APPENDIX L

Noise Assessment

FINAL REPORT

RTA Operations

Proposed Additional Crossing of the Clarence River at Grafton NSW - *Noise Assessment of Locality Options*

December 2003

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FINAL REPORT

RTA Operations

Proposed Additional Crossing of the Clarence River at Grafton NSW - *Noise Assessment of Locality Options*

December 2003

Reference: 0010401Noiserp3

For and on behalf of:
Environmental Resources Management Australia

Approved by: Murray Curtis

Signed: 

Position: Managing Principal

Date: 4 December 2003

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EXECUTIVE SUMMARY

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by RTA to investigate the selection of locality options for a proposed additional crossing of the Clarence River at Grafton, in terms of operational noise impacts. Noise impacts associated with construction of an additional crossing would be assessed at a later stage, as construction noise would be influenced by the concept design and construction techniques likely to be adopted.

Environmental noise levels were measured at the closest residences on the northern and southern sides of the existing Clarence River Bridge to ascertain the current level of traffic noise impacts with respect to relevant Department of Environment and Conservation (DEC) criteria. Traffic movements were also recorded in conjunction with noise monitoring to ensure direct correlation between traffic noise and volume. The measured traffic noise levels at the closest residences are currently below the appropriate DEC criteria by 2 dB(A).

To assess the future likely impact of road traffic noise associated with each of the proposed locality options, three basic parameters were chosen:

- number of residential properties potentially affected;
- future absolute noise level at each residence; and
- change in noise level (both increase and decrease) from the existing situation at each residence.

Through a qualitative analysis procedure, each of the proposed crossing localities were ranked in order according to prevalence of noise impacts on residential receivers. A representative value to enable comparison between each locality was determined by considering the three basic parameters chosen above in conjunction with the likely affects of absolute traffic noise level and of changes of traffic noise level on potential annoyance.

The following noise impact ranking in ascending order was concluded from the noise assessment:

1. **Locality 1** – provides the least noise impact, primarily because the proposed locality would mainly effect commercial properties north of the Clarence River and a low number of residents on the southern side adjacent to the Gwydir Highway. Predicted noise level changes associated with this option are as follows:

- weighted comparison value = 88
- traffic noise level increase over existing is in the order of 3dB(A); and
- nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.

2. **Locality 3 (upstream or downstream)** – provides minimal impact over the existing alignment, primarily because the existing traffic volume would be split equally over two bridges with total traffic noise generation being similar. However, some residents are likely to experience either an increase or decrease in received noise levels from being closer or further from traffic respectively. Assessment results associated with this option are as follows:

   - weighted comparison value = 110
   - traffic noise level increase over existing is in the order of 0 to 3dB(A); and
   - some residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.

3. **Locality 2** – this option impacts sensitive land use, that is a school and place of worship located either side of Villiers Street. Stringent DEC criteria for sensitive land use may significantly increase the difficulty for compliance. Assessment results associated with this option are as follows:

   - weighted comparison value = 407
   - traffic noise level increase over existing is in the order of 4dB(A); and
   - nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.

4. **Locality 7** – this option primarily impacts residential receptors that currently experience minimal existing traffic noise typical of a suburban local road network. Residents located near vacant rural land or the river frontage may have increased sensitivity to increased traffic noise. Assessment results associated with this option are as follows:

   - weighted comparison value = 2520
   - traffic noise level increase over existing is in the order of 11dB(A); and

- nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.

5. **Locality 5** – this option primarily impacts residential receptors that currently experience minimal existing traffic noise typical of a suburban local road network. Residents located near vacant rural land or the river frontage may have increased sensitivity to increased traffic noise. Assessment results associated with this option are as follows:

   - weighted comparison value = 3767
   - traffic noise level increase over existing is in the order of 10dB(A); and
   - nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.

6. **Locality 4** – this option primarily impacts residential receptors that currently experience minimal existing traffic noise typical of a suburban local road network. Residents located near vacant rural land or the river frontage may have increased sensitivity to increased traffic noise. Assessment results associated with this option are as follows:

   - weighted comparison value = 4274
   - traffic noise level increase over existing is in the order of 11dB(A); and
   - nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.

7. **Locality 6** – provides the greatest impact primarily because of a larger number of residential receptors that currently experience minimal existing traffic noise typical of a suburban local road network. This option also impacts sensitive land use, that is hospital wards located on Arthur Street. Assessment results associated with this option are as follows:

   - weighted comparison value = 4441
   - traffic noise level increase over existing is in the order of 12dB(A); and
   - nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.

All of the proposed localities, except for the existing locality (3), would reduce the received noise levels at residents located nearby the existing Clarence River Bridge; this is due to a portion of traffic using the second river crossing.

Localities 4, 5, 6 and 7 would generate the greatest potential impact due to affecting a larger number of residents further from the existing locality thereby being subjected to a greater change in absolute traffic noise level.

1 INTRODUCTION

1.1 BACKGROUND

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by RTA to investigate proposed locality options for an additional crossing of the Clarence River at Grafton, in terms of operational noise impacts.

This report details the operational noise assessment of the seven proposed locality options for an additional crossing. The objectives of the assessment are to:

- determine relevant traffic noise criteria;
- form a qualitative comparison of operational noise impacts associated with each proposed locality option; and
- rank each locality option in terms of the least to greatest operational noise impact.

1.2 DESCRIPTION OF LOCALITY OPTIONS

Table 1.1 presents descriptions of the proposed locality options.

Table 1.1 Description of locality Options

Locality Option	South End	North End
1	From Gwydir Highway to River via rural land crossing river via Susan Island	Direct onto Prince Street Crossing Victoria meeting Fitzroy
2	From Gwydir Highway in the vicinity of Abbot Street Kennedy Street Bank Street	Direct onto Villiers Street (School and Convent on either side of road) Crossing Victoria meeting Fitzroy
3	merge with existing route on Bent Street access	Merge with existing Fitzroy Street or Craig Street
4	From Pacific Highway to River via rural land	Crossing McHugh Street crossing Breimba Street crossing Bromley / Sutton Street crossing Kent Street crossing Clarence Street meeting Villiers Street

Locality Option	South End	North End
5	From Pacific Highway to River via rural land	Crossing McHugh Street crossing Breimba Street crossing Kent Street Dobie and Waratah Place crossing Clarence Street Dobie and Weiley Ave meeting Villiers Street
6	From Pacific Highway to River via rural land	Crossing Villiers Street crossing Chapman Street crossing Prince Street crossing Queen Street crossing Mary Street (vicinity of the hospital and Gaol) Arthur and Richards Lane crossing Alice Street meeting Turf Street
7	From Pacific Highway in the vicinity of Centenary Drive to River via rural land Crossing River via Elizabeth Island	Crossing Duke Street crossing Morrison Street crossing Challinor Street crossing Queen Street crossing Mary Street crossing Alice Street crossing Davey Ave x 2 meeting Richmond Road

Figure 1.1 also provides a graphical representation of the proposed locality options.

1.3 GLOSSARY

Technical terms used in this report are consistent with the definitions of Australian Standard AS1633 and are also defined in the glossary of this report in *Annex A*.

0010401

ERM

0 500m

Approximate only

Figure 1.1 Aerial Photograph Showing Locality Options

Proposed Additional Crossing of Clarence River at Grafton NSW
RTA Operations

2 TRAFFIC NOISE

2.1 CRITERIA

The DEC (former EPA) recommends that traffic noise impacts on potentially affected residences be assessed according to the EPA's *Environmental Criteria for Road Traffic Noise (ECRTN)* (1999).

The DEC's criteria is defined in terms of $L_{Aeq,\ T(hr)}$, which represent the continuous equivalent sound pressure level at a receiving location, measured over a specific time period (T) between 7 am to 10 pm (daytime) and between 10 pm to 7 am (night time). For the level of traffic noise to be considered acceptable, the relevant criteria in terms of $L_{Aeq,\ T(hr)}$ should be met for both day and night.

Residents that experience little or no traffic noise are likely to be more affected by traffic noise on a new road alignment than those residents that experience some road traffic noise where noise from traffic on a realigned or upgraded road may make little or no change. This requires road sections within each locality option to be categorised according to relevant DEC classifications, rather than a single classification for the whole route.

ECRTN classifies roads according to the functional categories applied by the RTA. The RTA differentiates roads by a range of factors, including traffic volume, heavy vehicle use, through or local traffic, vehicle speeds and applicable traffic management options. ECRTN also recognises that in some cases there will be extra noise sensitivities, for example, places of worship and schools, where more stringent standards are expected.

2.1.1 Locality Option 1

Table 2.1 presents the relevant criteria for the proposed locality option 1.

Table 2.1 Locality Option 1 - Road Traffic Noise Criteria

Road Section	Type of Development	Criteria - Day 7 am - 10 pm	Criteria - Night 10 pm - 7 am
Prince Street	Redevelopment of existing freeway / arterial road	$L_{Aeq\ (15hr)}$ of 60dB(A)	$L_{Aeq\ (9hr)}$ of 55dB(A)
From Gwydir Highway to River via rural land crossing river via Susan	New freeway or arterial road corridor	$L_{Aeq\ (15hr)}$ of 55dB(A)	$L_{Aeq\ (9hr)}$ of 50dB(A)

Road Section	Type of Development	Criteria - Day 7 am - 10 pm	Criteria - Night 10 pm - 7 am
Island			

Notes: 1. Source: EPA Environmental Criteria for Road Traffic Noise (1999).

2.1.2 Locality Option 2

Table 2.2 and *Table 2.3* presents the relevant traffic noise criteria for the proposed locality option 2.

Table 2.2 Locality Option 2 - Road Traffic Noise Criteria

Road Section	Type of Development	Criteria - Day 7 am - 10 pm	Criteria - Night 10 pm - 7 am
Villiers Street	Redevelopment of existing freeway / arterial road	$L_{Aeq\ (15hr)}$ of 60dB(A)	$L_{Aeq\ (9hr)}$ of 55dB(A)
From Gwydir Highway in the vicinity of Abbot Street	Redevelopment of existing local roads [2]	$L_{Aeq\ (1hr)}$ of 55dB(A)	$L_{Aeq\ (1hr)}$ of 50dB(A)

Notes: 1. Source: EPA Environmental Criteria for Road Traffic Noise (1999).

2. In consideration of the future functional category of the road, this classification may not be appropriate.

Table 2.3 Locality Option 2 - Road Traffic Noise Criteria for Sensitive Land Uses

Road Section	Sensitive Land Use	Criteria - Day 7 am - 10 pm	Criteria - Night 10 pm - 7 am
Villiers Street	Proposed school classrooms	$L_{Aeq(1hr)}$ of 40dB(A) (internal)	-
Villiers Street	Existing Schools	$L_{Aeq(1hr)}$ of 45dB(A) (internal)	-
Villiers Street	Places of worship	$L_{Aeq(1hr)}$ of 40dB(A) (internal)	$L_{Aeq(1hr)}$ of 40dB(A) (internal)
Villiers Street	Passive Recreation and school playgrounds	Collector and local roads: $L_{Aeq(1hr)}$ of	-

Road Section	Sensitive Land Use	Criteria - Day 7 am - 10 pm	Criteria - Night 10 pm - 7 am
		55dB(A) Freeway / arterial roads: $L_{Aeq(15hr)}$ of 55dB(A)	

Notes: 1. Source: EPA Environmental Criteria for Road Traffic Noise (1999).

2.1.3 Locality Option 3

Table 2.4 presents the relevant criteria for the proposed locality option 3.

Table 2.4 Locality Option 3 - Road Traffic Noise Criteria

Road Section	Type of Development	Criteria - Day 7 am - 10 pm	Criteria - Night 10 pm - 7 am
Merge with either existing Fitzroy Street or Craig Street	Redevelopment of existing freeway / arterial road	$L_{Aeq\ (15hr)}$ of 60dB(A)	$L_{Aeq\ (9hr)}$ of 55dB(A)
Merge with existing route on Bent Street	Redevelopment of existing freeway / arterial road	$L_{Aeq\ (15hr)}$ of 60dB(A)	$L_{Aeq\ (9hr)}$ of 55dB(A)

Notes: 1. Source: EPA Environmental Criteria for Road Traffic Noise (1999).

2.1.4 Locality Option 4

Table 2.5 presents the relevant criteria for the proposed locality option 4.

Table 2.5 Locality Option 4 - Road Traffic Noise Criteria

Road Section	Type of Development	Criteria - Day 7 am - 10 pm	Criteria - Night 10 pm - 7 am
Pound / Bacon / Oliver Street	Redevelopment of existing local roads [2]	$L_{Aeq\ (1hr)}$ of 55dB(A)	$L_{Aeq\ (1hr)}$ of 50dB(A)
From Pacific Highway to River via rural land	New freeway or arterial road corridor	$L_{Aeq\ (15hr)}$ of 55dB(A)	$L_{Aeq\ (9hr)}$ of 50dB(A)

Notes: 1. Source: EPA Environmental Criteria for Road Traffic Noise (1999).

2. In consideration of the future functional category of the road, this classification may not be appropriate.

2.1.5 Locality Option 5

Table 2.6 presents the relevant criteria for the proposed locality option 5.

Table 2.6 Locality Option 5 - Road Traffic Noise Criteria

Road Section	Type of Development	Criteria - Day 7 am - 10 pm	Criteria - Night 10 pm - 7 am
Fry / Dobie / Powell Street	Redevelopment of existing local roads [2]	$L_{Aeq\ (1hr)}$ of 55dB(A)	$L_{Aeq\ (1hr)}$ of 50dB(A)
From Pacific Highway to River via rural land	New freeway or arterial road corridor	$L_{Aeq\ (15hr)}$ of 55dB(A)	$L_{Aeq\ (9hr)}$ of 50dB(A)

Notes: 1. Source: EPA Environmental Criteria for Road Traffic Noise (1999).

2. In consideration of the future functional category of the road, this classification may not be appropriate.

2.1.6 Locality Option 6

Table 2.7 and *Table 2.8* presents the relevant criteria for the proposed locality option 6.

Table 2.7 Locality Option 6 - Road Traffic Noise Criteria

Road Section	Type of Development	Criteria - Day 7 am - 10 pm	Criteria - Night 10 pm - 7 am
Arthur Street vicinity	Redevelopment of existing collector road	$L_{Aeq\ (1hr)}$ of 60dB(A)	$L_{Aeq\ (1hr)}$ of 55dB(A)
From Pacific Highway to River via rural land and crossing river to Arthur Street vicinity	New freeway or arterial road corridor	$L_{Aeq\ (15hr)}$ of 55dB(A)	$L_{Aeq\ (9hr)}$ of 50dB(A)

Notes: 1. Source: EPA Environmental Criteria for Road Traffic Noise (1999).

