# Operational and Construction Noise and Vibration Assessment

## Additional Left Hand Lane
## New Lake Entrance Road & Pioneer Drive
## Oak Flats, NSW

Prepared for: Transport for NSW
C/- bd infrastructure Pty Ltd
June 2024
MAC232030-01RP1V1

Muller Acoustic Consulting

# *Document Information*

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Oak Flats, NSW

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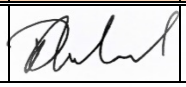
| MAC232030-01RP1V1 | 28 June 2024 | Dale Redwood |  | Oliver Muller |  |

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# 1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by bd infrastructure Pty Ltd (bd infrastructure), on behalf of Transport for NSW (TfNSW) to complete an Operational and Construction Noise and Vibration Assessment (OCNVA) for the proposed New Lake Entrance Road and Pioneer Drive Additional Left Hand Lane Project at Oak Flats, NSW (the proposal).

This report presents the results, findings and recommendations of the OCNVA and has been prepared to accompany the Review of Environmental Factors (REF) being prepared by bd infrastructure. The assessment has been completed in general accordance with the following standards and guidelines:

- Transport for NSW, Noise and Vibration Assessment Procedure (for road traffic and construction) February 2023;
- Transport for NSW, Construction Noise and Vibration Guideline (CNVG) (for road and maritime works) June 2022;
- NSW Roads and Maritime Services (2022), Road Noise Criteria Guideline (RNCG);
- NSW Roads and Maritime Services (2022), Road Noise Mitigation Guideline (RNMG);
- NSW Roads and Maritime Services,(2022) Road Noise Validation Guideline (RNVG);
- Department of Environment and Climate Change (DECC) (2009), Interim Construction Noise Guideline (ICNG);
- Department of Environment and Conservation (DEC) (2006), Assessing Vibration: A Technical Guideline;
- NSW Environment Protection Authority (2017), Noise Policy for Industry (NPI);
- NSW Environment Protection Authority (EPA's), Approved Methods for the measurement and analysis of environmental noise in NSW, 2022;
- Standards Australia – AS 2436-2010 (R2016) Guide to Noise Control on Construction, Maintenance and Demolition Sites;
- Standards Australia AS IEC 61672.1-2019 Electroacoustics – Sound level meters – Specifications;
- Standards Australia – AS 1055:2018 Acoustics- Description and measurement of environmental noise;
- British Standard BS 7385: Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2"; and
- German Institute for Standardisation – DIN 4150 (1999-02) Part 3 (DIN4150-3) – Structural Vibration - Effects of Vibration on Structures.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

## 1.1 Assessment Objectives

The OCNVA quantifies potential construction noise and vibration impacts and operational road traffic noise intrusion to residential receivers along the proposal alignment.

Primary considerations in this assessment report include:

- provide a technical document that can support the Construction Environmental Management Plan (CEMP) for the proposal;
- identification of sensitive receivers;
- quantifying potential operational road traffic noise based on the proposal concept design and concept design report;
- quantifying construction noise and vibration impacts from the proposal based on the proposal brief information; and
- review reasonable and feasible control measures to mitigate noise and vibration emissions with the aim of meeting Noise Management Levels (NMLs) and relevant vibration criteria.

The structure and format of this report has been prepared in accordance with the Transport for NSW (formerly Roads and Maritime Services) document Noise and Vibration Assessment Procedure (for road traffic and construction) (TfNSW, 2023), with consideration to the Editorial Style Guide (Roads and Maritime, 2019).

# 2 Project Description

## 2.1 Proposal Area

The proposal area is at the intersection of New Lake Entrance Road and Pioneer Drive, Oak Flats, a suburb of Shellharbour, in the NSW Illawarra region. The study area for the proposal is illustrated in **Figure 1**.

MR611 Lake Entrance Road is 4.4km in length and traverses a mix of residential and commercial properties. The section between the Princes Highway and College Avenue is referred to as "New Lake Entrance Road" as it is more recently constructed. The remaining section, which provides a link to MR522 Shellharbour Road and the suburb of Warilla, is known as Lake Entrance Road.

New Lake Entrance Road is a six-lane divided road to the north of the assessed intersection with Pioneer Drive, however on the roundabout approach and departure it consists of a four-lane divided carriageway. New Lake Entrance Road is a major arterial road linking towns in the east such as Warilla to towns in the west such as Oak Flats. The sign posted speed limit for New Lake Entrance Road at this location is 60km/h.

Pioneer Drive is a local road (Council managed) that forms a key route linking Oak Flats with Flinders, Shell Cove and Shellharbour Village. It is a two-lane undivided road with a 50km/h speed limit. At the intersection on the departure and approach, it consists of a four-lane divided carriageway. To the east of the intersection, this reduces to a two-lane undivided road with parking on both sides.

Construction site compound and/or stockpile facilities are proposed to be established adjacent to the Lake Illawarra Police Station off Pioneer Drive, while an amenities and parking area will be established at the rear of the commercial complex at the corner of New Lake Entrance Road and Pioneer Drive.

## 2.2 Proposal Description

TfNSW has identified that an upgrade at the intersection of New Lake Entrance Road and Pioneer Drive is needed to relieve congestion and queuing extending from the roundabout back onto the Oak Flats interchange and back onto the Princes Highway. To relieve this congestion and reduce queuing, the upgrade involves a new left turn lane on New Lake Entrance Road, on the southern approach to the roundabout.

Key features of the proposal include:

- construct a rockfill retaining structure along the northbound side of New Lake Entrance Road to allow for up to 11 metres (m) of new road pavement;
- construct up to 11m of new road pavement to allow for:

- an additional 3.5m wide left hand turning lane, providing about 150m length of additional waiting capacity for traffic turning left into Pioneer Drive from New Lake Entrance Road;
- a 3m wide sealed shoulder;
- 3-7.5m of new pavement for the future long term intersection upgrade; and
- 3m wide bike lane;

- provision of a 1m wide verge on the northbound side of New Lake Entrance Road;
- install an 'F type' concrete safety barrier along the edge of the new pavement;
- install a new SF kerb (with gaps) between the proposed left hand turning lane and bike lane;
- reseal the existing travel lane adjacent to the new left hand turning lane;
- reconstruct the impacted shared user path along the southern side of Pioneer Drive, including a new kerb ramp;
- remove the existing drainage pipe along the existing left hand lane and install new pits and pipe drainage along the western edge of new pavement to tie in to existing drainage system;
- provision of new signage and line marking; and
- protection and/or relocation of utilities.

The provision of the additional left-hand lane would increase the width of New Lake Entrance Road by 11m. This additional width would be used in the short-term to separate the cycle lane from live traffic and to install signs closer to the traffic lanes. Ultimately, this additional width would support the long-term upgrade of the intersection of New Lake Entrance Road and Pioneer Drive, by reducing the need for future work.

The Concept Design for the proposal is presented in **Appendix B**.

## 2.3 Construction Hours and Timing

Construction of the proposal would generally be carried out during standard working hours:

- Monday to Friday: 7:00am to 6:00pm.
- Saturday: 7:00am to 1:00pm.
- Sunday and Public holidays: no planned work.

Consultation with the adjacent daycare will be undertaken prior to the commencement of construction. Construction of the proposal will consider nominated quiet times by the adjacent childcare centre, and noisy activities will be undertaken outside of these nominated quiet times where feasible.

Some construction activities would be required to be undertaken outside of standard working hours, to minimise disruptions to local traffic on New Lake Entrance Road and Pioneer Drive. Out Of Hours Works (OOHW) may include:

- installation of temporary traffic controls associated with site establishment, including temporary traffic signage, install temporary concrete safety barriers (gates for entry and exit), and pedestrian and cyclist detours;
- relocation of utilities where traffic control is required;
- placement of pavement layers (SMZ and HBB);
- line marking;
- installation of slotted curb;
- removal of temporary concrete safety barriers; and
- installation of new concrete F-type barrier.

OOHW would be carried out during from Sunday to Thursday, between 8pm and 4am.

Construction of the proposal is expected to commence between July 2024 and September 2024 and will take about six months to complete.

## 2.4 Identification of Sensitive Receivers

The noise environment surrounding the proposal site is typical of suburban environment with low to medium density residential housing, public recreation areas, commercial and light industrial premises, childcare centres and schools. The dominant noise sources in the locality include road traffic noise, other transport noise (aircraft and trains) and environmental noise (birds and insects).

A review of aerial imagery identifies that the study area in the vicinity of the proposal site comprises predominantly residential properties. A summary of the type and number of sensitive receivers within approximately 1km of the proposal site is presented in **Table 1**. The locality plan identifying the position of the sensitive receivers is provided in **Figure 2.**

| Table 1 Type and Number of Noise Sensitive Receivers | |
|---|---|
| Receiver Type | Number of Buildings |
| Residential | ~1,000 |
| Commercial | ~180 |
| Educational | 1 |
| Childcare Centre | 1 |

The level of affectation for each receiver is influenced by the activity that is being undertaken and the distance and exposure of each receiver to the proposal site. It is noted that the area of affectation is the distance from the proposal where receivers may experience noise levels above the relevant Noise Management Levels.


FIGURE 1

Proposal Area

MAC232030-01

New Lake Entrance Road

KEY

Proposal Site

Ancillary Site

0 50 100 150 200 m

N

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FIGURE 2

Receiver Map

MAC232030-01

New Lake Entrance Road

## KEY

- Proposal Site
- Ancillary Site
- Noise Logger Location

**Receivers**

- Residential Receiver
- Educational Institution
- Commercial Premises
- Childcare Centre

0 60 120 180 240 m

N

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# 3 Existing Environment

The community's reaction to noise from construction may be influenced by the time of day that work is carried out. Residents are potentially more affected by work that occurs during OOH periods (ie evening or night periods). Therefore, it is important to understand the existing noise environment surrounding the proposal to manage and minimise potential noise impact on the environment and local community.

A review of the project locality identified that the area surrounding the proposal site is a suburban environment. Hence, a detailed background noise assessment was undertaken to determine the RBLs and subsequent NMLs.

## 3.1 Unattended Noise Monitoring

The unattended noise survey was conducted in general accordance with the procedures described in Standards Australia AS 1055:2018, "Acoustics - Description and Measurement of Environmental Noise". The selected monitoring location is shown in **Figure 2**. The noise monitoring charts for the background monitoring assessment are provided in **Appendix C.**

The measurements were carried out at two monitoring locations adjacent to New Lake Entrance Road, with Logger L1 located close to New Lake Entrance Road to measure existing road traffic noise levels, and L2 located at the boundary of dwellings at 30 and 32 Conway Crescent, to measure background noise level at the nearest sensitive receivers. Monitoring was undertaken using Svantek Type 1, Svan 977 noise monitors from Friday 8 March 2024 to Tuesday 19 March 2024. Observations on-site identified that road traffic noise was the dominant noise source at each of the monitoring locations.

All acoustic instrumentation used carries appropriate and current NATA (or manufacturer) calibration certificates with records of all calibrations maintained by MAC as per Approved Methods for the measurement and analysis of environmental noise in NSW (EPA, 2022) and complies with AS/NZS IEC 61672.1-2019-Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ±0.5dBA.

The results of the long-term unattended noise monitoring were used to determine the RBL for the assessment during the day, evening and night periods in accordance with the NPI, as required by the ICNG. Data affected by adverse meteorological conditions, including wind speeds above 5m/s at microphone height and rain have been excluded from the calculation of the RBLs in accordance with methodologies provided in Fact Sheet A4 of the NPI. The results of long-term unattended noise monitoring are provided in **Table 2**.

**Table 2 Summary of Existing Background Noise Levels**

| Location | Measured background noise level, RBL, dBA | | | Measured dB $LA_{eq}$ | | |
|---|---|---|---|---|---|---|
| | Day<br>7am to 6pm | Evening<br>6pm to 10pm | Night<br>10pm to 7am | Day<br>7am to 6pm | Evening<br>6pm to 10pm | Night<br>10pm to 7am |
| L1 | 63 | 55 | 39 | 71 | 70 | 65 |
| L2 | 47 | 45 | 37 | 55 | 61 | 50 |

Note: Excludes periods of wind or rain affected data, meteorological data obtained from the Bureau of Meteorology Shellharbour Airport (34.6°S 150.8°E 8m AMSL).

# 4 Construction Noise Impact Assessment

The assessment and management of noise from construction work is completed with reference to the Construction Noise and Vibration Guideline (CNVG). This guideline outlines the approach Transport for NSW takes when assessing and mitigating construction noise. The guideline provides the detail required to identify feasible and reasonable noise mitigation measures for construction, minor work and maintenance projects and needs to be considered for all Transport for NSW managed projects.

Construction noise impacts and mitigation measures need to be evaluated at various stages of a project to inform the concept design, environmental impact assessment, detail design and construction process.

The guideline describes the principles to be applied when reviewing and assessing construction noise, vibration and construction traffic. It also describes procedures to assist in reviewing noise and vibration mitigation.

The intention in all situations is to meet the following principles:

1. Good engagement with the community will be maintained to facilitate effective project delivery with balanced community impact.
2. Construction noise and vibration levels at sensitive receivers will be minimised where feasible and reasonable.
3. Feasible and reasonable mitigation will reflect the time of day, and/or the degree and duration of the impact.
4. The community will be informed of the dates for the intended work, sequencing and timing of noisy events. Where possible this will include an indicative schedule over a 24-hour period.
5. Minimising construction noise and vibration will be viewed as a continuous improvement exercise that is inclusive of stakeholders where no idea is too small to be considered.
6. Staff and community will be informed of the effort and methods undertaken to reduce noise and vibration for the work.
7. Any operational noise and vibration improvements resulting from the work will be promoted to the community.

## 4.1 Policies and Guidelines

### 4.1.1 Construction Noise and Vibration Guideline – Construction Hours

**Table 3** summaries the CNVG recommended standard and out of hours periods for construction. Note, although not mandatory, strong justification is required to work outside of normal construction hours.

**Table 3 Recommended Hours for Construction**

| Hour Commencing | 12 AM | 1 AM | 2 AM | 3 AM | 4 AM | 5 AM | 6 AM | 7 AM | 8 AM | 9 AM | 10 AM | 11 AM | 12 PM | 1 PM | 2 PM | 3 PM | 4 PM | 5 PM | 6 PM | 7 PM | 8 PM | 9 PM | 10 PM | 11 PM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monday | OOH Period 2 | | | | | | | Standard Hours | | | | | | | | | | | OOH Period 1 (Evening) | | | | | |
| Tuesday | | | | | | | | | | | | | | | | | | | | | | | | |
| Wednesday | | | | | | | | | | | | | | | | | | | | | | | | |
| Thursday | | | | | | | | | | | | | | | | | | | | | | | | |
| Friday | | | | | | | | | | | | | | | | | | | | | | | | |
| Saturday | | | | | | | | | | | | | | | | | | | | | | | | |
| Sunday | | | | | | | | | OOH Period 1 (Day) | | | | | | | | | | OOH Period 2 | | | | | |
| Public Holiday | | | | | | | | | | | | | | | | | | | | | | | | |

Out of Hours (OOH) work is divided into two periods of sensitivity and cover the hours listed below:

- **OOH Period 1 (day/low risk period):** Saturdays – 7am to 8am & 1pm to 6pm, Sundays/Public Holidays – 8am to 6pm.
- **OOH Period 1 (evening/low risk period):** Monday to Friday – 6pm to 10pm.
- **OOH Period 2 (night/medium to high-risk period):** Monday to Friday – 10pm to 7am, Saturdays/Sundays/Public Holidays – 6pm to 7am (8am on Sunday mornings and Public Holidays).

### 4.1.2 Interim Construction Noise Guideline

In accordance with the CNVG, construction Noise Management Levels are established with reference to the NSW Interim Construction Noise Guideline (ICNG). The ICNG is specifically aimed at managing noise from construction work regulated by the EPA and is used to help in setting statutory conditions in licences or other regulatory instruments. The types of construction regulated by the Environment Protection Authority (EPA) under the Protection of the Environment Operations Act 1997 (POEO Act), include construction, maintenance and renewal activities carried out by a public authority, such as road upgrades as described in Schedule 1 of the POEO Act.

The ICNG sets out procedures to identify and address the impact of construction noise on residences and other sensitive land uses. This section provides a summary of noise objectives that are applicable to the assessment. The ICNG provides two methodologies for the assessment of construction noise emissions:

- quantitative, which is suited to major construction proposals with typical durations of more than three weeks; and
- qualitative, which is suited to short term infrastructure maintenance (for proposals with a typical duration of less than three weeks).

The methodology for a quantitative assessment requires a more complex approach, involving noise emission predictions from construction activities to the relevant assessment locations, whilst the qualitative assessment methodology is a more simplified approach that relies more on noise management strategies.

This report has adopted a quantitative assessment approach. The assessment includes identification of potentially affected assessment locations, description of activities involved in the proposal, derivation of the construction noise criteria for standard and OOHs periods, quantification of potential noise impacts at receivers and, provides management and mitigation recommendations.

Table 4 reproduces the ICNG management levels for residential receivers. The construction Noise Management Level (NML) is the sum of the management level and relevant RBL for each specific assessment period. Table 5 reproduces the ICNG management levels for other receiver types.

| Table 4 ICNG Residential Management Levels | | |
|---|---|---|
| Time of Day | Management Level $LA_{eq(15min)}$[1] | How to Apply |
| Recommended standard hours:<br>Monday to Friday 7am to 6pm<br>Saturday 8am to 1pm No work on Sundays or public holidays. | Noise affected RBL + 10dB. | The noise affected level represents the point above which there may be some community reaction to noise.<br>Where the predicted or measured LAeq(15min) 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 75dBA. | 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>• 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>• if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times. |
| Outside recommended standard hours. | Noise affected RBL + 5dB. | 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 5dBA above the noise affected level, the proponent should negotiate with the community.<br>For guidance on negotiating agreements see section 7.2.2. |

Note 1: The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the construction NML for noise assessment purposes and is the median of the ABL's.

| Table 5 Noise Management Levels for Other Noise Sensitive Receivers | | |
|---|---|---|
| Land use | Where objective applies | Management Level $LA_{eq(15min)}$[1] |
| Classrooms at schools and other educational institutions | Internal noise level | 45dB |
| Hospital wards and operating theatres | Internal noise level | 45dB |
| Places of worship | Internal noise level | 45dB |
| Active recreation areas | External noise level | 65dB |
| Passive recreation areas | External noise level | 60dB |
| Commercial premises | External noise level | 70dB |
| Industrial premises | External noise level | 75dB |

Note 1: Noise Management Levels apply when receiver areas are in use only.

Where the predicted or measured $LA_{eq(15min)}$ noise level is greater than the NML, the proponent should apply all feasible and reasonable work practices to meet the relevant NML. Following the implementation of standard mitigation measures, where residual noise impacts occur, additional mitigation measures (AMMs) should be implemented.

### 4.1.3 Construction Noise Management Levels (Criteria)

The NMLs for standard and OOHs work periods are summarised in **Table 6** for residential receivers and **Table 7** for applicable non-residential receivers.

| Table 6 Construction NMLs – Residential Receivers | | | | |
|---|---|---|---|---|
| Location | Assessment Period | RBL, dBA | NML dB $LA_{eq(15min)}$ | Highly noise affected NML[1] dB $LA_{eq(15min)}$ |
| L2 – All Residential Receivers | Standard Hours | 47 | 57 | 75 |
| | OOH Period 1 Day | 47 | 52 | 75 |
| | OOH Period 1 Evening | 45 | 50 | 75 |
| | OOH Period 2 Night | 37 | 42 | 75 |

Note 1: The highly noise affected NML is a hypothetical level that is adopted to ensure the avoidance of strong community reaction. Should this level be exceeded the construction methodology is to be reviewed to reduce the impact on surrounding sensitive receivers.

| Table 7 Construction NMLs – Non-Residential Receivers | | | |
|---|---|---|---|
| Location | Assessment Period | Where NML Applies | NML dB $LA_{eq(15min)}$ |
| Education Institution | When in use | Internal noise level | 45 |
| Childcare Centres[1] | When in use | Internal sleeping areas | 35 |
| | | External play areas | 55 |
| Commercial Receivers | When in use | External noise level | 70 |

Note 1: As per AAAS guideline for Childcare Centre Acoustic Assessment v3.0.

## 4.2 Maximum Noise Level Assessment

The maximum noise level assessment (sleep disturbance) criterion of 65dB $L_{Amax}$ is referred to in Section 2.1.5 of the Noise and Vibration Assessment Procedure (for road traffic and construction) (2023) and Appendix E of the Construction Noise and Vibration Guideline (Roads) (2023).

The maximum noise level assessment criterion relates to both operational phase and construction phase sleep disturbance impacts and has been adopted as the relevant assessment criterion for this assessment.

## 4.3 Noise Assessment Methodology

A computer model was developed to quantify project noise emissions to neighbouring receivers using DGMR (iNoise, Version 2024) noise modelling software. iNoise is an intuitive and quality assured software for industrial noise calculations in the environment. 3D noise modelling is considered industry best practice for assessing noise emissions from projects.

The model incorporated a three-dimensional digital terrain map giving all relevant topographic information used in the modelling process. Additionally, the model uses relevant noise source data, ground type, attenuation from barrier or buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers. Where relevant, modifying factors in accordance with Fact Sheet C of the NPI have been applied to calculations.

The model calculation method used to predict noise levels was in accordance with ISO 9613-1 'Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere' and ISO 9613-2 'Acoustics - Attenuation of sound during propagation outdoors. Part 2: General method of calculation' including corrections for meteorological conditions using CONCAWE[1]. The ISO 9613 standard from 1996 is the most used noise prediction method worldwide. Many countries refer to ISO 9613 in their noise legislation. However, the ISO 9613 standard does not contain guidelines for quality assured software implementation, which leads to differences between applications in calculated results. In 2015 this changed with the release of ISO/TR 17534-3. This quality standard gives clear recommendations for interpreting the ISO 9613 method. iNoise fully supports these recommendations. The models and results for the 19 test cases are included in the software.

[1] Report no. 4/18, "the propagation of noise from petroleum and petrochemical complexes to neighbouring communities", Prepared by C.J. Manning, M.Sc., M.I.O.A. Acoustic Technology Limited (Ref.AT 931), CONCAWE, Den Haag May 1981

## 4.4 Proposed Works and Construction Scenarios

Construction activities considered to have the greatest potential for noise impact on nearby receivers were determined in consultation with TfNSW. The construction scenarios included in this assessment are described in **Table 8** and the typical plant and equipment, along with the fleet Sound Power Level (SWL) and maximum noise levels ($L_{Amax}$) for each of the construction activities are provided in **Table 9**. The fleet Sound Power Levels, and maximum noise levels were sourced from the TfNSW Construction and Maintenance Noise Estimator tool.

The precise locations and types of equipment used for construction are not known in detail at the concept design phase of the proposal. Hence, the construction fleet for each activity was modelled across the potential extent of each work area, with all plant and equipment operating simultaneously and at maximum capacity for the duration of the assessment period. It is noted that typical construction plant and equipment are unlikely to operate simultaneously but may be used sequentially across each part of the construction area. On that basis, this assessment provides a broad assessment of the likely worst-case impacts from each stage of the construction works.

**Table 8 Proposed Construction Scenarios**

| Scenarios | Description |
|---|---|
| S1 – Site establishment | ▪ Installation of boundary fences and traffic control measures |
| S2 – Corridor Clearing | ▪ Removal or trimming trees to provide a clear corridor |
| S3 – Utility adjustment | ▪ Relocation of services |
| S4 – Road widening works | ▪ Excavation and formation of road alignment<br>▪ Placement and compaction of sublayers |
| S5 – Drainage structures | ▪ Excavation of trenches and pits<br>▪ Delivery and placement of pipes and pits<br>▪ Compacting |
| S6 – Pavement works | ▪ Laying of new pavement |
| S7 – Road furniture installation / line marking | ▪ Signposting<br>▪ New line markings |
| S8 – Ancillary Site | ▪ Operation of ancillary site |

| Table 9 Construction Scenarios & Fleet Sound Power Levels dB $LA_{eq(15min)}$ – Construction Phase | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Item | SWLs | Construction Scenarios | | | | | | | |
| | | S1 Site Establishment | S2 Corridor Clearing | S3 Utility Adjustment | S4 Road Widening | S5 Drainage Works | S6 Paving Works | S7 Line Marking | S8 Ancillary Site |
| Light Vehicles | 88 | | | | | | | | ✓ |
| Truck (Medium) | 103 | ✓ | | ✓ | | | | | |
| Road Truck / Tipper | 108 | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ |
| EWP | 98 | ✓ | | | | | | ✓ | |
| Franna | 98 | ✓ | | | | ✓ | | ✓ | |
| Excavators (27t) | 106 | | ✓ | ✓ | ✓ | ✓ | | | |
| Hydraulic Hammer | 122 | | ✓ | | ✓ | | | | |
| Front-end Loader | 108 | | ✓ | | | | | | |
| Concrete Saw | 118 | | | ✓ | | | ✓ | | |
| Vacuum Truck | 109 | | | ✓ | | | | | |
| Backhoe | 104 | | | ✓ | ✓ | ✓ | | | |
| Dozer | 108 | | | | ✓ | | | | |
| Scraper | 110 | | | | ✓ | | | | |
| Skid Steer | 91 | | | | | | | | ✓ |
| Compressor | 109 | | | | | | | | ✓ |
| Chainsaw | 114 | | ✓ | | | | | | |
| Tub Grinder | 116 | | ✓ | | | | | | |
| Pneumatic Hammer | 113 | | | ✓ | | | | | |
| Concrete Truck | 109 | | | | | ✓ | ✓ | | |
| Generator / Lighting | 98 | | | ✓ | | | | | ✓ |
| Truck Compressor | 75 | | | | | ✓ | | | |
| Pavement Layer | 114 | | | | | | ✓ | | |
| Asphalt Truck | 106 | | | | | | ✓ | | |
| Rollers (Steel Drum/Multi-tire) | 107 | | | | | ✓ | ✓ | | |
| Compactor | 106 | | | | ✓ | | | | |
| Line Marking | 108 | | | | | | | ✓ | |
| Water Cart | 107 | | | | ✓ | | | | |
| **Total Fleet SWL**[1] | | 115 | 121 | 115 | 120 | 114 | 118 | 110 | 110 |
| **Maximum Noise Level Assessment ($LA_{max}$), Night-time periods (10pm to 7am)** | | | | | | | | | |
| **Fleet $LA_{max}$** | | 116 | n/a[2] | 116 | 128 | 116 | 130 | 116 | 116 |

Note 1: Includes an adjustment for duration.

