Merimbula Sewage Treatment Plant Upgrade and Ocean Outfall

Appendix L

Noise and Vibration Technical Report

Appendix D

Noise and Vibration Technical Report

Client: Bega Valley Shire Council

ABN: 26 987 935 332

Prepared by

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

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Executive Summary

Bega Valley Shire Council (BVSC) is proposing an upgrade to the Merimbula Sewage Treatment Plant (STP) including a new ocean outfall in Merimbula Bay (the Project). The Project would be located between Merimbula and Pambula on Arthur Kaine Drive, within the Bega Valley Shire local government area (LGA). The Merimbula STP is bounded by the Pambula Merimbula Golf Club to the south, Merimbula Lake to the west, Merimbula Airport to the north and Arthur Kaine Drive to the east. The Merimbula STP is accessed via Arthur Kaine Drive, which links to Princes Highway to the west and providing direct access to Merimbula Airport in the north.

The Project

The Project would involve an upgrade of sewage treatment at the Merimbula STP and replacement of the existing beach face outfall and dunal exfiltration ponds with an ocean outfall in Merimbula Bay. Specifically, the Project would involve:

- upgrade of the STP to improve the quality of treated wastewater (including for beneficial re-use);
- decommissioning of the beach-face outfall, as well as an STP effluent pond;
- discontinuing the use of the dunal exfiltration ponds;
- installation of a secondary disposal mechanism - an ocean outfall pipeline about 3.5 km in length to convey treated wastewater to a submerged diffuser;
- installation of upgraded pumps; and
- continuation of the beneficial re-use irrigation scheme at the PMGC grounds and the Oaklands agricultural area, with treated wastewater of improved quality.

The Project area comprises the existing Merimbula STP site and ocean outfall alignment, as well as areas required for construction, including laydown areas within the adjacent PMGC grounds and on Merimbula Beach (with access via Pambula Beach).

The Project is aimed at reducing the environmental and health impacts of current operations, by providing a higher level of treatment and a superior mode of discharge/ dispersion of the treated wastewater via an ocean outfall in Merimbula Bay. The upgraded STP would be operated with the additional treatment processes which would improve the quality of the treated wastewater.

This Noise and Vibration Technical Report is one of a number of technical documents that forms part of the Environmental Impact Statement (EIS) for the Project. This assessment addresses the relevant Secretary's Environmental Assessment Requirements (SEARs), aiming to identify potential impacts of the Project and to outline performance outcomes and mitigation and management measures relating to traffic and transport during detailed design, construction and operation of the Project.

Note that this report does not assess underwater noise; an assessment for underwater noise is provided in **Appendix M** (Underwater Noise Technical Report) of the EIS.

Construction noise and vibration

The construction noise assessment was conducted in accordance with the *Interim Construction Noise Guideline* (ICNG) (Department of Environment and Climate Change, 2009) as required by the SEARs for the Project.

Construction scenarios have been developed based on the proposed construction stages for the works. The construction scenarios are considered to represent the noisiest activities likely to occur. The following construction stages have been assessed:

- utility works/relocations;
- site establishment;
- STP upgrade works within STP site;
- pipeline butt welding and stringing;

- ocean outfall pipeline construction - directional drilling and pulling;
- offshore pipeline works; and
- commissioning.

Each construction stage has been modelled separately, however as some construction stages may overlap the impacts of these were also considered cumulatively. All equipment was assumed to be operating simultaneously during each construction scenario, unless otherwise noted, to provide a conservative approach.

To facilitate the assessment at nearby noise and vibration sensitive receivers, noise catchment areas were identified (i.e. areas in which receivers are considered to experience a similar noise environment). Noise and vibration sensitive receivers include residential properties, educational facilities, places of worship, recreational areas and some commercial and industrial properties (dependent on their use). Unattended and attended noise measurements were completed to characterise the existing noise environment of each noise catchment area. The measured noise levels were used to establish construction noise management levels for residential properties in accordance with the *Interim Construction Noise Guideline*.

The assessment indicates no exceedances of the noise management levels at sensitive receivers for works undertaken during standard construction hours, nor outside standard hours, except at Pambula Beach Caravan Park where noise levels may exceed NMLs by up to 6 dB(A) (A-Weighted decibels) during the site establishment scenario.

Minimum working distances for vibration intensive construction works have been presented and are up to 25 metres when vibratory rollers are in use. Equipment size would be selected by the contractor considering the minimum working distances and the distance between the area of construction and the most affected sensitive receiver. Work is unlikely to take place within the minimum working distances. If work needs to be undertaken within cosmetic damage minimum working distances then:

- vibration monitoring would be carried out; and
- site specific minimum working distances would be determined.

Sensitive structures would need to be considered on a case-by-case basis, depending on their sensitivity.

Measures have been recommended which would reduce construction noise and vibration impacts. The final number, degree and nature of these measures would ultimately be selected by the contractor and would be largely dependent on the construction strategy and work undertaken. Specific noise management and mitigation measures would be detailed in a Construction Noise and Vibration Management Plan.

Construction road traffic noise

The road traffic noise associated with traffic movements during construction was assessed in accordance with the *NSW Road Noise Policy* (DECCW, 2011) guidelines. Increases in road traffic noise levels due to construction traffic is expected to be less than 2 dB during the day and the night given the existing high noise levels from traffic on the site access roads. As such road traffic noise levels are predicted to comply with the *NSW Road Noise Policy*.

Fixed facility operational noise

Noise levels have been predicted at sensitive receiver locations throughout the operational noise study area for the night-time scenario, as this is the most sensitive period. No exceedances of the Project trigger levels have been identified, therefore no additional noise mitigation and management measures are required.

An operational road traffic impact noise assessment has been completed in accordance with the *NSW Noise Policy for Industry*, finding the impact would be negligible.

1.0 Introduction

Bega Valley Shire Council (BVSC) is proposing an upgrade to the Merimbula Sewage Treatment Plant (STP) including a new ocean outfall in Merimbula Bay (the Project). The Project would be located between Merimbula and Pambula, within the Bega Valley Shire local government area (LGA) (refer **Figure 2-1**).

This report has been prepared to assess the potential noise and vibration impacts of construction and operation of the Project.

1.1 Project overview

The Project would involve an upgrade of sewage treatment processes at the Merimbula STP, decommissioning of an existing effluent storage pond, and replacement of the existing beach-face outfall and dunal exfiltration ponds with an ocean outfall pipeline in Merimbula Bay.

When operational, the Project would involve continuation of the beneficial re-use irrigation scheme at the Pambula Merimbula Golf Club (PMGC) grounds and the nearby Oaklands agricultural area, with improved treated wastewater quality from the upgraded STP.

The Project would reduce the environmental and health impacts of the current operations, by providing a higher level of treatment and a superior mode of discharge/dispersion of the treated wastewater via the ocean outfall offshore in Merimbula Bay.

The Project is described in further detail in **Section 2.0**, and an overview of the Project area is provided in **Figure 2-1**. A full Project description is provided in the EIS (refer **Chapter 2 Project description**).

1.2 Purpose of this Technical report

This technical report provides a noise and vibration impact assessment of the Project and has been prepared to support the Environmental Impact Statement (EIS). The aim of this report is to address the relevant Secretary's Environmental Assessment Requirements (SEARs) for the Project, provided by the NSW Department of Planning Industry and Environment (DPIE) (Application number SS1 7614). The construction and operational phases of the Project have been assessed using the applicable noise and vibration guidelines.

1.2.1 Secretary's Environmental Assessment Requirements

The SEARs for the Merimbula STP Upgrade and Ocean Outfall relating to noise and vibration are presented in **Table 1-1**.

Table 1-1 Secretary's Environmental Assessment Requirements – Noise and vibration

Secretary's Environmental Assessment Requirements	Where addressed in report
11. Noise and Vibration - Amenity	
1. The Proponent must assess construction and operational noise and vibration impacts in accordance with current NSW noise and vibration guidelines including consideration of noise characteristics (tonal, intermittent and low frequency noise) and the impact on sensitive receivers	**Section 5.0** and **Section 6.0**
2. The assessment must include consideration of impacts to the structural integrity and heritage significance of items (including Aboriginal places and items of environmental heritage)	**Section 5.3**
3. The Proponent must demonstrate that blast impacts are capable of complying with the current guidelines, if blasting is required	No blasting is proposed as part of the Project

1.2.2 Structure of this Technical report

This Technical report is structured as follows:

- **Section 1.0**: Introduction – this section introduces the Project.
- **Section 2.0**: Project description – this section provides a description of the proposed upgrade, including construction activities.
- **Section 3.0**: Existing environment – this section provides a description of the existing noise environment within the study area, including the noise catchment areas assessed.
- **Section 4.0**: Methodology – this section summarises the assessment criteria and methodology that applies to this assessment.
- **Section 5.0**: Construction impact assessment – this section provides the results of the construction noise and vibration impact assessment.
- **Section 6.0**: Operational impact assessment – this section provides the results of the fixed facility and road traffic noise impact assessment.
- **Section 7.0**: Mitigation and management measures – this section outlines the recommended mitigation and management measures for potential construction and operational noise, subject to detailed design.
- **Section 8.0**: Conclusion – this section presents the conclusions of the noise and vibration impact assessments.

2.0 Project description

This chapter outlines the existing operations at the Merimbula STP and provides a summary of the Project description. A full Project description is provided in **Chapter 2 Project description** of the EIS.

The Project would be located between Merimbula and Pambula on Arthur Kaine Drive, within the Bega Valley LGA approximately 3.5 kilometres (km) south of the Merimbula town centre and 2.5 km north of Pambula village, as shown on **Figure 2-1**. The Merimbula STP is bounded by the PMGC to the south, Merimbula Lake to the west, Merimbula Airport to the north and Arthur Kaine Drive to the east. The Merimbula STP is accessed via Arthur Kaine Drive, which links to Princes Highway to the west and provides direct access to Merimbula Airport in the north.

2.1 Existing operations

The existing operations at the Merimbula STP consist of:

- sewage treatment at the Merimbula STP; and
- disposal of treated wastewater via:
  - a beach-face outfall;
  - dunal exfiltration ponds; and
  - a beneficial re-use scheme at the adjacent PMGC grounds, and at Oaklands agricultural area.

The STP is an intermittently decanted extended aeration (IDEA) activated sludge plant designed to serve an equivalent population of 15,500. The STP has a capacity to accommodate an average dry weather flow of up to 3.72 megalitres per day (ML/day) and a peak wet weather flow of seven times the average dry weather flow, or 26 ML/day. It handles an average of 790 megalitres (ML) of treated wastewater per year.

The current strategy for managing treated wastewater from the Merimbula STP comprises a combination of:

- beneficial re-use (the preferred disposal option): use of treated wastewater to irrigate the adjacent PMGC grounds and ‘Oaklands’ agricultural area (approximately 25% of annual treated wastewater), located on the Pambula River flats at South Pambula; and
- disposal: discharge of excess treated wastewater to the environment, via dunal exfiltration ponds located within the sand dunes east of the STP between the ocean and Merimbula Lake (approximately 25% of annual treated wastewater), or via the existing beach-face outfall east of the STP at Merimbula Beach (approximately 50% of annual treated wastewater).

2.2 The Project

The Project would involve:

- upgrade of the STP to improve the quality of treated wastewater (including for beneficial re-use);
- decommissioning of the beach-face outfall, as well as an STP effluent pond;
- discontinuing the use of the dunal exfiltration ponds;
- installation of a secondary disposal mechanism - an ocean outfall pipeline about 3.5 km in length to convey treated wastewater to a submerged diffuser;
- installation of upgraded pumps; and
- continuation of the beneficial re-use irrigation scheme at the PMGC grounds and nearby Oaklands agricultural area with treated wastewater of improved quality.

Upgrades to the STP and the ocean outfall would reduce the environmental and health risks and impacts of the current operations, by providing a higher level of treatment and a superior mode of discharge/ dispersion of the treated wastewater via an ocean outfall offshore in Merimbula Bay.

A summary of the proposed Project elements is provided in **Table 2-1**.

The Project area comprises the existing Merimbula STP site and the proposed outfall pipeline alignment. The Project construction areas would include areas within the Merimbula STP, temporary laydown areas on the adjacent PMGC grounds and on Merimbula Beach (with associated access from Pambula), as shown in **Table 2-1**.

The EIS is based on a concept design for the Project. It is noted that during subsequent design stages, and subsequent to a design and construction contractor(s) being engaged, details of the Project may change or be refined (e.g. specific locations of some elements or infrastructure within the existing STP site; materials to be used in plant construction and technology).

Table 2-1 Project elements

Project element	Summary
STP upgrade	The STP upgrade would involve additional treatment processes incorporated into the existing STP site, including two stage poly aluminium chloride (PAC) dosing, ultraviolet (UV) disinfection, chlorine dosing and tertiary filtration (if required). The indicative physical layout of the proposed STP upgrade is shown in **Figure 2-2**. The new treatment processes would be incorporated into the following existing STP phases (refer **Chapter 2 Project description** for further information): *Phase two: secondary treatment* Addition of: • two stage PAC dosing for phosphorous removal. *Phase three: disinfection* A change to the existing disinfection (chlorine dosing) treatment, involving: • addition of ultraviolet (UV) treatment; • chlorine dosing would continue to be applied to treated wastewater, however wastewater would be divided into two separate streams: - wastewater to be beneficially re-used would be dosed with chlorine; and - wastewater to be discharged via the ocean outfall would no longer be subject to chlorine dosing; • the chlorine dosing proposed would involve installation of a new chlorine dosing unit (including two 920 kg drum storage of chlorine, and a new pump system). The chlorine dosing unit would be stored at a dedicated storage facility within the STP (either the existing chlorine storage shed would be upgraded to house the increased volume of chlorine required for the Project, or a new shed would be built on or near to the site of the existing shed); and • tertiary filtration could also be installed (if required).

Project element	Summary
	The Project would also require the following within the existing STP site: • a new storage tank and new chlorine contact tank; • installation of up to four additional pump stations: - ocean outfall pump station – to pump treated wastewater through the outfall pipeline; - storage tank pump station – to pump treated wastewater to the new storage tank; - chemical sludge pump station (if tertiary filters required) – to pump sludge and treated wastewater; and - pump station – to pump from wet weather overflow back into the STP treatment train. • installation of ancillary infrastructure (including new sheds/structures to house new treatment processes, above-ground storage tanks, pipes, pits, power supply and additional low voltage (LV) connection (including transformer, cabling and distribution board), control kiosks, a retaining wall and internal access roads); and • relocation and upgrade of utilities to accommodate the additional features proposed.
Existing STP effluent storage pond	The existing 17 ML effluent storage pond within the STP site would be decommissioned, including dewatering and sediment/sludge removal.
New ocean outfall pipeline and effluent diffuser, and associated pump station	*Phase four: Disposal and beneficial re-use* New additions would involve: • installation of a 3.5 km outfall pipeline – the pipeline would travel from the STP in an east-south-easterly direction to a location approximately 2.7 km offshore in Merimbula Bay; • the pipeline would involve two construction methods for different sections of the pipeline as follows: - 'Section one' – STP to a location beyond surf zone: underground trenchless drilling method (refer **Figure 2-3**); and - 'Section two' – Location beyond surf zone to offshore pipeline termination point: laying of pipeline on sea floor and covering with rock or concrete mattresses (refer **Figure 2-4**); • Section one of the pipeline (the onshore component) would be about 0.8 km and below ground. installation of the underground section would be via a trenchless method (e.g. horizontal direction drilling or direct drive tunnelling), followed by pipeline insertion via pulling or pushing; • Section two (the above ground section of the pipeline) would be installed via direct placement on the sea floor in 600 m to 800 m pipe lengths. This would also involve progressive protection and stabilisation works for the pipeline (e.g. potentially using concrete or rock mattresses) held together with ropes/ slings/ cables; • the terrestrial component of the outfall pipeline would be laid between about -9.3 m and -19.5 m AHD, with greater depth largely depending on the nature of the overlying sand dunes; • a multi-port pipeline diffuser would be located at the end of the pipeline at a depth of approximately 30 m; the diffuser would be approximately 80 m in length; • the pipeline would have an outer diameter of up to 450 mm (366 mm internal diameter) and consist of pipeline lengths welded together; • a transition riser may be required to connect the underground pipeline with the above ground section of pipeline on the sea floor (if required, the riser would be located beyond the surf zone); and • the pipeline would contain valves along its length for mitigating against air entrapment.

Project element	Summary
Existing exfiltration ponds	The existing exfiltration ponds within the adjacent sand dunes (east of the STP site) would cease to be used under the Project.
Existing beach-face outfall	The existing public beach-face outfall pipeline would be decommissioned. The exposed end of the outfall pipeline would be removed, and the remainder of the pipeline would remain in-situ (i.e. would remain buried underground).
Water use	The STP would continue to use potable town water for kitchen and amenities on site. Apart from these water inputs, the Project would not require any other ongoing water source during operation.
Construction	
Construction footprint	The construction footprint includes temporary compound and laydown areas as shown in **Figure 2-5**. The location of laydown areas would be confirmed during detailed design and would depend on the method and location/s proposed to be used for directional drilling by the construction contractor. Temporary construction laydown areas would be located: • within the STP site; • within a portion of the adjacent PMGC grounds; and • on Merimbula Beach (if required, for pipe stringing and potentially an intermediate drill rig site for directional drilling). A total of approximately 2,800 square metres (m^2) (or 0.28 hectares) of vegetation removal / trimming would be required in the following locations: • approximately 217 m^2 at the Pambula Beach access track; and • approximately 2,464 m^2 of regrowth scrub within the existing STP site and for construction access from the construction laydown area within the PMGC grounds; and • approximately 47 m^2 at the existing beach face outfall pipeline (to be decommissioned).
Construction timing, hours and workforce	Pending Project approval, it is proposed to commence construction in 2022, with construction anticipated to be undertaken over a period of 24 months. Construction would be staged and there would be times when some construction stages overlap. Works would typically be limited to standard daytime hours, which include: • 7:00 am to 6:00 pm Monday to Friday; • 8:00 am to 1:00 pm Saturday; and • no work on Sundays, public holidays. Certain works may need to occur outside standard construction hours for the safety of workers, in accordance with transport licence requirements, or for constructability reasons. Activities to be carried out during out of hours periods may include oversized load deliveries and pipeline pulling as part of the directional drilling (which would need to be undertaken continuously until completed, which may take up to 48 hours). Construction works in Merimbula Bay could occur seven days a week to maximise works during favourable offshore weather conditions. Approval from BVSC would be required for any out of hours work and the affected community would be notified. Construction of the Project would require a workforce of around 20 workers, with peak construction periods requiring up to 30 workers.

Project element	Summary
Traffic, construction vehicle types and workforce	Construction traffic would indicatively comprise: • 5 to 10 heavy vehicles per day (e.g. truck and dogs); and • 10 to 20 light vehicles per day. Vehicles transporting machinery or oversized materials such as prefabricated units may be required from time to time, and oversized vehicles would require escort to and from site. The largest truck expected as part of construction is the directional drilling rig truck (the exact size would be confirmed by the construction contractor). The construction phase of the Project would require construction vehicles to transport materials and equipment along the existing road network to the construction compound/laydown areas at the Merimbula STP and PMGC grounds and, if required, at the Merimbula Beach laydown area via Pambula Beach. In facilitating these construction activities, various plant and equipment would be required, including: • small, medium and large excavators (3 tonne to 25 tonne) (tracked and wheeled); • compaction plant (e.g. roller/s, plate compactor); • grader; • bulldozer; • directional drilling rig truck and associated infrastructure (i.e. drilling fluid recovery and recovery unit); • pumps for dewatering (if required); • vacuum truck; • bobcat; • concrete trucks and pumps; • mobile cranes (e.g. franna crane, scissor lift, forklift); • semi-trailers and tipper truck; • telehandlers; • micro-piling rig (on barge); • water carts; • hand tools and welding equipment; • barges (e.g. 55 m and 73 m barges, jack-up barge) and tugs; • small, self-propelled vessel; • demolition saw, jackhammer, grinder; • generator/s, lighting tower; • forklift; • light vehicles and light trucks; and • heavy vehicles. The size of vehicles used for haulage would be consistent with the access route constraints, safety and any worksite constraints. Some construction activities (such as the delivery of precast sections) may require truck and trailer combinations or semi-trailers.

Project element	Summary
Access	Construction vehicles would access/egress the STP site via the following accesses: • Arthur Kane Drive, via either the northern end of the STP site, and/or the existing main STP entrance. Construction of the outfall pipeline would also utilise the following accesses: • Coraki Drive, Pambula (construction vehicles would enter the temporary beach access track from the end of Coraki Drive, before traversing the beach access track to the laydown area on Merimbula Beach); and • Port of Eden, Twofold Bay (barge/s would transport materials and equipment northward to the location of the proposed outfall pipeline alignment). Construction site accesses at Arthur Kaine Drive and Pambula Beach are shown in **Figure 2-5**. Construction materials and equipment could also be delivered to the Port of Eden using shipping containers, with construction vehicles expected to haul these containers to the construction sites via the Princes Highway.

2.3 Operational stage

The Project would be operated with the additional treatment processes which would improve the quality of the treated wastewater. Levels of total phosphorus, total suspended solids, biological oxygen demand, virus, bacteria and other pathogens would be managed to be within discharge limits. Treated wastewater would be tested for quality prior to discharge via the ocean outfall pipeline or via beneficial re-use offsite (to existing land application areas at the Oaklands agricultural area or the adjacent PMGC grounds). Maintenance activities for the STP and ocean outfall would also be undertaken and would continue until the STP is decommissioned or further upgraded in the future and would continue until the STP is decommissioned or further upgraded in the future..

FIGURE 2-1: PROJECT AREA

N

0 500 1,000 m

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Source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- Project area
- Project area (temporary construction area)

FIGURE 2-2: PROPOSED STP LAYOUT (INDICATIVE)

N 0 50 100 m

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Legend

- Project area
- Project area (temporary construction area)

Proposed Project Upgrades

- PAC dosing, UV disinfection, tertiary treatment
- Pump stations, storage, chlorine disinfection
- PAC dosing (second unit)
- Effluent storage pond to be decommissioned

Source: Nearmap, 2019

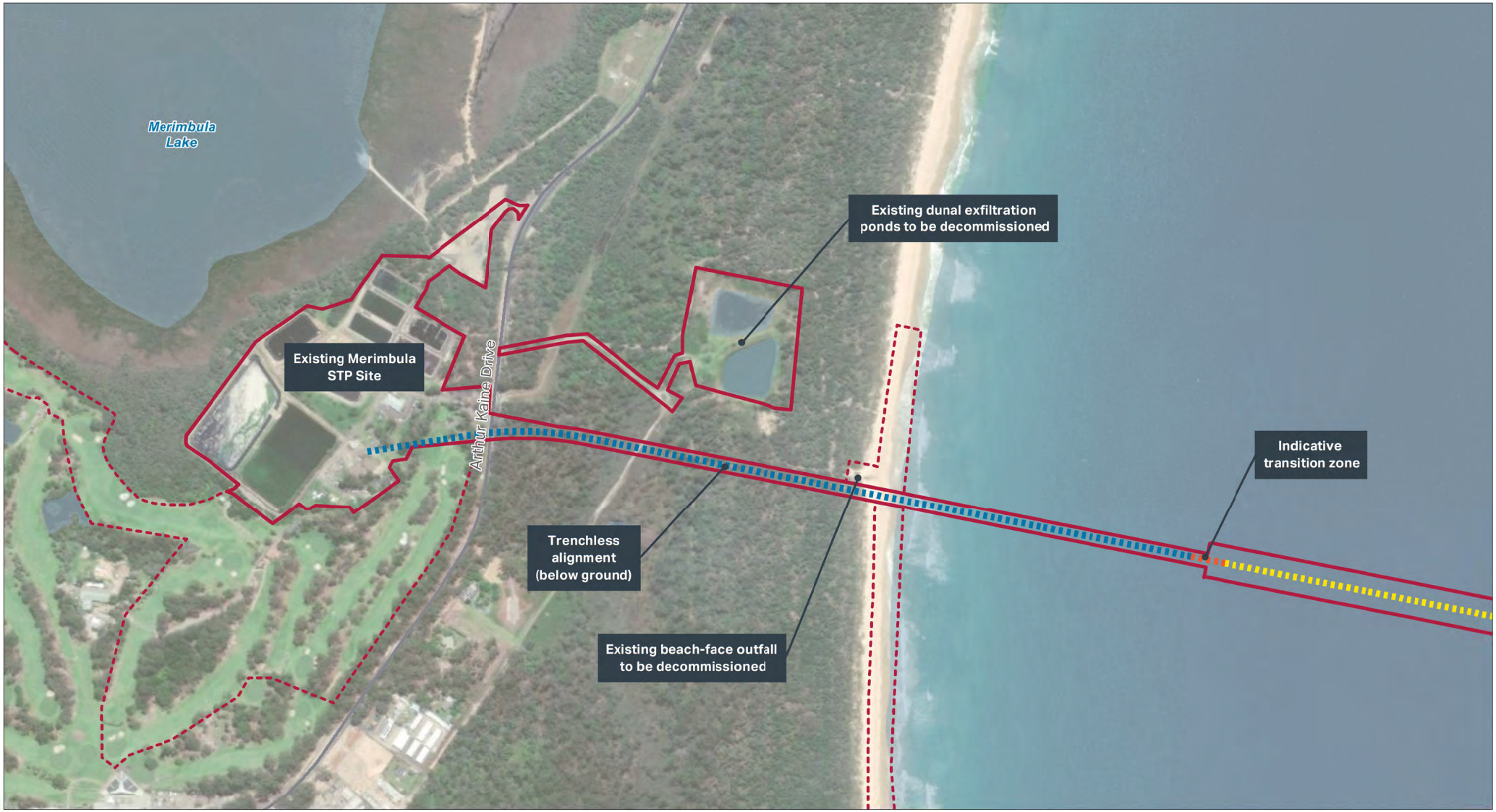

FIGURE 2-3: OCEAN OUTFALL PIPELINE - SECTION 1 (BELOW GROUND)

N

0 100 200 m

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Legend

- Project area
- Project area (temporary construction area)
- Outfall pipeline – Section 1 (below ground)
- Transition Zone
- Outfall pipeline – Section 2 (above seafloor)

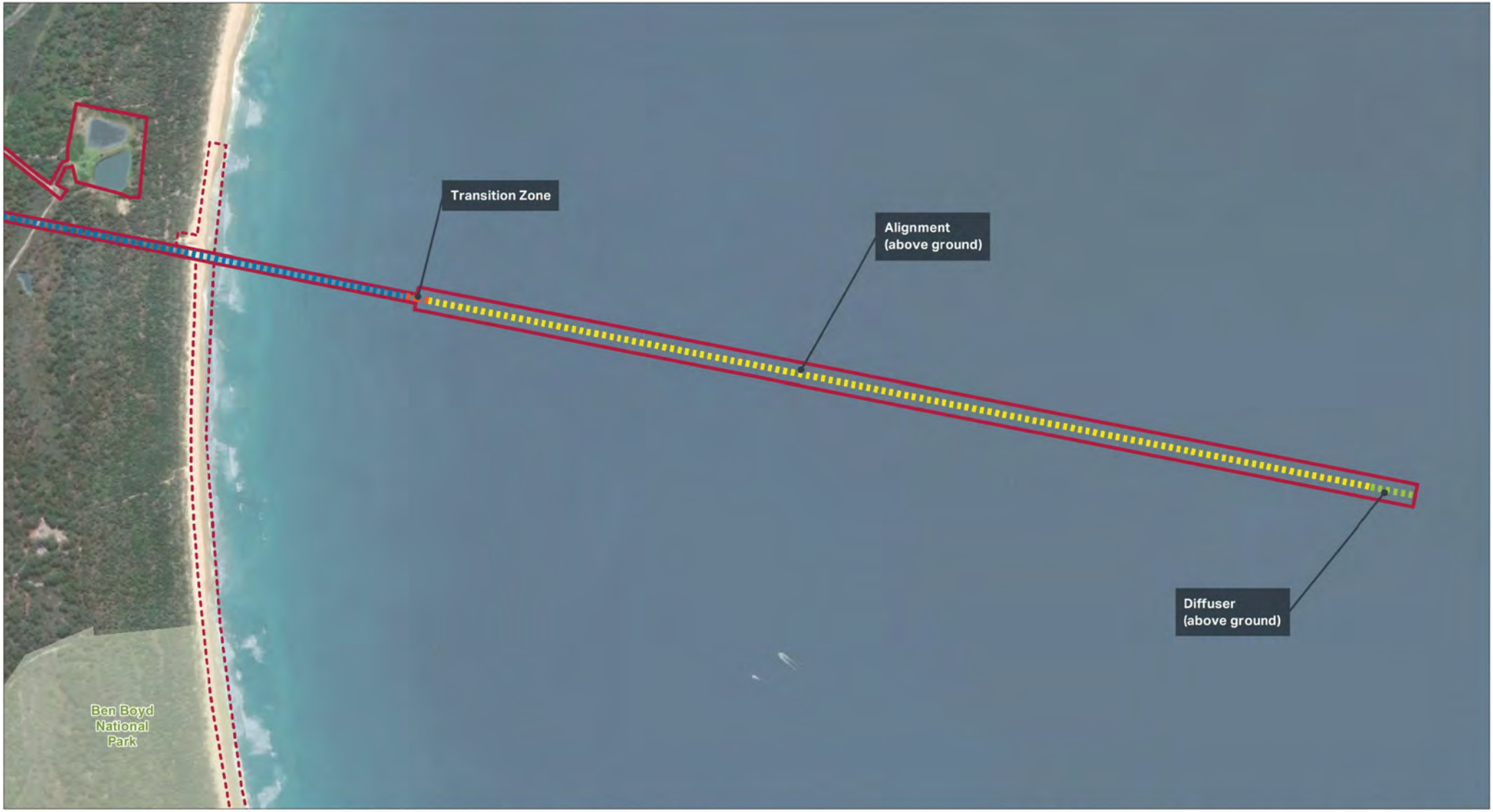

FIGURE 2-4 : OCEAN OUTFALL PIPELINE – SECTION 2 (ABOVE SEAFLOOR)

Legend

- Project area
- Project area (temporary construction area)
- Outfall pipeline – Section 1 (below ground)
- Transition Zone
- Outfall pipeline – Section 2 (above seafloor)
- Diffuser (above seafloor)

N

0 200 400 m

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FIGURE 2-5: CONSTRUCTION COMPOUND/LAYDOWN AREAS

N

0 300 600 m

AECOM

Legend

- Project area
- Temporary project area for construction
- Construction access
- Construction compound/laydown area
- Construction laydown area and potential intermediate drilling site
- Construction laydown area at Pambula-Merimbula Golf Club grounds

Source: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

3.0 Existing environment

3.1 Surrounding area

The Project is located within a mixed use environment. Merimbula Airport is located to the North of the site, Merimbula Lake lies to the North west, PMGC is located to the south/south east and the area to the east is mostly bushland. The closest residential receivers are located to the south east along Arthur Kaine Drive. Arthur Kaine Drive is an arterial road according to categories within the *NSW Road Noise Policy* (DECCW, 2011). The Project area and its surrounding environment are shown in **Figure 2-1**.

3.2 Noise sensitive receivers

3.2.1 Noise catchment areas

Three noise catchment areas (NCAs) were identified surrounding the Project area, as shown in **Figure 3-1.** The NCAs were determined by reviewing existing land use and identifying groups of noise sensitive receivers which are likely to be exposed to a similar noise environment. For suburban environments ambient noise levels in these areas are typically influenced by transport infrastructure and noise generating industry.

Noise sensitive receivers include people within noise sensitive land uses as defined by the ICNG, being:

- residential areas;
- educational establishments;
- hospitals;
- places of worship;
- active recreational areas;
- passive recreational areas; and
- community centres.