Table 2.8 Locality Option 6 - Road Traffic Noise Criteria for Sensitive Land Uses

Road Section	Sensitive Land Use	Criteria - Day 7 am - 10 pm	Criteria - Night 10 pm - 7 am
Arthur Street vicinity	Hospital Wards	$L_{Aeq(1hr)}$ of 35dB(A) (internal)	$L_{Aeq(1hr)}$ of 35dB(A) (internal)

Notes: 1. Source: EPA Environmental Criteria for Road Traffic Noise (1999).

2.1.7 Locality Option 7

Table 2.9 presents the relevant criteria for the proposed locality option 7.

Table 2.9 Locality Option 7 - Road Traffic Noise Criteria

Road Section	Type of Development	Criteria - Day 7 am - 10 pm	Criteria - Night 10 pm - 7 am
North Street vicinity	Redevelopment of existing collector road	$L_{Aeq\ (1hr)}$ of 60dB(A)	$L_{Aeq\ (1hr)}$ of 55dB(A)
From Pacific Highway to River via rural land and crossing river to North Street	New freeway or arterial road corridor	$L_{Aeq\ (15hr)}$ of 55dB(A)	$L_{Aeq\ (9hr)}$ of 50dB(A)

Notes: 1. Source: EPA Environmental Criteria for Road Traffic Noise (1999).

In relation to residents affected by road traffic noise in areas where these criteria are already exceeded, ECRTN recommends that:

- where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria;
- in all cases, traffic arising from the redevelopment should be designed so as not to increase existing noise levels by more than 2 dB; and
- the new road should be designed so as not to increase existing noise levels by more than 0.5 dB.

If the existing traffic noise levels are either below the criteria but within 2 dB, or exceed the criteria, then a 2 dB allowance may be applied in addition to the criteria. The same approach applies to a new road corridor where a 0.5 dB allowance is assigned.

However all feasible and reasonable noise mitigation is recommended to be considered prior to this. Where the predicted traffic noise levels are greater than 2 dB over existing noise levels although below the relevant criterion, the traffic noise attributable to the road development may be considered acceptable.

In relation to traffic noise impacting upon sensitive land use, ECRTN recommends that:

- to achieve internal noise criteria in the short-term, the most practicable mitigation measures are often related to building or facade treatments;

- in the medium to longer term, strategies such as regulation of exhaust noise from in-service vehicles, limitations on exhaust brake use, and restricting access for sensitive areas or sensitive times to low noise vehicles can be applied to mitigate noise impacts across the road system; and

- where existing levels of traffic noise exceed the criteria, all feasible and reasonable noise control measures should be evaluated and applied. Where this has been done and the internal or external criteria (as appropriate) cannot be achieved, the proposed road should be designed so as not to increase existing road traffic noise levels by more than 0.5 dB for new roads and 2 dB for redeveloped roads.

2.2 EXISTING BRIDGE TRAFFIC NOISE - LOCALITY 3

2.2.1 Noise Monitoring

The following equipment was used to measure and log environmental noise levels within the vicinity of the Clarence River Bridge.

- (2x) ARL EL215 noise data logger; and

- Bruel and Kjaer Type 423 sound level calibrator.

Existing background noise levels were measured using two noise data loggers from 15th to 23rd September 2003 at the closest residences on the northern and southern sides of the Clarence River, upstream of the existing bridge within locality option 3. The microphone position was located one metre from the residential facade most exposed to traffic noise for correlation with ECRTN. The logger locations are shown on *Figure 2.1*.

The assessment background level (ABL) for each day, evening and night period is determined by using the tenth percentile method. In other terms, the ABL is "the L_{90} of the L_{90}'s" over each day, evening and night period. The rating background level (RBL), used to establish the local noise criteria, is defined as the median assessment background level over all days for each period.

Table 2.10 and *Table 2.11* present the measured assessment background levels (ABL) and ambient noise levels $L_{Aeq, 15hr}$ and $L_{Aeq, 9hr}$ for the northern and southern residences respectively.

Table 2.10 Measured Noise Levels - North Side of Clarence River (upstream)

Date	ABL Day	ABL Evening	ABL Night	LAeq 15hr Day	LAeq 9hr Night
Monday, 15-09-03	-	41.0	29.5	-	51.2
Tuesday, 16-09-03	51.5	40.0	30.0	60.1	51.6
Wednesday, 17-09-03	51.5	39.0	31.5	56.4	51.7
Thursday, 18-09-03	49.5	44.5	33.0	56.6	52.3
Friday, 19-09-03	50.5	45.0	34.0	56.5	51.5
Saturday, 20-09-03	49.0	43.0	29.5	55.3	50.4
Sunday, 21-09-03	44.5	37.0	28.5	55.0	51.2
Monday, 22-09-03	50.5	46.0	31.0	57.1	51.7
Tuesday, 23-09-03	50.0	43.5	-	56.5	-
Summary Values	**50.3** [2]	**43.0** [2]	**30.5** [2]	**57.0** [3]	**51.5** [3]

1. Day: 7:00 to 18:00 ~ Evening: 18:00 to 22:00 ~ Night: 22:00 to 7:00.
2. Rating Background Level (RBL).
3. Median ambient noise level over all days for each period.

Table 2.11 Measured Noise Levels - South Side of Clarence River (upstream)

Date	ABL Day	ABL Evening	ABL Night	$L_{eq\ 15hr}$ Day	L_{eq9hr} Night
Monday, 15-09-03	-	45.0	30.0	-	52.9
Tuesday, 16-09-03	52.0	44.0	30.0	56.8	53.5
Wednesday, 17-09-03	52.5	43.0	33.0	56.5	53.7
Thursday, 18-09-03	51.5	47.5	35.0	56.5	53.7
Friday, 19-09-03	52.0	48.0	36.5	56.7	53.3
Saturday, 20-09-03	50.5	44.5	29.5	57.5	51.7
Sunday, 21-09-03	48.0	42.0	29.5	59.7	52.6
Monday, 22-09-03	53.0	44.0	33.5	57.3	53.7
Tuesday, 23-09-03	51.0	44.5	36.0	57.1	54.2
Summary Values	**51.8** [2]	**44.5** [2]	**33** [2]	**57.4** [3]	**53.3** [3]

1. Day: 7:00 to 18:00 ~ Evening: 18:00 to 22:00 ~ Night: 22:00 to 7:00.
2. Rating Background Level (RBL).
3. Median ambient noise level over all days for each period.

ERM

0 100m

Approximate only

Figure 2.1 **Noise Logger Locations**

Clarence River Bridge, Grafton - Noise Assessment

The graphed daily results for both monitoring sites are presented in *Annex B.*

Table 2.12 provides comparison between the measured traffic noise levels and appropriate DEC criteria, which in this case (locality 3) is redevelopment of an existing arterial road.

Table 2.12 Measured Traffic Noise Levels Versus DEC Criteria

Residential Receptor	Measured Day dB(A)	Criteria Day dB(A)	Criteria Exceedance dB	Measured Night dB(A)	Criteria Night dB(A)	Criteria Exceedance[6]
	$L_{Aeq,15hr}$	$L_{Aeq,15hr}$		$L_{Aeq,9hr}$	$L_{Aeq,9hr}$	
North	57.0	60.0	- 3.0	51.5	55.0	- 3.5
South	57.4	60.0	- 2.6	53.3	55.0	- 1.7

1. $L_{Aeq, T(hr)}$ represents the continuous equivalent sound pressure level at a receiving location for the traffic volume between the 15-hour period from 7 am to 10 pm and the 9-hour period from 10 pm to 7 am.

Table 2.12 shows the measured $L_{Aeq,15hr}$ and $L_{Aeq,9hr}$ traffic noise levels at both residences to be within the relevant DEC criteria by approximately 2 to 3dB.

2.2.2 Traffic Count Monitoring

Traffic movements were also recorded in conjunction with the noise monitoring to ensure direct correlation between traffic noise and volume, and are summarised in *Table 2.13*.

Table 2.13 Clarence River Bridge Traffic Counts

Period	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages	
	15 Sep 2003	16 Sep 2003	17 Sep 2003	18 Sep 2003	19 Sep 2003	20 Sep 2003	21 Sep 2003	5-Day	7-Day
15Hr [1]	24074	24784	25050	26692	27667	20018	15687	25653	23425
9Hr [2]	1712	1813	1697	1818	2156	1874	1230	2460	1757
24Hr	25786	26597	26747	28510	29823	21892	16917	27493	25182

1. ECRTN day period is 7:00am to 10:00pm.
2. ECRTN night period is 10:00pm to 7:00am.

Table 2.13 indicates weekday traffic to be relatively consistent with a significant reduction of traffic volume on the weekend, particularly Sunday with a drop of approximately 10,000 vpd from weekday average. Comparison with the measured noise levels in *Section 2.2.1* indicates a

reduction of weekend ABL's (background noise) by 2 to 4 dB, and $L_{Aeq, T (hr)}$ traffic noise levels by 1 to 2 dB.

Table 2.13 also indicates that 93% of traffic movements occur during the day period with only 7% of traffic movements occurring during the night period.

2.3 TRAFFIC LOCALITY OPTIONS ANALYSIS

The following procedure has been adopted from a technical article prepared by Neil Gross (Wilkinson Murray Pty Limited) and modified by ERM to provide a more realistic comparison in light of traffic assignment information for each proposed locality option.

To assess the future likely impact of road traffic noise associated with each of the proposed locality options, three basic parameters are chosen:

- number of residential properties potentially affected;
- future absolute noise level at each residence; and
- change in noise level (both increase and decrease) from the existing situation at each residence.

The procedure used to assess the proposed locality options, in consideration of the above parameters, is described as follows:

- the number of approximate residences along each locality option within different distance categories from the proposed locality is determined ie. 0-50m, 50-100m, 100-200m and 200-300m. The first distance category realistically deals with residences within 25 to 50 metres from the road. The move from one distance category to the next typically represents equal changes in traffic noise level;
- for each locality option for each residence, the distance from the existing Clarence River Bridge (locality 3) in relation to the distance from the proposed locality is determined;
- applicable weightings for each residence are then selected by using a paired comparison procedure in conjunction with the likely affects of absolute traffic noise level and of changes of traffic noise level on potential annoyance. The weightings range from 0.4 to 6.4 and have been selected starting with a weighting of 1. This represents the situation where there is no change in noise level at a residence set back 200 to 300 metres from the existing road. If noise levels are higher (residences are closer) or increases are bigger, a weighting greater than 1

needs to be applied since it would represent a greater impact. Similarly if noise levels were to reduce a weighting less than 1 needs to be applied. However for the same change in noise level either up or down, the procedure recognises that the increase is perceived to be worse than the decrease. Since a 10 dB(A) increase in noise level is widely accepted to be a subjective doubling in noise, this has been used to set the weightings by comparing the different distance categories. The weightings have then been refined by comparing different situations and deciding which would be better or worse;

- the totalled number of properties within each distance category is multiplied by the appropriate weighting and then summed together to provide a weighted grand total (WGT) for each locality ; and

- the weighted grand total assumes similar traffic volumes for each proposed locality option, therefore a further weighting is applied to realistically reflect the decibel increase perceptible by humans from the envisaged traffic assignment for each of the alternative crossing localities. A change in sound pressure level by two to three decibels is barely perceptible by humans under field conditions, hence the weighting is simply derived by dividing the likely increase in traffic noise by human perception (3 dB), as expressed in the following formula:

  Weighted Comparison Value (WCV) = WGT x $[(10Log_{10}(V_2 \div V_1)) \div 3]$

  Where:

  WGT = Weighted Grand Total

  V_2 = existing traffic + future traffic volume (vpd)

  V_1 = existing traffic volume (vpd)

2.3.1 Results

Table 2.14 provides a summary of results allowing comparison between the envisaged traffic assignment and likely absolute traffic noise increase for each route.

The lowest property total corresponds to the route that affects the least number of residents and the lowest weighted comparison value corresponds to the route with the least impact.

The tabulated analysis for each of the locality options is included in *Annex C* for reference.

Table 2.14 Locality Options Comparison

Locality	1 Prince Street Locality	2 Villiers Street Locality	3 Existing Locality	4 Bacon Street Locality	5 Dobie Street Locality	6 Arthur Street Locality	7 North Street Locality
Cars (vpd)	9346	10031	23588	5173	4556	3787	2686
Buses (vpd)	107	143	258	79	74	64	53
Light Commercial (vpd)	317	344	800	238	237	241	157
Heavy Commercial (vpd)	99	212	354	155	154	133	113
TOTAL (vpd)	9869	10730	25000	5645	5021	4225	3009
Traffic Assignment Percentage [3]	39.5%	42.9%	100.0%	22.6%	20.1%	16.9%	12.0%
Existing daily traffic volume	11334	6849	25000	500 [2]	500 [2]	300 [2]	300 [2]
Property Total [4]	31	93	83	358	324	369	207
Weighted Grand Total [5]	97	298	110	1177	1083	1130	725
Traffic Noise Increase dB(A)	2.7	4.1	0.0	10.9	10.4	11.8	10.4
Weighted Comparison Value [6]	**88**	**407**	**110**	**4274**	**3767**	**4441**	**2520**

1. Vehicles per day (vpd) information provided by RoadNet.
2. Relevant traffic count information not available, conservative vpd is assumed.
3. Traffic Assignment Percentage = the percentage portion of traffic to use the second river crossing rather than the existing bridge (3) eg. locality 1 = 9869 vpd or 39.5% of 25000 vpd.
4. Property Total = approximate residential receptor counts within 300 metres of the proposed route for each locality based upon a visual count of the information contained in the Grafton aerial photograph taken 15/8/2000 (600dpi version).
5. Weighted Grand Total = the totalled number of properties within each distance category multiplied by the appropriate weighting and then summed together for each locality.
6. Weighted Comparison Value = Weighted Grand Total x $[(10Log_{10}(V_2 \div V_1)) \div 3]$.

Table 2.14 clearly shows that the locality options closest to the existing bridge provide the least noise impact to Grafton residents, namely locality options 1 to 3.

For locality options 4 to 7, the residential receptor count is significantly higher while existing traffic volumes are significantly lower. These proposed locality options are conducive to a significantly greater noise impact upon locally affected residents. This is reflected by the large increase in received

traffic noise and weighted comparison values being significantly higher than localities 1 to 3.

