Appendix L
Noise and vibration

Australian Industrial Energy

Port Kembla Gas Terminal

Noise and Vibration Impact Assessment

November 2018

Executive summary

Australian Industrial Energy (AIE) proposes to develop the Port Kembla Gas Terminal (the project) in Port Kembla, New South Wales (NSW). The project involves the development of a liquified natural gas (LNG) import terminal including a Floating Storage and Regasification Unit (FSRU) moored at Berth 101 in the Inner Harbour, visiting LNG carriers, wharf offloading facilities and the installation of new pipeline to connect to the existing gas transmission network.

This report provides an assessment of the potential noise and vibration impacts during construction and operation of the project.

Existing environment

Long-term noise monitoring was undertaken at two locations to quantify the existing noise environment surrounding the project site. The existing environment is dominated by industrial noise from premises in Port Kembla (comprising of the coal terminal and mixed road, rail and ship processing activities), road traffic and rail noise.

The project footprint will be restricted to a highly disturbed area primarily within reclaimed and industrial land. The assessment of potential impacts has been undertaken at surrounding sensitive receivers to identify potential land uses that could be noise affected due to the project.

Airborne construction noise

Construction of the project is expected to take 10 - 12 months with completion due in early 2020. Construction would be anticipated to follow two concurrent stages: pipeline construction and berth demolition, dredging, excavation and disposal works. Construction noise levels have been assessed for the two stages against construction noise management levels determined in accordance with the *Interim Construction Noise Guideline*.

No exceedances of the noise management levels are predicted for non-residential receivers.

For residential receivers located in the study area, noise from construction works for both stages of construction have been modelled on the basis of all construction equipment operating at once and affecting the worst-case sensitive receiver. This is unlikely to occur in practice, nevertheless, under this scenario, noise is expected to exceed the construction noise management levels at surrounding receivers in some instances during construction.

The predicted noise levels are expected to exceed the noise management levels during standard and outside of construction hours for pipeline construction works located in the closest proximity to the residential receivers. The impacts from pipeline construction activities would be intermittent in duration as the pipeline construction would progress sequentially along the construction corridor.

Minor exceedances of the noise management levels are also predicted during standard and outside of construction hours for fixed construction activities. The impacted receivers would be subject to existing ambient rail traffic noise and industrial noise from the port area.

Construction noise mitigation measures have been recommended and should be implemented where reasonable and feasible.

Sleep disturbance impacts due to awakening events are not anticipated due to construction.

Construction traffic noise

The proposed construction traffic routes are along arterial roads with a high volume of existing traffic, including industrial traffic. This increase in traffic due to construction is considered unlikely to cause road traffic noise impacts on the road network.

Underwater construction noise

During dredging and piling activities underwater noise will be generated. Underwater noise impacts from dredging are not anticipated to cause irreversible auditory damage to marine megafauna in the area. Behaviour patterns are likely to be temporarily altered as marine megafauna seek to avoid the immediate dredging area. The effect on marine megafauna is discussed further in the *Marine Ecology Assessment* (GHD, 2018) report.

A 109 metre observation zone is recommended around the piling area to minimise underwater noise impacts. This would permit up to thirty minutes of continuous piling. Larger observation zones can permit longer durations of piling.

If marine species are sighted within the observation zone or about to enter the observation zone, piling would be stopped until the marine species moves outside the observation zone or 30 minutes have passed since the last marine species sighting.

Construction vibration

No vibration impacts above the vibration criteria are predicted from construction of the project due to the large distance between the construction area and the nearest residential receivers.

Operational noise

Noise emission from the project is expected to be constant throughout the day, evening and night-time periods. Operational noise has been modelled based on the equipment operating at maximum capacity. The predicted noise levels have been assessed against the *Noise Policy for Industry* project noise trigger levels to identify potential noise impacts during operation.

Operational noise levels are expected to be compliant with the project noise trigger levels during all periods. No specific operational noise mitigation measures are recommended.

Operational traffic noise

The proposed operational traffic routes are along arterial roads with a high volume of existing traffic, including industrial traffic. The increase in traffic due to operation is considered unlikely to cause road traffic noise impacts on the road network.

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1. Introduction

1.1 Background

Australian Industrial Energy (AIE) proposes to develop the Port Kembla Gas Terminal (the project) in Port Kembla, New South Wales (NSW). The project involves the development of a liquified natural gas (LNG) import terminal including a Floating Storage and Regasification Unit (FSRU) moored at Berth 101 in the Inner Harbour, visiting LNG carriers, wharf offloading facilities and the installation of new pipeline to connect to the existing gas transmission network. The project will be the first of its kind in NSW and provide a simple, flexible solution to the State's gas supply challenges.

NSW currently imports more than 95 % of the natural gas it uses, with the majority of supplies coming as interstate supplies from Victoria and South Australia. In recent years, gas supplies to the Australian east coast market have tightened, resulting in increased natural gas prices for both industrial and domestic users. Several recent economic studies have predicted significant future gas shortfalls for NSW by 2022.

The Port Kembla Gas Terminal provides an immediate solution to address predicted shortages and will result in considerable economic benefits for both the Illawarra region and NSW. The project will have capacity to deliver 100 petajoules of natural gas, equivalent to more than 70% of NSW gas needs and provide between 10 to 12 days of natural gas storage in case of interstate supply disruption. LNG will be sourced from worldwide suppliers and transported by LNG carriers to the gas terminal at Port Kembla. The LNG will then be re-gasified for input into the NSW gas transmission network.

The project has been declared critical state significant infrastructure in accordance with section 5.13 of the Environmental Planning and Assessment Act, 1979 (EP&A Act) and Schedule 5 of the State Environmental Planning Policy (SEPP) State and Regional Development. An Environmental Impact Statement (EIS) is required to support the application for approval for determination by the NSW Minister for Planning.

1.2 Project overview

1.2.1 Objectives

Key objectives for the project are to:

- Introduce a new source of competitively priced gas to meet predicted supply shortfalls and help put downward pressure on prices;
- Provide gas security to NSW with the ability to supply more than 70 % of the State's gas needs;
- Provide long-term contracts to industrial users and ability to meet 100 % of the State's industrial demand (manufacturers, power stations, hospitals, small businesses etc.);
- Help support the 300,000 jobs across NSW and the 15,000 jobs in the Illawarra, which rely on the competitive, reliable supply of natural gas;
- Support the diversification and future growth of Port Kembla.

1.2.2 The project

The project consists of four key components:

- LNG carrier vessels — there are hundreds of these in operation worldwide transporting LNG from production facilities all around the world to demand centres;
- FSRU — a cape-class ocean-going vessel which would be moored at Berth 101 in Port Kembla. There are around 30 such vessels currently in operation around the world;
- Berth and wharf facilities – including landside offloading facilities to transfer natural gas from the FSRU into a natural gas pipeline located on shore; and
- Gas pipeline – a Class 900 carbon steel high-pressure pipeline connection from the berth to the existing gas transmission network.

The project design and layout, construction, operation and decommissioning is described in the EIS.

The project, subject to approvals, is scheduled for construction in 2019 with first gas delivery in 2020. The project life is 10–15 years but could be extended with sufficient demand.

Construction of the project is expected to involve a capital investment of about $200–250 million and employ about 150 workers at its peak. Once fully operational, the project is expected to employ about 40–50 workers.

1.3 Purpose of this document

This Noise and Vibration Impact Assessment (NVIA) has been prepared to support the EIS for the project.

The NVIA provides a description of the existing noise environment, the compliance criteria during the construction and operational phases of the project and an assessment of the potential impacts due to activities associated with the project.

1.4 Scope

The scope of this NVIA includes:

- Identification of the existing noise levels in the project study area;
- Review the proposed construction methodology and identify potential construction equipment;
- Assessment of the potential construction noise and vibration impacts;
- Assessment of the potential underwater construction noise impacts;
- Review the proposed operations and identify source noise levels of the operational equipment;
- Assessment of the potential operational noise impacts;
- Assessment of the potential operational road noise impacts;
- Provision of mitigation and management measures where suitable; and
- Preparation of a report summarising the findings of the NVIA.

This report has been prepared with consideration of the following documents:

- *Assessing Vibration: A Technical Guideline* (DEC, 2006);
- *BS 6472 – 1992, Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)* (British Standard, 1992);
- *DIN 4150, Part 3: Structural Vibration in Buildings – Effects on Structures* (German Standard, 1999);

- *Interim Construction Noise Guideline* (ICNG) (DECC, 2009);
- *Noise Policy for Industry* (NPI) (EPA, 2017);
- *Road Noise Policy* (RNP) (DECCW, 2011);
- *Underwater Piling Noise Guidelines* (DPTI Government of South Australia, 2012).

1.5 Structure

The report is comprised of the following sections:

- **Section 1 – Introduction:** provides the background and an overview of the project and the assessment;
- **Section 2 – Existing environment:** summarises the existing noise conditions and details the noise monitoring methodology;
- **Section 3 – Compliance criteria:** provides an overview of the construction noise, construction vibration and operational noise criteria;
- **Section 4 – Construction impacts assessment:** presents a summary of the noise modelling and identifies potential noise and vibration impacts during construction;
- **Section 5 – Operational impacts assessment:** presents a summary of the noise modelling and identifies potential noise impacts during operation;
- **Section 6 – Mitigation measures:** provides an overview of the proposed noise and vibration mitigation measures during the construction and operational phases of the project;
- **Section 7 – Conclusion:** presents a summary of the NVIA findings and sets out the principal conclusions for the assessment;
- **Section 8 – References**.

1.6 Limitations

This report: has been prepared by GHD for Australian Industrial Energy and may only be used and relied on by Australian Industrial Energy for the purpose agreed between GHD and the Australian Industrial Energy as set out in section 1.4 of this report.

GHD otherwise disclaims responsibility to any person other than Australian Industrial Energy arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Australian Industrial Energy and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including measured noise levels) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

2. Existing environment

2.1 Location

2.1.1 Port Kembla

Port Kembla is a deep water harbour located in the Illawarra region, approximately 3 kilometres south of the Wollongong Central Business District and 80 kilometres south of Sydney. The port operates across two harbours, consisting of an Inner and Outer Harbour. NSW Ports is responsible for infrastructure at the port, while the NSW Port Authority manage functions including harbour control, vessel tracking, pilotage and navigation.

There are a total of 18 berths at Port Kembla with services ranging from motor vehicle imports, grain and coal exports, general cargo facilities, dry bulk and break bulk facilities and bulk liquid facilities as shown on Figure 2.1.

Two grain terminals operate on the northern side of the Inner Harbour along with bulk liquid facilities and a number of multi-purpose berths. BlueScope Steelworks operate five berths on the western side of the Inner Harbour and the Port Kembla Coal Terminal (PKCT) is a coal export facility located on the eastern side of the Inner Harbour operating from two berths.

Six berths operate in the Outer Harbour for use in fuel discharge and loading, bulk and break bulk cargo including copper concentrate, fertiliser, clinker, pulp/saw logs and steel products. The Outer Harbour redevelopment project has also been approved and involves reclamation and dredging to enable additional port facilities to be developed in the Outer Harbour.

2.1.2 Berth 101

Berth 101 is proposed for use as part of the project and is located between Berth 102 and “the Cut” shipping channel providing access to the Inner Harbour. Berth 101 is currently operated by the PKCT and was most recently utilised as an off-loading wharf for materials handling equipment, but does not currently have any regular use with the majority of coal exports operating out of Berth 102.

Land use surrounding Berth 101 is predominantly heavy industrial or special uses associated with port operations. Wollongong Sewage Treatment Plant is located to the north of the coal export facility.

The closest residential properties to Berth 101 are located approximately two kilometres to the north in Coniston, to the west in Cringila and to the south at Port Kembla and Warrawong.

The pipeline to connect the FSRU with the existing gas transportation network at Cringila passes through a predominantly industrial setting around the outskirts of Port Kembla.

2.1.3 Transport and access

Springhill Road and Masters Roads are the two main vehicular traffic routes connecting Port Kembla to the regional road network including the M1 Princes Motorway. Tom Thumb, Springhill and Masters Roads all carry a high level of heavy vehicle traffic due to their direct link to and from Port Kembla. Tom Thumb Road services the existing port facilities including the PKCT.

The rail network within the port precinct consists of rail lines, sidings and loops. The Port Kembla rail network links to the Illawarra and Moss Vale-Unanderra rail line, managed by the NSW Government and ARTC respectively. The Illawarra Line is a shared passenger and freight rail line.

2.2 Noise monitoring

2.2.1 Noise monitoring methodology

Unattended background noise monitoring was undertaken at two locations for a period of 13 days between 11 September to 24 September 2018. The two locations were:

- Location 1: Background noise monitoring location about 340 metres north of the proposed pipeline alignment and 2.5 kilometres north-west of Berth 101. This residential receiver is set-back at a similar distance to the closest sensitive receivers and is considered representative of the reasonably most-affected residences. Noise at this location is influenced by industrial noise from Port Kembla to the north-west, road traffic noise from Gladstone Avenue and rail operations located 20 metres to the south.
- Location 2: Background noise monitoring location about 170 metres south of the proposed pipeline alignment and 2.2 kilometres west of Berth 101. This residential receiver is set-back at a similar distance to the closest sensitive receivers and is considered representative of the reasonably most-affected residences. Noise at this location is influenced by industrial noise from Port Kembla to the north-west and road traffic noise from Five Islands Road located 60 metres to the north.

The methodology of the unattended noise monitoring data included:

- The noise loggers were set to record L_{A90}, L_{A10}, L_{Aeq} and L_{Amax} noise descriptors. The instruments were programmed to accumulate environmental noise data continuously over a sampling period of 15 minutes over the entire monitoring period;
- A calibration check was performed on the noise monitoring equipment using a sound level calibrator with a sound pressure level of 94 dBA at 1 kHz. At completion of the measurements, the meter's calibration was re-checked to ensure the sensitivity of the noise monitoring equipment had not varied. The noise loggers were found to be within the acceptable tolerance of ± 0.5 dB(A);
- Meteorological data for the monitoring period was sourced from the Bureau of Meteorology Port Kembla NTC Automatic Weather Station (AWS) (station number: 067113). The AWS is located about 1.3 kilometres north-west of the project site;
- Noise levels were excluded during periods where average wind speeds were greater than 5 m/s or when rainfall occurred.

A summary of the noise monitoring locations and details of the noise loggers are provided in Table 2-1.

Table 2-1 Unattended noise logger details

Parameter	Location 1	Location 2
Monitoring location	117 Gladstone Avenue, Coniston	16 Merrett Avenue, Cringilla
Logger Type / Serial No.	Rion NL-52 / 131632	SVAN 977 / 36871
Measurement started	11 September 2018	11 September 2018
Measurement ceased	24 September 2018	24 September 2018
Pre/Post calibration	94.1 / 93.9 @ 1 kHz	93.7 / 93.8 @ 1 kHz
Freq. weighting	A	A
Time response	Fast	Fast
Photo		

2.2.2 Noise monitoring results

The measured noise monitoring data was used to determine the Rating Background Levels for the assessment during the day, evening and night-time periods in accordance with the NPI. A summary of the measured Rating Background Levels and ambient noise levels is provided in Table 2-2. Daily noise levels are provided in Appendix B and daily noise level charts are provided in Appendix C.

The evening background noise levels are greater than the day-time background noise levels at location 1. The night-time levels are higher than the day and evening background noise levels at location 2. This is likely to be attributed to existing industrial noise in the area, noting that the evening period has fewer sample points, which inherently makes it more susceptible to variance using the NPI 90th percentile method.

Table 2-2 Summary of measured noise levels, dBA

Location	Rating background level, L_{A90}			Ambient level, L_{Aeq}		
	Day	Evening	Night	Day	Evening	Night
Location 1	39	40	39	52	50	50
Location 2	43	42	45	51	49	50

2.3 Sensitive receivers and land uses

Noise and vibration sensitive receivers are defined upon the type of occupancy and the activities performed within the land parcel. The receivers can be classified within the following categories:

- residential premises;
- educational institutes;
- hospitals and medical facilities;
- places of worship;
- passive and active recreation areas; and
- commercial or industrial premises.

Noise catchment areas (NCA) are used to represent areas with similar noise environments. Two NCAs have been identified for this assessment and are detailed in Table 2-3.

Table 2-3 Noise catchment areas

NCA	Distances to construction area (closest construction area)	Distances to operational areas	Description
NCA01	250 metres – 900 metres (gas pipeline construction)	2.5 kilometres – 3.5 kilometres	Mix of residential, commercial and industrial receivers located to the north of the project.
NCA02	100 metres – 900 metres (gas pipeline construction)	2.0 kilometres – 3.0 kilometres	Mix of residential, commercial and industrial receivers located to the south of the project.

The representative sensitive receivers used for modelling and assessment purposes are listed in Appendix D and shown in Figure 2.1. Representative sensitive receivers were modelled at the most affected point located within 30 metres of the building in accordance with the NPI.

Paper Size ISO A4

0 260 520 780 1,040

Metres

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Australian Industrial Energy
Port Kembla Gas Terminal

Representative sensitive receivers, noise monitoring locations and land use map

Project No.	**21-27477**
Revision No.	**A**
Date	**31 Oct 2018**

Figure 2.1

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3. Compliance criteria

3.1 Secretary's environmental assessment requirements

The Secretary's environmental assessment requirements with regards to noise and vibration include the following:

- an assessment of the likely construction noise impacts of the project under the *Interim Construction Noise Guideline* (DECCW, 2009);
- an assessment of the likely operational noise impacts of the project under the *NSW Industrial Noise Policy (EPA, 2000);*
- an assessment of the likely road noise impacts of the project under the *Road Noise Policy* (DECCW 2011);
- An assessment of the likely vibration amenity and structural impacts of the project under *Assessing Vibration: A Technical Guideline* (DEC 2006) and *German Standard DIN 4150-3 Structural Vibration – effects of vibration on structures*; and
- where blasting is required during construction, an assessment of blast impacts in accordance with relevant guidelines;

It should be noted that the *Industrial Noise Policy* has been superseded by the *Noise Policy for Industry*. Therefore, the NPI has been adopted as part of this assessment.

3.2 Construction noise

Construction noise management levels for the project are based on the Interim Construction Noise Guideline (ICNG).

3.2.1 Proposed construction hours

Construction works would be conducted during standard construction hours and outside standard hours. The standard construction hours are provided in Table 3-1.

Table 3-1 Construction hours

Construction hours	Monday to Friday	Saturday	Sunday/Public holiday
Standard hours	7 am to 6 pm	8 am to 1 pm	No work

The ICNG acknowledges that the following activities have justification to be undertaken outside standard construction hours assuming all feasible and reasonable mitigation measures are implemented to minimise the impacts to the surrounding sensitive land uses:

- The delivery of oversized plant, equipment and materials that police or other authorities determine require special arrangements to transport along public roads;
- Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm;
- Maintenance and repair of public infrastructure where disruption to essential services or considerations of worker safety do not allow work within standard hours;
- Public infrastructure works that shorten the length of the proposal and are supported by the affected community;
- Works where a proponent demonstrates and justifies a need to operate outside the recommended standard construction hours; and

- Works which maintain noise levels below the noise management levels outside of the recommended standard construction hours.

Construction works outside the standard construction hours would be justified for this project based on the last two points presented above, i.e.:

- Due to the large distances between the fixed construction areas and sensitive residential receivers, construction activities are generally within the recommended noise management levels; and
- Undertaking works outside of standard construction hours for pipeline construction would reduce the overall construction period and duration of potential noise impacts.

3.2.2 Construction noise management levels

Construction noise management levels for residential premises and other sensitive land uses are provided in the ICNG. The method to determine the noise management levels in accordance with the ICNG is outlined in Table 3-2.

Table 3-2 Noise management levels for residential receivers

Time of day	Noise management level, $L_{Aeq(15\ min)}$	Application notes
Recommended standard hours	Noise affected: RBL + 10 dBA	The noise affected level represents the point above which there may be some community reaction to noise. • where the predicted or measured $L_{Aeq(15\ min)}$ 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 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: • times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected: RBL + 5 dBA	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community.

Noise management levels for other sensitive land uses are provided in Table 3-3 and only apply when the properties are in use.

Table 3-3 Noise management levels for other sensitive land uses

Land use	Noise management level, $L_{Aeq(15\ min)}$
Classrooms Hospital wards and operating theatres Places of worship	45 dBA (internal)
Active recreation areas	65 dBA (external)
Passive recreation areas	60 dBA (external)
Commercial premises	70 dBA (external)
Industrial premises	75 dBA (external)

3.2.3 Sleep disturbance

The ICNG recommends that maximum noise level events and the frequency of maximum noise level events exceeding the RBL should be assessed where construction works are planned to extend over two or more consecutive nights.

The *Noise Policy for Industry* provides the most updated guidance for the assessment of sleep disturbance. The NPI recommends a maximum noise level assessment to assess the potential for sleep disturbance impacts which include awakenings and disturbance to sleep stages. An initial screening test for the maximum noise levels events should be assessed to the following levels.

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

If the screening test indicates there is a potential for sleep disturbance then a detailed maximum noise level assessment should be undertaken. 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.

3.2.4 Project construction noise management levels

A summary of the project construction noise management levels for residential receivers in the area is provided in Table 3-4. The noise management levels at non-residential receivers are as per Table 3-3.

Table 3-4 Project construction noise management levels, dBA

Receiver type	Construction noise management levels, $L_{Aeq(15\ min)}$				
	Standard construction hours		Outside standard construction hours[1]		
	Noise affected	Highly noise affected	Day	Evening	Night
Residential NCA01	49	75	44	44[2]	44 54 L_{AFmax}
Residential NCA02	53	75	48	47	47[3] 57 L_{AFmax}

Note 1: The *Noise Policy for Industry* (EPA, 2017) defines day, evening and night time periods as:

- Day: the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays.
- Evening: the period from 6 pm to 10 pm.
- Night: the remaining periods.

Note 2: Measured background levels during the day were used as the measured evening levels were higher than the measured day-time levels.

Note 3: Measured background levels during the evening were used as the measured night-time levels were higher than the measured evening levels.

3.2.5 Construction traffic noise criteria

The RNP provides road traffic noise criteria for residential land uses affected by construction traffic on the public road network.

The *Road Noise Policy* application notes state that any increase in the total noise level at existing residences and other sensitive land uses affected by traffic generation on existing roads should be limited to 2 dBA above current levels. This criteria only applies when the noise level without the development is within 2 dBA or exceeds the road traffic noise criterion provided in the RNP.

This has been used to identify potential impacts as a result of noise produced by construction traffic. If road traffic noise increases as a result of construction works within 2 dBA of current levels then the objectives of the RNP are considered to be met and no specific mitigation measures would be required.

Where construction traffic increases the existing road traffic noise levels by more than 2 dBA then further assessment against the road traffic noise criteria is required.

Table 3-5 Road traffic noise criteria, dBA

Type of development	Day 7 am to 10 pm	Night 10 pm to 7 am
Existing residence affected by additional traffic on arterial roads generated by land use developments	60 $L_{Aeq(15\ hour)}$	55 $L_{Aeq(9\ hour)}$
Existing residence affected by additional traffic on local roads generated by land use developments	55 $L_{Aeq(1\ hour)}$	50 $L_{Aeq(1\ hour)}$

3.3 Construction vibration

3.3.1 Human comfort

Vibration criteria have been set with consideration to *Assessing Vibration: a technical guideline* (DEC, 2006). British Standard *BS 6472 – 1992, Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)* which is recognised as the preferred standard for assessing the 'human comfort criteria'.

Typically, construction activities generate ground vibration of an intermittent nature. Intermittent vibration is assessed using the vibration dose value. Acceptable values of vibration dose are presented in Table 3-6 for sensitive receivers.

Whilst the assessment of response to vibration in *BS 6472-1:1992* is based on vibration dose value (refer to Table 3-6) and weighted acceleration, for construction related vibration, it is considered more appropriate to provide guidance in terms of a peak value, since this parameter is likely to be more routinely measured based on the more usual concern over potential building damage.

Humans are capable of detecting vibration at levels which are well below those causing risk of damage to a building. The degrees of perception for humans are suggested by the vibration level categories given in British Standard, BS 5228.2 – 2009, Code of Practice Part 2 Vibration for noise and vibration on construction and open sites – Part 2: Vibration and are shown below in Table 3-7.

Table 3-6 Human comfort intermittent vibration limits (BS 6472-1992)

Receiver type	Period	Intermittent vibration dose value ($m/s^{1.75}$)	
		Preferred value	Maximum value
Residential	Day (7 am and 10 pm)	0.2	0.4
	Night (10 pm and 7 am)	0.13	0.26
Offices, schools, educational institutes and places of worship	When in use	0.4	0.8

Table 3-7 Guidance on effects of vibration levels for human comfort (BS 5228.2-2009)

Vibration level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration at this level in residential environments will cause complaints, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure.

3.3.2 Structural damage

The German Standard *DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on structures* provides guideline values for the maximum absolute value of the velocity *'at the foundation of various types of building. Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur. If damage nevertheless occurs, it is to be assumed that other causes are responsible.'* These values are provided in Table 3-8.

Measured values exceeding those listed in Table 3-8 *'does not necessarily lead to damage; should they be significantly exceeded, however, further investigations are necessary.'*

Table 3-8 Guideline values for short term vibration on structures

Line	Type of structure	Guideline values for velocity, (mm/s)		
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[1]
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10

[1] At frequencies above 100 Hz the values given in this column may be used as minimum values

3.4 Operational noise

3.4.1 Noise Policy for Industry

The NPI provides guidance on the assessment of operational noise impacts.

The project noise trigger level is the lower value of the intrusiveness noise level and the amenity noise level. The intrusiveness noise aims to protect against significant changes in noise levels and the amenity noise level aims to protect against cumulative noise impacts from existing industry.

3.4.2 Project intrusiveness noise level

The intrusiveness noise level aims to protect against significant changes in noise levels. Typically, this will be the project noise trigger level in areas with low existing background noise levels. The intrusiveness noise level is determined by a 5 dBA addition to the measured background noise level. The NPI recommends that the intrusive noise criteria for the evening period should not exceed the day-time period and the night-time period should not exceed the evening period. The intrusiveness noise criteria are only applicable to residential receivers.

3.4.3 Project amenity noise level

The recommended amenity noise level is the noise level objective for total industrial noise at a receiver and is determined based on the overall acoustic characteristics of the receiver area, the receiver type and the existing level of industrial noise.

The project amenity noise level represents the noise level objective for noise from a single development. It aims to limit the cumulative noise impacts from other industries and

developments on all receiver types. The project amenity noise level is determined by a 5 dBA subtraction from the recommended amenity noise level for receivers that are not impacted by more than four individual industrial noise sources.

The project amenity noise level may be modified in the following cases:

- developments within high traffic noise levels;
- developments located near or inside an existing industrial cluster such as Port Kembla;
- where the project amenity noise level is at least 10 dBA lower than the existing industrial noise level; and
- where there are no other existing or proposed industries within the development area.

The NPI recommended amenity criteria for the identified receiver types surrounding the Project site are provided in Table 3-9.

Table 3-9 Noise policy for industry amenity noise levels

Type of receiver	Noise amenity area	Time of day	Recommended amenity noise level $L_{Aeq(period)}$ noise level, dBA
Residence	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	See column 4	See column 4	5 dBA above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School classroom	All	When in use (noisiest 1 hour period)	35 (internal)
Hospital ward	All	When in use (noisiest 1 hour period)	35 (internal) 50 (external)
Place of worship	All	When in use	40 (internal)
Passive recreation	All	When in use	50
Active recreation	All	When in use	55
Commercial premises	All	When in use	65
Industrial premises	All	When in use	70
Industrial interface (applicable only to residential noise amenity areas)	All	All	5 dBA above recommended noise amenity area

3.4.1 Maximum noise level events

The NPI recommends a maximum noise level assessment to assess the potential for sleep disturbance impacts which include awakenings and disturbance to sleep stages. An initial screening test for the maximum noise levels events should be assessed to the following levels.

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

If the screening test indicates there is a potential for sleep disturbance then a detailed maximum noise level assessment should be undertaken. 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.

3.4.2 Project noise trigger levels

The project noise trigger levels that would be used to assess operational noise impacts are provided in Table 3-10.

The NPI states that *"To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows:*

Project amenity noise level for industrial developments = Recommended amenity noise level (Table 2.2) minus 5 dB(A)"

As the project is in an existing industrial cluster and the development constitutes a single premises addition to the existing cluster, the project amenity noise level has been calculated by reducing the NPI amenity noise levels by 5 dBA.

Table 3-10 Project noise trigger levels, dBA

Receiver	Time period	Intrusiveness noise level $L_{Aeq(15\ min)}$	Project amenity noise level, $L_{Aeq(15\ min)}$[1,2,3]	Maximum noise level events	Project noise trigger level, dBA
Residential NCA01 suburban	Day	44	58	-	**44** $L_{Aeq(15\ min)}$
	Evening	44[4]	48	-	**44** $L_{Aeq(15\ min)}$
	Night	44	43	54 L_{Amax}	**43** $L_{Aeq(15\ min)}$ **54** L_{Amax}
Residential NCA02 suburban	Day	48	58	-	**48** $L_{Aeq(15\ min)}$
	Evening	47	48	-	**47** $L_{Aeq(15\ min)}$
	Night	47[5]	43		**43** $L_{Aeq(15\ min)}$
Place of worship	When in use		50[6]		**53** $L_{Aeq(15\ min)}$
Active recreation	When in use		55		**58** $L_{Aeq(15\ min)}$
Commercial	All		63	-	**63** $L_{Aeq(15\ min)}$
Industrial	All		68	-	**68** $L_{Aeq(15\ min)}$

Note 1: The project amenity noise levels have been calculated by subtracting 5 dBA from the recommended amenity noise levels as the project constitutes a single premises addition to an existing industrial area.

Note 2: The NPI recommends applies a 3 dBA addition to the $L_{Aeq(period)}$ noise level to convert the amenity noise level to a $L_{Aeq(15\ min)}$.

Note 3: Receivers are located in an industrial interface. A 5 dBA addition has been applied to the residential recommended amenity levels as existing industrial noise levels are above the suburban recommended amenity level.

Note 4: The NPI recommends that evening intrusiveness levels should be no greater than the day-time intrusiveness level. Therefore the day-time background noise level has been used to calculate the project intrusiveness noise level for the evening period.

Note 5: The NPI recommends that night-time intrusiveness levels should be no greater than the evening intrusiveness level. Therefore the evening background noise level has been used to calculate the project intrusiveness noise level for the night-time period.

Note 6: Assuming open windows provide a 10 dB external to internal noise reduction.

3.4.3 Low frequency, tonal and impulsive noise

The NPI requires that modifying factor adjustments are added to the measured or predicted noise levels if the noise sources contain tonal, low frequency or noise characteristics. These noise characteristics can cause greater annoyance to the community than other noise at the same noise level. The modifying factor adjustments are summarised in Table 3-11 and are assessed at the receiver.

Table 3-11 Modifying factor adjustments

Factor	Assessment/ measurement	When to apply	Correction[1,2]
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: • 5 dB or more if the centre frequency of the band containing the tone is in the range 500 – 10,000 Hz • 8 dB or more if the centre frequency of the band containing the tone is in the range 160 – 400 Hz • 15 dB or more if the centre frequency of the band containing the tone is in the range 25 – 125 Hz	5 dBA[2]
Low frequency noise	Measurement of C-weighted and A-weighted level	Measure/assess C and A weighted levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more and: • where any of the one-third octave noise threshold level are exceeded by up to and including 5 dB and cannot be mitigated, a 2-dBA positive adjustment to measured/predicted A-weighted levels applies for the evening/night period • where any of the one-third octave noise threshold levels are exceeded by more than 5 dB and cannot be mitigated, a 5-dBA positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2-dBA positive adjustment applies for the daytime period.	5 dBA[2]
Impulsive noise	A-weighted fast response and impulse response	If the difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB.	Apply the difference in measured noise levels as the correction up to a maximum of 5 dBA
Intermittent noise	Subjectively assessed	The source noise heard at the receiver varies by more than 5 dBA and the intermittent nature of the noise is clearly audible. This adjustment is applied to the night-time period only.	5 dBA
Duration[3]	If the duration of the noise event in any 24 hour period is as follows: • 1.0 to 2.5 hours then increase the noise criteria by 2 dBA day and 0 dBA night • 15 minutes to 1 hour then increase the noise criteria by 5 dBA day and 0 dBA night • 6 minutes to 15 minutes then increase the noise criteria by 7 dBA day and 2 dBA night • 1.5 minutes to 6 minutes then increase the noise criteria by 15 dBA day and 5 dBA night • less than 1.5 minutes then increase the noise criteria by 20 dBA day and 10 dBA night.		

Note 1: Where two or more modifying factors are present the maximum correction is limited to 10 dBA.

Note 2: Where a source emits a tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low frequency range.

Note 3: Duration correction is a negative correction which increases the noise criteria

3.5 Operational traffic

The RNP provides traffic noise criteria for residential receivers in the vicinity of existing roads (Table 3-12). The criteria is applied to operational and construction traffic on public roads to identify potential road traffic impacts and the requirement for feasible and reasonable mitigation measures.

The RNP application notes state that *"for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion."*

If road traffic noise increases during operation are within 2 dBA of current levels then the objectives of the RNP are met and no specific mitigation measures are required.

Table 3-12 Road traffic noise criteria, $L_{Aeq(period)}$, dBA

Type of development	Day 7 am to 10 pm	Night 10 pm to 7 am
Existing residence affected by additional traffic on arterial roads generated by land use developments	60 $L_{eq(15\ hour)}$	55 $L_{eq(9\ hour)}$
Existing residence affected by additional traffic on local roads generated by land use developments	55 $L_{eq(1\ hour)}$	50 $L_{eq(1\ hour)}$

4. Construction impact assessment

4.1 Construction works overview

The project is anticipated to involve two separate concurrent construction work stages detailed in Table 4-1. Construction of the project is expected to take 10 - 12 months with completion due in early 2020.

Table 4-1 Construction staging

Stage	Description	Timeframe	Type of works
1	Pipeline construction	6 months	Trenching works through the industrial port precinct Transport of material Pipe laying Rehabilitation works
2	Demolition, Dredging, excavation and disposal	10 – 12 months	Demolition of existing berth New construction of berth Excavation and dredging for quay wall construction Transport of material Installation of mooring facilities

4.1.1 Construction activities

The project is anticipated to involve the following work methodology and phasing provided in Table 4-2 and would be expected to last twelve months. The following construction scenarios in Table 4-2 have been modelled to predict noise levels and identify potential noise impacts during construction works.

Construction scenarios have been created based on the construction equipment operating simultaneously at any given time. All works are located within or adjacent to the project site.

Table 4-2 Construction methodology

Scenario	Stage	Description
Pipeline construction		
CS1.1	Site establishment	Establish construction compounds Vegetation removal (where required)
CS1.2	Compound operations	Personnel movements, material deliveries, stockpiling
CS1.3	Trenching works	Excavations along pipeline route
CS1.4	Directional drilling works	Underground excavation along pipeline route
CS1.5	Pipe set down	Rehabilitation works

Scenario	Stage	Description
CS1.6	Rehabilitation works	Removal of compounds, transport of material
Demolition, dredging and berth construction		
CS2.1	Dredging works	Removal of sediment from seabed
CS2.2	Enabling works for excavation	Demolish existing Berth 101 Remove and stockpile existing rock revetment Excavate fill layer across site Transport of excavated material to stockpile sites
CS2.3	Excavation	Excavation of insitu material
CS2.4	Perimeter bund	Construction of the perimeter bund at the disposal site Dredging of soft sediments
CS2.5	Bottom dump	Disposal of dredged material using a split hopper barge
CS2.6	Material transport	Transport stockpiled material to disposal site
CS2.7	Berth and mooring facilities	Installation of mooring facilities, construction of quay wall, berth and an onshore receiving facility
CS2.8	Material deliveries	Delivery of piles and concrete truck movements

4.1.2 Plant and equipment

The plant and equipment likely to be required throughout each stage of construction have been provided in Table 4-3 for each construction scenario modelled. Other equipment may be used, however, it is anticipated that they would produce similar net noise emissions when used concurrently with the equipment listed.

The magnitude of off-site noise impacts associated with construction is dependent upon a number of factors:

- the intensity and location of construction activities;
- the type of equipment used;
- existing background noise levels;
- intervening terrain and structures;
- the prevailing weather conditions.

Construction machinery would likely move about the project site altering the received noise for individual receivers. During any given period, the machinery items to be used would operate at maximum sound power levels for only brief stages. At other times, the machinery would produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all construction equipment would be operating at their maximum sound power levels at any one time. Certain types of construction machinery would be present in the study area for only brief periods during construction. Therefore, noise predictions are considered conservative.

Table 4-3 Construction equipment and sound power levels

Equipment	Sound power level	Operating time (minutes per 15 minute period)	Time corrected sound power level	Pipeline construction						Dredging, excavation and disposal							
				CS1.1	CS1.2	CS1.3	CS1.4	CS1.5	CS1.6	CS2.1	CS2.2	CS2.3	CS2.4	CS2.5	CS2.6	CS2.7	CS2.8
			Activity sound power level	**116**	**118**	**107**	**110**	**109**	**114**	**121**	**125**	**121**	**119**	**122**	**124**	**125**	**116**
Backhoe dredger	115	10	113	-	-	-	-	-	-	1	-	-	1	-	-	-	-
Tug boat	119	5	114	-	-	-	-	-	-	2	-	-	2	-	-	-	-
Survey / Service Tug	110	5	105	-	-	-	-	-	-	1	-	-	1	-	-	-	-
Split hopper barge	112	5	107	-	-	-	-	-	-	2	-	-	2	2	-	-	-
CAT 988 Loader	112	10	110	1	1	-	-	-	-	-	2	1	-	1	2	-	-
CAT D8 Dozer	118	10	116	-	-	-	-	-	-	-	1	-	-	1	1	-	-
Komatsu Excavator (90 tonne)	115	10	113	-	-	-	-	-	-	-	5	-	-	1	1	-	-
CAT 773 Dump truck	118	10	116	-	1	-	-	-	-	-	4	-	-	2	2	-	-
Excavator (40 tonne)	115	10	113	1	1	-	-	-	1	-	-	3	-	-	3	-	-
Komatsu 110 Long Reach Excavator	105	10	103	-	-	1	-	1	-	-	-	1	-	-	1	-	-
Road trucks/trailers	108	10	106	2	-	-	-	-	2	-	4	10	-	-	10	2	-
Hydraulic hammer	118	10	116	-	-	-	-	-	-	1	-	-	-	-	-	1	-
Vibro hammer	117	10	115	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Impact hammer (7 tonne – 16 tonne)	117	10	115	-	-	-	-	-	-	-	-	-	-	-	-	3	-
Crane (30 tonne to 150 tonne)	108	10	106	1	-	-	-	-	-	-	3	-	-	-	-	6	-
Piling rig	112	10	110	-	-	-	-	-	-	-	-	-	-	-	-	4	-
Crane (150 tonne to 300 tonne)	113	10	111	-	-	-	-	-	-	-	-	-	-	-	-	4	-
Directional Drilling machine (90 tonne)	110	10	108	-	-	-	-	-	-	-	-	-	-	-	-	3	-
Telehandler	105	10	103	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Concrete truck	109	15	109	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Semi-trailer	108	5	103	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Trencher	105	15	105	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Drill rig (directional drill)	105	15	105	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Mud pump	108	15	108	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Pipe laying machine	108	15	108	-	-	-	-	1	-	-	-	-	-	-	-	-	-

4.2 Air-borne noise impacts

4.2.1 Noise modelling inputs

Noise modelling was undertaken using SoundPlan Version 7.4. SoundPlan is a computer program for the calculation, assessment and prognosis of noise exposure. SoundPlan calculates environmental noise propagation according to *ISO 9613-2 'Acoustics – Attenuation of sound during propagation outdoors'.*

The following noise modelling assumptions were made:

- surrounding land outside the industrial area was modelled as a mix of soft and hard ground with a ground absorption coefficient of 0.5. Water and the industrial land surrounding the port was modelled as reflective with an absorption coefficient of 0;
- atmospheric absorption was based on an average temperature of 10°C and an average humidity of 70%;
- atmospheric propagation conditions were modelled with noise enhancing wind conditions for noise propagation (downwind conditions) or an equivalently well-developed moderate ground based temperature inversions;
- modelled scenarios take into account the shielding effect from surrounding buildings and structures on and adjacent to the site; and
- noise sources for each scenario are in some cases modelled at different locations. As such the noise modelling assesses the noise source at multiple locations and takes the maximum L_{Aeq} received noise level.

The predicted noise levels are based on the equipment operating at maximum capacity in the worst-case sensitive receiver area. In practice, noise levels would fluctuate based on the nature of construction works occurring in proximity to the sensitive receiver. Therefore, the assessment is considered to be conservative.

4.2.2 Construction noise impacts

Predicted noise levels for the construction scenarios outlined in Table 4-3 are presented in Appendix D. Construction noise contours for each modelled scenario are provided in Appendix F.

A summary of the number of exceedances of the noise management levels for the modelled representative sensitive receivers is presented in

Table 4-5 and Table 4-4 for residential receivers. No exceedances of the noise management levels are predicted for non-residential receivers.

Exceedances of the construction noise management levels are typical for construction projects of this scale. The noise impacts would be limited to the construction period only and can be managed via a number of best-practice activities (refer to mitigation Section 6).

4.2.2.1 Pipeline construction

The predicted noise levels and exceedances indicate that during pipeline construction activities:

- Minor exceedances of the NML (≤ 10 dBA) are predicted in NCA01 during standard and outside of standard construction hours. This would be limited to residential receivers within 300 metres of the pipeline alignment along Gladstone Avenue; and
- Minor (≤ 10 dBA) to moderate exceedances of the NML (10 – 22 dBA) are predicted in NCA 02 during standard and outside of standard construction hours. This would be limited to residential receivers within 300 metres of the pipeline alignment along Five Islands Road. Impacts at these sensitive receivers would be partially shielded due to the row of industrial and commercial premises directly facing the pipeline construction route on Five Islands Road.

The impacts from pipeline construction activities would be intermittent in duration as the pipeline construction would progress sequentially along the construction corridor.

The entire pipeline is anticipated to be constructed in six months. Therefore, predicted worst-case impacts at any one receiver would be expected to be short term (less than 2-3 weeks) in duration.

4.2.2.2 Demolition, dredging and construction

The predicted noise levels and exceedances indicate that during demolition, dredging and berth construction activities:

- No exceedances of the NML are predicted in NCA01 during all construction time periods. This is due to the intervening shielding and distances between these receivers and the fixed construction activities; and
- Minor (≤ 10 dBA) exceedances of the NML are predicted in NCA02 during standard and outside of standard construction hours. The worst impacted residential receivers are isolated residences along Flinders Street and residential blocks adjacent to Five Islands Road and Wentworth Street. These receivers would be subject to existing ambient rail traffic noise and industrial noise from port area.

Table 4-4 Residential exceedance summary – NCA 1

Time period	Summary	Construction scenario													
		CS1.1	CS1.2	CS1.3	CS1.4	CS1.5	CS1.6	CS2.1	CS2.2	CS2.3	CS2.4	CS2.5	CS2.6	CS2.7	CS2.8
Standard construction hours	Number of exceedances	3	1	0	0	0	2	0	0	0	0	0	0	0	0
	Highest noise level, dB(A)	55	55	46	48	48	53	37	41	37	27	30	44	41	44
	Highest exceedance, dB	2	2	-	-	-	0	-	-	-	-	-	-	-	-
	Worst affected receiver	R028	R028	R028	R028	R028	R028	R040	R043	R043	R032, R046	R043, R051, R056	R042	R040	R042
Outside standard construction hours (day)	Number of exceedances	23	19	0	1	2	13	0	0	0	0	0	0	0	0
	Highest noise level, dB(A)	55	55	46	48	48	53	37	41	37	27	30	44	41	44
	Highest exceedance, dB	7	7	-	0	0	5	-	-	-	-	-	-	-	-
	Worst affected receiver	R028	R028	R028	R028	R028	R028	R040	R043	R043	R032, R046	R043, R051, R056	R042	R040	R042

Time period	Summary	Construction scenario													
		CS1.1	CS1.2	CS1.3	CS1.4	CS1.5	CS1.6	CS2.1	CS2.2	CS2.3	CS2.4	CS2.5	CS2.6	CS2.7	CS2.8
Outside standard construction hours (evening and night)	Number of exceedances	25	23	0	1	2	19	0	0	0	0	0	0	0	0
	Highest noise level, dB(A)	55	55	46	48	48	53	37	41	37	27	30	44	41	44
	Highest exceedance, dB	8	8	-	1	1	6	-	-	-	-	-	-	-	-
	Worst affected receiver	R028	R028	R028	R028	R028	R028	R040	R043	R043	R032, R046	R043, R051, R056	R042	R040	R042

Table 4-5 Residential exceedance summary – NCA 2

Time period	Summary	Construction scenario													
		CS1.1	CS1.2	CS1.3	CS1.4	CS1.5	CS1.6	CS2.1	CS2.2	CS2.3	CS2.4	CS2.5	CS2.6	CS2.7	CS2.8
Standard construction hours	Number of exceedances	13	9	1	2	1	8	0	1	0	2	2	0	1	0
	Highest noise level, dB(A)	66	54	56	52	58	63	48	51	47	52	52	48	52	39
	Highest exceedance, dB	17	5	7	3	9	14	-	2	-	3	3	-	3	-
	Worst affected receiver	R065	R065	R065	R065	R065	R065	R076	R076, R078	R076, R078	R080	R079	R076	R076	R076
Outside standard construction hours (day, evening and night)	Number of exceedances	19	15	4	4	8	15	1	1	1	2	2	3	2	0
	Highest noise level, dB(A)	66	54	56	52	58	63	48	51	47	52	52	48	52	39
	Highest exceedance, dB	22	10	12	8	14	19	4	7	3	8	8	4	8	-
	Worst affected receiver	R065	R065	R065	R065	R065	R065	R076	R076, R078	R076, R078	R080	R079	R076	R076	R076

4.2.3 Sleep disturbance impacts

Construction activities are expected outside standard construction hours to achieve the required construction program and minimise disruption to local transport networks. There is the potential for maximum noise level events if the predicted maximum external noise level is above the screening criteria identified in Table 3-4 for residential receivers in NCA01 and NCA02.

The predicted maximum noise levels are above the screening criteria for residential receivers located within 300 metres of the pipeline construction alignment. Therefore a detailed maximum noise level assessment has been undertaken. The RNP states that maximum internal noise levels between 50 to 55 dBA are unlikely to awaken people from sleep. Typically a window will provide a 10 dBA reduction when partially open and a 20 dBA reduction when closed. For a conservative assessment, the windows have been assumed to be partially open to assess sleep disturbance impacts.

The predicted maximum external noise levels are:

- 55 dBA for receivers in NCA01;
- 65 dBA for receivers in NCA02.

Assuming a 10 dBA reduction through an open window would result in an internal noise level below 55 dBA. Therefore awakening events and sleep disturbance impacts are not anticipated as a result of construction.

4.3 Construction traffic impacts

Access to the project site would be off Springhill Road, Five Islands Road, Flinders Street, Princes Motorway, Port Kembla Road, Masters Road and Old Port Road. The construction traffic routes are detailed in Table 4-6.

Construction vehicle movements would consist of heavy vehicles associated with plant and material delivery and light vehicles used for staff movements. Residential receivers have been identified in the vicinity of the following construction traffic route roads:

- Routes A and B: Princes Motorway and Masters Road;
- Routes C and D: Princes Motorway, Masters Road and Five Islands Road;
- Routes E and F: Five Islands Road;
- Routes G and H: Princes Motorway and Masters Road.

The other construction traffic roads traverse industrial/commercial areas and are not anticipated to impact on residential receivers.

The worst case construction traffic movements would occur during wharf demolition and construction and dredging and reclamation. It is estimated that, on average, 225 light vehicle and 236 heavy vehicle construction vehicle movements would occur daily.

The existing light and heavy vehicle volumes along the construction traffic roads adjacent to the residential receivers have been sourced from the Roads and Maritime Traffic Volume Viewer[1] and the *Traffic Impact Assessment* (GHD, 2018):

- Princes Motorway: 32,628 daily vehicles;
- Masters Road: 41910 daily vehicles;

[1] Available online at http://www.rms.nsw.gov.au/about/corporate-publications/statistics/traffic-volumes/aadt-map/, last accessed 05/10/2018

- Five Islands Road: 40826 daily vehicles.

A significant increase in traffic volumes would be needed in order to increase road traffic noise by 2 dBA (as an example a doubling in traffic corresponds to an approximate 3 dBA increase).

The construction traffic movements are on arterial roads with significant existing daily traffic volumes. The additional heavy and light vehicles movements associated with the project are unlikely to be significant when compared with the existing vehicle numbers in the area. As a result, no noise impacts from construction traffic movements are expected.

4.4 Construction vibration

Construction of the project would involve the use of the following vibration generating equipment:

- Hydraulic hammer;
- Vibro hammer;
- Impact hammer;
- Piling rig.

The nearest residential sensitive receivers are located over 300 metres from the proposed pipeline construction area and 2 kilometres from the dredging works area. Non-residential structures are located over 40 metres from the project construction areas.

No vibration impacts are predicted from construction of the project due to the large distances between the construction area and the nearest residential receivers and structures.

Table 4-6 Construction traffic route segments

ID	From	To	1	2	3	4	5	6
A	Wollongong	Port Kembla (Wharf)	Princes Motorway	Masters Road	Springhill Road	Port Kembla Road	Unnamed Road	—
B	Port Kembla (Wharf)	Wollongong	Unnamed Road	Port Kembla Road	Springhill Road	Masters Road	Princes Motorway	—
C	Wollongong	Port Kembla (Reclamation)	Princes Motorway	Masters Road	Springhill Road	Five Islands Road	Flinders Street	Old Port Road
D	Port Kembla (Reclamation)	Wollongong	Old Port Road	Flinders Street	Five Islands Road	Springhill Road	Masters Road	Princes Motorway
E	Port Kembla (Wharf)	Port Kembla (Reclamation)	Unnamed Road	Port Kembla Road	Springhill Road	Five Islands Road	Flinders Street	Old Port Road
F	Port Kembla (Reclamation)	Port Kembla (Wharf)	Old Port Road	Flinders Street	Five Islands Road	Springhill Road	Port Kembla Road	Unnamed Road
G	Wollongong	Bluescope (pipeline)	Princes Motorway	Masters Road	Springhill Road	Bluescope	—	—
H	Bluescope (pipeline)	Wollongong	Bluescope	Springhill Road	Masters Road	Princes Motorway	—	—

4.5 Underwater noise impacts

Underwater noise impacts on marine megafauna may occur during piling and dredging activities associated with the construction of the quay wall.

Currently, there are no quantitative national guidelines on acceptable exposure levels for megafauna to underwater noise generated by construction works. However, the South Australian Department of Planning, Transport and Infrastructure has produced *Underwater Piling Noise Guidelines* (2012) which provide relevant behavioural and physiological noise criteria for some species of megafauna. These are reproduced in Table 4-7 and have been adopted for this assessment.

Table 4-7 Behavioural and physiological noise criteria for some megafauna

Species	Noise criteria	Impact piling
Cetaceans and pinnipeds	Behavioural	SPL 160 dB re: 1µPa
Low frequency cetaceans (All baleen whales)	Physiological (TTS)	Peak 224 dB re: 1µPa SEL 183 dB (M_{lf}) re: 1µPa^2-s
	Physiological (PTS)	Peak 230 dB re: 1µPa SEL 198 dB (M_{mf}) re: 1µPa^2-s
Mid frequency cetaceans (Majority of toothed whales)	Physiological (TTS)	Peak 224 dB re: 1µPa SEL 183 dB (M_{mf}) re: 1µPa^2-s
	Physiological (PTS)	Peak 230 dB re: 1µPa SEL 198 dB (M_{mf}) re: 1µPa^2-s
High frequency cetaceans (Other toothed whales)	Physiological (TTS)	Peak 224 dB re: 1µPa SEL 183 dB (M_{hf}) re: 1µPa^2-s
	Physiological (PTS)	Peak 230 dB re: 1µPa SEL 198 dB (M_{hf}) re: 1µPa^2-s
Pinnipeds (seals and sea lions)	Physiological (TTS)	Peak 212 dB re: 1µPa SEL 171 dB (M_{pw}) re: 1µPa^2-s
	Physiological (PTS)	Peak 218 dB re: 1µPa SEL 186 dB (M_{pw}) re: 1µPa^2-s

In an applied construction noise management context, TTS criteria are used in preference to PTS criteria to minimise the risk of irreversible auditory damage. Similarly, criteria for single or multiple pulses (high crest factor wave forms), particularly pertaining to the assessment of impact piling noise, are used without reference to the higher criteria relating to non-pulsed underwater sound (approximately sinusoidal waveforms).

While the *Underwater Piling Noise Guidelines* provides guidance on noise levels for cetaceans and pinnipeds, it does not include criteria on marine turtles or other fish. Based on a review of available literature, a conservative accumulated sound energy level of 183 dB SEL re: 1µPa^2-s

is proposed to assess cumulative noise impacts upon cetaceans, marine turtles, fish and sharks.

4.5.1.1 Dredging

Underwater noise levels associated with dredging will depend on the dredge type (e.g. hydraulic pipeline cutterhead dredges, bucket dredges or hopper dredges) utilised for construction. A review of source sound power levels associated with these dredges (U.S. Army Corps of Engineers, 2015) indicates conservative source levels of 186-188 dB re: 1µPa (rms).

A review of available scientific literature by the U.S. Army Corps of Engineers (2015) indicates that *"it is unlikely that underwater sound from conventional dredging operations can cause physical injury to fish species"* and *"the area of influence was limited to less than 100 m from the source"*. However, dredging operations are likely to cause a temporary behavioral shift as marine megafauna avoid the area immediately in the vicinity of dredging.

Therefore, underwater noise impacts from dredging are not anticipated to cause irreversible auditory damage to marine megafauna in the area. Behaviour patterns are likely to be temporarily altered as marine megafauna seek to avoid the immediate dredging area.

4.5.1.2 Piling

Piling noise data has been sourced from ICF Jones & Stokes et al. (2009), prepared for the California Department of Transportation. The impacts at 10 metre from a single strike on a 610 millimetre diameter pile (considered representative of the pile to be used for construction activities) are summarised in Table 4-8.

For the purposes of this assessment, the more conservative values at a depth of 15 metres have been used.

Table 4-8 Piling sound pressure levels

Pile type (610 mm)	Relative water depth (metre)	Average sound pressure (dB) at 10 metre		
		Peak (re: 1µPa)	RMS (re: 1µPa)	SEL (re: 1µPa^2-s)
Steel pipe	15	207	194	178
Steel pipe	5	203	190	177

As the number of strikes increases, the accumulated SEL noise levels increase according to the following relationship:

$$SEL_{Accumulated} = SEL_{Single\ strike} + 10 * \log (\text{number of pile strikes}) \quad \text{Equation 1}$$

As the number of hammer strikes can range from six to unlimited, accumulated SEL values have been calculated for a range of values. These are shown in Table 4-9.

Table 4-9 Piling accumulated SEL at 10 metre

Number of hammer strikes	Accumulated SEL at 10 metre (dB re: 1μPa^2-s)
6	186
12	189
100	198
300	203
600	206
1000	208

The dispersion of underwater noise from marine piling consists primarily of energy transmitted directly to the water column from the pile, with a secondary transmission path indirectly from the pile to the sea bed which is then re-radiated to the water column.

The rate of attenuation with distance is a complex interaction of multiple attenuation processes which generally differ across the acoustic frequency range (a comprehensive treatment of the subject is presented by Jensen *et al*. 2000):

- Geometrical wave-front spreading.
- Frequency dependent molecular sound absorption in the water column.
- Frequency dependent scattering of surface reflected acoustic waves, which is increased by higher (rougher) wave conditions.
- Frequency dependent scattering of bottom reflected acoustic waves.
- Frequency and depth dependent absorption of acoustic waves in thin bottom sediments (water borne waves) and deeper strata (sound radiated from pile via sea bed).
- Depth dependent cut off of lower-frequency wavemodes that are unsupportable in shallow water.

Two rates of distance attenuation of noise have been calculated for unattenuated piles on the basis of the measured bounds of attenuation rates in similar water depth reported by ICF Jones and Stokes *et al.* (2009). This study reported 4.5 dB attenuation per doubling of distance (F =15) to be the lower bound of attenuation (intermediate between cylindrical and hemispherical spreading) measured experimentally up to 1000 metres in water depths within the range of 12-16 metres, with an upper attenuation rate of 6.6 dB per doubling of distance (F = 22, slightly greater attenuation than hemispherical spreading). The presence of choppy wave conditions during piling will shift the apparent attenuation rate towards the higher bound estimate, as may a decreasing bathymetry and/or a silty acoustically absorptive bottom material.

Data from Port Kembla indicates a silty harbour bed. In addition, underwater background noise levels are likely to be high due to the existing industrial environment in the area. Therefore, the upper attenuation rate has been adopted for this assessment.

Observation zone distances have been calculated for an SEL criterion of 183 dB re: 1μPa^2 for multiple pile strikes. They have also been calculated for a single pile strike against an “effective quiet” SEL criterion of 150 dB re: 1μPa^2-s. This provides the maximum distance beyond which injury to fish would not be expected from an individual pile strike (though the cumulative distance may be higher depending on the number of pile strikes). The observation zone distances are provided in Table 4-10 for a variety of operational conditions.

Table 4-10 Observation zone distances

Number of pile strikes	Total time to conduct pile strikes	Observation zone for a 6.6 dB attenuation with doubling of distance (metre)
6	18 sec	13
12	36 sec	18
100	5 min	48
300	15 min	79
600	30 min	109
1000	50 min	137

Based on these distances, an establishment of a 109 metre observation zone would permit up to thirty minutes of continuous piling. Larger observation zones can permit longer durations of piling.

If marine species are sighted within the observation zone or about to enter the observation zone, piling would be stopped until the marine species moves outside the observation zone or 30 minutes have passed since the last sighting.

General noise mitigation measures to reduce potential impacts on marine megafauna are provided in Section 6.2. Additional mitigation measures such as cushion blocks, bubble curtains and aerated, damped or dewatered outer pile casings could also be investigated to reduce noise from underwater piling operations, if required.

5. Operational impact assessment

5.1 Assessment methodology

5.1.1 Modelling parameters

The noise modelling parameters used for the construction noise assessment in Section 4.2.1 have been used to assess potential operational noise modelling. Operational noise impacts have been assessed for the worst-case 15 minute assessment period during the day, evening and night-time periods.

5.1.2 Assumptions

The following assumptions have been applied to determine inputs for the model:

- the project would be operational for 24 hours per day, 7 days per week;
- all equipment would run at 100 % capacity during the assessment periods;
- four tugboats are used to guide the LNG carrier to its berthing location alongside the FSRU;
- the FSRU and LNG carrier engines would be located under the main deck. Two engines have been assumed to be operating for the carriers as a worst-case scenario. Noise propagation from the engines would be reduced by 40 dBA assuming airborne sound transmission through steel.

5.1.3 Operational noise equipment

The sound power levels of the operational equipment expected on site is provided in Table 5-1. The locations of the operational noise equipment are based off information provided by Australian Industrial Energy.

The following equipment would be operational however they are expected to be housed within shielded structures on the FSRU. Noise emission from these equipment would be considered negligible as they are shielded from direct emission to the surrounding environment.

- Mechanical plant in the air conditioning unit room;
- Generators to support utilities, controls and electricity;
- Gas compressors to vaporise the LNG.

Table 5-1 Equipment sound power levels, dBA

Source	Source height (metre)	Octave band centre frequency, Hz										Reference
		31.5	63	125	250	500	1000	2000	4000	8000	Total	
Wärtsilä Engine W 8L50DF FSRU engine room LNG Carrier engine room 3rd and 4th deck 40 dBA reduction assumed	10	-	45	59	70	78	78	77	75	64	83	Wärtsilä datasheet
Wärtsilä Exhaust W 8L50DF FSRU funnel LNG Carrier funnel 35 dBA exhaust silencer fitted	45	83	72	77	75	85	91	89	74	-	94	Wärtsilä datasheet
Regasification boiler FSRU engine room 3rd and 4th deck	10	-	49	64	71	82	85	86	71	69	90	Noise Emission from Industrial Facilities VDI2571
Regasification booster pump **Sea water pump** FSRU main deck	30	-	103	93	89	84	87	87	85	81	104	Based on diesel pump
Loading arm FSRU main deck	30	-	96	99	96	90	94	94	83	74	105	Based on a crane
Tugboat	1.5	-	78	87	94	100	103	104	104	102	110	Based on a diesel engine

5.1.4 Operational noise scenarios

The operational noise scenarios in Table 5-2 have been modelled for this assessment:

Table 5-2 Operational noise scenarios

Scenario	Stage	Description
OS1	LNG carrier berthing	Four tug boats would be used to moor and unmoor the LNG carrier from its berthing location beside the FSRU
OS2	FSRU operation	Transfer of LNG from the LNG carrier to the FSRU Regasification of the LNG

5.2 Operational noise impacts

Overall predicted $L_{Aeq(15\ min)}$ and $L_{Ceq(15\ min)}$ noise levels from the two modelled operational noise scenarios are provided in Appendix G for all receivers. Noise levels during the worst-case 15 minute assessment period are expected to be the same across the day, evening and night-time assessment periods as the FSRU and associated infrastructure would be in constant operation.

A summary of the maximum predicted noise levels in each NCA for residential receivers and for each non-residential receiver type is provided in Table 5-3.

The predicted noise levels during operation of the FSRU is expected to be below the project noise trigger levels during all time periods. No sleep disturbance impacts are anticipated as the operational noise sources are constant and do not have impulsive noise characteristics.

Table 5-3 Most affected receivers

Receiver type	Noise criteria		Operational scenario		
			OS1	OS2	OS1 and OS2 (cumulative)
Residential – NCA01	44 $L_{Aeq(15\ min)}$ (Day/Evening) 43 $L_{Aeq(15\ min)}$ (Night)	Highest noise level	16	25	26
		Worst affected receiver	R043	R042	R042
Residential – NCA02	48 $L_{Aeq(15\ min)}$ (Day) 47 $L_{Aeq(15\ min)}$ (Evening) 43 $L_{Aeq(15\ min)}$ (Night)	Highest noise level	26	32	33
		Worst affected receiver	R080	R076	R076
Commercial	63 $L_{Aeq(15\ min)}$ (All time periods)	Highest noise level	24	24	26
		Worst affected receiver	R081	R041	R081

Receiver type	Noise criteria		Operational scenario		
			OS1	OS2	OS1 and OS2 (cumulative)
Industrial	68 $L_{Aeq(15\ min)}$ (All time periods)	Highest noise level	29	29	32
		Worst affected receiver	R078	R078	R078
Place of worship	53 $L_{Aeq(15\ min)}$ (When in use)	Highest noise level	16	21	22
		Worst affected receiver	R074	R074	R074
Active recreation	58 $L_{Aeq(15\ min)}$ (When in use)	Highest noise level	12	19	20
		Worst affected receiver	R007	R007	R007

5.3 Operational traffic

The project would generate traffic along Springhill Road from light vehicle movements associated with staff. Staff movements would be limited as a proportion of the FSRU staff are expected to be based permanently on-board.

Road traffic impacts due to heavy vehicle movements is not anticipated. The access routes to the site was previously used for coal delivery with a high volume of daily truck movements. A significant number of truck movements from the project is not anticipated as material delivery trucks would not be required to transport gas which is transferred through the pipeline to connect to the existing network.

The objectives of the RNP would be met during operation if the road traffic noise increase due to operational changes is limited to 2 dBA above existing levels. The existing traffic along Springhill Road would be required to increase by approximately 58 % in order for noise levels to increase by 2 dBA.

No operational road traffic noise impacts are expected as existing traffic volumes are not anticipated to increase by over 58 %.

6. Mitigation measures

6.1 Construction airborne noise

Construction activities have the potential to cause adverse noise impacts on surrounding sensitive receivers during standard and outside of standard construction hours.

The following general construction noise mitigation measures should be implemented, where feasible and reasonable, to reduce noise impacts on the surrounding environment:

- notify the affected receivers detailing the construction activities, time periods over which they would occur and the duration of works;
- provide contact details to the affected receivers. If noise complaints are received they should be recorded and attended noise monitoring should be conducted to assess compliance with the predicted construction noise levels;
- provide site inductions to all employees, contractors and subcontractors regarding quiet work practices, any limitations on high noise generating activities, permissible hours of work and appropriate behavioural practices;
- quieter construction methods should be used where feasible;
- minimise pipeline construction activities near sensitive receivers during more sensitive time periods (evening, night); and
- turn off equipment after use.

A list of standard construction noise mitigation measures is provided in Table 6-1 which can be applied to minimise construction noise impacts. These should be implemented where feasible and reasonable.

Table 6-1 Construction mitigation measures

Action required	Details
Management measures	
Site inductions	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: • All relevant project specific and standard noise and vibration mitigation measures • Relevant licence and approval conditions • Permissible hours of work • Any limitations on noise generating activities with special audible characteristics • Location of nearest sensitive receivers • Construction employee parking areas • Designated loading/unloading areas and procedures • Site opening/closing times (including deliveries) • Environmental incident procedures.
Behavioural practices	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors. No excessive revving of plant and vehicle engines. Controlled release of compressed air.
Update Construction Environmental Management Plans	The Construction Environmental Management Plan (CEMP) must be regularly updated to account for changes in noise and vibration management issues and strategies.

Action required	Details
Source control measures	
Plan worksites and activities to minimise noise and vibration	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.
Use and siting of plant	Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be avoided. The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away from sensitive receivers.
Non-tonal reversing alarms	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work, including delivery vehicles.
Minimise disturbance arising from delivery of goods to construction sites	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.
Silencers on mobile plant	Where possible reduce noise from mobile plant through additional fittings including residential grade mufflers.
Prefabrication of materials off-site	Where practicable, pre-fabricate and/or prepare materials off-site to reduce noise with special audible characteristics occurring on site. Materials can then be delivered to site for installation.
Path control measures	
Shield stationary noise sources such as pumps	Stationary noise sources should be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained. Appendix F of AS 2436:1981 lists materials suitable for shielding
Shield sensitive receivers from noisy activities	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.

6.2 Construction underwater noise

It is recommended than a 109 metre observation zone be established around the underwater piling zone. The 109 metre observation zone would permit up to thirty minutes of continuous piling. Larger observation zones can permit longer durations of piling.

The *Underwater Piling Noise Guidelines* recommends the following standard management and mitigation procedures with respect to underwater piling operations:

- Avoid conducting piling activities during times when marine mammals are likely to be breeding, calving, feeding, migrating or resting in biologically important habitats located within the potential noise impact footprint;
- Use low noise piling methods, instead of impact piling, where possible;
- Presence of marine mammals should be visually monitored by a suitably trained crew member for at least 30 minutes before the commencement of the piling procedure;
- If no marine mammals are nearby, a soft-start piling procedure should be used. This involves gradually increasing the piling impact energy over a 10 minute time period.

Visual observations of marine mammals within the observation zone should be maintained by trained crew throughout the start period;

- If a marine mammal is sighted within the observation zone during the soft start of normal operation procedures, the operator of the piling rig should be placed on stand-by to shut down the piling rig;
- A record of procedures employed during the operations should be maintained by the piling contractor.

6.3 Operational noise

Operational noise levels are expected to comply with the operational noise criteria at the worst affected receiver. No specific operational mitigation measures are recommended.

7. Conclusion

7.1 Overview

GHD has been engaged by Australian Industrial Energy to prepare a NVIA to support the EIS for the project. The NIA has been prepared to:

- review the existing noise environment and identify existing background noise levels;
- assess potential impacts due to construction noise and vibration; and
- assess potential impacts due to operational noise.

7.2 Construction noise

Construction of the project is expected to take 10 -12 months with completion due in early 2020. Construction activities are proposed to be undertaken during and outside standard construction hours and have been developed based on the proposed construction staging.

The predicted noise levels are expected to exceed the noise management levels during standard and outside of construction hours for pipeline construction works located adjacent the residential receivers. The impacts from pipeline construction activities would be intermittent in duration as the pipeline construction would progress sequentially along the construction corridor.

Minor exceedances of the noise management levels are also predicted during standard and outside of construction hours for fixed construction activities. The impacted receivers would be subject to existing ambient rail traffic noise and industrial noise from the port area.

Predicted noise levels are not expected to be above the highly noise affected level of 75 dBA.

Traffic noise impacts due to construction are not expected as noise levels along the construction traffic routes are not predicted to significantly increase road traffic noise levels.

It is typical for construction projects to exceed the construction noise management levels. Any impacts due to construction works are temporary in nature and would not represent a permanent impact on the community and surrounding environment. The predicted noise levels are generally conservative and would only be experienced for limited periods during construction. Impacts may be reduced through the introduction of feasible and reasonable mitigation measures which have been recommended. However, these mitigation measures are unlikely to reduce noise levels below the construction noise management levels.

7.3 Construction vibration

Construction vibration levels are unlikely to generate levels above the vibration criteria due to the large distance between the construction area and the nearest residential receivers. No vibration impacts are predicted from construction of the project.

7.4 Operational noise

Operation noise emission is not expected to change as a result of construction of the project and would be expected to comply with the operational noise criteria at all sensitive receivers. Therefore, no operational mitigation measures are required.

8. References

Assessing Vibration a Technical Guideline, Department of Environment and Conservation, 2006

Australian Industrial Energy East Coast Project EIS Marine Ecology Assessment, GHD, 2018

Australian Industrial Energy East Coast Project Traffic Impact Assessment, GHD, 2018

BS 6472 – 1992, Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz), British Standards, 1992

Code of practice for noise and vibration control on construction and open sites, BS 5228-1, British Standards, 2009

Charleston Harbor Post 45 Charleston, South Carolina Noise Assessment, U.S. Army Corps of Engineers Charleston District, 2015

Computational Ocean Acoustics, Jensen F.B., Kuperman W.A., Porter M.B., and Schmidt H., 2000

DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on structures, German Standard, 1999

Final report to the California Department of Transportation *Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish*, ICF Jones & Stokes et al., 2009

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

Noise Policy for Industry, Environmental Protection Authority, 2017

Interim Construction Noise Guideline, Department of Environment and Climate Change, July 2009

ISO 9613-2, Acoustics – Attenuation of sound during propagation outdoors, International Organization for Standardization, 1996.

Road Noise Policy, Office of Environment and Heritage, March 2011

Underwater Piling Noise Guidelines, Department of Planning, Transport and Infrastructure (Government of South Australia), 2012

Appendices

Appendix A – Glossary

Abbreviation	Definition
Ambient noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far.
Background noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the LA90 descriptor.
dB	Decibel is the logarithmic unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics.
dBA	Frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at very low and very high frequencies.
dBC	Frequency weighting filter used to measure 'C-weighted' sound pressure levels, which is designed to be more response to low frequency noise
DECCW	Department of Environment, Climate Change and Water
EPA	Environment Protection Authority
ICNG	Interim Construction Noise Guideline (DECCW, 2009)
$L_{Aeq(period)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
$L_{A90(period)}$	The sound pressure level exceeded for 90% of the measurement period.
L_{Amax}	The maximum sound level recorded during the measurement period.
$L_{Aeq(15\ hour)}$	The LAeq noise level for the period 7 am to 10 pm.
$L_{Aeq(9\ hour)}$	The LAeq noise level for the period 10 pm to 7 am.
$L_{Aeq(1\ hour)}$	The highest hourly LAeq noise level during the day and night periods.
L_W	Sound power level
NML	Noise management level
Noise sensitive receiver	An area or place potentially affected by noise including residential dwellings, schools, child care centres, places of worship, health care institutions and active or passive recreational areas.
NPI	Noise Policy for Industry (EPA, 2017)
PNTL	Project noise trigger level
Rating background level (RBL)	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period.
RNP	Road Noise Policy (DECWW, 2011)

Appendix B – Measured noise levels

Location 1 117 Gladstone Avenue, Coniston

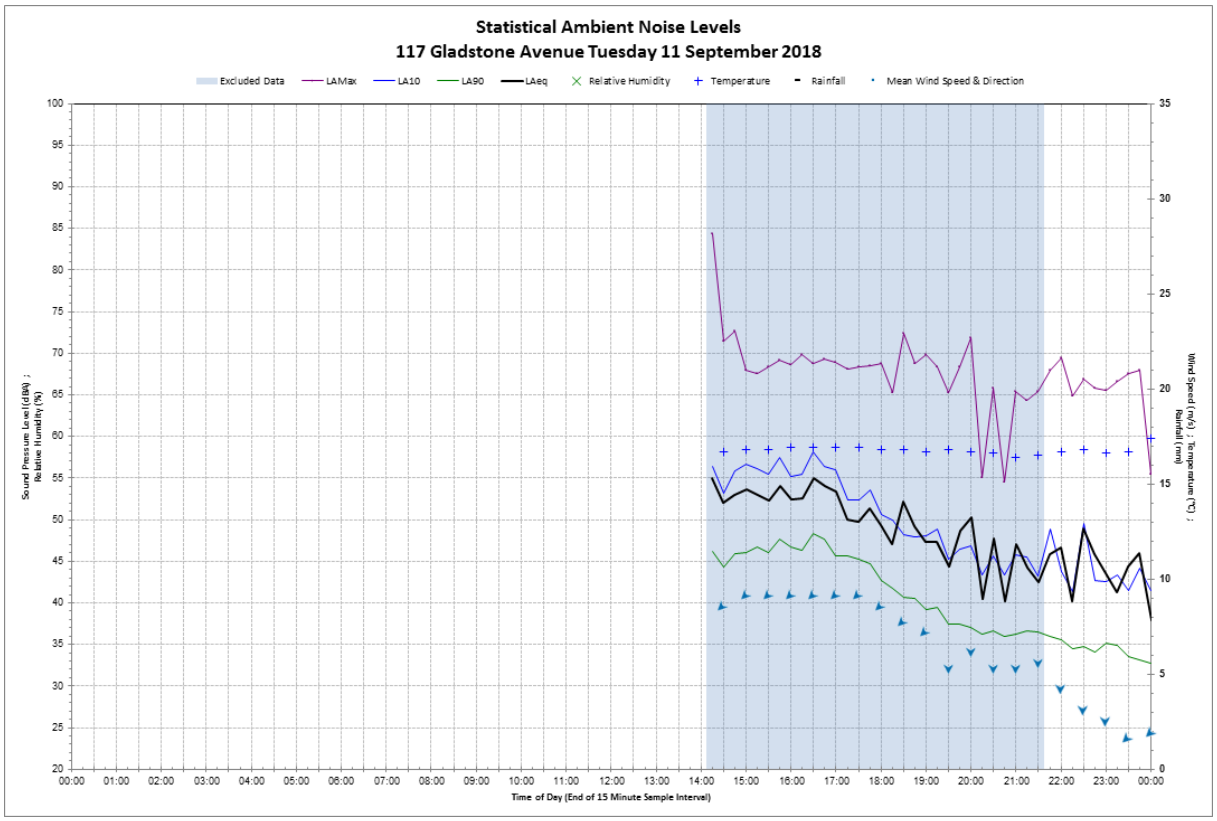
Date	Rating background level, L_{A90}			Ambient level, L_{Aeq}		
	Day	Evening	Night	Day	Evening	Night
Tuesday-11-Sep-18	-	36	32	-	46	51
Wednesday-12-Sep-18	42	41	41	51	54	52
Thursday-13-Sep-18	42	39	39	52	49	49
Friday-14-Sep-18	39	38	37	51	49	48
Saturday-15-Sep-18	38	-	40	50	-	45
Sunday-16-Sep-18	43	41	43	53	49	49
Monday-17-Sep-18	39	35	31	50	46	49
Tuesday-18-Sep-18	39	38	33	49	47	50
Wednesday-19-Sep-18	39	42	38	51	52	51
Thursday-20-Sep-18	43	40	40	55	50	52
Friday-21-Sep-18	39	36	38	51	51	48
Saturday-22-Sep-18	36	40	42	51	49	49
Sunday-23-Sep-18	42	46	43	51	51	49
Monday-24-Sep-18	-	-	-	-	-	-
RBL and Leq Overall	**39**	**40**	**39**	**52**	**50**	**50**

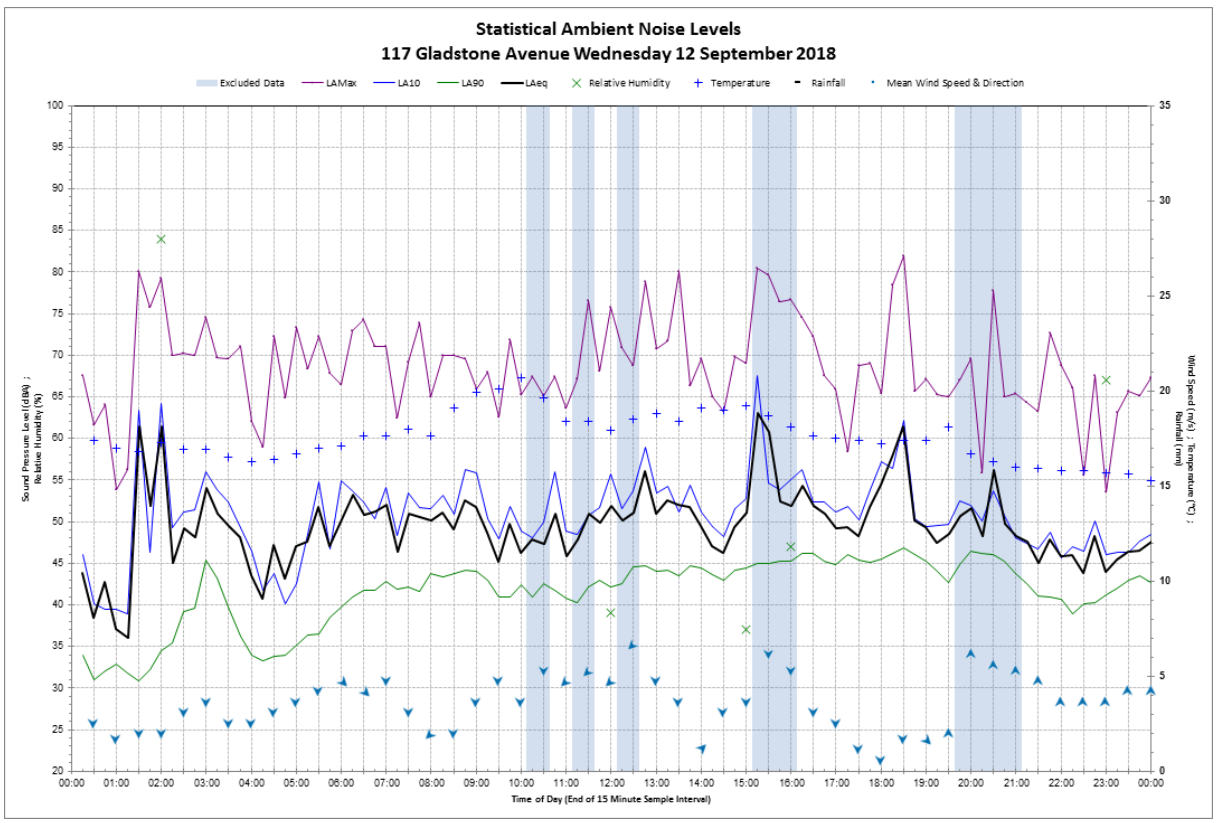
Location 2 16 Merrett Avenue, Cringilla

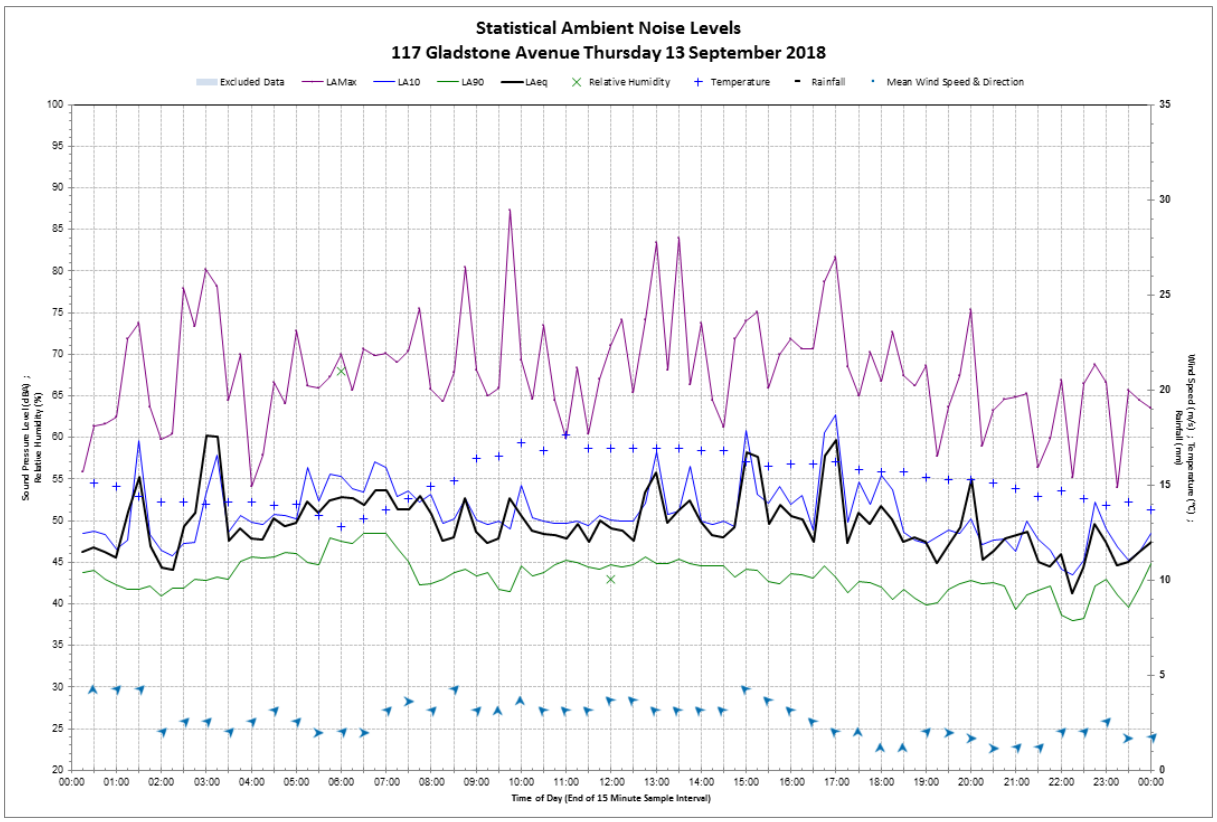
Date	Rating background level, L_{A90}			Ambient level, L_{Aeq}		
	Day	Evening	Night	Day	Evening	Night
Tuesday-11-Sep-18	-	47	47	-	49	51
Wednesday-12-Sep-18	47	37	33	53	48	47
Thursday-13-Sep-18	42	42	42	48	48	50
Friday-14-Sep-18	48	43	49	53	49	53
Saturday-15-Sep-18	43	-	40	50	-	46
Sunday-16-Sep-18	41	40	46	51	46	51
Monday-17-Sep-18	43	48	45	51	50	50
Tuesday-18-Sep-18	45	46	47	51	50	52
Wednesday-19-Sep-18	49	38	31	54	46	44
Thursday-20-Sep-18	42	43	46	51	48	52
Friday-21-Sep-18	43	46	48	51	51	52
Saturday-22-Sep-18	43	40	36	50	48	46
Sunday-23-Sep-18	40	39	36	49	45	42
Monday-24-Sep-18	-	-	-	-	-	-
RBL and Leq Overall	**43**	**42**	**45**	**51**	**49**	**50**

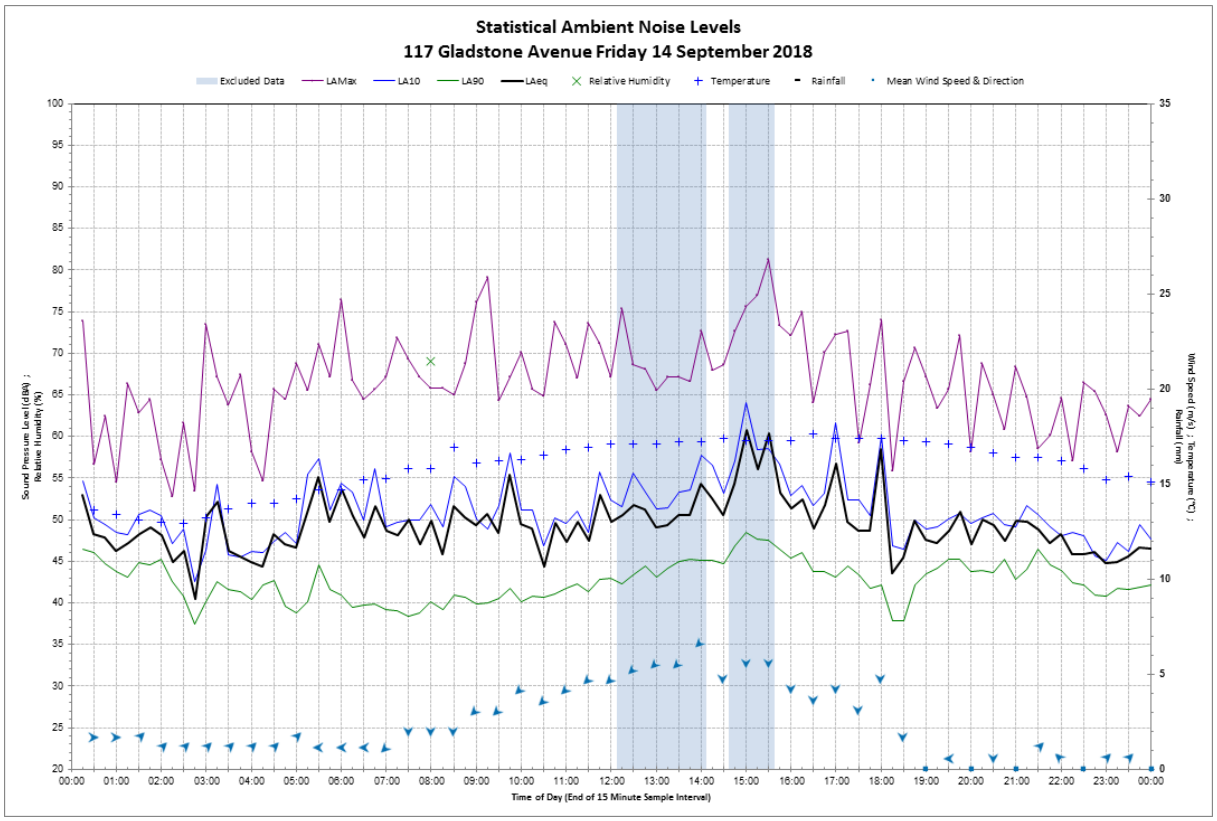
Appendix C – Daily noise level charts

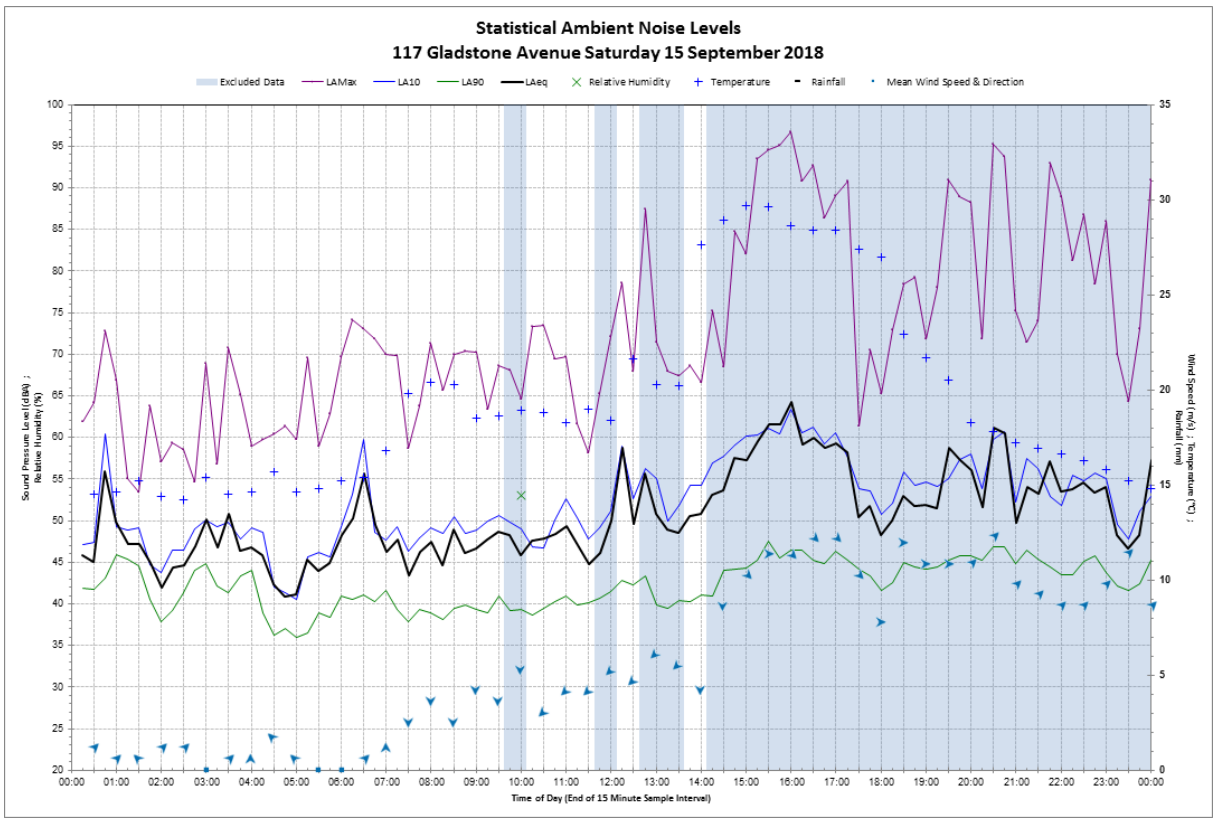
Location 1 117 Gladstone Avenue, Coniston

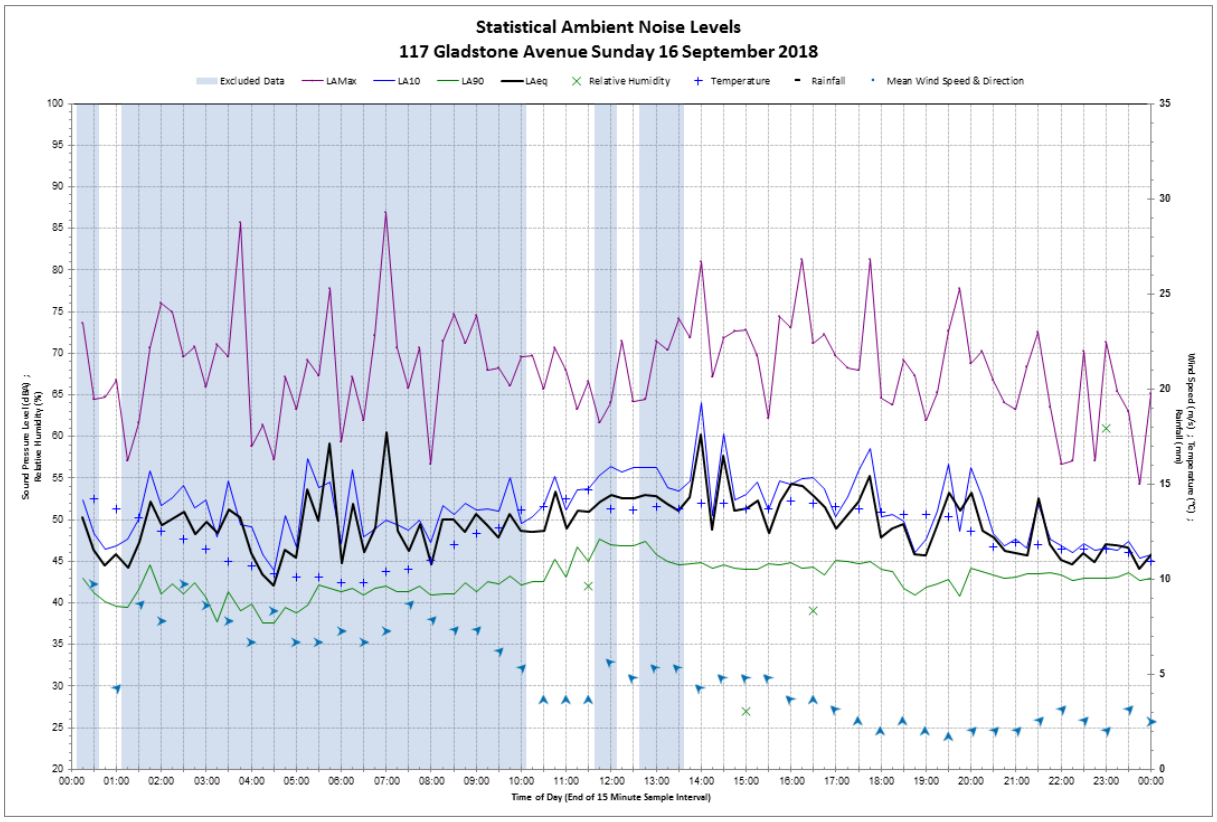


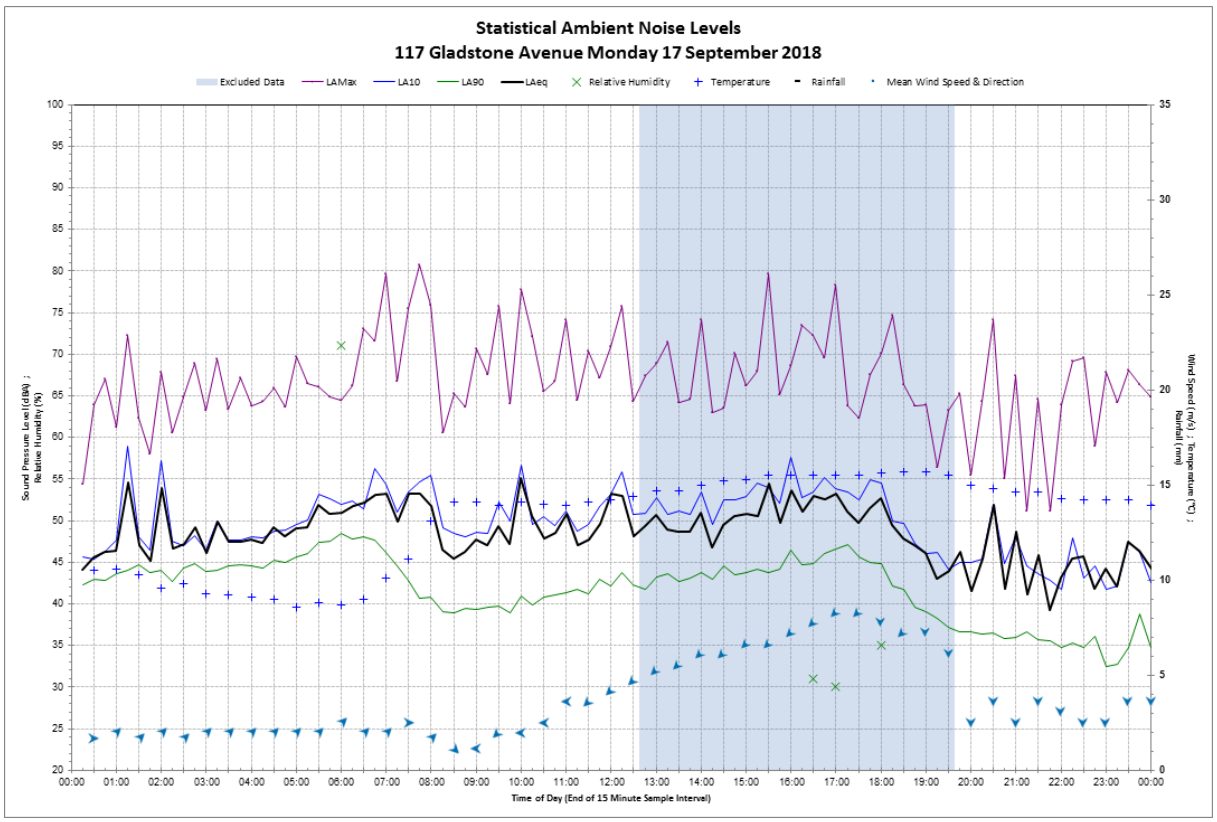


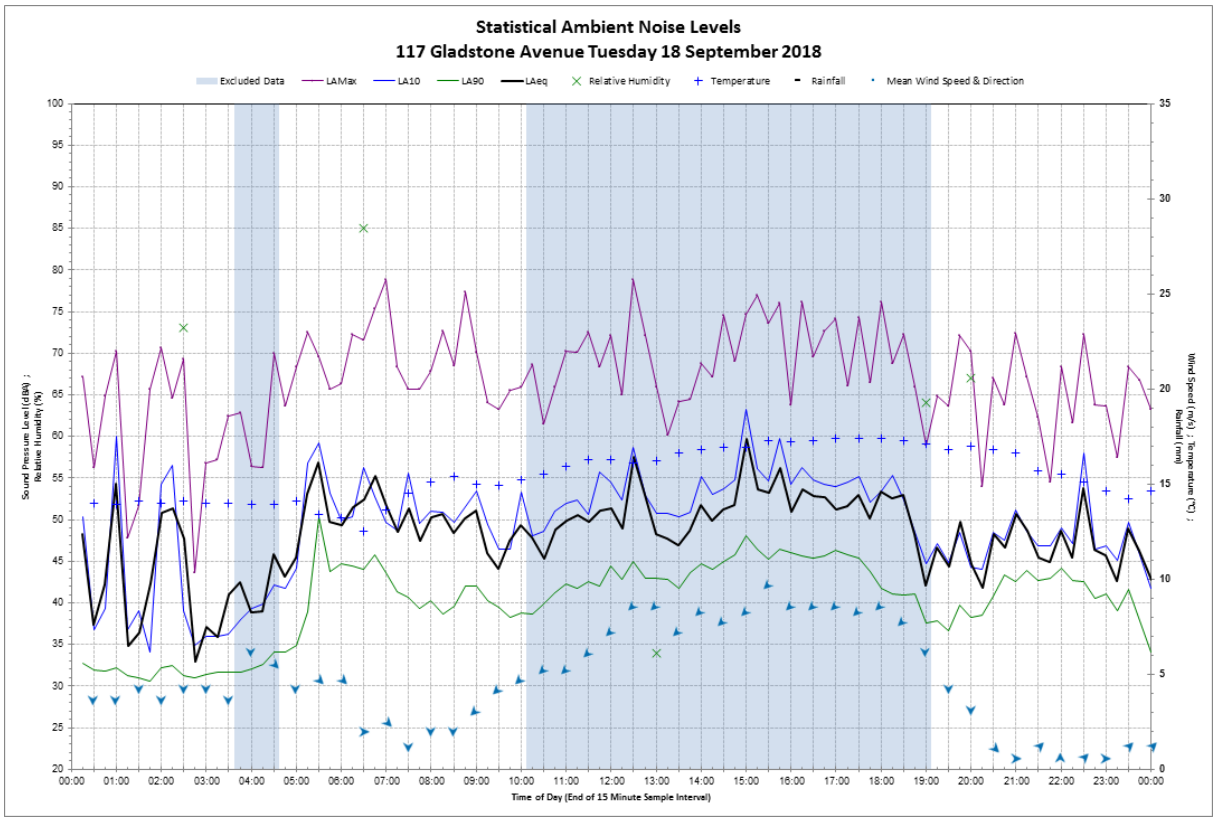

Statistical Ambient Noise Levels
117 Gladstone Avenue Thursday 13 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

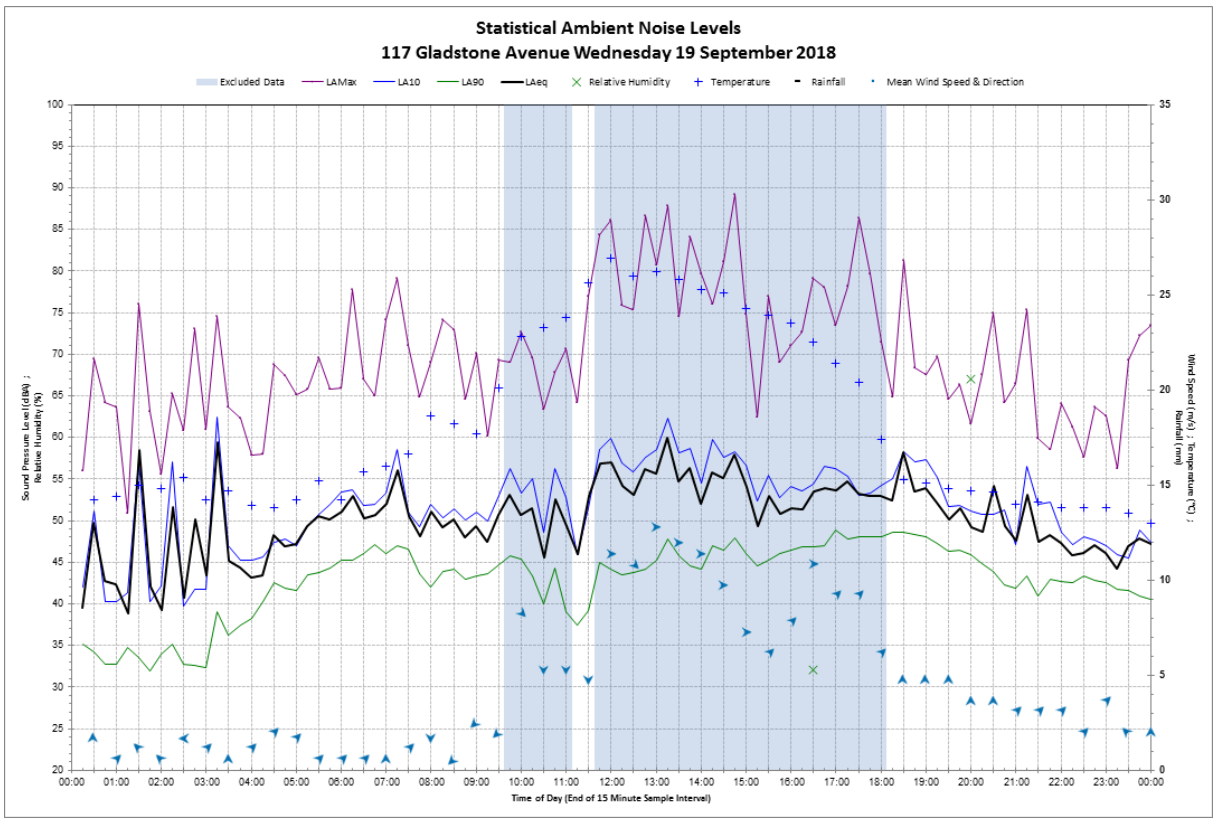

Statistical Ambient Noise Levels
117 Gladstone Avenue Friday 14 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

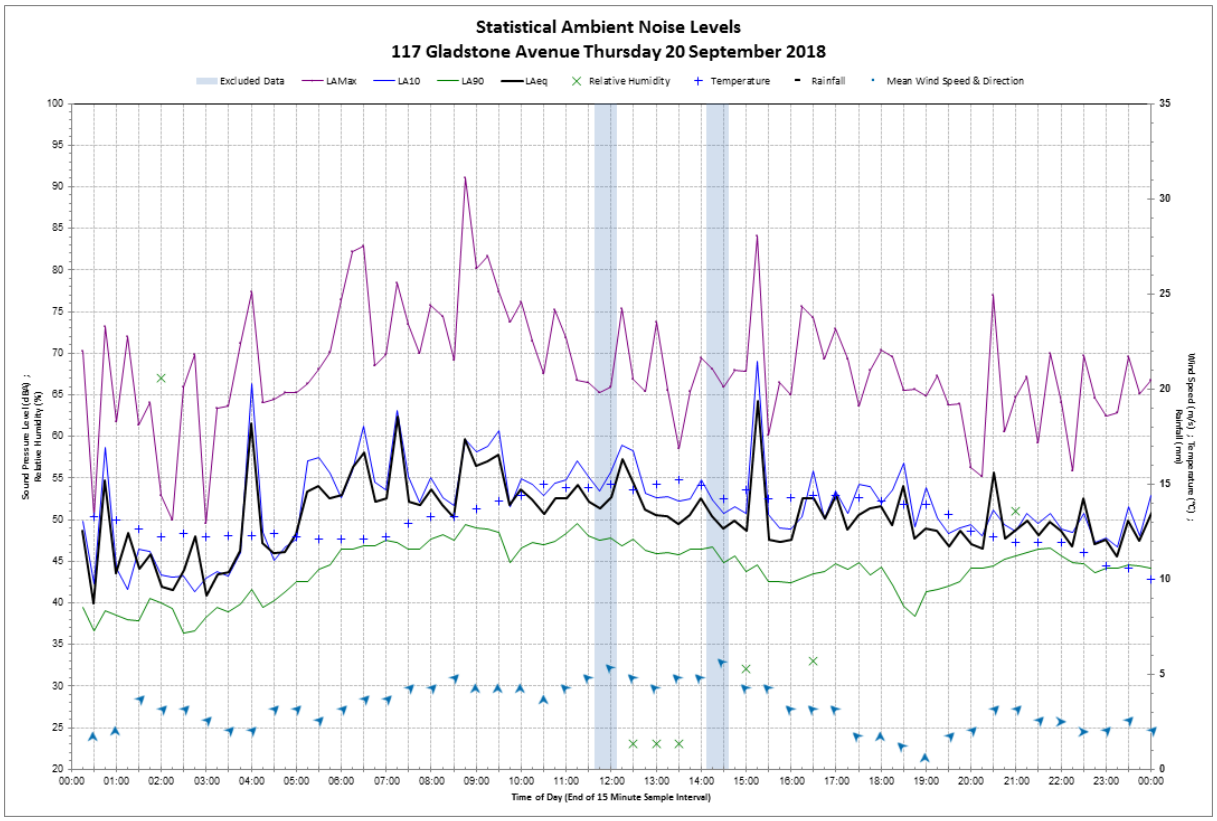

Statistical Ambient Noise Levels
117 Gladstone Avenue Saturday 15 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

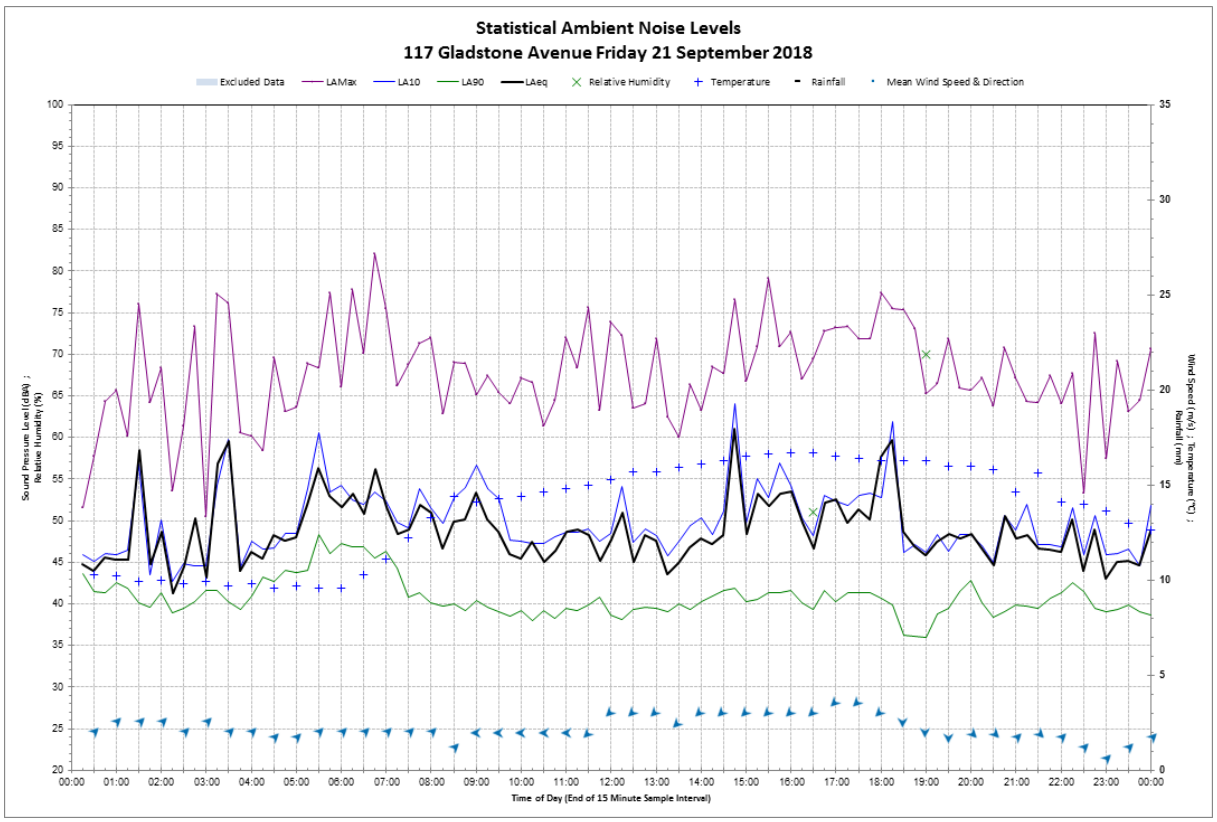

Statistical Ambient Noise Levels
117 Gladstone Avenue Sunday 16 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

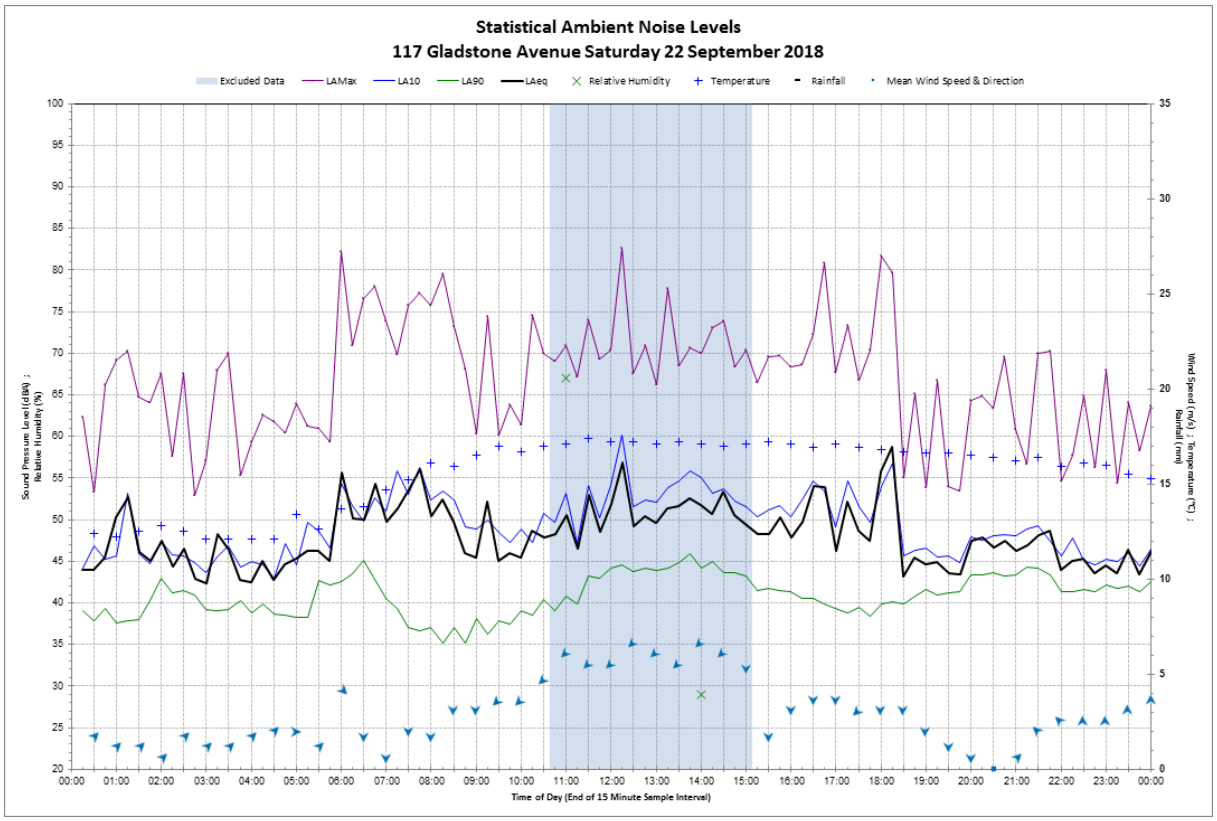

Statistical Ambient Noise Levels
117 Gladstone Avenue Monday 17 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

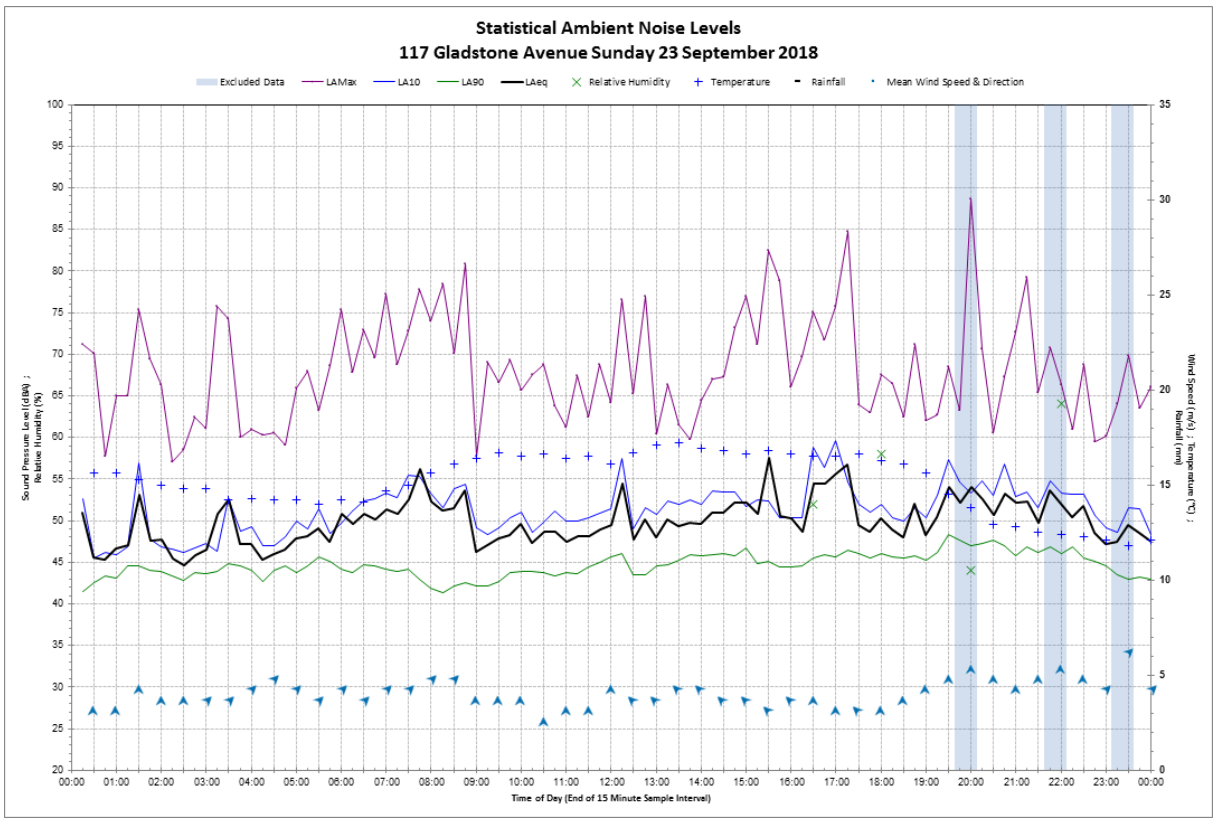

Statistical Ambient Noise Levels
117 Gladstone Avenue Tuesday 18 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

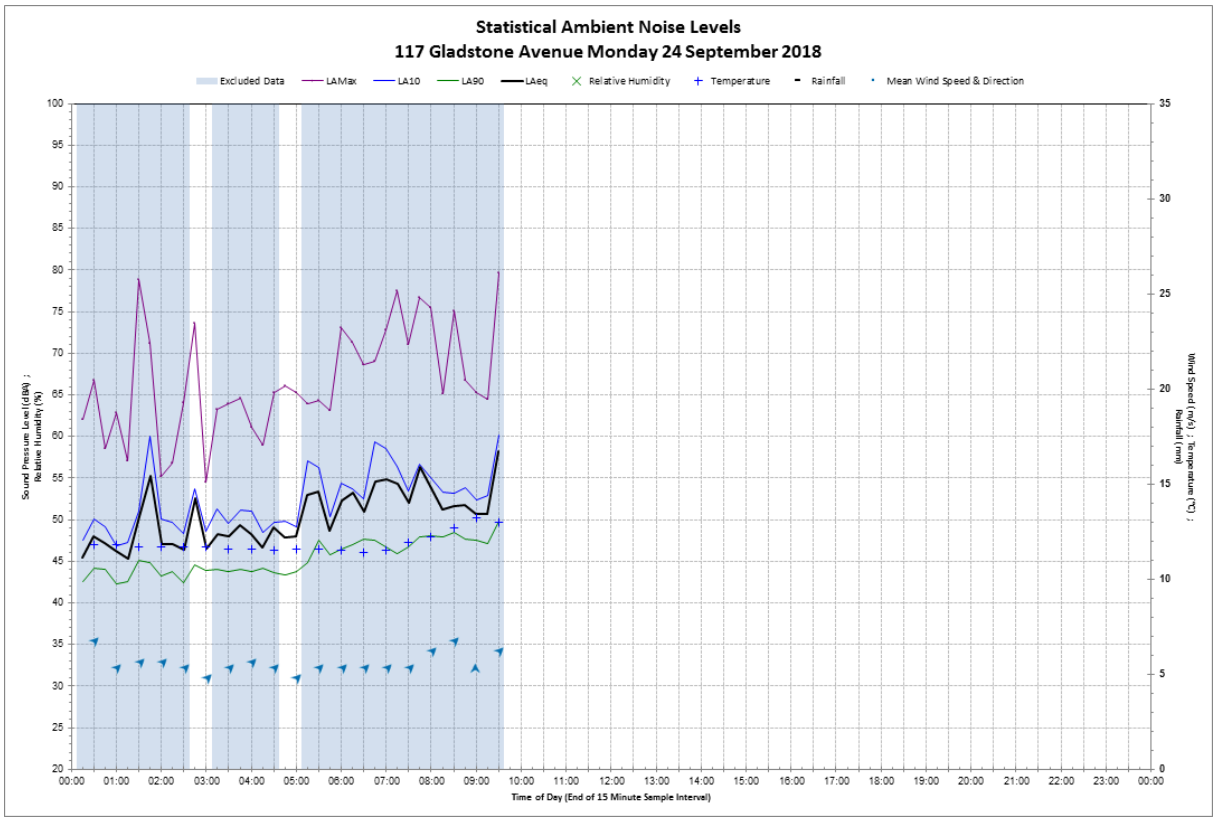

Statistical Ambient Noise Levels
117 Gladstone Avenue Wednesday 19 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Rainfall (mm) ; Temperature (°C) ;
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
117 Gladstone Avenue Thursday 20 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Rainfall (mm) ; Temperature (°C) ;
Time of Day (End of 15 Minute Sample Interval)

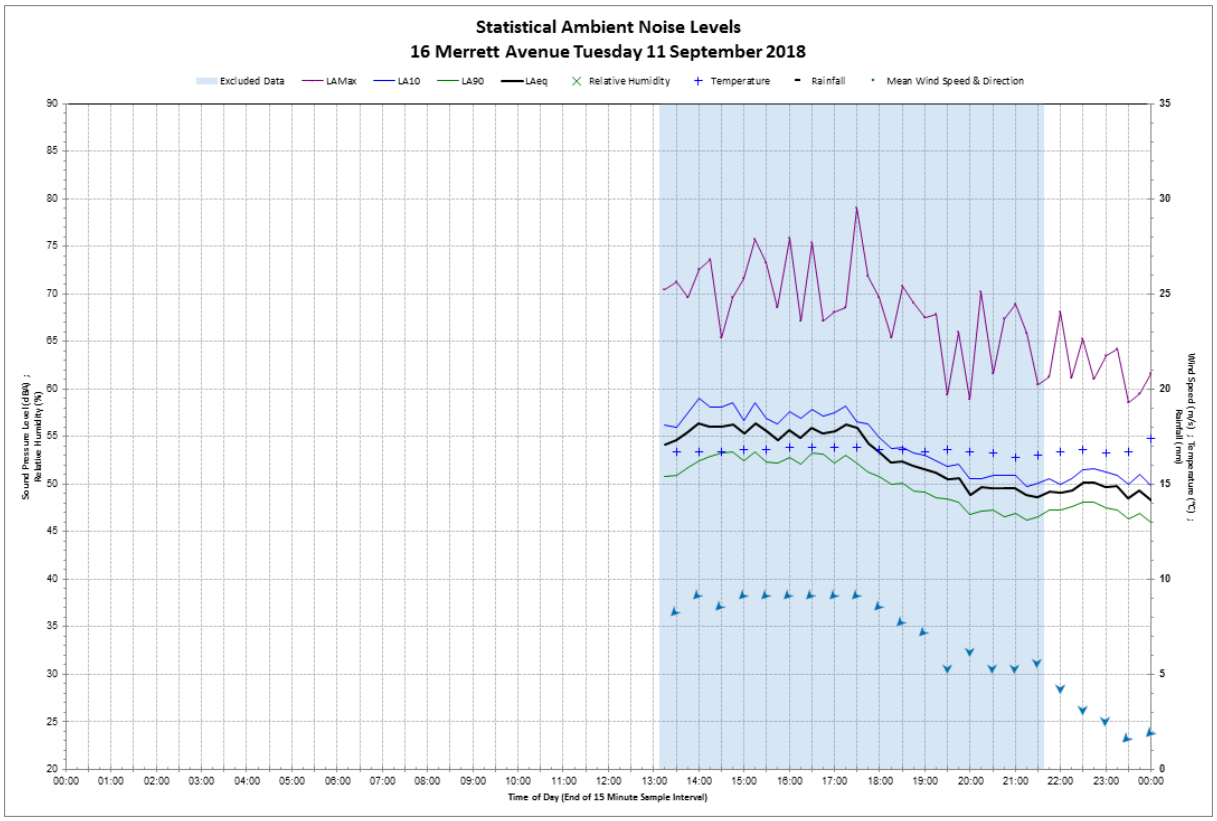

Statistical Ambient Noise Levels
117 Gladstone Avenue Friday 21 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Rainfall (mm) ; Temperature (°C) ;
Time of Day (End of 15 Minute Sample Interval)

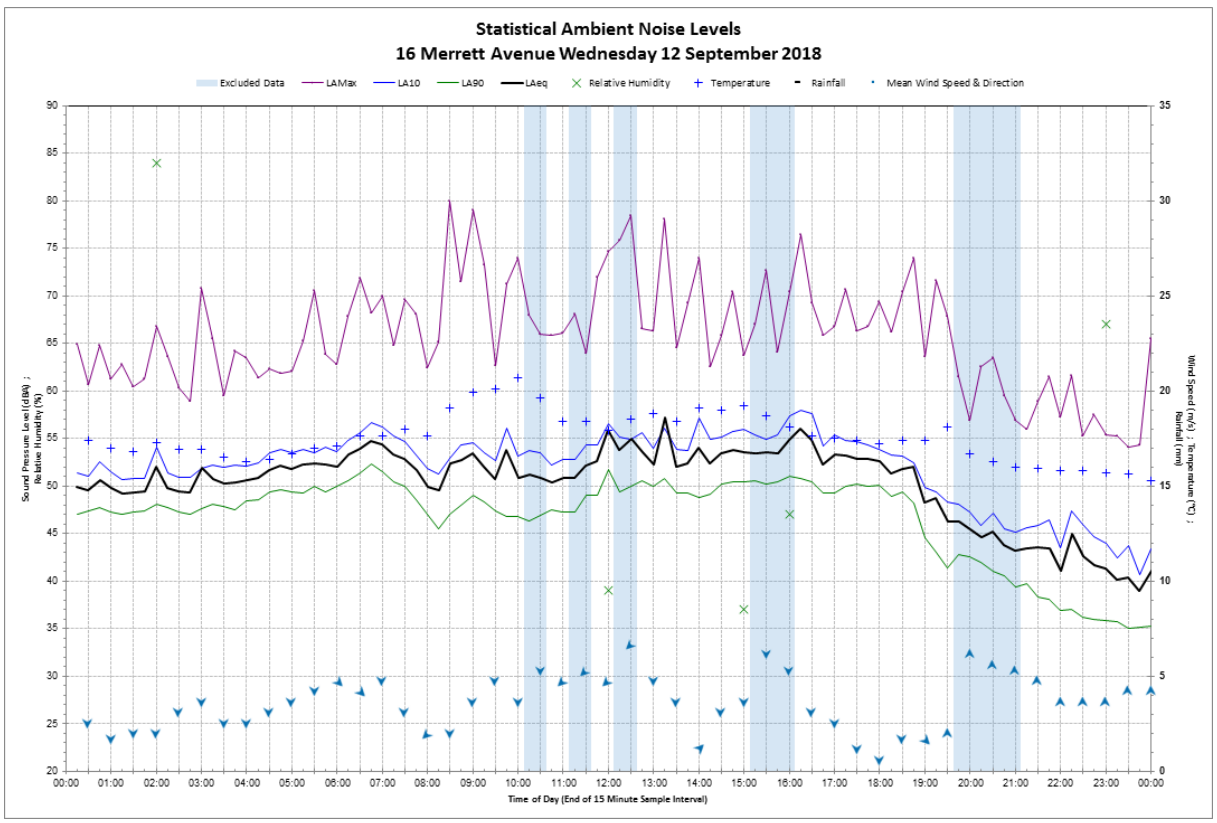

Statistical Ambient Noise Levels
117 Gladstone Avenue Saturday 22 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Rainfall (mm) ; Temperature (°C) ;
Time of Day (End of 15 Minute Sample Interval)

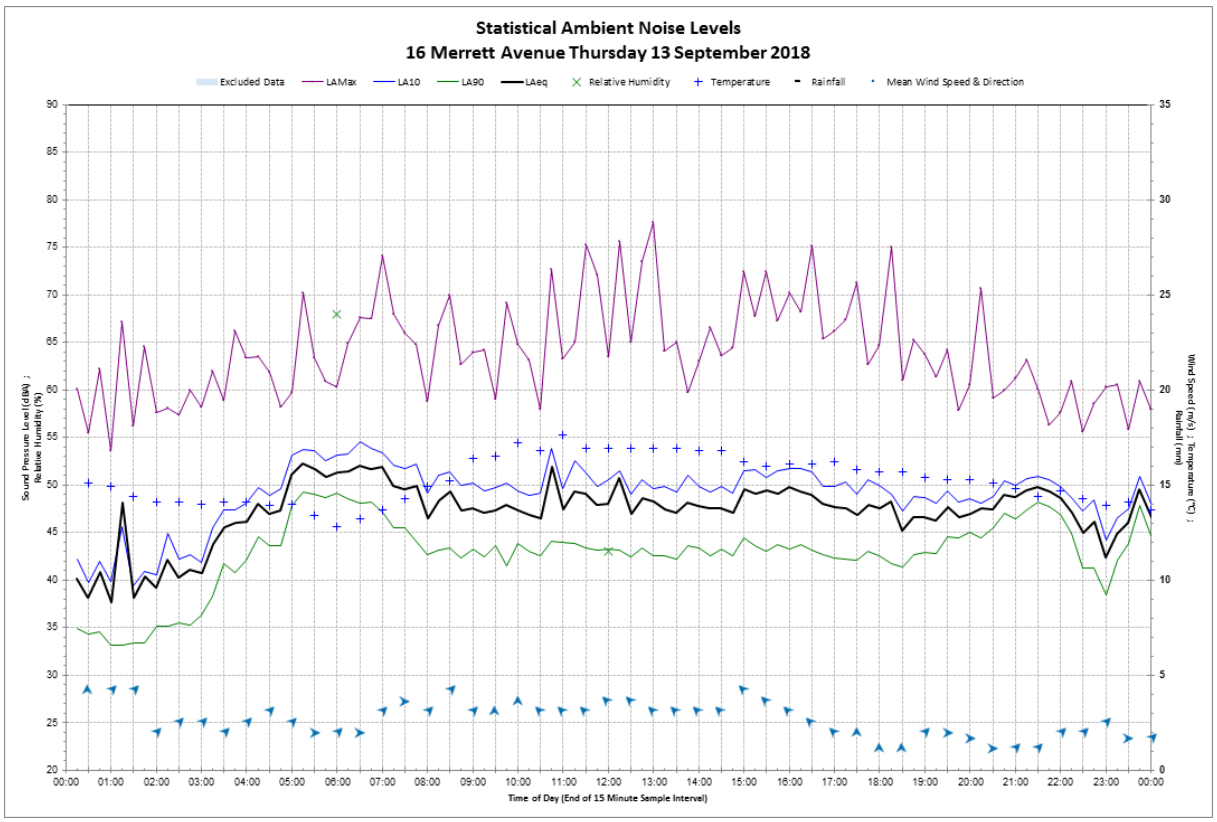

Statistical Ambient Noise Levels
117 Gladstone Avenue Sunday 23 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

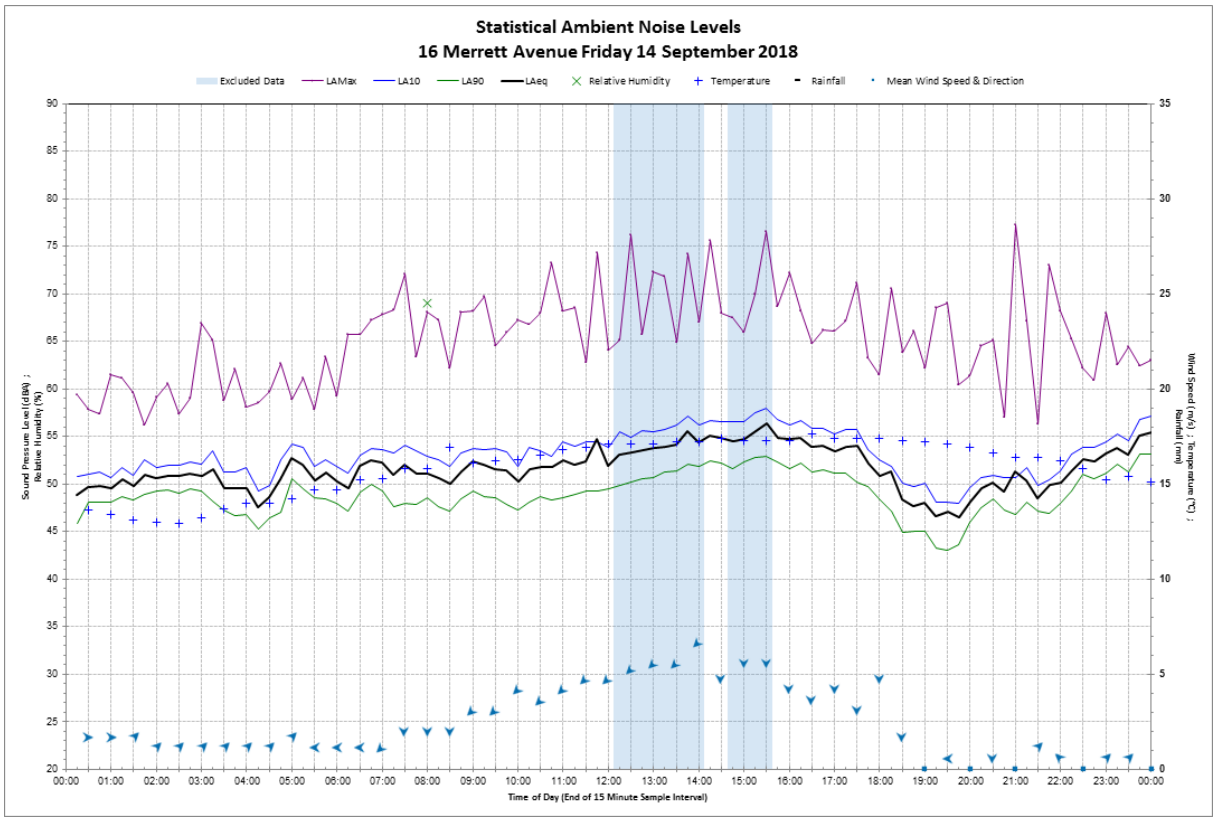

Statistical Ambient Noise Levels
117 Gladstone Avenue Monday 24 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

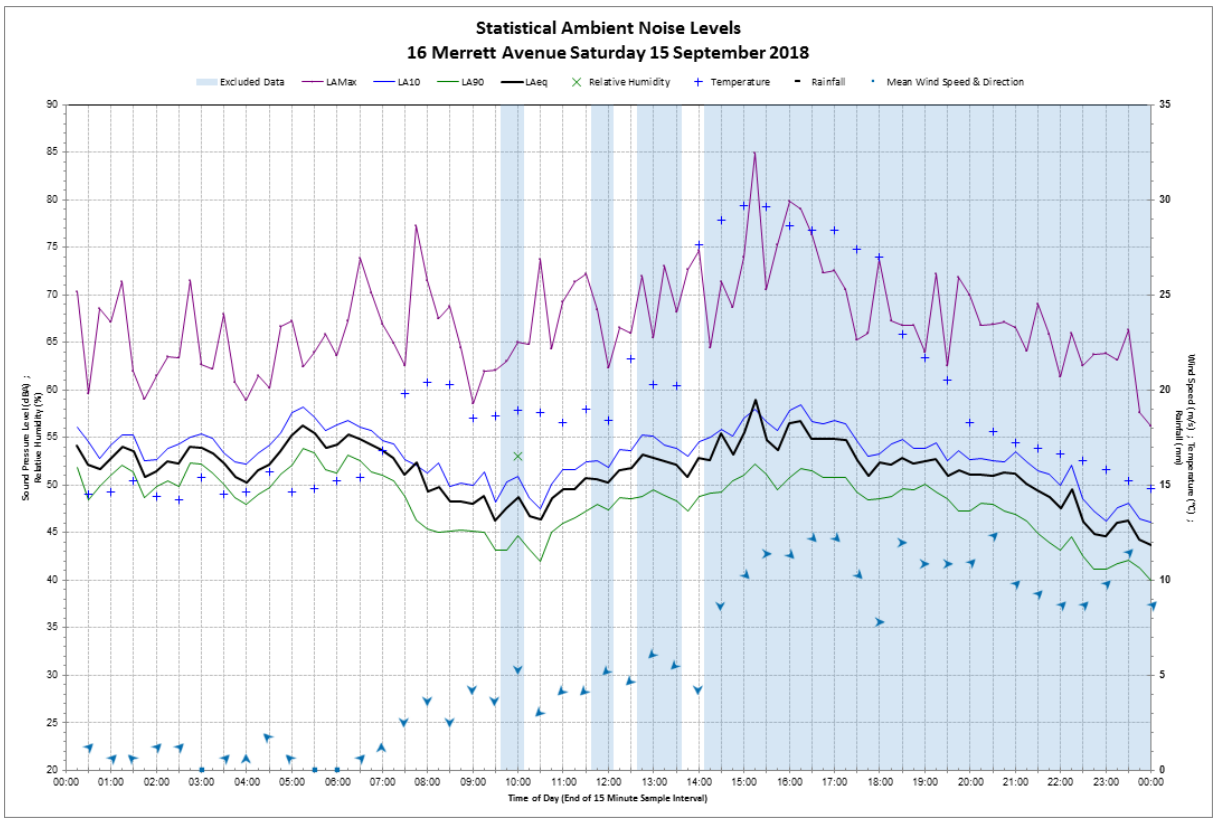
Location 2 16 Merrett Avenue, Cringilla

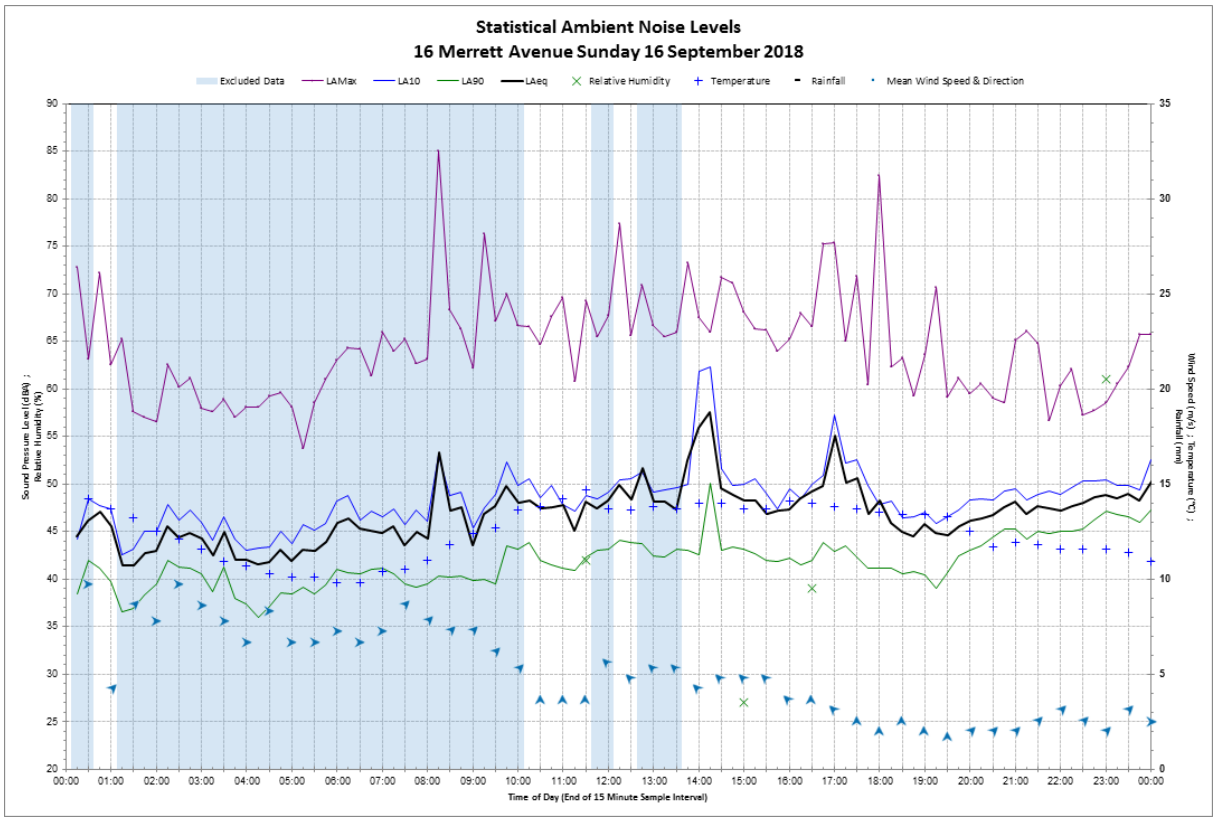


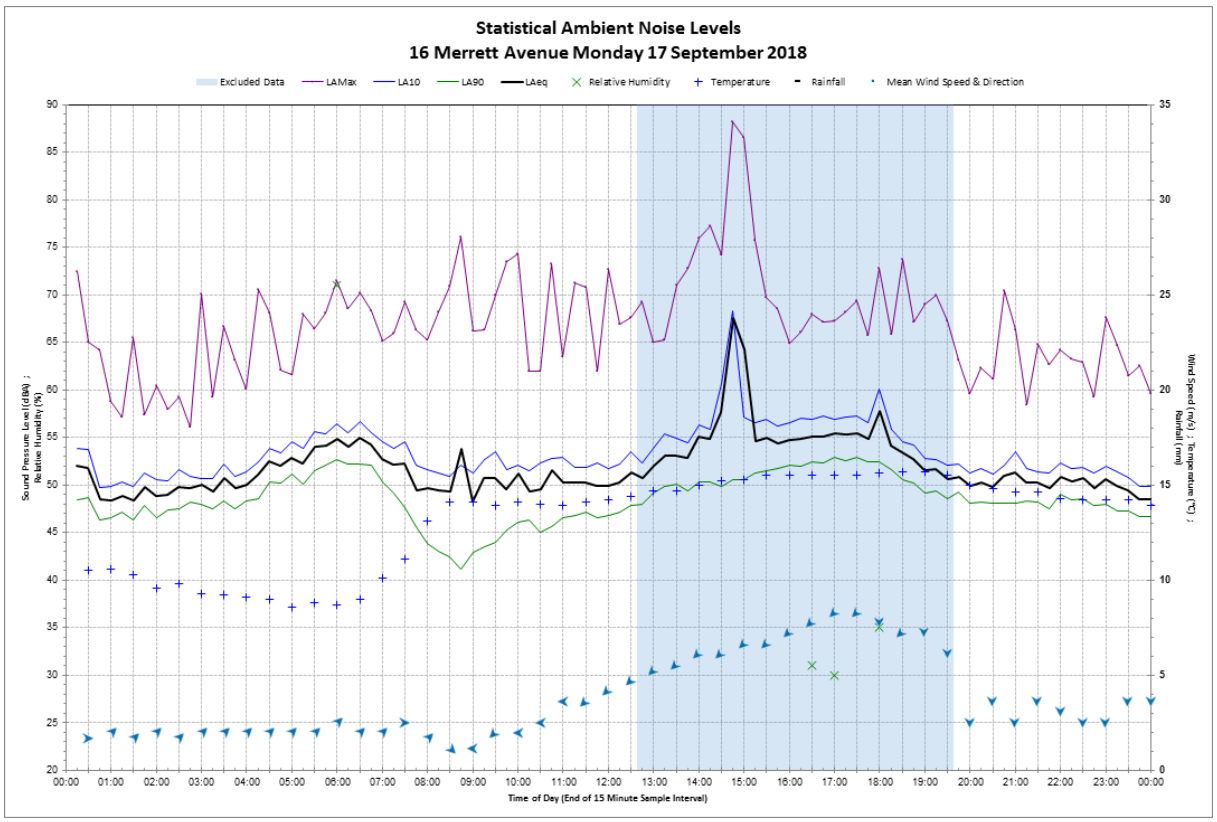


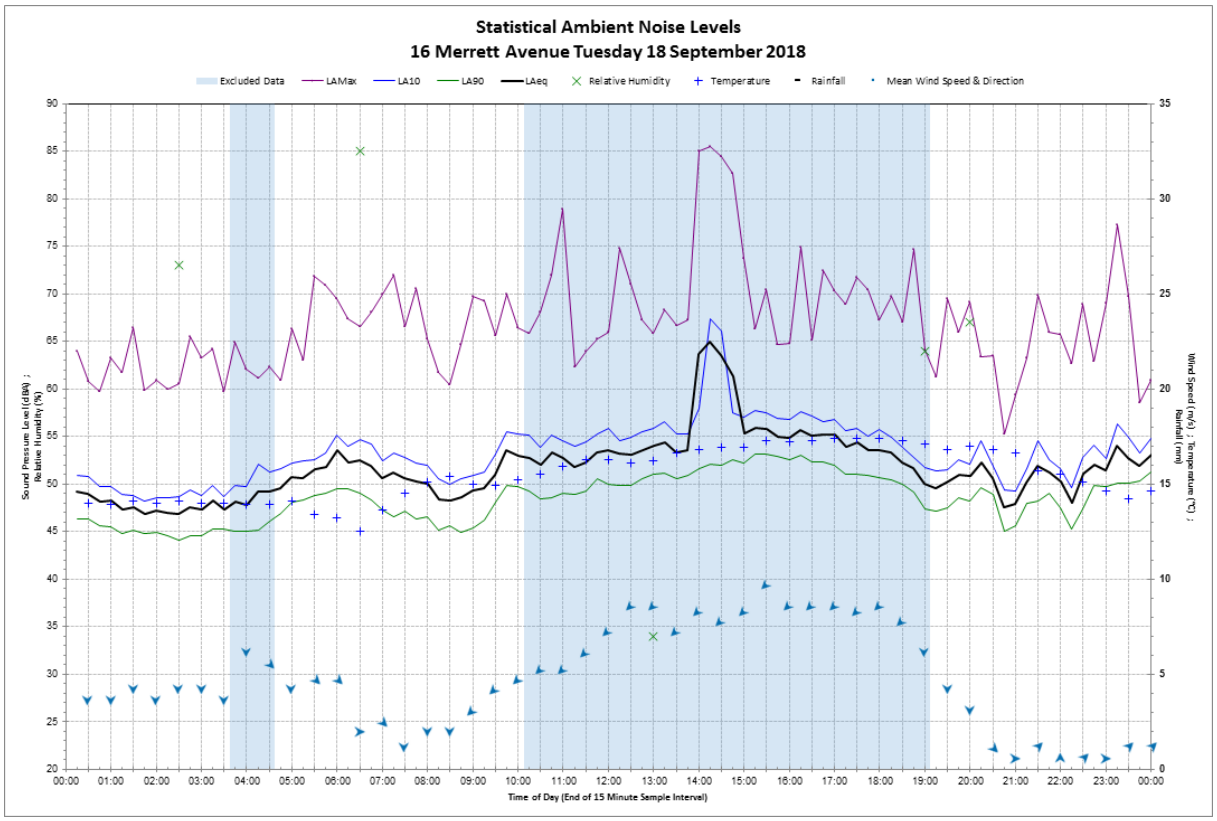

Statistical Ambient Noise Levels
16 Merrett Avenue Thursday 13 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

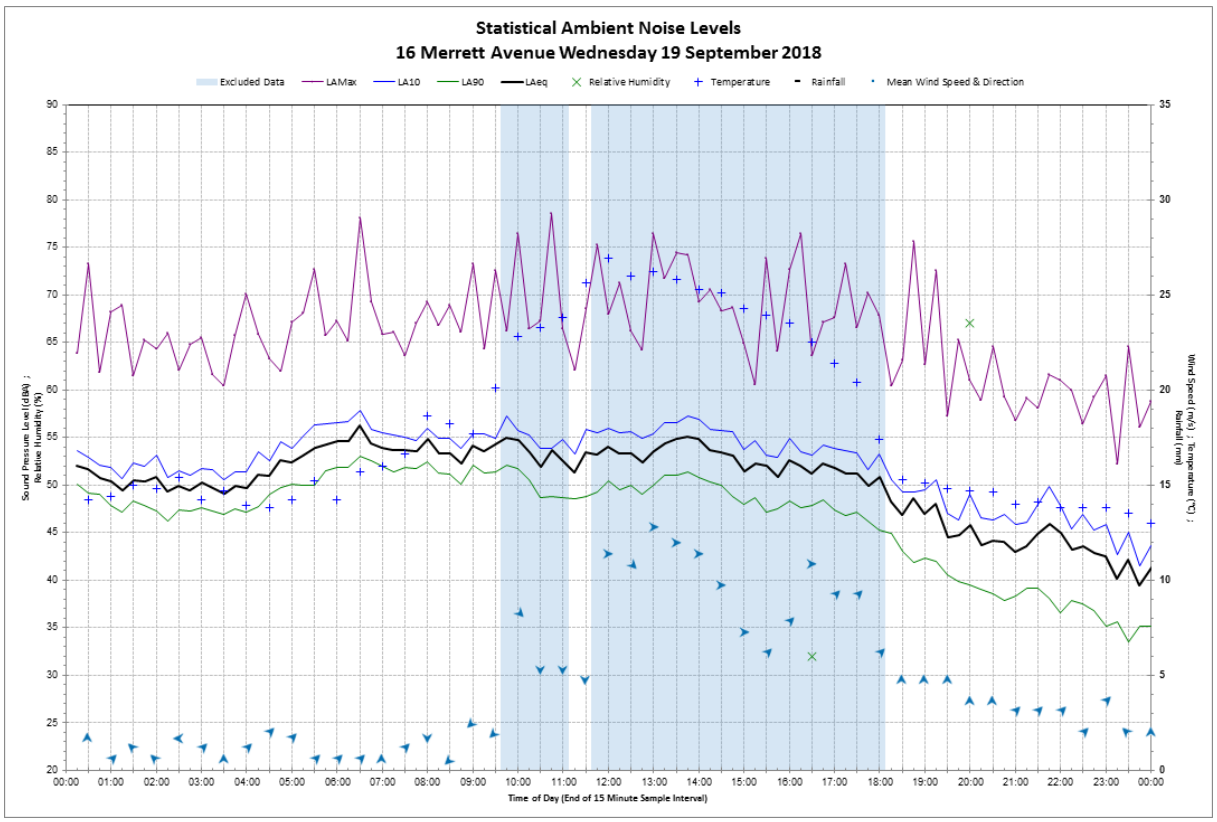

Statistical Ambient Noise Levels
16 Merrett Avenue Friday 14 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

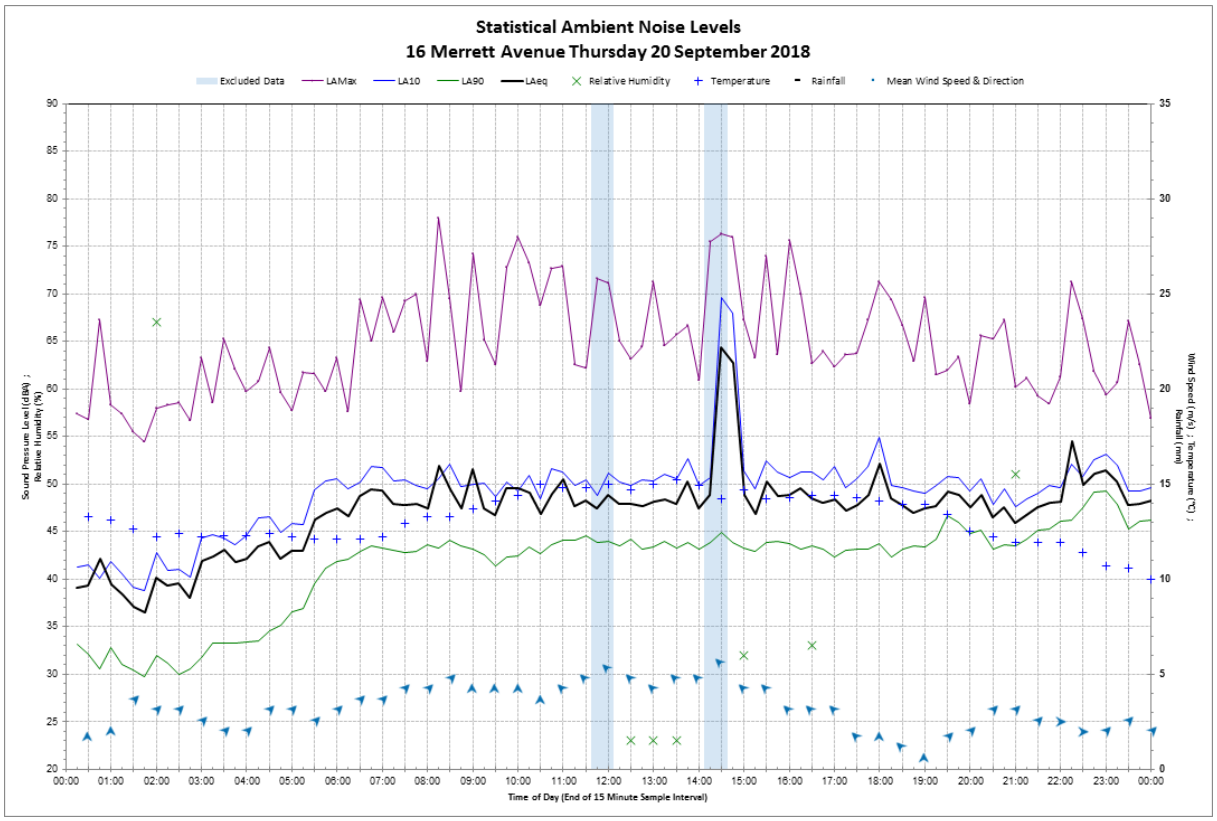

Statistical Ambient Noise Levels
16 Merrett Avenue Saturday 15 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

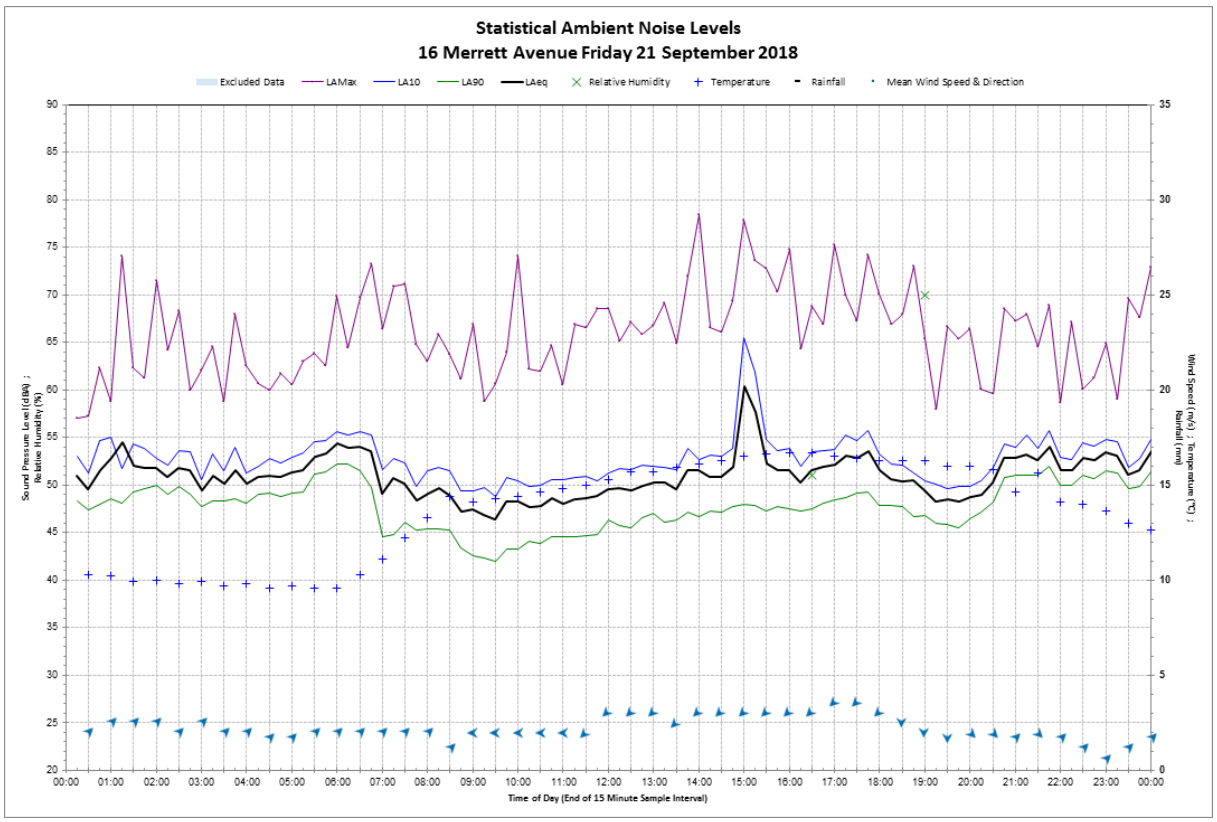

Statistical Ambient Noise Levels
16 Merrett Avenue Sunday 16 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
16 Merrett Avenue Monday 17 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
16 Merrett Avenue Tuesday 18 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
16 Merrett Avenue Wednesday 19 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
16 Merrett Avenue Thursday 20 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
16 Merrett Avenue Friday 21 September 2018
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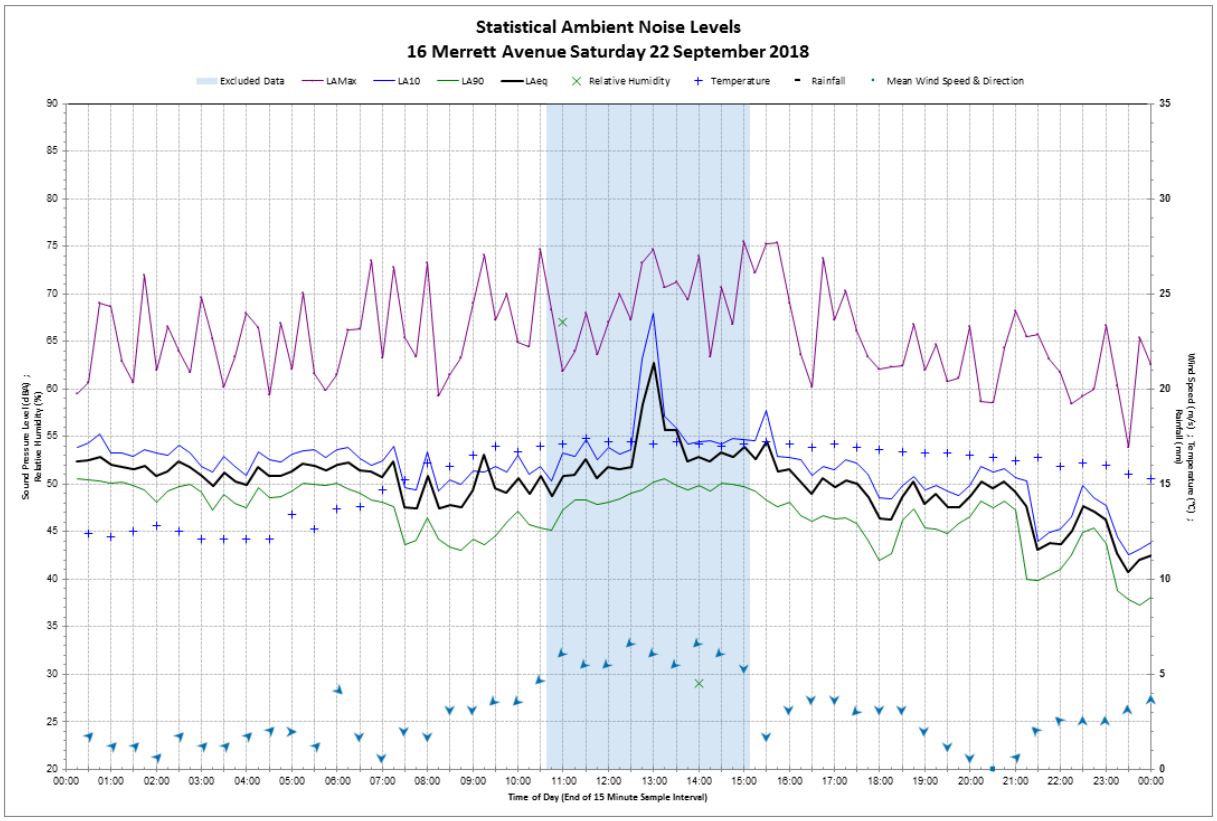
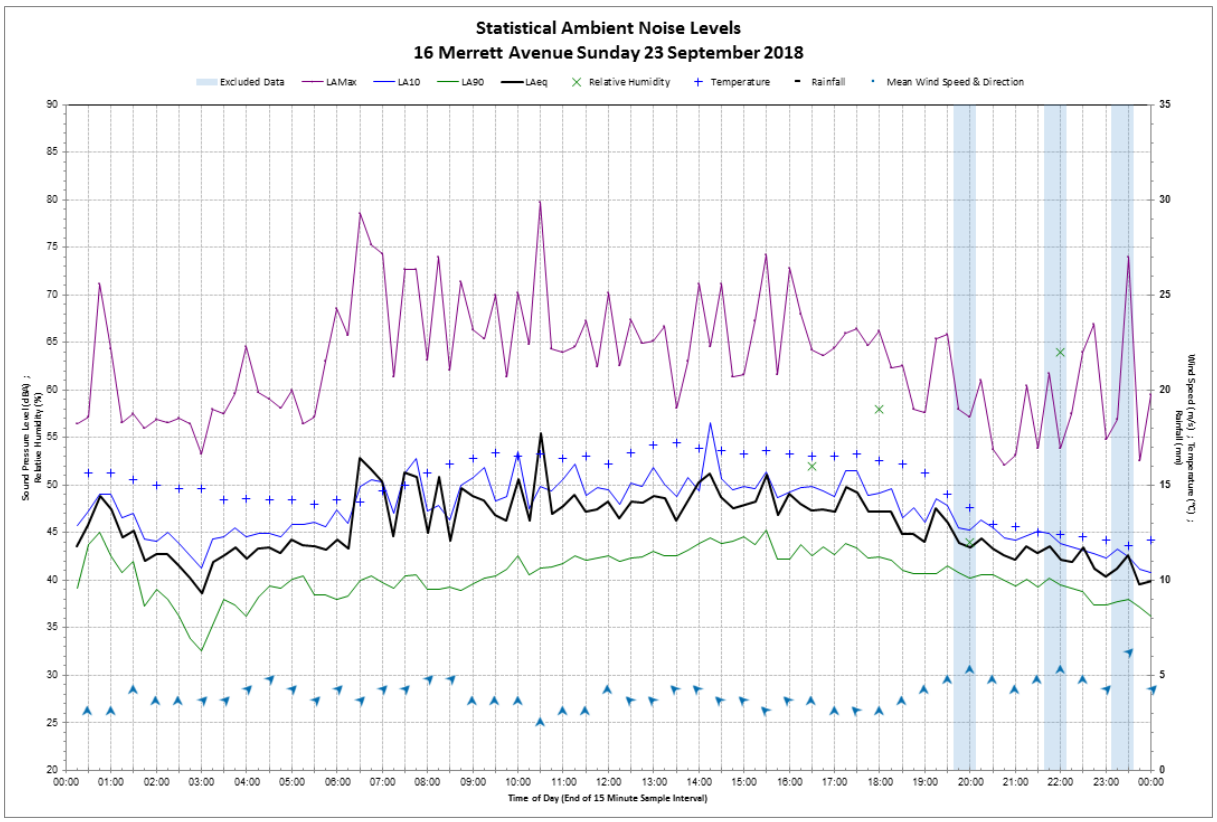
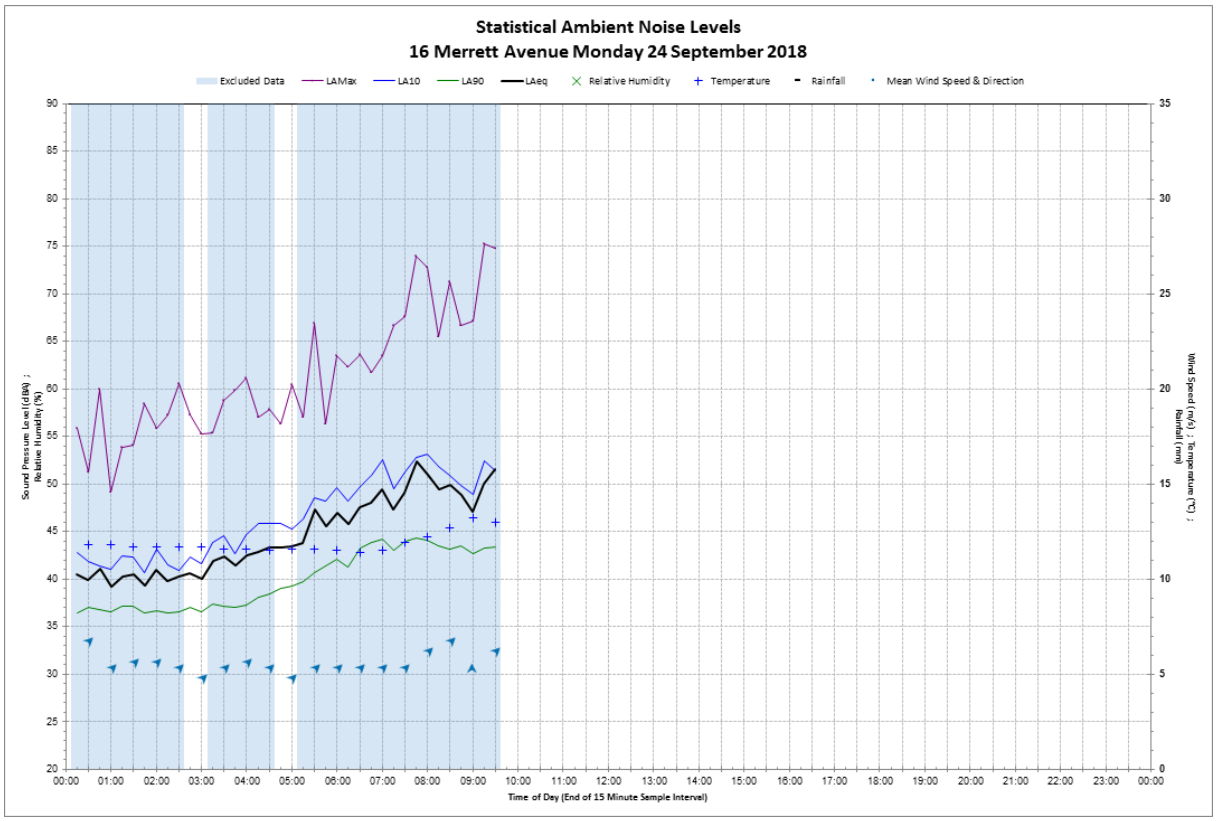
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
16 Merrett Avenue Saturday 22 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
16 Merrett Avenue Sunday 23 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
16 Merrett Avenue Monday 24 September 2018
Excluded Data
LAMax
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed & Direction
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

Appendix D – Representative sensitive receivers

Receiver ID	Address	Receiver Type	NCA
R001	330 Gladstone Avenue	Residential	NCA01
R002	136 Ocean Street	Residential	NCA01
R003	2 Mount Street	Residential	NCA01
R004	84 The Avenue	Residential	NCA01
R005	314 Gladstone Avenue	Residential	NCA01
R006	5 Hill Street	Residential	NCA01
R007	Drummond Street	Active recreation	NCA01
R008	Masters Road	Industrial	NCA01
R009	294-296 Gladstone Avenue	Residential	NCA01
R010	104 Ocean Street	Residential	NCA01
R011	8 Prospect Street	Residential	NCA01
R012	54 The Avenue	Residential	NCA01
R013	274 Gladstone Avenue	Residential	NCA01
R014	4 Grasmere Street	Residential	NCA01
R015	76 Ocean Street	Residential	NCA01
R016	262 Gladstone Avenue	Residential	NCA01
R017	3 Vale Street	Residential	NCA01
R018	23 The Avenue	Residential	NCA01
R019	250 Gladstone Avenue	Residential	NCA01
R020	4 John Street	Residential	NCA01
R021	46 Ocean Street	Residential	NCA01
R022	63 Robertson Street	Residential	NCA01
R023	12 The Avenue	Residential	NCA01
R024	230 Gladstone Avenue	Residential	NCA01
R025	47 Robertson Street	Residential	NCA01
R026	26 Ocean Street	Residential	NCA01
R027	85 Bridge Street	Residential	NCA01
R028	210 Gladstone Avenue	Residential	NCA01
R029	12 Ocean Street	Residential	NCA01
R030	192 Gladstone Avenue	Residential	NCA01
R031	21 Robertson Street	Residential	NCA01
R032	57 Bridge Street	Residential	NCA01
R033	Springhill Road	Residential	NCA01
R034	117 Gladstone Avenue	Residential	NCA01
R036	20 Robertson Street	Residential	NCA01
R037	160 Gladstone Avenue	Residential	NCA01
R038	46 Bridge Street	Residential	NCA01
R039	146A Gladstone Avenue	Residential	NCA01
R040	15 Bridge Street	Residential	NCA01
R041	5 Old Springhill Road	Commercial	NCA01
R042	Tate Street	Residential	NCA01
R043	392 Keira Street	Residential	NCA01
R044	175 Five Islands Road	Industrial	NCA02
R045	159-163 Five Islands Road	Industrial	NCA02

Receiver ID	Address	Receiver Type	NCA
R046	33 Dorman Street	Residential	NCA02
R047	147 Five Islands Road	Industrial	NCA02
R048	20 Lackawanna Street	Residential	NCA02
R049	25 Jarvie Road	Residential	NCA02
R050	1 Lackawanna Street	Residential	NCA02
R051	1 Dorman Street	Residential	NCA02
R052	17 Sheffield Street	Residential	NCA02
R053	4 Barry Street	Residential	NCA02
R054	19 Barry Street	Residential	NCA02
R055	14 Jarvie Road	Residential	NCA02
R056	52 Merrett Avenue	Residential	NCA02
R057	7 Barry Street	Residential	NCA02
R058	50 Lake Avenue	Residential	NCA02
R059	43 Cringila Street	Residential	NCA02
R060	43 Steel Street	Residential	NCA02
R061	1 Jarvie Road	Residential	NCA02
R062	41 Newcastle Street	Residential	NCA02
R063	22 Lake Avenue	Residential	NCA02
R064	6 Lake Avenue	Residential	NCA02
R065	87-93 Five Islands Road	Residential	NCA02
R066	25 Bethlehem Street	Residential	NCA02
R067	27 Merrett Avenue	Residential	NCA02
R068	59 Five Islands Road	Industrial	NCA02
R069	13 Newcastle Street	Residential	NCA02
R070	15 Birmingham Avenue	Residential	NCA02
R071	9 Steel Street	Residential	NCA02
R072	16 Merrett Avenue	Residential	NCA02
R073	1 Cringila Street	Residential	NCA02
R074	1-3 Bethlehem Street	Place of worship	NCA02
R075	4 Birmingham Street	Residential	NCA02
R076	Port Kembla Steelworks	Residential	NCA02
R077	1 Flinder Street	Industrial	NCA02
R078	16 Flinders Street	Industrial	NCA02

Appendix E – Predicted construction noise levels

Predicted construction noise levels: Standard construction hours

Receiver ID	Address	Receiver Type	NCA	CS01	CS02	CS03	CS04	CS05	CS06	CS07	CS08	CS09	CS10	CS11	CS12	CS13	CS14
Residential: Exceeds noise management level **Bold** Highly noise affected																	
Non-residential: Exceeds noise management level																	
R001	330 Gladstone Avenue	Residential	NCA01	44	42	35	37	37	42	31	35	31	23	25	34	35	28
R002	136 Ocean Street	Residential	NCA01	40	37	31	30	33	38	30	34	30	22	25	33	34	25
R003	2 Mount Street	Residential	NCA01	40	41	31	32	33	38	31	34	30	22	25	34	35	26
R004	84 The Avenue	Residential	NCA01	34	36	25	27	27	32	30	34	30	21	25	32	34	28
R005	314 Gladstone Avenue	Residential	NCA01	45	43	36	39	38	43	31	35	31	23	25	34	35	29
R006	5 Hill Street	Residential	NCA01	44	44	35	38	37	42	32	35	31	23	26	34	36	30
R007	Drummond Street	Active recreation	NCA01	51	47	43	45	45	50	32	36	32	24	26	35	36	31
R008	Masters Road	Industrial	NCA01	56	52	47	50	49	54	36	39	35	28	30	38	40	33
R009	294-296 Gladstone Avenue	Residential	NCA01	50	49	41	44	43	48	32	35	31	23	26	34	36	33
R010	104 Ocean Street	Residential	NCA01	45	47	36	39	38	43	34	38	34	25	27	37	38	31
R011	8 Prospect Street	Residential	NCA01	49	49	40	43	42	47	34	37	33	25	28	36	38	33
R012	54 The Avenue	Residential	NCA01	46	46	36	40	38	43	34	38	34	25	28	37	38	30
R013	274 Gladstone Avenue	Residential	NCA01	51	46	42	45	44	49	32	36	32	24	26	35	36	33
R014	4 Grasmere Street	Residential	NCA01	47	46	38	41	40	45	33	36	32	24	26	35	37	30
R015	76 Ocean Street	Residential	NCA01	49	46	40	43	42	47	34	37	33	24	26	36	38	33
R016	262 Gladstone Avenue	Residential	NCA01	51	47	42	45	44	49	33	36	32	24	26	35	37	34
R017	3 Vale Street	Residential	NCA01	46	43	37	40	39	44	32	36	32	24	26	33	36	27
R018	23 The Avenue	Residential	NCA01	48	50	39	41	41	46	35	38	34	26	29	36	39	33
R019	250 Gladstone Avenue	Residential	NCA01	51	48	42	45	44	49	33	36	32	24	26	35	37	34
R020	4 John Street	Residential	NCA01	48	48	40	42	42	47	33	36	32	24	26	35	37	34
R021	46 Ocean Street	Residential	NCA01	49	49	41	43	43	48	34	37	33	26	29	36	38	34
R022	63 Robertson Street	Residential	NCA01	41	41	32	31	34	39	31	35	31	23	26	33	35	33
R023	12 The Avenue	Residential	NCA01	49	51	40	41	42	47	35	39	35	26	29	35	39	28
R024	230 Gladstone Avenue	Residential	NCA01	52	50	43	42	45	50	34	37	33	24	27	38	38	38
R025	47 Robertson Street	Residential	NCA01	42	42	33	32	35	40	32	35	31	24	26	34	36	32
R026	26 Ocean Street	Residential	NCA01	48	48	39	42	41	46	35	39	35	25	27	41	39	40
R027	85 Bridge Street	Residential	NCA01	43	42	34	36	36	41	32	36	32	24	27	35	36	34
R028	210 Gladstone Avenue	Residential	NCA01	55	55	46	48	48	53	34	37	33	27	30	43	38	43
R029	12 Ocean Street	Residential	NCA01	51	50	42	44	44	49	34	37	33	25	27	40	38	40
R030	192 Gladstone Avenue	Residential	NCA01	53	50	44	44	46	51	33	37	33	25	27	40	37	40
R031	21 Robertson Street	Residential	NCA01	47	47	38	41	40	45	32	35	31	24	27	38	36	38
R032	57 Bridge Street	Residential	NCA01	49	49	40	42	42	47	35	38	34	27	29	40	39	40
R033	Springhill Road	Industrial	NCA01	66	57	56	60	58	63	38	42	38	29	31	45	42	45
R034	117 Gladstone Avenue	Residential	NCA01	55	49	46	45	48	53	35	39	35	27	29	44	39	43
R036	20 Robertson Street	Residential	NCA01	51	47	42	40	44	49	33	37	33	24	26	41	37	41
R037	160 Gladstone Avenue	Residential	NCA01	50	50	41	41	43	48	31	35	31	26	28	42	35	42
R038	46 Bridge Street	Residential	NCA01	48	48	39	40	41	46	34	37	33	26	28	39	38	39
R039	146A Gladstone Avenue	Residential	NCA01	48	48	39	42	41	46	34	37	33	25	27	41	38	41
R040	15 Bridge Street	Residential	NCA01	49	49	40	42	42	47	37	40	36	27	30	43	41	43
R041	5 Old Springhill Road	Commercial	NCA01	57	59	48	45	50	55	38	41	37	27	30	50	42	51
R042	Tate Street	Residential	NCA01	50	52	41	44	43	48	36	39	35	26	28	44	40	44
R043	392 Keira Street	Residential	NCA01	43	44	34	36	36	41	36	41	37	27	30	37	40	37
R044	175 Five Islands Road	Industrial	NCA02	49	50	39	43	41	46	33	37	33	26	28	36	37	26
R045	159-163 Five Islands Road	Industrial	NCA02	55	57	43	46	45	50	33	37	33	26	28	36	37	27
R046	33 Dorman Street	Residential	NCA02	42	43	33	36	35	40	31	35	31	27	29	34	35	25
R047	147 Five Islands Road	Industrial	NCA02	55	57	42	48	44	49	34	37	33	27	29	36	38	27
R048	20 Lackawanna Street	Residential	NCA02	29	30	17	23	19	24	21	27	23	20	22	24	25	15
R049	25 Jarvie Road	Residential	NCA02	50	49	41	43	43	48	35	39	35	30	32	36	39	27
R050	1 Lackawanna Street	Residential	NCA02	40	38	31	33	33	38	32	35	31	28	30	34	36	25
R051	1 Dorman Street	Residential	NCA02	44	41	35	35	37	42	33	37	33	28	30	35	37	26
R052	17 Sheffield Street	Residential	NCA02	41	42	29	35	31	36	33	36	32	29	31	35	37	26
R053	4 Barry Street	Residential	NCA02	51	49	42	43	44	49	33	37	33	29	31	35	37	27
R054	19 Barry Street	Residential	NCA02	49	48	40	42	42	47	33	37	33	27	30	35	37	27
R055	14 Jarvie Road	Residential	NCA02	48	49	39	40	41	46	34	38	34	28	30	37	38	26
R056	52 Merrett Avenue	Residential	NCA02	49	49	38	43	40	45	33	37	33	28	30	36	37	24
R057	7 Barry Street	Residential	NCA02	50	50	41	43	43	48	33	37	33	29	30	36	37	27
R058	50 Lake Avenue	Residential	NCA02	45	40	36	37	38	43	36	39	35	34	37	37	40	29
R059	43 Cringila Street	Residential	NCA02	38	36	29	28	31	36	36	40	36	30	33	36	40	27
R060	43 Steel Street	Residential	NCA02	41	40	32	33	34	39	36	40	36	31	33	36	40	27
R061	1 Jarvie Road	Residential	NCA02	49	46	40	41	42	47	35	39	35	32	34	38	39	27
R062	41 Newcastle Street	Residential	NCA02	46	41	37	35	39	44	34	38	34	32	34	36	38	28
R063	22 Lake Avenue	Residential	NCA02	54	49	45	44	47	52	34	37	33	30	31	36	38	28
R064	6 Lake Avenue	Residential	NCA02	55	51	46	49	48	53	34	38	34	29	31	36	38	28
R065	87-93 Five Islands Road	Residential	NCA02	66	54	56	52	58	63	36	40	36	29	31	39	40	30
R066	25 Bethlehem Street	Residential	NCA02	51	46	42	41	44	49	36	39	35	30	32	38	40	29
R067	27 Merrett Avenue	Residential	NCA02	54	50	45	45	47	52	36	39	35	30	31	38	40	29
R068	59 Five Islands Road	Industrial	NCA02	62	52	53	49	55	60	37	40	36	30	31	39	41	31
R069	13 Newcastle Street	Residential	NCA02	36	37	27	28	29	34	34	38	34	32	33	36	38	27
R070	15 Birmingham Avenue	Residential	NCA02	51	47	42	43	44	49	36	39	35	30	32	38	40	29
R071	9 Steel Street	Residential	NCA02	40	37	31	30	33	38	35	39	35	30	32	38	39	28
R072	16 Merrett Avenue	Residential	NCA02	45	45	36	35	38	43	31	35	31	29	32	34	35	26
R073	1 Cringila Street	Residential	NCA02	42	40	33	34	35	40	34	37	33	30	32	36	38	27
R074	1-3 Bethlehem Street	Place of worship	NCA02	41	40	32	34	34	39	36	40	36	30	32	38	40	29
R075	4 Birmingham Street	Residential	NCA02	52	48	43	43	45	50	34	39	35	28	30	36	38	27
R076	Port Kembla Steelworks	Residential	NCA02	44	42	35	33	37	42	48	51	47	36	37	48	52	39
R077	1 Flinder Street	Industrial	NCA02	34	31	25	27	27	32	44	47	43	44	45	46	48	27
R078	16 Flinders Street	Industrial	NCA02	38	34	29	28	31	36	48	51	47	46	46	50	52	30
R079	7 Wentworth Street	Residential	NCA02	33	28	24	22	26	31	40	43	39	50	52	44	44	32
R080	91 Five Islands Road	Residential	NCA02	31	27	22	20	24	29	39	43	39	52	51	47	43	31
R081	Wentworth Street	Commercial	NCA02	32	25	23	21	25	30	39	42	38	50	49	42	43	30

Predicted construction noise levels: OOHW Period 1 (Day)

Receiver ID	Address	Receiver Type	NCA	CS01	CS02	CS03	CS04	CS05	CS06	CS07	CS08	CS09	CS10	CS11	CS12	CS13	CS14
Residential: Exceeds noise management level **Bold** Highly noise affected																	
Non-residential: Exceeds noise management level																	
R001	330 Gladstone Avenue	Residential	NCA01	44	42	35	37	37	42	31	35	31	23	25	34	35	28
R002	136 Ocean Street	Residential	NCA01	40	37	31	30	33	38	30	34	30	22	25	33	34	25
R003	2 Mount Street	Residential	NCA01	40	41	31	32	33	38	31	34	30	22	25	34	35	26
R004	84 The Avenue	Residential	NCA01	34	36	25	27	27	32	30	34	30	21	25	32	34	28
R005	314 Gladstone Avenue	Residential	NCA01	45	43	36	39	38	43	31	35	31	23	25	34	35	29
R006	5 Hill Street	Residential	NCA01	44	44	35	38	37	42	32	35	31	23	26	34	36	30
R007	Drummond Street	Active recreation	NCA01	51	47	43	45	45	50	32	36	32	24	26	35	36	31
R008	Masters Road	Industrial	NCA01	56	52	47	50	49	54	36	39	35	28	30	38	40	33
R009	294-296 Gladstone Avenue	Residential	NCA01	50	49	41	44	43	48	32	35	31	23	26	34	36	33
R010	104 Ocean Street	Residential	NCA01	45	47	36	39	38	43	34	38	34	25	27	37	38	31
R011	8 Prospect Street	Residential	NCA01	49	49	40	43	42	47	34	37	33	25	28	36	38	33
R012	54 The Avenue	Residential	NCA01	46	46	36	40	38	43	34	38	34	25	28	37	38	30
R013	274 Gladstone Avenue	Residential	NCA01	51	46	42	45	44	49	32	36	32	24	26	35	36	33
R014	4 Grasmere Street	Residential	NCA01	47	46	38	41	40	45	33	36	32	24	26	35	37	30
R015	76 Ocean Street	Residential	NCA01	49	46	40	43	42	47	34	37	33	24	26	36	38	33
R016	262 Gladstone Avenue	Residential	NCA01	51	47	42	45	44	49	33	36	32	24	26	35	37	34
R017	3 Vale Street	Residential	NCA01	46	43	37	40	39	44	32	36	32	24	26	33	36	27
R018	23 The Avenue	Residential	NCA01	48	50	39	41	41	46	35	38	34	26	29	36	39	33
R019	250 Gladstone Avenue	Residential	NCA01	51	48	42	45	44	49	33	36	32	24	26	35	37	34
R020	4 John Street	Residential	NCA01	48	48	40	42	42	47	33	36	32	24	26	35	37	34
R021	46 Ocean Street	Residential	NCA01	49	49	41	43	43	48	34	37	33	26	29	36	38	34
R022	63 Robertson Street	Residential	NCA01	41	41	32	31	34	39	31	35	31	23	26	33	35	33
R023	12 The Avenue	Residential	NCA01	49	51	40	41	42	47	35	39	35	26	29	35	39	28
R024	230 Gladstone Avenue	Residential	NCA01	52	50	43	42	45	50	34	37	33	24	27	38	38	38
R025	47 Robertson Street	Residential	NCA01	42	42	33	32	35	40	32	35	31	24	26	34	36	32
R026	26 Ocean Street	Residential	NCA01	48	48	39	42	41	46	35	39	35	25	27	41	39	40
R027	85 Bridge Street	Residential	NCA01	43	42	34	36	36	41	32	36	32	24	27	35	36	34
R028	210 Gladstone Avenue	Residential	NCA01	55	55	46	48	48	53	34	37	33	27	30	43	38	43
R029	12 Ocean Street	Residential	NCA01	51	50	42	44	44	49	34	37	33	25	27	40	38	40
R030	192 Gladstone Avenue	Residential	NCA01	53	50	44	44	46	51	33	37	33	25	27	40	37	40
R031	21 Robertson Street	Residential	NCA01	47	47	38	41	40	45	32	35	31	24	27	38	36	38
R032	57 Bridge Street	Residential	NCA01	49	49	40	42	42	47	35	38	34	27	29	40	39	40
R033	Springhill Road	Industrial	NCA01	66	57	56	60	58	63	38	42	38	29	31	45	42	45
R034	117 Gladstone Avenue	Residential	NCA01	55	49	46	45	48	53	35	39	35	27	29	44	39	43
R036	20 Robertson Street	Residential	NCA01	51	47	42	40	44	49	33	37	33	24	26	41	37	41
R037	160 Gladstone Avenue	Residential	NCA01	50	50	41	41	43	48	31	35	31	26	28	42	35	42
R038	46 Bridge Street	Residential	NCA01	48	48	39	40	41	46	34	37	33	26	28	39	38	39
R039	146A Gladstone Avenue	Residential	NCA01	48	48	39	42	41	46	34	37	33	25	27	41	38	41
R040	15 Bridge Street	Residential	NCA01	49	49	40	42	42	47	37	40	36	27	30	43	41	43
R041	5 Old Springhill Road	Commercial	NCA01	57	59	48	45	50	55	38	41	37	27	30	50	42	51
R042	Tate Street	Residential	NCA01	50	52	41	44	43	48	36	39	35	26	28	44	40	44
R043	392 Keira Street	Residential	NCA01	43	44	34	36	36	41	36	41	37	27	30	37	40	37
R044	175 Five Islands Road	Industrial	NCA02	49	50	39	43	41	46	33	37	33	26	28	36	37	26
R045	159-163 Five Islands Road	Industrial	NCA02	55	57	43	46	45	50	33	37	33	26	28	36	37	27
R046	33 Dorman Street	Residential	NCA02	42	43	33	36	35	40	31	35	31	27	29	34	35	25
R047	147 Five Islands Road	Industrial	NCA02	55	57	42	48	44	49	34	37	33	27	29	36	38	27
R048	20 Lackawanna Street	Residential	NCA02	29	30	17	23	19	24	21	27	23	20	22	24	25	15
R049	25 Jarvie Road	Residential	NCA02	50	49	41	43	43	48	35	39	35	30	32	36	39	27
R050	1 Lackawanna Street	Residential	NCA02	40	38	31	33	33	38	32	35	31	28	30	34	36	25
R051	1 Dorman Street	Residential	NCA02	44	41	35	35	37	42	33	37	33	28	30	35	37	26
R052	17 Sheffield Street	Residential	NCA02	41	42	29	35	31	36	33	36	32	29	31	35	37	26
R053	4 Barry Street	Residential	NCA02	51	49	42	43	44	49	33	37	33	29	31	35	37	27
R054	19 Barry Street	Residential	NCA02	49	48	40	42	42	47	33	37	33	27	30	35	37	27
R055	14 Jarvie Road	Residential	NCA02	48	49	39	40	41	46	34	38	34	28	30	37	38	26
R056	52 Merrett Avenue	Residential	NCA02	49	49	38	43	40	45	33	37	33	28	30	36	37	24
R057	7 Barry Street	Residential	NCA02	50	50	41	43	43	48	33	37	33	29	30	36	37	27
R058	50 Lake Avenue	Residential	NCA02	45	40	36	37	38	43	36	39	35	34	37	37	40	29
R059	43 Cringila Street	Residential	NCA02	38	36	29	28	31	36	36	40	36	30	33	36	40	27
R060	43 Steel Street	Residential	NCA02	41	40	32	33	34	39	36	40	36	31	33	36	40	27
R061	1 Jarvie Road	Residential	NCA02	49	46	40	41	42	47	35	39	35	32	34	38	39	27
R062	41 Newcastle Street	Residential	NCA02	46	41	37	35	39	44	34	38	34	32	34	36	38	28
R063	22 Lake Avenue	Residential	NCA02	54	49	45	44	47	52	34	37	33	30	31	36	38	28
R064	6 Lake Avenue	Residential	NCA02	55	51	46	49	48	53	34	38	34	29	31	36	38	28
R065	87-93 Five Islands Road	Residential	NCA02	66	54	56	52	58	63	36	40	36	29	31	39	40	30
R066	25 Bethlehem Street	Residential	NCA02	51	46	42	41	44	49	36	39	35	30	32	38	40	29
R067	27 Merrett Avenue	Residential	NCA02	54	50	45	45	47	52	36	39	35	30	31	38	40	29
R068	59 Five Islands Road	Industrial	NCA02	62	52	53	49	55	60	37	40	36	30	31	39	41	31
R069	13 Newcastle Street	Residential	NCA02	36	37	27	28	29	34	34	38	34	32	33	36	38	27
R070	15 Birmingham Avenue	Residential	NCA02	51	47	42	43	44	49	36	39	35	30	32	38	40	29
R071	9 Steel Street	Residential	NCA02	40	37	31	30	33	38	35	39	35	30	32	38	39	28
R072	16 Merrett Avenue	Residential	NCA02	45	45	36	35	38	43	31	35	31	29	32	34	35	26
R073	1 Cringila Street	Residential	NCA02	42	40	33	34	35	40	34	37	33	30	32	36	38	27
R074	1-3 Bethlehem Street	Place of worship	NCA02	41	40	32	34	34	39	36	40	36	30	32	38	40	29
R075	4 Birmingham Street	Residential	NCA02	52	48	43	43	45	50	34	39	35	28	30	36	38	27
R076	Port Kembla Steelworks	Residential	NCA02	44	42	35	33	37	42	48	51	47	36	37	48	52	39
R077	1 Flinder Street	Industrial	NCA02	34	31	25	27	27	32	44	47	43	44	45	46	48	27
R078	16 Flinders Street	Industrial	NCA02	38	34	29	28	31	36	48	51	47	46	46	50	52	30
R079	7 Wentworth Street	Residential	NCA02	33	28	24	22	26	31	40	43	39	50	52	44	44	32
R080	91 Five Islands Road	Residential	NCA02	31	27	22	20	24	29	39	43	39	52	51	47	43	31
R081	Wentworth Street	Commercial	NCA02	32	25	23	21	25	30	39	42	38	50	49	42	43	30

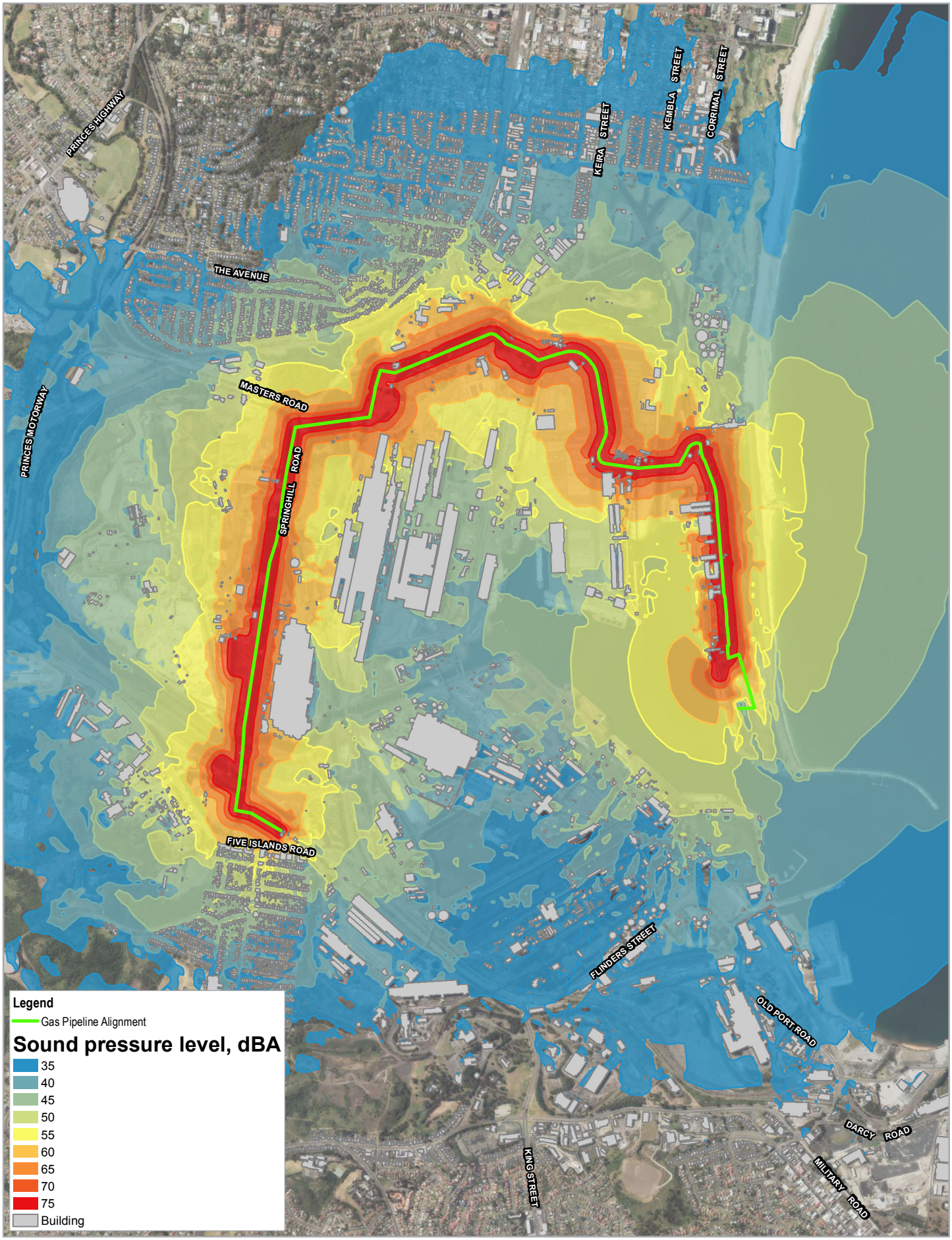
Predicted construction noise levels: OOHW Period 1 (Evening)

Receiver ID	Address	Receiver Type	NCA	CS01	CS02	CS03	CS04	CS05	CS06	CS07	CS08	CS09	CS10	CS11	CS12	CS13	CS14
Residential: Exceeds noise management level **Bold** Highly noise affected																	
Non-residential: Exceeds noise management level																	
R001	330 Gladstone Avenue	Residential	NCA01	44	42	35	37	37	42	31	35	31	23	25	34	35	28
R002	136 Ocean Street	Residential	NCA01	40	37	31	30	33	38	30	34	30	22	25	33	34	25
R003	2 Mount Street	Residential	NCA01	40	41	31	32	33	38	31	34	30	22	25	34	35	26
R004	84 The Avenue	Residential	NCA01	34	36	25	27	27	32	30	34	30	21	25	32	34	28
R005	314 Gladstone Avenue	Residential	NCA01	45	43	36	39	38	43	31	35	31	23	25	34	35	29
R006	5 Hill Street	Residential	NCA01	44	44	35	38	37	42	32	35	31	23	26	34	36	30
R007	Drummond Street	Active recreation	NCA01	51	47	43	45	45	50	32	36	32	24	26	35	36	31
R008	Masters Road	Industrial	NCA01	56	52	47	50	49	54	36	39	35	28	30	38	40	33
R009	294-296 Gladstone Avenue	Residential	NCA01	50	49	41	44	43	48	32	35	31	23	26	34	36	33
R010	104 Ocean Street	Residential	NCA01	45	47	36	39	38	43	34	38	34	25	27	37	38	31
R011	8 Prospect Street	Residential	NCA01	49	49	40	43	42	47	34	37	33	25	28	36	38	33
R012	54 The Avenue	Residential	NCA01	46	46	36	40	38	43	34	38	34	25	28	37	38	30
R013	274 Gladstone Avenue	Residential	NCA01	51	46	42	45	44	49	32	36	32	24	26	35	36	33
R014	4 Grasmere Street	Residential	NCA01	47	46	38	41	40	45	33	36	32	24	26	35	37	30
R015	76 Ocean Street	Residential	NCA01	49	46	40	43	42	47	34	37	33	24	26	36	38	33
R016	262 Gladstone Avenue	Residential	NCA01	51	47	42	45	44	49	33	36	32	24	26	35	37	34
R017	3 Vale Street	Residential	NCA01	46	43	37	40	39	44	32	36	32	24	26	33	36	27
R018	23 The Avenue	Residential	NCA01	48	50	39	41	41	46	35	38	34	26	29	36	39	33
R019	250 Gladstone Avenue	Residential	NCA01	51	48	42	45	44	49	33	36	32	24	26	35	37	34
R020	4 John Street	Residential	NCA01	48	48	40	42	42	47	33	36	32	24	26	35	37	34
R021	46 Ocean Street	Residential	NCA01	49	49	41	43	43	48	34	37	33	26	29	36	38	34
R022	63 Robertson Street	Residential	NCA01	41	41	32	31	34	39	31	35	31	23	26	33	35	33
R023	12 The Avenue	Residential	NCA01	49	51	40	41	42	47	35	39	35	26	29	35	39	28
R024	230 Gladstone Avenue	Residential	NCA01	52	50	43	42	45	50	34	37	33	24	27	38	38	38
R025	47 Robertson Street	Residential	NCA01	42	42	33	32	35	40	32	35	31	24	26	34	36	32
R026	26 Ocean Street	Residential	NCA01	48	48	39	42	41	46	35	39	35	25	27	41	39	40
R027	85 Bridge Street	Residential	NCA01	43	42	34	36	36	41	32	36	32	24	27	35	36	34
R028	210 Gladstone Avenue	Residential	NCA01	55	55	46	48	48	53	34	37	33	27	30	43	38	43
R029	12 Ocean Street	Residential	NCA01	51	50	42	44	44	49	34	37	33	25	27	40	38	40
R030	192 Gladstone Avenue	Residential	NCA01	53	50	44	44	46	51	33	37	33	25	27	40	37	40
R031	21 Robertson Street	Residential	NCA01	47	47	38	41	40	45	32	35	31	24	27	38	36	38
R032	57 Bridge Street	Residential	NCA01	49	49	40	42	42	47	35	38	34	27	29	40	39	40
R033	Springhill Road	Industrial	NCA01	66	57	56	60	58	63	38	42	38	29	31	45	42	45
R034	117 Gladstone Avenue	Residential	NCA01	55	49	46	45	48	53	35	39	35	27	29	44	39	43
R036	20 Robertson Street	Residential	NCA01	51	47	42	40	44	49	33	37	33	24	26	41	37	41
R037	160 Gladstone Avenue	Residential	NCA01	50	50	41	41	43	48	31	35	31	26	28	42	35	42
R038	46 Bridge Street	Residential	NCA01	48	48	39	40	41	46	34	37	33	26	28	39	38	39
R039	146A Gladstone Avenue	Residential	NCA01	48	48	39	42	41	46	34	37	33	25	27	41	38	41
R040	15 Bridge Street	Residential	NCA01	49	49	40	42	42	47	37	40	36	27	30	43	41	43
R041	5 Old Springhill Road	Commercial	NCA01	57	59	48	45	50	55	38	41	37	27	30	50	42	51
R042	Tate Street	Residential	NCA01	50	52	41	44	43	48	36	39	35	26	28	44	40	44
R043	392 Keira Street	Residential	NCA01	43	44	34	36	36	41	36	41	37	27	30	37	40	37
R044	175 Five Islands Road	Industrial	NCA02	49	50	39	43	41	46	33	37	33	26	28	36	37	26
R045	159-163 Five Islands Road	Industrial	NCA02	55	57	43	46	45	50	33	37	33	26	28	36	37	27
R046	33 Dorman Street	Residential	NCA02	42	43	33	36	35	40	31	35	31	27	29	34	35	25
R047	147 Five Islands Road	Industrial	NCA02	55	57	42	48	44	49	34	37	33	27	29	36	38	27
R048	20 Lackawanna Street	Residential	NCA02	29	30	17	23	19	24	21	27	23	20	22	24	25	15
R049	25 Jarvie Road	Residential	NCA02	50	49	41	43	43	48	35	39	35	30	32	36	39	27
R050	1 Lackawanna Street	Residential	NCA02	40	38	31	33	33	38	32	35	31	28	30	34	36	25
R051	1 Dorman Street	Residential	NCA02	44	41	35	35	37	42	33	37	33	28	30	35	37	26
R052	17 Sheffield Street	Residential	NCA02	41	42	29	35	31	36	33	36	32	29	31	35	37	26
R053	4 Barry Street	Residential	NCA02	51	49	42	43	44	49	33	37	33	29	31	35	37	27
R054	19 Barry Street	Residential	NCA02	49	48	40	42	42	47	33	37	33	27	30	35	37	27
R055	14 Jarvie Road	Residential	NCA02	48	49	39	40	41	46	34	38	34	28	30	37	38	26
R056	52 Merrett Avenue	Residential	NCA02	49	49	38	43	40	45	33	37	33	28	30	36	37	24
R057	7 Barry Street	Residential	NCA02	50	50	41	43	43	48	33	37	33	29	30	36	37	27
R058	50 Lake Avenue	Residential	NCA02	45	40	36	37	38	43	36	39	35	34	37	37	40	29
R059	43 Cringila Street	Residential	NCA02	38	36	29	28	31	36	36	40	36	30	33	36	40	27
R060	43 Steel Street	Residential	NCA02	41	40	32	33	34	39	36	40	36	31	33	36	40	27
R061	1 Jarvie Road	Residential	NCA02	49	46	40	41	42	47	35	39	35	32	34	38	39	27
R062	41 Newcastle Street	Residential	NCA02	46	41	37	35	39	44	34	38	34	32	34	36	38	28
R063	22 Lake Avenue	Residential	NCA02	54	49	45	44	47	52	34	37	33	30	31	36	38	28
R064	6 Lake Avenue	Residential	NCA02	55	51	46	49	48	53	34	38	34	29	31	36	38	28
R065	87-93 Five Islands Road	Residential	NCA02	66	54	56	52	58	63	36	40	36	29	31	39	40	30
R066	25 Bethlehem Street	Residential	NCA02	51	46	42	41	44	49	36	39	35	30	32	38	40	29
R067	27 Merrett Avenue	Residential	NCA02	54	50	45	45	47	52	36	39	35	30	31	38	40	29
R068	59 Five Islands Road	Industrial	NCA02	62	52	53	49	55	60	37	40	36	30	31	39	41	31
R069	13 Newcastle Street	Residential	NCA02	36	37	27	28	29	34	34	38	34	32	33	36	38	27
R070	15 Birmingham Avenue	Residential	NCA02	51	47	42	43	44	49	36	39	35	30	32	38	40	29
R071	9 Steel Street	Residential	NCA02	40	37	31	30	33	38	35	39	35	30	32	38	39	28
R072	16 Merrett Avenue	Residential	NCA02	45	45	36	35	38	43	31	35	31	29	32	34	35	26
R073	1 Cringila Street	Residential	NCA02	42	40	33	34	35	40	34	37	33	30	32	36	38	27
R074	1-3 Bethlehem Street	Place of worship	NCA02	41	40	32	34	34	39	36	40	36	30	32	38	40	29
R075	4 Birmingham Street	Residential	NCA02	52	48	43	43	45	50	34	39	35	28	30	36	38	27
R076	Port Kembla Steelworks	Residential	NCA02	44	42	35	33	37	42	48	51	47	36	37	48	52	39
R077	1 Flinder Street	Industrial	NCA02	34	31	25	27	27	32	44	47	43	44	45	46	48	27
R078	16 Flinders Street	Industrial	NCA02	38	34	29	28	31	36	48	51	47	46	46	50	52	30
R079	7 Wentworth Street	Residential	NCA02	33	28	24	22	26	31	40	43	39	50	52	44	44	32
R080	91 Five Islands Road	Residential	NCA02	31	27	22	20	24	29	39	43	39	52	51	47	43	31
R081	Wentworth Street	Commercial	NCA02	32	25	23	21	25	30	39	42	38	50	49	42	43	30

Predicted construction noise levels: OOHW Period 2 (Night)

Receiver ID	Address	Receiver Type	NCA	CS01	CS02	CS03	CS04	CS05	CS06	CS07	CS08	CS09	CS10	CS11	CS12	CS13	CS14
Residential: Exceeds noise management level **Bold** Highly noise affected																	
Non-residential: Exceeds noise management level																	
R001	330 Gladstone Avenue	Residential	NCA01	44	42	35	37	37	42	31	35	31	23	25	34	35	28
R002	136 Ocean Street	Residential	NCA01	40	37	31	30	33	38	30	34	30	22	25	33	34	25
R003	2 Mount Street	Residential	NCA01	40	41	31	32	33	38	31	34	30	22	25	34	35	26
R004	84 The Avenue	Residential	NCA01	34	36	25	27	27	32	30	34	30	21	25	32	34	28
R005	314 Gladstone Avenue	Residential	NCA01	45	43	36	39	38	43	31	35	31	23	25	34	35	29
R006	5 Hill Street	Residential	NCA01	44	44	35	38	37	42	32	35	31	23	26	34	36	30
R007	Drummond Street	Active recreation	NCA01	51	47	43	45	45	50	32	36	32	24	26	35	36	31
R008	Masters Road	Industrial	NCA01	56	52	47	50	49	54	36	39	35	28	30	38	40	33
R009	294-296 Gladstone Avenue	Residential	NCA01	50	49	41	44	43	48	32	35	31	23	26	34	36	33
R010	104 Ocean Street	Residential	NCA01	45	47	36	39	38	43	34	38	34	25	27	37	38	31
R011	8 Prospect Street	Residential	NCA01	49	49	40	43	42	47	34	37	33	25	28	36	38	33
R012	54 The Avenue	Residential	NCA01	46	46	36	40	38	43	34	38	34	25	28	37	38	30
R013	274 Gladstone Avenue	Residential	NCA01	51	46	42	45	44	49	32	36	32	24	26	35	36	33
R014	4 Grasmere Street	Residential	NCA01	47	46	38	41	40	45	33	36	32	24	26	35	37	30
R015	76 Ocean Street	Residential	NCA01	49	46	40	43	42	47	34	37	33	24	26	36	38	33
R016	262 Gladstone Avenue	Residential	NCA01	51	47	42	45	44	49	33	36	32	24	26	35	37	34
R017	3 Vale Street	Residential	NCA01	46	43	37	40	39	44	32	36	32	24	26	33	36	27
R018	23 The Avenue	Residential	NCA01	48	50	39	41	41	46	35	38	34	26	29	36	39	33
R019	250 Gladstone Avenue	Residential	NCA01	51	48	42	45	44	49	33	36	32	24	26	35	37	34
R020	4 John Street	Residential	NCA01	48	48	40	42	42	47	33	36	32	24	26	35	37	34
R021	46 Ocean Street	Residential	NCA01	49	49	41	43	43	48	34	37	33	26	29	36	38	34
R022	63 Robertson Street	Residential	NCA01	41	41	32	31	34	39	31	35	31	23	26	33	35	33
R023	12 The Avenue	Residential	NCA01	49	51	40	41	42	47	35	39	35	26	29	35	39	28
R024	230 Gladstone Avenue	Residential	NCA01	52	50	43	42	45	50	34	37	33	24	27	38	38	38
R025	47 Robertson Street	Residential	NCA01	42	42	33	32	35	40	32	35	31	24	26	34	36	32
R026	26 Ocean Street	Residential	NCA01	48	48	39	42	41	46	35	39	35	25	27	41	39	40
R027	85 Bridge Street	Residential	NCA01	43	42	34	36	36	41	32	36	32	24	27	35	36	34
R028	210 Gladstone Avenue	Residential	NCA01	55	55	46	48	48	53	34	37	33	27	30	43	38	43
R029	12 Ocean Street	Residential	NCA01	51	50	42	44	44	49	34	37	33	25	27	40	38	40
R030	192 Gladstone Avenue	Residential	NCA01	53	50	44	44	46	51	33	37	33	25	27	40	37	40
R031	21 Robertson Street	Residential	NCA01	47	47	38	41	40	45	32	35	31	24	27	38	36	38
R032	57 Bridge Street	Residential	NCA01	49	49	40	42	42	47	35	38	34	27	29	40	39	40
R033	Springhill Road	Industrial	NCA01	66	57	56	60	58	63	38	42	38	29	31	45	42	45
R034	117 Gladstone Avenue	Residential	NCA01	55	49	46	45	48	53	35	39	35	27	29	44	39	43
R036	20 Robertson Street	Residential	NCA01	51	47	42	40	44	49	33	37	33	24	26	41	37	41
R037	160 Gladstone Avenue	Residential	NCA01	50	50	41	41	43	48	31	35	31	26	28	42	35	42
R038	46 Bridge Street	Residential	NCA01	48	48	39	40	41	46	34	37	33	26	28	39	38	39
R039	146A Gladstone Avenue	Residential	NCA01	48	48	39	42	41	46	34	37	33	25	27	41	38	41
R040	15 Bridge Street	Residential	NCA01	49	49	40	42	42	47	37	40	36	27	30	43	41	43
R041	5 Old Springhill Road	Commercial	NCA01	57	59	48	45	50	55	38	41	37	27	30	50	42	51
R042	Tate Street	Residential	NCA01	50	52	41	44	43	48	36	39	35	26	28	44	40	44
R043	392 Keira Street	Residential	NCA01	43	44	34	36	36	41	36	41	37	27	30	37	40	37
R044	175 Five Islands Road	Industrial	NCA02	49	50	39	43	41	46	33	37	33	26	28	36	37	26
R045	159-163 Five Islands Road	Industrial	NCA02	55	57	43	46	45	50	33	37	33	26	28	36	37	27
R046	33 Dorman Street	Residential	NCA02	42	43	33	36	35	40	31	35	31	27	29	34	35	25
R047	147 Five Islands Road	Industrial	NCA02	55	57	42	48	44	49	34	37	33	27	29	36	38	27
R048	20 Lackawanna Street	Residential	NCA02	29	30	17	23	19	24	21	27	23	20	22	24	25	15
R049	25 Jarvie Road	Residential	NCA02	50	49	41	43	43	48	35	39	35	30	32	36	39	27
R050	1 Lackawanna Street	Residential	NCA02	40	38	31	33	33	38	32	35	31	28	30	34	36	25
R051	1 Dorman Street	Residential	NCA02	44	41	35	35	37	42	33	37	33	28	30	35	37	26
R052	17 Sheffield Street	Residential	NCA02	41	42	29	35	31	36	33	36	32	29	31	35	37	26
R053	4 Barry Street	Residential	NCA02	51	49	42	43	44	49	33	37	33	29	31	35	37	27
R054	19 Barry Street	Residential	NCA02	49	48	40	42	42	47	33	37	33	27	30	35	37	27
R055	14 Jarvie Road	Residential	NCA02	48	49	39	40	41	46	34	38	34	28	30	37	38	26
R056	52 Merrett Avenue	Residential	NCA02	49	49	38	43	40	45	33	37	33	28	30	36	37	24
R057	7 Barry Street	Residential	NCA02	50	50	41	43	43	48	33	37	33	29	30	36	37	27
R058	50 Lake Avenue	Residential	NCA02	45	40	36	37	38	43	36	39	35	34	37	37	40	29
R059	43 Cringila Street	Residential	NCA02	38	36	29	28	31	36	36	40	36	30	33	36	40	27
R060	43 Steel Street	Residential	NCA02	41	40	32	33	34	39	36	40	36	31	33	36	40	27
R061	1 Jarvie Road	Residential	NCA02	49	46	40	41	42	47	35	39	35	32	34	38	39	27
R062	41 Newcastle Street	Residential	NCA02	46	41	37	35	39	44	34	38	34	32	34	36	38	28
R063	22 Lake Avenue	Residential	NCA02	54	49	45	44	47	52	34	37	33	30	31	36	38	28
R064	6 Lake Avenue	Residential	NCA02	55	51	46	49	48	53	34	38	34	29	31	36	38	28
R065	87-93 Five Islands Road	Residential	NCA02	66	54	56	52	58	63	36	40	36	29	31	39	40	30
R066	25 Bethlehem Street	Residential	NCA02	51	46	42	41	44	49	36	39	35	30	32	38	40	29
R067	27 Merrett Avenue	Residential	NCA02	54	50	45	45	47	52	36	39	35	30	31	38	40	29
R068	59 Five Islands Road	Industrial	NCA02	62	52	53	49	55	60	37	40	36	30	31	39	41	31
R069	13 Newcastle Street	Residential	NCA02	36	37	27	28	29	34	34	38	34	32	33	36	38	27
R070	15 Birmingham Avenue	Residential	NCA02	51	47	42	43	44	49	36	39	35	30	32	38	40	29
R071	9 Steel Street	Residential	NCA02	40	37	31	30	33	38	35	39	35	30	32	38	39	28
R072	16 Merrett Avenue	Residential	NCA02	45	45	36	35	38	43	31	35	31	29	32	34	35	26
R073	1 Cringila Street	Residential	NCA02	42	40	33	34	35	40	34	37	33	30	32	36	38	27
R074	1-3 Bethlehem Street	Place of worship	NCA02	41	40	32	34	34	39	36	40	36	30	32	38	40	29
R075	4 Birmingham Street	Residential	NCA02	52	48	43	43	45	50	34	39	35	28	30	36	38	27
R076	Port Kembla Steelworks	Residential	NCA02	44	42	35	33	37	42	48	51	47	36	37	48	52	39
R077	1 Flinder Street	Industrial	NCA02	34	31	25	27	27	32	44	47	43	44	45	46	48	27
R078	16 Flinders Street	Industrial	NCA02	38	34	29	28	31	36	48	51	47	46	46	50	52	30
R079	7 Wentworth Street	Residential	NCA02	33	28	24	22	26	31	40	43	39	50	52	44	44	32
R080	91 Five Islands Road	Residential	NCA02	31	27	22	20	24	29	39	43	39	52	51	47	43	31
R081	Wentworth Street	Commercial	NCA02	32	25	23	21	25	30	39	42	38	50	49	42	43	30

Appendix F – Construction noise contours



Paper Size ISO A4

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Metres

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

GHD

Australian Industrial Energy
Port Kembla Gas Terminal

Predicted construction noise levels, dBA – CS1.1 (Site establishment)

Project No.	**21-27477**
Revision No.	**A**
Date	**31 Oct 2018**

Figure F1

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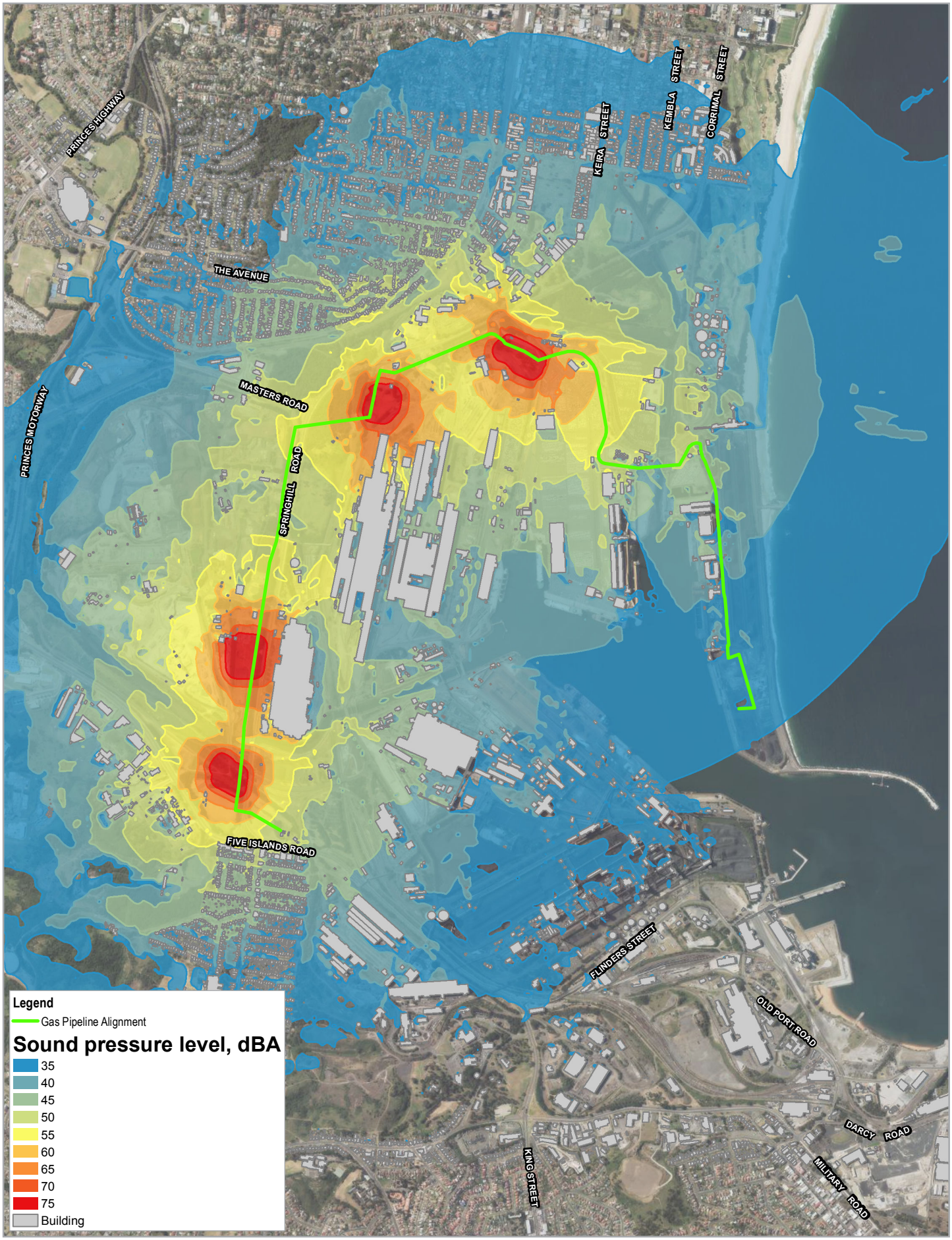
Print date: 31 Oct 2018 - 10:50 (SMA record: 2) (SMA record: 21)



Paper Size ISO A4

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Metres

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

GHD

Australian Industrial Energy
Port Kembla Gas Terminal

Predicted construction noise levels, dBA – CS1.2 (Compound operations)

Project No.	**21-27477**
Revision No.	**A**
Date	**31 Oct 2018**

Figure F2

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