

Mooloolah Off-Road Motorcycling Facility

Mooloolah, Queensland

Noise Impact Assessment

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11/04/14

Prepared for
Department of National Parks, Recreation, Sport and Racing

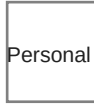
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1 Introduction

ASK Consulting Engineers Pty Ltd (ASK) was commissioned by the State of Queensland acting through the Department of National Parks, Recreation, Sport and Racing (NPSR) to undertake a noise impact assessment for the proposed off-road motorcycling facility at Mooloolah, Queensland.

The purpose of this report is as follows:

- Outline the relevant project noise criteria.
- Present the results of noise monitoring.
- Predict and assess the noise impact of the proposed facility onto the surrounding sensitive receivers.

To aid in the understanding of the terms in this report a glossary is included in **Appendix A**.

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2 Study Area Description

The proposed development is to be located at on the southern side of Steve Irwin Way and on the western side of the Bruce Highway. The site location is shown in **Figure 2.1** (source: Google Earth Pro).

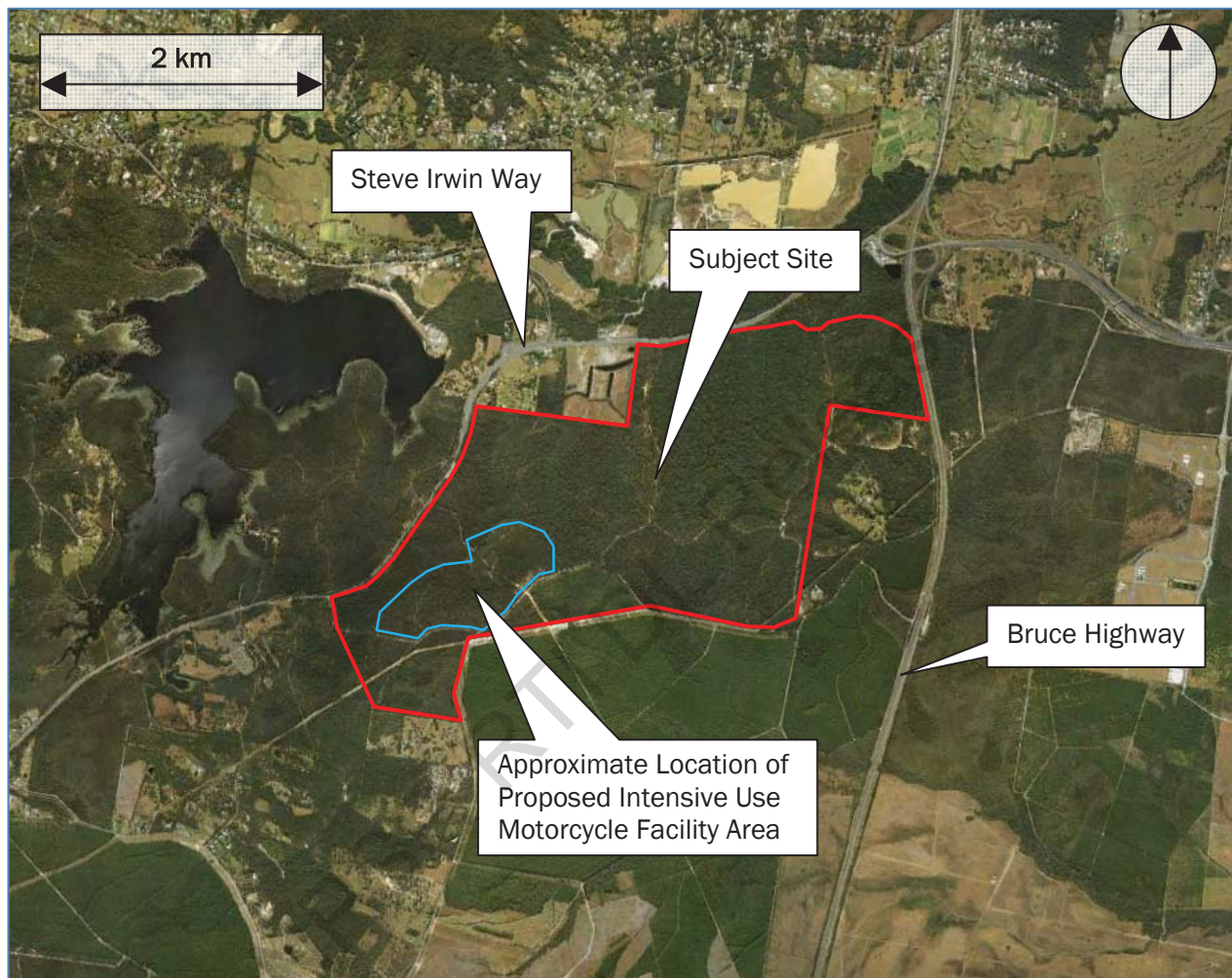


Figure 2.1 Site Location

The site is predominantly vacant, and generally consists of forested land with a number of existing trails running throughout the site.

The proposed development is surrounded by the following premises:

- Residential and commercial premises to the north, with residential receptors to the north of Steve Irwin Way.
- Bushland, residential premises and the Bruce Highway to the east.
- Bushland and residential premises to the south.
- Commercial and residential premises and Ewen Maddock Dam to the west.

The proposed development has the potential to create noise impacts on nearby residences and businesses due to onsite motorcycle activity. These potential impacts are required to be considered in the project design.

A number of surrounding residences have been identified as sensitive receivers as described in **Section 6** and presented in **Appendix D**.

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3 Proposed Development

The proposed off-road motorcycling facility will include a central intensive use area and off-road trails throughout the remainder of the site. A proposed master plan for the site and the central intensive use area has been provided and is included in **Appendix B**. The master plan indicates the following motorcycle track types, activities and other ancillary areas:

- Three (3) motocross tracks providing approximately 2km, 1.8km and 1.5km distances
- Freestyle motocross area
- Moto trials area
- Minikhana area
- Flat track and helipad area
- Motorcycle washdown area
- Administrative hub including office and amenities
- Facilities management building including storage and amenities
- Carparking area with approximately 250 spaces
- Potential future site for Sunshine Coast Junior Motocross Club.

Indicative off-road motorcycle trails have been shown on the master plan documents in **Appendix B**, which are generally based on existing trails. It is understood that a minimum 100m wide vegetation buffer is proposed between motorcycle tracks and the majority of the site boundary.

The proposed hours of operation are as follows:

- Opening times: 8:00am to 4:00pm
- Enduro/trails track opening: 8:30am to 3:30pm
- Motocross track opening: 9:00am to 4:00pm

The facility is proposed to be open 7 days per week.