Table 2.14 also indicates that the proposed locality options 4 to 7 would experience a greater percentage of heavy vehicles in relation to the total assigned traffic volume (ie. assuming currently experiencing negligible heavy vehicle traffic). Heavy vehicles are likely to significantly increase residential noise annoyance, including potential sleep arousal during night traffic movements.

2.4 PREDICTED TRAFFIC NOISE LEVELS

To determine the likely requirement of noise mitigation measures for each of the proposed locality options during operation, indicative traffic noise levels have been predicted using the DEC approved 'Calculation of Road Traffic Noise' (CoRTN) model.

The CoRTN method was devised by the UK Department of Transport and last updated in 1988. With suitable corrections, this method has been shown to give accurate predictions of traffic noise levels under Australian conditions.

Source heights of 0.5 metres, 1.5 metres and 3.6 metres were used for cars, heavy vehicles and heavy vehicle exhausts respectively. A dense graded asphalt road surface was assumed and corrections for facade effects in accordance with the ECRTN were incorporated in the model.

The CoRTN method predicts noise levels in terms of the L_{10} level. L_{eq} was then calculated by subtracting 3 dB from the L_{10} level. This is a standard correction, which is accurate under typical traffic conditions.

At this early stage, a less exhaustive modelling approach for each proposed locality option has been adopted to obtain an indicative understanding of the likely received traffic noise at nominated distances from the road alignment.

2.4.1 Results

Table 2.15 provides an indication of the likely traffic noise received by the closest residences during the day without noise mitigation.

Table 2.15 Predicted Daytime Traffic Noise Levels for Each Locality Option

	1	2	3	4	5	6	7
	Prince St Locality	**Villiers St Locality**	**Existing Locality**	**Bacon St Locality**	**Dobie St Locality**	**Arthur St Locality**	**North St Locality**
Total Vehicles (vph)	1272	1055	3000	369	331	272	199
Heavy Vehicles (%)	5%	7%	6%	8%	9%	10%	11%
Vehicle Speed (km/h)	60	60	60	60	60	60	60
Distance (m)	**Predicted Traffic Noise Level $L_{Aeq, 15hr}$ (dB(A))**						
10	68	68	62	64	64	63	62
20	65	65	59	61	61	60	59
30	62	63	57	59	59	58	57
40	61	62	56	57	57	57	55
50	60	61	55	56	56	56	54

1. Predicted noise levels do not account for noise shielding and are approximate only.
2. Vehicles per hour (vph) derived using 90 percent of the vehicles per day (vpd) from *Table 2.14* divided by 15 (ie. Day = 15 hr period).

DEC traffic noise criteria for day time is either 55 or 60 dB(A) $L_{Aeq, T}$ (refer *Section 2.1*) depending on the type of road development. *Table 2.15* shows that received traffic noise levels range from 55 to greater than 60 dB(A) L_{Aeq} as receptor distance from the traffic reduces from 50 to 10 metres.

3 CONCLUSION

The following noise impact ranking in ascending order was concluded from the noise assessment:

1. **Locality 1** – provides the least noise impact, primarily because the proposed locality would mainly effect commercial properties north of the Clarence River and a low number of residents on the southern side adjacent to the Gwydir Highway. Predicted noise level changes associated with this option are as follows:

   - weighted comparison value = 88
   - traffic noise level increase over existing is in the order of 3dB(A); and
   - nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.

2. **Locality 3 (upstream or downstream)** – provides minimal impact over the existing alignment, primarily because the existing traffic volume would be split equally over two bridges with total traffic noise generation being similar. However, some residents are likely to experience either an increase or decrease in received noise levels from being closer or further from traffic respectively. Assessment results associated with this option are as follows:

   - weighted comparison value = 110
   - traffic noise level increase over existing is in the order of 0 to 3dB(A); and
   - some residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.

3. **Locality 2** – this option impacts sensitive land use, that is a school and place of worship located either side of Villiers Street. Stringent DEC criteria for sensitive land use may significantly increase the difficulty for compliance. Assessment results associated with this option are as follows:

   - weighted comparison value = 407
   - traffic noise level increase over existing is in the order of 4dB(A); and
   - nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.

4. **Locality 7** – this option primarily impacts residential receptors that currently experience minimal existing traffic noise typical of a suburban local road network. Residents located near vacant rural land or the river frontage may have increased sensitivity to increased traffic noise. Assessment results associated with this option are as follows:

   - weighted comparison value = 2520
   - traffic noise level increase over existing is in the order of 11dB(A); and
   - nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.

5. **Locality 5** – this option primarily impacts residential receptors that currently experience minimal existing traffic noise typical of a suburban local road network. Residents located near vacant rural land or the river frontage may have increased sensitivity to increased traffic noise. Assessment results associated with this option are as follows:

   - weighted comparison value = 3767
   - traffic noise level increase over existing is in the order of 10dB(A); and
   - nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.

6. **Locality 4** – this option primarily impacts residential receptors that currently experience minimal existing traffic noise typical of a suburban local road network. Residents located near vacant rural land or the river frontage may have increased sensitivity to increased traffic noise. Assessment results associated with this option are as follows:

   - weighted comparison value = 4274
   - traffic noise level increase over existing is in the order of 11dB(A); and
   - nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.

7. **Locality 6** – provides the greatest impact primarily because of a larger number of residential receptors that currently experience minimal existing traffic noise typical of a suburban local road network. This option also impacts sensitive land use, that is hospital wards located on Arthur Street. Assessment results associated with this option are as follows:

    - weighted comparison value = 4441
    - traffic noise level increase over existing is in the order of 12dB(A); and
    - nearest residents are likely to experience traffic noise levels over relevant DEC criteria without appropriate mitigation.

All of the proposed localities, except for the existing locality (3), would reduce the received noise levels at residents located nearby the existing Clarence River Bridge; this is due to a portion of traffic using the second river crossing.

Localities 4, 5, 6 and 7 would generate the greatest potential impact due to affecting a larger number of residents further from the existing locality thereby being subjected to a greater change in absolute traffic noise level.

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Gross N. (Wilkinson Murray Pty Ltd*), Road Traffic Noise – The Selection of a Preferred Route,* Acoustics Australia Vol. 30 (2002) No. 3 – 115.

NSW Environmental Protection Authority (EPA)(1999), *Environmental Criteria for Road Traffic Noise*, prepared by Environmental Policy Branch Noise Policy Section.

NSW Environmental Protection Authority (EPA)(1994), *Environmental Noise Control Manual.*

Roads and Traffic Authority (RTA)(2001), *Environmental Noise Management Manual,* developed by J. Campbell and S. Isles of the RTA Environment and Community Policy Branch.

Annex A

Glossary of Acoustic Terminology

ABBREVIATIONS:

EPA - The Environmental Protection Authority of New South Wales

ENCM - The EPA's Environmental Noise Control Manual (1994)

INP - The EPA's Industrial Noise Policy (2000)

ECRTN - The EPA's Environmental Criteria for Road Traffic Noise Policy (1999)

CoRTN - The Calculation of Road Traffic Noise algorithm

THE DECIBEL SCALE (UNITS OF NOISE):

dB or decibel – Unit of relative noise level. Audible sound pressure varies across a range of 10^7Pa from the threshold of hearing (20μPa) to the threshold of pain (200Pa). In order to express noise with more manageable numbers, a logarithmic scale called Decibels is commonly used.

dB(A) – The decibel scale can have a number of weighting filters applied to it, the most common being the A-weighting filter. The purpose of the filter is to apply weighting adjustments over the frequency range of human hearing so that measured levels better match perceived levels. The (A) denotes the use of this filter.

dB(LinPeak) - Units indicating the peak sound pressure level (not RMS) expressed as decibels with no frequency weighting.

The following points give an indication of what the noise levels and differences represent in terms of perception, to an average person:

- 0 dB represents the threshold of human hearing (for a young person with ears in good condition).
- 140 dB represents the threshold of pain.
- noise level differences of less than 2 dB are generally imperceptible;
- differences of around 5 dB are usually significant; and
- an increase or decrease of around 10 dB appears to double or halve the loudness of a noise.

ENVIRONMENTAL NOISE DESCRIPTORS

Noise from environmental sources such as vehicles often varies with time. For this reason, noise emission from such sources is often described in terms of statistical noise descriptors. The following descriptors are commonly used to assess noise exposure:

SPL or L_{AF} – The level of sound pressure as determined by a sound level meter complying with AS1259. The frequency-weighting is specified (A) and the time-weighting is assumed to be Fast (F) if not specified.

L_{10}, the noise level that is exceeded for 10 per cent of the time and is approximately the average of the maximum noise levels;

L_{90}, the noise level exceeded for 90 per cent of the time and is approximately the average of the minimum noise levels. The L_{90} level is often referred to as the "background" noise level and is commonly used as a basis for determining noise criteria for assessment purposes;

L_{eq} is the continuous sound pressure level that embodies the equivalent sound energy as the fluctuating source measured, over the same time period. L_{eq} noise levels are often quoted with the time averaging period specified, for example: $L_{eq,1hr}$.

L_{max} - The absolute maximum noise level in a noise sample.

SEL – Sound Exposure Level. The constant sound pressure level that if maintained for one second, would deliver the same total sound energy as the original source. It is usually used to describe discrete noise events. It is similar in function to L_{eq} and can be used to calculate the L_{eq} arising from multiple occurrences of discrete events, over any time period.

L_w or SWL – Sound Power Level – This is a measure of the total power radiated by a source. The Sound Power of a source is a fundamental property of the source and is independent of the surrounding environment.

Octave Band – Noise related effects including perception and attenuation with distance are dependent on the frequency of the noise (among other factors). Standard frequency bands have been mathematically defined to assist in analysis of the frequency content of sounds. Each band is commonly referred to by its centre frequency value. Since the centre frequency doubles from band to band, the bands are collectively referred to as Octave Bands. Sometimes a more refined analysis of frequency content is

desired, and in those cases bands one-third the width of the standard Octave Bands are used - these are referred to as One-third Octave Bands.

ABL - The Assessment Background Level is the lowest tenth percentile value of the L_{90} levels measured for each day/evening/night assessment period of the monitoring cycle, and

RBL - The Rating Background Level is defined as the overall single value representative background noise level for each of the day, evening and night periods respectively. The RBL is calculated as the median value of the corresponding ABL's (eg. for each night period of the monitoring cycle). RBL's account for temporal variation of background noise and are used in determining the intrusiveness criterion for industrial noise.

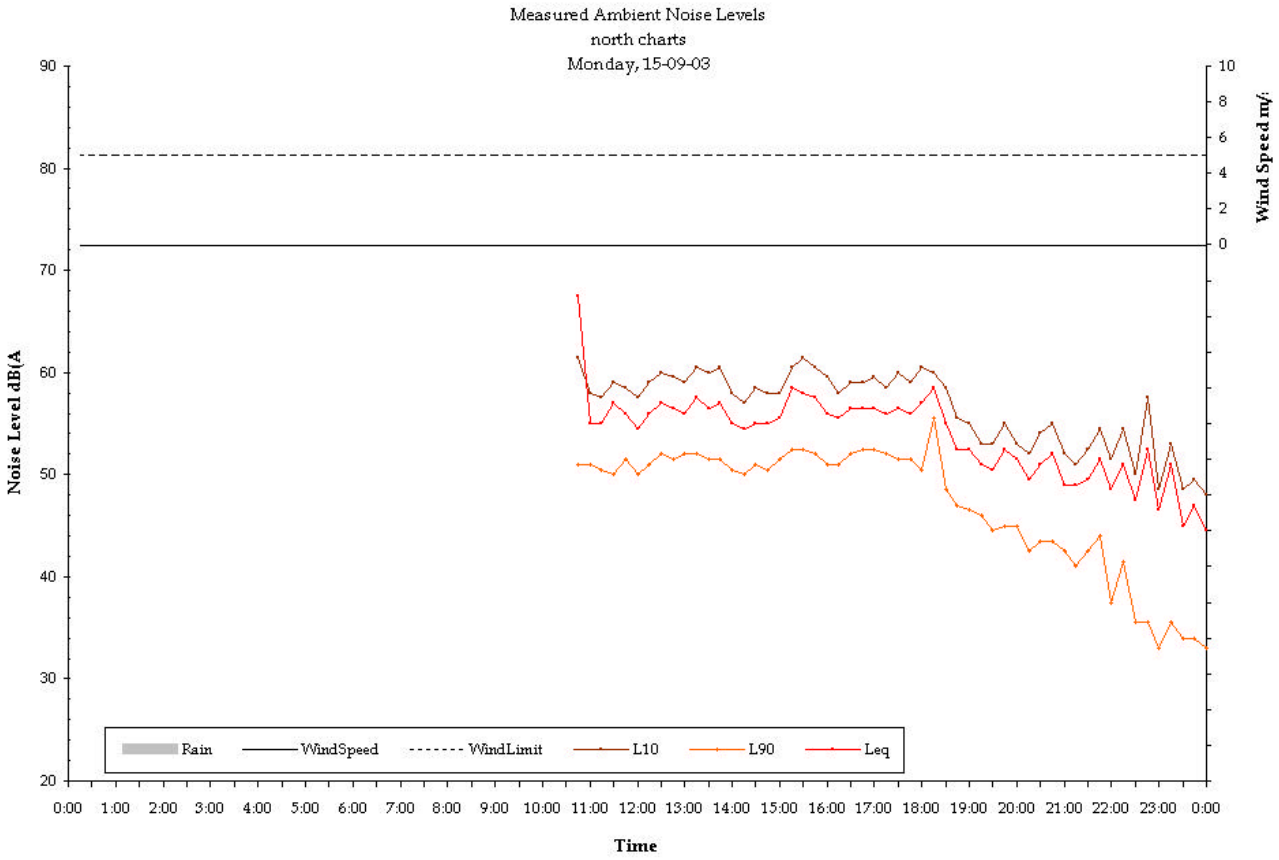
ASSESSMENT PERIODS

For industrial noise there are three assessment periods – Day/Evening/Night. **Day** is the time period from 7:00 am to 6:00 pm (Monday to Saturday) or 8:00 am to 6:00 pm on Sundays and public holidays. **Evening** is the time period from 6:00 pm to 10:00 pm. **Night** is the time period from 10:00 pm to 7:00 am (Monday to Saturday) or 10:00 pm to 8:00 am on Sundays and public holidays.

For road traffic noise in NSW the EPA defines two assessment periods - Day and Night. **Day** is the time period from 7:00 am to 10:00 pm. Daytime noise descriptors often carry the 15hr identifier - eg. $L_{eq,15hr}$. **Night** is the time period from 10:00 pm to 7:00 am. Night time noise descriptors often carry the 9hr identifier - eg. $L_{eq,9hr}$.

Annex B

Graphed Logger Results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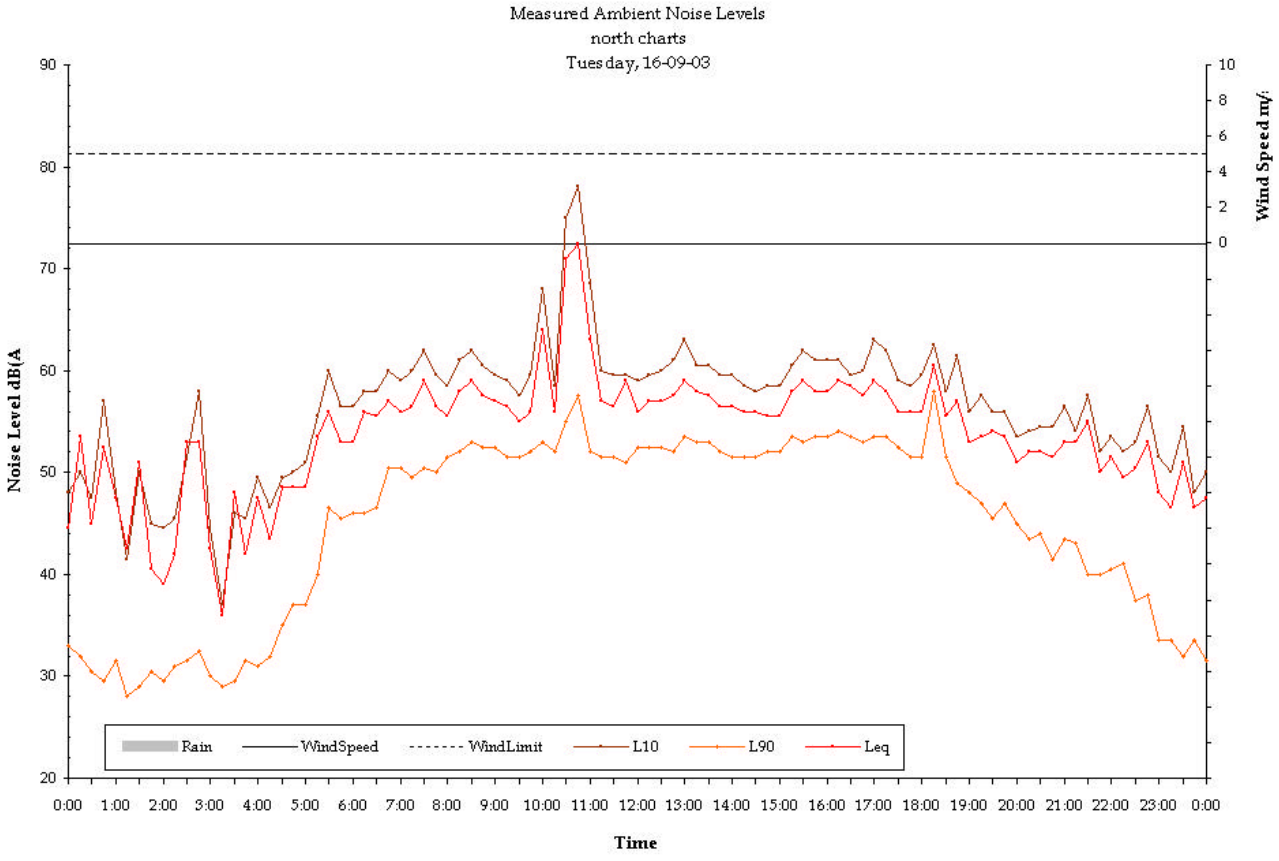
Noise Level dB(A
Wind Speed m/
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time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Tuesday, 16-09-03
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Wind Speed m/
Rain
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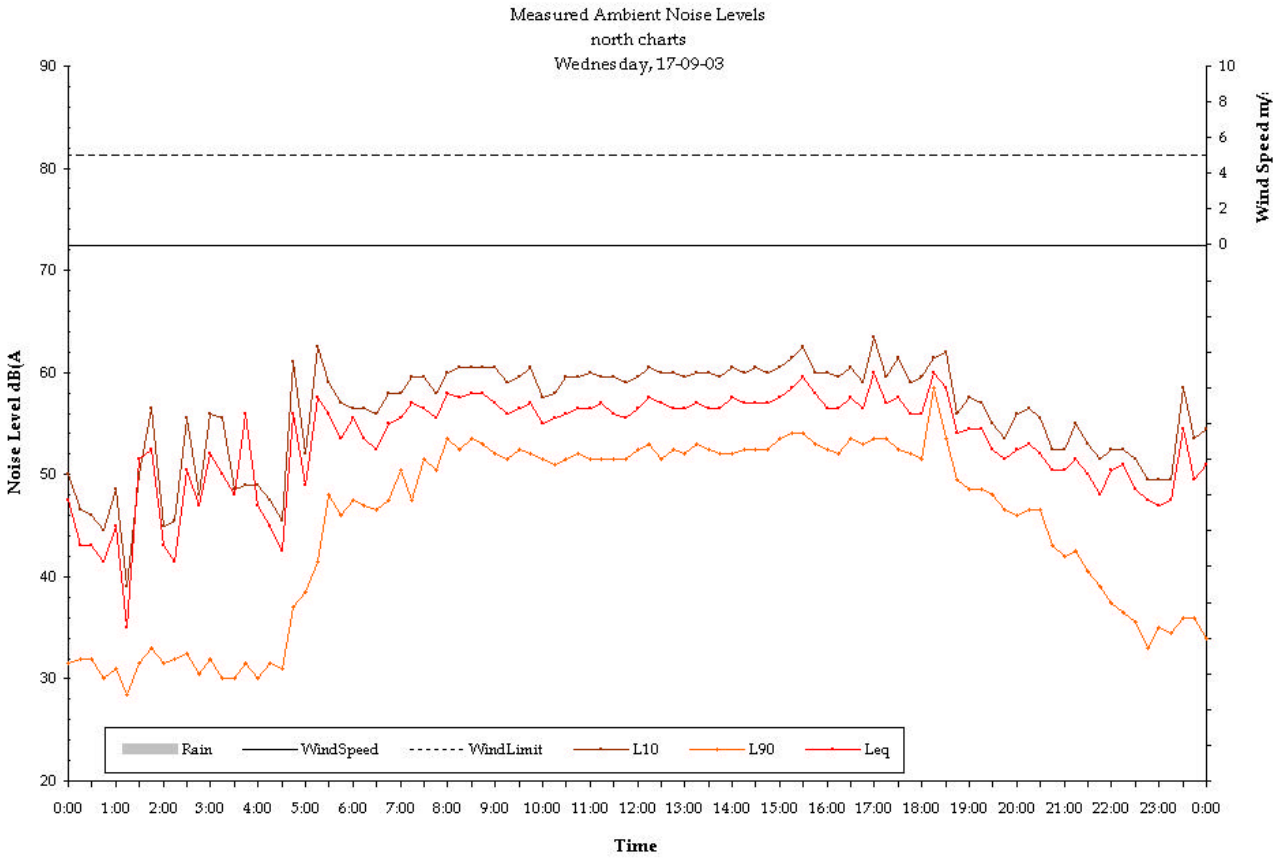
WindLimit
L10
L90
Leq
Time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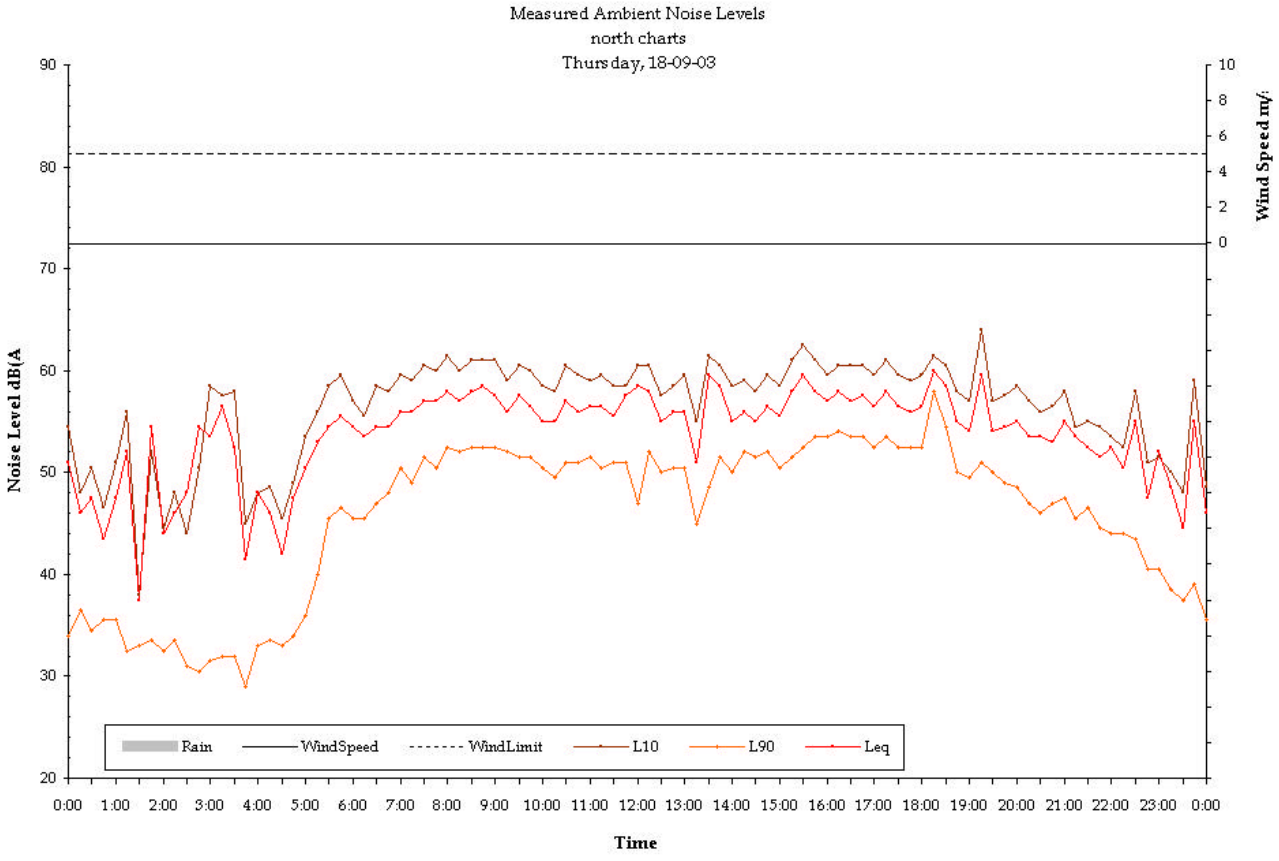
Wind Speed m/
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time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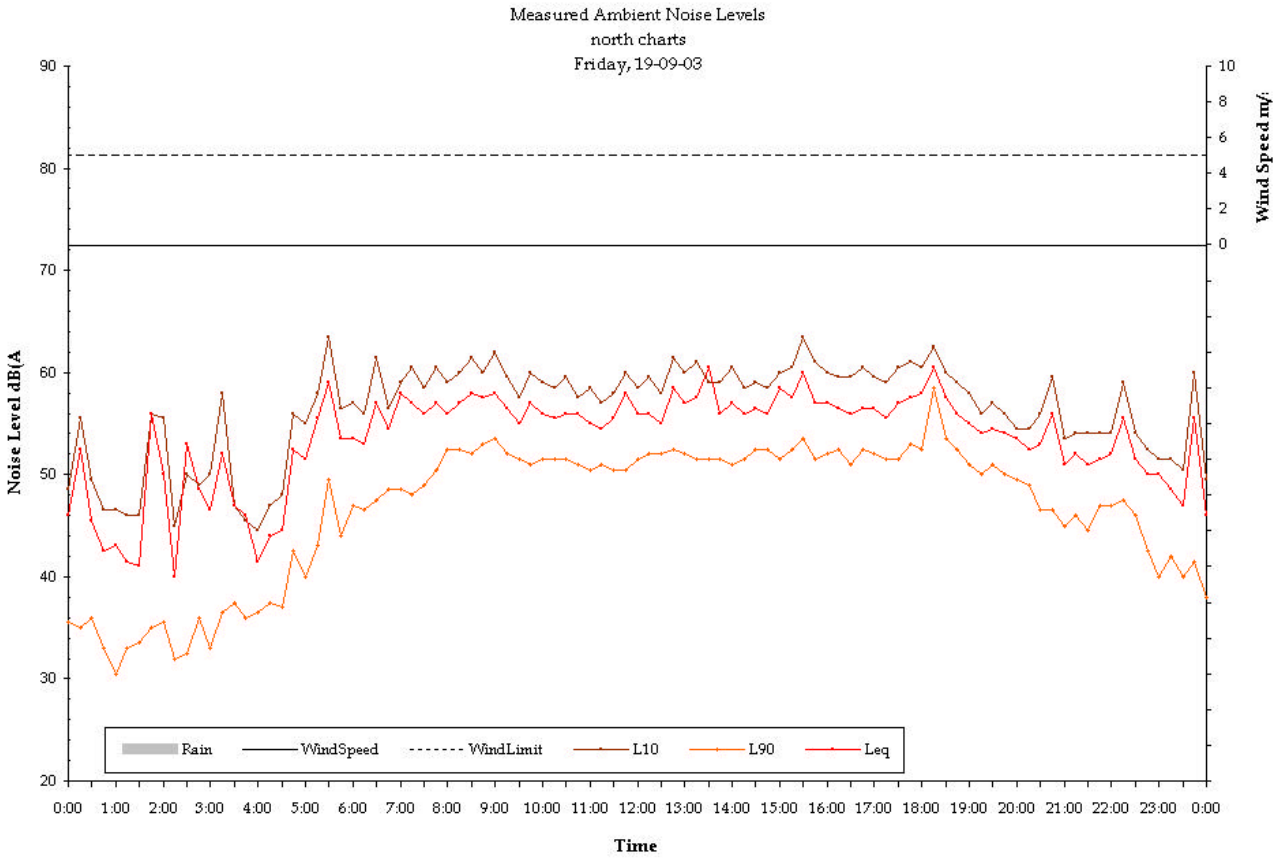
L90
Leq
Time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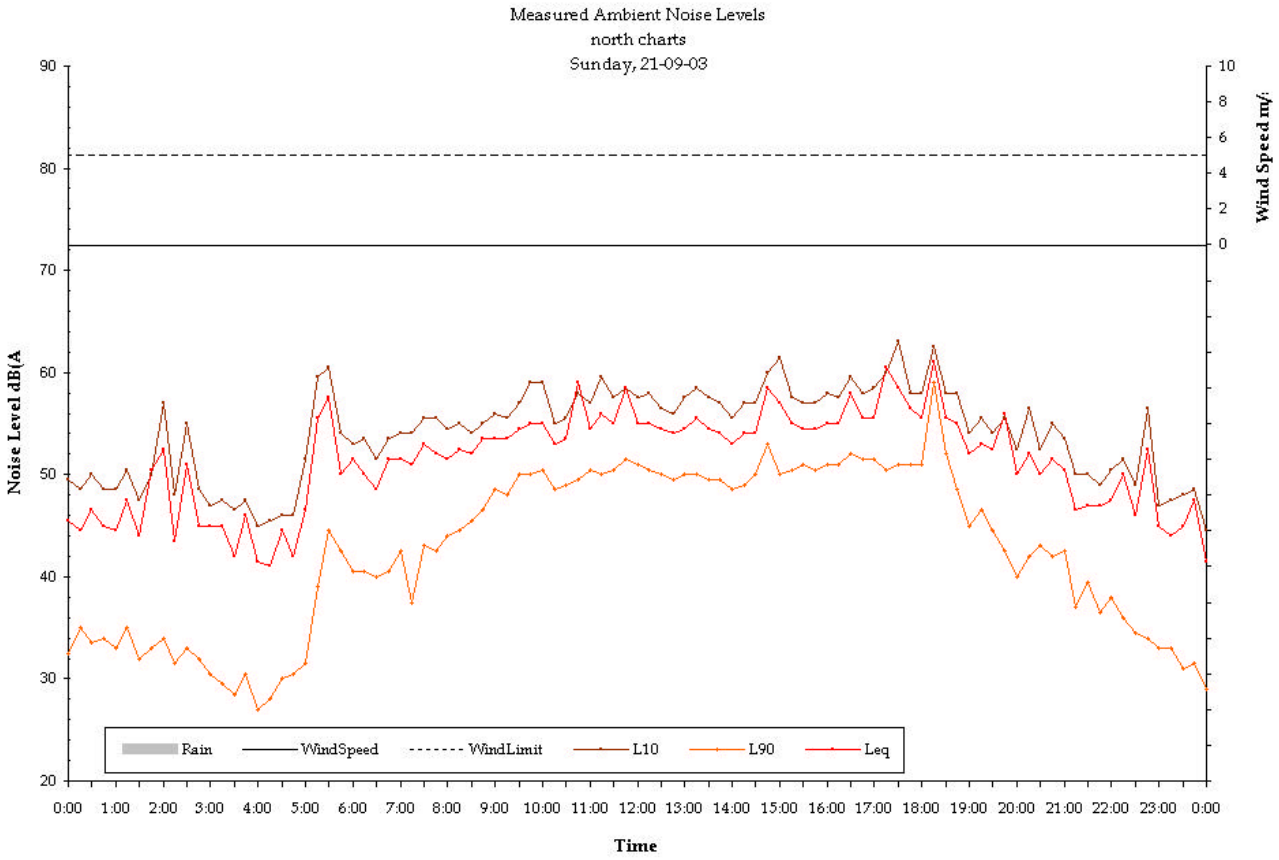
north charts
Friday, 19-09-03
Noise Level dB(A
Wind Speed m/
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time


Measured Ambient Noise Levels
north charts
Saturday, 20-09-03
Noise Level dB(A
Wind Speed m/
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time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Noise Level dB(A
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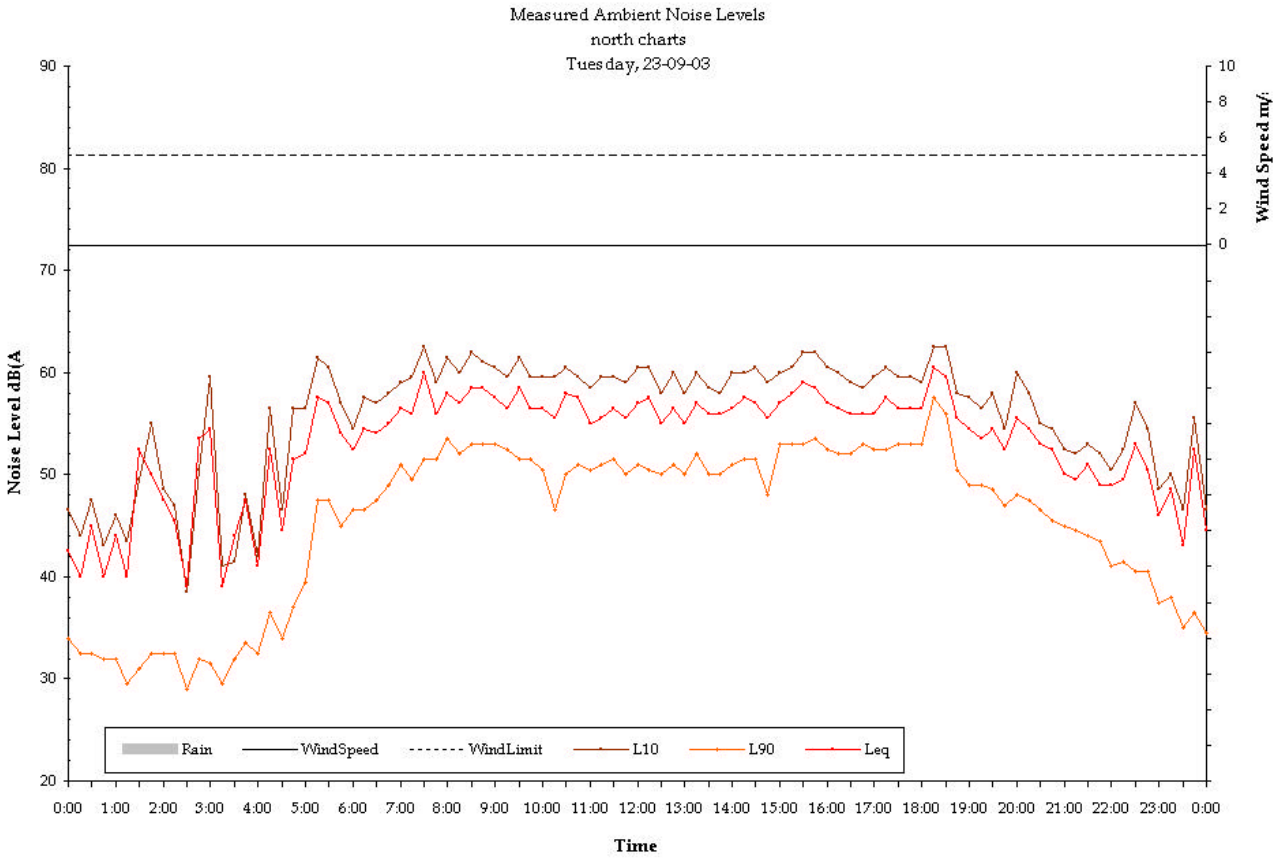
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time


Measured Ambient Noise Levels
north charts
Monday, 22-09-03
Noise Level dB(A
Wind Speed m/
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time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Leq
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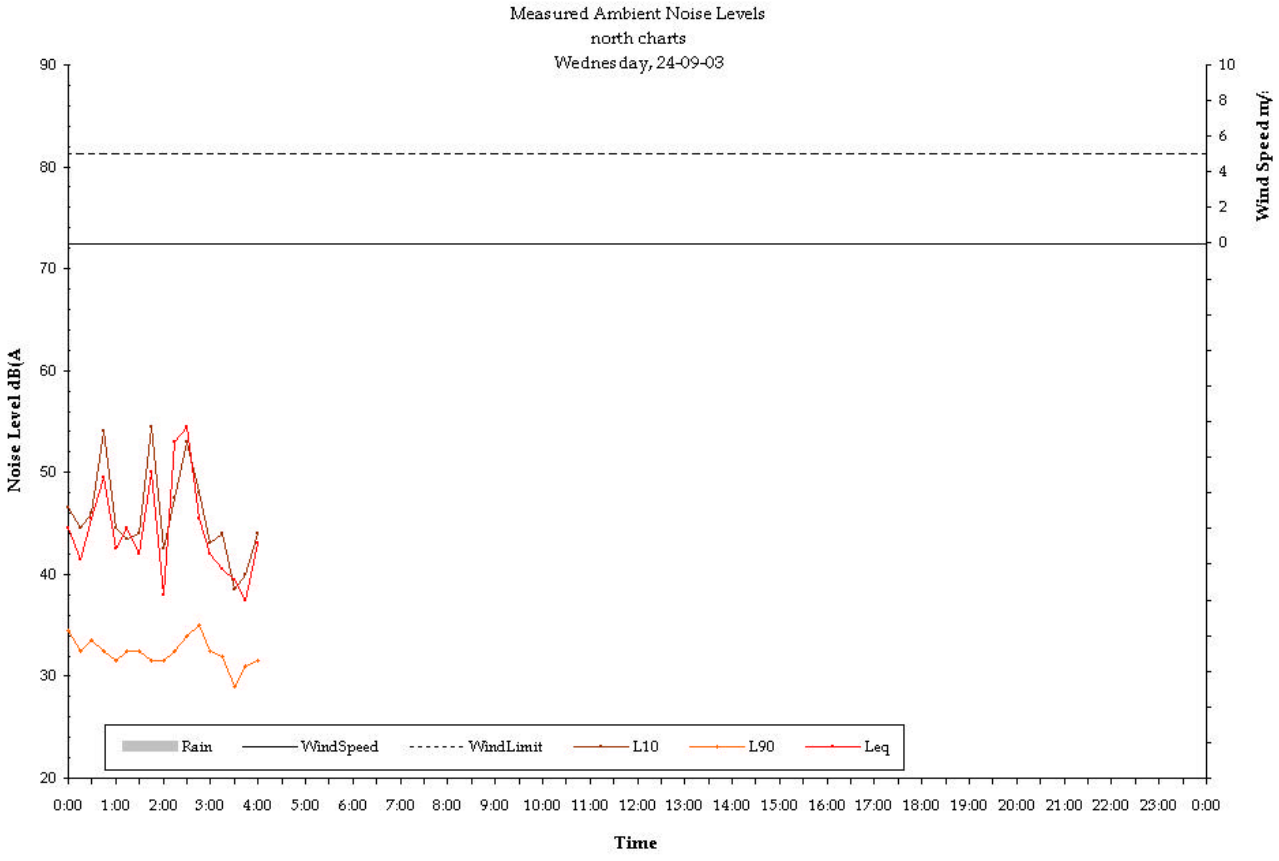
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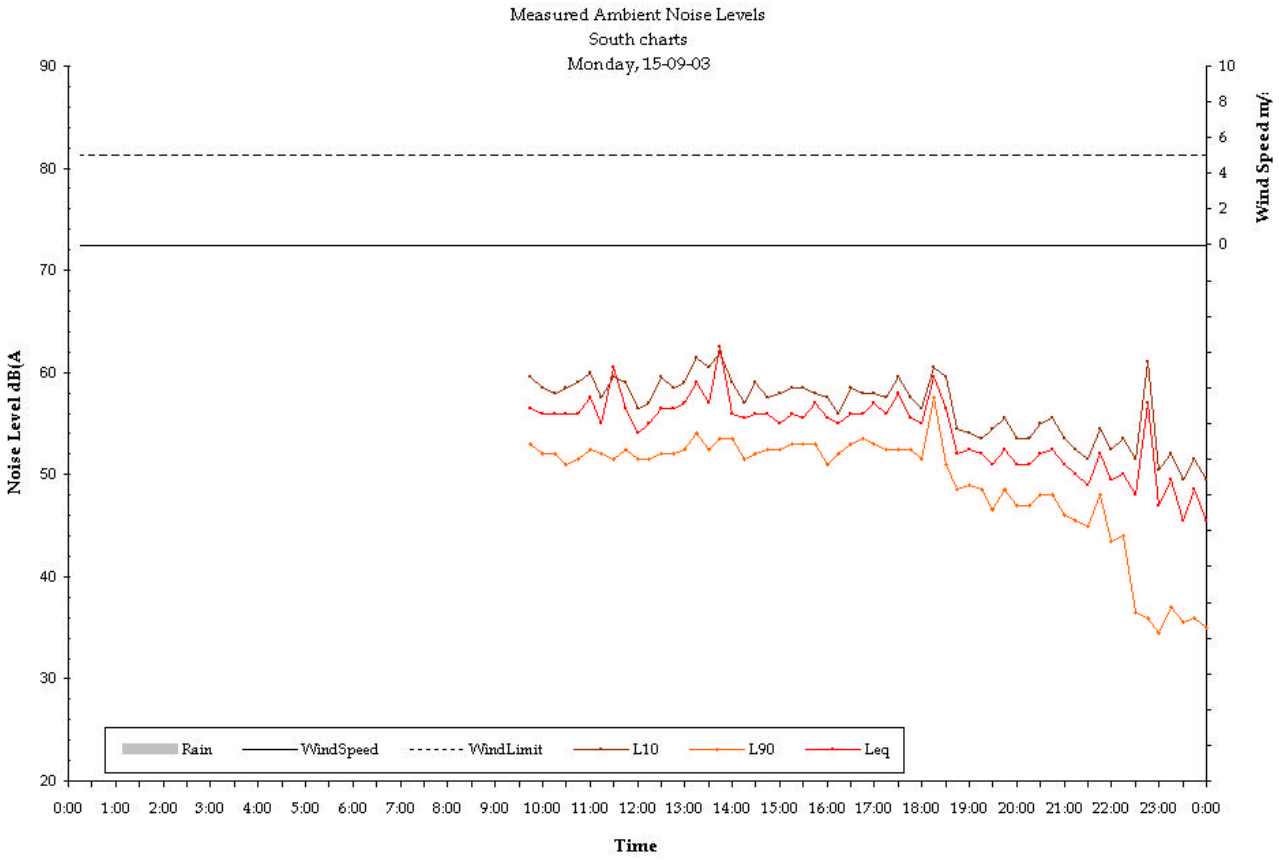
WindSpeed
WindLimit
L10
L90
Leq
Time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Rain
WindSpeed
WindLimit
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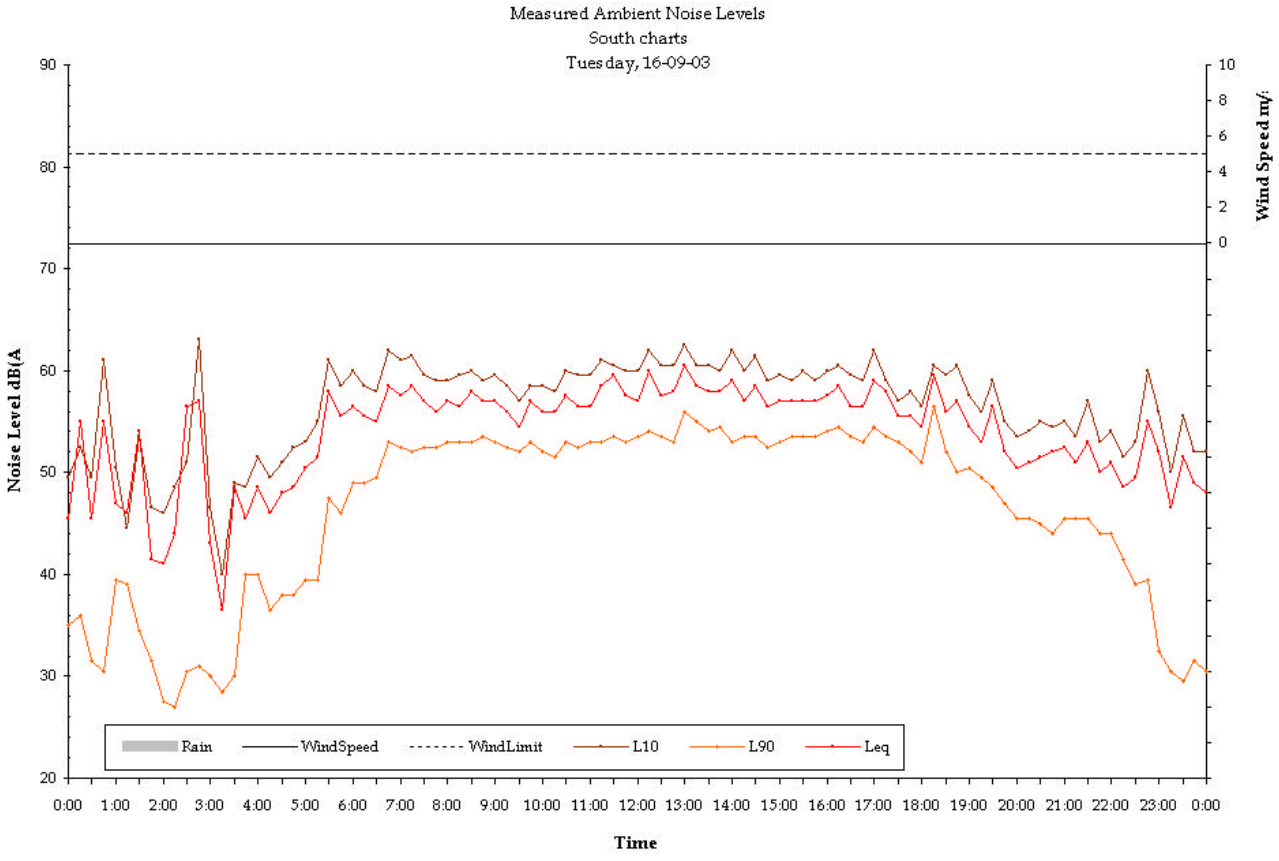
L90
Leq
Time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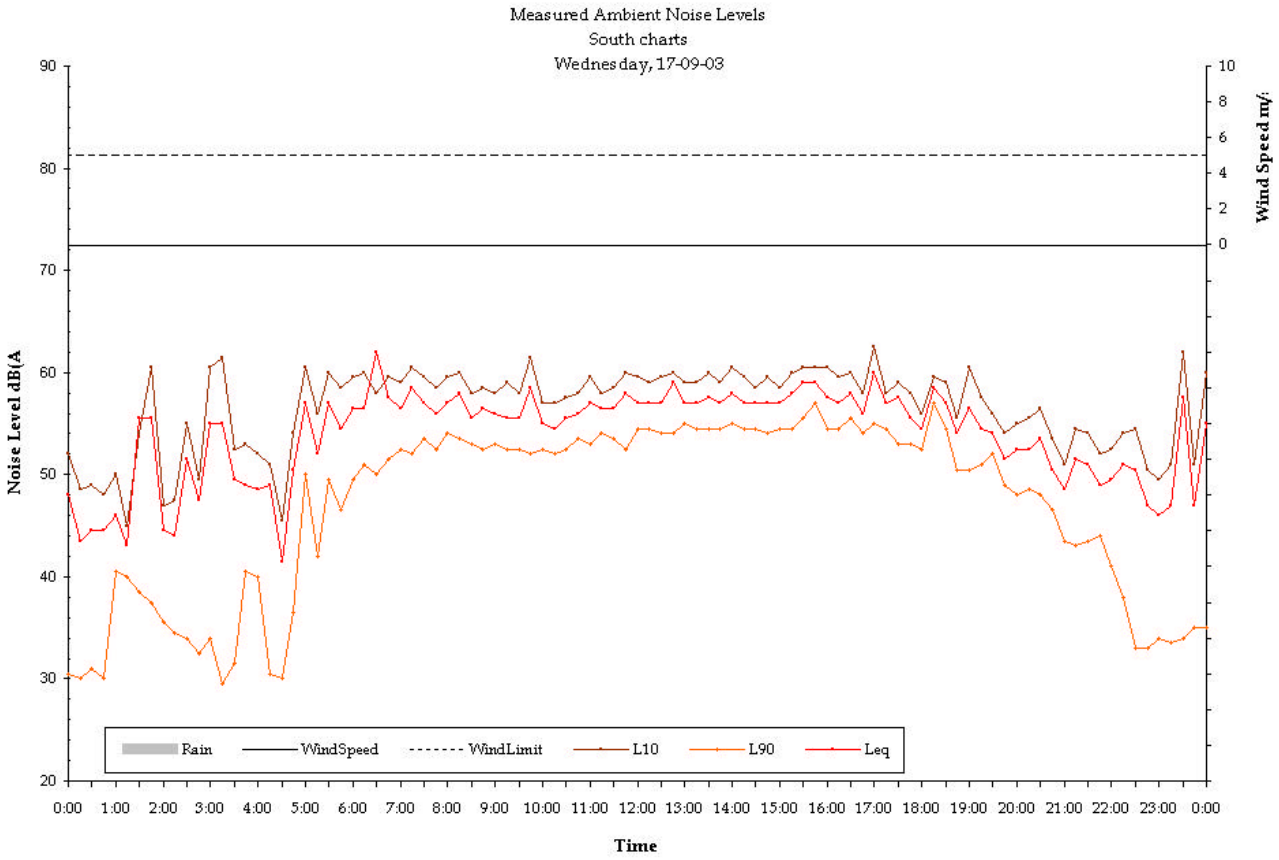
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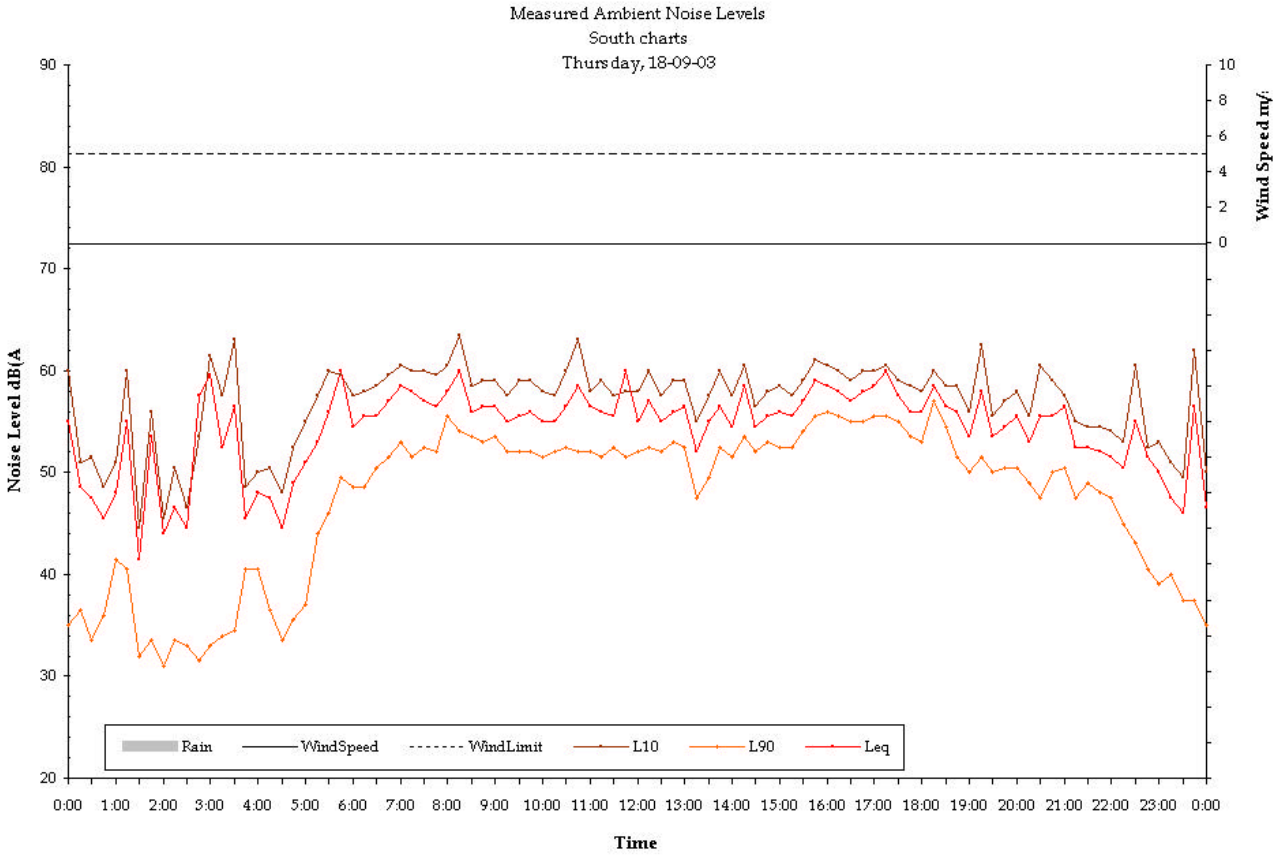
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WindSpeed
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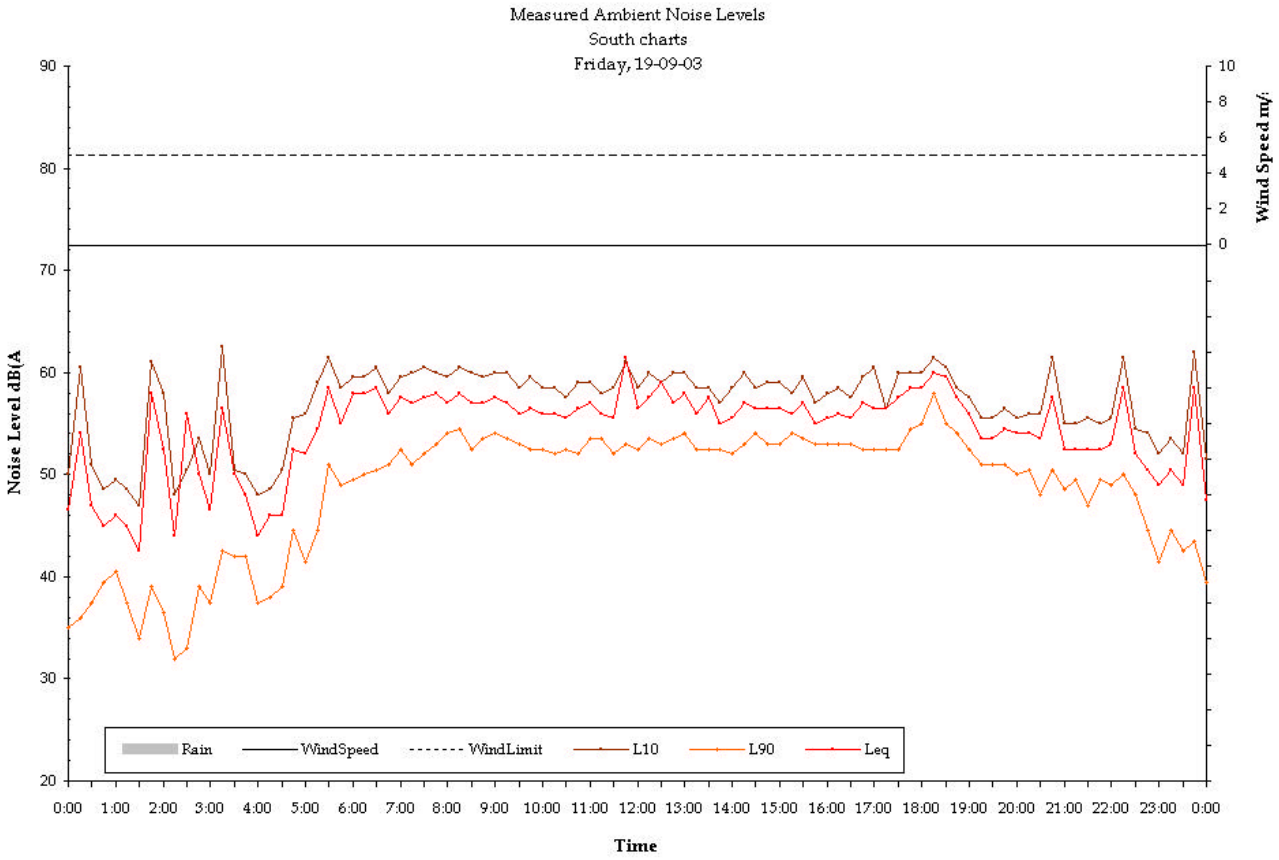
Leq
Time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Rain
WindSpeed
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Leq
Time


Measured Ambient Noise Levels
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Saturday, 20-09-03
Noise Level dB(A
Wind Speed m/
Rain
WindSpeed
WindLimit
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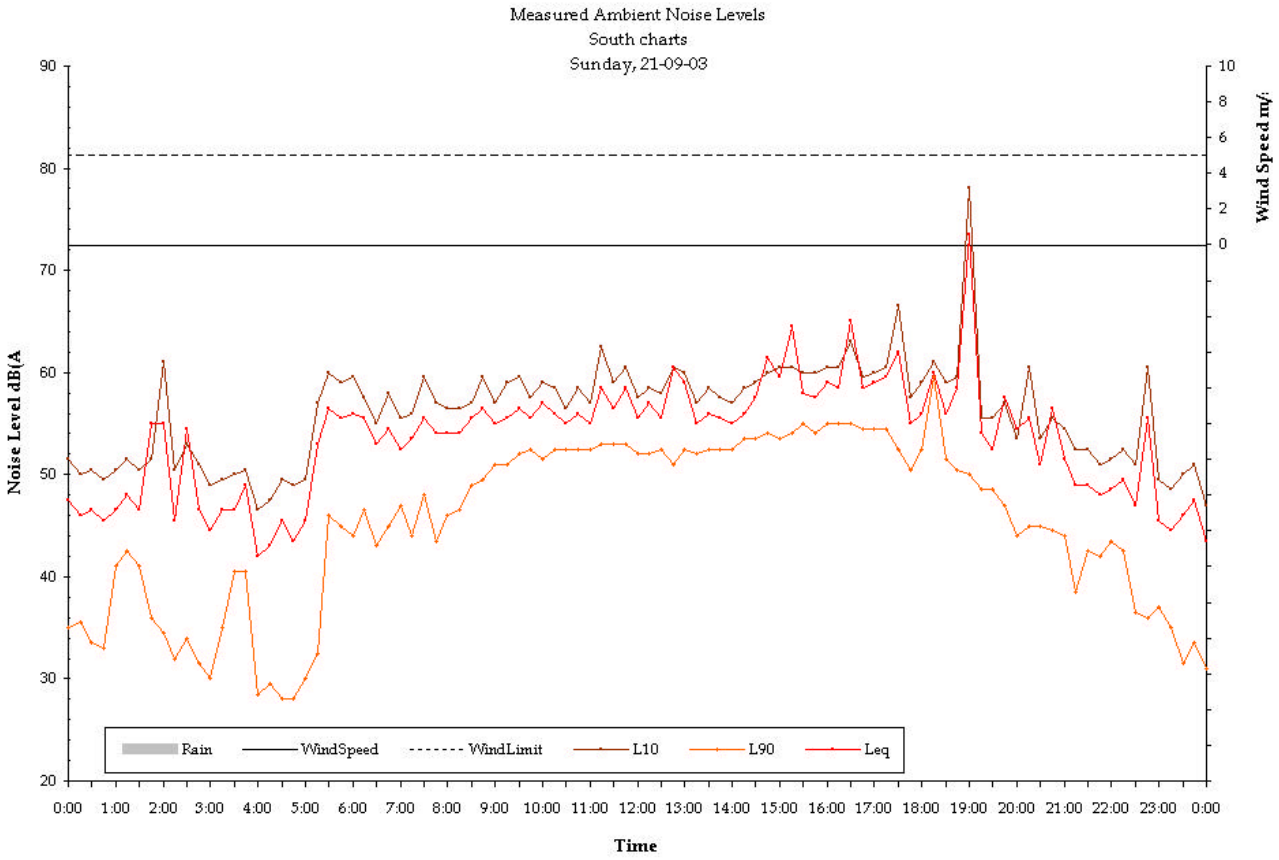
L90
Leq
Time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Wind Speed m/
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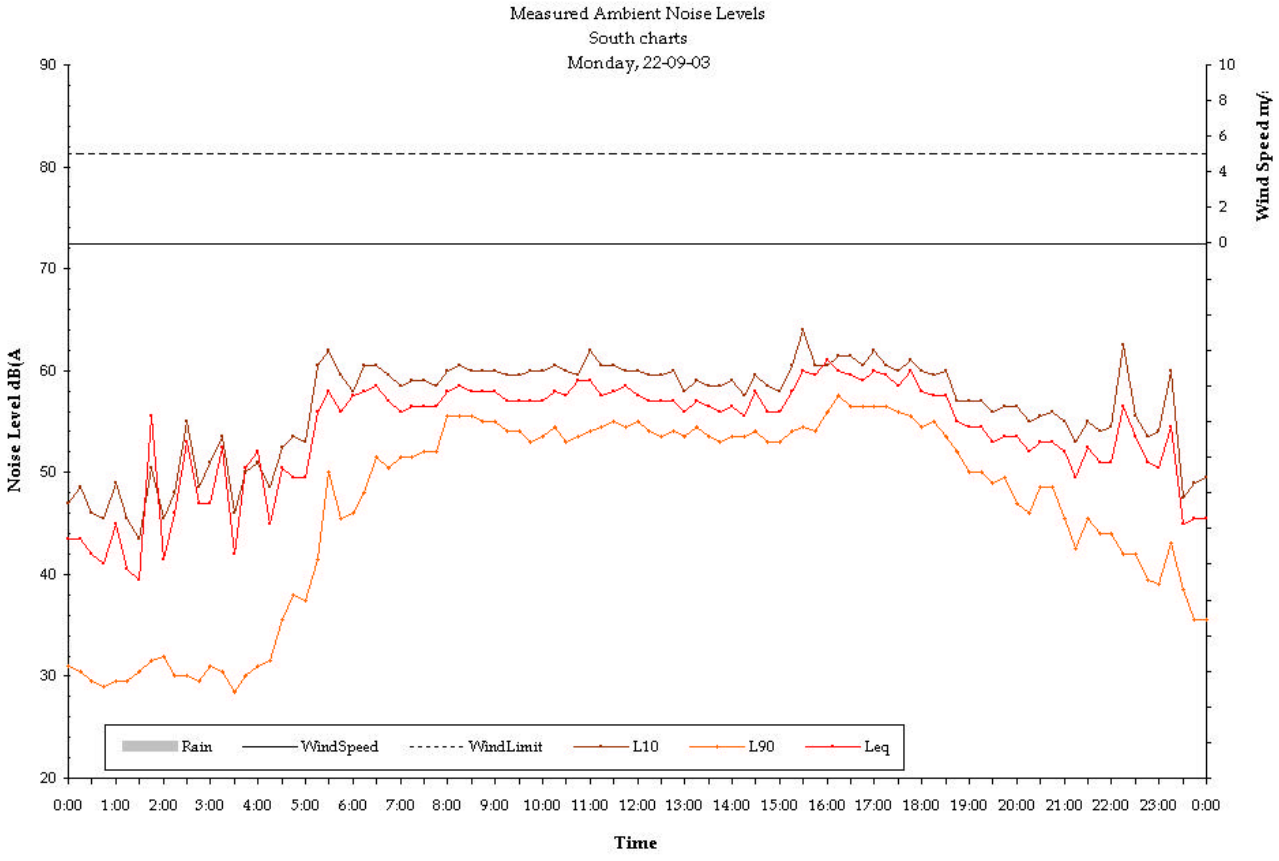
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WindLimit
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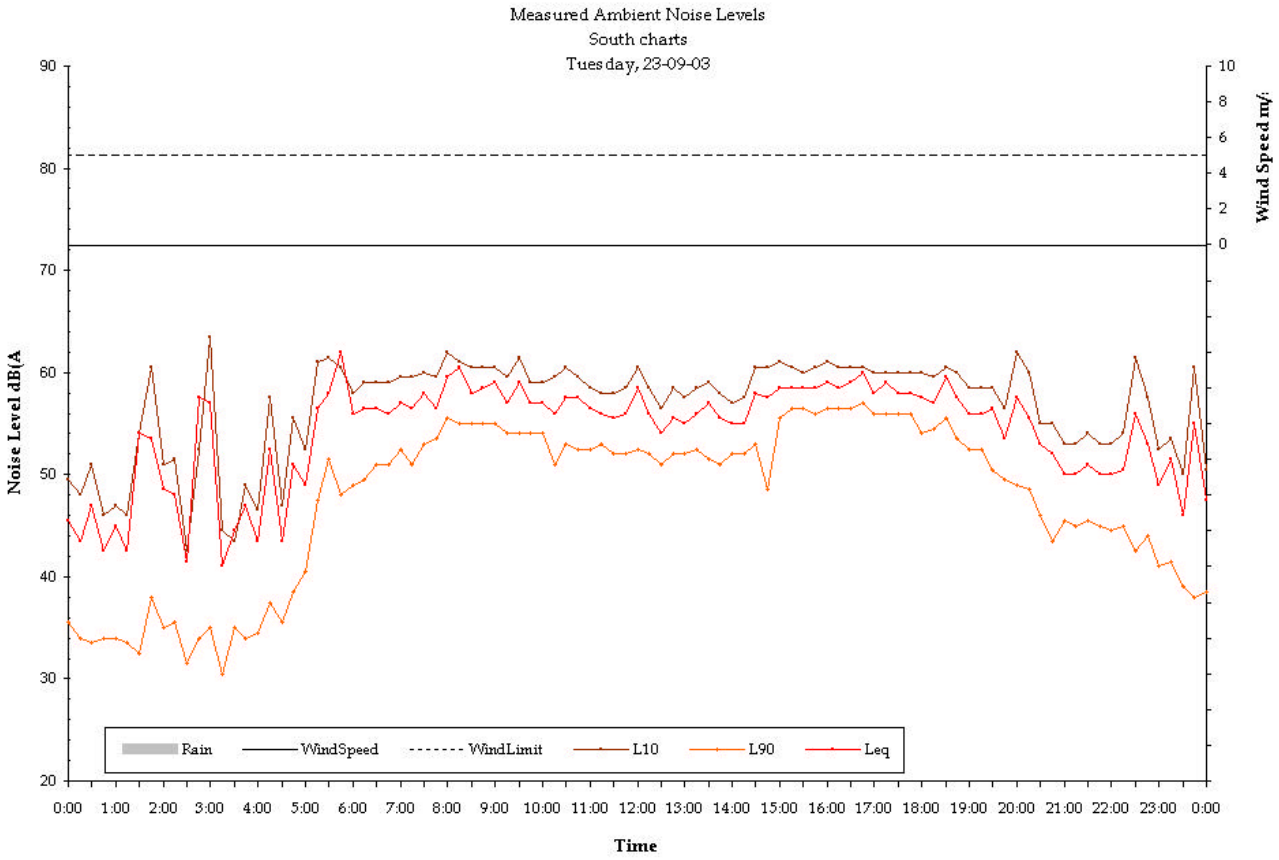
Leq
Time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WindSpeed
WindLimit
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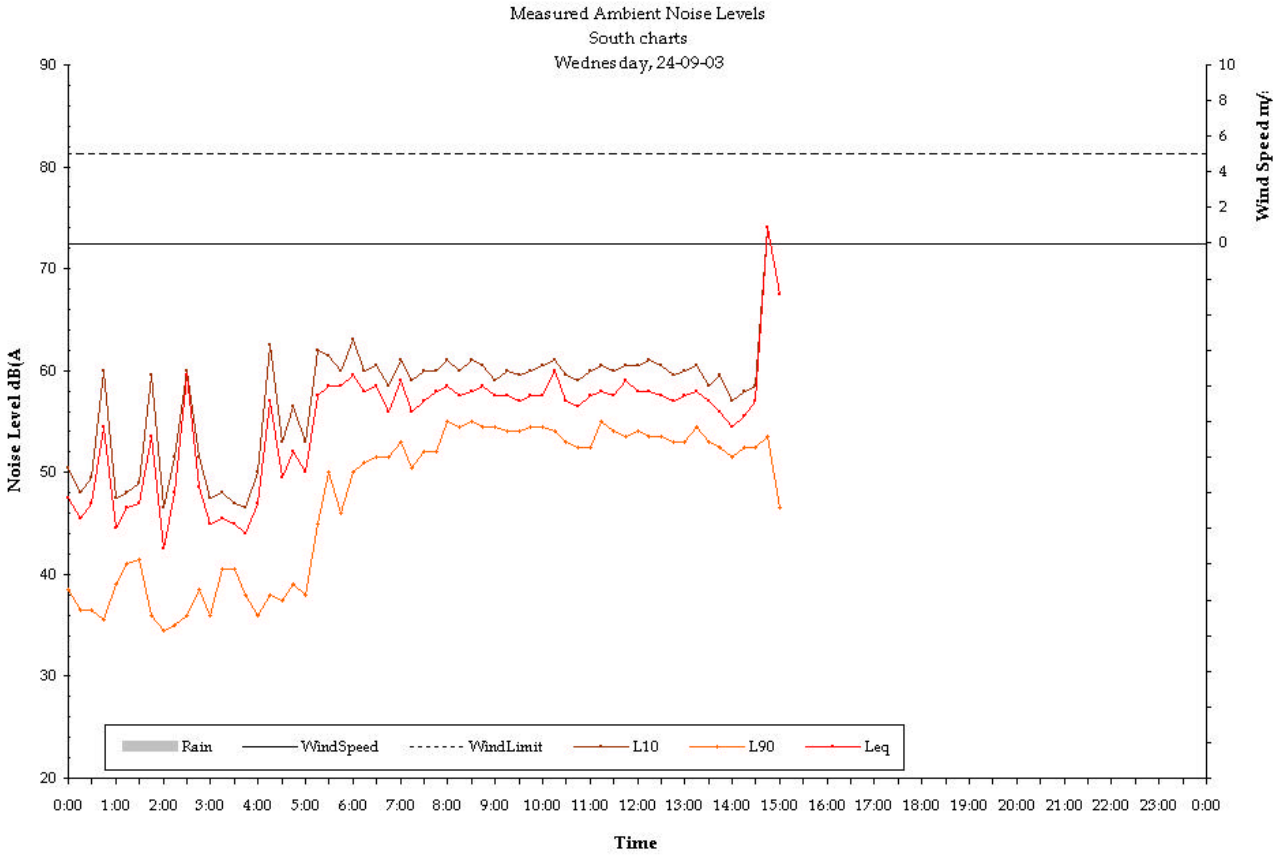
Time


Measured Ambient Noise Levels
South charts
Wednesday, 24-09-03
Noise Level dB(A
Wind Speed m/
Rain
WindSpeed
WindLimit
L10
L90
Leq
Time

Annex C

Locality Options Analysis

Table C.1 Proposed Locality 1 – Noise Impact Assessment

Distance from proposed alignment	**0-50**					**50-100**					**100-200**					**200-300**				
Distance from existing alignment	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50
Weighting	6.4	5.0	4.1	2.9	2.2	4.0	3.0	2.4	1.5	0.8	2.3	1.6	1.2	0.7	0.6	1.7	1.0	0.7	0.5	0.4
From Gwydir Highway to River via rural land crossing river via Susan Island	5					7					7					9				
Crossing Victoria meeting Fitzroy																3				
Properties	5	0	0	0	0	7	0	0	0	0	7	0	0	0	0	12	0	0	0	0
Properties x Weighting	32	0	0	0	0	28	0	0	0	0	16	0	0	0	0	20	0	0	0	0
Weighted Total			32					28					16					20		
Property Total	**31**																			
Weighted Grand Total	**97**																			

Weighting = applicable weightings for each residence are selected by using a paired comparison procedure in conjunction with the likely affects of absolute traffic noise level and of changes of traffic noise level on potential annoyance. The weightings range from 0.4 to 6.4 and have been selected starting with a weighting of 1. This represents the situation where there is no change in noise level at a residence set back 200 to 300 metres from the existing road. If noise levels are higher (residences are closer) or increases are bigger, a weighting greater than 1 needs to be applied since it would represent a greater impact. Similarly if noise levels were to reduce a weighting less than 1 needs to be applied. However for the same change in noise level either up or down, the procedure recognises that the increase is perceived to be worse than the decrease. Since a 10 dB(A) increase in noise level is widely accepted to be a subjective doubling in noise, this has been used to set the weightings by comparing the different distance categories. The weightings have then been refined by comparing different situations and deciding which would be better or worse.

Weighted Total = sum of Property x weighting for each distance segment.

Property Total = sum of all properties for the Locality.

Weighted Grand Total = sum of all Weighted Totals for the Locality.

Table C.2 Proposed Locality 2 – Noise Impact Assessment

Distance from proposed alignment (m)	**0-50**					**50-100**					**100-200**					**200-300**				
Distance from existing alignment (m)	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50
Weighting	6.4	5.0	4.1	2.9	2.2	4.0	3.0	2.4	1.5	0.8	2.3	1.6	1.2	0.7	0.6	1.7	1.0	0.7	0.5	0.4
From Gwydir Highway in the vicinity of Abbot Street	16					20					23					23				
Direct onto Villiers Street (School and Convent on either side of road)						2														
Crossing Victoria meeting Fitzroy											4					2		3		
Properties	16	0	0	0	0	22	0	0	0	0	27	0	0	0	0	25	0	3	0	0
Properties x Weighting	102	0	0	0	0	89	0	0	0	0	63	0	0	0	0	42	0	2	0	0
Weighted Total			102					89					63					44		
Property Total	**93**																			
Weighted Grand Total	**298**																			

Weighting = applicable weightings for each residence are selected by using a paired comparison procedure in conjunction with the likely affects of absolute traffic noise level and of changes of traffic noise level on potential annoyance. The weightings range from 0.4 to 6.4 and have been selected starting with a weighting of 1. This represents the situation where there is no change in noise level at a residence set back 200 to 300 metres from the existing road. If noise levels are higher (residences are closer) or increases are bigger, a weighting greater than 1 needs to be applied since it would represent a greater impact. Similarly if noise levels were to reduce a weighting less than 1 needs to be applied. However for the same change in noise level either up or down, the procedure recognises that the increase is perceived to be worse than the decrease. Since a 10 dB(A) increase in noise level is widely accepted to be a subjective doubling in noise, this has been used to set the weightings by comparing the different distance categories. The weightings have then been refined by comparing different situations and deciding which would be better or worse.

Weighted Total = sum of Property x weighting for each distance segment.

Property Total = sum of all properties for the Locality.

Weighted Grand Total = sum of all Weighted Totals for the Locality.

Table C.3 Proposed Locality 3 – Noise Impact Assessment

Distance from proposed alignment (m)	**0-50**				**50-100**					**100-200**					**200-300**				
Distance from existing alignment (m)	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50
Weighting	6.4	5.0	4.1	2.9	2.2	4.0	3.0	2.4	1.5	0.8	2.3	1.6	1.2	0.7	0.6	1.7	1.0	0.7	0.5	0.4
merge with existing route on Bent Street access																				
3a Merge with existing Fitzroy Street access																				
3b Merge with existing Craig Street access					15				11				18				39			
Properties	0	0	0	0	15	0	0	0	11	0	0	0	18	0	0	0	39	0	0	0
Properties x Weighting	0	0	0	0	33	0	0	0	16	0	0	0	22	0	0	0	39	0	0	0
Weighted Total			33					16					22					39		
Property Total	**83**																			
Weighted Grand Total	**110**																			

Weighting = applicable weightings for each residence are selected by using a paired comparison procedure in conjunction with the likely affects of absolute traffic noise level and of changes of traffic noise level on potential annoyance. The weightings range from 0.4 to 6.4 and have been selected starting with a weighting of 1. This represents the situation where there is no change in noise level at a residence set back 200 to 300 metres from the existing road. If noise levels are higher (residences are closer) or increases are bigger, a weighting greater than 1 needs to be applied since it would represent a greater impact. Similarly if noise levels were to reduce a weighting less than 1 needs to be applied. However for the same change in noise level either up or down, the procedure recognises that the increase is perceived to be worse than the decrease. Since a 10 dB(A) increase in noise level is widely accepted to be a subjective doubling in noise, this has been used to set the weightings by comparing the different distance categories. The weightings have then been refined by comparing different situations and deciding which would be better or worse.

Weighted Total = sum of Property x weighting for each distance segment.

Property Total = sum of all properties for the Locality.

Weighted Grand Total = sum of all Weighted Totals for the Locality.

Table C.4 Proposed Locality 4 – Noise Impact Assessment

Distance from proposed alignment (m)	**0-50**					**50-100**					**100-200**					**200-300**				
Distance from existing alignment (m)	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50
Weighting	6.4	5.0	4.1	2.9	2.2	4.0	3.0	2.4	1.5	0.8	2.3	1.6	1.2	0.7	0.6	1.7	1.0	0.7	0.5	0.4
From Pacific Highway to River via rural land																1				
crossing McHugh Street	4					5					3	4				3				
crossing Breimba Street	8					8					7					16		1		
crossing Bromley / Sutton Street	8					8					7	8				10		7		
crossing Kent Street	9					9					9	10				9		7		
crossing Clarence Street	14					14					17	10				18		11		
meeting Villiers Street	22					12					15					24				
meeting Duke Street	20					12					8									
Properties	85	0	0	0	0	68	0	0	0	0	66	32	0	0	0	81	0	26	0	0
Properties x Weighting	541	0	0	0	0	275	0	0	0	0	154	53	0	0	0	136	0	18	0	0
Weighted Total			541					275					206					154		
Property Total	**358**																			
Weighted Grand Total	**1177**																			

Weighting = applicable weightings for each residence are selected by using a paired comparison procedure in conjunction with the likely affects of absolute traffic noise level and of changes of traffic noise level on potential annoyance. The weightings range from 0.4 to 6.4 and have been selected starting with a weighting of 1. This represents the situation where there is no change in noise level at a residence set back 200 to 300 metres from the existing road. If noise levels are higher (residences are closer) or increases are bigger, a weighting greater than 1 needs to be applied since it would represent a greater impact. Similarly if noise levels were to reduce a weighting less than 1 needs to be applied. However for the same change in noise level either up or down, the procedure recognises that the increase is perceived to be worse than the decrease. Since a 10 dB(A) increase in noise level is widely accepted to be a subjective doubling in noise, this has been used to set the weightings by comparing the different distance categories. The weightings have then been refined by comparing different situations and deciding which would be better or worse.

Weighted Total = sum of Property x weighting for each distance segment.

Property Total = sum of all properties for the Locality.

Weighted Grand Total = sum of all Weighted Totals for the Locality.

Table C.5 Proposed Locality 5 – Noise Impact Assessment

Distance from proposed alignment (m)	**0-50**					**50-100**					**100-200**					**200-300**				
Distance from existing alignment (m)	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50
Weighting	6.4	5.0	4.1	2.9	2.2	4.0	3.0	2.4	1.5	0.8	2.3	1.6	1.2	0.7	0.6	1.7	1.0	0.7	0.5	0.4
From Pacific Highway to River via rural land											1					1				
crossing McHugh Street	5																			
crossing Breimba Street	12					16					29					12				
crossing Kent Street	17					14					23					26				
Dobie and Waratah Place	11					9					10					14				
crossing Clarence Street	10					8					11					15				
Dobie and Weiley Ave	11					9					14					19				
meeting Villiers Street	6					3					7					11				
Properties	72	0	0	0	0	59	0	0	0	0	95	0	0	0	0	98	0	0	0	0
Properties x Weighting	458	0	0	0	0	239	0	0	0	0	221	0	0	0	0	165	0	0	0	0
Weighted Total			458					239					221					165		
Property Total	**324**																			
Weighted Grand Total	**1083**																			

Weighting = applicable weightings for each residence are selected by using a paired comparison procedure in conjunction with the likely affects of absolute traffic noise level and of changes of traffic noise level on potential annoyance. The weightings range from 0.4 to 6.4 and have been selected starting with a weighting of 1. This represents the situation where there is no change in noise level at a residence set back 200 to 300 metres from the existing road. If noise levels are higher (residences are closer) or increases are bigger, a weighting greater than 1 needs to be applied since it would represent a greater impact. Similarly if noise levels were to reduce a weighting less than 1 needs to be applied. However for the same change in noise level either up or down, the procedure recognises that the increase is perceived to be worse than the decrease. Since a 10 dB(A) increase in noise level is widely accepted to be a subjective doubling in noise, this has been used to set the weightings by comparing the different distance categories. The weightings have then been refined by comparing different situations and deciding which would be better or worse.

Weighted Total = sum of Property x weighting for each distance segment.

Property Total = sum of all properties for the Locality.

Weighted Grand Total = sum of all Weighted Totals for the Locality.

Table C.6 Proposed Locality 6 – Noise Impact Assessment

Distance from proposed alignment (m)	**0-50**					**50-100**					**100-200**					**200-300**				
Distance from existing alignment (m)	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50
Weighting	6.4	5.0	4.1	2.9	2.2	4.0	3.0	2.4	1.5	0.8	2.3	1.6	1.2	0.7	0.6	1.7	1.0	0.7	0.5	0.4
From Pacific Highway to River via rural land											1					1				
crossing Arthur Street																4				
crossing Villiers Street	10					7					16					10				
crossing Chapman Street	11					9					18					14				
crossing Prince Street	3					3					6					4				
crossing Queen Street	14					11					11					25				
crossing Mary Street (route passes hospital and Gaol)						2					5					15				
Arthur and Richards Lane	4					7					12					8				
crossing Alice Street	9					9					13					12				
meeting Turf Street	11					11					41					32				
Properties	62	0	0	0	0	59	0	0	0	0	123	0	0	0	0	125	0	0	0	0
Properties x Weighting	395	0	0	0	0	239	0	0	0	0	286	0	0	0	0	211	0	0	0	0
Weighted Total			395					239					286					211		
Property Total	**369**																			
Weighted Grand Total	**1130**																			

Distance from proposed alignment (m)	0-50	50-100	100-200	200-300

Weighting = applicable weightings for each residence are selected by using a paired comparison procedure in conjunction with the likely affects of absolute traffic noise level and of changes of traffic noise level on potential annoyance. The weightings range from 0.4 to 6.4 and have been selected starting with a weighting of 1. This represents the situation where there is no change in noise level at a residence set back 200 to 300 metres from the existing road. If noise levels are higher (residences are closer) or increases are bigger, a weighting greater than 1 needs to be applied since it would represent a greater impact. Similarly if noise levels were to reduce a weighting less than 1 needs to be applied. However for the same change in noise level either up or down, the procedure recognises that the increase is perceived to be worse than the decrease. Since a 10 dB(A) increase in noise level is widely accepted to be a subjective doubling in noise, this has been used to set the weightings by comparing the different distance categories. The weightings have then been refined by comparing different situations and deciding which would be better or worse.

Weighted Total = sum of Property x weighting for each distance segment.

Property Total = sum of all properties for the Locality.

Weighted Grand Total = sum of all Weighted Totals for the Locality.

Table C.7 Proposed Locality 7 – Noise Impact Assessment

Distance from proposed alignment (m)	**0-50**					**50-100**					**100-200**					**200-300**				
Distance from existing alignment (m)	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50	>300	200-300	100-200	50-100	0-50
Weighting	6.4	5.0	4.1	2.9	2.2	4.0	3.0	2.4	1.5	0.8	2.3	1.6	1.2	0.7	0.6	1.7	1.0	0.7	0.5	0.4
From Pacific Highway at Centenary Drive to River via rural land						1					1									
Crossing River via Elizabeth Island																				
Direct to North St vicinity	2					2														
crossing Duke Street																				
crossing Morrison Street	2					6					1					1				
crossing Challinor Street	1										3									
crossing Queen Street	11					9					21					11				
crossing Mary Street	7					7					21					11				
crossing Alice Street	9					5					9					7				
crossing Davey Ave x 2	9					15					15									
meeting Richmond Road	4					5					3					8				
Properties	45	0	0	0	0	50	0	0	0	0	74	0	0	0	0	38	0	0	0	0
Properties x Weighting	286	0	0	0	0	202	0	0	0	0	172	0	0	0	0	64	0	0	0	0
Weighted Total			286					202					172					64		
Property Total	**207**																			
Weighted Grand Total	**725**																			

Distance from proposed alignment (m)	0-50	50-100	100-200	200-300

Weighting = applicable weightings for each residence are selected by using a paired comparison procedure in conjunction with the likely affects of absolute traffic noise level and of changes of traffic noise level on potential annoyance. The weightings range from 0.4 to 6.4 and have been selected starting with a weighting of 1. This represents the situation where there is no change in noise level at a residence set back 200 to 300 metres from the existing road. If noise levels are higher (residences are closer) or increases are bigger, a weighting greater than 1 needs to be applied since it would represent a greater impact. Similarly if noise levels were to reduce a weighting less than 1 needs to be applied. However for the same change in noise level either up or down, the procedure recognises that the increase is perceived to be worse than the decrease. Since a 10 dB(A) increase in noise level is widely accepted to be a subjective doubling in noise, this has been used to set the weightings by comparing the different distance categories. The weightings have then been refined by comparing different situations and deciding which would be better or worse.

Weighted Total = sum of Property x weighting for each distance segment.

Property Total = sum of all properties for the Locality.

Weighted Grand Total = sum of all Weighted Totals for the Locality.