Noise and Sound Services

Environmental Noise Impact Assessment

For an:-

Ethanol Manufacturing Plant and a Free-Stall Dairy Operation at Coleambally, the Kidman Highway (Jerilderie - Darlington Point Road), Murrumbidgee Shire, NSW.

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Prepared at the request of:-

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On behalf of:-

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Suite 59, Upper Deck Jones Bay Wharf,
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C O N T E N T S

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SUMMARY

This Noise Impact Statement considers the proposed development of an integrated ethanol plant and intensive dairy located in the Murrumbidgee Shire south of Griffith between the NSW towns of Darlington Point and Coleambally.

The proposed *'greenfield'* site, known as the *'Tubbo'* Station, is in a remote rural area on the Kidman Highway (Jerilderie-Darlington Point Road) with only one residential property (Farm 641) identified within a 1 km radius. This property (Farm 641) is at approximately 170 metres from the site boundary and approximately 2000 metres from the main ethanol plant.

The proposed ethanol plant includes the use of plant such as hammermills, centrifuges, cooker fans, a multi-column distillation system, compressors, pumps, forklifts and trucks.

Noise criteria provided by the NSW State Government have been considered. These are the Industrial Noise Policy (2000), the Environmental Criteria for Road Traffic Noise (1999) and Chapter 171 of the 'Environmental Noise Control Manual' (1994) for construction noise. The assessment procedure covers both controlling intrusive noise impacts and maintaining noise level amenity.

The existing acoustical climate has been assessed using a noise logger positioned close to the proposed development. The existing background noise levels (L_{A90}) were found to be 30 dBA (or less) in the day time, evening and night time.

Noise goals **($L_{Aeq, 15\ minute}$)** at the nearest residential properties have been set. The noise goals take into account current NSW Government guidelines and the measured and likely background in the area. For fixed stationary plant the noise goal is 35 dBA for day, evening and night time.

Acoustical modelling for the proposed expansion has been carried out. This uses methods given in the International Standard ISO 9613-2 (1996).

The noise criteria will be generally met for the continuous noise from the proposed development. The predicted noise levels are very close to the goals at the nearest residential receiver due to industrial noise and could exceed the limit assuming a +/- 4 dB confidence of the predicted results hence mitigation measures are recommended. The on-road truck noise will exceed the day time Road Traffic Criteria for residential dwellings within 40 metres of the road and all reasonably practicable means of minimising the impact is recommended.

1. INTRODUCTION

Noise and Sound Services was requested by Booth Associates of PO Box 1458, Griffith NSW 2680, to carry out a Noise Impact Statement (NIS) on behalf of Four Arrows Ethanol Pty Ltd part of the Four Arrows Rural Group of Suite 59, Upper Deck Jones Bay Wharf, 19-21 Pirrama Road, Pyrmont NSW 2009. This NIS is for the proposed construction and operation of an ethanol manufacturing plant with a production capacity of 300 million litres of ethanol per year and a free stall dairy operation with the capacity to milk 6000 cows.

This NIS is in line with the environmental assessment requirements made under section 75 F of the Environmental Planning and Assessment Act 1979. This NIS is part of the Environmental Assessment for the development.

The issues addressed in this NIS are the future noise emissions from construction plant, operational plant and on-road traffic from the proposed ethanol manufacturing plant.

2. SITE AND DEVELOPMENT DESCRIPTION

This section describes the location site for the proposed development and provides a detailed description of the proposed working activity of the development.

2.1 Site Description

It is proposed to construct and operate an ethanol manufacturing plant and a free stall dairy operation off of the Kidman Highway (Jerilderie-Darlington Point Road) in the Murrumbidgee Shire. The area is south of Griffith between the NSW towns of Darlington Point and Coleambally. The *'greenfield'* site is known as the *'Tubbo'* Station; Darlington Point (lots 78, 79, 80 and 112 DP 750896).

The surrounding area of the proposed expansion is a quiet rural zone and is surrounded by farmland and a few sparsely spaced dwellings. The closest surrounding property is Farm 641 known as *'Karinya'* which is occupied by a Four Arrows Rural Group employee. The nearest neighbouring residential properties are Farm 641 at approximately 170 metres from the boundary of the site and two residences on the opposite side of the Jerilderie-Darlington Point Road which are approximately 1100 to 1500 metres from the nearest boundary of the site. The main ethanol plant is approximately 2000 metres from the nearest residential property and approximately 300 metres from the nearest industrial premises.

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An indication of the approximate distances from the proposed site is shown in Figure 1 below:-

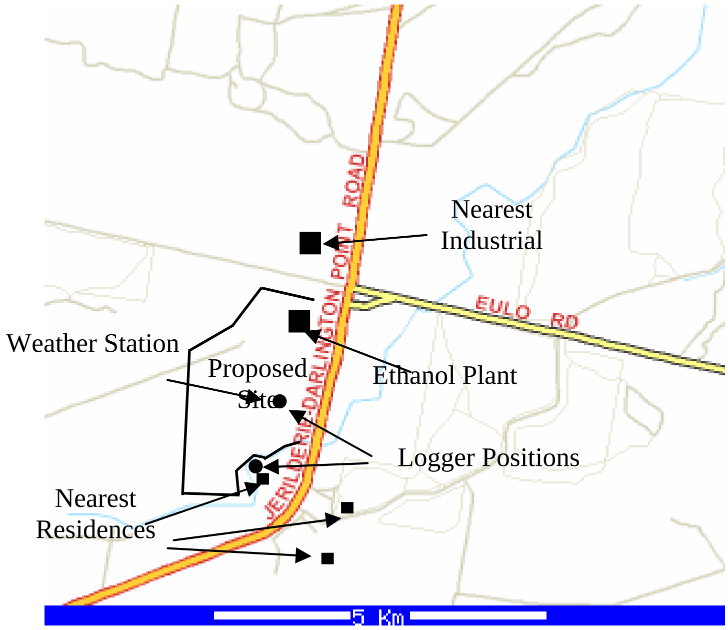


Figure 1. Site Plan Showing the Nearest Residences. Source and Background Noise Surveys were carried out at Farm 641 and on the Site as Indicated. Site Details Not to Scale. (Source Multimap- PSMA Ltd).

Strong wind patterns exist in the area. In the summer months, these are commonly south-westerly in the afternoons and prevailing north-easterly to easterly in the mornings. In the winter months, winds are commonly influenced by westerlies ranging from south-west to north-west. Temperature inversions are likely to occur between May and October with an average of six per month. The highest known recording of surface temperature inversions has been 15 days in July 1987.

2.2 Ethanol Manufacturing Plant Description

The specific details of the ethanol manufacturing have not been finalised at this stage. However the generalised major steps in the dry mill process of ethanol production are:

1) **Milling**. The feedstock passes through a hammermill which grinds it into a fine powder called meal.
2) **Liquefaction**. The meal is mixed with water and alpha-amylase, and then passed through cookers where the starch is liquefied. Heat is applied at this stage to enable liquefaction. Cookers with a high temperature stage (120 to 150 °C) and a lower temperature holding period (95 °C) are used. High temperatures reduce bacteria levels in the mash.
3) **Saccharification**. The mash from the cookers is cooled and the secondary enzyme (gluco-amylase) is added to convert the liquefied starch to fermentable sugars (dextrose).

4) **Fermentation**. Yeast is added to the mash to ferment the sugars to ethanol and carbon dioxide. Using a continuous process, the fermenting mash is allowed to flow through several fermenters until it is fully fermented and leaves the final tank. In a batch process, the mash stays in one fermenter for about 48 hours before the distillation process is started.

5) **Distillation**. The fermented mash, now called beer, contains about 10% alcohol plus all the non-fermentable solids from the corn and yeast cells. The mash is pumped to the continuous flow, multi-column distillation system where the alcohol is removed from the solids and the water. The alcohol leaves the top of the final column at about 96% strength, and the residue mash, called stillage, is transferred from the base of the column to the co-product processing area.

6) **Dehydration**. The alcohol from the top of the column passes through a dehydration system where the remaining water will be removed. Most ethanol plants use a molecular sieve to capture the last bit of water in the ethanol. The alcohol product at this stage is called anhydrous ethanol (pure, without water) and is approximately 200 proof.

7) **Denaturing**. Ethanol that will be used for fuel must be denatured, or made unfit for human consumption, with a small amount of gasoline (2-5%). This is done at the ethanol plant.

8) **Co-Products**. There are two main co-products created in the production of ethanol: distiller's grain and carbon dioxide. Distiller's grain, used wet or dry, is a highly nutritious livestock feed. Carbon dioxide is given off in great quantities during fermentation and many ethanol plants collect, compress, and sell it for use in other industries.

2.2.1 Stationary Plant

Specific noise generating stationary plant to be used for ethanol manufacture is assumed to be:-

- Cookers;
- Hammermills;
- Centrifuges;
- Compressors;
- A multi-column distillation system;
- Fermenters;
- Fans;
- Pumps with electric motors;
- Vacuum dryers.

Of these, centrifuges and hammermills should be located within concrete or brick buildings. Pumps with electric motors and vacuum dryers are to be located well within the site, thus significant acoustic shielding is achieved from proposed on-site building structures.

2.2.2 On-Site Mobile Plant

Specific noise generating on-site mobile plant to be used for the ethanol production has been identified during visits to similar sites within NSW. These are:-

- Large fork lifts (usually 1).
- Small fork lifts (usually 1 to 2).
- Trucks (usually 2 to 3).

2.2.3 On-Road Mobile Plant

The on-road mobile plant will consist of trucks (usually B-doubles or possibly semi-trailers) and staff vehicles. The trucks are required to deliver grain to the site and collect milk, ethanol, waste and sundry from the site. The on-road mobile plant are summarised below:-

1. Total vehicle movements per day (the total vehicle movements on and off site using scenario figures) are anticipated at being 460.
2. 360 of these movements are b-doubles whilst 100 movements are calculated at being light vehicles.
3. It is anticipated that 60% of vehicles will travel north whilst 40% will travel south. This equates to 276 vehicles heading north and 184 vehicles heading south per day.
4. A 60/40 split equates to approximately 216 heavy vehicles and 60 light vehicles north bound per day and 144 heavy vehicles and 40 light vehicles south bound per day.
5. It is anticipated that the heavy vehicles will operate for the full 15 hours which equates to an approx average of 16 truck movements per hour. Total staff vehicles movements will be 100 per day however these will arrive at the beginning of shift and leave at the end of shift. There will probably be two shifts so this will equate to 4 x 25 light vehicle movements per day.

2.2.4 Rail Traffic

Details of the required rail traffic movements are not known at this stage. However it is estimated that at this point in time a maximum of two trains per week bringing grain to the Willbriggie rail siding will be used. It is also suggested that train movements would be limited to daytime hours of operation. The numbers of train movements and operating times would be developed pursuant to negotiations between stakeholders (such as Four Arrows and GrainCorp) and the NSW Department of Planning.

2.3 Dairy Plant Description

Although specific detail of the dairy operation is not available at the time of preparation of this report a general overview of the process for the proposed facility is as follows. The milk is collected from the cows in the dairy and then stored and chilled until it is suitable for transfer to the processing shed. The milk is then stored in vats within the processing shed until the processing begins. There are three main steps in the process, but not all milk products will require each step for completion. These are, separating, pasteurising and homogenising.

The final product is usually stored in the cool rooms before collection and delivery. The delivery process is likely to occur several times per day and will be carried out using standard sized milk trucks.

Although miking of cows can start at early hours the milk processing will normally occur between the hours of 7.00 am and approximately 5.00 pm, although the hours are likely to vary once the process is refined.

2.3.1 Dairy Equipment Description

The equipment involved in the various processes normally used at these types of facilities consists of a chiller, pasteuriser, homogeniser and separator. In addition to the main chiller, processing plant and associated compressor for any hydraulic/pneumatic components, a refrigeration condenser will be required for running the cool room.

2.3.2 Proposed Building Description

A building is normally required consisting of the following areas: Processing room, packing room, dry room, cold room, laboratory, office, and amenities.

2.3.3 Cattle

Total head of cattle on site is proposed to be 18,000. Of these 7200 will be in freestall sheds to ensure 6000 in milk at any one time, with remainder of herd in the dry pens. Those in the freestall sheds are a mix of cows both milking and dry, and cattle in the maternity section and/or in the hospital section, where they will be under the attention of the on-site veterinarian.

The following points are noted:

- To maintain 6,000 cows constantly in milk requires 7,200 cows in the dairy herd with 1,200 cows dry at any one point in time;
- The cows are assumed to be artificially inseminated with sexed semen which historically has resulted in 90% heifer calves from a 90% calving rate;
- Bull calves are sold at under 3 months of age to the bull calf raising market;
- Obvious cull heifers are sold at 3 months of age and the retained heifer calves are placed into the young heifer grouping;
- The young heifer grouping are further culled at close to 9 months with the culls of this group being disposed of immediately;
- The next groups of heifer calves, those in the 9 to 15 month age bracket, are artificially joined to a mix of sexed and unsexed semen. The sexed semen is applied to the heifer calves which are deemed to be the select or high quality heifers and the unsexed semen is the heifer calves of a lesser standard. The lesser standard heifers are then sold to the Asian heifer market for transfer offshore; and
- The quality heifers are retained, ultimately introduced to the dry cow herd prior to calving. Later another culling down to approximately 1,900 head of best quality and best performing animals.

The herd is under constant selection pressure, for not only the best performing heifers and cows constitutionally, as well as in milk performance. The cattle will be fed to appetite; hence no pre-emptive bellowing is likely to occur before set feeding times. Calving times are unpredictable within a 24 hour period, but, where practicable this will occur within an enclosed shed.

2.4 Waste Water Treatment

A waste water treatment plant including aerobic ponds and anaerobic ponds is proposed. Although no details have been finalised at this stage, typical ponds have a capacity in the order of 60 ML. Typical pond dimensions are 300 meters long, 150 metres wide and 6 metres deep. The plant involved would be aerators and pumps. The proposed wastewater treatment plant is likely to be in operation, when required, for 7 days per week and 24 hours per day. The ponds are likely to located at least 600 metres from the nearest residential boundary.

2.5 Construction Plant

Specific noise generating construction plant, to be used for the construction of the proposed development, has been identified during the site visits. These are:-

- Water cart;
- Dozer;
- Grader;
- Scraper
- Excavator;
- Trucks.

3. CRITERIA

Noise criteria are provided by the NSW State Government and issued via the Department of the Environment and Conservation (DEC) which was formally known as the Environment Protection Authority. These criteria are generally in line with criteria given in other States of Australia and many countries of the world. This includes the Industrial Noise Policy (2000) and the Environmental Criteria for Road Traffic Noise (1999). These cover noise in urban, suburban and rural areas. Although specific local conditions can affect the criteria, convincing justification (for example the noise only produced over a limited period in any one year) must be given for any variation to State Government guidelines.

3.1 Industrial Noise Policy

The assessment procedure for industrial noise sources given in the State Government's Industrial Noise Policy (2000) has two components:-

- **Controlling intrusive noise impacts; and**
- **Maintaining noise level amenity.**

In assessing the noise impact of industrial or commercial noise sources all components must be taken into account for residential receivers, but, in most cases, only one will become the limiting criterion. The project-specific noise goals reflect the most stringent noise level requirement. It is derived from intrusive and amenity criteria and this is used to set a benchmark against which noise impacts and the need for noise mitigation are assessed. The overall aim of the policy is to allow the need for industrial activity to be balanced with the desire for quiet in the community. The noise criteria in the policy are not mandatory and numerous other factors need to be taken into account including local conditions, economic consequences and the social worth of the development.

3.1.1 Intrusive Noise Impacts

The Industrial Noise Policy (2000) states that:- *'The intrusiveness of an industrial noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq} descriptor) measured over a 15 minute period, does not exceed the background noise level measured in the absence of the source by more than 5 dB.'* Thus, when considering the environmental consequence of noise from a specific source, any increase above the background sound pressure level, which exceeds 5 dB, may be offensive.

The perception of noise and its level of offensiveness depends greatly on the broader situation within which it occurs. Noise that might intrude into a resting or sleeping place may be found offensive whereas the same noise occurring in a market place or noisy working area may pass unnoticed. The concept of *'background + 5 dB'* derives from this consideration.

