ACOUSTICS AND AIR

SHAOLIN TOURIST & RESIDENTIAL DEVELOPMENT
COMBERTON GRANGE, SOUTH NOWRA

NOISE ASSESSMENT

REPORT NO. 08370
VERSION B

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PREPARED FOR

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GLOSSARY OF ACOUSTIC TERMS

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 below, 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.

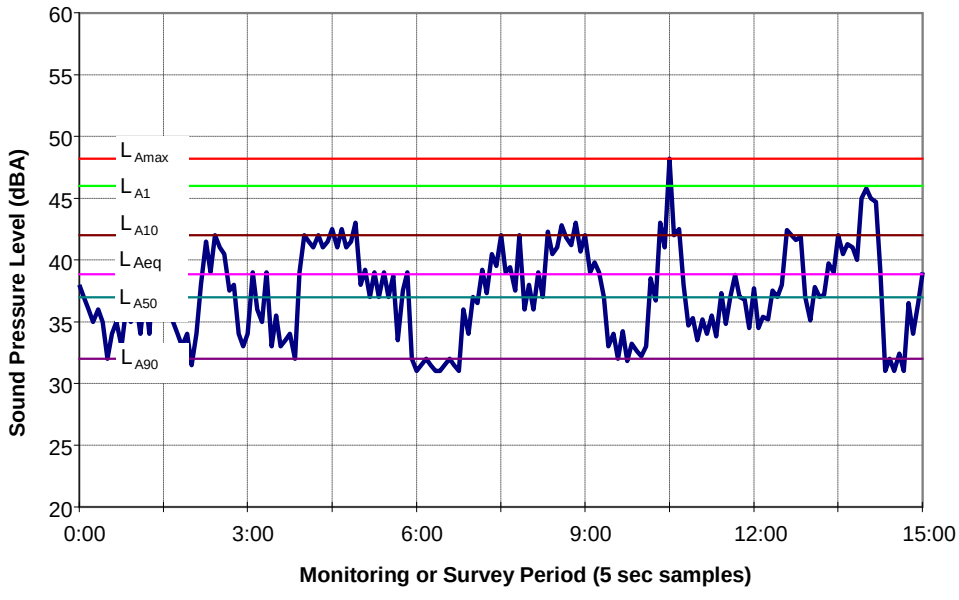
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

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.

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.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

The Shaolin Temple Foundation (Australia) Ltd has proposed a Shaolin Tourist and Residential Development at Comberton Grange, South Nowra, and a Part 3A Concept Plan Application is being prepared.

This report addressed noise issues raised in the Director-General's Requirements and Shoalhaven City Council's response to the Director Generals Environmental Assessment Requirements.

This report presents a noise assessment of the project. Aspects covered include;

- Helicopter noise from HMAS Albatross to the development;
- Noise from a nearby quarry to the development; and
- Traffic noise from traffic generated by the development.

2 PROJECT DESCRIPTION & SURROUNDINGS

2.1 The Project

The project location is shown on Figure 2-1. The site is located in the Currambene State Forest, north of the Cummambene Creek, south of Nowra.

Figure 2-2 shows the Masterplan of the development, which includes:

- Buddhist Temple Sanctuary with religious facilities, convention centre, amphitheatre and cultural centre, with residential accommodation for monks within the religious complex (numbers currently unknown);
- Kung-Fu Academy for up to 500 students with residential accommodation the Academy;
- Agricultural and herbal farm for traditional medicinal uses;
- 500 bed 4 star hotel with ancillary rooms for staff accommodation (up
- rooms);
- up to 300 dwellings comprising:
- self-contained independent living villas/ adaptable housing for the
- detached and medium density residential developments;
- small retail, commercial, professional and community services centre;
- 27 hole golf course and associated clubhouse (optional).

Within the site there is an existing sandstone and dolerite quarry used by Council for the harvesting of road base material. The quarry is approximately 900m from the nearest proposed structure. The figure shows the quarry buffer zone. The quarry is currently inactive; however potential noise from the quarry is to be assessed in case it becomes active once again.

The site lies on an established helicopter flight path 2 miles wide between Jervis Bay and the HMAS Albatross airfield. The site is close to the flight path of Runway 26. The Department of Defence has raised the issue of potential adverse noise impacts from military helicopters flying over the site as the flight path is in constant use during the week and on weekends. Typical helicopter flight movements vary from 25 to 100 movements per week, however during major fleet or army exercises movements may be up to 10-50 per day.

Figure 2-1 Aerial Photo showing Location of the Proposed Development

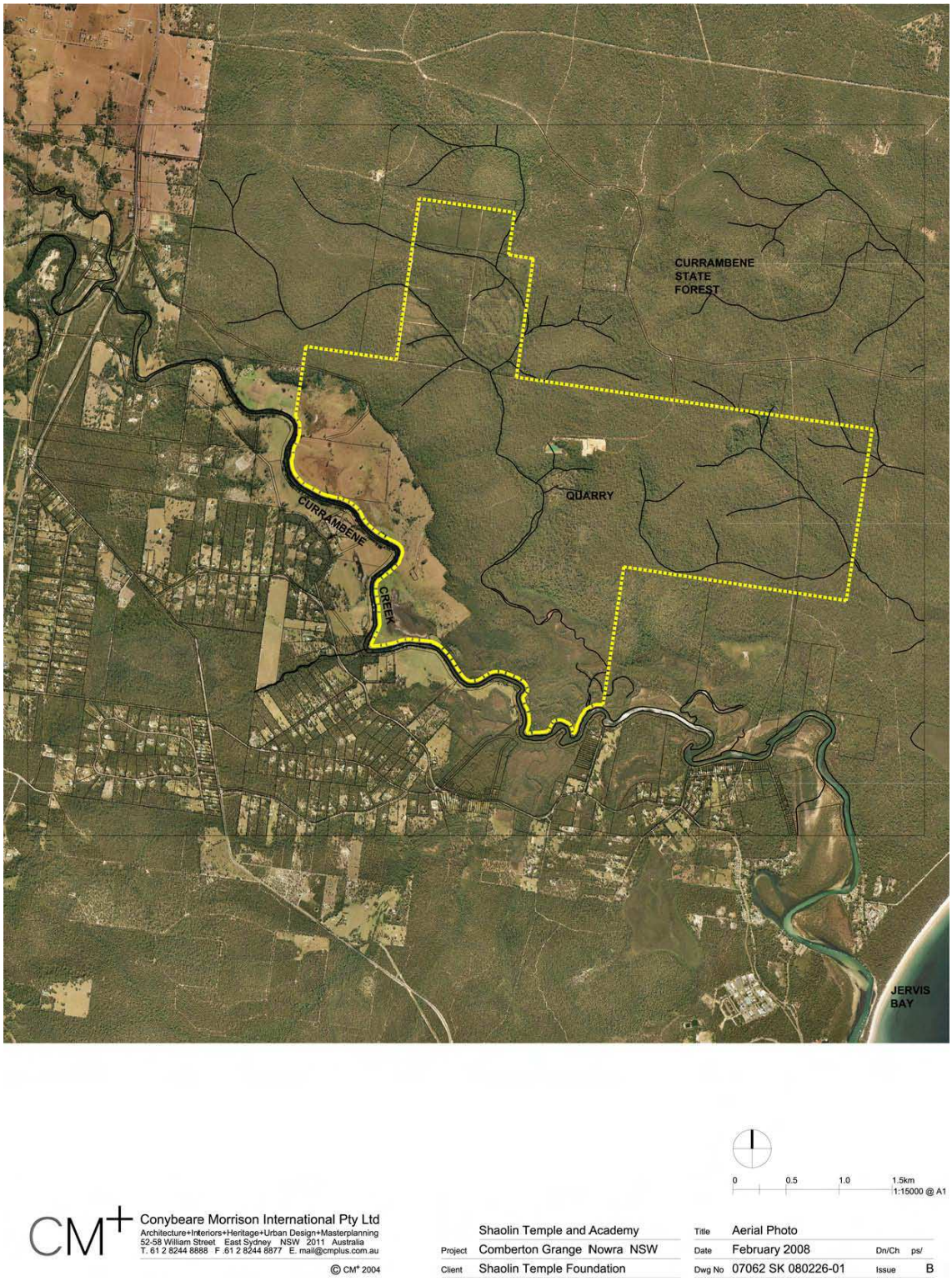


Figure 2-2 Masterplan for the Development

3 REQUIREMENTS

3.1 Director General Requirements

The Director-General Requirements from the NSW Department of Planning, date 16 July 2008, include the following:

Requirement 12 concerning noise -

> *Address potential noise impacts (existing and proposed) on the development, in particular, from road traffic noise, quarry operations and aircraft noise (Note: the site is located beneath the flight corridor between the HMAS Albatross and the Jervis Bay Training Area). Appropriate mitigation measures to ameliorate noise impacts should be addressed.*

3.2 Shoalhaven Council Recommendation

The Shoalhaven Council response to the Department of Planning Major Project Assessments dated 15 July 2008 includes the following:

Recommendation 7 concerning noise -

> *A noise impact assessment report prepared by a suitable qualified acoustic consultant prepared in accordance with the NSW EPA Industrial Noise Policy that assess the impact of Naval Air Base operations (from HMAS Albatross Airfield), quarry operations and traffic noise (generated from the development and surrounding road network) on the proposed development in particular, on the proposed accommodation components of the development (e.g. hotel, residential, etc).*

4 NOISE FROM THE QUARRY

4.1 Quarry Operations

Information from Council indicates that the quarry currently has development consent for a maximum annual production of 55,000 tonnes, but production has been limited to 25,000 tonnes on average. Extraction of material to date has consisted of low quality sandstone.

The quarry has been identified by the Department of Primary Industries (DPI) as being regionally significant due to the importance of its in-ground resource. The DPI has advised that the dolerite is generally overlain by a substantial thickness of sandstone, with the dolerite being a more significant hard rock construction resource.

4.2 *Industrial Noise Policy*

For the quarry appropriate noise criteria are specified in the NSW DECCW's *Industrial Noise Policy (INP).* The criterion depends on whether existing noise levels in an area are close to recommended amenity levels for different types of residential receiver areas (i.e. urban, rural, near existing roads).

For residential receivers, two criteria are specified in the *INP*: the intrusiveness criterion and the amenity criterion.

In general, intrusiveness criterion is that the L_{Aeq} noise level from such sources should not exceed the Rating Background Level (RBL) by more than 5dBA.

The amenity criterion sets an upper limit to control the total L_{Aeq} noise level from all industrial sources. In this case, the potentially affected residences in an area which would be classified as "Rural" and the relevant recommended "acceptable" amenity criteria for $L_{Aeq,period}$ are 50, 45 and 40dBA for daytime, evening and night time periods respectively. "Maximum" recommended levels are all 5dBA higher.

The intrusiveness criterion is applied over any 15 minute period, and will be used to assess total noise emission from the site, including truck delivery. The amenity criterion is assessed over an entire period (day, evening and night).

4.1 Background Noise Levels

Noise criteria depend on the existing noise levels. Those levels were measured using both attended and unattended noise monitoring.

4.1.1 Unattended Measurements

Noise logging was done firstly to gather background noise levels for setting goals for noise from the quarry. It was possible also that the results could be used to verify helicopter noise predictions. Two loggers were set out at locations shown on Figure 4-1. The monitoring was timed to coincide with fieldwork by the Kevin Mills and Associates (KMA) who would do observation of helicopter movements from the week commencing Monday 12 October.

Noise levels were monitored continuously from 12 October to 22 October 2009 at one location. The result charts of the logging are shown in Appendix B. The noise logger location is shown on. This followed a period of heavy rain and much of the site was inaccessible for noise monitoring. One logger was set near the western entrance of the site, the other near the western side of the temple area.

Loggers are typically set to 15 minute logging periods for background noise analysis. In this case the 5 minute sampling period was used in order to identify passage of helicopters across the site. From the samples from the logger, combined with observations from KMA, it was hoped to determine frequency of helicopter transits. The logger near the temple site failed after one day of monitoring. As discussed later the observations from KMA do not coincide with peaks of noise on the loggers, so the logger results could not be used to determine helicopter noise with certainty.

The noise monitoring equipment used for these measurements consisted of an environmental noise logger set to A-weighted, fast response, continuously monitoring over 5-minute sampling periods. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted.

The logger determines L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the ambient noise. L_{A1}, L_{A10} and L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Glossary for definitions). The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional pass-by of a heavy vehicle. This is used for the assessment of sleep disturbance. The L_{A90} level is normally taken as the background noise level during the relevant period.

The RBLS determined from Location 1 were:

- Daytime – RBL 35dBA;
- Evening – RBL – 32dBA; and
- Night time – RBL – 30dBA.

The RBL at this location was influenced by noise from the Princes Highway. Further east into the site, nearer the proposed residences, the noise from the Princes Highway would have less influence. In order to assess noise from the quarry, RBLs estimated from attended logging will be used.

4.1.2 Attended Measurements

Attended measurements were carried out during two site visit to set out and collect the noise loggers.

The measurements were taken in unoccupied offices. All measurements were conducted using a Bruel and Kjaer Type 2250 Sound Level Meter. This sound level meter conforms to Australian Standard 1259 *Acoustics – Sound Level Meters* as a Type 1 Precision Sound Level Meter which has an accuracy suitable for field and laboratory use. The A-Weighting filter of the meter was selected and the time weighting was set to "Fast". The calibration of the meter was checked before and after the measurements with a Bruel and Kjaer Type 4231 sound level calibrator and no significant drift was noted. The Bruel and Kjaer Type 2250 and Type 4231 have been laboratory calibrated within the previous two years in accordance with our in-house Quality Assurance Procedures.

The location of attended measurements is shown on Figure 4-1. The daytime L_{A90} noise level at this location was 28-30dBA. If the background is less than 30dBA, the *INP* procedure is to set the RBL at 30dBA. It is assumed therefore that the RBL at all times of day would be 30dBA. This is typical or rural settings distant from transport and industrial noise.

