

APPENDIX

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NOISE IMPACT ASSESSMENT (RICHARD HEGGIE ASSOCIATES)



RHA REPORT 10-2718-R1
Revision 0

Noise and Blasting Assessment Proposed Extension of Shipping Channels Port of Newcastle

Prepared for

GHD Pty Ltd
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Noise and Blasting Assessment Proposed Extension of Shipping Channels Port of Newcastle



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EXECUTIVE SUMMARY

Introduction

Richard Heggie Associates Pty Ltd has been commissioned by GHD Pty Ltd to assess the noise and blasting impact of the proposed Extension of Shipping Channels in the Hunter River South Arm, at the Port of Newcastle.

The objectives of the noise and blasting assessment are to identify the potential impacts of noise and vibration from the following activities:

- Dredging of an access channel within the proposed site.
- Dredging of sand from the proposed swing basin.
- Removal and remediation of contaminated material from the river bed.
- Transportation of remediated material offsite to Kooragang Island
- Driving of sheet piling.
- Removal of rock from the river bed.

Methodology

Project specific noise goals for the proposed Extension of Shipping Channels, Port of Newcastle project were developed in accordance with the Environment Protection Authority's Industrial Noise Policy from ambient noise levels measured at residential locations in the vicinity of the project. Noise emission levels for the project were predicted for calm and adverse atmospheric conditions for several stages of operation. An indicative cumulative noise impact assessment was also conducted for the site. The impact of blasting on the surrounding residential and potentially noise sensitive receivers was also assessed.

Impact Assessment

Results of the impact assessment of noise show that predicted noise emission levels for the proposed Extension of Shipping Channels, Port of Newcastle project will comply with the EPA project specific goals under calm weather conditions at all residential locations for daytime evening and night-time operation with the recommended mitigation strategies in place.

Predicted intrusive noise levels under adverse weather conditions (at night during winter months) will marginally exceed the amenity criterion by 1 dBA at residences at the southern end of Arthur Street (adjacent to NM3) and by 2 dBA at residences in the vicinity of Mayfield East Primary School (adjacent to NM4).

It should be noted that where an $L_{Aeq}(15\text{minute})$ intrusive noise level exceeds the amenity criteria by dBA to 2 dBA, it is unlikely that any change in noise level would be detectable by the residents of the area. It is likely that the noise level of the contributing noise source would be at or below the background noise level during each specific period.



EXECUTIVE SUMMARY

Assessment of the cumulative noise emissions from the proposed Extension of Shipping Channels, Protech Steel Mill and Multi Purpose Terminal construction, at surrounding residential locations, for calm and adverse conditions are below the relevant acceptable amenity criteria (modified for existing industrial operations) for industrial noise (ie non-transport related) during the daytime, evening and night-time.

Predictions of ground vibration and airblast from blasting during the proposed Extension of Shipping Channels project are demonstrated to meet the EPA guidelines for residences and other sensitive structures surrounding the development between 6.00 am and 8.00 pm from Monday to Saturday.

Noise Mitigation and Management

In order to reduce the noise impact on residential receivers surrounding the proposed Extension of Shipping Channels, Best Environmental Practice together with Best Achievable Technology have been considered and incorporated into the noise mitigation strategy for the operation which includes:

- Sheet piling should only be performed during the daytime period, 7.00 am and 6.00 pm.
- Remediation activities should only be performed during the daytime period, 7.00 am to 6.00 pm.
- Remediation activities and drilling should not occur simultaneously.
- Remediation activities and sheet piling should not occur simultaneously.
- Sirens and alarms on all equipment should be adjusted so as not to cause disturbance at surrounding residential receivers during night-time operation.

Mitigation of Blasting Impacts

In order to reduce the impact of ground vibration and airblast from drilling and blasting from the proposed Extension of Shipping Channels project it is recommended that blasting should only be conducted between 6.00 am and 8.00 pm from Mondays to Saturdays.

Traffic Noise Impacts

The impact of traffic from the proposed site is predicted to have a negligible increase in road traffic noise.



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1 INTRODUCTION

Richard Heggie Associates Pty Ltd has been commissioned by GHD Pty Ltd to assess the noise and blasting impact of the proposed Extension of Shipping Channels in the Hunter River South Arm at the Port of Newcastle.

The objectives of the noise and blasting assessment are to identify the potential impacts of noise and vibration from the following activities:

- Dredging of an access channel within the proposed site.
- Dredging of sand from the proposed swing basin.
- Removal and remediation of contaminated material from the river bed.
- Driving of sheet piling.
- Removal of rock from the river bed.

The noise and blasting assessment will form part of an EIS for the development and has been prepared in accordance with Australian Standard AS 1055-1997 "Description and Measurement of Environmental Noise" Part 1, 2 and 3 and with reference to the EPA's Industrial Noise Policy, Environmental Noise Control Manual and the Director-General's requirements S01/00533.

1.1 Description of Proposed Project

The proposed Extension of Shipping Channels project will consist of the following phases of development:

- Site Establishment
- Create Transport Corridor
- Piling
- Contaminated Material Removal and Remediation
- Clean Material Removal
- Drill and Blast and Removal of Hard Rock
- Establishment of a Swing Basin



1.2 Plant and Equipment

The acoustically significant plant and equipment proposed for the site includes the following:

- Small suction cutter dredge
- Large suction cutter dredge
- Small trailer suction dredge
- Medium trailer suction dredge
- Large trailer suction dredge
- Grab dredge
- Rock drill
- Excavators
- Off-road dump trucks
- Concrete transit mixers
- Piling rig
- Thermal desorption equipment
- Front end loaders
- On road dump trucks

1.3 Plant and Equipment Noise Levels

The sound power levels of the major noise generating plant and equipment proposed for the proposed Extension of Shipping Channels, Port of Newcastle project are given in **Table 1.3.1**. Sound power level details of acoustically significant plant and equipment proposed for the site were obtained from a RHA database of similar equipment. The details of the sound power levels used in the noise model are given in **Appendix A**.



Table 1.3.1 Equipment Sound Power Levels

Equipment	Sound Power Levels
Large suction cutter dredge	113 dBA
Small trailer suction dredge	98 dBA
Large trailer suction dredge	103 dBA
Backhoe dredge	111 dBA
Barge mounted excavator	107 dBA
Rock drill	119 dBA
30T Excavators	107 dBA
100T Backhoe Dredge	114 dBA
Off-road dump trucks	113 dBA
Piling rig	123 dBA
Concrete transit mixers	111 dBA
Thermal desorption equipment	111 dBA
Compactor	110 dBA
Front end loader	108 dBA
6 Wheel trucks (on road)	108 dBA

1.4 Site Details

The site of the proposed Extension of Shipping Channels, Port of Newcastle project is located within the South Arm of the Hunter River adjacent to the former BHP site, near Newcastle NSW. The site is bounded to the north by Kooragang Island, to the west by Tourle Street Bridge, and to the south by the existing One Steel site and former BHP site. The proposed Extension of Shipping Channels project extends along the Hunter River approximately 3.7 km east of the Tourle Street Bridge.

The closest residences to the site are to the south in Mayfield and Mayfield east (see Location Map **Appendix B**).

1.5 Hours of Operation

The proposed hours of operation for the proposed Extension of Shipping Channels, Port of Newcastle project are given in **Table 1.5.1**.



Table 1.5.1 Hours of Operation

Activity	Hours of Operation
Dredging of the access channel	24 hours a day 7 days per week
Dredging of sand from the proposed swing basin	24 hours a day 7 days per week
Driving of sheet piling	7.00 am to 6.00 pm Monday to Friday
Removal and remediation of contaminated material	7.00 am to 6.00 pm Monday to Saturday 8.00 am to 1.00 pm Sunday
Drilling and Blasting	24 hours a day 7 days per week

2 STATUTORY REQUIREMENTS AND OTHER ISSUES CONSIDERED

2.1 General Objectives for Noise Impact at Residential Receivers

The Director General's requirements issued by Planning NSW classify the proposed Extension of Shipping Channels, Port of Newcastle project as a scheduled activity under the Protection of the Environment Operations Act and as such the project is required to be licensed by the EPA.

The EPA released an Industrial Noise Policy (INP) in January 2000 that provides a framework and process for deriving noise criteria for consents and licences that will enable the EPA to regulate premises that are scheduled under the Protection of the Environment Operations Act, 1997.

The specific policy objectives are:

- To establish noise criteria that would protect the community from excessive intrusive noise and preserve amenity for specific land uses.
- To use the criteria as the basis for deriving project specific noise levels.
- To promote uniform methods to estimate and measure noise impacts, including a procedure for evaluating meteorological effects.
- To outline a range of mitigation measures that could be used to minimise noise impacts.
- To provide a formal process to guide the determination of feasible and reasonable noise limits for consents or licences that reconcile noise impacts with the economic, social and environmental considerations of industrial development.
- To carry out functions relating to the prevention, minimisation and control of noise from premises scheduled under the Act.



Assessing Intrusiveness

For assessing intrusiveness, the background noise needs to be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level (LAeq) of the source should not be more than 5 decibels above the measured background level (LA90).

Assessing Amenity

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include road, rail or community noise. The existing noise level from industry is measured. If it approaches the criterion value, then noise levels from new industries need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion. For high-traffic areas there is a separate amenity criterion. The cumulative effect of noise from industrial sources needs to be considered in assessing impact.

Sleep Disturbance

The EPA has acknowledged that the relationship between maximum noise levels and sleep disturbance is not currently well defined. Criteria for assessing sleep disturbance has not been identified under the INP but it is assumed that conformance with the INP would protect against the likelihood of awakening reactions. Notwithstanding the preceding, sleep arousal has been assessed using the guidelines set out in the EPA's Environmental Noise Control Manual Section 19-3.

Traffic Noise Goals Design Goals

The Environment Protection Authority released the "Environmental Criteria for Road Traffic Noise" in May 1999. The policy sets out noise criteria applicable to different road classifications for the purpose of defining traffic noise impacts.

Blast Emissions

The NSW EPA currently adopts the Australia and New Zealand Environment Council Committee (ANZECC) "Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration" dated September 1990 for assessing potential annoyance from blast emissions.

The assessment of blast emission impacts outside the hours advocated by ANZECC will be assessed according to the EPA's Environmental Noise Control Manual (ENCM) 1994 Chapter 154 Noise Control Guideline - Blasting.



Cumulative Noise Emissions

The NSW INP also provides cumulative noise assessment guidelines that address existing and successive industrial development by setting acceptable (and maximum) cumulative $L_{Aeq(15\text{minute})}$ amenity levels for all industrial (ie non-transport related) noise in an area.

3 METHODOLOGY

3.1 Existing Environment

Ambient Acoustic

The objective of the ambient monitoring study was to determine $LA_{90(15\text{minute})}$ background noise levels and industry contributed $L_{Aeq(15\text{minute})}$ noise levels at the nearest potentially affected receptors during daytime, evening and night-time periods to enable the establishment of the intrusiveness and amenity criteria for the proposed development.

Meteorological

Weather data was obtained for the past 12 months from a Bureau of Meteorology weather station located at Newcastle. This data was analysed to determine the frequency of occurrence of winds up to speeds of 3 m/s for daytime, evening and night in each season.

The occurrence of temperature inversions in the vicinity of the site was assessed using the NSW EPA Industrial Noise Policy Appendix F *Percentage occurrence of F-class temperature inversions in winter in the Hunter Valley*.

3.2 Noise Impact Assessment Goal

The noise emission design goals for the proposed Extension of Shipping Channels, Port of Newcastle project have been established with reference to the EPA Industrial Noise Policy and with reference to the data collected during the existing environment surveys.



3.3 Noise Prediction and Assessment

A computer model was used to predict the noise emissions from the proposed operation of the proposed Extension of Shipping Channels, Port of Newcastle project. The Environmental Noise Model (ENM) used has been produced in conjunction with the EPA. A three-dimensional digital terrain map giving all relevant topographic information was used in the modelling process. The model used this map, together with the noise source data, ground cover, shielding by barriers and/or adjacent buildings and atmospheric information to predict noise levels. Noise predictions and assessment were carried out for calm and prevailing conditions.

3.4 Noise and Vibration from Blasting

The assessment of noise and vibration from underwater blasting was undertaken by the establishment of blasting site laws for the project. The site laws were developed from extensive data collected by RHA from similar underwater blasting and harbour deepening projects.

3.5 Recommended Mitigation Measures

Based on the assessment of potential impacts, mitigation and management of issues relating to noise and blasting were devised for the proposed Extension of Shipping Channels, Port of Newcastle project.

4 EXISTING ENVIRONMENT

4.1 Existing Noise and Meteorological Environment

Noise Environment

The objective of the background monitoring survey was to measure LA90(15minute) and LAeq(15minute) noise levels at the nearest potentially affected receptors during daytime, evening and night-time periods to enable the determination of the intrusiveness and amenity criteria for the proposed development. The details of the monitoring locations are contained within **Table 4.1.1**.



Table 4.1.1 Noise Monitoring Locations

Noise Monitoring Location	Description
NM1	21 Crebert Street, Mayfield
NM2	52 Arthur Street, Mayfield
NM3	1 Arthur Street, Mayfield
NM4	Mayfield East Public School
NM5	Cnr Wye Street and Avon Street, Mayfield
NM6	45 Simpson Circuit, Mayfield

For locations NM1 to NM4, data used from a previous environmental noise assessment performed throughout 2001 and 2002 have been used to provide background levels and existing industry contribution. Background levels were assessed at locations NM5 and NM6 between 30 January 2003 and 6 February 2003.

An ARL Type EL215 environmental noise logger was used to monitor the ambient noise levels at all the residential monitoring locations. The noise logger was programmed to record statistical noise level indices continuously in 15 minute intervals, including the LA_{max}, LA₁, LA₁₀, LA₅₀, LA₉₀, LA₉₉, LA_{min} and the LA_{eq}.

Weather data for the survey period was obtained from the Bureau of Meteorology weather station at Newcastle. Noise data during periods of any rainfall and/or wind speed in excess of 5 m/s (approximately 9 knots) were discarded in accordance with INP data exclusion methods. A summary of the results of the background surveys is given in **Table 4.1.2**. The ambient noise levels for the surveys are presented in graphical format in **Appendix C**.



Table 4.1.2 Ambient Noise Levels

Location	Description	Background LA90 Noise Level	Measured Existing LAeq Noise Level	Existing LAeq Industrial Contribution
		Rating Background Level		
NM1 21 Crebert Street	Day 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday	57	69	45
	Evening 6.00 pm to 10.00 pm 7 days a week	53	63	45
	Night 10.00 pm to 7.00 am Monday to Saturday, 10.00 pm to 8.00 am Sunday	48	61	45
NM2 52 Arthur Street	Day 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday	51	58	41
	Evening 6.00 pm to 10.00 pm 7 days a week	50	56	41
	Night 10.00 pm to 7.00 am Monday to Saturday, 10.00 pm to 8.00 am Sunday	43	54	41
NM3 1 Arthur Street	Day 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday	46	58	42
	Evening 6.00 pm to 10.00 pm 7 days a week	46	62	42
	Night 10.00 pm to 7.00 am Monday to Saturday, 10.00 pm to 8.00 am Sunday	43	51	42
NM4 Mayfield East Primary School	Day 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday	47	64	44
	Evening 6.00 pm to 10.00 pm 7 days a week	45	54	44
	Night 10.00 pm to 7.00 am Monday to Saturday, 10.00 pm to 8.00 am Sunday	42	50	41
NM5 Cnr Wye Street & Avon Street	Day 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday	45	56	<40
	Evening 6.00 pm to 10.00 pm 7 days a week	45	51	<40
	Night 10.00 pm to 7.00 am Monday to Saturday, 10.00 pm to 8.00 am Sunday	42	47	<40
NM6 45 Simpson Ct	Day 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday	46	53	42
	Evening 6.00 pm to 10.00 pm 7 days a week	49	52	42
	Night 10.00 pm to 7.00 am Monday to Saturday, 10.00 pm to 8.00 am Sunday	46	51	42

Note: Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am. On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.

The LA90 represents the level exceeded for 90% of the interval period and is referred to as the average minimum or background noise level.

LAeq - The equivalent continuous noise level is defined as the level of noise equivalent to the energy average of noise levels occurring over a measurement period.



Meteorological Environment

Wind

Wind has the potential to increase noise at a receiver when it is light and stable and blows from the direction of the source of the noise. As the strength of the wind increases the noise produced by the wind will obscure noise from most industrial and transport sources.

Wind affects need to be considered when wind is a feature of the area under consideration. Where wind blows from the source to the receiver at speeds up to 3 m/s for more than 30% of the time in any season, then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

Weather data was obtained from the Bureau of Meteorology from the closest weather station at Nobby's Head, Newcastle over a 12-month period. This data was analysed to determine the frequency of occurrence of winds up to speeds of 3 m/s for daytime and night-time in each season. The results of this analysis are contained within **Tables 4.1.3, 4.1.4 and 4.1.5.**

Table 4.1.3 Seasonal Frequency of Occurrence Wind Speed Intervals - Daytime

Period	Calm	Wind Direction	0.5 to 2 m/s	2 to 3 m/s	0.5 to 3 m/s
Summer	0.8%	ESE	0.4%	1.5%	1.9%
Autumn	0.6%	SSE	0.4%	2.1%	2.6%
Winter	2.0%	NW	0.6%	1.9%	2.5%
Spring	3.3%	NNW	0.9%	1.6%	2.5%

Table 4.1.4 Seasonal Frequency of Occurrence Wind Speed Intervals - Evening

Period	Calm	Wind Direction	0.5 to 2 m/s	2 to 3 m/s	0.5 to 3 m/s
Summer	0.8%	ENE	0.6%	1.6%	2.1%
Autumn	1.1%	SSE	0.3%	1.6%	1.9%
Winter	2.8%	NW	0.9%	2.9%	3.8%
Spring	3.3%	NNW	0.9%	1.1%	2%



Table 4.1.5 Seasonal Frequency of Occurrence Wind Speed Intervals - Night-time

Period	Calm	Wind Direction	0.5 to 2 m/s	2 to 3 m/s	0.5 to 3 m/s
Summer	2.5%	ENE	1.4%	2.3%	3.8%
Autumn	2.1%	WNW	4.6%	11.5%	16%
Winter	4.7%	WNW	1.1%	6.3%	7.4%
Spring	4.6%	NNW	1.5%	3.5%	5%

Seasonal wind records indicate that winds (of up to 3m/s) do not occur from any direction for more than 30% of the time in any season. Hence, wind is not considered to be a feature of the area and does not need to be considered in noise level predictions.

Temperature Inversion

The occurrence of temperature inversions in the vicinity of the site was assessed using the NSW EPA Industrial Noise Policy Appendix F *Percentage occurrence of F-class temperature inversions in winter in the Hunter Valley*. This section of the INP tabulates the theoretical occurrence of temperature inversion using a 2 km by 2 km grid of the Hunter Valley. The predicted occurrence of F-Class temperature inversions in the residential receiver area (ISG 368000E 1360000N) is 30%-35% and the emission/ source area (ISG 370000E 1360000N) is 4%-45%.

Temperature inversion is therefore considered to be a feature of the area during winter months and have been taken into account in predictive noise modelling for the site.

4.2 Impact Assessment Noise Goals

4.2.1 Proposed Extension of Shipping Channels, Noise Emission Design Goals

The noise emission design goals for the proposed Extension of Shipping Channels, Port of Newcastle project have been established with reference to the EPA Industrial Noise Policy.

An extract from the EPA INP that relates to the setting of amenity criteria is given in **Table 4.2.1.1** and **Table 4.2.1.2**. The residences surrounding the proposed site are best described under the urban category. The RBL's used for the assessment are contained within **Table 4.1.1**.



Table 4.2.1.1 Amenity Criteria - Recommended LAeq Noise Levels from Industrial Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended LAeq Noise Level	
			Acceptable	Recommended Maximum
Residence	Urban	Day	60 dBA	65 dBA
		Evening	50 dBA	55 dBA
		Night	45 dBA	50 dBA

Note: Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am. On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.
The LAeq index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

Table 4.2.1.2 Modification to Acceptable Noise Level (ANL)* to Account for Existing Levels of Industrial Noise

Total Existing LAeq noise level from Industrial Noise Sources	Maximum LAeq Noise Level for Noise from New Sources Alone, dBA
≥ Acceptable noise level plus 2 dBA	If existing noise level is <i>likely to decrease</i> in future acceptable noise level minus 10 dBA If existing noise level is <i>unlikely to decrease</i> in future existing noise level minus 10 dBA
Acceptable noise level plus 1 dBA	Acceptable noise level minus 8 dBA
Acceptable noise level	Acceptable noise level minus 8 dBA
Acceptable noise level minus 1 dBA	Acceptable noise level minus 6 dBA
Acceptable noise level minus 2 dBA	Acceptable noise level minus 4 dBA
Acceptable noise level minus 3 dBA	Acceptable noise level minus 3 dBA
Acceptable noise level minus 4 dBA	Acceptable noise level minus 2 dBA
Acceptable noise level minus 5 dBA	Acceptable noise level minus 2 dBA
Acceptable noise level minus 6 dBA	Acceptable noise level minus 1 dBA
< Acceptable noise level minus 6 dBA	Acceptable noise level

* ANL = recommended acceptable LAeq noise level for the specific receiver, area and time of day from **Table 4.2.1.1**.

The amenity criteria outlined in **Table 4.2.1.3** have been established using LAeq levels of existing industrial sources measured at each monitoring location and with reference to assessment in areas of high traffic noise in accordance with the INP. In areas with high traffic noise, an industrial noise source which may exceed the recommended acceptable noise level may be effectively inaudible due to the masking affect of the road traffic noise.



The existing L_{Aeq} noise levels, measured at 21 Crebert Street (NM1) during the evening and night time periods are dominated by traffic on Industrial Drive and are greater than 10 dBA above the Acceptable Noise Level (ANL) given in **Table 4.2.1.1**. As a result, the amenity levels for these periods have been set at 10 dBA below the measured L_{Aeq} level. During the daytime period at 21 Crebert Street (NM1), although traffic noise still dominates, the measured ambient L_{Aeq} noise level is within 10 dBA of the ANL and hence, no modification to the ANL for daytime was required.

Section 2.2.1 of the INP makes allowances where existing schools are affected by industrial noise sources, and the acceptable L_{Aeq} noise level may be increased to 40 dB $L_{Aeq}(1hour)$.

The resulting project specific noise design goals for the proposed Extension of Shipping Channels, Port of Newcastle project are given in **Table 4.2.1.3**.



Table 4.2.1.3 Proposed Extension of Shipping Channels Project Specific Noise Design Goals

Location	Description	Intrusiveness Criterion L _{Aeq} (15minute)	Amenity Criterion L _{Aeq}
NM1 21 Crebert Street, Mayfield	Daytime	62 dBA	59 dBA
	Evening ⁺	58 dBA	53 dBA
	Night ⁺	53 dBA	51 dBA
NM2 52 Arthur Street, Mayfield	Daytime	56 dBA	60 dBA
	Evening	55 dBA	50 dBA
	Night	48 dBA	42 dBA
NM3 1 Arthur Street, Mayfield	Daytime	51 dBA	60 dBA
	Evening	51 dBA	50 dBA
	Night	48 dBA	42 dBA
NM4* Residents adjacent to Mayfield East Public School	Daytime	52 dBA	60 dBA
	Evening	50 dBA	50 dBA
	Night	47 dBA	43 dBA
NM4 Mayfield East Public School	Daytime	N/A	40 dBA(internal)
NM5 Cnr Wye Street and Avon Street, Mayfield*	Daytime	50 dBA	60 dBA
	Evening	50 dBA	50 dBA
	Night	47 dBA	43 dBA
NM6 45 Simpson Circuit, Mayfield	Daytime	51 dBA	60 dBA
	Evening	54 dBA	50 dBA
	Night	51 dBA	42 dBA

Note: *Intrusive and amenity criteria listed are for residences in the vicinity of the school. The school amenity levels are to be assessed directly against INP criteria for school classrooms. The internal noise level was assumed to be 10 dBA less than the predicted external noise level.

+ Criterion for the periods noted is adjusted to allow for traffic noise as per INP.

Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am.

On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm;

Night-time 10.00 pm - 8.00 am.

The INP states that these criteria have been selected to protect at least 90% of the population living in the vicinity of industrial noise sources from the adverse effects of noise for at least 90% of the time. Provided the criteria in the INP are achieved, it is unlikely that most people would consider the resultant noise levels excessive.



In those cases where the INP project specific assessment criteria are not achieved, it does not automatically follow that all people exposed to the noise would find the noise unacceptable. In subjective terms, exceedances of the INP project specific assessment criteria can be generally described as follows:

- Negligible noise level increase <1 dBA
(Not noticeable by all people)
- Marginal noise level increase 1 dBA to 2 dBA
(Not noticeable by most people)
- Moderate noise level increase 3 dBA to 5 dBA
(Not noticeable by some people but may be noticeable by others)
- Appreciable noise level increase >5 dBA
(Noticeable by most people)

In view of the foregoing, **Table 4.2.1.4** presents the methodology for assessing noise levels which may exceed the INP project specific noise assessment criteria.

Table 4.2.1.4 Project Noise Impact Assessment Methodology

Assessment Criteria	Project Specific Criteria	Noise Management Zone	Noise Affection Zone
Intrusive	Rating background level plus 5 dBA	≤ 5 dBA above project specific criteria	> 5 dBA above project specific criteria
Amenity	INP based on existing industrial level	≤ 5 dBA above project specific criteria	> 5 dBA above project specific criteria

For the purposes of assessing the potential noise impacts, the management and affection criteria are further defined as follows:

Noise Management Zone

Depending on the degree of exceedance of the project specific criteria (1 dBA to 5 dBA) noise impacts could range from negligible to moderate. It is recommended that management procedures be implemented including:

- Noise monitoring on site and within the community.
- Prompt response to any community issues of concern.
- Refinement of on site noise mitigation measures and mine operating procedures where practical.



- Discussions with relevant land owners to assess concerns.
- Consideration of acoustical mitigation at receivers.
- Consideration of negotiated agreements with land owners.

4.2.2 Sleep Disturbance Criteria

The EPA has acknowledged that the relationship between maximum noise levels and sleep disturbance is not currently well defined. However, it is recognised that sleep arousal is a function of both the noise level and the duration of the noise. To avoid the likelihood of sleep disturbance the EPA recommends that the LA1 of the noise source under consideration should not exceed the background noise level (LA90) by more than 15 dBA when measured outside the bedroom window of the receiver. The appropriate night-time sleep disturbance criteria are set out in Table 4.2.2.1.

Table 4.2.2.1 Proposed Extension of Shipping Channels, Port of Newcastle Sleep Disturbance Criteria

Location	Description	Sleep Disturbance Criterion LA1(1minute)
NM1 21 Crebert Street, Mayfield	Night 10.00 pm to 7.00 am	63 dBA
NM2 52 Arthur Street, Mayfield	Night 10.00 pm to 7.00 am	58 dBA
NM3 1 Arthur Street, Mayfield	Night 10.00 pm to 7.00 am	58 dBA
NM4* Residences adjacent to Mayfield East Public School	Night 10.00 pm to 7.00 am	57 dBA
NM5 Cnr Wye Street and Avon Street, Mayfield	Night 10.00 pm to 7.00 am	57 dBA
NM6 45 Simpson Circuit, Mayfield	Night 10.00 pm to 7.00 am	61 dBA

* Note: Sleep disturbance criteria listed are for residences in the vicinity of the school.

4.2.3 Traffic Noise Goals Design Goals

The Environment Protection Authority released the “Environmental Criteria for Road Traffic Noise” in May 1999. The policy sets out noise criteria applicable to different road classifications for the purpose of defining traffic noise impacts.



In the vicinity of the area subject to the proposal, the major road network consists of Cormorant Road, Tourle Street and Industrial Drive. Cormorant Road is a major arterial road running along the northern side of the south arm, near the northern bank. It is an RTA classified B-double route. Industrial Drive is also a major arterial road, and essentially runs parallel to the southern side of the Hunter River south arm, approximately one kilometre to the south of the southern bank.

The impact of road traffic external to the site will be assessed in relation to the criteria contained within **Table 4.2.3.1**.

Table 4.2.3.1 EPA Environmental Criteria for Road Traffic Noise

Policy	Descriptor	Traffic Noise Goal
8. Land use developments with the potential to create additional traffic on a freeway or arterial road	L _{Aeq} (15hour) daytime	60 dBA*
	L _{Aeq} (9hour) night-time	55 dBA*

Note: In all cases (where criteria are already exceeded), traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dBA.

5 POTENTIAL IMPACTS

5.1 Operational Noise Modelling

A computer model was used to predict the noise emissions from the proposed operation of the proposed Extension of Shipping Channels, Port of Newcastle project. The Environmental Noise Model (ENM) used has been produced in conjunction with the EPA. A three-dimensional digital terrain map giving all relevant topographic information was used in the modelling process. The model used this map, together with the noise source data, ground cover, shielding by barriers and/or adjacent buildings and atmospheric information to predict noise levels. Mobile noise sources were modelled at typical worst case locations and assumed to operate in repetitive cycles. Prediction of noise levels under calm and prevailing atmospheric conditions was conducted.

5.2 Operational Noise Prediction

Impact of Dredging Operations

Noise from proposed Extension of Shipping Channels, Port of Newcastle project was predicted at the nearest affected residential locations surrounding the site for daytime, evening and night-time operations. Each stage of the development was assessed and the 3 worst case operational stages have been used to assess the project.



The stages used in the assessment are as follows:

- Months 2 to 3: Sheet piling (daytime only), dredge access channel, remove fill & sand in the swing basin.
- Months 4 to 6: Dredge access channel, remove fill and sand in the swing basin, remove silt in channel.
- Months 14 to 15: Extract piles (daytime only), remove silt/sand in channel, remove fill and sand in the Swing Basin.

Noise contours were produced for the proposed Extension of Shipping Channels, and are contained within **Appendix D**. The noise contours represent the following operational stages:

- Worst case dredging operations.
- Activities associated with drilling and removal of rock.
- Worst case drilling under prevailing conditions (temperature inversion).

A summary of the predicted noise levels at the most potentially affected residences for each operational stages of the development are presented in **Table 5.2.1**.