The Industrial Noise Policy (2000) states that where the existing background noise level at the receptor is less than 30 dBA, as may occur in a quiet suburban or rural area, then 30 dBA should be assumed to be the existing background noise level.

Where the noise source contains characteristics such as prominent tonal components, impulsiveness, intermittency, irregularity or dominant low-frequency content, adjustments to the measured level are applied to allow for the increase in the annoyance value.

3.1.2 Protecting Noise Amenity

In the Industrial Noise Policy it is stated that *'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 Table 2.1.'*

The relevant parts of the recommended levels are given in Table 2 below:-

TABLE 2 – RECOMMENDED NOISE LEVELS FROM INDUSTRIAL NOISE SOURCES.

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level (dBA)	
			Acceptable	Recommended Maximum
Residence	Rural	Day Evening Night	50 45 40	55 50 45
Residence	Suburban	Day Evening Night	55 45 40	60 50 45
Residence	Urban	Day Evening Night	60 50 45	65 55 50
Residence	Urban/Industrial Interface – for existing situations only	Day Evening Night	65 55 50	70 60 55
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

Hence the acceptable **amenity** noise level ANL (L_{Aeq}) for rural areas is **50 dBA** day time; **45 dBA** evening time and **40 dBA** night time. Day time is defined as 07:00 to 18:00 hours, evening is 18:00 to 22:00 hours and night time is 22:00 hours to 07:00 hours. Modifications are made to the ANL to account for the existing level of industrial noise. These are shown in Table 3 below:-

TABLE 3 - MODIFICATIONS TO THE ACCEPTABLE NOISE LEVEL TO ACCOUNT FOR THE EXISTING LEVEL OF INDUSTRIAL NOISE.

Total existing L_{Aeq} noise level from Industrial sources, dBA	Maximum L_{Aeq} noise level from new sources alone, dBA
Acceptable noise level plus 2	Existing noise level minus 10
Acceptable noise level plus 1	Acceptable noise level minus 8
Acceptable noise level	Acceptable noise level minus 8
Acceptable noise level minus 1	Acceptable noise level minus 6
Acceptable noise level minus 2	Acceptable noise level minus 4
Acceptable noise level minus 3	Acceptable noise level minus 3
Acceptable noise level minus 4	Acceptable noise level minus 2
Acceptable noise level minus 5	Acceptable noise level minus 2
Acceptable noise level minus 6	Acceptable noise level minus 1
< Acceptable noise level minus 6	Acceptable noise level

3.1.3 Modifying Factor Adjustments

Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same sound pressure level. A correction should be applied to both the intrusive and the amenity measurement before a comparison is made with the criteria. An abbreviated version of the correction factors is shown in Table 4 below:-

TABLE 4 – MODIFYING FACTOR CORRECTIONS

Factor	Assessment/ Measurement	When to Apply	Correction	Comments
Tonal Noise	One-third octave band or narrow band analysis	Level of one third octave band exceeds the level of the adjacent bands by 5 dB or more (above 400 Hz)	+ 5 dB	Narrow band frequency analysis may be required to precisely detect occurrence
Low Frequency Noise	Measurement of C-weighted and A-weighted Level	Measure/assess C and A-weighted levels over same time period. Correction to be applied if the difference between the two is 15 dB or more	+ 5 dB	C-weighted is designed to be more responsive to low frequency noise
Impulsive Noise	Time weighting fast and impulse	If the difference in the A weighted maximum levels between ‘fast’ and ‘impulse’ are greater than 2 dB	Apply the difference in measured levels as the correction up to a maximum of 5 dB	Impulse time weighting is characterised by a short rise time (35msec) compared to 125msec for ‘fast’.
Intermittent Noise	Subjectively Assessed	Level varies by more than 5 dB	+ 5 dB	Adjustment to be applied for night time only

3.2 NSW Government Criteria for Road Traffic Noise

The NSW Government has produced criteria for road traffic noise *'Environmental Criteria for Road Traffic Noise'* (May 1999). This provides criteria for land use expansions with potential to create additional traffic on collector roads. Here the criterion ($L_{Aeq,\ 1\ hour}$) is 60 dBA for day time (7:00 hours until 22:00 hours) and 55 dBA for night time (22:00 hours until 07:00 hours).

Where criteria are already exceeded, traffic arising from the expansion should not lead to an increase in existing noise levels of more than 2 dB.

3.3 Rail Infrastructure Corporation / State Rail Authority - Interim Guidelines for Applicants November 2003.

The relevant criteria are the Rail Infrastructure Corporation/State Rail Authority interim guidelines for applicants and Councils (November 2003).

The Rail Infrastructure Corporation/State Rail Authority has produced interim guidelines for applicants and Councils giving consideration to rail noise and vibration in the planning stage (November 2003). This states that new residential buildings should be designed and constructed to comply with the design criteria (shown in Table 5 below) in habitable rooms, with external windows and doors closed.

TABLE 5 – RECOMMENDED DESIGN SOUND LEVEL FOR RESIDENTIAL BUILDINGS. FROM RIC INTERIM GUIDELINES FOR APPLICANTS.

Internal Space	Time Period	Railway Noise Level ($L_{Aeq,\ 1\ hour}$)
Living and Sleeping Areas	Day (7:00 am to 10:00 pm)	40 dBA
	Night (10:00 pm to 7:00 am)	35 dBA

If noise levels with windows or doors open exceed these criteria by more than 10 dBA, the design of the ventilation for these rooms should be such that the occupants can keep the windows closed if they so desire.

3.3.1 Rail Vibration

Floor vibration levels in habitable rooms should comply with the criteria in British Standard BS 6472: 1992 *'Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)'.*

Whole body vibration is assessed in terms of frequency weighted root-mean square (r.m.s) acceleration. The frequency weighting is based on the base curve as given in the British Standard referenced above and also the Australian Standard AS 2670 *'Evaluation of human exposure to whole body vibration'* (2001) and, in particular, AS 2670 part 2 (1990).

The base curve, given in the Standard, represents an overall frequency-weighted r.m.s acceleration magnitude of 0.005 m/s^2. Criteria for residential premises are overall frequency-weighted magnitudes of **0.007 m/s^2 to 0.01 m/s^2** for continuous vibration (night and day respectively) and **0.1 m/s^2 to 0.3 m/s^2** for intermittent or impulsive vibration (night and day respectively).

3.4 Construction Site Noise

Noise policy and criteria for construction noise are currently being revised by the Department of the Environment and Conservation (DEC) NSW State Government. Government license conditions would emphasize work practice approach rather than noise limits. A license would set achievable conditions based on what was both feasible and reasonable and target community consultation. However until the new guideline is published guidelines in the 'Environmental Noise Control Manual' (1994), Chapter 171 would apply. This states:-

"Where there is likelihood of annoyance due to noise from construction sites, conditions such as the following may be specified in a development consent or building application.

This applies particularly to non-scheduled premises such as commercial buildings where a long construction time is not likely.

Variation should be made according to local conditions.

Level Restrictions

i. *Construction period of 4 weeks and under.*

   The L_{10} level measured over a period of not less that 15 minutes when the construction site is in operation must not exceed the background level by more than 20 dB(A).

ii. *Construction period greater than 4 weeks and not exceeding 26 weeks.*

> *The L_{10} level measured over a period of not less that 15 minutes when the construction site is in operation must not exceed the background level by more than 10 dB(A).*

Time Restrictions

Monday to Friday, 7 am to 6 pm, Saturday, 7 am to 1 pm if inaudible on residential premises, otherwise 8 am to 1 pm.

No construction work to take place on Sundays or Public Holidays

Silencing

All possible steps should be taken to silence construction site equipment."

4. NOISE MEASUREMENTS AND SOURCE NOISE LEVELS

4.1 Existing Background and Ambient Noise Measurements

This section describes the instrumentation used for the existing background and ambient noise measurements, the measurement procedure and the results. The measurement locations are shown in Figure 1 and were chosen to be representative of the nearest residential properties to the proposed development site.

4.1.1 Instrumentation

The instrumentation used during the noise survey consisted of two 'Acoustic Research Laboratories Pty Ltd' - Type 1 Environmental Noise Loggers (serial numbers 194569 and 194550).

These loggers conform to Australian Standard 1259 "Acoustics - Sound Level Meters", (1990) as type 2 precision sound level meters and have accuracies suitable for field use.

The logger calibrations were checked before and after the measurement period with a Brüel and Kjær acoustical calibrator model 4230 (serial no. 2445349). No significant system drift occurred over the measurement periods.

4.1.2 Measurement Procedure

The noise logger measurements commenced on Thursday 2 March 2006 and finished on Monday 13 March 2006. The full results are shown in graphical form in Appendix A. The ‘fast’ time weighting and ‘A’ frequency weighting were used. All measurements were taken at a height of approximately 1.5 metres. The results are necessarily a "snapshot" of the noise levels on the particular days of the survey. Noise levels can vary with time due to different weather or traffic conditions, also low level measurements can be affected by animal or insect noises. However, during the noise survey it was understood that the noise levels were typical and the weather, which was hot with no rain, did not have an adverse effect on the measurements. One logger was situated at the closest residential property to the proposed site (Farm 641) at the rear of the property and one logger was situated on the proposed site, approximately 135 metres from the roadway.

4.1.3 Measurement Results

The assessment background noise level ABL (L_{A90}) is determined by the tenth percentile method for each period (i.e. day, evening and night) and for each day is shown in Tables 6 and 8 below. The rating background noise levels RBL (L_{A90}) over the monitoring period is found from the median ABL value for the day time, evening time, and night time respectively. This is shown in Tables 7 and 9 below together with the logarithmic average of the existing ambient noise (L_{Aeq}).

TABLE 6 – EXISTING NOISE LEVELS – On Site (Weather Station – Approximately 135 metres from the road).

Date	Time of Day	Assessment Background Noise Levels (L_{A90})	Existing Ambient Noise Levels (L_{Aeq})
2/03/06	Day	29	48
2/03/06	Evening	35	50
2-3/03/06	Night	26	47
3/03/06	Day	28	47
3/03/06	Evening	32	48
3-4/03/06	Night	26	45
4/03/06	Day	27	44
4/03/06	Evening	29	46
4-5/03/06	Night	26	43
5/03/06	Day	27	41
5/03/06	Evening	29	46
5-6/03/06	Night	26	43
6/03/06	Day	28	49
6/03/06	Evening	33	46
6-7/03/06	Night	26	44
7/03/06	Day	31	48
7/03/06	Evening	28	46
7-8/03/06	Night	26	46
8/03/06	Day	27	46
8/03/06	Evening	33	47
8-9/03/06	Night	26	48
9/03/06	Day	27	52
9/03/06	Evening	27	48
9-10/03/06	Night	27	48
10/03/06	Day	27	46
10/03/06	Evening	30	47
10-11/03/06	Night	27	46
11/03/06	Day	27	46
11/03/06	Evening	27	46
11-12/03/06	Night	27	44
12/03/06	Day	28	53
12/03/06	Evening	31	46
12-13/03/06	Night	27	47
13/03/06	Day	28	44

Notes - All levels rounded to the nearest whole decibel. The survey started on Thursday 2 March 2006 and finished on Monday 13 March 2006.

TABLE 7 – SUMMARY OF NOISE LEVELS – On Site at Weather Station – Approximately 135 metres from the road.

Time of Day	Rating Background Noise Levels (L_{A90})	Log Average Existing Ambient Noise Levels (L_{Aeq})
Day	**27**	**48**
Evening	**30**	**47**
Night	**Less than 26**	**46**

The measurements from the unattended noise loggers include noise from all sources including local road traffic, animal noise, insect noise, etc. Many of these noises are not constant enough to affect the background noise ($L_{A90,\ 15\ minute}$), which need to be present 90% of the 15-minute measurement time to have an effect. However they can have a large effect on the ambient noise ($L_{Aeq,\ 15\ minute}$), which is a simple (although logarithmic) average of all of the sound energy levels received at the microphone position.

TABLE 8 – EXISTING NOISE LEVELS – At the Rear of Farm 641.

Date	Time of Day	Assessment Background Noise Levels (L_{A90})	Existing Ambient Noise Levels (L_{Aeq})
2/03/06	Day	31	45
2/03/06	Evening	36	43
2-3/03/06	Night	37	44
3/03/06	Day	29	44
3/03/06	Evening	38	44
3-4/03/06	Night	36	42
4/03/06	Day	35	43
4/03/06	Evening	39	43
4-5/03/06	Night	35	42
5/03/06	Day	27	43
5/03/06	Evening	35	44
5-6/03/06	Night	32	43
6/03/06	Day	29	49
6/03/06	Evening	36	41
6-7/03/06	Night	32	41
7/03/06	Day	35	46
7/03/06	Evening	36	41
7-8/03/06	Night	31	40
8/03/06	Day	27	43
8/03/06	Evening	36	44
8-9/03/06	Night	33	43
9/03/06	Day	27	46
9/03/06	Evening	41	61
9-10/03/06	Night	32	41
10/03/06	Day	27	46
10/03/06	Evening	41	44
10-11/03/06	Night	39	42
11/03/06	Day	27	47
11/03/06	Evening	42	49
11-12/03/06	Night	36	42
12/03/06	Day	32	57
12/03/06	Evening	42	46
12-13/03/06	Night	29	46
13/03/06	Day	44	39

Notes - All levels rounded to the nearest whole decibel. The survey started on Thursday 2 March 2006 and finished on Monday 13 March 2006.

The full statistical noise measurement results are shown in graphical form in Appendix A.

TABLE 9 – SUMMARY OF NOISE LEVELS – At the Rear of Farm 641.

Time of Day	Rating Background Noise Levels (L_{A90})	Log Average Existing Ambient Noise Levels (L_{Aeq})
Day	**27**	**45**
Evening	**36**	**45**
Night	**32**	**42**

The higher evening and night time noise levels are thought to be due to the outdoor air conditioning units at the farm premises. Therefore the INP minimum 30 dBA is used for all project specific noise goals.

4.2 Source Noise Levels

This section provides specific sound power levels, derived from 1/3 octave band sound pressure level measurements carried out at various sites, of equipment similar to that proposed at the Ethanol plant. These are given in terms of octave band sound power levels in decibels re: 10^{-12} Watts, the ‘A’ frequency weighted sound power levels in decibels re: 10^{-12} Watts and the equivalent ‘A’ frequency weighted sound pressure levels in decibels re 20 µPa at a standardised distance of 10 metres.

4.2.1 Stationary Plant Instrumentation

The instrumentation used during the noise surveys at various sites consisted of a Brüel and Kjær sound level meter model 2260 (serial no. 2311706). This meter conforms to Australian Standard 1259 "*Acoustics - Sound Level Meters*", (1990) as type 1 precision sound level meter and has an accuracy suitable for both field and laboratory use.

The calibration of the meter was checked before and after the measurement periods with a Brüel and Kjær acoustical calibrator model 4231 (serial no. 2385023). No significant system drift occurred over the measurement periods.

The sound level meter and calibrator were checked, adjusted and aligned to conform to the Brüel and Kjær factory specifications and issued with conformance certificates within the last two years. The internal test equipment used is traceable to the National Measurement Laboratory at C.S.I.R.O., Lindfield, NSW, Australia.

The measurements were taken at a height of approximately 1.5 metres at various distances from plant in operation. The measurements were taken in a direction from the noise sources that provided the highest typical noise level. A Brüel and Kjær windshield was fitted to the microphone. The ‘A’ frequency weighting, the 'fast' time weighting and real time 1/3 octave band frequencies between 16 Hz and 12.5 kHz were used exclusively.

4.2.2 Stationary Plant Results

The source noise levels for stationary plant are shown in Table 10 below.