Commercial and industrial receivers are generally not considered noise sensitive, however some may comprise specific uses which are considered noise sensitive. For example; childcare centres, aged care and theatres (when in use) are considered noise sensitive receivers. Where a number of commercial and industrial receivers are located together and are not considered sensitive, they have not been included in an NCA; however they have still been assessed within this report.

FIGURE 3-1: NOISE CATCHMENT AREAS

N

0 300 600 m

AECOM

Legend

- Project area
- Project area (temporary construction area)
- Noise catchment area (NCA)
- Background noise monitoring location

Source: Department of Customer Service, 2020; Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

3.3 Noise measurement methodology

Long term unattended and short term attended measurements were undertaken to establish the existing ambient and background noise environment at potentially affected receivers.

All the acoustic instrumentation employed during the noise measurements comply with the requirements of "*AS IEC 61672.1-2004 Electroacoustics - Sound level meters - Specifications*" and were within their current National Association of Testing Authorities, Australia (NATA) certified in-calibration period (i.e. calibration in the last two years).

3.3.1 Unattended noise measurement methodology

Long term unattended noise monitoring was conducted at three locations between 11 and 25 September 2019. One noise logger was placed within each NCA at a representative location at the properties indicated in **Table 3-1**. The noise loggers were calibrated prior to and after the monitoring period with a drift in calibration not exceeding ± 0.5 dB.

Table 3-1 Noise monitoring details

Logger	Location	Model	Serial number
1	232 Arthur Kaine Drive, Merimbula	Rion NL21	765701
2	1 Narregol Street, Pambula	ARL 315	15-299-444
3	57 Green Point Road, Millingandi	Rion NL21	265112

In accordance with the EPA's NSW *Noise Policy for Industry*, noise monitoring affected by adverse weather conditions or extraneous noise events was excluded from the monitoring data. The *Noise Policy for Industry* advises that data may be affected where adverse weather, such as wind speeds higher than 5 metres per second (m/s) or rain, occurs. Weather data was acquired from the Bureau of Meteorology's Merimbula Airport AWS weather station (station number 069147) located around 700 m north of the Project.

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

The L_{A90} noise levels were analysed to determine a single assessment background level (ABL) for each day, evening and night period in accordance with the *Noise Policy for Industry* for each monitoring location. The ABL is established by determining the lowest ten-percentile level of the L_{A90} noise data acquired over each period of interest. **Table 3-2** presents individual ABLs for each day's assessment periods. The background noise level or rating background level (RBL) representing the day, evening and night-time assessment periods is based on the median of individual ABLs determined over the entire monitoring period.

3.3.2 Attended noise measurement methodology

Attended noise measurements were conducted at the three unattended monitoring locations and within the existing STP site on 12 September 2019 during the daytime. Each measurement was conducted over a 15 minute period. Weather conditions were overcast on the days of monitoring, with no wind.

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

3.4 Noise measurement results

3.4.1 Unattended noise measurement results

Table 3-2 presents the existing overall representative L_{Aeq} ambient noise level and the background L_{A90} noise levels for the day, evening and night-time periods, in accordance with the *Noise Policy for Industry*. The overall representative L_{Aeq} noise levels were determined by logarithmically averaging each assessment period for the entire monitoring period.

In total 14 days of logging were completed, however some periods of noise logging were excluded due to adverse weather. The data were processed in accordance with Fact Sheet B of the *Noise Policy for Industry*.

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

Table 3-2 Existing background (L_{A90}) and ambient (L_{Aeq}) noise levels

NCA	L_{A90} background rating noise level, dB(A)			Log average noise (ambient) L_{Aeq} levels dB(A)		
	Day[1]	Evening[1]	Night[1]	Day[1]	Evening[1]	Night[1]
1	49	38	38[2]	58	54	51
2	41	33	30	55	47	46
3	35[3]	30[3]	30[3]	45	40	42

Notes:

1. *Day is defined as 7:00 am to 6:00 pm, Monday to Saturday and 8:00 am to 6:00 pm Sundays & Public Holidays. Evening is defined as 6:00 pm to 10:00 pm, Monday to Sunday & Public Holidays. Night is defined as 10:00 pm to 7:00 am, Monday to Saturday and 10:00 pm to 8:00 am Sundays & Public Holidays.*
2. *Night-time RBL adjusted to the same as the evening RBL in accordance with the Noise Policy for Industry. This is because the community generally expects greater control of noise during the more sensitive night-time periods than during the evening period.*
3. *Set to minimum RBL in accordance with the Noise Policy for Industry.*

3.4.2 Attended noise measurements

The results of the attended noise monitoring are presented in **Table 3-3**. The daytime measurements indicated that residential receivers are affected by existing industrial noise and road traffic noise.

Table 3-3 Attended noise measurements

NCA	Date	Time	L_{Aeq} dB(A)	L_{A90} dB(A)	Comments
1	11/9/2019	16:23	58	52	Noise environment dominated by road traffic noise along Arthur Kaine Drive. Bird calls heard most of the time. Industrial hum heard in absence of vehicles, from north/north east direction, hard to distinguish at times from planes landing/taking off
2	11/9/2019	14:28	53	48	Noise environment dominated by road traffic noise to the east and north east along Arthur Kaine Drive. Bird calls heard. Industrial hum faintly audible from the south east at times
3	11/9/2019	13:09	44	38	Background controlled by environment. Some banging in distance could be faintly heard at times. Boats/watercraft in Merimbula Lake can be a heard, noise from airport can also be heard. Birds calling

3.4.3 Attended noise measurements – Existing STP

AECOM undertook noise measurements and observations at the STP on 12 September 2019. The measured sound power levels are provided below in **Table 3-4**. The noise measurement locations are shown in **Appendix C** of this report.

Table 3-4 Summary of L_{Aeq} sound power levels – Existing plant

Source	Overall SWL dB(A)
Aerators (3 off)	97
Pump 1	79
Pump 2	78
Pump 3	70

4.0 Methodology

4.1 Relevant guidelines and policies

The following policies and guidelines are relevant for this assessment:

- *Interim Construction Noise Guideline* (ICNG), Department of Environment and Climate Change, 2009;
- *Assessing Vibration: A Technical Guideline* (AVATG), Department of Environment and Conservation, 2006;
- *NSW Road Noise Policy* (RNP), Department of Environment, Climate Change and Water, 2011;
- *Noise Policy for Industry* (NPfI), Environment Protection Authority, 2017;
- DIN Standard 4150: Part 3 1999 *Structural Vibration in Buildings - Effects on Structures*, 1999;
- British Standard 6472: Part 1 2008 *Evaluation of Human Exposure to Vibration in Buildings*, 2008;
- Australian Standard AS 2436-2010, *Guide to noise and vibration control on construction, demolition and maintenance sites*, 2010;
- British Standard 5228: Part 1 2009 *Code of Practice for Noise and Vibration Control on Construction and Open Sites* Part 1: Noise, 2009 including Amendment 1, 2014;

Definitions for acoustic terminology used within this report can be found in the Glossary.

4.2 Study area

The study area for this report comprises the areas within the Project area, the noise catchment areas (NCA) and the surrounding roads. The Project area is shown on **Figure 2-1**. The NCAs are presented in **Figure 3-1**.

4.3 Noise modelling assumptions

The construction and operational noise associated with the Project has been modelled in SoundPLAN Version 8.0. The following features were included in the noise model:

- ground topography;
- ground absorption and reflection (the assessment also considers that noise would travel more easily over the water (i.e. ocean) (the water has been modelled as a reflective surface with no absorption);
- buildings (residential and commercial); and
- construction and operational noise sources.

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

4.3.1 Topography

The operational noise model has been based on topographical information (contours provided at 1.0 m intervals). The surface of the hardstand areas has been modelled using the 'ground absorption' function in SoundPLAN to replicate an acoustically 'hard' surface (i.e. reflective), with an absorption coefficient of 0. Areas other than the hardstand area have been modelled with a ground absorption of 0.75.

4.3.2 Buildings

Industrial, commercial and residential buildings have been incorporated into the model (obtained from digital survey information and/or digitisation of aerial photography).

4.3.3 Meteorological conditions

AECOM has undertaken modelling of industrial noise emission from the site under the following meteorological conditions:

- neutral weather conditions – 0.5 m/s winds and D class stability;
- winds of 3 m/s in the worst case direction and D class stability (night and evening only); and
- temperature inversion – 2 m/s winds and F class stability (night only).

4.4 Noise sources

4.4.1 Construction sources

The following items of construction equipment have been assumed for the Project. These would be confirmed by the construction contractor prior to construction commencing and further assessment would be undertaken if required. Noise sources and their respective L_{Aeq} sound power levels for each work package are shown in **Table 4-1**.

These sound power levels are typical values taken from data provided in Australian Standard AS2436-2010, *Guide to noise and vibration control on construction, demolition and maintenance sites* and British Standard 5228: Part 1 2009 *Code of practice for noise and vibration control on construction and open sites*, 2009 and assume equipment is modern and in good working order.

Table 4-1 Equipment sound power levels

Equipment	Sound power level, dB(A)
Barge 55 m and 73 m (includes piling ring, drill rig and pipe handler, etc.)	105
Bobcat	104
Bulldozer	109
Cement truck	105
Concrete pump	106
Crane truck	104
Demolition saw	115[1]
Directional drill rig	108
Drilling fluid recycling unit	102
Excavator 20t	98
Forklift	93
Franna crane	93
Generator	101
Grader	109
Grinder	108
Hand tools	94
Hand tools/welding equipment	101
Heavy truck	108[2]
Jackhammer	108
Jacking rig	102
Jack-up barge	104
Light vehicles	90
Lighting tower	95

Equipment	Sound power level, dB(A)
Micro-piling rig on barge	103
Plate compactor	104
Pump stations, sand filter	92
Roller	105
Scissor lift	100
Small excavator	94
Small self-propelled vessel	105
Small service truck, light truck	103
Telehandler	92
Tip truck	108
Truck (semi trailers and tipper)	108
Tug	105
Vacuum truck	103

Notes:
1 Assumes construction equipment is operating 33% of the time in any 15 minute period.
2 Assumes one heavy vehicle movements in any 15 minute period

4.4.2 Construction stages

The following construction stages have been assessed.

Table 4-2 Proposed construction stages

Stage	Description of activities	Noise emitting plant/ equipment involved	Duration	Timing[1]
Stage 1A - Utility works/ relocations	• identify existing services • excavate and relocate where required • identify mains to exfiltration ponds as well as beach-face outfall pipeline alignment, in order to avoid them (i.e. no excavation work required)	Demolition saw Small excavator Hand tools Vacuum truck Trucks (semi-trailer and tipper)	1 month	Standard construction hours
Stage 1B - Site establishment	• mobilisation of machinery and equipment needed for site establishment • clearing of ancillary facility/construction areas/pipeline stringing area and levelling where required • clearing of vegetation • laying down of gravel • installation of site offices, amenity	Hand tools Bobcat Generator Crane trucks (semi-trailer and tipper) Heavy trucks for floating equipment to site Lighting tower Grader 10 t Excavator Light vehicles	0.5 month	Standard construction hours

Stage	Description of activities	Noise emitting plant/ equipment involved	Duration	Timing[1]
	blocks and utility connections, and parking areas within the ancillary facility areas • erection of hoarding, fencing and flagging • installation of temporary erosion and sediment controls • clearing and establishment of access tracks to STP site and beach access	Bulldozer 10-15 t Grader		
Stage 3 - STP upgrade works within STP site	• heavy and light vehicles arriving/departing site each day • bulk earthworks and excavation (for pipes, new infrastructure) • importing of fill • decommissioning of existing effluent storage pond within the STP, including removing sludge/clean out and removal of pipes/pits and connections • further relocation and upgrade of utilities • construction of STP infrastructure, including buildings, dosing facilities, filtration units (sand filters), and a new pump stations - this would involve laying foundations/concrete slabs, installation of process units, placement and joining of pump station equipment, erection of buildings and pump station building • installation of storage tank and chlorine contact tank • installation of pipes,	Grader Excavators 2 x 20t Demolition saw Telehandler Franna crane Hand tools/welding equipment Grinder Generators Jackhammer Forklift Scissor lift Cement trucks Bobcat Vacuum truck Plate compactor Jacking rig Roller Trucks (semi-trailers and tipper) Concrete pump	10 months	Standard construction hours

Stage	Description of activities	Noise emitting plant/ equipment involved	Duration	Timing[1]
	switches, valves and connections throughout plant • installation of electrical and control infrastructure			
Stage 4 - Pipeline butt welding and stringing Note there are 2 options for Stage 4[2]	• mobilisation of pipe to laydown area and unloading pipe • inserting temporary ballast into pipe strings for directional drilled section • attaching permanent concrete weights to offshore section of pipe and diffuser • pipeline butt welding and stringing • moving pipe around within the laydown area and to site	Heavy trucks for pipes Welding gear/hand tools Excavator 5 t (with attachment to lift pipes) Trucks-welding Light vehicles Generator Telehandler	3 months	Standard construction hours
Stage 5 – Ocean outfall pipeline construction – directional drilling and pulling Note there are 3 options for Stage 5[3]	• establishment of drill pad and compound (about 40 m x 20 m), including site shed/s • mobilisation of drill rig and equipment/machinery to the drill site, including drilling fluid recycling unit set up (for separating spoil out, and re-using drilling fluids) • directional drilling from land-based pad (this would likely be done continuously over 48 hours and therefore involve 'out of standard hours' work) • trucking drilling spoil/waste away	Excavator 20t Grader Directional drill rig Drilling fluid recycling unit Tip truck Hand tools Vacuum truck Light vehicles Generators Heavy trucks for delivering rig, rods, mud separation/recycling Welding gear/hand tools	2.5 months, up to 4.5 months depending on drilling method/ locations used	Standard construction hours, plus out of hours work (evening and night-time work) for pulling (i.e. 48 hours continuous)

Stage	Description of activities	Noise emitting plant/ equipment involved	Duration	Timing[1]
Stage 6A - Offshore Pipeline riser/exit works	• barge to offshore location • install pipeline riser in seabed (at eastern extent of directional drilling location) using micro-piling • note that all that may be needed for the riser is an exit casing and/or exit pit or a temporary exit mound on the seabed to prevent drilling fluid blow out	Welding gear/hand tools Jack-Up barge (only required for exit casing (or if HDD operation is marine based)) Micro-piling rig on barge 73 m barge 55 m supply barge Anchor handling tug supply (AHTS) vessel Excavator Drill rig	3 months	Standard construction hours and out of hours work (evening and night-time works)
Stage 6C - Lay pipe strings for above ground offshore section[4]	• float out and progressively sink pipe strings for above ground offshore section, including: - loading pipe lengths onto 73 m barge at Port of Eden or Merimbula Beach laydown area - tow out to installation location - progressively lower pipe strings to seabed	73 m barge with crane/pipe handler to lower pipe 2 x small self-propelled vessels to assist Excavator with attachment (to load pipes onto barge)	1 month	24 hours
Stage 6D - Cover above-ground offshore pipeline[4]	• covering offshore pipeline using barges to lower rock or concrete mattresses to cover pipeline • an anchored vessel such as a small barge would act as the target vessel for the rock barges to tie up alongside and dump rock into a chute fixed to the target vessel	73 m barge 55 m barge Anchored vessel/small barge	1 month	24 hours

Stage	Description of activities	Noise emitting plant/ equipment involved	Duration	Timing[1]
Stage 6E - Diffuser works[4]	• float diffuser out to offshore location (from the Merimbula Beach laydown area), sink it, cover/protect it	73 m barge	<1 month	24 hours
		55 m barge		
		Anchored vessel/small barge		
Stage 7 - Commissioning (all new components)	• operating pump stations • operating new STP components • pipeline pigging • barge operation	Pump stations, sand filters	2 to 5 months	Standard construction hours
		Barge (up to 120 ft) with tug or self-propelled dive vessel		
		Small service trucks, light trucks		
		Hand tools		

Notes:

1: Certain works may need to occur outside standard daytime hours for the safety of workers and in accordance with transport licence requirements. Activities to be carried out during these periods may include oversized load deliveries. Approval would be required for any out of hours work and the affected community would be notified.

2: Option A includes pipeline welding/stringing within the PMGC laydown area and the STP site. Option B includes pipeline welding/stringing at the Merimbula Beach laydown area/intermediate site.

3: Option A includes drill rig located on the Merimbula Beach laydown area/intermediate drilling site and pipe strings located on Merimbula Beach laydown area/floated out to beyond surf zone.

Option B includes drill rig located at the Merimbula Beach laydown area/intermediate drilling site and pipe strings located on the PMGC laydown area/STP site.

Option C includes drill rig located at STP drill pad site (drilling eastbound) and pipes located at the Merimbula Beach laydown area; for this option a temporary noise barrier has been assumed to be located around the drill rig. Note that Option A and Option B would cover the possibility of a drill rig located offshore (about 150 metres from the shore line, where the underground section of pipeline is expected to join to the aboveground section of pipeline) and drilling westbound, as noise impacts would be greater on Merimbula Beach which is closer to noise sensitive receivers.

4: Marine work in Stages 6C, 6D and 6E may require extended hours and weekend work to take advantage of favourable conditions.

It is noted that a number of stages may overlap, these scenarios are presented in **Table 4-3**. Note that these scenarios are considered to be conservative, as for example, if two of the Stage 5 options are required during construction (i.e. two different directional drilling sites are required), it is unlikely that both of the drilling sites would be operating at the same time; the drill rig is more likely to finish drilling and pulling pipes at one site, and then mobilise to the next site.

Table 4-3 Construction scenarios based on stages that may overlap

Scenario (potential overlapping stages)
3 and 6A
3, 4B, 5A and 5C
4A, 4B, 5A and 5B
4B, 5A and 5C
4B and 5C
6C and 6D

4.4.3 Operational noise sources

Table 4-4 presents the sound power levels which were used in the operational noise model. These sound power levels are based upon measurements that AECOM made (existing plant) on 27

September 2019 at the STP and AECOM's library of sound power data (proposed plant). It is noted that there would also be small pumps associated with the Poly Aluminium Chloride (PAC) dosing system, however these would not be a significant noise source and therefore have not been included in the operational noise model.

Table 4-4 Summary of L_{Aeq} sound power levels – Existing and proposed plant

Source	Existing or proposed plant	Overall SWL dB(A)
Aerators (3 off)	Existing	97
Pump 1	Existing	79
Pump 2	Existing	78
Pump 3	Existing	70
Ocean outfall pump station (45 kW Pump)	Proposed	85
Storage tank pump station (<45 kW Pump)	Proposed	85
Chemical sludge pump station (<45 kW Pump)	Proposed	85
Sand filter pump station (<45 kW Pump)	Proposed	85

4.5 Construction activity noise criteria

4.5.1 Interim Construction Noise Guideline

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

The *Interim Construction Noise Guideline* is a NSW Government document that sets out ways to deal with the impacts of construction noise on residences and other sensitive land uses. It presents assessment approaches tailored to the scale of the construction project and identifies practices to minimise noise impacts. As the proposed works are expected to continue for a period of more than three weeks and are within relatively close proximity to noise sensitive receivers, a quantitative assessment, based on 'reasonable' worst case construction scenarios, has been carried out for these works.

Noise levels resulting from construction activities predicted at nearby noise sensitive receivers (such as residences, schools, hospitals, places of worship, passive and active recreation areas) are compared to the levels provided in the ICNG. Where an exceedance of the management levels is predicted the ICNG advises that receivers can be considered 'noise affected' and the proponent should apply all feasible and reasonable work practices to minimise the noise impact. The proponent should also inform all potentially affected residents of the nature of the works to be carried out, the expected noise level and duration, as well as contact details should they wish to make a complaint.

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

The construction noise management levels (NML) for the residential and other sensitive land uses are detailed in **Table 4-5**, **Table 4-6** and **Table 4-7**.

Table 4-5 ICNG residential noise management levels

Time of day	NML, $L_{Aeq,15min}$, dB(A)[1]	How to apply
Recommended standard hours: Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise • Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times
Outside recommended standard hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours • The proponent should apply all feasible and reasonable work practices to meet the noise affected level • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community • For guidance on negotiating agreements see section 7.2.2 of the ICNG

Notes:

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

The ICNG defines what is considered to be feasible and reasonable as follows:

- *"Feasible*

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

- *Reasonable*

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

Table 4-6 presents the NMLs applicable to residential receivers around the Project.

Table 4-6 Construction noise management levels – Residential receivers

NCA	Period	RBL, L_{A90} dB(A)	Standard construction hours noise management levels, $L_{Aeq,15min}$, dB(A)	Out-of-hours noise management levels, $L_{Aeq,15min}$, dB(A)
1	Day	49	59	54
	Evening	38	-	43
	Night	38	-	43
2	Day	41	51	46
	Evening	33	-	38
	Night	30	-	38
3	Day	35	45	40
	Evening	30	-	35
	Night	30	-	35
Pambula Beach Caravan Park (Discovery Parks – Pambula Beach)	Day	35	50[1]	45[1]
	Evening	30	-	40[1]
	Night	30	-	40[1]

Notes:
1. The NMLs for Pambula Beach Caravan Park have been set to the NMLs for NCA3 + 5 dB

Table 4-7 presents the NMLs applicable to other non-residential receivers around the Project.

Table 4-7 Construction noise management levels – Other receivers

Land use	Noise management levels, $L_{Aeq,15min}$ (applies when properties are in use)
Active Recreation	65 dB(A)
Commercial premises (including offices, retail outlets)	70 dB(A)
Industrial Premises	75 dB(A)

4.5.2 Sleep disturbance criteria

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

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

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

Based on the measured background noise levels during the night, the sleep disturbance criteria for the nearest noise sensitive residential receivers are presented in **Table 4-8**.

Table 4-8 Sleep disturbance criteria

NCA	Background noise level (L_{A90}), dB(A)	Sleep disturbance criteria,	$L_{A1(1\ minute)}$, dB(A)
		Screening level	Awakening reaction
1	38	53	65
2	30	45	65
3	30	45	65

4.6 Construction traffic noise criteria

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

Construction vehicles are expected to access the site using the following routes:

- Arthur Kaine Drive via Toallo Street and Princes Highway;
- Merimbula Beach via Coraki Drive, Pambula Beach Road and Princes Highway; and
- Port of Eden via Princes Highway and Imlay Street.

The classification of these roads the estimated traffic flows are listed in **Table 4-9**.

Table 4-9 Roads used by construction traffic

Road	Type	Residential receivers	Estimated Annual Average Daily Traffic
Arthur Kaine Drive	Arterial road	Yes	>5,000
Pambula Beach Road	Sub-arterial road	Yes	>1,000
Princes Highway	Arterial road	Yes	>5,000

4.7 Construction vibration criteria

The relevant standards/guidelines for the assessment of construction vibration are summarised in **Table 4-10**.

Table 4-10 Standards/guidelines used for assessing construction vibration

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

Notes:

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

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

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

4.7.1 Structural damage

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

The German standard (DIN 4150) and British standard (BS 7385) provide recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration and are presented in **Table 4-11** and **Table 4-12**. DIN 4150 states that buildings exposed to higher levels of vibration than recommended limits would not necessarily result in damage. Structural damage criteria for heritage and/or sensitive items have been taken from DIN 4150, whilst criteria for commercial/residential items have been taken from BS 7385.

Table 4-11 DIN 4150: Structural damage safe limits for building vibration

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

Notes:

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

Table 4-12 BS 7385: Transient vibration guide values for cosmetic damage

Group	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

4.7.2 Human comfort

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

Maximum and preferred VDVs for intermittent vibration arising from construction activities are listed in **Table 4-13**. The VDV criteria are based on the likelihood that a person would be annoyed by the level of vibration over the entire assessment period.

Table 4-13 Preferred and maximum vibration dose values for intermittent vibration ($m/s^{1.75}$)

Location	Daytime[1]		Night-time[1]	
	Preferred	Maximum	Preferred	Maximum
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

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

4.8 Operational noise criteria - Noise Policy for Industry

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

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

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

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

4.8.1 Intrusive noise impacts

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

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

The RBL and the respective intrusive criteria for the day, evening and night periods are provided in **Table 4-14**.

Table 4-14 Intrusive criteria

NCA	Period	RBL (L_{A90}), dB(A)	Intrusive criteria (RBL+5), dB(A)
1	Day	49	54
	Evening	38	43
	Night	38	43
2	Day	41	46
	Evening	33	38
	Night	30	35
3	Day	35	40
	Evening	30	35
	Night	30	35

Note that given the distance between Pambula Beach Caravan Park and the STP (> 2 km) operational noise levels would be insignificant and therefore no further consideration is required.

4.8.2 Protecting amenity

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

The project amenity level for a project is equal to the recommended amenity level – 5 dB(A). Therefore, relevant noise amenity level from **Table 4-15** is assigned as the project amenity noise level. The project amenity level is then converted to a 15 minute period by adding 3 dB(A).

The project amenity noise levels applicable the Project are provided in **Table 4-15**. The Pambula Beach Caravan Park is unlikely to be affected by operational noise from the Project and therefore its criteria is not included below.

Table 4-15 Project amenity noise levels

Type of receiver	Indicative noise amenity area	Time of day	Project amenity noise level, dB(A)	
			$L_{Aeq\ (period)}$	$L_{Aeq\ (15\ minute)}$
Residential receivers	Suburban	Day	50[1]	53
		Evening	40[1]	43
		Night	35[1]	38
Residential receivers	Rural	Day	45[1]	48
		Evening	40[1]	43
		Night	35[1]	38
Commercial premises	All	When in use	65	68
Active recreation area	All	When in use	55	58

Notes:

1. *Recommended amenity level minus 5 dB*
2. *External noise levels are based upon a 10 dB reduction from outside to inside through an open window.*

4.8.3 Summary

A summary of the Project noise trigger levels is presented in **Table 4-16** below. These trigger levels apply to environmental noise emissions from any activity undertaken or plant installed as part of the Project.

Table 4-16 Summary of environmental noise emission criteria

Location	Time of day	Project noise trigger levels[1] $L_{Aeq,15min}$, dB(A)
NCA1	Day	53
	Evening	43
	Night	38
NCA2	Day	46
	Evening	38
	Night	35
NCA3	Day	40
	Evening	35
	Night	35
School classroom	Noisiest 1-hour period when in use	48
Place of worship	When in use	53
Commercial premises	When in use	68
Active recreation area	When in use	58

Notes:

1. Project Noise Trigger Levels represent the lower of the intrusive and amenity criteria.

4.8.4 Maximum noise level assessment

The *Noise Policy for Industry* requires the potential for sleep disturbance to be assessed by considering maximum noise levels events during the night-time period.

Where the subject development/premises night-time noise levels at a residential location exceed the following screening levels a detailed maximum noise level event assessment should be undertaken:

- $L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater; and/or
- L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater.

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

Based on the measured background noise levels during the night, the sleep disturbance criteria for the nearest noise sensitive residential receivers are presented in **Table 4-17**.

Table 4-17 Night-time sleep disturbance screening levels

Location	Measured night-time RBL, $L_{A90,\ 15\ mins}$ dB(A)	Sleep disturbance screening levels	
		$L_{Aeq,15min}$, dB(A)	L_{AFmax}, dB(A)
NCA1	38	43	53
NCA2	30	40	52
NCA3	30	40	52

5.0 Construction impact assessment

5.1 Construction noise assessment

The residential receiver which is likely to be worst affected within each NCA has been identified and the construction noise levels have been assessed against the standard construction hours noise management levels. The level of impact may change depending on the final construction methodology.

During construction it is likely that all equipment would not be operating simultaneously at all times and in the one location, which would result in reduced noise levels compared with those predicted. As some construction stages may occur simultaneously, a cumulative noise impact has also been undertaken, which considers the scenarios described in **Table 4-3**.

Mitigation and management measures have been specified in **Section 7.1** which may reduce the impact of these exceedances on receivers.

Noise results are shown below for the closest receivers in each NCA and are presented graphically for each NCA in **Appendix D** of this report.

Table 5-1 Construction Noise Levels - 232 Arthur Kaine Drive, Merimbula (NCA1)

Construction Scenario	Predicted Noise Level	Criteria	Exceedance
1A - Day	48	59	-
1B - Day	55	59	-
3 - Day	52	59	-
3 and 6A - Day	52	59	-
3, 4B, 5A and 5C - Day	57	59	-
4A, 4B, 5A and 5B - Day	50	59	-
4B, 5A and 5C - Day	56	59	-
4B and 5C - Day	56	59	-
5 (worst case) - Night	42	43	-
6A – Night	38	43	-
6C and 6D – Night	36	43	-
6E – Night	36	43	-
7 - Day	39	59	-

Table 5-2 Construction Noise Levels - 3 Narregol Street, Pambula (NCA2)

Construction Scenario	Predicted Noise Level	Criteria	Exceedance
1A - Day	< 35	51	-
1B - Day	< 35	51	-
3 - Day	< 35	51	-
3 and 6A - Day	< 35	51	-
3, 4B, 5A and 5C - Day	< 35	51	-
4A, 4B, 5A and 5B - Day	< 35	51	-
4B, 5A and 5C - Day	< 35	51	-
4B and 5C - Day	< 35	51	-
5 (worst case) - Night	< 35	38	-
6A – Night	< 35	38	-
6C and 6D – Night	< 35	38	-
6E – Night	< 35	38	-
7 - Day	< 35	51	-

Table 5-3 Construction Noise Levels - 75 Green Point Road, Millingandi (NCA3)

Construction Scenario	Predicted Noise Level	Criteria	Exceedance
1A - Day	< 35	45	-
1B - Day	39	45	-
3 - Day	42	45	-
3 and 6A - Day	43	45	-
3, 4B, 5A and 5C - Day	44	45	-
4A, 4B, 5A and 5B - Day	< 35	45	-
4B, 5A and 5C - Day	42	45	-
4B and 5C - Day	42	45	-
5 (worst case) - Night	35	35	-
6A – Night	< 35	35	-
6C and 6D – Night	< 35	35	-
6E – Night	< 35	35	-
7 - Day	< 35	45	-

Table 5-4 Construction Noise Levels – Pambula Beach Caravan Park

Construction Scenario	Predicted Noise Level	Criteria	Exceedance
1A - Day	< 35	50	-
1B - Day	56	50	6
3 - Day	< 35	50	-
3 and 6A - Day	< 35	50	-
3, 4B, 5A and 5C - Day	< 35	50	-
4A, 4B, 5A and 5B - Day	< 35	50	-
4B, 5A and 5C - Day	< 35	50	-
4B and 5C - Day	< 35	50	-
5 (worst case) - Night	< 35	40	-
6A – Night	< 35	40	-
6C and 6D – Night	< 35	40	
6E – Night	< 35	40	
7 - Day	< 35	50	

5.1.1 Summary of impacts during standard construction hours

Results show construction noise levels are not expected to exceed the noise management levels during standard hours at any noise sensitive receivers, with the exception of Pambula Beach Caravan Park where the NMLs may be exceeded by up to 6 dB(A) at times. This exceedance is due to heavy vehicle movements into the Project area at the Pambula Beach access. It is also noted that noise levels due to the barges operating offshore were also predicted to be less than 35 dB(A) at Pambula Beach and Merimbula Wharf, which complies with the relevant minimum noise management levels from the ICNG.

5.1.2 Summary of impacts outside of standard hours

Results show construction noise levels are not expected to exceed the noise management levels outside of standard hours.

5.2 Construction traffic assessment

The numbers of construction vehicle movements have been estimated to be up to 20 light and up to 10 heavy vehicles per day during peak construction periods for delivery of materials, loading of spoil and waste and concreting activities.

The estimated existing traffic flows on all the roads listed in **Section 4.6** with residential receivers is substantially greater than the proposed construction traffic numbers. Therefore, the additional traffic would have a minor impact on existing road traffic noise in the area (traffic noise levels during construction are expected to increase by less than 2 dB).

5.3 Construction vibration assessment

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

- vibrating rollers; and
- jackhammers.

