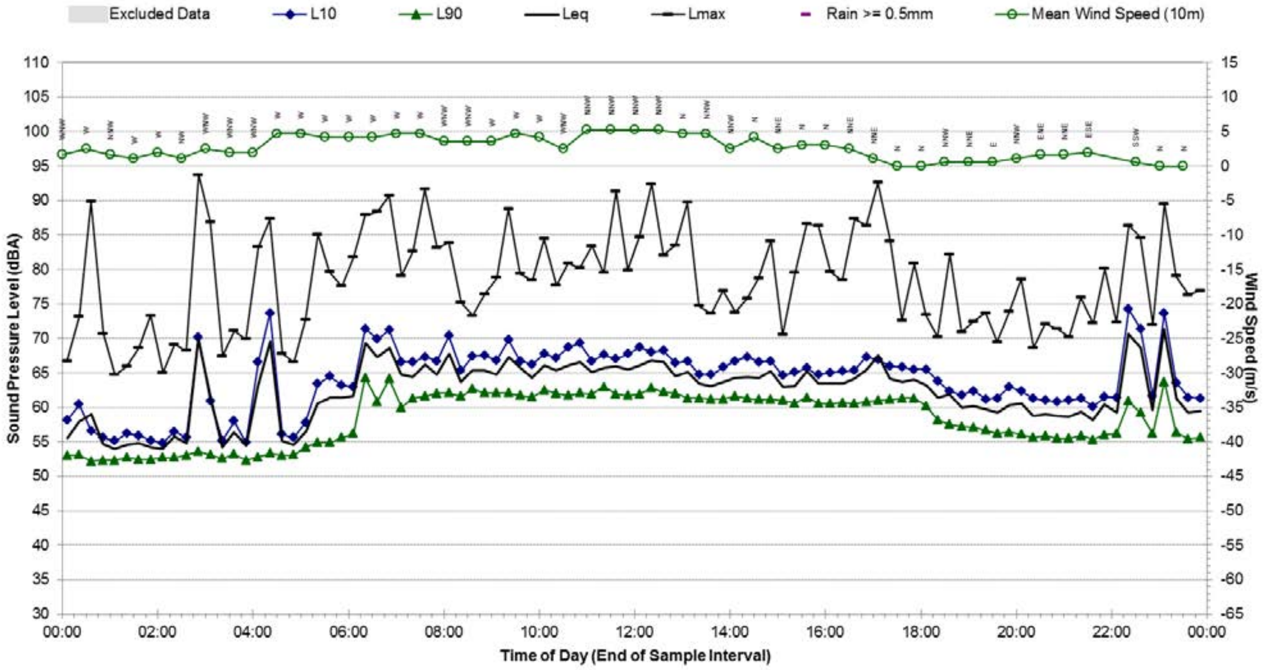
Background Noise Monitoring Results – B.11



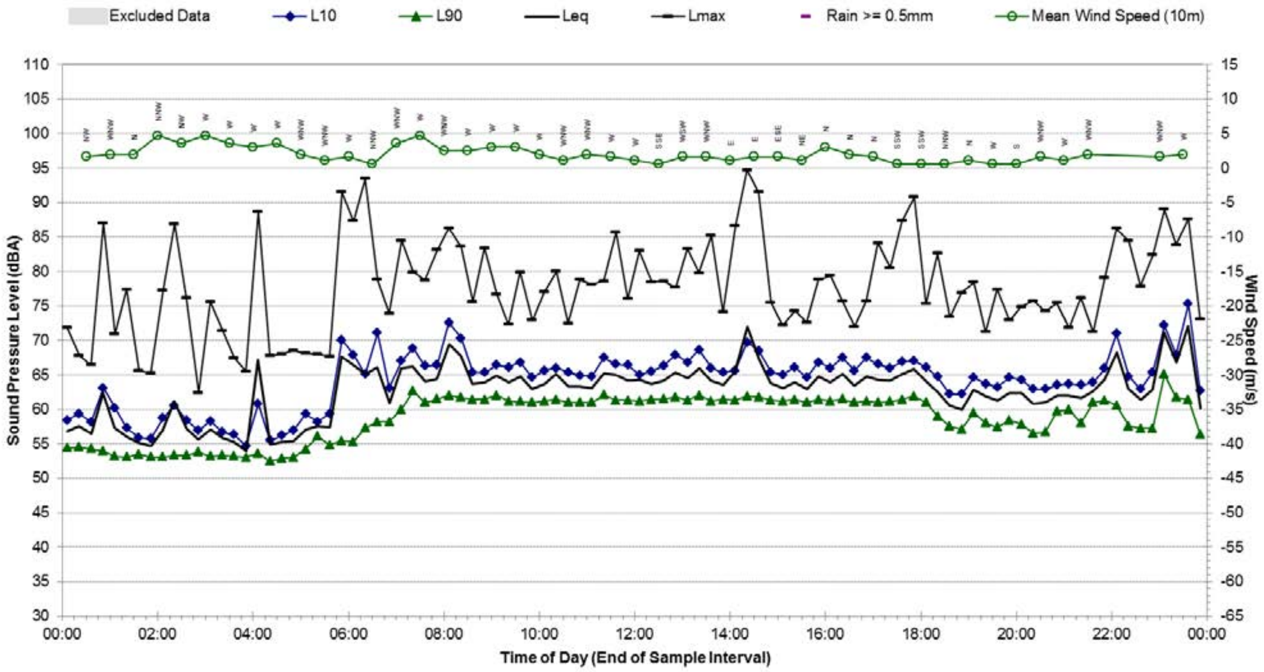


Background Noise Monitoring Results – B.11

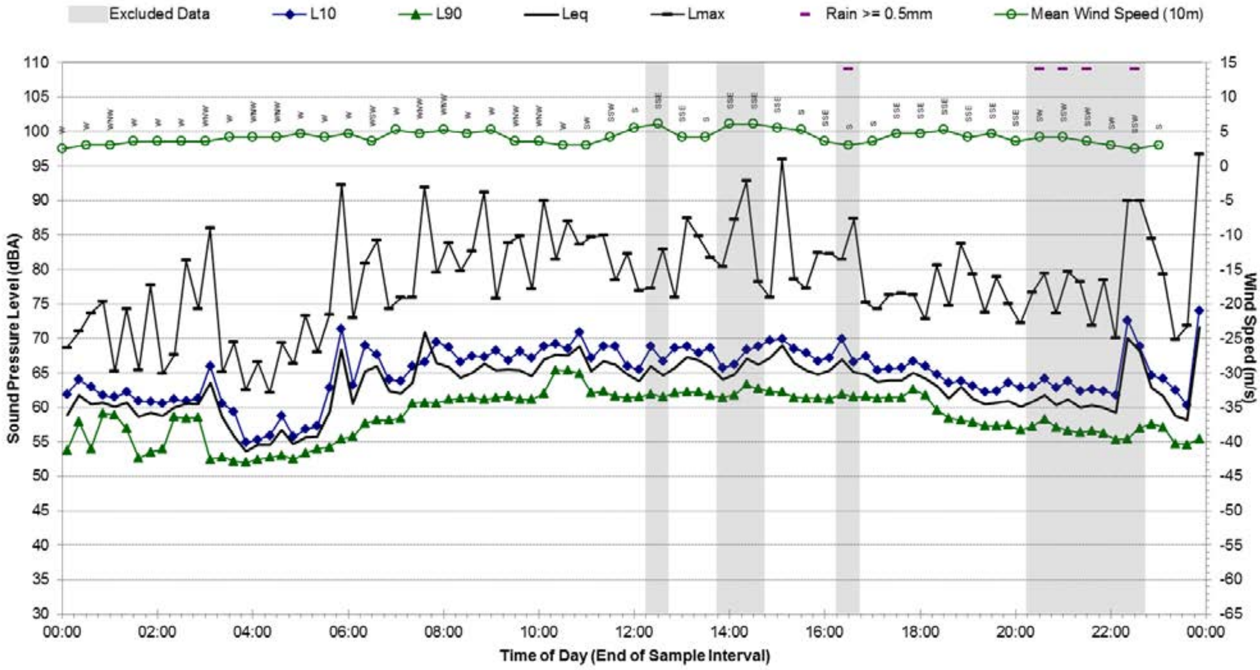
Statistical Ambient Noise Levels
B.11 - Tuesday, 23 June 2015



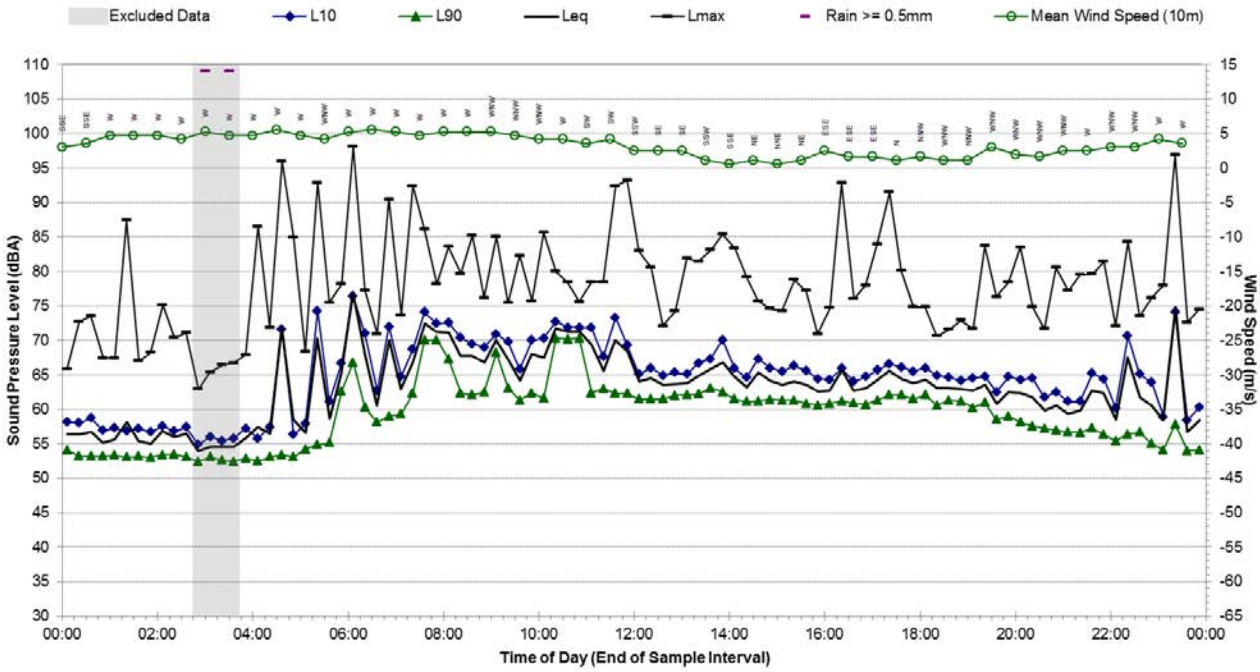
Statistical Ambient Noise Levels
B.11 - Wednesday, 24 June 2015

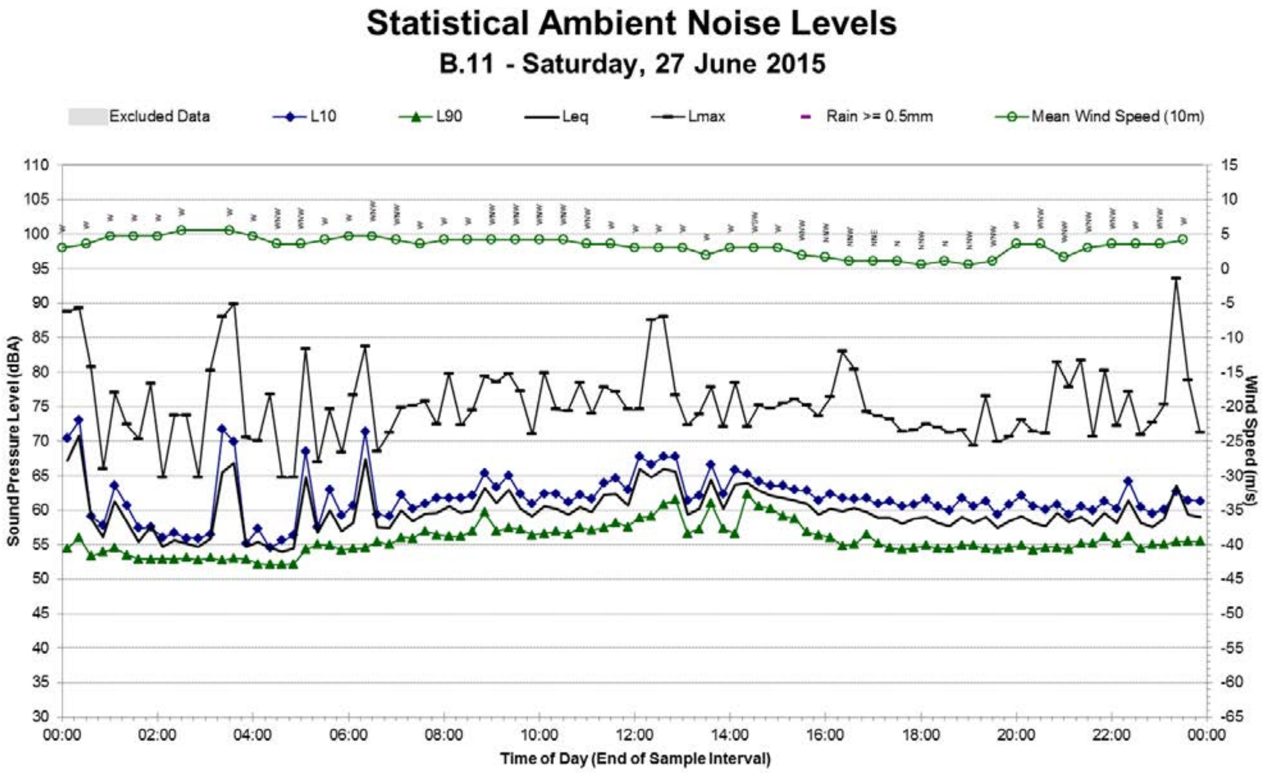


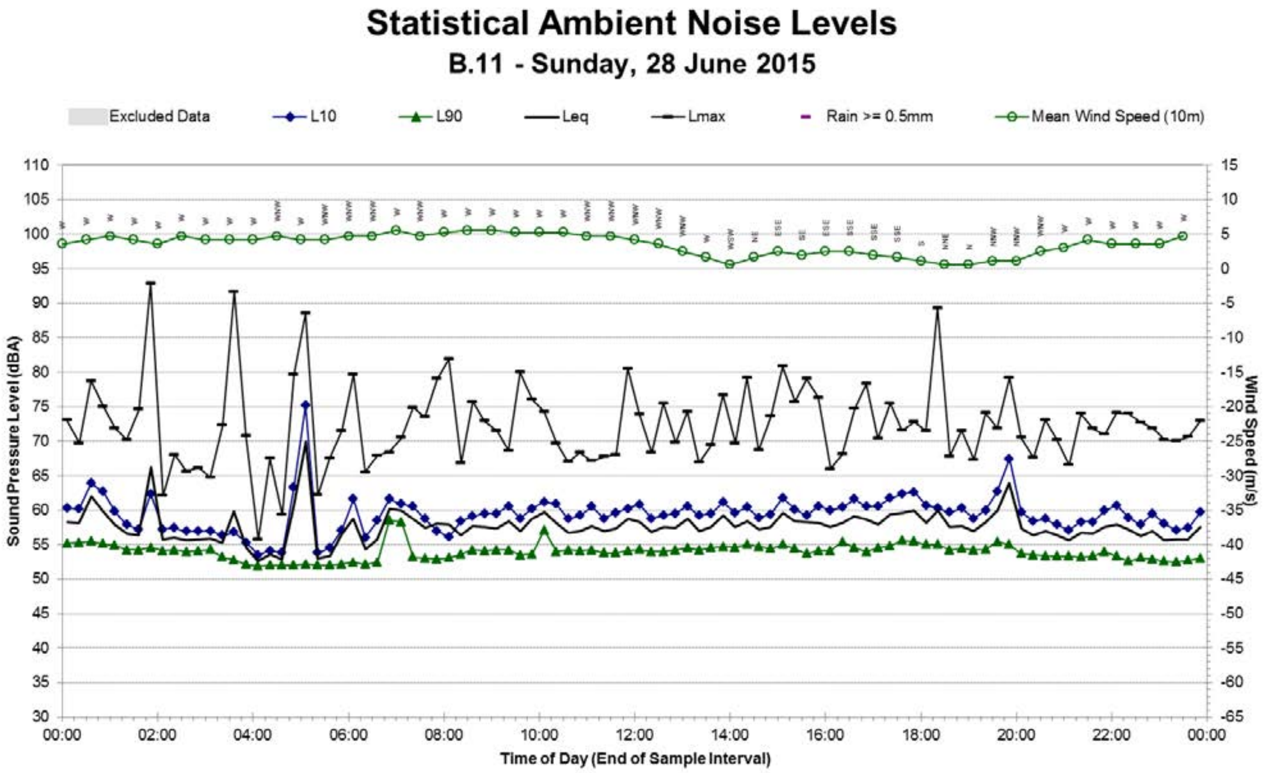
Statistical Ambient Noise Levels
B.11 - Thursday, 25 June 2015



Statistical Ambient Noise Levels
B.11 - Friday, 26 June 2015

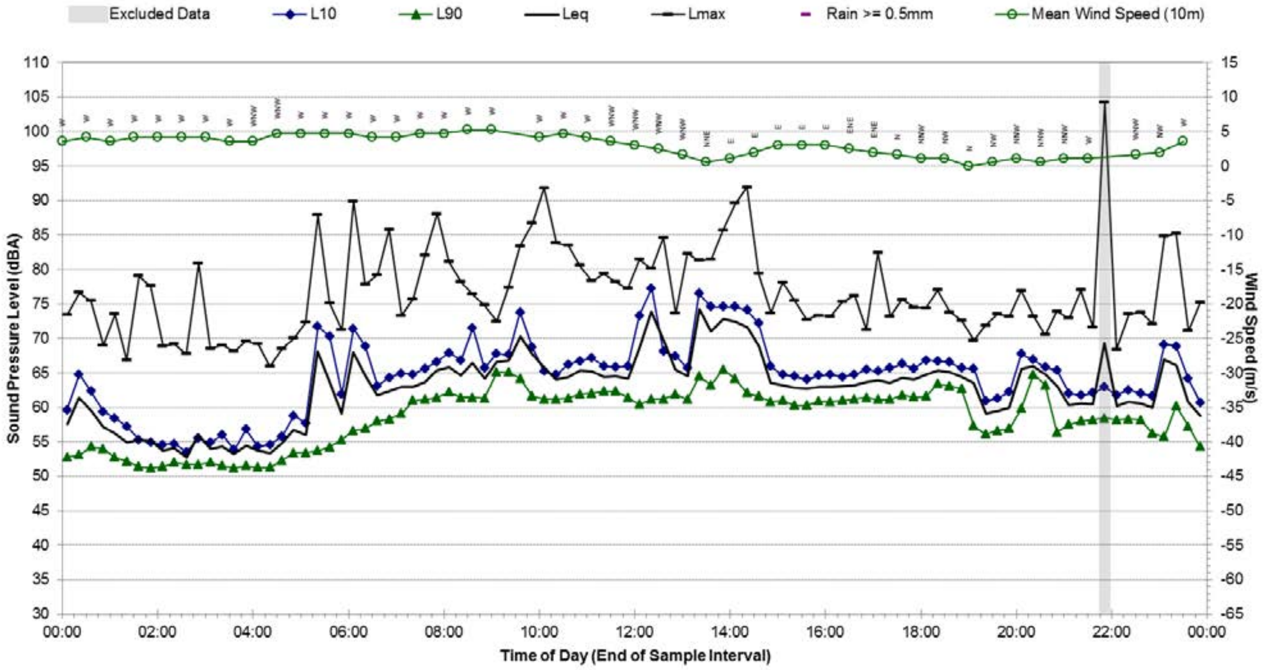



Statistical Ambient Noise Levels
B.11 - Saturday, 27 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

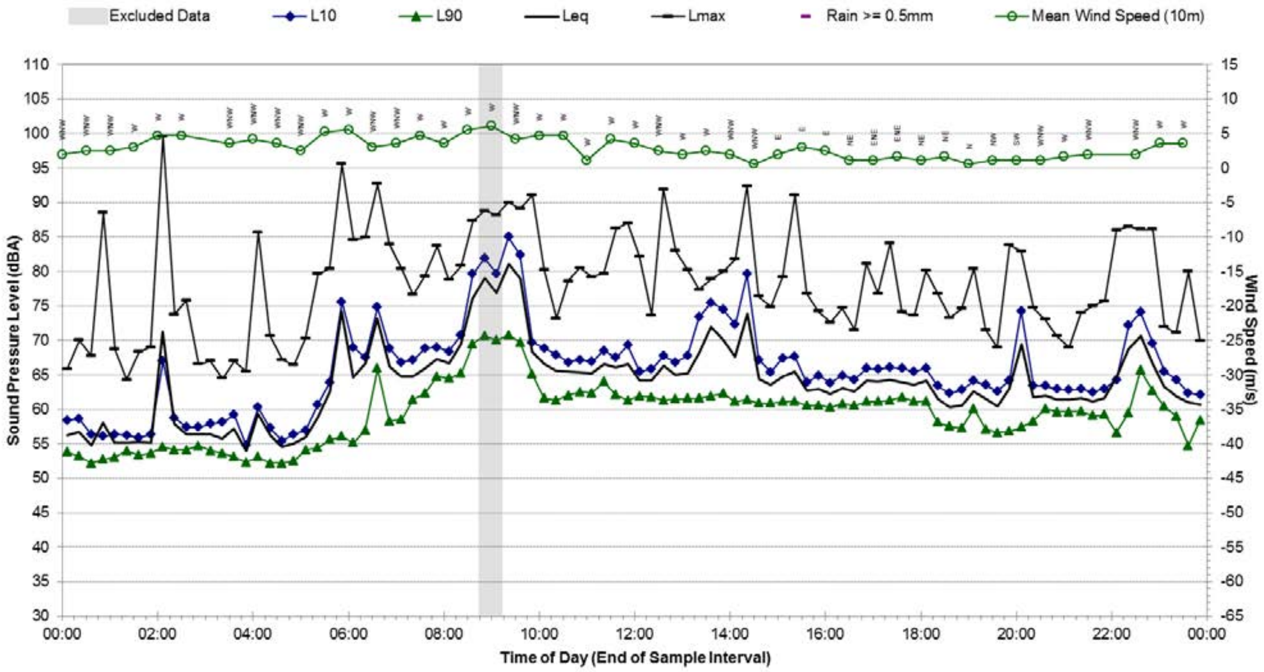

Statistical Ambient Noise Levels
B.11 - Sunday, 28 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Background Noise Monitoring Results – B.11

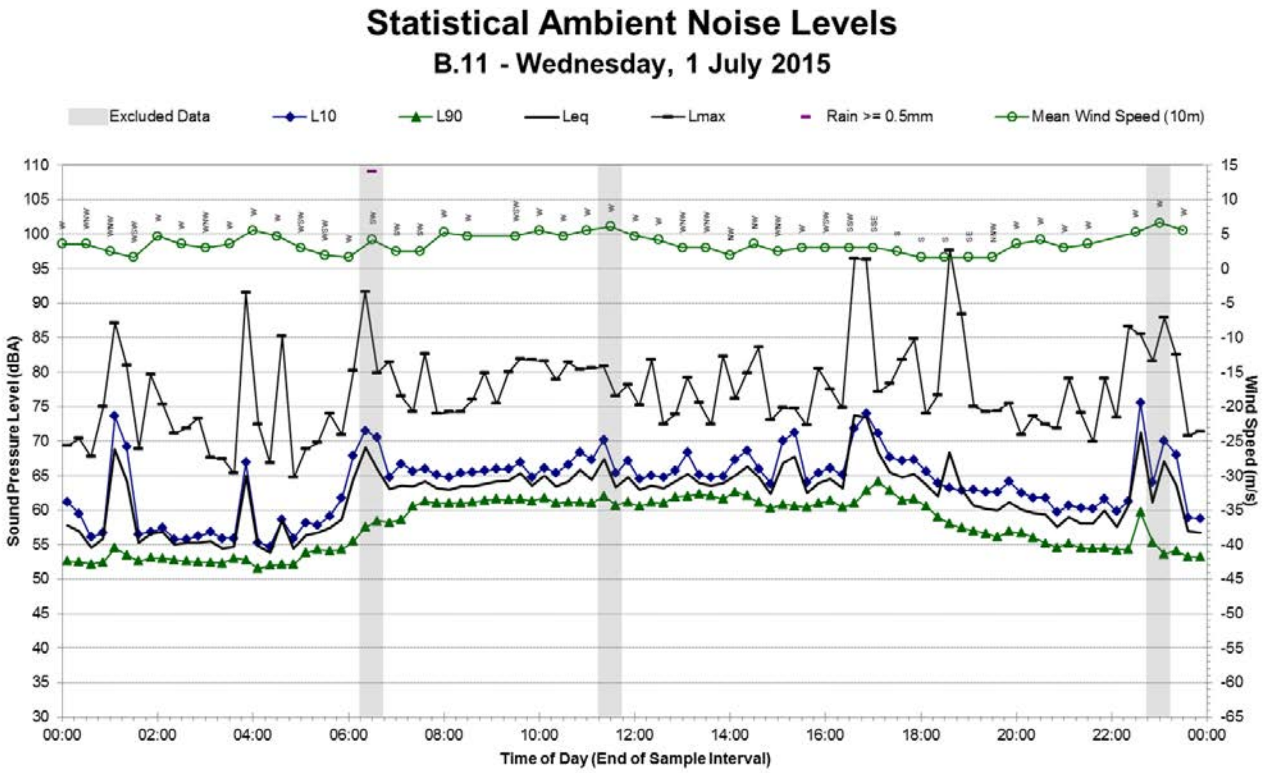
Statistical Ambient Noise Levels
B.11 - Monday, 29 June 2015

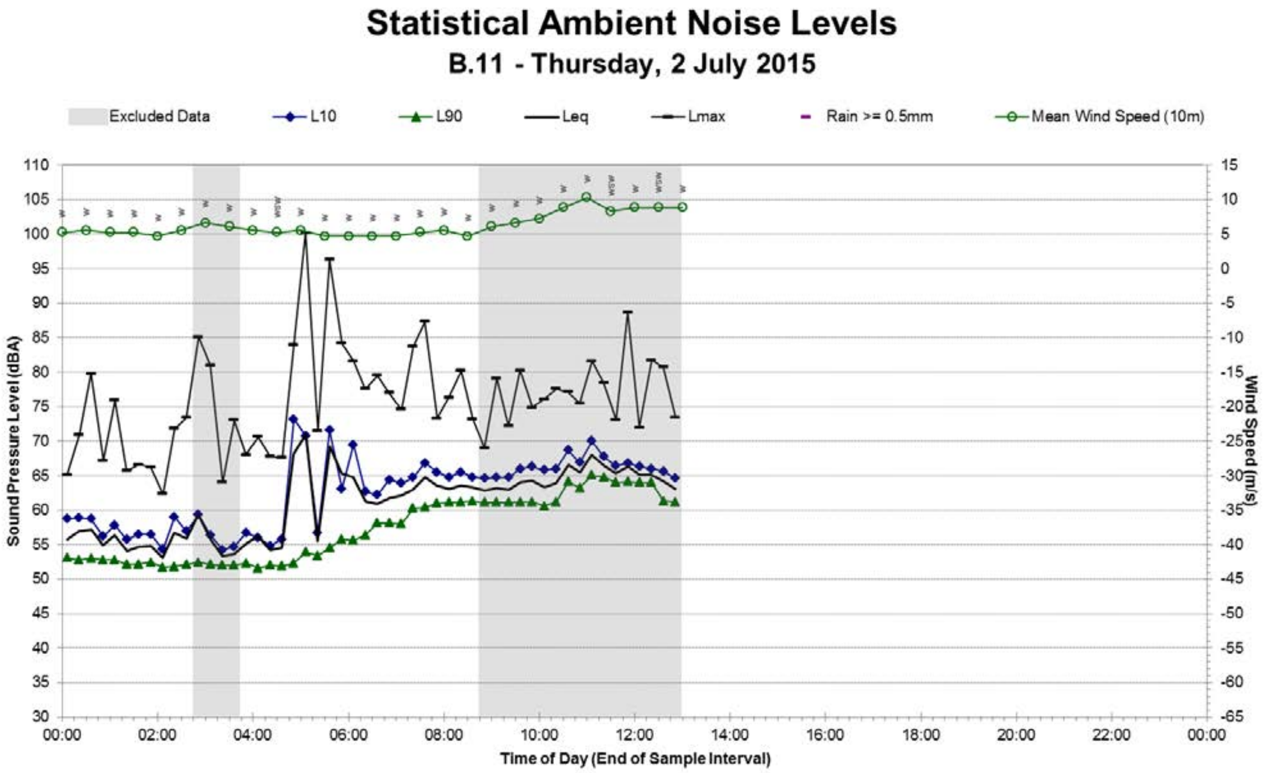


Statistical Ambient Noise Levels
B.11 - Tuesday, 30 June 2015



Background Noise Monitoring Results – B.11





Noise Monitoring Location:	**B.12**
Noise Monitoring Address:	**26A High Street, Millers Point 2000 (Barangaroo)**

Logger Device Type: Svantek 957
Logger Serial No: 27578

Ambient noise logger deployed on the balcony of residential address 26A High Street, Millers Point. Logger located two levels up with noise catchment over High Street and Hickson Road below.

Attended noise measurements indicate that the ambient noise environment at this location is dominated by road traffic noise and general equipment and plant noise from the Barangaroo construction site during the daytime. The LA90 background results are attributed to an observed "city hum" which is constant in the Sydney CBD.

Map of Noise Monitoring Location

Ambient Noise Logging Results – INP Defined Time Periods

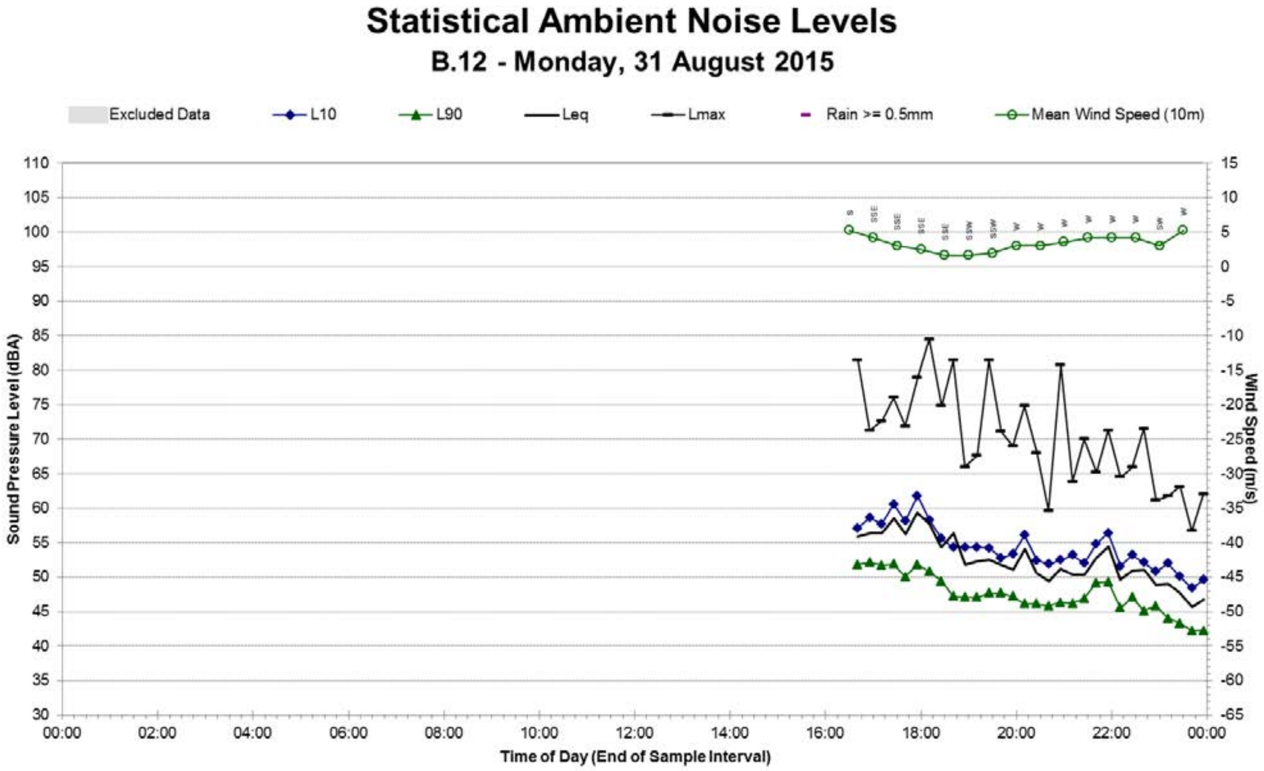
Monitoring Period	Noise Level (dBA)			
	RBL	**LAeq**	**L10**	**L1**
Daytime	50	61	59	68
Evening	45	64	54	62
Night-time	40	51	51	56

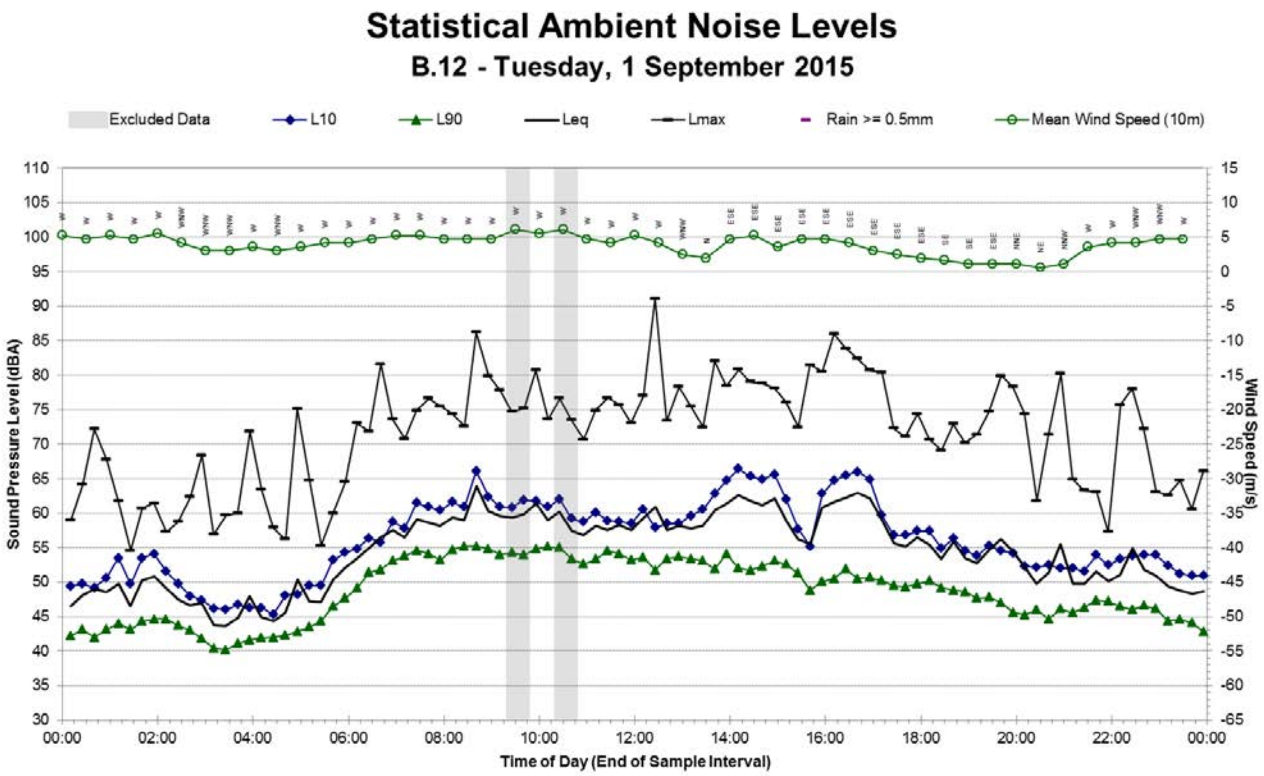
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	**LAeq**	**LAmax**
31/08/2015	16:13:29	53	56	66

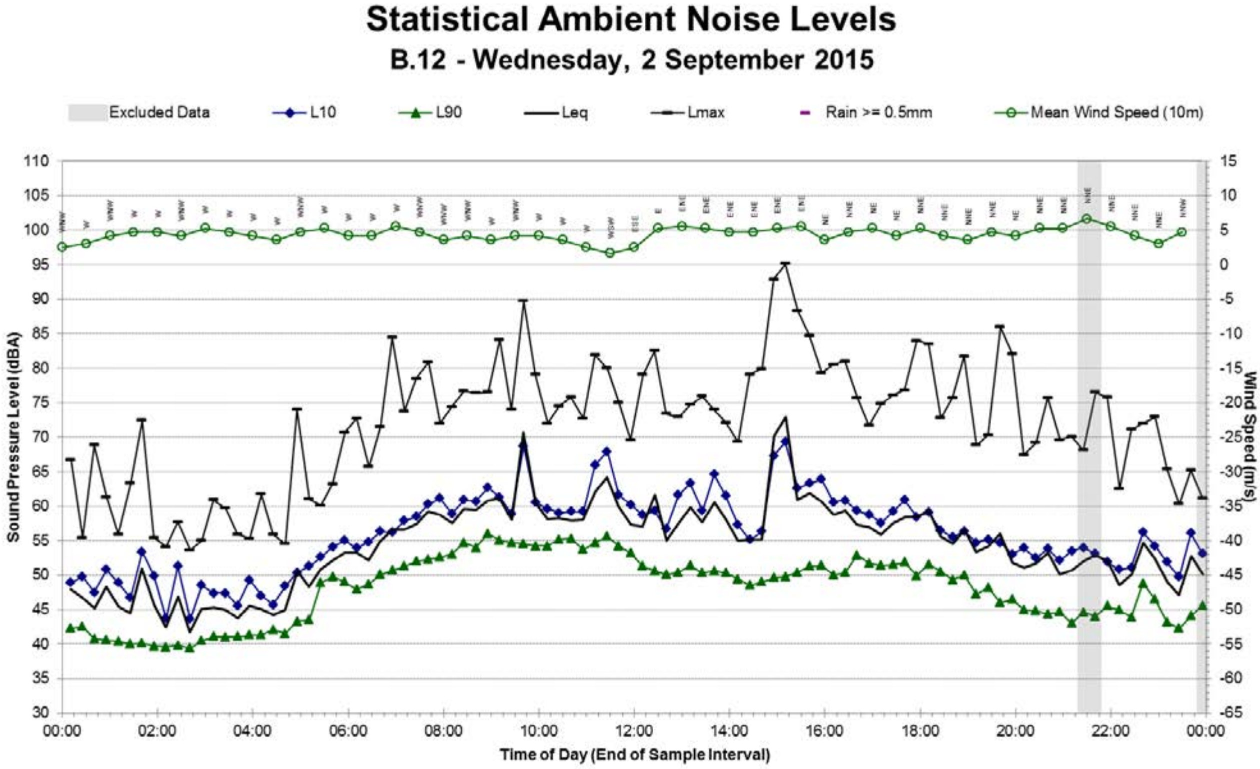
Photo of Noise Monitoring Location

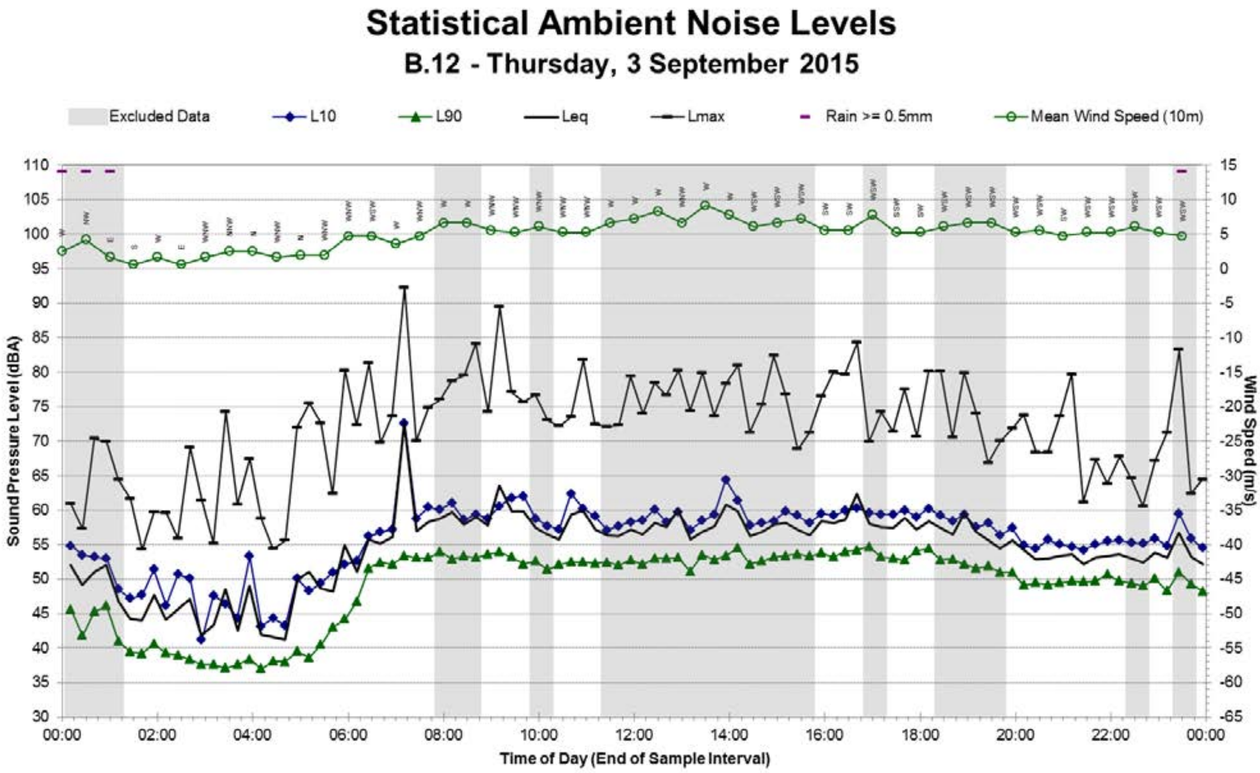
Background Noise Monitoring Results – B.12

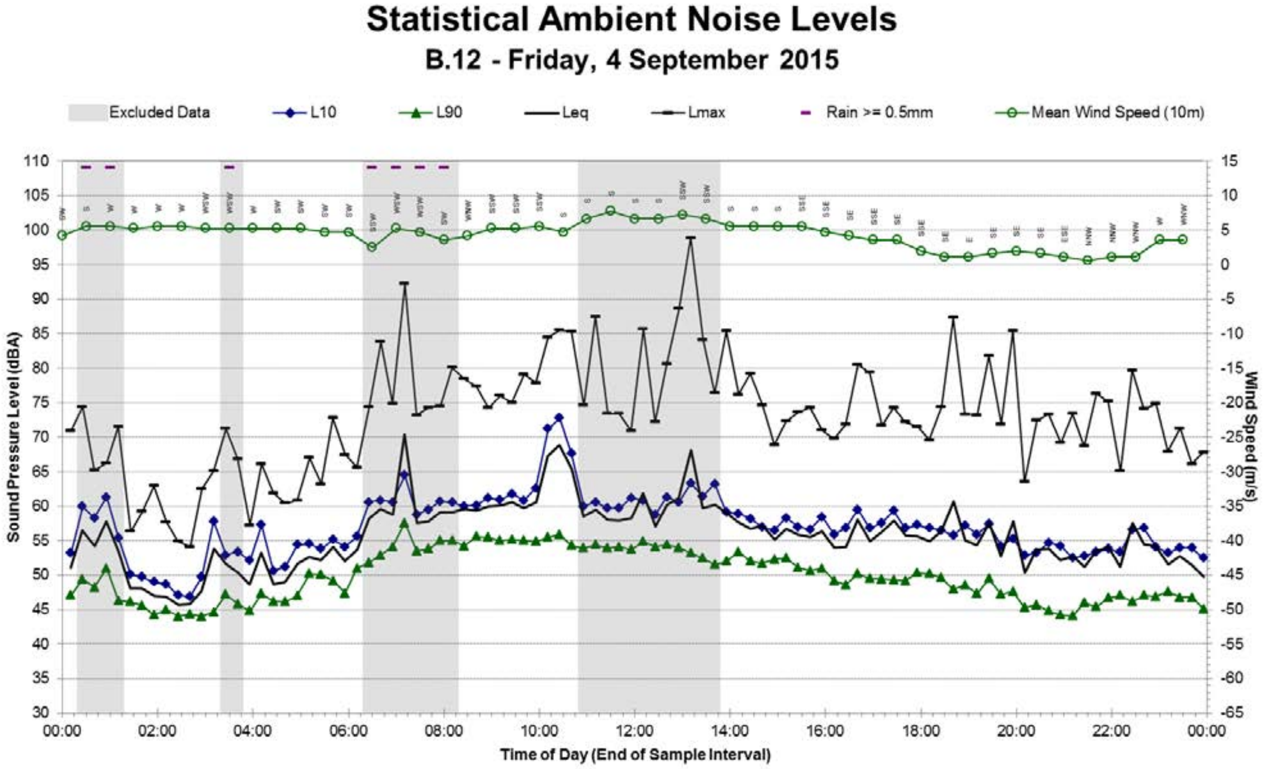


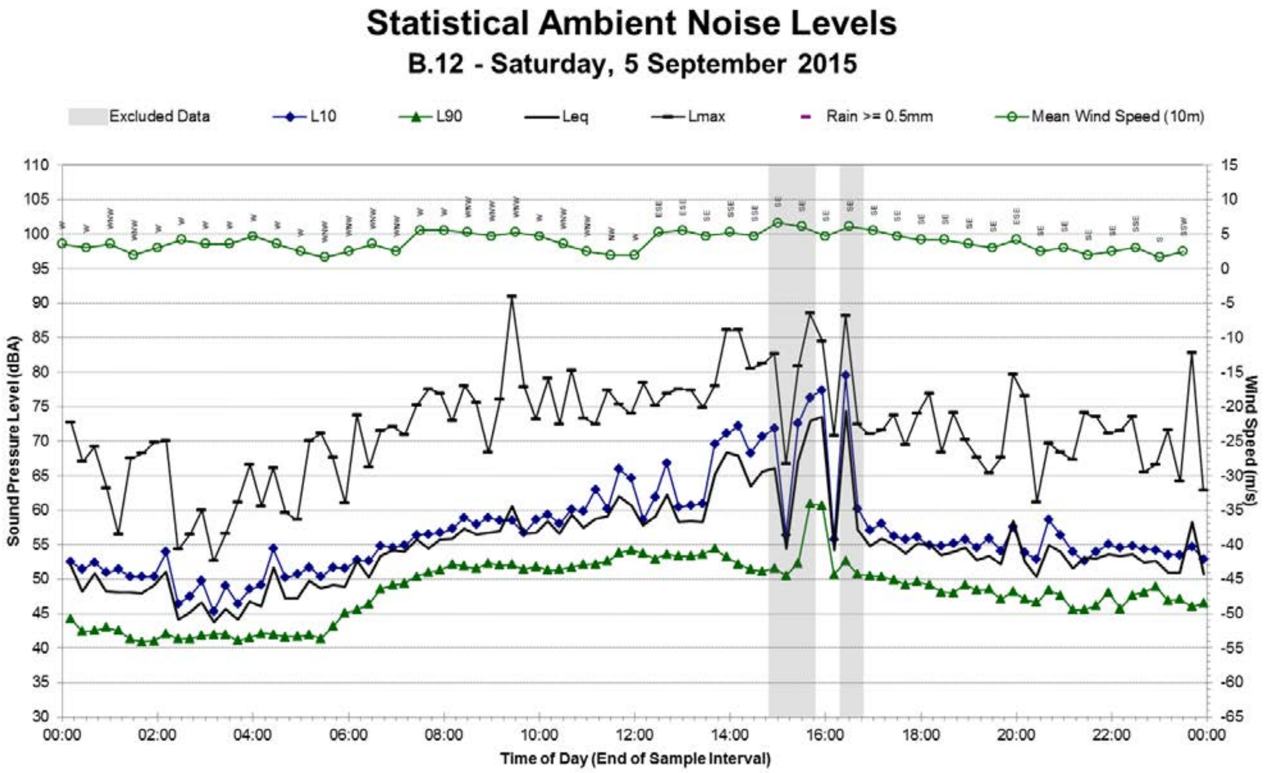


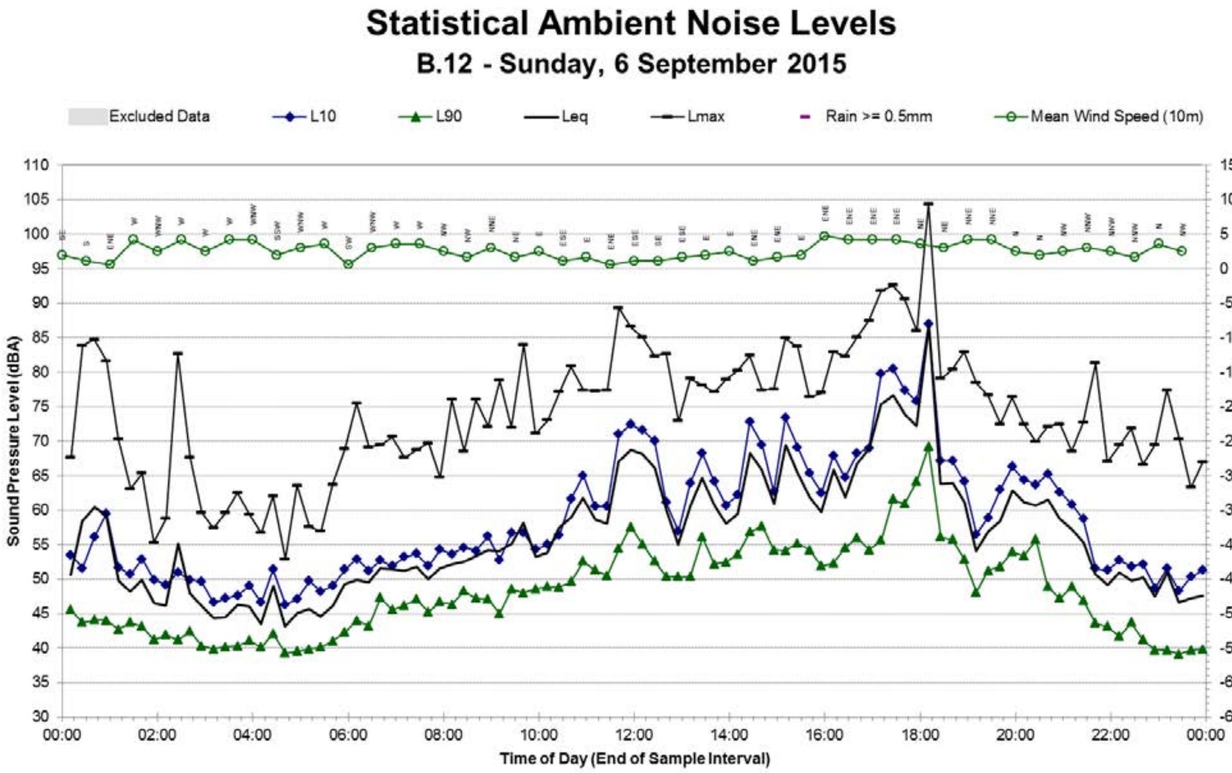
Background Noise Monitoring Results – B.12



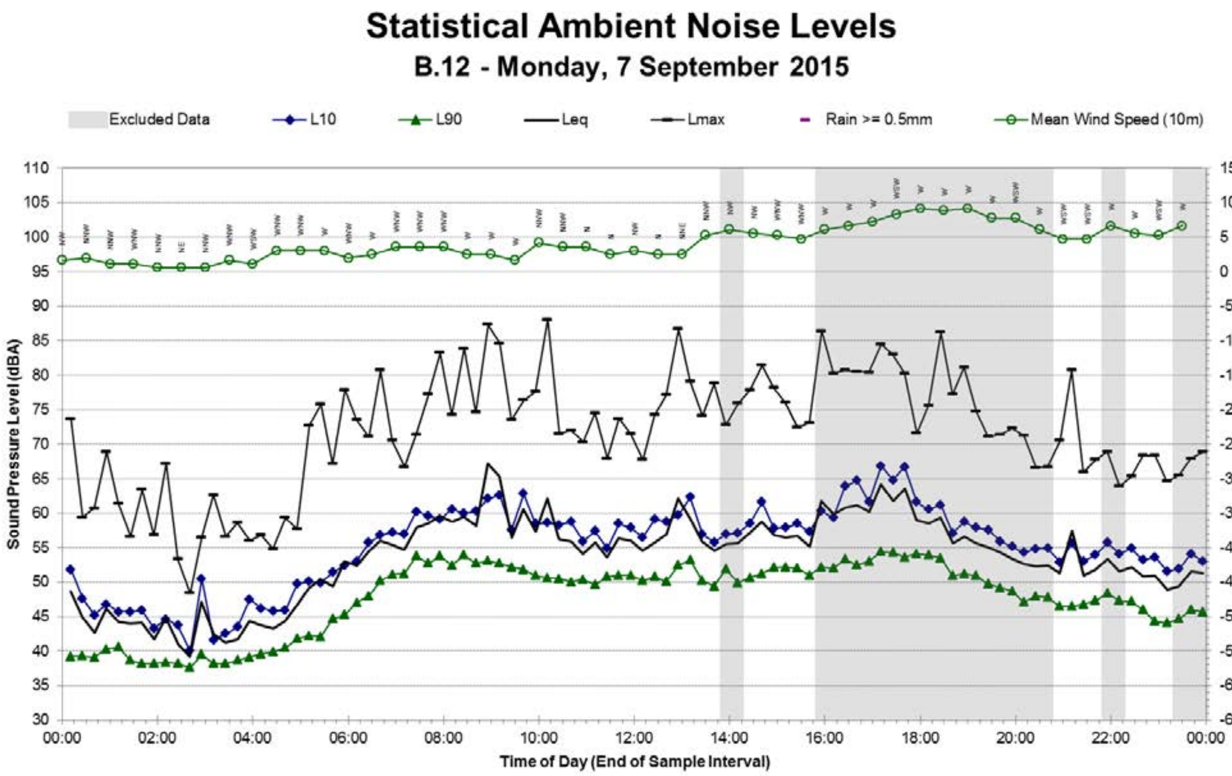



Statistical Ambient Noise Levels
B.12 - Friday, 4 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
B.12 - Saturday, 5 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



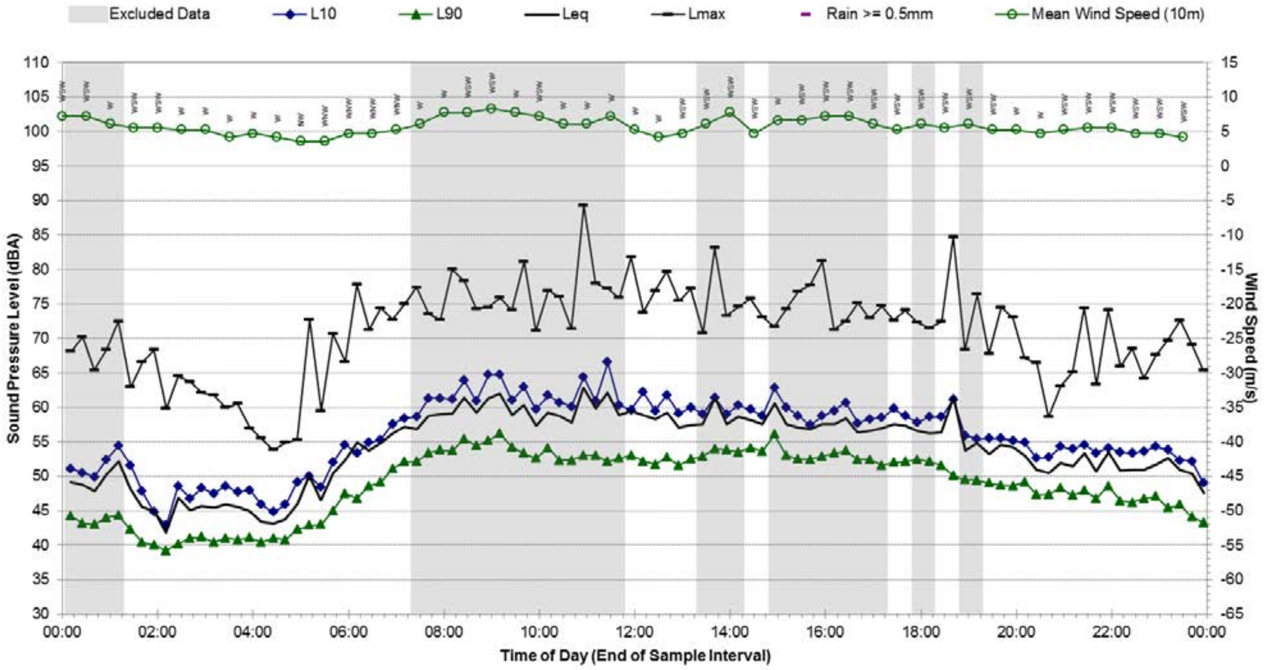
Statistical Ambient Noise Levels
B.12 - Sunday, 6 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



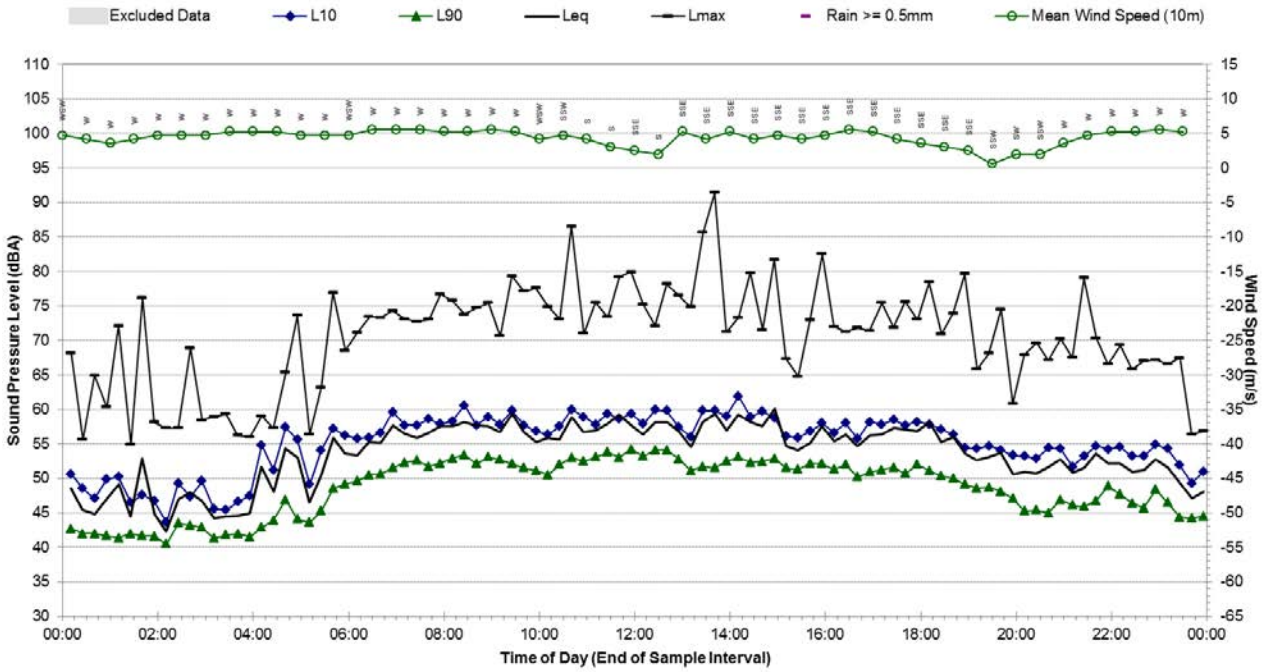
Statistical Ambient Noise Levels
B.12 - Monday, 7 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Background Noise Monitoring Results – B.12

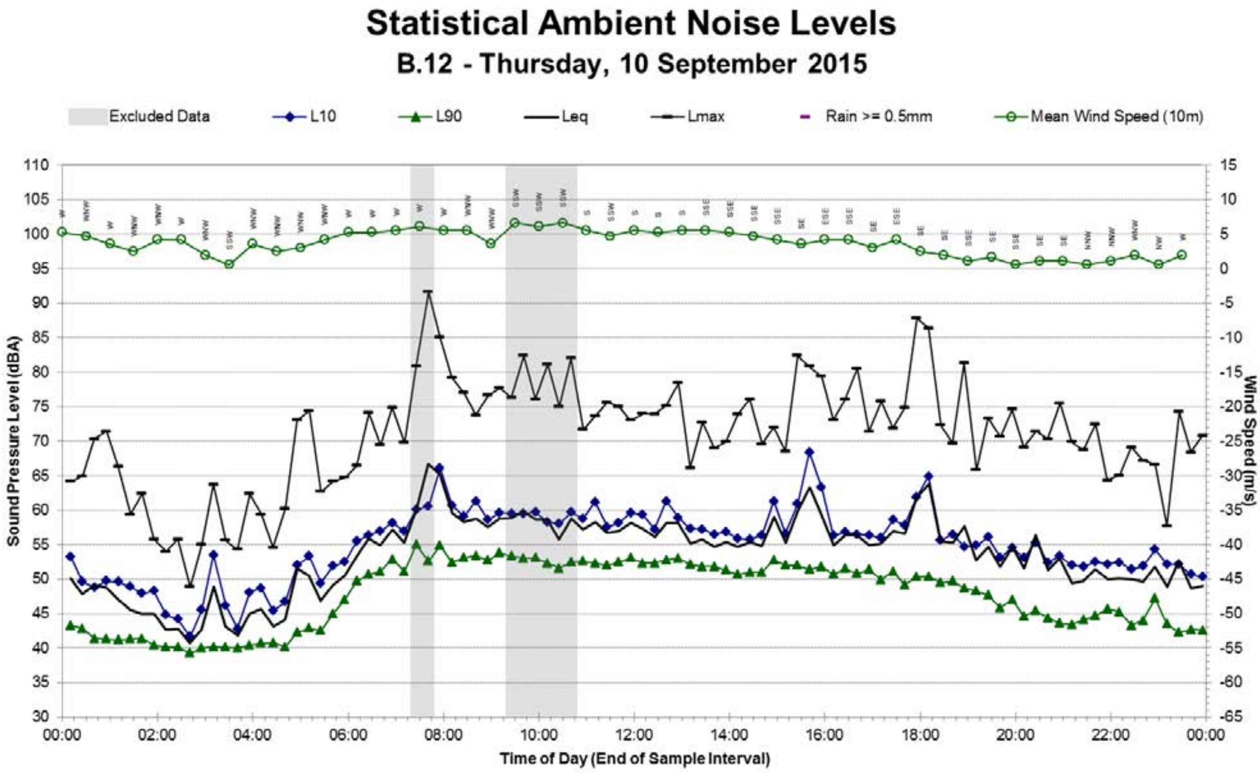
Statistical Ambient Noise Levels
B.12 - Tuesday, 8 September 2015

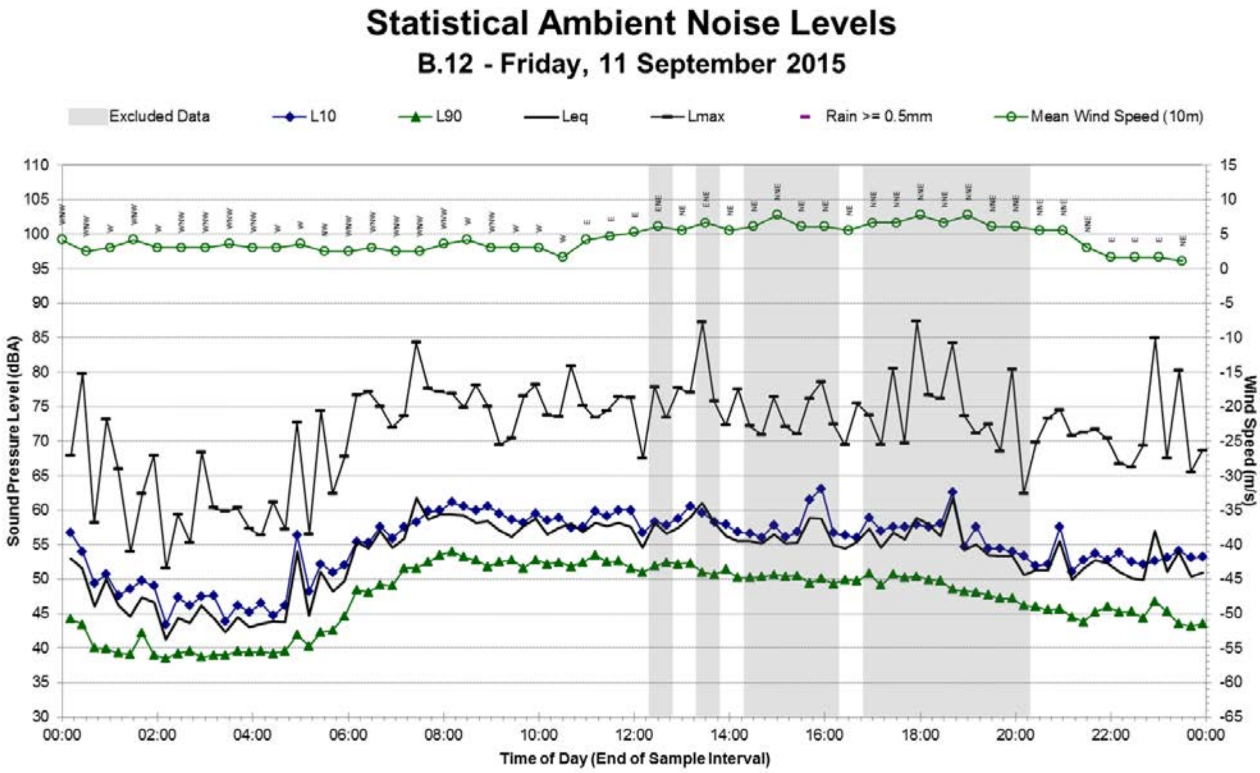


Statistical Ambient Noise Levels
B.12 - Wednesday, 9 September 2015

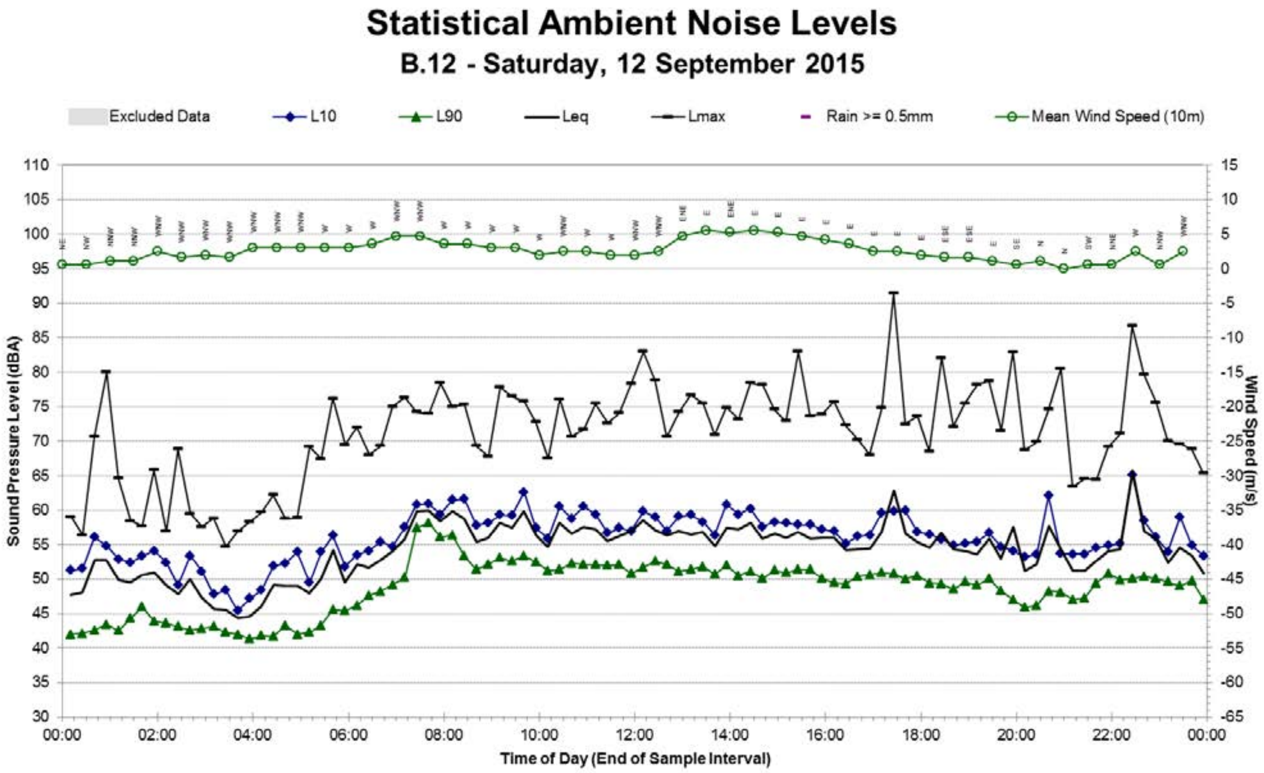


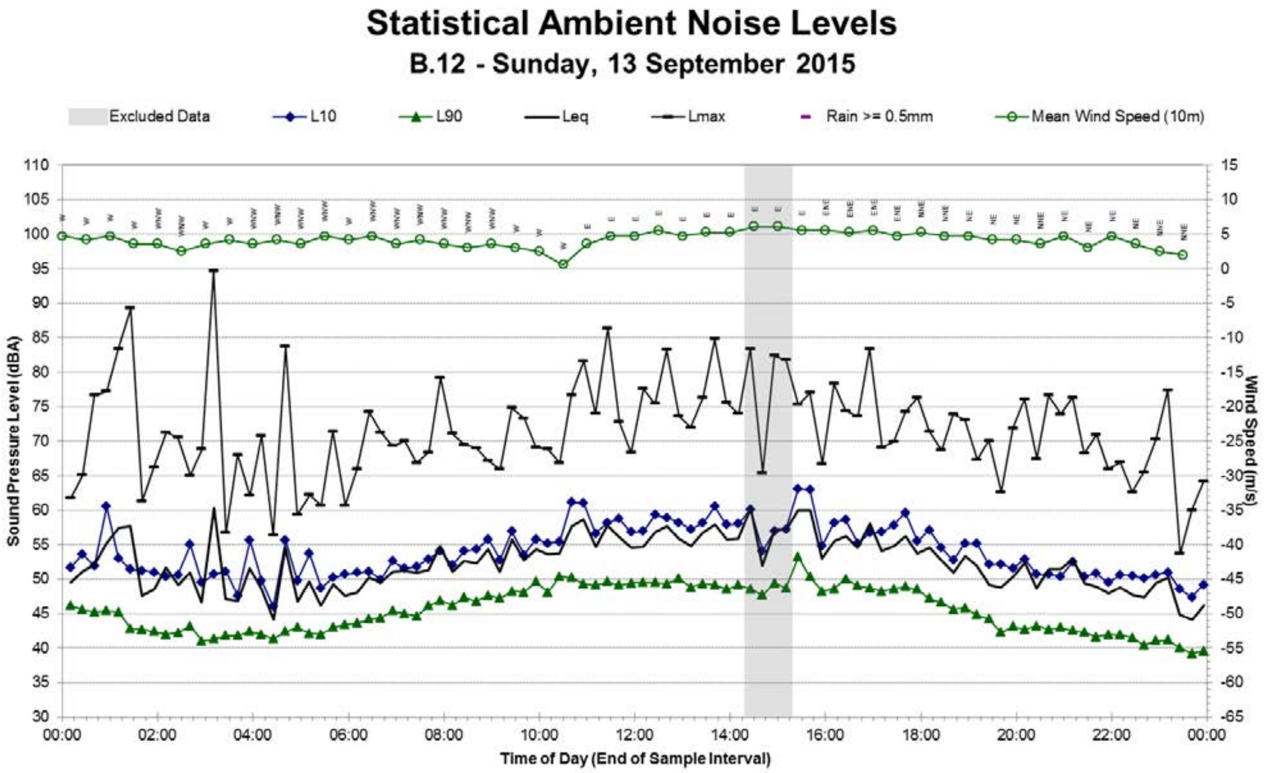
Background Noise Monitoring Results – B.12



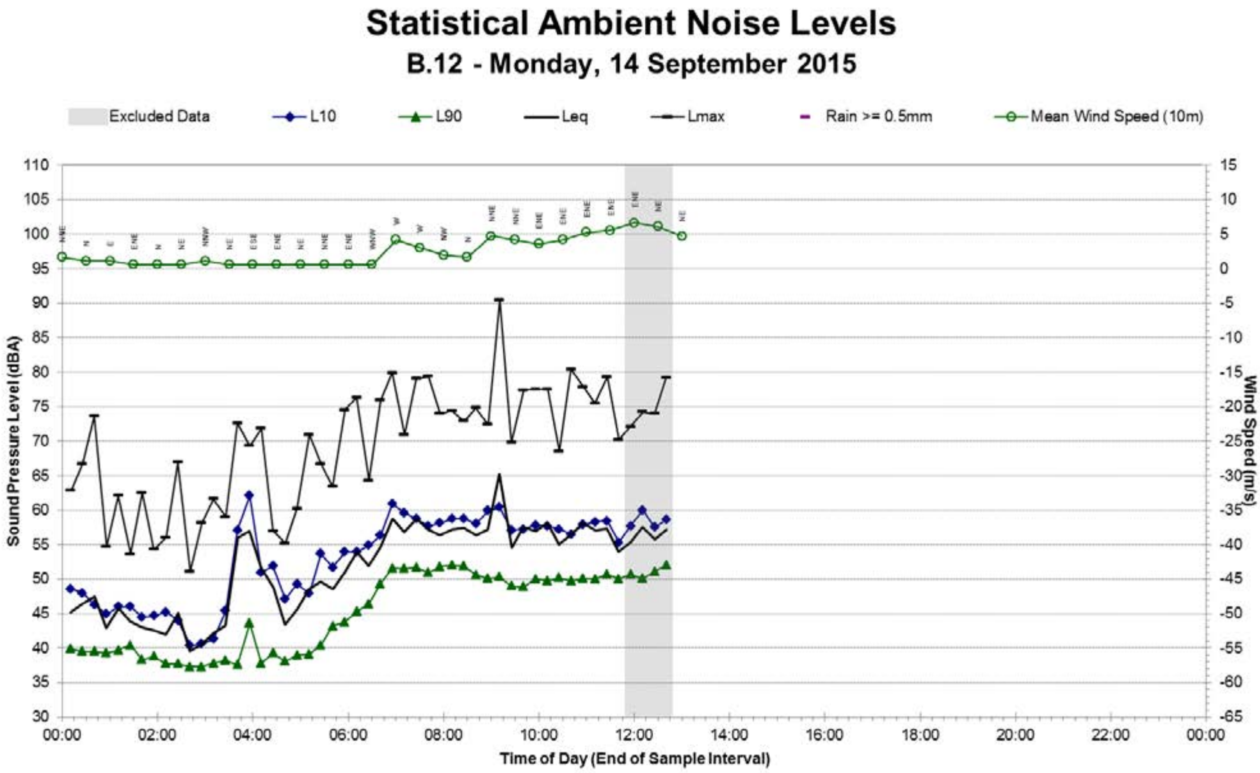


Background Noise Monitoring Results – B.12





Background Noise Monitoring Results – B.12



Background Noise Monitoring Results – B.13

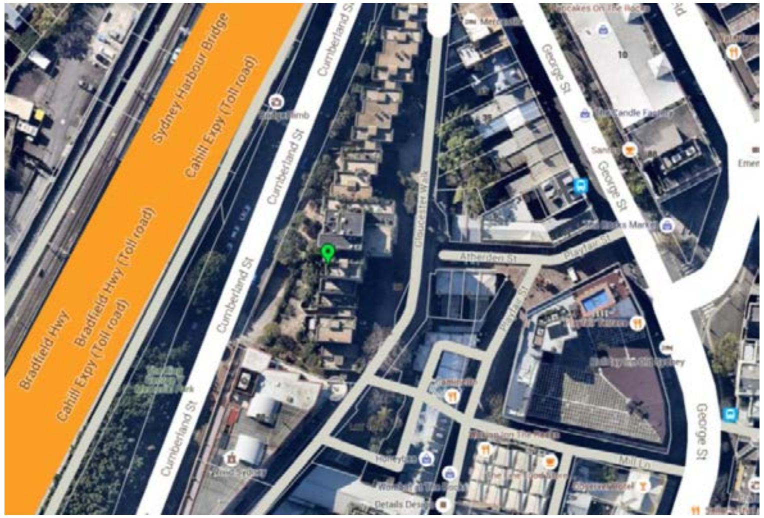
Noise Monitoring Location:	B.13
Noise Monitoring Address:	**2-60 Cumberland Street, The Rocks 2000**

Logger Device Type: Svantek 957
Logger Serial No: 23243

Ambient noise logger deployed on the rooftop balcony of residential building 2-60 Cumberland Street, The Rocks.

Attended noise measurements indicate that the ambient noise environment at this location is significantly dominated by road noise from traffic exiting the Harbour Bridge along the Cahill Expressway and Bradfield Highway. Constant noise from both light-vehicle tyre-pavement interaction and engines from medium to high-vehicle traffic volumes can be heard at this location. The LA90 background results are attributed to an observed "city hum" which is constant in the Sydney CBD.

Map of Noise Monitoring Location



Ambient Noise Logging Results – INP Defined Time Periods

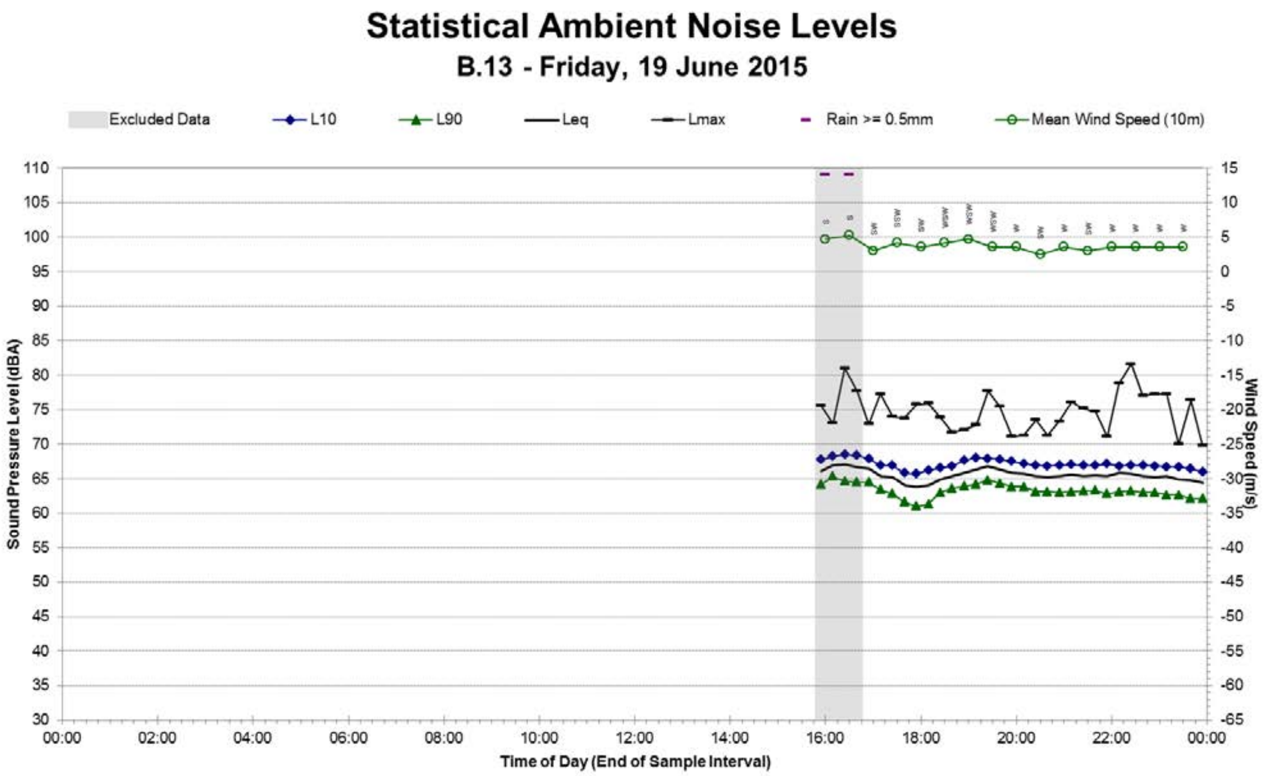
Monitoring Period	Noise Level (dBA)			
	RBL	**LAeq**	**L10**	**L1**
Daytime	62	66	67	70
Evening	62	65	66	69
Night-time	52	63	63	67

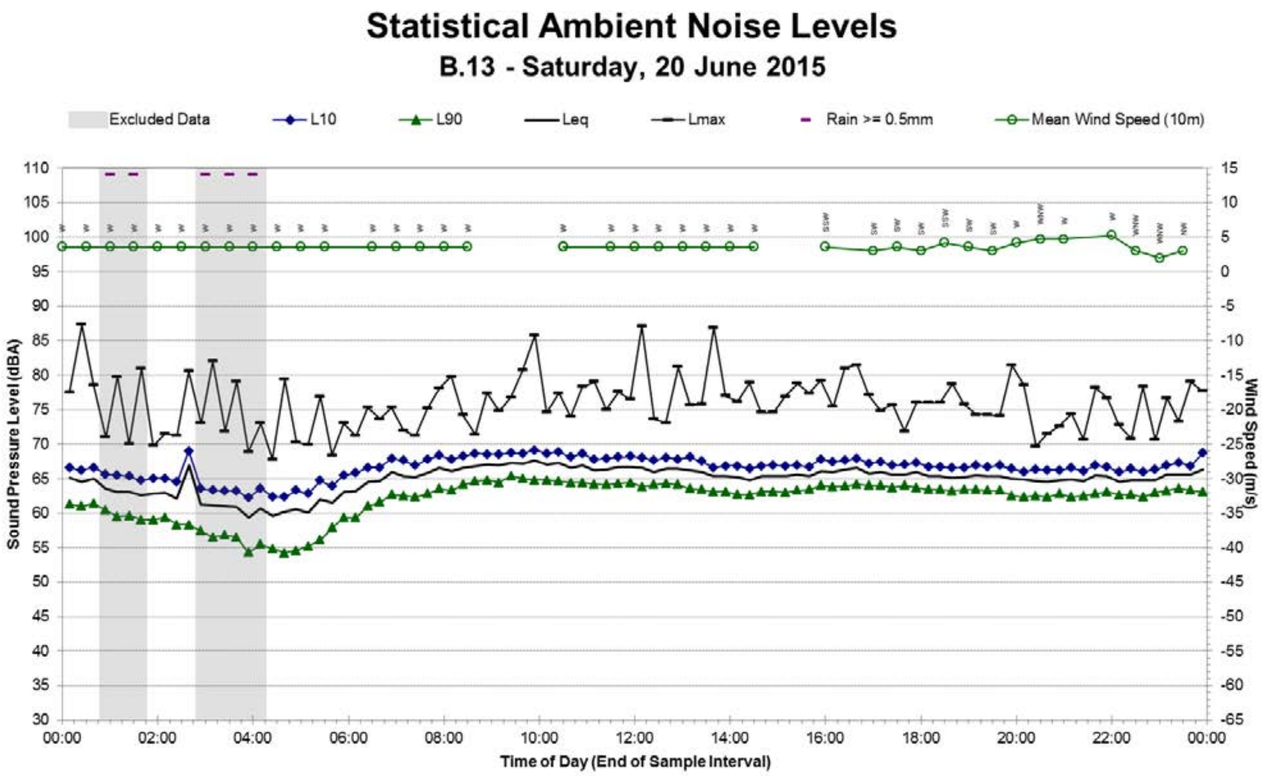
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	**LAeq**	**LAmax**
19/06/2015	15:29:28	64	66	74

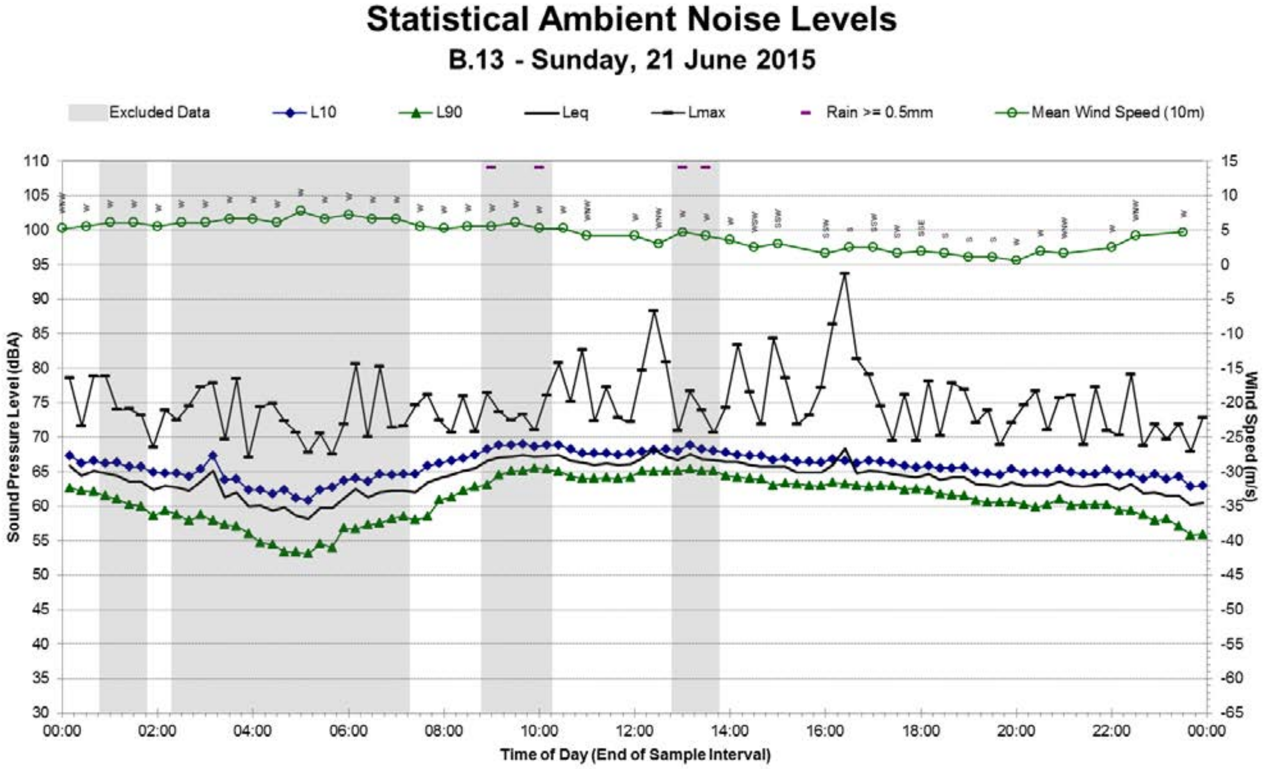
Photo of Noise Monitoring Location

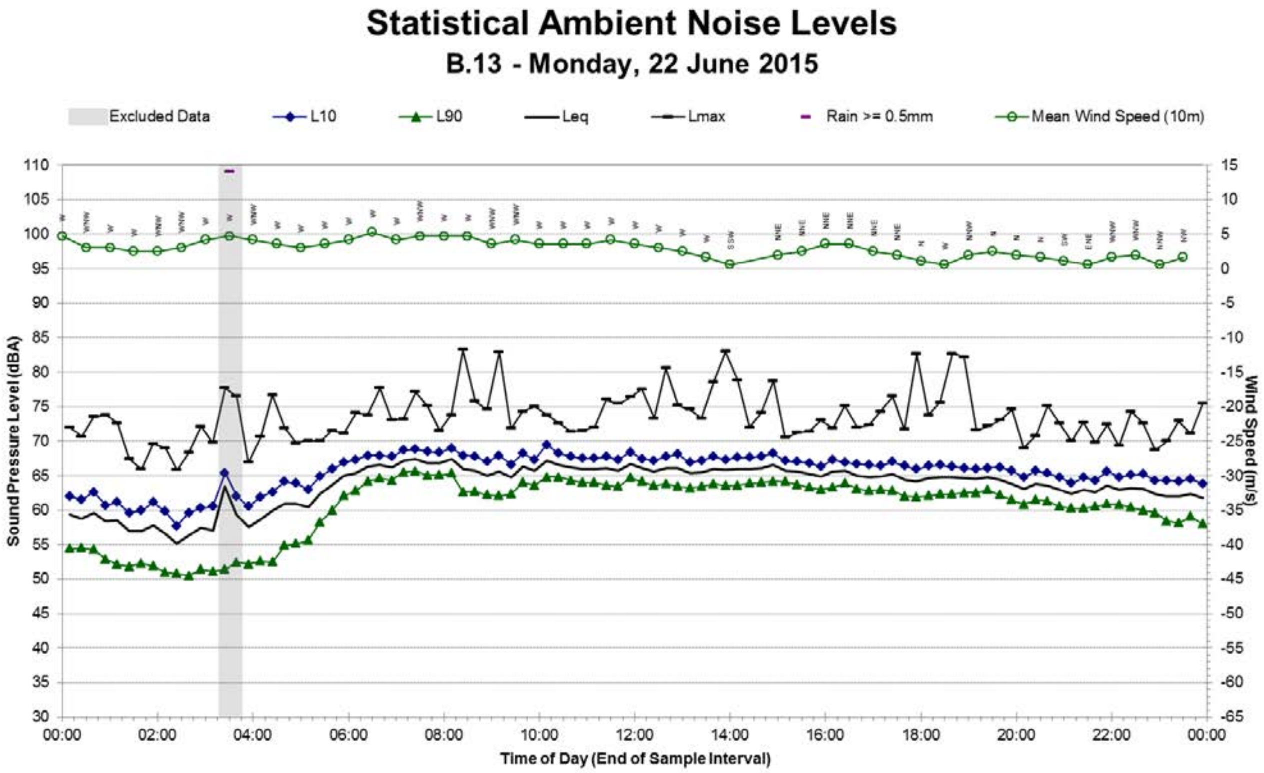
Background Noise Monitoring Results – B.13





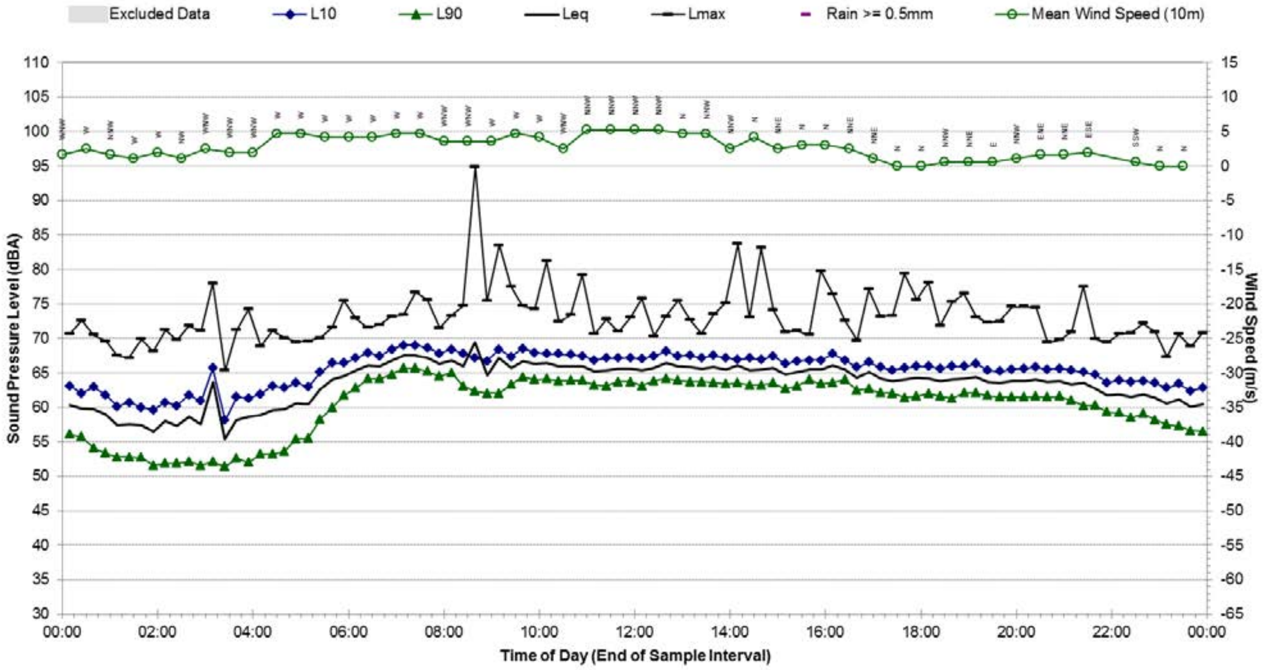
Background Noise Monitoring Results – B.13



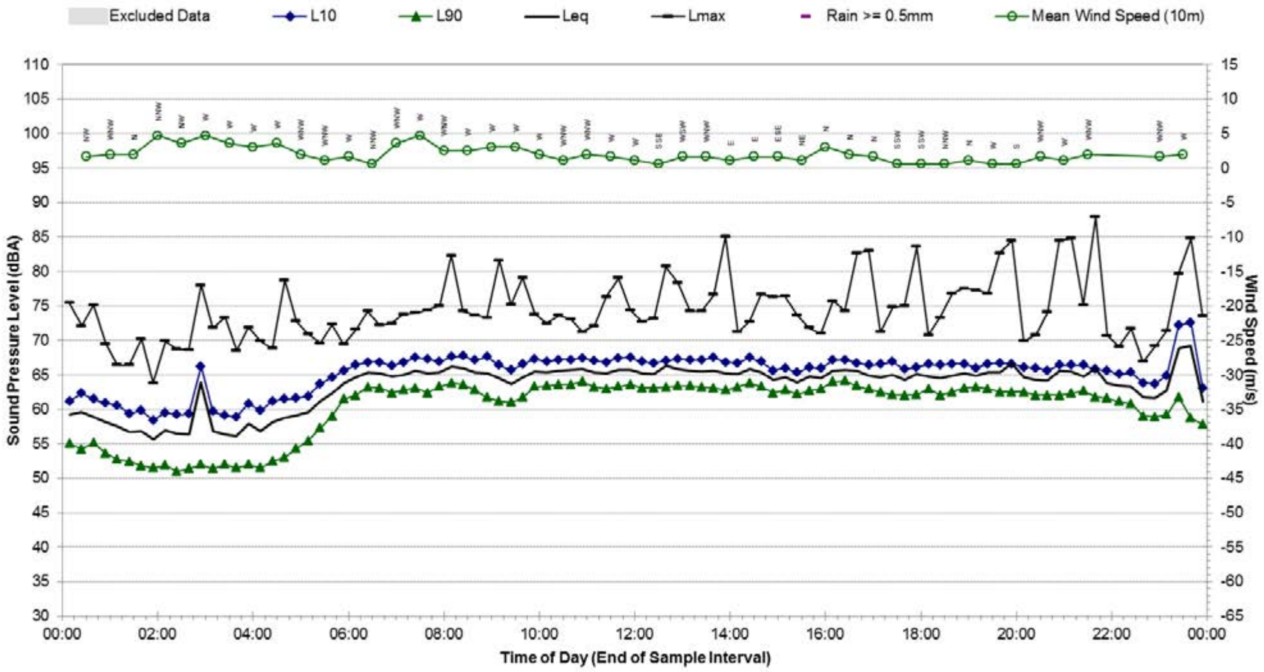


Background Noise Monitoring Results – B.13

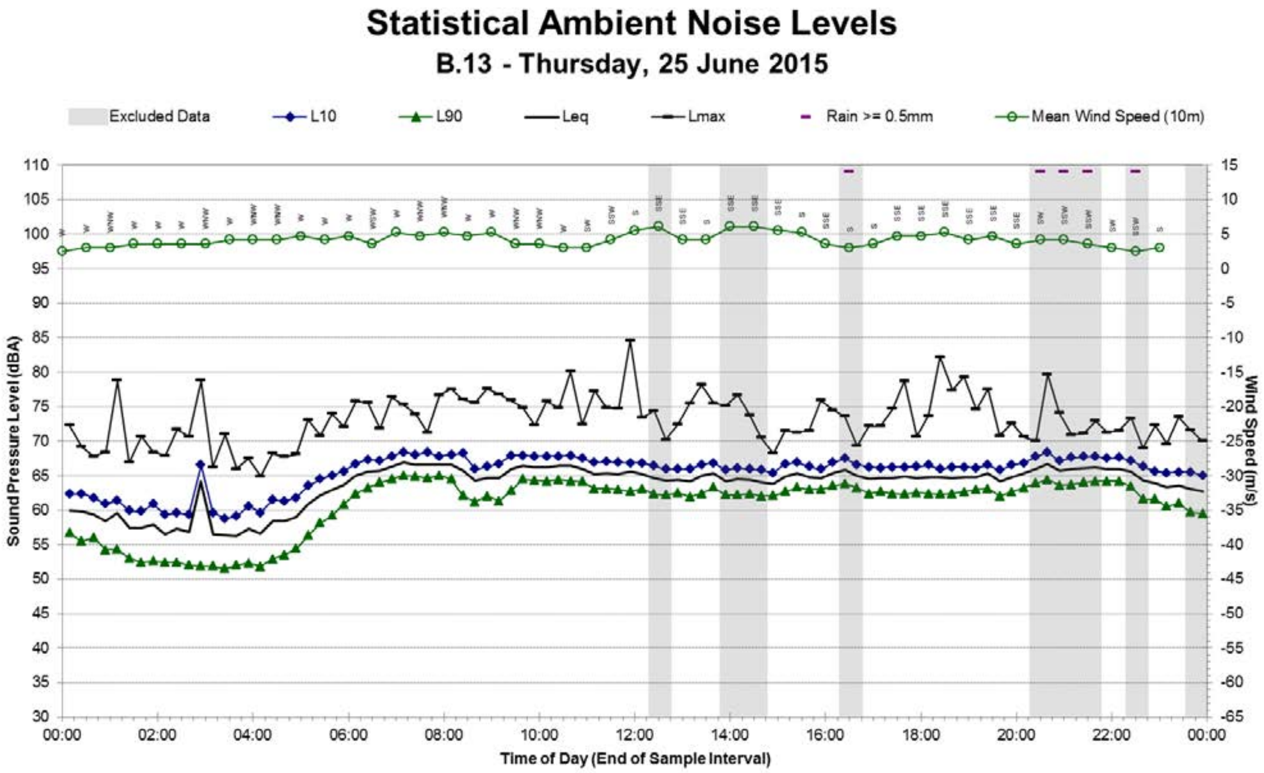
Statistical Ambient Noise Levels
B.13 - Tuesday, 23 June 2015

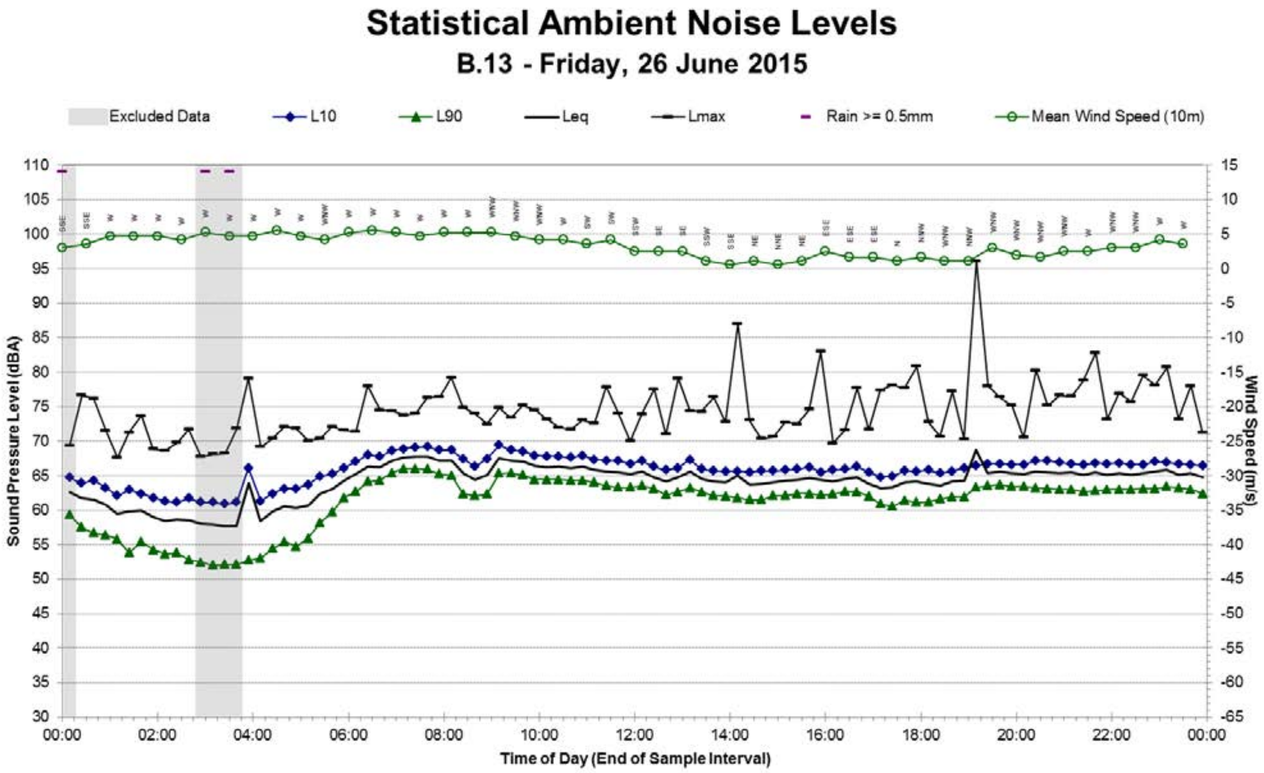


Statistical Ambient Noise Levels
B.13 - Wednesday, 24 June 2015



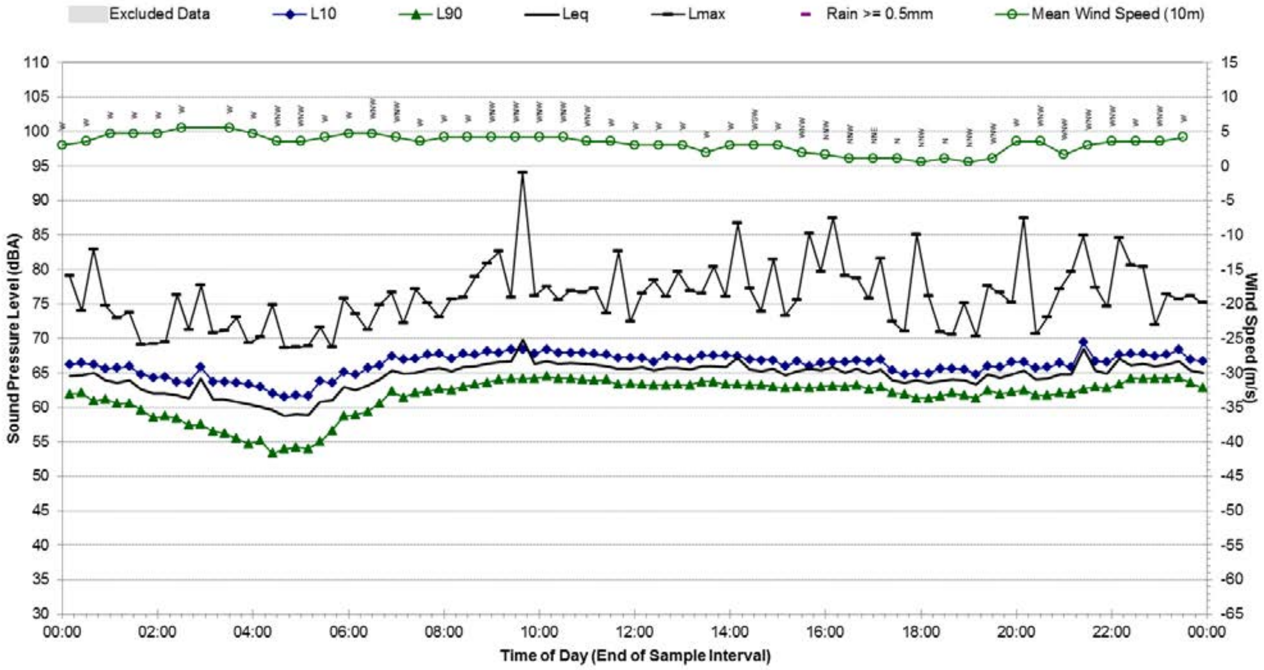
Background Noise Monitoring Results – B.13



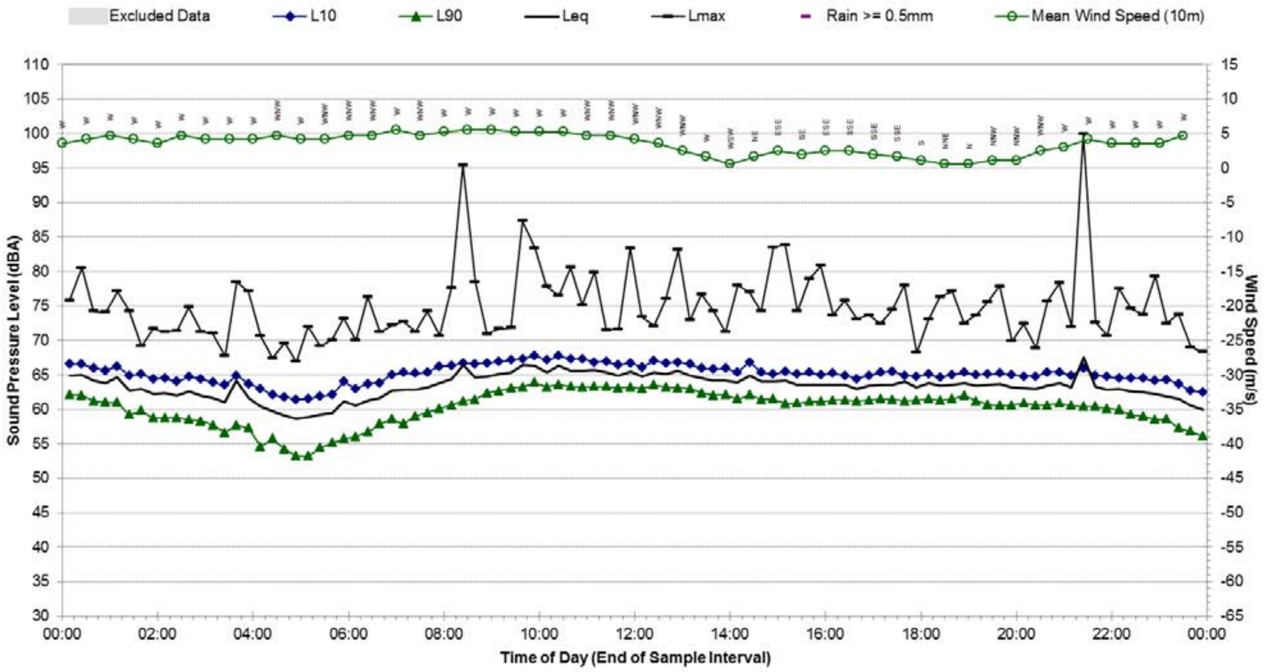


Background Noise Monitoring Results – B.13

Statistical Ambient Noise Levels
B.13 - Saturday, 27 June 2015

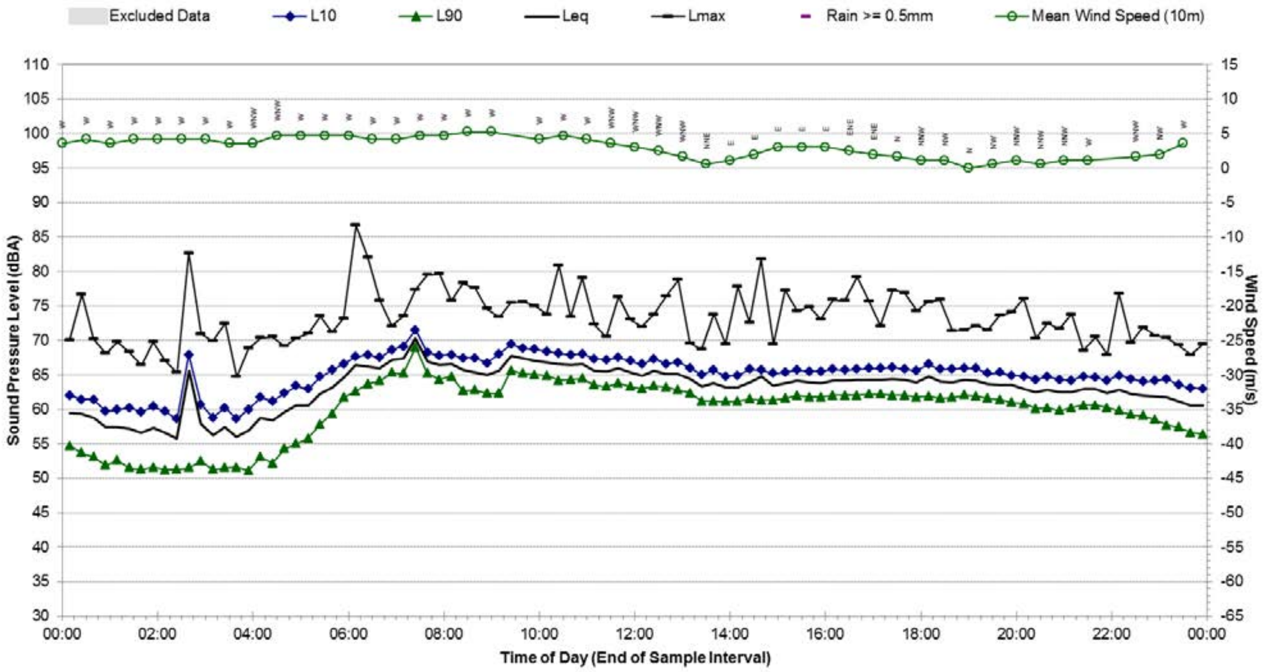


Statistical Ambient Noise Levels
B.13 - Sunday, 28 June 2015

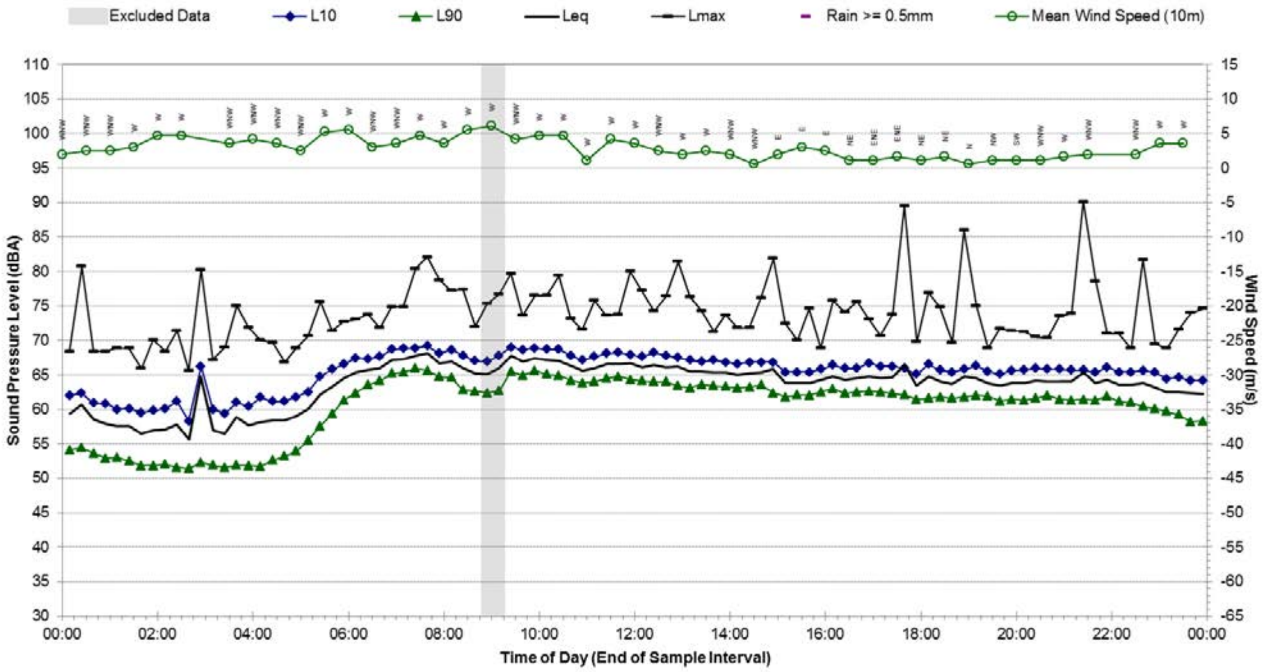


Background Noise Monitoring Results – B.13

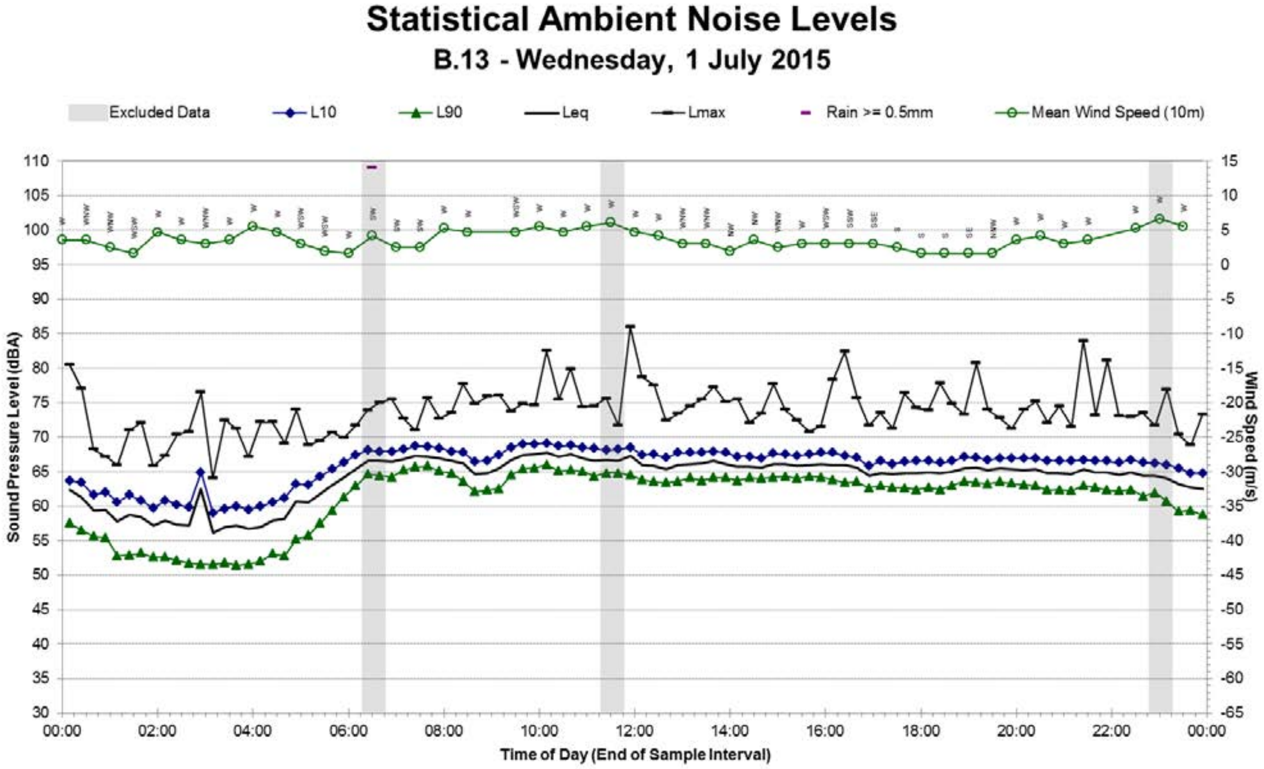
Statistical Ambient Noise Levels
B.13 - Monday, 29 June 2015

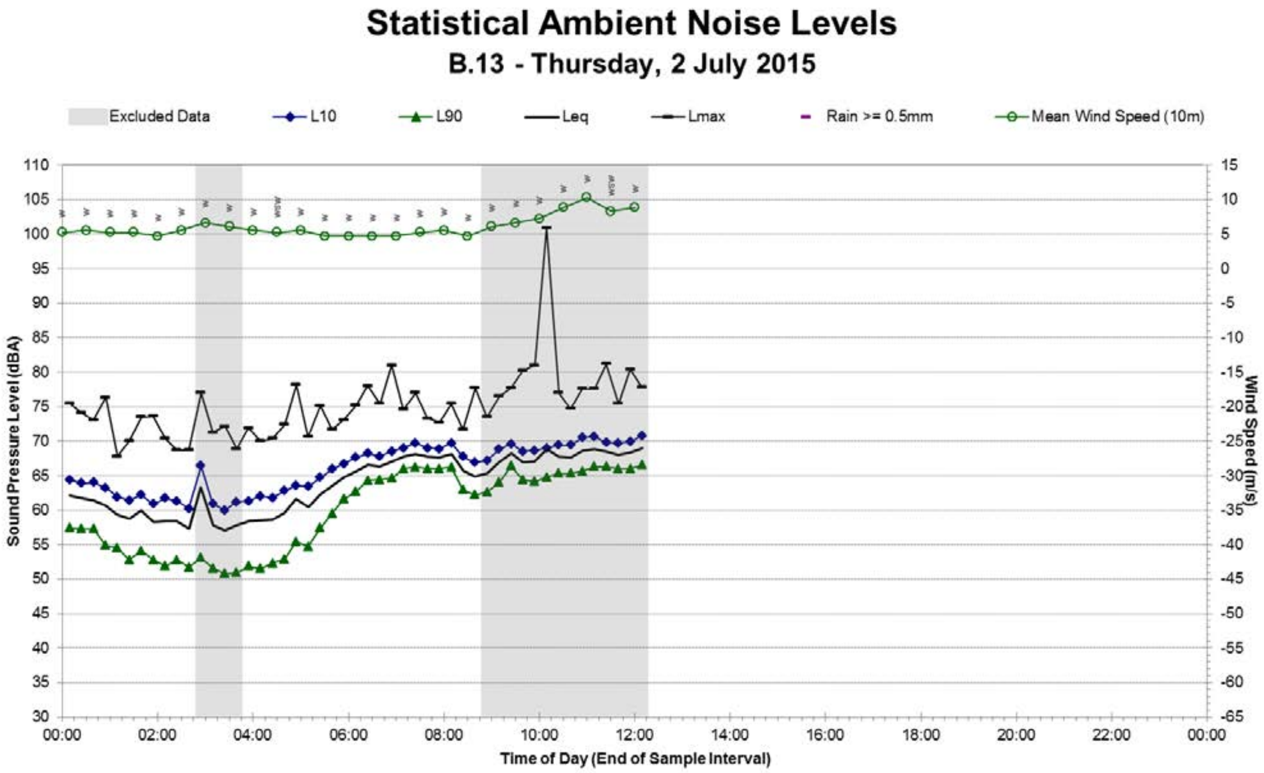


Statistical Ambient Noise Levels
B.13 - Tuesday, 30 June 2015



Background Noise Monitoring Results – B.13





Background Noise Monitoring Results – B.14

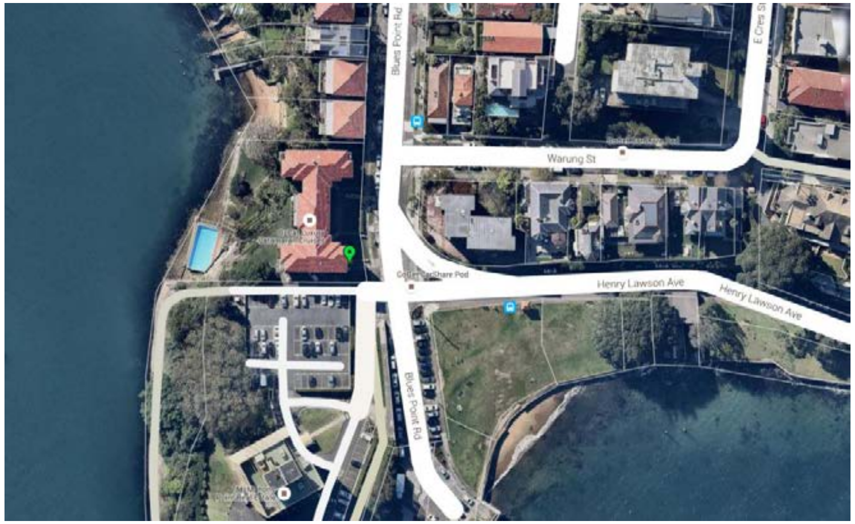
Noise Monitoring Location:	**B.14**
Noise Monitoring Address:	**20/30 Blues Point Road, McMahons Point 2060**

Logger Device Type: Svantek 957
Logger Serial No: 20670

Ambient noise logger deployed on the balcony of residential apartment address 20/30 Blues Point Road, McMahons Point.

Attended noise measurements indicate that the ambient noise environment at this location is dominated by road traffic noise from Blues Point Road. The LA90 background results are attributed to an observed "city hum" which is constant in the Sydney Harbour.

Map of Noise Monitoring Location



Ambient Noise Logging Results – INP Defined Time Periods

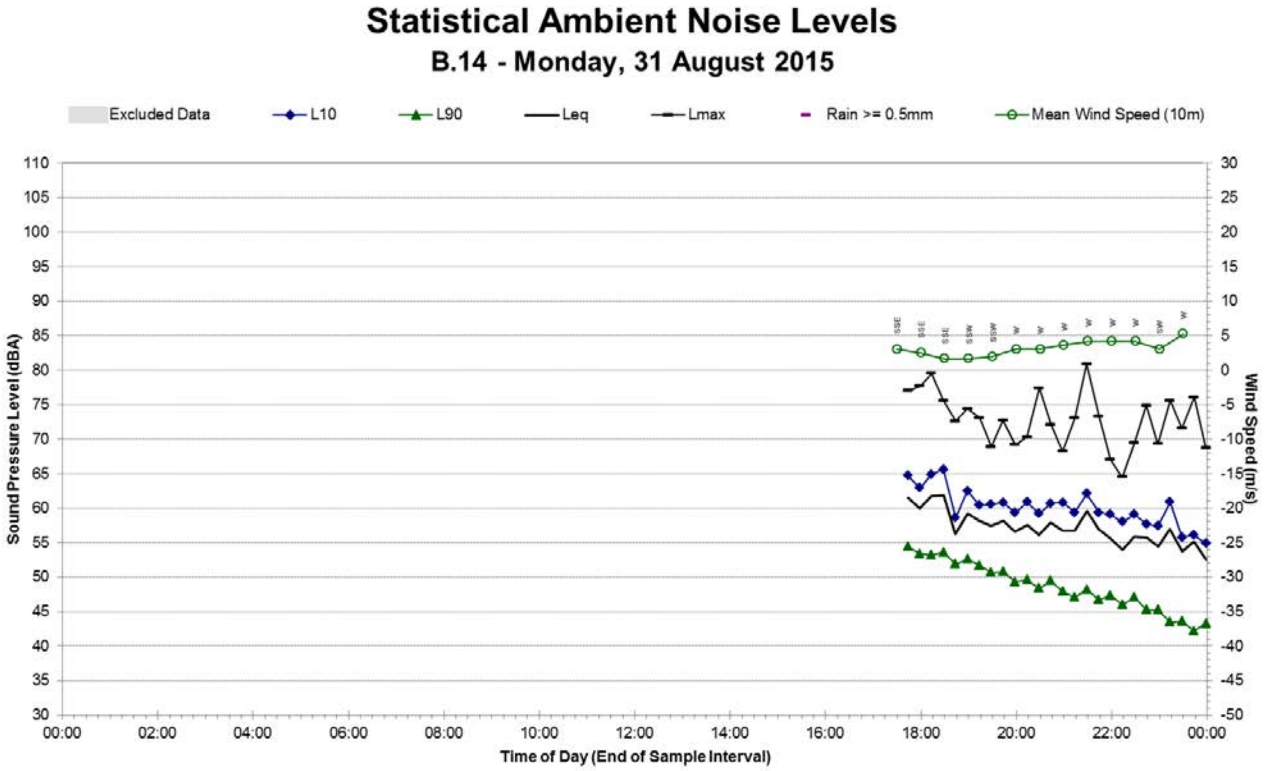
Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	51	62	63	70
Evening	49	61	61	67
Night-time	40	54	52	63

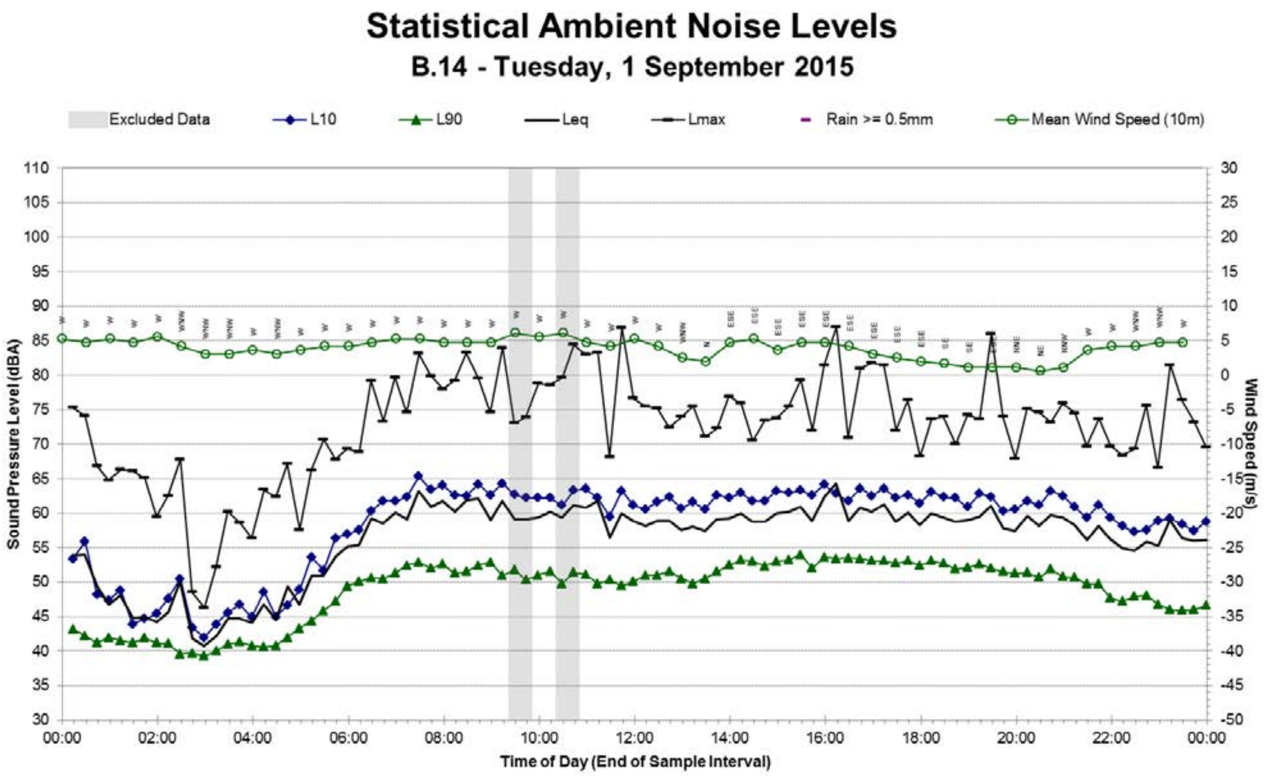
Attended Noise Measurement Results

Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
16/09/2015	08:50:11	51	60	77

Photo of Noise Monitoring Location

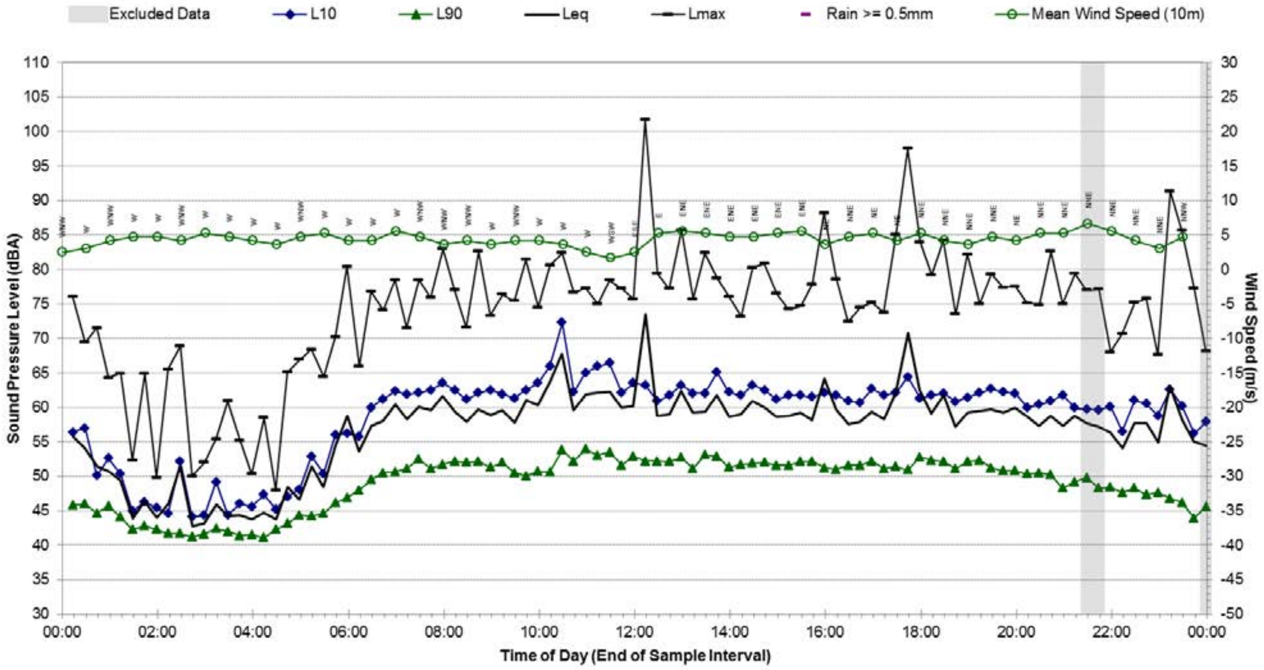
Background Noise Monitoring Results – B.14



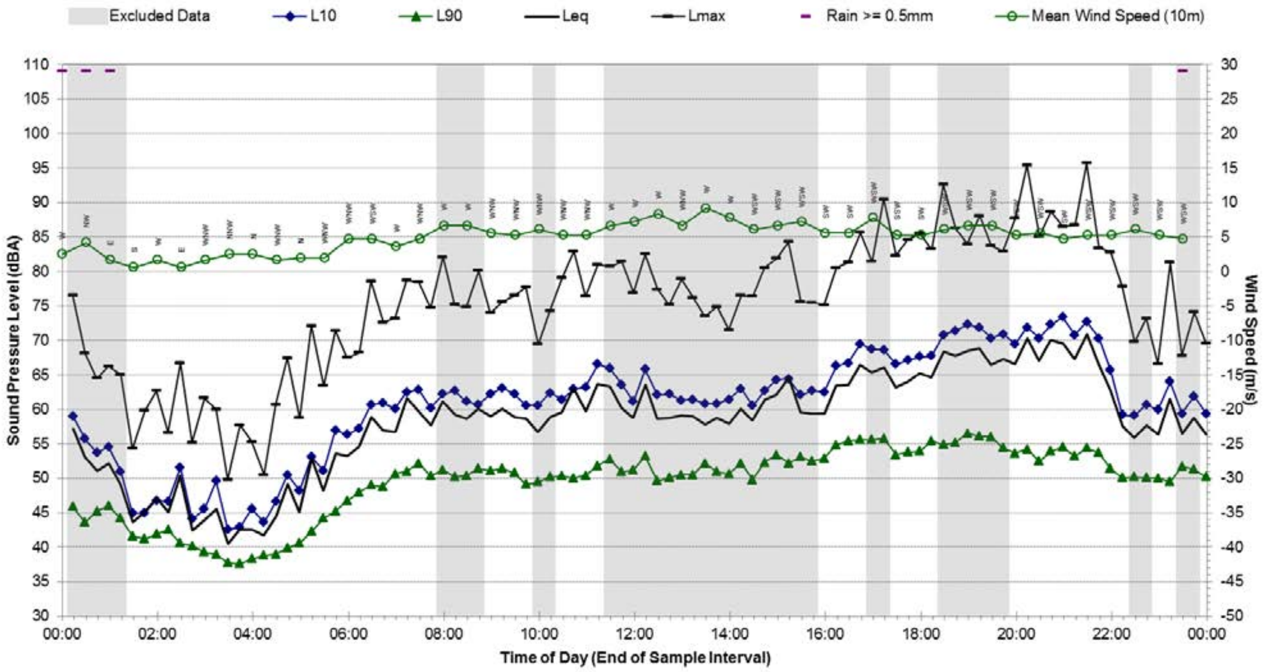


Background Noise Monitoring Results – B.14

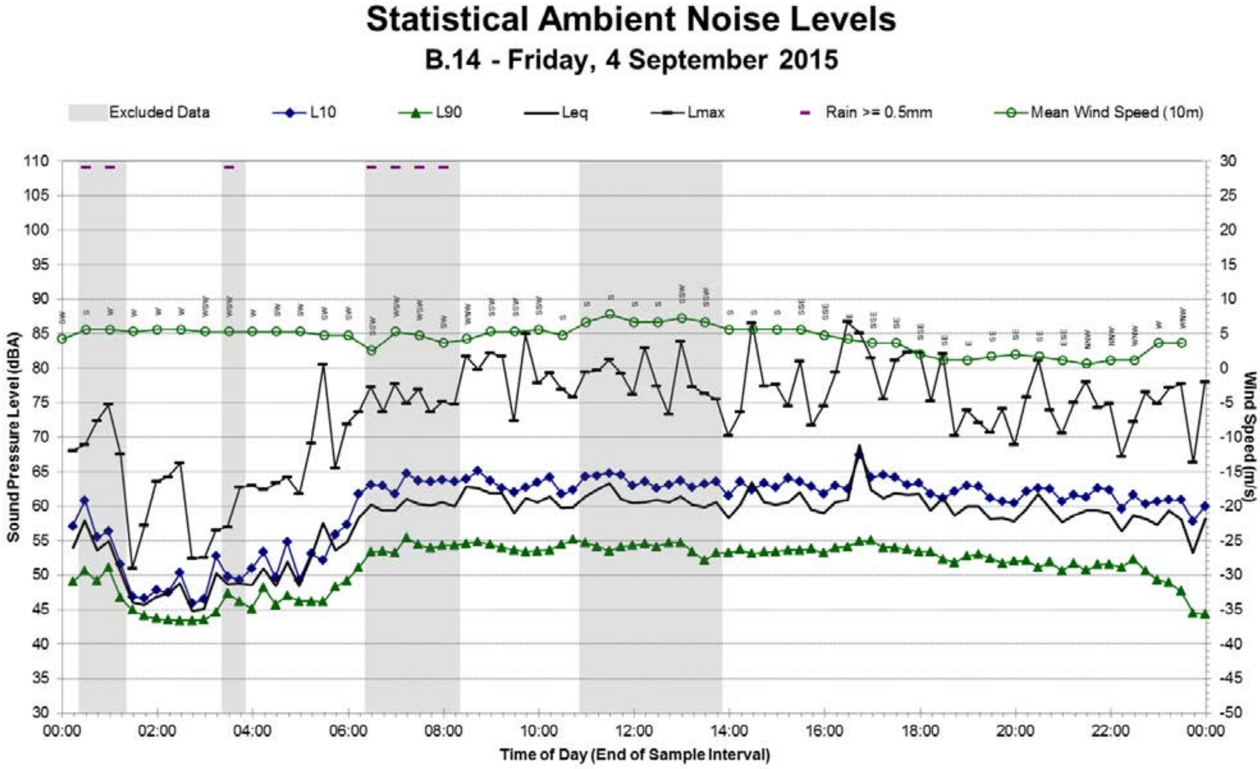
Statistical Ambient Noise Levels
B.14 - Wednesday, 2 September 2015

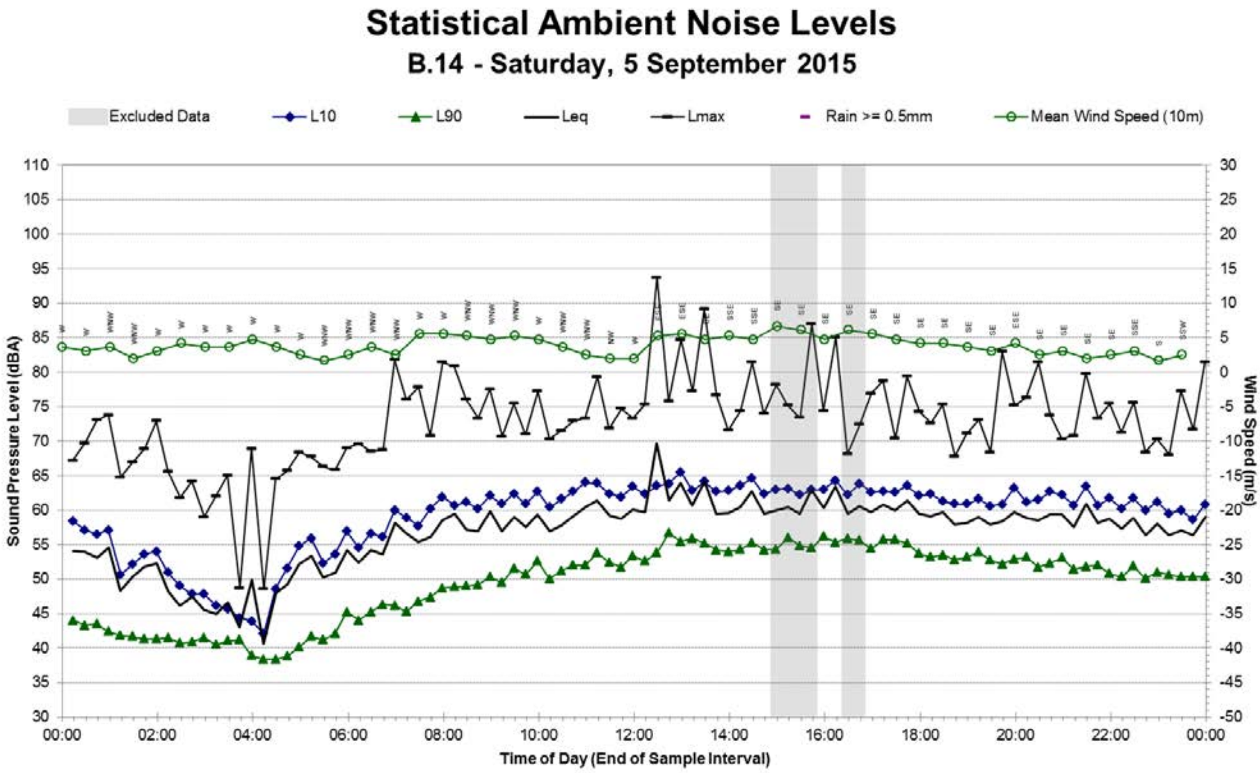


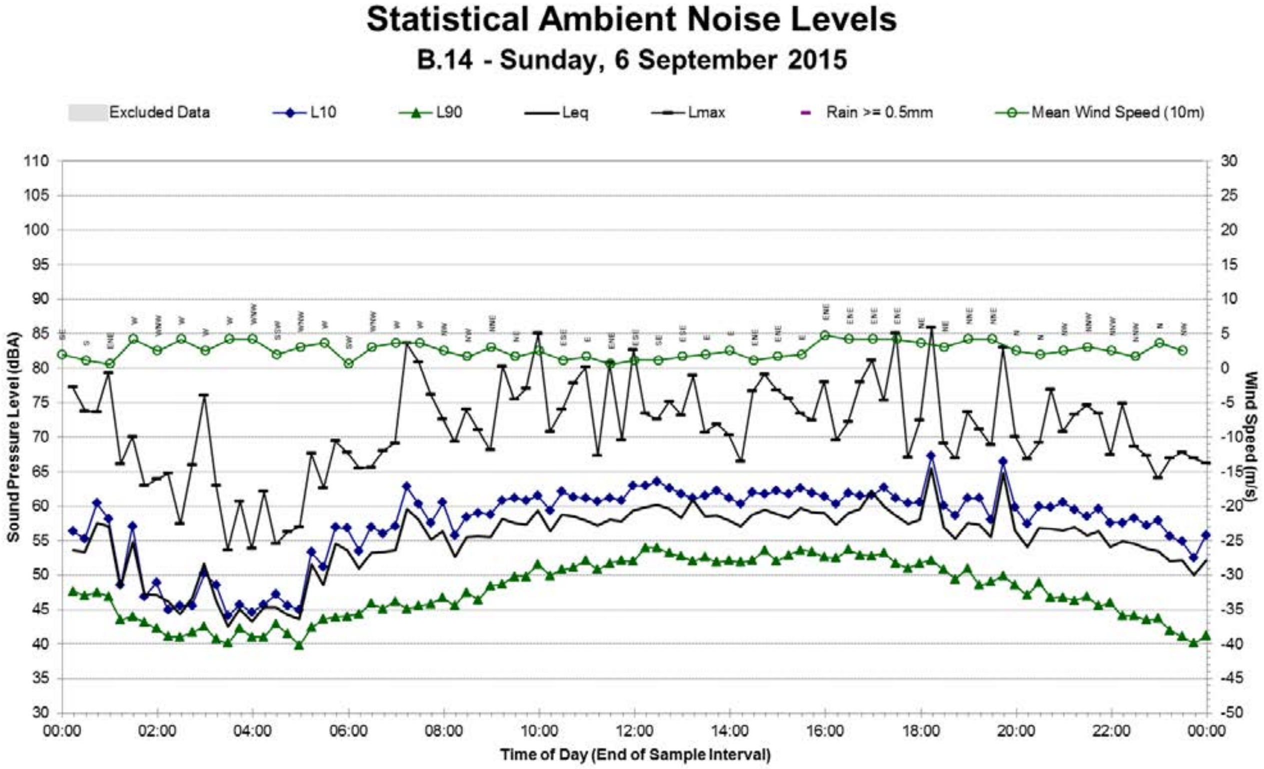
Statistical Ambient Noise Levels
B.14 - Thursday, 3 September 2015



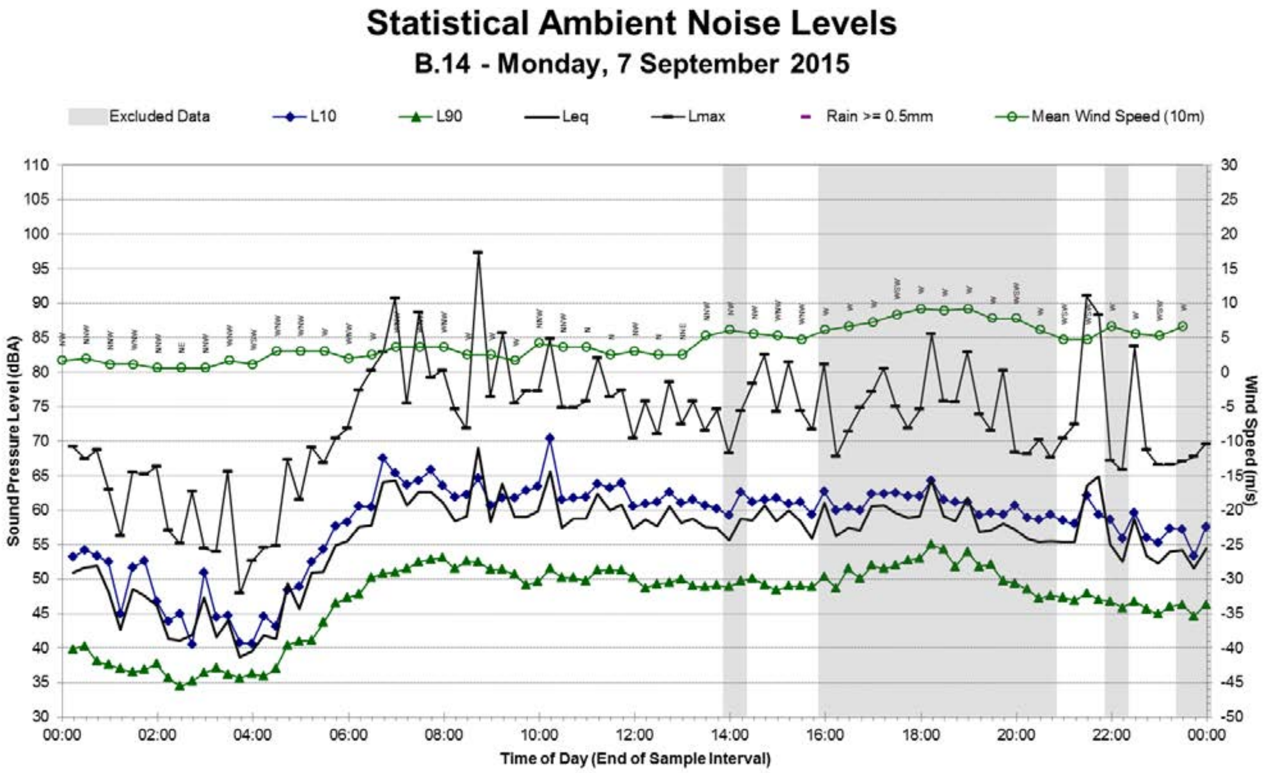
Background Noise Monitoring Results – B.14







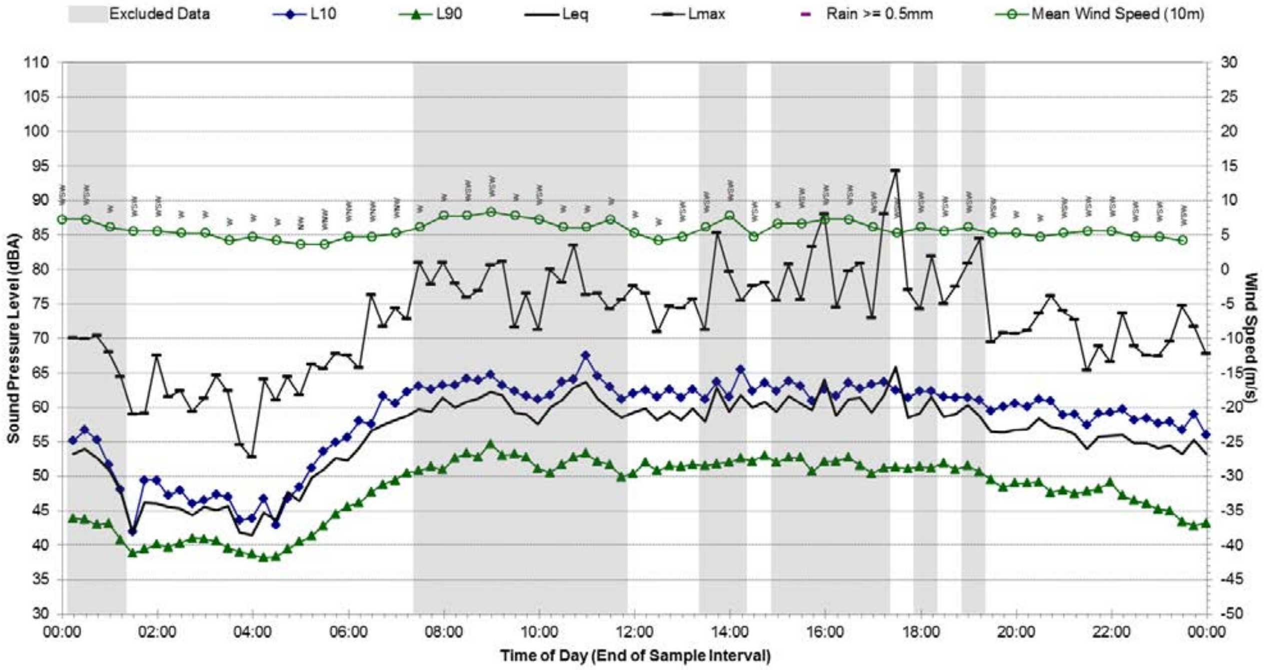
Statistical Ambient Noise Levels
B.14 - Sunday, 6 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



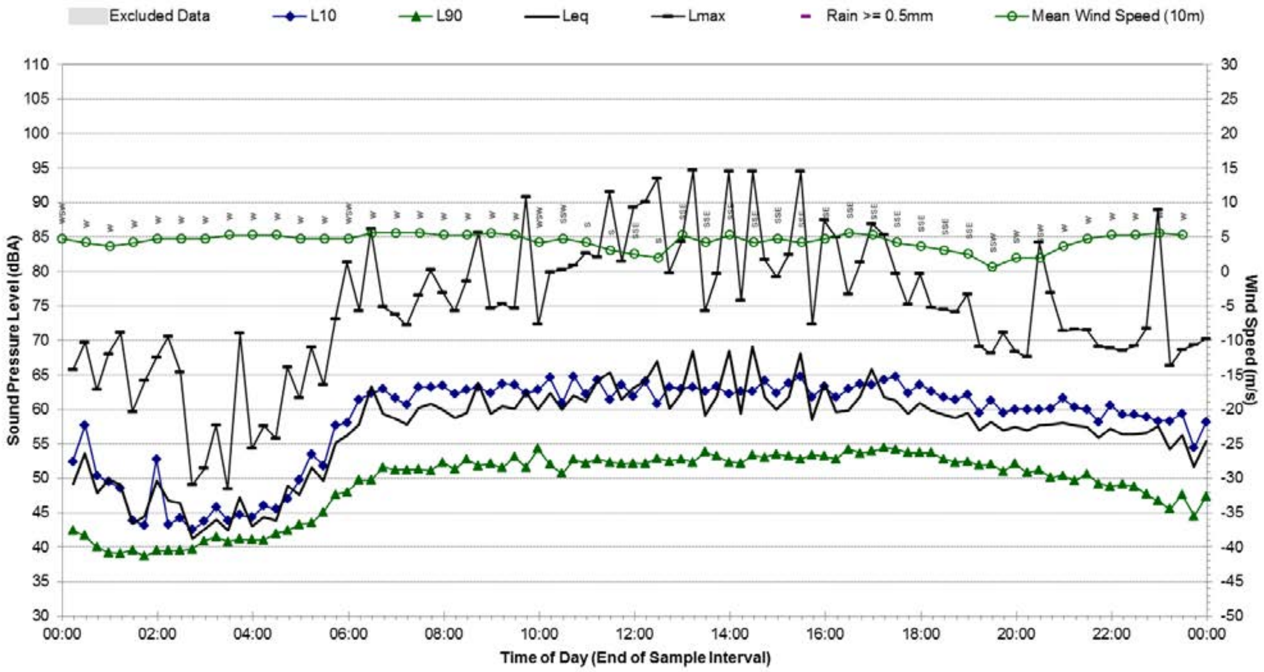
Statistical Ambient Noise Levels
B.14 - Monday, 7 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

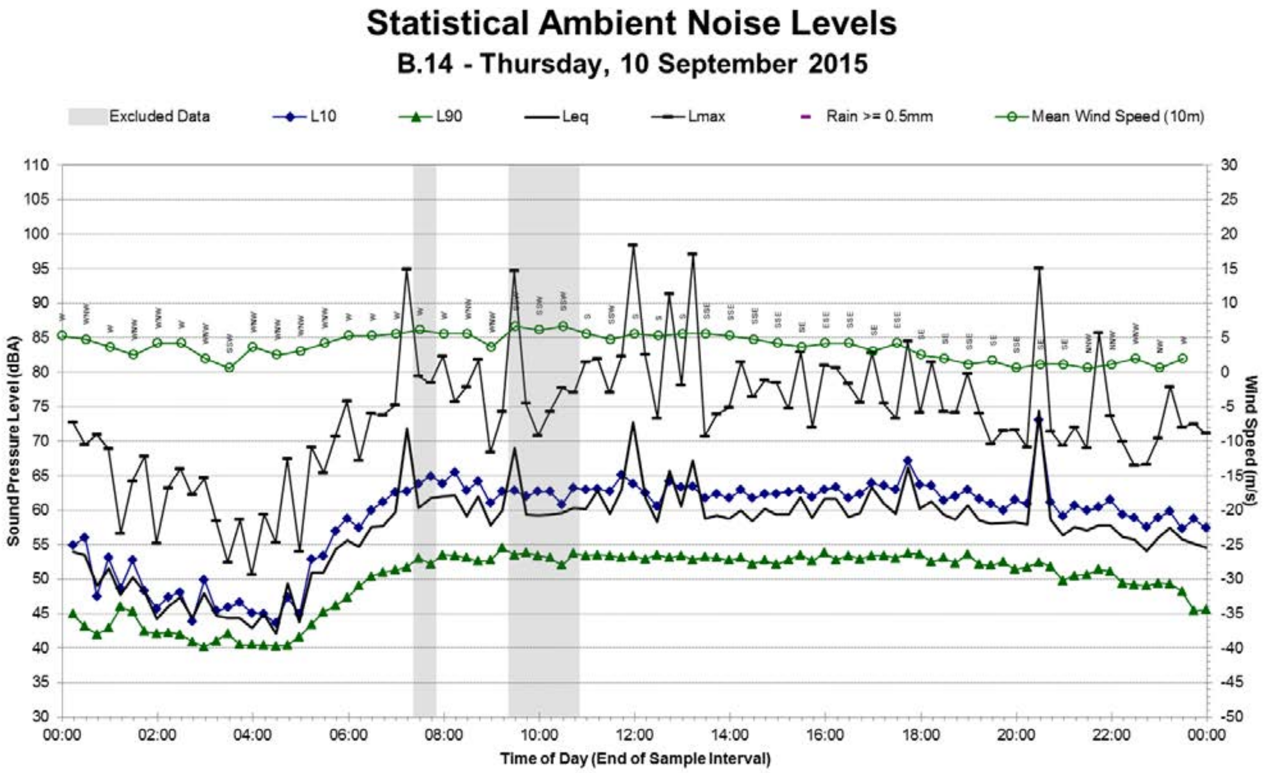
Background Noise Monitoring Results – B.14

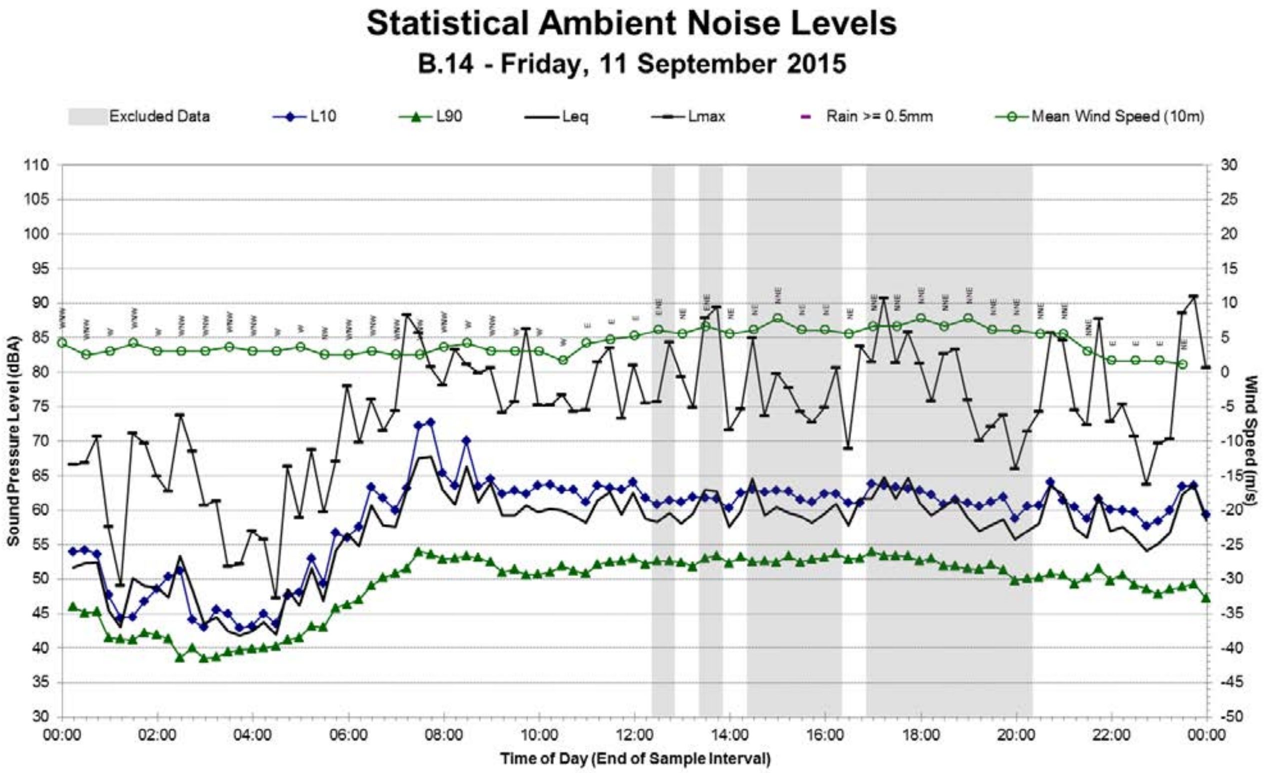
Statistical Ambient Noise Levels
B.14 - Tuesday, 8 September 2015



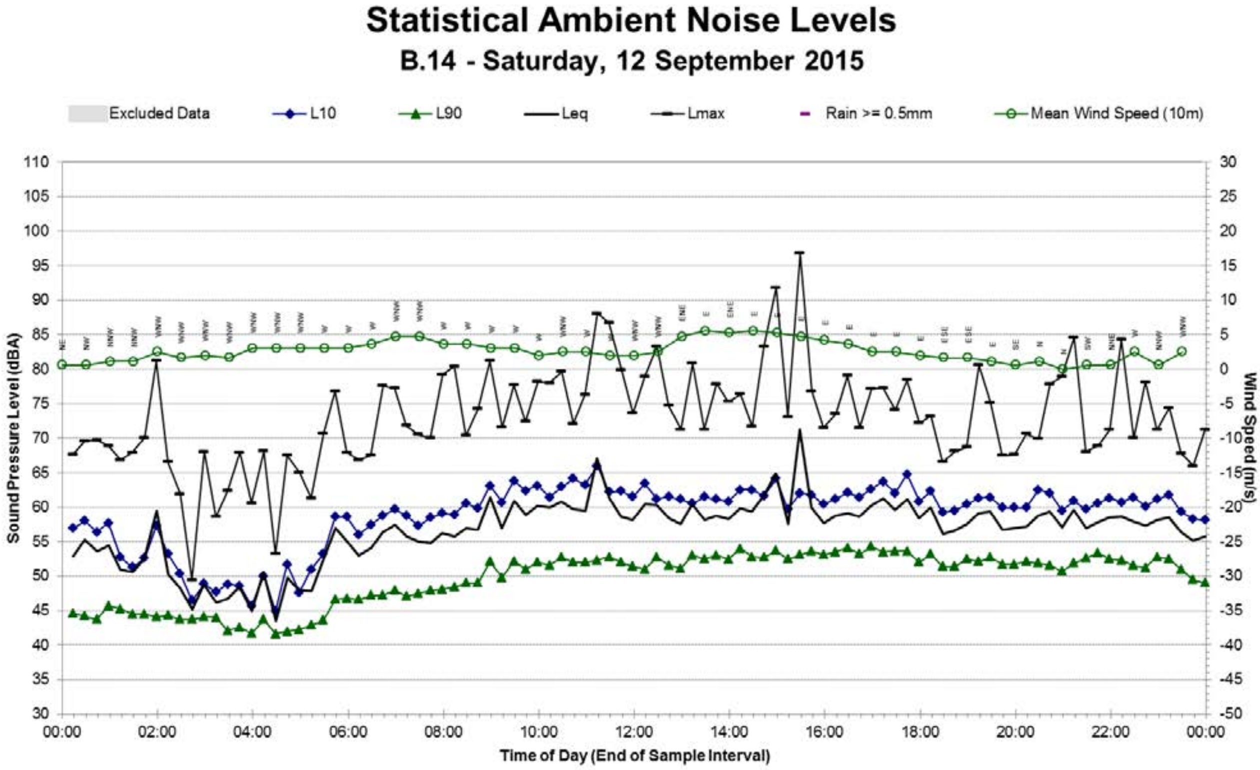
Statistical Ambient Noise Levels
B.14 - Wednesday, 9 September 2015

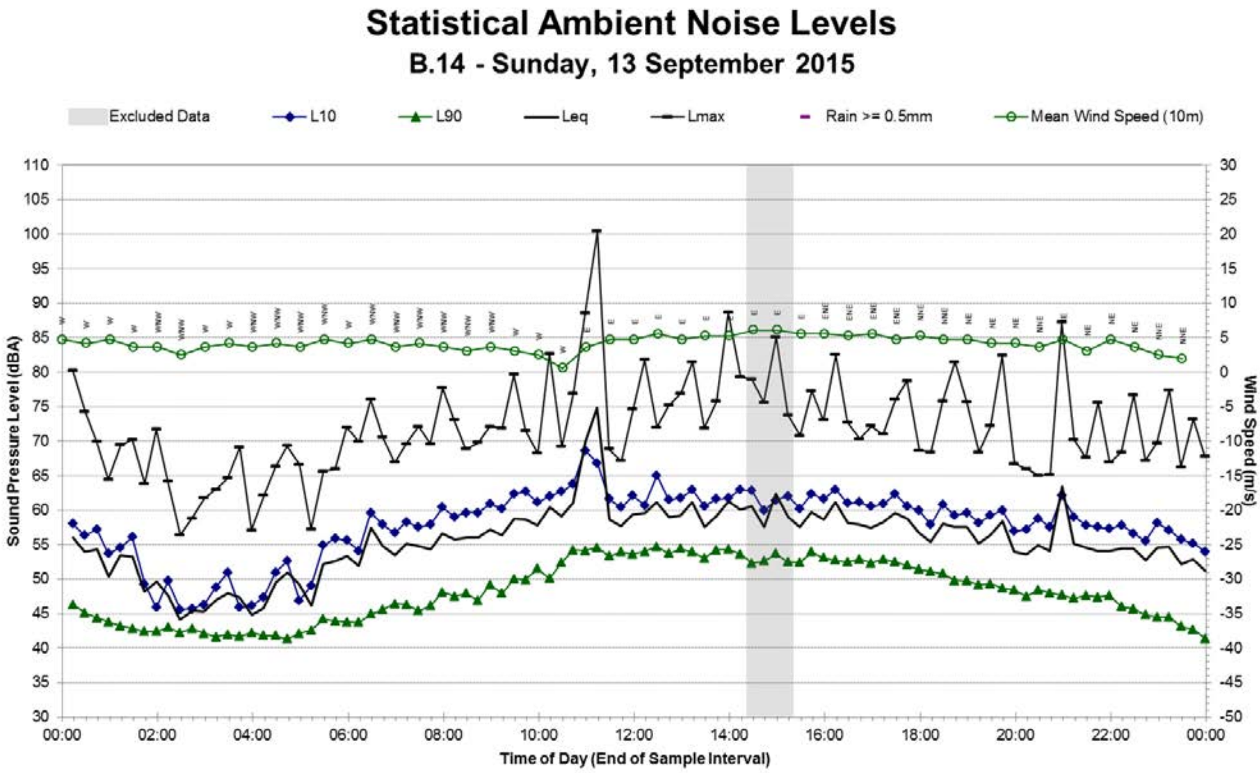



Statistical Ambient Noise Levels
B.14 - Thursday, 10 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
B.14 - Friday, 11 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

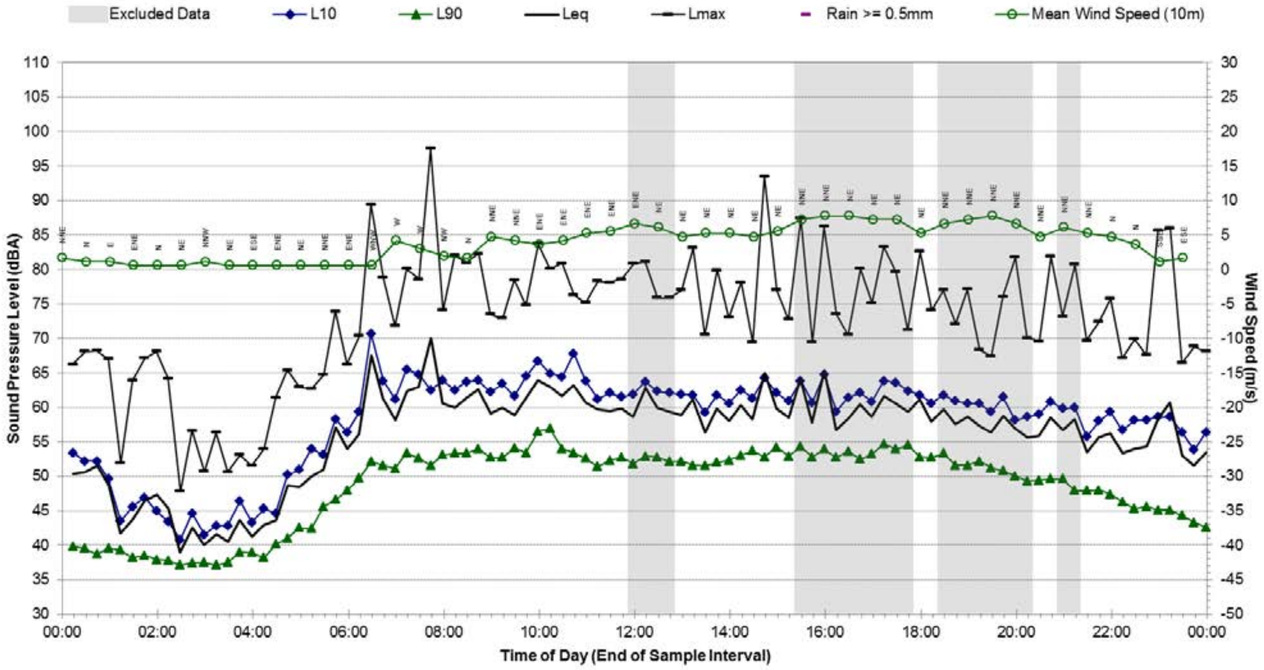
Background Noise Monitoring Results – B.14



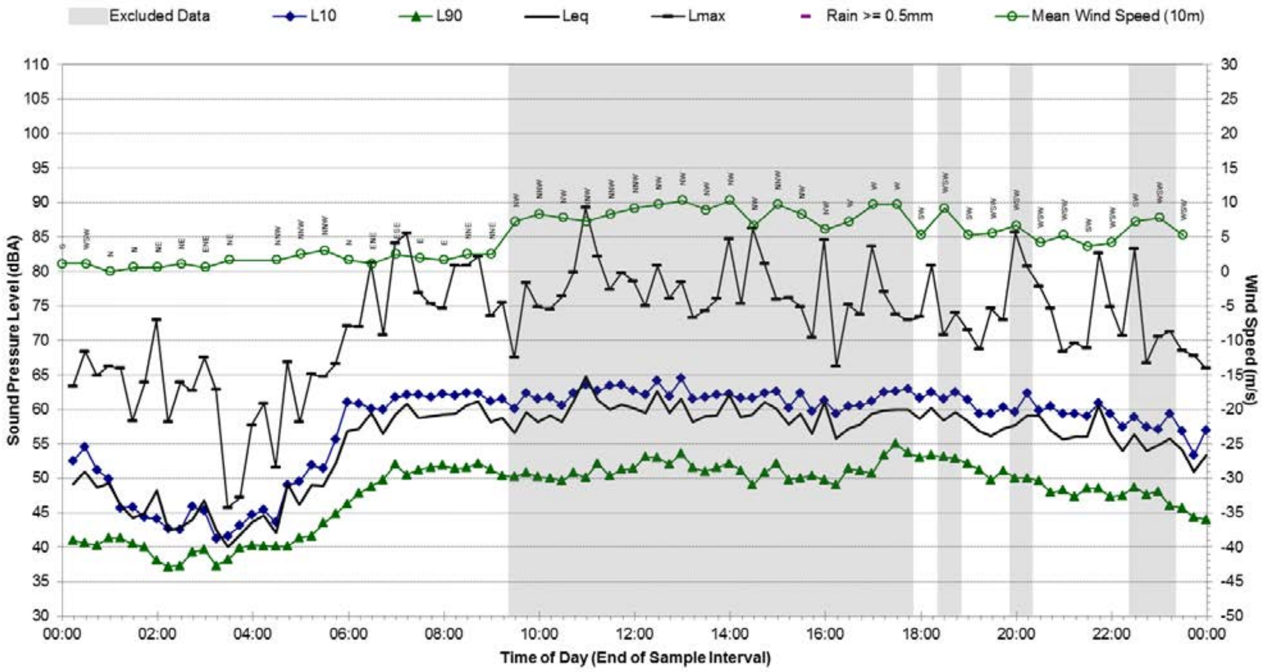


Background Noise Monitoring Results – B.14

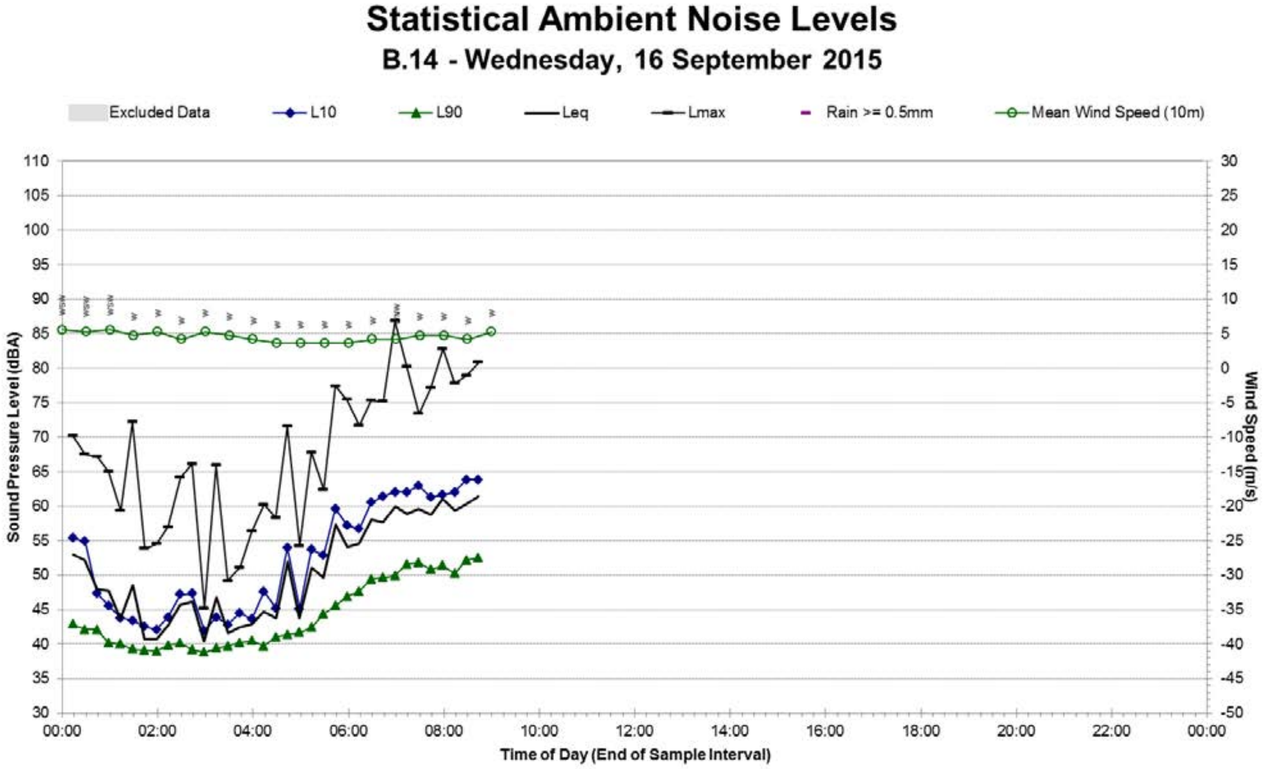
Statistical Ambient Noise Levels
B.14 - Monday, 14 September 2015



Statistical Ambient Noise Levels
B.14 - Tuesday, 15 September 2015



Background Noise Monitoring Results – B.14



Background Noise Monitoring Results – B.15

Noise Monitoring Location:	**B.15**
Noise Monitoring Address:	**23 Queens Avenue, McMahons Point 2060**

Logger Device Type: Svantek 957
Logger Serial No: 23816

Ambient noise logger deployed in the front yard of residential address 23 Queens Avenue, McMahons Point.