Note 2: Not recommended as OOHW, as per the CMNET.

## 4.5 Construction Noise Levels

Construction noise levels have been predicted for sensitive receiver locations for each of the construction scenarios described in **Section 4.4**. A summary of the predicted $L_{Aeq(15min)}$ noise emissions is presented for the most affected receiver location for each receiver type in **Table 10**. Predicted levels exceeding the NMLs are displayed **BOLD** text. For detailed mapping of the affected areas, noise contours for each modelled scenario are presented in **Appendix D**.

It is noted that at the concept design phase of the proposal, detailed schedules and construction hours have not yet been determined. Hence, the assessment has considered the potential noise impacts for each construction activity during standard and OOH work periods.

**Table 10 Summary of Noise Assessment Results – Most Affected Receivers**

| Receiver Type | Period | NML (dB $L_{Aeq}$) | Highest Predicted dB $L_{Aeq}$ Per Scenario[1] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | S1 | S2[3] | S3 | S4[3] | S5[3] | S6 | S7 | S8[3] |
| All Residential | Standard | 57 | **68** | **74** | **68** | **73** | **66** | **69** | **62** | **62** |
| | OH P1 Day | 52 | **68** | **n/a** | **68** | **n/a** | **n/a** | **69** | **62** | **n/a** |
| | OOH P1 Evening | 50 | **68** | **n/a** | **68** | **n/a** | **n/a** | **69** | **62** | **n/a** |
| | OOH P2 Night | 42 | **68** | **n/a** | **68** | **n/a** | **n/a** | **69** | **62** | **n/a** |
| Education | When in use | 70[2] | 52 | 51 | 51 | 51 | 52 | 51 | 51 | 50 |
| Childcare Centre | When in use | 60[2] | **64** | **70** | **65** | **69** | **62** | **66** | 59 | 41 |
| Commercial | When in use | 70 | **71** | **80** | **72** | **76** | 70 | **73** | 64 | 64 |

Note 1: Exceedance of relevant NMLs highlighted and shown in **BOLD**.

Note 2: External noise criteria derived using 25dBA façade attenuation for masonry building type with single glazed windows (closed) as per Table 4.2 of ENMM.

Note 3: Construction works to be undertaken during standard construction hours only.

The results of the assessment demonstrate that $L_{Aeq(15min)}$ noise emissions would be above the relevant NMLs for residential receivers for all construction scenarios during standard and OOH work periods. The highest $L_{Aeq(15min)}$ noise levels are predicted at up to 74dB at 30 Conway Crescent, Blackbutt during corridor clearing works, including demolition (S2). Construction noise levels are not predicted to exceed the highly noise affected NML of 75dB $L_{Aeq(15min)}$ at any residential receivers during the proposed construction works.

The construction noise emissions are predicted to exceed the NMLs at commercial premises, including the Lake Illawarra Police Station during establishment of the compound site (S1). and the commercial centre adjacent to the construction site at 10 Pioneer Drive, Oak Flats, during establishment of the compound site (S1), corridor clearing (S2), utility adjustment (S3), road widening (S4) and paving works (S6). Furthermore, construction noise levels are predicted to exceed the criteria for the childcare centre at 10 Pioneer Drive, Oak Flats, during all construction activities except for road furniture installation (S7) and operation of the compound site (S8).

### 4.5.1 Scenario 1 – Site Establishment

Site establishment works (S1) are anticipated to occur during standard and OOHW periods. **Table 10** demonstrates that $LA_{eq(15min)}$ noise emissions are predicted to be above the relevant NMLs for nearby residential receivers during standard and OOH work periods during site establishment works, with the highest predicted noise levels of up to 68dB at 13 Pioneer Drive, Oak Flats. The affected distances and number of residential receivers within the affected area are provided in **Table 11**.

**Table 11 Affected Distances – Site Establishment**

| Receiver Type | Assessment Period | NML dB $LA_{eq(15min)}$ | Affected Distance (m) | Number of Receivers Affected |
|---|---|---|---|---|
| All Residential | Standard Hours | 57 | ~70 | ~15 |
| | OH P1 Day | 52 | ~90 | ~25 |
| | OOH P1 Evening | 50 | ~120 | ~40 |
| | OOH P2 Night | 42 | ~450 | ~220 |
| | Highly Affected | 75 | n/a | 0 |

The results of the assessment demonstrate that during site establishment works, up to 15 residential receivers (within approximately 70m) would experience noise levels above the standard construction hours NMLs. During OOH P1 (Day) and OOH P1 (Evening), residential receivers within approximately 90m and 120m of the proposal respectively are anticipated to experience noise levels above the relevant NMLs, while receivers within approximately 450m of the proposal are anticipated to experience noise levels above the NMLs during OOH P2 (Night). Noise levels are not expected to exceed the highly affected NML at any sensitive receiver locations.

Furthermore, construction noise levels are predicted to exceed the relevant NML for commercial receivers at the commercial complex located at 10 Pioneer Drive, Oak Flats, and at the Lake Illawarra Police Station at 6 Pioneer Drive, Oak Flats. Construction noise levels are also predicted to exceed the NML for childcare centres, at the Little Peoples Early Learning Centre at 10 Pioneer Drive, Oak Flats during corridor site establishment works.

### 4.5.2 Scenario 2 – Corridor Clearing

Corridor clearing works (S2) are anticipated to occur during standard construction hours only, with no OOHW scheduled. **Table 10** demonstrates that $LA_{eq(15min)}$ noise emissions are predicted to be above the relevant NMLs for nearby residential receivers during standard and OOH work periods during corridor works, with the highest predicted noise levels of up to 74dB at 30 Conway Crescent, Blackbutt. The affected distances and number of residential receivers within the affected area are provided in **Table 12**.

**Table 12 Affected Distances – Corridor Clearing**

| Receiver Type | Assessment Period | NML dB $LA_{eq(15min)}$ | Affected Distance (m) | Number of Receivers Affected |
|---|---|---|---|---|
| All Residential | Standard Hours | 57 | ~120 | ~30 |
| | Highly Affected | 75 | n/a | 0 |

The results of the assessment demonstrate that during corridor clearing works, up to 30 residential receivers (within approximately 120m) would experience noise levels above the standard construction hours NMLs. Noise levels are not expected to exceed the highly affected NML at any residential receiver locations.

Additionally, construction noise levels are predicted to exceed the relevant NML, including highly affected NML of 75dB $LA_{eq(15min)}$, for commercial receivers at the commercial complex located at 10 Pioneer Drive, Oak Flats. Construction noise levels are also predicted to exceed the NML for childcare centres, at the Little Peoples Early Learning Centre at 10 Pioneer Drive, Oak Flats during corridor clearing works.

### 4.5.3 Scenario 3 – Utility Adjustment

Utility adjustment works (S3) are anticipated to occur during standard and OOHW periods. As shown in **Table 10**, $LA_{eq(15min)}$ noise emissions are predicted to be above the NMLs for standard and OOH work periods for nearby residential receivers, with noise levels predicted to 68dBA at Conway Crescent, Blackbutt. The affected distances and number of receivers within the affected areas are provided in **Table 13**.

**Table 13 Affected Distances – Utility Adjustment**

| Receiver Type | Assessment Period | NML dB $LA_{eq(15min)}$ | Affected Distance (m) | Number of Receivers Affected |
|---|---|---|---|---|
| All Residential | Standard Hours | 57 | ~85 | ~15 |
| | OH P1 Day | 52 | ~105 | ~25 |
| | OOH P1 Evening | 50 | ~150 | ~35 |
| | OOH P2 Night | 42 | ~450 | ~145 |
| | Highly Affected | 75 | n/a | 0 |

The results of the assessment demonstrate that during utility adjustment works, up to 15 residential receivers (within approximately 85m) would experience noise levels above the standard construction hours NMLs. During OOH P1 (Day) and OOH P1 (Evening), residential receivers within approximately 105m and 150m of the proposal respectively are anticipated to experience noise levels above the relevant NMLs, while receivers within approximately 450m of the proposal are anticipated to experience noise levels above the NMLs during OOH P2 (Night). Noise levels are not expected to exceed the highly affected NML at any sensitive receiver locations.

Furthermore, construction noise levels are predicted to exceed the relevant NML for commercial receivers at the 10 Pioneer Drive, Oak Flats commercial complex, and the NML for childcare centres, at the Little Peoples Early Learning Centre at 10 Pioneer Drive, Oak Flats during utility adjustment works.

### 4.5.4 Scenario 4 – Road Widening

Road widening works (S4) are anticipated to occur during standard construction hours only, with no OOHW scheduled. As shown in **Table 10**, $LA_{eq(15min)}$ noise emissions are predicted to be above the NMLs for standard construction hours for nearby residential receivers, with noise levels predicted to 73dBA at Conway Crescent, Blackbutt. The affected distances and number of receivers within the affected area are provided in **Table 14**.

**Table 14 Affected Distances – Road Widening Works**

| Receiver Type | Assessment Period | NML dB $LA_{eq(15min)}$ | Affected Distance (m) | Number of Receivers Affected |
|---|---|---|---|---|
| All Residential | Standard Hours | 57 | ~100 | <25 |
| | Highly Affected | 75 | n/a | 0 |

The results of the assessment demonstrate that during road widening works, up to 25 residential receivers (within approximately 100m) would experience noise levels above the standard construction hours NMLs. Noise levels are not expected to exceed the highly affected NML at any sensitive receiver locations.

Additionally, construction noise levels are predicted to exceed the relevant NML for commercial receivers at the 10 Pioneer Drive, Oak Flats commercial complex, and the NML for childcare centres, at the Little Peoples Early Learning Centre at 10 Pioneer Drive, Oak Flats during road widening works.

### 4.5.5 Scenario 5 – Drainage Structures

The installation of drainage structures (S5) are anticipated to occur during standard construction hours only, with no OOHW scheduled. As shown in **Table 10**, $LA_{eq(15min)}$ noise emissions are predicted to be above the NMLs for standard construction hours for nearby residential receivers, with noise levels predicted to 66dBA at 30 Conway Crescent, Blackbutt. The affected distances and number of receivers within the affected area are provided in **Table 15**.

**Table 15 Affected Distances – Installation of Drainage Structures**

| Receiver Type | Assessment Period | NML dB $LA_{eq(15min)}$ | Affected Distance (m) | Number of Receivers Affected |
|---|---|---|---|---|
| All Residential | Standard Hours | 57 | ~70 | ~12 |
| | Highly Affected | 75 | n/a | 0 |

The results of the assessment demonstrate that during the installation of drainage structures, approximately 12 residential receivers (within approximately 70m) would experience noise levels above the standard construction hours NMLs. Noise levels are not expected to exceed the highly affected NML at any sensitive receiver locations.

Additionally, construction noise levels are predicted to exceed the relevant NML for childcare centres, at the Little Peoples Early Learning Centre at 10 Pioneer Drive, Oak Flats during the installation of drainage structures.

### 4.5.6 Scenario 6 – Pavement Works

Pavement works (S6) are anticipated to occur during standard and OOHW periods. As shown in **Table 10**, $LA_{eq(15min)}$ noise emissions are predicted to be above the NMLs for standard and OOH work periods for nearby residential receivers during pavement works, with noise levels predicted to 69dBA at 30 Conway Crescent, Blackbutt. The affected distances and number of receivers within the affected area are provided in **Table 16**.

**Table 16 Affected Distances – Pavement Works**

| Receiver Type | Assessment Period | NML dB $LA_{eq(15min)}$ | Affected Distance (m) | Number of Receivers Affected |
|---|---|---|---|---|
| All Residential | Standard Hours | 57 | ~100 | ~15 |
| | OH P1 Day | 52 | ~160 | ~35 |
| | OOH P1 Evening | 50 | ~280 | ~50 |
| | OOH P2 Night | 42 | ~490 | ~245 |
| | Highly Affected | 75 | n/a | 0 |

The results of the assessment demonstrate that during pavement works, up to 15 residential receivers (within approximately 100m) would experience noise levels above the standard construction hours NMLs. During OOH P1 (Day) and OOH P1 (Evening), residential receivers within approximately 160m and 280m of the proposal respectively are anticipated to experience noise levels above the relevant NMLs, while receivers within approximately 490m of the proposal are anticipated to experience noise levels above the NMLs during OOH P2 (Night). Noise levels are not expected to exceed the highly affected NML at any sensitive receiver locations.

Furthermore, construction noise levels are predicted to exceed the relevant NML for commercial receivers at the 10 Pioneer Drive, Oak Flats commercial complex, and the NML for childcare centres, at the Little Peoples Early Learning Centre at 10 Pioneer Drive, Oak Flats during pavement works.

### 4.5.7 Scenario 7 – Line Marking / Road Furniture Installation

Line marking and road furniture installation works (S7) are anticipated to occur during standard and OOHW periods. As shown in **Table 10**, $LA_{eq(15min)}$ noise emissions are predicted to be above the NMLs for standard and OOH work periods for nearby residential receivers during line marking works, with noise levels predicted to 62dBA at Conway Crescent, Blackbutt. The affected distances and number of receivers within the affected area are provided in **Table 17**.

**Table 17 Affected Distances – Line Marking**

| Receiver Type | Assessment Period | NML dB $LA_{eq(15min)}$ | Affected Distance (m) | Number of Receivers Affected |
|---|---|---|---|---|
| All Residential | Standard Hours | 57 | ~50 | ~7 |
| | OH P1 Day | 52 | ~80 | ~13 |
| | OOH P1 Evening | 50 | ~100 | ~15 |
| | OOH P2 Night | 42 | ~290 | ~75 |
| | Highly Affected | 75 | n/a | 0 |

The results of the assessment demonstrate that during line marking and road furniture installation, approximately seven residential receivers (within approximately 50m) would experience noise levels above the standard construction hours NMLs. During OOH P1 (Day) and OOH P1 (Evening), residential receivers within approximately 80m and 100m of the proposal respectively are anticipated to experience noise levels above the relevant NMLs, while receivers within approximately 290m of the proposal are anticipated to experience noise levels above the NMLs during OOH P2 (Night). Noise levels are not expected to exceed the highly affected NML at any sensitive receiver locations.

Construction noise levels are not anticipated to exceed the NMLs for non-residential receivers during line marking and road furniture installation works.

### 4.5.8 Scenario 8 – Operation of Compound Sites

It is anticipated that the operation of the compound site would occur during standard construction hours only. As shown in **Table 10**, $LA_{eq(15min)}$ noise emissions are predicted to be above the NMLs for nearby residential, with noise levels predicted to 62dBA at 11 Pioneer Drive, Oak Flats. The affected distances and number of receivers within the affected area are provided in **Table 18**.

**Table 18 Affected Distances – Compound Sites**

| Receiver Type | Assessment Period | NML dB $LA_{eq(15min)}$ | Affected Distance (m) | Number of Receivers Affected |
|---|---|---|---|---|
| All Residential | Standard Hours | 57 | ~40 | 2 |
| | Highly Affected | 75 | n/a | 0 |

The results of the assessment demonstrate that during operation of the compound site, approximately two residential receivers would experience noise levels above the NMLs for standard construction hours. Noise levels are not expected to exceed the highly affected NML at any sensitive receiver locations, nor are they anticipated to exceed the NMLs for non-residential receivers during the operation of the compound site.

### 4.5.9 Maximum Noise Level Assessment Results

Out of hours construction activities occurring during the night-time have the potential to generate noise emissions that may cause sleep disturbance at receivers in proximity to the proposal site. It is important to note that maximum noise level events are typically representative of short duration transient events, such as impact noise, and are unlikely to be sustained for any length of time.

Maximum night-time noise level events have been predicted for sensitive receiver locations for each of the construction scenarios described in **Section 4.4**. Maximum noise levels were sourced from the TfNSW Construction and Maintenance Noise Estimator to represent emissions from transient sources during each of the construction activities.

A summary of the predicted $L_{Amax}$ noise emissions is presented for the most affected receiver location for residential receivers and accommodation services in **Table 19**. Predicted levels exceeding the maximum noise criterion are displayed **BOLD** text.

**Table 19 Summary of Maximum Noise Levels – Most Affected Receivers**

| Receiver Type | Period | NML | Highest Predicted dB $L_{Aeq}$ Per Scenario | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | (dB $L_{Amax}$) | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 |
| Residential | OOH P2 | 65 | **71** | n/a[1] | **71** | n/a[1] | n/a[1] | **85** | **71** | n/a[1] |

Note 1: Construction activities are not anticipated to occur during OOHW periods.

The results of the assessment demonstrate that maximum noise levels are predicted to exceed the maximum noise criterion of 65dB $L_{Amax}$ at nearby residential receivers during all construction scenarios. It is noted that in accordance with TfNSW guidelines, corridor clearing works are not recommended for OOH work periods.

Further assessment of maximum noise levels was undertaken for the activity with the greatest potential for sleep disturbance effects, identified as paving works (S6) utilising a concrete saw. The results of the modelling identified that approximately 23 residential receivers within about 220m of the proposal site, and two residential receivers within 65m of the compound site are predicted to experience noise levels above the maximum noise criterion during paving works New Lake Entrance Drive and Pioneer Road (see **Figure 3**). Therefore, it is recommended that the proposal proactively manages night-time noise emissions and implement reasonable and feasible noise control strategies to minimise the occurrence of sleep disturbance within the surrounding locality. It is also recommended that particularly noisy activities, such as concrete sawing should be avoided during OOH work where possible.

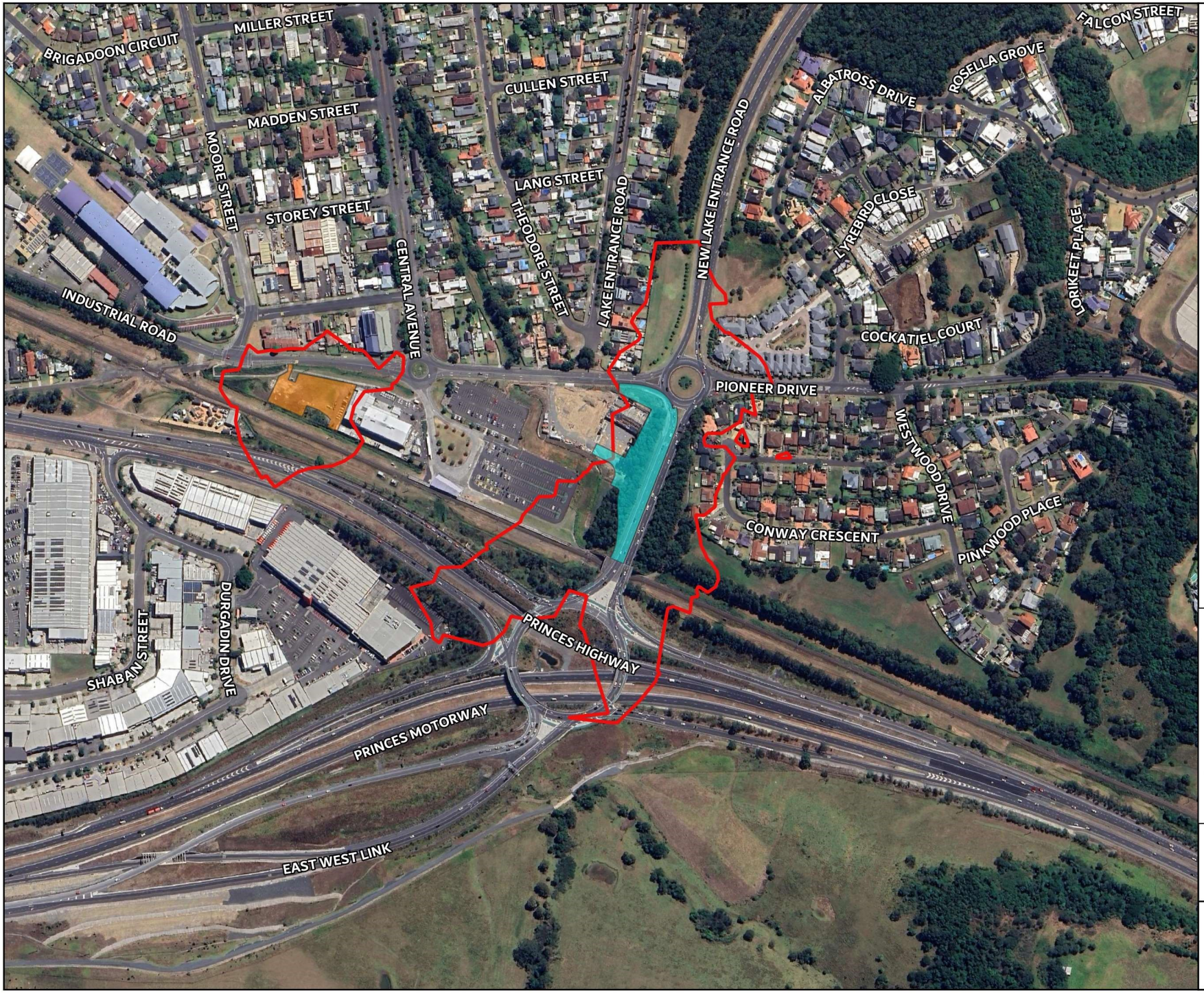


FIGURE 3

Maximum Noise Level Affectation Zone

MAC232030-01

New Lake Entrance Road

KEY

- Proposal Site
- Ancillary Site
- MNLA Affected Zone

0 60 120 180 240 m

N

MAC
Muller Acoustic Consulting

### 4.5.10 Construction Road Traffic Noise

Construction traffic will generate noise over a relatively wide area and beyond the construction site itself. It would be expected that traffic noise would be greatest where there is a concentration of vehicle movements, such as the compound sites and specific locations where construction is occurring.

The proposal is anticipated to generate up to 50 heavy vehicle movements and 20 light construction vehicle movements per day at the peak of construction activity. These movements will include approximately 10 light vehicles and 32 heavy vehicles during standard construction hours, and 10 light vehicles and 18 heavy vehicles during out of hours work periods.

Existing traffic flows for New Lake Entrance Road were measured using automatic tube counters from Friday 8 March 2024 to Sunday 17 March 2024. The results of the traffic monitoring indicated that the average daily traffic volumes were 34,549 vehicles per day during the day period (7am to 10pm) and 3,303 vehicles during the night period (10pm to 7am). Existing daily traffic volumes for Pioneer Drive were sourced from the Shell Harbour Council Traffic Committee Meeting Business Paper from 3 May 2023. Existing average daily traffic volumes on Pioneer Drive, east of New Lake Entrance Road are 12,356 vehicles per day. By applying the same percentage split of day and night period traffic volumes, it is estimated that approximately 11,278 vehicles use Pioneer Drive during the day period (7am to 10pm) and approximately 1,078 vehicles use Pioneer Drive during the night period (10pm to 7am).

An analysis of the increase in road traffic noise levels from construction traffic is presented in **Table 20**. The results of the analysis demonstrate that due to high existing road traffic noise levels in the locality, construction road noise levels would be negligible, with increases in noise levels anticipated to remain below the 2dB $LA_{eq(period)}$ increase criterion.

**Table 20 Construction Road Traffic Noise**

| Road Segment | Period | Existing Traffic | Construction Vehicles[1] | Increase in Traffic | Increase in Traffic Noise, dB $LA_{eq,period}$ |
|---|---|---|---|---|---|
| New Lake Entrance Road | Day | 34,549 | 42 | 0.2% | <0.1 |
| | Night | 3,303 | 28 | 0.9% | <0.1 |
| Pioneer Drive | Day | 11,278 | 42 | 0.4% | <0.1 |
| | Night | 1,078 | 28 | 2.6% | <0.2 |

Note 1: Construction vehicles per period.

## 4.6 Construction Noise Mitigation Measures

### 4.6.1 Standard Mitigation Measures

The TfNSW CNVG outlines noise management and mitigation measures to minimise the noise and vibration impacts from construction activities on nearby sensitive receivers. Adopting the standard mitigation measures may result in an attenuation of up to 10dBA where space requirements place limitations on the attenuation options, and up to 20dBA in situations where noise source noise mitigation measures (silencers, mufflers etc) can be combined with noise barriers and other management techniques. The standard mitigation measures as per the CNVG are reproduced in **Table 21**.