TABLE 10 – NOISE LEVELS OF STATIONARY PLANT SOURCES

Source	Sound Power Levels (dB re 10^{-12} Watts) Octave Band Centre Frequency (Hz)								Sound Power Level (L_w) re: 10^{-12} W	Sound Pressure Level (L_p) re: 20 µPa at 10 metres
	63	125	250	500	1k	2k	4k	8k	dBA	dBA
Hammermill in enclosure	100	101	111	110	107	104	100	95	112	84
Vacuum Dryer	80	78	88	86	89	87	83	80	93	65
Centrifuge	89	82	84	87	89	88	86	82	94	66
Fans	91	86	84	89	87	84	80	72	91	63
Distillation System & Fermenters	107	102	100	98	98	96	96	87	104	76
Electric Motor Driven Pumps	90	108	90	91	96	92	84	74	100	72
Compressors	91	95	95	95	87	83	79	71	95	67

- *Notes; All levels are rounded to the nearest whole decibel. The level in the last column assumes point noise sources and is calculated from the inverse square law i.e.* $L_{p,\ 10\ metres} = L_w - 10 \log_{10} (10)^2 - 10 \log_{10} (2\pi) = L_w - 28$ *dB. The 10-metre distance was chosen as arbitrary to give a better indication of the magnitude of the noise level at a standardised distance.*

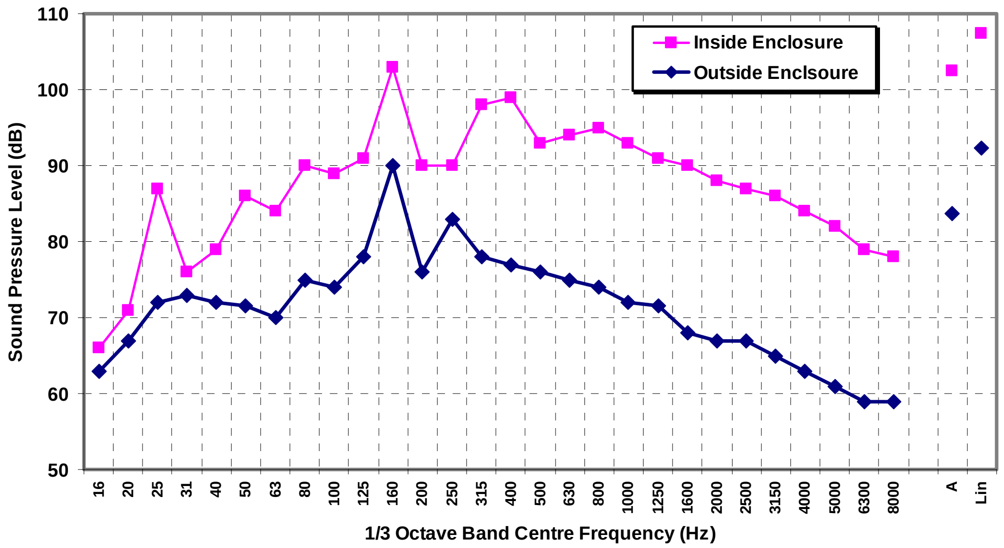


Figure 2. 1/3 Octave Band Frequency Analysis of a Hammermill both Inside and Outside an Enclosure. This Unweighted Analysis Shows a Strong Tone at 160 Hz, which alone is 91 dBA inside and 76 dBA Outside.

4.2.3 On-Site Mobile Plant

The source noise levels for on-site mobile plant are shown in Table 11 below.

TABLE 11 - NOISE LEVELS OF ON-SITE MOBILE PLANT SOURCES

Source	Sound Power Levels (dB re 10^{-12} Watts) Octave Band Centre Frequency (Hz)								Sound Power Level re 10^{-12} W	Sound Pressure Level at 10 metres
	63	125	250	500	1k	2k	4k	8k	dBA	dBA
Small Forklift	94	86	85	87	85	84	77	71	90	62
Large Forklift	86	88	92	92	93	92	82	78	98	70
'Mack' Truck at Idle	86	83	78	80	82	79	77	70	86	58

Notes; All levels are rounded to the nearest whole decibel. The level in the last column assumes point noise sources and is calculated from the inverse square law i.e. $L_{p\,,\,10\,metres} = L_w - 10\log_{10}(10)^2 - 10\log_{10}(2\pi) = 28$ *dB. The 10-metre distance is chosen as arbitrary to give a better indication of the magnitude of the noise level at a standardised distance.*

4.2.4 On Road Traffic

The noise levels from a sample of existing road traffic including cars, motor cycles trucks, B-double trucks and road trains were measured at a distance of 20 metres from the road (Kidman Highway/ Jerilderie – Darlington Point Road). This gave an energy average sound pressure level ($L_{Aeq,\ 1\ hour}$) of 60 to 65 dBA at 'fast' speed (about 80 km/hr).

TABLE 12 - NOISE LEVELS OF ROAD TRAFFIC SOURCES

Traffic Flow (Extrapolated to Vehicles per hour)	Percentage of Heavy Traffic	Noise Level at 20 metres ($L_{Aeq,\ 1\ hour}$)
90	30%	65 dBA
48	37%	62 dBA
57	16%	60 dBA
48	15%	60 dBA

4.2.5 Rail Traffic

Noise measurements have previously been carried out of country freight trains at approximately 16 metres from a railway line and at a height of approximately 1.5 metres.

The 'A' frequency weighting and the 'fast' time weighting were used exclusively. The weather, during the measurement period was fine and sunny with negligible wind. The noise measurement results are shown in Table 13 below:-

TABLE 13 – FREIGHT RAIL NOISE MEASUREMENT RESULTS (14 March 2005)

Energy Average During Passby ($L_{Aeq,\ 2\ minute}$)	Sound Exposure Level (L_{AE})	Maximum Noise Level (L_{Amax})
69 dBA	**89 dBA**	**93 dBA**

Note:
All results are rounded to the nearest whole decibel.

4.2.6 Dairy Plant

Measurements were taken at an existing milk processing facility and are considered to be representative of the type of operation proposed at the site. Table 14 below shows the measurement results for the various types of equipment associated with the operation as well as noise levels supplied by manufacturers for the chiller and condenser.

TABLE 14 – MEASURED SOUND PRESSURE LEVELS.

Noise Source	**Sound Pressure Level dBA Octave Band Frequency (Hz)**							
	125	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**Overall**
Separator & Pasteuriser	52	60	65	70	73	68	63	76
Conveyer - Motor & Gearbox	50	63	61	75	79	72	64	81
Homogeniser	50	58	66	68	72	68	63	76
Labeller	54	61	70	71	75	70	63	79
Chiller – Full Speed	77	83	77	74	70	69	60	85
Condenser – 2 Fan – High Speed	63	62	62	69	72	67	60	75

Notes: All levels rounded to nearest whole decibel
Measured levels are all at close range in a reverberant field
Chiller and condenser levels normalised to 1 metre + 3 dB for reverberant field.

4.2.7 Cattle

Measurements of cattle noise was carried out on Sunday 2 July 2006 at a quiet rural property with negligible extraneous noise other than birds that were not audible whilst vocal adult cows were measured.

Approximately 40 cows were in the field with a maximum simultaneously vocal at any one time of 6. Adult cows were measured when vocal at varying distances with the closest at approximately 20 metres and the furthest at approximately 40 metre**s.** One, tethered calf was measured at a distance of 5 metres.

Adult cows will generally only be vocal at feeding times, approximately twice per day and during or immediately after birth. Calves will be vocal sporadically throughout the day and on most days.

The results were 58 dBA for 6 adult cows at 20 metres and 53 dBA for a calf at 5 metres (equivalent to 41 dBA at 20 metres). The 1/3 octave band spectra are shown in Figure 3 below.

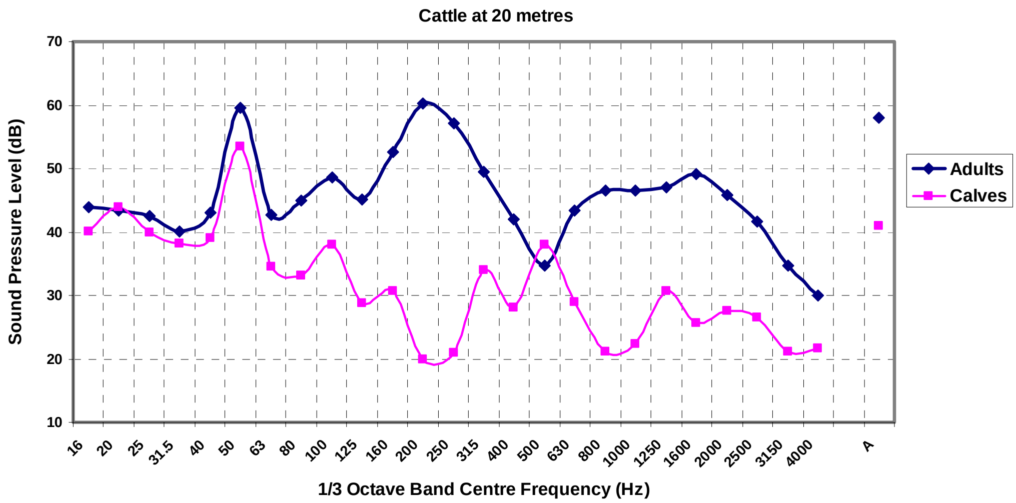


Figure 3. 1/3 Octave Band Frequency Analysis of a Cattle.

4.2.8 Water Treatment Plant

The source noise levels for typical wastewater treatment plant are shown in Table 15 below.

TABLE 15 – NOISE LEVELS OF STATIONARY PLANT SOURCES

Source	Sound Power Levels (dB re 10^{-12} Watts) Octave Band Centre Frequency (Hz)								Sound Power Level (L_w) re: 10^{-12} W	Sound Pressure Level (L_p) re:20 µPa at 10 metres
	63	125	250	500	1k	2k	4k	8k	dBA	dBA
PDA Blower 1750m3/hr, 40 si, 3490 rpm	84	85	86	82	80	82	80	79	88	60
Yenda Waste Water Treatment Plant	87	89	88	88	85	81	79	78	90	62

The sound pressure level of the PDA blower measured in 1/3 octave bands is shown in Figure 4 below. This shows frequency peaks at 160 Hz and 320 Hz which are likely to be associated with the rotation speed of the equipment.

However this sound level does not represent a spectrum where modifying factors apply as defined by the INP (2000) see Table 4 above.

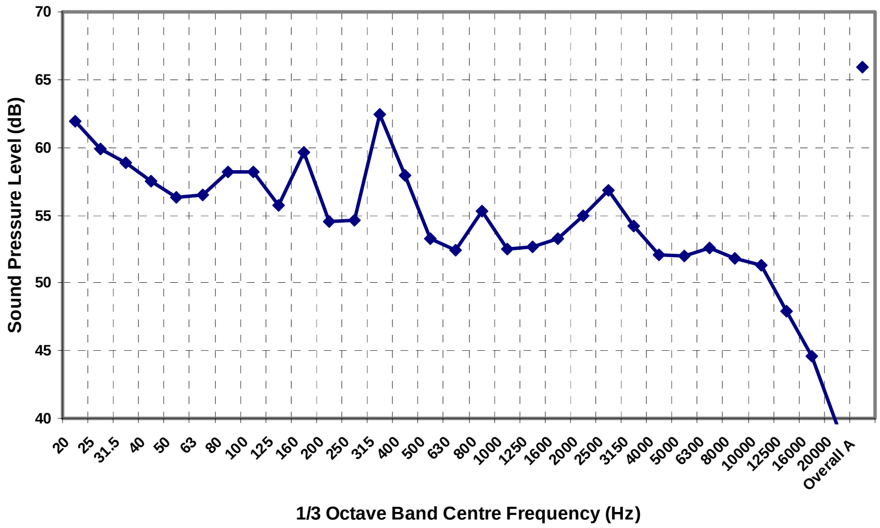


Figure 4. 1/3 Octave Band Centre Frequency of the PDA blower (model SN809.)

4.2.9 Construction Plant

The source noise levels for construction plant are shown in Table 16 below.

TABLE 16 - NOISE LEVELS OF CONSTRUCTION PLANT SOURCES

Source	Sound Power Levels (dB re 10^{-12} Watts) Octave Band Centre Frequency (Hz)								Sound Power Level re 10^{-12} W	Sound Pressure Level at 10 metres
	63	125	250	500	1k	2k	4k	8k	dBA	dBA
Watercart	94	86	82	80	82	78	75	73	86	58
Small Grader	95	85	80	79	82	77	69	63	85	57
Dozer	94	101	86	86	87	86	82	75	93	65
Crane	Not Available								105	77
Loader	Not Available								100	72
Excavator	99	102	90	87	89	85	85	79	94	66

Notes; All levels are rounded to the nearest whole decibel. The level in the last column assumes point noise sources and is calculated from the inverse square law i.e. $L_{p,\ 10\ metres} = L_w - 10\ log_{10}\ (10)^2 - 10\ log_{10}\ (2\pi) = 28$ *dB. The 10-metre distance is chosen as arbitrary to give a better indication of the magnitude of the noise level at a standardised distance.*

5. NOISE GOALS

It is important to note that the goals given below are for the noise level solely from the facilities in question and do not include extraneous noise from other sources. All noise goals from on-site sources are considered below. The most stringent applicable goals are applied for the **overall project specific noise goals** as shown in Table 19 below. No modifying factor corrections for character are deemed to apply.

5.1 Intrusive Noise Goals

For intrusive noise the goal is 5 dB plus the background noise level (L_{A90}) and these are shown in Table 17 below.

TABLE 17 – INTRUSIVE NOISE GOALS FROM INP (2000).

Time of Day	Rating Background Noise Levels (L_{A90})	Intrusive Noise Level Goal (L_{Aeq})
Day	**30**	**35**
Evening	**30**	**35**
Night	**30**	**35**

The Industrial Noise Policy (INP) is applied where the noise is produced continuously for the full year or close to the full year.

5.2 Noise Amenity Goals

The amenity noise goal is dependent upon the existing ambient noise level (L_{Aeq}) from other industrial sources. As there are no other industrial sources in the immediate area the 'Rural' amenity criteria apply. These are shown in Table 18 below.

TABLE 18 – SUMMARY OF EXISTING NOISE LEVELS – All Locations

Time of Day	Amenity Noise Level Goal (L_{Aeq})
Day	**50**
Evening	**45**
Night	**40**

5.3 Overall Project Specific Goals for On- Site Noise

In summary, the project specific noise goals for all relevant locations are shown in Table 19 below:-

TABLE 19 – OVERALL PROJECT SPECIFIC NOISE GOALS – FOR ON SITE PLANT AND EQUIPMENT.

Period	Intrusive Criterion	Amenity Criterion
Day	**35 dB $L_{Aeq, 15 minutes}$** (30 + 5)	50 dB $L_{Aeq, Day}$
Evening	**35 dB $L_{Aeq, 15 minutes}$** (30 + 5)	45 dB $L_{Aeq, Evening}$
Night	**35 dB $L_{Aeq, 15 minutes}$ (30 + 5)**	40 dB $L_{Aeq, Night}$

Note: The goals in bold apply.

5.4 On-Road Traffic Noise Goals

The external noise goal for land use expansions with potential to create additional traffic on local roads ($L_{Aeq, 1 hour}$) is 55 dBA for day time (7:00 hours until 22:00 hours) and 50 dBA for night time (22:00 hours until 07:00 hours).

5.5 Rail Traffic Noise Goals

The external noise goal for rail traffic ($L_{Aeq, 1 hour}$) is 50 dBA for day time (7:00 hours until 22:00 hours) and 45 dBA for night time (22:00 hours until 07:00 hours).

5.6 Construction Noise Goals

It is likely that the major part of the construction of the ethanol plant will be within the 4 to 26 week time period. Hence the upper percentile level ($L_{A10, 15 minute}$) when the construction site is in operation must not exceed **40 dBA** (i.e. the measured background level (L_{A90}) of 30 dBA plus 10 dB in the day time).

Construction works should not be carried out outside of day time hours (7 am to 6 pm), Monday to Friday or from 8 am to 1 pm on Saturday. No construction work should take place on Sundays or Public Holidays.

6. NOISE MODELLING AND ASSESSMENT

This section provides details of the noise modelling procedure and gives an assessment of the predicted noise levels.

6.1 Noise Modelling Specifications

The source noise has been modelled using the International Standard ISO 9613-2 (1996(E)) '*Acoustic – Attenuation of sound during propagation outdoors Part 2 General method of calculation'*. This Standard specifies methods for the description of noise outdoors in community environments. The method described in the Standard is general in the sense that it may be applied to a wide variety of noise sources, and covers the major mechanism of attenuation. The method allows for downwind propagation conditions namely:-

- wind direction within an angle of ± 45° of the direction connecting the centre of the dominant sound source and the centre of the specified receiver region with the wind blowing from source to receiver, and
- wind speed between approximately 1 m/s and 5 m/s measured at a height of 3 m to 11 m above the ground.