Attended noise measurements indicate that there are road traffic noise sources contributing to the background noise environment at this location.

Map of Noise Monitoring Location

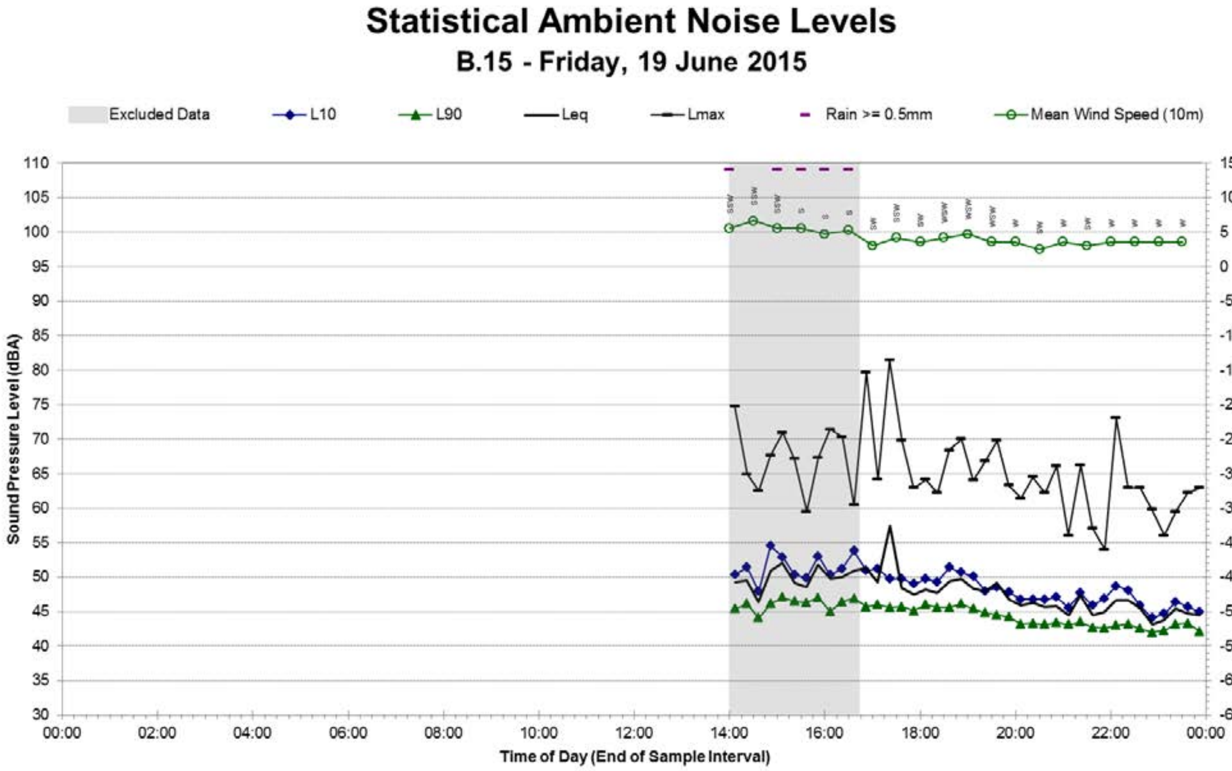
Ambient Noise Logging Results – INP Defined Time Periods

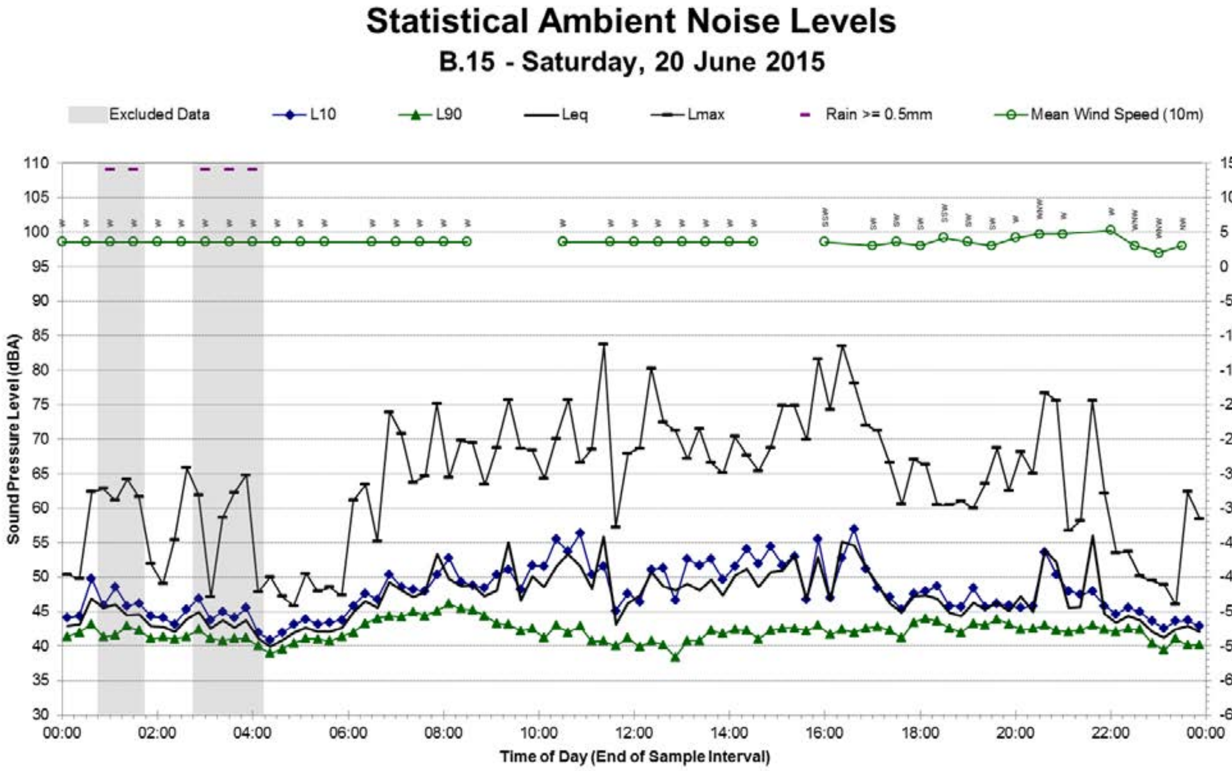
Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	38	51	50	60
Evening	38	47	46	54
Night-time	36	45	42	44

Attended Noise Measurement Results

Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
19/06/2015	13:39:13	45	49	75

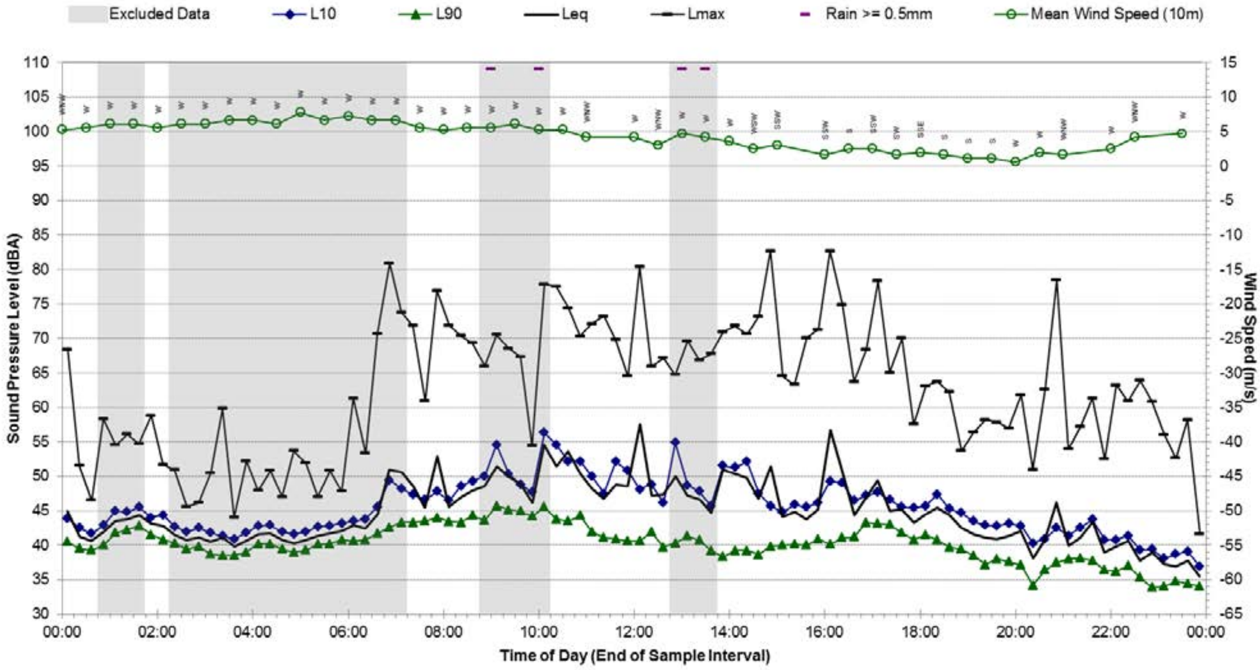
Photo of Noise Monitoring Location


Statistical Ambient Noise Levels
B.15 - Friday, 19 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

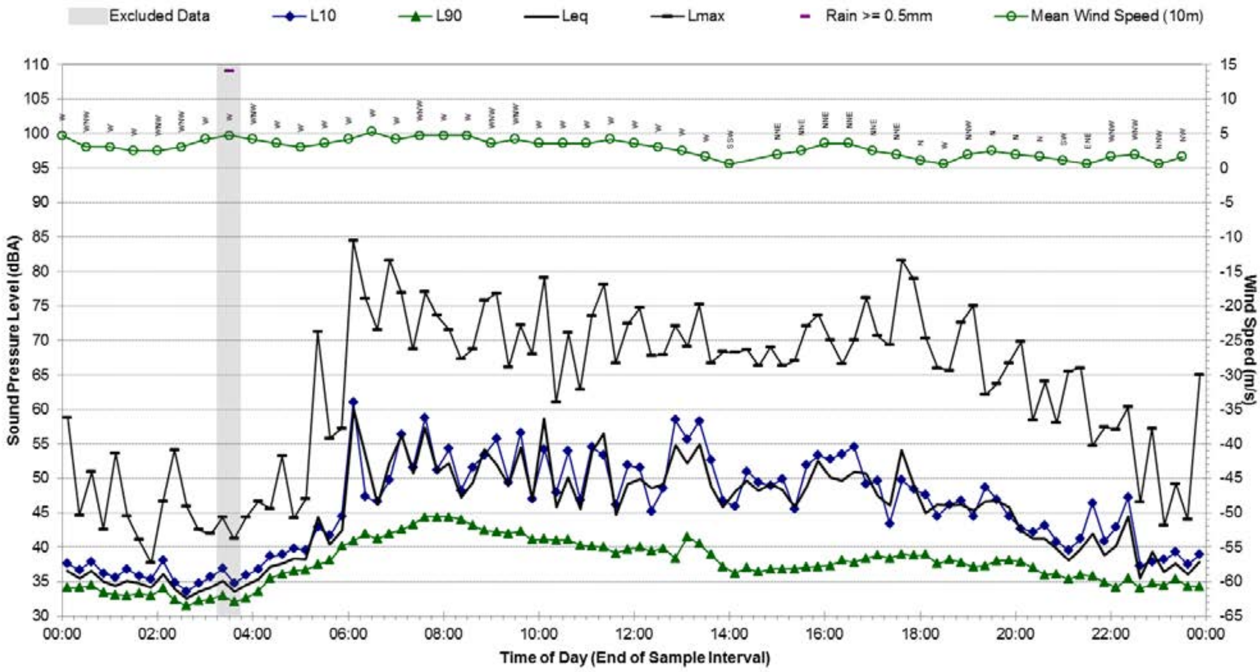

Statistical Ambient Noise Levels
B.15 - Saturday, 20 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Background Noise Monitoring Results – B.15

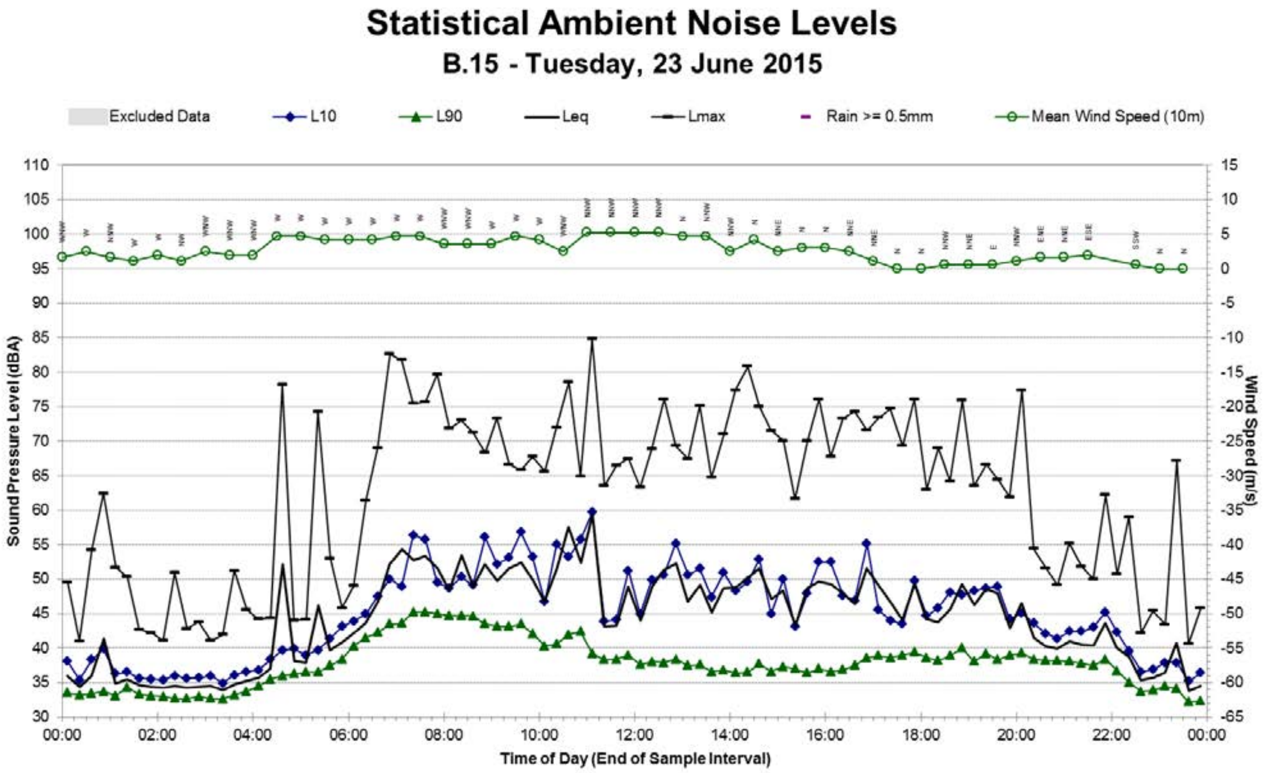
Statistical Ambient Noise Levels
B.15 - Sunday, 21 June 2015

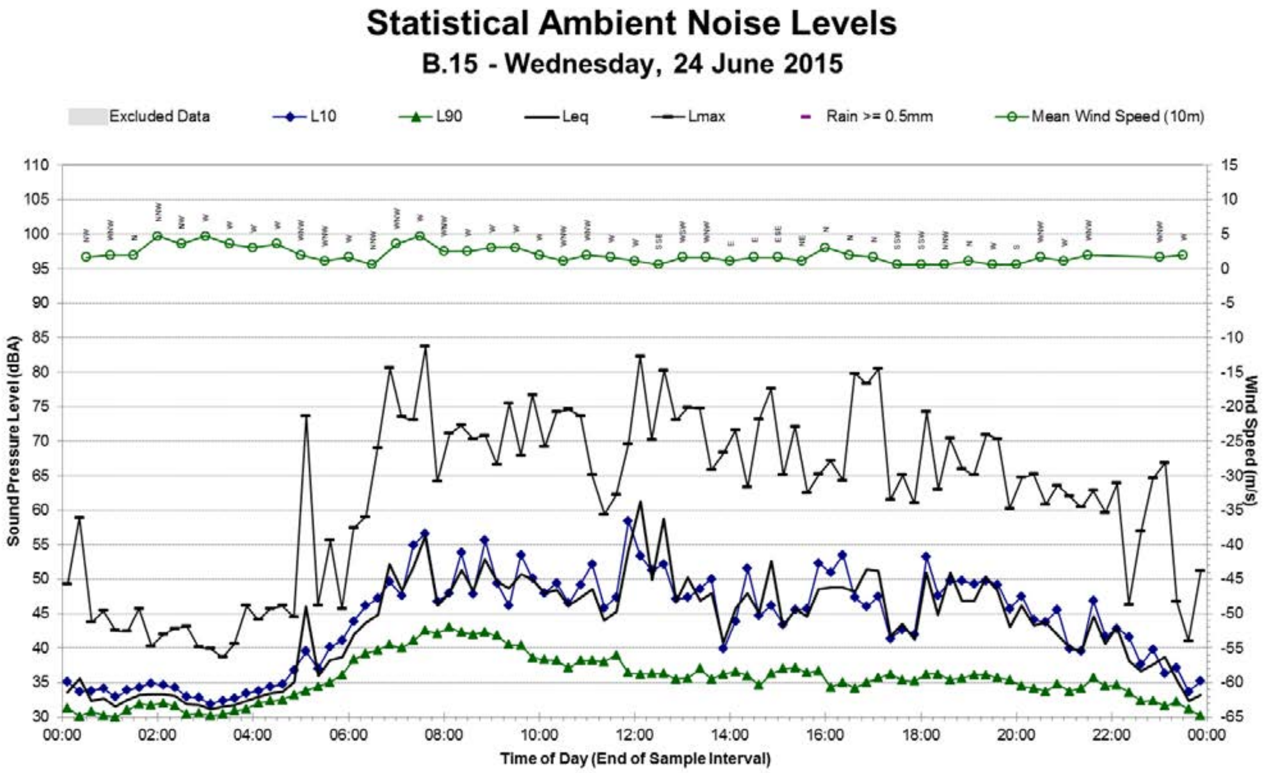


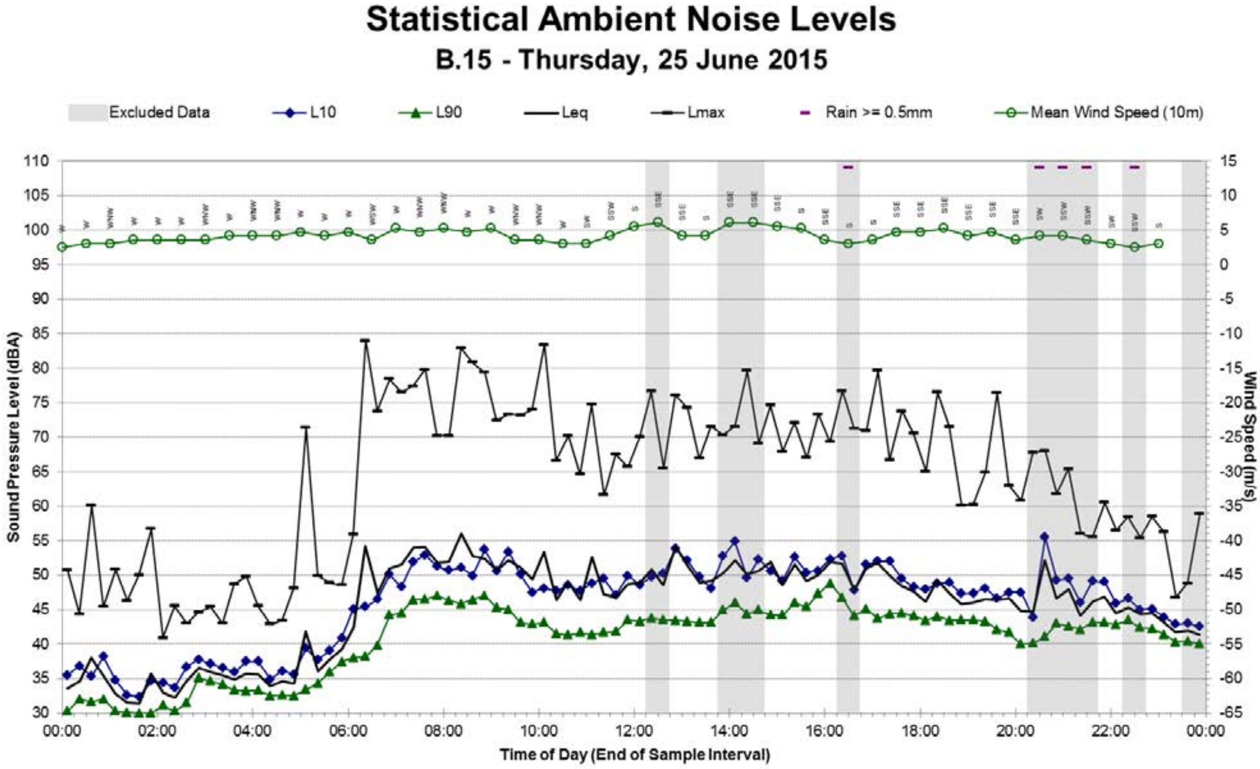
Statistical Ambient Noise Levels
B.15 - Monday, 22 June 2015

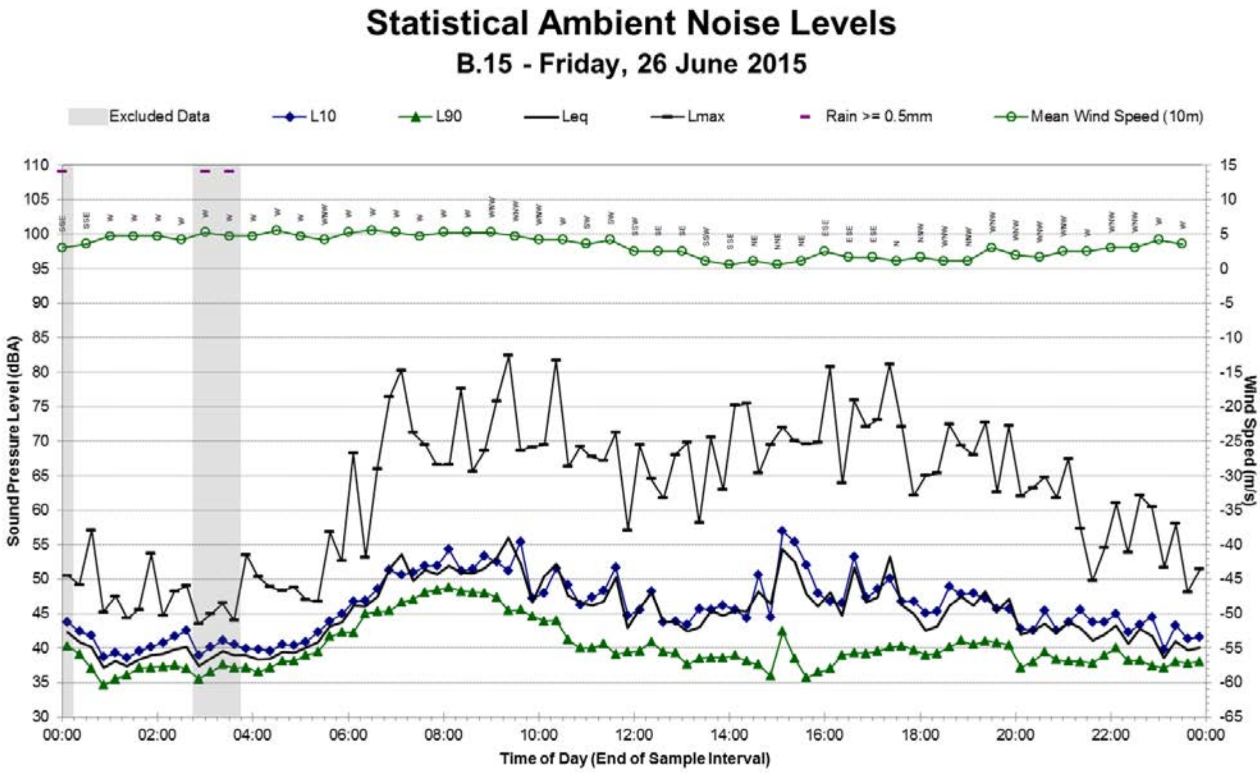


Background Noise Monitoring Results – B.15



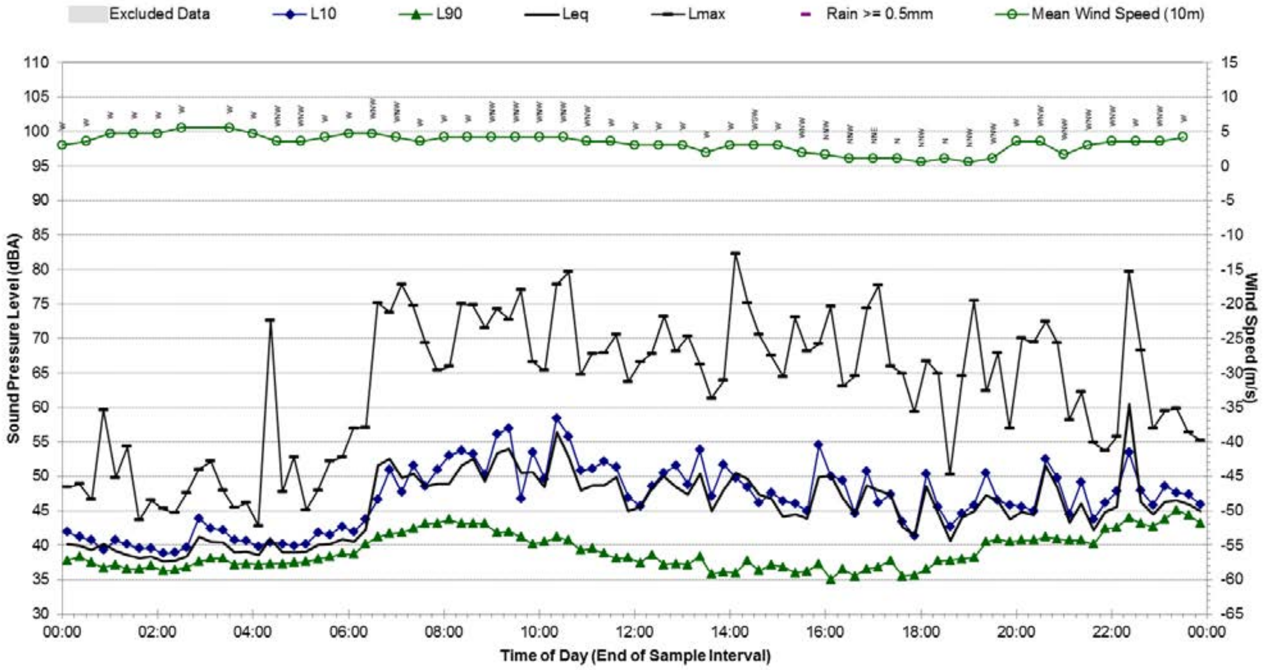



Statistical Ambient Noise Levels
B.15 - Thursday, 25 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

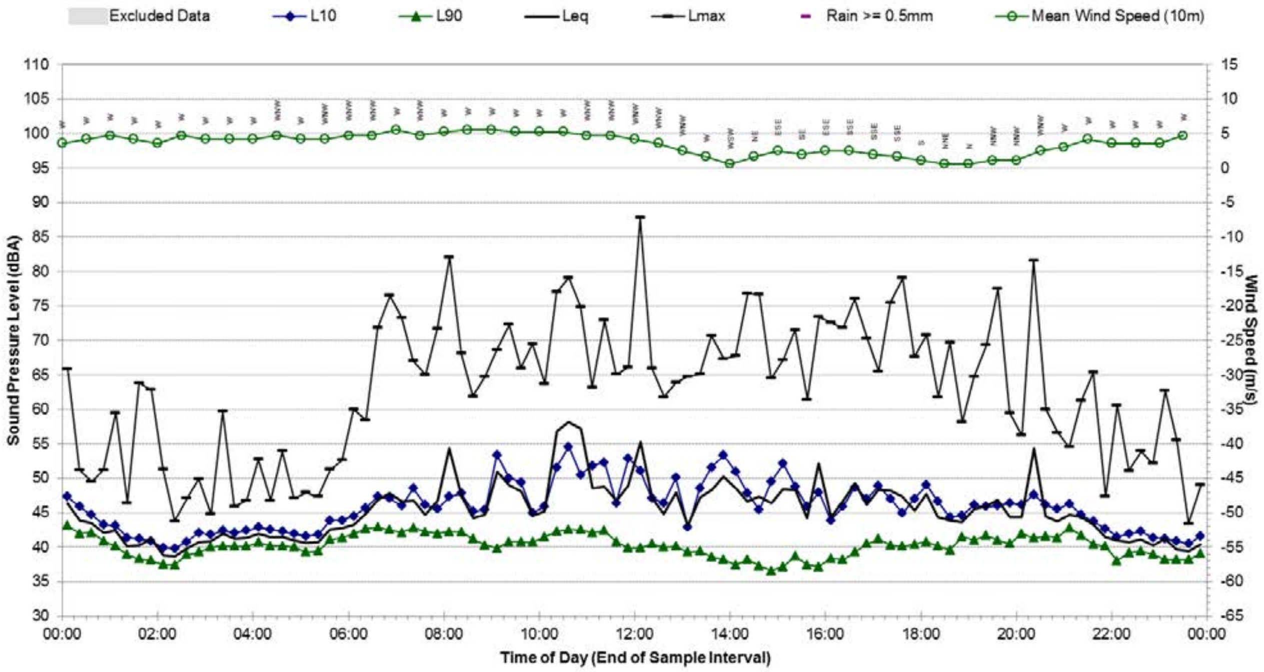

Statistical Ambient Noise Levels
B.15 - Friday, 26 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

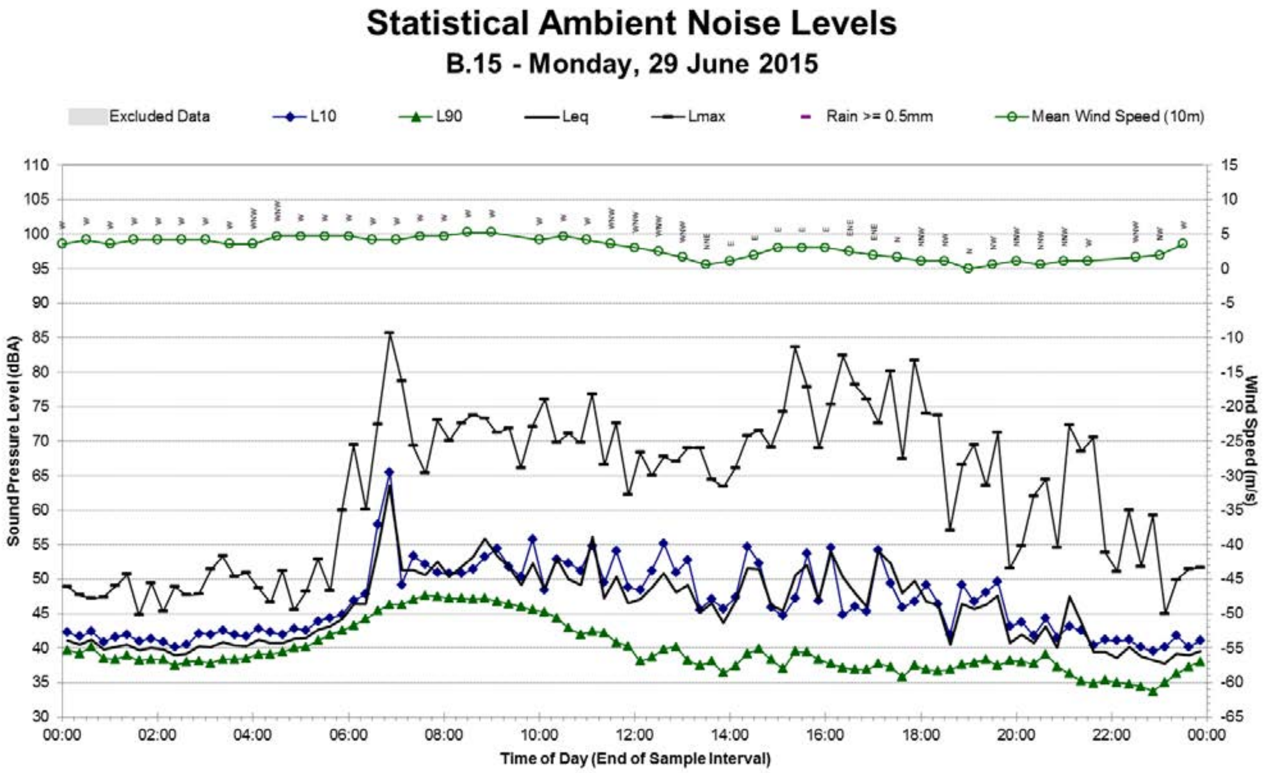
Background Noise Monitoring Results – B.15

Statistical Ambient Noise Levels
B.15 - Saturday, 27 June 2015

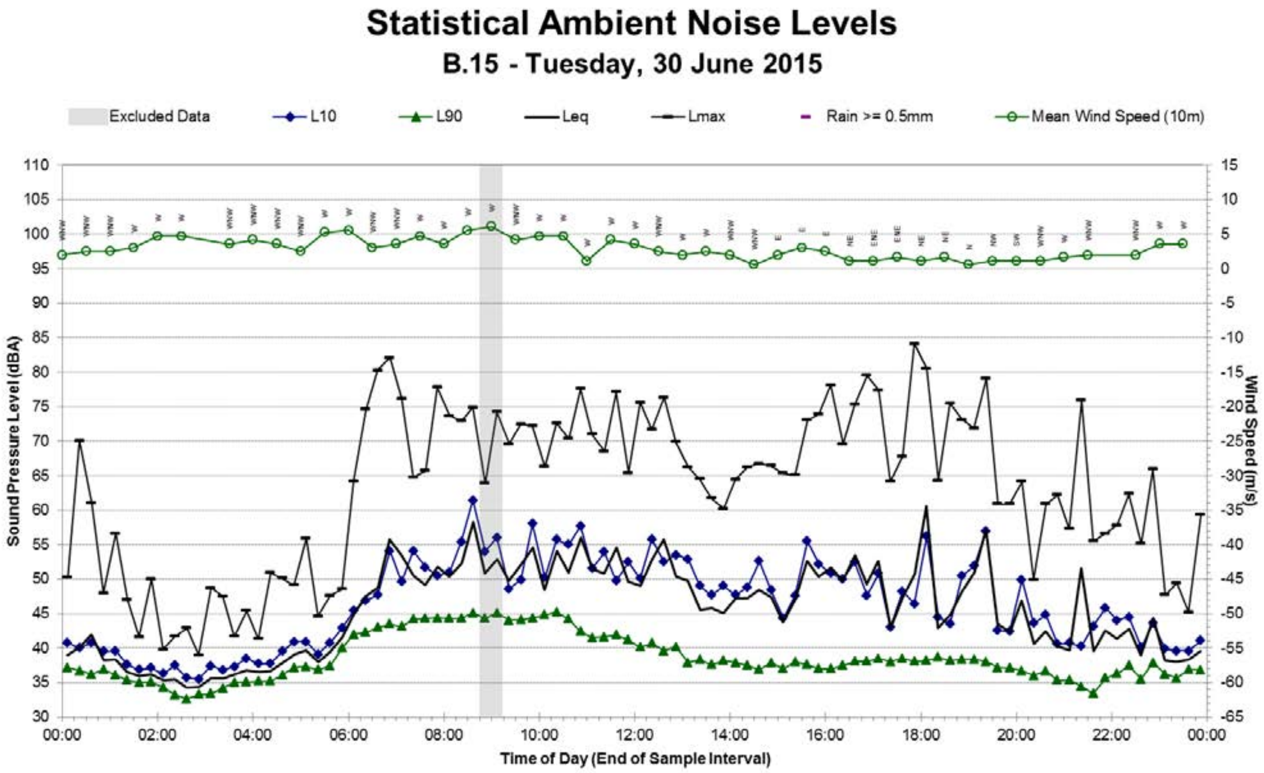


Statistical Ambient Noise Levels
B.15 - Sunday, 28 June 2015

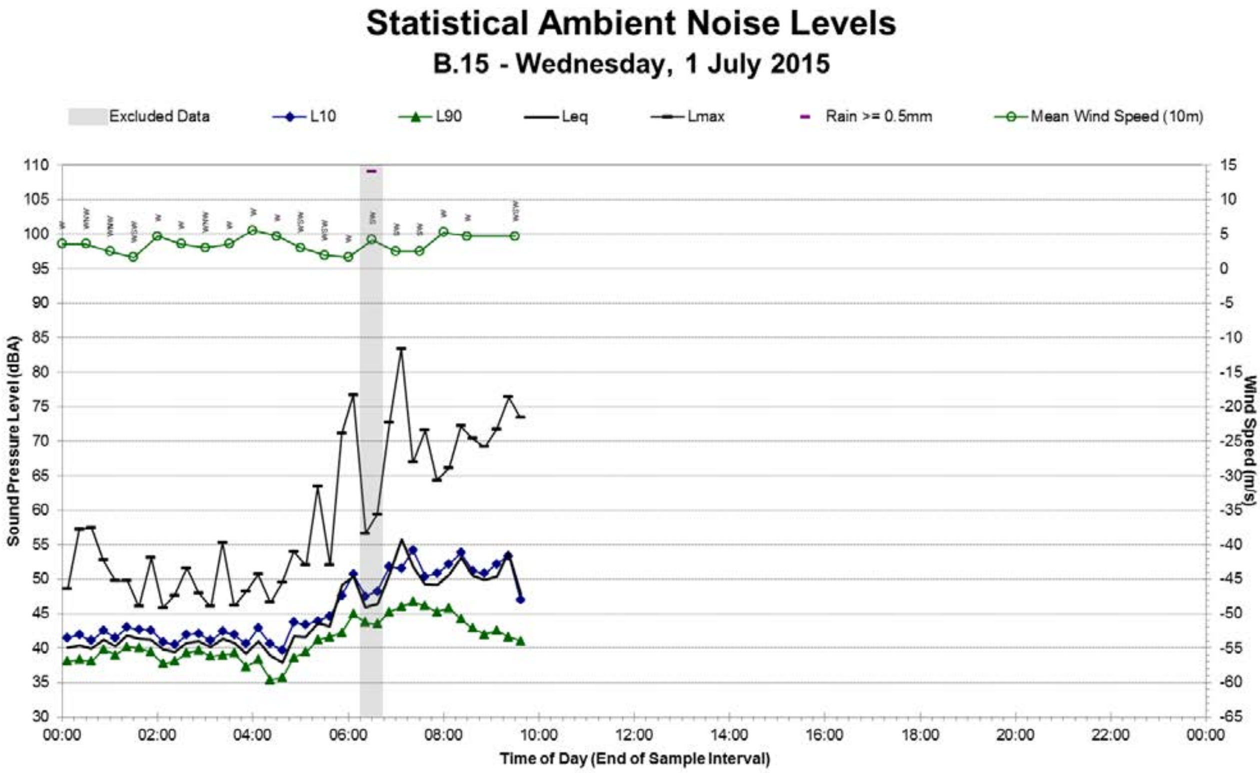




Statistical Ambient Noise Levels
B.15 - Monday, 29 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
B.15 - Tuesday, 30 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
B.15 - Wednesday, 1 July 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

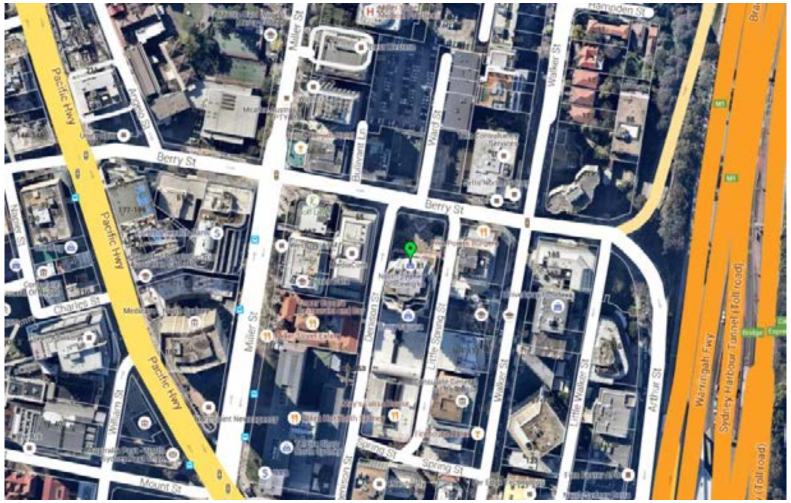
Noise Monitoring Location:	**B.16**
Noise Monitoring Address:	**Unit 3004 / 77-81 Berry Street, North Sydney 2060**

Logger Device Type: Svantek 957
Logger Serial No: 20667

Ambient noise logger deployed on the balcony of residential address Unit 3004 / 77-81 Berry Street, North Sydney. Logger located on the northern facade of the building.

Attended noise measurements indicate that the ambient noise environment at this location is dominated by road traffic noise in the general area and an observed "city hum" which is constant in North Sydney.

Map of Noise Monitoring Location



Ambient Noise Logging Results – INP Defined Time Periods

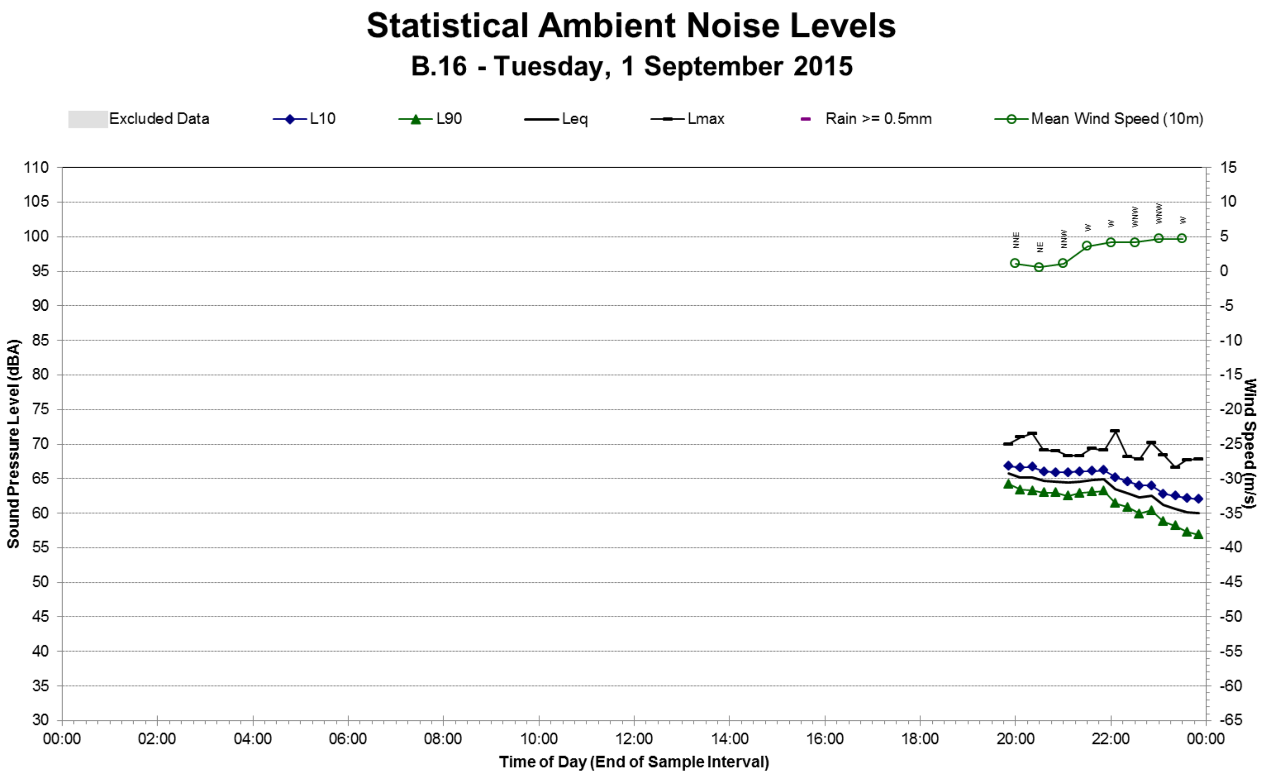
Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	65	68	70	72
Evening	63	65	66	68
Night-time	52	62	62	65

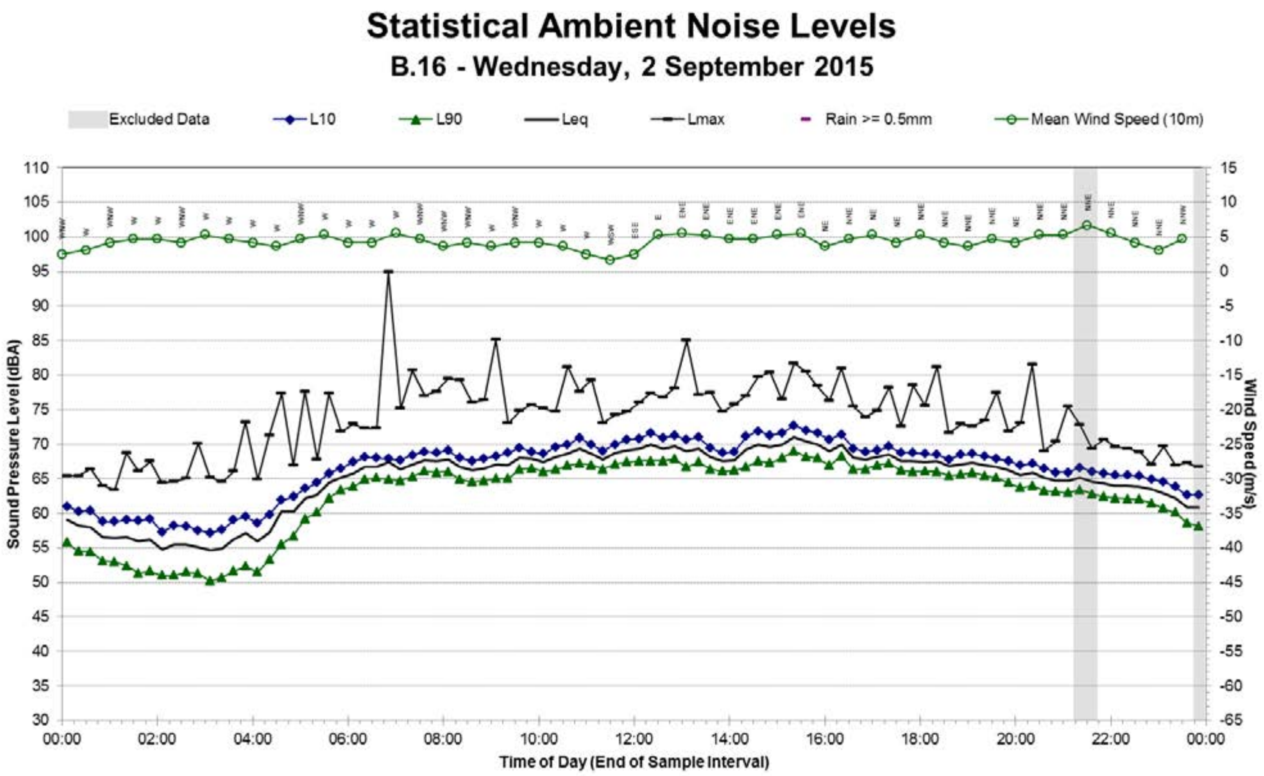
Attended Noise Measurement Results

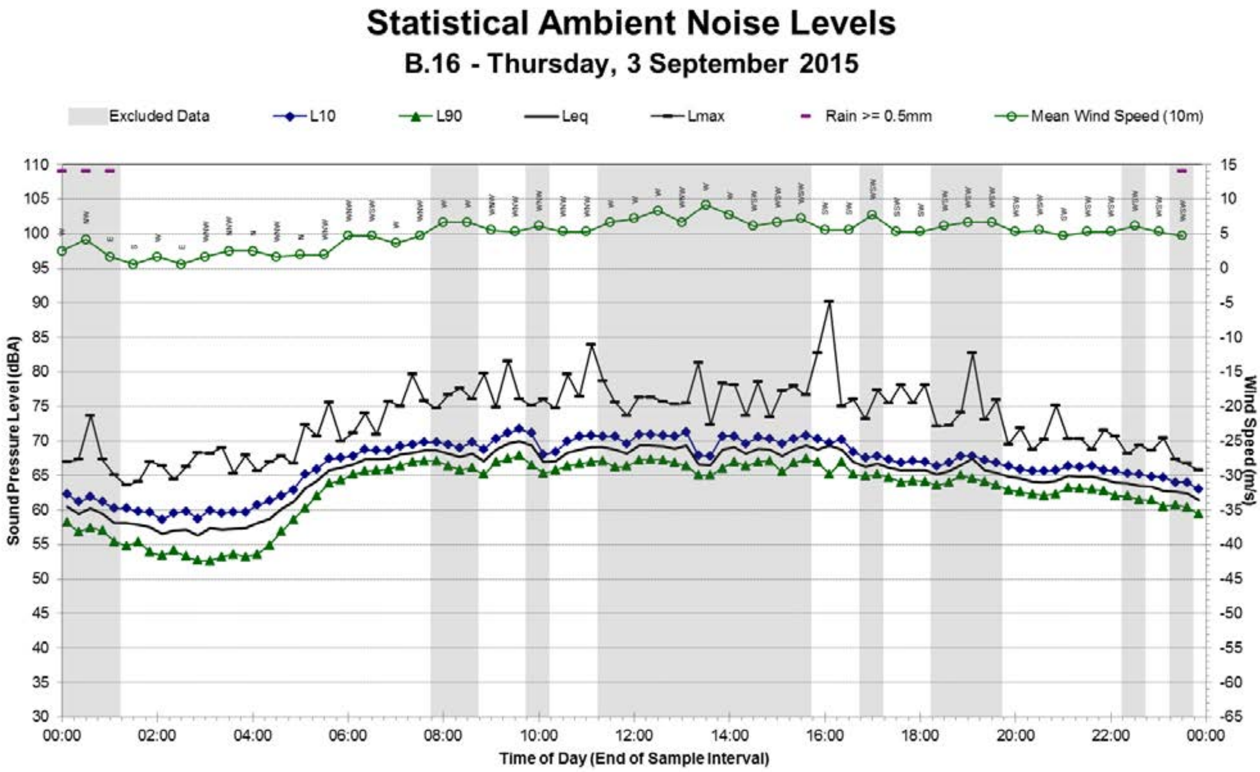
Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
15/09/2015	19:40:21	62	65	69

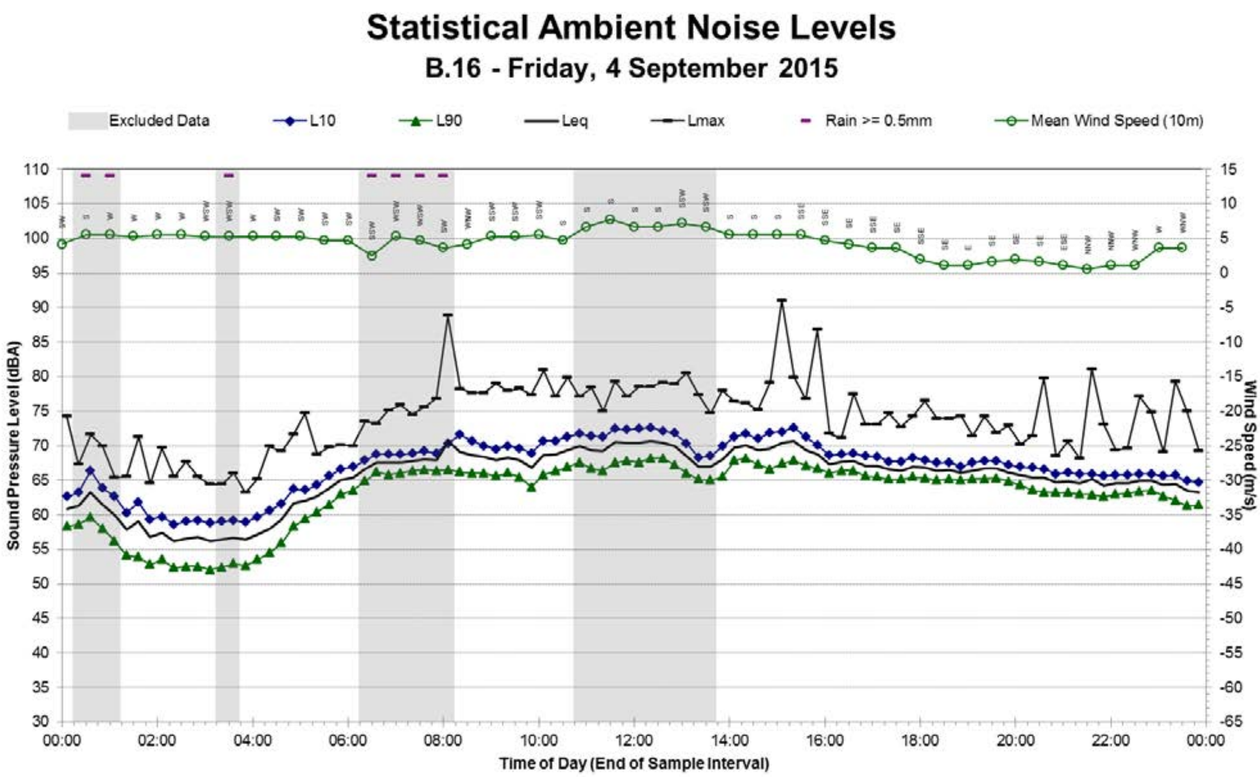
Photo of Noise Monitoring Location

Background Noise Monitoring Results – B.16



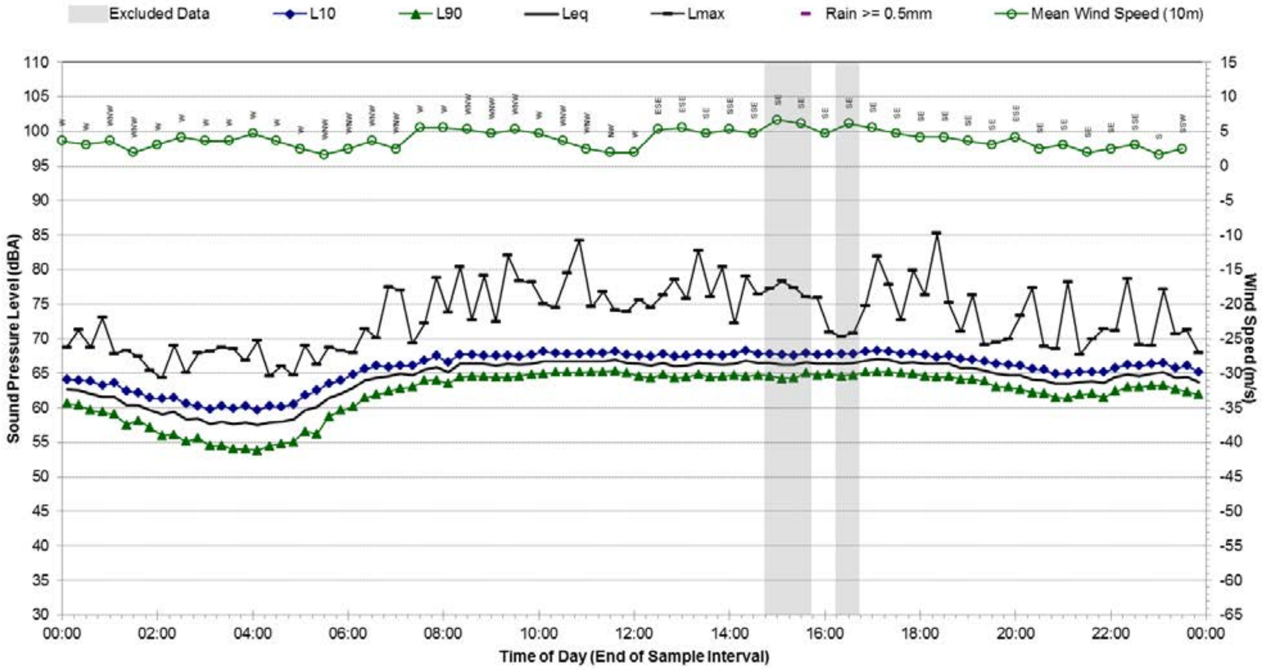



Statistical Ambient Noise Levels
B.16 - Thursday, 3 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

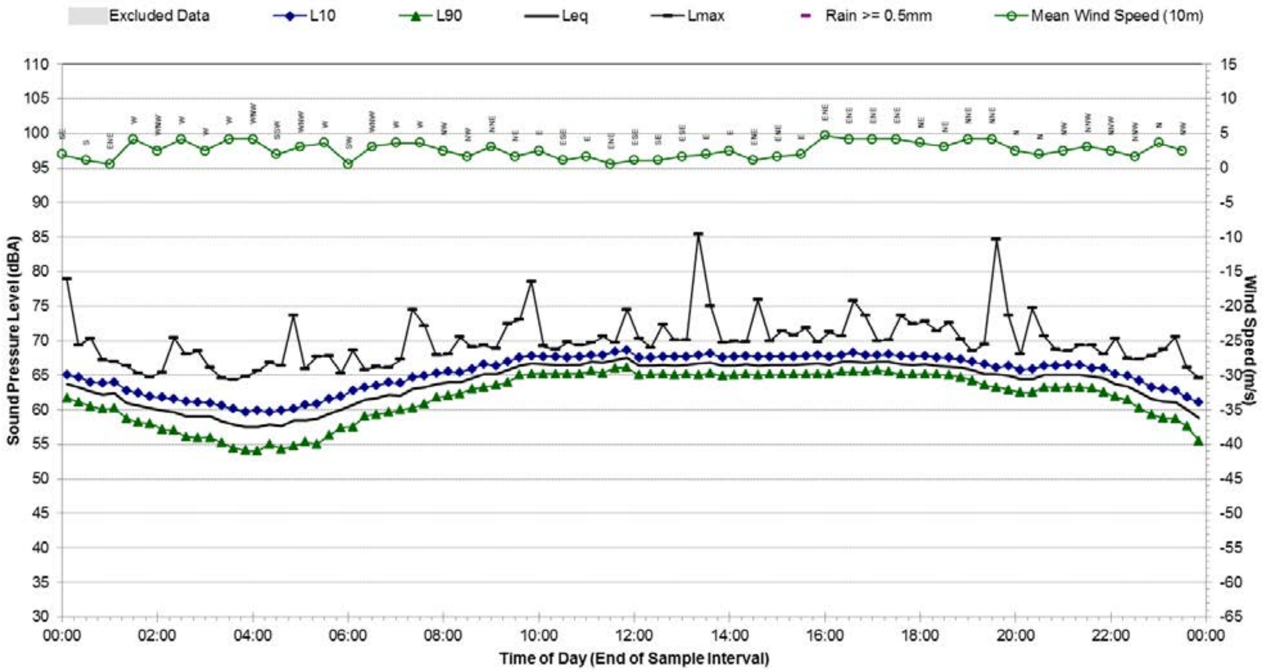

Statistical Ambient Noise Levels
B.16 - Friday, 4 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

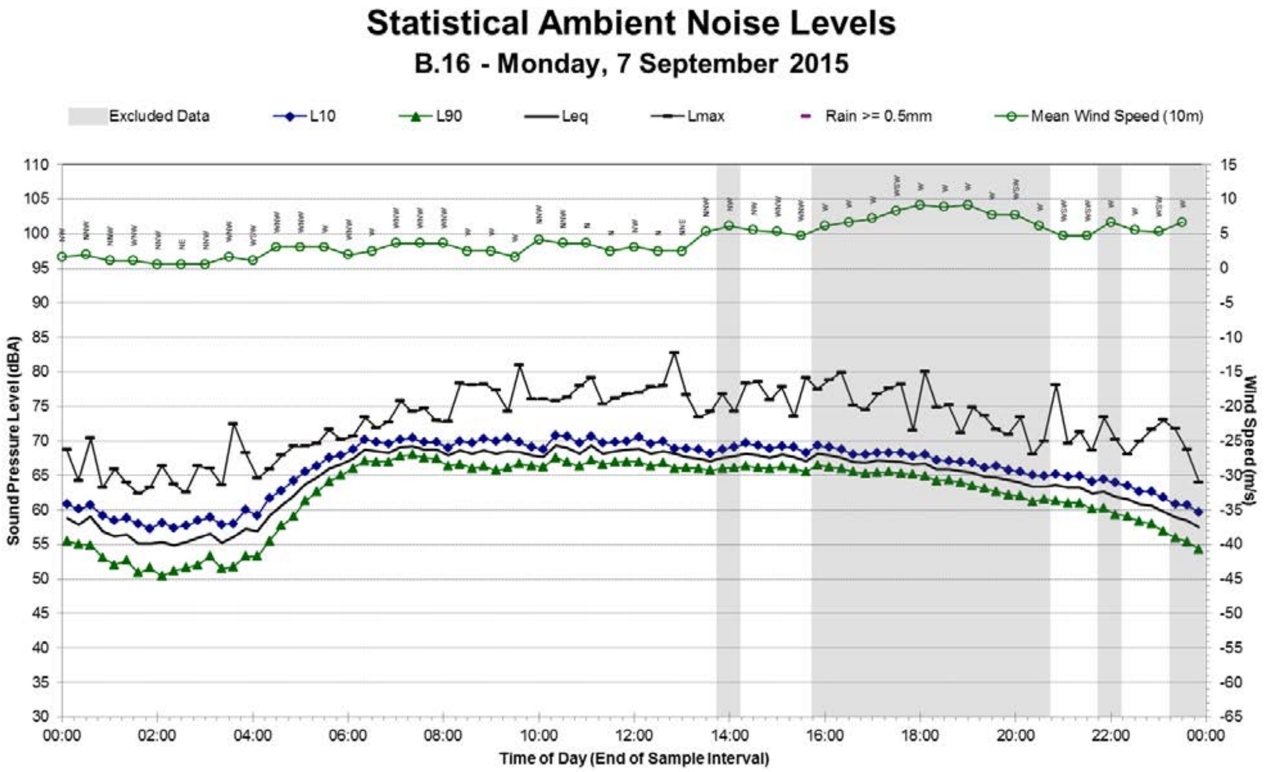
Background Noise Monitoring Results – B.16

Statistical Ambient Noise Levels
B.16 - Saturday, 5 September 2015

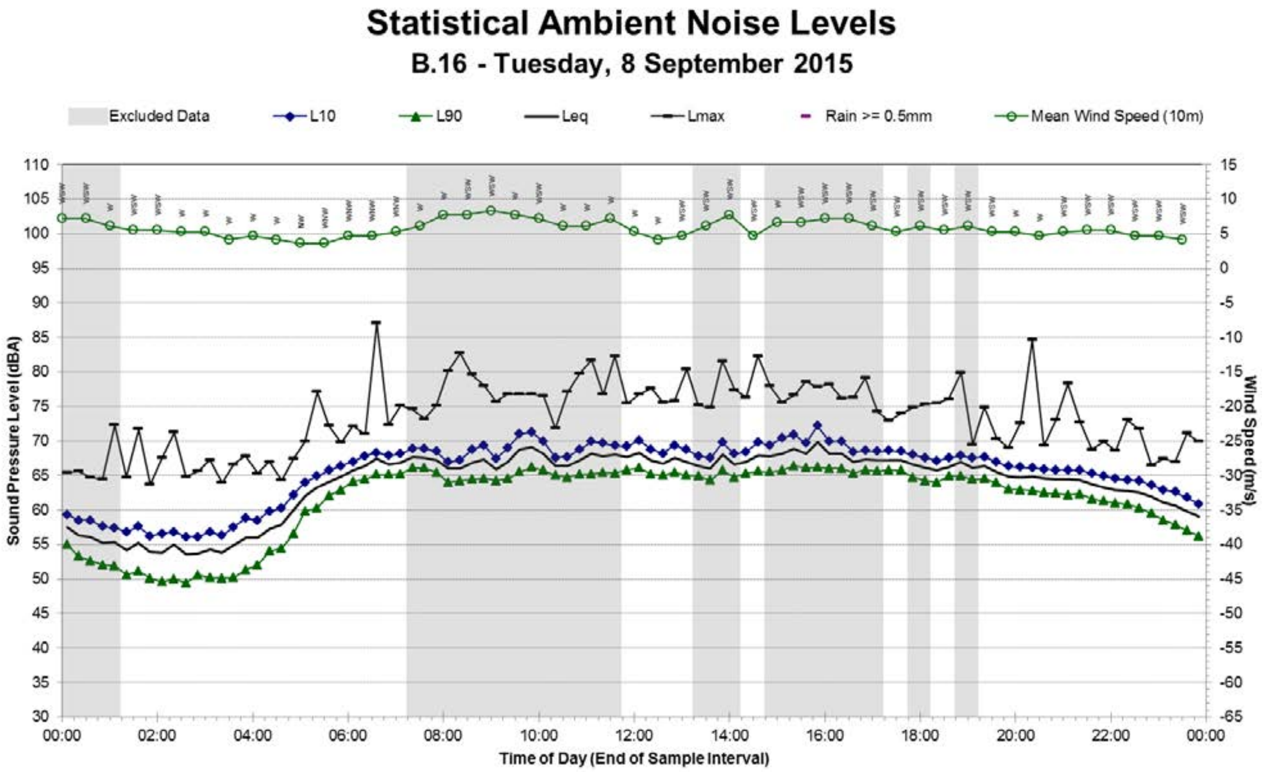


Statistical Ambient Noise Levels
B.16 - Sunday, 6 September 2015



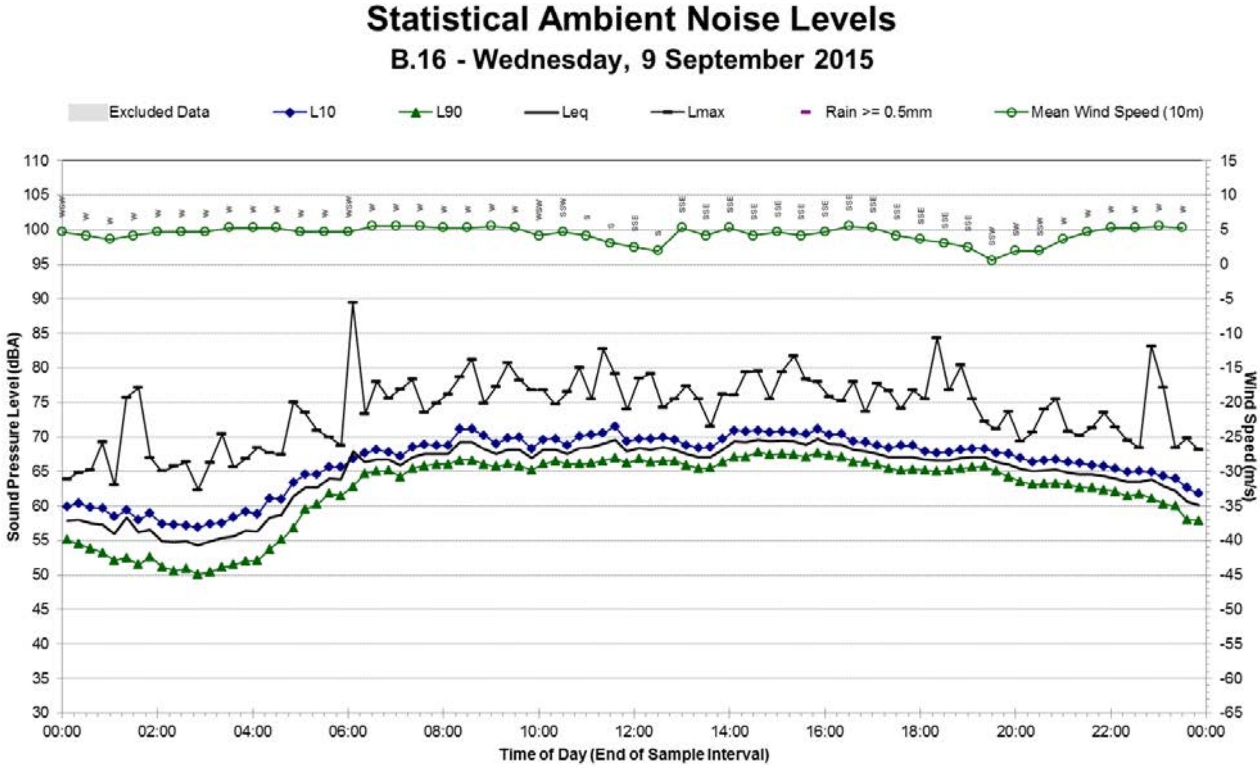


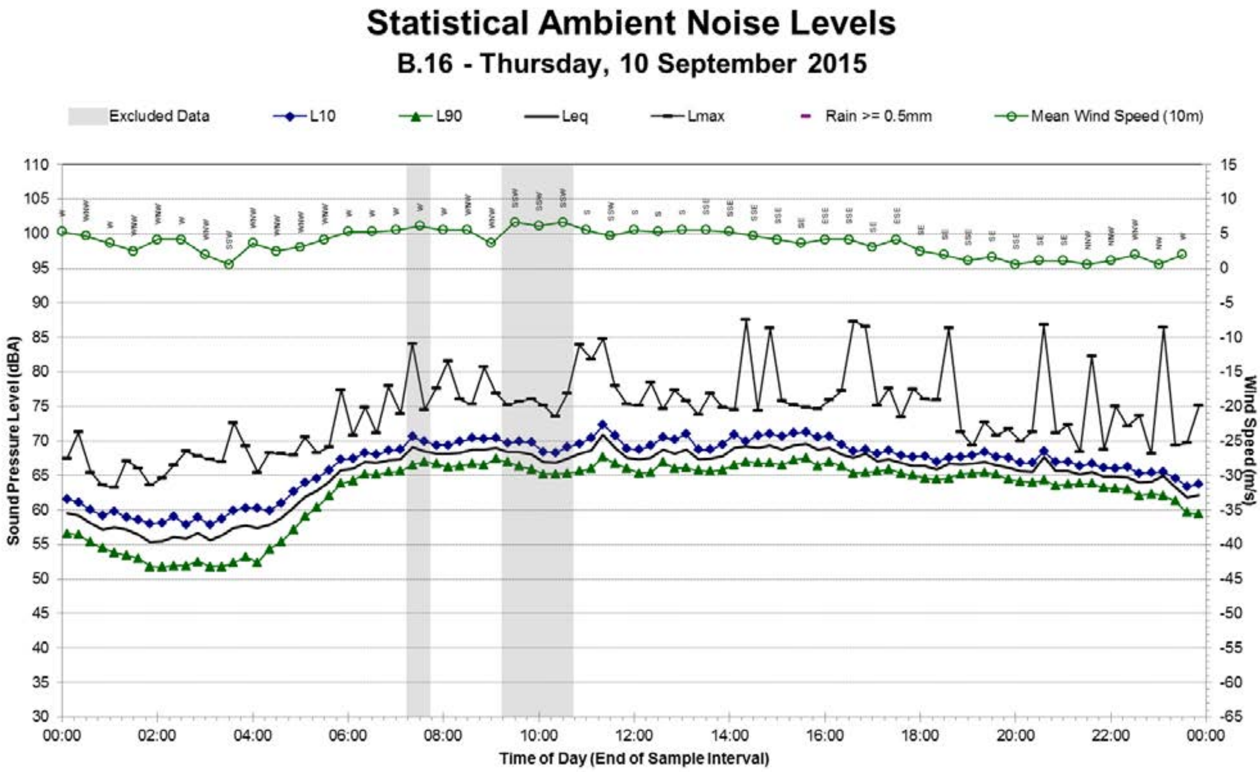
Statistical Ambient Noise Levels
B.16 - Monday, 7 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



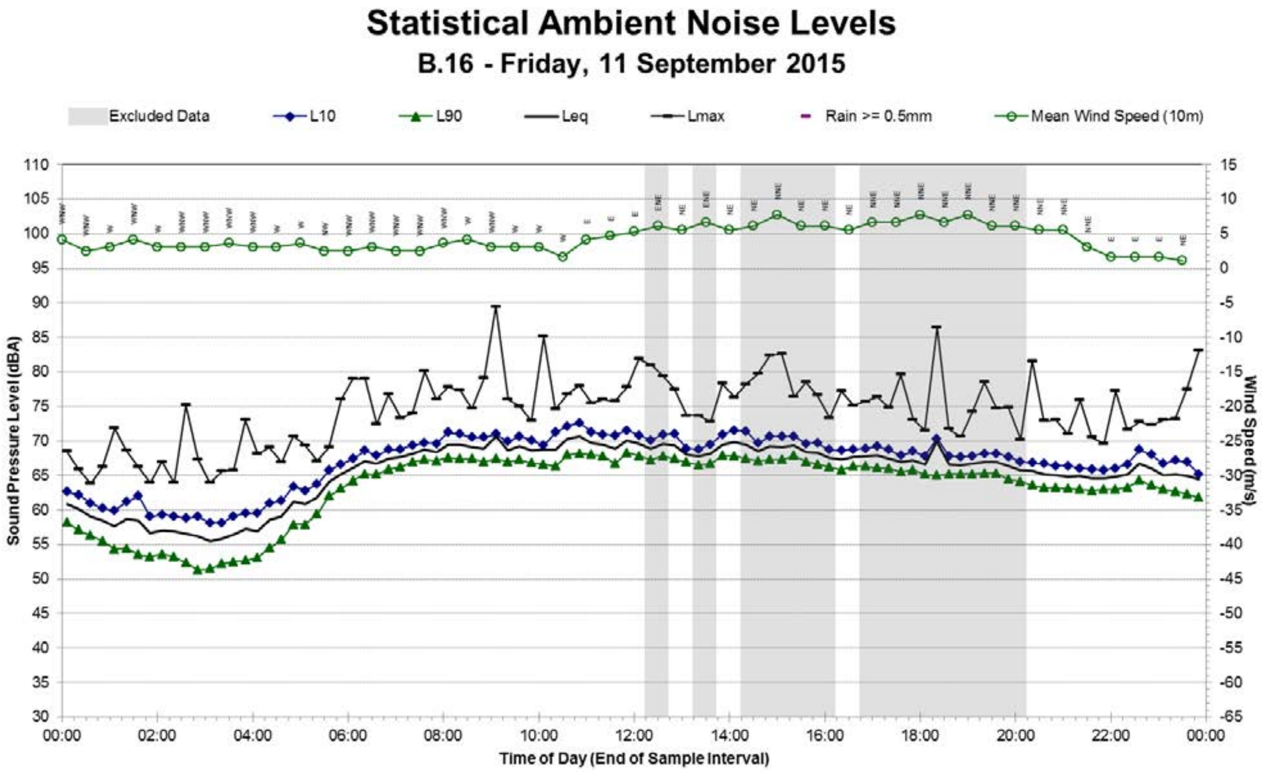
Statistical Ambient Noise Levels
B.16 - Tuesday, 8 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

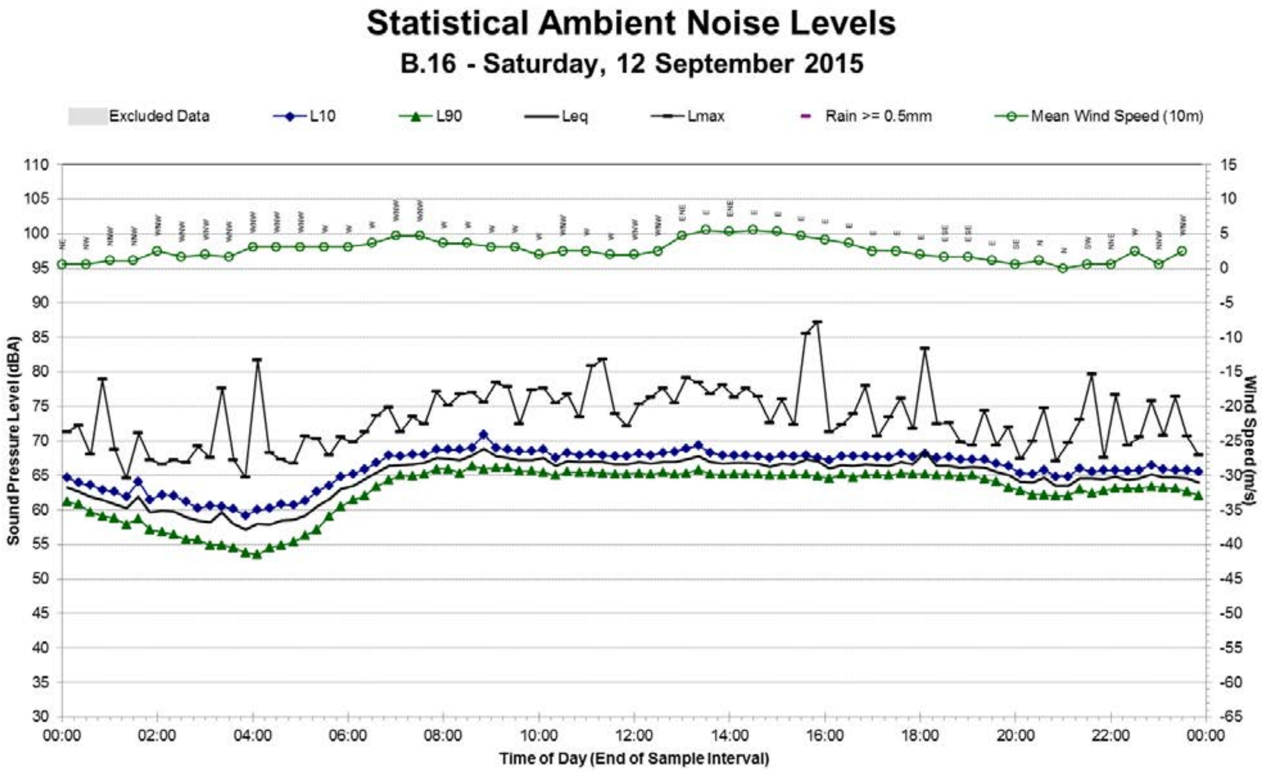
Background Noise Monitoring Results – B.16



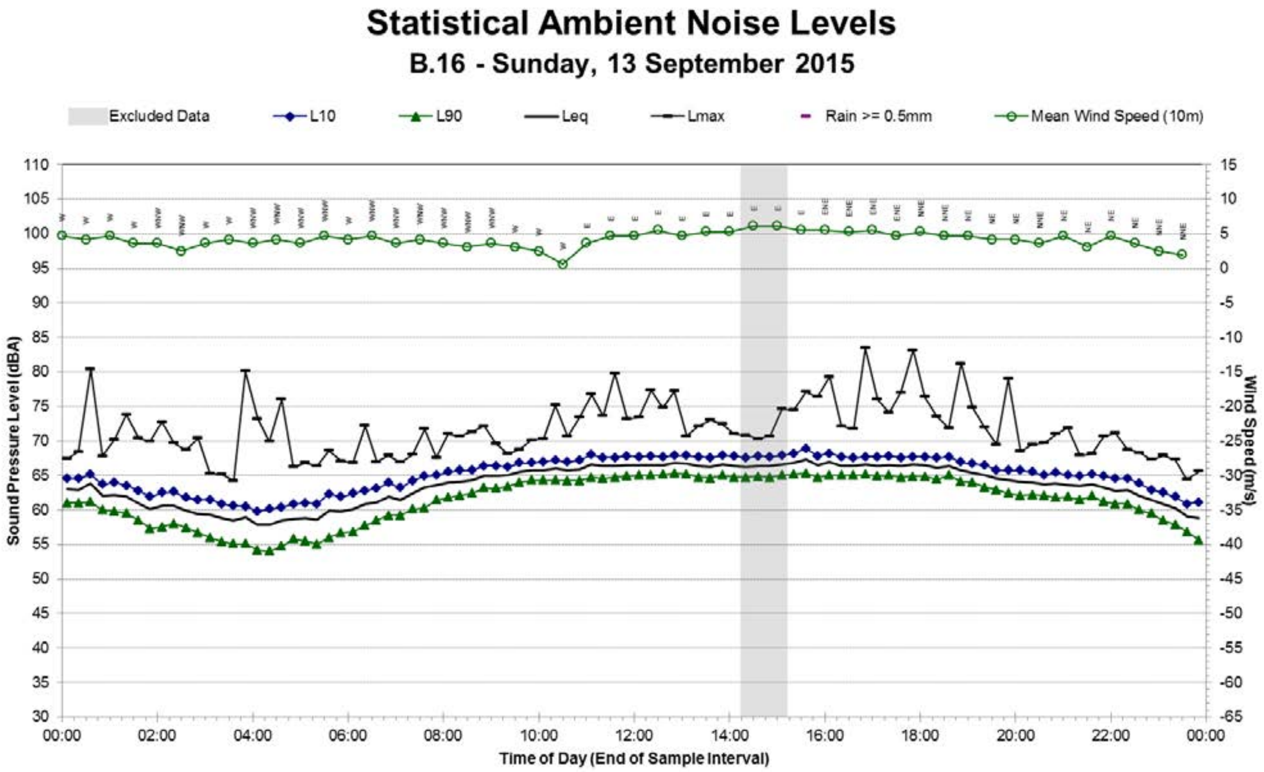


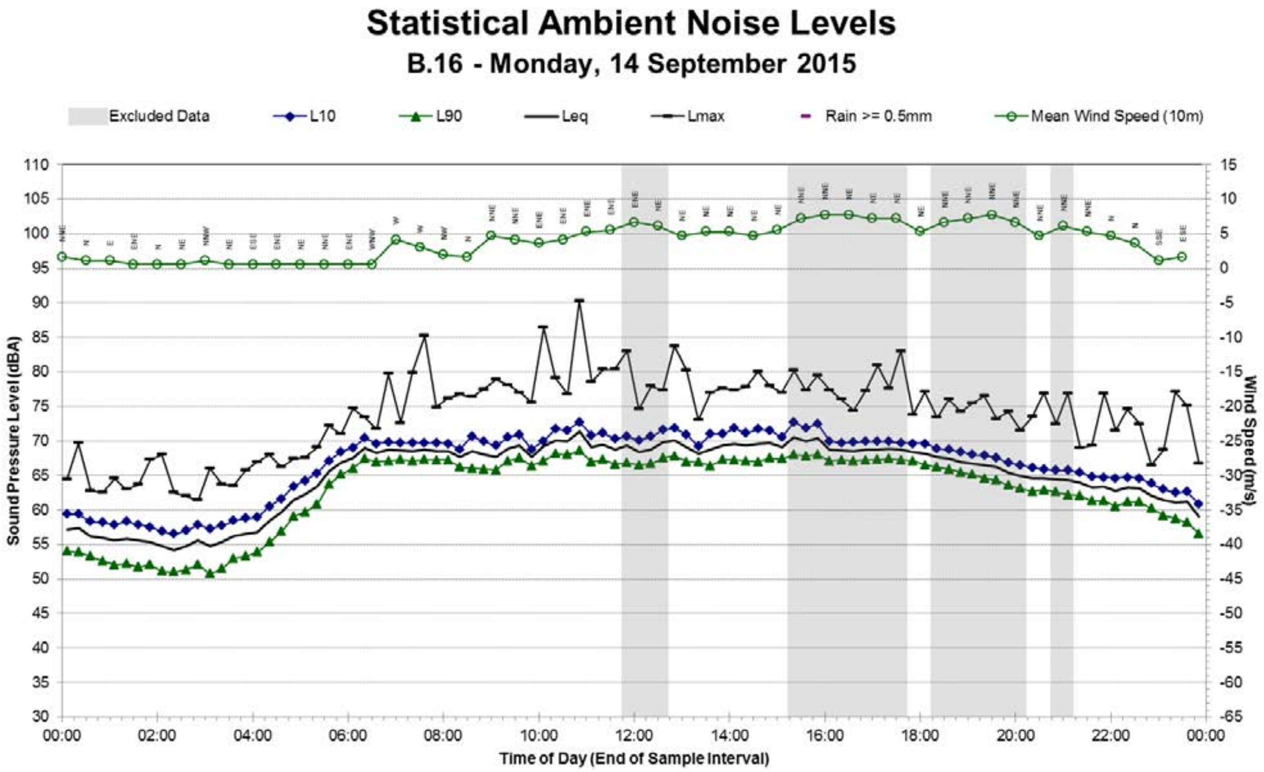
Background Noise Monitoring Results – B.16



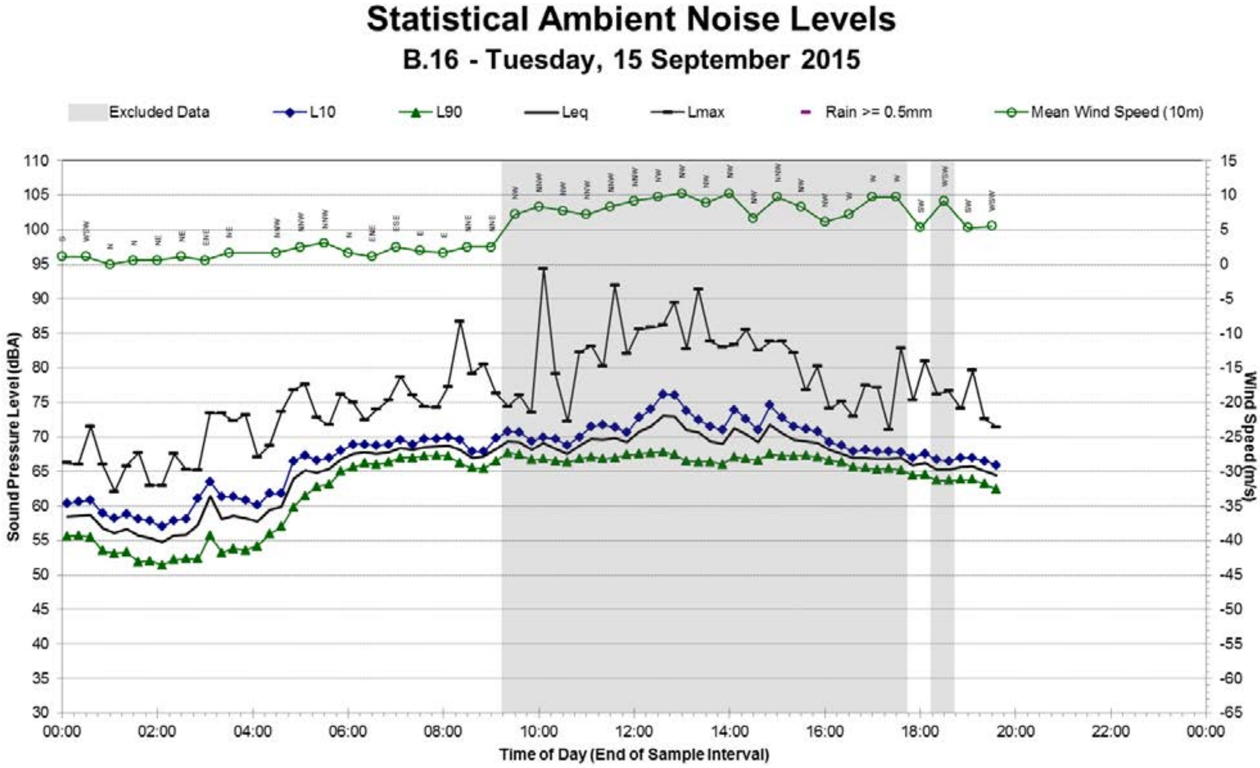


Background Noise Monitoring Results – B.16





Background Noise Monitoring Results – B.16



Background Noise Monitoring Results – B.17

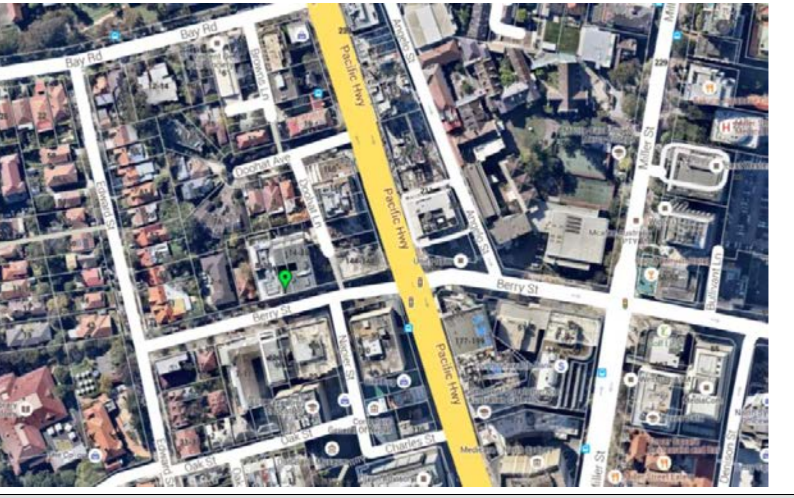
Noise Monitoring Location:	**B.17**
Noise Monitoring Address:	**12-16 Berry Street, North Sydney 2060**

Logger Device Type: Svantek 957
Logger Serial No: 23241

Ambient noise logger deployed on the roof of 12-16 Berry Street, North Sydney. Logger located on the southern facade with noise catchment over Berry Street below.

Attended noise measurements indicate that the ambient noise environment at this location is dominated by road traffic noise from Pacific Highway and Berry Street. Surrounding mechanical plant contributed to the LA90 (background) levels throughout as well as the observed "city hum" which is constant in North Sydney.

Map of Noise Monitoring Location



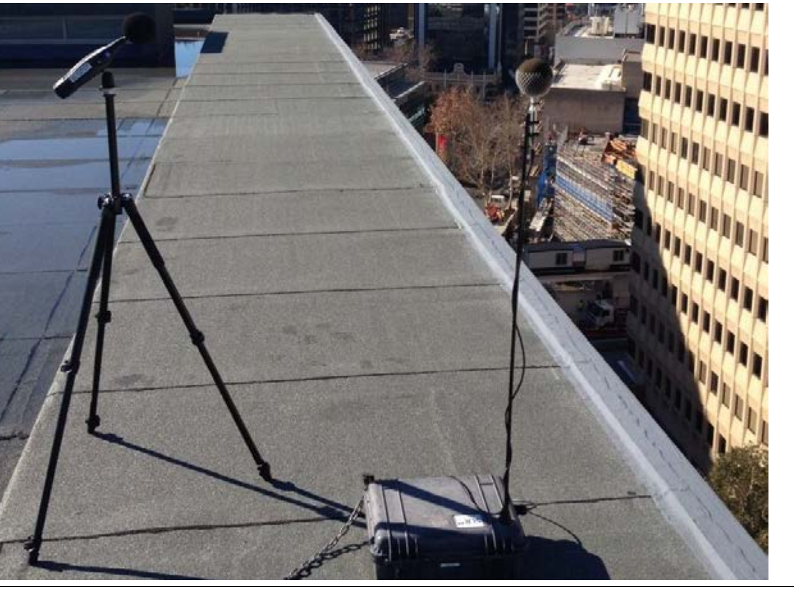
Ambient Noise Logging Results – INP Defined Time Periods

Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	55	61	62	67
Evening	50	55	57	61
Night-time	44	51	52	56

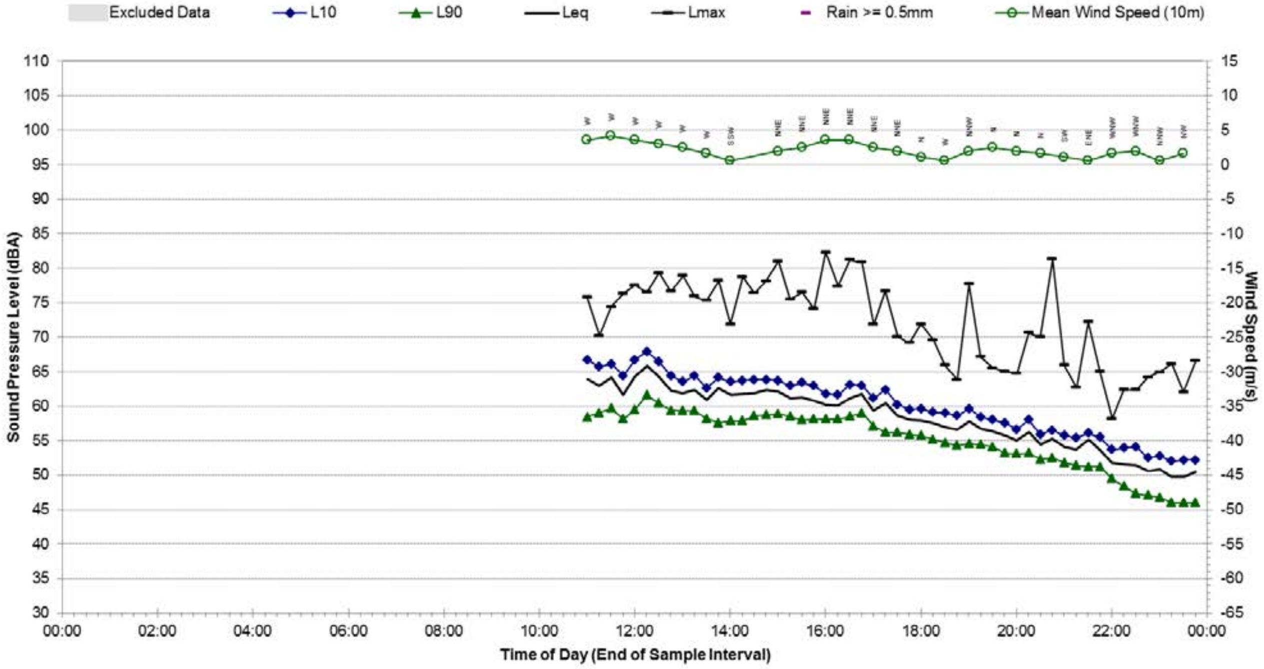
Attended Noise Measurement Results

Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
22/06/2015	10:38:43	58	61	74

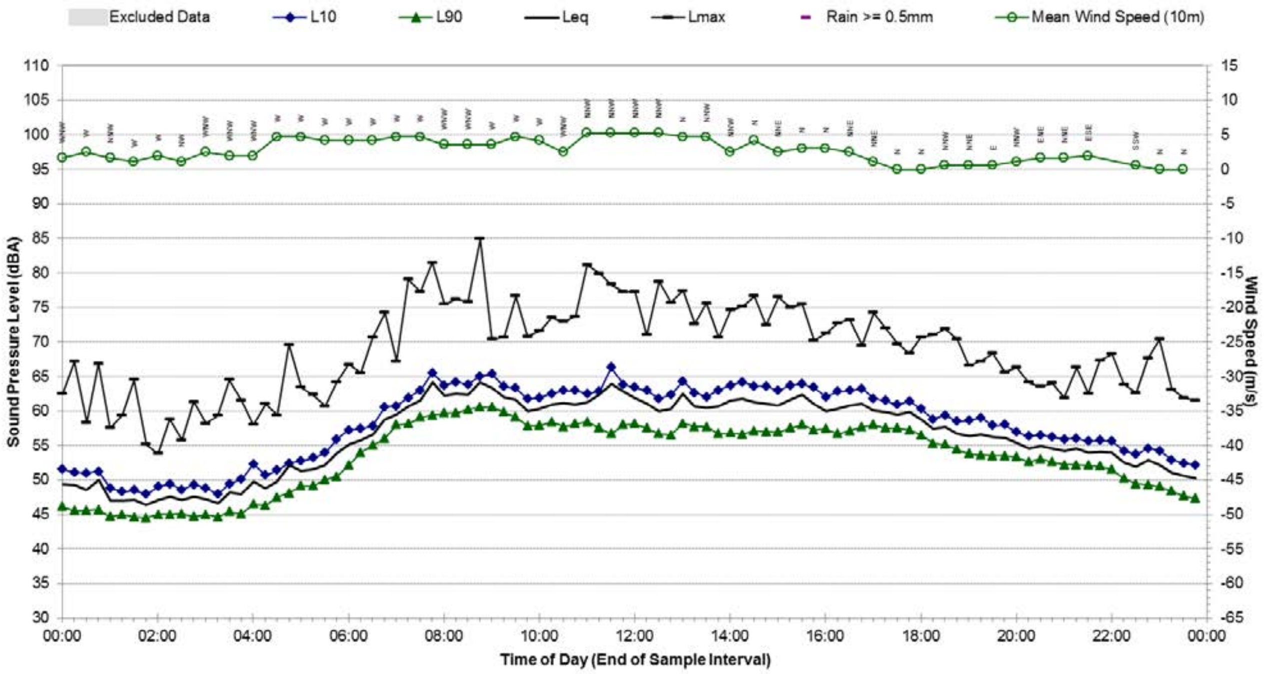
Photo of Noise Monitoring Location



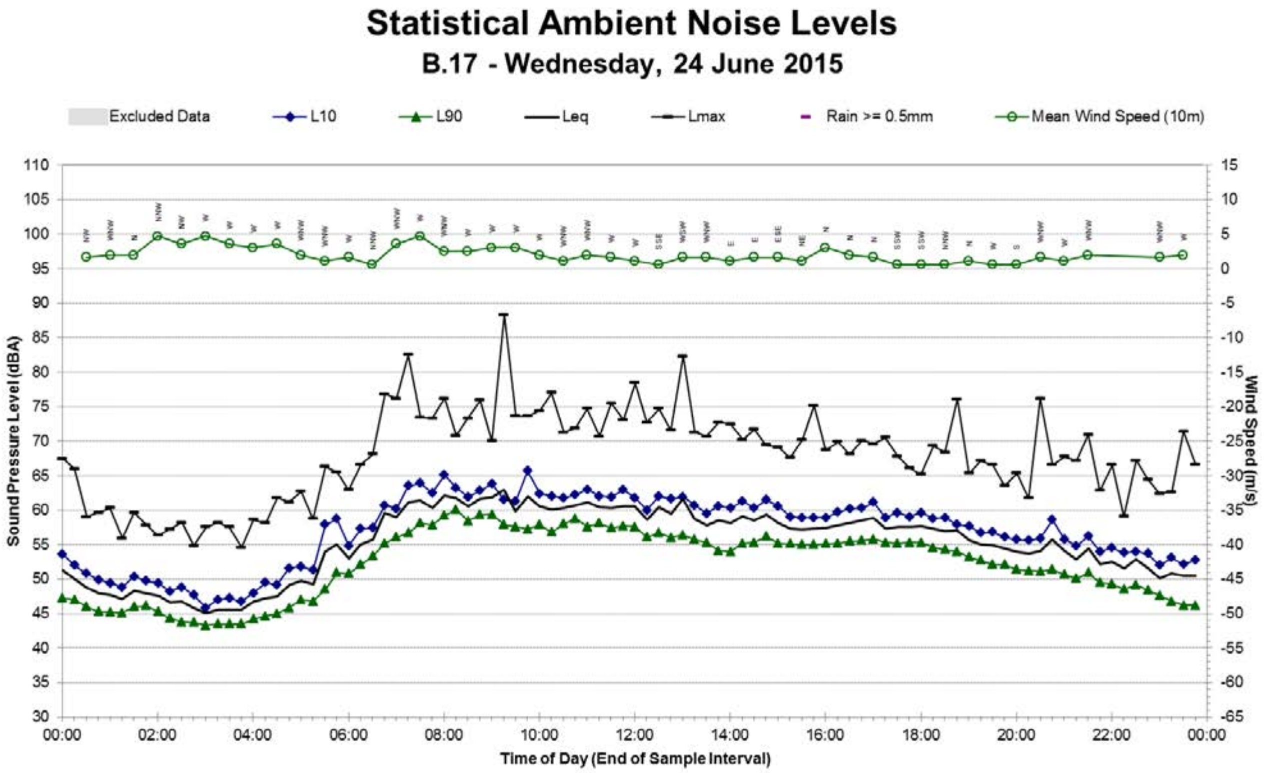
Statistical Ambient Noise Levels
B.17 - Monday, 22 June 2015

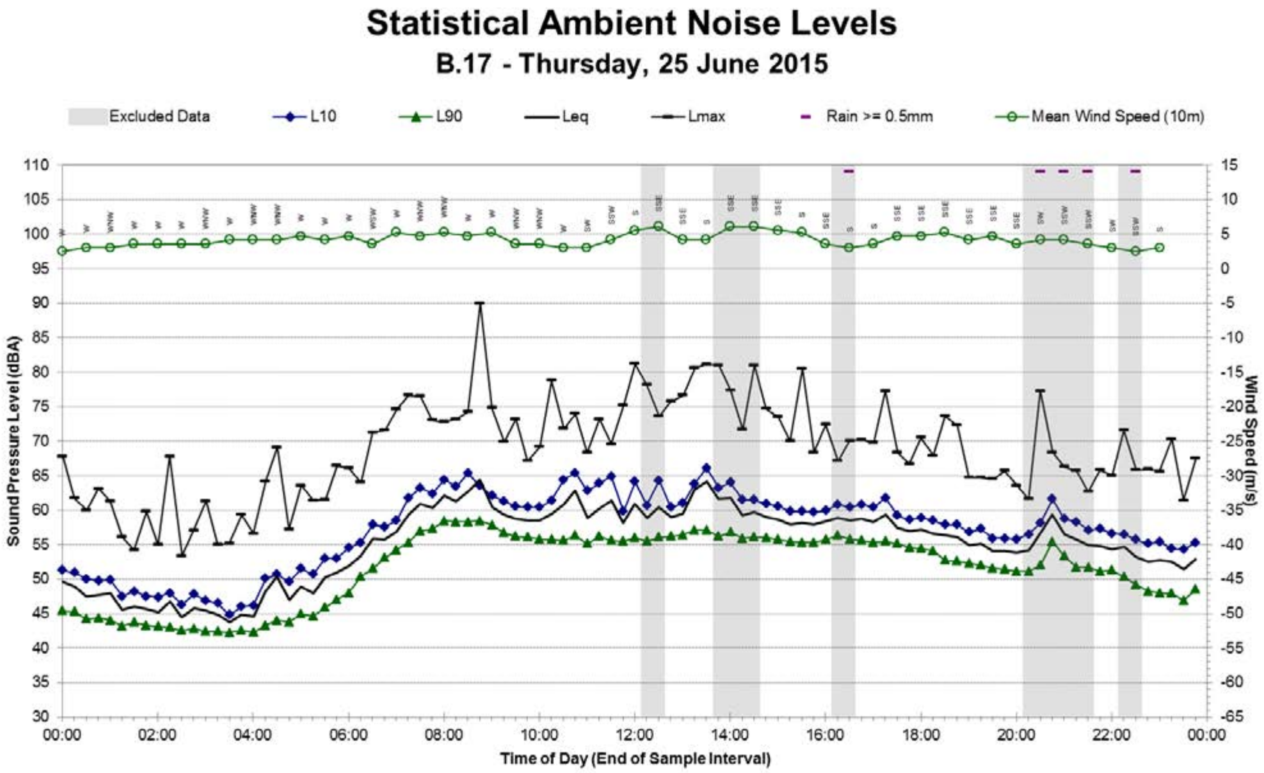


Statistical Ambient Noise Levels
B.17 - Tuesday, 23 June 2015



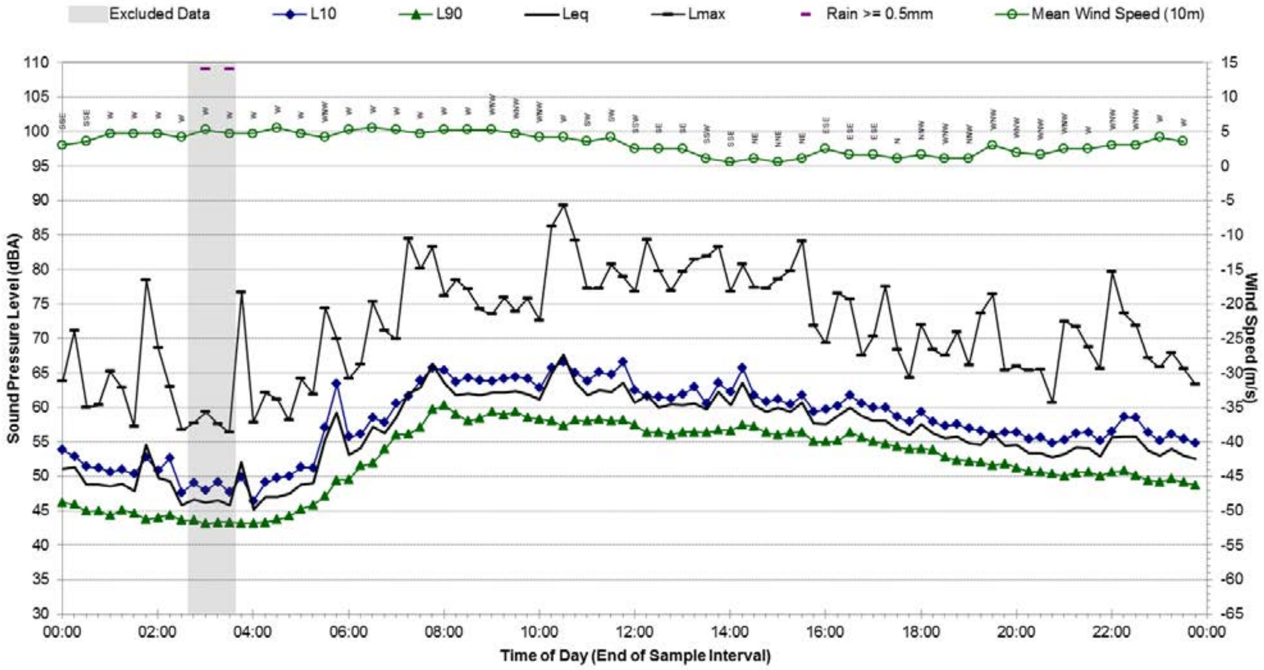
Background Noise Monitoring Results – B.17



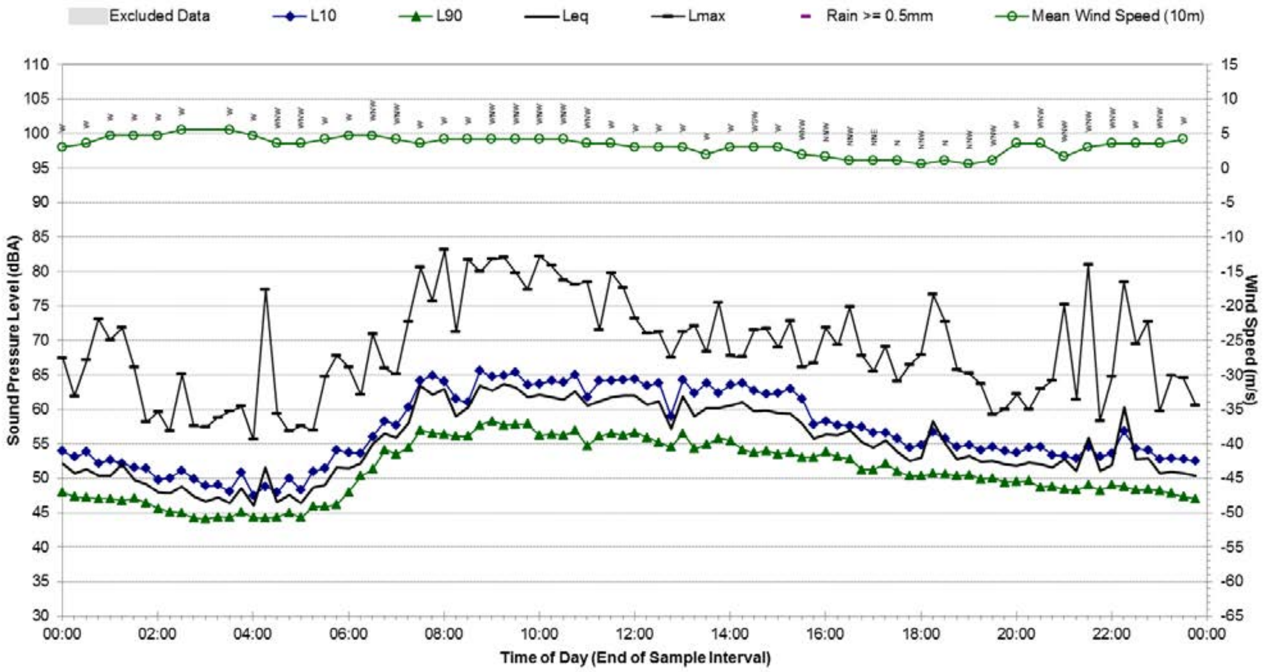


Background Noise Monitoring Results – B.17

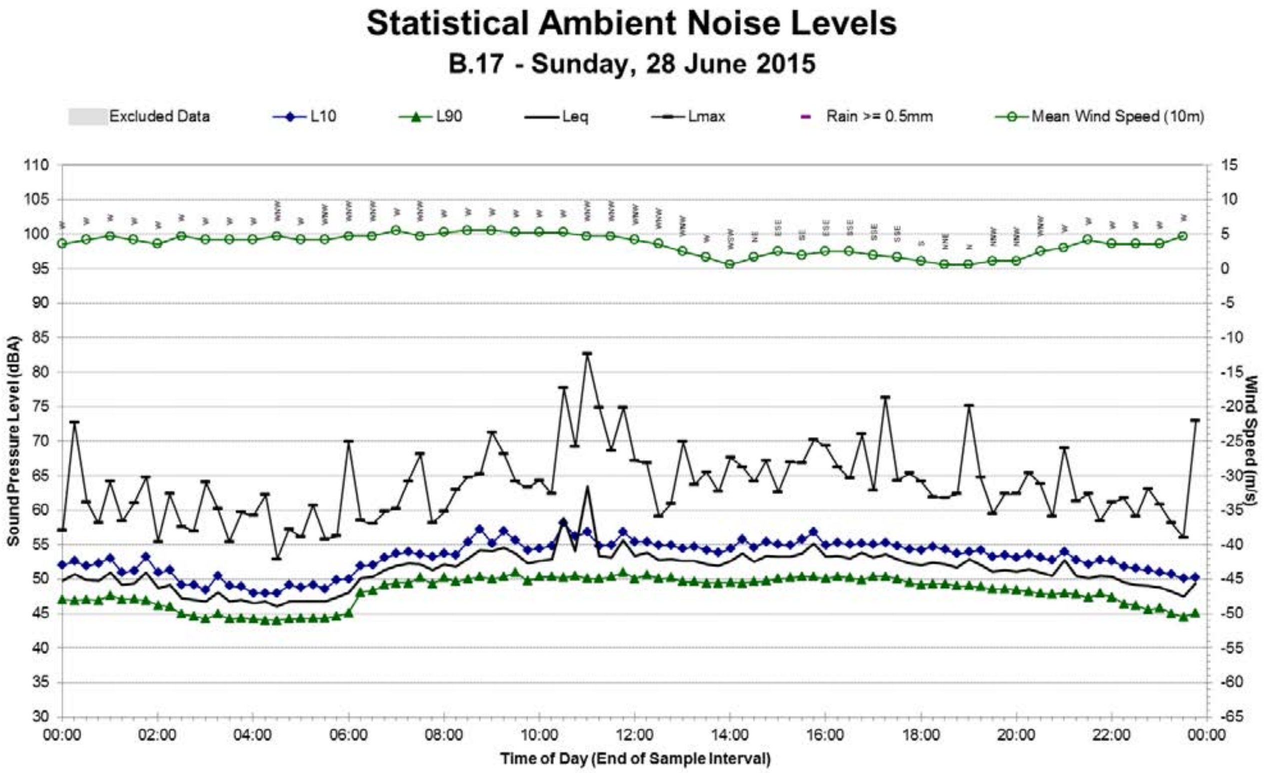
Statistical Ambient Noise Levels
B.17 - Friday, 26 June 2015

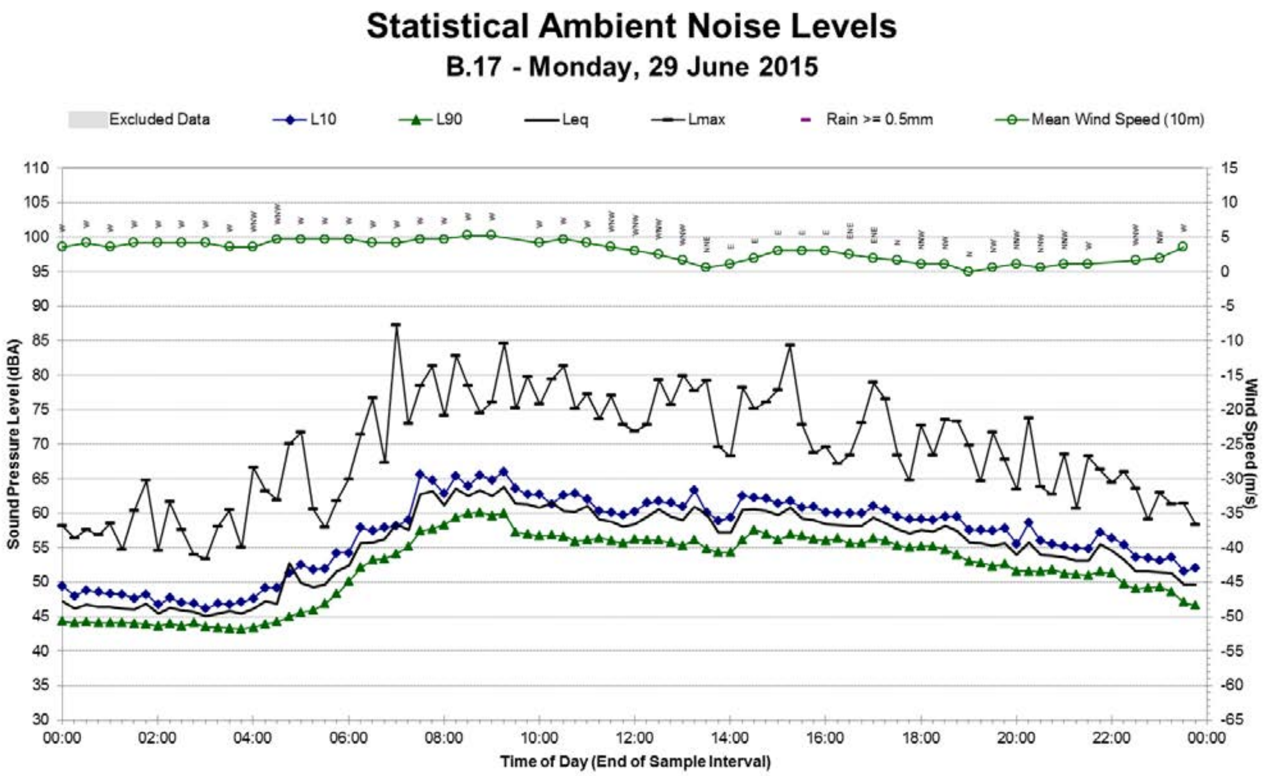


Statistical Ambient Noise Levels
B.17 - Saturday, 27 June 2015

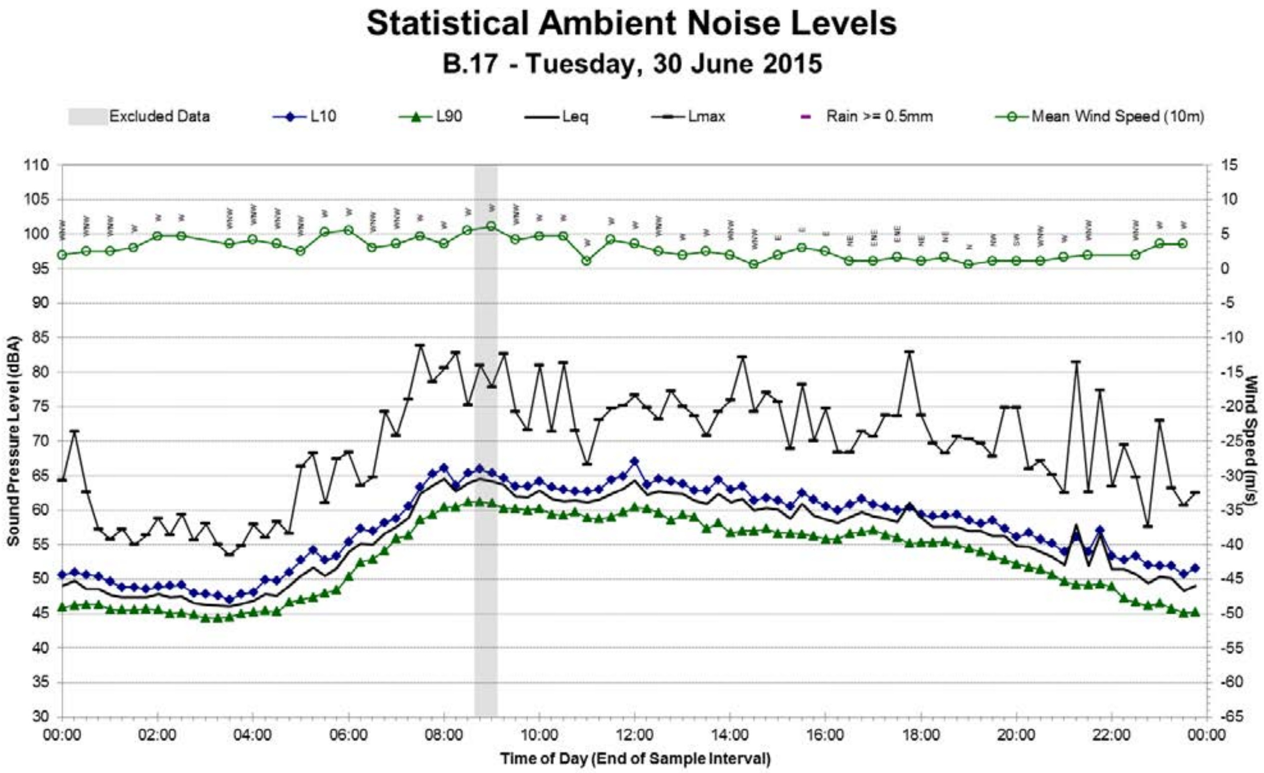


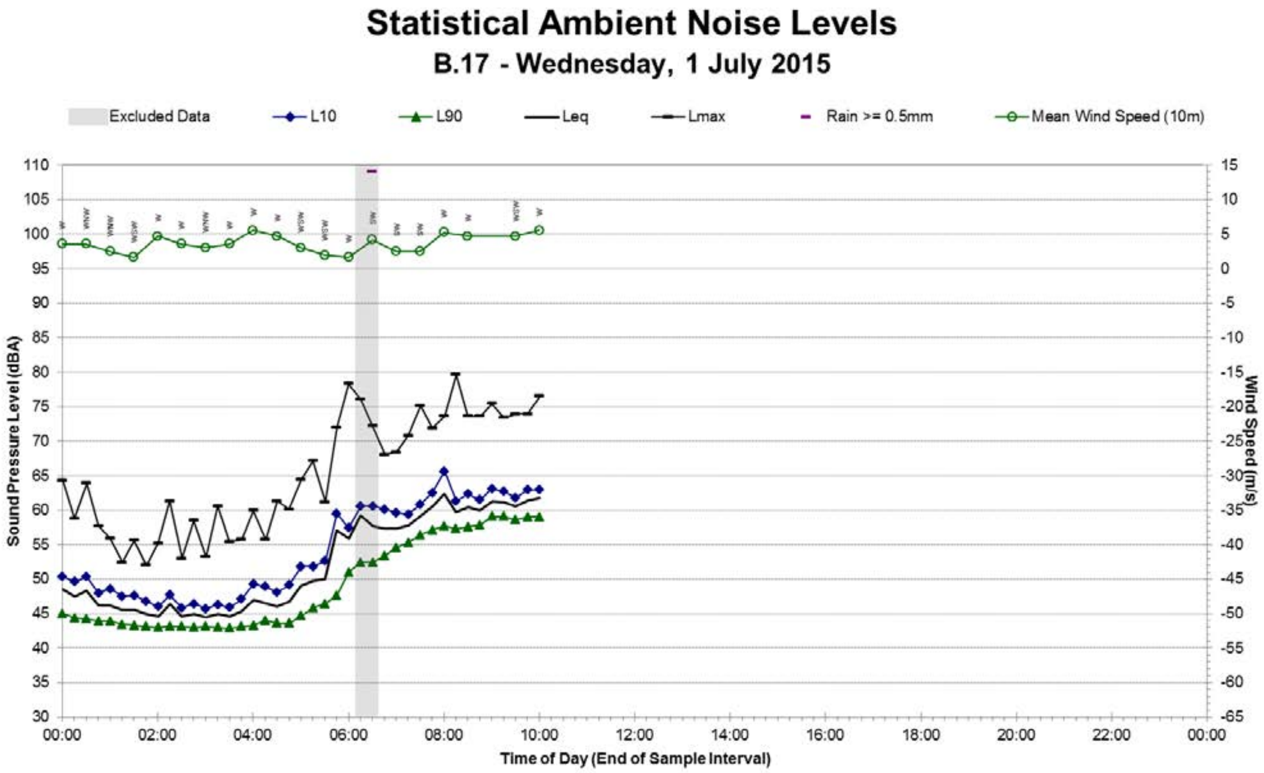
Background Noise Monitoring Results – B.17





Background Noise Monitoring Results – B.17





Background Noise Monitoring Results – B.18

Noise Monitoring Location:	**B.18**
Noise Monitoring Address:	**237 Miller Street, North Sydney 2060**

Logger Device Type: ARL-EL316
Logger Serial No: 16-306-047

Ambient noise logger deployed on the western wall of the pool area in residential apartment building 237 Miller Street, North Sydney.

Attended noise measurements indicate that the ambient noise environment at this location is dominated by road traffic noise from Miller Street and McLaren Street. Surrounding tree rustling (wind) contributed to the LA90 (background) noise level throughout, as well as the "city hum" which is constant in this section of North Sydney.