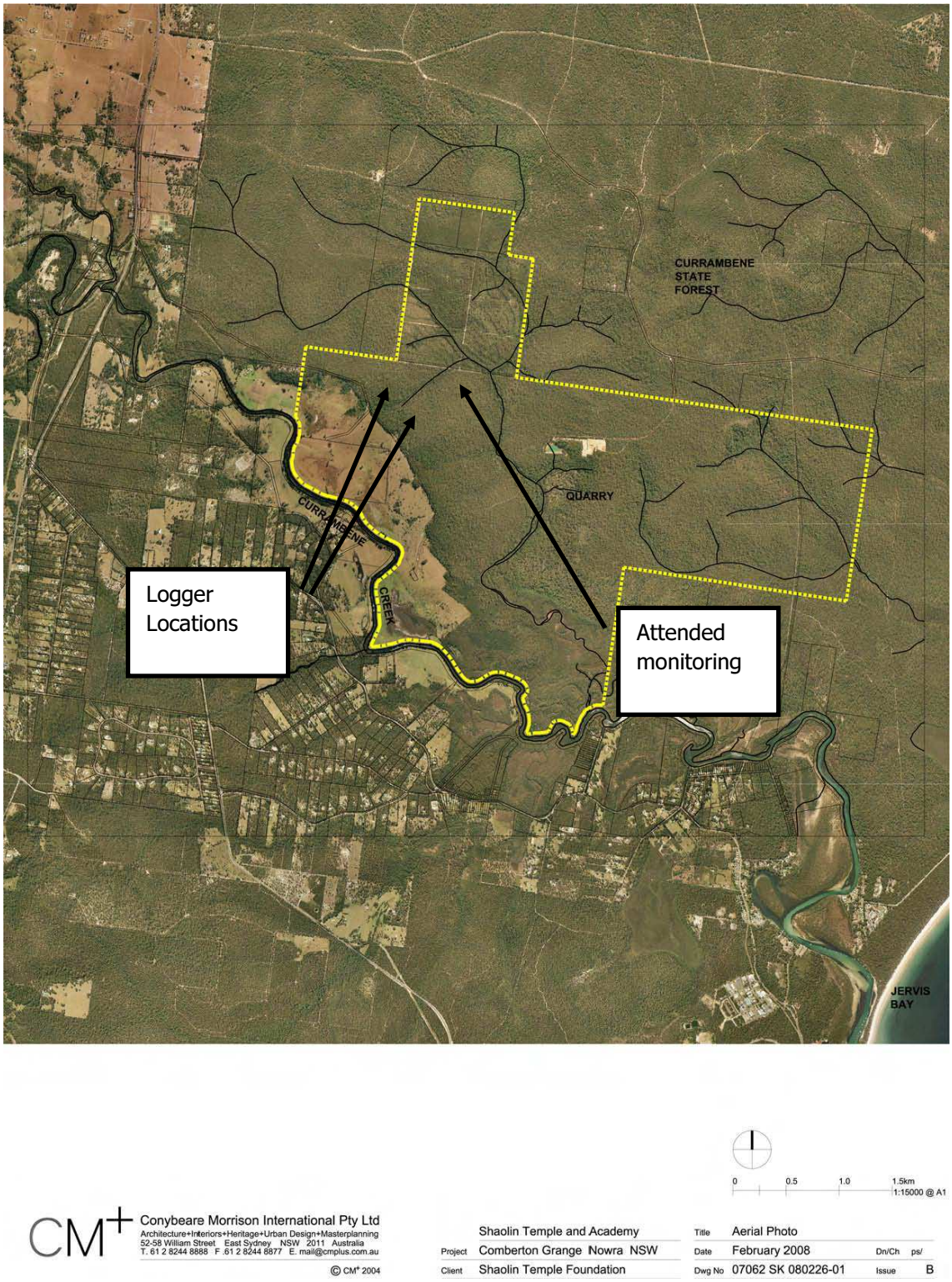
4.2 Site Specific Noise Criteria

There is no industrial noise in the area apart from the possible quarry operations. Hence the intrusive criteria will be the most stringent of the INP criteria. Table 4-1 shows the RBL and intrusive criteria.

Table 4-1 Site Specific Noise Criteria

Criterion	Day	Evening	Night
RBL dBA	30	30	30
Intrusive, $L_{Aeq,15min}$	35	35	35

Figure 4-1 Noise Logger Location



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	Shaolin Temple and Academy	Title	Aerial Photo		
Project	Comberton Grange Nowra NSW	Date	February 2008	Dn/Ch	ps/
Client	Shaolin Temple Foundation	Dwg No	07062 SK 080226-01	Issue	B

4.3 Non Residential Receivers

The recommended noise criteria from the INP for non-residential receivers are:

- Commercial premises – 65dBA;
- School classroom (internal) – 35dBA (or with windows open 45dBA outside);
- Places of worship – 40dBA (internal)
- Passive recreation – 50dBA
- Active recreation (for example the golf course) – 55dBA

4.4 Quarry Noise Levels

The equipment to be used in the quarry is not known.

The maximum noise levels of typical quarry equipment are given in Table 4-2. The total source level for the site, in terms of L_{Aeq}, depends on many factors, such as equipment mix and operating hours. For the noise assessment it is assumed that operational equipment would include an excavator, a bulldozer and a haul truck. The total site sound power level would be approximately L_{Aeq} 115dBA.

Table 4-2 Typical Quarry Plant Sound Levels

Plant	L_{A10} Sound Power Level (dBA)	L_{A10} Sound Pressure Level at 7m (dBA)
Front End Loader	111	86
Spoil, Materials or Concrete Truck	109	84
Excavator or Bobcat	107	82
Large Bored Drilling Rig	112	87
Small Bored Drilling Rig	108	83
30t Excavator operating with hydraulic hammer	122	97
Bulldozer	115	90

Operating hours for the quarry have been assumed to be standard operating hours, namely:

- 7.00am to 6.00pm Monday to Friday; and
- 7.00am to midday Saturday.

Hence the noise should comply with the daytime criterion, and consideration of sleep disturbance is not necessary.

The predicted noise level at the buildings of the development is 29-34dBA, depending on the location with respect to the quarry. This complies with the criteria for residential and non-residential areas. As the haul trucks move east to join Forest Road, noise from haul trucks to and from the quarry will not increase the noise at the development (assuming no more than two trucks in any 15 minute period).

4.5 Night Time Quarry Operation

It is unlikely that the quarry would operate at night. For night time operation it would be necessary to undertake a study of meteorological factors in the area in order to predict noise levels under meteorological conditions such as temperature inversions (which tend to enhance noise propagation).

5 HELICOPTER NOISE ASSESSMENT

5.1 Summary of Issues

The site of the development is south east of the HMAS Albatross on Currambene Creek. The site is located within the Nowra Military Control Zone under the 2 nautical mile wide helicopter flight corridor, known as "Husky Lane" along Currambene Creek between HMAS Albatross and the Jervis Bay Training Area.

The DGRs and Council require assessment of helicopter noise impact to the proposal. Helicopter noise could impact all areas of the proposal, but particularly the southern residential areas which are closer to the centre of the flight corridor.

5.2 The Department of Defence Response

In response to the proposal the Department of Defence (DoD) has assessed the likely noise impacts as a result of helicopter movements. They have stated that they do not wish to see the long term viability of HMAS Albatross compromised by inappropriate development near the flight corridor. They have conducted meetings with the proponent, and provided a noise assessment report (The Acoustic Group – *Proposed Shao Lin Temple Development Site near HMAS Albatross: Noise Assessment Report 36.4586.R1.ZSC* , October 2006).

The report states that while the site is outside the Australian Noise Exposure Forecast (ANEF) 20 contour for HMAS Albatross, the site is potential exposed to noise from the Husky Lane transits. The report presents noise contours calculated by the INM (Integrated Noise Model) Computer Program. The model predicts maximum noise levels along the corridor for the various helicopters that use the corridor. It states that helicopter transits can be as low as 25 per week, but at other times up to 100 per week. Discussions are ongoing with the DoD with respect to projected frequency of transits in the future.

With respect to noise criteria, the Acoustic Group report recommends that buildings be designed so that interior noise levels comply with the guidelines of Australian Standard AS 2021-2000 *"Acoustics – Aircraft Noise Intrusion – Building Siting and Construction".*

5.3 Noise Criteria

5.3.1 Air Services Australia Principles

There are no specific noise criteria (form the DECCW or otherwise) relating to helicopter movements.

Air Services Australia has produced the document "*Environmental Principles and procedures for minimising the impact of aircraft noise*" (Revised 21 November 2002) which provides guidance on noise exposure of aircraft as follows;

"Upper and Lower Limits of Noise Exposure

Principle 5: *Noise is not considered significant when selecting noise preferred options if exposure amounts to less than 40 $L_{Aeq,24hr}$ and there are less than 50 overflights per day.*

Principle 6: *No residential area should receive more than 60 $L_{Aeq,24hr}$, i.e., no residential area should receive more noise exposure than that which is considered "unacceptable" for residential housing under Australian Standard AS2021."*

For the purposes of this review the impact of helicopter flyover noise has been assessed with respect to these noise goals.

5.3.2 Internal Noise Level Guidelines

As discussed by the Acoustic Group AS2021 (Table 3.3) gives indoor design sound levels for determination of aircraft noise reduction – that is the level of reduction that should be provided by the building envelope.

The relevant entries in that table are reproduced here in Table 5-1.

Table 5-1 Indoor Design Sound Levels

Building Type	Activity	Indoor Design Sound level, dBA
Houses, home units, flats	Sleeping areas, dedicated lounges	50
	Other habitable spaces	55
	Bathrooms, toilets, laundries	60
Hotel	Relaxing, sleeping	55
	Social activities	70
	Service areas	75
Schools (the academy)	Libraries, study areas	50
	Teaching areas, assembly areas	55
	Workshops, gymnasia	75
Religious Activities (The Temple)	50	

5.3.3 Sleep Disturbance

No specific noise criterion applies to sleep disturbance associated with helicopters operating in the night period between 10 pm and 7 am. However the DECCW's *Environmental Criteria for Road Traffic Noise (ECRTN)* provides the following guidance with respect to transportation noise and sleep disturbance.

- Maximum internal noise levels below 50–55dBA are unlikely to cause sleep awakening reactions.
- One or two noise events per night, with maximum internal noise levels of 65–70dBA, are

not likely to affect health and wellbeing significantly.

