ACOUSTICS AND AIR

LOT A BURLEY ROAD, HORSLEY PARK EMPLOYMENT PRECINCT
CONCEPT PROJECT APPLICATION
REVISED NOISE AND VIBRATION IMPACT ASSESSMENT

REPORT NO. 10196
VERSION I

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PREPARED FOR

JACFIN PTY LTD

WILKINSON MURRAY

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Wilkinson Murray is an independent firm established 50 years ago originally as Carr & Wilkinson. In 1976 Barry Murray joined founding partner Roger Wilkinson and the firm adopted the name which remains today. From a successful operation in Australia, Wilkinson Murray expanded its reach into Asia by opening a Hong Kong office early in 2006. 2010 saw the introduction of our Queensland office and 2011 the introduction of our Orange office to service a growing client base in these regions. From these offices, Wilkinson Murray services the entire Asia-Pacific region.

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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.

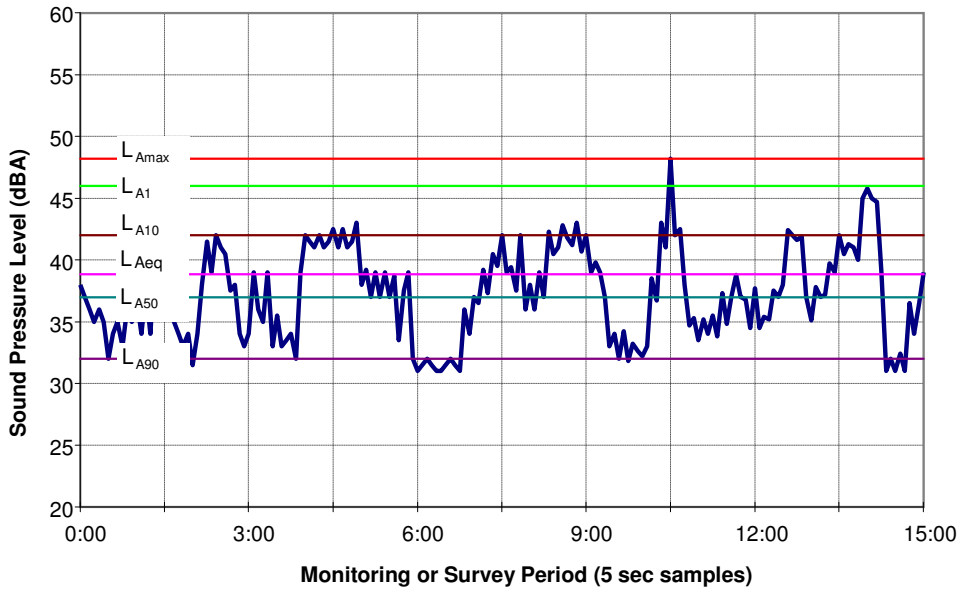
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

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

Wilkinson Murray Pty Limited has been previously commissioned by Jacfin Pty Ltd to prepare a concept plan construction and operational noise assessment in relation to a proposed employment precinct development at Horsley Park.

This report updates the previous assessment with respect to a revised layout for the site and proposed perimeter mounding and barriers. The revised assessment has identified future residential properties located to the South of the site. In addition, noise monitoring and meteorological data has been updated to reflect current conditions.

The report sets out the design concepts in relation to:

- Construction noise;
- Road traffic noise on the new link road; and
- Site noise emissions from the operation of the development.

In the case of road traffic noise, the findings of the previous assessment remain unchanged. Further, it is noted that in the case of the previously assessed Stage 1 Project Application for the first warehouse there are no changes proposed for this site. Therefore this report does not address that Application.

Neither vibration from construction or operational activities has the potential to adversely impact on surrounding receivers. This is because the distance to residences from the worksite is enough to ensure that vibration from construction equipment is of a sufficiently low magnitude as not to be an issue. Therefore, this issue will be not considered any further.

1.1 Project Description

Jacfin has prepared a concept plan for the Horsley Park Employment Precinct in accordance with the provisions of Part 3A of the Environmental Planning and Assessment Act 1979.