The Standard also states that *'These equations also hold, equivalently, for average propagation under a well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm nights'.*

6.2 Basic Noise Modelling Equations

The equivalent continuous downwind sound pressure level (L_{Aeq}) at each receiver point has been calculated for each point source using the equation below:-

$$\mathbf{L_{Aeq} = L_w + D_c} - \boldsymbol{A}$$

Where:

L_w is the sound power level of the noise source;
D_c is directivity correction; and
A is the attenuation that occurs during the propagation from source to receiver.

The attenuation term A in the equation above is given by:-

$$\boldsymbol{A = A_{div} + A_{atm} + A_{gr} + A_{bar} + A_{misc}}.$$

Where:

A_{div} is the attenuation due to geometric divergence;
A_{atm} is the attenuation due to atmospheric absorption;
A_{gr} is the attenuation due to the ground effects;
A_{bar} is the attenuation due to a barrier; and
A_{misc} is the attenuation due to miscellaneous other effects.

The noise attenuation due to barriers (A_{bar}) is a variable and is dependent upon the specific position of the plant and equipment. It can range from almost zero where a direct line of sight is applicable to 10 dB or even as much as 25 dB where plant is well shielded within the site. Atmospheric absorption (A_{atm}) is highly frequency dependant and is significant for the high frequency components of noise sources but insignificant for the low frequency components. Ground effects (A_{gr}) are significant over soft ground as is applicable for farm areas.

The last term generally refers to miscellaneous propagation through foliage, industrial sites and areas of houses. These factors are insignificant for the site in question and are not applied in this NIS.

6.3 Prediction of Stationary Plant Noise

The assessment results for constant operation of the proposed stationary plant, at the nearest industrial and residential receivers are shown in Tables 20 and 21 below.

TABLE 20 – PREDICTED NOISE LEVELS OF STATIONARY SOURCES AT INDUSTRIAL RECEIVERS - 300 METRES.

Source	Sound Pressure Level (L_p) re: 20 µPa at 300 metres								
	Unweighted Octave Band Centre Frequency (Hz)								Overall dBA ($L_{Aeq, 15 minute}$)
	63	125	250	500	1k	2k	4k	8k	
Hammermill in enclosure	45	46	56	55	51	47	39	17	56
Vacuum Dryer	25	23	33	31	33	30	22	2	36
Centrifuge	34	27	29	32	33	31	25	4	37
Fans	36	31	29	34	31	27	19	-6	35
Distillation System & Fermenters	52	47	45	43	42	39	35	9	46
Electric Motor Driven Pumps	35	53	35	36	40	35	23	0	43
Compressors	36	40	40	40	31	26	18	0	39
TOTAL									**56**

Note: All levels are rounded to the nearest whole decibel.

TABLE 21 – PREDICTED NOISE LEVELS OF STATIONARY SOURCES AT RESIDENTIAL RECEIVERS - 2000 METRES.

Source	Sound Pressure Level (L_p) re: 20 μPa at 2000 metres								
	Unweighted Octave Band Centre Frequency (Hz)								Overall dBA ($L_{Aeq, 15 minute}$)
	63	125	250	500	1k	2k	4k	8k	
Hammermill in enclosure	29	30	38	33	26	15	0	0	34
Vacuum Dryer	9	7	15	9	8	0	0	0	12
Centrifuge	18	11	11	10	8	0	0	0	12
Fans	20	15	11	12	6	0	0	0	12
Distillation System & Fermenters	36	31	27	21	17	7	0	0	23
Electric Motor Driven Pumps	19	37	17	14	15	3	0	0	22
Compressors	20	24	22	18	6	0	0	0	18
TOTAL									**34**

Note: All levels are rounded to the nearest whole decibel.

6.4 Prediction of On-Site Mobile Plant

The assessment results for constant operation of the proposed on-site mobile plant associated with the development at the nearest residential receivers are shown in Table 22 below.

TABLE 22 – PREDICTED NOISE LEVELS OF ON-SITE MOBILE SOURCES AT NEAREST INDUSTRIAL RECEIVERS - 300 METRES.

Source	Sound Pressure Level (L_p) re: 20 µPa at 300 metres								
	Unweighted Octave Band Centre Frequency (Hz)								Overall dBA ($L_{Aeq,\ 15\ minute}$)
	63	125	250	500	1k	2k	4k	8k	
Small Forklift	32	24	23	24	23	21	14	9	22
Large Forklift	24	26	29	30	31	30	20	16	30
‘*Mack*’ Truck at Idle	24	20	15	17	20	17	14	8	19
TOTAL									31

Note: All levels are rounded to the nearest whole decibel.

6.5 Temperature Inversion and Wind Effects

It is likely that during temperature inversions and strong wind conditions in unfavourable directions the predicted noise levels at the site could increase by 3 to 6 dB. Temperature inversions are likely to occur between May and October.

6.6 Prediction of On-Road Traffic Noise

This section gives predictions of the noise level from road traffic, using Jerilderie-Darlington Point Road, applying formulae given in the Calculation of Road Traffic Noise from the UK Department of Transport and Welsh Office (1988) and verification with on-site truck noise measurements.

The estimated vehicle movements entering or leaving the site via Jerilderie-Darlington Point Road are 460 per 15-hour day (i.e. 360 heavy vehicles and 100 light vehicles) which equates to an average 15.6 trucks per hour. The calculated truck noise levels results for north and south bound heavy traffic are shown in Tables 23a and 23 B below.

TABLE 23A – PREDICTED NOISE LEVELS OF ON-ROAD TRUCKS AT RESIDENTIAL RECEIVERS - SOUTH

Scenario	Average Number of Trucks per hour	Number of Trucks Movements per hour	Noise Level ($L_{Aeq, 1 hour}$) dBA	
			at 40 metres	at 20 metres
Average	4.8	9.6	53	56
Worst Case Hour / Day Time	5.6	11.2	54	57
Night Time Movements	0	0	Not Applicable	

Notes: All levels are rounded to the nearest whole decibel. Worst case model is based on 11.2 trucks per hour, to factor into the equation possible delays in loading at railhead, breakdowns etc.

TABLE 23B – PREDICTED NOISE LEVELS OF ON-ROAD TRUCKS AT RESIDENTIAL RECEIVERS- NORTH

Scenario	Average Number of Trucks per hour	Number of Trucks Movements per hour	Noise Level ($L_{Aeq, 1 hour}$) dBA	
			at 40 metres	at 20 metres
Average	7.2	14.4	55	57
Worst Case Hour / Day Time	8.4	16.8	56	58
Night Time Movements	0	0	Not Applicable	

Notes: All levels are rounded to the nearest whole decibel. Worst case model is based on 16.8 trucks per hour, to factor into the equation possible delays in loading at railhead, breakdowns etc.

6.7 Prediction of Rail Noise

Based on the measured sound exposure level (L_{AE}) of 89 dBA at 16 metres the hourly energy average ($L_{Aeq, 1 hour}$) for one train is found from the formula:-

$$L_{Aeq, 1 hour} = L_{AE} + 10 \log_{10} N - 10 \log_{10} (3600) \text{ dBA}$$

Where N is the number of trains in any one hour and 3600 is one hour in seconds.

Hence for 1 train

$$L_{Aeq, 1 hour} = L_{AE} - 35 \text{ dBA}$$

= 54 dBA at 16 metres

At 30 metres the noise level will be approximately 50 dBA (from 54 - 15 log10 (30/16))

6.8 Prediction of Dairy Plant Noise

The diary plant and sheds are to be located at least 1000 metres from the nearest residential premises. Plant located indoors will be below 20 dBA at 1000 metres. Plant that is required to be located outdoors or with outdoor air inlets or outlets such as refrigeration equipment (chiller and condensers) are assessed using formula as given in section 6.2 above. The results at the nearest residential boundary are shown in Table 24 below.

TABLE 24 – PREDICTED NOISE LEVELS FROM REFRIGERATION EQUIPMENT – NEAREST RESIDENTIAL BOUNDARY.

Noise Source	Predicted Sound Pressure Level dBA At the Nearest Residential Boundary
Chiller	**21**
Condenser	**15**

Note: All levels are rounded to the nearest whole decibel.

Calculations assume a minimum distance to the boundary of 1000 metres.

6.9 Prediction of Cattle Noise

Based on an assumption of 15% of 18,000 cattle vocal for 30 seconds in any one 15 minute time period the noise level at 20 metres would be:-

$$58 + 10 \log_{10}(18000 \times 0.15) + 10 \log_{10}(30/(15 \times 60) \text{ dBA}$$
$$=58 + 34 – 11 \text{ dBA}$$
$$= 80 \text{ dBA}$$

This equation is based on standard formula for the addition of sound sources (i.e. 10 $\log_{10}$ (n). At an average distance of 1000 metres this would reduce to **35 dBA** (from 80 – 10 log (1000/20 – 5 – 6). Where 5 dB is for ground attenuation and 6 dB is for atmospheric absorption.

6.10 Prediction of Water Treatment Plant Noise

The water treatment plant could be located as close as 170 metres from the nearest residential premises. Based on previously measured blowers used for aeration in water treatment plants and formula as given in section 6.2 above, the predicted noise levels at the nearest residential boundary are shown in Table 25 below.

TABLE 25 – NOISE LEVELS OF STATIONARY PLANT SOURCES

Source	Sound Power Levels (dB re 10^{-12} Watts) Octave Band Centre Frequency (Hz)								Sound Power Level (L_w) re: 10^{-12} W	Sound Pressure Level (L_p) re:20 µPa at 600 metres
	63	125	250	500	1k	2k	4k	8k	dBA	dBA
PDA Blower 1750m3/hr, 40 si, 3490 rpm	84	85	86	82	80	82	80	79	88	25
Yenda Waste Water Treatment Plant	87	89	88	88	85	81	79	78	90	27

Note: All levels are rounded to the nearest whole decibel.

6.11 Prediction of Construction Plant

The main construction of buildings will be at least 1000 metres from the nearest residential receivers. However some construction work is likely to be within 170 metres of the nearest residential receivers, for example the aerobic and anaerobic pond construction. The assessment results for operation of the proposed construction plant, at the nearest residential receivers are shown in Table 26 below.

TABLE 26 – PREDICTED NOISE LEVELS OF CONSTRUCTION PLANT AT RESIDENTIAL RECEIVERS - 170 METRES.

Source	Sound Pressure Level (L_p) re: 20 µPa at 170 metres Overall dBA ($L_{A10, 15 min}$)
Watercart	33
Small Grader	32
Dozer	40
Crane	52
Loader	47
Excavator	41
TOTAL	**54**

Note: All levels are rounded to the nearest whole decibel.

7. ASSESSMENT AND MITIGATION

A summary of all of the noise goals with the predicted noise levels are shown in Table 27 below.

TABLE 27 – A SUMMARY OF NOISE GOALS AND PREDICTED LEVELS.

Noise Source/ Receiver	Time of Day	Noise Goal $L_{Aeq, T}$ (dBA)	Noise Prediction $L_{Aeq, T}$ (dBA)
Industrial/Residential	Day/Evening	35	35
	Night	35	35
Industrial/ Industrial	When in Use	70	57
Industrial/ Commercial	When in Use	65	57
Road/ Residential	Day	55	55*
	Night	50	N/A*
Rail/ Residential	Day	50	50*
	Night	45	Not Applicable
Construction/Residential	Day	40+	54+
	Night	Not Applicable	Not Applicable

**Notes - At residences 40 metres from the roadway or rail line. +These values are $L_{A10, T}$ rather than $L_{Aeq, T}$. All levels are rounded to the nearest whole decibel.*

It can be seen from Table 27 above that the goals are met for:-

- Industrial and commercial receivers at 300 metres or more from the proposed development; and
- Residential receivers of road traffic at 40 metres or more from the roadway and rail traffic at 30 metres or more from the rail line.

The predicted noise levels are very close to the goals at the nearest residential receiver due to industrial noise and could exceed the limit assuming a +/- 4 dB confidence of the predicted results. The industrial noise is predominantly due to the hammermill which can be reduced by a further 5 dB with a better designed enclosure than the one measured. This will provide a 4 dB overall noise reduction and hence meet the noise goal within the 95% confidence limits. Other plant and equipment can be enclosed as required. Exceedances will then only be likely to occur under extreme wind or temperature inversion conditions.

The construction noise is predicted to significantly exceed the day time noise goal (i.e. by 14 dB) at the closest (170 metres) residential receiver (Farm 641). The noise goal is unlikely to be met until the construction works are at a distance of at least 900 metres from the residential dwelling. It is therefore recommended that an acoustic barrier in the form of an earth bund (mound) or fence is constructed between the construction works and Farm 641. A 2 metre high barrier constructed on the residential boundary line is likely to provide a noise reduction of approximately 5 dB if it cuts out the line of sight between the construction works and the residence.

8. CONCLUSIONS

It can be seen from the assessment results that: -

- The noise goals will be met for on-site stationary and mobile plant noise from the proposed development (with a suitable acoustic enclosure for the hammermill). The cattle noise level is predicted to meet the noise goal at an average distance of 1000 metres from the nearest residential boundary.

- The noise goals will be exceed for the daytime use of construction plant for the proposed development when operating relatively close to the nearest residential dwelling. An acoustic barrier will help to minimise the noise impact;

- The noise criteria for road and rail traffic from the proposed development will be met for residential dwellings 40 metres or more from the road or railway line respectively.

Date	Prepared by:	Status
28 March 2006	Ken Scannell MSc MAAS MIOA	Draft
21 April 2006	Ken Scannell MSc MAAS MIOA	Final
3 July 2006	Ken Scannell MSc MAAS MIOA	Rev A
6 July 2006	Ken Scannell MSc MAAS MIOA	Rev B
11 July 2006	Ken Scannell MSc MAAS MIOA	Rev C
19 July 2006	Ken Scannell MSc MAAS MIOA	Rev D
Date	**Checked by:**	**Status**
28 March 2006	Matthew Harwood AAAS	Draft
24 April 2006	Matthew Harwood AAAS	Final

Important Note. *All products and materials suggested by 'Noise and Sound Services' are selected for their acoustical properties only. All other properties such as airflow, aesthetics, chemical, corrosion, combustion, construction details, decomposition, expansion, fire rating, grout or tile cracking, loading, shrinkage, ventilation, etc are outside of 'Noise and Sound Services' field of expertise and* ***must be*** *checked with the supplier or suitably qualified specialist before purchase.*

APPENDIX A – MEASURED AMBIENT AND BACKGROUND NOISE LEVELS

Environmental noise levels can vary considerably with time; therefore it is not adequate to use a single number to fully describe the acoustic environment. The preferred, and now generally accepted, method of recording and presenting noise measurements is based upon a statistical approach. For example, the L_{A10} noise level is the level exceeded for 10% of the time, and is approximately the average maximum noise level. The L_{A90} level is the level that is exceeded for 90% of the time, and is considered to be approximately the average of the minimum noise level recorded. This level is often referred to as the 'background' noise level. The L_{Aeq} level represents the average noise energy during the measurement period. This level is often referred to as the 'ambient' noise level.

The following graphs are the noise logger results from measurements taken at the rear of the closest residential property to the proposed site - Farm 641 (Figures A1 to A12) and on the proposed site, approximately 135 metres from the roadway - Kidman Highway (Figures A13 to A24). The weather conditions were record at approximately 135 metres from the roadway during the time of noise logger measurements. These are shown in Appendix B below.