4 Noise Criteria

From discussions with NPRSR the noise criterion was selected to be 45 dBA $L_{eq,T}$ at nearby residential receptors.

This criterion is presented and endorsed in the NPRSR document entitled 'Providing Opportunities for Off-Road Motorcycling' in a noise planning policy document (Appendix 3) developed by Parsons Brinckerhoff Australia Pty Ltd (PB) referred to herein as the 'PB Report'. This criterion was also used for previous motorcycling facility noise impact assessments.

The 45 dBA $L_{eq,T}$ criterion is derived from the Department of Environment and Heritage Protection's Environmental Protection (Noise) Policy 2008 (EPP (Noise)) document, which provides fixed level acoustic quality objectives. The external acoustic quality objective for residential dwellings during the daytime is 50 dBA $L_{Aeq,adj,1hr}$. A 5 dBA adjustment is made to this criterion to allow for the character of off-road motorcycle noise, resulting in a limit of 45 dBA $L_{eq,T}$ as per the PB Report.

Given this limit is a general acoustic quality objective and not dependant on the existing noise environment, it could be construed that achieving this acoustic quality objective limit would not necessarily protect the background noise environment. However, it is noted that the approach of applying fixed noise limits independent of background noise level is also applied for other noise sources such as road noise, rail noise and aircraft noise.

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5 Noise Measurements

5.1 Mooloolah Site Ambient Noise Level Monitoring

Noise monitoring was conducted at three locations within the subject site to determine the existing ambient noise levels at areas representative of the nearest surrounding sensitive receivers. The noise monitoring locations are shown in **Figure 5.1**.

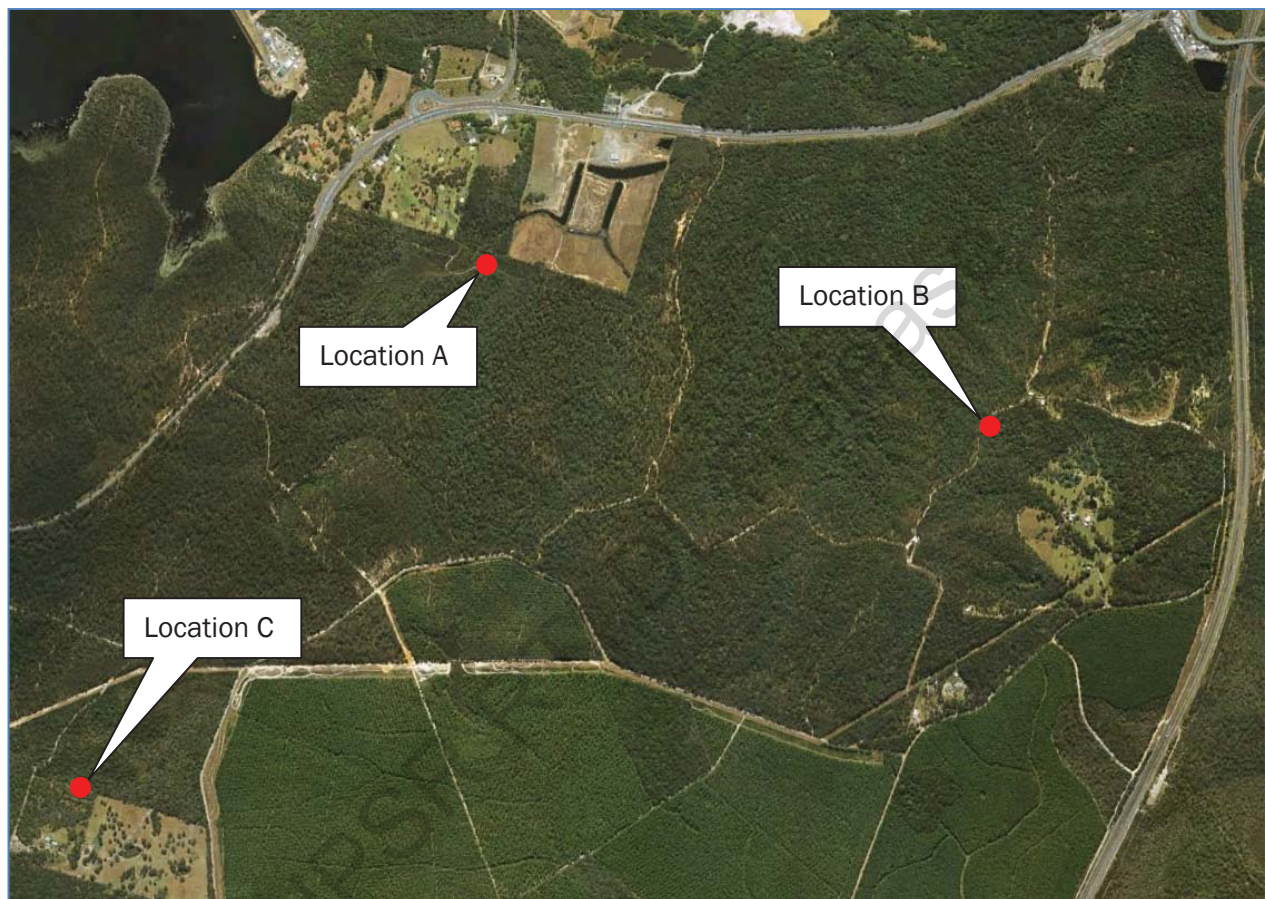


Figure 5.1 Noise Monitoring Locations

5.1.1 Attended Noise Measurement

An attended noise measurement was undertaken at each monitoring location as shown on **Figure 5.1**. The measurements were undertaken on 26/02/14 over 10 minute periods using a field and laboratory calibrated Norsonic Nor140 Type 1 sound level meter. The microphone height was approximately 1.3m above natural ground level and was located in the free field. Weather during the time of monitoring was overcast with occasional light rainfall and slight breezes from the east to the south-east at approximately 1 to 3 m/s.

The measured noise levels are summarised in **Table 5.1**. The parameters noted in **Table 5.1** are described in the glossary in **Appendix A**.

Table 5.1 Attended Noise Measurement Results

Location	Date & Time	Period (Minutes)	Results & Notes
A	10:54am 26/02/14	10	Statistical noise levels: L ₁₀ 43 dBA, L _{eq} 41 dBA, L ₉₀ 36 dBA Noise from traffic on Steve Irwin Way dominant: 37 to 43 dBA Birds: 40 to 57 dBA
B	12:03pm 26/02/14	10	Statistical noise levels: L ₁₀ 46 dBA, L _{eq} 44 dBA, L ₉₀ 41 dBA Noise from traffic on Bruce Highway dominant: 41 to 47 dBA Truck on Bruce Highway: 48 dBA Helicopter: 42 to 45 dBA Wind in trees: 41 to 47 dBA
C	12:40pm 26/02/14	10	Statistical noise levels: L ₁₀ 43 dBA, L _{eq} 42 dBA, L ₉₀ 40 dBA Insect noise dominant: 39 to 42 dBA Loud insect: 45 to 46 dBA Distant traffic occasionally audible

It is noted that the existing noise levels are highest at Location B due to the increased traffic noise from the Bruce Highway. Residences closer to the major roads (i.e. Steve Irwin Way or Bruce Highway) would be expected to be subject to higher noise levels than those measured at Locations A, B and C.

5.1.2 Noise Logging

Noise logging was undertaken at each monitoring location as shown on **Figure 5.1**. Logging was undertaken from 26/02/14 to 6/03/14 using two field and laboratory calibrated Larson Davis LD831 environmental noise loggers and one Norsonic Nor140 environmental noise logger. Noise logging was undertaken in the free field and measurement data was recorded for 15-minute intervals.

Data from the weather station setup by ASK onsite indicates that significant rainfall events occurred on 3/03/14 to 5/03/14.

By excluding the data affected by rainfall, the noise monitoring data is considered acceptable for use in this report.

Graphs of the measured noise levels are presented in **Figures C.1 to C.3** in **Appendix C**, and the parameters graphed in these figures are described in the glossary in **Appendix A**. The statistical results from the noise logging have been summarised in **Tables C.1 to C.3** in **Appendix C**.

The background noise levels calculated using the lowest 10th percentile method are shown in **Table 5.2** (days with significant rainfall excluded).

Table 5.2 Daytime Background Noise Levels at Locations A, B and C

Location	Background Noise Level L_{90} dBA
A	35
B	41
C	36

From **Table 5.2** it is again noted that the existing background noise levels are highest at Location B due to the increased traffic noise from the Bruce Highway.

5.2 Queensland Moto Park Motorcycle Noise Measurements

To understand the level of noise generated by the proposed development, noise measurements of motorcycle activities were taken at Queensland Moto Park on 1/02/14 (Saturday).

The measurements were taken using a field and laboratory calibrated Norsonic Nor140 sound level meter.

Measurements were taken near a section of motocross track where motorcycles were accelerating out of a corner and up a straight section, shown on **Figure 5.2** as Location A. The sound power levels (L_w) have been calculated based on the measured L_{max} levels from the motorcycle pass-bys and are presented in **Table 5.3**, along with the motorcycle engine types which were identified for this measurement.

Table 5.3 Motorcycle Pass-by Measurements at Location A

Motorcycle Engine Type	Calculated Sound Power Level $L_{w,max}$ (dBA)		
	Min	Max	Average (logarithmic)
250 cc 2s	111	120	117
250 cc 4s	112	124	122
450 cc 4s	112	125	121
510 cc 4s	124	125	125
Average (logarithmic)	-	-	121

Measurements were taken at a number of other locations. A selection of measurement data from the senior level motocross tracks is presented in **Table 5.4** with corresponding measurement locations shown in **Figure 5.2**. The exact motorcycle engine types were not identified for these measurements, however the majority of the motorcycles were observed to be 450 cc 4 stroke with a smaller number of 250 cc 4 stroke, 250 cc 2 stroke and 125 cc 2 stroke and occasional other types (e.g. 350 4 stroke, 510 4 stroke).

The 'average' values in these tables have been calculated logarithmically (not arithmetically).



Figure 5.2 Queensland Moto Park Measurement Locations

Table 5.4 Motorcycle Calculated Sound Power Levels

Location	Calculated Average L_w (dBA)
A	121
B	124
C	127
D	125
E	123
Average (logarithmic)	125

From **Table 5.3** and **Table 5.4** it can be seen that the noise level varies depending on the location (i.e. noise level depends in part on how much the motorcycles accelerate at particular parts of the track). Comparing the calculated sound power levels, Location A was lower than the other locations.

Apart from the engine type and track location, other factors that have a significant impact on the level of noise emission include the level of muffler attenuation (poorly maintained or modified mufflers can result in higher noise levels) and the skill or speed of the rider (more skilled or faster riders will often accelerate more, resulting in higher noise levels).

6 Noise Model

6.1 Model Information

Noise modelling was carried out using the SoundPLAN computer program, which is widely used and accepted for noise modelling and is approved by EHP.

The SoundPLAN program was used to develop a three-dimensional digital terrain noise model of the proposed off-road motorcycling facility and the surrounding area.

The noise propagation model used was ISO 9613-2: 1996 in accordance with the PB Report. ISO 9613-2: 1996 assumes downwind conditions and is therefore considered to be an adverse case for meteorological conditions during the day. Meteorological conditions can have a significant effect on noise emission levels, and varying conditions can result in a wide range of noise emission levels, particularly over long distances. The modelled meteorological conditions are based on providing noise predictions representative of typical daytime conditions.

The following inputs and assumptions were used in the model calculations:

- Ground absorption coefficient of 0.5 for majority of ground, 0.0 used for bodies of water.
- Ground contours for the site and surrounds were obtained from Geosciences Australia.
- Forest attenuation areas included in the model based on Google Earth imagery, with the proposed intensive use area being assumed cleared.

The nearest surrounding residences have been identified using Google Earth imagery. As such, the identified receivers have not been inspected onsite to confirm whether they are in use. Noise levels have been calculated at these receivers, and the receiver locations have been shown in **Appendix D**. A few of the nearest residences were observed onsite, and they were generally single-storey residences. Therefore the noise predictions have been based on a receiver height of 2.0m above natural ground level.

The receivers shown in **Appendix D** do not include all the residences within the extent of the presented aerial images, but are only a selection of the closest identified likely residences that surround the subject site. There are a number of residences not shown to the north of the subject site, but the selected residences give an indication of the closest residences in each general direction around the subject site. It is noted that there may be existing residences not identified and shown in this report. Businesses and premises have not been presented in the results or in **Appendix D**.

6.2 Noise Source Data

In addition to the data collected at Queensland Moto Park presented in **Section 5.2**, motorcycle noise data was evaluated from the following sources:

- ASK measurements for the Nolan Park Motorsports Facility (ASK Report 6670R01V02 dated 18/01/14) – referred to herein as 'Nolan Park'.
- NPRSR document entitled 'Providing Opportunities for Off-Road Motorcycling' in a noise planning policy document (Appendix 3) developed by Parsons Brinckerhoff Australia Pty Ltd (PB) – referred to herein as 'PB Report'.
- Internoise 2005 publication entitled 'Sound power levels of motocross courses' by Granneman et al. – herein referred to as 'Granneman et al.'.

Motorcycle noise data from these sources as well as data from the measurements at Queensland Moto Park have been summarised in **Table 6.1**.

For the Queensland Moto Park data the L_{eq} sound power level has been calculated based the L_{max} sound power level minus 8 dBA for motocross tracks and minus 10 dBA for trails. This is based on the L_{max} events (i.e. heavy acceleration) only occurring for approximately 15% of the time for a motocross track and 10% of the time for trails as described in Granneman et al. and referred to in the PB Report. A verification model was developed for the Queensland Moto Park site, and this difference between L_{eq} and L_{max} sound power levels correlated well at a number of measurement locations.

Table 6.1 Motorcycle Noise Data

Data Source	Track Type	Motorcycle Engine	Sound Power Level, dBA	
			L_{max}	L_{eq}
Nolan Park	Motocross	50 to 80 cc 4 stroke	110	100
		50 cc 2 stroke	110	100
		65 cc 2 stroke	119	109
		85 cc 2 stroke	123	113
		250 cc 4s	120	110
PB Report	Motocross	Various Senior Level	120	112
	Trail	Various Senior Level	120	110
Granneman et al.	Motocross	125 cc 2s	126 - 133	-
		250 cc 2s	124 - 133	-
		250 cc 4s	125 - 136	-
		450 cc 4s	127 - 134	-
		Various Senior Level	-	120
Queensland Moto Park	Motocross	Various Senior Level	125	117
	Trail	Various Senior Level	125	115

From **Table 6.1** the L_{max} sound power levels from Queensland Moto Park are similar but slightly lower (3 dBA) compared to the Granneman et al. data. The PB Report data is significantly lower than the other data.

The sound power levels from Queensland Moto Park are considered to be a reasonable noise level to represent the average day-to-day use of an off-road motorcycle facility for predominantly senior level motorcycles (e.g. 125 to 250 cc 2 stroke and 250 to 450 cc 4 stroke), and have therefore been used in the noise model. Although there would be a certain number of junior motorcycles present in the proposed facility, the sound power level has been based on senior level motorcycles as a conservative assumption. Even if a percentage of motorcycles were included based on junior level sound power data, the overall change in sound power level would be minimal.

The PB Report provides a standard spectrum for off-road motorcycles. However, this spectrum was found to differ from the spectra measured at Queensland Moto Park and at Nolan Park. From a number of motorcycle pass-by measurements taken at Queensland Moto Park, an average spectrum was calculated and is presented in **Table 6.2**. This spectrum has been used in the noise model.

Table 6.2 Sound Power Level Spectrum for Motorcycles

Track Type	Octave Band Sound Power Levels, Leq (dBA)								Total (dBA)
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
Motocross	86	102	110	108	108	112	109	102	117
Trail	84	100	108	106	106	110	107	100	115

6.3 Model Scenarios

A number of scenarios have been modelled with different numbers of motorcycles on the trails and in the intensive use area based on numbers provided to ASK and presented in **Table 6.3**.

Table 6.3 Modelling Scenarios

Scenario	Number of Motorcycles		
	Trails	Intensive Use Area	Total
1	25	50	75
2	50	50	100
3	25	100	125
4	50	100	150
5	25	150	175
6	50	150	200

6.4 Results

The noise emission levels from the proposed off-road motorcycle facility have been predicted for each of the six scenarios presented in **Table 6.3**, and the results are presented in **Table 6.4** at the identified residences and in **Appendix D** in the form of noise contours.

Table 6.4 Predicted Noise Levels at Residences

Receiver #	Address	Predicted Noise Level, Leq (dBA), For Scenarios 1 to 6					
		#1	#2	#3	#4	#5	#6
1	sch4p4(6) Personal information	52	54	54	55	56	57
2		52	52	55	55	57	57
3		51	51	54	54	55	55
4		50	53	50	53	51	53
5		50	52	53	53	54	55
6		50	51	51	53	53	54
7		50	51	51	53	53	54
8		49	52	50	52	51	53
9		49	49	51	52	53	53
10		48	50	49	51	50	52

Receiver #	Address	Predicted Noise Level, L_{eq} (dBA), For Scenarios 1 to 6					
		#1	#2	#3	#4	#5	#6
11	sch4p4(6) Personal information	48	50	49	51	50	52
12		48	48	51	51	52	52
13		47	49	49	50	50	51
14		47	47	50	50	51	51
15		45	46	47	48	49	49
16		45	46	48	48	50	50
17		44	45	47	47	49	49
18		44	45	46	47	48	48
19		44	45	46	47	48	48
20		43	44	46	46	47	48
21		43	44	46	46	47	48
22		42	43	43	45	45	46
23		41	42	44	44	45	45
24		41	42	42	44	44	45
25		41	41	43	44	45	45
26		40	42	42	43	43	44
27		40	41	41	43	43	44
28		39	41	41	42	42	43
29		39	39	42	42	43	43
30		37	38	38	40	40	41

From **Table 6.4** and the noise contours in **Appendix D** it can be seen that the 45 dBA $L_{eq,T}$ criterion is exceeded at a number of locations in each scenario.

The criterion is exceeded by up to 7 dBA in Scenario 1 and by up to 12 dBA in Scenario 6.

Receiver 2 (62 Bellaboo Road) is likely to be the worst-affected receiver given the high predicted noise levels and the low existing background noise levels.

7 Mitigation Measures

Potential noise mitigation measures could include the following:

- Noise barriers (e.g. acoustic fence or mounding).
- Relocating trails.
- Minimise noise through implementation of a noise management plan.

Acoustic treatments to facades of specific sensitive receiving buildings could also be considered. However, the noise criterion is based on an external noise level, and acoustic treatments to building facades would only reduce internal noise levels with all windows and doors closed. Therefore it is recommended that this option only be considered as a last resort.

7.1 Barrier

Noise predictions have been conducted with an 8m higher earth mound surrounding the entire site to determine the effectiveness of noise barriers in reducing noise levels at particular receivers. The resulting reductions in noise level were small, being predominantly less than 1 or 2 dBA (the highest reduction was 3 dBA at Receiver 21), indicating the noise barriers are generally ineffective for this site with the modelled down wind conditions.

7.2 Relocating Trails

Relocating particular sections of off-road trails could reduce noise levels at some receivers by increasing the distance between the trail and the receiver and by moving the trail to a location more shielded by natural terrain.

Noise modelling revealed that small noise reductions of 1 to 3 dBA could be achieved at the residences to the east (including Receivers 4, 8, 10, 11, 13, 21 and 26) if the easternmost trail is relocated as shown in **Figure 7.1**.