**Table 5.2.1 Proposed Extension of Shipping Channels, Port of Newcastle Impact Assessment
Worst Case Scenario - Calm Weather Conditions**

Location	Period	Predicted Noise Level LAeq(15 minute)				Project Specific Design Goal	
		Dredge Access Channel and Sheet Piling Months 2-3	Dredge Access Channel and Swing Basin Months 4-6	Dredge and Extract Piles Months 14-15	Drill & Blast Months 29-31	Intrusiveness Criterion LAeq(15minute)	Amenity Criterion LAeq
Crebert Street, Mayfield	Daytime	47 dBA*	39 dBA	46 dBA*	38 dBA	62 dBA	59 dBA
	Evening	38 dBA	39 dBA	31 dBA	38 dBA	58 dBA	53 dBA
	Night	38 dBA	39 dBA	31 dBA	38 dBA	53 dBA	51 dBA
North Arthur Street, Mayfield	Daytime	46 dBA*	35 dBA	46 dBA*	38 dBA	56 dBA	60 dBA
	Evening	34 dBA	35 dBA	25 dBA	38 dBA	55 dBA	50 dBA
	Night	34 dBA	35 dBA	25 dBA	38 dBA	48 dBA	42 dBA
South Arthur Street, Mayfield	Daytime	46 dBA*	39 dBA	46 dBA*	37 dBA	51 dBA	60 dBA
	Evening	38 dBA	39 dBA	34 dBA	37 dBA	51 dBA	50 dBA
	Night	38 dBA	39 dBA	34 dBA	37 dBA	48 dBA	42 dBA
Residences adjacent to Mayfield East Public School	Daytime	48 dBA*	39 dBA	47 dBA*	39 dBA	52 dBA	60 dBA
	Evening	38 dBA	39 dBA	34 dBA	39 dBA	50 dBA	50 dBA
	Night	38 dBA	39 dBA	34 dBA	39 dBA	47 dBA	43 dBA
Mayfield East Public School	Daytime	38dBA**	39dBA	37dBA**	39dBA	N/A	40dBA (internal)*
Vine Street, Mayfield	Daytime	38 dBA*	29 dBA	38 dBA*	29 dBA	50 dBA	60 dBA
	Evening	29 dBA	29 dBA	24 dBA	29 dBA	50 dBA	50 dBA
	Night	29 dBA	29 dBA	24 dBA	29 dBA	47 dBA	43 dBA
Simpson Close, Mayfield	Daytime	38 dBA*	32 dBA	40 dBA*	29 dBA	51 dBA	60 dBA
	Evening	35 dBA	32 dBA	34 dBA	29 dBA	54 dBA	50 dBA
	Night	35 dBA	32 dBA	34 dBA	29 dBA	51 dBA	42 dBA

Note: * denotes a 5 dBA penalty applied for impulsive noise character. Sheet piling not considered in evening and night-time calculations.

+ Represents internal noise level. The internal noise level was assumed to be 10dBA less than the predicted external noise level.

Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am.

On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm;

Night-time 10.00 pm - 8.00 am

Impact of Remediation Operations

Noise from the activities involved in the removal of contaminated materials and remediation activities have been predicted independently to the dredging and blasting operations at the nearest affected residential locations surrounding the site during the daytime period from 7.00 am to 6.00 pm.



During the remediation works the following activities are being carried out:

- Loading of contaminated material at a temporary wharf onto trucks by excavator.
- Transporting contaminated material by truck to the remediation site.
- The operation of a concrete batching plant and a thermal desorption plant
- Operation of front end loaders, compactor and a screw conveyor on the remediation site.

A summary of the predicted noise levels at the most potentially affected residences for remediation stages of the development are presented in **Table 5.2.2**.

Table 5.2.2 Remediation Work Impact Assessment - Calm Weather Conditions

Location	Period	Predicted Noise Level LAeq(15minute)	Project Specific Design Goal	
		Remediation Works	Intrusiveness Criterion LAeq(15minute)	Amenity Criterion LAeq
Crebert Street, Mayfield	Daytime	47 dBA	62 dBA	59 dBA
North Arthur Street, Mayfield	Daytime	30 dBA	56 dBA	60 dBA
South Arthur Street, Mayfield	Daytime	36 dBA	51 dBA	60 dBA
Residences adjacent to Mayfield East Public School *	Daytime	43 dBA	52 dBA	60 dBA
Mayfield East Public School	Daytime	33 dBA ⁺	N/A	40 dBA ⁺
Vine Street, Mayfield*	Daytime	30 dBA	50 dBA	60 dBA
Simpson Close, Mayfield	Daytime	22 dBA	51 dBA	60 dBA

Note: * Intrusive and amenity criteria listed are for residences in the vicinity of the school. The school amenity levels are to be assessed directly against INP criteria for school classrooms.

+ Internal noise level.

Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am. On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am

Combined Impact of Dredging & Remediation Operations

There are stages of the project, months 8 to 10 and 11 to 12, where the remediation works and dredging operations occur simultaneously. A study of the combined effect of these two operations has been conducted for the daytime period only, as remediation work is not being carried out during the evening and night-time periods.



A summary of the predicted noise levels at the most potentially affected residences for the combined effect of dredging and remediation operational stages of the development are presented in **Table 5.2.3** and **Table 5.2.4**.

Table 5.2.3 Combined Dredging Operations and Remediation Work Impact Assessment: Months 7 to10, Calm Weather Conditions

Location	Period	Predicted Noise Level LAeq(15 minute)			Project Specific Design Goal	
		Dredging Months 7-10	Remediation Work Months 7-10	Combined Impact Months 7-10	Intrusiveness Criterion LAeq(15minute)	Amenity Criterion LAeq
Crebert Street, Mayfield	Daytime	34 dBA	47 dBA	48 dBA	62 dBA	59 dBA
North Arthur Street, Mayfield	Daytime	29 dBA	30 dBA	33 dBA	56 dBA	60 dBA
South Arthur Street, Mayfield	Daytime	35 dBA	36 dBA	39 dBA	51 dBA	60 dBA
Residences adjacent to Mayfield East Public School*	Daytime	35 dBA	43 dBA	44 dBA	52 dBA	60 dBA
Mayfield East Public School	Daytime	25 dBA ⁺	33 dBA ⁺	34 dBA ⁺	N/A	40 dBA (internal)
Vine Street, Mayfield	Daytime	27 dBA	30 dBA	33 dBA	50 dBA	60 dBA
NM6 45 Simpson Circuit, Mayfield	Daytime	34 dBA	22 dBA	34 dBA	51 dBA	60 dBA

Note: * Intrusive and amenity criteria listed are for residences in the vicinity of the school. The school amenity levels are to be assessed directly against INP criteria for school classrooms.

+ Internal noise level

Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am. On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.



**Table 5.2.4 Combined Dredging Operations and Remediation Work Impact Assessment:
Months 11 to 12, Calm Weather Conditions**

Location	Period	Predicted Noise Level LAeq(15 minute)			Project Specific Design Goal	
		Dredging Months 11-12	Remediation Work Months 11-12	Combined Impact	Intrusiveness Criterion LAeq(15minute)	Amenity Criterion LAeq
Crebert Street, Mayfield	Daytime	36 dBA	48 dBA	48 dBA	62 dBA	59 dBA
North Arthur Street, Mayfield	Daytime	33 dBA	32 dBA	36 dBA	56 dBA	60 dBA
South Arthur Street, Mayfield	Daytime	36 dBA	37 dBA	40 dBA	51 dBA	60 dBA
Residences adjacent to Mayfield East Public School*	Daytime	37 dBA	44 dBA	45 dBA	52 dBA	60 dBA
Mayfield East Public School	Daytime	27 dBA ⁺	34 dBA ⁺	35 dBA ⁺	N/A	40 dBA ⁺
Vine Street, Mayfield	Daytime	27 dBA	31 dBA	33 dBA	50 dBA	60 dBA
Simpson Close, Mayfield	Daytime	35 dBA	23 dBA	35 dBA	51 dBA	60 dBA

Note: * Intrusive and amenity criteria listed are for residences in the vicinity of the school. The school amenity levels are to be assessed directly against INP criteria for school classrooms.

+ Internal noise level.

Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am.

On Sundays and Public Holidays - Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm;

Night-time 10.00 pm - 8.00 am.

Noise Impact under Calm Conditions

The most significant contribution to daytime noise emissions for the proposed Extension of Shipping Channels project is from the stages involving piling and drilling operations, including the stages involving the extraction of piles, based on the assumption that the removal process is similar to the installation process. As sheet piling will only be performed during daytime, the most significant contribution to night time noise emissions is from rock drilling.

Predicted noise emissions from dredging, sheet piling and drilling operations contained within **Table 5.2.1** will meet project specific noise goals for the development for daytime, evening and night-time operation.



The predicted effect of combined dredging and remediation operations will meet daytime project specific noise goals for the development, as the major noise contributing operations associated with the dredging operation, that is drilling and sheet piling, do not occur on the same time-line as the remediation phase.

5.3 Effects of Meteorology on Predicted Noise Levels

Wind

Wind has the potential to increase noise at a receiver when it is light and stable and blows from the direction of the source of the noise. As the strength of the wind increases the noise produced by the wind will obscure noise from most industrial and transport sources.

Wind effects need to be considered when wind is a feature of the area under consideration. Where wind blows from the source to the receiver at speeds up to 3 m/s for more than 30% of the time in any season, then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

Seasonal wind records indicate that winds of up to 3 m/s are not a feature of the area, as the frequency of such wind is below the 30% threshold. Modelling under prevailing wind was therefore not conducted as part of this investigation.

Temperature Inversion

Temperature inversions, when they occur, have the ability to increase noise levels by focusing sound waves. Temperature inversions occur predominantly at night during the winter months. For a temperature inversion to be a significant characteristic of the area it needs to occur for approximately 30% of the total time during winter, or about 2 nights per week.

As the frequency of occurrence of Stability Class F is above the 30% threshold temperature inversions were considered to be a feature of the area for the purposes of this assessment.



Noise Prediction under Prevailing Weather Conditions

Dredging Operations

Noise levels were predicted under prevailing weather conditions at all residences surrounding the proposed Extension of Shipping Channels, Port of Newcastle area. Noise modelling was conducted for prevailing atmospheric conditions which would occur during winter nights consisting of 8°C air temperature, 75% relative humidity, 0 m/s wind speed and 3°C/100 m temperature gradient. Predicted noise levels received at the potentially worst affected residences are presented in Table 5.3.1.

Table 5.3.1 Proposed Extension of Shipping Channels, Prevailing Weather Conditions Worst Case Scenario

Location	Period	Predicted Noise Level LAeq(15 minute)				Project Specific Design Goal	
		Dredge Access Channel Months 2-3	Dredge Access Channel & Swing Basin Months 4-6	Dredge and Extract Piles Months 14-15	Drill & Blast Months 29-31	Intrusiveness Criterion LAeq(15minute)	Amenity Criterion LAeq
Crebert Street Mayfield	Night	45 dBA	43 dBA	38 dBA	41 dBA	53 dBA	51 dBA
North Arthur Street Mayfield	Night	42 dBA	40 dBA	37 dBA	40 dBA	48 dBA	42 dBA
South Arthur Street Mayfield	Night	43 dBA	42 dBA	41 dBA	40 dBA	48 dBA	42 dBA
Residences adjacent to Mayfield East Public School	Night	45 dBA	43 dBA	41 dBA	42 dBA	47 dBA	43 dBA
Vine Street, Mayfield	Night	38 dBA	35 dBA	33 dBA	33 dBA	47 dBA	43 dBA
Simpson Close Mayfield	Night	40 dBA	41 dBA	40 dBA	37 dBA	51 dBA	42 dBA

Note: Sheet Piling not considered in evening and night time calculations.



Remediation Operations

Remediation operations are carried out between the hours of 7.00 am to 6.00 pm, therefore, an assessment of prevailing weather conditions is not required.

Noise Impact under Prevailing Weather Conditions

The most significant contribution to noise emissions from the proposed Extension of Shipping Channels, Port of Newcastle Project under prevailing conditions is from the 100 tonne backhoe dredger and large cutter suction dredge, when located in the area between the swing basin and eastern extent of the dredge pattern, and rock drilling operations.

Predicted noise emissions from dredging operations, utilising the large suction cutter dredge and the 100 tonne backhoe dredger, under prevailing conditions exceed amenity criterion by 1 dBA at residences at the southern end of Arthur Street (adjacent to NM3) and by 2 dBA at residences in the vicinity of Mayfield East Primary School (adjacent to NM4). Refer to **Table 5.3.1**.

It should be noted that where an $L_{Aeq}(15 \text{ minute})$ intrusive noise level exceeds the amenity criteria by 1 dBA to 2 dBA, it is unlikely that any change in noise level would be detectable by the residents of the area. It is likely that the noise level of the contributing noise source would be at or below the background noise level during each specific period.

5.4 Sleep Disturbance

To predict the possible occurrence of sleep disturbance from operation of the proposed Extension of Shipping Channels, Port of Newcastle at night the typical L_{A1} levels of acoustically significant plant (in particular the drill and large suction cutter dredge) were measured during their operation. These levels were used as input to the acoustic model for the site and predictions were made at surrounding residences under adverse weather conditions at night. No allowance has been made for sirens or alarms on any of the equipment in use. A summary of the predicted noise levels at the most affected residential locations surrounding the site are given in **Table 5.4.1**.



Table 5.4.1 Predicted Sleep Disturbance Noise Levels - Adverse Conditions

Location	Period	Predicted Noise Level L _{Aeq} (1minute)	Sleep Disturbance Design Goal
Crebert Street, Mayfield	Night	51 dBA	63 dBA
North Arthur Street, Mayfield	Night	48 dBA	58 dBA
South Arthur Street, Mayfield	Night	50 dBA	58 dBA
Residences adjacent to Mayfield East Public School*	Night	51 dBA	57 dBA
Vine Street Mayfield	Night	44 dBA	57 dBA
Simpson Court, Mayfield	Night	47 dBA	61 dBA

*Note: Sleep disturbance criteria listed are for residences in the vicinity of the school.

5.5 Cumulative Noise Impact Assessment

As discussed in Section 4.1 the NSW Industrial Noise Policy (INP) prescribes detailed calculation routines for establishing “project specific” L_{Aeq}(15minute) intrusive criteria and L_{Aeq}(period) amenity criteria at potentially affected receivers for a development (in isolation).

Potential cumulative noise impacts from existing and successive industrial developments are embraced by the INP procedures by ensuring that the appropriate noise emission criteria (and consent limits) are established with a view to maintaining acceptable noise amenity levels for residences.

The area surrounding the proposed Extension of Shipping Channels site is industrial in nature with the former BHP site to the south and Kooragang Island industrial area to the north. The cumulative industrial noise contribution from existing industries in the general area (eg One Steel, Kooragang Coal terminal and Carrington Coal Terminal) are accounted for by direct measurement during ambient noise monitoring. The measurement of these industrial noise contributions results in a modification of the amenity criteria at each receiver location. The inherent limitation of this approach is that approved developments that are not yet operational may result in further modifications to the amenity criteria.



This indicative cumulative noise assessment aims to determine the impact of the proposed Extension of Shipping Channels project in conjunction with the Protech Steel Mill (Kooragang) and construction phase of the Multi Purpose Terminal (former BHP Site) which are proposed approved industrial projects. It has been assumed that the proposed Extension of Shipping Channels project will not occur while the Multi Purpose Terminal is in operation but may occur during the construction of the terminal. The conditions of consent for noise for the Protech development and Multi Purpose Terminal construction are given in **Appendix E**.

In order to assess any cumulative noise impacts, it is important to appreciate and distinguish the INP's first and second environment noise control objectives as follows:

Intrusive Noise Criteria LAeq(15minute)

The INP's first objective, that the intrusive noise emission from any single source does not exceed the background level by more than 5 dBA, relates to individual industrial sites where the intrusive noise limit is generally specified in the Development Consent and/or Pollution Control Licence.

There is not an established procedure (or regulatory requirement) to derive intrusive LAeq(15minute) noise criteria for the cumulative operation of existing and/or approved industrial developments in a locality.

Noise Amenity Criteria LAeq(period)

The INP's second objective, that the LAeq(period) amenity level (ie non-transport related) is not to exceed the specified "acceptable" or "maximum" noise level appropriate for the particular locality and land use, is aimed at restricting the potential cumulative increase in amenity levels otherwise known as "background creep".

The INP based acceptable noise amenity criteria for the five (5) assessment localities adjusted to account for existing industrial operations are summarised in **Table 5.5.1**.



Table 5.5.1 Cumulative Impact Assessment - Acceptable Noise Amenity Criteria

Location	Description	Amenity Criterion L _{Aeq}
Crebert Street, Mayfield	Daytime	59 dBA
	Evening *	53 dBA
	Night *	51 dBA
Northern Arthur Street, Mayfield	Daytime	60 dBA
	Evening	50 dBA
	Night	42 dBA
Southern Arthur Street, Mayfield	Daytime	60 dBA
	Evening	50 dBA
	Night	42 dBA
Residences adjacent to Mayfield East Public School	Daytime	60 dBA
	Evening	50 dBA
	Night	43 dBA
Mayfield East Public School	Daytime	40 dBA (internal)
Avon Street, Mayfield	Daytime	60 dBA
	Evening	50 dBA
	Night	43 dBA
Simpson Close, Mayfield	Daytime	60 dBA
	Evening	50 dBA
	Night	42 dBA

Note: * Criterion for the periods noted is adjusted to allow for traffic noise as per INP.

Cumulative Noise Assessment

The potential for the simultaneous operation of adjoining industrial developments to exceed the acceptable noise amenity criteria can be assessed on a worst case scenario by adding the predicted intrusive noise levels from the proposed Extension of Shipping Channels project and the approved intrusive noise limits from the Protech Steel Mill and the construction phase of the Multi Purpose Terminal. The cumulative intrusive level is then adjusted to the equivalent amenity level for comparison with the criteria presented in **Table 5.5.1**.



In order to prepare the indicative assessment the following assumptions are necessary:

- The $L_{Aeq(15\text{minute})}$ emission level is approximately 3 dBA less than the $LA_{10(15\text{minute})}$ emission level.
- The individual $L_{Aeq(15\text{minute})}$ emission limits from each development are simultaneously additive to give a total $L_{Aeq(15\text{minute})}$ intrusive level.
- The cumulative $L_{Aeq(\text{period})}$ amenity level is approximately 3 dBA less than the total $L_{Aeq(15\text{minute})}$ intrusive level.

It should be noted that this is clearly a worst case assessment as it assumes that all industries simultaneously emit their maximum noise emission to a common receiver locality during calm or adverse weather conditions.

The indicative cumulative noise amenity levels during calm and adverse weather conditions are presented in **Tables 5.5.2** and **5.5.3** respectively for the six (6) assessment localities.



Table 5.5.2 Indicative Cumulative Noise Impact Assessment Summary - Calm Conditions

Location	Period	Intrusive Noise Level LAeq(15 minute)				Amenity Noise Level LAeq(period)	
		South Arm Dredging	Protech	MPT Construction	Cumulative Intrusive Level	Cumulative Amenity Level	Amenity Criterion LAeq
Crebert Street, Mayfield	Daytime	47 dBA	39 dBA	53 dBA	54 dBA	51 dBA	59 dBA
	Evening	39 dBA	39 dBA	N/A	42 dBA	39 dBA	53 dBA
	Night	39 dBA	39 dBA	N/A	42 dBA	39 dBA	51 dBA
North Arthur Street, Mayfield	Daytime	46 dBA	39 dBA	52 dBA	53 dBA	50 dBA	60 dBA
	Evening	38 dBA	39 dBA	N/A	42 dBA	39 dBA	50 dBA
	Night	38 dBA	39 dBA	N/A	42 dBA	39 dBA	42 dBA
South Arthur Street, Mayfield	Daytime	46 dBA	39 dBA	48 dBA	50 dBA	47 dBA	60 dBA
	Evening	39 dBA	39 dBA	N/A	42 dBA	39 dBA	50 dBA
	Night	39 dBA	39 dBA	N/A	42 dBA	39 dBA	42 dBA
Residences adjacent to Mayfield East Public School*	Daytime	48 dBA	39 dBA	44 dBA	50 dBA	47 dBA	60 dBA
	Evening	39 dBA	39 dBA	N/A	42 dBA	39 dBA	50 dBA
	Night	39 dBA	39 dBA	N/A	42 dBA	39 dBA	43 dBA
Mayfield East Public School	Daytime	38 dBA ⁺	29 dBA ⁺	34 dBA ⁺	40 dBA ⁺	37 dBA ⁺	40 dBA ⁺ (internal)
Vine Street, Mayfield	Daytime	38 dBA	32 dBA	52 dBA	52 dBA	49 dBA	60 dBA
	Evening	29 dBA	32 dBA	N/A	34 dBA	31 dBA	50 dBA
	Night	29 dBA	32 dBA	N/A	34 dBA	31 dBA	43 dBA
Simpson Court, Mayfield	Daytime	38 dBA	32 dBA	N/A	39 dBA	36 dBA	60 dBA
	Evening	35 dBA	32 dBA	N/A	36 dBA	33 dBA	50 dBA
	Night	35 dBA	32 dBA	N/A	36 dBA	33 dBA	42 dBA

Note: *Intrusive and amenity criteria listed are for residences in the vicinity of the school. The school amenity levels are to be assessed directly against INP criteria for school classrooms.

⁺ Internal noise level

Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am.

On Sundays and Public Holidays - Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm;

Night-time 10.00 pm-8.00 am



Table 5.5.3 Indicative Cumulative Noise Impact Assessment Summary - Adverse Conditions

Location	Period	Intrusive Noise Level LAeq(15 minute)				Amenity Noise Level LAeq(period)	
		South Arm Dredging	Protech	MPT Construction	Cumulative Intrusive Level	Cumulative Amenity Level	Amenity Criterion LAeq
Crebert Street, Mayfield	Night	45 dBA	39 dBA	N/A	46 dBA	43 dBA	51 dBA
North Arthur Street, Mayfield	Night	42 dBA	39 dBA	N/A	44 dBA	41 dBA	42 dBA
South Arthur Street, Mayfield	Night	42 dBA	39 dBA	N/A	44 dBA	41 dBA	42 dBA
Residences adjacent to Mayfield East Public School*	Night	43 dBA	39 dBA	N/A	44 dBA	41 dBA	43 dBA
Vine Street, Mayfield	Night	36 dBA	32 dBA	N/A	37 dBA	34 dBA	43 dBA
Simpson Court, Mayfield	Night	40 dBA	32 dBA	N/A	41 dBA	38 dBA	42 dBA

Note: *Intrusive and amenity criteria listed are for residences in the vicinity of the school.
Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am.
On Sundays and Public Holidays - Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm;
Night-time 10.00 pm-8.00 am

At all six (6) assessment localities the calm and adverse cumulative noise emissions from the proposed Extension of Shipping Channels project, Protech Steel Mill and MPT construction are below the relevant acceptable amenity criteria (modified for existing industrial operations) for industrial noise (ie non-transport related) during the daytime, evening and night-time.



5.6 Impact of Road Transport

Approximately 280,000 m³ of remediated material and 300,000 m³ of inert material needs to be removed from the proposed site. The location to which this material is to be transported has not yet been fully resolved. Three potential transport scenarios are evident:

- All of the material may be transported to the Closure Site (no external road transport required);
- All material may be transported to waste emplacement areas on Kooragang Island; or
- Some material may be transported to the Closure Site and some transported to Kooragang Island.

With respect to external road impacts, the worst case is to transport all material to Kooragang Island and that both treated and inert materials would be transported concurrently at certain times. Therefore, this scenario will be assessed.

5.6.1 Traffic Volume on Industrial Drive

In the vicinity of the area subject to the proposal, the major road network consists of Cormorant Road, Tourle Street and Industrial Drive. Cormorant Road is a major arterial road running along the northern side of the south arm, near the northern bank. It is an RTA classified B-double route. Industrial Drive is also a major arterial road, and essentially runs parallel to the southern side of the Hunter River south arm, approximately one kilometre to the south of the southern bank.

Cormorant Road and Industrial Drive are connected by Tourle Street, which crosses the south arm of the Hunter Rivers at the Tourle Street bridge.

Industrial Drive east of Tourle Street, has an AADT of approximately 30,000 and west of Tourle Street, has an AADT of approximately 38,000. Tourle Street/Cormorant Drive has an AADT of approximately 25,000. Traffic volumes on Industrial Drive and Tourle Street/ Cormorant Drive were obtained from a traffic study conducted by GHD.



5.6.2 Traffic Generation

The estimated traffic movements for the duration of the project are shown in **Table 5.6.2.1**.

Table 5.6.2.1 Proposed Traffic Movements

Activity Type	Estimated vehicle movements per day
Staff arriving on site & leaving site	90
Disposal of treated waste material	200
Disposal of inert waste material	200
Rock deliveries	180
Cementitious products	32
Delivery of dredging pipes	40
Delivery/ removal of sheet piles	6
Other	10
Total	758

This additional traffic represents a 3.0% increase in traffic for the Tourle Street/Cormorant Drive and a 1.9% increase in traffic for Industrial Drive

5.6.3 Noise Impact of Traffic

The increase in noise level, based on the worst case scenario where the transportation of treated waste material and inert waste material coincides, generating an additional 758 vehicles per day was calculated to increase noise levels by 0.1 dB LAeq(15hour) and 0.1 dB LAeq(9hour). At this level the impact can be considered negligible as it would not be detectable by receivers along the roadway.

5.7 Noise and Vibration from Blasting

5.7.1 Assessment Criteria

Residential Disturbance Daytime Criteria

The ground vibration and airblast levels which cause concern or discomfort to residents are generally lower than the relevant building damage limits.



The NSW EPA advocates the use of the ANZECC guidelines for assessing potential residential disturbance arising from blast emissions. The ANZECC guidelines for control of blasting impact at residences are as follows:

- The recommended maximum level for airblast is 115 dB Linear.
- The level of 115 dB Linear may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 120 dB Linear at any time.
- The recommended maximum for ground vibration is 5 mm/s, Peak Vector Sum (PVS) vibration velocity. It is recommended however, that 2 mm/s (PVS) be considered as the long term regulatory goal for the control of ground vibration.
- The PVS level of 5 mm/s may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level should not exceed 10 mm/s at any time.
- Blasting should generally only be permitted during the hours of 0900 hrs to 1700 hrs Monday to Saturday. Blasting should not take place on Sundays and public holidays.
- Blasting should generally take place no more than once per day.

The Australian Standard 2187.2-1993 "*Explosives - Storage, Transport and Use. Part 2: Use of Explosives*" does not present human comfort criteria for ground vibration from blasting. It does however make mention of human comfort level for airblast in saying the "a limit of 120 dB for human comfort is commonly used". This is not inconsistent with the ANZECC guidelines.

Residential Disturbance Evening and Night-time Criteria

The assessment of blast emission impacts outside the hours advocated by ANZECC remains according to the EPA's Environmental Noise Control Manual 1994) Chapter 154 Noise Control Guidelines – Blasting presented in Table 5.7.1.1.



Table 5.7.1.1 Evening and Night-time Blast Emission Assessment Criteria

Time of Blasting	5% Exceedance Airblast Level (dB Linear)	5% Exceedance PPV Ground Vibration ⁽¹⁾ (mm/s)
Monday to Saturday 10.00 am – 6.00 pm	115	5
Monday to Saturday 6.00 am – 10.00 am and 6.00pm – 8.00 pm	105	2
Sunday, Public Holidays 6.00 am – 8.00 pm	95	1
Any Day 8.00 pm – 6.00 am	95	1

Note 1: PPV - Peak Particle Velocity.

Building Damage Criteria

AS 2187.2-1993 nominates building damage assessment criteria as presented in **Table 5.7.1.2.**

Table 5.7.1.2 Blast Emission Building Damage Assessment Criteria (AS 2187)

Building Type	Vibration Level ⁽¹⁾	Airblast Level (dB re 20 µPa)
Sensitive (and Heritage)	PVS 5 mm/s	133 dB(Linear) Peak
Residential	PVS 10 mm/s	133 dB(Linear) Peak
Commercial/Industrial	PVS 25 mm/s	133 dB(Linear) Peak

Note 1: PVS - Peak Vector Sum vibration velocity.

5.7.2 Assessment of Blasting Impacts

In order to predict the levels of blast emissions (ground vibration and airblast) at the surrounding receivers from the proposed underwater blasting of rock during the proposed Extension of Shipping Channels project, the ground vibration and airblast levels, from an RHA database of similar underwater and harbour deepening blasting operations, were used to develop blast emissions site laws.

Ground Vibration and Airblast Site Laws

These site laws for ground vibration and airblast have been developed from the statistical analysis of blasting results for similar underwater blasting operations.



A regression analysis is conducted on the results in order to obtain site laws with confidence limits for the median of the data set (50% exceedance) and for 5% exceedance. The ground vibration and airblast criteria advocated by the EPA and ANZECC cater for the inherent variation in emission levels from a given blast design by allowing a five percent exceedance of a general criterion up to a (never to be exceeded) maximum. Correspondingly, the "5% exceedance" levels have been used in the blast emission site laws.

The 5% site laws for ground vibration and airblast are:

Ground Vibration

$$\text{PVS (5\%)} = 132.3 (\text{SD}_1)^{-0.95}$$

Airblast

$$\text{SPL(5\%)} = 208.4 - 39.5 \log (\text{SD}_2)$$

where PVS (5%) and SPL (5%) are the levels of ground vibration (Peak Vector Sum - mm/s) and airblast (dB Linear) respectively, above which 5% of the total population (of data points) will lie, assuming that the population has the same statistical distribution as the underlying measured sample.

SD_1 and SD_2 are the ground vibration and airblast scaled distances, where:

$$\text{SD}_1 = \frac{\text{Distance (m.kg}^{-0.5})}{\sqrt{\text{MIC}}}$$

and,

$$\text{SD}_2 = \frac{\text{Distance (o.k.}^{-0.33})}{\sqrt[3]{\text{MIC}}}$$

and MIC is maximum instantaneous explosive charge in kg.

Predicted Levels of Blast Emission

The level of airblast and ground vibration has been predicted using the developed site laws for the proposed Extension of Shipping Channels, Port of Newcastle project. It is proposed that the blast areas would typically comprise 32 cores arranged on a grid that is 4 cores wide and 8 cores long. The spacing between the cores would be 2.5 m.



It has been estimated that a charge of between 20 kg to 30 kg per core would be appropriate. The explosives would primarily be stored within a secure area on land and transferred to the working platform as required. It is anticipated that up to three days worth of explosives may be stored on the working platform and one month worth stored onshore.

The predicted levels of airblast and ground vibration for surrounding potentially sensitive receivers, based on an MIC of 30 kg, are given in **Table 5.7.2.1**.

Table 5.7.2.1 Predicted Blasting Levels proposed Extension of Shipping Channels, Port of Newcastle

Residential Location	Predicted Mine Blasting Level	
	Airblast dB Linear	Ground Vibration mm/s
Crebert Street, Mayfield	105.4	0.8
North Arthur Street, Mayfield	104.8	0.7
South Arthur Street, Mayfield	100.9	0.6
Mayfield East Public School	102.5	0.6
Vine Street, Mayfield	101.7	0.6
Simpson Close, Mayfield	100.8	0.6
Tourle Street Bridge	103.8	0.7
One Steel	124.8	2.2

Note Average MIC of 30 kg used for predictive purposes.

The blast prediction results presented in **Tables 5.7.2.1** demonstrate that predicted airblast and ground vibration levels will meet the EPA guidelines for residences and other sensitive structures surrounding the development between 6.00 am and 8.00 pm from Monday to Saturday.



6 RECOMMENDED MITIGATION MEASURES

6.1 Noise Mitigation and Management

In order to reduce the noise impact on residential receivers surrounding the proposed Extension of Shipping Channels, Port of Newcastle project, Best Environmental Practice together with Best Achievable Technology have been considered and incorporated into the noise mitigation strategy for the operation which includes:

- o It is recommended that sheet piling should only be performed during the daytime period between 7.00 am and 6.00 pm.
- o Remediation activities should only be performed during the daytime period between 7.00 am and 6.00 pm.
- o Remediation activities and drilling should not occur simultaneously.
- o Remediation activities and sheet piling should not occur simultaneously.
- o Sirens and alarms on all equipment should be adjusted so as not to cause disturbance at surrounding residential receivers during night-time operation.

6.2 Mitigation of Blasting Impacts

In order to reduce the impact of ground vibration and airblast from drilling and blasting from the proposed Extension of Shipping Channels, Port of Newcastle project, it is recommended that blasting should only be conducted between 6.00 am and 8.00 pm from Mondays to Saturdays.

7 CONCLUSION

Predicted noise emission levels for the proposed Extension of Shipping Channels, Port of Newcastle project will comply with the EPA project specific goals under calm weather conditions at all residential locations for daytime evening and night-time operation with the recommended mitigation strategies in place.

Predicted intrusive noise levels under adverse weather conditions (at night during winter months) will marginally exceed the amenity criterion by 1 dBA at residences at the southern end of Arthur Street (adjacent to NM3) and by 2 dBA at residences in the vicinity of Mayfield East Primary School (adjacent to NM4)



It should be noted that where an $L_{Aeq}(15 \text{ minute})$ intrusive noise level exceeds the amenity criteria by 1 dBA to 2 dBA, it is unlikely that any change in noise level would be detectable by the residents of the area. It is likely that the noise level of the contributing noise source would be at or below the background noise level during each specific period.

Assessment of the cumulative noise emissions from the proposed Extension of Shipping Channels, Port of Newcastle project, Protech Steel Mill and Multi Purpose Terminal construction, at surrounding residential locations, for calm and adverse weather conditions are below the relevant acceptable amenity criteria (modified for existing industrial operations) for industrial noise (ie non-transport related) during the daytime, evening and night-time.

The impact of an increase in traffic from the proposed site is predicted to have a negligible increase in road traffic noise.

Predictions of ground vibration and airblast from blasting during the proposed Extension of Shipping Channels, Port of Newcastle project are demonstrated to meet the EPA guidelines for residences and other sensitive structures surrounding the development between 6.00 am and 8.00 pm from Monday to Saturday.

Job Number
Job Description
Project Manager

10 2718
 South Arm Dredging - Dredging Operations
 JC

Remediation Works

Source No.	Equipment Description	Octave Band Centre Frequency (Hz) - dB re 1pW										Overall	ENM (m)		Ground RL(m)	Elevation RL(m)		
		31.5	63	125	250	500	1k	2k	4k	8k	16K		East	North				
1	Small Trailer Suction Dredge	101	96	100	98	95	94	89	88						8862	1624	0	2
5	Large Trailer Suction Dredge	104	99	103	101	98	97	92	91						7968	1990	0	2
9	Large Trailer Suction Dredge	104	99	103	101	98	97	92	91						7025	2443	0	2
14	Large Suction Cutter Dredge (Kunara)	104	104	101	105	110	109	105	100	0	0	0	0	0	6026	2333	0	2
17	Rock Drill	110	113	112	127	107	109	107	102	94	82	82	82	82	8862	1624	0	2
18	Sheet Piling	115	119	117	116	116	116	118	113	112	95	95	95	95	7968	1990	0	2
23	Barge Mounted 30T Excavator	107	106	110	101	101	102	100	96	88	88	88	88	88	8862	1624	0	2
28	Large Backhoe Dredger 100T	104	107	115	111	112	109	106	103	102	90	90	90	90	7025	2443	0	2

Job Number
Job Description
Project Manager

10 2718
 South Arm Dredging - Remediation Operations
 JC

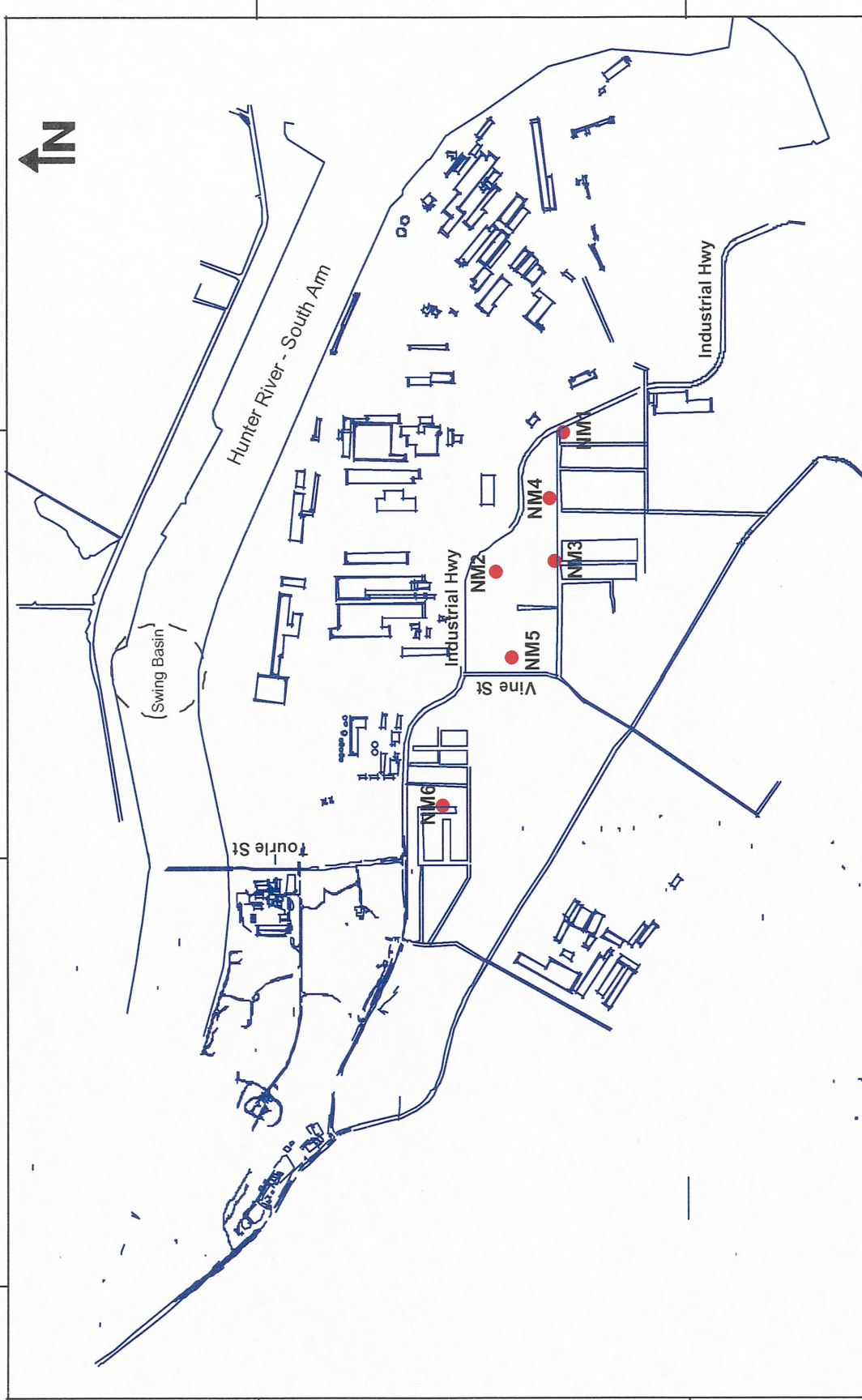
Remediation Works

Source No.	Equipment Description	Octave Band Centre Frequency (Hz) - dB re 1pW										Overall	ENM (m)		Ground RL(m)	Elevation RL(m)		
		31.5	63	125	250	500	1k	2k	4k	8k	16K		East	North				
1	Concrete plant	103	108	108	105	106	107	105	99	94	86	86	86	86	8930	674	0	5
3	Front End Loader 1m ³	95	96	101	100	104	104	102	96	89	77	77	77	77	8687	809	0	2
4	Compactor	99	104	109	112	107	105	102	96	90					8687	809	0	2
5	Screw conveyor	75	75	75	75	75	75	75	75	75	75	75	75	75	8687	809	0	1
6	Thermal desorption machine	98	105	99	106	106	106	103	100	93	93	93	93	93	8492	955	0	3
7	Caterpillar 245 Excavator	103	104	107	103	104	99	94	86	76					9505	875	0	3
8	Transit Mixer at Slump	96	113	99	107	108	108	104	102	94	94	94	94	94	8930	674	0	2
9	Transit Mixer in Loading Bay	98	105	99	106	106	106	103	100	93	93	93	93	93	8930	674	0	2
11	Ford Louisville 8000 15T	106	115	102	109	104	102	99	100	92					8884	620	0	3
13	Volvo NL 14 25T	114	121	114	111	106	105	104	99	91					8884	620	0	3
14	Barge Mounted 30T Excavator	107	106	110	101	101	102	100	96	88	88	88	88	88	8990	1640	0	3
18	Dump Truck Drive off	96	104	106	99	100	98	92	85	77	77	77	77	77	8884	620	0	2
19	Excavator Loading	104	103	108	99	98	99	97	94	85	85	85	85	85	9505	875	0	3
20	Dump truck Pass By	96	104	106	99	100	98	92	85	77	77	77	77	77	9190	620	0	2

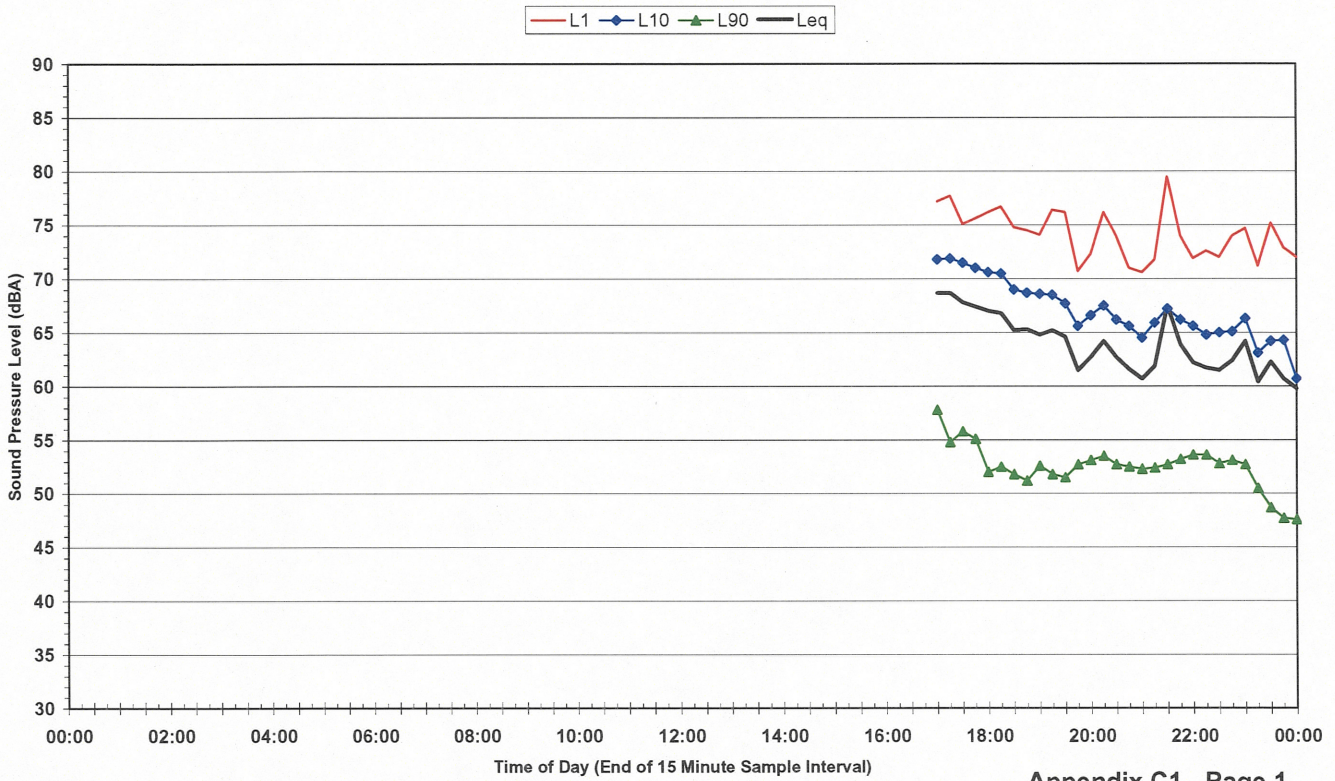
Appendix A
 Report 10-2718-R1 - Page 1 of 1
 Plant and Equipment Sound Power Levels

South Arm Dredging Newcastle

Location Map



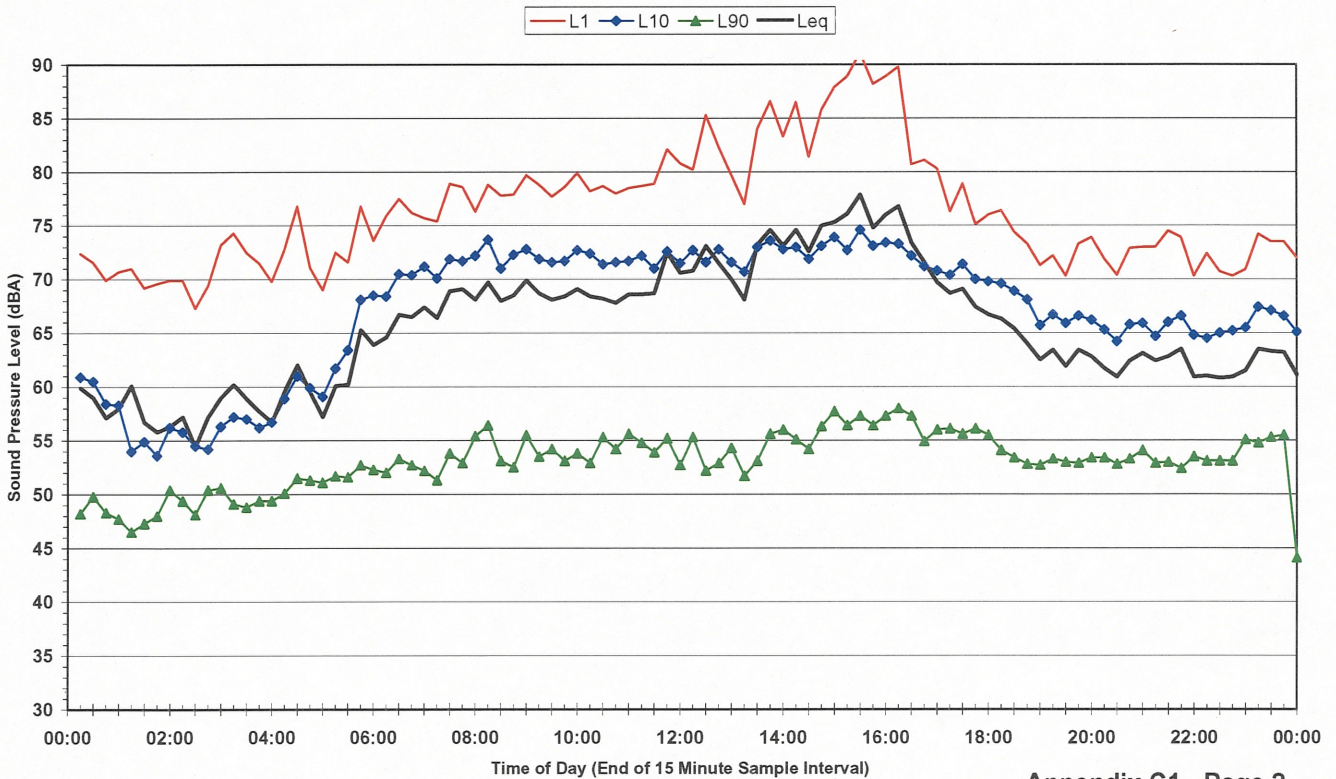
**Statistical Ambient Noise Levels
Crebert St, Mayfield East - Thursday 24 October 2002**



Appendix C1 - Page 1
Statistical Noise Levels
RHA Report 10-2718

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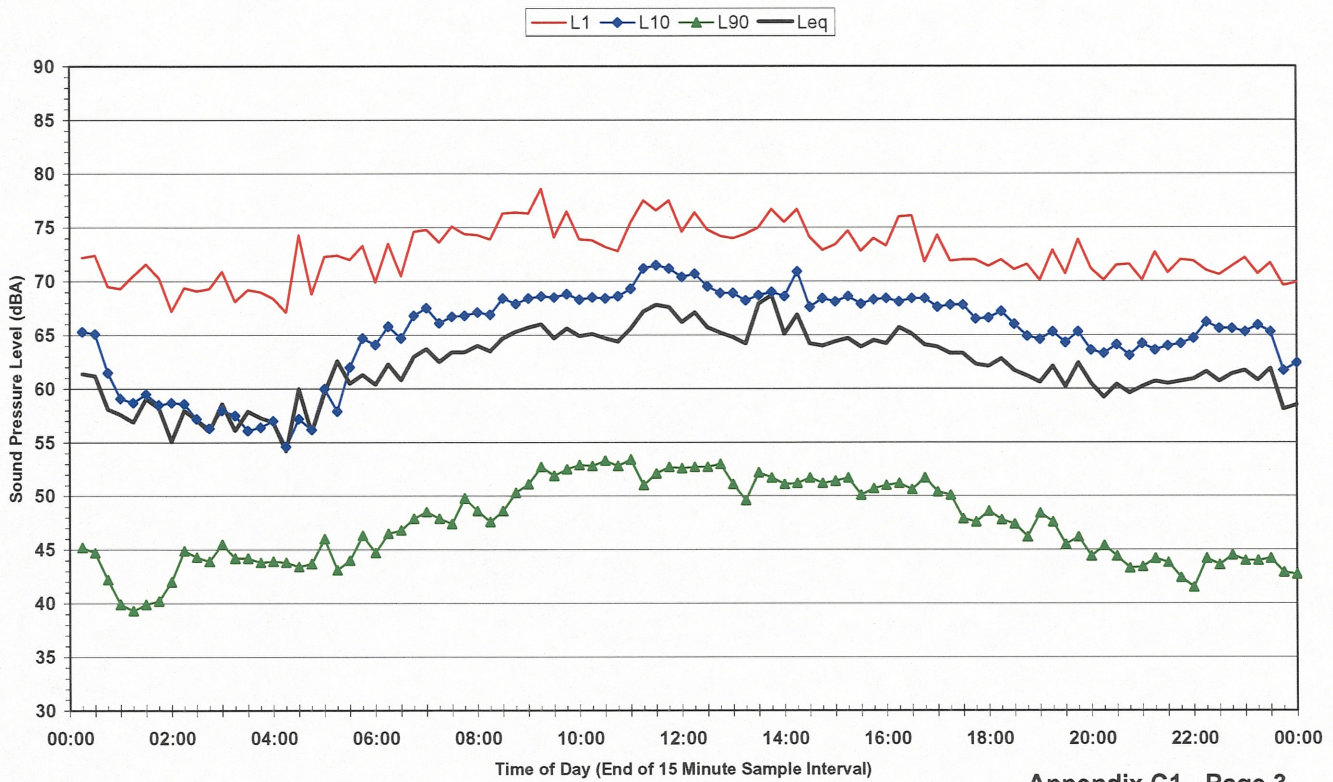
**Statistical Ambient Noise Levels
Crebert St, Mayfield East - Friday 25 October 2002**



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RHA Report 10-2718

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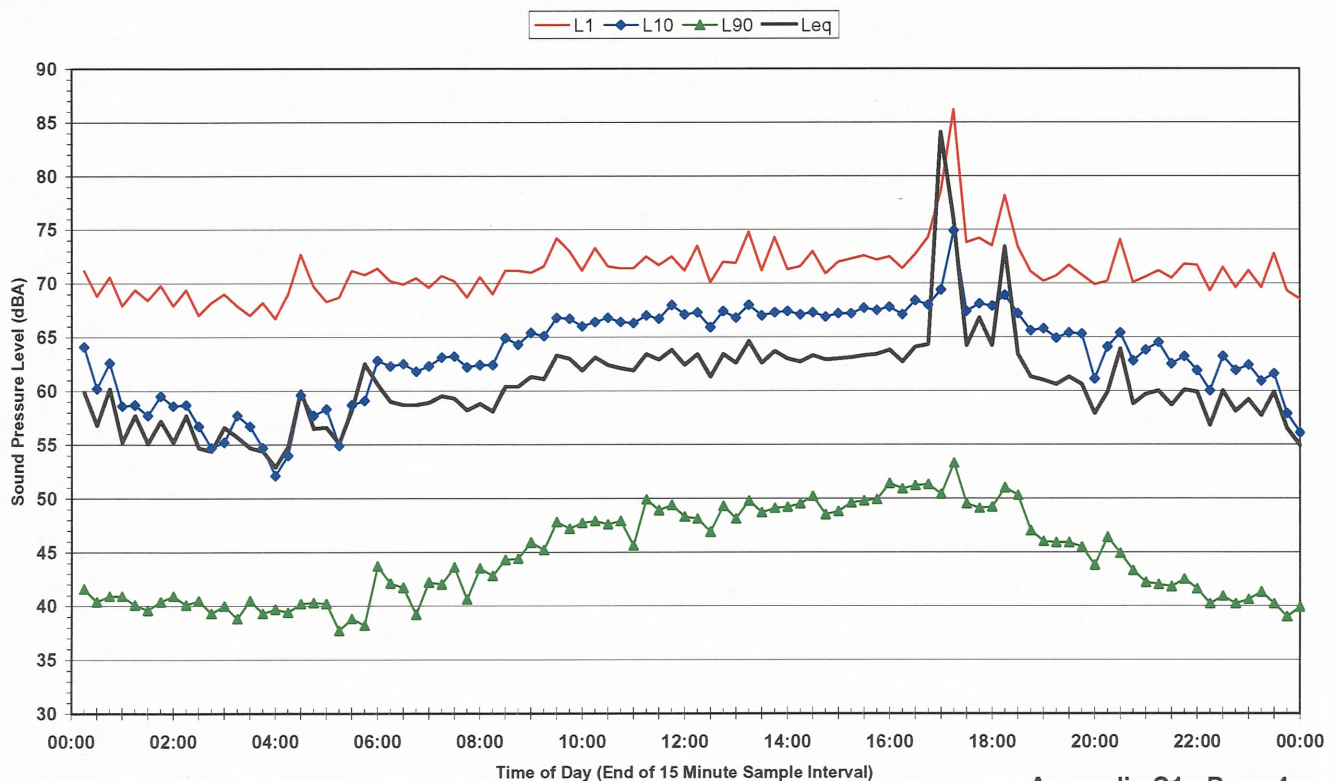


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Statistical Noise Levels
RHA Report 10-2718

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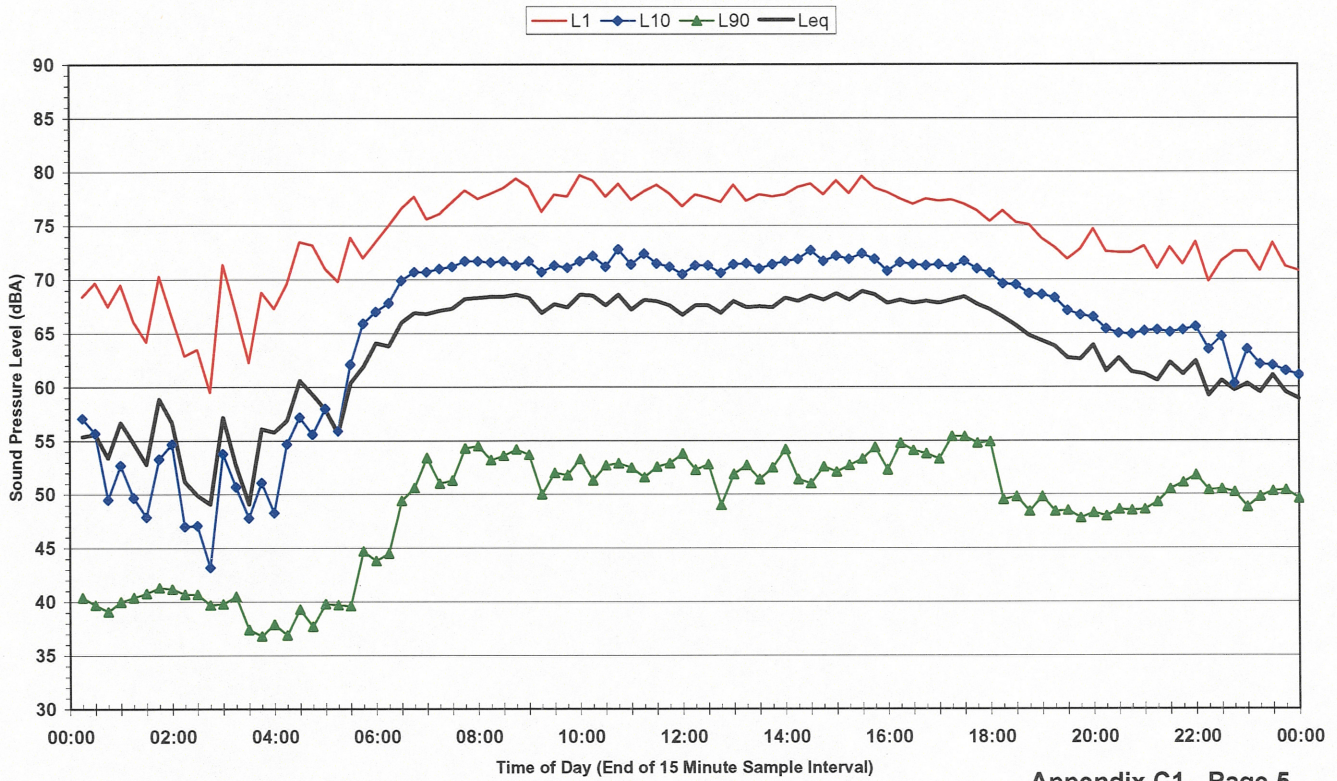


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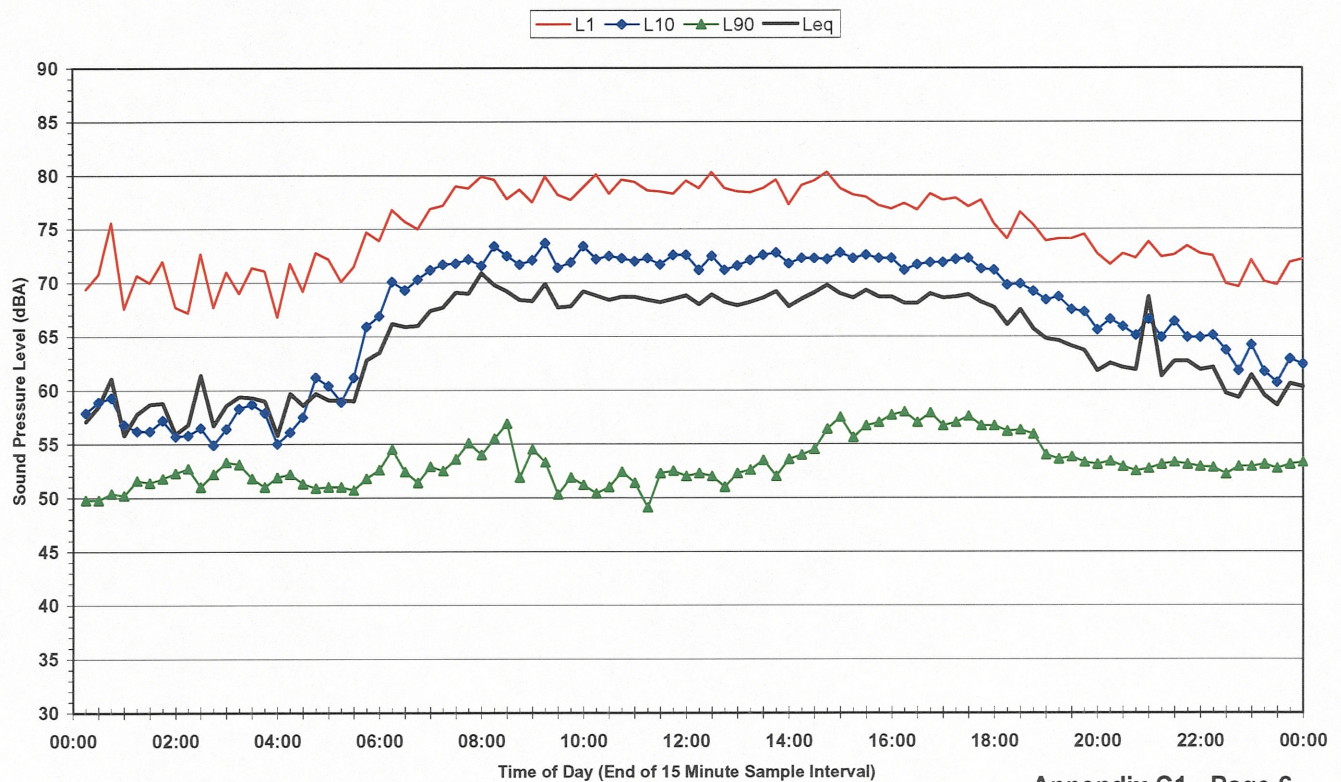
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**Statistical Ambient Noise Levels
Crebert St, Mayfield East - Monday 28 October 2002**



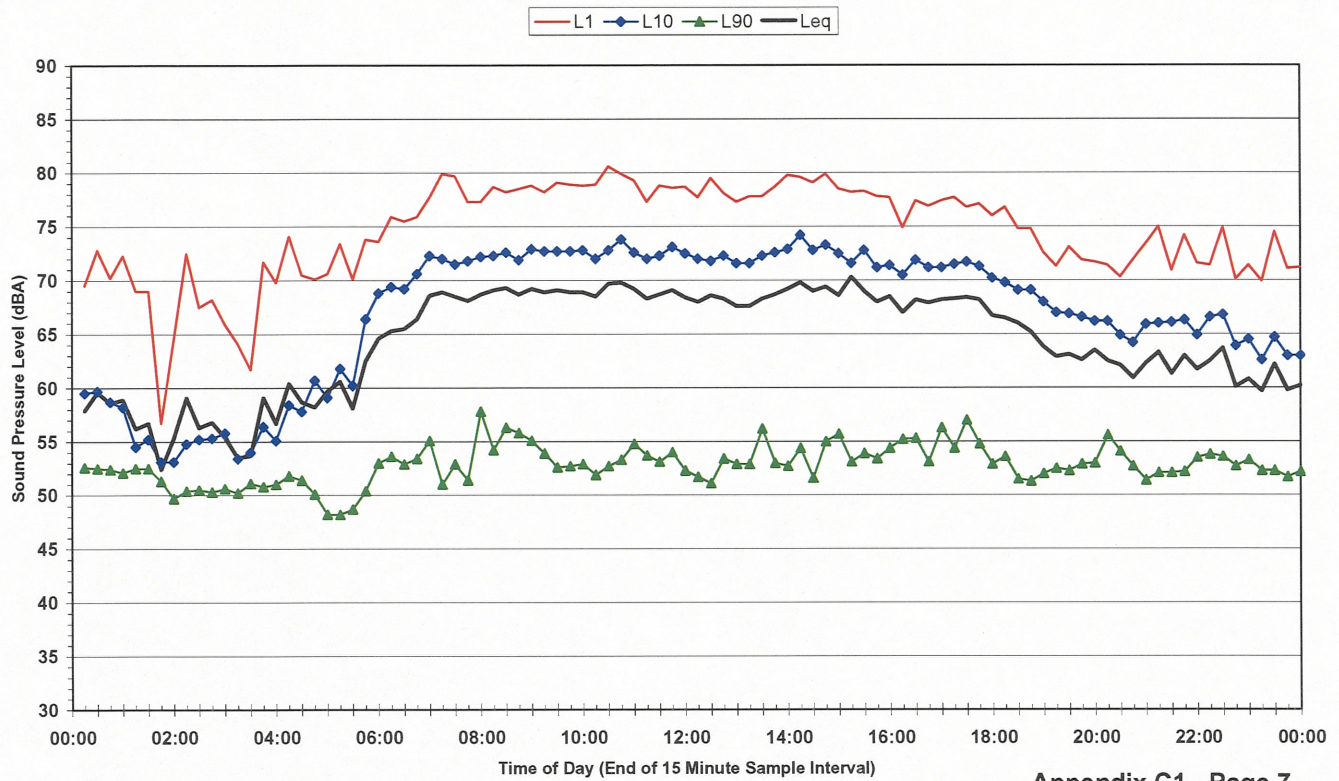
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Crebert St, Mayfield East - Tuesday 29 October 2002**



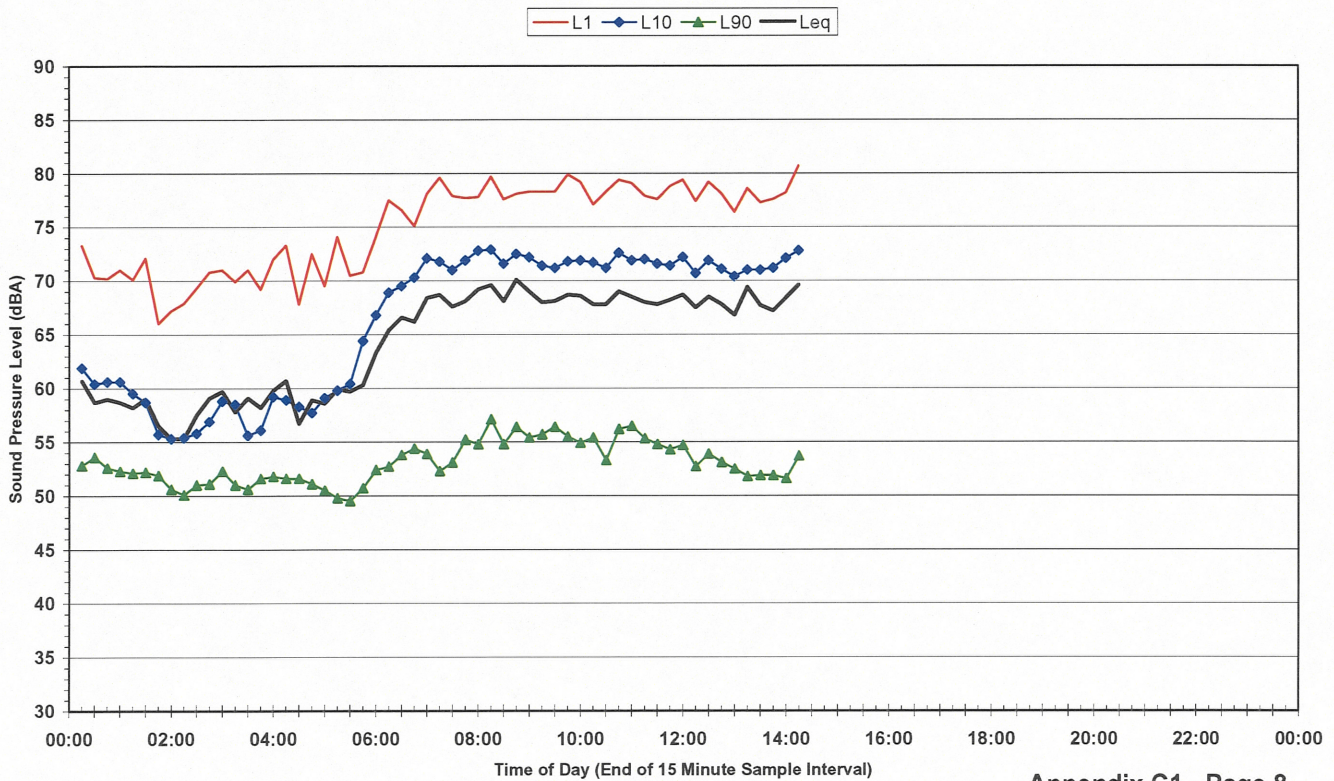
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Crebert St, Mayfield East - Wednesday 30 October 2002**



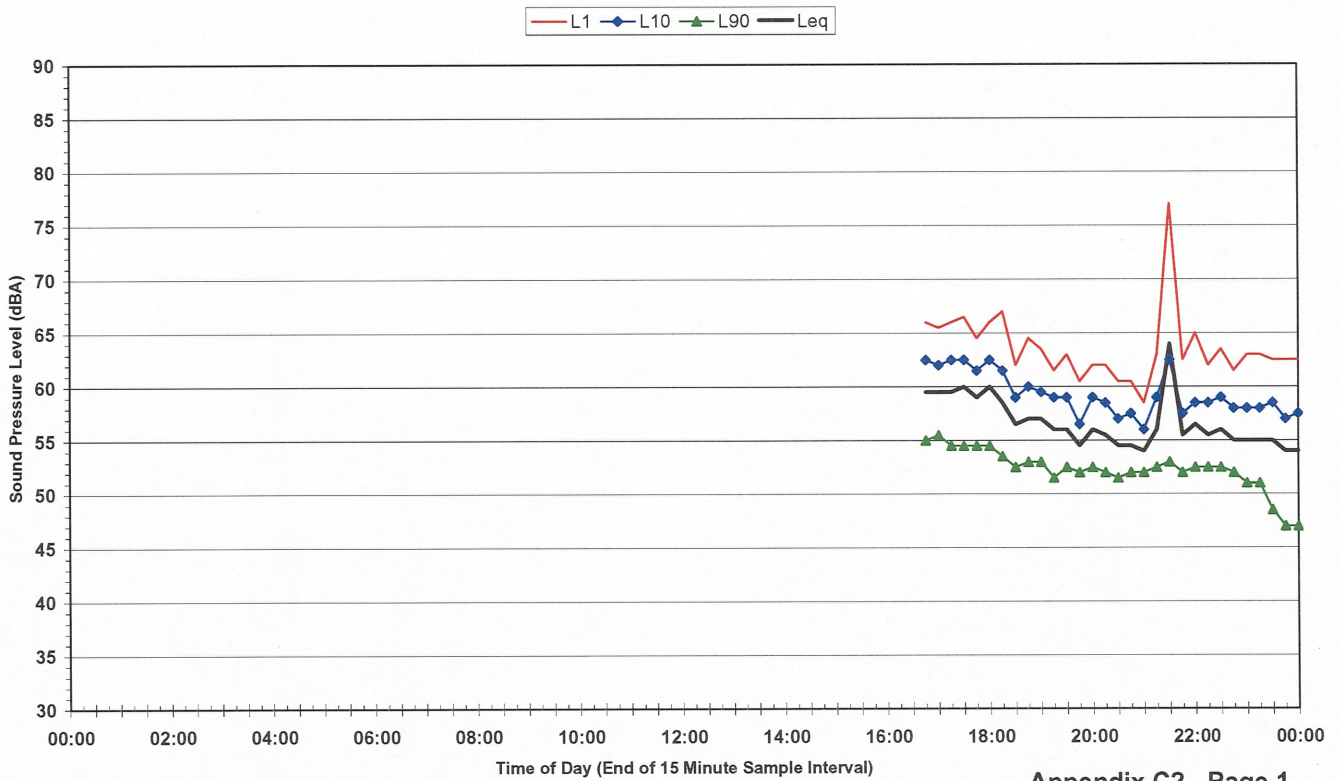
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Crebert St, Mayfield East - Thursday 31 October 2002**



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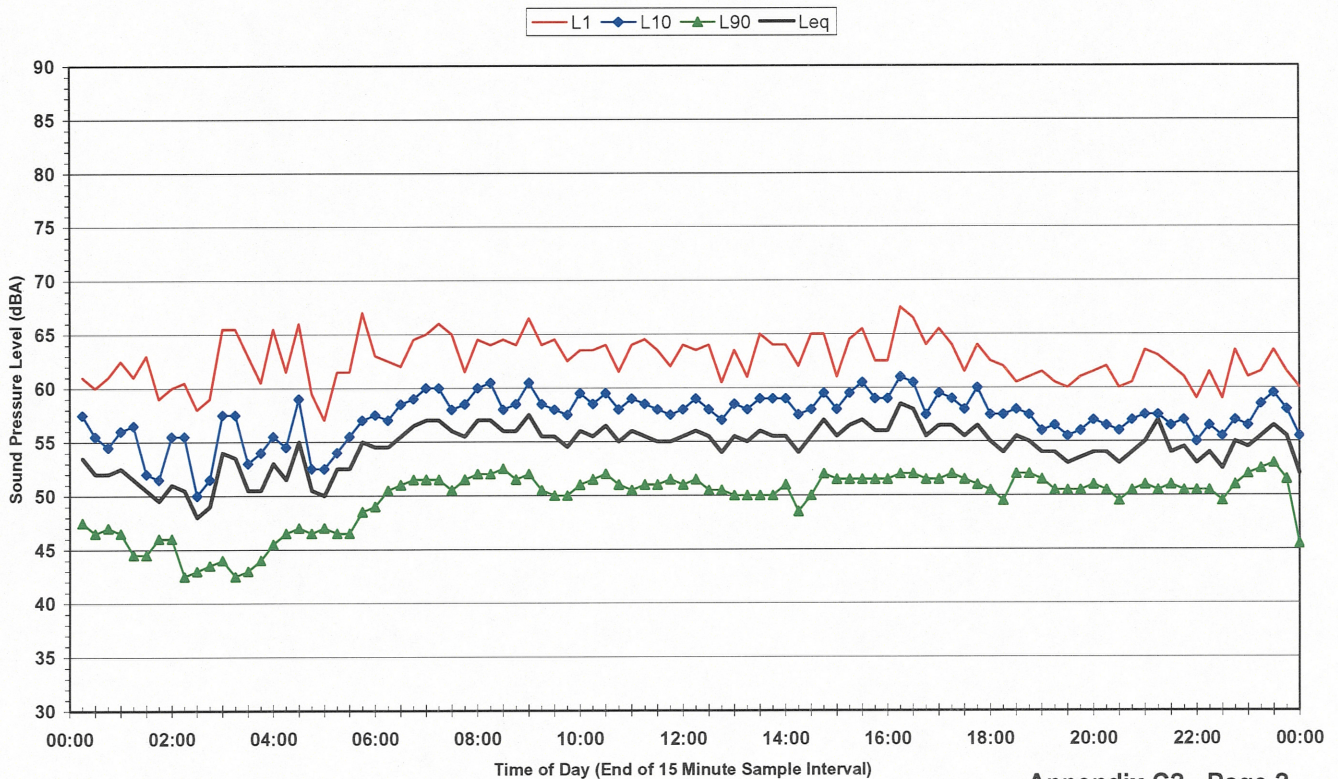
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52 Arthur St, Mayfield - Thursday 24 October 2002**



Appendix C2 - Page 1
Statistical Noise Levels
RHA Report 10-2718

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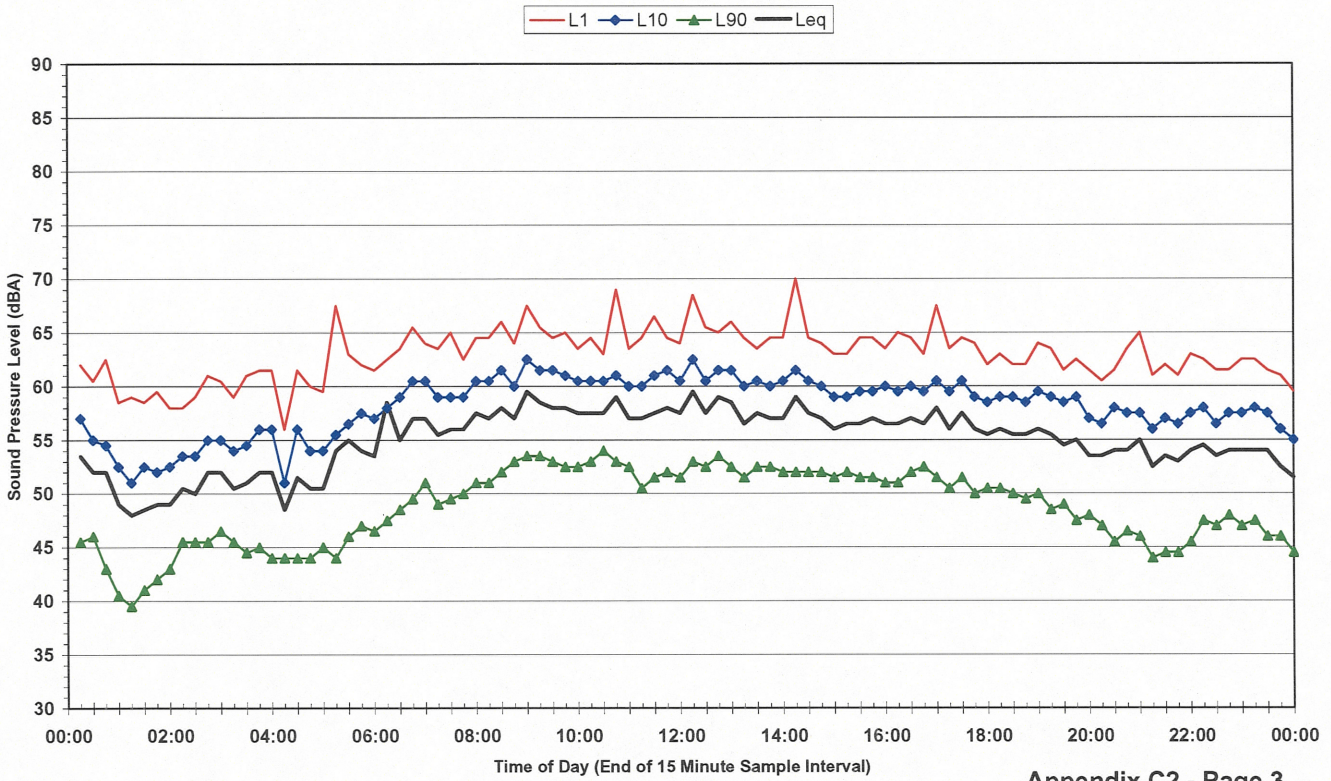
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52 Arthur St, Mayfield - Friday 25 October 2002**



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Statistical Noise Levels
RHA Report 10-2718

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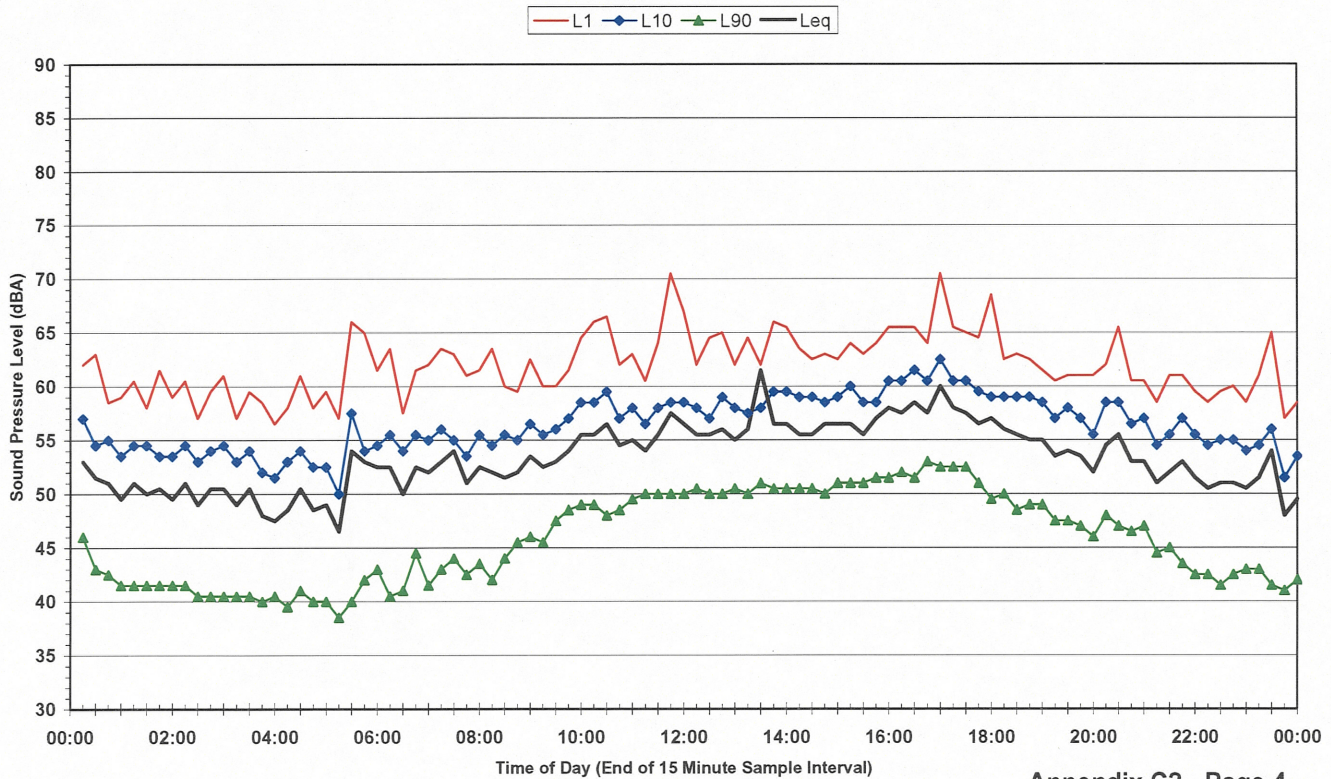


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Statistical Noise Levels
 RHA Report 10-2718

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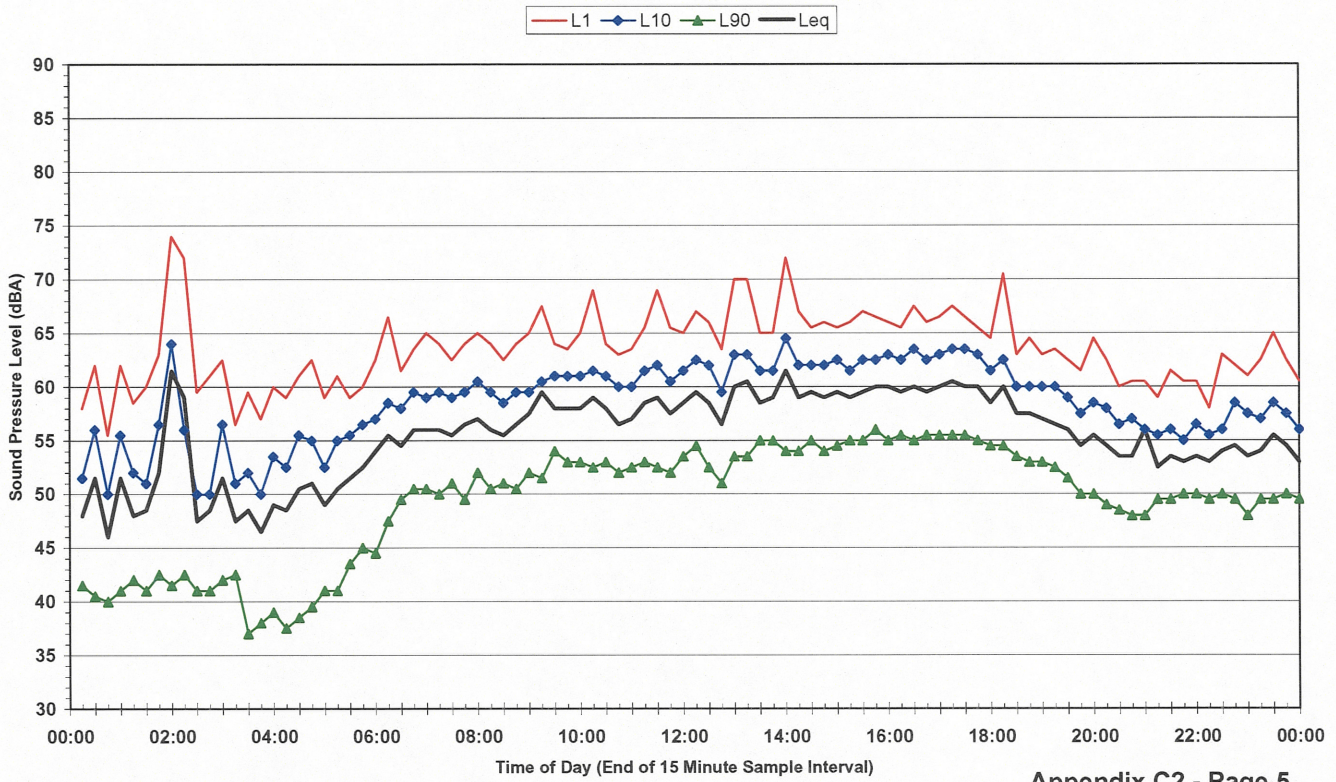


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Statistical Noise Levels
 RHA Report 10-2718

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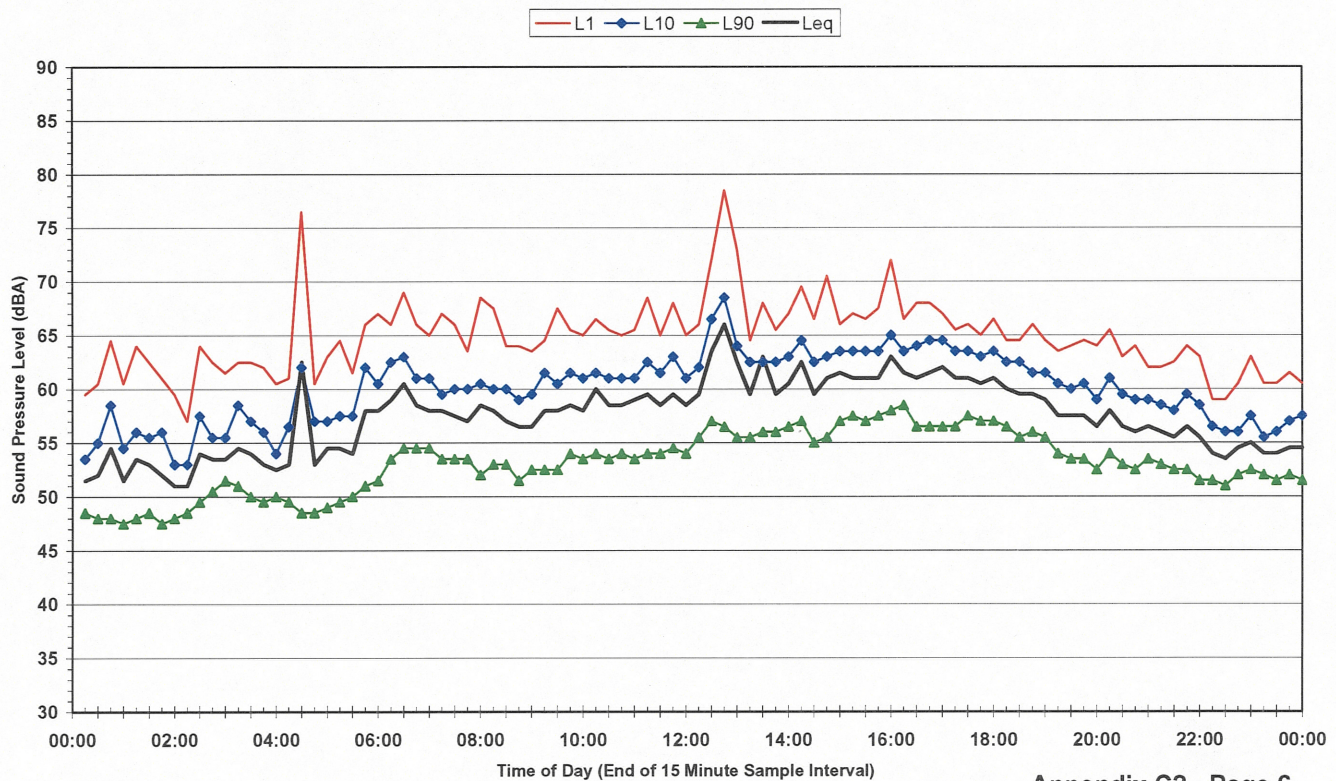
**Statistical Ambient Noise Levels
52 Arthur St, Mayfield - Monday 28 October 2002**



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Statistical Noise Levels
RHA Report 10-2718

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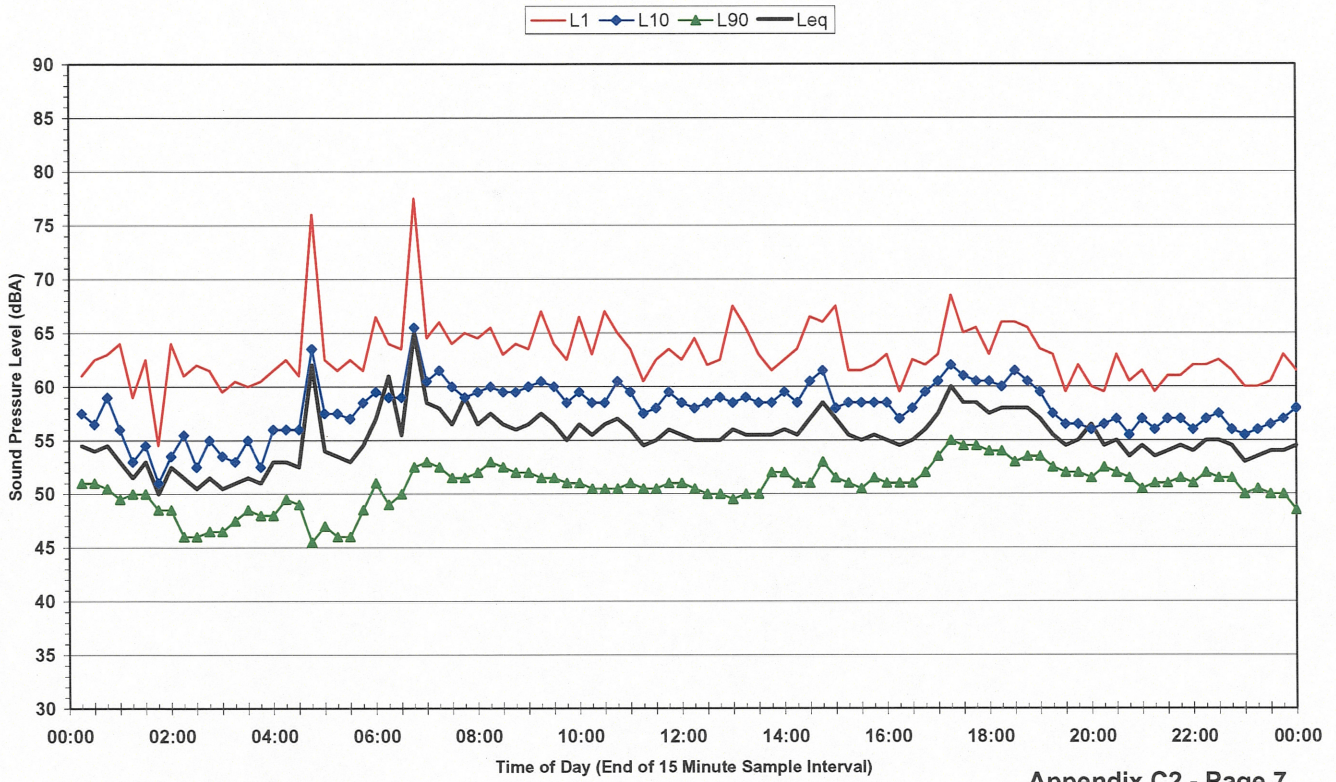
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52 Arthur St, Mayfield - Tuesday 29 October 2002**



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Statistical Noise Levels
RHA Report 10-2718

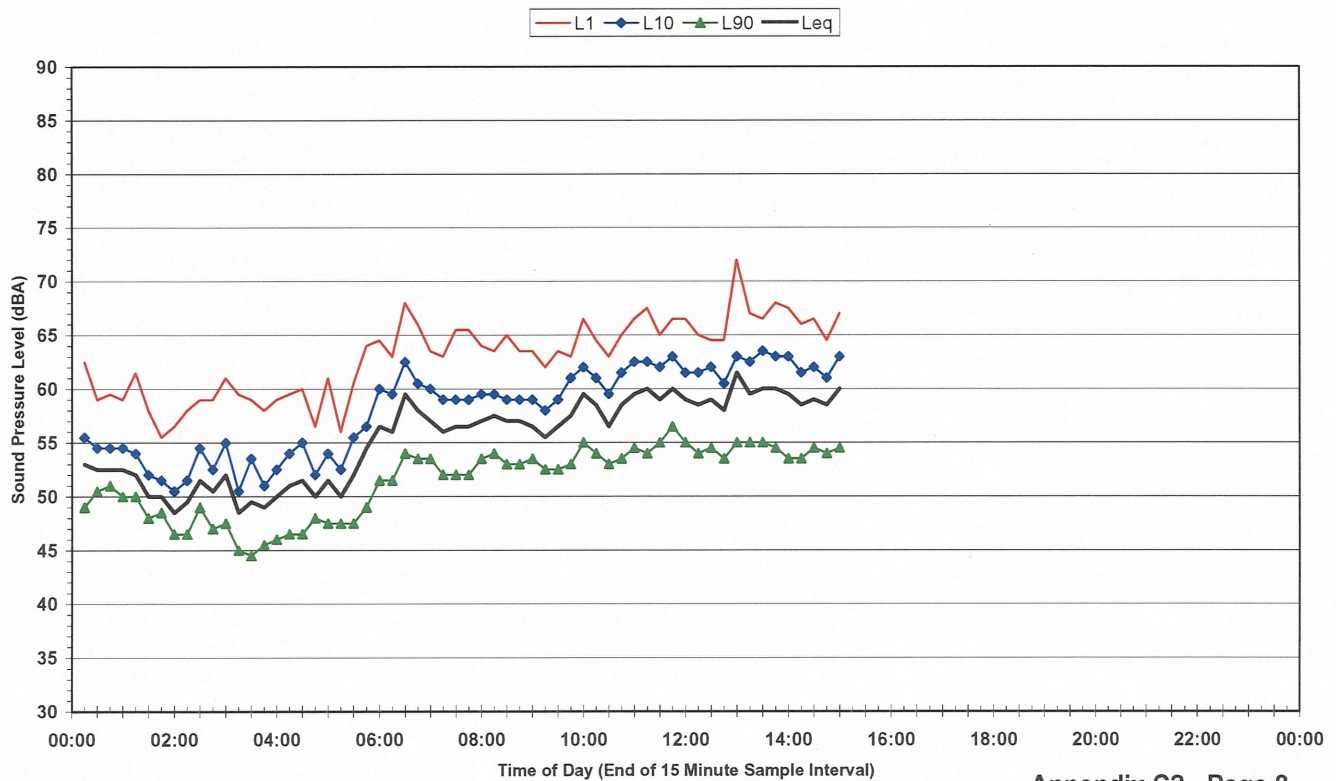
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**Statistical Ambient Noise Levels
52 Arthur St, Mayfield - Wednesday 30 October 2002**



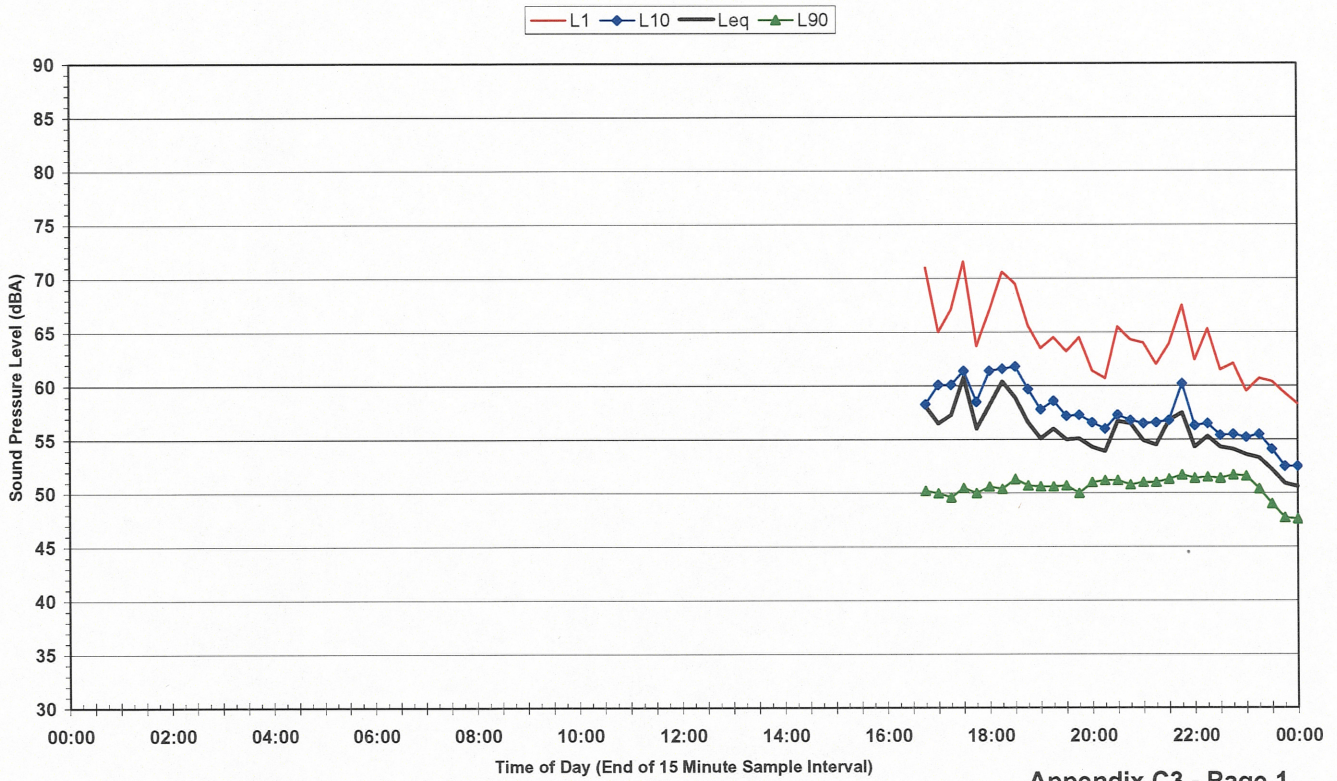
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**Statistical Ambient Noise Levels
52 Arthur St, Mayfield - Thursday 31 October 2002**



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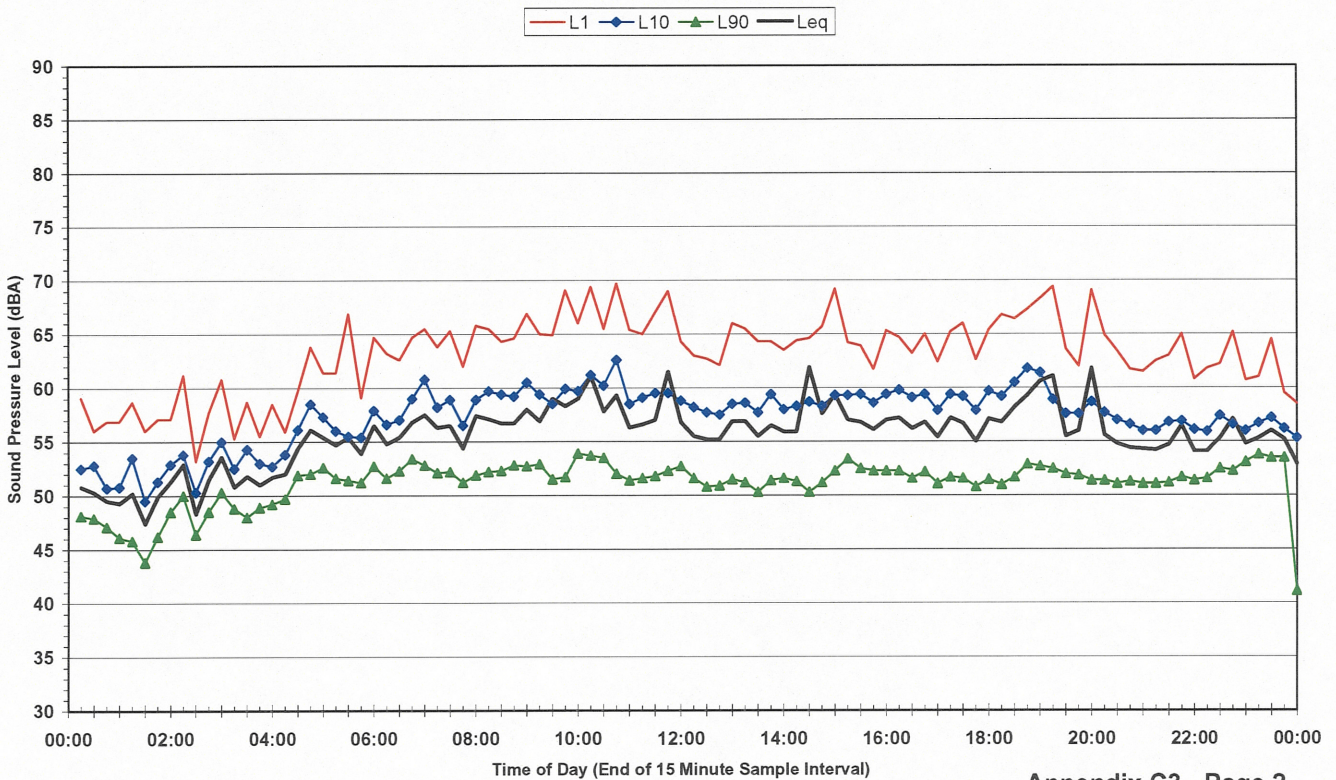
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No.1 Arthur St - Thursday 24 October 2002**



Appendix C3 - Page 1
Statistical Noise Levels
RHA Report 10-2718

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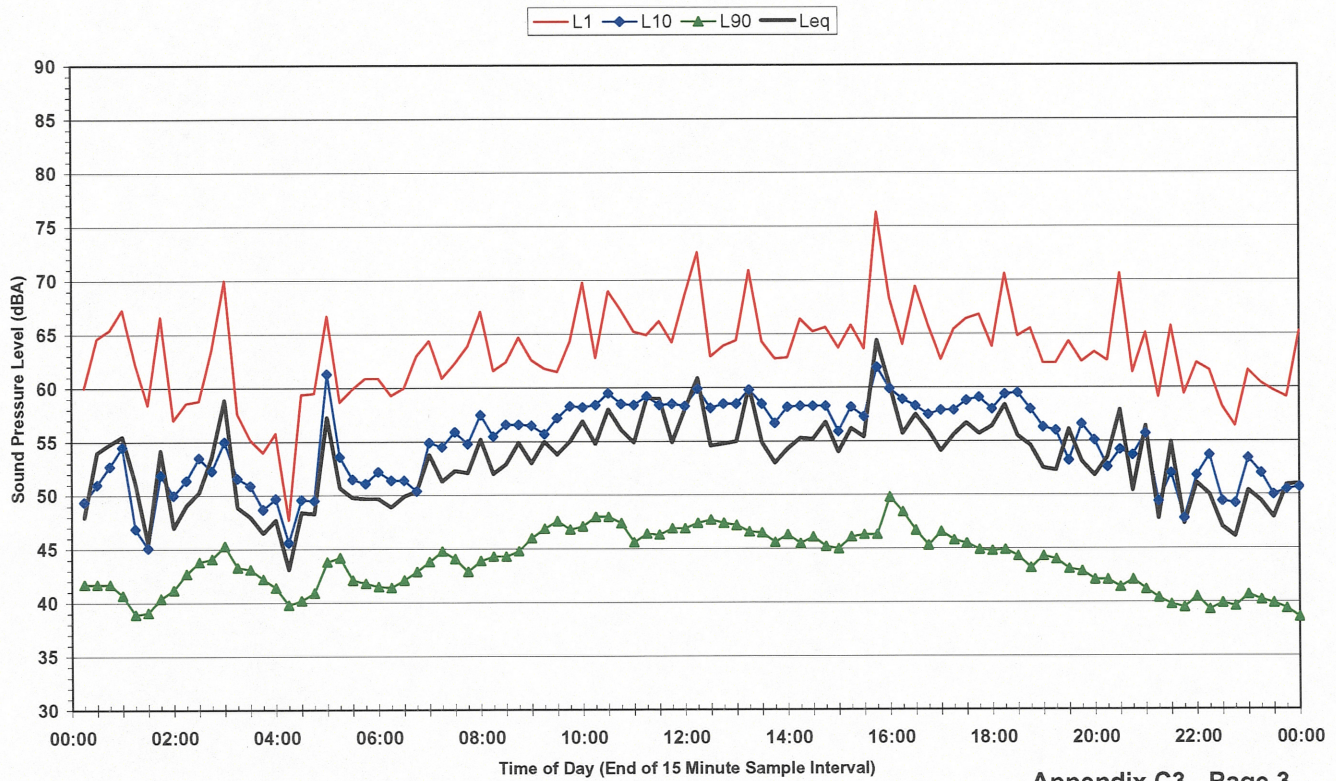
**Statistical Ambient Noise Levels
No.1 Arthur St - Friday 25 October 2002**



Appendix C3 - Page 2
Statistical Noise Levels
RHA Report 10-2718

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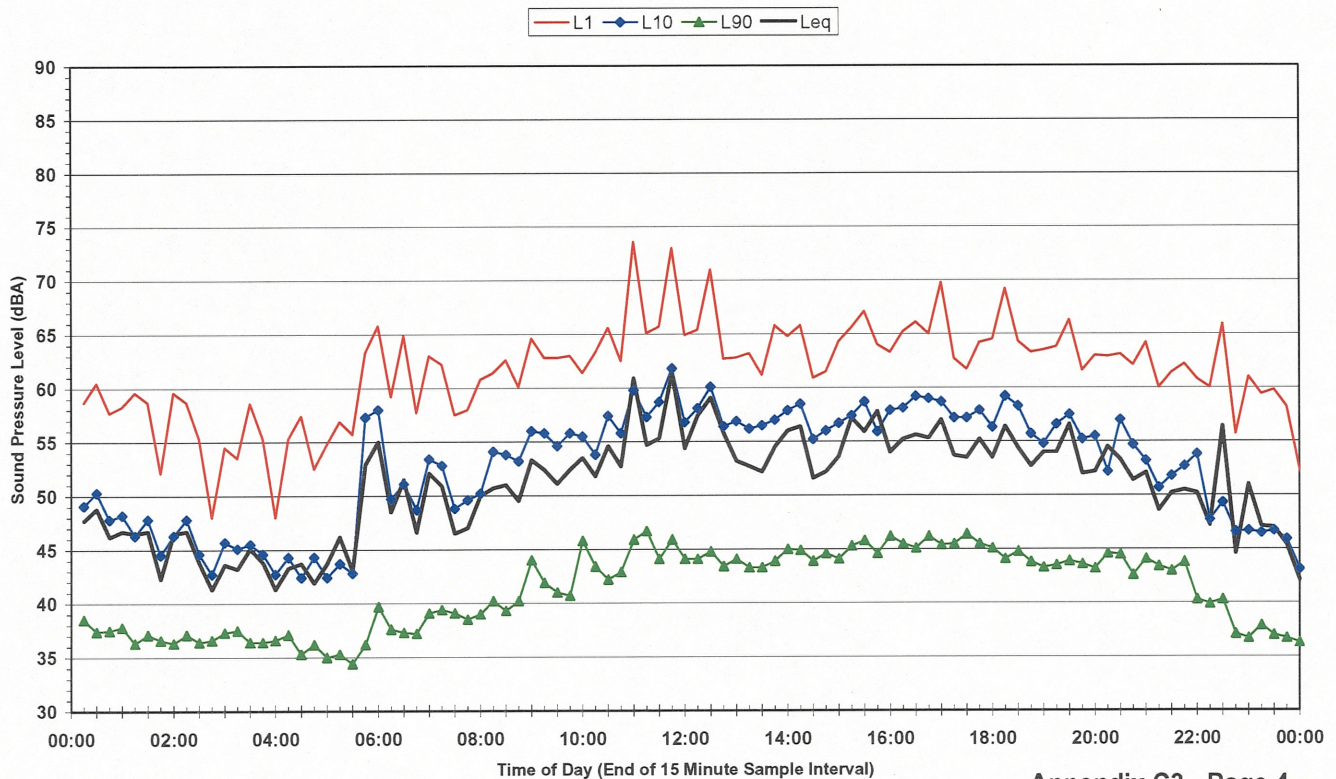
**Statistical Ambient Noise Levels
No.1 Arthur St - Saturday 26 October 2002**



Appendix C3 - Page 3
Statistical Noise Levels
RHA Report 10-2718

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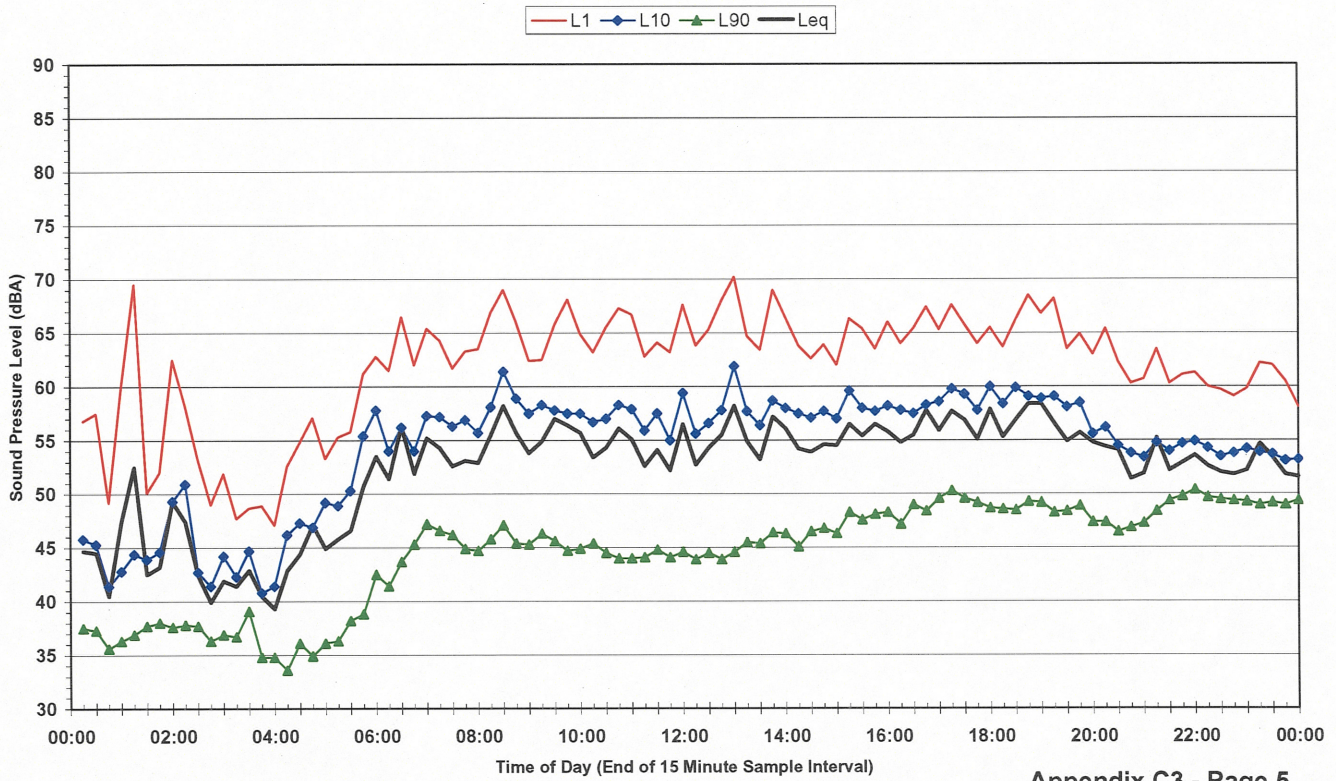
**Statistical Ambient Noise Levels
No.1 Arthur St - Sunday 27 October 2002**



Appendix C3 - Page 4
Statistical Noise Levels
RHA Report 10-2718

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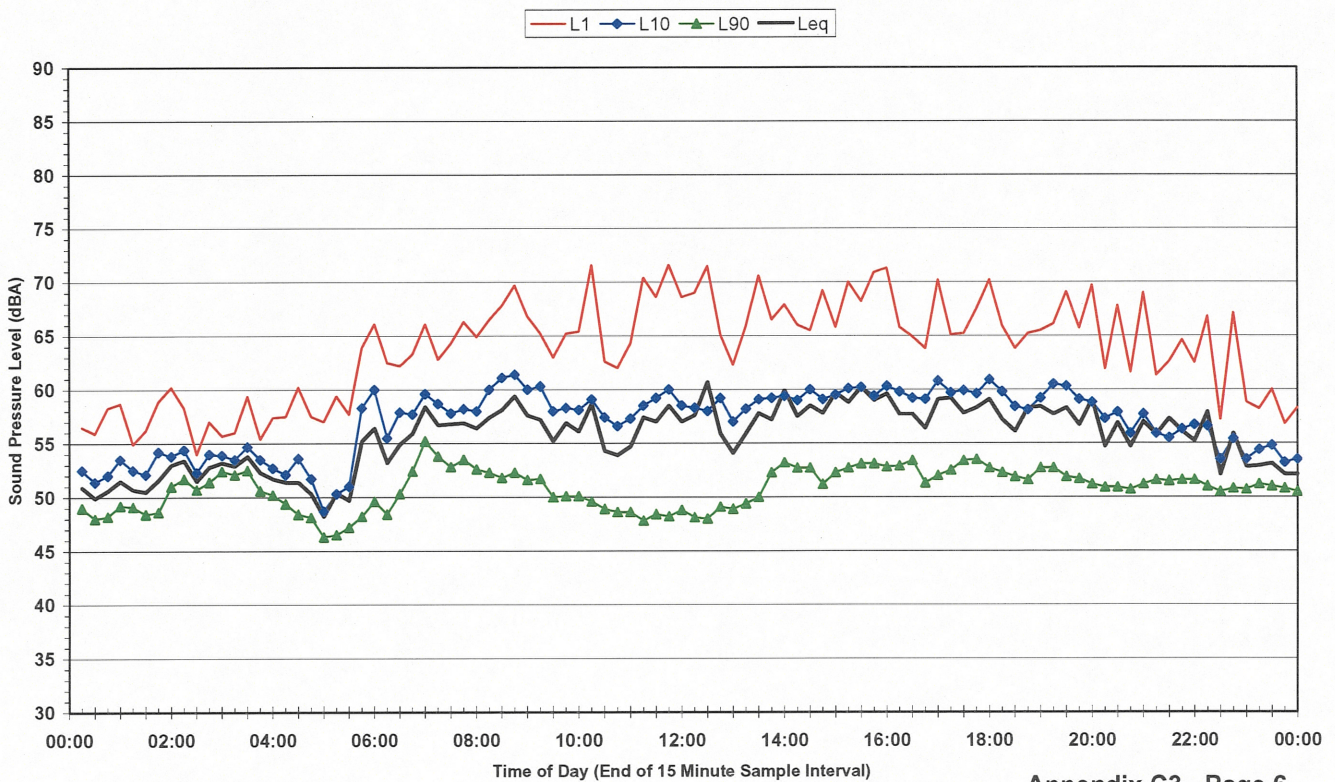
**Statistical Ambient Noise Levels
No.1 Arthur St - Monday 28 October 2002**



Appendix C3 - Page 5
Statistical Noise Levels
RHA Report 10-2718

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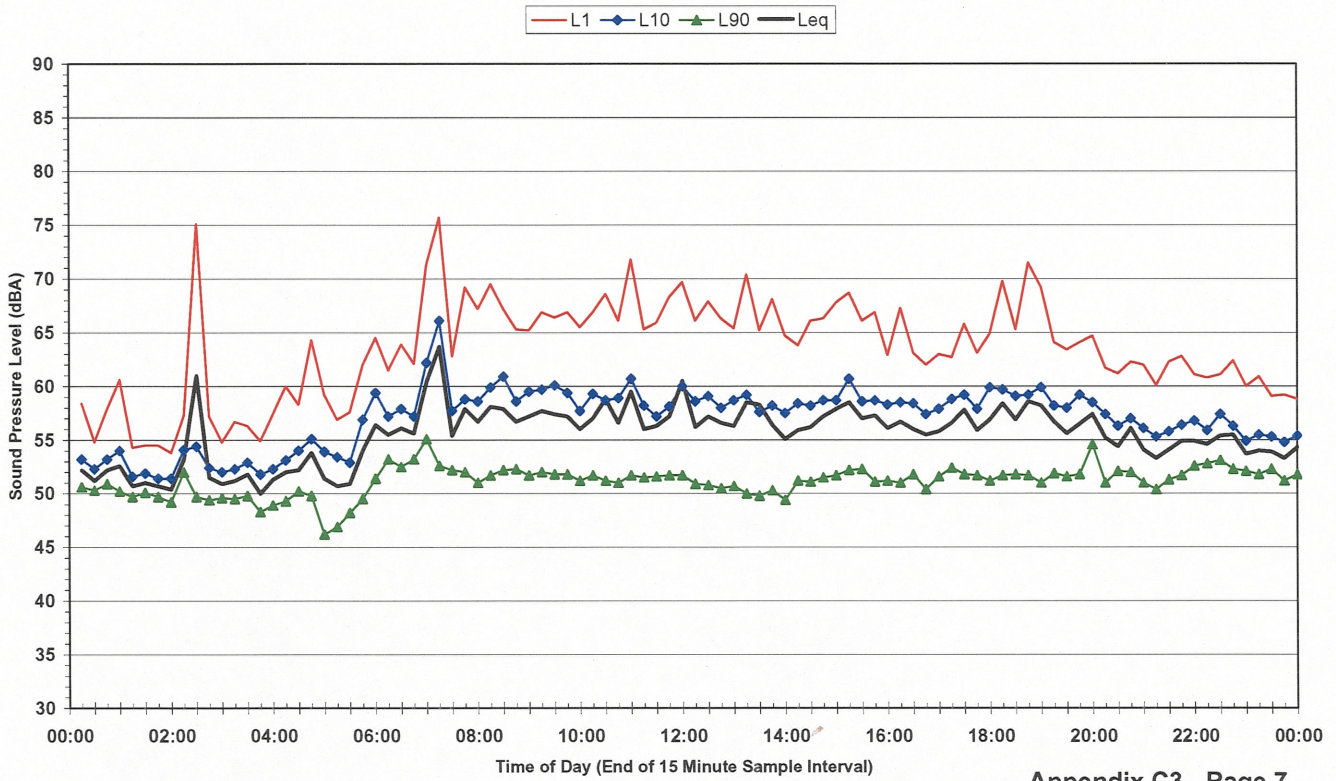
**Statistical Ambient Noise Levels
No.1 Arthur St - Tuesday 29 October 2002**



Appendix C3 - Page 6
Statistical Noise Levels
RHA Report 10-2718

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**Statistical Ambient Noise Levels
No.1 Arthur St - Wednesday 30 October 2002**

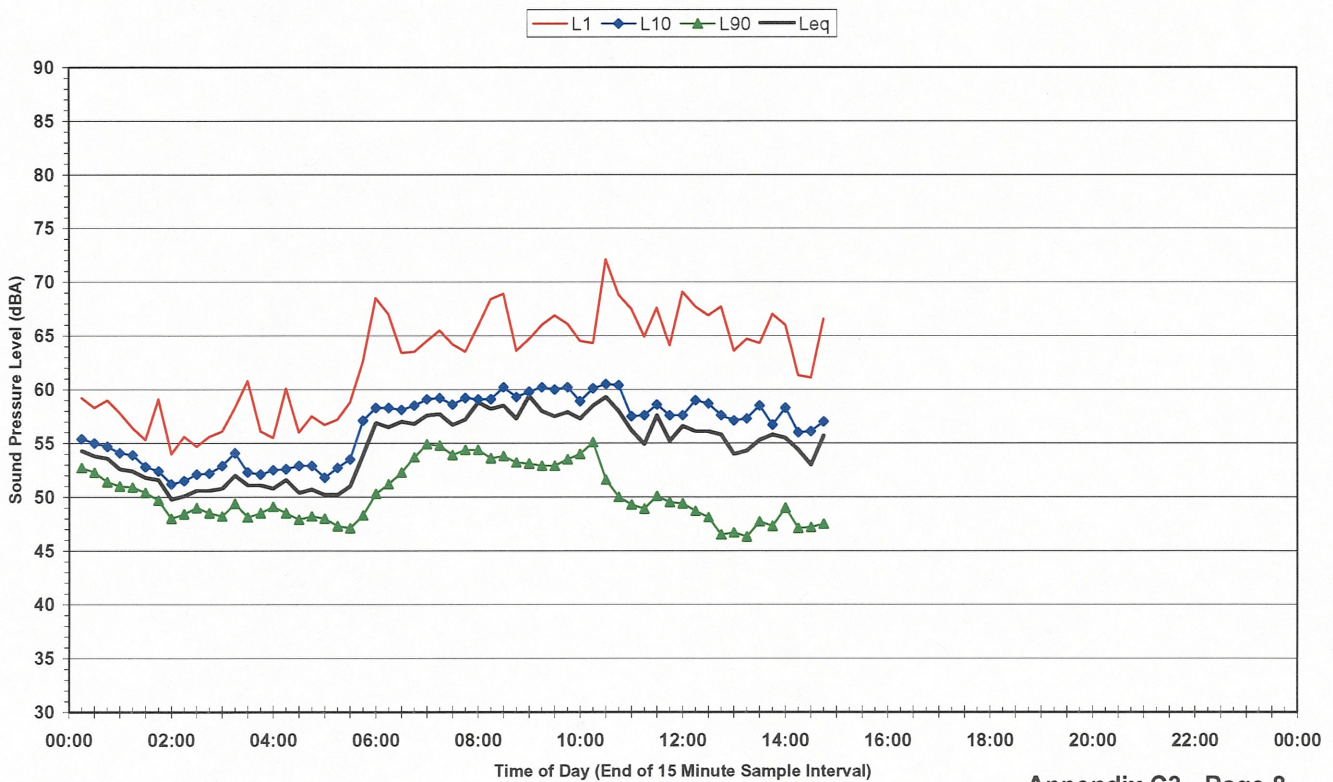


Appendix C3 - Page 7

Statistical Noise Levels
RHA Report 10-2718

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**Statistical Ambient Noise Levels
No.1 Arthur St - Thursday 31 October 2002**

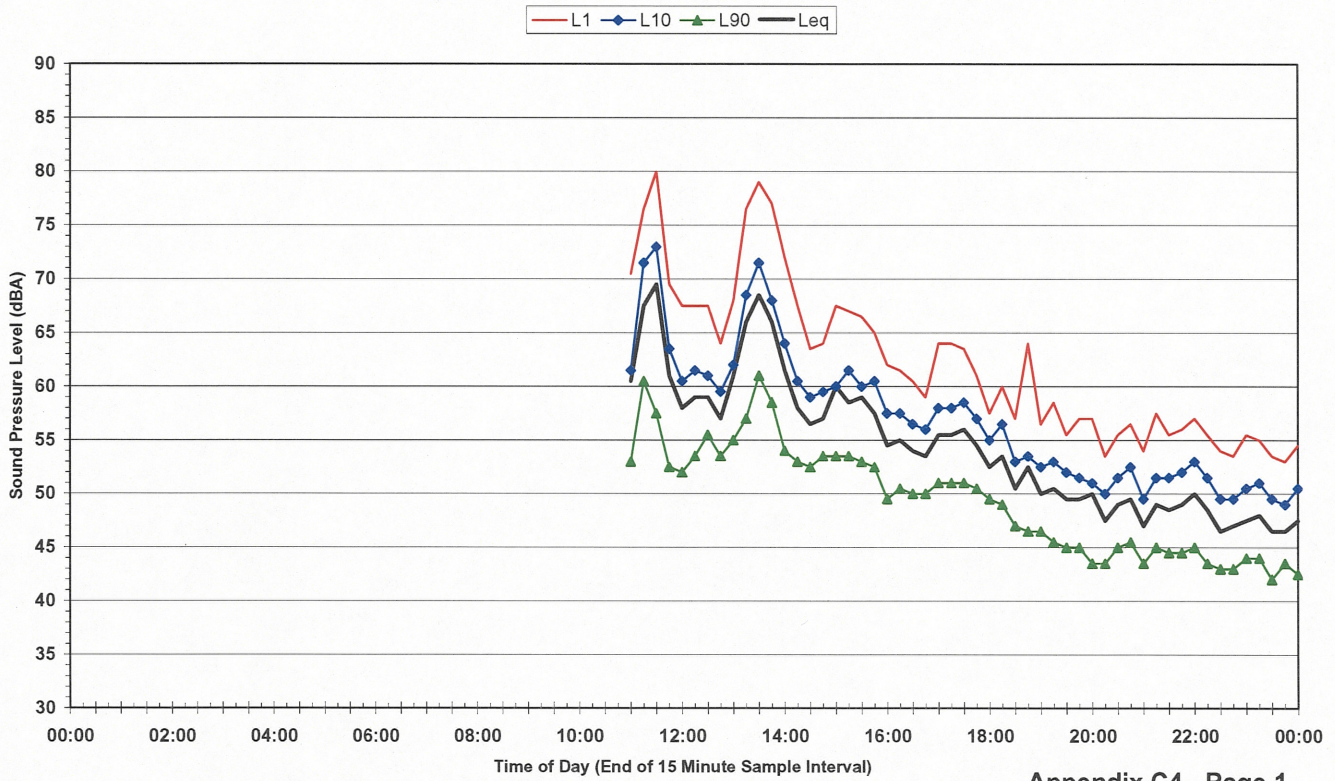


Appendix C3 - Page 8

Statistical Noise Levels
RHA Report 10-2718

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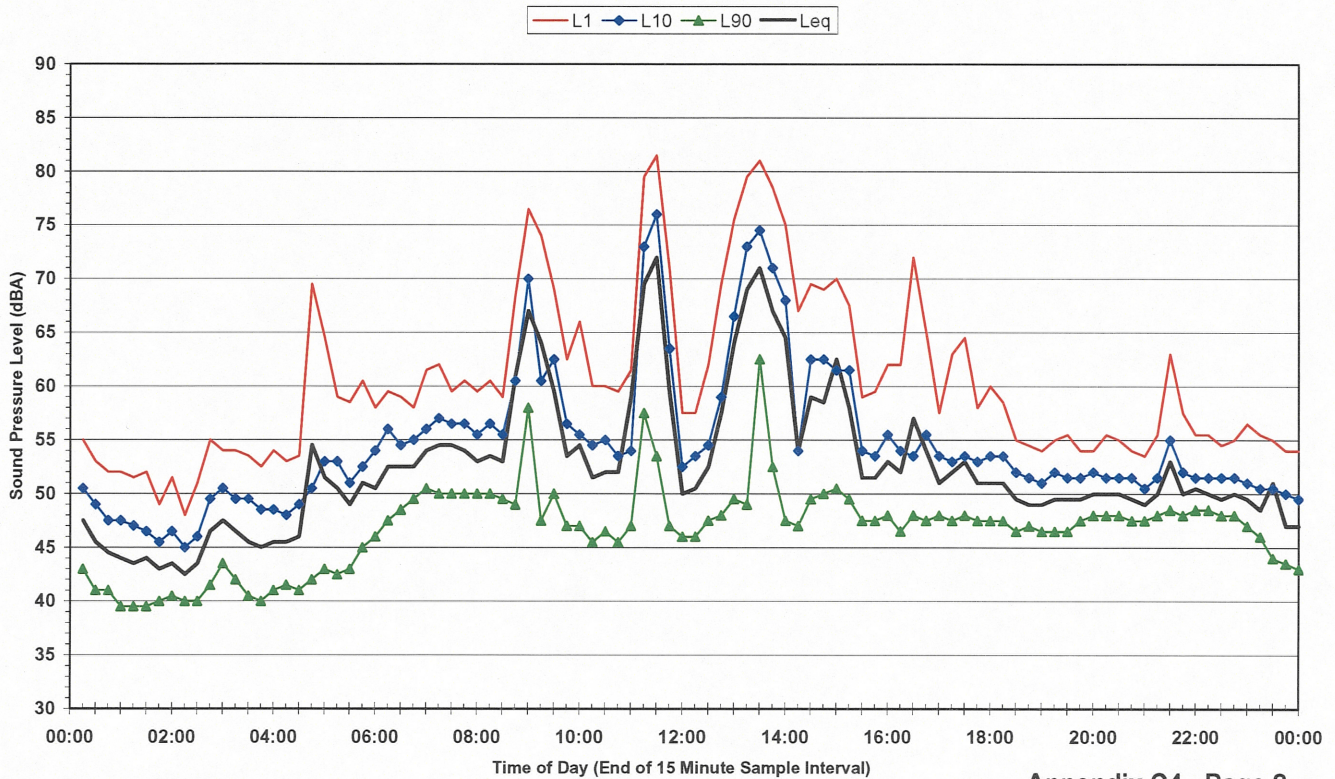
**Statistical Ambient Noise Levels
Mayfield East Primary School - Wednesday 23 October 2002**



Appendix C4 - Page 1
Statistical Noise Levels
RHA Report 10-2718

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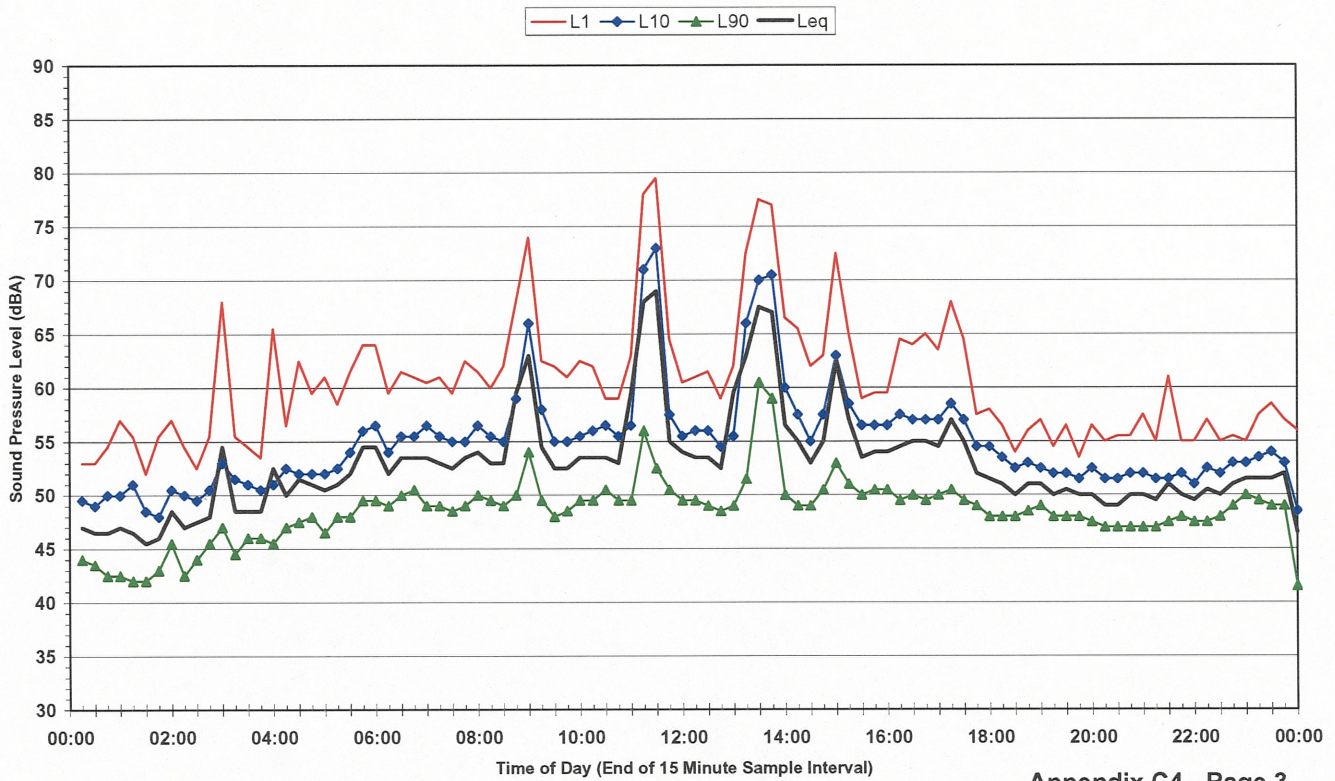
**Statistical Ambient Noise Levels
Mayfield East Primary School - Thursday 24 October 2002**



Appendix C4 - Page 2
Statistical Noise Levels
RHA Report 10-2718

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**Statistical Ambient Noise Levels
Mayfield East Primary School - Friday 25 October 2002**

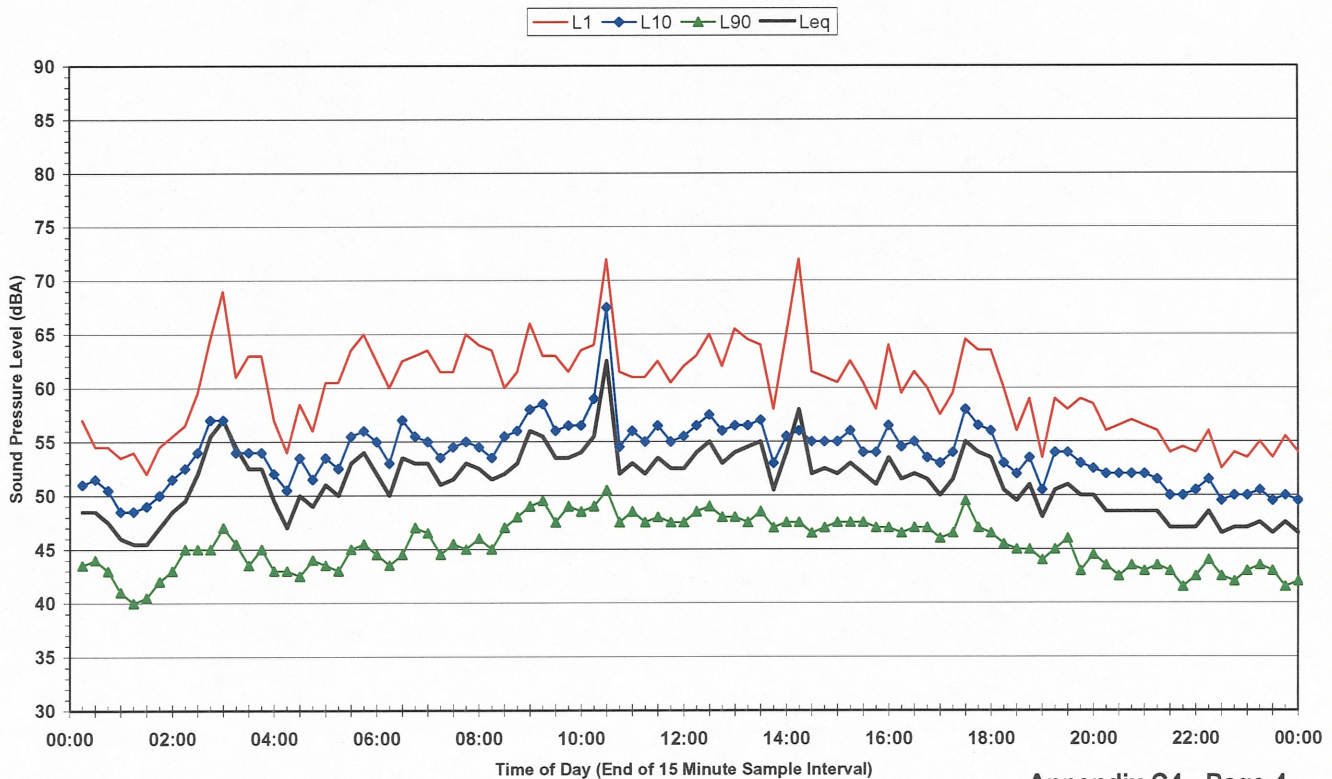


Appendix C4 - Page 3

Statistical Noise Levels
RHA Report 10-2718

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**Statistical Ambient Noise Levels
Mayfield East Primary School - Saturday 26 October 2002**

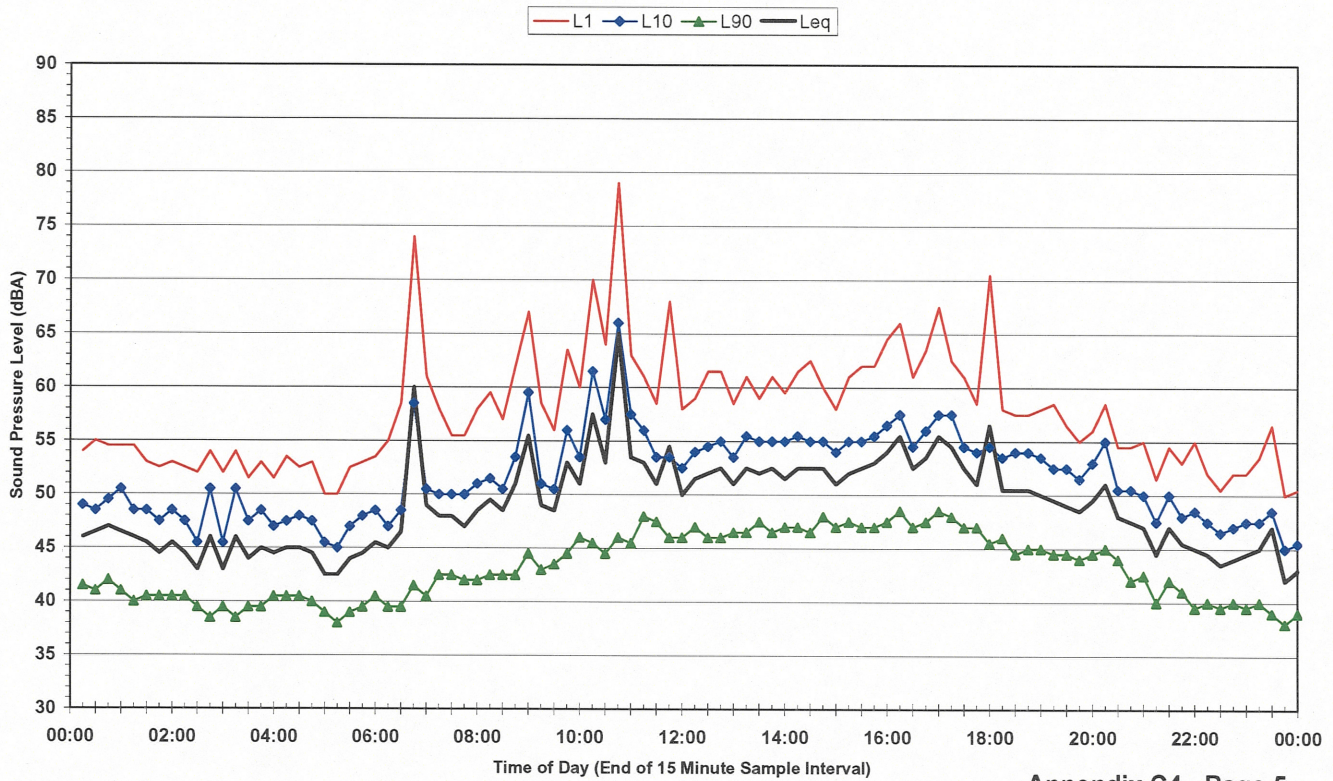


Appendix C4 - Page 4

Statistical Noise Levels
RHA Report 10-2718

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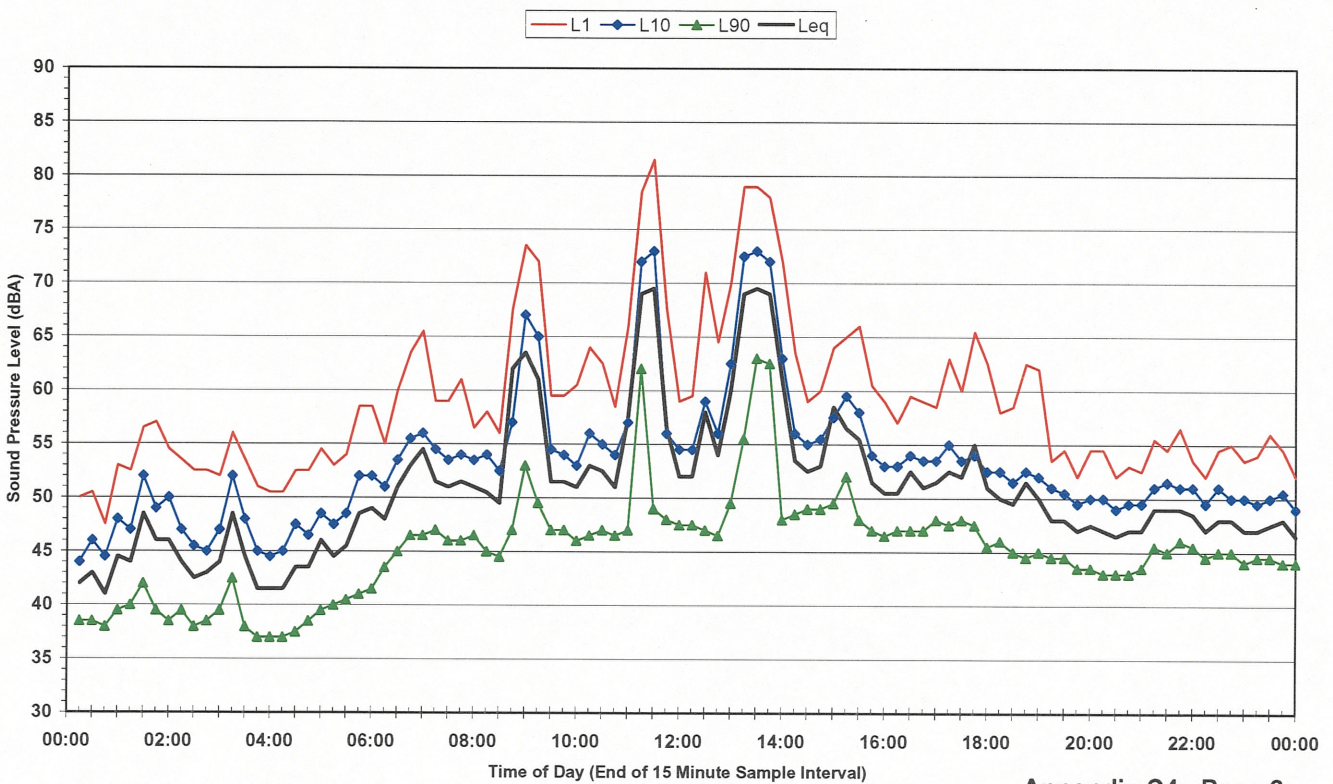
**Statistical Ambient Noise Levels
Mayfield East Primary School - Sunday 27 October 2002**



Appendix C4 - Page 5
Statistical Noise Levels
RHA Report 10-2718

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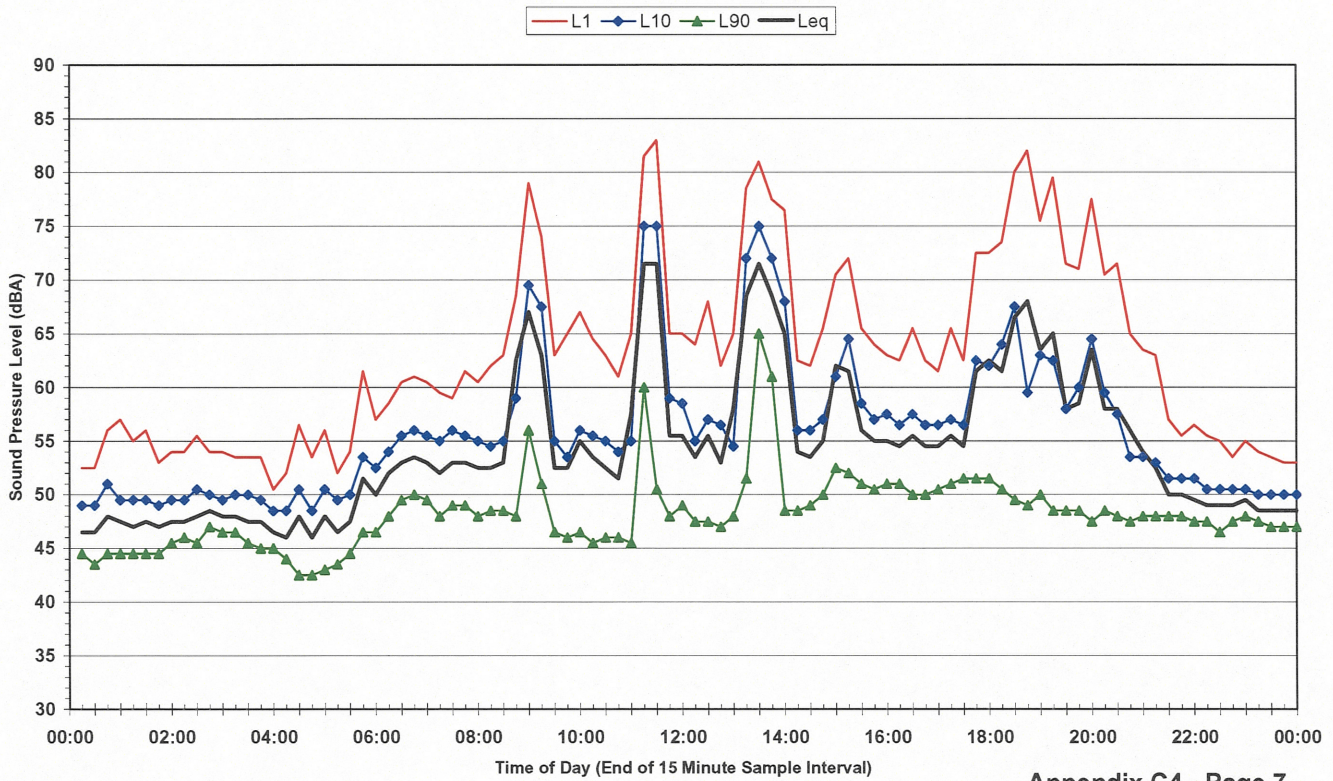
**Statistical Ambient Noise Levels
Mayfield East Primary School - Monday 28 October 2002**



Appendix C4 - Page 6
Statistical Noise Levels
RHA Report 10-2718

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**Statistical Ambient Noise Levels
Mayfield East Primary School - Tuesday 29 October 2002**

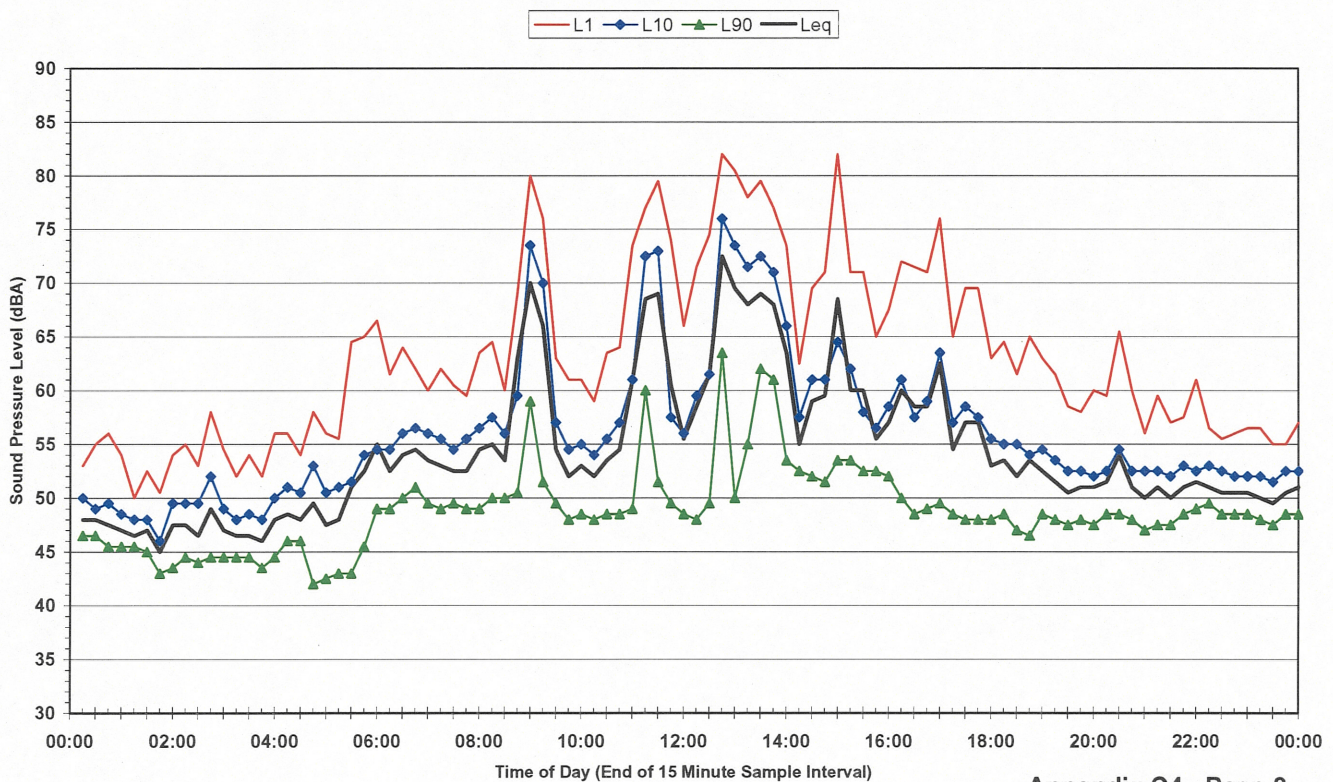


Appendix C4 - Page 7

Statistical Noise Levels
RHA Report 10-2718

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**Statistical Ambient Noise Levels
Mayfield East Primary School - Wednesday 30 October 2002**

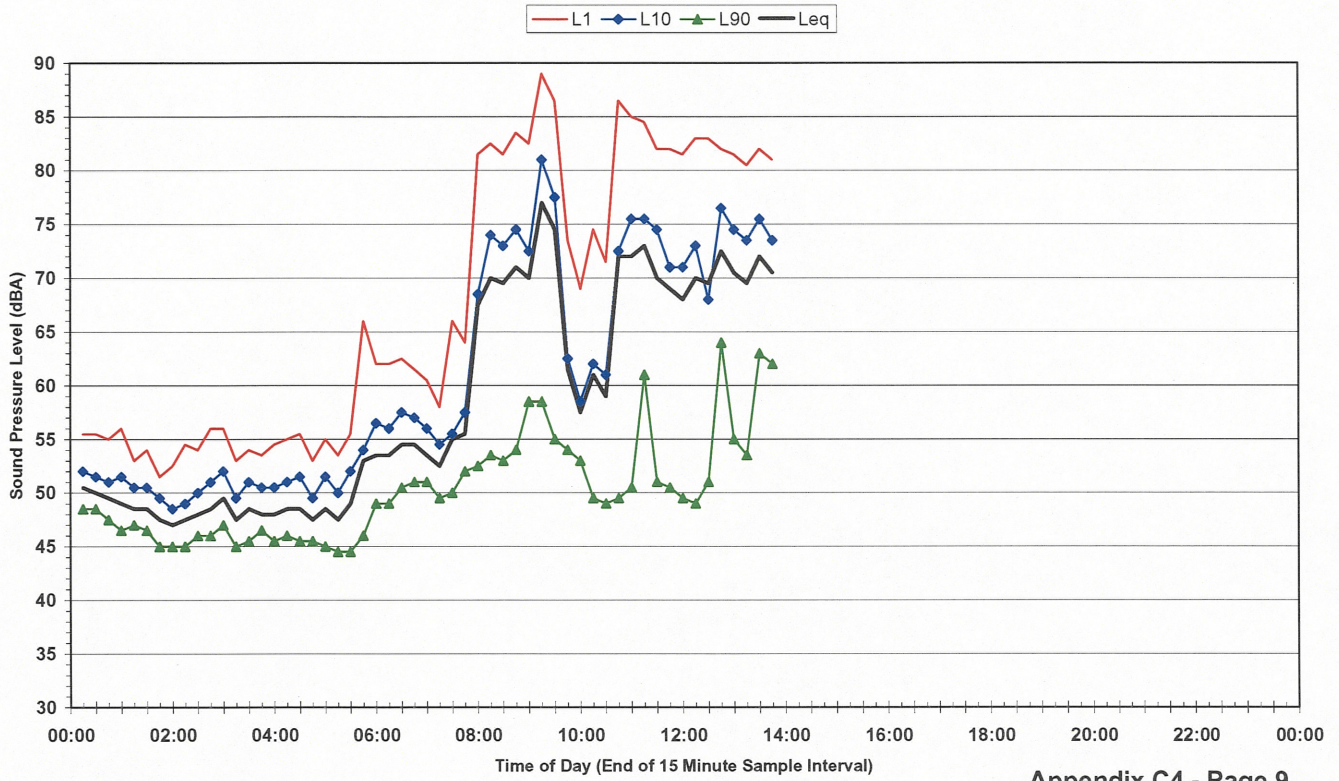


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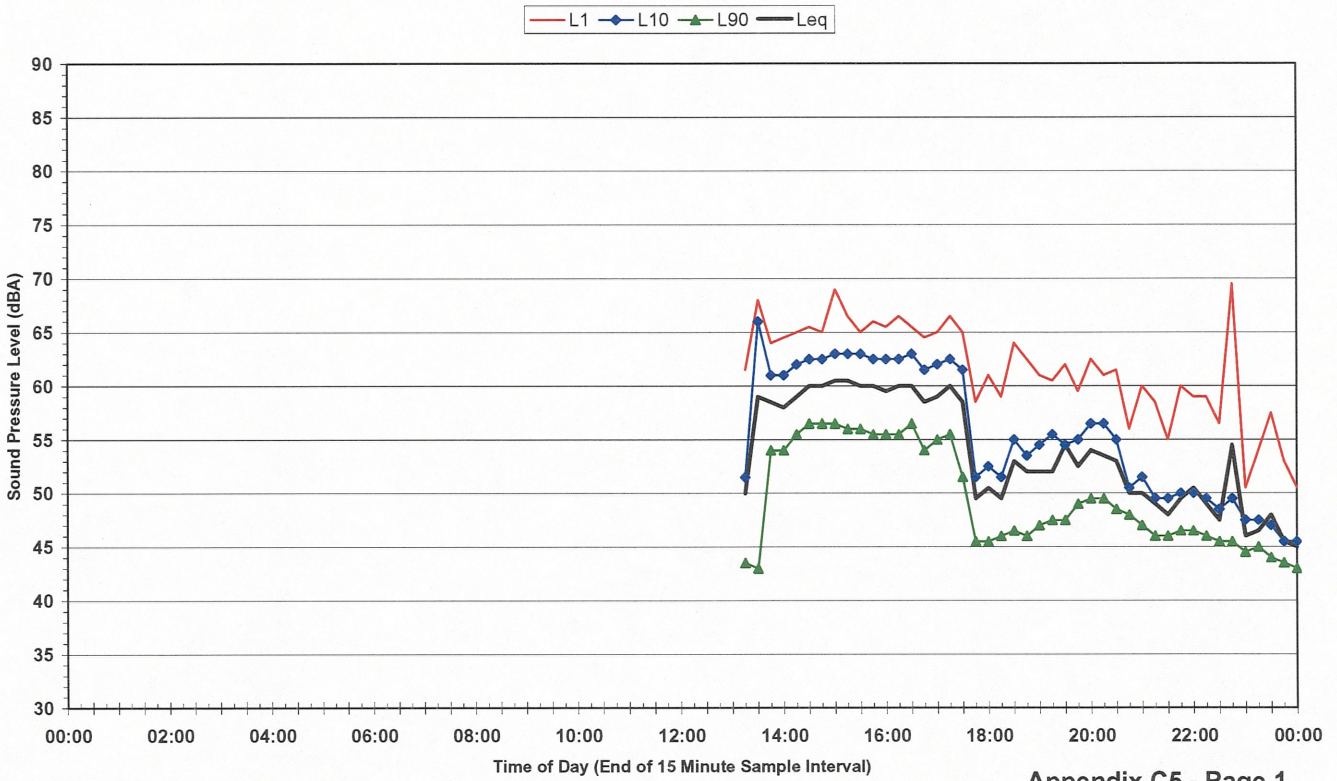
Statistical Noise Levels
RHA Report 10-2718

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**Statistical Ambient Noise Levels
Mayfield East Primary School - Thursday 31 October 2002**



Statistical Ambient Noise Levels
Cnr Wye & Avon St, Mayfield - Thursday 30 January 2003

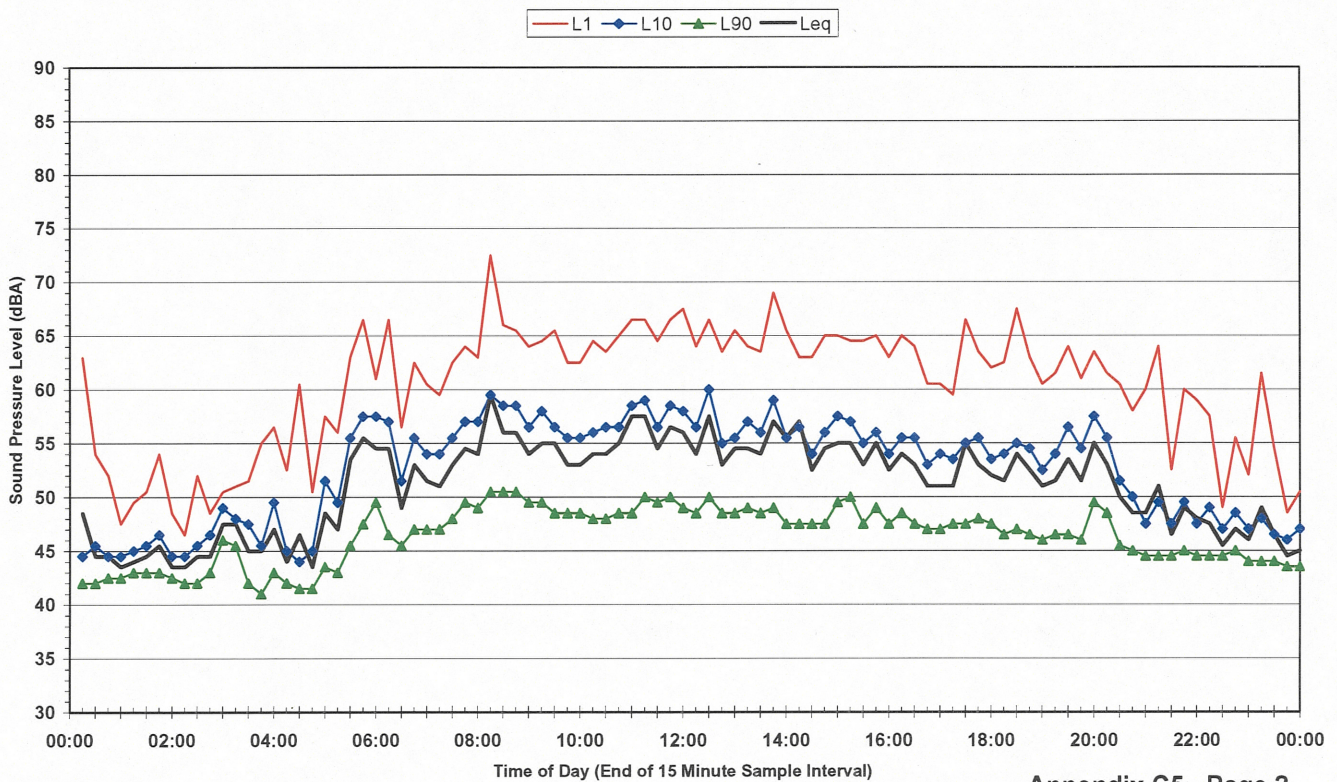


Appendix C5 - Page 1

Statistical Noise Levels
 RHA Report 10-2718

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Statistical Ambient Noise Levels
Cnr Wye & Avon St, Mayfield - Friday 31 January 2003

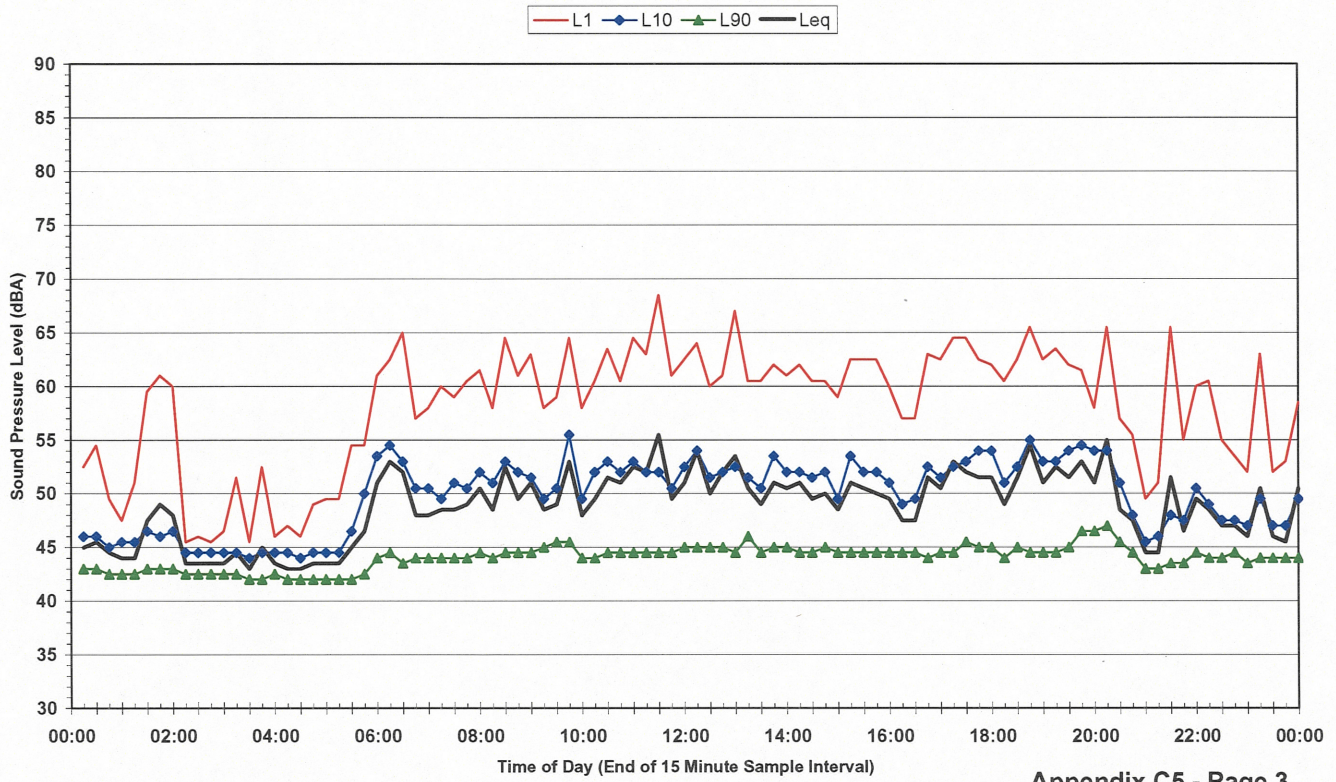


Appendix C5 - Page 2

Statistical Noise Levels
 RHA Report 10-2718

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**Statistical Ambient Noise Levels
Cnr Wye & Avon St, Mayfield - Saturday 1 February 2003**

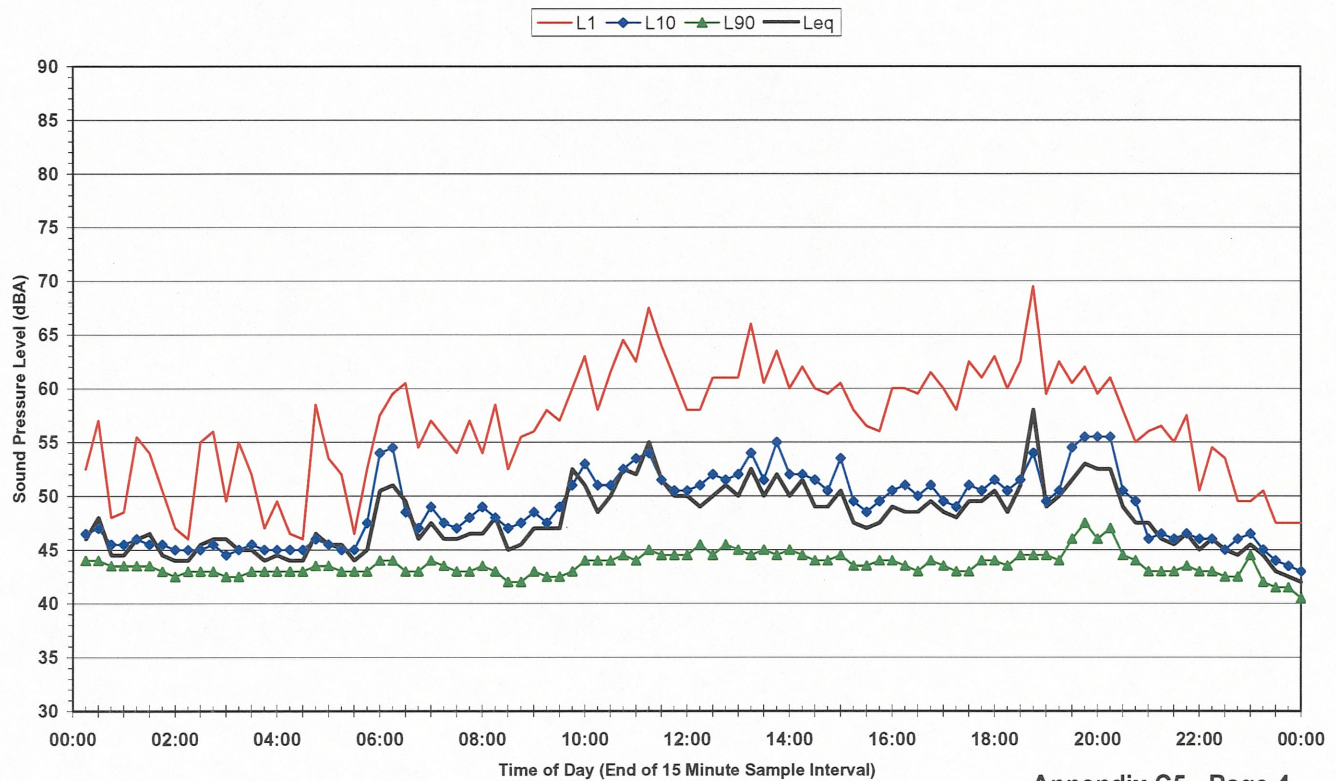


Appendix C5 - Page 3

Statistical Noise Levels
RHA Report 10-2718

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**Statistical Ambient Noise Levels
Cnr Wye & Avon St, Mayfield - Sunday 2 February 2003**

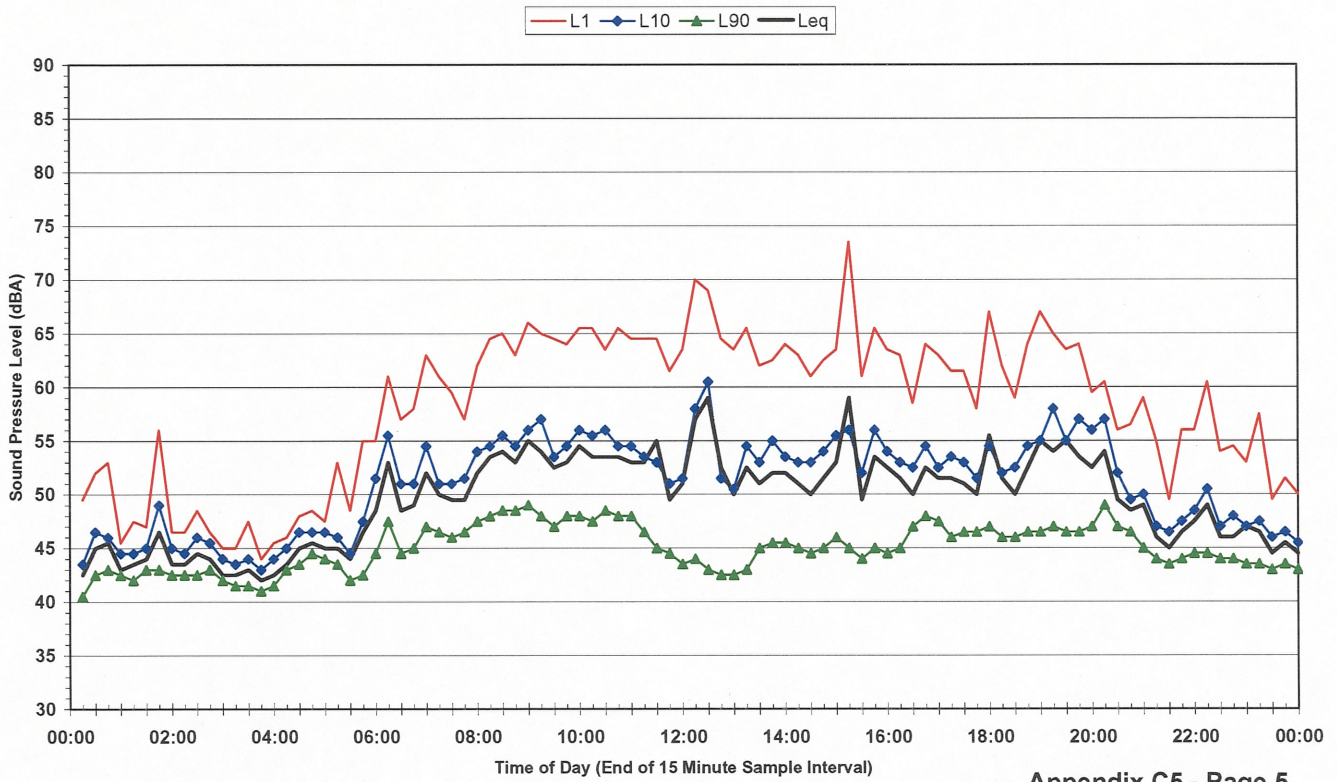


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Statistical Noise Levels
RHA Report 10-2718

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**Statistical Ambient Noise Levels
Cnr Wye & Avon St, Mayfield - Monday 3 February 2003**

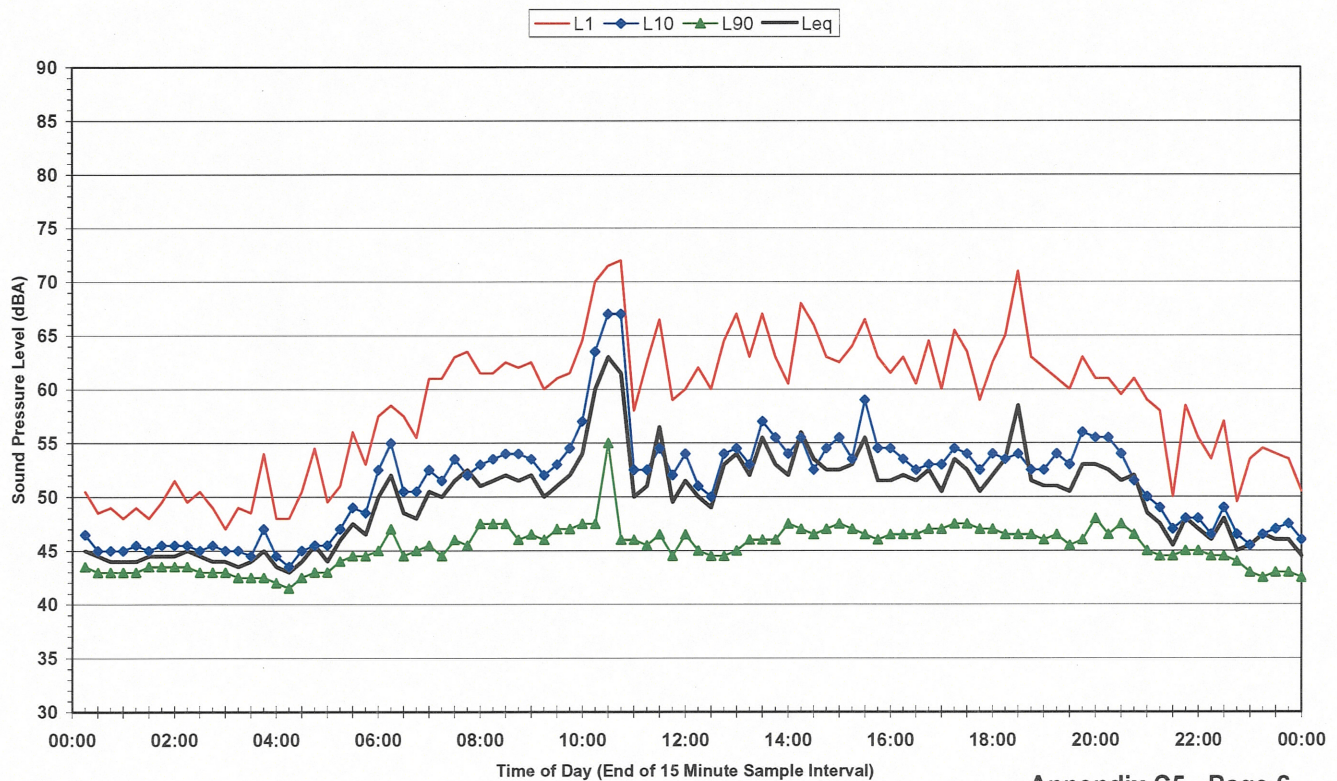


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Statistical Noise Levels
RHA Report 10-2718

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**Statistical Ambient Noise Levels
Cnr Wye & Avon St, Mayfield - Tuesday 4 February 2003**

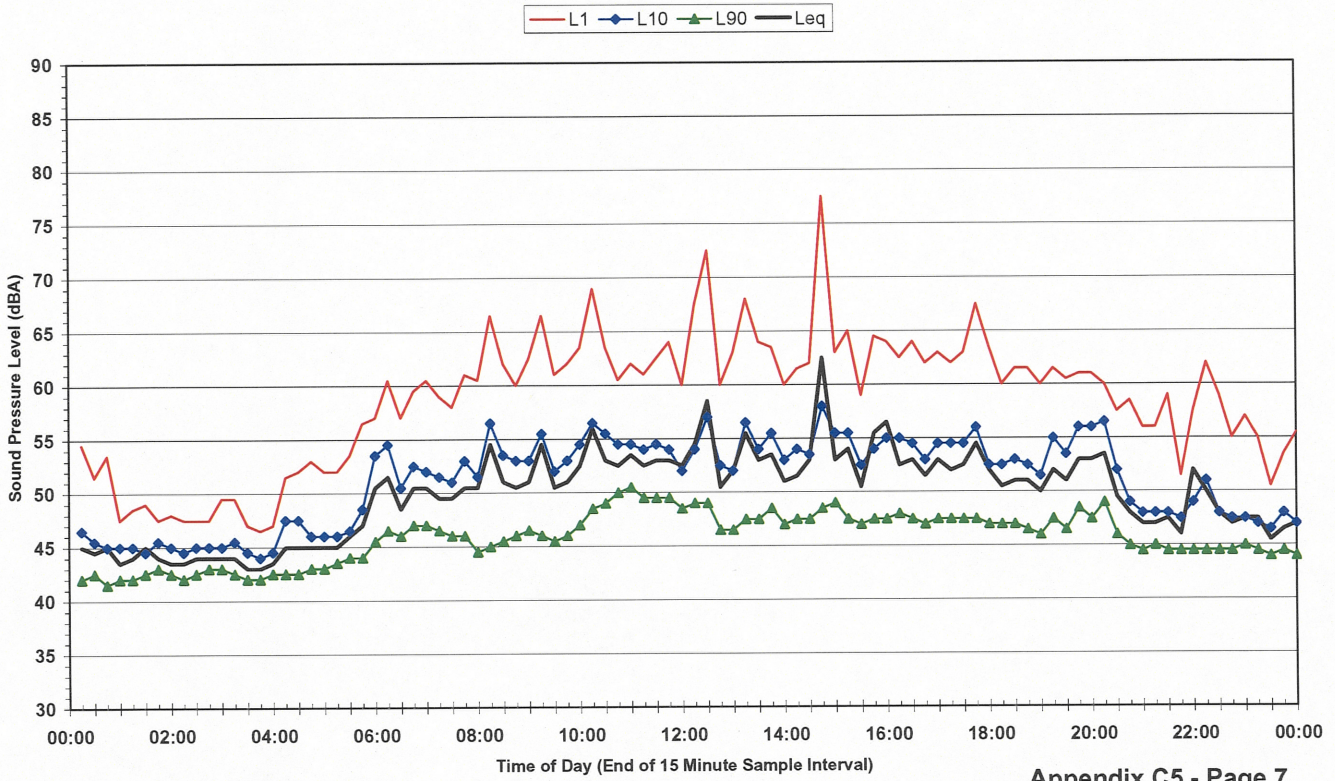


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Statistical Noise Levels
RHA Report 10-2718

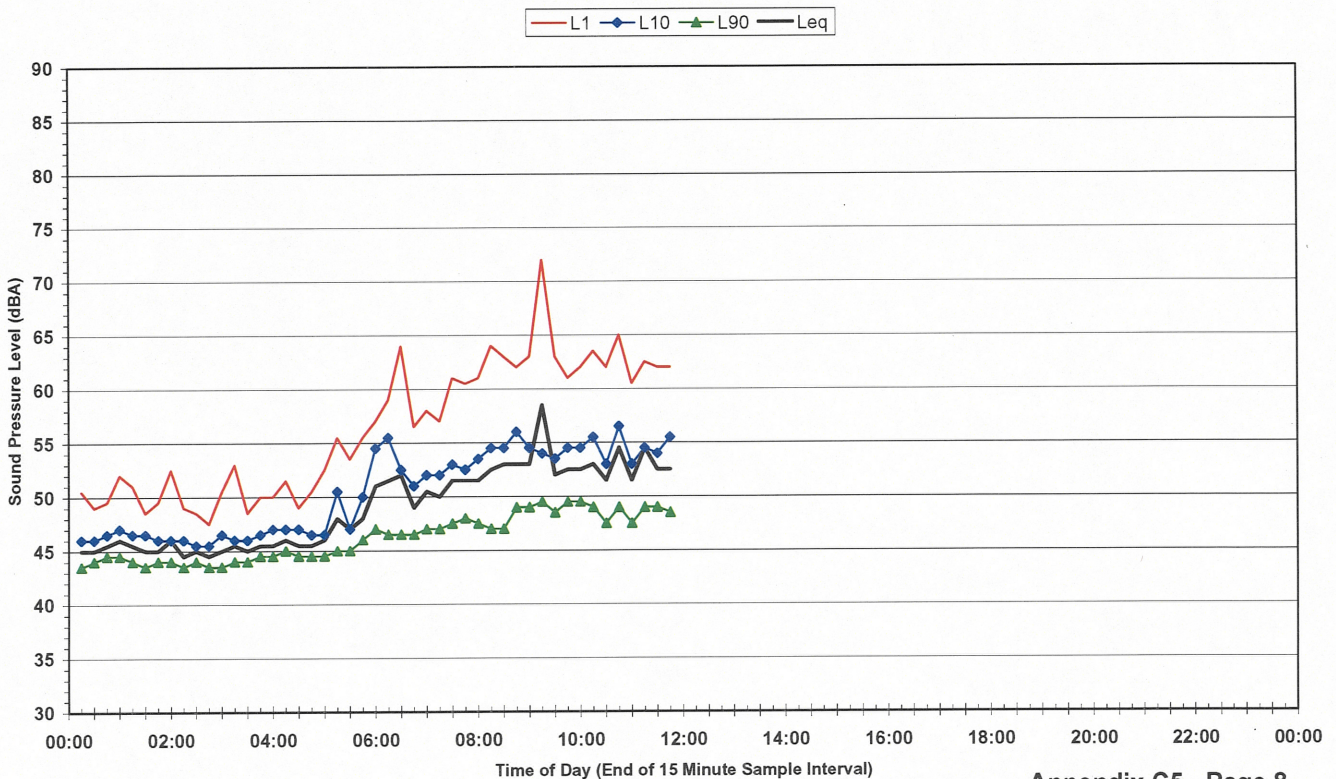
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**Statistical Ambient Noise Levels
Cnr Wye & Avon St, Mayfield - Wednesday 5 February 2003**



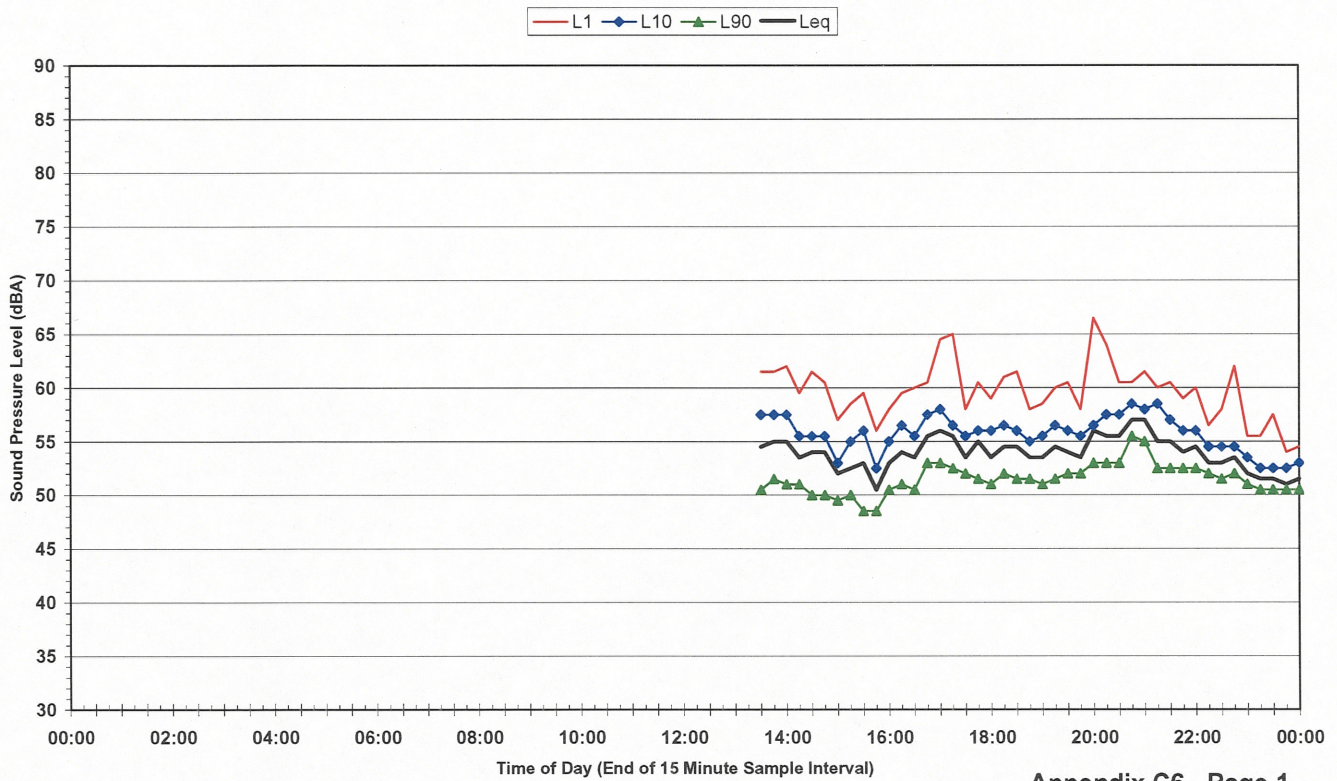
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**Statistical Ambient Noise Levels
Cnr Wye & Avon St, Mayfield - Thursday 6 February 2003**



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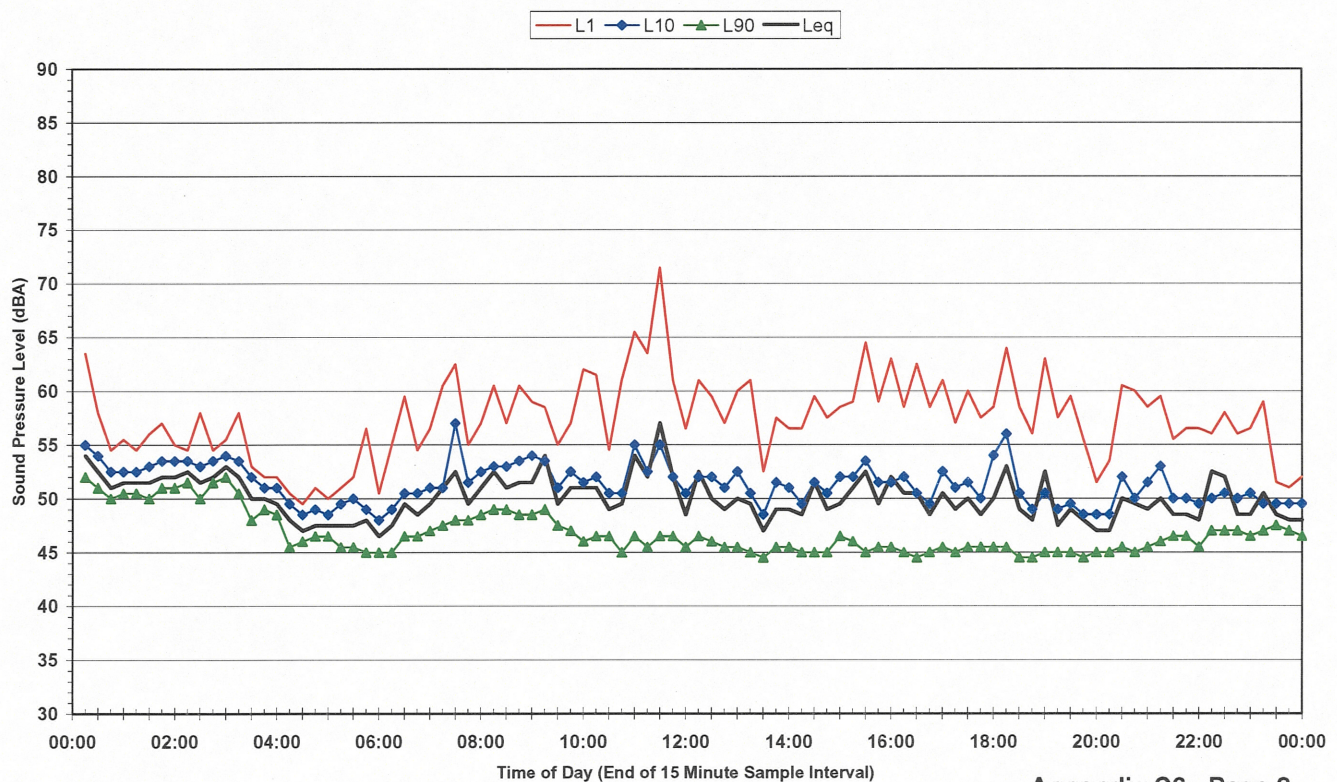
Statistical Ambient Noise Levels
Simpson Ct, Mayfield West - Thursday 30 January 2003



Appendix C6 - Page 1
 Statistical Noise Levels
 RHA Report 10-2718

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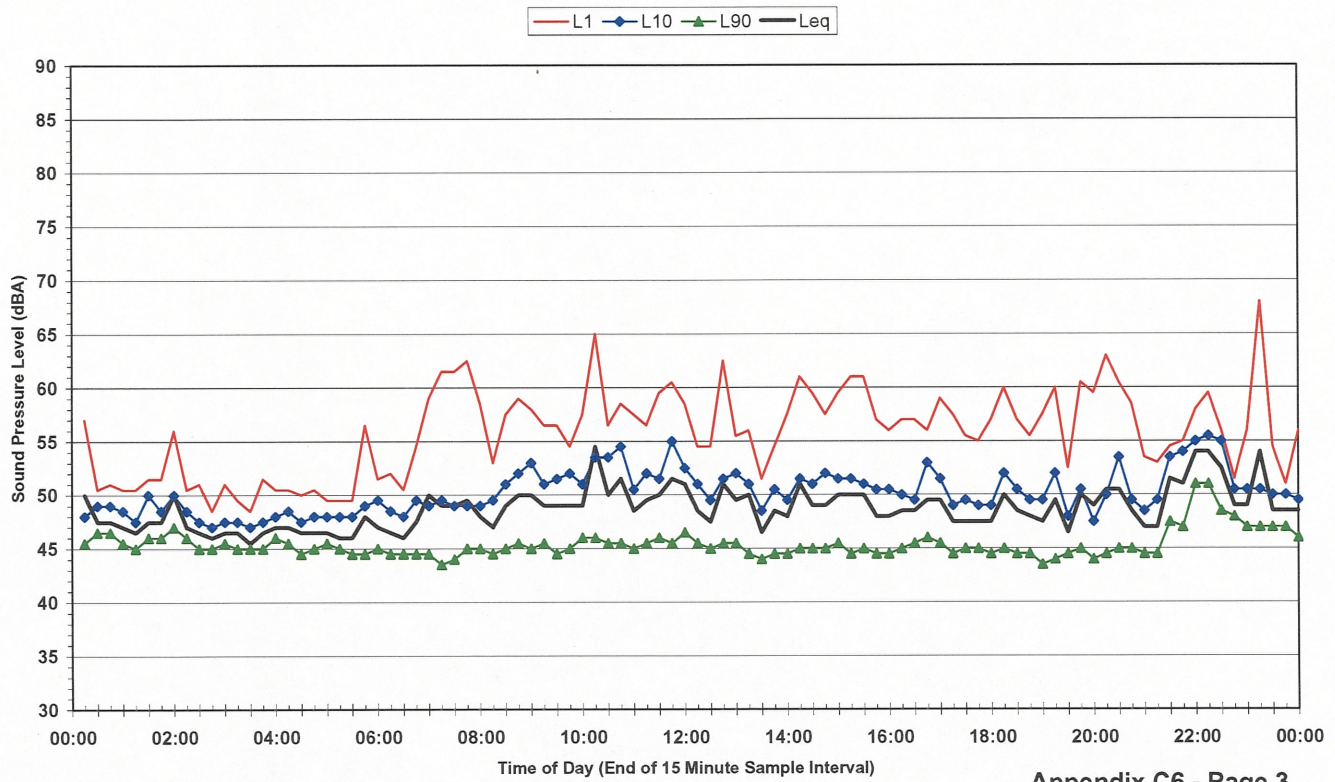
Statistical Ambient Noise Levels
Simpson Ct, Mayfield West - Friday 31 January 2003



Appendix C6 - Page 2
 Statistical Noise Levels
 RHA Report 10-2718

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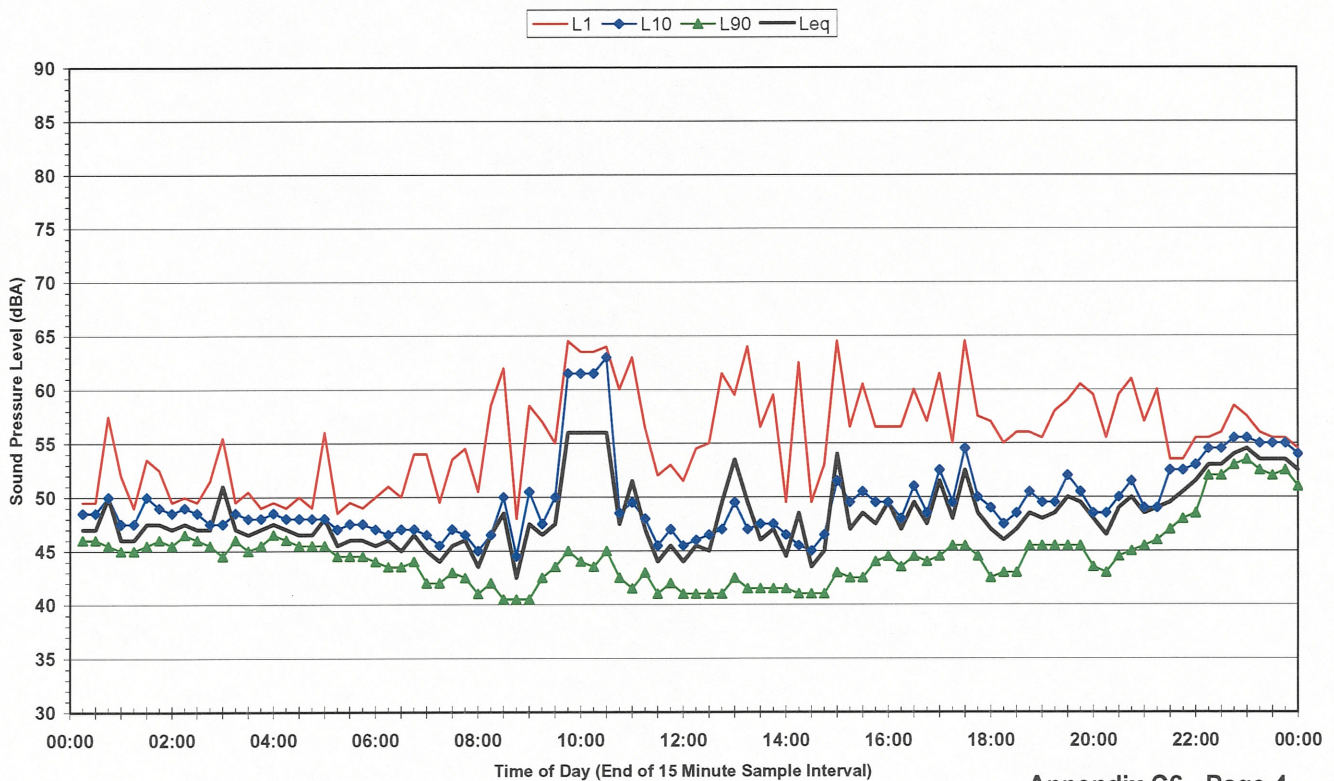
**Statistical Ambient Noise Levels
Simpson Ct, Mayfield West - Saturday 1 February 2003**



Appendix C6 - Page 3
Statistical Noise Levels
RHA Report 10-2718

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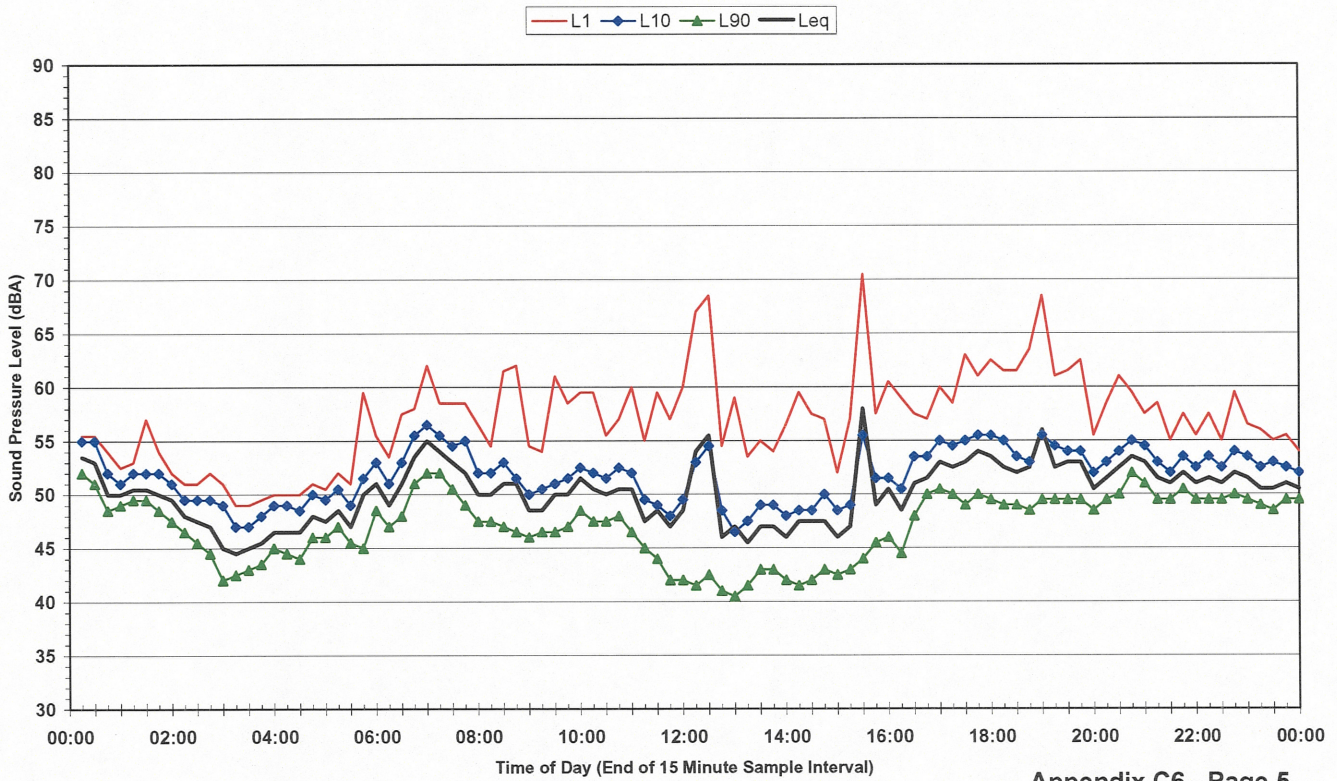
**Statistical Ambient Noise Levels
Simpson Ct, Mayfield West - Sunday 2 February 2003**



Appendix C6 - Page 4
Statistical Noise Levels
RHA Report 10-2718

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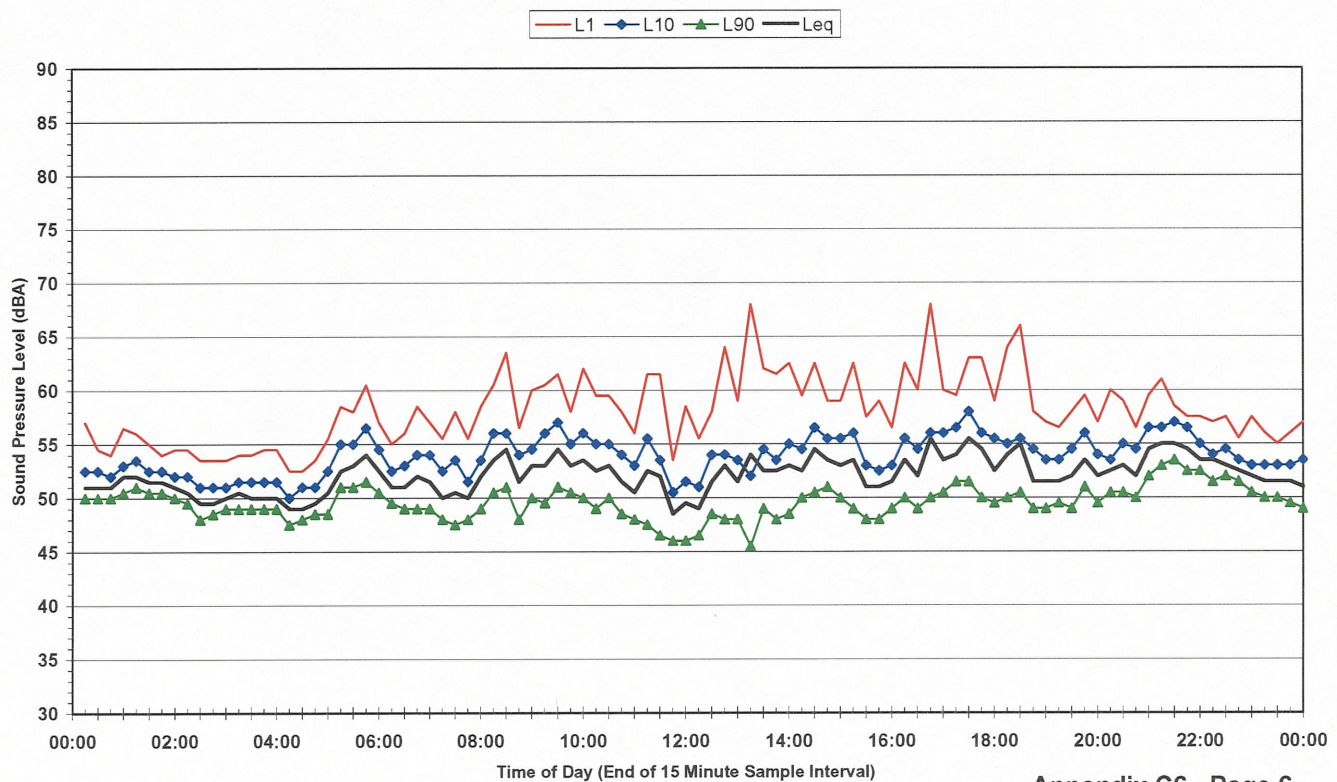
**Statistical Ambient Noise Levels
Simpson Ct, Mayfield West - Monday 3 February 2003**



Appendix C6 - Page 5
Statistical Noise Levels
RHA Report 10-2718

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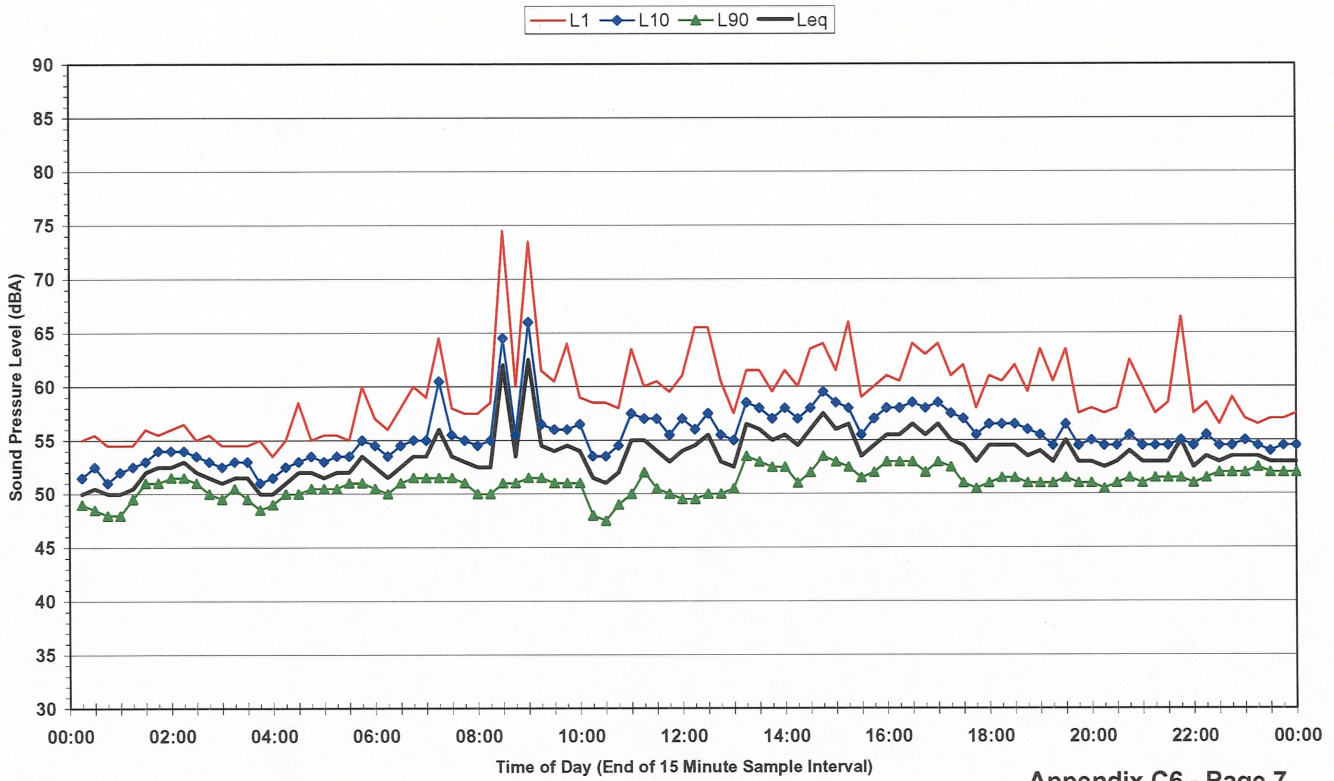
**Statistical Ambient Noise Levels
Simpson Ct, Mayfield West - Tuesday 4 February 2003**



Appendix C6 - Page 6
Statistical Noise Levels
RHA Report 10-2718

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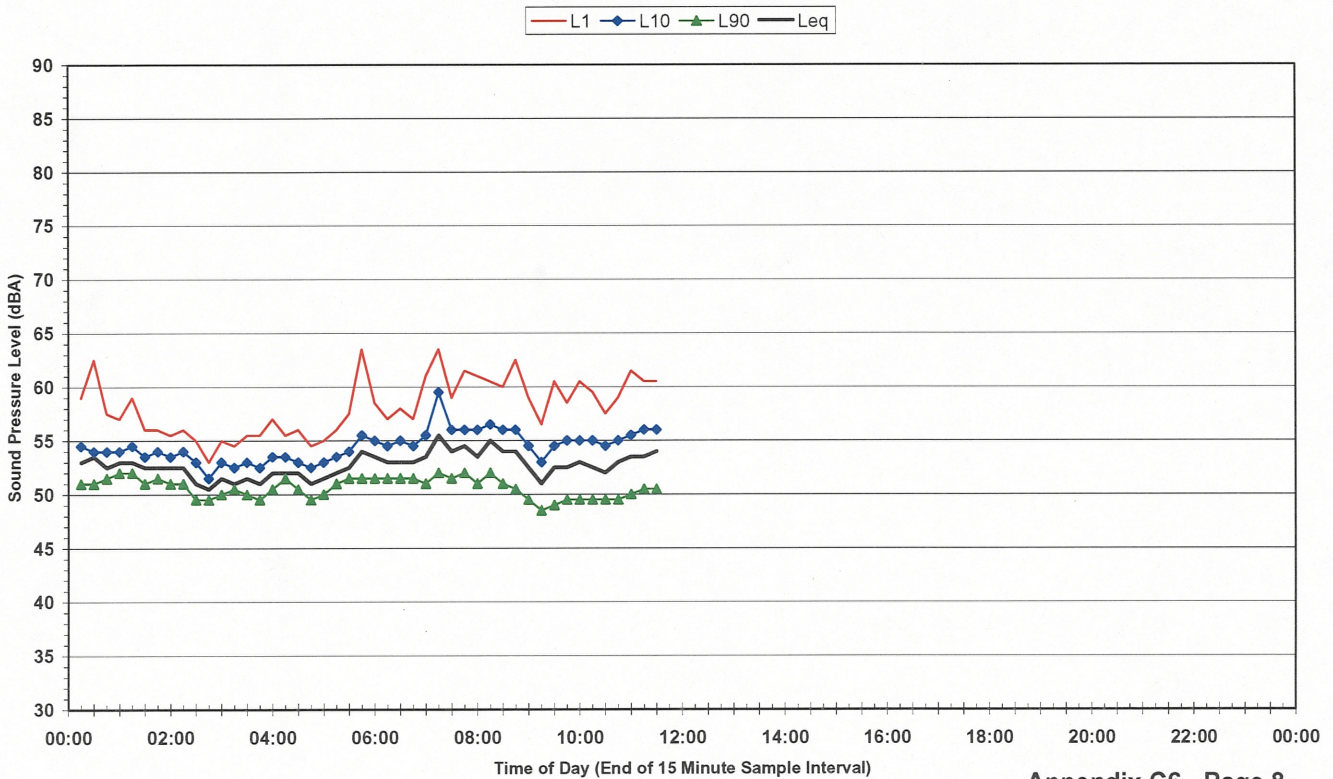
**Statistical Ambient Noise Levels
Simpson Ct, Mayfield West - Wednesday 5 February 2003**



Appendix C6 - Page 7
Statistical Noise Levels
RHA Report 10-2718

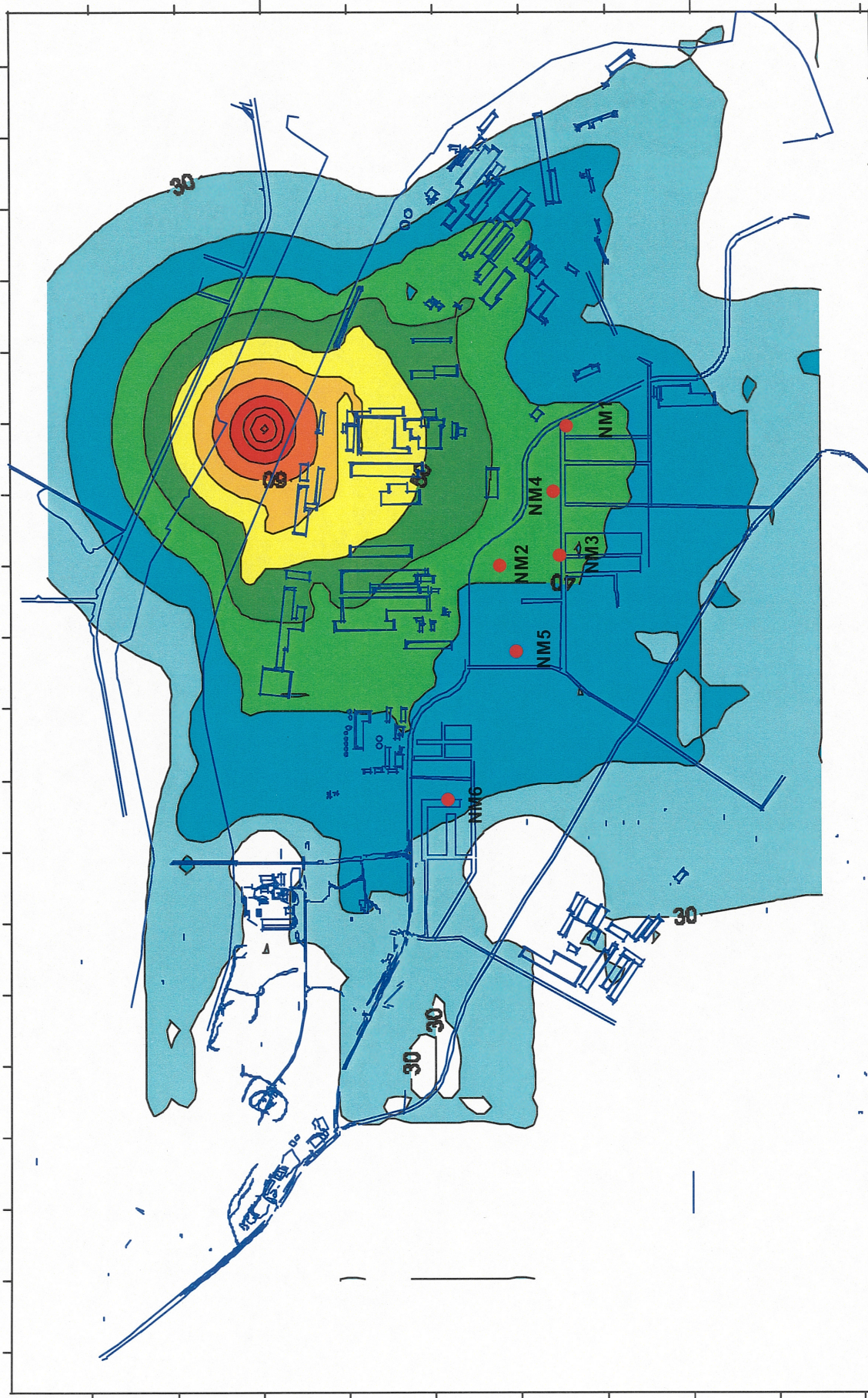
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**Statistical Ambient Noise Levels
Simpson Ct, Mayfield West - Thursday 6 February 2003**



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Statistical Noise Levels
RHA Report 10-2718

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Appendix D1
Report 10-2718
Extension of Shipping Channels Port of Newcastle
Noise Contours
Worst Case Drill & Blast Scenarios - Prevailing Conditions

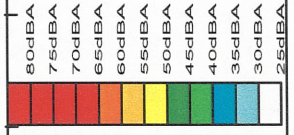


● **Noise Monitoring Locations**

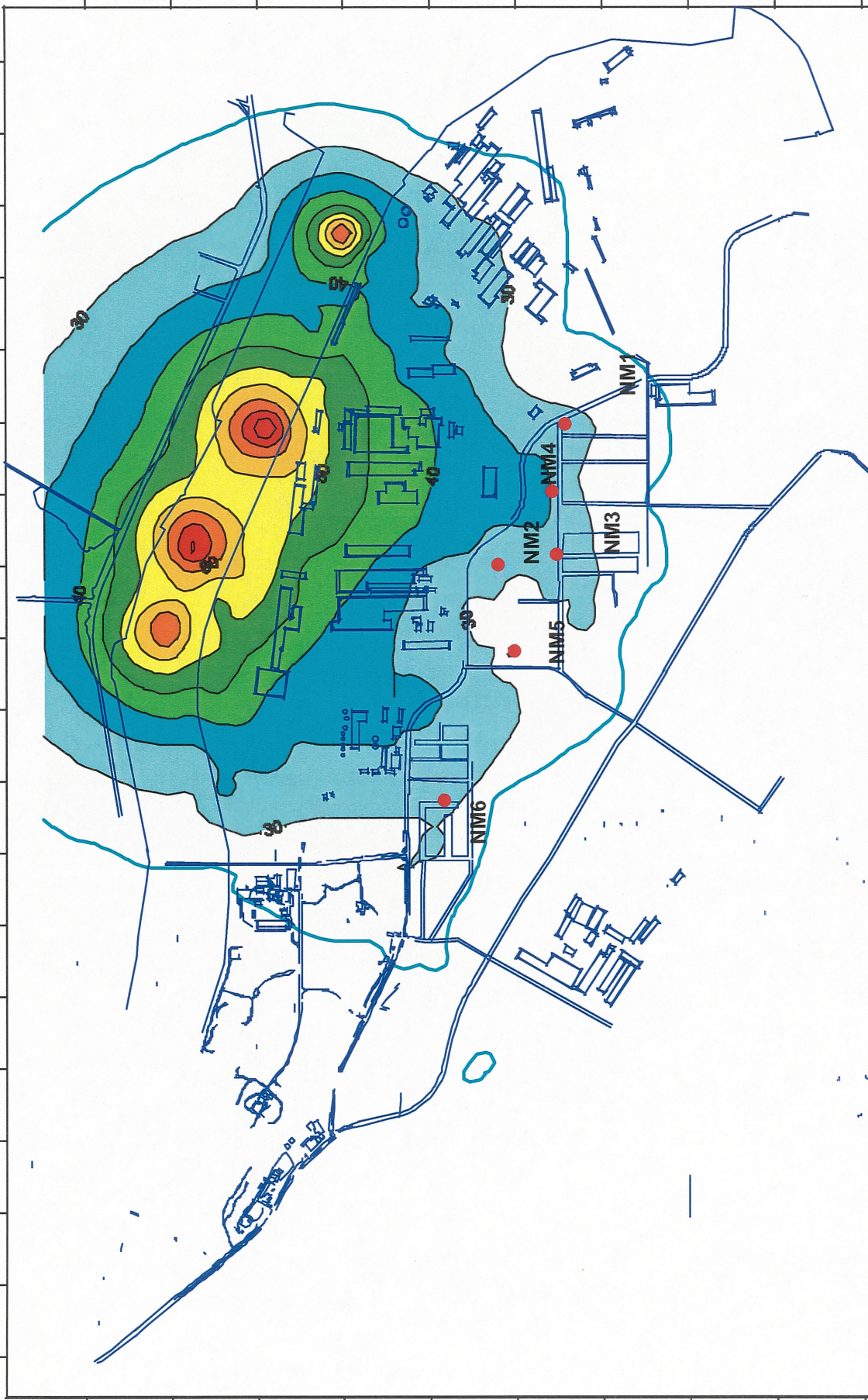




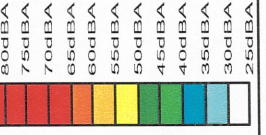
Appendix D2
Report 10-2718
Extension of Shipping Channels Port of Newcastle
Noise Contours
Typical Dredging (Months 7-10) - Calm Conditions



● **Noise Monitoring Locations**



Appendix D3
Report 10-2718
Extension of Shipping Channels Port of Newcastle
Noise Contours
Typical Dredging & Remediation Operations
(Months 7-10) - Calm Conditions



● **Noise Monitoring Locations**