Jacfin proposes to develop the site for employment purposes. Permissible uses for the site include;

> *Depots; Food and drink premises; Freight transport facilities; Industrial retail outlets; Industries (other than offensive or hazardous industries); Neighbourhood shops; Roads; Service stations; Transport depots; Truck depots; Warehouse or distribution centres.*

It is anticipated that much development in the estate may operate 24 hours per day. The proposed Concept Plan will identify the provision of necessary infrastructure including roads, drainage, utility and communications services to support the proposed development.

This report has been prepared with respect to the overall Concept Plan having regard to the natural features of the site and surrounding receivers as indicated in **Figure 1-1**. The site occurs within a mixed industrial / rural residential setting, with existing homes situated on rural land around the site. Surrounding receivers have been identified as:

- Greenway Place Residences to the east at a distance of approximately 60m;
- Capitol Hill Drive Residences to the south of the site at a distance of approximately 50m.
- Residentially zoned land immediately to the south of the site.

Figure 1-1 Proposed Site Layout Showing Surrounding Residences & Noise Measurement Locations

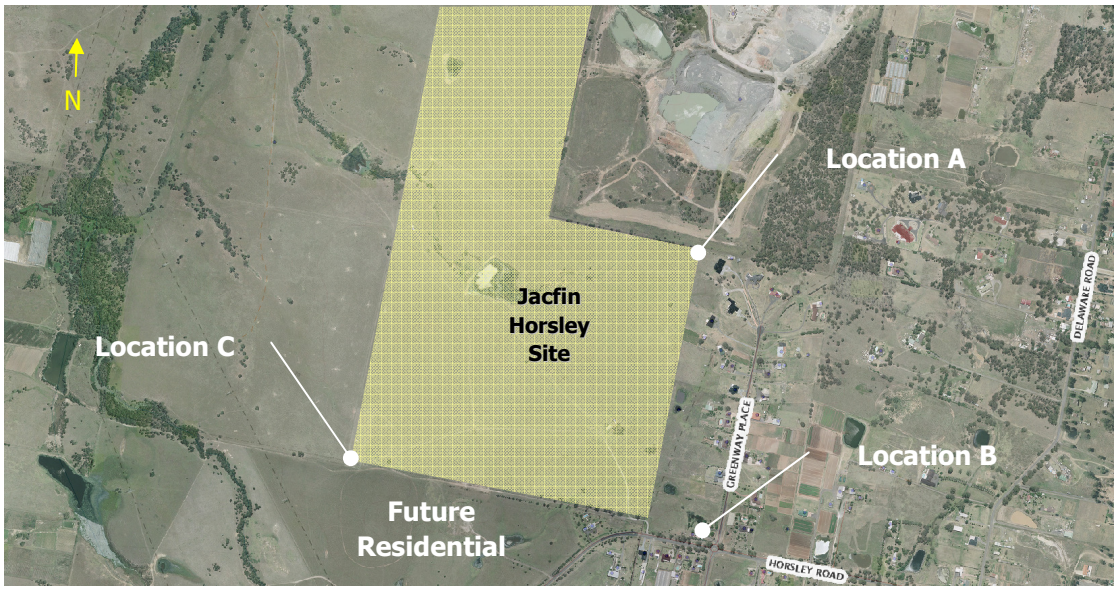
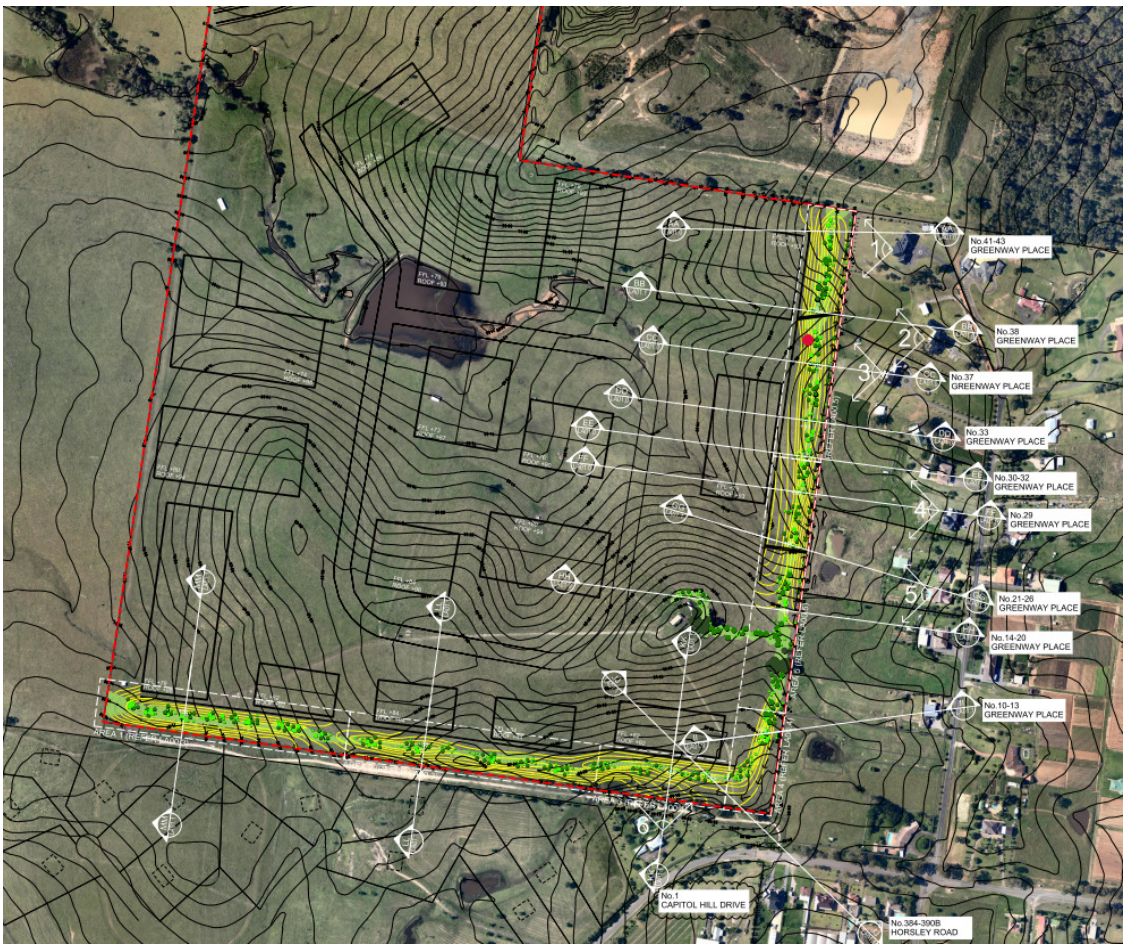


