VOLUME 2 APPENDICES JULY 2011

AGL Dalton Power Project Environmental Assessment

MP10-0035

Appendix G

Noise Impact Assessment

URS

AGL

Switched on Business.

Noise Impact Assessment Report

AGL Gas-Fired Power Station at Dalton, NSW

20 JULY 2011

Prepared for

AGL Energy Limited

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43217973

URS

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Abbreviations

Abbreviation	Description
AGL	AGL Energy Limited
ANL	Acceptable Noise Level
AS	Australian Standard
AWS	Automatic Weather Station
BOM	Bureau of Meteorology
dB	Decibel – See Appendix A
DECCW	NSW Department of Environment, Climate Change and Water
EA	Environmental Assessment
ECRTN	Environmental Criteria for Road Traffic Noise
EPA	NSW Environment Protection Authority, now OEH
GFPS	Gas-fired power station
INP	Industrial Noise Policy
L_{90}	Background Noise Level – See Appendix A
L_{eq}	The equivalent continuous level – See Appendix A
MW	Megawatt
NATA	National Association of Testing Authorities
OEH	Office of Environment and Heritage
OGCT	Open-Cycle Gas Turbine
POEO Act	Protection of the Environment Operations Act 1997
PSNL	Project-Specific Noise Levels
RBL	Rating Background Level – See Appendix A
SPL	Sound pressure level – See Appendix A
URS	URS Australia Pty Ltd

Executive Summary

URS Australia Pty Ltd (URS) has been commissioned by AGL Energy Limited (AGL) to undertake a noise impact assessment for the proposed gas-fired power station to be located at Dalton, NSW. This report forms part of the Environmental Assessment (EA) which supports the Project Application lodged for the proposal.

Potential noise issues related to the proposed development include noise associated with the construction and operation of the facility. The proposed power station could operate at any time, thus an assessment of sleep disturbance for the nearest potentially affected noise sensitive receptors has been considered in this study.

Vibration impacts of the proposed construction and operation have not been assessed in detail. Given that the distance from the proposed facility to the nearest receptor is greater than 2 kilometres, the vibration impacts would be negligible. Main activities that could create vibration during construction are piling and blasting, neither of which are anticipated for this project. Vibration during operation could be associated with rotating equipment. Gas turbine plant operate at high rotational speed and are very sensitive to vibration and hence very well balanced preventing vibration at levels that could be intrusive to surrounding receptors.

The nearest potentially affected noise sensitive receptor locations have been identified and the predicted noise impacts of the proposed construction and operation at these locations have been assessed with consideration of the following guidelines:

- NSW Office of Environment and Heritage (OEH) *Industrial Noise Policy* (INP, EPA 1999) for the assessment of the operational noise of the proposed development;
- NSW OEH *Environmental Criteria for Road Traffic Noise* (ECRTN, EPA 1999) for the assessment of the off-site traffic noise on public roads; and
- NSW OEH *Interim Construction Noise Guidelines* (ICNG, DECC, 2009) for the assessment of the noise from construction of the proposed development.

The noise limits have been established in accordance with the above guidelines and the results of background noise monitoring. The adopted noise limits are the lowest permissible noise limits as specified in the NSW *Industrial Noise Policy*.

Noise levels of the proposed construction and operation have been predicted using an acoustic computer model created in SoundPLAN Version 6.5. Details of the area's topography, receptor locations and sound power levels of the noise sources have been incorporated into the noise model. Typical and 'worst-case' scenarios have been taken into consideration throughout the noise modelling.

This study has found that the noise criteria can be achieved with no further noise mitigation measures beyond those already proposed by AGL.

With regard to the assessment of low frequency and tonal noise impacts, the current OEH requirement is to assess potential impact against the NSW Industrial Noise Policy. The assessment indicates that low frequency noise may exceed the INP Low Frequency Noise criteria at three residences.

Executive Summary

An alternative assessment of low frequency and tonal noise impacts in accordance with international research suggests that the predicted low frequency noise would not be at a level to cause annoyance to residential receptors as the overall C-weighted noise levels would not exceed 65 dB(C) at any receptor locations (Hessler/Broner method). Accordingly, based on the alternative approach to this assessment of the combination of the INP and international methods, no adjustment to the A-weighted predicted operational noise levels would be required. Notwithstanding this, AGL will commence discussions with receptors B, C and D regarding this assessment as consistent with other developments.

On the basis of this assessment, it is concluded that noise impacts of the proposed construction and operation of the plant are not expected to degrade the existing acoustic environment nor create annoyance to residential receptor locations surrounding the facility.

1

Introduction

URS Australia Pty Ltd (URS) has undertaken a noise impact assessment for the proposed gas-fired power station (GFPS) on a site north of Dalton, NSW.

This noise study forms part of the Environmental Assessment (EA) which supports the Project Application for the facility.

Potential noise impacts associated with the proposed construction and operational activities are assessed in accordance with the following NSW Office of Environment and Heritage (OEH, formerly Department of Environment and Climate Change and Water) guidelines:

- NSW *Industrial Noise Policy* (INP, EPA 1999) for the assessment of the operational noise of the proposed development;
- NSW *Environmental Criteria for Road Traffic Noise* (ECRTN, EPA 1999) for the assessment of the off-site traffic noise on public roads; and
- NSW *Interim Construction Noise Guidelines* (ICNG, DECC 2009) for the assessment of the noise from construction of the proposed development.

The following documents have additionally been considered for this assessment:

- World Health Organisation (WHO), *Guidelines for Community Noise*, 1999
- Proposed Criteria for the Assessment of Low Frequency Noise Disturbance, 2005, Prepared for DEFRA by Dr. Andy Moorhouse, Dr. David Waddington, Dr. Mags Adams
- Procedure for the Assessment of Low Frequency Noise Complaints, 2005, Prepared for DEFRA by Dr. Andy Moorhouse, Dr. David Waddington, Dr. Mags Adams.
- A Noise Limit on Low Frequency Noise Emission due to Power Plants, Dr. N. Broner, 2008

Potential for sleep disturbance has also been assessed as the proposed development is a ‘peaking’ power station and could operate at any time.

1.1 Scope of Assessment

The scope of this assessment is to:

- provide a description of the existing acoustic environment and the proposed development;
- assess the existing acoustic environment and establish appropriate project-specific noise levels (PSNL);
- predict potential noise impacts by means of noise modelling and calculations;
- assess predicted construction and operational noise levels against the established noise criteria;
- provide recommendations for appropriate noise mitigation measures and noise management practices, where required;
- provide a statement of potential noise impacts; and
- report the findings of the assessment.

2

Site Locality and Project Description

2.1 Site Location

The Site collectively refers to the property comprising "The Elms" (Lot 115,249,252,253,305,307 in DP754111);, "Holmes" (Lot 1 & 2 DP126122; Lot 14, 183,184,187,200,283,306 in DP 754111), and "Riverview" (Lot 116, 321, 322, 162, 317, 318 in DP754111). The Site also refers to the areas comprising the proposed gas pipeline (northern portion) and access road (including Lots 21,186 and 251 in DP754111); the gas pipeline (southern portion) within Walshs Road easement and parts of Lots 30 and 31 in DP754111; and the valve station within Lot 30 in DP754111.

The Site is currently accessed from the west via Walshs Road. The Project would involve the construction of a new access road which would extend in a north east direction to the Facility from the 90 degree west turn point along Walshs Road.

Figure 2-1 and **Figure 2-2** illustrates the location of the site.

2.2 Project Description

AGL proposes the development of an open-cycle gas turbine (OCGT) peaking power station with a total generation capacity of 1500 MW, with up to six turbines, constructed over two stages.

- Stage 1: Power generation of from 250 MW to 780 MW comprising:
  - two to four E-class machines ranging from 125 MW to 200 MW (total power generation of 250 MW – 720 MW); or
  - two to three F-class machines ranging from 200 MW to 300 MW (total power generation of 400 MW – 780 MW).
- Stage 2: Power generation of up to a total of 1500 MW comprising:
  - Any underbuild of Stage 1 plus additional E or F class turbines taking the maximum number of turbines to 6 with a total maximum generating capacity to 1500 MW.

The constituent elements of the Dalton Power Project would include the proposed power station inclusive of a lay-down area; an approximately 3 km lateral gas pipeline connection from the power station to an existing natural gas supply pipeline located to the south of the Site; access road to the Site, a communications tower connected to the Facility via underground services and an access track and a connection between the power station and the existing high voltage transmission system on Site requiring one or two transmission towers within the existing 330kV transmission line easement. Within the Facility, each gas turbine area would consist of a main enclosure housing the turbines, an exhaust stack and transformer.

The proposed facility is a peaking power station and could operate at any time. The typical operating hours of the proposed type of facility are approximately 5 % of the year or 440 hours. The facility would typically operate during periods of peak demand associated with the morning and evening peaks, particularly at times of extreme weather. However, the facility may operate at any time during the day or night and at any time of the year. Therefore, the noise study has considered all weather conditions and all times of day and night.

The power station would connect to the Moomba to Sydney gas pipeline via an underground lateral connection along existing road reserves and/or private property, generally well separated from sensitive receptors.

2.3 Noise Sensitive Receptors

The nearest potentially affected noise sensitive receptor locations shown in **Table 2-1** have been identified from examination of aerial photographs using Google Earth and a site inspection conducted in April 2009.

Table 2-1 Noise Sensitive Receptors

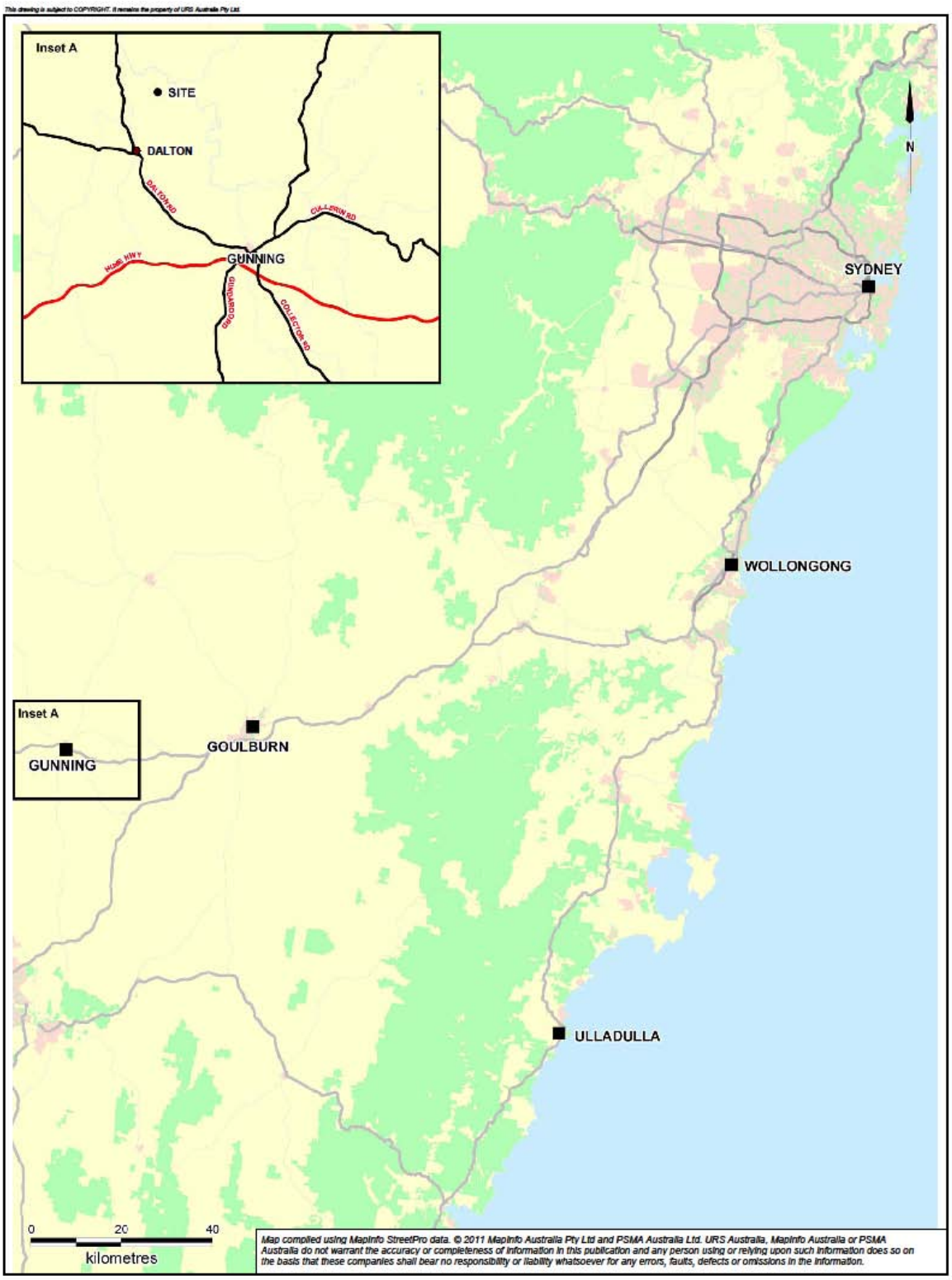
Receptor	Location	Approx Distance from Gas Turbines (km)	Indicative Noise Amenity Area[1]	Nearest Site Boundary
A	Rugby Road, Dalton (David Hallam)	4.2	Rural Residence	NNW
B	"Mt. Pleasant", 421 Walshs Road, Dalton	2.4	Rural Residence	NW
C	308 Rugby Road, Dalton	2.4	Rural Residence	SW
D	Walshs Road (Cowper Street), Dalton	2.3	Rural Residence	SSW
E	Bushs Lane, Dalton	3.7	Rural Residence	S
F	Alton Hill Road, Dalton	5.7	Rural Residence	SE
G	Alton Hill Road, Dalton	4.9	Rural Residence	E
H	Castle Hill Road, Dalton	4.2	Rural Residence	NNE
I	Castle Hill Road, Dalton	3.3	Rural Residence	N
J	Alton Hill Road, Adj. Merrill Creek	3.0	Rural Residence	NNE
K[2]	Site eastern boundary	1.5	Rural Residence	E

Notes:
1. According to the NSW Industrial Noise Policy.
2. This is not a noise sensitive receptor, but a site boundary location used for noise monitoring (Section 3.2)

Figure 2-2 shows the location of these receptors, together with a reference two-kilometre radius circle from the centre of the Site. **Figure 2-3** shows the proposed location of the facility within the site.

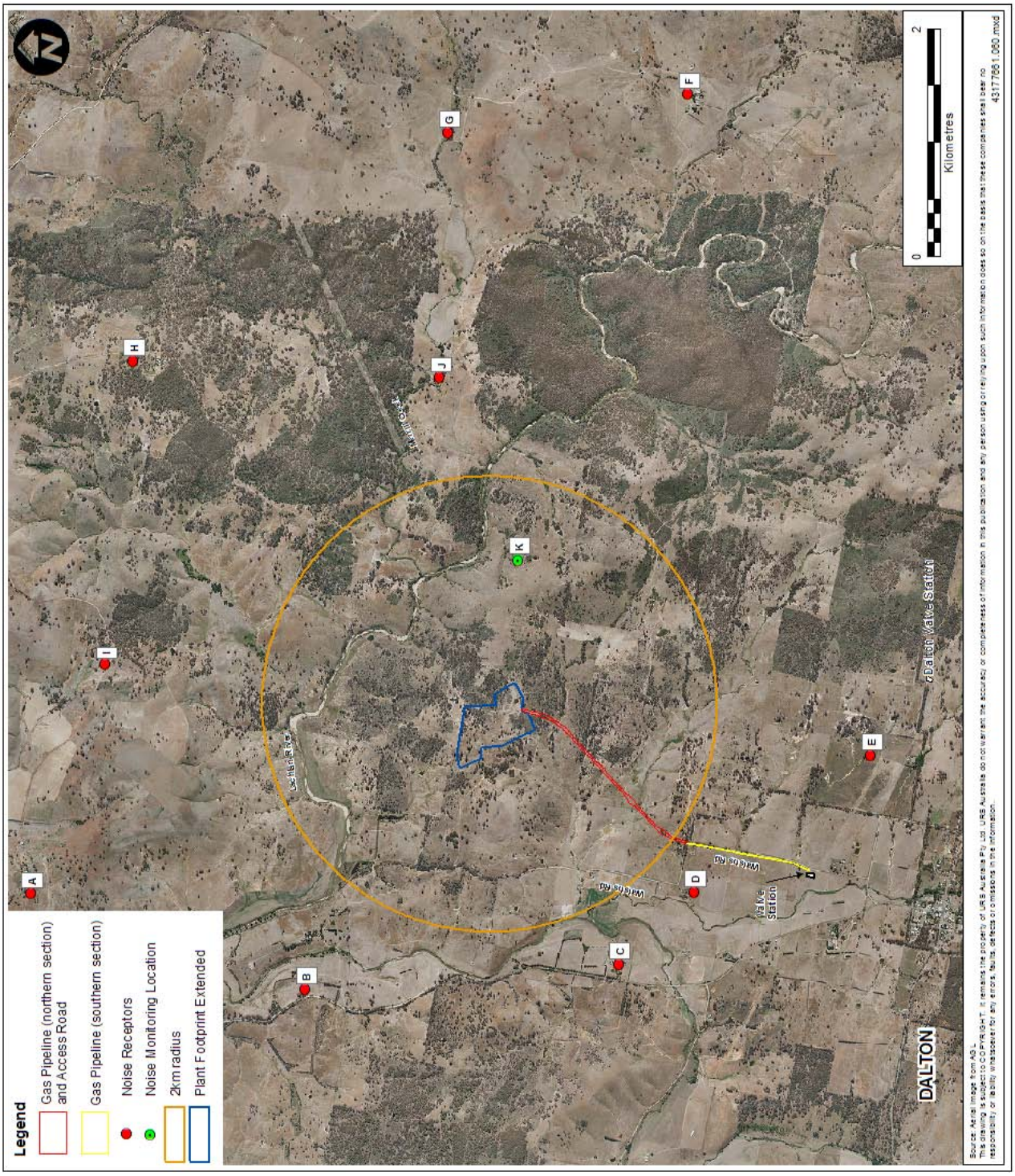
2 Site Locality and Project Description

Figure 2-1 Aerial showing Site Location and Township of Dalton and Gunning



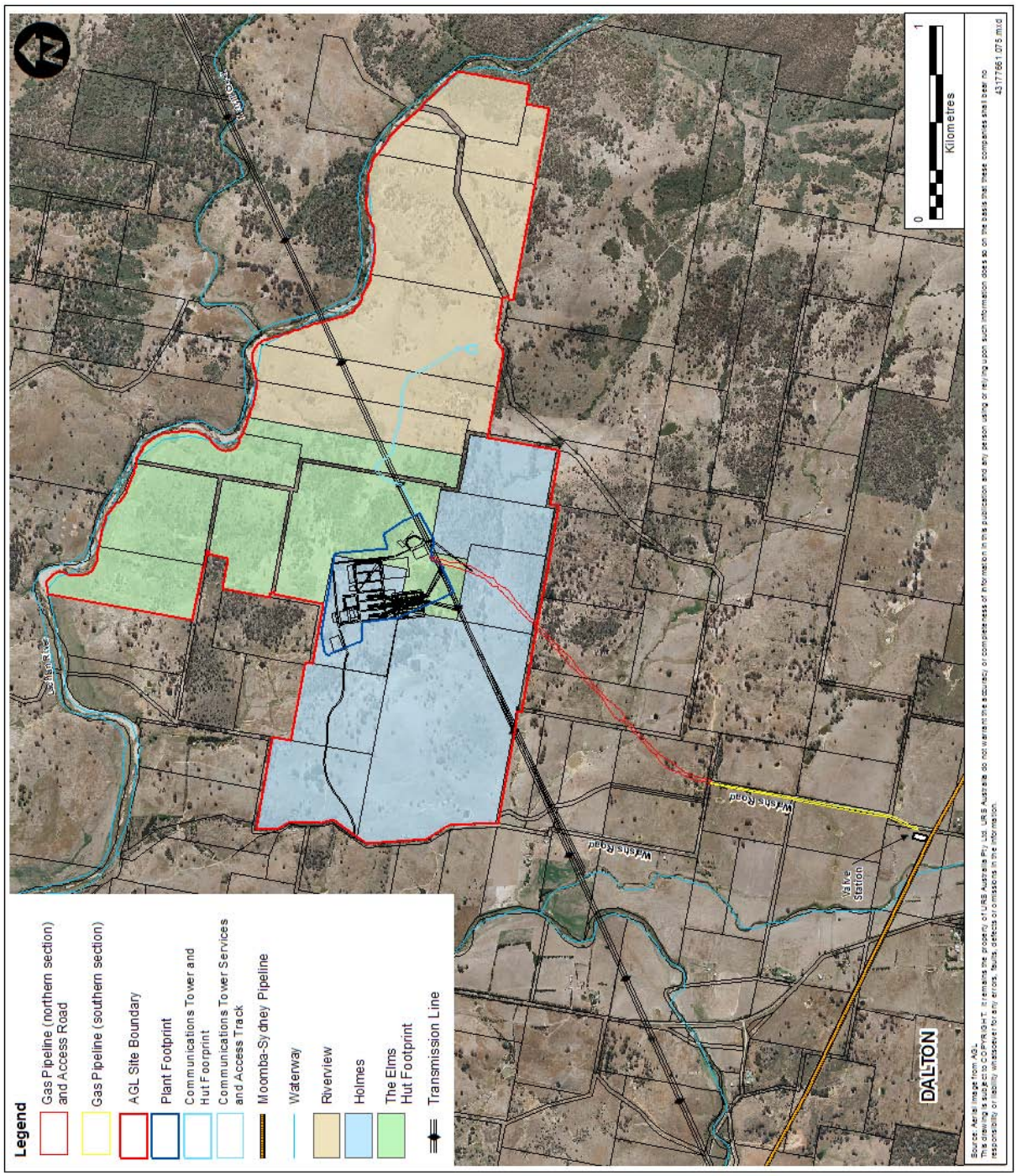
2 Site Locality and Project Description

Figure 2-2 Site and Noise Sensitive Receptor Locations



2 Site Locality and Project Description

Figure 2-3 Proposed Indicative Layout of Power Station Site



3

Existing Acoustic Environment

3.1 Noise Measurement Methodology

Noise measurements have been conducted by long-term unattended monitoring and short-term attended monitoring at selected noise sensitive receptors.

All the noise measurements were undertaken in accordance with AS1055:1997 "*Acoustics – Description and Measurement of Environmental Noise*".

The equipment detailed in **Table 3-1** was used in the survey. These instruments comply with AS IEC 61672.1 – 2004 "Electroacoustics – Sound level meters – Specifications" and AS IEC 60942-2004: "Electroacoustics - Sound Calibrators" as appropriate, and have a recent calibration certificate traceable to a NATA certified laboratory.

Table 3-1 Equipment used for noise survey

Monitoring	Item	Make	Model	Type
Long-term unattended	Noise logger	Acoustic Research Laboratories (ARL)	EL316	Type 1
	Calibrator	Rion	NC73	Class 1
Short-term attended	Sound level meter	SVANTEK SVAN	959	Type 1
	Calibrator	SVANTEK	SV30A	Class 1

The long-term noise monitoring was undertaken using the ARL noise loggers. The noise loggers were positioned with the microphones at 1.2 metres above ground level and were set to statistically process and store the measured noise levels every 15 minutes for the whole monitoring period. The noise loggers were calibrated before logging and the calibration was checked after logging using an acoustic calibrator. No significant discrepancies (greater than 0.3 dB) were noted in the reference calibration sound signals pre and post measurements.

When analysing the measured long-term noise levels, it is a usual practice to make reference to the meteorological data provided by the nearest Bureau of Meteorology (BOM) Automatic Weather Station (AWS) to the site. For the purpose of this assessment, a set of meteorological data obtained from an AWS location at Goulburn Airport (AWS ID: 70330), the nearest AWS to the site, have been reviewed.

However, given the distance separation between the nearest BOM AWS and the noise monitoring locations, the analysis of the measured data was considered but not reliant on the meteorological data. The trend of background noise during each monitoring period has been examined, and any noise monitoring periods affected by likely extraneous noise were excluded from the final data analysis.

The short-term attended noise monitoring was undertaken using a sound level meter which was positioned for each measurement with the microphone approximately 1.2 metres above the ground level. The sound level meter was calibrated using an acoustic calibrator before measurement sessions and the calibration was checked at the end of measurement sessions. No significant discrepancies (greater than 0.1 dB) were noted in the reference calibration sound signals pre and post measurements.

The short-term noise monitoring was conducted on a cool day with slight wind gusts (average speed of less than 3 m/s) and partial cloud cover. The weather conditions during the measurement periods would not have adversely affected the results.

3.2 Noise Measurement Locations

3.2.1 INP Assessment – Operational Noise

Noise monitoring locations were chosen after examination of satellite imagery of the locality and a site inspection. Consideration was given to selecting the monitoring locations to enable unattended long-term noise monitoring to establish the representative of the natural environment at each receptor location.

The two residential receptor locations were selected for the long-term noise monitoring in addition to one location near the eastern boundary of the site. Several short-term attended locations were also chosen to supplement the long-term noise monitoring. These locations are considered representative of the most potentially affected noise sensitive receptor locations near the site. No industrial or commercial premises have been found in proximity of these monitoring locations.

A brief description of each measurement location is given below:

- Location B: At the front yard of 421 Walshs Road, Dalton – located approximately 2,400 metres to the north-west of the facility. This location was used for long-term unattended noise monitoring to obtain background noise levels representative of the northern residential group (Locations A, B, H and I).

  The predominant noise sources at this location were local fauna (birds and insects) during the day, evening and night-time periods. Occasional road traffic was noticed during the daytime period. No industrial noise was audible at this location. However, this has not controlled the background noise levels as shown in **Table 3-4**.

  Short-term attended noise measurements were also conducted at this location to supplement the long-term noise monitoring.

- Location C: At the backyard of 308 Rugby Road, Dalton, located approximately 2,400 metres to the south-west of the site. This location was utilised for long-term unattended noise monitoring to obtain background noise levels representative of the southern and south-eastern residential group (Locations C, D and E).

  The predominant noise sources at this location were local fauna (birds and insects) during the day, evening and night-time periods. Road traffic noise from occasional vehicles was noticed during the daytime period, however this would not have adversely affected the long-term noise monitoring due to its short duration. No industrial noise was audible at this location.

  Short-term attended noise measurements were also conducted at this location to supplement the long-term noise monitoring.

- Location K: Near site eastern boundary. This location was utilised for long-term unattended noise monitoring to obtain background noise levels representative of the eastern residential group (Location F, G and J). The predominant noise sources at this location were local fauna (birds and insects) during the day, evening and night-time periods. No industrial noise was audible at this location.

  It is noted that this location was chosen as AGL have not obtained permission to have the noise monitoring undertaken at Locations F, G and J. The noise monitoring at this location would have

provided conservative noise levels as the location was not exposed to noise sources other than local fauna such as birds, insects and cattle.

Short-term attended noise measurements were not made at this location.

Table 3-2 provides a summary of the background monitoring locations representing each receiver.

Table 3-2 Summary of Noise Sensitive Receptors – INP Assessment

Receptor	Location	Representative Background Monitoring Location
A	Rugby Road, Dalton	B (421 Walshs Road)
B	421 Walshs Road, Dalton	B
C	308 Rugby Road, Dalton	C (308 Rugby Road)
D	Walshs Road (Cowper Street), Dalton	C
E	Bushs Lane, Dalton	C
F	Alton Hill Road, Dalton	K (Site eastern boundary)
G	Alton Hill Road, Dalton	K (Site eastern boundary)
H	Castle Hill Road or Street, Dalton	B
I	Castle Hill Road or Street, Dalton	B
J	Alton Hill Road, Dalton (Merrill Ck)	K (Site eastern boundary)

3.2.2 ECRTN Assessment – Off-Site Traffic Noise

Additional noise monitoring locations were chosen after examination of the proposed traffic route and a site inspection. Consideration was given to selecting the monitoring locations to enable unattended long-term noise monitoring to establish the representative noise trend at the worst potentially affected receptor locations. The locations were also chosen so that the noise loggers would not have been affected by extraneous noise (e.g. cattle, pumps, etc) which could result in unrepresentative elevated background noise levels.

Two residential receptor locations were selected for the long-term traffic noise monitoring. Several short-term attended locations were also chosen to supplement the long-term noise monitoring.

The worst potentially affected noise sensitive receptor locations are shown in **Table 3-3**.

Table 3-3 Summary of Noise Sensitive Receptors – ECRTN Assessment

Receptor	Location
D (See Figure 2-2)	Walshs Road (Cowper Street), Dalton
L	Dalton Road, Gunning
M	Warrataw Street, Gunning
N	Gundaroo Street, Gunning
O	Collector Road, Gunning

Figure 3-1 shows the monitoring locations used to measure existing road traffic noise followed by a brief description of each location:

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Figure 3-1 Traffic Noise Monitoring Locations - Gunning

Location M: At the balcony of 5 Warrataw Street, Gunning facing Warrataw Street. This location is considered one of the worst potentially affected residential receptors, due to its proximity to the road, and was used for long-term unattended noise monitoring to obtain existing traffic noise levels.

The predominant noise sources at this location were intermittent traffic on Warrataw Street during the day, evening and night-time periods. No industrial noise was audible at this location.

Short-term attended noise measurements were also conducted at this location to supplement the long-term noise monitoring.

- Location N: At the front yard of 1 Gundaroo Street, Gunning facing Gundaroo Street. This location is considered one of the worst potentially affected residential receptors, again due to its proximity to the road, and was used for long-term unattended noise monitoring to obtain existing traffic noise levels.

  The predominant noise sources at this location were intermittent traffic on Gundaroo Street and constant traffic hum from the Hume Highway during the day, evening and night-time periods. No industrial noise was audible at this location.

  Short-term attended noise measurements were also conducted at this location to supplement the long-term noise monitoring.

- Short-term attended noise measurements were conducted at Locations D, L and O to obtain existing noise levels.

3.3 Noise Measurement Results

3.3.1 INP Assessment

The results of the long-term noise monitoring are summarised in **Table 3-4, Table 3-5, Table 3-6** and. **Table 3-7**. Any 15-minute period affected by adverse weather conditions or likely extraneous noise were excluded from calculation.

For the purpose of INP assessment, the following time of day is defined:

- Day: 7.00 am – 6.00 pm, Monday to Saturday; or 8.00 am – 6.00 pm on Sundays and public holidays
- Evening: 6.00 pm – 10.00 pm, all days
- Night: 10.00 pm – 7.00 am, Monday to Saturday; or 10.00 pm – 8.00 am on Sundays and public holidays

Daily noise monitoring plots are provided in **Appendix D** of this report.

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Table 3-4 Measured Noise Levels – 421 Walshs Road, Dalton (Location B)

Date	Rating Background Level (RBL) L_{A90} dB(A)			Ambient Noise Level L_{Aeq} dB(A)		
	Day	Evening	Night	Day	Evening	Night
Tuesday, 31 March 2009	-	32	28	-	48	41
Wednesday, 1 April 2009	29	*	*	54	*	*
Thursday, 2 April 2009	34	26	24	52	44	42
Friday, 3 April 2009	27	29	*	49	43	*
Saturday, 4 April 2009	26	27	24	44	48	34
Sunday, 5 April 2009	27	24	24	45	43	33
Monday, 6 April 2009	26	25	24	45	45	35
Tuesday, 7 April 2009	26	26	24	49	53	34
Wednesday, 8 April 2009	26	-	-	45	-	-
Representative Level[1]	**26**	**26**	**24**	**50**	**48**	**38**

Notes: "-" noise logger deployed and collected during the daytime.
"*" period affected by adverse weather conditions or extraneous noise.
1. Represents median value for L_{A90}, and logarithmic average for L_{Aeq}.

Table 3-5 Measured Noise Levels – 308 Rugby Road, Dalton (Location C)

Date	Rating Background Level (RBL) L_{A90} dB(A)			Ambient Noise Level L_{Aeq} dB(A)		
	Day	Evening	Night	Day	Evening	Night
Tuesday, 31 March 2009	-	32	30	-	47	41
Wednesday, 1 April 2009	33	*	*	51	*	*
Thursday, 2 April 2009	32	25	25	45	40	38
Friday, 3 April 2009	27	27	26	43	40	37
Saturday, 4 April 2009	27	28	25	45	44	29
Sunday, 5 April 2009	27	25	25	44	42	45
Monday, 6 April 2009	27	25	25	45	40	45
Tuesday, 7 April 2009	27	26	25	43	38	44
Wednesday, 8 April 2009	27	-	-	42	-	-
Representative Level[1]	**27**	**26**	**25**	**46**	**43**	**42**

Notes: "-" noise logger deployed and collected during the daytime.
"*"period affected by adverse weather conditions or extraneous noise.
1. Represents median value for L_{A90}, and logarithmic average for L_{Aeq}.

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Table 3-6 Measured Noise Levels – Site Eastern Boundary (Location K)

Date	Rating Background Level (RBL) L_{A90} dB(A)			Ambient Noise Level L_{Aeq} dB(A)		
	Day	Evening	Night	Day	Evening	Night
Tuesday, 31 March 2009	-	32	34	-	50	45
Wednesday, 1 April 2009	37	*	*	50	*	*
Thursday, 2 April 2009	34	28	25	42	38	29
Friday, 3 April 2009	25	28	25	36	35	33
Saturday, 4 April 2009	25	27	25	32	40	37
Sunday, 5 April 2009	25	25	25	37	42	26
Monday, 6 April 2009	25	25	25	33	40	36
Tuesday, 7 April 2009	25	*	*	32	*	*
Wednesday, 8 April 2009	42	32	34	51	50	45
Representative Level[1]	**25**	**27[2]**	**25**	**45**	**44**	**39**

Notes: "-" noise logger deployed and collected during the daytime.
"*"period affected by adverse weather conditions or extraneous noise.
1. Represents median value for L_{A90}, and logarithmic average for L_{Aeq}.
2. Insects and birds noise during the evening period might have resulted in Average L_{A90} of evening period higher than L_{A90} of daytime period.

The daily noise logging results generally show consistent daily noise levels throughout each period at all the monitoring locations. The results at both monitoring locations show similar trend and background noise levels. The noise monitoring data is therefore considered representative of the area's acoustic environment, and therefore suitable for this assessment.

In the three tables above, an overall representative ambient noise level is determined by logarithmic averaging of each assessment period for the entire monitoring period, whereas the Rating Background Level (RBL) is determined by taking the median value of each assessment period for the entire monitoring period.

Table 3-7 presents a summary of overall ambient and background noise levels at each monitoring location.

Table 3-7 Summary of Measured Noise Levels – All Monitoring Locations

Location	Rating Background Level (RBL) L_{A90} dB(A)			Ambient Noise Level L_{Aeq} dB(A)		
	Day	Evening	Night	Day	Evening	Night
B: 421 Walshs Road	26	26	24	50	48	38
C: 308 Rugby Road	27	26	25	46	43	42
K: Site eastern boundary	25	27	25	45	44	39

The RBLs presented were used to derive day, evening and night-time noise limits for this noise impact assessment of the proposed construction and operation of the plant.

As described in **Section 3.2** of this report, noise limits for each assessment location were established by:

3 Existing Acoustic Environment

- Adopting the RBL obtained at Location B to derive noise limits for residential group adjacent to the north of the facility: Locations A, B, H and I;
- Adopting the RBL obtained at Location C to derive noise limits for residential group adjacent to the south and south-eastern of the facility: Locations C, D and E: and
- Adopting the RBL obtained at Location K to derive noise limits for residential group adjacent to the east of the facility: Locations F, G and J.

Section 3.1.2 – *Definitions to support methodologies* of the NSW INP states that where the rating background level is found to be less than 30 dB(A), then it is set to 30 dB(A). Therefore, the rating background levels for Locations B, C and K have been adjusted as shown in **Table 3-8**.

Table 3-8 Rating Background Noise Levels – All Monitoring Locations

Location	Rating Background Level (RBL), L_{A90} dB(A)		
	Day	Evening	Night
B: 421 Walshs Road	30	30	30
C: 308 Rugby Road	30	30	30
K: Site eastern boundary	30	30	30

Table 3-9 presents the short-term attended noise measurement results.

Table 3-9 Attended Measurement Results – Environmental Noise

Location	Date / Time	Background $L_{A90\ (5\text{-}10min)}$ dB(A)	Ambient $L_{Aeq\ (5\text{-}10min)}$ dB(A)	Comments
A	Wednesday, 1 April 2009 / 01:35 am	32.5	37.8	Noise environment governed by local fauna (birds and insects). No other noise was noted.
B	Wednesday, 1 April 2009 / 01:25 am	33.8	42.1	Noise environment governed by local fauna (birds and insects). No other noise was noted.
C	Wednesday, 1 April 2009 / 01:17 am	36.3	42.2	Noise environment governed by local fauna (birds and insects). No other noise was noted.
D	Wednesday, 1 April 2009 / 01:01 am	26.7	35.1	Noise environment governed by local fauna (birds and insects). No other noise was noted.
	Wednesday, 8 April 2009 / 09:35 am	30.7	37.8	Noise environment governed by local fauna (birds and cattle). No other noise was noted.
E	Wednesday, 1 April 2009 / 12:49 am	37	40.9	Noise environment governed by local fauna (birds and insects). No other noise was noted.
	Wednesday, 8 April 2009 / 09:20 am	22.5	44.5	Noise environment governed by local fauna (birds and cattle). No other noise was noted.
F	Wednesday, 1 April 2009 / 12:00 am	34.6	40.3	Noise environment governed by local fauna (birds and insects). No other noise was noted.
G	Wednesday, 1 April 2009 / 12:10 am	36.2	45.9	Noise environment governed by local fauna (birds and insects). No other noise was noted.

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Location	Date / Time	Background $L_{A90\ (5\text{-}10min)}$ dB(A)	Ambient $L_{Aeq\ (5\text{-}10min)}$ dB(A)	Comments
	Tuesday, 7 April 2009 / 04:55 pm	22.3	54.2	Noise environment governed by local fauna (birds and cattle). No other noise was noted.
H	Wednesday, 1 April 2009 / 01:45 pm	46.3	57.3	Noise environment governed by local fauna (birds and cattle). No other noise was noted.
K	Tuesday, 7 April 2009 / 12:10 pm	24.5	32.7	Noise environment governed by local fauna (birds and cattle). No other noise was noted.
	Tuesday, 7 April 2009 / 12:25 pm	24.5	29.0	Noise environment governed by local fauna (birds and cattle). No other noise was noted.

The results from the attended noise monitoring show that the measured night-time background noise levels at Location K are consistent with the results from the long-term monitoring. However, it shows that the background noise levels measured at other locations during night-time are much higher than the long-term monitoring results (which is the average levels over 11 hour period). This was attributed to the local fauna (birds and insects) during the short-term monitoring period. The long-term noise monitoring results are therefore considered more appropriate for the purpose of the assessment.

It is noted that noise monitoring has not been conducted at Location I. However, considering the sound sources in the vicinity of these receptors, background noise levels obtained from Locations H have been adopted to establish noise criteria at this location. It is our opinion that this approach is appropriate for the purpose of the background noise survey.

3.3.2 ECRTN Assessment

The results of the long-term noise monitoring are summarised in **Table 3-10** and **Table 3-11**.

Any 15-minute period affected by adverse weather conditions or suspected extraneous noise were excluded from the calculations.

For the purpose of the ECRTN assessment, the following time of day is defined:

- Day: 7.00 am – 10.00 pm, all days; and
- Night: 10.00 pm – 7.00 am, all days.

Daily noise monitoring plots are provided in **Appendix D** of this report.

Table 3-10 Measured Traffic Noise Levels – 5 Warrataw Street, Gunning (Location M)

Date	Average L_{Aeq} Levels, dB(A)		Highest $L_{Aeq,1hr}$ Levels, dB(A)	
	Day ($L_{Aeq,15hr}$)	Night ($L_{Aeq,9hr}$)	Day	Night
Wednesday, 1 April 2009	54.6	51.3	56.9	55.6
Thursday, 2 April 2009	54.6	48.3	57.7	53.5
Friday, 3 April 2009	54.5	50.1	58.2	54.9
Saturday, 4 April 2009	54.9	45.8	59.7	52.1
Sunday, 5 April 2009	53.1	-	57.2	-
Representative Level[1]	**54**	**48**	**58**	**54**

Notes: "-" noise logger collected during the daytime.
1. Represents logarithmic average.

3 Existing Acoustic Environment

Table 3-11 Measured Traffic Noise Levels – 1 Gundaroo Street, Gunning (Location N)

Date	Average L_{Aeq} Levels, dB(A)		Highest $L_{Aeq,1hr}$ Levels, dB(A)	
	Day	Night	Day	Night
Sunday, 5 April 2009	53.9	48.5	56.8	51.9
Monday, 6 April 2009	55.5	48.1	59.1	50.7
Tuesday, 7 April 2009	55.0	48.3	58.1	50.7
Wednesday, 8 April 2009	56.2	-	57.7	-
Representative Level[1]	**55**	**48**	**58**	**51**

Notes: "-" noise logger collected during the daytime.
1. Represents logarithmic average.

Table 3-12 Attended Measurement Results – Traffic Noise

Location	Date / Time	Measured Traffic Noise[1] L_{Aeq} dB(A)	Estimated Traffic Noise[2] L_{Aeq} dB(A)	Comments
J	Wednesday, 1 April 2009 / 12:55 pm	59.6	43	Noise environment governed by occasional road traffic and local fauna (birds). No other noise was noted.
	Wednesday, 8 April 2009 / 11:10 am	63.2	46	Noise environment governed by occasional road traffic and local fauna (birds). No other noise was noted.
M	Wednesday, 1 April 2009 / 12:35 pm	51.4	51	Noise environment governed by local activities and intermittent road traffic noise. No other noise was noted.
N	Wednesday, 1 April 2009 / 11:55 pm	56.2	56	Noise environment governed by local fauna (birds) and intermittent road traffic noise. No other noise was noted.
O	Wednesday, 1 April 2009 / 11:40 pm	58.8	55	Noise environment governed by local fauna (birds) and intermittent road traffic noise. No other noise was noted.
	Wednesday, 8 April 2009 / 11:45 am	60	56	Noise environment governed by local fauna (birds) and intermittent road traffic noise. No other noise was noted.

Notes:
1. Measurement location: either at worst affected façade of dwelling or close to kerb side of the road
2. Calculated based on the measured levels taking into consideration set-back distance of each receptor to road.

4

Project Acoustic Criteria

4.1 Legislation and Guidelines

The potential noise impacts of the site were assessed in accordance with the following documents:

- NSW *Industrial Noise Policy* (INP, EPA 2000) for operational noise assessment including Application Notes to the INP (July 2006);
- NSW *Environmental Criteria for Road Traffic Noise* (ECRTN, EPA 1999) for site associated road traffic noise assessment and sleep disturbance assessment;
- *Interim Construction Noise Guideline* (DECC, 2009) for construction noise; and

The following documents have additionally been considered for alternative assessment approaches to assist with this assessment :

- World Health Organisation (WHO), *Guidelines for Community Noise*, 1999
- Proposed Criteria for the Assessment of Low Frequency Noise Disturbance, 2005, Prepared for DEFRA by Dr. Andy Moorhouse, Dr. David Waddington, Dr. Mags Adams
- Procedure for the Assessment of Low Frequency Noise Complaints, 2005, Prepared for DEFRA by Dr. Andy Moorhouse, Dr. David Waddington, Dr. Mags Adams.
- A Noise Limit on Low Frequency Noise Emission due to Power Plants, Dr. N. Broner, 2008
- NSW Leafs Gully Gas Turbine Power Station – Noise & Vibration Assessment, Wilkinson Murray, 2008
- NSW Leafs Gully Gas Turbine Power Station – Director General's Report and Project Approval issued by NSW Department of Planning

The relevance of these guidelines is outlined in the following sections.

4.2 Operational Noise Criteria

4.2.1 NSW Industrial Noise Policy (INP)

The INP provides the framework and process for deriving noise limit conditions for consents and licences that enables the OEH to regulate premises that are scheduled under the *Protection of the Environment Operations Act 1997* (POEO Act). This policy seeks to promote environmental well-being through preventing and minimising noise.

Section 1.1 of the INP states the specific policy objectives as follows:

- To establish noise criteria what 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; and
- To carry out functions relating to the prevention, minimisation and control of noise from premises scheduled under the POEO Act.

The policy sets out two criteria (intrusive criterion and amenity criterion) to assess potential noise impacts of industrial sources. The first criterion is used to control intrusive noise impacts in the short-

term for residences, and the second criterion is used to maintain noise level amenity for particular land uses for residences and other land uses.

Intrusive Noise Impacts

The intrusive criterion is summarised as follows:

- $L_{Aeq,15\ minute} \leq$ rating background level (RBL, L_{A90}) + 5 dB(A)

where:

- $L_{Aeq,15minute}$ represents the equivalent continuous A-weighted sound pressure level of the source over 15 minutes, unless other descriptors are specified as more appropriate to characterise the source;
- This is to be assessed at the most affected point on or within the residential property boundary or if that is more than 30m from the residence, then at the most affected point within 30m of the residence.

Protecting Noise Amenity

The amenity criterion is established to limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in the INP. **Table 4-1** is a summary of the noise levels from the INP showing amenity criteria applicable to the different types of receptors and areas within the study area.

Table 4-1 Recommended L_{Aeq} Noise Levels from Industrial Noise Sources

Type of Receptor	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level, dB(A)	
			Acceptable (ANL)	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45

Notes: • Shaded levels represent the Amenity Criteria applicable to this assessment.

For the receptor locations considered in this assessment, the amenity area of “Rural” has been adopted for the purpose of establishing the project-specific noise levels. “Rural” area means an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic.

In addition, the INP specifies that modification is to be implemented where the existing noise level from industrial noise sources is close to the acceptable noise level (ANL) or already exceeds the ANL for the area in question.

Adjustments are to be applied to the source noise level received at the assessment point, before comparison with the amenity criterion, where the noise source contains characteristics such as prominent tonal components, impulsiveness, intermittency, irregularity and dominant low frequency content as there is evidence to suggest that it can cause greater annoyance than other noise at the

same noise level. The maximum correction to be applied to the criteria or the measured level is 10 dB(A) where the noise contains two or more modifying factors.

Modification to Acceptable Noise Level (ANL) is not required for the residential locations in this assessment as the L_{Aeq} noise levels obtained for these locations were dominated by natural sounds and not affected by industrial sources, as discussed in **Section 3.2** of this report.

Project-Specific Noise Levels (PSNL)

The PSNL reflect the most stringent noise level requirement from the criteria derived from both the intrusive and amenity criteria to ensure that intrusive noise is limited and amenity is protected.

Table 4-2 summarises the noise criteria applicable to the operation of the plant.

Table 4-2 Project-Specific Noise Levels (PSNL)

Receptor Location	Intrusive Criterion $L_{Aeq,15min}$ dB(A)			Amenity Criterion $L_{Aeq,period}$ dB(A)		
	Day	Evening	Night	Day	Evening	Night
All Receptor Locations	**35**	**35**	**35**	50	45	40
Notes: Shaded results represent the PSNL applicable to the assessment.						

It can been seen in **Table 4-2** that the controlling noise criteria will be the intrusive criteria, which are based on the representative rating background levels for each assessment period. It should be noted that 35 dB(A) $L_{Aeq,15min}$ is the lowest permissible noise limit in accordance with the INP.