**Table 21 Standard Mitigation Measures**

| Action Required | Details |
|---|---|
| Management Measures | |
| Implementation of any project specific mitigation measures required | Implementation of any project specific mitigation measures required. |
| Implement community consultation or notification measures | Notification detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night-time period, any operational noise benefits from the works (where applicable) and contact telephone number.<br>Notification should be a minimum of 7 calendar days prior to the start of works. For projects other than maintenance works more advanced consultation or notification may be required. Please contact Roads and Maritime Communication and Stakeholder Engagement for guidance.<br>▪ Website (If required).<br>▪ Contact telephone number for community.<br>▪ Email distribution list (if required).<br>▪ Community drop-in session (if required by approval conditions). |
| Site inductions | All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include:<br>▪ All relevant project specific and standard noise and vibration mitigation measures;<br>▪ Relevant licence and approval conditions;<br>▪ Permissible hours of work;<br>▪ Any limitations on noise generating activities;<br>▪ Location of nearest sensitive receivers;<br>▪ Construction employee parking areas;<br>▪ Designated loading/unloading areas and procedures;<br>▪ Site opening/closing times (including deliveries); and<br>▪ Environmental incident procedures. |

| Table 21 Standard Mitigation Measures | |
|---|---|
| **Action Required** | **Details** |
| 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. |
| Verification | Where specified under Appendix C a noise verification program is to be carried out for the duration of the works in accordance with the Construction Noise and Vibration Management Plan and any approval and licence conditions. |
| Attended vibration measurements | Where required attended vibration measurements should be undertaken at the commencement of vibration generating activities to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage. |
| Update Construction Environmental Management Plan | The CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies. |
| Building condition surveys | Undertake building dilapidation surveys on all buildings located within the buffer zone prior to commencement of activities with the potential to cause property damage. |
| Source Controls | |
| Construction hours and scheduling | Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating noise with special audible characteristics and/or vibration levels should be scheduled during less sensitive time periods |
| Construction respite period | Please refer to Appendix C of the CNVG for more details on the following respite measures:<br>▪ Respite Offers (RO);<br>▪ Respite Period 1 (R1);<br>▪ Respite Period 2 (R2); and<br>▪ Duration Respite (DR). |
| Equipment selection | Use quieter and less vibration emitting construction methods where feasible and reasonable.<br>For example, when piling is required, bored piles rather than impact-driven piles will minimise noise and vibration impacts. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, will have significant noise and vibration benefits.<br>Ensure plant including the silencer is well maintained. |
| Plant noise levels | The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the criteria in Appendix H of the CNVG.<br>Implement a noise monitoring audit program to ensure equipment remains within the more stringent of the manufacturer's specifications or Appendix H of the CNVG. |
| Rental plant and equipment | The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the criteria in Table 2 of the CNVG. |

| Table 21 Standard Mitigation Measures | |
|---|---|
| **Action Required** | **Details** |
| Use and siting of plant | The offset distance between noisy plant and adjacent sensitive receivers is to be maximised.<br>Plant used intermittently to be throttled down or shut down.<br>Noise-emitting plant to be directed away from sensitive receivers.<br>Only have necessary equipment on site. |
| Plan worksites and activities to minimise noise and vibration. | Locate compounds away from sensitive receivers and discourage access from local roads.<br>Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.<br>Where additional activities or plant may only result in a marginal noise increase and speed up works, consider limiting duration of impact by concentrating noisy activities at one location and move to another as quickly as possible.<br>Very noise activities should be scheduled for normal working hours. If the work cannot be undertaken during the day, it should be completed before 11:00pm.<br>Where practicable, work should be scheduled to avoid major student examination periods when students are studying for examinations such as before or during Higher School Certificate and at the end of higher education semesters.<br>If programmed night work is postponed the work should be re-programmed and the approaches in this guideline apply again. |
| Reduce equipment power | Use only the necessary size and power. |
| Non-tonal reversing alarms | Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.<br>Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level. |
| Minimise disturbance arising from delivery of goods to construction sites | Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers.<br>Select site access points and roads as far as possible away from sensitive receivers.<br>Dedicated loading/unloading areas to be shielded if close to sensitive receivers.<br>Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.<br>Avoid or minimise these out of hours movements where possible. |

| Table 21 Standard Mitigation Measures | |
|---|---|
| **Action Required** | **Details** |
| Engine compression brakes | Limit the use of engine compression brakes at night and in residential areas.<br><br>Ensure vehicles are fitted with a maintained original equipment manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's 'In-service test procedure' and standard. |
| Path Controls | |
| Shield stationary noise sources such as pumps, compressors, fans etc | Stationary noise sources should be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained. Appendix D of AS2436:2010 lists materials suitable for shielding |
| Shield sensitive receivers from noise activities | Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant. |
| Receptor Controls | |
| Structural surveys and vibration monitoring | Pre-construction surveys of the structural integrity of vibration sensitive buildings may be warranted.<br><br>At locations where there are high-risk receptors, vibration monitoring should be conducted during the activities causing vibration. |
| See Appendix C of the CNVG for additional measures | In some instances additional mitigation measures may be required. |

### 4.6.2 Additional Mitigation Measures

Standard noise mitigation and management measures in accordance with the ICNG would be implemented for the proposal where practicable.

The CNVG (TfNSW, 2023) outlines a range of mitigation measures which are recommended in order to manage the potential impact. The CNVG additional measures reproduced in **Table 22** will be considered by TfNSW or the construction contractor following incorporation of feasible and reasonable mitigation measures for the proposal. **Appendix E** provides a definition of each additional mitigation measure listed below.

**Table 22 CNVG Triggers for Additional Mitigation Measures - Airborne Noise**

| Perception | Predicted airborne $LA_{eq(15min)}$ noise level at receiver | | Additional mitigation measures Type | Mitigation Levels |
|---|---|---|---|---|
| | dB(A) above RBL | dB(A) above NML | | |
| All hours | | | | |
| 75dBA or greater | | | N, V, PC, RO | HA |
| Standard Hours: Mon - Fri (7am – 6pm), Sat (8am – 1pm), Sun/Pub Holidays (Nil) | | | | |
| Noticeable | 5 to 10 | 0 | - | NML |
| Clearly Audible | 10 to 20 | < 10 | - | NML |
| Moderately intrusive | 20 to 30 | 10 to 20 | N, V | NML+10 |
| Highly intrusive | > 30 | > 20 | N, V | NML+20 |
| OOH Period 1: Mon – Fri (6pm – 10pm), Sat (7am – 8am & 1pm – 10pm), Sun/Pub Hol (8am – 6pm) | | | | |
| Noticeable | 5 to 10 | < 5 | - | NML |
| Clearly Audible | 10 to 20 | 5 to 15 | N, R1, DR | NML+5 |
| Moderately intrusive | 20 to 30 | 15 to 25 | V, N, R1, DR | NML+15 |
| Highly intrusive | > 30 | > 25 | V, IB, N, R1, DR, PC, SN | NML+25 |
| OOH Period 2: Mon – Fri (10pm – 7am), Sat (10pm – 8am), Sun/Pub Holidays (6pm – 7am) | | | | |
| Noticeable | 5 to 10 | < 5 | N | NML |
| Clearly Audible | 10 to 20 | 5 to 15 | V, N, R2, DR | NML+5 |
| Moderately intrusive | 20 to 30 | 15 to 25 | V, IB, N, PC, SN, R2, DR | NML+15 |
| Highly intrusive | > 30 | > 25 | AA, V, IB, N, PC, SN, R2, DR | NML+25 |

Notes: AA = Alternative accommodation, R1 = Respite Period 1, V = Validation of predicted noise levels (not required for projects less than 3 weeks), PC = Phone calls, IB = Individual briefings (not required for projects less than 3 weeks), SN = Specific notifications, N = Notification, R2 = Respite Period 2, DR = Duration Respite, Perception = relates to level above RBL, NML = Noise Management Level (see Appendix C), HA = Highly Affected (> 75 dB(A) - applies to residences only).

It is understood that construction works would typically be undertaken during standard construction hours, however, some construction activities would be required to be undertaken outside of standard working hours to minimise disruptions to local traffic on New Lane Entrance Road and Pioneer Drive. OOHW may include site establishment works (S1), relocation of utilities (S3), paving works (S6) and line marking and road furniture installation (S7).

The assessment of AMM affected distances has considered the scenario with highest potential for noise impacts on surrounding receivers, identified as paving works (S6). Where other construction activities with a lower potential impact are undertaken during OOH work periods, the affected distances for each impact category are expected to be less than those presented in the section below. It is reiterated that in accordance with the CNVG, corridor clearing works are not recommended for OOH work periods.

The affected distances and the number of potentially affected receivers for each AMM category are presented in Table 23. It is noted that the derivation of affected distances has allowed for a conservative 5dB reduction to account for noise attenuation from the implementation of standard mitigation measures as per Section 4.6.1.

A visual representation of the affected distances is presented in Figure 4 to Figure 7 for paving works. It is noted that there are no applicable additional mitigation measures required beyond standard mitigation measures for the 'noticeable' category (standard hours and OOH period 1), or the 'clearly audible' category (standard hours).

| Table 23 – Additional Mitigation Measures – Affected Distances – Paving Works (Scenario 6) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Assessment Period | Noticeable | | Clearly Audible | | Moderately Intrusive | | Highly Intrusive | | Highly Affected | |
| | Distance | Receivers | Distance | Receivers | Distance | Receivers | Distance | Receivers | Distance | Receivers |
| Standard Hours | ~60m | 8[1] | ~25m | 0[1] | ~5m | 0 | <5m | 0 | ~20m | 0 |
| OOH1 (Day) | ~60m | 8[1] | ~25m | 0[1] | ~5m | 0 | <5m | 0 | ~20m | 0 |
| OOH1 (Evening) | ~65m | 13[1] | ~30m | 0 | ~10m | 0 | <10m | 0 | ~20m | 0 |
| OOH2 (Night) | ~150m | 40 | ~60m | 8 | ~25m | 0 | <25m | 0 | ~20m | 0 |

Note 1: No additional mitigation measures are applicable.


FIGURE 4

AMM Affectation Zone

Paving Works

Standard Hours

MAC232030-01

New Lake Entrance Road

## KEY

- Proposal Site
- Ancillary Site

**AMM Affected Area**

- Noticeable
- Clearly Audible
- Moderately Intrusive
- Highly Intrusive
- Highly Affected

0 40 80 120 160 m

N

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FIGURE 5

AMM Affectation Zone

Paving Works

OOH Period 1 (Day)

MAC232030-01

New Lake Entrance Road

KEY

Proposal Site

Ancillary Site

AMM Affected Area

Noticeable

Clearly Audible

Moderately Intrusive

Highly Intrusive

Highly Affected

0 40 80 120 160 m

N

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FIGURE 6

AMM Affectation Zone

Paving Works

OOH Period 1 (Evening)

MAC232030-01

New Lake Entrance Road

## KEY

- Proposal Site
- Ancillary Site

**AMM Affected Area**

- Noticeable
- Clearly Audible
- Moderately Intrusive
- Highly Intrusive
- Highly Affected

0 40 80 120 160 m

N

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FIGURE 7

AMM Affectation Zone

Paving Works

OOH Period 2 (Night)

MAC232030-01

New Lake Entrance Road

## KEY

- Proposal Site
- Ancillary Site

**AMM Affected Area**

- Noticeable
- Clearly Audible
- Moderately Intrusive
- Highly Intrusive
- Highly Affected

0 40 80 120 160 m

N

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## 4.7 Construction Vibration Criteria

British Standard BS 7385:Part 2-1993 “Evaluation and measurement for vibration in buildings Part 2”, gives guidance on the levels of vibration which building structures could be damaged. BS7385 also takes into consideration the frequency of the vibration which is critical when assessing the likelihood of building damage.

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

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and heavy commercial/industrial buildings are presented in **Table 24**. Where sources of continuous vibration may give rise to dynamic magnification due to resonance, the values provided in **Table 24** should be reduced by 50%, this is especially the case with respect to Peak Particle Velocity (PPV) at lower frequencies.

**Table 24 Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage**

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

## 4.8 Heritage Items

It is noted that the CNVG and BS7385 do not specify recommended vibration limits or minimum working distances for heritage items or other sensitive structures. BS7385 indicates that heritage buildings and structures should not be assumed to be more sensitive to vibration unless they are found to be structurally unsound. If a heritage building or structure is structurally unsound (following inspection) a more conservative cosmetic damage objective as per DIN 4150 would be applicable.

German Standard DIN 4150 - Part 3: 1999 provides guideline values for vibration velocity to be used with evaluating the effects of short-term vibration on structures, including for sensitive structures such as heritage items. The DIN 4150 values are summarised in **Table 25.**

**Table 25 Structural Damage Guideline – DIN4150**

| Type of Structure | Vibration Velocity in mm/s | | | |
|---|---|---|---|---|
| | Less than 10Hz | 10Hz to 50 Hz | 50Hz to 100Hz | … at horizontal plane of highest floor (all frequencies) |
| Buildings used for commercial purposes, industrial buildings and buildings of similar design | 20 | 20 to 40 | 40 to 50 | 40 |
| Dwellings and buildings of similar design and/or use | 5 | 5 to 15 | 15 to 20 | 15 |
| Structures that because of their particular sensitivity to vibration do not correspond to those above and have intrinsic value (e.g. heritage buildings) | 3 | 3 to 8 | 8 to 10 | 8 |

**Table 25** demonstrates that for sensitive buildings such as heritage structures, the guideline vibration values for effects on structures are typically half of those for dwellings. Therefore, based on the DIN 4150 structural damage guidelines, the minimum working distance for heritage structures that are found to be structurally unsound would be approximately equal to twice the minimum working distance for other building types.

## 4.9 Human Comfort – Assessing Vibration a Technical Guideline

Humans are far more sensitive to vibration than is commonly realised and may detect vibration levels which are well below levels that may cause damage to buildings or structures. Assessing vibration: a technical guideline was published in February of 2006 by the DECC and is based on guidelines contained in BS 6472 – 1992, Evaluation of human exposure to vibration in buildings (1-80 Hz) and provides guidance on assessing vibration against human comfort.

The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended the operator negotiate directly with the affected community.

The guideline defines three vibration types and provides direction for assessing and evaluating the applicable criteria. Table 2.1 of the guideline provides examples of the three vibration types and has been reproduced in **Table 26**.

**Table 26 Examples of types of vibration (from Table 2.1 of the guideline)**

| Continuous Vibration | Impulsive Vibration | Intermittent Vibration |
|---|---|---|
| Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery) | Infrequent: Activities that create up to three distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990). | Trains, intermittent nearby construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer these would be assessed against impulsive vibration criteria. |

### 4.9.1 Continuous Vibration

Appendix C of the guideline outlines acceptable criteria for human exposure to continuous vibration (1-80 Hz), the criteria are dependent on both the time of activity (usually daytime or night-time) and the occupied place being assessed. **Table 27** reproduces the preferred and maximum criteria relating to measured peak velocity.

**Table 27 Criteria for Exposure to Continuous Vibration**

| Place | Time[1] | Peak Velocity (mm/s) | |
|---|---|---|---|
| | | Preferred | Maximum |
| Critical working Areas (e.g. hospital operating theatres, precision laboratories) | Day or Night | 0.14 | 0.28 |
| Residences | Day | 0.28 | 0.56 |
| | Night | 0.20 | 0.40 |
| Offices | Day or Night | 0.56 | 1.1 |
| Workshops | Day or Night | 1.1 | 2.2 |

Note: rms velocity (mm/s) and vibration velocity value (dB re $10^{-9}$ mm/s) values given for most critical frequency >8Hz assuming sinusoidal motion.

Note 1: Daytime is 7am to 10pm and Night-time is 10pm to 7am.

### 4.9.2 Impulsive Vibration

Appendix C of the guideline outlines acceptable criteria for human exposure to impulsive vibration (1-80 Hz), these criteria are dependent on both the time of activity (usually daytime or night-time) and the occupied place being assessed. Impulsive vibration (as defined in Section 2.1 of the guideline) is generally associated with infrequent activities that create up to three (3) distinct vibration events in an assessment period e.g. occasional dropping of heavy equipment, occasional loading and unloading. **Table 28** reproduces the preferred and maximum criteria relating to measured peak velocity.

**Table 28 Criteria for Exposure to Impulsive Vibration**

| Place | Time[1] | Assessment Criteria | |
|---|---|---|---|
| | | Peak Velocity (mm/s) | |
| | | Preferred | Maximum |
| Critical working Areas (e.g. hospital operating theatres, precision laboratories) | Day or Night-time | 0.14 | 0.28 |
| Residences | Daytime | 8.6 | 17.0 |
| | Night-time | 2.8 | 5.6 |
| Offices | Day or Night-time | 18.0 | 36.0 |
| Workshops | Day or Night-time | 18.0 | 36.0 |

Note 1: Daytime is 7am to 10pm and Night-time is 10pm to 7am.

### 4.9.3 Intermittent Vibration

Intermittent vibration (as defined in Section 2.1 of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time.

Intermittent vibration is representative of activities such as impact hammering, rolling or general excavation work (such as an excavator tracking).

Section 2.4 of the Guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted RMS (root mean square) acceleration levels over the frequency range 1-80 Hz. To calculate VDV the following formula (refer section 2.4.1 of the guideline) was used:

$$VDV = \left[ \int_0^T a^4(t)dt \right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, a (t) is the frequency-weighted RMS of acceleration in $m/s^2$ and T is the total period of the day (in seconds) during which vibration may occur.

The Acceptable Vibration Dose Values (VDV) for Intermittent Vibration is reproduced in **Table 29**.

**Table 29 Acceptable Vibration Dose Values (VDV) for Intermittent Vibration**

| Location | Daytime | | Night-time | |
|---|---|---|---|---|
| | Preferred Value $m/s^{1.75}$ | Maximum Value $m/s^{1.75}$ | Preferred Value $m/s^{1.75}$ | Maximum Value $m/s^{1.75}$ |
| Critical Areas | 0.10 | 0.20 | 0.10 | 0.20 |
| Residences | 0.20 | 0.40 | 0.13 | 0.26 |
| Offices, Schools, Educational Institutions, and Places of Worship | 0.40 | 0.80 | 0.40 | 0.80 |
| Workshops | 0.80 | 1.60 | 0.80 | 1.60 |

Note: Daytime is 7am to 10pm and Night-time is 10pm to 7am.

Note: These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The guideline states that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

## 4.10 Vibration Assessment

For road construction projects, items of plant with the greatest potential for vibration typically include hydraulic hammers and vibratory rollers. It is understood that pneumatic hammers (jackhammers) would be used for the demolition of existing concrete structures and vibratory rollers would be used along the alignment prior to road resurfacing. Peak levels of vibration from rolling typically occurs as the roller stops to change direction and a resonance is created as the roller (and vibrator) is stationary.

**Table 30** provides the minimum working distances for the use of various vibration intensive sources to nearby receivers to meet cosmetic damage and human response criteria. It is important to note that the minimum working distances are indicative and will vary depending on the particular item of plant and local geotechnical conditions.

**Table 30 Minimum Working Distances or Vibratory Plant (m)**

| Plant item | Rating / Description | Minimum working distance | | |
|---|---|---|---|---|
| | | Cosmetic damage (BS 7385) | Heritage Item (DIN 4150) | Human response (OH&E) |
| Vibratory Roller | < 50 kN (Typically 1-2 tonnes) | 5m | 10m | 15m to 20m |
| | < 100 kN (Typically 2-4 tonnes) | 6m | 12m | 20m |
| | < 200 kN (Typically 4-6 tonnes) | 12m | 24m | 40m |
| | < 300 kN (Typically 7-13 tonnes) | 15m | 30m | 100m |
| | > 300 kN (Typically 13-18 tonnes) | 20m | 40m | 100m |
| | > 300 kN (> 18 tonnes) | 25m | 50m | 100m |
| Small Hydraulic Hammer | (300kg - 5 to 12t excavator) | 2m | 4m | 7m |
| Medium Hydraulic Hammer | (900kg - 12 to 18t excavator) | 7m | 14m | 23m |
| Large Hydraulic Hammer | (1600kg - 18 to 34t excavator) | 22m | 44m | 73m |
| Vibratory Pile Driver | Sheet piles | 2m to 20m | up to 40m | 20m |
| Pile Boring | ≤800mm | 2m (nominal) | 4m | 4m |
| Jackhammer | Handheld | 1m (nominal) | 2m | 2m |

Note: Source, CNVG (Roads and Maritime, 2016).

Precise details on the equipment to be used to construct the proposal has not been determined at the concept design stage. Hence, assessment of potential vibration impacts is based on the worst-case scenario, which is a large vibratory roller (>18t). Based on the minimum working distances presented in **Table 30**, receivers within approximately 25m of the proposal site may experience vibration levels above the cosmetic damage criterion, and receivers within approximately 100m of the proposal site may experience vibration levels above the human comfort criterion, during the use of the vibratory roller.

A review of aerial photography identifies that the nearest receiver to the proposal site is the commercial complex at 10 Pioneer Drive, immediately adjacent to the proposal site, while the nearest residential receiver (30 Conway Crescent), is located approximately 35m from the proposal site. The potential vibration affected areas are presented in **Figure 8**.

Following final selection of plant, where works are undertaken within the potential vibration affected areas, dilapidation surveys should be considered for potentially affected receivers, and the additional mitigation measures in **Table 31** should be implemented where feasible and reasonable. **Appendix E** provides a definition of each additional mitigation measure listed below.

**Table 31 Triggers for Additional Mitigation Measures - Vibration**

| Construction Period | Additional Mitigation Measures | |
|---|---|---|
| | Type | Apply to |
| Standard Hours | V, N, RP | All affected receivers |
| OOH1 | V, IB, N, RO, PC, RP, SN | |
| OOH2 | AA, V, IB, N, PC, RP, SN | |

Notes: AA = Alternative accommodation, V = Validation of predicted levels, PC = Phone calls, IB = Individual briefings, SN = Specific notifications, N = Notification, RO = Project respite offer.

A review of the Shoalhaven Local Environment Plan 2014 (LEP) indicates that there are no heritage items near to the proposal site.


FIGURE 8

Affected Area - Vibration

MAC232030-01

New Lake Entrance Road

KEY

Proposal Site

Affected Areas - Vibration

Cosmetic Damage

Human Comfort

0 30 60 90 120 m

N

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## 4.11 Construction Noise and Vibration Monitoring and Management

Where additional mitigation measures require the spot check verification of noise levels, attended measurements are to be undertaken within a period of 14 days from the commencement of construction activities. The purpose of these measurements is to confirm that:

- noise and vibration levels from construction in the adjacent community are consistent with the predictions in the noise assessment, approval and/or licence conditions; and
- mitigation is appropriate for the range of background noise levels at receivers affected by the works. Where the background noise levels differ from those assumed in the noise assessment then refinement of mitigation measures may be required, and the CEMP amended.

The attended measurements must be undertaken at:

- the potentially most exposed receivers; and
- locations further from the works and existing noise sources which may have lower background noise levels.

Where measured noise levels are found to exceed the predicted worst-case, the source of excessive noise generations will be identified, and any additional feasible and reasonable measures available will be implemented to either reduce noise emissions or reduce the impacts on receivers. At a minimum, the noise mitigation measures detailed in Table 21 and AMMs identified in Section 4.6.2 will be applied.

Noise measurements shall be undertaken consistent with the procedures documented in AS1055.1-2018 Acoustics – Description and Measurement of Environmental Noise – General Procedures. Vibration measurements shall be undertaken in accordance with the procedures documented in the OEH's Assessing Vibration – a technical guideline (2006) and BS7385 Part 2-1993 Evaluation and measurement for vibration in buildings.

For projects with a duration of less than three months, or where OOHs works are required, the attended measurements must be undertaken at the time intervals described in the assessment, out of hours assessment, approval and/or licence conditions.

When required, the operator shall quantify and characterise the maximum ($L_{Amax}$) and the energy equivalent ($L_{Aeq}$) intrusive noise level from construction over a 15-minute measurement period. In addition, the operator shall quantify and characterise the overall levels of ambient noise over the 15-minute measurement interval. It is recommended that instrumentation used during the monitoring is to be equivalent to a Type 1 meter with 1/3 octave band analysis and have audio recording functionality for post processing source identification. It is noted that 1/3 octave band analysis is required to establish whether modification factors in accordance with the NPI are to be applied.

All acoustic instrumentation used as part of the attended monitoring program must been designed to comply with the requirements of AS IEC 61672.1-2019, Electroacoustics – Sound level meters - Specifications and shall have current calibration certificates. All instrumentation shall be programmed to record statistical noise level indices in 15-minute intervals including $L_{Amax}$, $L_{Amin}$ and $L_{Aeq}$.

Instrument calibration shall be checked before and after each measurement survey, with the variation in calibrated levels not exceeding ±0.5 dBA. The measurement position(s) should be selected considering:

- weather conditions such as rain and wind, insect noise;
- the location and direction of any noise source/s;
- the most sensitive position at the affected receiver; and
- the need to avoid reflecting surfaces (where possible).

Where vibration intensive activities are required, vibration monitoring will be carried out within the established buffer distances, or where there is considered to be a risk that levels may exceed the relevant structural damage goals. Where vibration is found to exceed the safe levels, impacts will be avoided by changing the work method and/or equipment. In the event that a complaint relating to property damage is received, an inspection of the property would be undertaken, and an interim building condition survey prepared.

Attended vibration monitoring will be undertaken when checking the safe working distances from construction plant or in response to a complaint. The testing method includes:

- transducer to be affixed to ground or building in general accordance with AS 2775- 2004;
- monitoring to be conducted for at least three distances from the plant, where possible, including a representative distance for the nearest sensitive structures and/or receivers; and
- the testing will be conducted at each location to obtain a suitable representation of the range of vibration levels that would occur from the tested plant.

Peak (PPV) vibration levels and the dominant frequency of the vibration will be recorded for assessment against the structural and cosmetic damage criteria. In situations in which human comfort is also of concern then the rms vibration level should also be recorded

Longer-term unattended noise and/or vibration monitoring may be conducted throughout the construction period in situations where noise and/or vibration levels are predicted to exceed the NMLs for the majority of works or for extended periods of time, or where vibration intensive works would occur within safe working distances and there is a reasonable risk of exceeding the vibration criteria. These monitors would have the capability to send automated alerts or include audible or visual alarms, which would inform the need for further noise and/or vibration management.