Map of Noise Monitoring Location

Ambient Noise Logging Results – INP Defined Time Periods

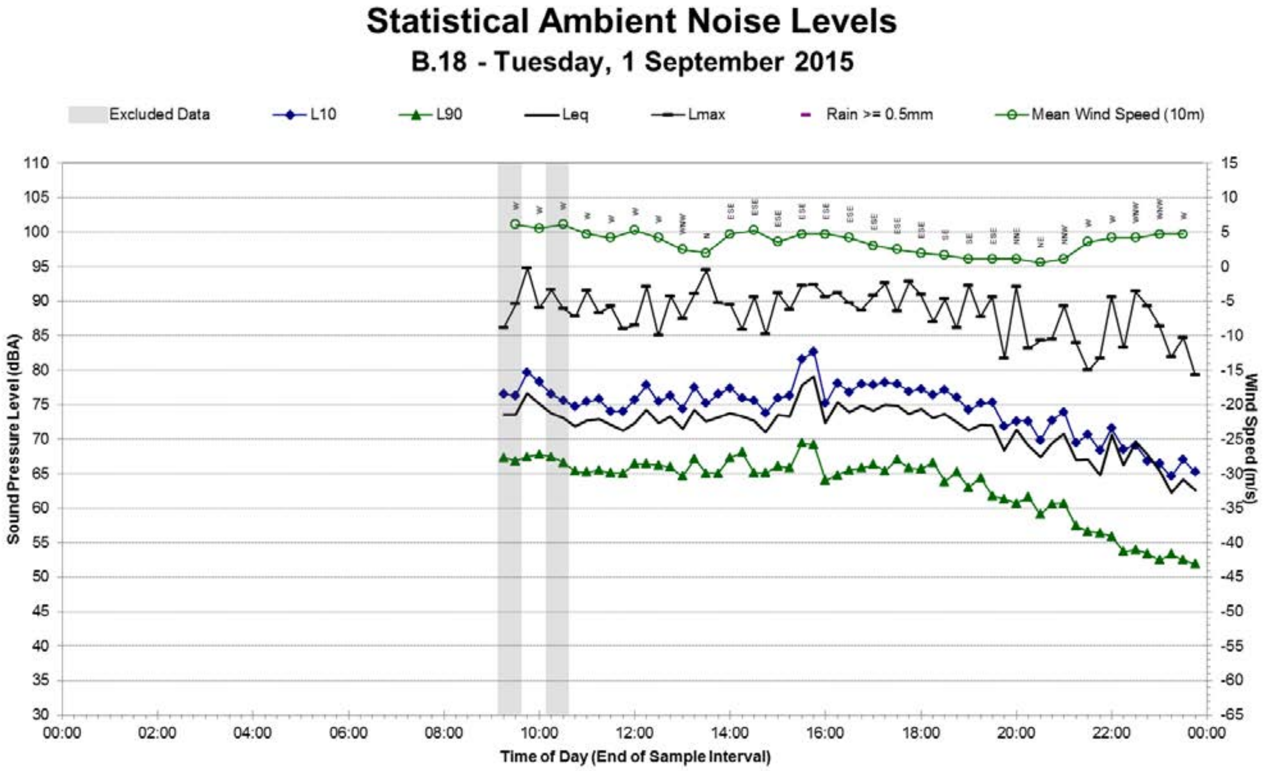
Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	65	74	76	83
Evening	57	71	72	81
Night-time	51	67	66	77

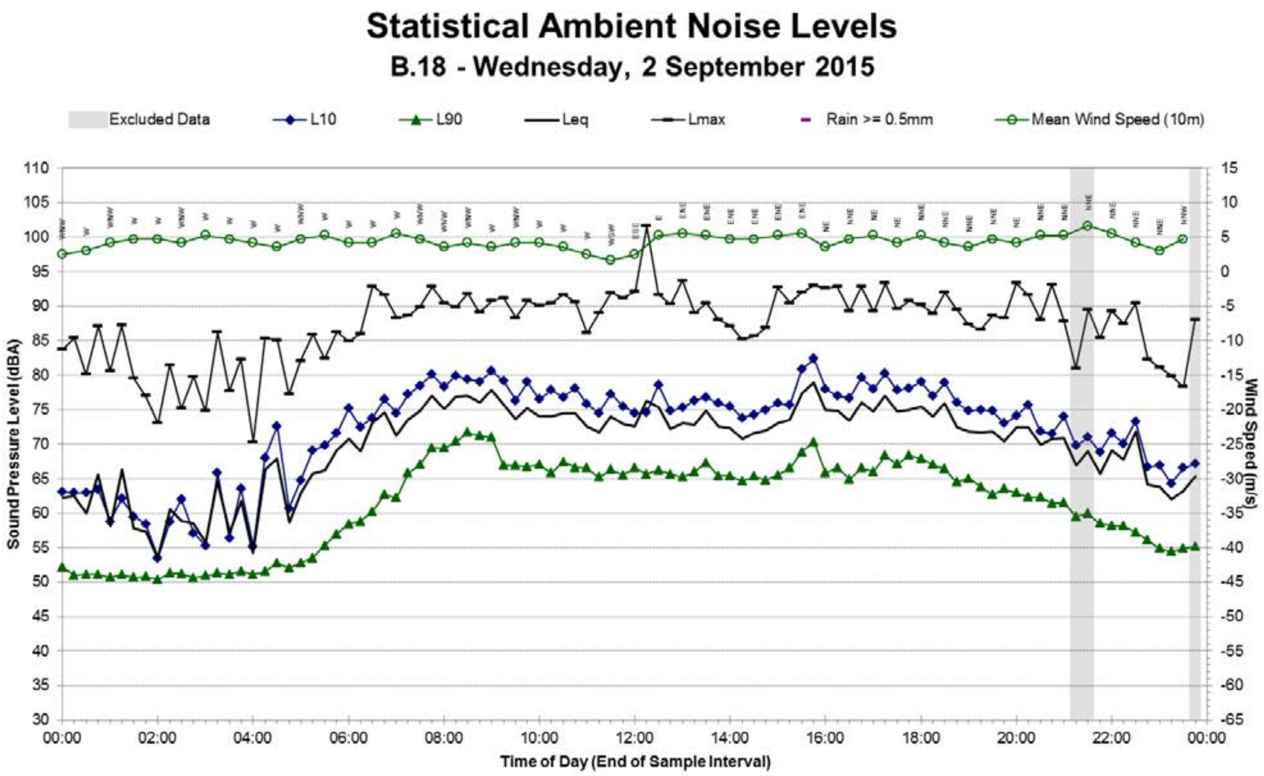
Attended Noise Measurement Results

Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
15/09/2015	09:53:07	59	72	96

Photo of Noise Monitoring Location

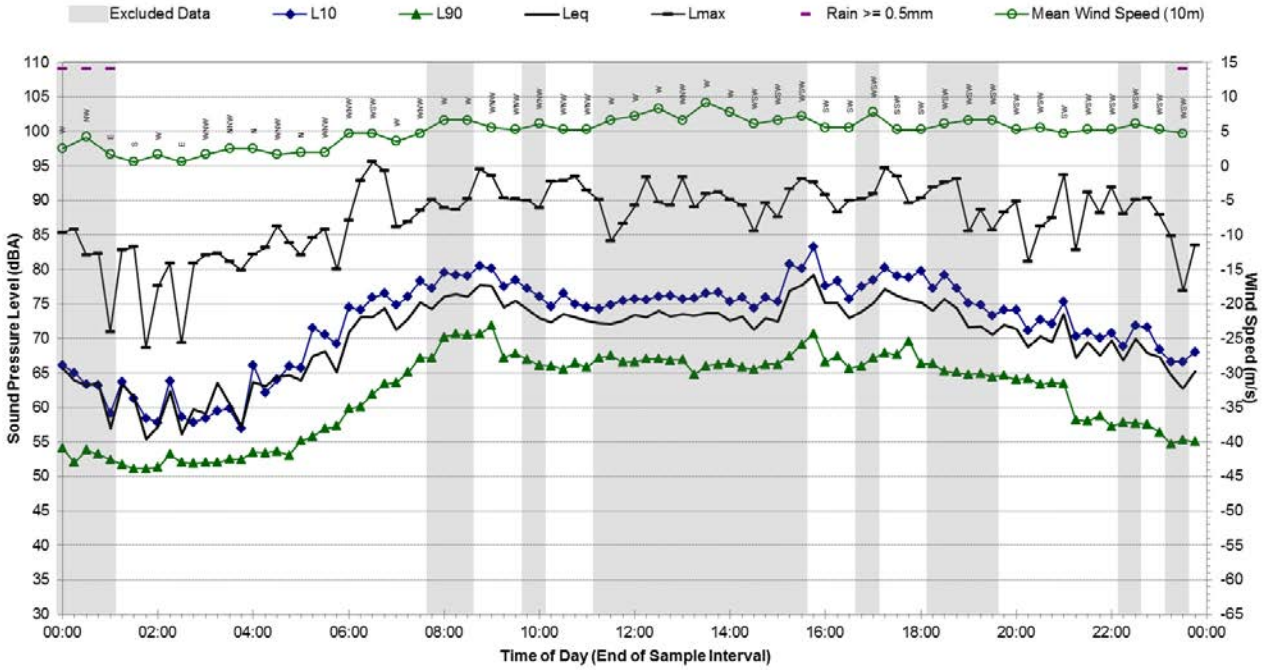
Background Noise Monitoring Results – B.18



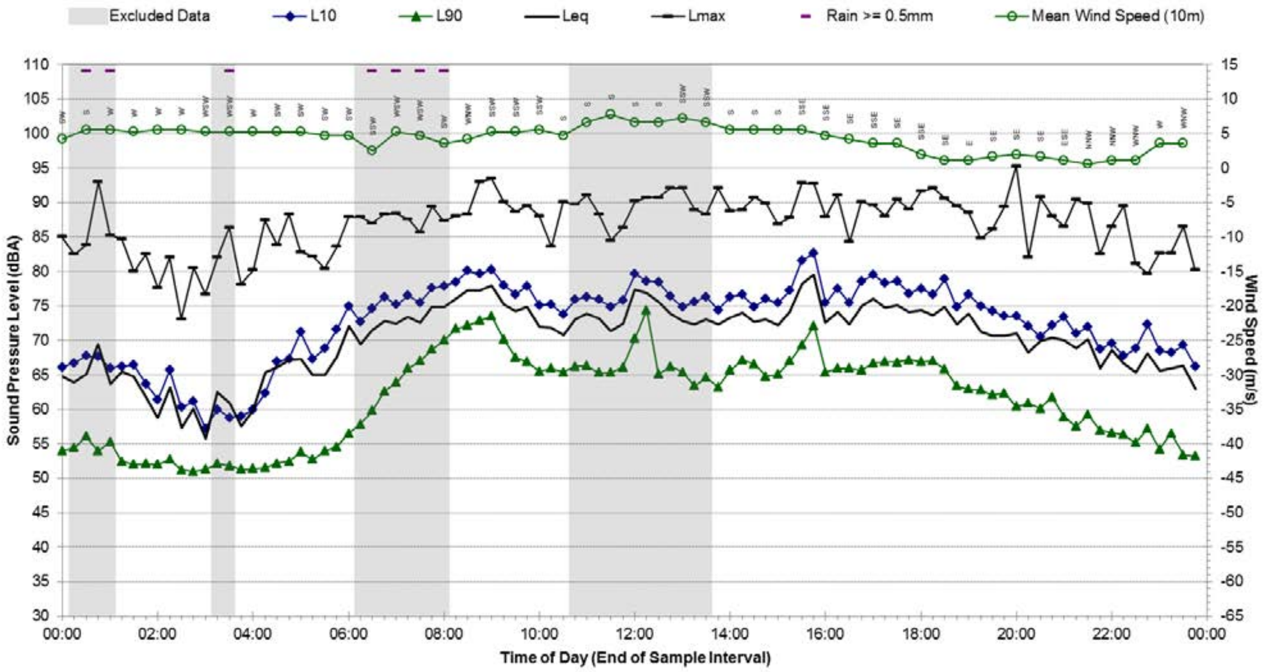


Background Noise Monitoring Results – B.18

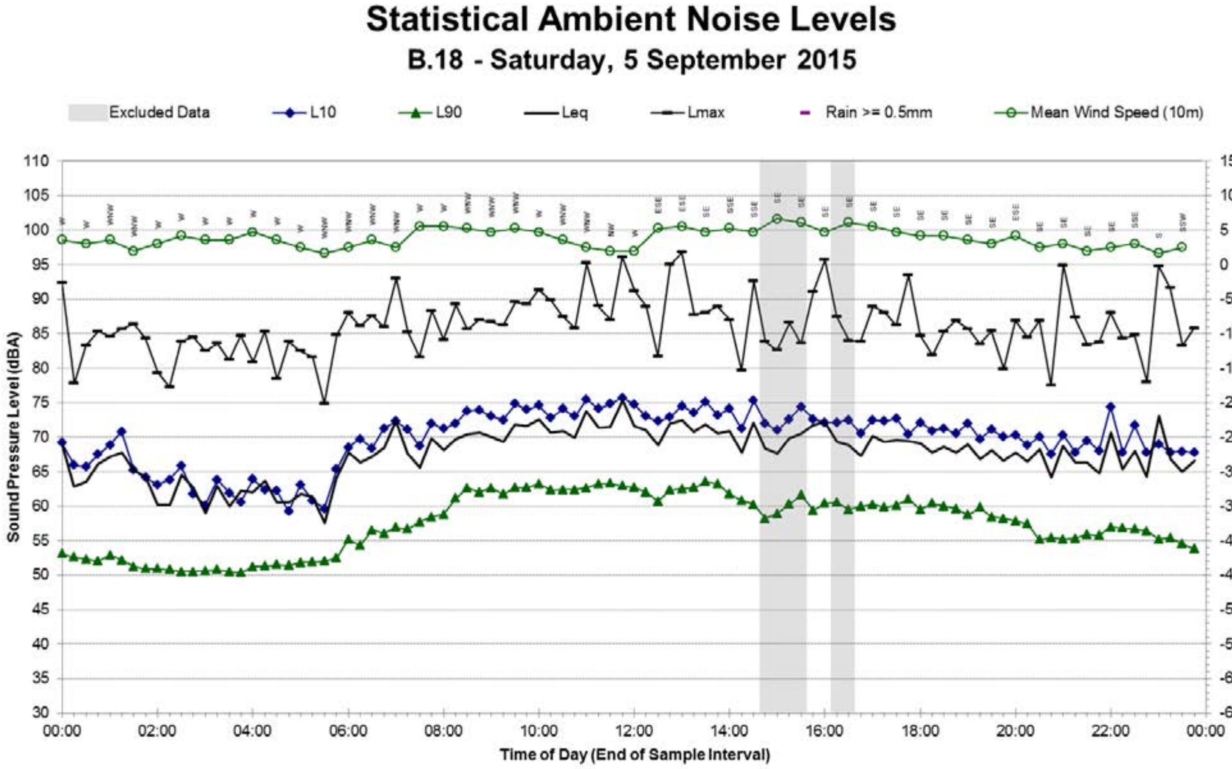
Statistical Ambient Noise Levels
B.18 - Thursday, 3 September 2015

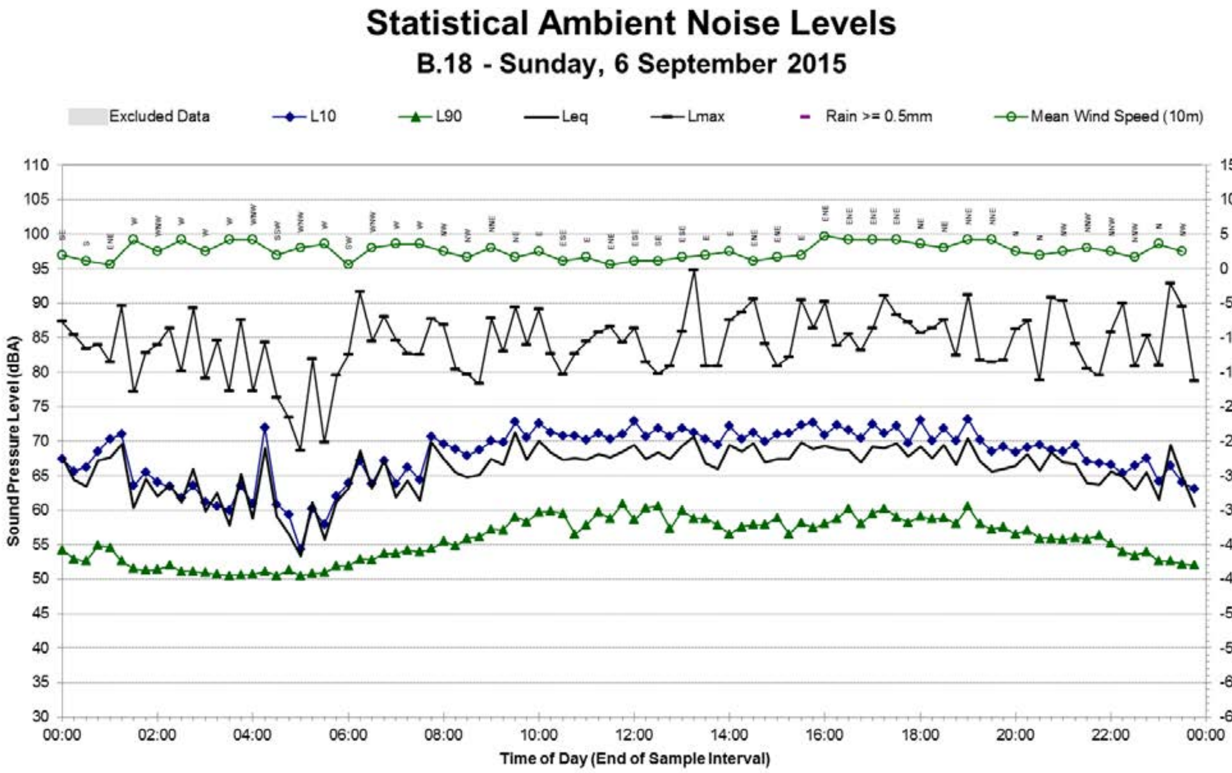


Statistical Ambient Noise Levels
B.18 - Friday, 4 September 2015

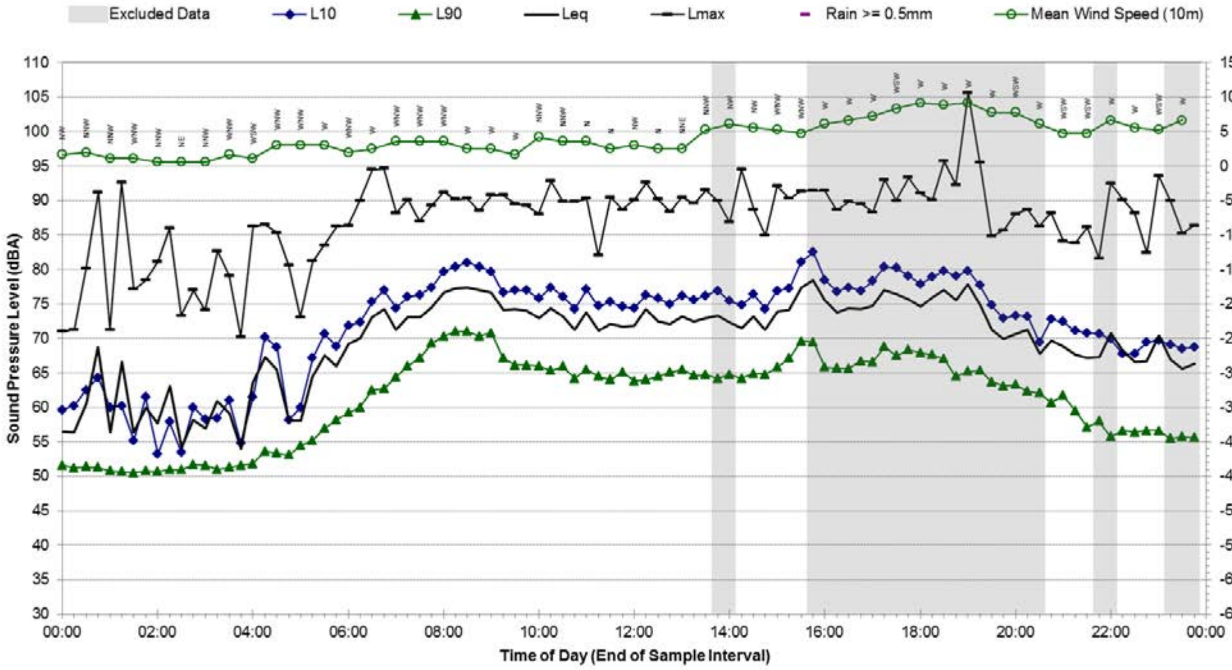


Background Noise Monitoring Results – B.18

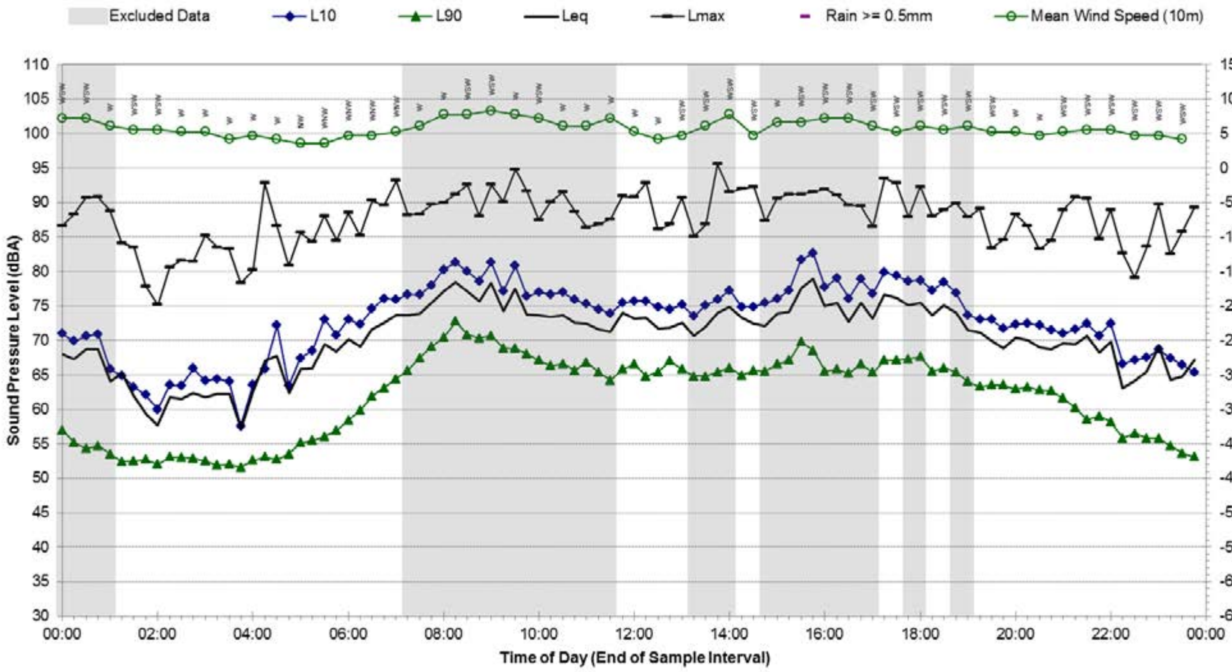




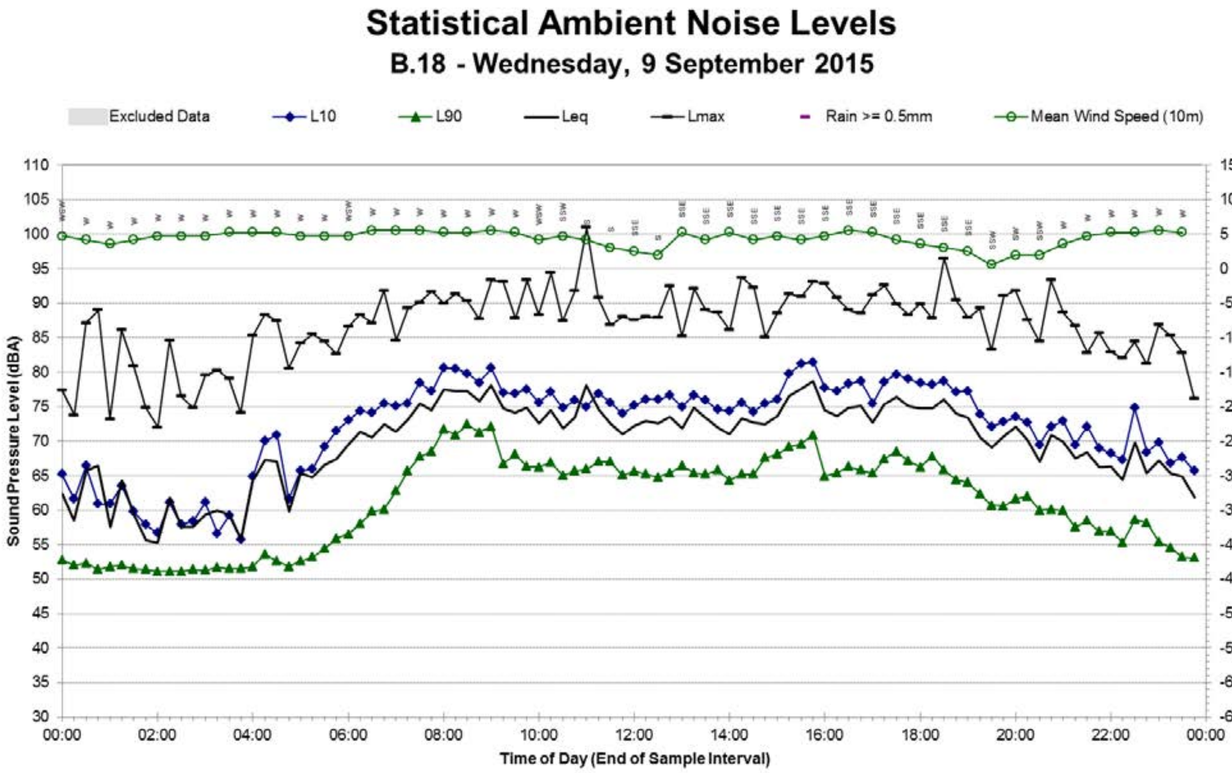
Statistical Ambient Noise Levels
B.18 - Monday, 7 September 2015

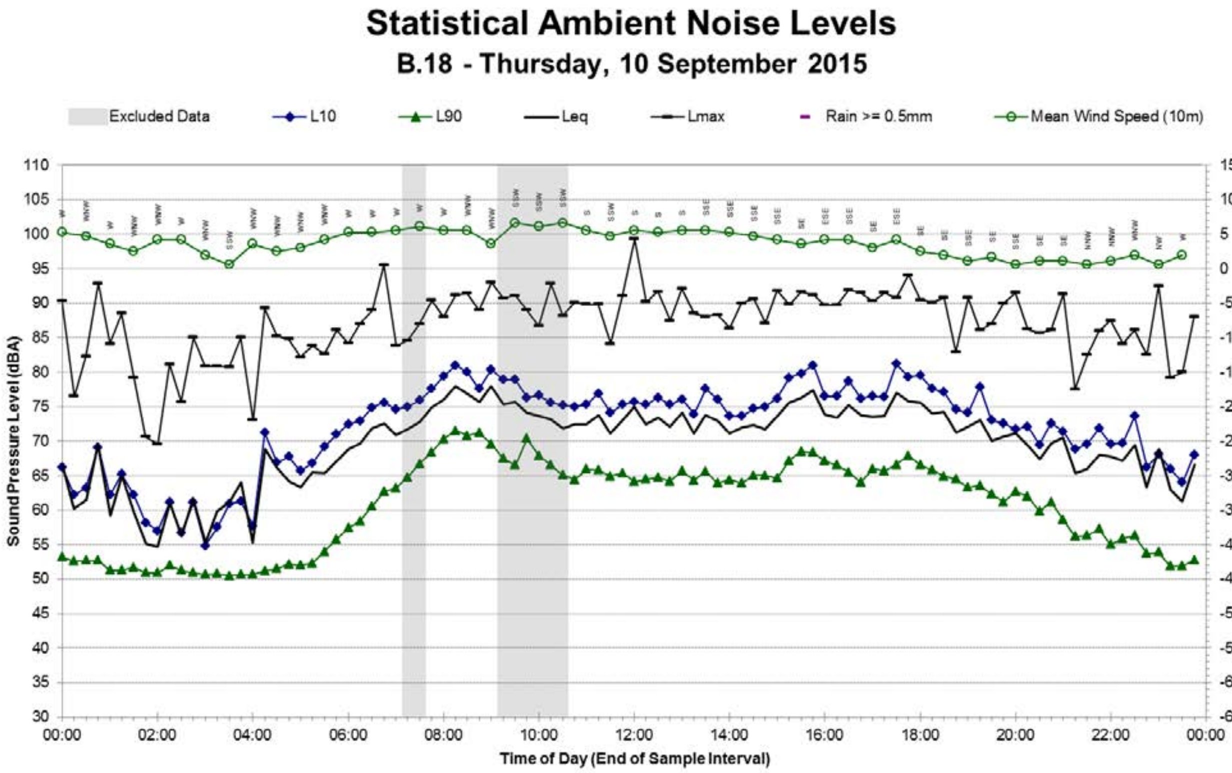


Statistical Ambient Noise Levels
B.18 - Tuesday, 8 September 2015

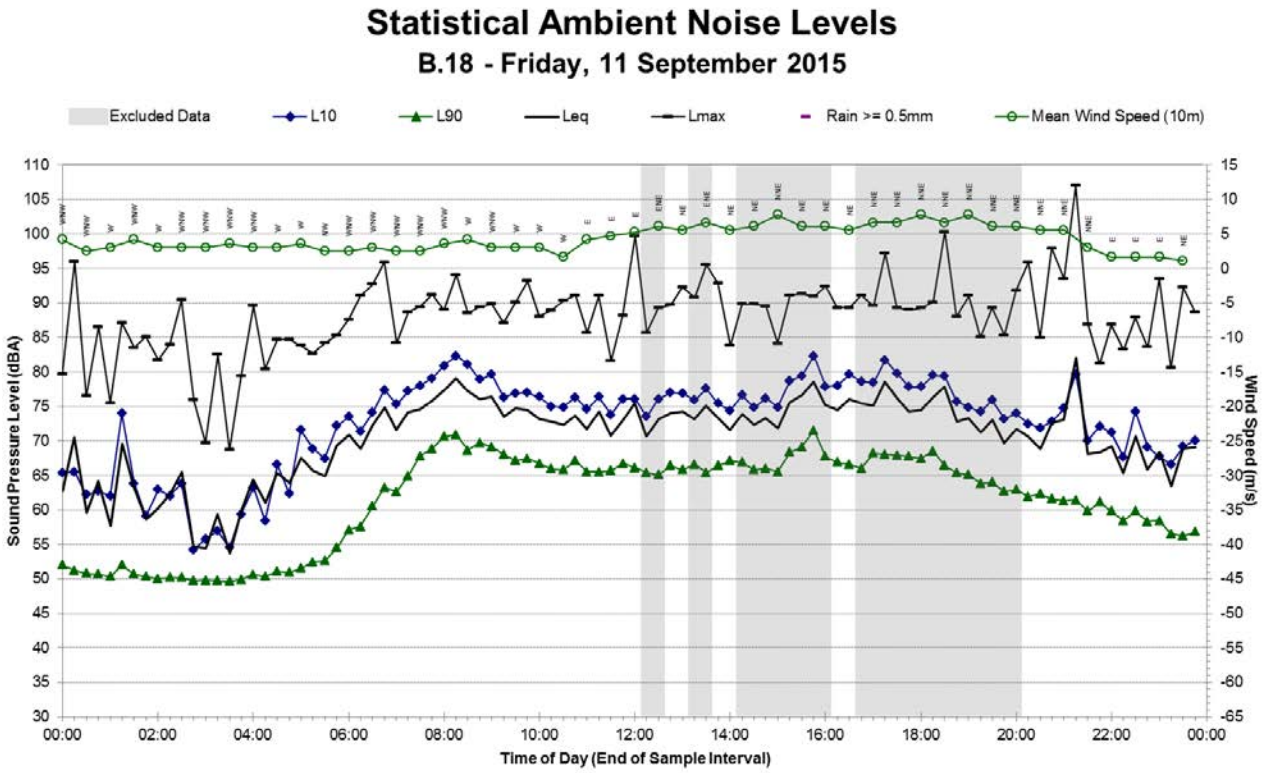


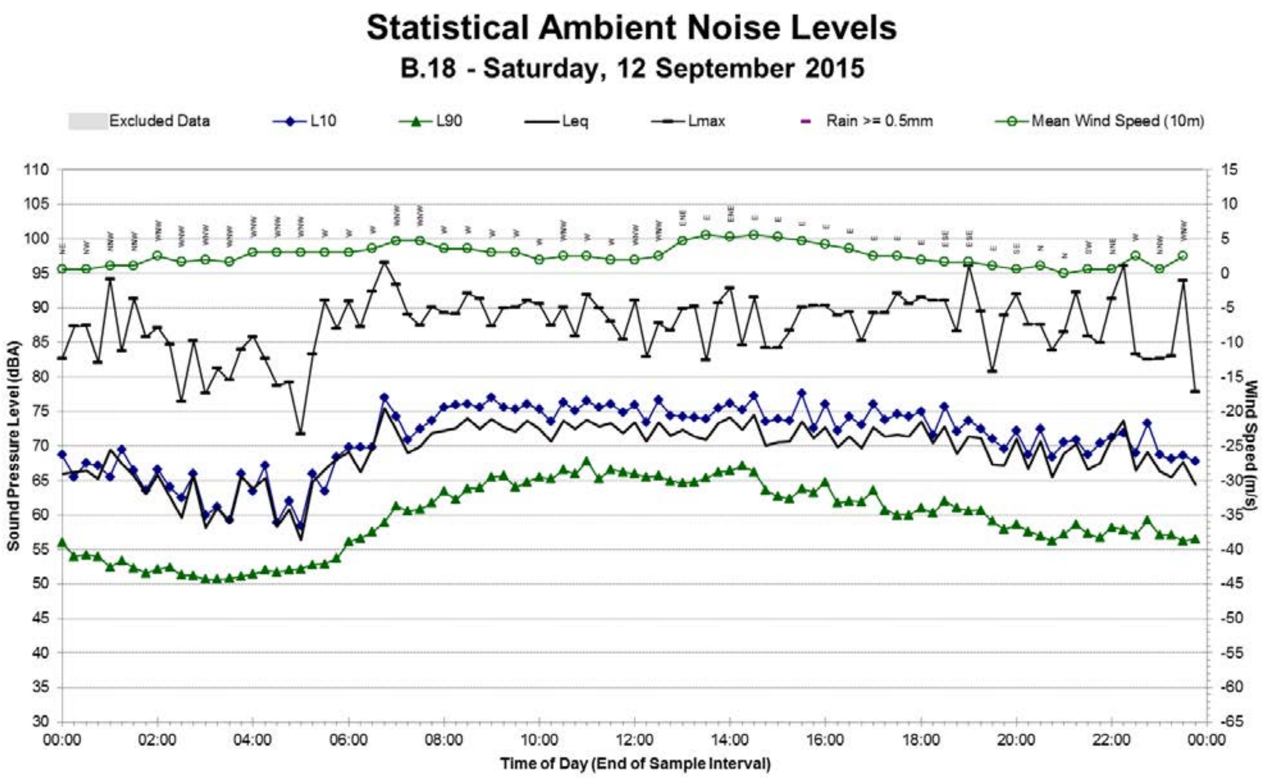
Background Noise Monitoring Results – B.18

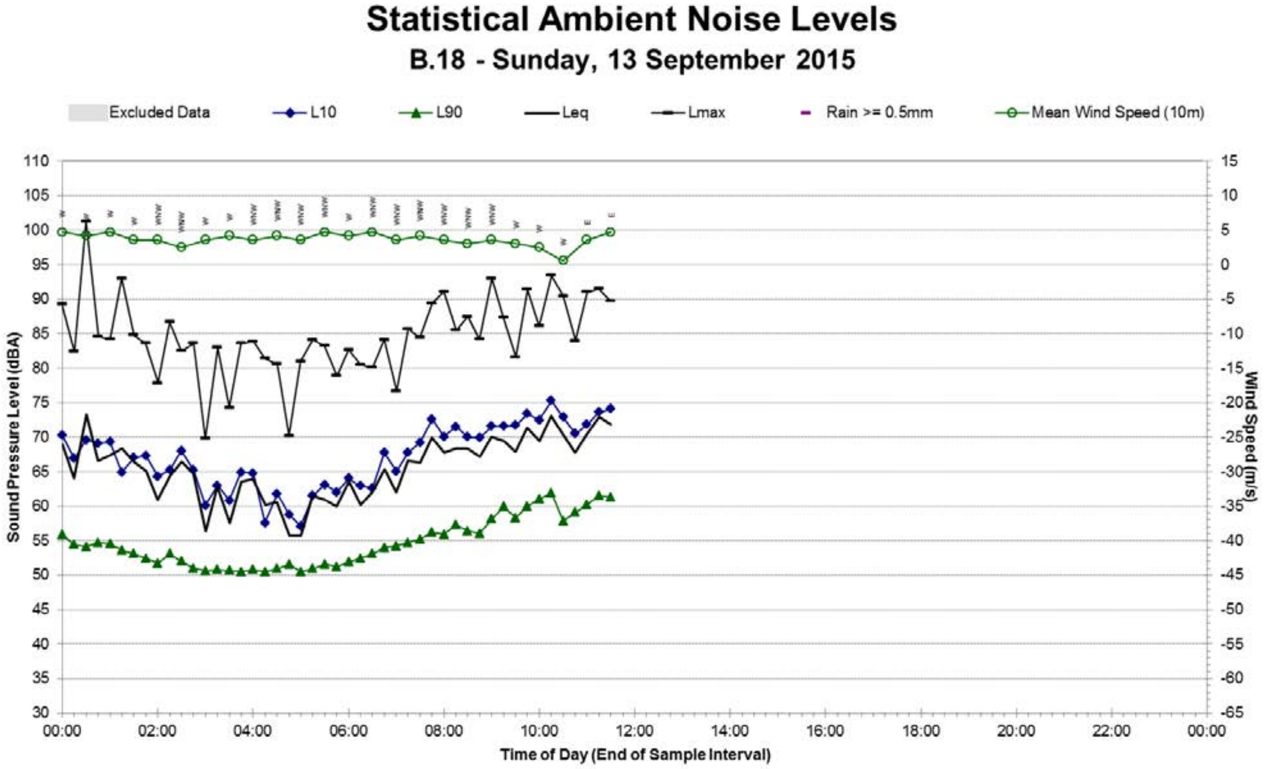




Background Noise Monitoring Results – B.18






Statistical Ambient Noise Levels
B.18 - Sunday, 13 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
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

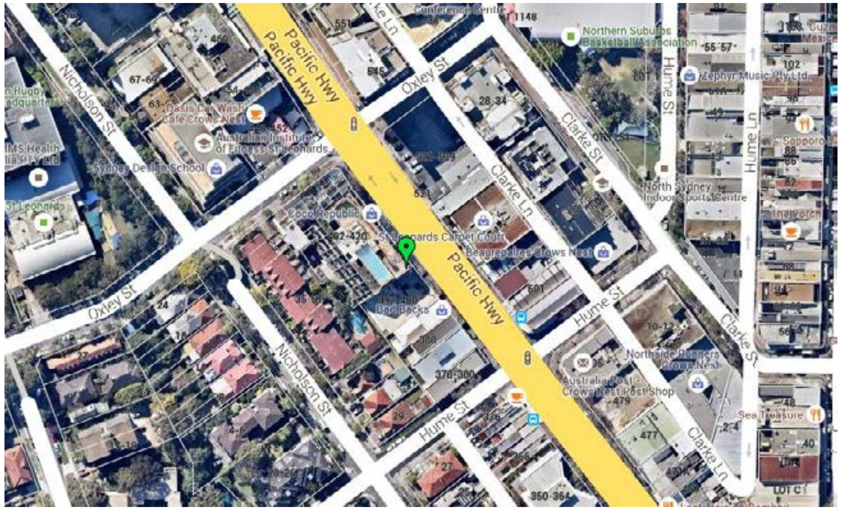
Noise Monitoring Location:	**B.19**
Noise Monitoring Address:	**420 Pacific Highway, Crows Nest 2065**

Logger Device Type: Svantek 957
Logger Serial No: 23241

Ambient noise logger deployed on the roof of 420 Pacific Highway, Crows Nest. Logger located on the north eastern facade with noise catchment over Pacific Highway below.

Attended noise measurements indicate that the ambient noise environment at this location is dominated by road traffic noise from Pacific Highway. Surrounding mechanical plant contributed to the LA90 (background) noise level throughout, as well as the constant road traffic along the main road below.

Map of Noise Monitoring Location



Ambient Noise Logging Results – INP Defined Time Periods

Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	59	68	70	74
Evening	55	67	68	72
Night-time	50	62	64	69

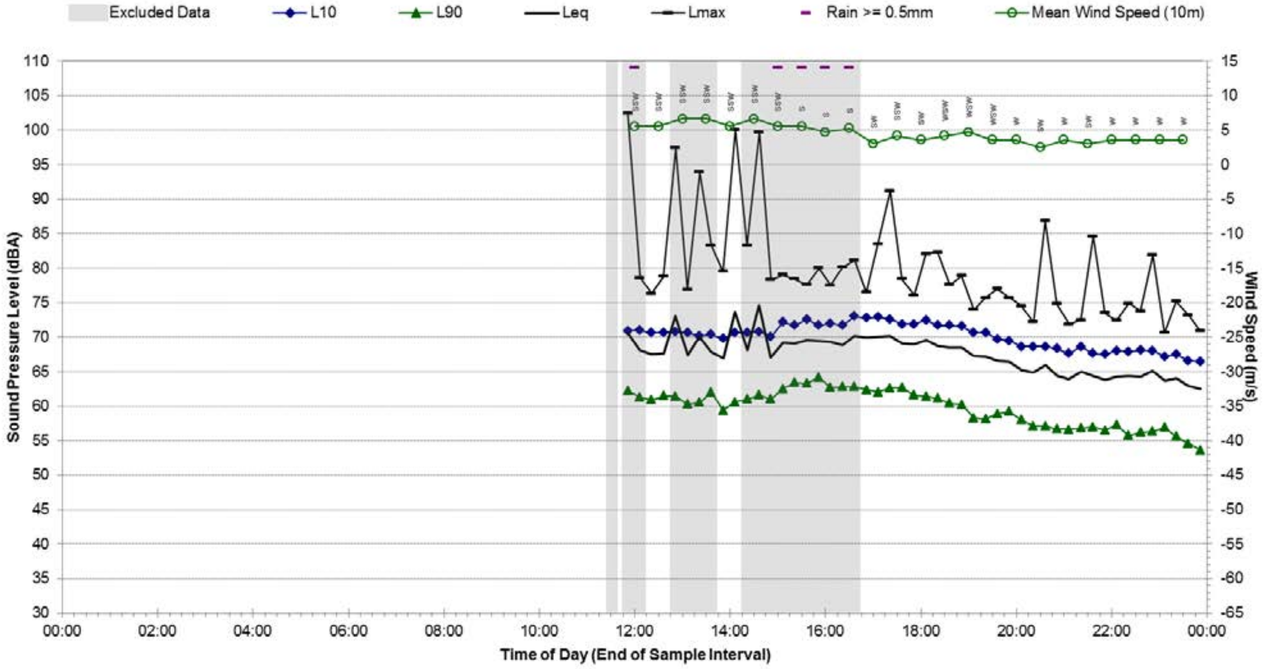
Attended Noise Measurement Results

Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
19/06/2015	11:39:56	62	67	78

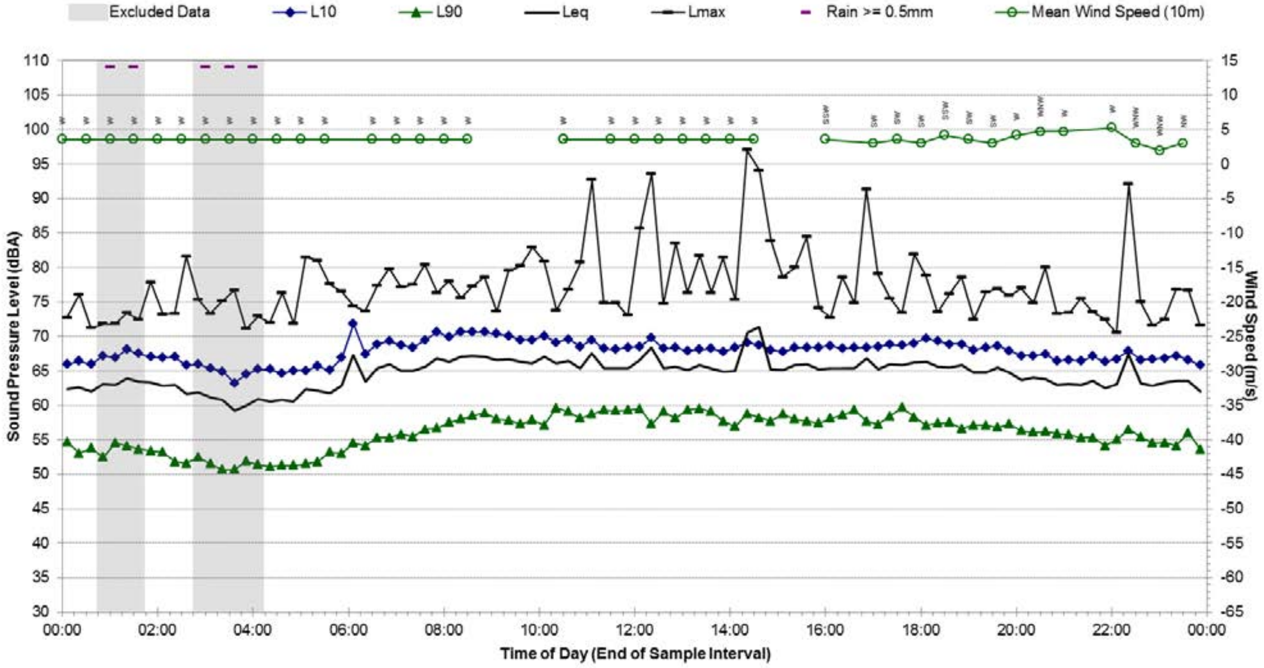
Photo of Noise Monitoring Location

Background Noise Monitoring Results – B.19

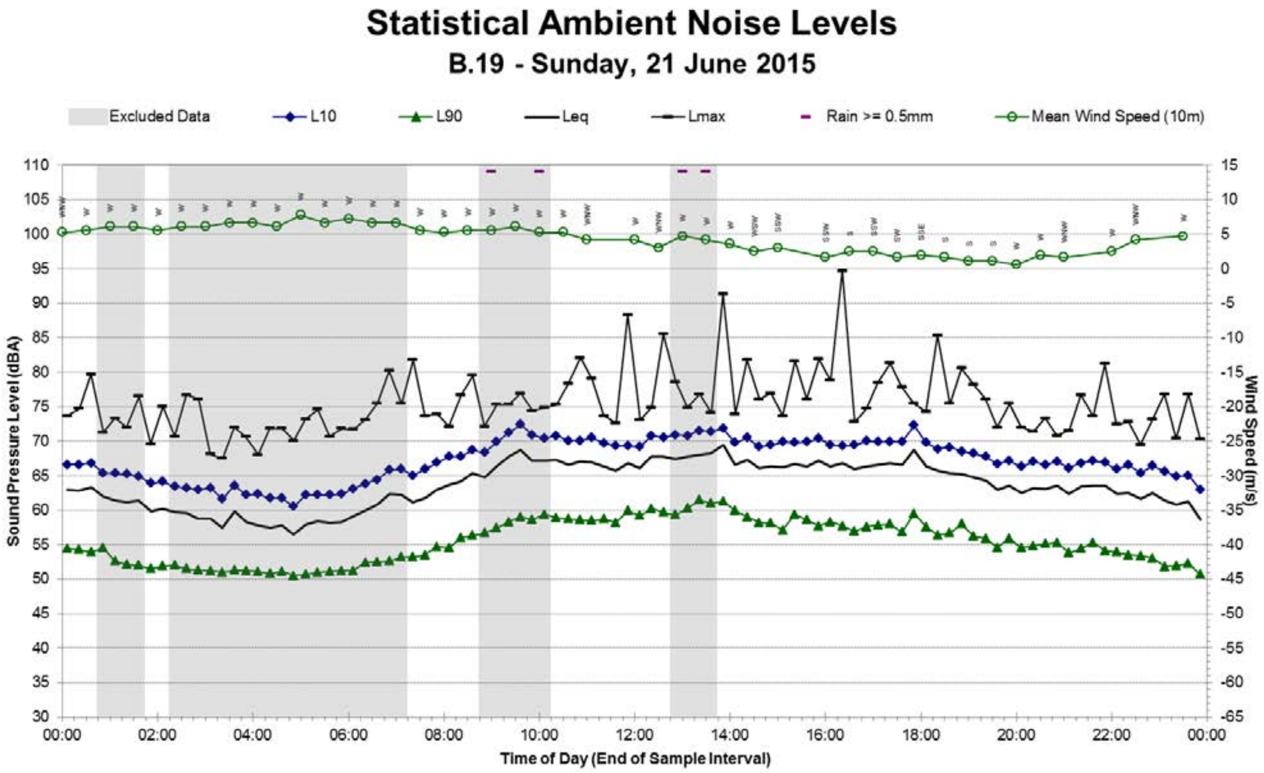
Statistical Ambient Noise Levels
B.19 - Friday, 19 June 2015

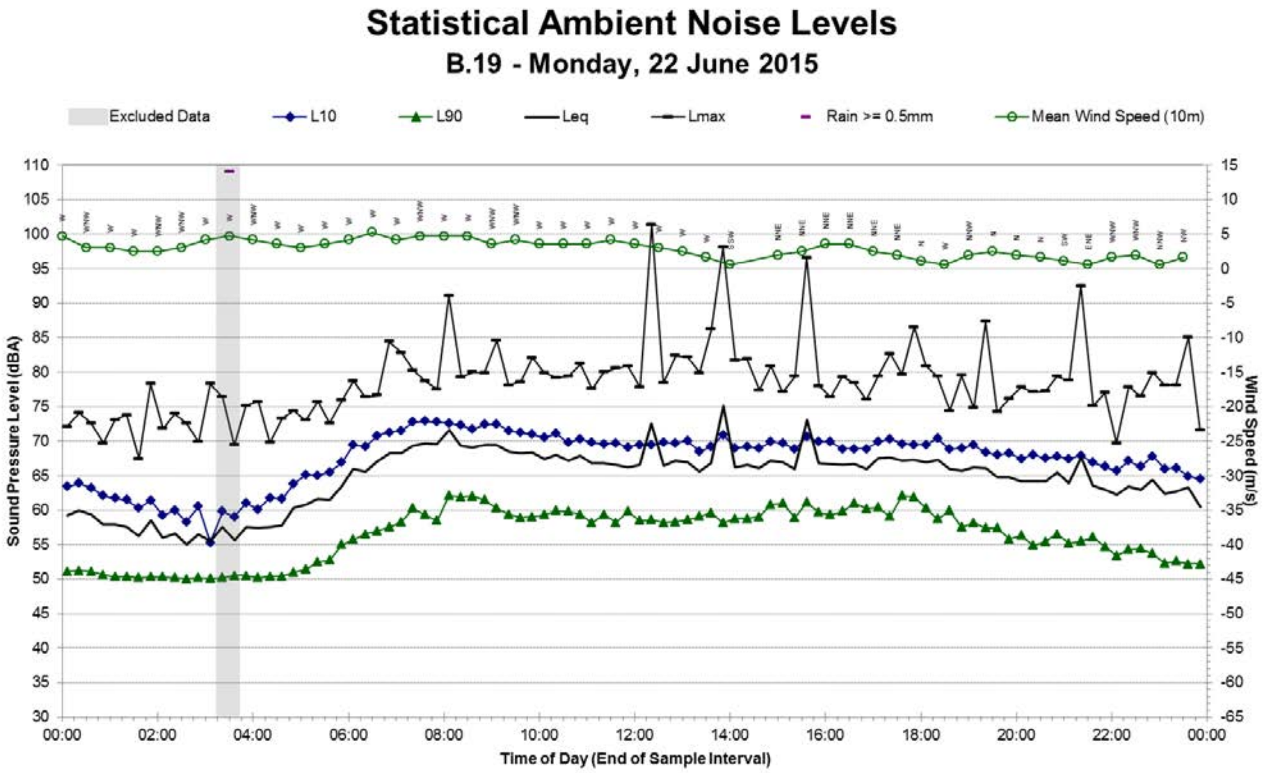


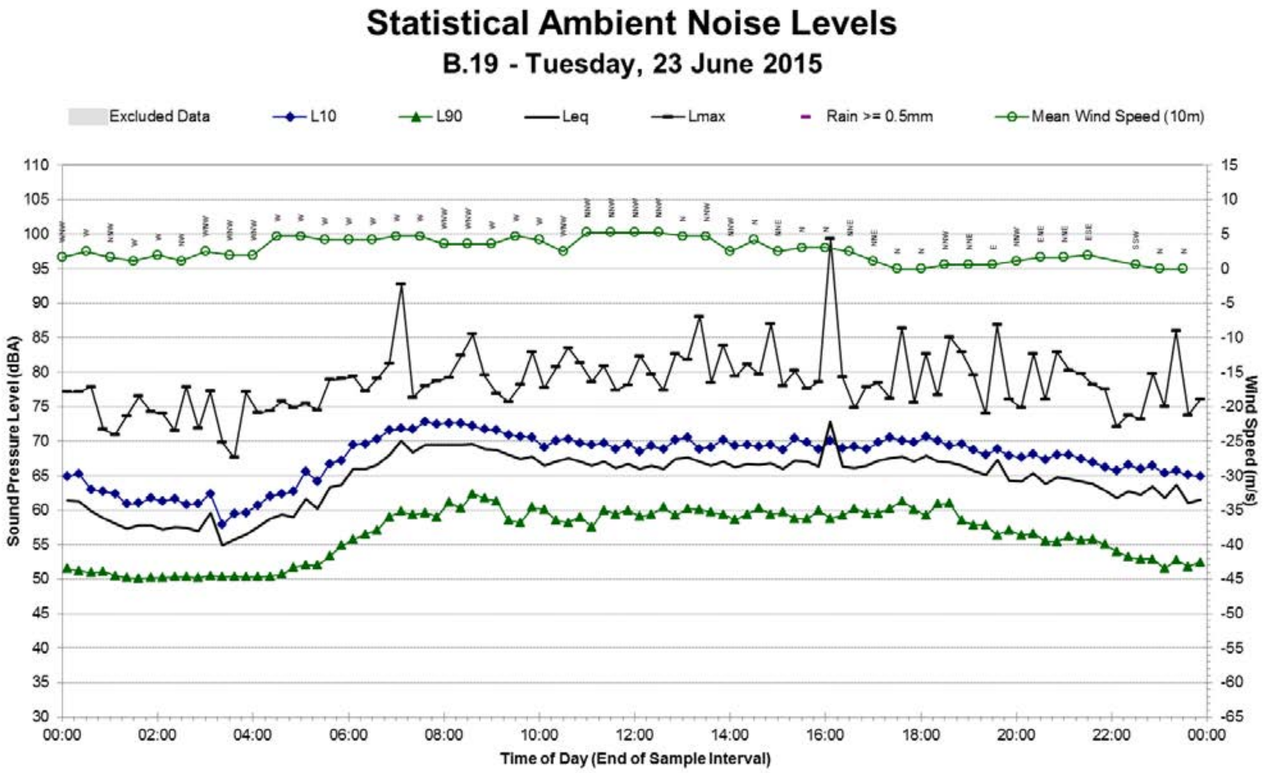
Statistical Ambient Noise Levels
B.19 - Saturday, 20 June 2015

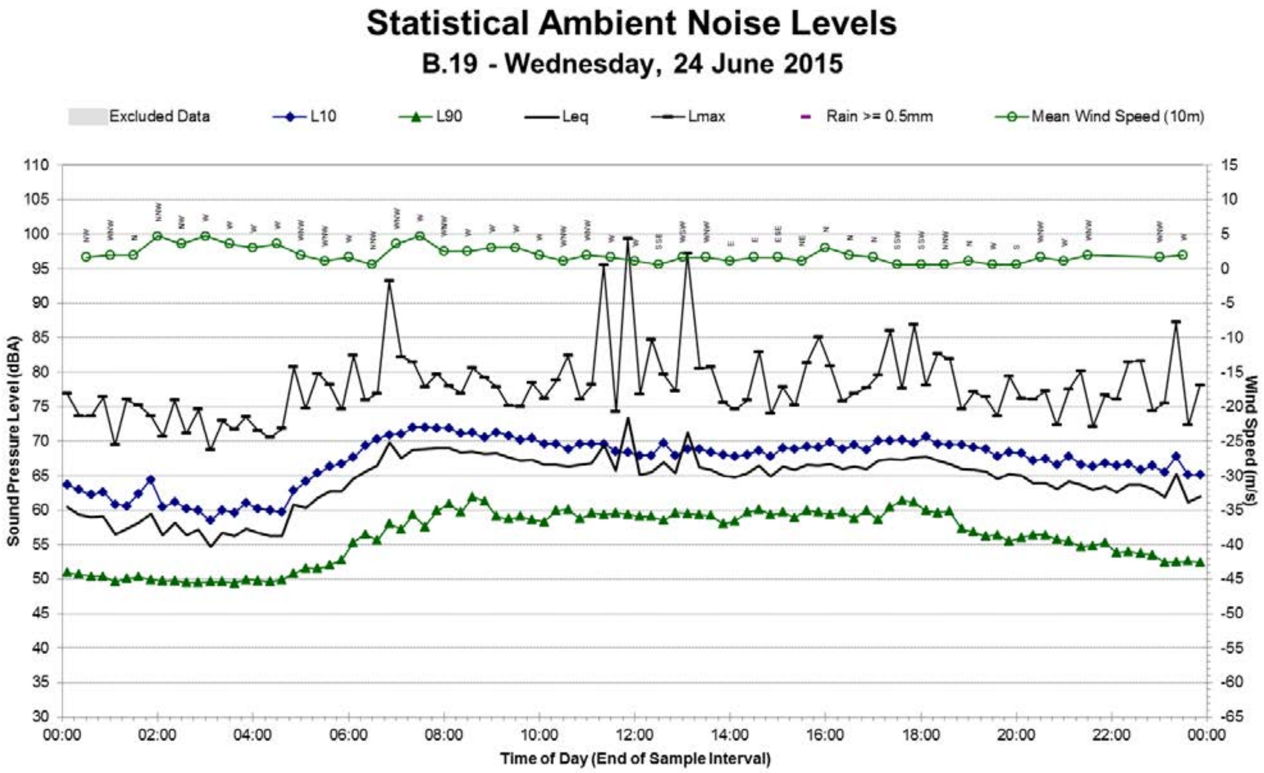


Background Noise Monitoring Results – B.19



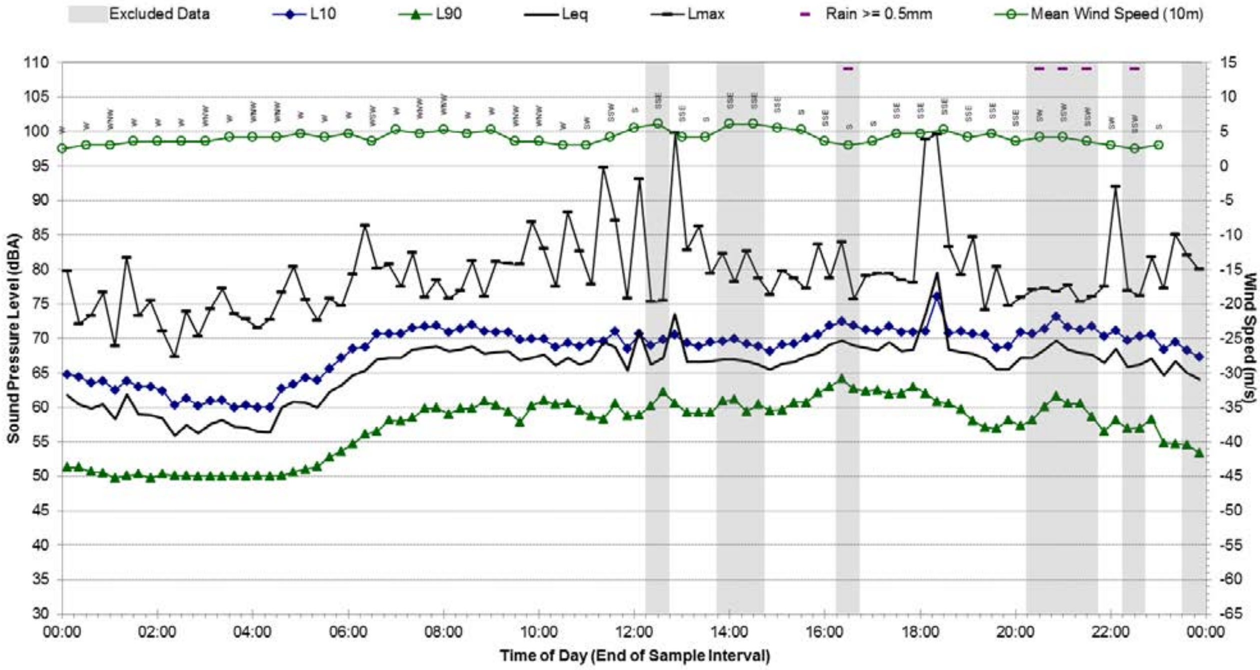



Statistical Ambient Noise Levels
B.19 - Tuesday, 23 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

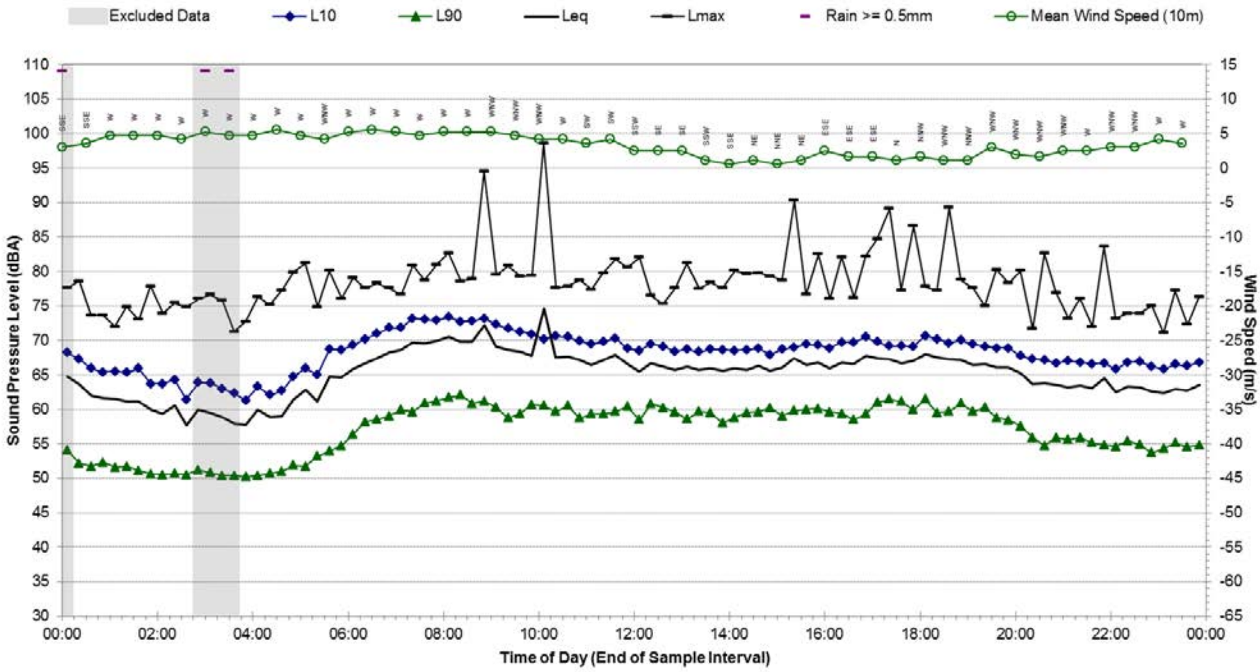

Statistical Ambient Noise Levels
B.19 - Wednesday, 24 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Background Noise Monitoring Results – B.19

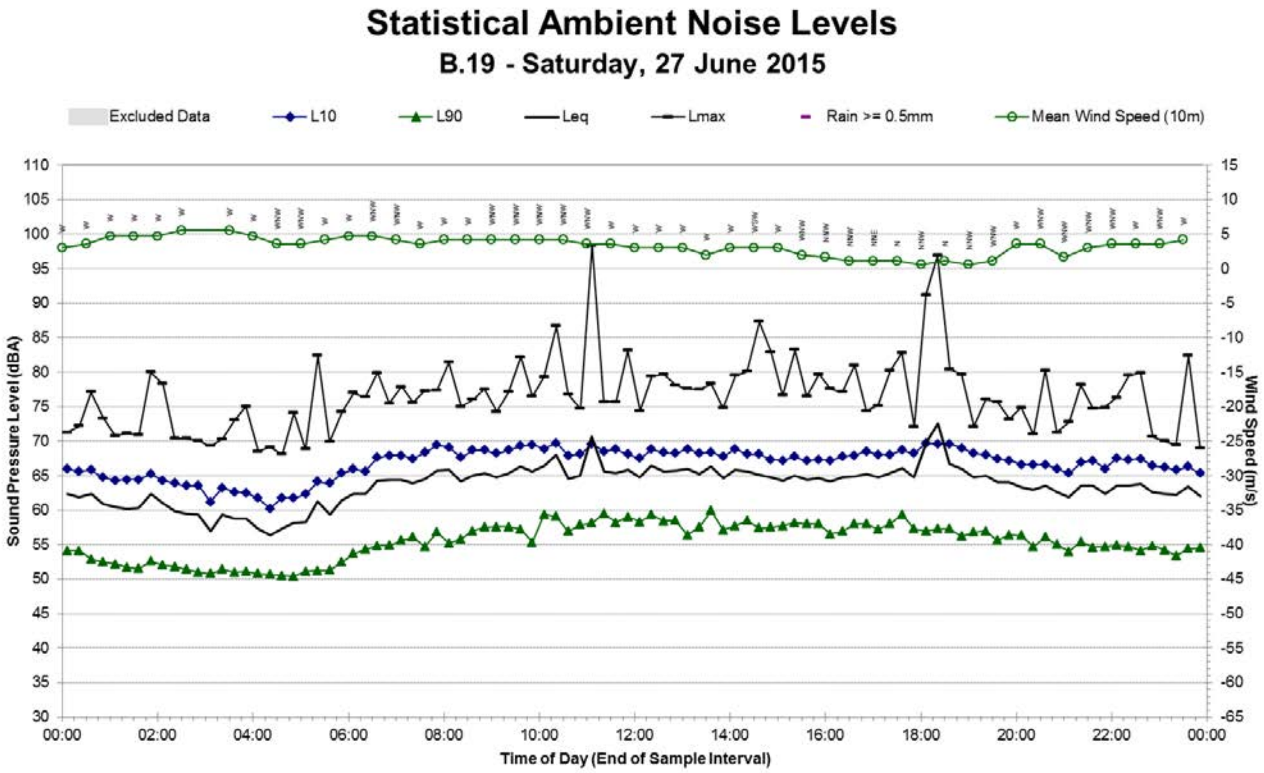
Statistical Ambient Noise Levels
B.19 - Thursday, 25 June 2015

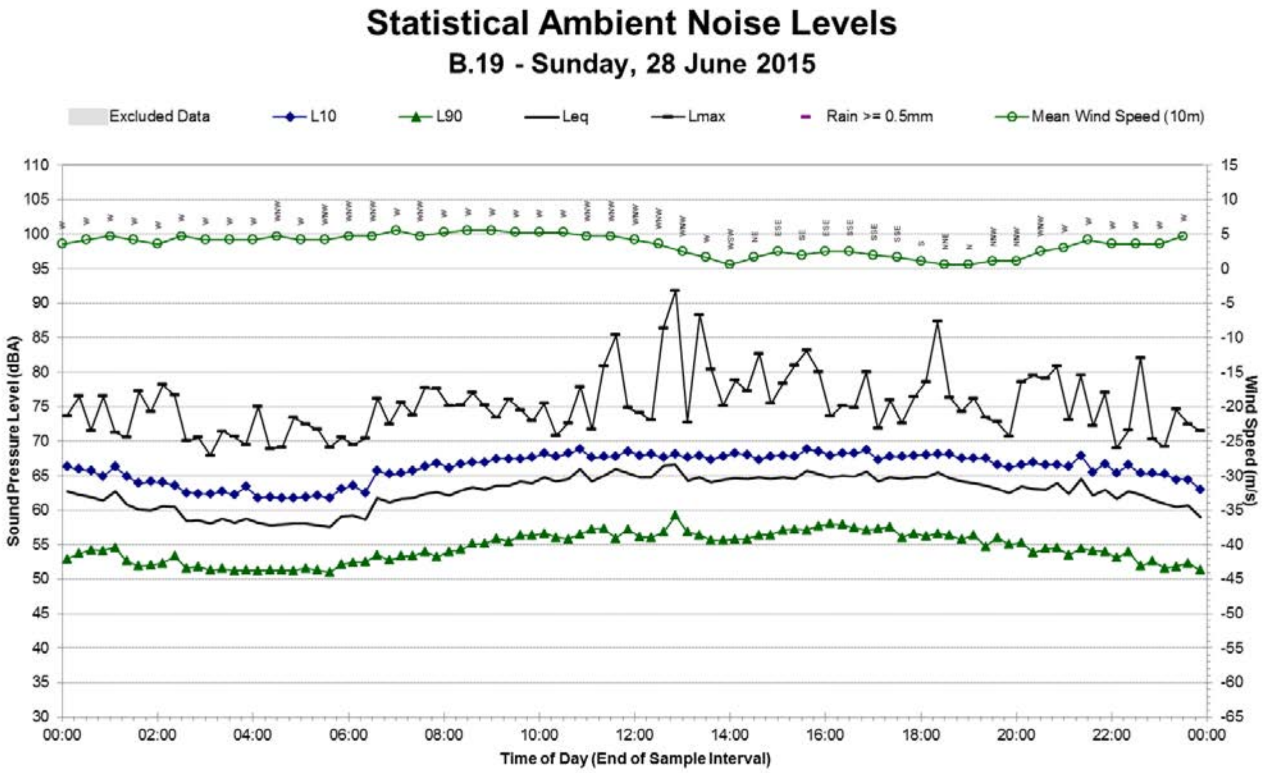


Statistical Ambient Noise Levels
B.19 - Friday, 26 June 2015

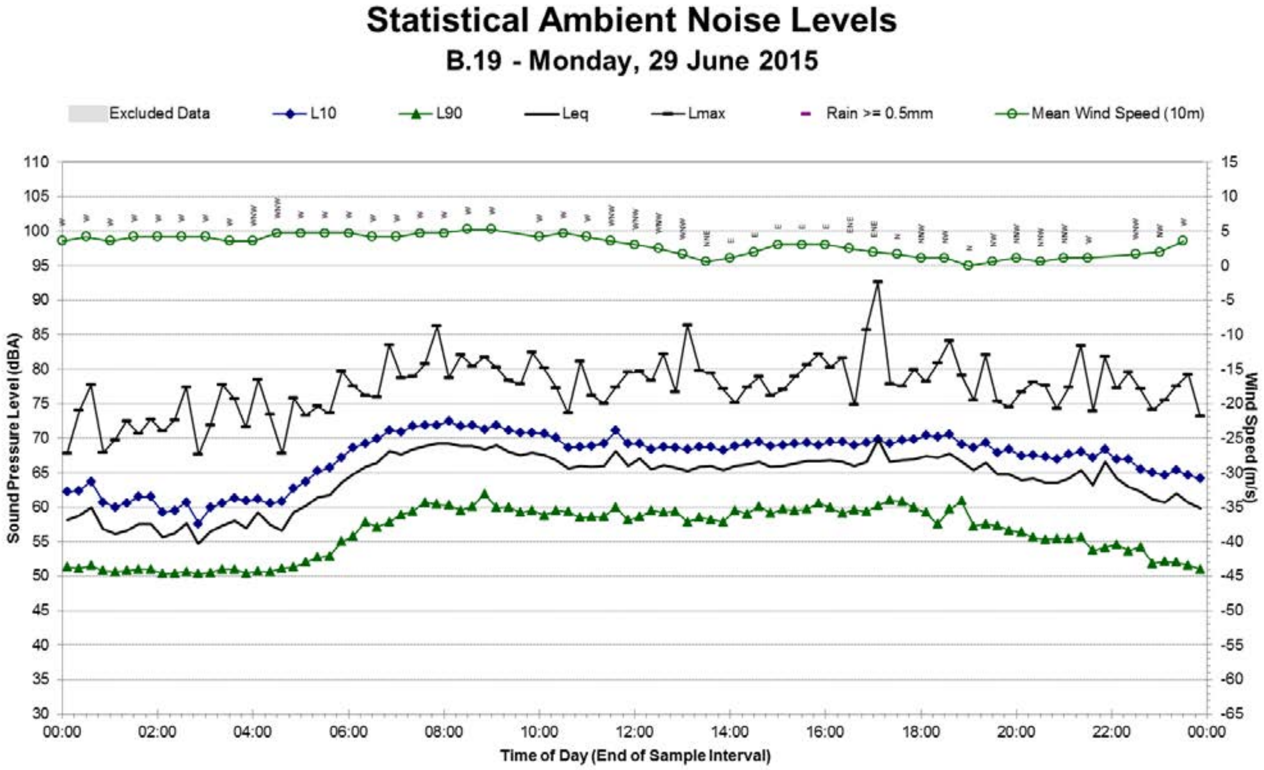


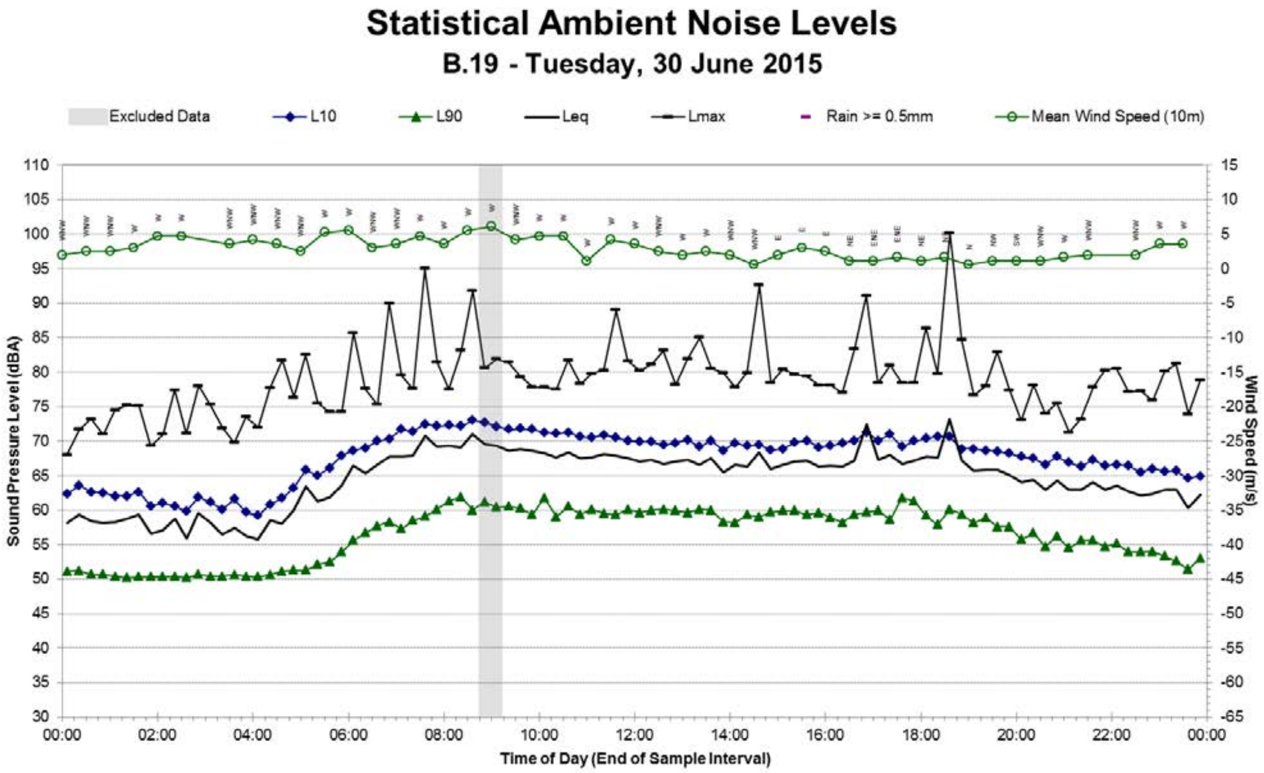
Background Noise Monitoring Results – B.19



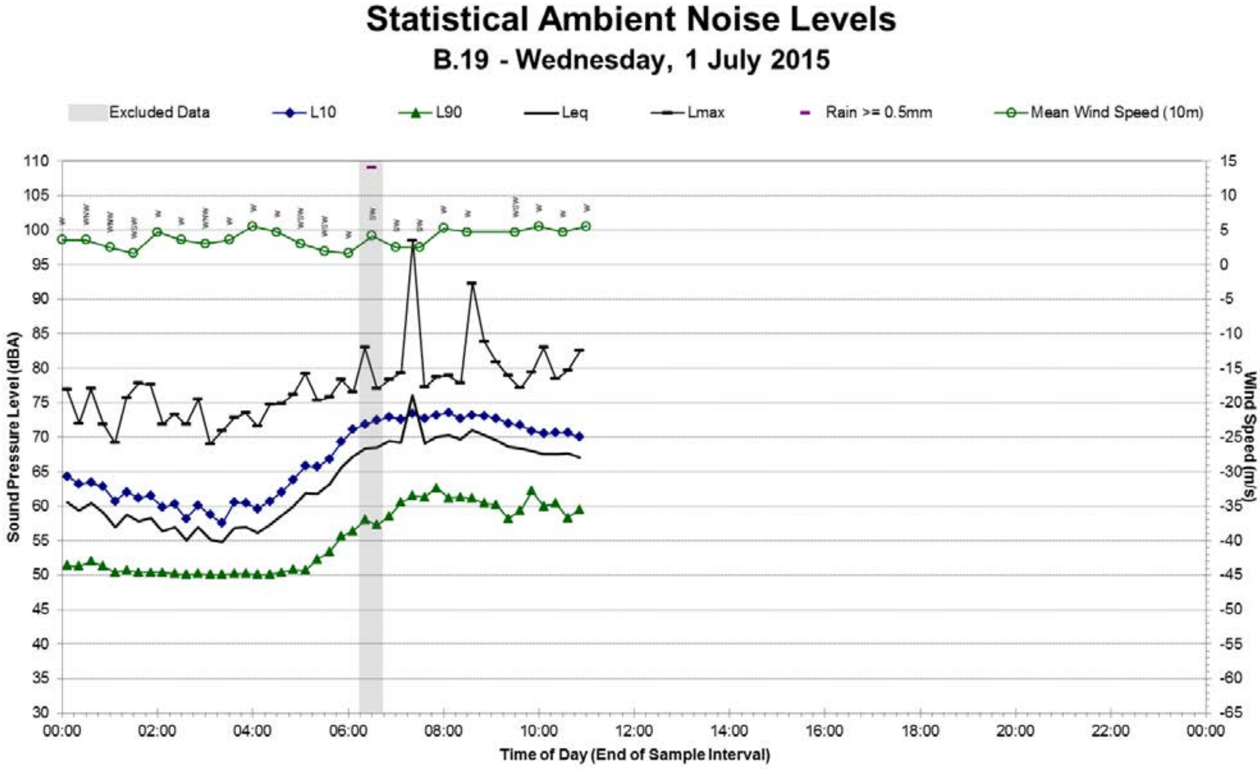


Background Noise Monitoring Results – B.19





Background Noise Monitoring Results – B.19



Background Noise Monitoring Results – B.20

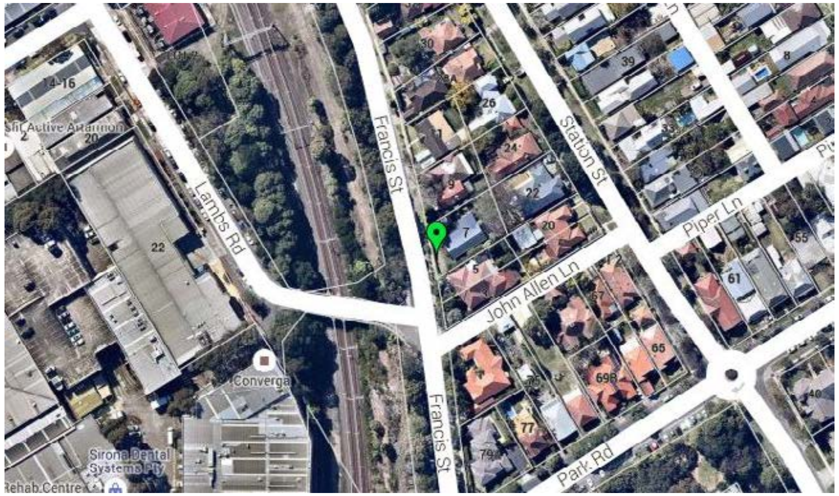
Noise Monitoring Location:	**B.20**
Noise Monitoring Address:	**7 Francis Street, Naremburn 2065**

Logger Device Type: Svantek 957
Logger Serial No: 23241

Ambient noise logger deployed in the front yard of residential address 7 Francis Street, Naremburn.

Attended noise measurements indicate that there are few road traffic noise sources contributing to the background noise environment at this location..

Map of Noise Monitoring Location



Ambient Noise Logging Results – INP Defined Time Periods

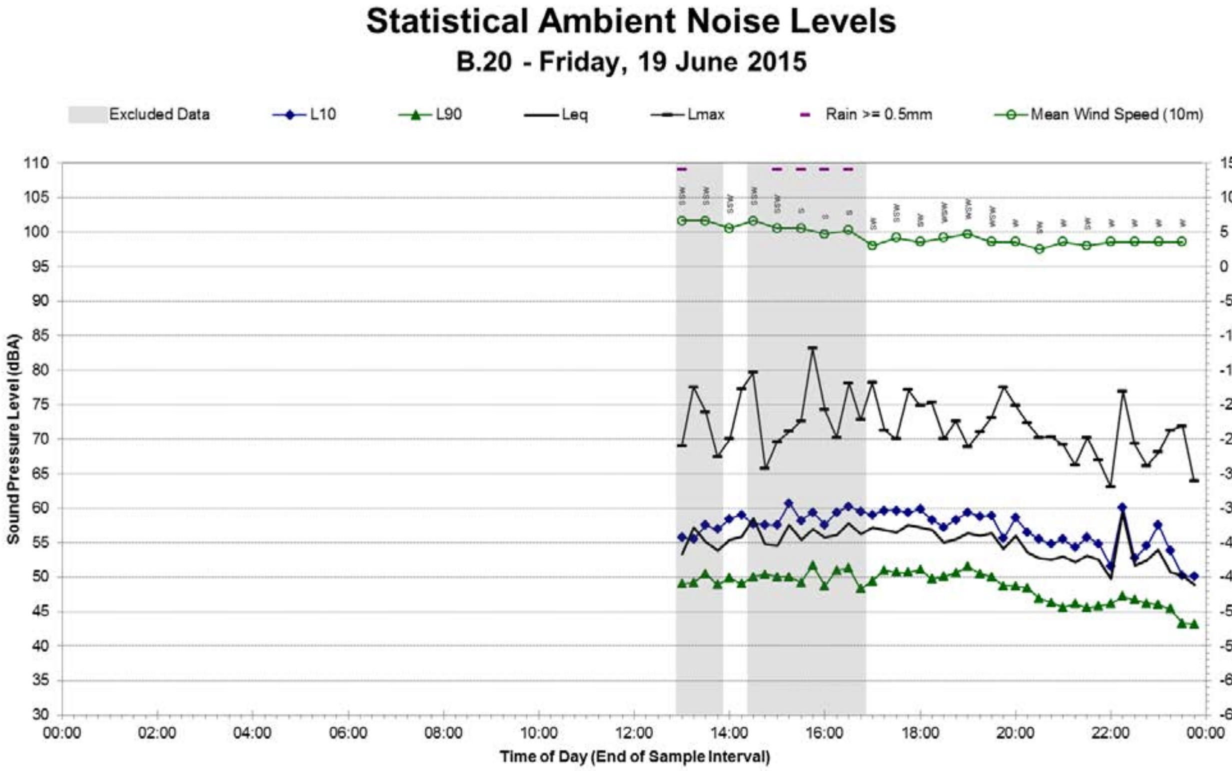
Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	45	56	58	64
Evening	46	54	56	63
Night-time	38	50	48	59

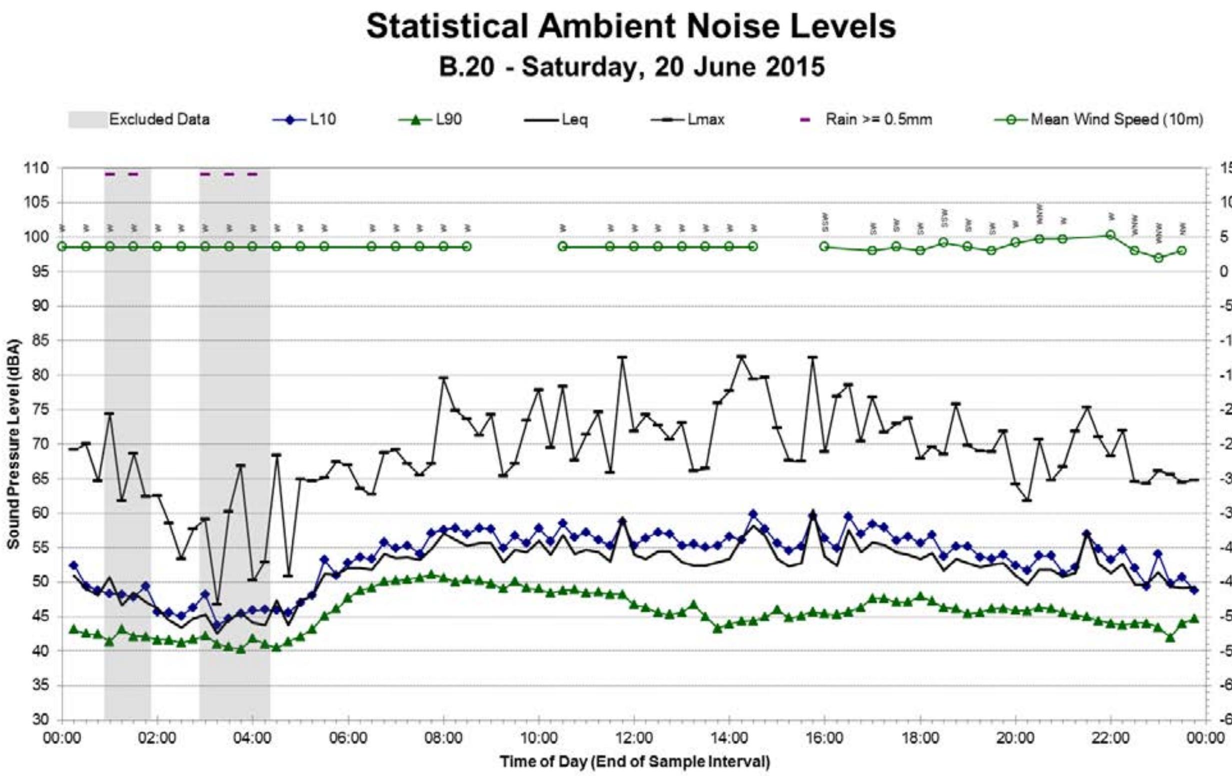
Attended Noise Measurement Results

Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
19/06/2015	12:35:47	51	54	71

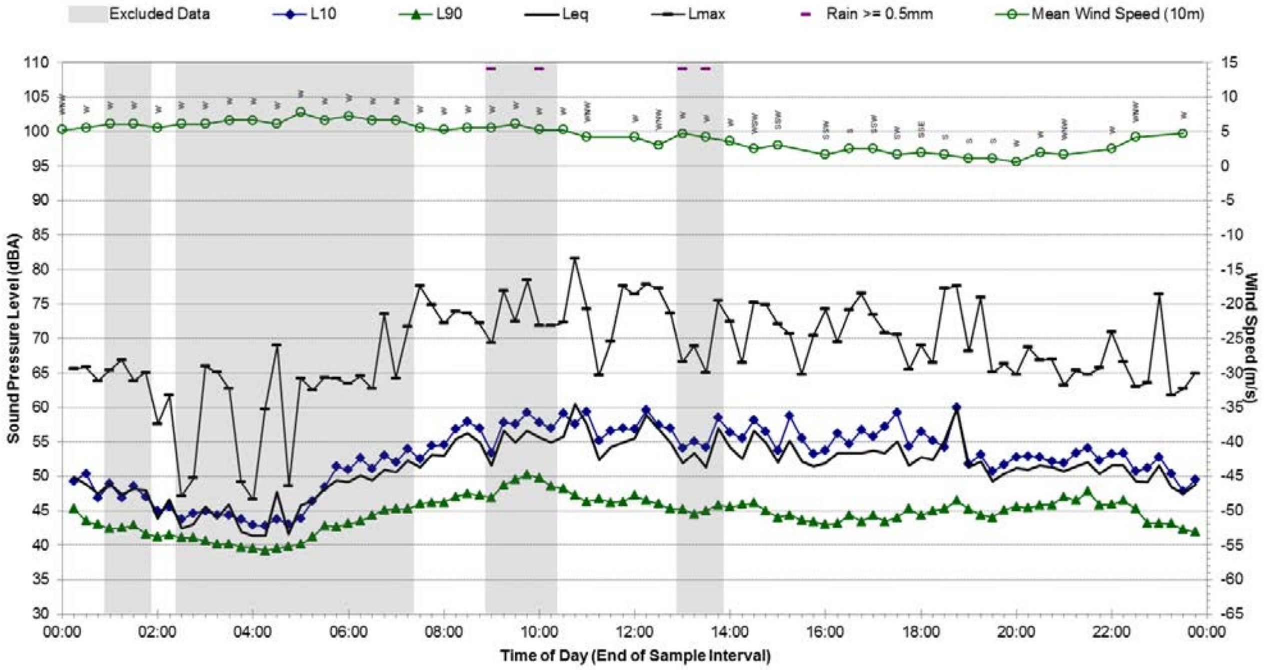
Photo of Noise Monitoring Location

Background Noise Monitoring Results – B.20

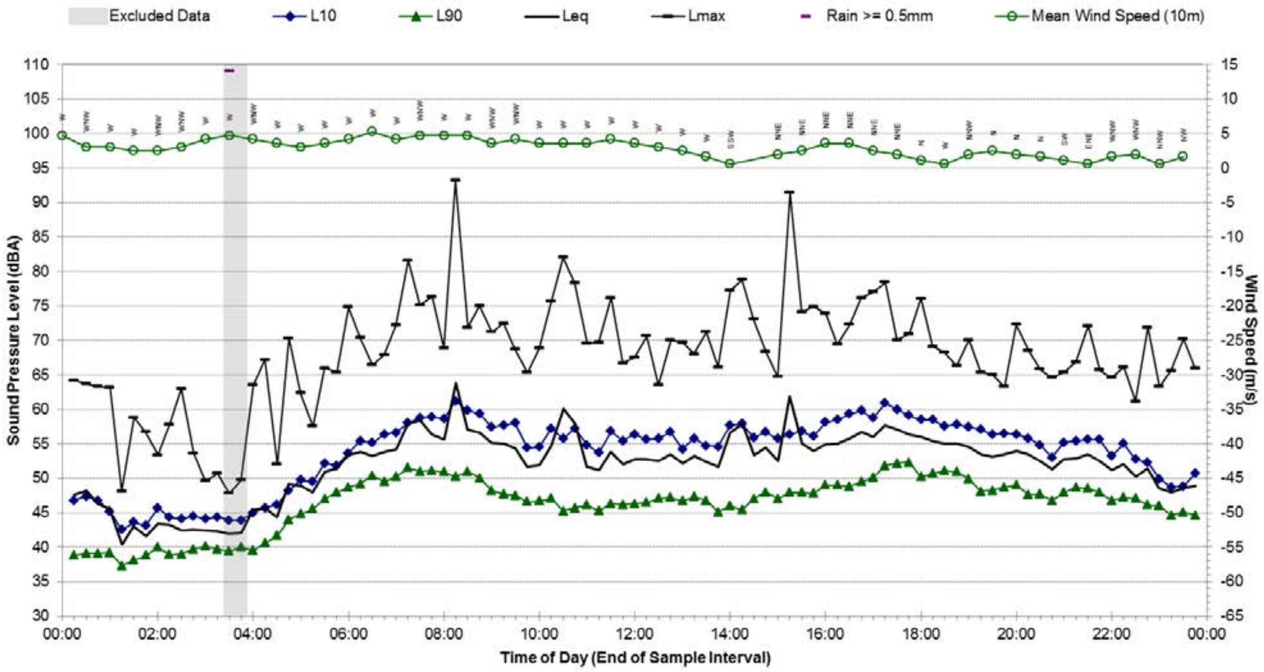


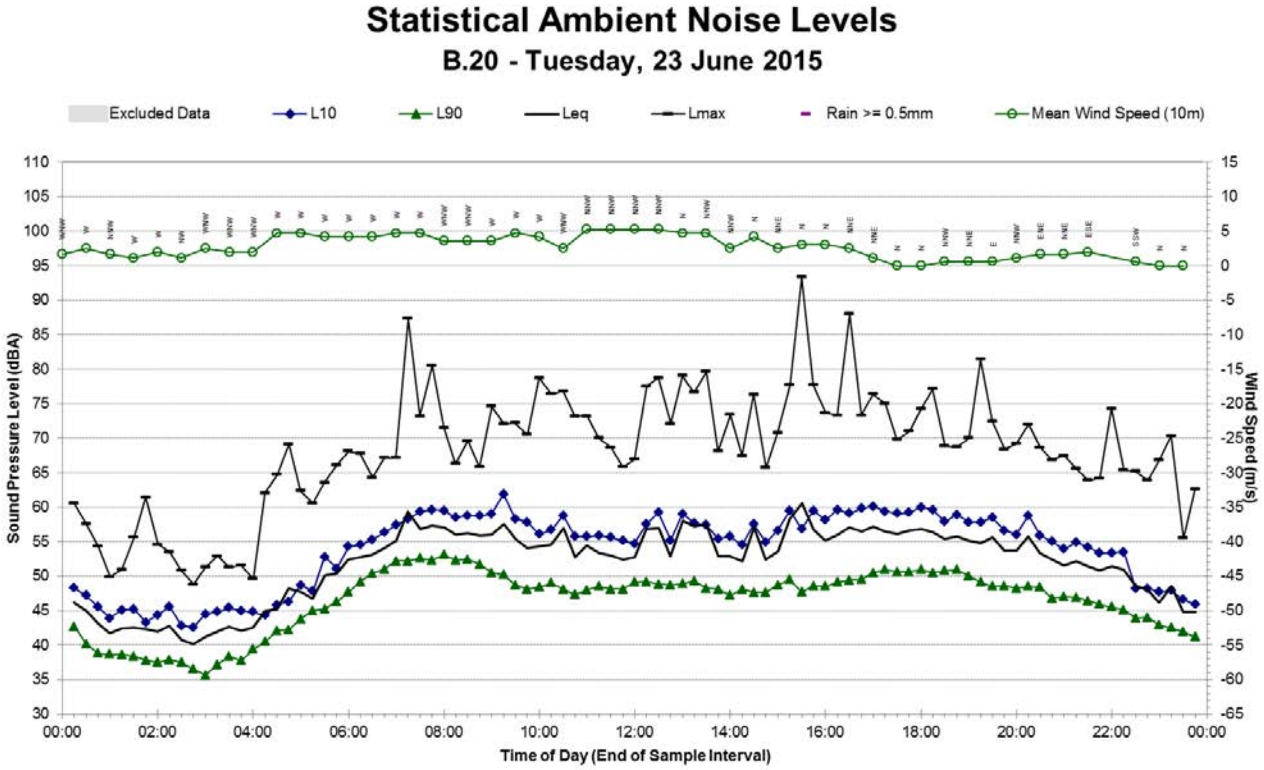


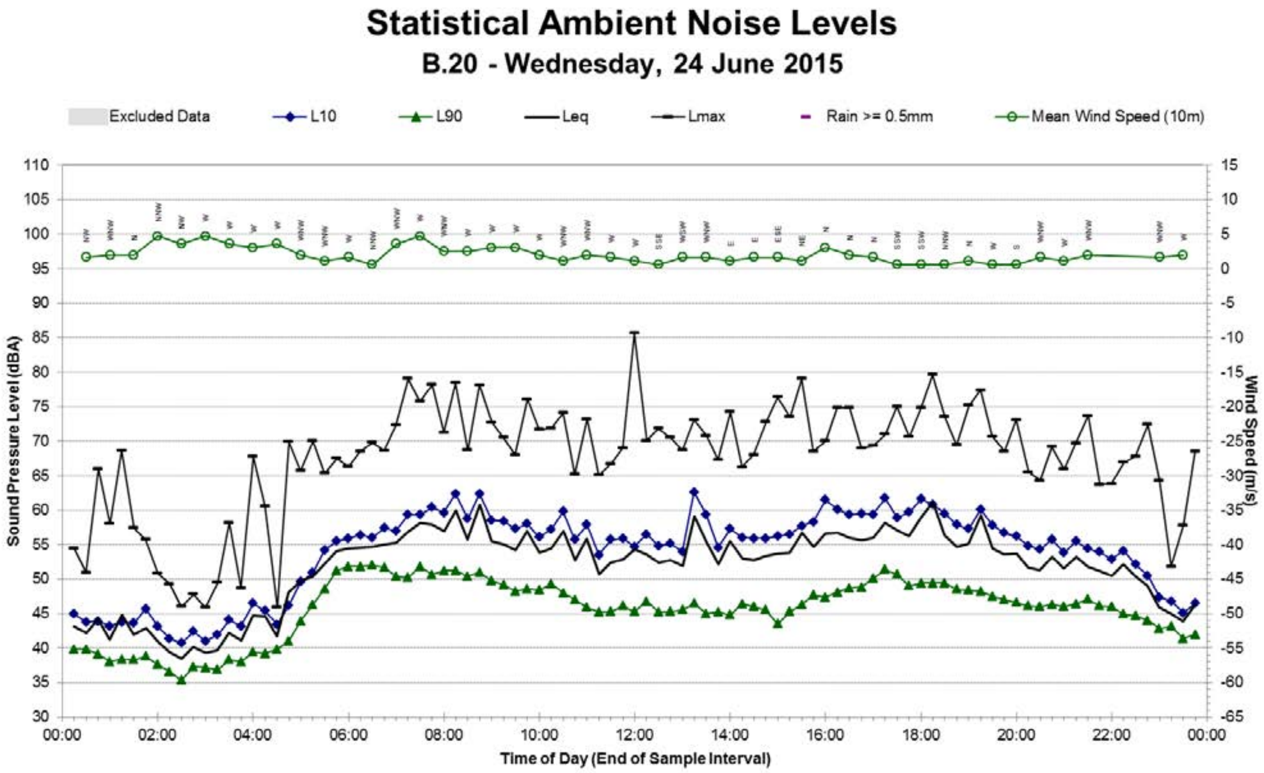
Statistical Ambient Noise Levels
B.20 - Sunday, 21 June 2015



Statistical Ambient Noise Levels
B.20 - Monday, 22 June 2015

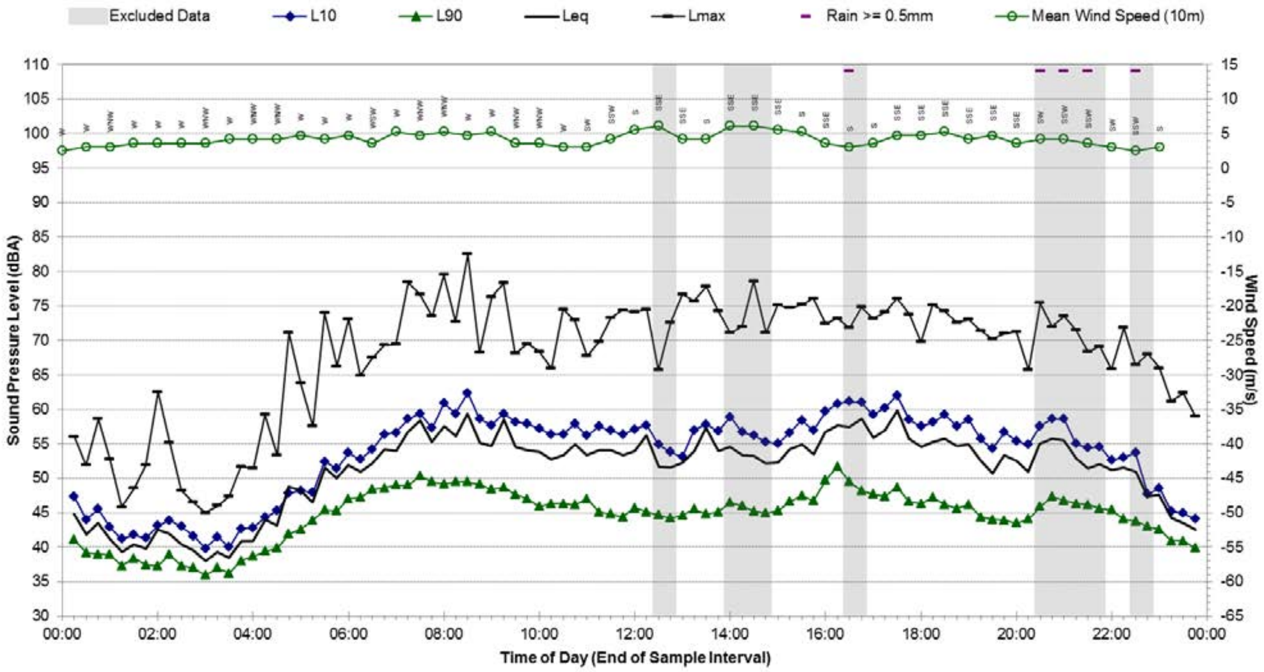



Statistical Ambient Noise Levels
B.20 - Tuesday, 23 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

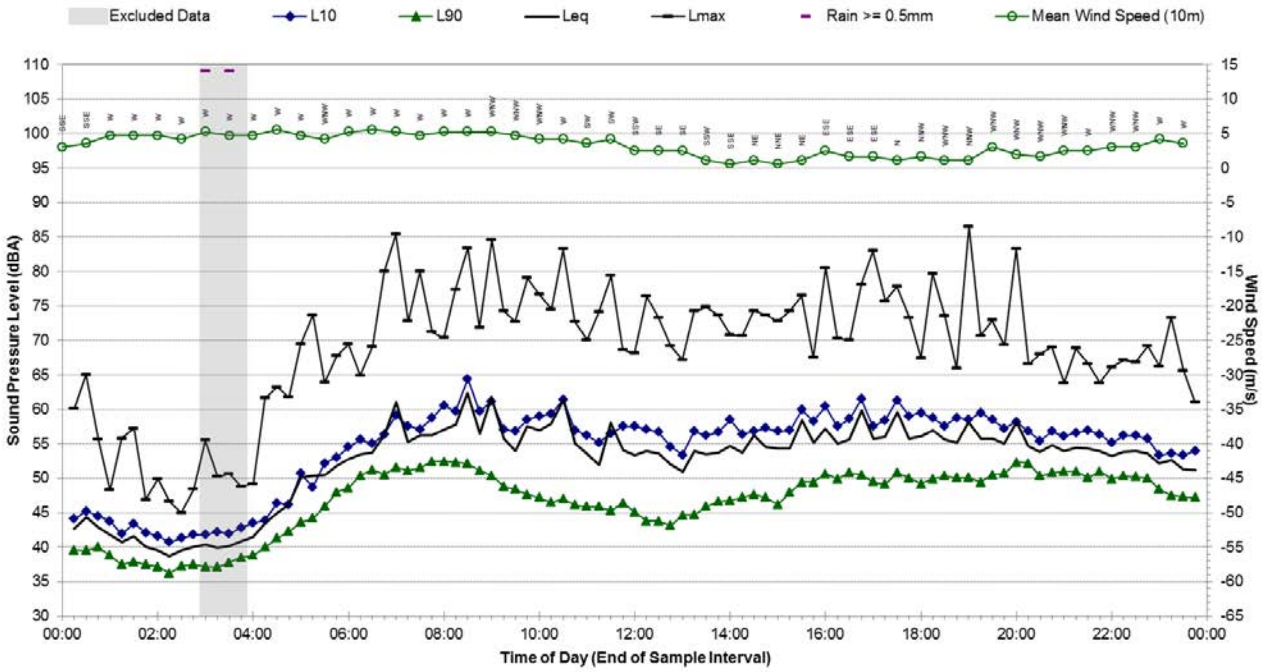

Statistical Ambient Noise Levels
B.20 - Wednesday, 24 June 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Background Noise Monitoring Results – B.20

Statistical Ambient Noise Levels
B.20 - Thursday, 25 June 2015

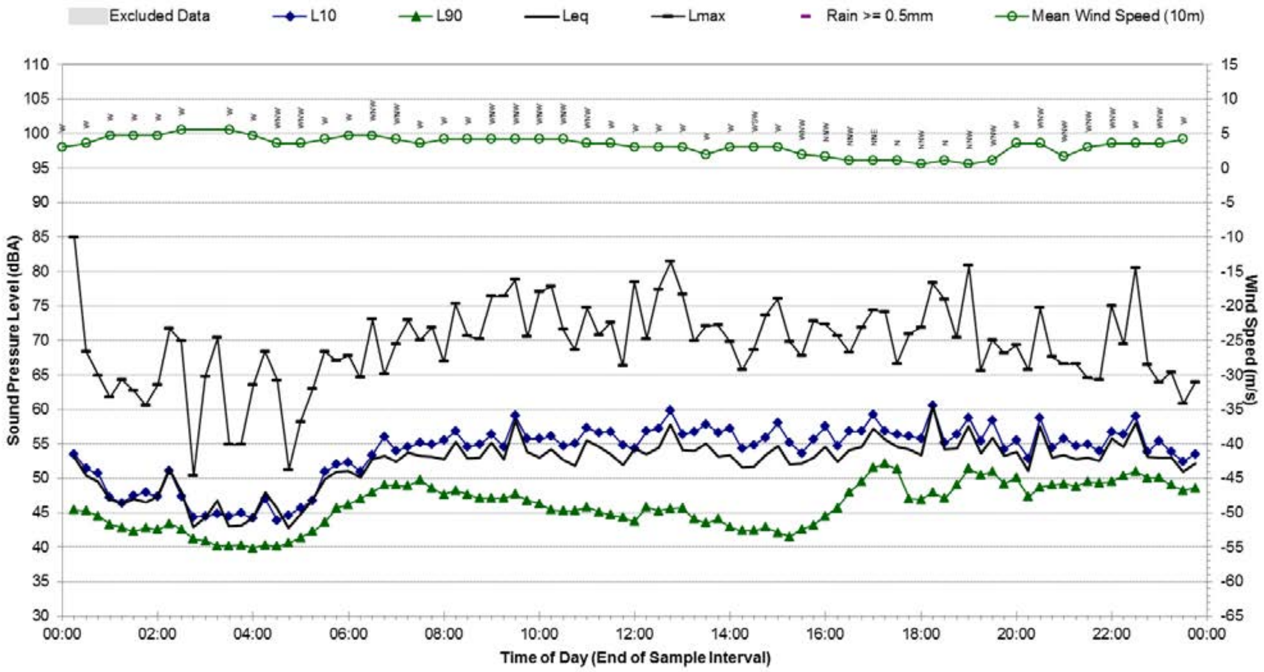


Statistical Ambient Noise Levels
B.20 - Friday, 26 June 2015

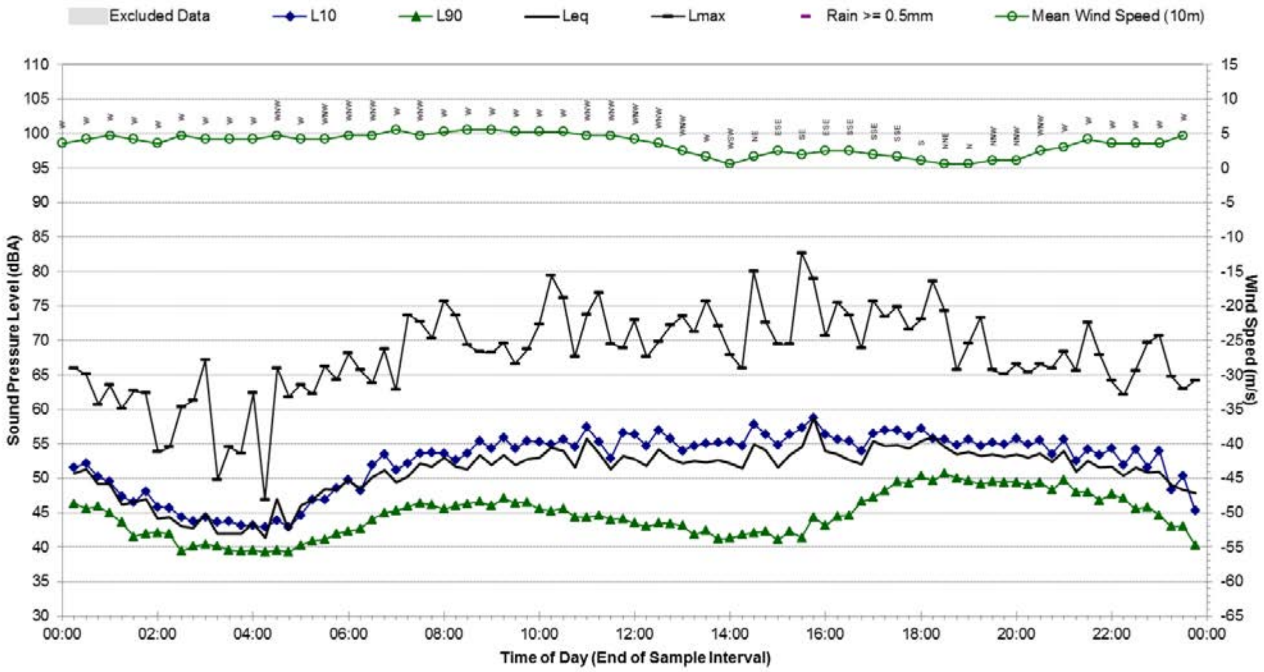


Background Noise Monitoring Results – B.20

Statistical Ambient Noise Levels
B.20 - Saturday, 27 June 2015

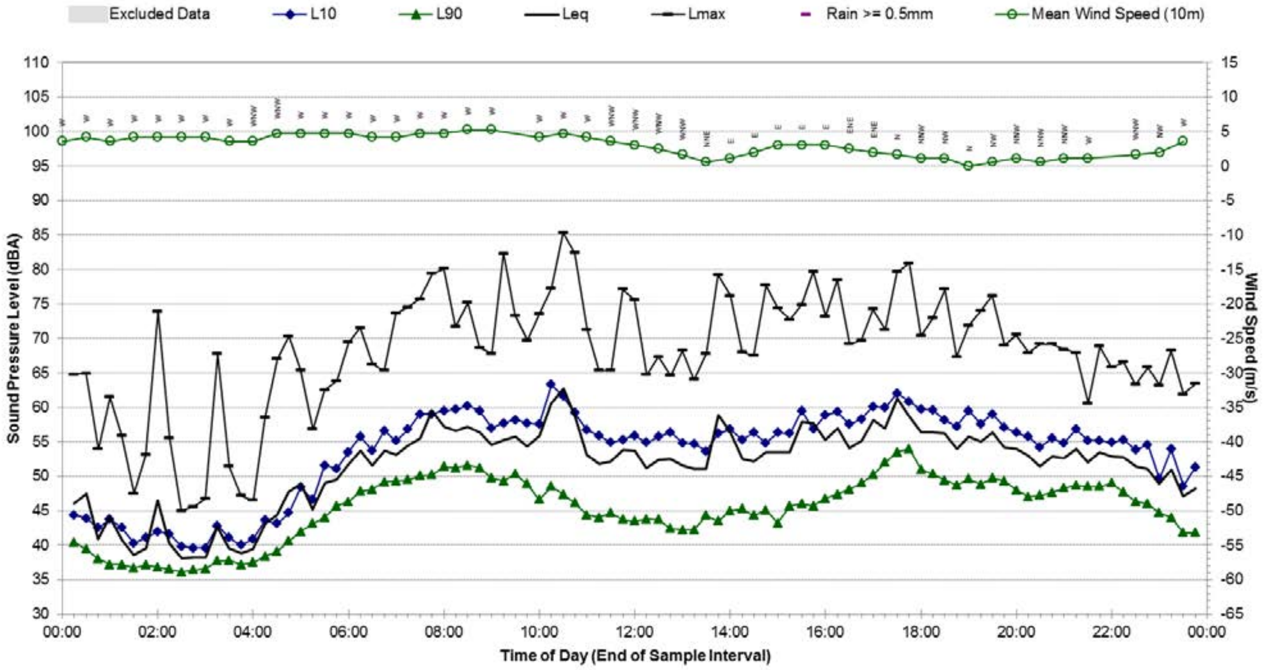


Statistical Ambient Noise Levels
B.20 - Sunday, 28 June 2015

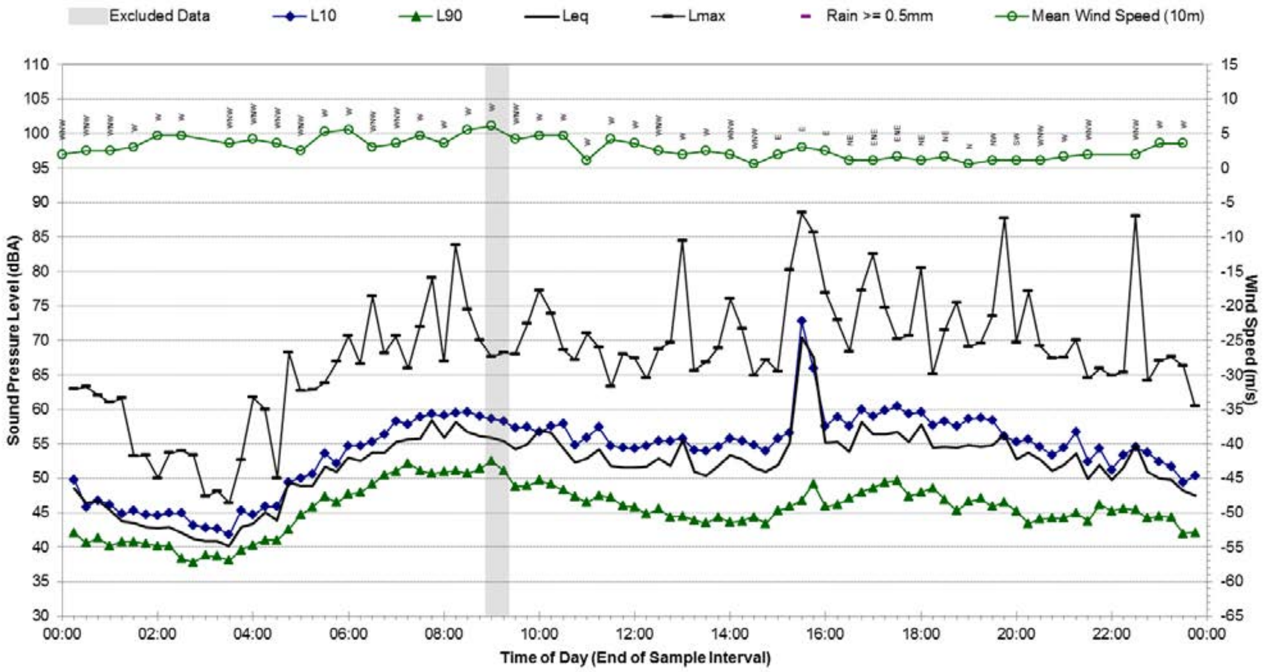


Background Noise Monitoring Results – B.20

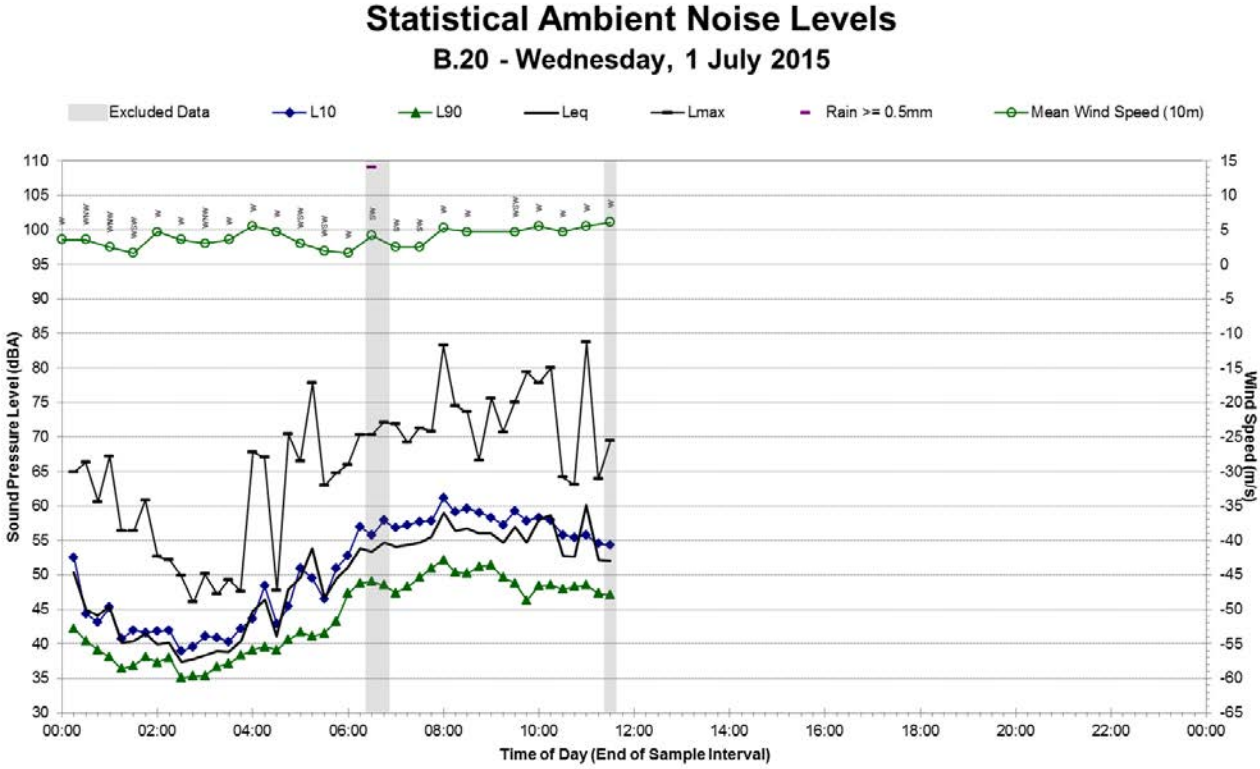
Statistical Ambient Noise Levels
B.20 - Monday, 29 June 2015



Statistical Ambient Noise Levels
B.20 - Tuesday, 30 June 2015



Background Noise Monitoring Results – B.20



Background Noise Monitoring Results – B.21

Noise Monitoring Location:	**B.21**
Noise Monitoring Address:	**6 Milner Road, Artarmon 2064**

Logger Device Type: ARL-EL316
Logger Serial No: 16-306-039

Ambient noise logger deployed in the backyard of residential address 6 Milner Road, Artarmon.

Attended noise measurements indicate that the ambient noise environment at this location is dominated by road traffic noise from Reserve Road and both the M1 and M2 motorways. Surrounding tree rustling (wind) also contributed to the LA90 (background) level throughout, as well as road traffic observed during the daytime.

Map of Noise Monitoring Location

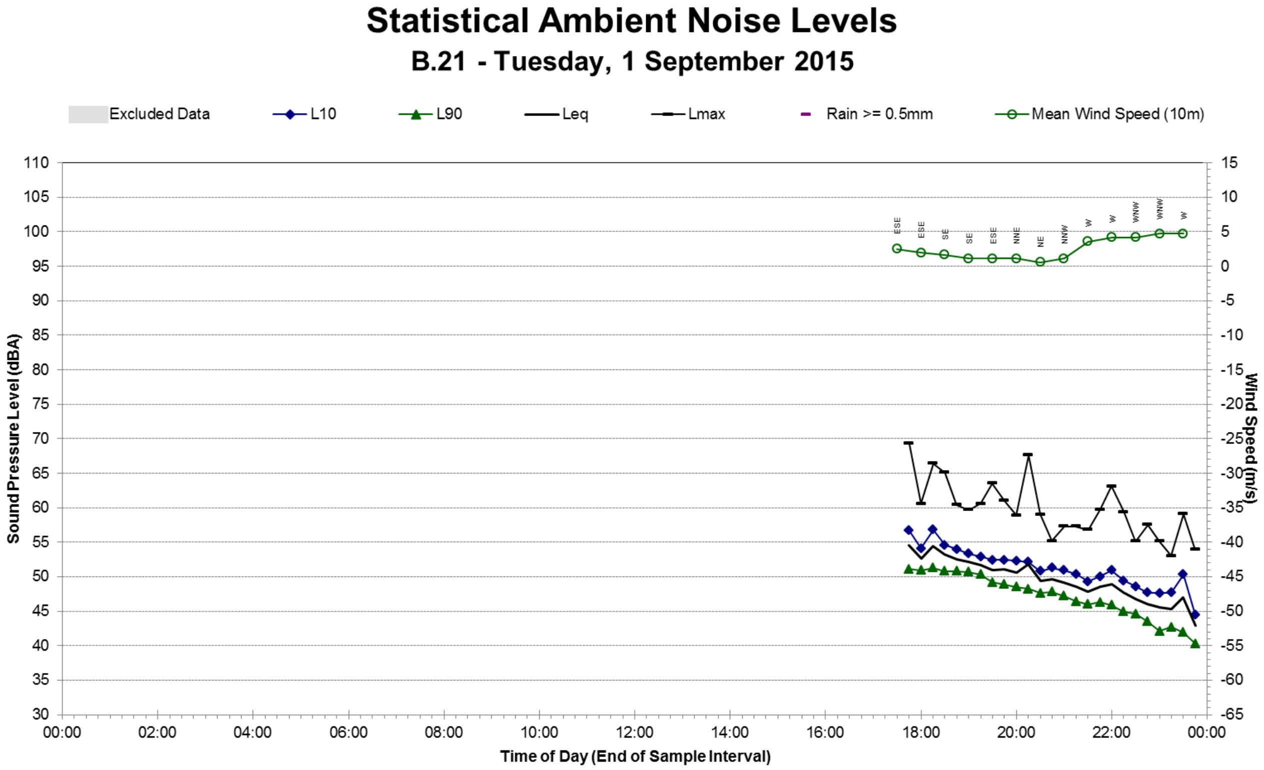
Ambient Noise Logging Results – INP Defined Time Periods

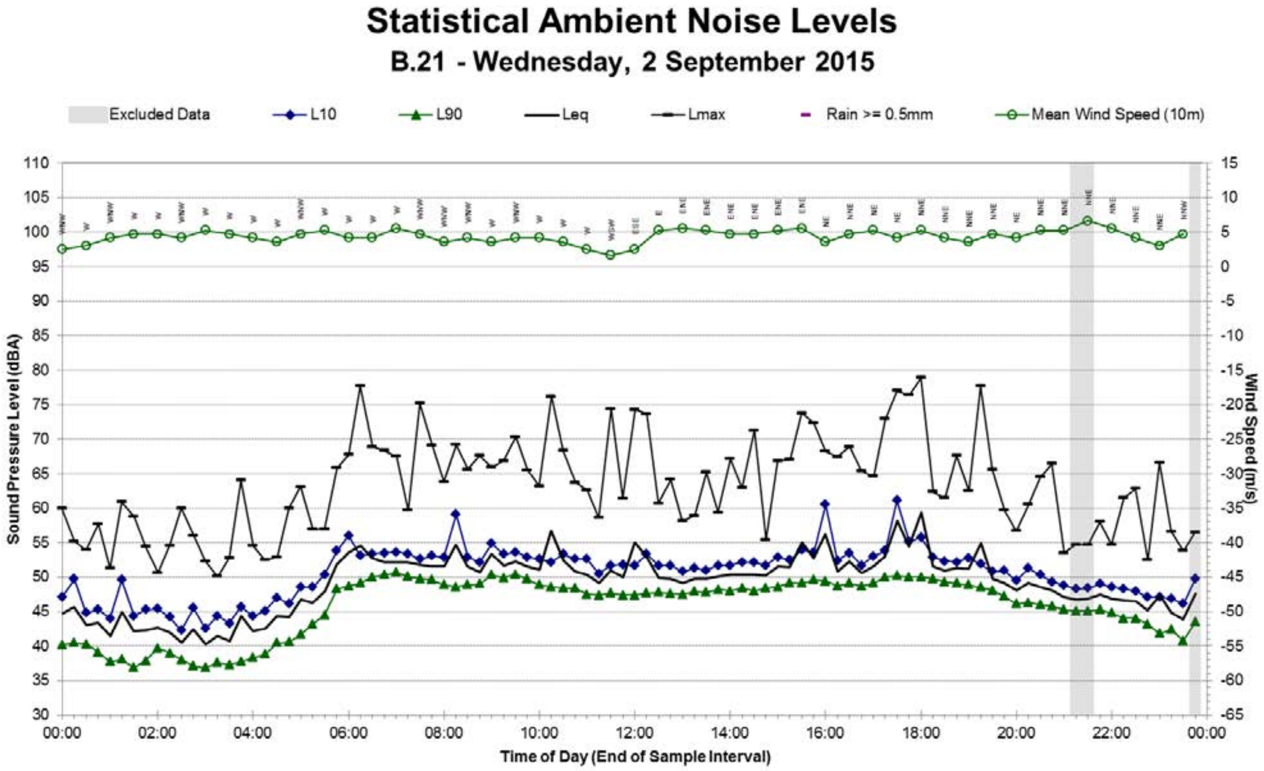
Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	49	55	54	59
Evening	46	50	51	54
Night-time	41	48	47	51

Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
15/09/2015	14:10:16	53	56	73

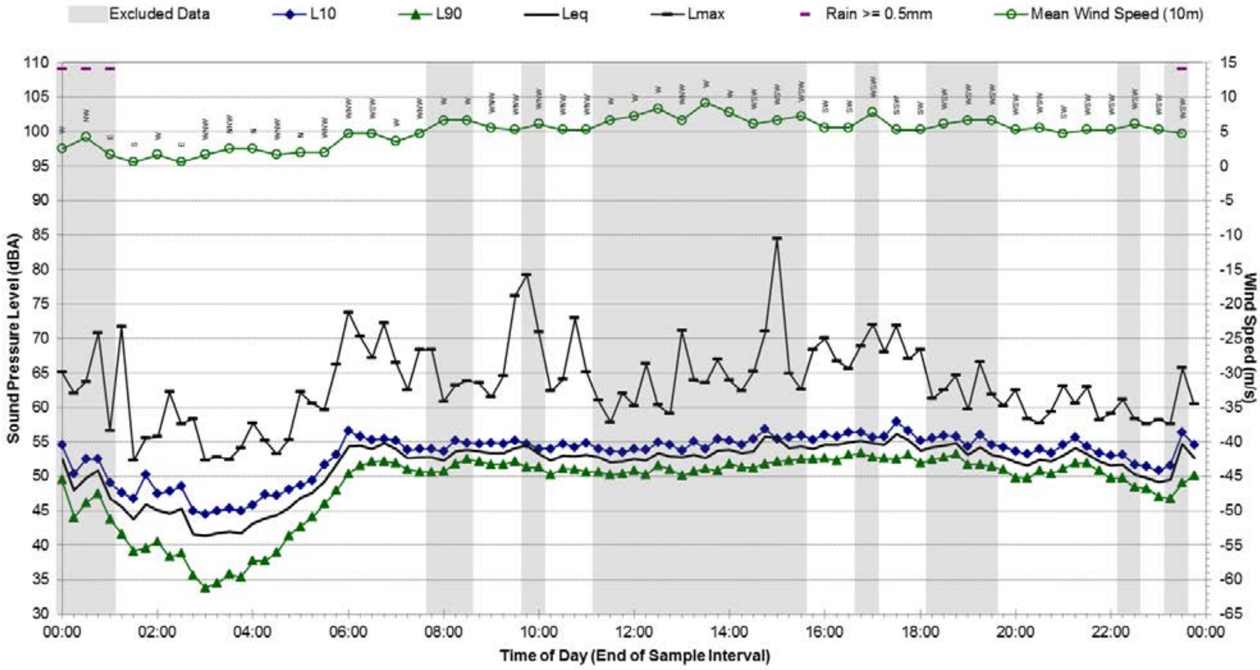
Photo of Noise Monitoring Location


Statistical Ambient Noise Levels
B.21 - Tuesday, 1 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

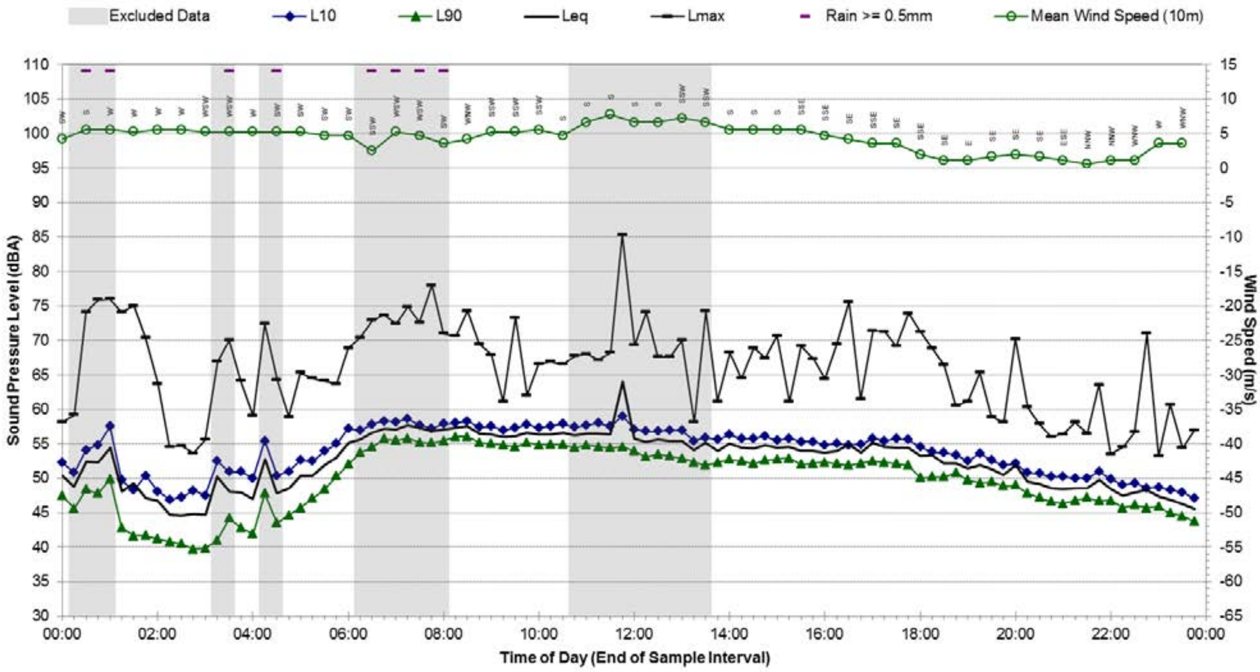

Statistical Ambient Noise Levels
B.21 - Wednesday, 2 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

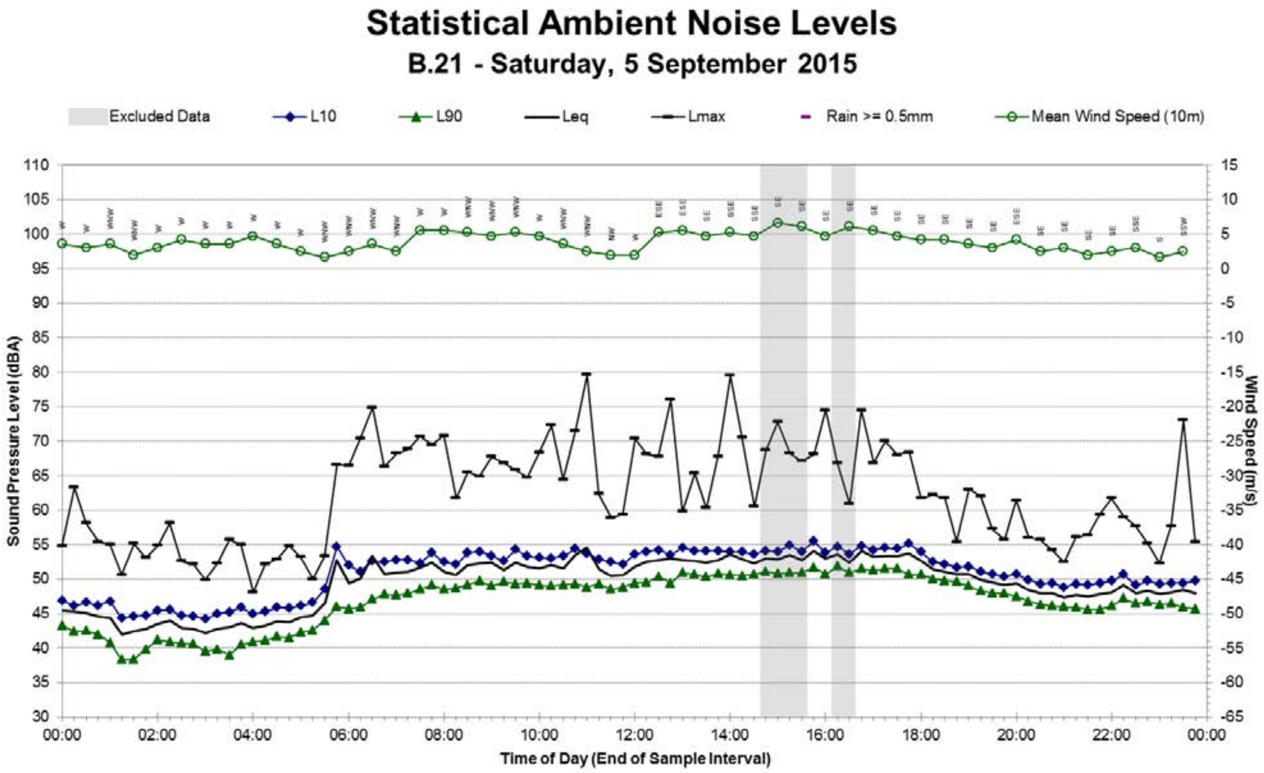
Background Noise Monitoring Results – B.21

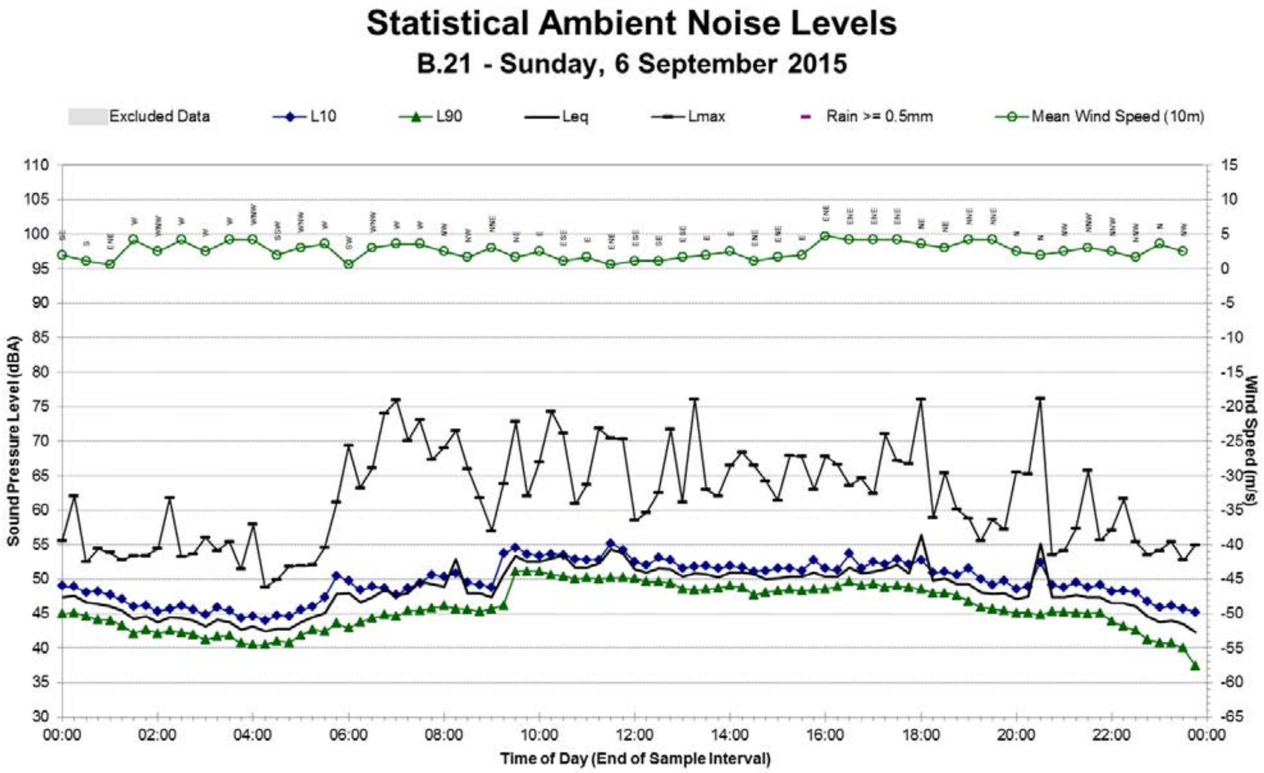
Statistical Ambient Noise Levels
B.21 - Thursday, 3 September 2015



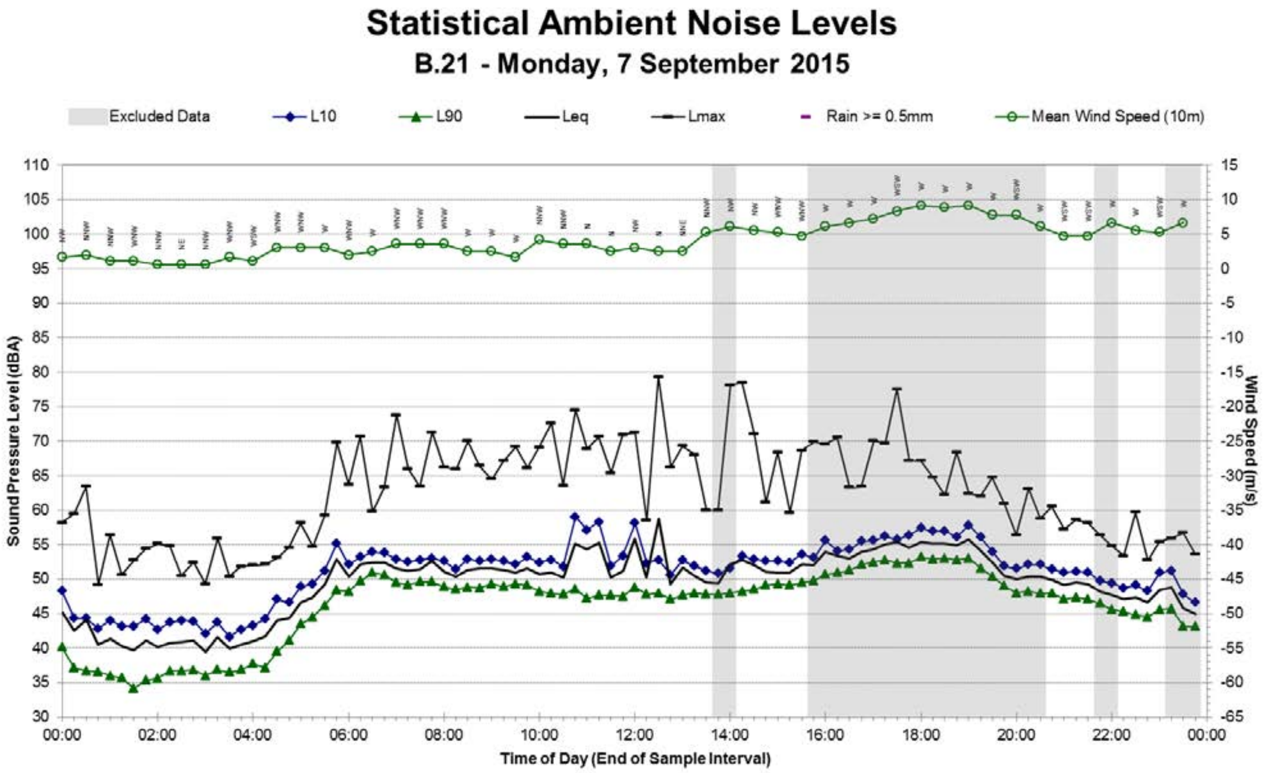
Statistical Ambient Noise Levels
B.21 - Friday, 4 September 2015

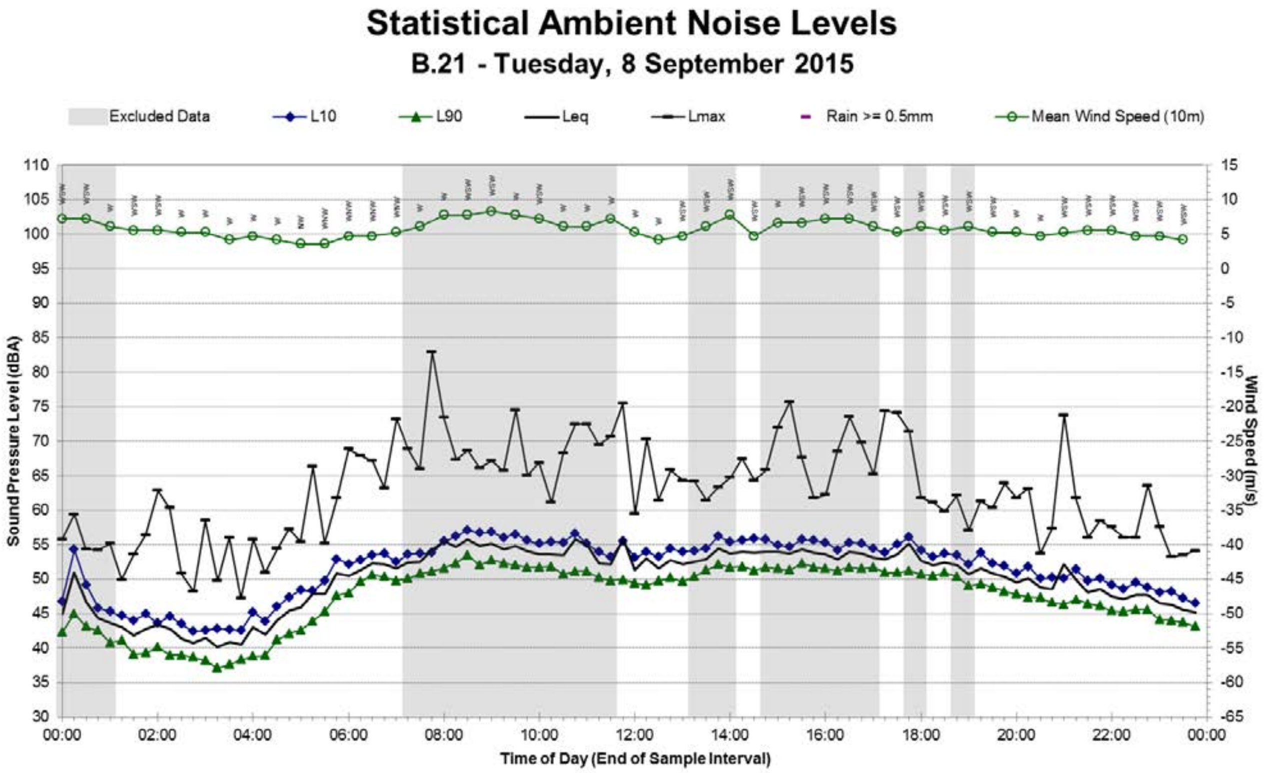



Statistical Ambient Noise Levels
B.21 - Saturday, 5 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

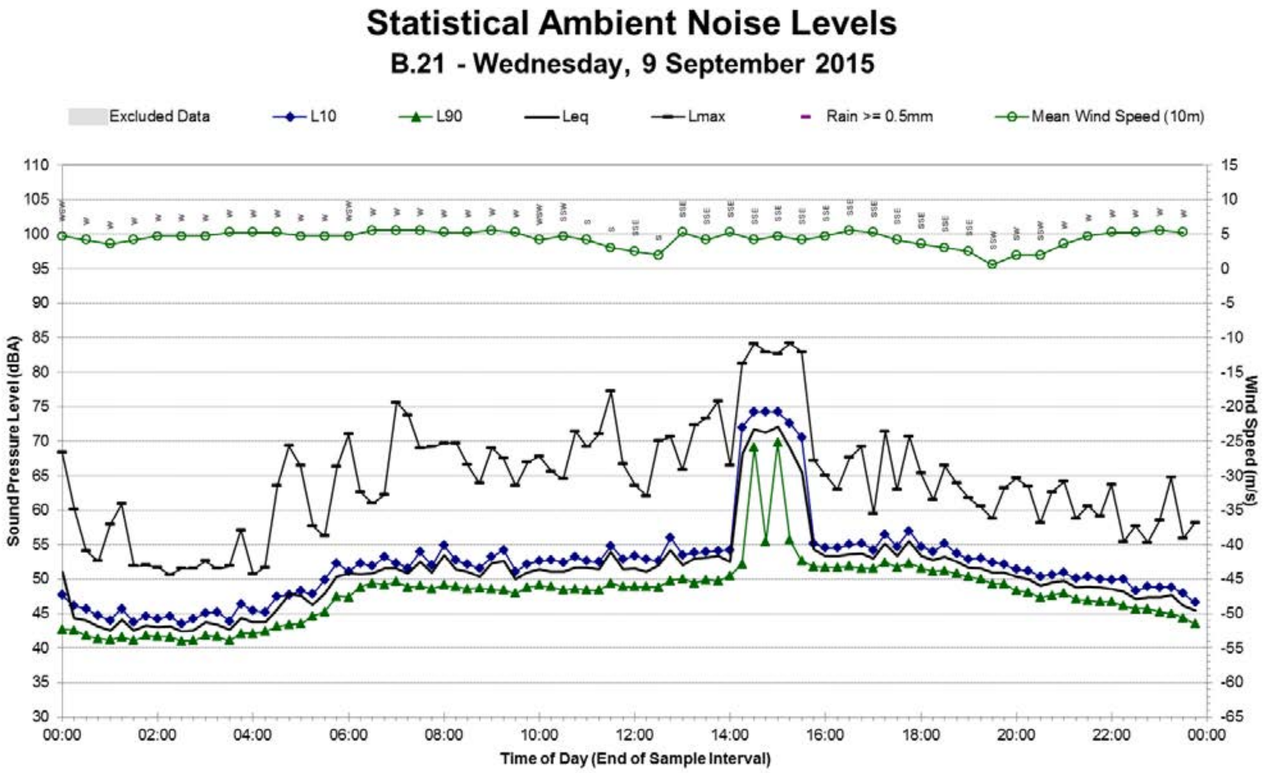

Statistical Ambient Noise Levels
B.21 - Sunday, 6 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

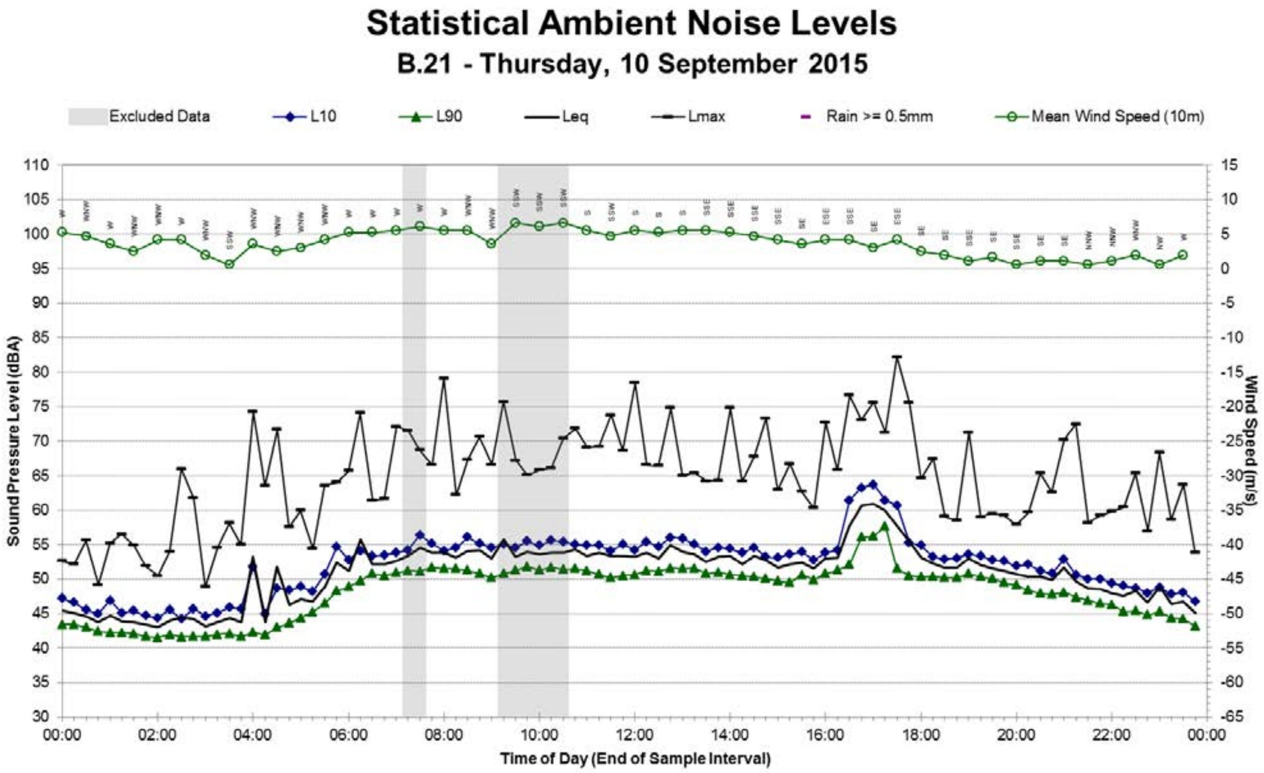
Background Noise Monitoring Results – B.21





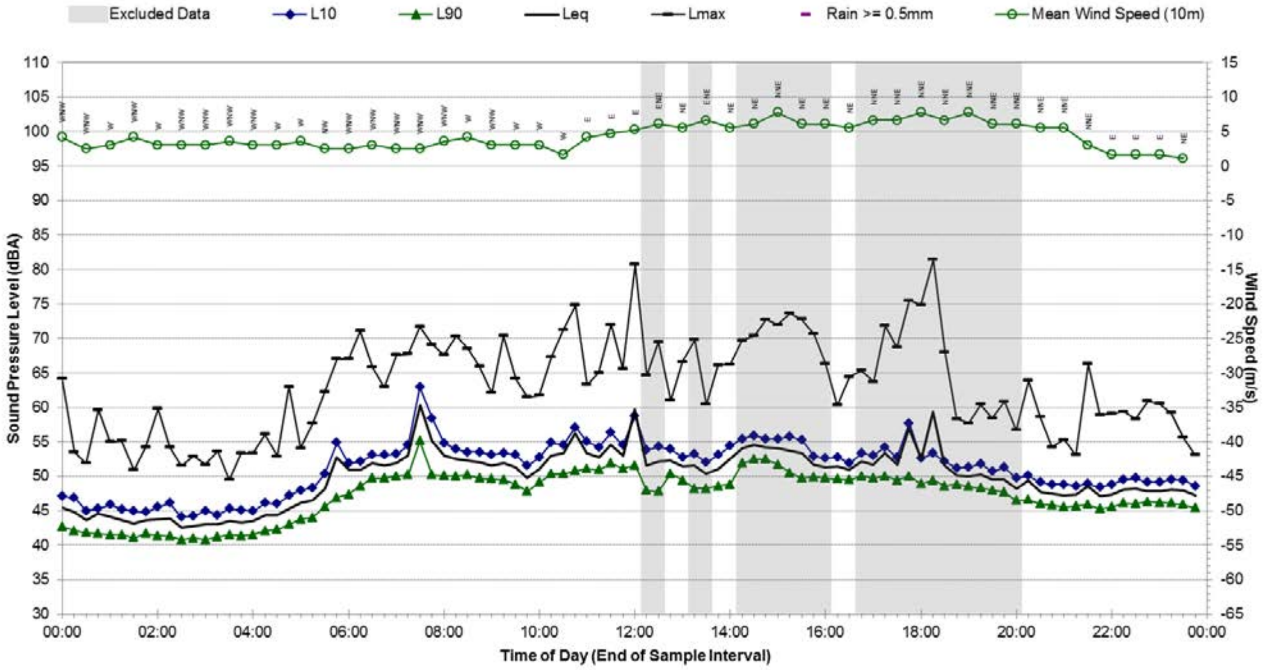
Background Noise Monitoring Results – B.21



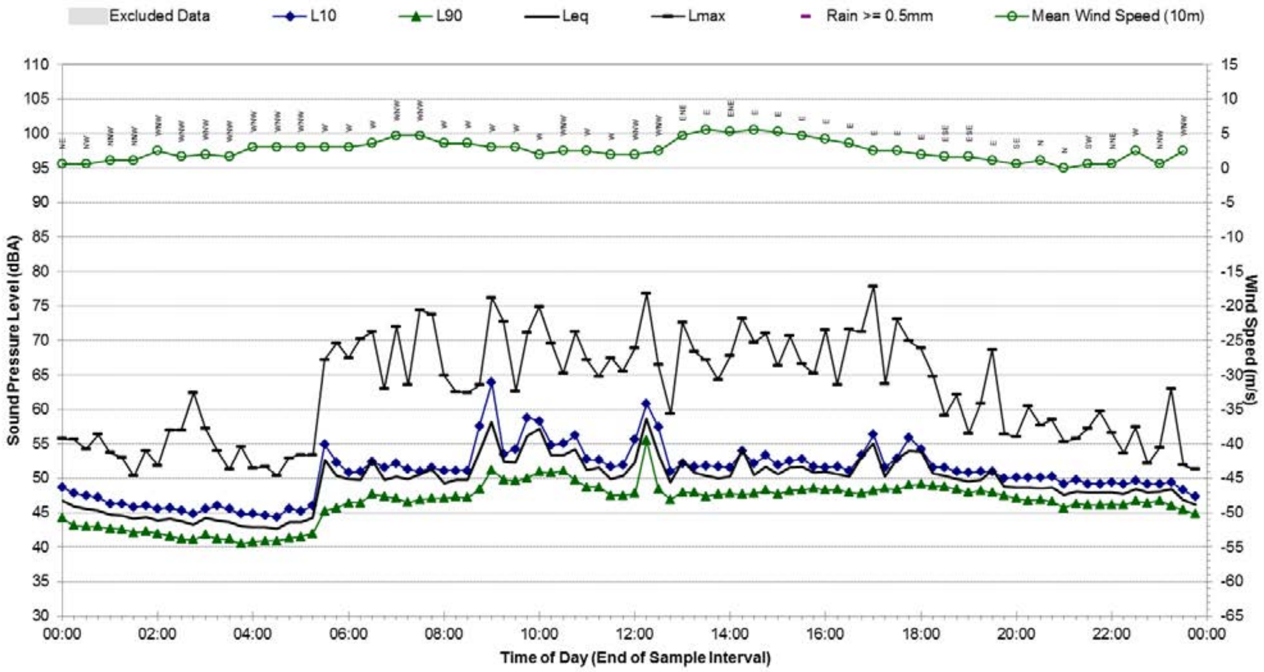


Background Noise Monitoring Results – B.21

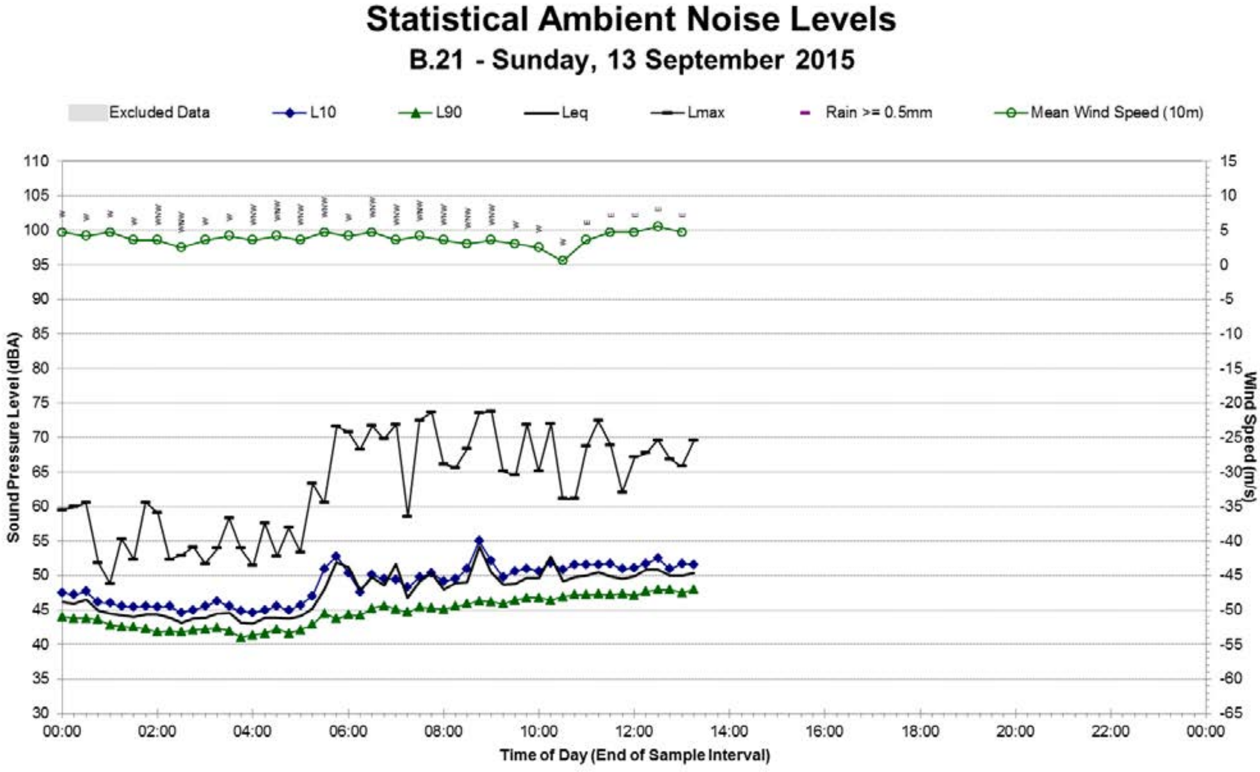
Statistical Ambient Noise Levels
B.21 - Friday, 11 September 2015



Statistical Ambient Noise Levels
B.21 - Saturday, 12 September 2015



Background Noise Monitoring Results – B.21



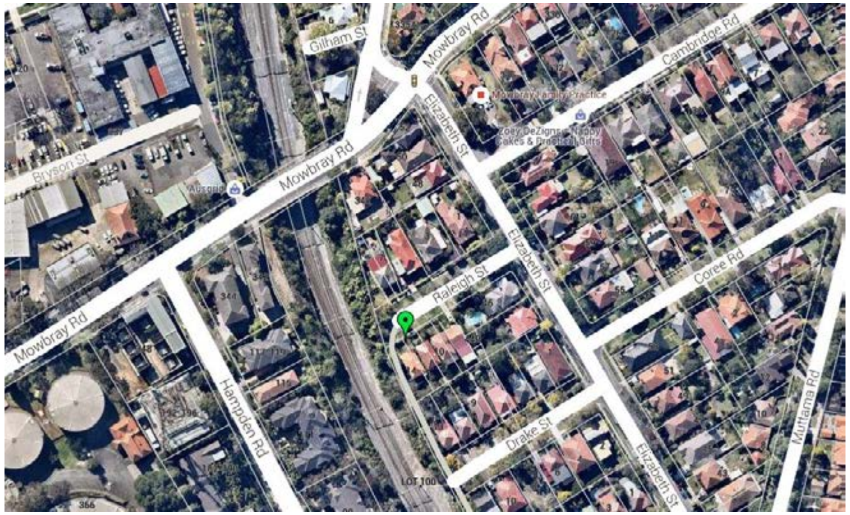
Noise Monitoring Location:	**B.22**
Noise Monitoring Address:	**14 Raleigh Street, Artarmon 2064**

Logger Device Type: Svantek 957
Logger Serial No: 20674

Ambient noise logger deployed in the front yard of residential address 14 Raleigh Street, Artarmon.

Attended noise measurements indicate that the ambient noise environment at this location is significantly dominated by rail traffic noise from the North Shore Line.