The PSNL is the noise contribution from the operation of the proposed power station only, i.e. excluding the contribution from the background noise level.

In assessing noise levels at residences, the noise level is to be assessed at the most affected point on or within the residential property boundary or, if this is more than 30 metres from the residence, at the most affected point within 30 metres of the residence.

As the proposed operations are up to 24 hours a day, the controlling noise criterion is the night-time criterion. For the purpose of this assessment, the night-time criterion is considered because compliance with that target leads to compliance at all other times.

4.2.2 Sleep Disturbance Criteria

In addition to the criteria in **Section 4.2.1**, an assessment of sleep disturbance for the potentially affected noise sensitive receptors has also been considered in this study. In the event that the power station operates during night-time hours (10.00pm – 7.00am), consideration should be given to the potential for the disturbance of sleep within residences.

Section 2.2 of the INP states that meeting the Acceptable Noise Limit (ANL) shown on **Table 4-1** will protect against sleep disturbance which recommends the acceptable external noise level for rural areas to be 40 dB(A) L_{Aeq} at night.

The World Health Organisation (WHO) suggests that the noise level inside bedroom should be limited to 30 – 35 dB(A) L_{Aeq} and 45 dB(A) L_{Amax}. When considering internal noise levels from an external noise source, it is common practice to assume that windows are partially open to allow natural ventilation. The noise reduction through partially opened windows is estimated to be 10 dB(A), as

specified in *AS 3671-1989: Acoustics – Road Traffic Noise Intrusion – Building Siting and Construction*.

The Application Notes to the INP state that:

- OEH reviewed research on sleep disturbance in the NSW Environmental Criteria for Traffic Noise (ECRTN), and the review concluded that the ECRTN sleep disturbance criterion of an $L_{A1,1min}$ not exceeding the $L_{A90,15min}$ by more than 15 dB(A) is not ideal.
- However, as there is insufficient evidence to determine what should replace it, OEH will continue to use it as a guide to identify the likelihood of sleep disturbance. Where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.

To achieve the internal noise levels described above, the noise levels inside and outside bedroom windows, should be limited to 45 dB(A) $L_{A1,1min}$ and 55 dB(A) $L_{A1,1min}$ which is in line with the $L_{A90,15min}$ + 15 dB(A) criterion provided in the INP Application Notes.

Table 4-3 summarises the sleep disturbance criteria adopted for this assessment that are applied to the nominated residential receptors.

Table 4-3 Sleep Disturbance Criteria

Receptor	Internal Noise Level, $L_{A1,1min}$, dB(A)	External Noise Level, $L_{A1,1min}$, dB(A)
All receptors	30 + 15 = 45	45 + 10 = **55**

The external noise levels are assessed at the most exposed side of residential premises. Sleep disturbance thresholds are also determined by factors including noise character and pitch, perceived personal danger, degree of habituation, age, illness or fatigue and the point in time when the noise occurs during the sleep period. For example, noisy events are generally less disturbing to people if confined to the earlier period of the evening when it is considered could be still possible to retrieve deep sleep.

It is noted that the nominated sleep disturbance noise criterion is greater than the project-specific noise levels (PSNL) as presented in **Table 4-2**. Therefore, where the PSNL is not exceeded at residential receptor locations, the sleep disturbance criterion would also be satisfied, and no additional noise control measures would be required.

4.2.3 Low Frequency Noise and Tonal Noise

The potential impacts of low frequency noise and tonal noise have been assessed in accordance with the NSW INP.

The INP recommendations for low frequency noise involve an assessment to be conducted on the difference between C and A weighting levels. The most common frequency weighting in current use is “A-weighting” providing results often denoted as dB(A), and approximate the response of the human ear at low sound levels. A “C-weighting” curve is also used, particularly when evaluating very loud or low-frequency sounds. If a difference greater than 15 dB exists between the A and C weighted levels, a correction of 5 dB is to be applied to the measured or predicted levels. This approach provides an assessment for potential for low frequency noise.

INP Criteria for Tonal Noise

The INP states that if the level of one-third octave band exceeds the level of the adjacent bands on both sides by:

- 5 dB or more if the centre frequency of the band containing the tone is above 400 Hz;
- 8 dB or more if the centre frequency of the band containing the tone is between 160 Hz and 400 Hz inclusive; or
- 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz

It also states that only one 5 dB correction should be applied where a source emits tonal and low frequency noise if the tone is in the low frequency range.

4.3 Construction Noise Criteria

4.3.1 NSW Interim Construction Noise Guideline

The noise criteria set out in the *Interim Construction Noise Guideline* (DECC, July 2009) have been used to assess the potential construction noise impact. This guideline is not mandatory although it will be used to assist OEH in setting statutory conditions in licences or other regulatory instruments for construction noise. **Table 4-4** and **Table 4-5** summarise the construction noise criteria specified in the Guideline.

Table 4-4 Construction Noise Criteria – Noise at Residences

Time of Day	Management Level $L_{Aeq, 15min}$	How to apply
Recommended standard hours: Monday to Friday: 7.00am to 6.00pm Saturday: 8.00am to 1.00pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise: Where the predicted or measured $L_{Aeq, 15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

4 Project Acoustic Criteria

Time of Day	Management Level $L_{Aeq, 15min}$	How to apply
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

Table 4-5 Construction Noise Criteria – Noise at Other Sensitive Land Uses

Land Use	Management Level, $L_{Aeq, 15min}$ (applies when properties are being used)
Classrooms at schools and other educational institutions	Internal noise level: 45 dB(A)
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level: 65 dB(A)
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level: 60 dB(A)
Commercial premises (offices, retail outlets, etc)	External noise level: 70 dB(A)
Industrial premises	External noise level: 75 dB(A)

In accordance with the above guideline, the following construction noise management levels are applicable for each receptor location within the study area.

Table 4-6 Project-specific Construction Noise Management Levels

Receptor Location	Rating Background Level L_{A90} dB(A)	Noise Affected Level $L_{Aeq,15min}$ dB(A)	Highly Noise Affected Level $L_{Aeq,15min}$ dB(A)
All Receptors	30	30 + 10 = 40	75

The interim construction noise guideline does not include any criteria to assess off-site traffic noise associated with the construction. The off-site traffic noise has therefore been assessed under the ECRTN. Noise from traffic associated with the proposed construction is minimised as much as practical by limitations on construction hours, and Australian Design Rules which apply to road-registered vehicles.

4.4 Off-Site Traffic Noise Criteria

4.4.1 NSW Environmental Criteria for Road Traffic Noise (ECRTN)

Criteria for off site road traffic noise are specified in the NSW *Environmental Criteria for Road Traffic Noise* (ECRTN). The criteria applicable are summarised in **Table 4-7**. The location of the worst potentially affected receptor locations fall under the ECRTN category of:

- Land use developments with potential to create additional traffic on local road (Locations L and M); and
- Land use developments with potential to create additional traffic on collector road (Locations N and O)

Regular vehicle movement within the facility is considered as an industrial noise source and thus, is to be assessed in accordance with the INP.

Table 4-7 Environmental Criteria for Road Traffic Noise

Type of Development	Day $L_{Aeq,1hr}$ dB(A)	Night $L_{Aeq,1hr}$ dB(A)	Where criteria are already exceeded
Land use developments with potential to create additional traffic on local roads	55	50	Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating time of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.
Land use developments with potential to create additional traffic on collector roads	60	55	
Notes: • Day: 7.00 am – 10.00 pm / Night: 10.00 pm – 7.00 am.			

In accordance with the above guideline, the following traffic noise criteria are applicable for each receptor location within the study area.

Table 4-8 Traffic Noise Criteria for Receptors

Receptor	Address	Type of Road (Table 4-7)	Noise Criteria ($L_{Aeq,1hr}$) dB(A)	
			Day	Night
D	Cowper Street	Local Road	55	50
L	Dalton Road	Local Road	55	50
M	Warrataw Street	Local Road	55	50
N	Gundaroo Street	Collector Road	60	55
O	Collector Road	Collector Road	60	55

5

Assessment of Potential Acoustic Impacts

5.1 Calculation Methodology

Noise levels due to the proposed construction and operation of the plant at the identified noise sensitive receptor locations have been predicted using an acoustic computer model created in SoundPLAN Version 6.5. This program is used and recognised internationally. This program is also considered by the INP as a preferred computer noise model (Section 6.2 – *Noise Prediction*)

The noise model was developed to allow the prediction of cumulative noise levels from the site including the contribution of each noise source. The noise model takes into account:

- sound power levels of each source;
- receptor locations;
- digital terrain map with 1 m height interval;
- screening effects due to topography;
- meteorological effects and attenuation due to distance; and
- ground and atmospheric absorption.

The noise calculations have been carried out using the L_{Aeq} descriptor to assess the operational and construction noise impacts.

The program allows the use of various noise prediction algorithms. To calculate noise emission levels under neutral and adverse meteorological conditions, the CONCAWE algorithm which is designed for industrial sites has been used.

The CONCAWE method was especially designed for the requirements of large industrial facilities such as petroleum and petrochemical complexes, and is now the principal prediction method used in Australia and widely used for calculating noise emissions from all types of industrial facilities. CONCAWE, where prevailing winds and meteorological conditions do not fit normal conditions that are assumed in some other alternate calculation methods, provides complex calculation methods in predicting noise levels under the influence of wind and the stability of the atmosphere as well as ground effects.

CONCAWE, available within SoundPLAN, calculates the sound pressure level at the receptor location taking into consideration the following:

- source levels entered for the 31.5 Hz octave band to 16 kHz octave band frequencies (Original CONCAWE calculation algorithm was only written for 63 Hz and above, however SoundPLAN makes an approximation for the 31.5 Hz octave band using the 63 Hz propagation);
- attenuation due to distance between the source and the receptor;
- attenuation due to air absorption which is evaluated in accordance with ISO9613 (Part 1), ISO3891 or ANSI 126;
- ground attenuation considering hard or soft surfaces;
- correction due to sound refractions by wind and temperature gradients which is based on the Pasquil meteorological atmosphere categories (Pasquil Stability Class);
- correction due to wind speed and direction; and
- screening based on the Nordic General Prediction method.

Additional noise modelling has been carried out using ISO9613 (Part 2) calculation method available within SoundPLAN for comparison with the results generated by CONCAWE method. ISO9613, available within SoundPLAN, calculates the sound pressure level at the receptor location taking into consideration the following:

- source levels entered for the 31.5 Hz octave band to 16 kHz octave band frequencies;
- attenuation due to distance between the source and the receptor;
- attenuation due to air absorption which is evaluated in accordance with ISO9613 (Part 1), ISO1913 (Part 1) or ANSI 126;
- ground absorption;
- correction due to sound refractions by wind and temperature gradients which is based on moderate temperature inversion and downwind meteorological conditions; and
- screening.

The effects of meteorological conditions are explained in more detail in Section **5.2** below.

5.2 Meteorological Conditions

Adverse meteorological conditions have the potential to increase noise levels at a receptor. Such phenomena generally occur during temperature inversions and where there is a wind gradient with wind direction from the source to the receptor. It is known that these meteorological effects typically increase noise levels by 5 to 10 dB, and even higher than 10 dB in extreme conditions.

Temperature inversions generally occur during the night-time and early morning periods during the winter season, thus the most significant meteorological effect during the daytime period is wind.

The prevailing meteorological conditions for the site were assessed using historical meteorological data collected from a BOM weather station located in Goulburn Airport (AWS ID: 70330) in 2006 and incorporated into an air dispersion program, TAPM (V4). The wind rose data used in the assessment are presented in **Appendix B**.

The results of the meteorological analysis are presented in **Table 5-1**:

Table 5-1 Prevailing Meteorological Conditions

Time of Day	Pasquill Stability Class	Wind Speed (m/s)	Wind Direction
Day (7.00 am – 6.00 pm)	C (28 %), D (26 %)	4	Summer: Easterly Autumn: Westerly & Easterly Winter: North-westerly & South-easterly Spring: North-westerly & South-easterly
Evening & Night (6.00 pm – 7.00 am)	F (65 % - 70 %)	2	

5.3 Operational Noise

5.3.1 Operational Scenarios

AGL proposes the following operational scenarios:

- Stage 1: Power generation of 250 MW– 750 MW comprising:
  - two to four "E" class machines (125 MW to 180 MW each); or
  - two to three "F" class machines (200 MW to 250 MW each)
- Stage 2: Power generation of 750 MW – 1500 MW comprising any underbuild of Stage plus:
  - six “E” class machines (125 MW to 180 MW each); or
  - six “F” class machines (200 MW to 250 MW each)

5 Assessment of Potential Acoustic Impacts

For the purposes of noise modelling, the following four operational scenarios have been considered:

Table 5-2 Operational Scenarios

Scenario	Stage	Machine Type	Quantity of Machine	Maximum Power Generation of Each Machine	Total Power Generation
A	1	13E2 Class	4	180 MW	720 MW
B		109FA Class	3	250 MW	750 MW
C	2	13E2 class	6	180 MW	1080 MW
D		109FA Class	6	250 MW	1500 MW

The sound power levels for the both E and F Class machines have been presented in **Section 5.3.2**.

5.3.2 Sound Power Levels

Table 5-3 presents the sound power levels of equipment that has been identified as the primary on-site noise sources for each of four operation scenarios. Sound power levels of these sources have been provided by AGL in octave frequency bands except for minor noise sources for which data have been provided as A-weighted values and for this propagation has been calculated as a single band (500 Hz) in the noise model. The data was found to be valid and suitable for the noise modelling.

The sound power levels presented in the table have been input into the noise model. Attenuation of the sound power level due to the proposed noise mitigation measures for some primary components of the proposed gas turbines have been incorporated in the sound power levels presented in **Table 5-3.** The detail of the proposed noise mitigation measures are described in **Section 5.3.4**.

Sound power level of the exhaust stack for F Class machine has been not been determined at this stage, therefore the data has been estimated. The estimate is comparable to the sound power levels of similar engine stacks from 109E Class machine.

Table 5-3 Sound Power Levels – 13E2 Class

Operational Noise Source		Source Height Used in Noise Modelling (m)	Estimated Overall Sound Power Level	
			dB(Lin)	dB(A)
Gas Turbine Units	Gas Turbines & Generator (with acoustic enclosure)	9	118	102
Flue Gas System	Diffuser	7	119	102
	Exhaust Duct and Elbow	7	127	109
	Stack Body	14	113	97
	Stack Opening	30	130	110
Gas Turbine Air Inlet System	Air Intake Cross Section	18	115	106
	Air Intake Duct	16	112	106
Gas Turbine Coolers		14	113	101
Cooling Water Pumps		6	103	87
Transformers		6	113	102
Unit Auxiliary Transformer		6	99	88
Gas Turbine Compressor Blow Out		10	n/a	110
Fuel Gas Blow out after Gas Turbine shut down		30	n/a	105

Table 5-4 Sound Power Levels – 109F Class

Operational Noise Source		Source Height Used in Noise Modelling (m)	Estimated Overall Sound Power Level[3]	
			dB(Lin)	dB(A)
Inlet System (silencer included)	Inlet Ducting (filter house included)	27	107	95
	Inlet Filter Face	17	117	107
GT Power Train Package	Accessory Unit	13	111	103
	Inlet Plenum	18	104	103
	Turbine Compartment (acoustic enclosure)	13	119	113
	Exhaust Diffuser (acoustic enclosure)	9	125	112
	Load Compartment	18	114	105
	Liquid Fuel & Atomising Air (LF/AA) Module	13	111	103
Vent Fans	Turbine Compartment Vent Fans	13	112	104
	Exhaust Compartment Vent Fans	13	113	102
Transformers	330 MVA Transformer	3	108[2]	99[2]
Exhaust Stack[1]	Stack Body	25	131	110
	Stack Opening	46		

Notes:
1. Sound power level of the exhaust stack has been estimated based on the maximum cumulative sound power level the site can generate in order to meet the noise limits. To ensure the compliance with the noise limit, the sound power level of exhaust stack opening and body combined should not exceed 110 dB(A).
2. Estimated based on AS/NZS 60076.10:2009 – Power Transformers: Determination of sound levels.
3. All manufacturer sound power levels were supplied to URS by AGL.

5.3.3 Meteorological Conditions Used in Noise Modelling

Potential noise impacts have been predicted separately for each of the meteorological scenarios in **Table 5-5**.

Table 5-5 Meteorological Conditions used in Noise Modelling

Met. Scenario	Meteorological Condition				
	Temperature (°C)	Relative Humidity (%)	Pasquill Stability Class	Wind Speed (m/s)	Wind Direction
Day Operation – Neutral Met. Conditions	25	60	D	0	n/a
Evening & Night-time Operation – Neutral Met Conditions	10	75	D	0	n/a
Day Operation – Adverse Met. Conditions	25	60	C[1]	4	source-to-receiver
Evening & Night-time Operation – Adverse Met. Conditions	10	75	F	2	source-to-receiver

Notes: 1. Modelling results indicated higher levels using C class than using D class.

5.3.4 Assumptions Made in Noise Modelling

The noise modelling was based on likely maximum operating conditions for each turbine option. In setting-up the noise model, all pre-defined sources were positioned according to the proposed site layout in the respective noise model (**Figure 2-3**).

In addition to the calculation method presented in **Sections 5.1** and **5.2**, the following assumptions were also made in the noise modelling:

- Noise sources were positioned according to the proposed mechanical layout, shown in **Figure 2-3**;
- Each noise generating equipment operates continuously;
- All the equipment operates continuously and simultaneously;
- Noise mitigation measures for the primary components of the proposed gas turbines are:
  - acoustic enclosure of turbine compartments consists of single layer of 2 mm thick steel outer plate, 75 mm thick rockwool insulation and perforated steel inner plate
  - acoustic enclosure of exhaust diffusers consists of single layer of 4 mm thick steel outer plate, 150 mm thick rockwool insulation and 4 mm thick steel inner plate
  - silencing on the inlet system via an 8 foot long parallel acoustic baffle

The sound power levels shown on **Table 5-3** and

Table 5-4 assume the application of the aforementioned mitigation measures. URS considers that the proposed mitigation measures proposed by AGL are best practice for the mitigation of noise from a peaker power station.

5.3.5 Predicted Operational Noise Levels

The noise modelling results, using the CONCAWE calculation method considering neutral and adverse meteorological conditions compared to the INP Noise Limits, are presented in **Table 5-6, Table 5-7, Table 5-8** and **Table 5-9**.

5 Assessment of Potential Acoustic Impacts

Scenario A – Four 13E2 Class Machines

Table 5-6 Predicted Operational Noise Levels – Scenario A

Receptor Location	Predicted Noise Levels (L_{Aeq}) dB(A)				Criterion (L_{Aeq}) dB(A)	Exceedance
	Neutral Met Conditions		Adverse Met Conditions		All Periods	
	Day	Evening / Night	Day	Evening / Night		
A	< 20	< 20	< 20	< 20	35	No
B	24	24	27	27	35	No
C	24	25	28	28	35	No
D	26	27	30	30	35	No
E	< 20	< 20	21	22	35	No
F	< 20	< 20	< 20	< 20	35	No
G	< 20	< 20	< 20	< 20	35	No
H	< 20	< 20	< 20	< 20	35	No
I	< 20	< 20	< 20	< 20	35	No
J	20	21	24	25	35	No

The results presented in **Table 5-6** show that the noise levels would be within the established noise limits at all receptor locations under the considered meteorological conditions.

Scenario B – Three 109FA Class Machines

Table 5-7 Predicted Operational Noise Levels – Scenario B

Receptor Location	Predicted Noise Levels (L_{Aeq}) dB(A)				Criterion (L_{Aeq}) dB(A)	Exceedance
	Neutral Met Conditions		Adverse Met Conditions		All Periods	
	Day	Evening / Night	Day	Evening / Night		
A	< 20	< 20	< 20	< 20	35	No
B	25	26	28	28	35	No
C	24	25	27	28	35	No
D	26	27	30	30	35	No
E	< 20	< 20	< 20	< 20	35	No
F	< 20	< 20	< 20	< 20	35	No
G	< 20	< 20	< 20	< 20	35	No
H	< 20	< 20	< 20	< 20	35	No
I	< 20	< 20	< 20	21	35	No
J	< 20	20	23	24	35	No

The results presented in **Table 5-7** show that the noise levels would be within the established noise limits at all receptor locations under the considered meteorological conditions.

Scenario C – Six 13E2 Class Machines

Table 5-8 Predicted Operational Noise Levels – Scenario C

Receptor Location	Predicted Noise Levels (L_{Aeq}) dB(A)				Criterion (L_{Aeq}) dB(A)	Exceedance
	Neutral Met Conditions		Adverse Met Conditions		All Periods	
	Day	Evening / Night	Day	Evening / Night		
A	< 20	< 20	< 20	< 20	35	No
B	25	26	28	29	35	No
C	26	27	29	30	35	No
D	27	28	31	31	35	No
E	< 20	< 20	23	23	35	No
F	< 20	< 20	< 20	< 20	35	No
G	< 20	< 20	< 20	< 20	35	No
H	< 20	< 20	< 20	< 20	35	No
I	< 20	21	21	22	35	No
J	21	22	25	26	35	No

The results presented in **Table 5-8** show that the noise levels would be within the established noise limits at all receptor locations under the considered meteorological conditions.

Scenario D – Six 109FA Class Machines

Table 5-9 Predicted Operational Noise Levels – Scenario D

Receptor Location	Predicted Noise Levels (L_{Aeq}) dB(A)				Criterion (L_{Aeq}) dB(A)	Exceedance
	Neutral Met Conditions		Adverse Met Conditions		All Periods	
	Day	Evening / Night	Day	Evening / Night		
A	< 20	< 20	< 20	< 20	35	No
B	27	28	31	31	35	No
C	26	27	30	30	35	No
D	28	29	32	32	35	No
E	< 20	< 20	< 20	23	35	No
F	< 20	< 20	< 20	< 20	35	No
G	< 20	< 20	< 20	< 20	35	No
H	< 20	< 20	< 20	< 20	35	No
I	< 20	21	< 20	24	35	No
J	22	23	28	28	35	No

The results presented in **Table 5-9** show that the noise levels would be within the established noise limits at all receptor locations under the considered meteorological conditions.

ISO Calculation Method – All Scenarios

The highest predicted noise levels, using the ISO calculation method compared to the INP Noise Limits, are presented in **Table 5-10**.

Table 5-10 Predicted Operational Noise Levels – ISO Conditions

Receptor Location	Predicted Noise Levels (L_{Aeq}) dB(A)				Criterion (L_{Aeq}) dB(A)	Exceedance
	Scenario A	Scenario B	Scenario C	Scenario D	All Periods	
	Night	Night	Night	Night		
A	< 20	< 20	< 20	< 20	35	No
B	30	30	32	33	35	No
C	30	30	32	33	35	No
D	31	31	33	34	35	No
E	26	25	28	28	35	No
F	20	19	22	22	35	No
G	< 20	20	23	24	35	No
H	< 20	15	18	19	35	No
I	23	23	24	26	35	No
J	26	25	28	29	35	No

The results presented in **Table 5-10** show that the noise levels would be within the established noise limits at all receptor locations under moderate meteorological conditions.

A predicted noise contour map for the adverse night-time meteorological conditions is presented in Appendix C. It should be noted that these noise contours are indicative only due to interpolation within the calculation grid, the results of the point-to-point calculations presented in **Table 5-6**, **Table 5-7**, **Table 5-8, Table 5-9** and **Table 5-10** are more accurate than the noise contours.

The results shown in Tables from **Table 5-6** to **Table 5-10** presents A-weighted noise levels predicted using SoundPLAN for 31.5 Hz to 8 kHz octave band frequencies. Noise levels of frequencies below 31.5 Hz were not considered attributing their levels to the A-weighted noise levels.

