Appendix C Noise Impact Assessment Report

PROPOSED ALTERNATIVE WASTE TECHNOLOGY & COMPOSTING FACILITY WOY WOY SOUTH

ASSESSMENT OF OPERATIONAL NOISE

ACOUSTICS AND AIR

REPORT NO. 06130
VERSION B

WILKINSON MURRAY

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AUGUST 2007

PREPARED FOR

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1 INTRODUCTION

It is proposed to construct an Alternative Waste Technology and Composting Facility (AWT&CF) at Nagari Road, Woy Woy South, at the southern end of the Woy Woy Waste Management Facility (WMF). A draft environment assessment (EA) for the project has been submitted to the NSW Department of Planning (DoP), and this included the draft document by URS Australia Pty Limited 2007 *Construction and Operation of an Alternate Waste Technology (AWT) and Composting Facility,* prepared to assess the potential noise impacts.

The NSW Department of Environment & Climate Change (DECC) advised the DoP via letter dated 20 March 2007, ref: FIL07/2423 - DOC07/10471 that the above document contains insufficient information to undertake a detailed review of noise issues. A further letter from DECC to DoP dated 29 June 2007 provides a second review by DECC and further comments.

Wilkinson Murray was engaged to conduct a further assessment of the noise associated with the proposal, and results of that assessment are presented in this report. The additional assessment considers comments made by DECC in the above mentioned letters and DECC documents:

- *NSW Industrial Noise Policy (INP)*, January 2000;
- *Noise Guide for Local Government (NGLG)*, June 2004; and
- *Environmental Criteria for Road Traffic Noise (ECRTN)*, May 1999.

Figure 1-1 Locality Map

2 DESCRIPTION OF PROPOSAL, SITE & SURROUNDS

The AWT&CF is proposed to be located within the southern portion of the WMF, covering an area of approximately three hectares. Access would be via Nagari Road, through the WMF. The site is located within the Gosford local government area. At this location there also exists Woy Woy Sewage Treatment Works (STW). The WMF and STW are both owned and operated by Gosford City Council. Vehicular access to both of these sites is only via Nagari Road.

The WMF would comprise:

- Access road and buildings platform (RL115)
- Two buildings – AWT and the Composting Building
- Biofilter
- Green Waste Maturation Area

Adjoining the site to the south, east and west is Brisbane Water National Park and to the north is the STW. With respect to on-site operational noise, a total of 6 receivers (approximate Locations R1 to R6 shown on Figure 2-1) have been used to represent the residential receivers to the north, west, north-west and south-west, and their locations and RLs are shown in Table 2-1. Figure 2-1 shows the location of residential areas, other zoned areas and the proposed Facility.

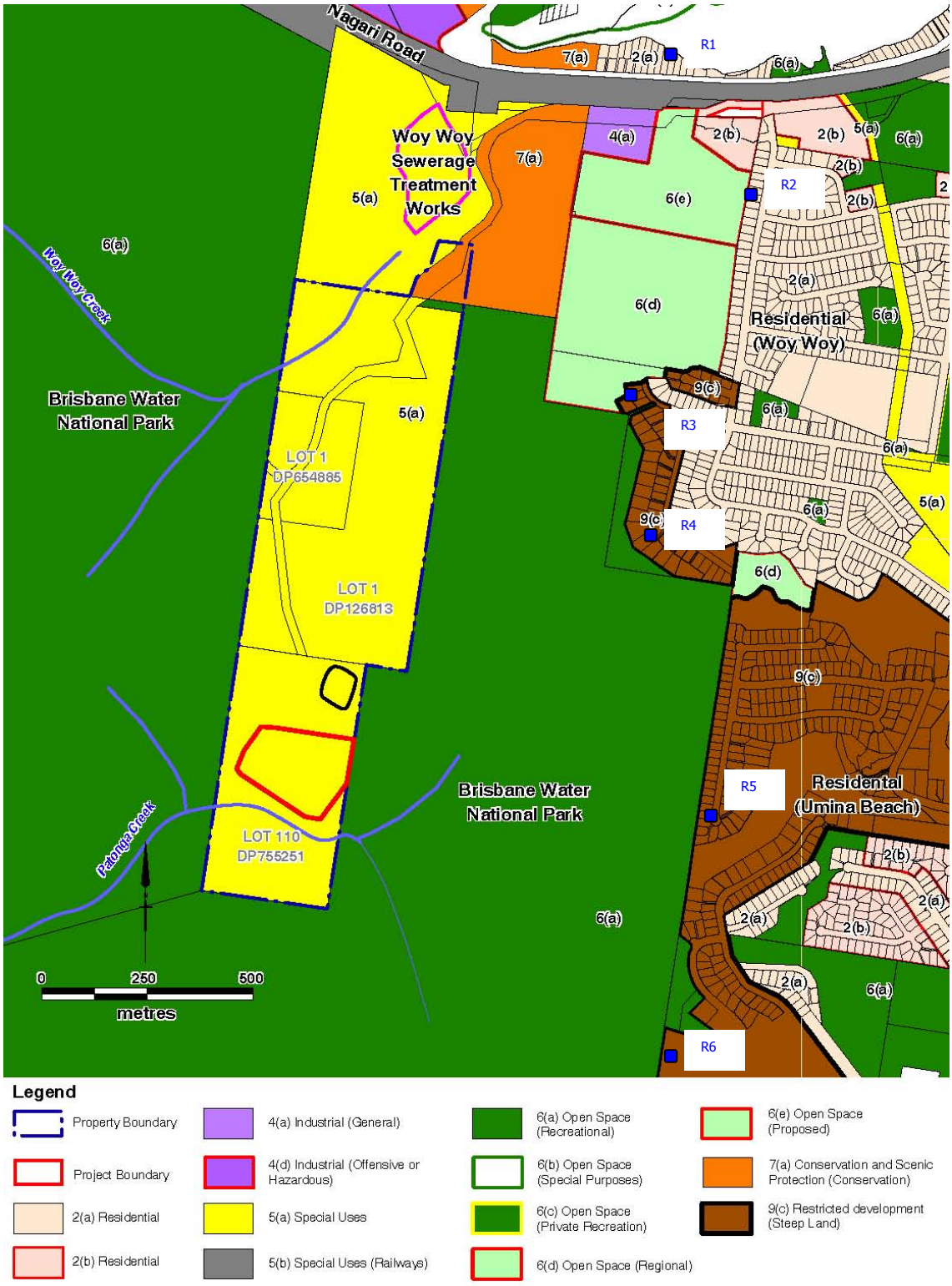
Table 2-1 Location of Surrounding Residences

Residence No.	Description	East (AMG)	North (AMG)	RL (m)
1	Woy Woy Road	342040.4	6292344.6	10
2	Shoalhaven Drive	342309.8	6292027.7	30
3	Veron Road	342036.4	6291552.4	40
4	Timbertop Drive	342036.4	6291247.3	75
5	The Citadel	342171.1	6290569.9	115
6	The Bastion	342068.1	6290035.2	95

Of these residences located in the vicinity, receivers 5 and 6 are considered to be potentially most affected by the proposed Facility and as such this assessment focuses on these residential locations. Notwithstanding this, the noise levels have been calculated to all 6 residential locations. Furthermore, an assessment to the National Park has also been presented.

With respect to receivers potentially impacted by vehicle movements along Nagari Road / Railway Street, there are residential receivers located on the southern side of Nagari Road / Railway Street, these are considered to be the potentially most exposed and have been assessed as part of this report.

Figure 2-1 Map Showing Location of Residential Areas & Site Boundary



3 EXISTING ACOUSTIC ENVIRONMENT

3.1 Existing Acoustic Environment

A noise logger was deployed at the rear yard of 1 The Citadel, Umina Beach (refer Figure 1-1) to quantify the existing background noise level. A noise logger (ARL215) was deployed on Friday, 13 July and retrieved on Monday, 23 July 2007.

This location is considered to be typical of the existing acoustic environment of the residences potentially to be most affected by the facility proposed, particularly noise from construction and on-site operation phases.

The detailed measurement results are shown in graphical format in Appendix C. The logger was set to A-weighted, fast response and to monitor every 15-minutes. The calibration was checked before and after the survey and no significant drift was noted.

With respect to noise from additional traffic movements, particularly during the operational phase, a noise logger (ARL316) was deployed at the side yard (in free field), in line with a location approximately 1m in front of the existing front facade at 274 Railway Street, Woy Woy (refer Figure 1-1). Of interest at this logger location is the level of noise from road traffic. Therefore, the logger was set to A-weighting, fast response and to monitor every three minutes. Given that the site is also subjected to railway noise, a vibration logger was deployed and set to store data every 1.5 minutes. This procedure allows noise from train passbys to be excluded from the measured L_{Aeq} noise level.

3.1.1 Rating Background Levels

From the background noise levels (L_{A90}) measured 1 The Citadel, the Rating Background Levels (RBLs) were determined using methodology as recommended by the *INP*. The DECC considers the RBL to represent the background noise level. Table 3-1 summarises the results of the noise monitoring at 1 The Citadel.

Table 3-1 Measured Noise Levels – Unattended at 1 The Citadel

Time Period (1)	Rating Background Level RBL (dBA)
Daytime	32
Evening	35 (2)
Night Time	31

Note 1) The *INP* considers daytime (7.00am-6.00pm); evening (6.00pm-10.00pm); night time (10.00pm-7.00am). On Sundays and Public Holidays, daytime begins at 8.00am and night time ends at 8.00am.

2) Influenced by road traffic from Woy Woy Road and possibly rail movements.

As required by the *INP*, extraneous noise and any effects due to adverse meteorological conditions (rain or wind greater than 5m/s at a height of 1.5m) have been excluded. With regard to exclusion of adverse weather conditions, hourly data from the Bureau of Meteorology's Gosford Narrara Research Station has been used. This data has also been supplemented with daily rain data from Woy Woy Sewage Treatment Works. Where measured noise levels were clearly affected by short-term extraneous noise, these periods were also

excluded in calculating the RBL values shown in Table 3-1.

3.1.2 Current Industrial Noise Levels

As identified in this report previously, nearby industry (refer Figure 1-1) in the area includes:

Woy Woy Sewage Treatment Works

This is a small STW with the major noise producing plant and processes located below ground. The general operation is relatively consistent (with plant and processes continuously switching on and off) over all time periods.