7.3 Noise Management Plan

A noise management plan could be implemented to minimise noise emissions. A noise management plan could include the following strategies:

- Regulate the number of riders using the tracks (fewer motorcycles results in lower noise levels).
- Place requirements on motorcycle noise emission levels, in particular on muffler type and maintenance, which can significantly affect the noise emission level from a motorbike.
- Place restrictions on the number of events that can occur during the year.
- Allow a higher noise limit for a limited number of events with larger numbers of riders.

Decreasing the number of riders using the tracks would reduce the noise emission levels further. From Scenario 1, which included 50 motorcycles in the intensive use area and 25 motorcycles on the trails, the 45 dBA $L_{eq,T}$ criterion was exceeded by up to 7 dBA. To reduce the noise emission levels by 7 dBA would require the number of riders to be decreased to approximately 10 motorcycles in the intensive use area and 5 motorcycles on the trails. Such a small number of motorcycles may not be viable for the development.

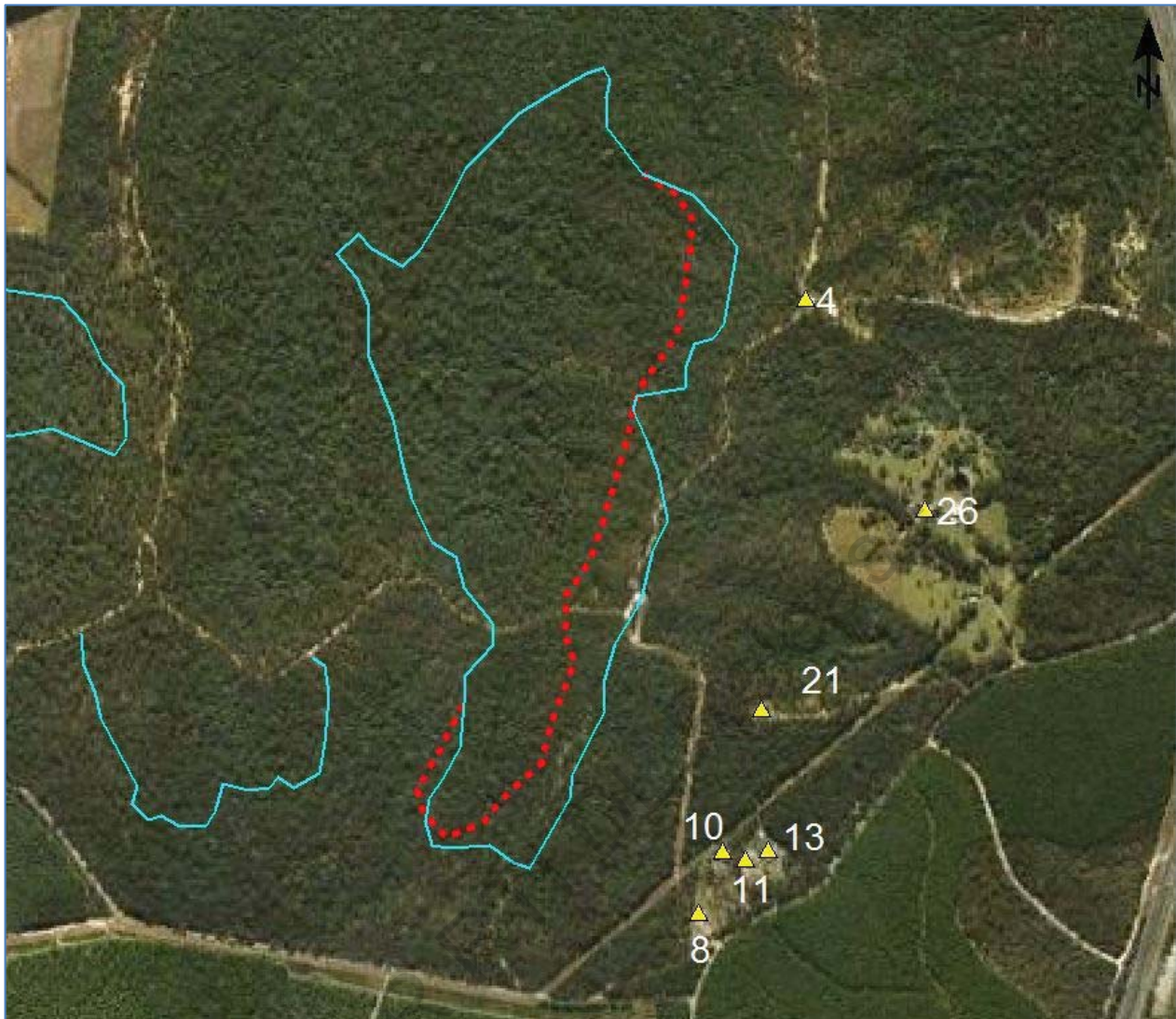


Figure 7.1 Alternative Off-Road Trail Location

7.4 Summary

From **Section 6.4** the required reductions to achieve the 45 dBA $L_{eq,T}$ criterion at the worst-affected receivers are 7 to 12 dBA. Since noise barriers were predicted to provide reductions of generally less than 3 dBA, and relocating trails provide reductions of 1 to 3 dBA for receivers to the east, it is not expected that a 7 to 12 dBA reduction in noise emission levels would be achievable. Noise emission levels could be reduced by decreasing the number of riders below those modelled in Scenario 1, however such a small number of motorcycles may not be viable for the development.

8 Recommendations & Conclusion

A noise impact assessment has been conducted for the proposed off-road motorcycling facility at Mooloolah, Queensland. The results and recommendations of the assessment are as follows:

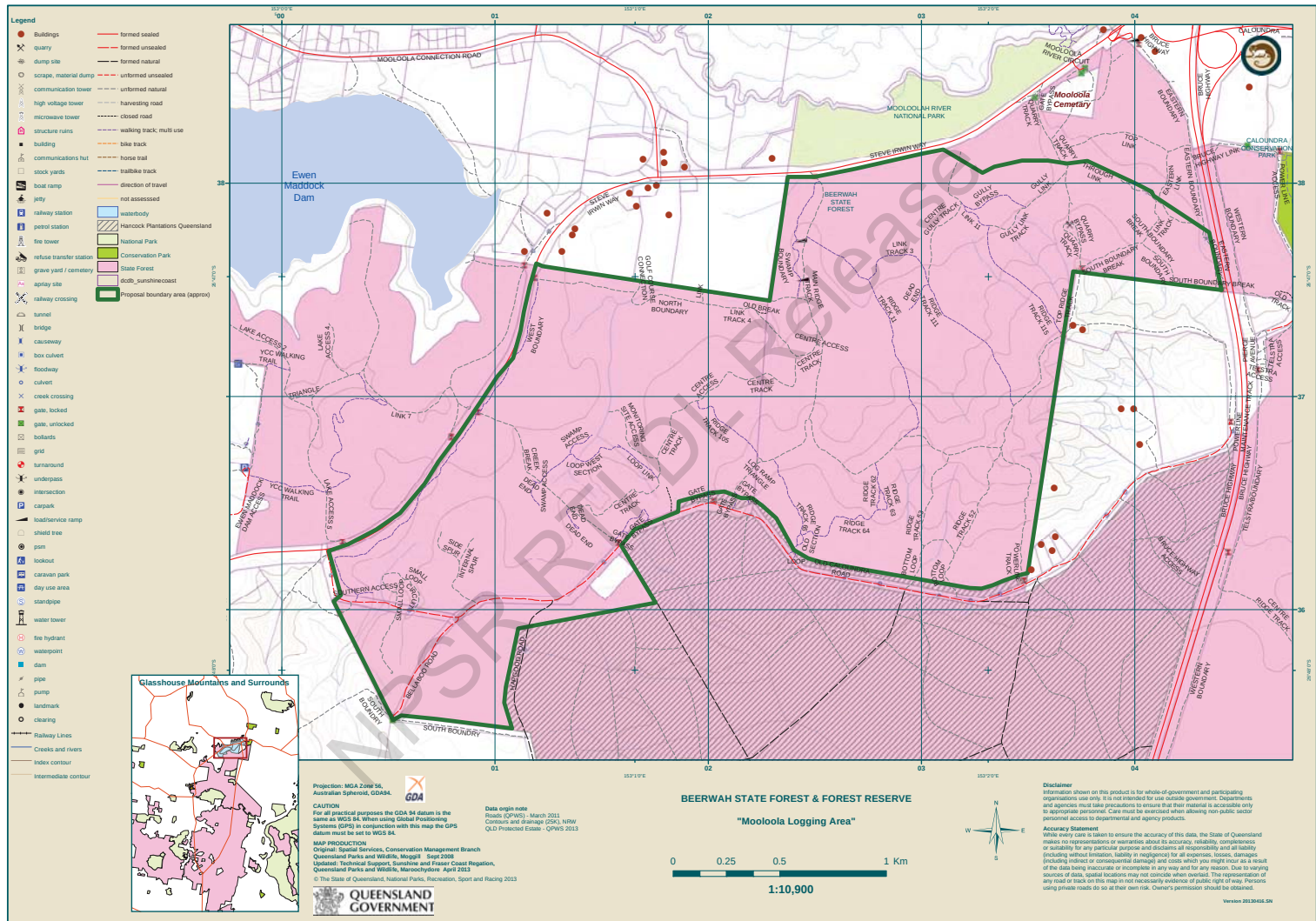
- Noise predictions are presented in **Table 6.4** at the identified residences and in **Appendix D** in the form of noise contours. The 45 dBA $L_{eq,T}$ criterion is exceeded at a number of locations in each of the six modelled scenarios. The criterion is exceeded by up to 7 dBA in Scenario 1 and by up to 12 dBA in Scenario 6.
- Modelling has revealed that noise barriers are generally ineffective at reducing the down-wind noise levels for this site due mainly to atmospheric effects over long distances as described in **Section 7.1**. An 8m high earth mound was predicted to provide a reduction of less than 1 to 2 dBA at most receivers.
- Modelling revealed that noise reductions of 1 to 3 dBA could be achieved at the residences to the east (including Receivers 4, 8, 10, 11, 13, 21 and 26) if the easternmost trail is relocated as shown in **Figure 7.1**.
- A noise management plan could be considered as described in **Section 7.3**.
- From the potential noise mitigation measures described in **Section 7**, it is not expected that the 45 dBA $L_{eq,T}$ criterion will be achievable at all sensitive receptors for the modelled Scenarios. Noise emission levels could be reduced by decreasing the number of riders below those modelled in Scenario 1, however such a small number of motorcycles may not be viable for the development.

Appendix A Glossary

Parameter or Term	Description
dB	The decibel (dB) is the unit measure of sound. Most noises occur in a range of 20 dB (quiet rural area at night) to 120 dB (nightclub dance floor or concert).
dBA	Noise levels are most commonly expressed in terms of the 'A' weighted decibel scale, dBA. This scale closely approximates the response of the human ear, thus providing a measure of the subjective loudness of noise and enabling the intensity of noises with different frequency characteristics (e.g. pitch and tone) to be compared.
Day	The period between 7am and 6pm.
Evening	The period between 6pm and 10pm.
Night	The period between 10pm and 7am.
Free-field	The description of a noise receiver or source location which is away from any significantly reflective objects (e.g. buildings, walls).
L ₁	The noise level exceeded for 1% of the measurement period.
L ₁₀	The noise level exceeded for 10% of the measurement period. It is sometimes referred to as the average maximum noise level.
L ₉₀	The noise level exceeded for 90% of the measurement period. This is commonly referred to as the background noise level.
L _{eq}	The equivalent continuous sound level, which is the constant sound level over a given time period, which is equivalent in total sound energy to the time-varying sound level, measured over the same time period.
L _{eq,T}	As for L _{eq} except the measurement intervals can be
L _{eq,1hour}	As for L _{eq} except the measurement intervals are defined as 1 hour duration.
L _{max}	Maximum A-weighted sound pressure level.
L _{eq} (24 hour)	The average L _{eq} noise level over the 24-hour period from midnight to midnight.
L ₁₀ (18 hour)	The arithmetic average of the one-hour L ₁₀ values between 6am and midnight. This parameter is used in the assessment of road traffic noise.
R _w	Weighted Sound Reduction Index – is a single number evaluation of the property of a partition to attenuate sounds. For the majority of partitions, the value of R _w will be similar to the value for STC. Partitions with particularly poor performance at 100 Hz may have lower values for R _w than for STC. Conversely, partitions with poor performance at 4000 Hz may have higher R _w than for STC. (As per AS1276.1-1999).