Map of Noise Monitoring Location



Ambient Noise Logging Results – INP Defined Time Periods

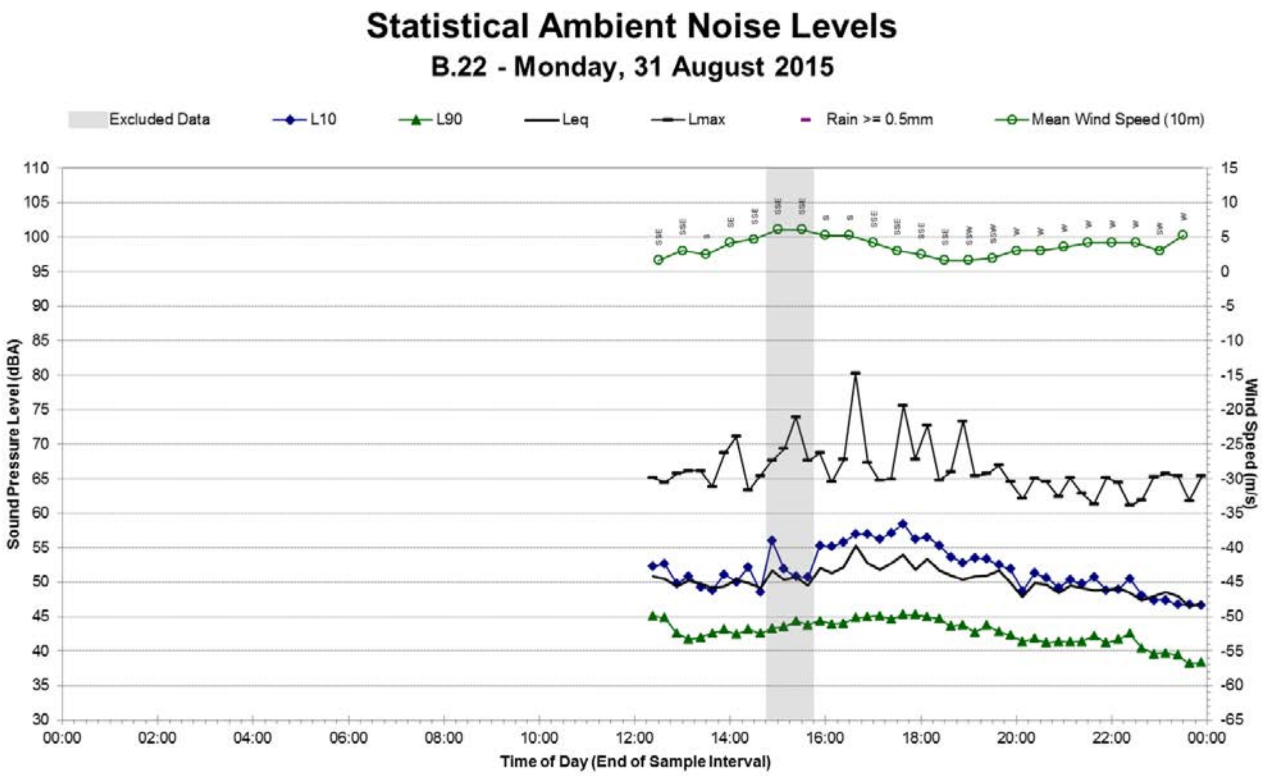
Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	42	55	54	62
Evening	41	50	51	61
Night-time	34	48	46	59

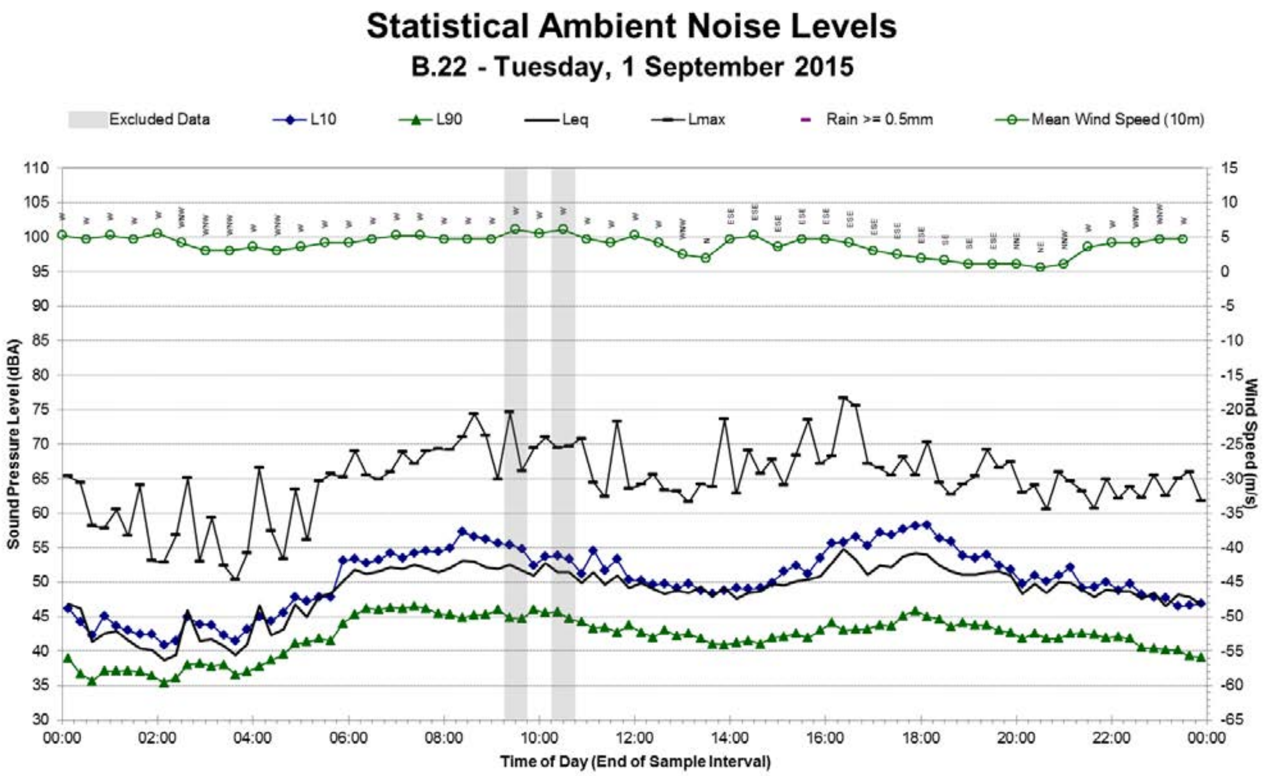
Attended Noise Measurement Results

Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
14/09/2015	14:31:33	44	50	70

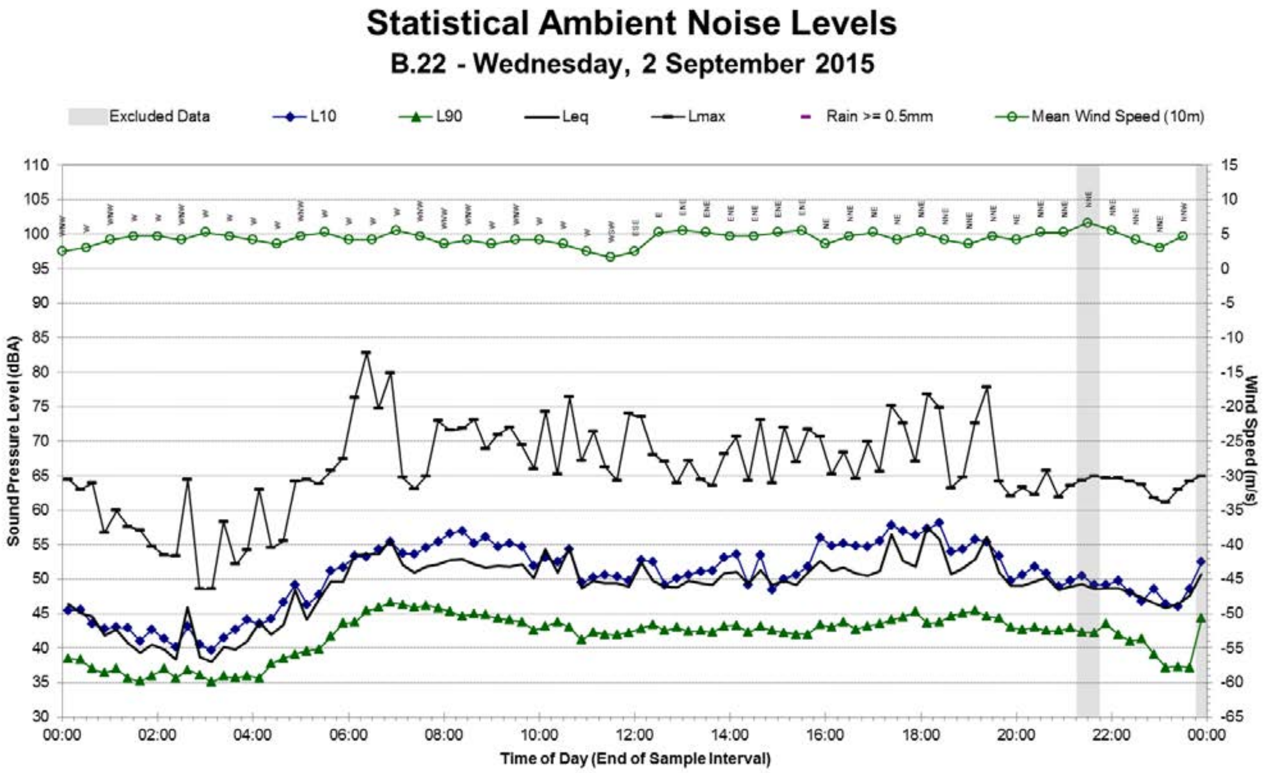
Photo of Noise Monitoring Location

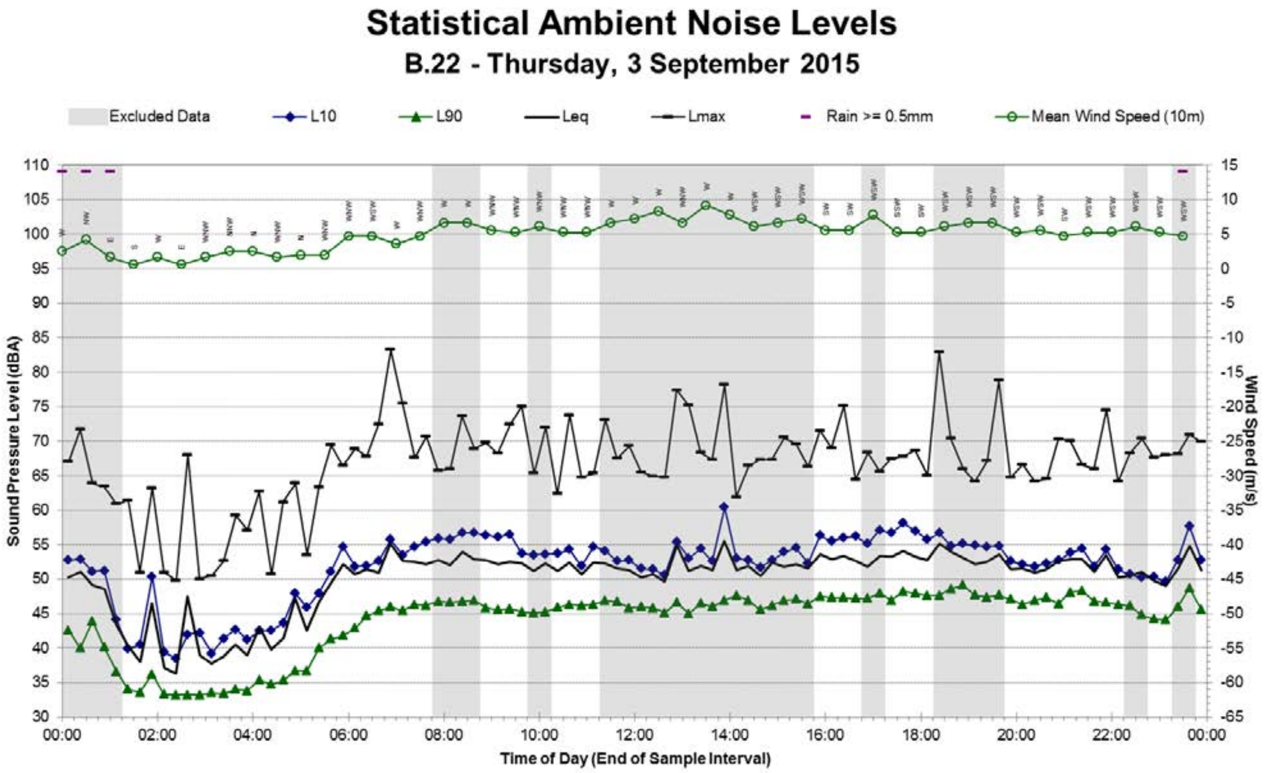
Background Noise Monitoring Results – B.22



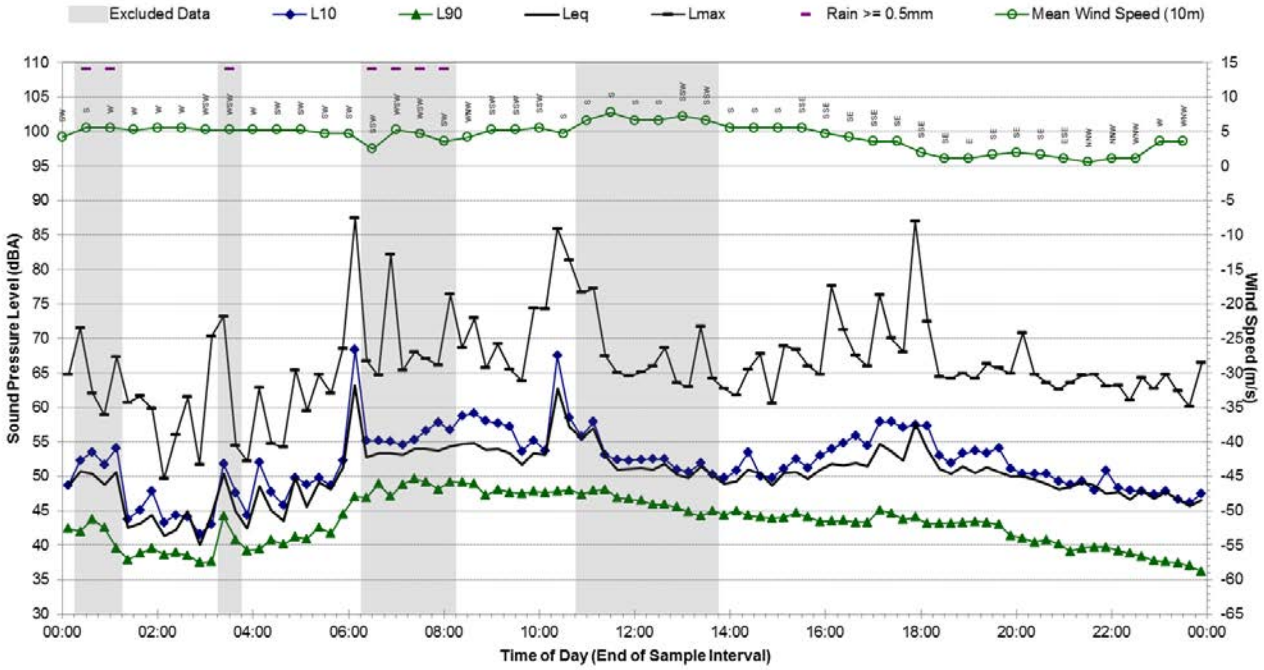


Background Noise Monitoring Results – B.22

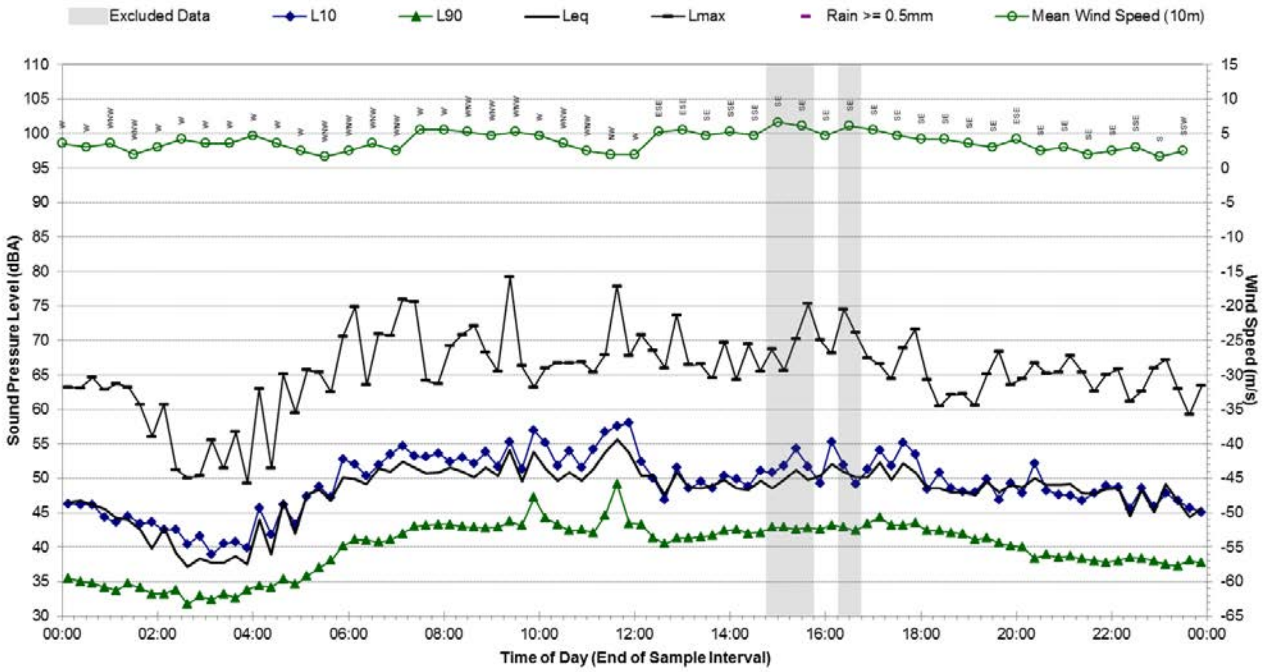


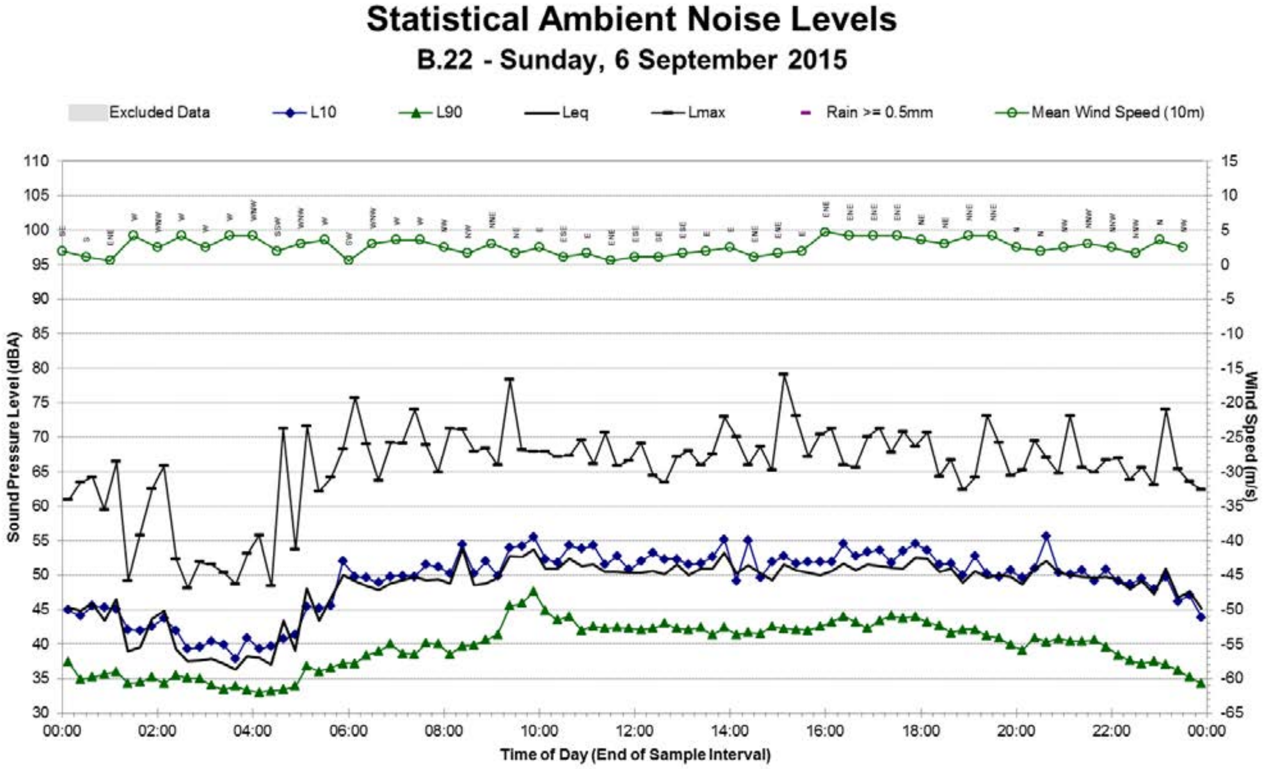


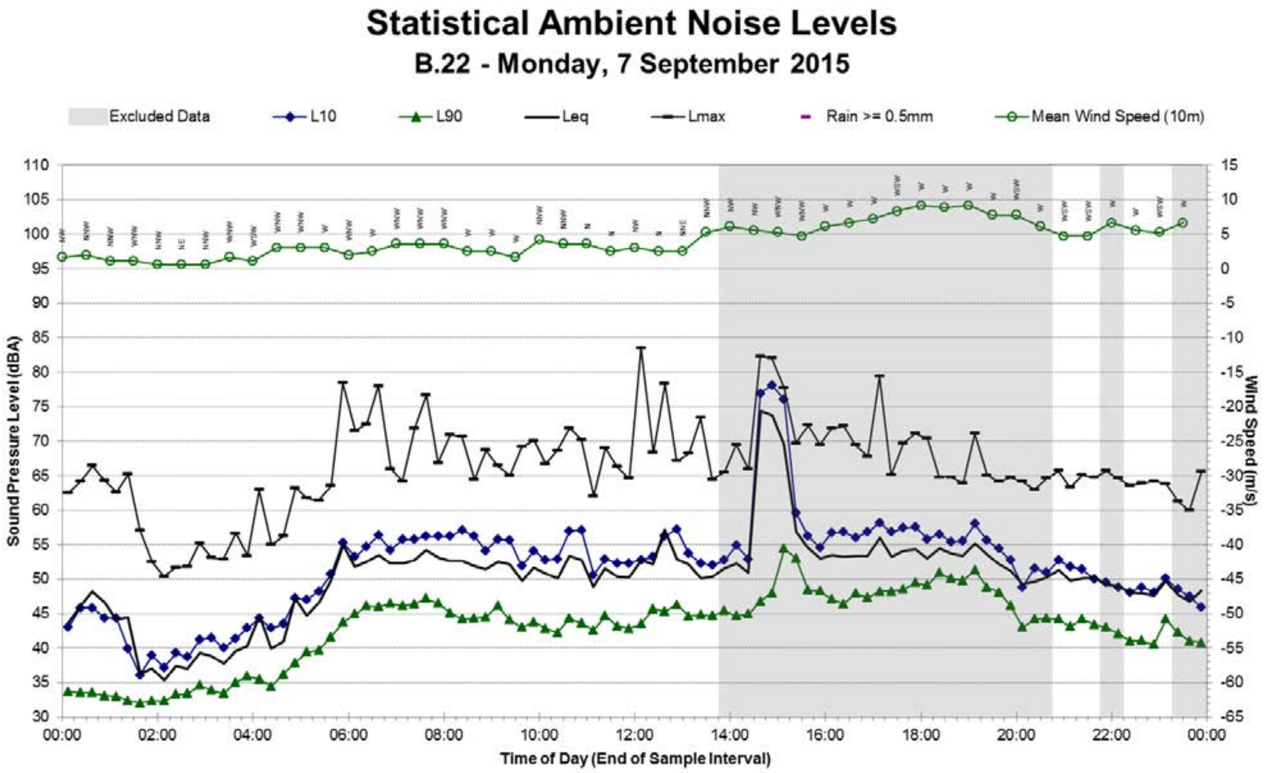
Statistical Ambient Noise Levels
B.22 - Friday, 4 September 2015



Statistical Ambient Noise Levels
B.22 - Saturday, 5 September 2015

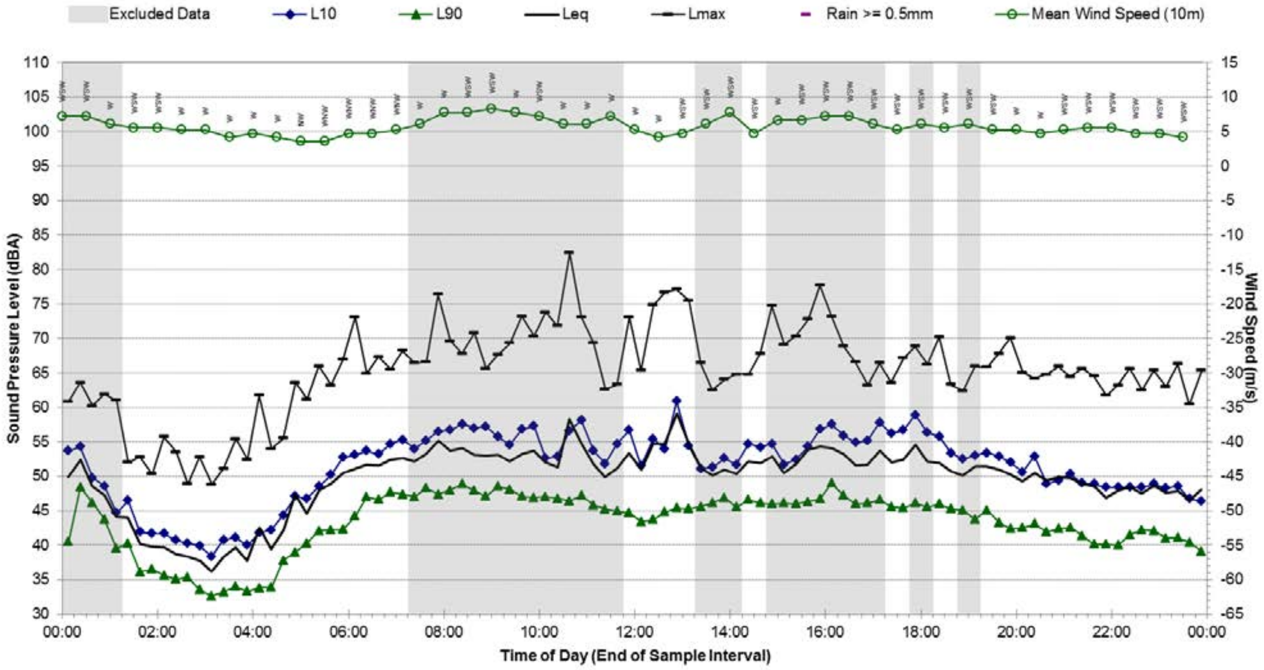



Statistical Ambient Noise Levels
B.22 - Sunday, 6 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

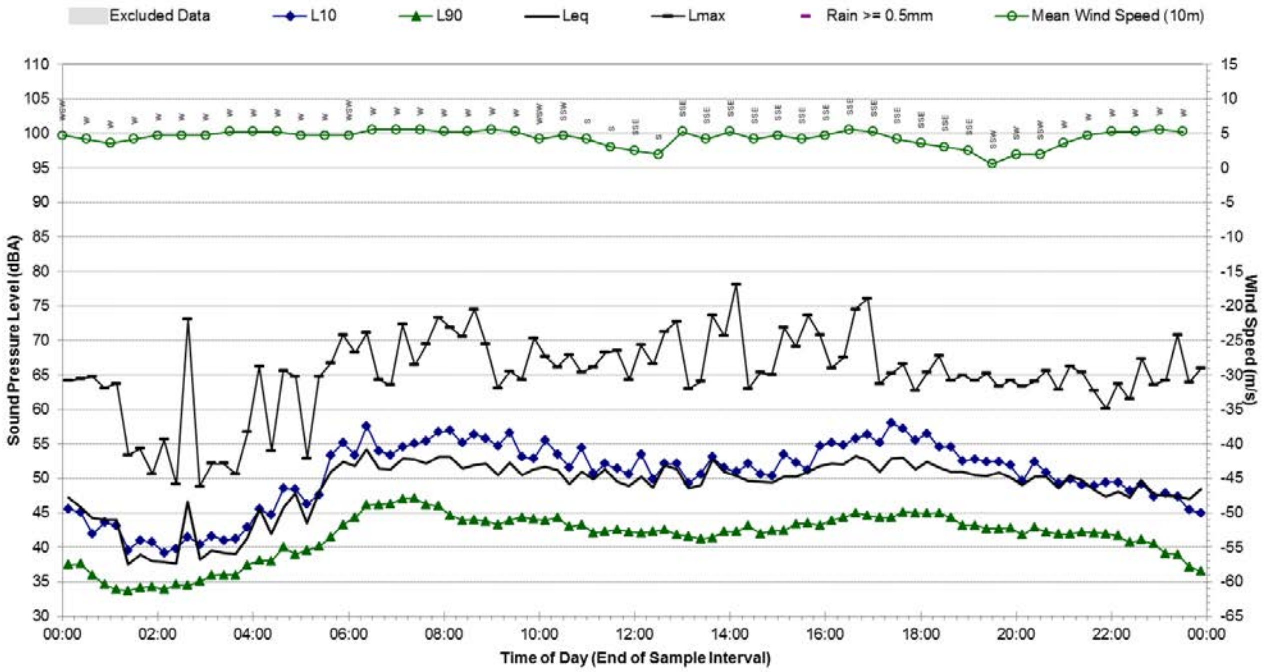

Statistical Ambient Noise Levels
B.22 - Monday, 7 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Background Noise Monitoring Results – B.22

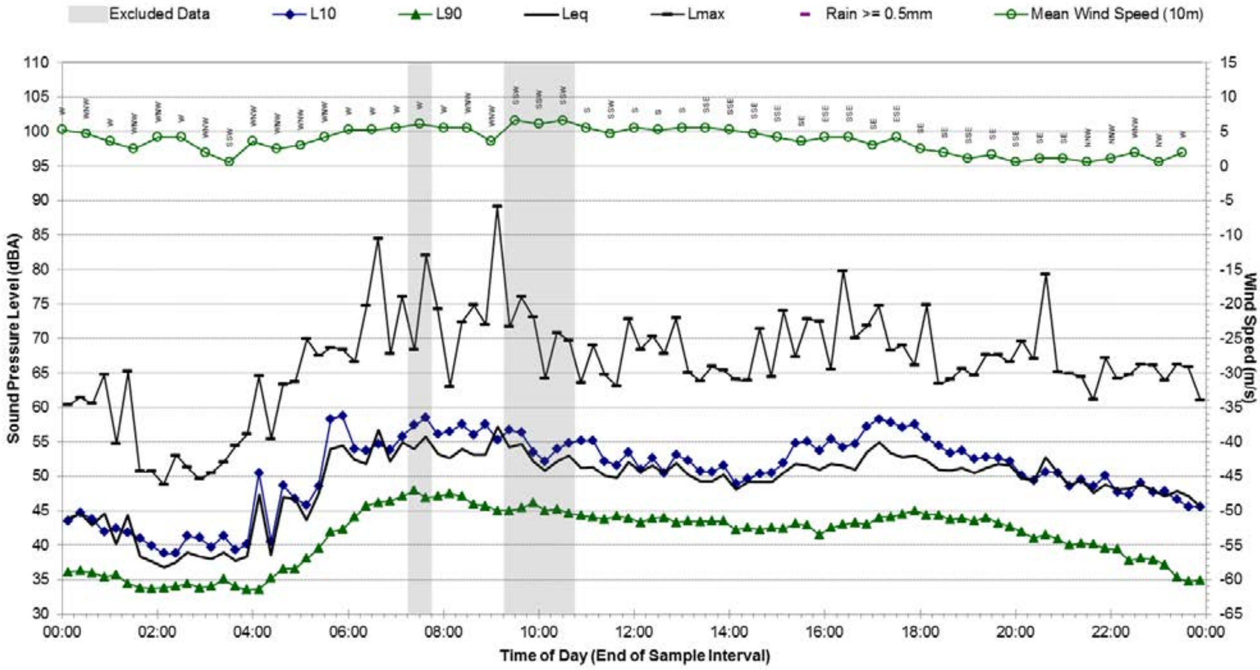
Statistical Ambient Noise Levels
B.22 - Tuesday, 8 September 2015



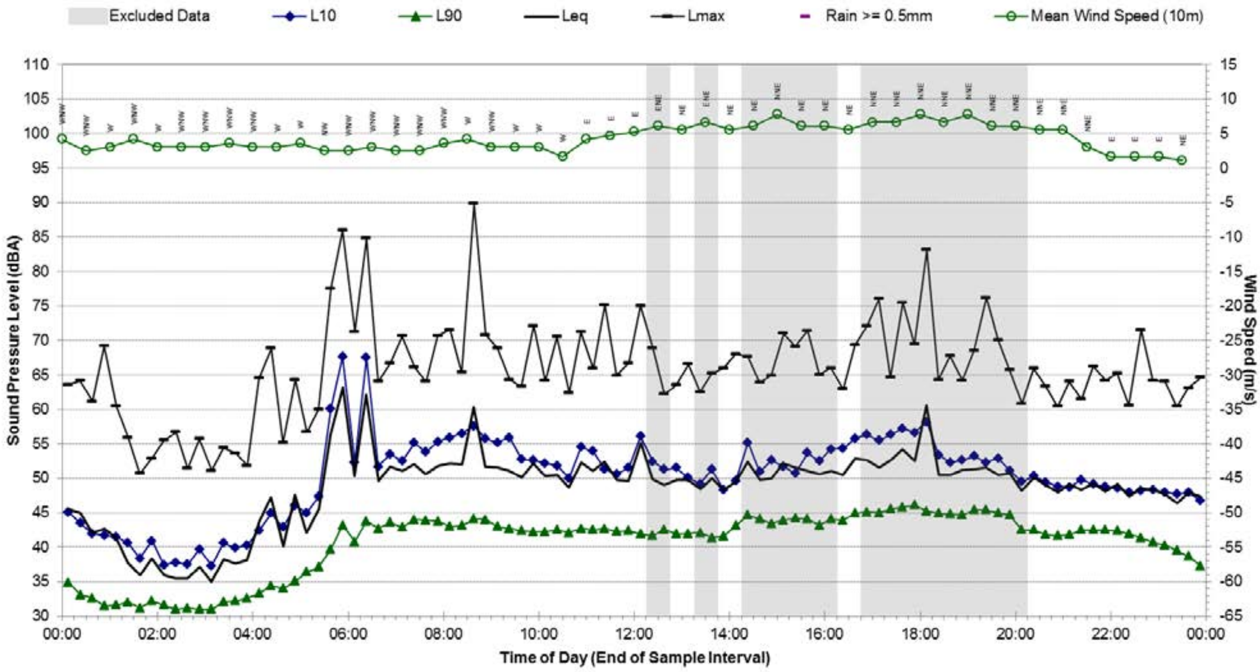
Statistical Ambient Noise Levels
B.22 - Wednesday, 9 September 2015

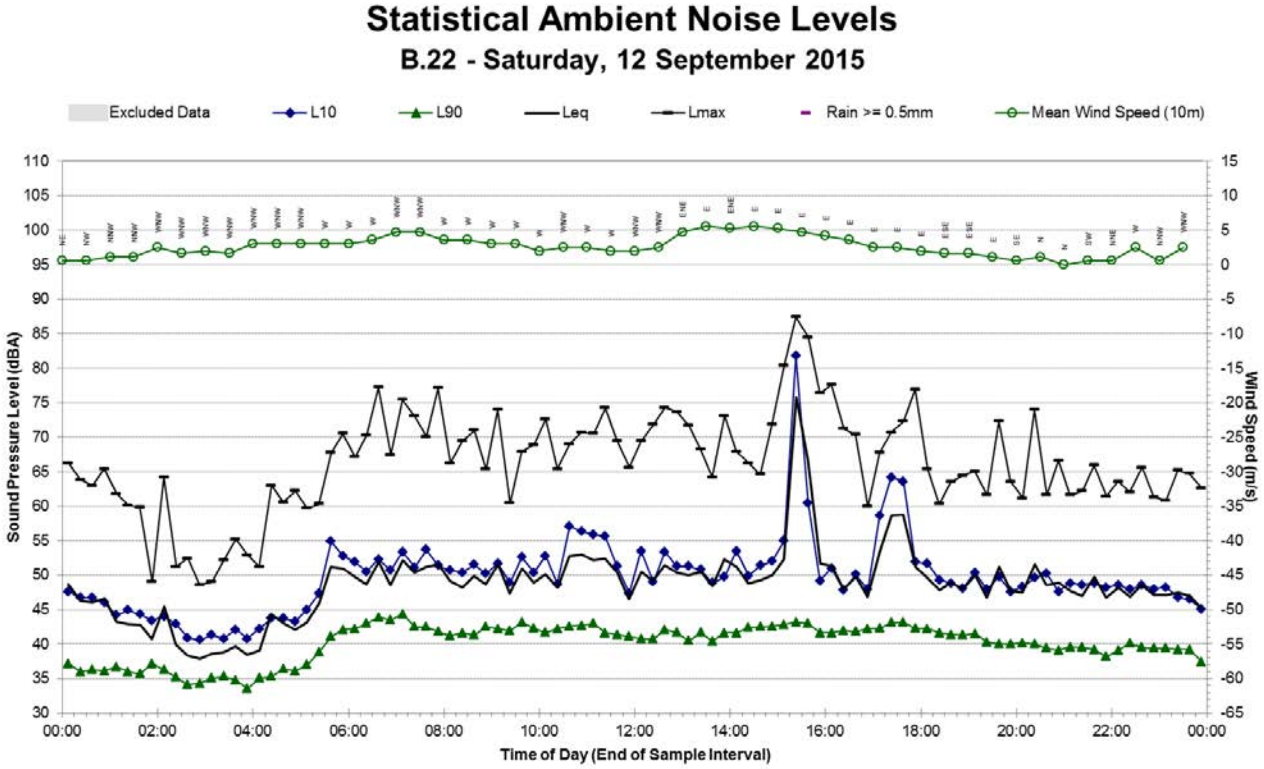


Statistical Ambient Noise Levels
B.22 - Thursday, 10 September 2015

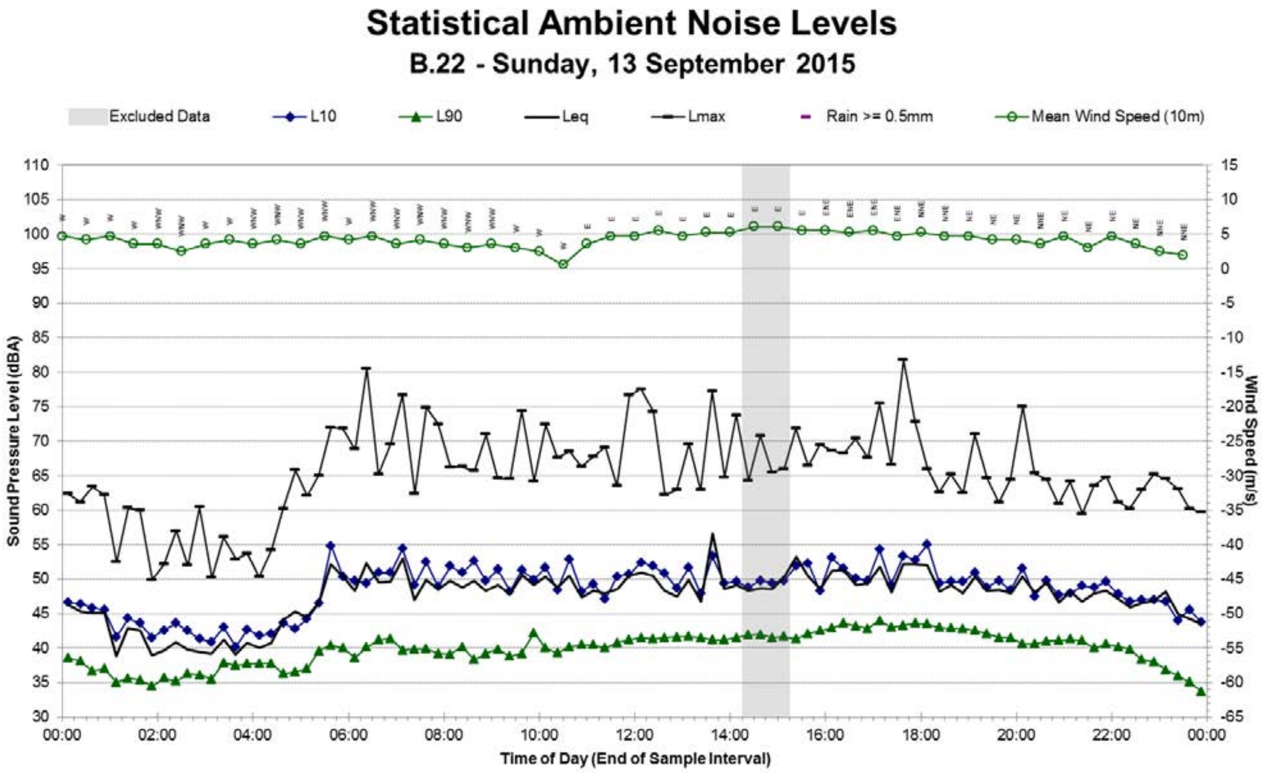


Statistical Ambient Noise Levels
B.22 - Friday, 11 September 2015



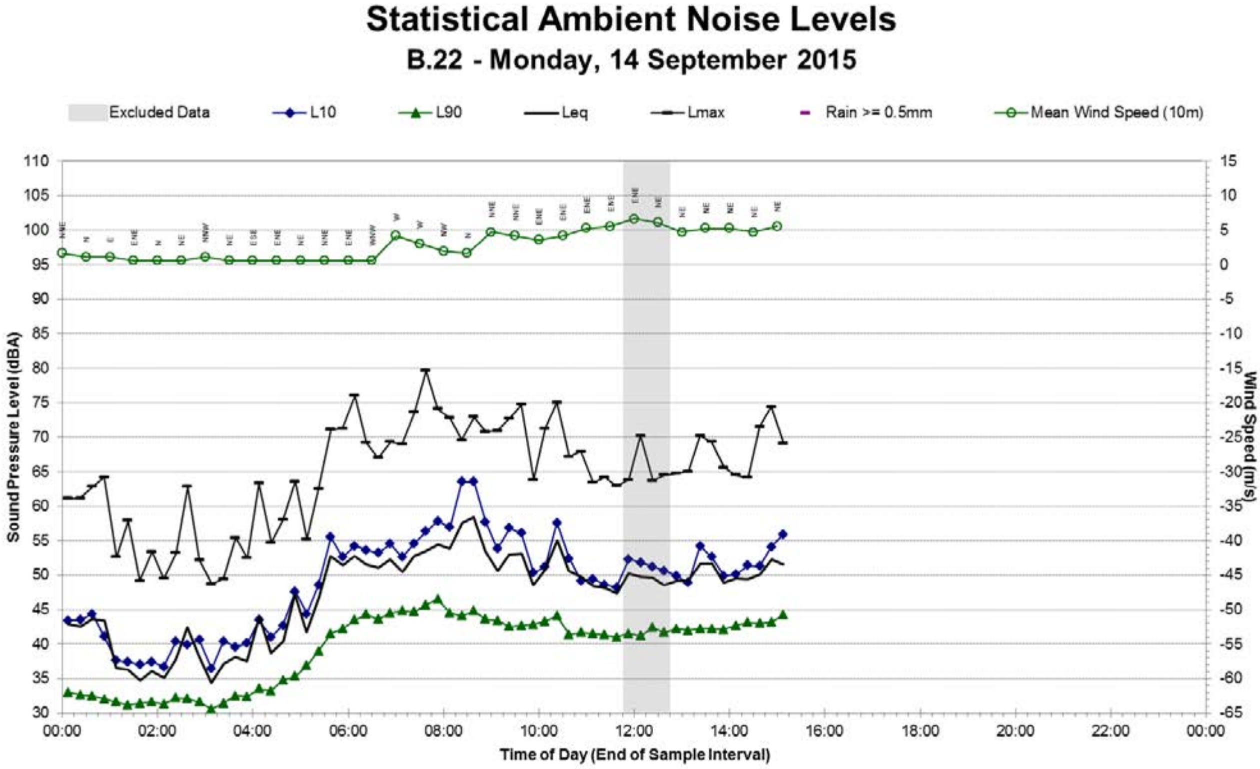


Statistical Ambient Noise Levels
B.22 - Saturday, 12 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
B.22 - Sunday, 13 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Background Noise Monitoring Results – B.22



Background Noise Monitoring Results – B.23

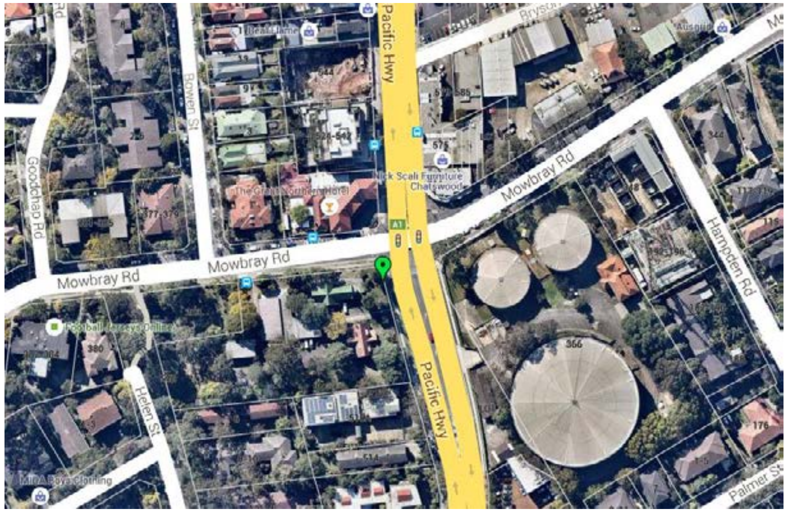
Noise Monitoring Location:	**B.23**
Noise Monitoring Address:	**518 Pacific Highway, Lane Cove North 2067 (Chatswood South Uniting Church)**

Logger Device Type: ARL-EL316
Logger Serial No: 16-306-041

Ambient noise logger deployed in the front garden of the Chatswood South Uniting Church at address 518 Pacific Highway, Lane Cove North.

Attended noise measurements indicate that the ambient noise environment at this location is dominated by road traffic noise from the Pacific Highway and Mowbray Road.

Map of Noise Monitoring Location



Ambient Noise Logging Results – INP Defined Time Periods

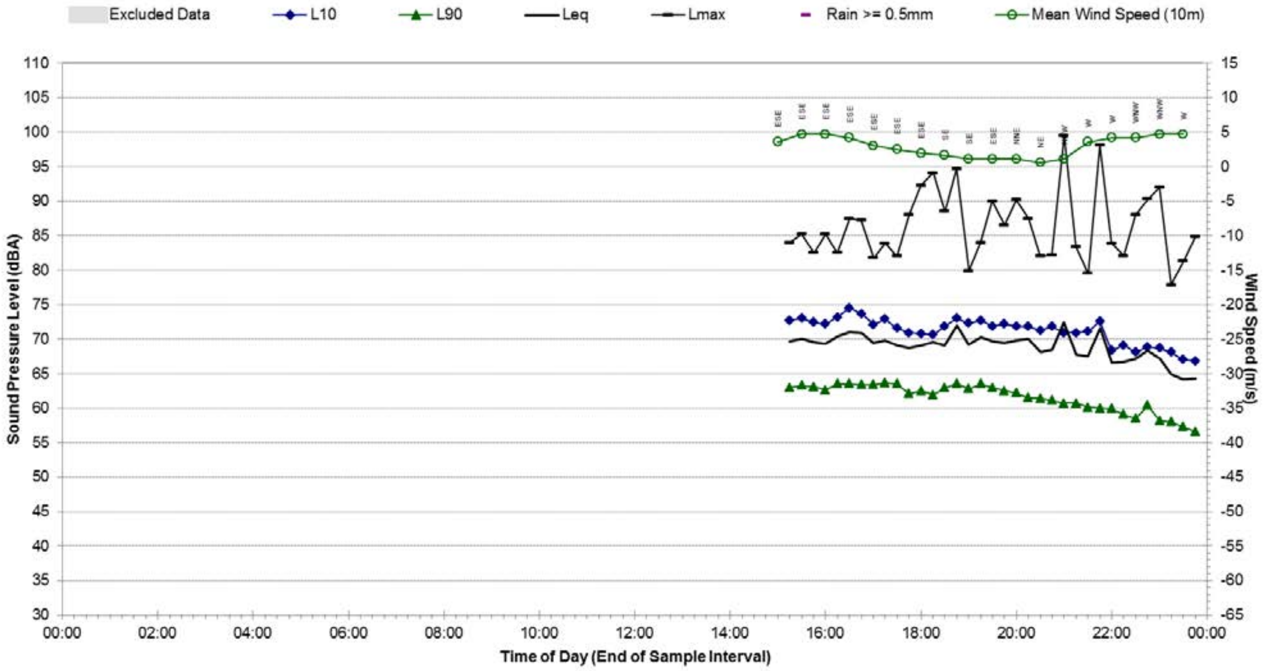
Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	63	71	73	78
Evening	60	70	71	77
Night-time	45	67	68	75

Attended Noise Measurement Results

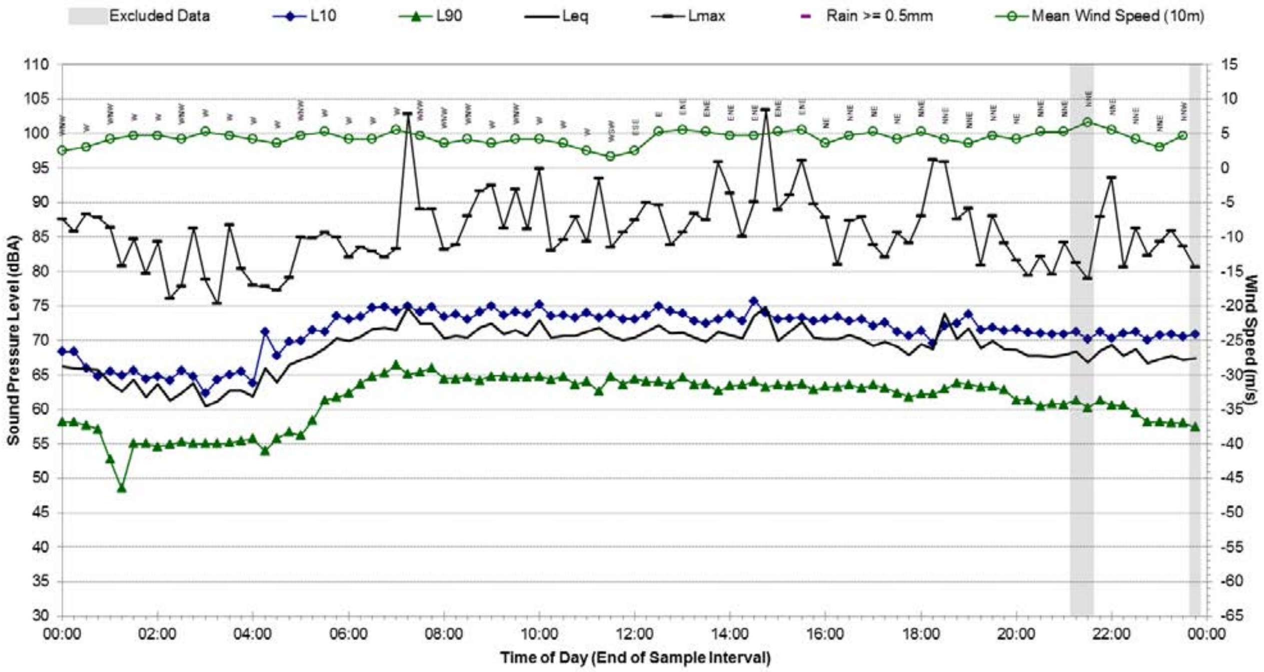
Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
15/09/2015	14:42:46	64	69	86

Photo of Noise Monitoring Location

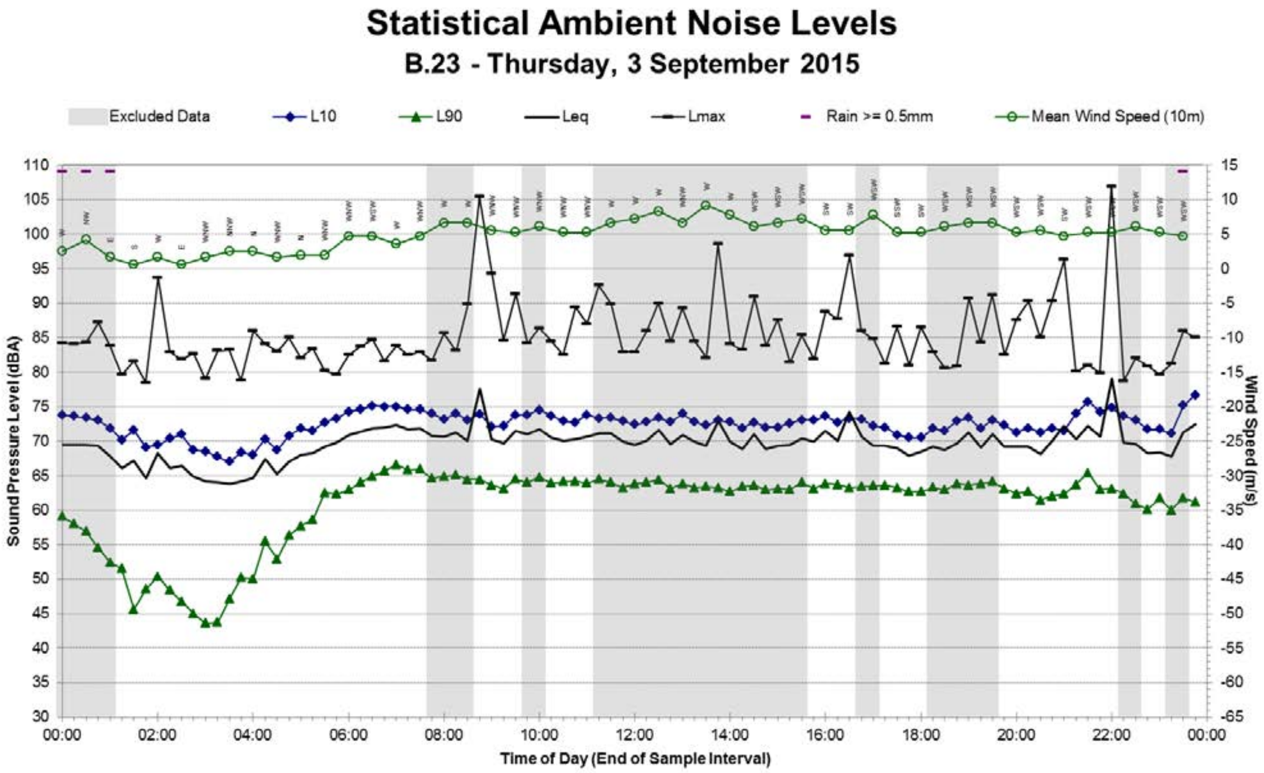
Statistical Ambient Noise Levels
B.23 - Tuesday, 1 September 2015

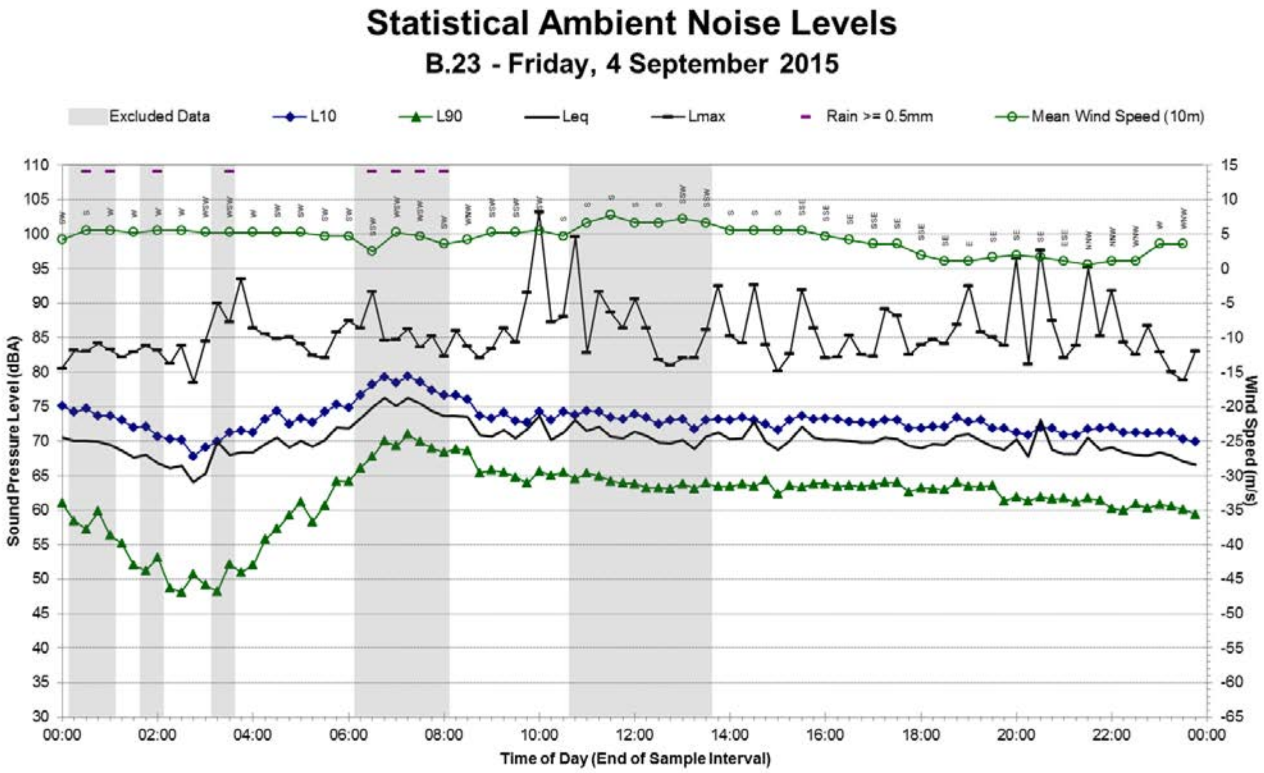


Statistical Ambient Noise Levels
B.23 - Wednesday, 2 September 2015



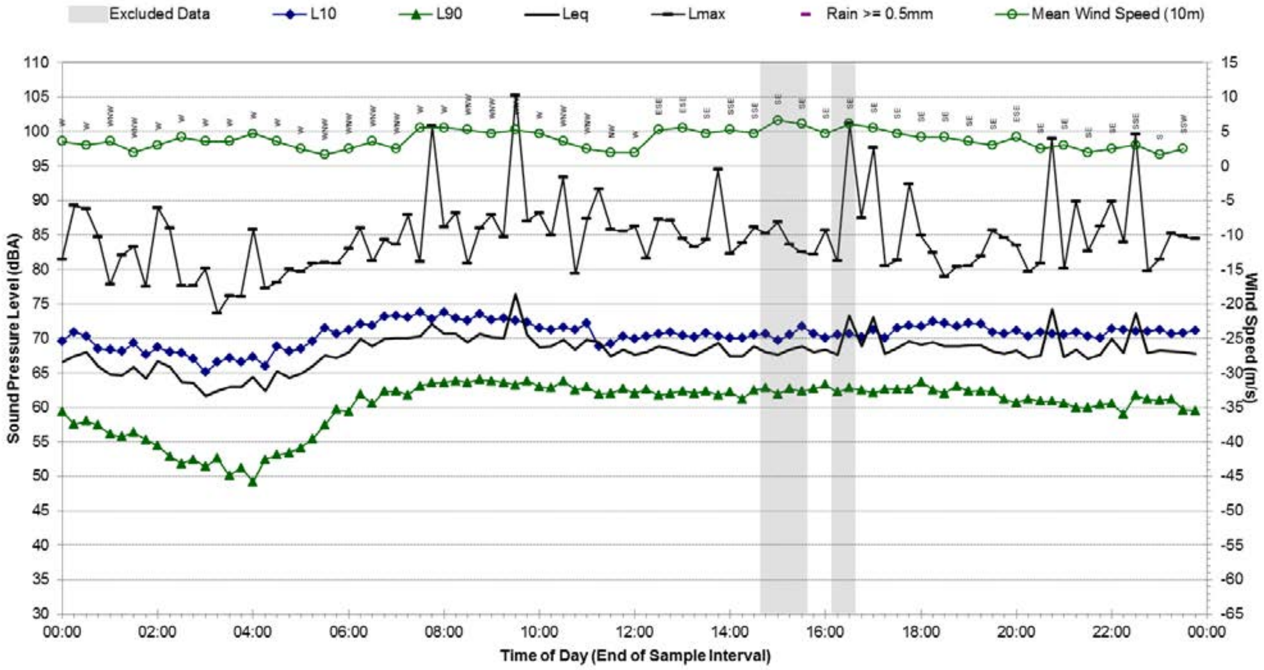
Background Noise Monitoring Results – B.23





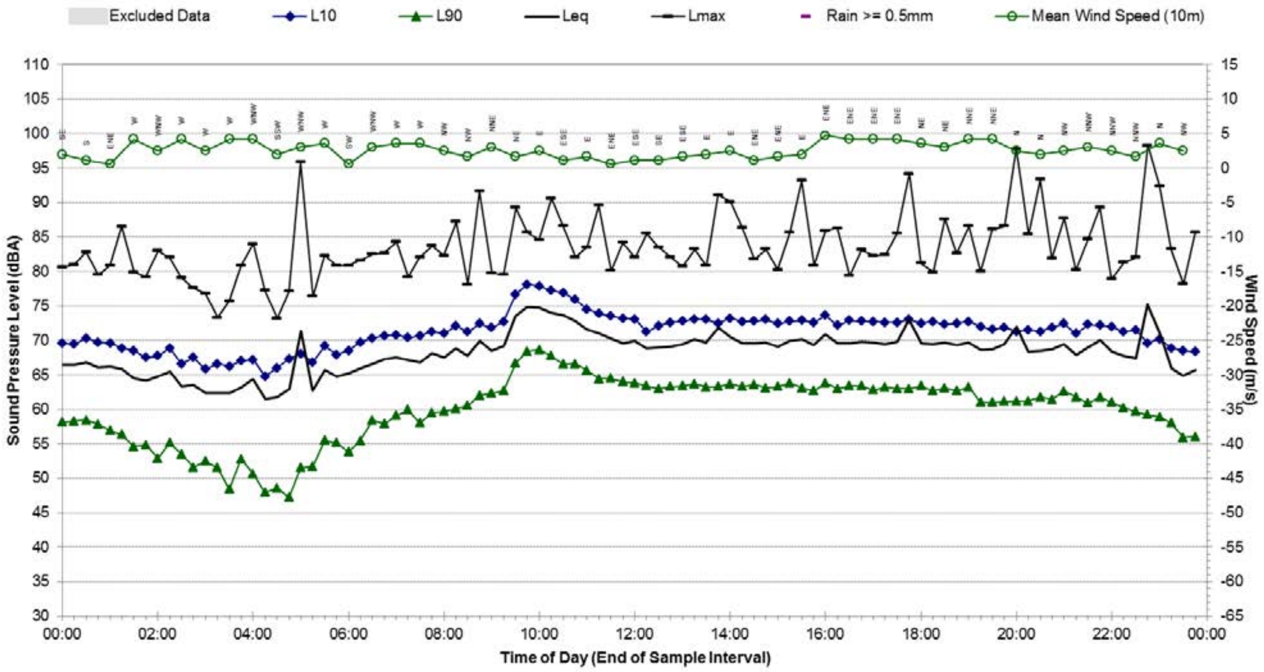
Statistical Ambient Noise Levels

B.23 - Saturday, 5 September 2015

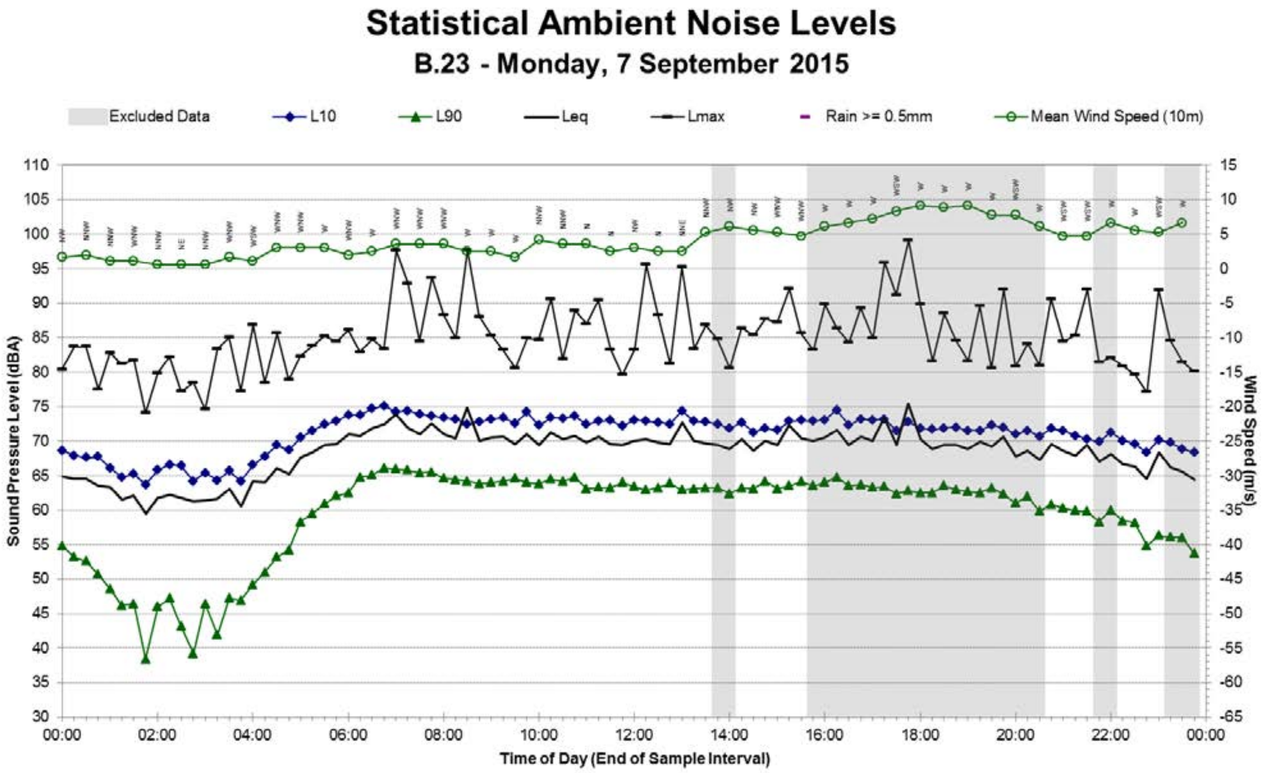


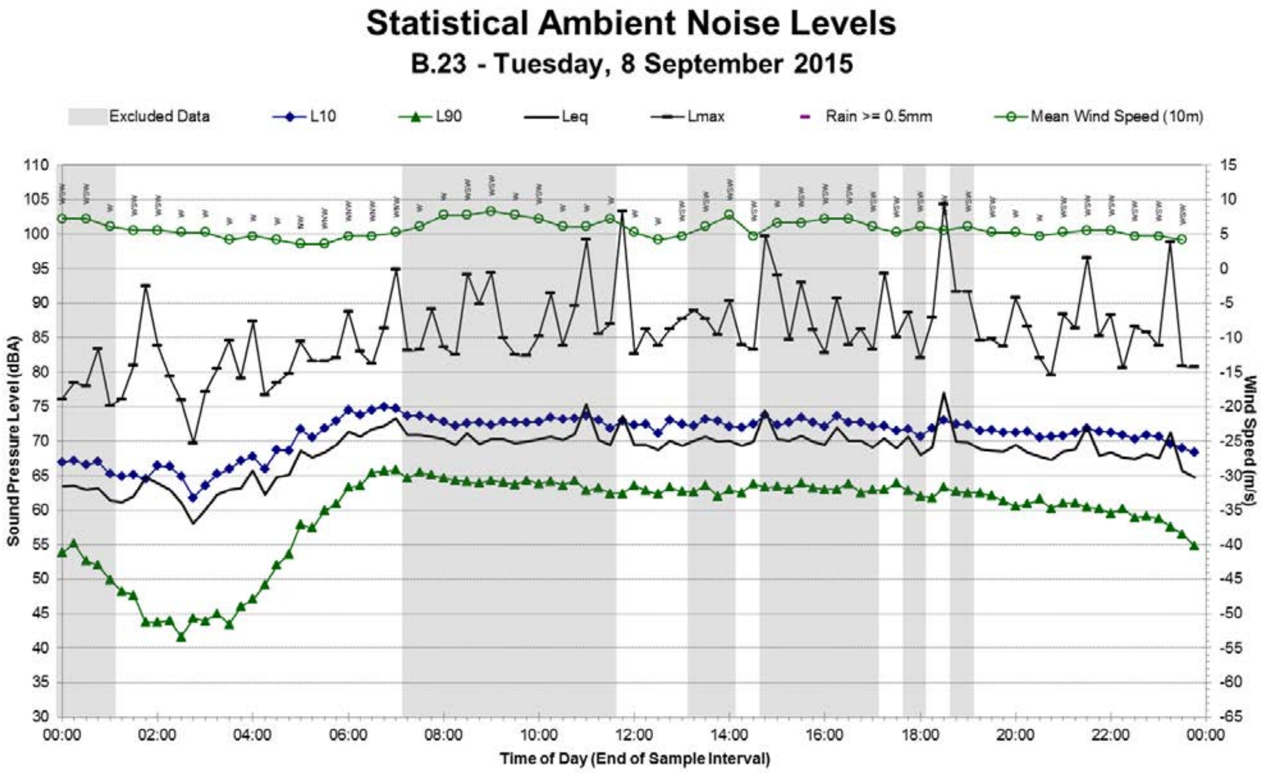
Statistical Ambient Noise Levels

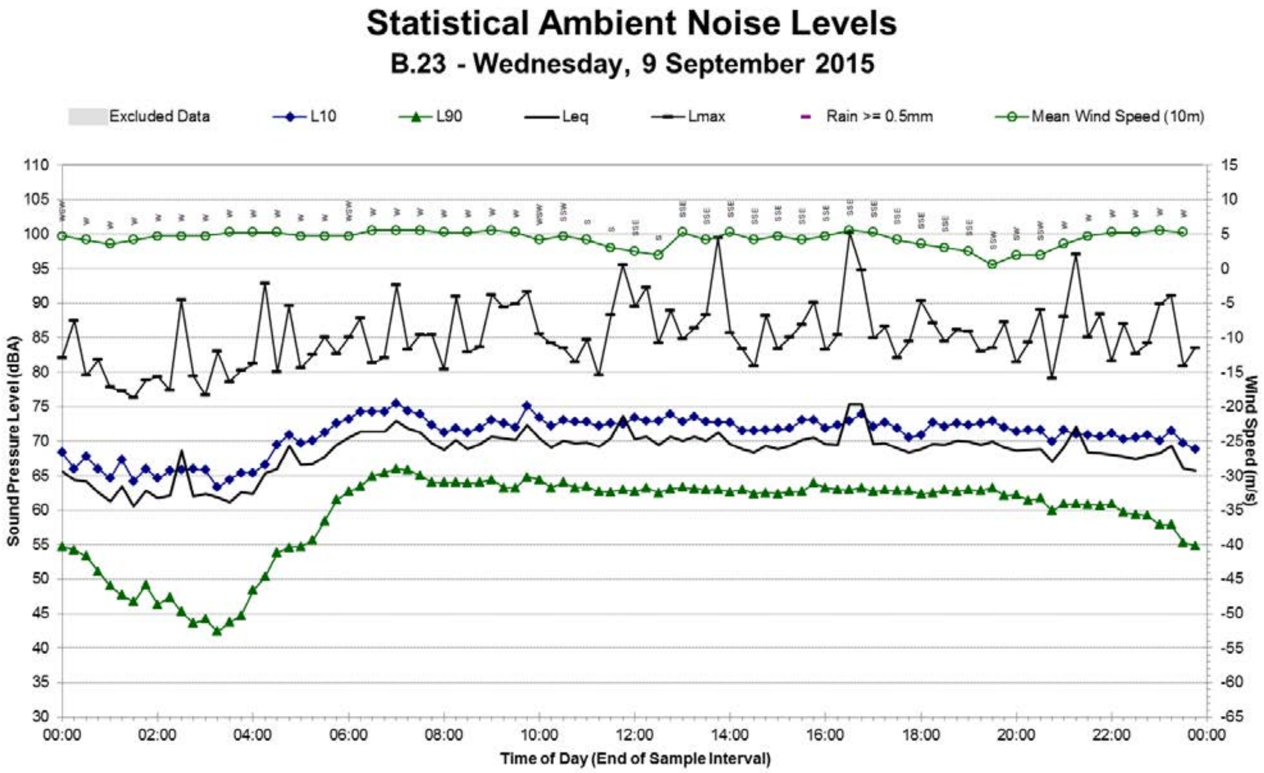
B.23 - Sunday, 6 September 2015

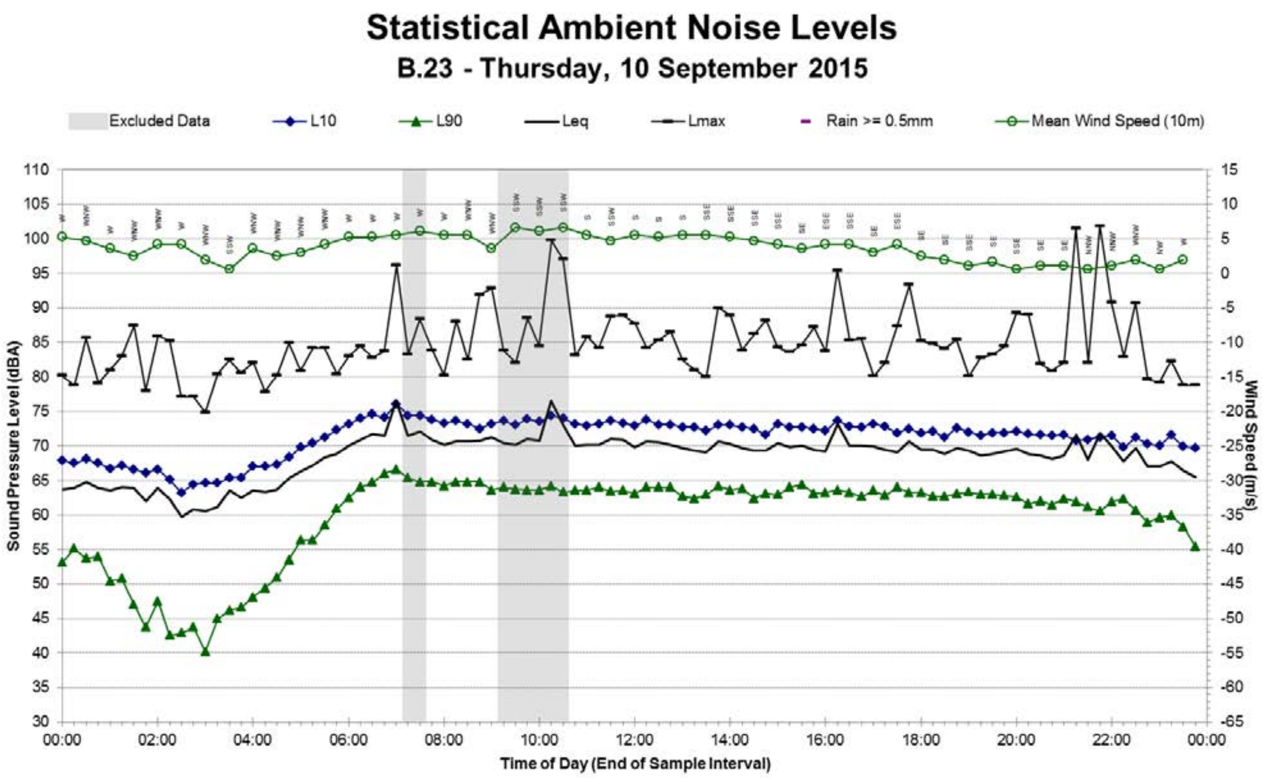


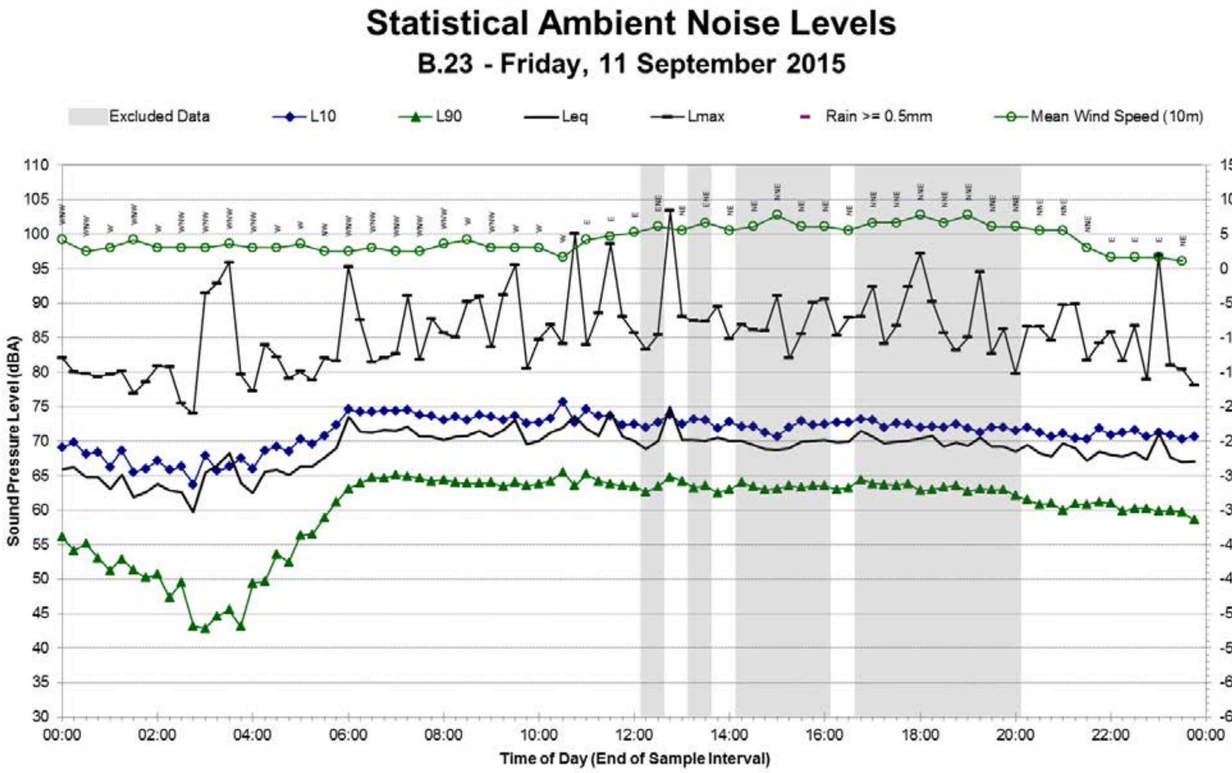
Background Noise Monitoring Results – B.23



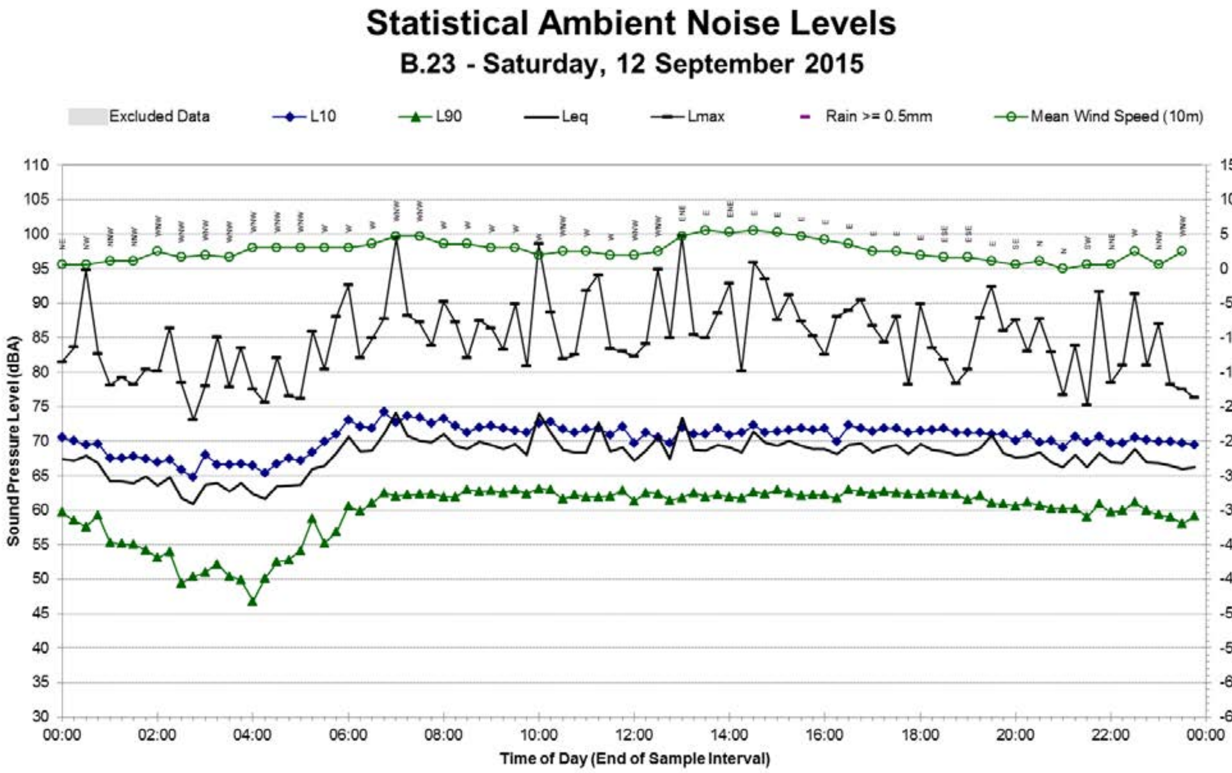



Statistical Ambient Noise Levels
B.23 - Wednesday, 9 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

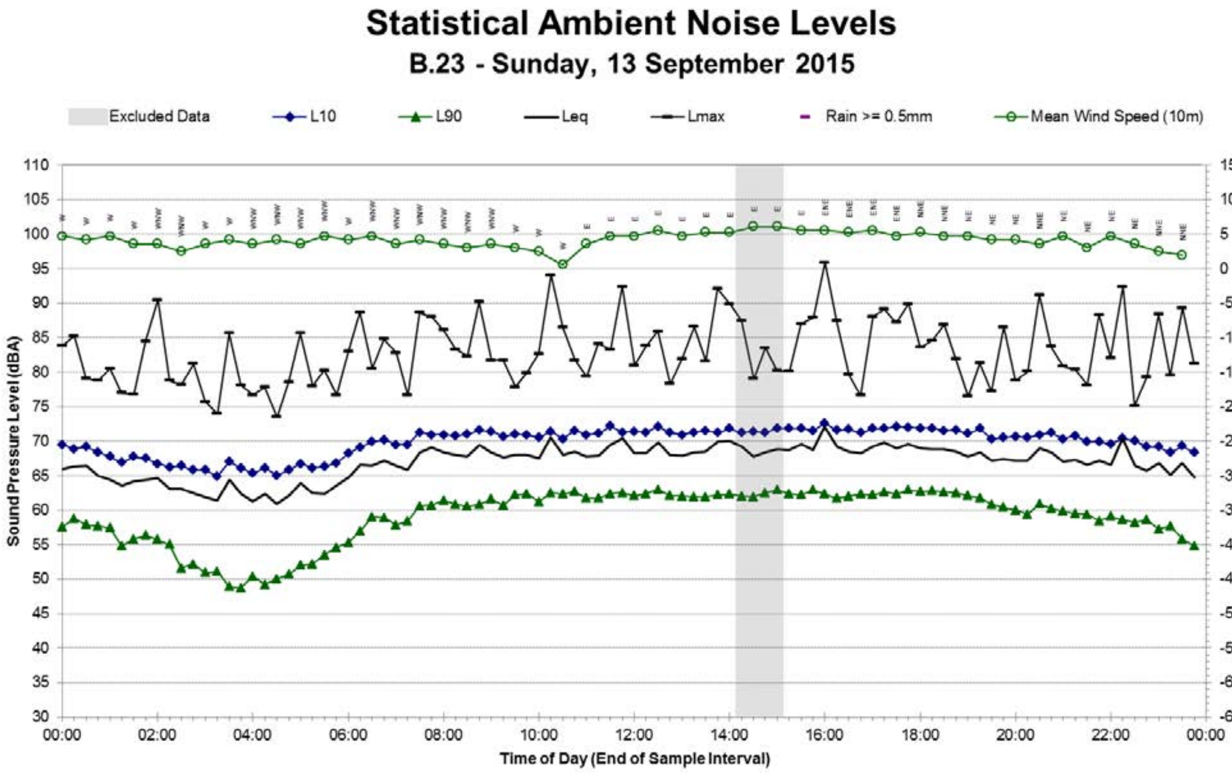

Statistical Ambient Noise Levels
B.23 - Thursday, 10 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

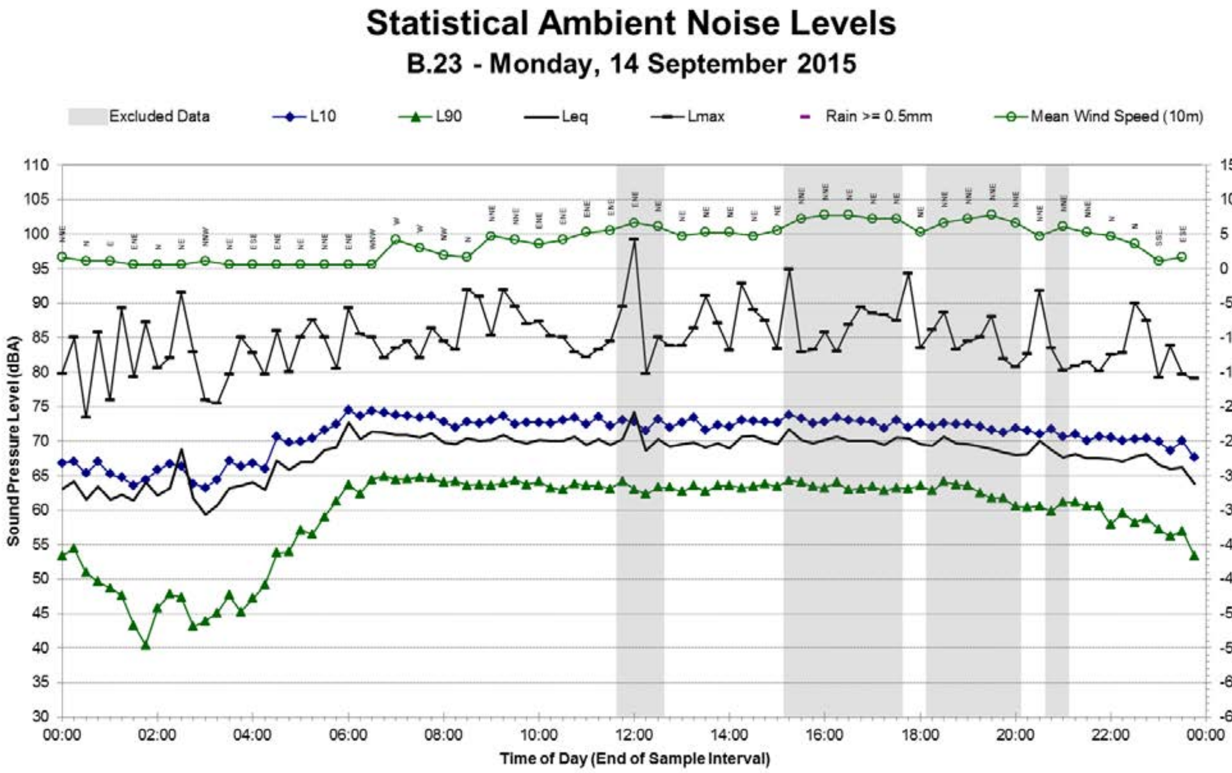


Statistical Ambient Noise Levels
B.23 - Friday, 11 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

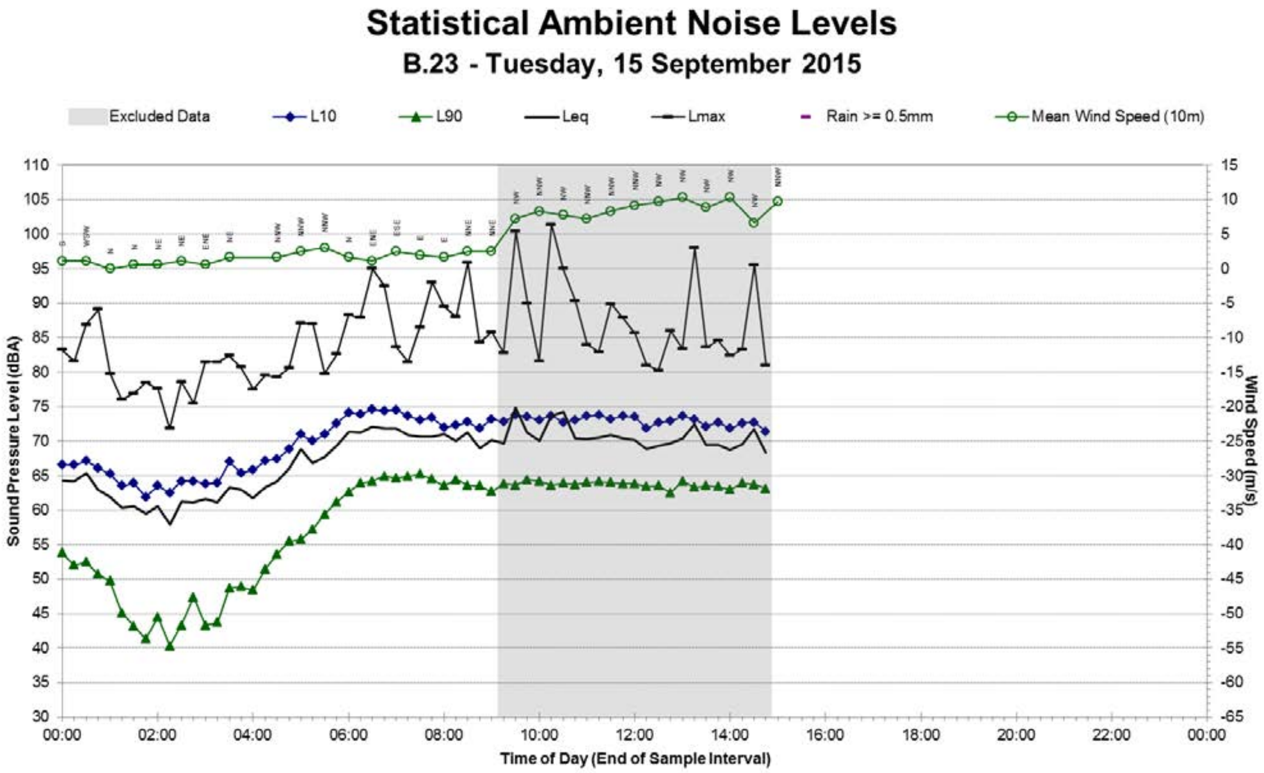


Statistical Ambient Noise Levels
B.23 - Saturday, 12 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
B.23 - Sunday, 13 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
B.23 - Monday, 14 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Background Noise Monitoring Results – B.23



Background Noise Monitoring Results – B.24

Noise Monitoring Location:	**B.24**
Noise Monitoring Address:	**14 Nelson Street, Chatswood 2067 (Ausgrid)**

Logger Device Type: Svantek 957
Logger Serial No: 21884

Ambient noise logger deployed on the eastern side of the Chatswood Ausgrid complex at address 14 Nelson Street, Chatswood.

Attended noise measurements indicate the ambient noise environment at this location is dominated by rail traffic noise from the North Shore Line. Road traffic noise from Mowbray Road also provides regular contribution to the background noise at this location.

Map of Noise Monitoring Location

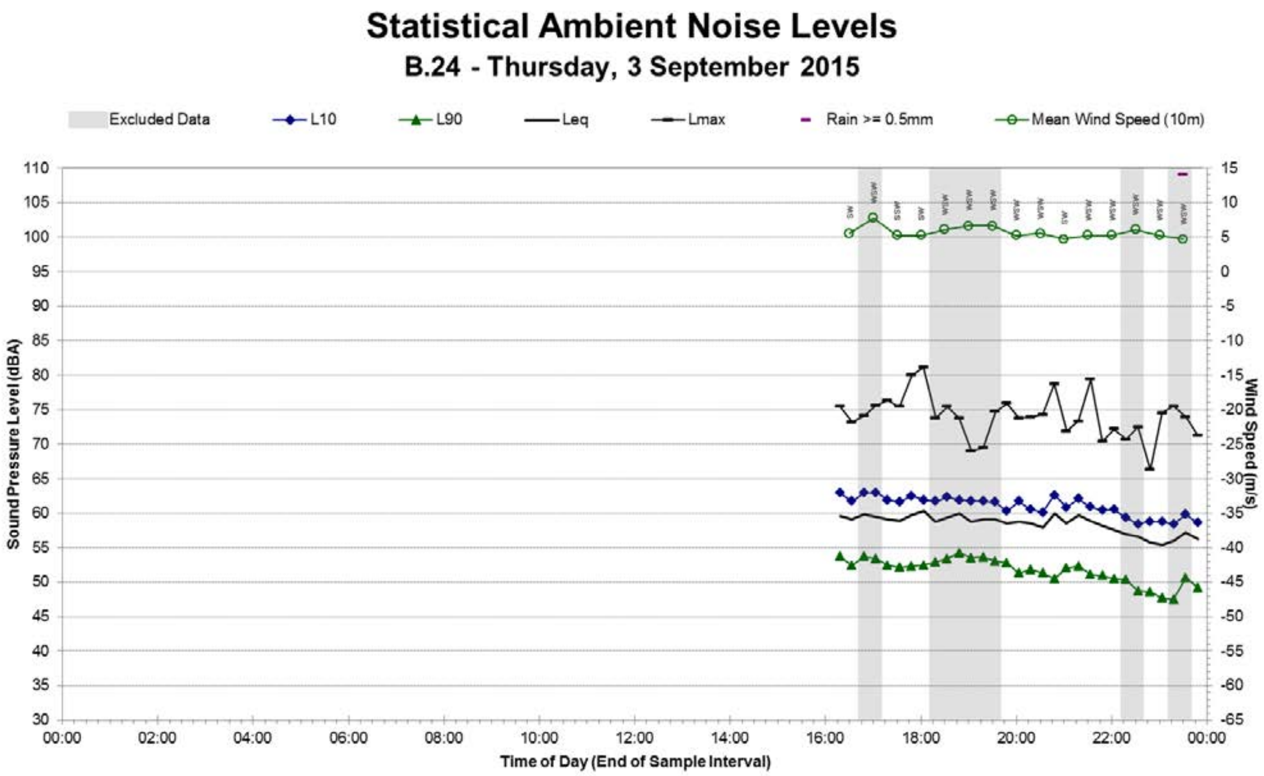
Ambient Noise Logging Results – INP Defined Time Periods

Monitoring Period	**Noise Level (dBA)**			
	RBL	**LAeq**	**L10**	**L1**
Daytime	50	59	62	68
Evening	47	58	60	68
Night-time	39	55	56	65

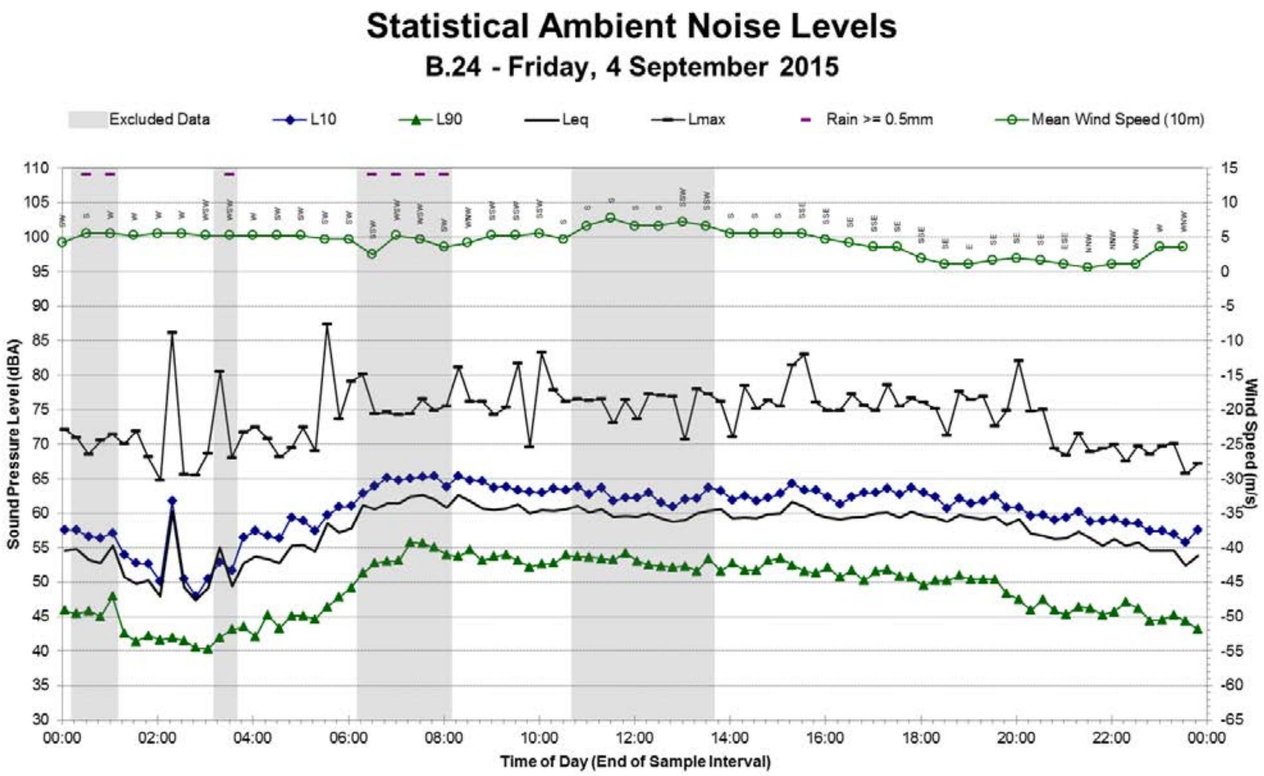
Attended Noise Measurement Results

Date	**Start Time**	**Measured Noise Level (dBA)**		
		LA90	**LAeq**	**LAmax**
16/09/2015	10:03:31	51	58	72

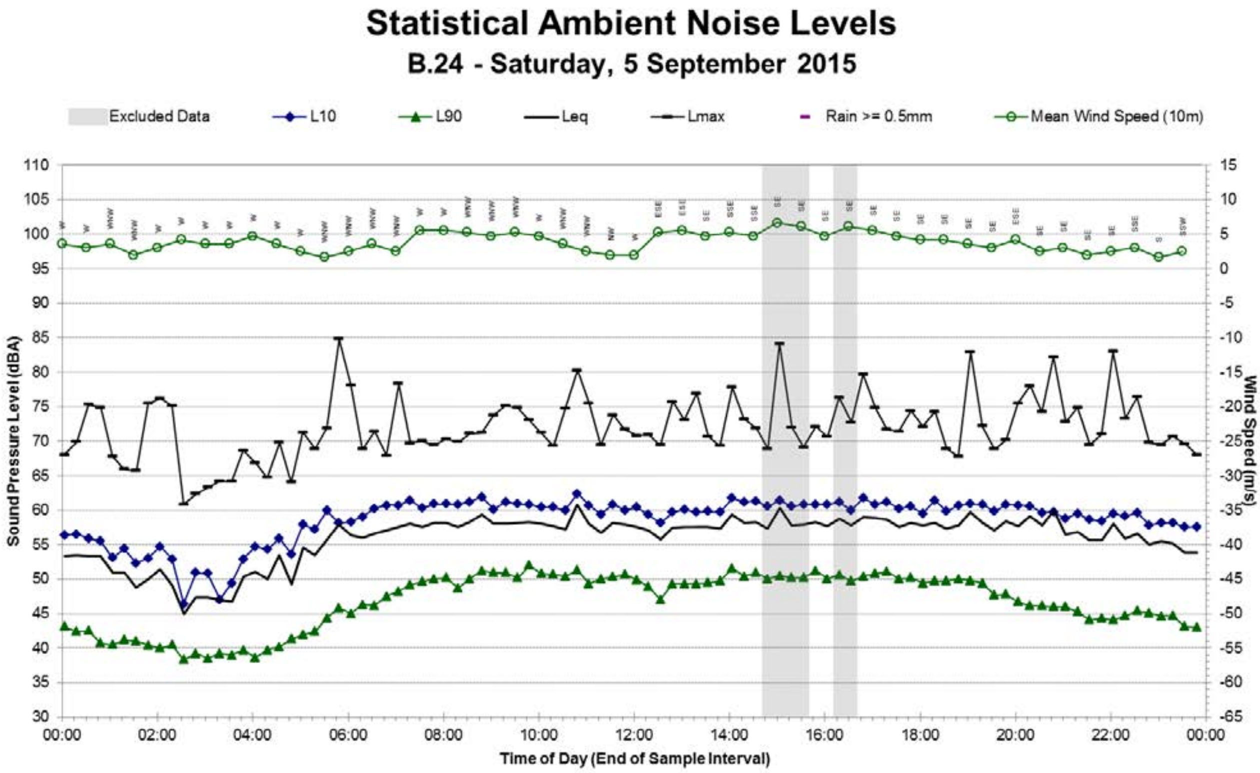
Photo of Noise Monitoring Location

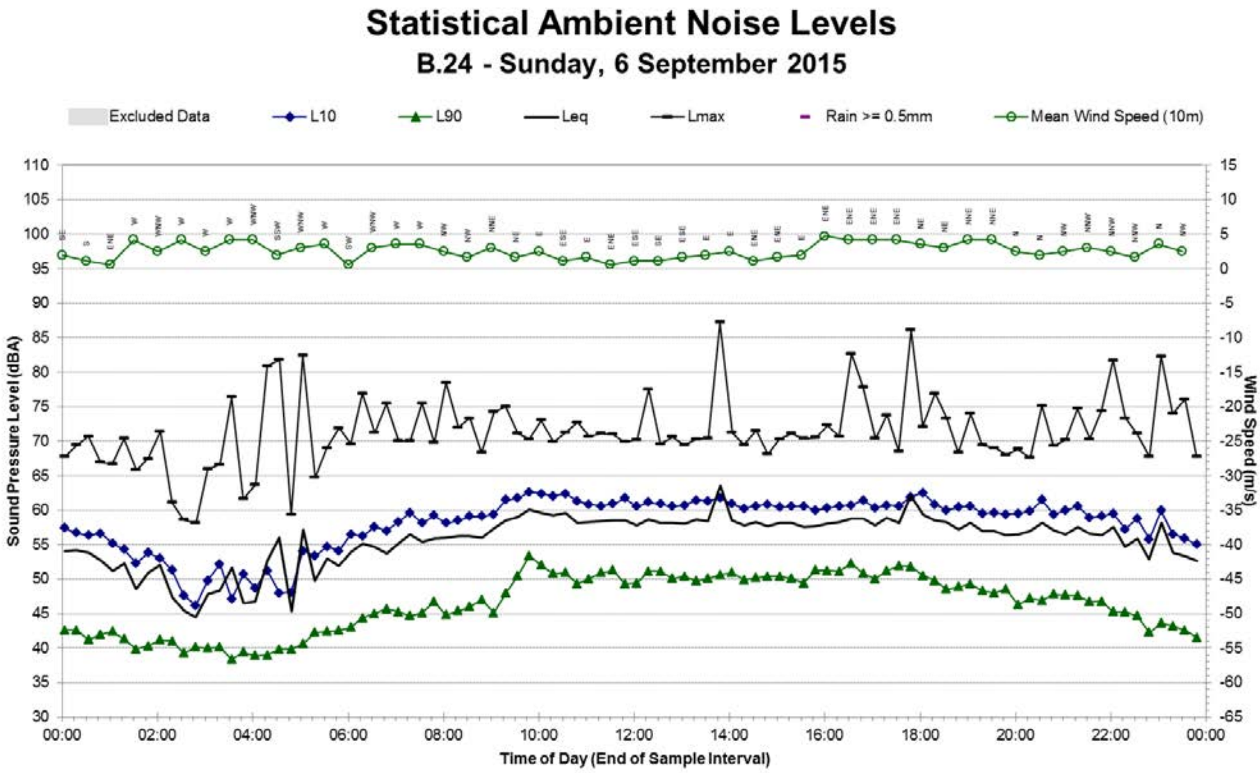


Statistical Ambient Noise Levels
B.24 - Thursday, 3 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

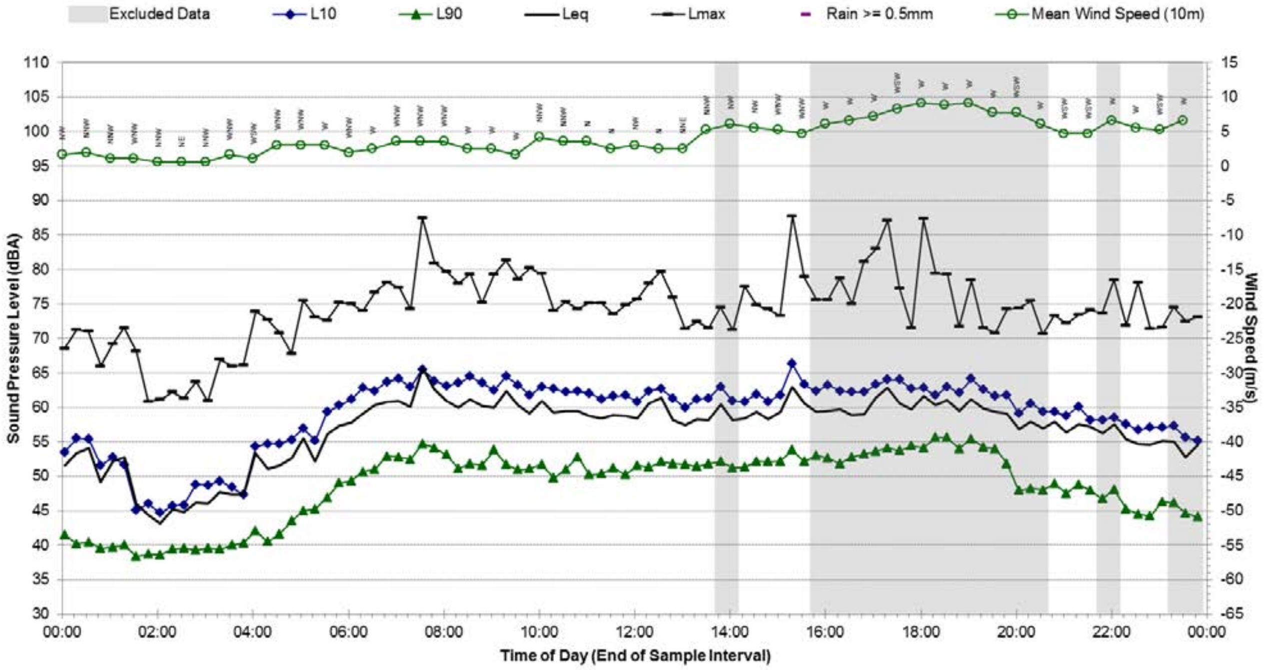


Statistical Ambient Noise Levels
B.24 - Friday, 4 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

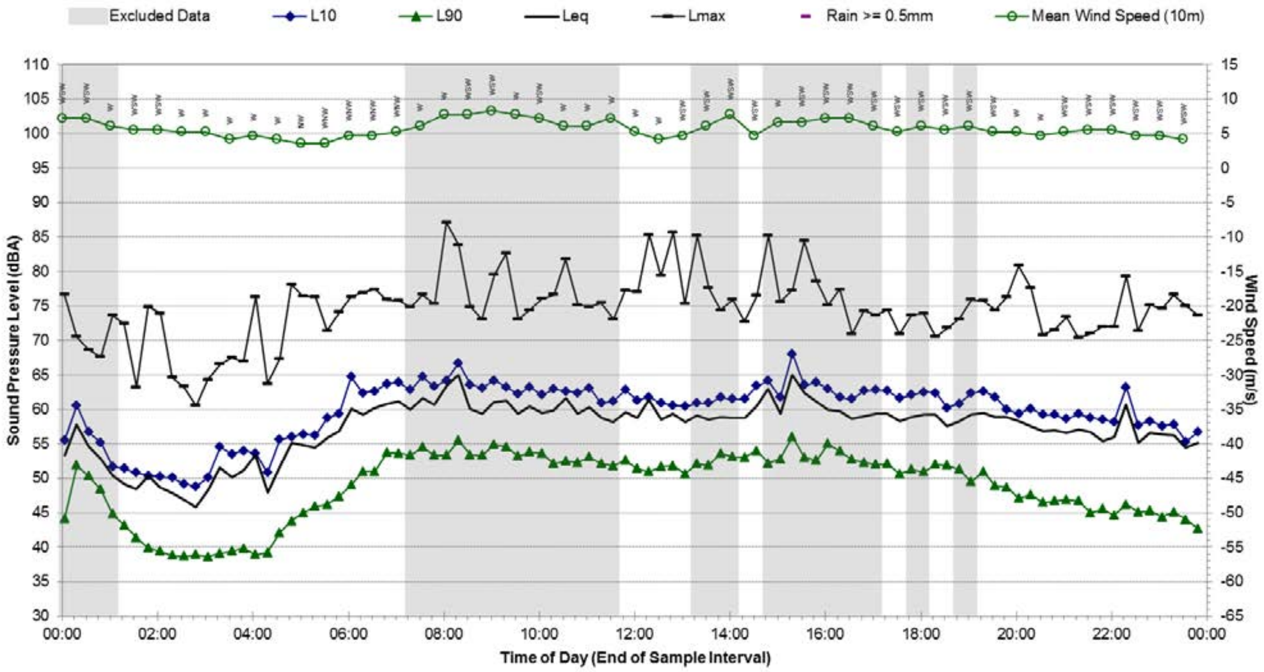

Statistical Ambient Noise Levels
B.24 - Saturday, 5 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
B.24 - Sunday, 6 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

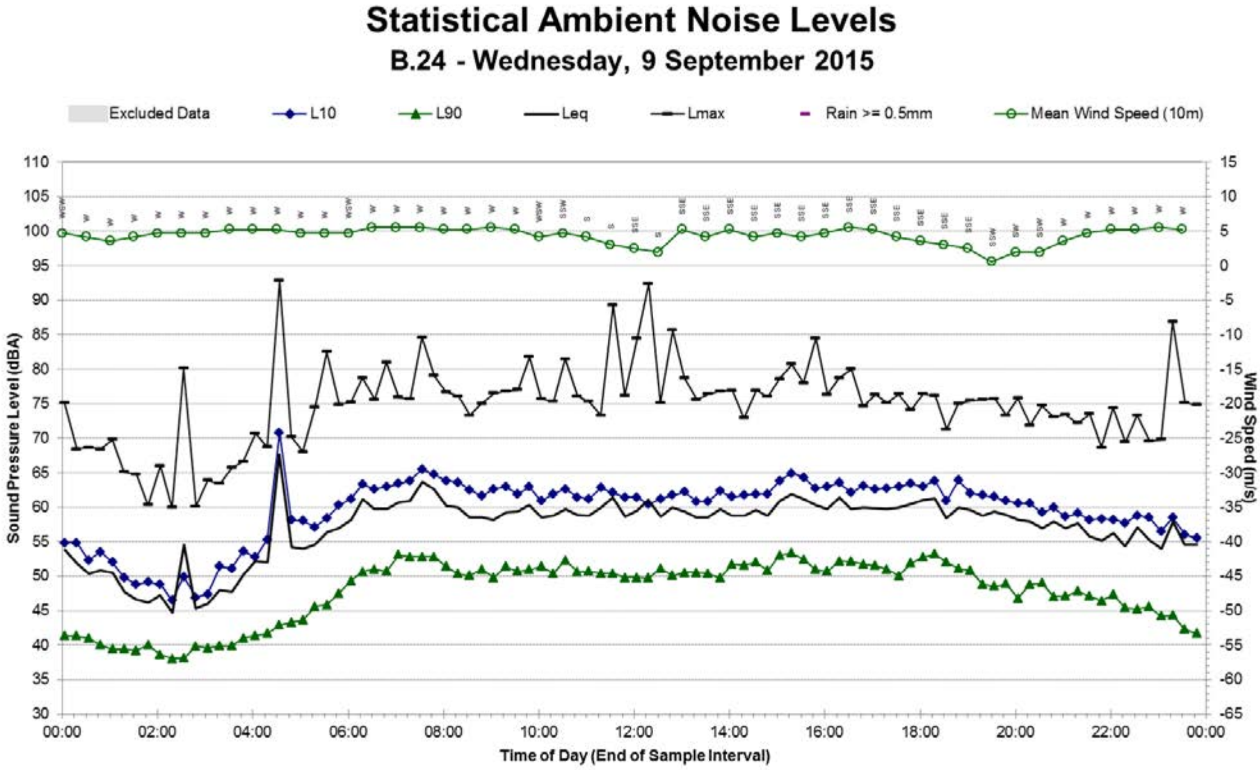
Statistical Ambient Noise Levels
B.24 - Monday, 7 September 2015

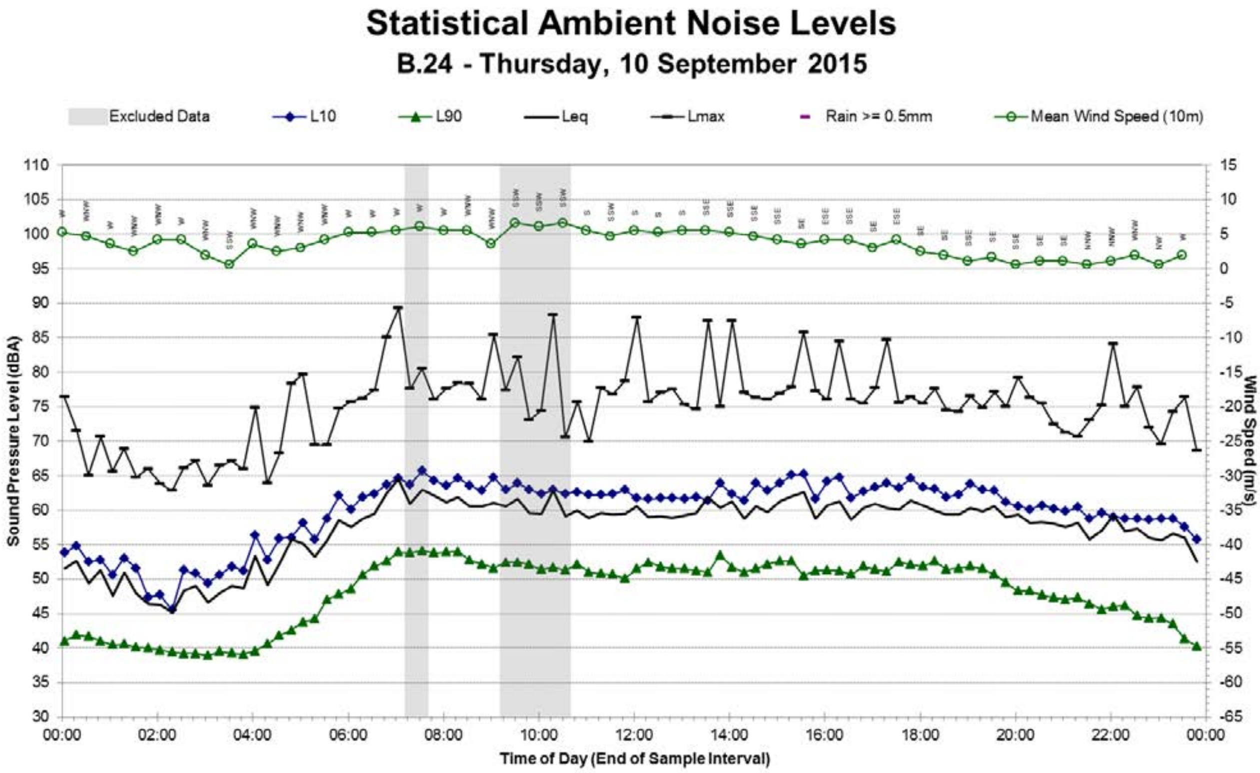


Statistical Ambient Noise Levels
B.24 - Tuesday, 8 September 2015

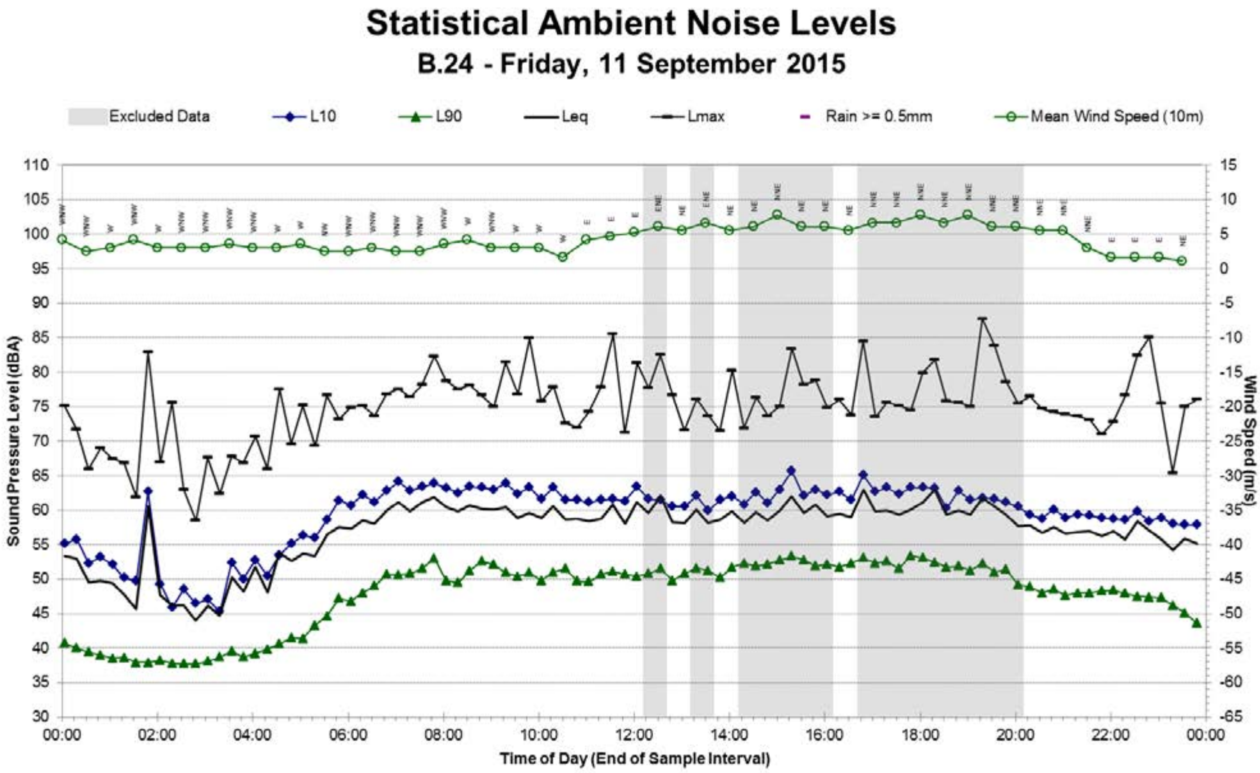


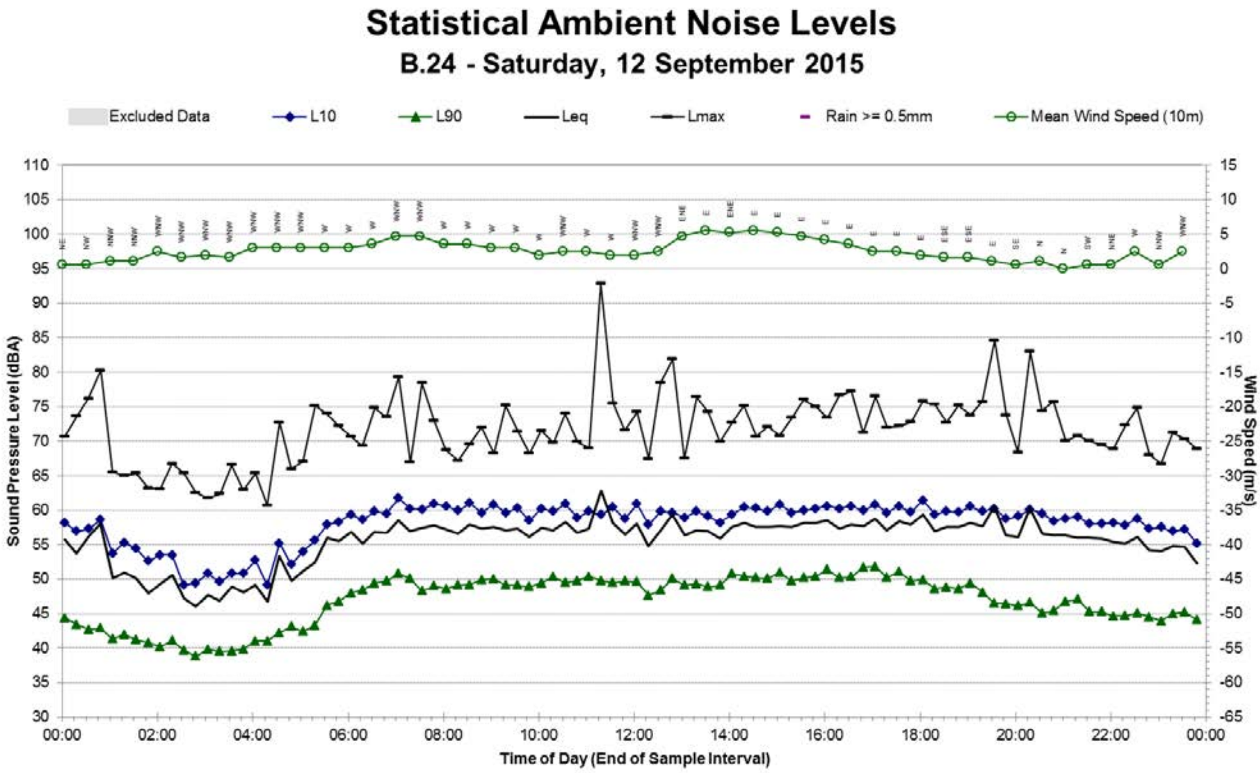
Background Noise Monitoring Results – B.24



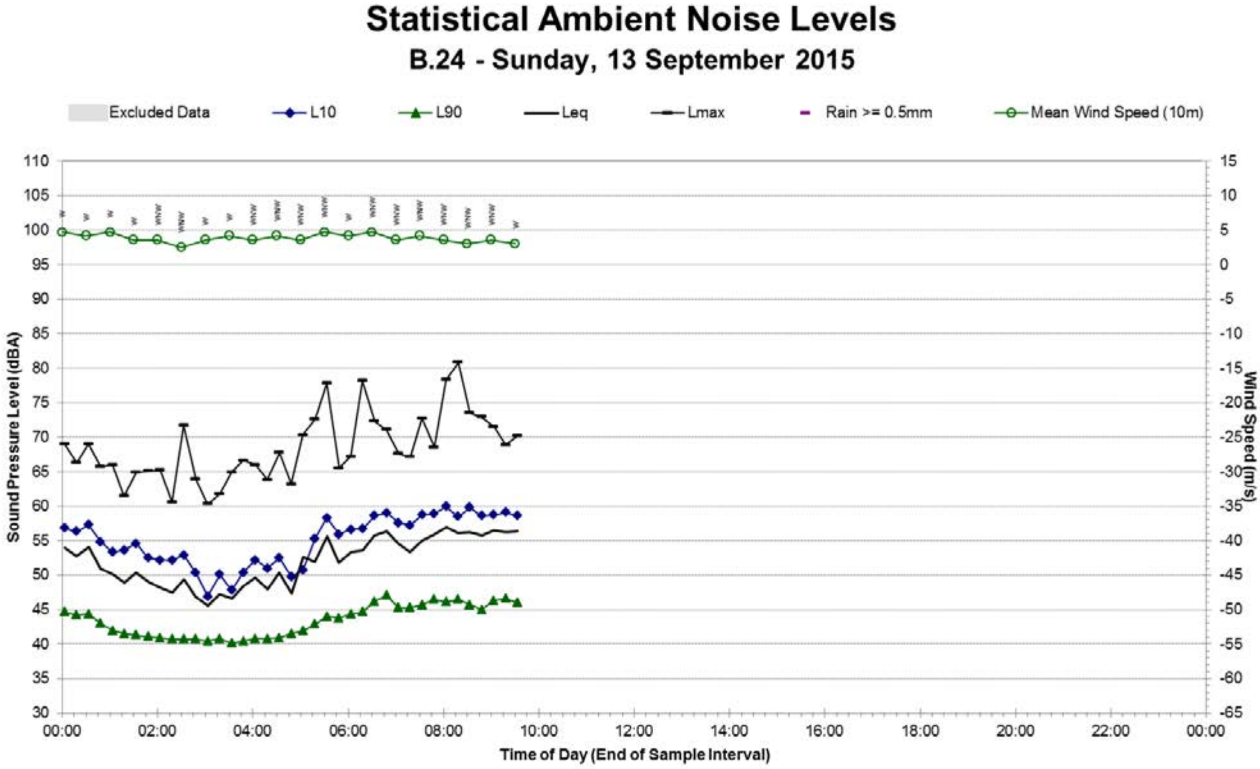


Background Noise Monitoring Results – B.24





Background Noise Monitoring Results – B.24



Noise Monitoring Location:	B.25
Noise Monitoring Address:	**13 Hopetoun Avenue, Chatswood 2067**

Logger Device Type: Svantek 957
Logger Serial No: 23815

Ambient noise logger deployed in the front garden of residential address 13 Hopetoun Avenue, Chatswood.

Attended noise measurements indicate the ambient noise environment at this location is affected by rail traffic noise from the North Shore Line. The shielding provided by the noise wall to the rail line and observed low speeds of the passing trains arriving and leaving Chatswood Station resulted in lower noise levels.

Map of Noise Monitoring Location

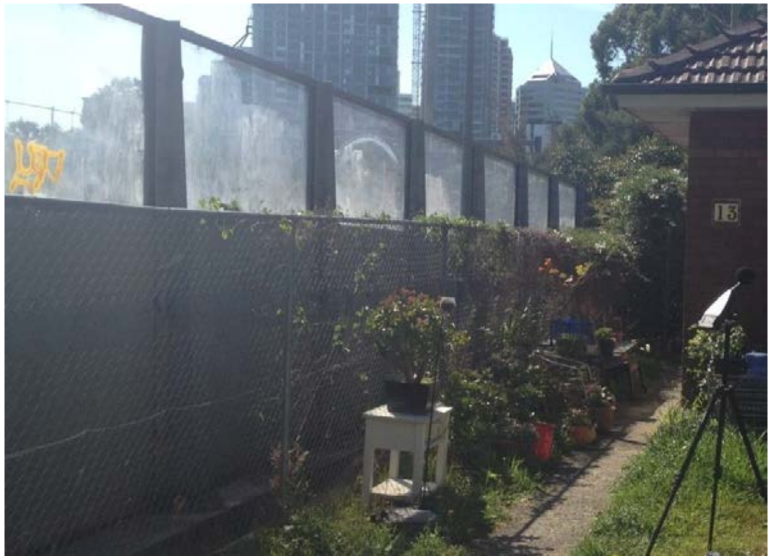
Ambient Noise Logging Results – INP Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	**LAeq**	**L10**	**L1**
Daytime	41	54	54	66
Evening	40	53	52	65
Night-time	35	49	43	62

Attended Noise Measurement Results

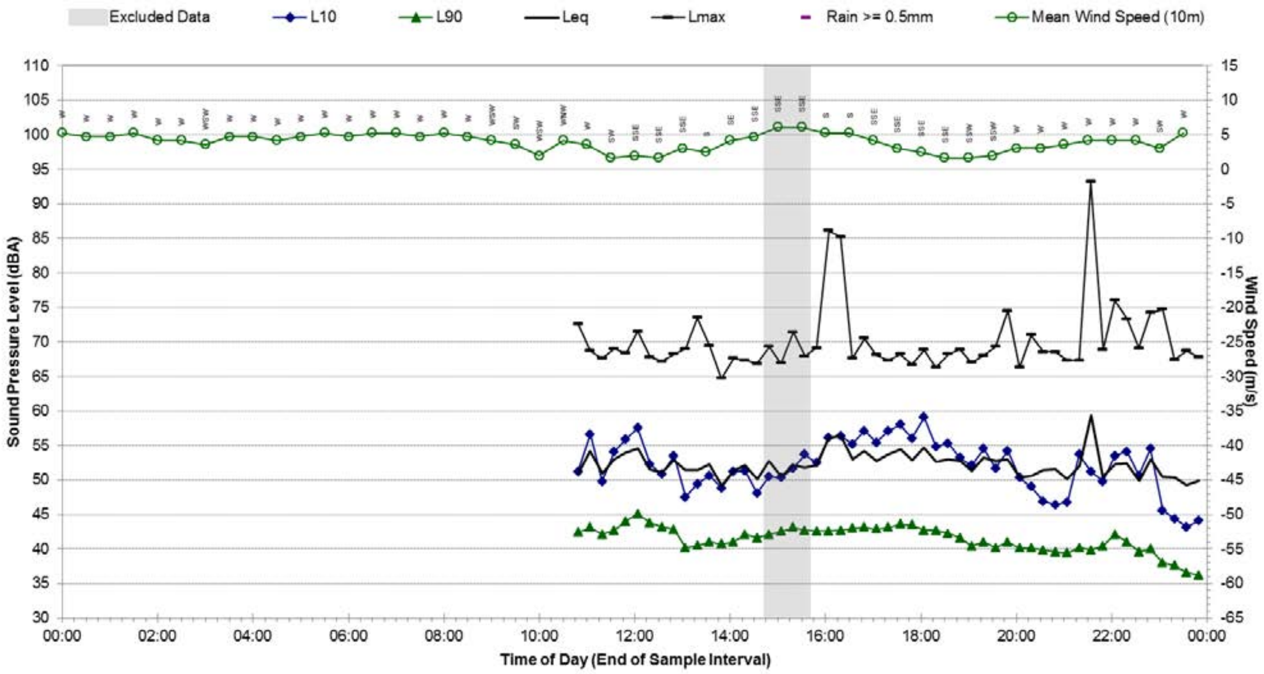
Date	Start Time	Measured Noise Level (dBA)		
		LA90	**LAeq**	**LAmax**
14/09/2015	13:34:19	45	51	67

Photo of Noise Monitoring Location

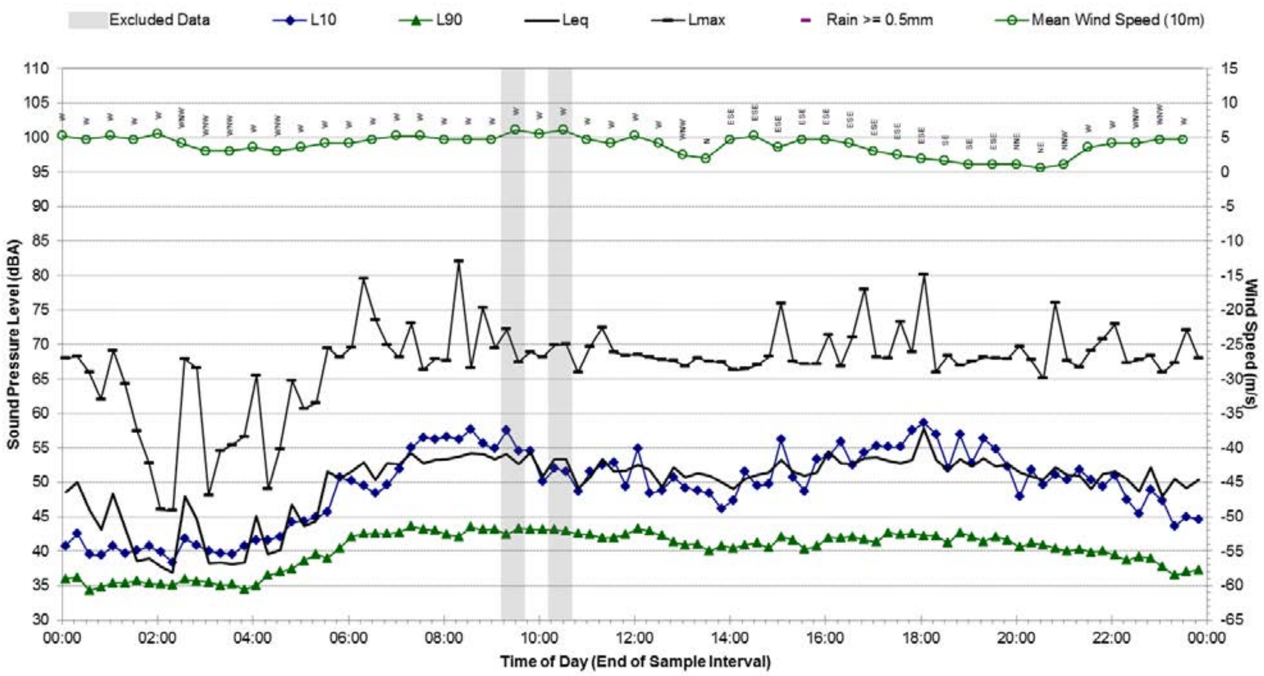


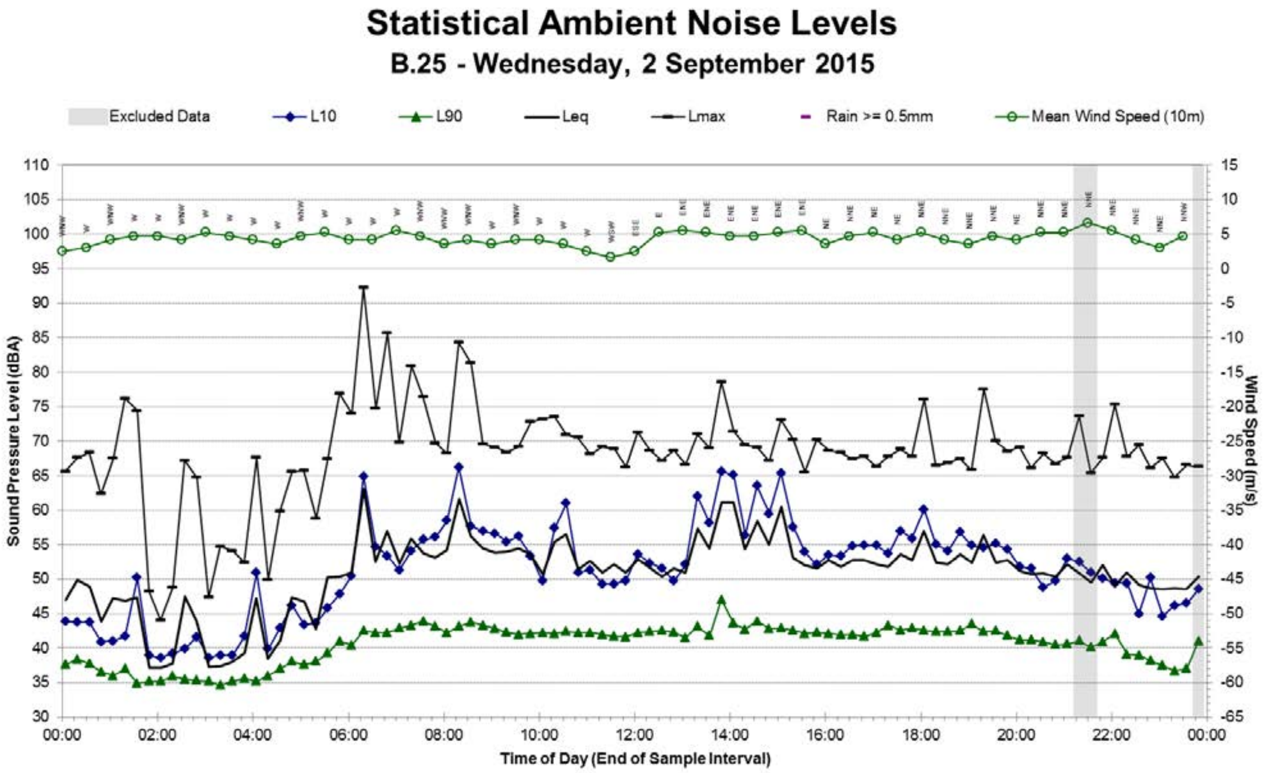
Background Noise Monitoring Results – B.25

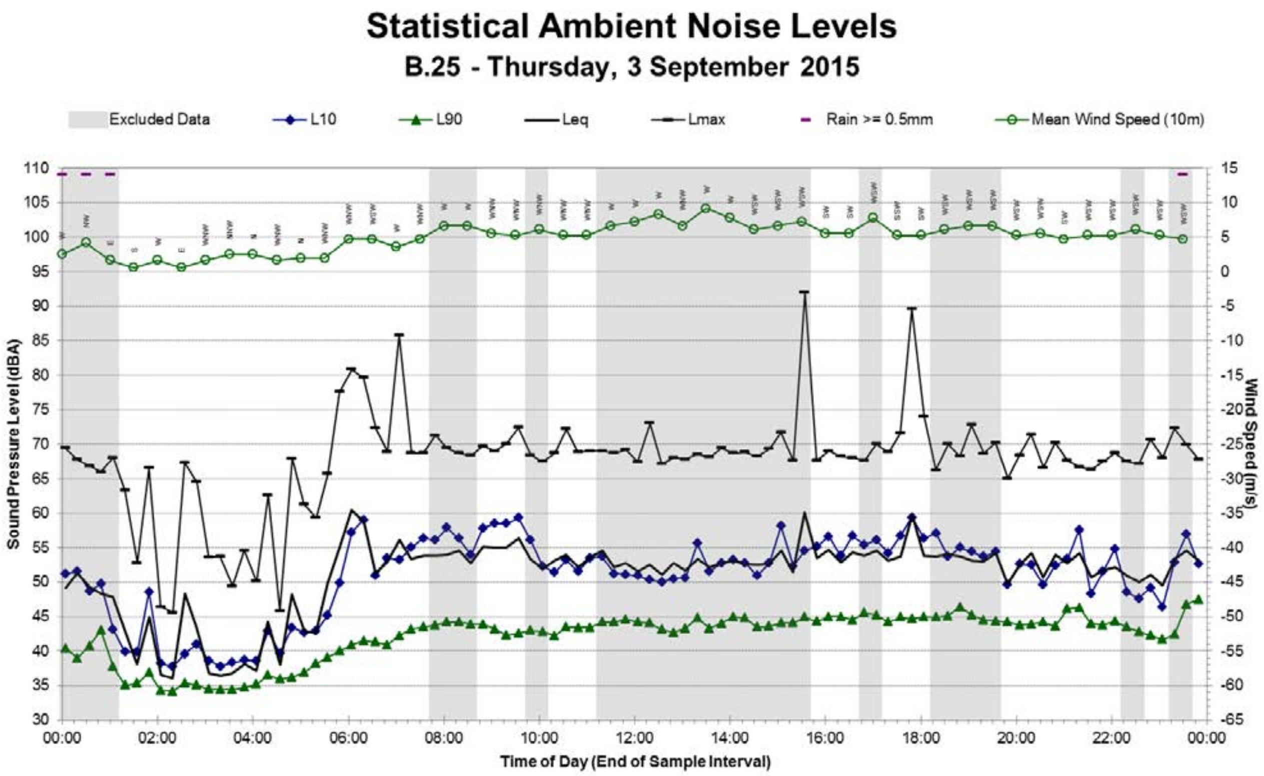
Statistical Ambient Noise Levels
B.25 - Monday, 31 August 2015



Statistical Ambient Noise Levels
B.25 - Tuesday, 1 September 2015

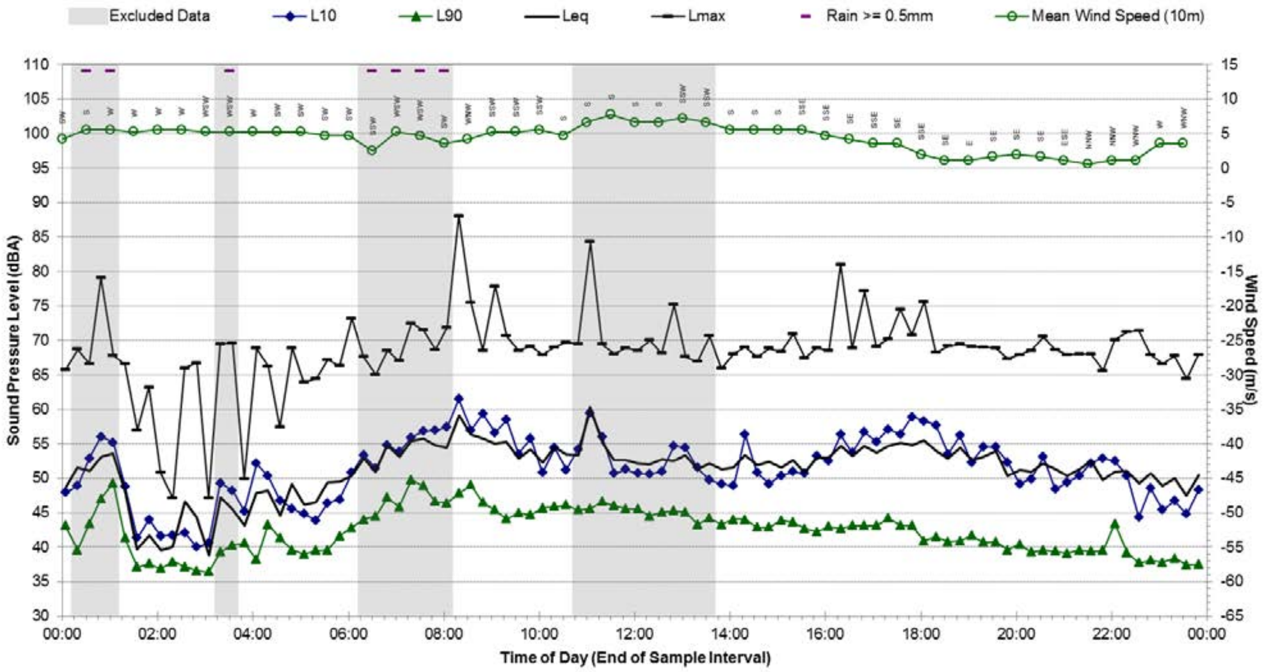



Statistical Ambient Noise Levels
B.25 - Wednesday, 2 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

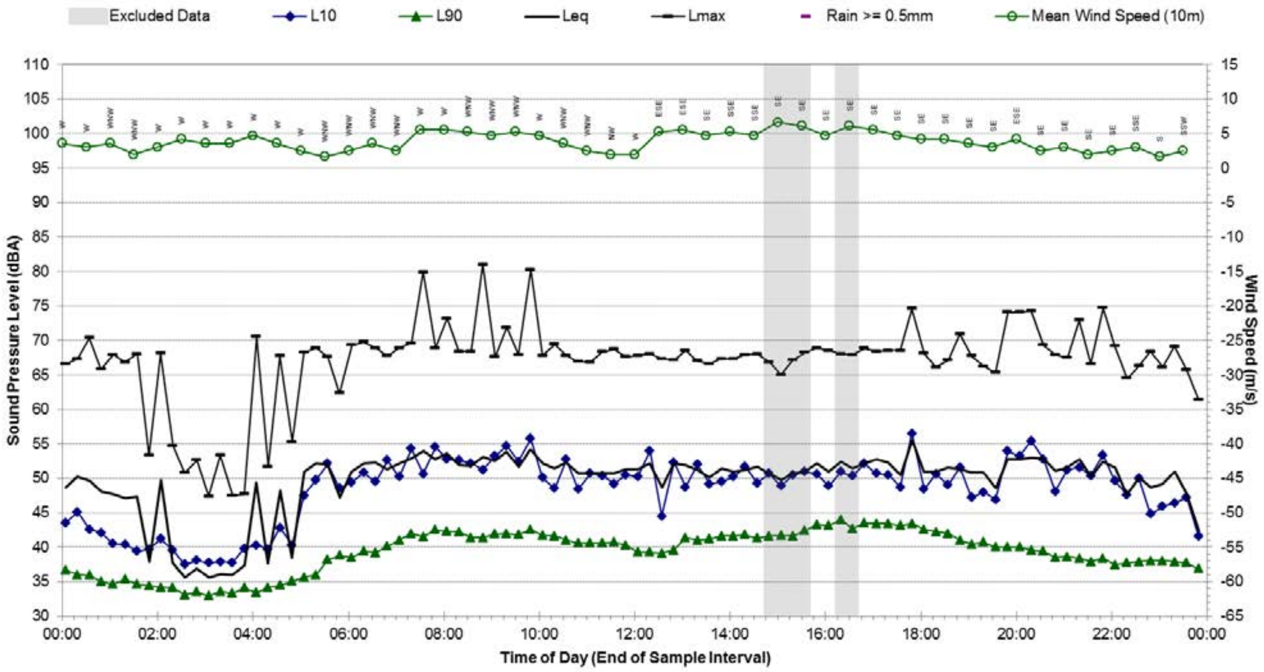

Statistical Ambient Noise Levels
B.25 - Thursday, 3 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

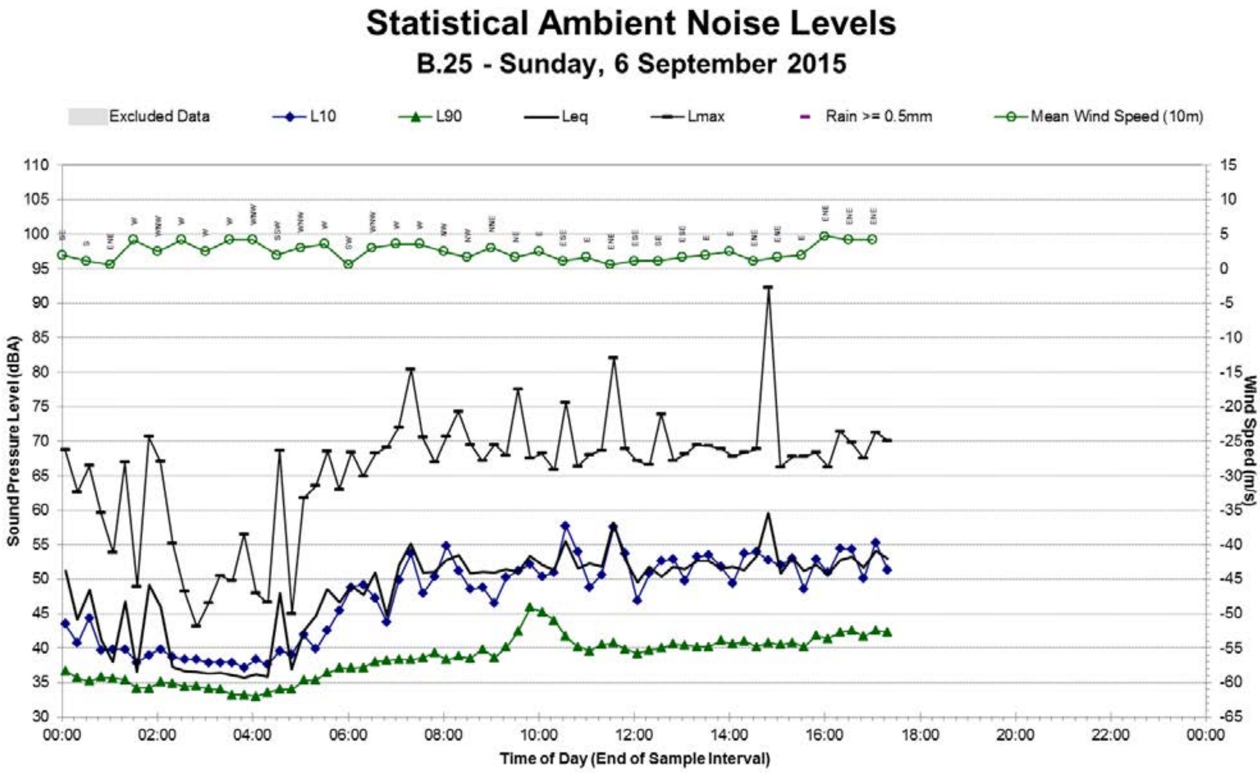
Background Noise Monitoring Results – B.25

Statistical Ambient Noise Levels
B.25 - Friday, 4 September 2015



Statistical Ambient Noise Levels
B.25 - Saturday, 5 September 2015

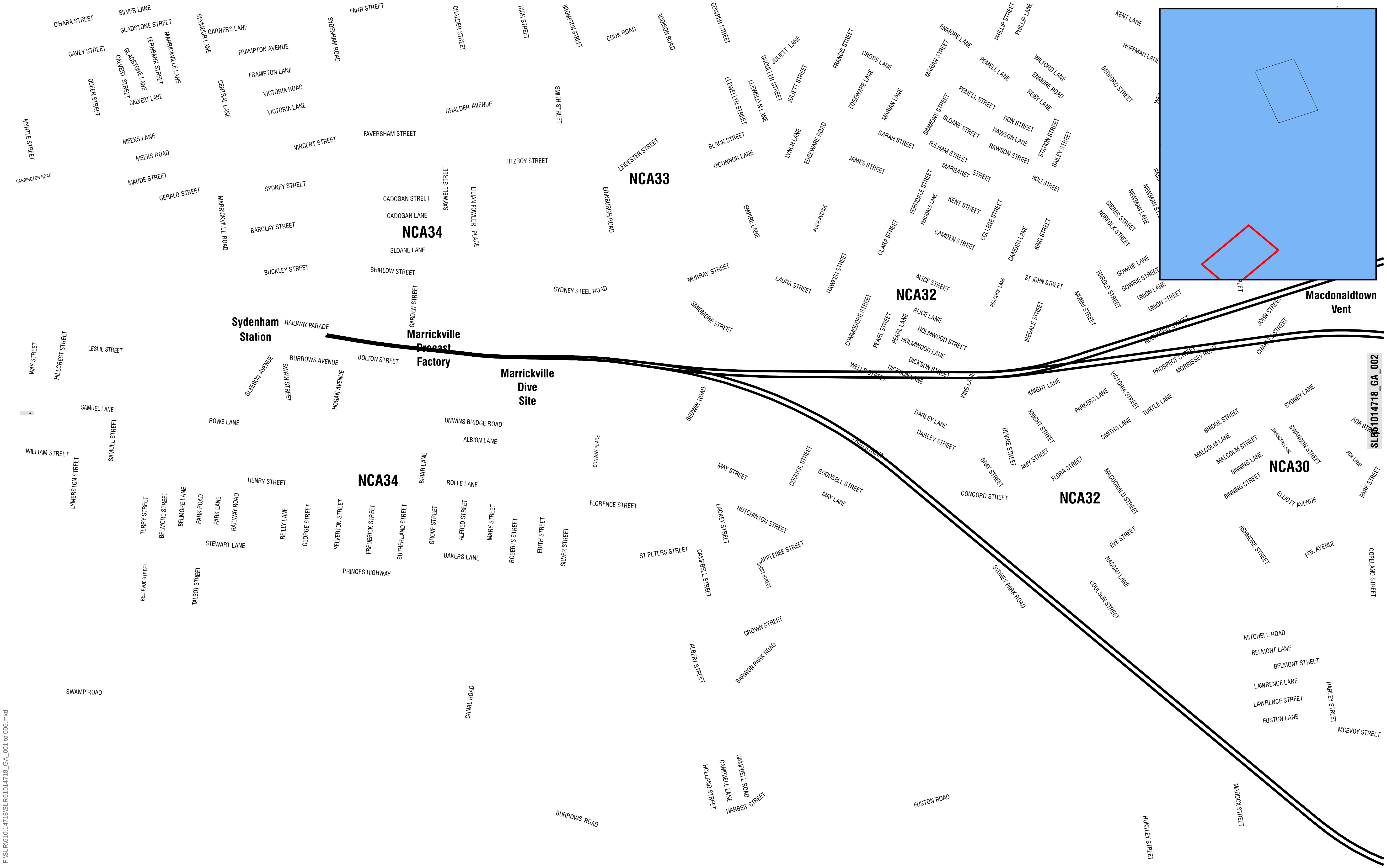



Statistical Ambient Noise Levels
B.25 - Sunday, 6 September 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (10m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Appendix C

Report 610.14718R1

Site Plan and Sensitive Receivers



LEGEND

- Proposed Rail Alignment
- Proposed Sydney Uni Alignment
- Proposed Waterloo Alignment
- Noise Catchment Area
- Construction Sites
- Portal Structure
- Stations

Receiver Types

- Passive Recreation
- Active Recreation
- Residential
- Commercial
- Industrial
- Other (Medical)
- Other (Worship)
- Other (Child Care)
- Other (Education)
- Other (Theatre)

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N E S W

0 100 200 300 400 m

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Sydney Metro Chatswood to Sydenham

Site Plan & Sensitive Receivers

Page 1 of 6

FIGURE : SLR61014718_GA_001

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0 100 200 300 400 m

LEGEND

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- Stations

Receiver Types

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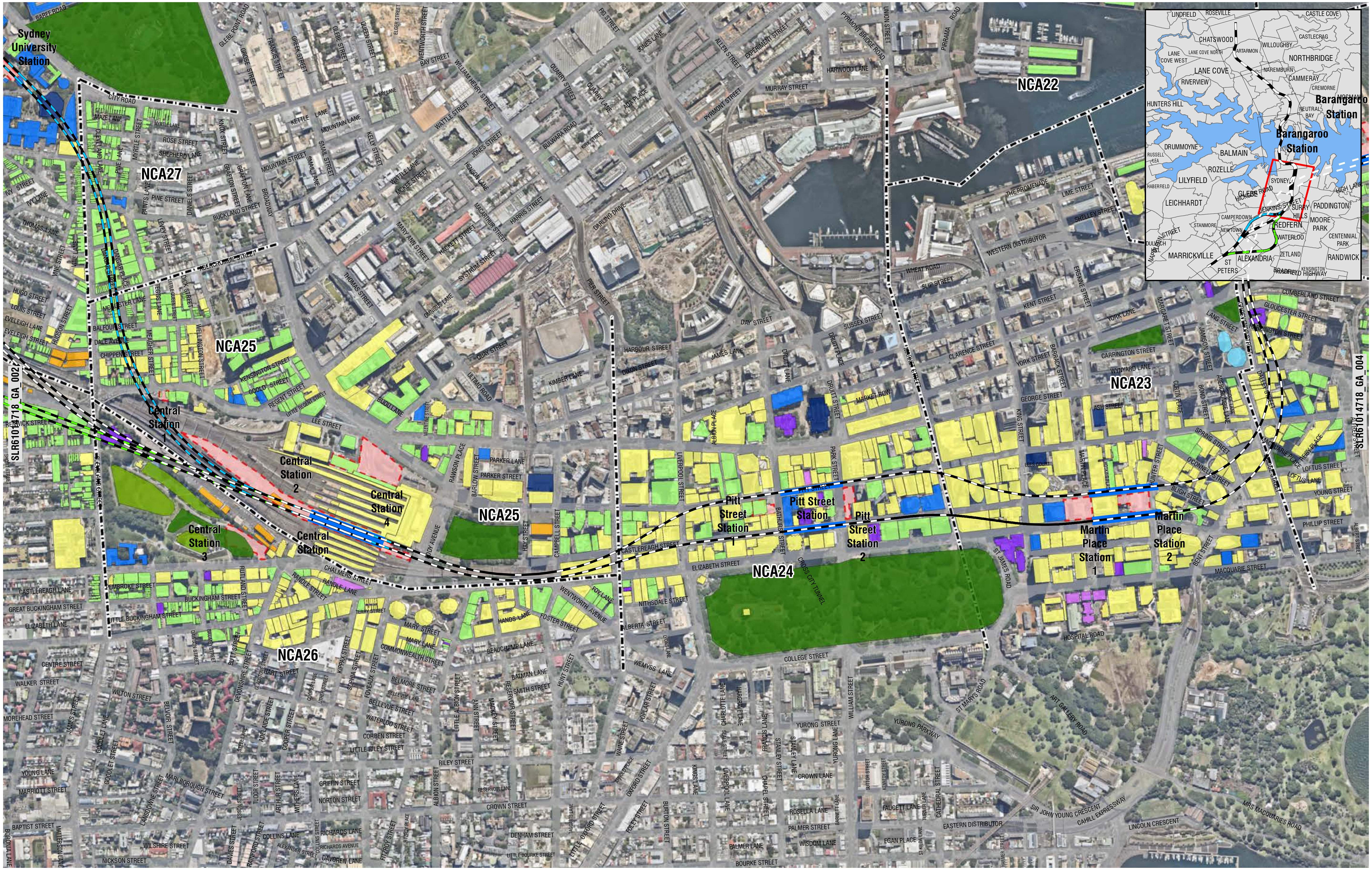
Site Plan & Sensitive Receivers

Page 2 of 6

FIGURE : SLR61014718_GA_002



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0 100 200 300 400 m

LEGEND

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- Noise Catchment Area
- Construction Sites
- Portal Structure
- Stations

Receiver Types

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- Residential
- Commercial
- Industrial
- Other (Medical)
- Other (Worship)
- Other (Child Care)
- Other (Education)
- Other (Theatre)

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Site Plan & Sensitive Receivers

FIGURE : SLR61014718_GA_003

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Projection:	GDA 1994 MGA Zone 56

0 100 200 300 400 m

LEGEND

- Proposed Rail Alignment
- Proposed Sydney Uni Alignment
- Proposed Waterloo Alignment
- Noise Catchment Area
- Construction Sites
- Portal Structure
- Stations

Receiver Types

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- Other (Education)
- Other (Theatre)

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Site Plan & Sensitive Receivers

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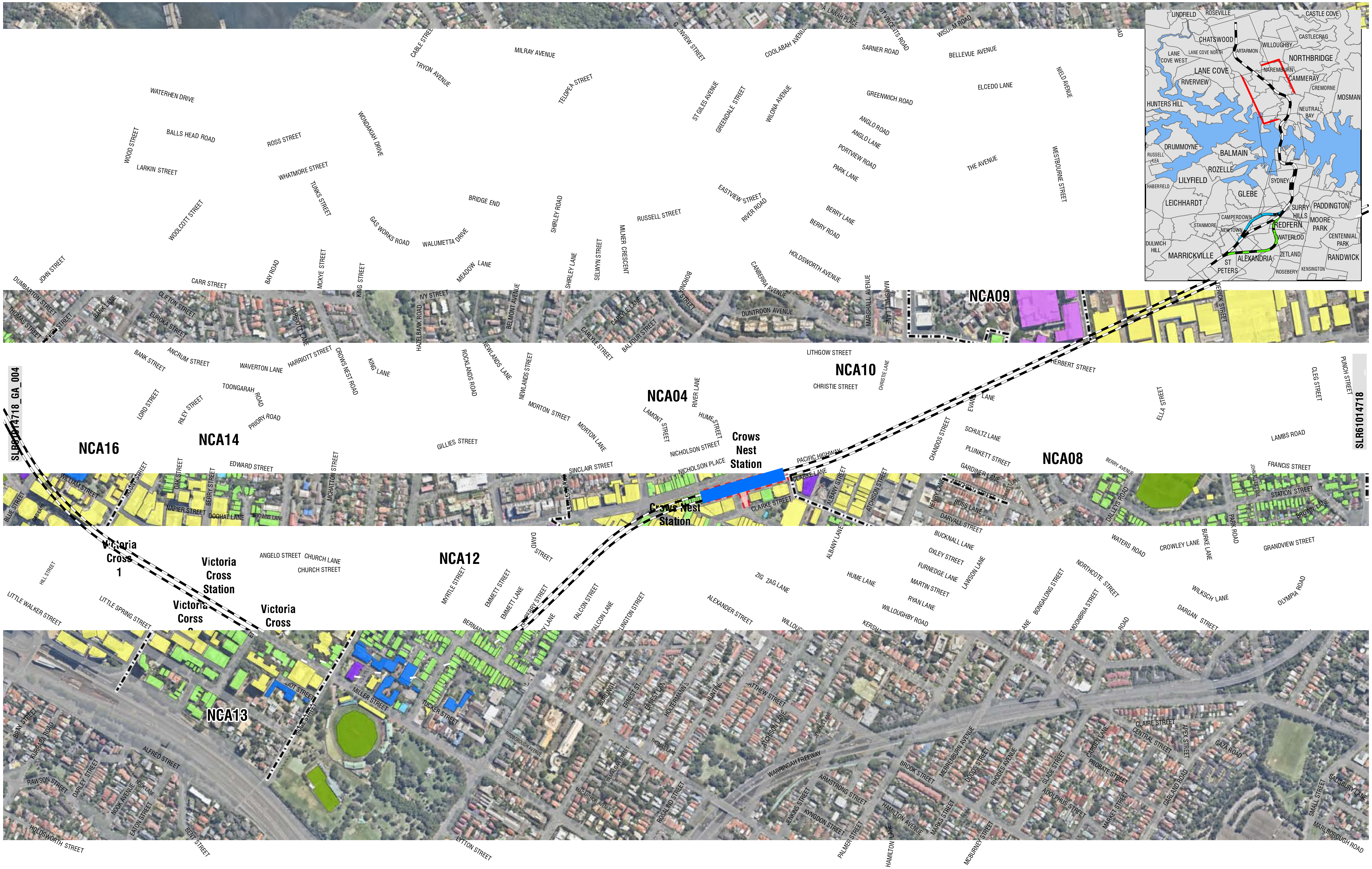
FIGURE : SLR61014718_GA_004



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0 100 200 300 400 m

LEGEND

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- Noise Catchment Area
- Construction Sites
- Portal Structure
- Stations

Receiver Types

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- Other (Child Care)
- Other (Education)
- Other (Theatre)

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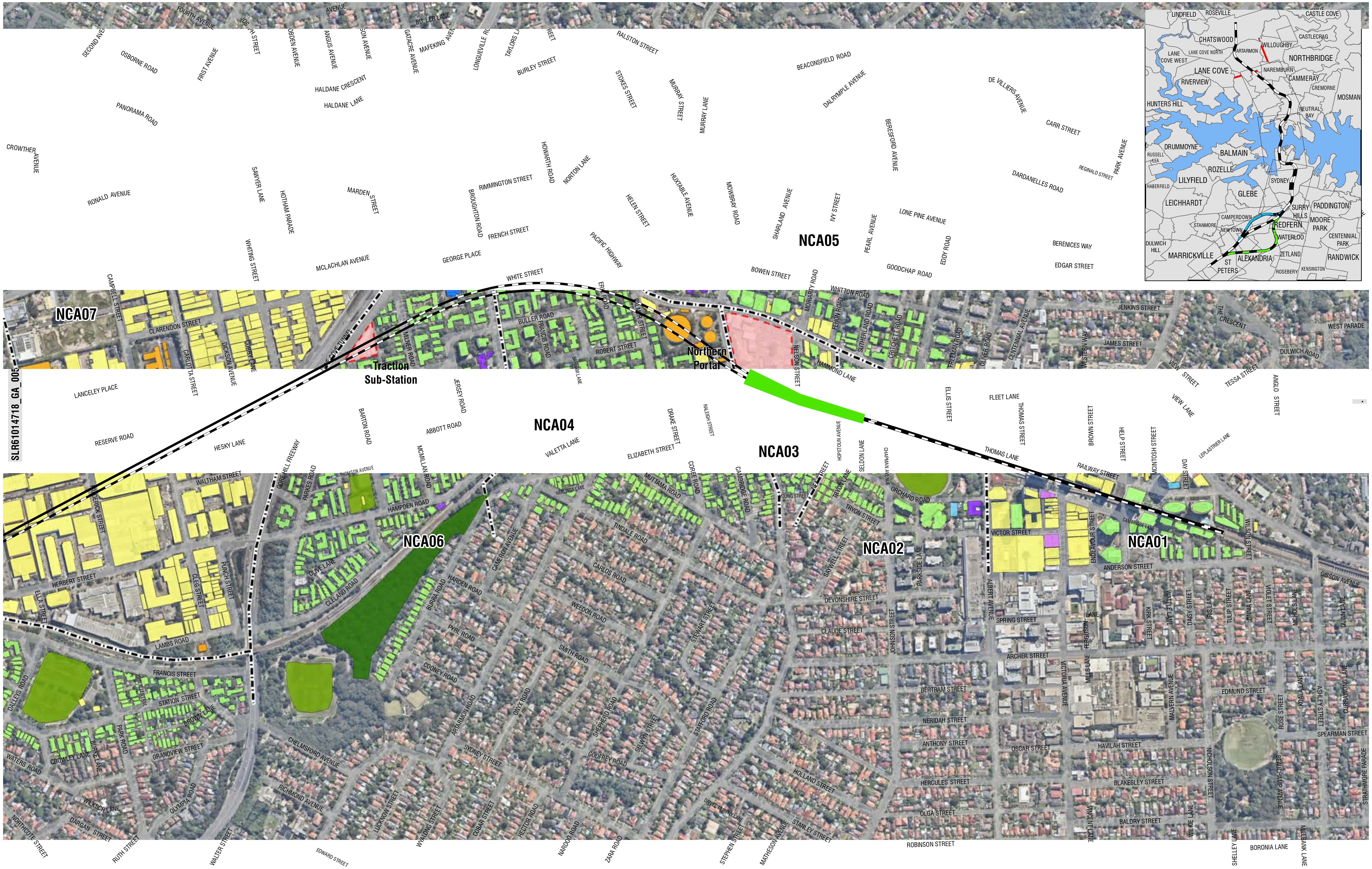
Site Plan & Sensitive Receivers



LEGEND

- Proposed Rail Alignment
- Proposed Sydney Uni Alignment
- Proposed Waterloo Alignment
- Noise Catchment Area
- Construction Sites
- Portal Structure
- Stations

Receiver Types

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Site Plan & Sensitive Receivers

FIGURE : SLR61014718_GA_006

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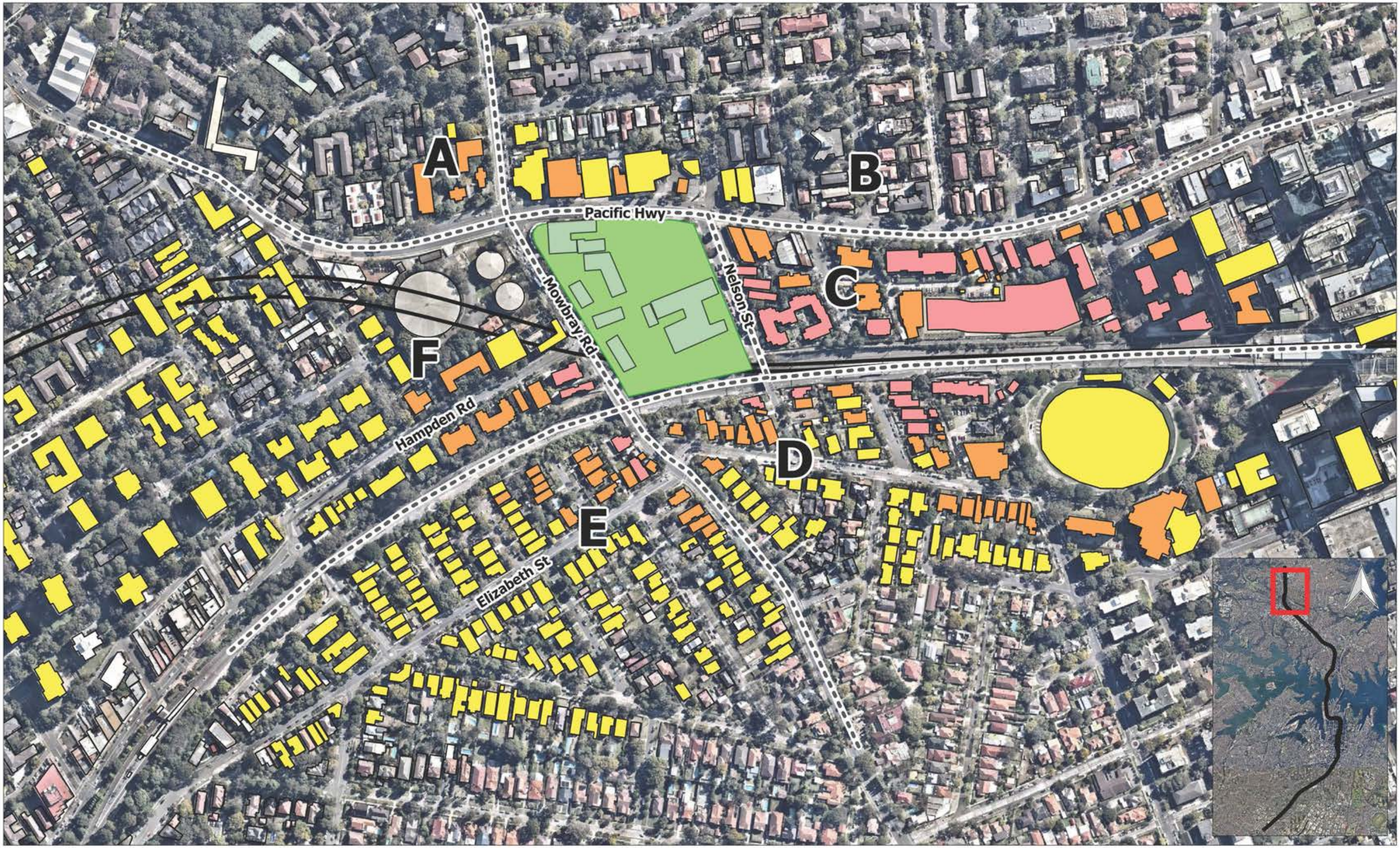
INDEX