Comparing the results using the CONCAWE calculation method (**Table 5-6**, **Table 5-7**, **Table 5-8**, **Table 5-9**) with the ISO results (**Table 5-10**) they predict similar noise levels at all receptor locations. The minor variations are primarily due to down-wind setting used in each calculation method.

5.3.6 Assessment of Low-Frequency Noise and Tonal Noise

To assess potential low frequency noise impacts, C-weighted noise levels of octave band frequency between 31.5 Hz and 8 kHz have been predicted by noise modelling using SoundPLAN. The predicted C-weighted noise levels at the receptors were then compared with the predicted A-weighted noise levels to examine if the difference between the C and A-weighted noise levels is greater than or equal to 15 dB. The result of the comparison is presented in **Table 5-11**.

It is noted that sound power levels of frequencies below 31.5 Hz were not available and are beyond the range of the modelling software. URS therefore estimated the contribution of sound at lower frequencies to the C-weighted noise levels at each receptor location, based on indicative turbine spectra.

5 Assessment of Potential Acoustic Impacts

Whilst attenuation of noise levels in 31.5 Hz to 8 kHz octave band frequencies considered in calculations using CONCAWE and ISO methods are dependent upon some factors such as air absorption, ground absorption or screening as explained in **Section 5.1**; attenuation of noise levels in frequencies below 31.5 Hz would primarily be due to geometrical spreading, i.e. attenuation mostly due to distance, with little adjustment due to air and ground absorption or screening.

Table 5-11 presents C-weighted noise levels predicted using SoundPLAN for 31.5 Hz to 8 kHz octave band frequencies as well as the estimated levels considering lower frequencies (down to 20 Hz) based on indicative turbine spectra.

Table 5-11 Predicted Operational Noise Levels (A- and C-weighted) – Worst-case Scenario

Receptor Location	Difference between C- and A-weighted Predicted Noise Levels (L_{eq}), dB	
	Worst-case Scenario (D)	Exceeds INP Low Frequency Noise[1] Criterion
A	52 – 20 > 15	Yes
B	56 – 33 > 15	Yes
C	56 – 33 > 15	Yes
D	57 – 34 > 15	Yes
E	53 – 28 > 15	Yes
F	49 – 22 > 15	Yes
G	50 – 24 > 15	Yes
H	52 – 20 > 15	Yes
I	54 – 26 > 15	Yes
J	52 – 29 > 15	Yes

It can be seen in **Table 5-11** that the difference between C and A-weighted noise levels would exceed the INP Low Frequency Noise criterion. Using the INP approach, the A–weighted noise predictions at the receptors would require a 5 dB(A) adjustment. This impact and subsequent comparison to the Project-Specific Noise Level (PSNL) of 35 dB(A) is presented in **Table 5-12**. The results indicate that the predicted noise levels would exceed the PSNL at Receptors B, C and D.

The noise data provided to URS was only available in octave band frequencies, which did not allow URS to undertake a detailed assessment to determine if the proposed operation would generate noise containing prominent tonal components. However, based on the information provided by AGL (**Table 5-3** and **Table 5-4**), it is considered that noise emanating from the proposed facility is not expected to contain tonality or impulsiveness.

5 Assessment of Potential Acoustic Impacts

Table 5-12 Predicted Operational Noise Levels (adjusted A-weighted) –Worst-case Scenario

Receptor Location	Predicted Noise Levels (L_{Aeq}) dB(A)				Criterion (L_{Aeq}) dB(A)	Exceedance
	Scenario A	Scenario B	Scenario C	Scenario D	All Periods	
A	20 *(25)*	20 *(25)*	20 *(25)*	20 *(25)*	35	No
B	30 *(35)*	30 *(35)*	32 ***(37)***	33 ***(38)***	35	**Yes**
C	30 *(35)*	30 *(35)*	32 ***(37)***	33 ***(38)***	35	**Yes**
D	31 ***(36)***	31 ***(36)***	33 ***(38)***	34 ***(39)***	35	**Yes**
E	26 *(31)*	25 *(30)*	28 *(33)*	28 *(33)*	35	No
F	20 *(25)*	20 *(25)*	22 *(27)*	22 *(27)*	35	No
G	20 *(25)*	20 *(25)*	23 *(28)*	24 *(29)*	35	No
H	20 *(25)*	20 *(25)*	20 *(25)*	20 *(25)*	35	No
I	23 *(28)*	23 *(28)*	24 *(29)*	26 *(31)*	35	No
J	26 (31)	25 (30)	28 (33)	29 (34)	35	No

Notes:
- Adjustment shown in brackets in italics.
- Exceedance of the criterion shown in brackets in bold italics.

Alternative Approach

URS has additionally reviewed the following noise policy and guidelines for an alternative assessment of potential low frequency noise impacts:

- A review of Published Research on Low Frequency Noise and its Effects, Report for Department for Environment, Food and Rural Affairs (UK) by Dr Geoff Leventhall, 2003
- Proposed criteria for the assessment of low frequency noise disturbance, prepared for UK DEFRA by Dr. Andy Moorhouse, Dr. David Waddington, Dr. Mags Adams, 2005
- Procedure for the assessment of low frequency noise complaints, prepared for UK DEFRA by Dr. Andy Moorhouse, Dr. David Waddington, Dr. Mags Adams, 2005
- Proposed Criteria for Low Frequency Noise from Combustion Turbine Power Plants, Noise – Con 2004, Baltimore, Maryland, G. F. Hesseler Jr, 2005 (as referenced in Broner, 2008)
- Proposed Criteria for Low Frequency Industrial Noise in Residential Communities, Journal of Low Frequency Noise, Vibration and Active Control 24, No 2, G. F. Hessler Jr, 2005 (as referenced in Broner, 2008)
- ANSI S12.9 – 2005/ Part 4 Quantities and Procedures for Description and Measurement of Environmental Sound – Part 4: Noise Assessment and Prediction of Long-term Community Response (as referenced in Broner, 2008)
- US Oregon Department of Environmental Quality, Noise Control Regulations for Industry and Commerce OAR 340-035-0035 (as referenced in Broner, 2008)
- A Noise Limit on Low Frequency Noise Emission due to Power Plants, Dr. N. Broner, 2008
- NSW Leafs Gully Gas Turbine Power Station – Noise & Vibration Assessment, Wilkinson Murray, 2008
- NSW Leafs Gully Gas Turbine Power Station – Director General's Report and Project Approval issued by NSW Department of Planning

5 Assessment of Potential Acoustic Impacts

Recent international research has shown that the use of the INP difference approach is not suitable when the noise levels are low, since the low frequencies may then be below the threshold of hearing levels (A review of Published Research on Low Frequency Noise and its Effects, Report for Department for Environment, Food and Rural Affairs (UK) by Dr Geoff Leventhall, 2003).

Current research suggests that (dB(C) – dB(A)) difference should not be used as an annoyance predictor, but as a simple indicator of whether further investigation may be necessary (Low Frequency Noise and Annoyance, Noise & Health 2004, 6:23, 59-72).

For protecting residential areas against potential low frequency noise issues caused by combustion turbine open cycle plants, Broner makes reference to Hessler's research which proposed C-weighted levels supplementary to the A-weighted site criteria as follows:

- For intermittent daytime only or seasonal source operation:
  - 70 dB(C) for normal suburban / urban residential areas, where background level (L_{A90}) is higher than 40 dB(A),
  - 65 dB(C) for quiet suburban or rural residential areas, where background level (L_{A90}) is lower than 40 dB(A),
- For extensive or 24/7 source operation:
  - 65 dB(C) for normal suburban / urban residential areas, where background level (L_{A90}) is higher than 40 dB(A),
  - 60 dB(C) for very quiet suburban or rural residential areas, where background level (L_{A90}) is lower than 40 dB(A).

ANSI S12.9 – 2005/Part 4 indicates that annoyance is generally minimal when octave band sound levels are less than 67 dB(C) and less than 72 dB(C) to prevent the likelihood of noise-induced rattles.

The US Oregon State Noise Control Regulations for industrial and commercial noise sources suggest the allowable low frequency noise level for the night-time period (10 pm – 7 am) to be 65 dB(C) and for the daytime period (7 am – 10 pm) to be 68 dB(C).

Consideration of International Research

In a review of the INP assessment method and the aforementioned papers, URS considers the following to be the most appropriate criterion to adopt for a low frequency noise assessment for this project and is a combination of the INP and Hessler (as referenced in Broner's paper) approach.

The proposed Dalton power station would operate intermittently, there will be a seasonal component (associated with peak electricity demand) to its operation, and it is proposed to be located in a rural area with background noise levels below 40 dB(A). For this situation, Hessler/Broner suggested that a criterion of 65 dB(C) as presented above.

- Measure / assess C and A weighted levels over same time period.
- If the difference between the C and A weighted levels is 15 dB or more:
  - Apply **5 dB correction** to the measured/predicted levels, if the overall noise level is **greater than L_{eq} 65 dB(C)**.
  - Apply **no correction** to the measured/predicted levels, if the overall noise level is **less than L_{eq} 65 dB(C)**.

For practical purposes, this is taken to be sound from the 25 Hz third octave band to the 200 Hz third octave band.

It is noted that this low frequency noise criterion is consistent with that imposed for AGL's recently approved power station development in Leafs Gully, NSW. The Leafs Gully power station is to be located in a rural area where background noise levels are similar to those of Dalton.

As with the Leafs Gully Project, the impact assessment process undertaken for the Dalton Project involved the review of relevant overseas research related to assessment of the potential for low frequency noise. The research indicated that the use of the approach provided in the NSW Industrial Noise Policy (INP) is not suitable when the predicted resultant noise levels are low.

The NSW Department of Planning and Infrastructure accepted the approach on the Leafs Gully Project, that considers a noise level not greater than 65 dB(C) as unlikely to cause low frequency noise annoyance impacts at sensitive receptors. For the Leafs Gully Project, the Department concluded that the 5 dB(A) adjustment to the noise criteria should only to be applied if the difference between the C and A-weighted noise levels is greater than or equal to 15 dB when the measured noise levels is greater than 65 dB(C).

Discussion

The results shown in **Table 5-11** and **Table 5-12** indicate that the predicted noise levels would exceed the PSNL at Receptors B, C and D, however international research suggests that the predicted low frequency noise would not be at a level to cause annoyance to residential receptors as the overall C-weighted noise levels would not exceed 65 dB(C) at any receptor locations (Hessler/Broner method). Accordingly, based on the approach to this assessment of the combination of the INP and international methods, no adjustment to the A-weighted predicted operational noise levels would be required.

Notwithstanding this, AGL will commence discussions with receptors B, C and D regarding this assessment as consistent with other developments.

5.3.7 Assessment of Sleep Disturbance

The potential for sleep disturbance within the residences would potentially be greatest during the early morning hours (notionally, 2.00 am - 4.00 am) when background noise levels are at their lowest. It should be noted that this time period is not when the demand for a peaking power plant is likely to occur and as such operation of plant is unlikely. However, the potential for sleep disturbance has been assessed for completeness.

Table 5-13 presents predicted L_{A1} noise levels of a worst-case scenario for an assessment of potential sleep disturbance. Given that the noise from the proposed operation would be steady rather than fluctuating, it was considered that the difference between L_{Aeq} and L_{A1} noise levels would not be greater than 10 dB.

Table 5-13 Predicted Operational Noise Levels (worst-case scenario) – Sleep Disturbance

Receptor Location	Predicted Noise Levels (external) $L_{A1,1min}$ dB(A)				Low Frequency Noise Criterion ($L_{A1,1min}$) dB(A)	Exceedance
	Scenario A	Scenario B	Scenario C	Scenario D		
A	30	30	30	30	55 (external) 45[1] (internal)	No
B	40	40	42	43		
C	40	40	42	43		
D	41	41	43	44		
E	36	35	38	38		
F	30	29	32	32		
G	30	30	33	34		
H	30	25	28	29		
I	33	33	34	36		
J	36	35	38	39		

Note: 1. The noise reduction through partially opened windows is estimated to be 10 dB(A), as explained in Section **4.2.2**.

As shown above, the ECRTN and INP sleep disturbance criterion of 45 dB(A) $L_{A1,1min}$ (or L_{Amax}), when measured inside bedroom, is not expected to be exceeded. Therefore, the proposed operation is not predicted to give rise to sleep disturbance.

AGL has confirmed that there are no sources that will produce instantaneous or short-duration high noise level events. If a turbine begins or ceases operation in the early hours of the morning, this will occur in a gradual process. If operation occurs during night or early morning period, the process is relatively steady state and free of instantaneous events. The main pressure from the gas line will be adequate and therefore, no gas compressor is required for this operation. Any repairs or maintenance works would be scheduled during the daytime period.

5.4 Construction Noise

Based on similar sized projects, the total construction period is expected to be approximately 24 months with a peak period of up to 6 months.

The main construction activities would involve the following stages:

- Stage 1: Removing the layer of vegetation and levelling,
- Stage 2: Bulk earthworks including site grading and excavation work including construction of access road and tracks,
- Stage 3: Establishing concrete foundations for plant and buildings,
- Stage 4: Construction of buildings and installation of equipment and machinery, and
- Stage 5: Pipe line construction.

5.4.1 Construction Equipment and Associate Noise Levels

Typical construction equipment expected on this construction site and corresponding noise levels are summarised in **Table 5-14**. The sound power levels of these items have been taken from Appendix D of AS 2436-1981: “Guide to noise control on construction, maintenance and demolition sites” and library data. The sound power levels presented in the table are indicative and should be used only as a guide.

Table 5-14 Sound Power Levels – Construction Equipment

Scenario	Proposed Activities	Equipment / Plant Item	Sound Power Level L_{Aeq} dB(A)
1	Site preparation & Earthworks	Excavator Bulldozer Grader Roller Loader Dump truck	110 110 116 108 108 105
2	Concrete Foundation Works	Concrete truck Concrete mixer Compactor Crane	108 110 114 106
3	Building Construction	Crane Delivery trucks Pneumatic tools Electric tools Power generators Hammers	106 106 112 104 104 110
4	Pre-pipeline Construction	Excavator Track trencher Crushing machine Truck Crane	108 114 110 106 106
5	Pipeline Construction	Welding / Bending machine Pipe layer Bulldozer Padding machine	96 102 110 102

5.4.2 Predicted Construction Noise Levels

The noise levels generated by the indicative construction activities listed above have been predicted at each receptor location. Noise emissions will vary as construction progresses. The noise modelling has been carried out considering the adverse meteorological conditions. The results are presented in **Table 5-15**.

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Table 5-15 Predicted Noise Levels during Power Station Construction

Receptor	Predicted Noise Level, $L_{Aeq,15min}$ dB(A)	Noise Criterion $L_{Aeq,15min}$ dB(A)		Exceedance
		Daytime	Evening/Night	
A	< 20	Noise Affected: 40 Highly Noise Affected: 75	35	No
B	24 – 27			No
C	23 – 26			No
D	24 – 27			No
J	Up to 22			No
E, F, G, H and I	< 20			No

The predicted construction noise levels presented in **Table 5-15** show that no exceedance of the noise limit is expected at any receptor locations.

Table 5-16 Predicted Noise Levels during Pipeline Construction

Receptor	Approx Distance from Pipeline (km)	Predicted Noise Level, $L_{Aeq,15min}$ dB(A)	Noise Criterion $L_{Aeq,15min}$ dB(A)		Exceedance
			Daytime	Evening/Night	
A	4.2	< 20	40	35	No
B	2.5	22 – 28			No
C	1.3	32 – 40			No
D	0.5	43 – 52			Up to 12 dB (day) and 17 dB (evening and night)
E	1.3	31 – 39			Up to 4 dB (evening and night only)
F	6	< 20			No
G	6.5	< 20			No
H	3.6	< 20			No
I	3.6	< 20			No
J	2.8	20 – 26			No

Note: * Although the corresponding predicted noise level (lower end of the range) exceeds the evening/night noise criteria, the construction scenario modelled would be considered a reasonable "worst case" daytime construction scenario. It would be still be feasible to conduct some selected construction activities at night whilst still achieving the noise criteria.

The predicted daytime construction noise levels presented in **Table 5-16** show that no exceedance of the "Noise Affected" noise level is predicted at all residential locations except for Receptor D, but no exceedances of the "Highly Affected" noise level at all residential locations.

"Noise Affected" level would be exceeded if the standard daytime construction were to occur during the evening and night-time however, construction activities will be scheduled to be undertaken at an appropriate time of the day for the activity in question. The construction activities generating the most noise will be conducted during the day.

It should be noted that the predicted noise levels presented above result from a conservative noise modelling approach where it has been assumed that all equipment would operate continuously and simultaneously during the assessment period.

It is also noted that the existing ambient noise levels at Receptor D are likely around 46 dB(A), 43 dB(A) and 42 dB(A) for daytime, evening and night-time period respectively, and the short-term pipeline construction noise would not significantly increase the existing ambient noise levels.

Physical construction noise mitigation measures are not considered necessary. However, adoption of noise management strategies implementing good industry practice is recommended to minimise noise emissions from the proposed construction works. Recommendations on construction noise management strategies are provided in **Section 6.1**. These will be incorporated into a construction phase Environmental Management Plan (EMP).

5.5 Off-Site Traffic Noise

The potential off-site traffic noise impact associated with the proposed construction and operation has been assessed based on the URS Traffic Study undertaken for the development.

To predict the increase in traffic noise levels, potentially caused by the proposed construction and operation of the facility, the United States' Federal Highway Administration Model (FHWA Model) was used. The model was verified and calibrated using the short-term noise monitoring results obtained for this assessment.

5.5.1 Construction

The estimated duration of construction is 18 to 24 months although activity on-site may only be evident for 18 months. This assessment assumes an18-month duration for construction traffic generation.

It is anticipated that construction would occur from 7.00 am to 6.00 pm during weekdays and 8.00 am to 1.00 pm on Saturdays.

Construction activities are likely to involve:

- typical workforce of 45 construction staff;
- peak workforce of 140 construction for a period of up to two months;
- between two and 20 truck deliveries per day of construction materials;
- the majority of the workforce to be sourced from the Sydney region;
- typical peak hourly construction workforce traffic generation of 70 vehicle trips per hour; and
- peak workforce hourly construction workforce traffic generation of 140 vehicle trips per hour.

Table 5-17 presents an assessment of the traffic noise impact due to the proposed construction.

Table 5-17 Predicted Traffic Noise Levels – Construction Phase

Receptor	Existing Hourly Traffic Volume	Increased Hourly Traffic Volume[1]	Existing Traffic Noise Level dB(A)[2]	Predicted Future Traffic Noise Level dB(A)	Noise Criteria dB(A)	Exceedance dB
D	5 / 23	183 / 40	37	37	55	No
L	28 / 287	447 / 45	46	48	55	No
M	23 / 230	390 / 39	51	53	55	No
N	42[1] / 543	703 / 73	56	58	60	No
O	42 / 543	703 / 73	55	57	60	No

Notes:
1. Estimated based on the volume at Location N
2. Table 3-11

As presented in **Table 5-17**, the increased road traffic noise levels due to the proposed construction of the facility would be within the ECRTN noise criteria. There would be increase in noise levels up to 2 dB at receptor locations L - O, however this is not predicted to cause a noise impact on these residences.

It is assumed that off-site traffic noise associated with the proposed construction will be minimised as much as is practically possible by limitations on construction hours, and Australian Design Rules which apply to road-registered vehicles.

Noise management strategies to minimise the noise from the off-site road traffic associated with the proposed construction are provided in **Section 6** of this report.

5.5.2 Operation

The ongoing operation of the power station will generate significantly less traffic than the construction phase of the project. The operational phase is likely to generate up to 14 vehicle trips within the peak hour periods. This assumes 10 vehicle trips for operation and 4 vehicle trips for water truck deliveries based on a worst case assuming water supply is by truck delivery and peak summer requirement for Stage 2 (1500 MW) and that 10 % of these movements would occur during the AM Peak Hour. The increase in traffic from the daily operation of the power station is accounted for in the general growth in traffic for the region. An increase in traffic volumes is expected during maintenance which would take place every 2 to 3 years.

Therefore the operational traffic generated by the proposed operation is expected to be similar to traffic currently generated in the assessment area, and a further detailed assessment is not deemed necessary.

It is assumed that parking would be provided on-site for facility employees and business vehicles in accordance with RTA and Council requirements.

5.6 Summary of Potential Acoustic Impacts

The following provides a summary of the outcomes of the assessment of potential acoustic impacts:

- Operation:
  - Noise levels generated by the proposed operation would be within the established noise limits at all receptor locations under neutral and the site's prevailing meteorological conditions.
- Sleep Disturbance:
  - Predicted noise levels are within the sleep disturbance noise limits established in accordance with the INP and ECRTN guidelines.
- Low frequency noise:
  - The proposed operational low frequency noise assessed using the INP criteria indicate that there would be exceedances of he PSNL at three residential receptor locations.
  - However, international research suggests that the predicted low frequency noise would not be at a level to cause annoyance to the closest residential receptors.
  - Notwithstanding this, AGL will commence discussions with receptors B, C and D regarding this assessment as consistent with other developments.
- Construction Noise:
  - No exceedance of the noise limit is expected at any residential locations during the proposed construction phase of the power station.
  - During pipeline construction, some exceedances may be experienced at a receptor (Receptor D).
- Off-Site Traffic Noise;
  - Construction: The predicted increases in road traffic noise levels are up to 2 dB at the most potentially affected dwellings. The resulting levels remain within the off-site traffic noise criteria.

6

Noise Mitigation Measures

A Construction and Operation Environmental Management Plan (EMP) would be prepared with a noise monitoring and management programme included.

6.1 Construction Noise

No exceedances were predicted for construction of the power station and although exceedances were predicted for the pipeline construction, the predicted impact will only be short-term. Therefore physical construction noise mitigation measures are not considered necessary.

While the proposed construction activities have limited potential for impact on the local ambient noise environment, the following noise management strategies can be applied and would be detailed in a Construction Noise Environmental Management Plan, which would further reduce the potential for noise issues during the proposed construction period:

- Considering construction noise and vibration management within a Construction Management Plan;
- Carrying out all noisy construction works during the standard daytime construction hours (**Table 4-4**);
- Scheduling construction to minimise multiple use of the noisiest equipment or plant items near noise sensitive receptors;
- Strategic positioning of plant items to reduce the noise emission to noise sensitive receptors, where possible;
- Carrying out maintenance work away from noise sensitive receptors, where practicable;
- Ensuring engine covers are closed, maintenance of silencers and mechanical condition. Regular maintenance and noise testing for major items of construction equipment that are significant contributors to construction noise levels;
- Awareness training for staff and contractors in environmental noise issues including;
  - Minimising the use of horn signals and maintaining to a low volume. Alternative methods of communication should be considered;
  - Avoiding any unnecessary noise when carrying out manual operations and when operating plant; and
  - Switching off any equipment not in use for extended periods during construction work;
- Minimising heavy vehicles' entry to site and departure from site outside the nominated construction hours;
- Where noise level exceedances cannot be avoided, consideration should be given to applying time restrictions and/or providing quiet periods for nearby residents;
- Community consultation with local residents and building owners to assist in the alleviation of community concerns. Previous experience on similar projects has demonstrated that affected noise sensitive receptors may be willing to endure higher construction noise levels for a shorter duration if they have been provided with sufficient warning in the place of intermittent but extended periods of construction noise at lower levels; and
- Maintaining a suitable complaint register. Should noise complaints be received, undertake noise monitoring at the locations concerned. Reasonable and feasible measures would need to be implemented to reduce noise impacts.

With the implementation of the aforementioned mitigation measures, construction noise at all receptor locations would be expected to practically comply with the noise limit.

6.2 Operational Noise

Noise emissions from the plant operation would be verified during design and commissioning stage to confirm compliance with the project noise criteria.

The exhaust stack is required to be designed to comply with the INP requirements.