It is noted from the *Aboriginal Cultural Heritage Assessment Report* (AECOM, 2020) (refer **Appendix I** of the EIS) that there are a total of six Aboriginal sites recognised within and immediately surrounding the Project area, including two shell midden sites, two open artefact sites, a registered burial site and a previously recorded scarred tree. Of these, three sites – the burial site, a shell midden and a subsurface artefact scatter - are located partially within the Project area.

The minimum working distances of the vibration intensive items of equipment from vibration sensitive receivers are shown in **Table 5-5** which is based on recommendations of the TfNSW *Construction Noise and Vibration Strategy* (CNVS). If these minimum working distances are complied with no adverse impacts from vibration intensive works are likely in terms of human response or cosmetic damage.

Based on the indicative construction activities assessed for the Project, it is not considered likely that works would occur within the minimum working distances. If, however, vibration intensive works are required within these minimum working distances, mitigation and management measures to control excessive vibration would be implemented as outlined in **Section 7.1**.

Table 5-5 Minimum working distances of vibration intensive equipment

Plant	Rating/ description	Cosmetic damage		Human response
		Residential/ commercial (BS 7385)	Heritage and other sensitive structures (DIN 4150)	
Vibratory roller	< 50 kN (typically 1-2t)	5 m	8 m	15 m
	< 100 kN (typically 2-4t)	6 m	10 m	20 m
	< 200 kN (typically 4-6t)	12 m	20 m	40 m
	< 300 kN (typically 7-13t)	15 m	25 m	100 m
	> 300 kN (typically 13-18t)	20 m	30 m	100 m
	> 300 kN (> 18 t)	25 m	38 m	100 m
Jackhammer	Handheld	1 m (nominal)	1 m (nominal)	Avoid contact with structure

6.0 Operational impact assessment

6.1 Site operational noise

6.1.1 Existing noise levels

As noted in **Section 3.3.2**, AECOM undertook noise measurements and observations at the STP on 15 September 2019. Based on these measurements and observations a SoundPLAN noise model of the STP was developed. The noise levels predicted using the noise model have been compared to the noise levels measured at logging location 2 for the daytime period. **Table 6-1** shows the existing modelled noise levels from the STP at the nearest receivers for each NCA.

Table 6-1 Existing modelled operational noise levels of the STP

NCA	Address	Approx. distance from project area (m)	Sound pressure level, L_{Aeq} dB(A)
1	232 Arthur Kaine Drive, Merimbula	180	34
2	3 Narregol Street, Pambula	1,500	< 20
3	75 Green Point Road, Millingandi	1,200	27
-	Pambula Merimbula Golf Club	50	49

6.1.2 Results

Based on the assumptions and modelling parameters as set out in the previous sections, the typical operational noise levels were predicted at the receivers most likely to be affected. The operational noise levels were predicted under neutral and adverse meteorological conditions. The results of the modelling are presented in **Table 6-2** and **Table 6-3**. While a single night-time operational scenario has been assessed, it is representative of the likely worst case.

An assessment of the resultant noise levels at receivers for tonality and low frequency noise indicated that no corrections were required to be applied in accordance with the *Noise Policy for Industry*.

The results are presented at the worst affected receiver in each of the NCAs for the night-time period as this is the most noise sensitive period.

Noise contour plots for normal operational scenarios are presented in **Appendix E** of this report for night-time neutral and adverse weather conditions (wind 3 m/s source to receiver and an F class inversion).

The predicted noise levels due to the proposed upgrade have been compared to the NPfI criteria in **Table 6-2**. It can be seen that the L_{Aeq} level from the operation of the STP is under the Project trigger level.

Table 6-2 Predicted operational noise levels at noise sensitive receivers due to the Project

Receiver	Weather conditions	Approx. distance from Project area (m)	Sound pressure level, L_{Aeq} dB(A)		
			Result	Project trigger level	Exceedance
232 Arthur Kaine Drive, Merimbula	Night neutral conditions	180	20	38	-
	Night 3m/s wind		25	38	-
	Night temperature inversion		25	38	-
3 Narregol Street, Pambula	Night neutral conditions	1,500	<20	35	-
	Night 3m/s wind		<20	35	-
	Night temperature inversion		<20	35	-
75 Green Point Road, Millingandi	Night neutral conditions	1,200	<20	35	-
	Night 3m/s wind		<20	35	-
	Night temperature inversion		<20	35	-
Pambula Merimbula Golf Club	Night neutral conditions	50	35	58	-
	Night 3m/s wind		36	58	-
	Night temperature inversion		36	58	-

For an existing facility (in operation for more than 10 years) where there is a proposed discrete development the NPfI notes that the Project should not increase the overall noise emissions from the entire site. The increase in noise from the STP due to the Project has been considered in **Table 6-3**.

It can be seen that the likely increase in L_{Aeq} noise emissions due to the Project is less than 1 dB(A).

Table 6-3 Predicted operational noise level increases at noise sensitive receivers due to the Project

Receiver	Weather conditions	Approx. distance from Project area (m)	Sound pressure level, L_{Amax} dB(A)		
			Current	Proposed	Increase
232 Arthur Kaine Drive, Merimbula	Night neutral conditions	180	34	34	0.2
	Night 3 m/s wind		38	39	0.2
	Night temperature inversion		38	39	0.2
3 Narregol Street, Pambula	Night neutral conditions	1,500	16	16	0.5
	Night 3 m/s wind		23	23	0.3
	Night temperature inversion		23	23	0.3
75 Green Point Road, Millingandi	Night neutral conditions	1,200	267	27	0.2
	Night 3 m/s wind		34	34	0.1
	Night temperature inversion		34	34	0.1
Pambula Merimbula Golf Club	Night neutral conditions	50	49.3	49.4	0.1
	Night 3m/s wind		49.9	50.0	0.1
	Night temperature inversion		49.9	50.0	0.1

6.1.3 Sleep disturbance results

The sleep disturbance noise levels associated with the typical operation of the Project were predicted at nearby receivers under calm meteorological conditions and worst-case weather conditions. The results are presented in **Table 6-4**.

It can be seen that the L_{Amax} and L_{Aeq} levels from the operation of the STP are well under the Project sleep disturbance criteria.

Table 6-4 Predicted night-time L_{Amax} operational noise levels and sleep disturbance criteria

Receiver	Weather conditions	Approx. distance from Project area (m)	Sound pressure level, L_{Amax} dB(A)		
			Result	Criterion	Exceedance
232 Arthur Kaine Drive, Merimbula	Night neutral conditions	500	34	53	-
	Night 3m/s wind		39	53	-
	Night temperature inversion		39	53	-
3 Narregol Street, Pambula	Night neutral conditions	1,500	< 20	52	-
	Night 3m/s wind		24	52	-
	Night temperature inversion		24	52	-
75 Green Point Road, Millingandi	Night neutral conditions	1,200	27	52	-
	Night 3m/s wind		34	52	-
	Night temperature inversion		34	52	-

Table 6-5 Predicted night-time L_{Aeq} operational noise levels and sleep disturbance criteria

Receiver	Weather conditions	Approx. distance from Project area (m)	Sound pressure level, L_{Aeq} dB(A)		
			Result	Criterion	Exceedance
232 Arthur Kaine Drive, Merimbula	Night neutral conditions	500	36	43	-
	Night 3m/s wind		38	43	-
	Night temperature inversion		38	43	-
3 Narregol Street, Pambula	Night neutral conditions	1,500	<20	40	-
	Night 3m/s wind		24	40	-
	Night temperature inversion		24	40	-
75 Green Point Road, Millingandi	Night neutral conditions	1,200	27	40	-
	Night 3m/s wind		34	40	-
	Night temperature inversion		34	40	-

6.1.4 Discussion

Operational noise from the Project is not expected to exceed the project noise trigger levels at nearby sensitive receivers. In addition, noise levels from the STP are not expected to increase significantly with the addition of the Project. A maximum increase of 0.5 dB(A) is predicted.

No exceedances of the sleep disturbance criteria are predicted as a result of the Project.

6.2 Operational traffic

It is anticipated that the upgraded STP facilities are likely to result in a marginal increase in traffic, from people accessing the site by car. This would have a negligible impact on road traffic noise levels of the surrounding road network given the existing traffic volumes.

7.0 Mitigation and management measures

7.1 Overview

This chapter describes the environmental management approach for noise and vibration during the construction and operation of the Project. This chapter also includes the performance outcomes as well as mitigation and management measures for the Project to manage potential noise impacts from the Project.

7.2 Performance outcomes

The airborne noise and vibration performance outcomes for the Project are as follows:

- minimise adverse impacts on acoustic amenity during construction; and
- community consultation/notifications in relation to construction noise are undertaken where necessary, in a timely fashion.

The Project would be designed, constructed and operated to achieve these performance outcomes.

7.3 Construction mitigation and management measures

Generally construction noise levels have been predicted to be below construction noise management levels with the exception of heavy vehicle movements into the beach work site. In order to minimise construction noise at receivers the following noise mitigation and management measures are proposed.

7.3.1 Construction Noise and Vibration Management Plan

A Construction Noise and Vibration Management Plan (CNVMP) would be developed for the Project and implemented prior to commencement of construction activities as part of the Construction Environment Management Plant (CEMP).

The CNVMP should include all reasonable and feasible safeguards to manage the noise emissions from the site and any complaints which may occur due to construction noise. The CNVMP should include, the following:

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

Construction works should be planned and carried out during standard construction hours wherever possible. **Table 7-1** presents the specific mitigation and management measures which should be considered as mitigation and management measures as part of the CNVMP, in addition to general feasible and reasonable work practices as identified in ‘Section 6 Work practices’ of the ICNG.

Table 7-1 Recommended construction mitigation and management measures

Action required	Safeguard details
Construction Noise and Vibration Management Plan (CNVMP)	A CNVMP would be prepared as part of the CEMP, and include general feasible and reasonable work practices as identified in 'Section 6 Work practices' of the *Interim Construction Noise Guideline* (ICNG) (Department of Environment and Climate Change (DECC), 2009).
Temporary noise barrier	During construction Stage 5, if Option C, is undertaken a temporary noise barrier should be located around the drill rig to shield residential properties to the south east on Arthur Kaine Drive.
Construction Related Traffic	Vehicle movements will be routed away from sensitive receivers and scheduled during less sensitive times where feasible and reasonable. The speed of vehicles will be limited and the use of engine compression brakes limited. On-site storage capacity will be maximised to reduce the need for truck movements during sensitive times.
Vibration minimum working distances	If vibration intensive equipment is to be used within the minimum working distances for cosmetic damage, as presented in **Table 5-5**, then it is recommended that attended vibration measurements are undertaken when work commences, to determine "site specific minimum working distances". The minimum working distances for cosmetic damage from **Table 5-5** are generally considered to be conservative and working within them would not necessarily result in damage however factors such as work practices and intervening structures can affect vibration levels. In addition, vibration intensive work should not proceed within the site specific safe working distances unless a permanent vibration monitoring system is installed approximately 1 m from the building footprint, to warn operators (e.g. via flashing light, audible alarm, SMS) when vibration levels are approaching the peak particle velocity objective. It is also advisable to carry out building condition surveys of sensitive historical structures before construction works begins.

7.4 Operation mitigation and management measures

As the operational noise levels are predicted to comply with the operational noise criteria no mitigation and management measures are proposed.

8.0 Conclusion

This Noise and Vibration Technical Report has been prepared to support the EIS and to address the relevant SEARs issued for the Project. Specifically this report has been prepared to identify potential noise and vibration impacts of construction and operation of the Project, and to identify appropriate mitigation and management measures to address the impacts identified. The findings of this assessment are summarised below.

8.1 Construction impacts

The assessment indicates no exceedances of the *Interim Construction Noise Guideline* noise management levels at sensitive receivers for works undertaken during standard hours and outside standard hours with the exception of Pambula Beach Caravan Park where noise levels may exceed NMLs by up to 6 dB(A) during standard hours.

Minimum working distances for vibration intensive construction works have been presented and are up to 38 m when vibratory rollers are in use near heritage items. Equipment size would be selected by the contractor considering the minimum working distances and the distance between the area of construction and the most affected sensitive receiver. Work is unlikely to take place within the minimum working distances. If works need to be undertaken within cosmetic damage minimum working distances:

- vibration monitoring would be carried out; and
- site specific minimum working distances would be determined.

Sensitive structures would need to be considered on a case-by-case basis, depending on their sensitivity.

The road traffic noise associated with traffic movements during construction was assessed in accordance with the *NSW Road Noise Policy* guidelines. Increases in road traffic noise levels due to construction traffic is expected to be less than 2 dB during the day and the night given the existing noise levels from traffic on the site access roads.

Measures have been recommended which would reduce construction noise impacts. The final number, degree and nature of these measures would ultimately be selected by the contractor and be largely dependent on the construction strategy and work activities. Specific noise mitigation and management measures would be detailed in the contractor's Construction Noise and Vibration Management Plan.

8.2 Operational impacts

An operational road traffic impact noise assessment has been completed in accordance with the EPA *NSW Noise Policy for Industry*.

Noise levels have been predicted at sensitive receiver locations throughout the operational noise study area for night-time scenarios. No exceedances of the project trigger levels have been identified.

9.0 Glossary and abbreviations

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

Term	Description
Ambient noise	The all-encompassing noise at a point composed of sound from all sources near and far.
Background noise	The underlying level of noise present in the ambient noise when extraneous noise (such as transient traffic and dogs barking) is removed. The L_{90} sound pressure level is used to quantify background noise.
Traffic noise	The total noise resulting from road traffic. The L_{eq} sound pressure level is used to quantify traffic noise.
Day	The period from 0700 to 1800 h Monday to Saturday and 0800 to 1800 h Sundays and Public Holidays.
Evening	The period from 1800 to 2200 h Monday to Sunday and Public Holidays.
Night	The period from 2200 to 0700 h Monday to Saturday and 2200 to 0800 h Sundays and Public Holidays.
Assessment background level (ABL)	The overall background level for each day, evening and night period for **each day** of the noise monitoring.
Rating background level (RBL)	The overall background level for each day, evening and night period for the **entire length** of noise monitoring.

10.0 References

Australian Standard AS 2436-2010, *Guide to noise and vibration control on construction, demolition and maintenance sites*, 2010.

British Standard 5228: Part 1 2009 *Code of Practice for Noise and Vibration Control on Construction and Open Sites* Part 1: Noise, 2009 including Amendment 1, 2014.

British Standard 6472: Part 1 2008 *Evaluation of Human Exposure to Vibration in Buildings*, 2008.

British Standard 7385: Part 2 1993 *Evaluation and Measurement for Vibration in Buildings Part 2*, 1993.

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* (AVATG).

Department of Environment, Climate Change and Water (DECCW), 2011. *NSW Road Noise Policy* (RNP).

NSW Environment Protection Authority (EPA), 2017. *Noise Policy for Industry* (NPfI).

German Standard DIN 4150: *Part 3 1999 Structural Vibration in Buildings - Effects on Structures*, 1999.

Appendix A

Logger Photos and Results

Noise Logger Report

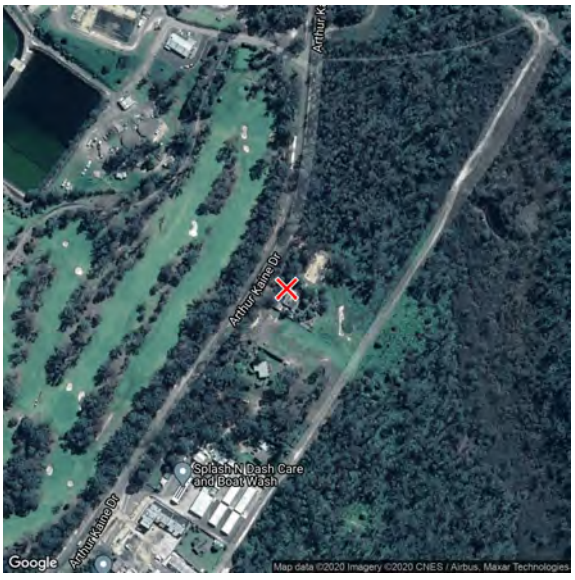
232 Arthur Kaine Drive, Merimbula

Item	Information
Logger Type	Rion NL21
Serial number	00765701
Address	232 Arthur Kaine Drive, Merimbula
Location	232 Arthur Kaine Drive, Merimbula
Facade / Free Field	Free field
Environment	Noise environment dominated by road traffic noise along Arthur Kaine Drive. Bird calls heard most of the time. Hum heard in absence of vehicles, from north/north east direction, hard to distinguish at times from planes landing/taking off.

Measured noise levels

Logging Date	L_{Aeq} Day	Eve	Night	ABL Day	Eve	Night	$L_{Aeq,15hr}$	$L_{Aeq,9hr}$
Wed Sep 11 2019	59	55	55	-	44	-	56	55
Thu Sep 12 2019	59	53	54	51	37	42	58	54
Fri Sep 13 2019	58	53	51	49	40	38	57	51
Sat Sep 14 2019	58	53	51	47	39	40	57	51
Sun Sep 15 2019	57	53	51	48	36	38	56	51
Mon Sep 16 2019	59	52	49	-	30	31	57	49
Tue Sep 17 2019	59	54	49	49	44	31	58	49
Wed Sep 18 2019	58	55	50	49	44	41	57	50
Thu Sep 19 2019	58	54	49	-	-	39	57	49
Fri Sep 20 2019	58	53	51	-	-	44	57	51
Sat Sep 21 2019	58	55	50	-	42	40	57	50
Sun Sep 22 2019	57	51	49	-	35	40	55	49
Mon Sep 23 2019	59	54	50	49	38	36	58	50
Tue Sep 24 2019	58	53	51	49	34	-	57	51
Wed Sep 25 2019	58	-	50	-	-	-	58	50
Summary	**58**	**54**	**51**	**49**	**38**	**39**	**57**	**51**

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

Logger Location	Logger Deployment Photo
	

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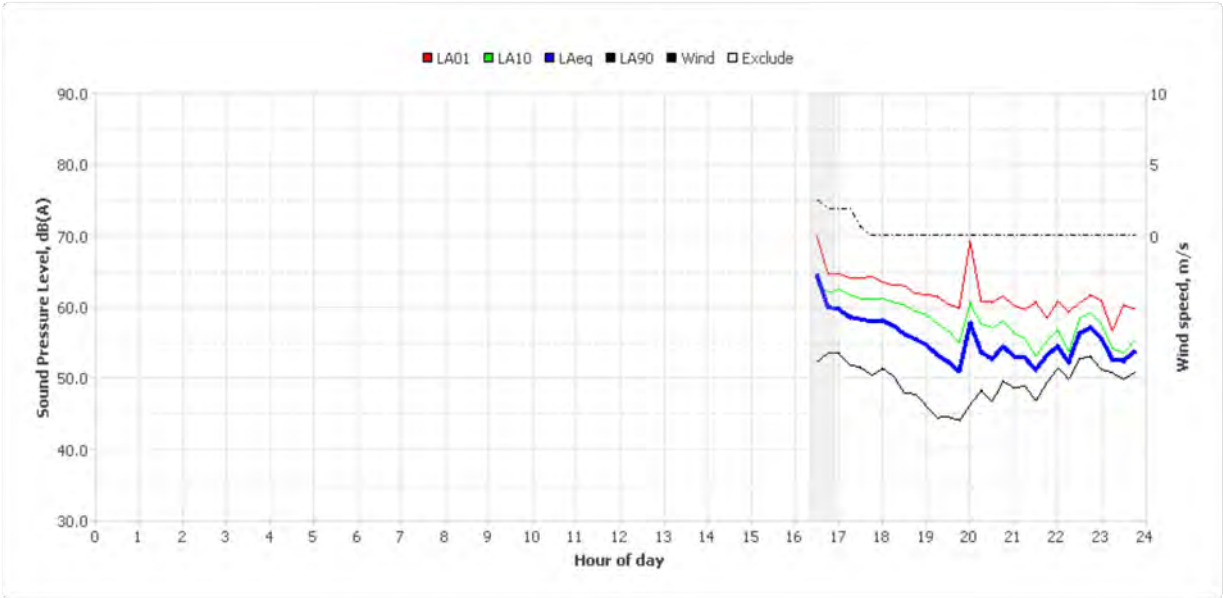

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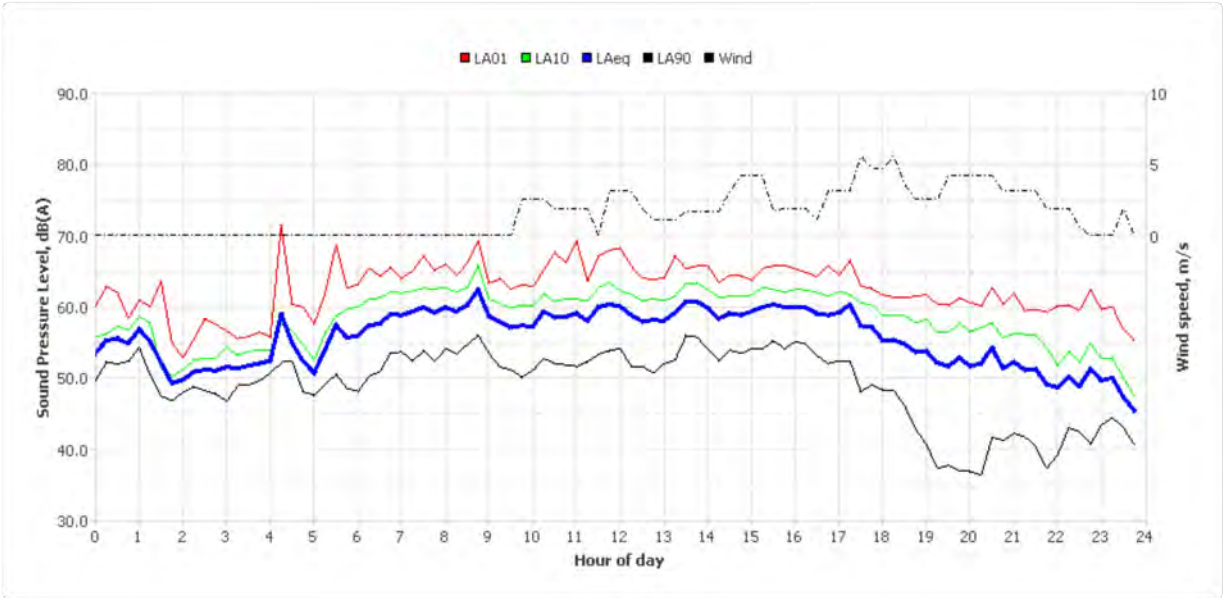

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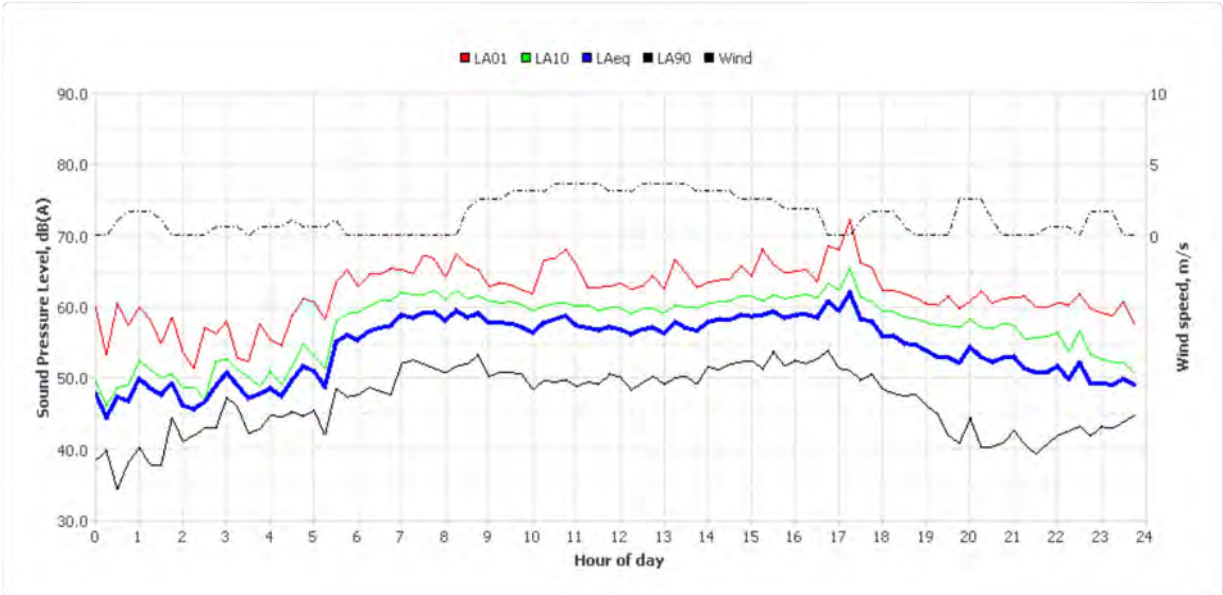

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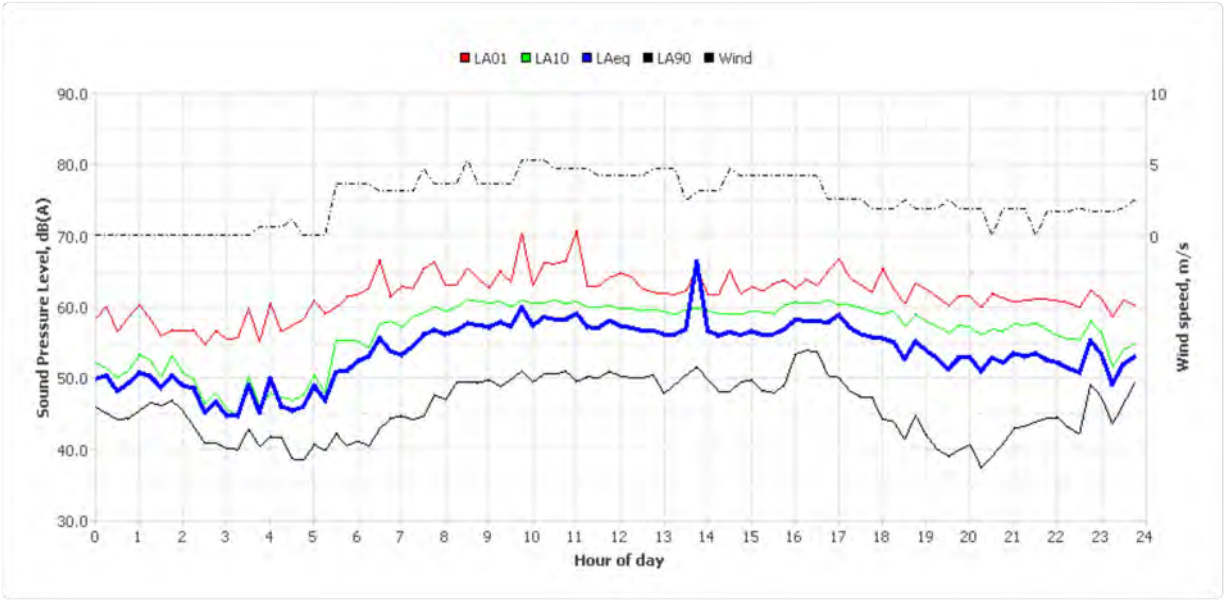

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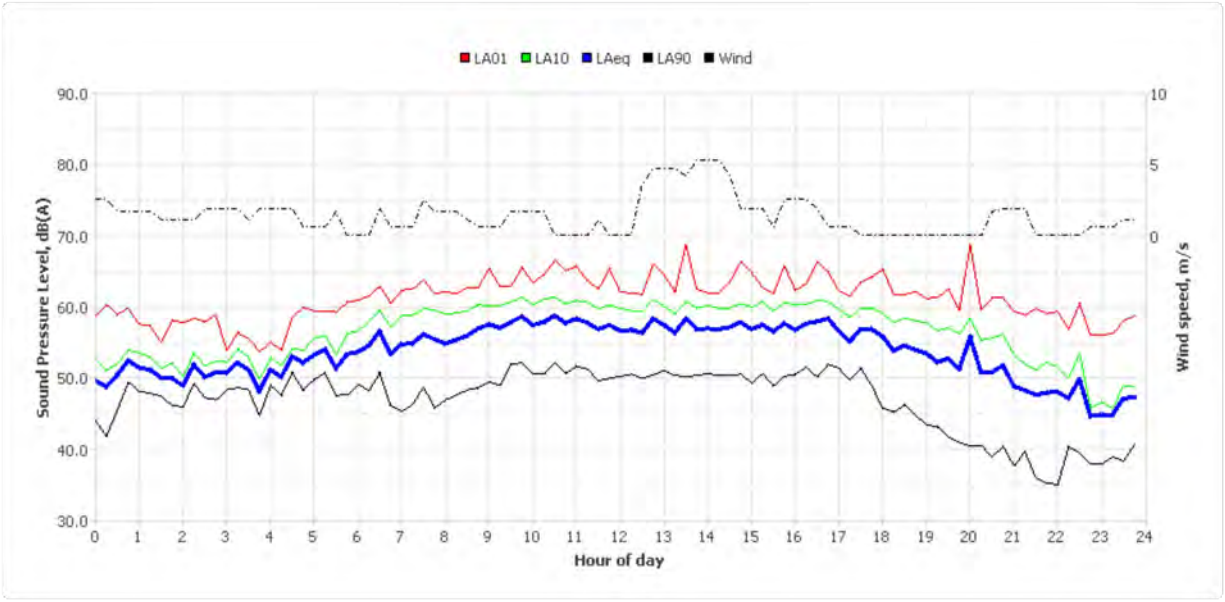

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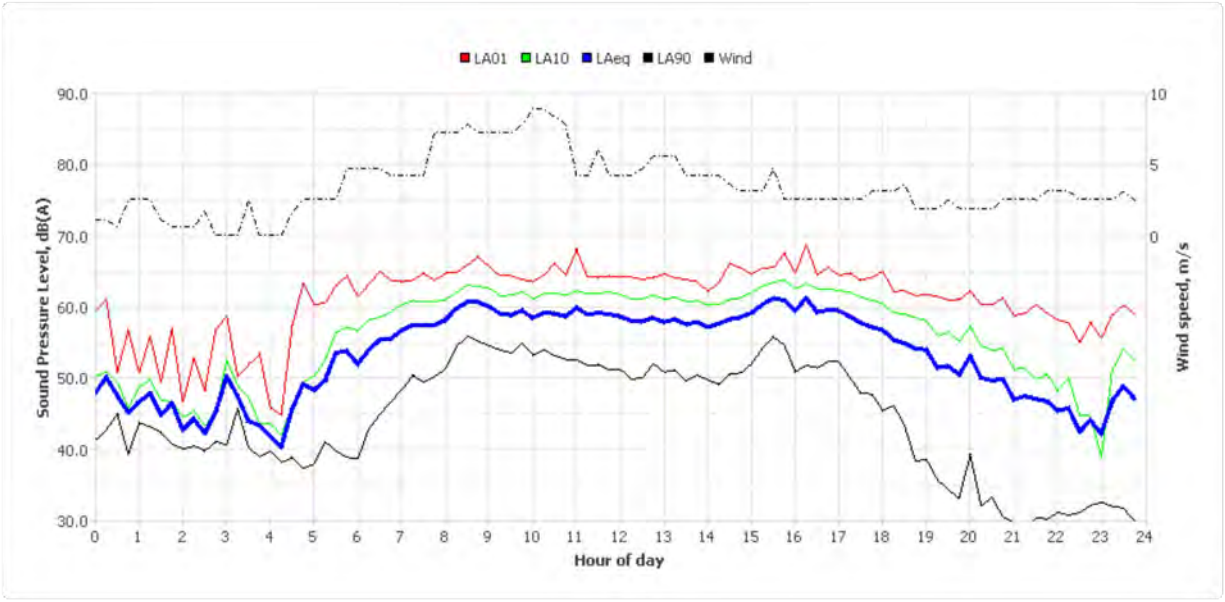