Appendix D1

Report 610.14718R1
Construction Noise Predictions

Enabling Works



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N

50 0 50 100 150 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Enabling Works - Daytime

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N

50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Construction Noise Predictions
Worst-case NML Exceedance
Enabling Works - Daytime

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Projection:	GDA 1994 MGA Zone 56

50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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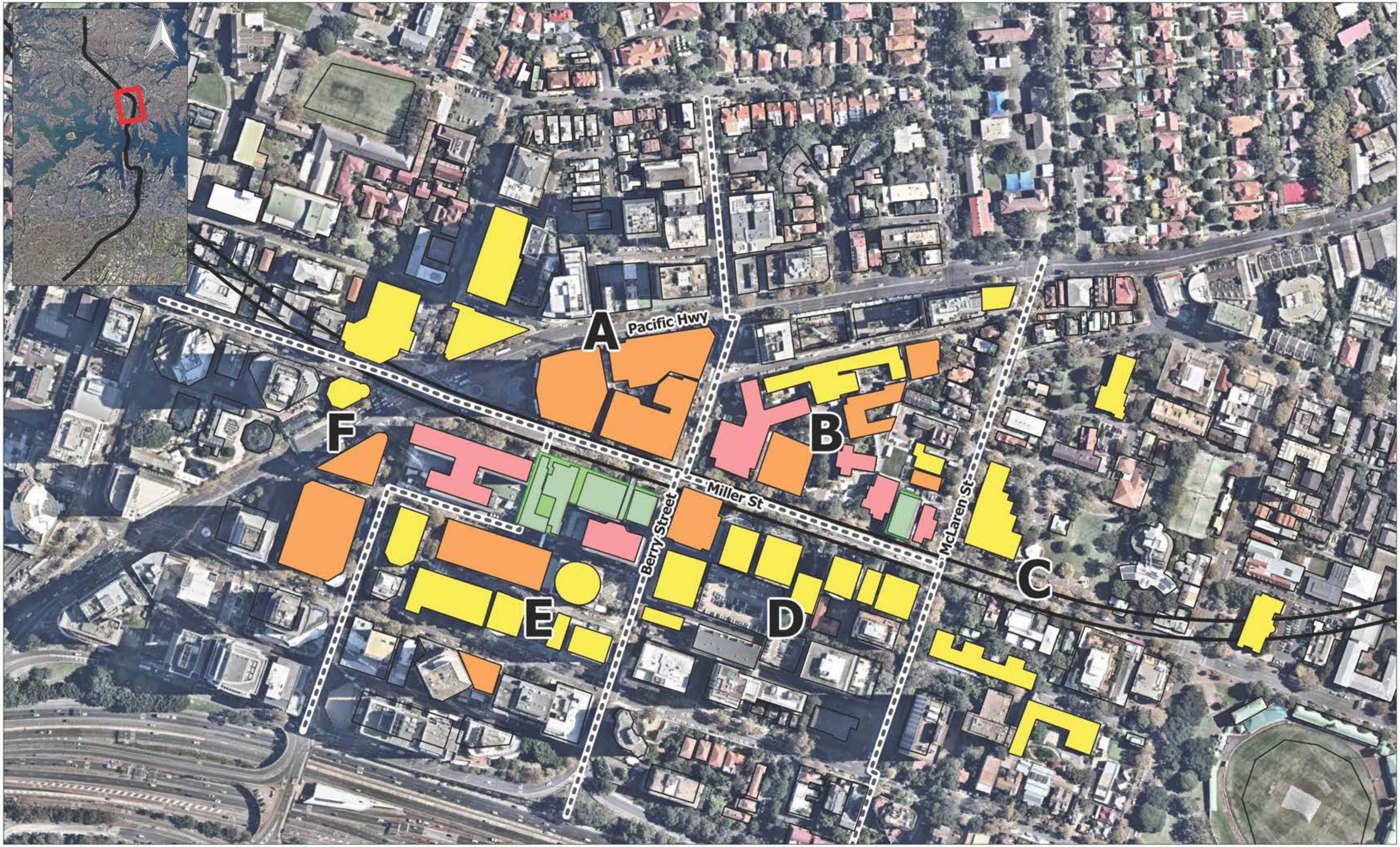
Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Enabling Works - Daytime



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Projection:	GDA 1994 MGA Zone 56

50 0 50 100 m

Receiver Area | Construction Area | Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB | 10 dB - 20 dB | > 20 dB

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Construction Noise Predictions
Worst-case NML Exceedance
Enabling Works - Daytime

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Receiver Area
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Worst-case Exceedance of NML

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10 dB - 20 dB
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50 0 50 100 m

N

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Construction Noise Predictions
Worst-case NML Exceedance
Enabling Works - Daytime

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N

50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Construction Noise Predictions
Worst-case NML Exceedance
Enabling Works - Daytime

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N

50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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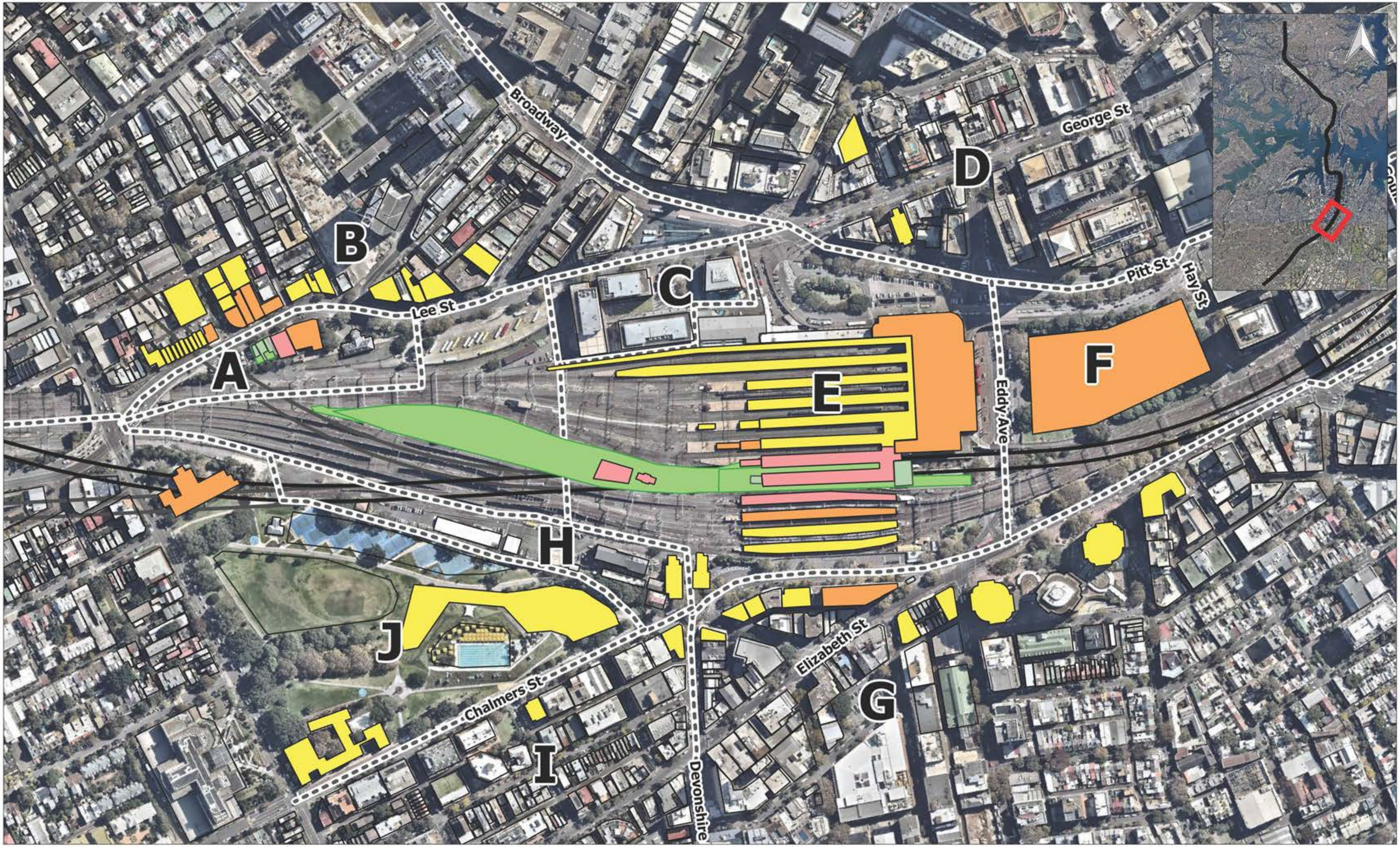
Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Enabling Works - Daytime



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50 0 50 100 150 m

Receiver Area | Construction Area | Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB | 10 dB - 20 dB | > 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Enabling Works - Daytime

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50 0 50 100 150 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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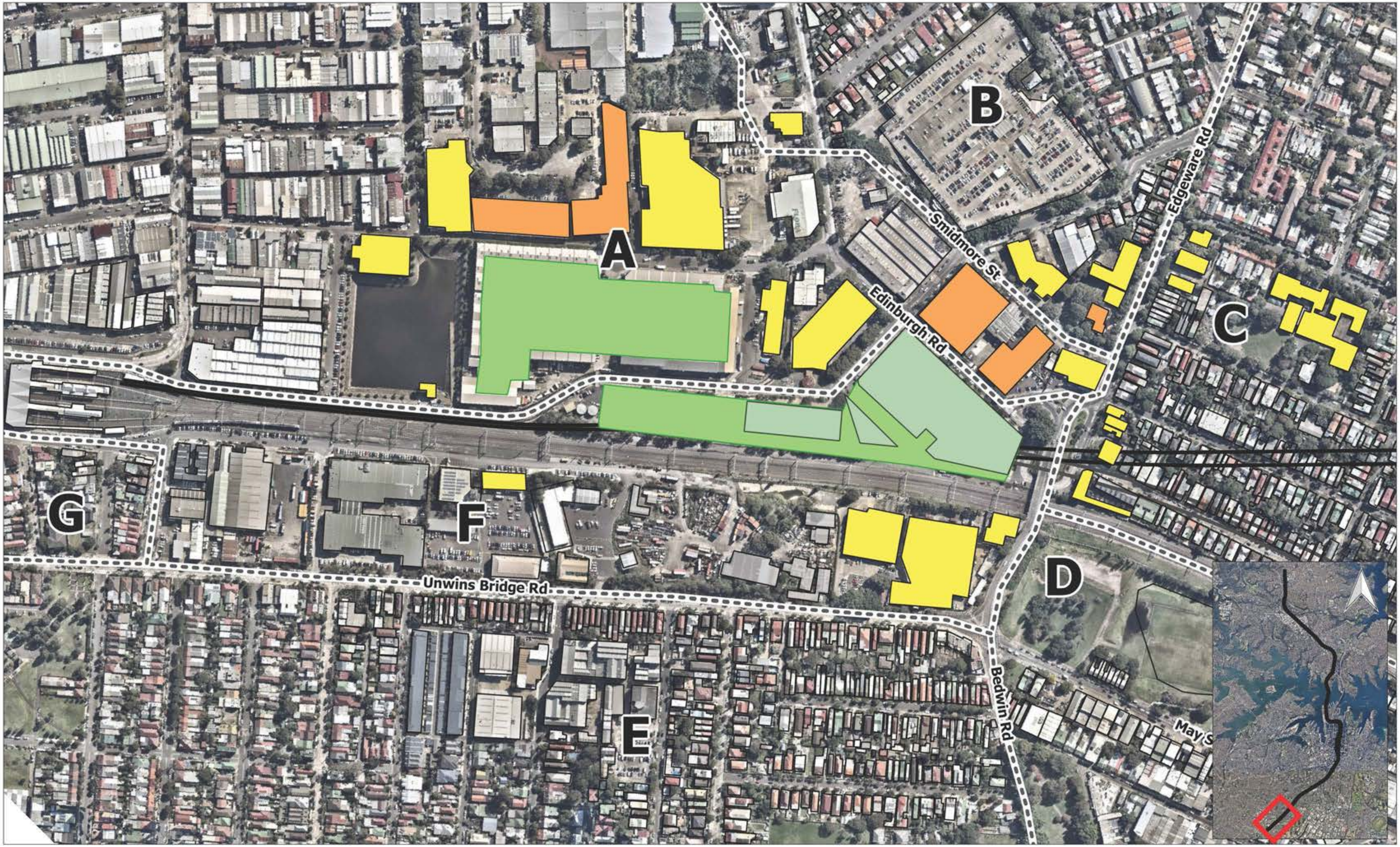
Sydney Metro Ch t wood to Sydenh m

Construction Noise Predictions
Worst-case NML Exceedance
Enabling Works - Daytime



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50 0 50 100 150 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Sydney Metro Chatswood to Sydenham

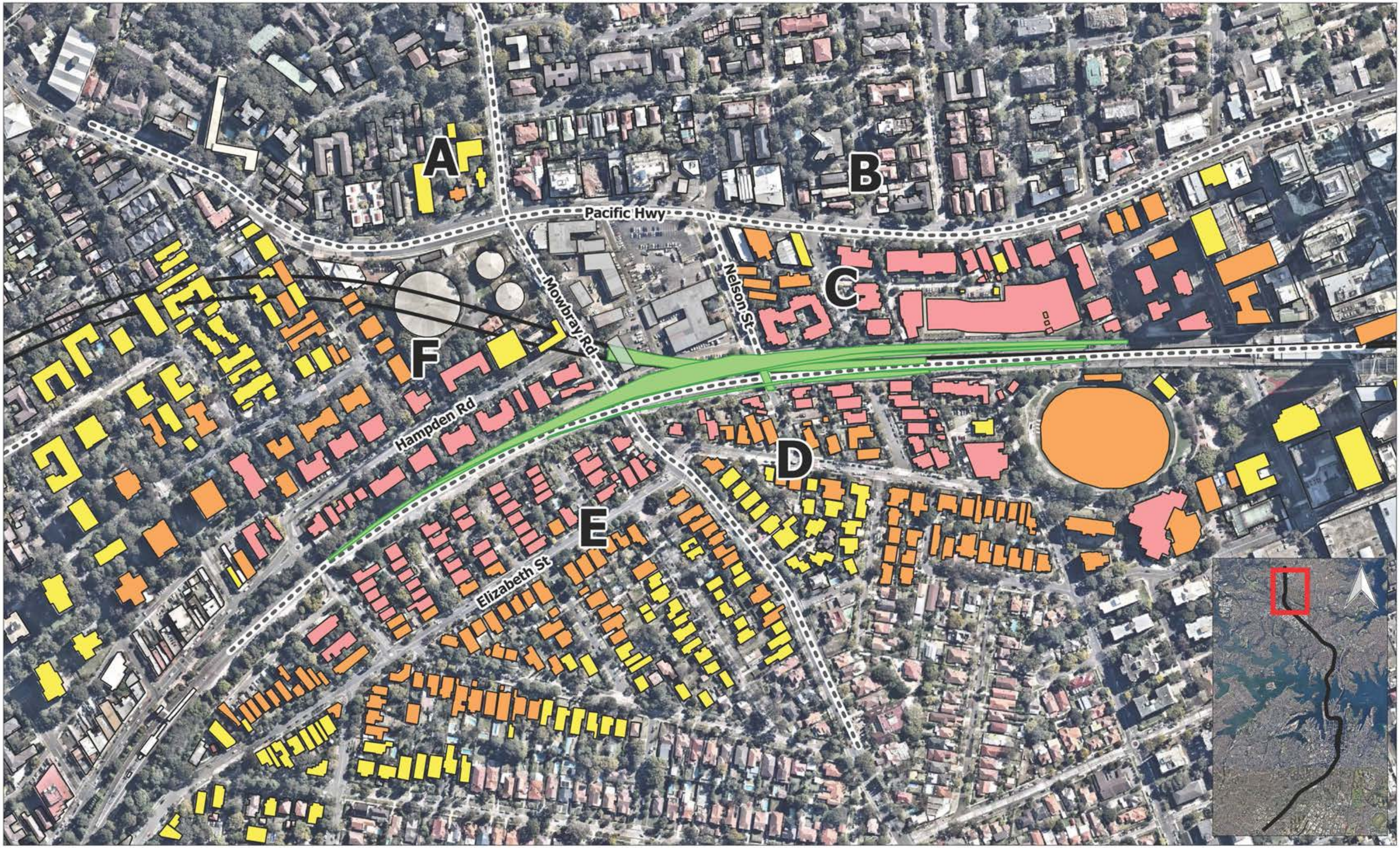
Construction Noise Predictions
Worst-case NML Exceedance
Enabling Works - Daytime

Appendix D2

Report 610.14718R1

Construction Noise Predictions

Surface Track



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50 0 50 100 150 m

Receiver Area | Construction Area | Acquired Building

Worst-case Exceedance of NML
0 dB - 10 dB | 10 dB - 20 dB | > 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Surface Track Works - Daytime

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Projection:	GDA 1994 MGA Zone 56

50 0 50 100 150 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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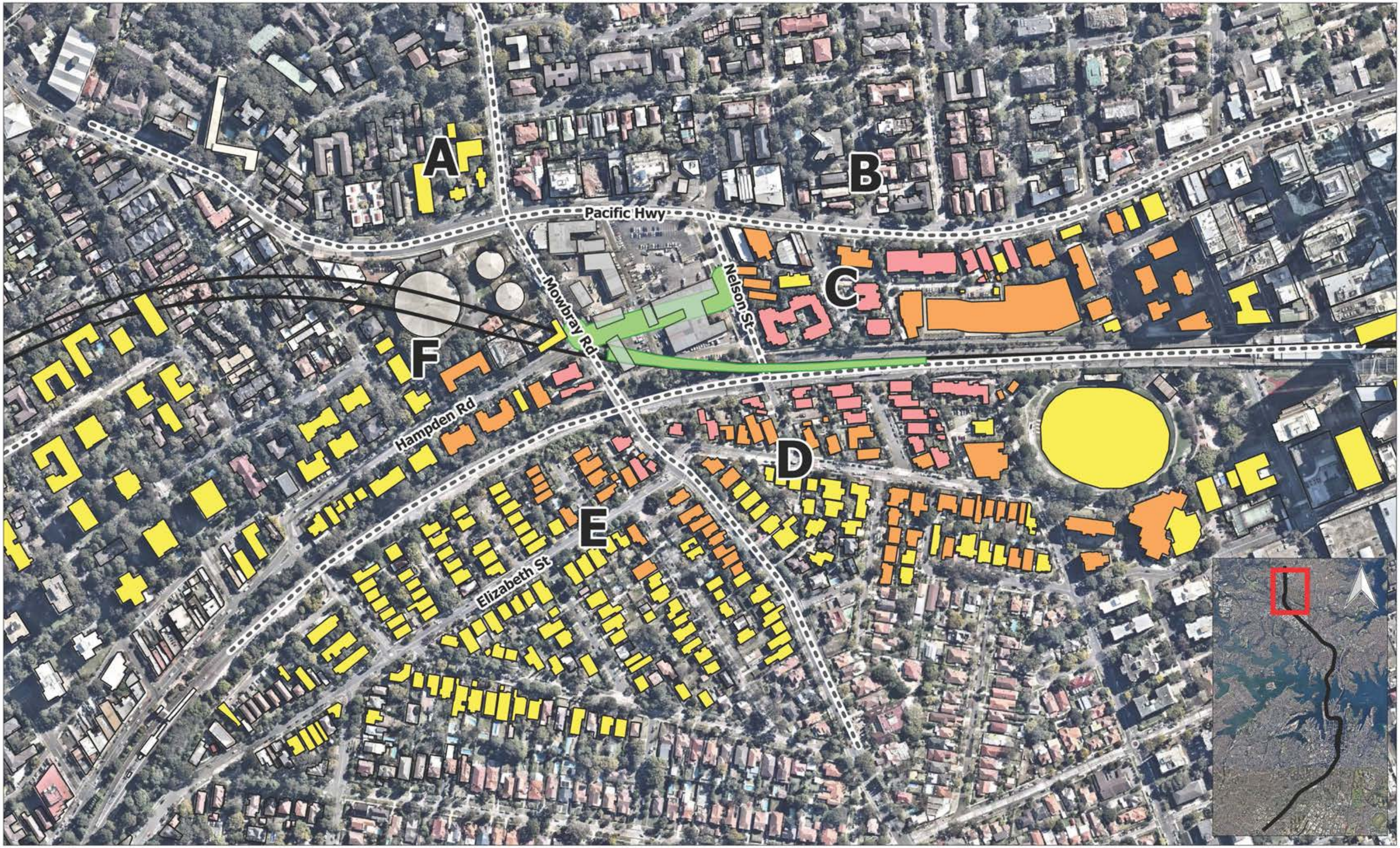
Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Surface Track Works - Daytime

Appendix D3

Report 610.14718R1
Construction Noise Predictions

Earthworks



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Sheet Size:	@A4
Projection:	GDA 1994 MGA Zone 56

N

50 0 50 100 150 m

Receiver Area — Construction Area — Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB — 10 dB - 20 dB — > 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Earthworks - Daytime

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Date:	08/12/2015
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Scale:	1:4,000
Sheet Size:	@A4
Projection:	GDA 1994 MGA Zone 56

50 0 50 100 m

N

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

Jacobs Group (Australia) Pty Limited

Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Earthworks - Daytime

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50 0 50 100 m

N

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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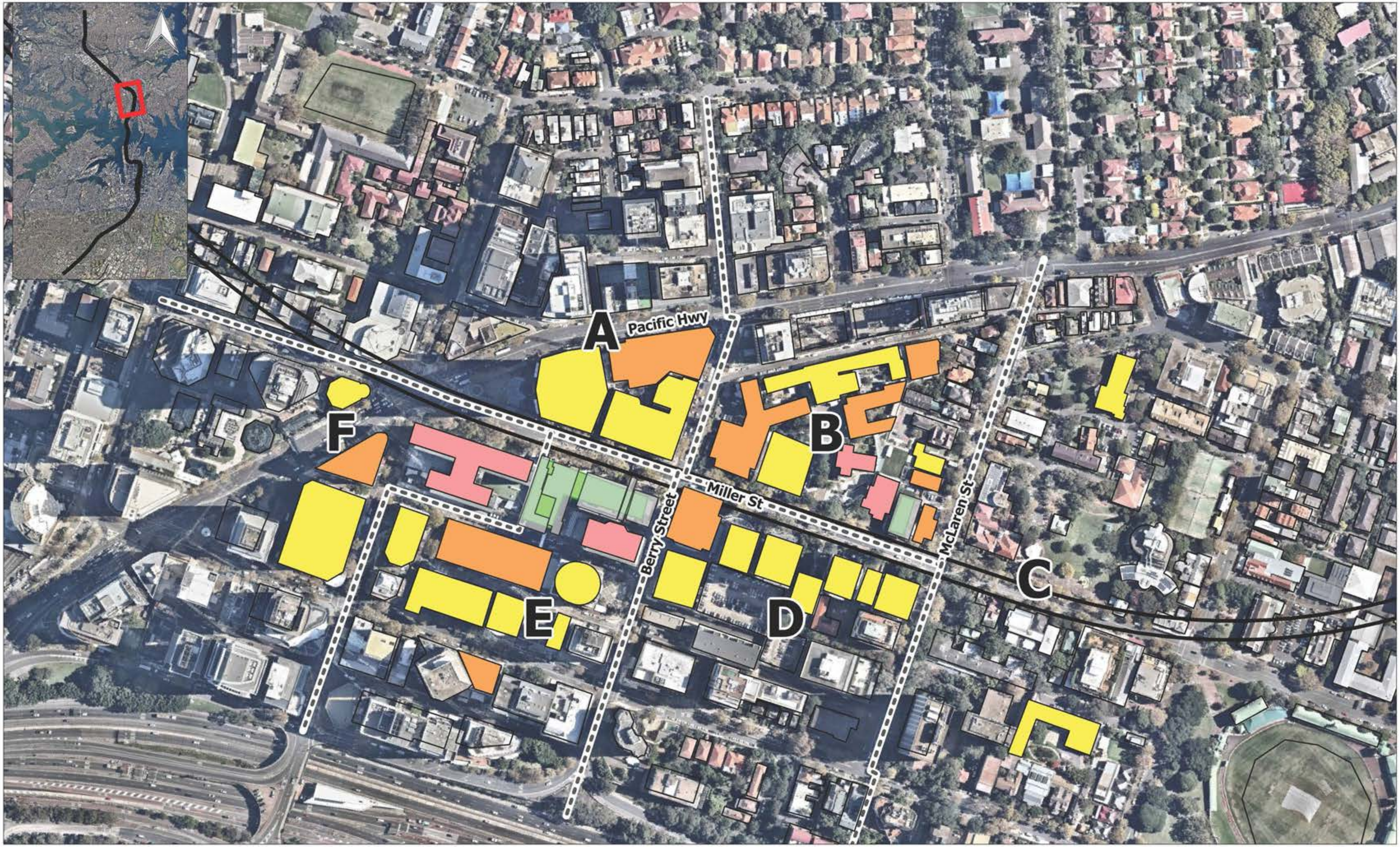
Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Earthworks - Daytime



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N

50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Earthworks - Daytime

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Earthworks - Daytime

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Receiver Area
Construction Area
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Worst-case Exceedance of NML

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> 20 dB

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N

50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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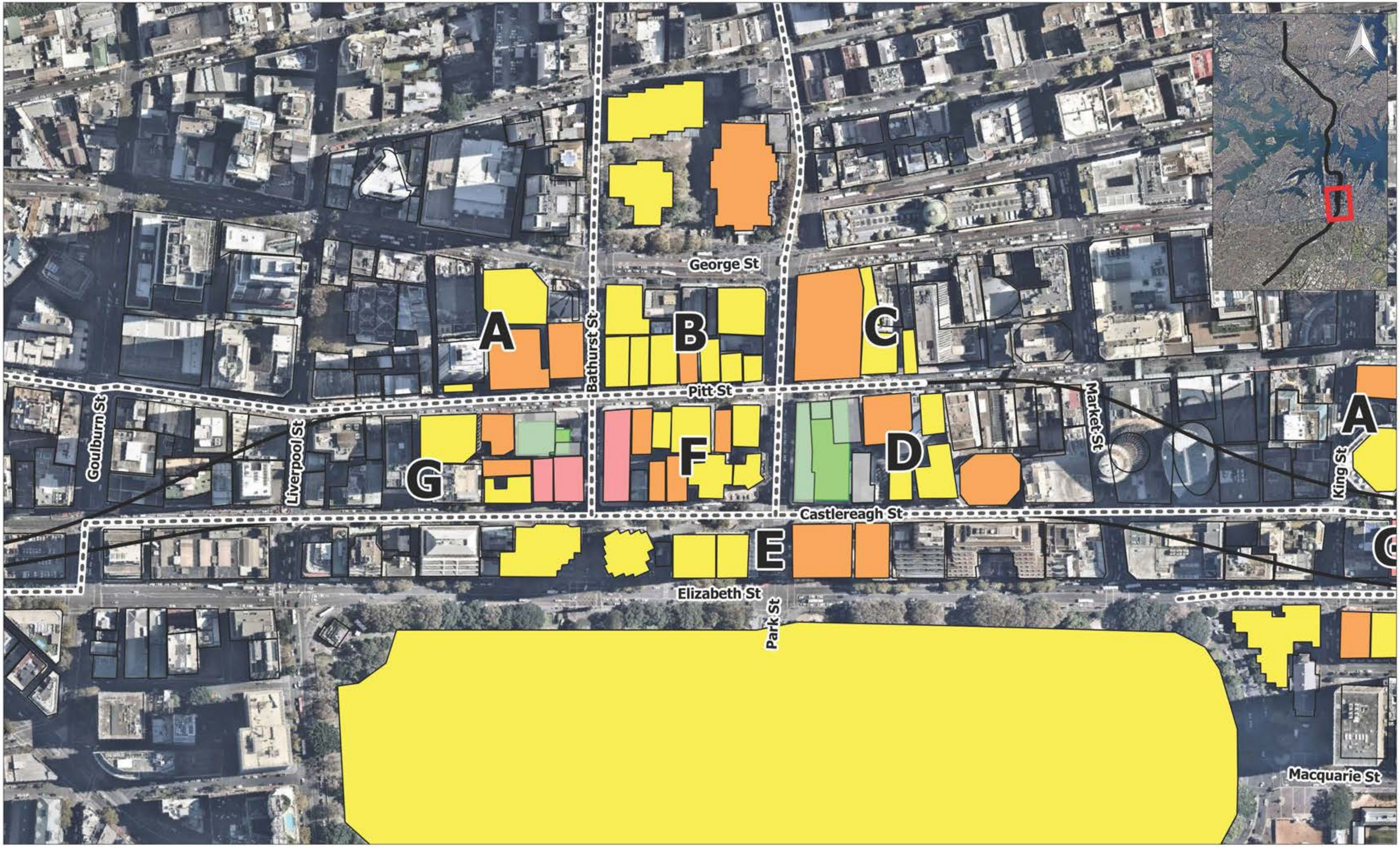
Construction Noise Predictions
Worst-case NML Exceedance
Earthworks - Daytime



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N

50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML
0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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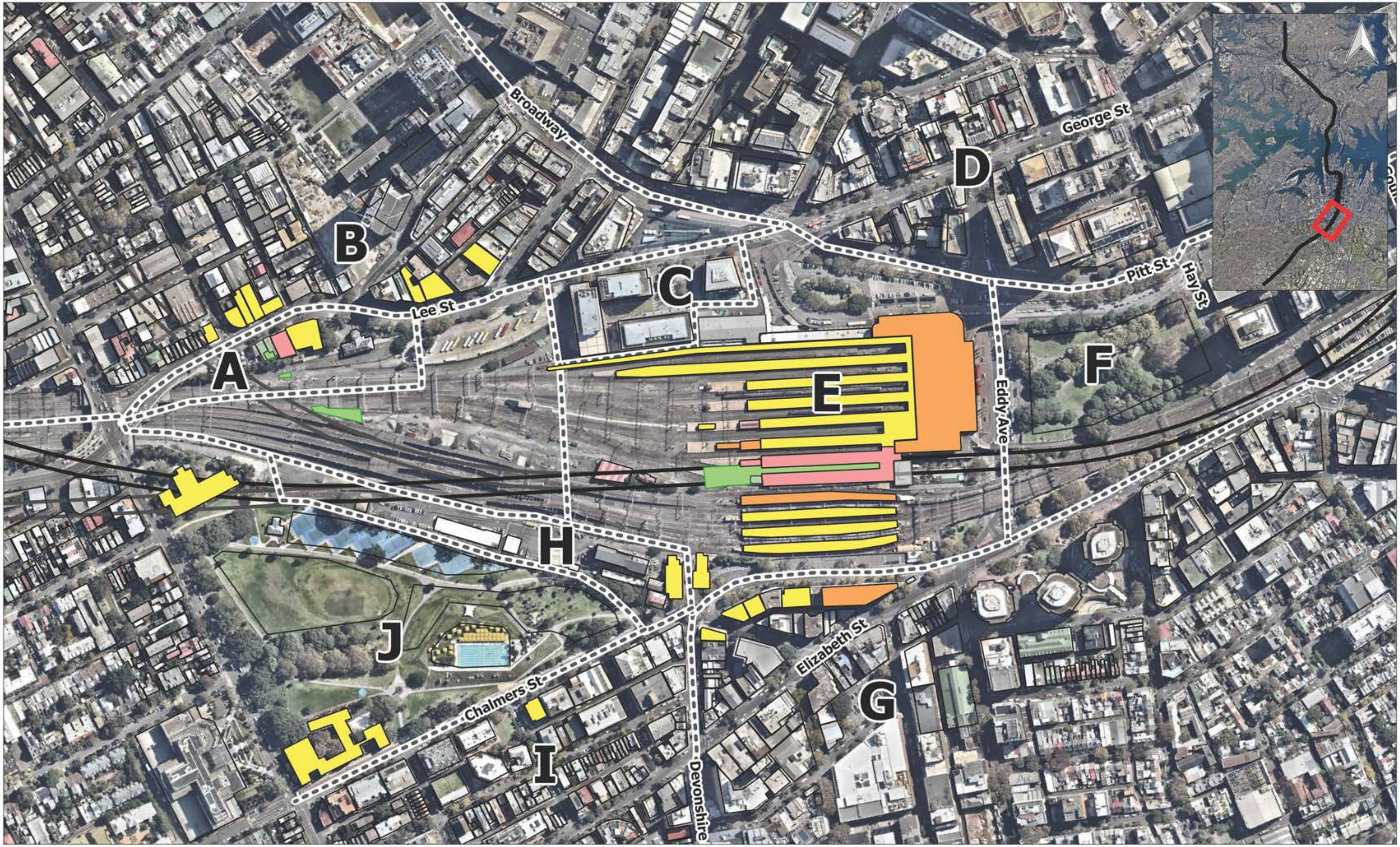
Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Earthworks - Daytime



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50 0 50 100 150 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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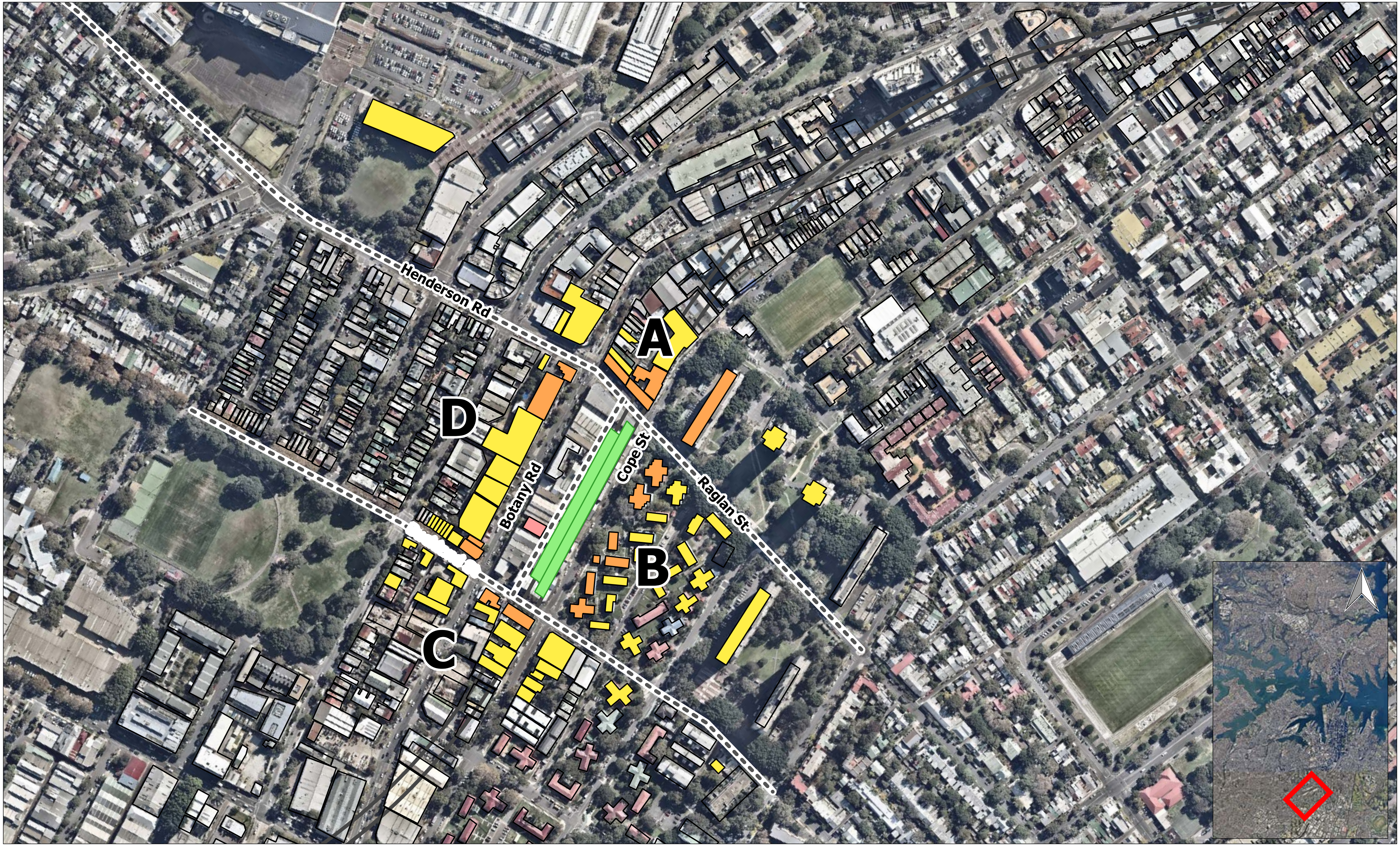
Construction Noise Predictions
Worst-case NML Exceedance
Earthworks - Daytime



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50 0 50 100 150 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Construction Noise Predictions
Worst-case NML Exceedance
Earthworks - Daytime

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Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Earthworks - Daytime

Appendix D4

Report 610.14718R1
Construction Noise Predictions

Construction of Acoustic Sheds

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Projection:	GDA 1994 MGA Zone 56

50 0 50 100 150 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Construction Noise Predictions
Worst-case NML Exceedance
Construction of Acoustic Shed – Daytime

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Projection:	GDA 1994 MGA Zone 56

50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML
0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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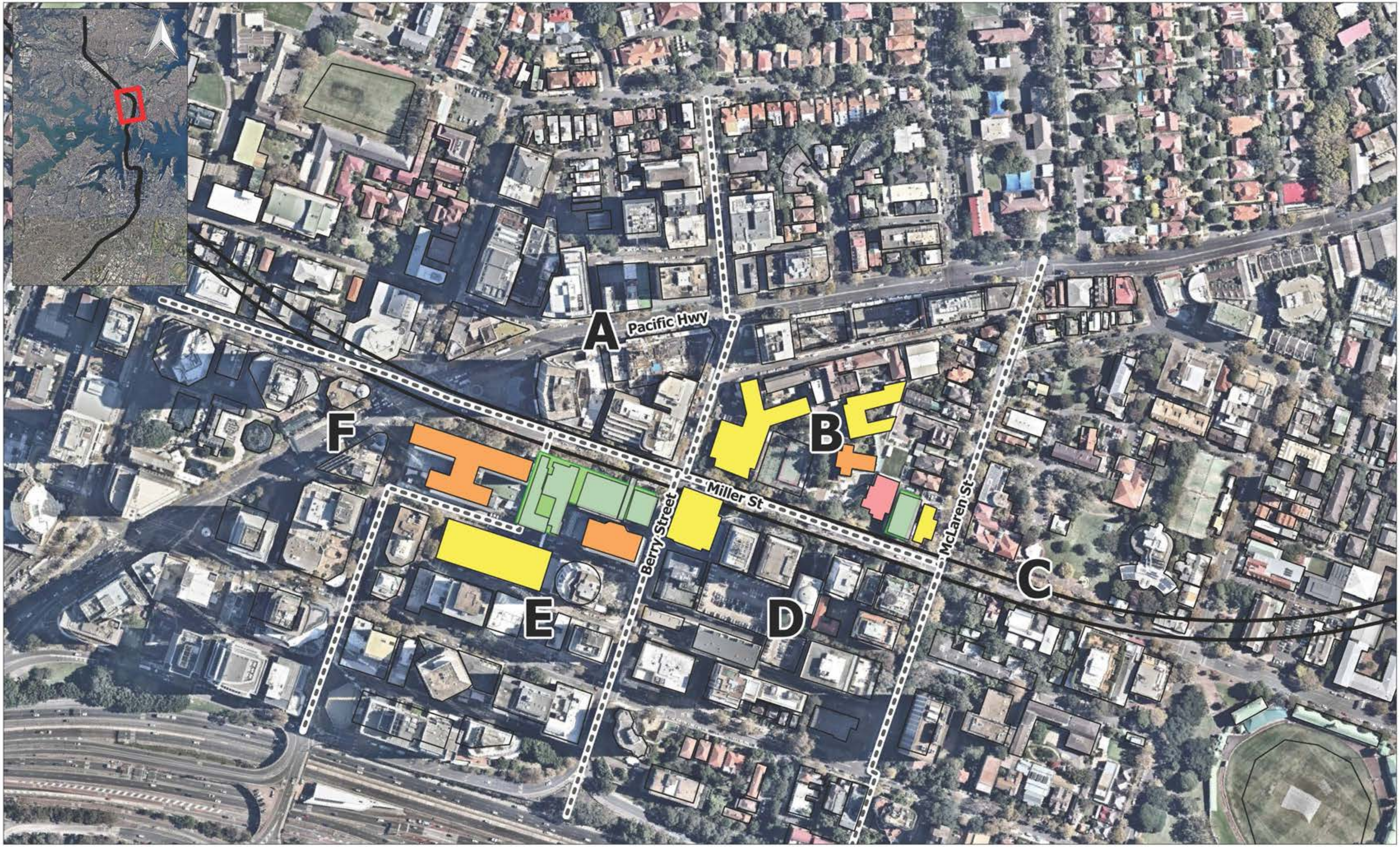
Construction Noise Predictions
Worst-case NML Exceedance
Construction of Acoustic Shed – Daytime



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Projection:	GDA 1994 MGA Zone 56

50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

Jacobs Group (Australia) Pty Limited

Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Construction of Acoustic Shed – Daytime

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Drawn by:	MR
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Sheet Size:	@A4
Projection:	GDA 1994 MGA Zone 56

N

50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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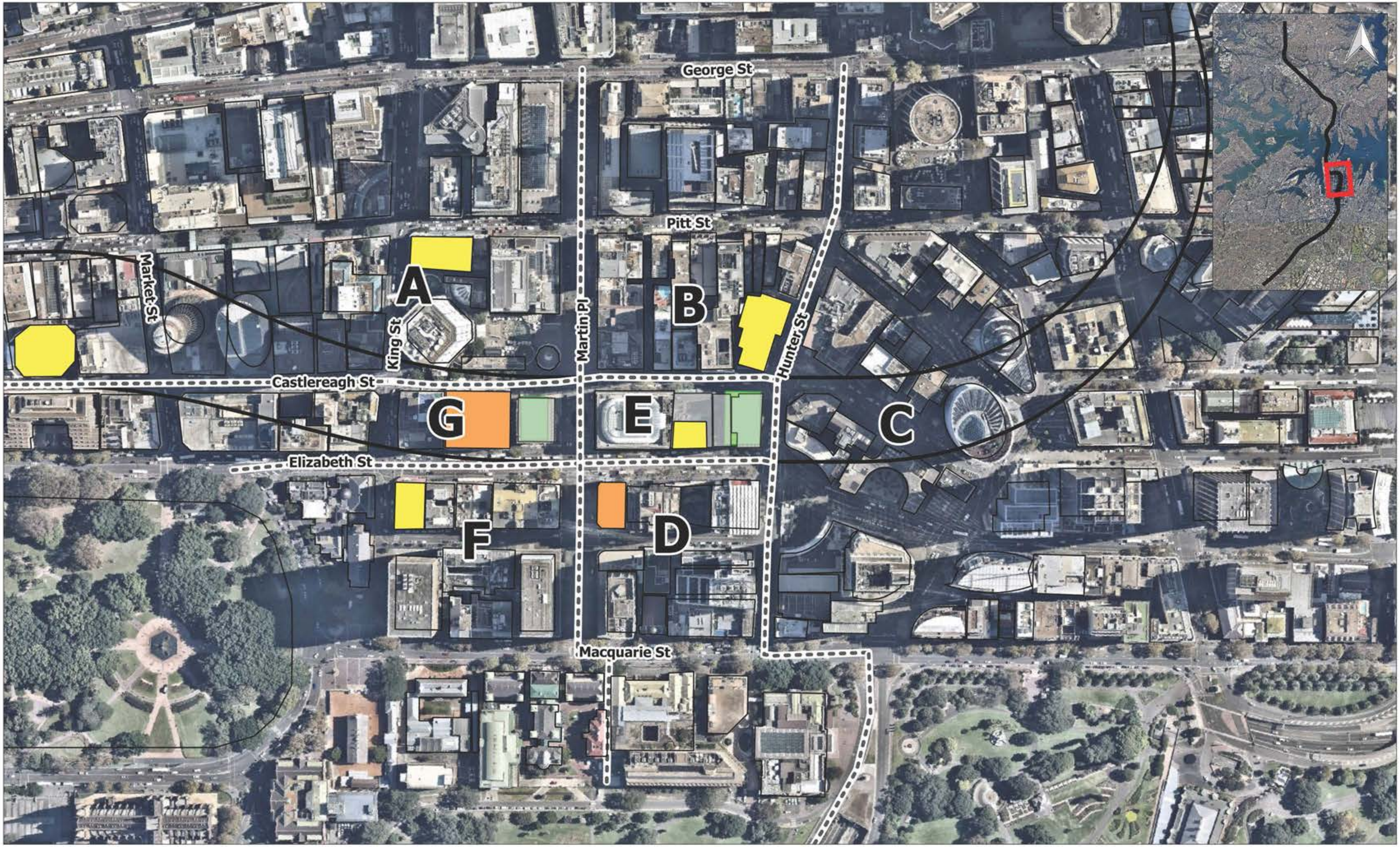
Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Construction of Acoustic Shed – Daytime



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Construction Noise Predictions
Worst-case NML Exceedance
Construction of Acoustic Shed – Daytime

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N

50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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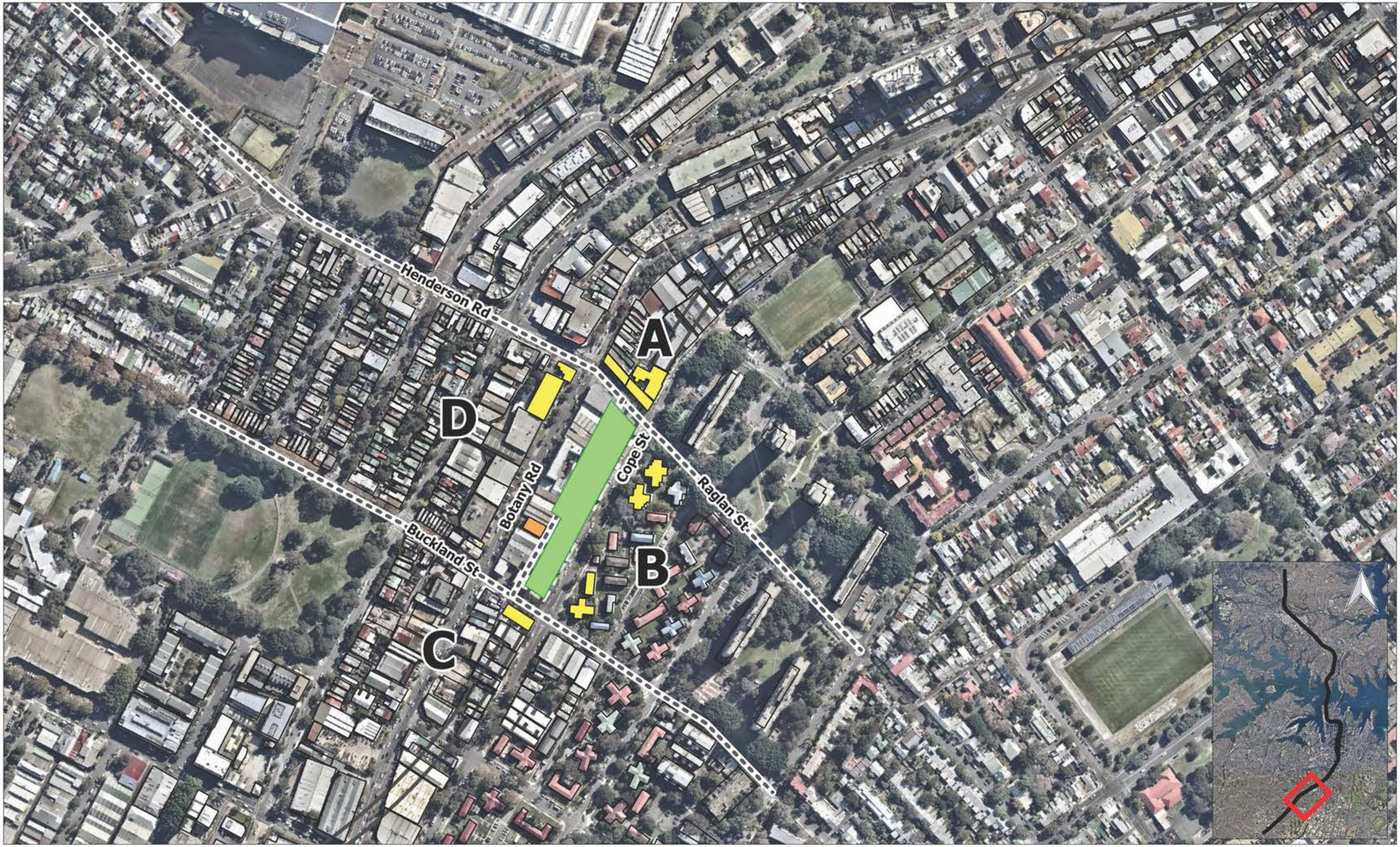
Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Construction of Acoustic Shed – Daytime



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50 0 50 100 150 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Construction of Acoustic Shed – Daytime

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50 0 50 100 150 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Construction of Acoustic Shed – Daytime

Appendix D5

Report 610.14718R1

Construction Noise Predictions

Tunnelling/Excavation

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N

50 0 50 100 150 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Construction Noise Predictions
Worst-case NML Exceedance
Tunnelling with Shed – Daytime

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N

50 0 50 100 150 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Construction Noise Predictions
Worst-case NML Exceedance
Tunnelling with Shed – Day OOH

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Sheet Size:	@A4
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N

50 0 50 100 150 m

Receiver Area · Construction Area · Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB · 10 dB - 20 dB · > 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Tunnelling with Shed – Evening

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Projection:	GDA 1994 MGA Zone 56

50 0 50 100 150 m

N

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Tunnelling with Shed – Night

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50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Construction Noise Predictions
Worst-case NML Exceedance
Excavation – Daytime

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Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Construction Noise Predictions
Worst-case NML Exceedance
Excavation with Shed – Daytime

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Construction Noise Predictions
Worst-case NML Exceedance
Excavation with Shed – Day OOH

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50 0 50 100 m

Receiver Area · Construction Area · Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB · 10 dB - 20 dB · > 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Excavation with Shed – Evening

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Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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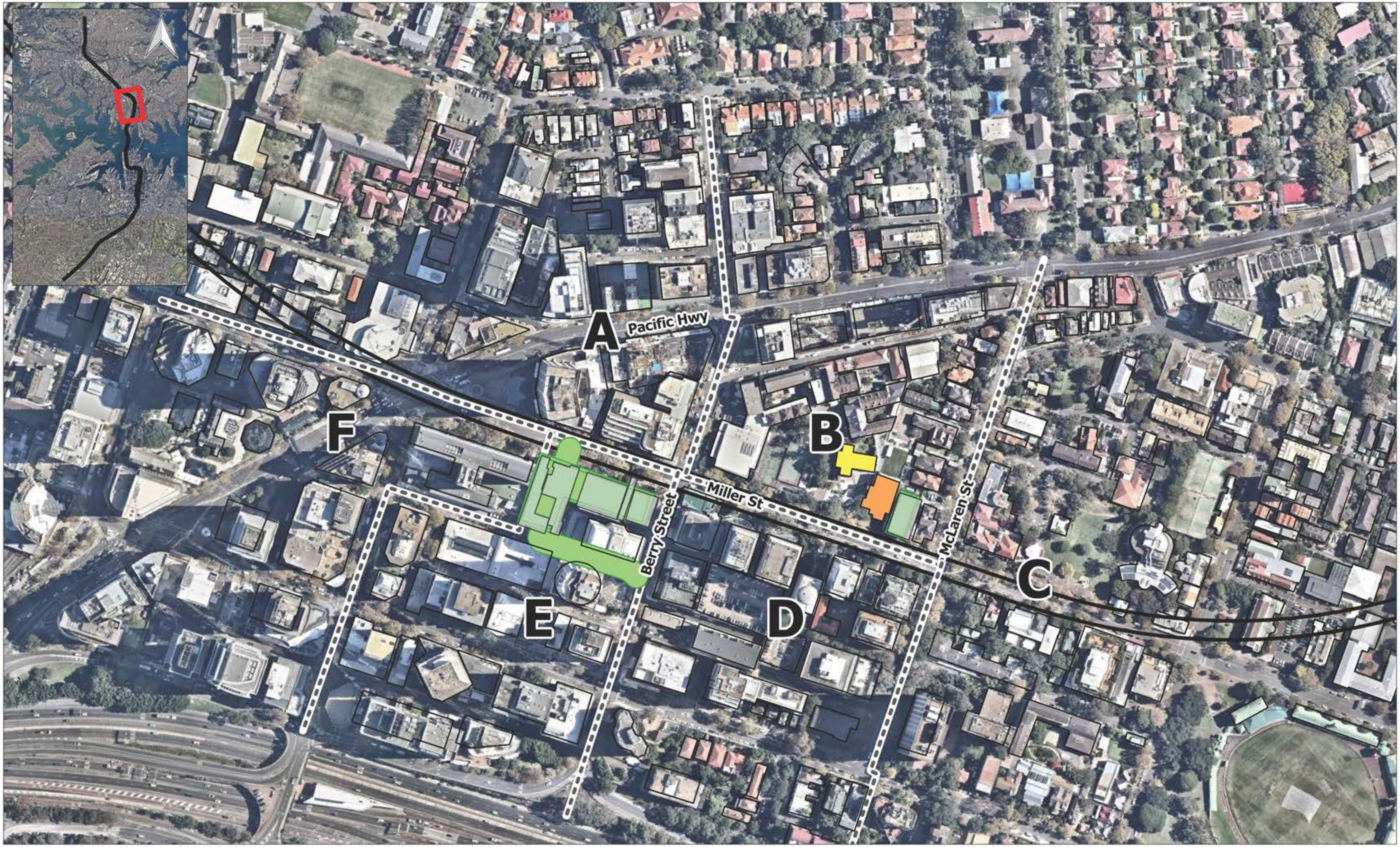
Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Excavation with Shed – Night



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50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Excavation with Shed – Daytime

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50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Construction Noise Predictions
Worst-case NML Exceedance
Excavation with Shed – Day OOH

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N

50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Construction Noise Predictions
Worst-case NML Exceedance
Excavation with Shed – Evening

- - - Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

50 0 50 100 m

N

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Worst-case NML Exceedance
Excavation with Shed – Night

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Date:	08/12/2015
Drawn by:	MR
Scale:	1:4,000
Sheet Size:	@A4
Projection:	GDA 1994 MGA Zone 56

50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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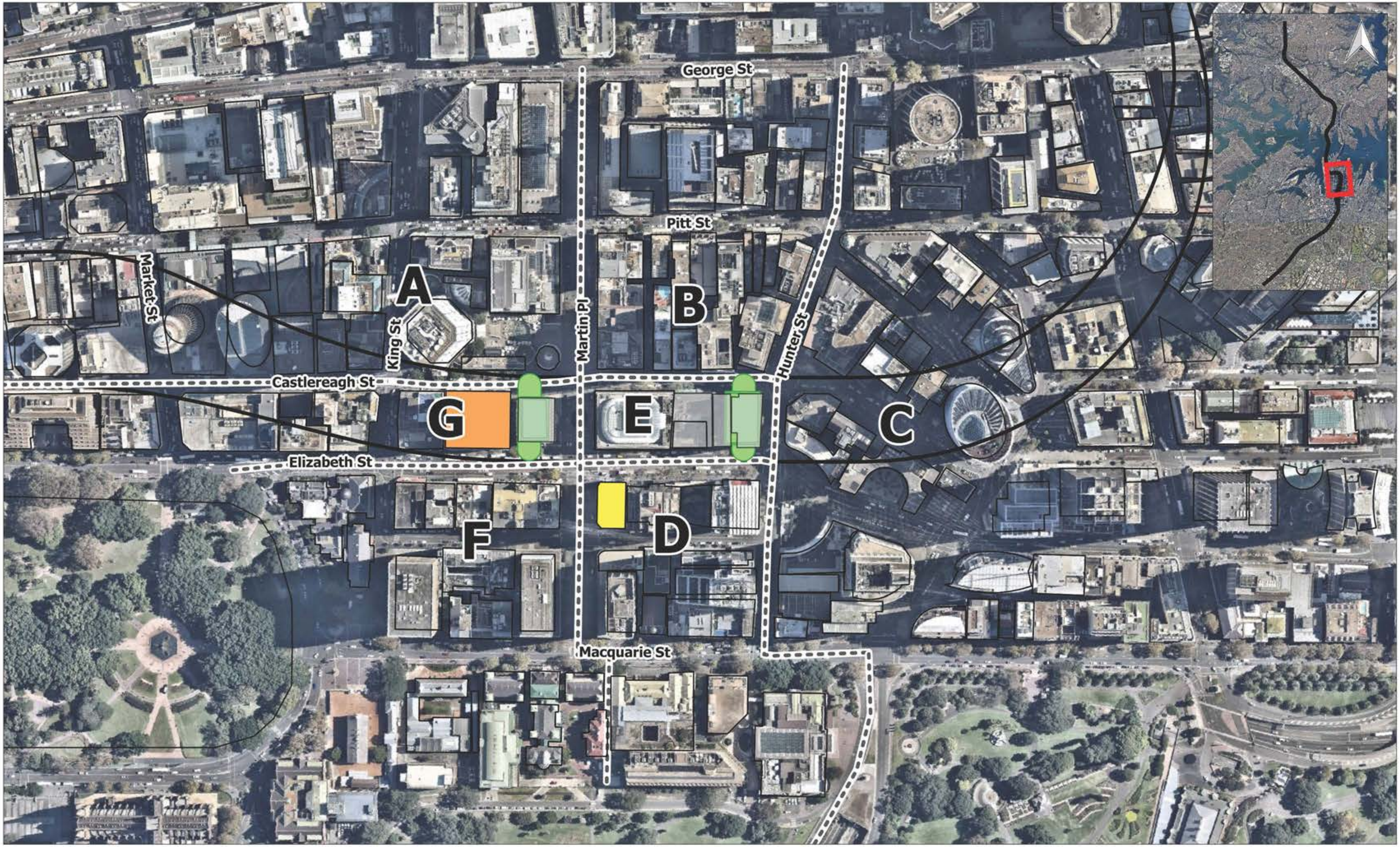

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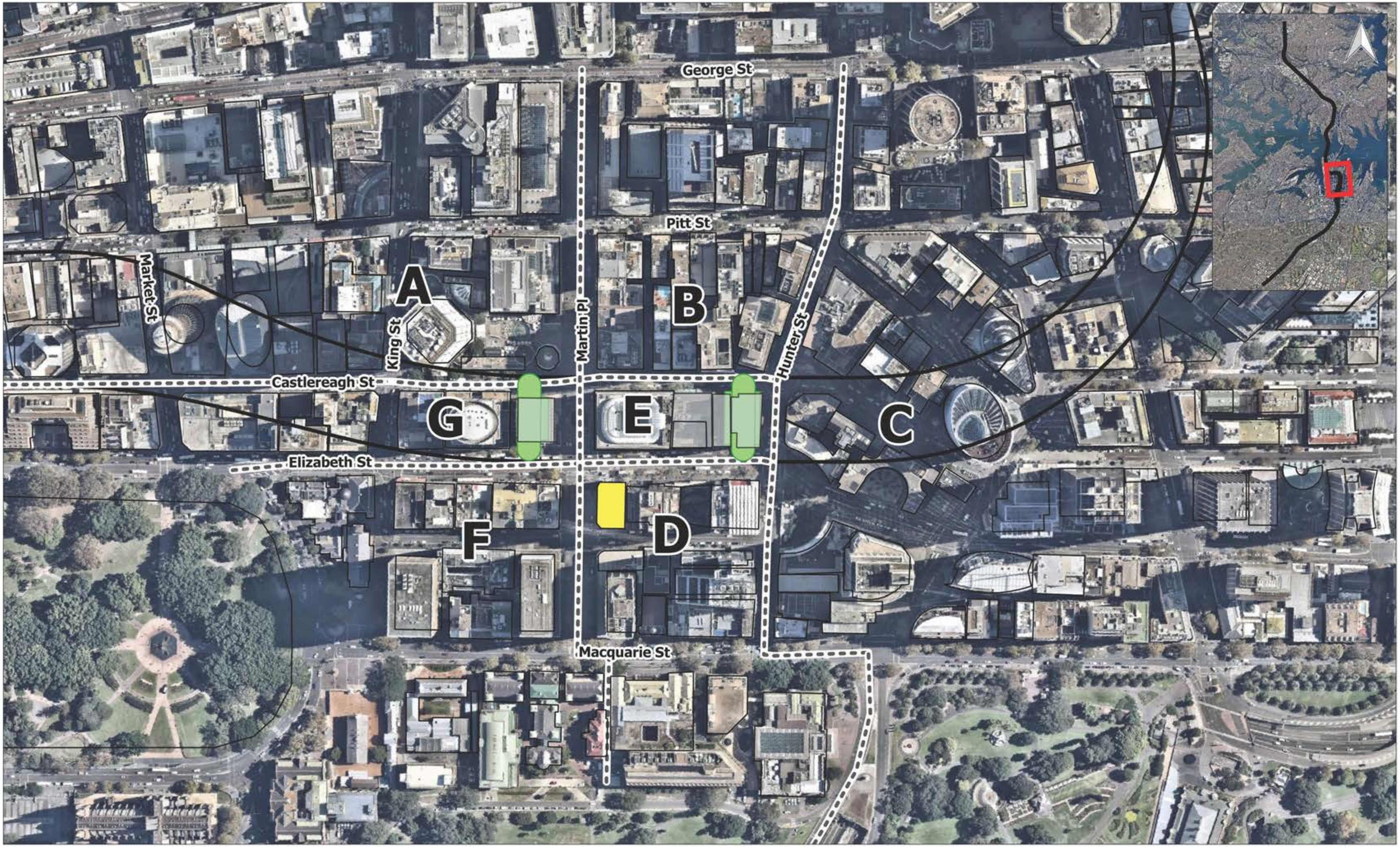

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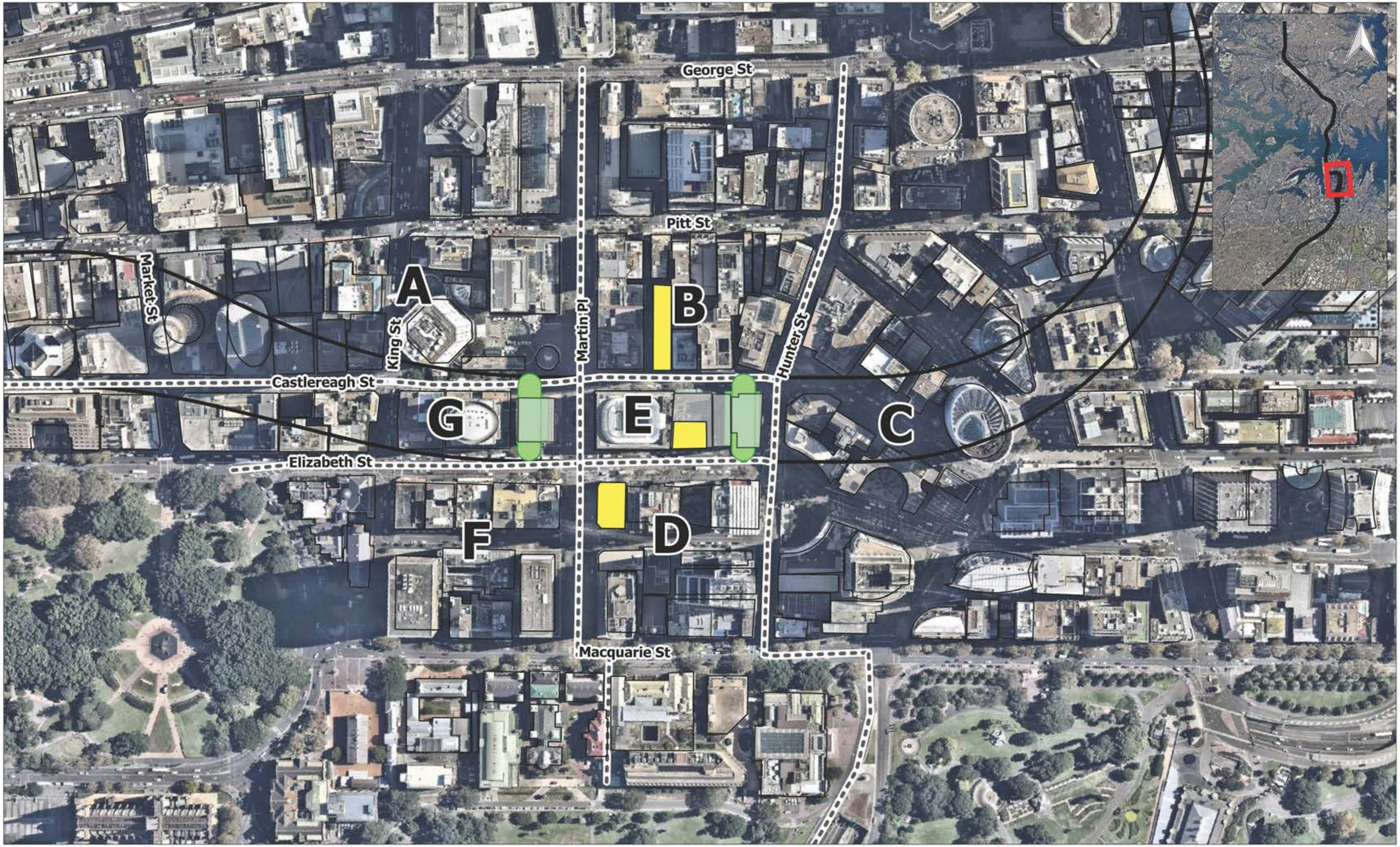

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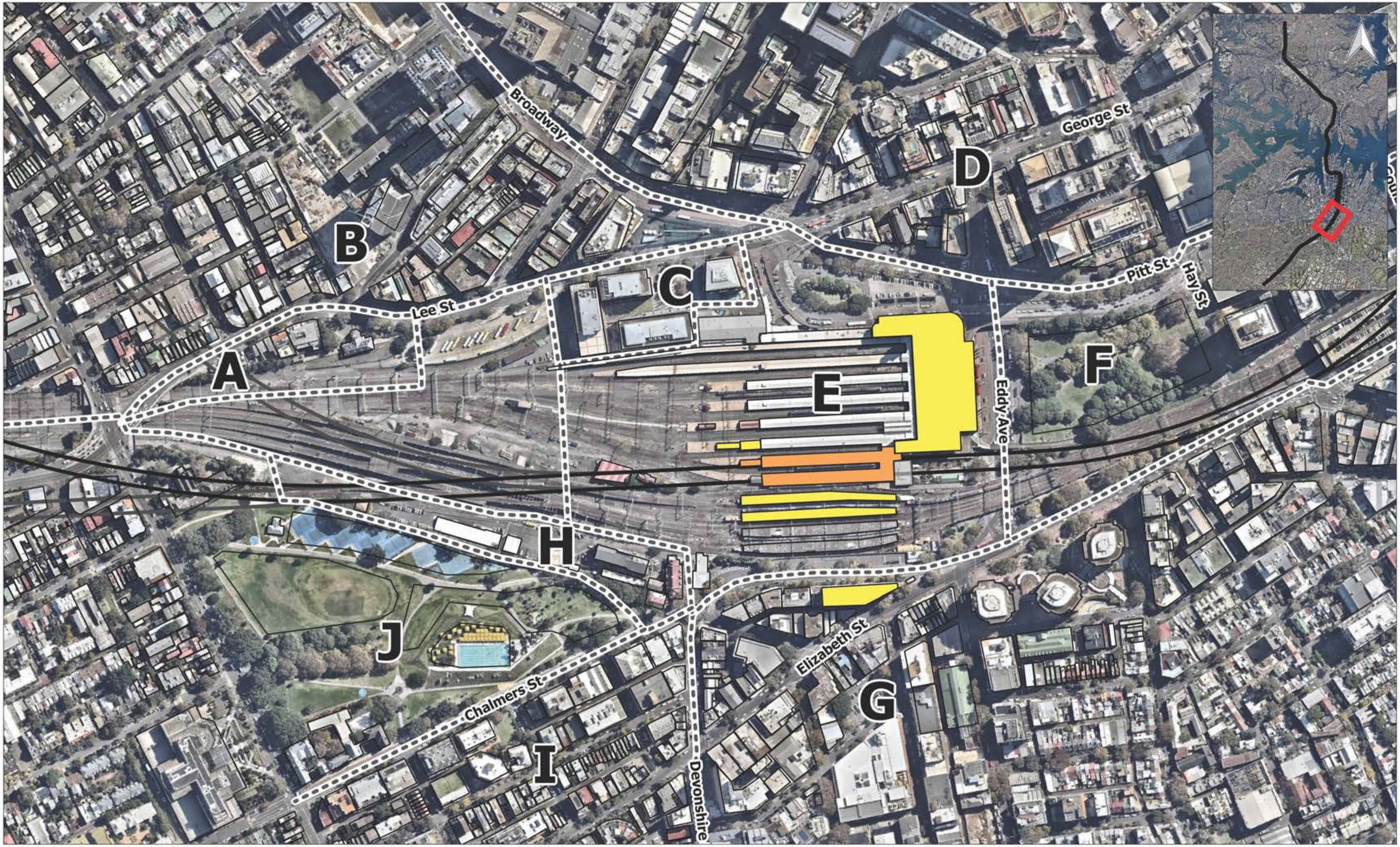

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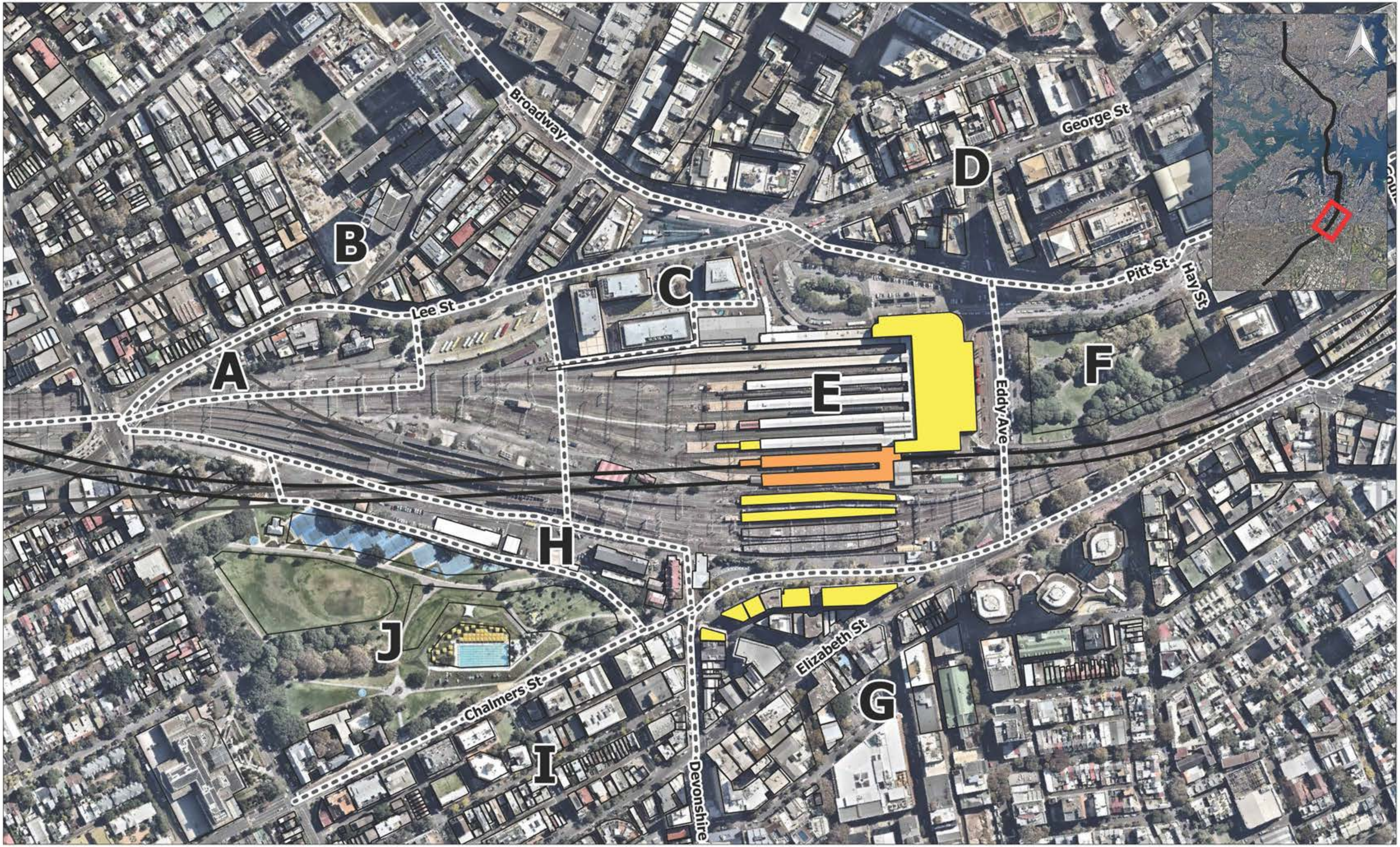

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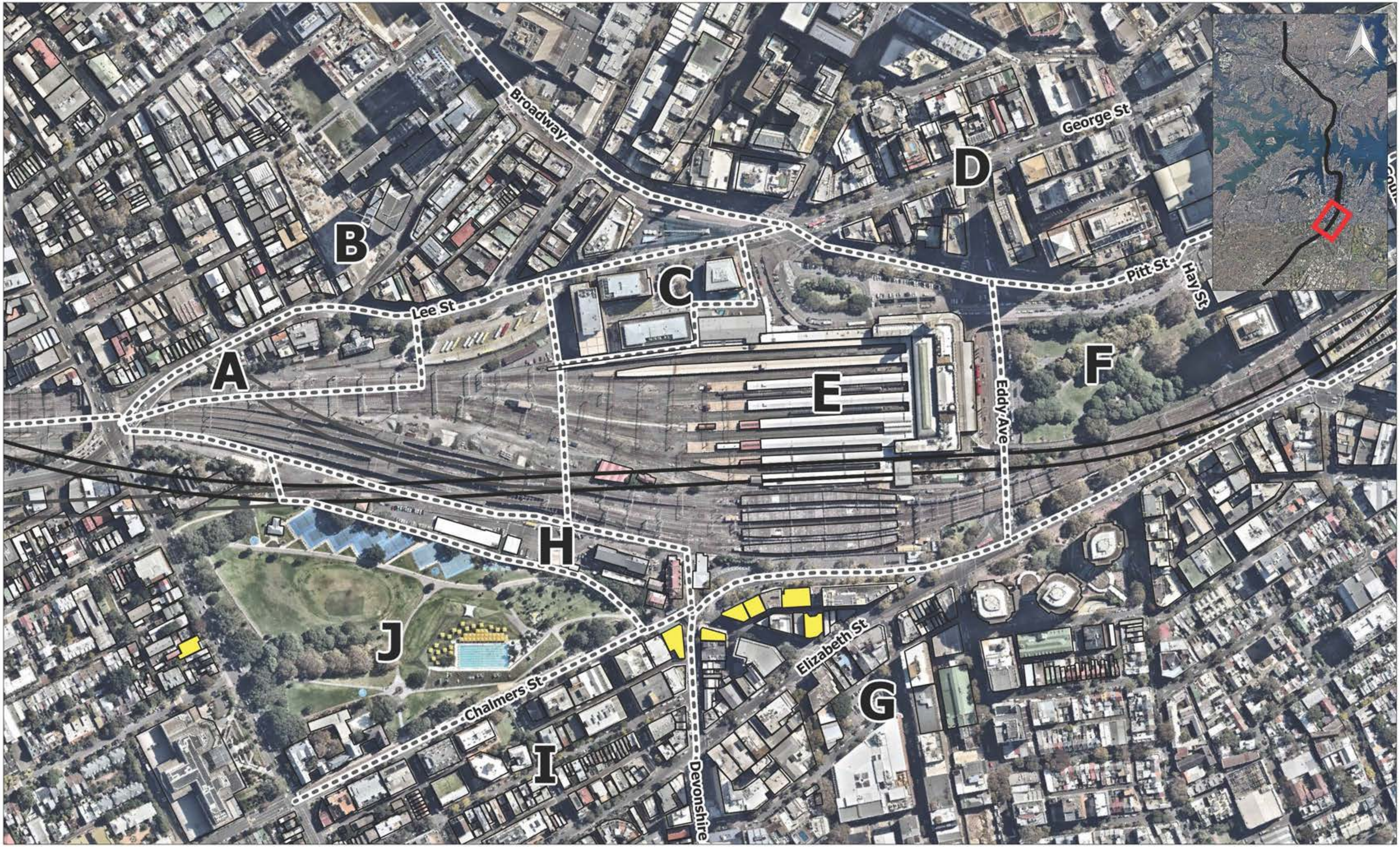

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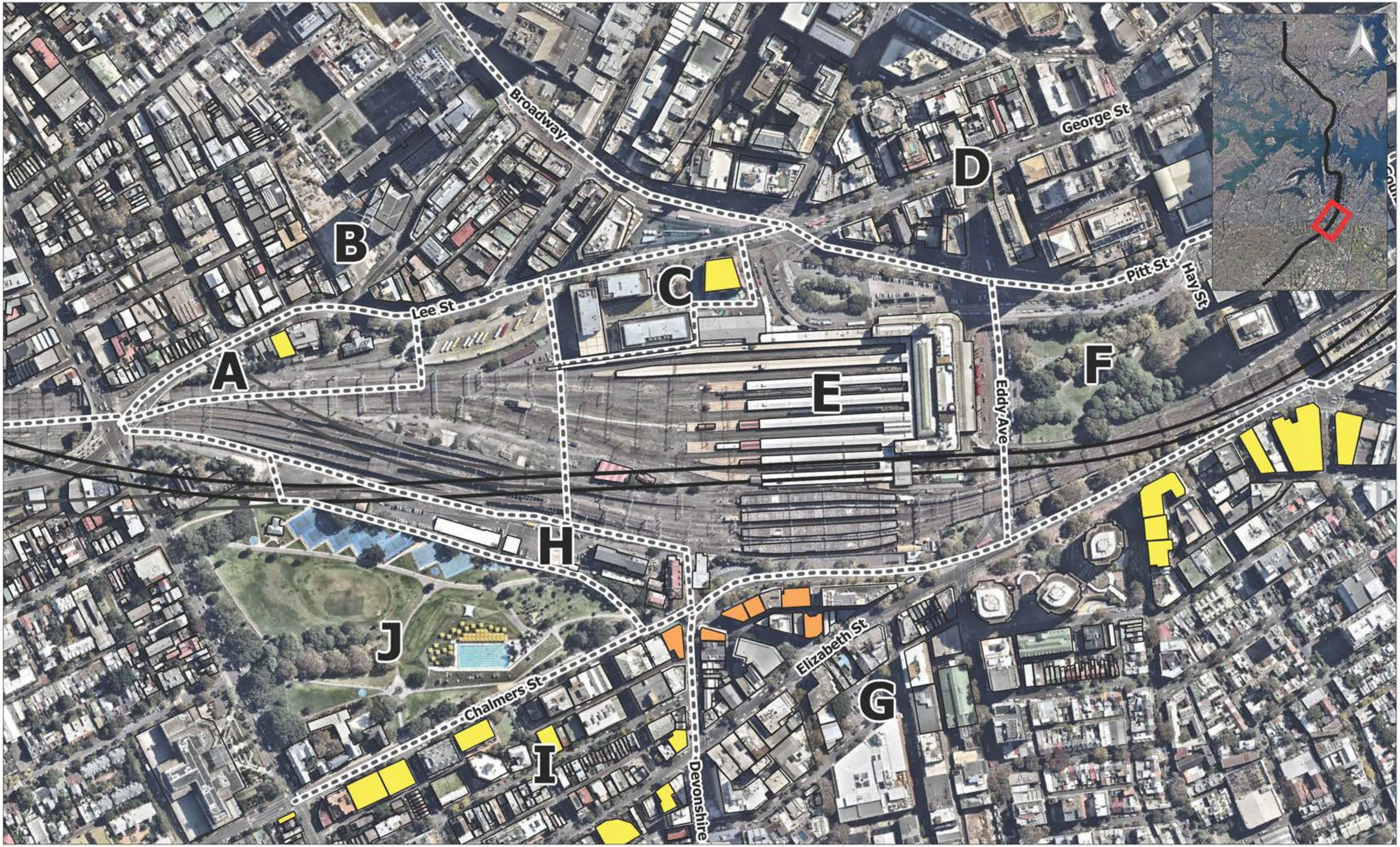

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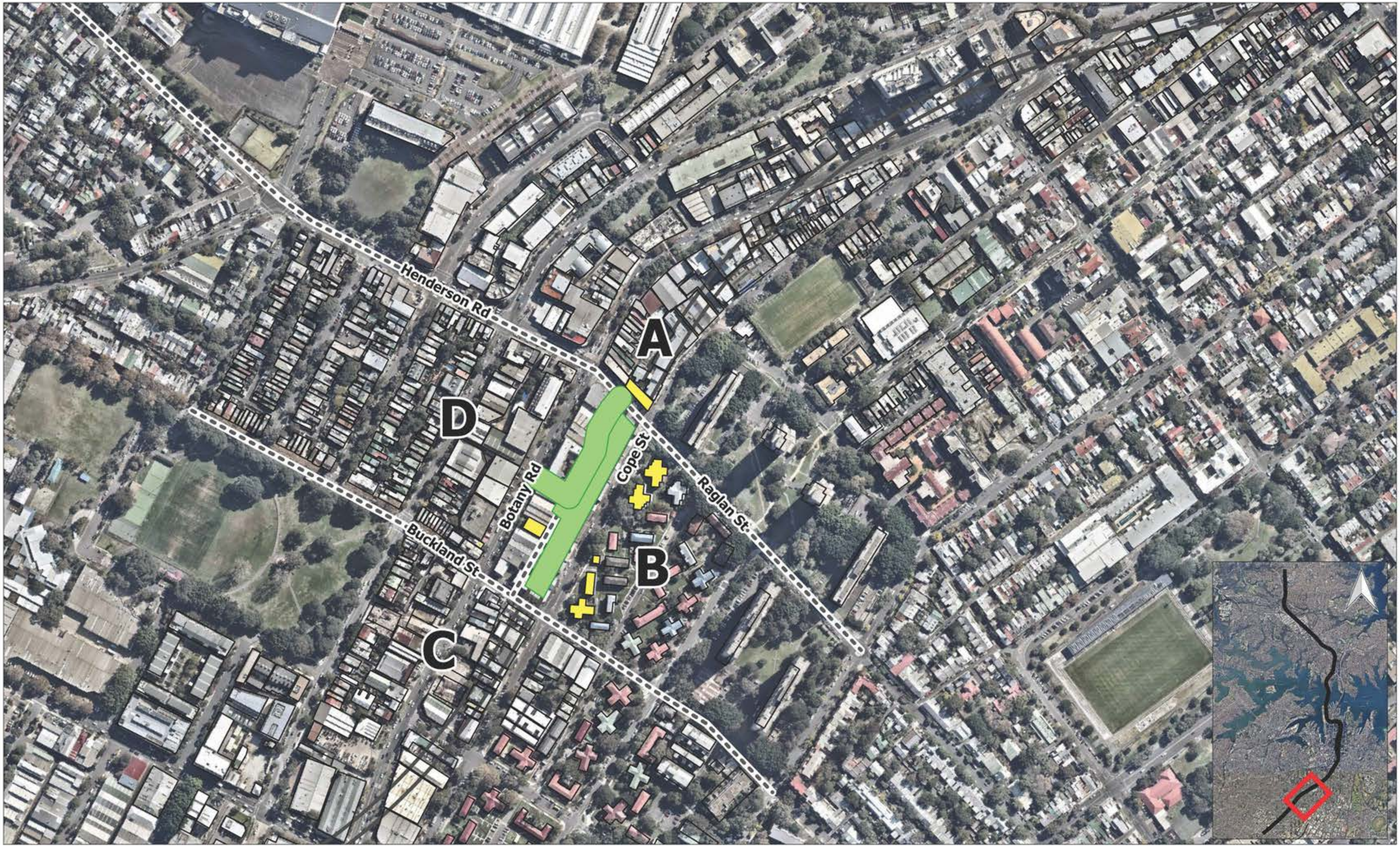

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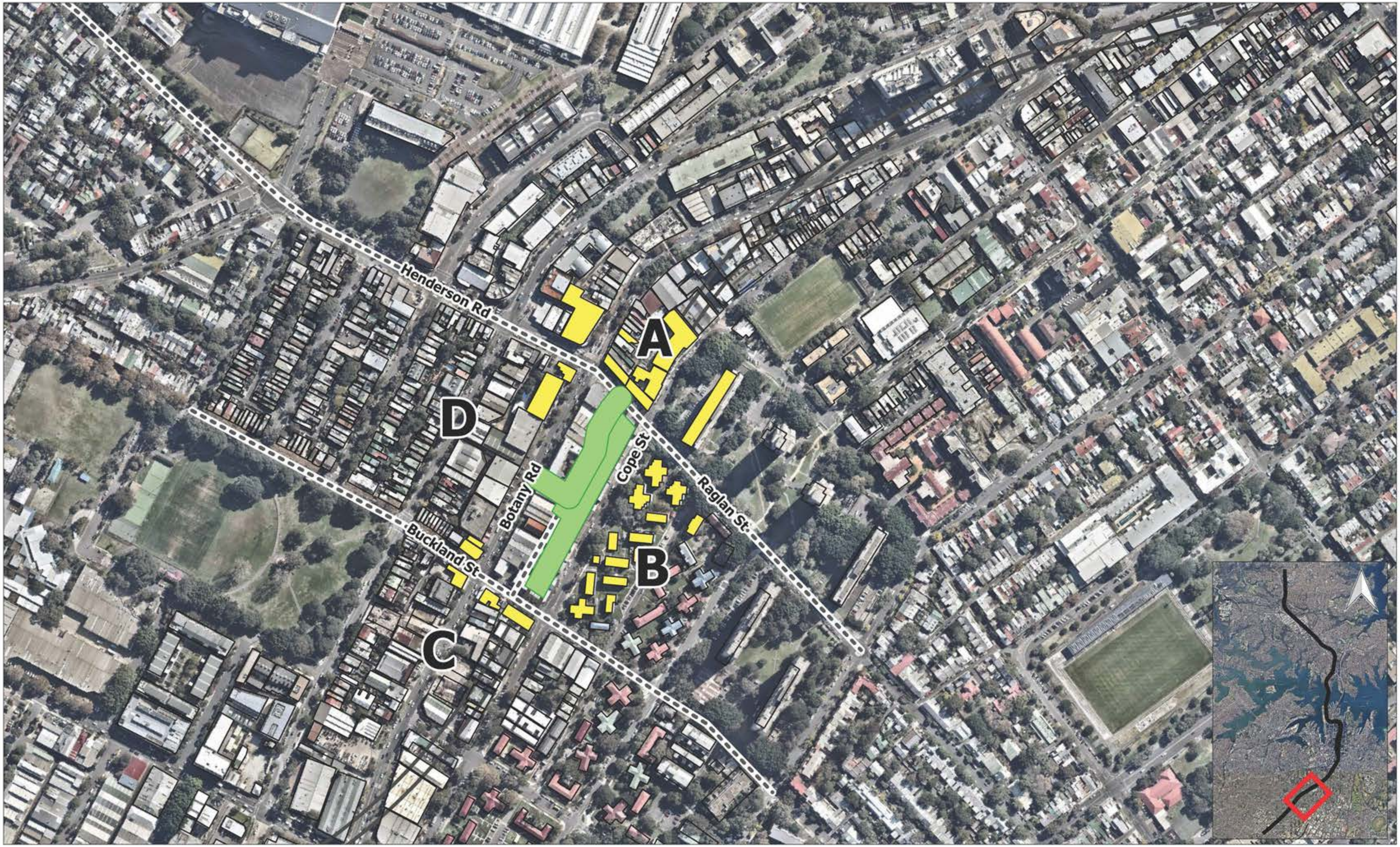

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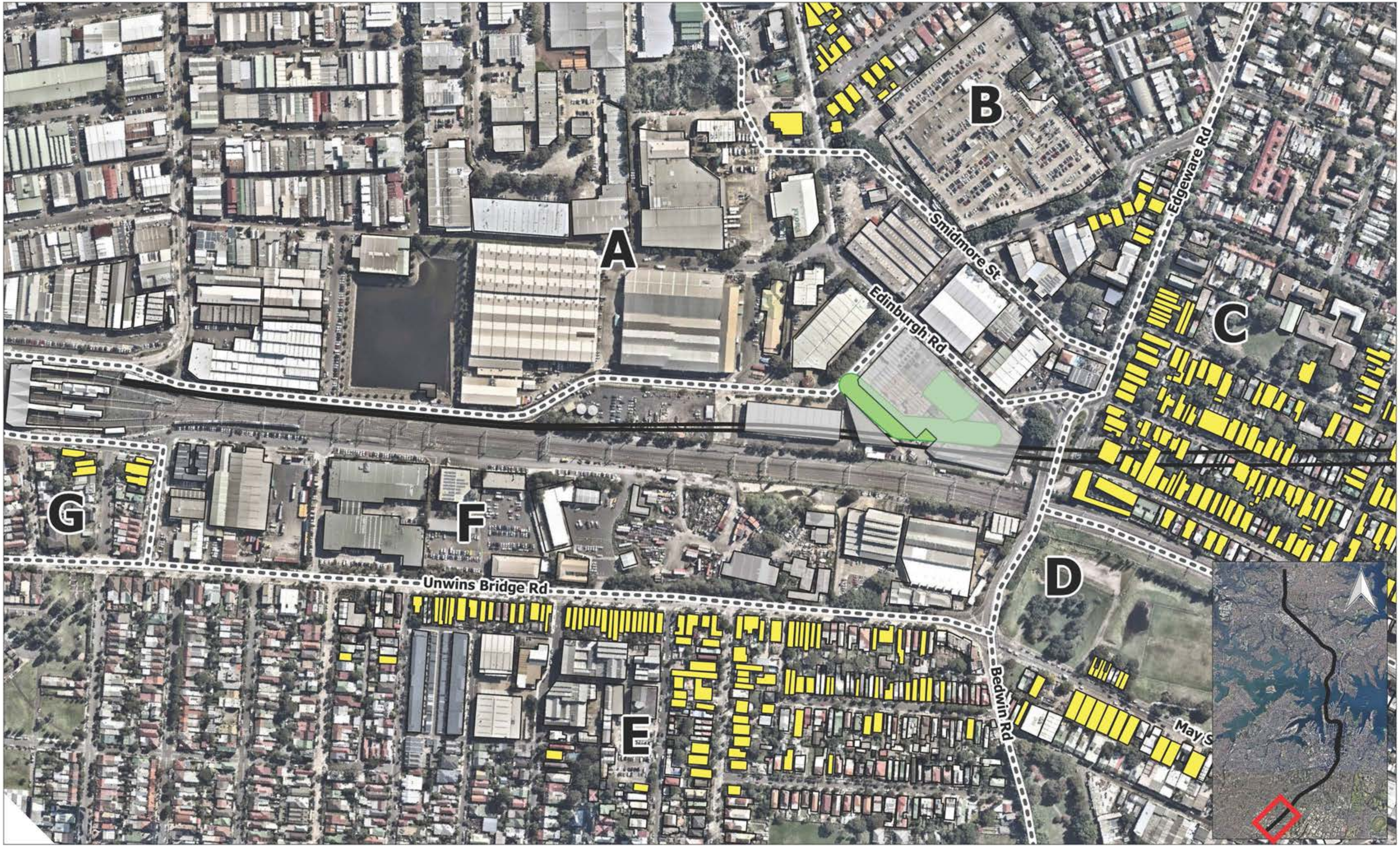

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Appendix D6

Report 610.14718R1
Construction Noise Predictions

Fitout

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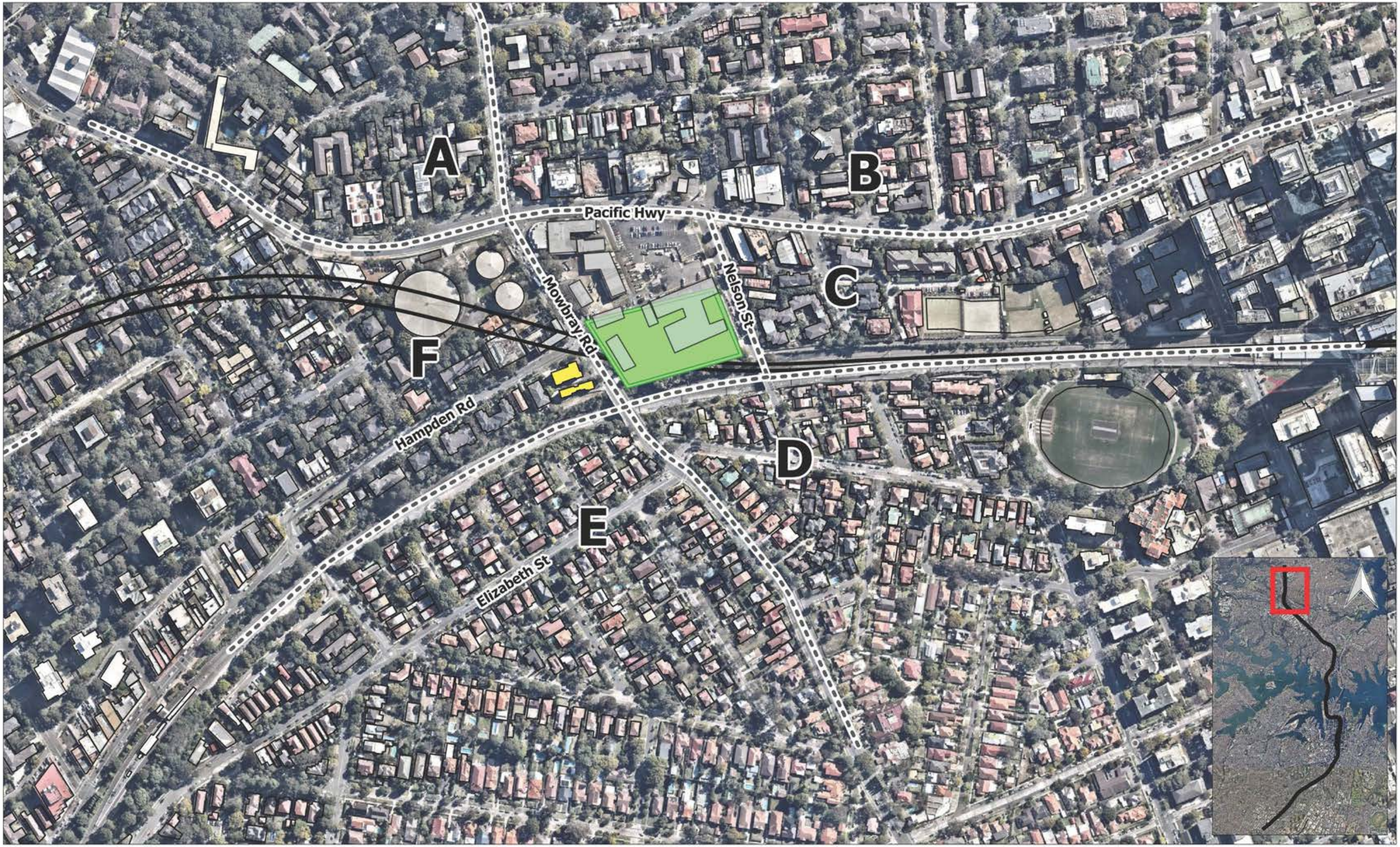

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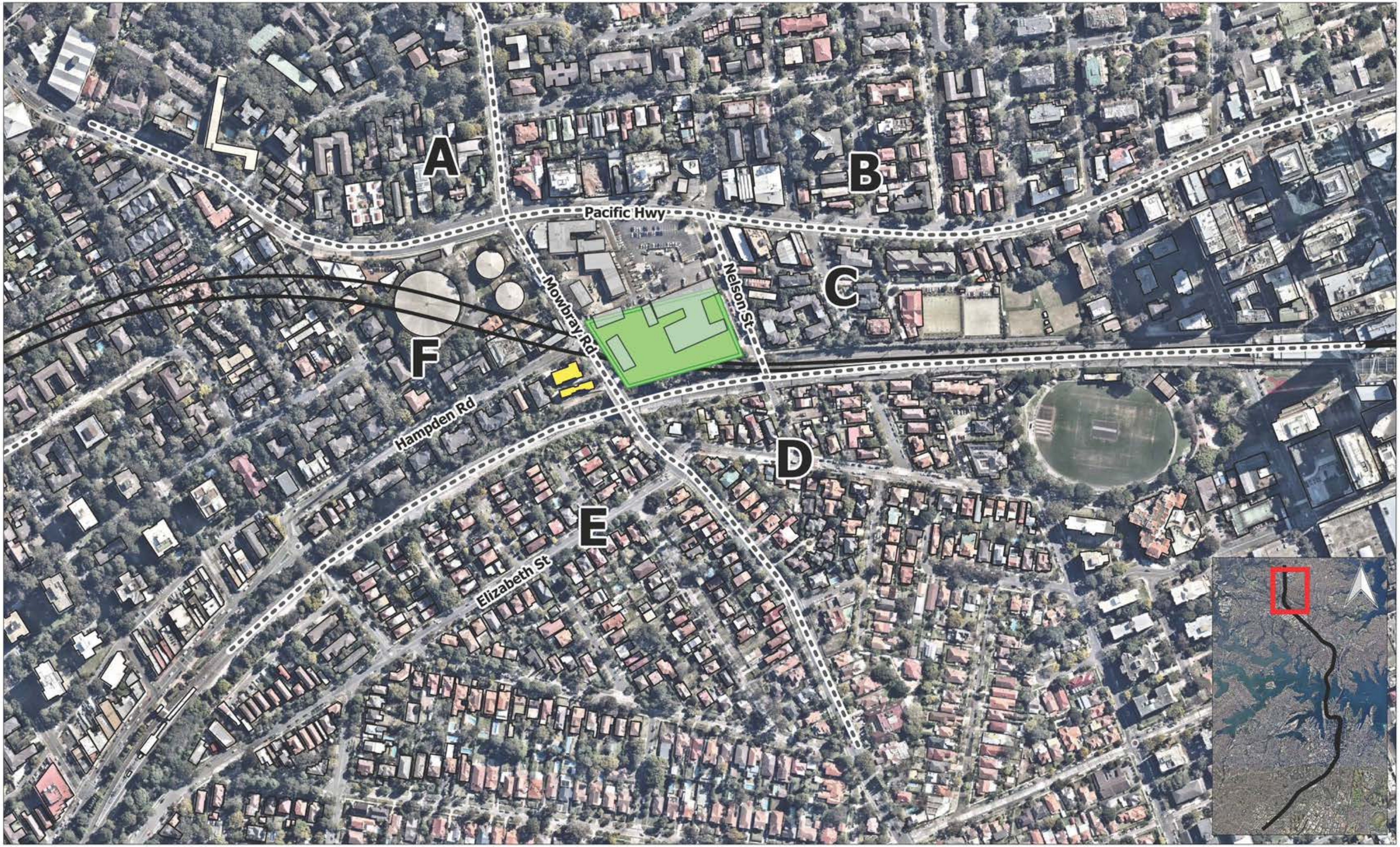

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50 0 50 100 150 m

Receiver Area — Construction Area — Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB — 10 dB - 20 dB — > 20 dB

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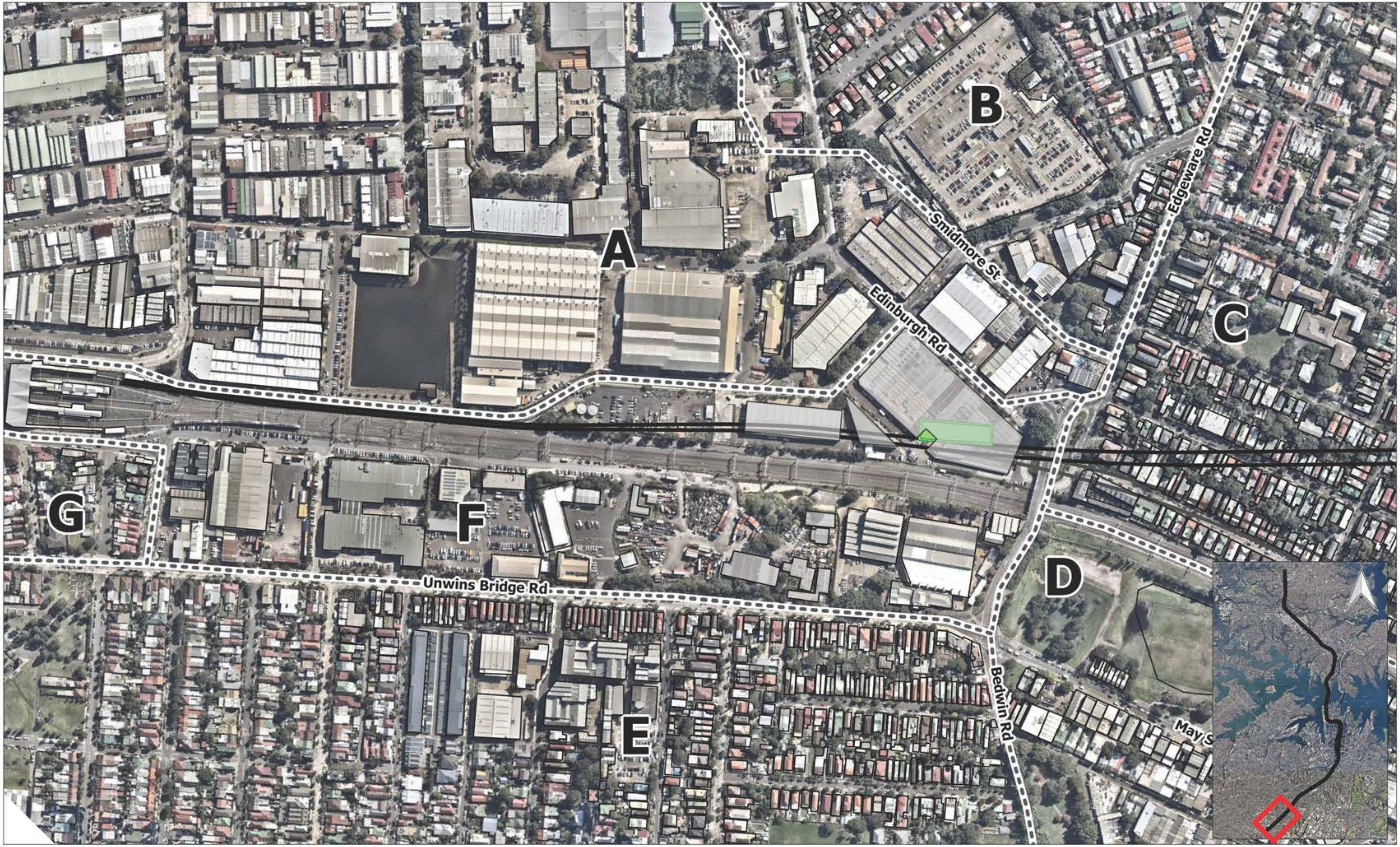
Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Fitout with Shed – Daytime



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50 0 50 100 150 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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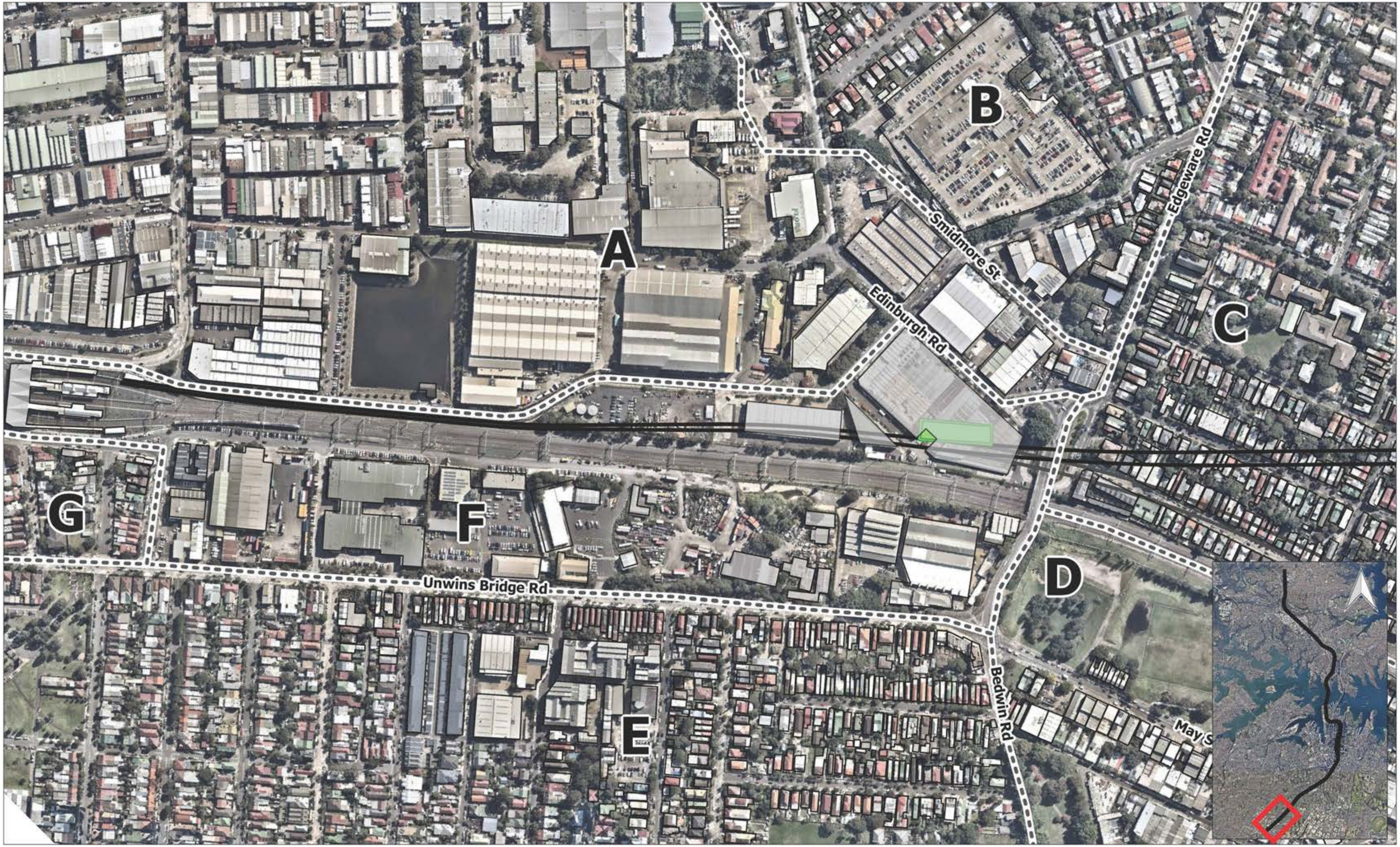
Construction Noise Predictions
Worst-case NML Exceedance
Fitout with Shed – Day OOH



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50 0 50 100 150 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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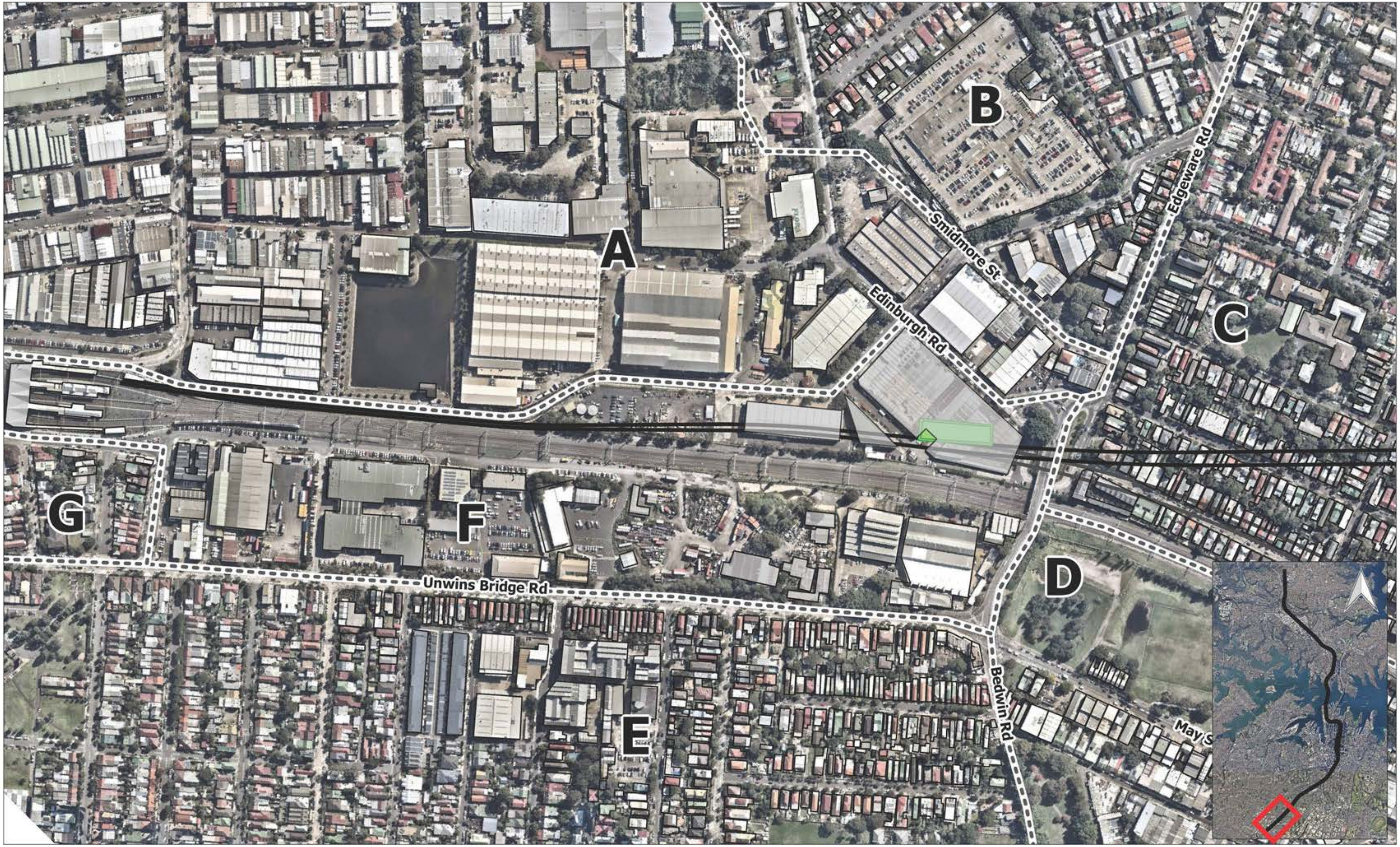
Construction Noise Predictions
Worst-case NML Exceedance
Fitout with Shed – Evening



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Projection:	GDA 1994 MGA Zone 56

50 0 50 100 150 m

Receiver Area · Construction Area · Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB · 10 dB - 20 dB · > 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Fitout with Shed – Night

Appendix D7

Report 610.14718R1
Construction Noise Predictions

Precast Factory

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Projection:	GDA 1994 MGA Zone 56

50 0 50 100 150 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Precast Factory – Day

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Projection:	GDA 1994 MGA Zone 56

50 0 50 100 150 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Construction Noise Predictions
Worst-case NML Exceedance
Precast Factory – Day OOH

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Projection:	GDA 1994 MGA Zone 56

50 0 50 100 150 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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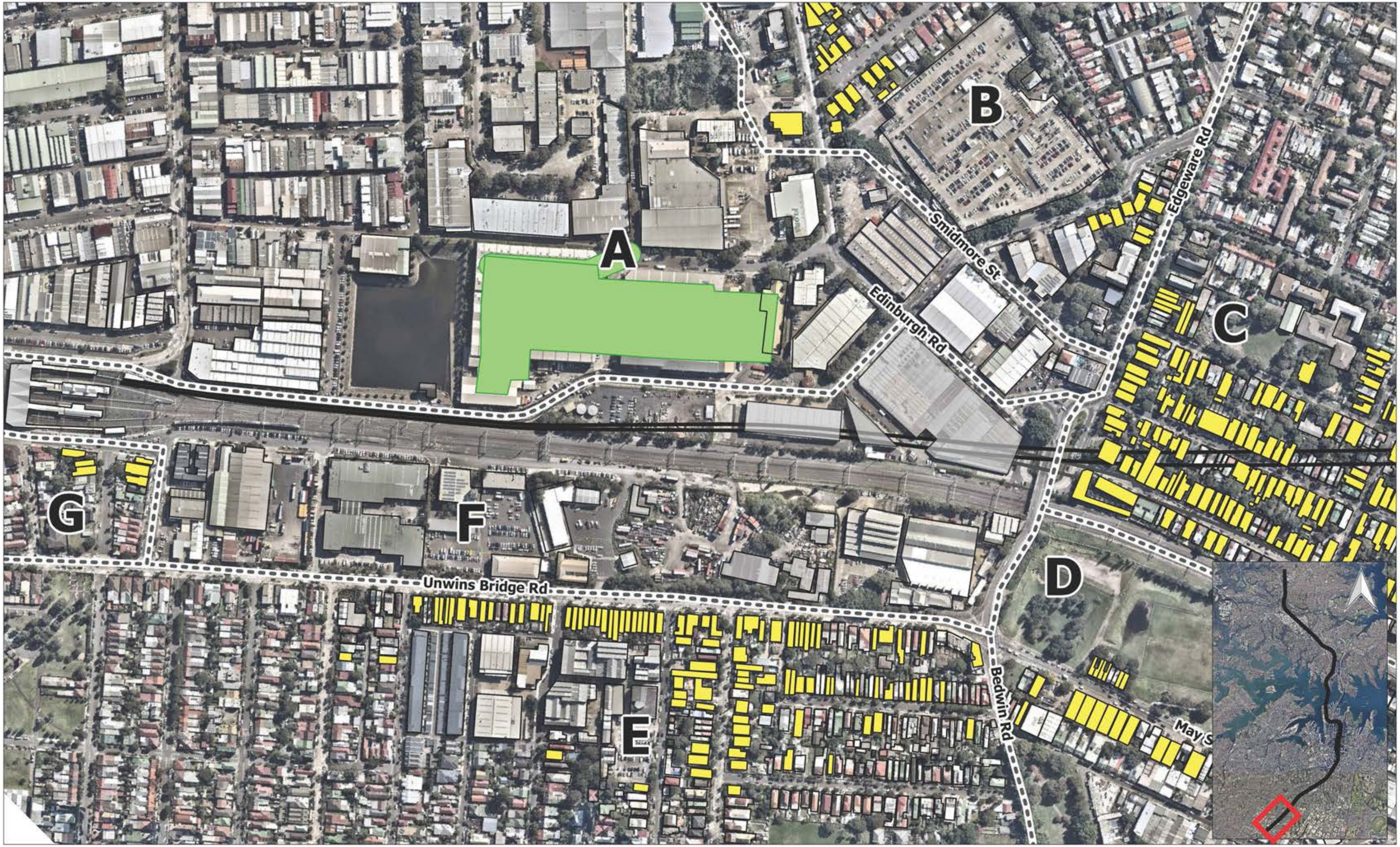
Construction Noise Predictions
Worst-case NML Exceedance
Precast Factory – Evening



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50 0 50 100 150 m

Receiver Area — Construction Area — Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB — 10 dB - 20 dB — > 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Precast Factory – Night

Appendix D8

Report 610.14718R1
Construction Noise Predictions

Harbour Crossing

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50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Harbour – Daytime


C
A
B
Kent St
Argyle St
Blues Point Rd
Henry Lawson Ave
E Crescent St
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Scale: 1:6,000
Sheet Size: @A4
Projection: GDA 1994 MGA Zone 56
N
50 0 50 100 m
Receiver Area
Construction Area
Acquired Building
Worst-case Exceedance of NML
0 dB - 10 dB
10 dB - 20 dB
> 20 dB
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Sydney Metro Chatswood to Sydenham
Construction Noise Predictions
Worst-case NML Exceedance
Harbour – Day OOH

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Projection:	GDA 1994 MGA Zone 56

N

50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Harbour – Evening

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Projection:	GDA 1994 MGA Zone 56

N

50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Harbour - Night

Appendix D9

Report 610.14718R1
Construction Noise Predictions

Construction

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50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Construction - Daytime

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50 0 50 100 m

N

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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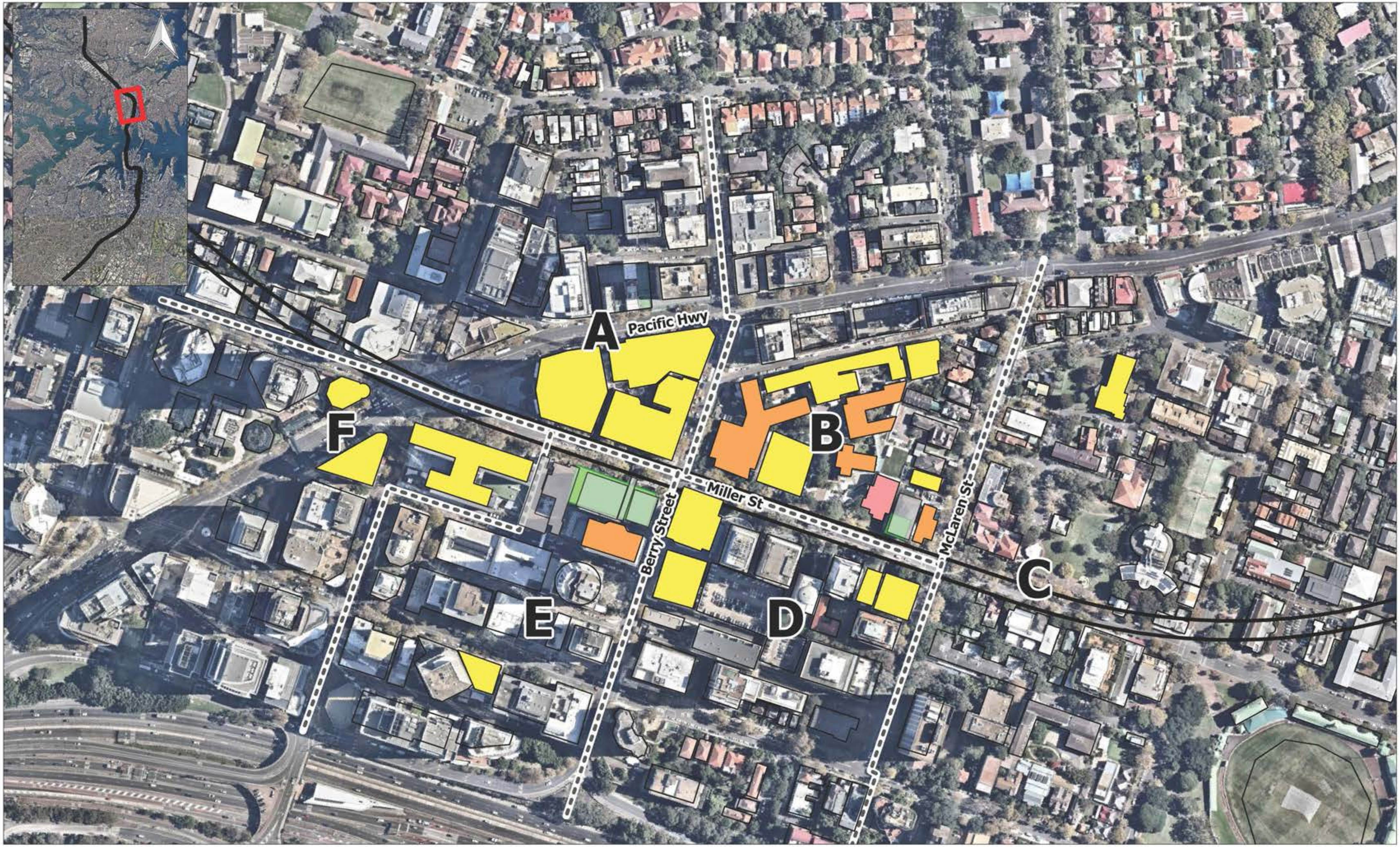
Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Construction - Daytime



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50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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Construction Noise Predictions
Worst-case NML Exceedance
Construction - Daytime

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50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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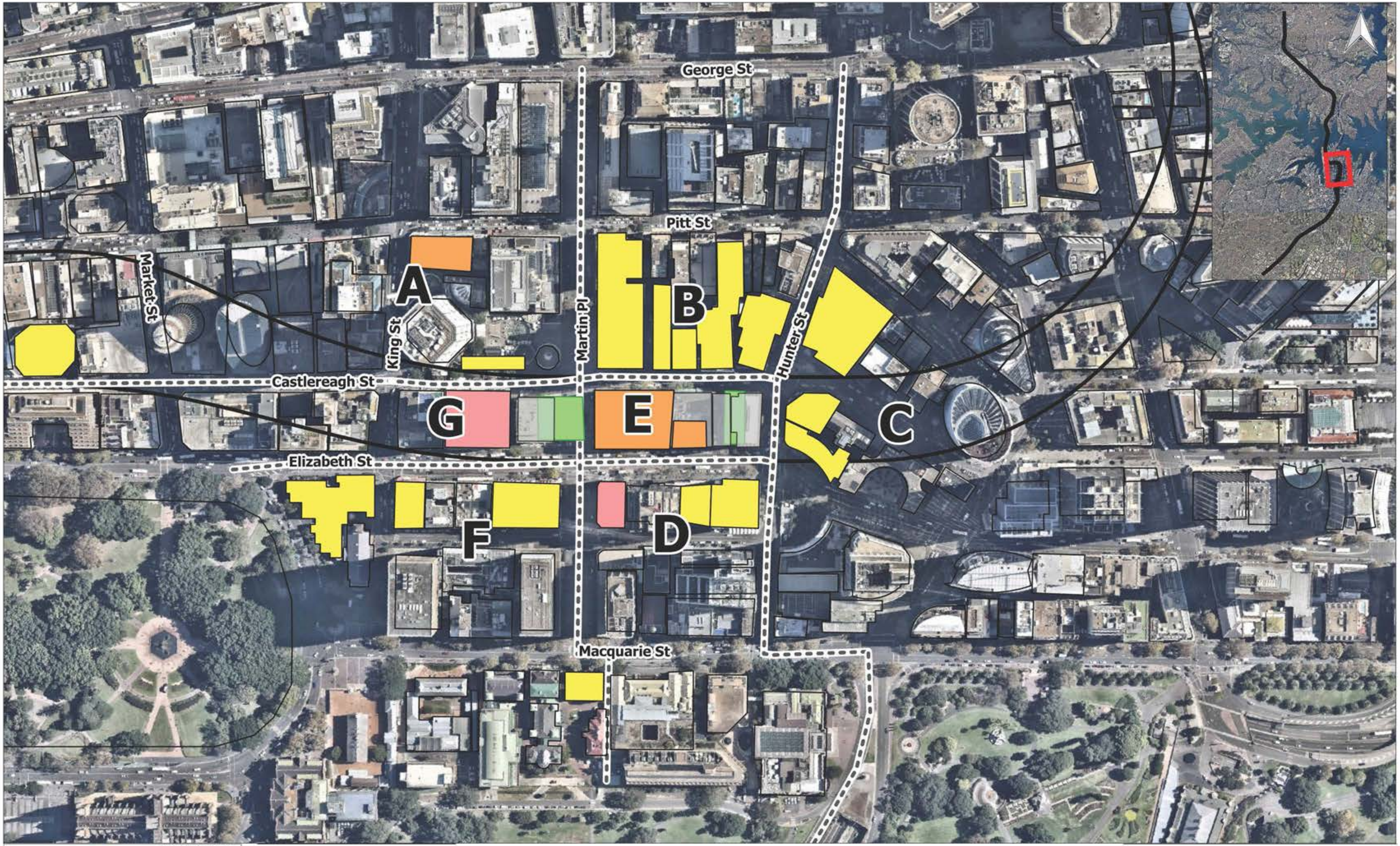
Construction Noise Predictions
Worst-case NML Exceedance
Construction - Daytime



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N

50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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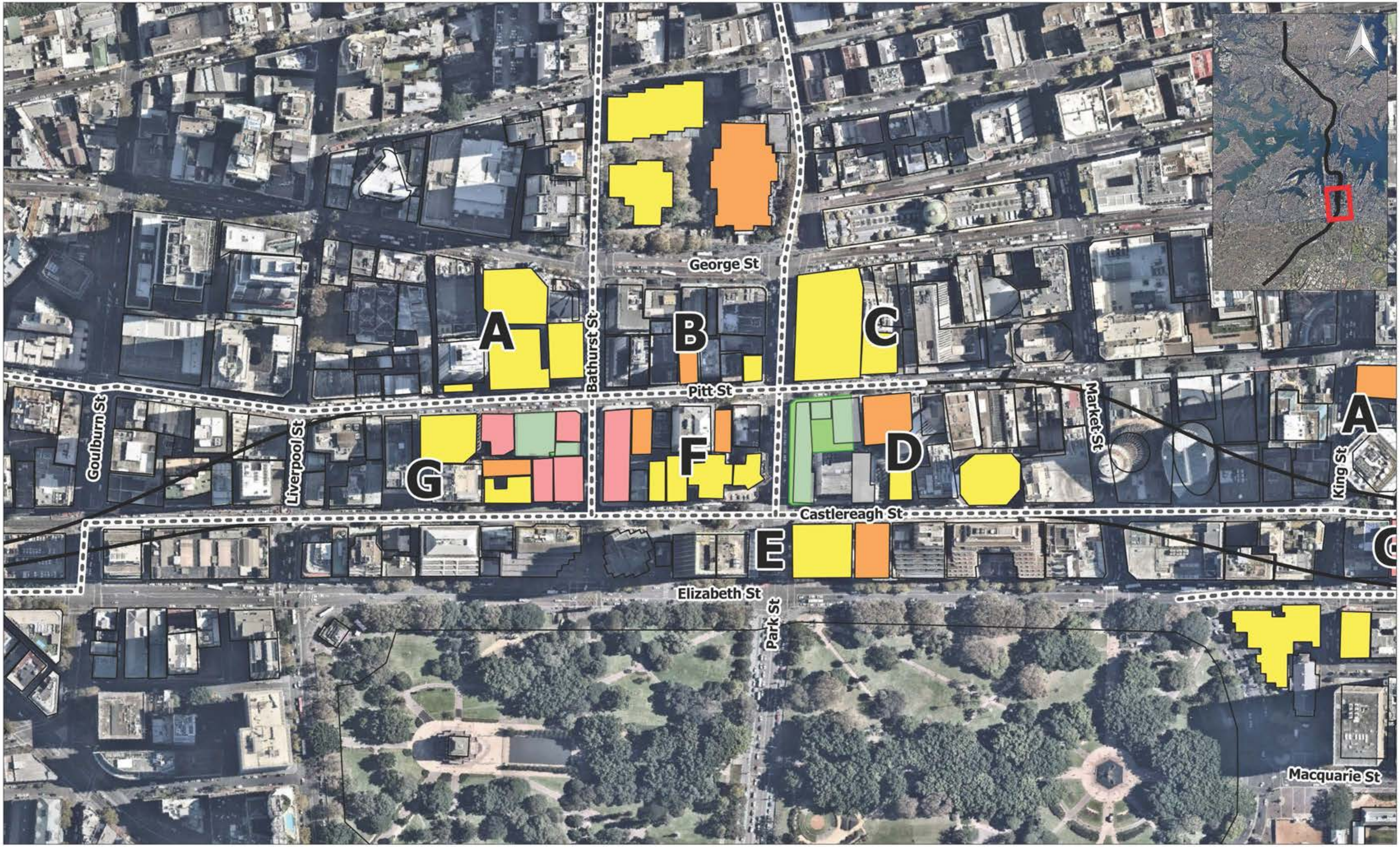
Construction Noise Predictions
Worst-case NML Exceedance
Construction - Daytime



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50 0 50 100 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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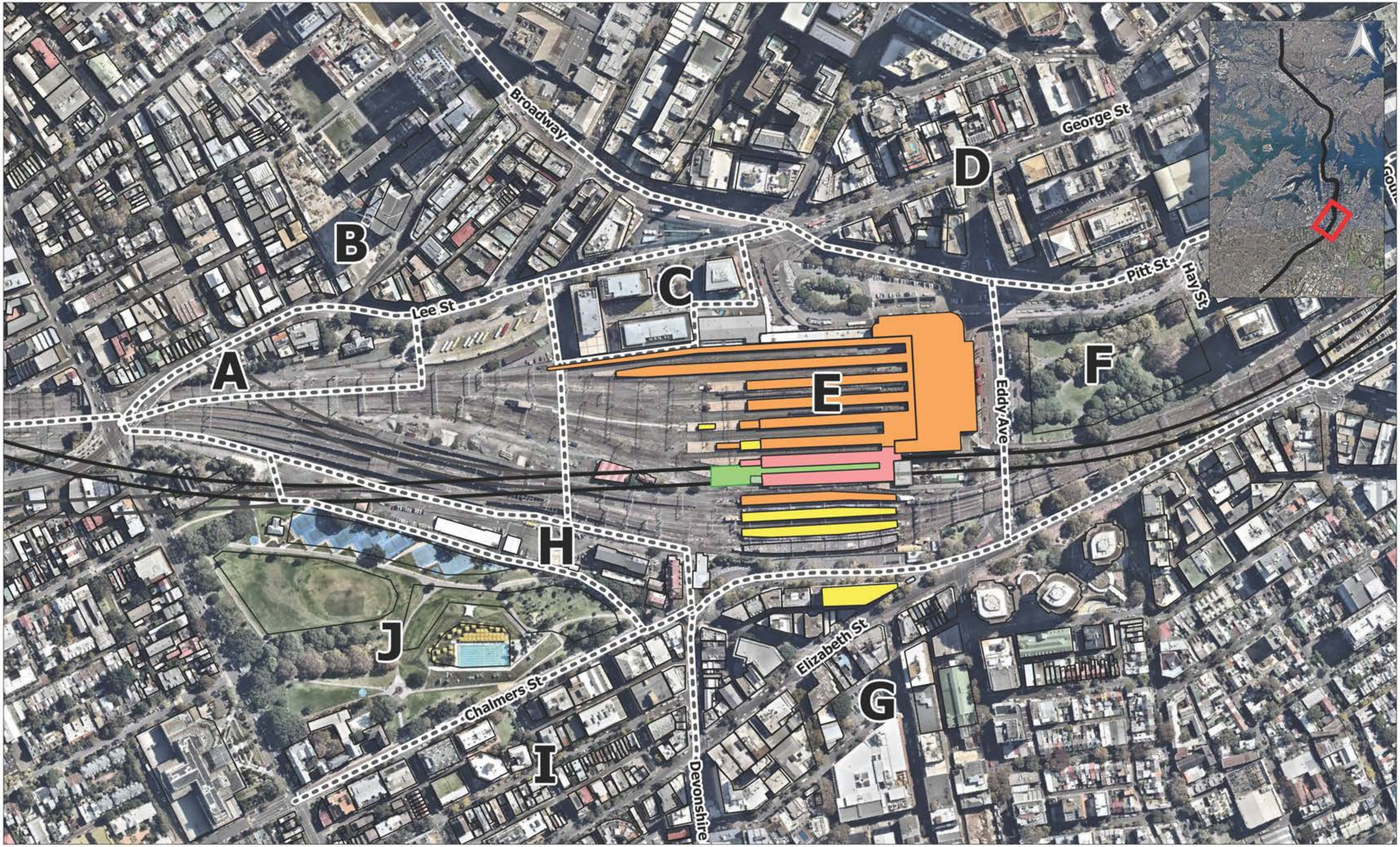
Construction Noise Predictions
Worst-case NML Exceedance
Construction - Daytime



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Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML
0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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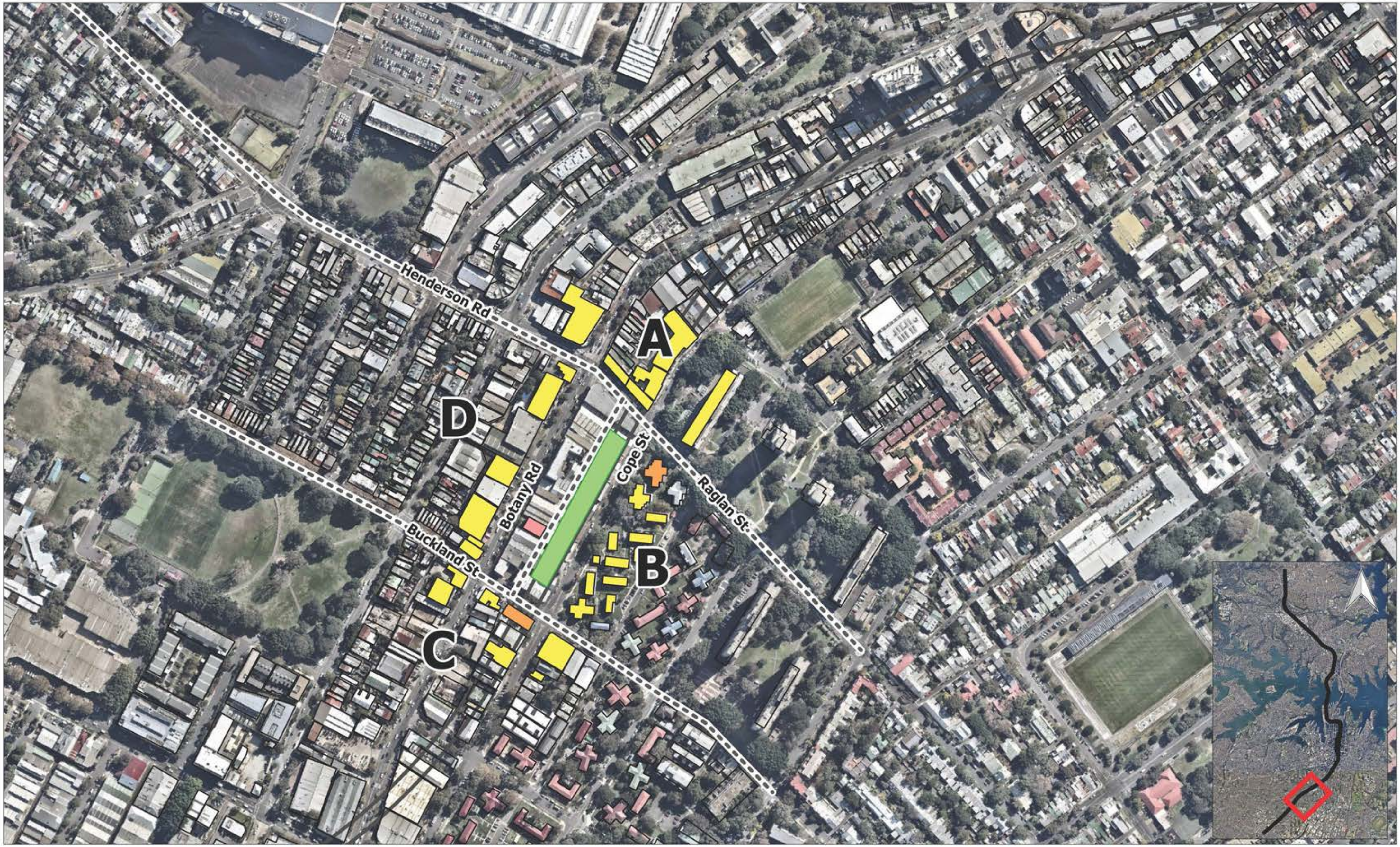
Sydney Metro Chatswood to Sydenham

Construction Noise Predictions
Worst-case NML Exceedance
Construction - Daytime



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50 0 50 100 150 m

Receiver Area
Construction Area
Acquired Building

Worst-case Exceedance of NML

0 dB - 10 dB
10 dB - 20 dB
> 20 dB

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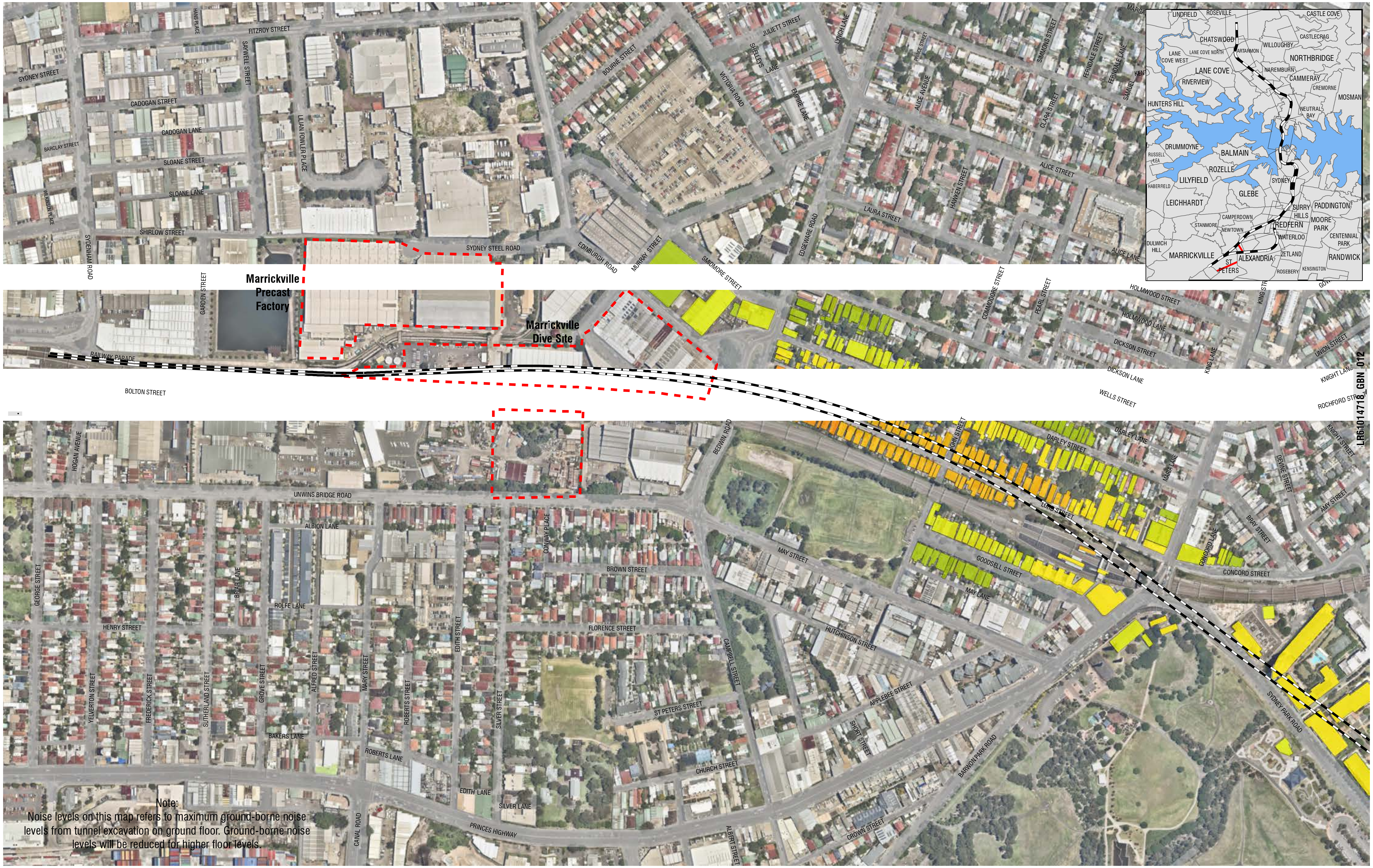
Construction Noise Predictions
Worst-case NML Exceedance
Construction - Daytime

Appendix E

Report 610.14718R1

Construction Tunnelling Ground-borne Noise Predictions



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0 50 100 150 200 m

LEGEND

- Proposed Rail Alignment
- Construction Sites

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 40 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Construction Phase
Ground Bourne Noise Levels

Page 1 of 10

FIGURE: SLR61014718_GBN_011

Noise levels on this map refers to maximum ground-borne noise levels from tunnel excavation on ground floor. Ground-borne noise levels will be reduced for higher floor levels.

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0 50 100 150 200 m

LEGEND

- Proposed Rail Alignment
- Construction Sites

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 40 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Sydney Metro Chatswood to Sydenham

Construction Phase
Ground Bourne Noise Levels

Page 2 of 10

FIGURE: SLR61014718_GBN_012

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Note:
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0 50 100 150 200 m

LEGEND

Proposed Rail Alignment

Construction Sites

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 40 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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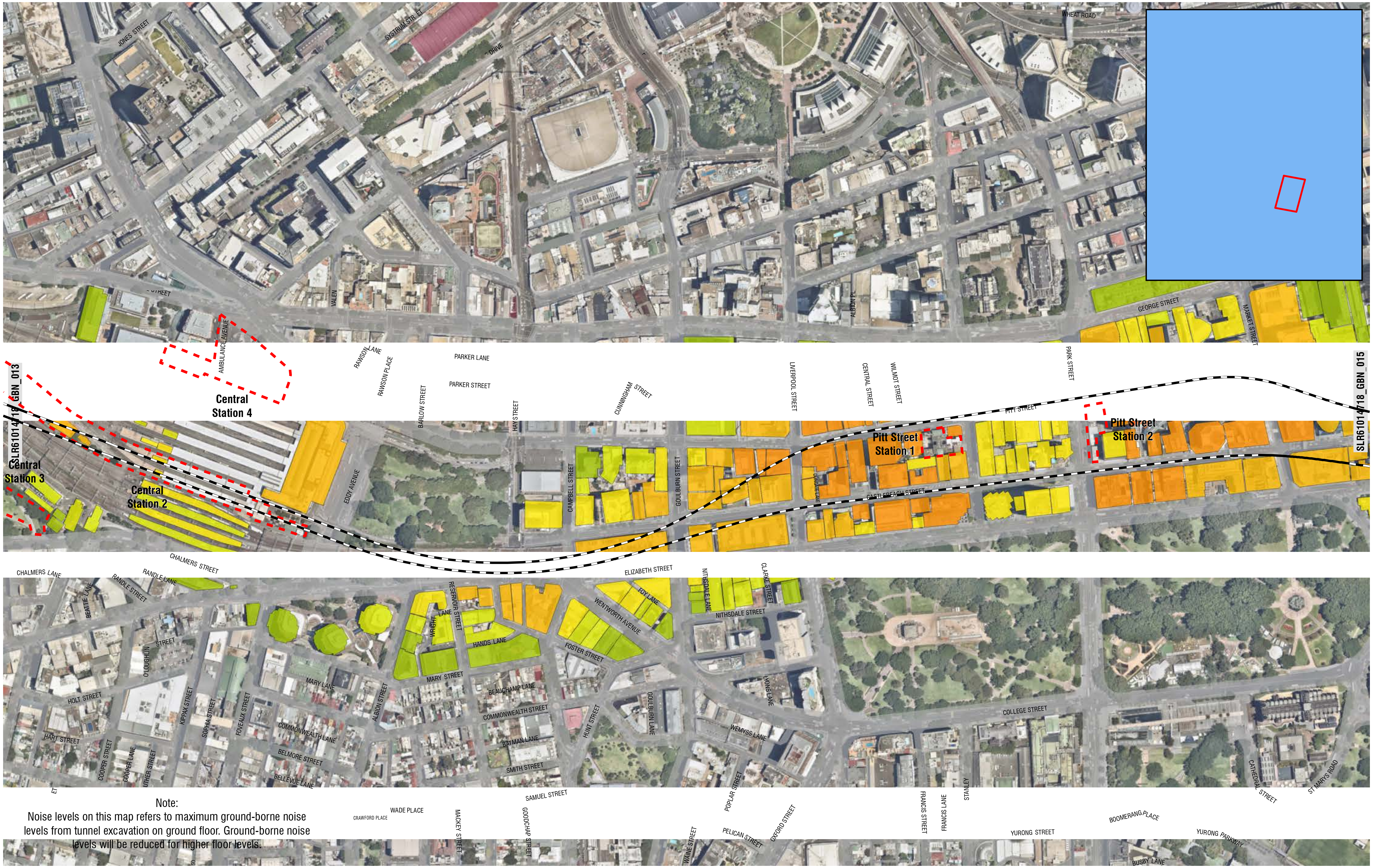
Construction Phase Ground Bourne Noise Levels

Page 3 of 10

FIGURE: SLR61014718_GBN_013



Note:
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0 50 100 150 200 m

LEGEND

- Proposed Rail Alignment
- Construction Sites

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 40 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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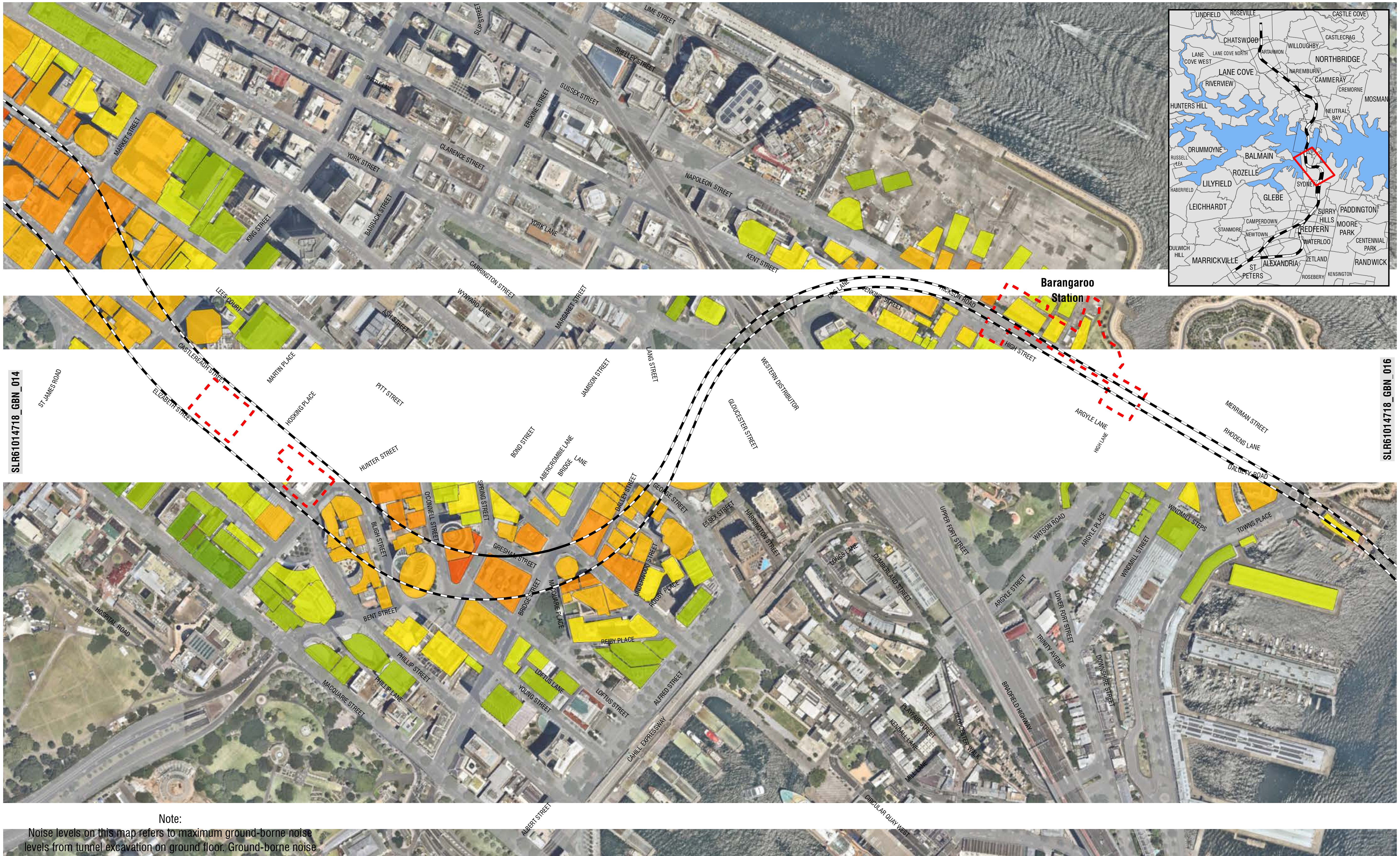
Sydney Metro Chatswood to Sydenham

Construction Phase Ground Bourne Noise Levels

Page 4 of 10

FIGURE: SLR61014718_GBN_014



Note:
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Projection:	GDA 1994 MGA Zone 56

0 50 100 150 200 m

LEGEND

Proposed Rail Alignment

Construction Sites

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 40 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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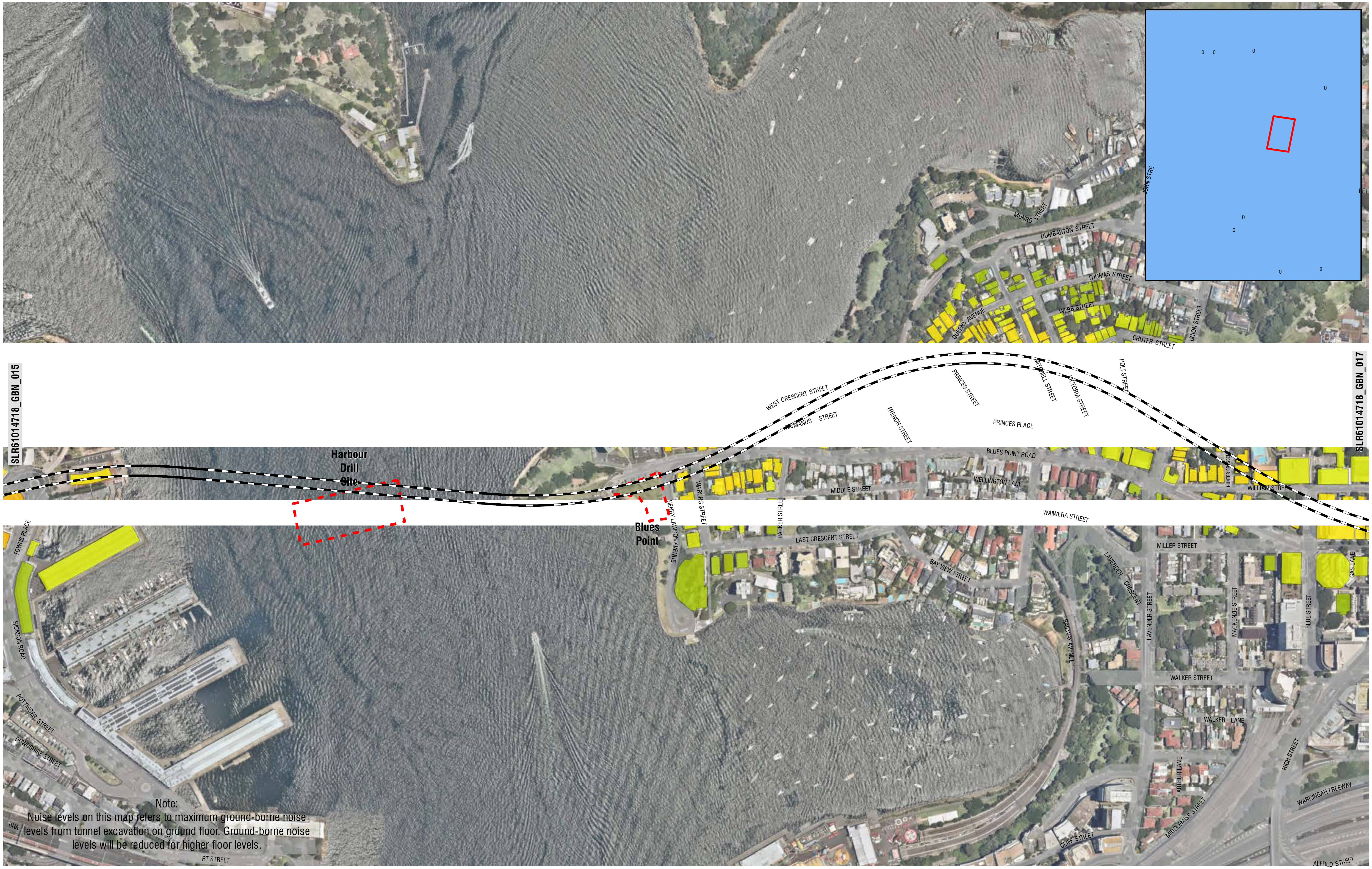
Construction Phase
Ground Bourne Noise Levels

Page 5 of 10

FIGURE: SLR61014718_GBN_015



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Projection:	GDA 1994 MGA Zone 56

0 50 100 150 200 m

LEGEND

Proposed Rail Alignment
Construction Sites

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 40 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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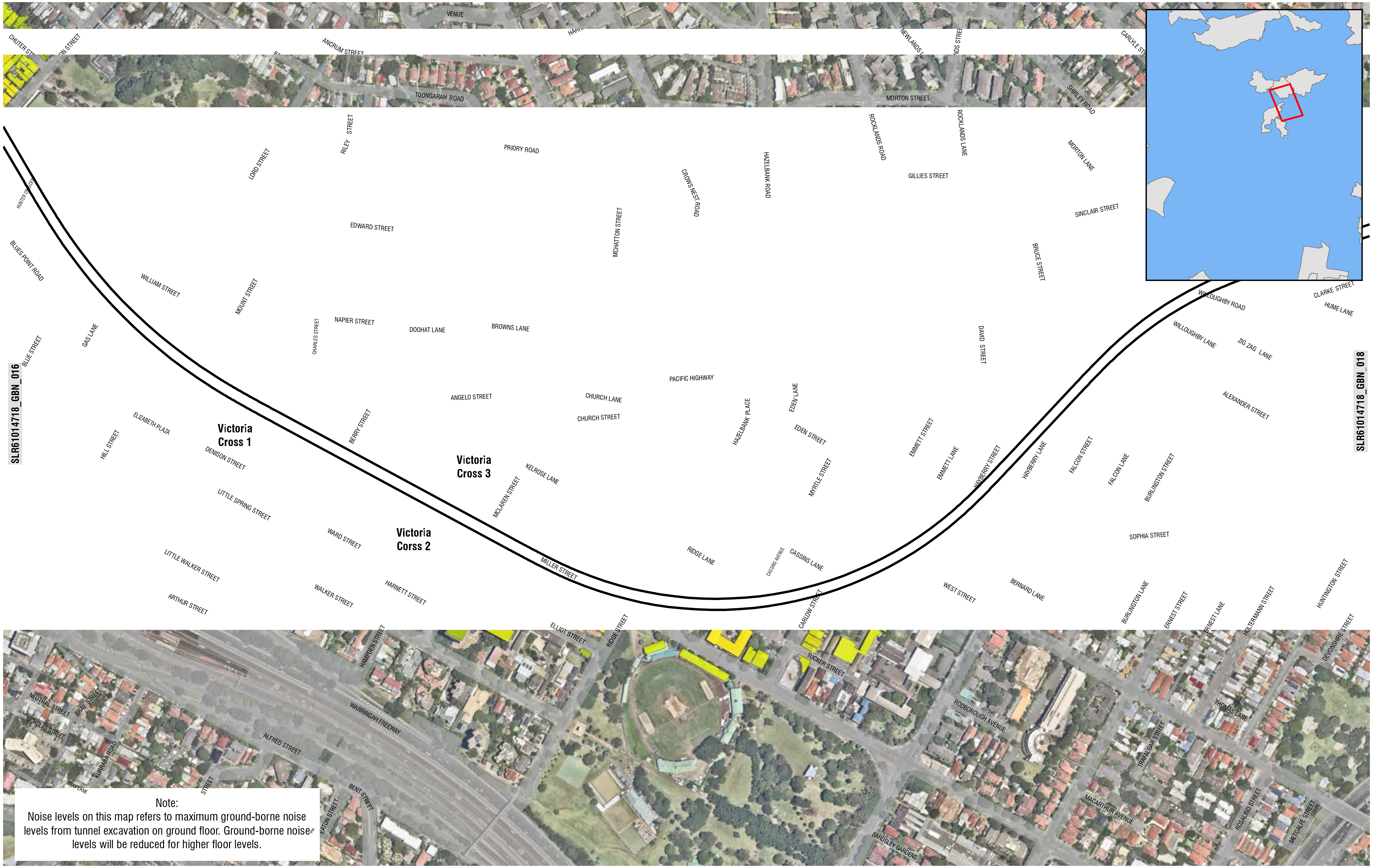
Sydney Metro Chatswood to Sydenham

Construction Phase
Ground Bourne Noise Levels
Page 6 of 10

FIGURE: SLR61014718_GBN_016



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LEGEND

- Proposed Rail Alignment
- Construction Sites

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 40 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Sydney Metro Chatswood to Sydenham

Construction Phase Ground Bourne Noise Levels

Page 7 of 10

FIGURE: SLR61014718_GBN_017

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0 50 100 150 200 m

LEGEND

Proposed Rail Alignment

Construction Sites

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 40 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Sydney Metro Chatswood to Sydenham

Construction Phase
Ground Bourne Noise Levels

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FIGURE: SLR61014718_GBN_018

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0 50 100 150 200 m

LEGEND

- Proposed Rail Alignment
- Construction Sites

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 40 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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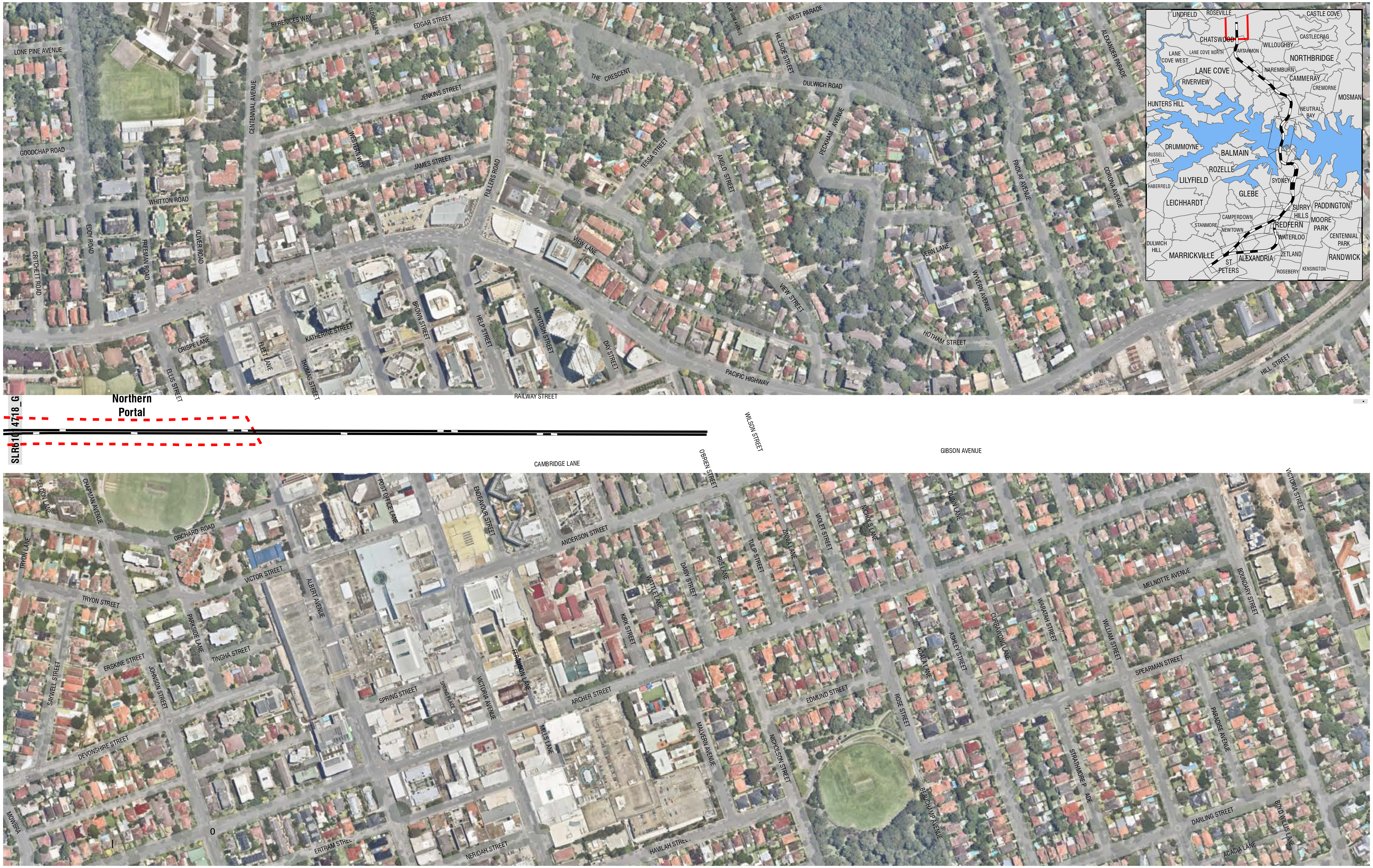
Sydney Metro Chatswood to Sydenham

Construction Phase Ground Bourne Noise Levels

Page 9 of 10

FIGURE: SLR61014718_GBN_019



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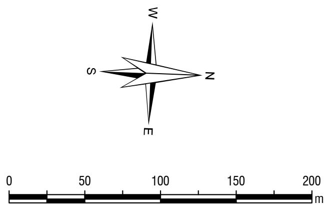

LEGEND

Proposed Rail Alignment

Construction Sites

Ground-borne Noise Level (dBA)

≤15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
40 - 45
46 - 50
51 - 55
56 - 60

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Sydney Metro Chatswood to Sydenham

Construction Phase Ground Bourne Noise Levels

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FIGURE: SLR61014718_GBN_020

Appendix F

Report 610.14718R1

Construction Ground-borne Noise Predictions

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Legend

One Storey Receiver

>One Storey Receiver

Shaft Locations

0 20 40 60 80 m

Exceedances Legend

Shaft Locations

One Storey Receiver

>One Storey Receiver

Other (NML Exceedance 0 to 10 dB)

Other (NML Exceedance 10 to 20 dB)

Other (NML Exceedance 20 to 25 dB)

Other (NML Exceedance > 25 dB)

Exceedances

Residential (NML Exceedance 0 to 10 dB)

Residential (NML Exceedance 10 to 20 dB)

Residential (NML Exceedance 20 to 25 dB)

Residential (NML Exceedance > 25 dB)

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Day-time
Chatswood
Barangaroo Station & Argyle Street

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Legend

- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

Exceedances

- Residential (NML Exceedance 0 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance > 20 dB)

0 20 40 60 80 m

Legend

Shaft Locations
One Storey Receiver
>One Storey Receiver

Exceedances

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Ground-borne Noise Assessment
Night-time
Daytime
Chatswood
Barangaroo Station & Argyle Street

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Legend

- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

0 20 40 60 80 m

Exceedances

- Other (NML Exceedance 0 to 10 dB)
- Other (NML Exceedance 10 to 20 dB)
- Other (NML Exceedance 20 to 25 dB)
- Other (NML Exceedance > 25 dB)

Legend
Shaft Locations
One Storey Receiver
>One Storey Receiver

Exceedances

- Residential (NML Exceedance 0 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance 20 to 25 dB)
- Residential (NML Exceedance > 25 dB)

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Ground-borne Noise Assessment
Day-time
Daytime
Crows Nest
Barangaroo Station & Argyle Street

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Legend
- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

0 20 40 60 80 m

Exceedances
- Residential (NML Exceedance 0 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance > 20 dB)

Legend
Shaft Locations
One Storey Receiver
>One Storey Receiver

Exceedances

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Night-time
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Legend

- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

0 20 40 60 80 m

Exceedances

- Other (NML Exceedance 0 to 10 dB)
- Other (NML Exceedance 10 to 20 dB)
- Other (NML Exceedance 20 to 25 dB)
- Other (NML Exceedance > 25 dB)

Legend

- Shaft Locations
- One Storey Receiver
- >One Storey Receiver

Exceedances

- Residential (NML Exceedance 0 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance 20 to 25 dB)
- Residential (NML Exceedance > 25 dB)

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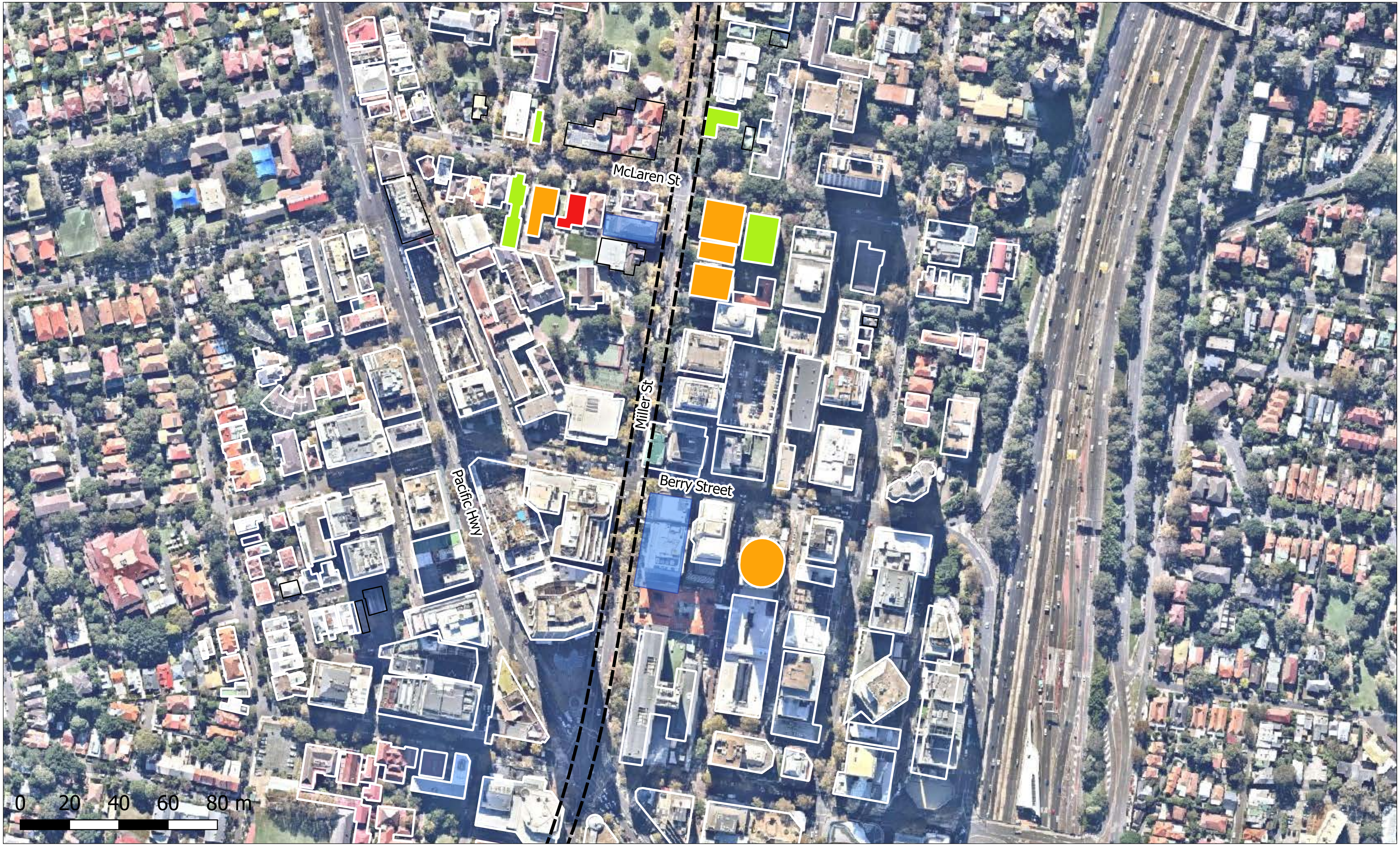
Sydney Metro Chatswood to Sydenham

Ground-Bourne Noise Assessment
Ground-borne Noise Assessment
Day-time
Daytime
Victoria Cross
Barangaroo Station & Argyle Street



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Legend

- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

0 20 40 60 80 m

Exceedances

- Residential (NML Exceedance 5 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance > 20 dB)

Legend
Shaft Locations
One Storey Receiver
>One Storey Receiver
Exceedances

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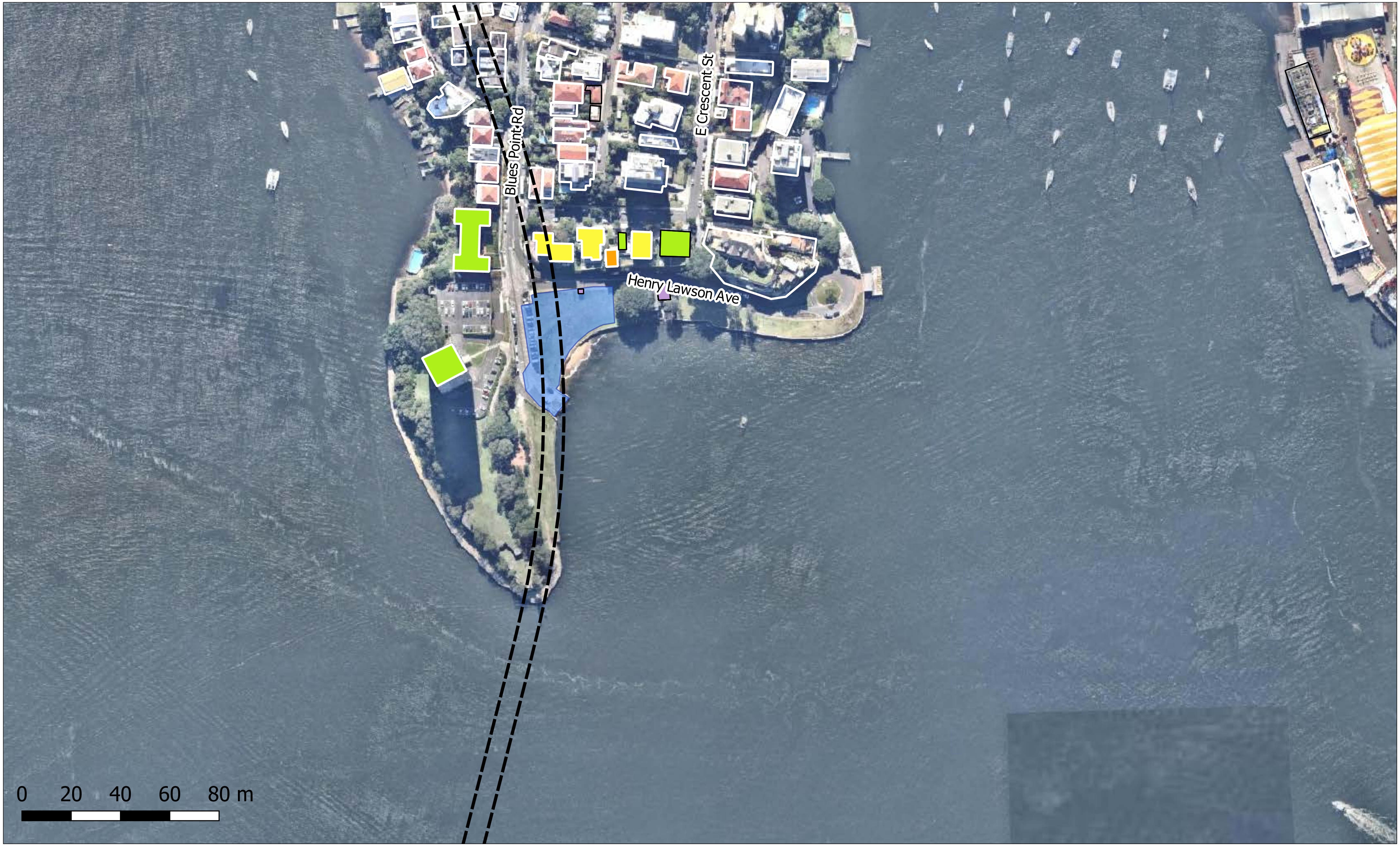
Sydney Metro Chatswood to Sydenham

Ground-Borne Noise Assessment
Ground-borne Noise Assessment
Night-time
Daytime
Victoria Cross
Barangaroo Station & Argyle Street



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Legend

- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

Exceedances

- Other (NML Exceedance 0 to 10 dB)
- Other (NML Exceedance 10 to 20 dB)
- Other (NML Exceedance 20 to 25 dB)
- Other (NML Exceedance > 25 dB)
- Residential (NML Exceedance 0 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance 20 to 25 dB)
- Residential (NML Exceedance > 25 dB)

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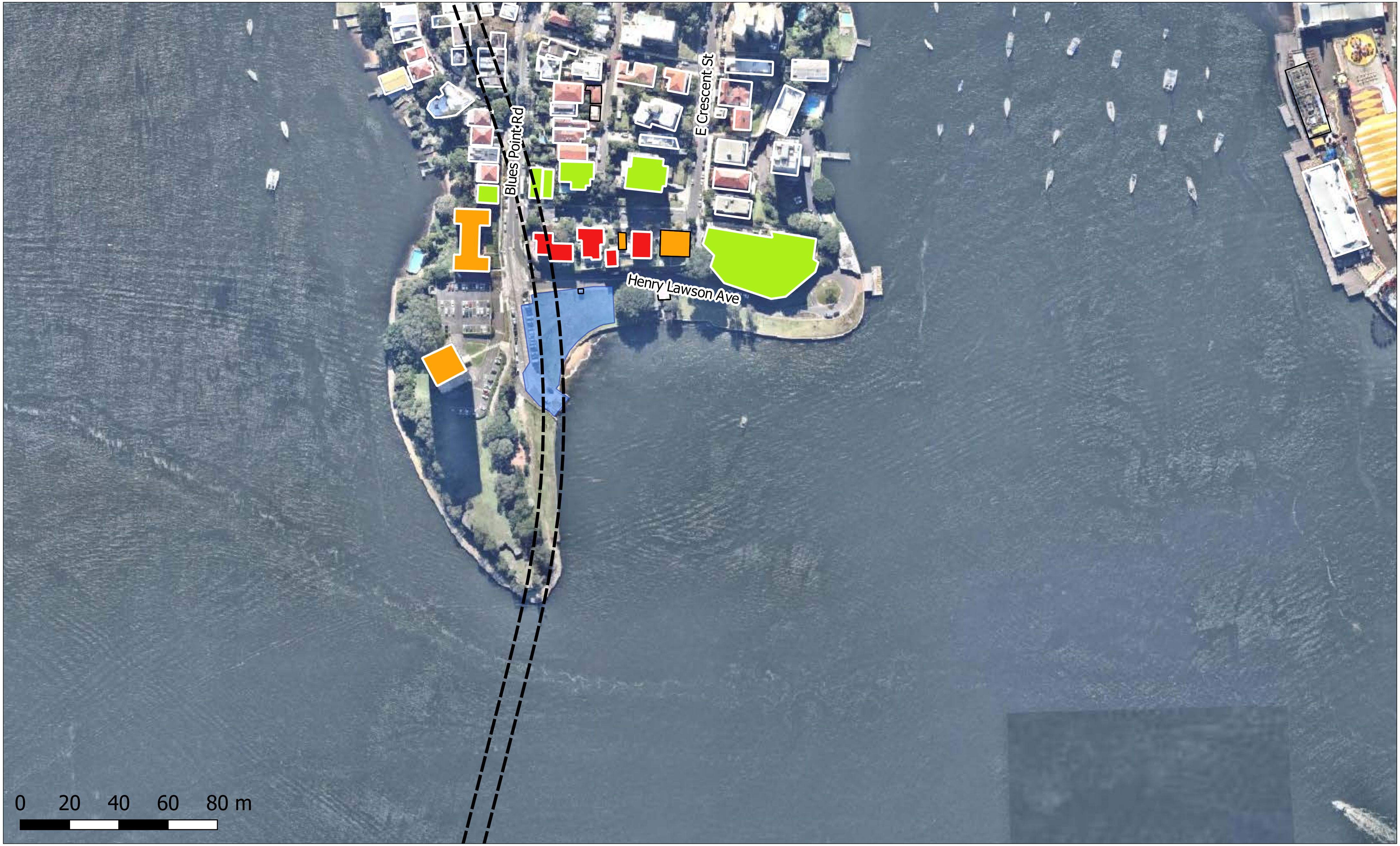
Sydney Metro Chatswood to Sydenham

Ground-Borne Noise Assessment
Daytime
Blues Point



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Legend

- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

0 20 40 60 80 m

Exceedances

- Residential (NML Exceedance 0 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance > 20 dB)

Legend

Shaft Locations
One Storey Receiver
>One Storey Receiver

Exceedances

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Ground-borne Noise Assessment
Ground Bourne Noise Assessment
Daytime
Night-time
Barangaroo Station & Argyle Street
Blues Point

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Legend

- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

0 20 40 60 80 m

Exceedances

- Other (NML Exceedance 0 to 10 dB)
- Other (NML Exceedance 10 to 20 dB)
- Other (NML Exceedance 20 to 25 dB)
- Other (NML Exceedance > 25 dB)
- Residential (NML Exceedance 0 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance 20 to 25 dB)
- Residential (NML Exceedance > 25 dB)

Legend
Shaft Locations
One Storey Receiver
>One Storey Receiver

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Sydney Metro Chatswood to Sydenham

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Daytime
Barangaroo Station & Argyle Street

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Legend

- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

0 20 40 60 80 m

Exceedances

- Residential (NML Exceedance 0 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance > 20 dB)

Legend

Shaft Locations
One Storey Receiver
>One Storey Receiver

Exceedances

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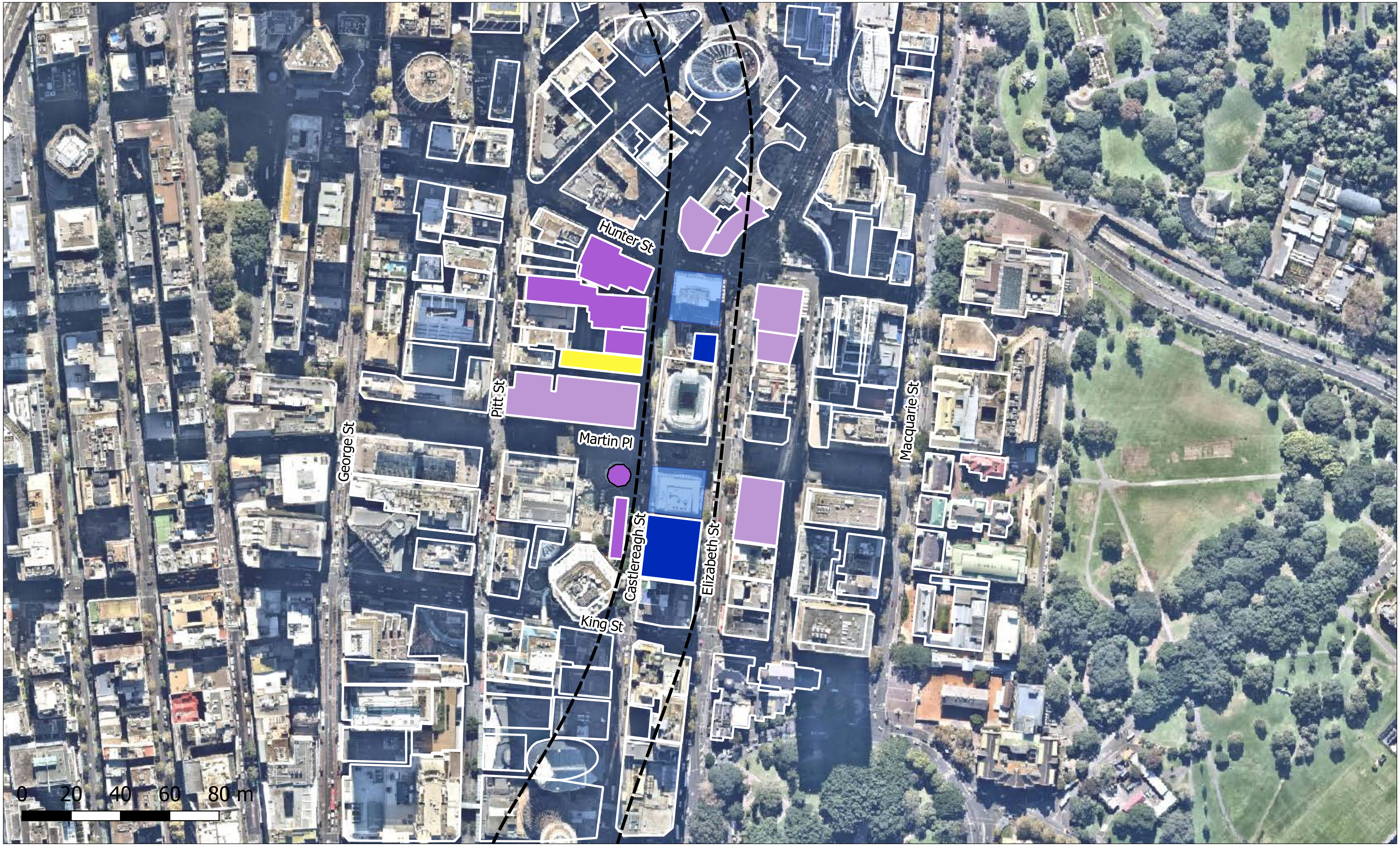
Sydney Metro Chatswood to Sydenham

Ground Borne Noise Assessment
Ground-bourne Noise Assessment
Day-time
Night-time
Barangaroo Station & Argyle Street
Barangaroo



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Legend

- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

Exceedances

- Other (NML Exceedance 0 to 10 dB)
- Other (NML Exceedance 10 to 20 dB)
- Other (NML Exceedance 20 to 25 dB)
- Other (NML Exceedance > 25 dB)

Exceedances

- Residential (NML Exceedance 0 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance 20 to 25 dB)
- Residential (NML Exceedance > 25 dB)

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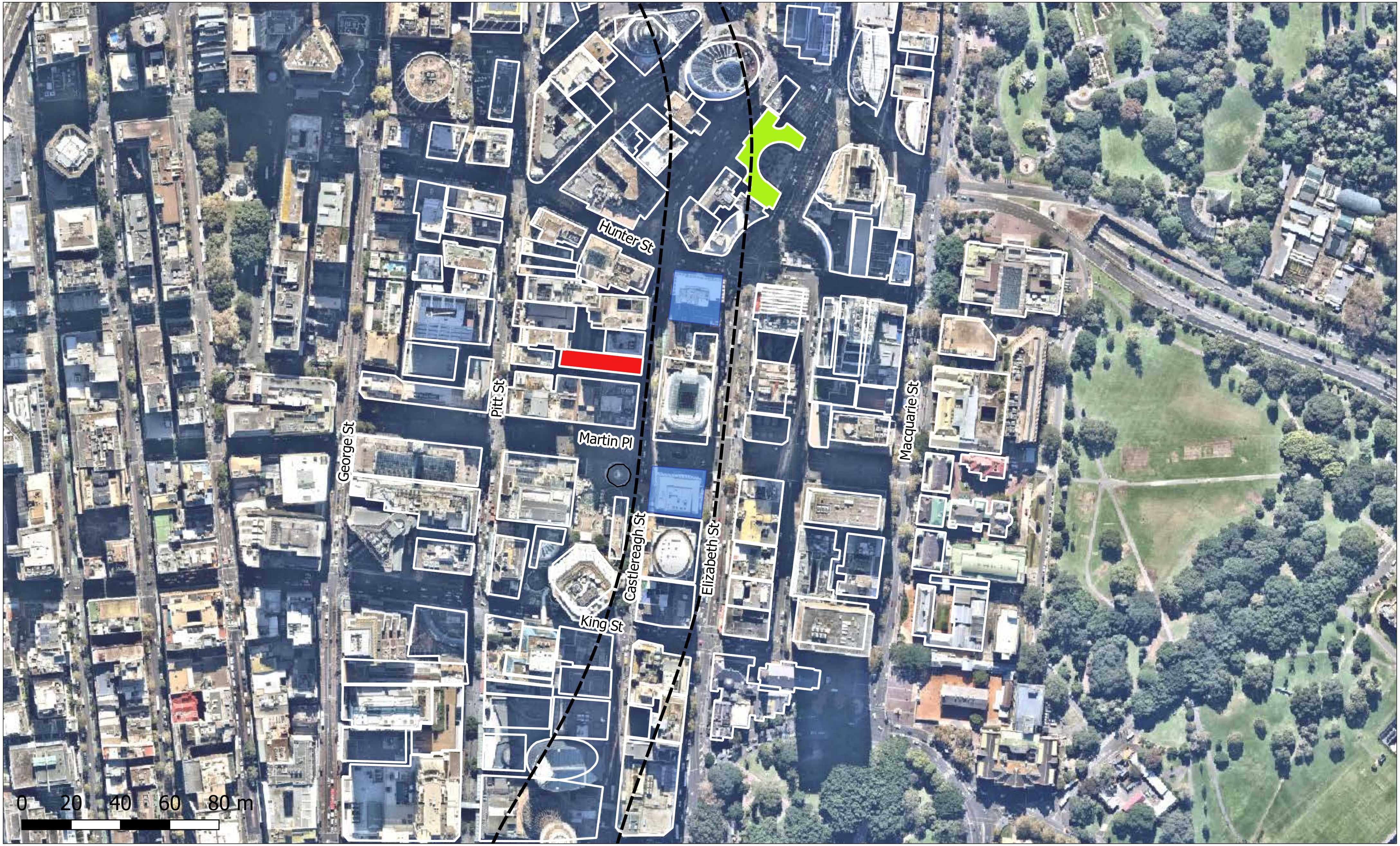
Ground-Borne Noise Assessment
Daytime
Barangaroo Station & Argyle Street / Martin Place



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Legend

- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

0 20 40 60 80 m

Exceedances

- Residential (NML Exceedance 0 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance > 20 dB)

Legend
Shaft Locations
One Storey Receiver
>One Storey Receiver
Exceedances

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Sydney Metro Chatswood to Sydenham

Ground-Borne Noise Assessment
Night-time
Day-time
Barangaroo Station & Argyle Street
Martin Place

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Legend
- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

Exceedances
- Other (NML Exceedance 0 to 10 dB)
- Other (NML Exceedance 10 to 20 dB)
- Other (NML Exceedance 20 to 25 dB)
- Other (NML Exceedance > 25 dB)
- Residential (NML Exceedance 0 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance 20 to 25 dB)
- Residential (NML Exceedance > 25 dB)

Legend
Shaft Locations
One Storey Receiver
>One Storey Receiver
0 20 40 60 80 m

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Ground Borne Noise Assessment
Daytime
Barangaroo Station & Argyle Street
Pitt Street

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Legend

- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

Exceedances

- Residential (NML Exceedance 0 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance > 20 dB)

Legend

Shaft Locations
One Storey Receiver
>One Storey Receiver

Exceedances

0 20 40 60 80 m

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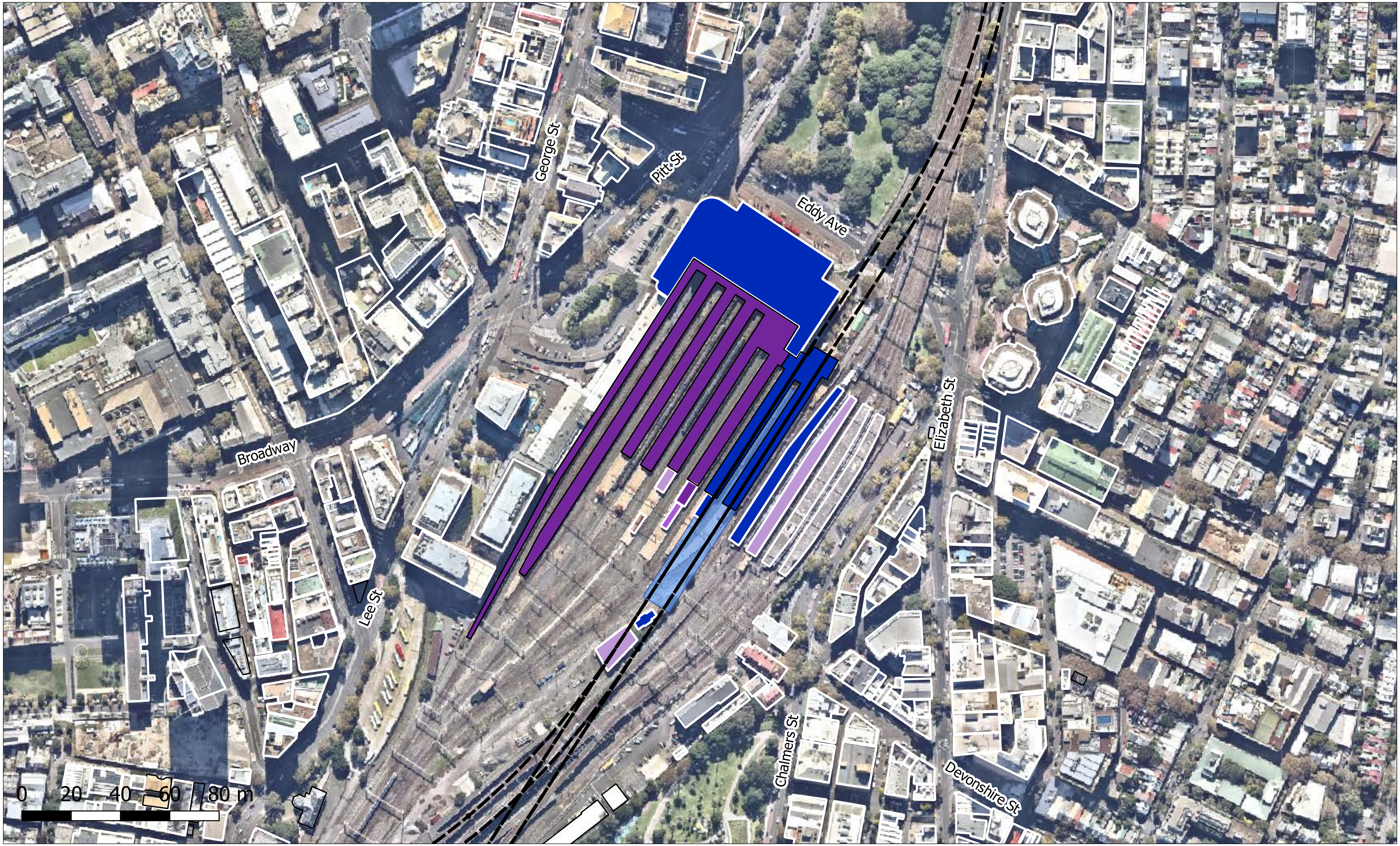
Sydney Metro Chatswood to Sydenham

Ground-borne Noise Assessment

Night-time / Daytime

Barangaroo Station & Argyle Street / Pitt Street



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Legend

- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

0 20 40 60 80 m

Exceedances

- Other (NML Exceedance 0 to 10 dB)
- Other (NML Exceedance 10 to 20 dB)
- Other (NML Exceedance 20 to 25 dB)
- Other (NML Exceedance > 25 dB)

Legend

- Shaft Locations
- One Storey Receiver
- >One Storey Receiver

Exceedances

- Residential (NML Exceedance 0 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance 20 to 25 dB)
- Residential (NML Exceedance > 25 dB)

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Sydney Metro Chatswood to Sydenham

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Daytime
Central Station
Barangaroo Station & Argyle Street

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Legend

- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

0 20 40 60 80 m

Exceedances

- Residential (NML Exceedance 0 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance > 20 dB)

Legend

Shaft Locations
One Storey Receiver
>One Storey Receiver

Exceedances

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Sydney Metro Chatswood to Sydenham

Ground-Borne Noise Assessment
Day-time
Night-time
Barangaroo Station & Angyle Street
Central Station

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Projection:	GDA 1994 MGA Zone 56

Legend

- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

Exceedances

- Other (NML Exceedance 0 to 10 dB)
- Other (NML Exceedance 10 to 20 dB)
- Other (NML Exceedance 20 to 25 dB)
- Other (NML Exceedance > 25 dB)
- Residential (NML Exceedance 0 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance 20 to 25 dB)
- Residential (NML Exceedance > 25 dB)

Legend
Shaft Locations
One Storey Receiver
>One Storey Receiver
0 20 40 60 80 m

Jacobs Group (Australia) Pty Limited PARSONS BRINCKERHOFF

Sydney Metro Chatswood to Sydenham

Ground Bourne Noise Assessment
Daytime
Barangaroo Station & Argyle Street
Waterloo

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Legend

- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

0 20 40 60 80 m

Exceedances

- Residential (NML Exceedance 0 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance > 20 dB)

Legend
Shaft Locations
One Storey Receiver
>One Storey Receiver
Exceedances

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Ground Borne Noise Assessment
Ground-borne Noise Assessment
Night-time
Daytime
Waterloo
Barangaroo Station & Argyle Street

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Legend

- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

0 20 40 60 80 m

Exceedances

- Other (NML Exceedance 0 to 10 dB)
- Other (NML Exceedance 10 to 20 dB)
- Other (NML Exceedance 20 to 25 dB)
- Other (NML Exceedance > 25 dB)

Legend

- Shaft Locations
- One Storey Receiver
- >One Storey Receiver

Exceedances

- Residential (NML Exceedance 0 to 10 dB)
- Residential (NML Exceedance 10 to 20 dB)
- Residential (NML Exceedance 20 to 25 dB)
- Residential (NML Exceedance > 25 dB)

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Ground-Borne Noise Assessment
Daytime
Barangaroo Station & Argyle Street / Sydenham

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Legend

One Storey Receiver

>One Storey Receiver

Shaft Locations

0 20 40 60 80 m

Exceedances Legend

Residential (NML Exceedance 0 to 10 dB)

Residential (NML Exceedance 10 to 20 dB)

Residential (NML Exceedance > 20 dB)

Shaft Locations
One Storey Receiver
>One Storey Receiver

Exceedances

Jacobs|ARCADIS|BRUNCKHORST|Limited

Sydney Metro Chatswood to Sydenham

Ground Borne Noise Assessment

Nighttime

Barangaroo Station & Argyle Street Sydenham

Appendix G

Report 610.14718R1

Construction Vibration Predictions

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Legend

One Storey Receiver

>One Storey Receiver

Shaft Locations

Exceedances

No Exceedance

Exceedance

Legend

Shaft Locations

One Storey Receiver

>One Storey Receiver

Exceedances

0 20 40 60 80 m

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Cosmetic Damage Vibration Assessment / Ground-borne Noise Assessment

Exceedance of Screening Criteria / Daytime

Chatswood

Barangaroo Station & Argyle Street

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Legend

One Storey Receiver

>One Storey Receiver

Shaft Locations

0 20 40 60 80 m

Exceedances

No Exceedance

Legend

Exceedance

Shaft Locations

One Storey Receiver

>One Storey Receiver

Exceedances

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Sydney Metro Chatswood to Sydenham

Cosmetic Damage Vibration Assessment

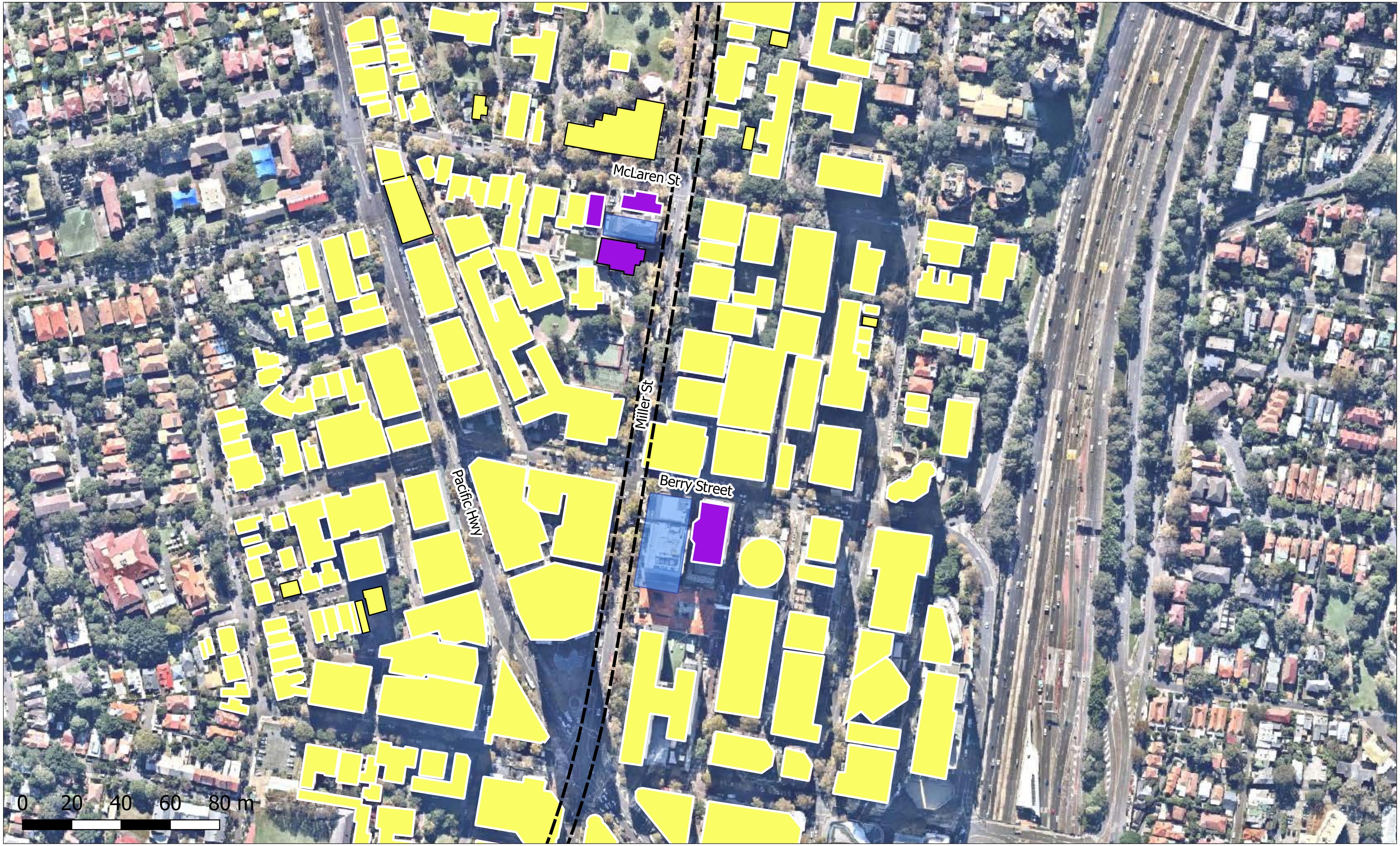
Ground-borne Noise Assessment

Exceedance of Screening Criteria

Daytime

Crows Nest

Barangaroo Station & Argyle Street



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Legend

One Storey Receiver

>One Storey Receiver

Shaft Locations

0 20 40 60 80 m

Exceedances

No Exceedance

Exceedance

Legend
Shaft Locations
One Storey Receiver
>One Storey Receiver
Exceedances

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Sydney Metro Chatswood to Sydenham

Cosmetic Damage Vibration Assessment

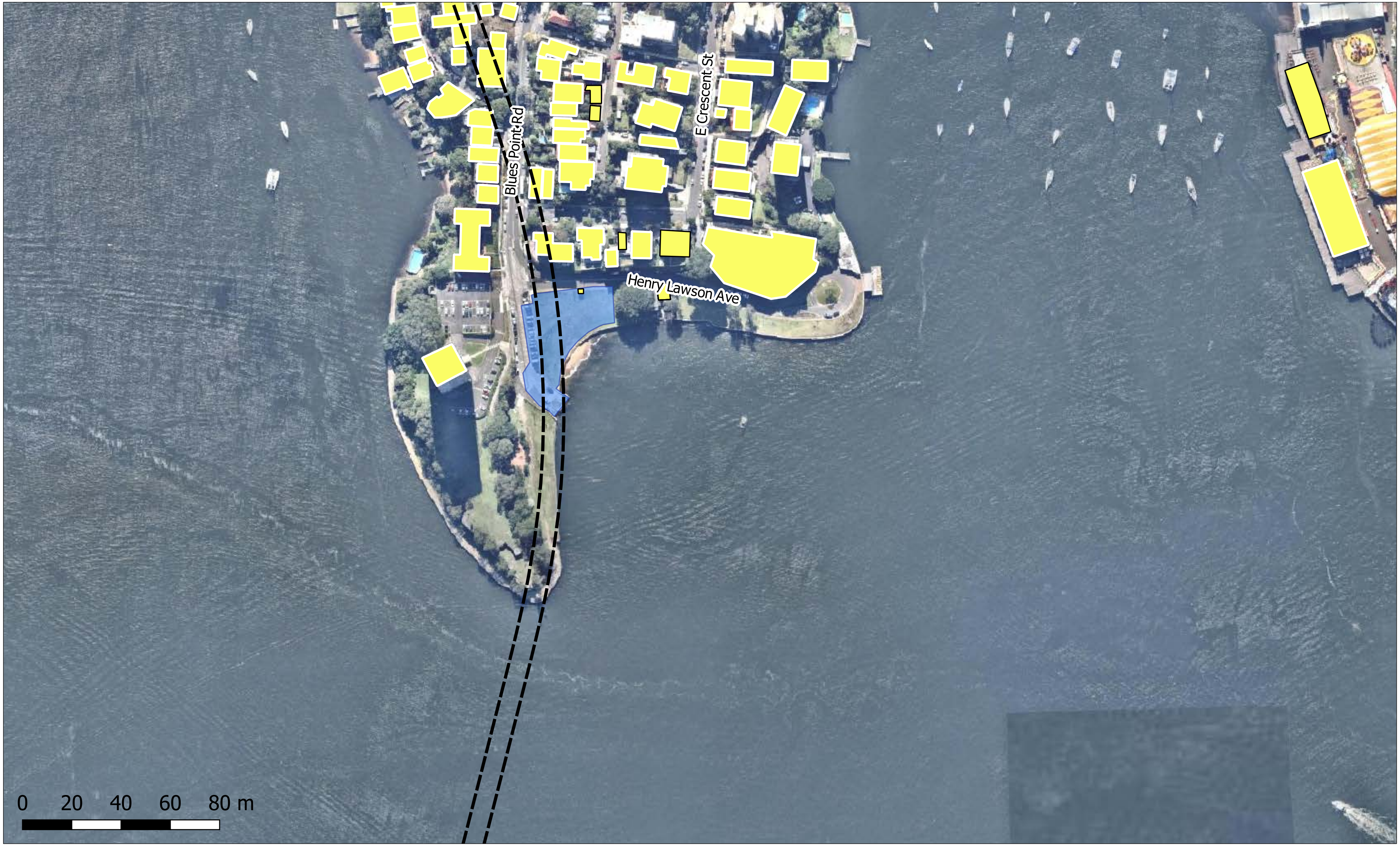
Ground-borne Noise Assessment

Exceedance of Screening Criteria

Daytime

Victoria Cross

Barangaroo Station & Argyle Street



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Legend

One Storey Receiver

>One Storey Receiver

Shaft Locations

0 20 40 60 80 m

Exceedances

No Exceedance

Legend

Exceedance

Shaft Locations

One Storey Receiver

>One Storey Receiver

Exceedances

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Sydney Metro Chatswood to Sydenham

Cosmetic Damage Vibration Assessment

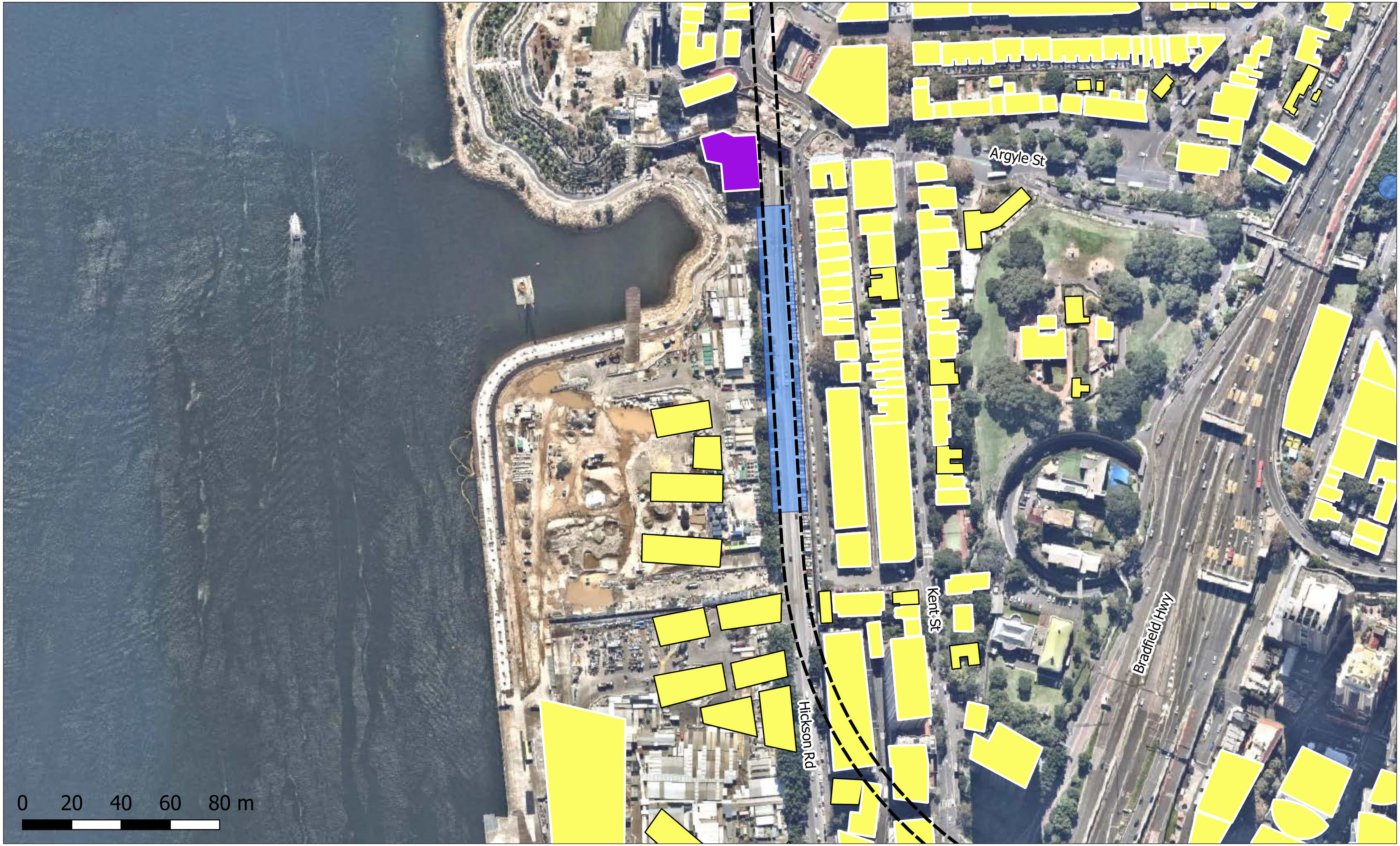
Ground-borne Noise Assessment

Exceedance of Screening Criteria

Daytime

Blues Point

Barangaroo Station & Argyle Street



Legend	Exceedances
One Storey Receiver	No Exceedance
>One Storey Receiver	Exceedance
Shaft Locations	

Legend
Shaft Locations
One Storey Receiver
>One Storey Receiver

Exceedances

0 20 40 60 80 m

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Groundborne Noise Assessment
Exceedance Of Screening Criteria
Daytime
Barangaroo Station & Argyle Street
Barangaroo

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Legend
One Storey Receiver
>One Storey Receiver
Shaft Locations
0 20 40 60 80 m

Exceedances
No Exceedance
Exceedance

Legend
Shaft Locations
One Storey Receiver
>One Storey Receiver

Exceedances

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Cosmetic Damage Vibration Assessment
Exceedance of Screening Criteria
Barangaroo Station & Argyle Street

Ground-borne Noise Assessment
Daytime
Martin Place

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Legend

- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

Exceedances

- No Exceedance
- Exceedance

0 20 40 60 80 m

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PARSONS BRINCKERHOFF

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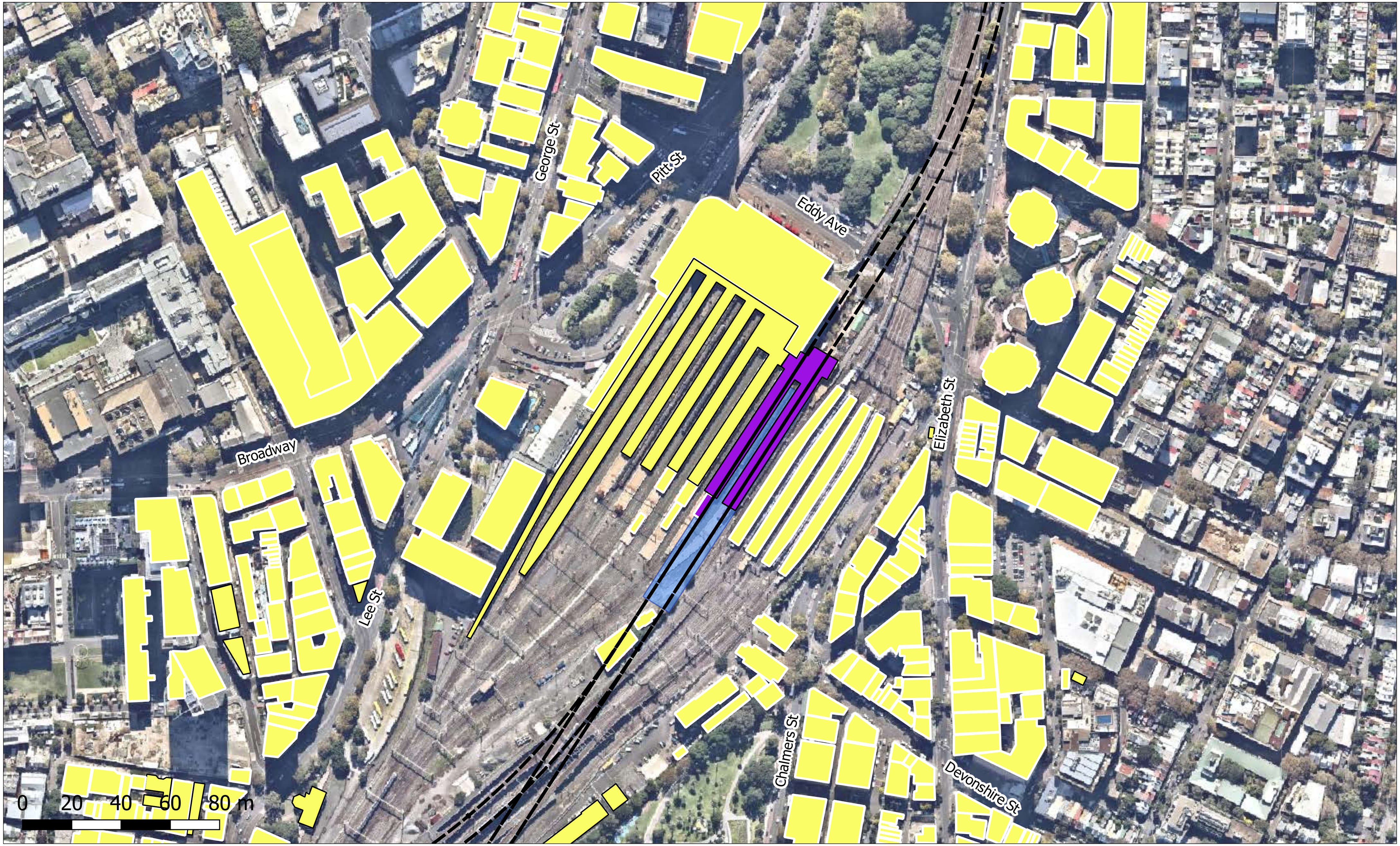
Cosmetic Damage Vibration Assessment
Exceedance of Screening Criteria
Barangaroo Station & Argyle Street

Ground-borne Noise Assessment
Daytime
Pitt Street



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Legend
- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

Exceedances
- No Exceedance

Legend
- Shaft Locations
- One Storey Receiver
- >One Storey Receiver

Exceedances

0 20 40 60 80 m

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Cosmetic Damage Vibration Assessment / Ground-borne Noise Assessment
Exceedance of Screening Criteria / Daytime
Barangaroo Station & Argyle Street / Central Station

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Legend
- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

0 20 40 60 80 m

Exceedances
- No Exceedance

Legend
- Exceedance
- Shaft Locations
- One Storey Receiver
- >One Storey Receiver

Exceedances

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Sydney Metro Chatswood to Sydenham

Cosmetic Damage Vibration Assessment / Ground-borne Noise Assessment
Exceedance Of Screening Criteria / Daytime
Barangaroo Station & Argyle Street / Waterloo

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Legend
- One Storey Receiver
- >One Storey Receiver
- Shaft Locations

0 20 40 60 80 m

Exceedances
- No Exceedance

Legend
Shaft Locations
One Storey Receiver
>One Storey Receiver

Exceedances
Exceedance

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Sydney Metro Chatswood to Sydenham

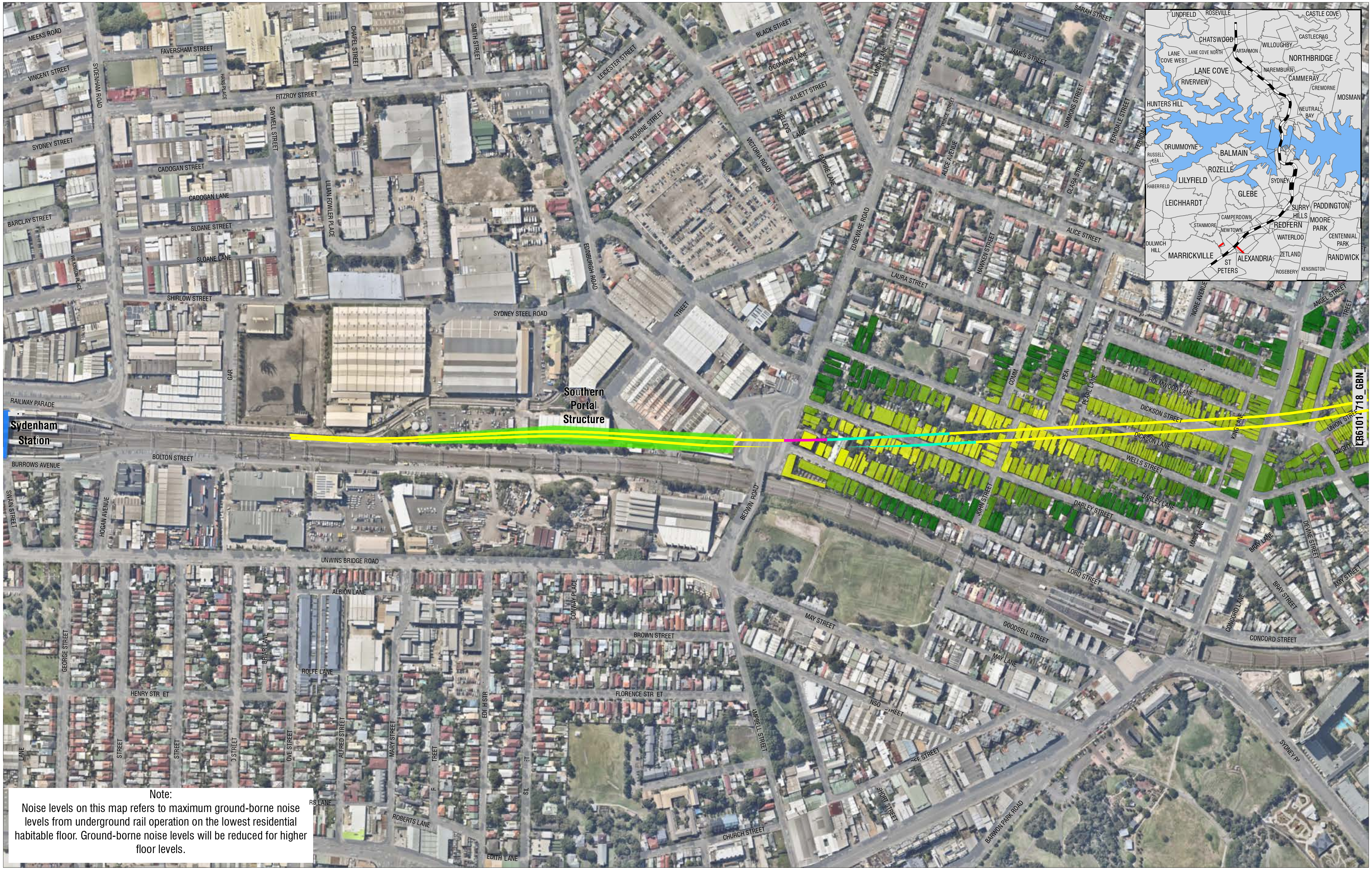
Construction Ground-borne Noise Assessment / Cosmetic Damage Vibration Assessment
Exceedance of Screening Criteria / Daytime
Barangaroo Station & Argyle Street / Sydenham Station

INDEX

Appendix H1

Report 610.14718R1
Operational Ground-borne Noise Predictions

Residential



Note:
Noise levels on this map refers to maximum ground-borne noise levels from underground rail operation on the lowest residential habitable floor. Ground-borne noise levels will be reduced for higher floor levels.

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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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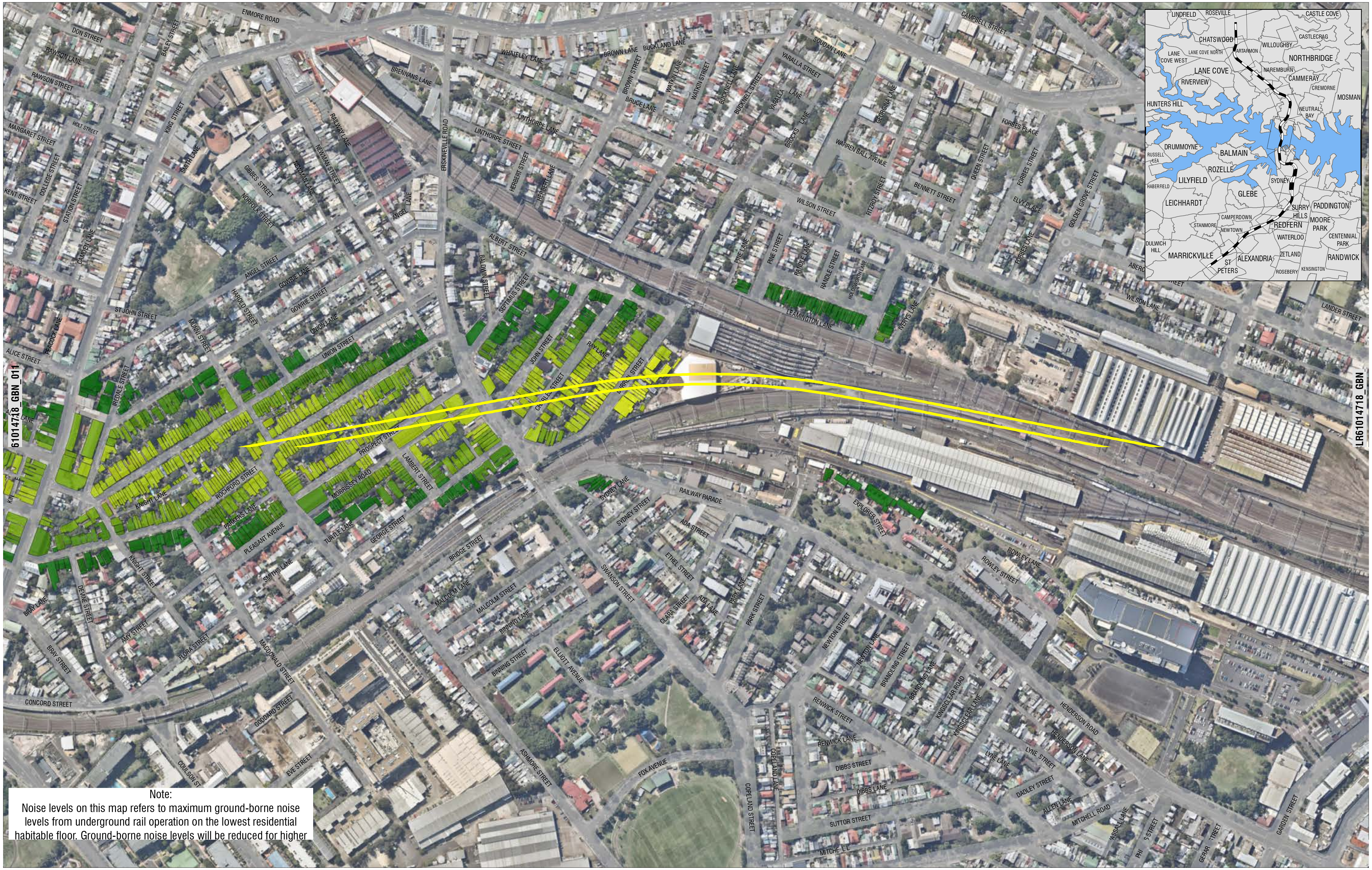
Sydney Metro Chatswood to Sydenham

Operation

Residential Ground-borne Noise Levels

Page 1 of 10

FIGURE: SLR61014718_GBN_011



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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Operation

Residential Ground-borne Noise Levels

Page 2 of 10

FIGURE: SLR61014718_GBN_012

Note:
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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Operation
Residential Ground-borne Noise Levels

FIGURE: SLR61014718_GBN_013

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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Residential Ground-borne Noise Levels

FIGURE: SLR61014718_GBN_014

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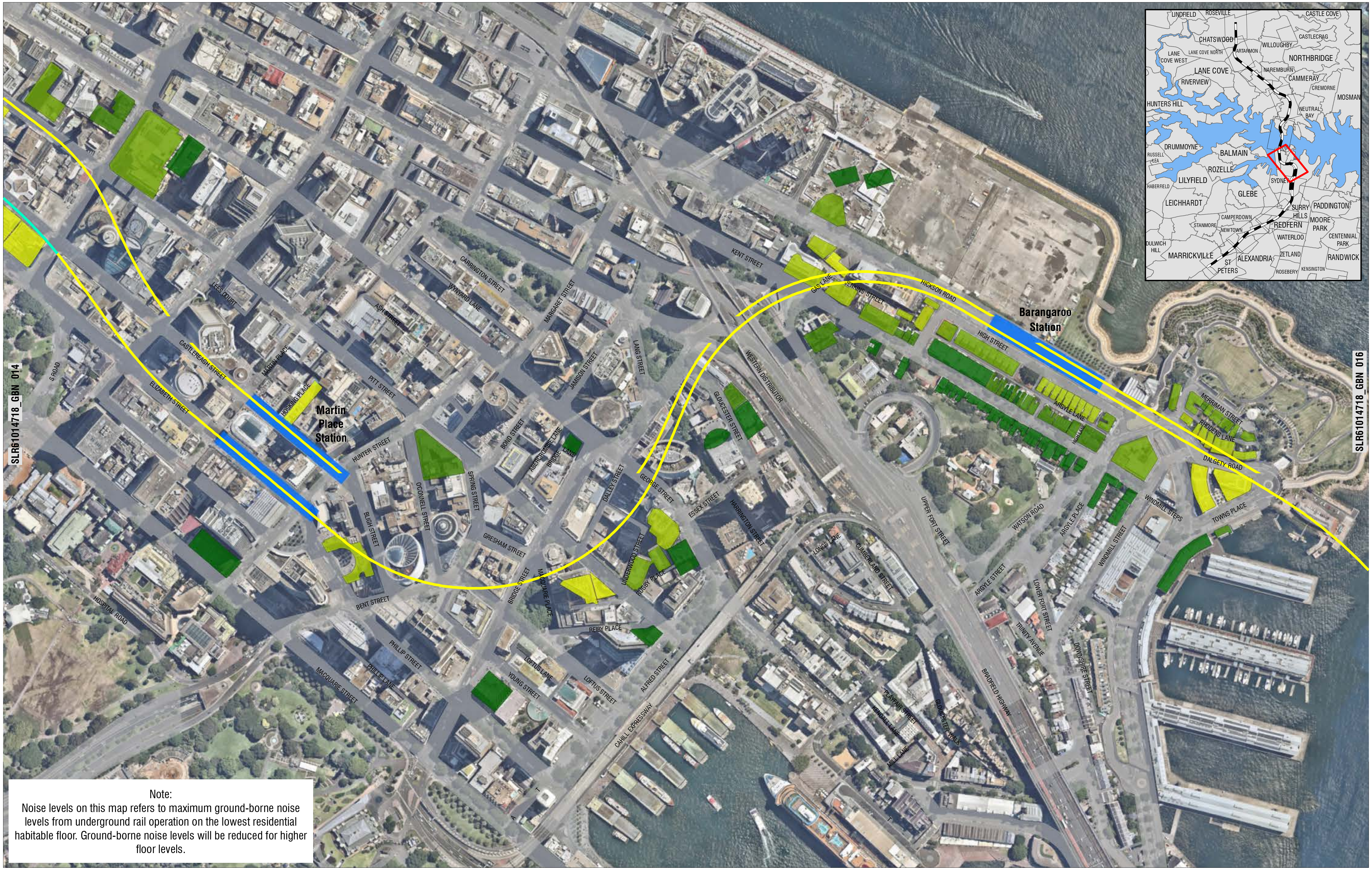

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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Operation

Residential Ground-borne Noise Levels

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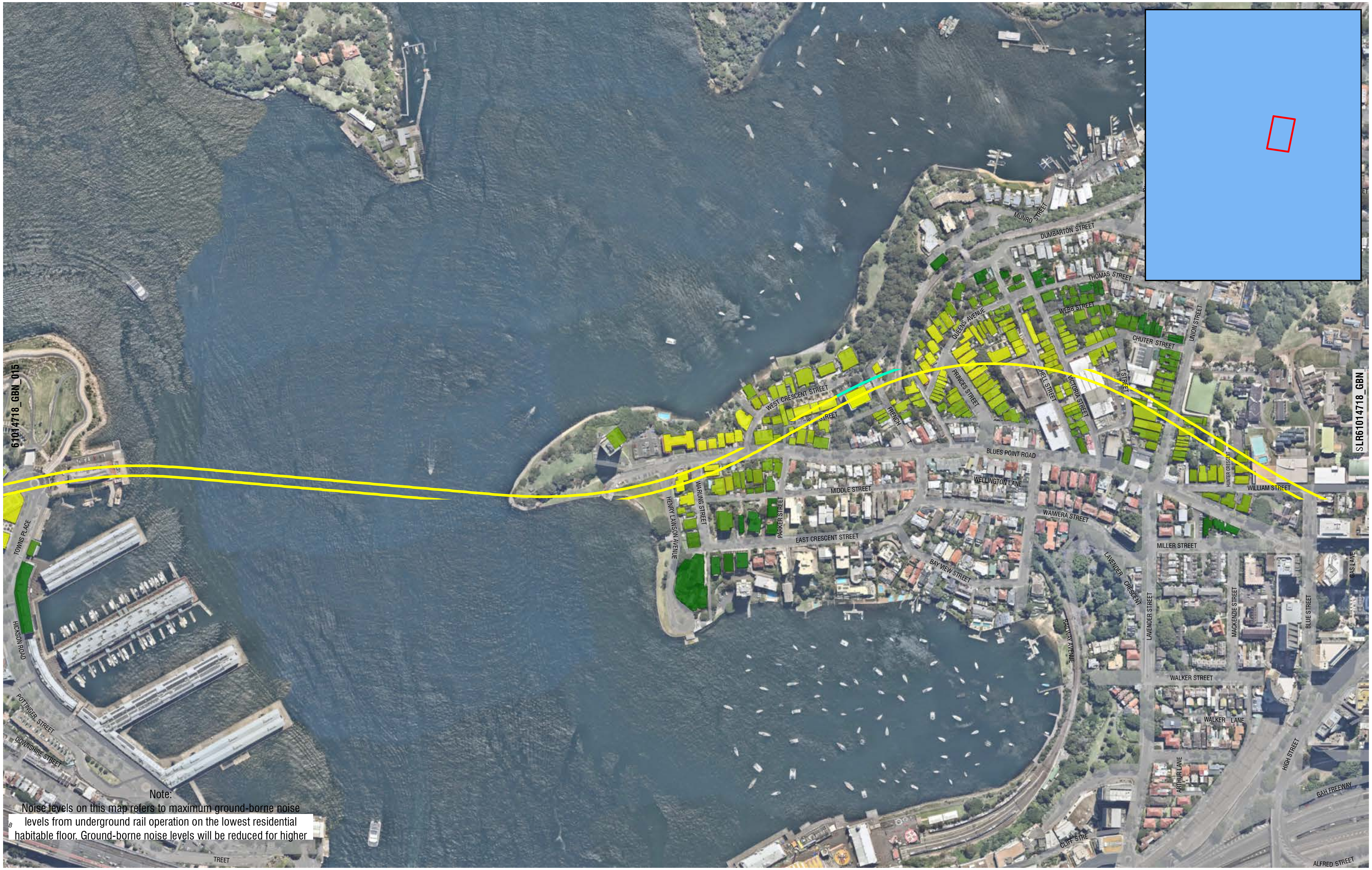
FIGURE: SLR61014718_GBN_015



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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Sydney Metro Chatswood to Sydenham

Operation

Residential Ground-borne Noise Levels

Page 6 of 10

FIGURE: SLR61014718_GBN_016

Note:
Noise levels on this map refers to maximum ground-borne noise levels from underground rail operation on the lowest residential habitable floor. Ground-borne noise levels will be reduced for higher floor levels.

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Projection:	GDA 1994 MGA Zone 56

0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Sydney Metro Chatswood to Sydenham

Operation
Residential Ground-borne Noise Levels
Page 7 of 10

FIGURE: SLR61014718_GBN_017

Note:
Noise levels on this map refers to maximum ground-borne noise levels from underground rail operation on the lowest residential habitable floor. Ground-borne noise levels will be reduced for higher

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0 50 100 150 200 m

LEGEND

Standard Attenuation Rail	**Ground-borne Noise Level (dBA)**	21 - 25	41 - 45
High Attenuation Rail		26 - 30	46 - 50
Very High Attenuation Rail	≤15	31 - 35	51 - 55
Stations	16 - 20	36 - 40	56 - 60
Portal Structure			

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Operation
Residential Ground-borne Noise Levels
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FIGURE: SLR61014718_GBN_018

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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Sydney Metro Chatswood to Sydenham

Operation

Residential Ground-borne Noise Levels

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FIGURE: SLR61014718_GBN_019

Note:
Noise levels on this map refers to maximum ground-borne noise levels from underground rail operation on the lowest residential habitable floor. Ground-borne noise levels will be reduced for higher floor levels.

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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Sydney Metro Chatswood to Sydenham

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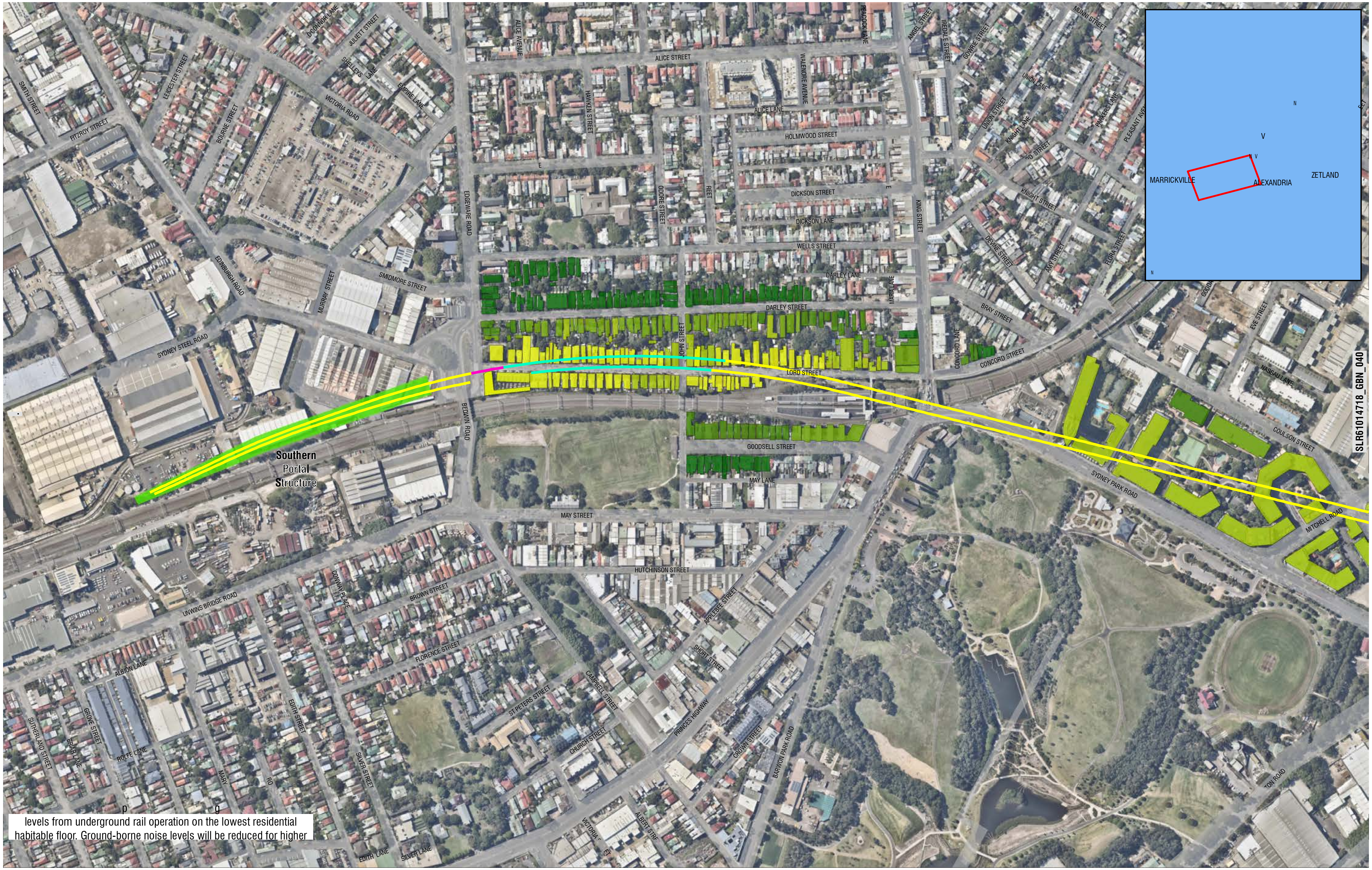
FIGURE: SLR61014718_GBN_020



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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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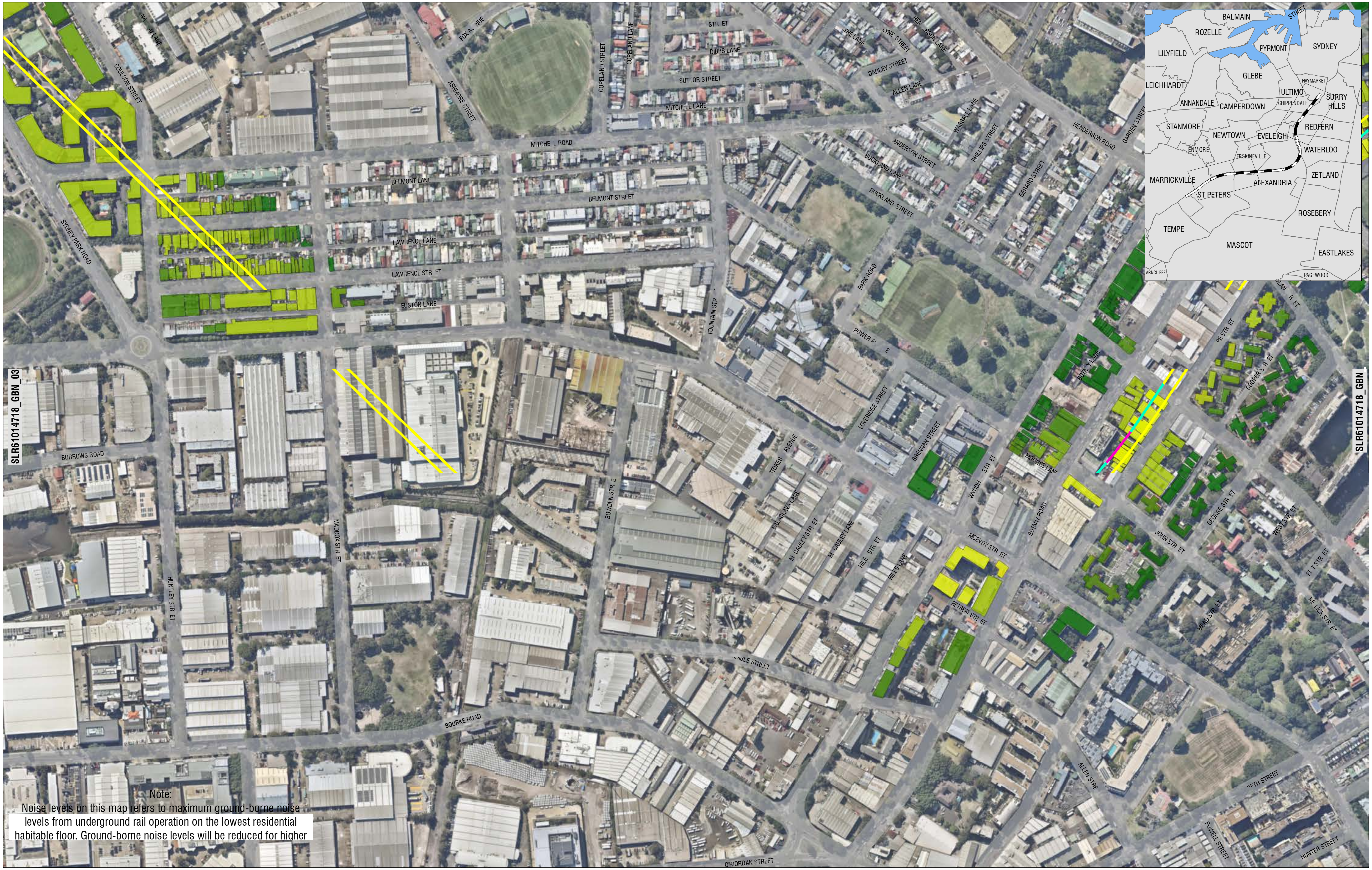
FIGURE: SLR61014718_GBN_039



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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Operation - Waterloo

Residential Ground-borne Noise Levels

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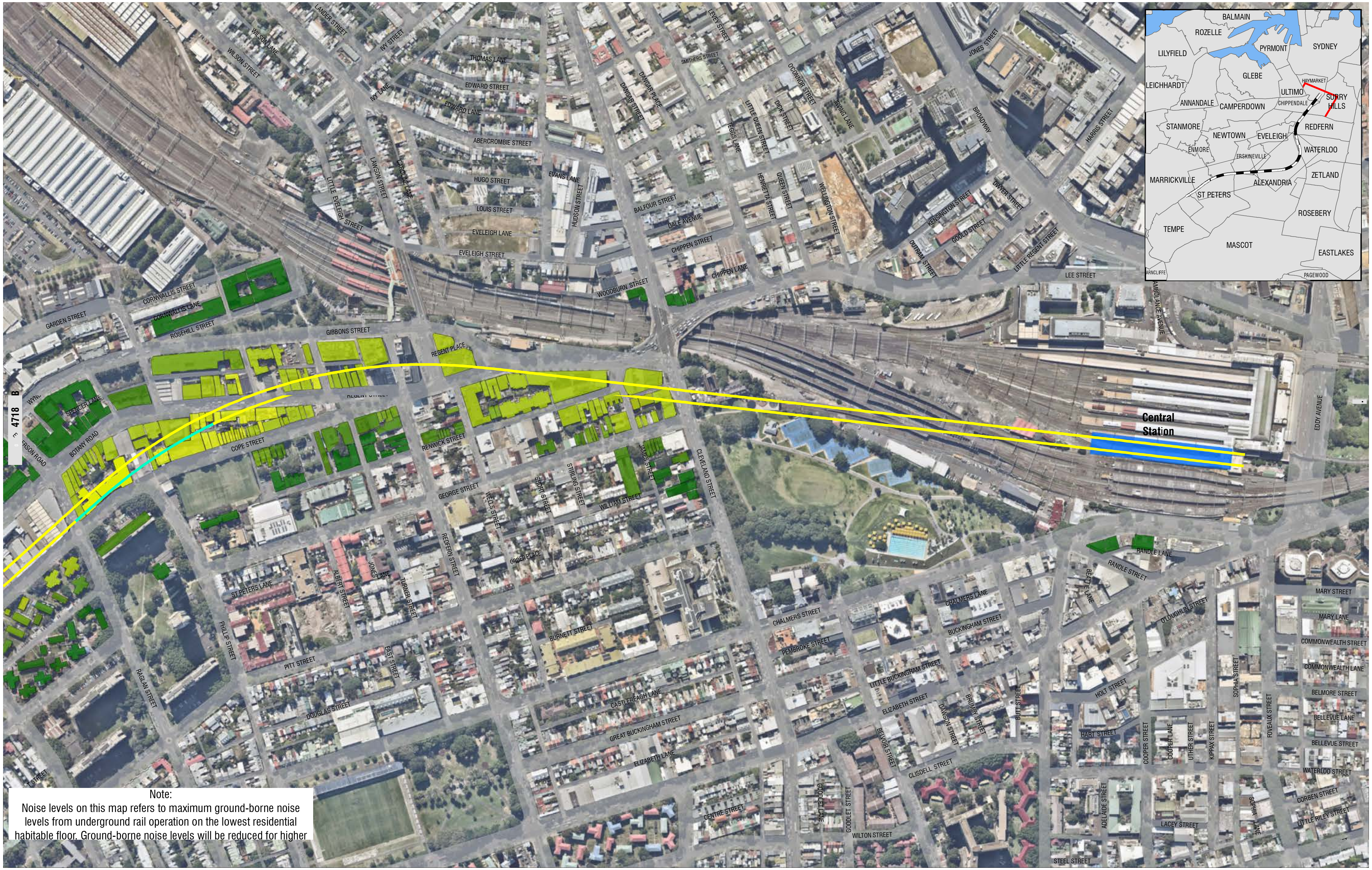
FIGURE: SLR61014718_GBN_040



Note:
Noise levels on this map refers to maximum ground-borne noise levels from underground rail operation on the lowest residential habitable floor. Ground-borne noise levels will be reduced for higher

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0 50 100 150 200 m

LEGEND

Standard Attenuation Rail	**Ground-borne Noise Level (dBA)**	21 - 25	41 - 45
High Attenuation Rail		26 - 30	46 - 50
Very High Attenuation Rail	≤15	31 - 35	51 - 55
Stations	16 - 20	36 - 40	56 - 60
Portal Structure			

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Sydney Metro Chatswood to Sydenham

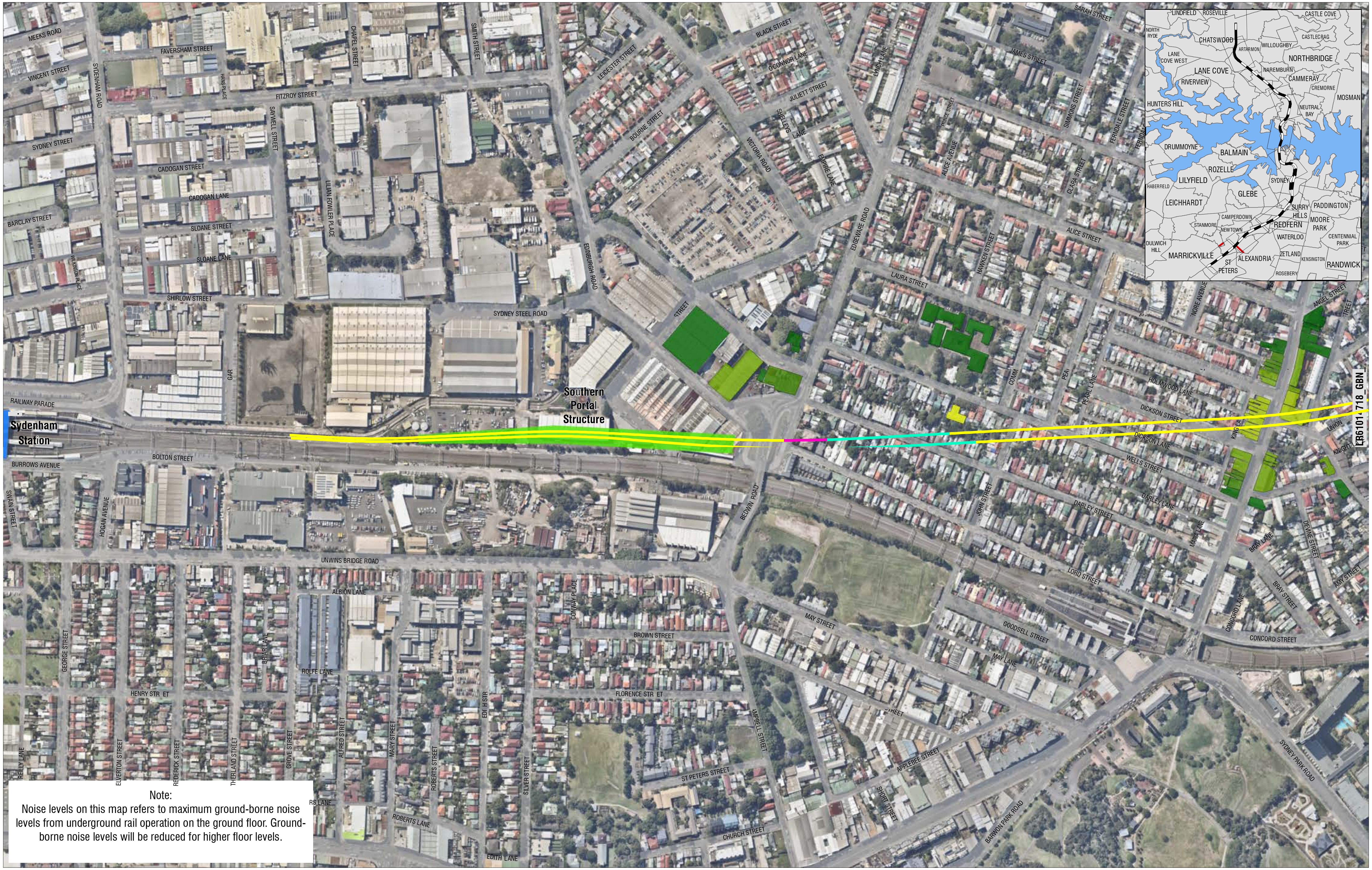
Operation - Waterloo
Residential Ground-borne Noise Levels
Page 3 of 3

FIGURE: SLR61014718_GBN_041

Appendix H2

Report 610.14718R1
Operational Ground-borne Noise Predictions

Commercial



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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Sydney Metro Chatswood to Sydenham

Operation

Commercial Ground-borne Noise Levels

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FIGURE: SLR61014718_GBN_021

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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Sydney Metro Chatswood to Sydenham

Operation

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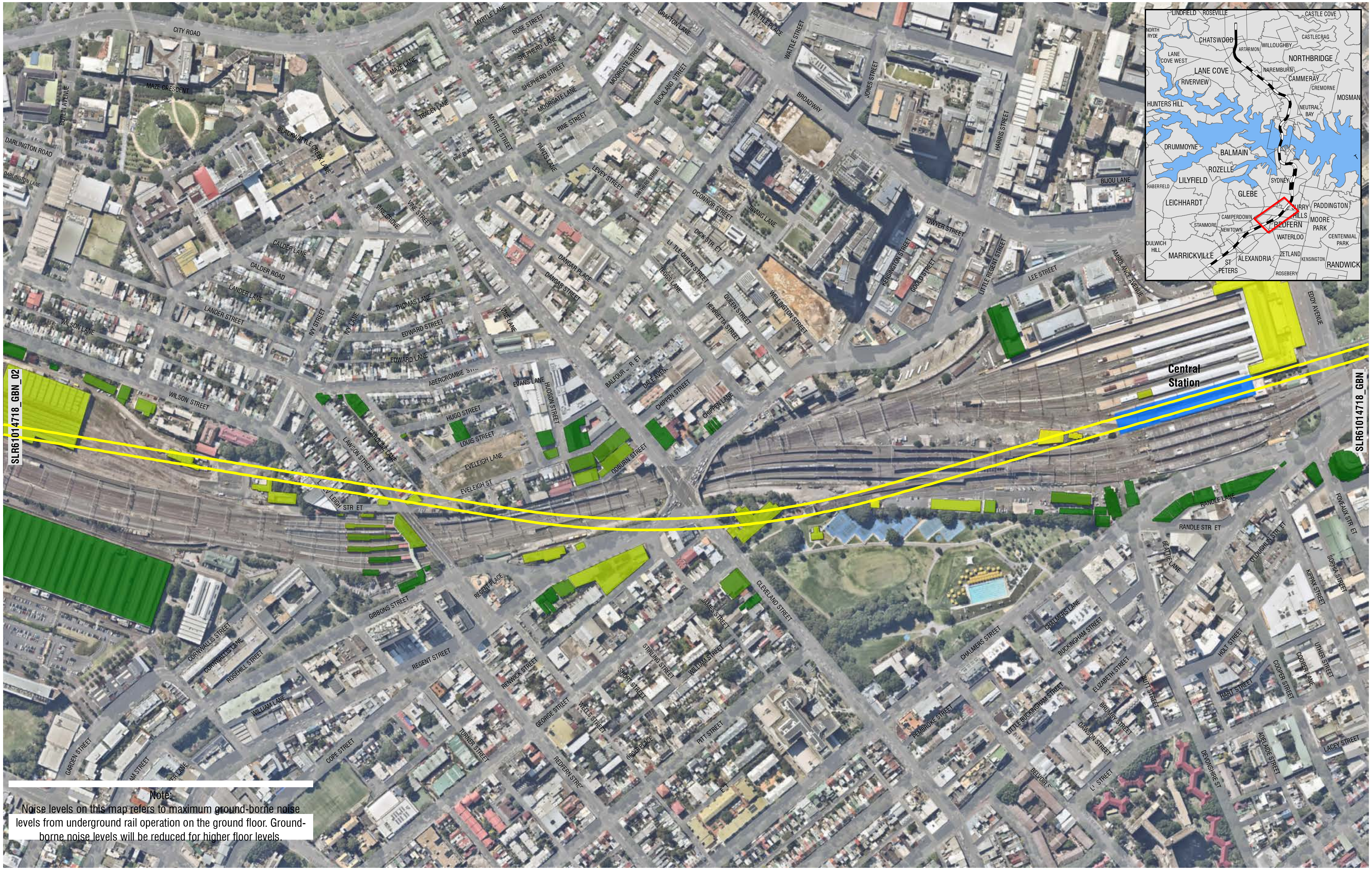
FIGURE: SLR61014718_GBN_022



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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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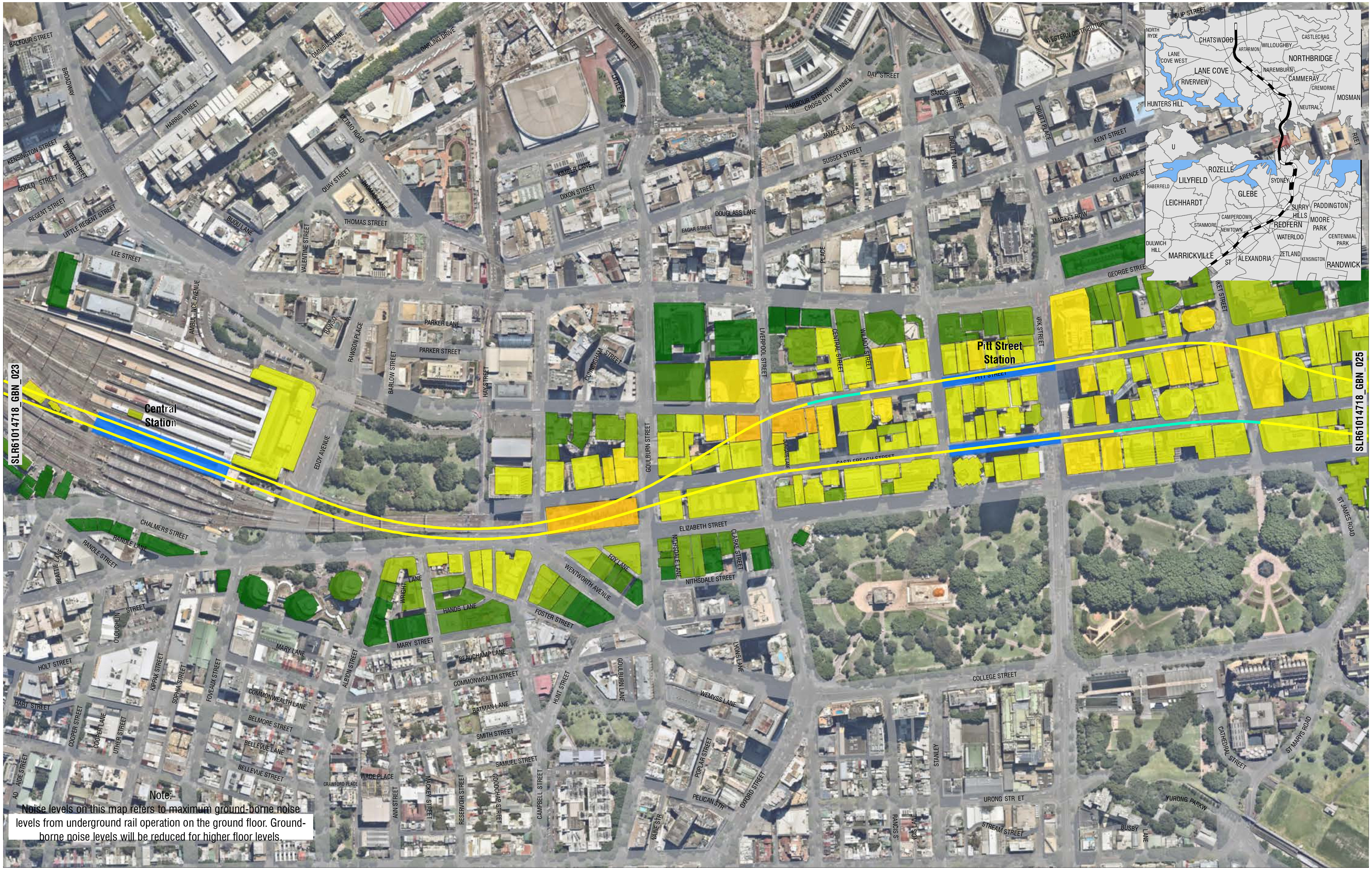
Operation

Commercial Ground-borne Noise Levels

FIGURE: SLR61014718_GBN_023



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LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Sydney Metro Chatswood to Sydenham

Operation

Commercial Ground-borne Noise Levels

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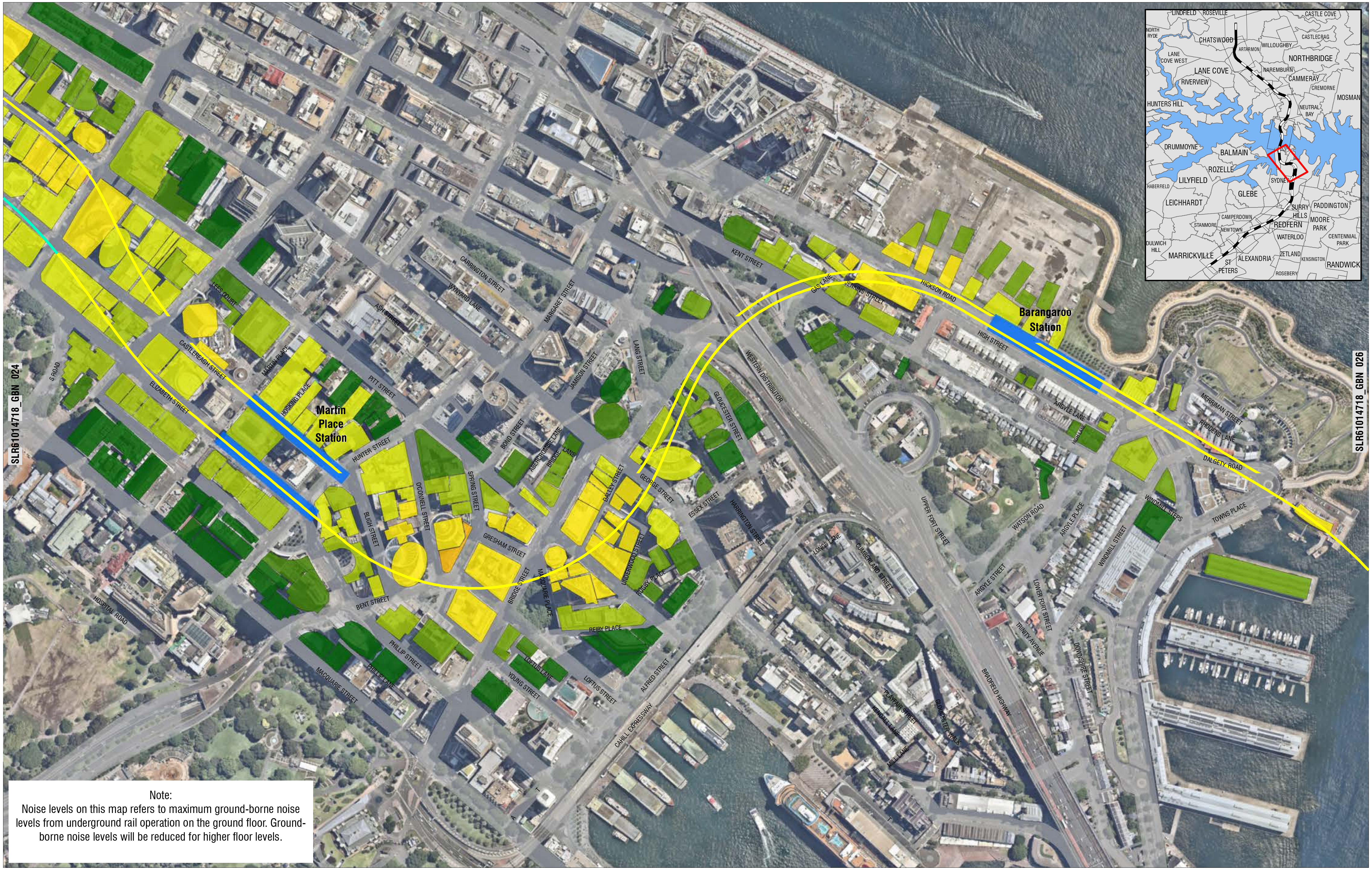
FIGURE: SLR61014718_GBN_024



Note:
Noise levels on this map refers to maximum ground-borne noise levels from underground rail operation on the ground floor. Ground-borne noise levels will be reduced for higher floor levels.

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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Sydney Metro Chatswood to Sydenham

Operation

Commercial Ground-borne Noise Levels

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FIGURE: SLR61014718_GBN_025

Note:
Noise levels on this map refers to maximum ground-borne noise levels from underground rail operation on the ground floor. Ground-borne noise levels will be reduced for higher floor levels.

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Projection:	GDA 1994 MGA Zone 56

0 50 100 150 200 m

LEGEND

Standard Attenuation Rail	**Ground-borne Noise Level (dBA)**	
High Attenuation Rail	≤15	21 - 25
Very High Attenuation Rail	16 - 20	26 - 30
Stations		31 - 35
Portal Structure		36 - 40
		41 - 45
		46 - 50
		51 - 55
		56 - 60

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Sydney Metro Chatswood to Sydenham

Operation

Commercial Ground-borne Noise Levels

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FIGURE: SLR61014718_GBN_026

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Projection:	GDA 1994 MGA Zone 56

0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Sydney Metro Chatswood to Sydenham

Operation

Commercial Ground-borne Noise Levels

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FIGURE: SLR61014718_GBN_027

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Projection:	GDA 1994 MGA Zone 56

0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Sydney Metro Chatswood to Sydenham

Operation

Commercial Ground-borne Noise Levels

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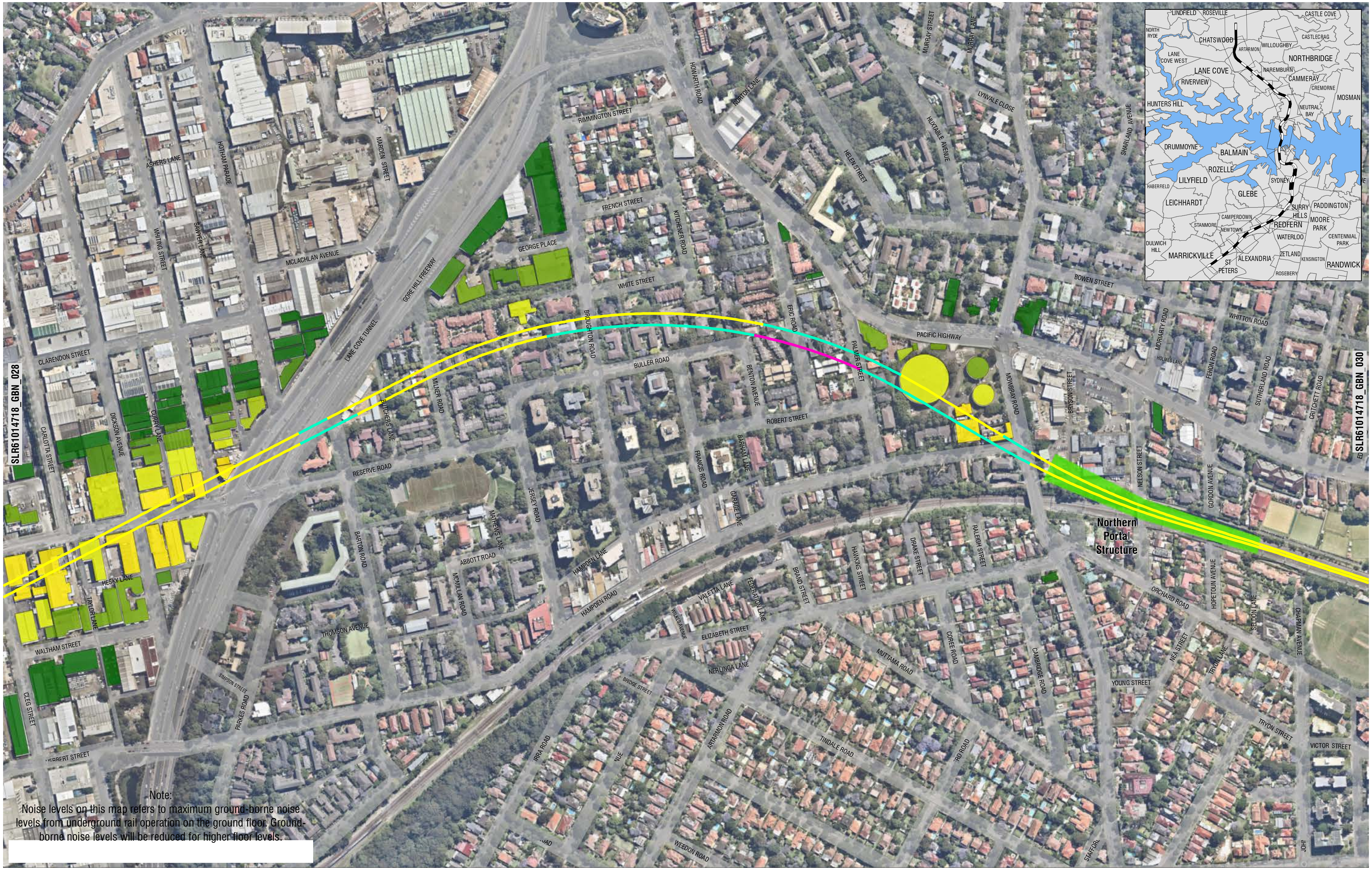
FIGURE: SLR61014718_GBN_028



Note:
Noise levels on this map refers to maximum ground-borne noise levels from underground rail operation on the ground floor. Ground-borne noise levels will be reduced for higher floor levels.

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LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Sydney Metro Chatswood to Sydenham

Operation

Commercial Ground-borne Noise Levels

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FIGURE: SLR61014718_GBN_029

Note:
Noise levels on this map refers to maximum ground-borne noise levels from underground rail operation on the ground floor. Ground-borne noise levels will be reduced for higher floor levels.

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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

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Sydney Metro Chatswood to Sydenham

Operation

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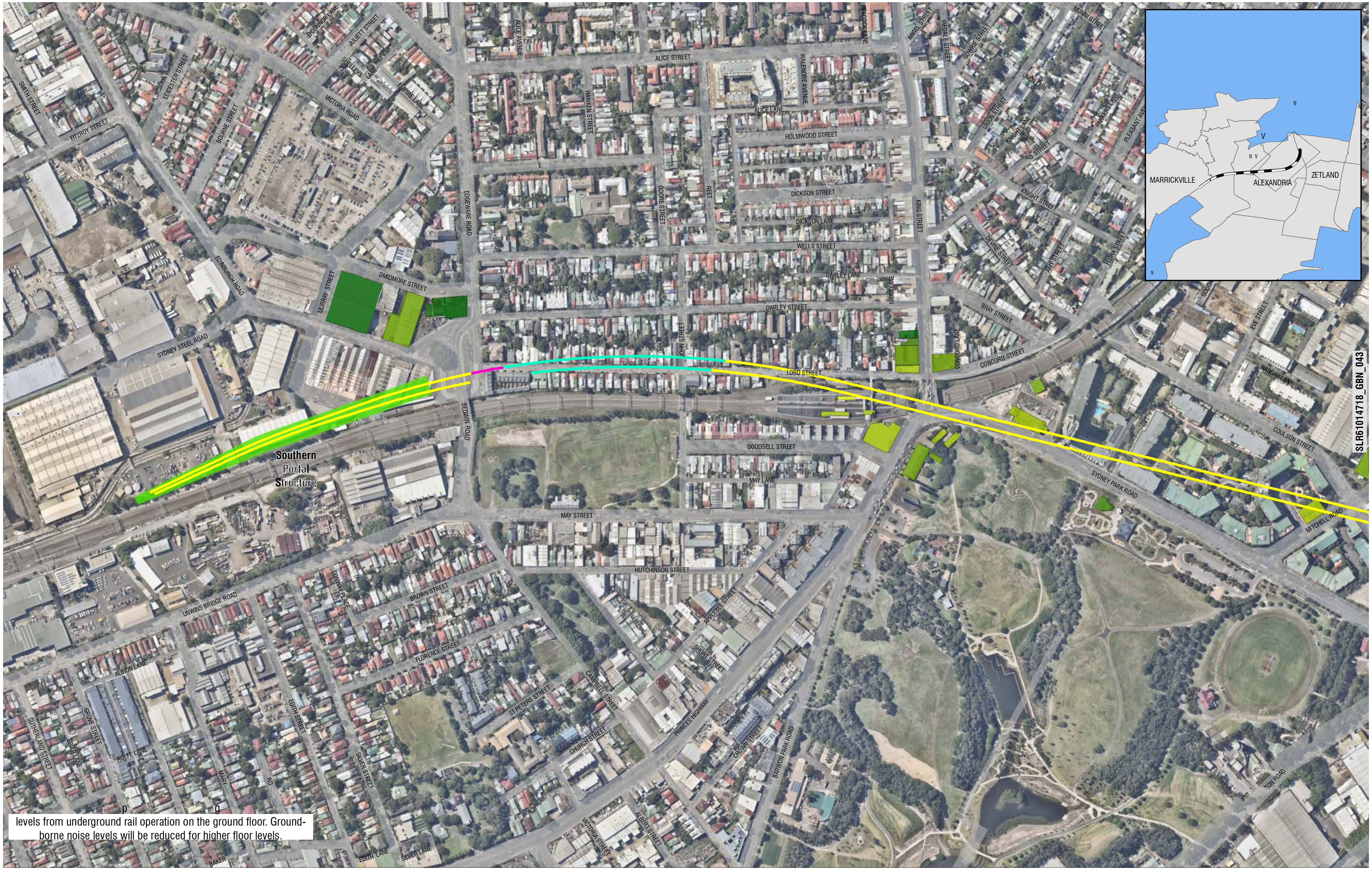
FIGURE: SLR61014718_GBN_030



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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

Jacobs Group (Australia) Pty Limited

Sydney Metro Chatswood to Sydenham

Operation - Waterloo

Commercial Ground-borne Noise Levels

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FIGURE: SLR61014718_GBN_042

Note:
Noise levels on this map refers to maximum ground-borne noise levels from underground rail operation on the ground floor. Ground-borne noise levels will be reduced for higher floor levels.

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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

Jacobs Group (Australia) Pty Limited

Sydney Metro Chatswood to Sydenham

Operation - Waterloo

Commercial Ground-borne Noise Levels

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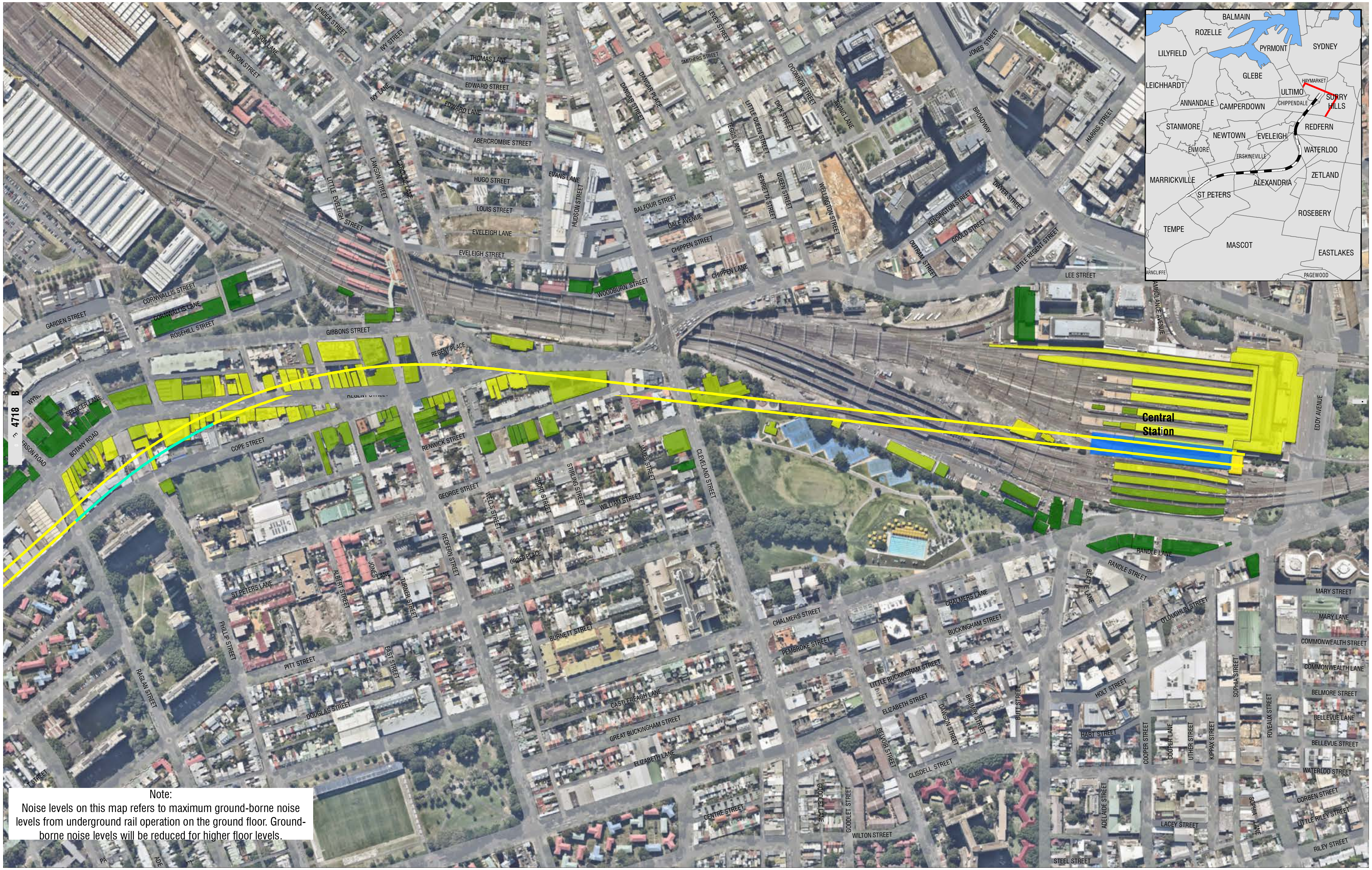
FIGURE: SLR61014718_GBN_043



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0 50 100 150 200 m

LEGEND

- Standard Attenuation Rail
- High Attenuation Rail
- Very High Attenuation Rail
- Stations
- Portal Structure

Ground-borne Noise Level (dBA)

- ≤15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60

Jacobs Group (Australia) Pty Limited

Sydney Metro Chatswood to Sydenham

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Commercial Ground-borne Noise Levels
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FIGURE: SLR61014718_GBN_044

Operational Airborne Noise Predictions - Noise Contours

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Appendix I1

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Operational Airborne Noise Predictions - Noise Contours

Daytime $L_{Aeq(15hr)}$ Noise Contours

SLR

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Projection:	GDA 1994 MGA Zone 56

50 0 50 100 150 200 m

Proposed Alignment
Existing Noise Barriers
Assessed Receivers

Daytime Noise Contours

55 dBA LAeq(15hr)
60 dBA LAeq(15hr)
65 dBA LAeq(15hr)
70 dBA LAeq(15hr)

Notes:
** Noise contour grid spacing: 10m*
** Noise contour height above ground: 4.5m*

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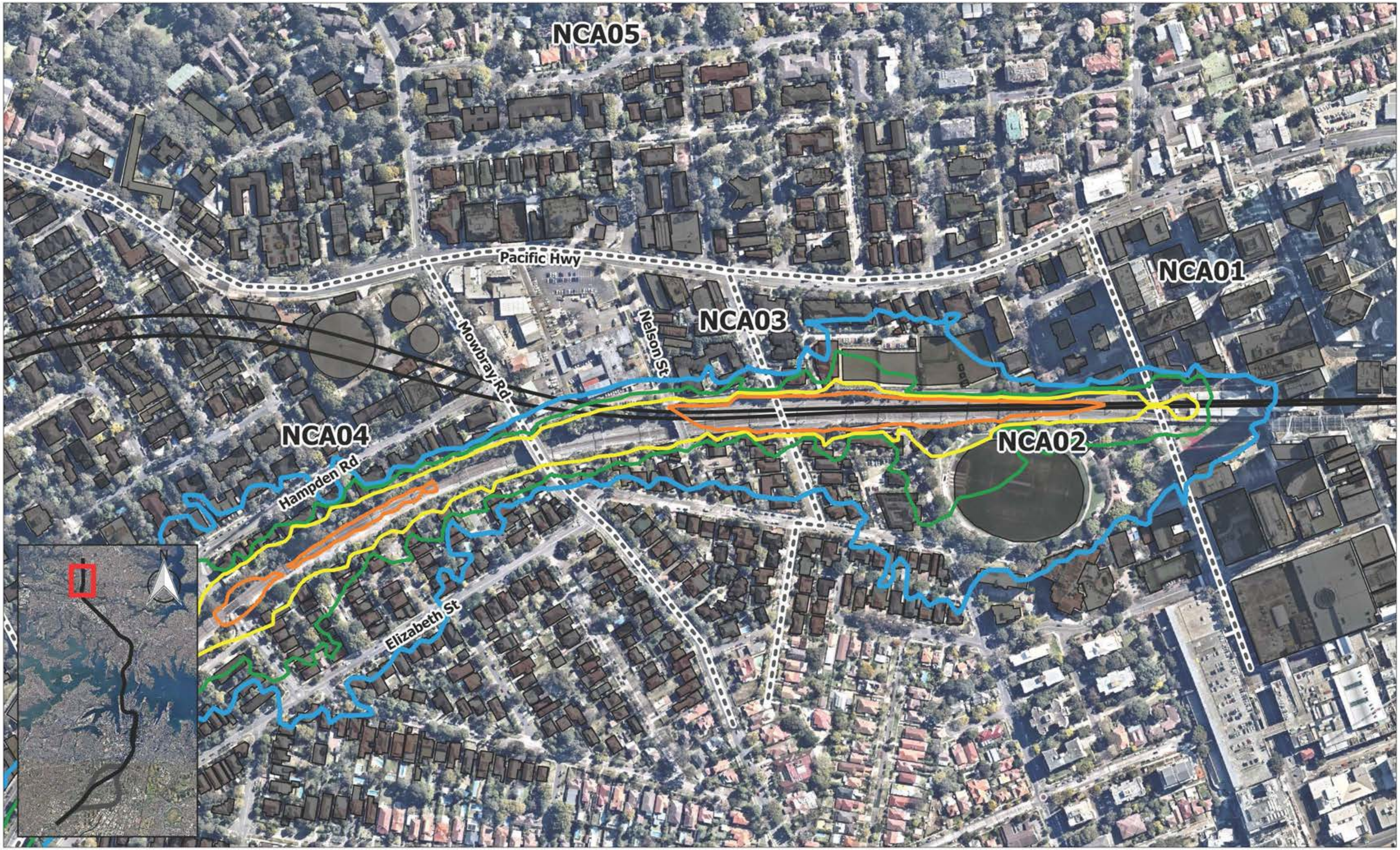
Sydney Metro Chatswood to Sydenham

2034 Daytime LAeq(15hr) Noise Contours With Project



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Project No.:	610.15326
Date:	11/02/2016
Drawn by:	DS
Scale:	1:6,976
Sheet Size:	@A4
Projection:	GDA 1994 MGA Zone 56

N

50 0 50 100 150 m

Proposed Alignment
Existing Noise Barriers
Assessed Receivers

Daytime Noise Contours

55 dBA LAeq(15hr)
60 dBA LAeq(15hr)
65 dBA LAeq(15hr)
70 dBA LAeq(15hr)

Notes:
** Noise contour grid spacing: 10m*
** Noise contour height above ground: 4.5m*

Jacobs Group (Australia) Pty Limited

Sydney Metro Chatswood to Sydenham

2034 Daytime LAeq(15hr) Noise Contours With Project

Appendix I2

Report 610.14718R1

Operational Airborne Noise Predictions - Noise Contours

Night-time $L_{Aeq(9hr)}$ Noise Contours

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Drawn by:	DS
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Projection:	GDA 1994 MGA Zone 56

50 0 50 100 150 200 m

Proposed Alignment
Existing Noise Barriers
Assessed Receivers

Night-time Noise Contours

55 dBA LAeq(9hr)
60 dBA LAeq(9hr)
65 dBA LAeq(9hr)
70 dBA LAeq(9hr)

Notes:
** Noise contour grid spacing: 10m*
** Noise contour height above ground: 4.5m*

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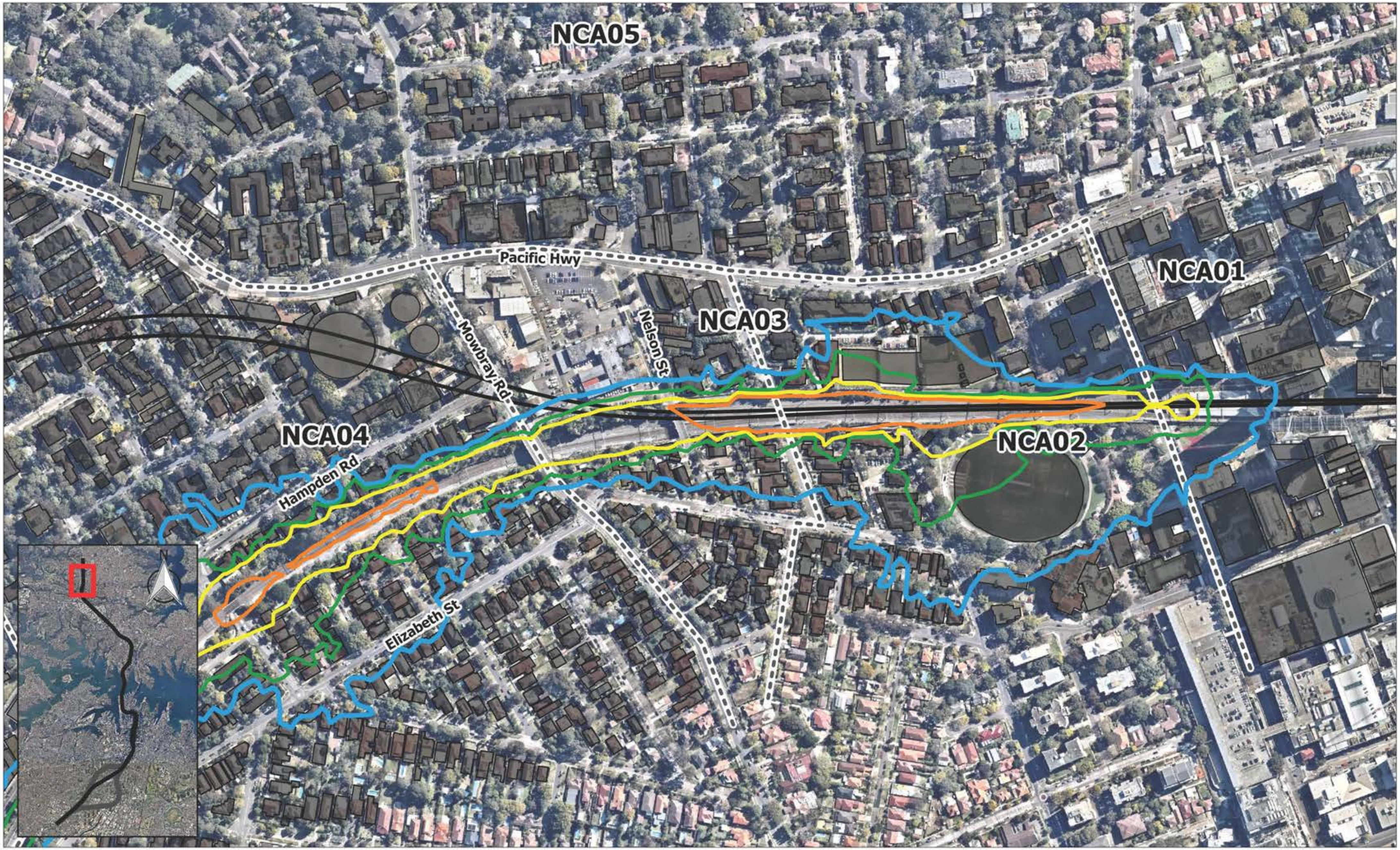
Sydney Metro Chatswood to Sydenham

2034 Night-time LAeq(9hr) Noise Contours With Project



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Scale:	1:6,976
Sheet Size:	@A4
Projection:	GDA 1994 MGA Zone 56

N

50 0 50 100 150 m

Proposed Alignment
Existing Noise Barriers
Assessed Receivers

Night-time Noise Contours

55 dBA LAeq(9hr)
60 dBA LAeq(9hr)
65 dBA LAeq(9hr)
70 dBA LAeq(9hr)

Notes:
** Noise contour grid spacing: 10m*
** Noise contour height above ground: 4.5m*

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Sydney Metro Chatswood to Sydenham

2034 Night-time LAeq(9hr) Noise Contours With Project

Appendix I3

Report 610.14718R1

Operational Airborne Noise Predictions - Noise Contours

Maximum L_{Amax} Noise Contours

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Projection:	GDA 1994 MGA Zone 56

50 0 50 100 150 200 m

Proposed Alignment
Existing Noise Barriers
Assessed Receivers

Maximum Noise Contours

75 dBA LAmax
80 dBA LAmax
85 dBA LAmax
90 dBA LAmax

Notes:
** Noise contour grid spacing: 10m*
** Noise contour height above ground: 4.5m*

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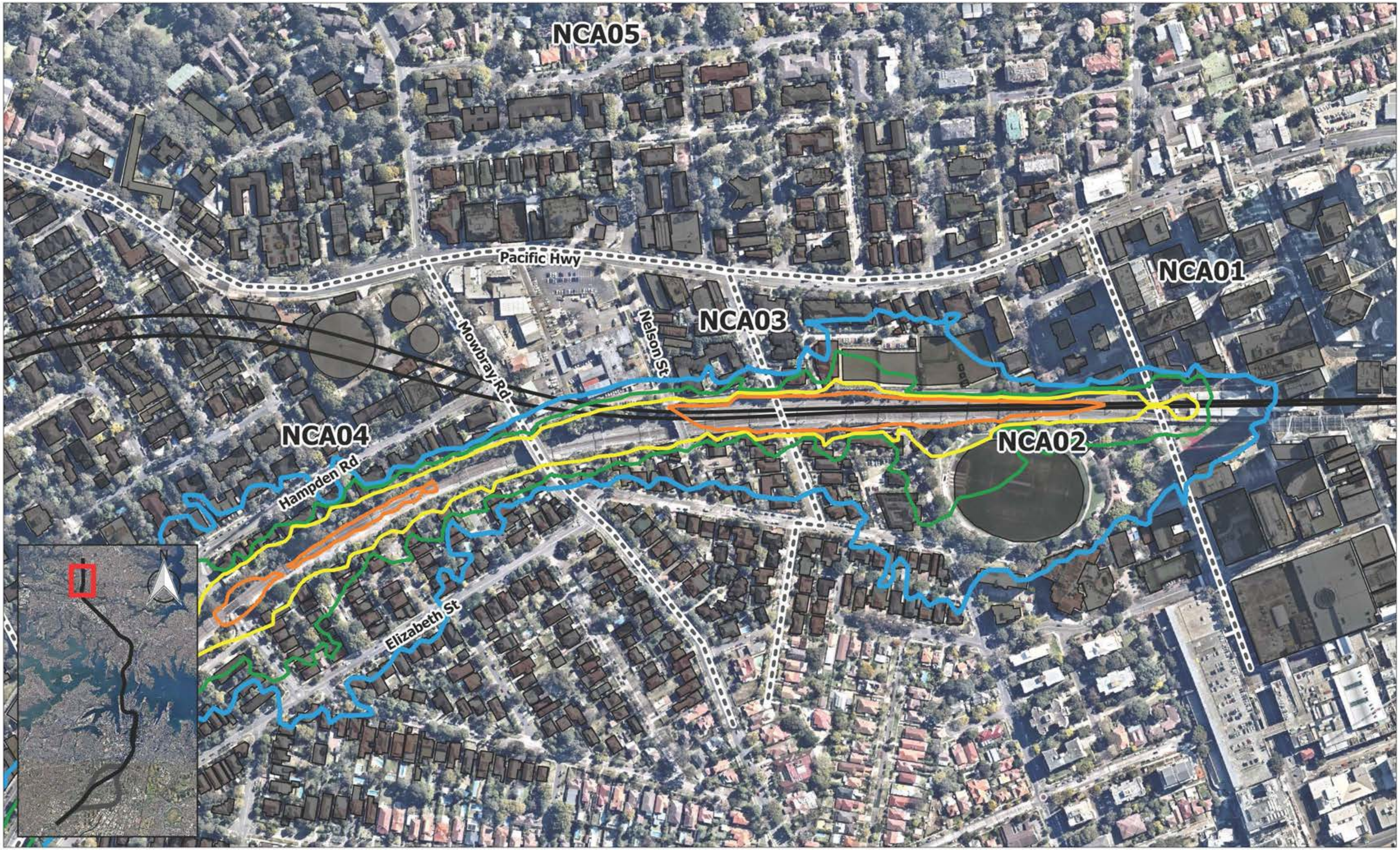
Sydney Metro Chatswood to Sydenham

2034 Maximum LAmax Noise Contours With Project



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Drawn by:	DS
Scale:	1:6,976
Sheet Size:	@A4
Projection:	GDA 1994 MGA Zone 56

N

50 0 50 100 150 m

Proposed Alignment
Existing Noise Barriers
Assessed Receivers

Maximum Noise Contours
75 dBA LAmax
80 dBA LAmax
85 dBA LAmax
90 dBA LAmax

Notes:
** Noise contour grid spacing: 10m*
** Noise contour height above ground: 4.5m*

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Sydney Metro Chatswood to Sydenham

2034 Maximum LAmax Noise Contours With Project

Appendix J

Report 610.14718R1

Operational Airborne Noise Detail Predictions

RECEIVER	TYPE	NCA	SIDE	2024 Without Project			2024 With Project			2024 Increase			2034 Without Project			2034 With Project			2034 Increase			Triggered for consideration of mitigation
				LAeq(15h)	LAeq(9h)	Lamax	LAeq(15h)	LAeq(9h)	Lamax	LAeq(15h)	LAeq(9h)	Lamax	LAeq(15h)	LAeq(9h)	Lamax	LAeq(15h)	LAeq(9h)	Lamax	LAeq(15h)	LAeq(9h)	Lamax	
NCA01.COM.0001	COM	NCA01	DOWN	45	41	61	46	41	61	1.5	0.7	-0.1	45	41	61	46	41	61	1.8	0.9	-0.1	No
NCA01.COM.0004	COM	NCA01	DOWN	45	41	61	47	42	60	1.4	0.5	-1.1	45	41	61	47	42	60	1.6	0.7	-1.1	No
NCA01.COM.0007	COM	NCA01	DOWN	44	40	61	45	41	61	1.1	0.4	0.3	44	40	61	46	41	61	1.3	0.5	0.3	No
NCA01.COM.0008	COM	NCA01	DOWN	45	41	62	46	41	62	1.0	0.2	0.0	45	41	62	46	41	62	1.2	0.4	0.0	No
NCA01.COM.0009	COM	NCA01	DOWN	45	41	62	46	41	62	0.6	-0.1	-0.7	45	41	62	46	41	62	0.8	0.1	-0.7	No
NCA01.COM.0010	COM	NCA01	DOWN	56	52	72	58	53	72	1.9	0.8	-0.4	56	52	72	58	53	72	2.2	1.0	-0.4	No
NCA01.COM.0011	COM	NCA01	DOWN	51	47	66	53	48	67	1.9	1.0	0.8	51	47	66	53	48	67	2.1	1.1	0.8	No
NCA01.COM.0012	COM	NCA01	DOWN	58	54	77	60	55	76	1.2	0.2	-0.7	58	54	77	60	55	76	1.4	0.4	-0.7	No
NCA01.COM.0013	COM	NCA01	UP	59	55	77	61	56	75	1.9	1.0	-1.3	59	55	77	61	56	75	2.2	1.2	-1.3	No
NCA01.COM.0014	COM	NCA01	UP	54	50	71	55	50	70	1.8	0.9	-0.5	54	50	71	56	51	70	2.0	1.1	-0.5	No
NCA01.COM.0015	COM	NCA01	DOWN	53	49	67	55	50	67	2.0	1.1	0.3	53	49	67	55	50	67	2.2	1.3	0.3	No
NCA01.COM.0016	COM	NCA01	DOWN	52	48	67	53	48	66	1.8	0.8	-0.4	52	48	67	54	49	66	2.0	0.9	-0.4	No
NCA01.COM.0018	COM	NCA01	DOWN	47	43	66	49	44	64	1.3	0.4	-1.7	47	43	66	49	44	64	1.5	0.6	-1.7	No
NCA01.COM.0019	COM	NCA01	DOWN	56	52	73	57	52	72	1.7	0.6	-1.4	56	52	73	58	52	72	1.9	0.8	-1.4	No
NCA01.COM.0020	COM	NCA01	UP	55	51	72	57	52	70	1.7	0.8	-1.5	55	51	72	57	52	70	1.9	1.0	-1.5	No
NCA01.COM.0022	COM	NCA01	DOWN	33	29	49	34	29	46	1.4	0.6	-3.4	33	29	49	34	29	46	1.6	0.8	-3.4	No
NCA01.COM.0023	COM	NCA01	UP	52	48	69	54	49	68	2.1	1.2	-0.3	52	48	69	54	49	68	2.4	1.4	-0.3	No
NCA01.COM.0024	COM	NCA01	UP	50	46	67	52	47	66	1.9	0.9	-1.1	50	46	67	52	47	66	2.1	1.1	-1.1	No
NCA01.COM.0025	COM	NCA01	UP	41	37	60	42	38	59	1.4	0.7	-1.6	41	37	60	43	38	59	1.7	0.9	-1.6	No
NCA01.COM.0026	COM	NCA01	DOWN	50	46	63	52	47	64	2.1	1.1	0.8	50	46	63	52	47	64	2.3	1.3	0.8	No
NCA01.COM.0028	COM	NCA01	DOWN	47	43	61	49	44	62	1.5	0.6	1.0	47	43	61	49	44	62	1.7	0.8	1.0	No
NCA01.COM.0029	COM	NCA01	UP	33	29	50	34	29	50	1.2	0.5	-0.3	33	29	50	34	29	50	1.3	0.6	-0.3	No
NCA01.COM.0030	COM	NCA01	UP	30	26	44	32	27	45	1.8	1.1	0.2	30	26	44	32	27	45	1.9	1.2	0.2	No
NCA01.COM.0031	COM	NCA01	UP	31	27	46	33	28	46	1.7	0.9	-0.6	31	27	46	33	28	46	1.9	1.0	-0.6	No
NCA01.COM.0032	COM	NCA01	DOWN	51	47	67	54	49	67	2.2	1.3	-0.1	51	47	67	54	49	67	2.4	1.5	-0.1	No
NCA01.COM.0033	COM	NCA01	UP	31	27	45	32	28	45	1.7	1.0	0.2	31	27	45	33	28	45	1.9	1.1	0.2	No
NCA01.COM.0034	COM	NCA01	UP	31	27	45	33	28	44	2.0	1.1	-0.2	31	27	45	33	28	44	2.2	1.3	-0.2	No
NCA01.COM.0035	COM	NCA01	UP	30	26	44	32	27	44	1.7	1.0	0.1	30	26	44	32	27	44	1.9	1.1	0.1	No
NCA01.COM.0036	COM	NCA01	UP	32	28	46	34	29	45	1.9	1.0	-0.3	32	28	46	34	29	45	2.1	1.1	-0.3	No
NCA01.COM.0037	COM	NCA01	UP	31	28	44	33	29	44	1.6	1.1	0.4	31	28	44	33	29	44	1.8	1.2	0.4	No
NCA01.COM.0038	COM	NCA01	DOWN	47	43	62	49	44	62	2.0	1.1	0.4	47	43	62	49	44	62	2.2	1.3	0.4	No
NCA01.COM.0040	COM	NCA01	UP	37	33	50	38	34	51	1.4	1.0	1.2	37	33	50	38	34	51	1.5	1.1	1.2	No
NCA01.COM.0041	COM	NCA01	UP	40	36	59	41	36	59	1.0	0.2	-0.4	40	36	59	41	37	59	1.2	0.4	-0.4	No
NCA01.COM.0042	COM	NCA01	UP	28	24	43	30	25	44	2.3	1.3	1.0	28	24	43	30	25	44	2.5	1.4	1.0	No
NCA01.COM.0043	COM	NCA01	UP	31	27	46	33	29	46	1.9	1.1	0.2	31	27	46	33	29	46	2.1	1.2	0.2	No
NCA01.COM.0044	COM	NCA01	UP	33	29	47	35	30	47	2.0	1.2	0.1	33	29	47	35	30	47	2.2	1.3	0.1	No
NCA01.COM.0045	COM	NCA01	DOWN	42	38	59	43	38	58	0.8	0.0	-0.8	42	38	59	43	38	58	1.0	0.2	-0.8	No
NCA01.COM.0047	COM	NCA01	UP	44	40	64	45	40	63	1.0	0.1	-0.6	44	40	64	45	40	63	1.2	0.3	-0.6	No
NCA01.COM.0048	COM	NCA01	UP	36	32	51	38	34	53	2.0	1.6	2.3	36	32	51	38	34	53	2.1	1.7	2.3	No
NCA01.COM.0049	COM	NCA01	UP	38	34	53	40	35	53	2.4	1.5	0.2	38	34	53	40	35	53	2.6	1.6	0.2	No
NCA01.COM.0050	COM	NCA01	UP	33	29	44	34	30	44	1.0	0.7	0.1	33	29	44	34	30	44	1.1	0.7	0.1	No
NCA01.COM.0051	COM	NCA01	DOWN	32	28	45	32	28	45	0.5	0.3	0.0	32	28	45	32	28	45	0.6	0.3	0.0	No
NCA01.COM.0052	COM	NCA01	UP	30	27	43	32	27	44	1.4	0.8	0.2	30	27	43	32	27	44	1.5	0.9	0.2	No
NCA01.COM.0053	COM	NCA01	UP	28	24	41	30	25	40	1.4	0.8	-1.2	28	24	41	30	25	40	1.6	0.9	-1.2	No
NCA01.COM.0054	COM	NCA01	DOWN	32	28	50	34	29	50	2.2	1.1	-0.8	32	28	50	34	29	50	2.4	1.3	-0.8	No
NCA01.COM.0055	COM	NCA01	DOWN	44	41	63	46	41	62	2.3	0.5	-1.5	44	41	63	46	41	62	2.5	0.6	-1.5	No
NCA01.COM.0057	COM	NCA01	DOWN	27	23	40	29	24	40	1.7	1.0	0.3	27	23	40	29	24	40	1.8	1.1	0.3	No
NCA01.COM.0058	COM	NCA01	DOWN	27	23	39	29	24	40	1.8	1.0	1.4	27	23	39	29	24	40	2.0	1.1	1.4	No
NCA01.COM.0060	COM	NCA01	DOWN	26	22	39	28	23	40	1.7	0.9	0.4	26	22	39	28	23	40	1.9	1.0	0.4	No
NCA01.COM.0062	COM	NCA01	DOWN	35	31	51	36	32	51	1.9	1.1	-0.2	35	31	51	37	32	51	2.1	1.2	-0.2	No
NCA01.COM.0067	COM	NCA01	DOWN	41	37	56	43	38	58	2.3	1.4	1.6	41	37	56	43	38	58	2.5	1.6	1.6	No
NCA01.COM.0075	COM	NCA01	DOWN	24	21	38	26	22	39	1.8	1.1	0.5	24	21	38	26	22	39	2.0	1.3	0.5	No
NCA01.COM.0089	COM	NCA01	DOWN	36	33	54	40	34	56	3.2	1.9	1.8	36	33	54	40	35	56	3.5	2.2	1.8	No
NCA01.OCC.0090	OCC	NCA01	DOWN	24	20	37	26	21	37	1.8	1.1	1.2	24	20	37	26	21	37	2.0	1.4	1.2	No
NCA01.OED.0003	OED	NCA01	DOWN	46	43	60	47	44	61	1.3	0.7	0.8	46	43	60	48	44	61	1.5	0.9	0.8	No
NCA01.OME.0027	OME	NCA01	UP	54	50	69	56	52	67	1.9	1.1	-1.5	54	50	69	56	52	67	2.1	1.3	-1.5	No
NCA01.OME.0039	OME	NCA01	UP	33	30	45	35	31	45	1.8	1.4	0.0	33	30	45	35	32	45	1.9	1.5	0.0	No
NCA01.RES.0002	RES	NCA01	DOWN	46	42	64	48	43	64	1.5	0.7	0.4	46	42	64	48	43	64	1.7	0.9	0.4	No

NCA01.RES.0005	RES	NCA01	DOWN	50	46	67	51	46	68	1.2	0.4	0.3	50	46	67	51	47	68	1.4	0.5	0.3	No
NCA01.RES.0006	RES	NCA01	DOWN	61	58	80	62	58	81	1.0	0.2	0.5	61	58	80	63	58	81	1.2	0.3	0.5	No
NCA01.RES.0017	RES	NCA01	UP	51	47	68	52	47	68	1.3	0.5	-0.1	51	47	68	52	47	68	1.6	0.7	-0.1	No
NCA01.RES.0021	RES	NCA01	DOWN	55	51	72	56	52	70	1.6	0.7	-1.6	55	51	72	57	52	70	1.9	0.9	-1.6	No
NCA01.RES.0046	RES	NCA01	DOWN	45	41	62	48	43	62	2.3	1.5	0.3	45	41	62	48	43	62	2.5	1.6	0.3	No
NCA01.RES.0056	RES	NCA01	UP	45	41	64	47	42	63	2.0	1.3	-0.2	45	41	64	47	42	63	2.2	1.4	-0.2	No
NCA01.RES.0059	RES	NCA01	UP	44	40	63	47	42	63	2.4	1.6	0.7	44	40	63	47	42	63	2.5	1.7	0.7	No
NCA01.RES.0061	RES	NCA01	DOWN	0	0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0	0	0.0	0.0	0.0	No
NCA01.RES.0063	RES	NCA01	UP	45	41	61	47	42	61	2.5	1.4	-0.2	45	41	61	47	42	61	2.7	1.6	-0.2	No
NCA01.RES.0064	RES	NCA01	UP	43	40	60	46	41	60	2.1	1.2	0.0	43	40	60	46	41	60	2.3	1.3	0.0	No
NCA01.RES.0065	RES	NCA01	UP	34	30	53	35	31	53	1.3	0.6	-0.3	34	30	53	35	31	53	1.5	0.7	-0.3	No
NCA01.RES.0066	RES	NCA01	UP	46	42	62	48	43	62	2.1	1.1	0.1	46	42	62	49	44	62	2.3	1.3	0.1	No
NCA01.RES.0068	RES	NCA01	UP	42	38	59	44	39	58	2.4	1.3	-0.1	42	38	59	45	39	58	2.7	1.5	-0.1	No
NCA01.RES.0069	RES	NCA01	DOWN	39	35	57	42	37	58	2.7	1.6	1.3	39	35	57	42	37	58	2.9	1.8	1.3	No
NCA01.RES.0070	RES	NCA01	UP	45	41	61	47	42	61	2.2	1.2	-0.1	45	41	61	47	42	61	2.4	1.4	-0.1	No
NCA01.RES.0071	RES	NCA01	UP	42	38	59	44	39	60	2.2	1.3	0.1	42	38	59	44	39	60	2.5	1.4	0.1	No
NCA01.RES.0072	RES	NCA01	UP	39	36	59	41	36	59	1.3	0.5	0.3	39	36	59	41	36	59	1.5	0.7	0.3	No
NCA01.RES.0073	RES	NCA01	UP	42	38	58	44	39	59	2.5	1.3	0.1	42	38	58	45	39	59	2.8	1.5	0.1	No
NCA01.RES.0074	RES	NCA01	UP	44	40	61	47	42	60	2.3	1.2	-0.3	44	40	61	47	42	60	2.5	1.4	-0.3	No
NCA01.RES.0076	RES	NCA01	UP	40	36	59	42	37	58	1.9	1.1	-0.2	40	36	59	42	37	58	2.1	1.3	-0.2	No
NCA01.RES.0077	RES	NCA01	DOWN	27	23	43	30	25	46	2.5	1.9	3.1	27	23	43	30	25	46	2.7	2.0	3.1	No
NCA01.RES.0078	RES	NCA01	UP	40	36	57	43	38	59	3.2	1.9	1.8	40	36	57	44	38	59	3.5	2.2	1.8	No
NCA01.RES.0079	RES	NCA01	UP	43	39	59	46	41	60	2.4	1.4	0.4	43	39	59	46	41	60	2.6	1.5	0.4	No
NCA01.RES.0080	RES	NCA01	UP	41	37	58	43	38	58	2.4	1.4	-0.1	41	37	58	44	39	58	2.6	1.5	-0.1	No
NCA01.RES.0081	RES	NCA01	DOWN	25	21	39	27	23	39	1.9	1.1	0.5	25	21	39	27	23	39	2.0	1.3	0.5	No
NCA01.RES.0082	RES	NCA01	UP	33	29	50	35	30	50	2.0	1.2	-0.5	33	29	50	35	31	50	2.2	1.3	-0.5	No
NCA01.RES.0083	RES	NCA01	DOWN	26	22	43	28	24	47	2.1	1.9	3.8	26	22	43	28	24	47	2.3	2.0	3.8	No
NCA01.RES.0084	RES	NCA01	DOWN	30	26	48	31	27	45	1.4	0.9	-2.2	30	26	48	31	27	45	1.5	1.1	-2.2	No
NCA01.RES.0085	RES	NCA01	DOWN	32	28	47	34	29	47	1.8	1.1	0.2	32	28	47	34	29	47	2.0	1.2	0.2	No
NCA01.RES.0086	RES	NCA01	UP	36	32	52	39	34	52	2.6	1.7	0.4	36	32	52	39	34	52	2.8	1.8	0.4	No
NCA01.RES.0087	RES	NCA01	DOWN	41	37	58	43	39	58	2.3	1.4	0.0	41	37	58	44	39	58	2.5	1.5	0.0	No
NCA01.RES.0088	RES	NCA01	UP	25	21	37	26	22	38	1.2	0.7	1.3	25	21	37	26	22	38	1.3	0.8	1.3	No
NCA02.COM.0106	COM	NCA02	DOWN	65	61	83	67	62	82	2.0	0.8	-0.6	65	61	83	67	62	82	2.2	1.0	-0.6	No
NCA02.COM.0122	COM	NCA02	DOWN	57	53	75	58	53	73	0.9	-0.2	-2.1	57	53	75	58	53	73	1.1	0.0	-2.1	No
NCA02.COM.0128	COM	NCA02	UP	62	58	80	64	59	80	1.8	0.9	-0.6	62	58	80	64	59	80	2.1	1.0	-0.6	No
NCA02.COM.0134	COM	NCA02	DOWN	55	51	74	56	51	72	1.1	0.1	-2.0	55	51	74	56	51	72	1.3	0.2	-2.0	No
NCA02.COM.0138	COM	NCA02	DOWN	57	53	75	58	53	73	1.1	0.1	-1.9	57	53	75	58	53	73	1.3	0.3	-1.9	No
NCA02.COM.0149	COM	NCA02	DOWN	56	52	74	56	51	73	0.4	-0.4	-1.2	56	52	74	56	52	73	0.6	-0.3	-1.2	No
NCA02.COM.0150	COM	NCA02	DOWN	56	52	75	56	52	74	0.2	-0.5	-1.0	56	52	75	57	52	74	0.4	-0.4	-1.0	No
NCA02.COM.0151	COM	NCA02	DOWN	57	53	76	57	52	75	0.0	-0.7	-1.0	57	53	76	57	52	75	0.1	-0.6	-1.0	No
NCA02.COM.0157	COM	NCA02	UP	68	64	85	70	65	85	2.1	1.1	-0.6	68	64	85	70	65	85	2.4	1.3	-0.6	No
NCA02.COM.0166	COM	NCA02	UP	65	61	84	67	62	82	1.8	0.8	-2.1	65	61	84	67	62	82	2.0	1.1	-2.1	No
NCA02.OCC.0170	OCC	NCA02	UP	54	50	70	55	50	69	1.6	0.6	-1.2	54	50	70	56	50	69	1.8	0.8	-1.2	No
NCA02.OED.0158	OED	NCA02	DOWN	59	55	75	58	54	74	-0.3	-0.9	-1.6	59	55	75	59	55	74	-0.1	-0.7	-1.6	No
NCA02.OOA.0173	OOA	NCA02	UP	52	49	68	54	50	66	1.7	1.0	-1.9	52	49	68	54	50	66	1.9	1.2	-1.9	No
NCA02.OOA.7700	OOA	NCA02	UP	62	58	79	63	59	79	1.7	1.0	0.3	62	58	79	64	60	79	1.9	1.2	0.3	No
NCA02.OOA.7701	OOA	NCA02	Down	59	56	76	60	56	74	0.4	-0.4	-2.1	59	56	76	60	56	74	0.5	-0.2	-2.1	No
NCA02.OPW.0172	OPW	NCA02	UP	55	52	71	57	53	68	1.5	0.9	-2.5	55	52	71	57	53	68	1.8	1.1	-2.5	No
NCA02.RES.0094	RES	NCA02	DOWN	55	51	74	58	53	73	2.6	1.5	-0.3	55	51	74	58	53	73	2.8	1.7	-0.3	No
NCA02.RES.0095	RES	NCA02	DOWN	59	55	76	62	57	77	3.2	2.0	1.6	59	55	76	62	57	77	3.4	2.2	1.6	No
NCA02.RES.0096	RES	NCA02	DOWN	66	62	84	69	63	85	3.0	1.5	1.3	66	0	84	69	0	85	3.2	1.7	1.3	Yes
NCA02.RES.0097	RES	NCA02	UP	47	43	64	49	44	64	2.5	1.6	0.0	47	43	64	49	45	64	2.4	1.7	0.0	No
NCA02.RES.0098	RES	NCA02	UP	51	47	68	53	48	68	2.4	1.5	0.4	51	47	68	53	49	68	2.6	1.7	0.4	No
NCA02.RES.0099	RES	NCA02	UP	50	46	67	53	48	67	2.5	1.6	0.4	50	46	67	53	48	67	2.8	1.7	0.4	No
NCA02.RES.0100	RES	NCA02	UP	50	46	67	52	47	66	2.3	1.4	-0.1	50	46	67	52	47	66	2.5	1.6	-0.1	No
NCA02.RES.0101	RES	NCA02	UP	51	47	67	54	49	68	3.1	2.1	0.5	51	47	67	55	50	68	3.3	2.3	0.5	No
NCA02.RES.0102	RES	NCA02	UP	62	58	81	61	56	76	-0.5	-1.6	-4.2	62	58	81	62	57	76	-0.3	-1.4	-4.2	No
NCA02.RES.0103	RES	NCA02	UP	63	59	83	65	60	81	1.9	0.8	-1.5	63	59	83	65	60	81	2.1	1.0	-1.5	No
NCA02.RES.0104	RES	NCA02	UP	50	46	66	52	47	66	2.3	1.3	-0.1	50	46	66	52	47	66	2.5	1.5	-0.1	No
NCA02.RES.0105	RES	NCA02	UP	49	45	66	52	47	65	2.4	1.5	-0.7	49	45	66	52	47	65	2.6	1.7	-0.7	No
NCA02.RES.0107	RES	NCA02	UP	46	43	61	49	44	62	2.8	1.8	0.9	46	43	61	49	44	62	3.0	1.9	0.9	No