Appendix B Project Drawings

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Possible location of tracks and infrastructure in Mooloolah Logging Area



Possible location of tracks and infrastructure in Mooloolah Logging Area



Appendix C Noise Logging Data

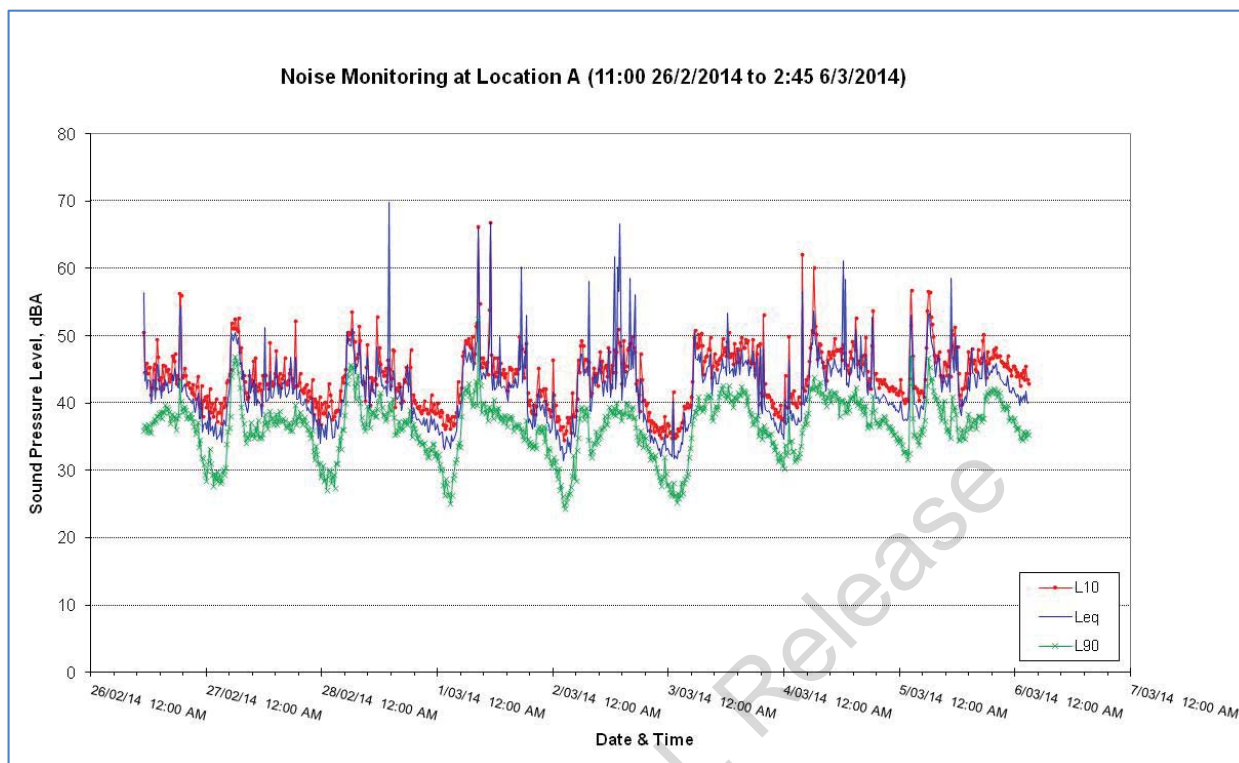


Figure C.1 Graph of Noise Logging Results at Location A

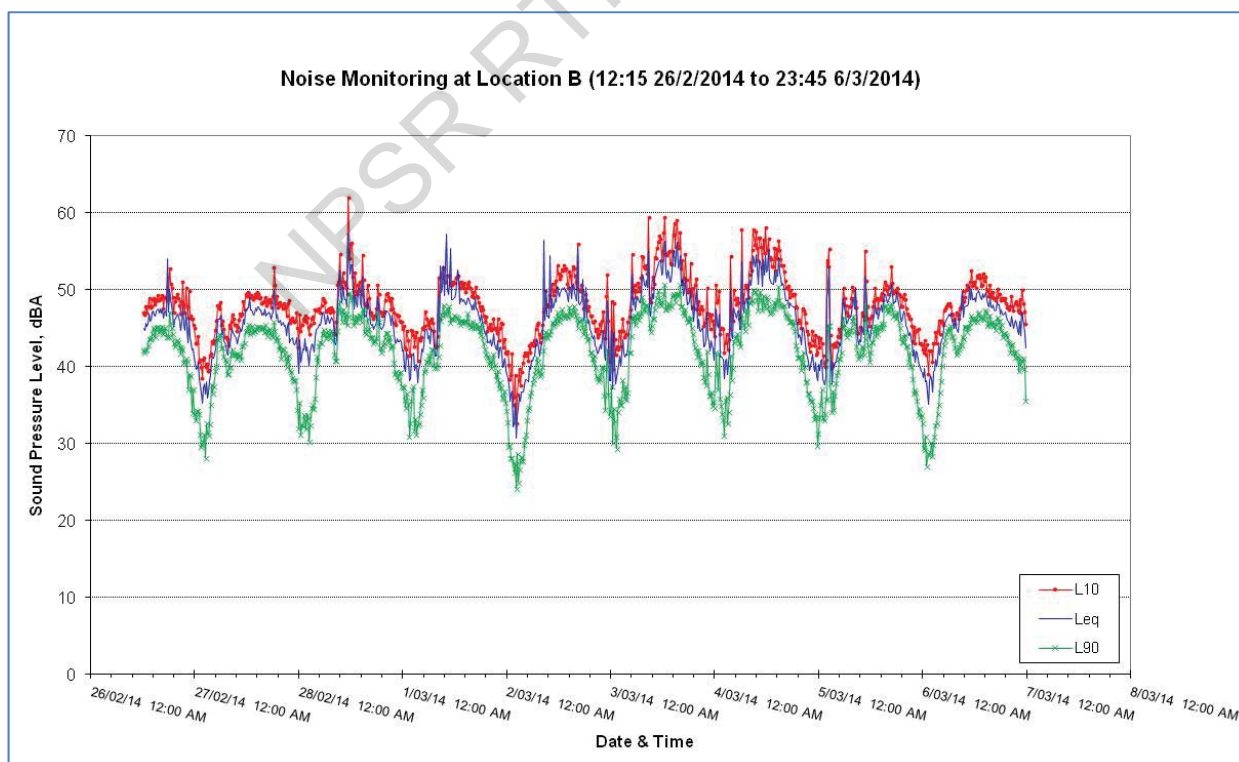


Figure C.2 Graph of Noise Logging Results at Location B

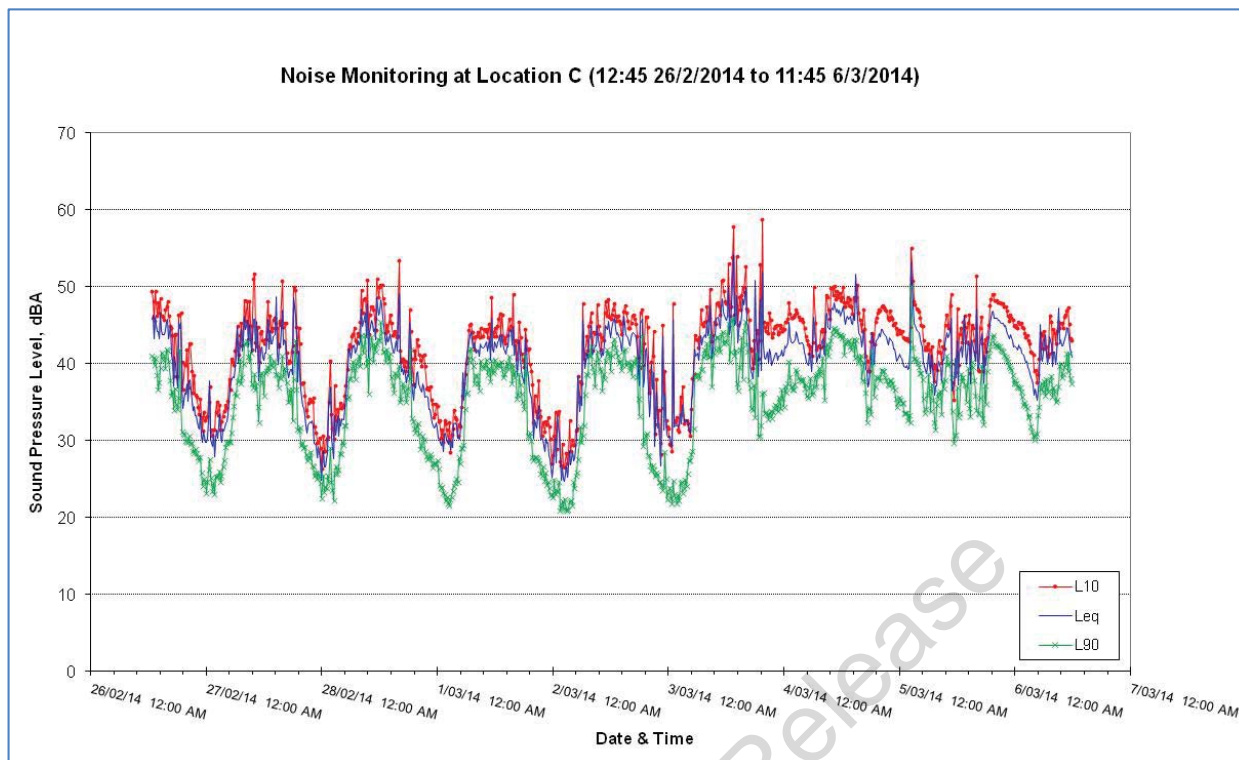


Figure C.3 Graph of Noise Logging Results at Location C

Table C.1 Statistical Noise Levels at Location A

Parameter	Statistic	Noise Levels dBA		
		Day	Evening	Night
L _{max}	Maximum	101	72	77
	Top 10%	72	62	67
	Average	64	53	53
	(Median)	63	51	50
	Bottom 10%	57	46	46
	Minimum	50	44	42
L ₁	Maximum	82	70	65
	Top 10%	59	55	57
	Average	53	47	47
	(Median)	52	46	46
	Bottom 10%	48	43	41
	Minimum	45	39	39
L ₁₀	Maximum	67	56	62
	Top 10%	49	48	50
	Average	46	43	42
	(Median)	46	42	41
	Bottom 10%	43	39	37
	Minimum	40	36	35

Parameter	Statistic	Noise Levels dBA		
		Day	Evening	Night
L _{eq}	Maximum	70	55	57
	Top 10%	48	46	48
	Average	45	41	39
	(Median)	44	40	38
	Bottom 10%	41	37	34
	Minimum	38	34	31
L ₉₀	Maximum	53	43	47
	Top 10%	41	41	42
	Average	38	37	34
	(Median)	38	37	33
	Bottom 10%	36	33	28
	Minimum	32	30	24

Table C.2 Statistical Noise Levels at Location B

Parameter	Statistic	Noise Levels dBA		
		Day	Evening	Night
L _{max}	Maximum	84	70	71
	Top 10%	64	59	60
	Average	59	55	54
	(Median)	58	55	53
	Bottom 10%	54	52	49
	Minimum	49	48	41
L ₁	Maximum	71	63	63
	Top 10%	60	53	52
	Average	54	51	49
	(Median)	53	51	49
	Bottom 10%	49	48	45
	Minimum	45	45	38
L ₁₀	Maximum	62	54	58
	Top 10%	55	50	49
	Average	50	48	45
	(Median)	50	48	45
	Bottom 10%	46	45	41
	Minimum	43	43	33
L _{eq}	Maximum	57	50	54
	Top 10%	53	48	47
	Average	49	46	42
	(Median)	48	46	42
	Bottom 10%	45	43	38

Parameter	Statistic	Noise Levels dBA		
		Day	Evening	Night
	Minimum	41	41	31
L ₉₀	Maximum	51	47	47
	Top 10%	48	45	44
	Average	45	42	37
	(Median)	46	43	37
	Bottom 10%	42	40	30
	Minimum	39	37	24

Table C.3 Statistical Noise Levels at Location C

Parameter	Statistic	Noise Levels dBA		
		Day	Evening	Night
L _{max}	Maximum	71	79	68
	Top 10%	60	57	58
	Average	54	50	49
	(Median)	53	49	48
	Bottom 10%	48	45	40
	Minimum	45	41	34
L ₁	Maximum	62	61	59
	Top 10%	53	50	49
	Average	49	45	42
	(Median)	49	45	42
	Bottom 10%	45	41	35
	Minimum	41	37	29
L ₁₀	Maximum	58	59	48
	Top 10%	49	46	45
	Average	45	41	35
	(Median)	45	41	34
	Bottom 10%	42	34	29
	Minimum	38	31	26
L _{eq}	Maximum	54	52	46
	Top 10%	46	45	42
	Average	43	38	33
	(Median)	43	37	32
	Bottom 10%	40	32	28
	Minimum	37	29	25
L ₉₀	Maximum	46	44	42
	Top 10%	43	38	37
	Average	40	32	28
	(Median)	40	31	26

Parameter	Statistic	Noise Levels dBA		
		Day	Evening	Night
	Bottom 10%	37	27	22
	Minimum	32	25	21

NPSR RTI DL Release

Appendix D Predicted Noise Contours and Receiver Locations

NPSR RTI DL Release

Receiver Locations

Job No. 7182

Location:
Mooloolah QLD

— Line source
▲ Point receiver

Length Scale 1:29528
0 125 250 500 750 1000
m