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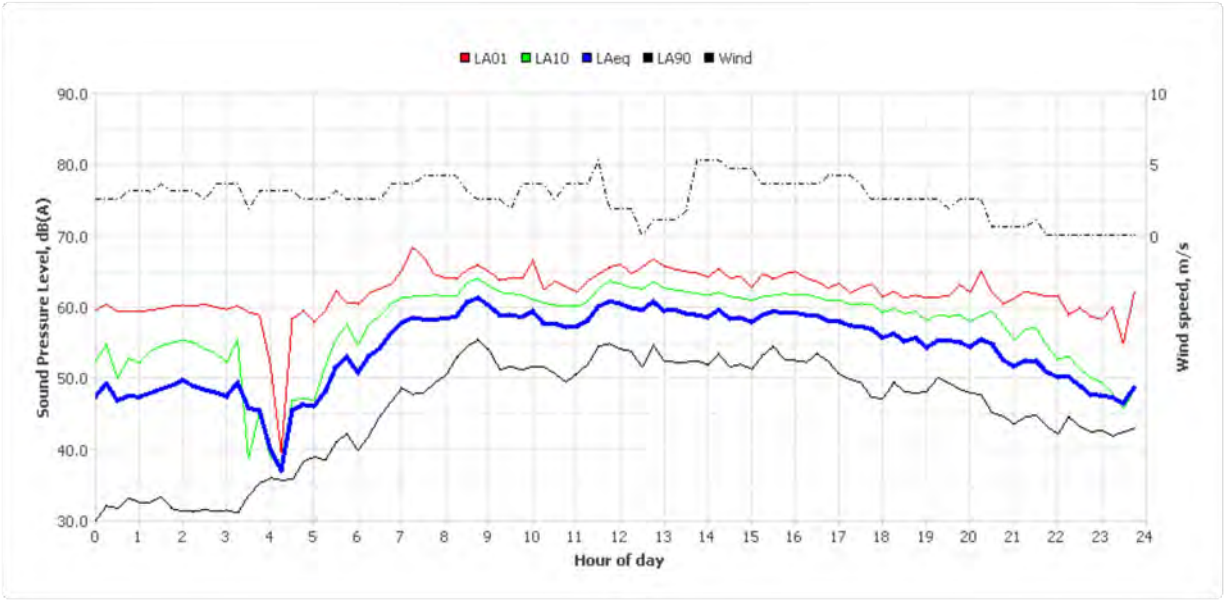

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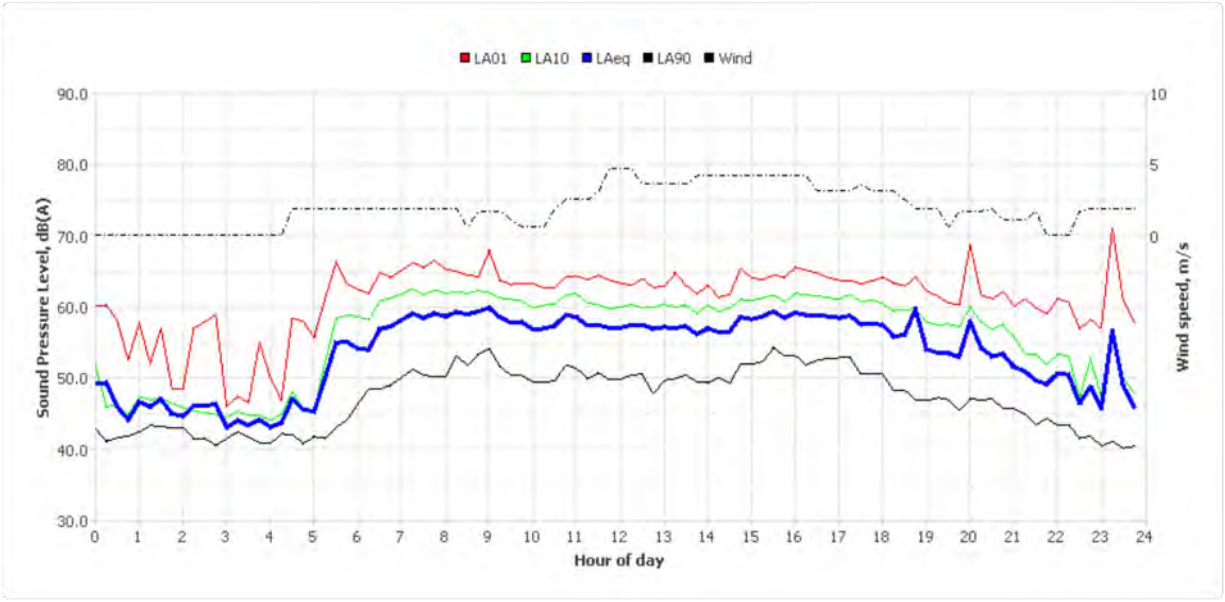

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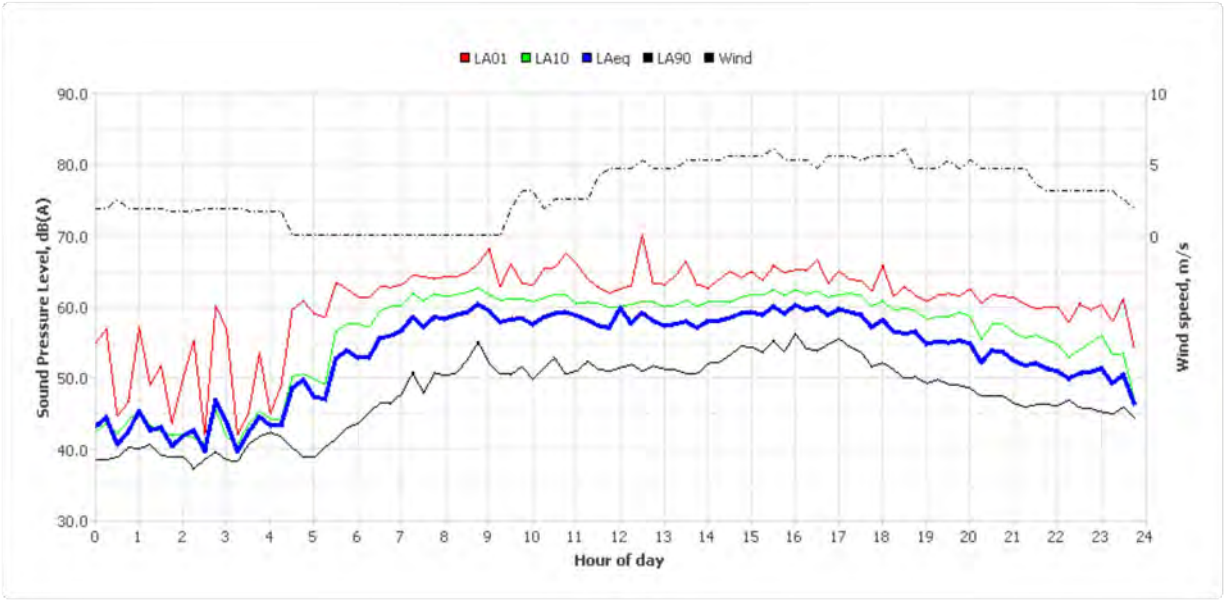

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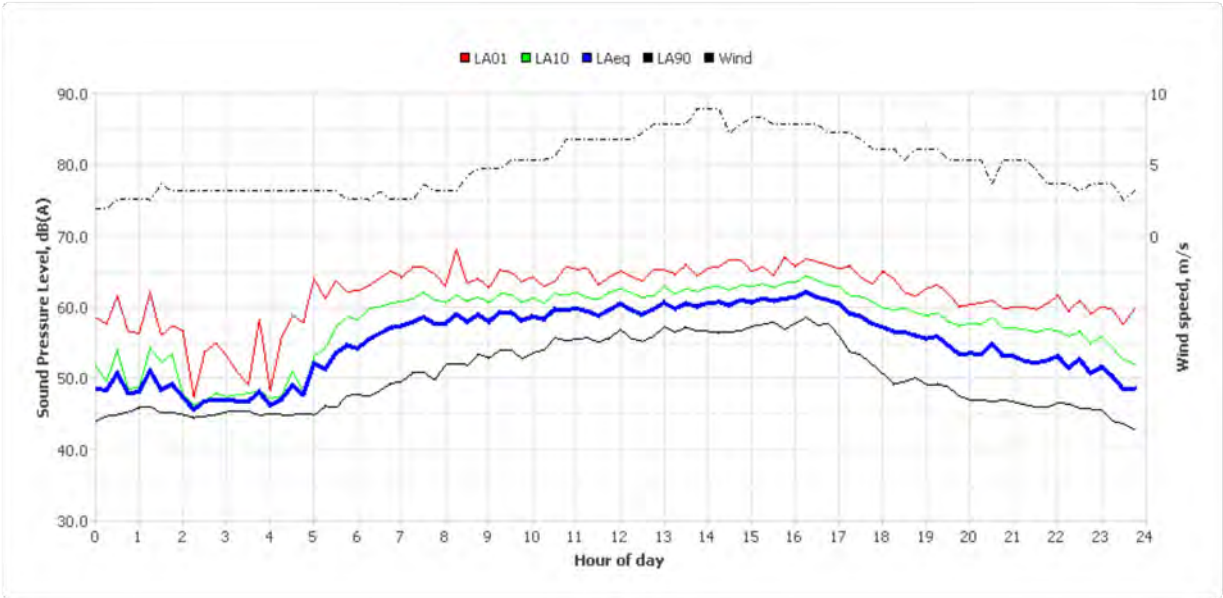

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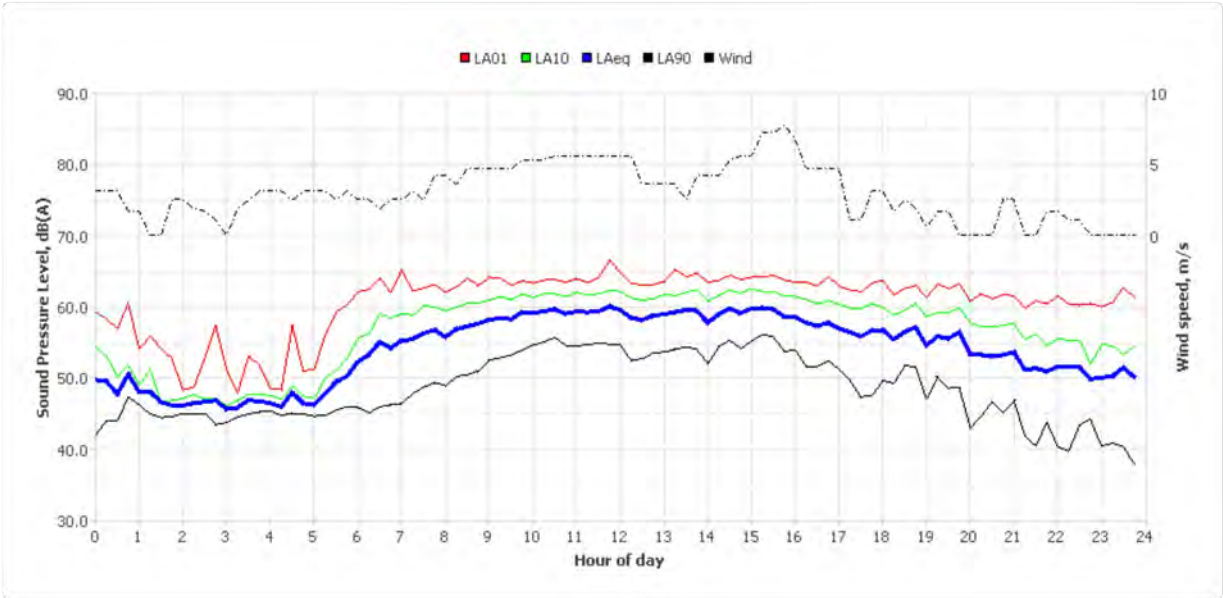

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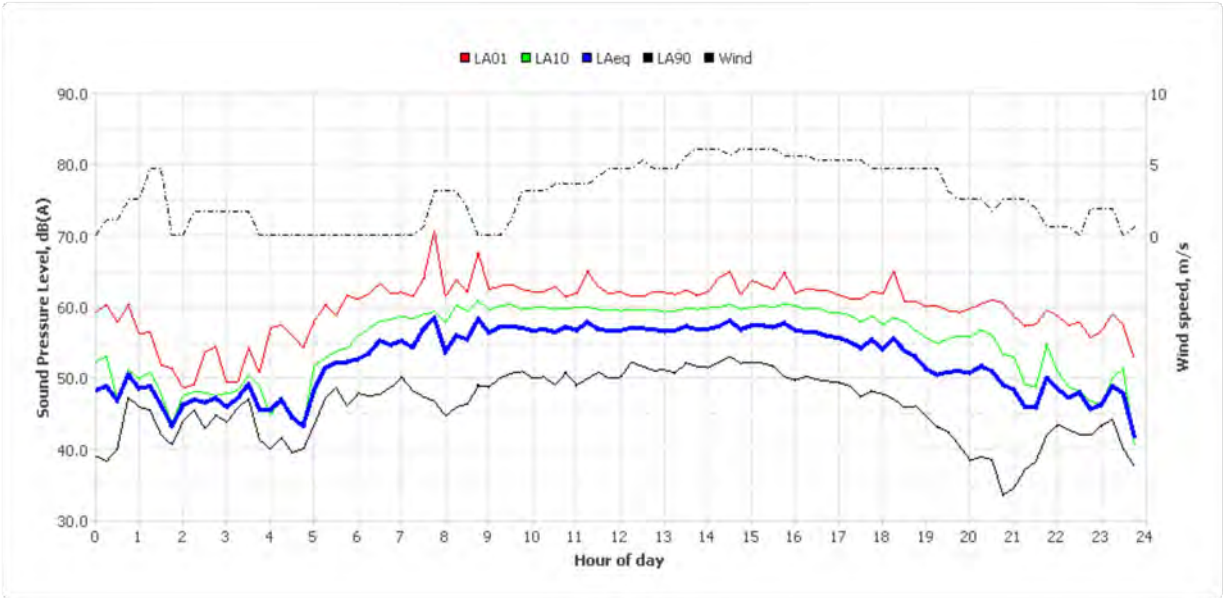

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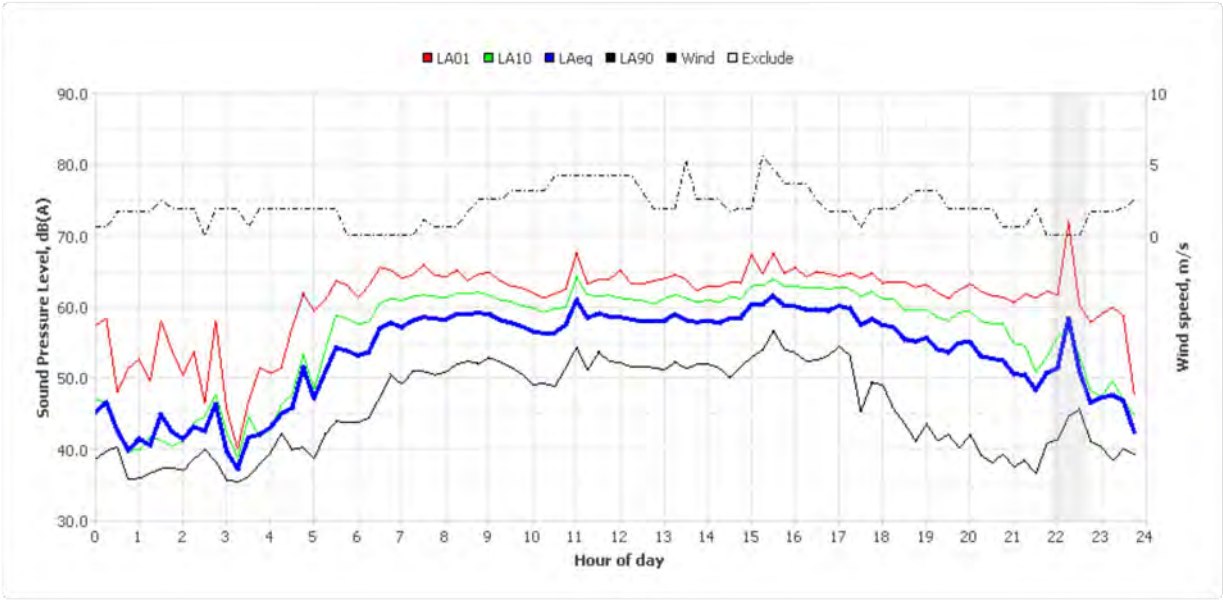

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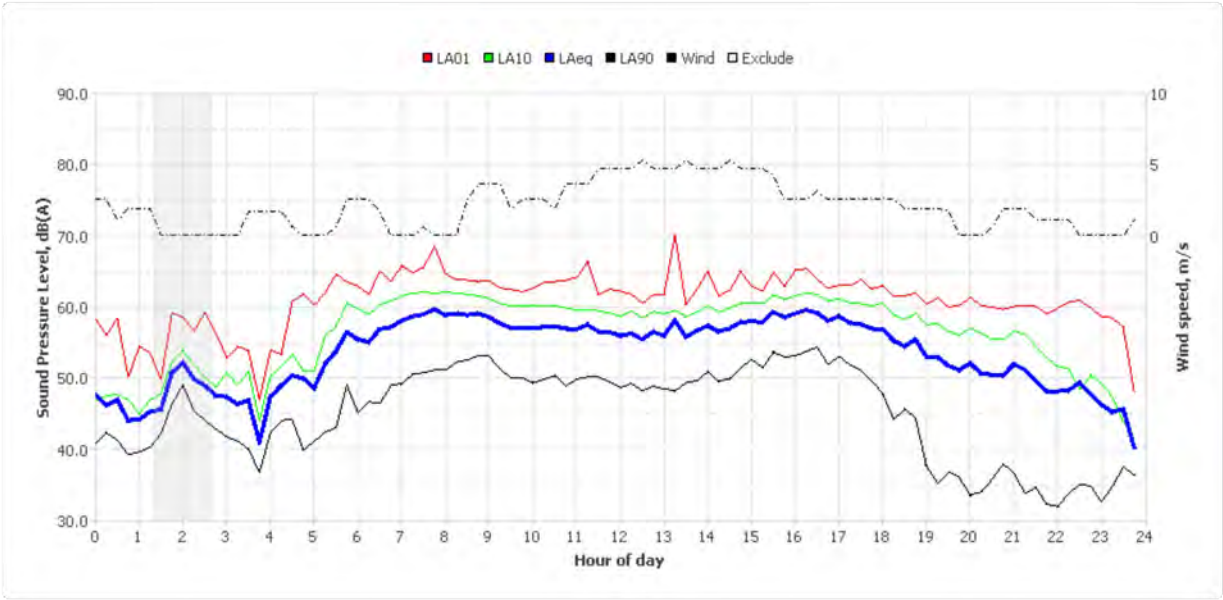

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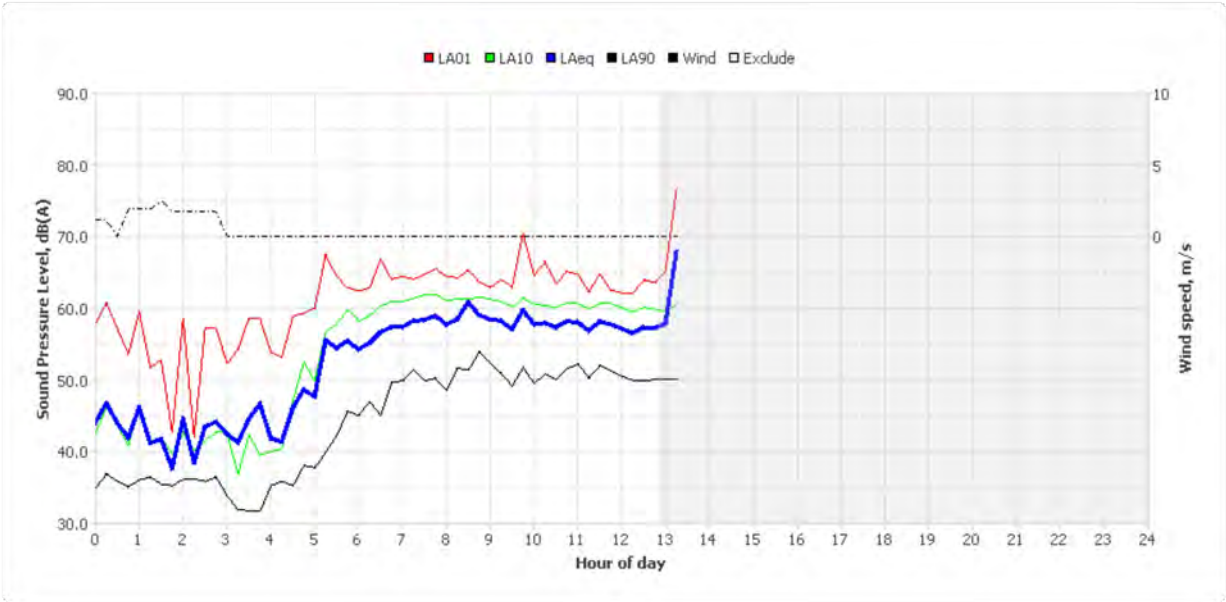


Noise Logger Report

1 Narregol Street, Pambula

Item	Information
Logger Type	ARL 315
Serial number	15-299-444
Address	1 Narregol Street, Pambula
Location	1 Narregol Street, Pambula
Facade / Free Field	Free field
Environment	Noise environment dominated by road traffic noise to the east and north east along Arthur Kaine Drive. Bird calls heard. Industrial hum faintly audible from the south east at times.

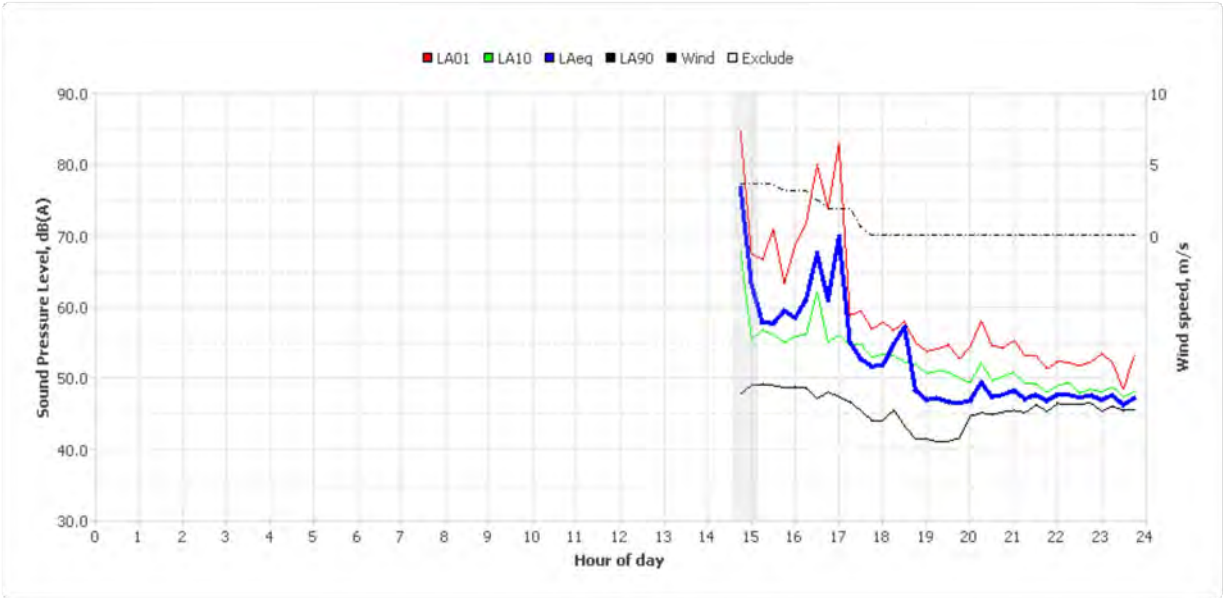
Measured noise levels

Logging Date	L_{Aeq} Day	Eve	Night	ABL Day	Eve	Night	$L_{Aeq,15hr}$	$L_{Aeq,9hr}$
Wed Sep 11 2019	63	50	47	-	41	-	59	47
Thu Sep 12 2019	54	47	47	40	29	41	53	47
Fri Sep 13 2019	53	45	47	43	32	42	52	47
Sat Sep 14 2019	51	50	46	39	42	42	50	46
Sun Sep 15 2019	55	46	48	43	40	40	54	48
Mon Sep 16 2019	51	42	44	-	27	27	50	44
Tue Sep 17 2019	53	50	43	42	41	26	52	43
Wed Sep 18 2019	52	48	44	41	39	30	51	44
Thu Sep 19 2019	50	44	41	-	-	28	49	41
Fri Sep 20 2019	57	41	46	-	-	31	55	46
Sat Sep 21 2019	52	46	41	-	33	30	51	41
Sun Sep 22 2019	51	45	43	-	29	27	49	43
Mon Sep 23 2019	54	45	44	39	32	31	53	44
Tue Sep 24 2019	52	45	47	41	28	27	51	47
Wed Sep 25 2019	51	-	46	-	-	-	51	46
Summary	**55**	**47**	**46**	**41**	**33**	**30**	**53**	**46**

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

Logger Location	Logger Deployment Photo
	

Wednesday, 11 Sep 2019



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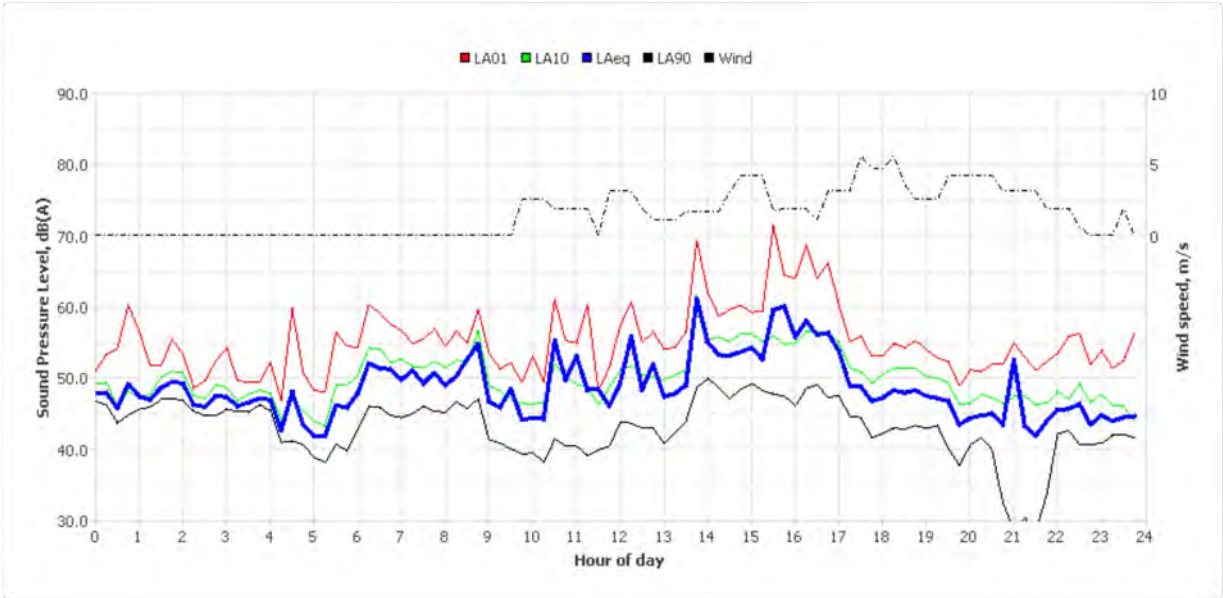

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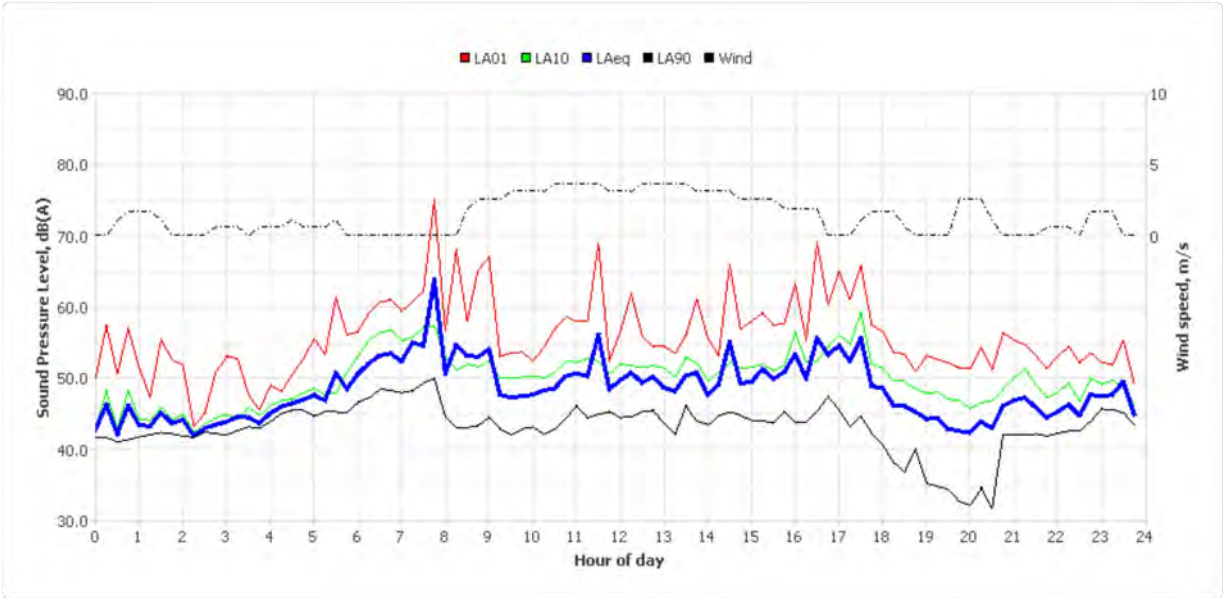

