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# Mittagong Station Upgrade

## Noise and Vibration Impact Assessment

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Noise and Vibration Impact Assessment

Client: Transport for New South Wales

ABN: 18 804 239 602

Prepared by

**AECOM Australia Pty Ltd**
Level 21, 420 George Street, Sydney NSW 2000, PO Box Q410, QVB Post Office NSW 1230, Australia
T +61 2 8934 0000 F +61 2 8934 0001 www.aecom.com
ABN 20 093 846 925

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# Abbreviations

| Term | Meaning |
|---|---|
| **AADT** | Annual Average Daily Traffic |
| **CEMP** | Construction Environmental Management Plan |
| **CNVMP** | Construction Noise and Vibration Management Plan |
| **CTMP** | Construction Traffic Management Plan |
| **dB** | Decibel |
| **DECC** | Department of Environment and Climate Change |
| **DECCW** | Department of Environment, Climate Change and Water |
| **EMS** | Environmental Management System |
| **EPA** | Environment Protection Authority |
| **EP&A Act** | *Environmental Planning and Assessment Act 1979* (NSW) |
| **EP&A Regulation** | Environmental Planning and Assessment Regulation 2000 (NSW) |
| **EPI** | Environmental Planning Instrument |
| **EPL** | Environment Protection Licence |
| **ESD** | Ecologically Sustainable Development (refer to Definitions) |
| **Heritage Act** | *Heritage Act 1977* (NSW) |
| **ICNG** | *Interim Construction Noise Guideline* (Department of Environment and Climate Change, 2009). |
| **Infrastructure SEPP** | *State Environmental Planning Policy (Infrastructure) 2007* (NSW) |
| **LEP** | Local Environmental Plan |
| **LGA** | Local Government Area |
| **NCA** | Noise Catchment Areas |
| **NML** | Noise Management Level |
| **NPfI** | *Noise Policy for Industry* (Environment Protection Authority, 2017) |
| **NSW** | New South Wales |
| **OEH** | NSW Office of the Environment and Heritage |
| **OOHW** | Out of Hours Works |
| **POEO Act** | *Protection of the Environment Operations Act 1997* (NSW) |
| **RailCorp** | (former) Rail Corporation of NSW |
| **RBL** | Rating Background Level |
| **REF** | Review of Environmental Factors |
| **SEPP** | State Environmental Planning Policy |
| **SHR** | State Heritage Register |
| **TfNSW** | Transport for NSW |
| **TMP** | Traffic Management Plan |
| **VDV** | Vibration Dose Values |

# 1.0 Introduction

## 1.1 Background Information

Transport for NSW (TfNSW) is the government agency responsible for the delivery of major transport infrastructure projects in NSW and is the proponent for the Mittagong Station Upgrade (the Proposal).

The Proposal is part of the Transport Access Program which is a NSW Government initiative to provide a better experience for public transport customers by delivering accessible, modern, secure and integrated transport infrastructure.

AECOM Australia Pty Ltd (AECOM) has been commissioned by TfNSW to undertake a Noise and Vibration Impact Assessment of the construction and operation of the Proposal. Construction of the Mittagong Station Upgrade is expected to commence in 2019, take up to 12 months to complete and would be undertaken both during and outside of standard construction hours. Approximately three weekend rail shutdowns are likely to be required over the 12 month construction period.

## 1.2 Scope

The scope of this Noise and Vibration Impact Assessment is to:

- establish the existing background noise levels in the vicinity of the Proposal
- establish construction noise management levels and vibration limits that would apply to the Proposal
- predict environmental noise and vibration levels at nearby residential and other sensitive receivers due to the Proposal
- predict noise levels from additional off-site construction traffic generated by the Proposal
- recommend mitigation measures, where necessary, to reduce and manage noise and vibration impacts from the Proposal to comply with established construction noise management levels and vibration limits
- consider noise from the operation of the upgraded Mittagong Station.

## 1.3 Proposed Works

The key features of the Proposal are summarised as follows:

**Lifts and footbridge**

- construction of two new lifts, one at each end of the existing footbridge
- low voltage (LV) electrical work to support the installation of the two new lifts, including trenching on the station platform for new LV service routes, upgrade and installation of fuses, switches, distribution board, circuit breakers and cables
- installation of air conditioning in all lift cars
- upgrading existing footbridge stairs with new compliant handrails, tactile ground surface indicators (TGSI) and nosing.

**Platforms and lift lobbies**

- new path at the city end of Platform 1 of the station to gain access to the lift lobby
- installation of additional lighting to all upper and lower lift lobbies and platform extension
- installation of a new opal card reader near the lift on Platform 1
- upgrading existing phone booth and installation of new drinking water fountain
- existing memorial plaque and memorial rock would be retained.

**Platform buildings**

- construction of a new family accessible toilet, replacing the existing lobby to the female toilets on Platform 1
- provision of a new entry to the existing female toilet, and retention of the existing door to the lobby of the female toilets (in a permanently open position) to improve accessibility and safety
- construction of a new ambulant toilet in the male toilets, and a new ambulant toilet in the female toilets, and adjustment of the existing toilets cubicles to accommodate them
- provision of a portable fire extinguisher, attached to the wall in the Station Master's office.

**General**

- installation of wayfinding signage to indicate the location of the new toilets and lifts
- installation of a minimum of nine additional closed-circuit television (CCTV) cameras to ensure coverage of all accessible areas.

**Commuter car parks – Regent Street**

- construction of a new pedestrian crossing on Regent Street and a connecting access footpath from the new pedestrian crossing to the station with associated kerb ramps and tactile markers
- re-grading of the Regent Street car park at the eastern end near the station entrance
- provision of a kiss and ride bay adjacent to the existing accessible parking spaces in the Regent Street car park
- removal of existing kerbside kiss and ride bays at the front of the station, and provision of a formal bus stop.

**Commuter car parks – Railway Parade**

- reconfiguration of two existing accessible car spaces in the Railway Parade car park to achieve compliance with current applicable statutory requirements (including line markings with a new kerb ramp extension to provide access from these parking spaces).

A detailed description of the Proposal is provided in Chapter 3 of the *Mittagong Station Upgrade Review of Environmental Factors* (AECOM, 2019).

## 1.4 Policies and Guidelines

The following policies and guidelines are relevant for this assessment:

- *Interim Construction Noise Guideline* (ICNG), Department of Environment and Climate Change, 2009
- *Assessing Vibration: A Technical Guideline* (AVATG), Department of Environment and Conservation, 2006
- *NSW Road Noise Policy* (RNP), Department of Environment, Climate Change and Water, 2011
- *Noise Policy for Industry* (NPfI), Environment Protection Authority, 2017
- *Construction Noise and Vibration Strategy* (CNVS), Transport for NSW, 2018
- DIN Standard 4150: Part 3 1999 *Structural Vibration in Buildings - Effects on Structures*, 1999
- British Standard 7385: Part 2 1993 *Evaluation and Measurement of Vibration in Buildings*, 1993
- British Standard 6472: Part 1 2008 *Evaluation of Human Exposure to Vibration in Buildings*, 2008
- Australian Standard AS 2436-2010, *Guide to noise and vibration control on construction, demolition and maintenance sites*, 2010
- Australian Standard AS 1055-2018 – *Acoustics—Description and measurement of environmental noise*, 2018

- International Standard ISO 9613-2:1996 - *Acoustics -- Attenuation of sound during propagation outdoors - Part 2: General method of calculation*
- Australia Standard AS IEC 61672.1-2019 - *Electroacoustics – Sound level meters Specifications*
- UK Department for Environment, Food and Rural Affairs (DEFRA) *Update of noise database for prediction of noise on construction and open sites*, 2006.

Definitions for acoustic terminology used within this report can be found in Appendix A.

# 2.0 Existing Acoustic Environment

## 2.1 Site Description

Mittagong Station is located within a mainly residential suburban environment. The closest residential receivers are located on Regent Street and Railway Parade. Mittagong Police Station and Highlands Christian Church are located to the north of the station on the opposite side of Regent Street. The station and its surrounding environment are shown in Figure 2-1.

Regent Street and Railway Parade to the north and south of the station respectively, are considered to be sub-arterial roads as per categories within the *NSW Road Noise Policy*.

### 2.1.1 Representative Receivers

To provide a comprehensive assessment, 34 representative residential receivers surrounding the Proposal, as listed in Table 1, have been selected to describe the noise impacts in accordance with the *Interim Construction Noise Guideline*. Residences located closest to the Proposal within each block were selected as the potentially worst affected receivers.

Impacts were also assessed at representative non-residential sensitive receivers as listed in Table 2.

The locations of the residential and non-residential receivers identified for use in the assessment are presented in Figure 2-2. It is noted that other residential and non-residential sensitive receivers which could potentially be affected by the Proposal are scattered around the vicinity of the Proposal area, however as noted above, noise impacts have been assessed at representative worst-affected receivers.

**Table 1 Representative receiver addresses – residential**

| Receiver ID | Receiver address | Approximate distance to Proposal in metres |
|---|---|---|
| R1 | 39 Regent Street, Mittagong | 50 |
| R2 | 40 Railway Parade, Mittagong | 52 |
| R3 | 24-26 Railway Parade, Mittagong | 83 |
| R4 | 2 Oxley Drive, Mittagong | 125 |
| R5 | 49 Regent Street, Mittagong | 125 |
| R6 | 21 Regent Street, Mittagong | 139 |
| R7 | 32-34 Vernon Street, Mittagong | 191 |
| R8 | 57 Regent Street, Mittagong | 206 |
| R9 | 10 Victoria Street, Mittagong | 288 |
| R10 | 17 Oxley Drive, Mittagong | 344 |
| R11 | 1 Regent Street, Mittagong | 356 |
| R12 | 47 Main Street, Mittagong | 359 |
| R13 | 51 Range Road, Mittagong | 369 |
| R14 | 119 Old Hume Highway, Mittagong | 371 |
| R15 | 23 Bowral Road, Mittagong | 409 |
| R16 | 18 Victoria Street, Mittagong | 415 |
| R17 | 2 Bessemer Street, Mittagong | 425 |
| R18 | 23 Oxford Street, Mittagong | 471 |
| R19 | 36 Oxley Drive, Mittagong | 503 |
| R20 | 17-19 Railway Crescent, Mittagong | 545 |
| R21 | 37 Alfred Street, Mittagong | 551 |
| R22 | 135 Old Hume Highway, Mittagong | 579 |
| R23 | 23-27 Pioneer Street, Mittagong | 647 |
| R24 | 29 Arthur Street, Mittagong | 663 |
| R25 | 47 Bowral Road, Mittagong | 664 |
| R26 | 24 Oxford Street, Mittagong | 665 |
| R27 | 1 Colo Street, Mittagong | 697 |
| R28 | 17 Old Hume Highway, Mittagong | 699 |
| R29 | 19 Faraday Street, Mittagong | 705 |
| R30 | 26 Payten Street, Mittagong | 716 |
| R31 | 21 Spencer Street, Mittagong | 728 |
| R32 | 11 Alice Street, Mittagong | 742 |
| R33 | 2 Spencer Street, Mittagong | 794 |
| R34 | 39 Regent Street, Mittagong | 798 |

**Table 2 Representative receiver addresses – non-residential**

| Receiver ID | Receiver | Approximate distance to Proposal in metres |
|---|---|---|
| N1 | Mittagong Police Station | 7 |
| N2 | Highlands Christian Church and The Potters Pre School | 32 |
| N3 | Mittagong Anglican Church | 63 |
| N4 | Berrima District Historical & Family History Society | 141 |
| N5 | Lion Rampant Hotel | 145 |
| N6 | Frensham School | 194 |
| N7 | Southern Highlands Spiritualist Church | 243 |
| N8 | Mittagong Uniting Church | 268 |
| N9 | Mittagong Preschool Kindergarten Inc. | 289 |
| N10 | Mittagong Community Centre | 294 |
| N11 | Grand Country Lodge Motel | 422 |

### 2.1.2 Noise Catchment Areas

To assist in determining noise criteria for the receivers surrounding the Proposal, two noise catchment areas (NCAs) were identified. The noise environment at each of the residential receivers within a NCA is considered to have a similar noise environment. Each NCA is shown in Figure 2-1.

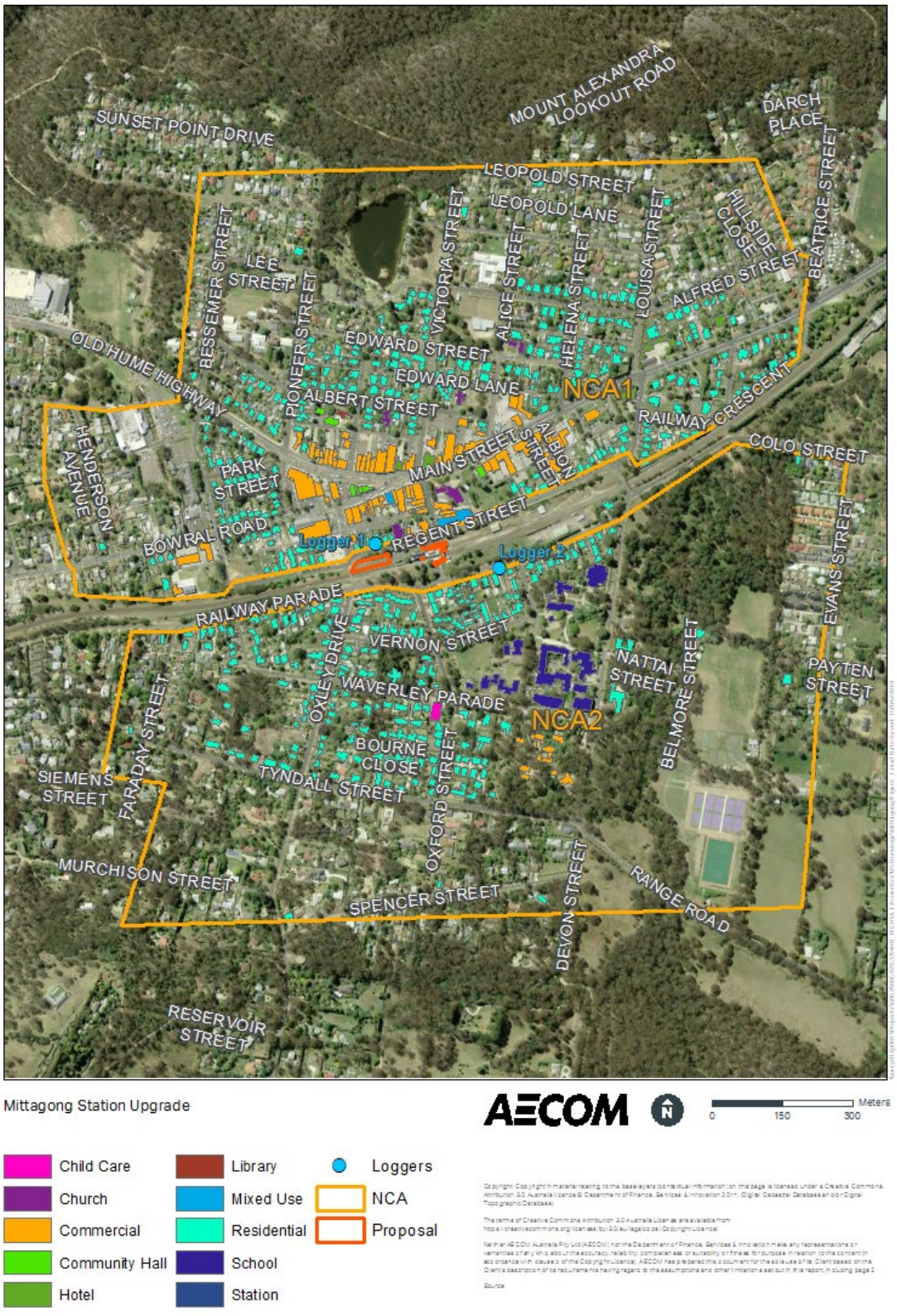



**Figure 2-1 Noise and vibration receivers and logger locations**

**Figure 2-2 Representative receiver locations**

### 2.1.3 Heritage Items

Mittagong Station is bound by heritage constraints. The 'Mittagong Railway Station and yard group' is designated a heritage item and would be directly impacted by the Proposal. The design of the Mittagong Station building represents a group of Victorian Georgian railway buildings that remain substantially intact and are an important civic landmark in the townscape of Mittagong. The footbridge was identified as an item of high heritage significance in the 2016 'Railway Footbridges Heritage Conservation Strategy'. The Mittagong Station footbridge is a good representative example of a 1914 design featuring a steel riveted through warren truss which contributes strongly to the Mittagong Railway Station precinct. There are also two additional heritage items which are located within approximately 50 metres of the Proposal (see Figure 2-3). These heritage sites are:

- The former post office building (5 Station Street, Mittagong)
- The Mittagong Police Station (1–3 Station Street, Mittagong)

Refer to the REF and Statement of Heritage Impact for more information.

**Figure 2-3 Surrounding sensitive heritage receivers**

## 2.2 Noise Measurement Methodology

Long term unattended and short term attended measurements were undertaken to establish the existing ambient and background noise environment at potentially affected receivers. The location of the noise logger is shown in Figure 2-1.

### 2.2.1 Unattended Noise Measurement Methodology

Long term unattended noise monitoring was conducted between 4 and 13 March 2019. Two noise loggers were placed at representative locations at the properties indicated in Table 3 and shown in Figure 2-1. The noise loggers were calibrated prior to and after the monitoring period with a drift in calibration not exceeding ±0.5 dB.

All the acoustic instrumentation employed during the noise measurements comply with the requirements of "*AS IEC 61672.1-2019 Electroacoustics - Sound level meters Specifications*" and were within their current National Association of Testing Authorities, Australia (NATA) certified in-calibration period (i.e. calibration in the last two years).

**Table 3 Noise monitoring details**

| NCA | Logger | Location | Model | Serial number |
|---|---|---|---|---|
| 1 | 1 | 43 Regent Street, Mittagong | Rion NL52 | 386741 |
| 2 | 2 | 26 Regent Street, Mittagong | ARL 315 | 15299444 |

The noise environment at each of the residential receivers within a NCA is considered to have a similar noise environment to the unattended monitoring location within that NCA. As such each of these residential receivers is assigned the same background noise level and construction noise management level.

