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Thakral Holdings Limited

Report for Pacific Bay Western Lands

Traffic Noise Intrusion Assessment

March 2009

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Contents

Table Index

Figure Index

Appendices

Glossary – Acoustics

dB	Decibel, which is 10 times the logarithm (base 10) of the ratio of a given sound pressure to a reference pressure; used as a unit of sound.
dB(A)	Unit used to measure 'A-weighted' sound pressure levels.
$L_{A10\ (Time)}$	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
$L_{A10\ (1\ hour)}$	The L_{10} level measured over a 1-hour period.
$L_{A10\ (18\ hour)}$	The arithmetic average of the L_{10} levels for the 18-hour period between 0600 and 2400 hours on a normal working day. It is a common traffic noise descriptor.
$L_{A90\ (Time)}$	The A-weighted sound pressure level that is exceeded for 90% of the time over which a given sound is measured. This is considered to represent the background noise e.g. $L_{A90\ (15\ min)}$
$L_{Aeq\ (Time)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
$L_{Aeq\ (15\ hr)}$	The L_{Aeq} noise level for the period 7 am to 10 pm.
$L_{Aeq\ (9\ hr)}$	The L_{Aeq} noise level for the period 10 pm to 7 am.
$L_{Aeq\ (1\ hr)}$	The L_{Aeq} noise level for a one-hour period. In the context of the NSW EPA Environmental Criteria for Road Traffic Noise, it represents the highest tenth percentile hourly A-weighted L_{eq} during the period 7 am to 10 pm, or 10 pm to 7 am, (whichever is relevant). If this cannot be defined accurately, use the highest A-weighted L_{eq} noise level.
Rating Background Level (RBL)	The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24 hour period used for the assessment background level). This is the level used for assessment purposes. It is defined as the median value of: ◗ All the day assessment background levels over the monitoring period for the day; ◗ All the evening assessment background levels over the monitoring period for the evening; or ◗ All the night assessment background levels over the monitoring period for the night.
Tonality	Noise containing prominent a prominent frequency or frequencies characterised by definite pitch.
Traffic Noise Reduction (TNR)	As per AS3671, TNR = L_{AeqT} - L_{Arec}. Where, L_{Arec} – AS2107 indoor recommended design sound level; and L_{AeqT} – Traffic noise exposure level.

Executive Summary

As part of the preparation of the Environmental Assessment, GHD was commissioned by Thakral Holdings Limited to undertake an assessment of potential road traffic noise intrusion from the Pacific Highway and surrounding roadways on the proposed Residential Subdivision land situated at Lot 1 DP 592173, Lot 2 DP 226560, Lots 3, 4, and 5 DP820652 and Lot 23 DP 716144, Pacific Highway, West Korora, Coffs Harbour, known as the Pacific Bay Resort (Western Lands).

Noise monitoring was undertaken at three locations on site so as to ascertain the existing ambient noise environment and establish project specific noise goals for the land.

The traffic noise assessment was conducted based on unattended noise monitoring conducted at three locations on site between the 27th March and the 4th April 2008. Based on the monitoring results, it was found that:

- Traffic noise is a feature of the ambient environment in the area; and
- Current traffic noise levels may potentially exceed the Environmental Criteria for Road Traffic Noise (ECRTN) criteria at the nearest proposed building footprint for a new residential development affected by freeway / arterial road traffic noise.

Predicted traffic noise levels at the facades of Lots within the proposed development are given in Table D-1 (Appendix D) of this report. The predicted results indicate that both the ECRTN external and internal residential criteria may potentially be exceeded at some of the future building locations. GHD suggest that feasible and reasonable architectural noise control mitigation measures and options should be implemented, endeavouring to meet the internal noise criteria.

In-principle internal noise mitigation measures with consideration to the construction categories required to achieve indoor sound levels recommended as satisfactory in AS2107 are given in Table D-1 (Appendix D).

Examples of construction materials corresponding to the construction categories are shown in Table 7-1.

By using standard acoustic attenuation mitigation measures outlined in the assessment, it can be reasonably expected that ECRTN adopted road traffic noise levels may be achieved for future proposed residences within the assessment site.

1. Introduction

GHD was commissioned by Thakral Holdings Limited to undertake an assessment of potential road traffic noise intrusion from the Pacific Highway on the proposed western Lands Project Residential Subdivision land situated at Lot 1 DP 592173, Lot 2 DP 226560, Lots 3, 4, and 5 DP820652 and Lot 23 DP 716144, Pacific Highway, West Korora, Coffs Harbour, NSW.

This report was prepared with consideration to the following documents:

- NSW Department of Environment & Climate Change (DECC) publications:
  - Environmental Criteria for Road Traffic Noise (ECRTN); and
  - Environmental Noise Control Manual (ENCM);
- Road & Transport Authority (RTA) Environmental Noise Management Manual.

1.1 Scope of Works

The scope of works for the noise impact assessment from the adjacent surrounding roadways onto the site comprised:

- Unattended noise monitoring at three locations representative of the local noise environment to establish the rating background levels in the vicinity of the development and existing ambient and traffic noise levels;
- Establishing day and night time noise levels in the vicinity of the development with consideration to the noise criteria in the NSW DECC publication of the Environmental Criteria for Road Traffic Noise (ECRTN); and
- Preparation of a report discussing the results.

1.2 Assessment Methodology

- The following steps for the noise assessment were undertaken:
- Unattended site noise monitoring measurements were undertaken;
- Ambient noise sources at the time of unattended monitoring and potential future ambient noise sources identified and classified;
- Compliance criteria for the proposed development were determined with consideration of the unattended noise monitoring measurements;
- Assessment of compliance; and
- If the assessment results suggest a potential noise exceedance against relevant guidelines, outline in-principle acoustic design advice options pertaining to possible in-principle site layout and architectural treatments.

1.3 Limitations

This report has been prepared for Thakral Holdings Limited. The purpose of the report was to provide an independent assessment of the potential road traffic noise intrusion at Lot 1 DP 592173, Lot 2 DP 226560, Lots 3, 4, and 5 DP820652 and Lot 23 DP 716144, Pacific Highway, West Korora, Coffs Harbour, as part of the Environmental Assessment for the project.

It is not the intention of the assessment to cover every element of the acoustic environment, but rather to conduct the assessment with consideration to the prescribed work scope.

The findings of the acoustic assessment represent the findings apparent at the date and time of the conducted monitoring, the conditions of the area at the time and the information provided for the project. It is the nature of environmental assessments that all variations in environmental conditions cannot be accessed and all uncertainty concerning the conditions of the ambient noise environment cannot be eliminated. Professional judgement must be exercised in the investigation and interpretation of observations.

In conducting this assessment and preparing the report, current guidelines for noise were referred to. This work has been conducted in good faith with GHD's understanding of the client's brief and the generally accepted consulting practice.

No other warranty, expressed or implied, is made as to the information and professional advice included in this report. It is not intended for other parties or other uses.

2. Project Description

2.1 Site Description

GHD understand that the Concept Plan proposes a residential subdivision in the order of approximately 200-lots on the western side of the Pacific Highway near the Pacific Bay Resort.

The site is located on the western side of the existing Pacific Highway in West Korora, approximately 4.5km north of the Coffs Harbour CBD. The location of the site and an aerial photo indicating the site outline is shown in Figure 1 and Figure 2. The indicative concept plan of the site, as of March 2009 is provided in Figure 3.

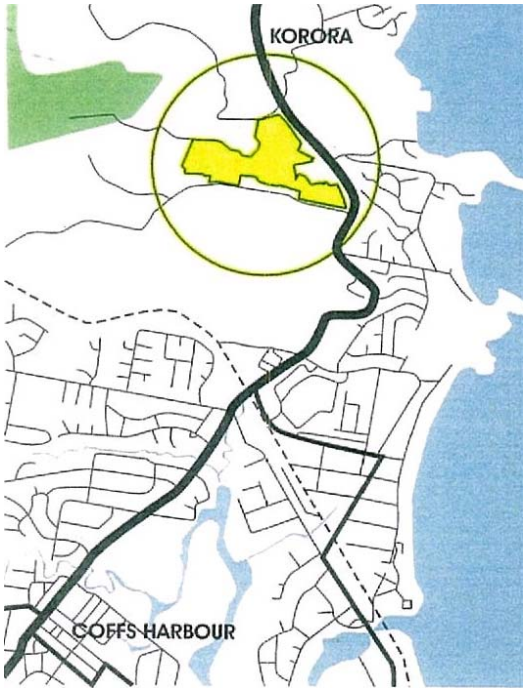


Figure 1 – Site Location Relative to Coffs Harbour

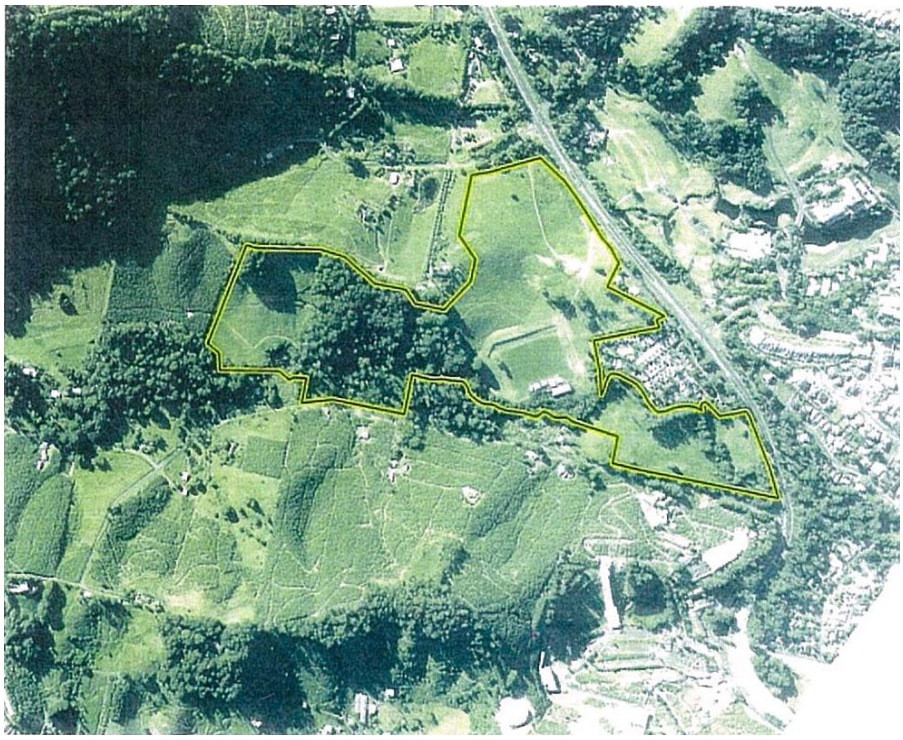


Figure 2 – Aerial Image of the Proposed Site Boundary

Figure 3 – Indicative Concept Plan, [JAL_0701_A3_landscape_master_plan_30 01 09]

2.2 Description

The site has an area of approximately 24 hectares. It is bounded by Bruxner Park Road (northern boundary), the Pacific Highway (eastern boundary), West Korora Road (southern boundary) and private land to the west.

The site comprises the properties identified by the following title details:

- Lot 1 DP 592173;
- Lot 2 DP 226560;
- Lot 3 DP 820652;
- Lot 4 DP 820652;
- Lot 5 DP 820652; and
- Lot 23 DP 716144.

2.3 Topography

The site contains an undulating topography with some level areas. The steeper sloping land is located in the northern and north western parts of the site near Bruxner Park Road. The site ranges in height from 13 AHD in the south eastern corner up to 55 AHD in the north western part of the site.

3. Existing Environment

3.1 Monitoring Locations

Three *Acoustic Research Laboratories (ARL) Pty Ltd EL-215 Type 1* continuous environmental noise loggers, within current calibration, were used to monitor the noise environment at the locations detailed in Table 3-1 and shown graphically in Figure 4.

- Terrestrial site photos of the long-term unattended noise monitoring locations are shown in Figure 5 to Figure 10.

Unattended noise monitoring was undertaken over the period 27th March to 4th April 2008. The instruments were programmed to accumulate environmental noise data continuously over sampling periods of 15 minutes for the entire monitoring period. Internal software then calculated and stored the L_n percentile noise levels for each sampling period, which was later retrieved for analysis. The instruments were calibrated before and after the logging periods.

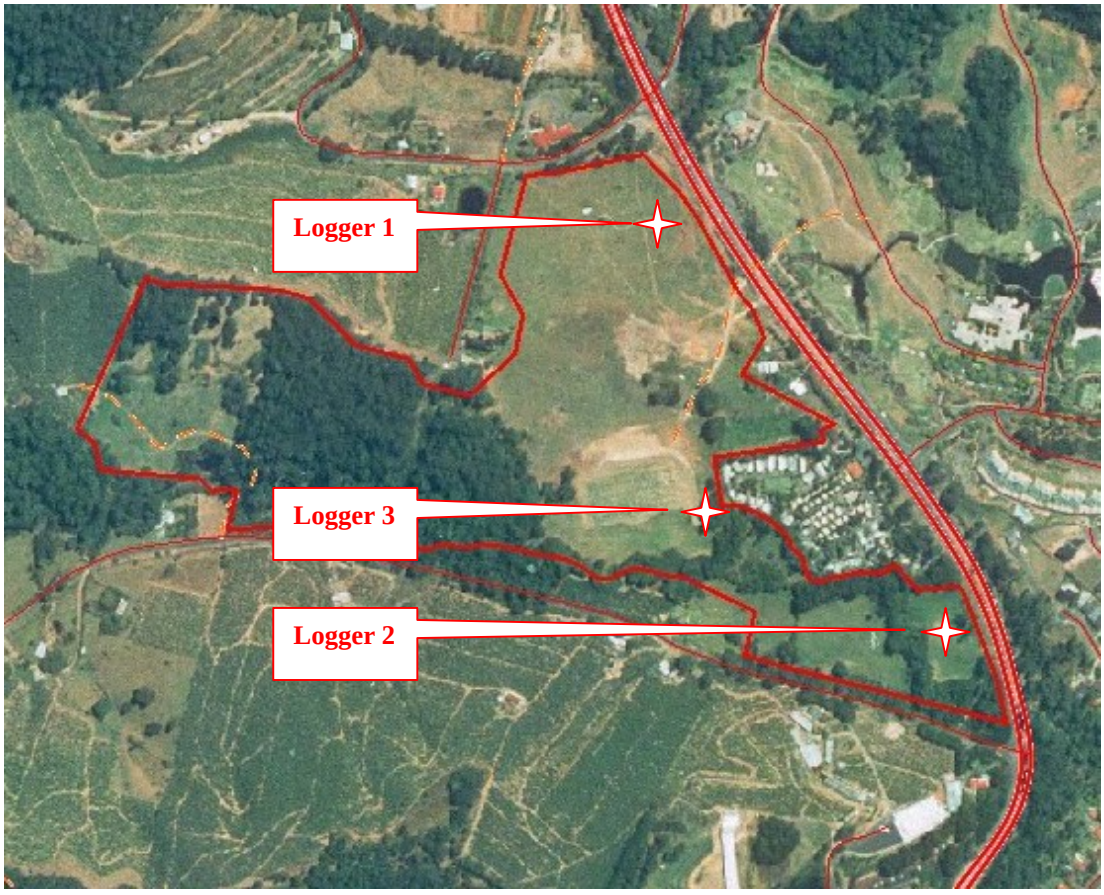


Figure 4 – Aerial Figure of Existing Site Location and Long-Term Unattended Monitoring Locations [Source: *NSW Department of Lands, Spatial information Exchange*]

Table 3-1 – Continuous Noise Logger Details

Measurement Title	Logger 1	Logger 2	Logger 3
Monitoring Location	Elevated location, representative of road traffic noise ingress into the site, approximately 50m separation distance between the logging location and the Pacific Highway.	Approximately 26m separation distance between the logging location and the Pacific Highway.	The western boundary of the caravan park.
Logger Serial No.	194561	194801	194803
Measurement period started at:	12:45, 27th March 2008	13:30, 27th March 2008	14:15, 27th March 2008
Measurement period ceased at:	12:45, 4th April 2008	12:30, 4th April 2008	12:45, 4th April 2008
Frequency Weighting	A	A	A
Time Response	Fast	Fast	Fast
Engineering Units	dB(A) SPL re:20µPa	dB(A) SPL re:20µPa	dB(A) SPL re:20µPa
Pacific Highway speed limit past the location.	80 km/hr	80 km/hr, although the 60km/hr transition is situated approximately 30m south of the site.	n/a

Figure 5 – View of Logger 1 Towards the Pacific Highway

Figure 6 – View From the Pacific Highway Towards Logger 1 Location

Figure 7 – View of Logger 2 Location, Situated at the Western end of the Sign

Figure 8 – View From Logger 2 Towards the Pacific Highway. Note the Speed Transition to 60km/hr from 80km/hr

Figure 9 – View of Logger Location 3 Facing Towards the South-East

Figure 10 – View of Logger 3 Facing Towards the North-West

3.2 Weather Monitoring Results

Meteorological data (wind speed, direction, rainfall) was obtained from the Coffs Harbour Bureau of Meteorology weather station, Aviation Drive, Coffs Harbour. The BoM Station is situated approximately 8km to the south of the site and therefore was considered to be an appropriate location to obtain indicative weather information for the purposes of this study.

The wind speed and rainfall weather details are presented graphically are presented in Figure 11. A graphical summary of the Wind Rose of wind direction versus wind speed (m/sec) and Annual Stability Class for Coffs Harbour [*Source: Bureau of Meteorology*] are provided in Appendix A.