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# 5 Assessment of Road Traffic Noise Impacts

## 5.1 Operational Road Traffic Noise Criteria

In accordance with Section 4.5 of the Road Noise Criteria Guideline (RNCG) (Roads and Maritime, 2022), the proposal is classified as minor work. Section 4.5 of the NCG is reproduced below:

> *Some works may be primarily to improve safety. This may include minor straightening of curves, installing traffic control devices, intersection widening and turning bay extensions or making minor road realignments. These works are not considered redeveloped or new as they are not intended to increase the traffic carrying capacity of the overall road or accommodate a significant increase in heavy vehicle traffic.*

Section 5.6 of the RNCG outlines that the existing road criteria applies where the minor work increases noise levels by more than 2dBA relative to the existing noise levels at the worst affected receiver.

## 5.2 Existing Traffic Flows

Existing traffic flows for New Lake Entrance Road were measured using automatic tube counters from Friday 8 March 2024 to Sunday 17 March 2024, while existing daily traffic volumes for Pioneer Drive were sourced from the Shell Harbour Council Traffic Committee Meeting Business Paper from 3 May 2023. It is noted that daily traffic volumes for Pioneer Drive were not provided as classified hourly traffic counts. Hence, the day period and night period traffic volumes, as well as heavy vehicle percentage, were determined by applying the percentage splits recorded form the traffic counts on New Lake Entrance Road. A summary of the traffic data used for this assessment are presented in **Table 32.**

**Table 32 Existing Traffic Flows**

| Road | Total Traffic Volume | Day (07:00 to 22:00) | | | Night (22:00 to 07:00) | | |
|---|---|---|---|---|---|---|---|
| | | Volume Total Vehicles | % Heavy Vehicles | Speed Limit | Volume Total Vehicles | % Heavy Vehicles | Speed Limit |
| New Lake Entrance Road | 37,852 | 34,549 | 1 | 60 | 3,303 | 2 | 60 |
| Pioneer Drive | 12,356 | 11,278 | 1 | 50 | 1,078 | 2 | 50 |

## 5.3 Operational Noise Assessment

The operational road traffic assessment has been completed utilising Predictor (v11.10) noise modelling software, incorporating the Calculation of Road Traffic Noise (CoRTN) algorithm. The calculation method, developed by the United Kingdom Department of Environment, is widely accepted in Australia and is the preferred method for assessing operational road traffic emissions by the NSW Environmental Protection Agency (EPA) and Transport for NSW.

The modeled noise levels were calibrated using the results of the unattended noise monitoring undertaken at logger location L1 adjacent to New Lake Entrance Road from Friday 8 March 2024 to Tuesday 19 March 2024. **Table 33** summarises the results of the calibration model, outlining the traffic noise levels for existing conditions compared to the measured traffic noise levels at monitoring location. Noise calculations demonstrate a consistency of ±<2dB tolerance when compared against measured levels and are therefore within industry accepted tolerances.

**Table 33 Road Traffic Noise Model Calibration**

| Location | dB $LA_{eq(15hr)}$ Daytime Noise Level | | | dB $LA_{eq(9hr)}$ Night-time Noise Level | | |
|---|---|---|---|---|---|---|
| | Measured Level | Predicted Level | Variance dB | Measured Level | Predicted Level | Variance dB |
| New Lake Entrance Road | 70.4 | 72.1 | 1.7 | 65.7 | 64.8 | -0.9 |

### 5.3.1 Comparison of Existing and Future Road Traffic Noise Levels

In accordance with the Noise and Vibration Assessment Procedure (for road traffic and construction) (TfNSW, 2023), an assessment of road traffic noise has been carried out for the existing and future road alignment.

The primary aim of the proposal is to relieve congestion and improve traffic flows through the provision of a new left turn lane on New Lake Entrance Road. It is understood that the proposal would not result in a change to daily traffic volumes or a significant increase in average vehicle speeds, which are the primary determinants for road traffic noise.

Road noise levels were modelled to the nearest residential receivers adjacent to New Lake Entrance Road and Pioneer Drive, identified as 30 Conway Crescent (east of proposal site) and 2 Lake Entrance Road (northwest of proposal site). Additionally, road noise levels were modelled to the commercial centre and childcare centre at 10 Pioneer Drive (west of proposal site).

A review of modelled noise levels for the existing and proposed road alignments identified that change in day period (7am to 10pm) and night period (10pm to 7am) road traffic noise levels would be negligible (<0.2dB $LA_{eq(period)}$) for residential and commercial receivers, including the childcare centre at 10 Pioneer Drive, where average vehicle speeds do not significantly change as a result of the proposal.

A second modelling scenario was assessed, assuming an increase in average vehicle speeds of approximately 25%. The results of the analysis indicated that where vehicle speeds do increase as a result of the proposal, road traffic noise levels are anticipated to increase by up to 0.8dB $LA_{eq(period)}$ for nearby residential receivers, and up to 1dB $LA_{eq(period)}$ for commercial receivers.

The noise level changes are therefore within the 2dBA increase criteria and ameliorative measures are not required.

### 5.3.2 Maximum Noise Level Assessment

Under Section 2.1.5 of the Noise and Vibration Assessment Procedure (for road traffic and construction) (TfNSW, 2023) and Practice Note iii of the Environmental Noise Management Manual (ENMM) (Roads and Traffic Authority, 2001) a maximum noise level assessment should be undertaken where noise impacts (potential sleep disturbance) from road traffic noise at night are expected to occur.

A review of unattended monitoring data, representative of the nearest residential receivers adjacent to New Lake Entrance Road (logger location L2), indicates that the $LA_{eq(1hr)}$ noise levels for the night period, with a +2.5dB correction for façade reflection (58dBA) were below the maximum noise level assessment criterion of 65dB $LA_{max}$. Given that existing maximum noise level events are typically below the maximum noise level assessment criterion, and that the proposal would result in a minor lane adjustment with a lateral shift away from the nearest residential receivers, the proposal is unlikely to negatively affect the nature of maximum noise level events.

### 5.3.3 Operational Noise Attenuation Measures

As demonstrated in **Section 5.3.1**, changes in road traffic noise levels are not predicted to increase by more than the 2dBA increase criteria. It is therefore considered that operational noise attenuation measures are not required for receivers near to the proposal site, and an *Operational Noise Attenuation Measures Report* is not applicable.

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# 6 Discussion and Conclusion

An Operational and Construction Noise and Vibration Assessment has been prepared in accordance with Transport for NSW requirements to quantify potential noise and vibration impacts from the construction of a new left turn lane from New Lake Entrance Road, Oak Flats, NSW.

The construction noise assessment demonstrates that noise from the construction works are anticipated to exceed the Noise Management Levels at residential receivers adjacent to the proposal site during each of the construction activities during standard and Out of Hours work periods. Furthermore, construction noise levels are anticipated to exceed the relevant Noise Management Levels for the Little Peoples Early Learning Centre (childcare centre) and commercial receivers at 10 Pioneer Drive, Oak Flats during site establishment, corridor clearing, utility adjustment, road widening, installation of drainage structures (childcare centre only) and pavement works. During site establishment, construction noise levels are also anticipated to exceed the Noise Management Level for commercial receivers at the Lake Illawarra Police Station at 6 Pioneer Drive, Oak Flats.

During corridor clearing works, considered to be the construction activity with the greatest potential for noise impacts during standard construction hours, up to 30 residential receivers, within approximately 120m of the proposal site are predicted to experience noise levels above the standard hours Noise Management Level. Furthermore, construction noise levels are predicted to exceed the Noise Management Level for childcare centres at the Little Peoples Early Learning Centre, and the Noise Management Level for commercial receivers, including highly affected Noise Management Level of 75dB $LA_{eq(15min)}$, at the commercial complex at 10 Pioneer Drive, Oak Flats during corridor clearing works.

During paving works, considered to be the construction activity with the greatest potential for noise impacts during Out of Hour work periods, up to 35 residential receivers within approximately 160m of the proposal site are predicted to experience noise levels above the OOH Period 1 (Day) NML, while up to 50 residential receivers within approximately 280m of the proposal site are predicted to experience noise levels above the OOH Period 1 (Evening) NML. During OOH Period 2 (Night), up to 245 residential receivers, within approximately 490m of the proposal site, are predicted to experience construction noise levels above the OOH Period 2 NML.

Following implementation of standard mitigation measures, it is predicted that no residential receivers would experience noise levels above the trigger levels for the implementation of AMMs during standard hours or OOH Period 1. During OOH Period 2, it is predicted that up to 40 residential receivers would experience noise levels above the 'noticeable' AMM trigger level, and up to 8 residential receivers would experience noise levels above the 'clearly audible' AMM trigger level during paving works.

Predictive noise modelling identifies that the maximum noise trigger level for sleep disturbance has the potential to be exceeded at up to 23 residential receivers within 200m of the proposal site during pavement works, and up to two residential receivers within approximately 65m of the compound site. Hence, it is recommended that the proposal proactively manages night-time noise emissions to minimise the occurrence of sleep disturbance impacts on nearby residential receivers.

An analysis of construction road traffic noise levels demonstrated that due to high existing road traffic noise levels on the local road network, noise emissions from construction vehicles would not result in an increase in road traffic noise levels at the nearest residential receivers.

A review of safe working distances for vibration intensive plant indicates that construction vibration levels would potentially exceed the criteria for cosmetic damage to buildings and human comfort for receivers 25m and 100m from the proposal site respectively. Hence, additional mitigation measures should be implemented for highly vibration intensive activities in close proximity to residential receivers.

The results of the operational road traffic noise assessment demonstrates that the sensitive receivers adjacent to New Lake Entrance Road are anticipated to experience a negligible increase in road traffic noise levels during the day period and night period. Where the proposal achieves a significant increase in average vehicle speeds (assumed to be up to 25%), through reducing congestion, nearby sensitive receivers are anticipated to experience an increase in road traffic noise levels of up to 1dB $LA_{eq(period)}$. The changes in noise levels are therefore demonstrated to remain below 2dBA, which is be the level above which the increase in noise levels would be discernible. Hence, it is considered that there would be no additional impact from road traffic noise resulting from the development.

# Appendix A – Glossary of Terms

A number of technical terms have been used in this report and are explained in **Table A1**.

**Table A1 Glossary of Acoustical Terms**

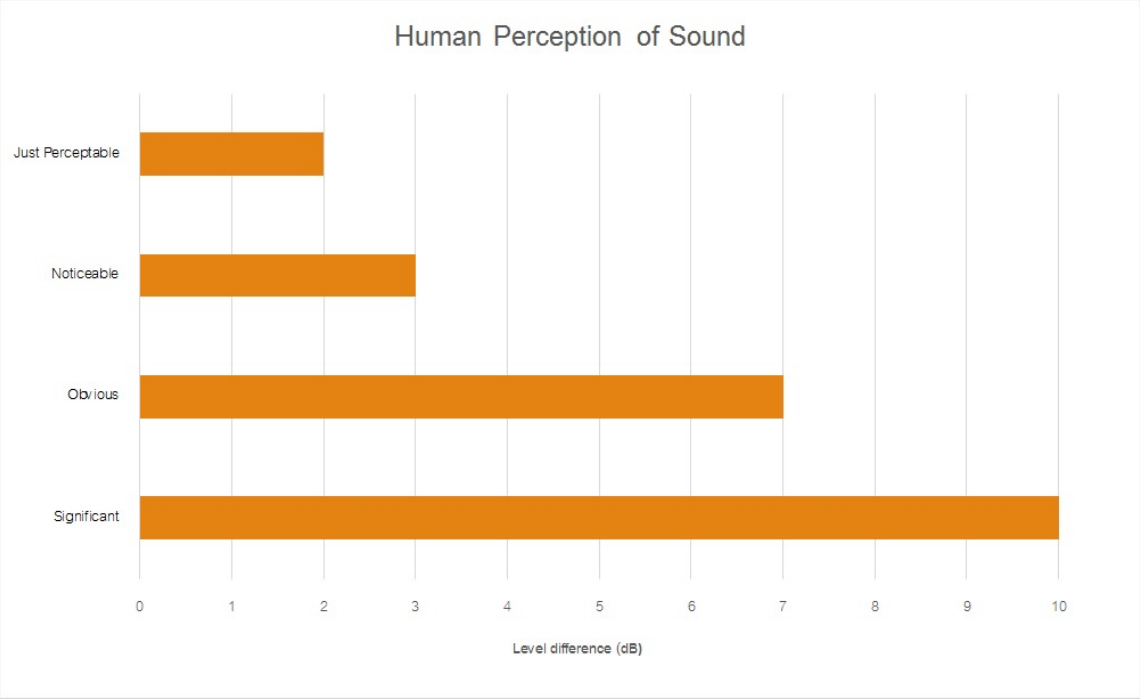
| Term | Description |
|---|---|
| 1/3 Octave | Single octave bands divided into three parts |
| Octave | A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit. |
| ABL | Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels. |
| Ambient Noise | The total noise associated with a given environment. Typically, a composite of sounds from all sources located both near and far where no particular sound is dominant. |
| A Weighting | A standard weighting of the audible frequencies designed to reflect the response of the human ear to sound. |
| Background Noise | The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is usually represented by the LA90 descriptor |
| dBA | Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear. |
| dB(Z), dB(L) | Decibels Z-weighted or decibels Linear (unweighted). |
| Extraneous Noise | Sound resulting from activities that are not typical of the area. |
| Hertz (Hz) | The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz. |
| LA10 | A sound level which is exceeded 10% of the time. |
| LA90 | Commonly referred to as the background noise, this is the level exceeded 90% of the time. |
| LAeq | Represents the average noise energy or equivalent sound pressure level over a given period. |
| LAmax | The maximum sound pressure level received at the microphone during a measuring interval. |
| Masking | The phenomenon of one sound interfering with the perception of another sound.<br>For example, the interference of traffic noise with use of a public telephone on a busy street. |
| RBL | The Rating Background Level (RBL) as defined in the NPI, is an overall single figure representing the background level for each assessment period over the whole monitoring period. The RBL, as defined is the median of ABL values over the whole monitoring period. |
| Sound Power Level (Lw or SWL) | This is a measure of the total power radiated by a source in the form of sound and is given by 10.log10 (W/Wo). Where W is the sound power in watts to the reference level of $10^{-12}$ watts. |
| Sound pressure level (Lp or SPL) | the level of sound pressure; as measured at a distance by a standard sound level meter. This differs from Lw in that it is the sound level at a receiver position as opposed to the sound 'intensity' of the source. |

**Table A2** provides a list of common noise sources and their typical sound level.

**Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA**

| Source | Typical Sound Pressure Level |
|---|---|
| Threshold of pain | 140 |
| Jet engine | 130 |
| Hydraulic hammer | 120 |
| Chainsaw | 110 |
| Industrial workshop | 100 |
| Lawn-mower (operator position) | 90 |
| Heavy traffic (footpath) | 80 |
| Elevated speech | 70 |
| Typical conversation | 60 |
| Ambient suburban environment | 40 |
| Ambient rural environment | 30 |
| Bedroom (night with windows closed) | 20 |
| Threshold of hearing | 0 |

**Figure A1** – Human Perception of Sound



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# Appendix B – Concept Design


Industrial Road
Moore Street
Pioneer Drive
Maintain access to rail corridor gate during construction
Maintain access to parking area and police station during construction
Princes Highway
Ancillary facility
Lot boundary
Railway
N
0
10
20
40
Metres


Pioneer Drive
New Lake Entrance Road
Proposal footprint
Aproximate clearing/earthworks area
Slip lane
Amenities, parking and plant access area
Lot boundary
Railway
N
0
10
20
40
Metres

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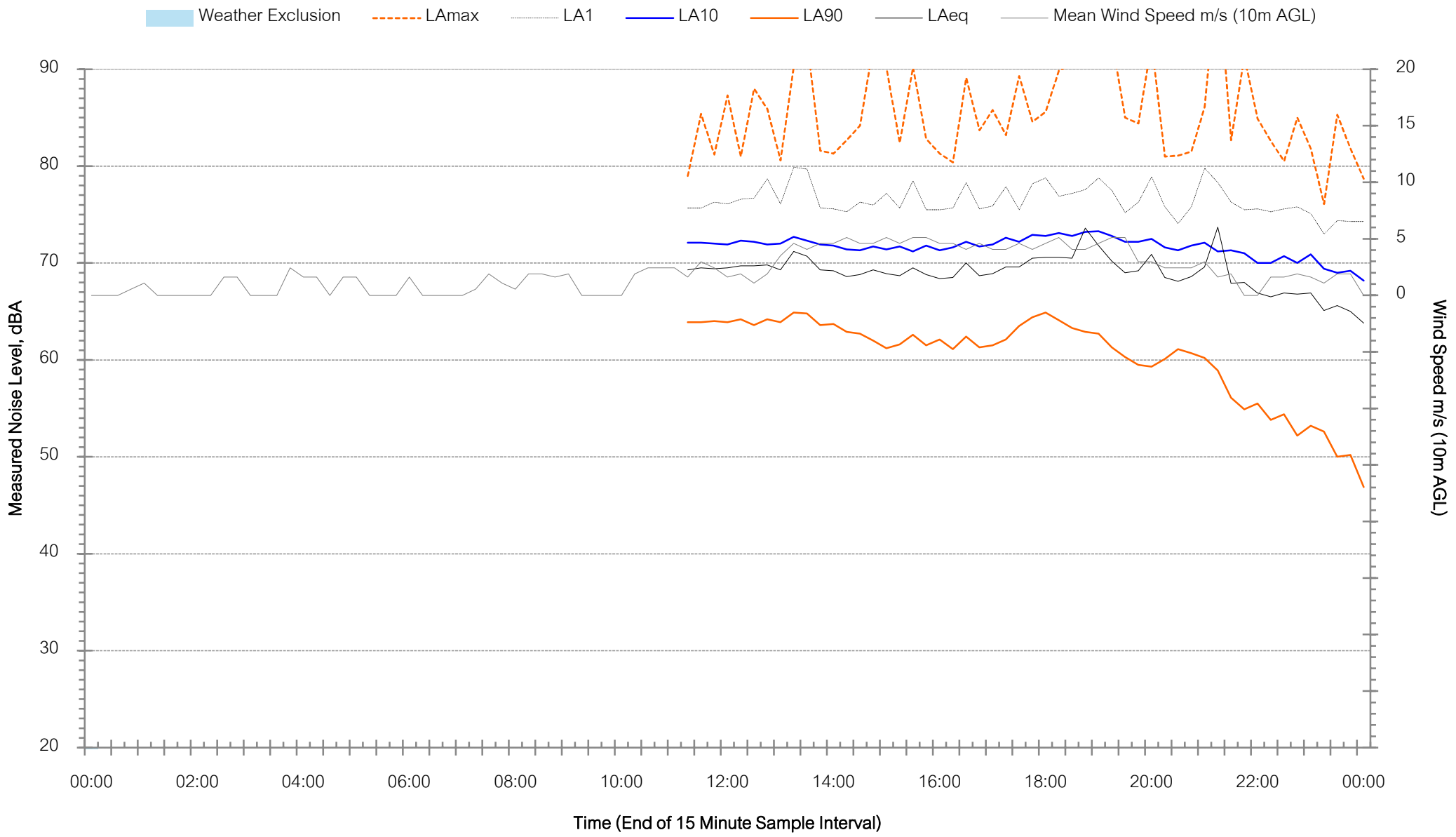
# Appendix C – Background Monitoring Charts