In accordance with the *Noise Policy for Industry*, noise monitoring affected by adverse weather conditions or extraneous noise events is excluded from the monitoring data. The *Noise Policy for Industry* advises that data may be affected where adverse weather, such as wind speeds higher than 5 m/s or rain, occurs. Weather data was acquired from the Bureau of Meteorology's Moss Vale weather station (station number 068239) located around ten kilometres north of the Proposal.

The logger measured noise levels over the sample period and then determined $L_{A1}$, $L_{A10}$, $L_{A90}$, and $L_{Aeq}$ levels of the noise environment. The $L_{A1}$, $L_{A10}$ and $L_{A90}$ noise levels are the levels exceeded for 1%, 10% and 90% of the measurement period respectively. The $L_{A90}$ is taken as the background level. The $L_{A1}$ is indicative of the maximum noise levels due to individual noise events such as the pass-by of a heavy vehicle. The $L_{Aeq}$ level is the equivalent continuous sound level and has the same sound energy over the sample period as the actual noise environment with fluctuating sound levels.

The $L_{A90}$ noise levels were analysed to determine a single assessment background level (ABL) for each day, evening and night period in accordance with the *Noise Policy for Industry* for each monitoring location. The ABL is established by determining the lowest ten-percentile level of the $L_{A90}$ noise data acquired over each period of interest. Table 4 presents individual ABLs for each day's assessment periods. The background noise level or rating background level (RBL) representing the day, evening and night-time assessment periods is based on the median of individual ABLs determined over the entire monitoring period.

### 2.2.2 Attended Noise Measurement Methodology

Attended noise measurements were conducted at the unattended monitoring location on 4 March 2019. The measurement was conducted over a 15 minute period. Weather conditions were overcast on the day of monitoring, with no wind.

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

All the acoustic instrumentation employed during the noise measurements comply with the requirements of *AS IEC 61672.1-2019 Electroacoustics - Sound level meters Specifications* and were within their current National Association of Testing Authorities, Australia (NATA) certified in-calibration period (i.e. calibration in the last two years).

## 2.3 Noise Measurement Results

### 2.3.1 Unattended Noise Measurement Results

Table 4 also presents the existing overall representative $L_{Aeq}$ ambient noise level and the background $L_{A90}$ noise levels for the day, evening and night-time periods, in accordance with the *Noise Policy for Industry*. The overall representative $L_{Aeq}$ noise levels were determined by logarithmically averaging each assessment period for the entire monitoring period.

The results for each day and the graphical noise logging results are presented in Appendix B.

**Table 4 Existing background ($L_{A90}$) and ambient ($L_{Aeq}$) noise levels – NCA 1 & NCA 2**

| Location | $L_{A90}$ background Rating noise level, dB(A) | | | Log average noise (ambient) $L_{Aeq}$ Levels dB(A) | | |
|---|---|---|---|---|---|---|
| | Day[1] | Evening[1] | Night[1] | Day[1] | Evening[1] | Night[1] |
| NCA 1 | 39 | 31 | 30[2] | 59 | 58 | 58 |
| NCA 2 | 39 | 38 | 31 | 63 | 61 | 61 |

*Notes:*

1. *Day is defined as 7:00 am to 6:00 pm, Monday to Saturday and 8:00 am to 6:00 pm Sundays & Public Holidays. Evening is defined as 6:00 pm to 10:00 pm, Monday to Sunday & Public Holidays. Night is defined as 10:00 pm to 7:00 am, Monday to Saturday and 10:00 pm to 8:00 am Sundays & Public Holidays.*
2. *Set to the minimum RBL as recommended by the NPfI.*

### 2.3.2 Attended Noise Measurements

The results of the attended noise monitoring are presented in Table 5.

**Table 5 Attended noise measurements**

| Logger | Date | Time | $L_{Aeq}$ dB(A) | $L_{A90}$ dB(A) | Comments |
|---|---|---|---|---|---|
| 1 | 4/03/2019 | 11:39 | 67 | 39 | Local road traffic and rail traffic contribute to noise environment. Freight train pass by 65-74 dB(A). Bus pass by 66 dB(A). Freight train horn 100 dB(A). Car pass by 62 dB(A) |
| 2 | 4/03/2019 | 11:04 | 57 | 45 | Humming of machinery to the north dominates background. Construction works to northwest. Voices and sawing from construction site can be heard. Vehicle passbys every few minutes 68 dB(A). Birds calling. Emergency siren heard. Train horn heard. Country train pass by 64 dB(A). |

## 2.4 Existing Noise Environment Summary

The acoustic environment in both NCAs is dominated by local vehicle traffic and natural sounds, with machine hum in NCA 2. Intermittent rail noise is also audible. These characteristics are typical of a suburban environment.

# 3.0 Construction Noise and Vibration Criteria

## 3.1 Construction Activity Noise Criteria

### 3.1.1 Interim Construction Noise Guideline

The *Interim Construction Noise Guideline* is the principal guideline for the assessment and management of construction noise in NSW. As the proposed works are expected to continue for a period of more than three weeks and are within relatively close proximity to noise sensitive receivers, a quantitative assessment, based on 'reasonable' worst case construction scenarios, has been carried out for these works.

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

Where an exceedance of the noise management levels is predicted, the *Interim Construction Noise Guideline* advises that receivers can be considered 'noise affected' and the proponent should apply all feasible and reasonable work practices to minimise the noise impact. The proponent should also inform all potentially impacted residents of the nature of the works to be carried out, the expected noise level and duration, as well as provide contact details to facilitate feedback from affected residents during construction.

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

The construction noise management levels (NML) for the residential and other sensitive land uses are detailed in Table 6, Table 7 and Table 8.

**Table 6** ***Interim Construction Noise Guideline*** **Residential noise management levels**

| Time of day | NML, $L_{Aeq,15min}$, dB(A)[1] | How to apply |
|---|---|---|
| **Recommended standard hours:**<br>Monday to Friday<br>7 am to 6 pm<br>Saturday<br>8 am to 1 pm<br>No work on Sundays or<br><br>public holidays | Noise affected<br>RBL + 10 dB | The noise affected level represents the point above which there may be some community reaction to noise.<br>• where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level<br>• 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<br>75 dB(A) | The highly noise affected level represents the point above which there may be strong community reaction to noise.<br>• where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:<br>1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences<br>2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times. |
| **Outside recommended standard hours** | Noise affected<br>RBL + 5 dB | • a strong justification would typically be required for works outside the recommended standard hours<br>• the proponent should apply all feasible and reasonable work practices to meet the noise affected level<br>• where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community<br>• for guidance on negotiating agreements see section 7.2.2 of the *Interim Construction Noise Guideline*. |

*Notes:*

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

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

- *"Feasible*

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

- *Reasonable*

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

Table 7 presents the NMLs applicable to residential receivers nearby to the Proposal.

**Table 7 Construction noise management levels – Residential receivers**

| Noise catchment area | Period | RBL, $L_{A90}$ dB(A) | Standard hours noise management levels, $L_{Aeq,15min}$, dB(A) | Out-of-hours noise management levels, $L_{Aeq,15min}$, dB(A) |
|---|---|---|---|---|
| 1 | Day | 39 | 49 (75 - highly noise affected level) | 44 |
| | Evening | 31 | - | 36 |
| | Night | 30 | - | 35 |
| 2 | Day | 39 | 49 (75 - highly noise affected level) | 44 |
| | Evening | 38 | - | 43 |
| | Night | 31 | - | 36 |

Table 8 presents the NMLs applicable to other noise sensitive receivers such as educational facilities and places of worship and to commercial receivers.

**Table 8 Construction noise management levels – Other receivers**

| Land use | Noise management levels, $L_{Aeq,15min}$ (applies when properties are in use) (external) |
|---|---|
| Community centres | 55 dB(A)[1] |
| Commercial premises (including offices, retail outlets) | 70 dB(A) |
| School classrooms | 55 dB(A)[1] |
| Places of worship | 55 dB(A)[1] |
| Child care centres | 55 dB(A)[1] |

*Notes:*

1. *This external management level is based upon a 45 dB(A) internal noise management level and a 10 dB reduction from outside to inside through an open window.*

### 3.1.2 Sleep Disturbance Criteria

The *Interim Construction Noise Guideline* requires a sleep disturbance analysis where construction works are planned to extend over more than two consecutive nights. The $L_{A1}$ noise levels and number of expected $L_{A1}$ noise events should be predicted in order to determine the likelihood of potential sleep disturbance.

The EPA recommends that to minimise the risk of sleep disturbance during the night-time period (10.00 pm to 7.00 am), the $L_{A1(1\ min)}$ noise level outside a bedroom window should not exceed the $L_{A90\ (15\ minute)}$ background noise level by more than 15 dB(A). If this screening criterion is found to be exceeded then a more detailed analysis must be undertaken and include the extent that the maximum noise level exceeds the background noise level and the number of times this is likely to happen during the night-time period.

Sleep disturbance research presented in the *Road Noise Policy* concludes that *'Maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions'*. Therefore, given that an open window provides approximately 10 dB(A) in noise attenuation from outside to inside, external noise levels of 60-65 dB(A) are unlikely to result in awakening reactions.

Based on the measured background noise levels during the night, the sleep disturbance criteria for the nearest noise sensitive residential receivers are presented in Table 9.

**Table 9 Sleep disturbance criteria**

| Noise catchment area | Background noise level ($L_{A90}$), dB(A) | Sleep disturbance criteria (external) $L_{A1(1\ minute)}$, dB(A) | |
|---|---|---|---|
| | | Screening level | Awakening reaction |
| 1 | 30 | 45 | 60 – 65 |
| 2 | 31 | 46 | 60 – 65 |

## 3.2 Construction Traffic Noise Criteria

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

Regent Street and Railway Parade provide the main road access to the site. These roads are classified as sub-arterial and are listed in Table 10. The external noise criteria are applied one metre from the external facade of an affected building.

**Table 10 Roads used by construction traffic**

| Road | Type | Residential Receivers | Estimated AADT[1] |
|---|---|---|---|
| Regent Street | Sub-Arterial | Yes | >500 |
| Railway Parade | Sub-Arterial | Yes | >500 |

*Notes:*

*1. Annual average daily traffic*

## 3.3 Construction Vibration Criteria

The relevant standards/guidelines for the assessment of construction vibration are summarised in Table 11.

**Table 11 Standards/guidelines used for assessing construction vibration**

| Item | Standard/guideline |
|---|---|
| Structural damage | German Standard DIN 4150 – *Part 3 – Structural Vibration in Buildings – Effects on Structures* (DIN 4150) |
| Human comfort (tactile vibration) [1] | *Assessing Vibration: A Technical Guideline* (AVATG) |

*Note 1: This document is based upon the guidelines contained in British Standard 6472:1992, "Evaluation of human exposure to vibration in buildings (1-80 Hz)". This British Standard was superseded in 2008 with BS 6472-1:2008 "Guide to evaluation of human exposure to vibration in buildings – Part 1: Vibration sources other than blasting" and the 1992 version of the Standard was withdrawn. Although a new version of BS 6472 has been published, the Environment Protection Authority still requires vibration to be assessed in accordance with the 1992 version of the Standard at this point in time.*

Vibration, at levels high enough, has the potential to cause damage to structures and disrupt human comfort. Vibration and its associated effects are usually classified as continuous, impulsive or intermittent as follows:

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

### 3.3.1 Structural Damage

At present, no Australian Standards exist for the assessment of building damage caused by vibration.

The German standard (DIN 4150) provides recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration and are presented in Table 12. DIN 4150 states that buildings exposed to higher levels of vibration than recommended limits would not necessarily result in damage.

**Table 12 DIN 4150: Structural damage safe limits for building vibration**

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

*Notes:*

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

### 3.3.2 Human Comfort

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

Maximum and preferred VDVs for intermittent vibration arising from construction activities are listed in Table 13. The VDV criteria are based on the likelihood that a person would be annoyed by the level of vibration over the entire assessment period.

**Table 13 Preferred and maximum vibration dose values for intermittent vibration (m/s$^{1.75}$)**

| Location | Daytime [1] Preferred | Daytime Max | Night time Preferred | Night time Max |
|---|---|---|---|---|
| Residences | 0.2 | 0.4 | 0.13 | 0.26 |
| Offices, schools, educational institutions, commercial premises and places of worship | 0.4 | 0.8 | 0.4 | 0.8 |
| Workshops or factory environments | 0.8 | 1.6 | 0.8 | 1.6 |

*Notes:*
*1. Day is defined as 7:00 am to 10:00 pm. Night is defined as 10:00 pm to 7:00 am.*

# 4.0 Operational Noise Criteria

The Proposal includes changes to the station only; it does not include changes to rail movements. As a result, operation noise is to be assessed under the *Noise Policy for Industry*.

## 4.1 Noise Policy for Industry

The *Noise Policy for Industry* provides guidance in relation to acceptable noise limits for industrial noise emissions, which includes, but is not limited to, noise emissions from mechanical plant.

The assessment procedure in the *Noise Policy for Industry* has two components:

- controlling **intrusive** noise impacts in the short term for residences
- maintaining noise level **amenity** for residences and other land uses.

Both components are assessed at the boundary of the noise sensitive receiver site, or if the site boundary is more than 30 metres from the noise sensitive building, a distance of 30 metres from the noise sensitive building.

### 4.1.1 Intrusive Noise Impacts

The *Noise Policy for Industry* states that the noise from any single noise source should not be greatly above the prevailing background noise level. Industrial noise sources are generally considered acceptable if the A-weighted equivalent continuous sound pressure level of noise from the source, measured over a 15 minute period ($L_{Aeq,15\ min}$) does not exceed the Rating Background Level (RBL) by more than 5 dB(A) for the period under consideration. This is termed the Intrusiveness Criterion.

The RBL is the background noise level to be used for assessment purposes and is determined by the methods given in the Noise Policy for Industry.

The RBL and the respective intrusive criteria for the day, evening and night periods are provided in Table 14.

**Table 14 Intrusive criteria**

| Location | Period | RBL ($L_{A90}$), dB(A) | Intrusive criteria (RBL+5), dB(A) |
|---|---|---|---|
| NCA1 Residential Receivers | Day | 39 | 44 |
| | Evening | 31 | 36 |
| | Night | 30 | 35 |
| NCA2 Residential Receivers | Day | 39 | 44 |
| | Evening | 38 | 43 |
| | Night | 31 | 36 |

### 4.1.2 Protecting Amenity

To limit continuing increase in noise levels, the maximum ambient noise level within an area from all industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.1 of the *Noise Policy for Industry* and presented in column four of Table 15. That is the noise level should not exceed the level appropriate for the particular locality and land use. This is often termed the “background creep” or “amenity criterion”.

The project amenity level for a project is equal to the ‘recommended amenity level’ minus 5 dB. However, at this location the cumulative industrial noise is not a necessary consideration as no other industries are present or likely to be introduced. Therefore, relevant noise amenity level from Table 15 is assigned as the project amenity noise level. The project amenity level is then converted to a 15 minute period by adding 3 dB.

The amenity criteria applicable the Proposal are provided in Table 15.

**Table 15 Amenity criteria**

| Type of receiver | Indicative noise amenity area | Time of day | Recommended Noise level, dB(A) | |
|---|---|---|---|---|
| | | | $L_{Aeq\ (period)}$ | $L_{Aeq\ (15\ minute)}$ |
| NCA 1 Residential receivers | Suburban | Day | 50 | 53 |
| | | Evening | 45 | 48 |
| | | Night | 40 | 43 |
| NCA 2 Residential receivers | Suburban | Day | 50 | 53 |
| | | Evening | 45 | 48 |
| | | Night | 40 | 43 |
| Hotels | Suburban | Day | 55 | 58 |
| | | Evening | 50 | 53 |
| | | Night | 45 | 48 |
| Commercial premises | All | When in use | 65 | 68 |
| Community hall[1] | All | When in use | 55 | 58 |
| School classroom[1] | All | When in use | 45 | 48 |

*Notes:*

*1. External noise levels are based upon a 10 dB reduction from outside to inside through an open window.*

### 4.1.3 Environmental Noise Emission Criteria Summary

A summary of the project specific noise levels is presented in Table 16 below in accordance with the NPfI. These criteria apply to environmental noise emissions from any plant installed as part of the Proposal. For residential receivers, these criteria represent the lower of the intrusive and amenity criteria.

**Table 16 Summary of environmental noise emission criteria**

| Location | Time of day | Project specific noise levels criteria $L_{Aeq}$, dB(A) |
|---|---|---|
| NCA 1 | Day | 44 |
| | Evening | 36 |
| | Night | 35 |
| NCA 2 | Day | 44 |
| | Evening | 43 |
| | Night | 36 |
| Hotels | Day | 58 |
| | Evening | 53 |
| | Night | 48 |
| Commercial premises | When in use | 68 |
| Community hall | When in use | 58 |
| School classroom | When in use | 48 |

# 5.0 Construction Noise Assessment

## 5.1 Construction Stages and Scheduling

In consultation with TfNSW, eight distinct work packages, each consisting of a number of construction activities, have been assumed to occur for the Proposal. These would be confirmed by the construction contractor prior to construction commencing and further assessment would be undertaken if required. These work packages are described in Table 17. All work packages have been assessed with the exception of Work package 8 - Testing and Commissioning as it is expected to be a relatively low noise impact activity. These work packages have been assessed as representative 'reasonable' worst-case construction scenarios for the Proposal.

Noise from activities within the site compounds has been assumed to be minor in comparison to the noise generated by the worst case construction scenarios assessed.

Out-of-hours works would likely be required during around three weekend rail shutdowns over the 12 month construction period. It should be noted that night-time construction works during rail shutdown periods would not take place over more than two consecutive nights. This would provide some respite periods during weekdays between works.