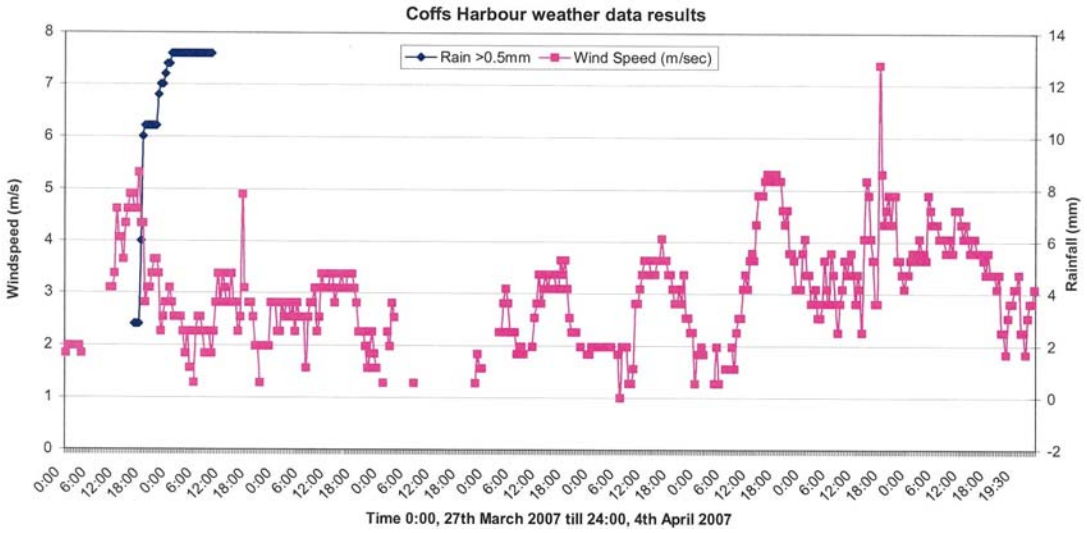


Figure 11 – Wind Speed and Rainfall Data Results, Coffs Harbour

3.3 Noise Monitoring Results

A summary of calculated background $L_{A90(period)}$ day, evening, and night for the monitoring period is provided in Table 3-2. A summary of calculated traffic noise descriptors $L_{Aeq\ (15hr)}$, $L_{Aeq\ (9hr)}$, and $L_{A10\ (18hr)}$ for the monitoring period is provided in Table 3-3[1].

Extraneous noise data where anomalous 'peaks' or 'spikes' were recorded which were not considered to be associated with the ambient background noise, were removed from the data sets.

As per the NSW INP, data was also excluded from the analysis set where wind data in excess of 5m/s was recorded during the monitoring period.

Detailed background noise levels for L_{A90} day, evening and night, $L_{Aeq(15hr)}$, $L_{Aeq(9hr)}$, $L_{A10(18hr)}$ and $L_{Aeq(1hr)}$ are provided in the tables of Appendix B.

A graphical summary of the daily long term noise monitoring results from each monitoring location are provided in Appendix C.

Long term noise monitoring and attended field observations indicated that the noise environment at logging location 1 & 2 was primarily described by traffic noise emanating from the Pacific Highway. Field observations noted that the ambient noise environment at monitoring location 3 were typically dominated by relatively low background noise levels with intermittent noise contributions from the likes of Pacific Highway traffic.

[1] Refer to Glossary page for definition of these parameters

Table 3-2 – Noise Monitoring Results – Background RBL L_{A90} Noise Levels

Monitoring	Day 7 am to 6 pm (RBL)	Evening 6 pm to 10 pm (RBL)	Night 10 pm to 7 am (RBL)
Logger 1	55	53	40
Logger 2	55	49	40
Logger 3	42	43	38

Table 3-3 – Noise Monitoring Results – Traffic Noise Descriptors

Monitoring location	$L_{Aeq(15hr)}$ 7:00 am to 10:00 pm [Average dB(A)]	$L_{Aeq(9hr)}$ 10:00 pm to 7:00 am [Average dB(A)]	$L_{A10(18hr)}$ 6:00 am to 12:00 pm [Average dB(A)]
Logger 1	64	62	67
Logger 2	66	65	70
Logger 3	51	47	51

Table 3-4 Highest Hourly $L_{Aeq\ (1\ hour)}$ (10 pm to 7 am)

Date	Logger 1	Logger 2	Logger 3
Thursday-27-Mar-08	65	67	46
Friday-28-Mar-08	61	64	43
Saturday-29-Mar-08	59	61	43
Sunday-30-Mar-08	62	64	46
Monday-31-Mar-08	64	67	49
Tuesday-1-Apr-08	64	67	48
Wednesday-2-Apr-08	64	67	55
Thursday-3-Apr-08	63	66	45
Friday-4-Apr-08	65	67	46
Maximum	**65**	**67**	**55**

3.4 Attended Monitoring Results

Attended noise monitoring was undertaken at the identified long term monitoring location, Logger 1, to gain a further understanding of the ambient noise environment in the vicinity of the proposed development. Measurements were taken approximately 1.5 metres above ground using a B & K 2250 Sound Level Meter (SLM). The SLM was programmed to record 15-minute statistical noise data.

Prior to deployment, the meter was calibrated using a Bruel and Kjaer Type 4231 sound level Calibrator (serial number 2022685) with a sound pressure level of 94 dB(A) at 1kHz. At completion of the measurements, the meter's calibration was re-checked to ensure readings were still correct.

Table 3-5 provides details of the SLM used for attended measurements.

Table 3-5 Attended Noise Monitoring Details at Logger Location 1

Meter Type	B & K 2250 Sound Level Meter
Meter Serial No.	2473295
Measurement Started	14:15, 27th March 2008
Measurement Ceased	14:30, 27th March 2008
Pre-measurement Calibration	94.0 dB(A)
Post Measurement Calibration Check	94.0 dB(A)
Frequency Weighting	A
Time response	Fast

Table 3-6 shows a summary of the results of attended monitoring conducted.

Table 3-6 Summary of Daytime Attended Noise Monitoring – 15 Minute dB(A)

Daytime Measurements	$L_{Aeq\ (15min)}$	$L_{A90\ (15min)}$	$L_{A1\ (15min)}$	$L_{Amax\ (15min)}$
Logger location 1 (27/3/08 14:15)	67.3	58.2	76.4	78.6

A traffic count was conducted over the same period, to gain a further understanding of the percentage of heavy vehicles along the Pacific Highway in the vicinity of the proposed development. Table 3-7 shows a summary of the results. The overall percentage of heavy vehicles was found to be approximately 7.38%.

Table 3-7 Summary of Attended Traffic Count

Location / Period	Southbound		Northbound	
	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles
Logger 1 (27/3/08 14:15 – 14:30)	207	17	236	18

4. Noise Criteria

4.1 Director General's Requirements

It is understood that Noise has been noted as one of the Key Issues of the Director General's Environmental Assessment Requirements (DGR's).

The Director General's Environmental Assessment Requirements (DGR's) pertaining to the key issue of noise, is:

> *"9.1 Address potential noise impacts, in particular road traffic noise, for future residents and appropriate mitigation measures, including consideration of the impacts of the RTA's Pacific Highway Upgrade."*

It is understood that the RTA's Pacific Highway Upgrade may entail acquisition of a portion of the western end of the site in order to construct a Motorway. Figure 12 presents the indicative road corridor.

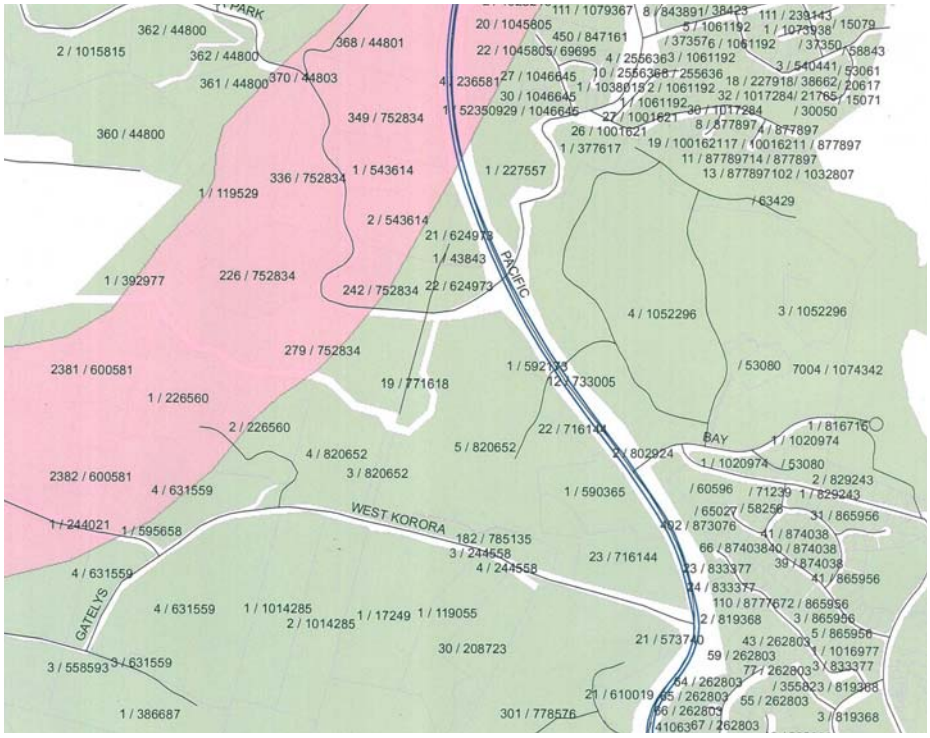


Figure 12 – Indicative Image of Proposed Road Corridor

Such a roadway would likely result in an increase in traffic noise levels across the site.

Mr Ian Greenbank of the NSW DECC Grafton, 27th May 2008, has concurred that at this stage of the planning for the proposed Pacific Highway Upgrade, that we adopt a desktop approach to this component of the DG requirements. Indicative predicted increases of traffic noise levels at modelled residential receivers on site are presented in Section 6.1.2 of this report.

At this stage, the assessment has been undertaken solely addressing potential future traffic noise levels from the existing roadways to the north, east and south of the site, Bruxner Park Road, the Pacific Highway and West Korora Road respectively. This is due to the many unknown variables of any final design of the proposed bypass to the west of the site.

4.2 Construction Noise

Criteria for the construction phase were sourced from Chapter 171 of the ENCM. The construction noise criteria were established using the measured daytime background noise levels (Table 3-2) and applying a conversion factor based on the expected construction period. The construction noise criteria based on the daytime background noise levels are detailed in Table 4-1. GHD understand that no construction activities are planned during evening or night time periods.

Table 4-1 Construction Noise Criteria, [$L_{A10(15min)}$ dB(A) Sound Pressure Level re:20µPa]

Construction Period	Level Restrictions	Logger 1	Logger 2	Logger 3
Less than 4 weeks	Background + 20 dB	75	75	62
Less than 26 weeks	Background + 10 dB	65	65	52
More than 26 weeks	Background + 5 dB	60	60	47

Note that the construction noise criteria for Logger Location 3 would be representative of criteria for residential receivers along the western boundary of the caravan park and the nearest residential receivers along West Korora Road, such as # 40.

GHD understand that construction work may extend for more than 26 consecutive weeks and as such the construction noise criterion should be considered as being Background + 5 dB(A).

Time restrictions are between 7am to 6pm Monday to Friday, and 8 am to 1 pm Saturday and at no time on Sundays and public holidays.

Construction activity outside those hours is not preferred but can usually occur provided the normal operational noise criteria are met and construction noise is not substantially audible or intrusive inside a dwelling. If construction work is required outside of these hours, the work methods and recommendations of Practice Note VII of the RTA's ENMM should be considered.

4.3 Road Traffic Noise Criteria

All changes in traffic flows on public roads must be assessed with consideration to the Environmental Criteria for Road Traffic Noise (ECRTN).

4.4 Development Affected by Road Traffic Noise

The ECRTN contains "base" target criteria for different types of development at sensitive receptors. For a new residential development affected by traffic noise, the ECRTN sets noise criteria based on the functional category of the road. The framework embodies a non-mandatory performance-based approach where the criteria are applied as targets.

For the purposes of this assessment the Pacific Highway is considered to be a freeway / arterial road[2] as it handles through traffic with characteristically heavy and continuous traffic flows during peak periods.

The "base" target road traffic noise criteria for a new residential development affected by sub-arterial traffic noise is shown in Table 4-2, as per Category 2 of Table 1 of the ECRTN.

Table 4-2 Criteria for New Residential Development Affected by Freeway / Arterial Traffic Noise

Type of Development	Criteria		
	Day (7am–10pm)	Night (10pm–7am)	Where Criteria are Already Exceeded
New residential developments affected by sub-arterial traffic noise.	$L_{Aeq(15hr)}$ 55 dB(A)	$L_{Aeq(9hr)}$ 50 dB(A)	Where feasible and reasonable, existing noise levels should be reduced to meet the noise criteria via judicious design and construction of the development. Locations, internal layouts, building materials and construction should be chosen so as to minimise noise impacts.

4.5 Internal Noise Levels

Guidance regarding internal noise levels are presented within Section 2 of the ECRTN. The DEC prefers internal noise level criteria to be set by the relevant planning or building authority, with levels depending on the type of development the planning authority wants to encourage within certain areas.

In the absence of specific local codes, the ECRTN recommends internal levels of 35–40 dB(A) at night for Sleeping areas, being the most sensitive area to noise impact.

Guidance for other living areas is that internal noise levels 10 dB below external levels are recommended on the basis of openable windows opened sufficiently to provide adequate ventilation, typically equating to a minimum of 20% of the window area being open.

For new residential developments affected by freeway / arterial traffic noise, the criteria is summarised in Table 4-3.

Table 4-3 Internal Criteria for New Residential Development Affected by Freeway / Arterial Traffic Noise

Type of Development	Internal Criteria		
	Day (7am–10pm)	Night (10pm–7am)	
New residential developments	55 – 10 =	Sleeping Areas	Other Living areas

2 As per the ECRTN classification of Freeway/Arterial roadways, that '*…carry predominantly through-traffic from one region to another, forming principal avenues of communication for urban traffic movements.*'

Type of Development	Internal Criteria		
	Day (7am–10pm)	Night (10pm–7am)	
affected by freeway / arterial traffic noise.	45dB(A)	35 to 40dB(A)	50–10 = 40dB(A)

In addition to the above criteria GHD recommend that an approach be adopted for the detailed design phase of the proposed development, whereby for each specific building type/area, the recommended satisfactory indoor sound level be determined from *AS/NZS 2107:2000 Acoustics – Recommended design sound levels and reverberation times for building interiors*, with the required building component construction chosen with consideration to the traffic noise reduction of *AS 3671:1989 Acoustics – Road Traffic Noise Intrusion – Building Siting and Construction* (AS3671).

An extract of AS2107 recommended design sound levels and reverberation times for residential buildings is shown in Table 4-4.

Table 4-4 Extract of 'Table 1 – Recommended Design Sound Levels for different areas of occupancy in buildings,' AS/NZS 2107-2000

Type of Occupancy/Activity	Recommended Design Sound Level, L_{Aeq}, dB(A)		Recommended Reverberation Time (T), Sec
	Satisfactory	Maximum	
7. Residential Buildings			
Dining Rooms	40	45	< 1.0
Enclosed carparks	55	65	-
Foyers and recreation areas	45	50	*
Kitchen, laundry and maintenance areas	45	55	-
Sleeping Areas –	30	35	-
- Hotels and Motels near minor roads	35	40	-
- Hotels and Motels near major roads	45	55	-
Washrooms and toilets			

Note: * Reverberation time should be minimized as far as practicable for noise control.
+ With reference to AS2107, Appendix A, Figure 1A mean reverberation times for selected spaces.

4.6 Sleep Disturbance

4.6.1 Sleep Disturbance Criteria - General

The NSW DECC publication ENCM[3], Chapter 19 provides consideration for sleep arousal levels. It states that noise control should be applied with the general intent to protect people from sleep arousal. The DECC's *Noise Guide for Local Government* provides further clarification on sleep disturbance.

[3] ENCM: The DECC's *Environmental Noise Control Manual* has been incorporated and superseded by other DECC policy documents, although still recognized as a useful source of information and planning reference document.

The purpose of sleep arousal guidelines is to address short high-level noise likely to cause awakening during night time period 10 pm to 7 am and 8 am on Sundays and Public Holidays. To achieve this, the $L_{A1(60\ seconds)}$ or L_{Amax} noise level of any specific noise source should not exceed the background noise level (L_{90}) by more than 15 dB(A) when measured 1 metre from outside a bedroom window.

4.6.2 Sleep Disturbance Criteria – Road Traffic Noise Related

Sleep arousal goals are not set within the ECRTN. To evaluate potential sleep disturbance where impacts may occur during the sensitive night period, the Environmental Noise Management Manual (ENMM) provides an assessment protocol based on the evaluation of the maximum noise level. Essentially, the number and degree of L_{max} noise events of individual vehicle pass-bys that exceed the L_{eq} for each hour of the night.

The maximum noise assessment is meant as a tool to help choose mitigation strategies and not as an ultimate criterion. As described in Section 4.5 of this report, the DECC prefers internal noise level criteria to be set by the relevant planning or building authority.

For *continuous* road traffic noise emission at residential receiver locations the ECRTN night period $L_{Aeq(9hr)\ noise}$ criteria apply.

For *intermittent* nighttime traffic a *"maximum noise event"* resulting from vehicle pass-by applies, defined as:

$$\mathbf{L_{max} - L_{eq(1hr)} \geq 15\ dB(A)}$$

Based on long-term monitoring conducted at location Logger 1 indicative criteria are expressed in Table 4-5.

Table 4-5 Sleep Disturbance Criteria – Intermittent and Continuous Night Time Road Traffic, dB(A)

Receivers	Continuous Traffic $L_{Aeq(9hr)}$	Intermittent Traffic $L_{max} \leq L_{eq(1hour)} + 15$ dB(A)
Residential receivers directly exposed to Pacific Highway traffic noise	[1]50	[2]75

Note: *1.* From Table 4-2, LAeq(9hr) level, criterion for new residential development affected by freeway/arterial traffic noise; and

2. From

Table 3-4, 63 $L_{Aeq\ (1\ hour)}$ (10 pm to 7 am) + 15 = 78dB(A).

5. Noise Modelling

5.1 Noise Modelling Software

Acoustic modelling was undertaken using Computer Aided Noise Abatement (CadnaA) to predict the effects of traffic and site related noise from the proposed development.

CadnaA is a computer program for the calculation, assessment and prognosis of noise propagation. CadnaA calculates environmental noise propagation according to ISO 9613-2, *"Acoustics – Attenuation of sound during propagation outdoors*". Ground absorption, reflection, terrain and relevant shielding objects are taken into account in the calculations.

Traffic noise modelling was conducted using the CadnaA program and The United Kingdom Department of Environment's *Calculation of Road Traffic Noise* (CoRTN).

The proposed development has been modelled based on available data at the time of assessment and, as such, should be used for comparison purposes only.

5.2 Ground Contours and Buildings

Digital terrain contours and cadastral data were provided by the Client and utilised in the model.

Assumed building footprints situated within the indicative Lot layouts were used within the noise model. Only single storey receivers were modelled 1.5m above ground level, the buildings each being set at 4.5m high above ground.

5.3 Noise Models

A traffic noise model was used to predict potential increase in noise levels due to the expected growth in traffic volumes on Bruxner Park Road, West Korora Road and the Pacific Highway.

The traffic noise model was first verified with measured traffic noise data to ensure predicted noise levels were accurate. This formed a base onto which the traffic noise model could be adjusted to include predicted traffic increases due to the proposed development.

5.4 Model Configuration

The following assumptions were made with regard to the model configuration:

- A general ground absorption coefficient of 0.5 was used throughout the model;
- The roads and car park were set to have a ground absorption coefficient of zero (reflective);
- For daytime, atmospheric conditions of 20°C and 70% humidity were used; and
- Due to the close proximity of the residential receivers, and the minor extent of prevailing winds that would enhance Pacific Highway noise across the site, all noise models were assessed under neutral meteorological conditions.

5.5 Noise Source Details

The following presents a summary of the operational noise sources used in this assessment.

5.5.1 Traffic Data

GHD traffic engineers supplied existing peak period traffic data for the roads surrounding the proposed development.

Table 5-1 presents the results of the peak period traffic survey completed in March 2008 and predicted 4% per annum traffic volume increases based on year 2008 volumes.

Table 5-1 Traffic Movement

	Pacific Highway	Bruxner Park Road	West Korora Road
Existing peak period traffic (Year 2008)	2300	63	30
Predicted year 2008 (No development) 18hr (6am-midnight) traffic volume.	41396	63	30
Predicted year 2019 (No development) 18hr (6am-midnight) traffic volume.	63726	97	46

5.6 Traffic Noise Model Validation

Outputs of the traffic noise model were validated against the $L_{A10,\ 18hr}$ noise levels measured during the monitoring period and site visits. Site monitoring was measured at free-field locations. A comparison of the measured and predicted free-field noise levels is presented in Table 5-2. Refer to Figure 13 for the $L_{A10,\ 18hr}$ predicted existing noise contours across the site.

Table 5-2 Comparison of Monitoring Results and Prediction Results $L_{A10,\ 18hr}$ dB(A)

Location	Measured Results $L_{A10,\ 18hr}$	Modelled Results $L_{A10,\ 18\ hr}$	Difference
Logger 1[1]	67.0	66.8	- 0.2
Logger 2[1]	69.5	71.1	+ 1.6

[1] This logger location is directly exposed to Pacific Highway Road traffic noise.

These results show a close correlation between the measured and modelled results, with variations of less than 2 dB(A). Therefore the traffic noise model is considered to be a valid approximation of the measured acoustic environment.

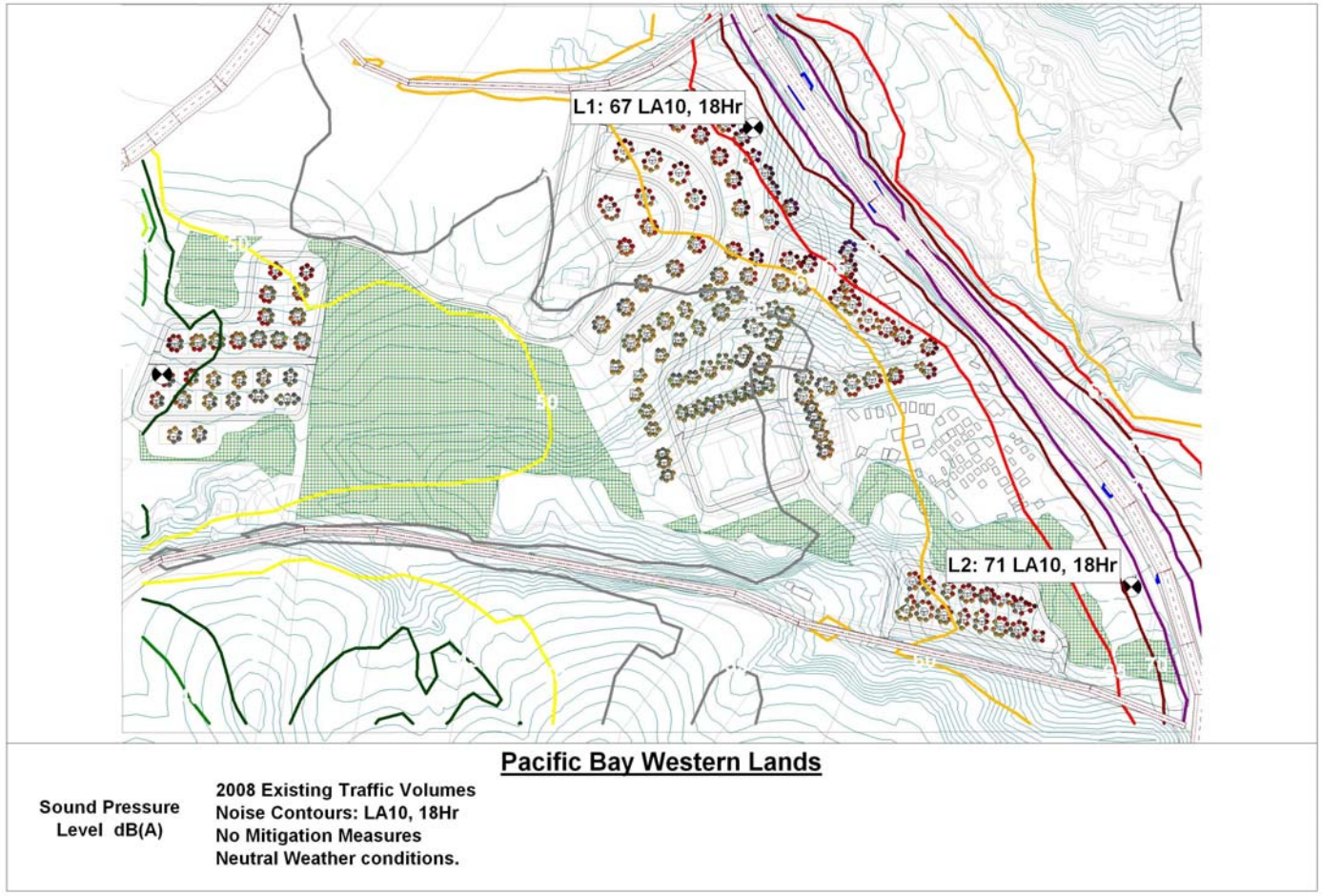


Figure 13 – Predicted Existing (Year 2008) Traffic Noise Contours $L_{10\ (18hr)}$ dB(A)

6. Assessment of Potential Noise Impacts

6.1 Traffic Noise

6.1.1 Predicted Traffic Noise Contribution From Existing Roadways

The CoRTN model outputs are $L_{A10(18hr)}$ values. These need to be converted to $L_{Aeq(15hr)}$ and $L_{Aeq(9hr)}$ to suit the ECRTN criteria.

The predicted $L_{Aeq(15hr)}$ and $L_{Aeq(9hr)}$ were derived using the relationships outlined in 'Table 2: Factors for simple conversion between road traffic noise descriptors' of the Austroads' document, *"Modelling, Measuring and Mitigating Road Traffic Noise"* (2005) AP-R277/05:

$L_{Aeq(15hr)} = L_{A10(18hr)} – 2.2dB(A)$

$L_{Aeq(9hr)} = L_{A10(18hr)} – 5.1dB(A)$

The ECRTN states that the acceptable traffic noise levels incorporate an allowance for reflection from the facade of any building under investigation. When measurements are taken at a distance of 1 meter from the nearest façade a correction factor of 2.5 dB(A) should be added to the results. Façade reflection has not been taken into account in the model noise contour predictions, hence a façade correction factor of 2.5 dB(A) has been manually applied to the predicted receiver levels.

The Austroads Research Report, *"An Approach to the Validation of Road Traffic Noise Models"* (2002) provides guidance on applying conversion factors to noise levels generated by CoRTN for Australian roads. The results of the ARRB Transport Research study are shown below in Table 6-1.

Table 6-1 Australian Road Conversions – ARRB Study – Austroads 2002

Parameter	With Facade
Mean	1.7 dB
Standard Deviation	2.5 dB
Number of Sites	41

Source: Saunders et al 1983

Correction factors were applied to the predicted results to incorporate the ARRB façade corrections for Australian roads (-1.7 for facades and –0.7 for free field), as well as the 2.5 dB(A) façade correction for reflection, as per ENMM guidelines.

Modelling results are based on available information provided and should only be used as a guide for comparative purposes.

Figure 14and Figure 15 show predicted project opening year 2019 traffic noise contours $L_{10\ (18hr)}$ dB(A).

Error! Reference source not found. Figure 14 indicates that predicted non-compliance to the daytime ECRTN criterion ($L_{Aeq(15hr)}$ 55dB(A)) is likely within:

- Lots located in the southeast corner of the site (Lots No. 98 – 112); and
- Lots modelled adjacent to the pacific highway and those situated in the northern end of the site.

Figure 15 indicates that predicted non-compliance to the night period ECRTN criterion ($L_{Aeq(9hr)}$ 50dB(A)) is likely within:

- All of the eastern half of the development (Lot No. 1 – 112); and
- The north-eastern most houses of the western half of the development (Lot No. 115 – 119).

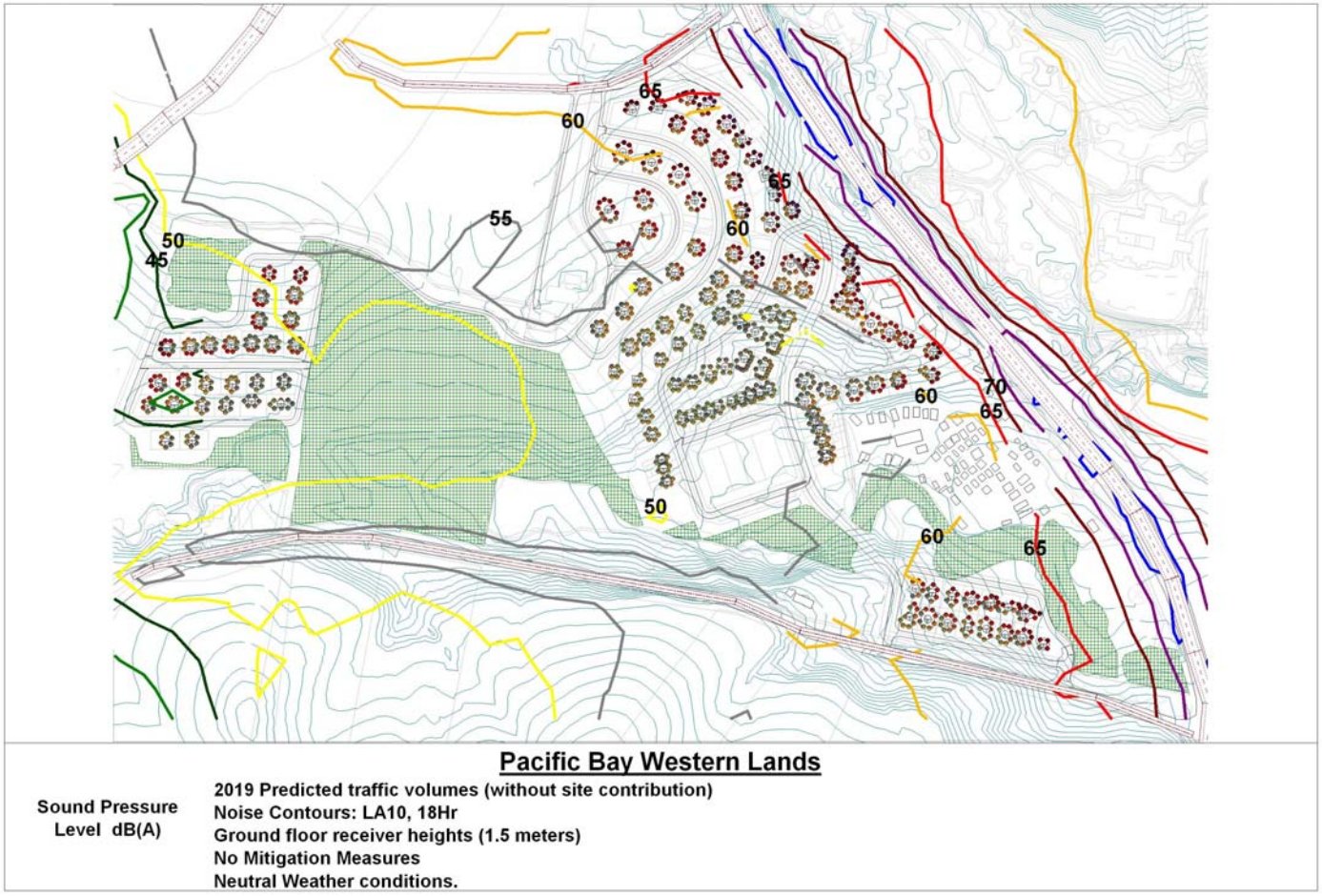


Figure 14 – Predicted Project Opening Year 2019 Traffic Noise Contours $L_{10\ (18hr)}$ dB(A) - Daytime

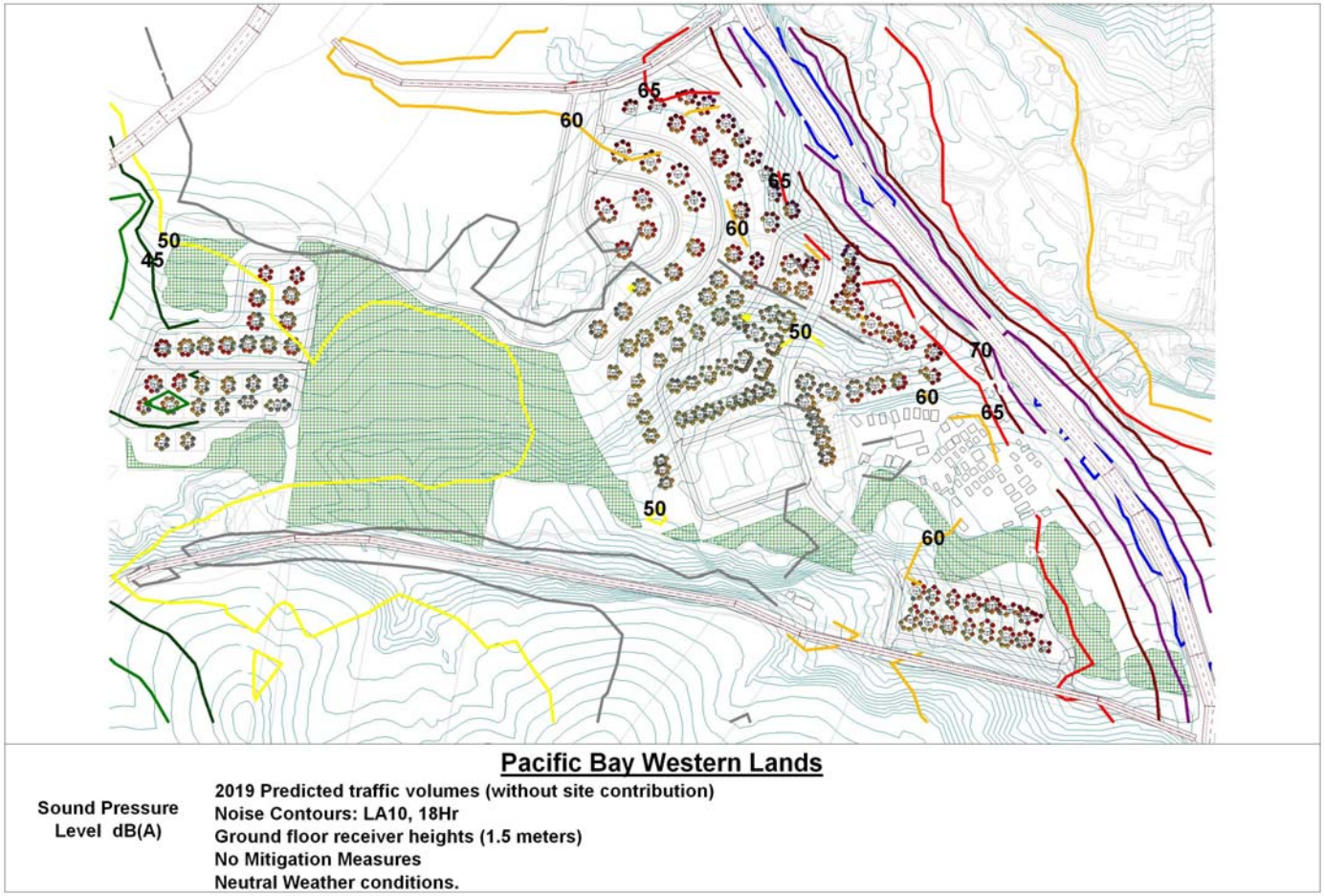


Figure 15 – Predicted Project Opening Year 2019 Traffic Noise Contours $L_{10\ (18hr)}$ dB(A) – Night Time

6.1.2 Predicted Traffic Noise Contribution Including Proposed Upgrade

This section outlines the predicted potential future traffic noise levels at modelled receiver locations resulting from a desktop modelling of the proposed Pacific Highway Upgrade.

Comparison of the cumulative predicted levels is made with the predicted potential future traffic noise level from the existing roadways to the north, east and south of the site, Bruxner Park Road, the Pacific Highway and West Korora Road respectively.

Modelling assumptions of the proposed Pacific Highway Upgrade to the west of the site include:

- Motorway class roadway centred between the indicated corridor extent shown in Figure 12;
- The relative height of the motorway has been set relative to the digital terrain model of the known existing ground contours in the vicinity of the site;
- 2019 predicted vehicle counts per 18Hr of 20123 along the motorway;
- Predicted percentage of heavy vehicle during the day period of 25% and 45% during the night period;
- Predicted vehicle speed of 110km/hr; and
- No noise attenuation modelled of roadside barriers, cuttings, fills or road surface type.

Table D-1 in Appendix D outlines the predicted received traffic noise levels at the facades of the buildings to be located on the proposed Lots within the development area. The construction categories corresponding to the received traffic noise levels are also given. The results indicate that the Lot numbers fall into either Construction Category 2 or 3. Further detail regarding the construction categories are given in Section 7.

7. Recommended Mitigation Measures

7.1 Traffic Noise – Architectural Noise Mitigation Measures

In the event of any proposed new residential development being constructed within the study area zones in close proximity to the existing and proposed roadways where non-compliance to site specific ECRTN traffic noise goals is predicted, GHD suggest that all feasible[4] and reasonable[5] noise control options should be investigated. As such, architectural noise mitigation measures are detailed in the following Section.

7.1.1 Internal Noise Mitigation

Appropriate site planning, building design, and the use of insulation and sound absorbing materials in building construction could be utilised as outlined below for any proposed residences fronting any of the surrounding roadways. GHD recommend the following building processes and ways to design a house to mitigate road traffic related noise intrusion.

Using building materials, which insulate or absorb sound in the floors, walls, ceilings and roofs is another way of keeping traffic noise out of the home. For example, adding thermal insulation to the ceiling can reduce noise levels by 7 to 8 decibels.

Table D-1 in Appendix D of this report outlines the various construction categories applicable to individual lots within the proposed development area. The construction categories applicable to residential buildings exposed to different external traffic noise levels ($L_{Aeq,T}$) are shown in Table 7-1.

Table 7-1 Construction categories required to achieve indoor sound levels recommended as satisfactory in AS2107.

Type of Building	Category	Traffic Noise Level ($L_{Aeq,T}$) [dB(A)]	Definition of Construction Category
Residential buildings (private houses, hotels)	1	$L_{Aeq,T} \leq 45$	Standard construction; Openings, including open windows and doors may comprise up to 10% of the exposed façade.
	2	$45 < L_{Aeq,T} \leq 60$	Standard construction, except for lightweight elements such as plasterboard or metal cladding or all-glass façades. Windows, doors and other openings must be closed.
	3	$60 < L_{Aeq,T} \leq 75$	Special construction, chosen in accordance with AS3671 component selection derivations. Windows, doors and other openings must be closed.
	4*	$L_{Aeq,T} > 75$	Detailed and specialist acoustic advice to be sought.

[4] With reference to engineering practicality.

[5] A weighted analysis of factors such as: Costs and benefits of mitigation; Community comment; Aesthetic impacts; Existing & future noise levels at affected sensitive receivers; and, the overall benefit of the development.

Notes: * Category 4 is not applicable as the predicted received noise levels are less than 75 dB $L_{Aeq,T}$

Taken from Appendix B of AS3671 and based on assumptions of element dimensions, the weighted sound reduction index (R_W) data for a number of representative components and constructions per category are provided below:

- **Category 1:**
  - External Walls –
    - Conventional timber stud-framed walls, clad externally with 9mm thick-timber or hardboards or flat cellulose-cement sheets, and internally lined with 10mm thick plasterboard or 6mm thick hardboard; or
    - As above, plus cavity filled with mineral wool, or weatherboards backed by 12mm thick wood fibreboard, or similar;
  - Ceiling/Roof systems –
    - Pitched roof clad with tiles, or 0.5mm corrugated galvanised iron or 6mm corrugated cellulose-cement over 100 gypsum plasterboard, or similar; or
    - Flat 0.6mm galvanized steel tough roofing, attached to the same timber framework and about 150mm above, the same ceiling as above;
  - External Windows – Typically single glazing 4 – 6mm thickness, or similar;
  - External Doors – Solid-core approximately 35mm thick plywood door with appropriate acoustic seals around sides, top and base, or similar.

- **Category 2:**
  - External Walls – Double-skin (cavity) clay brick wall, 270mm thick in which the wall space is ventilated by connection with sub-floor vents; Upper part of internal wall sheeting is exposed to, and penetrated by upper wall vents leading to, the eaves space, or similar;
  - Ceiling/Roof systems:
    - As for Category 1 above, but with ceiling of two layers of gypsum plaster board, , or similar; or
    - Pitched tiled roof and ceiling as for Category 1, plus 2-sided aluminium foil over rafters, or similar;
  - External Windows – Appropriate double glazing system or 10-14mm thick single glazing;
  - External Doors – Solid-core approximately 35mm thick plywood door with appropriate acoustic seals around sides, top and base, or similar.

- **Category 3:**
  - External Walls – 220mm cavity brick wall of two leaves of 90 mm extruded perforated modular bricks with a 40mm cavity, overall thickness 220mm, surface density 310 kg/, or similar; or
  - Single-leaf wall of 230mm x 110mm x 76mm rendered 13mm both sides, overall thickness 140mm, surface density 230kg/m^2 or similar, or
  - Poured dense concrete, 100mm thick, or similar;

- Ceiling/Roof systems –
    - As for Category 2 above, plus 50mm, 12kg/m^2 glass fibre blanket between ceiling joists, or similar;
    - As for option 2 of Category 1, plus 75mm thick 85 kg/m^3 mineral wool batts, or 100mm thick 45 kg/m^3 cellulose fibre fluff between ceiling joists, or similar;
- External Windows – Appropriate double glazing system;
- External Doors – Solid-core approximately 42mm thick plywood door with appropriate acoustic seals around sides, top and base, or similar.

8. Conclusion

Noise monitoring and establishment of indicative project specific noise goals was undertaken on behalf of Thakral Holdings Limited as part of the environmental assessment for the proposed development known as the Pacific Bay Resort (Western Lands).

Results of the assessment suggest traffic noise onto the site has the potential to adversely affect the development site.

Results of noise monitoring adjacent to the Pacific Highway indicated that existing traffic noise is a feature of the ambient environment in the area, and current traffic noise levels exceed ECRTN criteria for a new residential development affected by freeway / arterial road traffic noise at the monitoring locations representative of nearest proposed building footprints.

Predicted traffic noise levels at the facades of Lots within the proposed development were outlined in Table D-1 (Appendix D) of this report. The predicted results indicated that both the ECRTN external and internal residential criteria might potentially be exceeded at some of the future building locations.

GHD suggest that feasible and reasonable architectural noise control mitigation measures and options should be implemented, endeavouring to meet the internal noise criteria.

In-principle internal noise mitigation measures with consideration to the construction categories required to achieve indoor sound levels recommended as satisfactory in AS2107 are shown in Table D-1 (Appendix D).

Examples of construction materials corresponding to the construction categories are shown in Table 7-1.

By using standard acoustic attenuation mitigation measures it can be reasonably expected that ECRTN adopted road traffic noise levels may be achieved for future proposed residences within the assessment site.

9. References

9.1 Acoustics

NSW DEC, *Environmental Criteria for Industrial Noise Policy (INP)*, January 2000.

NSW DEC *Application Notes to the NSW Industrial Noise Policy*, released 4th May 2006.

- DEC NSW, Environmental Criteria for Road Traffic Noise, Roads and Traffic Authority, Environmental Protection Authority, Chatswood, 1999;
- NSW Roads & Traffic Authority publication, RTA Environmental Noise Management Manual (ENMM), Version 1, Issued December 2001;
- Australian Standards AS/NZS 2107:2000, *Acoustics – Recommended design sound levels and reverberation times for building interiors*; and
- Australian Standards AS 3671:1989, Acoustics – Road traffic noise intrusion – Building siting and construction.

CadnaA Computer Aided Noise Abatement Manual, Version 3.5, Greifenberg 2005. CadnaA is a registered trademark of Datakustik GmbH, Greifenberg, Germany).

Appendix A

Bureau of Meteorology Wind Roses & Stability Class

BoM Wind Rose and Stability Class, Coffs Harbour, 1998

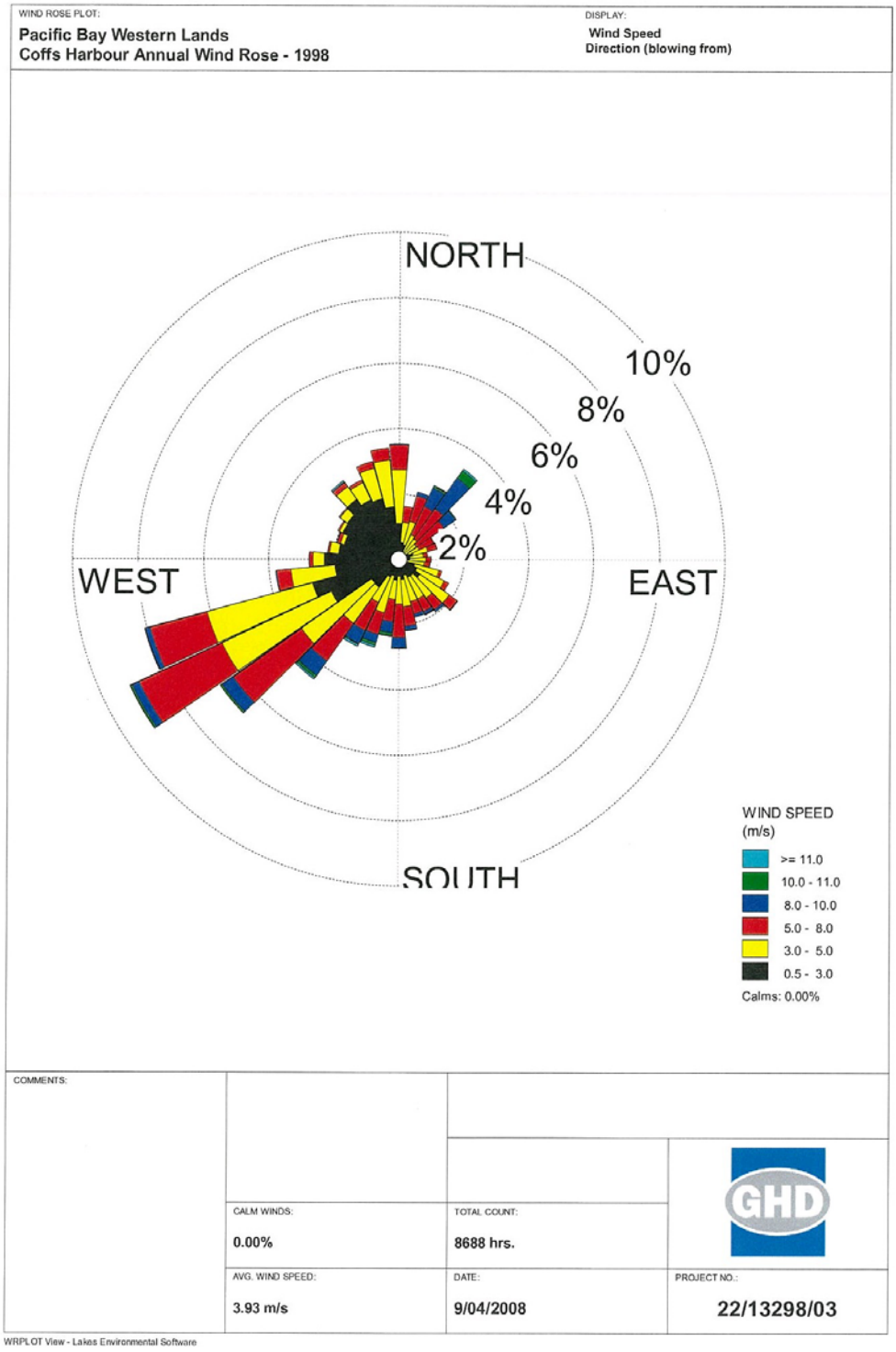


Figure A-16 – Wind Rose of Wind Direction Versus Wind Speed (M/Sec) at Coffs Harbour, 1998 [*Source: Bureau of Meteorology*]

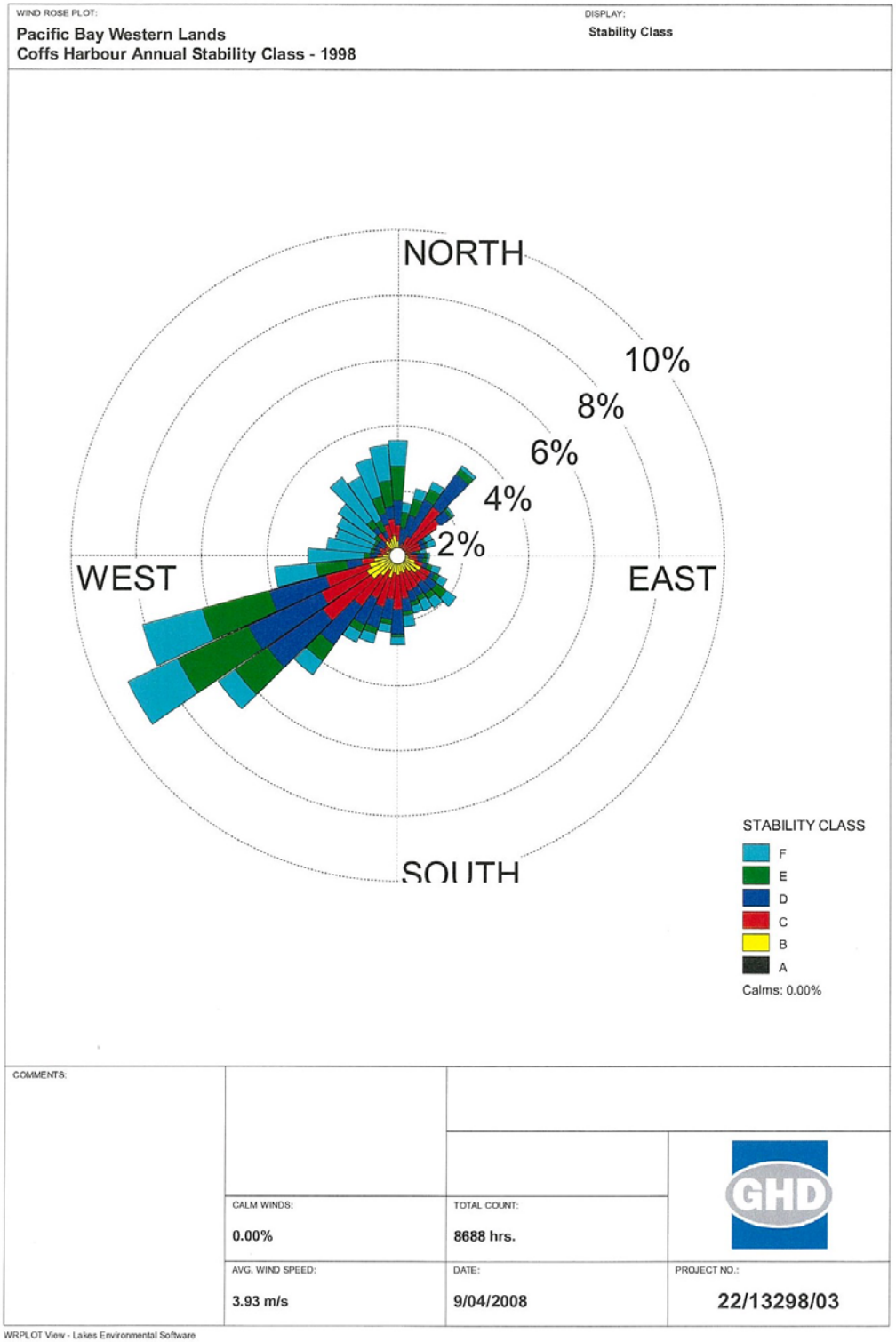


Figure A-17 – Annual Stability Class for Coffs Harbour, 1998

Appendix B

Noise Monitoring Results

Detailed Background Noise Levels Each Logger Location:

- L_{A90} day, evening and night;
- $L_{Aeq(15hr)}$;
- $L_{Aeq(9hr)}$; and
- $L_{A10(18hr)}$.

Table B-9-1 - Logger Location 1 – Noise Monitoring Results – Background L_{A90} ABL & RBL Noise Levels

Date	Day 7 am to 6 pm	Evening 6 pm to 10 pm	Night 10 pm to 7 am
Thursday-27-Mar-08	-	50.8	40.5
Friday-28-Mar-08	56.5	55.5	40.0
Saturday-29-Mar-08	54.2	50.5	35.0
Sunday-30-Mar-08	53.5	49.0	37.5
Monday-31-Mar-08	55.1	51.8	39.8
Tuesday-1-Apr-08	54.5	54.7	41.5
Wednesday-2-Apr-08	54.7	59.1	50.0
Thursday-3-Apr-08	56.6	55.8	54.3
Friday-4-Apr-08	-	-	-
RBL	55	53	40

Table B-9-2 Logger Location 2 – Noise Monitoring Results – Background L_{A90} ABL & RBL Noise Levels

Date	Day 7 am to 6 pm	Evening 6 pm to 10 pm	Night 10 pm to 7 am
Thursday-27-Mar-08	-	50.4	39.6
Friday-28-Mar-08	57.5	48.5	39.3
Saturday-29-Mar-08	55.0	48.5	37.0
Sunday-30-Mar-08	54.4	48.8	35.8
Monday-31-Mar-08	55.0	51.0	41.0
Tuesday-1-Apr-08	55.5	49.5	41.8
Wednesday-2-Apr-08	55.0	48.8	41.5
Thursday-3-Apr-08	57.1	48.6	45.8
Friday-4-Apr-08	-	-	-
RBL	55	49	40

Table B-9-3 - Logger Location 3 – Noise Monitoring Results – Background L_{A90} ABL & RBL Noise Levels

Date	Day 7 am to 6 pm	Evening 6 pm to 10 pm	Night 10 pm to 7 am
Thursday-27-Mar-08	-	43.7	36.5
Friday-28-Mar-08	42.1	41.0	36.0
Saturday-29-Mar-08	40.7	41.0	34.5
Sunday-30-Mar-08	41.0	42.5	35.0
Monday-31-Mar-08	41.5	44.5	39.0
Tuesday-1-Apr-08	42.0	43.2	38.5
Wednesday-2-Apr-08	42.7	44.0	42.0
Thursday-3-Apr-08	44.6	41.1	40.8
Friday-4-Apr-08	-	-	-
RBL	42	43	38

Table B- 9-4 Logger Location 1 Noise Monitoring Results – $L_{A10(18hr)}$, $L_{Aeq(24hr)}$, $L_{Aeq(15hr)}$, $L_{Aeq(9hr)}$

Date	L10 18hr [6:00 am to 10:00 pm]	Leq 24hr [12:00 am to 12:00 am]	Leq 15hr [7:00 am to 10:00 pm]	Leq 9hr [10:00 pm to 7:00 am]
Thursday-27-Mar-08	70.0	65.9	66.2	62.8
Friday-28-Mar-08	67.5	63.7	64.4	60.2
Saturday-29-Mar-08	66.0	61.8	62.7	56.4
Sunday-30-Mar-08	66.0	61.4	62.7	59.6
Monday-31-Mar-08	67.0	63.1	64.1	63.2
Tuesday-1-Apr-08	67.5	63.8	64.3	62.9
Wednesday-2-Apr-08	66.5	63.3	63.9	62.6
Thursday-3-Apr-08	67.0	63.2	64.1	63.0
Friday-4-Apr-08	59.0	56.3	56.3	-
Overall	67	63	64	62

Table B-9-5 - Logger Location 2 Noise Monitoring Results – $L_{A10(18hr)}$, $L_{Aeq(24hr)}$, $L_{Aeq(15hr)}$, $L_{Aeq(9hr)}$

Date	L10 18hr [6:00 am to 10:00 pm]	Leq 24hr [12:00 am to 12:00 am]	Leq 15hr [7:00 am to 10:00 pm]	Leq 9hr [10:00 pm to 7:00 am]
Thursday-27-Mar-08	72.0	68.3	68.7	65.9
Friday-28-Mar-08	70.0	66.2	66.6	63.7
Saturday-29-Mar-08	68.3	64.3	64.8	58.3
Sunday-30-Mar-08	68.5	63.6	65.0	62.6
Monday-31-Mar-08	69.5	65.5	66.5	65.8
Tuesday-1-Apr-08	69.5	66.1	66.2	65.9
Wednesday-2-Apr-08	69.0	66.0	66.4	65.3
Thursday-3-Apr-08	69.5	65.9	66.5	65.7
Friday-4-Apr-08	68.0	64.0	64.0	-
Overall	70	66	66	65

Table B-9-6 Logger Location 3 Noise Monitoring Results – $L_{A10(18hr)}$, $L_{Aeq(24hr)}$, $L_{Aeq(15hr)}$, $L_{Aeq(9hr)}$

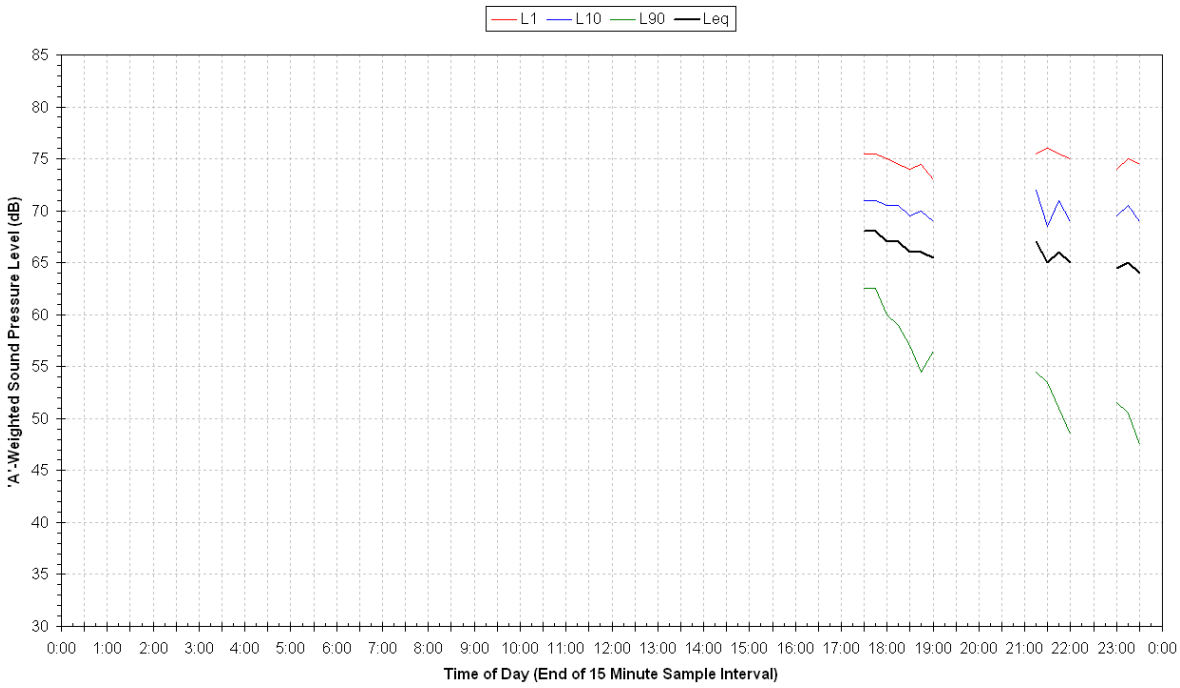
Date	L10 18hr [6:00 am to 10:00 pm]	Leq 24hr [12:00 am to 12:00 am]	Leq 15hr [7:00 am to 10:00 pm]	Leq 9hr [10:00 pm to 7:00 am]
Thursday-27-Mar-08	52.0	51.1	52.0	44.3
Friday-28-Mar-08	50.0	48.8	50.3	42.3
Saturday-29-Mar-08	48.5	47.4	48.9	42.2
Sunday-30-Mar-08	49.5	47.7	49.1	44.5
Monday-31-Mar-08	51.3	49.2	50.5	48.0
Tuesday-1-Apr-08	50.5	51.4	53.0	46.9
Wednesday-2-Apr-08	52.3	49.2	51.7	52.3
Thursday-3-Apr-08	54.0	52.8	53.7	45.0
Friday-4-Apr-08	51.0	48.7	48.7	-
Overall	51	50	51	47

Appendix C

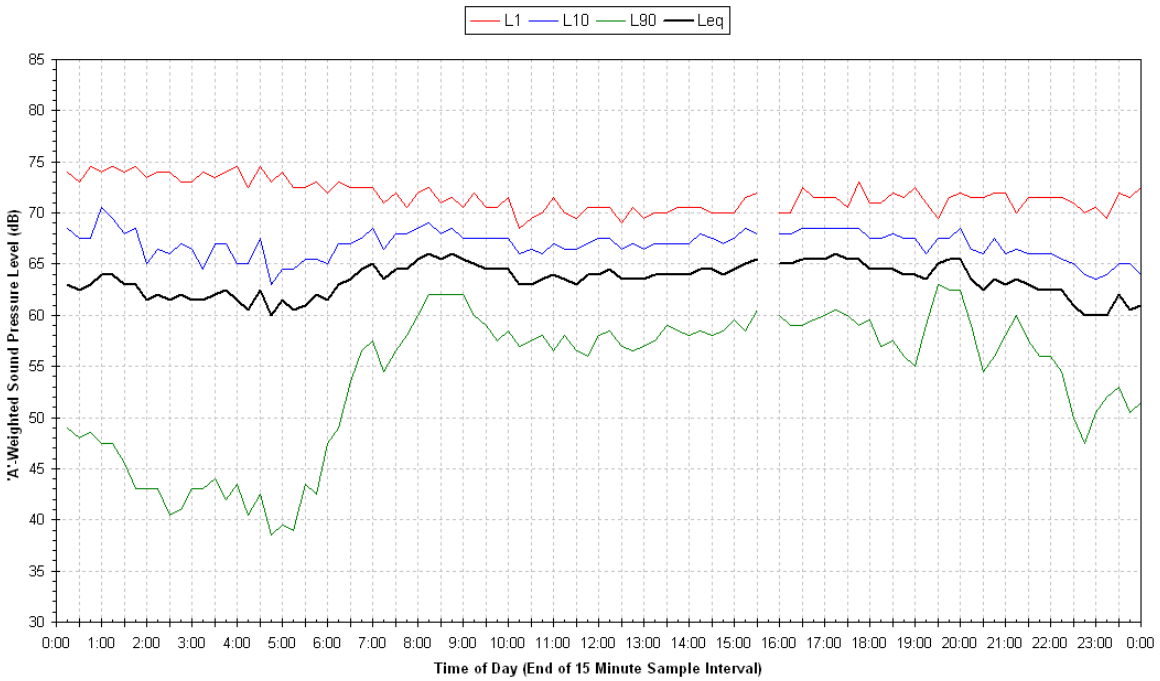
Noise Monitoring Charts

Daily Charts of Background Noise Levels for Each Logger Location

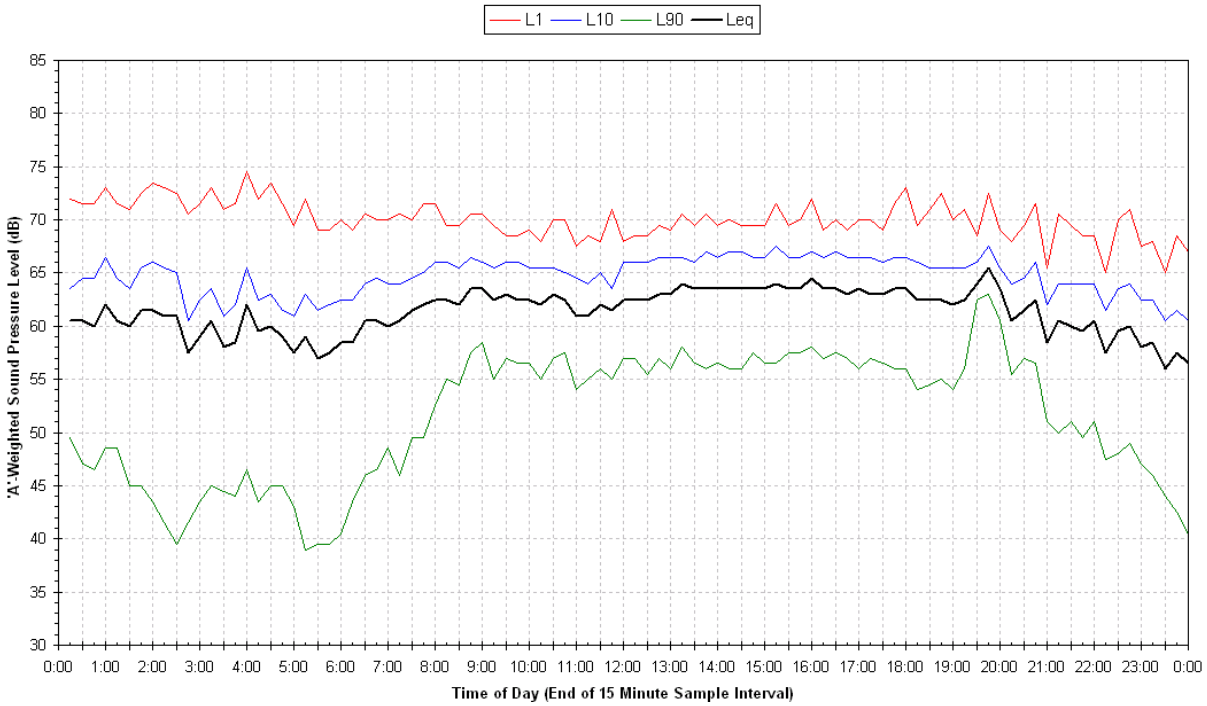
Statistical Ambient Noise Levels
194561 - Thursday 27 March 2008



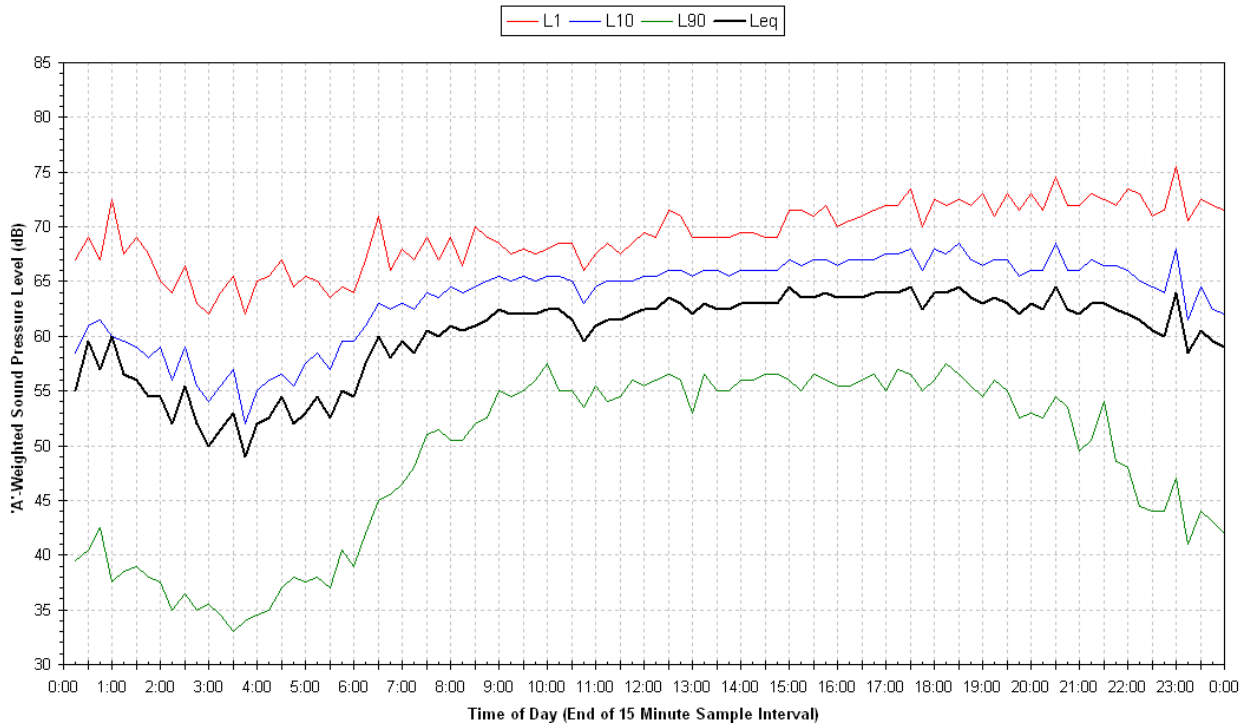
Statistical Ambient Noise Levels
194561 - Friday 28 March 2008

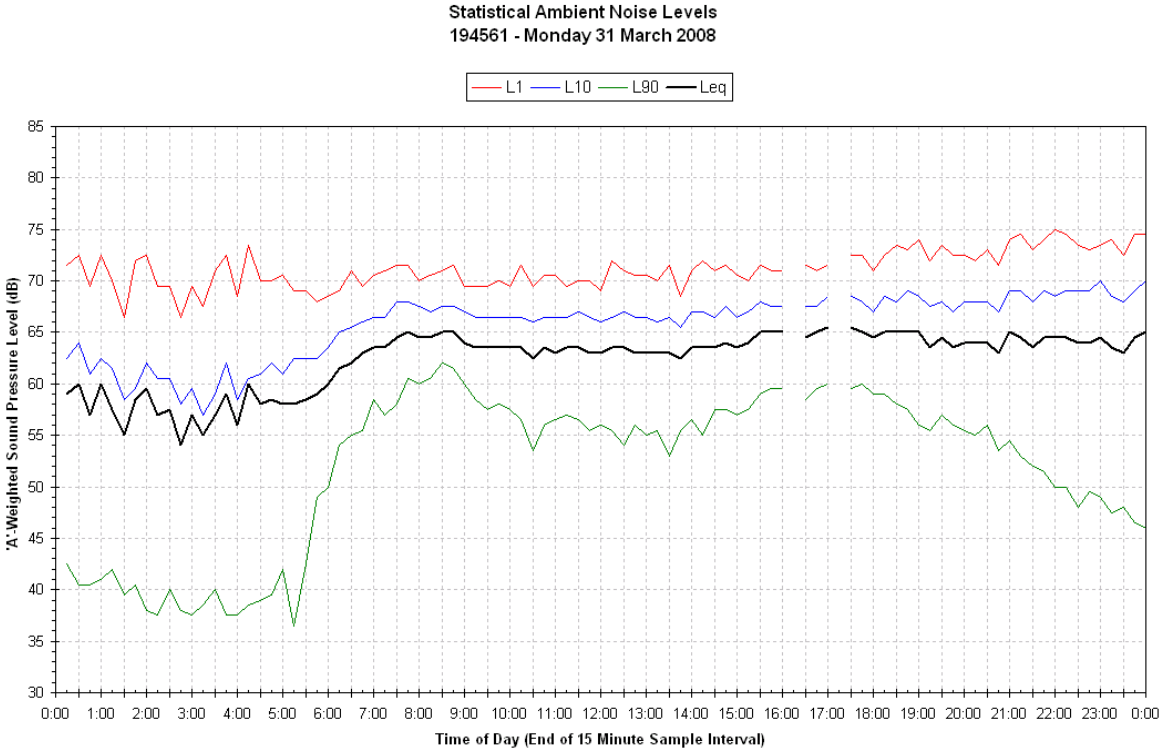


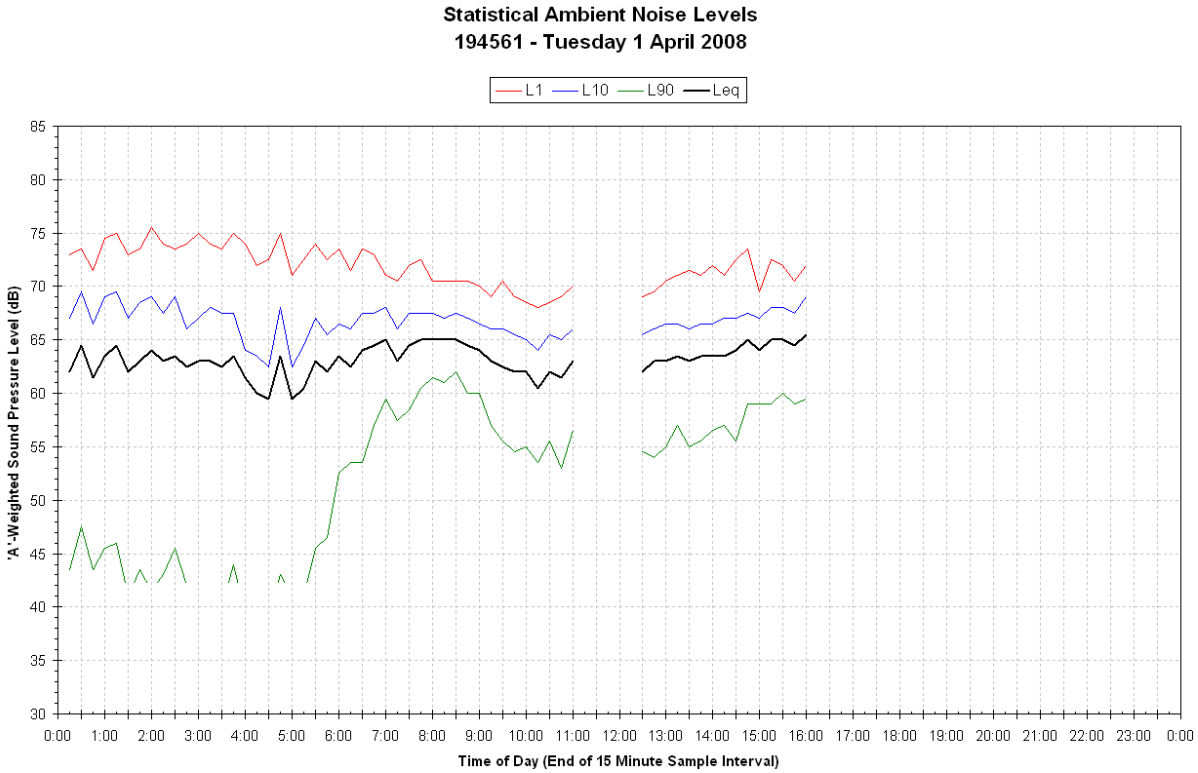
Statistical Ambient Noise Levels
194561 - Saturday 29 March 2008



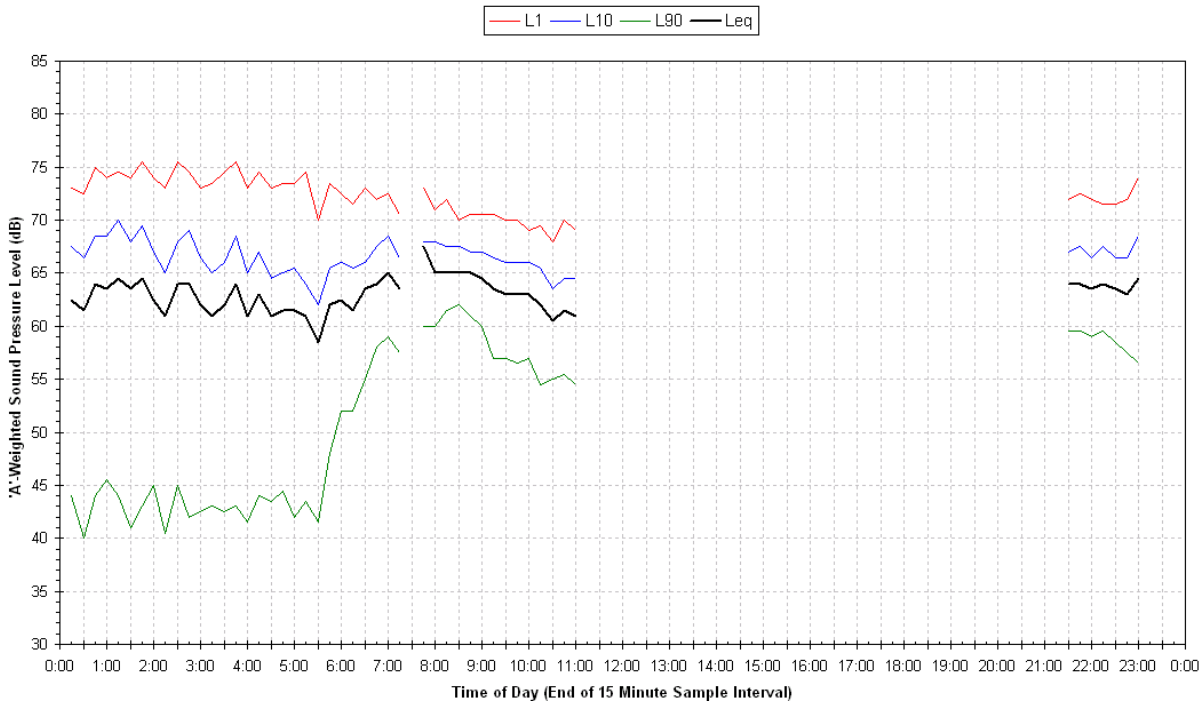
Statistical Ambient Noise Levels
194561 - Sunday 30 March 2008



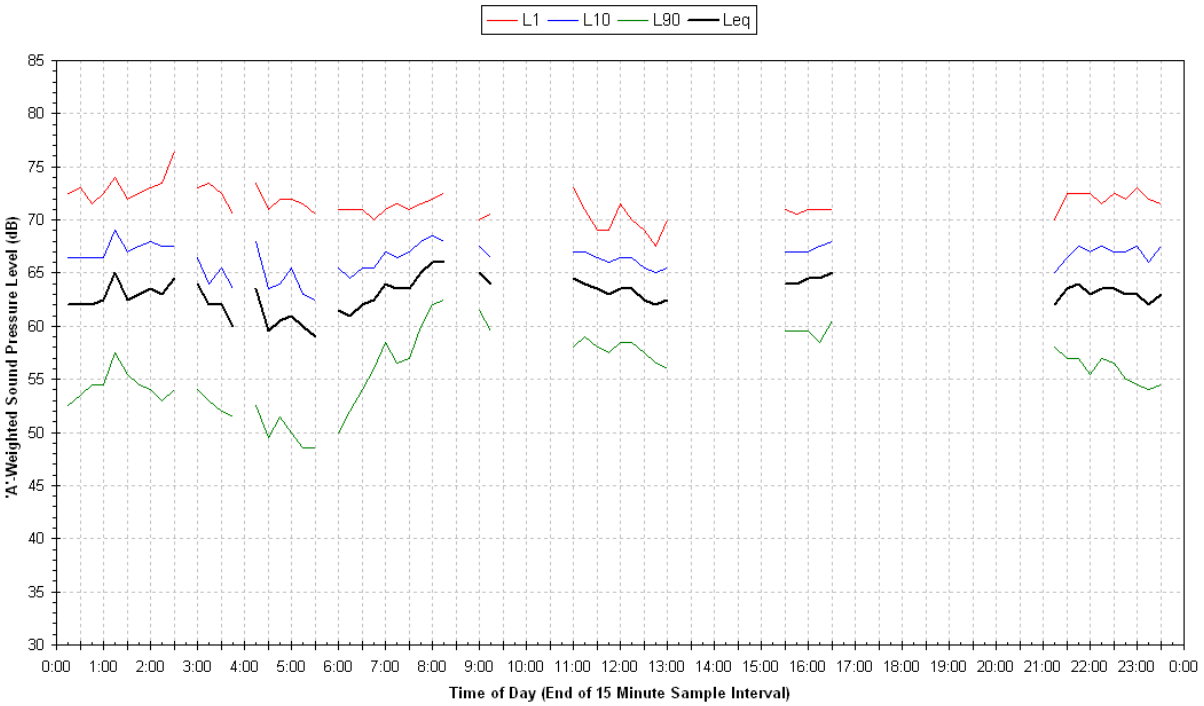

Statistical Ambient Noise Levels
194561 - Monday 31 March 2008
L1
L10
L90
Leq
'A'-Weighted Sound Pressure Level (dB)
85
80
75
70
65
60
55
50
45
40
35
30
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time of Day (End of 15 Minute Sample Interval)

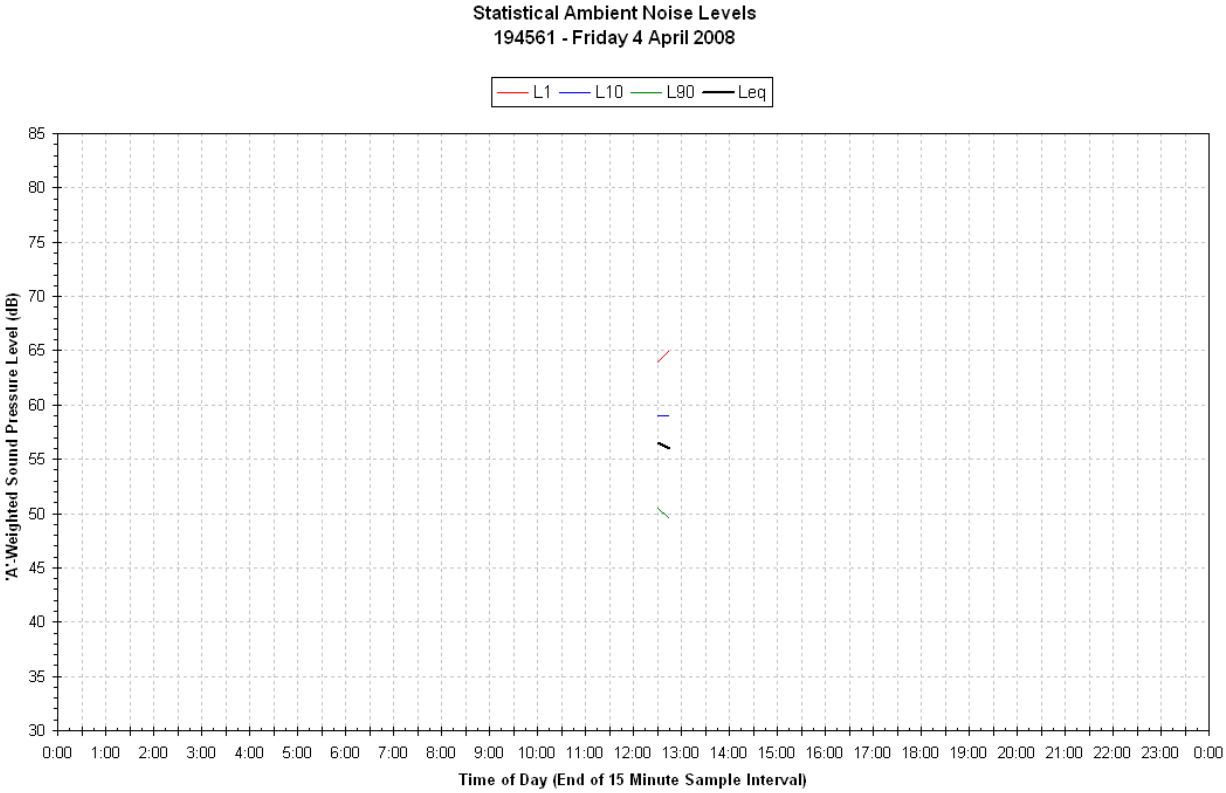

Statistical Ambient Noise Levels
194561 - Tuesday 1 April 2008
L1
L10
L90
Leq
'A'-Weighted Sound Pressure Level (dB)
85
80
75
70
65
60
55
50
45
40
35
30
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time of Day (End of 15 Minute Sample Interval)

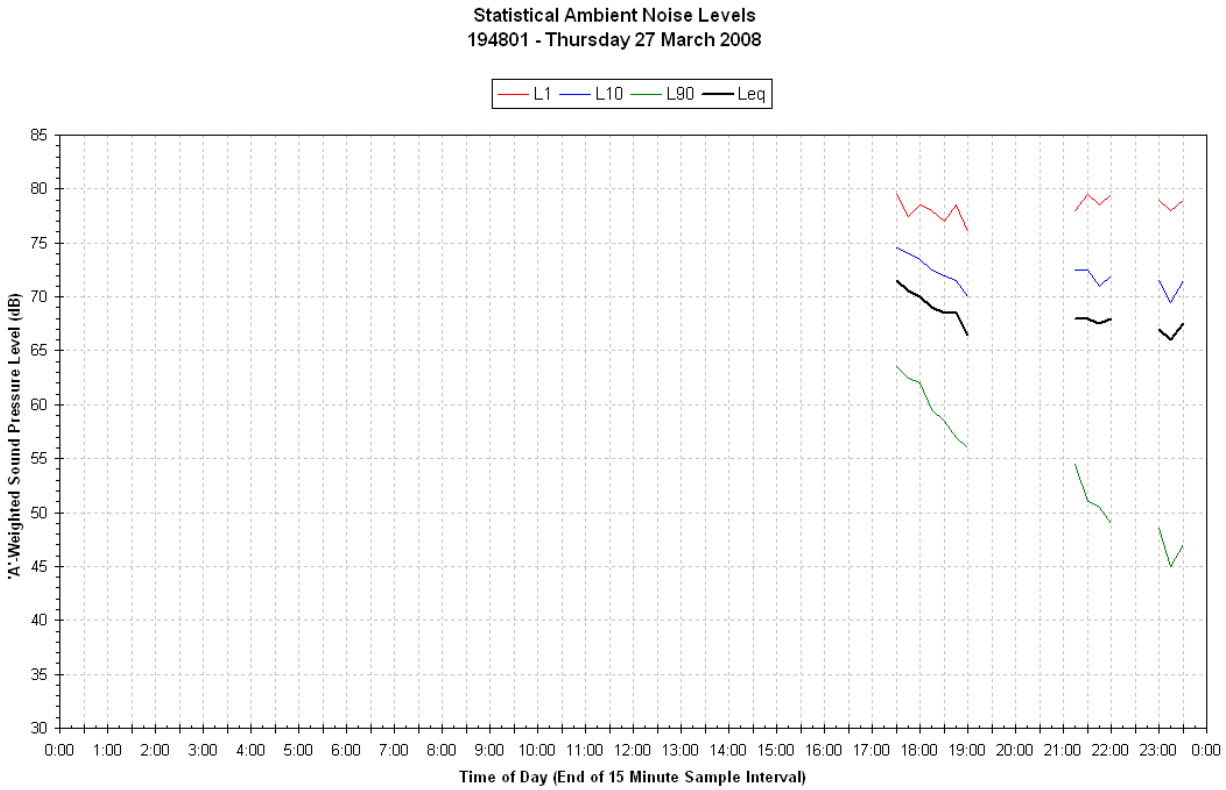
Statistical Ambient Noise Levels
194561 - Wednesday 2 April 2008

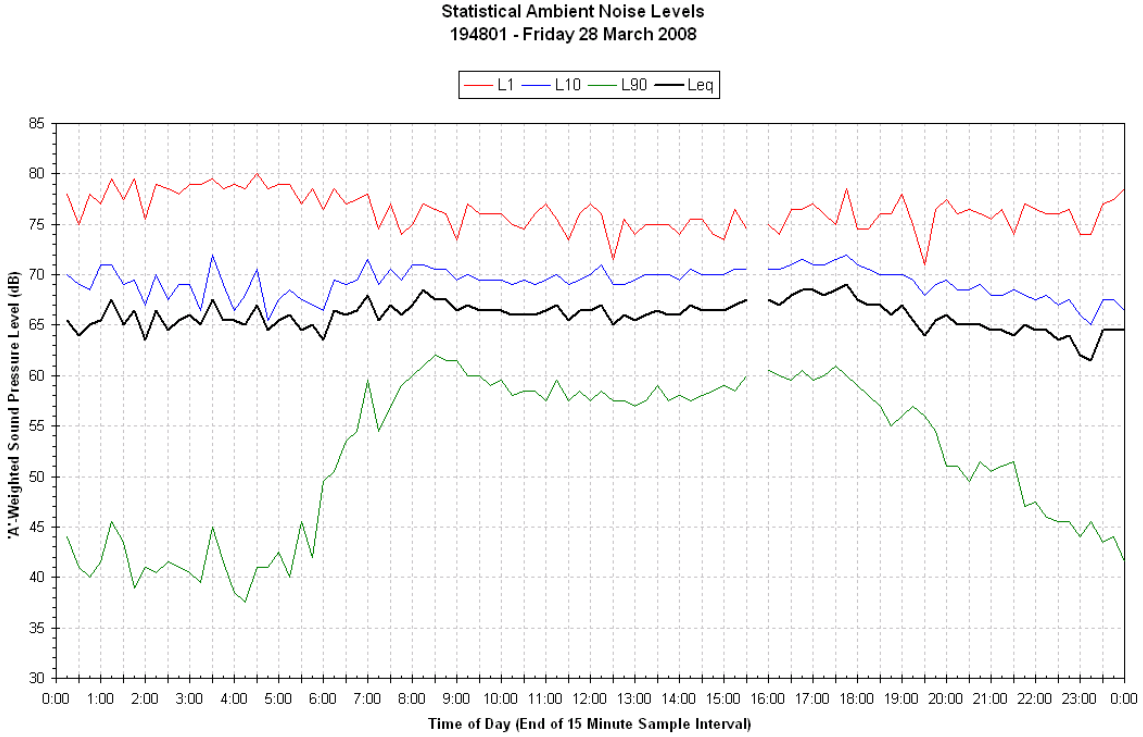


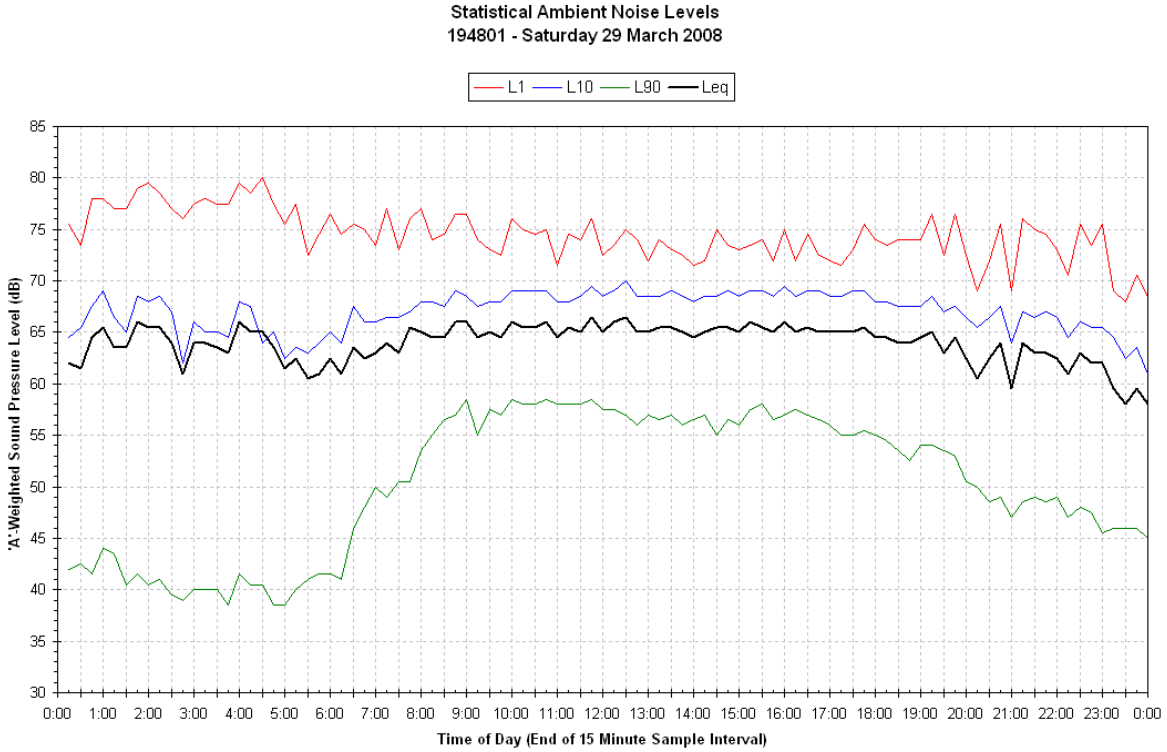
Statistical Ambient Noise Levels
194561 - Thursday 3 April 2008



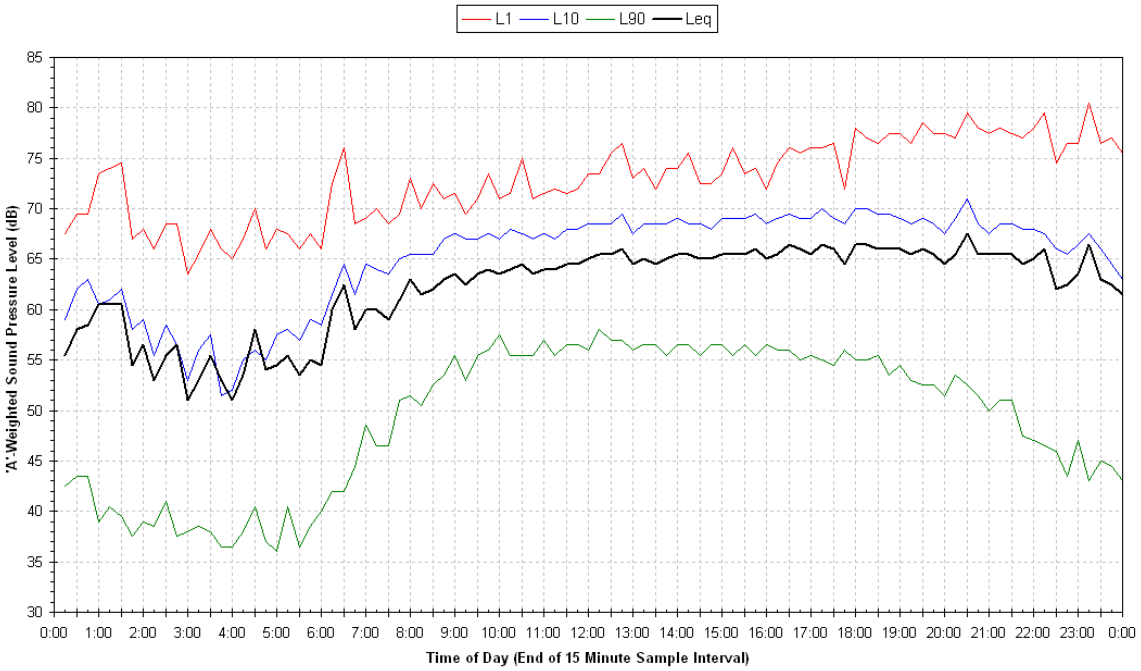

Statistical Ambient Noise Levels
194561 - Friday 4 April 2008
L1
L10
L90
Leq
'A'-Weighted Sound Pressure Level (dB)
85
80
75
70
65
60
55
50
45
40
35
30
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
194801 - Thursday 27 March 2008
L1
L10
L90
Leq
'A'-Weighted Sound Pressure Level (dB)
85
80
75
70
65
60
55
50
45
40
35
30
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00
Time of Day (End of 15 Minute Sample Interval)

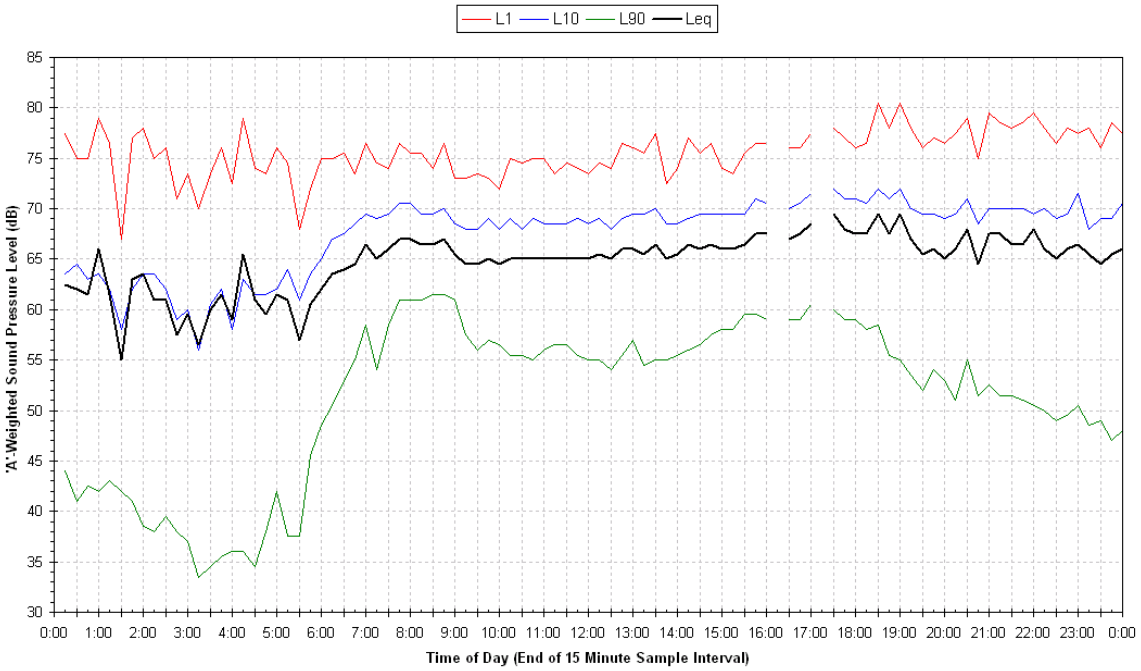

Statistical Ambient Noise Levels
194801 - Friday 28 March 2008
L1
L10
L90
Leq
'A'-Weighted Sound Pressure Level (dB)
85
80
75
70
65
60
55
50
45
40
35
30
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
194801 - Saturday 29 March 2008
L1
L10
L90
Leq
'A'-Weighted Sound Pressure Level (dB)
85
80
75
70
65
60
55
50
45
40
35
30
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time of Day (End of 15 Minute Sample Interval)

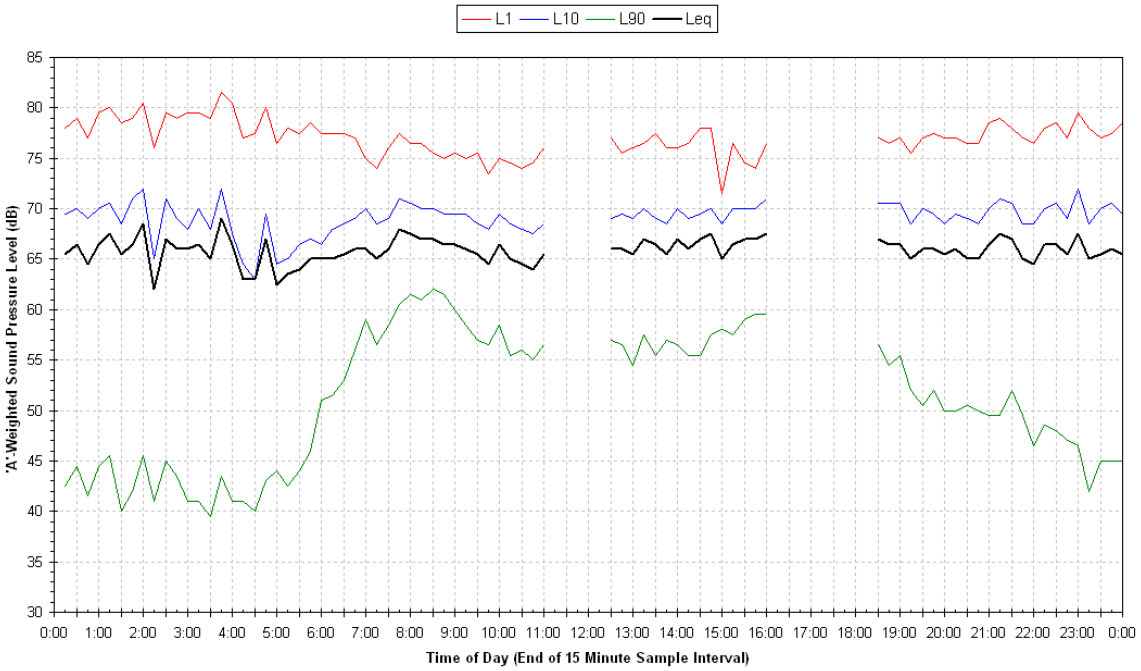
Statistical Ambient Noise Levels
194801 - Sunday 30 March 2008



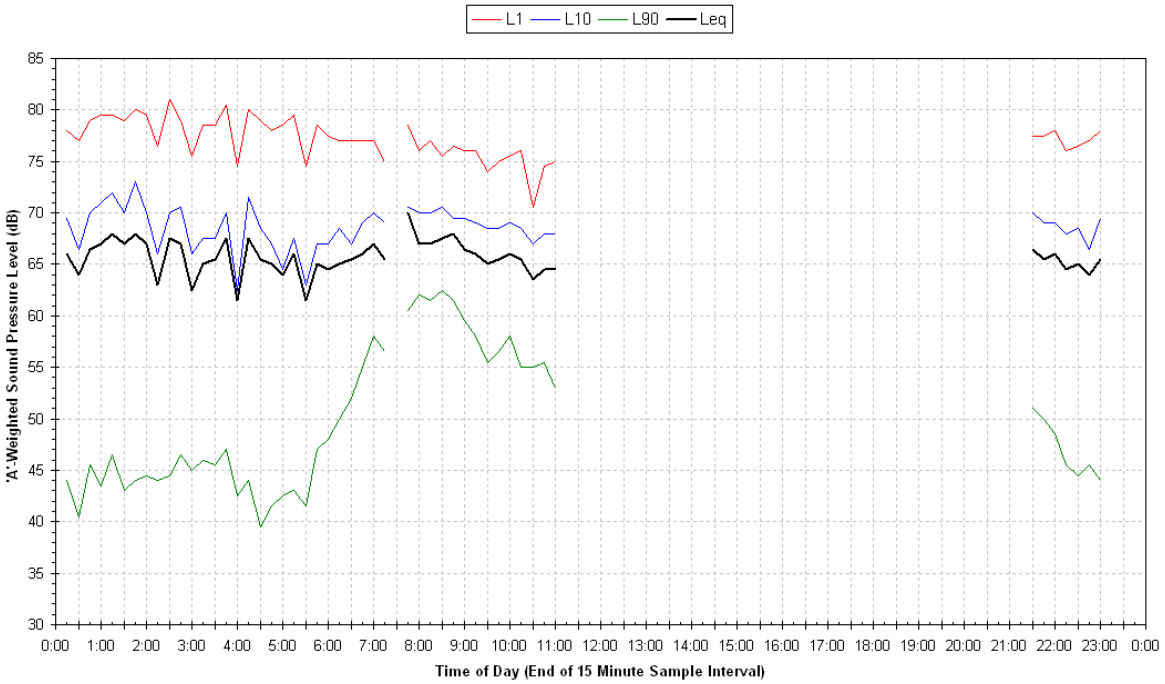
Statistical Ambient Noise Levels
194801 - Monday 31 March 2008



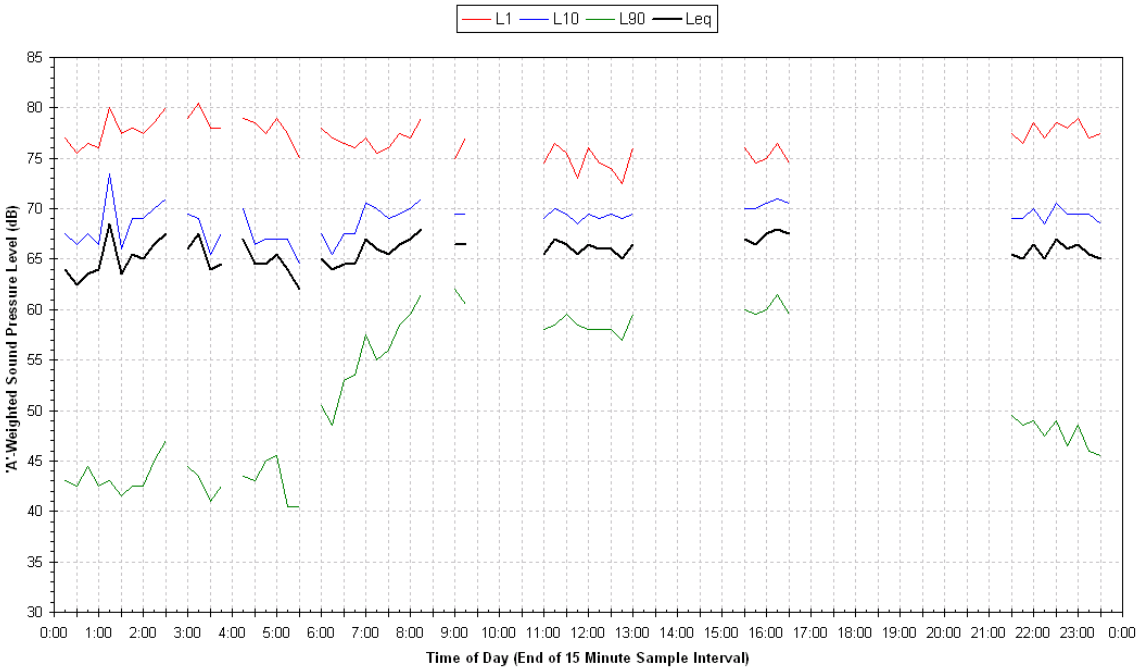
Statistical Ambient Noise Levels
194801 - Tuesday 1 April 2008



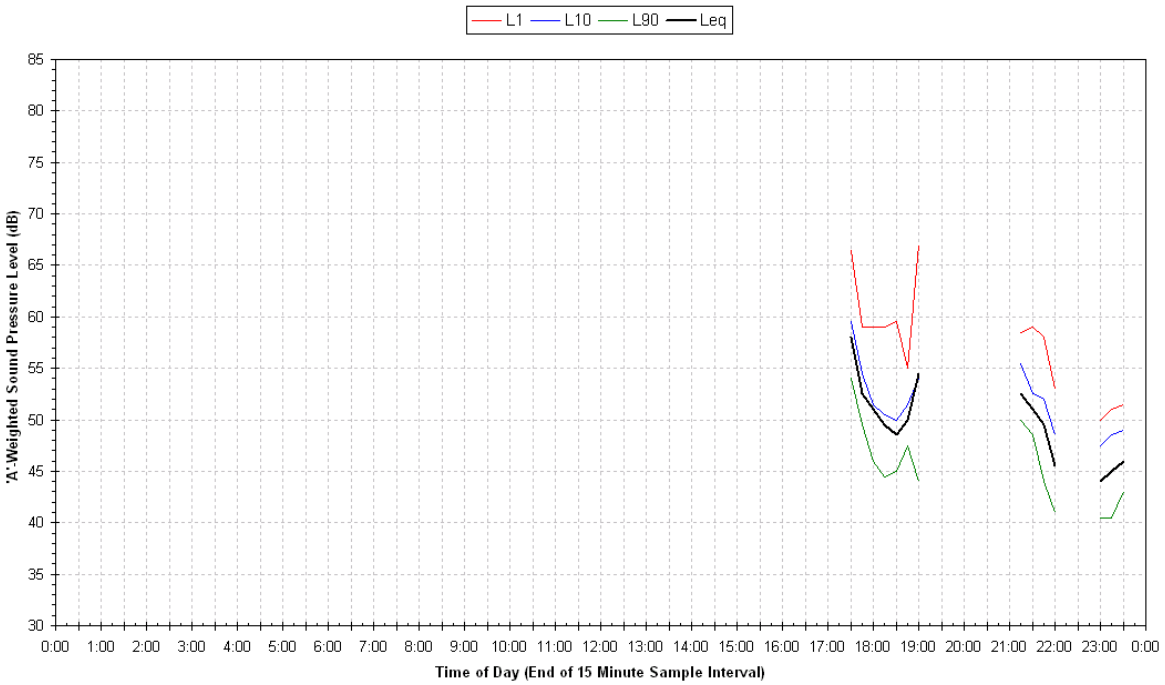
Statistical Ambient Noise Levels
194801 - Wednesday 2 April 2008



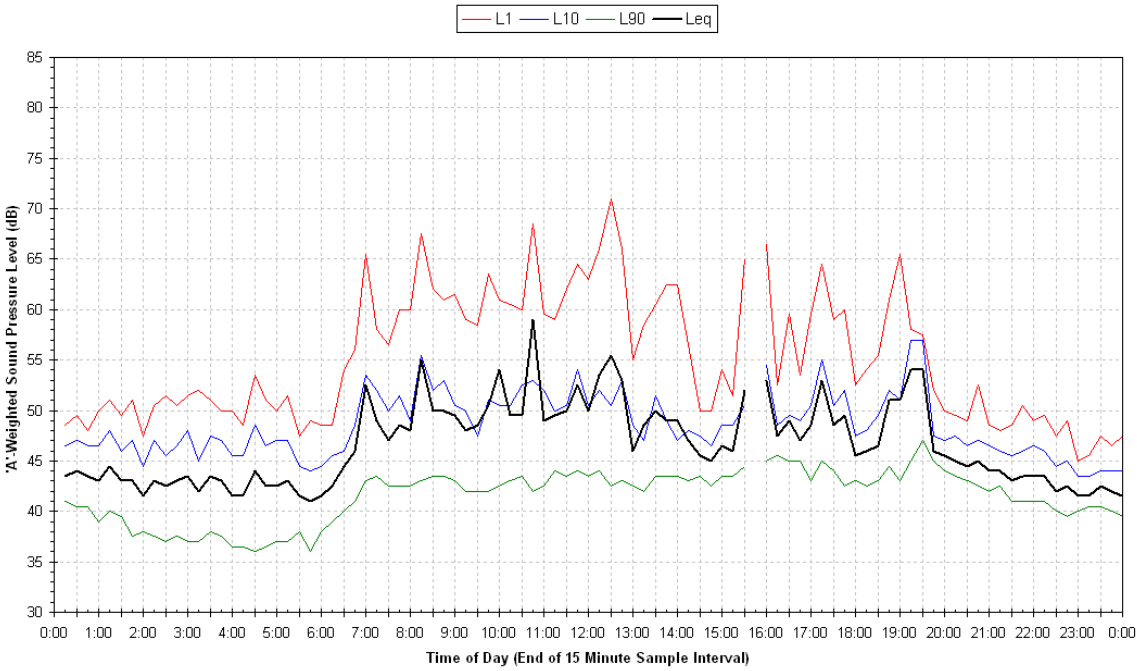
Statistical Ambient Noise Levels
194801 - Thursday 3 April 2008



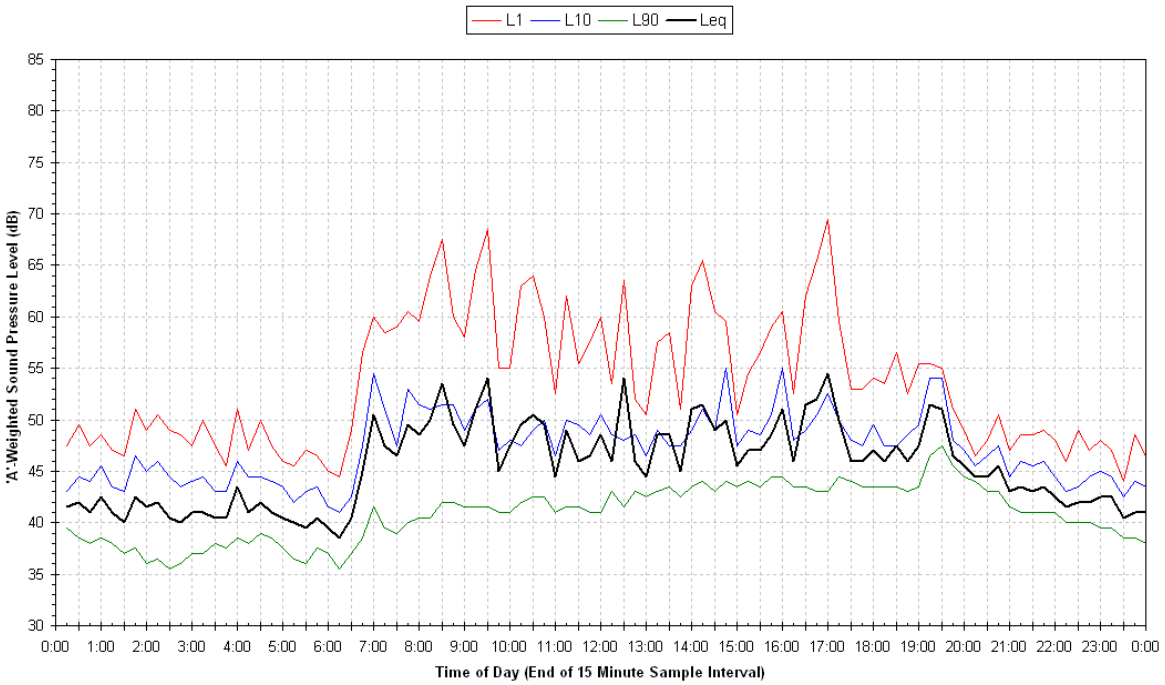
Statistical Ambient Noise Levels
194803 - Thursday 27 March 2008



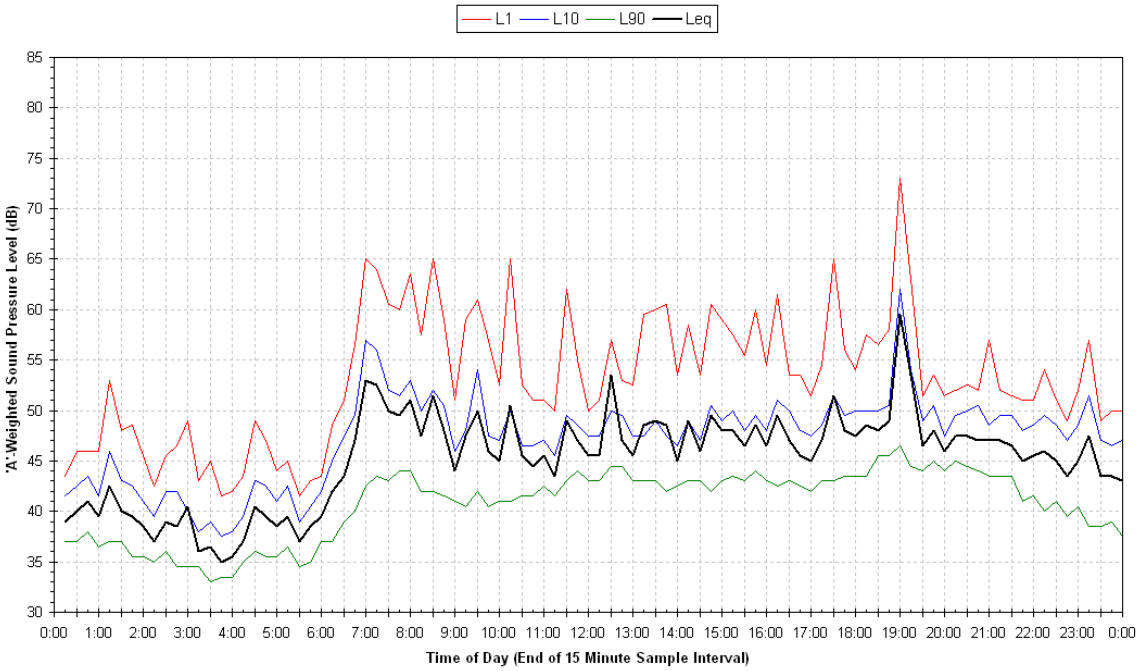
Statistical Ambient Noise Levels
194803 - Friday 28 March 2008



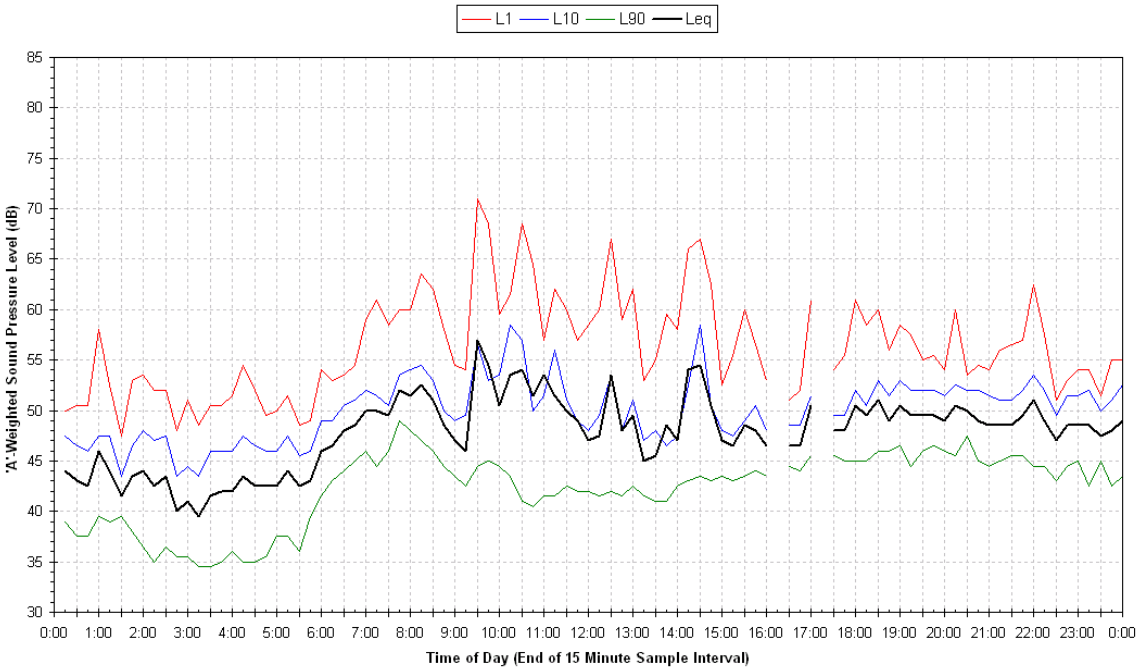
Statistical Ambient Noise Levels
194803 - Saturday 29 March 2008



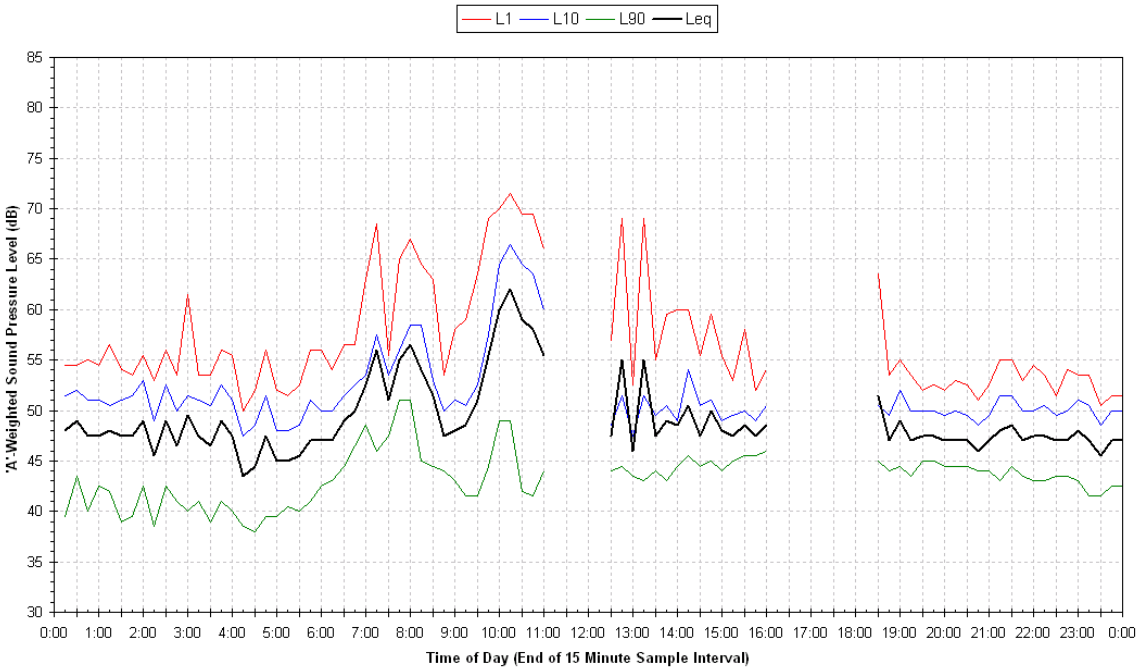
Statistical Ambient Noise Levels
194803 - Sunday 30 March 2008



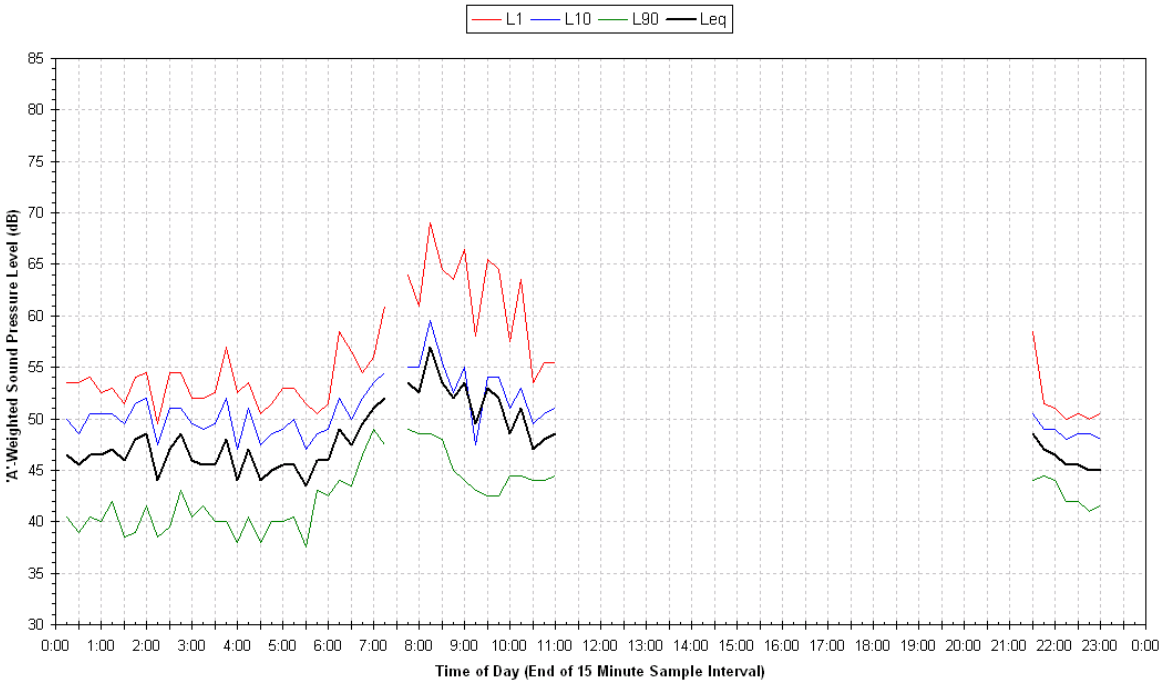
Statistical Ambient Noise Levels
194803 - Monday 31 March 2008



Statistical Ambient Noise Levels
194803 - Tuesday 1 April 2008

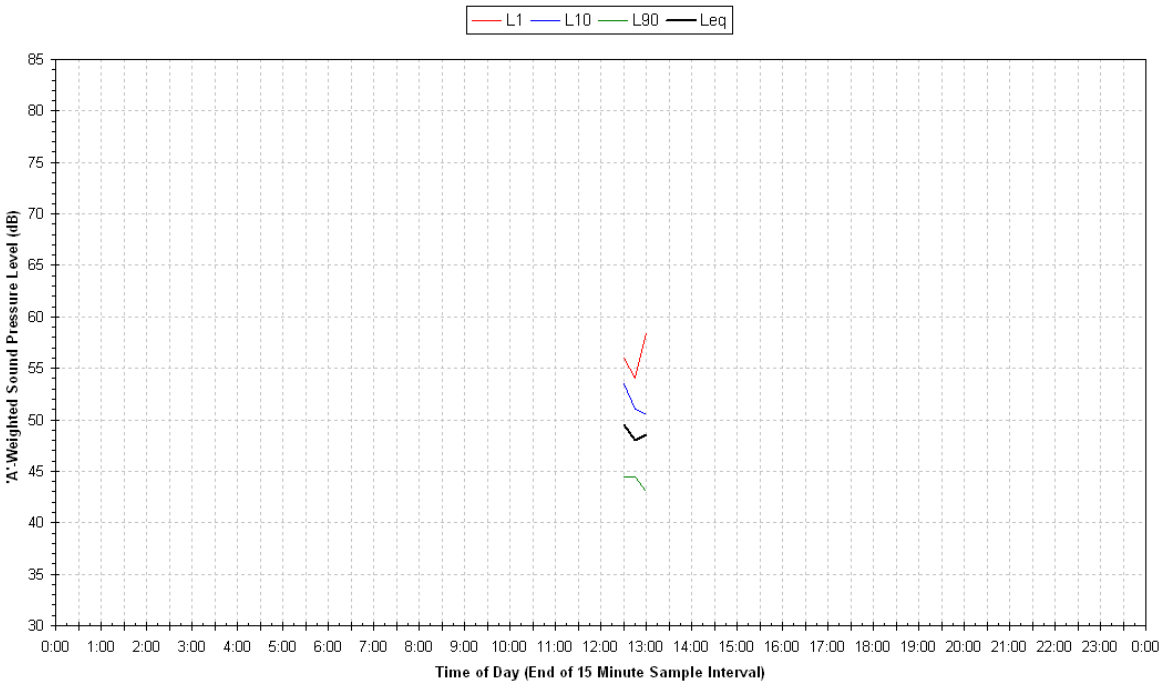


Statistical Ambient Noise Levels
194803 - Wednesday 2 April 2008



Statistical Ambient Noise Levels
194803 - Thursday 3 April 2008

Statistical Ambient Noise Levels
194803 - Friday 4 April 2008



Appendix D

Received Noise Levels

Received Noise Levels and Corresponding Construction Categories

Table D-1 Predicted Received Traffic Noise and Corresponding Construction Categories

Lot Number	LAeq Day [dB(A)]	Category 1	Category 2	Category 3
Lot001	61			✓
Lot002	61			✓
Lot003	59		✓	
Lot004	60		✓	
Lot004	63			✓
Lot006	63			✓
Lot007	64			✓
Lot008	64			✓
Lot009	60		✓	
Lot010	57		✓	
Lot011	55		✓	
Lot012	55		✓	
Lot013	55		✓	
Lot014	54		✓	
Lot015	54		✓	
Lot016	54		✓	
Lot017	54		✓	
Lot018	53		✓	
Lot019	54		✓	
Lot020	55		✓	
Lot021	60			✓
Lot022	64			✓
Lot023	63			✓
Lot024	62			✓
Lot025	62			✓
Lot026	63			✓
Lot027	65			✓
Lot028	64			✓
Lot029	67			✓

Lot Number	LAeq Day [dB(A)]	Category 1	Category 2	Category 3
Lot030	68			✓
Lot031	68			✓
Lot032	68			✓
Lot033	68			✓
Lot034	67			✓
Lot035	66			✓
Lot036	68			✓
Lot037	63			✓
Lot038	67			✓
Lot039	57		✓	
Lot040	53		✓	
Lot041	52		✓	
Lot042	52		✓	
Lot043	52		✓	
Lot044	54		✓	
Lot045	54		✓	
Lot046	54		✓	
Lot047	53		✓	
Lot048	53		✓	
Lot049	53		✓	
Lot050	53		✓	
Lot051	53		✓	
Lot052	52		✓	
Lot053	51		✓	
Lot054	51		✓	
Lot055	52		✓	
Lot056	55		✓	
Lot057	64			✓
Lot058	66			✓
Lot059	56		✓	

Lot Number	LAeq Day [dB(A)]	Category 1	Category 2	Category 3
Lot060	54		✓	
Lot061	52		✓	
Lot062	52		✓	
Lot063	70			✓
Lot064	66			✓
Lot065	64			✓
Lot066	63			✓
Lot067	62			✓
Lot068	60		✓	
Lot069	59		✓	
Lot070	61			✓
Lot071	64			✓
Lot072	62			✓
Lot073	60		✓	
Lot074	59		✓	
Lot075	57		✓	
Lot076	55		✓	
Lot077	52		✓	
Lot078	55		✓	
Lot079	54		✓	
Lot080	54		✓	
Lot081	54		✓	
Lot082	54		✓	
Lot083	54		✓	
Lot084	55		✓	
Lot085	52		✓	
Lot086	52		✓	
Lot087	52		✓	
Lot088	52		✓	
Lot089	51		✓	

Lot Number	LAeq Day [dB(A)]	Category 1	Category 2	Category 3
Lot090	52		✓	
Lot091	52		✓	
Lot092	52		✓	
Lot093	52		✓	
Lot094	53		✓	
Lot095	52		✓	
Lot096	52		✓	
Lot097	52		✓	
Lot098	59		✓	
Lot099	59		✓	
Lot100	60		✓	
Lot101	60			✓
Lot102	61			✓
Lot103	62			✓
Lot104	63			✓
Lot105	62			✓
Lot106	61			✓
Lot107	59		✓	
Lot108	59		✓	
Lot109	58		✓	
Lot110	58		✓	
Lot111	58		✓	
Lot112	58		✓	
Lot113	59		✓	
Lot114	59		✓	
Lot115	60		✓	
Lot116	61			✓
Lot117	57		✓	
Lot118	57		✓	
Lot119	57		✓	

Lot Number	LAeq Day [dB(A)]	Category 1	Category 2	Category 3
Lot120	56		✓	
Lot121	57		✓	
Lot122	58		✓	
Lot123	58		✓	
Lot124	59		✓	
Lot125	63			✓
Lot126	60		✓	
Lot127	59		✓	
Lot128	55		✓	
Lot129	55		✓	
Lot130	52		✓	
Lot131	52		✓	
Lot132	50		✓	
Lot133	50		✓	
Lot134	52		✓	
Lot135	54		✓	
Lot136	56		✓	
Lot137	57		✓	
Lot138	55		✓	
Lot139	53		✓	

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1	S Kozakiewicz	G Collins	*G Collins*	S Lawer	*S Lawer*	11/12/08
2	S Kozakiewicz	G Collins		P Pigram		11/03/09