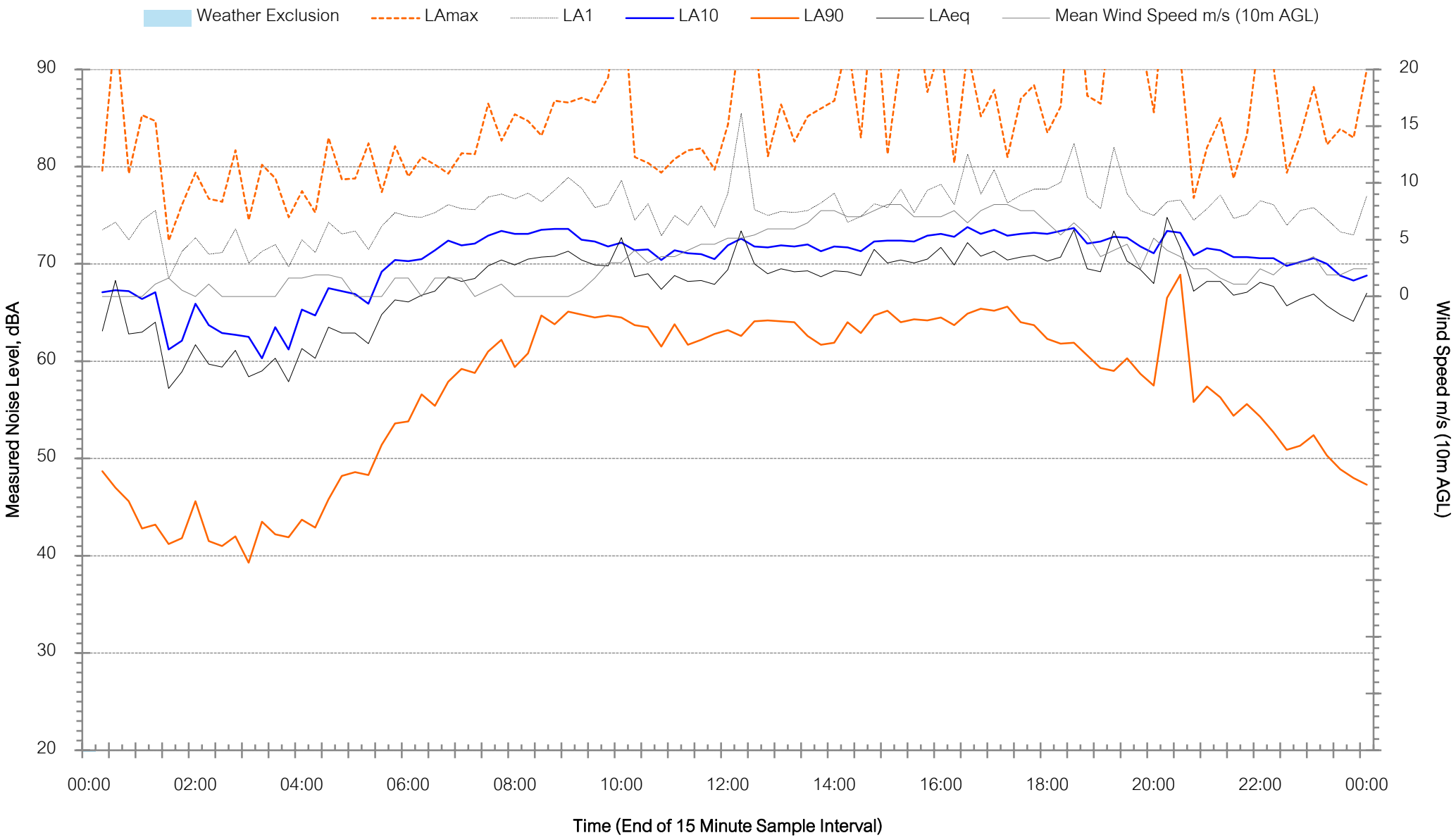
# Background Noise Levels

## New Lake Entrance Road, Oak Flats - Friday 8 March 2024



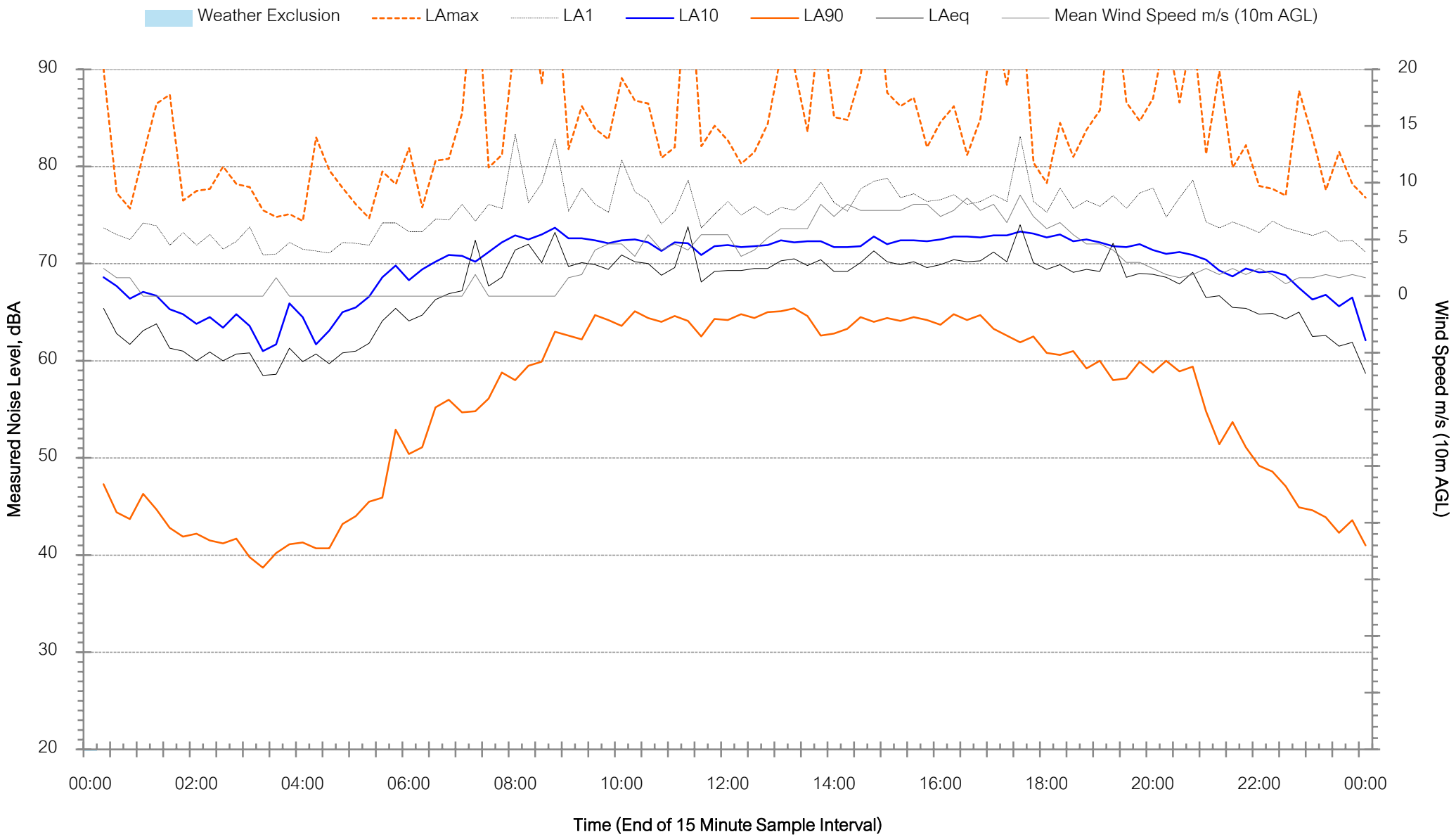
# Background Noise Levels

## New Lake Entrance Road, Oak Flats - Saturday 9 March 2024



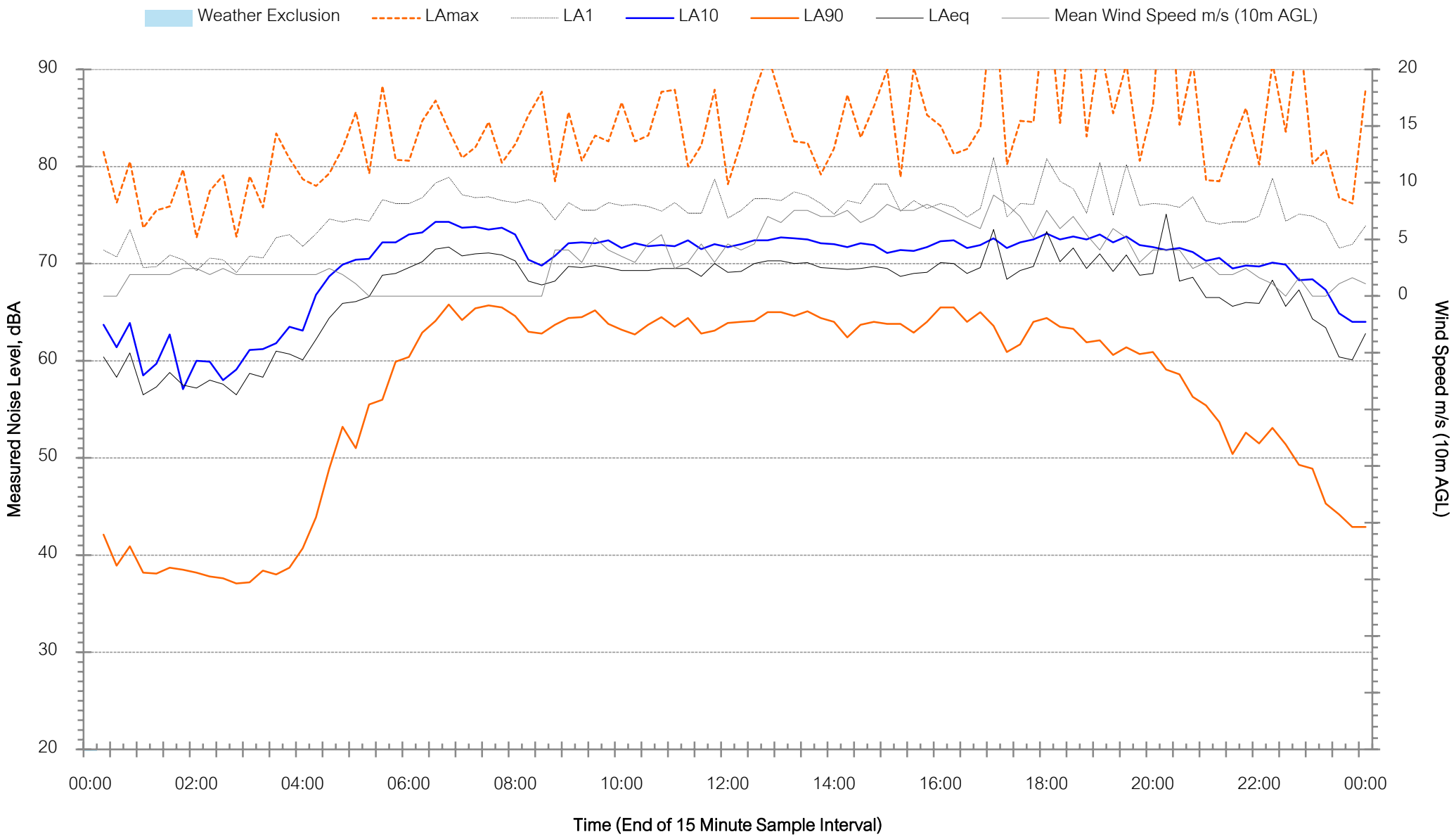
# Background Noise Levels

## New Lake Entrance Road, Oak Flats - Sunday 10 March 2024



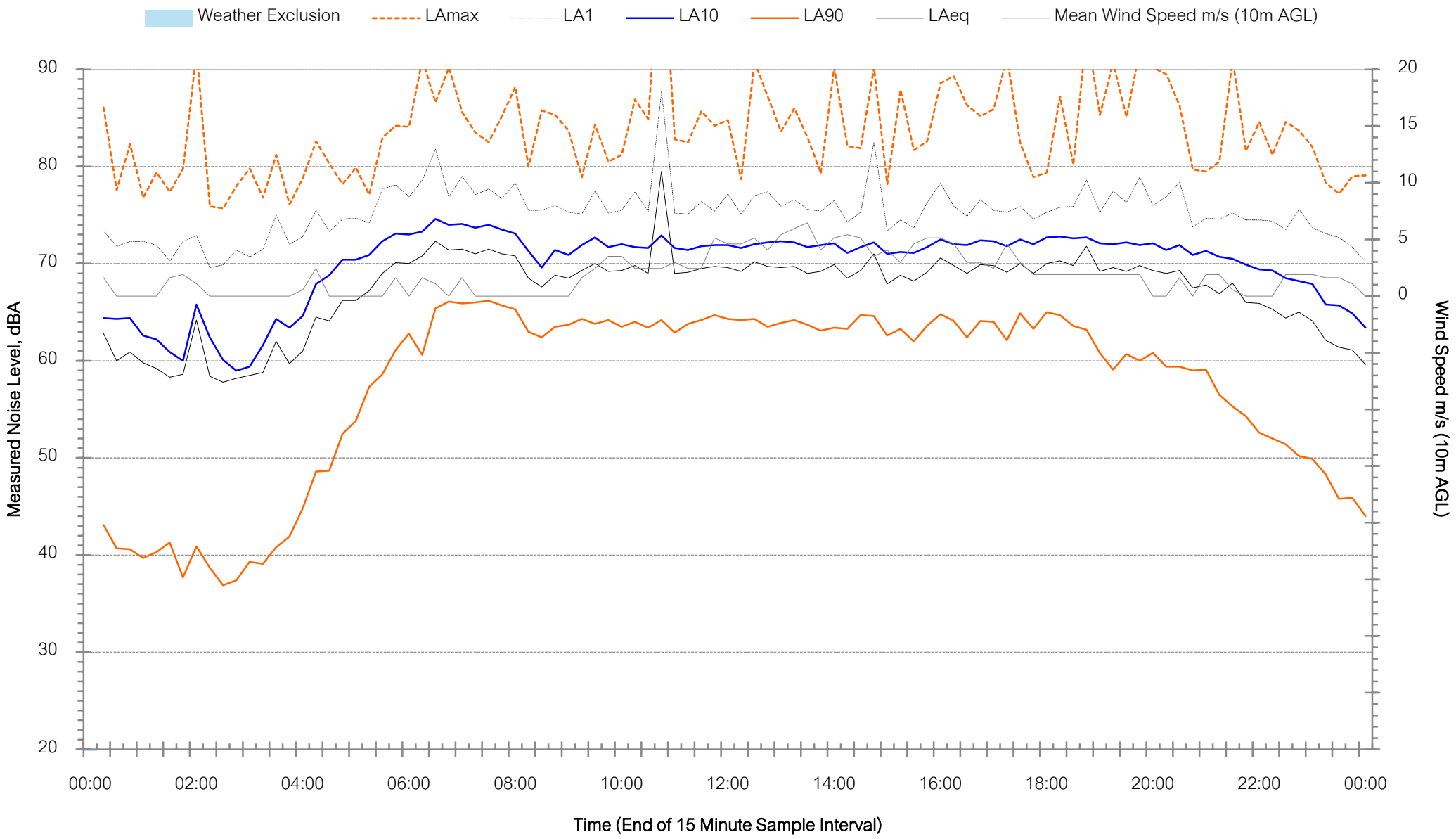
# Background Noise Levels

## New Lake Entrance Road, Oak Flats - Monday 11 March 2024



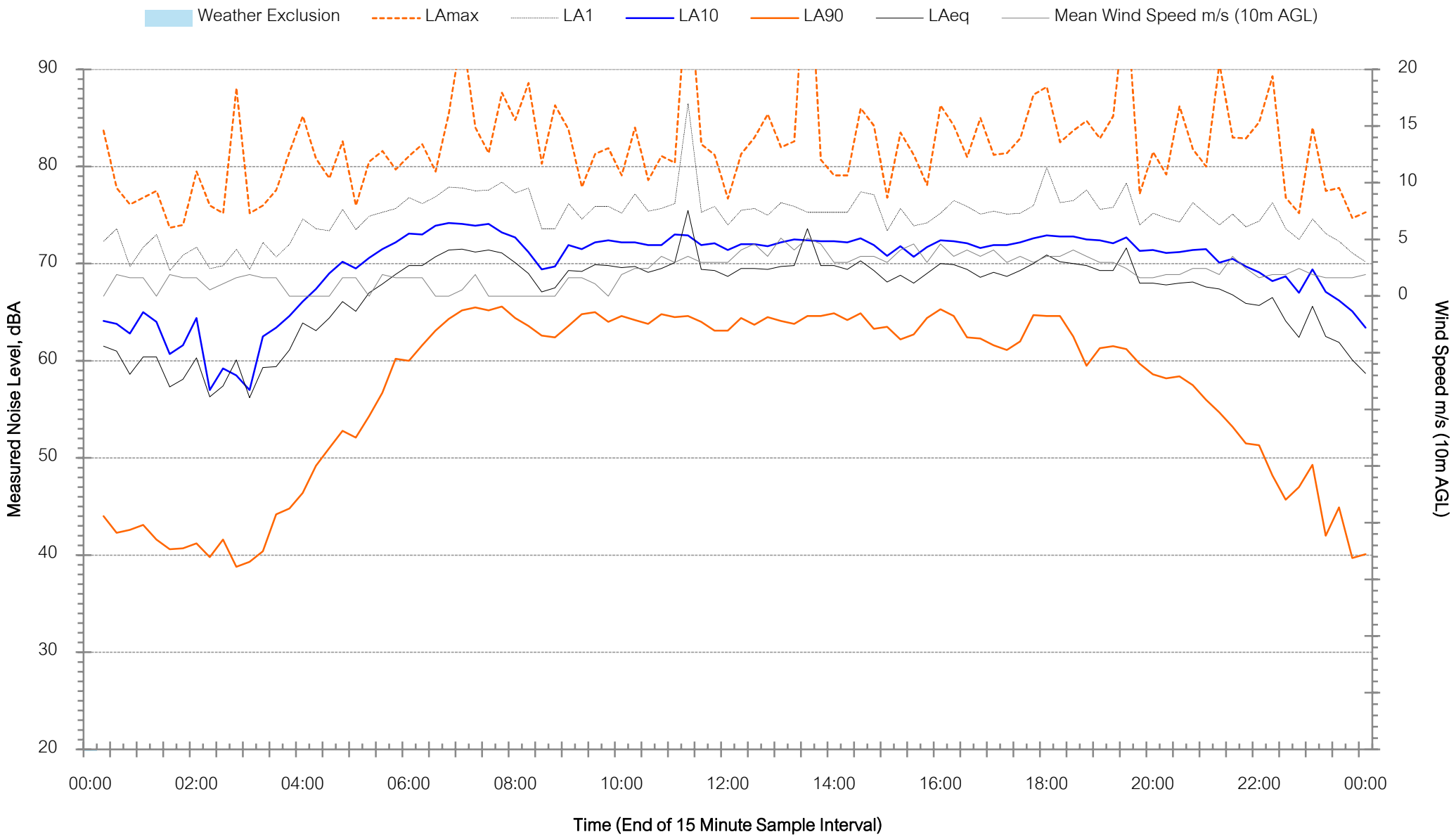
# Background Noise Levels

## New Lake Entrance Road, Oak Flats - Tuesday 12 March 2024



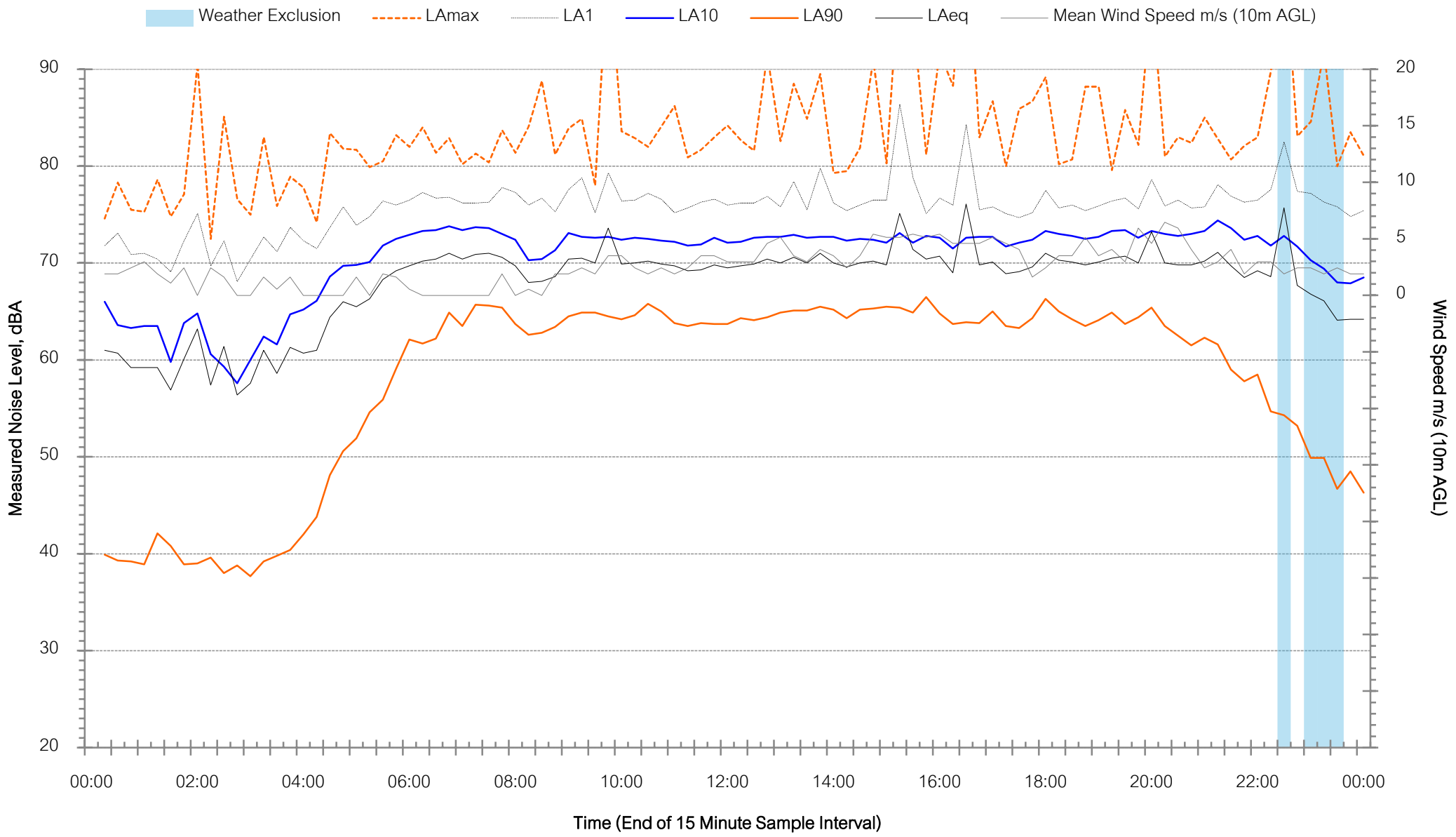
# Background Noise Levels

## New Lake Entrance Road, Oak Flats - Wednesday 13 March 2024



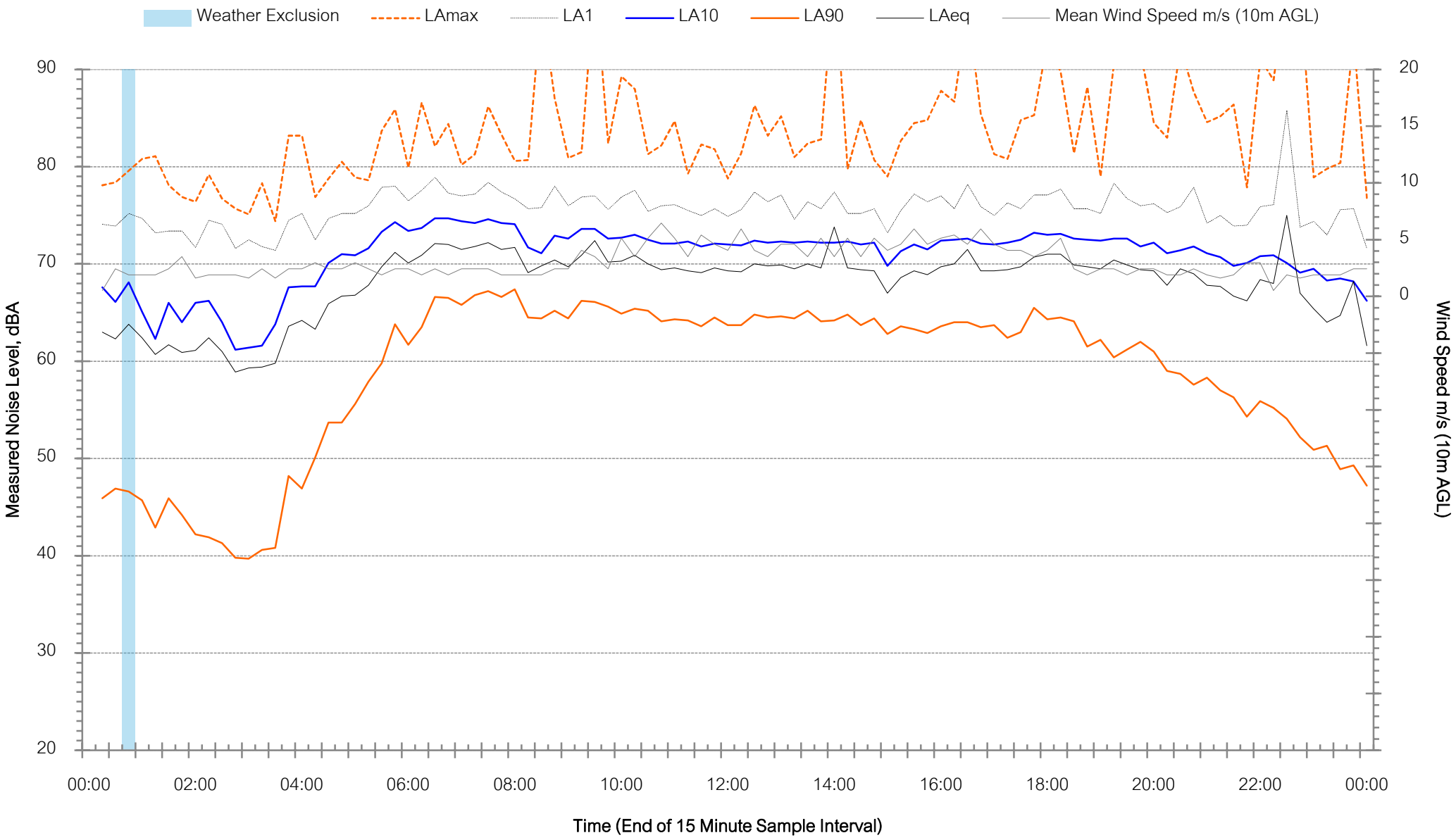
# Background Noise Levels

## New Lake Entrance Road, Oak Flats - Thursday 14 March 2024



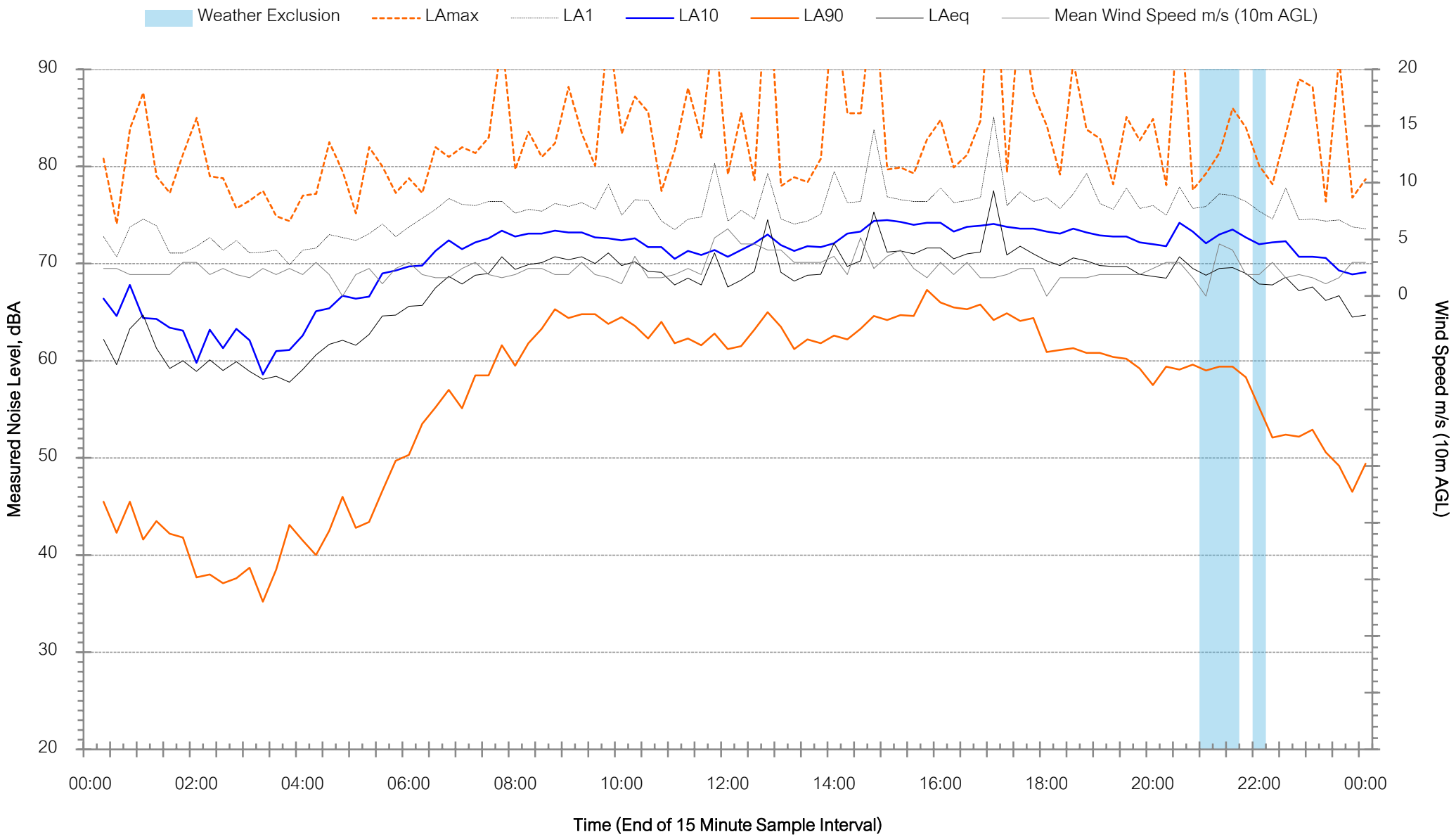
# Background Noise Levels

## New Lake Entrance Road, Oak Flats - Friday 15 March 2024



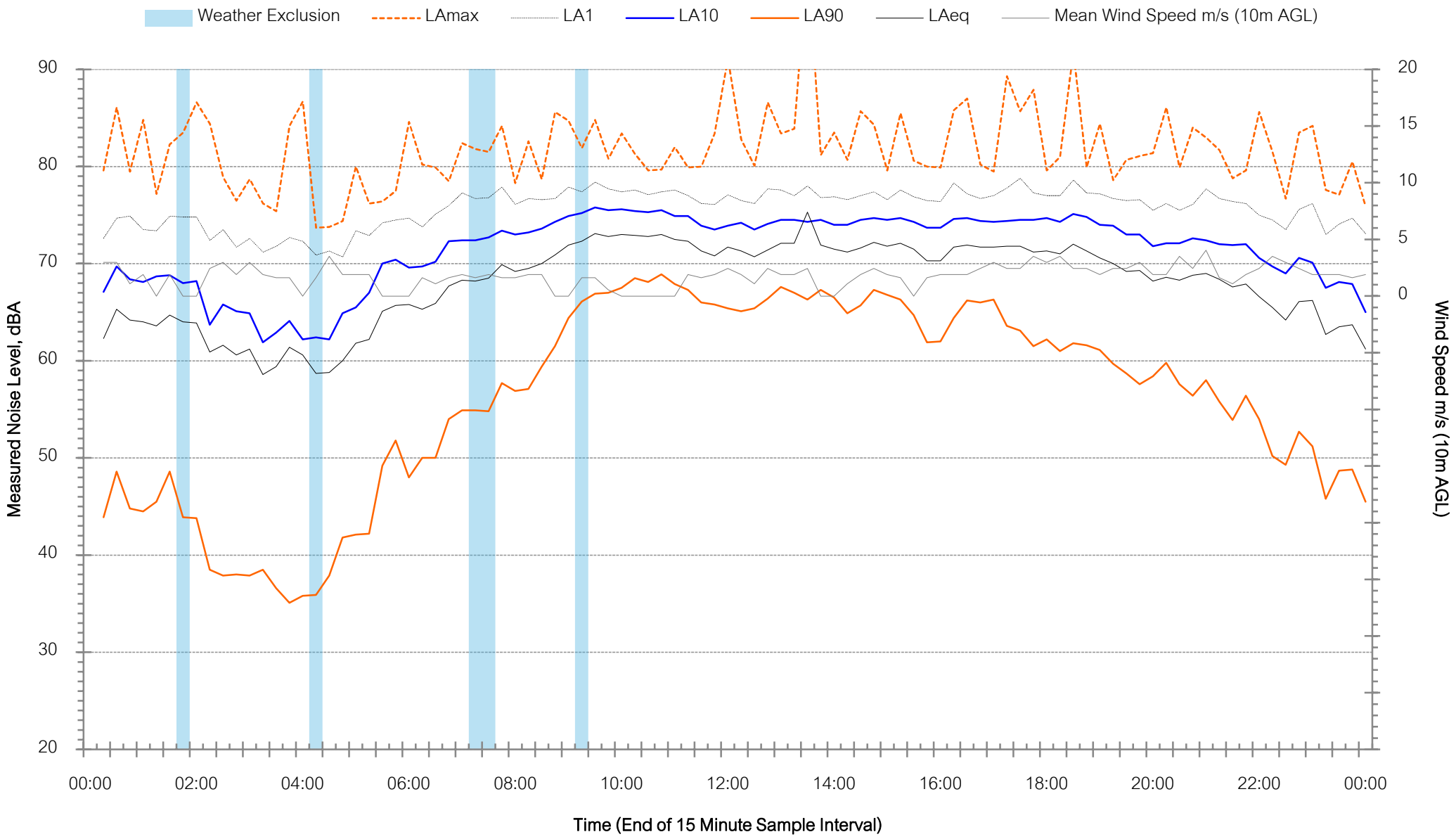
# Background Noise Levels

## New Lake Entrance Road, Oak Flats - Saturday 16 March 2024



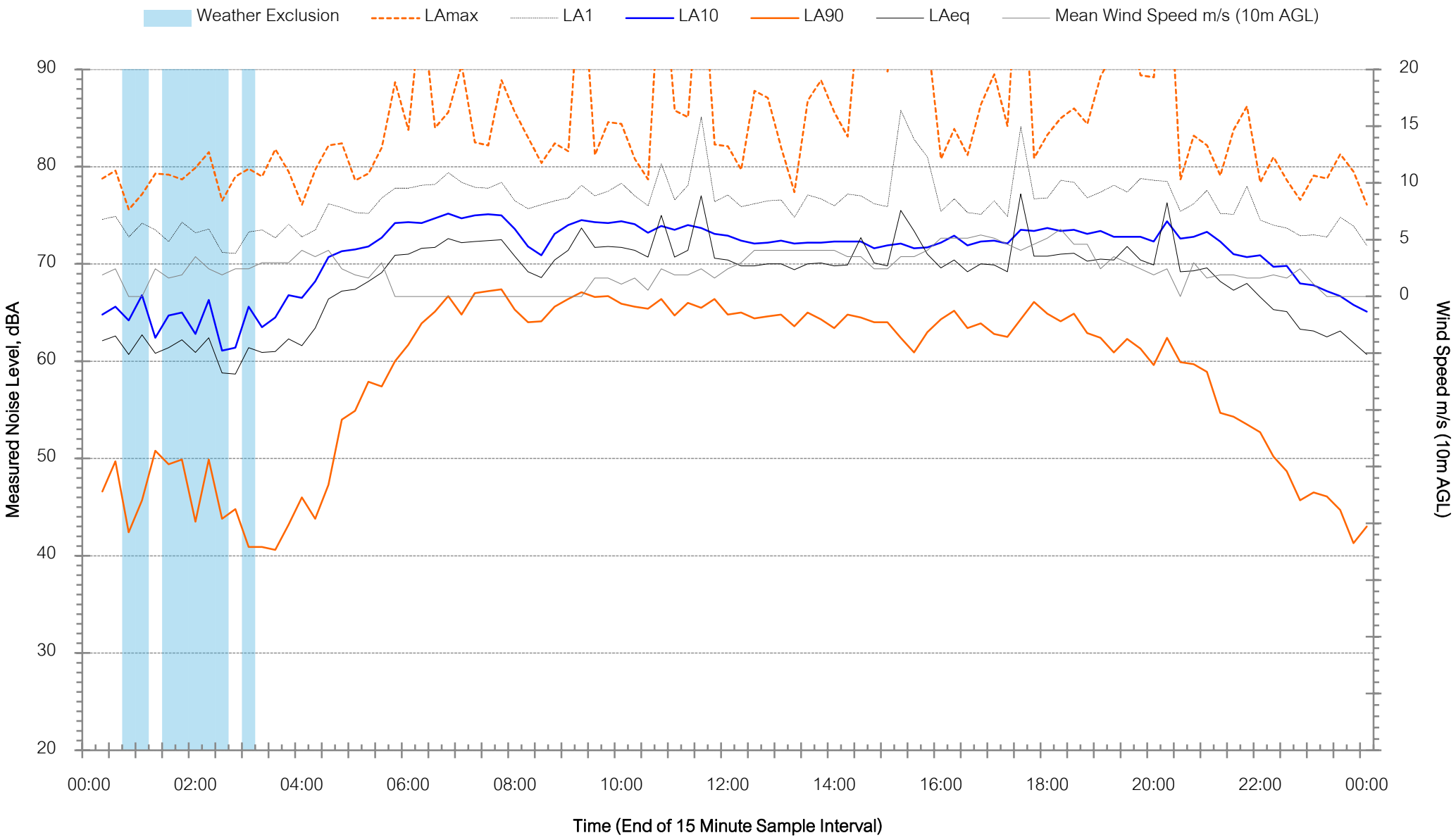
# Background Noise Levels

## New Lake Entrance Road, Oak Flats - Sunday 17 March 2024



# Background Noise Levels

## New Lake Entrance Road, Oak Flats - Monday 18 March 2024

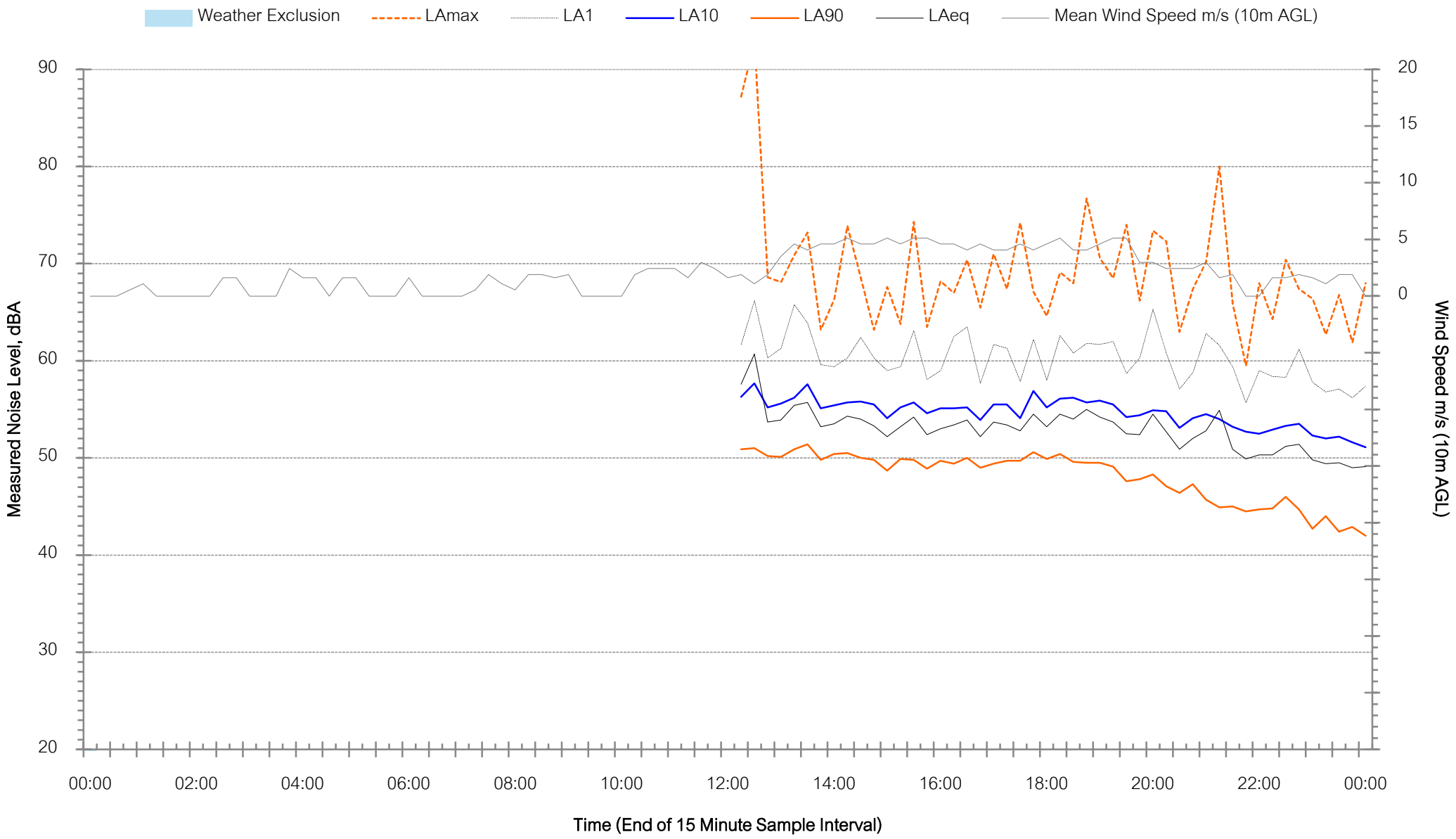


# Background Noise Levels

## New Lake Entrance Road, Oak Flats - Tuesday 19 March 2024

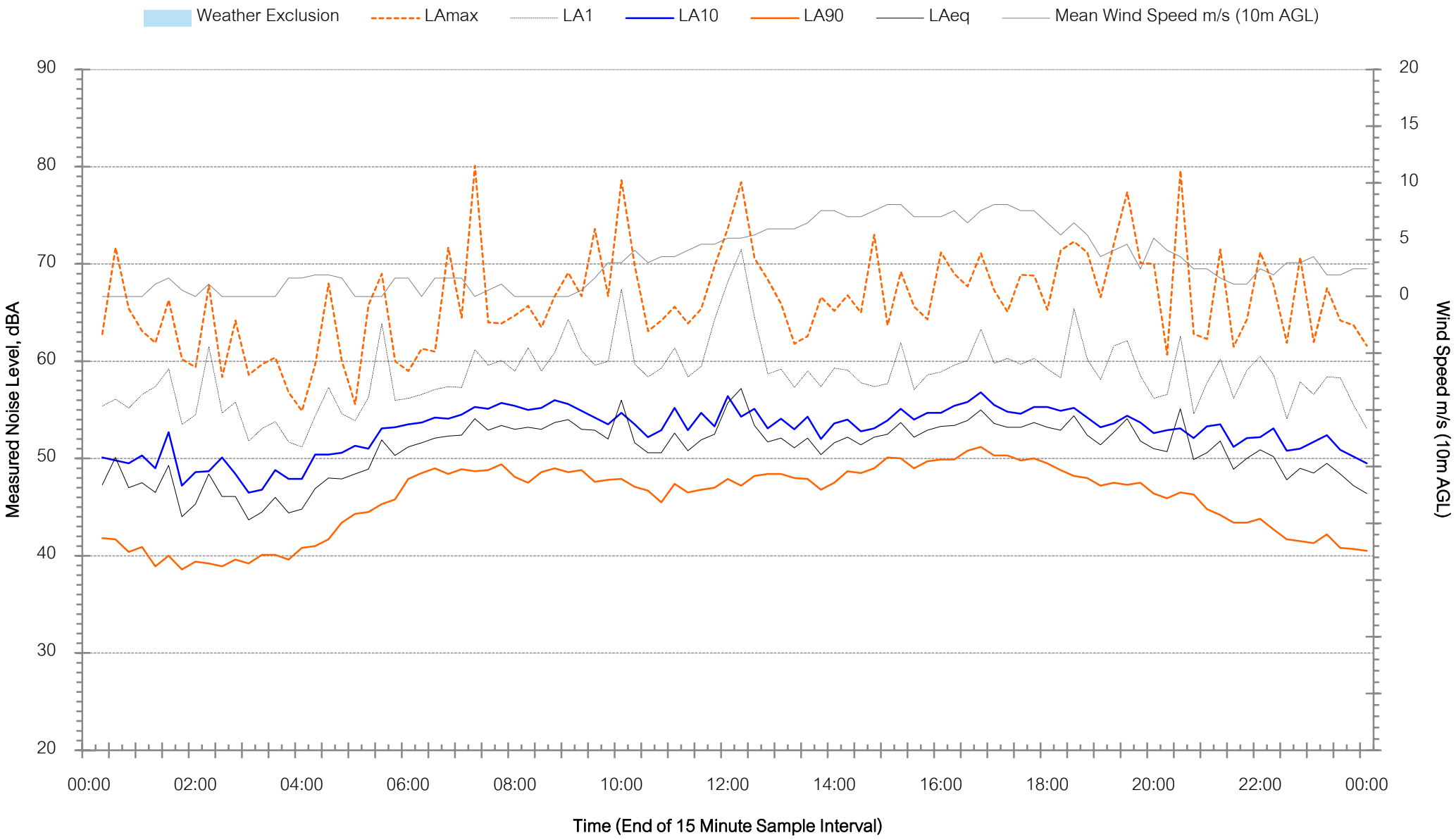
# Background Noise Levels

## Off Conway Cresent, Blackbutt - Friday 8 March 2024



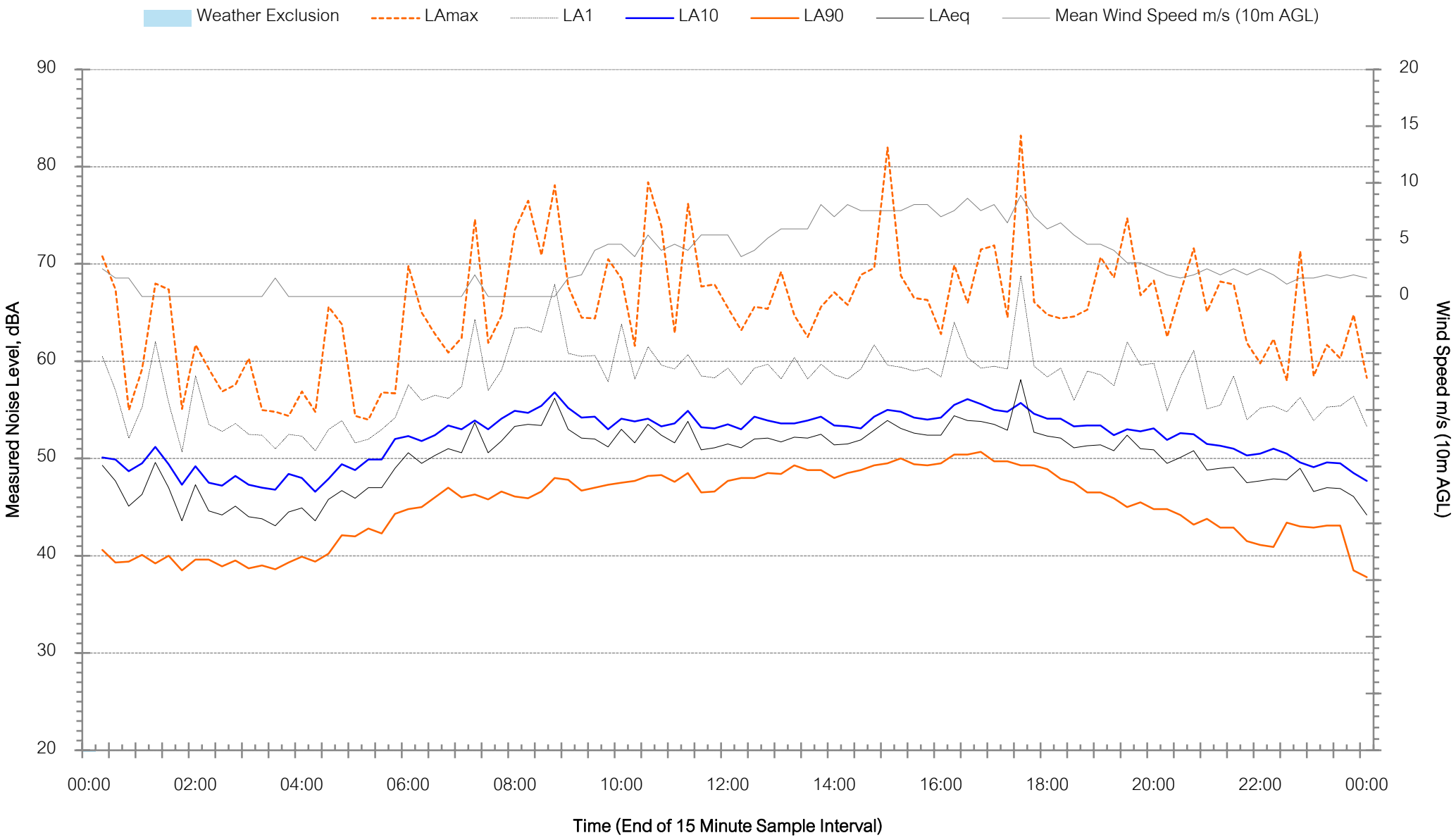
# Background Noise Levels

## Off Conway Cresent, Blackbutt - Saturday 9 March 2024



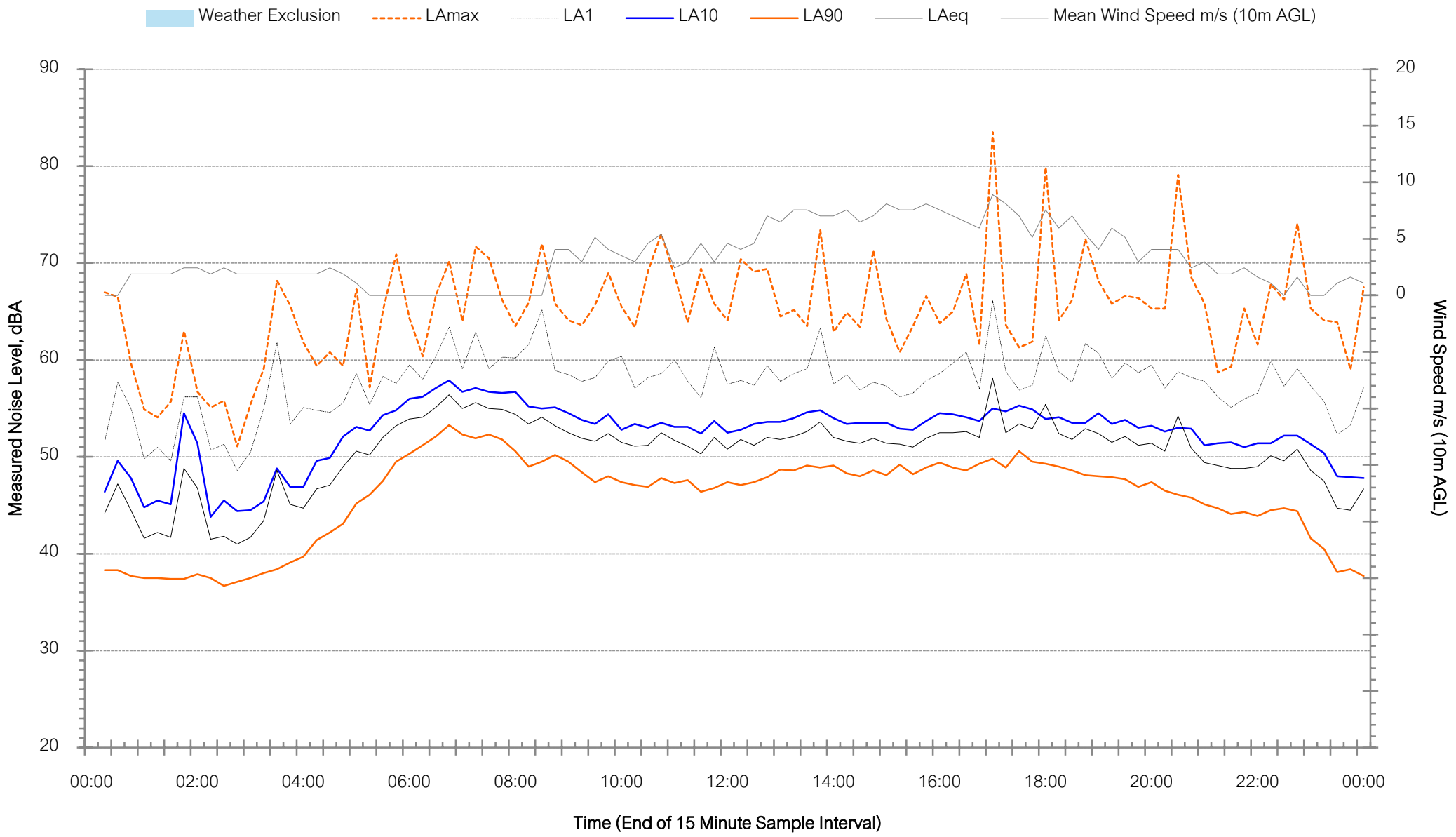
# Background Noise Levels

## Off Conway Cresent, Blackbutt - Sunday 10 March 2024



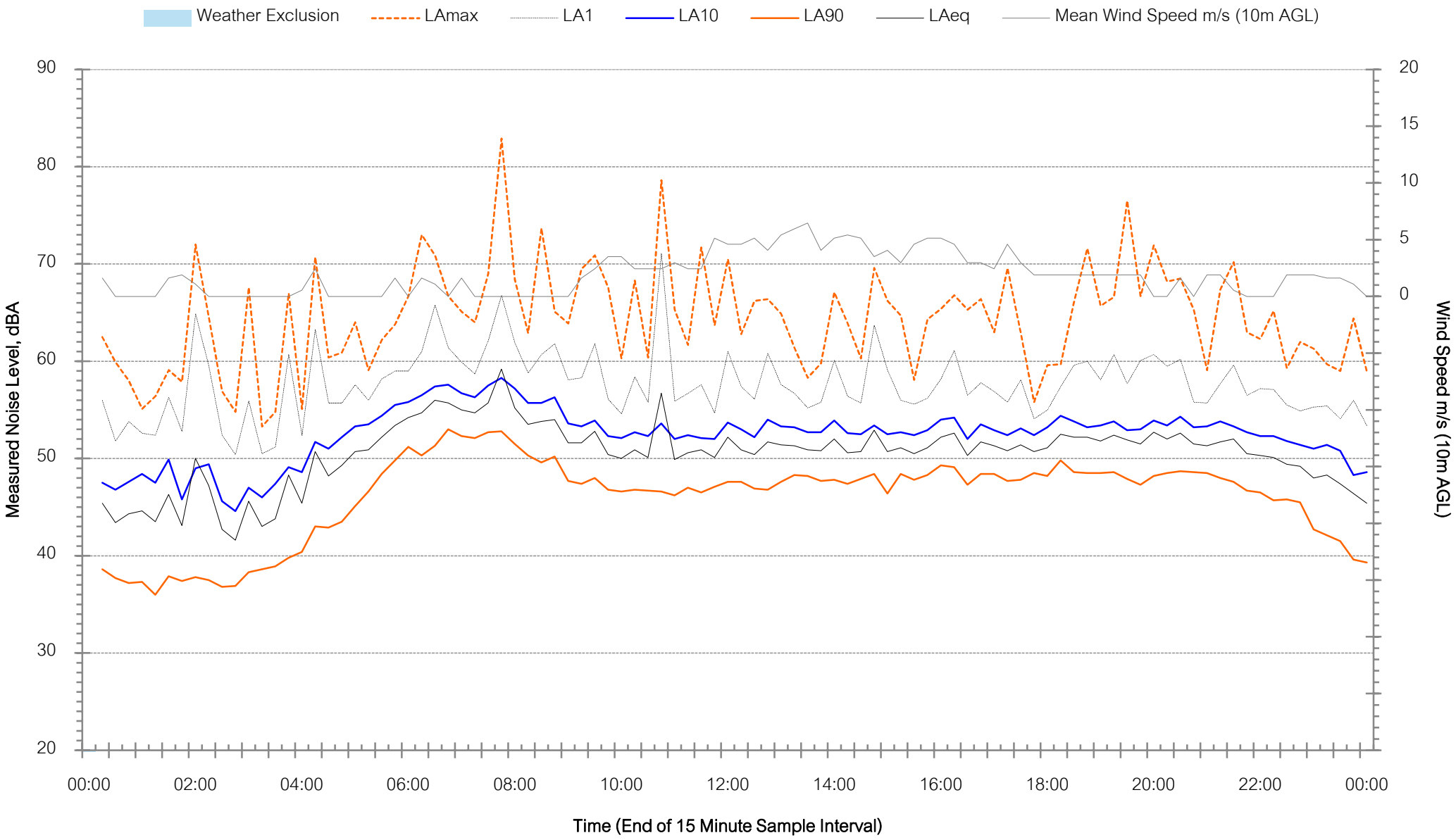
# Background Noise Levels

## Off Conway Cresent, Blackbutt - Monday 11 March 2024



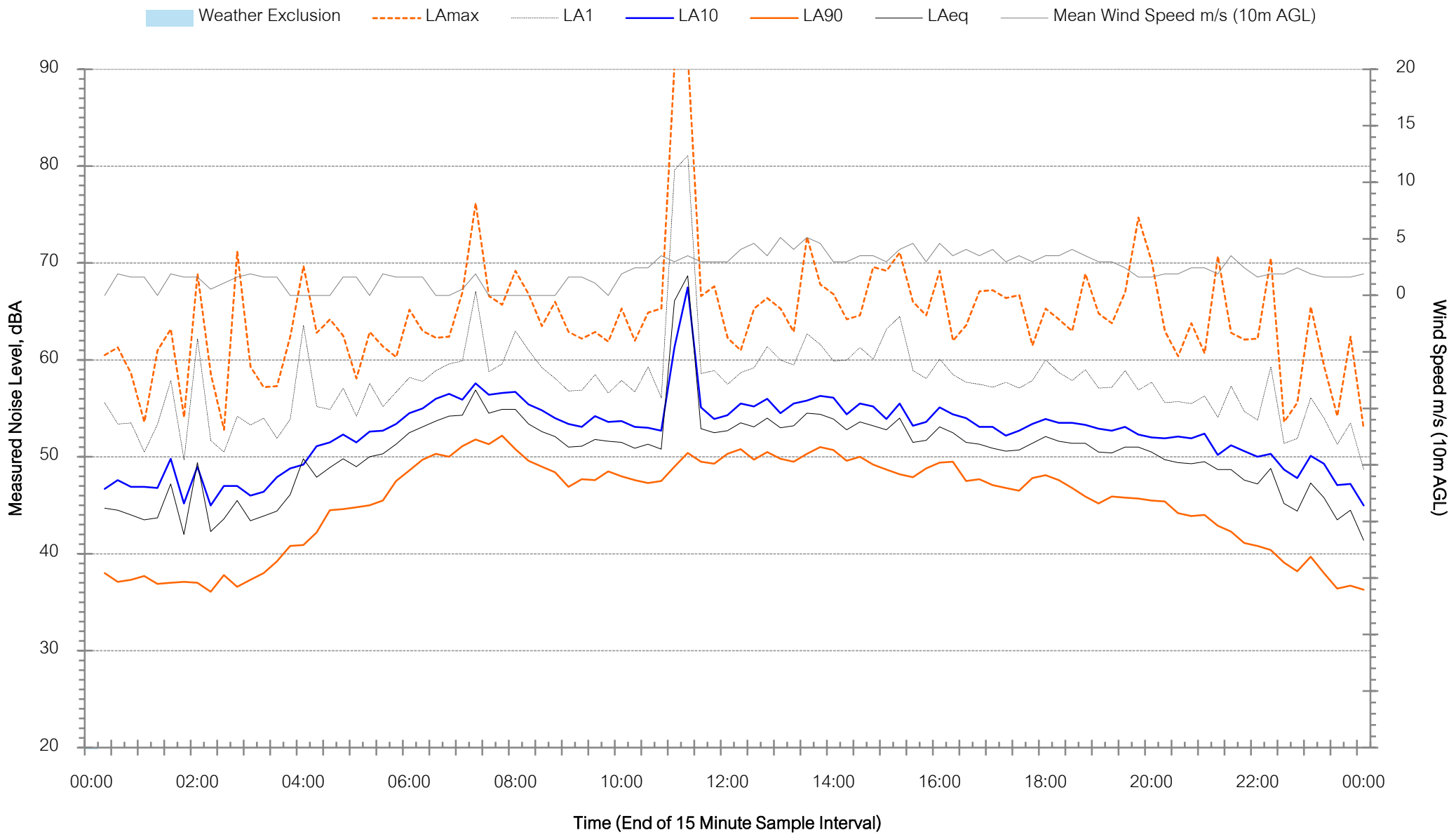
# Background Noise Levels

## Off Conway Cresent, Blackbutt - Tuesday 12 March 2024



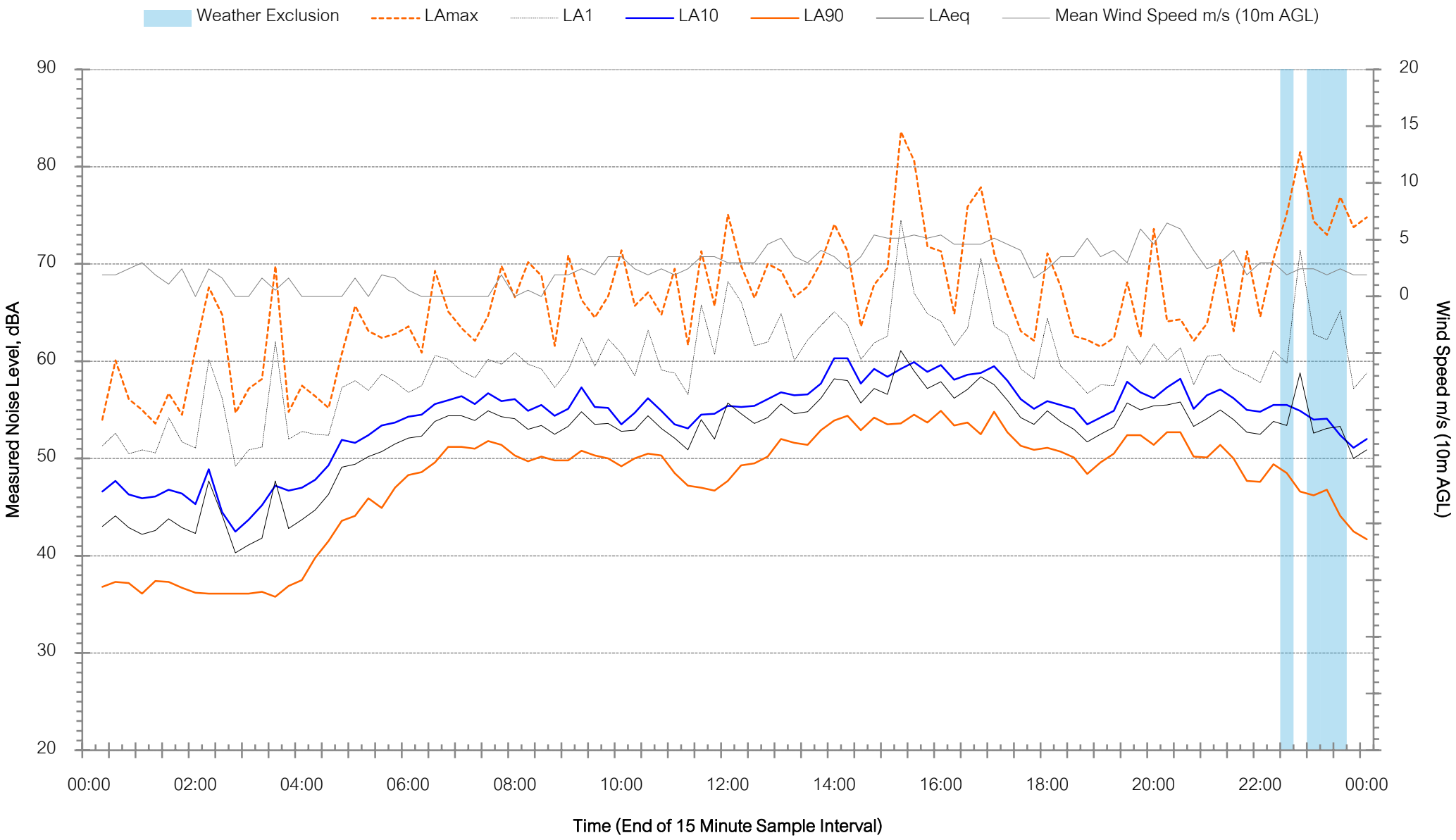
# Background Noise Levels

## Off Conway Cresent, Blackbutt - Wednesday 13 March 2024



# Background Noise Levels

## Off Conway Cresent, Blackbutt - Thursday 14 March 2024

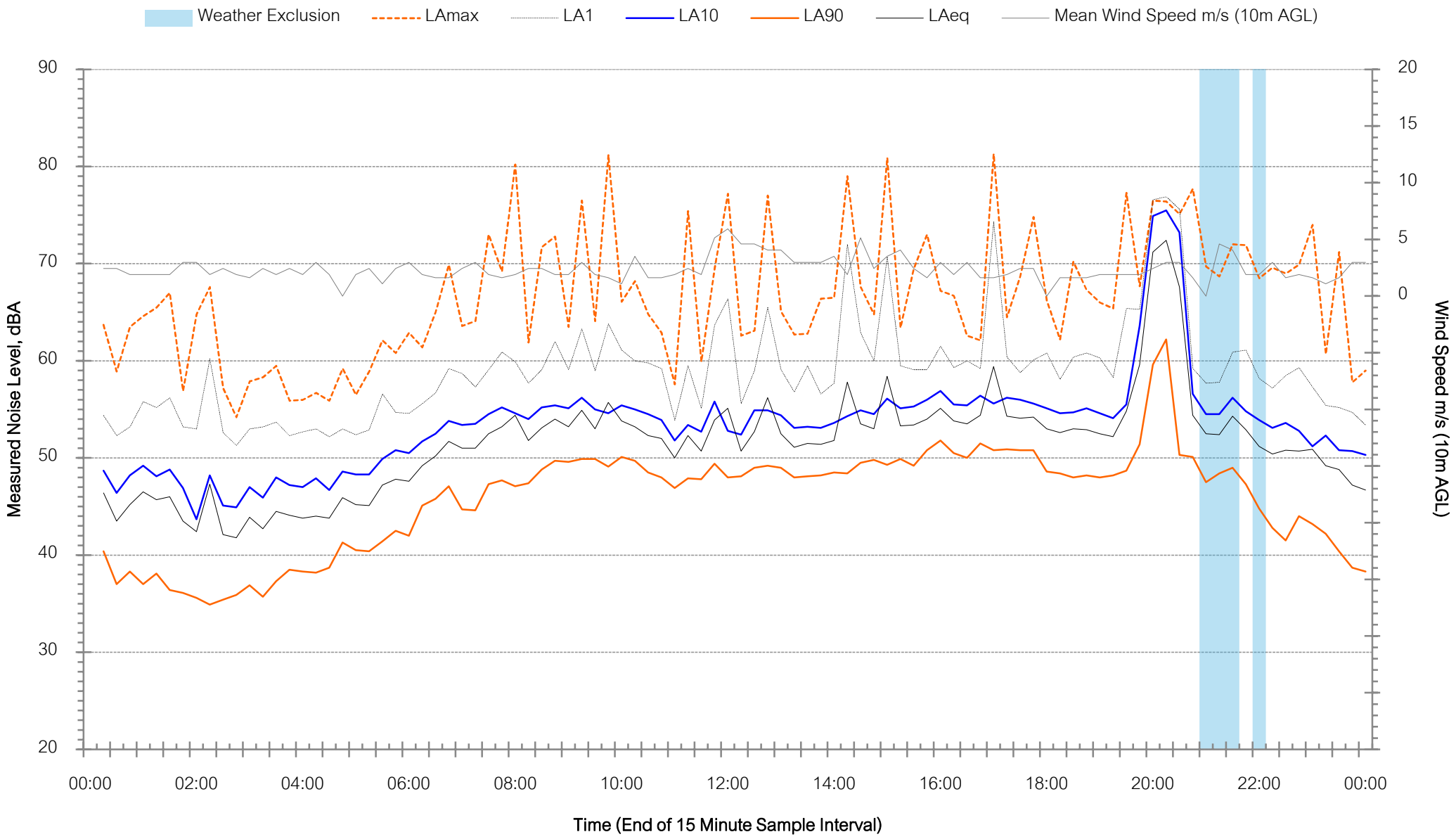


# Background Noise Levels

## Off Conway Cresent, Blackbutt - Friday 15 March 2024

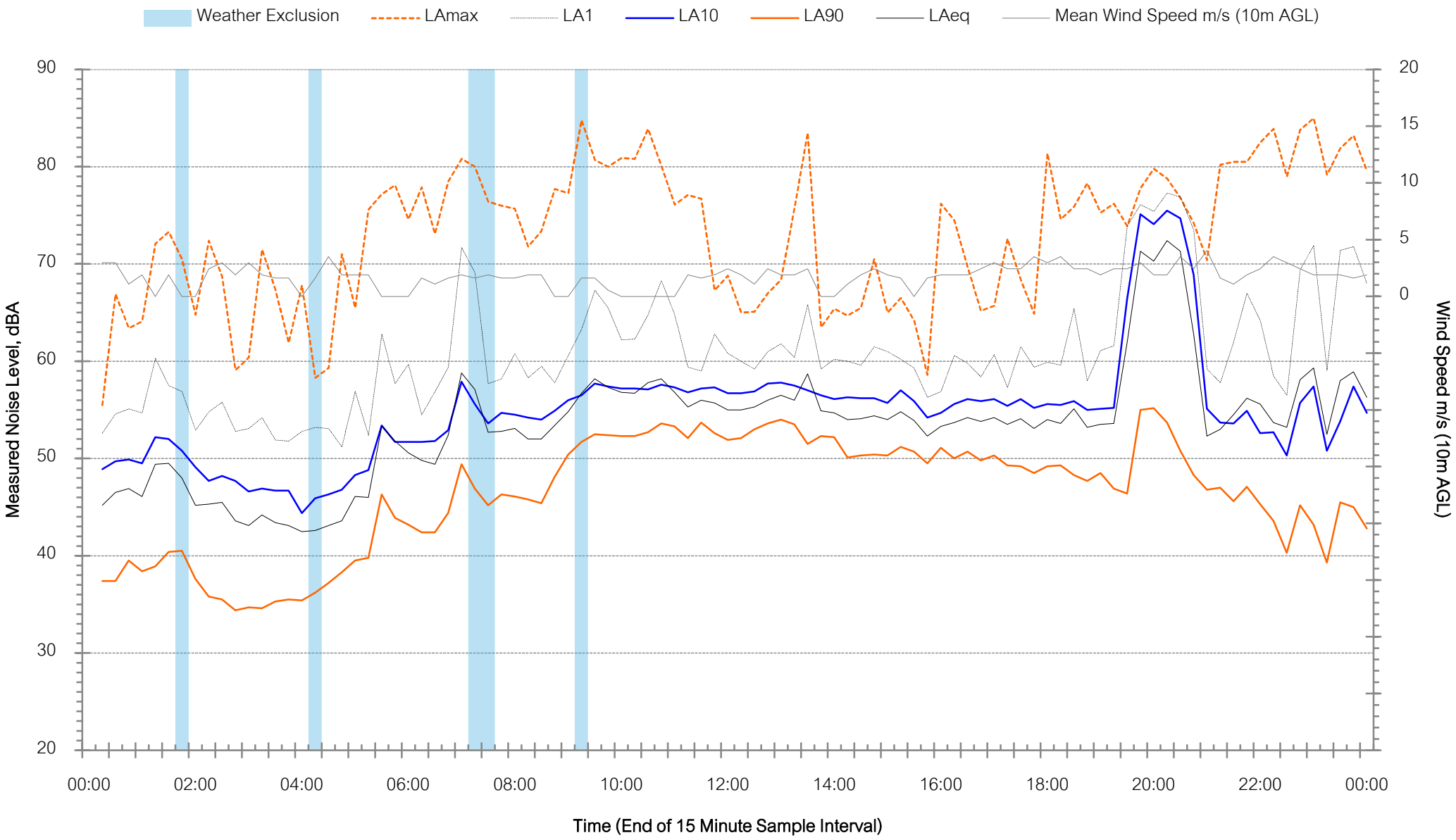
# Background Noise Levels

## Off Conway Cresent, Blackbutt - Saturday 16 March 2024



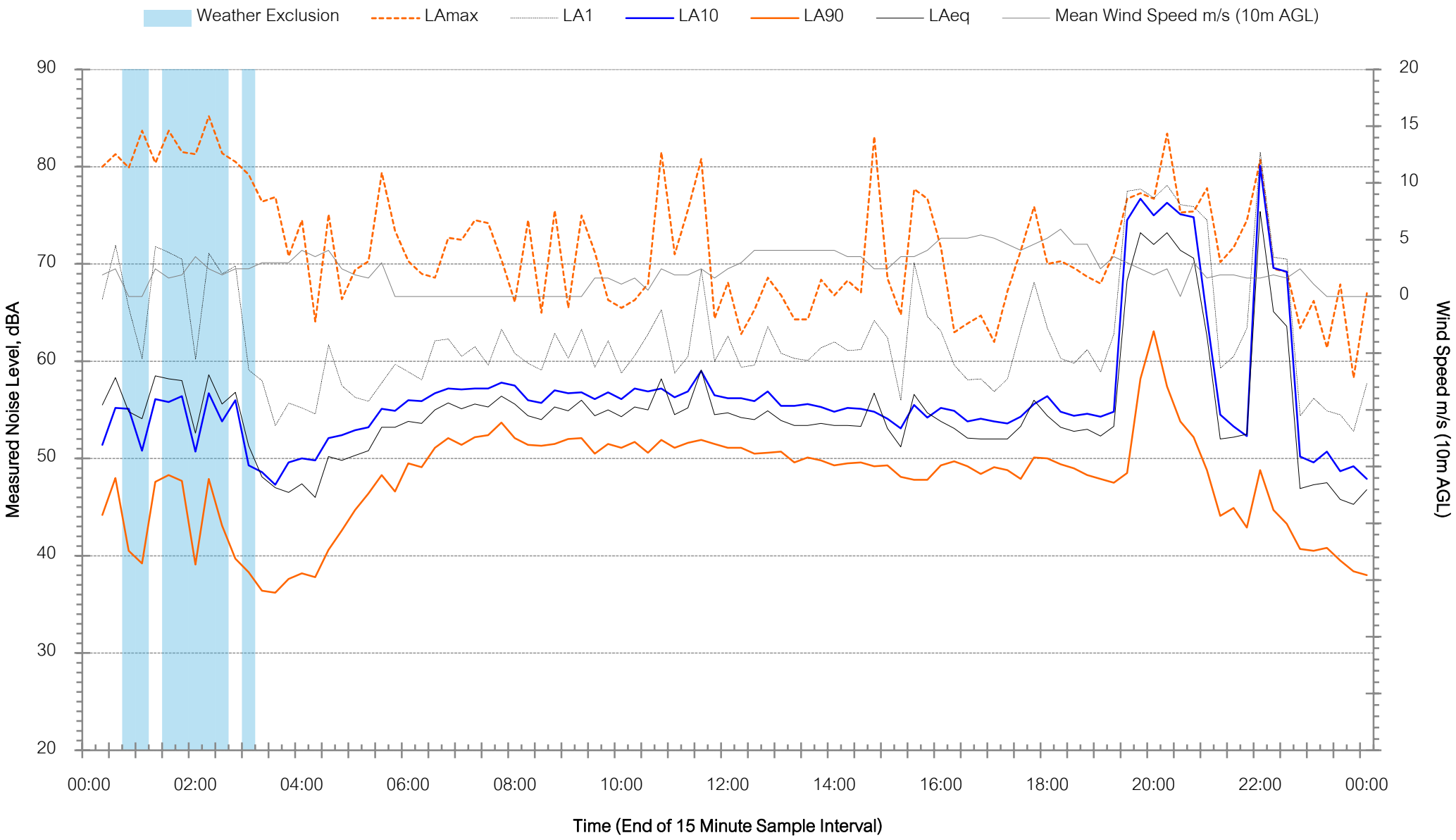
# Background Noise Levels

## Off Conway Cresent, Blackbutt - Sunday 17 March 2024



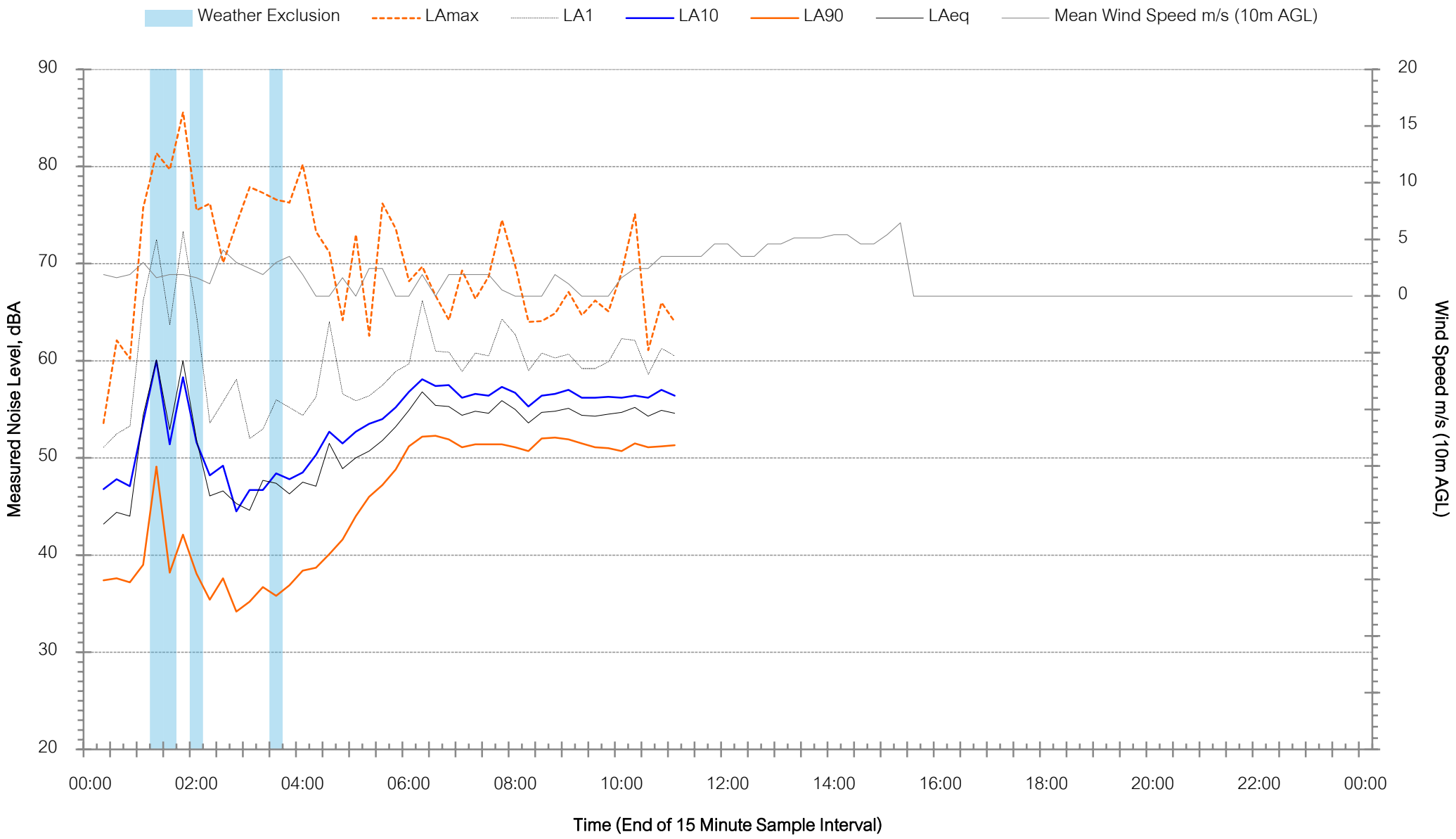
# Background Noise Levels

## Off Conway Cresent, Blackbutt - Monday 18 March 2024



# Background Noise Levels

## Off Conway Cresent, Blackbutt - Tuesday 19 March 2024



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# Appendix D – Construction Noise Contours