Woy Woy Waste Management Facility

The onsite noise sources associated with the WMF includes:

a) movement of trucks both delivering and removing waste
b) non-stationary plant including a compactor, front-end loader and excavator
c) drainage system incorporating tanks and pumps
d) gas extraction system

Items (a) and (b) would be restricted to daytime operation only (7.00am-6.00pm), the Facility actually operates Monday to Friday between 7.00am-5.00pm and on weekends and public holidays between 8.00am – 4.00pm. There are no works on Christmas Day, New Years Day and Good Friday. Items (c) and (d) operate continuously, 24 hours per day.

In addition to the long-term noise measurements, attended short-term measurements were undertaken in the evening and daytime to determine the level of noise from industry.

During the deployment of the noise logger (1 The Citadel) no industrial noise was audible. The background at the time (approximately 5.50pm Friday, 13 July 2007) was typically 38dBA. Observations were again conducted on Monday, 23 July 2007 at approximately 3.10pm in the rear yard of 1 The Citadel. During this observation, the typical background was 35dBA and again no industrial noise was audible.

Site personnel associated with both the STW and WMF confirmed that operations were typical during our observations.

It is concluded that any industrial noise contribution would be significantly less than 30dBA at the rear of residences in the vicinity of The Citadel.

3.2 Operational Noise Criteria – Continuous Noise

The *INP* is designed to assess "industrial noise" using the more stringent of the following two approaches:

- preventing intrusive noise impacts in the short term for residences; and
- preserving amenity for particular land uses, including residences.

The *INP's* intrusive goal is set 5dBA above the Rating Background Level (RBL) for each time period (daytime, evening or night time) of interest. The RBL's are derived from the measured L_{A90} noise levels as per DECC guidelines. Refer to Appendix A for an explanation of acoustic terminology.

The amenity goal sets an upper limit to the total noise level (L_{Aeq}) in an area from all industrial

noise (existing and future). The Acceptable Noise Level (ANL) for the development is set based on the time of day, area classifications and the total measured L_{Aeq} (and contribution from existing industrial noise).

The potentially affected residential area is classified as "Suburban" by the *INP*. Given this, the "acceptable" amenity levels ($L_{Aeq, period}$) which apply over the whole day, evening or night period are as follows:

- Daytime 55dBA
- Evening 45dBA
- Night time 40dBA

The "maximum" amenity levels are 5dBA higher. These levels are applicable if there are no other "industrial" noise sources when measured at the residential receivers.

Amenity criteria are also to be considered at other receivers, notably the adjacent Brisbane Water National Park, where the Acceptable Noise Level ($L_{Aeq, period}$) is 50dBA and the maximum 55dBA.

Further to this, the *INP* requires that where noise sources contain certain characteristics, such as tonality, impulsiveness, intermittency or dominant low frequency content, a modifying factor of +5dBA (to a maximum of +10dBA) should be applied because these type of noises typically cause greater annoyance to the community. These modifying factors take effect at the residential receiver and would typically be judged by measurement at the residential receiver where the measurement would be made up of both the plant noise and existing ambient noise environment as experienced by the receiver.

3.3 Operational Noise Criteria – Sleep Disturbance

Where there exists the possibility that instantaneous, short-duration, high-level noise events may occur during night time hours (10.00pm-7.00am), the DECC requires that consideration be given to the potential for the disturbance of sleep within residences.

The *INP* does not specifically address sleep disturbance, however the DECC has undertaken a literature review concerning research on sleep disturbance (primarily due to transportation noise). This review concluded that the range of results is sufficiently diverse that it was not reasonable to issue new noise criteria for sleep disturbance.

From the research DECC recognises that the sleep disturbance criterion from the superseded *Environmental Noise Control Manual*, i.e. $L_{A1,1min}$ not to exceed the background noise (considered to be the RBL) by more that 15dBA - is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, DECC will continue to use it as a guide to identify the likelihood of sleep disturbance. This means that where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.

The detailed analysis should cover at least the following:

- Absolute level (either $L_{A1\ (1\ minute)}$ or L_{Amax})
- The amount by which the absolute level "emerges" above the general ambient (L_{Aeq}) and background (L_{A90}) at the time of the event (usually the $L_{A90,\ 1\ hour}$ or $L_{Aeq,1hour}$)
- Number of events per hour (usually between 10.00pm-7.00am inclusive)

Some guidance on possible impact is contained in the review of research results in the appendices to the DECC's *ECRTN*.

3.4 Road Traffic Noise Criteria

Additional road traffic movements generated by the proposed Facility may lead to increased noise potentially impacting residential receivers along Nagari Road / Railway Street. Particularly for heavy vehicles, this is the only vehicular access for the STW, WMF and proposed Facility. The functional category of this road (confirmed via telephone conversation with the RTA) is a "local" road providing vehicular access to the STW, WMF and proposed Facility and Hillview Street. After Hillview Street it is considered to be a "collector" road.

Using the ECRTN, the applicable criteria during the daytime (when vehicular movements associated with this proposed Facility will occur) is as follows:

- Land use development with potential to create additional traffic on a local road — $L_{Aeq,1hr}$ — 55dBA
- Land use development with potential to create additional traffic on a collector road — $L_{Aeq,1hr}$ — 60dBA

In addition to these criteria, there is an allowance of up to 2dB increase above existing traffic noise levels once all reasonable and feasible mitigations have been considered.

3.4.1 Existing Noise from Road Traffic

The data from the noise logger located at 237 Railway Street has been processed and the contribution from rail movements excluded. Table 3-2 summarises the $L_{Aeq,1hr}$ for weekdays and weekend days during the time periods that the proposal will operate.

Table 3-2 Summary of Road Traffic Noise ($L_{Aeq,1hr}$)

Hour beginning	7.00am	8.00am	9.00am	10.00am	11.00am	12.00am	1.00pm	2.00pm	3.00pm	4.00pm
Weekday	69.7	69.1	67.4	67.1	66.5	66.5	66.2	67.3	67.7	68.4
Weekend day	-	66.9	68.3	69.2	68.2	68.3	67.8	67.7	68.0	-

The noise levels tabulated are median levels (from either weekdays or weekend days) and include a façade reflection of 2.5dBA.

It clearly can be seen from Table 3-2 that the existing road traffic noise levels exceed the criteria for both local and collector roads. Therefore mitigation that could reduce the impact from the additional road traffic noise (resulting from additional traffic movements associated with the proposed Facility) should be considered. Some possible mitigation measures include:

- Alternate entry to Facility or alternate routes
- Reduced speeds, particularly for garbage trucks or the use of quieter trucks

As there are no other roads that lead to either the WMF or STW, and considering the ridge located east of the WMF and a railway line north of the STW, the option for an alternate entry is not feasible.

With respect to alternate routes that lead to Nagari Road, given that there are many surrounding roads with 'weight limits' and the height restriction for vehicles moving under the railway line, there are no other feasible route options.

Reducing the speed of the garbage trucks and the use of quieter garbage trucks would reduce the absolute noise levels from vehicle movements, however as there is also a significant contribution from Woy Woy Road, reducing the speed along Nagari road for garbage trucks or the use of quieter garbage trucks would result in only limited benefit to the residents.

In light of the above, the 2dB allowance is therefore considered reasonable and has been applied to assess the increased noise from increased vehicle movements associated with the proposed Facility.

3.5 Project Specific Noise Criteria – Residential Receivers

Based on the measured night-time RBL value of 31dBA (Table 3-1), the primary sleep disturbance criterion adopted for this project is L_{Amax} 46dBA during the hours 10.00pm-7.00am, assessed external to a bedroom window.

Given that there is effectively no industrial noise contribution at the residential receivers likely to be most impacted by this proposal, the *INP's* intrusiveness criterion is applicable. Based on the measured RBL values, this criterion is $L_{Aeq,15min}$ 36dBA at the most affected residential receiver, under meteorological conditions that could enhance noise propagation. As per the *INP,* consideration of the 'character' of the noise emitted is required to determine whether any "modifying factors" should is applied. Wilkinson Murray considers that these factors are very unlikely to apply for the proposed type of noise, at the receiver locations considered.

3.6 Project Specific Noise Criteria – National Park

An amenity level of $L_{Aeq,period}$ 50dBA (including the consideration of any modifying factor corrections) has been adopted for the Brisbane Water National Park during the day, where the noise sources are higher than during the evening or night periods. Wilkinson Murray considers the use of the National Park during the evening and night would be minimal and assessment during these times is not deemed necessary.

4 PREDICTIONS OF ON-SITE OPERATIONAL NOISE

4.1 Introduction

Intervening topography attenuates noise before it reaches receivers. Additionally, noise propagation over distances of at least several hundred metres is influenced by meteorological factors such as wind speed, wind direction and the presence of temperature inversions. In addition to increasing noise levels, these meteorological conditions significantly reduce the attenuating effect of intervening topography (and bunds) since the sound waves follow a curved path that can go over such barriers.

For this assessment, noise predictions were made using the Environmental Noise Model (ENM) modelling software algorithm. This is a point-to-point model that takes into account the attenuation factors including; distance, topography, ground absorption, air absorption and meteorological conditions. ENM predictions have been validated in the field (on Australian projects) by many researchers and are approved to be used in NSW by the DECC.

4.2 Noise Model Inputs

ENM requires a variety of inputs including sound power levels (SWL) of each source, location of sources (including height above ground), topographic information and the ground type. Meteorological conditions are also required.

4.2.1 Meteorological Conditions

During the night time period, the worst case noise levels are likely to be experienced during temperature inversions, and with wind in the direction from source(s) to receiver. Temperature inversions are rarely present during the daytime or evening periods. Therefore, the most significant meteorological effect during the daytime and evening periods is wind. Acoustically neutral conditions have also been considered.

Wilkinson Murray has developed a process to assess the weather conditions in an area, and their effect on noise, that is more rigorous than that required by the *INP*. It provides the impact at all receivers during all weather conditions by calculating the noise level that is exceeded 10% of the time for each DECC defined time period (day, evening and night) during each season (Summer, Winter, Spring and Autumn). This is presented at each receiver and is compared against the relevant criteria. This process has been accepted by the DECC.

ALL meteorological data modelled is presented in Appendix B.

Daytime

Acoustically neutral conditions – calm wind (≤0.5m/s), together with a temperature of 19.0ºC and relative humidity of 62.2%. Wind speed at; 0.75m/s, 1.25m/s, 1.75m/s, 2.25m/s and 2.75m/s (encompassing a 0.25m/s range either side). Wind direction at every 45 degrees (encompassing a 22.5 degree range either side). A total of 41 conditions are considered for both the day and evening for each season.