The following details the noise mitigation measures for the primary components of the proposed gas turbines which have already been incorporated in the noise modelling for this assessment as explained in **Section 5.3.4**. The sound power levels shown on **Table 5-3** and **Table 5-4** assume the application of these mitigation measures:

- acoustic enclosure of turbine compartments consists of single layer of 2 mm thick steel outer plate, 75 mm thick rockwool insulation and perforated steel inner plate;
- acoustic enclosure of exhaust diffusers consists of single layer of 4 mm thick steel outer plate, 150 mm thick rockwool insulation and 4 mm thick steel inner plate; and
- silencing on the inlet system via a 2.4 m long parallel acoustic baffle.

Beyond these measures, the modelling did not identify a requirement for further mitigation.

Although the modelling results indicate that low frequency noise may exceed the INP Low Frequency Noise criteria, but is not expected to be at a level to cause annoyance to the closest residential receptors as discussed in Section **4.2.3**.

7

Conclusion

URS has completed a noise impact assessment for the proposed AGL gas-fired power station at Dalton, NSW. This assessment has been prepared to support the Environmental Assessment (EA) of the proposed development.

The assessment of potential noise impacts of the proposed construction and operation of the facility, on surrounding noise sensitive receptor locations, has been carried out in accordance with relevant NSW noise guidelines. Throughout the assessment, typical and 'worst-case' factors have been taken into consideration.

The assessment found that the adopted noise limits can be achieved with no further mitigation measures beyond those already proposed by AGL (including mitigation measures for the proposed stack).

Although the modelling results indicate that low frequency noise may exceed the INP Low Frequency Noise criteria, but is not expected to be at a level to cause annoyance to the closest residential receptors according to international research.

No exceedances of the noise management levels are predicted for activities relating to the construction of the power station, although some activities may need to be restricted in the evening and night periods.

The predicted noise levels should be verified during commissioning, and in the unlikely event of any significant discrepancies from this assessment, there is scope to provide additional attenuation through measures such as acoustic insulation, enclosures and silencers with higher noise reduction rating.

On the basis of this assessment, it is therefore concluded that noise impacts of the proposed construction and operation of the power station are not expected to degrade the existing acoustic environment, nor cause annoyance to residential receptor locations surrounding the plant.

8

References

- *Industrial Noise Policy*, NSW Environment Protection Authority, 1999
- *Interim Construction Noise Guideline*, NSW Department of Environment and Climate Change, 2009
- *Environmental Criteria for Road Traffic Noise*, NSW Environment Protection Authority, 1999
- *Guidelines for Community Noise*, World Health Organisation (WHO), 1999
- Australian Standard 2004, *Electroacoustics – Sound level meters – Specifications*, AS IEC 61672.1:2004
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- Australian Standard 1997, *Acoustics – Description and measurement of environmental noise*, AS 1055:1997
- *Proposed Criteria for the Assessment of Low Frequency Noise Disturbance*, 2005, Prepared for DEFRA by Dr. Andy Moorhouse, Dr. David Waddington, Dr. Mags Adams
- *Procedure for the Assessment of Low Frequency Noise Complaints,* 2005, Prepared for DEFRA by Dr. Andy Moorhouse, Dr. David Waddington, Dr. Mags Adams.
- Proposed Criteria for Low Frequency Noise from Combustion Turbine Power Plants, Noise – Con 2004, Baltimore, Maryland, G. F. Hesseler Jr, 2005 (as referenced in Broner, 2008)
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- ANSI S12.9 – 2005/ Part 4 Quantities and Procedures for Description and Measurement of Environmental Sound – Part 4: Noise Assessment and Prediction of Long-term Community Response (as referenced in Broner, 2008)
- US Oregon Department of Environmental Quality, Noise Control Regulations for Industry and Commerce OAR 340-035-0035 (as referenced in Broner, 2008)
- *A Noise Limit on Low Frequency Noise Emission due to Power Plants*, Dr. N. Broner, 2008
- NSW Leafs Gully Gas Turbine Power Station – Noise & Vibration Assessment, Wilkinson Murray, 2008
- NSW Leafs Gully Gas Turbine Power Station – Director General's Report and Project Approval issued by NSW Department of Planning

9

Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of AGL Energy Limited (AGL) and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 16 January 2009.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between March 2009 and June 2011 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

A

Appendix A Glossary of Acoustic Terminology

Appendix A

A wide range of acoustic parameters and technical terms are used in this report. To assist in understanding the technical contents, a brief description of the acoustic terms is provided in this section.

Typical Noise Levels: Compared to the static air pressure (10^5 Pa), the audible sound pressure variations are very small ranging from about 20 µPa ($20x10^{-6}$ Pa), which is called "threshold of hearing" to 100 Pa. A sound pressure of approximately 100 Pa is so loud that it causes pain and is therefore called "threshold of pain".

dB (Decibel): A unit of sound level measurement. The human ear responds to sound logarithmically rather than linearly, so it is convenient to deal in logarithmic units in expressing sound levels. To avoid a scale which is too compressed, a factor of 10 is introduced, giving rise to the decibel. It is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure.

Perception of Sound: The number of sound pressure variation per second is called the frequency of sound, and is measured in Hertz (Hz). The normal hearing for a healthy young person ranges from approximately 20 Hz to 20 kHz. In terms of sound pressure levels, audible sound ranges from the threshold of hearing at 0 dB to the threshold of pain at 130 dB and over. A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to small but noticeable change in loudness. An increase of about 8 – 10 dB is required before the sound subjectively appears to be significantly louder.

Sound Pressure (SPL): Sound pressure is the measure of the level or loudness of sound. Like sound power level, it is measured in logarithmic units. The symbol used for sound pressure level is SPL, and it is generally specified in dB. 0 dB is taken as the threshold of human hearing.

Sound Pressure Levels of Some Common Sources		
Sound Pressure Level (dB)	Sound Source	Typical Subjective Description
140	Propeller aircraft; artillery fire, gunner's position	Intolerable
120	Riveter; rock concert, close to speakers; ship's engine room	
110	Grinding; sawing	
100	Punch press and wood planers, at operator's position; pneumatic hammer or drilling (at 2 m)	Very noisy
80	Kerbside of busy highway; shouting; Loud radio or TV	Noisy
70	Kerbside of busy traffic	
60	Department store, restaurant, conversational speech	
50	General office	Moderate
40	Private office; Quiet residential area	Quiet
30	Unoccupied theatre; quiet bedroom at night	
20	Unoccupied recording studio; Leaves rustling	Very quiet
10	Hearing threshold, good ears at frequency of maximum sensitivity	
0	Hearing threshold, excellent ears at frequency maximum response	

Sound Power (SWL): Sound power is the energy radiated from a sound source. This power is essentially independent of the surroundings, while the sound pressure depends on the surroundings (e.g. reflecting surfaces) and distance to the receptor. If the sound power is known, the sound pressure at a point can be calculated. Sound power is also measured in logarithmic units, 0 dB sound

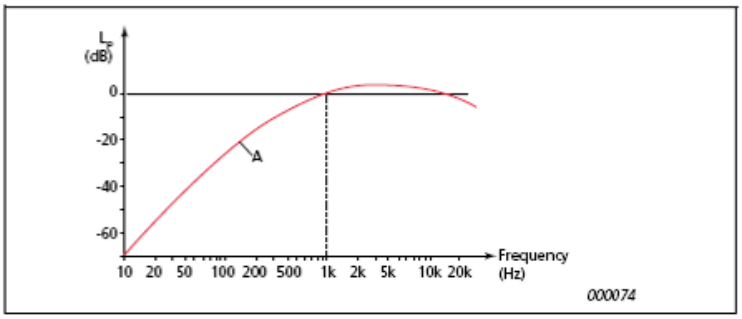
Appendix A

power level corresponding to 1 pW (10^{-12} W). The symbol used for sound power level is SWL or Lw, and it is specified in dB.

Frequency: Frequency is synonymous to pitch and is measured in units of Hz.

Frequency Spectrum: In environmental noise investigations, it is often found that the single-number indices, such as L_{Aeq}, do not fully represent the characteristics of the noise. If the source generates noise with distinct frequency components, then it is useful to measure the frequency content in octave or one-third octave frequency bands. For calculating noise levels, octave spectra are often used to account for the frequency characteristics of propagation.

"A" Frequency Weighting: The method of frequency weighting the electrical signal with a noise measuring instrument to simulate the way the human ear responds to a range of acoustic frequencies. It is based on the 40 dB equal loudness contour. The symbols for the noise parameters often include the letter "A" (e.g. L_{Aeq}) to indicate that frequency weighting has been included in the measurement.



Adverse Weather: Weather effects (wind and temperature inversions) that enhance noise. The prescribed conditions are for wind occurring more than 30 % of the time in any assessment period in any season and/or for temperature inversions occurring more than 30 % of the nights in winter.

Assessment Period: The period in a day over which assessments are made: day (7.00am – 6.00pm, Monday to Saturday; or 8.00am – 6.00pm on Sundays and public holidays), evening (6.00pm – 10.00pm, all days) or night (10.00pm – 7.00am, Monday to Saturday; or 10.00pm – 8.00am on Sundays and public holidays).

Ambient Noise: The all-encompassing sound at a site comprising all sources such as industry, traffic, domestic, and natural noises. This is represented as the L_{Aeq} noise level in environmental noise assessment. (See also L_{Aeq})

Background Noise: Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is measured statistically as the A-weighted noise level exceed for ninety per cent of a sample period. This is represented as the L_{A90} noise level. (See also L_{A90}).

Assessment Background Level (ABL): A single number representing the typical background noise level during each assessment period (day, evening and night) for each day. The ABLs measured on all the monitoring days are used to determine the overall RBL at a site. (See RBL)

Rating Background Level (RBL): A single number representing the median value of the ABL values of each assessment period over all of the monitoring days.

Appendix A

Free Field: An environment in which a sound wave may propagate in all directions without obstructions or reflections. Free field noise measurements are carried out outdoors at least 3.5 m from any acoustic reflecting structures other than the ground.

Extraneous Noise: Noise resulting from activities that are not typical of the area. Untypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.

Impulsive Noise: Noise having a high peak of short duration or a sequence of such peaks. Noise from impacts or explosions, e.g., from a pile driver, punch press or gunshot, is called impulsive noise. It is brief and abrupt, and its startling effect causes greater annoyance than would be expected from a simple measurement of the sound pressure level.

Intermittent Noise: Noise with a level that abruptly drops to the level of or below the background noise several times during the period of observation. The time during which the level remains at a constant value different from that of the ambient being of the order of 1 s or more.

Meteorological Conditions/Effects: Wind and temperature inversion conditions.

Noise Barrier: Solid walls or partitions, solid fences, earth mounds, earth berms, buildings. Etc used to reduce noise without eliminating it.

Project-Specific Noise Levels (PSNL): PSNL are target noise levels for a particular noise generating facility. They are based on the most stringent of the intrusive criteria or amenity criteria. The most stringent criteria is determined by measuring the level and nature of existing noise in the area surrounding the actual or proposed noise generating facility.

Temperature Inversion: An atmospheric condition in which temperature increases with height above the ground.

Tonality: Noise containing a prominent frequency and characterised by a definite pitch.

L_{Aeq}: A-weighted equivalent continuous noise level. This parameter is widely used and is the constant level of noise that would have the same energy content as the varying noise signal being measured. The letter “A” denotes that the A-weighting has been included and “eq” indicates that an equivalent level has been calculated. This is referred to as the ambient noise level. (See Ambient Noise)

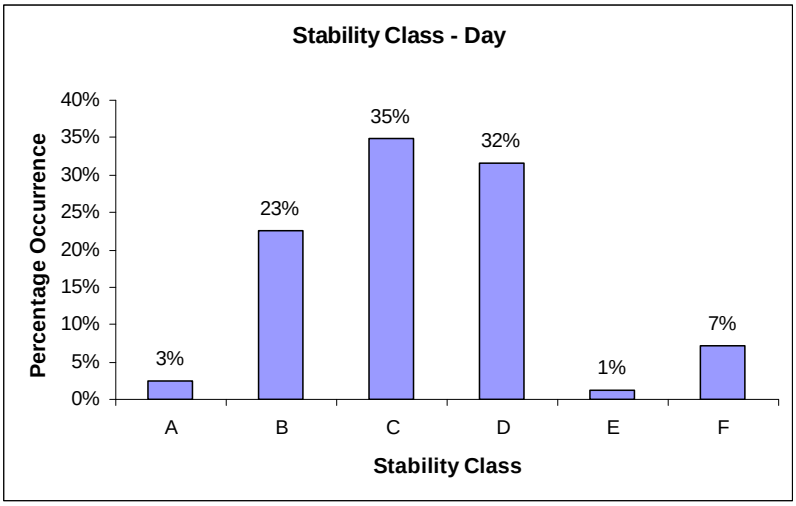
L_{A90}: The A-weighted sound pressure level which is exceeded for 90 % of the measurement period. It is determined by calculating the 90^{th} percentile (lowest 10 %) noise level of the period. This is referred to as the background noise level. (See Background Noise)

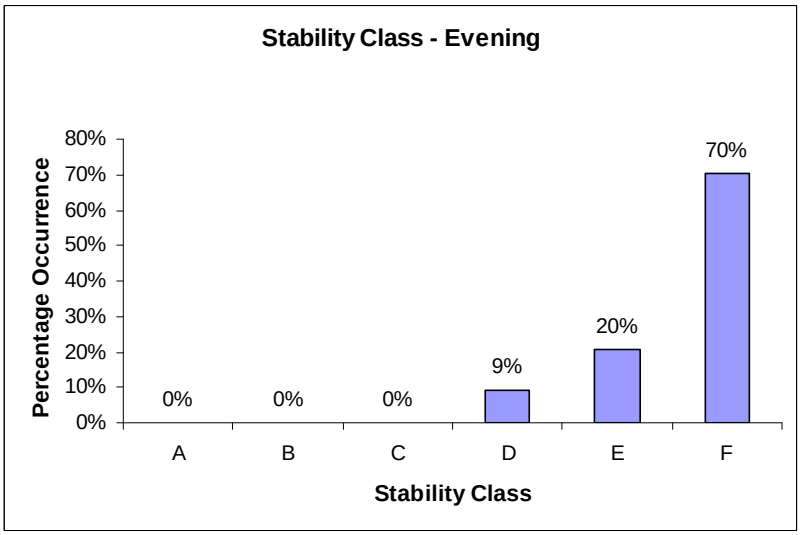
B

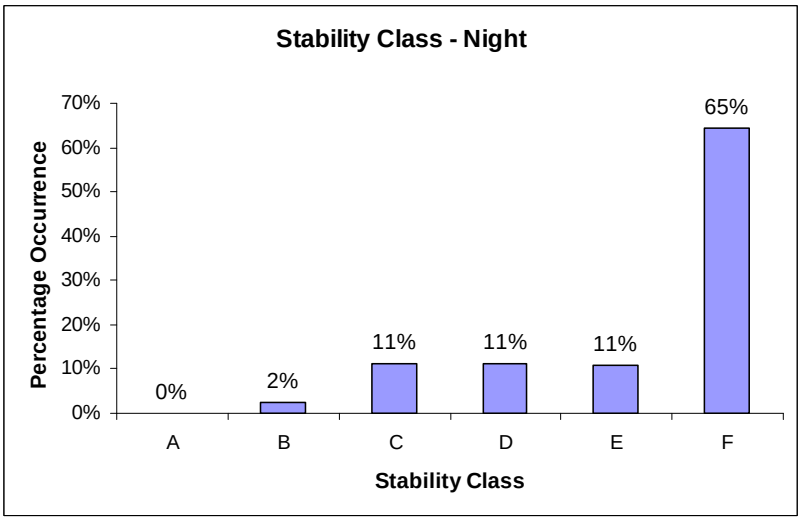
Appendix B Analysis of Meteorological Data

Appendix B

Calculated Stability Categories from Met Data

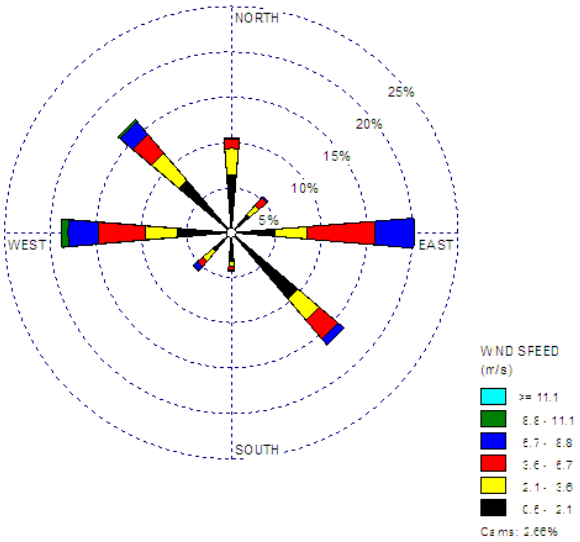


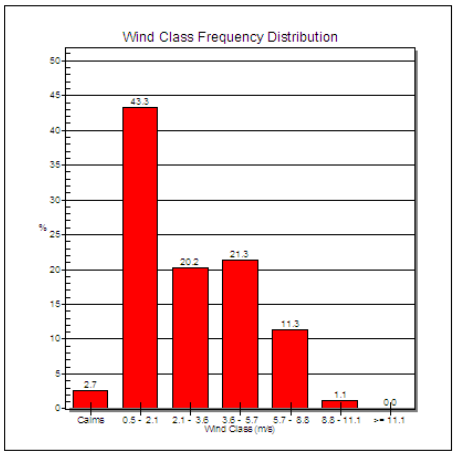




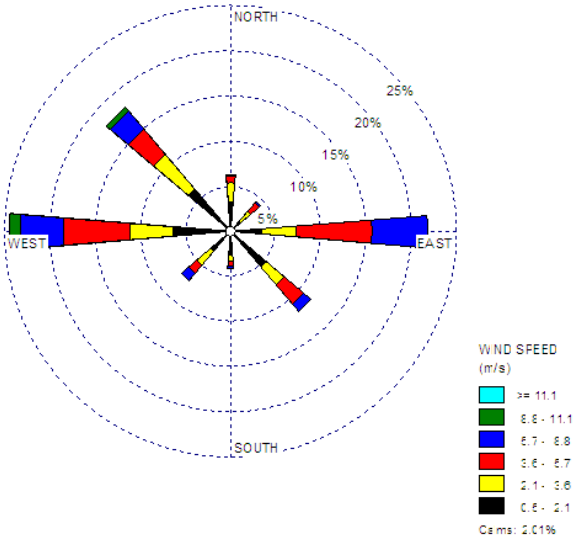
Wind Rose Analysis

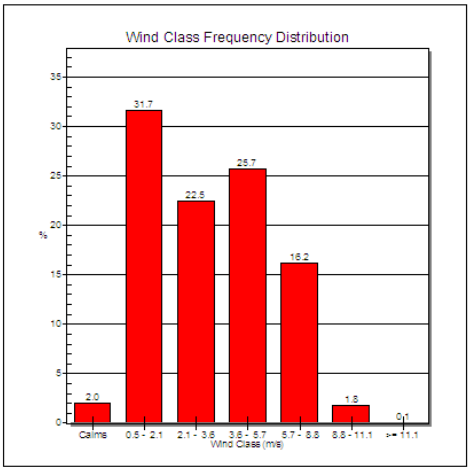
All Seasons





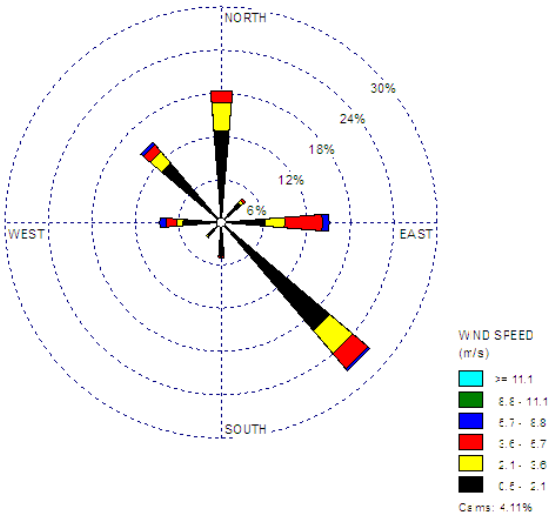
Day & Evening time (7.00am – 10.00pm)

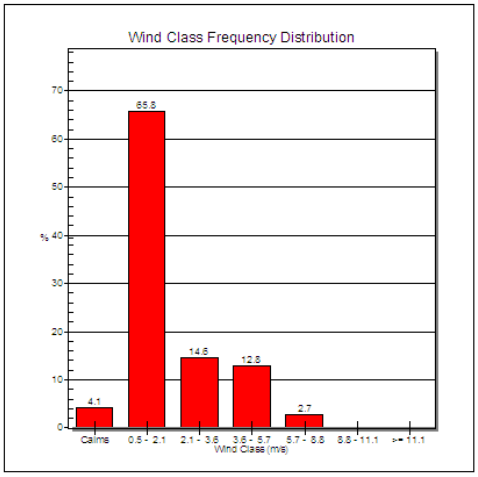




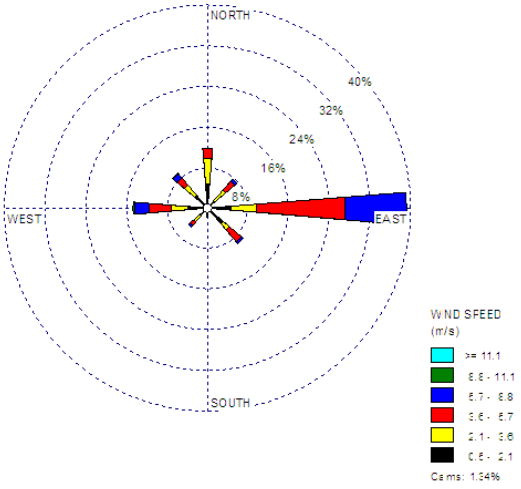
Appendix B

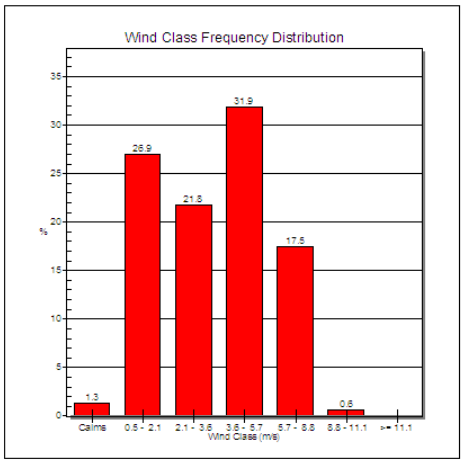
Night-time (10.00pm – 7.00am)



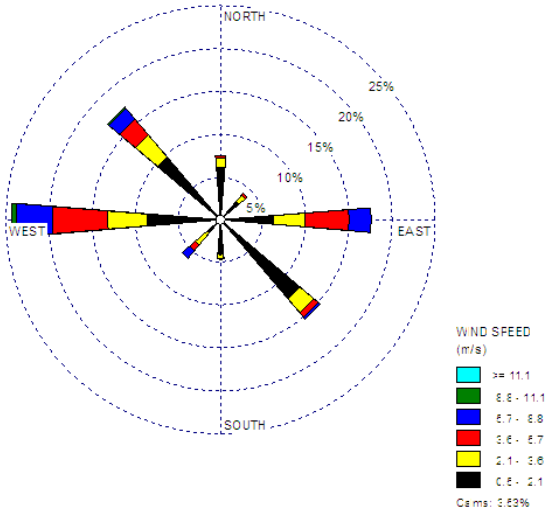


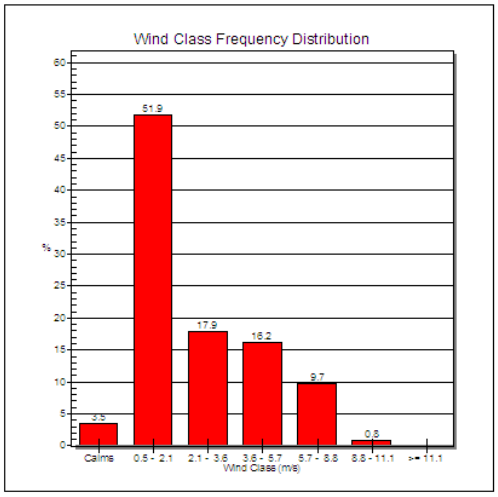
Summer (December – February)



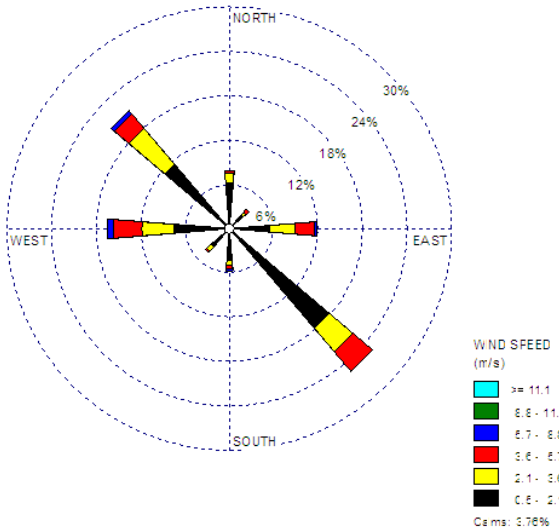


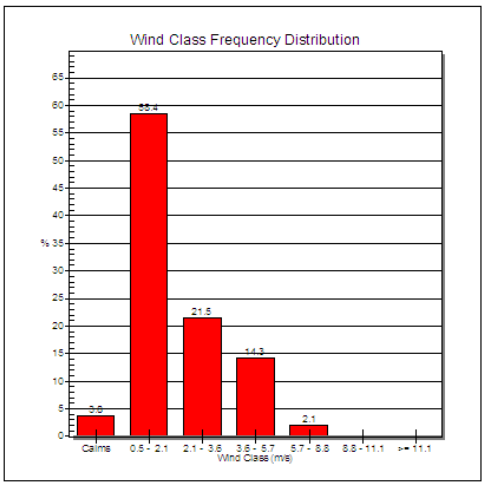
Autumn (March – May)





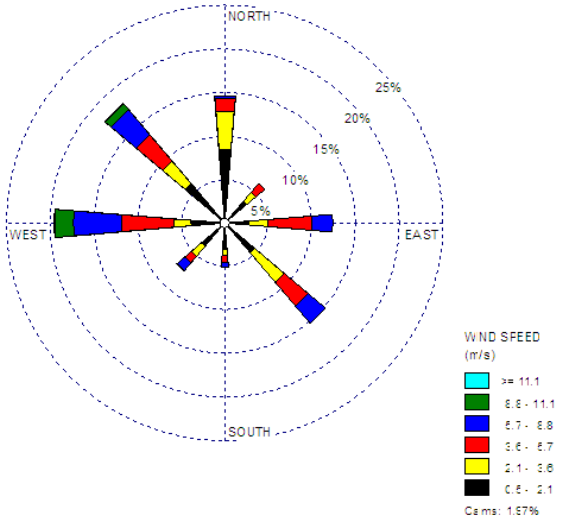
Winter (June – August)

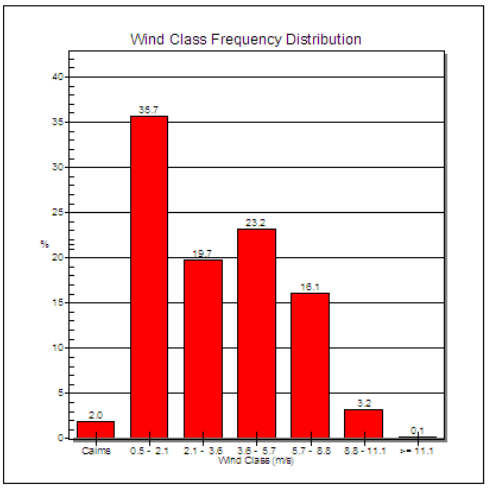




Appendix B

Spring (September – November)



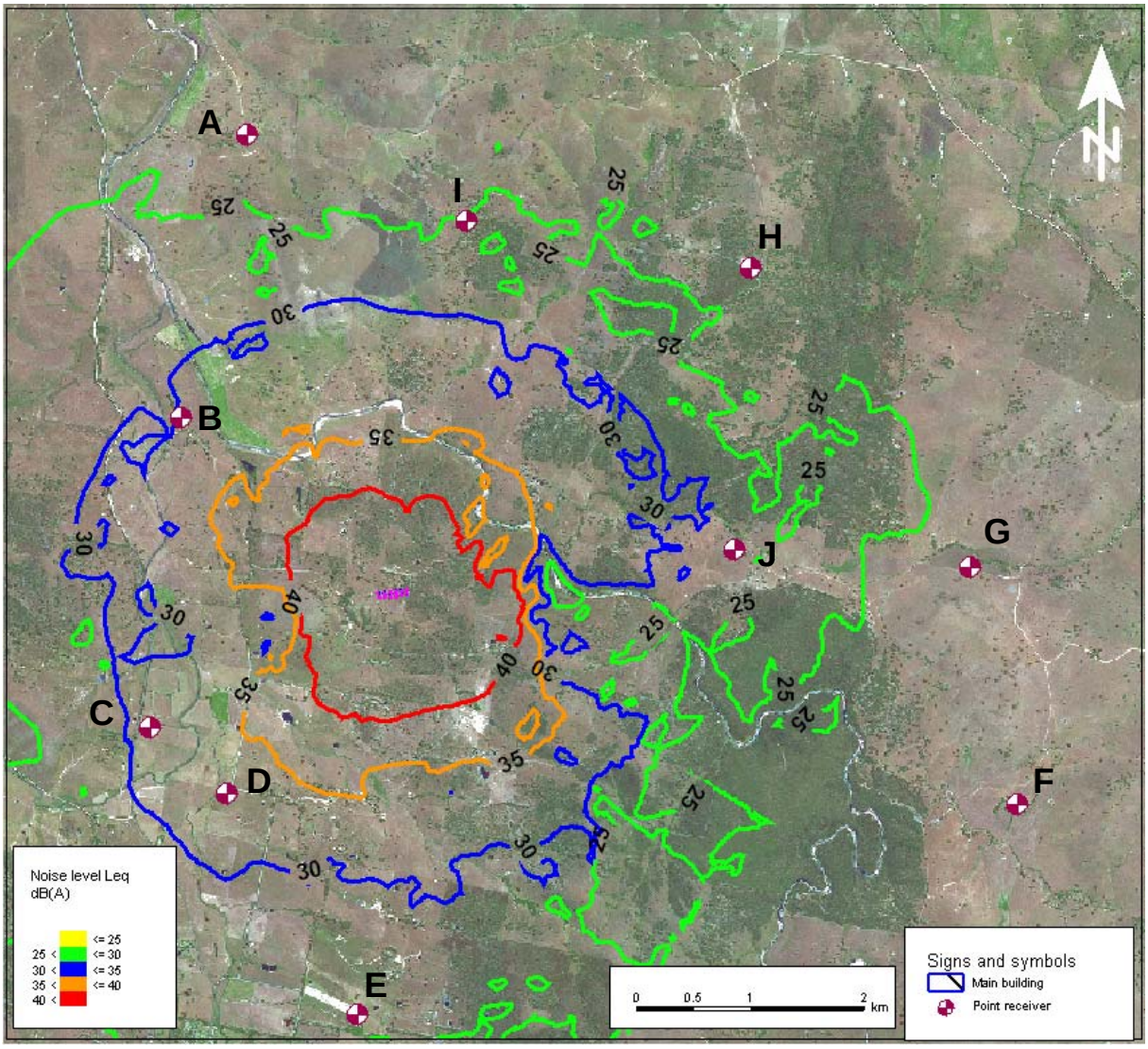


C

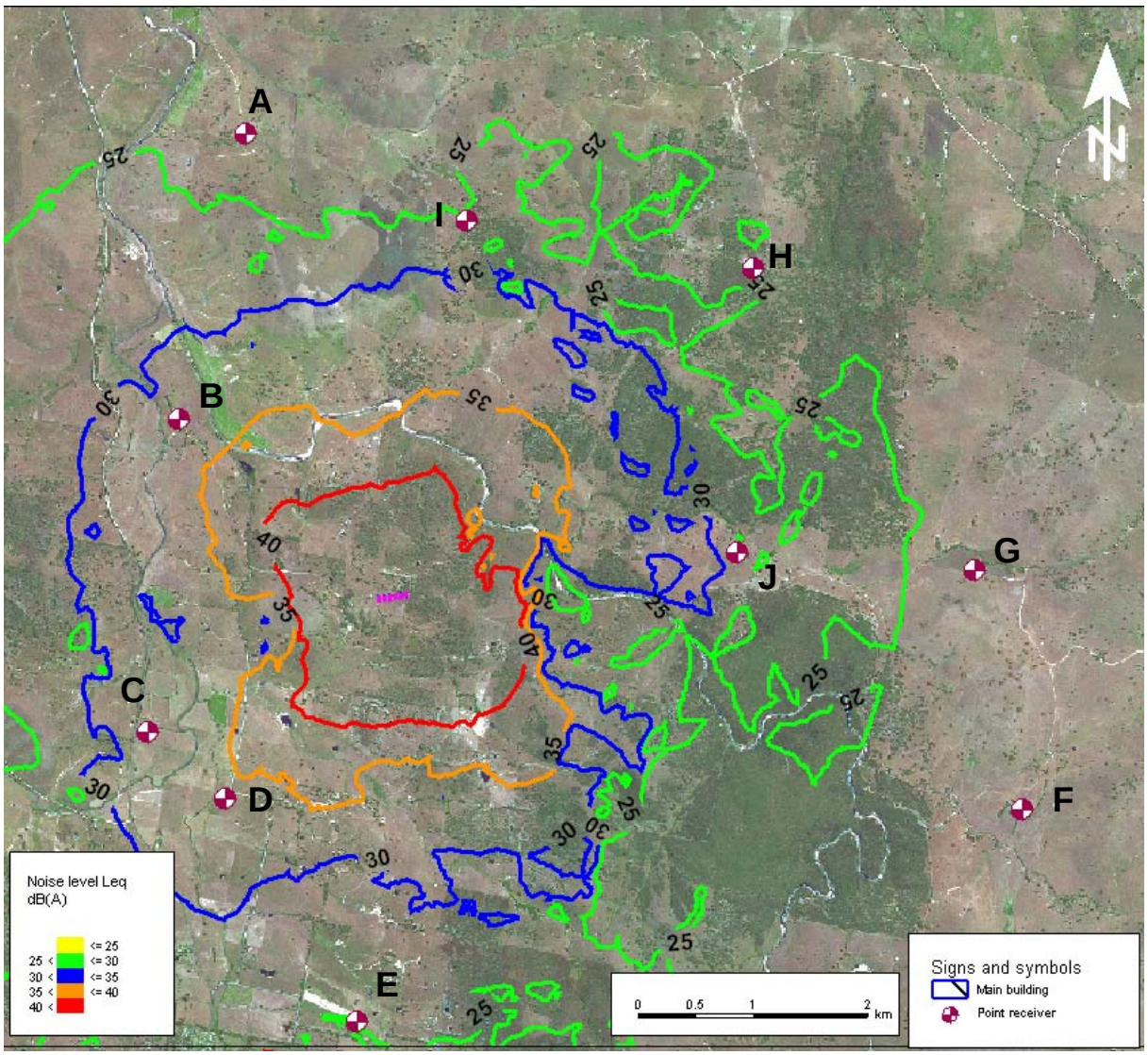
Appendix C Noise Contours

Appendix C

Stage 2 – Operation of 6 “E” Class Machines



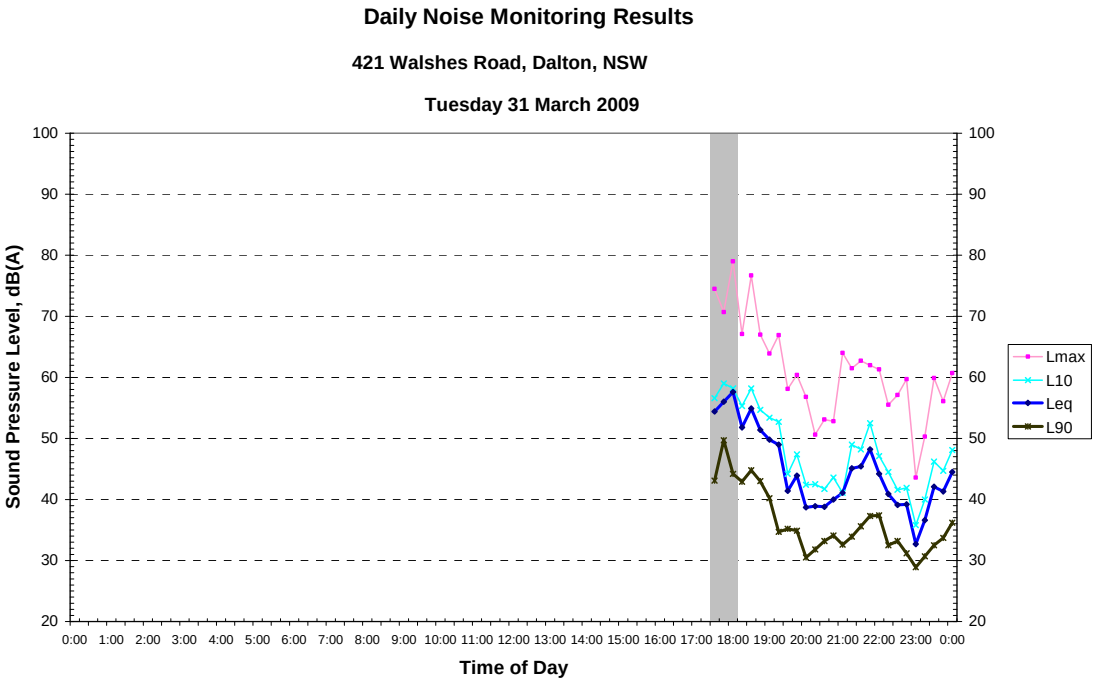
Stage 2 – Operation of 6 “F” Class Machines



D

Appendix D Daily Noise Monitoring Plots

Appendix D



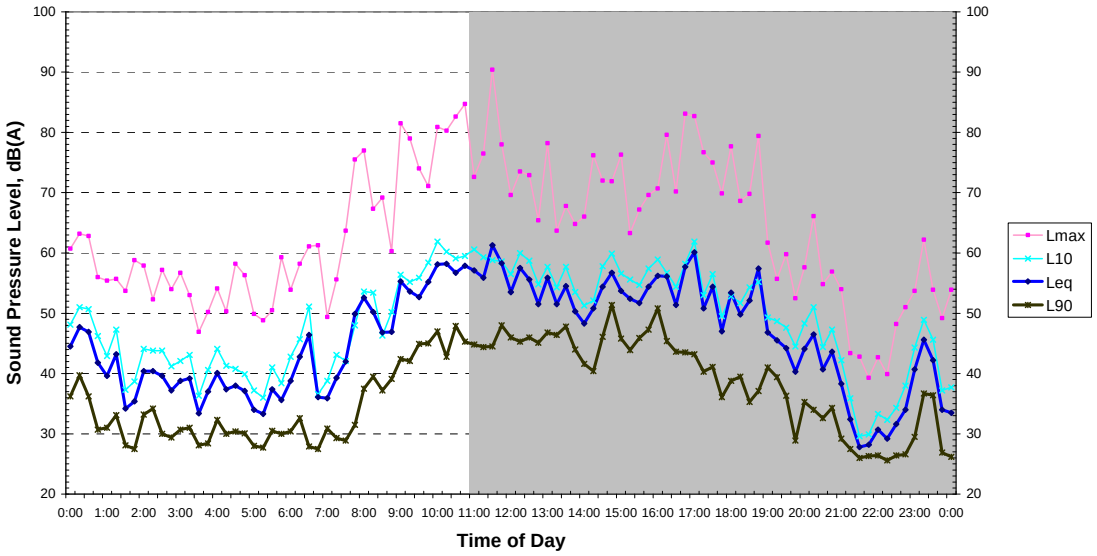
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

421 Walshes Road, Dalton, NSW

Wednesday 1 April 2009



Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
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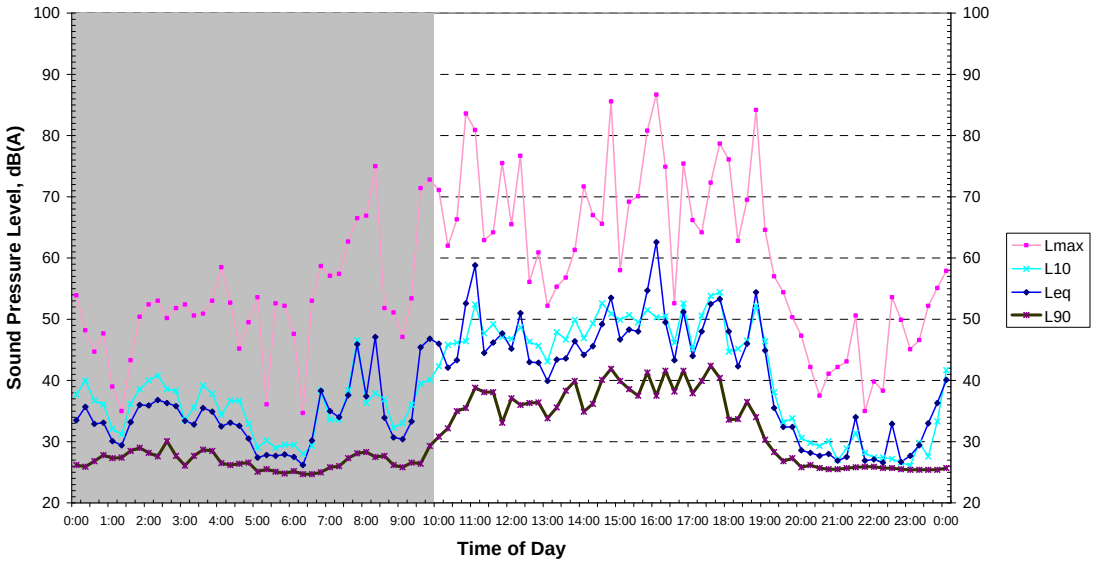
Daily Noise Monitoring Results

421 Walshes Road, Dalton, NSW

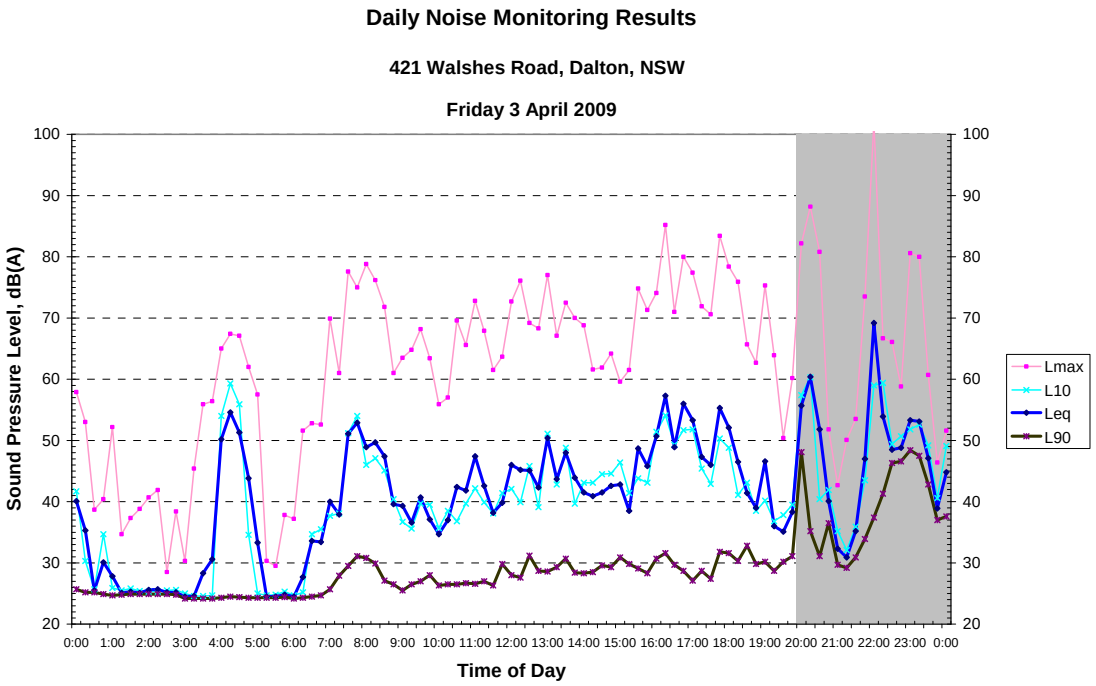
Thursday 2 April 2009



Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Appendix D



Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
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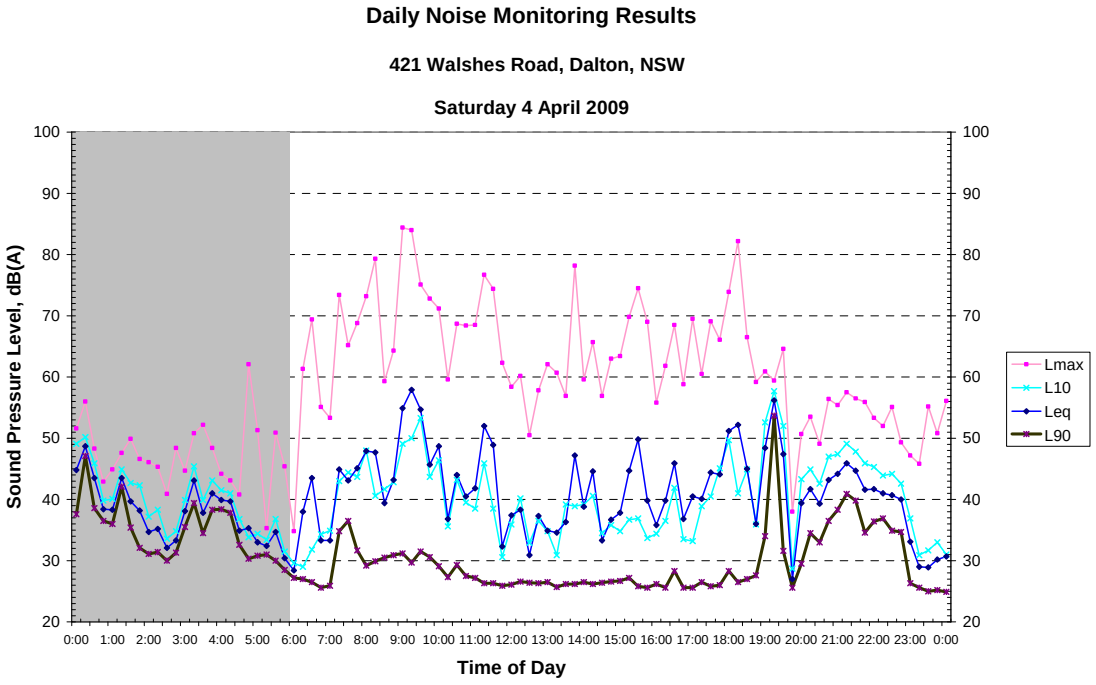


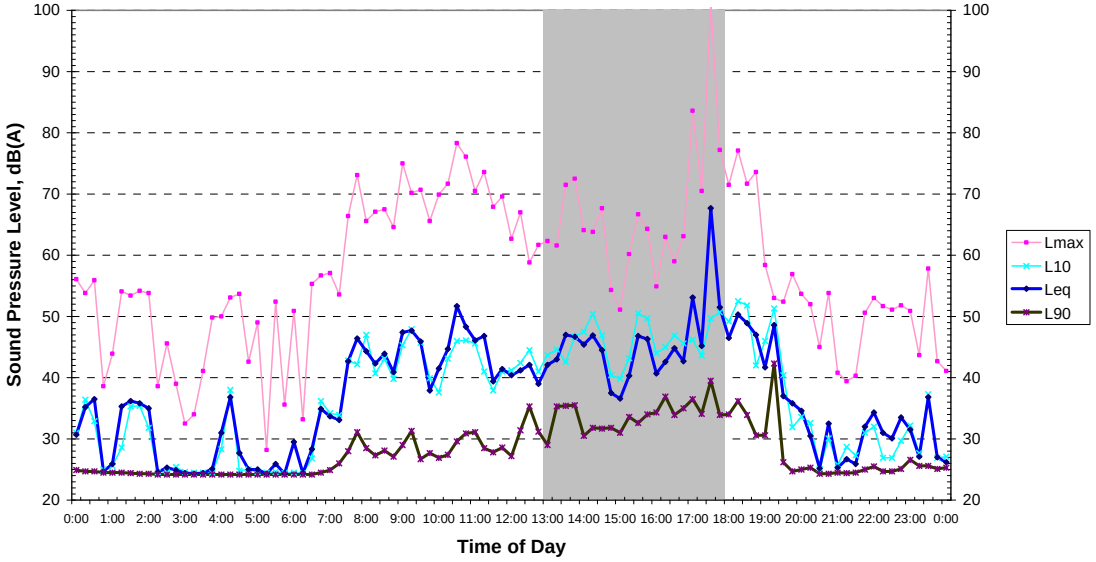
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

421 Walshes Road, Dalton, NSW

Sunday 5 April 2009



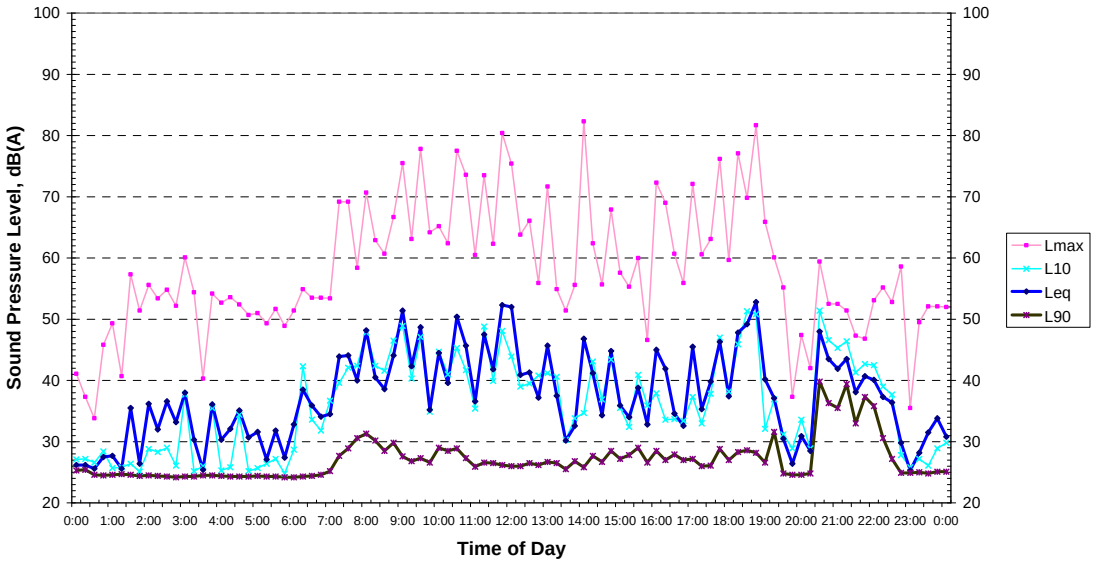
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

421 Walshes Road, Dalton, NSW

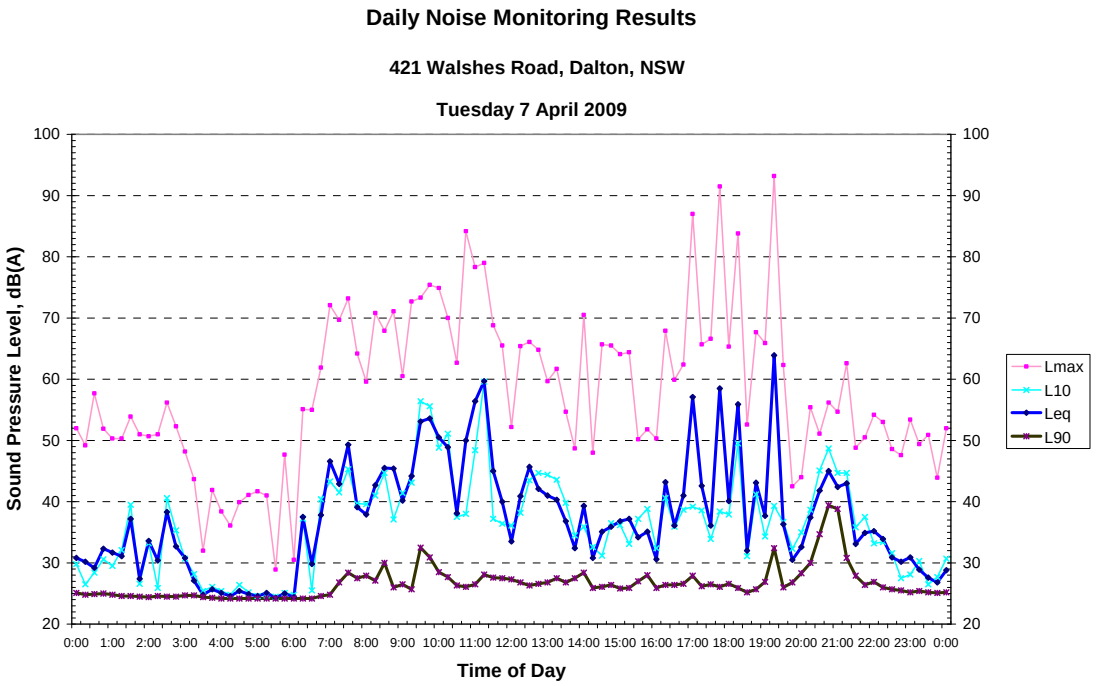
Monday 6 April 2009



Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Appendix D



Note:

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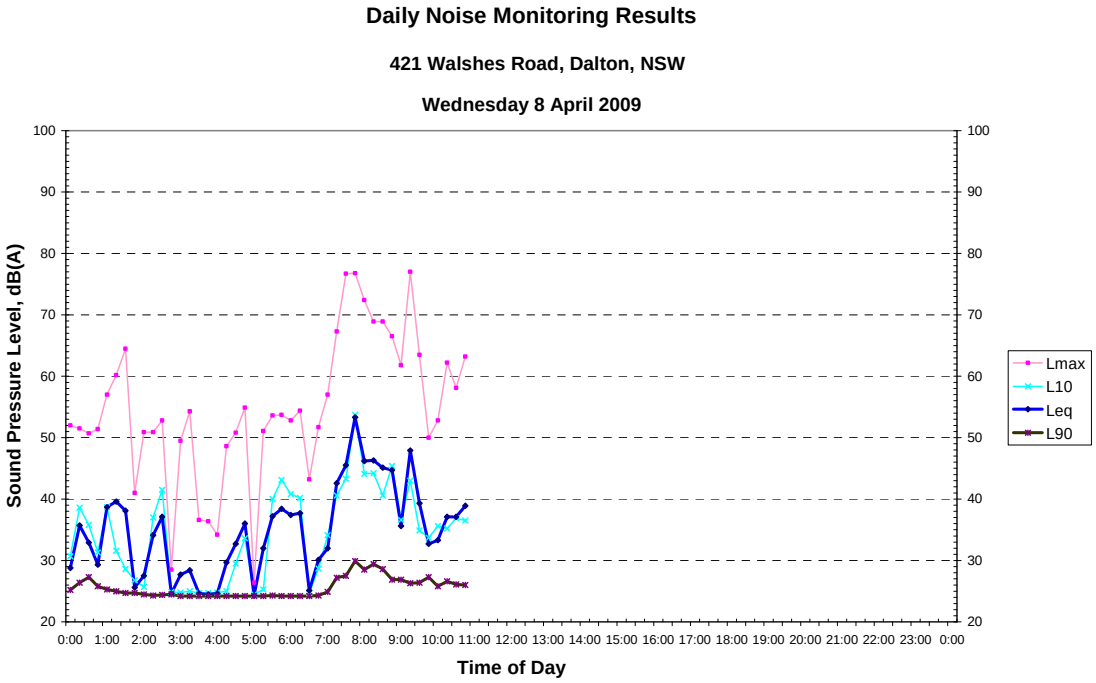


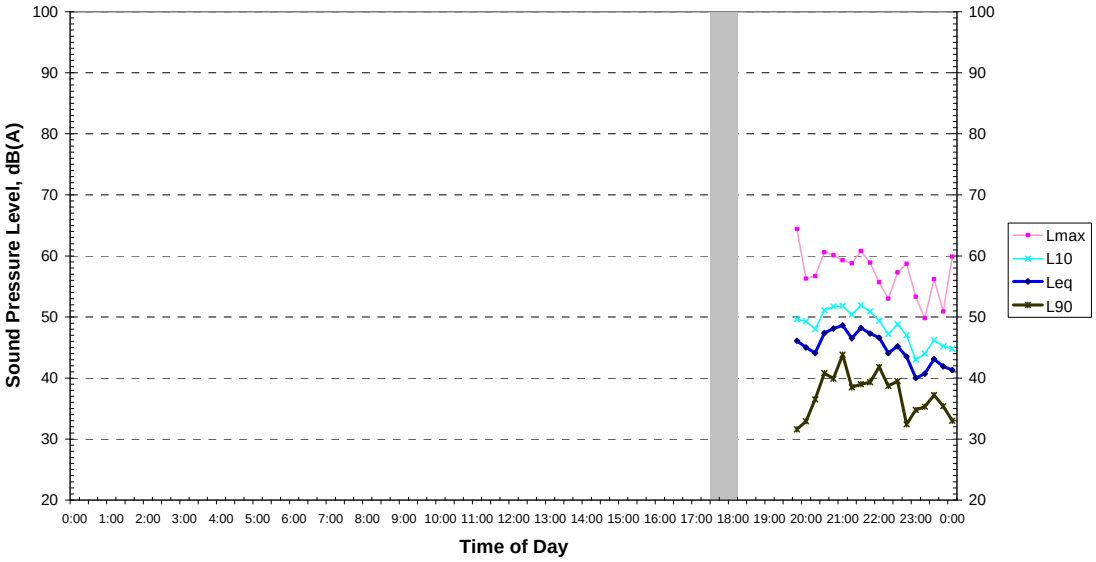
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

308 Rugby Road, Dalton, NSW

Tuesday 31 March 2009



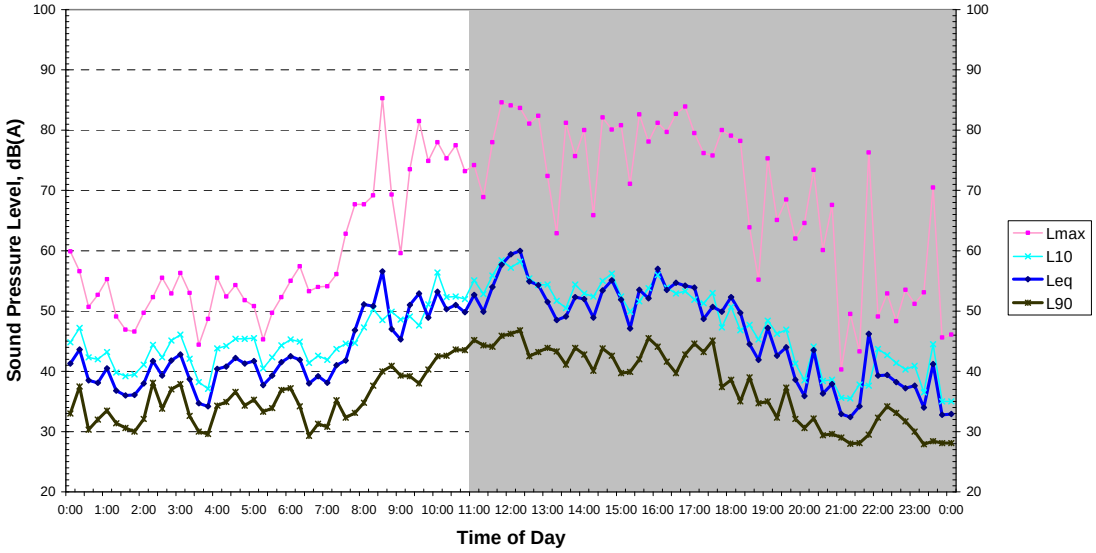
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

308 Rugby Road, Dalton, NSW

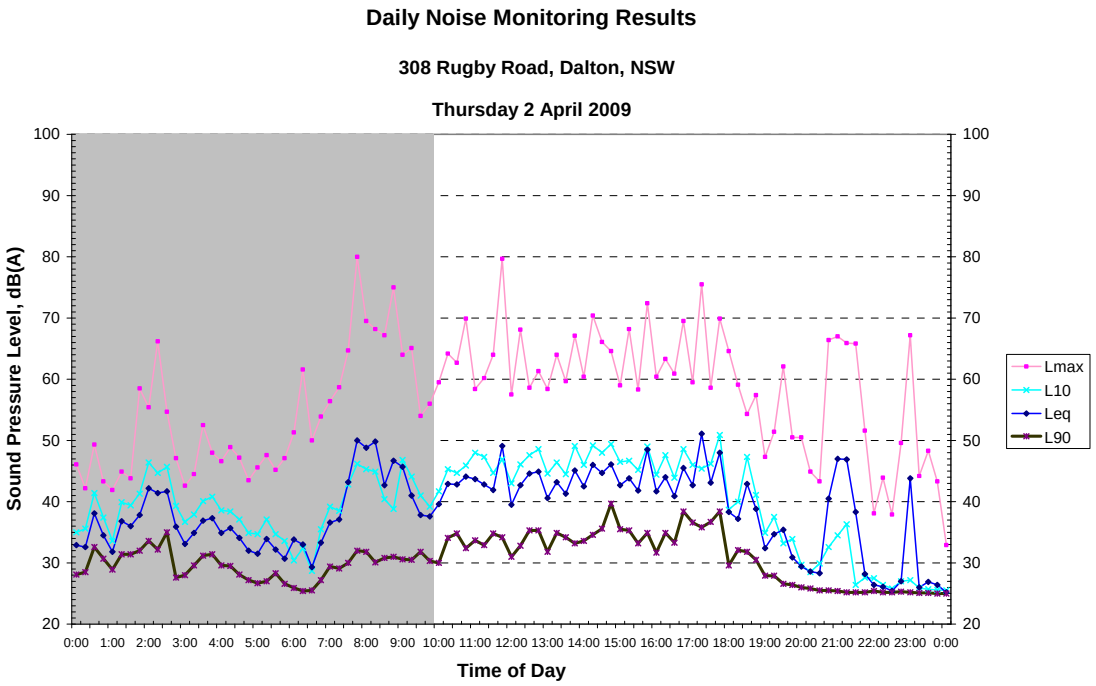
Wednesday 1 April 2009



Note:

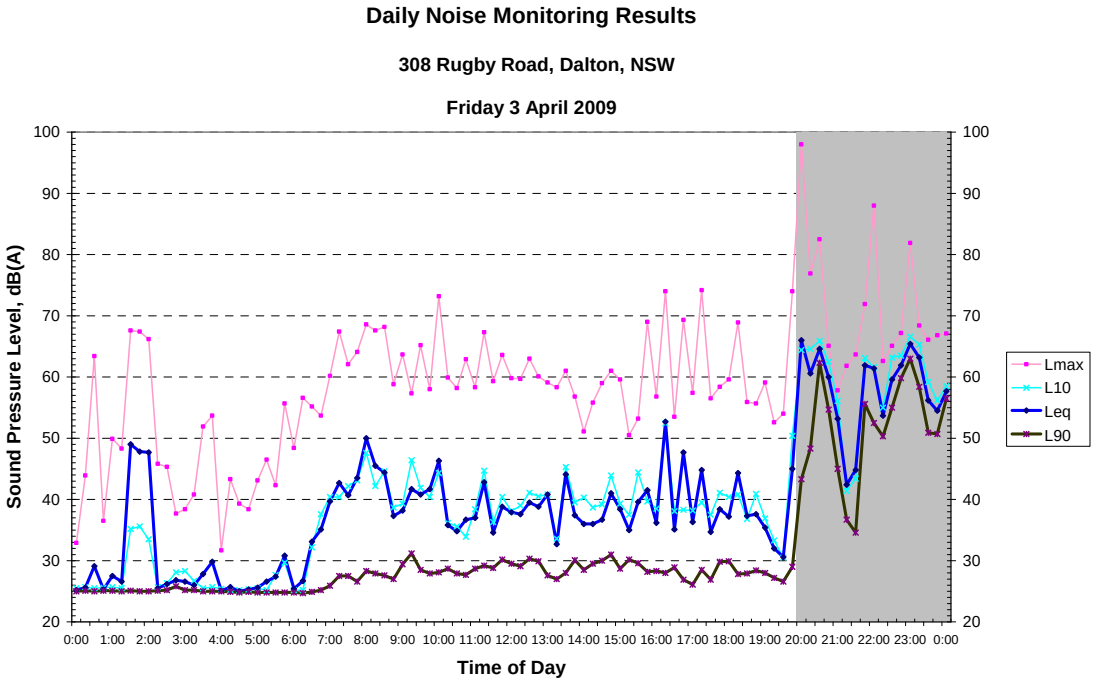
Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Appendix D



Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.



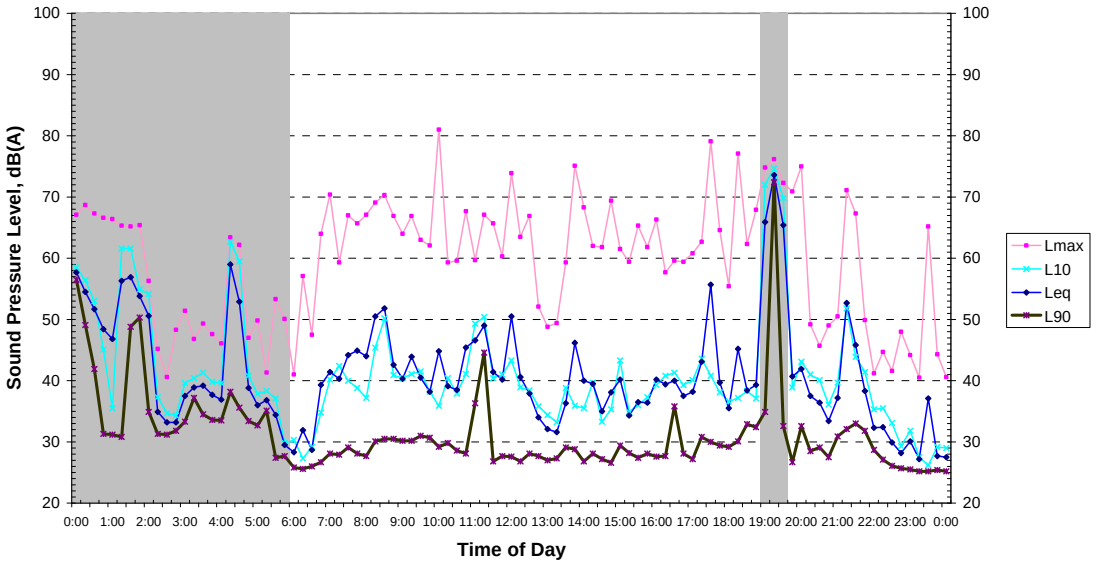
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

308 Rugby Road, Dalton, NSW

Saturday 4 April 2009



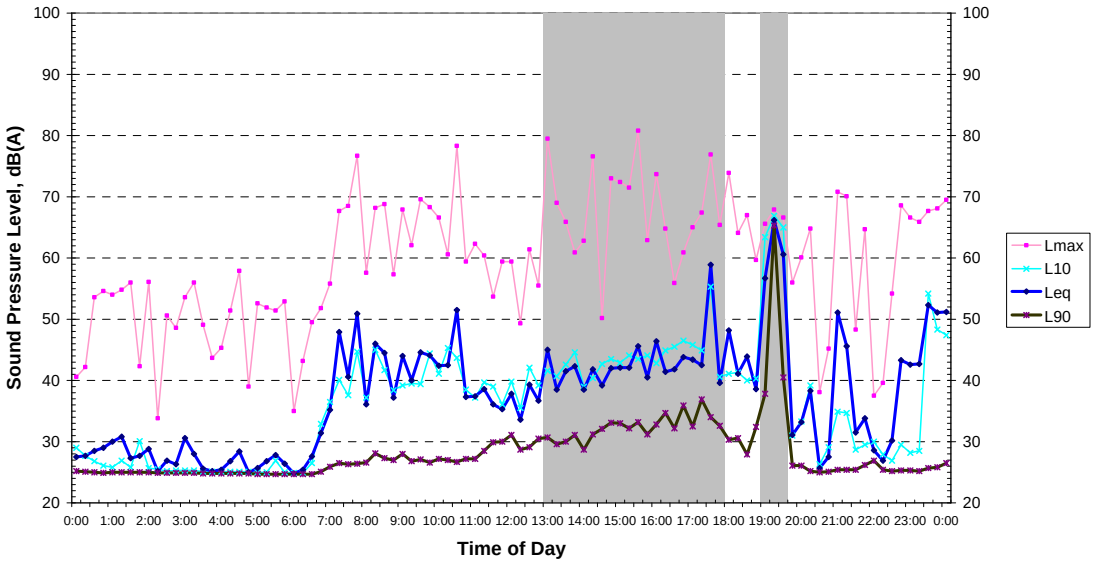
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

308 Rugby Road, Dalton, NSW

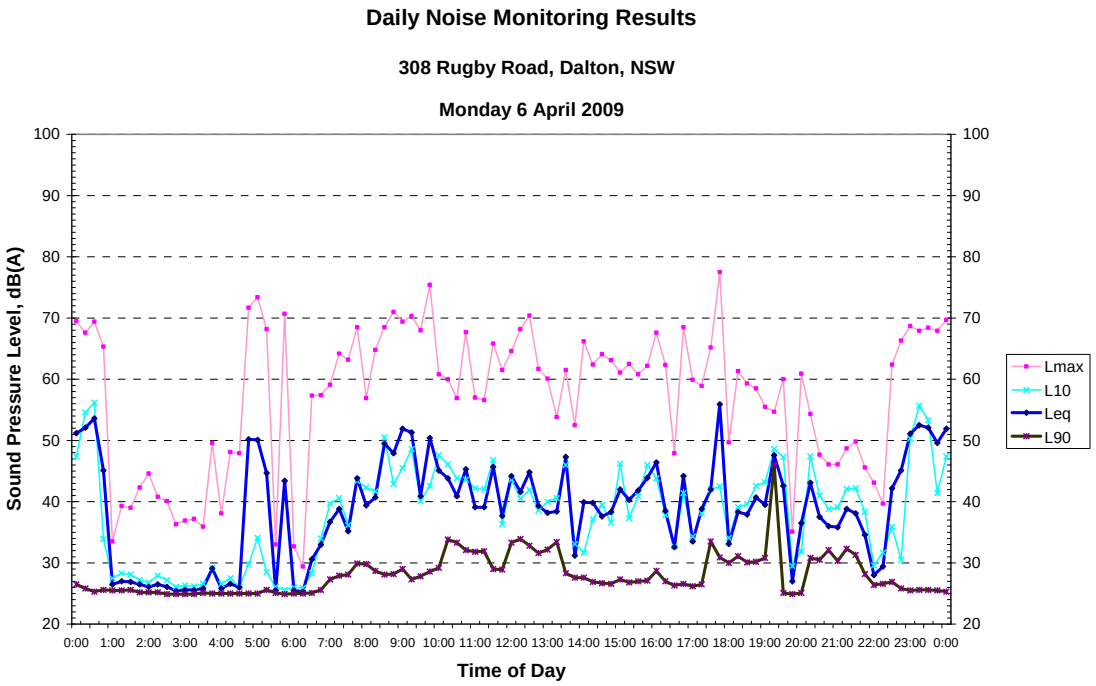
Sunday 5 April 2009



Note:

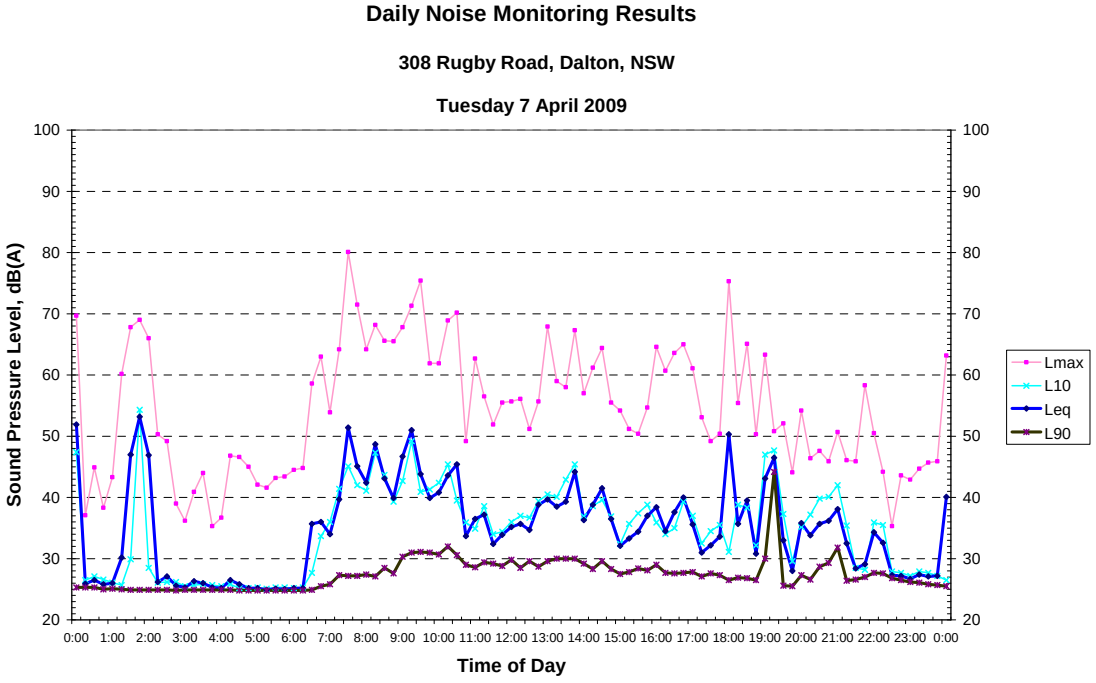
Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Appendix D



Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.



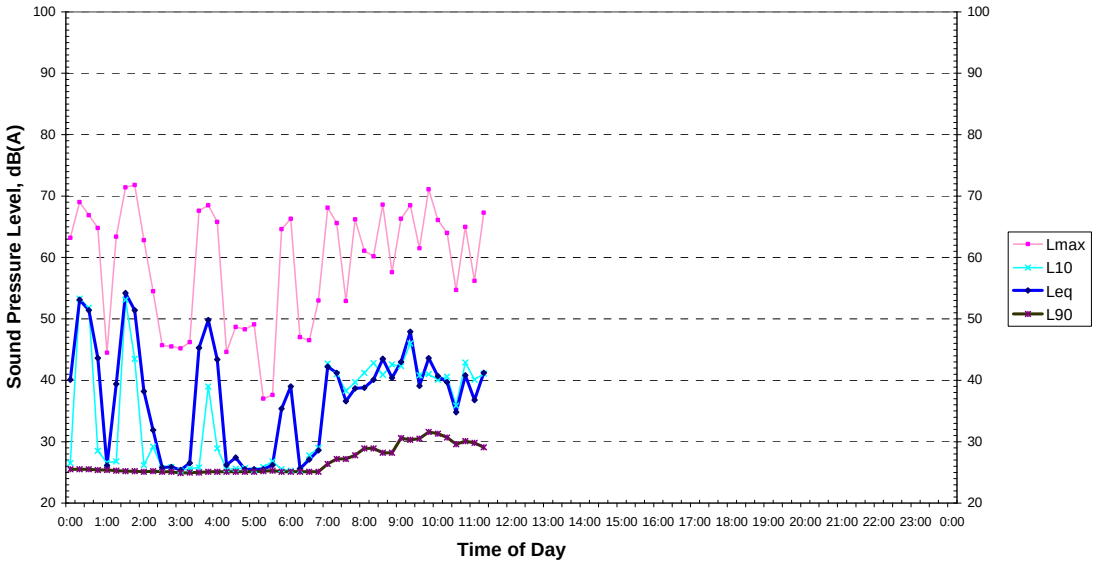
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

308 Rugby Road, Dalton, NSW

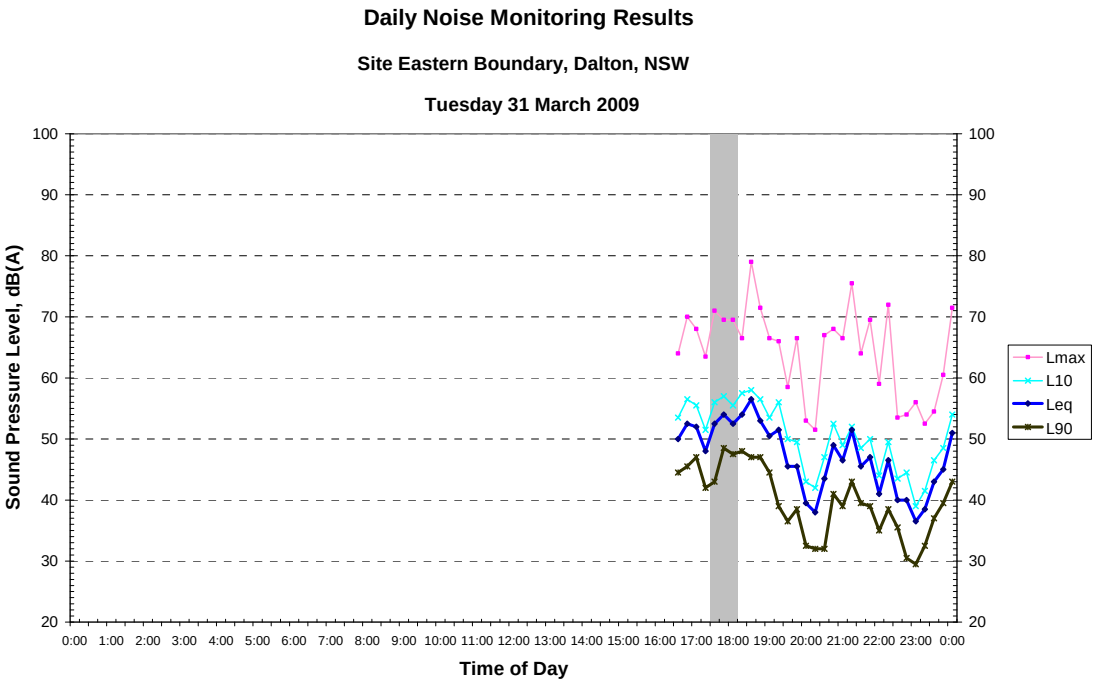
Wednesday 8 April 2009



Note:

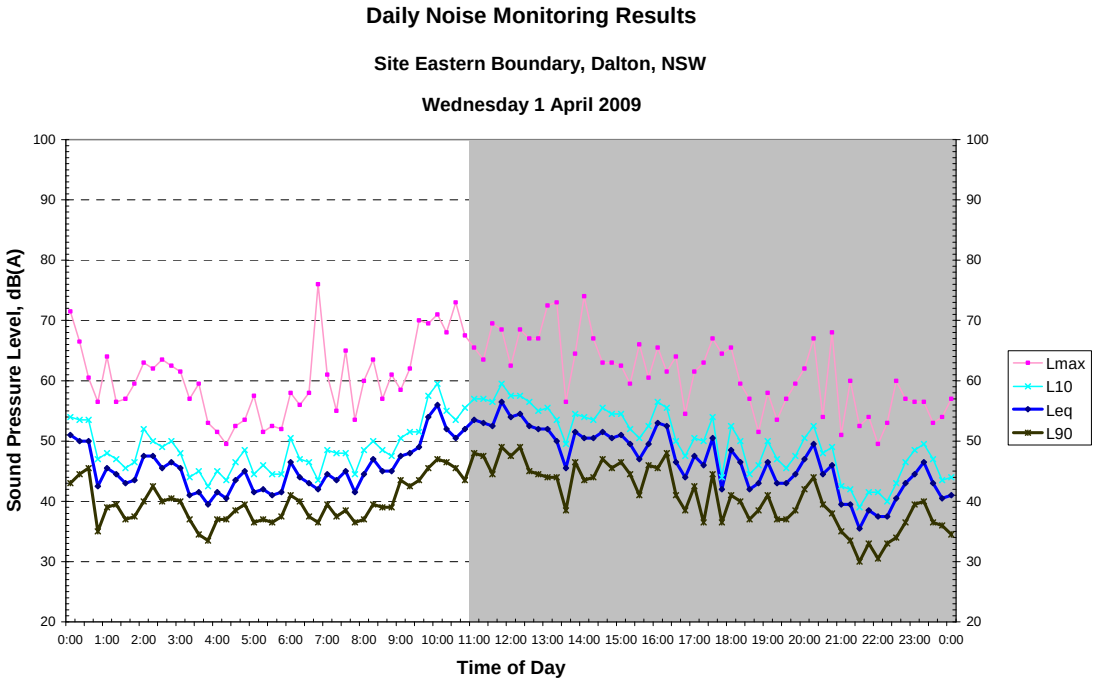
Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Appendix D



Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous
Measured data during these periods were excluded from calculation of noise levels averaged for the period.



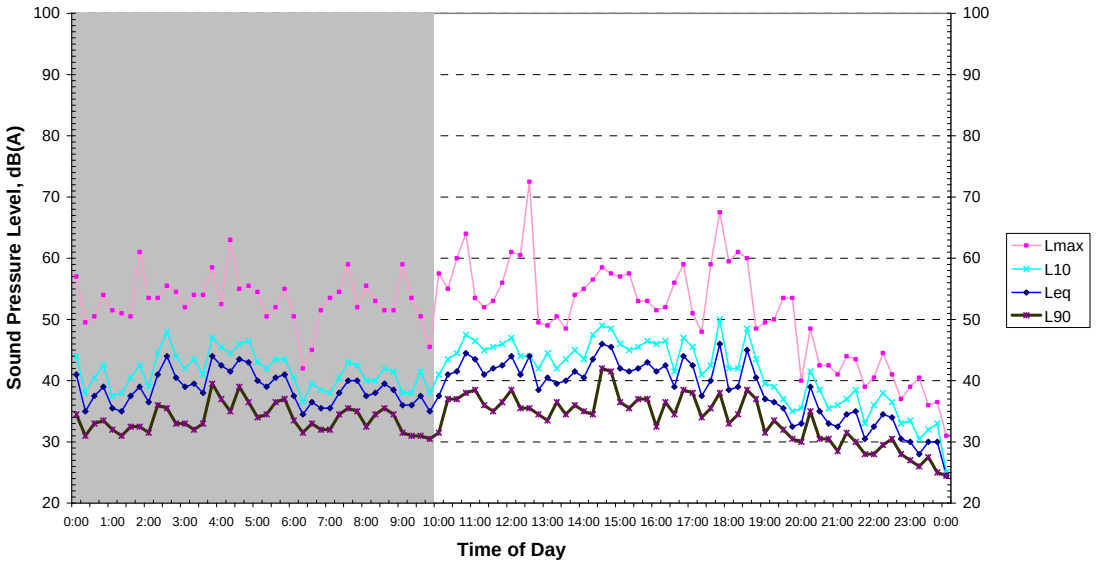
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

Site Eastern Boundary, Dalton, NSW

Thursday 2 April 2009



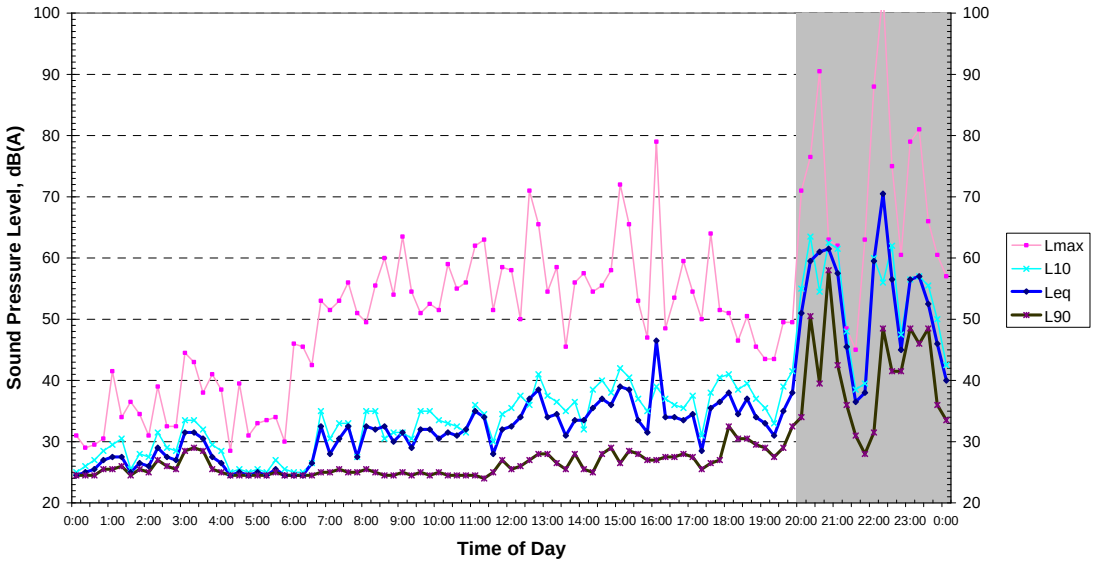
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

Site Eastern Boundary, Dalton, NSW

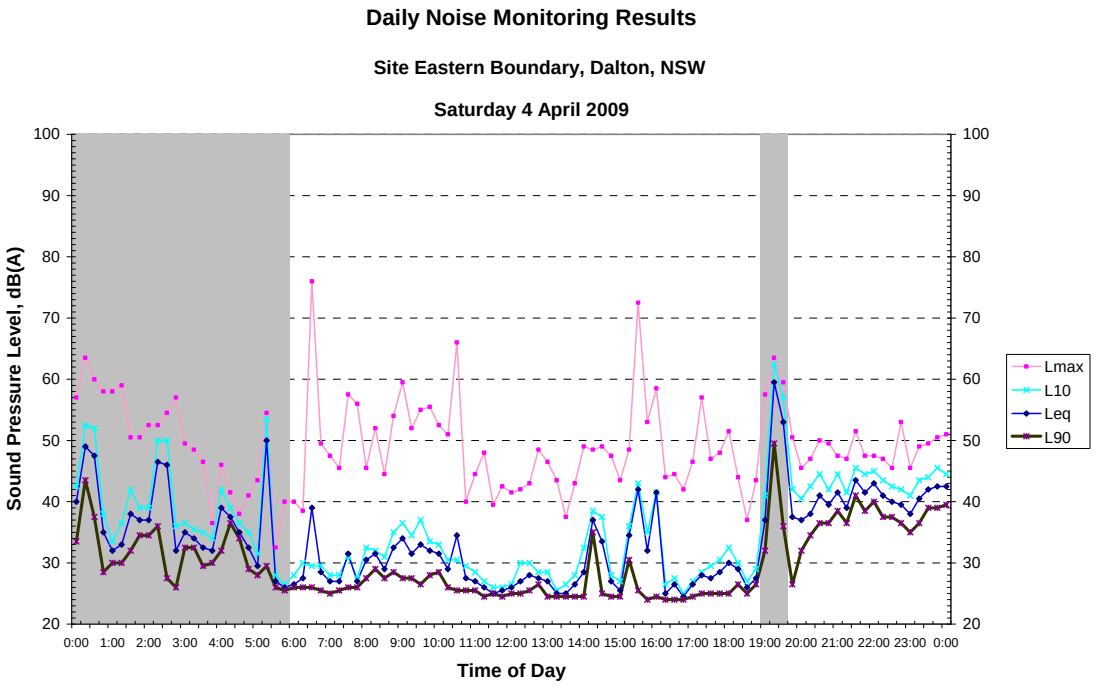
Friday 3 April 2009



Note:

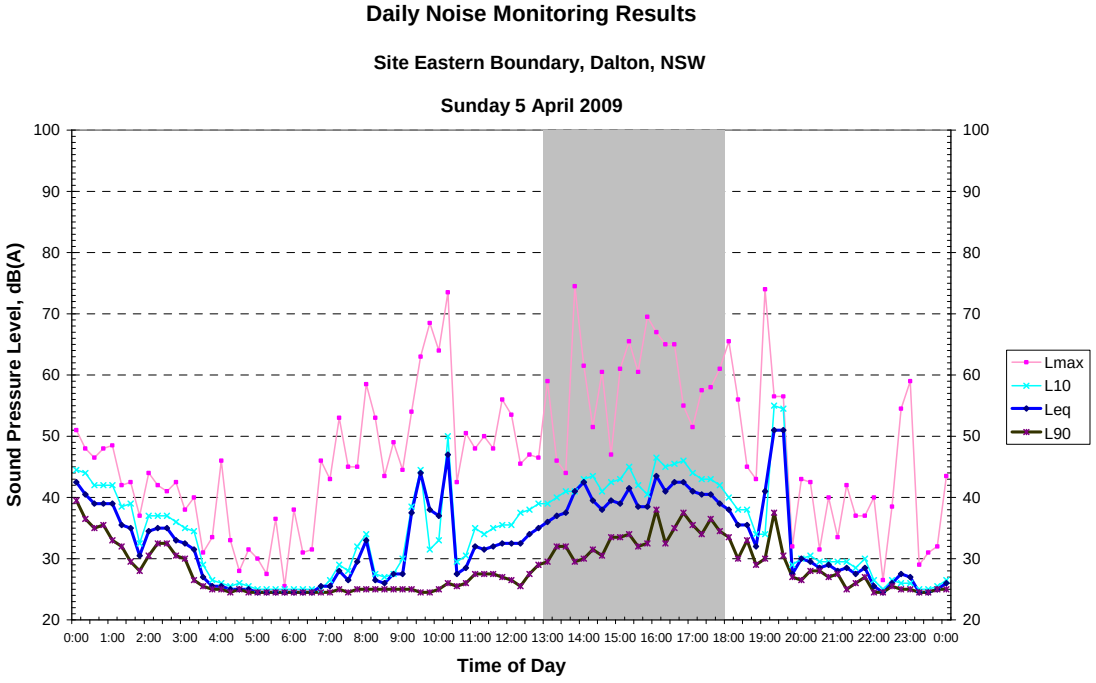
Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Appendix D



Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.



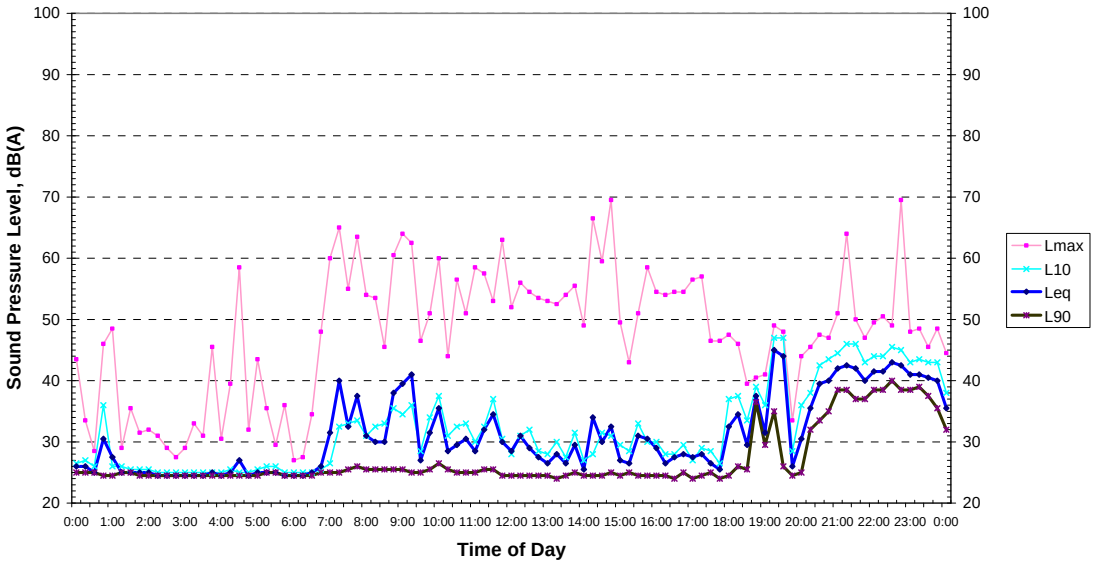
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

Site Eastern Boundary, Dalton, NSW

Monday 6 April 2009



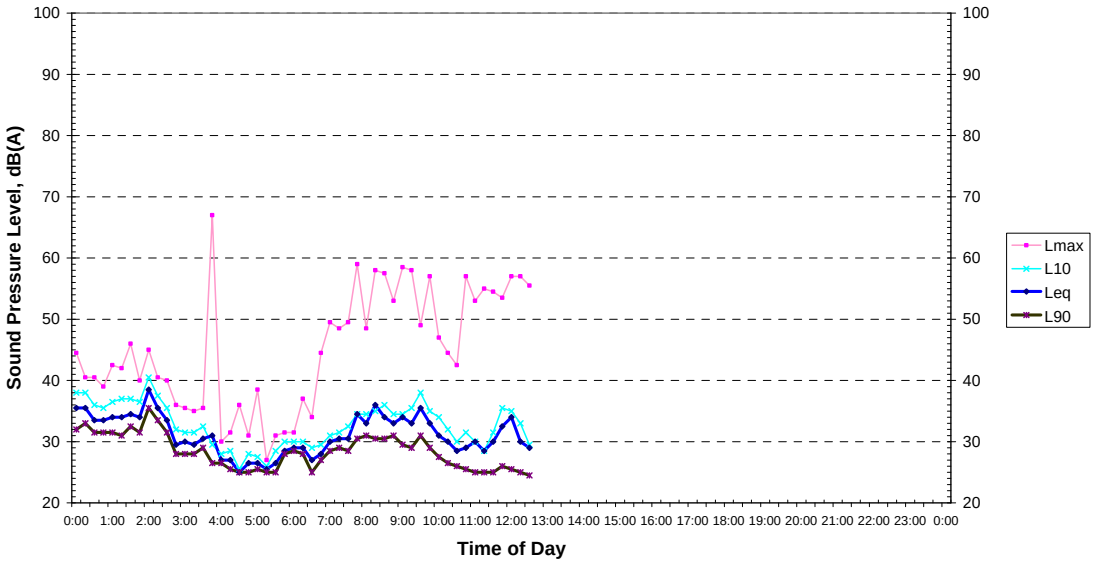
Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

Daily Noise Monitoring Results

Site Eastern Boundary, Dalton, NSW

Tuesday 7 April 2009



Note:

Shaded periods indicate periods affected by adverse weather conditions or extraneous noise.
Measured data during these periods were excluded from calculation of noise levels averaged for the period.

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