FIGURE D1

Construction Noise Levels

S1 - Site Establishment

MAC232030-01

New Lake Entrance Road

## KEY

- Proposal Site
- Ancillary Site

**LAeq(15min) Noise Contours**

- OOH P2 Night
- OOH P1 Evening
- OOH P1 Day
- Standard Hours
- HNA

0 75 150 225 300 m

N

MAC
Muller Acoustic Consulting

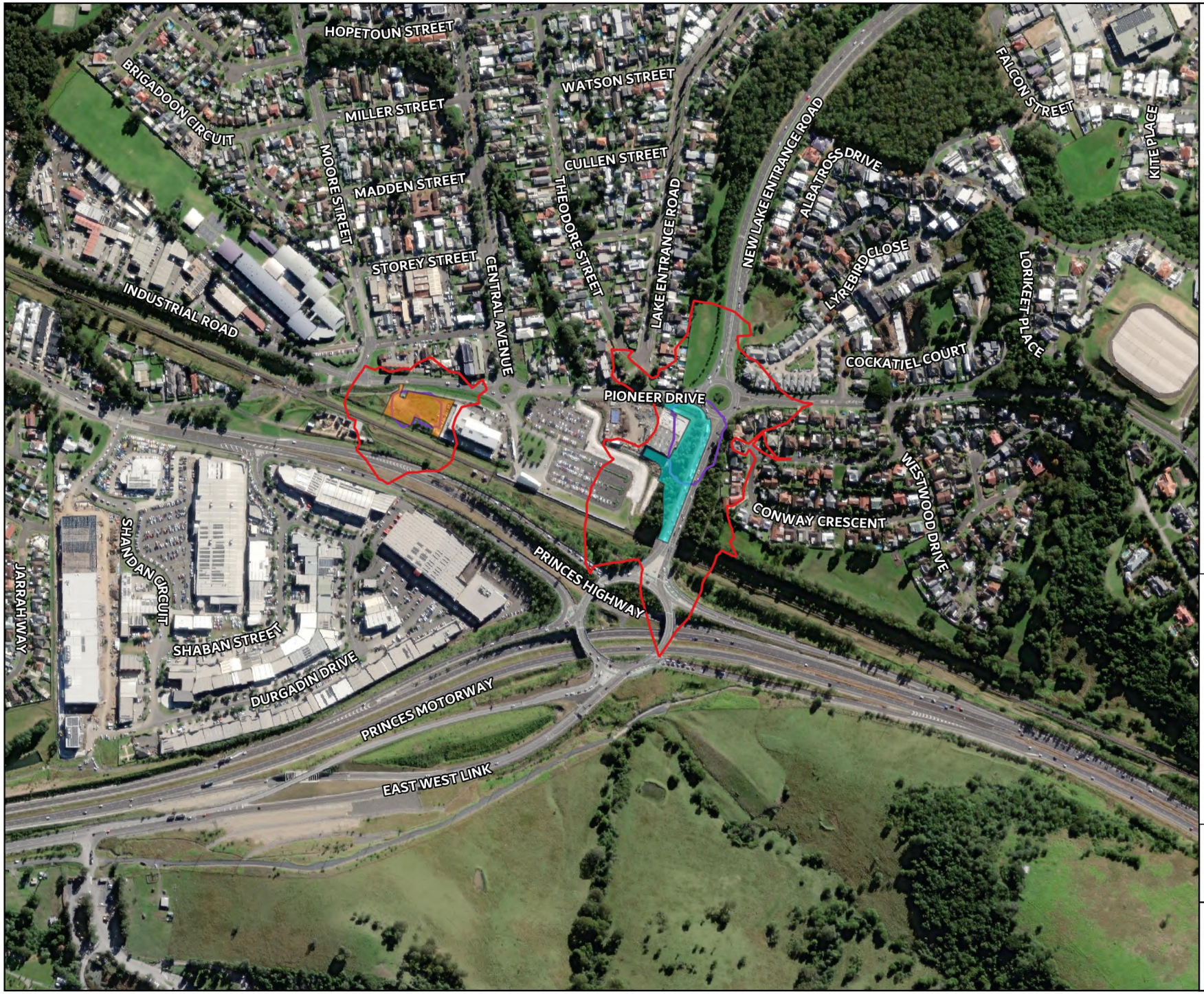


FIGURE D2

Construction Noise Levels

S2 - Corridor Clearing

MAC232030-01

New Lake Entrance Road

## KEY

Proposal Site

Ancillary Site

**LAeq(15min) Noise Contours**

Standard Hours

HNA

0 75 150 225 300 m

N

MAC
Muller Acoustic Consulting

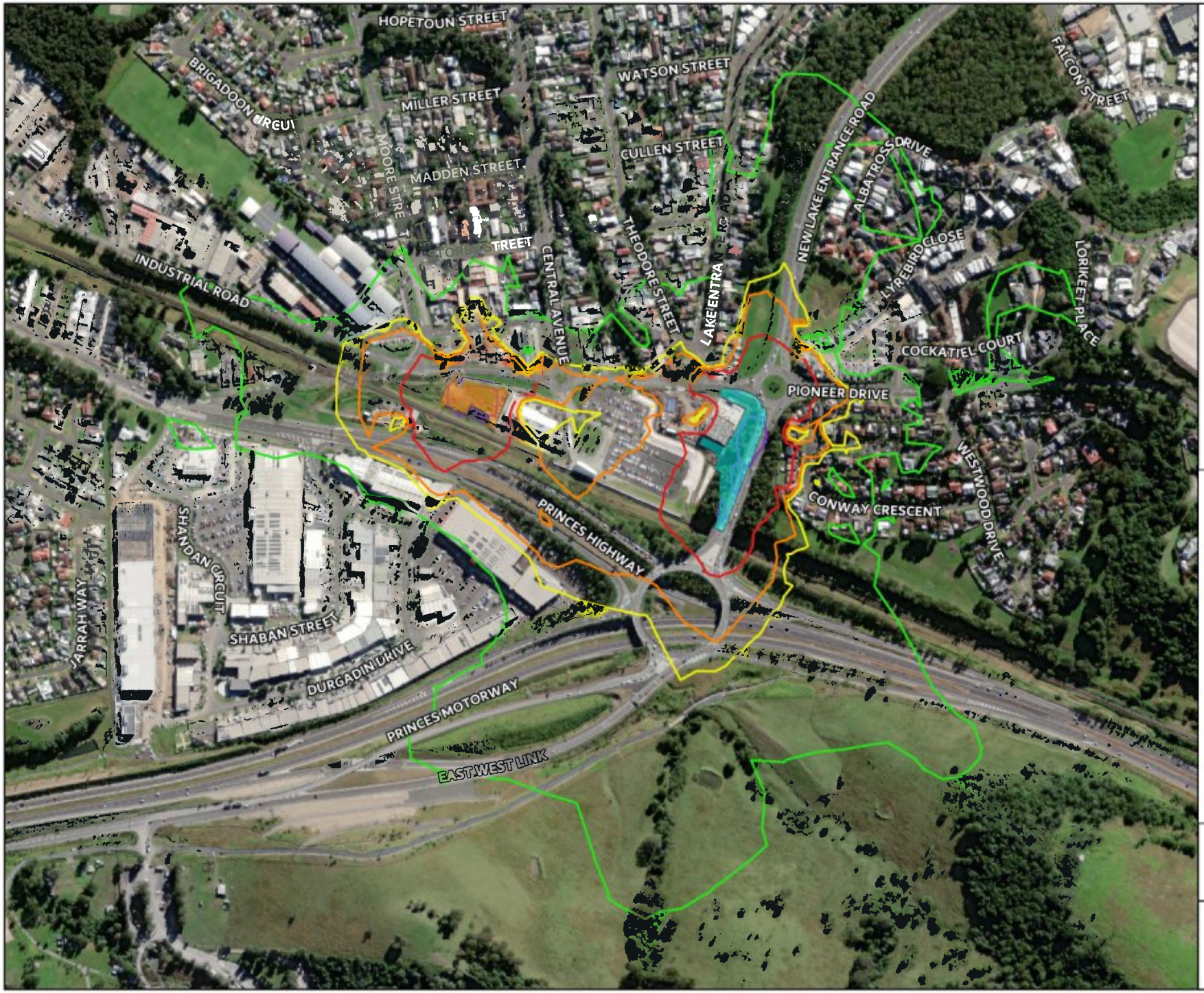


FIGURE D3

Construction Noise Levels

S3 - Utility Adjustment

MAC232030-01

New Lake Entrance Road

KEY

Proposal Site

Ancillary Site

LAeq(15min) Noise Contours

OOH P2 Night

OOH P1 Evening

OOH P1 Day

Standard Hours

HNA

0 75 150 225 300 m

N

MAC

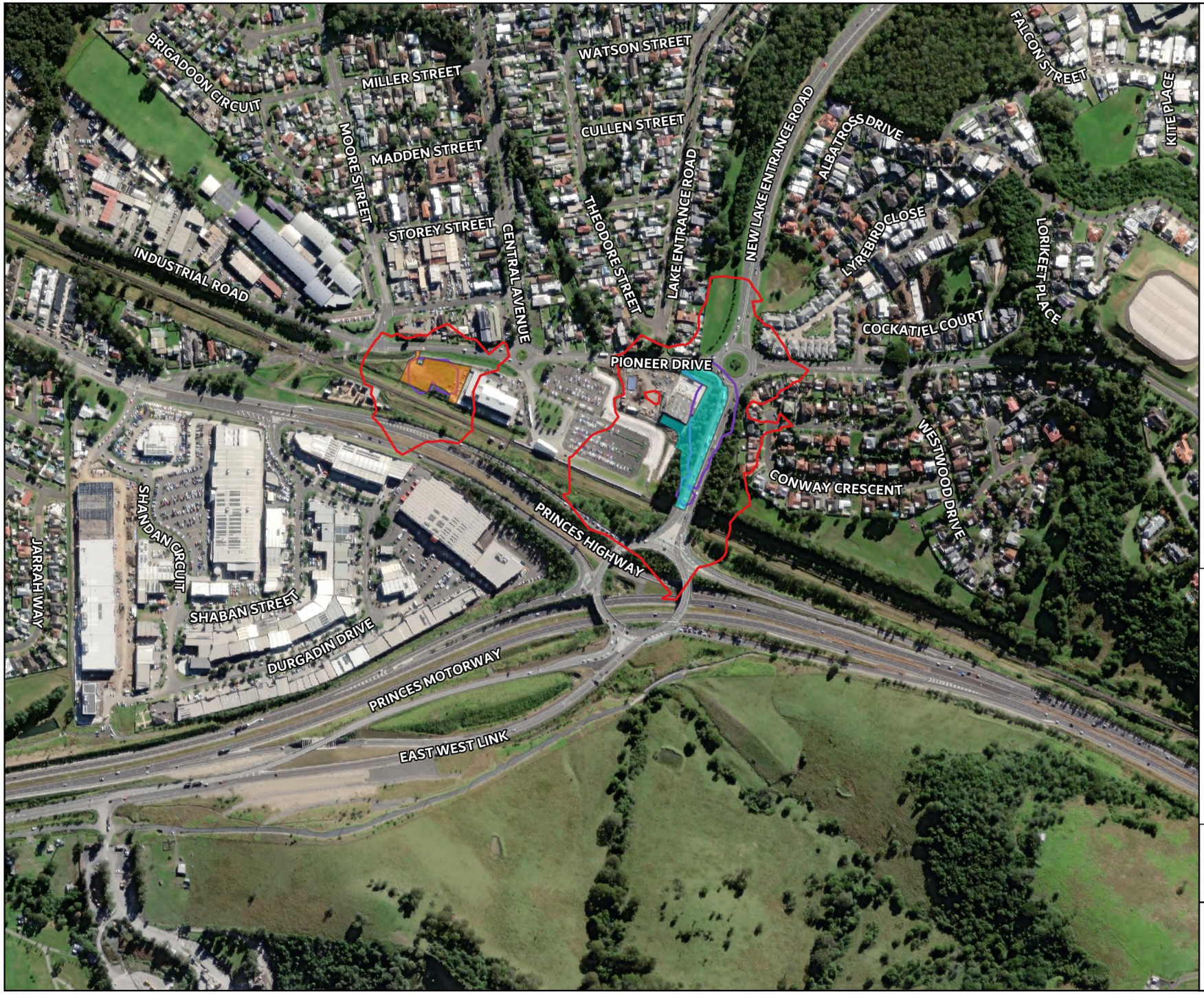


FIGURE D4

Construction Noise Levels

S4 - Road Widening

MAC232030-01

New Lake Entrance Road

## KEY

- Proposal Site
- Ancillary Site

**LAeq(15min) Noise Contours**

- Standard Hours
- HNA

0 75 150 225 300 m

N

MAC
Muller Acoustic Consulting

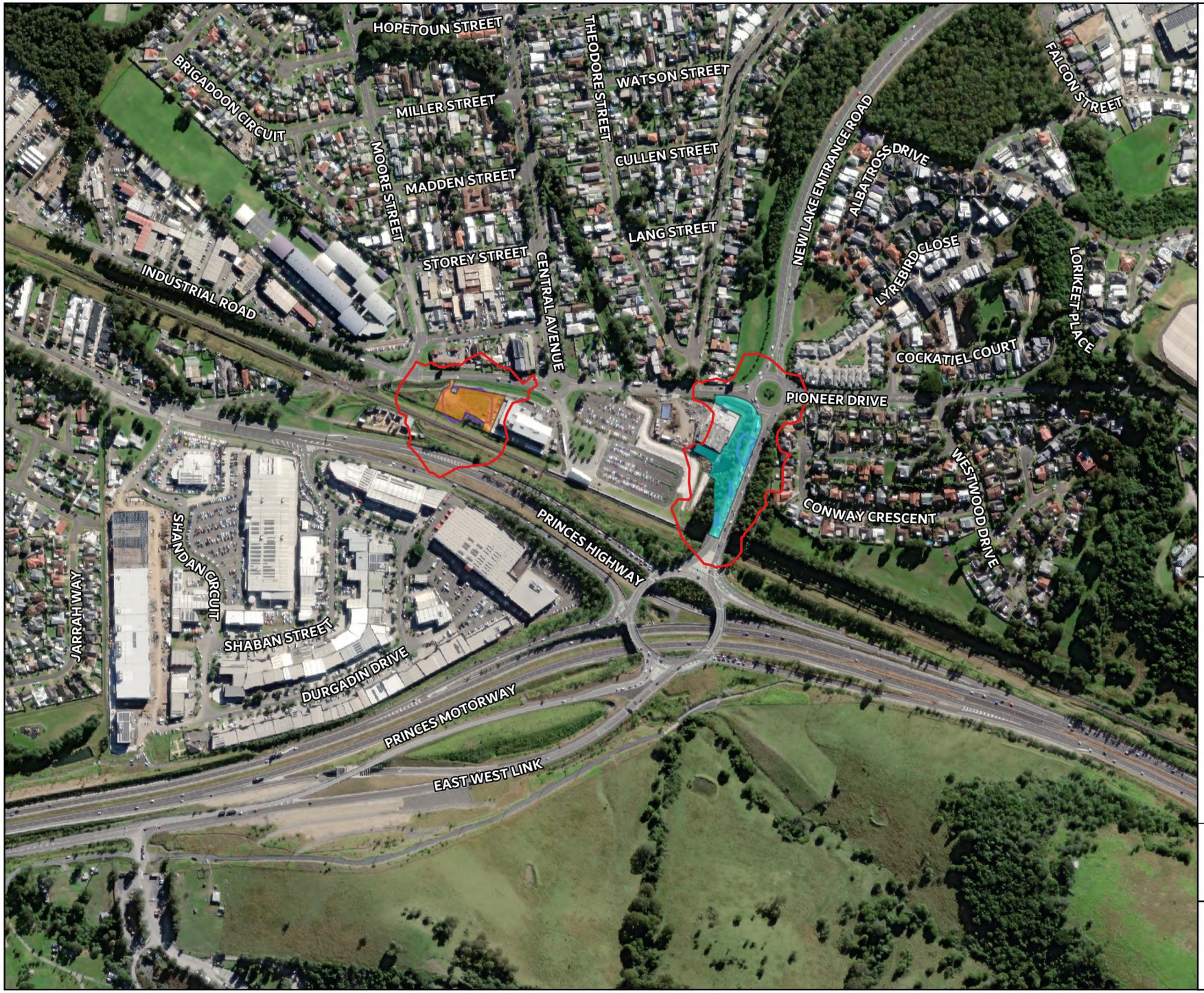


FIGURE D5

Construction Noise Levels

S5 - Drainage Structures

MAC232030-01

New Lake Entrance Road

## KEY

Proposal Site

Ancillary Site

LAeq(15min) Noise Contours

Standard Hours

HNA

0 75 150 225 300 m

N

MAC
Muller Acoustic Consulting

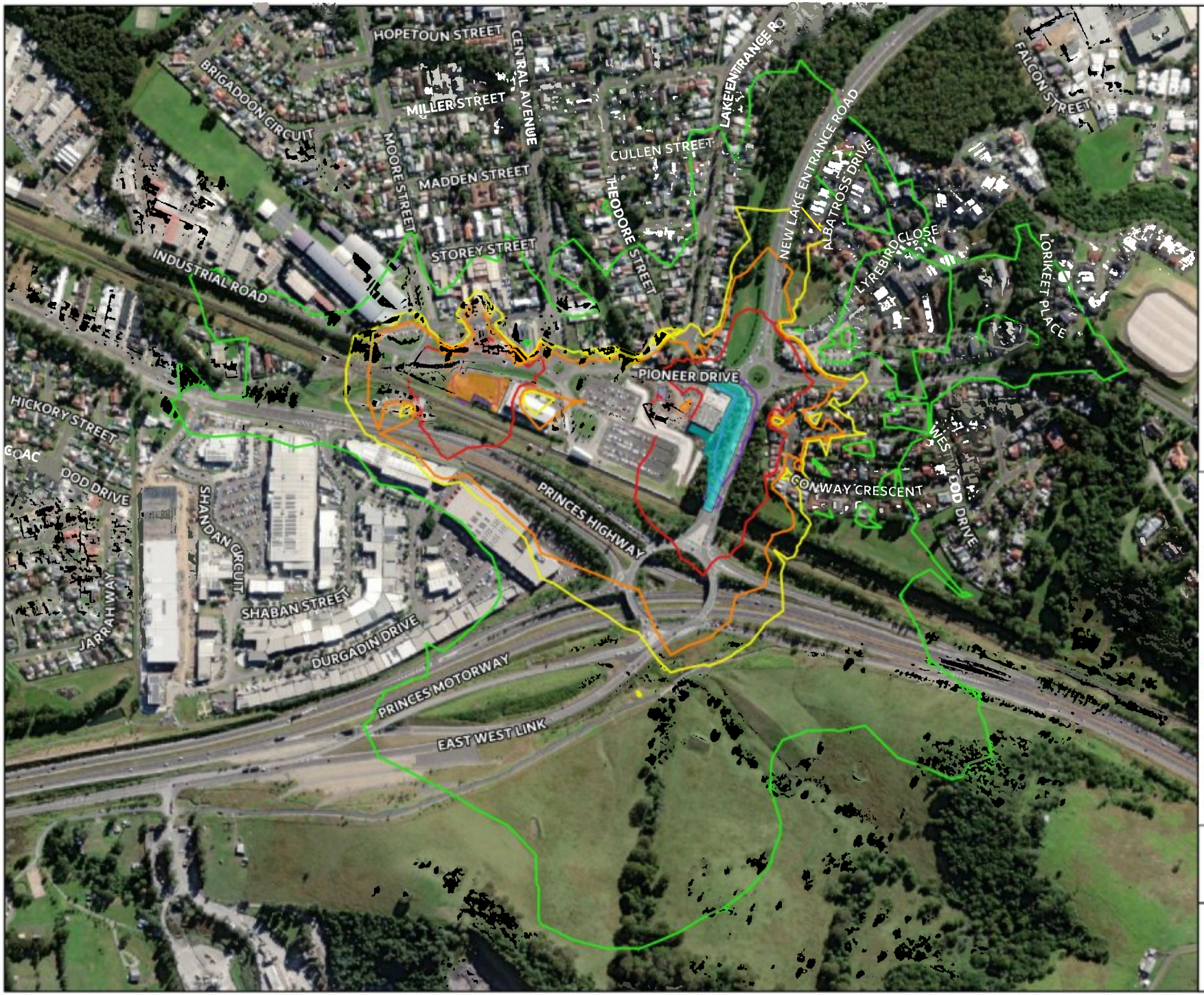


FIGURE D6

Construction Noise Levels

S6 - Paving Works

MAC232030-01

New Lake Entrance Road

## KEY

- Proposal Site
- Ancillary Site

LAeq(15min) Noise Contours

- OOH P2 Night
- OOH P1 Evening
- OOH P1 Day
- Standard Hours
- HNA

0 75 150 225 300 m

N

MAC

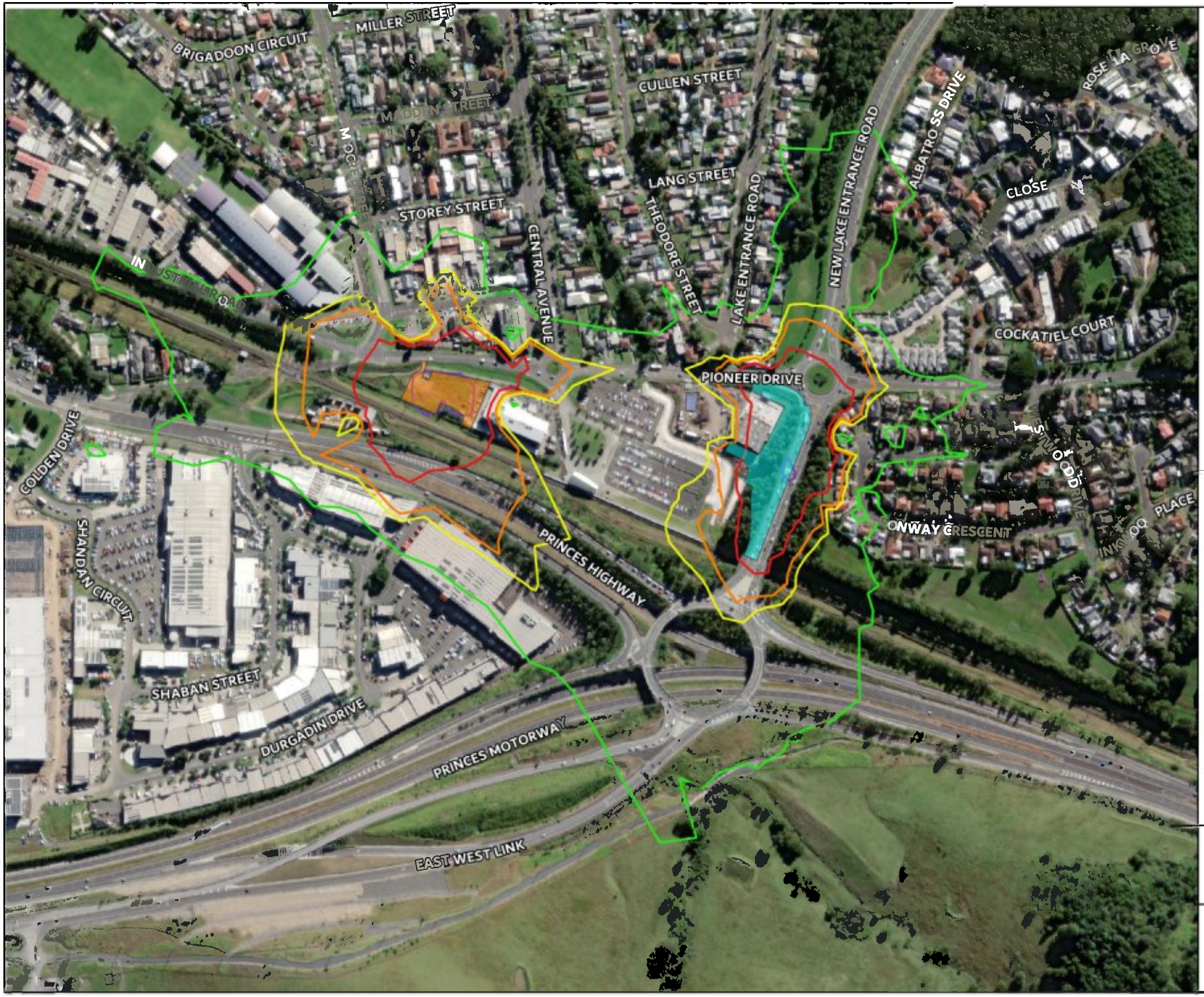


FIGURE D7

Construction Noise Levels

S7 - Road Furniture

MAC232030-01

New Lake Entrance Road

## KEY

- Proposal Site
- Ancillary Site

**LAeq(15min) Noise Contours**

- OOH P2 Night
- OOH P1 Evening
- OOH P1 Day
- Standard Hours
- HNA

0 60 120 180 240 m

N

MAC


FIGURE D8

Construction Noise Levels

S8 - Compound Site

MAC232030-01

New Lake Entrance Road

## KEY

- Proposal Site
- Ancillary Site

**LAeq(15min) Noise Contours**

- Standard Hours
- HNA

0 40 80 120 160 m

N

MAC
Muller Acoustic Consulting

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# Appendix E – Additional Mitigation Measures

Additional mitigation measures as outlined in Section 11.2.2 of the CNVG (Roads and Maritime, 2015) are summarised below. Many of these measures require communication with the community.

### Notifications (letterbox drop or equivalent) (N)

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

### Specific notifications (SN)

Specific notifications are letterbox dropped or hand distributed to identified stakeholders no later than seven days ahead of construction activities that are likely to exceed the noise objectives. The exact conditions under which specific notifications would proceed are defined in the relevant Additional Mitigation Measures (Tables C1 to C3). This form of communication is used to support periodic notifications, or to advertise unscheduled work.

### Phone calls (PC)

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.

### Individual briefings (IB)

Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will 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 proposal.

### Respite Offer (RO)

Respite Offers should be made where there are high noise and vibration generating activities near receivers. As a guide work should be carried out in continuous blocks that do not exceed 3 hours each, with a minimum respite period of one hour between each block. The actual duration of each block of work and respite should be flexible to accommodate the usage of and amenity at nearby receivers.

### Respite Period 1 (R1)

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

### Respite Period 2 (R2)

Night time construction noise in out of hours period 2 shall be limited to two consecutive nights except for where there is a Negotiated Respite. For night work these periods of work should be separated by not less than one week and 6 nights per month.

### Duration Respite (DR)

Respite periods 1 and 2 may be counterproductive in reducing the impact on the community for longer duration proposals. In this instance and where it can be strongly justified it may be beneficial to increase the number of evenings or nights worked through Negotiated Respite so that the proposal can be completed more quickly.

Pre-purchased movie tickets or a similar offer may also provide respite for the community while providing provision for additional out of hours work. This measure is determined on a proposal-by-proposal basis, and may not be applicable to all RMS proposals.

The receivers that should be liaised with to gain community support for Negotiated Respite include those where out of hours work exceed the NML.

Where there are few receivers above the NML each of these receivers should be visited to discuss the proposal to gain support for Negotiated Respite.

In instances where there are many receivers above the NML it may not be practical discuss the proposal with every receiver. Instead the community should be proactively engaged so they have an incentive to participate in discussion supporting Negotiated Respite. Support may be demonstrated from surveys, online feedback, contact phone numbers and community events.

### Alternative accommodation (AA)

Alternative accommodation options should be provided to residents living in close proximity to construction work that are likely to incur noise levels significantly above the applicable level (Tables C1-C3). The specifics of the offer will be determined on a proposal-by-proposal basis.

### Verification

Appendix F of the CNVG provides details about verification of Noise and Vibration levels following complaints and as part of routine checks of noise levels.

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