**Table 17 Construction assessment work packages and scheduling**

| Work package | Activities | Scheduling |
|---|---|---|
| 1. Site establishment and enabling works | • establishment of site compound (i.e. erect fencing, site offices, amenities and plant/material storage areas)<br>• establishment of temporary facilities as required (e.g. hoarding, temporary toilets etc.). | Standard hours |
| 2. Utility relocation | • trenching for new, low voltage service routes on the station platform<br>• installation of low voltage, fire-rated cable routes from station point of supply to lift control panels. | Standard hours and rail shutdown periods |
| 3. Earthworks and piling works | • temporary earthworks and dismantling of fencing and barriers to allow piling rigs to reach desired location<br>• mobilisation of piling rigs to access lift locations. | Standard hours and rail shutdown periods |
| 4. Lift installation works | • removal of existing fencing, barriers and site regrading<br>• excavation of lift shaft well and establishment of foundations and formworks<br>• insertion of piles at the two locations for new lift foundations<br>• construction of lift shafts<br>• installation of lifts. | Standard hours and rail shutdown periods |
| 5. Station, toilet and lobby reconfiguration works | • reconfiguration of the existing platform building lobby to the female toilets to provide a family accessible toilet<br>• installation of new ambulant toilets and adjustment of existing male and female toilet cubicles to accommodate them<br>• provision of a new entry to the existing female toilet and retention of the existing door to the lobby of the female toilets in a permanently open position to improve accessibility and safety<br>• footbridge modifications, including partial demolition and installation of landings and new handrails<br>• installation of fixtures, lighting, signage and CCTV cameras for the lift areas<br>• provision of a portable fire extinguisher, attached to the wall | Standard hours |

| Work package | Activities | Scheduling |
|---|---|---|
| | in the Station Master's office<br>• services and fit-out works and electrical works (including any re-directed services/utilities). | |
| 6. Station surrounds works | • installation of signage and tactiles as required<br>• installation of the remainder of the additional closed-circuit television (CCTV) cameras (a minimum of nine in total) to ensure coverage of all accessible areas<br>• installation of a pedestrian crossing, access footpath and associated kerb ramps, linking the station to the northern side of Regent Street<br>• provision of a formal bus stop at the front of the station (to replace the existing kerbside kiss and ride bays)<br>• provision of a new kiss and ride bay adjacent to the existing accessible parking spaces in the Regent Street commuter car park<br>• re-grading of the Regent Street commuter car park<br>• line-marking for the reconfigured accessible car spaces in the Railway Parade commuter car park and new extent of footpath and kerb ramp to Mittagong Station. | Standard hours |
| 7. Demobilisation | • dismantling of existing site compounds/hoarding areas. | Standard hours |
| 8. Testing and commissioning | • testing electrical, communications and signalling components. | Standard hours |

## 5.2 Construction Sources

Noise sources and their respective $L_{Aeq}$ sound power levels for each work package are shown in Table 18. These sound power levels are typical values taken from data provided in Australian Standard AS2436-2010, *Guide to noise and vibration control on construction, demolition and maintenance sites* and the UK Department for Environment, Food and Rural Affairs (DEFRA) *Update of noise database for prediction of noise on construction and open sites* noise database and assume equipment is modern and in good working order.

**Table 18 Equipment sound power levels per construction work package**

| Equipment | Sound Power Level, dB(A) | Work package |
|---|---|---|
| Bobcat | 104 | 1 ,3, 6, 7 |
| Concrete pump | 106 | 4, 6 |
| Concrete truck | 106 | 4, 6 |
| Coring machine | 110[1] | 6 |
| Demolition saw | 110[1] | 2, 4, 5 |
| Excavator (with auger) | 103 | 3 |
| Franna crane | 93 | 4 |
| Generator | 101 | 1, 4, 7, 8 |
| Grinder | 108 | 4, 5 |
| Hand tools | 94 | 1, 2 ,3, 4, 5, 6, 7, 8 |
| Hydreama/hi-rail | 94 | 4 |
| Impact drill | 107 | 5 |
| Jack hammer | 108 | 4, 5, 6 |
| Lighting tower | 95 | 2 ,3, 4, 6, 7, 8 |
| Line marking truck | 102 | 6 |
| Manitou (forklift) | 92 | 4 |
| Mini excavator | 94 | 2, 6 |
| Mobile crane | 104 | 4, 6 |
| Nail gun | 90 | 5 |
| Piling rig (augered) | 103 | 3 |
| Plate compactor | 105 | 6 |
| Scissor lift | 100 | 4 |
| Trucks (semi-trailer and tipper) | 98[1] | 1, 2, 3, 4, 5, 6, 7 |
| Vacuum truck | 103 | 3 |
| Wacker packer (vibratory ramer) | 104 | 6 |
| 250 tonne crane | 100 | 3 |

*Notes:*

1. *Sound powers are time weighted (i.e. expected equipment levels per 15 minute period).*

## 5.3 Modelling and Conditions

In order to assess noise impacts from the site during construction, a noise model was created to represent 'reasonable' worst periods of upgrade works.

The construction of the Proposal has been modelled in SoundPLAN Version 8.0. The following features were included in the noise model:

- ground topography
- ground absorption and reflection
- buildings (residential and commercial)
- receivers (shown in Figure 2-1)
- construction noise sources (listed in Table 18).

Noise emissions from the construction sites have been modelled using an implementation of the ISO 9613 propagation algorithm with neutral metrological conditions.

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

## 5.4 Construction Noise Assessment

The identified residential and non-residential receivers have been assessed against the standard hours and out-of-hours night-time noise management levels as appropriate. The level of impact may change depending on the final construction methodology and further assessment would be undertaken if required.

During construction it is likely that all equipment would not be operating simultaneously at all times and in the one location, which would result in reduced noise levels compared with those predicted. As each construction work package would be occurring discretely a cumulative noise impact is unlikely. Mitigation measures have been specified in Section 5.8 which may reduce the impact of these exceedances on receivers.

Noise results are presented graphically in Appendix C.

### 5.4.1 Summary of impacts during standard hours at residential receivers

Results show construction noise levels are predicted to exceed the noise management levels during standard hours for all assessed construction work packages at the closest representative receivers (R2 and R3), as shown in red in Table 20.

The largest numbers of exceedances occur during Work package 4 - Lift installation works. The largest impact is experienced at R2. No residential receivers are predicted to be 'highly affected'.

**Table 19 Predicted $L_{Aeq}$ noise impacts at representative residential receivers for each work package during standard hours, dB(A)**

| Receiver ID | Distance (metres) | NML Standard | Work Package | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| R1 | 50 | 49 | **57** | 49 | **58** | **61** | **52** | **66** | 45 |
| R2 | 52 | 49 | **50** | **53** | **65** | **66** | **58** | **67** | **51** |
| R3 | 83 | 49 | 45 | **51** | **60** | **62** | **50** | **61** | **51** |
| R4 | 125 | 49 | **59** | 46 | **55** | **57** | **53** | **59** | 46 |
| R5 | 125 | 49 | **60** | 44 | **53** | **55** | 46 | **59** | 43 |
| R6 | 139 | 49 | 37 | 43 | **51** | **53** | 40 | **54** | 45 |
| R7 | 191 | 49 | 46 | 41 | **52** | **54** | 47 | **54** | 42 |
| R8 | 206 | 49 | **52** | 40 | 47 | **50** | 42 | **53** | 40 |
| R9 | 288 | 49 | <35 | 37 | 45 | 47 | <35 | **50** | 35 |
| R10 | 344 | 49 | 42 | <35 | 42 | 44 | 40 | 45 | <35 |
| R11 | 356 | 49 | <35 | <35 | 43 | 45 | <35 | 45 | <35 |
| R12 | 359 | 49 | <35 | 36 | 45 | 47 | <35 | 49 | 37 |
| R13 | 369 | 49 | 36 | <35 | 44 | 46 | 38 | 47 | 37 |
| R14 | 371 | 49 | <35 | <35 | 40 | 42 | <35 | 44 | <35 |
| R15 | 409 | 49 | <35 | <35 | <35 | <35 | <35 | 36 | <35 |
| R16 | 415 | 49 | <35 | <35 | 41 | 44 | <35 | 46 | <35 |
| R17 | 425 | 49 | 42 | <35 | 40 | 43 | 39 | 46 | 36 |
| R18 | 471 | 49 | 36 | <35 | 39 | 42 | 37 | 43 | <35 |
| R19 | 503 | 49 | 37 | <35 | 38 | 41 | 37 | 42 | <35 |
| R20 | 545 | 49 | <35 | <35 | 39 | 41 | <35 | 43 | <35 |
| R21 | 551 | 49 | <35 | <35 | 41 | 43 | <35 | 45 | <35 |
| R22 | 579 | 49 | <35 | <35 | 35 | 38 | <35 | 38 | <35 |
| R23 | 647 | 49 | <35 | <35 | 35 | 37 | <35 | 40 | <35 |
| R24 | 663 | 49 | <35 | <35 | 35 | 37 | <35 | 39 | <35 |
| R25 | 664 | 49 | <35 | <35 | <35 | 36 | <35 | 38 | <35 |
| R26 | 665 | 49 | <35 | <35 | 35 | 38 | <35 | 39 | <35 |
| R27 | 697 | 49 | <35 | <35 | <35 | 36 | <35 | 39 | <35 |
| R28 | 699 | 49 | <35 | <35 | 37 | 39 | <35 | 41 | <35 |
| R29 | 705 | 49 | <35 | <35 | <35 | 37 | <35 | 39 | <35 |
| R30 | 716 | 49 | <35 | <35 | <35 | 36 | <35 | 38 | <35 |
| R31 | 728 | 49 | <35 | <35 | 35 | 37 | <35 | 39 | <35 |
| R32 | 742 | 49 | <35 | <35 | <35 | 36 | <35 | 38 | <35 |
| R33 | 794 | 49 | <35 | <35 | <35 | 36 | <35 | 37 | <35 |
| R34 | 798 | 49 | <35 | <35 | <35 | 35 | <35 | 37 | <35 |

*Notes:*

1. *Items in **BOLD RED** indicate the predicted noise levels at this receiver during this work stage exceed the daytime NMLs.*

### 5.4.2 Summary of impacts during night works at residential receivers

Results show construction noise levels exceed the NMLs at residential receivers during night works during construction work packages 2, 3 and 4, as shown in blue in Table 20. For Work package 4 construction noise levels are expected to exceed the NMLs at all representative receivers within the NCA (with the exception of R15 and R34).

The largest number of exceedances occur during Work package 4 - Lift installation works. The largest impact is experienced at R2. Noise levels at receivers R1, R2 and R3 are predicted to exceed the noise management levels by more than 25 dB(A) at times. However, these exceedances would be limited to three rail possession periods. In addition, night works would not be undertaken for more than two consecutive nights.

**Table 20 Predicted $L_{Aeq}$ noise impacts at representative residential receivers for each work package outside standard hours, dB(A)**

| Receiver ID | Distance (metres) | NML Night | Work Package | | |
|---|---|---|---|---|---|
| | | | 2 | 3 | 4 |
| R1 | 50 | 36 | **49** | **58** | **61** |
| R2 | 52 | 35 | **53** | **65** | **66** |
| R3 | 83 | 35 | **51** | **60** | **62** |
| R4 | 125 | 35 | **46** | **55** | **57** |
| R5 | 125 | 36 | **44** | **53** | **55** |
| R6 | 139 | 36 | **43** | **51** | **53** |
| R7 | 191 | 35 | **41** | **52** | **54** |
| R8 | 206 | 36 | **40** | **47** | **50** |
| R9 | 288 | 36 | **37** | **45** | **47** |
| R10 | 344 | 35 | <35 | **42** | **44** |
| R11 | 356 | 36 | <35 | **43** | **45** |
| R12 | 359 | 36 | **36** | **45** | **47** |
| R13 | 369 | 35 | <35 | **44** | **46** |
| R14 | 371 | 36 | <35 | **40** | **42** |
| R15 | 409 | 36 | <35 | <35 | <35 |
| R16 | 415 | 36 | <35 | **41** | **44** |
| R17 | 425 | 35 | <35 | **40** | **43** |
| R18 | 471 | 35 | <35 | **39** | **42** |
| R19 | 503 | 35 | <35 | **38** | **41** |
| R20 | 545 | 36 | <35 | **39** | **41** |
| R21 | 551 | 36 | <35 | **41** | **43** |
| R22 | 579 | 36 | <35 | 35 | **38** |
| R23 | 647 | 36 | <35 | 35 | **37** |
| R24 | 663 | 36 | <35 | 35 | **37** |
| R25 | 664 | 36 | <35 | <35 | **36** |
| R26 | 665 | 35 | <35 | 35 | **38** |
| R27 | 697 | 35 | <35 | <35 | **36** |
| R28 | 699 | 36 | <35 | **37** | **39** |
| R29 | 705 | 35 | <35 | <35 | **37** |
| R30 | 716 | 35 | <35 | <35 | **36** |
| R31 | 728 | 35 | <35 | 35 | **37** |
| R32 | 742 | 36 | <35 | <35 | **36** |
| R33 | 794 | 35 | <35 | <35 | **36** |

| Receiver ID | Distance (metres) | NML Night | Work Package | | |
|---|---|---|---|---|---|
| | | | 2 | 3 | 4 |
| R34 | 798 | 36 | <35 | <35 | 35 |

*Notes:*

*1. Items in **BOLD BLUE** indicate the predicted noise levels at this receiver during this work stage exceed the night-time NMLs.*

### 5.4.3 Summary of impacts to non-residential receivers

Four non-residential receivers are predicted to be exposed to noise levels which exceed the NMLs as shown in orange in Table 21. These are the:

- Mittagong Police Station during Work package 6 – Station surrounds works
- Highlands Christian Church during Work packages 3, 4 and 6
- Berrima District Historical & Family History Society during Work package 6
- Frensham School during Work packages 4 and 6.

Key noisy activities include the use of demolition saws, coring machines and jack hammers.

**Table 21 Predicted noise impacts at representative non-residential receivers, dB(A)**

| Receiver ID | Distance (metres) | NML | Work Package | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| N1 | 7 | 70 | 49 | 60 | 67 | 70 | 54 | **77** | 56 |
| N2 | 32 | 55 | **56** | 53 | **63** | **66** | 54 | **73** | 51 |
| N3 | 63 | 55 | 38 | 41 | 50 | 52 | 36 | 55 | 45 |
| N4 | 96 | 55 | 38 | 41 | 50 | 52 | 42 | **58** | 41 |
| N5 | 141 | 55 | 35 | <35 | 43 | 45 | <35 | 50 | <35 |
| N6 | 145 | 54 | 36 | 44 | 52 | **55** | 39 | **57** | 42 |
| N7 | 194 | 55 | 39 | 40 | 49 | 52 | 42 | 52 | 42 |
| N8 | 243 | 55 | <35 | 40 | 48 | 51 | <35 | 53 | 38 |
| N9 | 268 | 55 | <35 | 37 | 46 | 48 | <35 | 49 | 36 |
| N10 | 289 | 55 | 42 | 39 | 48 | 50 | 42 | 50 | 39 |
| N11 | 294 | 55 | 37 | <35 | 43 | 45 | <35 | 49 | 36 |
| N12 | 422 | 54 | <35 | <35 | 43 | 45 | <35 | 47 | 35 |

Notes:

*1. Items in **BOLD ORANGE** indicate predicted noise levels at this receiver during this work stage exceed the NML.*

## 5.5 Sleep Disturbance Assessment

A sleep disturbance assessment was undertaken to assess works potentially required during the night-time period (e.g. during weekend rail shutdown periods). Appendix C presents the predicted maximum $L_{A1(1min)}$ noise level contours. The awakening reaction criterion of 65 dB(A) is predicted to be exceeded at residences along Railway Parade, Vernon Street, Waverly Parade, Regent Street and Albert Street (those within about 300 m of the construction site including receivers R1 to R5) for Work packages 2, 3 and 4.

The predicted construction $L_{A1(1min)}$ noise levels presented in Appendix C are external noise levels. The typical outdoor to indoor noise reductions provided by most standard dwellings (i.e. without acoustical treatment) is generally accepted as being 10 dB with windows slightly open and a minimum of 20 dB with windows closed. Therefore, by closing their windows during noisy activities residents can potentially attenuate external noise levels by 20 dB.

In addition, the predicted construction noise levels are typically the worst case noise levels, therefore the majority of the actual $L_{A1(1min)}$ noise levels are likely to be less than those predicted.

These impacts would be limited to three rail possession periods and night works would not be undertaken for more than two consecutive nights. Construction activities would be undertaken during the daytime where feasible.

## 5.6 Construction Traffic Assessment

The numbers of construction vehicles have been estimated by TfNSW as up to ten light and two heavy vehicles per day during peak construction periods. Vehicles would access the site via Railway Parade and Regent Street.

Traffic noise levels during construction are unlikely to increase by more than 2 dB on Railway Parade and Regent Street during the daytime. Traffic noise levels may increase by more than 2 dB during the night-time, during rail possessions, however the overall traffic noise level (including construction traffic) is expected to be less than 50 dB(A), which complies with the *Road Noise Policy* criteria.

To minimise the construction traffic noise levels and reduce the risk of negative impacts occurring, construction traffic management should be considered as part of the Noise and Vibration Management Plan.

## 5.7 Construction Vibration Assessment

Vibration intensive works may include the use of the following items of equipment:

- jackhammer
- bored piling rig
- wacker packer or plate compactor.

The minimum working distances of these items of equipment from off-site receivers are shown in Table 22 which is based on recommendations of the TfNSW *Construction Noise and Vibration Strategy*. If these minimum working distances are complied with no adverse impacts from vibration intensive works are likely in terms of human response or cosmetic damage.

As shown in section 2.1.3 there are a number of heritage items within the vicinity of the construction works including the station itself. It is unlikely that construction works would be undertaken within the minimum working distances for nearby heritage residential and commercial properties, however the works may be within these minimum distances when undertaken at the station.

If vibration intensive works are required within these minimum working distances, mitigation measures to control excessive vibration would be implemented as outlined in Section 5.8.

**Table 22 Minimum working distances of vibration intensive equipment to be used during the Proposal**

| Plant | Rating/ Description | Cosmetic damage | Cosmetic damage | Human response |
|---|---|---|---|---|
| | | Heritage | Residential/commercial | |
| Jackhammer | Handheld | 1 m (nominal) | 1 m (nominal) | Avoid contact with structure |
| Wacker packer or plate compactor[1] | Handheld | 8 m | 5 m | 15 m to 20 m |
| Bored piling | ≤ 800 mm | 4 m | 2 m | N/A |

*Notes:*

1. *No recommendations provided in the Construction Noise and Vibration Strategy for a wacker packer or plate compactor (assumed to be the same as a small roller)*

## 5.8 Construction Mitigation Measures

### 5.8.1 Construction Noise and Vibration Management Plan

A Construction Noise and Vibration Management Plan (CNVMP) should be developed for the Proposal and implemented prior to commencement of construction activities. The CNVMP should include all feasible and reasonable safeguards to manage the noise emissions from the site and any complaints which may occur due to construction noise. The CNVMP should include, as a minimum, the following:

- identification of nearby residences and other sensitive land uses (e.g. Frensham School)
- description of approved hours of work
- description and identification of all construction activities, including work areas, equipment and duration
- description of what work practices (generic and specific) would be applied to minimise noise and vibration
- a complaints handling process
- noise and vibration monitoring procedures, including for heritage structures
- overview of community consultation required for identified high impact works (including consultation with Frensham School to avoid exam periods, etc.).

Construction works should be planned and carried out during standard construction hours wherever possible. Table 23 presents the standard mitigation measures contained within the *Construction Noise and Vibration Strategy* which should be considered as mitigation measures as part of the CNVMP.

**Table 23 Transport for *NSW Construction Noise and Vibration Strategy* standard mitigation measures**

| Action required | Safeguard details |
|---|---|
| **Management measures** | |
| Implement any project specific mitigation measures required | In addition to the measures set out in this table, any project specific mitigation measures identified in this report. |
| Implement stakeholder consultation measures | Periodic notification (monthly letterbox drop and website notification) detailing all upcoming construction activities will be delivered to sensitive receivers at least 7 days prior to commencement of relevant works. |
| Site inductions | All employees, contractors and subcontractors will receive an environmental induction. |
| Behavioural practices | No swearing or unnecessary shouting or loud stereos/radios on site.<br>No dropping of materials from height, throwing of metal items and slamming of doors. |
| Noise Monitoring | A noise monitoring program will be implemented to assist in confirming and controlling the site specific potential for disturbance at particularly sensitive localities at the commencement of activities and periodically during the construction program as the works progress. The program will be developed in accordance with the CNVMP and any approval/licence conditions.<br>The results will be reviewed to determine if additional mitigation measures are required. All measurements will be undertaken in accordance with Australian Standard *1055.2018 – Acoustics – Description and measurement of environmental noise.* |

| Action required | Safeguard details |
|---|---|
| **Source controls** | |
| Construction hours and scheduling | Where feasible and reasonable, construction will be carried out during the standard daytime working hours. Should out-of-hours works be required an out-of-hours works application form will be submitted to TfNSW for approval on a case-by-case basis. Work generating high noise and/or vibration levels will be scheduled during less sensitive time periods as far as practicable. This will include the use of demolition saws, coring machines, grinders, impact drills and jackhammers. |
| Construction respite period | Noise with special audible characteristics and vibration generating activities (including jack hammering) will only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block.<br>'Continuous' includes any period during which there is less than a 1 hour respite between ceasing and recommencing any of the work. No more than two consecutive nights of noise with special audible characteristics and/or vibration generating work will be undertaken in the same NCA over any 7-day period, unless otherwise approved by the relevant authority. |
| Equipment selection | Quieter and less vibration emitting construction methods will be used where feasible and reasonable (e.g. rubber wheeled instead of steel tracked plant).<br>Equipment will be regularly inspected and maintained to ensure it is in good working order. |
| Maximum noise levels | The noise levels of plant and equipment will have operating sound power or sound pressure levels that would meet the predicted noise levels. |
| Rental plant and equipment | Noise emissions will be considered as part of the selection process. |
| Use and siting of plant | Simultaneous operation of noisy plant within discernible range of a sensitive receiver will be avoided.<br>The offset distance between noisy plant and adjacent sensitive receivers will be maximised.<br>Plant used intermittently will be throttled down or shut down.<br>Plant and vehicles will be turned off when not in use.<br>Noise-emitting plant will be directed away from sensitive receivers where reasonable and feasible. |
| Plan works site and activities to minimise noise and vibration | Traffic flow, parking and loading/unloading areas will be planned to minimise reversing movements within the site.<br>Truck drivers will be advised of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (i.e. minimising the use of engine brakes, and no extended periods of engine idling). |
| Non-tonal reversing alarms | Non-tonal reversing beepers (or an equivalent mechanism) will be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work. |

| Action required | Safeguard details |
|---|---|
| Minimise disturbance arising from delivery of goods to construction sites | Loading and unloading of materials/deliveries will occur as far as possible from sensitive receivers.<br>Site access points and roads will be selected as far as possible away from sensitive receivers.<br>Dedicated loading/unloading areas will be shielded if close to sensitive receivers.<br>Delivery vehicles will be fitted with straps rather than chains for unloading, wherever possible. |
| Silencers on Mobile Plant | Where possible noise from mobile plant will be reduced through additional fittings including:<br>• residential grade mufflers<br>• air parking brake engagement is silenced. |
| Construction Related Traffic | Vehicle movements will be routed away from sensitive receivers and scheduled during less sensitive times.<br>The speed of vehicles will be limited and the use of engine compression brakes will be minimised.<br>On-site storage capacity will be maximised to reduce the need for truck movements during sensitive times. |
| Vibration minimum working distances | If vibration intensive equipment is to be used within the minimum working distances for cosmetic damage, as presented in Table 22, then it is recommended that attended vibration measurements are undertaken when work commences, to determine “site specific minimum working distances”.<br>The minimum working distances for cosmetic damage from Table 22 are generally considered to be conservative and working within them would not necessarily result in damage however as factors such as work practices and intervening structures can affect vibration levels.<br>In addition, vibration intensive work should not proceed within the site specific minimum working distances unless a permanent vibration monitoring system is installed approximately one metre from the building footprint, to warn operators (e.g. via flashing light, audible alarm, SMS) when vibration levels are approaching the peak particle velocity objective. It is also advisable to carry out building condition surveys of sensitive historical structures before construction works begins. |
| **Path controls** | |
| Shield stationary noise sources such as pumps, compressors, fans etc. | Stationary noise sources will be enclosed or shielded to the greatest extent possible whilst ensuring that the occupational health and safety of workers is maintained. |
| Shield sensitive receivers from noisy activities | Structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) will be used. |

### 5.8.2 Community Consultation and Complaints Handling

All residents and sensitive receivers impacted by noise levels from the Proposal which are expected to exceed the NML should be consulted prior to the commencement of the particular activity, with the highest consideration given to those that are predicted to be most affected as a result of the works.

The information provided to the residents will include:

- programmed times and locations of construction work
- the hours of proposed works
- construction noise and vibration impact predictions
- construction noise and vibration mitigation measures being implemented on site.

Community consultation regarding construction noise and vibration will be detailed in a Community Liaison Plan for the construction of the Proposal and will include a 24 hour hotline and complaints management process.

### 5.8.3 TfNSW Construction Noise and Vibration Strategy - Additional Mitigation Measures

TfNSW's *Construction Noise and Vibration Strategy* provides practical guidance on how to minimise, to the fullest extent practicable, the impacts on the community from airborne noise, ground-borne noise and vibration generated during the construction of TfNSW projects. This is managed through the application of all feasible and reasonable mitigation measures. Where exceedances are still expected to occur after standard mitigation measures have been applied, the *Construction Noise and Vibration Strategy* recommends the implementation of additional mitigation measures. These mitigation measures are specified within the *Construction Noise and Vibration Strategy* and presented in Table 24.

The provision of additional mitigation is based on the predicted exceedances above RBLs and when the exceedances occur. The RBLs can be found in Table 7.

**Table 24 Additional mitigation measures matrix**

| Time period | | Action level[1] | Mitigation measures[2] | Mitigation measures[2] | Mitigation measures[2] |
|---|---|---|---|---|---|
| | | 0 – 10 dB(A) Noticeable | 10 – 20 dB(A) Clearly audible | 20 – 30 dB(A) Moderately intrusive | >30 dB(A) Highly intrusive |
| Standard | Weekday (7am-6pm)<br>Saturday (8am-1pm)<br>Sun/Pub Hol (Nil) | - | - | LB, M | LB, M |
| Out of Hours Work<br>Period 1 | Weekday (6pm-10pm)<br>Saturday (7-8am) & (1-10pm)<br>Sun/Pub Hol (8am-6pm) | - | LB | LB, M | LB, M, IB,<br>RO, PC, SN |
| Out of Hours Work<br>Period 2 | Weekday (10pm-7am)<br>Saturday (10pm-8am)<br>Sun/Pub Hol (6pm-7am) | LB | LB, M | LB, M, IB,<br>PC, SN | LB, M, IB,<br>PC, SN, AA |

*Notes:*

*1. Action level is $L_{Aeq(15\ minute)}$ noise level above background (RBL) - qualitative assessment of noise levels.*

*2. The following abbreviations have been used (refer to Table 25 for further details):*

*AA: Alternative accommodation*
*M: Monitoring*
*IB: Individual briefings*
*LB: Letterbox drops*
*RO: Proposal specific respite offer*
*PC: Phone calls*
*SN: Specific notifications.*

Table 25 outlines the additional mitigation measures, as outlined in the *Construction Noise and Vibration Strategy*.

**Table 25 Description of additional mitigation measures**

| Abbreviation | Mitigation measure | Explanation |
|---|---|---|
| LB | Letter box drops | All residences should be notified as a minimum by letterbox drop seven days ahead of construction activities. |
| M | Monitoring | Attended noise monitoring is to be undertaken as follows:<br>At the commencement of out-of-hours works (within the first two nights), where out-of-hours works activities change; and<br>Noise measurements shall be undertaken in accordance with the procedure documented in AS1055-2018 *Acoustics - Description and Measurement of Environmental Noise*. |
| IB | Individual briefings | Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that would be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project. |
| RO | Project specific respite offer | Residents subjected to lengthy periods of noise or vibration may be eligible for a project specific respite offer. The purpose of such an offer is to provide residents with respite from an ongoing impact. The offer could comprise pre-purchased movie tickets or similar offer. This measure is determined on a project-by-project basis. |
| PC | Phone calls | Phone calls detailing relevant information would be made to identified/affected stakeholders within seven days of proposed work. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc. |
| SN | Specific notifications | Specific notifications are letterbox dropped or hand distributed to identified stakeholders no later than seven days ahead of construction activities that are likely to exceed the noise management levels. This form of communication is used to support periodic notifications, or to advertise unscheduled works. |
| AA | Alternative accommodation | Alternative accommodation options should be provided for residents living in close proximity to construction works that are likely to incur noise levels significantly above the applicable level. |

# 6.0 Operational Noise

Additional operational equipment at the station would include two new lifts and refurbished toilet facilities (including mechanical ventilation systems) which would not produce significant noise emissions. As such, the operational noise environment is expected to remain largely unchanged. Standard noise controls such as appropriate selection of mechanical plant would reduce any impacts. If required, operational noise emissions shall be addressed during the detailed design phase in order to comply with operational noise criteria as per the *Noise Policy for Industry.* Operational noise criteria are presented in Section 4.0.

# 7.0 Conclusions

A construction and operational Noise and Vibration Impact Assessment has been completed for the Mittagong Station Upgrade (the 'Proposal'). Nearby noise and vibration sensitive receivers were identified. Attended and unattended noise measurements were completed to characterise the existing noise environment. The measured noise levels were used to establish operational noise criteria and construction noise management levels.

The Proposal is expected to commence in 2019, take up to 12 months to complete and would be undertaken during both standard construction hours and out-of-hours. The construction works would primarily be undertaken during standard hours. Some works may need to occur outside standard hours and would include night works and works during routine rail shutdowns which are scheduled closures that would occur regardless of the Proposal when part of the rail network is temporarily closed and trains are not operating. A number of weekend rail shutdowns are likely to be required over the construction period.

Construction work packages have been developed in consultation with TfNSW and the proposed equipment has been detailed within this report. Seven distinct work packages were used in a computer-based noise model to determine the potential changes to noise levels. Construction noise impacts were assessed at 34 representative residential receivers surrounding the Proposal. Impacts were also assessed at 11 representative nearby non-residential sensitive receivers, the closest of these receivers include Mittagong Police Station, Highlands Christian Church and The Potters Pre School, Mittagong Anglican Church, Berrima District Historical & Family History Society, Lion Rampant Hotel and Frensham School.

## 7.1 Construction Noise

The predicted construction noise levels exceed the construction noise management levels for all scenarios at the closest residential and commercial receivers. Noise exceedances are generally unavoidable given the proposed works and proximity to receivers, notwithstanding the implementation of feasible and reasonable noise mitigation measures. The largest impacts would be experienced by residents along Railway Parade and Regent Street. No residents are predicted to be 'highly affected' during any of the work packages.

Implementation of mitigation measures outlined in Section 5.8 would aim to minimise and manage noise impacts where possible. Mitigation measures have been recommended in line with TfNSW's *Construction Noise and Vibration Strategy* in order to minimise and manage the impact of construction noise on nearby noise sensitive receivers.

## 7.2 Construction Vibration

Minimum working distances to nearby structures have been recommended for nominated plant. If these distances are maintained, then no adverse impact from the vibration intensive works are likely in terms of human response or cosmetic damage. It is unlikely that work would be undertaken within the minimum working distances for heritage, commercial and residential receivers during the proposed vibration intensive works however they may be undertaken within the minimum working distances for works within the station itself. Should works be required within the minimum working distances, the recommended additional mitigation measures would be implemented.

## 7.3 Operation

During the operation of the Proposal, there may be minor changes to the existing noise levels due to the operation of the new lifts, however these are not considered to be significant. As such, the operational noise environment is expected to remain largely unchanged. If required, operational noise emissions shall be addressed during the detailed design phase in order to comply with operational noise criteria as per the *Noise Policy for Industry.*

# Appendix A

## Acoustic Terminology

# Appendix A Acoustic Terminology

The following is a brief description of acoustic terminology used in this report.

| | |
|---|---|
| *Sound power level* | The total sound emitted by a source. |
| *Sound pressure level* | The amount of sound at a specified point. |
| *Decibel [dB]* | The measurement unit of sound. |
| *A Weighted decibels [dB(A)]* | The A weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1kHz and 4 kHz) which the human ear is most sensitive to, and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A). |
| *Decibel scale* | The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows: |

| | |
|---|---|
| 0dB(A) | Threshold of human hearing |
| 30dB(A) | A quiet country park |
| 40dB(A) | Whisper in a library |
| 50dB(A) | Open office space |
| 70dB(A) | Inside a car on a freeway |
| 80dB(A) | Outboard motor |
| 90dB(A) | Heavy truck pass-by |
| 100dB(A) | Jackhammer/Subway train |
| 110 dB(A) | Rock Concert |
| 115dB(A) | Limit of sound permitted in industry |
| 120dB(A) | 747 take off at 250 metres |

| | |
|---|---|
| *Frequency [f]* | The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high pitched sound and a low frequency to a low pitched sound. |
| *Equivalent continuous sound level [$L_{eq}$]* | The constant sound level which, when occurring over the same period of time, would result in the receiver experiencing the same amount of sound energy. |
| $L_{max}$ | The maximum sound pressure level measured over the measurement period. |
| $L_{min}$ | The minimum sound pressure level measured over the measurement period. |
| $L_{10}$ | The sound pressure level exceeded for 10% of the measurement period. For 10% of the measurement period it was louder than the $L_{10}$. |

| | |
|---|---|
| *$L_{90}$* | The sound pressure level exceeded for 90% of the measurement period. For 90% of the measurement period it was louder than the $L_{90}$. |
| *Ambient noise* | The all-encompassing noise at a point composed of sound from all sources near and far. |
| *Background noise* | The underlying level of noise present in the ambient noise when extraneous noise (such as transient traffic and dogs barking) is removed. The $L_{90}$ sound pressure level is used to quantify background noise. |
| *Traffic noise* | The total noise resulting from road traffic. The $L_{eq}$ sound pressure level is used to quantify traffic noise. |
| *Day* | The period from 0700 to 1800 h Monday to Saturday and 0800 to 1800 h Sundays and Public Holidays. |
| *Evening* | The period from 1800 to 2200 h Monday to Sunday and Public Holidays. |
| *Night* | The period from 2200 to 0700 h Monday to Saturday and 2200 to 0800 h Sundays and Public Holidays. |
| *Noise catchment area [NCA]* | The noise environment at each of the sensitive receivers within a noise catchment area is considered to be similar to the unattended monitoring location within that NCA. |
| *Assessment background level [ABL]* | The overall background level for each day, evening and night period for **each day** of the noise monitoring. |
| *Rating background level [RBL]* | The overall background level for each day, evening and night period for the **entire length** of noise monitoring. |

*Definitions of a number of terms have been adapted from Australian Standard AS1633:1985 *"Acoustics – Glossary of terms and related symbols"*, the EPA's *Noise Policy for Industry* and the EPA's *Road Noise Policy*.

# Appendix B

## Noise Logging

# Noise Logger Report

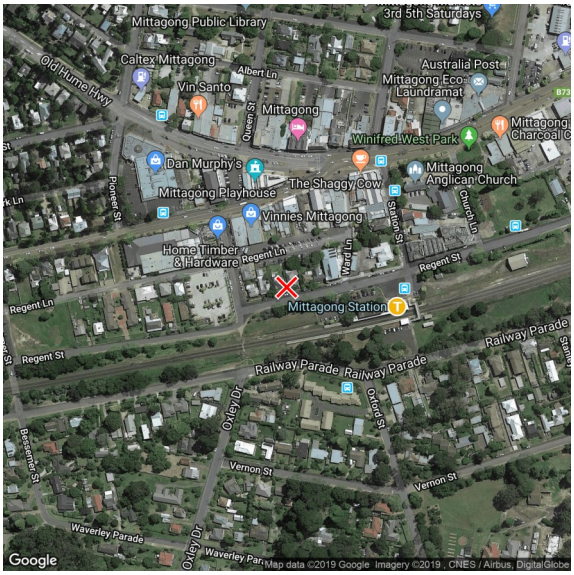
**43 Regent Street, Mittagong**

| Item | Information |
|---|---|
| Logger Type | Rion NL52 |
| Serial number | 386741 |
| Address | 43 Regent Street, Mittagong |
| Location | Front Yard |
| Facade / Free Field | Free Field |
| Environment | Local road traffic and rail traffic contribute to noise environment. Freight train pass by 65-74 dBA. Bus pass by 66 dBA. Freight train horn 100 dBA. Car pass by 62 dB(A) |

## Measured noise levels

| Logging Date | $L_{Aeq}$ Day | Eve | Night | ABL Day | Eve | Night | $L_{Aeq,15hr}$ | $L_{Aeq,9hr}$ |
|---|---|---|---|---|---|---|---|---|
| Mon Mar 4 2019 | 59 | 58 | 54 | - | 31 | - | 58 | 54 |
| Tue Mar 5 2019 | 59 | 59 | 59 | 38 | 34 | 25 | 59 | 59 |
| Wed Mar 6 2019 | 61 | 59 | 59 | - | - | 28 | 60 | 59 |
| Thu Mar 7 2019 | 58 | 57 | 59 | 39 | 30 | 25 | 58 | 59 |
| Fri Mar 8 2019 | 59 | 55 | 60 | - | - | - | 58 | 60 |
| Sat Mar 9 2019 | 58 | 57 | 56 | 38 | 31 | 28 | 58 | 56 |
| Sun Mar 10 2019 | 56 | 59 | 54 | - | - | 25 | 57 | 54 |
| Mon Mar 11 2019 | 59 | 56 | 59 | 40 | 29 | 28 | 59 | 59 |
| Tue Mar 12 2019 | 57 | 57 | 57 | - | - | 26 | 57 | 57 |
| Wed Mar 13 2019 | 59 | - | 59 | - | - | - | 59 | 59 |
| **Summary** | **59** | **58** | **58** | **39** | **31** | **26** | **58** | **58** |

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

| Logger Location | Logger Deployment Photo |
|---|---|
|  | |

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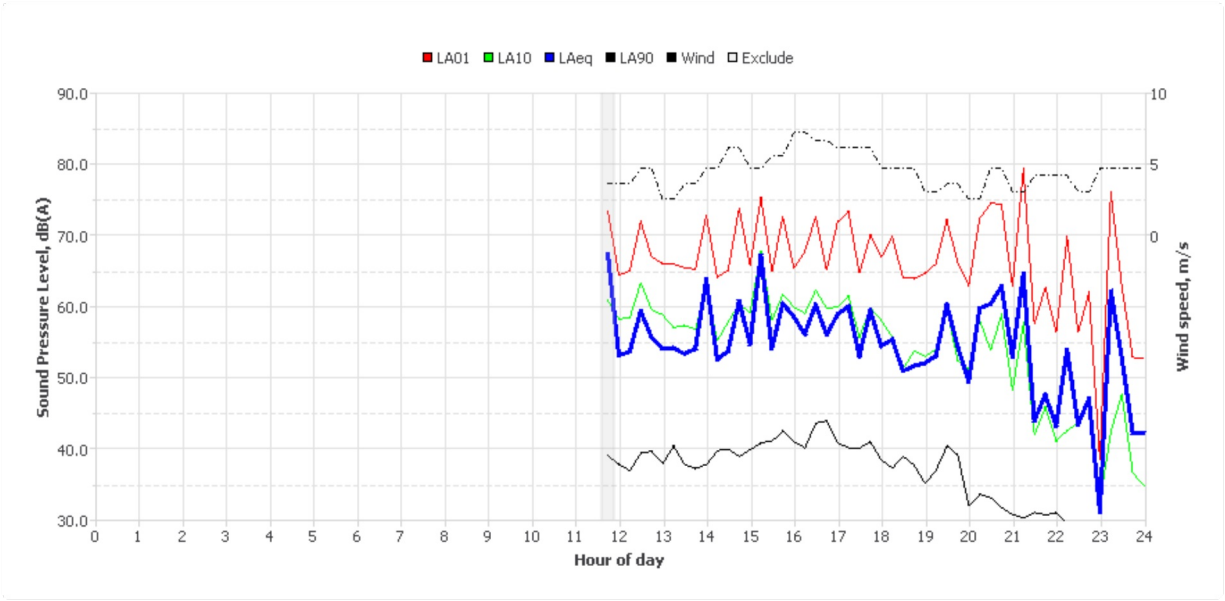


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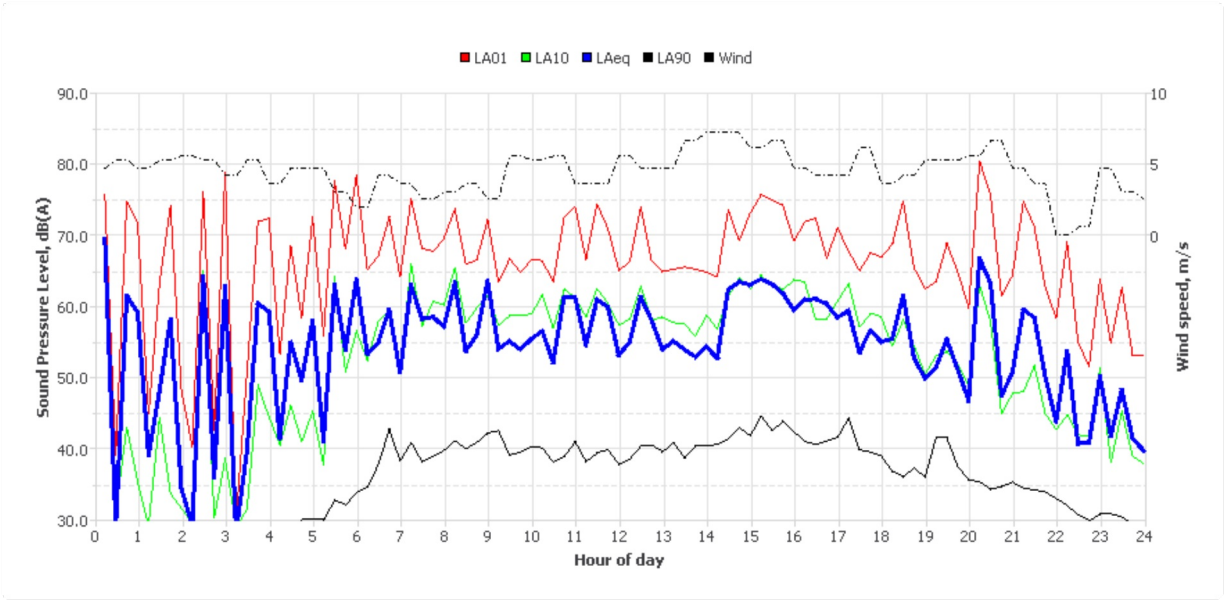
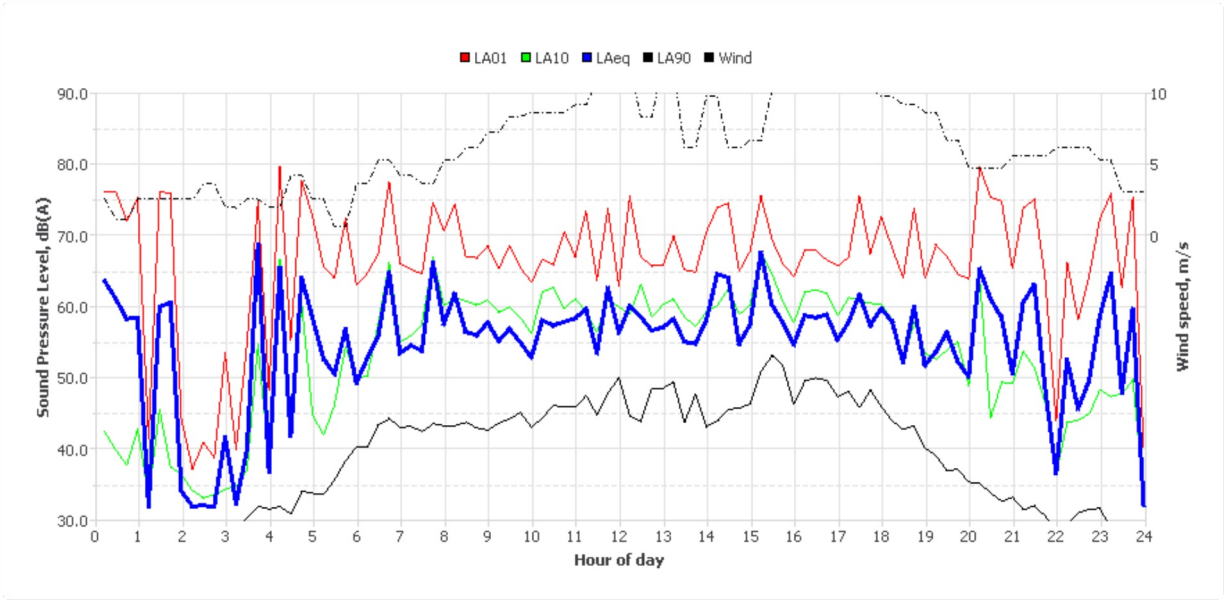
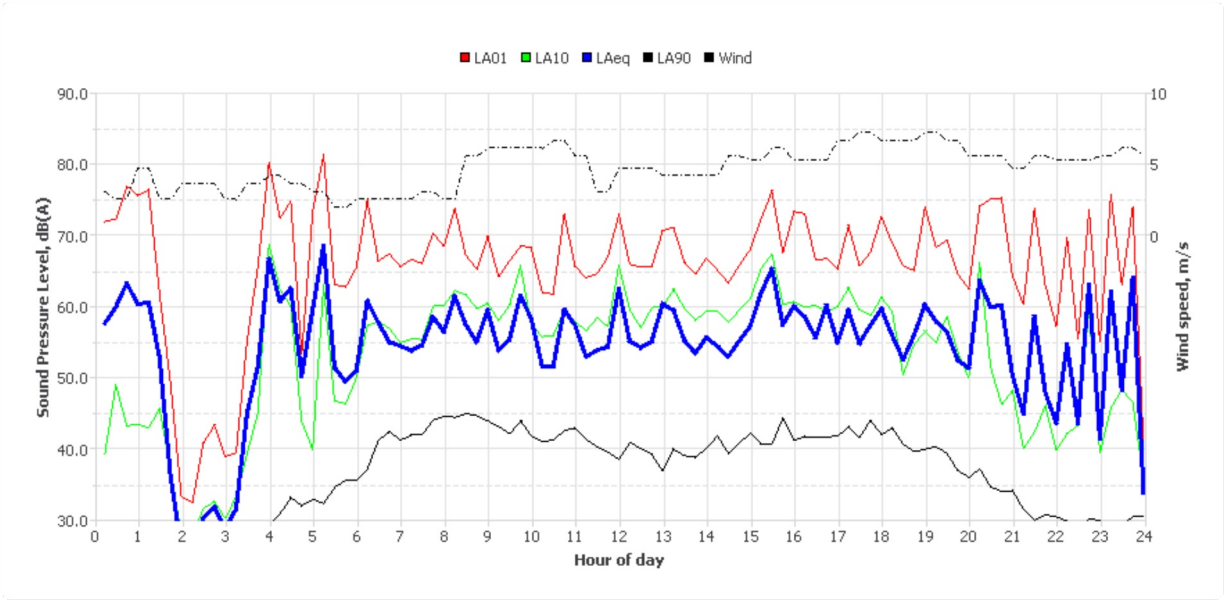


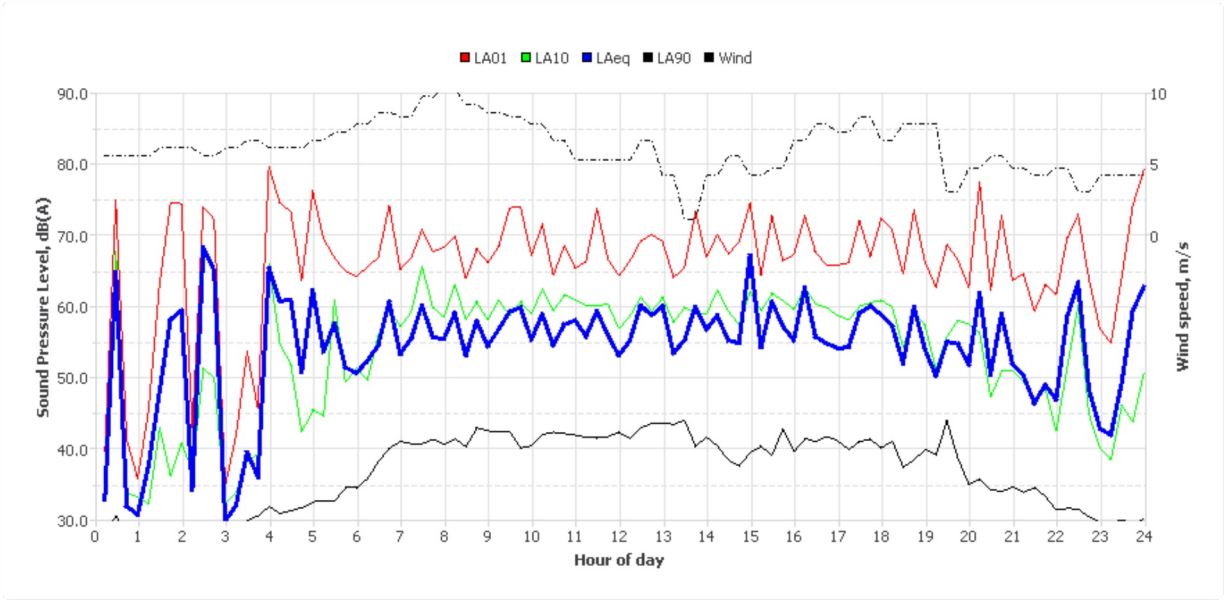

## Wednesday, 06 Mar 2019



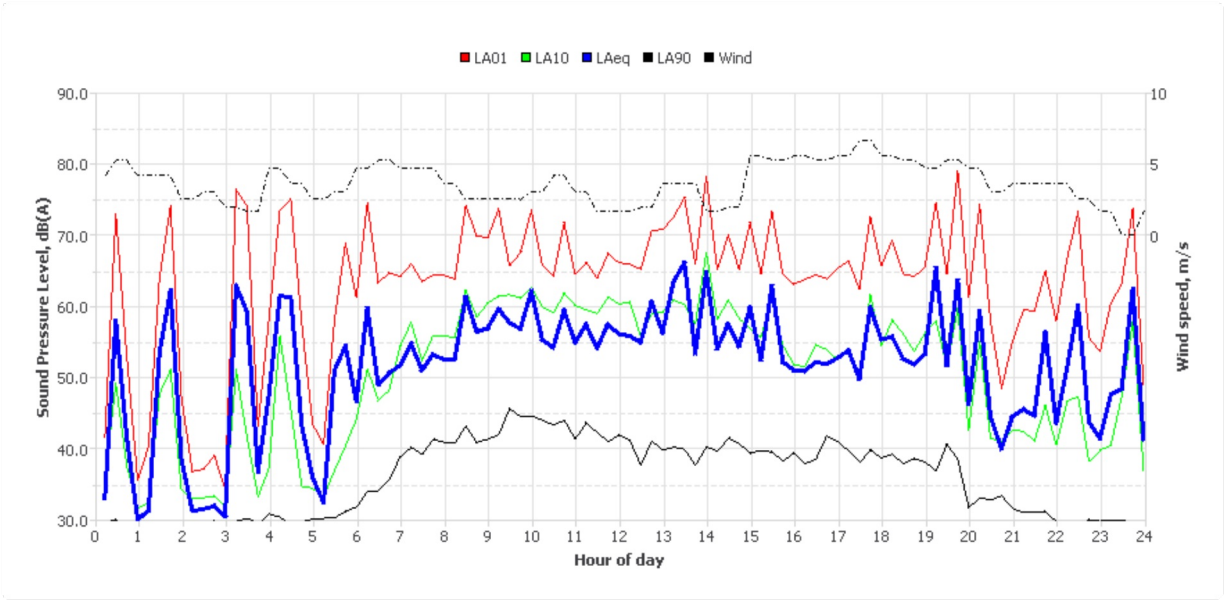
**Thursday, 07 Mar 2019**



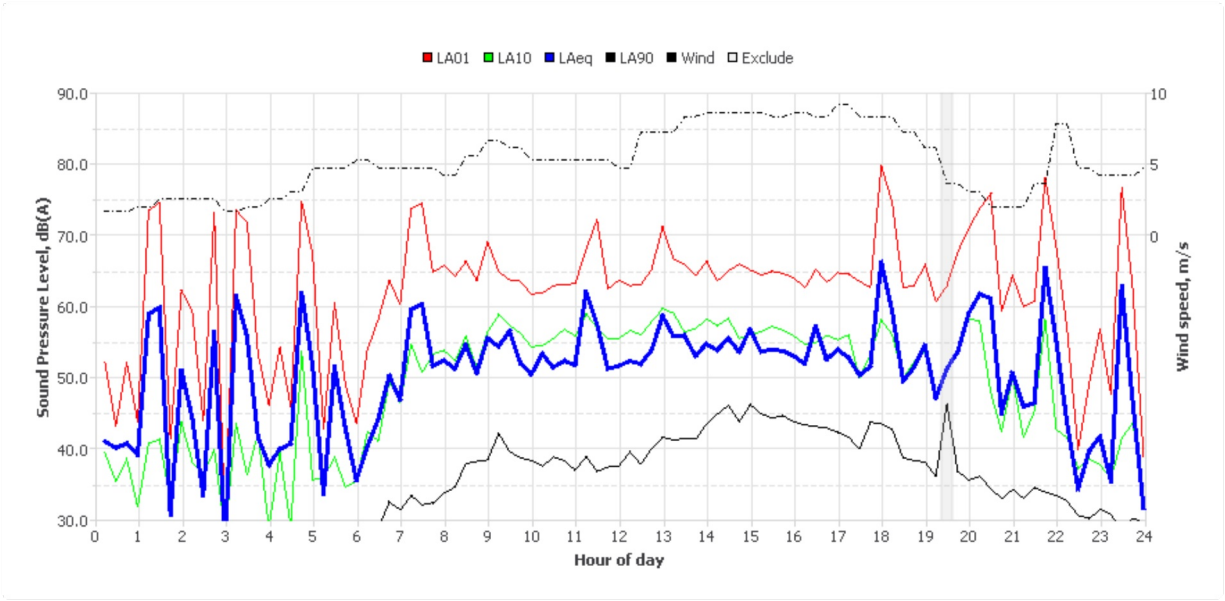

**Friday, 08 Mar 2019**




**Saturday, 09 Mar 2019**



**Sunday, 10 Mar 2019**

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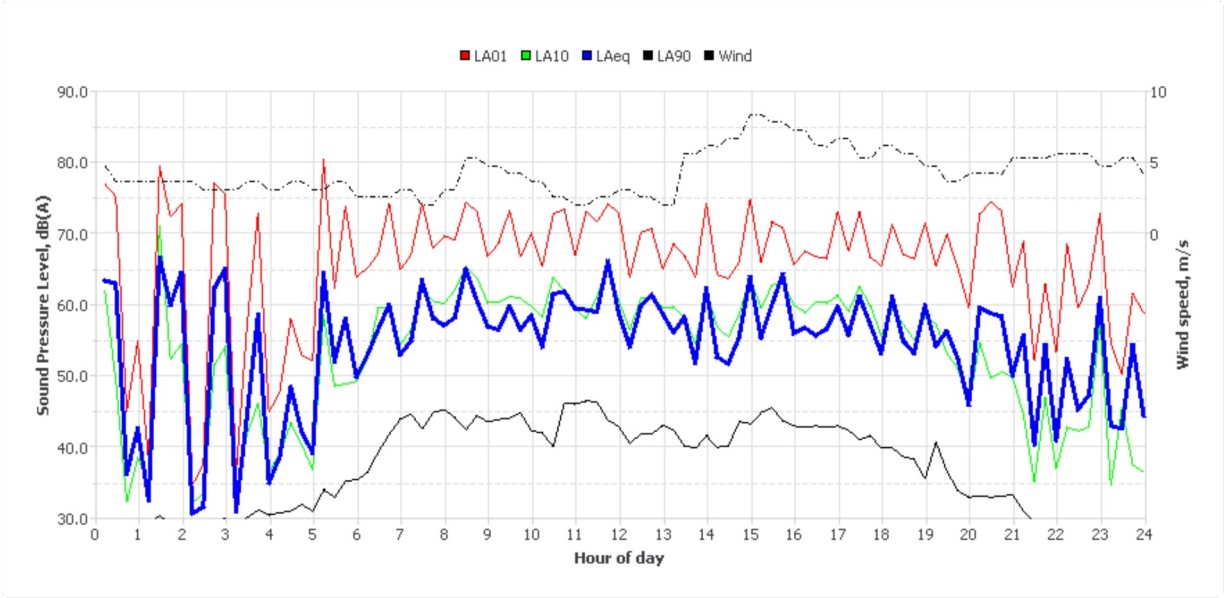


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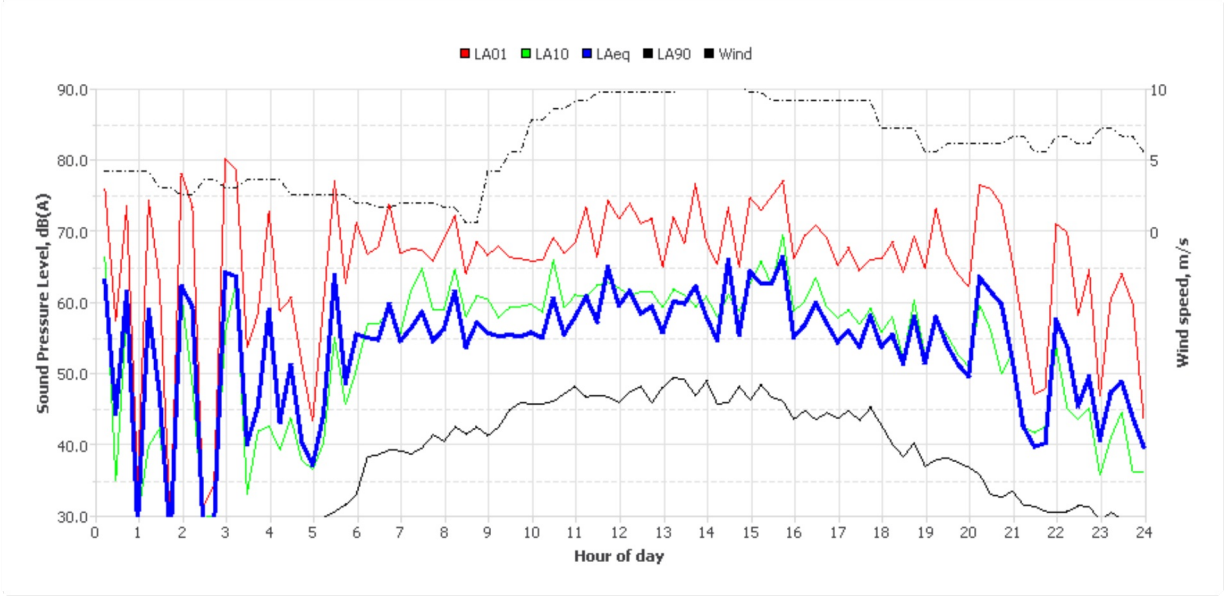
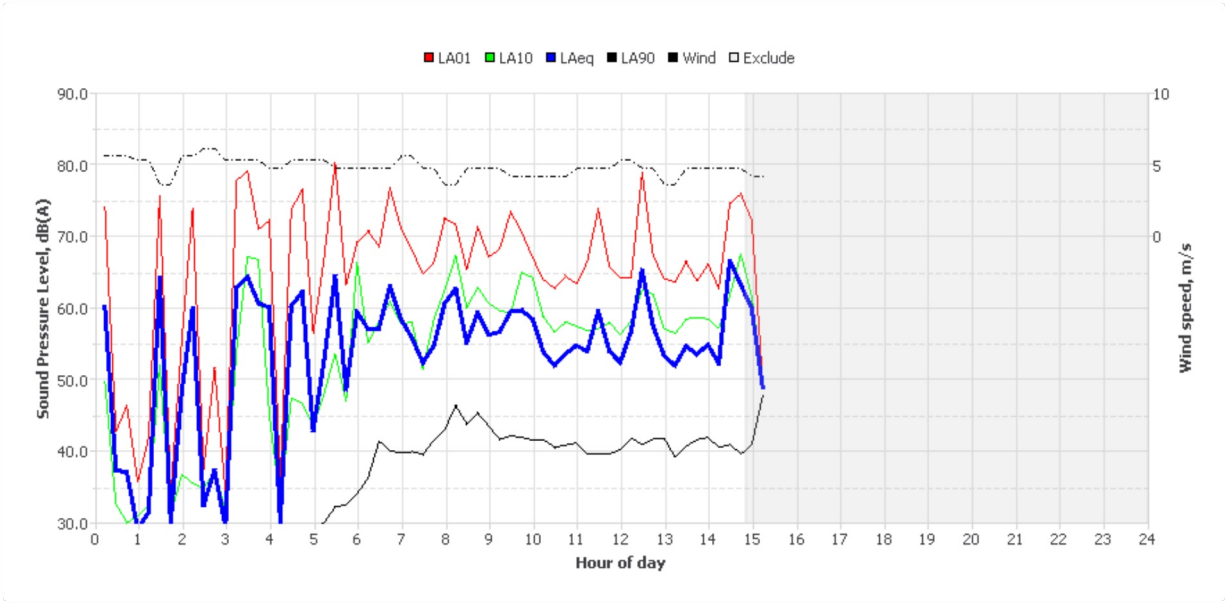


**Wednesday, 13 Mar 2019**



# Noise Logger Report

**26 Railway Parade, Mittagong**

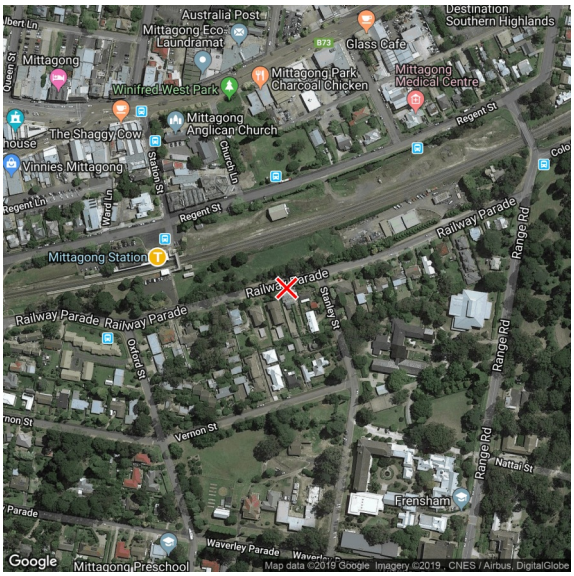
| Item | Information |
|---|---|
| Logger Type | ARL 315 |
| Serial number | 15299444 |
| Address | 26 Railway Parade, Mittagong |
| Location | Front Yard |
| Facade / Free Field | Free Field |
| Environment | Humming of machinery to the north dominates back ground. Construction works to northwest. Voices and sawing from construction site can be heard. Vehicle passbys every few minutes 68 dBA. Birds calling. Emergency siren heard. Train horn heard. Country train pass by 64 dBA. |

## Measured noise levels

| Logging Date | $L_{Aeq}$ Day | Eve | Night | ABL Day | Eve | Night | $L_{Aeq,15hr}$ | $L_{Aeq,9hr}$ |
|---|---|---|---|---|---|---|---|---|
| Mon Mar 4 2019 | 62 | 61 | 60 | - | 35 | - | 61 | 60 |
| Tue Mar 5 2019 | 62 | 62 | 61 | 40 | 38 | - | 62 | 61 |
| Wed Mar 6 2019 | 63 | 62 | 61 | - | - | 35 | 63 | 61 |
| Thu Mar 7 2019 | 61 | 64 | 61 | 39 | 39 | 27 | 62 | 61 |
| Fri Mar 8 2019 | 67 | 62 | 62 | - | - | - | 66 | 62 |
| Sat Mar 9 2019 | 60 | 61 | 60 | 38 | 35 | - | 61 | 60 |
| Sun Mar 10 2019 | 59 | 58 | 60 | - | - | - | 59 | 60 |
| Mon Mar 11 2019 | 61 | 60 | 61 | 39 | 38 | 31 | 61 | 61 |
| Tue Mar 12 2019 | 62 | 59 | 61 | - | - | - | 61 | 61 |
| Wed Mar 13 2019 | 63 | - | 60 | - | - | - | 63 | 60 |
| **Summary** | **63** | **61** | **61** | **39** | **38** | **31** | **62** | **61** |

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

**Logger Location**




**Logger Deployment Photo**

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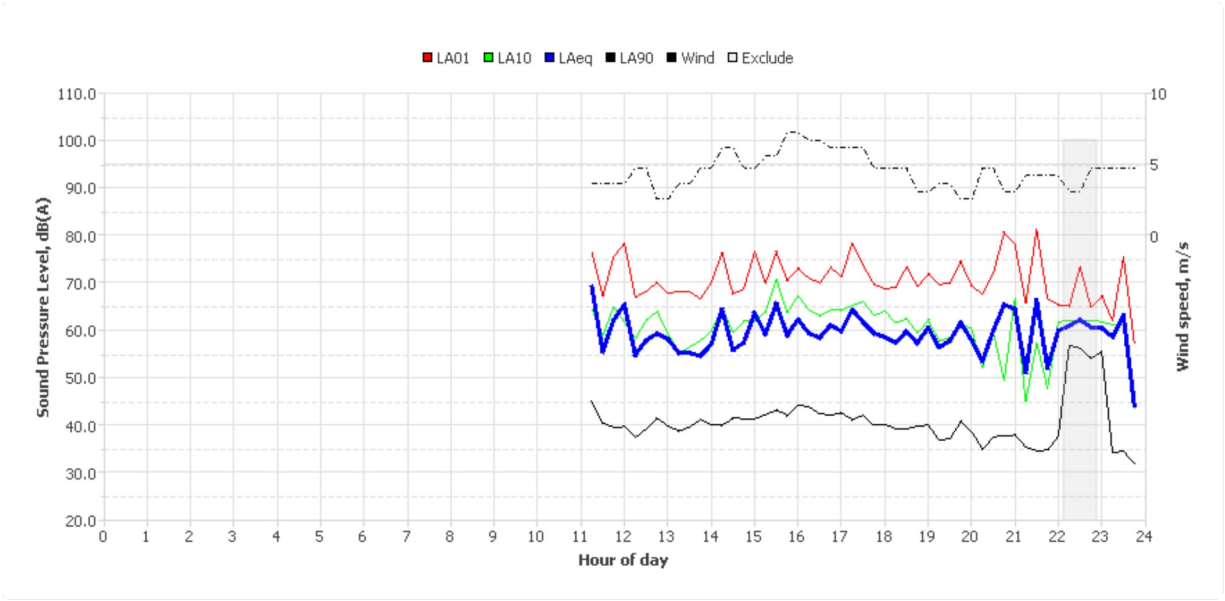


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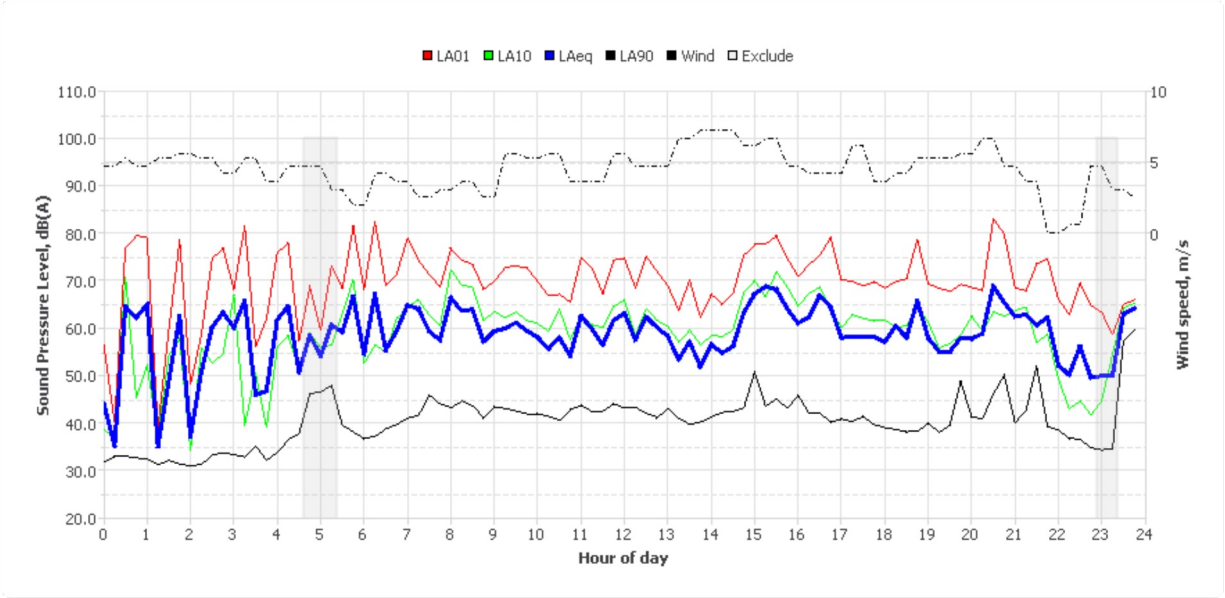
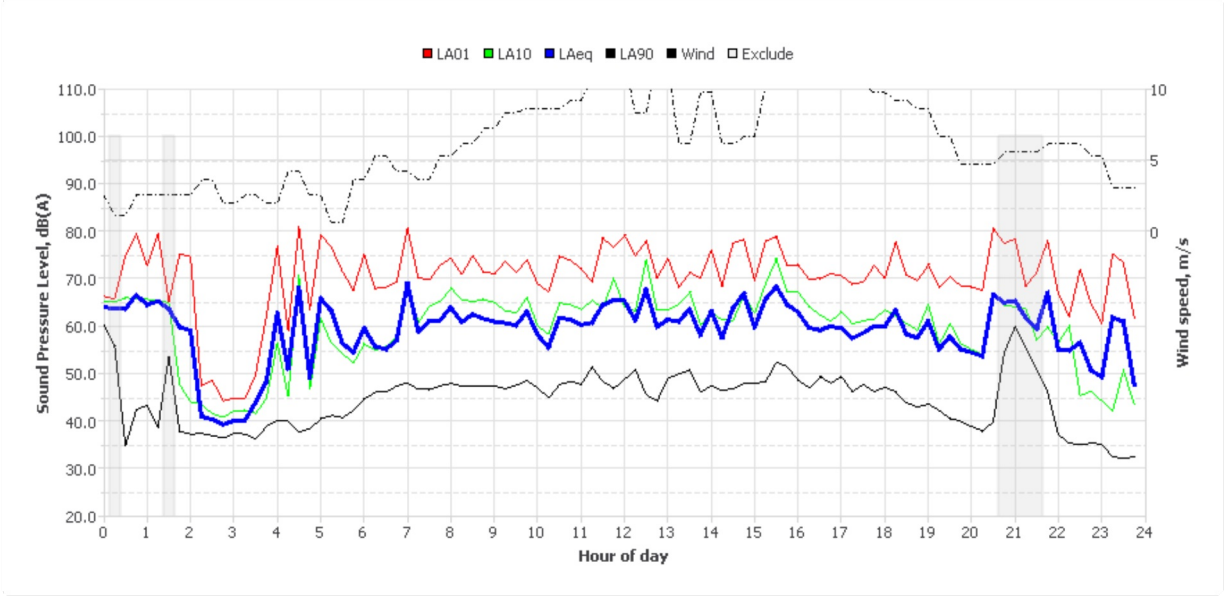
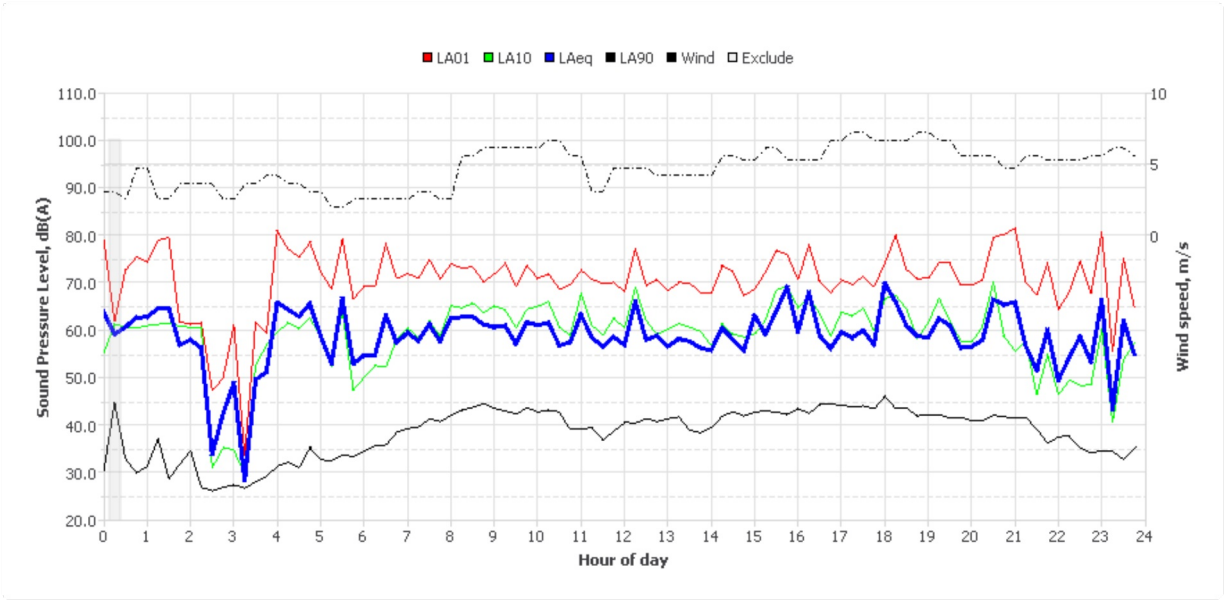


