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Sapphire to Woolgoolga Pacific Highway upgrade

Post-construction

Operational Noise Report

AUGUST 2015

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Acoustics Vibration Structural Dynamics

SAPPHIRE TO WOOLGOOLGA -PACIFIC HIGHWAY UPGRADE

Operational Noise Report

August 2015

Roads and Maritime Services





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Executive Summary

Renzo Tonin & Associates (NSW) Pty Ltd has prepared this Operational Noise Report (ONR) in accordance with the relevant Minister's Conditions of Approval (MCoA) and the NSW Roads and Maritime Services 'Environmental Noise Management Manual' (ENMM), for the recently completed and now operational Sapphire to Woolgoolga Pacific Highway Upgrade (the Project).

In accordance with the MCoA and the ENMM, operational noise monitoring is required within one year after the commencement of operation of the Project to assess the performance and effectiveness of the noise mitigation measures implemented on the Project. Where mitigation measures are determined to not be adequate, then additional feasible and reasonable measures will be investigated.

Noise mitigation measures implemented on the Project were detailed in the Operational Noise Management Report (ONMR), which include:

- Low noise pavement using Stone Mastic Asphalt (SMA) on the majority of the main carriageway and associated ramps.
- Noise barriers specific noise barriers have been constructed at locations determined in the ONMR. The use of headlight screens to reduce glare from vehicle headlights also act as noise barriers providing noise attenuation benefits.
- At-property noise control treatment where all the above feasible and reasonable 'at-road' treatments have been exhausted, remaining properties still predicted to be impacted by traffic noise in excess of approved criteria were identified for 'at-property' noise mitigation treatments in accordance with the ENMM.

Where possible, operational noise monitoring was conducted at the same locations as those monitored and presented in the ONMR. Additional noise monitoring locations were selected based on concerns raised by the community. As a result, a total of 22 long-term operational noise monitoring locations were selected and operational noise monitoring commenced in October 2014. Short-term noise monitoring was conducted at 17 locations to represent noise sensitive areas further removed from the Project.

In accordance with the requirements of the ENMM, traffic volumes, classification and speeds were monitored concurrently with the operational noise monitoring. Locations of the traffic monitoring included the main carriageway of the Project, on / off ramps and local roads and overpasses.

In addition to operational traffic noise monitoring, a study of engine brake noise from heavy vehicles was also undertaken at four (4) strategic locations along the Project chosen to represent areas where engine brake noise is a common occurrence. Results of the engine brake noise study indicate that less than 1% of heavy vehicles exceed a Modulated RMS value of 2.5 at all monitoring locations and, less than 0.5% exceed the Modulated RMS value of 3.0.

The assessment of operational noise was in accordance with the requirements of Practice Note viii of the ENMM, which states that if the monitoring indicates operational noise levels exceeding the design noise levels for Year 1 then the following action shall be taken:

- 1. "If the measured noise levels exceed the design noise levels for Year 1 by 2 dB(A) or less, the noise data should be examined, the prediction methodology and suitability of mitigation measures should be reassessed and the reasons for the marginal exceedance(s) be identified and reported.
- 2. If measured noise levels exceed the design noise level for Year 1 by more than 2 dB(A), the adequacy of the noise mitigation needs to be reviewed, and if problems are identified steps need to be taken to rectify the situation. Additional noise treatments may be required to achieve the design noise level, where this is feasible and reasonable."

The pre-construction 'design' noise model was updated with the 'as-built' road design including all noise barriers and headlight screens constructed, to provide an 'as-built' post-construction noise model. The 'as-built' noise model was validated using the operational noise monitoring results and concurrent traffic monitoring results. The validated 'as-built' noise model was used to predict opening year (Year 1) traffic noise levels at receiver locations previously assessed in the ONMR. Results were compared to the opening year noise levels predicted in the design (pre-construction) noise assessment, as required by the MCoA and ENMM.

Where receiver locations were identified as exceeding predicted noise levels they were analysed in detail, which included the prediction of 2024 (Year 10) noise levels using the validated 'as-built' noise model and assessment of the predicted Year 10 noise levels against the applicable traffic noise criteria established in the ONMR for each receiver location.

Following the detailed analysis of the receiver locations, it was determined that a further two (2) receiver locations were identified for noise mitigation treatment, which included one (1) location predicted to have 'acute' Year 10 noise levels. The additional two receiver locations identified for noise mitigation treatment were not previously recommended in the ONMR for treatment and would now require Type 1 treatment.

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1 Introduction

Renzo Tonin & Associates (NSW) Pty Ltd has prepared this Operational Noise Report (ONR) for the recently completed and now operational Sapphire to Woolgoolga Pacific Highway Upgrade (the Project).

This ONR has been prepared in accordance with the Minister's Conditions of Approval (MCoA) Conditions 3.2 and 3.3, and the post-construction noise monitoring requirements set out in the NSW Roads and Maritime Services (RMS) 'Environmental Noise Management Manual' (ENMM – RTA 2001).

This ONR presents results of the operational noise monitoring carried out at selected representative residential monitoring locations along the length of the Project including selected worst-case and other locations; compares monitored traffic volumes with forecast traffic volumes used during the design phase of the Project; and compares monitored noise levels with the modelled noise levels at each corresponding noise monitoring location.

This ONR aims to evaluate the adequacy of the noise mitigation measures as installed on the Project by comparing operational noise monitoring results to modelled noise levels at selected representative locations along the length of the Project. Where monitored operational noise levels are equal to or less than those modelled during the detailed design process, then compliance with the Project's noise objectives is demonstrated. However, where operational noise levels are measured to be greater than the levels modelled, then steps shall be taken to examine the prediction methodology, review the suitability and adequacy of the installed noise mitigation measures, and assess additional feasible and reasonable mitigation measures.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

2 Purpose and Objectives

This ONR has been prepared to meet Commitment No. ON5 as set out in Chapter 5 - Statement of Commitments of the Environmental Assessment Submissions Report (July 2008) and the requirements set out in the Minister's Conditions of Approval No. 3.2 and 3.3 (January 2009) for the Project.

2.1 Purpose

The purpose of this ONR is to:

- Outline the objectives of the operational noise monitoring study,
- Describe the methodology of the operational noise monitoring study,
- Compare monitored traffic volumes with forecasted traffic volumes,
- Compare long-term monitored traffic noise levels with modelled traffic noise levels,
- Assess the adequacy of the installed traffic noise mitigation measures, and
- Present the results, findings and conclusions of the operational noise monitoring study.

In addition to the above, a study of engine brake noise from heavy vehicles was also undertaken. The purpose of the study is to get an understanding of the frequency of occurrences and characteristics of engine brake noise at strategic locations along the Project. It is noted that the results of the study is not be used to assess the adequacy of the installed traffic noise mitigation measures, nor is it be used to determine additional traffic noise mitigation options.

2.2 Objectives

The environmental requirements for the design of a large, high speed roadway like the Sapphire to Woolgoolga Pacific Highway Upgrade need to be comprehensive in order to address the potential environmental noise effects of sensitive noise receivers potentially affected by traffic noise from the roadway. These noise requirements were addressed by Aecom SMEC JV during the detailed design phase of the Project in consultation with relevant government agencies, including the NSW Roads and Maritime Services (RMS), NSW Department of Planning and Infrastructure (DP&I) and the NSW Environment Protection Authority (EPA), and the community prior to the construction and implementation of noise mitigation measures.

The Project's noise objectives and selected noise mitigation measures and design outcomes are all documented in the Operational Noise Management Report (ONMR) addressing the requirements of MCoA 2.24, the NSW 'Environmental Criteria for Road Traffic Noise' (ECRTN – EPA 1999), the NSW Roads and Maritime Services 'Environmental Noise Management Manual' (ENMM – RTA 2001) and Appendix 4 of the RMS Scope of Work and Technical Criteria (SWTC). The ONMR provides details on the Project's

noise objectives, the selected noise mitigation measures and the design outcomes, therefore only a brief summary of these are presented in Chapter 4 of this ONR.

As described in the ONMR, the detailed design process involves modelling and assessing noise at all potentially impacted properties along the Project in terms of the environmental noise criteria applicable to the Project. This ONR aims to evaluate the adequacy of the noise mitigation measures as installed on the Project by comparing operational noise monitoring results to modelled noise levels at selected representative worst-case locations along the length of the Project.

Where monitored operational noise levels are equal to or less than those modelled from the same noise model used during the detailed design process, then compliance with the Project's noise objectives is demonstrated.

Where operational noise levels are measured to be greater than the noise levels modelled from the design noise model, then the following steps are undertaken:

- an examination of the prediction methodology,
- a review of the suitability and adequacy of the installed noise mitigation measures, and
- an assessment of additional feasible and reasonable mitigation measures at those locations.

Therefore, the primary objectives of the ONR are to:

- present the results and outcomes of operational noise monitoring in accordance with MCoA
 3.2 and 3.3, and the post-construction noise monitoring requirements set out in Practice
 Note viii of the ENMM,
- compare actual noise monitoring results against noise level outputs from the noise model used to review and design the noise mitigation measures required by MCoA 2.24 and documents specified under MCoA 1.1, and
- identify areas of exceedance and non-conformance where additional feasible and reasonable noise mitigation measures may be warranted.

3 Environmental and Legal Obligations

3.1 Statement of Commitments

Table 3.1 summarises the Revised Statement of Commitments (SoCs) that require consideration in preparation of this ONR. The SoCs listed below are those issued as part of the Environmental Assessment Submissions Report prepared in July 2008.

SoC No.	Objective	Commitment	Reference in this document
ON5	Determine effectiveness of operational noise control measures	Monitoring of operational noise will be undertaken between six months and one year after opening along the proposed highway upgrade and within Woolgoolga. Should the monitoring indicate traffic noise impacts exceeding the relevant noise level criteria in NSW Government's Environmental Criteria for Road Traffic Noise; the RTA will investigate and implement further "reasonable and feasible" mitigation measures. The selection of these measures will be undertaken in consultation with affected property owners. The mitigation measures will be confirmed against predictions of noise levels 10 years after opening.	This document

Table 3.1 – Fi	inal Statement	of Commitments

3.2 Minister's Conditions of Approval

Table 3.2 summarises the Minister's Conditions of Approval (MCoA) that require consideration during preparation of this ONR. The conditions of approval listed below are those issued by the Minister for Planning in January 2009.

MCoA No.	MCoA Details	Reference in this document
3.2	No later than one year after commencement of operation of the project, or as otherwise agreed by the Director-General, the Proponent shall undertake operational noise monitoring to compare actual noise performance of the project against noise performance predicted in the review of noise mitigation measures required by Condition 2.24 and prepare an Operational Noise Report. The Report shall include, but not necessarily be limited to:	This document
a)	Noise monitoring to assess compliance with the operational noise levels predicted in the review of operational noise mitigation measures required under Condition 2.24 and documents specified under Condition 1.1 of this approval;	Section 6
b)	A review of the operational noise levels in terms of criteria and noise goals established in the Environmental Criteria for Road Traffic Noise (EPA 1999);	Section 4
c)	Methodology, location and frequency of noise monitoring undertaken, including monitoring sites at which project noise levels are ascertained, with specific reference to locations indicative of impacts on sensitive receivers;	Section 6
d)	Details of any complaints and enquiries received in relation to the operational noise generated by the project between the date of commencement of operation and the date the report was prepared;	Appendix F

Table 3.2 -	- Minister's	Conditions	of Approval

MCoA No.	MCoA Details	Reference in this document
e)	Any required recalibrations of the noise model taking into consideration factors such as noise monitoring undertaken and actual traffic numbers and proportions;	Section 9
f)	An assessment of the performance and effectiveness of applied noise mitigation measures together with the review and if necessary, reassessment of all reasonable and feasible mitigation measures; and	Section 9
g)	Any additional feasible and reasonable measures to those identified in the review of noise mitigation measures required by Condition 2.24, that would be implemented to comply with the criteria outlined in the Environmental Criteria for Road Traffic Noise (NSW EPA, 1999), when these measures would be implemented and how their effectiveness would be measured and reported to the Director-General and the EPA.	Section 9
3.3	The Proponent shall provide the Director-General and the EPA with a copy of the Operational Noise Report within 60 days of completing the operational noise monitoring referred to under condition 3.2 of this approval, or as otherwise agreed by the Director-General.	This document

3.3 Legislation

Key environmental legislation relating to the management of road traffic noise includes:

- Protection of the Environment Operations Act (1997);
- Protection of the Environment Administration Act (1991);
- Environment Planning and Assessment Act (1979); and
- Local Government Act (1993).

3.4 Guidelines and Background Documents

The key references relevant to general road traffic noise management specific to the Project include:

- Environmental Criteria for Road Traffic Noise (ECRTN), NSW EPA, May 1999;
- Environmental Noise Management Manual, NSW RMS (ex RTA), 2001; and
- Noise Wall Design Guidelines, NSW RMS (ex RTA), May 2003.

Background studies and assessment of potential noise impacts as a result of the operation of the Project include:

- Coffs Harbour Highway Planning Sapphire to Woolgoolga Section Environmental Assessment – Main Volume (Including Appendices A to E), Connell Wagner Pty Ltd, November 2007
- Coffs Harbour Highway Planning Sapphire to Woolgoolga Section Environmental Assessment Submissions Report, Connell Wagner Pty Ltd, July 2008

- Major Project Assessment Pacific Highway Upgrade, Sapphire to Woolgoolga, NSW Roads and Traffic Authority – Director-General's Environmental Assessment Report, NSW Department of Planning, January 2009
- Coffs Harbour City Council, HW10 Pacific Highway, Sapphire to Woolgoolga Upgrade Operational Noise Management Report (Parts 1, 2, 3 and 4), Aecom SMEC JV, December 2013
- Sapphire to Woolgoolga Pacific Highway Upgrade Post-Opening Noise Monitoring Plan, Renzo Tonin & Associates, October 2014

Reference documents relevant to the study and monitoring of engine brake noise from heavy vehicles include:

- Engine Brake Noise Final Proposal and Regulatory Impact Statement, National Transport Commission, August 2007
- National In-Service Test Procedures for Engine Brake Noise From Heavy Vehicles, National Transport Commission, August 2007
- Review of the National In-Service Standard for Engine Brake Noise, National Transport Commission, May 2013

4 **Project Noise Level Objectives**

During the design stage, noise level objectives for this Project were established as per the ECRTN and the ENMM, in accordance with the requirements of MCoA 2.24. Further to this, other Environmental Documents for the Project (outlined in Section 3.4) were taken into consideration during the development of the operational noise mitigation measures.

The noise level objectives for the Project are detailed in the Operational Noise Management Report (ONMR) – Part 1; prepared by Aecom SMEC JV [ref. S2W-REP-20-0000-EN052E-FD-14, December 2013]. A summary of these is presented below.

4.1 Residential Noise Receptors

In accordance with the EPA guidelines, the Project is considered to be a "redevelopment of an existing arterial road" where the route follows the alignment of the existing (old) Pacific Highway and, where the Woolgoolga bypass alignment differs substantially from the existing (old) Pacific Highway alignment, it is considered to be a "new arterial road corridor".

Therefore, in accordance with the ECRTN the relevant noise criteria for the Project are summarised in Table 4.1 below.

Tune of Dovelonment	Noise Criteria, dB(A)		- Whore Criteria are Already Exceeded	
Type of Development	Day	Night	where Chiena are Alleady Exceeded	
New freeway or arterial road corridor	L _{Aeq(15hr)} 55	L _{Aeq(9hr)} 50	The new road should be designed so as not to increase existing noise levels by more than 0.5dB.	
Redevelopment of existing freeway/ arterial road	L _{Aeq(15hr)} 60	L _{Aeq(9hr)} 55	In all cases, the redevelopment should be designed so as not to increase existing noise levels by more than 2dB.	

Table 4.1 – Noise Criteria for Residential Receivers

(Source: NSW ECRTN)

In addition to the above, where the predicted design year noise levels at residences are equal to or greater than 65dB(A) Day and 60dB(A) Night as a result of the Project, then the noise exposure is considered to be 'acute' and noise control measures were considered.

To establish the most reasonable and feasible noise mitigation treatment in areas affected by significant traffic noise levels, reference is made to Practice Note iv of the ENMM.

4.2 Engine Brake Noise Study

For the study of engine brake noise from heavy vehicles, reference is made to a report prepared by the National Transport Commission (NTC), titled 'Engine Brake Noise – Final Proposal and Regulatory Impact Statement', dated August 2007. The report recommends the use of Modulated Root Mean Square

(MRMS) as the relevant noise descriptor to describe the pulsing effect of the noise from engine braking, which was determined to be the primary cause of community annoyance.

Furthermore, the NTC report states the following:

"The NTC recommends an in-service standard with a modulated Root Mean Square of three that takes into account community annoyance and best practice muffler performance."

Therefore, as recommended by the NTC a MRMS value of 3.0 is used to assess engine brake noise from heavy vehicles. Engine brake noise which results in values above 3.0 are considered to be either 'very much' annoying or 'extremely' annoying, as concluded from a community panel study presented in the report.

Although the NTC has recommended a MRMS value of 3.0, for the study conducted as part of this ONR a MRMS value of **2.5** has been set for a conservative assessment of engine brake noise.

5 **Project Noise Mitigation Measures**

There have been a number of methods used on the Project to mitigate traffic noise. The following summarises the suite of noise mitigation measures implemented on the Project to reduce noise impacts to receivers:

- increased distance between the road and some receivers;
- use of cuttings in road to provide noise shielding;
- shielding from road structures (eg retaining walls, bridge structures etc);
- reduced road gradient
- low-noise pavement;
- roadside noise barriers and headlight screens; and
- at-property noise control treatments.

5.1 Road Design Features

Road design features of the Project which assist in reducing traffic noise impacts include:

- Various cuttings and retaining walls, which shield the road from residences.
- Noise walls and mounds which provide shielding of the road from residences.
- The gradient of the road has been reduced in some areas.

5.2 Low-Noise Pavements

The main carriageway and associated ramps of the Project are typically finished with a low-noise surface of Stone Mastic Asphalt (SMA). SMA provides significant and worthwhile noise reduction benefits.

The main carriageway on the northern end of the Project, from approximately 700m north of the Bark Hut Road overpass to the Arrawarra Interchange, has a concrete pavement with longitudinal tyning.

Local and service roads were finished with either Dense Graded Asphalt (DGA) or bitumen seal (10mm aggregate), including the old Pacific Highway at Sapphire Beach.

5.3 Noise Barriers

In accordance with MCoA 2.24 noise barriers were designed to meet the requirements of the ECRTN during the design phase of the Project.

Noise barriers are most feasible where residences are closely grouped, where the barriers do not cause access difficulties to properties, and where they are visually acceptable. To derive the most appropriate height for noise barriers, a detailed feasibility analysis of the noise barriers was completed during the design phase in accordance with Practice Note iv of the ENMM. The analysis confirmed the optimum noise mitigation requirements, including the appropriate mix of at-road and at-property treatments. A summary of the feasibility analysis and assessment outputs is presented in the ONMR.

In summary, noise barriers have been constructed in accordance with the requirements of the ECRTN and the ENMM. The ONMR presents the schedule of the noise barriers that were designed for the Project and these range from 2.5m to 4.0m in height.

Furthermore, as part of the Project, headlight screens were installed at various locations to aid in reducing glare from headlights of vehicles travelling along the upgraded highway and/or the old highway impacting oncoming traffic. The headlight screens have been designed and constructed from the same materials as the noise barriers for aesthetic reasons, thus consequently providing additional noise mitigation benefits. The ONMR presents the schedule of the headlight screens that were designed for the Project and these range from 2.5m to 3.5m in height.

5.4 At-Property Noise Control Treatment

At-property noise control treatments were applied after implementing all feasible and reasonable 'atroad' noise mitigation measures, such as:

- road design features (eg minimising road grades, provision of cuttings and embankments, changes in alignment, etc);
- low-noise pavement; and
- noise barriers.

The remaining properties impacted by traffic noise in excess of the applicable criteria were offered 'atproperty' noise mitigation treatments. At-property noise mitigation treatments were selected in accordance with the ENMM.

Following the noise modelling process undertaken during the design phase of the Project and presented in the ONMR, a total of 114 properties were identified for at-property treatment in addition to at-road noise mitigation measures described above. Of the 114 properties, 41 were identified during the Environmental Assessment (EA) stage of the Project and an additional 73 were identified during the design stage. However, the property identified as Receiver No. 1080, has since been determined to be ineligible for treatment. Therefore, a total of 113 properties were eligible for at-property treatment in accordance with the ONMR.

Addresses of properties identified for at-property treatment and the type of treatment proposed were presented in Parts 2 and 3 of the ONMR.

The types of at-property treatment generally offered according to the ONMR included:

- **Type 1** treatment options available for exceedances of up to and including 10dB(A) are:
 - Air conditioning (that complies with the fresh air requirements of the Building Code of Australia) and the sealing of wall vents, and
 - Upgraded window and door seals.
- Type 2 treatment options available for exceedances greater than 10dB(A) are:
 - Type 1 treatment as per above, and
 - Upgraded windows, glazing and doors.

6 Noise Monitoring

6.1 Noise Monitoring Methodology

Noise monitoring was conducted in accordance with:

- Australian Standard 2702-1984 "Acoustic Methods of Measurement of Road Traffic Noise",
- ECRTN Appendix C4 'Noise monitoring procedures',
- ENMM Appendix E 'Model consultant brief for post-construction road traffic noise monitoring', and
- NTC 'National In-Service Test Procedures for Engine Brake Noise from Heavy Vehicles' (January 2007).

Furthermore, Renzo Tonin & Associates produced the 'Sapphire to Woolgoolga Pacific Highway Upgrade – Post-Opening Noise Monitoring Plan' (October 2014) which captures the key elements of the above documents and provides a noise monitoring and assessment methodology that is specific to this Project. The monitoring plan was prepared in consultation with RMS and the community.

6.1.1 Long-Term Noise Monitoring

All long-term (unattended) noise monitoring was conducted using Renzo Tonin & Associates' noise monitors. The noise monitoring equipment complies with IEC 61672 (parts 1-3) "*Electroacoustics - Sound Level Meters*" and are designated as Type 1 instruments suitable for laboratory and field use.

A noise monitor consists of a sound level meter in a weather resistant enclosure. Ambient noise levels are recorded at a rate as low as a few milliseconds per sample. Every 15 minutes, the data is processed statistically and stored in memory.

A noise monitor was installed at each nominated monitoring location and generally positioned 1m from the most affected facade to a habitable area and at a height of 1.5m above the floor level for a minimum of seven (7) valid days in accordance with the ENMM.

In some instances, the most affected facade to a habitable area was either located on the first floor level (eg. garage or storage area on ground floor) or was covered over by a roof (eg. verandahs, balconies, pergolas, awnings etc) which can adversely affect noise readings. In these cases, the noise monitor was located in the 'free-field' (ie. a minimum 3.5m away from any facade) and a +2.5dB(A) facade correction was applied to the measured noise levels to convert the free-field measurements to equivalent measurements at 1m from the relevant building facade.

6.1.2 Short-Term Noise Monitoring

For multi-storey dwellings, long-term (unattended) noise monitoring was conducted at the most accessible floor of the dwelling and additional short-term (attended) noise monitoring was conducted at 1m from the subject facade on the other floor/s and at a height of 1.5m above the corresponding floor level. Short-term monitoring was conducted concurrently with the long-term noise monitoring, using a Type 1 sound level meter [complying with IEC 61672 (parts 1-3) "*Electroacoustics - Sound Level Meters*"] during the deployment and / or the collection of the long-term noise monitor.

The measured short-term results were compared to the concurrent results of the corresponding longterm monitor to determine a correlation between the two measurement locations. This procedure is used to establish the equivalent traffic noise levels over the long-term monitoring period at the shortterm measurement location.

To illustrate this procedure, assume the following example:

Say a noise level of 55dB(A) was measured during the day at the short-term location (Location A) and over exactly the same short-term period a noise level of 52dB(A) was measured at the long-term location (Location B). That means that noise levels at Location A are generally 3dB(A) louder than at Location B during the day. If this noise level difference between the two locations is repeatable and found to be reasonably consistent throughout different periods in the day, then if at Location B a daytime noise level of 57dB(A) was measured over a 7 day period, this means that at Location A daytime noise levels would be expected to be 60dB(A). A similar process can be followed for night-time noise levels.

In addition to the short-term monitoring at different floor levels of dwellings where long-term noise monitoring was undertaken, short-term (attended) noise monitoring was also conducted at selected residences where no long-term noise monitoring was conducted. These additional short-term monitoring locations were selected through consultation with RMS and the community and were chosen to represent noise sensitive areas further removed from the Project.

6.1.3 Engine Brake Noise Monitoring

Engine brake noise levels from the Project were monitored continuously throughout the monitoring periods using ARL Ngara Real Time Sound Acquisition Systems which comply with IEC 61672 (parts 1-3) *"Electroacoustics - Sound Level Meters"* and are designated as Type 1 instruments suitable for laboratory and field use.

Engine brake noise levels were monitored at four (4) locations strategically selected.

6.1.4 Noise Monitors

All acoustic instrumentation used for the operational noise monitoring is designed to comply with the requirements of IEC 61672 (parts 1-3) "*Electroacoustics - Sound Level Meters*" and carries appropriate and current NATA (or manufacturer) calibration certificates.

6.1.5 Meteorology During Monitoring

Measurements affected by extraneous noise, wind (greater than 5m/s at the microphone) or rain were excluded from the recorded data.

Meteorological data was obtained from two (2) weather stations (Davis Instruments – Vantage Vue, Model no. 6357) installed and located at various locations along the Project during the two stages of long-term (unattended) noise monitoring. The measurements of meteorological data allowed for greater accuracy in checking weather conditions closer to the noise monitoring sites. During the noise monitoring there was a large amount of wet and windy weather and as a result the monitoring period was extended over a suitable length to obtain a minimum of seven (7) valid days in order to obtain valid data for each day of the week at all monitoring locations.

It is noted that analysis of noise enhancing or noise diminishing meteorological conditions from winds and temperature inversions do not form part of the requirements of the ECRTN and ENMM.

Upon processing the noise monitoring data, any noise levels monitored during adverse weather conditions were excluded. Adverse weather conditions include:

- Rain traffic noise during wet weather conditions are considered to be atypical and not modelled or designed for, so would not provide an accurate representation of the three main sources of traffic noise, being tyre, engine and exhaust noise which the project design aims to mitigate.
- Wind wind greater than 5m/s at the microphone of a noise monitor would create noise that only occurs because of the presence of the microphone and this noise would act to mask noise from traffic which is the subject and reason for the noise monitoring.

Further to the exclusion of noise data affected by adverse weather, noise data was further reviewed to also discard extraneous non-road traffic noise. Extraneous noise was determined based on the following considerations:

- unusually high L_{Aeq(15min)} noise peaks in comparison to adjacent periods and in comparison to noise levels during the same period on other similar days of the week;
- unusually high peaks across all noise metrics within the same periods and equivalent periods on other similar days of the week;
- short periods of anomalous traffic flow in comparison to adjacent periods and the same periods on other similar days of the week;

- fauna noise (eg insects, birds etc) affecting noise levels, in particular during the night time periods;
- moderate winds potentially increasing flora noise (eg. rustling leaves) and potentially influencing noise propagation; and
- review of audio files to confirm the likely cause of identified extraneous noise events.

Once extraneous noise data was removed, days and nights with the least amount of excluded data were preferred over those with large amounts of data missing, in order to adopt valid daytime and night-time noise levels representing each of the 7 days of the week.

6.2 Noise Monitoring Locations

Where possible, the noise monitoring sites were selected to be the same as those monitored as part of the design phase of the Project and as presented in the ONMR so to allow direct comparisons to be made with noise monitoring locations selected prior to the Project's construction.

Where it was not possible to conduct noise monitoring at the previously monitored locations, noise monitors were setup at suitable alternative locations within close proximity to the originally selected locations.

Furthermore, additional noise monitoring locations to those monitored as part of the design phase of the Project were selected to monitor noise levels at properties where *concerns have been raised by the community* with regard to traffic noise. This provides an opportunity for RMS to address specific areas of concern raised by the community.

Other site specific conditions also influenced the selection of final noise monitoring locations, including access availability to a site, consideration of localised extraneous noise sources (eg. air conditioners, pool plant, other equipment etc) and building features (eg, covered balconies, verandahs, pergolas, awnings etc), which could adversely affect noise measurements.

6.2.1 Long-Term Noise Monitoring Locations

The locations where long-term (unattended) operational noise monitoring was conducted are listed in Table 6.1 below.

Following the preparation of the 'Sapphire to Woolgoolga Pacific Highway Upgrade – Post-Opening Noise Monitoring Plan' (October 2014) and a review of the plan by RMS, operational noise monitoring commenced in October 2014.

Location No.	Monitoring Address	Facade of Dwelling
M1	11 Coachmans Close, Sapphire Beach	Northeast
M2	280 Old Coast Road, Korora	East
M3 ¹	28 Warrawee Street, Sapphire Beach	West
M4	33 Old Coast Road, Korora	East
M5	7 Reicks Close, Sapphire Beach	West
M6 ¹	7 Wakelands Road, Sapphire Beach	East
M7	1206C Pacific Highway, Moonee Beach	West
M8 ²	545 Solitary Islands Way, Moonee Beach	North
M9 ¹	1579 Pacific Highway, Moonee Beach	Southeast
M10	3 Fiddaman Road, Emerald Beach	West
M11	1 Emerald Heights Drive, Emerald Beach	East
M12	9 Casuarina Court, Sandy Beach	Northeast
M13	8 Oak Close, Sandy Beach	East
M14	7 Pines Crescent, Sandy Beach	West
M15	8 Hearnes Lake Road, Woolgoolga (The Pines Estate)	South
M16	1719B Solitary Islands Way, Woolgoolga	South
M17	25 Greys Road, Woolgoolga	Southwest
M18	17 Park Avenue, Woolgoolga	East
M19	187 Newmans Road, Woolgoolga	West
M20	66A Palmer Road, Woolgoolga	West
M21	226 Bark Hut Road, Woolgoolga	East
M22	333 Solitary Islands Way, Arrawarra	West

Table 6.1 – Long-Term Operational Noise Monitoring Locations

Notes: 1. Same noise monitoring locations to those monitored during the design phase

2. Previous noise monitoring location known as 39 Hoys Road, Moonee Beach

Long-term noise monitoring was undertaken at the above locations over two stages as follows:

- <u>Stage 1</u> Locations M11 to M22 between 29th October and 13th November 2014
- <u>Stage 2</u> Locations M1 to M10 between 13th November and 27th November 2014

Traffic counts, vehicle classifications and vehicle speed data were monitored concurrently with the noise monitoring, by a third-party contractor who provided data enabling the commencement of the operational noise monitoring analysis on 29th October 2014.

6.2.2 Short-Term Noise Monitoring Locations

Short-term (attended) noise monitoring was undertaken at the properties listed in Table 6.1, where there were multi-storey dwellings or where it was not practical for long-term noise monitors to be installed over several weeks at the applicable habitable floor level requiring assessment.

Short-term noise monitoring was undertaken concurrently with the corresponding long-term noise monitoring at the locations listed in Table 6.2 below.

Location No.	Monitoring Address	Facade of Dwelling	Details
MS1	11 Coachmans Close, Sapphire Beach	Northeast	Double storey dwelling
MS8	545 Solitary Islands Way, Moonee Beach	North	Double storey dwelling
MS11	1 Emerald Heights Drive, Emerald Beach	East	Double storey dwelling
MS15	8 Hearnes Lake Road, Woolgoolga (The Pines Estate)	South	Double storey dwelling
MS22	333 Solitary Islands Way, Arrawarra	West	Ground floor non-habitable area, first floor habitable area

Table 6.2 – Short-Term Operational Noise Monitoring Locations

In addition to the above short-term monitoring locations, short-term (attended) noise monitoring was also conducted at selected residences where no long-term noise monitoring was conducted. These additional short-term monitoring locations were selected through consultation with RMS and the community and were chosen to represent noise sensitive areas further removed from the Project. Monitoring was undertaken over 15-30 minutes during the day period (7am to 10pm) and 15-30 minutes during the night period (10pm to 7am).

The additional short-term monitoring locations are presented in Table 6.3 below.

Location No.	Monitoring Address
S1	219 Old Coast Road, Korora
S2	387D Old Coast Road, Korora
S3	6 Alpini Place, Sapphire Beach
S4	26 Gaudrons Road, Sapphire Beach
S5	22 Woodhouse Road, Moonee Beach
S6	1 Tidal Crescent, Moonee Beach
S7	40 Heritage Drive, Moonee Beach
S8	36 Pinehyrst Drive, Moonee Beach
S9	9 Bream Close, Emerald Beach
S10	29 Fishermans Drive, Emerald Beach
S11	63 Dammerel Crescent, Emerald Beach
S12	2 Anselmo Close, Emerald Beach
S13	20 Redbox Crescent, Sandy Beach
S14	14 Mahogany Avenue, Sandy Beach
S15	15 Ryan Crescent, Woolgoolga
S16	21 Gresham Drive, Woolgoolga
S17	44A Whitton Place, Mullaway

Table 6.3 – Additional Short-Term Operational Noise Monitoring Locations

6.2.3 Engine Brake Noise Monitoring Locations

Engine brake noise monitoring was undertaken at four locations shown in Table 6.4 below. The locations were selected through consultation with RMS and represented specific sections along the Project where engine brake noise was considered prevalent due to factors where heavy vehicles are required to slow down such as a change in road grade or change in speed limits.

The engine brake noise monitoring was undertaken by a third-party contractor, Acoustic Research Labs (ARL) Pty Ltd, who also analysed the monitored data and assessed the results.

Location No.	Monitoring Location	Side of Road
EB1	Between Bark Hut Road overpass and Poundyard Creek bridge	Eastern
EB2	Between Greys Road overpass and Woolgoolga Creek twin bridges	Western
EB3	Between southbound off-ramp to Woolgoolga and Solitary Islands Way overpass (near high voltage power lines)	Eastern
EB4	West of Sapphire Beach Apartments, change in speed limit from 110km/h to 80km/h	Eastern

Table 6.4 – Engine Brake Noise Monitoring Locations

Engine brake noise monitoring was undertaken during the following periods for each location:

- Locations EB1 and EB2 29th October to 12th November 2014
- Location EB3 12th November to 26th November 2014
- Location EB4 12th November to 22nd November 2014

6.3 Noise Monitoring Results

The noise monitoring instruments typically stored LA90, LAeq,15hr, LAeq,9hr and LAmax noise levels as a minimum on a continuous basis at 15-minute intervals. While measurement results for all these indices were retained, the study primarily focuses on the LAeq,15hr and LAeq,9hr results, as these are the noise assessment indices embodied in the ECRTN.

The results of the long-term (unattended), short-term (attended) and engine brake noise monitoring are presented in the following sections.

6.3.1 Long-Term Noise Monitoring Results

Traffic noise levels are assessed separately for daytime and night time periods, defined by the ECRTN as follows:

- Day is defined as 7:00am to 10:00pm;
- Night is defined as 10:00pm to 7:00am.

Where possible and practical, noise levels at the majority of locations were measured at 1m from the building facade in accordance with the ECRTN and the RMS requirements for traffic noise measurements. However, due to site conditions (eg. covered facades, etc) noise levels at some locations were measured in the free-field (ie. away from buildings) and the measured noise levels were corrected [+2.5dB(A)] to include facade reflections as recommended in the ECRTN and the RMS procedures.

Therefore, the road traffic noise levels presented in Table 6.5 below represent the measured or equivalent noise levels at 1m from the subject building facade.

	Approx. Distance	2014 Measured L_{Aeq} Traffic Noise Levels, dB(A)		
Noise Monitoring Location	from Pacific Highway	L _{Aeq,15hr} Day	L _{Aeq,9hr} Night	
M1 – 11 Coachmans Close, Sapphire Beach ¹	70	63	61	
MS1 – 11 Coachmans Close, Sapphire Beach ¹²	70m	60	58	
M2 – 280 Old Coast Road, Korora ¹	145m	60	57	
M3 – 28 Warrawee Street, Sapphire Beach	60m	53	49	
M4 – 33 Old Coast Road, Korora ¹	50m	65	61	
M5 – 7 Reicks Close, Sapphire Beach ¹	63m	59	56	
M6 – 7 Wakelands Road, Sapphire Beach ¹	55m	60	56	
M7 – 1206C Pacific Highway, Moonee Beach ¹	45m	65	61	
M8 – 545 Solitary Islands Way, Moonee Beach	190	59	54	
MS8 – 545 Solitary Islands Way, Moonee Beach ²	18011	60	56	
M9 – 1579 Pacific Highway, Moonee Beach ¹	80m	60	57	
M10 – 3 Fiddaman Road, Emerald Beach ¹	70m	63	59	
M11 – 1 Emerald Heights Drive, Emerald Beach		59	56	
MS11 – 1 Emerald Heights Drive, Emerald Beach ^{1,2}	2011	56	52	
M12 – 9 Casuarina Court, Sandy Beach	55m	62	60	
M13 – 8 Oak Close, Sandy Beach ¹	22m	59	56	
M14 – 7 Pines Crescent, Sandy Beach ¹	25m	61	60	
M15 – 8 Hearnes Lake Road, Woolgoolga (The Pines Estate) ¹		60	57	
MS15 – 8 Hearnes Lake Road, Woolgoolga (The Pines Estate) ^{1,2}	75m	62	60	
M16 – 1719B Solitary Islands Way, Woolgoolga	110m	54	52	
M17 – 25 Greys Road, Woolgoolga ¹	85m	56	54	
M18 – 17 Park Avenue, Woolgoolga ¹	180m	54	52	
M19 – 187 Newmans Road, Woolgoolga	90m	53	53	
M20 – 66A Palmer Road, Woolgoolga ¹	120m	53	57	
M21 – 226 Bark Hut Road, Woolgoolga ¹	65m	65	64	
M22 – 333 Solitary Islands Way, Arrawarra	100	59	55	
MS22 – 333 Solitary Islands Way, Arrawarra ²	13011	62	57	

Table 6.5 – 2014 Long-Term Monitored L_{Aeq} Road Traffic Noise Levels

Noise Monitoring Location	Approx. Distance from Pacific Highway	2014 Measured L_{Aeq} Traffic Noise Levels, dB(A)		
		L _{Aeq,15hr} Day	L _{Aeq,9hr} Night	

Notes: 1. Free-field location; therefore, traffic noise levels include correction of +2.5dB(A) to represent equivalent traffic noise levels at 1m from facade

2. Short-term measurement locations where multi-storey dwelling or where not practical for long-term noise monitor to be installed on affected habitable floor level. Day and night noise levels for these locations have been determined through correlation with the corresponding long-term monitoring location

From the noise monitoring results presented in the table above, night time traffic noise levels at Location M20 were measured to be higher than the traffic noise levels during the daytime period at the same location. A review of audio files captured at Location M20 was conducted and it was confirmed that the likely cause of the unusually high monitored night time noise level was due to fauna noise (eg. insects and/or birds) that was clearly audible in the audio recordings.

The results of the long-term unattended noise monitoring at each monitoring location are presented graphically in Appendix G.

6.3.2 Short-Term Noise Monitoring Results

Short-term (attended) noise monitoring results at locations representing areas generally further removed from the Project are presented in Table 6.6.

Noise Monitoring Location	Approx. Distance from	2014 Measured Traffic Noise Levels, dB(A)		
Noise Monitoring Location	Pacific Highway	L _{Aeq, (15min)} Day	L _{Aeq, (15min)} Night	
S1 – 219 Old Coast Road, Korora	545m	55	50	
S2 – 387D Old Coast Road, Korora	135m	59	58	
S3 – 6 Alpini Place, Sapphire Beach	123m	-	51	
S4 – 26 Gaudrons Road, Sapphire Beach	185m	55	49	
S5 – 22 Woodhouse Road, Moonee Beach	300m	58	54	
S6 – 1 Tidal Crescent, Moonee Beach	505m	51	45	
S7 – 40 Heritage Drive, Moonee Beach	82m	62	60	
S8 – 36 Pinehyrst Drive, Moonee Beach	600m	47	47	
S9 – 9 Bream Close, Emerald Beach	345m	48	46	
S10 – 29 Fishermans Drive, Emerald Beach	445m	52	51	
S11 – 63 Dammerel Crescent, Emerald Beach	1,100m	43	41	
S12 – 2 Anselmo Close, Emerald Beach	125m	55	53	
S13 – 20 Redbox Crescent, Sandy Beach	225m	45	46	
S14 – 14 Mahogany Avenue, Sandy Beach	90m	57	48	
S15 – 15 Ryan Crescent, Woolgoolga	530m	57	42	
S16 – 21 Gresham Drive, Woolgoolga	365m	52	50	
S17 – 44A Whitton Place, Mullaway	1,560m	53	51	

Table 6.6 – 2014 Short-Term Monitored L_{Aeq} Road Traffic Noise Levels

During the measurements at the short-term monitoring locations it was observed that although traffic noise from the Project was audible, other sources of noise also contributed to the measured noise levels such as insects, birds, frogs, rustling of leaves and/or ocean (wave) noise.

An exception was at Location S7 (40 Heritage Drive), where noise from the highway was clearly audible and dominated the noise environment. This was due to the relatively short distance and a direct line-ofsight to the highway and the highway being slightly elevated above the monitoring location.

6.3.3 Engine Brake Noise Monitoring Results

Engine brake noise monitoring was undertaken by Acoustic Research Labs (ARL) Pty Ltd at four (4) nominated locations, considered to represent areas of the Project where engine brake noise is most prevalent. Sound recordings at each monitoring location were listened to and categorised as either 'engine brake', 'general traffic' or 'miscellaneous / other' noise based on their noise content. Results of the engine brake noise monitoring are presented in the following figures.

Figure 1 – Engine Brake MRMS Level Distribution





Figure 2 – Hourly Engine Brake Event Distribution (MRMS >2.5)

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Time (Hourly)





Daily Engine Brake RMS Event Distribution

A review of the above graphs presents the following outcomes of the engine brake noise monitoring. The results represent the total engine brake events over the monitoring period.

Location EB1

- Monitoring period from 29/10/2014 to 12/11/2014 (14 days)
- **30** total engine brake events where MRMS is greater than conservative value of 2.5
- 16 total engine brake events where MRMS is greater than NTC recommended value of 3.0

Location EB2

- Monitoring period from 29/10/2014 to 12/11/2014 (14 days)
- 37 total engine brake events where MRMS is greater than conservative value of 2.5
- **15** total engine brake events where MRMS is greater than NTC recommended value of 3.0

Location EB3

- Monitoring period from 12/11/2014 to 26/11/2014 (14 days)
- 103 total engine brake events where MRMS is greater than conservative value of 2.5
- **32** total engine brake events where MRMS is greater than NTC recommended value of 3.0

Location EB4

- Monitoring period from 12/11/2014 to 22/11/2014 (10 days)
- 95 total engine brake events where MRMS is greater than conservative value of 2.5
- 27 total engine brake events where MRMS is greater than NTC recommended value of 3.0

The results indicate that engine brake noise occurs more often at Locations EB3 and EB4, compared to Locations EB1 and EB2. This may be due to heavy vehicles travelling southbound having to reduce speed in the vicinity of Location EB3 as a result of a slight decline and sweeping curve in the road and the reduction in the posted speed limit from 110km/h to 80km/h at Location EB4.

A further assessment of the percentage of engine brake noise events versus the number of heavy vehicles counted during the monitoring period was also undertaken and results are as follows.

Location EB1

- 12,039 total heavy vehicles (class 4-12 vehicles) along the southbound carriageway (adjacent to monitor) during the monitoring period from 29/10/2014 to 12/11/2014 (14 days)
- 0.25% of total heavy vehicles where MRMS greater than 2.5 was detected
- 0.13% of total heavy vehicles where MRMS greater than 3.0 was detected

Location EB2

- 11,514 total heavy vehicles (class 4-12 vehicles) along the northbound carriageway (adjacent to monitor) during the monitoring period from 29/10/2014 to 12/11/2014 (14 days)
- 0.92% of total heavy vehicles where MRMS greater than 2.5 was detected
- 0.13% of total heavy vehicles where MRMS greater than 3.0 was detected

Location EB3

- 12,395 total heavy vehicles (class 4-12 vehicles) along the southbound carriageway (adjacent to monitor) during the monitoring period from 12/11/2014 to 26/11/2014 (14 days)
- 0.83% of total heavy vehicles where MRMS greater than 2.5 was detected
- 0.26% of total heavy vehicles where MRMS greater than 3.0 was detected

Location EB4

- 10,363 total heavy vehicles (class 4-12 vehicles) along the southbound carriageway (adjacent to monitor) during the monitoring period from 12/11/2014 to 22/11/2014 (10 days)
- 0.83% of total heavy vehicles where MRMS greater than 2.5 was detected
- 0.26% of total heavy vehicles where MRMS greater than 3.0 was detected

The results show that less than 1% of heavy vehicles exceed the MRMS value of 2.5 at all monitoring locations and, less than 0.5% exceed the MRMS value of 3.0.

7 Traffic Volumes and Classification

In accordance with Practice Note viii of the ENMM, traffic volumes, classification of vehicles and vehicle speeds were monitored concurrently with the operational noise monitoring along the Project corridor by a third-party contractor, Skyhigh Traffic Data Australia Pty Ltd.

The locations where traffic counting was conducted are listed below.

Pacific Highway Main Alignment

- Site T1 Approx. 1km south of Old Coast Road overpass
- Site T4 Approx. 1.4km south of Moonee Beach Interchange
- Site T11 Approx. 700m north of Moonee Beach Interchange
- Site T12 Approx. 1.7km south of Emerald Beach Interchange
- Site T18 Approx. 750m north of Emerald Beach Interchange
- Site T23 Approx. 600m south of south Woolgoolga Interchange
- Site T28 Approx. 400m south of Greys Road overpass

Pacific Highway Ramps

- Site T6 Moonee Beach Interchange northbound off-ramp
- Site T7 Moonee Beach Interchange southbound on-ramp
- Site T8 Moonee Beach Interchange southbound off-ramp
- Site T9 Moonee Beach Interchange northbound on-ramp
- Site T14 Emerald Beach Interchange northbound off-ramp (near Fiddaman Road)
- Site T16 Emerald Beach Interchange southbound on-ramp
- Site T19 Emerald Beach Interchange northbound off-ramp (near Emerald Heights Drive)
- Site T21 Emerald Beach Interchange northbound on-ramp
- Site T22 Emerald Beach Interchange southbound off-ramp
- Site T24 south Woolgoolga Interchange northbound off-ramp
- Site T25 south Woolgoolga Interchange northbound on-ramp
- Site T27 south Woolgoolga Interchange southbound on-ramp

Local Roads and Overpasses

- Site T2 Hunter Close south of Old Coast Road
- Site T3 Solitary Islands Way (east of Pacific Highway), approx. 450m south of Old Coast Road overpass
- Site T5 Solitary Islands Way (west of Pacific highway), approx. 1.3km south of Moonee Beach Interchange
- Site T10 Solitary Islands Way (ex Hoys Road), approx. 100m north of Moonee Beach Interchange
- Site T13 Solitary Islands Way (east of Pacific Highway), approx. 1.9km south of Emerald Beach Interchange
- Site T15 Fiddaman Road, approx. 100m east of Emerald Beach Interchange
- Site T17 Solitary Islands Way (east of Pacific Highway), approx. 600m north of Emerald Beach Interchange
- Site T20 Solitary Islands Way overpass (at Emerald Beach)
- Site T26 Solitary Islands Way overpass (at south Woolgoolga)
- Site T29 Solitary Islands Way (old Pacific Highway), approx. 900m north of Mullaway Drive

Table 7.1 below presents the counted traffic volumes, vehicle classifications and vehicle speeds (based on an 85th percentile) at the traffic monitoring sites listed above.

Traffic Counting Site		Day – 7am to 10pm (15hr)			Night – 10pm to 7am (9hr)		
		Total Vehicles	Heavy Vehicles %	Speed ¹	Total Vehicles	Heavy Vehicles %	Speed ¹
Pacific Highwa	y Main Alignme	ent					
Site T1	northbound	10,535	10.4%	111	1,190	36.7%	108
	southbound	10,100	11.9%	111	1,354	28.8%	108
Site T4	northbound	9,977	11.2%	111	1,145	39.1%	110
	southbound	10,042	10.5%	110	1,323	27.2%	108
Site T11	northbound	8,865	10.4%	109	1,063	40.2%	106
	southbound	8,865	13.4%	113	1,159	33.4%	111
Site T12	northbound	9,019	10.2%	111	1,093	38.7%	107
	southbound	8,837	11.8%	111	1,187	30.9%	110
Site T18	northbound	7,809	11.4%	111	988	42.9%	109
	southbound	6,778	16.9%	114	925	39.4%	113
Site T23	northbound	7,547	11.9%	109	987	42.0%	107
	southbound	7,728	14.0%	113	939	34.6%	110

Table 7.1 – Monitored 2014 Traffic	: Volumes, Vehicle	Classifications and	Speeds					
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		Day – 7am to	10pm (15hr)		Night – 10pm to 7am (9hr)			
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Traffic Countir	ng Site	Total Vehicles	Heavy Vehicles %	Speed ¹	Total Vehicles	Heavy Vehicles %	Speed ¹	
Site T28	northbound	4,240	16.9%	112	740	53.4%	108	
Site 128	southbound	4,438	21.5%	114	648	50.6%	112	
Pacific Highwa	ay Ramps							
Site T6		2,256	7.3%	80	122	12.6%	80	
Site T7		2,143	6.5%	78	197	8.5%	79	
Site T8		1,012	6.8%	75	37	15.1%	75	
Site T9		1,136	3.8%	78	43	13.9%	77	
Site T14		1,001	5.8%	72	60	10.6%	72	
Site T16		2,016	2.7%	49	254	3.3%	48	
Site T19		1,130	5.1%	84	68	5.5%	82	
Site T21		874	6.6%	73	78	6.6%	73	
Site T22		950	7.9%	85	56	10.9%	87	
Site T24		3,444	7.7%	93	263	10.3%	95	
Site T25		175	14.1%	72	25	13.1%	72	
Site T27		3,521	6.6%	91	340	8.1%	93	
Local Roads &	Overpasses – co	ombined both o	directions					
Site T2		76	6.0%	37	7	8.4%	35	
Site T3		2,180	5.3%	76	169	5.4%	76	
Site T5		609	9.2%	85	28	10.7%	81	
Site T10		3,505	6.5%	61	270	9.5%	62	
Site T13		1,061	8.4%	86	75	7.7%	86	
Site T15		2,044	8.1%	50	129	9.5%	50	
Site T17		3,273	6.3%	75	308	7.1%	78	
Site T20		2,719	6.4%	52	262	6.8%	53	
Site T26		4,818	8.5%	58	360	11.5%	60	
Site T29		3,867	7.3%	101	335	9.7%	101	

Note: 1. Speed represents the 85th percentile speed monitored during the traffic volume monitoring

2. Data based on traffic survey undertaken by Skyhigh Traffic Data Australia Pty Ltd, concurrently with noise monitoring

The post construction traffic data presented in Table 7.1 are the outputs of a traffic survey undertaken over a short period of a few weeks, and are not directly comparable to Annual Average Daily Traffic (AADT), which provides an average of all days over a one year period.

Therefore, the monitored 2014 traffic volume data presented in Table 7.1 was only used for the validation of the 'as-built' (surveyed road design) noise model. Once the model was validated, the forecast 2014 AADT traffic volumes provided by Aecom were input into the calibrated noise model to determine the 2014 (Year 1 – opening year) traffic noise levels at all the sensitive receiver locations assessed in the ONMR. The forecast 15 hour and 9 hour traffic data for 2014 (Year 1) provided by Aecom is reproduced below.

		Day – 7am t	o 10pm (15hr)	Night – 10pm to 7am (9hr)		
Traffic Counting Site	Direction	Total Vehicles	Heavy Vehicles %	Speed ¹	Total Vehicles	Heavy Vehicles %	Speed ¹
Pacific Highway Main	Alignment						
Courts of Lloadlands	northbound	13,618	8.90%	110	1343	38.53%	110
South of Headlands	southbound	13,543	9.40%	110	1,478	23.02%	110
North of Gaudrons	northbound	12,951	9.1%	110	1,293	39.4%	110
Road/ Split Solitary Road	southbound	12,764	9.6%	110	1,404	23.7%	110
North of Moonee	northbound	11,282	9.7%	110	1,171	41.8%	110
Beach Road	southbound	11,088	10.2%	110	1,248	25.4%	110
North of Fiddaman	northbound	10,254	10.1%	110	1,094	43.6%	110
Road	southbound	8,770	11.5%	110	1,038	28.5%	110
North of Graham	northbound	9,902	10.3%	110	1,068	44.2%	110
Drive South	southbound	9,491	11.0%	110	1,103	27.4%	110
Bunass Section	northbound	4,163	14.5%	110	655	61.9%	110
bypass section	southbound	4,173	18.1%	110	491	53.4%	110
Pacific Highway Ramp	s						
Gaudrons/Split Solitary Road	northbound on-ramp	632	5.3%	60 / 110	47	15.7%	80
Interchange	northbound off-ramp	1,304	5.3%	60 / 110	97	15.7%	80
	southbound on-ramp	1,513	5.7%	60 / 110	147	9.7%	80
	southbound off-ramp	731	5.6%	60 / 110	70	9.1%	80
Moonee Beach Road/Hoys Road	northbound on-ramp	2,565	5.3%	60 / 110	191	15.5%	80
Interchange	northbound off-ramp	4,227	5.3%	60 / 110	312	15.7%	80
	southbound on-ramp	3,622	5.6%	60 / 110	343	9.6%	80
	southbound off-ramp	1,941	5.7%	60 / 110	187	9.5%	80
Emerald Beach Interchange	northbound off-ramp	971	5.3%	60 / 110	73	15.8%	80
(Fiddaman Road)	southbound on-ramp	2,395	5.6%	60 / 110	221	9.8%	80
Graham Drive (South) Interchange	northbound on-ramp	941	5.3%	60 / 110	69	15.3%	80
	northbound off-ramp	1,378	5.3%	60 / 110	103	15.9%	80
	southbound off-ramp	128	5.3%	60 / 110	12	8.3%	80

Table 7.2 – Opening Year 2014 AADT Traffic Volumes and Compositions

		Day – 7am t	o 10pm (15hr	·)	Night – 10pm to 7am (9hr)		
Traffic Counting Site	Direction	Total Vehicles	Heavy Vehicles %	Speed ¹	Total Vehicles	Heavy Vehicles %	Speed ¹
Graham Drive (North) / Woolgoolga Bypass	northbound on-ramp	135	5.0%	60 / 110	11	18.2%	80
Interchange	northbound off-ramp	5,886	7.2%	60 / 110	423	16.2%	80
	southbound on-ramp	5,454	5.5%	60 / 110	627	6.6%	80
	southbound off-ramp	797	5.6%	60 / 110	78	10.0%	80
Arrawarra Interchange	northbound on-ramp	1,917	5.3%	60 / 110	143	15.5%	80
	northbound off-ramp	426	5.2%	60 / 110	31	14.7%	80
	southbound on-ramp	367	5.6%	60 / 110	36	10.3%	80
	southbound off-ramp	2,193	5.7%	60 / 110	211	9.1%	80
Service Roads – combi	ined both directio	ns					
South of Headlands		1,052	5.5%	60	90	11.7%	80
North of Headlands		1,661	5.6%	60	142	11.6%	80
North of Gaudrons Roa	ad	383	5.6%	80	33	11.8%	60
North of Bucca Road		1,606	5.6%	80	136	11.3%	80
North of Fiddaman Roa	ad	3,478	5.5%	60	296	11.4%	80

Note: 1. Speed represents posted speed limit

2. Traffic data provided by Aecom and used for detailed design (pre-construction) noise modelling

In addition to the forecast 2014 AADT traffic volumes, Aecom also provided forecast 2024 AADT traffic volumes, which would be input into the calibrated noise model to determine the 2024 (10 years after opening year) traffic noise levels, should a detailed analysis be required for affected sensitive receiver locations. The forecast 15 hour and 9 hour traffic data for 2024 (Year 10) provided by Aecom is reproduced below.

Table 7.3 – 2024 AAD	Traffic Volumes and	l Compositions
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		Day – 7am t	o 10pm (15hı	·)	Night – 10pm to 7am (9hr)				
Traffic Counting Site	Direction	Total Vehicles	Heavy Vehicles %	Speed ¹	Total Vehicles	Heavy Vehicles %	Speed ¹		
Pacific Highway Main Alignment									
South of Headlands	northbound	17,496	9.0%	110	1733	38.9%	110		
	southbound	17,401	9.5%	110	1,904	23.3%	110		
North of Gaudrons	northbound	16,661	9.2%	110	1,671	39.8%	110		
Road/ Split Solitary Road	southbound	16,422	9.8%	110	1,811	24.0%	110		
North of Moonee	northbound	14,492	9.8%	110	1,512	42.3%	110		
Beach Road	southbound	14,245	10.4%	110	1,607	25.8%	110		

		Day – 7am t	o 10pm (15hr	·)	Night – 10pm to 7am (9hr)		
Traffic Counting Site	Direction	Total Vehicles	Heavy Vehicles %	Speed ¹	Total Vehicles	Heavy Vehicles %	Speed ¹
North of Fiddaman	northbound	13,388	10.2%	110	1,433	43.8%	110
Road	southbound	11,453	11.6%	110	1,358	28.6%	110
North of Graham	northbound	12,888	10.4%	110	1,395	44.5%	110
Drive South	southbound	12,353	11.1%	110	1,438	27.6%	110
Bypass Section	northbound	5,456	14.6%	110	861	62.1%	110
bypass section	southbound	5,470	18.2%	110	645	53.6%	110
Pacific Highway Ramp	s						
Gaudrons/Split Solitary Road	northbound on-ramp	745	5.3%	60 / 110	56	15.7%	80
Interchange	northbound off-ramp	1,580	5.3%	60 / 110	118	15.7%	80
	southbound on-ramp	1,855	5.7%	60 / 110	180	9.7%	80
	southbound off-ramp	875	5.6%	60 / 110	84	9.1%	80
Moonee Beach Road/Hoys Road	northbound on-ramp	3,212	5.3%	60 / 110	239	15.5%	80
Interchange	northbound off-ramp	5,381	5.3%	60 / 110	398	15.7%	80
	southbound on-ramp	4,551	5.6%	60 / 110	432	9.6%	80
	southbound off-ramp	2,377	5.7%	60 / 110	229	9.5%	80
Emerald Beach Interchange	northbound off-ramp	1,101	5.3%	60 / 110	83	15.8%	80
(Fiddaman Road)	southbound on-ramp	2,786	5.6%	60 / 110	257	9.8%	80
Graham Drive (South) Interchange	northbound on-ramp	1,065	5.3%	60 / 110	79	15.3%	80
	northbound off-ramp	1,566	5.3%	60 / 110	117	15.9%	80
	southbound off-ramp	143	5.3%	60 / 110	13	8.3%	80
Graham Drive (North) / Woolgoolga Bypass	northbound on-ramp	152	5.0%	60 / 110	12	18.2%	80
Interchange	northbound off-ramp	7,584	7.2%	60 / 110	545	16.2%	80
	southbound on-ramp	7,026	5.5%	60 / 110	808	6.6%	80
	southbound off-ramp	894	5.6%	60 / 110	87	10.0%	80

	Direction	Day – 7am te	o 10pm (15hr)	Night – 10pm to 7am (9hr)		
Traffic Counting Site		Total Vehicles	Heavy Vehicles %	Speed ¹	Total Vehicles	Heavy Vehicles %	Speed ¹
Arrawarra Interchange	northbound on-ramp	2,747	5.3%	60 / 110	204	15.5%	80
	northbound off-ramp	504	5.2%	60 / 110	37	14.7%	80
	southbound on-ramp	431	5.6%	60 / 110	43	10.3%	80
	southbound off-ramp	2,997	5.7%	60 / 110	288	9.1%	80
Service Roads – combi	ned both directio	ns					
South of Headlands		1,207	5.5%	60	103	11.7%	80
North of Headlands		1,987	5.6%	60	169	11.6%	80
North of Gaudrons Road		433	5.6%	80	37	11.8%	60
North of Bucca Road		1,829	5.6%	80	155	11.3%	80
North of Fiddaman Roa	ad	3,934	5.5%	60	334	11.4%	80

Note: 1. Speed represents posted speed limit

2. Traffic data provided by Aecom and used for detailed design (pre-construction) noise modelling

8 Noise Assessment Methodology

8.1 Noise Assessment Protocol

According to Practice Note viii of the ENMM, the operational noise monitoring and assessment protocol is as follows:

"Post-construction monitoring is undertaken to determine whether the mitigation measures have been adequate for the predicted design noise levels to be met.

The "Design Noise Level for Year 1" is the noise level for the road development at project opening, after all feasible and reasonable mitigation strategies have been applied.

Provided traffic flows and mixes following the road's opening are in line with those used for the predictions, it can be expected that if the predicted noise levels for Year 1 are achieved the predicted Year 10 noise levels will also be achieved.

It should be recognised that noise prediction modelling has some accuracy limitations and will commonly produce acceptable errors of around 2 dB(A). In addition, when noise levels for a new road are being monitored short-term and uncharacteristic variations in traffic flow need to be taken into account when comparing the measured and predicted noise levels."

Also according to Practice Note viii of the ENMM, if the monitoring indicates operational noise levels exceeding the design noise levels for Year 1 then the following action shall be taken:

- 1. "If the measured noise levels exceed the design noise levels for Year 1 by 2 dB(A) or less, the noise data should be examined, the prediction methodology and suitability of mitigation measures should be reassessed and the reasons for the marginal exceedance(s) be identified and reported.
- 2. If measured noise levels exceed the design noise level for Year 1 by more than 2 dB(A), the adequacy of the noise mitigation needs to be reviewed, and if problems are identified steps need to be taken to rectify the situation. Additional noise treatments may be required to achieve the design noise level, where this is feasible and reasonable."

It is noted that during the detailed design stage of the Project and from the results presented in the ONMR, it was determined that the night time period was the critical period, where traffic noise levels are more likely to exceed the night time traffic noise criteria than would exceed the daytime noise criteria. Therefore, for the comparison of the pre- and post- construction noise levels presented in this ONR and any subsequent noise mitigation assessment, only the night time period was modelled and assessed.

8.2 Compliance Assessment Procedure

Compliance was assessed of the operational noise levels predicted in the review of operational noise mitigation measures presented in the ONMR, as required by MCoA 3.2. The methodology used for the assessment is as follows:

- 1. Monitor operational traffic noise levels of the Project in Year 1 (October 2014) at the monitoring locations presented in Table 6.1 and Table 6.2 of this ONR.
- 2. Correlate the long-term monitoring with the short-term monitoring at relevant location/s on each property and apply a correction to establish equivalent traffic noise levels at all critical floor levels and positions of buildings selected for assessment.
- 3. Concurrently with the noise monitoring, monitor traffic volumes, vehicle classifications and vehicle speeds in Year 1 (October 2014) along the main alignment, ramps and local roads.
- 4. Using the monitored traffic noise levels and the monitored traffic data in Table 7.1, validate the 'as-built' noise model by comparing the monitored traffic noise levels for Year 1 to the traffic noise levels modelled using the 'as-built' model.
- 5. Where the comparison between monitored and modelled noise levels is within <u>+</u> 2dB(A), then the 'as-built' noise model predicts results that are generally in agreement with the noise monitoring and there is a reasonable level of confidence that can be placed on the 'as-built' noise model for predicting traffic noise levels.
- 6. Using the validated 'as-built' noise model and the forecasted 2014 traffic data presented in Table 7.2, model the Year 1 traffic noise levels for all receivers impacted by the Project and assessed in the ONMR. To maintain consistency with the ONMR, only the night time period will be assessed.
- Compare the Year 1 traffic noise levels modelled during the preparation of the ONMR ('design' noise model) with the Year 1 traffic noise levels modelled using the validated 'asbuilt' model as part of this ONR (operational stage).
- 8. Where the operational noise levels for Year 1 are found to exceed the predicted Year 1 noise levels by more than 2dB(A), then a detailed analysis is required including:
 - i. predicting 2024 (Year 10) noise levels using the 'as-built' noise model for the applicable receiver locations,
 - ii. checking predicted 2024 noise levels for compliance with the relevant noise criteria,
 - iii. evaluating the adequacy of the noise mitigation measures implemented, and
 - iv. considering additional reasonable and feasible noise mitigation measures, where necessary.
- 9. Where the operational stage noise levels for Year 1 are found to exceed the predicted noise levels for Year 1 by 2dB(A) or less, then a detailed analysis similar to Step 8 above will also be

undertaken. It is noted that this approach of undertaking a detailed analysis for receivers found to be within +2dB(A) of predicted noise levels is unique to this Project only, because of the widespread concerns raised by the community regarding the extent of noise mitigation measures implemented.

8.3 Additional Noise Mitigation Measures

In accordance with the ENMM, additional mitigation measures will be considered where modelled 2014 operational noise levels are found to be greater than 2dB(A) in comparison to modelled 2014 design noise levels [ie. operational noise levels are greater than +2dB(A) of design noise levels]. For those properties, any necessary additional mitigation measures will be determined and provided where feasible and reasonable in accordance with the ECRTN and the ENMM.

However, due to community concerns, additional mitigation measures will also be investigated where modelled 2014 operational noise levels are found to be greater than the modelled 2014 design noise levels noise levels by up to 2dB(A) [ie. post-construction 'as-built' modelled noise levels are greater than pre-construction 'design' modelled noise levels by up to 2dB(A)]. For those properties, any necessary additional mitigation measures will be determined and provided where feasible and reasonable in accordance with the ECRTN and the ENMM.

'Feasibility' relates to engineering considerations and what can practically be built. 'Reasonableness' is judged in terms of noise mitigation benefits and costs, and many other aspects such as community views, aesthetic impacts, existing and future noise levels at the affected sites and the benefits arising from the development.

9 Noise Modelling Results and Assessment

9.1 Noise Prediction Model

Noise modelling was undertaken using the Road Traffic Noise Module in the SoundPLAN noise modelling software. This method is recognised and accepted by both Roads and Maritime and EPA.

The traffic noise prediction model adopted by SoundPLAN is based on a method developed by the United Kingdom Department of Environment entitled "Calculation of Road Traffic Noise (1988)" known as the CoRTN88 method. This method has been adapted to Australian conditions and extensively tested by the Australian Road Research Board. The model predicts noise levels for free flowing traffic and a modified method has been developed which enables an accurate prediction of noise from high truck exhausts to be taken into account.

The method predicts the L_{10, 1hour} noise levels, and a correction of -3dB(A) is applied to obtain the $L_{eq(1 \text{ hour})}$ noise levels. The $L_{eq(1 \text{ hour})}$ noise levels for the daytime 15 hour period from 7.00am to 10.00pm are used to derive the daily $L_{eq(15 \text{ hour})}$ noise levels. Similarly, the $L_{eq(1 \text{ hour})}$ noise levels for the night-time 9 hour period from 10.00pm to 7.00am are used to derive the night time $L_{eq(9 \text{ hour})}$ noise levels.

The SoundPLAN noise model developed by Aecom during the pre-construction detailed design stage of the Project was provided to Renzo Tonin & Associates in order to provide a reliable comparison of preand post- construction noise levels. The pre-construction 'design' noise model was updated with the 'as-built' road design, which included all the noise barriers and headlight screens implemented, to provide an 'as-built' post-construction noise model.

Table 9.1 following sets out the inputs and assumptions used in the as-built post construction traffic noise prediction model.

Input Parameters	Data Acquired From
Traffic volumes and mix	<u>Noise model validation</u> : using 2014 traffic classifications (total vehicles and % heavy vehicles) from traffic survey by Skyhigh Traffic Data Australia (see Table 7.1 of Section 7) <u>Noise prediction modelling</u> : using 2014 forecasted traffic volumes (total vehicles and % heavy vehicles) provided by Aecom (see Table 7.2 of Section 7)
Vehicle speed	Noise model validation: using 2014 traffic speeds based on traffic speeds (85th percentile) from traffic survey by Skyhigh Traffic Data Australia (see Table 7.1 of Section 7)
	Pacific Highway, ramps and service roads (see Table 7.2 of Section 7)
Gradient of roadway	From 'as-built' road design drawings provided by Roads and Maritime
Source height	0.5m for car exhaust, 1.5m for car and truck engines and 3.6m for truck exhaust and detailed within CoRTN88
Ground topography at receiver and road	Digital topographic data and road design drawings provided by Roads and Maritime
Angles of view from receiver	Determined during site inspections and aerial photos

able 9.1 – Summary of SoundPLAN Noise Modelling Inputs
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Input Parameters	Data Acquired From
Structures and cuttings on opposite side of road	Determined during site inspections and review of surveys
Air and ground absorption	Detailed within CoRTN88, ground absorption varied along route. Numeric values varied between 0 (hard surface) to 1 (soft ground); a value of 0.75 was used
Receiver Heights	1.5m above ground level for ground floor and 4.5m above ground level for first floor
Facade correction	+2.5dB(A)
Correction for Australian conditions	No Australian conditions correction applicable for night time period
Acoustic properties of road surfaces	 <u>Stone Mastic Asphalt (SMA)</u> on main carriageway and associated ramps from southern end of Project to 700m north of Bark Hut Road overpass = -2dB(A) noise reduction
	 <u>Concrete with longitudinal tyning</u> on main carriageway from 700m north of Bark Hut Road overpass to Arrawarra Interchange = +3dB(A) noise increase
	• <u>Dense Graded Asphalt (DGA)</u> on all local and service roads, including the old Pacific Highway = 0dB(A) noise reduction
	<u>Spray seal locations</u> on the service road at Sapphire Beach and Emerald Beach
Roadside barriers	Details of 'as-built' noise barriers provided by Roads and Maritime
Traffic noise levels (L _{Aeq})	Based on long-term monitoring results (see Section 6.1.1)

9.2 Model Validation

The 'as-built' post-construction noise model was validated using the 2014 long-term noise monitoring results at Locations M1 to M22 including the results at the short-term monitoring locations MS1, MS8, MS11, MS15 and MS22; and 2014 traffic classification counts obtained concurrently during the post construction noise monitoring.

Table 9.2 summarises the results of the traffic noise model validation, providing a comparison of the modelled traffic noise levels for existing conditions compared to the measured traffic noise levels, all presented to one decimal point for the purpose of the validation process.

	L _{Aeq(15hr)} No	ise Level, dB	(A)	L _{Aeq(9hr)} Noise Level, dB(A)			
Monitoring Locations	Measured	Modelled	Variation	Measured	Modelled	Variation	
M1 – 11 Coachmans Close, Sapphire Beach	63.4	61.9	1.5	60.8	57.5	3.3	
MS1 – 11 Coachmans Close, Sapphire Beach	59.9	58.8	1.1	58.5	54.4	4.1	
M2 – 280 Old Coast Road, Korora	59.9	57.9	2.0	57.2	53.8	3.4	
M3 – 28 Warrawee Street, Sapphire Beach	53.3	53.5	-0.2	49.0	49.8	-0.8	
M4 – 33 Old Coast Road, Korora	65.2	65.1	0.1	60.7	61.3	-0.6	
M5 – 7 Reicks Close, Sapphire Beach	58.9	60.1	-1.2	55.9	56.5	-0.6	
M6 – 7 Wakelands Road, Sapphire Beach	60.0	61.5	-1.5	56.3	57.5	-1.2	
M7 – 1206C Pacific Highway, Moonee Beach	64.6	66.3	-1.7	61.3	62.2	-0.9	
M8 – 545 Solitary Islands Way, Moonee Beach	58.9	58.4	0.5	54.3	54.5	-0.2	
MS8 – 545 Solitary Islands Way, Moonee Beach2	59.9	58.9	1.0	56.4	54.6	1.8	

Table 9.2 – Noise Model Validation Results

Monitoring Locations	L _{Aeq(15hr)} No	ise Level, dB	(A)	L _{Aeq(9hr)} Noise Level, dB(A)		
Monitoring Locations	Measured	Modelled	Variation	Measured	Modelled	Variation
M9 – 1579 Pacific Highway, Moonee Beach	60.2	62.1	-1.9	56.6	58.2	-1.6
M10 – 3 Fiddaman Road, Emerald Beach	62.9	63.8	-0.9	59.0	59.6	-0.6
M11 – 1 Emerald Heights Drive, Emerald Beach	59.2	59.5	-0.3	55.6	56.4	-0.8
MS11 – 1 Emerald Heights Drive, Emerald Beach	55.7	55.4	0.3	52.4	51.4	1.0
M12 – 9 Casuarina Court, Sandy Beach	61.6	61.7	-0.1	60.0	58.9	1.1
M13 – 8 Oak Close, Sandy Beach	58.5	58.3	0.2	55.6	54.9	0.7
M14 – 7 Pines Crescent, Sandy Beach	61.3	63.1	-1.8	59.9	59.4	0.5
M15 – 8 Hearnes Lake Road, Woolgoolga (The Pines Estate)	60.0	61.5	-1.5	57.3	57.0	0.3
MS15 – 8 Hearnes Lake Road, Woolgoolga (The Pines Estate)	61.6	62.6	-1.0	60.0	58.1	1.9
M16 – 1719B Solitary Islands Way, Woolgoolga	54.2	55.6	-1.4	52.1	53.9	-1.8
M17 – 25 Greys Road, Woolgoolga	56.3	57.6	-1.3	54.4	55.0	-0.6
M18 – 17 Park Avenue, Woolgoolga	54.0	53.8	0.2	51.6	51.3	0.3
M19 – 187 Newmans Road, Woolgoolga	52.9	54.3	-1.4	52.6	53.0	-0.4
M20 – 66A Palmer Road, Woolgoolga	53.5	52.9	0.6	57.5	50.7	6.8
M21 – 226 Bark Hut Road, Woolgoolga	64.5	63.1	1.4	63.7	60.5	3.2
M22 – 333 Solitary Islands Way, Arrawarra	58.7	58.7	0.0	54.7	56.7	-2.0
MS22 – 333 Solitary Islands Way, Arrawarra	62.0	61.0	1.0	57.2	58.9	-1.7
Mean (all data)			-0.2			0.5
Mean (excluding fauna affected data)			-0.2			-0.3

The noise model validation results presented in Table 9.2 above show that the as-built noise model predicts results that are generally in good agreement with the noise monitoring at each location. However, the validation results for the night time period at the monitoring Locations M1, MS1, M2, M20 and M21 show that the noise model significantly under-predicts traffic noise levels when compared to the noise monitoring results at these locations. That is, the monitored noise levels during the night time period were significantly higher [> 2dB(A)] than the predicted noise levels from the noise modelling. A review of audio files captured at these monitoring locations was conducted and it was confirmed that the likely cause of the unusually high monitored noise levels was due to fauna noise (eg. insects and/or birds) that was clearly audible in the audio recordings. Furthermore, the night time noise levels at Locations M1 and MS1 were also influenced by wave noise from Sapphire Beach.

The mean differences in the day and night time periods are less than 1dB(A), therefore the post construction as-built noise model is found to validate well and there is a reasonable level of confidence that can be placed on the ability of the model to predict future traffic noise levels.

9.3 Predicted Post Construction Traffic Noise Levels

Noise levels for the receiver locations assessed as part of the detailed design (pre-construction) noise assessment and presented in the ONMR, were predicted using the validated post-construction 'as-built' noise model and forecasted traffic classification data for the opening year (Year 1), as presented in Table 7.2. Results of the noise modelling were then compared to the opening year noise levels that were predicted in the design (pre-construction) noise assessment at the same receiver locations, in order to compare noise levels in accordance with Practice Note viii of the ENMM and MCoA 3.2.

Table B.1 in Appendix B presents the Year 1 noise modelling results at the receiver locations for the critical night time period and also details the comparison between the post-construction and the design (pre-construction) Year 1 noise modelling results. Noise modelling was conducted for a total of 797 receiver locations, corresponding to the same receiver locations as those presented in the ONMR.

Where receiver locations **exceeded their previously predicted noise levels by more than +2dB(A)** they have been analysed in detail as per Step 8 of the compliance assessment procedure presented in Section 8.2 and results are presented in Table C.1 of Appendix C. The analysis includes the prediction of 2024 (Year 10) noise levels for the affected receiver locations using the post construction as-built calibrated noise model and assessment of the predicted Year 10 noise levels against the applicable criteria established in the ONMR for each receiver location. If no treatment was previously recommended in the ONMR, then the type of treatment required (if any) following the detailed analysis was determined.

Where **receiver locations exceeded their previously predicted noise levels by up to +2dB(A)** they also underwent the same analysis as those identified to have differences of more than +2dB(A). That is, Year 10 noise levels were predicted using the as-built noise model, assessment of the predicted noise levels against the applicable criteria was undertaken and any additional noise mitigation treatment determined. Results of the detailed analysis for these receiver locations are presented in Table D.1 in Appendix D.

Based on the results in Table C.1, **no additional receiver locations** were identified for noise mitigation treatment, while the results in Table D.1 identified **two (2) additional receiver locations** for noise mitigation treatment. It is noted that these receivers were not identified for treatment during the preconstruction noise assessment, as presented in the ONMR.

The table below presents a summary of the number of receiver locations assessed and the number of locations identified for treatment.

Difference Between Post and Pre- Construction Year 1 Noise Levels	No. or Receivers	No. of Receivers Requiring Mitigation Treatment	No. of Receivers Requiring Mitigation Treatment due to 'Acute' Noise Exposure
>2B(A)	1	0	0
>0dB(A) to <2dB(A)	63	2	1
TOTAL	64	2	1

Table 9.3 – Summary of Treatment Analysis

From the above table it can be seen that a total of **two (2) additional receiver locations have been identified for noise mitigation treatment**. Of the two receiver locations, one (1) location was identified for treatment due to Year 10 noise levels being 'acute'.

A further review of the previously recommended noise mitigation treatment presented in the ONMR, confirms that locations previously recommended for Type 1 treatment as part of the detailed design stage would not require additional treatment. The two locations identified for noise mitigation treatment would require Type 1 treatment.

A list of additional receiver locations identified for treatment and the type of treatment required is presented in Table 9.4 below.

Table 9.4 – Additional	Properties	Identified	for Noise	Mitigation	Treatment

Receiver ID	Property Address	Type of Treatment Applied ¹	Type of Additional Treatment Required ²
546	2986 Pacific Highway, Arrawarra Headland	-	1
3028	286 Bark Hut Road, Woolgoolga	-	1

Notes: 1. Treatment applied as part of detailed design and identified in ONMR

2. Type 1 Treatment (as per ONMR) = Air conditioning, sealing of wall vents and upgraded window and door seals

Appendix E presents aerial maps which show the 113 receiver locations eligible for noise mitigation treatment in the ONMR and the 2 additional receiver locations identified in Table 9.4 above.

10 Conclusion

Renzo Tonin & Associates (NSW) Pty Ltd has completed the operational noise monitoring and assessment of road traffic noise for the Sapphire to Woolgoolga Pacific Highway Upgrade in accordance with the requirements set out in the relevant Ministers Conditions of Approval, the NSW 'Environmental Criteria for Road Traffic Noise' and the NSW 'Environmental Noise Management Manual'.

Operational noise levels for Year 1 were predicted using a validated post-construction 'as-built' noise model. Results were found to exceed the previously predicted noise levels for Year 1 by a margin of more than 2dB(A) at one receiver location only. A detailed analysis, including the prediction and assessment of Year 10 noise levels at this receiver location, was undertaken and it was found that no additional noise mitigation treatment was required.

Results were found to exceed the previously predicted noise levels for Year 1 by a margin of up to 2dB(A) at sixty three (63) receiver locations. A detailed analysis, including the prediction and assessment of Year 10 noise levels at these receiver locations, was undertaken and it was found that additional noise mitigation treatment was required at two (2) additional locations.

APPENDIX A Glossary of Terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB] dB(A)	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: OdB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dBThe sound of a rock band 115dBLimit of sound permitted in industry 120dBDeafening A-weighted decibels. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard
	as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L _{Max}	The maximum sound pressure level measured over a given period.
L _{Min}	The minimum sound pressure level measured over a given period.
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.

L ₁₀	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L ₉₀	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L _{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B Comparison of 2014 (Year 1) Traffic Noise Levels

Receiver ID	Property Address	Pre-Construction Predicted Year 1 $L_{Aeq(9hr)}$ Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
2	9-9A Gaudrons Road, Sapphire Beach	52	51	-0.4	-
3	9-9A Gaudrons Road, Sapphire Beach	52	50	-2.0	-
4	19 Gaudrons Road, Sapphire Beach	50	50	0.3	-
5	21 Gaudrons Road, Sapphire Beach	47	47	0.2	-
6	19 The Mountain Way (Row), Sapphire Beach	55	54	-0.7	-
7	18C The Mountain Way (Row), Sapphire Beach		PRE-TREA	TED	
8	18 The Mountain Way (Row), Sapphire Beach	60	60	-0.7	-
9	33 Hunter Close, Korora	63	62	-0.7	-
10	35 Hunter Close, Korora	57	56	-0.8	-
11	49 Hunter Close, Korora	53	52	-0.8	-
12	355-355A Old Coast Road, Korora	51	51	-0.7	-
13	355-355A Old Coast Road, Korora	49	49	-0.3	-
14	361-371 Old Coast Road, Korora	57	56	-0.6	-
15	369 Old Coast Rd and 19-21 Hunter Close, Korora	55	55	-0.8	-
16	369 Old Coast Rd and 19-21 Hunter Close, Korora	54	53	-0.7	-
17	17 Hunter Close, Korora	57	56	-0.9	-
18	13 Hunter Close, Korora	55	55	-0.6	-
19	11 Hunter Close, Korora	60	58	-2.2	-
20	369 Old Coast Rd and 19-21 Hunter Close, Korora	52	52	-0.6	-
21	817-817A Pacific Highway, Korora		INELIGIB	LE	
22	300 Old Coast Road, Korora	50	50	0.3	-
23	290 Old Coast Road, Korora	51	51	0.2	-

Table B.1 – Comparison of Pre and Post Construction Night L_{Aeq(9hr)} Traffic Noise Levels, dB(A)

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
24	815 Pacific Highway, Korora	65	64	-0.4	-
25	275 Old Coast Road, Korora	50	50	-0.2	-
26	245 Old Coast Road, Korora	51	51	-0.3	-
27	37 Campbell Close, Korora	51	50	-0.7	-
28	33-35 Campbell Close, Korora	51	51	-0.7	-
29	39 Campbell Close, Korora	58	57	-1.0	-
30	33-35 Campbell Close, Korora	52	51	-1.2	-
31	29-29A Campbell Close, Korora	51	49	-1.2	-
32	29-29A Campbell Close, Korora	49	47	-1.3	-
33	18-20 Campbell Close, Korora	53	51	-1.1	-
34	15-15A Campbell Close, Korora	57	56	-0.8	-
35	11 Campbell Close, Korora	56	56	0.0	-
36	9-11 Seaview Close, Korora	61	60	-0.2	-
37	9-11 Seaview Close, Korora	60	60	0.6	-
38	15-15A Campbell Close, Korora	53	52	-0.9	-
39	134 Old Coast Road, Korora	47	47	-0.4	-
40	18 Maccues Road, Moonee Beach	56	55	-1.3	-
41	14-30 Maccues Road, Moonee Beach	55	55	0.2	-
42	25 Maccues Road, Moonee Beach	55	55	-0.6	-
43	9 Maccues Road, Moonee Beach	58	57	-1.6	-
45	57 Maccues Road, Moonee Beach	50	51	0.7	-
46	56 Fairview Road, Sapphire Beach	49	49	-0.3	-
47	44 Fairview Road, Sapphire Beach	50	50	-0.6	-
48	40 Fairview Road, Sapphire Beach	53	52	-0.6	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
49	45 Fairview Road, Sapphire Beach	51	51	-0.7	-
50	49 Fairview Road, Sapphire Beach	51	50	-0.6	-
51	3 Fairview Road, Sapphire Beach	51	50	-0.8	-
52	4 Fairview Road, Sapphire Beach	54	53	-0.7	-
53	16 Wakelands Road, Sapphire Beach	55	54	-0.9	-
55	7 Wakelands Road, Sapphire Beach	59	58	-1.1	-
56	1 Wakelands Road, Sapphire Beach	60	58	-1.2	-
57	1a Wakelands Road, Sapphire Beach	60	59	-1.3	-
58	15 Wakelands Road, Sapphire Beach	55	54	-0.9	-
59	31 Wakelands Road, Sapphire Beach	53	52	-0.8	-
60	1059 Pacific Highway, Sapphire Beach	61	60	-1.0	-
61	37 Wakelands Road, Sapphire Beach	50	49	-0.7	-
62	1049 Pacific Highway, Sapphire Beach	60	59	-0.5	-
63	2 Sugarmill Road, Sapphire Beach	62	61	-0.9	-
64	2A Sugarmill Road, Sapphire Beach	62	61	-1.3	-
65	16 Sugarmill Road, Sapphire Beach	59	58	-0.9	-
66	28 Sugarmill Road, Sapphire Beach	51	51	-0.1	-
67	40 Sugarmill Road, Sapphire Beach	50	49	-0.5	-
68	29 Sugarmill Road, Sapphire Beach	53	53	-0.3	-
69	35 Sugarmill Road, Sapphire Beach	51	51	0.0	-
70	23 Sugarmill Road, Sapphire Beach	56	55	-0.8	-
71	48 Gaudrons Road, Sapphire Beach	47	46	-0.9	-
72	30-38 Gaudrons Road, Sapphire Beach	49	48	-0.7	-
73	1469 Pacific Highway, Moonee Beach	59	58	-0.7	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
75	98 Old Bucca Road, Moonee Beach	48	47	-0.3	-
76	105 Hoys Road, Moonee Beach	59	59	-0.7	-
77	61 Old Bucca Road, Moonee Beach	48	47	-0.5	-
78	55 Hoys Road, Moonee Beach	51	51	-0.4	-
79	39 Hoys Road, Moonee Beach	55	55	-0.5	-
80	41 Hoys Road, Moonee Beach	51	51	-0.6	-
81	45 Hoys Road, Moonee Beach	51	50	-0.5	-
82	49 Hoys Road, Moonee Beach	52	51	-0.8	-
83	38-48 Hoys Road, Moonee Beach	53	53	0.1	-
84	49B Hoys Road, Moonee Beach	50	49	-0.2	-
85	104 Hoys Road, Moonee Beach		INELIGIB	LE	
86	38-48 Hoys Road, Moonee Beach	58	57	-0.5	-
88	1721 Pacific Highway, Emerald Beach	54	54	-0.8	-
89	10 Lake Russell Drive, Emerald Beach	48	47	-0.3	-
90	4 Lake Russell Drive, Emerald Beach	49	49	-0.4	-
91	28 Smiths Road, Emerald Beach	51	50	-0.6	-
92	12 Smiths Road, Emerald Beach	52	51	-0.7	-
93	12 Smiths Road, Emerald Beach	54	53	-0.7	-
94	14-22 Smiths Road, Emerald Beach	53	52	-0.9	-
95	14-22 Smiths Road, Emerald Beach	54	53	-0.8	-
96	14-22 Smiths Road, Emerald Beach	56	55	-0.8	-
97	9 Smiths Road, Emerald Beach	58	57	-0.8	-
98	15E Smiths Road, Emerald Beach	61	61	-0.9	-
99	15 Smiths Road, Emerald Beach	52	51	-0.3	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
100	19 Smiths Road, Emerald Beach	53	52	-0.9	-
101	33 Smiths Road, Emerald Beach	51	50	-0.8	-
102	35 Smiths Road, Emerald Beach	51	50	-0.9	-
103	39 Smiths Road, Emerald Beach	49	47	-1.3	-
104	36 Smiths Road, Emerald Beach	49	48	-0.6	-
106	15A Smiths Road, Emerald Beach	52	51	-0.8	-
107	15B Smiths Road, Emerald Beach	55	54	-0.8	-
108	15C Smiths Road, Emerald Beach	56	55	-1.0	-
109	15F Smiths Road, Emerald Beach	54	53	-0.8	-
110	1637 Pacific Highway, Emerald Beach	62	62	-0.6	-
111	1635-1635A Pacific Highway, Emerald Beach	57	56	-0.8	-
112	1635-1635A Pacific Highway, Emerald Beach	56	56	-0.7	-
113	35 Goonaroo Place, Emerald Beach	53	52	-0.9	-
114	36 Goonaroo Place, Emerald Beach	53	52	-0.9	-
115	32 Goonaroo Place, Emerald Beach	52	51	-1.0	-
116	41 Kumbaingeri Close, Moonee Beach	56	54	-1.3	-
117	76 Heritage Drive, Moonee Beach	50	49	-1.3	-
118	75 Heritage Drive, Moonee Beach	51	50	-1.2	-
119	62 Heritage Drive, Moonee Beach	55	53	-1.3	-
121	1579 Pacific Highway, Moonee Beach		INELIGIB	LE	
122	1579 Pacific Highway, Moonee Beach	60	58	-2.1	-
123	46 Heritage Drive, Moonee Beach	60	59	-1.2	-
124	65 Heritage Drive, Moonee Beach	53	52	-1.2	-
125	40 Heritage Drive, Moonee Beach	60	60	-0.7	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
126	22 Heritage Drive, Moonee Beach	57	56	-0.8	-
127	16 Heritage Drive, Moonee Beach	54	53	-1.0	-
128	6 Heritage Drive, Moonee Beach	55	54	-0.7	-
129	9 Heritage Drive, Moonee Beach	52	51	-0.7	-
130	2 Sharpe Close, Moonee Beach	55	54	-1.1	-
131	2 Sharpe Close, Moonee Beach	53	52	-0.8	-
132	45 Heritage Drive, Moonee Beach	53	52	-1.0	-
133	4 Sharpe Close, Moonee Beach	52	51	-1.4	-
134	1 Sharpe Close, Moonee Beach	53	52	-0.6	-
135	19 Heritage Drive, Moonee Beach	52	51	-0.7	-
136	6 Sharpe Close, Moonee Beach	52	51	-0.6	-
137	91 Heritage Drive, Moonee Beach	50	49	-0.9	-
138	83 Graham Drive, Sandy Beach	48	47	-0.6	-
139	101 Graham Drive, Sandy Beach	50	49	-0.7	-
140	107 Graham Drive, Sandy Beach	51	51	-0.6	-
141	113 Graham Drive, Sandy Beach	51	50	-0.7	-
142	119 Graham Drive, Sandy Beach	52	51	-0.7	-
143	121 Graham Drive, Sandy Beach	52	51	-0.8	-
144	123 Graham Drive, Sandy Beach	51	51	-0.8	-
145	125 Graham Drive, Sandy Beach	51	50	-0.8	-
146	3 Casuarina Court, Sandy Beach	51	50	-1.2	-
147	5 Casuarina Court, Sandy Beach	53	53	-0.8	-
148	9 Casuarina Court, Sandy Beach	60	58	-1.7	-
149	8 Casuarina Court, Sandy Beach	58	57	-0.9	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
150	6 Casuarina Court, Sandy Beach	56	56	-0.7	-
151	2 Casuarina Court, Sandy Beach	52	50	-1.3	-
152	2A Casuarina Court, Sandy Beach	50	49	-1.2	-
153	127 Graham Drive, Sandy Beach	51	50	-0.9	-
154	4 Anselmo Close, Emerald Beach	52	51	-0.9	-
155	2 Anselmo Close, Emerald Beach	55	53	-1.3	-
156	1 Emerald Heights Drive, Emerald Beach	60	56	-4.1	-
158	5 Emerald Heights Drive, Emerald Beach	58	57	-0.4	-
159	9 Emerald Heights Drive, Emerald Beach	60	59	-0.6	-
160	1 Anselmo Close, Emerald Beach	48	47	-0.8	-
161	5 Anselmo Close, Emerald Beach	45	44	-1.1	-
162	10 Emerald Heights Drive, Emerald Beach	49	48	-1.0	-
163	2 Stefan Close, Emerald Beach	48	47	-0.8	-
164	4 Stefan Close, Emerald Beach	51	51	-0.5	-
165	6 Stefan Close, Emerald Beach	47	47	-0.1	-
166	8 Stefan Close, Emerald Beach	48	48	-0.6	-
167	10 Stefan Close, Emerald Beach	47	46	-0.7	-
168	17 Emerald Heights Drive, Emerald Beach	59	58	-0.3	-
169	21 Emerald Heights Drive, Emerald Beach	59	58	-0.7	-
170	25 Emerald Heights Drive, Emerald Beach	57	56	-1.3	-
171	29 Emerald Heights Drive, Emerald Beach	56	54	-1.8	-
172	33 Emerald Heights Drive, Emerald Beach	55	54	-1.7	-
173	37 Emerald Heights Drive, Emerald Beach	55	53	-2.0	-
174	41 Emerald Heights Drive, Emerald Beach	55	53	-2.0	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
175	45 Emerald Heights Drive, Emerald Beach	54	52	-2.0	-
176	Nursery, 49 Emerald Heights Drive, Emerald Beach	54	52	-2.4	-
177	53 Emerald Heights Drive, Emerald Beach	52	50	-2.2	-
178	61 Emerald Heights Drive, Emerald Beach	54	52	-2.0	-
179	65 Emerald Heights Drive, Emerald Beach	54	52	-2.0	-
180	69 Emerald Heights Drive, Emerald Beach	59	57	-1.6	-
181	73 Emerald Heights Drive, Emerald Beach	58	56	-1.3	-
182	77 Emerald Heights Drive, Emerald Beach	57	55	-1.3	-
183	34 Emerald Heights Drive, Emerald Beach	51	49	-1.4	-
184	1 Stefan Close, Emerald Beach	55	54	-0.7	-
185	44 Emerald Heights Drive, Emerald Beach	49	48	-1.5	-
186	81 Emerald Heights Drive, Emerald Beach	56	54	-1.2	-
187	46 Emerald Heights Drive, Emerald Beach	53	52	-1.5	-
188	7 Poynten Drive, Emerald Beach	48	47	-1.4	-
189	54 Emerald Heights Drive, Emerald Beach	52	51	-1.1	-
190	85 Emerald Heights Drive, Emerald Beach	55	54	-1.0	-
191	5 Poynten Drive, Emerald Beach	49	47	-1.6	-
192	11 Poynten Drive, Emerald Beach	47	45	-1.3	-
193	4 Poynten Drive, Emerald Beach	47	46	-1.3	-
194	42 Emerald Heights Drive, Emerald Beach	49	47	-1.7	-
195	1789 Pacific Highway, Emerald Beach	62	61	-0.5	-
196	6 Oak Close, Sandy Beach	58	56	-1.6	-
197	8 Oak Close, Sandy Beach	57	56	-1.0	-
198	7 Oak Close, Sandy Beach	56	54	-1.7	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
199	5 Oak Close, Sandy Beach	54	53	-1.0	-
200	3 Oak Close, Sandy Beach	52	51	-1.1	-
201	1 Oak Close, Sandy Beach	53	52	-0.4	-
202	79 Blackbutt Avenue, Sandy Beach	54	53	-0.7	-
203	77 Blackbutt Avenue, Sandy Beach	53	53	-0.8	-
204	75 Blackbutt Avenue, Sandy Beach	53	52	-0.7	-
205	73 Blackbutt Avenue, Sandy Beach	53	53	-0.8	-
206	71 Blackbutt Avenue, Sandy Beach	52	51	-0.9	-
207	50 Blackbutt Avenue, Sandy Beach	53	52	-0.8	-
209	47 Diamond Head Drive, Sandy Beach	52	51	-0.9	-
210	61 Blackbutt Avenue, Sandy Beach	51	51	-0.5	-
211	26 Diamond Head Drive, Sandy Beach	48	47	-0.5	-
212	44 Turpentine Avenue, Sandy Beach	49	48	-0.7	-
213	58 Turpentine Avenue, Sandy Beach	53	53	-0.5	-
214	30 Mahogany Avenue, Sandy Beach	54	53	-0.5	-
215	35 Mahogany Avenue, Sandy Beach	55	54	-0.8	-
216	33 Mahogany Avenue, Sandy Beach	56	55	-0.7	-
217	31 Mahogany Avenue, Sandy Beach	55	55	-0.9	-
218	29 Mahogany Avenue, Sandy Beach	55	53	-1.2	-
219	27 Mahogany Avenue, Sandy Beach	55	54	-0.8	-
220	21 Mahogany Avenue, Sandy Beach	54	53	-0.7	-
221	13 Mahogany Avenue, Sandy Beach	53	52	-1.4	-
222	9 Mahogany Avenue, Sandy Beach	59	58	-1.4	-
223	7 Mahogany Avenue, Sandy Beach	64	63	-1.1	-

Receiver ID	Property Address	$\begin{array}{l} \mbox{Pre-Construction Predicted} \\ \mbox{Year 1} \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
224	5 Mahogany Avenue, Sandy Beach	65	64	-1.0	-
225	52 Diamond Head Drive, Sandy Beach	68	67	-1.0	-
227	34 Turpentine Avenue, Sandy Beach		INELIGIB	LE	
228	65 Graham Drive, Sandy Beach	48	47	-0.6	-
229	65 Graham Drive, Sandy Beach	47	46	-0.6	-
231	30 Ironbark Avenue, Sandy Beach	52	52	-0.3	-
232	96 Diamond Head Drive, Sandy Beach	52	52	-0.5	-
233	60 Diamond Head Drive, Sandy Beach	54	53	-0.8	-
234	1/56 Diamond Head Drive, Sandy Beach	54	52	-1.7	-
235	54 Diamond Head Drive, Sandy Beach	66	64	-1.9	-
236	62 Diamond Head Drive, Sandy Beach	55	54	-1.2	-
237	3 Pine Crescent, Sandy Beach	59	54	-5.0	-
238	5 Pine Crescent, Sandy Beach	63	58	-5.2	-
239	7 Pine Crescent, Sandy Beach	61	57	-3.9	-
240	9 Pine Crescent, Sandy Beach	65	64	-1.2	-
241	11 Pine Crescent, Sandy Beach	58	57	-1.2	-
242	13 Pine Crescent, Sandy Beach	56	55	-1.0	-
243	15 Pine Crescent, Sandy Beach	53	52	-0.8	-
244	17 Pine Crescent, Sandy Beach	53	52	-0.7	-
246	21 Pine Crescent, Sandy Beach	52	52	-0.5	-
247	25 Pine Crescent, Sandy Beach	52	52	-0.6	-
248	23 Pine Crescent, Sandy Beach	52	51	-0.7	-
249	12 Pine Crescent, Sandy Beach	47	46	-0.8	-
250	10 Pine Crescent, Sandy Beach	47	47	-0.4	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
251	8 Pine Crescent, Sandy Beach	52	51	-0.7	-
252	6 Pine Crescent, Sandy Beach	53	52	-0.8	-
253	4 Pine Crescent, Sandy Beach	51	50	-1.3	-
255	61 Diamond Head Drive, Sandy Beach	52	51	-1.2	-
256	65 Diamond Head Drive, Sandy Beach	51	50	-0.9	-
257	67 Diamond Head Drive, Sandy Beach	50	49	-1.2	-
258	69 Diamond Head Drive, Sandy Beach	50	49	-1.0	-
259	14 Pine Crescent, Sandy Beach	48	47	-0.6	-
260	1800 Pacific Highway, Emerald Beach	59	58	-1.4	-
261	6 Fiddaman Road, Emerald Beach	58	57	-1.2	-
262	8 Fiddaman Road, Emerald Beach	53	51	-1.9	-
263	14 Fiddaman Road, Emerald Beach	53	52	-1.3	-
264	16 Fiddaman Road, Emerald Beach	53	52	-1.2	-
265	18 Fiddaman Road, Emerald Beach	54	53	-1.3	-
266	20 Fiddaman Road, Emerald Beach	50	49	-0.7	-
267	1 Fiddaman Road, Emerald Beach		DEMOLIS	Ή	
268	3 Fiddaman Road, Emerald Beach	62	59	-2.6	-
269	5 Fiddaman Road, Emerald Beach	60	59	-1.4	-
270	9 Fiddaman Road, Emerald Beach	58	56	-1.6	-
271	13 Fiddaman Road, Emerald Beach	56	55	-1.2	-
272	15 Fiddaman Road, Emerald Beach	55	53	-1.4	-
273	17 Fiddaman Road, Emerald Beach	55	54	-1.1	-
274	19 Fiddaman Road, Emerald Beach	55	53	-1.6	-
275	1720 Pacific Highway, Moonee Beach		INELIGIB	LE	

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
277	9 Bream Close, Emerald Beach	51	50	-0.3	-
278	6 Estuary Drive, Moonee Beach	51	50	-0.3	-
279	10-12 Estuary Drive, Moonee Beach		INELIGIB	LE	
280	18 Estuary Drive, Moonee Beach	50	49	-0.4	-
281	1-9 Tidal Crescent, Moonee Beach	50	50	-0.1	-
282	1-9 Tidal Crescent, Moonee Beach	50	49	-0.4	-
283	2 Tiki Road (Row), Moonee Beach	62	62	-0.8	-
284	10 Tiki Road (Row), Moonee Beach	58	58	-0.6	-
285	10 Tiki Road (Row), Moonee Beach	59	58	-0.5	-
286	16 Tiki Road (Row), Moonee Beach	55	53	-1.2	-
287	26 Tiki Road (Row), Moonee Beach	53	52	-1.2	-
288	36 Tiki Road (Row), Moonee Beach	51	50	-0.8	-
289	60 Tiki Road (Row), Moonee Beach	51	50	-0.6	-
290	1206A Pacific Highway, Moonee Beach	60	59	-0.6	-
291	1206B Pacific Highway, Moonee Beach	61	60	-0.4	-
292	1206C Pacific Highway, Moonee Beach	62	62	-0.2	-
295	1206B Pacific Highway, Moonee Beach		INELIGIB	LE	
297	22-24 Woodhouse Road, Moonee Beach	55	55	-0.5	-
298	6 Woodhouse Road, Moonee Beach	53	51	-1.9	-
299	8 Moonee Beach Road, Moonee Beach	53	51	-1.4	-
300	21 Moonee Beach Road, Moonee Beach	52	50	-1.5	-
301	7 Moonee Beach Road, Moonee Beach	53	50	-2.8	-
302	9 Moonee Beach Road, Moonee Beach	53	49	-3.9	-
303	11 Moonee Beach Road, Moonee Beach	53	50	-2.7	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
304	13 Moonee Beach Road, Moonee Beach	52	49	-3.1	-
305	15 Moonee Beach Road, Moonee Beach	54	52	-1.4	-
306	19 Moonee Beach Road, Moonee Beach	53	51	-1.4	-
307	12 Alpini Place, Sapphire Beach	56	55	-1.0	-
308	10 Alpini Place, Sapphire Beach	57	56	-0.9	-
309	8 Alpini Place, Sapphire Beach	60	59	-0.8	-
310	8 Alpini Place, Sapphire Beach	60	59	-0.8	-
311	6 Alpini Place, Sapphire Beach	55	54	-0.8	-
312	4 Alpini Place, Sapphire Beach	54	53	-1.0	-
313	2 Alpini Place, Sapphire Beach	54	54	-0.5	-
314	18 Split Solitary Road, Sapphire Beach	49	48	-1.7	-
315	5 Split Solitary Road, Sapphire Beach		DEMOLIS	ίΗ	
316	11 Split Solitary Road, Sapphire Beach	53	53	-0.5	-
317	15 Split Solitary Road, Sapphire Beach	50	50	-0.6	-
318	13 Split Solitary Road, Sapphire Beach	52	51	-0.5	-
319	1026 Pacific Highway, Sapphire Beach	55	54	-0.9	-
320	1026F Pacific Highway, Sapphire Beach	57	56	-1.0	-
321	1026E Pacific Highway, Sapphire Beach	57	55	-2.0	-
322	1026G Pacific Highway, Sapphire Beach	59	57	-1.9	-
323	1026A Pacific Highway, Sapphire Beach	58	56	-2.1	-
324	1/1026B Pacific Highway, Sapphire Beach	58	56	-1.8	-
325	1026C Pacific Highway, Sapphire Beach	58	56	-2.1	-
326	1026D Pacific Highway, Sapphire Beach	58	56	-2.1	-
327	1026 Pacific Highway, Sapphire Beach		DEMOLIS	5H	

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?	
328	7 Alpini Place, Sapphire Beach	55	53	-1.8	-	
329	5 Alpini Place, Sapphire Beach	51	49	-2.3	-	
330	3 Alpini Place, Sapphire Beach	49	48	-1.0	-	
331	26 Coachmans Close, Korora	52	52	0.5	-	
332	1 Coachmans Close, Sapphire Beach	63	63	-0.3	-	
333	13 Coachmans Close, Sapphire Beach		PRE-TREAT	TED		
334	Nautilus Beachfront Villas, 746 Pacific Highway, Sapphire Beach	51	51	-0.6	-	
335	Ben Nevis, 770 Pacific Highway, Sapphire Beach		PRE-TREAT	red		
336	786 Pacific Highway, Sapphire Beach	62	60	-1.4	-	
337	8 Sapphire Place, Sapphire Beach	PRE-TREATED				
338	4 Sapphire Place, Sapphire Beach		PRE-TREAT	red		
339	2 Sapphire Place, Sapphire Beach		PRE-TREAT	red		
340	21 Sapphire Crescent, Sapphire Beach	53	51	-1.5	-	
341	19 Sapphire Crescent, Sapphire Beach	50	49	-0.5	-	
342	17 Sapphire Crescent, Sapphire Beach	52	51	-1.2	-	
343	15 Sapphire Crescent, Sapphire Beach	52	51	-1.3	-	
344	13 Sapphire Crescent, Sapphire Beach	49	48	-1.1	-	
345	11 Sapphire Crescent, Sapphire Beach	52	51	-1.3	-	
347	9 Sapphire Crescent, Sapphire Beach	50	50	-0.2	-	
348	3 Sapphire Crescent, Sapphire Beach	50	49	-1.3	-	
349	1 Sapphire Crescent, Sapphire Beach	48	47	-1.3	-	
350	4 Sapphire Crescent, Sapphire Beach	50	49	-1.3	-	
351	6 Sapphire Crescent, Sapphire Beach	50	49	-0.8	-	
352	8 Sapphire Crescent, Sapphire Beach	51	50	-0.8	-	

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
353	10 Sapphire Crescent, Sapphire Beach	55	54	-1.4	-
354	11 Sapphire Place, Sapphire Beach	50	49	-0.5	-
355	5 Sapphire Place, Sapphire Beach	46	46	-0.9	-
356	1 Sapphire Place, Sapphire Beach	50	49	-1.2	-
357	27A Sapphire Crescent, Sapphire Beach	55	54	-1.3	-
359	840 Pacific Highway, Sapphire Beach	57	56	-1.3	-
360	29/840 Pacific Highway, Sapphire Beach	53	52	-1.2	-
361	46A Warrawee Street, Sapphire Beach	52	51	-1.3	-
362	44 Warrawee Street, Sapphire Beach		PRE-TREA	red	
363	46 Warrawee Street, Sapphire Beach	54	51	-2.1	-
364	48 Warrawee Street, Sapphire Beach	46	45	-0.9	-
365	29 Warrawee Street, Sapphire Beach	56	55	-1.1	-
366	27 Warrawee Street, Sapphire Beach	57	55	-1.7	-
367	25 Warrawee Street, Sapphire Beach	51	50	-1.0	-
368	23 Warrawee Street, Sapphire Beach	54	52	-1.4	-
369	2 Elouera Drive, Sapphire Beach	54	53	-0.6	-
370	42 Warrawee Street, Sapphire Beach	59	58	-0.9	-
371	40 Warrawee Street, Sapphire Beach	57	56	-0.8	-
372	38 Warrawee Street, Sapphire Beach	54	53	-1.1	-
373	36 Warrawee Street, Sapphire Beach	52	51	-0.9	-
374	1 Elouera Drive, Sapphire Beach	51	50	-1.2	-
375	34 Warrawee Street, Sapphire Beach	53	52	-0.9	-
376	32 Warrawee Street, Sapphire Beach	52	52	-0.8	-
377	30 Warrawee Street, Sapphire Beach	50	49	-0.9	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 $L_{Aeq(9hr)}$ Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
378	1/28 Warrawee Street, Sapphire Beach		PRE-TREA	TED	
379	26 Warrawee Street, Sapphire Beach		PRE-TREA	TED	
380	24 Warrawee Street, Sapphire Beach	52	52	-0.9	-
381	22 Warrawee Street, Sapphire Beach	50	49	-0.8	-
382	18 Warrawee Street, Sapphire Beach	50	49	-0.9	-
383	16 Warrawee Street, Sapphire Beach	51	50	-0.9	-
384	14 Warrawee Street, Sapphire Beach	51	50	-0.9	-
385	12 Warrawee Street, Sapphire Beach	52	51	-0.9	-
386	10 Warrawee Street, Sapphire Beach	52	51	-1.0	-
387	8 Warrawee Street, Sapphire Beach	55	53	-1.4	-
388	6 Warrawee Street, Sapphire Beach	54	53	-1.1	-
389	The Corner Store, 4 Headland Road, Sapphire Beach	58	56	-1.7	-
390	6 Headland Road, Sapphire Beach	53	52	-1.7	-
391	16 Headland Road, Sapphire Beach	50	50	-0.7	-
392	9 Headland Road, Sapphire Beach	52	51	-1.5	-
393	1 Beach Road, Sapphire Beach	53	52	-1.7	-
394	3 Beach Road, Sapphire Beach	55	53	-1.8	-
395	2 Crystal Drive, Sapphire Beach	53	52	-1.4	-
396	4 Crystal Drive, Sapphire Beach	55	53	-1.6	-
397	4A Crystal Drive, Sapphire Beach	53	52	-1.8	-
398	6 Crystal Drive, Sapphire Beach	49	48	-1.3	-
399	1 Crystal Drive, Sapphire Beach		PRE-TREA	TED	
400	3 Crystal Drive, Sapphire Beach		PRE-TREA	TED	
401	5 Crystal Drive, Sapphire Beach	58	56	-2.0	-

Receiver ID	Property Address	$\begin{array}{l} \mbox{Pre-Construction Predicted} \\ \mbox{Year 1 } L_{\mbox{Aeq(9hr)}} \mbox{ Noise Level }^1 \end{array}$	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
402	7 Crystal Drive, Sapphire Beach		PRE-TREA	TED	
403	9 Crystal Drive, Sapphire Beach		PRE-TREA	TED	
404	11 Crystal Drive, Sapphire Beach	54	53	-1.5	-
405	13 Crystal Drive, Sapphire Beach	52	51	-1.6	-
406	15 Crystal Drive, Sapphire Beach	52	50	-1.5	-
407	17 Crystal Drive, Sapphire Beach	51	50	-1.4	-
408	19 Crystal Drive, Sapphire Beach	50	49	-1.3	-
409	21 Crystal Drive, Sapphire Beach	50	48	-1.3	-
410	23 Crystal Drive, Sapphire Beach	49	48	-1.1	-
411	25 Crystal Drive, Sapphire Beach	49	48	-1.2	-
412	27 Crystal Drive, Sapphire Beach	48	47	-1.1	-
414	281A Graham Drive, Sandy Beach	51	51	-0.1	-
415	285 Graham Drive, Sandy Beach	54	54	-0.1	-
416	3 Unwins Road, Woolgoolga	55	54	-0.4	-
417	Pacific Highway, Woolgoolga	53	53	-0.2	-
424	309 Newmans Road, Woolgoolga	45	45	0.1	-
425	227 Newmans Road, Woolgoolga	56	57	1.1	-
426	237 Woolgoolga Creek Road, Woolgoolga	47	46	-0.2	-
427	241 Woolgoolga Creek Road, Woolgoolga	45	45	-0.5	-
428	30 Freemans Road, Woolgoolga	45	44	-0.5	-
429	12 Freemans Road, Woolgoolga	43	43	0.2	-
430	200 Woolgoolga Creek Road, Woolgoolga	51	50	-0.8	-
431	14 Sanctuary Drive, Woolgoolga	51	51	-0.8	-
432	6 Freemans Road, Woolgoolga	50	49	-0.6	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?	
433	11 Freemans Road, Woolgoolga	45	45	0.1	-	
434	19 Freemans Road, Woolgoolga	44	44	0.3	-	
435	39 Freemans Road, Woolgoolga	45	45	0.1	-	
436	16 Park Avenue, Woolgoolga	49	48	-0.9	-	
437	28 Park Avenue, Woolgoolga	47	47	-0.4	-	
438	29 Park Avenue, Woolgoolga	48	48	-0.3	-	
439	25 Park Avenue, Woolgoolga	51	50	-0.7	-	
440	17 Park Avenue, Woolgoolga	52	51	-1.1	-	
441	15 Park Avenue, Woolgoolga	56	54	-2.0	-	
442	42 Greys Road, Woolgoolga	DEMOLISH				
443	18 Sanctuary Drive, Woolgoolga	50	49	-0.9	-	
444	244 Bark Hut Road, Woolgoolga	55	55	0.4	-	
445	235-235A Bark Hut Road, Woolgoolga	53	53	0.1	-	
446	234 Bark Hut Road, Woolgoolga	55	56	0.5	-	
447	226 Bark Hut Road, Woolgoolga	57	57	-0.4	-	
450	1 Arrawarra Beach Road, Arrawarra	54	54	0.1	-	
451	1 Arrawarra Beach Road, Arrawarra	51	51	0.4	-	
452	74 Eggins Drive, Arrawarra	53	53	0.3	-	
453	74 Eggins Drive, Arrawarra	53	53	0.4	-	
454a	115 Wedding Bells Way (Row), Woolgoolga		INELIGIB	LE		
454b	115 Wedding Bells Way (Row), Woolgoolga	54	55	0.8	-	
455	85 Wedding Bells Way (Row), Woolgoolga	53	53	0.8	-	
456	210 Bark Hut Road, Woolgoolga		DEMOLIS	5H		
457	199 Bark Hut Road, Woolgoolga	48	47	-0.6	-	

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
458	185 Bark Hut Road, Woolgoolga	45	45	-0.2	-
459	181 Bark Hut Road, Woolgoolga	43	43	-0.3	-
460	215 Bark Hut Road, Woolgoolga	49	48	-0.8	-
461	169 Bark Hut Road, Woolgoolga	43	43	-0.1	-
462	45 Palmer Road, Woolgoolga	43	43	-0.5	-
463	49 Palmer Road, Woolgoolga	44	44	-0.7	-
464	181 Bark Hut Road, Woolgoolga	42	41	-0.4	-
465	33 Palmer Road, Woolgoolga	43	43	0.0	-
466	40 Palmer Road, Woolgoolga	43	43	-0.2	-
467	32 Palmer Road, Woolgoolga	43	43	0.0	-
468	46 Palmer Road, Woolgoolga	50	50	-0.5	-
469	52 Palmer Road, Woolgoolga	51	50	-0.7	-
470	56 Palmer Road, Woolgoolga	54	53	-0.9	-
471	49 Palmer Road, Woolgoolga	44	43	-0.7	-
472	66 Palmer Road, Woolgoolga	51	50	-0.9	-
473	254 Newmans Road, Woolgoolga		INELIGIB	LE	
474	254 Newmans Road, Woolgoolga	47	47	-0.4	-
475	240 Newmans Road, Woolgoolga	48	48	-0.2	-
476	216 Newmans Road, Woolgoolga	46	45	-0.5	-
477	210 Newmans Road, Woolgoolga		INELIGIB	LE	
478	Newmans Road, Woolgoolga	50	49	-1.2	-
479	207-209 Newmans Road, Woolgoolga		INELIGIB	LE	
480	201 Newmans Road, Woolgoolga		INELIGIB	LE	
481	210 Newmans Road, Woolgoolga	45	45	0.0	-
Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
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482	187 Newmans Road, Woolgoolga	54	52	-1.4	-
483	4 Wolstenholme Court, Woolgoolga	47	47	-0.2	-
484	1/19 Gresham Drive, Woolgoolga	47	46	-0.7	-
485	21 Gresham Drive, Woolgoolga	50	49	-0.4	-
486	17 Gresham Drive, Woolgoolga	47	46	-0.2	-
487	15 Gresham Drive, Woolgoolga	42	42	0.1	-
488	20 Gresham Drive, Woolgoolga	47	46	-0.6	-
489	22 Gresham Drive, Woolgoolga	48	47	-0.5	-
490	24 Gresham Drive, Woolgoolga	49	48	-0.6	-
491	26 Gresham Drive, Woolgoolga	50	49	-0.8	-
492	11 Stanner Close, Woolgoolga	48	47	-0.6	-
493	10 Stanner Close, Woolgoolga	47	46	-0.7	-
494	102 Woolgoolga Creek Road, Woolgoolga	44	44	-0.6	-
495	12-12A Greys Road, Woolgoolga	54	53	-0.6	-
496	25 Greys Road, Woolgoolga	56	55	-0.5	-
497	9 Greys Road, Woolgoolga	46	45	-0.5	-
498	127 Woolgoolga Creek Road, Woolgoolga	54	53	-0.8	-
499	111E Woolgoolga Creek Road, Woolgoolga	42	41	-0.6	-
500	109 Woolgoolga Creek Road, Woolgoolga	45	44	-0.4	-
501	111D Woolgoolga Creek Road, Woolgoolga	41	41	-0.5	-
502	111B Woolgoolga Creek Road, Woolgoolga	46	45	-0.7	-
503	111C Woolgoolga Creek Road, Woolgoolga	46	46	0.0	-
504	21 Greys Road, Woolgoolga	51	51	-0.2	-
505	111 Woolgoolga Creek Road, Woolgoolga	48	49	0.2	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 $L_{Aeq(9hr)}$ Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
506	111B Woolgoolga Creek Road, Woolgoolga	41	41	-0.4	-
507	2377C Pacific Highway, Woolgoolga	51	49	-1.9	-
508	2377 Pacific Highway, Woolgoolga	45	44	-0.8	-
509	Haviland Street, Woolgoolga	29	29	-0.1	-
510	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	55	55	-0.3	-
511	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	54	54	-0.2	-
512	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	53	53	-0.3	-
513	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga		INELIGIB	LE	
514	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	59	58	-0.9	-
515	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	49	48	-0.3	-
516	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	53	52	-1.1	-
517	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	51	51	-0.5	-
518	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	50	50	-0.4	-
519	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	47	48	0.8	-
520	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	48	49	1.5	-
521	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	48	49	0.9	-
522	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	47	45	-1.9	-
523	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	47	47	-0.7	-
525	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	47	46	-0.8	-
526	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	47	47	-0.2	-
527	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	47	47	-0.4	-
528	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	47	47	-0.1	-
529	11 Hearnes Lake Road, Woolgoolga		INELIGIB	LE	
530	11a Hearnes Lake Road, Woolgoolga	52	52	0.2	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 $L_{Aeq(9hr)}$ Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
531	1 Hearnes Lake Road, Woolgoolga	55	54	-1.1	-
532	1 Hearnes Lake Road, Woolgoolga	55	54	-0.9	-
533	13 Hearnes Lake Road, Woolgoolga	53	52	-0.8	-
545	2986 Pacific Highway, Arrawarra Headland	54	54	-0.7	-
546	2986 Pacific Highway, Arrawarra Headland	58	58	0.1	-
547	2921 Pacific Highway, Woolgoolga	51	50	-1.1	-
567	26 Arkan Avenue, Woolgoolga	45	45	-0.4	-
568	24 Arkan Avenue, Woolgoolga	45	44	-0.5	-
569	Presbyterian Church, 1 Landrigan Close, Woolgoolga	44	44	-0.3	-
600	8 Pine Brush Crescent, Korora	45	46	0.5	-
601	4 Coachmans Close, Korora	44	45	0.5	-
602	6 Coachmans Close, Korora	45	46	0.7	-
603	8 Coachmans Close, Korora		PRE-TREA	ſED	
604	10 Coachmans Close, Korora	46	47	0.8	-
605	12 Coachmans Close, Korora	47	48	0.8	-
606	14 Coachmans Close, Korora	48	49	0.7	-
607	16 Coachmans Close, Korora	48	49	1.2	-
608	4 Fernleigh Avenue, Korora	47	48	0.9	-
609	1 Fernleigh Avenue, Korora	51	52	0.8	-
610	22 Coachmans Close, Korora		PRE-TREA	red	
611	28 Coachmans Close, Korora		PRE-TREA	ſED	
612	30 Coachmans Close, Korora		PRE-TREA	red	
613	34 Coachmans Close, Sapphire Beach	51	52	0.2	-
614	36 Coachmans Close, Sapphire Beach	44	47	2.8	Yes

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
615	Bellevue, 689 Pacific Highway, Korora		PRE-TREA	TED	
616	701 Pacific Highway, Korora		PRE-TREA	TED	
617	1 Seaview Close, Korora		PRE-TREA	TED	
618	3A Coachmans Close, Sapphire Beach	57	56	-0.5	-
619	3 Coachmans Close, Sapphire Beach	57	56	-1.0	-
620	5A Coachmans Close, Sapphire Beach	52	51	-0.5	-
621	7 Coachmans Close, Sapphire Beach	49	49	-0.6	-
622	9 Coachmans Close, Sapphire Beach	56	54	-2.0	-
623	11 Coachmans Close, Sapphire Beach	58	57	-1.4	-
624	7/744 Pacific Highway, Sapphire Beach	58	58	-0.9	-
625	7/744 Pacific Highway, Sapphire Beach	53	51	-1.4	-
626	Nautilus Beachfront Villas, 746 Pacific Highway, Sapphire Beach	48	47	-0.7	-
627	Nautilus Beachfront Villas, 746 Pacific Highway, Sapphire Beach	47	47	-0.6	-
628	Nautilus Beachfront Villas, 746 Pacific Highway, Sapphire Beach	47	46	-0.5	-
629	Nautilus Beachfront Villas, 746 Pacific Highway, Sapphire Beach	46	46	-0.7	-
630	Nautilus Beachfront Villas, 746 Pacific Highway, Sapphire Beach	46	45	-1.0	-
631	Nautilus Beachfront Villas, 746 Pacific Highway, Sapphire Beach	46	45	-0.6	-
632	Nautilus Beachfront Villas, 746 Pacific Highway, Sapphire Beach	46	45	-0.8	-
634	Sapphire Pines, 29/784 Pacific Highway, Sapphire Beach	60	59	-1.1	-
635	6 Sapphire Place, Sapphire Beach		PRE-TREA	TED	
636	27 Sapphire Crescent, Sapphire Beach		PRE-TREA	TED	
637	23 Sapphire Crescent, Sapphire Beach	52	51	-1.5	-
638	45 The Mountain Way (Row), Sapphire Beach	50	50	-0.6	-
639	40 The Mountain Way (Row), Sapphire Beach	52	52	-0.1	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 $L_{Aeq(9hr)}$ Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?	
640	1 Alpini Place, Sapphire Beach	50	49	-0.9	-	
641	3 Gumtree Glen, Sapphire Beach	47	45	-1.7	-	
642	7 Gumtree Glen, Sapphire Beach	49	47	-1.5	-	
643	28-30 Split Solitary Road, Sapphire Beach	49	48	-1.4	-	
644	32-34 Split Solitary Road, Sapphire Beach	48	47	-1.2	-	
645	18 Gaudrons Road, Sapphire Beach	56	55	-0.6	-	
646	26 Gaudrons Road, Sapphire Beach	51	50	-1.0	-	
647	1510 Pacific Highway, Moonee Beach	58	57	-0.9	-	
648	55 Tiki Road (Row), Moonee Beach	52	51	-0.7	-	
649	1768 Pacific Highway, Moonee Beach	DEMOLISH				
650	10 Fiddaman Road, Emerald Beach	56	55	-1.6	-	
651	12 Fiddaman Road, Emerald Beach	52	51	-1.3	-	
652	7 Fiddaman Road, Emerald Beach	59	57	-1.3	-	
653	21 Fiddaman Road, Emerald Beach	55	54	-1.4	-	
654	Shell Service Stn, 1850-1850A Pacific Highway, Emerald Beach		INELIGIB	LE		
655	50 Emerald Heights Drive, Emerald Beach	53	52	-1.0	-	
656	48 Emerald Heights Drive, Emerald Beach	53	52	-0.8	-	
657	3 Topaz Drive, Emerald Beach	48	46	-1.9	-	
658	1 Topaz Drive, Emerald Beach	50	48	-1.9	-	
659	2 Topaz Drive, Emerald Beach	51	49	-1.8	-	
660	32 Emerald Heights Drive, Emerald Beach	52	51	-1.5	-	
661	30 Emerald Heights Drive, Emerald Beach	54	52	-1.3	-	
662	28 Emerald Heights Drive, Emerald Beach	54	53	-1.6	-	
663	26 Emerald Heights Drive, Emerald Beach	53	52	-1.4	-	

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
664	1/24 Emerald Heights Drive, Emerald Beach	55	54	-1.5	-
665	22 Emerald Heights Drive, Emerald Beach	55	54	-0.8	-
666	20 Emerald Heights Drive, Emerald Beach	55	53	-1.7	-
667	18 Emerald Heights Drive, Emerald Beach	55	54	-1.0	-
668	16 Emerald Heights Drive, Emerald Beach	54	53	-1.2	-
669	3 Stefan Close, Emerald Beach	55	54	-0.9	-
670	5 Stefan Close, Emerald Beach	54	53	-0.8	-
671	3 Anselmo Close, Emerald Beach	44	43	-0.9	-
672	6 Anselmo Close, Emerald Beach	52	51	-0.9	-
673	8 Anselmo Close, Emerald Beach	50	49	-1.2	-
674	7 Anselmo Close, Emerald Beach	48	47	-0.9	-
675	130 Graham Drive, Sandy Beach	49	48	-0.9	-
676	4 Casuarina Court, Sandy Beach	54	52	-1.2	-
677	7 Casuarina Court, Sandy Beach	57	56	-1.4	-
678	20 Redbox Crescent, Sandy Beach	54	54	-0.5	-
679	22 Redbox Crescent, Sandy Beach	54	54	-0.5	-
680	24 Redbox Crescent, Sandy Beach	53	52	-0.4	-
681	26 Redbox Crescent, Sandy Beach	52	51	-0.8	-
682	18 Redbox Crescent, Sandy Beach	54	53	-0.6	-
683	19 Mahogany Avenue, Sandy Beach	54	53	-0.8	-
684	17 Mahogany Avenue, Sandy Beach	52	51	-0.9	-
685	15 Mahogany Avenue, Sandy Beach	54	53	-0.9	-
686	25 Mahogany Avenue, Sandy Beach	55	54	-0.7	-
687	28 Mahogany Avenue, Sandy Beach	50	49	-0.7	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
688	26 Mahogany Avenue, Sandy Beach	51	51	-0.4	-
689	24 Mahogany Avenue, Sandy Beach	51	51	-0.4	-
690	60 Turpentine Avenue, Sandy Beach	51	50	-0.4	-
691	37 Turpentine Avenue, Sandy Beach	50	50	-0.6	-
692	18 Mahogany Avenue, Sandy Beach	51	50	-0.7	-
693	16 Mahogany Avenue, Sandy Beach	51	51	-0.7	-
694	14 Mahogany Avenue, Sandy Beach	52	51	-0.9	-
695	12 Mahogany Avenue, Sandy Beach	53	52	-1.0	-
696	10 Mahogany Avenue, Sandy Beach	53	52	-1.0	-
697	8 Mahogany Avenue, Sandy Beach	54	53	-0.9	-
698	6 Mahogany Avenue, Sandy Beach	55	54	-1.0	-
699	4 Mahogany Avenue, Sandy Beach	56	55	-0.9	-
700	46 Diamond Head Drive, Sandy Beach	56	55	-1.4	-
702	85 Blackbutt Avenue, Sandy Beach	56	54	-1.7	-
703	4 Oak Close, Sandy Beach	60	57	-2.5	-
704	53 Diamond Head Drive, Sandy Beach	55	54	-1.2	-
705	51 Diamond Head Drive, Sandy Beach	54	53	-0.8	-
706	54 Blackbutt Avenue, Sandy Beach	54	53	-0.9	-
707	66 Diamond Head Drive, Sandy Beach	53	52	-0.8	-
708	68 Diamond Head Drive, Sandy Beach	52	52	-0.7	-
709	70 Diamond Head Drive, Sandy Beach	52	52	-0.7	-
710	74 Diamond Head Drive, Sandy Beach	52	51	-0.7	-
711	76 Diamond Head Drive, Sandy Beach	52	51	-0.7	-
712	78 Diamond Head Drive, Sandy Beach	52	51	-0.7	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
713	34-40 Unwins Road, Woolgoolga	54	51	-2.5	-
714	2377B Pacific Highway, Woolgoolga	55	53	-1.6	-
715	2377A Pacific Highway, Woolgoolga	52	51	-0.8	-
716	124 Woolgoolga Creek Road, Woolgoolga	50	49	-0.6	-
717	105 Woolgoolga Creek Road, Woolgoolga	45	45	-0.1	-
718	101 Woolgoolga Creek Road, Woolgoolga	45	45	-0.3	-
720	146 Newmans Road, Woolgoolga	42	42	-0.5	-
721	149 Newmans Road, Woolgoolga	44	44	-0.5	-
722	35 Shearer Drive, Woolgoolga	40	40	-0.2	-
723	2421 Pacific Highway, Woolgoolga	45	45	-0.3	-
724	2425 Pacific Highway, Woolgoolga	44	44	-0.3	-
740	21 Arkan Avenue, Woolgoolga	45	44	-0.2	-
770	2940 Pacific Highway, Arrawarra Headland	49	48	-1.1	-
771	3 Arrawarra Beach Road, Arrawarra	53	54	0.4	-
772	7 Arrawarra Beach Road, Arrawarra	51	51	0.6	-
773	9 Arrawarra Beach Road, Arrawarra	50	50	0.5	-
774	11 Arrawarra Beach Road, Arrawarra	48	49	0.8	-
775	12 Ellem Close, Arrawarra	47	48	0.9	-
776	74 Eggins Drive, Arrawarra	53	54	0.1	-
1003	18-20 Campbell Close, Korora	54	53	-1.0	-
1006	33 Hunter Close, Korora	60	60	-0.2	-
1007	18 Gaudrons Road, Sapphire Beach	55	54	-0.9	-
1008	20 Woodhouse Road, Moonee Beach	55	54	-0.7	-
1009	18 Woodhouse Road, Moonee Beach	55	54	-1.0	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 $L_{Aeq(9hr)}$ Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
1010	16 Woodhouse Road, Moonee Beach	56	55	-0.5	-
1011	16 Woodhouse Road, Moonee Beach	55	55	-0.7	-
1012	14 Woodhouse Road, Moonee Beach	54	53	-0.7	-
1013	12 Woodhouse Road, Moonee Beach	54	53	-0.8	-
1014	10 Woodhouse Road, Moonee Beach	55	54	-0.6	-
1015	8 Woodhouse Road, Moonee Beach	54	52	-1.5	-
1016	5 Moonee Beach Road, Moonee Beach	52	51	-1.2	-
1017	5 Hoys Road, Moonee Beach		INELIGIB	LE	
1018	38-48 Hoys Road, Moonee Beach	55	56	0.4	-
1019	104 Hoys Road, Moonee Beach	58	58	-0.3	-
1020	54 Heritage Drive, Moonee Beach	57	55	-2.1	-
1021	23 Kumbaingeri Close, Moonee Beach	53	52	-1.3	-
1022	Kumbaingeri Close, Moonee Beach	51	50	-1.4	-
1023	13 Kumbaingeri Close, Moonee Beach	51	50	-1.2	-
1024	Kumbaingeri Close, Moonee Beach	59	57	-2.2	-
1025	88 Heritage Drive, Moonee Beach	49	48	-1.2	-
1026	98 Heritage Drive, Moonee Beach	48	47	-1.3	-
1027	12 Smiths Road, Emerald Beach	55	54	-0.8	-
1028	12 Smiths Road, Emerald Beach	55	54	-0.8	-
1029	8 Drummer Crescent, Emerald Beach	52	51	-0.4	-
1030	9 Drummer Crescent, Emerald Beach	50	50	0.0	-
1032	10 Lights Street, Emerald Beach	54	53	-1.2	-
1033	8 Lights Street, Emerald Beach	54	52	-1.4	-
1034	6 Lights Street, Emerald Beach	53	51	-1.1	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
1035	12 Lights Street, Emerald Beach	51	50	-0.9	-
1036	10 Drummer Crescent, Emerald Beach	51	49	-1.8	-
1037	12 Beacon Crescent, Emerald Beach	51	50	-0.5	-
1038	10 Beacon Crescent, Emerald Beach	50	50	-0.5	-
1039	4 Lights Street, Emerald Beach	54	53	-0.8	-
1040	7 Drummer Crescent, Emerald Beach	52	52	-0.8	-
1042	29 Emerald Heights Drive, Emerald Beach		INELIGIB	LE	
1043	6 Anselmo Close, Emerald Beach	51	50	-1.0	-
1044	5 Casuarina Court, Sandy Beach	56	55	-0.7	-
1045	23 Mahogany Avenue, Sandy Beach	53	51	-1.7	-
1046	11 Mahogany Avenue, Sandy Beach	54	52	-1.5	-
1047	3 Mahogany Avenue, Sandy Beach	64	62	-1.3	-
1048	50 Diamond Head Drive, Sandy Beach	63	62	-1.0	-
1049	48 Diamond Head Drive, Sandy Beach	55	54	-0.8	-
1050a	55 Diamond Head Drive, Sandy Beach	54	51	-2.9	-
1050b	55 Diamond Head Drive, Sandy Beach	60	59	-1.6	-
1051	4 Oak Close, Sandy Beach	56	55	-1.3	-
1052	13 Pine Crescent, Sandy Beach	55	54	-1.0	-
1053	1/56 Diamond Head Drive, Sandy Beach	57	54	-2.8	-
1054	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	50	49	-0.3	-
1055	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	49	48	-0.3	-
1056	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	47	49	1.3	-
1057	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	47	49	1.2	-
1058	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	48	48	-0.2	-

Receiver ID	Property Address	$\begin{array}{l} \mbox{Pre-Construction Predicted} \\ \mbox{Year 1 } L_{\mbox{Aeq(9hr)}} \mbox{ Noise Level }^1 \end{array}$	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
1059	Unwins Road, Woolgoolga		INELIGIB	LE	
1060	34-40 Unwins Road, Woolgoolga	52	52	-0.2	-
1061	2377C Pacific Highway, Woolgoolga		INELIGIB	LE	
1062	Greys Road, Woolgoolga		INELIGIB	LE	
1063	Greys Road, Woolgoolga		INELIGIB	LE	
1064	37 Greys Road, Woolgoolga		DEMOLIS	SH	
1065	127 Woolgoolga Creek Road, Woolgoolga		INELIGIB	LE	
1066	11 Freemans Road, Woolgoolga		INELIGIB	LE	
1067	201 Newmans Road, Woolgoolga	50	49	-0.8	-
1068	240 Newmans Road, Woolgoolga		INELIGIB	LE	
1069	300 Newmans Road, Woolgoolga	48	48	-0.4	-
1070	300A Newmans Road, Woolgoolga	45	44	-0.5	-
1072	3006 Pacific Highway, Arrawarra Headland	58	57	-0.4	-
1074	9 Emerald Heights Dr, Emerald Beach	57	56	-1.0	-
1080	229 Newmans Road, Woolgoolga		INELIGIB	LE	
3001	11 Coachmans Close, Sapphire Beach	55	54	-0.8	-
3002	54 Coachmans Close, Sapphire Beach	51	50	-1.1	-
3003	Lot 109 Island Rd, Sapphire Beach	51	50	-0.6	-
3004	38 Island Rd, Sapphire Beach	50	50	-0.7	-
3005	5 Whitewater Pl, Sapphire Beach	48	47	-1.2	-
3006	3 Whitewater Pl, Sapphire Beach	48	47	-1.3	-
3007	39 Island Rd, Sapphire Beach	51	50	-0.5	-
3008	36 Island Rd, Sapphire Beach	50	50	-0.9	-
3009	37 Island Rd, Sapphire Beach	50	49	-0.6	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
3010	7 San Simeon Circuit, Sapphire Beach	49	48	-0.6	-
3011	37 Island Rd, Sapphire Beach	50	49	-0.7	-
3012	5 Whitewater PI, Sapphire Beach	48	47	-0.9	-
3013	9 San Simeon Circuit, Sapphire Beach	49	48	-0.4	-
3014	7-9 San Simeon Circuit, Sapphire Beach	48	48	-0.5	-
3015	30 Island Rd, Sapphire Beach	49	48	-0.7	-
3016	2 Split Solitary Rd, Sapphire Beach	46	46	-0.2	-
3017	42 N Sapphire Ln, Sapphire Beach	48	48	-0.7	-
3018	2 Red Ash Ln, Sapphire Beach	48	48	-0.7	-
3019	4 Paperbark St, Sapphire Beach	49	48	-0.7	-
3020	Lot 34 Kumbaingeri Close, Moonee Beach	57	54	-2.5	-
3021	34 Kumbaingeri Close, Moonee Beach	58	56	-2.2	-
3022	Lot 8 Goonaroo PI, Emerald Beach	50	50	-0.4	-
3023	45 Kumbaingeri Close, Moonee Beach	55	54	-1.0	-
3024	48 Kumbaingeri Close, Moonee Beach	59	58	-0.9	-
3025	Lot 31 Kumbaingeri Close, Moonee Beach		INELIGIB	.E	
3026	Lot 40 Kumbaingeri Close, Moonee Beach	55	54	-0.8	-
3027	235 Bark Hut Rd, Woolgoolga	58	57	-0.6	-
3028	286 Bark Hut Road, Woolgoolga	49	50	1.5	-
3029	180 Bark Hut Road, Woolgoolga		INELIGIB	.E	
3030	5A Bream Close, Emerald Beach	50	50	-0.3	-
3031	11 Coachmans Close, Sapphire Beach	54	54	0.1	-
3032	40 Fairview Rd, Sapphire Beach	53	52	-0.5	-
3033	Lot 2 Pacific Hwy, Sapphire Beach	44	43	-0.9	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
3034	10 Emerald Ave, Sapphire Beach	40	40	-0.9	-
3035	7 Whitewater Pl, Sapphire Beach	47	46	-1.0	-
3036	33 Island Rd, Sapphire Beach	47	46	-0.5	-
3037	11 Whitewater Pl, Sapphire Beach	47	46	-0.9	-
3038	38 Split Solitary Rd, Sapphire Beach	47	47	-0.7	-
3039	40 Split Solitary Rd, Sapphire Beach	47	46	-0.6	-
3040	13 Whitewater Pl, Sapphire Beach	45	44	-0.9	-
3041	49 N Sapphire Rd, Sapphire Beach	46	45	-0.6	-
3042	20 Island Rd, Sapphire Beach	43	43	-0.4	-
3043	1 White Bluff Rd, Sapphire Beach	43	43	-0.6	-
3044	8 Paperbark St, Sapphire Beach	46	46	-0.5	-
3045	11 Woodhouse Rd, Moonee Beach	52	52	-0.1	-
3046	9 Parish Close, Moonee Beach	50	49	-0.6	-
3047	Lot 130 N Sapphire Rd, Sapphire Beach	44	43	-0.5	-
3048	8 Paperbark St, Sapphire Beach	45	44	-0.5	-
3049	10 Paperbark St, Sapphire Beach	45	44	-0.6	-
3050	58 N Sapphire Rd, Sapphire Beach	43	43	-0.5	-
3051	6 Tidal Crescent, Moonee Beach	51	50	-0.3	-
3052	23 Island Rd, Sapphire Beach	43	42	-0.5	-
3053	60 N Sapphire Rd, Sapphire Beach	43	43	-0.6	-
3054	9 Dawn Dr, Moonee Beach	48	48	-0.2	-
3055	60 N Sapphire Rd, Sapphire Beach	43	43	-0.6	-
3056	10 Estuary Dr, Moonee Beach	50	50	-0.1	-
3057	8 Tidal Crescent, Moonee Beach	51	50	-0.2	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 $L_{Aeq(9hr)}$ Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
3058	5 Estuary Dr, Moonee Beach	51	50	-0.3	-
3059	10-12 Estuary Dr, Moonee Beach	50	50	-0.1	-
3060	12 Tidal Crescent, Moonee Beach	50	50	-0.1	-
3061	10-16 Estuary Dr, Moonee Beach	50	50	-0.2	-
3062	14 Tidal Crescent, Moonee Beach	50	50	-0.1	-
3063	11 Estuary Dr, Moonee Beach	49	49	-0.1	-
3064	13 Estuary Dr, Moonee Beach	49	49	0.0	-
3065	31 Tidal Crescent, Moonee Beach	44	44	0.5	-
3066	36 Tidal Crescent, Moonee Beach	44	44	0.5	-
3067	26 Tidal Crescent, Moonee Beach	44	45	0.6	-
3068	34 Tidal Crescent, Moonee Beach	43	44	0.6	-
3069	32 Tidal Crescent, Moonee Beach	43	44	0.9	-
3070	30 Tidal Crescent, Moonee Beach	44	45	0.5	-
3071	19-35 Goonaroo Pl, Emerald Beach	51	51	-0.4	-
3073	1 Pacific Hwy, Woolgoolga	48	49	0.4	-
3074	10 Stanner Close, Woolgoolga		INELIGIB	LE	
3076	124A Woolgoolga Creek Rd, Woolgoolga	42	42	-0.1	-
3077	36 Lights St, Emerald Beach	50	49	-0.3	-
3078	Lot 29 Mcintosh Crescent, Woolgoolga	42	42	0.3	-
3079	18 Blackbutt Ave, Sandy Beach	41	41	-0.3	-
3080	65 Graham Dr, Sandy Beach	48	47	-0.7	-
3081	17 Diamond Head Dr, Sandy Beach	46	45	-0.4	-
3082	4 Blackbutt Ave, Sandy Beach	48	48	0.1	-
3083	130 Graham Dr, Sandy Beach	51	50	-1.3	-

Receiver ID	Property Address	Pre-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ¹	Post-Construction Predicted Year 1 L _{Aeq(9hr)} Noise Level ²	Difference between Post- and Pre-Construction Noise Levels	>2dB(A) Difference?
3084	52 Blackbutt Ave, Sandy Beach	53	53	-0.7	-
3085	10 Featherstone Dr, Woolgoolga	47	47	0.1	-
3086	16 Hawke Dr, Woolgoolga	46	45	-0.3	-
3087	80 Diamond Head Dr, Sandy Beach	51	51	-0.6	-
3088	6 Ironbark Ave, Sandy Beach	50	50	-0.4	-
3089	11 Ironbark Ave, Sandy Beach	50	50	-0.3	-
3090	13 Acacia Ave, Sandy Beach	50	50	-0.4	-
3091	86 Ironbark Ave, Sandy Beach	50	49	-0.4	-
3093	42 Kumbaingeri Close, Moonee Beach	59	57	-1.9	-
3095	207-209 Newmans Road, Woolgoolga	46	48	1.9	-
3096	180 Bark Hut Road, Woolgoolga	45	44	-0.3	-

Notes: 1. Pre-construction predicted Year 1 noise levels calculated based on pre-construction calibrated noise models

2. Post construction predicted Year 1 noise levels calculated based on post construction ("as-built" equivalent) calibrated noise model

APPENDIX C Detailed Analysis of Receivers with >2dB(A) Differences

Table C.1 – Detailed Compliance Assessment for Receivers with Differences of >2dB(A)

Receiver ID	Property Address	Post Construction Predicted Year 10 (2024) L _{Aeq(9hr)} Noise Level ¹	Target L _{Aeq(9hr)} Criteria ²	Allowance L _{Aeq(9hr)} Criteria ³	Target Criteria Exceedance	Allowance Criteria Exceedance	Acute? [ie. <u>></u> 60dB(A)]	Type of Treatment Applied ⁴	Additional Treatment Required ⁵
614	36 Coachmans Close, Sapphire Beach	48	55	-	-	-	-	-	-

Notes: 1. Post construction predicted Year 10 (2024) noise levels calculated based on post construction ("as-built" equivalent) calibrated noise model

2. Target criteria in accordance with ECRTN [ie. LAeq(9hr) 55dB(A) for redeveloped road; and LAeq(9hr) 50dB(A) for new road]

3. Allowance criteria in accordance with ECRTN

4. Treatment applied as part of detailed design and identified in ONMR

5. Type 1 Treatment: = Air conditioning, sealing of wall vents and upgraded window and door seals;

Type 2 Treatment = Type 1 Treatment, plus upgraded windows, glazing and doors (for masonry structures and colorbond/timber structures where walls include insulation materials)

APPENDIX D Detailed Analysis of Receivers with >0dB(A) and <2dB(A) Differences

Receiver ID	Property Address	Post Construction Predicted Year 10 (2024) L _{Aeq(9hr)} Noise Level ¹	Target L _{Aeq(9hr)} Criteria ²	Allowance L _{Aeq(9hr)} Criteria ³	Target Criteria Exceedance	Allowance Criteria Exceedance	Acute? [ie. <u>></u> 60dB(A)]	Type of Treatment Applied ⁴	Additional Treatment Required ⁵
4	19 Gaudrons Road, Sapphire Beach	51	55	-	-	-	-	-	-
5	21 Gaudrons Road, Sapphire Beach	48	55	-	-	-	-	-	-
22	300 Old Coast Road, Korora	52	55	-	-	-	-	-	-
23	290 Old Coast Road, Korora	52	55	-	-	-	-	-	-
37	9-11 Seaview Close, Korora	61	55	60	6	1	YES	1	-
41	14-30 Maccues Road, Moonee Beach	56	55	59	1	-	-	-	-
45	57 Maccues Road, Moonee Beach	52	55	-	-	-	-	-	-
83	38-48 Hoys Road, Moonee Beach	54	55	58	-	-	-	-	-
331	26 Coachmans Close, Korora	53	55	62	-	-	-	-	-
424	309 Newmans Road, Woolgoolga	46	50	-	-	-	-	-	-
425	227 Newmans Road, Woolgoolga	58	50	-	8	-	-	1	-
429	12 Freemans Road, Woolgoolga	44	50	-	-	-	-	-	-
433	11 Freemans Road, Woolgoolga	46	50	-	-	-	-	-	-
434	19 Freemans Road, Woolgoolga	46	50	-	-	-	-	-	-
435	39 Freemans Road, Woolgoolga	46	50	-	-	-	-	-	-
444	244 Bark Hut Road, Woolgoolga	57	50	-	7	-	-	1	-
445	235-235a Bark Hut Road, Woolgoolga	55	50	-	5	-	-	1	-
446	234 Bark Hut Road, Woolgoolga	57	50	-	7	-	-	1	-
450	1 Arrawarra Beach Road, Arrawarra	55	55	58	-	-	-	-	-
451	1 Arrawarra Beach Road, Arrawarra	52	55	56	-	-	-	-	-
452	74 Eggins Drive, Arrawarra	54	55	57	-	-	-	-	-
453	74 Eggins Drive, Arrawarra	54	55	58	-	-	-	-	-

Table D.1 – Detailed Compliance Assessment for Receivers with Differences of >0dB(A) and $\leq 2dB(A)$

Receiver ID	Property Address	Post Construction Predicted Year 10 (2024) L _{Aeq(9hr)} Noise Level ¹	Target L _{Aeq(9hr)} Criteria ²	Allowance L _{Aeq(9hr)} Criteria ³	Target Criteria Exceedance	Allowance Criteria Exceedance	Acute? [ie. <u>></u> 60dB(A)]	Type of Treatment Applied ⁴	Additional Treatment Required ⁵
454b	115 Wedding Bells Way (Row), Woolgoolga	56	50	-	6	-	-	1	-
455	85 Wedding Bells Way (Row), Woolgoolga	55	50	-	5	-	-	1	-
487	15 Gresham Drive, Woolgoolga	44	50	-	-	-	-	-	-
505	111 Woolgoolga Creek Road, Woolgoolga	50	50	-	-	-	-	-	-
519	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	49	55	58	-	-	-	-	-
520	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	50	55	59	-	-	-	-	-
521	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	50	55	59	-	-	-	-	-
530	11a Hearnes Lake Road, Woolgoolga	54	55	56	-	-	-	-	-
546	2986 Pacific Highway, Arrawarra Headland	60	55	67	5	-	YES	-	1
600	8 Pine Brush Crescent, Korora	47	55	56	-	-	-	-	-
601	4 Coachmans Close, Korora	46	55	62	-	-	-	-	-
602	6 Coachmans Close, Korora	47	55	62	-	-	-	-	-
604	10 Coachmans Close, Korora	48	55	59	-	-	-	-	-
605	12 Coachmans Close, Korora	49	55	61	-	-	-	-	-
606	14 Coachmans Close, Korora	50	55	58	-	-	-	-	-
607	16 Coachmans Close, Korora	50	55	57	-	-	-	-	-
608	4 Fernleigh Avenue, Korora	49	55	56	-	-	-	-	-
609	1 Fernleigh Avenue, Korora	53	55	61	-	-	-	-	-
613	34 Coachmans Close, Sapphire Beach	53	55	58	-	-	-	-	-
771	3 Arrawarra Beach Road, Arrawarra	55	55	57	-	-	-	-	-
772	7 Arrawarra Beach Road, Arrawarra	52	55	-	-	-	-	-	-

Receiver ID	Property Address	Post Construction Predicted Year 10 (2024) L _{Aeq(9hr)} Noise Level ¹	Target L _{Aeq(9hr)} Criteria ²	Allowance L _{Aeq(9hr)} Criteria ³	Target Criteria Exceedance	Allowance Criteria Exceedance	Acute? [ie. <u>></u> 60dB(A)]	Type of Treatment Applied ⁴	Additional Treatment Required ⁵
773	9 Arrawarra Beach Road, Arrawarra	51	55	-	-	-	-	-	-
774	11 Arrawarra Beach Road, Arrawarra	50	55	-	-	-	-	-	-
775	12 Ellem Close, Arrawarra	49	55	-	-	-	-	-	-
776	74 Eggins Drive, Arrawarra	55	55	58	-	-	-	-	-
1018	38-48 Hoys Road, Moonee Beach	57	55	60	2	-	-	-	-
1056	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	50	55	59	-	-	-	-	-
1057	The Pines Live Smart, 8 Hearnes Lake Road, Woolgoolga	50	55	59	-	-	-	-	-
3028	286 Bark Hut Road, Woolgoolga	51	50	-	1	-	-	-	1
3031	11 Coachmans Close, Sapphire Beach	55	55	56	-	-	-	-	-
3065	31 Tidal Crescent, Moonee Beach	45	55	-	-	-	-	-	-
3066	36 Tidal Crescent, Moonee Beach	45	55	-	-	-	-	-	-
3067	26 Tidal Crescent, Moonee Beach	46	55	-	-	-	-	-	-
3068	34 Tidal Crescent, Moonee Beach	45	55	-	-	-	-	-	-
3069	32 Tidal Crescent, Moonee Beach	45	55	-	-	-	-	-	-
3070	30 Tidal Crescent, Moonee Beach	46	55	-	-	-	-	-	-
3073	1 Pacific Hwy, Woolgoolga	50	50	-	-	-	-	-	-
3078	Lot 29 Mcintosh Crescent, Woolgoolga	44	50	-	-	-	-	-	-
3082	4 Blackbutt Ave, Sandy Beach	49	55	-	-	-	-	-	-
3085	10 Featherstone Dr, Woolgoolga	48	50	-	-	-	-	-	-
3095	207-209 Newmans Road, Woolgoolga	49	50	-	-	-	-	-	-

Receiver ID	Property Address	Post Construction Predicted Year 10 (2024) L _{Aeq(9hr)} Noise Level ¹	Target L _{Aeq(9hr)} Criteria ²	Allowance L _{Aeq(9hr)} Criteria ³	Target Criteria Exceedance	Allowance Criteria Exceedance	Acute? [ie. <u>></u> 60dB(A)]	Type of Treatment Applied ⁴	Additional Treatment Required ⁵
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Notes: 1. Post construction predicted Year 10 (2024) noise levels calculated based on post construction ("as-built" equivalent) calibrated noise model

2. Target criteria in accordance with ECRTN [ie. L_{Aeq(9hr)} 55dB(A) for redeveloped road; and L_{Aeq(9hr)} 50dB(A) for new road]

3. Allowance criteria in accordance with ECRTN

4. Treatment applied as part of detailed design and identified in ONMR

5. Type 1 Treatment: = Air conditioning, sealing of wall vents and upgraded window and door seals;

Type 2 Treatment = Type 1 Treatment, plus upgraded windows, glazing and doors (for masonry structures and colorbond/timber structures where walls include insulation materials)

APPENDIX F Details of Complaints Received

A wide range of complaints have been received in relation to road traffic noise on the Sapphire to Woolgoolga Pacific Highway upgrade. Public meetings were held in September 2014 to discuss the noise issues for the project and to explain the operational noise assessment process.

The summary of complaints received are outlined below. The complaints have been grouped by area, as the issues raised by residents from each locality were similar in nature. Complaints were raised by the community via email, letter, verbally and through the Local Member of Parliament.

F.1 Sapphire Beach – Korora

Number of complaints – approximately 30 complaints from 25 complainants

The majority of the residential area is on the eastern side of the combination noise wall and headlight screen. The adjacent highway is at the transition between the 80km/hr and 110 km/hr speed limit. The main issues raised in this area included:

- Engine braking and acceleration noise due to the change in speed limit,
- Increased noise from the highway due to the increase in speed limit from the 80km/hr temporary roadworks speed limit to the 110km/hr operational speed limit,
- Noise walls being too low for the residents in nearby multi-storey apartments,
- Noise entering the residential area via an opening in the noise wall (the southern access from Solitary Islands Way to Coffs Harbour in the southbound direction)
- Change in the road levels from the concept design in the environmental assessment

NB: For multi-unit residential buildings, Roads and Maritime predicts noise levels at all levels. However due to common design limitations in existing multi-level residential apartment buildings it is not generally considered reasonable and feasible to retrofit items such as supplementary glazing, introduce forced air ventilation or alter the façade.

F.2 Old Coast Road

Number of complaints – approximately 55 complaints from 50 complainants

This section of the highway is on the western side of the combination noise wall and headlight screen at Sapphire Beach. The main issues raised in this area included:

• Some residents in the Old Coast Road area felt that the addition of the noise wall may have improved noise for some but has also created an amphitheatre for noise travelling to others on the western side of the highway.

• Residents felt that contributing factors to highway noise in the area include the elevated height of the new highway and that cuttings and clearing had created a valley for noise to travel through.

Roads and Maritime has met with many residents including an on-site meeting organised by residents.

F.3 Moonee Beach village

Number of complaints – approximately 20 complaints from 17 complainants

The Moonee Beach village area is on the eastern side of the highway upgrade. The main issues raised relate to the noise from heavy vehicles, both engine noise and tyre noise on the highway surface. Sections of the Moonee Beach area are close to the highway. There are no noise walls in the Moonee Beach area and some residents have requested a noise wall.

F.4 Forest Glen, Heritage Park and Avocado Heights

Number of complaints – approximately 40 complaints from 35 complainants

Forest Glen, Heritage Park and Avocado Heights are rural residential subdivisions between the villages of Moonee Beach and Emerald Beach on the western side of the highway. Some residences in these areas have boundaries with the road alignment.

The main issues raised in these areas related to heavy vehicle noise, both engine noise and tyre noise. Many complainants describe a higher pitched "whining" sound from the heavy vehicles. Concerns were raised about the low lying topography of the area which seems to be less effective in attenuating the noise from heavy vehicles.

Many residents have requested a noise wall.

F.5 Emerald Beach

Number of complaints – approximately 80 complaints from 65 complainants

Emerald Beach village area is on the eastern side of the highway upgrade. The main issues raised relate to the noise from heavy vehicles, both engine noise and tyre noise on the highway surface. Many residences in the Emerald Beach area are close to the highway.

Some residents complained of noise being reflected from the noise wall that was erected between the highway and the residences to the west of the highway in the Emerald Heights area.

Many complaints were received as a form letter from the residents of Emerald Beach requesting an additional noise barrier between the highway and Emerald Beach Village.

A public demonstration was held in relation to the issues raised by Emerald Beach residents. Roads and Maritime Services representatives attended the demonstration to hear the concerns of residents.

F.6 Emerald Heights

Number of complaints - approximately 25 complaints from 23 complainants

The Emerald Heights area is a combination of rural residential subdivisions and urban subdivisions to the west of Emerald Beach on the western side of the highway. Some residences in these areas have boundaries with the road alignment.

The main issues raised in this area related to heavy vehicle noise, including engine noise, engine braking and tyre noise. Concerns were raised about the topography of the area which seems to funnel the noise from heavy vehicles near the interchange. Some residents complained that noise was reflecting from the retaining wall below the ramp on the eastern side of the highway.

F.7 Hearnes Lake

Number of complaints - approximately 15 complaints from 10 complainants

The Hearnes Lake area is a combination of rural residential subdivision and permanent sites in a relocatable home village and lifestyle resort. This area is to the south of Woolgoolga and east of the highway.

The main issues raised in this area related to heavy vehicle noise, including engine noise, engine braking and tyre noise. The engine braking is an issue at this location due to the gradient of the highway from the north.

F.8 Woolgoolga Bypass

Number of complaints – approximately 80 complaints from 60 complainants

The Woolgoolga bypass section is approximately 10km long on the western side of Woolgoolga. The area is a mix of large rural residential subdivisions, some urban subdivisions on the western edge of Woolgoolga and rural farmland. Some residences in these areas have boundaries with the road alignment. Prior to the construction of the bypass many residences received negligible road traffic noise.

The main issues raised in these areas related to the change in the noise environment, where previously no road traffic noise was audible. The main issues raised in this area related to heavy vehicle noise, including engine noise, engine braking and tyre noise. Many complainants describe a higher pitched "whining" sound from the heavy vehicles. Concerns were raised about the topography of the area which seems to be less effective in attenuating the noise from heavy vehicles. Some residences were quite distant from the bypass but found the noise levels from the highway unacceptable. Complaints were received in relation to the lack of attenuation from the noise walls. RMS representatives have met with many of the residents either personally or in small groups.