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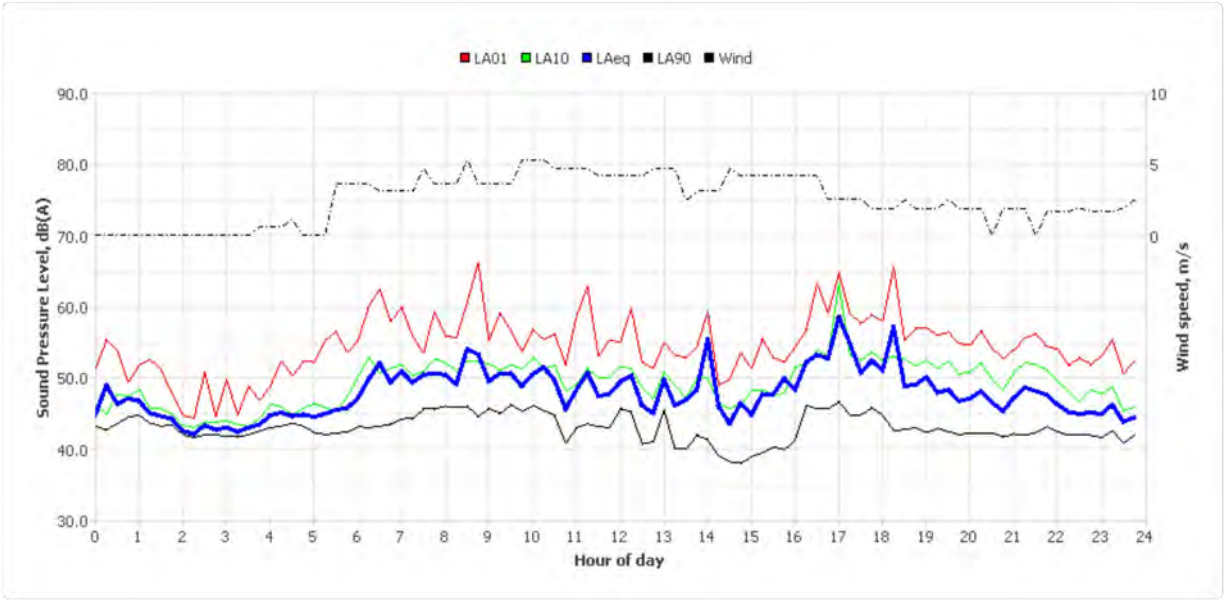
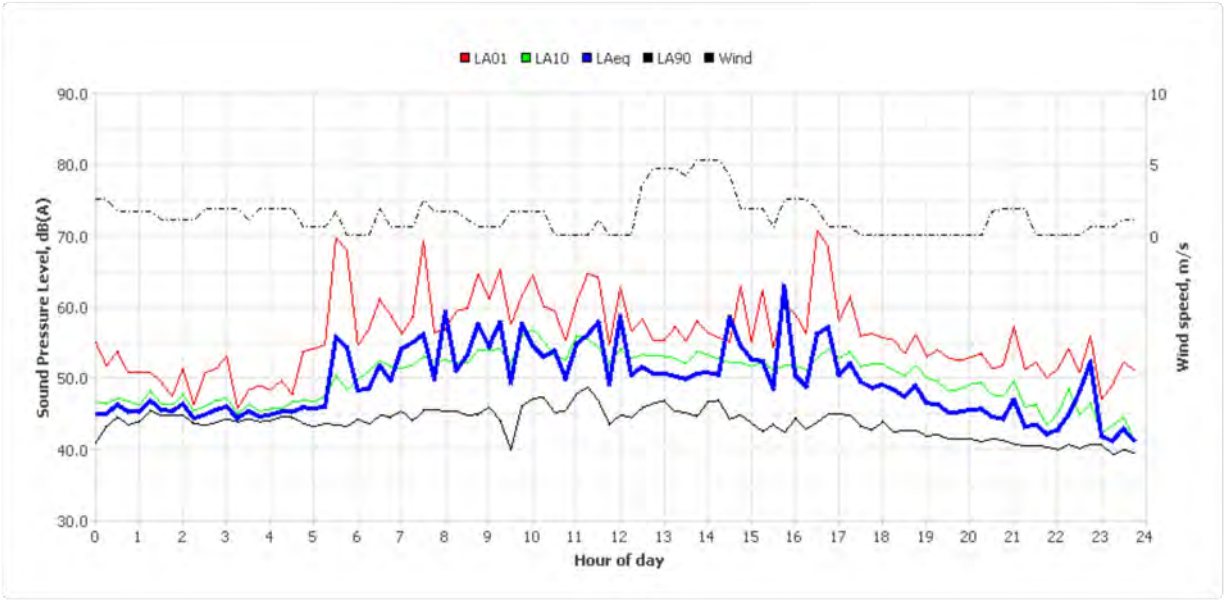


Sunday, 15 Sep 2019



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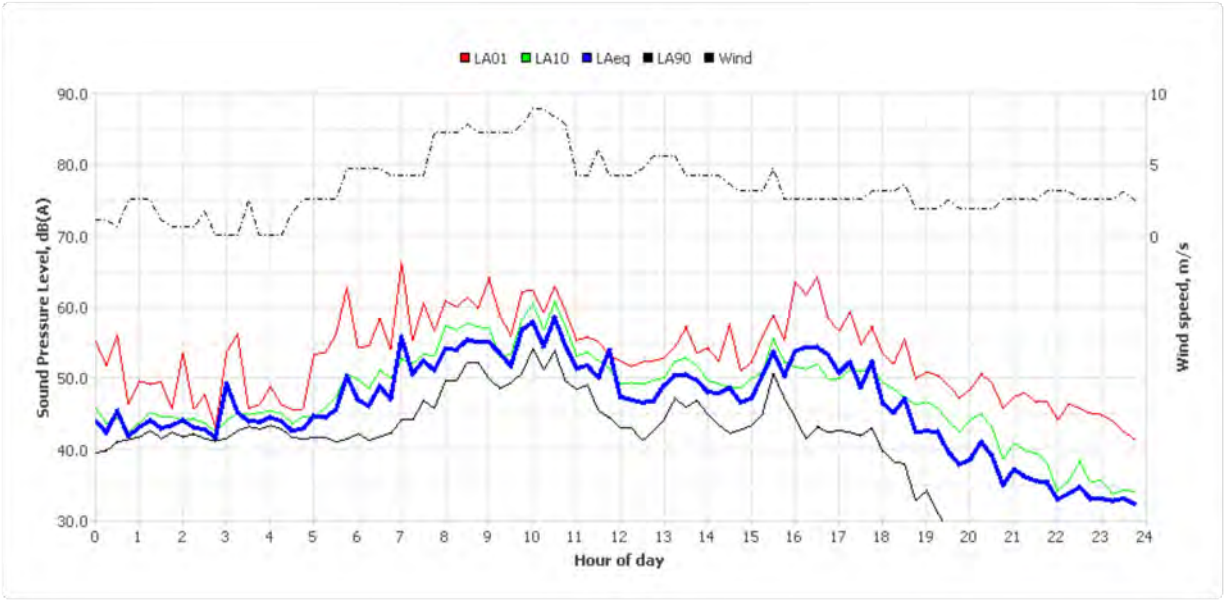
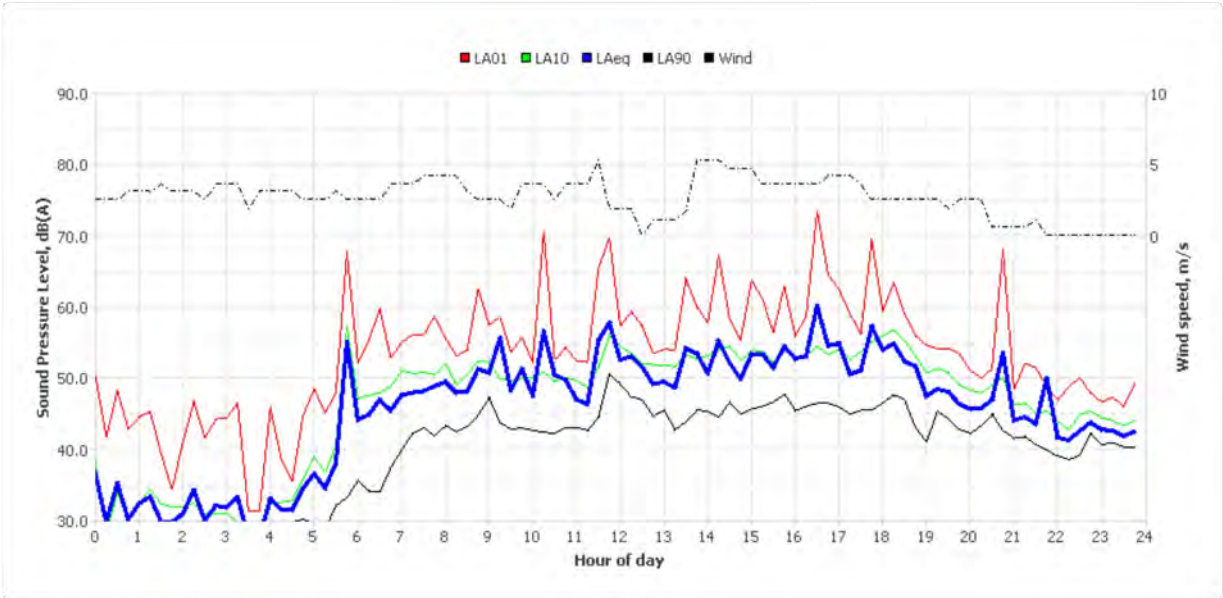


Tuesday, 17 Sep 2019



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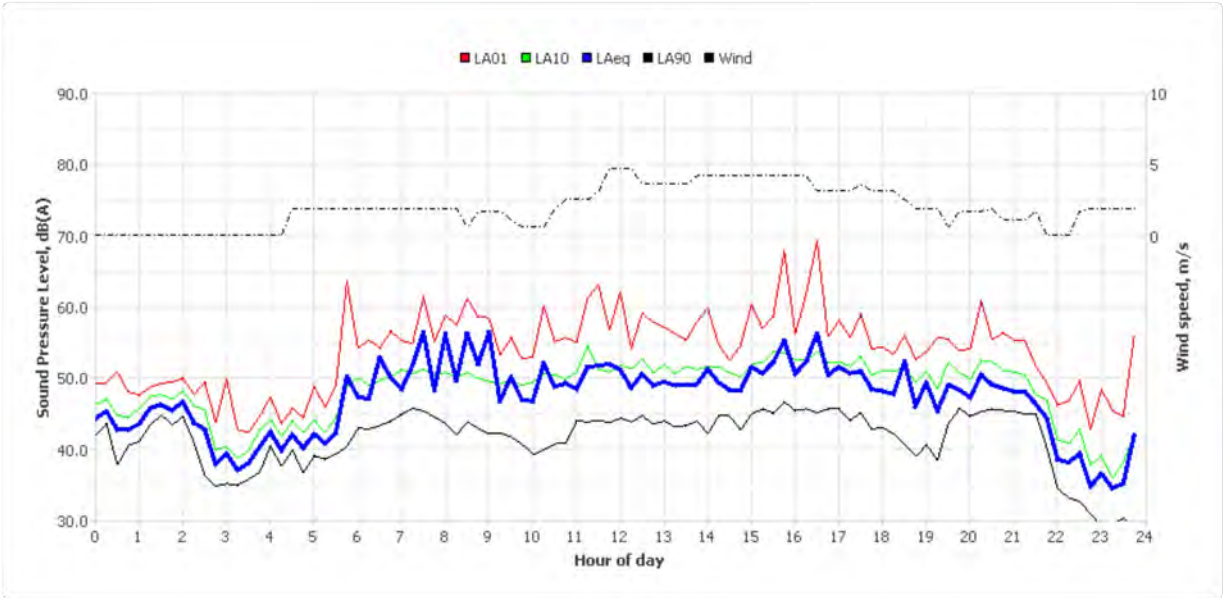

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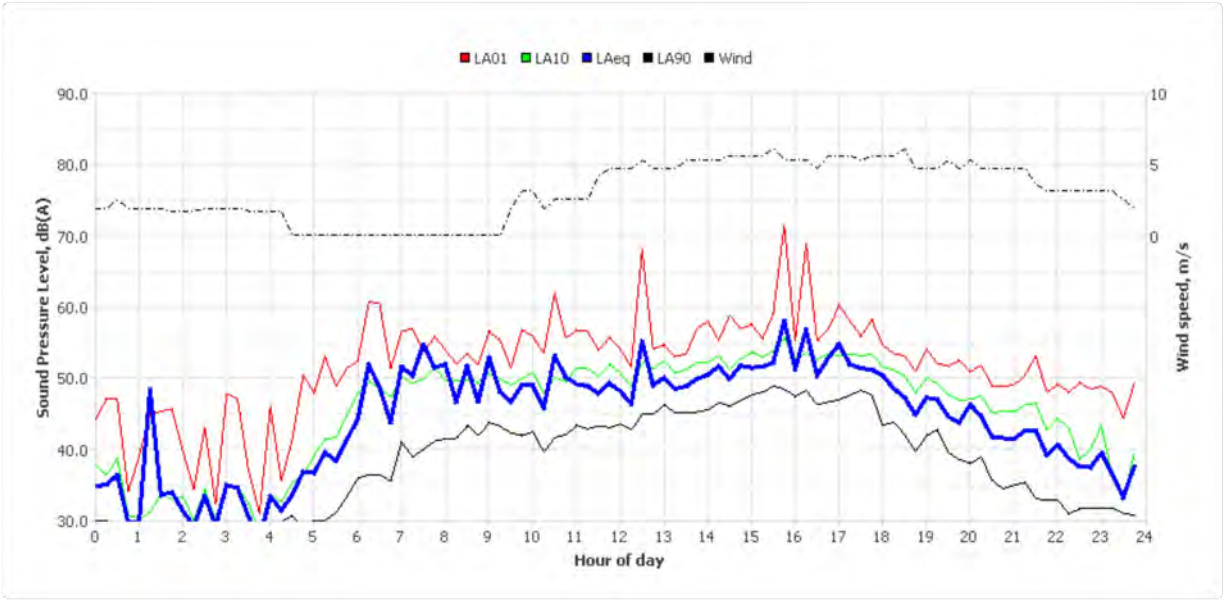

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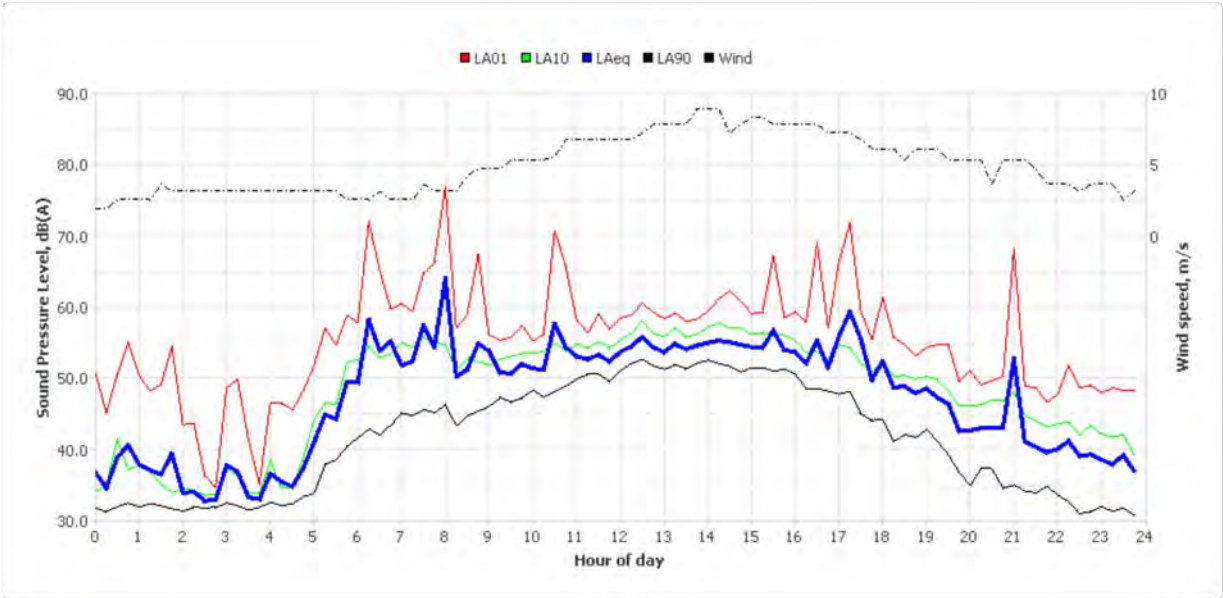

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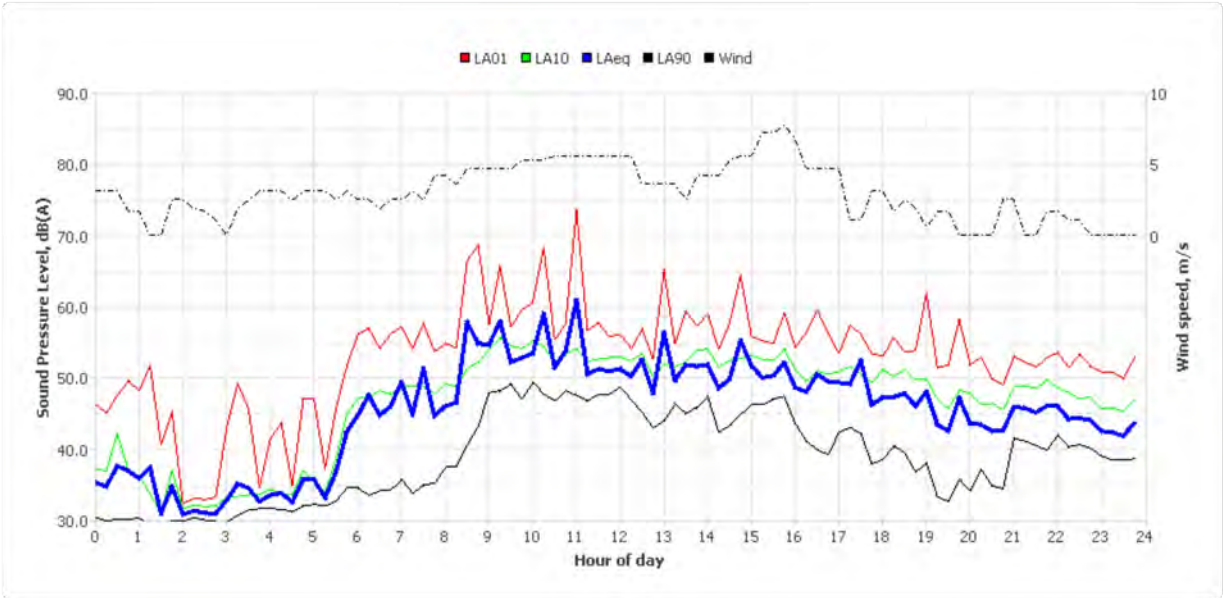
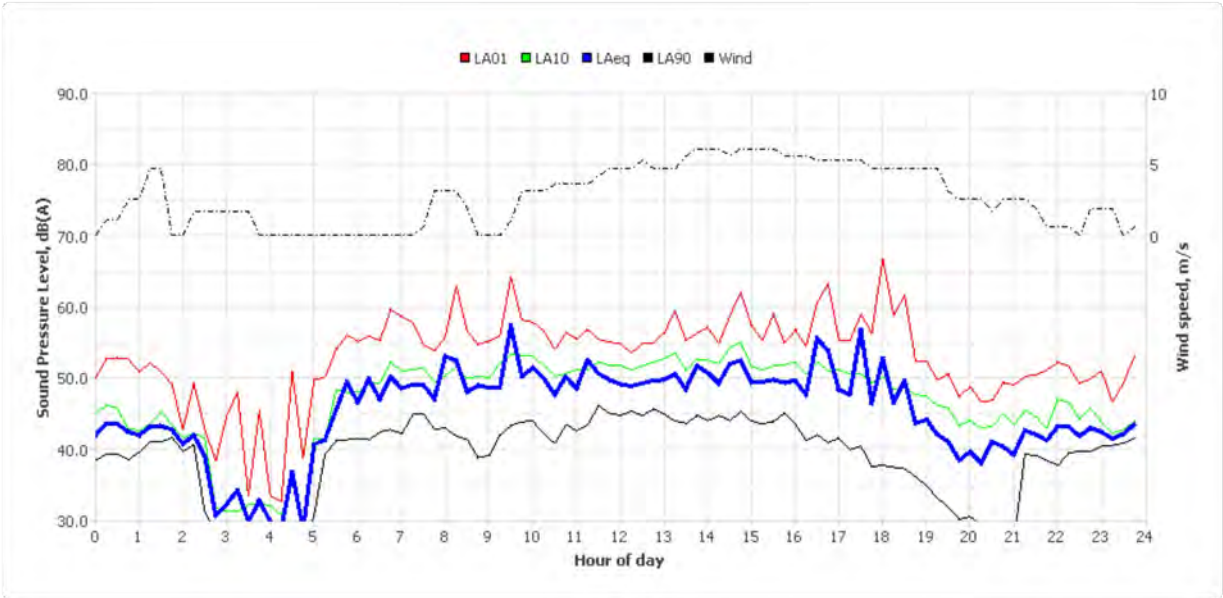


Sunday, 22 Sep 2019



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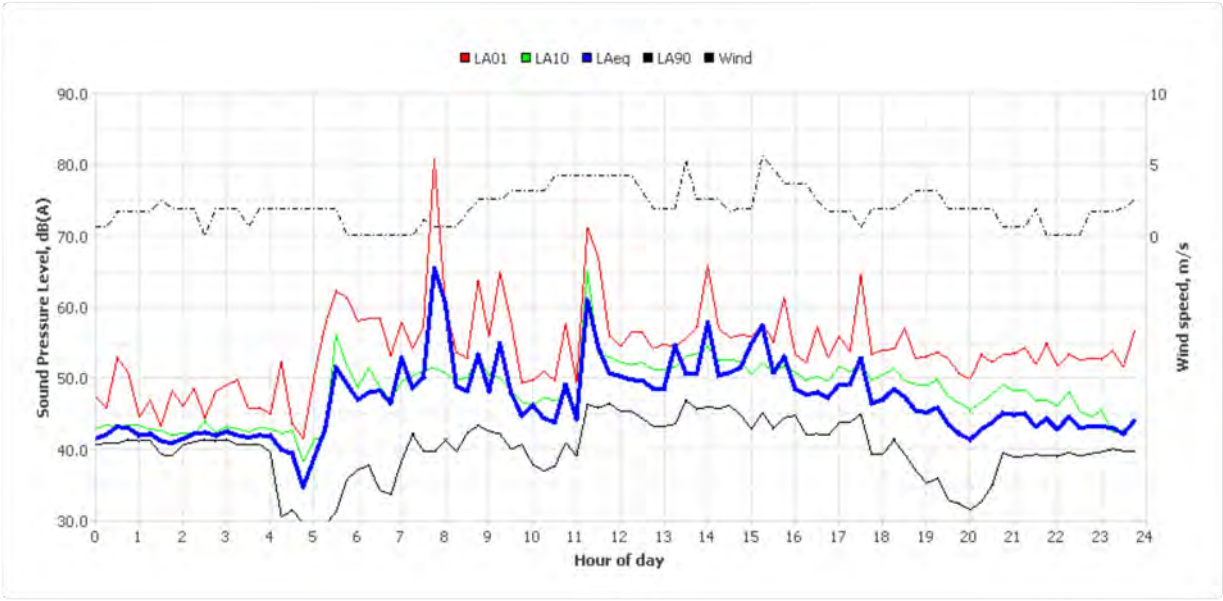
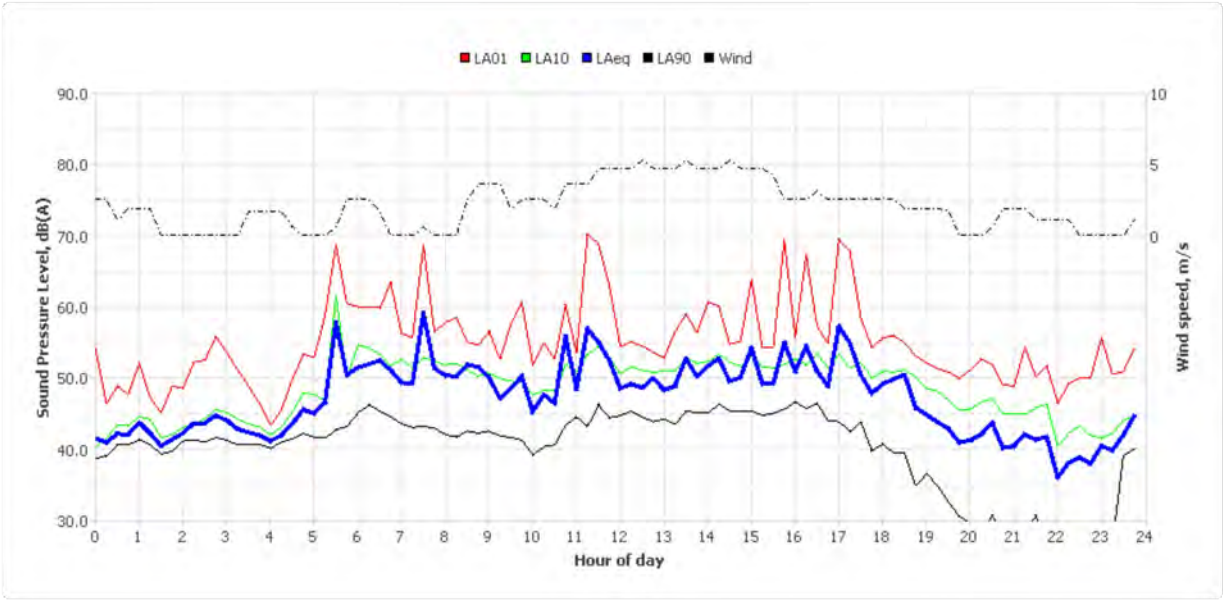


Tuesday, 24 Sep 2019



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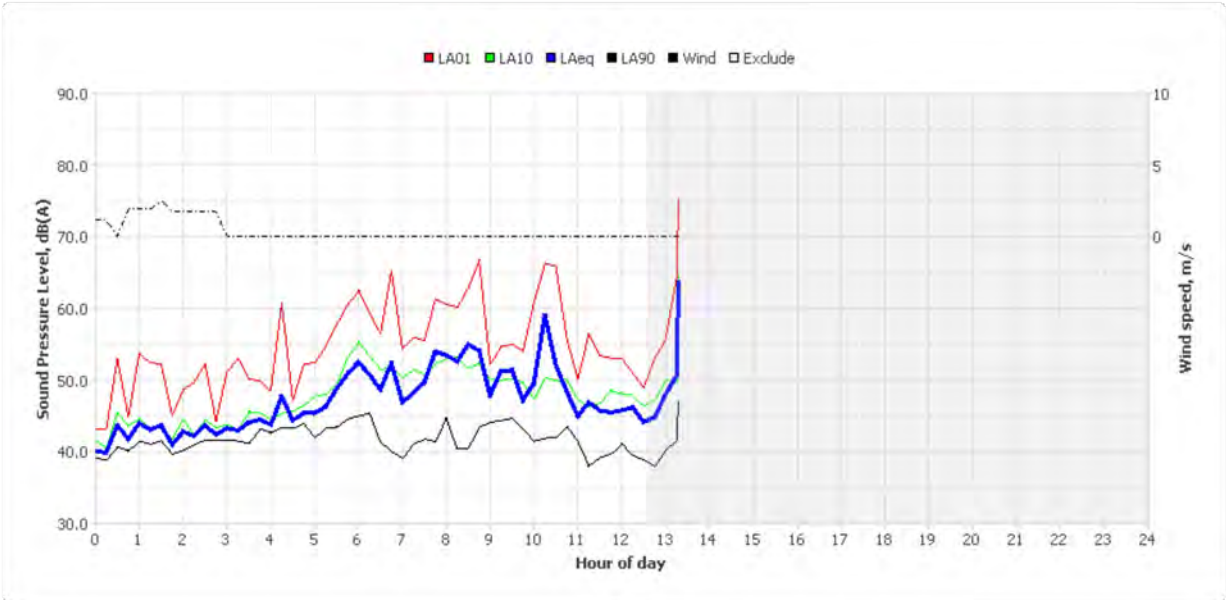


Noise Logger Report

57 Green Point Road, Millingandi

Item	Information
Logger Type	Rion NL21
Serial number	265112
Address	57 Green Point Road, Millingandi
Location	57 Green Point Road, Millingandi
Facade / Free Field	Free field
Environment	Background controlled by environment. Some banging in distance could be faintly heard at times. Boats/watercraft in lake can be a heard, noise from airport can also be heard. Birds calling

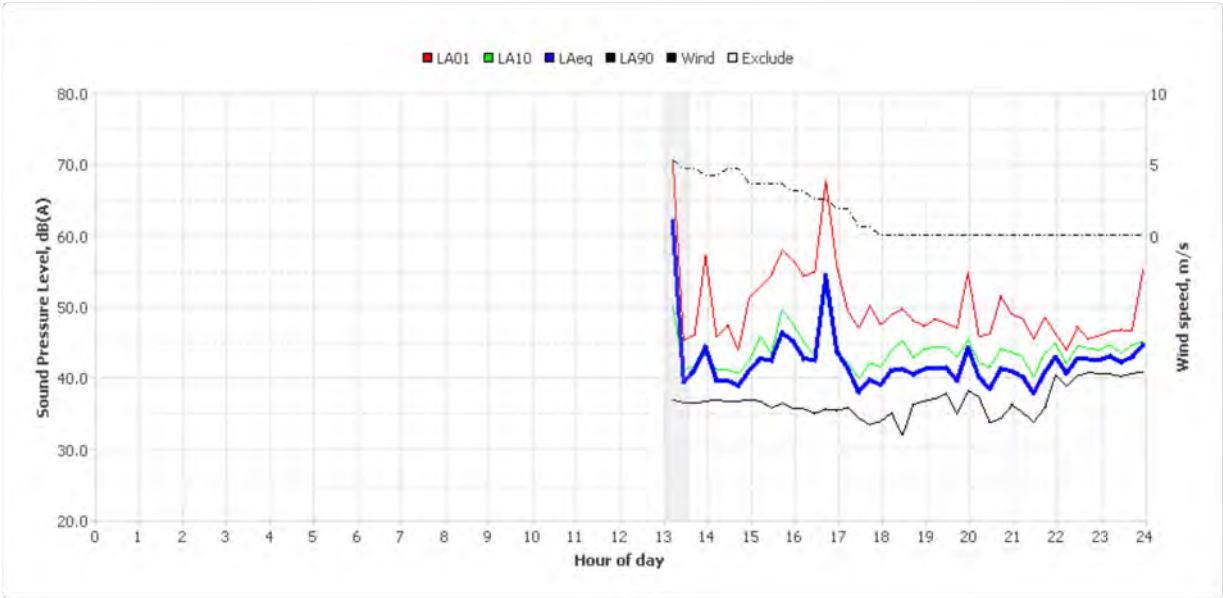
Measured noise levels

Logging Date	L_{Aeq} Day	Eve	Night	ABL Day	Eve	Night	$L_{Aeq,15hr}$	$L_{Aeq,9hr}$
Wed Sep 11 2019	45	41	43	-	34	-	43	43
Thu Sep 12 2019	48	38	44	32	24	32	47	44
Fri Sep 13 2019	42	38	43	33	32	33	42	43
Sat Sep 14 2019	42	36	42	32	28	28	41	42
Sun Sep 15 2019	45	39	42	32	26	27	44	42
Mon Sep 16 2019	44	33	40	-	22	22	42	40
Tue Sep 17 2019	44	42	40	34	35	23	44	40
Wed Sep 18 2019	44	41	42	32	35	26	43	42
Thu Sep 19 2019	46	44	41	-	-	25	46	41
Fri Sep 20 2019	44	42	42	-	-	33	44	42
Sat Sep 21 2019	44	38	40	-	32	29	42	40
Sun Sep 22 2019	44	36	41	-	24	25	42	41
Mon Sep 23 2019	44	38	43	34	23	22	43	43
Tue Sep 24 2019	45	36	43	33	19	21	44	43
Wed Sep 25 2019	43	-	42	-	-	-	43	42
Summary	**45**	**40**	**42**	**33**	**27**	**26**	**44**	**42**

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

Logger Location	Logger Deployment Photo
	

Wednesday, 11 Sep 2019



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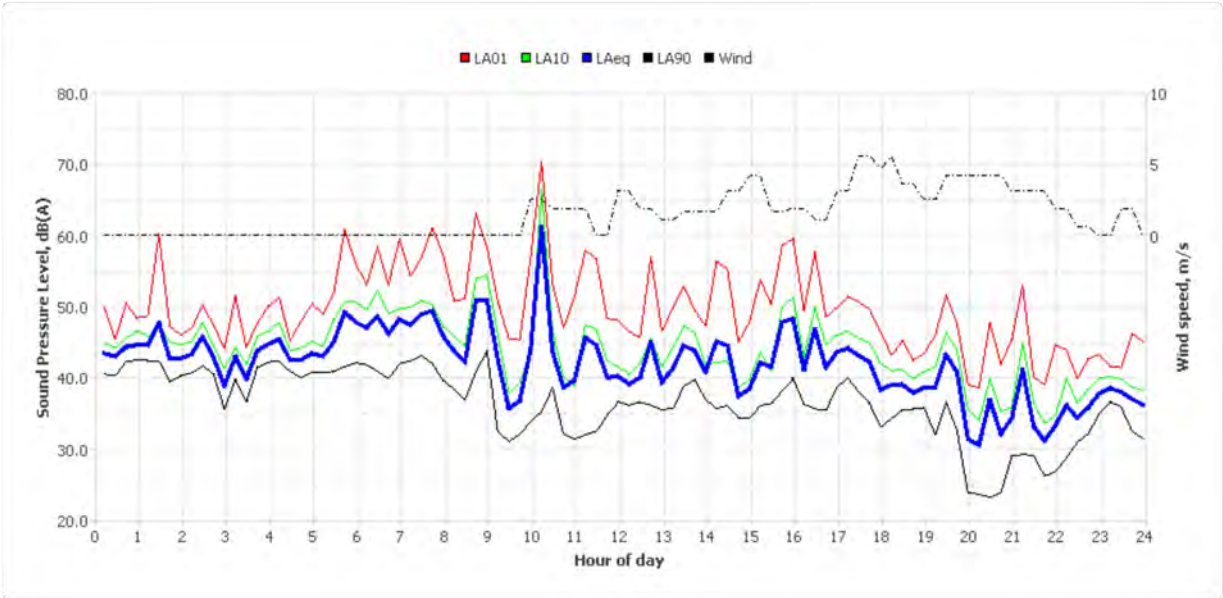