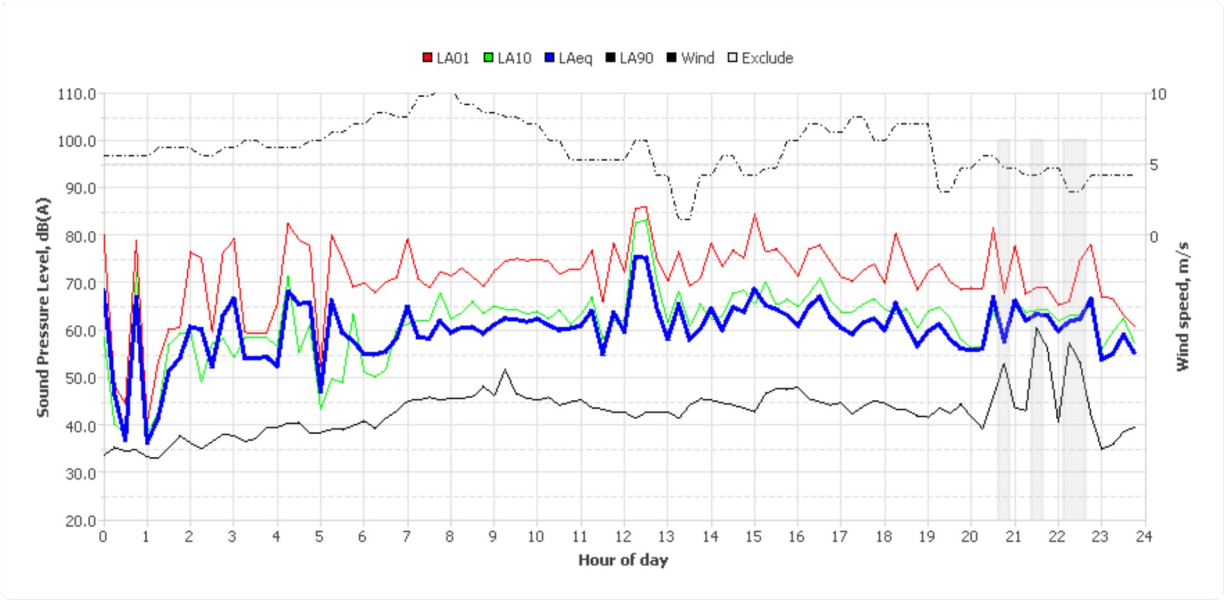

## Wednesday, 06 Mar 2019



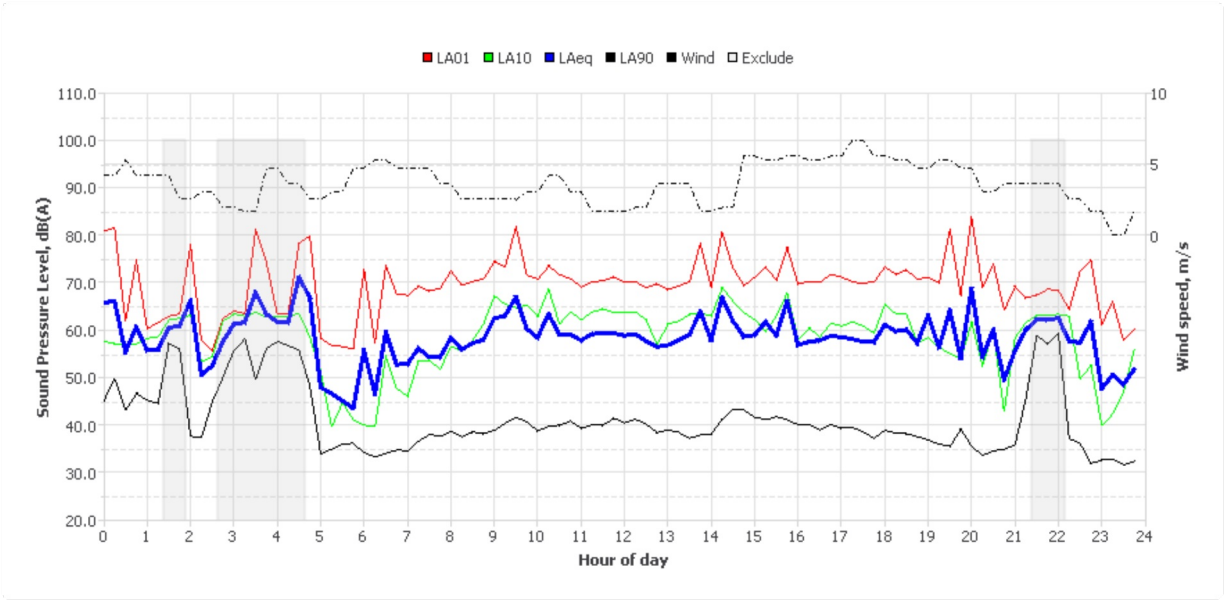
**Thursday, 07 Mar 2019**



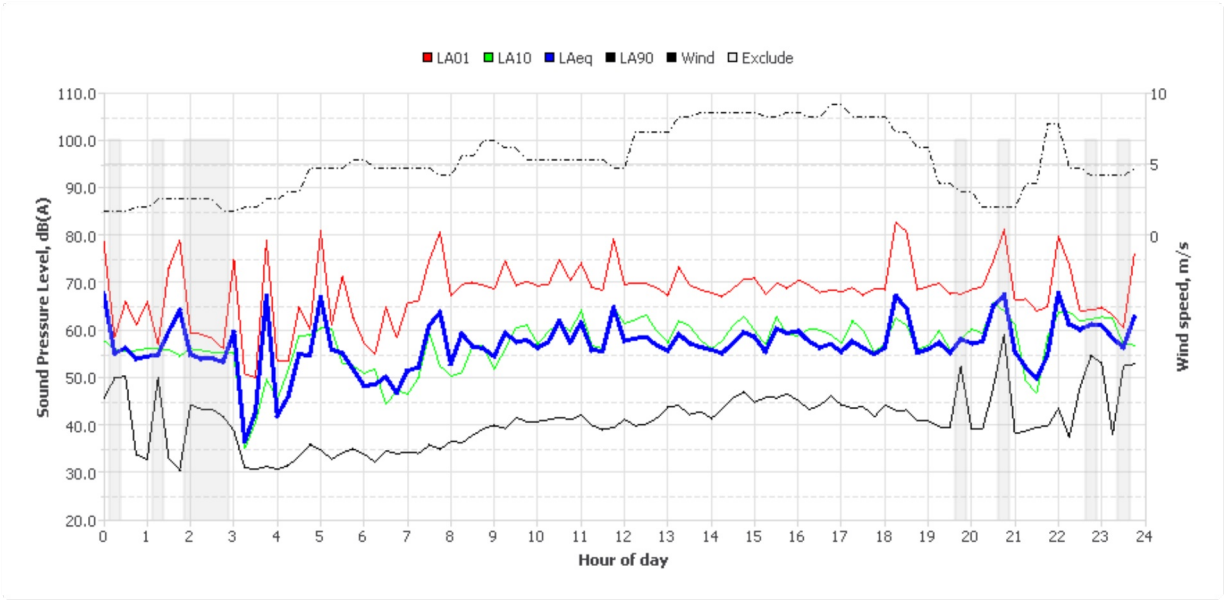

**Friday, 08 Mar 2019**



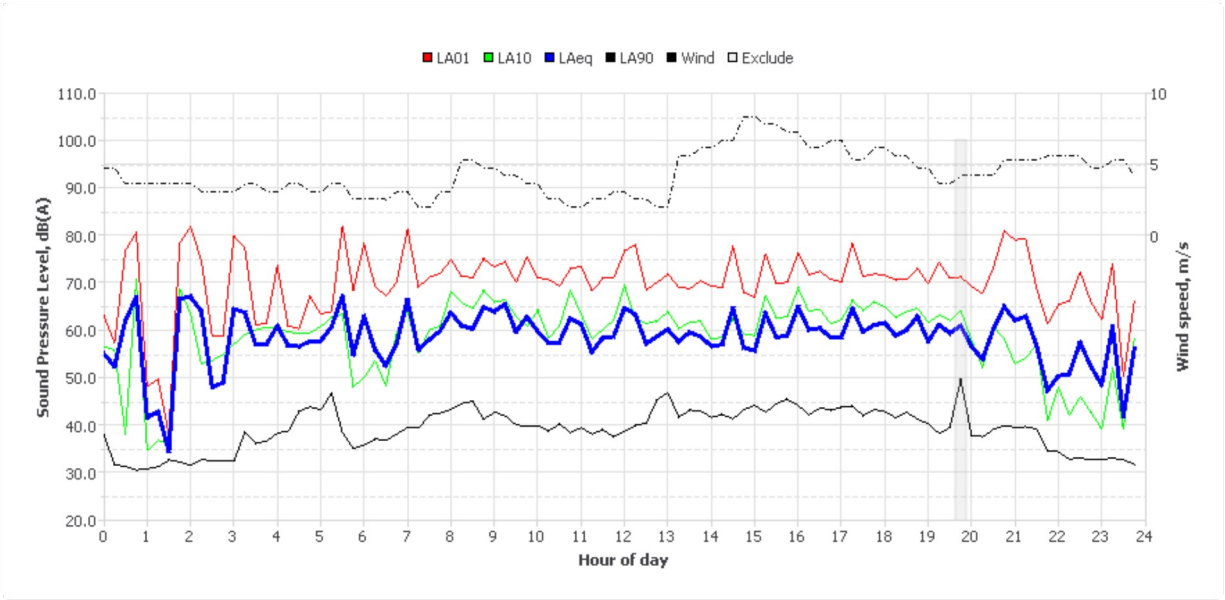

**Saturday, 09 Mar 2019**



## Sunday, 10 Mar 2019




## Monday, 11 Mar 2019

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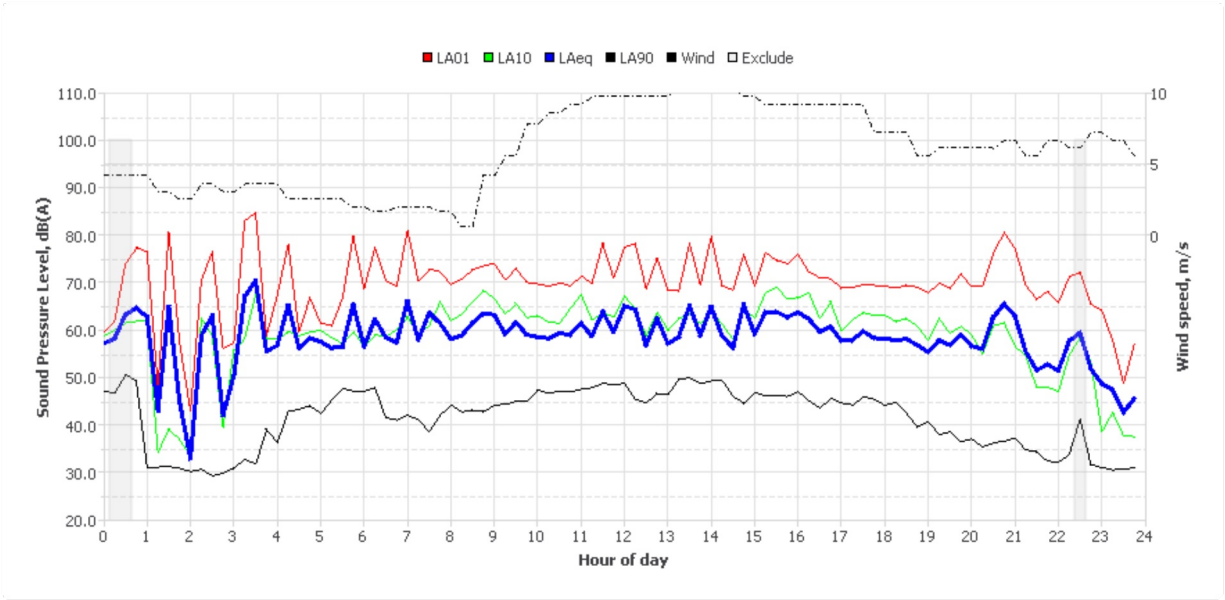
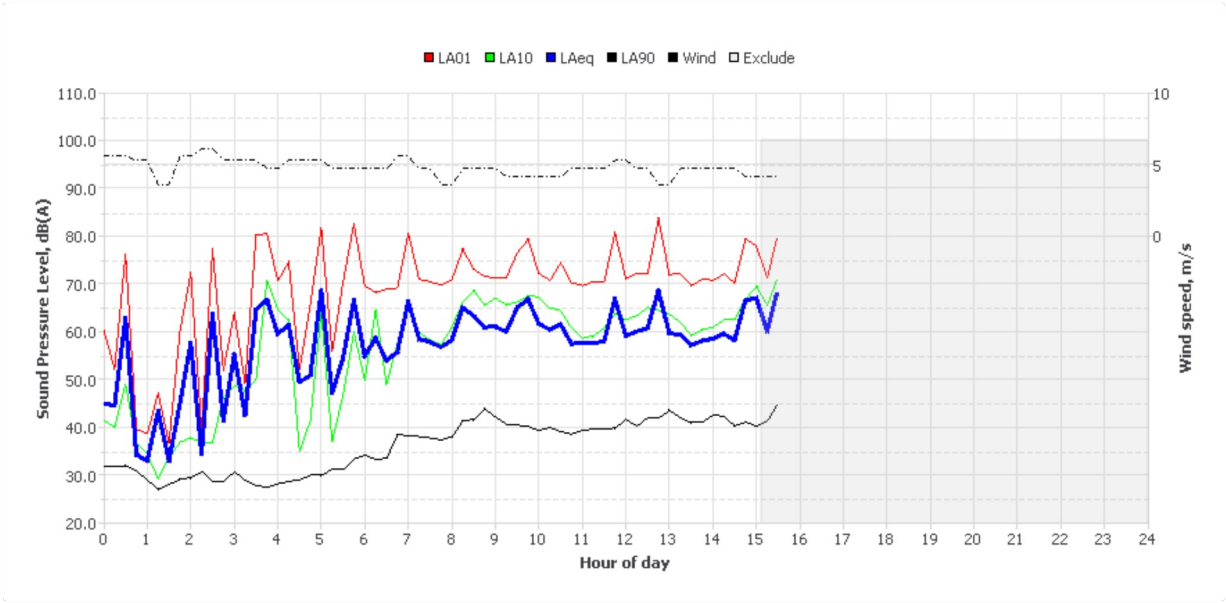


**Wednesday, 13 Mar 2019**



# Appendix C

## Predicted Noise Contours - Construction

Mittagong Station Upgrade - Site establishment and enabling

AECOM

N

0 150 300 Meters

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

< 40 | 40 - 44 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | 65 - 69 | > 70

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Mittagong Station Upgrade - Utility installation

AECOM

N

0 150 300 Meters

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

< 40 | 40 - 44 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | 65 - 69 | > 70

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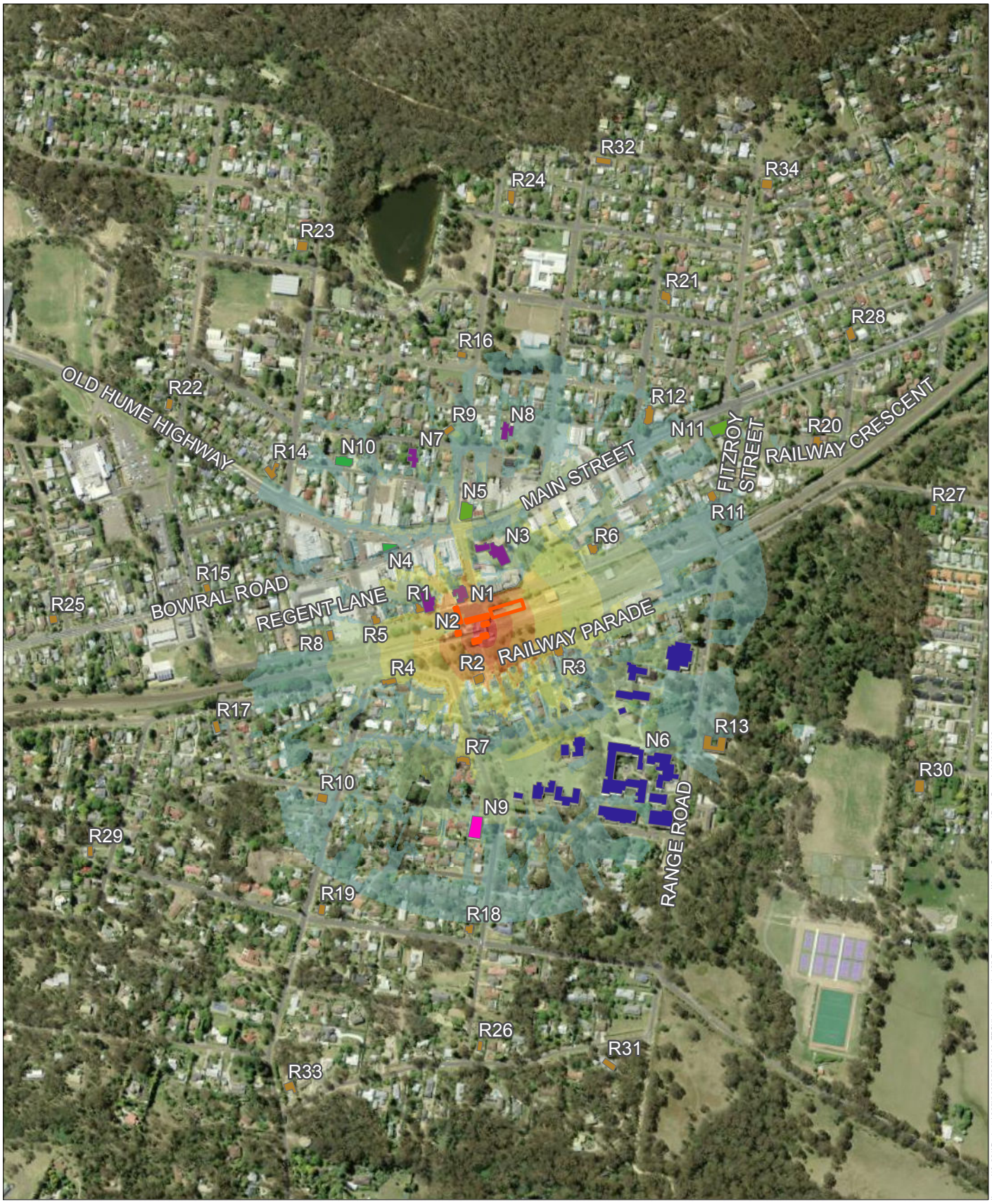