Evening

Acoustically neutral conditions – calm wind (≤0.5m/s), together with a temperature of 17.3°C and relative humidity of 68.7%. Wind speed at; 0.75m/s, 1.25m/s, 1.75m/s, 2.25m/s and 2.75m/s (encompassing a 0.25m/s range either side). Wind direction at every 45 degrees (encompassing a 22.5 degree range either side). A total of 41 conditions are considered for both the day and evening for each season.

Night

Acoustically neutral conditions – calm wind (≤0.5m/s) together with a temperature of 14.8° and relative humidity of 76.3%. All wind speeds and directions as described above are modelled, both with a temperature inversion of 3°/100m and without a temperature inversion. A total of 82 conditions are considered for each season.

4.2.2 Topography

URS Pty Ltd supplied a 3D digital terrain map of the immediate surrounding area using 10m contours as well as the location and sizes of buildings associated with the proposal.

The locations of all residences, and other major structures such as buildings associated with the STP, were added by Wilkinson Murray. The contours across the WMF were estimated by Wilkinson Murray using the various contours supplied.

The ground between sources and receivers has been modelled as acoustically "soft ground".

It should be noted a ridge at RL 150 (with many sections up to RL 180) exists and effectively shields residences from the noise sources, which range from RL 112.5 (trucks) to 125.5 (roof of buildings). The residences to the east and north east are at RLs ranging from 11.5 to 116.5, assuming an assessment point 1.5m above ground.

5 ASSESSMENT OF ONSITE OPERATIONAL NOISE

This section of the report assesses the potential operational noise from onsite activities potentially impacting to the existing residential receivers.

5.1 Operational Activities

The final technology to be used will not be selected until the detailed design phase, however in order to provide a worst case scenario Wilkinson Murray has considered the more common technologies and assumed the noisier activities. The following is a summary of our assumptions:

- Waste to be brought onto the site via garbage trucks of up to approximately 10t. As per the draft EA, a total of 78 trucks (additional 57 trucks) is predicted (156 movements) in a day (7.00am-5.00pm). On average this would result in two to three truck movements in a given 15-minute period, however considering peak periods are likely to carry two to four times this traffic, the calculations have conservatively assumed 10 movements in a given 15-minute period. The anticipated speed onsite would be 20-30km/h.
- The Composting Building is assumed to be a simple metal clad (approx 0.48mm thick steel, approx R_W 19), portal framed building of 10m in height. The transmission loss of the roof and entry door has been reduced to R_W 15 and R_W 10 to allow for louvers, translucent sheeting and the like. Green waste would be delivered to this building using the garbage trucks. A front end loader, screen and shredders would be used to sort, shred etc prior to being processed.
- The AWT building is assumed to be similar to the above building. Waste would also be delivered to this building using garbage trucks. A front-end loader and screens would be used to sort prior to being processed.
- On occasion some items would be disposed off site (hazardous waste, recyclables) or to the maturation pond.
- All air from both buildings would be treated using a biofilter.
- The delivery, sorting of waste would be between the hours of 7.00am-5.00pm, whereas the biological processing of waste is of course a continuous (24 hour) operation.

5.2 Assigned Noise Levels

URS have provided Wilkinson Murray with the noise levels of similar technologies via a report for Jacks Gully by Heggies Australia *Jacks Gully Proposed Alternate Waste Facility, Noise Assessment, Report 10-4578R1R1, dated 5 April, 2006*. This information was further supplemented with data from Wilkinson Murray's database.

Garbage Trucks

A Sound Exposure Level (SEL or L_{AE}) of 84dBA @ 9m for a 14t truck, travelling at 50km/h has been used to derive a SWL of $L_{Aeq,15min}$ 73dBA/m (travelling 30km/h) for 10 truck movements in a 15-minute period during the day. The SEL is a measure of the entire energy of a single event, such as a truck pass-by, normalised to one second.

Biofilter Fans

The previously mentioned Heggies report used an SWL of 95dBA and assumed a single fan. Wilkinson Murray has assumed two fans (one for each building) and a total SWL of $L_{Aeq,15min}$ 98dBA. These are assumed to operate continuously (24 hours).

The AWT and Composting Buildings

The reverberant noise level within the composting building has been predicted to be $L_{Aeq,15min}$ 92dBA assuming the worst case scenario that a front end loader, shredder and screen would operate continuously in a 15-minute period during the day. As a comparison, the Heggies report assumed 85-90dBA. During the evening and night time period, only the green waste processing plant would operate. For these scenarios, a reverberant noise level of $L_{Aeq,15min}$ 66dBA has been predicted, assuming the major noise contribution would be fans, pumps etc.

With respect to the AWT building, a reverberant noise level of $L_{Aeq,15min}$ 86dBA has been predicted assuming the worst case scenario that a front end loader and screen would operate continuously in a 15-minute period during the day. As a comparison, the Heggies report assumed 75-78dBA. During the evening and night-time period, only the waste processing plant would operate. For these scenarios, a reverberant noise level of $L_{Aeq,15min}$ 66dBA has been predicted, assuming the major noise contribution would be fans, pumps etc.

For each of these buildings, a point source on each building element (roof, wall, door) has been modelled. The sound power level of each building element was calculated considering the reverberant noise, transmission loss, surface area and directivity (roof only).

5.3 Calculated Noise Levels – Unmitigated

The unmitigated noise levels have been calculated using the ENM modelling software and are summarised in Table 5-1. Levels for both neutral meteorological conditions and meteorological conditions that could enhance the propagation of noise are presented.

The calculated noise levels comfortably meet the relevant criteria at all residential receivers. It is to be noted that the expected enhancement due to wind was limited due to the size of the barrier between the sources and receivers.

Figure 5-1 presents the 36dBA daytime noise contour in the worst-case season, to graphically represent the impact (from Table 5-1, daytime represents the worst-case time period for assessment). In this regard it is important to understand that the calculated (point to point) levels in Table 5-1 are more accurate than the contours presented in Figure 5-1.

It is noted that the noise levels for the sources Wilkinson Murray have considered are generic, although worst case, and it is suggested that these levels be confirmed together with the assumptions. These items are to be further assessed during the Detailed Design phase.

Table 5-1 Summary of Calculated Noise Levels to Residences – Unmitigated

Residence No.	Time Period	Calculated $L_{Aeq,15min}$ Noise Level (dBA)		Noise Criteria $L_{Aeq,15min}$ (dBA)
		Meteorological Condition		
		Neutral	Enhanced (worst case Season)	
1	Daytime	9	10	36
	Evening/Night Time	<0	<0	
2	Daytime	9	10	
	Evening/Night Time	<0	<0	
3	Daytime	11	12	
	Evening/Night Time	<0	<0	
4	Daytime	13	14	
	Evening/Night Time	<0	<0	
5	Daytime	17	18	
	Evening/Night Time	<0	<0	
6	Daytime	13	14	
	Evening/Night Time	<0	<0	

5.4 Assessment of the Potential for Sleep Disturbance

The potential for sleep disturbance within the residences will be greatest during the early morning hours when background noise levels are at their lowest.

Given that the operation will be continuous and not involve sudden instantaneous noise sources, maximum noise levels can be estimated as no more than 5dBA higher than the $L_{Aeq,15min}$ values shown in Table 5-1, and well below the conservative criterion of 46dBA. Hence the risk of sleep disturbance for the residences assessed will be negligible.

5.5 Assessment to the Adjoining National Park

An assessment of the noise impact on the national park during the day is presented in Figure 5-2 using contours. This indicates that area over which noise levels due to the project will exceed the amenity criterion of 50dBA $L_{Aeq,\ period}$.

Figure 5-1 Residential 36dBA $L_{Aeq,15min}$ Noise Contour (blue) and Site Boundary (black)

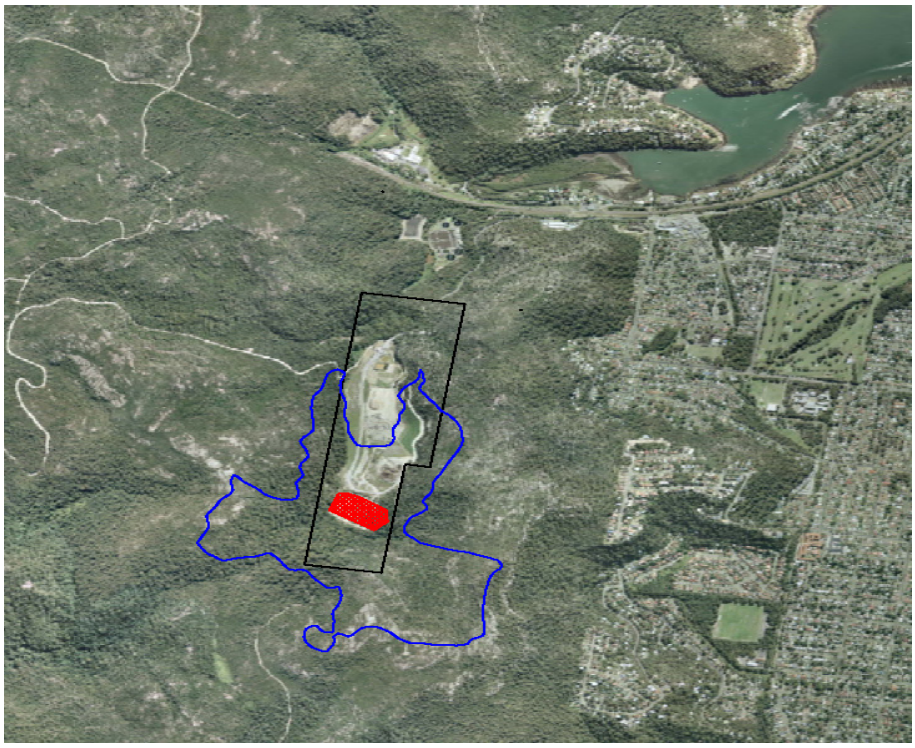
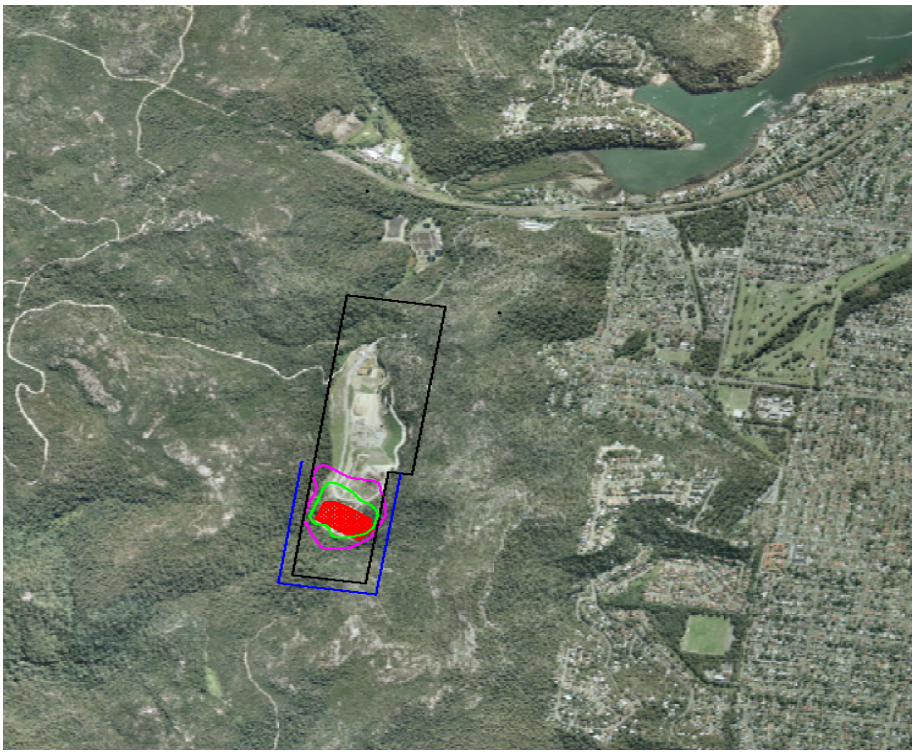


