FREDERICKTON TO EUNGAI PACIFIC HIGHWAY UPGRADE

Operational Noise Report

APRIL 2014

ACOUSTICS AND AIR

PACIFIC HIGHWAY UPGRADE FREDERICKTON TO EUNGAI

OPERATIONAL NOISE MANAGEMENT REPORT (FINAL DESIGN – 100%)

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PREPARED FOR

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DOCUMENT CONTROL

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Note Section 7.2 in Version D4 has been changed to account for SDD (100%) road alignment changes.

Note

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Wilkinson Murray is an independent firm established in 1962, originally as Carr & Wilkinson. In 1976 Barry Murray joined founding partner Roger Wilkinson and the firm adopted the name which remains today. From a successful operation in Australia, Wilkinson Murray expanded its reach into Asia by opening a Hong Kong office early in 2006. 2010 saw the introduction of our Queensland office and 2011 the introduction of our Orange office to service a growing client base in these regions. From these offices, Wilkinson Murray services the entire Asia-Pacific region.

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GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

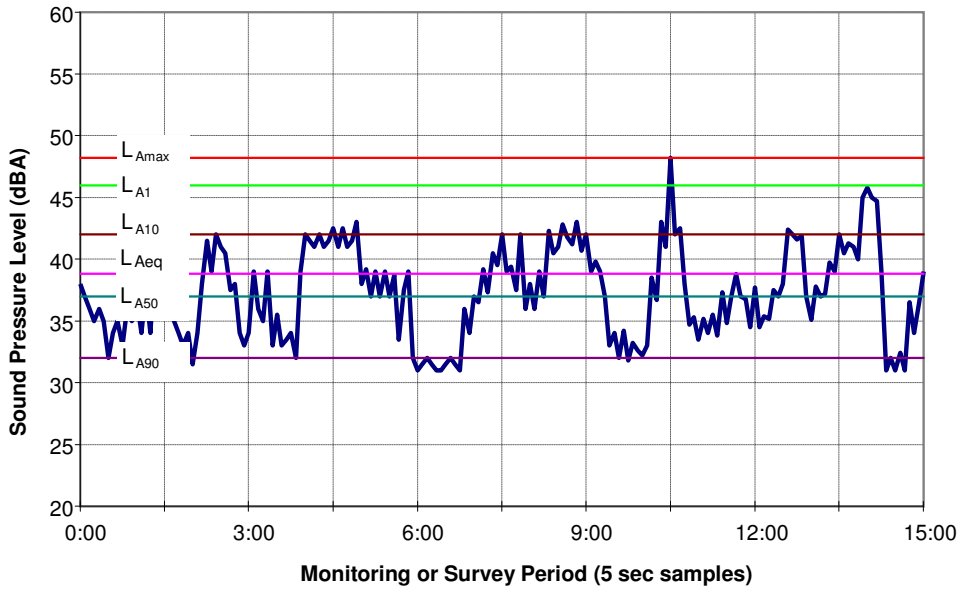
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10^{th} percentile (lowest 10^{th} percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

Roads and Maritime Services (RMS) proposed to upgrade 26.5km of the Pacific Highway between Frederickton and Eungai in northern New South Wales. The Frederickton to Eungai Pacific Highway Upgrade project (F2E) begins to the north-east of Frederickton then passes to the west of the existing Pacific Highway through Collombatti and the edge of the Tamban State Forest, and north through Barraganyatti to join the existing Pacific Highway south of Eungai Rail (shown in Figure 1-1). The project includes:

- Four-lane divided carriageways (two lanes in each direction);
- Retention of the existing highway as a local road with two significant diversions of the existing highway; and
- Rest area located near Cooks Lane.

This project is the northern part of the Kempsey to Eungai Upgrading of the Pacific Highway Submission which was assessed in the environmental assessment dated in July 2007. Thiess Pty Limited has been appointed by RMS to undertake detailed design and construction of the F2E project and Wilkinson Murray Pty Ltd (WM) has been commissioned to undertake the operational noise assessment.

This report has been prepared to form part of the detailed design of the proposed upgrade in accordance with Section 4.16 of the SWTC Appendix 4. It details the extent of potential noise impacts at nearby receivers associated with the traffic noise of the proposed upgrade, including mitigation measures where relevant.

Potential noise impacts have been assessed in accordance with the NSW Government's *Environmental Criteria for Road Traffic Noise (ECRTN)* and *the RTA Environmental Noise Management Manual (ENMM)*.

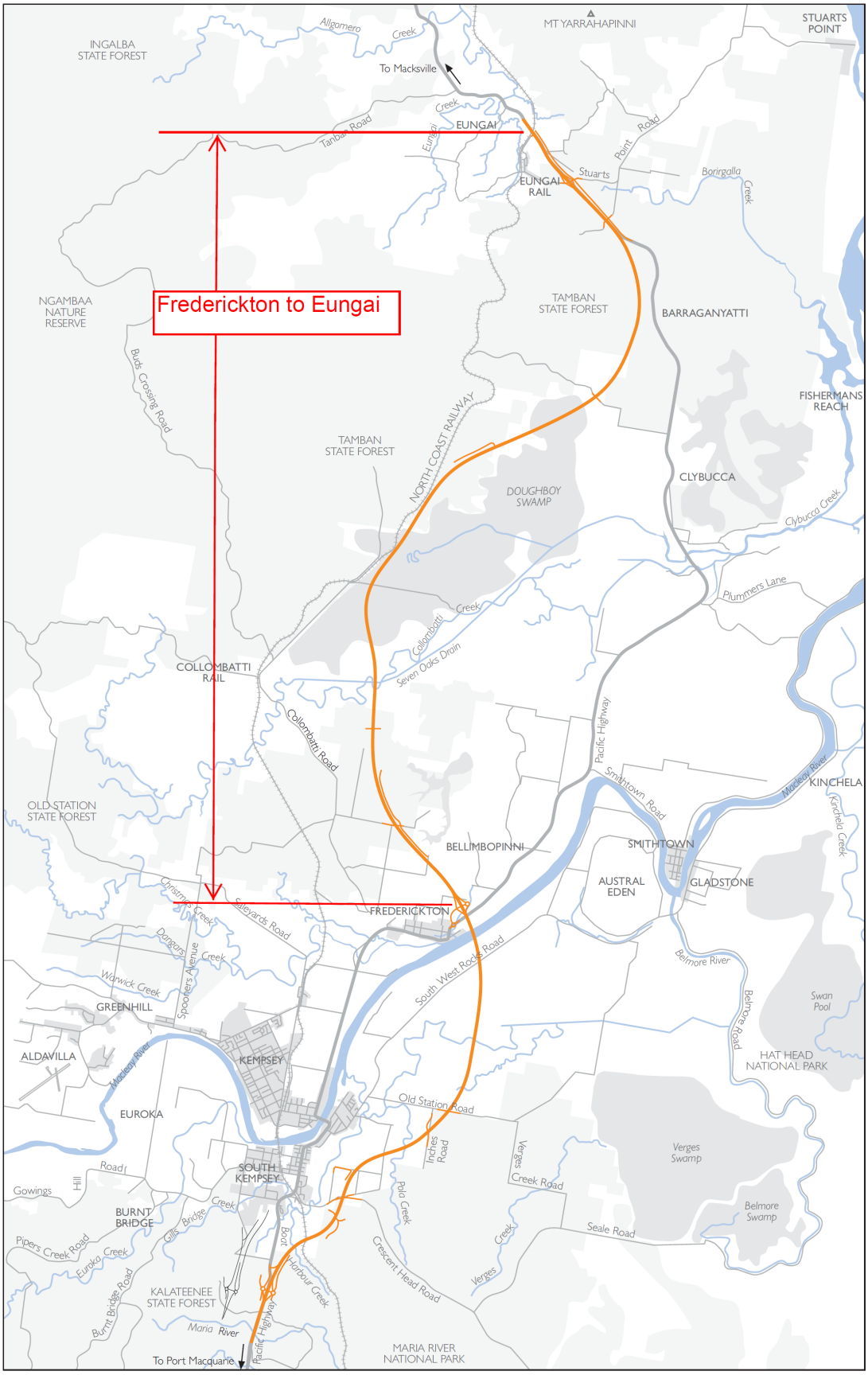


FIGURE 1.1 LOCATION OF ROUTE

2 SITE DESCRIPTION

This study concentrates on the area of Pacific Highway and proposed Upgrade route between Frederickton and Eungai Rail. Specifically, this study investigates traffic noise impacts at sensitive receivers along the proposed Upgrade route.

The highway upgrade works commence at the Macleay River crossing at the north termination of the Kempsey bypass, east of Frederickton. In the township of Frederickton, residential premises potentially affected by the proposed Upgrade are currently exposed to traffic noise from the existing Pacific Highway. In some cases the proposed Upgrade works will change the direction in which traffic noise travels to residential properties. That is, a different facade of the residence (and possibly different rooms within the residence) will become exposed to traffic noise. The existing exposed facade will be exposed to significantly less noise, as the old Pacific Highway route becomes a local service road with minor traffic flows.

The proposed Upgrade then deviates to the west of the existing Pacific Highway and travels north for approximately 20km through rural land, near Colombatti Rail, with scattered residential properties where there is minimal existing road traffic noise.

At Barraganyatti the proposed Upgrade rejoins the Pacific Highway, where the road is then upgraded to meet the existing dual carriageway north of Eungai Rail. Through this area, many residences are currently exposed to traffic noise from the Pacific Highway.

The study identified approximately 62 residential properties potentially affected by the construction of the proposed Upgrade, majority of which are currently unexposed, or exposed to only low levels of road traffic noise. Site inspection indicated that residences in the study area are both single and double storey. In many cases, particularly in the low lying areas, residences are single storey, but elevated above ground level by up to approximately 2 metres.

2.1 Noise Catchment Areas

To facilitate the assessment of noise impacts from the proposed Upgrade, residential areas along the route have been divided into Noise Catchment Areas (NCAs) as part of the *Kempsey to Eungai – Upgrading the Pacific Highway Technical Report 3 Noise & Vibration Assessment* (EA).

The EA defines NCAs as *areas that are likely to have similar noise exposures, on the basis of factors such as topography, road design (cuttings, embankments, intersection etc.), setback distances, and types of residences or other noise receptors. For the purpose of this assessment the catchment areas were defined as within 300m of the road alignment. 300 metres is the distance within which most road traffic noise models are capable of producing reliable results (ENMM p97).*

A total of 31 NCAs were identified in the EA, however, the noise assessment of the proposed Upgrade only considers relevant NCAs north of Frederickton, i.e. NCAs 19 to 31.

3 CONCEPT DESIGN REVIEW

F2E concept design noise assessment has been undertaken by Renzo Tonin & Associates Pty Ltd (RTA) on behalf of Parsons Brinckerhoff for the Kempsey to Eungai Upgrading of the Pacific Highway Submission. Details of this study are reported in the Technical Report 3 Noise & Vibration Assessment in Volumes 2 of the Environmental Assessment (EA) undertaken for the project Kempsey to Eungai Upgrading of the Pacific Highway*, July 2007*.

Due to the relatively sparse density of residential premises along the project route, it was generally found in the EA that residences were singular or gathered in groups of 3 or less, making the use of low noise pavement and noise barrier construction unreasonable to mitigate the noise. The EA contains information, as a guide, which cross-references the noise control options (architectural treatment) with the level of noise reduction required. This information is reproduced here as shown below:

Option 1 ***Mechanical ventilation only***

<5dB(A) reduction *Where external noise levels are less than 5dB(A) above the ECRTN 'base' criteria, the internal 'base' criteria may be achieved with windows closed. A light framed building with single glazed windows will provide a minimum noise reduction of up to 15dB(A) from outside to inside when windows are closed. If the ECRTN internal 'base' criteria can only be achieved with windows closed, then mechanical ventilation or air conditioning must be provided to ensure fresh airflow inside the dwelling so to meet the requirements of the Building Code of Australia.*

Option 2 ***Mechanical ventilation and sealing of wall vents***

5-10 dB(A) reduction *Where external noise levels are less than 10dB(A) above the ECRTN 'base' criteria, the internal 'base' criteria may be achieved with windows closed. A light framed building with single glazed windows will provide a minimum noise reduction of up to 20dB(A) from outside to inside (RTA Noise Management Manual p20) when windows are closed and wall vents are sealed. If the ECRTN internal 'base' criteria can only be achieved with windows closed, then mechanical ventilation or air conditioning must be provided to ensure fresh airflow inside the dwelling so to meet the requirements of the Building Code of Australia.*

It is important to ensure that mechanical ventilation does not provide a new noise leakage path into the dwelling and does not create a noise nuisance to neighbouring residential premises.

Option 3 ***Upgraded windows, glazing and doors***

>10 dB(A) reduction *Where the predicted external noise level exceeds the ECRTN 'base' criteria by significantly more than 10dB(A), then upgraded windows and glazing and the provision of solid core doors will be required on the facades exposed to the proposed Upgrade, in addition to the mechanical ventilation described in Option 1. Note that these upgrades are only suitable for masonry buildings. It is unlikely that this degree of upgrade would provide significant benefits to light framed structures should there be no acoustic insulation in the walls.*

As seen previously, architectural treatment is only designed as 1 of 3 packages that provide either 5dBA, up to 10dBA or more than 10dBA of noise reduction. It is noted by RMS that the allowable exceedance in Table 4.4 and Table 4.5 of the SWTC for receivers reflects how much noisier it can be without requiring a better architectural package. For example, if the criterion is 55dBA and the noise level in the EA was predicted to be 62dBA then the up to 10dBA package would be chosen. This mitigates noise levels up to 65dBA and results in an allowable exceedance of 10dBA (obtained from 65dBA - 55dBA = 10dBA).

Further to the EA, RMS undertook additional acoustic modelling of the concept design and identified a series of noise sensitive receivers. RMS has indicated they will organise mitigation (in the form of architectural treatment) at most of those identified noise sensitive receivers. This negates the need for further noise mitigations such that no noise walls, noise mounds, or low-noise pavements. Changes to the concept design may alter the predicted noise levels and consequently the number of noise sensitive receivers. However, modelling of the Thiess 100% alignment has shown that no further noise sensitive receivers require architectural treatment as a result of the alignment changes from RMS concept design to Thiess 100% design.

In summary, the EA noise and vibration study reported 24 receiver locations (one was 2 storey) within the F2E study area would require at-residence noise mitigation treatments to achieve night time internal noise goals. These receivers are presented in Table 4.4 in Appendix 4 of the SWTC. Moreover, additional RMS investigations identified a further 30 receiver locations that would require at-residence noise mitigation treatments. These additional receivers are presented in Table 4.5 in Appendix 4 of the SWTC. These receivers listed in the SWTC include the criteria (based on the *ECRTN*) and the allowable exceedance above the criteria, which forms the basis of the noise assessment contained in this ONMR.

In addition to the noise receivers identified in Table 4.4 and Table 4.5 in Appendix 4 of the SWTC, the Thiess final design noise assessment identified 9 additional receivers for assessment purposes in the potentially affected area of Eungai Rail and 13 additional receivers along the bypass section of the Project. Some of these receivers are located beyond the EA assessment area, 500m either side of the proposed route, which was limited by the topographic contour data. Therefore, additional topographic contour data provided by Thiess was incorporated into the RMS provided concept design noise model (TA456-12C03 rev0) to normalise the two noise models (viz. RMS' concept and Thiess' Final Design). It was also found that Blackbutt Shute Road was not included in the RMS concept design modelling. Further investigation using the RMS provided concept design noise model with the additional data included in that model indicated four more receivers that should have been identified as part of the RMS concept design modelling (and hence included in SWTC Appendix 4, Table 4.5) prior to Thiess' assessment for noise mitigation. This is further discussed in Section 8.5 of this ONMR.

4 KEY PROJECT REQUIREMENTS & TRAFFIC NOISE CRITERIA

4.1 Key Project Requirements

Section 4.15 of Appendix 4 of the Scope of Works and Technical Criteria (SWTC) document addresses noise mitigation and noise modelling requirements. This section requires:

(a) Further to and as a consequence of condition 2.20 of the Planning Minister's Approvals and commitment ON3 of the Statement of Commitments, RMS has undertaken further investigations to those identified in other Environmental Documents and has consulted with the owners of properties to determine;

(i) noise sensitive receivers (where the term 'noise-sensitive receiver' is as defined in the RTA Environmental Noise Management Manual – RTA, December 2001 (Note – check title) (ENMM) and noise sensitive land uses; and

(ii) in consultation with the owners, the scope and extent of all noise mitigation measures and treatments to be undertaken to residences as a part of the operational noise mitigation measures and treatments.

Notwithstanding and further to any other requirements of the Environmental Documents;

(iii) at-residence noise mitigation treatments are only to be undertaken on the residences identified in Table 4.4 and Table 4.5 and these treatments are to be undertaken by RMS;

(iv) the residences identified in Table 4.6 are not noise sensitive receivers, do not require operational noise mitigation treatments and at-residence noise mitigation treatments are not to be undertaken on these residences; and

(v) the Contractor must not undertake any at-residence treatments on the residences identified in Table 4.4 and Table 4.5 to address and comply with the operational noise and mitigation requirements of the Environmental Documents.

(b) The Contractor must comply with the operational noise mitigation requirements of the NSW Government's Environmental Criteria for Road Traffic Noise (ECRTN) and the ENMM, using noise mitigation measures and treatments other than at-residence treatments.

(c) Notwithstanding the requirements of Practice Note ii of ENMM, noise mitigation measures are not required at commercial or industrial premises.

(d) Further to any other requirements of the Environmental Documents in relation to noise mitigation measures, the Contractor must design and provide at road operational noise mitigation measures and treatments:

(i) notwithstanding and so as not to be constrained by any financial, costing, feasibility or other constraints on types of mitigation identified in the ENMM; and

(ii) to maintain operational night noise levels (LAeq(9h)) at the noise sensitive receiver locations identified in Table 4.4 and Table 4.5 for the year 2026 traffic volumes to no greater than the LAeq(9h) criteria plus the allowable exceedance identified in Table 4.4 and Table 4.5.

(iii) to maintain operational day and night noise levels at all other noise sensitive receiver locations that are not identified in sub-section (ii) above that comply with the ECRTN and the ENMM requirements for the year 2026 traffic volumes.

Table 4.4 At-residence noise mitigation treatments on the residences identified in the Environmental Documents to be undertaken by RMS

EA Identifier	Location	Criteria (LAeq(9h))	Allowable Exceedance
19a	107 Raymonds Lane	50 dBA	10 dBA
20a	322 Kemps Access	50 dBA	0 dBA
20c	279 Kemps Access	50 dBA	15 dBA
21a	232 Quarry Road	50 dBA	15 dBA
21 a (2nd storey)	232 Quarry Road	50 dBA	15 dBA
21c	26 Seashore Lane	50 dBA	15 dBA
21d	53 Seashore Lane	50 dBA	15 dBA
21e	202 Kemps Access	50 dBA	5 dBA
21g	243 Kemps Access	50 dBA	15 dBA
25a	288 Cooks Lane	50 dBA	5 dBA
26a	80 Hills Lane	50 dBA	5 dBA
27a	92 Nirvana Way	50 dBA	0 dBA
28a	6 Nirvana Way	50 dBA	10 dBA
28b	2925 Pacific Highway	50 dBA	10 dBA
29a	33 Barraganyatti Hut Road	55 dBA	10 dBA
29b	3349 Pacific Highway	55 dBA	15 dBA
29c	3381 Pacific Highway	55 dBA	15 dBA
29d	3423 Pacific Highway	55 dBA	15 dBA
30a	60 Stuarts Point Road	55 dBA	5 dBA
30b	51 Stuarts Point Road	55 dBA	5 dBA
30c	21 Stuarts Point Road	55 dBA	5 dBA
30d	Lot 2 Thurgood Lane	55 dBA	5 dBA
31a	29 Brushbox Road	55 dBA	10 dBA
31b	3386 Pacific Highway	55 dBA	10 dBA
31c	3420 Pacific Highway	55 dBA	15 dBA

Note: Architectural treatment is only designed as 1 of 3 packages that provide either 5dBA, up to 10dBA or more than 10dBA of noise reduction. The allowable exceedance for receivers reflects how much noisier it can be without requiring a better architectural package. For example, if the criterion is 55dBA and the noise level in the EA was predicted to be 62dBA then the up to 10dBA package would be chosen. This mitigates noise levels up to 65dBA and results in an allowable exceedance of 10dBA (obtained from 65dBA-55dBA = 10dBA).

Table 4.5 At-residence noise mitigation treatments on the residences identified through further RMS investigations subject to noise mitigation treatments to be undertaken by RMS

Identifier	*Location*	*Criteria (LAeq(9h))*	*Allowable Exceedance*
19c	*Yarrabindi Road*	*50 dBA*	*10 dBA*
19d	*77 Raymonds Lane*	*50 dBA*	*10 dBA*
19e	*67 Raymonds Lane*	*50 dBA*	*5 dBA*
19f	*47 Raymonds Lane*	*50 dBA*	*5 dBA*
20d	*285 Kemps Access*	*50 dBA*	*10 dBA*
21h	*260 Quarry Road*	*50 dBA*	*15 dBA*
21i	*276 Quarry Road*	*50 dBA*	*5 dBA*
21j	*298 Quarry Road*	*50 dBA*	*5 dBA*
21j (2nd storey)	*298 Quarry Road*	*50 dBA*	*5 dBA*
22b	*Tamban Road*	*50 dBA*	*10 dBA*
23a	*114 Seven Hills Lane*	*50 dBA*	*5 dBA*
25b	*269 Cooks Lane*	*50 dBA*	*15 dBA*
25c	*321 Cooks Lane*	*50 dBA*	*5 dBA*
26b	*2693 Pacific Highway*	*50 dBA*	*0 dBA*
25d	*Lot 42 Cooks Lane*	*50 dBA*	*10dBA*
26c	*59 Nirvana Way*	*50 dBA*	*10 dBA*
27b	*Lot 47 Nirvana Way*	*50 dBA*	*10 dBA*
27c	*3037 Pacific Highway*	*50 dBA*	*10 dBA*
28c	*2987 Pacific Highway*	*50 dBA*	*15 dBA*
29e	*3345 Pacific Highway*	*55 dBA*	*10 dBA*
29f	*Lot 1 Station Street*	*55 dBA*	*5 dBA*
29g	*Lot 1 Station Street*	*55 dBA*	*10 dBA*
29h	*76 Station Street*	*55 dBA*	*5 dBA*
29i	*74 Station Street*	*55 dBA*	*5 dBA*
29j	*72 Station Street*	*55 dBA*	*5 dBA*
29k	*70 Station Street*	*55 dBA*	*5 dBA*
29l	*68 Station Street*	*55 dBA*	*5 dBA*
29m	*64 Station Street*	*55 dBA*	*5 dBA*
29n	*135 South Bank Road*	*55 dBA*	*5 dBA*
30e	*55 Stuarts Point Road*	*55 dBA*	*5 dBA*

Note: Architectural treatment is only designed as 1 of 3 packages that provide either 5dBA, up to 10dBA or more than 10dBA of noise reduction. The allowable exceedance for receivers reflects how much noisier it can be without requiring a better architectural package. For example, if the criterion is 55dBA and the noise level in the EA was predicted to be 62dBA then the up to 10dBA package would be chosen. This mitigates noise levels up to 65dBA and results in an allowable exceedance of 10dBA (obtained from 65dBA-55dBA = 10dBA).

(e) Any at-road operational noise mitigation measures must be located and contained within the Site, Local Road Works Areas and existing road reserves.

(f) The Contractor must undertake noise modelling on the design of the Project Works to:

(i) predict the 2016 traffic volume and 2026 traffic volume 60 dB(A) / 55dB(A) LA eq 15hr (day) and 55dB(A) / 50dB (A) LAeq9hr (night) noise contours for redeveloped / new roads respectively as appropriate for the whole of the Construction Site and surrounding properties; and

(ii) predict the operational LAeq15hr (day) and LAeq9hr (night) noise levels at all the noise sensitive receiver locations identified in Table 4.4 and Table 4.5 for the year 2016 traffic volumes and year 2026 traffic volumes.

The noise modelling must:

(iii) use the following 85th percentile traffic speeds for all vehicles:

Main Carriageways; 15hr 7am – 10pm (day)	*115Km/hr*
Main Carriageways; 9hr 10pm – 7am (night)	*120Km/hr*
Local Roads Works, (including Service Road and Access Roads) and Ramps	*Posted speeds identified in Figure 9.2 of Appendix 9 of the Scope of Works And Technical Criteria.*

(iv) use the year 2016 traffic volumes and year 2026 traffic volumes identified in Tables 9. 9 and 9.10 respectively of Appendix 9 of the Scope of Works and Technical Criteria;

(v) apply source heights of 0.5m for exhausts / engines and car / truck tyre noise, 1.5m for truck engines and 3.6m for truck exhausts;

(vi) use pavement corrections of +3dB(A) for concrete, 0 dB(A) for dense graded asphalt and -2dB(A) for stone mastic asphalt;

(vii) adopt receiver heights at 1.5m and 4.5m above ground level for single and double story premises respectively;

(viii) adopt a ground absorption factor of 60%, except for over water where a ground absorption factor of 0% must be adopted;

(ix) adopt an angle increment of 1.0 degree, a reflection depth of 0, a number of reflections of 0 and a maximal search radius of 2.500;

(x) adopt a grid space of 20, a height above ground of 1.5m, a grid interpretation field size of 9 x 9, a grid interpretation min / max of 2.0dB(A) and a grid interpolation difference of 0.1dB(A);

(xi) use calibration adjustment/s determined by comparing the Contractor's measured existing noise levels with the predicted noise levels modelled using the Contractor's concurrently collected traffic and noise data (i.e. calibration adjustment =

monitored noise levels – modelled noise levels);

(xii) use a risk allowance/s of at least one standard deviation for the data set obtained by comparing the Contractor's measured existing noise levels with the noise levels modelled using the Contractor's concurrently collected traffic and noise data (i.e. risk allowance = 1 x standard deviation); and

(xiii) include a +2.5dB(A) facade reflection.

4.2 Relevant Traffic Noise Criteria

At time of approval criteria for assessment of road traffic noise are set out in the NSW Government's *Environmental Criteria for Road Traffic Noise (ECRTN)*. RMS has also published the *Environmental Noise Management Manual (ENMM)* to assist in implementing the *ECRTN*.

Under the *ECRTN*, road developments for the Pacific Highway are classified as either 'new freeway' or 'redevelopment of an existing freeway'. The criteria set out in Table 4-1 would therefore apply.

Table 4-1 *Environmental Criteria for Road Traffic Noise* Criteria for Operational Traffic Noise - Residences

Type of Development	Noise Level Criterion		Where Criteria are already Exceeded
	Day (7.00am-10.00pm)	Night (10.00pm-7.00am)	
New freeway or arterial road corridor	$L_{Aeq,15hr}$ 55dBA	$L_{Aeq,9hr}$ 50dBA	The new road should be designed as not to increase existing noise levels by more than 2dB. *Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may be achievable only through long-term strategies …*
Redevelopment of existing freeway/arterial road	$L_{Aeq,15hr}$ 60dBA	$L_{Aeq,9hr}$ 55dBA	In all cases, the redevelopment should be designed so as not to increase existing noise levels by more than 2dB. *Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may be achievable only through long-term strategies …*

In applying Table 4-1, the noise level criterion applies to the predicted noise level at opening of the project (design year) and at a time 10 years after opening of the project, which in this case is year 2026.

Practice note (i) of the Environmental Noise Management Manual describes the circumstances under which the 'new freeway' and 'redevelopment of an existing freeway' criteria apply.

Applying this practice note to the Project, the northern highway section between the Stuarts Point interchange and north of Station Street would be classified as a '*redevelopment of existing freeway/arterial road*'.

Practice Note (iv) of the *ENMM* provides further discussion of situations where provision of additional controls would be considered "feasible and reasonable". in particular, for "redevelopment of existing freeway/arterial road" it is generally not considered reasonable to take action to reduce noise levels to the target levels if the noise levels with the proposal, ten years after project opening, are predicted to be:

- Within the "allowance" criterion – that is, 2dBA above "future existing" noise levels; and
- Not "acute" - that is, less than 65dBA $L_{Aeq,15hr}$ and 60dBA $L_{Aeq,9hr}$.

4.3 Relevant Criteria for Assessing Maximum Noise Levels

The *ECRTN* includes a review of international sleep arousal research and concludes that at our current level of understanding, it is not possible to establish absolute noise level criteria that would correlate to an acceptable level of sleep disturbance. The only guidance offered in terms of acceptable maximum noise levels are:

- Maximum internal noise levels below 50-55dBA are unlikely to cause awakening reactions; and
- One or two noise events per night, with maximum internal noise levels of 65-70 dBA are not likely to affect health and well being significantly.

Note that the cause of sleep disturbance varies between studies, however, it is largely recognised that the maximum noise level of an event, the number of occurrences, the duration of the event, and the emergence above background or ambient noise levels are key factors. Not all people are affected to the same degree or by the same noise exposure. Findings from studies of sleep disturbance measured by an awakening, change in sleep state or awakening-effects reflect the considerable variation in the populations response to noise.

The RTA's *Environmental Noise Management Manual (ENMM)* puts forward a protocol for assessing maximum traffic noise levels. In Practice Note (iii) the document states:

At locations where road traffic is continuous rather than intermittent, the $L_{Aeq, 9hr}$ target noise levels should sufficiently account for sleep disturbance impacts.

However, where the emergence of the L_{Amax} over the ambient is equal to or greater than15dB, the $L_{Aeq,9hr}$ criteria may not sufficiently account for sleep disturbance impacts.

A 'maximum noise event' can therefore be defined as any passby for which

$$L_{Amax} - L_{Aeq,1hr} >= 15dBA$$

The *ECRTN* requires that a maximum noise level assessment be used to assess the relative impacts on sleep of different options for new roadway developments and to rank maximum noise level impacts on residences so that noise control measures can be prioritised. The maximum noise level assessment is not be used to determine which properties require noise control measures.

5 OPERATIONAL NOISE MANAGEMENT REPORT COMPLIANCE REQUIREMENTS

Section 4.16 of Appendix 4 of the Scope of Works and Technical Criteria (SWTC) contains a list of requirements with which the Operational Noise Management Report (ONMR) must comply. All requirements from the SWTC pertaining to the ONMR are identified below. Furthermore, the intended method of compliance has also been nominated for each requirement.

SWTC App. 4 Reference	Relevant Condition	How Complied With in ONMR
4.16(a)	*a description of the prevailing ambient noise environment;*	See Section 6 – Existing Noise Environment
4.16(b)	*the results of noise modelling and proposed mitigations required by section 4.15 of this Appendix 4;*	Results and mitigation required are discussed in Section 8 – Operational Noise Assessment for free flowing traffic and the results of noise modelling are presented in Appendix D & E
4.16(c)	*the results of all field survey and noise monitoring required to calibrate the modelling required by section 4.15 of this Appendix. As a minimum, noise monitoring must include those sensitive receivers which have been identified and monitored in the Environmental Documents;*	See Table 6-2 Summary of Unattended Monitoring Noise Levels and Table 6-4 Summary of Attended Monitoring Noise Levels in Section 6 – Existing Noise Environment
4.16(d)	*details on the noise-sensitive receivers and noise monitoring locations, including distances to the nearest roads where roads are located close to the noise monitors;*	See Table 6-1 Unattended Noise Monitoring Locations in Section 6 – Existing Noise Environment
4.16(e)	*a site plan showing the noise-sensitive receivers and noise monitoring locations;*	See Appendix A – Locality Plan
4.16(f)	*aerial photographs showing the noise-sensitive receivers and noise monitoring locations;*	See Appendix B for aerial photographs
4.16(g)	*details on the positioning of noise loggers at each noise monitoring location, including photographs of the noise logger in its monitoring position;*	GPS coordinates are shown in Table 6-1 Unattended Noise Monitoring Locations in Section 6 – Existing Noise Environment and photographs of the noise logger (where available) are shown in Appendix B

SWTC App. 4 Reference	Relevant Condition	How Complied With in ONMR
4.16(h)	*charts and a summary table of measured and / or computed noise modelling parameters, including the LAmax, LA10, LAeq and LA90, at 15-minute intervals for each 24-hour period of the noise monitoring survey;*	See Appendix C
4.16(i)	*a table summarising the noise parameters measured;*	See Table 6-2 Summary of Unattended Monitoring Noise Levels and Table 6-4 Summary of Attended Monitoring Noise Levels in Section 6 – Existing Noise Environment
4.16(j)	*tabulations of average annual daily traffic (AADT) predictions for the day and night time periods;*	In accordance with Table 9.10 and Table 9.11 in Appendix 9 of the SWTC
4.16(k)	*summaries of the computational algorithms used in the noise model and justification for their selection, the location of noise-sensitive receivers and how the modelling parameters were addressed;*	See Section 7 – Road Traffic Noise Modelling
4.16(l)	*summaries of the calibration adjustment/s determined by comparing the Contractor's measured existing noise levels with the predicted noise levels modelled using the Contractors concurrently collected traffic and noise data (i.e. calibration adjustment = monitored noise levels – modelled noise levels);*	No calibration adjustment/s has been applied to the noise model for this project. Justification can be found in Section 7 – Road Traffic Noise Modelling
4.16(m)	*summaries of the risk allowances applied to the noise model to reduce design and operational risks and improve modelling confidence limits;*	A risk allowance of 0.7dB has been applied to the noise model. Justification can be found in Section 7 – Road Traffic Noise Modelling
4.16(n)	*a table summarising the relevant noise modelling parameters computed at the monitoring locations and comparisons with the design noise objectives and requirements of the Environmental Documents and section 4.15 of this Appendix 4;*	See Section 7 Table 7.1

SWTC App. 4 Reference	Relevant Condition	How Complied With in ONMR
4.16(o)	*sensitivity and statistical analysis of key data in order to estimate confidence interval and reliability;*	See Section 7 – Road Traffic Noise Modelling
4.16(p)	*well presented noise contour maps for years 2016 and 2026 detailing the LAeq (9hr) Night and LAeq (15hr) Day and identifying all noise-sensitive receiver locations. The contour maps must be presented for intervals of not greater than 5 dB(A) and extend out to 45 dB(A);*	Noise contour maps for years 2016 and 2026 are shown in Appendix E. The noise contours extend out to 45dBA where topography data is available.
4.16(q)	*an assessment of maximum noise levels to evaluate sleep disturbance impacts and determination of mitigation options;*	See Section 8.6 – Assessment of Maximum Noise Levels
4.16(r)	*details on all noise-sensitive receivers that are predicted to exceed the ECRTN (base criteria and allowance criteria) for the year 2026 (10 years after opening);*	See Appendix D
4.16(s)	*identification of noise-sensitive receivers predicted to have noise levels, for the year 2026 (10 years after opening), at an acute noise level or above; and*	See Appendix D
4.16(t)	*identification of all operational noise mitigation measures.*	No at-source noise mitigation measures are required

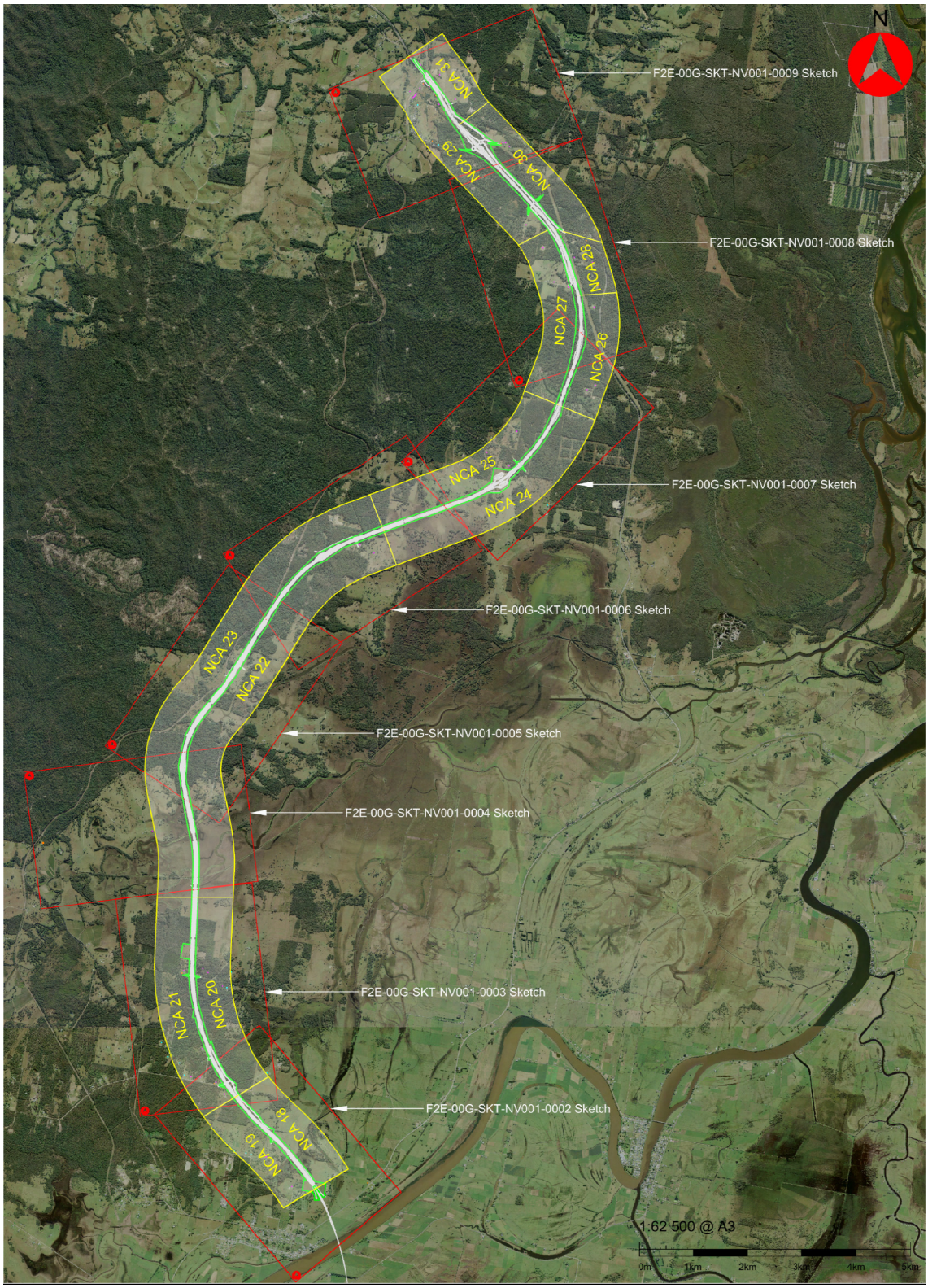
6 EXISTING NOISE ENVIRONMENT

It is not practicable to carry out monitoring of traffic noise levels at all of the identified sensitive receiver locations. Accordingly, as recommended by the *ENMM,* monitoring has been undertaken at representative locations within the study area, to broadly characterise the noise environment and to verify the traffic noise model. Unattended long-term noise monitoring was undertaken at ten locations across a 12 day period between Monday, 11 March 2013 and Friday, 22 March 2013. In addition, several short term attended measurements were undertaken at satellite locations to assist in model validation.

Noise monitoring locations have been selected based on a detailed inspection of potentially affected areas, giving considerations to other noise sources which may adversely influence the measurements, security issues for the noise monitoring devices and gaining permission for access from the residents or landowner. This also included using some façade locations and some free field locations. It is noted all criteria relate to façade locations and assessment is undertaken on this basis, albeit free field locations are often more appropriate for model validation. It should be noted that accurate measurement of road traffic noise becomes more difficult as distance from the road increases. This is because the traffic noise contribution decreases as a function of distance from the road and as such other extraneous noise sources in the environment have a greater relative influence on the measured levels. Additionally the influence of meteorological conditions on noise levels increases with distance from the source. Experience on similar projects has shown that measurements made at distances exceeding typically 200-300 m are not suitable for road noise model validation for these reasons.

Figure 6-1 presents a copy of the alignment key plan with locality drawings that shows the location of noise receivers and monitoring locations. The locality plan can be found in Appendix A.

Figure 6-1 Alignment Key Plan – Locality Plan of Noise Sensitive Receivers



6.1 Unattended Traffic Noise Monitoring

Unattended noise loggers were deployed between Monday, 11 March and Friday, 22 March 2013 at ten representative locations, along the length of the existing Pacific Highway between Frederickton and Eungai Rail, outlined in Table 6-1 and are shown in Appendix B. In addition, fully classified traffic count data were collected concurrently during the unattended noise monitoring.

Table 6-1 Unattended Noise Monitoring Locations

Site	Address	Coordinates (Easting, Northing)	Approx. Setback Distance to Road (m)
U1	921 Pacific Highway	489641, 6567760	25
U3	Cnr of Nirvana Way and Pacific Highway	494070, 6583947	21
U4	6 Nirvana Way	493966, 6584044	150
U5	2986 Pacific Highway	493749, 6584882	19
U6	3035 Pacific Highway	493318, 6584924	106
U7	51 Stuarts Point Road	492175, 6586656	340
U8	12 South Bank Road East	490908, 6586705	560
U9	3349 Pacific Highway	490975, 6587540	35
U10	3381 Pacific Highway	490868, 6587707	31
U11	90 Station Street	490741, 6587759	97

6.1.1 Noise Monitoring Equipment

Equipment used for the noise measurements comprised six ARL-215, two ARL-316 and two ARL NGARA environmental noise loggers. The ARL 215 and 316 noise loggers were set to A-weighted, fast response, continuously monitoring each 15-minute period. The ARL NGARA noise logger was set to A-weighted, fast response and is capable of remotely monitoring and storing L_{max} noise levels every one-tenth of a second. These instruments are capable of monitoring and storing various noise level descriptors for later detailed analysis. The loggers determine $L_{A1,}$ $L_{A10,}$ L_{A90} and L_{Aeq} levels of the existing noise environment. The $L_{A1,}$ L_{A10} and L_{A90} levels are the levels exceeded for 1%, 10% and 90% of the sample time respectively. The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional passby of a heavy vehicle. The L_{A90} level is normally taken as the background noise level. The L_{Aeq} level is the equivalent continuous sound level and has the same sound energy over the sampling period as the actual noise environment with its fluctuating sound levels. While the L_{A10} has in the past been used as a descriptor for traffic noise, the L_{Aeq} is now the standard descriptor for traffic noise in NSW.

All loggers were placed in a free-field position with respect to traffic noise except for U10, where it was placed at a façade position. It was noted the unattended monitoring results at all locations were not influenced by industrial noise. However, background noise levels may be influenced by other noise sources such fauna (i.e. insects and frogs) as the distance from the road increases. Observations made during the site survey indicate the primary noise source at

the monitoring locations was road traffic from the Pacific Highway except at 12 South Bank East Road and 51 Stuarts Point Road. Whilst traffic noise from the Pacific Highway was audible at 51 Stuarts Point Road, ambient noise environment was dominated by other sources such as fauna, rustling foliage and occasional local traffic noise on Stuarts Point Road which masked distant highway traffic noise for most the time. Traffic noise from the Pacific Highway was barely audible at 12 South Bank East Road, the ambient noise environment was dominated by other noise sources such as fauna and rustling foliage.

6.1.2 Unattended Noise Monitoring Results

All data considered to be affected by adverse weather conditions were excluded from the results. Further review of the data was performed to exclude rain and sources of extraneous noise. These sources are not always identifiable; however discrete 15 minute measurements for which the L_{Aeq} level is significantly higher than the L_{A10} level, with an unusually high maximum level are unlikely to be controlled by 'normal' traffic noise. These measurements have therefore been excluded from the statistical analysis of the logger data. The noise results are presented in graphical form in Appendix C and summarised below in Table 6-2.

Table 6-2 Summary of Unattended Monitoring Noise Levels

Site	Approx. Setback Distance to the Nearside Carriageway (m)	Day time $L_{Aeq,15hr}$ (dBA)	Night time $L_{Aeq,9hr}$ (dBA)	Rating Background Level (RBL) (dBA)		
				Day	Evening	Night
U1	25	67	67	48	45	41
U3	21	69	67	46	39	36
U4	150	52	50	41	39	35
U5	19	66	65	45	40	36
U6	106	59	58	45	40	36
U7	340	58	52	39	39	36
U8	560	50	49	37	39	38
U9	35	61	60	45	41	38
U10	31	65	64	43	39	31
U11	97	54	53	42	41	37

6.2 Attended Noise Measurements

Further to the unattended noise monitoring, attended noise measurements were made at appropriate "satellite" locations during the daytime and night period to provide more data for the traffic noise model verification process. Traffic volume and classifications were monitored concurrently during the attended noise monitoring periods at some locations. The locations were chosen to represent all potentially affected noise sensitive receivers along the route. The locations are listed in Table 6-3 and are shown in Appendix A. Note that Bellimbopinni Primary School and 2165 Pacific Highway cannot be found in the locality plan and are not given an identification number due to being located off the project route. Bellimbopinni Primary School and 2165 Pacific Highway are included on the list primarily to help improve confidence in validating the noise model.

Table 6-3 Attended Noise Monitoring Locations

Site	Address	Coordinates (Easting/Northing)	Approx. Setback Distance to the Nearside Carriageway (m)
A1-a	921 Pacific Highway (Free-field)	489718, 6567497	30
A1-b	921 Pacific Highway (Façade)	489725, 6567503	30
-	Bellimbopinni Primary School	491387, 6569583	41
-	2165 Pacific Highway (Free-field)	494620, 6577037	15
-	2165 Pacific Highway (Façade)	494627, 6577020	15
A5	Road side opposite 3035 Pacific Highway	493327, 6585060	13
A6-a	3035 Pacific Highway	493295, 6585033	15
A6-b	3035 Pacific Highway	493317, 6584924	106
A7-a	3349 Pacific Highway (Free-field)	490963, 6587561	37
A7-b	3349 Pacific Highway (Façade)	490955, 6587577	37

Table 6-4 presents a summary of the attended monitoring results.

Table 6-4 Summary of Attended Monitoring Noise Levels

Site	Date - Time	Position	Traffic Count LV / HV	$L_{Aeq,period}$ (dBA)	$L_{Aeq,period}$ at the nearest logger (dBA)
A1	11/03/13 08:00 to 08:15	Free-field	NB: 44 / 7* SB: 45 / 10*	66	67 (921 PH U1)
A1	11/03/13 08:00 to 08:15	Facade	NB: 44 / 7* SB: 45 / 10*	67	67 (921)
School	10/03/13 - 20:00 to 20:15	Free-field	NB: 15 / 10 SB: 24 / 8	65	N/A
-	11/03/13 19:45 to 20:00	Free-field	NB: 11 / 16 SB: 19 / 12	68	70 (6 Nirvana)
-	11/03/13 19:45 to 20:00	Facade	NB: 11 / 16 SB: 19 / 12	70	70 (6 Nirvana)
A5	11/03/13 16:00 to 17:00	Free-field	NB: 303 / 54 SB: 238 / 40	71	60 (3035)
A6	22/03/13 15:45 to 16:00	Free-field (15m)	NB: 82 / 19 SB: 57 / 13	72	62 (3035)
A6	22/03/13 15:45 to 16:00	Free-field (106m)	NB: 82 / 19 SB: 57 / 13	61	62 (3035)
A7	22/03/13 16:15 to 16:30	Free-field	NB: 64 / 18 SB: 50 / 17	62	70 (6 Nirvana)
A7	22/03/13 16:15 to 16:30	Facade	NB: 64 / 18 SB: 50 / 17	63	70 (6 Nirvana)

* 15 minute data obtained as an average from hourly data

7 ROAD TRAFFIC NOISE MODELLING

7.1 Methodology of Assessing Traffic Noise Impact

Detailed noise calculations have been carried out for year of opening (2016) and 10 years after opening (2026). All calculations and modelling are based on the traffic volumes specified in SWTC Appendix 9, Table 9.9 and Table 9.10. The following factors have been considered during the assessment process:

- Traffic volume and percentage of heavy vehicles for daytime and night time;
- Vehicle speeds for daytime and night time;
- Road surface types and road gradient;
- Different noise emission levels and source heights;
- Location of the noise sources on the highway;
- Topographical information along and surrounding the entire project corridor;
- Shielding from mounds or barriers and large building structures.
- Land use (types of noise sensitive receivers) surrounding the project;

7.2 Noise Modelling Procedures

Noise levels from the proposed road designs were calculated using procedures based on the *CoRTN (Calculation of Road Traffic Noise)* (UK Department of Transport, 1988) prediction algorithms. The standard prediction procedures were modified in the following ways:

- L_{Aeq} values were calculated from the L_{A10} values predicted by the *CoRTN* algorithms using the well-validated approximation $L_{Aeq,1hour} = L_{A10,1hr} - 3$. (NSW RTA, 2001). It is worth noting the predicted $L_{Aeq,1hr}$ is equivalent to the $L_{Aeq,period}$ as required by the noise criteria since the input is the "average" traffic flow over the given daytime and night time periods;
- Noise source heights were set at 0.5m for cars, 1.5m for heavy vehicle engines and 3.6m for heavy vehicle exhausts, representative of typical values for Australian vehicles (Road Traffic Noise: Interim Traffic Noise Policy, 1992);
- Noise from a heavy vehicle exhaust is 8dBA lower than the (steady continuous) noise from the engine; and
- Previous research in Australia has established a negative correction to the *CoRTN* predictions of -1.7 dB for façade-corrected levels (Samuels and Saunders, 1982). Corrections for Australian conditions have been included in noise modelling for this project.
- The same correction for a given road pavement surface were applied to all light and heavy vehicle sources in the 3 source height model.

The model was implemented using SoundPLAN software (Version 7.1). Road design information (alignment) was based on Revision 7 85% data supplied by Thiess. Since this Revision 7 (85%) of the road alignment design, the only changes in the SDD (100%) road alignment design that

could potentially have a material impact on the noise outcome are as follows:

- Mainline Cut 23 (ch 32920 to 33760) vertical alignment has been lifted by a maximum of 1.3m (to reduce cut volume); and
- Access Road C has been lowered and optimised (vertical and horizontal), given that the Optus fibre optic cable previous constraint has now been removed.

An 'equivalent' review exercise has been conducted using Revision 7 (85%) road design data as the basis. Examination of the above changes indicates:

- Lifting the vertical alignment between ch 32920 and 33760 by 1.3m throughout (as a conservative approximation) resulted in negligible change in modelled noise levels at the nearest affected noise receivers. Thus lifting the vertical alignment in this section by a maximum of 1.3m would also result in negligible change in modelled noise levels; and
- Lowering and optimising Access Road C would result in negligible change in noise levels for the reason that the $L_{Aeq,period}$ traffic noise contribution from the main carriageway is considerably greater than the noise contribution from Access Road C.

It can therefore be concluded that the alignment changes made in SDD (100%) would not result in any material changes to the noise assessment outcome of Revision 7 (85%) road design as stated in Section 10 below.

Percentage of absorbent ground cover was set to 60% as required by the SWTC and has been applied over the project site with the exception of areas over water where the absorption factor was set to 0%. It should be noted that use of absorbent ground cover in the range of 60% to 89% is taken by *CoRTN* to adopt a soft ground factor of 0.75.

Table 7-1 summarises other variables used in the noise model.

Table 7-1 Variables used for Noise Modelling

Parameter	Comment
Traffic Speed	Existing road: Weighted average (validation) and 85th percentile data supplied by Austraffic; New road: 115 km/h and 120 km/h on the main carriageway at day and night respectively; Local roads: 80 km/h on service roads. 60 km/h on access roads; and Ramps: 80km/h.
Road Surface	Existing road: 0dB for dense grade asphalt (DGA) and +3dB for chipseal (+1dB for worn chipseal) ; Main Carriageway (MC): -2dB for stone mastic asphalt (SMA)on north bound MC beyond Ch39220 and the rest of the MC as +3dB for concrete; Ramps: +3dB for concrete; Bridge decks: -2dB for stone mastic asphalt; and Overpasses: 0 for DGA
Façade Correction	+2.5dB in accordance with *CoRTN; and* -1.7dB for ARRB's Australian condition correction at 1m from façade conditions and -0.7dB for free-field conditions.

Parameter	Comment
Traffic Volume	All existing traffic data came from a survey conducted by AusTraffic in March 2013. Years 2016 and 2026 traffic predictions came from Tables 9.9 and 9.10 of Appendix 9 of the SWTC.
Calculation Settings	Grid space of 20m; height above ground = 1.5m; grid interpretation field size = 9 x 9; grid interpretation min/max = 2dBA; grid interpretation difference = 0.1dBA; angle increment = 1 degree; reflection depth = 0; number of reflections = 0; and maximal search radius = 7000m.
Receivers	1.5m and 4.5m above existing floor level for single and double storey premises respectively.
Buildings	4.5m and 6m above maximum terrain height of building footprint for single and double storey premises respectively.

Note for the existing scenario majority of the existing Pacific Highway in the vicinity of the project has been modelled with chipseal or concrete pavement at +3dB, above the *CoRTN* reference of 0dB for DGA, except for the section north of Stuarts Point Road where +1dB has been applied for worn chipseal pavement.

Note that since running the design model with a concrete pavement on the main carriageway and on ramps, except for bridge decks, overpasses and NB main carriageway beyond Ch39220, we understand a flexible pavement may be required in some areas for other than acoustic reasons. This is not included in the report and the associated noise contours, which is

7.3 Modelling Scenarios

The following scenarios were modelled under both daytime and night time conditions.

- Existing road. Current noise levels were calculated based on a traffic survey conducted in March 2013. This was used to calibrate the noise model by comparing predicted levels with those measured at corresponding noise logger locations. It was also used to determine current noise levels at residences. These results are implemented in *ECRTN* procedures to establish mitigation conditions.
- Year 2016. Noise levels were calculated based on predicted traffic data.
- Year 2026. Noise levels were calculated based on provided traffic data. Results are compared with existing results and baseline criteria.

For each model, exceedances of *ECRTN* criteria at residences were generally highest at night, so that if mitigation measures are designed to meet relevant criteria at night they will also meet them during the daytime. For this reason, when considering protection of residences in the discussion below, only night-time noise levels are considered.

7.4 Traffic Data

Traffic inputs were provided by AusTraffic (Existing scenarios) and SWTC (Future scenarios) and are categorised as being associated with the main carriageway, ramps or local roads for the existing road as well as the year of opening, 2016, and 10 years after opening in 2026.

The traffic inputs for the existing scenarios are summarised in Table 7-2 below.

Table 7-2 Existing Traffic Summary (March 2013)

Location			Direction	Day (7am to 10pm)		Night (10pm to 7am)		85th Percentile Speed	
Pt.	North of	South of		Light	Heavy	Light	Heavy	Day	Night
1	Frederickton	Smithtown Road	NB	4004	718	313	344	80	89
			SB	4013	733	387	336	94	98
2	Smithtown Road	Plummers Lane	NB	3534	679	312	336	101	103
			SB	4013	733	387	336	94	98
3	Plummers Lane	Stuarts Point Road	NB	3138	697	270	351	101	104
			SB	3132	705	302	329	102	104
4	Stuarts Point Road	Station Street	NB	2976	639	271	341	103	103
			SB	2898	739	262	324	103	104
5	Station Street	Dual Carriageway	NB	3096	678	272	343	103	103
			SB	3176	669	424	254	103	104

The traffic volumes in Tables 9.9 and 9.10 of Appendix 9 of the SWTC must be used for noise modelling and are those required for the noise modelling requirements of Appendix 4 of the SWTC. These tables are reproduced in this document as Table 7-3 and Table 7-4 below. The traffic volumes for two way Local Road Works are the total traffic volumes for both directions of flow and the traffic volumes in each direction are 50% of the total traffic volumes.

Table 7-3 Traffic Volumes Year 2016

Year 2016 (Opening)	Day 15hr (hourly average)		Night 9hr (hourly average)	
	Total No of Vehicles	% heavy vehicles	Total number of vehicles	% heavy vehicles
Main Carriageway				
North of Frederickton Interchange	738	14	139	53
Northbound Main Carriageway	340		64	
Southbound Main Carriageway	398		75	
North of Stuarts Point Interchange	798	18	150	62
Northbound Main Carriageway	370		70	
Southbound Main Carriageway	428		80	
Frederickton Interchange				
On Ramp - Northbound	72	13	18	52
Off Ramp - Southbound	81	13	15	52
Stuarts Point Interchange				
On Ramp Northbound	88	10	20	15
Off Ramp Northbound	61	7	10	10
On Ramp Southbound	61	7	10	10
Off Ramp - Southbound	88	10	20	15
Local Roads				
Service Road	128	7	20	10
Stuarts Point Road	156	7	29	10
Blackbutt Shute Road	17	7	6	10

Table 7-4 Traffic Volumes Year 2026

Year 2026 10 years after new date of opening	day 15hr (hourly average)		night 9hr (hourly average)	
	Total No of Vehicles	% heavy vehicles	Total number of vehicles	% heavy vehicles
Main Carriageway				
North of Frederickton Interchange	930	14	170	52
Northbound Main Carriageway	428		78	
Southbound Main Carriageway	502		92	
North of Stuarts Point Interchange	1000	18	190	61
Northbound Main Carriageway	463		88	
Southbound Main Carriageway	537		102	
Frederickton Interchange				
On Ramp - Northbound	100	13	20	52
Off Ramp - Southbound	220	13	40	52
Stuarts Point Interchange				
On Ramp Northbound	110	10	20	15
Off Ramp Northbound	80	7	20	10
On Ramp Southbound	80	7	20	10
Off Ramp - Southbound	110	10	20	15
Local Roads				
Service Road	200	7	40	10
Stuarts Point Road	250	7	50	10
Blackbutt Shute Road	30	7	10	10

7.5 Validation of Noise Model

It is considered the measured noise levels are the most reliable data to validate predicted noise levels so the noise model has been established primarily on this basis. In order to validate the noise model, as required by the *ENMM*, a noise model for the existing road was prepared based on topographic data and design strings provided by Thiess. Measured results are compared with model predictions for the existing road using current traffic volumes and average weighted vehicle speeds (equivalent to approximately 0.3dB lower than 85th percentile speeds). Agreement to within 2dBA is generally considered acceptable given the expected accuracy of standard noise modelling procedures, and also variability in traffic speeds along the whole alignment. Table 7-5 shows the difference between measured and predicted values at 9 locations along the existing highway. The results are discussed below.

Table 7-5 Predicted & Measured Results Based On 0.75 Soft Ground Factor (Unattended Monitoring)

Location	Daytime $L_{Aeq,15hr}$			Night time $L_{Aeq,9hr}$		
	Measured	Predicted	Difference	Measured	Predicted	Difference
921 Pacific Highway	66.9	68.1	+1.2	66.8	65.8	-1.0
Corner of Nirvana Way and Pacific Highway	69.2	70.4	+1.2	67.2	68.0	+0.8
6 Nirvana Way	51.5	57.7	+6.2	50.2	55.4	+5.2
2986 Pacific Highway	66.3	68.1	+1.8	65.3	65.8	+0.5
3035 Pacific Highway	58.5	61.4	+2.9	57.8	58.9	+1.1
51 Stuarts Point Road	57.8	53.3	-	52.1	50.7	-
3349 Pacific Highway	61.2	63.2	+2.0	60.1	60.9	+0.8
3381 Pacific Highway	64.8	66.4	+1.6	64.3	64.0	-0.3
90 Station Street	53.5	56.3	+2.8	53.3	53.7	+0.4

It can be seen in Table 7-5 the predicted noise levels are generally higher than measured noise levels. The difference between measured and predicted noise levels appears to be higher during the day while a better correlation exists for the night comparison. This is possibly due to meteorological effects as well as variation in road pavement temperatures between day and night time. Typically, the atmosphere is unstable by day and stable by night resulting in lower noise levels at daytime. Hotter road surfaces also lead to small reductions in tyre/road noise. Therefore, the noise model verification process is focused on the night period.

51 Stuarts Point Road is located at a distance of 340m from the highway which is just over the 300m distance where the accuracy of the *CoRTN* algorithm is not as well documented. Whilst the measured night time level compares well with the predicted contribution from the Pacific Highway, vegetation effect on sound and local road traffic noise contribution has not been considered due to insufficient data. It is noted while traffic noise from the Pacific Highway is audible at this location other sources such as insects, birds or the local road directly in front of the residence would have dominated the $L_{Aeq,period.}$ Therefore, 51 Stuarts Point Road has not been used to validate the noise model of the existing Pacific Highway.

Whilst the predicted noise level at a road side location adjacent to Nirvana Way and Pacific Highway agrees well with measured result, there is a significant discrepancy between the measured and predicted results at 6 Nirvana Way. This is most likely due to the presence of dense bush between the noise logger and the road that was not integrated in the model. Similar project experience indicates that this can provide additional attenuation of up to 6dB. This is consistent with the difference between the two results and is therefore likely to fall within the acceptable range.

Additionally, several attended measurements at locations close to the road were also taken to validate the noise model and are summarised below in Table 7-6.

Table 7-6 Predicted-Measured Results Based On 0.75 Soft Ground Factor (Attended Monitoring)

Location	Position	Measured L_{Aeq} (dBA)	Predicted L_{Aeq} (dBA)	Difference (dBA)
A1	Free field	65.5	65.8	+0.3
A5	Free field	70.5	71.8	+1.3
School	Free field	64.9	64.4	-0.5

This again shows that the predicted noise levels are within the +/- 2dB range. Attended measurement results at 2165 and 3349 Pacific Highway have been primarily established to identify the difference between free-field and façade conditions and therefore has not been used in the verification process.

7.5.1 Sensitivity Analysis

In order to determine modelling confidence limits, a sensitivity study of key parameters, including traffic speed, volume and percentage of absorbent ground, has been undertaken. As seen in Table 7-7 below, when the soft ground factor is increased from 0.5 through to 1.0 the average numerical difference between measured and predicted noise levels reduced from +0.9dB to -0.3dB (where the influence of ground effect increases with the increase in distance from the source to receiver).

Table 7-7 Sensitivity Study of Soft Ground Factor

Location	Distance	Difference (Predicted-Measured)		
		Soft Ground Factor 0.5	Soft Ground Factor 0.75	Soft Ground Factor 1.0
921 Pacific Highway	25	-0.3	-1.0	-1.5
Corner of Nirvana Way and Pacific Highway	21	+1.1	+0.8	+0.5
6 Nirvana Way	150	+6.5	+5.2	+3.5
2986 Pacific Highway	19	+1.2	+0.5	-0.1
3035 Pacific Highway	106	+2.1	+1.1	+0.1
3349 Pacific Highway	35	+1.3	+0.8	0
3381 Pacific Highway	31	+0.3	-0.3	-1
90 Station Street	97	+0.7	+0.4	-0.2
Average		+0.9 (1.6)	+0.3 (0.9)	-0.3 (0.2)
Standard Deviation		0.8 (2.1)	0.7 (1.9)	0.7 (1.5)

( ) refers to the data set inclusive of 6 Nirvana Way

Whilst for this Project the predicted levels with soft ground factor of 1.0 may show a better numerical alignment with measured levels at some locations and worse at others, we believe this is due to sound reduction due to dense bush/trees rather than just grass or paddock. Trees are not accounted for in *CoRTN* and as a result not in the modelling itself. Sound reduction due to trees should not be taken into account when modelling using the *CoRTN* algorithm. We note in our experience by adopting a proportion soft ground factor of 1.0 in *CoRTN* predicts lower than measured levels over grass or paddock, and the numerical difference increases with increasing distance from the nearside carriageway.

Furthermore, a sensitivity analysis has been undertaken to determine the variations in noise levels due to traffic speeds and traffic flows. For a fixed traffic volume, increasing the traffic speed increases the noise level by approximately 0.6dB per 10km/h. For a fixed traffic speed of 110km/h and 40% heavy vehicles, increasing the traffic volume increases the noise level by approximately 0.4dB per 10% traffic volume.

In undertaking the noise model verification process and sensitivity analysis, Wilkinson Murray has considered the implementation of *CoRTN* algorithm in SoundPLAN with soft ground factor of 0.75 to be valid for this Project. Therefore, on this basis, no further implementation of calibration adjustment(s) is needed to improve the modelling confidence limits.

7.5.2 Risk Analysis

Adopting the absorbent ground cover of 60% (soft ground factor of 0.75) and using the night time results the risk allowance for the Project would be +0.7dB based on one standard deviation. As no calibration adjustment has been adopted, the overall correction for the Project is +0.7dB. This is added to the predicted noise levels.

8 OPERATIONAL NOISE ASSESSMENT FOR FREE FLOWING TRAFFIC

8.1 General Assessment Methodology

Noise level predictions for the year 2016 (year of opening) and 2026 (10 years after opening) have been calculated at all identified residential receivers. Details concerning noise levels for relevant receivers in 2016 and 2026 are shown in Appendix D, with noise contour maps presented in Appendix E. Additionally, noise level predictions for residences identified in Table 4.4 and Table 4.5 in Appendix 4 of the SWTC are shown in this chapter.

The IDs used to identify receivers are the same as those in SWTC Appendix 4. Beyond observations made during the course of the noise monitoring from within the existing corridor, detailed survey has been carried out to identify additional receivers. An examination of the 60dBA and 55dBA noise contour lines for day and night respectively provided an indicator for areas where most detail was required. Ground truthing was then conducted by Thiess to confirm some of these structures as sheds or other non-residential structures. Additional receivers were identified and included in these sections.

Based on the outputs of the noise model, night time noise levels (as compared to day time) exceed the base criteria by the highest margin and also exhibit the largest increase when compared to existing noise levels. Mitigation measures designed to meet relevant criteria at night will also meet them during the daytime.

8.2 Determining Feasible and Reasonable Noise Mitigation Measures

Where the 'base' criteria in Table 4-1 (See Section 4.2 above) are already exceeded, Practice Note (iv) of the RTA's *Environmental Noise Management Manual (ENMM)* provides further discussion of situations where provision of additional controls would be considered 'feasible and reasonable'. It should be acknowledged that these considerations apply only if it can be demonstrated that all 'feasible and reasonable' traffic management and other road design opportunities for reducing traffic noise have been exhausted.

For 'new freeways or arterial roads' it is generally not considered reasonable to take action to reduce noise levels to the base noise levels if the noise levels with the proposal, ten years after project opening, are predicted to be:

- Within 2dBA of 'existing' noise levels; and
- No more than 2dBA above the noise criteria set out in *ECRTN* (See Table 4-1 in Section 4.2).

For road 'redevelopments' where existing noise levels already exceed the base noise levels, it is generally not considered reasonable to apply additional treatments (after opportunities for noise control have been incorporated into the road design) if predicted design year noise levels:

- Do not exceed the *ECRTN* allowance of 2dBA over 'existing' noise levels, and
- Will not be 'acute' (i.e. do not exceed 65dBA $L_{Aeq,15h}$ and 60dBA $L_{Aeq,9h}$).

Two further points should be noted in applying the guidelines in the *ENMM*. First, *ECRTN* indicates (technical note ix) that if the existing noise level is below the criterion but within 2dB of the criterion, then the 2dB allowance may also be applied. Hence, the exclusion above is also taken to apply to cases where an existing noise level below the 'base' criterion is predicted to increase by 2dBA or less.

8.3 Design of Operational Noise Mitigation Measures

For all locations where noise mitigation would be required, guidance is taken from the *ENMM* which was published to assist in interpretation of the Environmental Criteria for Road Traffic Noise and in particular, provides guidance on the selection of appropriate mitigation measures. It should be noted that this document states that community views should be fully taken into account in following the processes for evaluating and selecting noise treatments.

For the purpose of this report, it is expected that architectural treatment will be implemented to those residences requiring mitigation as a consequence of low residential density negating any benefits that may be obtained from other methods.

8.4 Predicted Noise Levels for 2026 (10 Years After Opening Completion)

The predicted noise levels at all the residential receivers considered in the 100% Design are presented in Appendix D. This is shown together with the process of determining the need for 'feasible' and 'reasonable' noise mitigation measures in accordance with the *ENMM* guidelines, as described in Section 8.2 above. The associated noise contours are presented in Appendix E. Note that noise contours are subject to tolerance as the contours are based on an interpolation of noise levels carried out in a regular rectangular grid.

As indicated above in Section 4, Table 4.4 and Table 4.5 of Appendix 4 of the SWTC have identified a total of 53 residences in 12 catchment areas as requiring at-residence noise mitigation. RMS has indicated they will organise mitigation in the form of architectural treatment at these SWTC identified noise sensitive receivers.

Table 8-1 presents the applicable SWTC night time operational noise criteria as well as the allowable exceedance above these criteria at each of the receivers along with the predicted noise levels. Compliance with the SWTC is indicated where the predicted exceedance (see Table 8-1 column 4) above the $L_{Aeq,9hr}$ noise criteria is lower than the allowable exceedance (see Table 8-1 column 3).

Table 8-1 Predicted 2026 "10 Years After Opening" $L_{Aeq,9hr}$ Noise Levels at RMS Identified Noise Receivers Requiring At-Residence Noise Mitigation Treatments

ID	Location	Applicable SWTC $L_{Aeq,9hr}$ Noise Criteria (Allowable Exceedance) - dBA	Predicted 2026 "10 Years After Opening" $L_{Aeq,9hr}$ (Predicted Exceedance) -dBA
19a	107 Raymonds Lane	50 (10)	56 (+6)
19c	Yarrabindi Road	50 (10)	55 (+5)
19d	77 Raymonds Lane	50 (10)	53 (+3)
19e	67 Raymonds Lane	50 (5)	52 (+2)
19f	47 Raymonds Lane	50 (5)	51 (+1)
20a	322 Kemps Access	50 (0)	48 (-2)
20c	279 Kemps Access	50 (15)	59 (+9)

ID	Location	Applicable SWTC $L_{Aeq,9hr}$ Noise Criteria (Allowable Exceedance) - dBA	Predicted 2026 "10 Years After Opening" $L_{Aeq,9hr}$ (Predicted Exceedance) -dBA
20d	285 Kemps Access	50 (10)	55 (+5)
21 a (2nd storey)	232 Quarry Road	50 (15)	61 (+11)
21a	232 Quarry Road	50 (15)	59 (+9)
21c	26 Seashore Lane	50 (15)	59 (+9)
21d	53 Seashore Lane	50 (15)	60 (+10)
21e	202 Kemps Access	50 (5)	50 (0)
21g	243 Kemps Access	50 (15)	58 (+8)
21h	260 Quarry Road	50 (15)	60 (+10)
21i	276 Quarry Road	50 (5)	49 (-1)
21j	298 Quarry Road	50 (5)	47 (-3)
21j (2nd storey)	298 Quarry Road	50 (5)	49 (-1)
22b	Tamban Road	50 (10)	56 (+6)
23a	114 Seven Hills Lane	50 (5)	52 (+2)
25a	288 Cooks Lane	50 (5)	52 (+2)
25b	269 Cooks Lane	50 (15)	62 (+12)
25c	321 Cooks Lane	50 (5)	51 (+1)
25d	Lot 42 Cooks Lane	50 (10)	55 (+5)
26a	80 Hills Lane	50 (5)	54 (+4)
26b	2693 Pacific Highway	50 (0)	49 (-1)
26c	59 Nirvana Way	50 (10)	59 (+9)
27a	92 Nirvana Way	50 (0)	50 (0)
27b	Lot 47 Nirvana Way	50 (10)	58 (+8)
27c	3037 Pacific Highway	50 (10)	55 (+5)
28a	6 Nirvana Way	50 (10)	55 (+5)
28b	2925 Pacific Highway	50 (10)	54 (+4)
28c	2987 Pacific Highway	50 (15)	61 (+11)
29a	33 Barraganyatti Hut Road	55 (10)	55 (0)
29b	3349 Pacific Highway	55 (15)	68 (+13)
29c	3381 Pacific Highway	55 (15)	68 (+13)
29d	3423 Pacific Highway	55 (15)	62 (+7)
29e	3345 Pacific Highway	55 (10)	62 (+7)
29f	Lot 1 Station Street	55 (5)	55 (0)
29g	Lot 1 Station Street	55 (10)	60 (+5)
29h	76 Station Street	55 (5)	54 (-1)

ID	Location	Applicable SWTC $L_{Aeq,9hr}$ Noise Criteria (Allowable Exceedance) - dBA	Predicted 2026 "10 Years After Opening" $L_{Aeq,9hr}$ (Predicted Exceedance) -dBA
29i	74 Station Street	55 (5)	55 (0)
29j	72 Station Street	55 (5)	54 (-1)
29k	70 Station Street	55 (5)	54 (-1)
29l	68 Station Street	55 (5)	54 (-1)
29m	64 Station Street	55 (5)	54 (-1)
29n	135 South Bank Road	55 (5)	55 (0)
30a	60 Stuarts Point Road	55 (5)	57(+2)
30b	51 Stuarts Point Road	55 (5)	60 (+5)
30c	21 Stuarts Point Road	55 (5)	64 (+9)
30d	Lot 2 Thurgood Lane	55 (5)	54 (-1)
30e	55 Stuarts Point Road	55 (5)	59 (+4)
31a	29 Brushbox Road	55 (10)	58 (+3)
31b	3386 Pacific Highway	55 (10)	60 (+5)
31c	3420 Pacific Highway	55 (15)	68 (+13)

As seen in Table 8-1 the predicted noise levels at RMS identified noise receivers requiring at-residence treatment generally exceed the night time noise criteria and are within the allowable exceedance limit at all locations except only Receiver ID 30c 21 Stuarts Point Road. It is to our understanding that Receiver 30c has been demolished due to the Project. Therefore, further acoustic consideration will not be required at this location.

Furthermore, it is noted that there are a total of 16 receivers identified for "at-residence" noise mitigation treatment where the predicted future design $L_{Aeq,9hr}$ noise levels in the year 2026 complies with the *ECRTN* base criteria, namely Receivers 20a, 21e, 21i, 21j, 26b, 27a, 29a,29f, 29h, 29i, 29j, 29k, 29l, 29m, 29n and 30d.

In addition to the RMS identified noise receivers, the detail design noise modelling has considered 22 additional receivers classed as potentially affected. These additional receivers that are not identified in Section 4.15 (d) (ii) of SWTC Appendix 4 as to be acoustically treated are assessed against the *ECRTN* and *ENMM* requirements for the year 2026 traffic volumes. For this Project, if the noise levels comply with the more stringent night time criterion of 55dBA for redeveloped road and 50dBA for new road, the daytime would also comply.

As described in the last paragraph of Section 3 above, in the northern redeveloped section of the Project, 9 additional receivers within the identified potential affected area, located along Station Street and South Bank Road East, has been considered for assessment purposes. The potential affected area is shown on Sheet 9 of Appendix A. The predicted year 2026 $L_{Aeq,9hr}$ at these representative locations are presented in Table 8-2. The indicative predicted noise levels at other locations within the potential affected area are presented as noise contours and are shown in Appendix E (Drawing reference F2E-00G-SKT-NV005-0009).

Table 8-2 Predicted $L_{Aeq,9hr}$ Noise Levels At Additional Potentially Affected Noise Receivers (Redeveloped Road Section)

ID	Address	Predicted 2026 Future Design $L_{Aeq,9hr}$	ECRTN Redeveloped Road Criterion $L_{Aeq,9hr}$	ENMM Allowance Criterion (Existing + 2dB) $L_{Aeq,9hr}$	Mitigation Required?
29p	2 South Bank Road East	56	55	51	Yes
-	4 South Bank Road East	56	55	51	Yes
-	6 South Bank Road East	55	55	49	No
-	36 Station Street	54	55	50	No
-	40 Station Street	53	55	49	No
29o	46 Station Street	56	55	52	Yes
-	50 Station Street	55	55	50	No
-	60 Station Street	55	55	50	No
-	62 Station Street	54	55	50	No

Examination of the predicted traffic noise levels in Table 8-2 shows the predicted levels at these residences generally comply with the *ECRTN* base criteria with the exception of three receivers, namely, 2 South Bank Road East, 4 South Bank Road East and 46 Station Street, where it should be considered for noise mitigation in accordance with the *ENMM.* The mitigation at the identified residences should be architectural treatment as the affected residences are in groups of three or less meaning the use of low noise pavement or noise barrier construction to mitigate traffic noise would not be considered reasonable.

As also described in the last paragraph of Section 3 above, along the bypass section of the Project, 13 additional receivers have been identified as potentially affected. The predicted noise levels at these additional receivers are presented in Table 8-3.

Table 8-3 Predicted $L_{Aeq,9hr}$ Noise Levels At Additional Potentially Affected Noise Receivers (New Road Section)

ID	Address	Predicted 2026 Future Design $L_{Aeq,9hr}$	ECRTN New Road Criterion $L_{Aeq,9hr}$	ENMM Allowance Criterion (Existing + 2dB) $L_{Aeq,9hr}$	Mitigation Required?
135	135 Cooks Lane	49	50	45	No
20e	330 Kemps Access	47	50	36	No
20f	331 Kemps Access	50	50	38	No
20g	336 Kemps Access	47	50	36	No
20h	Lot 126	48	50	37	No
20i	244 Quarry Road	51	50	42	Yes

ID	Address	Predicted 2026 Future Design $L_{Aeq,9hr}$	ECRTN New Road Criterion $L_{Aeq,9hr}$	ENMM Allowance Criterion (Existing + 2dB) $L_{Aeq,9hr}$	Mitigation Required?
21k	312 Quarry Road	49	50	37	No
21l	318 Quarry Road	49	50	35	No
21m	82 Kemps Access	47	50	35	No
21n	84 Kemps Access	47	50	35	No
25e	Lot 1862	50	50	41	No
28d	3012 Pacific Highway	52	50	58	No
28e	6 Thurgood Lane	51	50	54	No

Examination of the predicted traffic noise levels in Table 8-3 shows that the predicted 2026 Future Design $L_{Aeq,9hr}$ comply with the *ECRTN* new road criterion of 50dBA at most of the additional noise receivers along the by-pass section with the exception of 20i, 28d and 28e.

Although Receivers 28d and 28e exceed the new road criteria, the predicted '10 years after opening' operational traffic noise levels reduced as a result of the new road. On this basis, it is considered in accordance with *ENMM* not "reasonable" to take action to implement both at-source and/or at-residence noise mitigation measures to reduce predicted '10 years after opening' noise levels.

Receiver 20i should be considered for noise mitigation in accordance with the *ENMM.* The mitigation at the identified residences should be architectural treatment as the affected residences are in groups of three or less.

8.5 Normalisation of Models (RMS Concept Design and Thiess Final Design)

Four additional receivers have been identified for noise mitigation compared to Table 4.4 and Table 4.5 in Appendix 4 of the SWTC. As discussed in Section 3 of this ONMR, these additional receivers have not been previously assessed, possibly, due to the insufficient topographic data at the time.

Further investigation using the RMS provided concept design noise model (TA456-12C03 rev 0) with additional topographic data indicates all four receivers also require at-residence noise mitigation using the same modelling parameters. Note the RMS provided concept design noise model has not included Blackbutt Shute Road in the modelling. Therefore, the local road partial noise level based on Thiess modelling was logarithmically added to the main carriageway partial noise level to give the total noise level. The predicted 2026 night $L_{Aeq,9hr}$ noise levels from the Thiess final design and the RMS provided concept design models are presented below in Table 8-4.

Table 8-4 Further Modelling of RMS Provided Concept Design 2026 Night

Location	ECRTN Criteria $L_{Aeq,9hr}$	Without Risk Allowance $L_{Aeq,9hr}$ (Final Design)	With +0.7dB Risk Allowance $L_{Aeq,9hr}$ (Final Design)
244 Quarry Road	50	50.5 (50.4)	51.2 (51.1)
46 Station Street	55	54.8 (54.8)	55.5 (55.5)
4 South Bank Road East	55	55.4 (55.2)	56.1 (55.9)
2 South Bank Road East	55	55.6 (55.4)	56.3 (56.1)

A comparative examination of the predicted noise levels in Table 8-4 indicate the Thiess final design noise levels are no greater than the output from the RMS provided concept design noise model. The predicted noise levels from both models with +0.7dB risk allowance exceeds the *ECRTN* criteria. The receivers would have been included in SWTC Appendix 4, Table 4.5, had the additional data described in Section 3 above been included in the RMS concept modelling.

8.6 Assessment of Maximum Noise Levels

Although sleep disturbance assessment goals are not provided in the *ECRTN*, it is recommended that an assessment of maximum noise levels should be made where impacts may occur during the night as noise events that are substantially higher than the relative continuous ambient noise level are likely to cause awakening and generate annoyance within a community.

It is expected the $L_{Aeq,9hr}$ night target noise levels should sufficiently account for sleep disturbance impact as the proposed Upgrade route has been designed to minimise changes in gradient and to smooth curves in the road alignment, to enable a more continuous flow of traffic rather than intermittent. It is therefore expected that on the proposed Upgrade route the need for heavy vehicles to utilise engine brakes (generally noticed on downhill gradients) would be greatly reduced from the current usage on the Pacific Highway, thus minimising maximum noise events. It should however be noted that the use of truck exhaust brakes is at the driver's discretion.

The northern end of the project involves the upgrade and duplication of the existing Pacific Highway. In this area, the likely change in maximum noise levels would be insignificant at most receivers with the exception of areas located to the east of the Upgrade. This is the direct result of the duplication. However, given the setback distances from the road at these receivers are relatively large the increase in maximum noise levels would be marginal.

The number of maximum noise level events along the existing Pacific Highway route between Frederickton to Barraganyatti will be significantly reduced by the proposed upgrade alignment as most vehicles will bypass these residences. However, the residences located through Collombatti and the edge of the Tamban State Forest has not been previously exposed to traffic noise will be introduced to a new source of noise.

The assessment of maximum noise impacts for the project was undertaken by sampling night time traffic noise at 100ms sampling interval at a representative location along the existing Pacific Highway. The night time noise levels were recorded and later analysed to determine the maximum noise level events for the existing traffic flows.

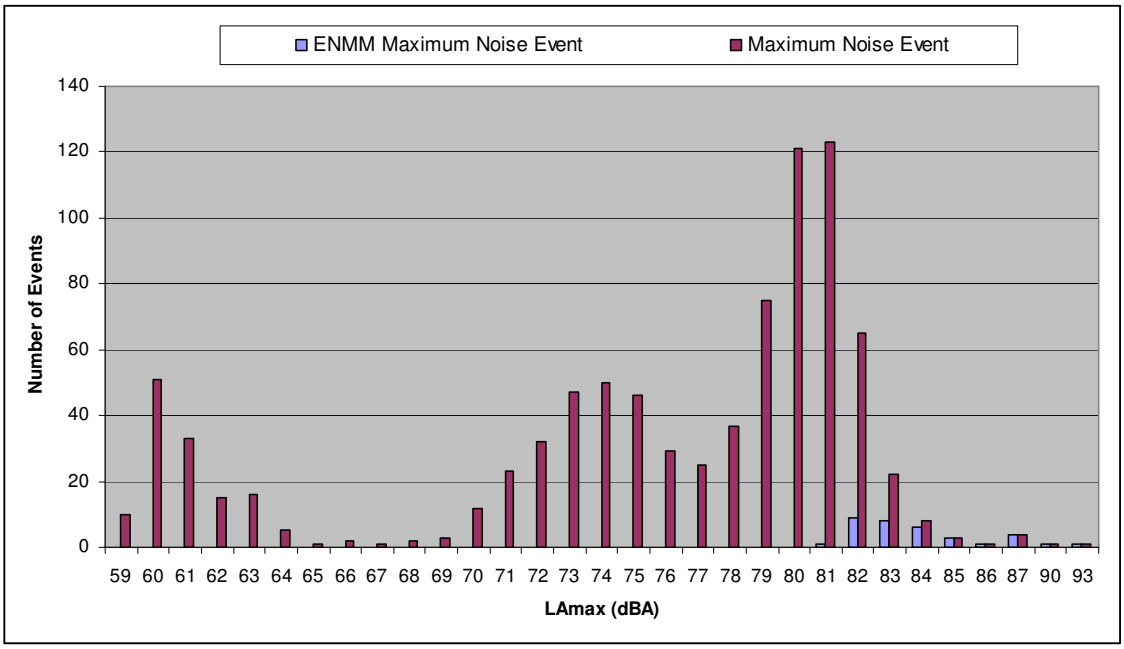
The measurements were made at the corner of Nirvana Way and Pacific Highway at a distance of 21m from the edge of the nearest carriageway. The measured $L_{Aeq,1hr}$ traffic noise levels, hourly frequency distribution of *ENMM* maximum noise events and maximum noise events that are greater than 75dBA (representative of internal noise levels of 65dBA with windows open for ventilation) have been categorised and are presented in Table 8-5 for the night time period. The weekday nightly $L_{Aeq,9hr}$ at this location is approximately 69dBA which is 2dB above the lowest nightly $L_{Aeq,1hr}$.

Table 8-5 Measured $L_{Aeq,1hr}$ Noise Levels, Hourly Frequency Distribution of Maximum Noise Levels and *ENMM* Maximum Noise Events at the Corner of Nirvana Way and Pacific Highway

Start Time	$L_{Aeq,1hr}$ dBA	Number of L_{Amax} Events >75dBA	Number of ENMM L_{Amax} Events
22:00	69	60	0
23:00	68	71	3
0:00	70	65	2
1:00	70	60	4
2:00	69	56	1
3:00	68	49	8
4:00	68	57	4
5:00	67	48	5
6:00	67	62	7

Figure 8-1 shows the frequency distribution of recorded maximum noise events at the corner of Nirvana Way and Pacific Highway. Note that the raw data does not allow for an appropriate assessment of sleep disturbance as it is likely many of the L_{Amax} events would not be sufficiently above the ambient noise level to cause sleep disturbance impact.

Figure 8-1 Frequency Distribution of Maximum Noise Levels and *ENMM* Maximum Noise Events at the Corner of Nirvana Way and Pacific Highway



A review of Table 8-5 and Figure 8-1 indicate that at a set back of 21m there are 34 occurrences where the *ENMM* maximum noise events are greater than 65dBA internally, which is more than the health and wellbeing goals of two events at 65-70dBA per night. However, whilst at a distance of 21m from the edge of the nearest carriageway the number of *ENMM* defined maximum noise events is relatively high, at increased set back distance the number of *ENMM* defined maximum noise events will only decrease. This is because the noise arising from continuous traffic flow decreases at 3dB per doubling of distance (line source) while the maximum noise from a truck pass-by, for example, decreases at 6dB per doubling of distance (point source). The predicted typical maximum noise levels from truck pass-by (sound power level of 114dBA) are presented in Table 8-6.

Table 8-6 Predicted Typical Maximum Noise Levels L_{Amax} (dBA) from Truck Pass-By

ID	Address	Predicted 2026 "10 Years After Opening" $L_{Aeq,1hr}$	Predicted Typical L_{Amax}	*ENMM* L_{Amax} Criteria
19a	107 Raymonds Lane	54	55	69
19c	Yarrabindi Road	53	56	68
19d	77 Raymonds Lane	51	51	66
19e	67 Raymonds Lane	50	50	65
19f	47 Raymonds Lane	49	48	64
20a	322 Kemps Access	46	44	61
20c	279 Kemps Access	57	60	72
20d	285 Kemps Access	53	56	68

ID	Address	Predicted 2026 "10 Years After Opening" $L_{Aeq,1hr}$	Predicted Typical L_{Amax}	*ENMM* L_{Amax} Criteria
21a	232 Quarry Road	59	63	74
21c	26 Seashore Lane	57	63	72
21d	53 Seashore Lane	58	64	73
21e	202 Kemps Access	48	51	63
21g	243 Kemps Access	56	62	71
21h	260 Quarry Road	58	63	73
21i	276 Quarry Road	47	54	62
21j	298 Quarry Road	45	51	60
22b	Tamban Road	54	55	69
23a	114 Seven Hills Road	50	47	65
25a	288 Cooks Lane	50	52	65
25b	269 Cooks Lane	60	65	75
25c	321 Cooks Lane	49	50	64
25d	Lot 42 Cooks Lane	53	53	68
26a	80 Hills Lane	52	54	67
26b	2693 Pacific Highway	47	53	62
26c	59 Nirvana Way	57	65	72
27a	92 Nirvana Way	48	52	63
27b	Lot 47 Nirvana Way	56	62	71
27c	3037 Pacifc Highway	53	55	68
28a	6 Nirvana Way	53	61	68
28b	2925 Pacific Highway	52	60	67
28c	2987 Pacific Highway	59	64	74
29a	33 Barragantyatti Hut R	53	55	68
29b	3349 Pacific Highway	66	73	81
29c	3381 Pacific Highway	66	73	81
29d	3423 Pacific Highway	60	69	75
29e	3345 Pacific Highway	60	64	75
29f	Lot 1_113 Station Street	53	59	68
29g	Lot 1_135 Station Street	58	65	73
29h	76 Station Street	52	55	67
29i	74 Station Street	53	55	68
29j	72 Station Street	52	54	67
29k	70 Station Street	52	54	67
29l	68 Station Street	52	53	67
29m	64 Station Street	52	53	67
29n	135 South Bank Road	53	53	68

ID	Address	Predicted 2026 "10 Years After Opening" $L_{Aeq,1hr}$	Predicted Typical L_{Amax}	*ENMM* L_{Amax} Criteria
30a	60 Stuarts Point Road	55	55	70
30b	51 Stuarts Point Road	58	58	73
30c	21 Stuarts Point Road	62	72	77
30d	Lot 2 Thurgood Lane	52	55	67
30e	55 Stuarts Point Road	57	56	72
31a	29 Brushbox Road	56	58	71
31b	3386 Pacific Highway	58	60	73
31c	3420 Pacifc Highway	66	74	81

As seen in Table 8-6, the predicted L_{Amax} noise levels are less than the *ENMM* maximum noise criteria. Therefore, as expected, the operational traffic noise assessment for free flowing traffic in Section 8.4 is deemed sufficient to account for sleep disturbance impacts.

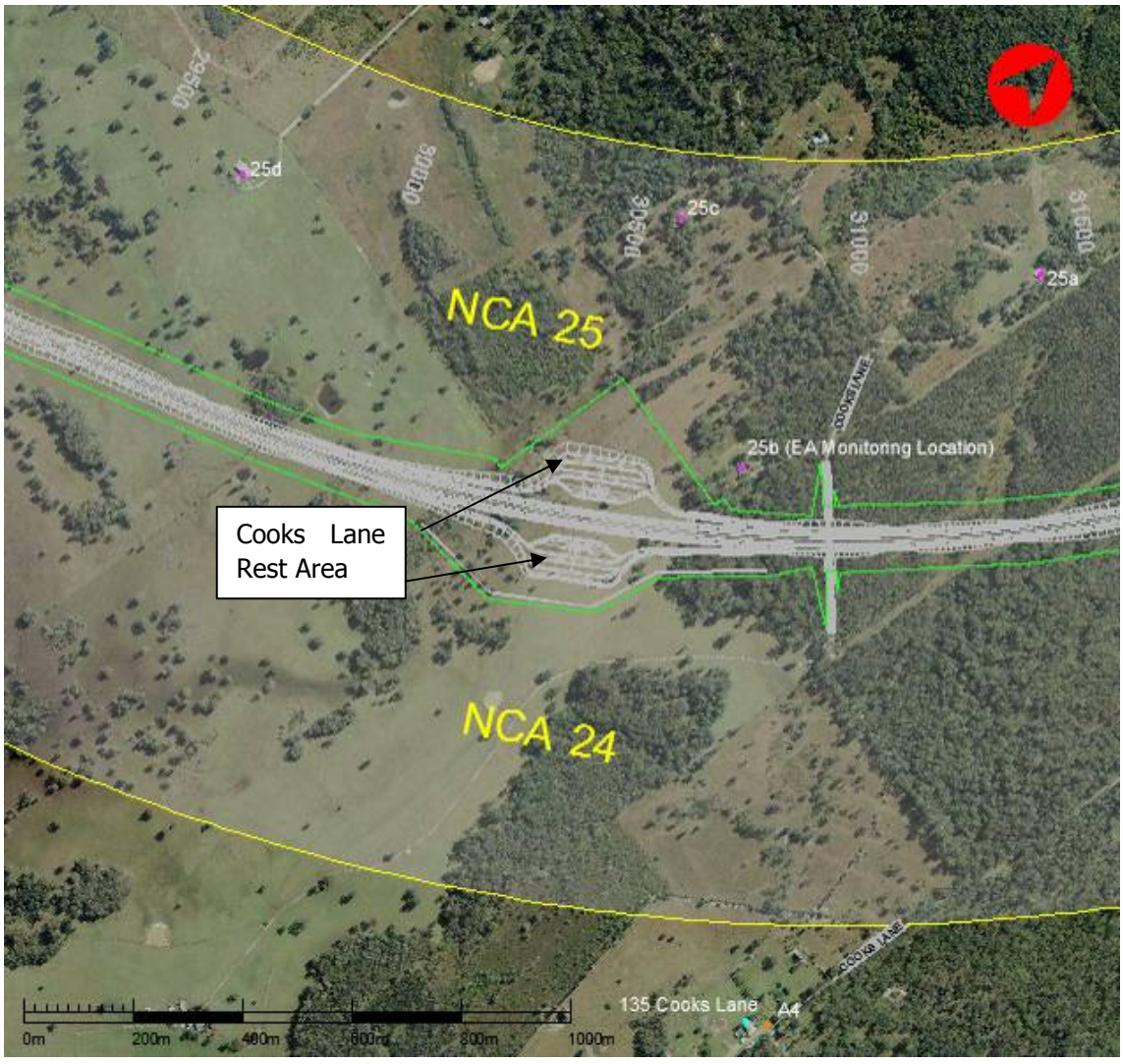
9 OPERATIONAL NOISE ASSESSMENT FOR COOKS LANE REST AREA

Northbound and southbound rest areas are proposed to the south of Cooks Lane. The identified nearest potentially affected residential receivers are listed below:

- 269 Cooks Lane (25b) – Approximately 200m northeast of the proposed rest area;
- 321 Cooks Lane (25c)– Approximately 500m northwest of the proposed rest area;
- Lot 42 Cooks Lane (25d) – Approximately 800m west of the proposed rest area;
- 288 Cooks Lane (25a) – Approximately 850m northeast of the proposed rest area; and
- 135 Cooks Lane – Approximately 950m southeast of the proposed rest area

The receiver locations and proposed road and rest area are displayed in Figure 9-1.

Figure 9-1 Location of Residential Receiver Surrounding Cooks Lane Rest Area



There are no specific criteria for addressing noise from rest areas so the most relevant assessment methodologies have been reviewed and a conservative approach adopted.

The Environmental Criteria for Road Traffic Noise is primarily concerned with the assessment of noise from continually flowing traffic and does not specifically address rest areas adjacent to roads or freeways. The Environmental Criteria for Road Traffic Noise requires assessment of L_{Aeq} noise levels over either the daytime or night time periods.

The Environmental Criteria for Road Traffic Noise also recommends consideration of maximum (L_{Amax}) noise levels and suggests levels outside a residence of between 60-65dBA are unlikely to cause annoyance. The document also suggests that if typical maximum noise levels are less than 15dBA above the L_{Aeq} noise level from traffic noise, the L_{Aeq} parameter is sufficient to assess likely annoyance. It is considered that while a truck is slowing to approach the rest area or is accelerating away, the noise is associated with a moving vehicle within the road reserve and should therefore be assessed in accordance with the Environmental Criteria for Road Traffic Noise.

Previous studies of vehicle noise when all vehicles are slowing to stop at tollgates and accelerate away indicate a reduction in L_{Aeq} noise levels, although the character of noise is different, particularly for heavy vehicles accelerating. In comparison, for a rest area adjacent to a highway, where only a relatively small proportion of the heavy vehicle component of traffic is stopping, then L_{Aeq} noise levels would remain unchanged compared with the situation without a rest area.

However, there would be a different character of noise associated with the small percentage of heavy vehicles which do stop and associated activities within the rest area. An additional method of assessment has therefore also been considered.

The additional procedure is to consider the rest area as if it were an "industrial" operation and assess the noise levels generated in accordance with the *Industrial Noise Policy* (*INP*). This policy requires criterion that limits the permissible level of noise from mechanical plant at commercial or industrial premises to no more than the background noise plus 5dBA when measured over a 15-minute period ($L_{Aeq,15\ min}$).

For night time use of the rest area it is also relevant to consider the Department of Environment and Climate Change sleep arousal guidelines contained in the *Environmental Noise Control Manual (ENCM)*. This requires that the typical maximum noise level (denoted as $L_{A1.1min}$ in the *ENCM*) associated with noise from heavy vehicles at the rest area (engines starting/doors closing) should not exceed the background L_{A90} noise level by more than 15dBA.

The unattended noise monitoring conducted, by Renzo Tonin in 2004 as part of the EA, at 269 Cooks Lane is indicative of background levels at the rest area and nearby residences. The measured Rating Background Levels (RBLs) are shown in Table 9-1 and the project specific criteria are presented in Table 9-2.

Table 9-1 Background Noise Level at 269 Cooks lane

Time Period	RBL (dBA)
Daytime (7.00am–6.00pm)	34
Evening (6.00–10.00pm)	37
Night time (10.00pm–7.00am)	35

These levels are likely to increase in the future once the new highway is operational, particularly at daytime and evening.

Table 9-2 Project Specific Criteria for Rest Area Operation

Time Period	INP Intrusiveness Criteria ($L_{Aeq,15\ minute}$ dBA)	Sleep Disturbance Criterion (L_{Amax} dBA)
Daytime (7am to 6pm)	39	-
Evening (6pm to 10pm)	42	-
Night Time (10pm to 7am)	40	50

9.1 Noise Level Predictions and Assessment

For noise within the rest area the following source noise levels have been assumed (See Table 9-3). These are based on previous measurements conducted by Wilkinson Murray of similar facilities and infrastructure.

Table 9-3 Noise Source Sound Pressure Levels

Noise Source	Noise Level
Truck Idle	66dBA $L_{Aeq,15minute}$ @ 7m
Truck Movement	80dBA $L_{Aeq,15minute}$ @ 7m
Truck Refrigeration Unit	73dBA $L_{Aeq,15minute}$ @ 7m
Truck Door Close	75dBA $L_{A1,1min}$ @ 7m
Truck Start	85dBA $L_{A1,1min}$ @ 7m
Engine Brake	98dBA $L_{A1,1min}$ @ 7m

The traffic conditions for noise assessment purposes for the rest area are in response to F2E-Hyd-RFI-00018. This information is presented below in Table 9-4 have been used regarding the usage of the rest area and are assumed to apply for the combined north and southbound rest areas collectively.

Table 9-4 15-Minute Volumes at the Cooks Lane Rest Area

Activity	No. of Trucks		
	Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)
Refrigeration Trucks	1	2	3
Trucks Idling	7	8	5
Trucks Arriving/Departing	1	1	2

The number of trucks in Table 9-4 is assumed to be distributed 50% NB and 50% SB. It is assumed that trucks moving within the rest area would travel at 20kph over a maximum possible distance of 200m. Moreover, refrigeration units as well as idling truck engines are assumed to be in operation constantly over any 15 minute period. A conservative approach has been implemented to provide an upper limit for predicted levels. Therefore, assessment with respect to 'F class Pasquill stability' (i.e. temperature inversion) with no wind has been adopted for the assessment of noise during the night time period.

There are only five residences located within 1000m of the proposed rest areas, 135 Cooks Lane (950m from rest area), 269 Cooks Lane (200m from rest area), 288 Cooks Lane (850m from rest area), 321 Cooks Lane (500m from rest area) and Lot 42 Cooks Lane (800 metres from rest area). The calculated $L_{Aeq,\ 15\ min}$ noise levels for day, evening and night time periods for those residences are provided in Table 9-5.

Table 9-5 Predicted Operational Noise Levels At Residences Due to Rest Area (dBA)

Location	Predicted $L_{Aeq,15min}$			
	Daytime [39dBA]	Evening [42dBA]	Night Neutral [40dBA]	Night Worst Case [40dBA]
135 Cooks Lane	28	29	29	33
269 Cooks Lane	43 (+4)	44 (+2)	44 (+4)	46 (+6)
288 Cooks Lane	28	30	30	34
321 Cooks Lane	37	38	39	42 (+2)
Lot 42 Cooks Lane	31	32	33	37

Note: (1) *INP* Intrusiveness criterion for each time period are shown in […]; and (2) predicted exceedance is shown in (…).

Noise levels are predicted to be within INP intrusiveness criteria during daytime and evening periods at all locations except at 269 Cooks Lane. Compliance with the night time intrusiveness criterion of 40dBA is achieved at all locations (under temperature inversion) with the exception of 269 Cooks Lane (200m from rest area) and 321 Cooks Lane (500m from rest area). Compliance with the *INP* intrusiveness criteria at 269 Cooks Lane and 321 Cooks Lane would be difficult to achieve without further increase in height and width of the noise mound or further noise mitigation. The internal noise level could be reduced by keeping the windows shut but mechanical ventilation would have to be provided. 269 Cooks Lane and 321 Cooks Lane have

been identified for noise mitigation by RMS in Table 4.5 of Appendix 4 of the SWTC and are to be treated architecturally. Therefore no further noise mitigation is required for these residences.

Further to the above, sleep arousal is also relevant in the assessment. The Calculated L_{Amax} noise levels due to various activities at the rest area are shown in Table 9-6. Predicted noise levels for acoustically neutral weather conditions are displayed in brackets.

Table 9-6 Predicted Maximum Noise Levels for Sleep Disturbance Assessment (dBA)

Location	L_{Amax} Noise Level (dBA)		
	Truck Door Close	Truck Engine Start	Compression Brake
135 Cooks Lane	30 (26)	36 (31)	52 (47)
269 Cooks Lane	40 (39)	47 (44)	67 (65)
288 Cooks Lane	31 (27)	38 (33)	52 (48)
321 Cooks Lane	40 (36)	49 (45)	60 (57)
Lot 42 Cooks Lane	34 (31)	41 (37)	56 (52)

() indicates values where temperature inversions have been excluded

Maximum external noise levels comply with the "screening" criterion of 50dBA for the two sleep disturbance scenarios (door slam and engine start) considered whilst maximum external noise arising from compression brake indicates exceedance at all locations.

Whilst the external noise levels exceed the sleep disturbance "screening" criterion, the *ECRTN* offers additional guidance in terms of acceptable noise levels which are:

- *Maximum internal noise levels below 50-55dBA are unlikely to cause awakening reactions*
- *One or two noise events per night with maximum internal noise levels of 65-70dBA are not likely to significantly affect health and wellbeing.*

To assess noise impact in an internal space, a reduction of 10dB from outside to inside has been used to conservatively estimate internal noise levels with windows open for ventilation. This gives an internal maximum noise level of 57dBA at 269 Cooks Lane and 50dBA at 321 Cooks Lane, which is significantly lower than the maximum noise levels of 65-70dBA. However, it is likely that there will be more than 1-2 events per night so windows at 269 Cooks Lane should be kept closed to reduce internal noise level to between 50-55dBA. This form of noise mitigation is consistent with the outcome of the operational traffic noise assessment.

It is recommended that the entrance ramps to the rest areas are signposted to remind drivers to limit the use of compression brakes.

10 CONCLUSION

Operational traffic noise from the proposed Upgrade of Pacific Highway between Frederickton and Eungai Rail has been assessed in accordance with the requirements of the NSW Government's *Environmental Criteria for Road Traffic Noise (ECRTN)*, the RTA *Environmental Noise Management Manual (ENMM)* and EPA's *Industrial Noise Policy* as well as the environmental requirements, specific for Frederickton and Eungai Project, defined in RMS *Scope of Works and Technical Criteria Appendix 4 Additional Environmental Requirements.*

The predicted operational noise levels at RMS identified noise receivers and additional potentially affected noise receivers have been quantified and additional mitigation measures, above those architectural treatments to be undertaken by RMS as identified in SWTC Appendix 4, are required;

The assessment can be summarised as follows:

- Based on the 100% alignment design provided by Thiess the operational traffic noise levels in Year 2026 comply with the SWTC environmental requirements at all the noise sensitive receiver locations identified in Table 4.4 and Table 4.5 in Appendix 4 of the SWTC. Not only that, some of the receivers in Table 4.4 and Table 4.5 do not require treatment (refer to paragraph 5 in Section 8.4 above);

- Based on the 100% alignment design provided by Thiess the operational traffic noise levels in Year 2026 comply with the *ECRTN* and the *ENMM* requirements at most additional noise sensitive locations, identified in Locality Plan shown in Appendix A of this ONMR, which are not identified in Section 4.15 (d) (ii) in Appendix 4 of the SWTC. There are a total of four receivers that should be considered for noise mitigation, namely, 244 Quarry Road (ID 20i), 46 Station Street (ID 29o), 2 South Bank Road East (ID 29p) and 4 South Bank Road East. The mitigation at these additionally identified residences should be architectural treatment in accordance with *ENMM.* Further investigation using the RMS provided concept design model indicates these receivers should have been identified for treatment prior to this current assessment; and

- An assessment of the Cooks Lane rest areas has been undertaken. Predicted operational noise levels at most locations comply with the requirements of the *INP* with the exception of 269 Cooks Lane and 321 Cooks Lane. At 269 Cooks Lane, the predicted maximum noise levels arising from compression brake exceed the sleep disturbance "screening" criteria and acceptable maximum internal noise levels suggested in the *ECRTN*. To achieve "acceptable" internal noise levels windows must be kept closed at the 2 identified locations. This form of noise mitigation is consistent with the outcome of the operational traffic noise assessment for free flowing traffic which recommends architectural treatment, with windows kept closed, at this property. Furthermore, it is also recommended that rest areas are to be signposted to remind drivers to limit the use of compression brake.

Hence, the overall conclusion is that no at-road noise mitigation measures are required. The required form of noise mitigation measures are:

- Architectural treatments at most of the residences as noted in SWTC Appendix 4, Tables 4.4 and 4.5 (See Table 10-1 and Table 10-2 below);
- Architectural treatment at 244 Quarry Road, 46 Station Street, 2 South Bank Road East and 4 South Bank Road East (See Table 10-3 and Table 10-4 below); and
- Signs at the rest areas to limit the use of compression brakes.

Table 10-1 Outcome of Thiess alignment design for the residences identified in the Environmental Documents (SWTC Appendix 4 Table 4.4)

ID	Location	Requires Architectural Treatment?
19a	107 Raymonds Lane	Yes
20a	322 Kemps Access	No
20c	279 Kemps Access	Yes
21a	232 Quarry Road	Yes
21 a (2nd storey)	232 Quarry Road	Yes
21c	26 Seashore Lane	Yes
21d	53 Seashore Lane	Yes
21e	202 Kemps Access	No
21g	243 Kemps Access	Yes
25a	288 Cooks Lane	Yes
26a	80 Hills Lane	Yes
27a	92 Nirvana Way	No
28a	6 Nirvana Way	Yes
28b	2925 Pacific Highway	Yes
29a	33 Barraganyatti Hut Road	No
29b	3349 Pacific Highway	Yes
29c	3381 Pacific Highway	Yes
29d	3423 Pacific Highway	Yes
30a	60 Stuarts Point Road	Yes
30b	51 Stuarts Point Road	Yes
30c	21 Stuarts Point Road	Yes
30d	Lot 2 Thurgood Lane	No
31a	29 Brushbox Road	Yes
31b	3386 Pacific Highway	Yes
31c	3420 Pacific Highway	Yes

Table 10-2 Outcome of Thiess alignment design for the residences identified through further RMS investigations (SWTC Appendix 4 Table 4.5)

ID	Location	Requires Architectural Treatment?
19c	Yarrabindi Road	Yes
19d	77 Raymonds Lane	Yes
19e	67 Raymonds Lane	Yes
19f	47 Raymonds Lane	Yes
20d	285 Kemps Access	Yes
21h	260 Quarry Road	Yes
21i	276 Quarry Road	No
21j	298 Quarry Road	No
21j (2nd storey)	298 Quarry Road	No
22b	Tamban Road	Yes
23a	114 Seven Hills Lane	Yes
25b	269 Cooks Lane	Yes
25c	321 Cooks Lane	Yes
25d	Lot 42 Cooks Lane	Yes
26b	2693 Pacific Highway	No
26c	59 Nirvana Way	Yes
27b	Lot 47 Nirvana Way	Yes
27c	3037 Pacific Highway	Yes
28c	2987 Pacific Highway	Yes
29e	3345 Pacific Highway	Yes
29f	Lot 1 Station Street	No
29g	Lot 1 Station Street	Yes
29h	76 Station Street	No
29i	74 Station Street	No
29j	72 Station Street	No
29k	70 Station Street	No
29l	68 Station Street	No
29m	64 Station Street	No
29n	135 South Bank Road	No
30e	55 Stuarts Point Road	Yes

Table 10-3 Outcome of Thiess alignment design for the additionally identified residences in the northern redeveloped section

ID	Location	Requires Architectural Treatment?
29p	2 South Bank Road East	Yes
-	4 South Bank Road East	Yes
-	6 South Bank Road East	No
-	36 Station Street	No
-	40 Station Street	No
29o	46 Station Street	Yes
-	50 Station Street	No
-	60 Station Street	No
-	62 Station Street	No

Table 10-4 Outcome of Thiess alignment design for the additionally identified residences along the bypass section

ID	Location	Requires Architectural Treatment?
135	135 Cooks Lane	No
20e	330 Kemps Access	No
20f	331 Kemps Access	No
20g	336 Kemps Access	No
20h	Lot 126	No
20i	244 Quarry Road	Yes
21k	312 Quarry Road	No
21l	318 Quarry Road	No
21m	82 Kemps Access	No
21n	84 Kemps Access	No
25e	Lot 1862	No
28d	3012 Pacific Highway	No
28e	6 Thurgood Lane	No

Note: It is understood that 244 Quarry Road will be demolished.

APPENDIX A

LOCALITY PLAN

PACIFIC HIGHWAY UPGRADE

Frederickton to Eungai

Locality Plan - Noise Sensitive Receivers

Cover Page

Drawing Set

F2E-00G-SKT-NV001-0000 Cover Page
F2E-00G-SKT-NV001-0001 Key Plan
F2E-00G-SKT-NV001-0002 Sketch
F2E-00G-SKT-NV001-0003 Sketch
F2E-00G-SKT-NV001-0004 Sketch
F2E-00G-SKT-NV001-0005 Sketch
F2E-00G-SKT-NV001-0006 Sketch
F2E-00G-SKT-NV001-0007 Sketch
F2E-00G-SKT-NV001-0008 Sketch
F2E-00G-SKT-NV001-0009 Sketch

Rev	Description	Date	Approved
D1	DETAILED DESIGN ISSUE	10-09-13	NG
B2	DETAILED DESIGN ISSUE	18-07-13	NG

Legend

- SWTC Noise Sensitive Receiver
- Monitoring Location
- Potentially Affected Noise Receiver
- Potentially Affected Noise Catchment Area

1:10 000 @ A3

0m 100m 200m 300m 400m 500m

SKETCH

Status: DETAILED DESIGN

Original Size	A3	Drawn	JP
Coordinate System	MGA ZONE 56	Designed	JP
		Date Printed	10 Sep 2013

Filename: F2E-00G-SKT-NV001-0000.dwg

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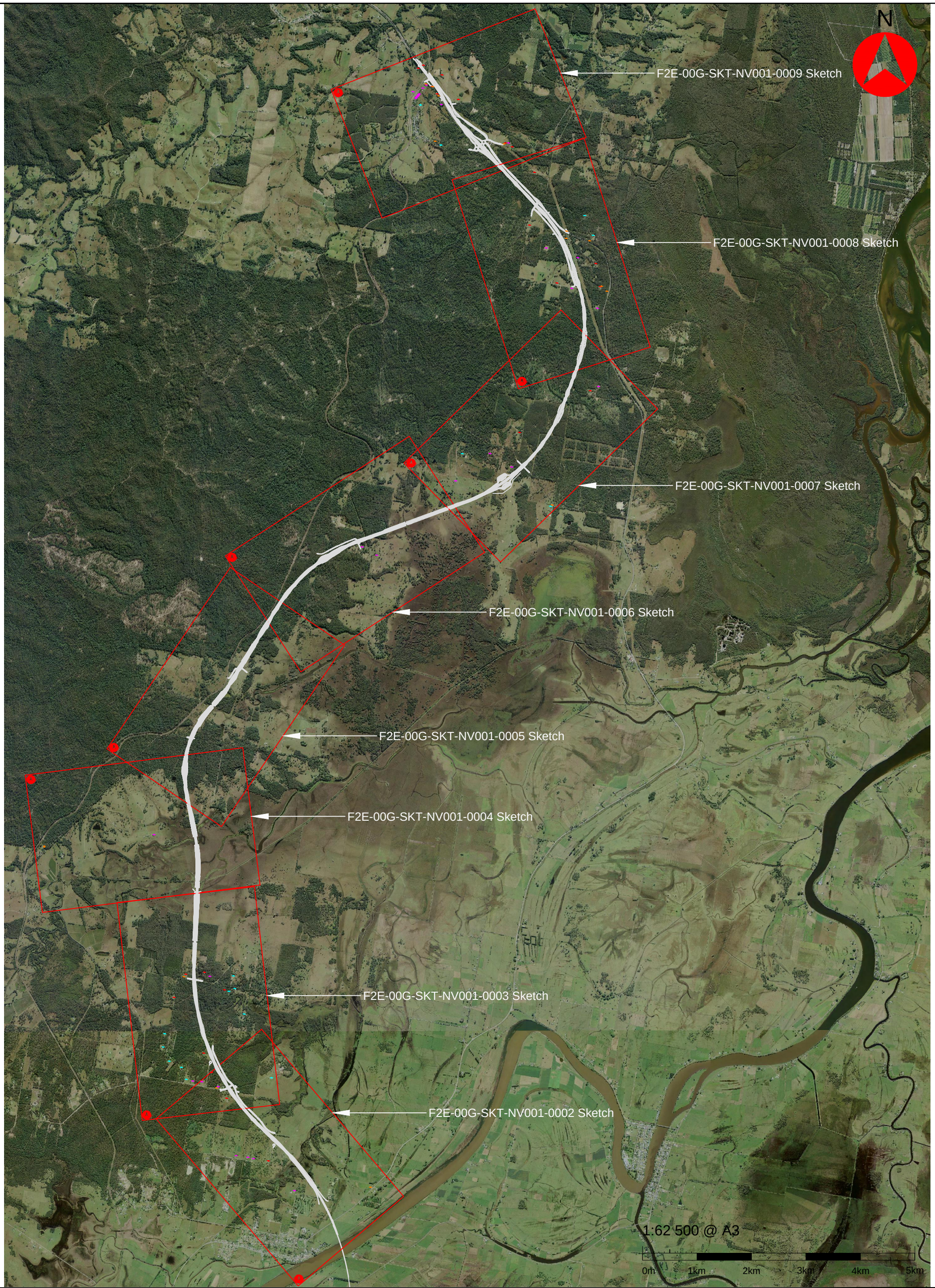
PACIFIC HIGHWAY UPGRADE
FREDERICKTON TO EUNGAI
LOCALITY PLAN
COVER PAGE

Company	Zone	Type	Design Lot	Sketch No.	Rev
F2E	00G	SKT	NV001	0000	D1



Rev	Description	Date	Approved
D1	DETAILED DESIGN ISSUE	10-09-13	NG
B2	DETAILED DESIGN ISSUE	18-07-13	NG

Status: DETAILED DESIGN

Original Size	A3	Drawn	JP
Coordinate System: MGA ZONE 56		Designed	JP
		Date Printed	10 Sep 2013

Filename: F2E-00G-SKT-NV001-0001.dwg

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FREDERICKTON TO EUNGAI
LOCALITY PLAN
ALIGNMENT KEY PLAN
SHEET 1 OF 9

Company	Zone	Type	Design Lot	Sketch No.	Rev
F2E	00G	SKT	NV001	0001	D1

Rev	Description	Date	Approved
D1	DETAILED DESIGN ISSUE	10-09-13	NG
B2	DETAILED DESIGN ISSUE	18-07-13	NG

Legend

- SWTC Table 4.4 Noise Receiver (RMS Treated)
- SWTC Table 4.5 Noise Receiver (RMS Treated)
- Thiess Monitoring Location
- Additional Noise Receiver
- Additional Noise Catchment Area

1:10 000 @ A3

0m 100m 200m 300m 400m 500m

SKETCH

Status: DETAILED DESIGN

Original Size	A3	Drawn	JP
Coordinate System	MGA ZONE 56	Designed	JP
		Date Printed	10 Sep 2013

Filename: F2E-00G-SKT-NV001-0002.dwg

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FREDERICKTON TO EUNGAI
LOCALITY PLAN
SHEET 2 OF 9

Company	Zone	Type	Design Lot	Sketch No.	Rev
F2E	00G	SKT	NV001	0002	D1

Rev	Description	Date	Approved
D1	DETAILED DESIGN ISSUE	10-09-13	NG
B2	DETAILED DESIGN ISSUE	18-07-13	NG

Legend

- SWTC Table 4.4 Noise Receiver (RMS Treated)
- SWTC Table 4.5 Noise Receiver (RMS Treated)
- Thiess Monitoring Location
- Additional Noise Receiver
- Additional Noise Catchment Area

1:10 000 @ A3

0m 100m 200m 300m 400m 500m

SKETCH

Status: DETAILED DESIGN

Original Size	A3	Drawn	JP
Coordinate System	MGA ZONE 56	Designed	JP
		Date Printed	10 Sep 2013

Filename: F2E-00G-SKT-NV001-0003.dwg

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ACOUSTICS AND AIR

PACIFIC HIGHWAY UPGRADE

FREDERICKTON TO EUNGAI
LOCALITY PLAN
SHEET 3 OF 9

Company	Zone	Type	Design Lot	Sketch No.	Rev
F2E	00G	SKT	NV001	0003	D1

KEY PLAN

Rev	Description	Date	Approved
D1	DETAILED DESIGN ISSUE	10-09-13	NG
B2	DETAILED DESIGN ISSUE	18-07-13	NG

Legend

- SWTC Table 4.4 Noise Receiver (RMS Treated)
- SWTC Table 4.5 Noise Receiver (RMS Treated)
- Thiess Monitoring Location
- Additional Noise Receiver
- Additional Noise Catchment Area

1:10 000 @ A3

0m 100m 200m 300m 400m 500m

SKETCH

Status: DETAILED DESIGN

Original Size	A3	Drawn	JP
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LOCALITY PLAN
SHEET 4 OF 9

Company	Zone	Type	Design Lot	Sketch No.	Rev
F2E	00G	SKT	NV001	0004	D1