NCA02.RES.0108	RES	NCA02	UP	59	55	78	61	56	76	2.1	1.0	-1.5	59	55	78	61	56	76	2.3	1.2	-1.5	No
NCA02.RES.0109	RES	NCA02	UP	54	50	71	57	52	72	2.8	1.8	0.4	54	50	71	57	52	72	3.1	2.0	0.4	No
NCA02.RES.0110	RES	NCA02	UP	55	51	73	58	53	72	3.1	2.0	-0.5	55	51	73	58	53	72	3.3	2.2	-0.5	No
NCA02.RES.0111	RES	NCA02	UP	52	48	69	55	50	69	2.5	1.5	0.0	52	48	69	55	50	69	2.8	1.7	0.0	No
NCA02.RES.0112	RES	NCA02	DOWN	59	55	78	61	56	77	2.3	1.1	-0.6	59	55	78	62	57	77	2.5	1.3	-0.6	No
NCA02.RES.0113	RES	NCA02	UP	54	50	70	56	51	70	2.7	1.7	0.1	54	50	70	57	52	70	2.9	1.9	0.1	No
NCA02.RES.0114	RES	NCA02	UP	56	52	74	58	53	72	1.8	0.7	-1.8	56	52	74	58	53	72	2.0	0.9	-1.8	No
NCA02.RES.0115	RES	NCA02	UP	50	46	66	52	47	66	2.5	1.5	0.3	50	46	66	52	47	66	2.7	1.7	0.3	No
NCA02.RES.0116	RES	NCA02	UP	55	51	72	58	53	72	2.3	1.3	-0.2	55	51	72	58	53	72	2.6	1.5	-0.2	No
NCA02.RES.0117	RES	NCA02	UP	55	51	73	58	53	72	2.3	1.3	-0.2	55	51	73	58	53	72	2.5	1.4	-0.2	No
NCA02.RES.0118	RES	NCA02	UP	56	52	72	58	53	72	2.1	1.1	-0.1	56	52	72	58	53	72	2.3	1.3	-0.1	No
NCA02.RES.0119	RES	NCA02	UP	54	50	72	56	51	73	2.2	1.3	0.5	54	50	72	56	51	73	2.5	1.5	0.5	No
NCA02.RES.0120	RES	NCA02	UP	50	46	66	52	47	66	2.3	1.3	0.2	50	46	66	53	47	66	2.6	1.5	0.2	No
NCA02.RES.0121	RES	NCA02	UP	68	64	86	70	65	86	1.6	0.5	-0.3	68	64	86	70	65	86	1.9	0.6	-0.3	No
NCA02.RES.0123	RES	NCA02	UP	55	51	73	57	52	73	2.0	1.0	-0.1	55	51	73	57	52	73	2.2	1.2	-0.1	No
NCA02.RES.0124	RES	NCA02	UP	55	51	74	57	52	73	1.9	0.9	-0.2	55	51	74	57	52	73	2.1	1.0	-0.2	No
NCA02.RES.0125	RES	NCA02	DOWN	59	55	77	60	55	75	1.7	0.7	-1.3	59	55	77	60	55	75	1.9	0.8	-1.3	No
NCA02.RES.0126	RES	NCA02	UP	55	51	73	58	53	73	2.2	1.2	0.2	55	51	73	58	53	73	2.4	1.4	0.2	No
NCA02.RES.0127	RES	NCA02	DOWN	56	52	74	57	52	72	1.1	0.1	-1.7	56	52	74	57	52	72	1.3	0.3	-1.7	No
NCA02.RES.0129	RES	NCA02	UP	51	48	69	54	49	69	2.3	1.3	0.2	51	48	69	54	49	69	2.5	1.4	0.2	No
NCA02.RES.0130	RES	NCA02	DOWN	57	53	75	58	53	73	1.0	0.0	-2.1	57	53	75	58	53	73	1.2	0.1	-2.1	No
NCA02.RES.0131	RES	NCA02	DOWN	56	52	74	57	52	73	1.6	0.5	-0.9	56	52	74	57	52	73	1.8	0.7	-0.9	No
NCA02.RES.0132	RES	NCA02	UP	60	56	78	62	57	78	2.0	1.0	-0.1	60	56	78	62	57	78	2.3	1.2	-0.1	No
NCA02.RES.0133	RES	NCA02	UP	56	52	74	58	53	74	2.1	1.0	-0.2	56	52	74	58	54	74	2.3	1.2	-0.2	No
NCA02.RES.0135	RES	NCA02	DOWN	55	51	74	57	52	72	1.5	0.4	-1.3	55	51	74	57	52	72	1.7	0.6	-1.3	No
NCA02.RES.0136	RES	NCA02	UP	54	50	71	56	51	72	1.8	0.8	0.6	54	50	71	56	51	72	2.1	1.0	0.6	No
NCA02.RES.0137	RES	NCA02	UP	0	0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0	0	0.0	0.0	0.0	No
NCA02.RES.0139	RES	NCA02	UP	55	51	73	57	52	73	2.1	1.2	0.1	55	51	73	57	53	73	2.3	1.3	0.1	No
NCA02.RES.0140	RES	NCA02	DOWN	58	54	76	60	55	75	1.4	0.3	-1.4	58	54	76	60	55	75	1.6	0.5	-1.4	No
NCA02.RES.0141	RES	NCA02	UP	57	53	75	59	54	75	1.8	0.9	0.3	57	53	75	59	54	75	2.1	1.1	0.3	No
NCA02.RES.0142	RES	NCA02	UP	0	0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0	0	0.0	0.0	0.0	No
NCA02.RES.0143	RES	NCA02	UP	54	50	71	56	51	71	2.0	1.1	0.2	54	50	71	56	51	71	2.2	1.2	0.2	No
NCA02.RES.0144	RES	NCA02	UP	57	54	76	60	55	76	2.1	1.1	0.2	57	54	76	60	55	76	2.3	1.3	0.2	No
NCA02.RES.0145	RES	NCA02	UP	55	51	72	57	52	72	2.0	1.0	0.1	55	51	72	57	52	72	2.2	1.2	0.1	No
NCA02.RES.0146	RES	NCA02	UP	57	53	75	59	54	75	2.0	1.0	0.0	57	53	75	59	54	75	2.2	1.2	0.0	No
NCA02.RES.0147	RES	NCA02	DOWN	59	55	76	61	56	76	2.5	1.4	0.2	59	55	76	61	56	76	2.7	1.5	0.2	No
NCA02.RES.0148	RES	NCA02	UP	55	51	72	57	52	72	2.1	1.1	0.0	55	51	72	57	52	72	2.3	1.2	0.0	No
NCA02.RES.0152	RES	NCA02	DOWN	50	46	68	52	47	67	1.8	0.7	-0.4	50	46	68	52	47	67	2.0	0.9	-0.4	No
NCA02.RES.0153	RES	NCA02	DOWN	60	56	77	62	57	77	2.4	1.1	0.3	60	56	77	63	57	77	2.7	1.4	0.3	No
NCA02.RES.0154	RES	NCA02	UP	57	53	76	60	55	76	2.3	1.3	0.1	57	53	76	60	55	76	2.5	1.5	0.1	No
NCA02.RES.0155	RES	NCA02	UP	49	45	67	50	45	66	1.6	0.7	-0.8	49	45	67	51	46	66	1.8	0.8	-0.8	No
NCA02.RES.0156	RES	NCA02	DOWN	61	57	80	62	57	77	0.2	-0.8	-3.4	61	57	80	62	57	77	0.5	-0.6	-3.4	No
NCA02.RES.0159	RES	NCA02	DOWN	49	45	66	50	45	65	0.8	-0.1	-0.9	49	45	66	50	45	65	1.0	0.1	-0.9	No
NCA02.RES.0160	RES	NCA02	DOWN	48	44	66	49	44	65	1.0	0.1	-0.9	48	44	66	49	44	65	1.2	0.2	-0.9	No
NCA02.RES.0161	RES	NCA02	DOWN	59	55	78	61	55	76	1.7	0.8	-2.2	59	55	78	61	56	76	2.0	0.8	-2.2	No
NCA02.RES.0162	RES	NCA02	DOWN	48	44	66	50	45	65	2.0	1.0	-0.9	48	44	66	50	45	65	2.3	1.2	-0.9	No
NCA02.RES.0163	RES	NCA02	UP	59	55	76	61	56	76	2.0	1.0	0.0	59	55	76	61	56	76	2.2	1.2	0.0	No
NCA02.RES.0164	RES	NCA02	DOWN	61	57	81	61	56	76	-0.6	-1.3	-5.2	61	57	81	61	56	76	-0.3	-1.1	-5.2	No
NCA02.RES.0165	RES	NCA02	DOWN	51	47	70	54	49	70	2.9	1.6	0.1	51	47	70	54	49	70	3.1	1.8	0.1	No
NCA02.RES.0167	RES	NCA02	DOWN	59	55	78	61	55	76	1.6	0.4	-2.2	59	55	78	61	55	76	1.9	0.6	-2.2	No
NCA02.RES.0168	RES	NCA02	UP	50	46	66	52	47	66	1.8	0.8	-0.4	50	46	66	52	47	66	2.0	0.9	-0.4	No
NCA02.RES.0169	RES	NCA02	DOWN	64	60	82	65	61	82	1.4	0.5	-0.2	64	60	82	66	61	82	1.6	0.7	-0.2	No
NCA02.RES.0171	RES	NCA02	UP	54	50	72	56	51	69	1.7	0.7	-2.2	54	50	72	56	51	69	1.9	0.9	-2.2	No
NCA03.COM.0191	COM	NCA03	DOWN	47	43	62	49	44	63	2.1	1.3	1.3	47	43	62	49	44	63	2.2	1.4	1.3	No
NCA03.COM.0207	COM	NCA03	DOWN	46	42	61	48	44	62	2.5	1.7	1.8	46	42	61	49	44	62	2.6	1.8	1.8	No
NCA03.COM.0213	COM	NCA03	DOWN	49	45	66	51	47	66	2.4	1.5	-0.1	49	45	66	52	47	66	2.6	1.7	-0.1	No
NCA03.RES.0184	RES	NCA03	UP	65	61	83	64	60	82	-0.7	-0.8	-0.2	65	61	83	64	60	82	-0.7	-0.8	-0.2	No
NCA03.RES.0186	RES	NCA03	UP	67	63	86	67	63	86	-0.3	-0.4	-0.1	67	63	86	67	63	86	-0.3	-0.4	-0.1	No
NCA03.RES.0187	RES	NCA03	UP	50	46	66	53	48	68	2.2	1.7	2.8	50	46	66	53	48	68	2.4	1.8	2.8	No
NCA03.RES.0188	RES	NCA03	UP	56	52	75	60	56	80	3.9	3.7	4.8	56	52	75	60	56	80	3.9	3.7	4.8	No
NCA03.RES.0189	RES	NCA03	UP	48	44	61	50	46	64	2.0	1.3	2.4	48	44	61	51	46	64	2.1	1.4	2.4	No

NCA03.RES.0190	RES	NCA03	UP	48	44	62	51	46	64	2.6	1.9	2.0	48	44	62	51	46	64	2.7	2.0	2.0	No
NCA03.RES.0192	RES	NCA03	UP	55	51	73	60	55	79	4.7	4.6	6.4	55	51	73	60	56	79	4.8	4.6	6.4	No
NCA03.RES.0193	RES	NCA03	DOWN	47	43	62	49	44	63	2.4	1.6	1.4	47	43	62	49	45	63	2.5	1.7	1.4	No
NCA03.RES.0194	RES	NCA03	UP	48	44	62	51	46	64	2.6	1.8	2.3	48	44	62	51	46	64	2.7	1.9	2.3	No
NCA03.RES.0195	RES	NCA03	UP	67	63	86	68	64	87	0.6	0.4	0.8	67	63	86	68	64	87	0.7	0.5	0.8	No
NCA03.RES.0196	RES	NCA03	UP	56	52	75	59	54	78	2.3	2.1	2.5	56	52	75	59	55	78	2.3	2.2	2.5	No
NCA03.RES.0197	RES	NCA03	DOWN	46	42	63	50	45	64	3.2	2.2	1.7	46	42	63	50	45	64	3.4	2.4	1.7	No
NCA03.RES.0198	RES	NCA03	DOWN	52	48	69	55	50	70	2.8	1.8	0.5	52	48	69	55	50	70	3.0	1.9	0.5	No
NCA03.RES.0199	RES	NCA03	UP	48	44	63	51	46	64	2.7	2.0	1.4	48	44	63	51	46	64	2.9	2.1	1.4	No
NCA03.RES.0200	RES	NCA03	UP	53	49	70	57	53	76	4.0	3.6	5.9	53	49	70	57	53	76	4.1	3.6	5.9	No
NCA03.RES.0201	RES	NCA03	DOWN	51	47	66	54	49	68	3.1	2.3	1.8	51	47	66	54	49	68	3.2	2.4	1.8	No
NCA03.RES.0202	RES	NCA03	UP	49	45	64	52	47	66	2.8	1.9	1.6	49	45	64	52	47	66	2.9	2.1	1.6	No
NCA03.RES.0203	RES	NCA03	UP	54	50	71	58	54	77	4.1	3.6	6.0	54	50	71	58	54	77	4.2	3.7	6.0	No
NCA03.RES.0204	RES	NCA03	UP	47	43	62	50	45	64	2.8	2.0	2.0	47	43	62	50	45	64	3.0	2.1	2.0	No
NCA03.RES.0205	RES	NCA03	UP	50	46	65	53	48	68	3.1	2.3	2.5	50	46	65	53	48	68	3.3	2.4	2.5	No
NCA03.RES.0206	RES	NCA03	UP	47	44	63	50	46	65	2.8	2.0	2.5	47	44	63	50	46	65	2.9	2.1	2.5	No
NCA03.RES.0208	RES	NCA03	DOWN	51	47	68	53	48	68	2.7	1.7	0.1	51	47	68	54	49	68	2.9	1.9	0.1	No
NCA03.RES.0209	RES	NCA03	DOWN	63	59	81	64	60	81	1.6	1.1	0.7	63	59	81	65	60	81	1.8	1.2	0.7	No
NCA03.RES.0210	RES	NCA03	UP	50	46	65	54	49	69	3.3	2.5	3.2	50	46	65	54	49	69	3.5	2.6	3.2	No
NCA03.RES.0211	RES	NCA03	UP	46	42	60	48	44	61	2.2	1.5	1.1	46	42	60	49	44	61	2.4	1.6	1.1	No
NCA03.RES.0212	RES	NCA03	UP	69	65	88	57	52	75	-12.1	-12.8	-12.7	69	65	88	57	52	75	-12.0	-12.7	-12.7	No
NCA03.RES.0214	RES	NCA03	UP	56	52	73	59	54	76	2.9	2.1	3.6	56	52	73	59	54	76	3.1	2.2	3.6	No
NCA03.RES.0215	RES	NCA03	UP	53	49	68	56	51	72	3.3	2.5	3.7	53	49	68	56	51	72	3.5	2.7	3.7	No
NCA03.RES.0216	RES	NCA03	UP	48	44	63	51	46	65	2.7	1.9	1.5	48	44	63	51	46	65	2.9	2.1	1.5	No
NCA03.RES.0217	RES	NCA03	UP	53	49	69	57	53	74	3.9	3.3	4.5	53	49	69	57	53	74	4.0	3.4	4.5	No
NCA03.RES.0218	RES	NCA03	UP	50	46	65	53	49	68	3.2	2.4	2.7	50	46	65	54	49	68	3.4	2.5	2.7	No
NCA03.RES.0219	RES	NCA03	UP	47	43	64	50	46	65	3.0	2.1	1.1	47	43	64	51	46	65	3.2	2.3	1.1	No
NCA03.RES.0220	RES	NCA03	UP	46	42	60	48	44	61	1.9	1.2	0.1	46	42	60	48	44	61	2.0	1.3	0.1	No
NCA03.RES.0221	RES	NCA03	UP	47	43	62	49	44	62	2.4	1.5	0.2	47	43	62	49	44	62	2.6	1.6	0.2	No
NCA03.RES.0222	RES	NCA03	UP	53	49	69	56	51	70	2.9	1.9	1.0	53	49	69	56	51	70	3.1	2.1	1.0	No
NCA03.RES.0223	RES	NCA03	UP	46	42	62	49	44	62	2.6	1.8	0.3	46	42	62	49	44	62	2.8	1.9	0.3	No
NCA03.RES.0224	RES	NCA03	UP	53	49	69	56	51	70	3.2	2.3	0.4	53	49	69	56	51	70	3.4	2.4	0.4	No
NCA03.RES.0225	RES	NCA03	UP	53	49	70	57	52	71	3.5	2.5	1.5	53	49	70	57	52	71	3.7	2.7	1.5	No
NCA03.RES.0226	RES	NCA03	UP	50	46	66	53	48	66	2.8	1.8	-0.1	50	46	66	53	48	66	3.0	2.0	-0.1	No
NCA03.RES.0227	RES	NCA03	UP	57	53	77	59	54	75	1.7	0.6	-1.8	57	53	77	59	54	75	1.9	0.8	-1.8	No
NCA03.RES.0228	RES	NCA03	UP	60	56	78	62	57	78	2.4	1.4	-0.4	60	56	78	62	57	78	2.6	1.6	-0.4	No
NCA03.RES.0229	RES	NCA03	UP	48	44	64	50	45	64	2.3	1.4	-0.2	48	44	64	50	45	64	2.5	1.6	-0.2	No
NCA03.RES.0230	RES	NCA03	UP	47	43	63	49	45	63	2.5	1.6	0.5	47	43	63	50	45	63	2.7	1.7	0.5	No
NCA03.RES.0231	RES	NCA03	UP	50	46	66	53	48	66	2.7	1.7	0.4	50	46	66	53	48	66	2.9	1.9	0.4	No
NCA03.RES.0232	RES	NCA03	UP	59	55	77	62	57	77	2.9	1.9	-0.1	59	55	77	62	57	77	3.1	2.0	-0.1	No
NCA03.RES.0233	RES	NCA03	UP	0	0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0	0	0.0	0.0	0.0	No
NCA03.RES.0234	RES	NCA03	UP	54	50	72	57	52	72	2.7	1.8	0.3	54	50	72	57	52	72	3.0	2.0	0.3	No
NCA03.RES.0235	RES	NCA03	UP	51	47	66	54	49	67	2.8	1.9	0.2	51	47	66	54	49	67	3.0	2.0	0.2	No
NCA03.RES.0236	RES	NCA03	UP	53	49	70	56	51	71	3.0	2.1	0.7	53	49	70	56	51	71	3.2	2.3	0.7	No
NCA04.COM.0308	COM	NCA04	DOWN	60	56	75	60	56	75	-0.1	0.0	0.0	60	56	75	60	56	75	-0.1	0.0	0.0	No
NCA04.COM.0314	COM	NCA04	DOWN	60	56	75	60	56	75	0.0	0.0	0.0	60	56	75	60	56	75	0.0	0.0	0.0	No
NCA04.COM.0317	COM	NCA04	DOWN	60	56	75	60	56	75	-0.1	-0.1	0.0	60	56	75	60	56	75	-0.1	-0.1	0.0	No
NCA04.COM.0318	COM	NCA04	DOWN	60	56	75	60	56	75	0.0	-0.1	-0.1	60	56	75	60	56	75	0.0	-0.1	-0.1	No
NCA04.COM.0322	COM	NCA04	DOWN	61	57	76	61	57	76	-0.1	0.0	0.0	61	57	76	61	57	76	-0.1	0.0	0.0	No
NCA04.COM.0327	COM	NCA04	DOWN	61	57	77	61	57	77	0.0	0.0	0.0	61	57	77	61	57	77	0.0	0.0	0.0	No
NCA04.COM.0328	COM	NCA04	DOWN	37	33	52	37	33	52	0.7	0.4	0.0	37	33	52	38	33	52	0.7	0.4	0.0	No
NCA04.COM.0330	COM	NCA04	DOWN	61	57	77	61	57	77	0.0	0.0	0.0	61	57	77	61	57	77	0.0	0.0	0.0	No
NCA04.COM.0332	COM	NCA04	DOWN	61	57	79	61	57	79	-0.1	-0.2	0.0	61	57	79	61	57	79	-0.1	-0.2	0.0	No
NCA04.COM.0335	COM	NCA04	DOWN	60	56	77	60	56	77	-0.2	-0.2	0.0	60	56	77	60	56	77	-0.2	-0.2	0.0	No
NCA04.COM.0336	COM	NCA04	DOWN	61	57	77	61	57	77	-0.1	0.0	0.0	61	57	77	61	57	77	-0.1	0.0	0.0	No
NCA04.COM.0337	COM	NCA04	UP	53	49	68	53	49	68	0.0	0.0	0.0	53	49	68	53	49	68	0.0	0.0	0.0	No
NCA04.COM.0338	COM	NCA04	DOWN	62	58	79	62	58	79	-0.1	-0.1	0.0	62	58	79	62	58	79	-0.1	-0.1	0.0	No
NCA04.COM.0339	COM	NCA04	DOWN	62	58	78	62	58	78	0.0	0.0	0.0	62	58	78	62	58	78	0.0	0.0	0.0	No
NCA04.COM.0344	COM	NCA04	DOWN	62	58	80	62	58	80	-0.1	-0.1	0.0	62	58	80	62	58	80	-0.1	-0.1	0.0	No
NCA04.COM.0345	COM	NCA04	DOWN	62	58	79	62	58	79	-0.1	-0.1	0.0	62	58	79	62	58	79	-0.1	-0.1	0.0	No
NCA04.COM.0349	COM	NCA04	UP	52	48	68	52	48	68	0.1	0.0	-0.1	52	48	68	52	48	68	0.1	0.0	-0.1	No

NCA04.COM.0355	COM	NCA04	DOWN	63	59	81	63	59	81	-0.1	-0.2	0.0	63	59	81	63	59	81	-0.1	-0.2	0.0	No
NCA04.COM.0357	COM	NCA04	DOWN	41	37	56	41	37	56	0.7	0.4	0.0	41	37	56	41	37	56	0.7	0.4	0.0	No
NCA04.COM.0419	COM	NCA04	DOWN	47	43	63	46	42	62	-0.5	-0.4	-0.8	47	43	63	46	42	62	-0.4	-0.4	-0.8	No
NCA04.COM.0445	COM	NCA04	DOWN	44	40	58	44	40	57	0.0	-0.1	-0.1	44	40	58	44	40	57	0.0	-0.1	-0.1	No
NCA04.COM.0450	COM	NCA04	DOWN	39	35	51	40	36	51	0.9	0.6	0.8	39	35	51	40	36	51	0.9	0.7	0.8	No
NCA04.IND.0302	IND	NCA04		64	60	108	64	60	108	0.0	0.0	0.0	64	60	108	64	60	108	0.0	0.0	0.0	No
NCA04.IND.0307	IND	NCA04		62	58	100	62	58	100	-0.1	0.0	-0.2	62	58	100	62	58	100	-0.1	0.0	-0.2	No
NCA04.IND.0312	IND	NCA04		66	62	115	66	62	115	0.0	0.0	0.3	66	62	115	66	62	115	0.0	0.0	0.3	No
NCA04.IND.0315	IND	NCA04		64	60	96	64	60	96	0.0	0.0	0.0	64	60	96	64	60	96	0.0	0.0	0.0	No
NCA04.IND.0329	IND	NCA04		66	62	111	66	62	111	0.0	0.0	0.1	66	62	111	66	62	111	0.0	0.0	0.1	No
NCA04.IND.0354	IND	NCA04		62	58	80	62	58	80	-0.2	-0.2	0.0	62	58	80	62	58	80	-0.2	-0.2	0.0	No
NCA04.IND.0463	IND	NCA04		52	49	68	52	48	68	0.0	-0.3	0.0	52	49	68	52	48	68	0.0	-0.3	0.0	No
NCA04.IND.0465	IND	NCA04		39	35	52	41	36	53	1.3	0.9	1.0	39	35	52	41	36	53	1.4	1.0	1.0	No
NCA04.IND.0490	IND	NCA04		48	44	55	48	44	59	0.5	0.3	4.2	48	44	55	48	44	59	0.5	0.3	4.2	No
NCA04.IND.0492	IND	NCA04		47	43	61	47	43	60	0.2	0.0	-0.4	47	43	61	47	43	60	0.3	0.0	-0.4	No
NCA04.IND.0502	IND	NCA04		46	42	62	47	43	62	0.7	0.5	-0.2	46	42	62	47	43	62	0.8	0.6	-0.2	No
NCA04.IND.0503	IND	NCA04		47	43	58	48	44	62	1.4	1.2	4.1	47	43	58	48	44	62	1.5	1.2	4.1	No
NCA04.IND.0525	IND	NCA04		51	47	66	53	48	67	1.8	1.3	0.9	51	47	66	53	48	67	2.0	1.4	0.9	No
NCA04.OME.0359	OME	NCA04		66	62	81	66	62	81	-0.1	-0.1	0.0	66	62	81	66	62	81	-0.1	-0.1	0.0	No
NCA04.OME.0574	OME	NCA04		0	0	0	0	0	0	0.0	0.0	0.0	0	0	0	0	0	0	0.0	0.0	0.0	No
NCA04.RES.0240	RES	NCA04		35	31	47	36	32	47	1.2	1.0	0.0	35	31	47	37	32	47	1.3	1.0	0.0	No
NCA04.RES.0241	RES	NCA04		34	30	47	36	31	47	1.2	1.0	-0.1	34	30	47	36	31	47	1.3	1.1	-0.1	No
NCA04.RES.0242	RES	NCA04		35	31	46	36	31	46	1.1	0.9	0.0	35	31	46	36	31	46	1.1	0.9	0.0	No
NCA04.RES.0243	RES	NCA04		33	30	47	35	30	47	1.2	0.6	-0.1	33	30	47	35	30	47	1.2	0.6	-0.1	No
NCA04.RES.0244	RES	NCA04		34	30	46	35	31	46	0.9	0.7	0.0	34	30	46	35	31	46	1.0	0.7	0.0	No
NCA04.RES.0245	RES	NCA04		34	30	45	35	31	45	1.2	1.0	0.0	34	30	45	35	31	45	1.3	1.0	0.0	No
NCA04.RES.0246	RES	NCA04		35	31	47	36	32	47	1.2	0.9	0.0	35	31	47	36	32	47	1.2	0.9	0.0	No
NCA04.RES.0247	RES	NCA04		34	30	46	35	31	46	0.8	0.7	0.0	34	30	46	35	31	46	0.9	0.7	0.0	No
NCA04.RES.0248	RES	NCA04		35	31	48	36	32	48	1.1	0.8	0.0	35	31	48	36	32	48	1.2	0.8	0.0	No
NCA04.RES.0249	RES	NCA04		35	31	48	36	32	48	1.0	0.6	0.1	35	31	48	36	32	48	1.1	0.6	0.1	No
NCA04.RES.0250	RES	NCA04		34	30	46	35	31	46	1.4	1.0	0.0	34	30	46	35	31	46	1.5	1.1	0.0	No
NCA04.RES.0251	RES	NCA04		35	31	49	36	32	49	1.0	0.6	0.1	35	31	49	36	32	49	1.0	0.7	0.1	No
NCA04.RES.0252	RES	NCA04		34	31	46	36	31	46	1.1	0.8	0.2	34	31	46	36	31	46	1.2	0.8	0.2	No
NCA04.RES.0253	RES	NCA04		36	32	49	36	32	49	0.7	0.5	0.0	36	32	49	36	32	49	0.8	0.5	0.0	No
NCA04.RES.0254	RES	NCA04		35	31	48	36	32	48	0.8	0.6	0.0	35	31	48	36	32	48	0.8	0.7	0.0	No
NCA04.RES.0255	RES	NCA04		36	32	49	36	32	49	0.7	0.5	0.0	36	32	49	36	32	49	0.8	0.6	0.0	No
NCA04.RES.0256	RES	NCA04		35	31	48	36	31	48	0.9	0.6	0.0	35	31	48	36	31	48	0.9	0.6	0.0	No
NCA04.RES.0257	RES	NCA04		35	31	48	36	32	48	0.9	0.7	0.0	35	31	48	36	32	48	1.0	0.7	0.0	No
NCA04.RES.0258	RES	NCA04		35	31	48	36	32	48	0.9	0.5	0.0	35	31	48	36	32	48	1.0	0.6	0.0	No
NCA04.RES.0259	RES	NCA04		35	31	48	36	32	48	1.2	0.8	0.0	35	31	48	36	32	48	1.3	0.9	0.0	No
NCA04.RES.0260	RES	NCA04		36	32	49	37	32	49	1.1	0.9	0.0	36	32	49	37	33	49	1.2	0.9	0.0	No
NCA04.RES.0261	RES	NCA04		35	31	48	36	32	48	1.1	0.8	0.0	35	31	48	36	32	48	1.2	0.9	0.0	No
NCA04.RES.0262	RES	NCA04		34	30	47	35	31	47	0.8	0.6	0.0	34	30	47	35	31	47	0.8	0.6	0.0	No
NCA04.RES.0263	RES	NCA04		35	31	50	36	32	50	0.7	0.5	-0.1	35	31	50	36	32	50	0.8	0.6	-0.1	No
NCA04.RES.0264	RES	NCA04		37	33	50	38	34	50	0.7	0.5	0.4	37	33	50	38	34	50	0.8	0.5	0.4	No
NCA04.RES.0265	RES	NCA04		36	32	49	37	33	49	1.0	0.7	0.0	36	32	49	37	33	49	1.1	0.7	0.0	No
NCA04.RES.0266	RES	NCA04		36	32	49	37	32	49	0.9	0.6	0.0	36	32	49	37	32	49	0.9	0.7	0.0	No
NCA04.RES.0267	RES	NCA04		38	34	50	39	34	50	1.2	0.7	0.0	38	34	50	39	35	50	1.3	0.8	0.0	No
NCA04.RES.0268	RES	NCA04		37	33	50	38	34	50	1.1	0.8	0.0	37	33	50	38	34	50	1.2	0.9	0.0	No
NCA04.RES.0269	RES	NCA04		37	33	49	38	33	49	1.0	0.6	0.0	37	33	49	38	33	49	1.0	0.6	0.0	No
NCA04.RES.0270	RES	NCA04		36	32	49	36	32	49	0.9	0.7	0.0	36	32	49	36	32	49	1.0	0.7	0.0	No
NCA04.RES.0271	RES	NCA04		37	33	50	38	33	50	0.9	0.7	0.0	37	33	50	38	33	50	1.0	0.7	0.0	No
NCA04.RES.0272	RES	NCA04		37	33	50	38	33	50	1.0	0.7	0.0	37	33	50	38	33	50	1.1	0.8	0.0	No
NCA04.RES.0273	RES	NCA04		36	32	49	37	33	49	1.0	0.7	0.0	36	32	49	37	33	49	1.1	0.8	0.0	No
NCA04.RES.0274	RES	NCA04		38	34	51	38	34	51	0.8	0.5	0.1	38	34	51	39	34	51	0.8	0.5	0.1	No
NCA04.RES.0275	RES	NCA04		36	32	49	37	33	49	1.2	0.8	0.0	36	32	49	37	33	49	1.3	0.9	0.0	No
NCA04.RES.0276	RES	NCA04		37	33	51	38	34	51	0.8	0.6	0.0	37	33	51	38	34	51	0.9	0.6	0.0	No
NCA04.RES.0277	RES	NCA04		37	33	52	38	34	52	0.6	0.3	0.0	37	33	52	38	34	52	0.6	0.3	0.0	No
NCA04.RES.0278	RES	NCA04		35	31	51	37	32	51	1.3	0.9	0.0	35	31	51	37	32	51	1.4	1.0	0.0	No
NCA04.RES.0279	RES	NCA04		37	33	50	38	34	50	0.8	0.5	0.0	37	33	50	38	34	50	0.8	0.5	0.0	No
NCA04.RES.0280	RES	NCA04		43	39	60	43	39	60	0.2	0.2	0.0	43	39	60	43	39	60	0.2	0.2	0.0	No

NCA04.RES.0281	RES	NCA04		37	33	52	38	34	52	0.5	0.4	0.0	37	33	52	38	34	52	0.5	0.4	0.0	No
NCA04.RES.0282	RES	NCA04		45	41	62	45	41	62	-0.1	-0.1	0.0	45	41	62	45	41	62	-0.1	-0.1	0.0	No
NCA04.RES.0283	RES	NCA04		38	34	53	39	35	53	0.9	0.6	0.0	38	34	53	39	35	53	0.9	0.7	0.0	No
NCA04.RES.0284	RES	NCA04		36	32	52	37	33	52	0.7	0.3	0.0	36	32	52	37	33	52	0.7	0.4	0.0	No
NCA04.RES.0285	RES	NCA04		38	34	52	38	34	52	0.7	0.4	0.0	38	34	52	38	34	52	0.7	0.5	0.0	No
NCA04.RES.0286	RES	NCA04		38	34	53	39	35	53	0.5	0.3	-0.1	38	34	53	39	35	53	0.5	0.4	-0.1	No
NCA04.RES.0287	RES	NCA04		43	39	60	43	39	60	0.5	0.0	0.0	43	39	60	43	39	60	0.5	0.0	0.0	No
NCA04.RES.0288	RES	NCA04		49	45	63	50	46	63	0.6	0.4	0.0	49	45	63	50	46	63	0.6	0.4	0.0	No
NCA04.RES.0289	RES	NCA04		38	34	53	39	35	53	0.4	0.3	0.0	38	34	53	39	35	53	0.5	0.3	0.0	No
NCA04.RES.0290	RES	NCA04		37	33	51	38	34	51	1.1	0.8	0.0	37	33	51	38	34	51	1.2	0.9	0.0	No
NCA04.RES.0291	RES	NCA04		47	43	64	48	43	64	0.2	0.1	0.0	47	43	64	48	44	64	0.3	0.1	0.0	No
NCA04.RES.0292	RES	NCA04		38	34	52	38	34	52	0.5	0.2	0.0	38	34	52	38	34	52	0.5	0.3	0.0	No
NCA04.RES.0293	RES	NCA04		38	34	53	39	35	53	0.9	0.6	0.0	38	34	53	39	35	53	0.9	0.6	0.0	No
NCA04.RES.0294	RES	NCA04		38	34	52	38	34	52	0.5	0.2	0.0	38	34	52	38	34	52	0.5	0.3	0.0	No
NCA04.RES.0295	RES	NCA04		53	49	71	53	49	71	-0.2	-0.2	0.0	53	49	71	53	49	71	-0.2	-0.2	0.0	No
NCA04.RES.0296	RES	NCA04		38	34	52	39	34	52	0.8	0.6	0.0	38	34	52	39	34	52	0.8	0.6	0.0	No
NCA04.RES.0297	RES	NCA04		39	35	55	39	35	55	0.4	0.3	0.0	39	35	55	39	35	55	0.4	0.3	0.0	No
NCA04.RES.0298	RES	NCA04		41	37	57	41	37	57	0.3	0.0	0.0	41	37	57	41	37	57	0.3	0.0	0.0	No
NCA04.RES.0299	RES	NCA04		37	33	52	38	34	52	0.8	0.3	0.0	37	33	52	38	34	52	0.8	0.3	0.0	No
NCA04.RES.0300	RES	NCA04		44	40	62	44	40	62	0.2	0.0	0.0	44	40	62	44	40	62	0.2	0.1	0.0	No
NCA04.RES.0301	RES	NCA04		53	49	70	53	49	70	0.1	0.0	0.0	53	49	70	53	49	70	0.2	0.1	0.0	No
NCA04.RES.0303	RES	NCA04		58	54	76	58	54	76	-0.1	-0.1	0.0	58	54	76	58	54	76	-0.1	-0.1	0.0	No
NCA04.RES.0304	RES	NCA04		39	35	55	38	34	55	0.0	-0.1	0.0	39	35	55	39	34	55	0.0	-0.1	0.0	No
NCA04.RES.0305	RES	NCA04		39	34	53	39	35	53	0.5	0.4	0.0	39	34	53	39	35	53	0.5	0.4	0.0	No
NCA04.RES.0306	RES	NCA04		48	44	66	48	44	66	-0.4	-0.4	0.0	48	44	66	48	44	66	-0.4	-0.4	0.0	No
NCA04.RES.0309	RES	NCA04		37	33	51	38	34	51	1.0	0.7	0.0	37	33	51	38	34	51	1.1	0.7	0.0	No
NCA04.RES.0310	RES	NCA04		45	41	63	45	41	63	-0.1	-0.1	0.0	45	41	63	45	41	63	-0.1	-0.1	0.0	No
NCA04.RES.0311	RES	NCA04		38	34	53	39	35	53	0.5	0.4	0.0	38	34	53	39	35	53	0.5	0.4	0.0	No
NCA04.RES.0313	RES	NCA04		52	48	70	51	47	70	-0.4	-0.5	0.0	52	48	70	51	47	70	-0.4	-0.4	0.0	No
NCA04.RES.0316	RES	NCA04		58	54	75	58	54	75	-0.1	-0.1	0.0	58	54	75	58	54	75	-0.1	-0.1	0.0	No
NCA04.RES.0319	RES	NCA04		38	35	53	39	35	53	0.8	0.5	0.0	38	35	53	39	35	53	0.9	0.6	0.0	No
NCA04.RES.0320	RES	NCA04		51	47	69	51	47	69	-0.4	-0.4	0.0	51	47	69	51	47	69	-0.4	-0.4	0.0	No
NCA04.RES.0321	RES	NCA04		57	53	72	57	53	72	0.0	0.1	0.0	57	53	72	57	53	72	0.0	0.1	0.0	No
NCA04.RES.0323	RES	NCA04		38	34	53	39	35	53	0.7	0.5	0.0	38	34	53	39	35	53	0.8	0.6	0.0	No
NCA04.RES.0324	RES	NCA04		56	52	72	56	52	72	0.1	0.1	0.0	56	52	72	56	52	72	0.1	0.1	0.0	No
NCA04.RES.0325	RES	NCA04		46	42	63	46	42	63	0.0	-0.1	0.0	46	42	63	46	42	63	0.0	-0.1	0.0	No
NCA04.RES.0326	RES	NCA04		40	36	55	41	37	55	0.5	0.3	0.0	40	36	55	41	37	55	0.6	0.3	0.0	No
NCA04.RES.0331	RES	NCA04		47	43	65	47	43	65	-0.3	-0.3	0.0	47	43	65	47	43	65	-0.2	-0.3	0.0	No
NCA04.RES.0333	RES	NCA04		46	42	65	46	42	65	-0.6	-0.6	0.0	46	42	65	46	42	65	-0.5	-0.6	0.0	No
NCA04.RES.0334	RES	NCA04		50	46	68	50	46	68	-0.4	-0.4	0.0	50	46	68	50	46	68	-0.4	-0.4	0.0	No
NCA04.RES.0340	RES	NCA04		54	50	71	54	50	71	0.0	0.0	0.0	54	50	71	54	50	71	0.0	0.0	0.0	No
NCA04.RES.0341	RES	NCA04		51	47	69	51	47	69	-0.2	-0.2	0.0	51	47	69	51	47	69	-0.2	-0.2	0.0	No
NCA04.RES.0342	RES	NCA04		49	45	67	48	44	67	-0.1	-0.2	0.0	49	45	67	48	44	67	-0.1	-0.2	0.0	No
NCA04.RES.0343	RES	NCA04		59	55	76	59	55	76	-0.1	0.0	0.0	59	55	76	59	55	76	-0.1	0.0	0.0	No
NCA04.RES.0346	RES	NCA04		45	41	63	45	41	63	-0.1	0.0	0.0	45	41	63	45	41	63	0.0	0.0	0.0	No
NCA04.RES.0347	RES	NCA04		40	36	56	41	37	56	0.7	0.5	0.0	40	36	56	41	37	56	0.8	0.5	0.0	No
NCA04.RES.0348	RES	NCA04		51	47	65	51	47	65	0.1	0.1	0.1	51	47	65	51	47	65	0.1	0.1	0.1	No
NCA04.RES.0350	RES	NCA04		53	49	70	53	49	70	0.0	0.0	0.0	53	49	70	53	49	70	0.0	0.0	0.0	No
NCA04.RES.0351	RES	NCA04		59	55	76	59	54	76	0.0	0.0	0.0	59	55	76	59	54	76	0.0	0.0	0.0	No
NCA04.RES.0352	RES	NCA04		48	44	65	48	44	65	0.6	0.5	0.1	48	44	65	48	44	65	0.6	0.5	0.1	No
NCA04.RES.0353	RES	NCA04		61	57	78	61	57	78	-0.1	-0.1	0.0	61	57	78	61	57	78	-0.1	-0.1	0.0	No
NCA04.RES.0356	RES	NCA04		47	43	65	47	43	65	0.0	-0.1	0.0	47	43	65	47	43	65	0.0	-0.1	0.0	No
NCA04.RES.0358	RES	NCA04		40	36	56	41	37	56	0.5	0.3	0.0	40	36	56	41	37	56	0.6	0.4	0.0	No
NCA04.RES.0360	RES	NCA04		46	42	63	46	42	63	0.2	0.2	0.0	46	42	63	46	42	63	0.2	0.2	0.0	No
NCA04.RES.0361	RES	NCA04		58	54	75	58	54	75	-0.1	-0.1	0.0	58	54	75	58	54	75	-0.1	-0.1	0.0	No
NCA04.RES.0362	RES	NCA04		61	57	78	61	57	78	-0.1	-0.1	-0.1	61	57	78	61	57	78	-0.1	-0.1	-0.1	No
NCA04.RES.0363	RES	NCA04		52	48	70	51	47	70	-0.4	-0.5	0.0	52	48	70	51	47	70	-0.4	-0.5	0.0	No
NCA04.RES.0364	RES	NCA04		60	56	78	60	56	78	-0.5	-0.4	0.0	60	56	78	60	56	78	-0.5	-0.4	0.0	No
NCA04.RES.0365	RES	NCA04		41	37	56	41	37	56	0.4	0.2	0.0	41	37	56	41	37	56	0.5	0.3	0.0	No
NCA04.RES.0366	RES	NCA04		50	46	69	50	46	69	-0.3	-0.3	0.0	50	46	69	50	46	69	-0.3	-0.3	0.0	No
NCA04.RES.0367	RES	NCA04		53	49	67	53	49	67	0.0	0.1	0.0	53	49	67	53	49	67	0.0	0.1	0.0	No

NCA04.RES.0368	RES	NCA04		61	57	78	61	57	78	-0.1	-0.1	0.0	61	57	78	61	57	78	-0.1	-0.1	0.0	No
NCA04.RES.0369	RES	NCA04		64	60	82	64	60	82	-0.2	-0.1	0.0	64	60	82	64	60	82	-0.2	-0.1	0.0	No
NCA04.RES.0370	RES	NCA04		54	50	67	54	50	67	0.1	0.1	0.0	54	50	67	54	50	67	0.1	0.1	0.0	No
NCA04.RES.0371	RES	NCA04		43	39	60	43	39	60	0.2	0.1	0.0	43	39	60	43	39	60	0.2	0.1	0.0	No
NCA04.RES.0372	RES	NCA04		61	57	78	61	57	78	0.0	-0.1	0.0	61	57	78	61	57	78	0.0	-0.1	0.0	No
NCA04.RES.0373	RES	NCA04		51	47	64	51	47	64	0.1	0.1	0.3	51	47	64	51	47	64	0.1	0.1	0.3	No
NCA04.RES.0374	RES	NCA04		54	50	70	54	50	70	0.0	0.0	0.0	54	50	70	54	50	70	0.0	0.0	0.0	No
NCA04.RES.0375	RES	NCA04		41	37	58	42	38	58	0.4	0.3	0.0	41	37	58	42	38	58	0.4	0.3	0.0	No
NCA04.RES.0376	RES	NCA04		42	38	57	42	38	57	0.4	0.2	0.1	42	38	57	42	38	57	0.5	0.2	0.1	No
NCA04.RES.0377	RES	NCA04		46	42	63	47	43	63	0.5	0.4	0.0	46	42	63	47	43	63	0.5	0.4	0.0	No
NCA04.RES.0378	RES	NCA04		53	49	67	53	49	67	0.1	0.0	0.0	53	49	67	53	49	67	0.1	0.0	0.0	No
NCA04.RES.0379	RES	NCA04		45	41	61	45	41	61	0.1	0.1	0.0	45	41	61	45	41	61	0.1	0.1	0.0	No
NCA04.RES.0380	RES	NCA04		64	60	82	64	60	82	-0.2	-0.2	0.0	64	60	82	64	60	82	-0.2	-0.2	0.0	No
NCA04.RES.0381	RES	NCA04		60	56	77	60	56	77	0.0	0.0	0.0	60	56	77	60	56	77	0.0	0.0	0.0	No
NCA04.RES.0382	RES	NCA04		52	48	68	52	48	68	0.0	0.1	0.0	52	48	68	52	48	68	0.0	0.1	0.0	No
NCA04.RES.0383	RES	NCA04		57	53	76	57	53	76	-0.4	-0.4	0.0	57	53	76	57	53	76	-0.4	-0.4	0.0	No
NCA04.RES.0384	RES	NCA04		54	50	70	54	50	70	0.0	0.0	0.0	54	50	70	54	50	70	0.0	0.0	0.0	No
NCA04.RES.0385	RES	NCA04		43	39	60	44	40	60	0.2	0.2	0.0	43	39	60	44	40	60	0.2	0.2	0.0	No
NCA04.RES.0386	RES	NCA04		59	55	76	59	55	76	0.0	-0.1	0.0	59	55	76	59	55	76	0.0	-0.1	0.0	No
NCA04.RES.0387	RES	NCA04		62	58	79	62	58	79	-0.1	-0.1	0.0	62	58	79	62	58	79	-0.1	-0.1	0.0	No
NCA04.RES.0388	RES	NCA04		50	46	66	50	46	66	0.1	0.0	0.0	50	46	66	50	46	66	0.1	0.0	0.0	No
NCA04.RES.0389	RES	NCA04		59	55	77	59	55	77	-0.4	-0.3	0.0	59	55	77	59	55	77	-0.4	-0.3	0.0	No
NCA04.RES.0390	RES	NCA04		45	41	60	45	41	60	0.1	0.1	0.0	45	41	60	45	41	60	0.1	0.2	0.0	No
NCA04.RES.0391	RES	NCA04		48	45	63	49	45	63	0.1	0.1	0.2	48	45	63	49	45	63	0.1	0.1	0.2	No
NCA04.RES.0392	RES	NCA04		51	47	64	51	47	64	0.1	0.1	0.0	51	47	64	51	47	64	0.1	0.1	0.0	No
NCA04.RES.0393	RES	NCA04		54	50	70	54	50	70	0.0	0.0	0.0	54	50	70	54	50	70	0.0	0.0	0.0	No
NCA04.RES.0394	RES	NCA04		43	39	61	44	40	61	0.4	0.4	0.0	43	39	61	44	40	61	0.4	0.4	0.0	No
NCA04.RES.0395	RES	NCA04		58	54	76	58	54	76	-0.2	-0.2	0.0	58	54	76	58	54	76	-0.2	-0.2	0.0	No
NCA04.RES.0396	RES	NCA04		45	41	62	45	41	62	0.3	0.3	0.0	45	41	62	45	41	62	0.3	0.3	0.0	No
NCA04.RES.0397	RES	NCA04		49	45	64	49	45	64	0.0	0.0	0.0	49	45	64	49	45	64	0.0	0.0	0.0	No
NCA04.RES.0398	RES	NCA04		45	41	60	45	41	60	0.3	0.1	0.0	45	41	60	45	41	60	0.3	0.1	0.0	No
NCA04.RES.0399	RES	NCA04		61	57	79	61	57	79	-0.2	-0.2	0.0	61	57	79	61	57	79	-0.2	-0.2	0.0	No
NCA04.RES.0400	RES	NCA04		54	50	69	54	50	69	0.0	0.0	0.0	54	50	69	54	50	69	0.0	0.0	0.0	No
NCA04.RES.0401	RES	NCA04		45	41	62	45	41	62	0.0	0.1	0.0	45	41	62	45	41	62	0.0	0.1	0.0	No
NCA04.RES.0402	RES	NCA04		60	56	77	60	56	77	0.0	0.1	0.1	60	56	77	60	56	77	0.0	0.1	0.1	No
NCA04.RES.0403	RES	NCA04		59	55	76	59	55	76	0.0	0.0	0.0	59	55	76	59	55	76	0.0	0.0	0.0	No
NCA04.RES.0404	RES	NCA04		53	49	69	53	49	69	0.0	0.0	0.0	53	49	69	53	49	69	0.0	0.0	0.0	No
NCA04.RES.0405	RES	NCA04		52	48	64	52	48	64	0.1	0.1	0.0	52	48	64	52	48	64	0.1	0.1	0.0	No
NCA04.RES.0406	RES	NCA04		68	64	85	68	64	85	0.1	0.0	0.0	68	64	85	68	64	85	0.1	0.0	0.0	No
NCA04.RES.0407	RES	NCA04		52	48	65	52	48	65	0.1	0.1	0.2	52	48	65	52	48	65	0.1	0.1	0.2	No
NCA04.RES.0408	RES	NCA04		52	48	70	53	49	70	0.3	0.3	0.0	52	48	70	53	49	70	0.3	0.3	0.0	No
NCA04.RES.0409	RES	NCA04		46	42	61	46	42	62	0.1	0.1	0.1	46	42	61	46	42	62	0.2	0.1	0.1	No
NCA04.RES.0410	RES	NCA04		51	47	67	51	47	67	0.0	0.1	0.0	51	47	67	51	47	67	0.0	0.1	0.0	No
NCA04.RES.0411	RES	NCA04		66	62	84	65	61	84	-0.2	-0.2	0.0	66	62	84	65	61	84	-0.2	-0.2	0.0	No
NCA04.RES.0412	RES	NCA04		57	53	75	57	53	75	0.0	-0.1	0.0	57	53	75	57	53	75	0.0	-0.1	0.0	No
NCA04.RES.0413	RES	NCA04		52	48	67	52	48	67	0.0	0.0	0.0	52	48	67	52	48	67	0.0	0.0	0.0	No
NCA04.RES.0414	RES	NCA04		67	63	85	67	63	85	0.4	0.4	0.0	67	63	85	67	63	85	0.4	0.4	0.0	No
NCA04.RES.0415	RES	NCA04		47	43	64	47	43	64	0.0	-0.1	-0.3	47	43	64	47	43	64	0.0	-0.1	-0.3	No
NCA04.RES.0416	RES	NCA04		54	50	69	54	50	69	0.1	0.0	0.0	54	50	69	54	50	69	0.1	0.0	0.0	No
NCA04.RES.0417	RES	NCA04		62	58	81	62	58	81	0.0	0.0	0.0	62	58	81	62	58	81	0.0	0.0	0.0	No
NCA04.RES.0418	RES	NCA04		65	61	83	65	61	83	0.4	0.4	0.0	65	61	83	65	61	83	0.4	0.4	0.0	No
NCA04.RES.0420	RES	NCA04		59	55	77	59	55	77	0.1	0.1	0.0	59	55	77	59	55	77	0.1	0.1	0.0	No
NCA04.RES.0421	RES	NCA04		48	44	66	48	44	66	0.0	0.1	-0.1	48	44	66	48	44	66	0.0	0.1	-0.1	No
NCA04.RES.0422	RES	NCA04		66	62	84	66	62	84	0.1	0.1	0.0	66	62	84	66	62	84	0.1	0.1	0.0	No
NCA04.RES.0423	RES	NCA04		45	41	62	45	41	62	0.1	0.0	0.0	45	41	62	45	41	62	0.1	0.0	0.0	No
NCA04.RES.0424	RES	NCA04		60	56	79	61	57	79	0.0	0.1	0.0	60	56	79	61	57	79	0.0	0.1	0.0	No
NCA04.RES.0425	RES	NCA04		54	51	72	54	50	72	-0.2	-0.2	0.0	54	51	72	54	50	72	-0.2	-0.2	0.0	No
NCA04.RES.0426	RES	NCA04		46	42	64	46	42	63	-0.4	-0.5	-0.4	46	42	64	46	42	63	-0.4	-0.5	-0.4	No
NCA04.RES.0427	RES	NCA04		66	62	84	66	62	84	0.0	0.1	0.0	66	62	84	66	62	84	0.0	0.1	0.0	No
NCA04.RES.0428	RES	NCA04		69	65	87	69	65	87	0.3	0.3	0.0	69	65	87	69	65	87	0.3	0.3	0.0	No
NCA04.RES.0429	RES	NCA04		53	49	65	53	49	65	0.1	0.1	0.3	53	49	65	53	49	65	0.1	0.1	0.3	No

NCA04.RES.0430	RES	NCA04		67	63	85	67	63	85	0.1	0.1	0.0	67	63	85	67	63	85	0.1	0.1	0.0	No
NCA04.RES.0431	RES	NCA04		49	45	66	49	45	66	0.0	0.0	0.0	49	45	66	49	45	66	0.0	0.0	0.0	No
NCA04.RES.0432	RES	NCA04		63	59	82	63	59	82	-0.2	-0.2	0.0	63	59	82	63	59	82	-0.2	-0.2	0.0	No
NCA04.RES.0433	RES	NCA04		57	53	74	57	53	74	0.2	0.1	0.0	57	53	74	57	53	74	0.2	0.1	0.0	No
NCA04.RES.0434	RES	NCA04		52	48	66	52	48	66	0.1	0.1	0.0	52	48	66	52	48	66	0.1	0.1	0.0	No
NCA04.RES.0435	RES	NCA04		54	51	71	55	51	71	0.1	0.2	0.0	54	51	71	55	51	71	0.1	0.2	0.0	No
NCA04.RES.0436	RES	NCA04		52	48	65	52	48	65	0.1	0.1	0.0	52	48	65	52	48	65	0.1	0.1	0.0	No
NCA04.RES.0437	RES	NCA04		51	47	62	51	47	63	0.1	0.1	0.2	51	47	62	51	47	63	0.1	0.1	0.2	No
NCA04.RES.0438	RES	NCA04		50	46	62	50	46	62	0.1	0.2	0.3	50	46	62	50	46	62	0.1	0.2	0.3	No
NCA04.RES.0439	RES	NCA04		58	54	76	58	54	76	0.2	0.2	0.0	58	54	76	58	54	76	0.2	0.2	0.0	No
NCA04.RES.0440	RES	NCA04		64	60	82	64	60	82	0.1	0.1	0.0	64	60	82	64	60	82	0.1	0.1	0.0	No
NCA04.RES.0441	RES	NCA04		49	45	67	49	45	67	0.5	-0.2	-0.3	49	45	67	49	45	67	0.6	-0.2	-0.3	No
NCA04.RES.0442	RES	NCA04		51	48	64	52	48	64	0.1	0.1	0.2	51	48	64	52	48	64	0.1	0.1	0.2	No
NCA04.RES.0443	RES	NCA04		66	62	84	66	62	84	-0.1	0.0	0.0	66	62	84	66	62	84	-0.1	0.0	0.0	No
NCA04.RES.0444	RES	NCA04		63	59	81	63	59	81	0.1	0.1	0.0	63	59	81	63	59	81	0.1	0.1	0.0	No
NCA04.RES.0446	RES	NCA04		67	63	86	67	63	85	0.1	0.1	-0.1	67	63	86	67	63	85	0.1	0.1	-0.1	No
NCA04.RES.0447	RES	NCA04		58	54	76	58	54	76	0.0	0.0	0.0	58	54	76	58	54	76	0.0	0.0	0.0	No
NCA04.RES.0448	RES	NCA04		63	59	81	63	59	81	0.2	0.2	0.0	63	59	81	63	59	81	0.2	0.2	0.0	No
NCA04.RES.0449	RES	NCA04		55	51	70	54	50	70	-0.2	-0.2	0.0	55	51	70	54	50	70	-0.2	-0.2	0.0	No
NCA04.RES.0451	RES	NCA04		60	56	79	60	56	79	0.0	0.0	0.0	60	56	79	60	56	79	0.0	0.0	0.0	No
NCA04.RES.0452	RES	NCA04		62	58	79	62	58	79	0.1	0.1	0.0	62	58	79	62	58	79	0.1	0.1	0.0	No
NCA04.RES.0453	RES	NCA04		49	45	63	49	45	63	0.1	0.1	0.0	49	45	63	49	45	63	0.1	0.1	0.0	No
NCA04.RES.0454	RES	NCA04		63	59	81	63	59	81	0.2	0.2	0.0	63	59	81	63	59	81	0.2	0.2	0.0	No
NCA04.RES.0455	RES	NCA04		51	47	68	51	47	68	-0.2	-0.1	-0.1	51	47	68	51	47	68	-0.2	-0.1	-0.1	No
NCA04.RES.0456	RES	NCA04		63	59	81	63	59	81	0.0	0.1	0.0	63	59	81	63	59	81	0.0	0.1	0.0	No
NCA04.RES.0457	RES	NCA04		56	52	74	56	52	74	-0.1	0.0	0.0	56	52	74	56	52	74	-0.1	0.1	0.0	No
NCA04.RES.0458	RES	NCA04		57	53	75	57	53	75	0.2	0.1	0.0	57	53	75	57	53	75	0.2	0.1	0.0	No
NCA04.RES.0459	RES	NCA04		61	58	80	61	58	80	0.0	0.0	0.0	61	58	80	61	58	80	0.0	0.0	0.0	No
NCA04.RES.0460	RES	NCA04		49	45	61	49	45	62	0.4	0.4	1.3	49	45	61	49	45	62	0.4	0.4	1.3	No
NCA04.RES.0461	RES	NCA04		61	57	79	62	58	79	0.3	0.2	0.0	61	57	79	62	58	79	0.3	0.2	0.0	No
NCA04.RES.0462	RES	NCA04		67	63	85	67	63	85	0.0	0.0	-0.1	67	63	85	67	63	85	0.0	0.0	-0.1	No
NCA04.RES.0464	RES	NCA04		61	57	79	61	57	79	0.0	0.1	0.0	61	57	79	61	57	79	0.0	0.1	0.0	No
NCA04.RES.0466	RES	NCA04		67	63	86	67	63	86	0.0	-0.1	-0.1	67	63	86	67	63	86	0.0	-0.1	-0.1	No
NCA04.RES.0467	RES	NCA04		58	54	76	58	54	76	0.0	0.0	0.0	58	54	76	58	54	76	0.0	0.0	0.0	No
NCA04.RES.0468	RES	NCA04		48	44	61	48	44	61	0.1	0.1	0.3	48	44	61	48	44	61	0.1	0.1	0.3	No
NCA04.RES.0469	RES	NCA04		64	60	82	64	60	82	0.0	0.1	0.0	64	60	82	64	60	82	0.0	0.1	0.0	No
NCA04.RES.0470	RES	NCA04		60	56	78	60	56	78	0.0	0.0	0.0	60	56	78	60	56	78	0.0	0.0	0.0	No
NCA04.RES.0471	RES	NCA04		57	53	75	57	53	75	0.1	0.0	0.0	57	53	75	57	53	75	0.1	0.0	0.0	No
NCA04.RES.0472	RES	NCA04		60	56	78	60	56	78	0.0	0.0	0.0	60	56	78	60	56	78	0.0	0.0	0.0	No
NCA04.RES.0473	RES	NCA04		51	47	63	51	47	64	0.1	0.1	0.2	51	47	63	51	47	64	0.1	0.1	0.2	No
NCA04.RES.0474	RES	NCA04		59	55	77	59	55	77	0.0	0.0	0.0	59	55	77	59	55	77	0.0	0.0	0.0	No
NCA04.RES.0475	RES	NCA04		67	63	85	67	63	85	0.0	0.0	0.0	67	63	85	67	63	85	0.0	0.0	0.0	No
NCA04.RES.0476	RES	NCA04		57	53	75	56	53	75	0.0	-0.1	0.0	57	53	75	56	53	75	0.0	-0.1	0.0	No
NCA04.RES.0477	RES	NCA04		66	62	85	66	62	85	-0.1	-0.1	-0.1	66	62	85	66	62	85	-0.1	-0.1	-0.1	No
NCA04.RES.0478	RES	NCA04		58	54	76	58	54	76	-0.1	0.0	0.0	58	54	76	58	54	76	-0.1	0.0	0.0	No
NCA04.RES.0479	RES	NCA04		54	50	73	52	48	70	-1.6	-1.6	-2.8	54	50	73	52	48	70	-1.6	-1.6	-2.8	No
NCA04.RES.0480	RES	NCA04		50	46	61	50	46	61	0.1	0.1	0.1	50	46	61	50	46	61	0.1	0.1	0.1	No
NCA04.RES.0481	RES	NCA04		62	58	80	62	58	80	0.0	0.0	-0.1	62	58	80	62	58	80	0.0	0.0	-0.1	No
NCA04.RES.0482	RES	NCA04		58	54	75	58	54	75	0.0	0.0	0.0	58	54	75	58	54	75	0.0	0.0	0.0	No
NCA04.RES.0483	RES	NCA04		59	55	77	59	55	77	0.1	0.1	0.1	59	55	77	59	55	77	0.1	0.1	0.1	No
NCA04.RES.0484	RES	NCA04		54	50	71	54	50	71	0.4	0.4	0.0	54	50	71	54	50	71	0.4	0.4	0.0	No
NCA04.RES.0485	RES	NCA04		54	50	72	54	50	72	0.2	0.1	0.0	54	50	72	54	50	72	0.2	0.2	0.0	No
NCA04.RES.0486	RES	NCA04		58	54	76	58	54	76	0.0	0.1	-0.1	58	54	76	58	54	76	0.0	0.1	-0.1	No
NCA04.RES.0487	RES	NCA04		60	56	78	60	56	78	0.0	0.0	0.0	60	56	78	60	56	78	0.0	0.0	0.0	No
NCA04.RES.0488	RES	NCA04		52	48	69	52	48	69	-0.1	0.0	0.0	52	48	69	52	48	69	-0.1	0.0	0.0	No
NCA04.RES.0489	RES	NCA04		61	57	78	61	57	78	-0.1	-0.1	-0.2	61	57	78	61	57	78	-0.1	-0.1	-0.2	No
NCA04.RES.0491	RES	NCA04		53	49	70	53	49	70	0.0	0.0	0.0	53	49	70	53	49	70	0.0	0.0	0.0	No
NCA04.RES.0493	RES	NCA04		57	53	75	57	53	75	0.1	0.1	0.0	57	53	75	57	53	75	0.1	0.1	0.0	No
NCA04.RES.0494	RES	NCA04		59	55	77	59	55	77	0.1	0.0	0.0	59	55	77	59	55	77	0.1	0.0	0.0	No
NCA04.RES.0495	RES	NCA04		66	62	84	65	61	85	-0.6	-0.6	0.1	66	62	84	65	61	85	-0.6	-0.6	0.1	No
NCA04.RES.0496	RES	NCA04		67	63	86	67	63	86	-0.4	-0.4	-0.1	67	63	86	67	63	86	-0.4	-0.4	-0.1	No

NCA04.RES.0497	RES	NCA04		56	52	73	56	52	73	0.2	0.2	0.0	56	52	73	56	52	73	0.2	0.2	0.0	No
NCA04.RES.0498	RES	NCA04		51	47	69	52	48	69	0.2	0.3	0.0	51	47	69	52	48	69	0.2	0.3	0.0	No
NCA04.RES.0499	RES	NCA04		62	58	80	62	58	80	-0.2	-0.2	-0.1	62	58	80	62	58	80	-0.2	-0.2	-0.1	No
NCA04.RES.0500	RES	NCA04		52	48	70	52	48	70	0.0	0.0	0.0	52	48	70	52	48	70	0.0	0.0	0.0	No
NCA04.RES.0501	RES	NCA04		57	53	75	57	53	75	0.1	0.1	-0.1	57	53	75	57	53	75	0.1	0.1	-0.1	No
NCA04.RES.0504	RES	NCA04		61	57	79	61	57	79	-0.1	-0.1	0.3	61	57	79	61	57	79	-0.1	-0.1	0.3	No
NCA04.RES.0505	RES	NCA04		45	41	58	45	41	58	0.2	0.2	0.0	45	41	58	45	41	58	0.2	0.2	0.0	No
NCA04.RES.0506	RES	NCA04		55	51	72	55	51	72	0.2	0.1	0.0	55	51	72	55	51	72	0.2	0.1	0.0	No
NCA04.RES.0507	RES	NCA04		60	56	77	60	56	77	-0.2	-0.1	-0.1	60	56	77	60	56	77	-0.2	-0.1	-0.1	No
NCA04.RES.0508	RES	NCA04		58	54	76	58	54	76	0.1	0.0	0.0	58	54	76	58	54	76	0.1	0.0	0.0	No
NCA04.RES.0509	RES	NCA04		50	46	67	50	46	67	0.2	0.2	0.0	50	46	67	50	46	67	0.2	0.2	0.0	No
NCA04.RES.0510	RES	NCA04		63	59	81	61	57	81	-1.4	-1.5	-0.8	63	59	81	61	57	81	-1.4	-1.5	-0.8	No
NCA04.RES.0511	RES	NCA04		59	55	76	59	55	76	0.0	-0.1	0.0	59	55	76	59	55	76	0.0	-0.1	0.0	No
NCA04.RES.0512	RES	NCA04		57	53	74	57	53	74	-0.1	-0.1	-0.3	57	53	74	57	53	74	-0.1	-0.1	-0.3	No
NCA04.RES.0513	RES	NCA04		58	54	75	58	54	75	0.0	0.0	0.0	58	54	75	58	54	75	0.0	0.0	0.0	No
NCA04.RES.0514	RES	NCA04		66	62	85	66	62	85	-0.4	-0.3	0.0	66	62	85	66	62	85	-0.4	-0.3	0.0	No
NCA04.RES.0515	RES	NCA04		55	51	72	55	51	72	0.1	0.1	0.0	55	51	72	55	51	72	0.1	0.1	0.0	No
NCA04.RES.0516	RES	NCA04		48	44	65	48	44	65	0.1	0.0	0.0	48	44	65	48	44	65	0.1	0.0	0.0	No
NCA04.RES.0517	RES	NCA04		58	54	75	58	54	75	0.0	0.0	-0.1	58	54	75	58	54	75	0.0	0.0	-0.1	No
NCA04.RES.0518	RES	NCA04		63	59	81	62	58	81	-0.4	-0.4	-0.2	63	59	81	62	58	81	-0.4	-0.4	-0.2	No
NCA04.RES.0519	RES	NCA04		65	61	83	64	60	83	-1.5	-1.7	-0.1	65	61	83	64	60	83	-1.5	-1.6	-0.1	No
NCA04.RES.0520	RES	NCA04		62	58	80	62	58	80	-0.4	-0.5	-0.4	62	58	80	62	58	80	-0.4	-0.5	-0.4	No
NCA04.RES.0521	RES	NCA04		57	53	74	57	53	74	-0.1	-0.2	-0.3	57	53	74	57	53	74	-0.1	-0.2	-0.3	No
NCA04.RES.0522	RES	NCA04		60	56	78	60	56	77	-0.5	-0.5	-0.6	60	56	78	60	56	77	-0.5	-0.5	-0.6	No
NCA04.RES.0523	RES	NCA04		46	42	62	46	42	62	0.1	0.1	0.0	46	42	62	46	42	62	0.1	0.1	0.0	No
NCA04.RES.0524	RES	NCA04		54	50	72	54	50	72	-0.1	0.0	0.0	54	50	72	54	50	72	-0.1	0.0	0.0	No
NCA04.RES.0526	RES	NCA04		55	51	72	55	51	72	-0.1	0.0	0.0	55	51	72	55	51	72	-0.1	0.0	0.0	No
NCA04.RES.0527	RES	NCA04		48	44	65	48	44	65	0.2	0.2	0.0	48	44	65	48	44	65	0.2	0.2	0.0	No
NCA04.RES.0528	RES	NCA04		57	53	73	57	53	73	0.0	0.0	0.0	57	53	73	57	53	73	0.0	0.0	0.0	No
NCA04.RES.0529	RES	NCA04		45	41	59	46	42	59	0.4	0.1	-0.2	45	41	59	46	42	59	0.4	0.1	-0.2	No
NCA04.RES.0530	RES	NCA04		48	44	64	48	44	64	0.2	0.1	0.1	48	44	64	48	44	64	0.2	0.1	0.1	No
NCA04.RES.0531	RES	NCA04		55	51	74	55	51	74	-0.1	-0.1	0.6	55	51	74	55	51	74	0.0	-0.1	0.6	No
NCA04.RES.0532	RES	NCA04		56	52	72	57	53	72	0.4	0.4	0.0	56	52	72	57	53	72	0.4	0.4	0.0	No
NCA04.RES.0533	RES	NCA04		47	43	63	47	43	63	0.6	0.5	0.0	47	43	63	47	43	63	0.7	0.5	0.0	No
NCA04.RES.0534	RES	NCA04		53	50	71	53	49	71	0.0	-0.2	0.0	53	50	71	53	49	71	0.0	-0.2	0.0	No
NCA04.RES.0535	RES	NCA04		65	61	83	63	59	83	-1.9	-2.0	-0.1	65	61	83	63	59	83	-1.9	-2.0	-0.1	No
NCA04.RES.0536	RES	NCA04		46	42	60	47	43	60	0.2	0.1	0.0	46	42	60	47	43	60	0.2	0.1	0.0	No
NCA04.RES.0537	RES	NCA04		65	61	84	65	61	84	-0.3	-0.4	0.0	65	61	84	65	61	84	-0.3	-0.4	0.0	No
NCA04.RES.0538	RES	NCA04		49	45	66	49	45	66	0.1	0.0	-0.1	49	45	66	49	45	66	0.1	0.0	-0.1	No
NCA04.RES.0539	RES	NCA04		52	49	69	52	49	69	0.0	-0.1	0.0	52	49	69	52	49	69	0.0	-0.1	0.0	No
NCA04.RES.0540	RES	NCA04		46	42	63	47	43	63	0.6	0.3	0.0	46	42	63	47	43	63	0.6	0.4	0.0	No
NCA04.RES.0541	RES	NCA04		61	57	79	60	57	79	-0.3	-0.3	0.0	61	57	79	60	57	79	-0.3	-0.3	0.0	No
NCA04.RES.0542	RES	NCA04		47	43	60	47	43	60	0.3	0.1	0.1	47	43	60	47	43	60	0.3	0.2	0.1	No
NCA04.RES.0543	RES	NCA04		49	45	66	49	45	66	0.1	0.1	0.0	49	45	66	49	45	66	0.1	0.1	0.0	No
NCA04.RES.0544	RES	NCA04		56	52	72	57	53	74	0.6	0.6	1.9	56	52	72	57	53	74	0.6	0.6	1.9	No
NCA04.RES.0545	RES	NCA04		51	47	67	51	47	67	-0.1	-0.1	-0.2	51	47	67	51	47	67	0.0	-0.1	-0.2	No
NCA04.RES.0546	RES	NCA04		53	49	69	54	50	70	1.2	1.2	1.6	53	49	69	54	50	70	1.2	1.2	1.6	No
NCA04.RES.0547	RES	NCA04		43	39	55	44	39	55	0.7	0.4	0.0	43	39	55	44	39	55	0.7	0.4	0.0	No
NCA04.RES.0548	RES	NCA04		50	46	66	51	47	66	0.2	0.2	0.0	50	46	66	51	47	66	0.2	0.2	0.0	No
NCA04.RES.0549	RES	NCA04		47	43	64	48	44	63	0.2	0.1	-0.3	47	43	64	48	44	63	0.3	0.2	-0.3	No
NCA04.RES.0550	RES	NCA04		48	44	64	48	44	64	0.2	0.0	-0.3	48	44	64	48	44	64	0.2	0.1	-0.3	No
NCA04.RES.0551	RES	NCA04		50	47	65	51	47	65	0.1	0.0	0.3	50	47	65	51	47	65	0.1	0.0	0.3	No
NCA04.RES.0552	RES	NCA04		44	40	59	45	41	59	0.7	0.5	-0.1	44	40	59	45	41	59	0.7	0.5	-0.1	No
NCA04.RES.0553	RES	NCA04		45	41	57	45	41	57	0.4	0.3	0.1	45	41	57	45	41	57	0.5	0.3	0.1	No
NCA04.RES.0554	RES	NCA04		49	45	62	50	46	62	0.7	0.5	0.0	49	45	62	50	46	62	0.8	0.6	0.0	No
NCA04.RES.0555	RES	NCA04		66	62	84	65	61	84	-0.4	-0.4	0.1	66	62	84	65	61	84	-0.4	-0.4	0.1	No
NCA04.RES.0556	RES	NCA04		43	39	57	44	39	57	1.1	0.7	-0.1	43	39	57	44	40	57	1.2	0.7	-0.1	No
NCA04.RES.0557	RES	NCA04		49	45	64	50	45	65	0.3	0.1	0.7	49	45	64	50	45	65	0.4	0.2	0.7	No
NCA04.RES.0558	RES	NCA04		42	38	55	44	39	55	1.1	0.7	0.0	42	38	55	44	39	55	1.2	0.7	0.0	No
NCA04.RES.0559	RES	NCA04		40	36	53	41	37	53	0.9	0.5	0.0	40	36	53	41	37	53	1.0	0.5	0.0	No
NCA04.RES.0560	RES	NCA04		47	43	61	48	44	61	1.0	0.8	-0.2	47	43	61	49	44	61	1.1	0.8	-0.2	No

NCA04.RES.0561	RES	NCA04		50	46	66	53	49	72	3.0	3.0	6.5	50	46	66	53	49	72	3.1	3.0	6.5	No
NCA04.RES.0562	RES	NCA04		42	38	56	43	38	56	1.1	0.7	0.0	42	38	56	43	39	56	1.2	0.8	0.0	No
NCA04.RES.0563	RES	NCA04		42	38	56	42	38	56	0.7	0.4	0.0	42	38	56	42	38	56	0.8	0.5	0.0	No
NCA04.RES.0564	RES	NCA04		50	46	65	51	47	69	1.3	1.3	3.8	50	46	65	51	47	69	1.4	1.3	3.8	No
NCA04.RES.0565	RES	NCA04		45	41	59	46	42	59	1.2	0.8	0.0	45	41	59	47	42	59	1.2	0.8	0.0	No
NCA04.RES.0566	RES	NCA04		44	40	56	45	41	56	1.2	0.8	0.1	44	40	56	45	41	56	1.3	0.9	0.1	No
NCA04.RES.0567	RES	NCA04		43	39	56	45	40	56	1.3	0.9	0.1	43	39	56	45	40	56	1.4	0.9	0.1	No
NCA04.RES.0568	RES	NCA04		49	45	65	51	47	70	1.7	1.8	4.9	49	45	65	51	47	70	1.8	1.8	4.9	No
NCA04.RES.0569	RES	NCA04		44	40	57	45	41	57	1.3	0.9	0.0	44	40	57	46	41	57	1.4	1.0	0.0	No
NCA04.RES.0570	RES	NCA04		43	39	55	44	40	55	1.0	0.6	0.0	43	39	55	44	40	55	1.0	0.7	0.0	No
NCA04.RES.0571	RES	NCA04		44	40	56	45	41	56	1.2	0.8	0.0	44	40	56	45	41	56	1.3	0.8	0.0	No
NCA04.RES.0572	RES	NCA04		43	39	55	44	39	55	1.2	0.8	0.0	43	39	55	44	39	55	1.2	0.8	0.0	No
NCA04.RES.0573	RES	NCA04		44	40	56	46	41	57	1.3	0.8	1.2	44	40	56	46	41	57	1.4	0.8	1.2	No
NCA04.RES.0575	RES	NCA04		44	40	56	45	41	57	1.3	0.9	1.1	44	40	56	45	41	57	1.4	0.9	1.1	No
NCA04.RES.0576	RES	NCA04		42	38	55	43	38	55	0.9	0.7	0.0	42	38	55	43	38	55	1.0	0.8	0.0	No
NCA04.RES.0577	RES	NCA04		44	40	57	45	40	57	1.0	0.7	0.0	44	40	57	45	40	57	1.1	0.7	0.0	No
NCA04.RES.0578	RES	NCA04		45	41	58	47	42	59	1.2	0.7	0.4	45	41	58	47	42	59	1.3	0.8	0.4	No
NCA04.RES.0579	RES	NCA04		47	43	60	49	44	62	1.3	0.9	1.4	47	43	60	49	44	62	1.4	1.0	1.4	No
NCA04.RES.0580	RES	NCA04		43	39	56	44	40	56	1.4	0.9	0.0	43	39	56	44	40	56	1.5	1.0	0.0	No
NCA04.RES.0581	RES	NCA04		45	41	59	46	42	59	1.1	0.6	0.3	45	41	59	46	42	59	1.2	0.7	0.3	No
NCA04.RES.0582	RES	NCA04		47	43	60	48	44	61	1.2	0.8	1.4	47	43	60	49	44	61	1.3	0.9	1.4	No
NCA04.RES.0583	RES	NCA04		43	39	56	45	40	56	1.1	0.8	0.0	43	39	56	45	40	56	1.2	0.8	0.0	No
NCA04.RES.0584	RES	NCA04		42	38	55	43	39	55	1.1	0.7	0.0	42	38	55	43	39	55	1.1	0.8	0.0	No
NCA04.RES.0585	RES	NCA04		46	42	59	48	43	60	1.4	0.9	1.0	46	42	59	48	43	60	1.5	0.9	1.0	No
NCA04.RES.0586	RES	NCA04		43	39	55	43	39	55	1.0	0.7	0.0	43	39	55	44	39	55	1.0	0.7	0.0	No
NCA04.RES.0587	RES	NCA04		43	39	56	45	40	56	1.1	0.7	0.1	43	39	56	45	40	56	1.2	0.8	0.1	No
NCA04.RES.0588	RES	NCA04		46	43	60	48	43	61	1.5	0.9	0.8	46	43	60	48	44	61	1.6	1.0	0.8	No
NCA04.RES.0589	RES	NCA04		43	39	55	45	40	56	1.4	0.9	1.0	43	39	55	45	40	56	1.5	0.9	1.0	No
NCA04.RES.0590	RES	NCA04		46	42	60	48	43	61	1.8	1.2	1.3	46	42	60	48	43	61	1.9	1.3	1.3	No
NCA04.RES.0591	RES	NCA04		42	38	55	43	39	55	1.0	0.6	-0.1	42	38	55	43	39	55	1.0	0.7	-0.1	No
NCA04.RES.0592	RES	NCA04		43	39	56	45	40	57	1.5	0.9	1.1	43	39	56	45	40	57	1.6	1.0	1.1	No
NCA04.RES.0593	RES	NCA04		45	41	58	47	42	59	2.0	1.4	0.9	45	41	58	47	42	59	2.2	1.5	0.9	No
NCA04.RES.0594	RES	NCA04		45	41	57	46	42	59	1.5	1.0	1.1	45	41	57	46	42	59	1.6	1.1	1.1	No
NCA04.RES.0595	RES	NCA04		43	39	55	44	40	57	1.2	0.8	1.1	43	39	55	44	40	57	1.3	0.9	1.1	No
NCA04.RES.0596	RES	NCA04		44	40	57	46	41	58	1.7	1.1	1.3	44	40	57	46	42	58	1.8	1.2	1.3	No
NCA04.RES.0597	RES	NCA04		45	41	56	45	41	57	0.7	0.5	1.4	45	41	56	45	41	57	0.7	0.6	1.4	No
NCA04.RES.0598	RES	NCA04		44	40	56	46	41	58	1.3	1.0	1.9	44	40	56	46	41	58	1.6	1.0	1.9	No
NCA04.RES.0599	RES	NCA04		44	40	57	46	41	58	1.2	0.8	1.0	44	40	57	46	41	58	1.3	0.9	1.0	No
NCA04.RES.0600	RES	NCA04		44	40	56	46	41	56	1.1	0.7	0.3	44	40	56	46	41	56	1.2	0.7	0.3	No
NCA04.RES.0601	RES	NCA04		44	40	56	45	41	56	1.2	0.7	0.3	44	40	56	46	41	56	1.3	0.8	0.3	No
NCA04.RES.0602	RES	NCA04		44	40	56	45	40	56	0.8	0.5	0.1	44	40	56	45	40	56	0.9	0.6	0.1	No
NCA04.RES.0603	RES	NCA04		44	40	56	45	40	56	0.4	0.2	0.2	44	40	56	45	40	56	0.4	0.2	0.2	No
NCA05.COM.0647	COM	NCA05		43	39	55	45	41	58	1.9	1.3	3.0	43	39	55	45	41	58	2.1	1.4	3.0	No
NCA05.COM.0655	COM	NCA05		42	39	58	44	40	59	2.1	0.9	1.0	42	39	58	44	40	59	2.2	0.9	1.0	No
NCA05.COM.0658	COM	NCA05		43	39	57	45	40	59	1.7	1.0	1.5	43	39	57	45	40	59	1.8	1.1	1.5	No
NCA05.COM.0661	COM	NCA05		45	41	59	47	42	60	2.4	1.6	1.2	45	41	59	47	42	60	2.6	1.7	1.2	No
NCA05.COM.0666	COM	NCA05		44	40	58	46	41	59	2.2	1.3	0.7	44	40	58	46	41	59	2.3	1.4	0.7	No
NCA05.COM.0671	COM	NCA05		45	41	60	48	43	62	2.8	2.0	1.6	45	41	60	48	43	62	3.0	2.1	1.6	No
NCA05.COM.0703	COM	NCA05		45	41	61	47	42	61	1.9	1.0	-0.4	45	41	61	48	43	61	2.1	1.2	-0.4	No
NCA05.COM.0706	COM	NCA05		41	37	57	44	39	58	2.5	1.4	0.1	41	37	57	44	39	58	2.7	1.6	0.1	No
NCA05.OPW.0629	OPW	NCA05		41	38	50	43	39	53	2.2	1.8	2.8	41	38	50	43	39	53	2.3	1.9	2.8	No
NCA05.OPW.0630	OPW	NCA05		41	38	51	42	39	53	1.3	0.9	2.1	41	38	51	42	39	53	1.4	1.0	2.1	No
NCA05.OPW.0632	OPW	NCA05		42	38	53	44	41	55	2.5	2.1	2.5	42	38	53	45	41	55	2.7	2.2	2.5	No
NCA05.OPW.0633	OPW	NCA05		41	38	52	44	40	55	2.6	2.1	2.7	41	38	52	44	40	55	2.8	2.2	2.7	No
NCA05.OPW.0634	OPW	NCA05		40	37	51	42	39	54	1.9	1.5	2.8	40	37	51	43	39	54	2.0	1.6	2.8	No
NCA05.RES.0607	RES	NCA05		39	35	55	39	35	55	0.8	0.5	-0.2	39	35	55	39	35	55	0.9	0.5	-0.2	No
NCA05.RES.0608	RES	NCA05		41	37	58	41	37	58	0.3	0.2	0.0	41	37	58	41	37	58	0.4	0.2	0.0	No
NCA05.RES.0609	RES	NCA05		39	35	57	40	36	57	1.0	0.6	0.0	39	35	57	40	36	57	1.0	0.7	0.0	No
NCA05.RES.0610	RES	NCA05		41	37	59	41	37	58	0.8	0.5	-0.5	41	37	59	42	37	58	0.9	0.5	-0.5	No
NCA05.RES.0611	RES	NCA05		39	35	53	40	36	54	1.4	0.9	0.1	39	35	53	40	36	54	1.5	1.0	0.1	No
NCA05.RES.0612	RES	NCA05		36	35	55	39	35	55	2.8	-0.1	0.0	36	35	55	39	35	55	2.9	0.0	0.0	No

NCA05.RES.0613	RES	NCA05		35	31	47	37	33	49	1.8	1.2	2.2	35	31	47	37	33	49	1.9	1.3	2.2	No
NCA05.RES.0614	RES	NCA05		39	35	54	40	36	54	1.0	0.7	0.0	39	35	54	41	36	54	1.1	0.7	0.0	No
NCA05.RES.0615	RES	NCA05		39	35	55	41	36	55	1.2	0.8	0.0	39	35	55	41	36	55	1.3	0.8	0.0	No
NCA05.RES.0616	RES	NCA05		40	36	53	41	37	54	1.3	0.8	0.1	40	36	53	41	37	54	1.4	0.9	0.1	No
NCA05.RES.0617	RES	NCA05		36	32	47	38	33	49	1.5	1.0	2.0	36	32	47	38	33	49	1.6	1.1	2.0	No
NCA05.RES.0618	RES	NCA05		40	36	51	42	37	53	1.9	1.3	1.9	40	36	51	42	37	53	2.0	1.4	1.9	No
NCA05.RES.0619	RES	NCA05		35	32	47	37	32	48	1.1	0.6	0.8	35	32	47	37	32	48	1.2	0.7	0.8	No
NCA05.RES.0620	RES	NCA05		36	32	47	37	33	49	1.5	1.0	1.9	36	32	47	37	33	49	1.6	1.1	1.9	No
NCA05.RES.0621	RES	NCA05		40	36	52	41	37	52	1.4	0.9	0.0	40	36	52	41	37	52	1.5	1.0	0.0	No
NCA05.RES.0622	RES	NCA05		39	35	51	41	36	53	1.6	1.1	2.4	39	35	51	41	36	53	1.7	1.2	2.4	No
NCA05.RES.0623	RES	NCA05		40	36	52	42	37	54	2.2	1.6	2.2	40	36	52	42	37	54	2.4	1.7	2.2	No
NCA05.RES.0624	RES	NCA05		40	36	49	41	37	52	1.2	0.8	2.5	40	36	49	41	37	52	1.3	0.9	2.5	No
NCA05.RES.0625	RES	NCA05		34	30	46	36	31	49	2.0	1.3	2.5	34	30	46	36	31	49	2.2	1.4	2.5	No
NCA05.RES.0626	RES	NCA05		38	34	51	41	36	53	2.3	1.7	2.0	38	34	51	41	36	53	2.5	1.8	2.0	No
NCA05.RES.0627	RES	NCA05		36	32	48	38	33	50	1.7	1.3	2.4	36	32	48	38	33	50	1.8	1.4	2.4	No
NCA05.RES.0628	RES	NCA05		38	34	50	40	36	52	2.0	1.4	2.2	38	34	50	40	36	52	2.2	1.5	2.2	No
NCA05.RES.0631	RES	NCA05		37	33	48	38	34	51	1.8	1.3	2.5	37	33	48	39	34	51	2.0	1.4	2.5	No
NCA05.RES.0635	RES	NCA05		38	34	49	39	35	52	2.0	1.4	2.3	38	34	49	40	35	52	2.1	1.5	2.3	No
NCA05.RES.0636	RES	NCA05		38	34	51	41	36	54	2.5	2.0	2.6	38	34	51	41	36	54	2.7	2.1	2.6	No
NCA05.RES.0637	RES	NCA05		39	34	53	41	37	54	2.7	2.5	1.6	39	34	53	42	37	54	2.8	2.6	1.6	No
NCA05.RES.0638	RES	NCA05		40	36	53	42	37	55	1.4	0.8	1.9	40	36	53	42	37	55	1.5	0.9	1.9	No
NCA05.RES.0639	RES	NCA05		36	32	50	39	34	52	2.6	1.9	2.8	36	32	50	39	34	52	2.8	2.0	2.8	No
NCA05.RES.0640	RES	NCA05		39	36	52	42	37	54	2.6	1.9	2.4	39	36	52	42	37	54	2.7	2.0	2.4	No
NCA05.RES.0641	RES	NCA05		39	35	52	41	37	53	2.3	1.5	1.5	39	35	52	41	37	53	2.4	1.6	1.5	No
NCA05.RES.0642	RES	NCA05		43	39	57	46	41	61	2.7	2.1	4.8	43	39	57	46	41	61	2.8	2.2	4.8	No
NCA05.RES.0643	RES	NCA05		39	35	52	41	37	55	2.3	1.6	2.3	39	35	52	42	37	55	2.5	1.7	2.3	No
NCA05.RES.0644	RES	NCA05		39	36	52	42	37	54	2.1	1.5	2.0	39	36	52	42	37	54	2.3	1.6	2.0	No
NCA05.RES.0645	RES	NCA05		40	36	53	42	37	55	2.1	1.4	1.8	40	36	53	42	38	55	2.2	1.5	1.8	No
NCA05.RES.0646	RES	NCA05		40	36	54	42	38	56	2.1	1.3	1.9	40	36	54	43	38	56	2.2	1.4	1.9	No
NCA05.RES.0648	RES	NCA05		40	36	55	43	38	56	2.7	1.9	0.5	40	36	55	43	38	56	2.8	2.0	0.5	No
NCA05.RES.0649	RES	NCA05		42	38	56	44	40	58	2.8	2.0	2.0	42	38	56	45	40	58	2.9	2.2	2.0	No
NCA05.RES.0650	RES	NCA05		41	37	55	44	39	57	2.4	1.7	1.8	41	37	55	44	39	57	2.6	1.8	1.8	No
NCA05.RES.0651	RES	NCA05		44	41	59	46	42	61	2.7	1.3	2.0	44	41	59	47	42	61	2.9	1.3	2.0	No
NCA05.RES.0652	RES	NCA05		41	37	54	44	39	56	2.4	1.6	1.8	41	37	54	44	39	56	2.6	1.8	1.8	No
NCA05.RES.0653	RES	NCA05		42	38	59	44	40	58	2.1	1.4	-0.6	42	38	59	45	40	58	2.2	1.5	-0.6	No
NCA05.RES.0654	RES	NCA05		40	36	54	43	38	56	2.8	2.1	1.9	40	36	54	43	38	56	2.9	2.2	1.9	No
NCA05.RES.0656	RES	NCA05		40	36	54	43	38	57	2.8	2.1	2.1	40	36	54	43	38	57	2.9	2.2	2.1	No
NCA05.RES.0657	RES	NCA05		42	38	56	44	40	58	2.5	1.7	2.1	42	38	56	45	40	58	2.7	1.8	2.1	No
NCA05.RES.0659	RES	NCA05		40	36	54	42	37	56	2.6	1.8	1.3	40	36	54	42	38	56	2.8	2.0	1.3	No
NCA05.RES.0660	RES	NCA05		40	36	56	43	38	56	2.6	1.8	0.6	40	36	56	43	38	56	2.8	2.0	0.6	No
NCA05.RES.0662	RES	NCA05		39	35	55	42	37	56	2.7	1.9	0.6	39	35	55	42	37	56	2.9	2.0	0.6	No
NCA05.RES.0663	RES	NCA05		44	40	58	46	41	59	2.1	1.2	1.2	44	40	58	46	41	59	2.2	1.3	1.2	No
NCA05.RES.0664	RES	NCA05		44	40	60	46	41	60	2.0	1.1	0.3	44	40	60	46	41	60	2.2	1.3	0.3	No
NCA05.RES.0665	RES	NCA05		39	35	54	42	37	55	2.6	1.9	1.5	39	35	54	42	37	55	2.7	2.0	1.5	No
NCA05.RES.0667	RES	NCA05		40	36	54	42	37	55	2.2	1.5	0.9	40	36	54	42	37	55	2.4	1.6	0.9	No
NCA05.RES.0668	RES	NCA05		40	36	56	42	38	57	2.9	2.1	1.4	40	36	56	43	38	57	3.0	2.2	1.4	No
NCA05.RES.0669	RES	NCA05		39	35	54	42	37	55	2.6	1.9	1.0	39	35	54	42	37	55	2.8	2.0	1.0	No
NCA05.RES.0670	RES	NCA05		45	41	61	47	42	60	2.2	1.3	-0.4	45	41	61	47	42	60	2.4	1.5	-0.4	No
NCA05.RES.0672	RES	NCA05		42	38	58	44	39	58	2.3	1.4	-0.1	42	38	58	44	39	58	2.5	1.5	-0.1	No
NCA05.RES.0673	RES	NCA05		46	42	61	48	44	62	2.6	1.8	1.3	46	42	61	49	44	62	2.8	1.9	1.3	No
NCA05.RES.0674	RES	NCA05		41	37	58	43	38	58	2.2	1.4	-0.3	41	37	58	43	39	58	2.4	1.5	-0.3	No
NCA05.RES.0675	RES	NCA05		44	40	62	45	41	61	1.8	0.9	-1.0	44	40	62	46	41	61	2.0	1.1	-1.0	No
NCA05.RES.0676	RES	NCA05		52	48	69	55	50	70	3.1	2.1	1.0	52	48	69	55	50	70	3.3	2.3	1.0	No
NCA05.RES.0677	RES	NCA05		46	42	63	48	43	63	2.3	1.3	-0.2	46	42	63	49	44	63	2.5	1.5	-0.2	No
NCA05.RES.0678	RES	NCA05		47	43	65	49	45	64	2.0	1.0	-1.1	47	43	65	50	45	64	2.2	1.2	-1.1	No
NCA05.RES.0679	RES	NCA05		49	45	67	51	46	65	2.1	1.1	-1.4	49	45	67	51	46	65	2.3	1.2	-1.4	No
NCA05.RES.0680	RES	NCA05		48	44	65	50	45	66	2.7	1.7	0.2	48	44	65	51	46	66	2.8	1.9	0.2	No
NCA05.RES.0681	RES	NCA05		44	40	61	47	43	62	3.1	2.1	0.5	44	40	61	48	43	62	3.2	2.3	0.5	No
NCA05.RES.0682	RES	NCA05		43	40	61	45	40	60	1.7	0.8	-1.0	43	40	61	45	40	60	1.9	1.0	-1.0	No
NCA05.RES.0683	RES	NCA05		45	41	63	48	43	63	2.3	1.3	0.1	45	41	63	48	43	63	2.5	1.5	0.1	No
NCA05.RES.0684	RES	NCA05		48	44	65	49	45	64	1.9	1.0	-0.9	48	44	65	50	45	64	2.2	1.2	-0.9	No

NCA05.RES.0685	RES	NCA05		44	40	62	45	40	61	1.4	0.5	-1.0	44	40	62	45	41	61	1.6	0.6	-1.0	No
NCA05.RES.0686	RES	NCA05		51	47	69	53	48	68	1.9	0.9	-0.3	51	47	69	53	48	68	2.1	1.0	-0.3	No
NCA05.RES.0687	RES	NCA05		51	47	69	52	47	67	1.6	0.7	-1.1	51	47	69	52	47	67	1.9	0.8	-1.1	No
NCA05.RES.0688	RES	NCA05		45	41	62	48	43	63	2.6	1.8	0.4	45	41	62	48	43	63	2.8	1.9	0.4	No
NCA05.RES.0689	RES	NCA05		45	41	62	47	43	62	2.7	1.8	0.4	45	41	62	48	43	62	2.9	1.9	0.4	No
NCA05.RES.0690	RES	NCA05		45	41	63	48	43	63	2.7	1.7	0.0	45	41	63	48	43	63	2.9	1.8	0.0	No
NCA05.RES.0691	RES	NCA05		51	47	69	53	48	68	2.2	1.0	-0.8	51	47	69	54	48	68	2.4	1.2	-0.8	No
NCA05.RES.0692	RES	NCA05		47	43	66	49	44	65	1.6	0.6	-0.9	47	43	66	49	44	65	1.9	0.8	-0.9	No
NCA05.RES.0693	RES	NCA05		49	45	67	51	46	66	1.9	1.0	-0.8	49	45	67	51	46	66	2.1	1.2	-0.8	No
NCA05.RES.0694	RES	NCA05		46	42	64	48	43	63	1.7	0.7	-1.0	46	42	64	48	43	63	1.9	0.9	-1.0	No
NCA05.RES.0695	RES	NCA05		51	47	69	53	48	68	2.0	0.9	-1.0	51	47	69	53	48	68	2.2	1.1	-1.0	No
NCA05.RES.0696	RES	NCA05		46	42	64	49	44	64	2.5	1.5	0.0	46	42	64	49	44	64	2.7	1.7	0.0	No
NCA05.RES.0697	RES	NCA05		52	48	70	54	48	68	1.6	0.4	-1.6	52	48	70	54	49	68	1.8	0.6	-1.6	No
NCA05.RES.0698	RES	NCA05		50	46	67	51	47	67	1.8	0.8	-0.9	50	46	67	52	47	67	2.0	1.0	-0.9	No
NCA05.RES.0699	RES	NCA05		52	48	71	53	48	69	1.3	0.2	-1.9	52	48	71	54	49	69	1.5	0.4	-1.9	No
NCA05.RES.0700	RES	NCA05		50	46	69	52	47	68	1.2	0.2	-1.2	50	46	69	52	47	68	1.4	0.4	-1.2	No
NCA05.RES.0701	RES	NCA05		45	41	63	46	41	62	1.5	0.5	-1.4	45	41	63	46	42	62	1.7	0.7	-1.4	No
NCA05.RES.0702	RES	NCA05		52	48	71	54	49	69	1.8	0.7	-1.6	52	48	71	54	49	69	2.0	0.8	-1.6	No
NCA05.RES.0704	RES	NCA05		43	39	60	45	40	59	2.0	1.1	-1.2	43	39	60	45	40	59	2.2	1.2	-1.2	No
NCA05.RES.0705	RES	NCA05		42	38	59	44	39	58	2.0	1.0	-1.0	42	38	59	44	39	58	2.1	1.2	-1.0	No
NCA05.RES.0707	RES	NCA05		40	36	52	42	37	55	2.5	1.8	2.3	40	36	52	42	38	55	2.6	1.9	2.3	No
NCA06.COM.0741	COM	NCA06		33	29	47	34	30	47	0.6	0.5	0.0	33	29	47	34	30	47	0.6	0.5	0.0	No
NCA06.COM.0752	COM	NCA06		46	42	62	46	42	62	0.4	0.3	0.3	46	42	62	46	42	62	0.4	0.3	0.3	No
NCA06.COM.0754	COM	NCA06		34	30	47	35	31	47	0.9	0.6	0.0	34	30	47	35	31	47	1.0	0.7	0.0	No
NCA06.COM.0770	COM	NCA06		33	29	49	34	30	49	0.8	0.6	0.0	33	29	49	34	30	49	0.9	0.7	0.0	No
NCA06.COM.0780	COM	NCA06		34	30	50	34	30	50	0.6	0.3	0.0	34	30	50	35	30	50	0.7	0.4	0.0	No
NCA06.COM.0781	COM	NCA06		50	46	68	51	47	69	0.1	0.1	0.1	50	46	68	51	47	69	0.1	0.1	0.1	No
NCA06.COM.0791	COM	NCA06		35	31	46	36	31	46	0.9	0.7	0.0	35	31	46	36	31	46	0.9	0.7	0.0	No
NCA06.COM.0801	COM	NCA06		33	29	46	33	29	46	0.3	0.1	0.0	33	29	46	33	29	46	0.4	0.2	0.0	No
NCA06.COM.0817	COM	NCA06		34	30	47	35	31	47	0.9	0.6	0.0	34	30	47	35	31	47	1.0	0.7	0.0	No
NCA06.COM.0873	COM	NCA06		59	55	76	59	55	76	0.2	0.1	0.3	59	55	76	59	55	76	0.2	0.1	0.3	No
NCA06.COM.0882	COM	NCA06		58	55	75	58	55	75	0.1	0.0	0.1	58	55	75	58	55	75	0.1	0.0	0.1	No
NCA06.COM.0884	COM	NCA06		59	55	75	59	55	75	0.0	0.1	0.1	59	55	75	59	55	75	0.0	0.1	0.1	No
NCA06.COM.0885	COM	NCA06		59	55	75	59	55	75	0.0	0.1	0.1	59	55	75	59	55	75	0.0	0.1	0.1	No
NCA06.COM.0886	COM	NCA06		59	55	75	59	55	75	0.1	0.1	0.0	59	55	75	59	55	75	0.1	0.1	0.0	No
NCA06.COM.0887	COM	NCA06		59	55	75	59	55	75	0.0	0.0	0.0	59	55	75	59	55	75	0.0	0.0	0.0	No
NCA06.COM.0888	COM	NCA06		55	51	71	55	51	71	0.0	0.0	0.0	55	51	71	55	51	71	0.0	0.0	0.0	No
NCA06.COM.0889	COM	NCA06		59	55	75	59	55	75	0.0	0.0	0.0	59	55	75	59	55	75	0.0	0.0	0.0	No
NCA06.COM.0890	COM	NCA06		54	50	70	54	50	70	0.0	0.0	0.0	54	50	70	54	50	70	0.0	0.0	0.0	No
NCA06.COM.0891	COM	NCA06		59	55	75	59	55	75	-0.1	0.0	0.0	59	55	75	59	55	75	-0.1	0.0	0.0	No
NCA06.OCC.0762	OCC	NCA06		33	29	45	34	30	45	0.6	0.4	0.0	33	29	45	34	30	45	0.6	0.4	0.0	No
NCA06.OED.0779	OED	NCA06		44	41	58	45	41	58	0.5	0.5	0.1	44	41	58	45	41	58	0.5	0.5	0.1	No
NCA06.OED.0784	OED	NCA06		43	40	54	44	40	54	0.6	0.5	0.2	43	40	54	44	40	54	0.6	0.5	0.2	No
NCA06.OED.0787	OED	NCA06		45	41	58	45	42	59	0.3	0.2	0.1	45	41	58	45	42	59	0.3	0.2	0.1	No
NCA06.OED.0792	OED	NCA06		45	42	59	45	42	59	0.2	0.3	-0.1	45	42	59	45	42	59	0.2	0.3	-0.1	No
NCA06.OED.0796	OED	NCA06		46	43	61	46	43	61	0.0	0.0	-0.5	46	43	61	46	43	61	0.0	0.0	-0.5	No
NCA06.OED.0797	OED	NCA06		41	37	52	41	37	52	0.3	0.3	0.2	41	37	52	41	37	52	0.3	0.3	0.2	No
NCA06.OED.0804	OED	NCA06		40	36	51	40	37	51	0.5	0.4	0.3	40	36	51	40	37	51	0.5	0.4	0.3	No
NCA06.OED.0805	OED	NCA06		38	34	47	39	35	47	0.8	0.7	0.0	38	34	47	39	35	47	0.8	0.8	0.0	No
NCA06.OED.0807	OED	NCA06		44	41	55	45	41	55	0.5	0.4	0.0	44	41	55	45	41	55	0.5	0.4	0.0	No
NCA06.OED.0809	OED	NCA06		41	37	51	41	37	51	0.1	0.1	0.2	41	37	51	41	37	51	0.1	0.2	0.2	No
NCA06.OED.0811	OED	NCA06		41	37	51	41	37	51	0.2	0.3	0.1	41	37	51	41	37	51	0.3	0.3	0.1	No
NCA06.OED.0812	OED	NCA06		44	40	57	44	41	58	0.4	0.4	0.1	44	40	57	44	41	58	0.4	0.4	0.1	No
NCA06.OED.0814	OED	NCA06		49	46	63	50	46	63	0.2	0.3	0.7	49	46	63	50	46	63	0.2	0.3	0.7	No
NCA06.OED.0815	OED	NCA06		41	37	51	41	38	51	0.3	0.2	0.4	41	37	51	41	38	51	0.3	0.2	0.4	No
NCA06.OED.0820	OED	NCA06		43	40	57	44	40	58	0.3	0.3	0.5	43	40	57	44	40	58	0.3	0.3	0.5	No
NCA06.OED.0823	OED	NCA06		51	47	63	51	47	63	0.1	0.1	0.2	51	47	63	51	47	63	0.1	0.1	0.2	No
NCA06.OED.0825	OED	NCA06		42	38	54	42	39	54	0.6	0.7	0.3	42	38	54	42	39	54	0.6	0.7	0.3	No
NCA06.OED.0827	OED	NCA06		50	47	62	51	47	63	0.1	0.2	0.5	50	47	62	51	47	63	0.1	0.2	0.5	No
NCA06.OED.0831	OED	NCA06		41	37	51	41	37	51	0.4	0.4	0.3	41	37	51	41	37	51	0.4	0.4	0.3	No
NCA06.OOA.7702	OOA	NCA06		36	33	47	37	33	47	0.4	0.4	0.1	36	33	47	37	33	47	0.4	0.4	0.1	No

NCA06.OOA.7703	OOA	NCA06		58	54	76	58	54	76	0.0	0.0	0.0	58	54	76	58	54	76	0.0	0.0	0.0	No
NCA06.OOA.7714	OOA	NCA06		51	48	68	51	48	68	0.1	0.1	0.0	51	48	68	51	48	68	0.1	0.1	0.0	No
NCA06.OOP.7715	OOP	NCA06		58	55	74	58	55	74	0.1	0.0	0.0	58	55	74	58	55	74	0.1	0.0	0.0	No
NCA06.OPW.0852	OPW	NCA06		47	44	64	47	43	64	-0.7	-0.6	0.0	47	44	64	47	43	64	-0.7	-0.6	0.0	No
NCA06.OPW.0856	OPW	NCA06		41	38	55	42	38	55	0.3	0.3	0.0	41	38	55	42	38	55	0.3	0.3	0.0	No
NCA06.OPW.0859	OPW	NCA06		67	63	83	67	63	83	0.1	0.1	0.2	67	63	83	67	63	83	0.1	0.1	0.2	No
NCA06.RES.0711	RES	NCA06		47	43	64	47	43	64	0.1	0.1	0.0	47	43	64	47	43	64	0.1	0.1	0.0	No
NCA06.RES.0712	RES	NCA06		47	43	64	47	43	64	0.1	0.1	0.0	47	43	64	47	43	64	0.1	0.1	0.0	No
NCA06.RES.0713	RES	NCA06		51	47	69	51	47	69	0.1	0.1	0.0	51	47	69	51	47	69	0.1	0.1	0.0	No
NCA06.RES.0714	RES	NCA06		50	46	67	50	46	67	0.1	0.1	0.0	50	46	67	50	46	67	0.1	0.1	0.0	No
NCA06.RES.0715	RES	NCA06		46	42	64	46	42	64	0.0	0.1	0.0	46	42	64	46	42	64	0.0	0.1	0.0	No
NCA06.RES.0716	RES	NCA06		48	44	66	48	44	66	0.1	0.0	-0.1	48	44	66	48	44	66	0.1	0.0	-0.1	No
NCA06.RES.0717	RES	NCA06		40	36	57	40	36	57	0.2	0.2	0.0	40	36	57	40	36	57	0.2	0.2	0.0	No
NCA06.RES.0718	RES	NCA06		42	38	59	42	38	59	0.2	0.1	0.0	42	38	59	42	38	59	0.2	0.1	0.0	No
NCA06.RES.0719	RES	NCA06		39	35	57	40	36	57	0.2	0.2	0.0	39	35	57	40	36	57	0.2	0.2	0.0	No
NCA06.RES.0720	RES	NCA06		43	39	60	44	40	60	0.2	0.2	0.0	43	39	60	44	40	60	0.2	0.2	0.0	No
NCA06.RES.0721	RES	NCA06		35	31	51	36	32	51	0.7	0.7	0.0	35	31	51	36	32	51	0.8	0.7	0.0	No
NCA06.RES.0722	RES	NCA06		37	33	52	37	33	52	0.7	0.6	0.0	37	33	52	37	33	52	0.7	0.6	0.0	No
NCA06.RES.0723	RES	NCA06		52	48	69	52	48	69	0.1	0.1	0.0	52	48	69	52	48	69	0.1	0.1	0.0	No
NCA06.RES.0724	RES	NCA06		45	41	62	45	41	62	0.3	0.3	-0.1	45	41	62	45	41	62	0.3	0.3	-0.1	No
NCA06.RES.0725	RES	NCA06		47	43	64	47	43	64	0.1	0.1	0.0	47	43	64	47	43	64	0.1	0.1	0.0	No
NCA06.RES.0726	RES	NCA06		46	42	62	46	42	62	0.2	0.1	0.0	46	42	62	46	42	62	0.2	0.1	0.0	No
NCA06.RES.0727	RES	NCA06		45	41	62	45	41	62	0.2	0.2	0.0	45	41	62	45	41	62	0.2	0.2	0.0	No
NCA06.RES.0728	RES	NCA06		38	34	56	38	34	56	0.2	0.1	0.0	38	34	56	38	34	56	0.2	0.1	0.0	No
NCA06.RES.0729	RES	NCA06		35	31	50	36	32	50	0.9	0.8	0.0	35	31	50	36	32	50	0.9	0.8	0.0	No
NCA06.RES.0730	RES	NCA06		51	47	68	51	47	68	0.1	0.1	0.0	51	47	68	51	47	68	0.1	0.1	0.0	No
NCA06.RES.0731	RES	NCA06		36	32	51	37	33	51	0.6	0.6	0.0	36	32	51	37	33	51	0.6	0.6	0.0	No
NCA06.RES.0732	RES	NCA06		54	50	71	54	50	71	0.1	0.0	0.0	54	50	71	54	50	71	0.1	0.0	0.0	No
NCA06.RES.0733	RES	NCA06		52	48	70	52	48	70	0.0	0.1	0.0	52	48	70	52	48	70	0.0	0.1	0.0	No
NCA06.RES.0734	RES	NCA06		46	42	63	46	42	63	0.2	0.2	0.0	46	42	63	46	42	63	0.2	0.2	0.0	No
NCA06.RES.0735	RES	NCA06		54	50	72	54	50	72	0.1	0.0	0.0	54	50	72	54	50	72	0.1	0.0	0.0	No
NCA06.RES.0736	RES	NCA06		47	43	64	48	44	64	0.2	0.2	0.0	47	43	64	48	44	64	0.2	0.2	0.0	No
NCA06.RES.0737	RES	NCA06		52	48	69	52	49	69	0.1	0.0	0.0	52	48	69	52	49	69	0.1	0.0	0.0	No
NCA06.RES.0738	RES	NCA06		46	42	62	46	42	63	0.1	0.1	0.6	46	42	62	46	42	63	0.1	0.1	0.6	No
NCA06.RES.0739	RES	NCA06		35	31	50	36	32	50	0.7	0.6	0.0	35	31	50	36	32	50	0.7	0.6	0.0	No
NCA06.RES.0740	RES	NCA06		54	50	72	54	50	72	0.0	0.0	0.0	54	50	72	54	50	72	0.0	0.0	0.0	No
NCA06.RES.0742	RES	NCA06		63	59	81	63	59	81	0.0	0.0	0.0	63	59	81	63	59	81	0.0	0.0	0.0	No
NCA06.RES.0743	RES	NCA06		36	32	50	37	33	50	0.7	0.6	0.0	36	32	50	37	33	50	0.7	0.6	0.0	No
NCA06.RES.0744	RES	NCA06		48	44	65	48	44	65	0.1	0.1	0.0	48	44	65	48	44	65	0.1	0.1	0.0	No
NCA06.RES.0745	RES	NCA06		48	44	64	48	44	64	0.1	0.1	0.0	48	44	64	48	44	64	0.1	0.1	0.0	No
NCA06.RES.0746	RES	NCA06		37	33	50	37	33	50	0.6	0.7	0.0	37	33	50	37	33	50	0.6	0.7	0.0	No
NCA06.RES.0747	RES	NCA06		52	48	70	52	48	70	0.0	0.1	0.1	52	48	70	52	48	70	0.1	0.1	0.1	No
NCA06.RES.0748	RES	NCA06		47	43	64	47	43	64	0.1	0.1	0.0	47	43	64	47	43	64	0.1	0.1	0.0	No
NCA06.RES.0749	RES	NCA06		63	59	82	63	59	82	0.0	0.0	0.0	63	59	82	63	59	82	0.0	0.0	0.0	No
NCA06.RES.0750	RES	NCA06		36	32	47	37	33	47	0.8	0.8	0.1	36	32	47	37	33	47	0.8	0.8	0.1	No
NCA06.RES.0751	RES	NCA06		36	32	49	37	33	49	0.3	0.3	0.0	36	32	49	37	33	49	0.3	0.3	0.0	No
NCA06.RES.0753	RES	NCA06		48	44	64	48	44	64	0.2	0.1	0.0	48	44	64	48	44	64	0.2	0.1	0.0	No
NCA06.RES.0755	RES	NCA06		36	32	47	36	32	47	0.5	0.4	0.0	36	32	47	36	32	47	0.5	0.5	0.0	No
NCA06.RES.0756	RES	NCA06		64	60	82	64	60	82	0.0	0.0	0.0	64	60	82	64	60	82	0.0	0.0	0.0	No
NCA06.RES.0757	RES	NCA06		37	33	54	38	34	54	0.2	0.2	0.0	37	33	54	38	34	54	0.2	0.2	0.0	No
NCA06.RES.0758	RES	NCA06		38	34	52	39	35	52	0.3	0.3	0.1	38	34	52	39	35	52	0.4	0.3	0.1	No
NCA06.RES.0759	RES	NCA06		46	42	62	46	42	62	0.1	0.2	0.0	46	42	62	46	42	62	0.1	0.2	0.0	No
NCA06.RES.0760	RES	NCA06		52	48	69	52	48	69	0.0	0.1	0.0	52	48	69	52	48	69	0.0	0.1	0.0	No
NCA06.RES.0761	RES	NCA06		36	32	48	36	32	48	0.5	0.5	0.1	36	32	48	36	32	48	0.5	0.5	0.1	No
NCA06.RES.0763	RES	NCA06		64	61	83	64	61	83	0.0	0.0	0.0	64	61	83	64	61	83	0.0	0.0	0.0	No
NCA06.RES.0764	RES	NCA06		35	31	47	36	32	47	0.7	0.6	0.0	35	31	47	36	32	47	0.7	0.6	0.0	No
NCA06.RES.0765	RES	NCA06		37	33	53	37	33	53	0.4	0.3	0.0	37	33	53	37	33	53	0.4	0.3	0.0	No
NCA06.RES.0766	RES	NCA06		36	32	49	36	32	49	0.7	0.7	0.1	36	32	49	36	32	49	0.7	0.7	0.1	No
NCA06.RES.0767	RES	NCA06		50	46	67	50	46	67	0.0	0.0	0.0	50	46	67	50	46	67	0.0	0.0	0.0	No
NCA06.RES.0768	RES	NCA06		38	34	51	39	35	51	0.5	0.4	0.1	38	34	51	39	35	51	0.5	0.4	0.1	No
NCA06.RES.0769	RES	NCA06		64	61	83	64	61	83	0.0	0.0	0.0	64	61	83	64	61	83	0.0	0.0	0.0	No

NCA06.RES.0771	RES	NCA06		37	33	48	37	33	48	0.7	0.6	0.1	37	33	48	37	33	48	0.7	0.6	0.1	No
NCA06.RES.0772	RES	NCA06		40	36	54	41	37	54	0.5	0.5	0.1	40	36	54	41	37	54	0.5	0.5	0.1	No
NCA06.RES.0773	RES	NCA06		37	33	50	38	34	50	0.8	0.8	0.0	37	33	50	38	34	50	0.8	0.8	0.0	No
NCA06.RES.0774	RES	NCA06		54	50	72	54	50	72	0.1	0.1	0.2	54	50	72	54	50	72	0.1	0.1	0.2	No
NCA06.RES.0775	RES	NCA06		63	59	81	63	59	81	0.0	0.0	0.0	63	59	81	63	59	81	0.0	0.0	0.0	No
NCA06.RES.0776	RES	NCA06		40	36	52	40	36	52	0.5	0.5	0.2	40	36	52	40	36	52	0.6	0.5	0.2	No
NCA06.RES.0777	RES	NCA06		64	60	83	64	60	83	0.0	0.0	0.0	64	60	83	64	60	83	0.0	0.0	0.0	No
NCA06.RES.0778	RES	NCA06		37	33	48	37	33	48	0.7	0.5	0.0	37	33	48	37	33	48	0.7	0.6	0.0	No
NCA06.RES.0782	RES	NCA06		37	33	48	37	33	48	0.8	0.7	0.2	37	33	48	37	33	48	0.8	0.7	0.2	No
NCA06.RES.0783	RES	NCA06		64	60	82	64	60	82	0.0	0.0	0.0	64	60	82	64	60	82	0.0	0.0	0.0	No
NCA06.RES.0785	RES	NCA06		37	33	49	37	33	49	0.5	0.4	0.0	37	33	49	37	33	49	0.5	0.4	0.0	No
NCA06.RES.0786	RES	NCA06		40	36	54	41	37	54	0.4	0.4	0.1	40	36	54	41	37	54	0.4	0.4	0.1	No
NCA06.RES.0788	RES	NCA06		38	34	51	38	34	51	0.6	0.5	0.0	38	34	51	38	34	51	0.6	0.5	0.0	No
NCA06.RES.0789	RES	NCA06		56	52	75	56	53	75	0.1	0.2	0.2	56	52	75	56	53	75	0.1	0.2	0.2	No
NCA06.RES.0790	RES	NCA06		36	32	47	36	32	47	0.5	0.4	0.1	36	32	47	36	32	47	0.5	0.7	0.1	No
NCA06.RES.0793	RES	NCA06		64	60	82	64	60	83	0.1	0.1	0.1	64	60	82	64	60	83	0.1	0.1	0.1	No
NCA06.RES.0794	RES	NCA06		36	32	48	37	33	48	0.6	0.6	0.1	36	32	48	37	33	48	0.6	0.6	0.1	No
NCA06.RES.0795	RES	NCA06		36	32	47	37	33	48	0.8	0.7	0.1	36	32	47	37	33	48	0.8	0.7	0.1	No
NCA06.RES.0798	RES	NCA06		59	55	78	59	55	78	0.1	0.1	0.2	59	55	78	59	55	78	0.1	0.1	0.2	No
NCA06.RES.0799	RES	NCA06		40	36	53	40	36	53	0.5	0.4	0.2	40	36	53	40	36	53	0.5	0.4	0.2	No
NCA06.RES.0800	RES	NCA06		36	32	48	37	33	48	0.5	0.5	0.2	36	32	48	37	33	48	0.5	0.5	0.2	No
NCA06.RES.0802	RES	NCA06		64	60	82	64	60	83	0.1	0.0	0.1	64	60	82	64	60	83	0.1	0.0	0.1	No
NCA06.RES.0803	RES	NCA06		37	33	49	38	34	49	0.5	0.5	0.0	37	33	49	38	34	49	0.5	0.6	0.0	No
NCA06.RES.0806	RES	NCA06		50	46	66	50	46	67	0.2	0.2	0.4	50	46	66	50	46	67	0.2	0.2	0.4	No
NCA06.RES.0808	RES	NCA06		38	34	49	38	34	49	0.5	0.4	0.2	38	34	49	38	34	49	0.5	0.4	0.2	No
NCA06.RES.0810	RES	NCA06		63	59	82	63	59	82	0.1	0.0	0.2	63	59	82	63	59	82	0.1	0.0	0.2	No
NCA06.RES.0813	RES	NCA06		37	33	48	38	34	48	0.5	0.4	0.2	37	33	48	38	34	48	0.5	0.4	0.2	No
NCA06.RES.0816	RES	NCA06		56	52	74	56	52	74	0.1	0.2	0.2	56	52	74	56	52	74	0.1	0.2	0.2	No
NCA06.RES.0818	RES	NCA06		53	49	70	53	49	70	0.1	0.1	0.2	53	49	70	53	49	70	0.1	0.1	0.2	No
NCA06.RES.0819	RES	NCA06		63	59	81	63	59	81	0.1	0.1	0.1	63	59	81	63	59	81	0.1	0.1	0.1	No
NCA06.RES.0821	RES	NCA06		55	51	72	55	51	72	0.0	0.0	0.0	55	51	72	55	51	72	0.0	0.0	0.0	No
NCA06.RES.0822	RES	NCA06		58	54	75	58	54	76	0.2	0.1	0.2	58	54	75	58	54	76	0.2	0.1	0.2	No
NCA06.RES.0824	RES	NCA06		37	33	49	38	34	49	1.0	0.8	0.0	37	33	49	38	34	49	1.0	0.9	0.0	No
NCA06.RES.0826	RES	NCA06		58	54	77	58	55	77	0.1	0.1	0.3	58	54	77	58	55	77	0.1	0.1	0.3	No
NCA06.RES.0828	RES	NCA06		57	53	74	57	53	74	0.1	0.1	0.3	57	53	74	57	53	74	0.1	0.1	0.3	No
NCA06.RES.0829	RES	NCA06		35	31	47	36	32	47	1.0	0.8	-0.2	35	31	47	36	32	47	1.1	0.9	-0.2	No
NCA06.RES.0830	RES	NCA06		54	50	72	54	50	72	0.1	0.1	0.1	54	50	72	54	50	72	0.1	0.1	0.1	No
NCA06.RES.0832	RES	NCA06		60	56	79	60	57	79	0.1	0.1	0.2	60	56	79	60	57	79	0.1	0.1	0.2	No
NCA06.RES.0833	RES	NCA06		60	56	79	60	56	79	0.1	0.1	0.2	60	56	79	60	56	79	0.1	0.1	0.2	No
NCA06.RES.0834	RES	NCA06		36	32	46	37	33	47	1.0	0.8	1.4	36	32	46	37	33	47	1.1	0.8	1.4	No
NCA06.RES.0835	RES	NCA06		55	51	71	55	51	71	0.1	0.2	0.1	55	51	71	55	51	71	0.1	0.2	0.1	No
NCA06.RES.0836	RES	NCA06		64	60	82	64	60	83	0.1	0.1	0.2	64	60	82	64	60	83	0.1	0.1	0.2	No
NCA06.RES.0837	RES	NCA06		60	56	78	60	56	78	0.1	0.1	0.2	60	56	78	60	56	78	0.1	0.1	0.2	No
NCA06.RES.0838	RES	NCA06		39	35	52	40	36	53	0.4	0.4	0.2	39	35	52	40	36	53	0.4	0.4	0.2	No
NCA06.RES.0839	RES	NCA06		48	44	63	48	44	64	0.3	0.3	0.8	48	44	63	48	44	64	0.3	0.3	0.8	No
NCA06.RES.0840	RES	NCA06		35	32	49	36	32	49	0.5	0.3	0.0	35	32	49	36	32	49	0.5	0.3	0.0	No
NCA06.RES.0841	RES	NCA06		63	59	81	63	59	81	0.1	0.1	0.2	63	59	81	63	59	81	0.1	0.1	0.2	No
NCA06.RES.0842	RES	NCA06		51	47	64	51	47	64	0.2	0.1	0.0	51	47	64	51	47	64	0.2	0.1	0.0	No
NCA06.RES.0843	RES	NCA06		46	42	64	46	42	64	-0.5	-0.5	0.0	46	42	64	46	42	64	-0.5	-0.5	0.0	No
NCA06.RES.0844	RES	NCA06		48	44	64	49	45	64	0.3	0.3	0.5	48	44	64	49	45	64	0.3	0.3	0.5	No
NCA06.RES.0845	RES	NCA06		62	58	81	63	59	81	0.1	0.1	0.2	62	58	81	63	59	81	0.1	0.1	0.2	No
NCA06.RES.0846	RES	NCA06		47	43	65	47	43	65	-0.2	-0.2	0.0	47	43	65	47	43	65	-0.1	-0.2	0.0	No
NCA06.RES.0847	RES	NCA06		53	49	69	53	49	69	0.1	0.1	0.3	53	49	69	53	49	69	0.1	0.1	0.3	No
NCA06.RES.0848	RES	NCA06		63	59	81	63	59	81	0.1	0.1	0.2	63	59	81	63	59	81	0.1	0.1	0.2	No
NCA06.RES.0849	RES	NCA06		41	37	56	43	38	57	2.1	1.4	0.7	41	37	56	43	38	57	2.3	1.5	0.7	No
NCA06.RES.0850	RES	NCA06		56	53	74	57	53	74	0.2	0.1	0.3	56	53	74	57	53	74	0.2	0.1	0.3	No
NCA06.RES.0851	RES	NCA06		64	60	82	64	60	83	0.1	0.1	0.2	64	60	82	64	60	83	0.1	0.1	0.2	No
NCA06.RES.0853	RES	NCA06		53	49	67	53	49	67	0.1	0.0	0.5	53	49	67	53	49	67	0.1	0.0	0.5	No
NCA06.RES.0854	RES	NCA06		52	48	67	52	48	67	0.2	0.1	0.0	52	48	67	52	48	67	0.2	0.1	0.0	No
NCA06.RES.0855	RES	NCA06		58	54	76	58	54	76	0.2	0.2	0.3	58	54	76	58	54	76	0.2	0.2	0.3	No
NCA06.RES.0857	RES	NCA06		56	52	71	56	52	71	0.0	-0.1	0.0	56	52	71	56	52	71	0.0	-0.1	0.0	No

NCA06.RES.0858	RES	NCA06		56	52	71	56	52	71	0.0	0.0	0.0	56	52	71	56	52	71	0.0	0.0	0.0	No
NCA06.RES.0860	RES	NCA06		56	52	71	56	52	71	0.1	0.0	0.0	56	52	71	56	52	71	0.1	0.0	0.0	No
NCA06.RES.0861	RES	NCA06		58	55	76	59	55	76	0.2	0.2	0.4	58	55	76	59	55	76	0.2	0.2	0.4	No
NCA06.RES.0862	RES	NCA06		57	53	72	57	53	72	0.0	0.1	0.1	57	53	72	57	53	72	0.0	0.1	0.1	No
NCA06.RES.0863	RES	NCA06		57	53	72	57	53	72	0.1	0.1	0.1	57	53	72	57	53	72	0.1	0.1	0.1	No
NCA06.RES.0864	RES	NCA06		57	53	72	57	53	72	0.1	0.0	0.0	57	53	72	57	53	72	0.1	0.0	0.0	No
NCA06.RES.0865	RES	NCA06		57	53	72	57	53	72	0.1	0.0	0.0	57	53	72	57	53	72	0.1	0.0	0.0	No
NCA06.RES.0866	RES	NCA06		58	54	76	58	55	76	0.2	0.2	0.4	58	54	76	58	55	76	0.2	0.2	0.4	No
NCA06.RES.0867	RES	NCA06		57	53	72	57	53	72	0.0	0.0	0.0	57	53	72	57	53	72	0.0	0.0	0.0	No
NCA06.RES.0868	RES	NCA06		57	53	72	57	53	72	0.0	0.0	0.0	57	53	72	57	53	72	0.0	0.0	0.0	No
NCA06.RES.0869	RES	NCA06		57	53	72	57	53	72	0.0	0.0	0.0	57	53	72	57	53	72	0.0	0.0	0.0	No
NCA06.RES.0870	RES	NCA06		57	54	73	57	54	73	0.0	0.1	0.0	57	54	73	57	54	73	0.0	0.1	0.0	No
NCA06.RES.0871	RES	NCA06		54	51	69	54	51	69	0.0	0.0	0.0	54	51	69	54	51	69	0.0	0.0	0.0	No
NCA06.RES.0872	RES	NCA06		58	54	73	58	54	73	0.1	0.1	0.2	58	54	73	58	54	73	0.1	0.1	0.2	No
NCA06.RES.0874	RES	NCA06		58	54	73	58	54	73	0.0	0.0	0.1	58	54	73	58	54	73	0.0	0.0	0.1	No
NCA06.RES.0875	RES	NCA06		51	47	66	52	48	66	0.1	0.1	0.3	51	47	66	52	48	66	0.1	0.1	0.3	No
NCA06.RES.0876	RES	NCA06		58	54	75	58	55	75	0.1	0.1	0.2	58	54	75	58	55	75	0.1	0.1	0.2	No
NCA06.RES.0877	RES	NCA06		58	54	75	58	54	75	0.1	0.1	0.2	58	54	75	58	54	75	0.1	0.1	0.2	No
NCA06.RES.0878	RES	NCA06		58	55	75	59	55	75	0.1	0.1	0.2	58	55	75	59	55	75	0.1	0.1	0.2	No
NCA06.RES.0879	RES	NCA06		59	55	75	59	55	76	0.1	0.1	0.2	59	55	75	59	55	76	0.1	0.1	0.2	No
NCA06.RES.0880	RES	NCA06		59	55	76	59	55	76	0.1	0.1	0.2	59	55	76	59	55	76	0.1	0.1	0.2	No
NCA06.RES.0881	RES	NCA06		59	55	76	59	55	76	0.1	0.1	0.2	59	55	76	59	55	76	0.1	0.1	0.2	No
NCA06.RES.0883	RES	NCA06		56	52	71	56	52	71	0.0	0.0	0.0	56	52	71	56	52	71	0.0	0.0	0.0	No
NCA07.COM.0975	COM	NCA07		38	34	54	38	34	54	0.4	0.4	0.0	38	34	54	38	34	54	0.4	0.4	0.0	No
NCA07.COM.0991	COM	NCA07		37	33	51	37	33	51	0.7	0.6	0.0	37	33	51	37	33	51	0.7	0.6	0.0	No
NCA07.COM.0995	COM	NCA07		42	38	59	42	38	59	0.1	0.2	0.0	42	38	59	42	38	59	0.1	0.2	0.0	No
NCA07.COM.0996	COM	NCA07		32	28	42	33	29	44	1.2	0.8	2.1	32	28	42	33	29	44	1.3	0.9	2.1	No
NCA07.COM.0997	COM	NCA07		34	30	45	35	30	46	0.6	0.4	0.2	34	30	45	35	30	46	0.6	0.5	0.2	No
NCA07.COM.0998	COM	NCA07		37	33	51	37	33	51	0.4	0.3	0.0	37	33	51	37	33	51	0.4	0.3	0.0	No
NCA07.COM.0999	COM	NCA07		36	32	51	36	32	51	0.5	0.3	0.0	36	32	51	36	32	51	0.5	0.3	0.0	No
NCA07.COM.1001	COM	NCA07		36	32	50	37	33	50	0.6	0.5	0.0	36	32	50	37	33	50	0.7	0.5	0.0	No
NCA07.COM.1002	COM	NCA07		42	38	60	43	39	60	0.2	0.2	0.0	42	38	60	43	39	60	0.2	0.2	0.0	No
NCA07.COM.1003	COM	NCA07		37	33	51	37	33	51	0.8	0.7	0.0	37	33	51	37	33	51	0.8	0.7	0.0	No
NCA07.COM.1004	COM	NCA07		42	38	59	42	38	59	0.2	0.1	0.0	42	38	59	42	38	59	0.2	0.1	0.0	No
NCA07.COM.1005	COM	NCA07		36	32	50	37	33	50	0.9	0.7	0.0	36	32	50	37	33	50	1.0	0.7	0.0	No
NCA07.COM.1007	COM	NCA07		43	39	60	43	39	60	0.2	0.1	0.0	43	39	60	43	39	60	0.2	0.1	0.0	No
NCA07.COM.1008	COM	NCA07		41	37	58	41	37	58	0.1	0.2	0.0	41	37	58	41	37	58	0.1	0.2	0.0	No
NCA07.COM.1009	COM	NCA07		42	38	59	43	39	59	0.3	0.3	0.0	42	38	59	43	39	59	0.3	0.3	0.0	No
NCA07.COM.1010	COM	NCA07		36	32	50	36	32	50	0.6	0.4	0.0	36	32	50	36	32	50	0.7	0.4	0.0	No
NCA07.COM.1012	COM	NCA07		36	32	52	36	32	52	0.9	0.7	0.0	36	32	52	36	32	52	0.9	0.7	0.0	No
NCA07.COM.1013	COM	NCA07		42	39	60	43	39	60	0.1	0.0	0.0	42	39	60	43	39	60	0.1	0.0	0.0	No
NCA07.COM.1014	COM	NCA07		35	31	50	36	32	50	0.9	0.8	0.0	35	31	50	36	32	50	1.0	0.9	0.0	No
NCA07.COM.1016	COM	NCA07		33	29	44	34	29	45	1.3	0.8	1.0	33	29	44	34	30	45	1.4	0.9	1.0	No
NCA07.COM.1017	COM	NCA07		41	37	57	42	38	57	0.2	0.2	0.0	41	37	57	42	38	57	0.2	0.2	0.0	No
NCA07.COM.1018	COM	NCA07		42	38	58	42	38	58	0.1	0.2	0.0	42	38	58	42	38	58	0.1	0.2	0.0	No
NCA07.COM.1019	COM	NCA07		40	36	57	41	37	57	0.3	0.3	0.0	40	36	57	41	37	57	0.3	0.3	0.0	No
NCA07.COM.1020	COM	NCA07		35	31	46	36	32	46	1.1	0.7	0.1	35	31	46	36	32	46	1.2	0.8	0.1	No
NCA07.COM.1023	COM	NCA07		34	30	44	35	31	45	1.1	0.8	1.2	34	30	44	35	31	45	1.2	0.8	1.2	No
NCA07.COM.1024	COM	NCA07		35	31	46	36	32	46	0.7	0.5	0.0	35	31	46	36	32	46	0.8	0.6	0.0	No
NCA07.COM.1025	COM	NCA07		35	31	46	36	31	46	0.9	0.6	0.0	35	31	46	36	31	46	1.0	0.6	0.0	No
NCA07.COM.1026	COM	NCA07		35	31	46	35	31	46	0.5	0.4	0.0	35	31	46	35	31	46	0.5	0.5	0.0	No
NCA07.COM.1028	COM	NCA07		40	36	57	41	37	57	0.2	0.2	0.0	40	36	57	41	37	57	0.2	0.2	0.0	No
NCA07.COM.1030	COM	NCA07		40	36	56	40	36	56	0.2	0.2	0.0	40	36	56	40	36	56	0.2	0.2	0.0	No
NCA07.COM.1031	COM	NCA07		35	31	45	36	32	46	0.6	0.5	0.3	35	31	45	36	32	46	0.6	0.5	0.3	No
NCA07.COM.1032	COM	NCA07		42	38	59	42	38	59	0.1	0.1	0.0	42	38	59	42	38	59	0.1	0.1	0.0	No
NCA07.COM.1033	COM	NCA07		35	31	45	36	31	45	0.6	0.4	0.0	35	31	45	36	31	45	0.7	0.4	0.0	No
NCA07.COM.1034	COM	NCA07		35	31	48	36	31	48	0.6	0.4	0.0	35	31	48	36	31	48	0.7	0.4	0.0	No
NCA07.COM.1035	COM	NCA07		35	31	45	35	31	46	0.5	0.5	0.8	35	31	45	36	31	46	0.6	0.5	0.8	No
NCA07.COM.1036	COM	NCA07		34	30	44	35	31	46	1.2	0.9	1.7	34	30	44	35	31	46	1.3	1.0	1.7	No
NCA07.COM.1037	COM	NCA07		36	32	50	37	32	50	0.6	0.4	0.0	36	32	50	37	33	50	0.7	0.5	0.0	No
NCA07.COM.1038	COM	NCA07		36	32	46	37	33	47	1.1	0.7	1.0	36	32	46	37	33	47	1.2	0.8	1.0	No

NCA07.COM.1039	COM	NCA07		40	36	57	40	36	57	0.3	0.3	0.0	40	36	57	40	36	57	0.3	0.3	0.0	No
NCA07.COM.1040	COM	NCA07		44	40	62	44	40	62	0.1	0.0	0.0	44	40	62	44	40	62	0.1	0.0	0.0	No
NCA07.COM.1042	COM	NCA07		43	39	60	43	39	60	0.1	0.1	0.0	43	39	60	43	39	60	0.1	0.1	0.0	No
NCA07.COM.1043	COM	NCA07		40	36	56	40	36	56	0.2	0.2	0.0	40	36	56	40	36	56	0.2	0.2	0.0	No
NCA07.COM.1044	COM	NCA07		36	32	51	37	33	51	0.5	0.4	0.0	36	32	51	37	33	51	0.5	0.5	0.0	No
NCA07.COM.1045	COM	NCA07		36	32	48	37	32	48	1.0	0.7	0.0	36	32	48	37	32	48	1.1	0.8	0.0	No
NCA07.COM.1047	COM	NCA07		42	38	59	42	38	59	0.2	0.1	0.0	42	38	59	42	38	59	0.2	0.1	0.0	No
NCA07.COM.1048	COM	NCA07		35	31	46	36	32	46	0.9	0.6	0.0	35	31	46	36	32	46	0.9	0.7	0.0	No
NCA07.COM.1051	COM	NCA07		40	36	56	40	36	56	0.3	0.2	0.0	40	36	56	40	36	56	0.3	0.2	0.0	No
NCA07.COM.1052	COM	NCA07		42	38	59	42	38	59	0.1	0.1	0.0	42	38	59	42	38	59	0.1	0.1	0.0	No
NCA07.COM.1053	COM	NCA07		39	35	55	39	35	55	0.3	0.3	0.0	39	35	55	39	35	55	0.3	0.3	0.0	No
NCA07.COM.1054	COM	NCA07		37	33	52	37	33	52	0.4	0.4	0.0	37	33	52	37	33	52	0.5	0.4	0.0	No
NCA07.COM.1055	COM	NCA07		41	37	57	41	37	57	0.2	0.2	0.0	41	37	57	41	37	57	0.2	0.2	0.0	No
NCA07.COM.1056	COM	NCA07		41	37	56	41	37	56	0.3	0.3	0.0	41	37	56	41	37	56	0.3	0.3	0.0	No
NCA07.COM.1057	COM	NCA07		36	32	49	37	33	49	0.5	0.5	0.0	36	32	49	37	33	49	0.5	0.5	0.0	No
NCA07.COM.1058	COM	NCA07		39	35	56	39	35	56	0.4	0.4	0.0	39	35	56	39	35	56	0.4	0.4	0.0	No
NCA07.COM.1059	COM	NCA07		41	37	56	42	38	56	0.3	0.3	0.0	41	37	56	42	38	56	0.4	0.3	0.0	No
NCA07.COM.1060	COM	NCA07		42	38	58	42	38	58	0.3	0.2	0.0	42	38	58	42	38	58	0.3	0.2	0.0	No
NCA07.COM.1063	COM	NCA07		34	30	47	35	31	47	0.7	0.5	0.0	34	30	47	35	31	47	0.8	0.5	0.0	No
NCA07.COM.1064	COM	NCA07		35	31	48	36	32	48	0.8	0.6	0.0	35	31	48	36	32	48	0.9	0.6	0.0	No
NCA07.COM.1065	COM	NCA07		36	32	53	36	32	53	0.3	0.2	0.0	36	32	53	36	32	53	0.3	0.2	0.0	No
NCA07.COM.1066	COM	NCA07		46	42	63	46	42	63	0.1	0.1	0.0	46	42	63	46	42	63	0.1	0.1	0.0	No
NCA07.COM.1068	COM	NCA07		42	38	59	42	38	59	0.1	0.1	0.0	42	38	59	42	38	59	0.1	0.1	0.0	No
NCA07.COM.1069	COM	NCA07		42	38	57	42	38	57	0.2	0.2	0.0	42	38	57	42	38	57	0.2	0.2	0.0	No
NCA07.COM.1070	COM	NCA07		39	35	55	39	35	55	0.3	0.2	0.0	39	35	55	39	35	55	0.3	0.2	0.0	No
NCA07.COM.1071	COM	NCA07		42	38	59	42	39	59	0.1	0.2	0.0	42	38	59	42	39	59	0.1	0.2	0.0	No
NCA07.COM.1072	COM	NCA07		36	32	48	36	32	48	0.6	0.5	0.0	36	32	48	36	32	48	0.7	0.6	0.0	No
NCA07.COM.1073	COM	NCA07		42	38	58	43	39	58	0.3	0.3	0.0	42	38	58	43	39	58	0.3	0.3	0.0	No
NCA07.COM.1074	COM	NCA07		41	37	59	41	37	59	0.1	0.2	0.0	41	37	59	41	37	59	0.2	0.2	0.0	No
NCA07.COM.1075	COM	NCA07		42	38	58	42	38	58	0.2	0.2	0.0	42	38	58	42	38	58	0.2	0.2	0.0	No
NCA07.COM.1076	COM	NCA07		35	31	46	36	32	46	0.6	0.5	0.0	35	31	46	36	32	46	0.6	0.5	0.0	No
NCA07.COM.1077	COM	NCA07		43	40	60	44	40	60	0.2	0.1	0.0	43	40	60	44	40	60	0.2	0.1	0.0	No
NCA07.COM.1078	COM	NCA07		42	38	59	42	38	59	0.1	0.1	0.0	42	38	59	42	38	59	0.1	0.1	0.0	No
NCA07.COM.1079	COM	NCA07		43	39	60	43	39	60	0.1	0.1	0.0	43	39	60	43	39	60	0.1	0.1	0.0	No
NCA07.COM.1080	COM	NCA07		35	31	48	36	32	48	0.6	0.5	0.0	35	31	48	36	32	48	0.6	0.5	0.0	No
NCA07.COM.1081	COM	NCA07		42	39	59	43	39	59	0.3	0.2	0.0	42	39	59	43	39	59	0.3	0.2	0.0	No
NCA07.COM.1082	COM	NCA07		42	38	59	42	39	59	0.2	0.2	0.0	42	38	59	42	39	59	0.2	0.2	0.0	No
NCA07.COM.1084	COM	NCA07		32	29	47	34	29	47	1.1	0.6	0.0	32	29	47	34	29	47	1.2	0.6	0.0	No
NCA07.COM.1085	COM	NCA07		34	30	45	35	31	45	0.8	0.5	0.0	34	30	45	35	31	45	0.8	0.5	0.0	No
NCA07.COM.1087	COM	NCA07		35	31	48	36	32	48	1.0	0.8	0.0	35	31	48	36	32	48	1.0	0.8	0.0	No
NCA07.COM.1088	COM	NCA07		49	45	67	49	45	67	0.0	0.1	0.0	49	45	67	49	45	67	0.0	0.1	0.0	No
NCA07.COM.1089	COM	NCA07		36	32	53	36	32	53	0.8	0.7	0.0	36	32	53	36	32	53	0.8	0.7	0.0	No
NCA07.COM.1090	COM	NCA07		40	36	56	41	37	56	0.3	0.2	0.0	40	36	56	41	37	56	0.3	0.2	0.0	No
NCA07.COM.1091	COM	NCA07		41	37	57	41	37	57	0.3	0.2	0.1	41	37	57	41	37	57	0.3	0.2	0.1	No
NCA07.COM.1092	COM	NCA07		35	32	53	36	32	53	1.2	0.1	0.0	35	32	53	36	32	53	1.2	0.1	0.0	No
NCA07.COM.1093	COM	NCA07		41	37	58	41	37	58	0.2	0.2	0.0	41	37	58	41	37	58	0.3	0.2	0.0	No
NCA07.COM.1094	COM	NCA07		45	41	63	45	41	63	0.0	0.1	0.0	45	41	63	45	41	63	0.0	0.1	0.0	No
NCA07.COM.1096	COM	NCA07		40	37	57	41	37	57	0.3	0.2	-0.1	40	37	57	41	37	57	0.3	0.2	-0.1	No
NCA07.COM.1098	COM	NCA07		42	38	58	42	38	58	0.1	0.2	0.0	42	38	58	42	38	58	0.1	0.2	0.0	No
NCA07.COM.1099	COM	NCA07		37	33	54	38	34	54	0.3	0.2	0.0	37	33	54	38	34	54	0.3	0.2	0.0	No
NCA07.COM.1100	COM	NCA07		47	43	64	47	43	64	0.1	0.1	0.0	47	43	64	47	43	64	0.1	0.1	0.0	No
NCA07.COM.1101	COM	NCA07		38	34	55	38	34	55	0.3	0.2	0.0	38	34	55	38	34	55	0.3	0.2	0.0	No
NCA07.COM.1102	COM	NCA07		41	37	58	41	37	58	0.2	0.0	0.0	41	37	58	41	37	58	0.2	0.0	0.0	No
NCA07.COM.1103	COM	NCA07		43	39	61	43	39	61	0.1	0.1	-0.1	43	39	61	43	39	61	0.1	0.1	-0.1	No
NCA07.COM.1104	COM	NCA07		41	37	58	41	37	58	0.2	0.2	0.0	41	37	58	41	37	58	0.2	0.2	0.0	No
NCA07.COM.1105	COM	NCA07		41	37	58	41	37	58	0.1	0.2	0.0	41	37	58	41	37	58	0.1	0.2	0.0	No
NCA07.COM.1106	COM	NCA07		33	29	46	33	29	46	0.8	0.5	0.7	33	29	46	33	29	46	0.9	0.5	0.7	No
NCA07.COM.1107	COM	NCA07		41	37	58	41	37	58	0.2	0.2	0.0	41	37	58	41	37	58	0.2	0.2	0.0	No
NCA07.COM.1109	COM	NCA07		40	36	57	40	36	57	0.2	0.2	0.0	40	36	57	40	36	57	0.2	0.2	0.0	No
NCA07.COM.1111	COM	NCA07		44	40	61	44	40	61	0.1	0.1	0.0	44	40	61	44	40	61	0.1	0.1	0.0	No
NCA07.COM.1112	COM	NCA07		42	38	59	42	38	59	0.1	0.1	0.0	42	38	59	42	38	59	0.1	0.1	0.0	No

NCA07.COM.1113	COM	NCA07		42	38	59	42	38	59	0.1	0.2	0.0	42	38	59	42	38	59	0.1	0.2	0.0	No
NCA07.COM.1114	COM	NCA07		36	32	52	37	33	52	0.4	0.3	0.0	36	32	52	37	33	52	0.5	0.4	0.0	No
NCA07.COM.1115	COM	NCA07		46	42	64	46	42	64	0.1	0.1	0.0	46	42	64	46	42	64	0.1	0.1	0.0	No
NCA07.COM.1117	COM	NCA07		49	45	67	49	45	67	0.1	0.1	0.0	49	45	67	49	45	67	0.1	0.1	0.0	No
NCA07.COM.1119	COM	NCA07		42	38	59	42	38	59	0.2	0.2	0.0	42	38	59	42	38	59	0.2	0.2	0.0	No
NCA07.COM.1122	COM	NCA07		39	35	54	40	36	54	0.3	0.2	0.0	39	35	54	40	36	54	0.3	0.2	0.0	No
NCA07.COM.1123	COM	NCA07		51	47	69	51	47	69	0.1	0.0	0.0	51	47	69	51	47	69	0.1	0.0	0.0	No
NCA07.COM.1124	COM	NCA07		47	43	65	47	43	65	0.1	0.1	0.0	47	43	65	47	43	65	0.1	0.1	0.0	No
NCA07.COM.1125	COM	NCA07		37	33	50	37	33	50	0.7	0.6	0.1	37	33	50	37	33	50	0.7	0.7	0.1	No
NCA07.COM.1128	COM	NCA07		43	39	60	43	39	60	0.1	0.1	-0.1	43	39	60	43	39	60	0.1	0.1	-0.1	No
NCA07.COM.1129	COM	NCA07		41	37	57	41	37	57	0.2	0.2	0.0	41	37	57	41	37	57	0.2	0.2	0.0	No
NCA07.COM.1132	COM	NCA07		39	35	54	39	35	54	0.4	0.3	0.0	39	35	54	39	35	54	0.4	0.3	0.0	No
NCA07.COM.1135	COM	NCA07		36	32	48	36	32	48	0.6	0.5	0.0	36	32	48	37	32	48	0.7	0.5	0.0	No
NCA07.COM.1136	COM	NCA07		40	36	57	40	37	57	0.1	0.2	0.0	40	36	57	40	37	57	0.1	0.2	0.0	No
NCA07.COM.1138	COM	NCA07		40	36	56	40	37	56	0.4	0.3	0.1	40	36	56	40	37	56	0.4	0.3	0.1	No
NCA07.COM.1140	COM	NCA07		45	41	63	45	41	63	0.0	0.1	0.0	45	41	63	45	41	63	0.0	0.1	0.0	No
NCA07.COM.1141	COM	NCA07		49	45	67	49	45	67	0.0	0.1	0.0	49	45	67	49	45	67	0.0	0.1	0.0	No
NCA07.COM.1142	COM	NCA07		40	36	55	40	36	55	0.3	0.4	0.0	40	36	55	40	36	55	0.3	0.4	0.0	No
NCA07.COM.1144	COM	NCA07		45	41	63	45	41	63	0.1	0.1	0.0	45	41	63	45	41	63	0.1	0.1	0.0	No
NCA07.COM.1145	COM	NCA07		39	35	55	39	35	55	0.3	0.2	0.0	39	35	55	39	35	55	0.3	0.3	0.0	No
NCA07.COM.1147	COM	NCA07		39	35	53	39	35	53	0.4	0.3	0.0	39	35	53	39	35	53	0.4	0.3	0.0	No
NCA07.COM.1148	COM	NCA07		37	33	52	37	33	52	0.4	0.4	0.0	37	33	52	37	33	52	0.4	0.4	0.0	No
NCA07.COM.1149	COM	NCA07		40	36	56	40	36	56	0.2	0.2	0.0	40	36	56	40	36	56	0.2	0.2	0.0	No
NCA07.COM.1150	COM	NCA07		40	36	56	40	36	56	0.2	0.2	0.0	40	36	56	40	36	56	0.2	0.2	0.0	No
NCA07.COM.1152	COM	NCA07		44	40	61	44	40	61	0.1	0.1	0.0	44	40	61	44	40	61	0.1	0.1	0.0	No
NCA07.COM.1154	COM	NCA07		41	37	59	41	38	59	0.2	0.2	0.0	41	37	59	41	38	59	0.2	0.2	0.0	No
NCA07.COM.1156	COM	NCA07		46	42	64	46	42	64	0.1	0.1	0.0	46	42	64	46	42	64	0.1	0.1	0.0	No
NCA07.COM.1157	COM	NCA07		42	38	59	42	38	59	0.2	0.2	0.0	42	38	59	42	38	59	0.2	0.2	0.0	No
NCA07.COM.1158	COM	NCA07		39	35	53	39	35	53	0.4	0.4	0.0	39	35	53	39	35	53	0.4	0.4	0.0	No
NCA07.COM.1161	COM	NCA07		35	31	51	36	32	51	0.6	0.4	0.0	35	31	51	36	32	51	0.6	0.4	0.0	No
NCA07.COM.1164	COM	NCA07		36	32	50	36	32	50	0.6	0.5	0.0	36	32	50	36	32	50	0.6	0.6	0.0	No
NCA07.COM.1165	COM	NCA07		49	45	67	49	45	67	0.0	0.1	0.0	49	45	67	49	45	67	0.0	0.1	0.0	No
NCA07.COM.1166	COM	NCA07		41	37	57	41	37	57	0.3	0.3	0.0	41	37	57	41	37	57	0.3	0.3	0.0	No
NCA07.COM.1167	COM	NCA07		39	35	56	39	35	56	0.2	0.2	0.0	39	35	56	39	35	56	0.2	0.2	0.0	No
NCA07.COM.1168	COM	NCA07		39	35	54	40	36	54	0.4	0.4	-0.1	39	35	54	40	36	54	0.4	0.4	-0.1	No
NCA07.COM.1169	COM	NCA07		40	36	57	40	36	57	0.2	0.2	0.1	40	36	57	40	36	57	0.2	0.2	0.1	No
NCA07.COM.1171	COM	NCA07		44	40	62	44	41	62	0.1	0.1	0.0	44	40	62	44	41	62	0.1	0.1	0.0	No
NCA07.COM.1175	COM	NCA07		37	33	49	37	33	49	0.6	0.6	0.0	37	33	49	37	33	49	0.6	0.6	0.0	No
NCA07.COM.1176	COM	NCA07		42	38	59	42	38	59	0.2	0.2	0.0	42	38	59	42	38	59	0.2	0.2	0.0	No
NCA07.COM.1179	COM	NCA07		36	32	53	37	33	53	0.7	0.3	0.0	36	32	53	37	33	53	0.8	0.3	0.0	No
NCA07.COM.1182	COM	NCA07		38	34	54	38	34	54	0.4	0.4	0.0	38	34	54	38	34	54	0.4	0.4	0.0	No
NCA07.COM.1183	COM	NCA07		38	34	54	38	34	54	0.4	0.4	0.0	38	34	54	38	34	54	0.4	0.4	0.0	No
NCA07.COM.1185	COM	NCA07		39	35	54	39	35	54	0.4	0.4	0.0	39	35	54	39	35	54	0.4	0.4	0.0	No
NCA07.COM.1187	COM	NCA07		40	37	57	41	37	57	0.2	0.2	0.0	40	37	57	41	37	57	0.3	0.2	0.0	No
NCA07.COM.1189	COM	NCA07		40	36	57	40	36	57	0.3	0.2	0.0	40	36	57	40	36	57	0.3	0.2	0.0	No
NCA07.COM.1191	COM	NCA07		40	36	56	40	36	56	0.2	0.2	0.0	40	36	56	40	36	56	0.2	0.2	0.0	No
NCA07.COM.1192	COM	NCA07		37	33	53	37	33	53	0.3	0.3	0.0	37	33	53	37	33	53	0.3	0.3	0.0	No
NCA07.COM.1195	COM	NCA07		36	32	53	37	33	53	0.3	0.2	0.0	36	32	53	37	33	53	0.3	0.2	0.0	No
NCA07.IND.1120	IND	NCA07		36	32	52	37	33	52	0.4	0.3	0.0	36	32	52	37	33	52	0.4	0.3	0.0	No
NCA07.IND.1133	IND	NCA07		33	29	45	34	30	45	0.6	0.4	0.0	33	29	45	34	30	45	0.6	0.4	0.0	No
NCA07.IND.1173	IND	NCA07		33	29	45	34	29	45	1.0	0.6	0.0	33	29	45	34	29	45	1.1	0.7	0.0	No
NCA07.IND.1181	IND	NCA07		37	33	54	38	34	54	0.3	0.3	0.0	37	33	54	38	34	54	0.3	0.3	0.0	No
NCA07.IND.1193	IND	NCA07		33	30	50	34	30	50	0.9	0.7	0.0	33	30	50	34	30	50	1.0	0.7	0.0	No
NCA07.IND.1194	IND	NCA07		37	33	53	37	33	53	0.4	0.3	0.0	37	33	53	37	33	53	0.4	0.3	0.0	No
NCA07.IND.1196	IND	NCA07		37	33	54	37	33	54	0.4	0.3	0.0	37	33	54	37	33	54	0.4	0.3	0.0	No
NCA07.IND.1197	IND	NCA07		33	29	44	34	30	44	0.7	0.5	0.1	33	29	44	34	30	44	0.8	0.5	0.1	No
NCA07.IND.1198	IND	NCA07		32	28	43	33	28	43	0.9	0.6	0.0	32	28	43	33	28	43	0.9	0.6	0.0	No
NCA32.COM.6277	COM	NCA32		52	49	73	53	49	73	0.3	0.2	0.0	52	49	73	53	49	73	0.3	0.2	0.0	No
NCA32.COM.6278	COM	NCA32		52	48	74	52	49	74	0.3	0.2	0.0	52	48	74	52	49	74	0.4	0.2	0.0	No
NCA32.COM.6304	COM	NCA32		53	49	72	53	49	72	0.1	0.0	0.0	53	49	72	53	49	72	0.1	0.0	0.0	No
NCA32.COM.6306	COM	NCA32		48	44	67	48	44	67	0.1	0.1	0.0	48	44	67	48	44	67	0.1	0.1	0.0	No

NCA32.COM.6307	COM	NCA32		47	44	67	47	44	67	0.2	0.1	0.0	47	44	67	47	44	67	0.2	0.1	0.0	No
NCA32.COM.6308	COM	NCA32		48	45	68	48	45	68	0.1	0.1	0.0	48	45	68	48	45	68	0.1	0.1	0.0	No
NCA32.COM.6310	COM	NCA32		46	42	66	46	42	66	0.2	0.1	0.0	46	42	66	46	42	66	0.2	0.1	0.0	No
NCA32.COM.6311	COM	NCA32		47	44	68	48	44	68	0.1	0.0	0.0	47	44	68	48	44	68	0.1	0.1	0.0	No
NCA32.COM.6316	COM	NCA32		54	51	74	54	51	74	0.0	0.0	0.0	54	51	74	54	51	74	0.0	0.0	0.0	No
NCA32.COM.6317	COM	NCA32		54	50	73	54	50	73	0.0	0.0	0.0	54	50	73	54	50	73	0.0	0.0	0.0	No
NCA32.COM.6418	COM	NCA32		62	58	86	62	58	86	0.0	0.0	0.0	62	58	86	62	58	86	0.0	0.0	0.0	No
NCA32.COM.6599	COM	NCA32		60	56	82	60	56	82	0.0	0.0	0.0	60	56	82	60	56	82	0.0	0.0	0.0	No
NCA32.IND.6394	IND	NCA32		46	42	67	46	42	67	0.1	0.1	0.0	46	42	67	46	42	67	0.2	0.1	0.0	No
NCA32.IND.6411	IND	NCA32		42	38	62	42	38	62	0.1	0.1	0.0	42	38	62	42	38	62	0.1	0.1	0.0	No
NCA32.IND.6424	IND	NCA32		66	63	105	66	63	105	0.0	0.0	0.0	66	63	105	66	63	105	0.0	0.0	0.0	No
NCA32.IND.6443	IND	NCA32		64	61	96	64	61	96	0.0	0.0	0.0	64	61	96	64	61	96	0.0	0.0	0.0	No
NCA32.IND.6446	IND	NCA32		48	44	67	48	44	67	0.1	0.1	0.0	48	44	67	48	44	67	0.1	0.1	0.0	No
NCA32.IND.6449	IND	NCA32		45	41	65	45	41	65	0.2	0.1	0.0	45	41	65	45	41	65	0.2	0.1	0.0	No
NCA32.IND.6453	IND	NCA32		66	62	103	66	62	103	0.0	0.0	0.0	66	62	103	66	62	103	0.0	0.0	0.0	No
NCA32.OED.6545	OED	NCA32		49	48	66	50	49	66	1.0	0.4	0.0	49	48	66	50	49	66	1.1	0.5	0.0	No
NCA32.OED.6653	OED	NCA32		46	45	62	50	47	64	3.6	1.8	2.4	46	45	62	50	47	64	3.8	1.9	2.4	No
NCA32.OED.6709	OED	NCA32		46	45	61	50	47	65	3.3	1.6	3.8	46	45	61	50	47	65	3.5	1.8	3.8	No
NCA32.OOA.7713	OOA	NCA32		63	62	83	63	62	83	0.0	0.0	0.0	63	62	83	63	62	83	0.0	0.0	0.0	No
NCA32.OPW.6559	OPW	NCA32		46	46	62	50	47	65	4.0	1.6	2.4	46	46	62	51	47	65	4.2	1.7	2.4	No
NCA32.OPW.6596	OPW	NCA32		46	45	62	50	47	64	3.8	1.9	2.4	46	45	62	50	47	64	4.1	2.1	2.4	No
NCA32.OPW.6641	OPW	NCA32		42	41	58	46	43	60	4.1	2.1	2.4	42	41	58	46	43	60	4.4	2.3	2.4	No
NCA32.RES.6273	RES	NCA32		48	44	67	49	44	67	1.0	0.6	0.0	48	44	67	49	45	67	1.1	0.7	0.0	No
NCA32.RES.6274	RES	NCA32		48	44	67	49	45	67	1.0	0.6	0.0	48	44	67	49	45	67	1.1	0.7	0.0	No
NCA32.RES.6275	RES	NCA32		50	47	71	51	47	71	0.3	0.1	0.0	50	47	71	51	47	71	0.3	0.2	0.0	No
NCA32.RES.6276	RES	NCA32		49	46	70	50	46	70	0.4	0.3	0.0	49	46	70	50	46	70	0.5	0.3	0.0	No
NCA32.RES.6279	RES	NCA32		52	49	73	53	49	73	0.2	0.1	0.0	52	49	73	53	49	73	0.2	0.1	0.0	No
NCA32.RES.6280	RES	NCA32		54	50	75	54	50	75	0.1	0.1	0.0	54	50	75	54	50	75	0.1	0.1	0.0	No
NCA32.RES.6281	RES	NCA32		52	49	74	53	49	74	0.2	0.1	0.0	52	49	74	53	49	74	0.2	0.1	0.0	No
NCA32.RES.6282	RES	NCA32		50	46	71	50	46	71	0.3	0.1	0.0	50	46	71	50	46	71	0.3	0.1	0.0	No
NCA32.RES.6283	RES	NCA32		49	45	68	49	45	68	0.3	0.1	0.0	49	45	68	49	45	68	0.3	0.2	0.0	No
NCA32.RES.6284	RES	NCA32		49	45	69	49	45	69	0.2	0.1	0.0	49	45	69	49	45	69	0.3	0.2	0.0	No
NCA32.RES.6285	RES	NCA32		50	47	71	51	47	71	0.2	0.1	0.0	50	47	71	51	47	71	0.2	0.1	0.0	No
NCA32.RES.6286	RES	NCA32		53	49	73	53	49	73	0.1	0.0	0.0	53	49	73	53	49	73	0.1	0.0	0.0	No
NCA32.RES.6287	RES	NCA32		54	50	73	54	50	73	0.1	0.0	0.0	54	50	73	54	50	73	0.1	0.0	0.0	No
NCA32.RES.6288	RES	NCA32		54	50	73	54	50	73	0.1	0.0	0.0	54	50	73	54	50	73	0.1	0.0	0.0	No
NCA32.RES.6289	RES	NCA32		53	50	73	54	50	73	0.1	0.0	0.0	53	50	73	54	50	73	0.1	0.0	0.0	No
NCA32.RES.6290	RES	NCA32		54	50	73	54	50	73	0.1	0.0	0.0	54	50	73	54	50	73	0.1	0.0	0.0	No
NCA32.RES.6291	RES	NCA32		56	52	76	56	52	76	0.0	0.0	0.0	56	52	76	56	52	76	0.0	0.0	0.0	No
NCA32.RES.6292	RES	NCA32		54	50	74	54	50	74	0.1	0.0	0.0	54	50	74	54	50	74	0.1	0.1	0.0	No
NCA32.RES.6293	RES	NCA32		56	52	76	56	52	76	0.0	0.0	0.0	56	52	76	56	52	76	0.0	0.0	0.0	No
NCA32.RES.6294	RES	NCA32		56	52	76	56	52	76	0.0	0.0	0.0	56	52	76	56	52	76	0.0	0.0	0.0	No
NCA32.RES.6295	RES	NCA32		54	50	73	54	50	73	0.1	0.0	0.0	54	50	73	54	50	73	0.1	0.0	0.0	No
NCA32.RES.6296	RES	NCA32		56	52	76	56	52	76	0.0	0.0	0.0	56	52	76	56	52	76	0.0	0.0	0.0	No
NCA32.RES.6297	RES	NCA32		56	52	76	56	52	76	0.0	0.0	0.0	56	52	76	56	52	76	0.0	0.0	0.0	No
NCA32.RES.6298	RES	NCA32		56	52	76	56	52	76	0.0	0.0	0.0	56	52	76	56	52	76	0.0	0.0	0.0	No
NCA32.RES.6299	RES	NCA32		55	51	74	55	51	74	0.0	0.0	0.0	55	51	74	55	51	74	0.0	0.0	0.0	No
NCA32.RES.6300	RES	NCA32		56	52	76	56	52	76	0.0	0.0	0.0	56	52	76	56	52	76	0.0	0.0	0.0	No
NCA32.RES.6301	RES	NCA32		56	52	76	56	52	76	0.0	0.0	0.0	56	52	76	56	52	76	0.0	0.0	0.0	No
NCA32.RES.6302	RES	NCA32		53	49	73	53	49	73	0.1	0.0	0.0	53	49	73	53	49	73	0.1	0.0	0.0	No
NCA32.RES.6303	RES	NCA32		53	50	74	54	50	74	0.0	0.0	0.0	53	50	74	54	50	74	0.0	0.0	0.0	No
NCA32.RES.6305	RES	NCA32		45	42	63	46	42	63	0.4	0.2	0.0	45	42	63	46	42	63	0.4	0.3	0.0	No
NCA32.RES.6309	RES	NCA32		45	42	64	46	42	64	0.3	0.2	0.0	45	42	64	46	42	64	0.3	0.2	0.0	No
NCA32.RES.6312	RES	NCA32		45	42	65	45	42	65	0.1	0.1	0.0	45	42	65	45	42	65	0.1	0.1	0.0	No
NCA32.RES.6313	RES	NCA32		55	52	75	55	52	75	0.0	0.0	0.0	55	52	75	55	52	75	0.0	0.0	0.0	No
NCA32.RES.6314	RES	NCA32		55	51	75	55	51	75	0.0	0.0	0.0	55	51	75	55	51	75	0.0	0.0	0.0	No
NCA32.RES.6315	RES	NCA32		56	52	76	56	52	76	0.0	0.0	0.0	56	52	76	56	52	76	0.0	0.0	0.0	No
NCA32.RES.6318	RES	NCA32		56	52	76	56	52	76	0.0	0.0	0.0	56	52	76	56	52	76	0.0	0.0	0.0	No
NCA32.RES.6319	RES	NCA32		55	51	75	55	51	75	0.0	0.0	0.0	55	51	75	55	51	75	0.0	0.0	0.0	No
NCA32.RES.6320	RES	NCA32		54	51	74	54	51	74	0.0	0.0	0.0	54	51	74	54	51	74	0.0	0.0	0.0	No
NCA32.RES.6321	RES	NCA32		65	61	90	65	61	90	0.0	0.0	0.0	65	61	90	65	61	90	0.0	0.0	0.0	No

NCA32.RES.6322	RES	NCA32		53	49	73	53	49	73	0.0	0.0	0.0	53	49	73	53	49	73	0.0	0.0	0.0	No
NCA32.RES.6323	RES	NCA32		54	50	74	54	50	74	0.0	0.0	0.0	54	50	74	54	50	74	0.0	0.0	0.0	No
NCA32.RES.6324	RES	NCA32		54	51	75	54	51	75	0.0	0.0	0.0	54	51	75	54	51	75	0.0	0.0	0.0	No
NCA32.RES.6325	RES	NCA32		55	51	75	55	51	75	0.0	0.0	0.0	55	51	75	55	51	75	0.0	0.0	0.0	No
NCA32.RES.6326	RES	NCA32		52	48	71	52	48	71	0.0	0.0	0.0	52	48	71	52	48	71	0.0	0.0	0.0	No
NCA32.RES.6327	RES	NCA32		60	56	82	60	56	82	0.0	0.0	0.0	60	56	82	60	56	82	0.0	0.0	0.0	No
NCA32.RES.6328	RES	NCA32		51	47	71	51	47	71	0.0	0.0	0.0	51	47	71	51	47	71	0.0	0.0	0.0	No
NCA32.RES.6329	RES	NCA32		51	47	70	51	47	70	0.0	0.0	0.0	51	47	70	51	47	70	0.0	0.0	0.0	No
NCA32.RES.6330	RES	NCA32		65	61	88	65	61	88	0.0	0.0	0.0	65	61	88	65	61	88	0.0	0.0	0.0	No
NCA32.RES.6331	RES	NCA32		65	61	88	65	61	88	0.0	0.0	0.0	65	61	88	65	61	88	0.0	0.0	0.0	No
NCA32.RES.6332	RES	NCA32		65	61	88	65	61	88	0.0	0.0	0.0	65	61	88	65	61	88	0.0	0.0	0.0	No
NCA32.RES.6333	RES	NCA32		65	62	90	65	62	90	0.0	0.0	0.0	65	62	90	65	62	90	0.0	0.0	0.0	No
NCA32.RES.6334	RES	NCA32		64	61	86	64	61	86	0.0	0.0	0.0	64	61	86	64	61	86	0.0	0.0	0.0	No
NCA32.RES.6335	RES	NCA32		68	64	92	68	64	92	0.0	0.0	0.0	68	64	92	68	64	92	0.0	0.0	0.0	No
NCA32.RES.6336	RES	NCA32		54	50	73	55	51	73	1.2	0.7	0.0	54	50	73	55	51	73	1.3	0.8	0.0	No
NCA32.RES.6337	RES	NCA32		65	61	89	65	61	89	0.0	0.0	0.0	65	61	89	65	61	89	0.0	0.0	0.0	No
NCA32.RES.6338	RES	NCA32		53	49	72	54	50	72	1.3	0.8	0.0	53	49	72	54	50	72	1.4	0.9	0.0	No
NCA32.RES.6339	RES	NCA32		65	62	90	65	62	90	0.0	0.0	0.0	65	62	90	65	62	90	0.0	0.0	0.0	No
NCA32.RES.6340	RES	NCA32		52	48	72	53	49	72	0.7	0.4	0.0	52	48	72	53	49	72	0.8	0.5	0.0	No
NCA32.RES.6341	RES	NCA32		65	61	86	65	61	86	0.0	0.0	0.0	65	61	86	65	61	86	0.0	0.0	0.0	No
NCA32.RES.6342	RES	NCA32		65	62	91	66	62	91	0.0	0.0	0.0	65	62	91	66	62	91	0.0	0.0	0.0	No
NCA32.RES.6343	RES	NCA32		64	60	85	64	60	85	0.0	0.0	0.0	64	60	85	64	60	85	0.0	0.0	0.0	No
NCA32.RES.6344	RES	NCA32		64	61	86	64	61	86	0.0	0.0	0.0	64	61	86	64	61	86	0.0	0.0	0.0	No
NCA32.RES.6345	RES	NCA32		65	62	90	65	62	90	0.0	0.0	0.0	65	62	90	65	62	90	0.0	0.0	0.0	No
NCA32.RES.6346	RES	NCA32		56	53	77	57	53	77	0.5	0.3	0.0	56	53	77	57	53	77	0.6	0.3	0.0	No
NCA32.RES.6347	RES	NCA32		56	52	77	56	52	77	0.3	0.2	0.0	56	52	77	56	52	77	0.3	0.2	0.0	No
NCA32.RES.6348	RES	NCA32		64	60	85	64	60	85	0.0	0.0	0.0	64	60	85	64	60	85	0.0	0.0	0.0	No
NCA32.RES.6349	RES	NCA32		66	62	92	66	62	92	0.0	0.0	0.0	66	62	92	66	62	92	0.0	0.0	0.0	No
NCA32.RES.6350	RES	NCA32		49	45	67	52	47	71	2.6	1.7	3.7	49	45	67	52	47	71	2.8	1.9	3.7	No
NCA32.RES.6351	RES	NCA32		55	51	76	55	51	76	0.5	0.3	0.0	55	51	76	55	51	76	0.5	0.3	0.0	No
NCA32.RES.6352	RES	NCA32		64	60	85	64	60	85	0.0	0.0	0.0	64	60	85	64	60	85	0.0	0.0	0.0	No
NCA32.RES.6353	RES	NCA32		65	62	89	65	62	89	0.0	0.0	0.0	65	62	89	65	62	89	0.0	0.0	0.0	No
NCA32.RES.6354	RES	NCA32		54	51	75	55	51	75	0.8	0.5	0.0	54	51	75	55	51	75	0.8	0.5	0.0	No
NCA32.RES.6355	RES	NCA32		64	60	85	64	60	85	0.0	0.0	0.0	64	60	85	64	60	85	0.0	0.0	0.0	No
NCA32.RES.6356	RES	NCA32		66	62	91	66	62	91	0.0	0.0	0.0	66	62	91	66	62	91	0.0	0.0	0.0	No
NCA32.RES.6357	RES	NCA32		63	60	85	63	60	85	0.0	0.0	0.0	63	60	85	63	60	85	0.0	0.0	0.0	No
NCA32.RES.6358	RES	NCA32		47	44	65	51	46	71	3.0	2.0	5.4	47	44	65	51	46	71	3.2	2.1	5.4	No
NCA32.RES.6359	RES	NCA32		49	46	70	51	47	70	1.9	1.2	0.0	49	46	70	51	47	70	2.0	1.3	0.0	No
NCA32.RES.6360	RES	NCA32		54	50	74	55	51	74	0.7	0.4	0.0	54	50	74	55	51	74	0.8	0.5	0.0	No
NCA32.RES.6361	RES	NCA32		54	50	74	55	51	74	0.8	0.5	0.0	54	50	74	55	51	74	0.9	0.5	0.0	No
NCA32.RES.6362	RES	NCA32		63	59	84	63	59	84	0.0	0.0	0.0	63	59	84	63	59	84	0.0	0.0	0.0	No
NCA32.RES.6363	RES	NCA32		66	62	91	66	62	91	0.0	0.0	0.0	66	62	91	66	62	91	0.0	0.0	0.0	No
NCA32.RES.6364	RES	NCA32		63	59	85	63	59	85	0.0	0.0	0.0	63	59	85	63	59	85	0.0	0.0	0.0	No
NCA32.RES.6365	RES	NCA32		54	50	74	54	50	74	0.6	0.3	0.0	54	50	74	54	50	74	0.6	0.4	0.0	No
NCA32.RES.6366	RES	NCA32		48	44	66	50	45	68	2.2	1.4	2.1	48	44	66	50	45	68	2.4	1.5	2.1	No
NCA32.RES.6367	RES	NCA32		65	62	90	65	62	90	0.0	0.0	0.0	65	62	90	65	62	90	0.0	0.0	0.0	No
NCA32.RES.6368	RES	NCA32		50	46	70	52	47	70	1.5	1.0	0.0	50	46	70	52	47	70	1.6	1.1	0.0	No
NCA32.RES.6369	RES	NCA32		63	59	85	63	59	85	0.0	0.0	0.0	63	59	85	63	59	85	0.0	0.0	0.0	No
NCA32.RES.6370	RES	NCA32		54	50	74	55	51	74	0.6	0.4	0.0	54	50	74	55	51	74	0.7	0.4	0.0	No
NCA32.RES.6371	RES	NCA32		65	62	89	65	62	89	0.0	0.0	0.0	65	62	89	65	62	89	0.0	0.0	0.0	No
NCA32.RES.6372	RES	NCA32		63	59	87	63	59	87	0.0	0.0	0.0	63	59	87	63	59	87	0.0	0.0	0.0	No
NCA32.RES.6373	RES	NCA32		55	52	76	56	52	76	0.7	0.4	0.0	55	52	76	56	52	76	0.7	0.4	0.0	No
NCA32.RES.6374	RES	NCA32		65	62	89	65	62	89	0.0	0.0	0.0	65	62	89	65	62	89	0.0	0.0	0.0	No
NCA32.RES.6375	RES	NCA32		46	42	65	51	46	71	4.8	3.4	6.1	46	42	65	51	46	71	5.0	3.6	6.1	No
NCA32.RES.6376	RES	NCA32		47	43	66	50	45	68	2.5	1.6	2.6	47	43	66	50	45	68	2.7	1.8	2.6	No
NCA32.RES.6377	RES	NCA32		55	51	75	56	52	75	0.7	0.4	0.0	55	51	75	56	52	75	0.7	0.4	0.0	No
NCA32.RES.6378	RES	NCA32		65	61	89	65	61	89	0.0	0.0	0.0	65	61	89	65	61	89	0.0	0.0	0.0	No
NCA32.RES.6379	RES	NCA32		55	51	76	55	52	76	0.2	0.1	0.0	55	51	76	55	52	76	0.2	0.1	0.0	No
NCA32.RES.6380	RES	NCA32		66	62	92	66	62	92	0.0	0.0	0.0	66	62	92	66	62	92	0.0	0.0	0.0	No
NCA32.RES.6381	RES	NCA32		55	52	76	56	52	76	0.2	0.1	0.0	55	52	76	56	52	76	0.2	0.1	0.0	No
NCA32.RES.6382	RES	NCA32		66	62	91	66	62	91	0.0	0.0	0.0	66	62	91	66	62	91	0.0	0.0	0.0	No

NCA32.RES.6383	RES	NCA32		47	44	65	51	46	70	3.4	2.3	5.8	47	44	65	51	46	70	3.6	2.5	5.8	No
NCA32.RES.6384	RES	NCA32		54	51	75	55	51	75	0.3	0.2	0.0	54	51	75	55	51	75	0.3	0.2	0.0	No
NCA32.RES.6385	RES	NCA32		50	46	62	51	47	70	0.8	0.5	7.7	50	46	62	51	47	70	0.8	0.5	7.7	No
NCA32.RES.6386	RES	NCA32		54	50	73	54	50	73	0.4	0.2	0.0	54	50	73	54	50	73	0.4	0.3	0.0	No
NCA32.RES.6387	RES	NCA32		49	45	65	52	48	72	3.2	2.1	6.5	49	45	65	53	48	72	3.4	2.3	6.5	No
NCA32.RES.6388	RES	NCA32		50	47	71	51	47	71	0.9	0.6	0.0	50	47	71	51	47	71	1.0	0.6	0.0	No
NCA32.RES.6389	RES	NCA32		52	48	72	52	48	72	0.5	0.3	0.0	52	48	72	52	48	72	0.6	0.3	0.0	No
NCA32.RES.6390	RES	NCA32		64	60	93	64	60	93	0.0	0.0	0.0	64	60	93	64	60	93	0.0	0.0	0.0	No
NCA32.RES.6391	RES	NCA32		54	50	73	54	50	73	0.5	0.3	0.0	54	50	73	54	50	73	0.6	0.3	0.0	No
NCA32.RES.6392	RES	NCA32		65	61	88	65	61	88	0.0	0.0	0.0	65	61	88	65	61	88	0.0	0.0	0.0	No
NCA32.RES.6393	RES	NCA32		53	49	72	53	49	72	0.7	0.4	0.0	53	49	72	53	49	72	0.7	0.5	0.0	No
NCA32.RES.6395	RES	NCA32		66	62	90	66	62	90	0.0	0.0	0.0	66	62	90	66	62	90	0.0	0.0	0.0	No
NCA32.RES.6396	RES	NCA32		55	51	74	55	51	74	0.3	0.2	0.0	55	51	74	55	51	74	0.4	0.2	0.0	No
NCA32.RES.6397	RES	NCA32		66	62	91	66	62	91	0.0	0.0	0.0	66	62	91	66	62	91	0.0	0.0	0.0	No
NCA32.RES.6398	RES	NCA32		49	45	66	52	47	68	2.9	2.0	2.5	49	45	66	52	47	68	3.1	2.1	2.5	No
NCA32.RES.6399	RES	NCA32		52	49	72	53	49	72	0.4	0.2	0.0	52	49	72	53	49	72	0.4	0.3	0.0	No
NCA32.RES.6400	RES	NCA32		53	49	73	54	50	73	0.7	0.4	0.0	53	49	73	54	50	73	0.8	0.5	0.0	No
NCA32.RES.6401	RES	NCA32		54	50	73	54	50	73	0.5	0.3	0.0	54	50	73	54	50	73	0.5	0.3	0.0	No
NCA32.RES.6402	RES	NCA32		52	49	72	53	49	72	0.9	0.5	0.0	52	49	72	53	49	72	0.9	0.6	0.0	No
NCA32.RES.6403	RES	NCA32		65	61	88	65	61	88	0.0	0.0	0.0	65	61	88	65	61	88	0.0	0.0	0.0	No
NCA32.RES.6404	RES	NCA32		67	63	99	67	63	99	0.0	0.0	0.0	67	63	99	67	63	99	0.0	0.0	0.0	No
NCA32.RES.6405	RES	NCA32		52	48	71	53	49	71	0.8	0.5	0.0	52	48	71	53	49	71	0.8	0.5	0.0	No
NCA32.RES.6406	RES	NCA32		53	49	72	54	50	72	0.8	0.5	0.0	53	49	72	54	50	72	0.9	0.6	0.0	No
NCA32.RES.6407	RES	NCA32		54	51	74	55	51	74	0.2	0.1	0.0	54	51	74	55	51	74	0.3	0.1	0.0	No
NCA32.RES.6408	RES	NCA32		66	62	96	66	62	96	0.0	0.0	0.0	66	62	96	66	62	96	0.0	0.0	0.0	No
NCA32.RES.6409	RES	NCA32		46	44	63	51	46	69	4.7	1.7	6.3	46	44	63	51	46	69	5.0	1.9	6.3	No
NCA32.RES.6410	RES	NCA32		64	60	88	64	60	88	0.0	0.0	0.0	64	60	88	64	60	88	0.0	0.0	0.0	No
NCA32.RES.6412	RES	NCA32		52	48	71	52	48	71	0.6	0.4	0.0	52	48	71	52	48	71	0.7	0.4	0.0	No
NCA32.RES.6413	RES	NCA32		66	62	97	66	62	97	0.0	0.0	0.0	66	62	97	66	62	97	0.0	0.0	0.0	No
NCA32.RES.6414	RES	NCA32		52	48	71	52	48	71	0.8	0.5	0.0	52	48	71	52	48	71	0.8	0.5	0.0	No
NCA32.RES.6415	RES	NCA32		66	62	95	66	62	95	0.0	0.0	0.0	66	62	95	66	62	95	0.0	0.0	0.0	No
NCA32.RES.6416	RES	NCA32		54	50	74	54	50	74	0.2	0.1	0.0	54	50	74	54	50	74	0.2	0.1	0.0	No
NCA32.RES.6417	RES	NCA32		52	48	71	53	49	71	1.0	0.6	0.0	52	48	71	53	49	71	1.1	0.7	0.0	No
NCA32.RES.6419	RES	NCA32		47	46	64	52	47	70	4.6	1.2	6.9	47	44	64	52	47	70	4.9	3.4	6.9	No
NCA32.RES.6420	RES	NCA32		47	45	63	51	46	69	4.5	1.7	6.0	47	43	63	52	46	69	4.7	3.3	6.0	No
NCA32.RES.6421	RES	NCA32		65	61	90	65	61	90	0.0	0.0	0.0	65	61	90	65	61	90	0.0	0.0	0.0	No
NCA32.RES.6422	RES	NCA32		46	42	64	50	45	69	4.5	3.2	4.6	46	42	64	51	45	69	4.8	3.4	4.6	No
NCA32.RES.6423	RES	NCA32		51	48	71	53	49	71	2.0	0.9	0.0	51	48	71	53	49	71	2.1	1.0	0.0	No
NCA32.RES.6425	RES	NCA32		58	54	78	58	54	78	0.2	0.1	0.0	58	54	78	58	54	78	0.2	0.1	0.0	No
NCA32.RES.6426	RES	NCA32		49	45	67	51	47	69	2.1	1.3	2.1	49	45	67	51	47	69	2.2	1.5	2.1	No
NCA32.RES.6427	RES	NCA32		51	47	70	52	48	70	1.2	0.5	0.0	51	47	70	52	48	70	1.2	0.6	0.0	No
NCA32.RES.6428	RES	NCA32		49	45	67	51	46	67	1.4	0.9	0.0	49	45	67	51	46	67	1.5	1.0	0.0	No
NCA32.RES.6429	RES	NCA32		49	45	67	50	46	68	1.0	0.6	0.8	49	45	67	50	46	68	1.1	0.7	0.8	No
NCA32.RES.6430	RES	NCA32		52	49	72	53	49	72	1.0	0.6	0.0	52	49	72	53	49	72	1.1	0.7	0.0	No
NCA32.RES.6431	RES	NCA32		65	61	92	65	61	92	0.0	0.0	0.0	65	61	92	65	61	92	0.0	0.0	0.0	No
NCA32.RES.6432	RES	NCA32		51	47	69	51	47	69	0.7	0.4	0.0	51	47	69	51	47	69	0.8	0.5	0.0	No
NCA32.RES.6433	RES	NCA32		52	48	71	52	48	71	0.9	0.5	0.0	52	48	71	52	48	71	1.0	0.6	0.0	No
NCA32.RES.6434	RES	NCA32		54	50	75	54	51	75	0.2	0.1	0.0	54	50	75	54	51	75	0.2	0.1	0.0	No
NCA32.RES.6436	RES	NCA32		55	52	76	56	52	76	0.1	0.1	0.0	55	52	76	56	52	76	0.1	0.1	0.0	No
NCA32.RES.6437	RES	NCA32		47	43	64	51	46	68	4.3	3.0	4.7	47	43	64	51	46	68	4.6	3.2	4.7	No
NCA32.RES.6438	RES	NCA32		56	52	77	56	52	77	0.2	0.1	0.0	56	52	77	56	52	77	0.2	0.1	0.0	No
NCA32.RES.6439	RES	NCA32		49	45	69	50	46	69	1.0	0.6	0.0	49	45	69	50	46	69	1.1	0.7	0.0	No
NCA32.RES.6440	RES	NCA32		47	43	62	51	46	68	3.6	2.5	5.9	47	43	62	51	46	68	3.8	2.7	5.9	No
NCA32.RES.6441	RES	NCA32		51	48	70	52	48	70	0.6	0.4	0.0	51	48	70	52	48	70	0.7	0.4	0.0	No
NCA32.RES.6442	RES	NCA32		56	52	77	56	52	77	0.2	0.1	0.0	56	52	77	56	52	77	0.2	0.1	0.0	No
NCA32.RES.6444	RES	NCA32		50	46	69	51	47	69	1.0	0.6	0.0	50	46	69	51	47	69	1.1	0.7	0.0	No
NCA32.RES.6445	RES	NCA32		57	53	78	57	53	78	0.1	0.1	0.0	57	53	78	57	53	78	0.2	0.1	0.0	No
NCA32.RES.6447	RES	NCA32		57	53	78	57	53	78	0.1	0.1	0.0	57	53	78	57	53	78	0.1	0.1	0.0	No
NCA32.RES.6448	RES	NCA32		46	42	62	50	45	68	4.3	3.0	5.2	46	42	62	51	46	68	4.6	3.3	5.2	No
NCA32.RES.6450	RES	NCA32		50	47	68	51	47	68	0.6	0.4	0.0	50	47	68	51	47	68	0.7	0.4	0.0	No
NCA32.RES.6451	RES	NCA32		50	46	68	51	47	68	0.8	0.5	0.0	50	46	68	51	47	68	0.9	0.5	0.0	No

NCA32.RES.6452	RES	NCA32		49	46	69	50	46	69	1.0	0.6	0.0	49	46	69	50	46	69	1.1	0.7	0.0	No
NCA32.RES.6454	RES	NCA32		50	46	68	51	46	68	1.0	0.6	0.0	50	46	68	51	47	68	1.1	0.7	0.0	No
NCA32.RES.6455	RES	NCA32		51	47	70	51	48	70	0.5	0.3	0.0	51	47	70	51	48	70	0.5	0.3	0.0	No
NCA32.RES.6456	RES	NCA32		59	56	81	59	56	81	0.1	0.1	0.0	59	56	81	59	56	81	0.1	0.1	0.0	No
NCA32.RES.6457	RES	NCA32		50	46	69	51	47	69	0.9	0.6	0.0	50	46	69	51	47	69	1.0	0.6	0.0	No
NCA32.RES.6458	RES	NCA32		57	53	77	57	53	77	0.1	0.0	0.0	57	53	77	57	53	77	0.1	0.1	0.0	No
NCA32.RES.6459	RES	NCA32		52	48	71	53	49	71	0.6	0.4	0.0	52	48	71	53	49	71	0.7	0.4	0.0	No
NCA32.RES.6460	RES	NCA32		50	46	68	51	46	68	0.9	0.6	0.0	50	46	68	51	46	68	1.0	0.6	0.0	No
NCA32.RES.6461	RES	NCA32		46	43	62	51	45	69	4.7	2.8	6.8	46	43	62	51	46	69	4.9	3.0	6.8	No
NCA32.RES.6463	RES	NCA32		48	44	65	52	47	69	4.2	2.9	4.2	48	44	65	52	47	69	4.5	3.2	4.2	No
NCA32.RES.6465	RES	NCA32		46	43	64	49	44	65	2.3	1.5	0.7	46	43	64	49	44	65	2.4	1.6	0.7	No
NCA32.RES.6466	RES	NCA32		47	43	65	51	46	68	3.7	2.5	3.2	47	43	65	51	46	68	4.0	2.7	3.2	No
NCA32.RES.6467	RES	NCA32		47	43	65	52	47	70	5.0	3.5	5.1	47	43	65	52	47	70	5.2	3.8	5.1	No
NCA32.RES.6468	RES	NCA32		58	54	80	58	54	80	0.1	0.0	0.0	58	54	80	58	54	80	0.1	0.0	0.0	No
NCA32.RES.6469	RES	NCA32		50	46	69	51	47	69	0.9	0.6	0.0	50	46	69	51	47	69	1.0	0.6	0.0	No
NCA32.RES.6470	RES	NCA32		49	46	69	50	46	69	0.7	0.2	0.0	49	46	69	50	46	69	0.8	0.3	0.0	No
NCA32.RES.6471	RES	NCA32		51	47	71	52	48	71	0.5	0.3	0.0	51	47	71	52	48	71	0.5	0.3	0.0	No
NCA32.RES.6472	RES	NCA32		50	46	69	51	47	69	1.0	0.6	0.0	50	46	69	51	47	69	1.0	0.6	0.0	No
NCA32.RES.6473	RES	NCA32		56	52	78	56	52	78	0.1	0.0	0.0	56	52	78	56	52	78	0.1	0.0	0.0	No
NCA32.RES.6475	RES	NCA32		59	55	82	59	55	82	0.0	0.0	0.0	59	55	82	59	55	82	0.0	0.0	0.0	No
NCA32.RES.6476	RES	NCA32		46	43	67	50	45	67	3.2	2.1	0.0	46	43	67	50	45	67	3.4	2.3	0.0	No
NCA32.RES.6477	RES	NCA32		45	41	62	49	44	67	3.8	2.6	4.8	45	41	62	49	44	67	4.1	2.8	4.8	No
NCA32.RES.6478	RES	NCA32		50	46	68	51	47	68	1.3	0.8	0.0	50	46	68	51	47	68	1.5	0.9	0.0	No
NCA32.RES.6479	RES	NCA32		50	46	68	51	47	68	0.7	0.4	0.0	50	46	68	51	47	68	0.7	0.4	0.0	No
NCA32.RES.6480	RES	NCA32		53	49	73	53	49	73	0.3	0.2	0.0	53	49	73	53	49	73	0.4	0.2	0.0	No
NCA32.RES.6482	RES	NCA32		46	42	63	49	44	66	3.2	2.2	3.1	46	42	63	49	44	66	3.4	2.4	3.1	No
NCA32.RES.6483	RES	NCA32		58	54	81	58	54	81	0.1	0.0	0.0	58	54	81	58	54	81	0.1	0.0	0.0	No
NCA32.RES.6484	RES	NCA32		49	45	67	50	45	67	0.8	0.5	0.0	49	45	67	50	46	67	0.9	0.5	0.0	No
NCA32.RES.6485	RES	NCA32		60	56	83	60	56	83	0.0	0.0	0.0	60	56	83	60	56	83	0.0	0.0	0.0	No
NCA32.RES.6486	RES	NCA32		59	56	83	59	56	83	0.0	0.0	0.0	59	56	83	59	56	83	0.0	0.0	0.0	No
NCA32.RES.6487	RES	NCA32		48	44	65	50	46	68	2.6	1.7	3.6	48	44	65	51	46	68	2.8	1.8	3.6	No
NCA32.RES.6488	RES	NCA32		47	43	66	50	45	66	2.8	1.9	0.0	47	43	66	50	45	66	3.0	2.1	0.0	No
NCA32.RES.6490	RES	NCA32		50	46	69	50	46	69	0.6	0.3	0.0	50	46	69	50	46	69	0.6	0.4	0.0	No
NCA32.RES.6492	RES	NCA32		52	49	72	53	49	72	0.5	0.3	0.0	52	49	72	53	49	72	0.6	0.4	0.0	No
NCA32.RES.6493	RES	NCA32		50	46	68	50	46	68	0.6	0.4	0.0	50	46	68	50	46	68	0.7	0.4	0.0	No
NCA32.RES.6495	RES	NCA32		49	46	67	50	46	67	0.6	0.3	0.0	49	46	67	50	46	67	0.6	0.4	0.0	No
NCA32.RES.6496	RES	NCA32		46	42	64	47	43	64	1.7	1.1	0.0	46	42	64	47	43	64	1.9	1.2	0.0	No
NCA32.RES.6498	RES	NCA32		59	56	83	59	56	83	0.0	0.0	0.0	59	56	83	59	56	83	0.0	0.0	0.0	No
NCA32.RES.6499	RES	NCA32		60	56	84	60	56	84	0.0	0.0	0.0	60	56	84	60	56	84	0.0	0.0	0.0	No
NCA32.RES.6500	RES	NCA32		48	44	65	50	45	68	2.6	1.7	3.6	48	44	65	50	46	68	2.8	1.8	3.6	No
NCA32.RES.6501	RES	NCA32		51	48	71	52	48	71	0.5	0.3	0.0	51	48	71	52	48	71	0.6	0.4	0.0	No
NCA32.RES.6502	RES	NCA32		49	45	67	49	45	67	0.6	0.3	0.0	49	45	67	49	45	67	0.6	0.4	0.0	No
NCA32.RES.6503	RES	NCA32		45	41	62	48	43	65	3.3	2.2	3.3	45	41	62	48	44	65	3.5	2.4	3.3	No
NCA32.RES.6504	RES	NCA32		50	46	69	50	46	69	0.5	0.3	0.0	50	46	69	50	46	69	0.6	0.3	0.0	No
NCA32.RES.6505	RES	NCA32		59	56	84	60	56	84	0.0	0.0	0.0	59	56	84	60	56	84	0.0	0.0	0.0	No
NCA32.RES.6508	RES	NCA32		49	45	66	49	45	66	0.7	0.4	0.0	49	45	66	49	45	66	0.8	0.5	0.0	No
NCA32.RES.6509	RES	NCA32		49	46	69	51	46	69	1.3	0.4	0.0	49	46	69	51	46	69	1.4	0.9	0.0	No
NCA32.RES.6511	RES	NCA32		48	45	66	49	45	66	1.0	0.6	0.0	48	45	66	49	45	66	1.1	0.7	0.0	No
NCA32.RES.6512	RES	NCA32		49	45	69	49	46	69	0.2	0.1	0.0	49	45	69	49	46	69	0.2	0.1	0.0	No
NCA32.RES.6513	RES	NCA32		47	43	64	48	44	64	1.5	1.0	0.0	47	43	64	48	44	64	1.6	1.1	0.0	No
NCA32.RES.6514	RES	NCA32		45	41	64	47	43	64	2.3	1.5	0.0	45	41	64	47	43	64	2.4	1.6	0.0	No
NCA32.RES.6515	RES	NCA32		58	54	83	58	54	83	0.0	0.0	0.0	58	54	83	58	54	83	0.0	0.0	0.0	No
NCA32.RES.6516	RES	NCA32		47	43	65	48	44	65	1.5	0.9	0.0	47	43	65	49	44	65	1.6	1.0	0.0	No
NCA32.RES.6518	RES	NCA32		59	55	84	59	55	84	0.0	0.0	0.0	59	55	84	59	55	84	0.0	0.0	0.0	No
NCA32.RES.6519	RES	NCA32		45	41	60	48	43	64	3.1	2.1	3.6	45	41	60	48	43	64	3.3	2.3	3.6	No
NCA32.RES.6520	RES	NCA32		49	45	69	50	46	69	0.5	0.3	0.0	49	45	69	50	46	69	0.5	0.3	0.0	No
NCA32.RES.6523	RES	NCA32		45	41	60	47	43	63	2.7	1.8	2.8	45	41	60	48	43	63	2.9	1.9	2.8	No
NCA32.RES.6525	RES	NCA32		45	41	63	46	41	63	1.2	0.7	0.0	45	41	63	46	41	63	1.3	0.8	0.0	No
NCA32.RES.6526	RES	NCA32		51	48	71	52	48	71	0.5	0.3	0.0	51	48	71	52	48	71	0.5	0.3	0.0	No
NCA32.RES.6527	RES	NCA32		49	46	69	51	46	69	1.3	0.8	0.0	49	46	69	51	46	69	1.4	0.9	0.0	No
NCA32.RES.6528	RES	NCA32		47	44	66	49	45	66	1.6	1.0	0.0	47	44	66	49	45	66	1.8	1.1	0.0	No

NCA32.RES.6529	RES	NCA32		45	41	63	47	42	63	1.6	1.0	0.0	45	41	63	47	42	63	1.8	1.1	0.0	No
NCA32.RES.6530	RES	NCA32		52	48	71	52	48	71	0.7	0.4	0.0	52	48	71	52	48	71	0.8	0.5	0.0	No
NCA32.RES.6531	RES	NCA32		59	55	84	59	55	84	0.0	0.0	0.0	59	55	84	59	55	84	0.0	0.0	0.0	No
NCA32.RES.6532	RES	NCA32		48	44	66	50	45	66	1.7	1.1	0.0	48	44	66	50	45	66	1.8	1.2	0.0	No
NCA32.RES.6533	RES	NCA32		50	47	70	51	47	70	0.5	0.3	0.0	50	47	70	51	47	70	0.5	0.3	0.0	No
NCA32.RES.6535	RES	NCA32		58	54	83	58	54	83	0.1	0.0	0.0	58	54	83	58	54	83	0.1	0.1	0.0	No
NCA32.RES.6536	RES	NCA32		51	47	70	51	47	70	0.7	0.3	0.0	51	47	70	52	47	70	0.8	0.4	0.0	No
NCA32.RES.6537	RES	NCA32		59	55	83	59	55	83	0.1	0.0	0.0	59	55	83	59	55	83	0.1	0.0	0.0	No
NCA32.RES.6538	RES	NCA32		49	45	68	50	45	68	0.8	0.5	0.0	49	45	68	50	45	68	0.9	0.5	0.0	No
NCA32.RES.6539	RES	NCA32		48	44	66	49	45	66	1.0	0.6	0.0	48	44	66	49	45	66	1.1	0.7	0.0	No
NCA32.RES.6540	RES	NCA32		56	52	77	56	52	77	0.2	0.1	0.0	56	52	77	56	52	77	0.2	0.1	0.0	No
NCA32.RES.6542	RES	NCA32		59	55	84	59	55	84	0.0	0.0	0.0	59	55	84	59	55	84	0.1	0.0	0.0	No
NCA32.RES.6544	RES	NCA32		50	46	69	51	47	69	1.0	0.6	0.0	50	46	69	51	47	69	1.0	0.7	0.0	No
NCA32.RES.6546	RES	NCA32		48	45	67	50	46	67	1.5	0.4	0.0	48	45	67	50	46	67	1.6	0.4	0.0	No
NCA32.RES.6549	RES	NCA32		46	42	60	49	44	65	3.0	2.0	4.2	46	42	60	49	44	65	3.2	2.2	4.2	No
NCA32.RES.6550	RES	NCA32		48	44	66	49	45	66	0.9	0.5	0.0	48	44	66	49	45	66	1.0	0.6	0.0	No
NCA32.RES.6551	RES	NCA32		59	55	83	59	55	83	0.1	0.0	0.0	59	55	83	59	55	83	0.1	0.0	0.0	No
NCA32.RES.6552	RES	NCA32		50	46	69	51	47	69	0.9	0.5	0.0	50	46	69	51	47	69	0.9	0.6	0.0	No
NCA32.RES.6553	RES	NCA32		58	54	83	58	54	83	0.1	0.0	0.0	58	54	83	58	54	83	0.1	0.0	0.0	No
NCA32.RES.6555	RES	NCA32		56	52	77	56	52	77	0.1	0.1	0.0	56	52	77	56	52	77	0.1	0.1	0.0	No
NCA32.RES.6556	RES	NCA32		50	47	70	51	47	70	0.7	0.4	0.0	50	47	70	51	47	70	0.7	0.5	0.0	No
NCA32.RES.6557	RES	NCA32		50	47	69	51	47	69	0.9	0.5	0.0	50	47	69	51	47	69	0.9	0.6	0.0	No
NCA32.RES.6558	RES	NCA32		48	44	67	49	45	67	0.7	0.4	0.0	48	44	67	49	45	67	0.8	0.5	0.0	No
NCA32.RES.6560	RES	NCA32		58	55	83	58	55	83	0.0	0.0	0.0	58	55	83	58	55	83	0.0	0.0	0.0	No
NCA32.RES.6561	RES	NCA32		49	45	67	49	45	67	0.8	0.5	0.0	49	45	67	49	45	67	0.8	0.5	0.0	No
NCA32.RES.6563	RES	NCA32		48	44	68	49	45	68	0.5	0.3	0.0	48	44	68	49	45	68	0.6	0.3	0.0	No
NCA32.RES.6565	RES	NCA32		53	49	74	53	49	74	0.1	0.1	0.0	53	49	74	53	49	74	0.1	0.1	0.0	No
NCA32.RES.6568	RES	NCA32		49	45	68	50	46	68	1.0	0.6	0.0	49	45	68	50	46	68	1.0	0.7	0.0	No
NCA32.RES.6570	RES	NCA32		48	44	66	49	45	66	1.0	0.6	0.0	48	44	66	49	45	66	1.1	0.7	0.0	No
NCA32.RES.6571	RES	NCA32		46	42	66	46	42	66	0.5	0.3	0.0	46	42	66	46	42	66	0.5	0.3	0.0	No
NCA32.RES.6573	RES	NCA32		52	48	73	52	48	73	0.1	0.1	0.0	52	48	73	52	48	73	0.1	0.1	0.0	No
NCA32.RES.6574	RES	NCA32		49	45	67	50	46	67	1.2	0.8	0.0	49	45	67	50	46	67	1.3	0.8	0.0	No
NCA32.RES.6575	RES	NCA32		48	45	66	50	45	66	1.2	0.7	0.0	48	45	66	50	46	66	1.3	0.8	0.0	No
NCA32.RES.6577	RES	NCA32		50	46	70	51	47	70	1.1	0.7	0.0	50	46	70	51	47	70	1.2	0.7	0.0	No
NCA32.RES.6579	RES	NCA32		50	46	69	51	47	69	0.9	0.6	0.0	50	46	69	51	47	69	1.0	0.6	0.0	No
NCA32.RES.6580	RES	NCA32		49	46	67	50	46	67	1.0	0.6	0.0	49	46	67	51	46	67	1.1	0.7	0.0	No
NCA32.RES.6581	RES	NCA32		49	45	70	49	45	70	0.1	0.1	0.0	49	45	70	49	45	70	0.2	0.1	0.0	No
NCA32.RES.6582	RES	NCA32		48	44	65	49	45	65	1.0	0.6	0.0	48	44	65	49	45	65	1.1	0.7	0.0	No
NCA32.RES.6583	RES	NCA32		46	42	65	46	42	65	0.6	0.4	0.0	46	42	65	46	42	65	0.6	0.4	0.0	No
NCA32.RES.6585	RES	NCA32		49	46	71	50	46	71	0.4	0.2	0.0	49	46	71	50	46	71	0.5	0.3	0.0	No
NCA32.RES.6586	RES	NCA32		50	46	68	51	47	68	1.5	0.9	0.0	50	46	68	51	47	68	1.6	1.0	0.0	No
NCA32.RES.6587	RES	NCA32		49	45	67	50	46	67	1.2	0.7	0.0	49	45	67	50	46	67	1.3	0.8	0.0	No
NCA32.RES.6589	RES	NCA32		47	43	67	48	44	67	0.8	0.5	0.0	47	43	67	48	44	67	0.8	0.5	0.0	No
NCA32.RES.6591	RES	NCA32		50	46	71	50	46	71	0.2	0.1	0.0	50	46	71	50	46	71	0.2	0.1	0.0	No
NCA32.RES.6592	RES	NCA32		48	45	68	50	45	68	1.7	0.5	0.0	48	44	68	50	45	68	1.8	1.2	0.0	No
NCA32.RES.6594	RES	NCA32		47	43	64	48	44	64	0.5	0.3	0.0	47	43	64	48	44	64	0.6	0.4	0.0	No
NCA32.RES.6595	RES	NCA32		47	43	66	47	43	66	0.5	0.3	0.0	47	43	66	47	43	66	0.6	0.3	0.0	No
NCA32.RES.6597	RES	NCA32		49	45	70	49	46	70	0.3	0.2	0.0	49	45	70	49	46	70	0.3	0.2	0.0	No
NCA32.RES.6602	RES	NCA32		47	43	63	48	44	64	1.6	1.0	1.2	47	43	63	48	44	64	1.7	1.1	1.2	No
NCA32.RES.6603	RES	NCA32		49	45	69	49	45	69	0.3	0.2	0.0	49	45	69	49	45	69	0.3	0.2	0.0	No
NCA32.RES.6607	RES	NCA32		47	44	66	49	45	66	1.9	1.2	0.0	47	44	66	49	45	66	2.1	1.3	0.0	No
NCA32.RES.6608	RES	NCA32		49	45	70	50	46	70	0.4	0.2	0.0	49	45	70	50	46	70	0.4	0.3	0.0	No
NCA32.RES.6609	RES	NCA32		47	43	65	48	44	65	0.9	0.6	0.0	47	43	65	48	44	65	1.0	0.6	0.0	No
NCA32.RES.6612	RES	NCA32		48	44	66	49	45	66	1.4	0.9	0.0	48	44	66	49	45	66	1.5	1.0	0.0	No
NCA32.RES.6613	RES	NCA32		48	44	66	49	45	66	1.1	0.7	0.0	48	44	66	49	45	66	1.2	0.8	0.0	No
NCA32.RES.6614	RES	NCA32		49	45	67	50	46	67	1.3	0.8	0.0	49	45	67	50	46	67	1.4	0.9	0.0	No
NCA32.RES.6615	RES	NCA32		47	43	65	48	44	65	1.1	0.7	0.0	47	43	65	48	44	65	1.2	0.7	0.0	No
NCA32.RES.6616	RES	NCA32		47	44	66	48	44	66	1.0	0.6	0.0	47	44	66	49	44	66	1.1	0.7	0.0	No
NCA32.RES.6617	RES	NCA32		47	43	67	48	44	67	0.6	0.4	0.0	47	43	67	48	44	67	0.7	0.4	0.0	No
NCA32.RES.6619	RES	NCA32		48	44	65	49	45	65	0.9	0.6	0.0	48	44	65	49	45	65	1.0	0.6	0.0	No
NCA32.RES.6622	RES	NCA32		59	55	81	59	55	81	0.0	0.0	0.0	59	55	81	59	55	81	0.0	0.0	0.0	No

NCA32.RES.6623	RES	NCA32		48	44	65	49	45	65	1.2	0.6	0.0	48	44	65	49	45	65	1.5	0.7	0.0	No
NCA32.RES.6626	RES	NCA32		48	44	67	49	45	67	0.9	0.5	0.0	48	44	67	49	45	67	1.0	0.6	0.0	No
NCA32.RES.6629	RES	NCA32		46	42	66	47	43	66	0.5	0.3	0.0	46	42	66	47	43	66	0.6	0.4	0.0	No
NCA32.RES.6630	RES	NCA32		47	43	66	48	44	66	1.1	0.7	0.0	47	43	66	48	44	66	1.2	0.8	0.0	No
NCA32.RES.6631	RES	NCA32		48	44	64	49	45	65	1.5	0.9	0.8	48	44	64	49	45	65	1.6	1.0	0.8	No
NCA32.RES.6632	RES	NCA32		46	42	66	47	43	66	0.9	0.5	0.0	46	42	66	47	43	66	1.0	0.6	0.0	No
NCA32.RES.6635	RES	NCA32		49	45	66	50	46	66	1.3	0.8	0.0	49	45	66	50	46	66	1.4	0.9	0.0	No
NCA32.RES.6636	RES	NCA32		49	45	66	51	46	66	1.3	0.8	0.0	49	45	66	51	46	66	1.4	0.9	0.0	No
NCA32.RES.6637	RES	NCA32		47	43	65	48	44	65	0.9	0.5	0.0	47	43	65	48	44	65	1.0	0.6	0.0	No
NCA32.RES.6639	RES	NCA32		48	44	68	49	45	68	0.7	0.4	0.0	48	44	68	49	45	68	0.8	0.5	0.0	No
NCA32.RES.6643	RES	NCA32		48	44	66	49	45	66	1.1	0.7	0.0	48	44	66	49	45	66	1.2	0.8	0.0	No
NCA32.RES.6644	RES	NCA32		48	44	66	49	45	66	0.9	0.6	0.0	48	44	66	49	45	66	1.0	0.6	0.0	No
NCA32.RES.6645	RES	NCA32		48	44	67	49	45	67	1.2	0.8	0.0	48	44	67	49	45	67	1.3	0.8	0.0	No
NCA32.RES.6646	RES	NCA32		48	44	64	49	45	65	1.2	0.8	0.4	48	44	64	50	45	65	1.3	0.8	0.4	No
NCA32.RES.6647	RES	NCA32		48	44	65	49	45	65	0.8	0.5	0.0	48	44	65	49	45	65	0.9	0.5	0.0	No
NCA32.RES.6648	RES	NCA32		59	55	81	59	55	81	0.0	0.0	0.0	59	55	81	59	55	81	0.0	0.0	0.0	No
NCA32.RES.6652	RES	NCA32		58	54	80	58	54	80	0.0	0.0	0.0	58	54	80	58	54	80	0.0	0.0	0.0	No
NCA32.RES.6654	RES	NCA32		47	43	67	48	44	67	0.7	0.4	0.0	47	43	67	48	44	67	0.8	0.5	0.0	No
NCA32.RES.6655	RES	NCA32		46	42	63	48	43	63	1.4	0.9	0.0	46	42	63	48	43	63	1.5	0.9	0.0	No
NCA32.RES.6657	RES	NCA32		47	44	67	48	44	67	0.9	0.6	0.0	47	44	67	48	44	67	1.0	0.6	0.0	No
NCA32.RES.6658	RES	NCA32		46	42	61	48	43	64	1.7	1.1	3.1	46	42	61	48	44	64	1.8	1.2	3.1	No
NCA32.RES.6659	RES	NCA32		48	44	65	49	44	65	0.9	0.6	0.0	48	44	65	49	45	65	1.0	0.6	0.0	No
NCA32.RES.6661	RES	NCA32		55	51	77	55	51	77	0.0	0.0	0.0	55	51	77	55	51	77	0.0	0.0	0.0	No
NCA32.RES.6664	RES	NCA32		46	43	67	47	43	67	0.2	0.1	0.0	46	43	67	47	43	67	0.2	0.1	0.0	No
NCA32.RES.6666	RES	NCA32		47	44	64	48	44	64	0.9	0.5	0.0	47	44	64	48	44	64	0.9	0.6	0.0	No
NCA32.RES.6667	RES	NCA32		58	55	80	58	55	80	0.0	0.0	0.0	58	55	80	58	55	80	0.0	0.0	0.0	No
NCA32.RES.6668	RES	NCA32		48	44	66	49	45	66	0.9	0.6	0.0	48	44	66	49	45	66	1.0	0.6	0.0	No
NCA32.RES.6669	RES	NCA32		48	44	65	50	45	65	1.9	1.3	0.0	48	44	65	50	45	65	2.1	1.4	0.0	No
NCA32.RES.6671	RES	NCA32		49	45	66	50	45	66	1.1	0.7	0.0	49	45	66	50	45	66	1.2	0.8	0.0	No
NCA32.RES.6672	RES	NCA32		48	45	66	49	45	66	0.8	0.5	0.0	48	45	66	49	45	66	0.9	0.6	0.0	No
NCA32.RES.6675	RES	NCA32		48	45	66	50	46	66	1.4	0.9	0.0	48	45	66	50	46	66	1.5	0.9	0.0	No
NCA32.RES.6677	RES	NCA32		45	43	66	47	43	66	1.4	0.1	0.0	45	43	66	47	43	66	1.5	0.1	0.0	No
NCA32.RES.6678	RES	NCA32		48	44	66	49	45	66	1.1	0.7	0.0	48	44	66	49	45	66	1.3	0.8	0.0	No
NCA32.RES.6680	RES	NCA32		46	42	63	47	43	63	1.3	0.8	0.0	46	42	63	47	43	63	1.4	0.9	0.0	No
NCA32.RES.6681	RES	NCA32		48	44	64	49	45	64	1.4	0.7	0.0	48	44	64	49	45	64	1.5	0.8	0.0	No
NCA32.RES.6683	RES	NCA32		48	44	66	49	45	66	1.4	0.8	0.0	48	44	66	50	45	66	1.5	0.9	0.0	No
NCA32.RES.6686	RES	NCA32		48	44	65	49	45	65	1.3	0.8	0.0	48	44	65	49	45	65	1.4	0.9	0.0	No
NCA32.RES.6687	RES	NCA32		48	44	65	49	45	65	1.5	0.9	0.0	48	44	65	49	45	65	1.6	1.0	0.0	No
NCA32.RES.6688	RES	NCA32		49	45	64	50	45	65	1.1	0.7	1.6	49	45	64	50	46	65	1.2	0.8	1.6	No
NCA32.RES.6691	RES	NCA32		47	43	65	48	44	65	1.5	0.9	0.0	47	43	65	48	44	65	1.6	1.1	0.0	No
NCA32.RES.6694	RES	NCA32		46	42	61	48	43	64	1.8	1.1	2.4	46	42	61	48	43	64	1.9	1.2	2.4	No
NCA32.RES.6695	RES	NCA32		47	43	64	49	44	64	1.4	0.9	0.0	47	43	64	49	44	64	1.6	1.0	0.0	No
NCA32.RES.6696	RES	NCA32		47	43	64	48	44	64	0.9	0.6	0.0	47	43	64	48	44	64	1.0	0.6	0.0	No
NCA32.RES.6698	RES	NCA32		48	44	65	50	45	65	1.5	1.0	0.0	48	44	65	50	45	65	1.6	1.1	0.0	No
NCA32.RES.6699	RES	NCA32		47	43	64	48	44	64	1.1	0.7	0.0	47	43	64	48	44	64	1.2	0.8	0.0	No
NCA32.RES.6700	RES	NCA32		46	43	63	48	44	63	1.6	1.0	0.0	46	43	63	48	44	63	1.7	1.1	0.0	No
NCA32.RES.6701	RES	NCA32		47	43	64	49	44	64	2.0	1.3	0.0	47	43	64	49	44	64	2.1	1.4	0.0	No
NCA32.RES.6704	RES	NCA32		46	42	64	48	43	64	1.4	0.9	0.0	46	42	64	48	43	64	1.5	0.9	0.0	No
NCA32.RES.6705	RES	NCA32		47	43	64	50	45	66	2.9	1.9	2.1	47	43	64	50	45	66	3.1	2.1	2.1	No
NCA32.RES.6706	RES	NCA32		46	42	62	48	43	62	1.3	0.8	0.0	46	42	62	48	43	62	1.4	0.9	0.0	No
NCA32.RES.6708	RES	NCA32		47	43	61	49	44	65	2.5	1.6	3.9	47	43	61	49	45	65	2.7	1.8	3.9	No
NCA32.RES.6711	RES	NCA32		47	43	64	48	44	64	0.7	0.4	0.0	47	43	64	48	44	64	0.8	0.5	0.0	No
NCA32.RES.6712	RES	NCA32		46	42	62	48	44	63	1.7	1.1	1.6	46	42	62	48	44	63	1.9	1.2	1.6	No
NCA32.RES.6713	RES	NCA32		47	43	65	48	44	65	1.4	0.9	0.0	47	43	65	48	44	65	1.5	1.0	0.0	No
NCA32.RES.6716	RES	NCA32		47	43	64	48	44	64	1.6	1.0	0.0	47	43	64	48	44	64	1.8	1.1	0.0	No
NCA32.RES.6719	RES	NCA32		43	40	57	46	41	62	2.3	1.5	5.7	43	40	57	46	41	62	2.5	1.6	5.7	No
NCA32.RES.6721	RES	NCA32		48	44	64	49	45	64	1.6	1.1	0.0	48	44	64	49	45	64	1.8	1.2	0.0	No
NCA32.RES.6722	RES	NCA32		48	44	64	50	45	64	1.7	1.1	0.1	48	44	64	50	45	64	1.9	1.2	0.1	No
NCA32.RES.6726	RES	NCA32		46	42	62	48	43	63	1.6	1.0	1.0	46	42	62	48	43	63	1.7	1.1	1.0	No
NCA32.RES.6730	RES	NCA32		47	43	63	49	44	64	2.3	1.6	1.1	47	43	63	49	45	64	2.5	1.7	1.1	No
NCA32.RES.6731	RES	NCA32		46	43	63	47	43	64	0.9	0.4	1.5	46	43	63	47	43	64	1.0	0.6	1.5	No

NCA32.RES.6733	RES	NCA32		44	40	59	46	42	62	2.5	1.6	5.3	44	40	59	46	42	62	2.7	1.8	5.3	No
NCA32.RES.6735	RES	NCA32		46	43	63	47	43	63	0.8	0.5	0.0	46	43	63	47	43	63	0.8	0.5	0.0	No
NCA32.RES.6736	RES	NCA32		47	43	62	48	44	64	1.2	0.7	1.8	47	43	62	49	44	64	1.3	0.8	1.8	No
NCA32.RES.6737	RES	NCA32		47	43	64	47	43	64	0.7	0.4	0.0	47	43	64	47	43	64	0.8	0.5	0.0	No
NCA32.RES.6739	RES	NCA32		46	43	64	48	44	64	1.5	0.7	0.0	46	43	64	48	44	64	1.6	0.8	0.0	No
NCA32.RES.6741	RES	NCA32		46	42	63	47	43	63	1.2	0.7	0.0	46	42	63	48	43	63	1.3	0.8	0.0	No
NCA32.RES.6744	RES	NCA32		44	40	60	45	41	60	1.4	0.9	0.0	44	40	60	46	41	60	1.5	1.0	0.0	No
NCA32.RES.6746	RES	NCA32		48	44	64	49	45	64	1.5	0.9	0.0	48	44	64	49	45	64	1.6	1.0	0.0	No
NCA32.RES.6747	RES	NCA32		46	42	64	48	43	64	1.7	1.1	0.0	46	42	64	48	43	64	1.8	1.2	0.0	No
NCA32.RES.6749	RES	NCA32		45	41	63	46	42	63	1.1	0.7	0.0	45	41	63	46	42	63	1.2	0.8	0.0	No
NCA32.RES.6750	RES	NCA32		46	42	62	48	43	63	1.2	0.8	1.6	46	42	62	48	43	63	1.3	0.8	1.6	No
NCA32.RES.6752	RES	NCA32		47	43	62	49	44	63	1.4	0.9	0.1	47	43	62	49	44	63	1.5	0.9	0.1	No
NCA32.RES.6755	RES	NCA32		45	41	63	46	42	63	1.2	0.8	0.0	45	41	63	46	42	63	1.3	0.8	0.0	No
NCA32.RES.6756	RES	NCA32		45	42	62	47	43	62	1.7	1.0	0.0	45	42	62	47	43	62	1.8	1.2	0.0	No
NCA32.RES.6757	RES	NCA32		46	43	61	47	43	64	1.0	0.6	2.8	46	43	61	47	43	64	1.1	0.7	2.8	No
NCA32.RES.6758	RES	NCA32		45	41	63	47	42	63	1.8	1.2	0.0	45	41	63	47	42	63	2.0	1.3	0.0	No
NCA32.RES.6760	RES	NCA32		47	43	61	49	44	66	2.1	1.4	4.5	47	43	61	49	44	66	2.3	1.5	4.5	No
NCA32.RES.6761	RES	NCA32		45	41	63	47	42	63	1.4	0.9	0.0	45	41	63	47	42	63	1.5	1.0	0.0	No
NCA32.RES.6762	RES	NCA32		48	44	62	49	45	63	1.2	0.8	0.5	48	44	62	50	45	63	1.3	0.8	0.5	No
NCA32.RES.6764	RES	NCA32		46	43	66	48	44	66	1.6	1.0	0.0	46	43	66	48	44	66	1.7	1.1	0.0	No
NCA32.RES.6765	RES	NCA32		46	42	63	47	43	63	1.5	1.0	0.0	46	42	63	47	43	63	1.6	1.1	0.0	No
NCA32.RES.6767	RES	NCA32		45	41	60	47	42	61	1.6	1.0	1.8	45	41	60	47	42	61	1.7	1.1	1.8	No
NCA32.RES.6768	RES	NCA32		45	41	63	46	42	63	1.1	0.7	0.0	45	41	63	46	42	63	1.2	0.8	0.0	No
NCA32.RES.6769	RES	NCA32		47	43	62	48	44	63	1.3	0.8	1.6	47	43	62	48	44	63	1.4	0.9	1.6	No
NCA32.RES.6772	RES	NCA32		48	44	62	49	44	63	0.8	0.5	1.8	48	44	62	49	44	63	0.9	0.6	1.8	No
NCA32.RES.6773	RES	NCA32		45	41	63	46	42	63	1.2	0.7	0.0	45	41	63	46	42	63	1.3	0.8	0.0	No
NCA32.RES.6775	RES	NCA32		44	40	59	45	41	61	2.0	1.3	1.8	44	40	59	46	41	61	2.1	1.4	1.8	No
NCA32.RES.6776	RES	NCA32		46	42	61	47	42	61	1.2	0.8	0.0	46	42	61	47	43	61	1.3	0.9	0.0	No
NCA32.RES.6778	RES	NCA32		46	42	60	48	43	64	1.8	1.2	3.1	46	42	60	48	43	64	2.0	1.3	3.1	No
NCA32.RES.6779	RES	NCA32		46	42	60	47	43	62	1.5	0.9	2.0	46	42	60	47	43	62	1.6	1.0	2.0	No
NCA32.RES.6780	RES	NCA32		45	41	62	47	42	62	1.8	1.2	0.0	45	41	62	47	42	62	2.0	1.3	0.0	No
NCA32.RES.6782	RES	NCA32		46	42	61	47	43	61	1.0	0.6	0.0	46	42	61	47	43	61	1.1	0.7	0.0	No
NCA32.RES.6785	RES	NCA32		46	42	62	47	43	62	1.0	0.6	0.0	46	42	62	47	43	62	1.1	0.7	0.0	No
NCA32.RES.6787	RES	NCA32		45	41	63	46	42	63	1.2	0.7	0.0	45	41	63	46	42	63	1.3	0.8	0.0	No
NCA32.RES.6788	RES	NCA32		46	42	62	47	43	62	1.4	0.6	0.0	46	42	62	47	43	62	1.5	0.7	0.0	No
NCA32.RES.6790	RES	NCA32		43	39	61	44	40	61	1.7	1.1	0.0	43	39	61	45	40	61	1.8	1.2	0.0	No
NCA32.RES.6792	RES	NCA32		44	40	59	46	42	63	2.2	1.4	3.9	44	40	59	47	42	63	2.4	1.6	3.9	No
NCA32.RES.6793	RES	NCA32		46	42	63	47	43	63	1.1	0.7	0.0	46	42	63	47	43	63	1.2	0.8	0.0	No
NCA32.RES.6794	RES	NCA32		43	39	61	44	40	61	1.0	0.6	0.0	43	39	61	44	40	61	1.0	0.7	0.0	No
NCA32.RES.6796	RES	NCA32		43	40	61	44	40	61	1.5	0.5	0.0	43	39	61	45	40	61	1.6	1.1	0.0	No
NCA32.RES.6797	RES	NCA32		45	41	59	47	43	63	2.3	1.5	4.6	45	41	59	47	43	63	2.5	1.7	4.6	No
NCA32.RES.6798	RES	NCA32		45	41	61	47	42	62	1.9	1.2	1.0	45	41	61	47	42	62	2.1	1.4	1.0	No
NCA32.RES.6799	RES	NCA32		46	42	62	48	43	62	1.4	0.9	0.8	46	42	62	48	43	62	1.5	1.0	0.8	No
NCA32.RES.6800	RES	NCA32		47	44	63	49	45	66	1.6	1.0	3.5	47	44	63	49	45	66	1.7	1.1	3.5	No
NCA32.RES.6801	RES	NCA32		45	42	61	47	43	61	1.5	1.0	0.4	45	42	61	47	43	61	1.7	1.1	0.4	No
NCA32.RES.6802	RES	NCA32		46	42	62	47	43	62	0.9	0.6	0.0	46	42	62	47	43	62	1.0	0.6	0.0	No
NCA32.RES.6803	RES	NCA32		43	39	61	44	40	61	1.0	0.6	0.0	43	39	61	44	40	61	1.1	0.7	0.0	No
NCA32.RES.6805	RES	NCA32		45	41	61	46	42	61	1.6	1.0	0.0	45	41	61	47	42	61	1.7	1.1	0.0	No
NCA32.RES.6806	RES	NCA32		48	44	63	50	45	66	1.4	0.9	3.6	48	44	63	50	45	66	1.6	1.0	3.6	No
NCA32.RES.6807	RES	NCA32		46	43	63	48	44	63	1.4	0.9	0.0	46	43	63	48	44	63	1.6	1.0	0.0	No
NCA32.RES.6808	RES	NCA32		47	43	62	49	44	64	1.3	0.9	2.4	47	43	62	49	44	64	1.5	0.9	2.4	No
NCA32.RES.6809	RES	NCA32		46	42	63	48	43	63	1.5	0.9	0.0	46	42	63	48	43	63	1.6	1.0	0.0	No
NCA32.RES.6810	RES	NCA32		43	39	59	45	41	60	1.6	1.1	0.2	43	39	59	45	41	60	1.8	1.2	0.2	No
NCA32.RES.6811	RES	NCA32		47	43	63	49	44	63	1.6	1.0	0.8	47	43	63	49	45	63	1.8	1.1	0.8	No
NCA32.RES.6813	RES	NCA32		46	42	61	48	43	65	1.8	1.2	4.6	46	42	61	48	43	65	2.0	1.3	4.6	No
NCA32.RES.6814	RES	NCA32		43	39	59	44	40	59	1.3	0.8	0.0	43	39	59	44	40	59	1.4	0.9	0.0	No
NCA32.RES.6815	RES	NCA32		46	43	64	48	44	64	1.5	1.0	0.0	46	43	64	48	44	64	1.7	1.0	0.0	No
NCA32.RES.6816	RES	NCA32		41	38	60	42	38	60	1.2	0.1	0.0	41	38	60	42	38	60	1.3	0.1	0.0	No
NCA32.RES.6819	RES	NCA32		47	43	62	48	44	65	1.3	0.8	3.2	47	43	62	48	44	65	1.4	0.9	3.2	No
NCA32.RES.6820	RES	NCA32		46	42	63	48	43	63	1.5	1.0	0.0	46	42	63	48	43	63	1.6	1.0	0.0	No
NCA32.RES.6823	RES	NCA32		47	43	59	48	44	63	1.0	0.6	4.2	47	43	59	48	44	63	1.1	0.7	4.2	No

NCA32.RES.6824	RES	NCA32		44	41	61	46	41	61	1.2	0.7	0.0	44	41	61	46	41	61	1.3	0.8	0.0	No
NCA32.RES.6825	RES	NCA32		46	42	61	47	43	65	1.7	1.1	4.1	46	42	61	47	43	65	1.9	1.2	4.1	No
NCA32.RES.6826	RES	NCA32		44	40	61	44	40	61	0.6	0.4	0.0	44	40	61	44	40	61	0.7	0.4	0.0	No
NCA32.RES.6827	RES	NCA32		43	39	59	45	41	62	2.1	1.3	2.8	43	39	59	45	41	62	2.3	1.5	2.8	No
NCA32.RES.6828	RES	NCA32		44	40	61	45	41	61	1.1	0.7	0.0	44	40	61	45	41	61	1.1	0.7	0.0	No
NCA32.RES.6829	RES	NCA32		44	40	60	46	41	61	1.9	1.2	1.2	44	40	60	46	42	61	2.1	1.4	1.2	No
NCA32.RES.6830	RES	NCA32		46	42	61	48	43	64	1.6	1.0	3.3	46	42	61	48	43	64	1.8	1.1	3.3	No
NCA32.RES.6832	RES	NCA32		45	41	60	46	42	60	1.4	0.9	0.0	45	41	60	46	42	60	1.5	1.0	0.0	No
NCA32.RES.6834	RES	NCA32		45	41	60	47	42	61	1.7	1.1	1.0	45	41	60	47	42	61	1.9	1.2	1.0	No
NCA32.RES.6835	RES	NCA32		44	41	59	46	42	62	2.0	1.3	3.0	44	41	59	47	42	62	2.2	1.4	3.0	No
NCA32.RES.6836	RES	NCA32		44	41	61	46	41	61	1.2	0.8	0.0	44	41	61	46	41	61	1.3	0.8	0.0	No
NCA32.RES.6837	RES	NCA32		45	41	61	46	42	61	1.3	0.6	0.0	45	41	61	46	42	61	1.4	0.6	0.0	No
NCA32.RES.6838	RES	NCA32		45	41	60	46	42	63	1.2	0.8	2.9	45	41	60	46	42	63	1.3	0.8	2.9	No
NCA32.RES.6839	RES	NCA32		45	41	62	47	43	63	2.3	1.5	1.3	45	41	62	48	43	63	2.5	1.6	1.3	No
NCA32.RES.6840	RES	NCA32		45	41	59	47	43	63	2.1	1.4	3.4	45	41	59	48	43	63	2.3	1.5	3.4	No
NCA32.RES.6841	RES	NCA32		44	41	62	47	42	62	2.3	1.5	0.1	44	41	62	47	42	62	2.4	1.6	0.1	No
NCA32.RES.6842	RES	NCA32		46	42	61	47	43	61	1.2	0.7	0.1	46	42	61	47	43	61	1.2	0.8	0.1	No
NCA32.RES.6843	RES	NCA32		43	39	61	44	40	61	1.6	1.0	0.0	43	39	61	44	40	61	1.7	1.1	0.0	No
NCA32.RES.6844	RES	NCA32		44	40	61	46	41	61	1.6	1.0	0.0	44	40	61	46	42	61	1.7	1.1	0.0	No
NCA32.RES.6845	RES	NCA32		46	42	61	48	43	62	1.4	0.9	1.6	46	42	61	48	43	62	1.5	1.0	1.6	No
NCA32.RES.6846	RES	NCA32		44	40	60	45	41	60	1.0	0.6	0.0	44	40	60	45	41	60	1.1	0.7	0.0	No
NCA32.RES.6847	RES	NCA32		46	42	62	47	43	62	1.4	0.6	0.0	46	42	62	47	43	62	1.5	0.7	0.0	No
NCA32.RES.6848	RES	NCA32		41	38	60	43	39	60	1.5	0.3	0.0	41	38	60	43	39	60	1.6	0.4	0.0	No
NCA32.RES.6849	RES	NCA32		46	42	60	47	43	60	1.0	0.6	0.0	46	42	60	47	43	60	1.0	0.7	0.0	No
NCA32.RES.6850	RES	NCA32		47	43	61	48	44	62	1.3	0.8	1.4	47	43	61	48	44	62	1.4	0.9	1.4	No
NCA32.RES.6851	RES	NCA32		42	38	60	43	39	60	0.9	0.5	0.0	42	38	60	43	39	60	1.0	0.6	0.0	No
NCA32.RES.6852	RES	NCA32		42	39	60	44	39	60	1.2	0.7	0.0	42	39	60	44	39	60	1.3	0.7	0.0	No
NCA32.RES.6853	RES	NCA32		45	41	60	46	42	60	1.4	0.9	0.0	45	41	60	46	42	60	1.5	1.0	0.0	No
NCA32.RES.6854	RES	NCA32		47	43	59	49	44	65	1.5	1.0	5.5	47	43	59	49	44	65	1.7	1.1	5.5	No
NCA32.RES.6855	RES	NCA32		47	43	62	49	44	64	1.5	1.0	2.0	47	43	62	49	44	64	1.6	1.1	2.0	No
NCA32.RES.6856	RES	NCA32		44	41	59	46	42	63	2.3	0.5	4.1	44	40	59	47	42	63	2.5	1.6	4.1	No
NCA32.RES.6857	RES	NCA32		44	40	61	45	41	61	1.1	0.6	0.0	44	40	61	45	41	61	1.2	0.7	0.0	No
NCA32.RES.6858	RES	NCA32		46	42	59	46	42	62	0.8	0.5	3.1	46	42	59	47	42	62	0.9	0.5	3.1	No
NCA32.RES.6859	RES	NCA32		41	38	59	43	38	59	1.5	0.3	0.0	41	37	59	43	38	59	1.6	1.0	0.0	No
NCA32.RES.6860	RES	NCA32		46	42	60	47	43	62	1.0	0.6	1.8	46	42	60	47	43	62	1.0	0.7	1.8	No
NCA32.RES.6861	RES	NCA32		46	42	59	47	42	63	0.9	0.6	4.3	46	42	59	47	43	63	1.0	0.6	4.3	No
NCA32.RES.6862	RES	NCA32		43	39	57	44	40	59	1.6	1.0	1.8	43	39	57	44	40	59	1.7	1.1	1.8	No
NCA32.RES.6863	RES	NCA32		45	42	61	46	42	62	1.1	0.7	1.3	45	42	61	46	42	62	1.2	0.7	1.3	No
NCA32.RES.6864	RES	NCA32		43	39	60	44	39	60	1.0	0.6	0.0	43	39	60	44	39	60	1.0	0.7	0.0	No
NCA32.RES.6865	RES	NCA32		46	42	60	47	42	60	0.8	0.5	0.0	46	42	60	47	43	60	0.8	0.5	0.0	No
NCA32.RES.6866	RES	NCA32		45	41	60	46	42	62	1.2	0.8	1.6	45	41	60	47	42	62	1.3	0.8	1.6	No
NCA32.RES.6867	RES	NCA32		42	38	59	44	39	59	2.0	1.2	0.0	42	38	59	44	39	59	2.1	1.4	0.0	No
NCA32.RES.6868	RES	NCA32		47	43	58	48	44	62	0.9	0.6	3.3	47	43	58	48	44	62	1.0	0.7	3.3	No
NCA32.RES.6869	RES	NCA32		45	41	60	46	41	62	1.1	0.7	1.7	45	41	60	46	42	62	1.2	0.8	1.7	No
NCA32.RES.6870	RES	NCA32		42	38	60	42	38	60	0.7	0.4	0.0	42	38	60	42	38	60	0.7	0.4	0.0	No
NCA32.RES.6871	RES	NCA32		40	37	59	42	37	59	1.2	0.8	0.0	40	37	59	42	38	59	1.3	0.8	0.0	No
NCA32.RES.6872	RES	NCA32		45	41	60	45	41	60	0.8	0.5	0.0	45	41	60	45	41	60	0.9	0.5	0.0	No
NCA32.RES.6873	RES	NCA32		42	39	60	44	40	60	1.9	0.6	0.0	42	39	60	44	40	60	2.0	0.6	0.0	No
NCA32.RES.6874	RES	NCA32		45	41	60	47	42	61	1.3	0.8	1.6	45	41	60	47	42	61	1.4	0.9	1.6	No
NCA32.RES.6875	RES	NCA32		44	41	57	45	41	61	0.6	0.4	4.2	44	41	57	45	41	61	0.7	0.4	4.2	No
NCA32.RES.6876	RES	NCA32		41	37	59	42	38	59	0.9	0.6	0.0	41	37	59	42	38	59	1.0	0.6	0.0	No
NCA32.RES.6877	RES	NCA32		45	41	59	46	42	62	0.7	0.4	2.8	45	41	59	46	42	62	0.7	0.4	2.8	No
NCA32.RES.6878	RES	NCA32		44	41	55	46	41	61	1.4	0.9	5.8	44	41	55	46	41	61	1.5	0.9	5.8	No
NCA32.RES.6879	RES	NCA32		39	35	58	40	36	58	1.0	0.6	0.0	39	35	58	40	36	58	1.1	0.7	0.0	No
NCA32.RES.6880	RES	NCA32		46	42	59	47	42	63	1.1	0.7	4.4	46	42	59	47	43	63	1.2	0.7	4.4	No
NCA32.RES.6881	RES	NCA32		41	37	57	42	37	57	0.9	0.6	0.0	41	37	57	42	38	57	1.0	0.6	0.0	No
NCA32.RES.6882	RES	NCA32		45	42	58	47	42	64	1.3	0.8	5.7	45	42	58	47	42	64	1.4	0.9	5.7	No
NCA32.RES.6883	RES	NCA32		39	35	55	41	36	55	1.6	1.0	0.0	39	35	55	41	37	55	1.7	1.1	0.0	No
NCA32.RES.6884	RES	NCA32		43	40	58	45	40	58	1.4	0.9	0.5	43	40	58	45	41	58	1.5	0.9	0.5	No
NCA32.RES.6885	RES	NCA32		45	41	58	47	42	61	1.6	1.0	2.9	45	41	58	47	42	61	1.7	1.1	2.9	No
NCA32.RES.6886	RES	NCA32		43	39	57	46	41	62	2.7	1.8	5.4	43	39	57	46	41	62	2.9	2.0	5.4	No

NCA32.RES.6887	RES	NCA32		45	41	59	46	41	62	1.1	0.7	2.9	45	41	59	46	41	62	1.2	0.8	2.9	No
NCA32.RES.6888	RES	NCA32		46	42	60	48	43	63	2.1	1.4	3.2	46	42	60	48	43	63	2.3	1.5	3.2	No
NCA32.RES.6889	RES	NCA32		44	40	56	46	41	62	1.9	1.2	5.5	44	40	56	46	42	62	2.1	1.4	5.5	No
NCA32.RES.6890	RES	NCA32		44	40	60	45	41	60	1.5	0.9	0.0	44	40	60	46	41	60	1.6	1.0	0.0	No
NCA32.RES.6891	RES	NCA32		43	39	58	44	40	58	1.2	0.8	0.0	43	39	58	44	40	58	1.3	0.9	0.0	No
NCA32.RES.6892	RES	NCA32		45	41	59	46	42	63	1.1	0.7	3.7	44	41	59	46	42	63	1.8	0.8	3.7	No
NCA32.RES.6893	RES	NCA32		43	39	57	44	40	59	1.0	0.6	2.4	43	39	57	44	40	59	1.1	0.7	2.4	No
NCA32.RES.6894	RES	NCA32		43	40	58	46	41	62	2.7	0.9	4.3	43	40	58	46	41	62	2.9	1.1	4.3	No
NCA32.RES.6896	RES	NCA32		44	40	58	44	40	61	0.8	0.5	2.8	44	40	58	44	40	61	0.8	0.5	2.8	No
NCA32.RES.6897	RES	NCA32		44	40	60	45	41	60	1.3	0.8	0.0	44	40	60	46	41	60	1.4	0.9	0.0	No
NCA32.RES.6898	RES	NCA32		44	40	59	45	41	61	1.0	0.6	2.0	44	40	59	45	41	61	1.1	0.7	2.0	No
NCA32.RES.6899	RES	NCA32		44	40	59	47	42	63	2.2	1.4	3.9	44	40	59	47	42	63	2.3	1.6	3.9	No
NCA32.RES.6900	RES	NCA32		43	40	60	45	41	60	1.5	0.9	0.0	43	40	60	45	41	60	1.6	1.0	0.0	No
NCA32.RES.6901	RES	NCA32		44	40	59	45	40	60	0.8	0.5	1.2	44	40	59	45	40	60	0.9	0.5	1.2	No
NCA32.RES.6902	RES	NCA32		41	38	59	42	38	59	1.0	0.6	0.0	41	38	59	42	38	59	1.1	0.7	0.0	No
NCA32.RES.6903	RES	NCA32		44	40	59	45	41	61	0.8	0.5	1.3	44	40	59	45	41	61	0.9	0.5	1.3	No
NCA32.RES.6905	RES	NCA32		44	40	59	46	41	61	1.7	1.1	1.9	44	40	59	46	41	61	1.8	1.2	1.9	No
NCA32.RES.6906	RES	NCA32		42	38	57	44	39	59	1.8	1.1	2.4	42	38	57	44	39	59	1.9	1.3	2.4	No
NCA32.RES.6907	RES	NCA32		44	40	59	46	41	63	2.3	1.5	3.7	44	40	59	46	42	63	2.5	1.7	3.7	No
NCA32.RES.6908	RES	NCA32		41	37	58	42	38	58	0.7	0.4	0.0	41	37	58	42	38	58	0.7	0.5	0.0	No
NCA32.RES.6909	RES	NCA32		44	40	59	45	41	62	1.0	0.6	2.8	44	40	59	45	41	62	1.1	0.7	2.8	No
NCA32.RES.6911	RES	NCA32		44	40	59	47	42	64	2.4	1.6	4.4	44	40	59	47	42	64	2.6	1.7	4.4	No
NCA32.RES.6912	RES	NCA32		37	33	55	37	33	55	0.5	0.3	0.0	37	33	55	37	33	55	0.5	0.3	0.0	No
NCA32.RES.6913	RES	NCA32		44	40	58	45	41	63	1.2	0.7	4.8	44	40	58	45	41	63	1.3	0.8	4.8	No
NCA32.RES.6914	RES	NCA32		44	40	58	46	42	63	2.1	1.4	4.9	44	40	58	47	42	63	2.3	1.5	4.9	No
NCA32.RES.6915	RES	NCA32		42	38	58	43	39	58	0.6	0.3	0.0	42	38	58	43	39	58	0.6	0.4	0.0	No
NCA32.RES.6916	RES	NCA32		44	40	59	46	41	63	2.2	1.4	4.2	44	40	59	46	42	63	2.3	1.5	4.2	No
NCA32.RES.6918	RES	NCA32		44	40	59	46	41	63	2.1	1.4	4.3	44	40	59	46	41	63	2.3	1.5	4.3	No
NCA32.RES.6919	RES	NCA32		44	40	57	45	41	63	1.3	0.8	5.2	44	40	57	45	41	63	1.4	0.9	5.2	No
NCA32.RES.6920	RES	NCA32		37	33	54	38	34	54	0.8	0.5	0.0	37	33	54	38	34	54	0.8	0.5	0.0	No
NCA32.RES.6921	RES	NCA32		40	36	57	42	37	57	1.2	0.8	0.0	40	36	57	42	37	57	1.3	0.8	0.0	No
NCA32.RES.6922	RES	NCA32		43	39	56	44	40	57	0.9	0.6	1.5	43	39	56	44	40	57	1.0	0.6	1.5	No
NCA32.RES.6923	RES	NCA32		44	40	59	46	41	63	2.3	1.5	4.9	44	40	59	46	41	63	2.4	1.6	4.9	No
NCA32.RES.6924	RES	NCA32		43	39	56	44	39	57	1.2	0.8	1.5	43	39	56	44	39	57	1.3	0.9	1.5	No
NCA32.RES.6925	RES	NCA32		44	40	59	46	41	63	1.9	1.2	4.4	44	40	59	46	41	63	2.0	1.3	4.4	No
NCA32.RES.6926	RES	NCA32		43	39	58	45	40	59	2.0	1.3	0.9	43	39	58	45	40	59	2.1	1.4	0.9	No
NCA32.RES.6927	RES	NCA32		43	39	57	44	40	61	1.3	0.9	4.1	43	39	57	45	40	61	1.4	1.0	4.1	No
NCA32.RES.6928	RES	NCA32		43	39	58	45	41	63	2.0	1.3	5.0	43	39	58	45	41	63	2.2	1.4	5.0	No
NCA32.RES.6931	RES	NCA32		44	40	58	45	40	62	1.1	0.7	4.5	44	40	58	45	41	62	1.2	0.8	4.5	No
NCA32.RES.6932	RES	NCA32		41	37	57	42	38	57	1.1	0.7	0.0	41	37	57	42	38	57	1.2	0.8	0.0	No
NCA32.RES.6933	RES	NCA32		43	39	57	45	40	63	1.8	1.2	5.5	43	39	57	45	40	63	2.0	1.3	5.5	No
NCA32.RES.6935	RES	NCA32		40	36	55	41	37	55	0.6	0.4	0.0	40	36	55	41	37	55	0.7	0.4	0.0	No
NCA32.RES.6936	RES	NCA32		40	36	54	41	36	55	1.2	0.7	1.6	40	36	54	41	37	55	1.3	0.8	1.6	No
NCA32.RES.6937	RES	NCA32		42	38	57	42	38	57	0.6	0.4	0.0	42	38	57	42	38	57	0.7	0.4	0.0	No
NCA32.RES.6939	RES	NCA32		40	36	54	42	38	61	2.1	1.3	6.4	40	36	54	42	38	61	2.2	1.4	6.4	No
NCA32.RES.6940	RES	NCA32		39	35	55	40	36	55	0.7	0.4	0.0	39	35	55	40	36	55	0.8	0.5	0.0	No
NCA32.RES.6942	RES	NCA32		39	36	57	40	36	57	0.3	0.2	0.0	39	36	57	40	36	57	0.3	0.2	0.0	No
NCA32.RES.6943	RES	NCA32		39	35	55	39	35	55	0.4	0.2	0.0	39	35	55	39	35	55	0.4	0.3	0.0	No
NCA32.RES.6944	RES	NCA32		38	34	53	39	34	53	0.8	0.5	0.0	38	34	53	39	35	53	0.8	0.5	0.0	No
NCA32.RES.6946	RES	NCA32		41	37	55	42	37	57	0.8	0.5	1.5	41	37	55	42	38	57	0.9	0.6	1.5	No
NCA32.RES.6947	RES	NCA32		39	35	56	40	36	56	0.6	0.4	0.0	39	35	56	40	36	56	0.7	0.4	0.0	No
NCA32.RES.6948	RES	NCA32		39	35	56	40	36	56	0.8	0.5	0.0	39	35	56	40	36	56	0.9	0.6	0.0	No
NCA32.RES.6950	RES	NCA32		42	38	55	45	40	62	3.2	2.1	7.3	42	38	55	45	40	62	3.4	2.3	7.3	No
NCA32.RES.6951	RES	NCA32		42	38	58	43	39	58	1.0	0.6	0.0	42	38	58	43	39	58	1.1	0.7	0.0	No
NCA32.RES.6952	RES	NCA32		39	35	57	40	35	57	0.3	0.2	0.0	39	35	57	40	35	57	0.4	0.2	0.0	No
NCA32.RES.6954	RES	NCA32		40	36	56	40	36	56	0.5	0.3	0.0	40	36	56	40	36	56	0.6	0.3	0.0	No
NCA32.RES.6956	RES	NCA32		40	36	55	41	37	56	1.3	0.8	0.8	40	36	55	42	37	56	1.4	0.9	0.8	No
NCA32.RES.6957	RES	NCA32		40	36	54	41	36	54	1.0	0.6	0.0	40	36	54	41	36	54	1.1	0.7	0.0	No
NCA32.RES.6958	RES	NCA32		41	37	57	41	37	57	0.6	0.4	0.0	41	37	57	41	37	57	0.7	0.4	0.0	No
NCA32.RES.6960	RES	NCA32		38	34	53	39	35	53	0.9	0.6	0.0	38	34	53	39	35	53	1.0	0.6	0.0	No
NCA32.RES.6961	RES	NCA32		42	38	58	42	38	58	0.2	0.1	0.0	42	38	58	42	38	58	0.2	0.1	0.0	No

NCA32.RES.6963	RES	NCA32		38	34	53	39	35	53	1.2	0.8	0.0	38	34	53	39	35	53	1.3	0.9	0.0	No
NCA32.RES.6964	RES	NCA32		38	34	50	39	35	53	1.0	0.6	3.4	38	34	50	39	35	53	1.1	0.7	3.4	No
NCA32.RES.6967	RES	NCA32		37	34	51	39	34	54	2.0	0.5	3.4	37	33	51	39	34	54	2.2	1.5	3.4	No
NCA32.RES.6968	RES	NCA32		37	33	51	39	35	54	2.2	1.5	3.7	37	33	51	39	35	54	2.4	1.6	3.7	No
NCA32.RES.6969	RES	NCA32		37	34	53	39	34	53	1.1	0.7	0.0	37	34	53	39	34	53	1.2	0.8	0.0	No
NCA32.RES.6970	RES	NCA32		39	36	55	41	37	57	1.6	1.0	2.1	39	36	55	41	37	57	1.7	1.1	2.1	No
NCA32.RES.6971	RES	NCA32		39	35	52	41	36	56	2.0	1.3	3.8	39	35	52	41	36	56	2.2	1.5	3.8	No
NCA32.RES.6973	RES	NCA32		38	34	55	39	35	55	1.0	0.6	0.0	38	34	55	39	35	55	1.0	0.7	0.0	No
NCA32.RES.6974	RES	NCA32		38	34	53	39	35	53	1.3	0.8	0.0	38	34	53	39	35	53	1.5	0.9	0.0	No
NCA32.RES.6975	RES	NCA32		40	36	55	41	36	55	1.2	0.8	0.0	40	36	55	41	36	55	1.3	0.9	0.0	No
NCA32.RES.6976	RES	NCA32		41	37	54	43	39	59	2.4	1.6	4.9	41	37	54	43	39	59	2.6	1.8	4.9	No
NCA32.RES.6977	RES	NCA32		40	36	55	42	37	57	1.4	0.9	1.6	40	36	55	42	37	57	1.5	1.0	1.6	No
NCA32.RES.6979	RES	NCA32		40	36	54	40	36	54	0.5	0.3	0.0	40	36	54	40	36	54	0.6	0.4	0.0	No
NCA32.RES.6980	RES	NCA32		40	36	55	41	37	56	1.4	0.9	1.4	40	36	55	42	37	56	1.5	1.0	1.4	No
NCA32.RES.6981	RES	NCA32		39	36	54	41	37	58	2.6	0.8	4.1	39	36	54	42	37	58	2.8	0.9	4.1	No
NCA32.RES.6983	RES	NCA32		39	35	55	40	36	55	1.0	0.7	0.0	39	35	55	40	36	55	1.1	0.7	0.0	No
NCA32.RES.6984	RES	NCA32		39	36	51	41	36	56	1.3	0.8	4.5	39	36	51	41	36	56	1.4	0.8	4.5	No
NCA32.RES.6987	RES	NCA32		34	31	48	36	32	51	2.0	0.5	2.8	34	31	48	36	32	51	2.2	0.6	2.8	No
NCA32.RES.6988	RES	NCA32		37	33	55	37	33	55	0.3	0.2	0.0	37	33	55	37	33	55	0.4	0.2	0.0	No
NCA32.RES.6989	RES	NCA32		37	33	55	38	34	55	0.5	0.3	0.0	37	33	55	38	34	55	0.6	0.3	0.0	No
NCA32.RES.6991	RES	NCA32		35	31	47	36	32	51	1.3	0.9	3.6	35	31	47	36	32	51	1.5	1.0	3.6	No
NCA32.RES.6992	RES	NCA32		38	35	55	40	35	55	1.6	0.5	0.0	38	35	55	40	35	55	1.7	0.6	0.0	No
NCA32.RES.6993	RES	NCA32		39	35	54	41	36	55	1.2	0.8	0.7	39	35	54	41	36	55	1.3	0.8	0.7	No
NCA32.RES.6994	RES	NCA32		40	36	54	42	37	58	1.6	1.0	3.5	40	36	54	42	37	58	1.7	1.1	3.5	No
NCA32.RES.6997	RES	NCA32		40	36	54	41	36	55	1.0	0.6	1.4	40	36	54	41	36	55	1.1	0.7	1.4	No
NCA32.RES.7003	RES	NCA32		39	35	56	40	36	56	1.1	0.7	0.0	39	35	56	40	36	56	1.2	0.8	0.0	No
NCA32.RES.7006	RES	NCA32		40	36	52	42	38	58	2.3	1.5	6.1	40	36	52	42	38	58	2.4	1.6	6.1	No
NCA32.RES.7013	RES	NCA32		38	34	53	39	35	53	0.7	0.5	0.0	38	34	53	39	35	53	0.8	0.5	0.0	No
NCA32.RES.7017	RES	NCA32		38	34	52	40	36	55	2.0	1.3	3.4	38	34	52	40	36	55	2.2	1.4	3.4	No
NCA32.RES.7020	RES	NCA32		39	35	52	40	36	55	1.5	1.0	3.2	39	35	52	40	36	55	1.7	1.1	3.2	No
NCA32.RES.7021	RES	NCA32		40	36	53	43	38	60	2.9	1.9	7.2	40	36	53	43	39	60	3.1	2.1	7.2	No
NCA32.RES.7024	RES	NCA32		40	36	52	41	37	56	1.4	0.9	4.6	40	36	52	41	37	56	1.5	1.0	4.6	No
NCA32.RES.7033	RES	NCA32		38	35	52	40	35	54	1.3	0.8	2.2	38	35	52	40	36	54	1.5	0.9	2.2	No
NCA32.RES.7038	RES	NCA32		40	36	53	42	37	56	1.6	1.0	2.6	40	36	53	42	37	56	1.7	1.1	2.6	No
NCA32.RES.7047	RES	NCA32		40	36	53	41	37	57	1.8	1.2	3.9	40	36	53	41	37	57	2.0	1.3	3.9	No
NCA33.COM.7244	COM	NCA33		51	47	72	52	48	72	1.8	1.1	0.0	51	47	72	53	48	72	1.9	1.3	0.0	No
NCA33.COM.7247	COM	NCA33		43	39	59	48	43	65	5.0	3.5	6.5	43	39	59	48	43	65	5.3	3.8	6.5	No
NCA33.COM.7250	COM	NCA33		46	42	64	50	45	67	4.2	2.9	3.4	46	42	64	50	45	67	4.5	3.1	3.4	No
NCA33.COM.7264	COM	NCA33		45	41	65	47	42	65	2.2	1.4	0.0	45	41	65	47	42	65	2.3	1.5	0.0	No
NCA33.COM.7266	COM	NCA33		42	38	57	48	42	65	5.6	4.0	7.6	42	38	57	48	43	65	5.9	4.4	7.6	No
NCA33.COM.7277	COM	NCA33		37	33	51	40	35	55	3.0	2.0	3.8	37	33	51	40	35	55	3.2	2.1	3.8	No
NCA33.IND.7236	IND	NCA33		46	42	62	51	46	69	5.6	4.0	6.9	46	42	62	52	46	69	5.9	4.3	6.9	No
NCA33.IND.7237	IND	NCA33		45	42	62	51	46	69	5.9	3.4	6.4	45	42	62	51	46	69	6.2	3.7	6.4	No
NCA33.IND.7238	IND	NCA33		46	42	65	52	47	70	6.1	4.4	4.9	46	42	65	52	47	70	6.4	4.7	4.9	No
NCA33.IND.7240	IND	NCA33		41	37	57	48	42	65	7.0	5.2	8.2	41	37	57	48	42	65	7.3	5.5	8.2	No
NCA33.IND.7241	IND	NCA33		49	45	70	50	46	70	1.2	0.8	0.0	49	45	70	50	46	70	1.4	0.8	0.0	No
NCA33.IND.7242	IND	NCA33		41	38	56	45	40	61	3.5	2.4	5.1	41	38	56	45	40	61	3.7	2.6	5.1	No
NCA33.OED.7252	OED	NCA33		50	49	68	55	51	69	4.6	2.4	1.2	50	49	68	55	51	69	4.8	2.6	1.2	No
NCA33.OED.7261	OED	NCA33		45	44	62	51	47	66	6.1	3.5	4.1	45	44	62	51	47	66	6.5	3.7	4.1	No
NCA33.OED.7265	OED	NCA33		43	42	60	49	45	64	5.6	3.1	4.1	43	42	60	49	45	64	5.9	3.3	4.1	No
NCA33.OED.7284	OED	NCA33		42	41	59	44	42	59	4.0	1.0	0.0	42	41	59	44	42	59	4.3	1.1	0.0	No
NCA33.RES.7239	RES	NCA33		41	38	55	50	44	68	9.1	6.3	13.5	41	37	55	50	45	68	9.5	7.5	13.5	No
NCA33.RES.7243	RES	NCA33		43	39	55	45	40	60	2.3	1.5	4.4	43	39	55	45	40	60	2.4	1.6	4.4	No
NCA33.RES.7245	RES	NCA33		40	38	55	46	41	64	5.9	3.1	9.1	40	37	55	46	41	64	6.2	4.0	9.1	No
NCA33.RES.7246	RES	NCA33		42	38	54	45	40	61	2.8	1.8	7.2	42	38	54	45	40	61	3.0	2.0	7.2	No
NCA33.RES.7248	RES	NCA33		43	39	56	48	43	65	5.1	3.6	8.8	43	39	56	48	43	65	5.3	3.9	8.8	No
NCA33.RES.7249	RES	NCA33		43	39	56	45	41	60	2.2	1.4	4.1	43	39	56	45	41	60	2.3	1.5	4.1	No
NCA33.RES.7251	RES	NCA33		39	35	54	45	39	62	5.7	4.2	7.8	39	35	54	45	40	62	6.0	4.4	7.8	No
NCA33.RES.7253	RES	NCA33		40	36	53	43	39	59	3.3	2.2	6.1	40	36	53	44	39	59	3.5	2.4	6.1	No
NCA33.RES.7254	RES	NCA33		42	39	55	45	40	59	2.4	1.6	4.5	42	39	55	45	40	59	2.5	1.7	4.5	No
NCA33.RES.7255	RES	NCA33		38	35	54	44	39	61	5.9	4.3	7.4	38	35	54	45	39	61	6.2	4.6	7.4	No

NCA33.RES.7256	RES	NCA33		41	37	55	47	41	64	5.9	4.2	8.6	41	37	55	47	42	64	6.2	4.5	8.6	No
NCA33.RES.7257	RES	NCA33		39	35	54	46	41	64	7.7	5.8	10.2	39	35	54	47	41	64	8.0	6.2	10.2	No
NCA33.RES.7258	RES	NCA33		42	39	52	44	40	58	1.9	1.2	6.3	42	39	52	45	40	58	2.1	1.4	6.3	No
NCA33.RES.7259	RES	NCA33		41	37	52	43	38	58	2.4	1.5	5.1	41	37	52	43	39	58	2.5	1.7	5.1	No
NCA33.RES.7260	RES	NCA33		40	36	53	45	40	62	5.1	3.7	8.9	40	36	53	45	40	62	5.4	4.0	8.9	No
NCA33.RES.7262	RES	NCA33		40	36	55	46	41	63	6.3	4.7	8.6	40	36	55	46	41	63	6.6	5.0	8.6	No
NCA33.RES.7263	RES	NCA33		42	38	53	44	39	58	1.9	1.2	4.4	42	38	53	44	39	58	2.1	1.4	4.4	No
NCA33.RES.7267	RES	NCA33		43	39	59	47	42	63	3.7	2.5	3.1	43	39	59	47	42	63	3.9	2.7	3.1	No
NCA33.RES.7268	RES	NCA33		44	40	60	47	42	63	3.6	2.5	3.0	44	40	60	47	42	63	3.9	2.7	3.0	No
NCA33.RES.7269	RES	NCA33		42	38	57	46	41	62	3.9	2.6	4.7	42	38	57	46	41	62	4.1	2.8	4.7	No
NCA33.RES.7270	RES	NCA33		44	40	63	46	42	63	2.3	1.5	0.0	44	40	63	46	42	63	2.4	1.6	0.0	No
NCA33.RES.7271	RES	NCA33		43	39	60	46	41	61	3.0	2.0	0.6	43	39	60	46	41	61	3.2	2.1	0.6	No
NCA33.RES.7272	RES	NCA33		43	39	60	47	42	63	3.7	2.5	3.0	43	39	60	47	42	63	3.9	2.7	3.0	No
NCA33.RES.7273	RES	NCA33		42	38	60	46	41	62	3.9	2.6	2.1	42	38	60	46	41	62	4.2	2.9	2.1	No
NCA33.RES.7274	RES	NCA33		42	38	58	45	40	61	3.3	2.2	2.9	42	38	58	45	40	61	3.6	2.4	2.9	No
NCA33.RES.7275	RES	NCA33		43	39	58	47	42	63	3.9	2.6	5.3	43	39	58	47	42	63	4.1	2.8	5.3	No
NCA33.RES.7276	RES	NCA33		42	39	57	46	41	63	4.0	2.8	5.3	42	39	57	47	42	63	4.3	3.0	5.3	No
NCA33.RES.7278	RES	NCA33		43	40	58	48	43	64	4.2	2.9	6.0	43	40	58	48	43	64	4.4	3.1	6.0	No
NCA33.RES.7279	RES	NCA33		40	36	56	43	39	59	3.1	2.1	2.7	40	36	56	44	39	59	3.3	2.2	2.7	No
NCA33.RES.7280	RES	NCA33		42	38	58	45	40	60	3.0	2.0	2.3	42	38	58	45	40	60	3.2	2.2	2.3	No
NCA33.RES.7281	RES	NCA33		40	36	55	43	38	59	3.3	2.2	3.7	40	36	55	43	38	59	3.5	2.4	3.7	No
NCA33.RES.7282	RES	NCA33		41	37	57	44	39	60	3.2	2.1	2.3	41	37	57	44	39	60	3.4	2.3	2.3	No
NCA33.RES.7283	RES	NCA33		40	37	56	44	39	60	3.7	2.5	4.0	40	37	56	44	39	60	3.9	2.7	4.0	No
NCA34.COM.7292	COM	NCA34		68	64	111	68	64	111	0.0	0.0	0.0	68	64	111	68	64	111	0.0	0.0	0.0	No
NCA34.COM.7297	COM	NCA34		64	61	106	64	61	106	0.0	0.0	0.0	64	61	106	64	61	106	0.0	0.0	0.0	No
NCA34.COM.7305	COM	NCA34		48	44	69	49	45	69	0.5	0.3	0.0	48	44	69	49	45	69	0.5	0.3	0.0	No
NCA34.COM.7311	COM	NCA34		69	64	118	69	64	118	0.0	0.0	0.0	69	64	118	69	64	118	0.0	0.0	0.0	No
NCA34.COM.7374	COM	NCA34		63	59	85	63	59	85	0.1	0.1	0.0	63	59	85	63	59	85	0.1	0.1	0.0	No
NCA34.COM.7392	COM	NCA34		53	49	71	56	51	73	3.4	2.3	2.0	53	49	71	56	51	73	3.6	2.5	2.0	No
NCA34.COM.7438	COM	NCA34		64	60	85	65	61	85	1.2	0.7	0.0	64	60	85	65	61	85	1.3	0.8	0.0	No
NCA34.IND.7295	IND	NCA34		51	47	71	51	47	71	0.1	0.0	0.0	51	47	71	51	47	71	0.1	0.1	0.0	No
NCA34.IND.7299	IND	NCA34		55	51	74	55	51	74	0.1	0.0	0.0	55	51	74	55	51	74	0.1	0.0	0.0	No
NCA34.IND.7303	IND	NCA34		62	58	81	62	58	81	0.1	0.1	0.0	62	58	81	62	58	81	0.1	0.1	0.0	No
NCA34.IND.7309	IND	NCA34		63	59	83	63	60	83	0.2	0.1	0.0	63	59	83	63	60	83	0.2	0.1	0.0	No
NCA34.IND.7317	IND	NCA34		45	41	59	48	43	64	3.3	2.3	5.6	45	41	59	48	43	64	3.5	2.5	5.6	No
NCA34.IND.7318	IND	NCA34		53	49	70	53	49	70	0.1	0.0	0.0	53	49	70	53	49	70	0.1	0.1	0.0	No
NCA34.IND.7325	IND	NCA34		53	50	71	54	50	71	0.1	0.1	0.0	53	50	71	54	50	71	0.1	0.1	0.0	No
NCA34.IND.7330	IND	NCA34		53	49	72	54	50	72	0.1	0.1	0.0	53	49	72	54	50	72	0.2	0.1	0.0	No
NCA34.IND.7333	IND	NCA34		42	38	56	45	40	61	3.2	2.1	4.4	42	38	56	45	40	61	3.4	2.3	4.4	No
NCA34.IND.7334	IND	NCA34		52	48	71	52	49	71	0.1	0.0	0.0	52	48	71	52	49	71	0.1	0.1	0.0	No
NCA34.IND.7338	IND	NCA34		54	50	72	54	50	72	0.2	0.1	0.0	54	50	72	54	50	72	0.2	0.1	0.0	No
NCA34.IND.7346	IND	NCA34		48	44	63	50	45	66	1.9	1.3	3.1	48	44	63	50	45	66	2.1	1.4	3.1	No
NCA34.IND.7347	IND	NCA34		41	38	54	43	39	57	1.8	1.1	4.4	41	38	54	43	39	57	1.9	1.3	4.4	No
NCA34.IND.7348	IND	NCA34		54	51	72	55	51	72	0.3	0.2	0.0	54	51	72	55	51	72	0.3	0.2	0.0	No
NCA34.IND.7349	IND	NCA34		44	40	57	46	42	59	1.8	1.1	2.0	44	40	57	46	42	59	1.9	1.2	2.0	No
NCA34.IND.7353	IND	NCA34		53	49	71	54	50	71	0.7	0.5	0.0	53	49	71	54	50	71	0.8	0.5	0.0	No
NCA34.IND.7357	IND	NCA34		45	41	58	47	43	63	2.0	1.3	5.2	45	41	58	47	43	63	2.1	1.4	5.2	No
NCA34.IND.7358	IND	NCA34		46	42	62	50	45	67	4.0	2.8	5.0	46	42	62	50	45	67	4.3	3.1	5.0	No
NCA34.IND.7359	IND	NCA34		64	61	86	65	61	86	0.4	0.2	0.0	64	61	86	65	61	86	0.4	0.2	0.0	No
NCA34.IND.7370	IND	NCA34		41	39	56	45	40	61	4.1	0.9	5.6	41	39	56	45	40	61	4.3	1.0	5.6	No
NCA34.IND.7377	IND	NCA34		51	47	69	53	48	69	2.0	1.3	0.0	51	47	69	53	48	69	2.2	1.4	0.0	No
NCA34.IND.7385	IND	NCA34		49	46	66	51	47	66	2.0	1.3	0.0	49	46	66	52	47	66	2.2	1.4	0.0	No
NCA34.IND.7386	IND	NCA34		51	47	69	54	49	72	3.7	2.5	2.4	51	47	69	55	50	72	3.9	2.7	2.4	No
NCA34.IND.7389	IND	NCA34		49	45	66	53	48	71	4.4	3.1	4.5	49	45	66	54	48	71	4.6	3.3	4.5	No
NCA34.IND.7400	IND	NCA34		65	61	86	65	61	86	0.6	0.3	0.0	65	61	86	65	61	86	0.7	0.4	0.0	No
NCA34.IND.7408	IND	NCA34		56	52	77	57	53	77	1.4	0.9	0.0	56	52	77	57	53	77	1.6	1.0	0.0	No
NCA34.IND.7413	IND	NCA34		52	48	70	56	51	74	4.6	3.2	3.6	52	48	70	56	51	74	4.8	3.4	3.6	No
NCA34.IND.7419	IND	NCA34		55	51	76	57	52	76	1.7	1.0	0.0	55	51	76	57	52	76	1.8	1.1	0.0	No
NCA34.IND.7425	IND	NCA34		54	50	72	57	52	75	3.7	2.5	2.9	54	50	72	58	53	75	3.9	2.7	2.9	No
NCA34.IND.7448	IND	NCA34		65	61	86	65	61	86	0.4	0.2	0.0	65	61	86	65	61	86	0.4	0.2	0.0	No
NCA34.IND.7453	IND	NCA34		62	58	83	67	62	84	4.5	3.1	1.0	62	58	83	67	62	84	4.8	3.4	1.0	No

NCA34.IND.7467	IND	NCA34		56	52	76	61	55	78	4.7	3.3	2.2	56	52	76	61	56	78	4.9	3.5	2.2	No
NCA34.IND.7505	IND	NCA34		56	52	77	57	53	77	1.7	1.1	0.0	56	52	77	57	53	77	1.9	1.2	0.0	No
NCA34.IND.7510	IND	NCA34		63	59	84	67	62	84	3.7	2.5	0.0	63	59	84	67	62	84	3.9	2.7	0.0	No
NCA34.IND.7546	IND	NCA34		58	54	79	61	56	79	3.5	2.4	0.0	58	54	79	62	57	79	3.8	2.6	0.0	No
NCA34.IND.7574	IND	NCA34		54	51	75	57	52	75	2.5	1.6	0.0	54	51	75	57	52	75	2.6	1.7	0.0	No
NCA34.IND.7575	IND	NCA34		57	53	77	60	55	77	3.3	2.2	0.0	57	53	77	60	55	77	3.5	2.4	0.0	No
NCA34.IND.7591	IND	NCA34		53	50	74	57	52	74	3.4	2.3	0.0	53	50	74	57	52	74	3.6	2.5	0.0	No
NCA34.IND.7600	IND	NCA34		59	55	80	60	56	80	1.9	1.2	0.0	59	55	80	61	56	80	2.0	1.3	0.0	No
NCA34.IND.7603	IND	NCA34		62	59	83	63	59	83	1.0	0.6	0.0	62	59	83	63	59	83	1.1	0.7	0.0	No
NCA34.IND.7605	IND	NCA34		43	39	58	54	48	72	10.6	8.7	14.3	43	39	58	54	48	72	11.0	9.0	14.3	No
NCA34.IND.7608	IND	NCA34		63	60	84	64	60	84	0.5	0.3	0.0	63	60	84	64	60	84	0.5	0.3	0.0	No
NCA34.IND.7610	IND	NCA34		63	60	84	64	60	84	0.3	0.2	0.0	63	60	84	64	60	84	0.3	0.2	0.0	No
NCA34.IND.7611	IND	NCA34		42	38	57	47	42	63	4.5	3.2	6.7	42	38	57	47	42	63	4.8	3.4	6.7	No
NCA34.IND.7613	IND	NCA34		47	44	68	55	49	73	7.5	5.7	5.0	47	44	68	55	50	73	7.9	6.0	5.0	No
NCA34.IND.7615	IND	NCA34		41	38	55	47	42	65	5.8	4.3	10.3	41	38	55	48	42	65	6.1	4.5	10.3	No
NCA34.IND.7616	IND	NCA34		42	38	56	46	41	62	3.8	2.7	6.1	42	38	56	46	41	62	4.1	2.9	6.1	No
NCA34.IND.7617	IND	NCA34		53	49	74	60	54	77	6.8	5.0	3.4	53	49	74	60	54	77	7.1	5.4	3.4	No
NCA34.IND.7618	IND	NCA34		66	63	89	66	63	89	0.1	0.0	0.0	66	63	89	66	63	89	0.1	0.0	0.0	No
NCA34.IND.7619	IND	NCA34		43	39	58	56	50	75	13.1	11.0	16.9	43	39	58	56	50	75	13.5	11.4	16.9	No
NCA34.IND.7620	IND	NCA34		54	50	73	59	54	76	4.8	3.3	3.0	54	50	73	59	54	76	5.1	3.6	3.0	No
NCA34.IND.7621	IND	NCA34		46	42	64	52	46	69	6.0	4.4	5.2	46	42	64	52	47	69	6.3	4.6	5.2	No
NCA34.IND.7623	IND	NCA34		42	40	57	50	44	68	7.5	4.6	10.8	42	40	57	50	44	68	7.9	4.9	10.8	No
NCA34.IND.7624	IND	NCA34		47	43	66	55	49	73	8.2	6.3	7.5	47	43	66	55	50	73	8.5	6.7	7.5	No
NCA34.RES.7288	RES	NCA34		54	50	73	54	50	73	0.2	0.1	0.0	54	50	73	54	50	73	0.2	0.1	0.0	No
NCA34.RES.7289	RES	NCA34		55	51	73	56	52	73	0.6	0.4	0.0	55	51	73	56	52	73	0.6	0.4	0.0	No
NCA34.RES.7290	RES	NCA34		54	51	74	55	51	74	0.2	0.1	0.0	54	51	74	55	51	74	0.2	0.1	0.0	No
NCA34.RES.7291	RES	NCA34		52	48	71	53	49	71	0.1	0.1	0.0	52	48	71	53	49	71	0.1	0.1	0.0	No
NCA34.RES.7293	RES	NCA34		54	50	74	54	51	74	0.1	0.1	0.0	54	50	74	55	51	74	0.2	0.1	0.0	No
NCA34.RES.7294	RES	NCA34		55	51	74	55	51	74	0.2	0.1	0.0	55	51	74	55	51	74	0.2	0.1	0.0	No
NCA34.RES.7296	RES	NCA34		58	54	76	58	54	76	0.1	0.0	0.0	58	54	76	58	54	76	0.1	0.0	0.0	No
NCA34.RES.7298	RES	NCA34		47	43	67	47	43	67	0.2	0.1	0.0	47	43	67	47	43	67	0.2	0.1	0.0	No
NCA34.RES.7300	RES	NCA34		47	43	68	48	44	68	0.5	0.3	0.0	47	43	68	48	44	68	0.5	0.3	0.0	No
NCA34.RES.7301	RES	NCA34		46	43	66	47	43	66	0.5	0.3	0.0	46	43	66	47	43	66	0.5	0.3	0.0	No
NCA34.RES.7302	RES	NCA34		47	43	67	47	43	67	0.5	0.3	0.0	47	43	67	47	43	67	0.5	0.3	0.0	No
NCA34.RES.7304	RES	NCA34		44	40	57	47	42	62	2.2	1.4	4.7	44	40	57	47	42	62	2.4	1.6	4.7	No
NCA34.RES.7306	RES	NCA34		48	44	66	50	45	66	1.6	1.0	0.0	48	44	66	50	45	66	1.7	1.1	0.0	No
NCA34.RES.7307	RES	NCA34		45	41	58	48	43	63	2.6	1.7	5.4	45	41	58	48	43	63	2.8	1.9	5.4	No
NCA34.RES.7308	RES	NCA34		46	42	59	48	43	63	2.3	1.6	3.5	46	42	59	48	43	63	2.5	1.7	3.5	No
NCA34.RES.7310	RES	NCA34		49	45	64	50	46	64	1.1	0.7	0.0	49	45	64	50	46	64	1.2	0.8	0.0	No
NCA34.RES.7312	RES	NCA34		47	43	61	49	45	64	2.2	1.4	3.1	47	43	61	50	45	64	2.3	1.5	3.1	No
NCA34.RES.7313	RES	NCA34		46	42	65	46	42	65	0.3	0.2	0.0	46	42	65	46	42	65	0.4	0.2	0.0	No
NCA34.RES.7314	RES	NCA34		46	42	61	49	44	63	2.2	1.5	2.3	46	42	61	49	44	63	2.4	1.6	2.3	No
NCA34.RES.7315	RES	NCA34		45	41	59	47	43	63	2.4	1.6	3.8	45	41	59	48	43	63	2.6	1.7	3.8	No
NCA34.RES.7316	RES	NCA34		42	38	56	44	39	58	2.0	1.3	2.0	42	38	56	44	39	58	2.1	1.4	2.0	No
NCA34.RES.7319	RES	NCA34		46	42	61	48	43	63	2.4	1.6	2.3	46	42	61	48	44	63	2.6	1.8	2.3	No
NCA34.RES.7320	RES	NCA34		41	37	55	43	39	59	2.6	1.7	3.6	41	37	55	44	39	59	2.8	1.9	3.6	No
NCA34.RES.7321	RES	NCA34		44	41	59	46	42	62	2.7	0.5	2.6	44	41	59	47	42	62	2.9	0.6	2.6	No
NCA34.RES.7322	RES	NCA34		41	37	54	43	38	57	1.8	1.2	2.6	41	37	54	43	39	57	1.9	1.3	2.6	No
NCA34.RES.7323	RES	NCA34		45	41	59	46	41	59	1.1	0.7	0.0	45	41	59	46	41	59	1.2	0.8	0.0	No
NCA34.RES.7324	RES	NCA34		45	41	57	46	42	61	1.7	1.1	4.3	45	41	57	47	42	61	1.8	1.2	4.3	No
NCA34.RES.7326	RES	NCA34		47	43	67	48	44	67	1.8	1.1	0.0	47	43	67	48	44	67	1.9	1.2	0.0	No
NCA34.RES.7327	RES	NCA34		40	36	51	42	37	55	1.3	0.8	4.1	40	36	51	42	37	55	1.4	0.9	4.1	No
NCA34.RES.7328	RES	NCA34		48	44	69	49	45	69	1.1	0.7	0.0	48	44	69	49	45	69	1.3	0.8	0.0	No
NCA34.RES.7329	RES	NCA34		44	40	58	47	42	62	2.6	1.7	4.5	44	40	58	47	42	62	2.8	1.9	4.5	No
NCA34.RES.7331	RES	NCA34		43	39	58	44	39	58	1.1	0.7	0.0	43	39	58	44	39	58	1.2	0.7	0.0	No
NCA34.RES.7332	RES	NCA34		48	44	69	49	45	69	1.1	0.7	0.0	48	44	69	49	45	69	1.2	0.7	0.0	No
NCA34.RES.7335	RES	NCA34		43	39	55	44	40	58	1.7	1.1	2.9	43	39	55	45	40	58	1.9	1.2	2.9	No
NCA34.RES.7336	RES	NCA34		48	44	68	49	45	68	1.2	0.7	0.0	48	44	68	49	45	68	1.3	0.8	0.0	No
NCA34.RES.7337	RES	NCA34		43	39	52	44	40	58	1.5	1.0	5.4	43	39	52	45	40	58	1.7	1.1	5.4	No
NCA34.RES.7339	RES	NCA34		47	44	69	49	44	69	1.2	0.7	0.0	47	44	69	49	45	69	1.3	0.8	0.0	No
NCA34.RES.7340	RES	NCA34		40	36	53	43	38	58	2.9	1.9	5.2	40	36	53	43	38	58	3.1	2.1	5.2	No

NCA34.RES.7341	RES	NCA34		47	43	68	48	44	68	1.4	0.9	0.0	47	43	68	48	44	68	1.5	0.9	0.0	No
NCA34.RES.7342	RES	NCA34		43	39	54	44	40	58	1.8	1.2	3.7	43	39	54	45	40	58	2.0	1.3	3.7	No
NCA34.RES.7343	RES	NCA34		43	39	54	45	40	60	1.4	0.9	5.5	43	39	54	45	40	60	1.5	1.0	5.5	No
NCA34.RES.7344	RES	NCA34		42	38	54	43	39	57	1.2	0.8	3.4	42	38	54	43	39	57	1.3	0.8	3.4	No
NCA34.RES.7345	RES	NCA34		46	42	67	48	43	67	1.5	0.9	0.0	46	42	67	48	43	67	1.6	1.0	0.0	No
NCA34.RES.7350	RES	NCA34		44	40	59	46	41	59	1.5	1.0	0.7	44	40	59	46	41	59	1.6	1.1	0.7	No
NCA34.RES.7351	RES	NCA34		46	42	67	48	43	67	2.1	1.3	0.0	46	42	67	48	44	67	2.2	1.5	0.0	No
NCA34.RES.7352	RES	NCA34		43	39	55	44	40	59	1.8	1.2	4.0	43	39	55	45	40	59	2.0	1.3	4.0	No
NCA34.RES.7354	RES	NCA34		43	39	56	44	40	58	1.9	1.2	2.1	43	39	56	45	40	58	2.0	1.3	2.1	No
NCA34.RES.7355	RES	NCA34		43	39	58	44	39	58	1.2	0.8	0.0	43	39	58	44	39	58	1.3	0.9	0.0	No
NCA34.RES.7356	RES	NCA34		45	42	66	48	43	66	2.3	1.5	0.0	45	42	66	48	43	66	2.4	1.6	0.0	No
NCA34.RES.7360	RES	NCA34		48	44	62	51	46	67	2.8	1.8	4.7	48	44	62	51	46	67	2.9	2.0	4.7	No
NCA34.RES.7361	RES	NCA34		41	37	54	43	38	58	2.0	1.3	3.9	41	37	54	43	39	58	2.1	1.4	3.9	No
NCA34.RES.7362	RES	NCA34		44	40	57	46	41	61	2.3	1.5	3.5	44	40	57	46	42	61	2.5	1.6	3.5	No
NCA34.RES.7363	RES	NCA34		49	45	63	51	46	67	2.4	1.6	3.1	49	45	63	51	47	67	2.6	1.8	3.1	No
NCA34.RES.7364	RES	NCA34		44	40	57	46	41	61	2.2	1.4	3.5	44	40	57	46	42	61	2.4	1.6	3.5	No
NCA34.RES.7365	RES	NCA34		47	43	63	50	45	66	2.7	1.8	2.2	47	43	63	50	45	66	2.9	1.9	2.2	No
NCA34.RES.7366	RES	NCA34		44	40	57	46	42	62	2.7	1.8	4.9	44	40	57	47	42	62	3.0	2.0	4.9	No
NCA34.RES.7367	RES	NCA34		42	39	56	45	40	60	2.8	1.2	4.3	42	39	56	45	40	60	2.9	1.3	4.3	No
NCA34.RES.7368	RES	NCA34		47	43	64	49	45	65	2.5	1.6	1.4	47	43	64	50	45	65	2.7	1.8	1.4	No
NCA34.RES.7369	RES	NCA34		48	44	63	51	46	67	2.9	1.9	4.0	48	44	63	51	46	67	3.1	2.1	4.0	No
NCA34.RES.7371	RES	NCA34		43	39	60	45	40	60	2.3	1.5	0.4	43	39	60	45	41	60	2.4	1.6	0.4	No
NCA34.RES.7372	RES	NCA34		42	38	61	44	39	61	2.2	1.4	0.0	42	38	61	44	40	61	2.4	1.6	0.0	No
NCA34.RES.7373	RES	NCA34		45	42	59	48	43	63	2.4	1.6	4.3	45	42	59	48	43	63	2.5	1.7	4.3	No
NCA34.RES.7375	RES	NCA34		46	43	61	49	44	66	3.3	1.9	4.6	46	43	61	49	45	66	3.0	2.1	4.6	No
NCA34.RES.7376	RES	NCA34		41	38	56	44	39	58	2.4	1.6	2.7	41	38	56	44	39	58	2.6	1.7	2.7	No
NCA34.RES.7378	RES	NCA34		43	39	57	46	41	62	2.7	1.8	4.4	43	39	57	46	41	62	2.9	2.0	4.4	No
NCA34.RES.7379	RES	NCA34		46	42	63	49	45	66	3.5	2.4	3.0	46	42	63	50	45	66	3.7	2.6	3.0	No
NCA34.RES.7380	RES	NCA34		43	39	61	44	40	61	1.5	0.5	0.0	43	39	61	44	40	61	1.6	0.6	0.0	No
NCA34.RES.7381	RES	NCA34		44	40	59	48	42	64	3.9	2.7	4.5	44	40	59	48	43	64	4.2	3.0	4.5	No
NCA34.RES.7382	RES	NCA34		46	42	60	49	44	64	3.1	2.1	4.4	46	42	60	49	44	64	3.3	2.3	4.4	No
NCA34.RES.7383	RES	NCA34		45	42	63	50	45	67	4.4	3.0	4.6	45	42	63	50	45	67	4.7	3.3	4.6	No
NCA34.RES.7384	RES	NCA34		47	43	64	51	46	69	4.4	3.1	4.5	47	43	64	52	46	69	4.7	3.3	4.5	No
NCA34.RES.7387	RES	NCA34		45	41	62	46	42	62	1.5	0.9	0.0	45	41	62	47	42	62	1.6	1.0	0.0	No
NCA34.RES.7388	RES	NCA34		45	41	61	48	43	64	3.2	2.2	3.7	45	41	61	49	44	64	3.4	2.3	3.7	No
NCA34.RES.7390	RES	NCA34		44	40	60	48	43	64	4.0	2.7	4.2	44	40	60	48	43	64	4.2	3.0	4.2	No
NCA34.RES.7391	RES	NCA34		46	42	63	47	43	63	1.6	1.0	0.0	46	42	63	47	43	63	1.7	1.1	0.0	No
NCA34.RES.7393	RES	NCA34		51	47	71	55	50	73	4.3	3.0	1.9	51	47	71	56	50	73	4.5	3.2	1.9	No
NCA34.RES.7394	RES	NCA34		43	40	59	48	43	64	4.3	2.3	4.5	43	40	59	48	43	64	4.6	2.5	4.5	No
NCA34.RES.7395	RES	NCA34		44	40	60	48	43	64	3.9	2.7	4.2	44	40	60	48	43	64	4.1	2.9	4.2	No
NCA34.RES.7396	RES	NCA34		52	48	71	56	51	73	4.3	3.0	2.0	52	48	71	56	51	73	4.6	3.2	2.0	No
NCA34.RES.7397	RES	NCA34		44	40	59	48	43	64	4.2	2.9	4.3	44	40	59	48	43	64	4.4	3.1	4.3	No
NCA34.RES.7398	RES	NCA34		52	48	72	56	51	74	4.3	3.0	2.3	52	48	72	57	51	74	4.6	3.3	2.3	No
NCA34.RES.7399	RES	NCA34		43	39	59	46	41	63	3.8	2.5	3.9	43	39	59	47	42	63	4.0	2.7	3.9	No
NCA34.RES.7401	RES	NCA34		42	39	61	48	42	64	5.3	3.7	3.5	42	39	61	48	43	64	5.5	4.0	3.5	No
NCA34.RES.7402	RES	NCA34		52	48	72	57	51	74	4.4	3.0	2.4	52	48	72	57	52	74	4.6	3.3	2.4	No
NCA34.RES.7403	RES	NCA34		46	42	64	48	43	64	2.2	1.5	0.0	46	42	64	48	44	64	2.4	1.6	0.0	No
NCA34.RES.7404	RES	NCA34		42	39	60	47	42	64	5.0	3.6	3.8	42	39	60	48	42	64	5.3	3.8	3.8	No
NCA34.RES.7405	RES	NCA34		52	48	72	57	52	75	4.6	3.2	2.7	52	48	72	57	52	75	4.8	3.5	2.7	No
NCA34.RES.7406	RES	NCA34		45	42	63	49	44	66	4.2	2.3	3.0	45	42	63	49	44	66	4.4	2.5	3.0	No
NCA34.RES.7407	RES	NCA34		46	42	64	47	43	64	1.0	0.6	0.0	46	42	64	47	43	64	1.1	0.7	0.0	No
NCA34.RES.7409	RES	NCA34		52	49	72	57	52	75	4.7	3.3	2.9	52	49	72	57	52	75	4.9	3.5	2.9	No
NCA34.RES.7410	RES	NCA34		44	40	60	48	43	64	4.3	3.0	4.7	44	40	60	48	43	64	4.5	3.2	4.7	No
NCA34.RES.7411	RES	NCA34		46	42	64	48	43	64	2.3	1.5	0.0	46	42	64	48	44	64	2.4	1.6	0.0	No
NCA34.RES.7412	RES	NCA34		53	49	72	58	52	75	4.9	3.4	3.2	53	49	72	58	53	75	5.2	3.7	3.2	No
NCA34.RES.7414	RES	NCA34		46	42	64	47	43	64	1.1	0.7	0.0	46	42	64	47	43	64	1.2	0.7	0.0	No
NCA34.RES.7415	RES	NCA34		43	40	62	49	44	66	5.5	4.0	4.8	43	40	62	49	44	66	5.8	4.3	4.8	No
NCA34.RES.7416	RES	NCA34		44	41	60	49	44	65	4.2	2.9	4.8	44	41	60	49	44	65	4.5	3.2	4.8	No
NCA34.RES.7417	RES	NCA34		53	49	72	58	52	76	5.1	3.6	3.2	53	49	72	58	53	76	5.4	3.9	3.2	No
NCA34.RES.7418	RES	NCA34		52	48	72	57	52	75	5.4	3.9	3.6	52	48	72	57	52	75	5.7	4.2	3.6	No
NCA34.RES.7420	RES	NCA34		44	41	62	46	42	62	1.6	1.0	0.0	44	41	62	46	42	62	1.8	1.1	0.0	No

NCA34.RES.7421	RES	NCA34		48	44	67	53	47	70	4.7	3.3	3.0	48	44	67	53	48	70	4.9	3.5	3.0	No
NCA34.RES.7422	RES	NCA34		46	42	61	49	44	64	3.2	2.1	3.6	46	42	61	49	44	64	3.4	2.3	3.6	No
NCA34.RES.7423	RES	NCA34		53	49	73	58	53	76	5.1	3.6	3.1	53	49	73	58	53	76	5.4	3.9	3.1	No
NCA34.RES.7424	RES	NCA34		44	42	64	47	43	64	3.0	0.8	0.0	44	42	64	47	43	64	3.2	0.9	0.0	No
NCA34.RES.7426	RES	NCA34		44	41	62	46	42	62	2.1	1.3	0.0	44	41	62	47	42	62	2.2	1.5	0.0	No
NCA34.RES.7427	RES	NCA34		46	42	64	47	43	64	0.8	0.5	0.0	46	42	64	47	43	64	0.9	0.5	0.0	No
NCA34.RES.7428	RES	NCA34		53	49	73	58	53	76	5.1	3.6	3.1	53	49	73	58	53	76	5.3	3.9	3.1	No
NCA34.RES.7429	RES	NCA34		46	42	62	49	44	66	3.5	2.4	4.9	46	42	62	50	45	66	3.7	2.5	4.9	No
NCA34.RES.7430	RES	NCA34		46	42	65	48	44	65	1.9	1.2	0.0	46	42	65	48	44	65	2.1	1.3	0.0	No
NCA34.RES.7431	RES	NCA34		53	49	73	58	53	76	5.0	3.6	3.0	53	49	73	58	53	76	5.4	3.9	3.0	No
NCA34.RES.7432	RES	NCA34		46	42	65	47	43	65	0.8	0.5	0.0	46	42	65	47	43	65	0.9	0.5	0.0	No
NCA34.RES.7433	RES	NCA34		47	43	65	48	44	65	1.0	0.6	0.0	47	43	65	48	44	65	1.1	0.7	0.0	No
NCA34.RES.7434	RES	NCA34		53	49	73	58	53	76	5.1	3.6	3.0	53	49	73	59	53	76	5.3	3.8	3.0	No
NCA34.RES.7435	RES	NCA34		45	41	62	47	43	62	2.0	1.3	0.0	45	41	62	47	43	62	2.2	1.4	0.0	No
NCA34.RES.7436	RES	NCA34		45	41	64	50	44	67	4.7	3.3	3.4	45	41	64	50	45	67	5.0	3.5	3.4	No
NCA34.RES.7437	RES	NCA34		46	42	62	49	44	66	3.3	2.3	3.6	46	42	62	50	45	66	3.6	2.5	3.6	No
NCA34.RES.7439	RES	NCA34		46	42	65	47	43	65	0.8	0.5	0.0	46	42	65	47	43	65	0.8	0.5	0.0	No
NCA34.RES.7440	RES	NCA34		53	49	73	58	53	76	4.9	3.5	2.7	53	49	73	58	53	76	5.2	3.7	2.7	No
NCA34.RES.7441	RES	NCA34		47	43	65	48	44	65	0.8	0.5	0.0	47	43	65	48	44	65	0.9	0.5	0.0	No
NCA34.RES.7442	RES	NCA34		53	49	73	58	53	76	4.9	3.4	2.7	53	49	73	58	53	76	5.1	3.7	2.7	No
NCA34.RES.7443	RES	NCA34		46	43	65	47	43	65	0.7	0.4	0.0	46	43	65	47	43	65	0.8	0.5	0.0	No
NCA34.RES.7444	RES	NCA34		46	43	63	50	45	66	3.6	2.4	3.2	46	43	63	50	45	66	3.8	2.6	3.2	No
NCA34.RES.7445	RES	NCA34		44	41	62	47	42	62	2.0	1.3	0.0	44	41	62	47	42	62	2.2	1.4	0.0	No
NCA34.RES.7446	RES	NCA34		47	44	65	51	46	69	3.8	2.6	3.9	47	44	65	51	46	69	4.1	2.8	3.9	No
NCA34.RES.7447	RES	NCA34		53	49	73	58	53	76	4.7	3.3	2.5	53	49	73	58	53	76	5.0	3.6	2.5	No
NCA34.RES.7449	RES	NCA34		49	45	68	54	49	72	5.1	3.6	4.7	49	45	68	54	49	72	5.4	3.9	4.7	No
NCA34.RES.7450	RES	NCA34		48	44	67	48	44	67	0.6	0.3	0.0	48	44	67	48	44	67	0.6	0.4	0.0	No
NCA34.RES.7451	RES	NCA34		43	39	58	46	41	63	3.4	2.3	4.6	43	39	58	47	42	63	3.6	2.5	4.6	No
NCA34.RES.7452	RES	NCA34		44	41	60	49	44	65	4.2	2.5	5.2	44	41	60	49	44	65	4.4	2.8	5.2	No
NCA34.RES.7454	RES	NCA34		45	42	61	49	44	66	4.3	2.6	5.1	45	42	61	49	44	66	4.6	2.8	5.1	No
NCA34.RES.7455	RES	NCA34		45	41	64	45	41	64	0.6	0.3	0.0	45	41	64	45	41	64	0.6	0.4	0.0	No
NCA34.RES.7456	RES	NCA34		54	50	71	58	53	76	4.1	2.8	4.5	54	50	71	58	53	76	4.3	3.0	4.5	No
NCA34.RES.7457	RES	NCA34		46	42	63	50	45	67	4.3	2.9	4.2	46	42	63	50	45	67	4.5	3.2	4.2	No
NCA34.RES.7458	RES	NCA34		47	43	65	52	47	70	5.4	3.9	5.3	47	43	65	53	47	70	5.7	4.2	5.3	No
NCA34.RES.7459	RES	NCA34		45	41	63	47	43	63	1.8	1.1	0.0	44	41	63	47	43	63	2.8	1.2	0.0	No
NCA34.RES.7460	RES	NCA34		47	43	64	49	45	64	2.0	1.3	0.0	47	43	64	49	45	64	2.2	1.4	0.0	No
NCA34.RES.7461	RES	NCA34		46	42	65	47	43	65	0.7	0.4	0.0	46	42	65	47	43	65	0.8	0.5	0.0	No
NCA34.RES.7462	RES	NCA34		45	42	61	49	44	66	3.7	2.5	5.4	45	42	61	49	44	66	4.0	2.7	5.4	No
NCA34.RES.7463	RES	NCA34		45	41	61	47	42	61	2.2	1.4	0.1	45	41	61	47	43	61	2.3	1.5	0.1	No
NCA34.RES.7464	RES	NCA34		45	41	64	47	42	64	2.0	1.3	0.0	45	41	64	47	43	64	2.2	1.4	0.0	No
NCA34.RES.7465	RES	NCA34		53	49	73	57	52	75	4.0	2.7	1.1	53	49	73	57	52	75	4.2	3.0	1.1	No
NCA34.RES.7466	RES	NCA34		49	46	66	54	49	71	4.5	3.1	5.0	49	46	66	54	49	71	4.8	3.4	5.0	No
NCA34.RES.7468	RES	NCA34		45	41	61	49	44	66	3.7	2.5	4.8	45	41	61	49	44	66	3.9	2.8	4.8	No
NCA34.RES.7469	RES	NCA34		47	44	65	49	45	65	2.3	1.1	0.0	47	44	65	49	45	65	2.5	1.2	0.0	No
NCA34.RES.7470	RES	NCA34		47	43	66	48	44	66	1.1	0.7	0.0	47	43	66	48	44	66	1.2	0.7	0.0	No
NCA34.RES.7471	RES	NCA34		46	42	65	46	42	65	0.9	0.5	0.0	46	42	65	46	42	65	0.9	0.6	0.0	No
NCA34.RES.7472	RES	NCA34		46	43	65	48	44	65	1.4	0.9	0.0	46	43	65	48	44	65	1.6	1.0	0.0	No
NCA34.RES.7473	RES	NCA34		46	42	65	47	43	65	1.1	0.7	0.0	46	42	65	47	43	65	1.2	0.8	0.0	No
NCA34.RES.7474	RES	NCA34		45	42	63	48	43	63	2.2	1.3	0.0	45	42	63	48	43	63	2.4	1.4	0.0	No
NCA34.RES.7475	RES	NCA34		49	45	63	51	47	69	2.7	1.8	5.8	49	45	63	52	47	69	2.9	1.9	5.8	No
NCA34.RES.7476	RES	NCA34		46	42	64	46	42	64	0.9	0.6	0.0	46	42	64	47	42	64	1.0	0.6	0.0	No
NCA34.RES.7477	RES	NCA34		53	49	73	57	52	75	4.1	2.8	1.5	53	49	73	58	52	75	4.3	3.0	1.5	No
NCA34.RES.7478	RES	NCA34		50	46	68	55	50	73	5.1	3.6	5.0	50	46	68	56	50	73	5.4	3.9	5.0	No
NCA34.RES.7479	RES	NCA34		49	46	67	51	47	67	1.7	1.1	0.0	49	46	67	51	47	67	1.8	1.1	0.0	No
NCA34.RES.7480	RES	NCA34		52	48	73	57	52	74	4.6	3.2	1.8	52	48	73	57	52	74	4.9	3.4	1.8	No
NCA34.RES.7481	RES	NCA34		46	42	63	47	43	63	1.8	1.1	0.0	46	42	63	48	43	63	1.9	1.2	0.0	No
NCA34.RES.7482	RES	NCA34		47	44	67	48	44	67	0.5	0.3	0.0	47	44	67	48	44	67	0.5	0.3	0.0	No
NCA34.RES.7483	RES	NCA34		47	43	65	47	43	65	0.8	0.5	0.0	47	43	65	47	43	65	0.9	0.5	0.0	No
NCA34.RES.7484	RES	NCA34		46	42	66	47	43	66	0.6	0.4	0.0	46	42	66	47	43	66	0.7	0.4	0.0	No
NCA34.RES.7485	RES	NCA34		47	43	66	48	44	66	1.3	0.8	0.0	47	43	66	48	44	66	1.4	0.9	0.0	No
NCA34.RES.7486	RES	NCA34		49	45	66	51	46	66	1.7	1.1	0.0	49	45	66	51	46	66	1.8	1.2	0.0	No

NCA34.RES.7487	RES	NCA34		44	40	60	46	42	60	2.1	1.3	0.0	44	40	60	46	42	60	2.2	1.4	0.0	No
NCA34.RES.7488	RES	NCA34		45	41	64	46	42	64	1.1	0.7	0.0	45	41	64	46	42	64	1.2	0.8	0.0	No
NCA34.RES.7489	RES	NCA34		48	44	67	49	45	67	1.3	0.8	0.0	48	44	67	49	45	67	1.4	0.9	0.0	No
NCA34.RES.7490	RES	NCA34		47	43	67	48	44	67	0.8	0.5	0.0	47	43	67	48	44	67	0.8	0.5	0.0	No
NCA34.RES.7491	RES	NCA34		49	45	67	50	46	67	1.4	0.9	0.0	49	45	67	50	46	67	1.5	1.0	0.0	No
NCA34.RES.7492	RES	NCA34		50	47	70	56	50	74	5.3	3.7	3.6	50	47	70	56	51	74	5.5	4.0	3.6	No
NCA34.RES.7493	RES	NCA34		47	43	66	47	43	66	0.7	0.4	0.0	47	43	66	48	43	66	0.8	0.5	0.0	No
NCA34.RES.7494	RES	NCA34		47	44	67	48	44	67	0.9	0.6	0.0	47	44	67	48	44	67	1.0	0.6	0.0	No
NCA34.RES.7495	RES	NCA34		46	42	63	48	43	63	1.9	1.2	0.0	46	42	63	48	43	63	2.1	1.3	0.0	No
NCA34.RES.7496	RES	NCA34		49	46	69	50	46	69	1.0	0.6	0.0	49	46	69	51	46	69	1.0	0.6	0.0	No
NCA34.RES.7497	RES	NCA34		46	42	66	47	43	66	0.8	0.5	0.0	46	42	66	47	43	66	0.9	0.5	0.0	No
NCA34.RES.7498	RES	NCA34		46	43	65	47	43	65	1.0	0.5	0.0	46	43	65	47	43	65	1.0	0.5	0.0	No
NCA34.RES.7499	RES	NCA34		46	42	66	46	42	66	0.8	0.5	0.0	46	42	66	46	42	66	0.9	0.5	0.0	No
NCA34.RES.7500	RES	NCA34		46	42	64	47	43	64	0.9	0.6	0.0	46	42	64	47	43	64	1.0	0.6	0.0	No
NCA34.RES.7501	RES	NCA34		49	45	68	50	46	68	1.0	0.6	0.0	49	45	68	50	46	68	1.0	0.6	0.0	No
NCA34.RES.7502	RES	NCA34		46	43	66	47	43	66	0.7	0.4	0.0	46	43	66	47	43	66	0.8	0.5	0.0	No
NCA34.RES.7503	RES	NCA34		48	44	67	49	45	67	0.8	0.5	0.0	48	44	67	49	45	67	0.8	0.5	0.0	No
NCA34.RES.7504	RES	NCA34		50	46	68	53	48	70	3.8	2.6	1.8	50	46	68	54	49	70	4.0	2.8	1.8	No
NCA34.RES.7506	RES	NCA34		47	43	66	48	44	66	0.9	0.5	0.0	47	43	66	48	44	66	1.0	0.6	0.0	No
NCA34.RES.7507	RES	NCA34		48	46	66	53	48	70	4.8	1.8	4.8	48	46	66	53	48	70	5.0	2.0	4.8	No
NCA34.RES.7508	RES	NCA34		47	44	67	48	44	67	0.4	0.2	0.0	47	44	67	48	44	67	0.4	0.2	0.0	No
NCA34.RES.7509	RES	NCA34		46	43	66	47	43	66	0.7	0.4	0.0	46	43	66	47	43	66	0.8	0.5	0.0	No
NCA34.RES.7511	RES	NCA34		46	42	63	47	43	63	1.3	0.8	0.0	46	42	63	47	43	63	1.4	0.9	0.0	No
NCA34.RES.7512	RES	NCA34		47	43	66	48	44	66	0.8	0.5	0.0	47	43	66	48	44	66	0.9	0.5	0.0	No
NCA34.RES.7513	RES	NCA34		47	44	65	49	45	65	2.0	1.2	0.0	47	44	65	50	45	65	2.1	1.3	0.0	No
NCA34.RES.7514	RES	NCA34		43	40	61	44	40	61	1.0	0.6	0.0	43	40	61	44	40	61	1.1	0.7	0.0	No
NCA34.RES.7515	RES	NCA34		46	43	65	48	43	65	1.5	0.9	0.0	46	43	65	48	44	65	1.6	1.0	0.0	No
NCA34.RES.7516	RES	NCA34		49	45	68	50	45	68	1.0	0.6	0.0	49	45	68	50	46	68	1.1	0.7	0.0	No
NCA34.RES.7517	RES	NCA34		47	43	67	48	44	67	0.8	0.5	0.0	47	43	67	48	44	67	0.9	0.6	0.0	No
NCA34.RES.7518	RES	NCA34		48	44	66	49	45	66	1.8	1.1	0.0	48	44	66	49	45	66	1.9	1.2	0.0	No
NCA34.RES.7519	RES	NCA34		47	44	66	48	44	66	1.2	0.7	0.0	47	44	66	49	44	66	1.2	0.8	0.0	No
NCA34.RES.7520	RES	NCA34		48	45	68	51	46	68	2.8	1.2	0.0	48	45	68	51	46	68	3.0	1.3	0.0	No
NCA34.RES.7521	RES	NCA34		48	45	68	50	45	68	1.0	0.6	0.0	48	45	68	50	45	68	1.1	0.7	0.0	No
NCA34.RES.7522	RES	NCA34		48	44	68	49	45	68	0.6	0.3	0.0	48	44	68	49	45	68	0.6	0.4	0.0	No
NCA34.RES.7523	RES	NCA34		47	43	66	48	44	66	0.9	0.5	0.0	47	43	66	48	44	66	0.9	0.6	0.0	No
NCA34.RES.7524	RES	NCA34		49	45	69	50	46	69	0.4	0.3	0.0	49	45	69	50	46	69	0.5	0.3	0.0	No
NCA34.RES.7525	RES	NCA34		48	44	67	49	45	67	0.8	0.5	0.0	48	44	67	49	45	67	0.9	0.5	0.0	No
NCA34.RES.7526	RES	NCA34		50	46	70	52	47	70	1.6	1.0	0.0	50	46	70	52	48	70	1.7	1.1	0.0	No
NCA34.RES.7527	RES	NCA34		49	45	68	50	46	68	1.3	0.8	0.0	49	45	68	51	46	68	1.4	0.9	0.0	No
NCA34.RES.7528	RES	NCA34		49	45	69	49	45	69	0.3	0.2	0.0	49	45	69	49	45	69	0.4	0.2	0.0	No
NCA34.RES.7529	RES	NCA34		47	43	64	50	45	65	2.9	1.9	1.0	47	43	64	50	45	65	3.2	2.1	1.0	No
NCA34.RES.7530	RES	NCA34		46	42	66	47	43	66	1.2	0.7	0.0	46	42	66	47	43	66	1.3	0.8	0.0	No
NCA34.RES.7531	RES	NCA34		49	45	68	50	46	68	1.0	0.6	0.0	49	45	68	50	46	68	1.1	0.7	0.0	No
NCA34.RES.7532	RES	NCA34		46	42	64	47	43	64	1.3	0.8	0.0	46	42	64	47	43	64	1.4	0.9	0.0	No
NCA34.RES.7533	RES	NCA34		48	44	68	48	44	68	0.5	0.3	0.0	48	44	68	48	44	68	0.5	0.3	0.0	No
NCA34.RES.7534	RES	NCA34		47	43	64	49	45	65	2.8	1.8	1.0	47	43	64	50	45	65	3.0	2.0	1.0	No
NCA34.RES.7535	RES	NCA34		49	45	68	50	46	68	1.0	0.6	0.0	49	45	68	50	46	68	1.1	0.7	0.0	No
NCA34.RES.7536	RES	NCA34		48	44	67	49	45	67	1.0	0.6	0.0	48	44	67	49	45	67	1.1	0.7	0.0	No
NCA34.RES.7537	RES	NCA34		49	45	68	50	46	68	1.2	0.7	0.0	49	45	68	50	46	68	1.3	0.8	0.0	No
NCA34.RES.7538	RES	NCA34		47	43	64	50	45	66	3.3	2.2	2.5	47	43	64	50	46	66	3.6	2.4	2.5	No
NCA34.RES.7539	RES	NCA34		49	45	69	49	45	69	0.3	0.2	0.0	49	45	69	49	45	69	0.4	0.2	0.0	No
NCA34.RES.7540	RES	NCA34		48	44	68	49	45	68	0.4	0.3	0.0	48	44	68	49	45	68	0.5	0.3	0.0	No
NCA34.RES.7541	RES	NCA34		48	44	68	48	44	68	0.6	0.4	0.0	48	44	68	48	44	68	0.7	0.4	0.0	No
NCA34.RES.7542	RES	NCA34		48	44	67	50	45	67	1.4	0.9	0.0	48	44	67	50	45	67	1.5	1.0	0.0	No
NCA34.RES.7543	RES	NCA34		48	44	67	49	45	67	1.5	0.9	0.0	48	44	67	49	45	67	1.6	1.0	0.0	No
NCA34.RES.7544	RES	NCA34		46	43	63	50	45	66	3.6	2.5	3.3	46	43	63	50	45	66	3.9	2.7	3.3	No
NCA34.RES.7545	RES	NCA34		48	44	66	49	45	66	1.3	0.8	0.0	48	44	66	49	45	66	1.4	0.9	0.0	No
NCA34.RES.7547	RES	NCA34		49	45	70	50	46	70	0.3	0.2	0.0	49	45	70	50	46	70	0.4	0.2	0.0	No
NCA34.RES.7548	RES	NCA34		48	44	66	51	46	67	3.1	2.0	0.9	48	44	66	51	46	67	3.3	2.2	0.9	No
NCA34.RES.7549	RES	NCA34		48	44	68	49	45	68	0.7	0.4	0.0	48	44	68	49	45	68	0.7	0.4	0.0	No
NCA34.RES.7550	RES	NCA34		48	44	67	49	45	67	1.0	0.6	0.0	48	44	67	49	45	67	1.1	0.7	0.0	No

NCA34.RES.7551	RES	NCA34		48	44	67	49	45	67	1.4	0.9	0.0	48	44	67	49	45	67	1.6	1.0	0.0	No
NCA34.RES.7552	RES	NCA34		48	45	68	49	45	68	0.9	0.6	0.0	48	45	68	49	45	68	1.0	0.6	0.0	No
NCA34.RES.7553	RES	NCA34		48	44	67	48	44	67	0.8	0.5	0.0	48	44	67	49	44	67	0.8	0.5	0.0	No
NCA34.RES.7554	RES	NCA34		49	45	69	49	45	69	0.3	0.2	0.0	49	45	69	49	45	69	0.3	0.2	0.0	No
NCA34.RES.7555	RES	NCA34		47	43	66	48	44	66	1.3	0.8	0.0	47	43	66	48	44	66	1.4	0.9	0.0	No
NCA34.RES.7556	RES	NCA34		47	43	66	50	45	66	3.2	2.2	0.6	47	43	66	50	46	66	3.5	2.3	0.6	No
NCA34.RES.7557	RES	NCA34		49	45	69	49	45	69	0.8	0.5	0.0	49	45	69	49	45	69	0.8	0.5	0.0	No
NCA34.RES.7558	RES	NCA34		47	43	66	48	44	66	1.5	0.9	0.0	47	43	66	48	44	66	1.6	1.0	0.0	No
NCA34.RES.7559	RES	NCA34		49	45	70	49	45	70	0.2	0.1	0.0	49	45	70	49	45	70	0.3	0.2	0.0	No
NCA34.RES.7560	RES	NCA34		47	44	66	50	45	66	2.8	1.9	0.0	47	44	66	50	46	66	3.0	2.0	0.0	No
NCA34.RES.7561	RES	NCA34		47	43	65	48	44	65	1.6	1.0	0.0	47	43	65	48	44	65	1.7	1.1	0.0	No
NCA34.RES.7562	RES	NCA34		49	46	69	50	46	69	0.3	0.1	0.0	49	46	69	50	46	69	0.3	0.2	0.0	No
NCA34.RES.7563	RES	NCA34		47	43	65	49	45	65	2.1	1.3	0.0	47	43	65	49	45	65	2.2	1.5	0.0	No
NCA34.RES.7565	RES	NCA34		47	43	65	48	44	65	1.5	0.9	0.0	47	43	65	48	44	65	1.7	1.0	0.0	No
NCA34.RES.7566	RES	NCA34		49	45	69	49	45	69	0.3	0.2	0.0	49	45	69	49	45	69	0.3	0.2	0.0	No
NCA34.RES.7567	RES	NCA34		48	44	66	49	45	66	1.4	0.8	0.0	48	44	66	49	45	66	1.5	0.9	0.0	No
NCA34.RES.7568	RES	NCA34		48	45	68	49	45	68	0.6	0.4	0.0	48	45	68	49	45	68	0.7	0.4	0.0	No
NCA34.RES.7569	RES	NCA34		47	43	66	48	44	66	1.3	0.8	0.0	47	43	66	49	44	66	1.4	0.9	0.0	No
NCA34.RES.7570	RES	NCA34		47	44	67	49	44	67	1.1	0.7	0.0	47	44	67	49	44	67	1.2	0.8	0.0	No
NCA34.RES.7571	RES	NCA34		49	45	68	50	46	68	1.4	0.9	0.0	49	45	68	51	46	68	1.5	1.0	0.0	No
NCA34.RES.7572	RES	NCA34		49	45	68	50	46	68	0.6	0.4	0.0	49	45	68	50	46	68	0.7	0.4	0.0	No
NCA34.RES.7573	RES	NCA34		48	44	66	49	45	66	1.1	0.7	0.0	48	44	66	49	45	66	1.2	0.7	0.0	No
NCA34.RES.7576	RES	NCA34		48	44	68	48	44	68	0.5	0.3	0.0	48	44	68	48	44	68	0.6	0.3	0.0	No
NCA34.RES.7577	RES	NCA34		48	44	67	49	45	67	1.1	0.7	0.0	48	44	67	49	45	67	1.2	0.7	0.0	No
NCA34.RES.7578	RES	NCA34		50	46	68	51	46	68	1.0	0.6	0.0	50	46	68	51	47	68	1.1	0.7	0.0	No
NCA34.RES.7579	RES	NCA34		49	46	69	50	46	69	0.7	0.4	0.0	49	46	69	50	46	69	0.7	0.5	0.0	No
NCA34.RES.7580	RES	NCA34		49	46	68	50	46	68	0.6	0.4	0.0	49	46	68	50	46	68	0.7	0.4	0.0	No
NCA34.RES.7581	RES	NCA34		49	45	69	50	46	69	0.4	0.3	0.0	49	45	69	50	46	69	0.5	0.3	0.0	No
NCA34.RES.7582	RES	NCA34		47	43	66	48	44	66	1.1	0.7	0.0	47	43	66	48	44	66	1.2	0.8	0.0	No
NCA34.RES.7583	RES	NCA34		51	47	71	51	47	71	0.4	0.2	0.0	51	47	71	51	47	71	0.4	0.3	0.0	No
NCA34.RES.7584	RES	NCA34		47	44	67	48	44	67	0.9	0.5	0.0	47	44	67	48	44	67	1.0	0.6	0.0	No
NCA34.RES.7585	RES	NCA34		48	44	67	49	45	67	0.7	0.4	0.0	48	44	67	49	45	67	0.8	0.5	0.0	No
NCA34.RES.7586	RES	NCA34		50	46	69	50	46	69	0.6	0.4	0.0	50	46	69	50	46	69	0.6	0.4	0.0	No
NCA34.RES.7587	RES	NCA34		48	45	69	50	46	69	2.0	1.3	0.0	48	45	69	51	46	69	2.2	1.4	0.0	No
NCA34.RES.7588	RES	NCA34		47	44	65	49	45	65	1.9	1.2	0.0	47	44	65	49	45	65	2.1	1.3	0.0	No
NCA34.RES.7589	RES	NCA34		48	44	67	49	45	67	0.8	0.5	0.0	48	44	67	49	45	67	0.9	0.5	0.0	No
NCA34.RES.7590	RES	NCA34		48	44	68	49	45	68	0.6	0.3	0.0	48	44	68	49	45	68	0.9	0.4	0.0	No
NCA34.RES.7592	RES	NCA34		49	45	69	50	46	69	1.0	0.6	0.0	49	45	69	50	46	69	1.1	0.7	0.0	No
NCA34.RES.7593	RES	NCA34		48	44	68	49	45	68	1.2	0.7	0.0	48	44	68	49	45	68	1.3	0.8	0.0	No
NCA34.RES.7594	RES	NCA34		52	48	73	52	48	73	0.3	0.1	0.0	52	48	73	52	48	73	0.3	0.2	0.0	No
NCA34.RES.7595	RES	NCA34		52	48	72	52	48	72	0.3	0.2	0.0	52	48	72	52	48	72	0.3	0.2	0.0	No
NCA34.RES.7596	RES	NCA34		50	46	70	51	47	70	0.8	0.5	0.0	50	46	70	51	47	70	0.9	0.6	0.0	No
NCA34.RES.7597	RES	NCA34		51	47	72	51	47	72	0.2	0.1	0.0	51	47	72	51	47	72	0.2	0.1	0.0	No
NCA34.RES.7598	RES	NCA34		51	47	71	52	48	71	0.8	0.5	0.0	51	47	71	52	48	71	0.9	0.5	0.0	No
NCA34.RES.7599	RES	NCA34		51	48	72	52	48	72	0.3	0.2	0.0	51	48	72	52	48	72	0.3	0.2	0.0	No
NCA34.RES.7601	RES	NCA34		53	49	73	53	49	73	0.3	0.2	0.0	53	49	73	53	49	73	0.3	0.2	0.0	No
NCA34.RES.7602	RES	NCA34		50	47	71	51	47	71	0.7	0.4	0.0	50	47	71	51	47	71	0.8	0.5	0.0	No
NCA34.RES.7604	RES	NCA34		52	48	73	52	48	73	0.4	0.2	0.0	52	48	73	52	48	73	0.4	0.2	0.0	No
NCA34.RES.7606	RES	NCA34		53	49	73	53	49	73	0.2	0.1	0.0	53	49	73	53	49	73	0.2	0.1	0.0	No
NCA34.RES.7607	RES	NCA34		53	50	73	54	50	73	0.2	0.1	0.0	53	50	73	54	50	73	0.2	0.1	0.0	No