These are internal levels, but the noise prediction techniques predict only external noise levels. Typically noise is reduced by approximately 10dBA by a façade with open windows. This gives the following noise goals for helicopters:

- Maximum external noise levels below 60– 65dBA are unlikely to cause sleep awakening reactions.
- One or two noise events per night, with maximum external noise levels of 75–80dBA, are not likely to affect health and wellbeing significantly.

5.4 Noise Predictions from Department of Defence

The Acoustic Group report gives noise contours for the types of aircraft that use Husky Lane. These were predicted using INM, using as input the topography of the site and measured noise levels of the helicopter types.

While we do not have access to the topographic information, nor the noise measurements, a simple INM noise model was constructed in order to verify the predictions of the Acoustic Group. Based on noise levels of similar helicopters, broad agreement was found with the Acoustic Group report; hence the noise assessment can be done with confidence based on those predictions. The range of predicted noise levels is presented in Table 5-2.

Table 5-2 Predicted Helicopter Noise Levels

Building/Site	Seahawk Maximum Noise Levels, dBA	Squirrel Maximum Noise Levels, dBA
Residential Areas	71-75	65-70
Hotel	68-72	64-68
Temple	60-65	58-62
Academy	68-72	60-63

5.5 Noise Survey

The first week of noise logging was timed to coincide with a site survey carried out by Kevin Mills & Associates (KMA) who planned to be on site for the entire time. They agreed to note time of transit of helicopters whenever they noticed one.

It was also intended that two loggers, set to short logging intervals, would detect passage of helicopters by showing coincidental high noise levels.

During the site visit Wilkinson Murray measured noise levels from six helicopter transits. The observations are presented in Table 5-3. Likely observations of the same transit are shaded. As both observations were from different areas of the site, the time will be slightly different.

The Wilkinson Murray measured levels were in an area between the two noise loggers. According to the Acoustic Group noise contours, the maximum noise levels of all types of helicopter would be approximately 68–72dBA in this area.

Table 5-3 Observations of Helicopters

Date	Time of KMA Observed Helicopter Transit	Time of WM Observed Helicopter Transit	Maximum Noise Level, dBA
12.10.09	11.22		
	11.36		
	12.15		
		12.20	37
		12.25	49
		12.30	56
	12.36		
		12.45	40
		12.50	40
	12.56		
	13.17		
	20.40		
	22.17		
13.10.09	08.36		
14.10.09	10.15		

The KMA observations do not coincide with peaks on the noise logger charts. It is probable that the peaks on the charts are due to insects, birds, or other causes, and the number of helicopter transits cannot be deduced from the charts.

The number of helicopter transits noticed by KMA is significantly smaller than the number proposed by the DoD.

The noise levels measured by attended monitoring are lower than predicted by the Acoustic Group contours. From so few observations, however, it cannot be concluded that the contours are conservative.

5.6 Recommendations

Table 5-4 shows the aircraft noise reduction required at different buildings of the development. The reduction refers to how much the building envelope needs to reduce helicopter noise in order to provide satisfactory noise levels inside. The maximum aircraft noise reduction required is 25dBA.

Table 5-4 Indoor Design Sound Levels

Building Type	Activity	Indoor Design Sound level, dBA	Maximum Predicted Helicopter Noise	Aircraft Noise Reduction Required
Houses, home units, flats	Sleeping areas, dedicated lounges	50	75	25
	Other habitable spaces	55	75	20
	Bathrooms, toilets, laundries	60	75	15
Hotel	Relaxing, sleeping	55	68	13
	Social activities	70	68	-
	Service areas	75	68	-
Schools (the academy)	Libraries, study areas	50	62	12
	Teaching areas, assembly areas	55	72	17
	Workshops, gymnasia	75	72	-
Religious Activities (The Temple)		50	65	15

5.7 Building components

The selection of building components depends on such things as:

- Type of room;
- Size of room;
- Shielding by eaves or other buildings; and
- Size and type of windows.

This level of reduction would be normally be provided by standard building constructions. Typical building component requirements for residential buildings are given in Table 5-5. The table shows that the only room requiring special attention are bedrooms, where 3mm glass would be insufficient.

All external doors should have acoustic seals. Non sliding doors may require drop seals on the threshold (for example Raven Products Type RP38).

Table 5-5 Recommended Building Components

Building Space	External Element	Min. Sound Reduction Indices	Recommended Construction	
			Construction	Typical installed Sound Reduction Index R_W

		R_W dB Required		
Bedroom	Window	25	5 or 6mm safety glass	26
	Walls	30	200mm brick	45
	Roof / Ceiling	30	Pitched roof clad with tiles or steel roofing, Glasswool ceiling batts between ceiling joists, plasterboard ceiling.	45
Living Area	Windows and Glazed External Doors	20	3mm glass	20
	Walls	20	110mm brick	40
	Roof/Ceiling	20	Pitched roof clad with tiles or steel roofing, Glasswool ceiling batts between ceiling joists, plasterboard ceiling.	45
Bathrooms, laundry	Window	18	3mm glass	20
	Walls	20	110mm brick Masonry	45
	Roof/Ceiling	20	As above	45

In order to fully comply with AS2021 it is necessary to provide alternative ventilation so that external windows and doors can be kept closed. In this way, the indoor noise goals can be met while providing room ventilation that meets the Building Code of Australia. Three typical ways to achieve this are:

1. Ducted Air-Conditioning System where the Fan Coil Units also provide Outside Air mixed with the Return Air. Air-conditioning ductwork and plenums must be acoustically treated.
2. A device similar to the Aeropac Room Ventilator and Air-Filter. (Available from Acoustica – ph: 1300 722 825).
3. Silenceair external wall vents, together with upgraded toilet and laundry fans to provide forced flow-through ventilation. The fans in this case must be operating whenever external doors/windows are closed (available from www.silenceair.com).

At non residential buildings, the requirement is only mechanical ventilation be provided in order that doors and windows may be closed. The aircraft noise reduction for these buildings is only 15-17dBA. Typical noise reduction through a façade with windows and doors normally open for ventilation is 10dBA. However, this is a "rule of thumb" and it is quite feasible to design buildings with greater aircraft noise reduction through openings – for example, if there is a lobby that has a significant amount of acoustic absorption on the walls.

6 TRAFFIC NOISE

6.1 Traffic Noise Criteria

The *Road Noise Policy (RNP)* sets out criteria for assessment of noise from vehicles on public roads.

The *RNP* sets out noise criteria for 'arterial', 'sub-arterial' and 'local roads'.

All roads at the development, and Comberton Grange Road, would be considered local roads. Forest Road and the Princes Highway would be considered arterial roads.

6.1.1 Noise Criteria for Residences

The criteria for residences (including the Hotel) are:

- Arterial Roads
  - Daytime (7.00am-10.00pm) $L_{Aeq,15hr}$ = 60dBA
  - Night Time (10.00pm-7.00am) $L_{Aeq,9hr}$ = 55dBA
- Local Roads
  - Daytime (7.00am-10.00pm) $L_{Aeq,1hr}$ = 55dBA
  - Night Time (10.00pm-7.00am) $L_{Aeq,1hr}$ = 50dBA

Where existing levels exceed these criteria, the development should not increase existing levels by more than 2dBA. This criterion is to be met at a time ten years after the opening of the development.

6.1.2 Noise Criteria for Places of Worship

For places of worship (in this case the Temple), only internal noise is considered in the *RNP*. The criterion is that the $L_{Aeq,1hr}$ should not exceed 40dBA during times when the place of worship would be in use.

6.1.3 Noise Criteria for Recreation Areas

For passive open space areas (for example the Temple Garden) the criterion is $L_{Aeq,15hr}$ 55dBA.

For active open space areas the criterion is $L_{Aeq,15hr}$ 60dBA.

6.2 Traffic Volumes and Network

Predicted traffic volumes are given in *Traffic Impact Assessment for Proposed Shaolin Tourist Residential Development at Comberton Grange, South Nowra, NSW*, by Lyle Marshall and Associates, March 2012.

The predicted external traffic generation for the ultimate use of the site is 3084 movements (total of in and out) on weekdays, 3750 vehicles on Saturdays, and on 4385 Sundays. Most of

this traffic would travel to connect to the Princes Highway via Forest Road.

The road network within the development is shown on the Masterplan in Figure 2-2. After entering the site from the north it bifurcates near the temple, where most traffic would turn left and a smaller number would turn right to the academy and residential precincts.

6.2.1 Traffic Noise Predictions

Traffic noise was predicted using the *Calculation of Road Traffic Noise (CoRTN)* algorithms. The predictions take into account the traffic volume and speed, as well as distance to the receiver.

Based on the proposed road layout, the proportion of vehicle movements passing the different noise sensitive receivers, and the approximate distance to the road, are shown in Table 6-1. These results assume that there are no barriers, either from natural topology, walls or other buildings, between the road and the receiver.

The hotel is 500m from the main loop and the maximum traffic flow to it is 25 vehicles an nour on a Sunday afternoon. No traffic noise impact is predicted at the hotel.

Table 6-1 Predicted Maximum Hourly Traffic Noise

Location	Maximum number of Vehicles per hour, Peak Daytime	Typical Distance to Road	Predicted Traffic Noise, $L_{Aeq,1hr}$	Criterion, $L_{Aeq,1hr}$
Temple	419	150 (to entrance)	53	40 (internal)
Temple Garden	419	70-150	50-53	55
Residential (worst case Precinct A)	50	15	55	55
Residential	38	15	54	55

(worst case Precinct B)				
Residential (worst case Precinct C)	46	15	54	55

6.2.2 Traffic Noise Assessment to the Temple

Noise at the Temple is predicted to be $L_{Aeq,1hr}$ 53dBA at the busiest times of day, but generally between 40 and 50dBA. The internal noise level will be below the 40dBA guideline if doors and windows are closed. There may be a minor exceedance (approximately 43dBA) inside the entrance if doors are open during the busiest hours of the day.

6.2.3 Traffic Noise Assessment to Residences

Traffic noise predictions to residential precints are shown in Table 6-1.

The predictions at residence include a 2.5dBA correction for façade reflection as required by the RNP. The predictions are worst case hour to the worst case receiver – at most times and at most receivers the noise will be less. Traffic speed was assumed to be 60kmph. Lower speeds would lead to even lower noise predictions.

Noise is predicted to comply at all residences at all times.

6.3 Traffic Noise to Residences External to the Development

The development will generated up to 4,985 daily vehicle movements off the site. The traffic will enter Forest Road north of the site. Most will connect to the Princes Highway, approximately 3km west of the intersection with Forest Road.

The only residences potentially impacted by noise from traffic generated from the proposal are in a group of approximately 6 houses near the intersection of Forest Road and Princes Highway. The group, and their relationship to the development and traffic corridors, is shown on Figure 6-1. This aerial photograph shows Forest Road as a gravel road. It has been surfaced with bitumen since the photograph was taken.

The house closest to Forest Road is the easternmost house – this is also the house least impacted by traffic noise from the Princes Highway. The house is approximately 460m from the Princes Highway, and 60m from Forest Road. The daytime criterion for noise from an arterial road is $L_{Aeq,15hr}$ 60dBA.

Based on measurements of traffic noise from the Princes Highway undertaken during our site visit, the typical existing daytime traffic noise at this house is $L_{Aeq,1hr}$ 55dBA.

Assuming all traffic to the site uses Forest Road, and that it all occurs in the 15hour daytime period, the predicted maximum noise level at the house from Forest Road, when the development is $L_{Aeq,15hr}$ 54BA. This is based on a traffic speed of 60kmph and a chipseal road surface. When added to the existing 55dBA from the Pacific Highway, the total noise level is 58dBA. This complies with the criterion.

Figure 6-1 Intersection of Forest Road and Princes Highway

The Princes Highway has a high traffic volume relative to the maximum flow to be generated by the development. Hence, once traffic joins the Princes Highway the increase in traffic noise would be insignificant and no noise impact is predicted on residence on the Princes Highway.

7 CONCLUSION

Noise aspects of the proposed Shaolin Tourist and Residential Development at Comberton Grange have been assessed. General recommendations to meet appropriate guidelines were made based on the Masterplan for the project.

7.1 Helicopter Noise

Noise from helicopters using the Husky Lane flight corridor was assessed. Several helicopter flights were measured, and the maximum noise levels were less than predicted in the DoD commissioned report from The Acoustic Group. However, very few helicopters were measured, and in a limited part of the development site, it is recommended that the noise levels predicted by The Acoustic Group be adopted for design purposes. The number of helicopter overflights could not be determined.

The buildings on the site would require appropriate design against intrusion of aircraft noise. For most buildings the requirement would only be provision of mechanical ventilation in order to allow doors and windows to remain closed. In some bedrooms toward the south of the site,

acoustic glazing would be recommended. The glazing would depend on the final design of the dwellings, however a minimum of 5mm safety glass would be recommended.

7.2 Traffic Noise

The development would increase traffic on Forest Road, but is not predicted to exceed the noise criterion at any residence.

7.3 Quarry Noise

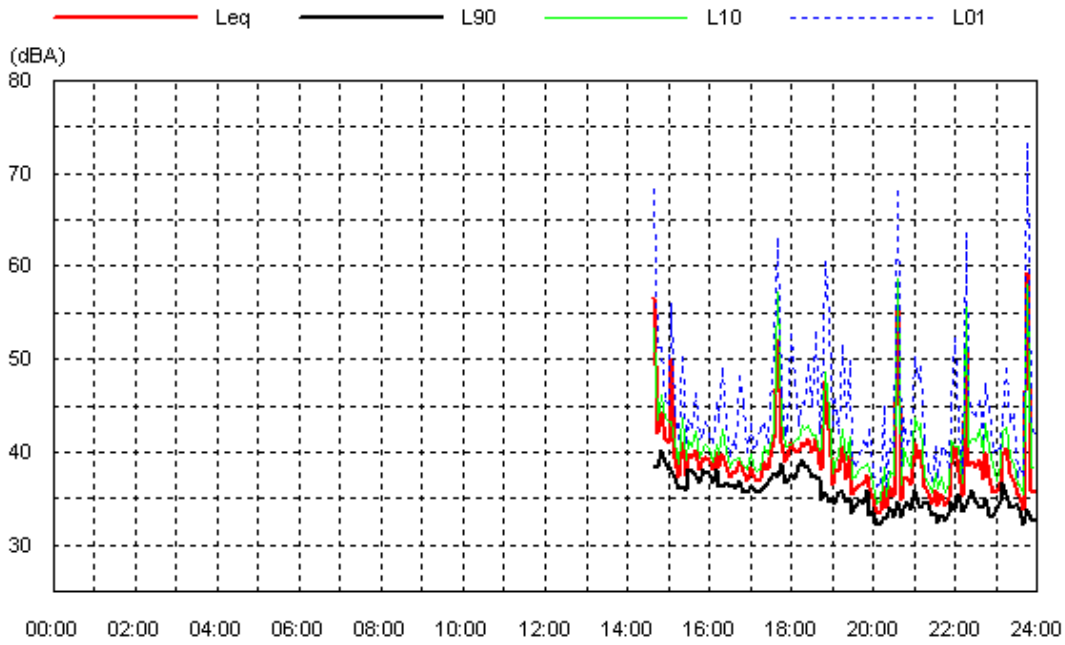
Noise from the quarry was predicted to meet daytime goals given the assumptions concerning the equipment to be used at the quarry. Noise from night time operation of the quarry would require a more detailed analysis of quarry operations. As the quarry is currently disused, this is not possible.

APPENDIX A

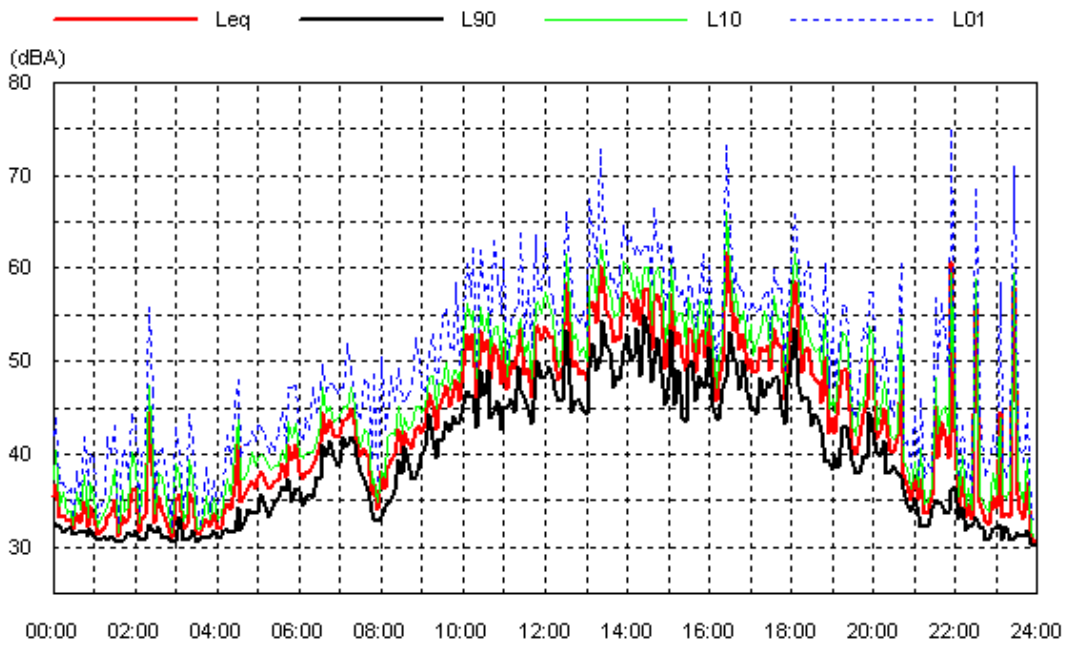
NOISE MEASUREMENT RESULTS

Location: West logger

Mon 12 Oct 09

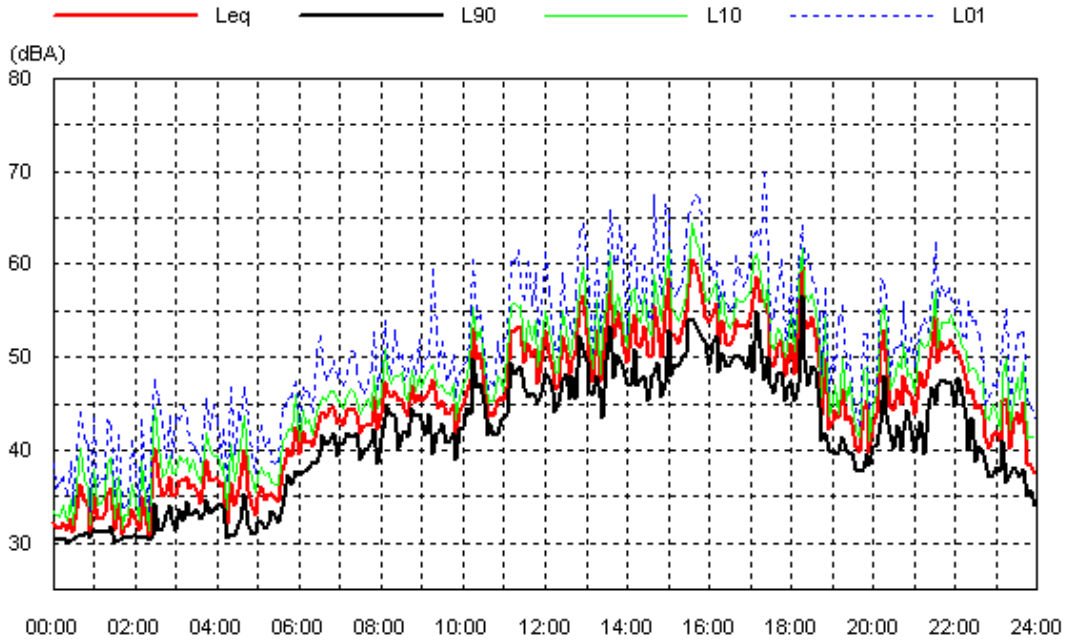


Tue 13 Oct 09

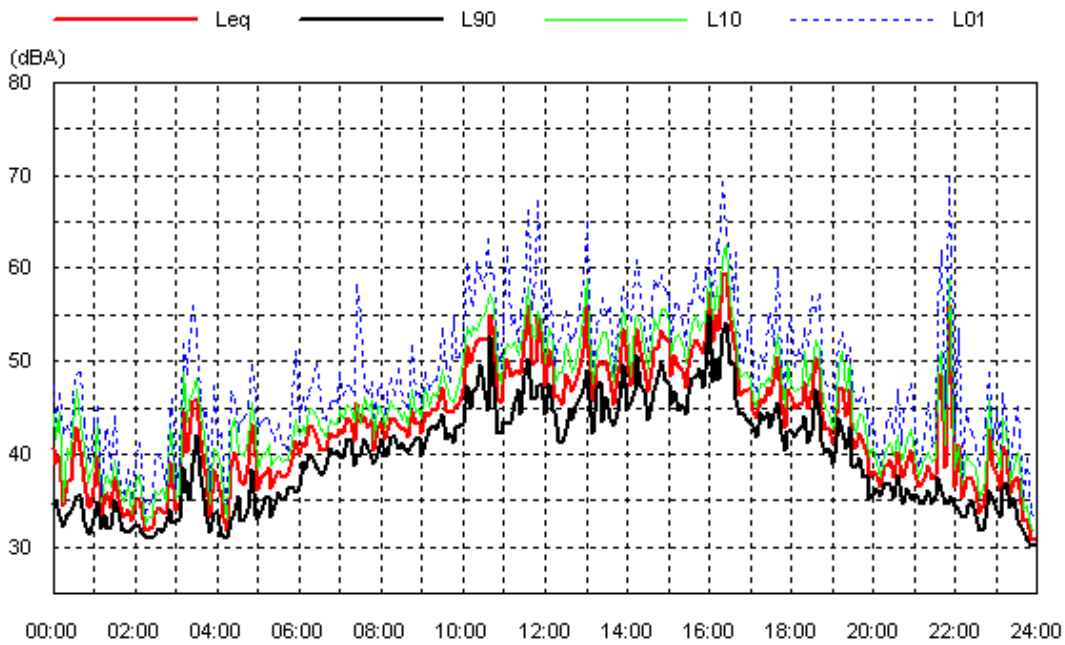


Location: West logger

Wed 14 Oct 09

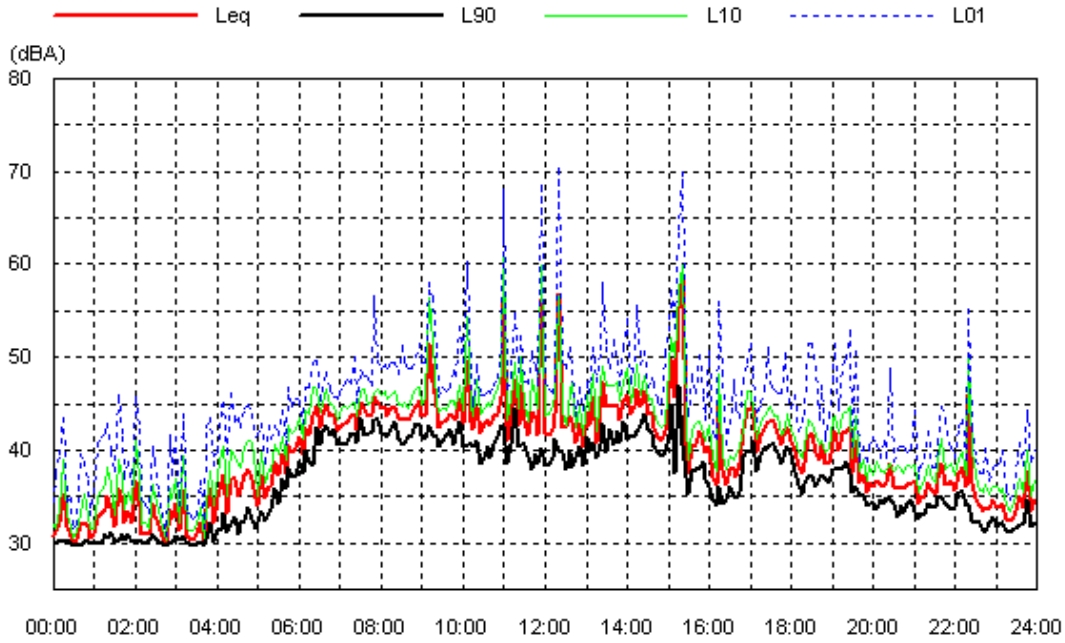


Thu 15 Oct 09



Location: West logger

Fri 16 Oct 09



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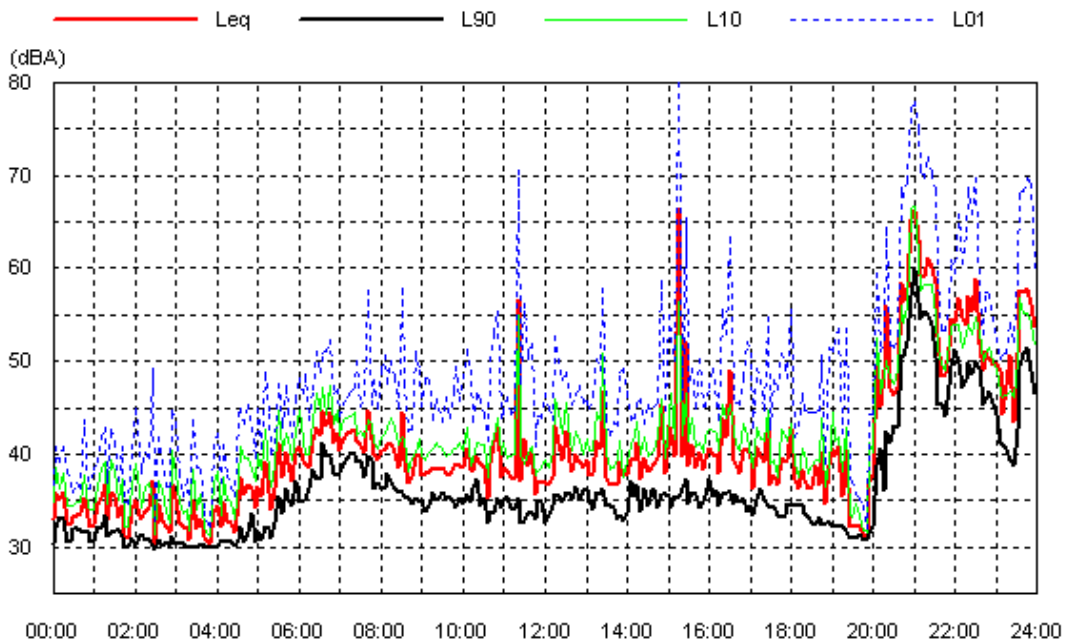
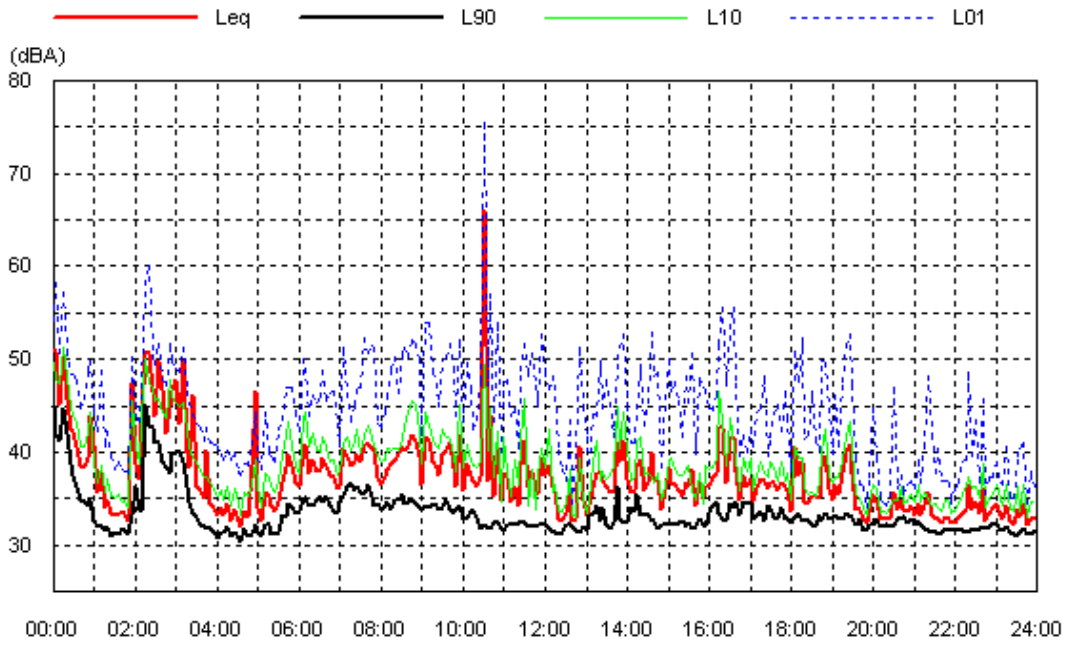


Location: West logger

Sun 18 Oct 09



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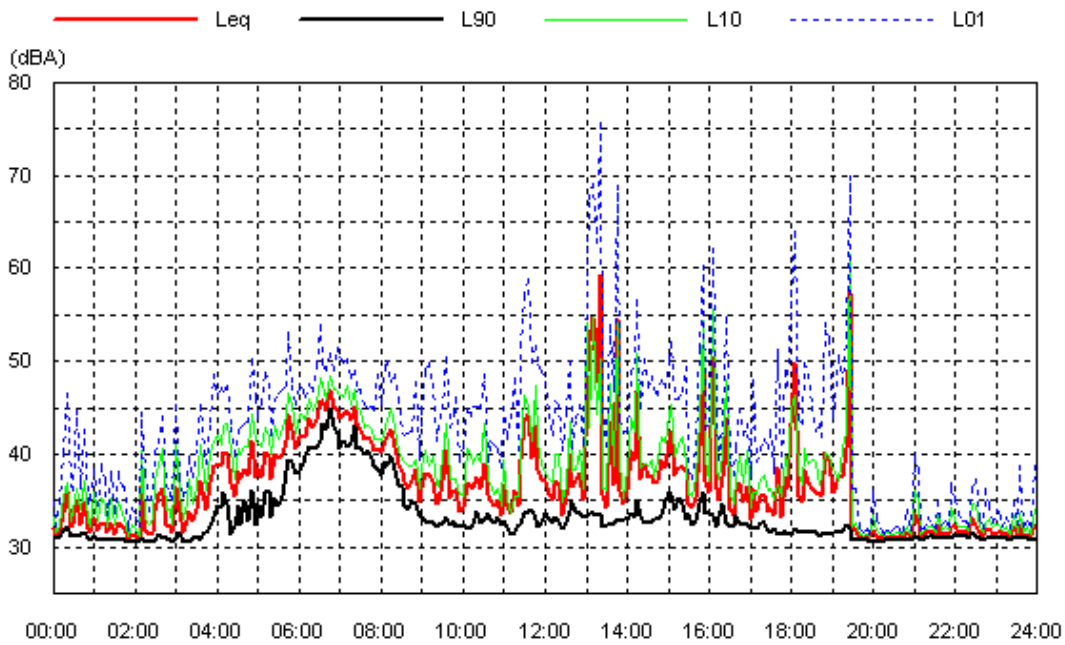
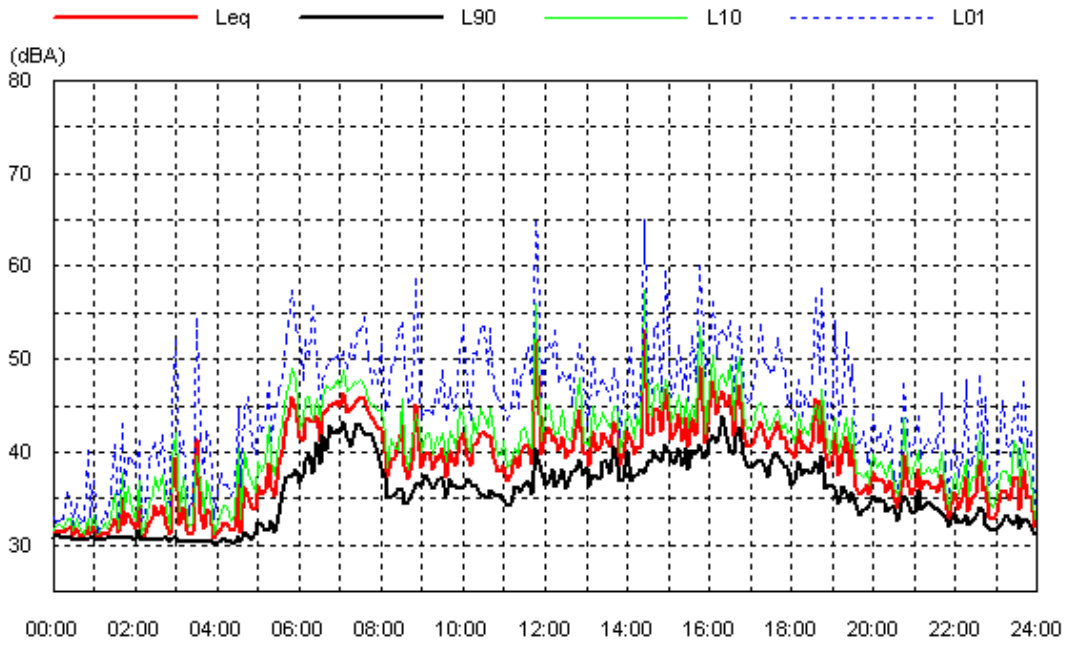


Location: West logger

Tue 20 Oct 09



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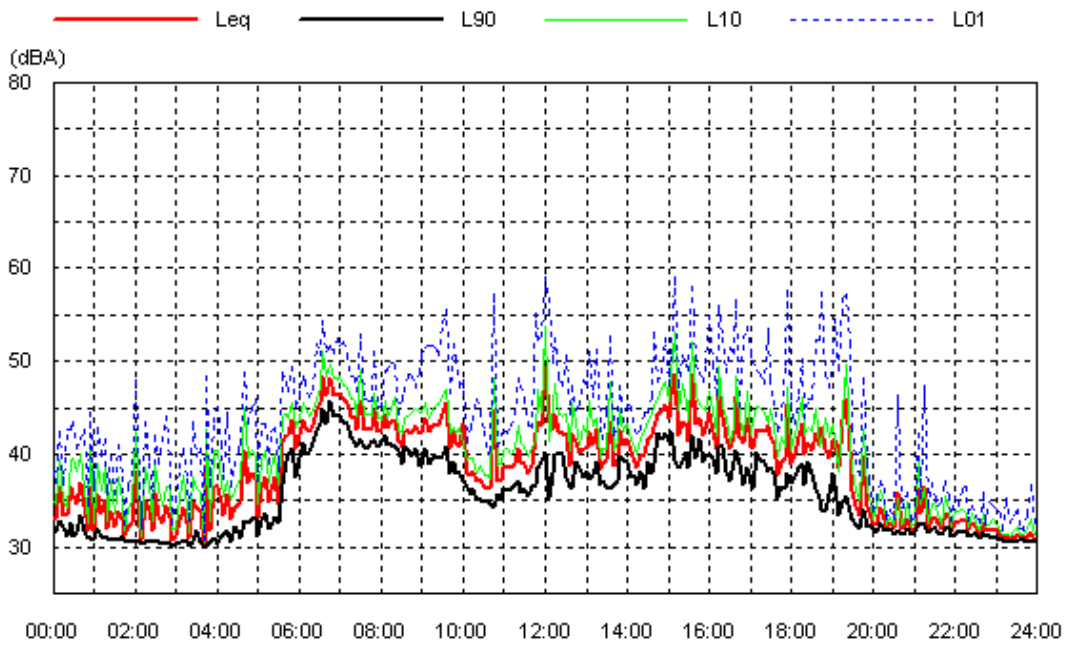

Location: West logger

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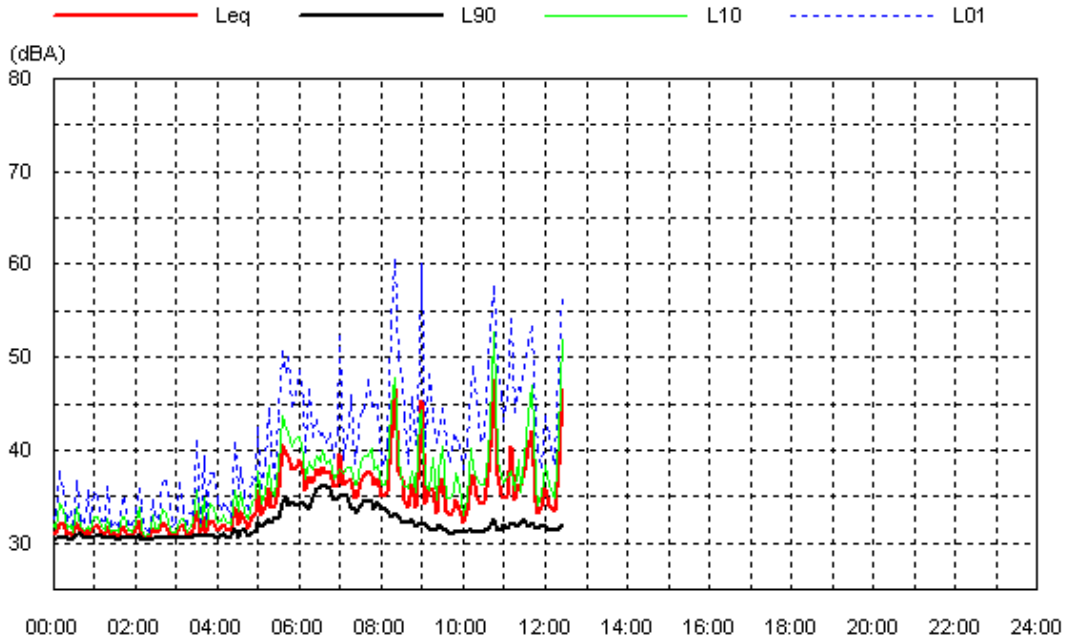
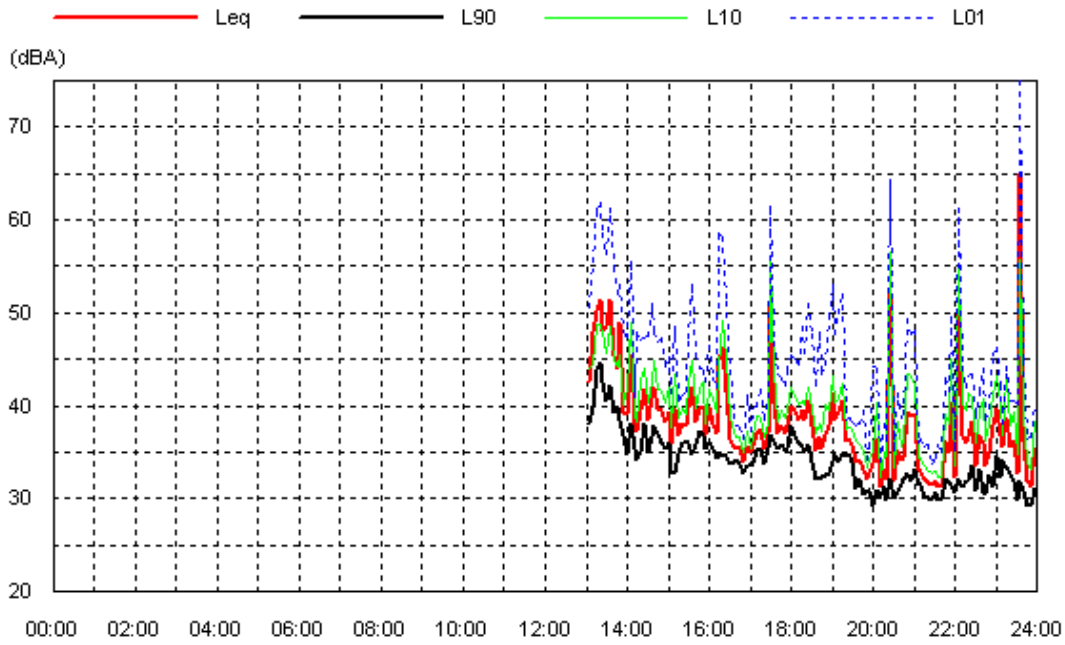


Location: Temple Gate

Mon 12 Oct 09



Tue 13 Oct 09