Mittagong Station Upgrade - Earthworks and piling

AECOM

Meters
0 150 300

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

< 40 | 40 - 44 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | 65 - 69 | > 70

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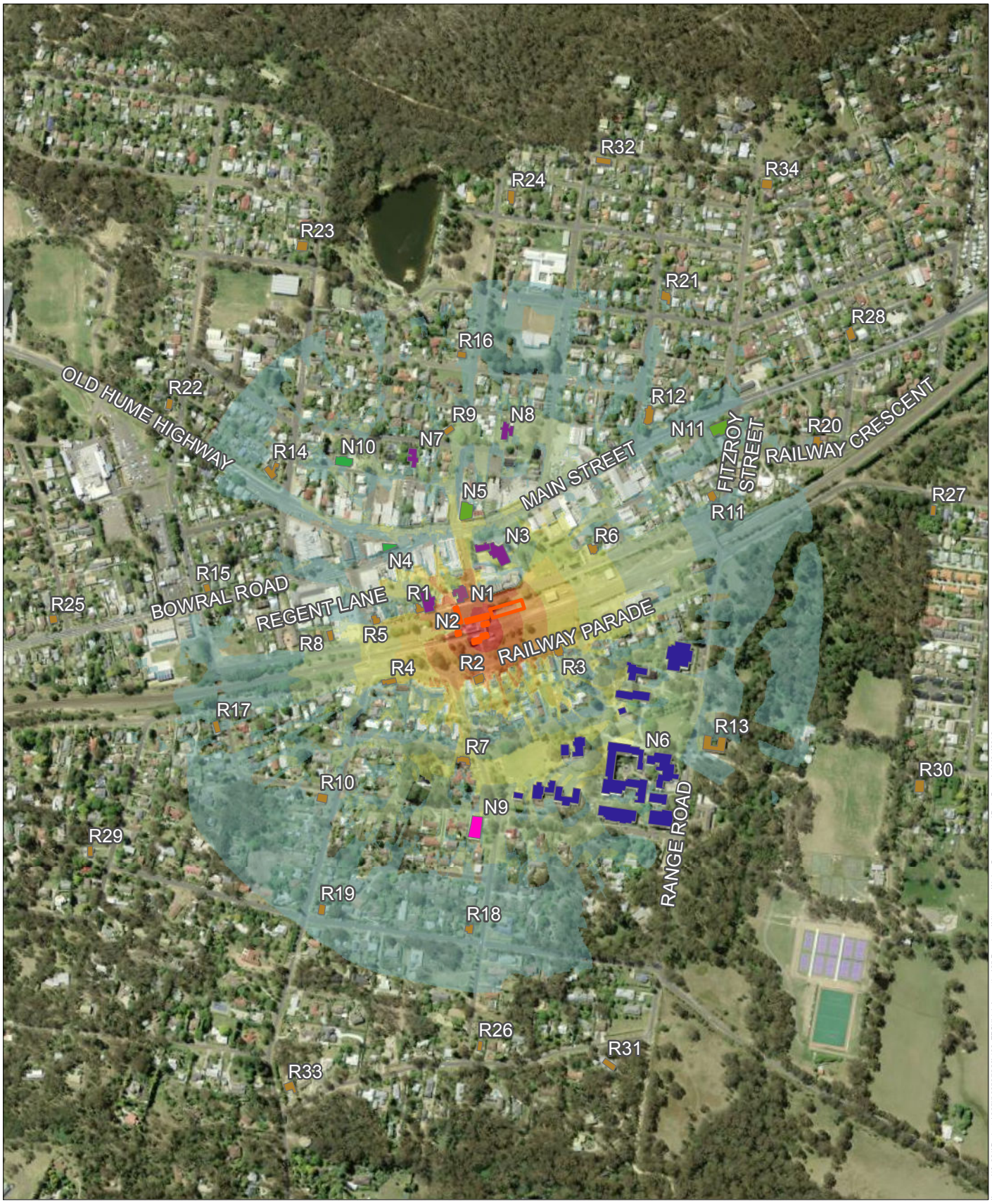


Mittagong Station Upgrade - Lift installation

AECOM

Meters
0 150 300

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

< 40 | 40 - 44 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | 65 - 69 | > 70

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Mittagong Station Upgrade - Station, toilet and waiting room reconfiguration

AECOM

Meters
0 150 300

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

< 40 | 40 - 44 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | 65 - 69 | > 70

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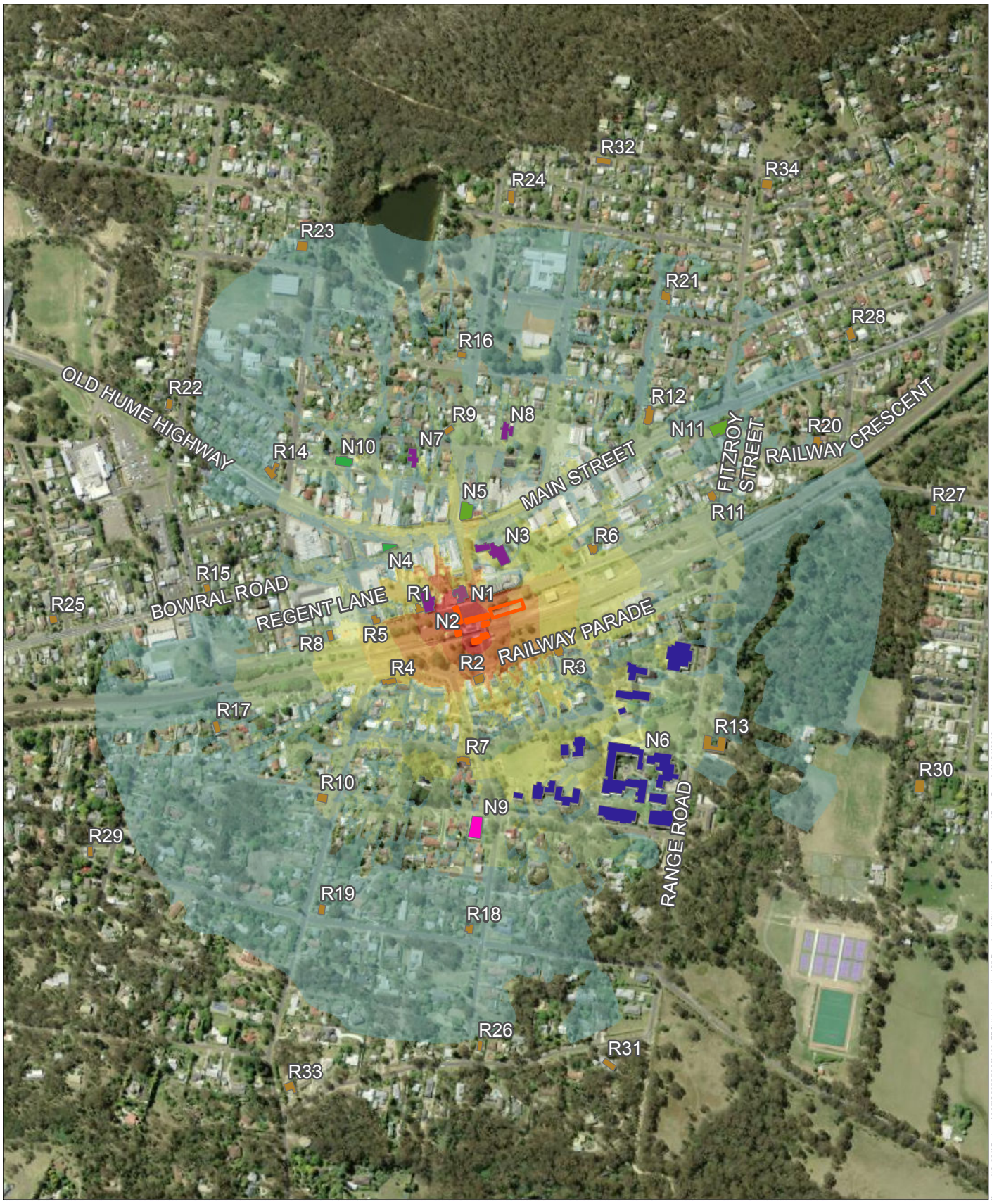


Mittagong Station Upgrade - Station surrounds works

AECOM

N

0 150 300 Meters

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

< 40 | 40 - 44 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | 65 - 69 | > 70

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Mittagong Station Upgrade - Demobilisation

AECOM

Meters
0 150 300

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

< 40 | 40 - 44 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | 65 - 69 | > 70

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Mittagong Station Upgrade - Utility installation

AECOM

N

0 150 300 Meters

**Sound Pressure Level, $L_{A1}$ dB(A)**

| < 45 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | 65 - 69 | 70 - 74 | > 75 |
|---|---|---|---|---|---|---|---|

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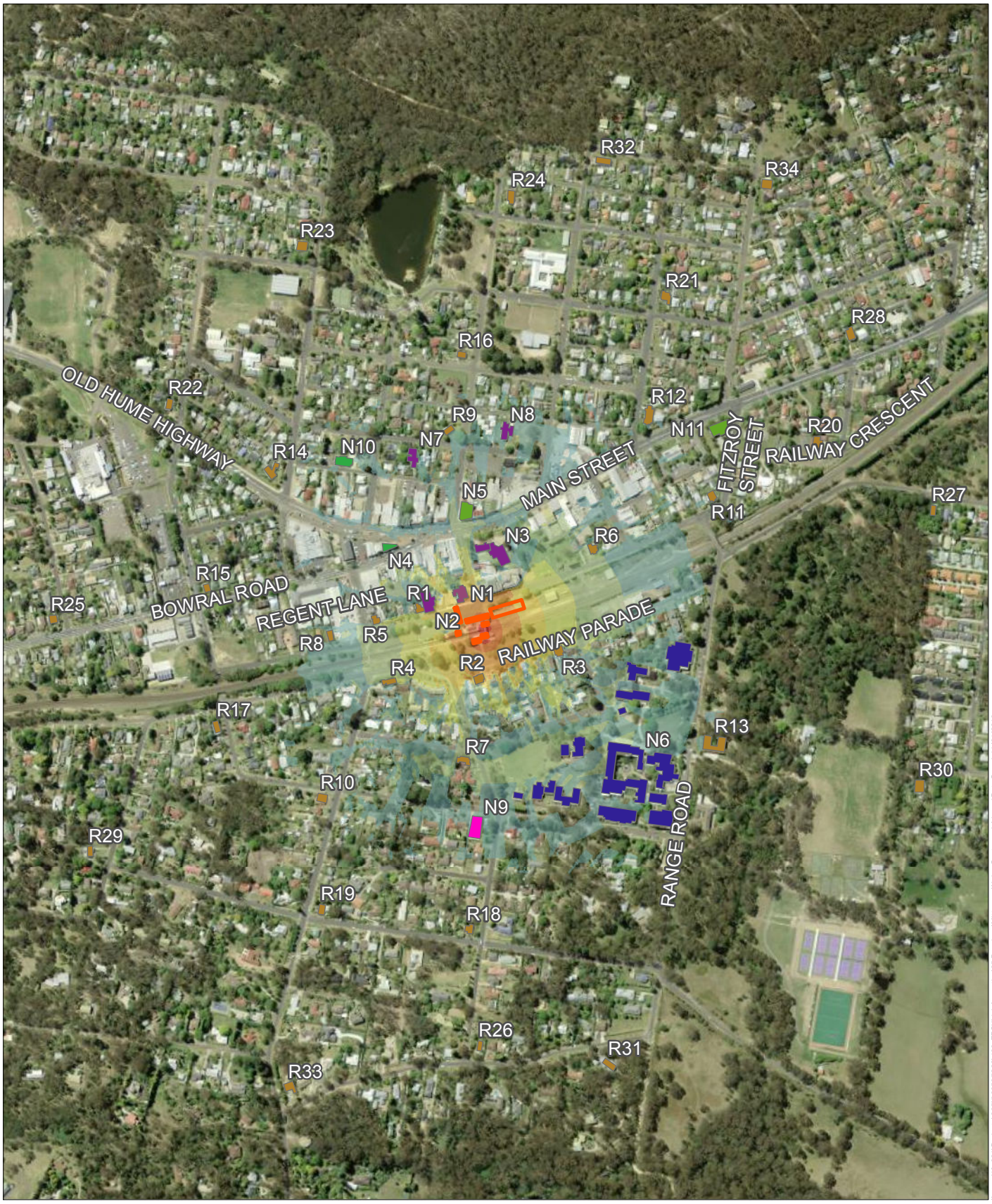


Mittagong Station Upgrade - Earthworks and piling

AECOM

N

0 150 300 Meters

**Sound Pressure Level, $L_{A1}$ dB(A)**

< 45 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | 65 - 69 | 70 - 74 | > 75

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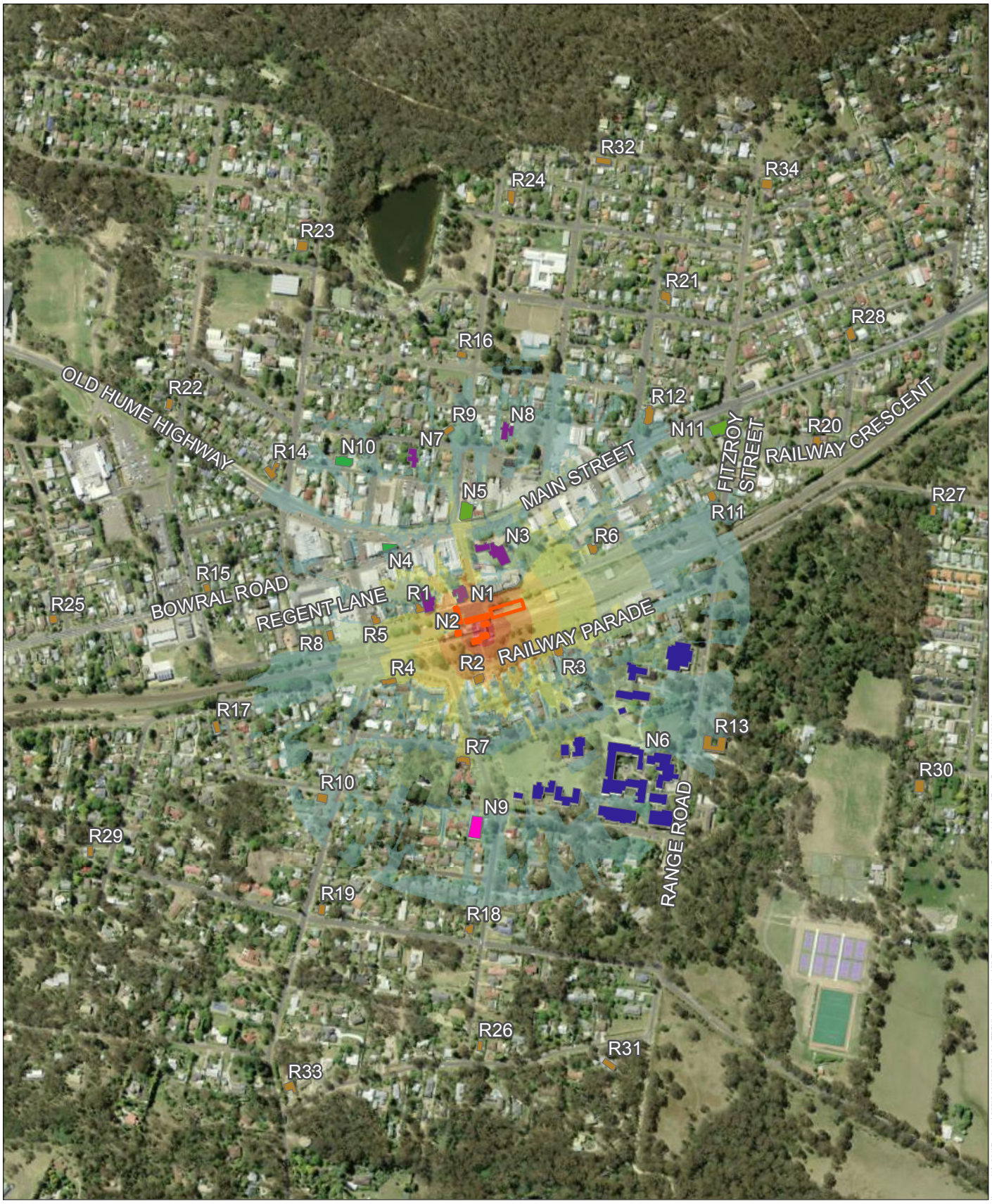


Mittagong Station Upgrade - Lift installation

AECOM

N

0 150 300 Meters

**Sound Pressure Level, $L_{A1}$ dB(A)**

| < 45 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | 65 - 69 | 70 - 74 | > 75 |
|---|---|---|---|---|---|---|---|

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