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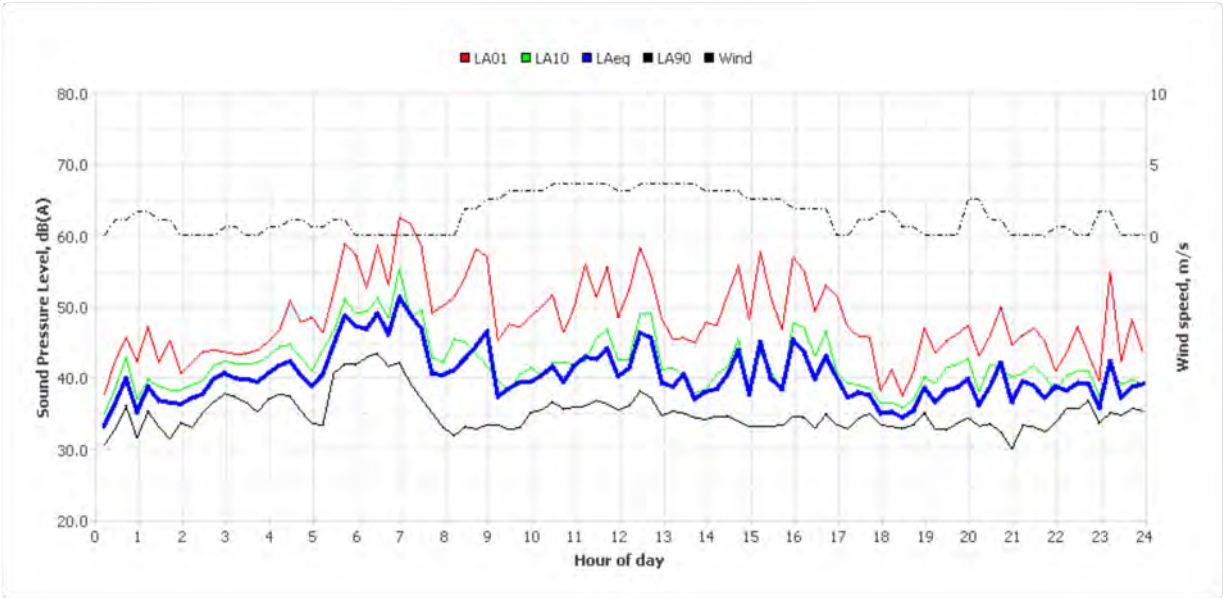

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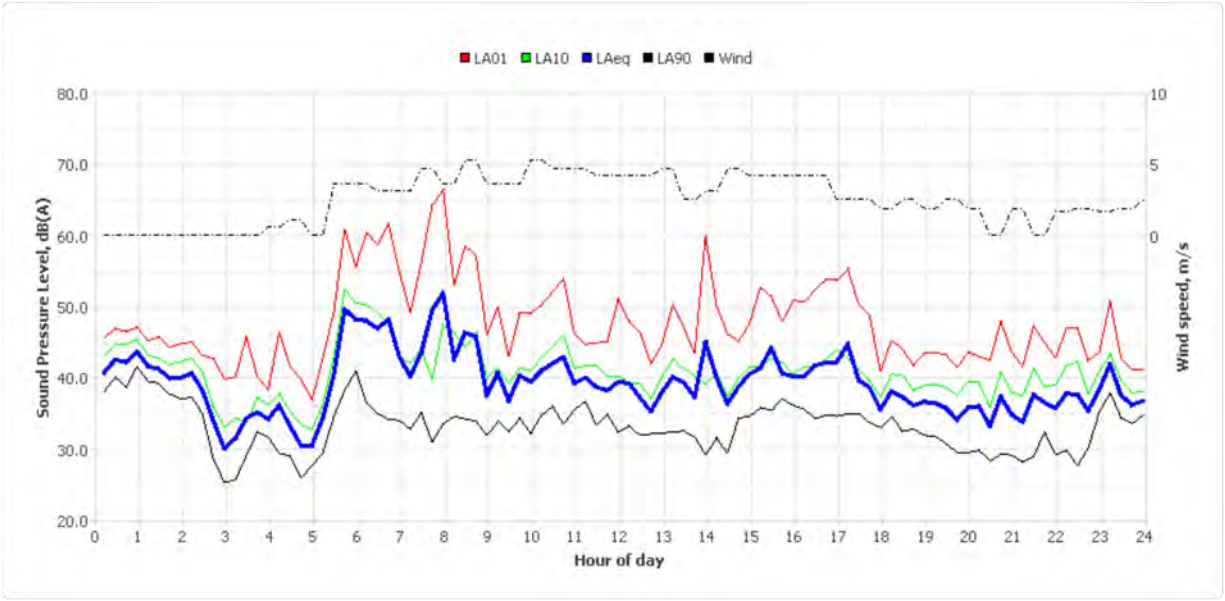
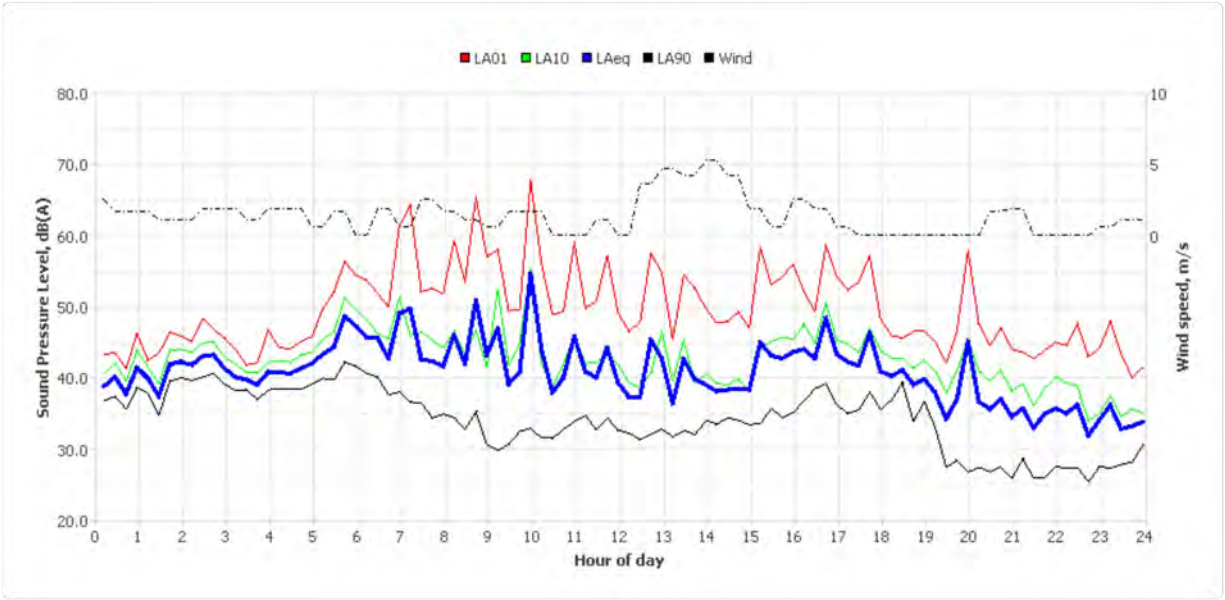
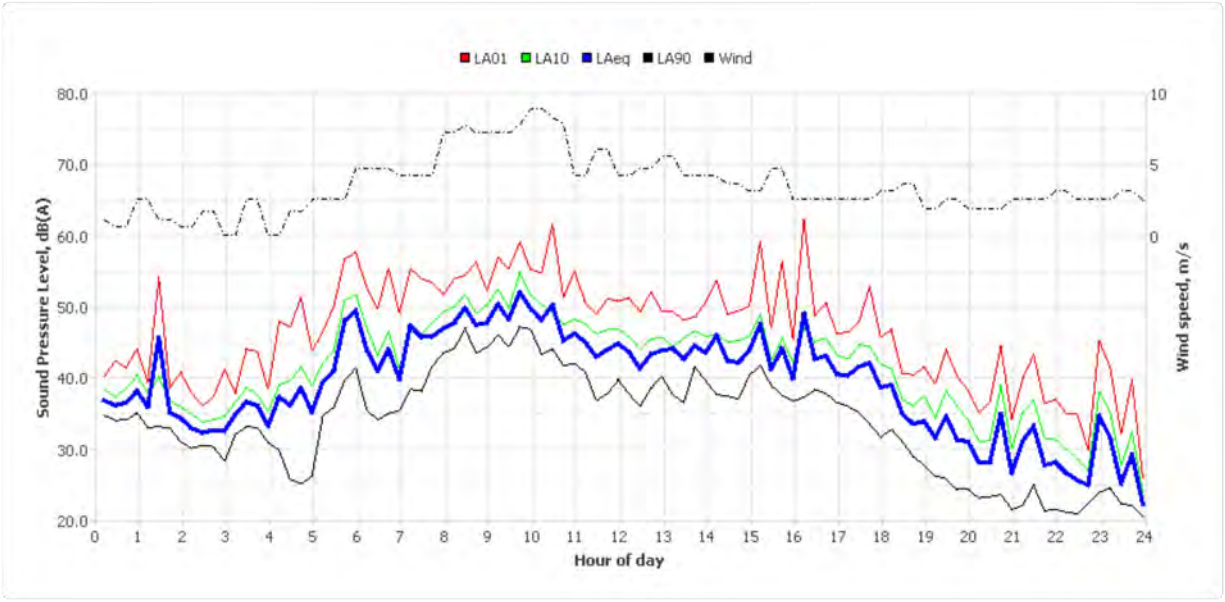


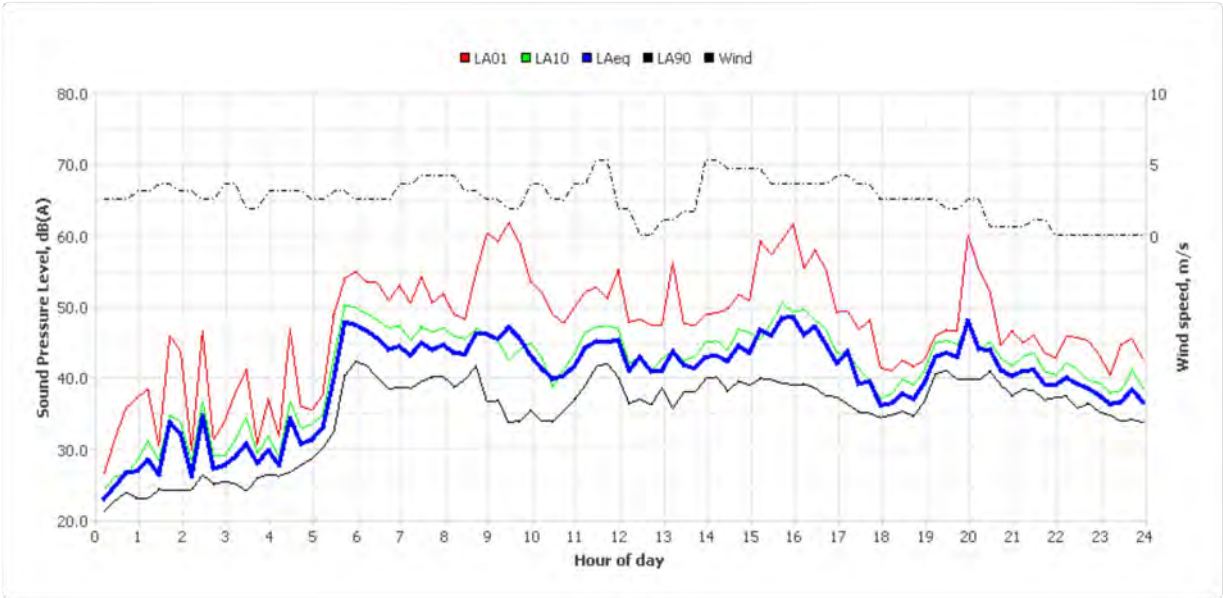
Sunday, 15 Sep 2019



Monday, 16 Sep 2019



Tuesday, 17 Sep 2019



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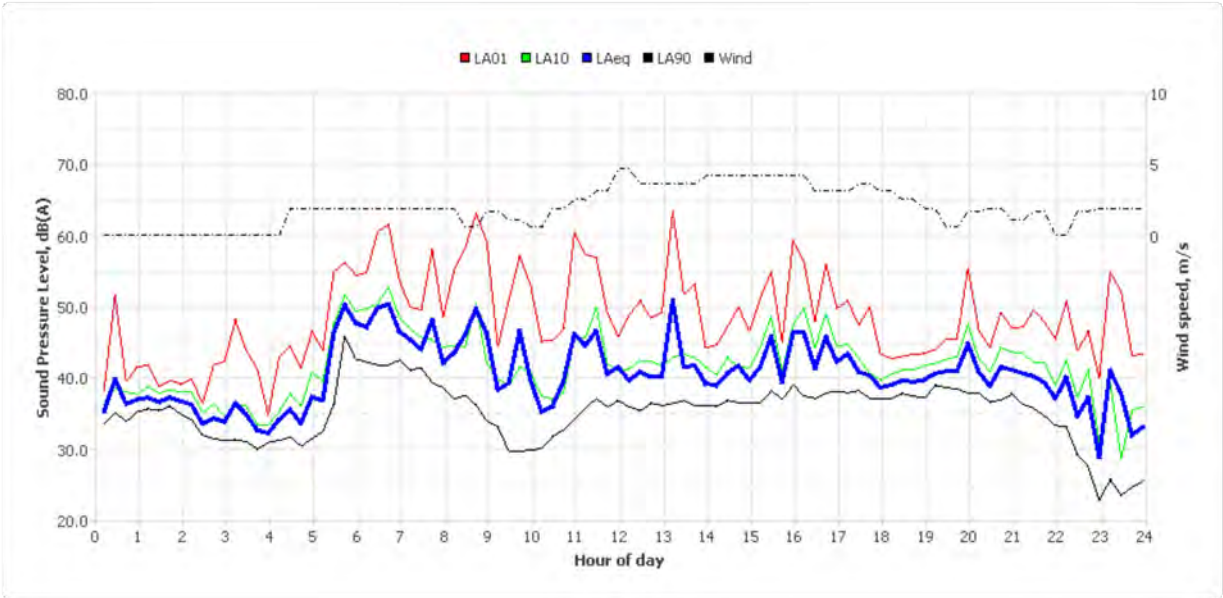

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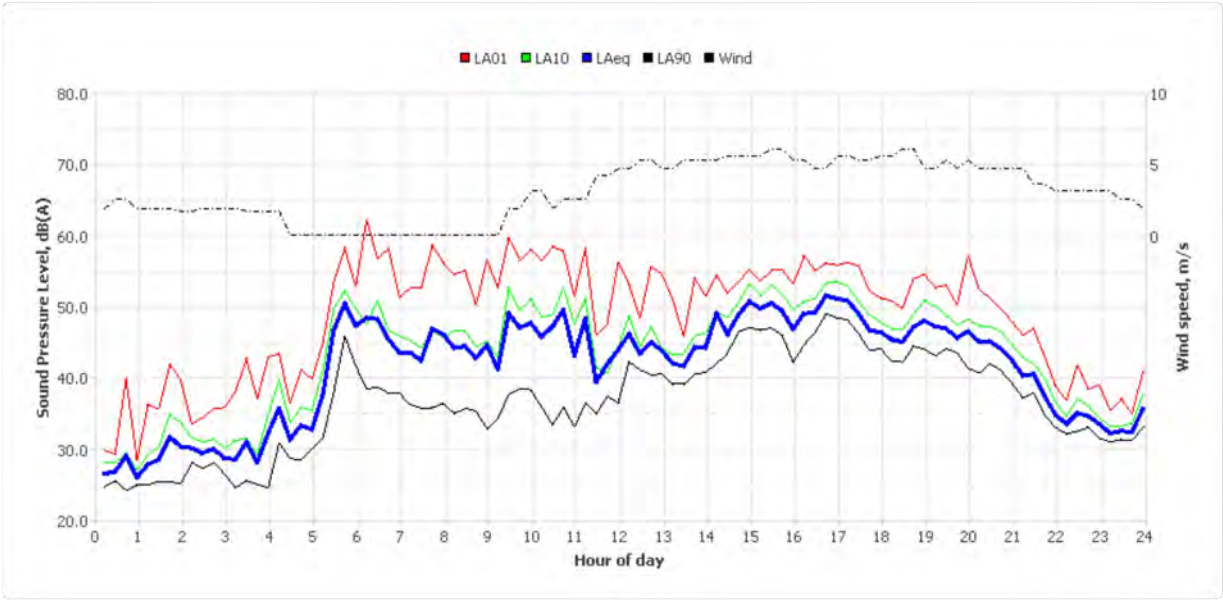

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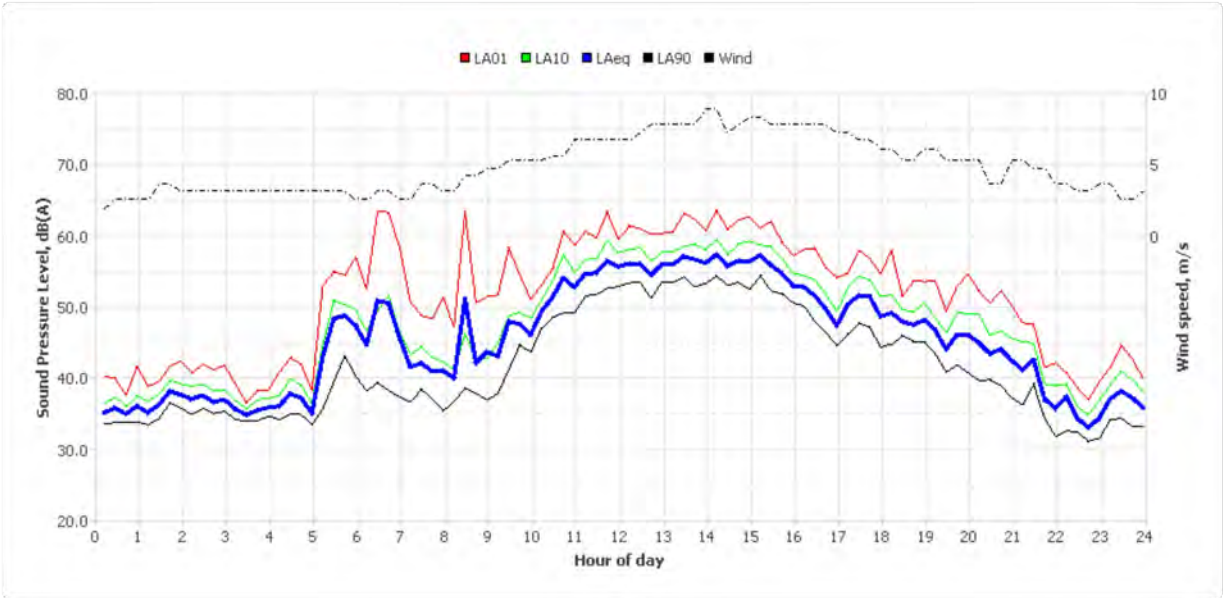
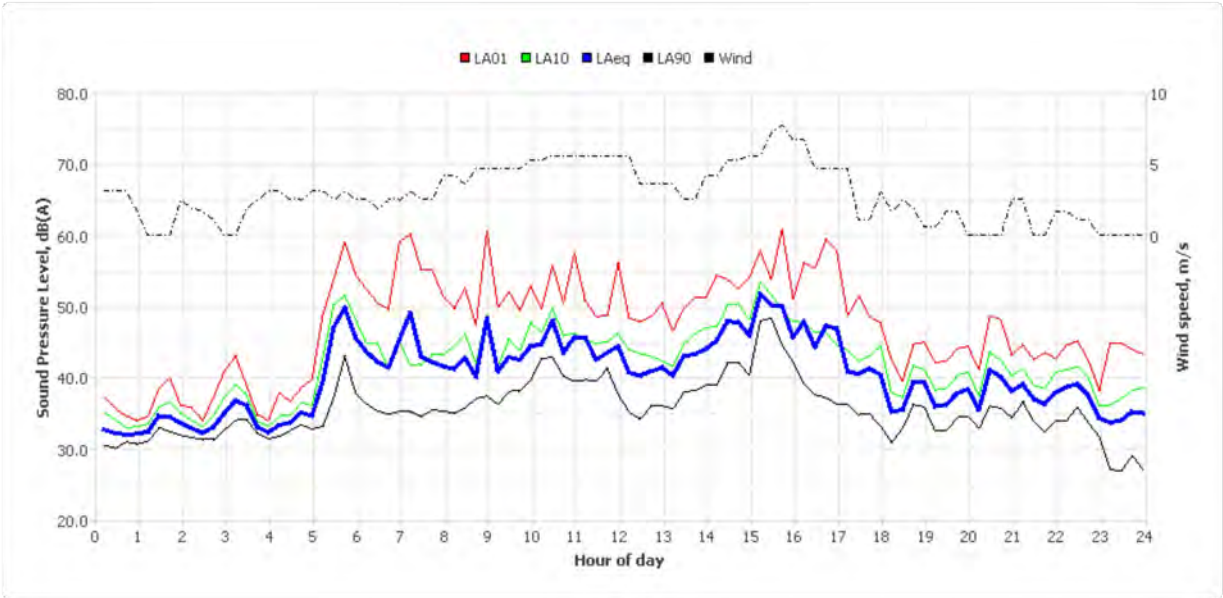
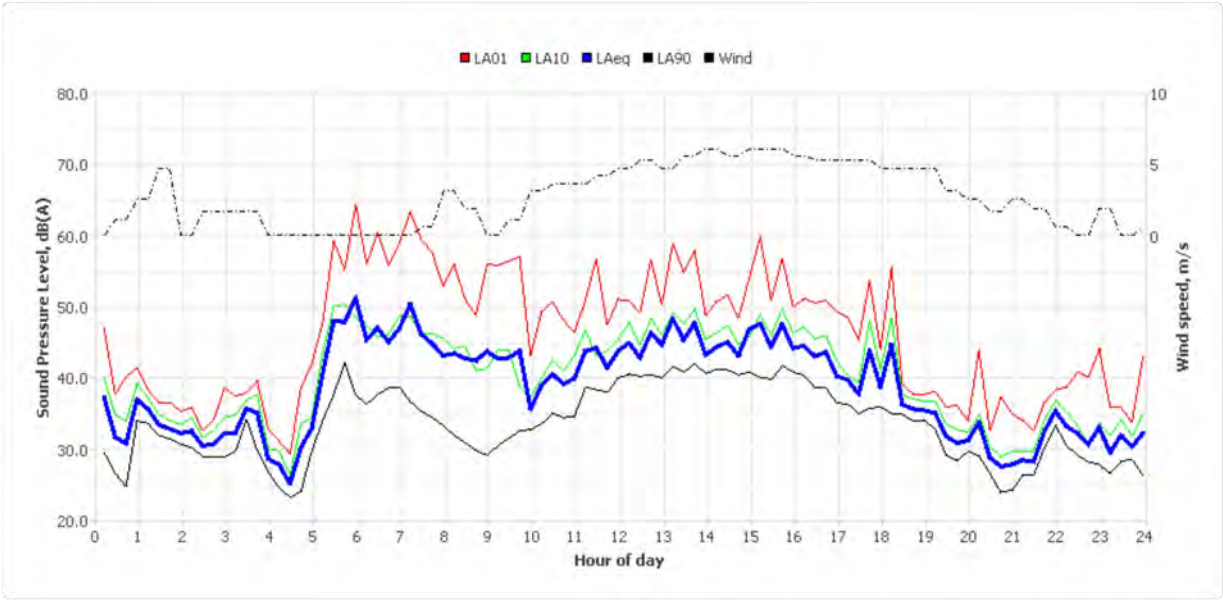


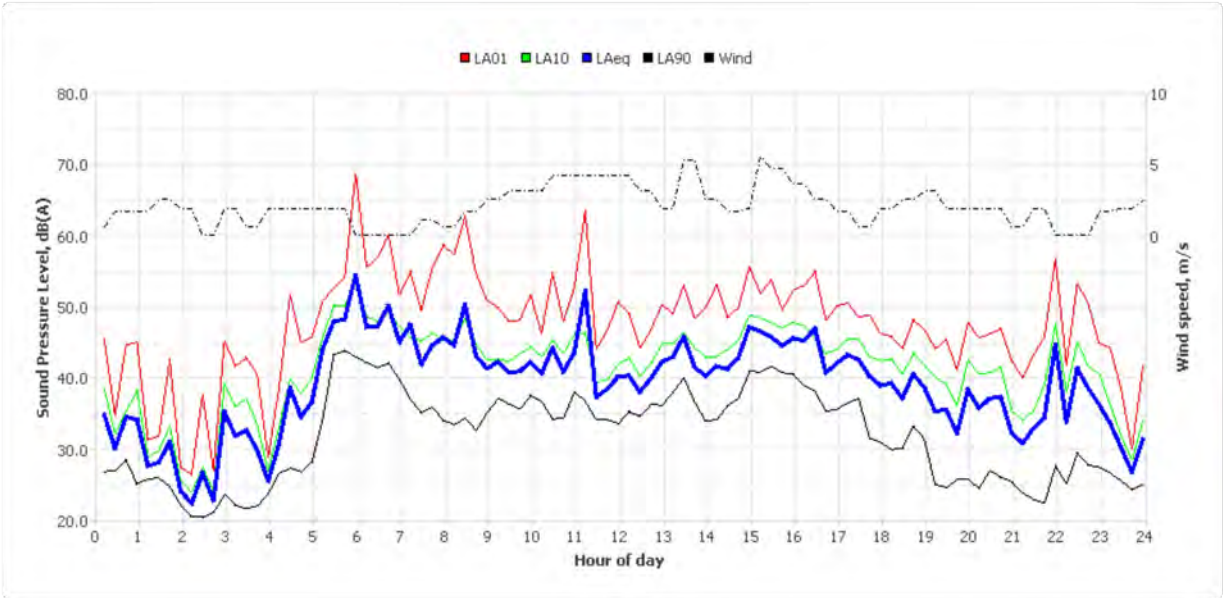
Saturday, 21 Sep 2019



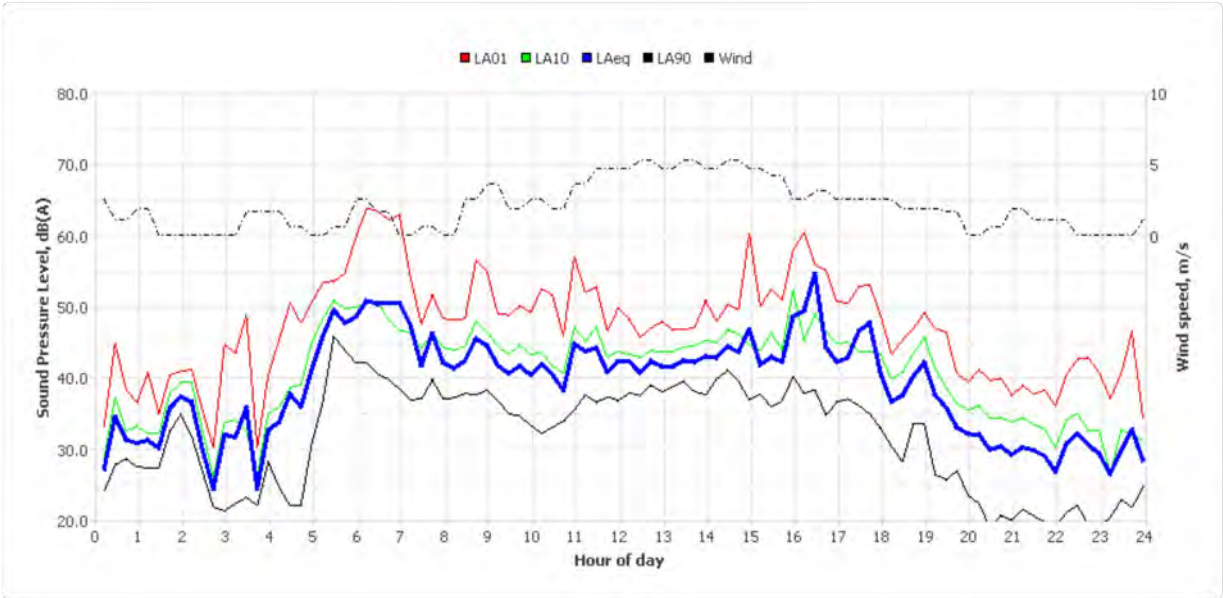
Sunday, 22 Sep 2019



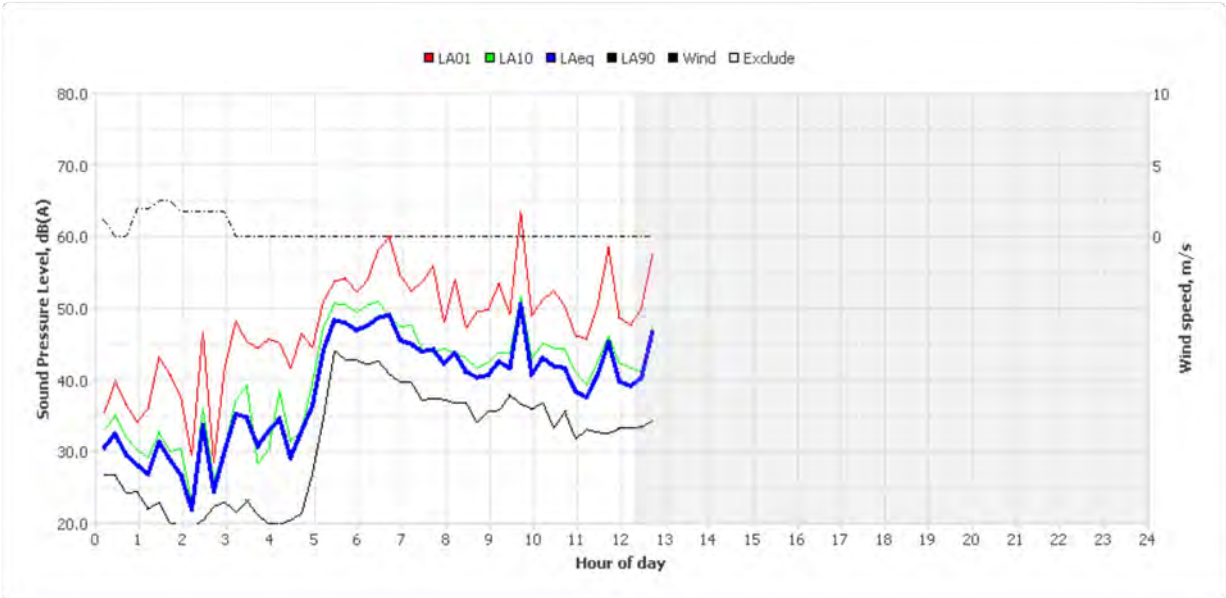
Monday, 23 Sep 2019



Tuesday, 24 Sep 2019



Wednesday, 25 Sep 2019



Appendix B

Attended Noise Measurement Locations

Merimbula STP

N

0 20 40 Meters

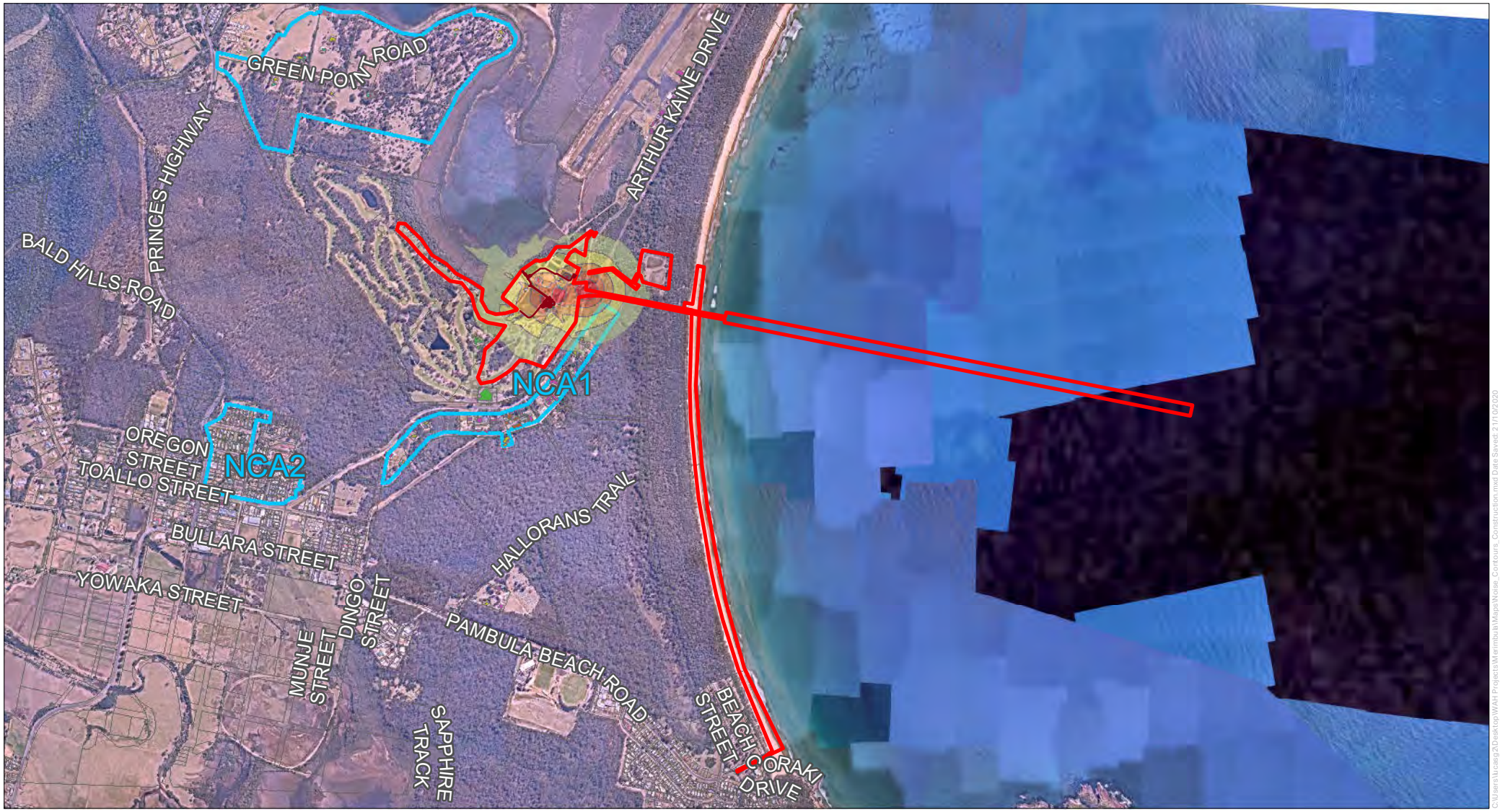
AECOM

- STP Future Noise Sources
- Measurement Points

Source:

Appendix C

Construction Noise Levels



Construction Noise Levels - Scenario 1A

Construction Boundary

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

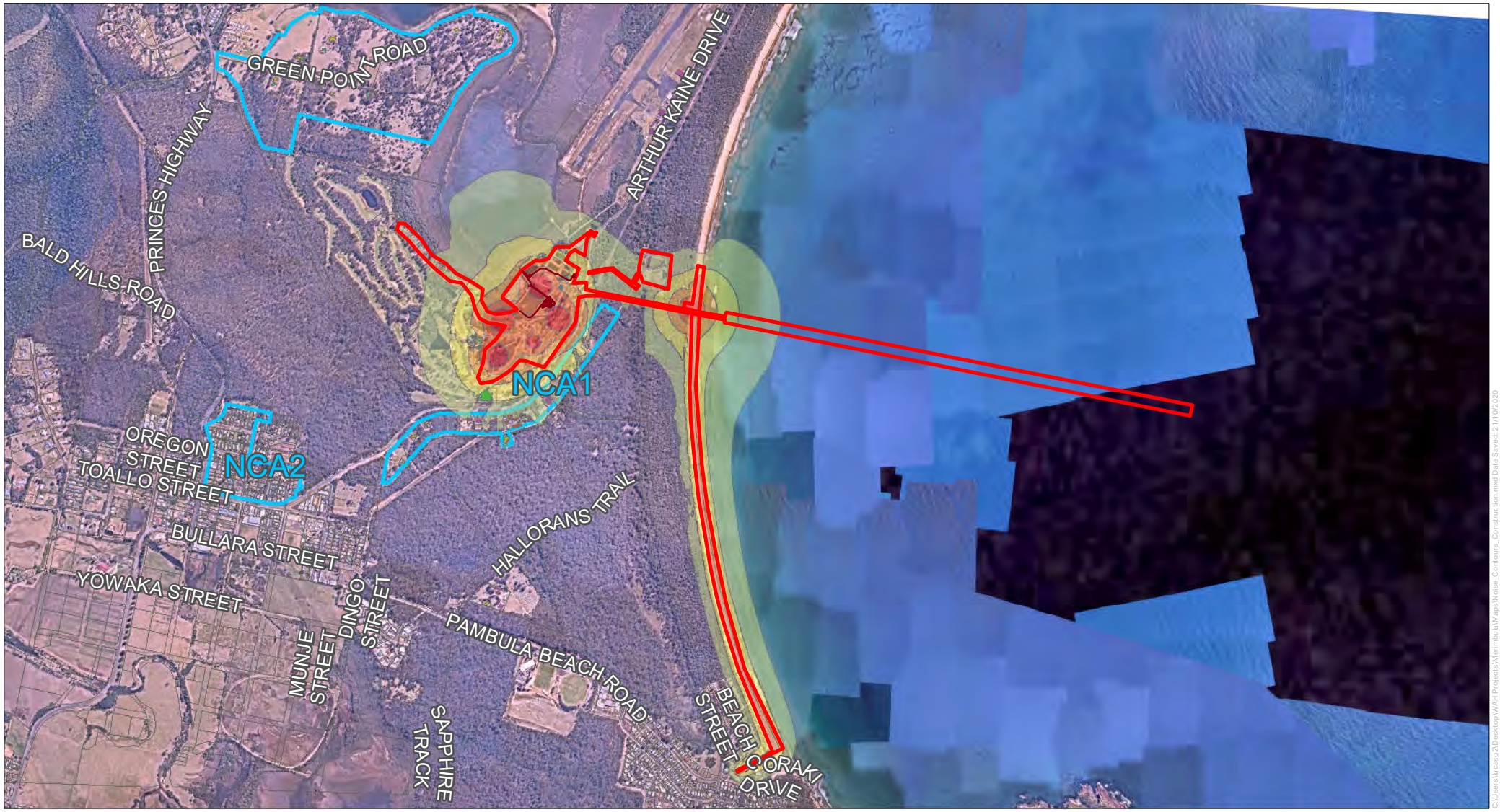
45 50 55 60 65

N

0 400 800 Meters

AECOM

Source:



Construction Noise Levels - Scenario 1B

Construction Boundary

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

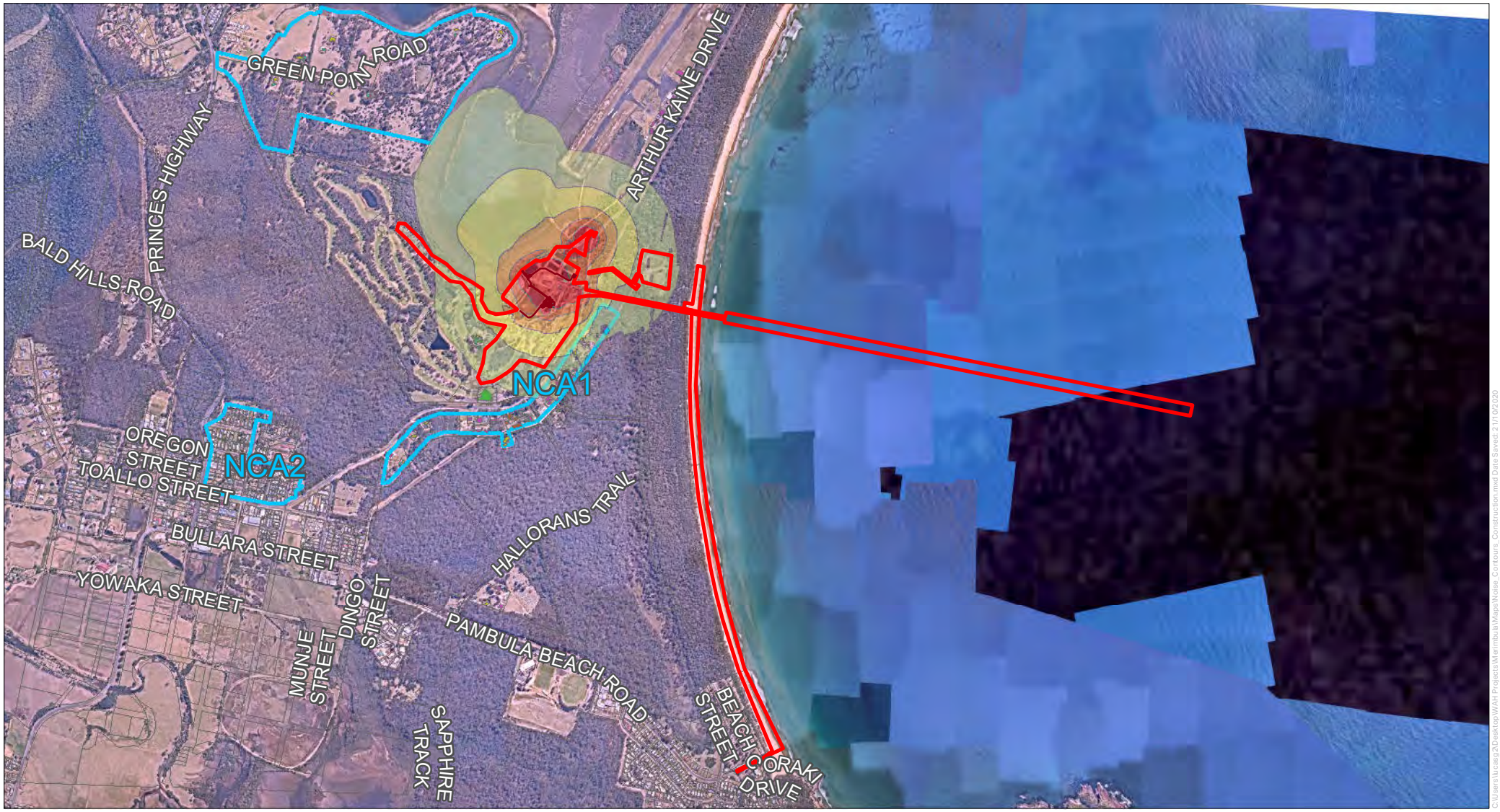
45 50 55 60 65

N

0 400 800 Meters

AECOM

Source:



Construction Noise Levels - Scenario 3

Construction Boundary

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

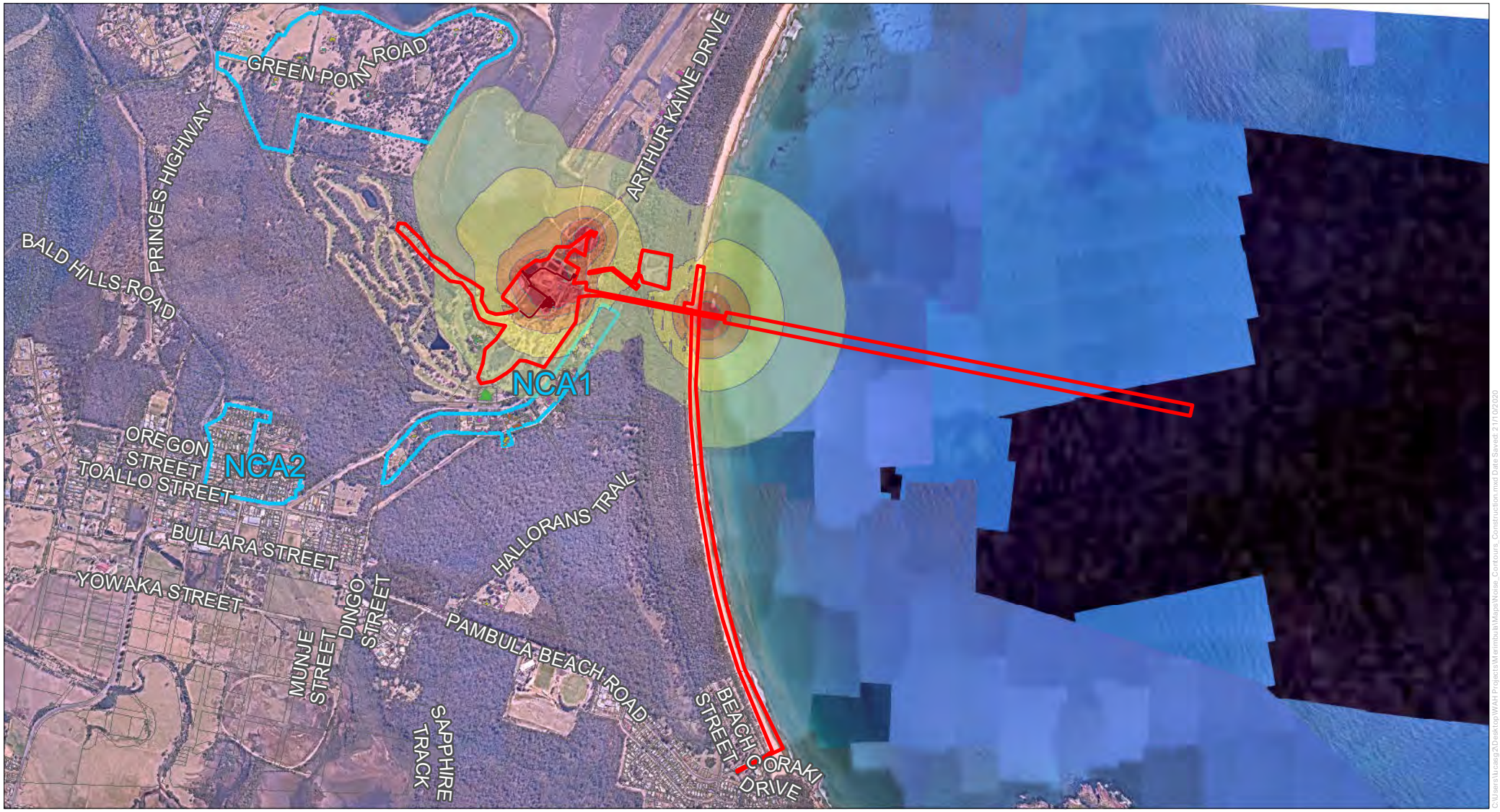
45 50 55 60 65

N

0 400 800 Meters

AECOM

Source:



Construction Noise Levels - Scenario 3 & 6A

Construction Boundary

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

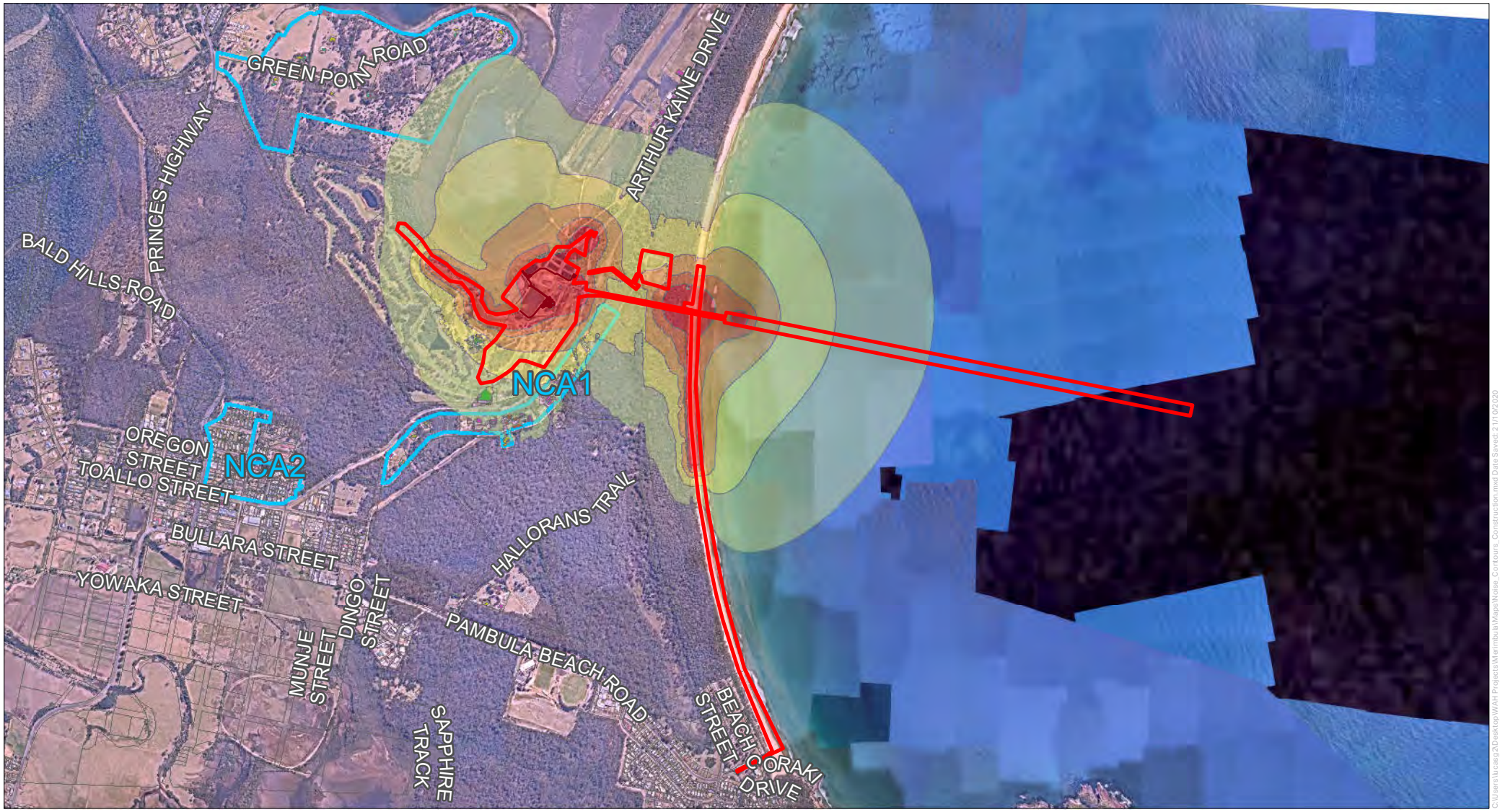
45 50 55 60 65

N

0 400 800 Meters

AECOM

Source:



Construction Noise Levels - Scenario 3, 4B, 5A&C

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

45 50 55 60 65

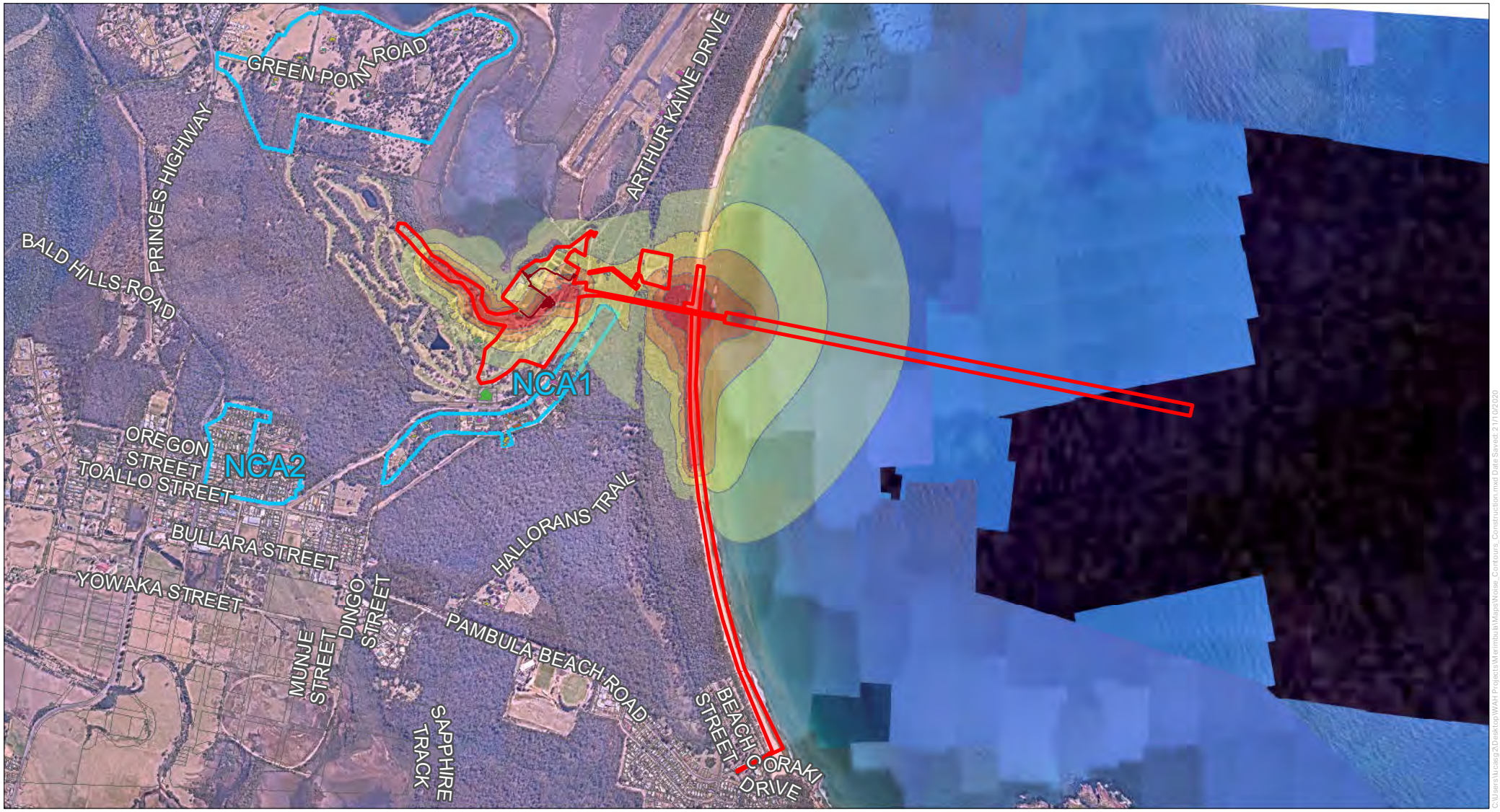
Construction Boundary

N

0 400 800 Meters

AECOM

Source:



Construction Noise Levels - Scenario 4A&B, 5A&B

Construction Boundary

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

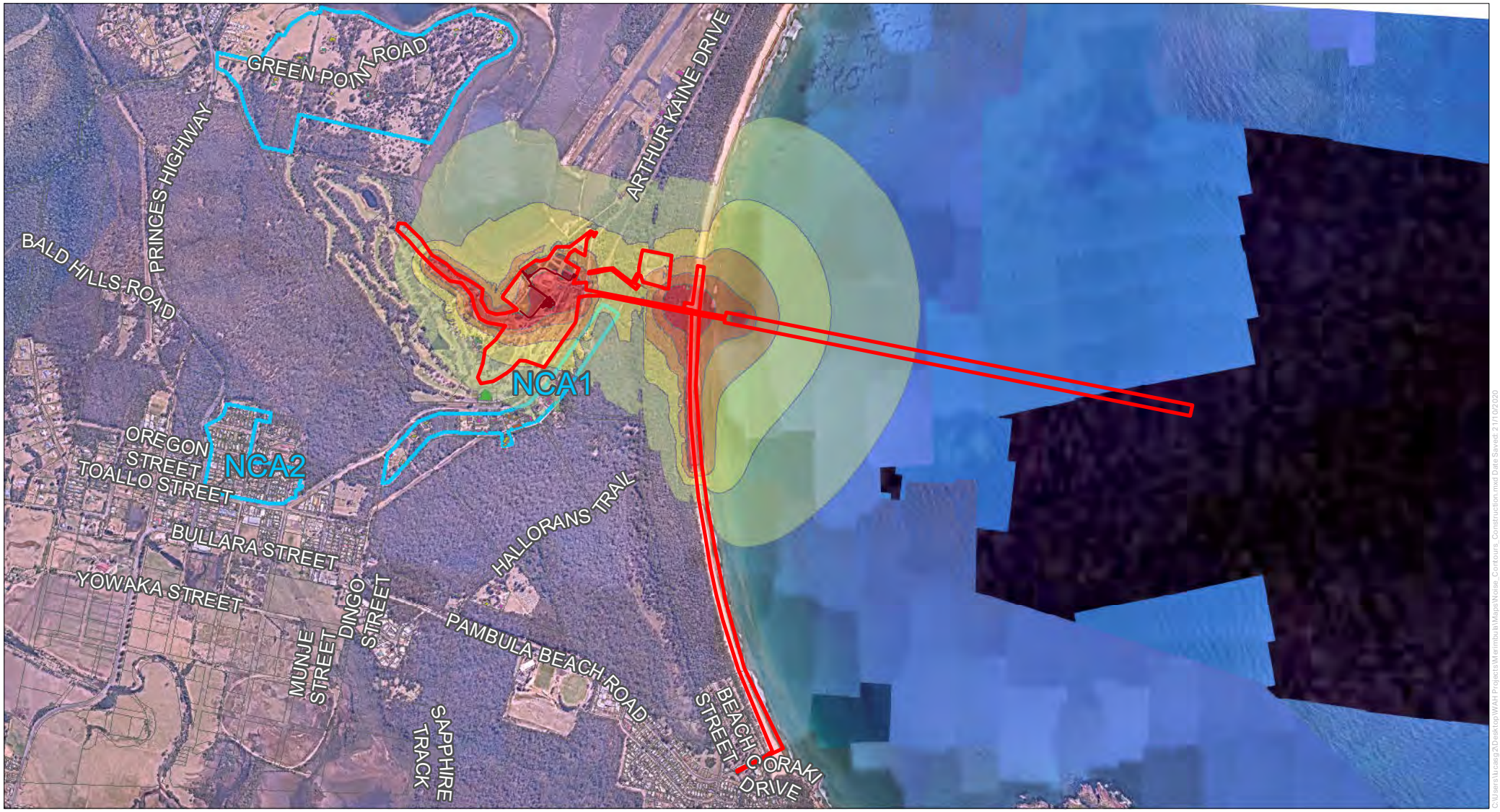
45 50 55 60 65

N

0 400 800 Meters

AECOM

Source:



Construction Noise Levels - Scenario 4B, 5A&C

Construction Boundary

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

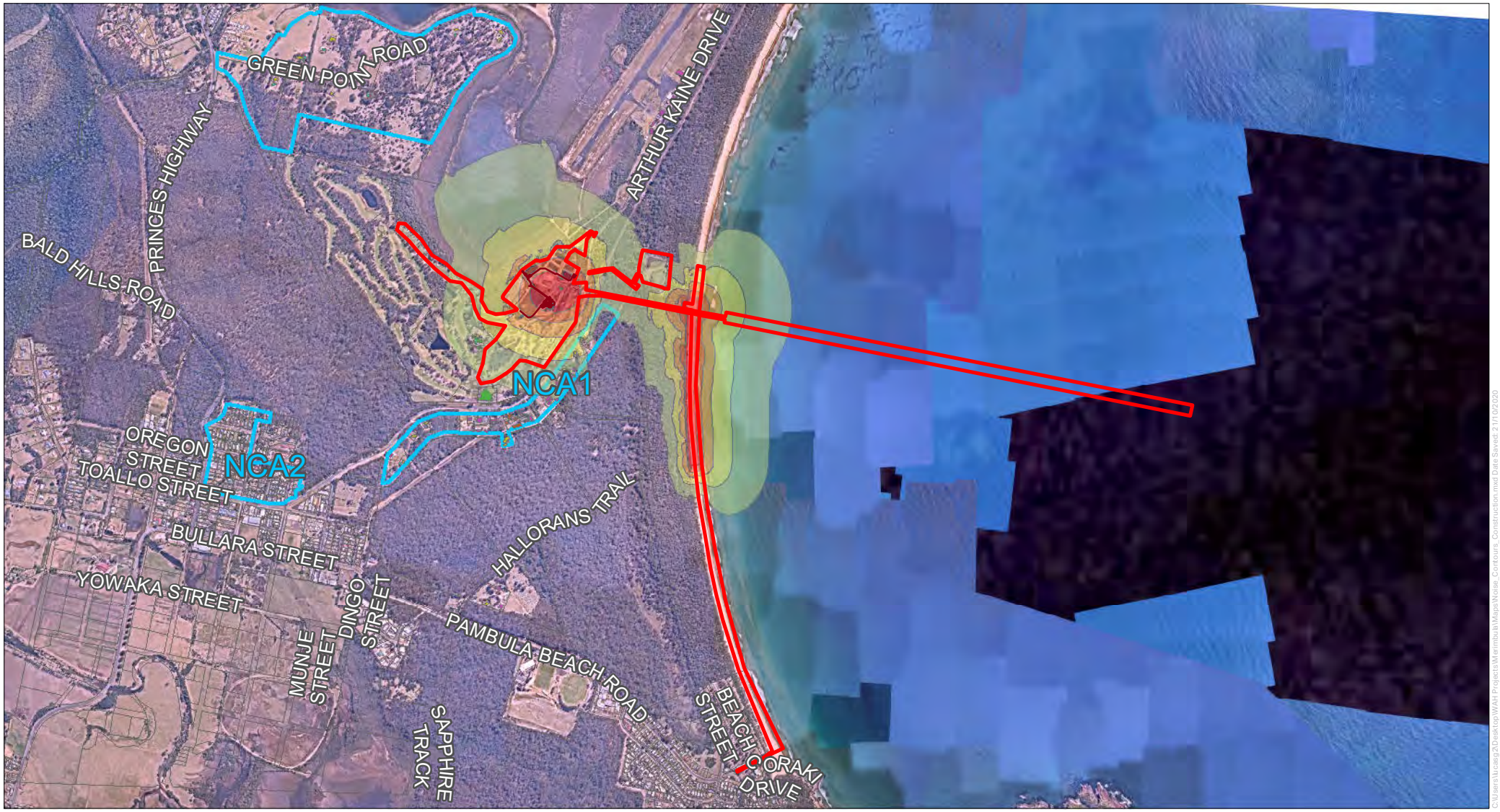
45 50 55 60 65

N

0 400 800 Meters

AECOM

Source:



Construction Noise Levels - Scenario 4B, 5C

Construction Boundary

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

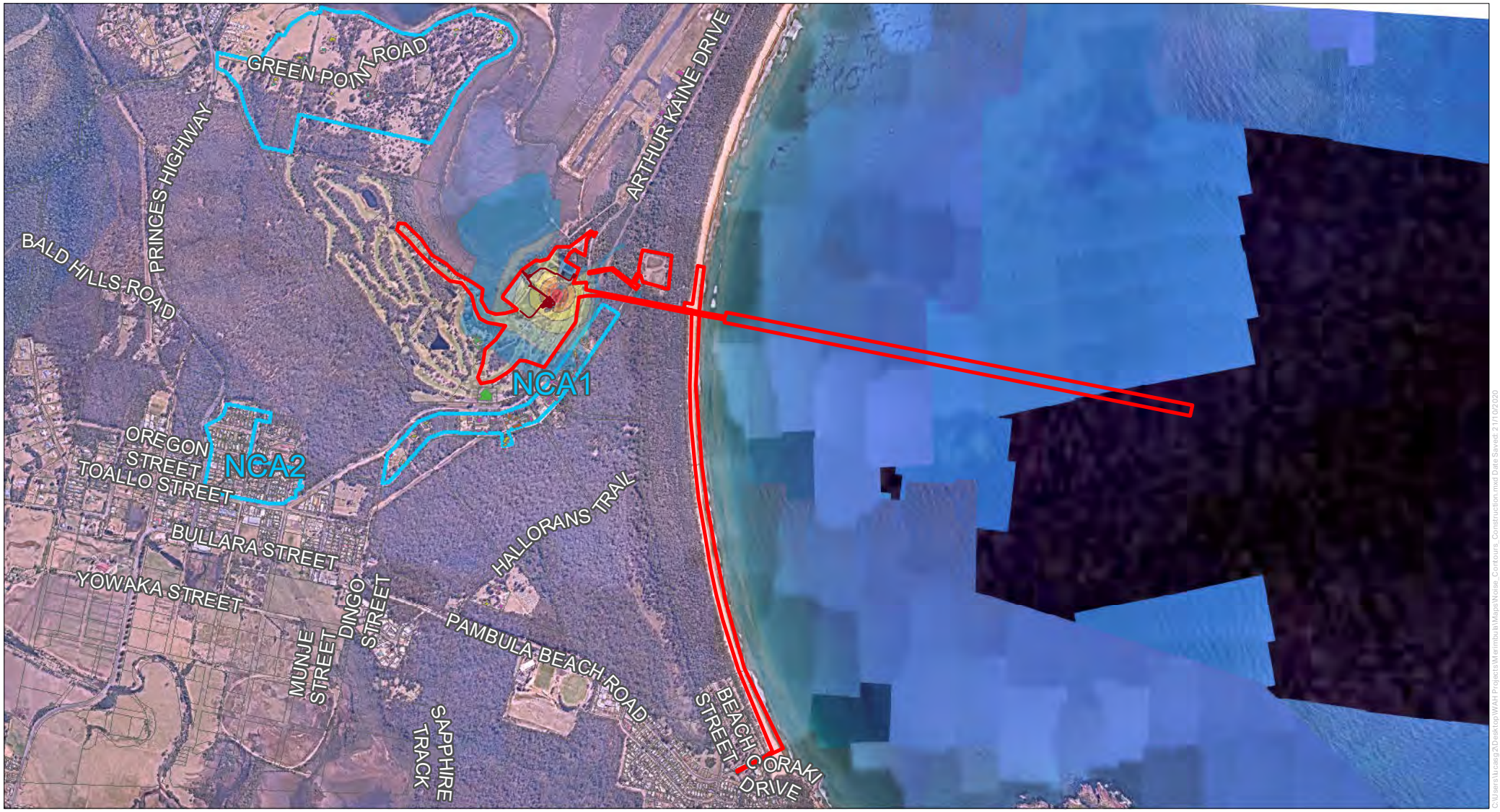
45 50 55 60 65

N

0 400 800 Meters

AECOM

Source:



Construction Noise Levels - Scenario 5 - Night

Construction Boundary

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

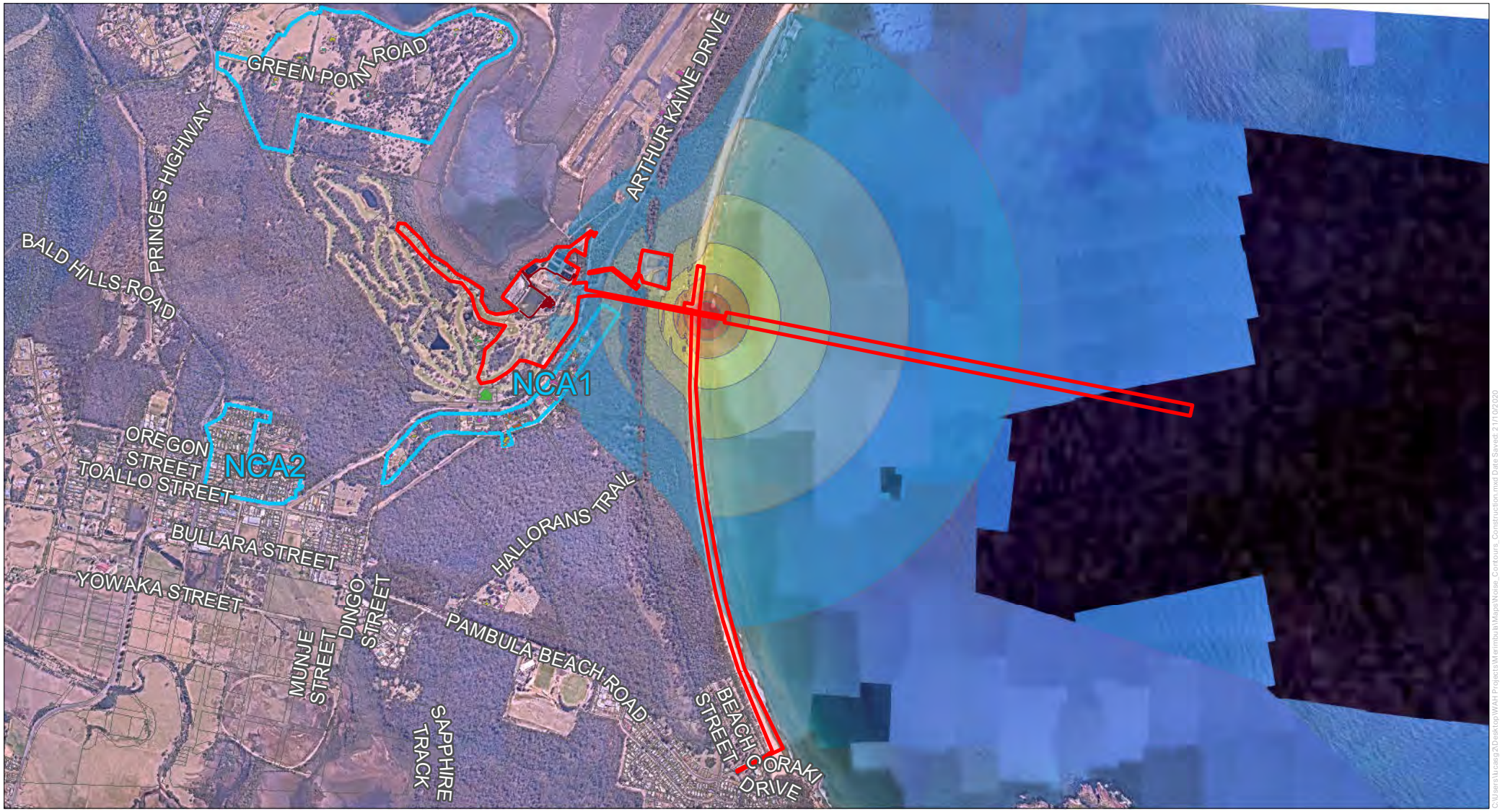
35 40 45 50 55 60 65

N

0 400 800 Meters

AECOM

Source:



Construction Noise Levels - Scenario 6A

Construction Boundary

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

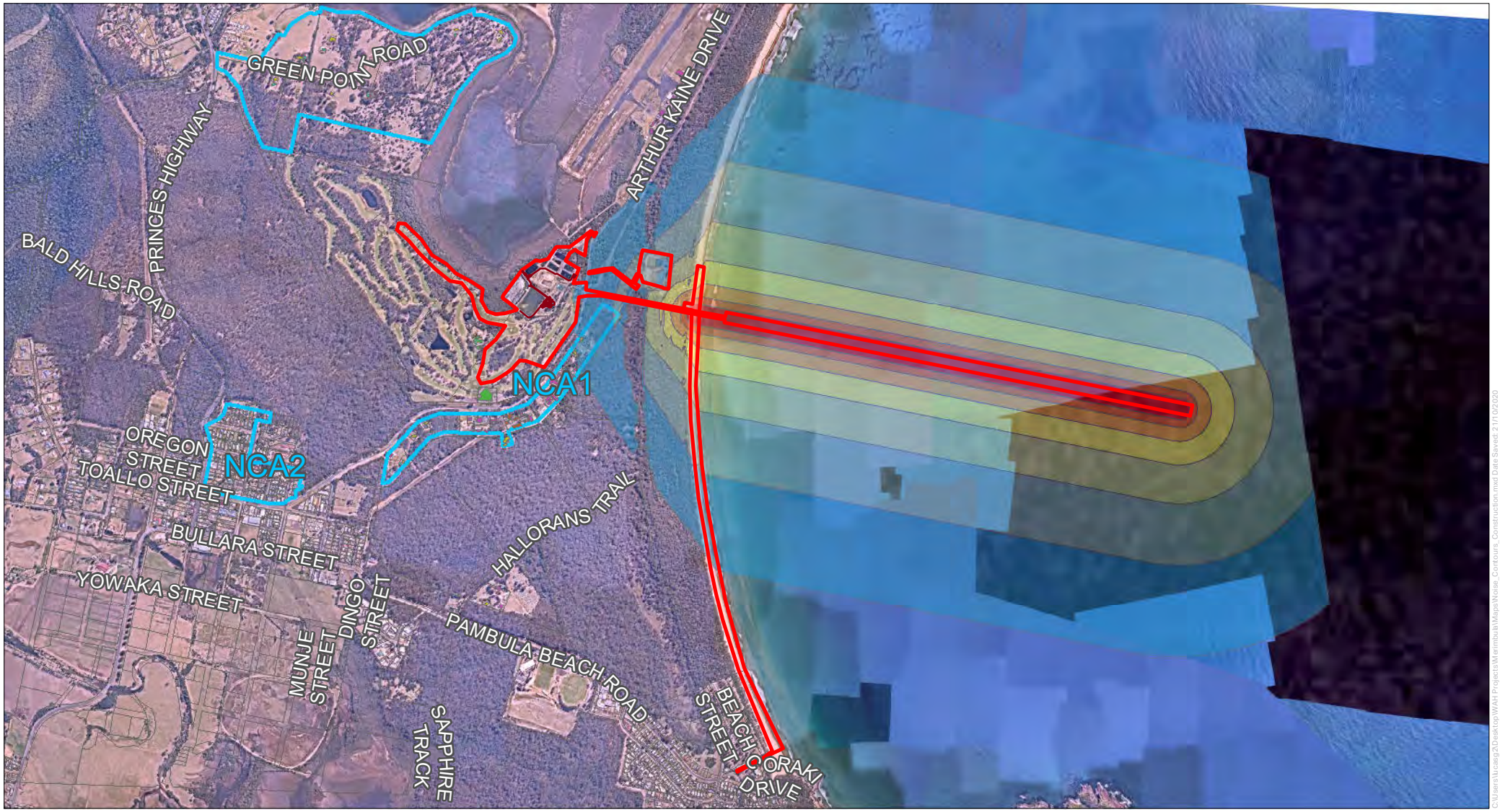
35 40 45 50 55 60 65

N

0 400 800 Meters

AECOM

Source:



Construction Noise Levels - Scenario 6C & D

Construction Boundary

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

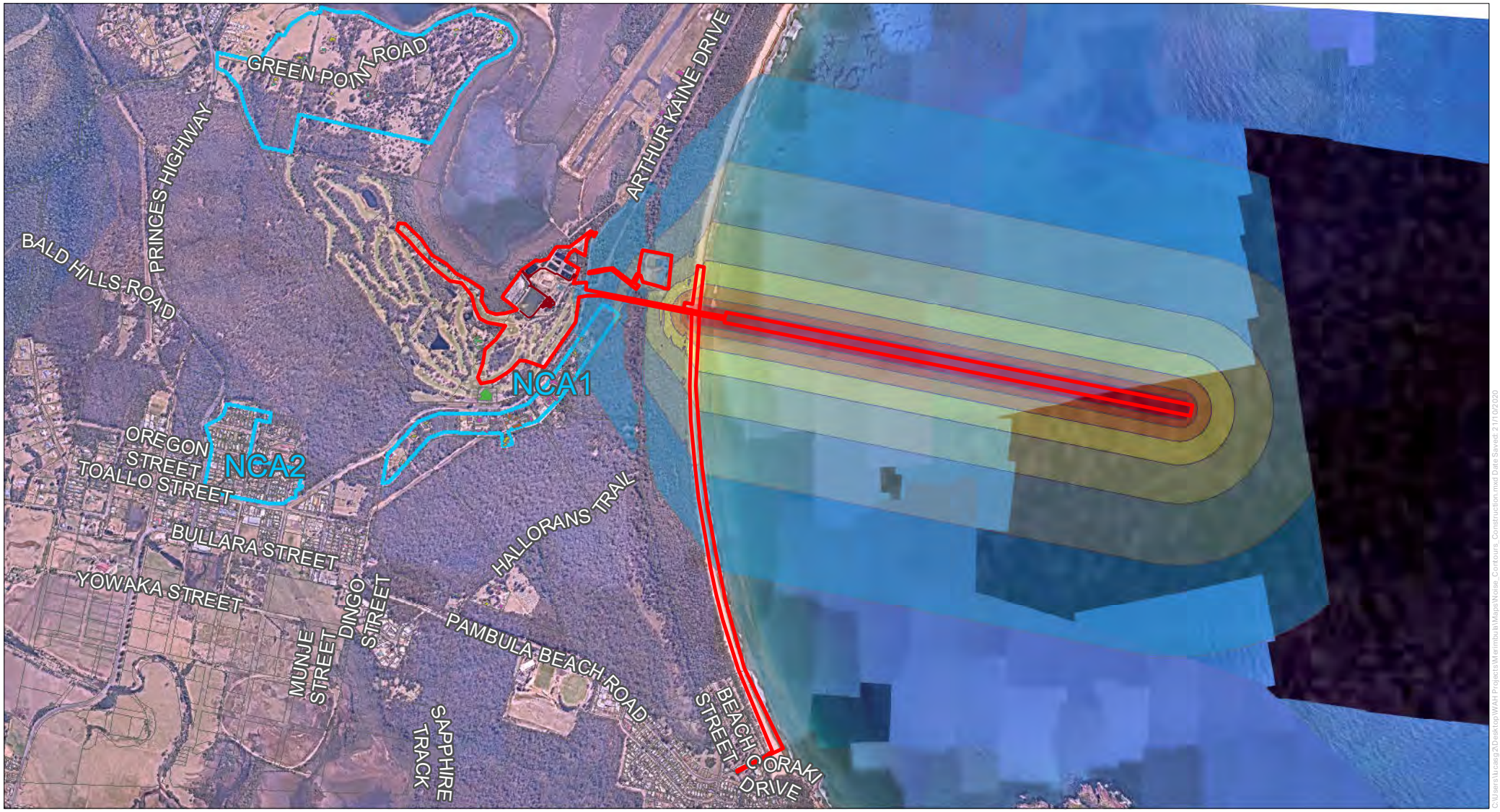
35 40 45 50 55 60 65

N

0 400 800 Meters

AECOM

Source:



Construction Noise Levels - Scenario 6E

Construction Boundary

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

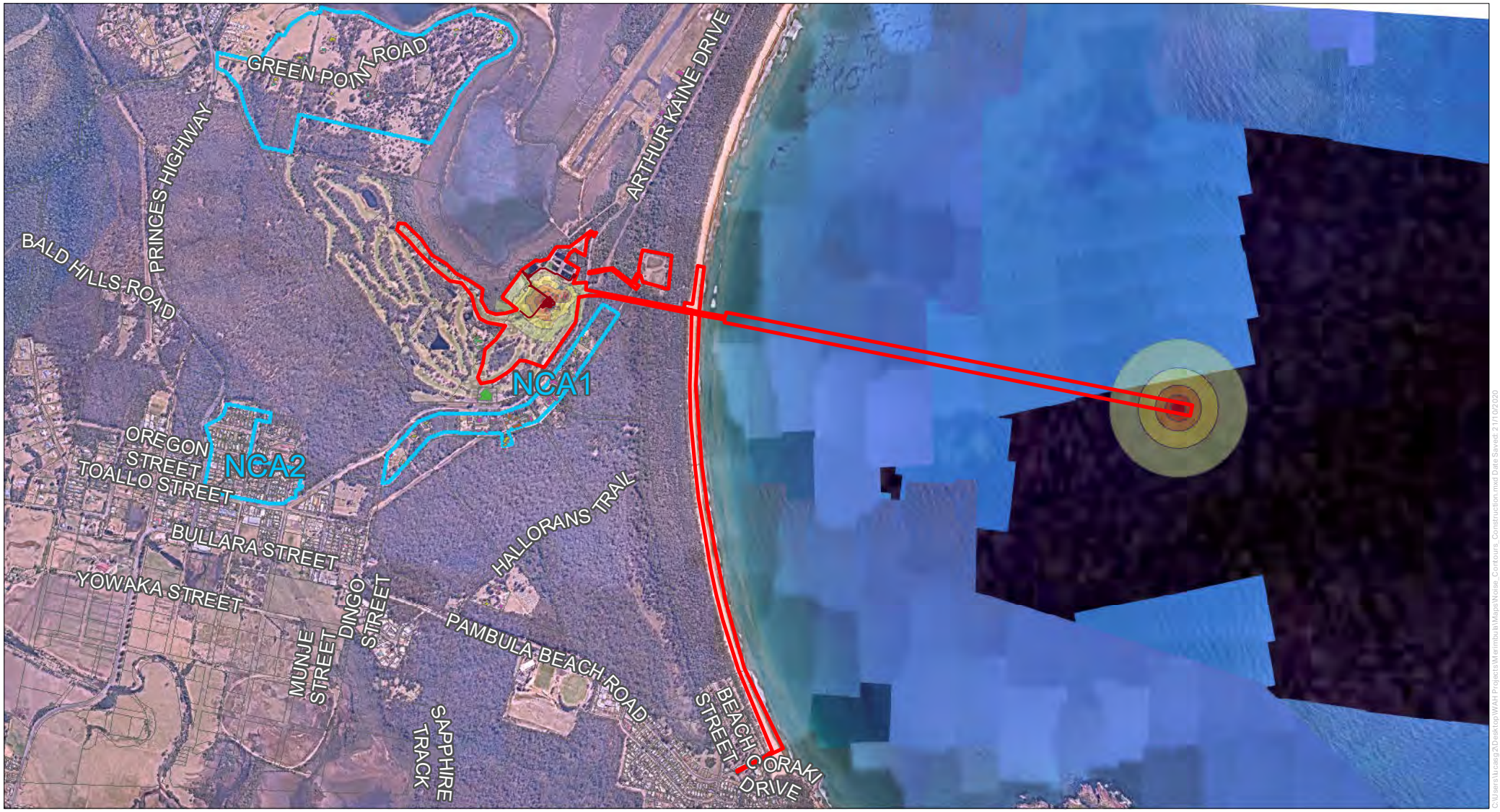
35 40 45 50 55 60 65

N

0 400 800 Meters

AECOM

Source:



Construction Noise Levels - Scenario 7

Construction Boundary

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

45 50 55 60 65

N

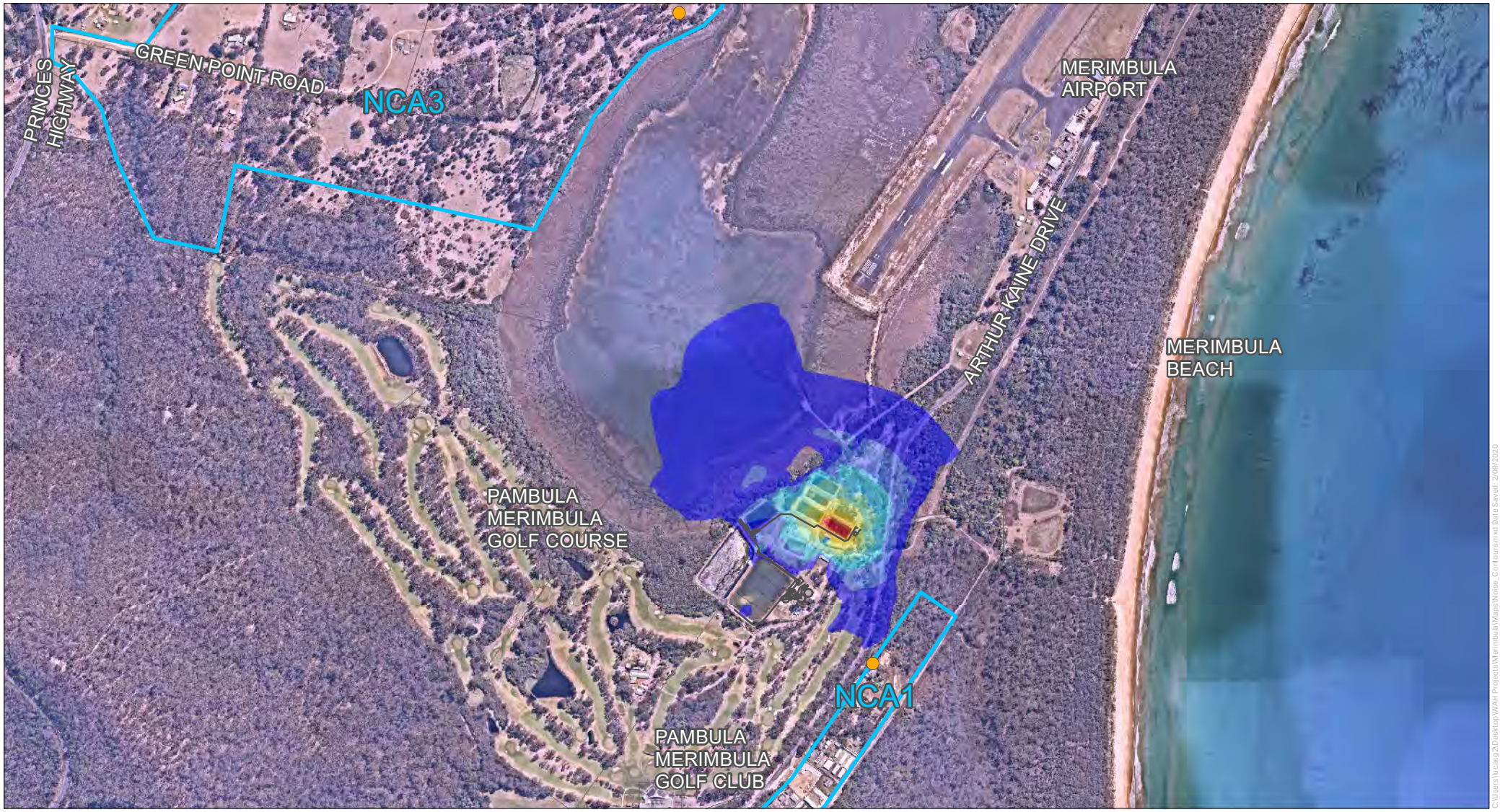
0 400 800 Meters

AECOM

Source:

Appendix D

Operational Noise Levels



Merimbla STP - Operational Noise Levels - Existing STP

Receivers

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

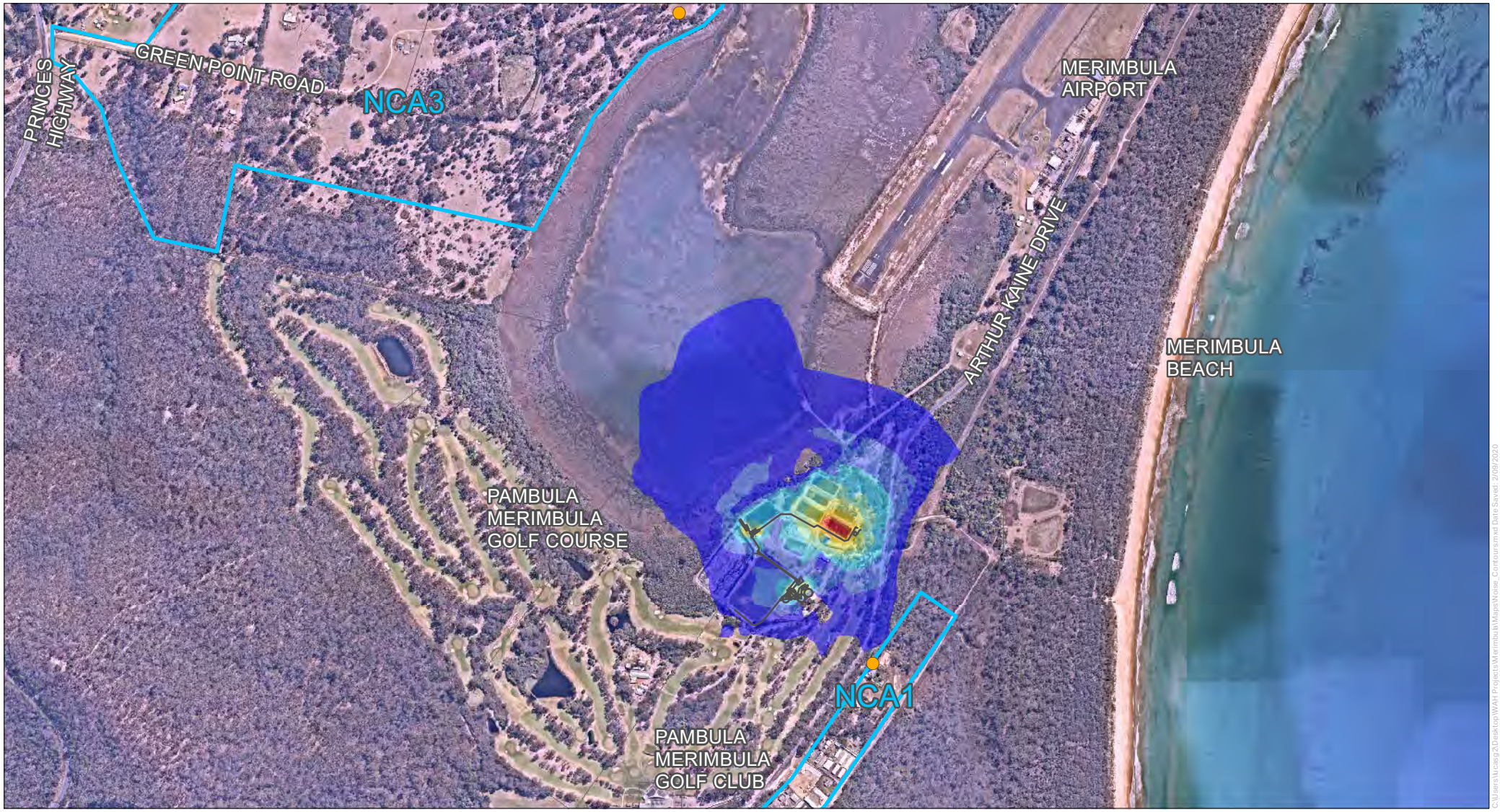
35 - 39 | 40 - 44 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | 65 - 69 | > 69

N

0 200 400 Meters

AECOM

Source:



Merimbla STP - Operational Noise Levels - Future STP

Receivers

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

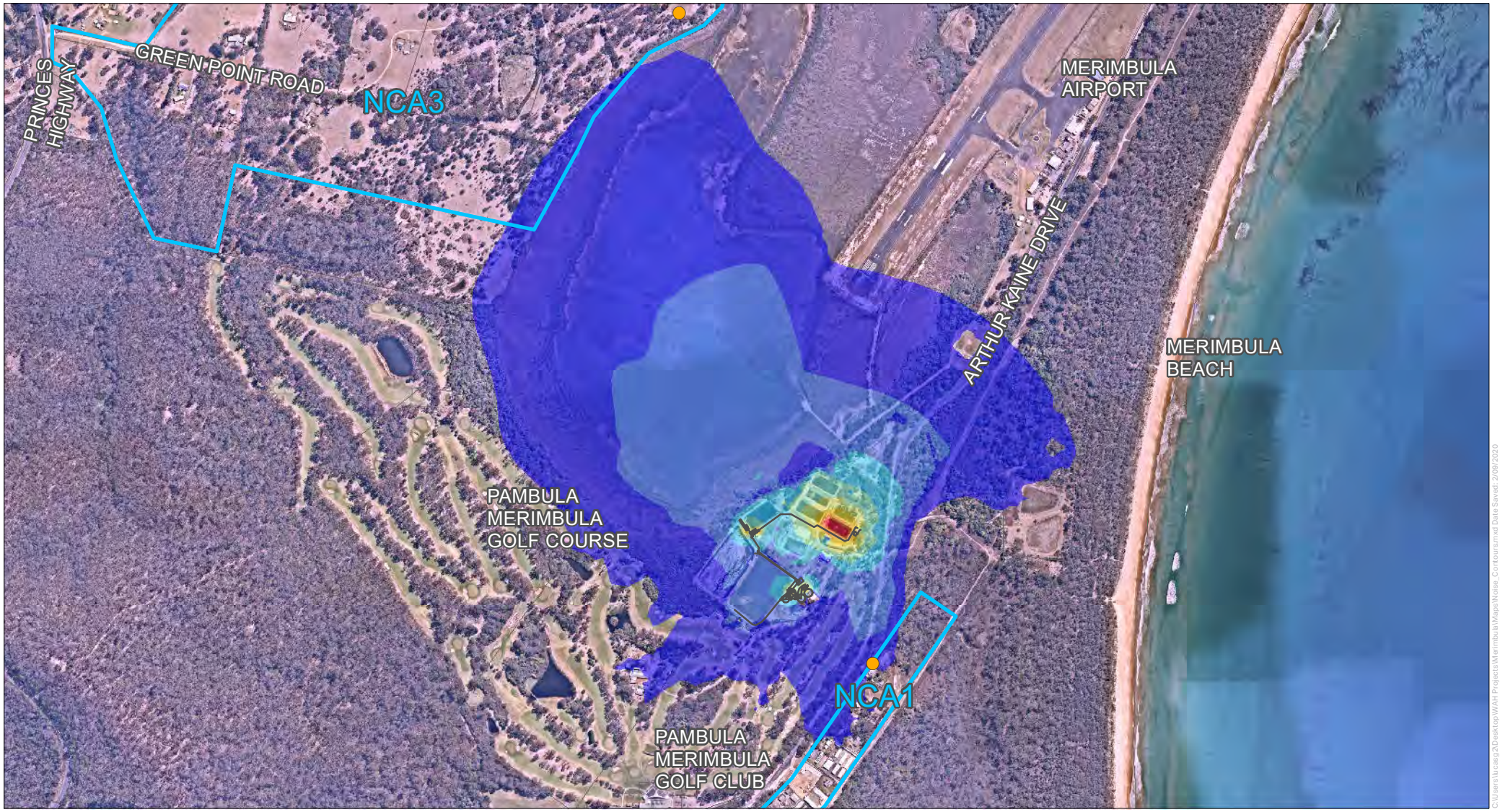
35 - 39 | 40 - 44 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | 65 - 69 | > 69

N

0 200 400 Meters

AECOM

Source:



Merimbla STP - Operational Noise Levels - Future STP - 3m/s wind

Receivers

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

35 - 39 | 40 - 44 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | 65 - 69 | > 69

N

0 200 400 Meters

AECOM

Source: