



Australian Government

BUILDING OUR FUTURE



Transport
Roads & Maritime
Services

Frederickton to Eungai Pacific Highway upgrade

Post-construction

Operational Noise Report

March 2017

PACIFIC HIGHWAY FREDERICKTON TO EUNGAI
POST OPENING COMPLIANCE MONITORING

**REPORT NO. 11315-CM
VERSION D**

MARCH 2017

PREPARED FOR

CPB CONTRACTORS PTY LIMITED
LEVEL 20, ZENITH CENTRE, TOWER A
821 PACIFIC HIGHWAY
CHATSWOOD NSW 2067

TABLE OF CONTENTS

	Page
GLOSSARY OF ACOUSTIC TERMS	
1 INTRODUCTION	1
2 CONDITIONS OF APPROVAL	3
3 OPERATIONAL NOISE CRITERIA	4
4 TRAFFIC NOISE MITIGATION	5
5 POST COMPLETION NOISE MONITORING	6
5.1 Methodology	6
5.2 Measured Noise Levels	8
5.3 Estimated Road Traffic Noise Level	8
5.4 Short-Term Attended Noise Monitoring	10
6 TRAFFIC VOLUMES, CLASSIFICATION & SPEED MONITORING	13
6.1 Measured Traffic Volumes	13
6.2 Predicted Traffic Volumes	15
6.3 Comparison of Measured & Predicted Traffic Volumes	15
7 VALIDATION & ASSESSMENT OF OPERATIONAL NOISE LEVELS	17
7.1 Model Inputs	17
7.1.1 Comparison of Receiver Locations used in Model and during Survey	18
7.2 Comparison of Measured & Predicted Road Traffic Noise Levels	19
7.3 Factors Affecting Over Prediction	20
8 DETAILS OF COMPLAINTS RECEIVED	22
9 SUMMARY & CONCLUSION	24
APPENDIX A – AT-RECEIVER ARCHITECTURAL TREATMENT	
APPENDIX B – NOISE LOGGER LOCATIONS & DAILY NOISE PLOTS	
APPENDIX C – NOISE MEASUREMENT RESULTS	
APPENDIX D – TRAFFIC COUNT LOCATIONS	
APPENDIX E – PREDICTED LEVELS FOR ALL RECEIVERS	
APPENDIX F – RECEIVER LOCATIONS	

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.

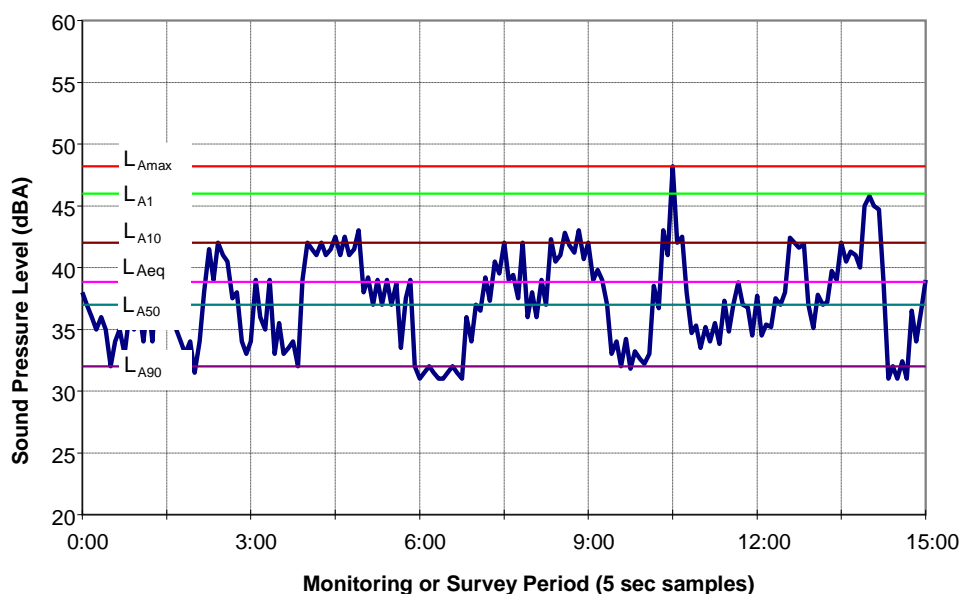
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

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 10th percentile (lowest 10th 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

The recently completed Pacific Highway Upgrade from Frederickton to Eungai was officially opened to traffic on 16 May 2016.

The realigned and upgraded section of the Pacific Highway consists of 26.5km of four-lane divided road along with a new interchange at Stuarts Point and a rest area located near Cooks Lane, with the existing highway retained and used as local road.

The Frederickton to Eungai concept design noise assessment was undertaken by Renzo Tonin & Associates Pty Ltd (RTA) on behalf of Parsons Brinckerhoff for the Kempsey to Eungai Upgrade of the Pacific Highway. Details of this study are reported in "Technical Report 3: Noise & Vibration Assessment" in Volume 2 of the Environmental Assessment (EA) undertaken for the project, July 2007.

Detailed design was undertaken by Wilkinson Murray Pty Limited on behalf of CPB Contractors Pty Limited (formally Thesis Pty Ltd) and is detailed in the Wilkinson Murray report entitled *Pacific Highway Upgrade Frederickton to Eungai: Operational Noise Management Report Version D5* (WM Report No. F2E-00G-RPT-AC001-0001, dated April 2014).

This report is to describe the post-completion operational noise review to fulfil the requirements of Conditions 3.2 and 3.3 of the Ministers Conditions of Approval for the project.

This assessment is to include the following aspects:

- Measurement of traffic noise at representative noise sensitive receivers along the project;
- Simultaneous traffic counts;
- Validation of the noise model developed during detailed design used to predict noise impacts due to the upgrade;
- Evaluation of compliance against the *Environmental Criteria for Road Traffic Noise (ECRTN)*; and
- Evaluation of the mitigation measures determined during detailed design stage.

The report is broken down in the following sections:

- Chapter 2 – Conditions of Approval;
- Chapter 3 – the *ECRTN* Criteria;
- Chapter 4 – Detailed Design Mitigation Measures;
- Chapter 5 – Measured Noise Levels;
- Chapter 6 – Measured Traffic Volumes;
- Chapter 7 – Validation of Noise Model;
- Chapter 8 – Noise Complaints; and
- Chapter 9 – Summary and Conclusions.

Figure 1-1 Frederickton to Eungai Pacific Highway Upgrade Section

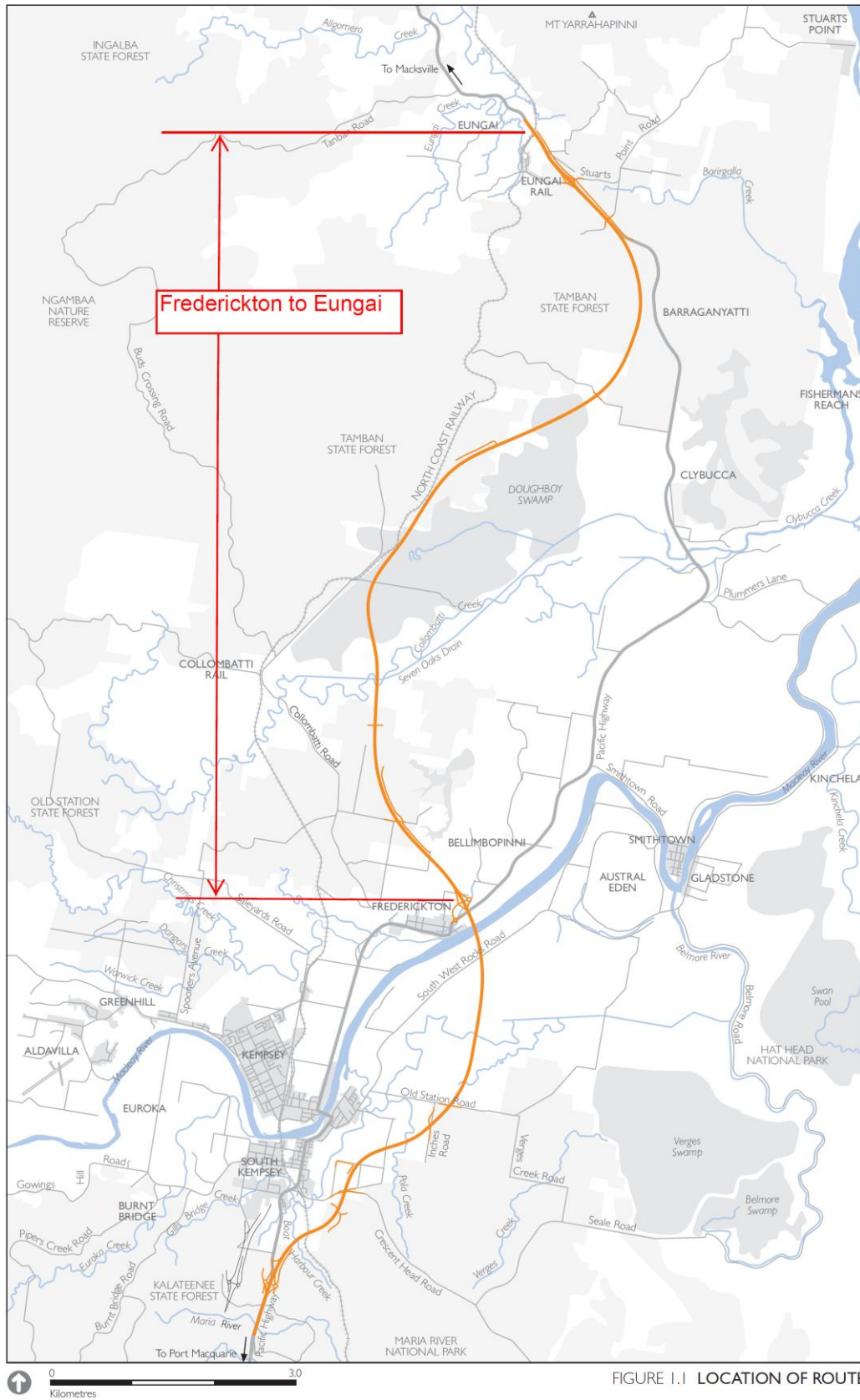


FIGURE 1.1 LOCATION OF ROUTE

2 CONDITIONS OF APPROVAL

The Ministers Conditions of Approval relevant to operational noise compliance are outlined below.

- 3.2 *No later than one year after commencement of operation of the project, or as otherwise agreed by the Director General, the Proponent shall undertake operational noise monitoring to confirm the predicted noise performance of the project against actual performance and prepare an Operational Noise Report. The Report shall include, but not necessarily be limited to:*
- a) *Noise monitoring to assess compliance with the operational noise outcomes predicted in the documents specified under condition 1.1 of this approval;*
 - b) *A review of the operational noise levels in terms of criteria and noise goals established in the 'Environmental Criteria for Road Traffic Noise' (EPA 1999) and the 'Environmental Noise Management Manual' (RTA, 2001);*
 - c) *Methodology, location and frequency of noise monitoring, to be undertaken in accordance with the 'Environmental Noise Management Manual' (RTA, 2001);*
 - d) *Identification of monitoring sites at which background noise and project noise levels can be ascertained, with specific reference to locations indicative of impacts on sensitive receivers;*
 - e) *Details of any complaints and enquiries received in relation to operational noise generated by the project between the date of commencement of operation of the project and the date the report was prepared;*
 - f) *Any required recalibrations of the noise model taking into consideration factors such as noise monitoring undertaken and actual traffic numbers and proportions;*
 - g) *An assessment of the performance and effectiveness of applied noise mitigation measures together with a review and if necessary, reassessment of all reasonable and feasible mitigation measures; and*
 - h) *Any additional noise mitigation measures required and timetables for implementation.*
- 3.3 *Within 60 days, or as otherwise agreed by the Director General, of completing the operational noise monitoring referred to under condition 3.2 of this approval, the Proponent shall provide the Director General and the DECCW with a copy of the Operational Noise Report. If the Report identifies any non-compliance with the noise objectives specified in the Environmental Criteria for Road Traffic Noise (EPA 1999), the Proponent shall detail what additional measures would be implemented to ensure compliance, clearly indicating these measures, when these measures would be implemented, and how the effectiveness of these measures would be measured and reported to the Director General.*

3 OPERATIONAL NOISE CRITERIA

At time of approval, criteria for assessment of road traffic noise were set out in the NSW Government's *Environmental Criteria for Road Traffic Noise (ECRTN)*. Roads and Maritime Services 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 3-1 would therefore apply.

Table 3-1 Environmental Criteria for Road Traffic Noise Criteria for Operational Traffic Noise – Residences

Type of Development	Noise Level Criterion		Where Criteria are already Exceeded
	Day (7am-10pm)	Night (10pm-7am)	
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. <i>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 ...</i>
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. <i>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 ...</i>

The main noise descriptors referred to in Table 3-1 are defined in the Glossary of Acoustic Terms.

In applying Table 3-1, the noise level criterion applies to the predicted noise level at opening of the project (design year, 2016) and at a time 10 years after opening of the project (2026).

4 TRAFFIC NOISE MITIGATION

Noise mitigation options were identified in the detailed design report by Wilkinson Murray entitled Pacific Highway Upgrade Frederickton to Eungai Operational Noise Management Report Version D5 (WM Report No. F2E-00G-RPT-AC001-0001, dated April 2014).

The overall conclusion of the detailed design report was that no at-road noise mitigation measures were required. However, other forms of noise mitigation measures were recommended, namely:

- At-receiver architectural treatment where deemed reasonable and feasible; and
- Signs at the rest areas to limit the use of compression brakes.

A copy of the list of receivers recommended for architectural treatment by the detailed design report is provided in Appendix A for ease of reference.

5 POST COMPLETION NOISE MONITORING

5.1 Methodology

Long-term unattended noise monitoring was conducted in two rounds from 15 August until 6 September 2016, with simultaneous traffic counts undertaken from 16 August to 5 September 2016.

Noise logger locations were selected to represent the potentially most impacted residences at various locations throughout the project with all locations shown in Figure 5-1.

In order to determine whether there was a significant difference in noise between the two separate monitoring periods, one location (135 Cooks Lane) was re-monitored and held as a reference point.

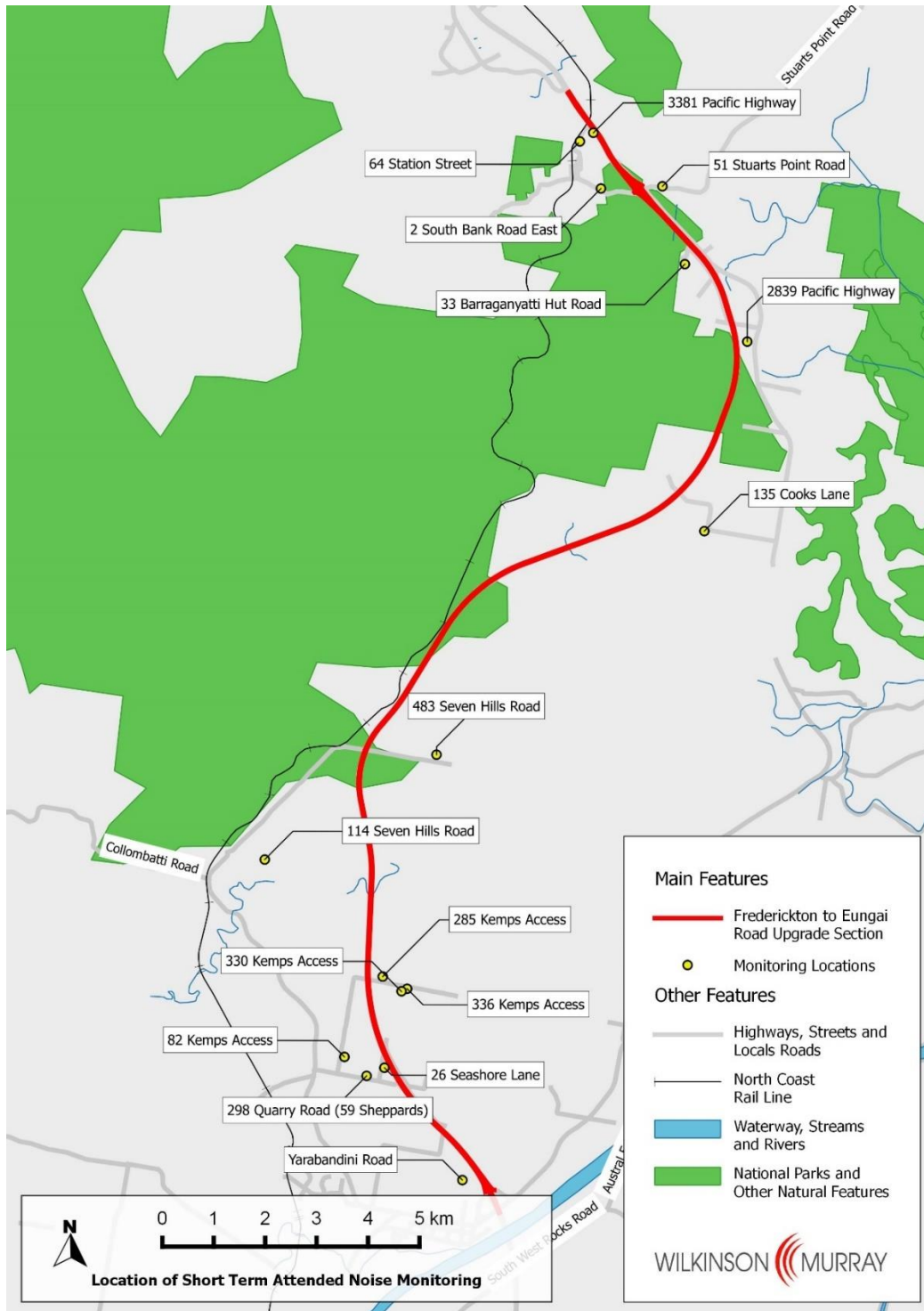
The noise monitoring equipment used for these measurements consisted of environmental noise loggers set to A-weighted, fast response, continuously monitoring over 15-minute sampling periods. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted.

The loggers determine LA_1 , LA_{10} , LA_{90} and LA_{eq} levels of the ambient noise. LA_1 , LA_{10} and LA_{90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Glossary of Acoustic Terms for definitions). The LA_1 is indicative of maximum noise levels due to individual noise events such as the occasional pass-by of a heavy vehicle. This is used for the assessment of sleep disturbance. The LA_{90} level is normally taken as the background noise level during the relevant period.

Table 5-1 Noise Monitoring Locations

First Round 15/8 to 23/8	Noise Monitoring Equipment	Second Round 25/8 to 6/9	Noise Monitoring Equipment
3381 Pacific Highway	ARL NGARA	64 Station Street	ARL NGARA
2839 Pacific Highway	ARL NGARA	2 South Bank Road East	ARL NGARA
135 Cooks Lane	ARL NGARA	33 Barraganyatti Road	ARL NGARA
114 Seven Hills Road	ARL NGARA	51 Stuarts Point Road	ARL NGARA
330 Kemps Access	ARL NGARA	135 Cooks Lane	Rion NL-52
336 Kemps Access	ARL NGARA	483 Seven Hills Road	ARL NGARA
298 Quarry Road	ARL NGARA	285 Kemps Access	ARL NGARA
82 Kemps Access	ARL NGARA	26 Seashore Lane	ARL NGARA
		Yarrabandini Road	ARL NGARA

Figure 5-1 Long-Term Unattended Noise Monitoring Locations



5.2 Measured Noise Levels

In order to validate a traffic noise model it is necessary to compare the predicted noise levels for known traffic volumes to the noise levels measured during the same periods. Since many of the noise monitoring locations are some distance from the road, the initial analysis of the noise data indicated that because truck volumes were much lower on the weekends compared with the week, the most robust validation process would be to use the 5-day traffic volumes and corresponding 5-day noise levels to achieve better correlation. Table 5-2 shows the measured level at each location, for the 5-day average and 7-day average (for information purposes), with only periods of inclement weather excluded per NSW EPA requirements.

Daily noise level plots are provided in Appendix B for each monitoring location, and tabulated data summarising the measured noise level is provided in Appendix C. The daily noise level plots show the periods excluded due to inclement weather and extraneous noise.

Table 5-2 Long-Term Unattended Noise Monitoring Raw Results

Location	Address	Date		Measured Noise Level			
				7-Day Average		5-Day Average	
		Start	Stop	Day L _{Aeq,15hr}	Night L _{Aeq,9hr}	Day L _{Aeq,15hr}	Night L _{Aeq,9hr}
19c	Yarrabandini Road	26/08/2016	06/09/2016	55.5	53.6	56.2	55.2
21J	298 Quarry Road	15/08/2016	23/08/2016	55.1	44.8	55.2	45.4
21c	26 Seashore Lane	25/08/2016	06/09/2016	56.7	55.0	57.1	54.9
21m	82 Kemps Access	15/08/2016	23/08/2016	57.4	51.2	58.4	52.3
20c	285 Kemps Access	25/08/2016	06/09/2016	57.8	52.1	59.0	52.3
20e	330 Kemps Access	15/08/2016	23/08/2016	51.5	51.8	52.1	51.8
20g	336 Kemps Access	15/08/2016	23/08/2016	47.7	45.4	47.4	45.9
	114 Seven Hills Road	15/08/2016	23/08/2016	52.1	48.2	51.8	48.3
	483 Seven Hills Road	26/08/2016	06/09/2016	66.0	66.2	65.2	66.1
	135 Cooks Lane	15/08/2016	23/08/2016	52.6	48.3	52.8	48.9
		26/08/2016	06/09/2016	58.0	49.3	58.0	48.5
26c	2839 Pacific Highway ¹	15/08/2016	25/08/2016	58.9	58.1	59.2	58.8
29a	33 Barraganyatti Hut Road	25/08/2016	06/09/2016	57.5	53.0	57.4	54.2
30b	51 Stuarts Point Road	25/08/2016	06/09/2016	54.3	52.9	53.2	53.9
29p	2 South Bank Road East	25/08/2016	06/09/2016	55.0	51.0	55.6	50.8
29m	64 Station Street	25/08/2016	06/09/2016	55.3	51.8	55.0	52.5
29c	3381 Pacific Highway	15/08/2016	23/08/2016	67.6	66.1	67.9	66.9

Note 1: 2839 Pacific Highway has previously been referred to as 59 Nirvana Way in the detailed design report.

5.3 Estimated Road Traffic Noise Level

Because the measured noise levels at each receiver include a combination of road traffic noise and other extraneous noise (birds, insects, local activity etc.), it is necessary to exclude extraneous noise from the measured noise levels. Table 5-3 shows the estimated road traffic noise level at each location. This level is obtained by removing any readily identifiable extraneous noise sources from the long-term unattended noise measurement data by analysing the data and listening to audio recordings as required.

At 298 Quarry Road, the road traffic noise level cannot be estimated with sufficient accuracy due to the significant external noise sources during the daytime. The long-term unattended noise monitoring contains varying large periods of mechanical plant (diesel engine) noise and what appears to be a radio making the road traffic noise difficult to distinguish. It should be noted that the measured noise level at night time without these external influences is in close agreement with the surrounding noise monitor locations and is considered valid.

Table 5-3 Estimated Road Traffic Noise Level

ID	Address	Measured Noise Level (5-day)		Estimated Traffic Noise Level (5-day)		Comment on Extraneous Noise
		Day	Night	Day	Night	
		L _{Aeq,15hr}	L _{Aeq,9hr}	L _{Aeq,15hr}	L _{Aeq, 9 hour}	
19c	Yarrabandini Road	56.2	55.2	56.2	54.8	Two periods excluded, both after periods of rain
21J	298 Quarry Road (59 Sheppard)	55.2	45.4	-	45.3	Several exclusions from wildlife (ie. birds) typically in the early morning and during the daytime period. Periods containing mechanical plant noise and radio difficult to exclude fully to due to length and frequency, and hence daytime cannot be accurately established. Minimal exclusions during the night time period.
21c	26 Seashore Lane	57.1	54.9	55	51.7	Several exclusions from wildlife (ie. birds) typically in the early morning and during the daytime period.
21m	82 Kemps Access	58.4	52.3	47	41.1	Periods of high noise level excluded predominately featuring dog barking.
20c	285 Kemps Access	59.0	52.3	52.7	51.3	Several exclusions from wildlife (ie. birds) typically in the morning and during the daytime period.
20e	330 Kemps Access	52.1	51.8	46.9	45.1	Several exclusions from wildlife (ie. birds) typically in the morning and during the daytime period. Some periods affected by noise emanating from the house.
20g	336 Kemps Access	47.4	45.9	45.8	45.8	Several exclusions from wildlife (ie. birds) typically in the morning and during the daytime period.
	114 Seven Hills Road	51.8	48.3	46.7	46.3	Several exclusions from wildlife (ie. birds) typically in the early morning and during the daytime period.
	483 Seven Hills Road	65.2	66.1	53.7	50.1	Large number of periods excluded due to extraneous noise from chickens and wildlife.
	135 Cooks Lane	52.8	48.9	47.7	48.3	Several exclusions from wildlife (ie. birds) typically in the early morning and during the daytime period.
		58.0	48.5	48.5	48	
26c	2839 Pacific Highway	59.2	58.8	59.2	58.8	One exclusion on Saturday 20 August caused from wildlife (ie birds) and dog barking.

ID	Address	Measured Noise Level (5-day)		Estimated Traffic Noise Level (5-day)		Comment on Extraneous Noise
		Day	Night	Day	Night	
		L _{Aeq,15hr}	L _{Aeq,9hr}	L _{Aeq,15hr}	L _{Aeq, 9 hour}	
29a	33 Barraganyatti Hut Road	57.4	54.2	53.8	52.7	Several exclusions from wildlife (ie. birds) typically in the morning and during the daytime period, some periods excluded due to noise emanating from the house and dog barking.
30b	51 Stuarts Point Road	53.2	53.9	52.5	54	One period excluded after period of rain. Exclusion on Thursday 1 September due to noise from wildlife (ie. birds).
29p	2 South Bank Road East	55.6	50.8	51.6	50.8	Several exclusions from wildlife (ie. birds).
29m	64 Station Street	55.0	52.5	54.4	52.1	Periods excluded typically from noise emanating from the house.
29c	3381 Pacific Highway	67.9	66.9	67.9	66.9	Minimal exclusions from extraneous noise, only two periods on Sunday 21 August due to abnormal noise levels.

5.4 Short-Term Attended Noise Monitoring

In addition to the long-term unattended noise monitoring presented above, short-term attended noise measurements were also conducted at several noise-sensitive receivers.

The locations used for the short-term attended noise measurements are shown in Figure 5-2 and a summary of attended noise measurements conducted is given in Table 5-4.

Figure 5-2 Location of Short-Term Attended Noise Monitoring

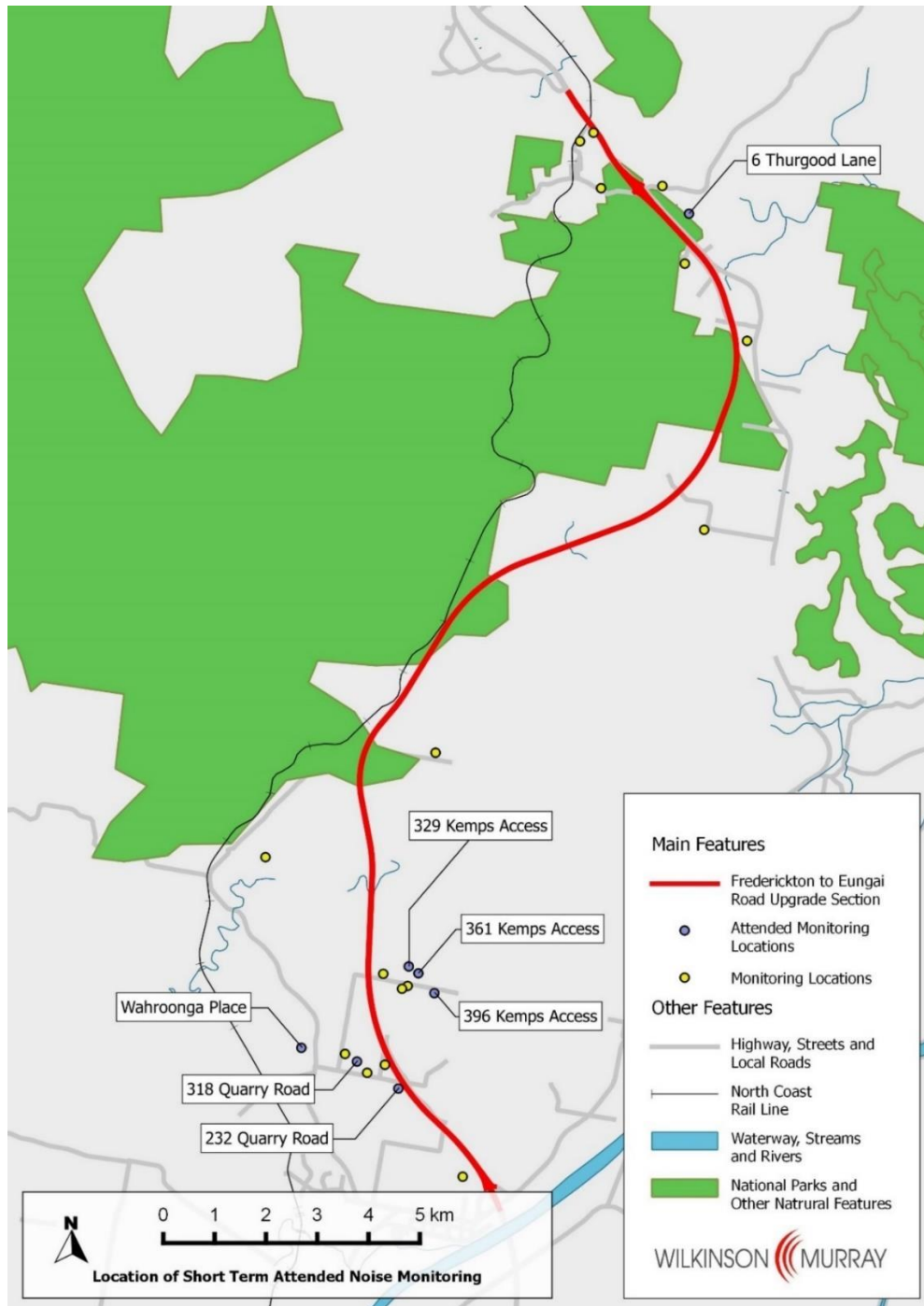


Table 5-4 Summary of Undertaken Short-Term Attended Noise Measurement

Location	Date Measurement Conducted	Time	L ₁₀	L _{Aeq,15min}	Comment
232 Quarry Road	16/08/2016	16:45-17:00	58.5	60.0	Truck noise forms high background, noise is fairly consistent although L _{eq} affected by dogs and birds.
		17:00-17:15	59.0	56.6	Constant traffic noise from freeway, extraneous noise from dogs.
Wahroonga Place	16/08/2016	18:00-18:15	41.7	43.5	Freeway clearly audible. L _{eq} dominated by dog barking.
		18:15-18:30	42.5	41.3	Freeway clearly audible.
396 Kemps Access	16/08/2016	15:15-15:30	44.5	42.3	Noise from freeway varies from audible to inaudible, dominant noise source is birds and other wildlife.
		15:30-15:45	44.5	42.1	Birds dominate noise levels, highway audible at times.
329 Kemps Access	16/08/2016	14:15-14:30	45.5	43.2	Freeway audible but major noise source is wildlife (ie birds) and trees rustling.
		14:30-14:45	46.2	44.5	Traffic noise fairly constant, exhaust brake audible for short duration. Measurement dominated by birds and other wildlife.
361 Kemps Access	26/08/2016	15:45-16:00	44.0	49.6	Freeway audible in background, measurement dominated by birds and other wildlife.
		16:00-16:15	44.0	44.0	Freeway audible in background, measurement dominated by birds and other wildlife. Truck exhaust brake audible for short duration.
318 Quarry Road	26/08/2016	16:30-16:45	46.5	44.7	Traffic noise clearly audible, although bird dominate at times.
		16:45-17:00	50.5	47.6	Traffic noise is main noise source, although birds periodically through measurement.
6 Thurgood Lane	26/08/2016	14:15-14:30	45.5	45.0	Traffic noise clearly audible, radio clearly audible in lulls in traffic. Significant noise from dogs barking.
		14:30-14:45	44.0	44.6	Traffic noise clearly audible, radio clearly audible in lulls in traffic. Significant noise from dogs barking.

6 TRAFFIC VOLUMES, CLASSIFICATION & SPEED MONITORING

6.1 Measured Traffic Volumes

Traffic counts were undertaken at nine locations for Roads and Maritime Services by National Traffic Survey Pty Ltd from 16 August to 5 September 2016, with locations relative to the project shown in Appendix D.

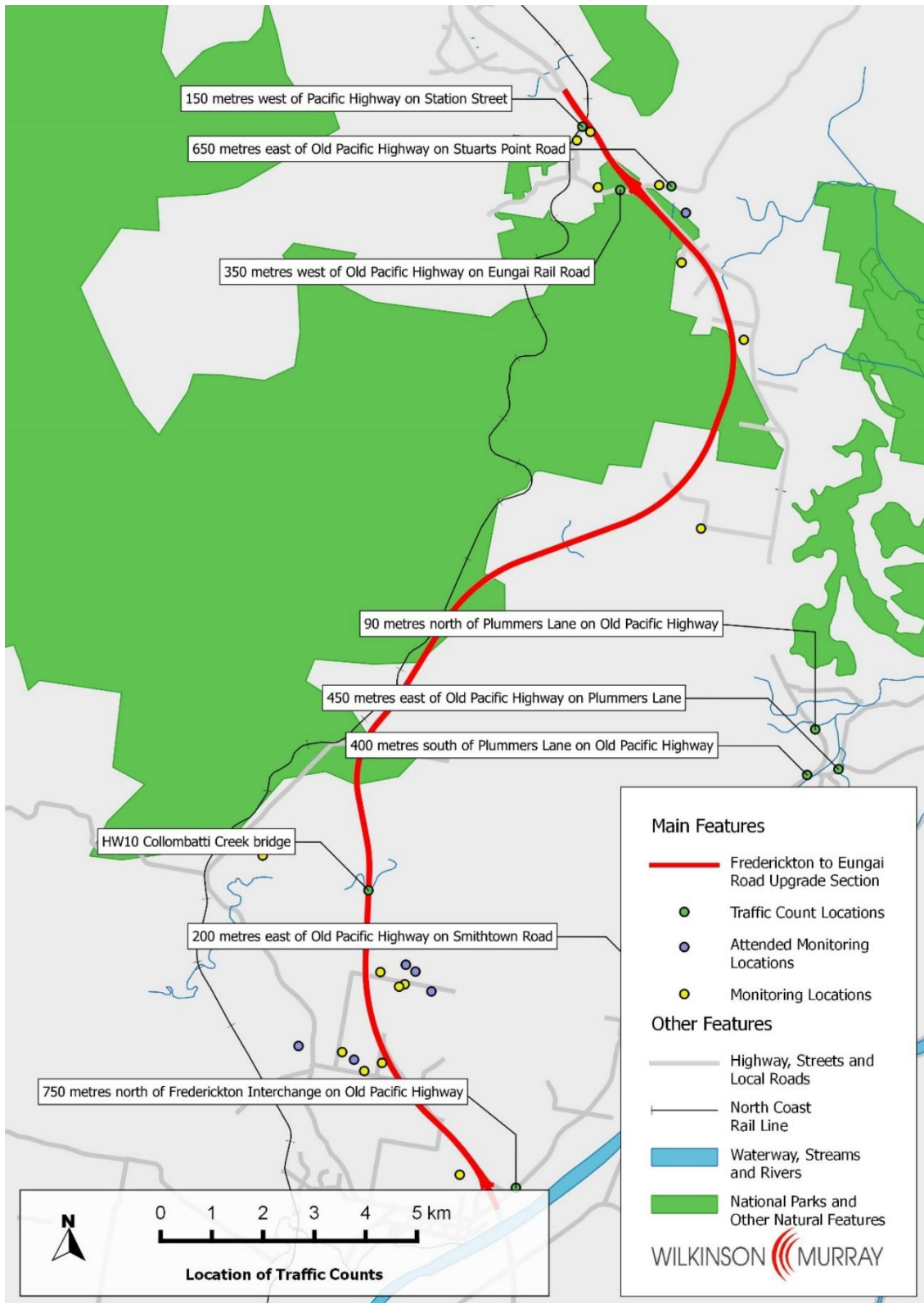
The location of the traffic counts in reference to the noise monitoring undertaken is shown in Figure 6-1.

The average daytime (7.00am-10.00pm) and night time (10.00pm-7.00am) hourly vehicle counts are shown in Table 6-1 for all days of the week (7 day) and for the weekdays only (5 day).

Table 6-1 Traffic Counts for the period 16/08/2016 to 5/09/2016

Traffic Count Number	Location	Period	Daytime (15hr)		Night Time (9hr)	
			Total	% Heavy	Total	% Heavy
1	750 metres north of Frederickton Interchange on Old Pacific Highway	7 day	244	11%	49	26%
		5 day	258	12%	57	27%
2	200 metres east of Old Pacific Highway on Smithtown Road	7 day	110	11%	20	14%
		5 day	112	12%	24	14%
3	400 metres south of Plummers Lane on Old Pacific Highway	7 day	160	10%	40	25%
		5 day	169	11%	46	26%
4	450 metres east of Old Pacific Highway on Plummers Lane	7 day	162	7%	26	9%
		5 day	169	8%	30	9%
5	90 metres north of Plummers Lane on Old Pacific Highway	7 day	90	14%	32	26%
		5 day	90	17%	38	26%
6	650 metres east of Old Pacific Highway on Stuarts Point Road	7 day	72	9%	10	7%
		5 day	75	10%	11	7%
7	350 metres west of Old Pacific Highway on Eungai Rail Road	7 day	19	4%	2	5%
		5 day	20	5%	2	2%
8	150 metres west of Pacific Highway on Station Street	7 day	14	6%	2	8%
		5 day	15	7%	3	4%
9	HW10 Collombatti Creek Bridge	7 day	505	20%	150	42%
		5 day	514	23%	173	44%

Figure 6-1 Location of Traffic Counts



6.2 Predicted Traffic Volumes

The predicted road traffic volumes used in the detailed design modelling undertaken in the Detailed Design Report by Wilkinson Murray entitled *Pacific Highway Upgrade Frederickton to Eungai Operational Noise Management Report Version D5* (WM Report No. F2E-00G-RPT-AC001-0001, dated April 2014) are presented in Table 6-2.

Table 6-2 Predicted Road Traffic Volumes – 2016 Year After Opening

Year 2016 Year After Opening	Daytime (15hr)		Night Time (9hr)	
	Hourly Average Traffic Volume		Hourly Average Traffic Volume	
	Total	% Heavy	Total	% Heavy
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

6.3 Comparison of Measured & Predicted Traffic Volumes

Table 6-3 details a comparison of the measured traffic counts with the predicted road traffic volumes as used in the detailed design modelling. These differences are used to adjust the predicted noise levels from the detailed design report to align them with the measured traffic volumes during the survey period over the 5 weekdays used for validation.

Table 6-3 Comparison of Measured & Predicted Traffic Volumes on the Main Carriageway

Location		Daytime (15hr)			Night Time (9hr)		
		LV	HV	% HV	LV	HV	% HV
North of Frederickton Interchange	Detailed Design	635	103	14%	65	74	53%
	First Measurement Period 5-Day Average	389	116	23%	100	78	44%
HW10 Collombatti Creek Bridge	Difference	-246	+13		+35	+4	
	Second Measurement Period 5-Day Average	406	97	22%	93	73	44%
	Difference	-229	-6		+28	-1	

7 VALIDATION & ASSESSMENT OF OPERATIONAL NOISE LEVELS

Updated noise modelling has been undertaken using the noise model developed during the detailed design stage. The model output has been modified to incorporate the measured traffic volumes conducted in-conjunction with the long term unattended noise monitoring (Chapter 6) as well as updating any receiver locations which required adjustment. The results are shown in Table 7-3, where they are compared to the traffic noise levels.

7.1 Model Inputs

A summary of the assumptions and model settings are provided in Table 7-1. Full details relating to the modelling procedure, assumptions and model inputs including the road alignment, topography, road surface correction, receiver heights, façade reflections and Australian conditions corrections are set out in full in the Detailed Design Report by Wilkinson Murray entitled *Pacific Highway Upgrade Frederickton to Eungai Operational Noise Management Report Version D5* (WM Report No. F2E-00G-RPT-AC001-0001, dated April 2014).

Table 7-1 Summary of Modelling Assumptions

Parameter	Comment
Traffic Speed	Main Carriageway: 115 km/h Daytime 120 km/h Night Time
	Local roads: 80 km/h on service roads 60 km/h on access roads
	Ramps: 80km/h
	Main Carriageway: +3dB for concrete
Road Surface	North bound Main Carriageway beyond Ch39220 -2dB for Stone Mastic Asphalt (SMA)
	Ramps: +3dB for concrete
	Bridge decks: -2dB for Stone Mastic Asphalt (SMA)
	Overpasses: +0dB for Dense Graded Asphalt (DGA)
Buildings	Single Storey: 4.5m
	Double Storey: 6.5m
Receivers	Single Storey: 1.5m
	Double Storey: 4.5m
Façade Correction	+2.5 dB in accordance with <i>CoRTM</i> .
Australian condition correction	The Australian correction of -1.7 dB was applied to facade predictions and -0.7 dB to free field predictions (April 1983 Australian Road Research Board report – Research Report ARR No.122)
Traffic Volumes	Measured Traffic Volumes as per Section 6
Calculation Setting	Grid space of 20m
	Height above ground = 1.5m
	Grid interpretation field size = 9 x 9

Parameter	Comment
	Grid interpretation min/max = 2dBA
	Grid interpretation difference = 0.1dBA
	Angle increment = 1 degree
	Reflection depth = 0
	Number of reflections = 0
	Maximal search radius = 7000m

7.1.1 Comparison of Receiver Locations used in Model and during Survey

A review of the actual long-term unattended measurement locations against the locations used for predictions in the detailed design report has been conducted.

2839 Pacific Highway (labelled as 59 Nirvana Way in the Detailed Design Report) had the prediction point adjacent to an auxiliary building rather than the residence where monitoring was undertaken.

The relative location of the predicted and measured locations is shown in Figure 7-1, with the comparative distance from the road and receiver height given in Table 7-2. The correct location has been incorporated in the model and results presented in Table 7-3.

Figure 7-1 Relative location of Long-Term Monitoring Locations & Predicted Location – 2839 Pacific Highway

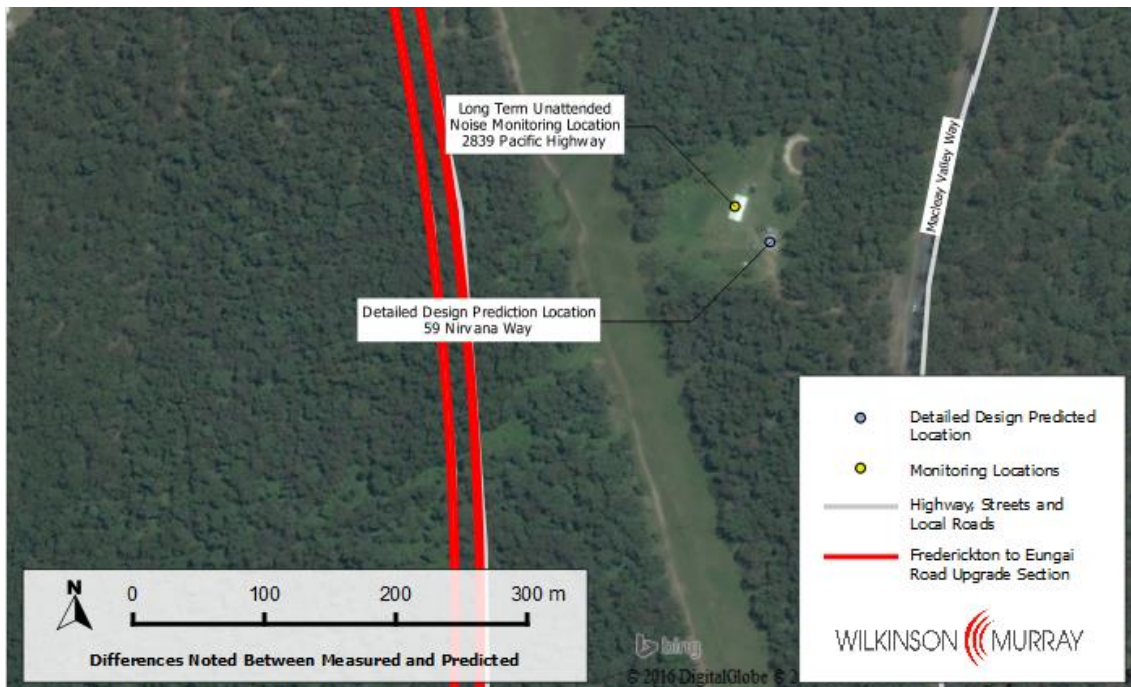


Table 7-2 Comparison between Long-Term Monitoring Locations & Predicted Location – 2839 Pacific Highway

2839 Pacific Highway (59 Nirvana Way)	Distance to Road	Receiver Height
As Predicted Level in Detailed Design	240m	1.5m
As Per Long-Term Unattended Measurement	220m	3.3m

7.2 Comparison of Measured & Predicted Road Traffic Noise Levels

Table 7-3 details a comparison of the measured road traffic noise with the predicted levels for the same traffic volumes and receiver locations. The average and standard deviation are also shown.

Table 7-3 Comparison of Measured & Predicted Noise Levels

Location	Address	Measured Noise Level		Predicted Noise Level		Difference	
		Day	Night	Day	Night	Day	Night
		L _{Aeq,15hr}	L _{Aeq,9hr}	L _{Aeq,15hr}	L _{Aeq,9hr}		
19c	Yarrabandini Road	56.2	54.8	55.3	52.9	0.9	1.9
21J	298 Quarry Road (59 Sheppard)	-	45.3	47.5	45.2	-	0.1
21c	26 Seashore Lane	55	51.7	59.4	56.8	-4.4	-5.1
21m	82 Kemps Access	47	41.1	47.3	45	-0.3	-3.9
20c	285 Kemps Access	52.7	51.3	55.8	53.2	-3.1	-1.9
20e	330 Kemps Access	46.9	45.1	47.9	45.6	-1	-0.5
20g	336 Kemps Access	45.8	45.8	47.1	44.8	-1.3	1
	114 Seven Hills Road	46.7	46.3	-	-	-	-
	483 Seven Hills Road	53.7	50.1	-	-	-	-
	135 Cooks Lane (week 1)	47.7	48.3	49.5	47.2	-1.8	1.1
	136 Cooks Lane (week 2)	48.5	48	49.5	46.9	-1	1.1
26c	2839 Pacific Highway	59.2	58.8	59.9	57.6	-0.7	1.2
29a	33 Barraganyatti Hut Road	53.8	52.7	55.9	53.3	-2.1	-0.6
30b	51 Stuarts Point Road	52.5	54	60.7	58.1	-8.2	-4.1
29p	2 South Bank Road East	51.6	50.8	57	54.4	-5.4	-3.6
29m	64 Station Street	54.4	52.1	54.5	51.9	-0.1	0.2
29c	3381 Pacific Highway	67.9	66.9	68.8	66.5	-0.9	0.4
Averages & Standard Deviations							
Average – Entire Dataset						-2.1	-0.8
Standard Deviation – Entire Dataset						2.3	2.2
Average – Excluding Outliers (bold)						-0.8	0.4
Standard Deviation – Excluding Outliers						0.8	1.0

Close correlation between the predicted and measured levels is achieved across all locations on the project. No further model adjustment or additional calibration of the detailed design model is considered to be warranted.

On this basis, the predicted levels for year of opening (2016) and plus ten years (2026) as reported in the detailed design Report by Wilkinson Murray are considered valid, albeit updated noise levels at 2839 Pacific Highway due to the location change (although this does not alter the mitigation recommendations for this receiver). Some receivers feature over-prediction and is discussed in more detail in Section 7.3.

The average difference considering all datasets shows that the measured level is below the predicted level, leading to the conclusion the model marginally over predicts.

If measurement locations are excluded that feature a large over-prediction (>3dB) due to the reasoning provided in Section 7.3, the average more closely matches the predicted level indicating for these locations the predicted levels are within close agreement of the measured levels (an over-prediction of less than 1dBA at daytime and an under prediction of less than 0.5dBA at night time).

Predicted daytime and night time noise levels for all receivers considered by the detailed design assessment are provided in Appendix E. Additionally, Appendix F contains a series of receiver maps to identify each noise-sensitive receiver.

7.3 Factors Affecting Over Prediction

As noted in Section 7.2 several receivers have a difference of up to 6dB with the measured level below the predicted level in the detailed design report.

Most receivers are at distances typically between 250 and 600m with some over 1,500m from the highway, well over the 300m distance where the accuracy of the *CoRTN* algorithm is not as well validated.

Table 7-4 details the approximate distance from each receiver to the road.

Large sections of the project pass through sections of dense bush between the road verge and the noise monitoring location. *CoRTN* does not include require the effects of vegetation to be integrated into the detailed design model, and similar project experience indicates that this can provide additional attenuation of up to 6dB. Even at location 21c, 125m from the road, the relatively low measured noise level is likely due to the effect of dense vegetation between the road and the monitor. Close correlation is seen at 3381 Pacific Highway, only approximately 31m from the road.

Table 7-4 Approximate Distance of Noise Monitoring Locations to Road

Location	Address	Approximate Distance (m)	Noise Level, Measured – Predicted	
			Day	Night
			L _{Aeq,15hr}	L _{Aeq,9hr}
19c	Yarrabandini Road	375	0.9	1.9
21J	298 Quarry Road (59 Sheppard)	620	-	0.1
21c	26 Seashore Lane	125	-4.4	-5.1
21m	82 Kemps Access	900	-0.3	-3.9
20c	285 Kemps Access	320	-3.1	-1.9
20e	330 Kemps Access	730	-1	-0.5
20g	336 Kemps Access	870	-1.3	1
23a	114 Seven Hills Road	~2,400	-	-
	483 Seven Hills Road	~1,500	-	-
	135 Cooks Lane	~1000	-1.8	1.1
			-1	1.1
26c	2839 Pacific Highway	220	-0.7	1.2
29a	33 Barraganyatti Road	380	-2.1	-0.6
30b	51 Stuarts Point Road	450	-8.2	-4.1
29p	2 South Bank Road East	610	-5.4	-3.6
29m	64 Station Street	400	-0.1	0.2
29c	3381 Pacific Highway	31	-0.9	0.4

8 DETAILS OF COMPLAINTS RECEIVED

A number of enquiries and complaints have been received in relation to the road traffic noise on the Frederickton to Eungai Pacific Highway upgrade since the project opened to traffic.

The summary of complaints received is outlined below. The complaints raised by residents were similar in nature. Complaints were raised by the community via email, letter and verbally.

Number of complaints – approximately 40 enquiries and complaints from 19 residents.

The Frederickton to Eungai upgrade project is approximately 26 kilometres long and begins to the north east of Frederickton and then passes to the west of the Macleay Valley Way (old Pacific Highway) through Collombatti and north through Barranganyatti, Clybucca to join the existing Pacific Highway south of Eungai Rail. The area is a mix of large rural subdivisions, some urban subdivisions and rural farmland. Some residences in these areas have boundaries with the road alignment. Prior to the construction of the highway most residences received negligible road traffic noise, except those located near the existing highway.

The main issues raised related to the change in the noise environment, where previously no road traffic noise was audible. The enquiries and complaints included:

- Road traffic noise being excessive and unacceptable.
- Heavy vehicle noise including engine noise and tyre noise.
- Many complainants describe a higher pitched sound from the heavy vehicles.
- Some residents raised concerns about possible health issues arising from excessive noise
- Some residences were quite distant from the highway but found noise levels unacceptable.
- Requests for updates on the progress of the operational noise assessment.

Phone calls were made to complainants to discuss the noise issues for the project and follow up letters were sent to explain the operational noise assessment process.

The location and nature of complaints was used to assist with the location of monitoring points for this report, with some monitors located at or near areas where most complaints were received, as shown in Table 8-1.

Table 8-1 Summary of Complaints Locations where monitoring was conducted

Address	Measurement Status
232 Quarry Road, Collombatti	Short-Term Attended Measurement Conducted 16/08/2016
Wahroonga Place, Collombatti	Short-Term Attended Measurement Conducted 16/08/2016
396 Kemps Access, Collombatti	Short-Term Attended Measurement Conducted 16/08/2016
329 Kemps Access, Collombatti	Short-Term Attended Measurement Conducted 16/08/2016
361 Kemps Access, Collombatti	Short-Term Attended Measurement Conducted 26/08/2016
318 Quarry Road, Collombatti	Short-Term Attended Measurement Conducted 26/08/2016
Thurgoood Lane, Barraganyatti	Short-Term Attended Measurement Conducted 26/08/2016
298 Quarry Road, Collombatti	Measurement Conducted as apart of Long-Term Unattended Noise Monitoring
82 Kemps Access, Collombatti	Measurement Conducted as apart of Long-Term Unattended Noise Monitoring
2839 Kemps Access, Barraganyatti	Measurement Conducted as apart of Long-Term Unattended Noise Monitoring
135 Cooks Lane, Clybucca	Measurement Conducted as apart of Long-Term Unattended Noise Monitoring
336 Kemps Access, Collombatti	Measurement Conducted as apart of Long-Term Unattended Noise Monitoring
330 Kemps Access, Collombatti	Measurement Conducted as apart of Long-Term Unattended Noise Monitoring
33 Barraganyatti Hut Road, Barraganyatti	Measurement Conducted as apart of Long-Term Unattended Noise Monitoring
483 Seven Hills Road, Collombatti	Measurement Conducted as apart of Long-Term Unattended Noise Monitoring
Yarrabandini Road	Measurement Conducted as apart of Long-Term Unattended Noise Monitoring

9 SUMMARY & CONCLUSION

This report presents a review of the road traffic noise levels associated with the opening of the Pacific Highway Upgrade between Frederickton and Eungai.

This review has undertaken long-term unattended noise monitoring at 16 noise-sensitive receivers, conducted in two rounds from 15 August to 6 September 2016, with simultaneous traffic counts undertaken from 16 August to 5 September 2016.

The measured results are within close agreement (within 2dB) or lower than the predicted levels, with some degree of over-prediction at more distance receivers as discussed in Section 7.3.

For a subset of the receivers closer to the Highway the average difference between measured and predicted noise levels showed an over-prediction of less than 1dBA at daytime and an under prediction of less than 0.5dBA at night time.

A close correlation between the predicted and measured levels is achieved across all locations on the project, and no further model adjustment is warranted. On this basis, the predicted levels for year of opening (2016) and plus ten years (2026) as reported in the detailed design Report by Wilkinson Murray entitled *Pacific Highway Upgrade Frederickton to Eungai: Operational Noise Management Report Version D5* (WM Report No. F2E-00G-RPT-AC001-0001, dated April 2014) are considered valid. No changes are recommended to noise mitigation measures.