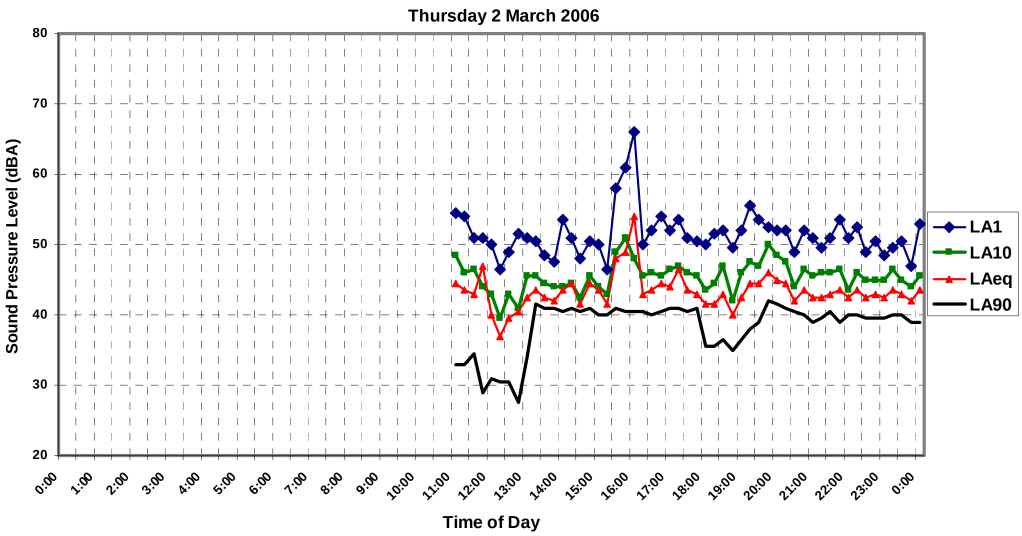


Figure A1 - Noise Logger Results from Measurements Taken at the Rear of the Closest Residential Property to the Proposed Site (Farm 641).

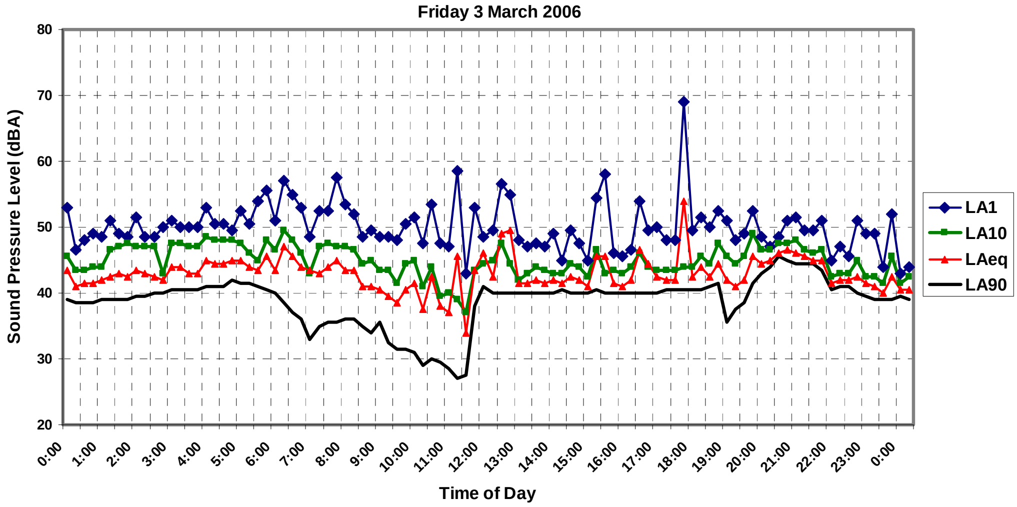


Figure A2 - Noise Logger Results from Measurements Taken at the Rear of the Closest Residential Property to the Proposed Site (Farm 641).

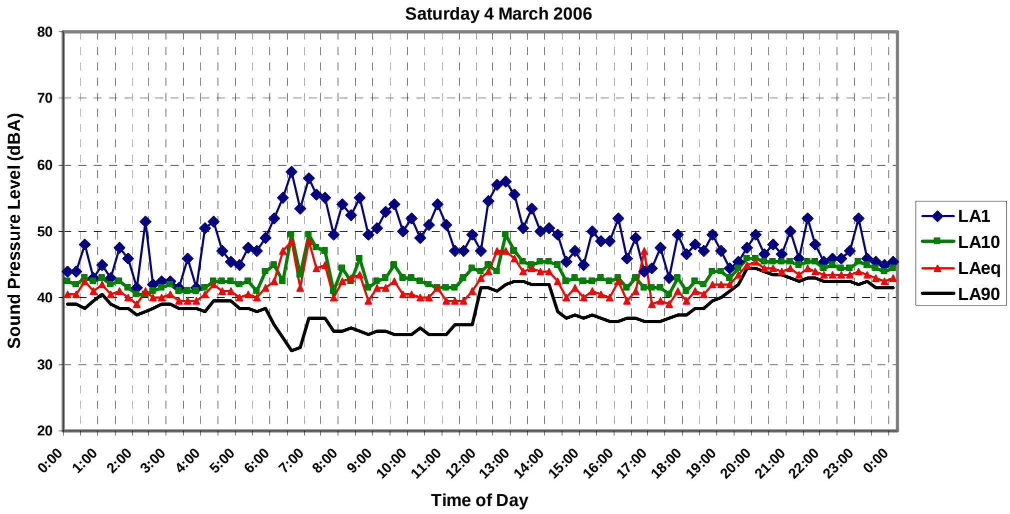


Figure A3 - Noise Logger Results from Measurements Taken at the Rear of the Closest Residential Property to the Proposed Site (Farm 641).

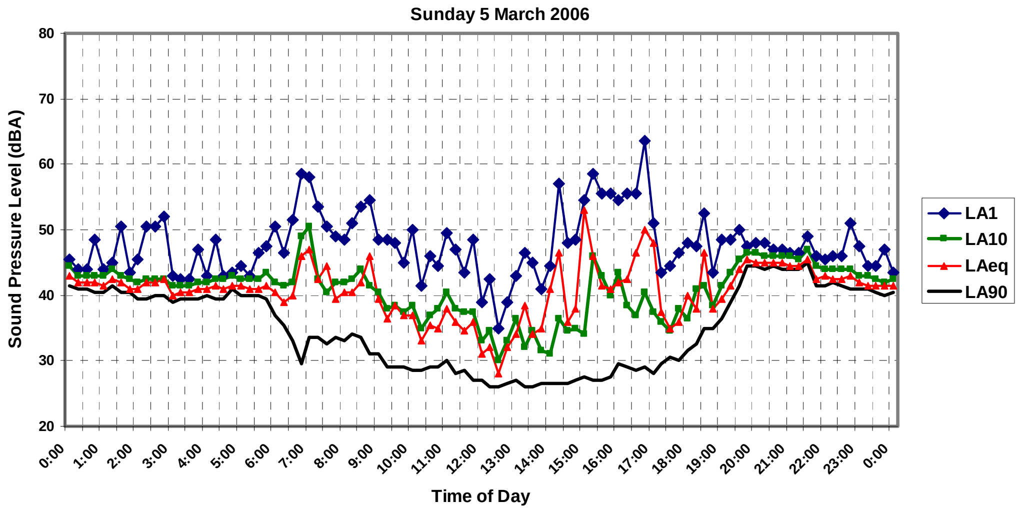


Figure A4 - Noise Logger Results from Measurements Taken at the Rear of the Closest Residential Property to the Proposed Site (Farm 641).

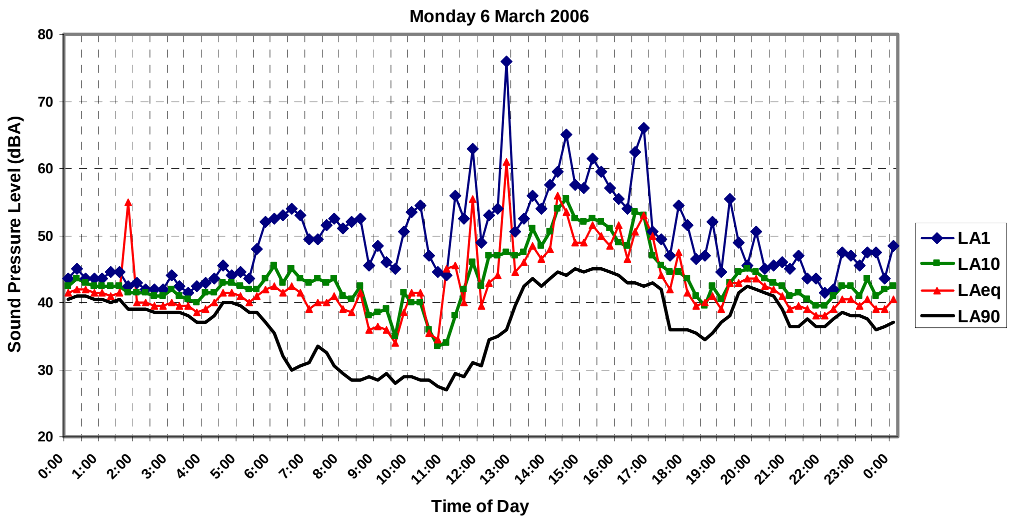


Figure A5 - Noise Logger Results from Measurements Taken at the Rear of the Closest Residential Property to the Proposed Site (Farm 641).

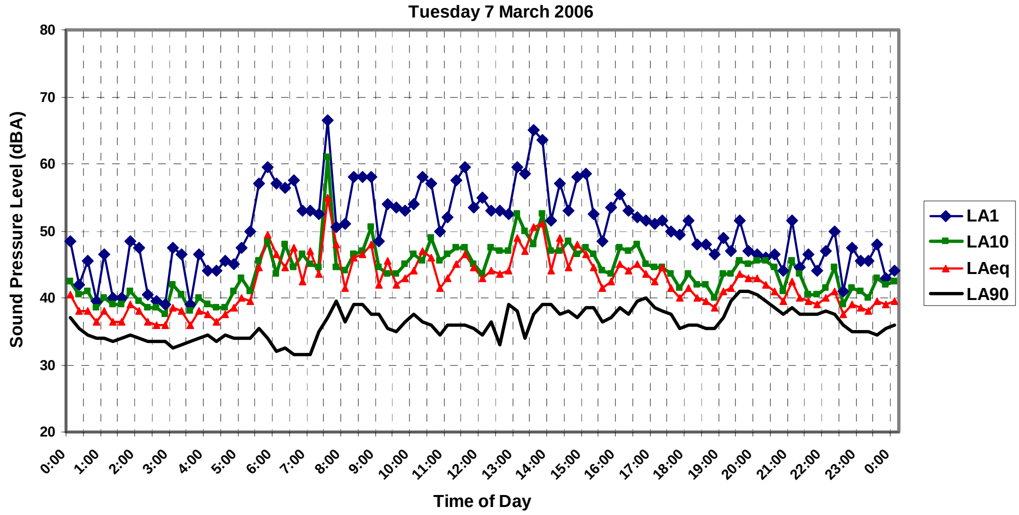


Figure A6 - Noise Logger Results from Measurements Taken at the Rear of the Closest Residential Property to the Proposed Site (Farm 641).

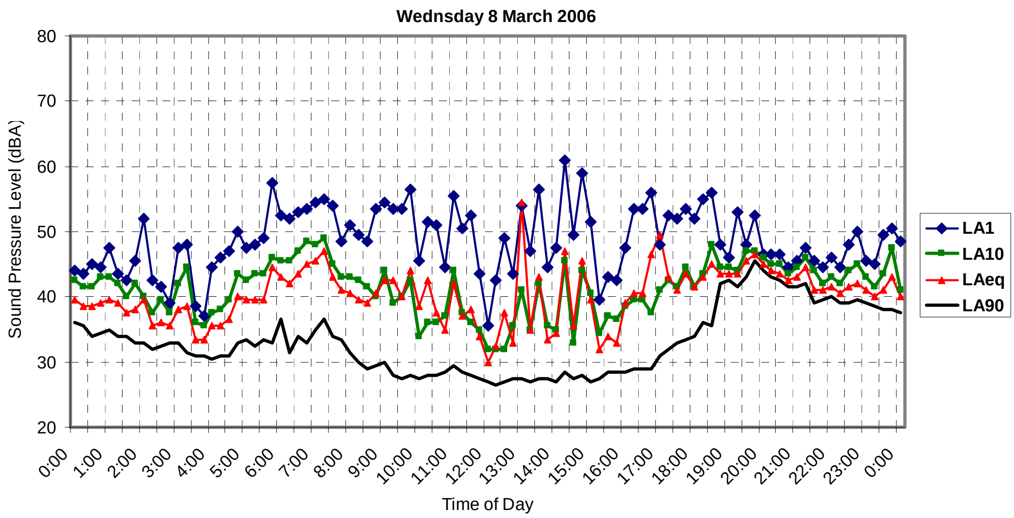


Figure A7 - Noise Logger Results from Measurements Taken at the Rear of the Closest Residential Property to the Proposed Site (Farm 641).

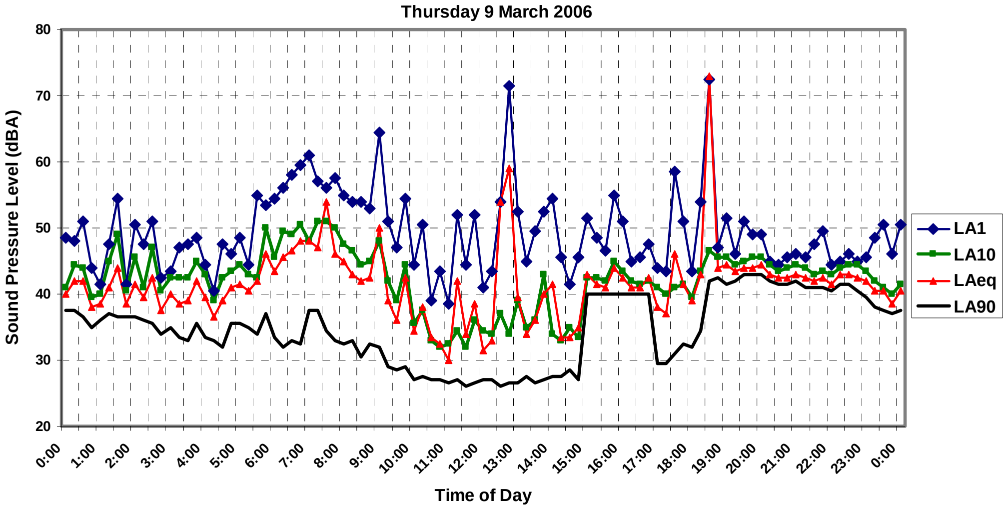


Figure A8 - Noise Logger Results from Measurements Taken at the Rear of the Closest Residential Property to the Proposed Site (Farm 641).

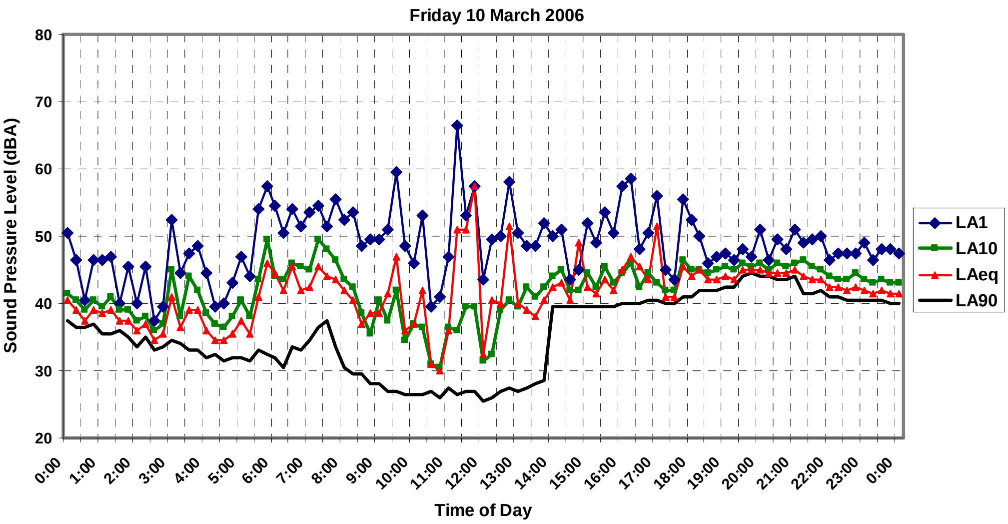


Figure A9 - Noise Logger Results from Measurements Taken at the Rear of the Closest Residential Property to the Proposed Site (Farm 641).

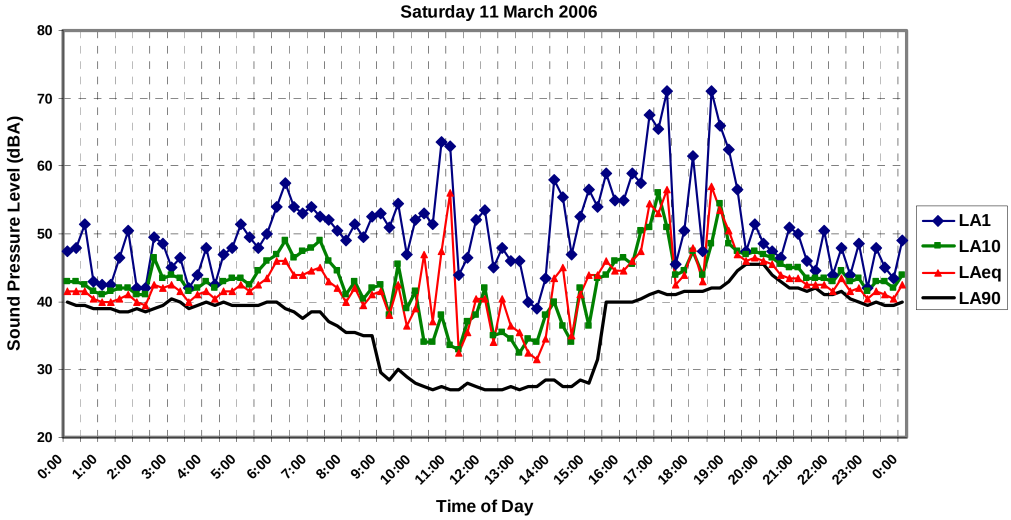


Figure A10 - Noise Logger Results from Measurements Taken at the Rear of the Closest Residential Property to the Proposed Site (Farm 641).

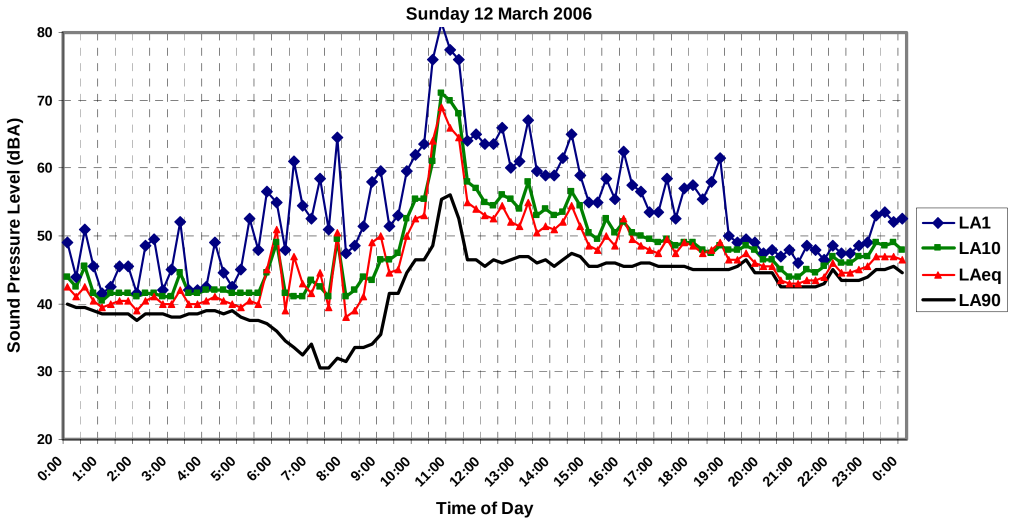


Figure A11 - Noise Logger Results from Measurements Taken at the Rear of the Closest Residential Property to the Proposed Site (Farm 641).

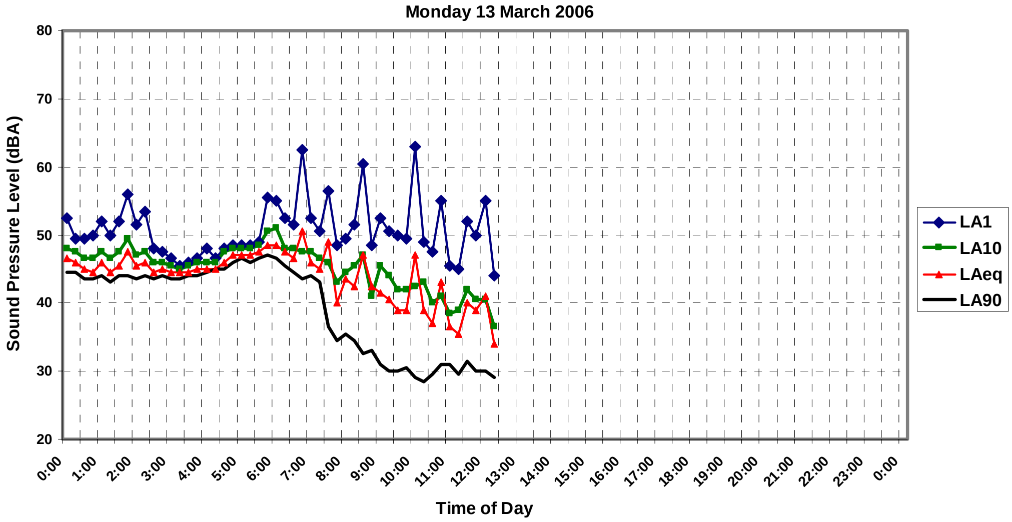


Figure A12 - Noise Logger Results from Measurements Taken at the Rear of the Closest Residential Property to the Proposed Site (Farm 641).

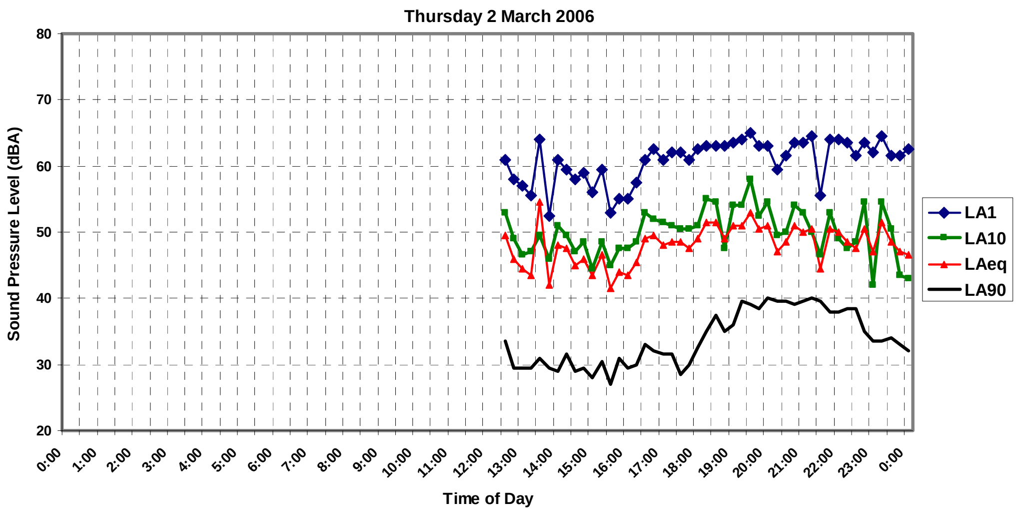


Figure A13 - Noise Logger Results from Measurements Taken at Approximately 135 metres from the Kidman Highway.

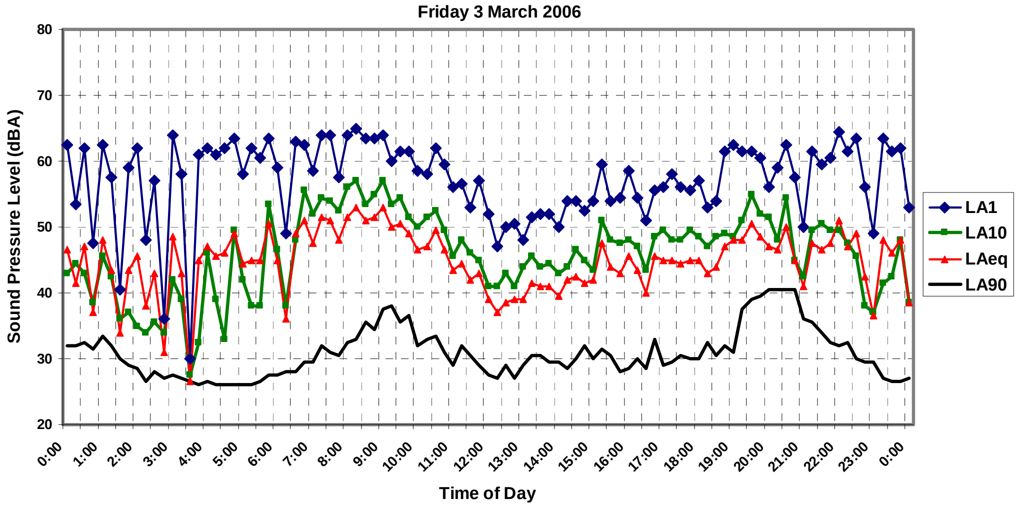


Figure A14 - Noise Logger Results from Measurements Taken at Approximately 135 metres from the Kidman Highway.

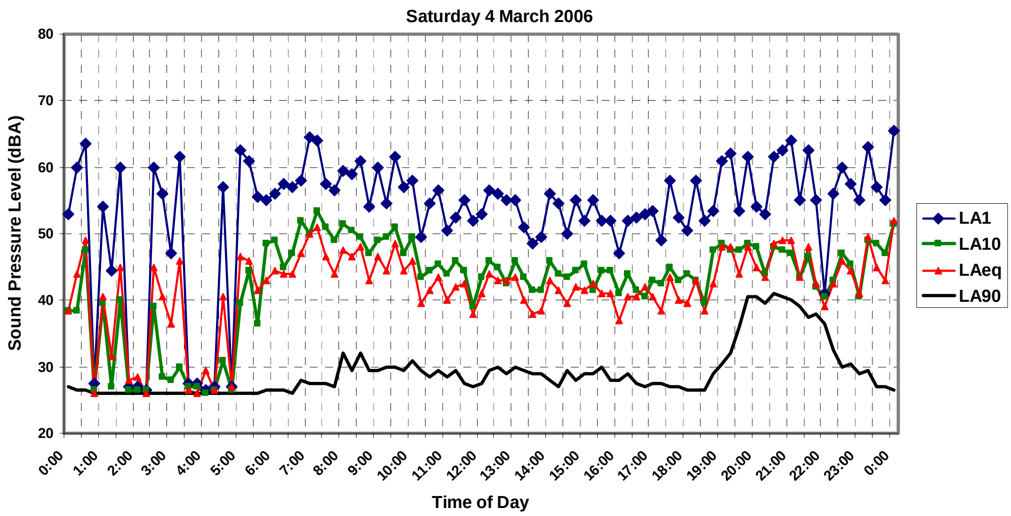


Figure A15 - Noise Logger Results from Measurements Taken at Approximately 135 metres from the Kidman Highway.

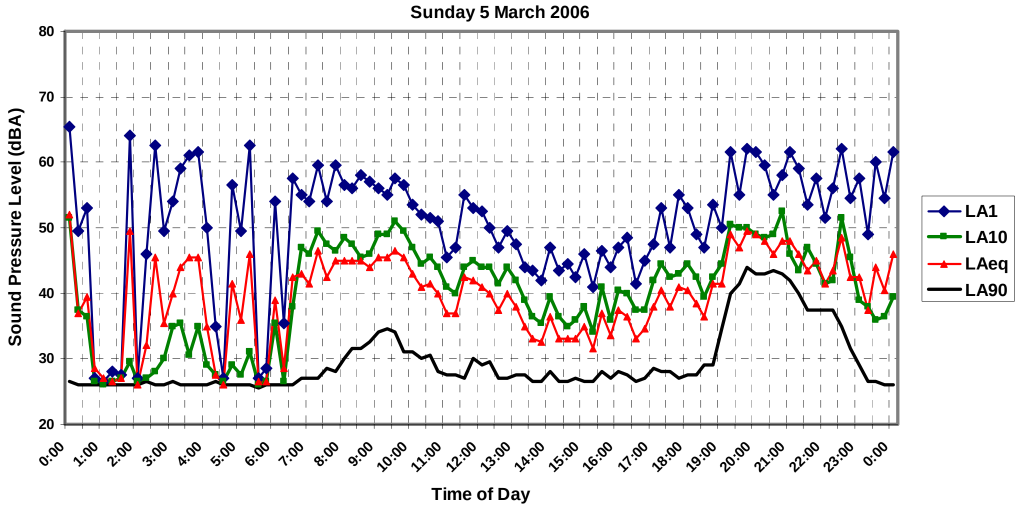


Figure A16 - Noise Logger Results from Measurements Taken at Approximately 135 metres from the Kidman Highway.

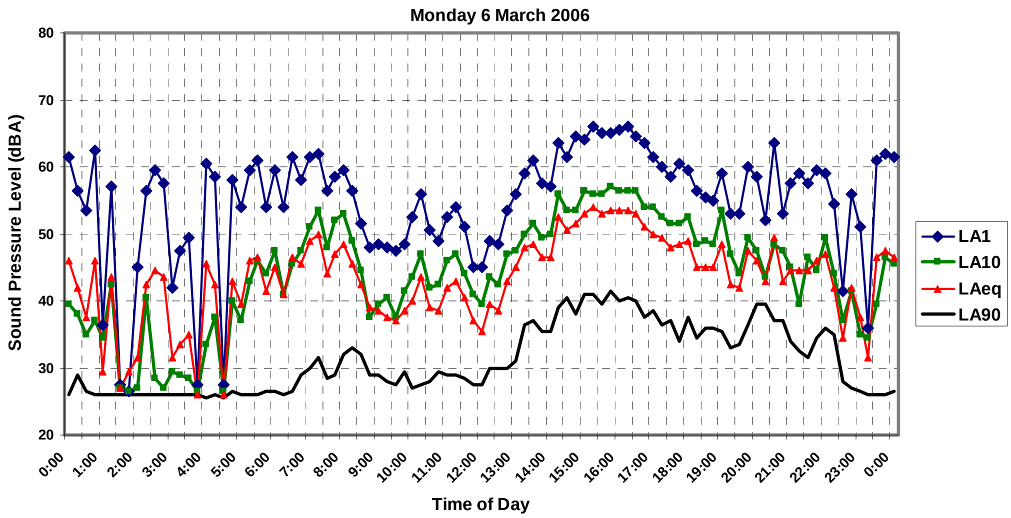


Figure A17 - Noise Logger Results from Measurements Taken at Approximately 135 metres from the Kidman Highway.

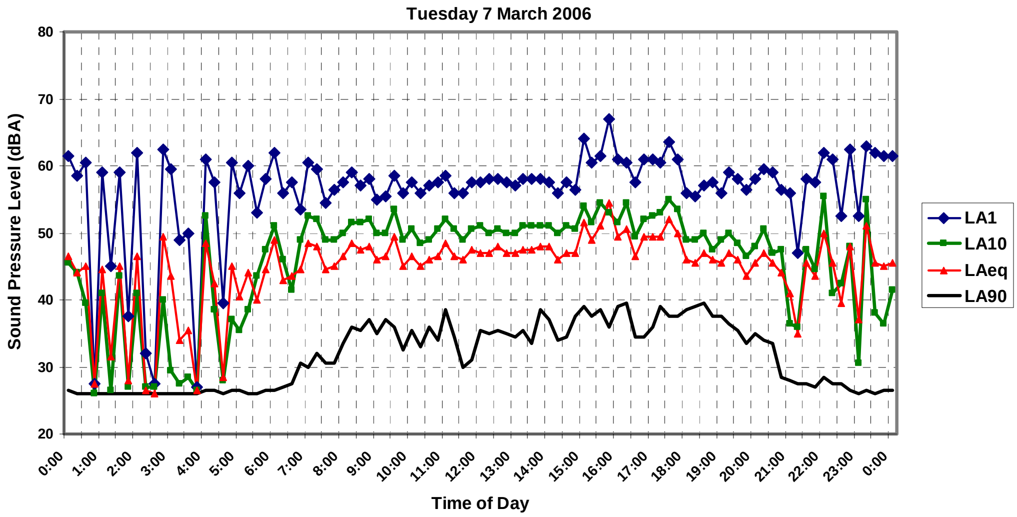


Figure A18 - Noise Logger Results from Measurements Taken at Approximately 135 metres from the Kidman Highway.

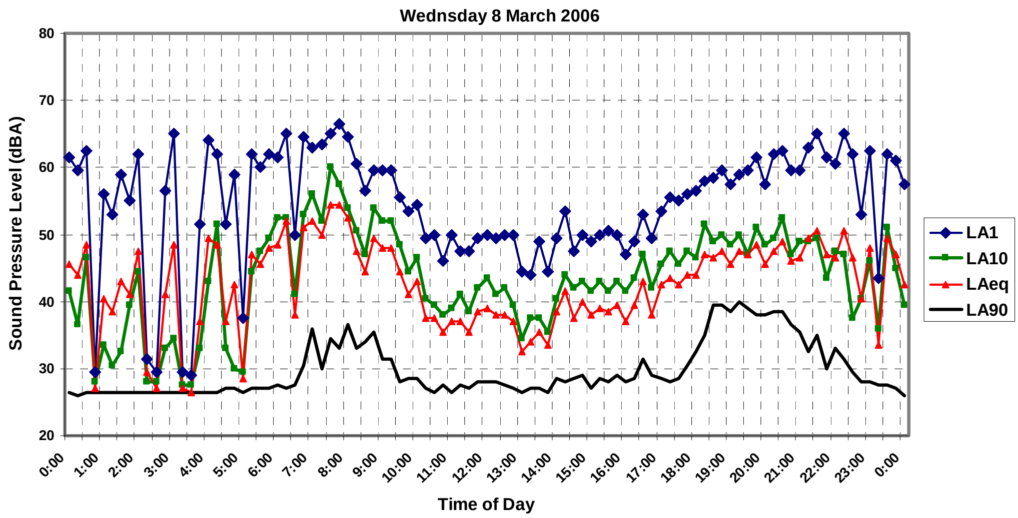


Figure A19 - Noise Logger Results from Measurements Taken at Approximately 135 metres from the Kidman Highway.

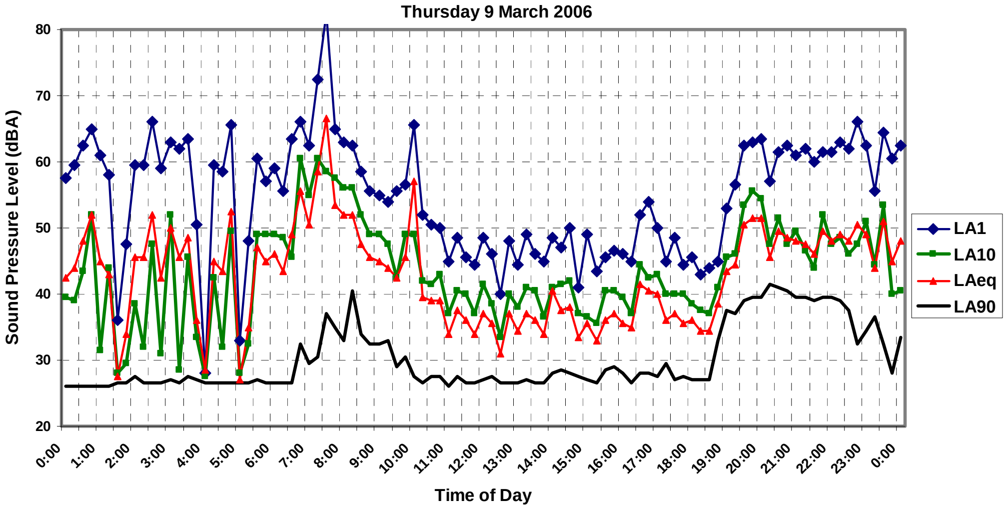


Figure A20 - Noise Logger Results from Measurements Taken at Approximately 135 metres from the Kidman Highway.

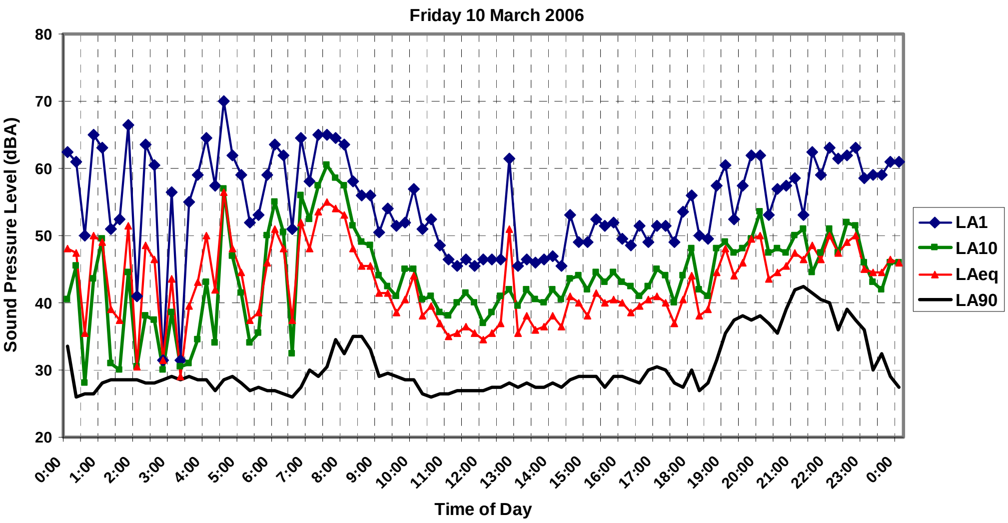


Figure A21 - Noise Logger Results from Measurements Taken at Approximately 135 metres from the Kidman Highway.

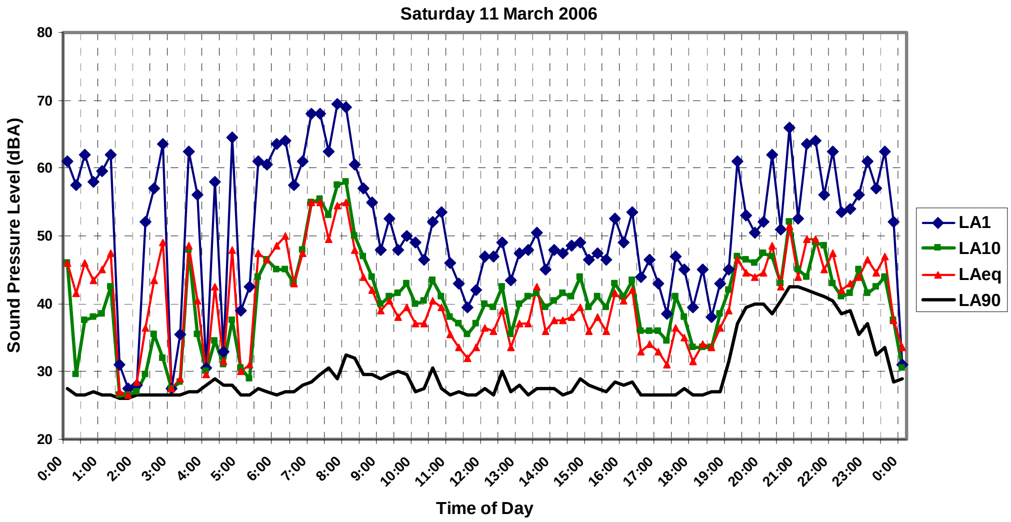


Figure A22 - Noise Logger Results from Measurements Taken at Approximately 135 metres from the Kidman Highway.

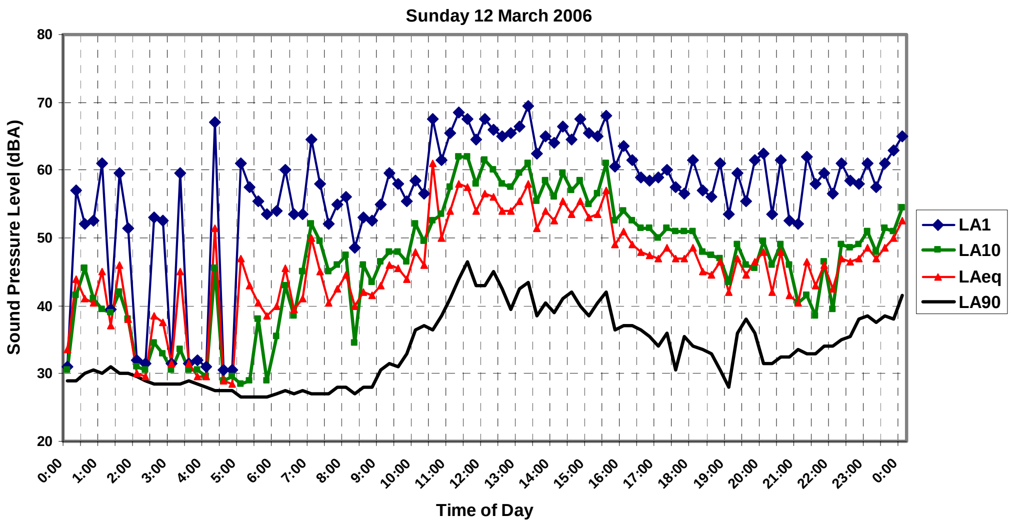


Figure A23 - Noise Logger Results from Measurements Taken at Approximately 135 metres from the Kidman Highway.

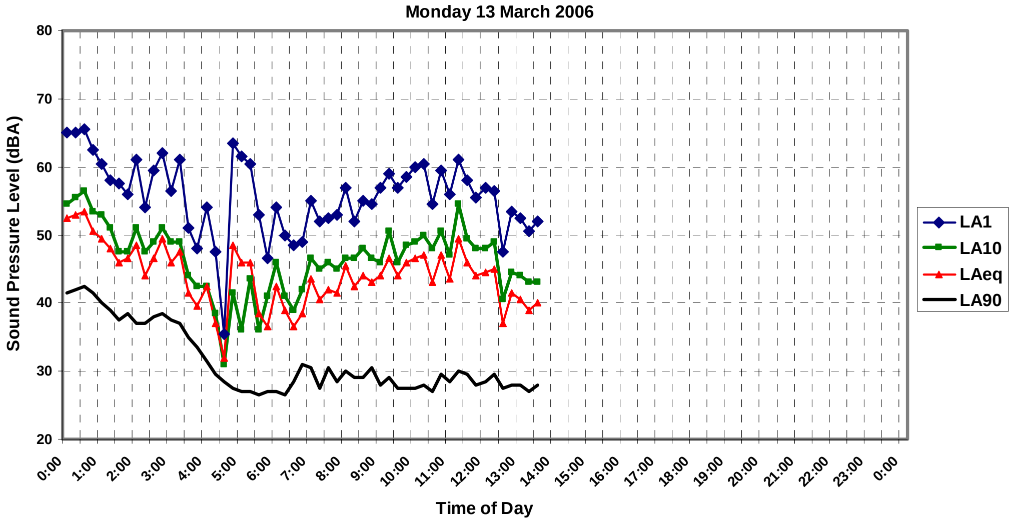
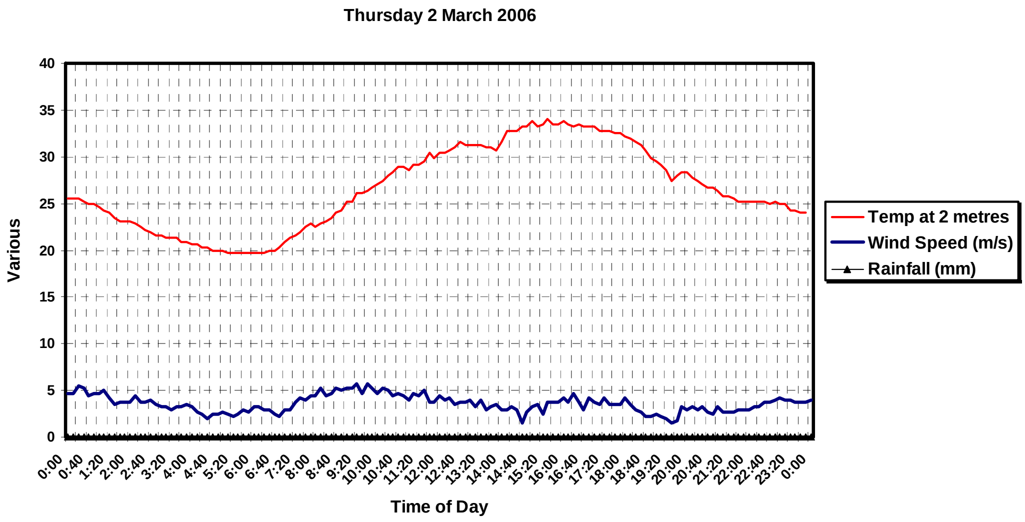
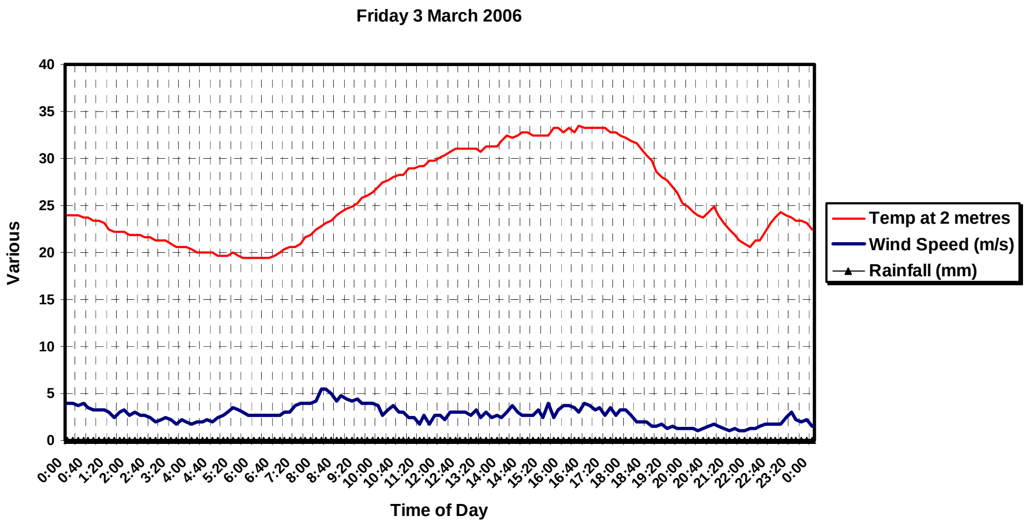
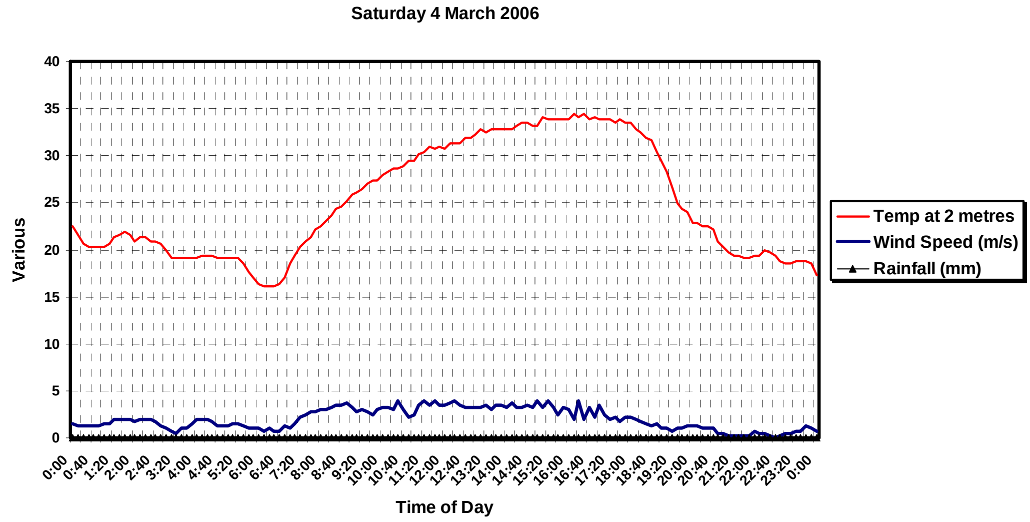


Figure A24 - Noise Logger Results from Measurements Taken at Approximately 135 metres from the Kidman Highway.

APPENDIX B – WEATHER DATA



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25
20
15
10
5
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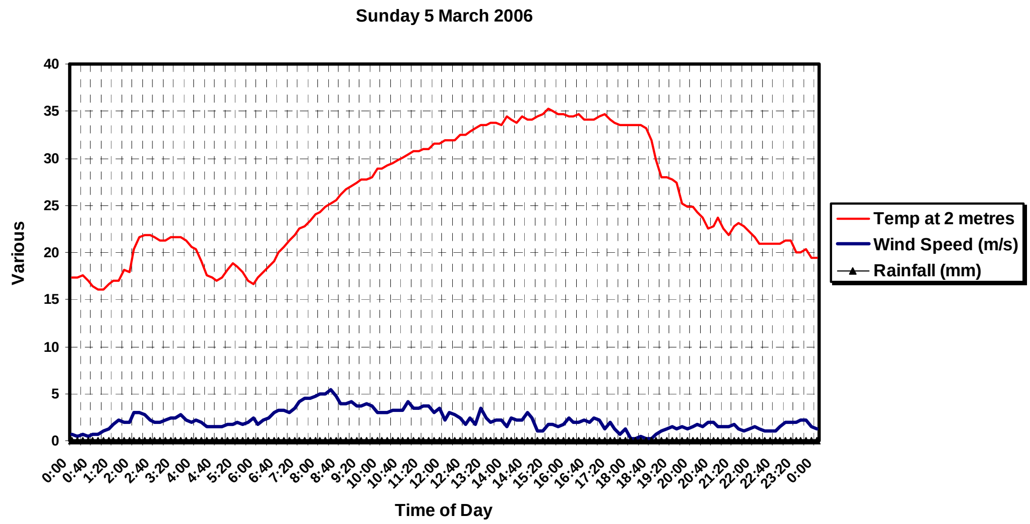
0:00 0:40 1:20 2:00 2:40 3:20 4:00 4:40 5:20 6:00 6:40 7:20 8:00 8:40 9:20 10:00 10:40 11:20 12:00 12:40 13:20 14:00 14:40 15:20 16:00 16:40 17:20 18:00 18:40 19:20 20:00 20:40 21:20 22:00 22:40 23:20 0:00
Time of Day
Temp at 2 metres
Wind Speed (m/s)
Rainfall (mm)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15
10
5
0
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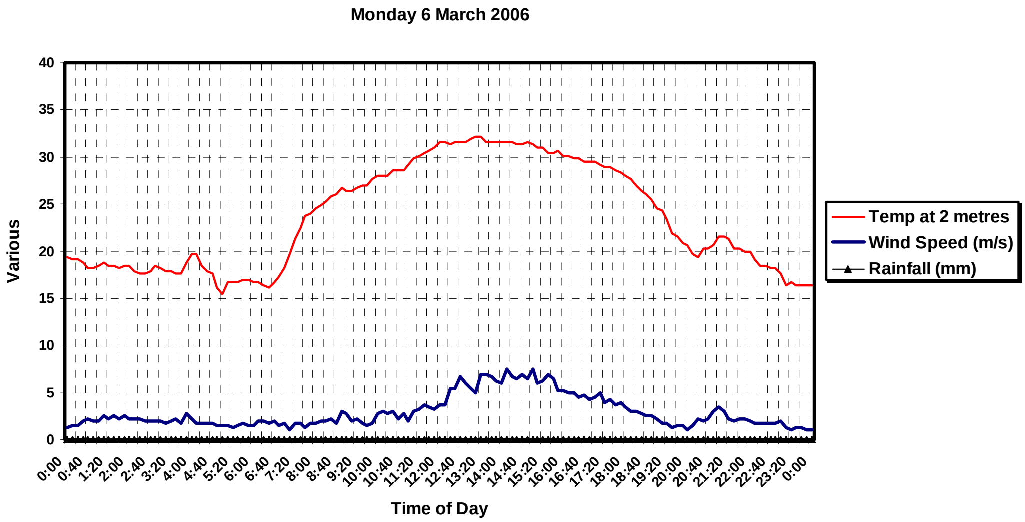
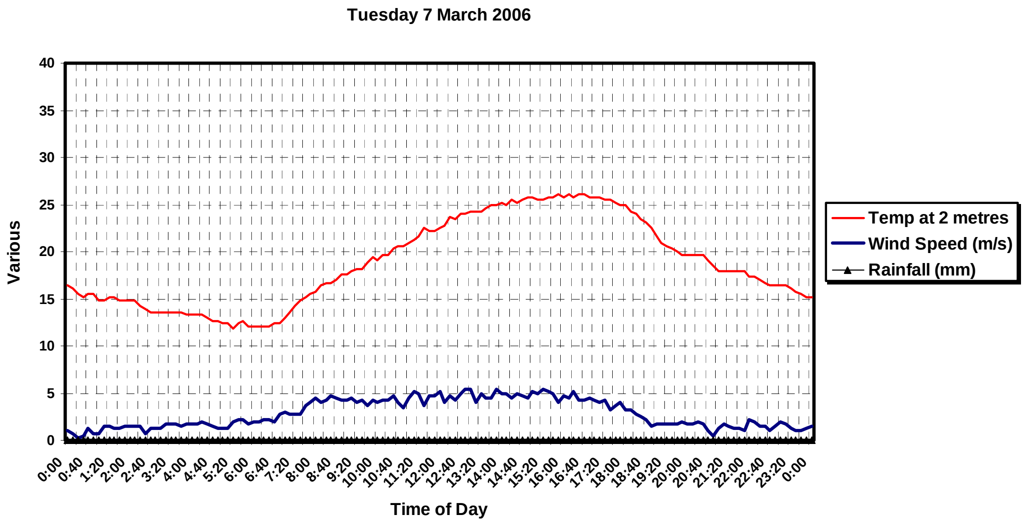
Time of Day
Temp at 2 metres
Wind Speed (m/s)
Rainfall (mm)


Monday 6 March 2006
Various
Time of Day
Temp at 2 metres
Wind Speed (m/s)
Rainfall (mm)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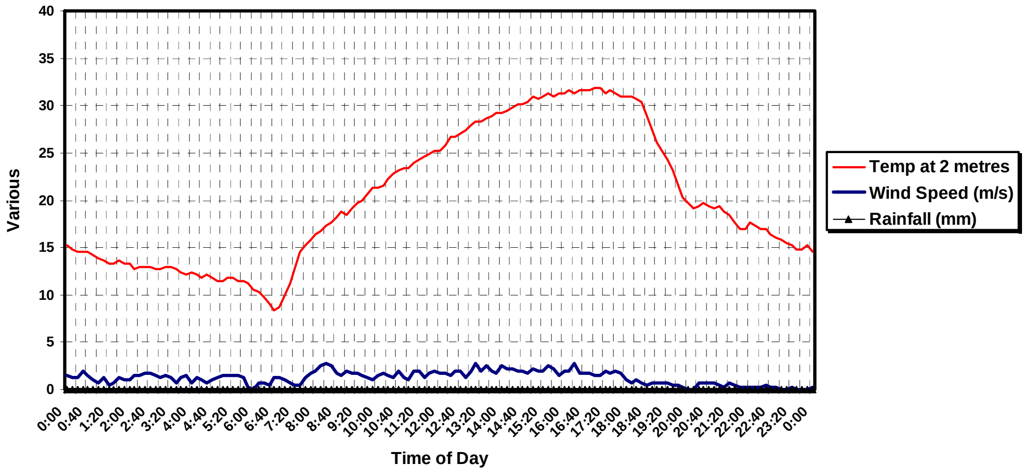
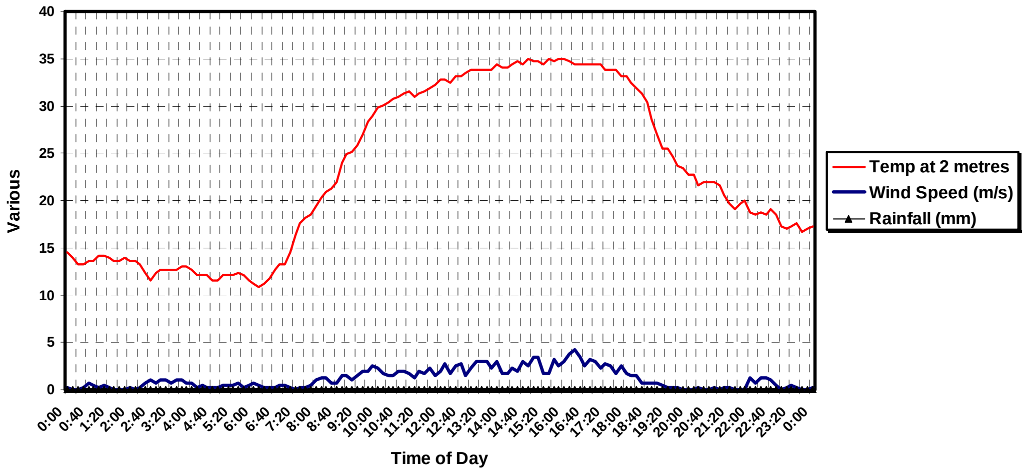
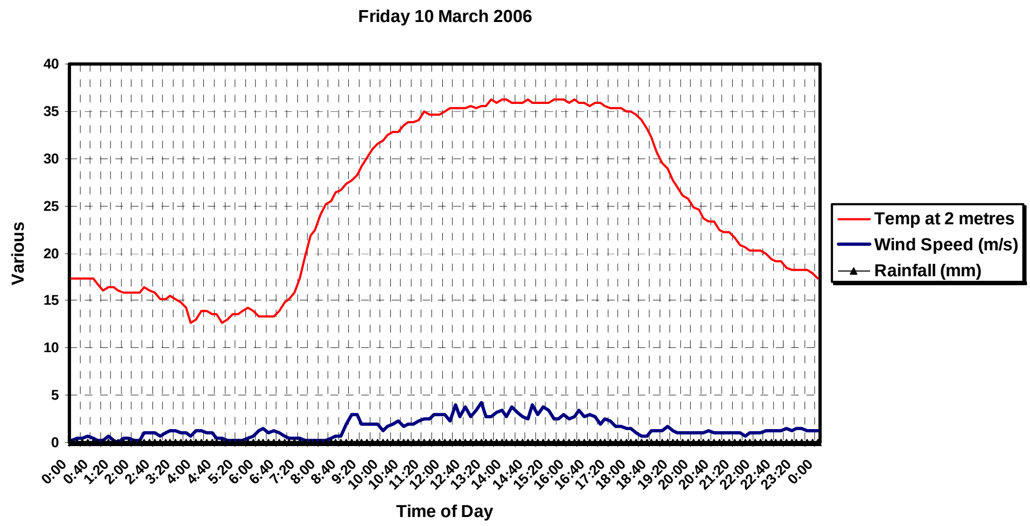
Time of Day
Temp at 2 metres
Wind Speed (m/s)
Rainfall (mm)

Wednesday 8 March 2006



Thursday 9 March 2006

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Time of Day
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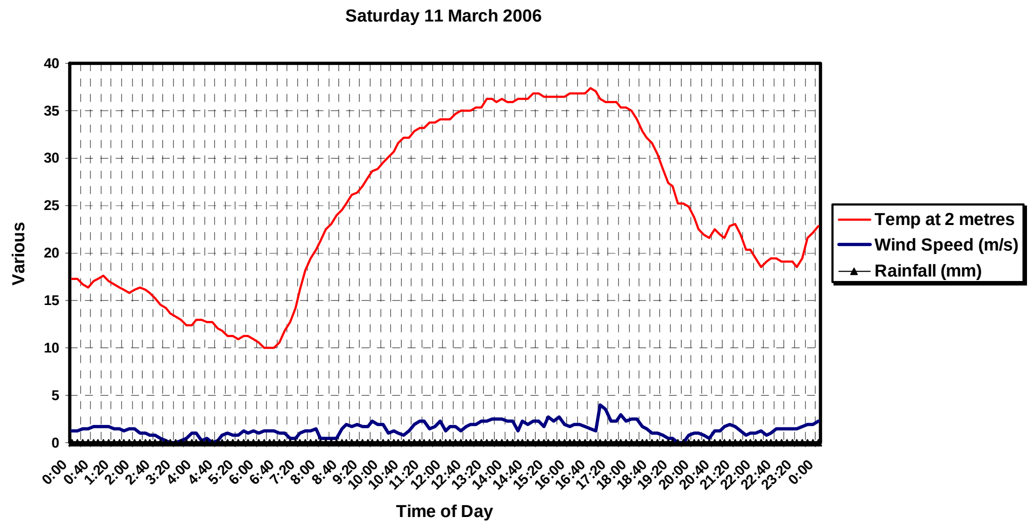
Wind Speed (m/s)
Rainfall (mm)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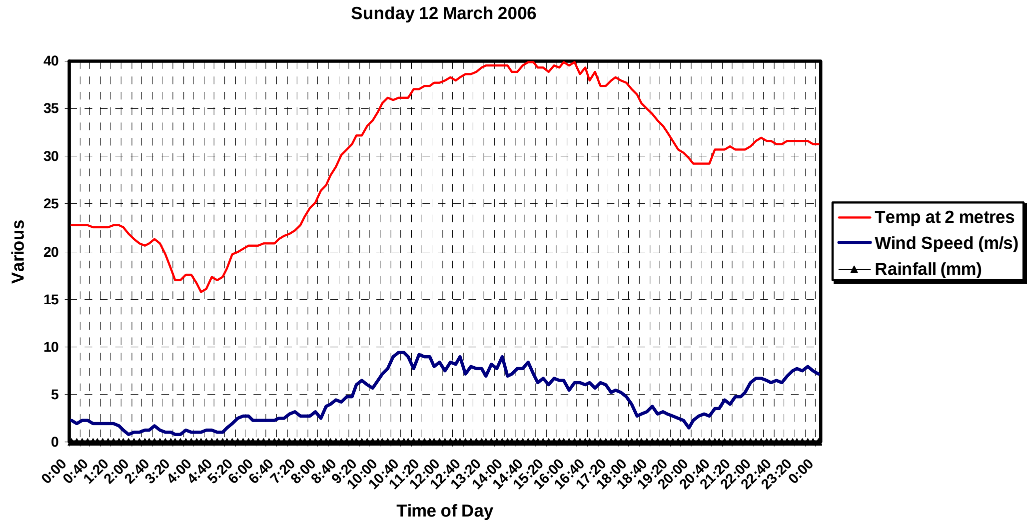
Time of Day
Temp at 2 metres
Wind Speed (m/s)
Rainfall (mm)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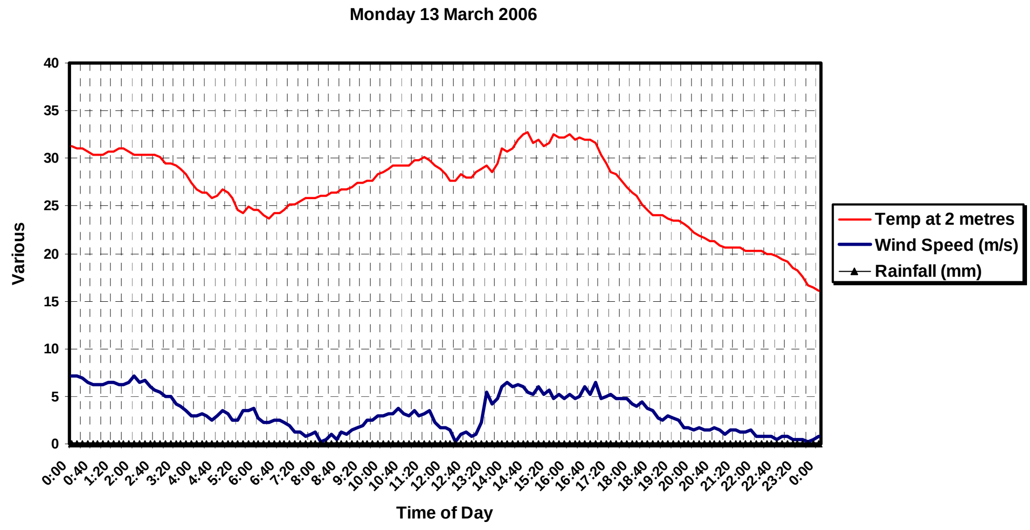
Time of Day
Temp at 2 metres
Wind Speed (m/s)
Rainfall (mm)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20:00
20:40
21:20
22:00
22:40
23:20
0:00
Time of Day
Temp at 2 metres
Wind Speed (m/s)
Rainfall (mm)