Figure 5-2 National Park 50dBA (magenta) and 55dBA (green) $L_{Aeq,Period}$ Noise Contours and Site Boundary (black)



It can be seen that the 55dBA contour is totally within the site boundary, however there are some parts of the 50dBA contour that intersect with the boundary. No contours project more than 50m into the park (they are within 50m of the site boundary is shown in blue in Figure 5-2).

The small area resulting from the intersection of the boundary to the west and the 50dBA contour is approximately 25m long and located from 0 to 3m into the National Park. Along the eastern boundary the 50dBA contour intersects with the boundary for a length of approximately 160m and is located a distance of 0 to 25m into the National Park.

Note that these values represent a conservative estimate of actual $L_{Aeq,Period}$ noise levels, as they assume the sound power emission of equipment would be constant at its maximum level during an entire daytime period.

6 ASSESSMENT OF OPERATIONAL ROAD TRAFFIC NOISE

This section assesses the impact of increased noise potentially impacting residential receivers due to additional road traffic generated by the proposed Facility, particularly medium to heavy vehicles,

As per the draft EA, an additional 57 trucks, or 114 movements, are predicted in a typical day (7.00am-5.00pm). Based in data provided by Council (via URS), the hourly movements would vary from 7 to 17. As a worst case scenario, the absolute noise level from 17 medium to heavy vehicle movements has been calculated and then added (logarithmically) to the existing noise level between 1:00pm and 2:00pm on weekdays (from Table 3-2), calculated to be the quietest hourly period with an existing level of $L_{Aeq,1hr}$ 66.2dBA from road traffic noise.

The Federal Highways traffic noise prediction method (FHWA) has been used to calculate the noise level from medium to heavy vehicle pass-bys. The equations applicable to 'hard ground' have been used at a distance of 13m (closest lane) and 17m (furthest lane) and these two levels added logarithmically. Although the sign posted speed is 50km/h, a speed of 64km/h has been used in the calculation as derived from continuous automatic traffic counts. To represent the most exposed residential receivers, such as 273 Railway Street, no shielding (such as a fence) was allowed for in the calculation. To account for facade reflections, 2.5dB was added to the calculated level.

A level of $L_{Aeq,1hr}$ 61.2dBA was calculated to represent 17 medium to heavy vehicle movements an hour past the most exposed residential receiver along Railway Street / Nagari Road. Should all 17 movements occur during the quietest hourly period during the daytime ($L_{Aeq,1hr}$ 67.4dBA), the increase in traffic noise would be 1.2dB, which is below the allowable 2dB increase.

7 CONCLUSION

The operational noise impacts due to the proposed alternative waste technology and composting facility (AWT&CF) at Nagari Road, Woy Woy South have been assessed by Wilkinson Murray.

With respect to noise, the following policy guidelines published by the NSW Department of Environment & Conservation (DEC) have been referenced:

- *NSW Industrial Noise Policy (INP)*, dated January 2000
- *Noise Guide for Local Government (NGLG)*, dated June 2004
- *Environmental Criteria for Road Traffic Noise (ECRTN)*, dated May 1999

With respect to the assessing the operational noise impact to the existing residences, noting the assumed noise levels and building constructions, the 36dBA criterion is comfortably met and the operation of the facility is likely to be inaudible.

The impact on the National Park is likely to be below the 50dBA criterion.

The potential of sleep disturbance due to the operation of the development was found to be negligible.

Impacts relating to the increased movement of heavy vehicles along Railway Street / Nagari Road were found to be below the allowance of 2dB above existing traffic noise levels at relevant residences, and are therefore considered acceptable.

Version	Status	Date	Prepared by	Checked by
A	Draft	27 June 2007	Sam Demasi	Rob Bullen
B	Final	27 August 2007	Sam Demasi	Rob Bullen

APPENDIX A

GLOSSARY OF TERMS

GLOSSARY

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph overleaf, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

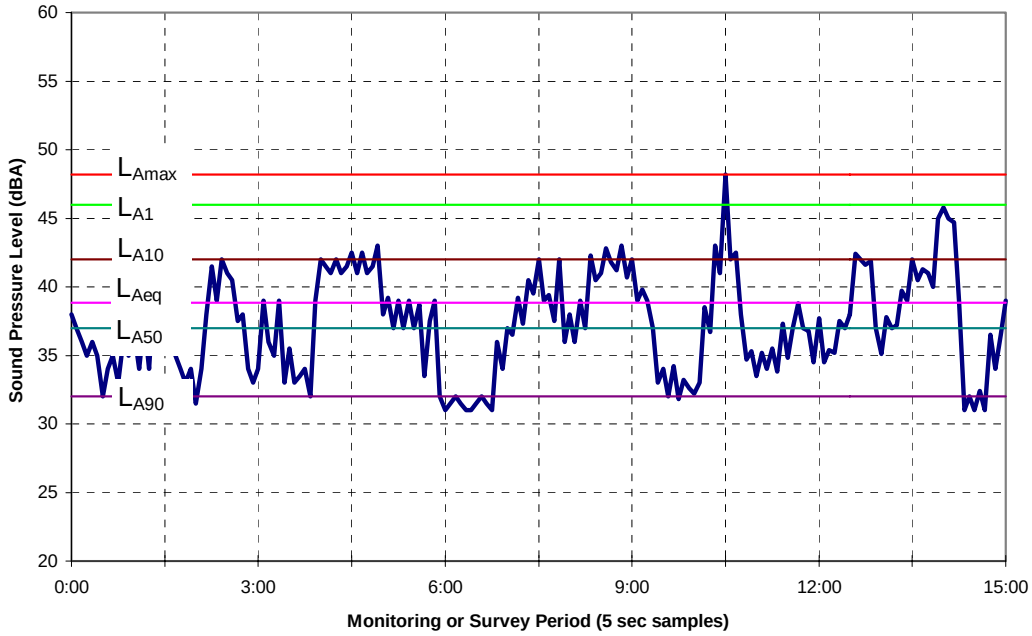
L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

L_{A50} – The L_{A50} level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the L_{A50} level for 50% of the time.

L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10^{th} percentile (lowest 10^{th} percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.


60
55
50
45
40
35
30
25
20
Sound Pressure Level (dBA)
LAmax
LA1
LA10
LAeq
LA50
LA90
0:00
3:00
6:00
9:00
12:00
15:00
Monitoring or Survey Period (5 sec samples)

APPENDIX B

SUMMARY OF METEOROLOGICAL CONDITIONS MODELLED

Period: Day
Season: Autumn

Wind Dir	Wind Speed	Inv Strength	% Occurr.
0	0	0	64.6%
45	0.75	0	0.4%
90	0.75	0	0.1%
180	0.75	0	0.2%
225	0.75	0	0.3%
270	0.75	0	0.1%
315	0.75	0	0.2%
0	1.25	0	0.2%
45	1.25	0	0.4%
90	1.25	0	0.6%
135	1.25	0	0.1%
180	1.25	0	0.1%
225	1.25	0	0.1%
270	1.25	0	0.6%
315	1.25	0	0.2%
45	1.75	0	0.7%
90	1.75	0	0.9%
135	1.75	0	0.6%
180	1.75	0	0.8%
225	1.75	0	0.6%
270	1.75	0	0.9%
315	1.75	0	0.4%
0	2.25	0	0.6%
45	2.25	0	2.1%
90	2.25	0	2.5%
135	2.25	0	2.6%
180	2.25	0	0.3%
225	2.25	0	1.7%
270	2.25	0	1.4%
315	2.25	0	1.0%
0	2.75	0	0.8%
45	2.75	0	2.2%
90	2.75	0	2.8%
135	2.75	0	2.7%
180	2.75	0	1.0%
225	2.75	0	0.8%
270	2.75	0	1.3%
315	2.75	0	2.7%
0	0	3	0.4%
225	2.25	3	0.1%
0	2.75	3	0.1%
180	2.75	3	0.1%
225	2.75	3	0.1%

Period: Day
Season: Spring

Wind Dir	Wind Speed	Inv Strength	% Occurr.
0	0	0	77.3%
0	0.75	0	0.2%
45	0.75	0	0.1%
135	0.75	0	0.1%
270	0.75	0	0.2%
315	0.75	0	0.1%
0	1.25	0	0.2%
45	1.25	0	0.4%
90	1.25	0	0.5%
135	1.25	0	0.2%
180	1.25	0	0.1%
225	1.25	0	0.1%
270	1.25	0	0.1%
315	1.25	0	0.1%
0	1.75	0	0.1%
45	1.75	0	0.3%
90	1.75	0	0.5%
135	1.75	0	0.1%
180	1.75	0	1.0%
225	1.75	0	1.2%
270	1.75	0	0.5%
315	1.75	0	0.4%
0	2.25	0	0.2%
45	2.25	0	0.7%
90	2.25	0	0.6%
135	2.25	0	1.1%
180	2.25	0	1.3%
225	2.25	0	1.6%
270	2.25	0	1.4%
315	2.25	0	0.3%
45	2.75	0	0.6%
90	2.75	0	1.0%
135	2.75	0	1.8%
180	2.75	0	1.5%
225	2.75	0	1.2%
270	2.75	0	2.1%
315	2.75	0	0.8%

Period: Day
Season: Summer

Wind Dir	Wind Speed	Inv Strength	% Occurr.
0	0	0	80.7%
0	0.75	0	0.1%
45	0.75	0	0.1%
90	0.75	0	0.3%
135	0.75	0	0.1%
180	0.75	0	0.1%
225	0.75	0	0.1%
270	0.75	0	0.1%
315	0.75	0	0.2%
0	1.25	0	0.2%
45	1.25	0	0.4%
90	1.25	0	0.1%
135	1.25	0	0.2%
180	1.25	0	0.1%
225	1.25	0	0.1%
270	1.25	0	0.3%
315	1.25	0	0.4%
0	1.75	0	0.3%
45	1.75	0	0.5%
90	1.75	0	0.8%
135	1.75	0	0.4%
180	1.75	0	0.2%
225	1.75	0	0.4%
270	1.75	0	0.3%
315	1.75	0	0.2%
0	2.25	0	0.7%
45	2.25	0	1.4%
90	2.25	0	1.5%
135	2.25	0	0.5%
180	2.25	0	0.4%
225	2.25	0	0.3%
270	2.25	0	0.5%
315	2.25	0	0.2%
0	2.75	0	0.8%
45	2.75	0	1.5%
90	2.75	0	2.5%
135	2.75	0	2.0%
180	2.75	0	0.2%
225	2.75	0	0.1%
270	2.75	0	0.6%
315	2.75	0	0.1%

Period: Day
Season: Winter

Wind Dir	Wind Speed	Inv Strength	% Occurr.
0	0	0	76.0%
135	0.75	0	0.2%
180	0.75	0	0.3%
225	0.75	0	0.4%
270	0.75	0	0.2%
315	0.75	0	0.1%
0	1.25	0	0.5%
45	1.25	0	0.8%
90	1.25	0	0.3%
135	1.25	0	0.4%
180	1.25	0	0.2%
225	1.25	0	0.2%
270	1.25	0	0.6%
315	1.25	0	0.5%
0	1.75	0	0.2%
45	1.75	0	0.3%
90	1.75	0	0.9%
135	1.75	0	0.2%
180	1.75	0	1.4%
225	1.75	0	0.5%
270	1.75	0	1.4%
315	1.75	0	0.1%
0	2.25	0	0.5%
45	2.25	0	1.0%
90	2.25	0	0.2%
135	2.25	0	1.5%
180	2.25	0	0.9%
225	2.25	0	0.4%
270	2.25	0	1.0%
315	2.25	0	0.1%
0	2.75	0	0.5%
45	2.75	0	1.1%
90	2.75	0	0.7%
135	2.75	0	0.8%
180	2.75	0	1.2%
225	2.75	0	1.6%
270	2.75	0	1.5%
315	2.75	0	0.8%
0	0	3	0.5%
270	1.75	3	0.1%
0	2.75	3	0.1%
270	2.75	3	0.1%
315	2.75	3	0.1%

Period: Evening
Season: Autumn

Wind Dir	Wind Speed	Inv Strength	% Occurr.
0	0	0	44.8%
0	0.75	0	0.5%
45	0.75	0	0.5%
90	0.75	0	0.3%
135	0.75	0	0.3%
225	0.75	0	0.5%
45	1.25	0	1.1%
90	1.25	0	1.6%
135	1.25	0	0.3%
270	1.25	0	0.3%
315	1.25	0	0.3%
0	1.75	0	0.3%
45	1.75	0	0.3%
90	1.75	0	1.1%
135	1.75	0	0.3%
180	1.75	0	0.3%
225	1.75	0	0.3%
270	1.75	0	0.3%
0	2.25	0	0.3%
45	2.25	0	0.3%
90	2.25	0	0.5%
135	2.25	0	1.9%
180	2.25	0	0.5%
270	2.25	0	0.5%
0	2.75	0	0.5%
45	2.75	0	1.4%
135	2.75	0	0.3%
315	2.75	0	0.3%
0	0	3	14.1%
135	1.25	3	0.3%
225	1.25	3	0.3%
0	1.75	3	0.8%
45	1.75	3	1.6%
90	1.75	3	1.1%
135	1.75	3	0.3%
180	1.75	3	0.3%
225	1.75	3	0.5%
0	2.25	3	1.6%
45	2.25	3	2.4%
90	2.25	3	1.9%
135	2.25	3	1.6%
180	2.25	3	1.1%
225	2.25	3	0.3%
270	2.25	3	0.8%
0	2.75	3	44.8%

Period: Evening
Season: Autumn

Wind Dir	Wind Speed	Inv Strength	% Occurr.
45	2.75	3	2.7%
90	2.75	3	1.1%
135	2.75	3	0.3%
180	2.75	3	0.3%
225	2.75	3	0.3%
270	2.75	3	0.3%
315	2.75	3	0.5%

Period: Evening
Season: Spring

Wind Dir	Wind Speed	Inv Strength	% Occurr.
0	0	0	60.2%
45	0.75	0	0.3%
270	0.75	0	0.5%
0	1.25	0	0.3%
45	1.25	0	0.3%
180	1.25	0	0.3%
225	1.25	0	0.3%
270	1.25	0	0.3%
45	1.75	0	0.3%
90	1.75	0	0.5%
180	1.75	0	0.5%
225	1.75	0	0.3%
45	2.25	0	0.5%
90	2.25	0	0.3%
225	2.25	0	0.3%
315	2.25	0	0.3%
0	2.75	0	0.3%
45	2.75	0	0.3%
90	2.75	0	0.8%
135	2.75	0	3.0%
225	2.75	0	0.5%
0	0	3	9.9%
135	0.75	3	0.3%
45	1.25	3	0.3%
0	1.75	3	0.8%
45	1.75	3	2.7%
90	1.75	3	0.5%
180	1.75	3	0.3%
225	1.75	3	1.1%
270	1.75	3	0.5%
315	1.75	3	0.3%
0	2.25	3	1.4%
45	2.25	3	2.2%
90	2.25	3	1.1%
135	2.25	3	0.8%
180	2.25	3	0.5%
225	2.25	3	1.6%
270	2.25	3	0.3%
0	2.75	3	1.6%
45	2.75	3	0.3%
135	2.75	3	1.6%
180	2.75	3	0.5%
315	2.75	3	0.8%

Period: Evening
Season: Summer

Wind Dir	Wind Speed	Inv Strength	% Occurr.
0	0	0	64.3%
45	0.75	0	0.5%
90	0.75	0	1.1%
0	1.25	0	0.5%
45	1.25	0	0.8%
135	1.25	0	0.5%
45	1.75	0	1.1%
90	1.75	0	0.3%
135	1.75	0	0.5%
0	2.25	0	0.8%
45	2.25	0	1.4%
90	2.25	0	0.8%
135	2.25	0	0.5%
315	2.25	0	0.3%
45	2.75	0	2.5%
90	2.75	0	1.1%
135	2.75	0	1.6%
180	2.75	0	0.5%
0	0	3	9.6%
0	1.25	3	0.5%
315	1.25	3	0.3%
0	1.75	3	0.3%
135	1.75	3	0.3%
0	2.25	3	0.5%
45	2.25	3	0.3%
90	2.25	3	0.8%
180	2.25	3	0.5%
270	2.25	3	0.3%
315	2.25	3	0.5%
0	2.75	3	0.8%
45	2.75	3	0.3%
90	2.75	3	0.8%
135	2.75	3	1.4%
180	2.75	3	2.2%
225	2.75	3	0.3%
315	2.75	3	0.8%

Period: Evening
Season: Winter

Wind Dir	Wind Speed	Inv Strength	% Occurr.
0	0	0	70.4%
0	0.75	0	0.8%
45	0.75	0	0.3%
135	0.75	0	0.5%
180	0.75	0	0.8%
270	0.75	0	0.3%
315	0.75	0	0.5%
0	1.25	0	0.5%
45	1.25	0	0.8%
90	1.25	0	0.5%
180	1.25	0	0.5%
225	1.25	0	0.3%
90	1.75	0	1.1%
180	1.75	0	0.5%
225	1.75	0	0.5%
270	1.75	0	0.3%
0	2.25	0	0.3%
180	2.25	0	0.3%
0	2.75	0	0.8%
0	0	3	6.8%
0	1.25	3	0.5%
270	1.25	3	0.3%
0	1.75	3	0.8%
90	1.75	3	0.8%
135	1.75	3	0.3%
180	1.75	3	0.8%
270	1.75	3	0.3%
315	1.75	3	1.1%
0	2.25	3	0.8%
90	2.25	3	0.3%
135	2.25	3	0.3%
270	2.25	3	0.8%
315	2.25	3	0.8%
0	2.75	3	1.1%
90	2.75	3	0.3%
135	2.75	3	0.3%
180	2.75	3	1.1%
225	2.75	3	0.3%
270	2.75	3	0.8%
315	2.75	3	1.4%

Period: Night
Season: Summer

Wind Dir	Wind Speed	Inv Strength	% Occurr.
0	0	0	61.4%
0	0.75	0	0.1%
45	0.75	0	0.1%
90	0.75	0	0.1%
135	0.75	0	0.1%
270	0.75	0	0.1%
315	0.75	0	0.1%
0	1.25	0	0.2%
45	1.25	0	0.9%
90	1.25	0	0.1%
180	1.25	0	0.4%
270	1.25	0	0.2%
0	1.75	0	0.2%
45	1.75	0	1.0%
90	1.75	0	1.5%
180	1.75	0	0.9%
225	1.75	0	0.2%
270	1.75	0	0.1%
315	1.75	0	0.4%
0	2.25	0	0.5%
45	2.25	0	0.5%
90	2.25	0	1.6%
135	2.25	0	1.7%
180	2.25	0	0.6%
225	2.25	0	0.5%
270	2.25	0	0.2%
315	2.25	0	0.9%
0	2.75	0	0.7%
45	2.75	0	0.5%
90	2.75	0	1.5%
135	2.75	0	1.5%
180	2.75	0	0.4%
225	2.75	0	1.2%
270	2.75	0	1.3%
315	2.75	0	0.5%
0	0	3	0.7%
0	1.75	3	0.7%
45	1.75	3	7.8%
90	1.75	3	0.1%
135	1.75	3	0.2%
225	1.75	3	0.1%
270	1.75	3	0.1%
315	1.75	3	0.1%
0	2.25	3	0.6%
45	2.25	3	0.2%

Period: Night
Season: Summer

Wind Dir	Wind Speed	Inv Strength	% Occurr.
90	2.25	3	0.4%
135	2.25	3	0.2%
180	2.25	3	0.1%
225	2.25	3	0.1%
270	2.25	3	0.1%
315	2.25	3	0.5%
0	2.75	3	1.5%
45	2.75	3	1.0%
90	2.75	3	0.7%
135	2.75	3	0.7%
180	2.75	3	0.6%
225	2.75	3	0.1%
270	2.75	3	0.2%
315	2.75	3	0.5%

Period: Night
Season: Spring

Wind Dir	Wind Speed	Inv Strength	% Occurr.
0	0	0	73.6%
0	0.75	0	0.1%
45	0.75	0	0.1%
225	0.75	0	0.1%
270	0.75	0	0.1%
315	0.75	0	0.1%
0	1.25	0	0.4%
45	1.25	0	0.1%
135	1.25	0	0.1%
270	1.25	0	0.1%
0	1.75	0	0.1%
90	1.75	0	0.1%
180	1.75	0	0.7%
225	1.75	0	0.1%
135	2.25	0	1.7%
180	2.25	0	0.7%
225	2.25	0	0.5%
270	2.25	0	0.2%
0	2.75	0	0.2%
90	2.75	0	0.4%
135	2.75	0	0.9%
180	2.75	0	2.0%
225	2.75	0	1.2%
270	2.75	0	0.1%
315	2.75	0	0.4%
0	0	3	7.2%
45	1.25	3	0.1%
270	1.25	3	0.1%
0	1.75	3	0.7%
45	1.75	3	0.4%
90	1.75	3	0.2%
225	1.75	3	0.2%
315	1.75	3	0.4%
90	2.25	3	0.2%
135	2.25	3	0.1%
225	2.25	3	0.2%
270	2.25	3	0.9%
315	2.25	3	0.2%
0	2.75	3	1.2%
45	2.75	3	0.1%
90	2.75	3	0.2%
135	2.75	3	1.1%
180	2.75	3	0.6%
225	2.75	3	0.2%
270	2.75	3	1.0%

Period: Night
Season: Summer

Wind Dir	Wind Speed	Inv Strength	% Occurr.
0	0	0	61.4%
0	0.75	0	0.1%
45	0.75	0	0.1%
90	0.75	0	0.1%
180	0.75	0	0.1%
225	0.75	0	0.1%
315	0.75	0	0.1%
0	1.25	0	0.2%
45	1.25	0	0.9%
90	1.25	0	0.1%
180	1.25	0	0.4%
270	1.25	0	0.2%
315	1.25	0	0.2%
0	1.75	0	1.0%
45	1.75	0	1.5%
90	1.75	0	0.9%
135	1.75	0	0.2%
180	1.75	0	0.1%
225	1.75	0	0.4%
270	1.75	0	0.5%
315	1.75	0	0.5%
0	2.25	0	1.6%
45	2.25	0	1.7%
90	2.25	0	0.6%
135	2.25	0	0.5%
180	2.25	0	0.2%
225	2.25	0	0.9%
270	2.25	0	0.7%
315	2.25	0	0.5%
0	2.75	0	1.5%
45	2.75	0	1.5%
90	2.75	0	0.4%
135	2.75	0	1.2%
180	2.75	0	1.3%
225	2.75	0	0.5%
270	2.75	0	0.7%
315	2.75	0	0.7%
0	0	3	7.8%
0	1.75	3	0.1%
45	1.75	3	0.2%
90	1.75	3	0.1%
135	1.75	3	0.1%
315	1.75	3	0.1%
0	2.25	3	0.6%
0	0	0	0.2%

Period: Night
Season: Summer

Wind Dir	Wind Speed	Inv Strength	% Occurr.
90	2.25	3	0.4%
135	2.25	3	0.2%
180	2.25	3	0.1%
225	2.25	3	0.1%
270	2.25	3	0.1%
315	2.25	3	0.5%
0	2.75	3	1.5%
45	2.75	3	1.0%
90	2.75	3	0.7%
135	2.75	3	0.7%
180	2.75	3	0.6%
225	2.75	3	0.1%
270	2.75	3	0.2%
315	2.75	3	0.5%

Period: Night
Season: Summer

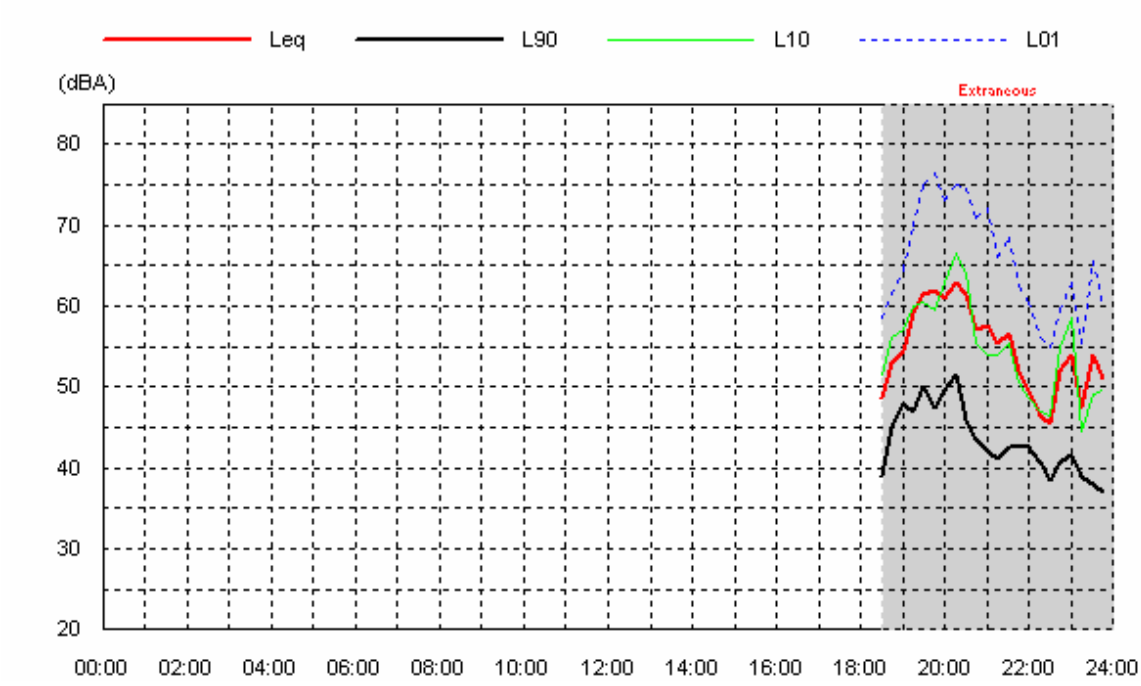
Wind Dir	Wind Speed	Inv Strength	% Occurr.
0	0	0	88.8%
225	0.75	0	0.2%
0	1.25	0	0.1%
45	1.25	0	0.8%
135	1.25	0	0.1%
225	1.25	0	0.2%
270	1.25	0	0.1%
45	1.75	0	0.7%
90	1.75	0	0.1%
270	1.75	0	0.1%
45	2.25	0	0.5%
90	2.25	0	0.4%
135	2.25	0	0.2%
180	2.25	0	0.2%
315	2.25	0	0.1%
90	2.75	0	0.1%
135	2.75	0	0.1%
180	2.75	0	0.2%
270	2.75	0	0.1%
0	0	3	4.5%
0	1.25	3	0.1%
0	1.75	3	0.1%
270	1.75	3	0.1%
315	1.75	3	0.2%
270	2.25	3	0.1%
315	2.25	3	0.4%
90	2.75	3	0.1%
180	2.75	3	0.1%
270	2.75	3	0.4%
315	2.75	3	0.4%

APPENDIX C

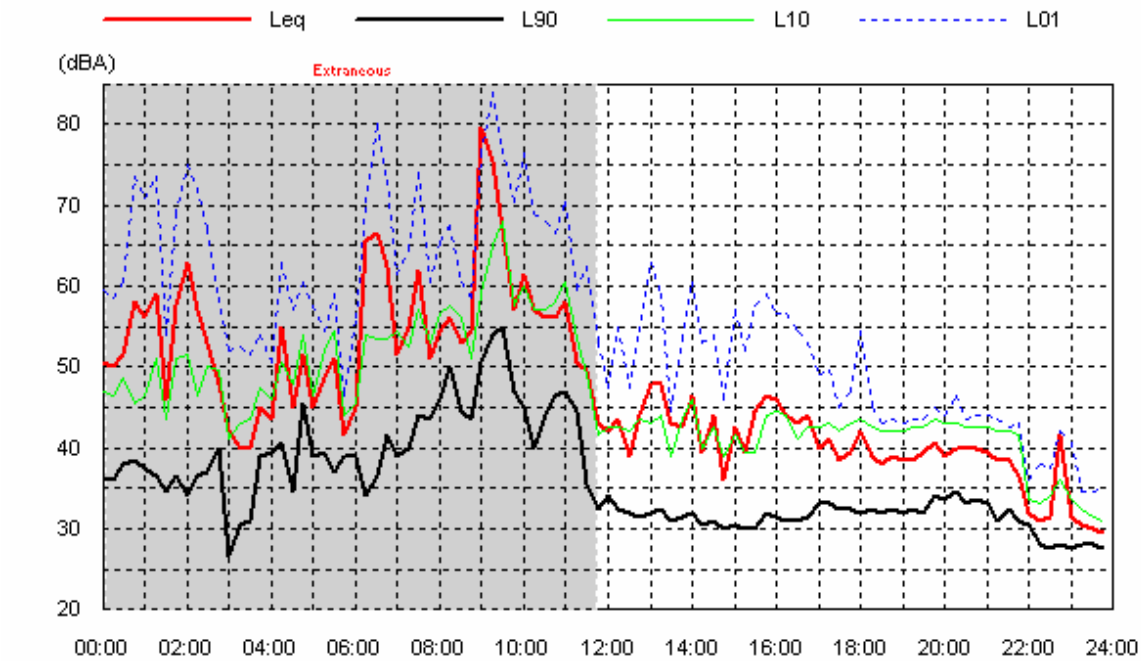
NOISE MEASUREMENT RESULTS

Location: Rear Yard
Data shaded: Rain; Extraneous

Fri 13 Jul 07

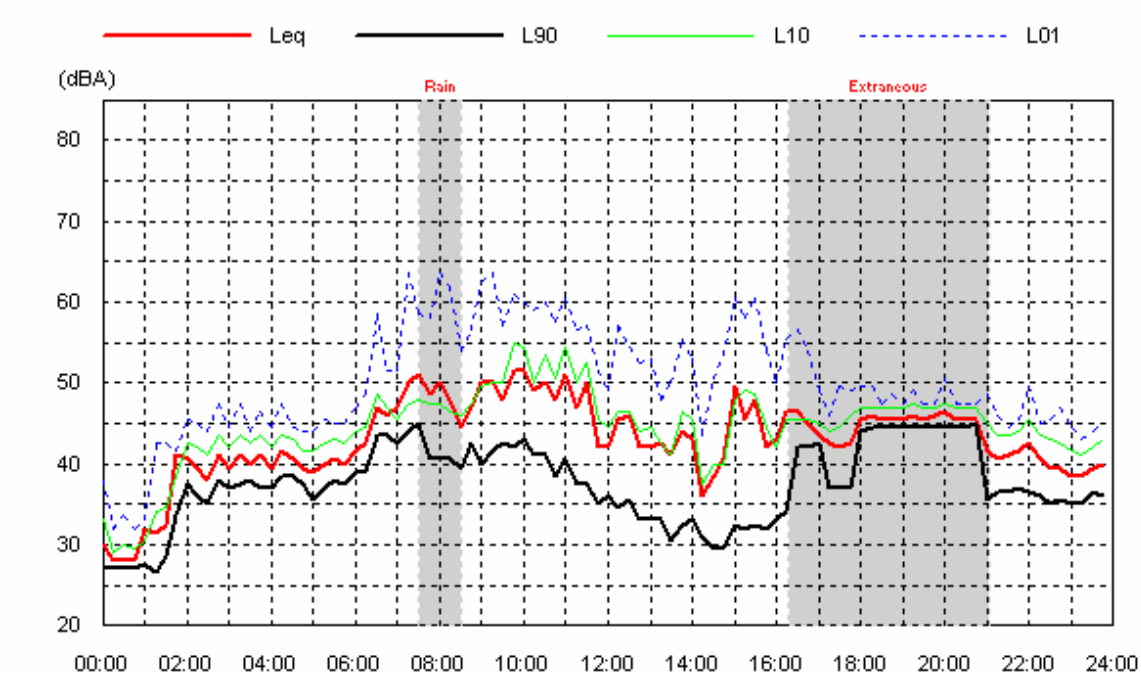


Sat 14 Jul 07

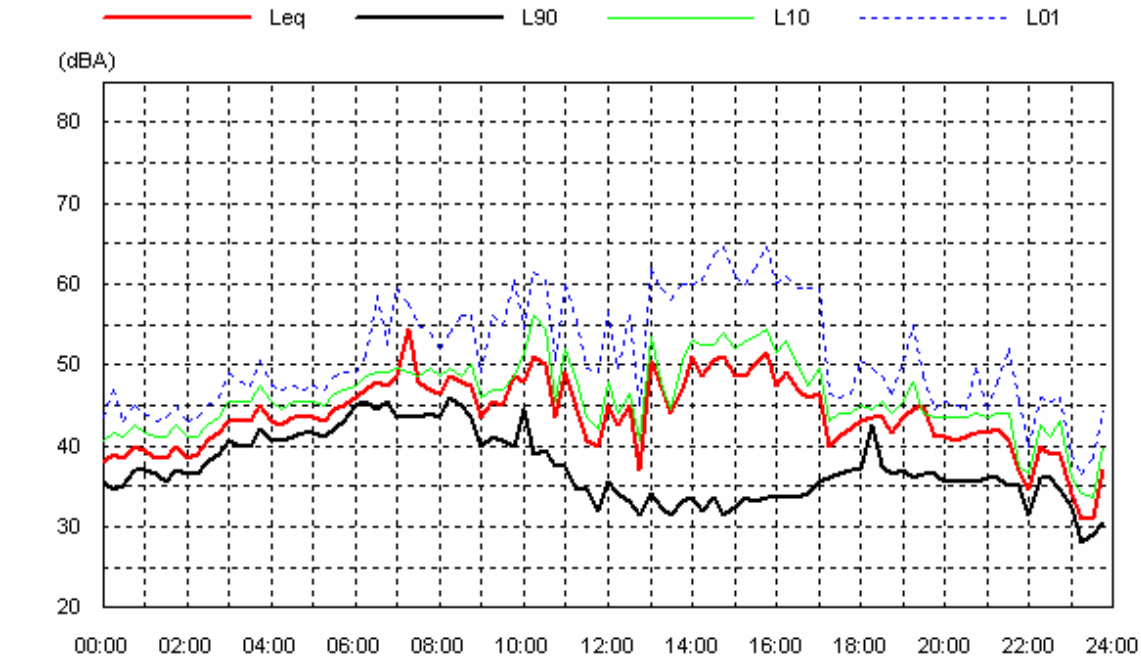


Location: Rear Yard
Data shaded: Rain; Extraneous

Sun 15 Jul 07

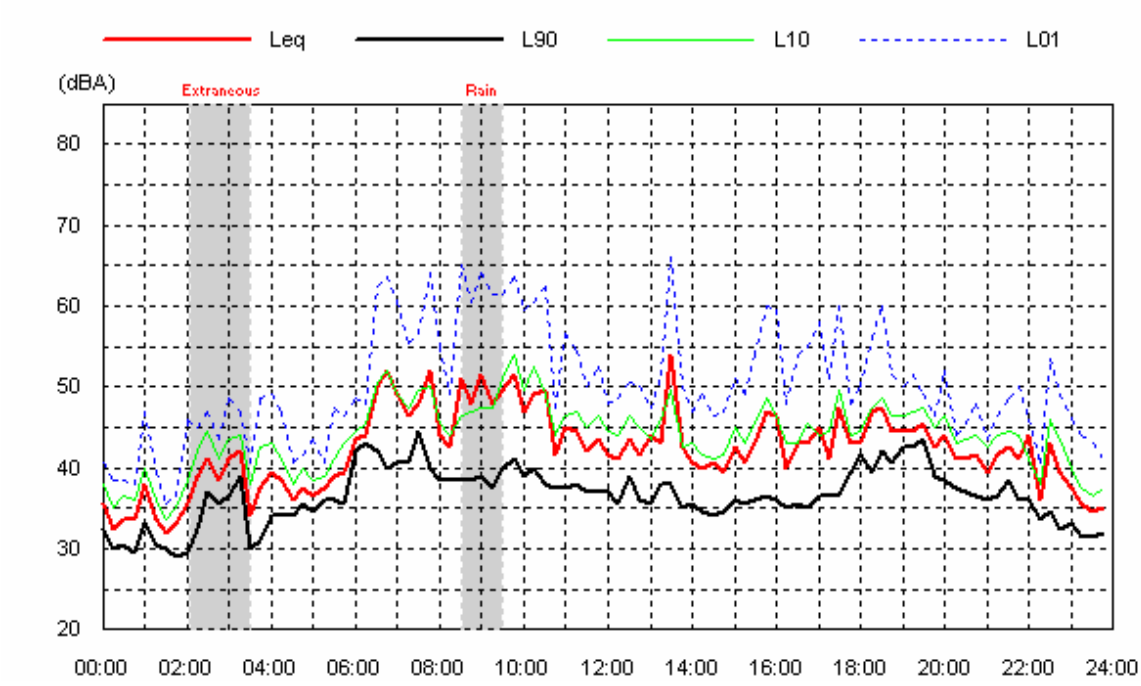


Mon 16 Jul 07

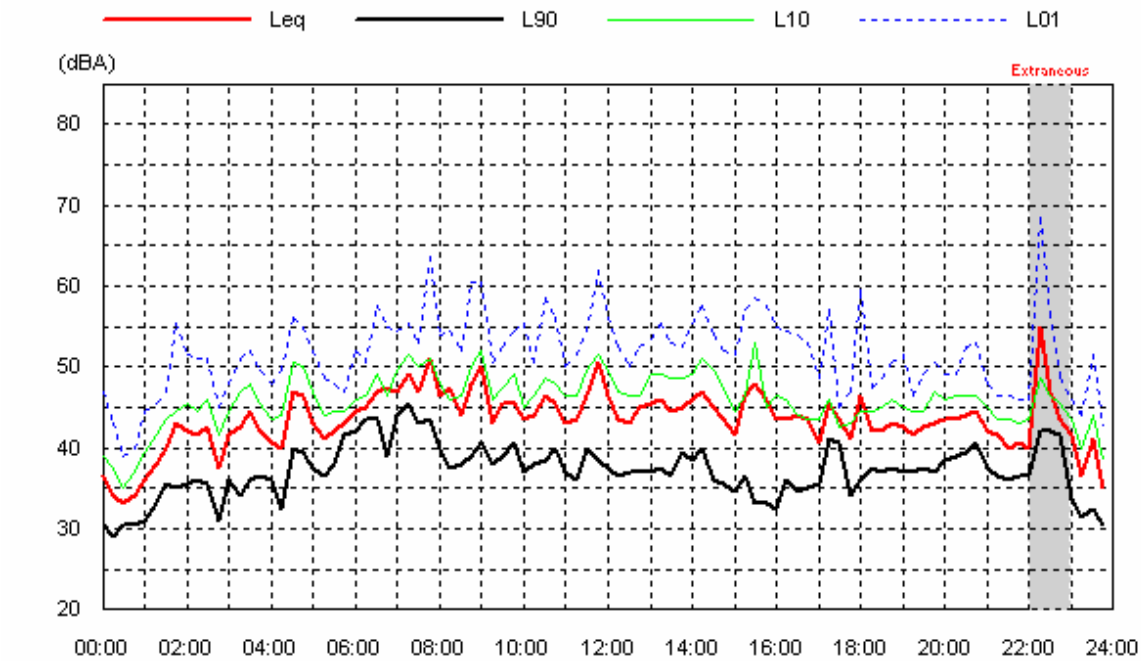


Location: Rear Yard
Data shaded: Rain; Extraneous

Tue 17 Jul 07

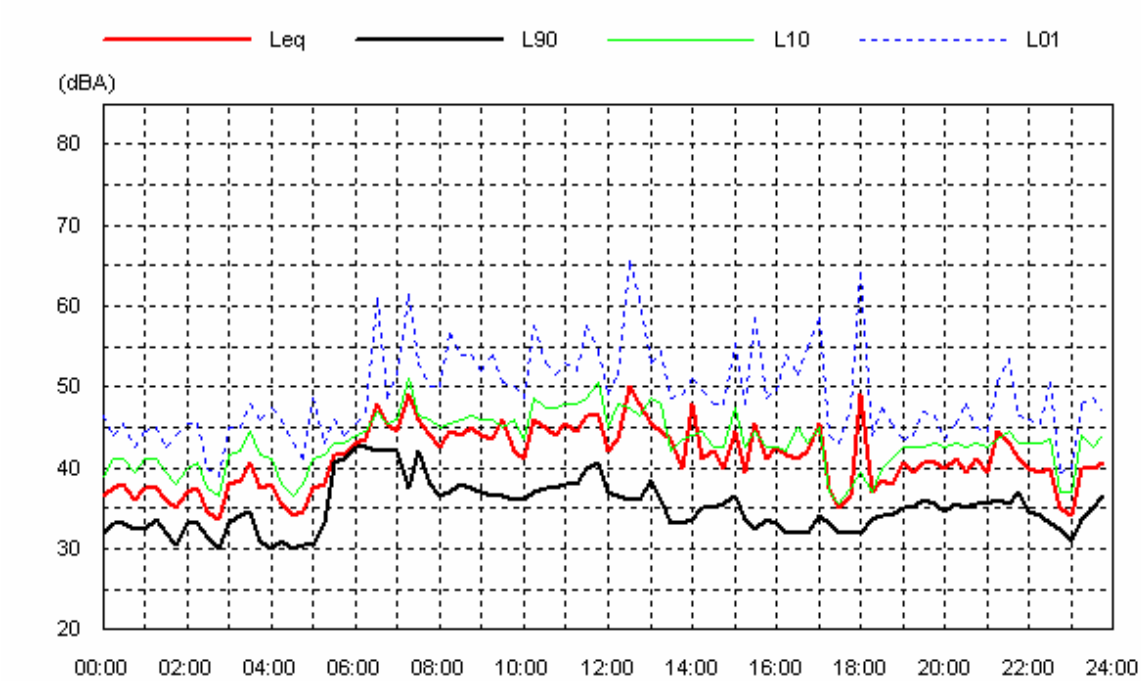


Wed 18 Jul 07

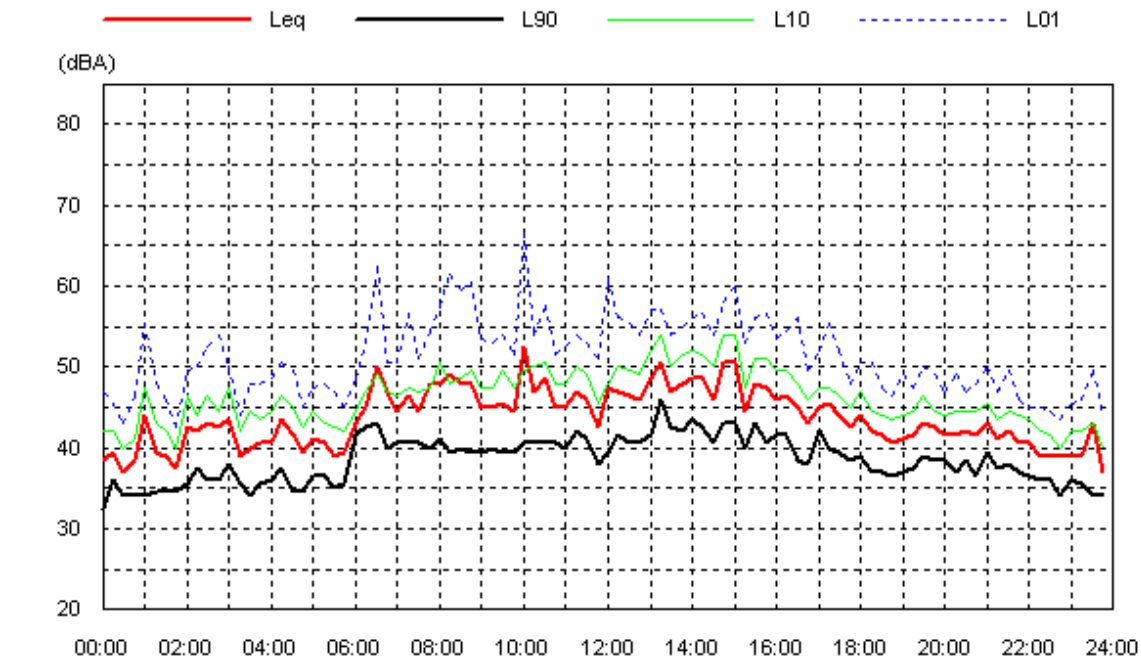


Location: Rear Yard
Data shaded: Rain; Extraneous

Thu 19 Jul 07

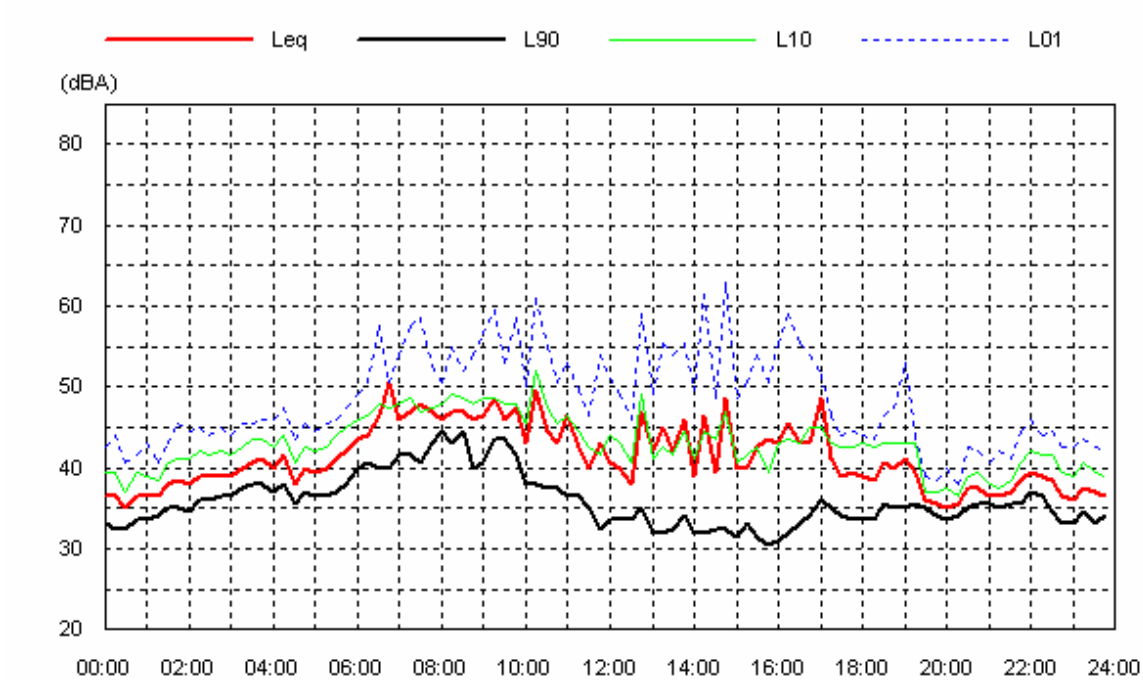


Fri 20 Jul 07

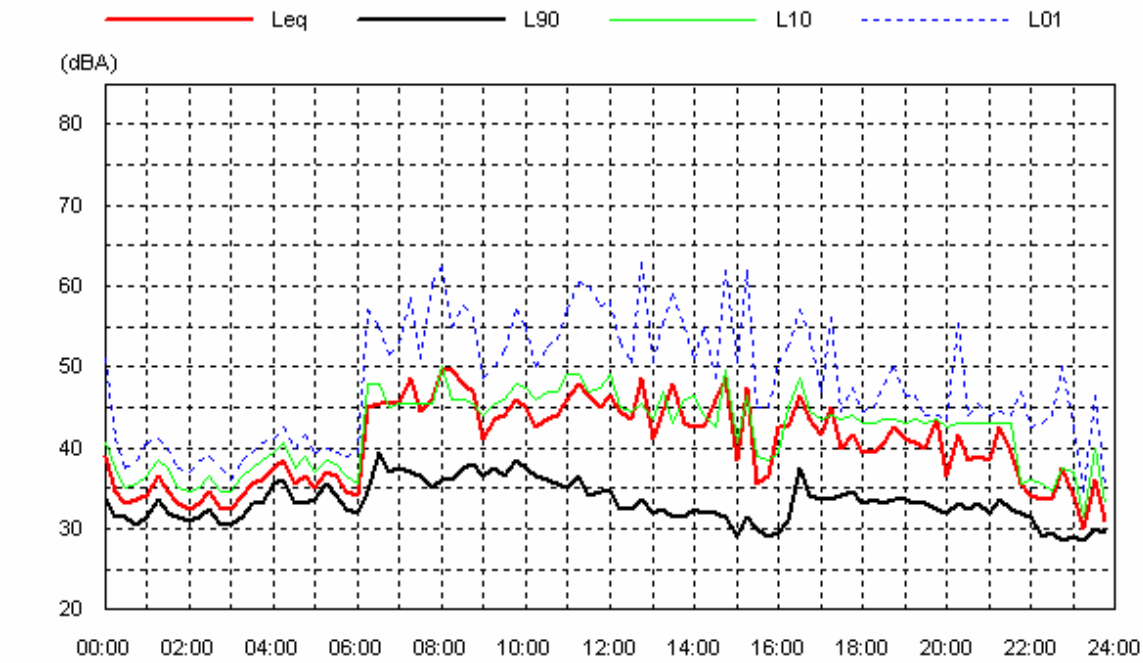


Location: Rear Yard
Data shaded: Rain; Extraneous

Sat 21 Jul 07



Sun 22 Jul 07



Location: Rear Yard
Data shaded: Rain; Extraneous

Mon 23 Jul 07