Figure 1-2 illustrates the proposed revised concept layout of the site. This concept plan shows indicative buildings and access routes which will be detailed at the project application stage for each development.

Figure 1-2 Revised Horsley Park Concept Site Layout



1.2 Acoustic Terminology

The following report uses specialist acoustic terminology. An explanation of common terms is provided in the Glossary.

2 AMBIENT NOISE LEVELS

Ambient noise measurements were recently conducted around the site to establish current 2012 noise levels of the area. Long-term ambient noise levels were monitored at three locations surrounding the site, selected to cover the range of environments in the potentially-affected receiver areas. The locations are presented in Table 2-1. The logger locations are shown in Figures 2-1 to 2-3.

Table 2-1 Long-Term Noise Monitoring Locations

Monitoring Site	Address	Relevant Noises Noted on Site Visits
A	NW Boundary with 41-43 Greenway Place	Rural Residential Area
B	1 Greenway Place	Rural Noise – Local Traffic
C	SW boundary of Jacfin Site	Rural Undeveloped Area

Noise monitoring was conducted between Saturday, 4 August and Thursday, 16 August 2012. The noise monitoring equipment used for these measurements consisted of ARL Type EL215 and EL315 environmental noise loggers set to A-weighted, fast response, continuously monitoring over 15-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. The L_{A90} level is normally taken as the background noise level during the relevant period.

Detailed results for each monitoring location are shown in graphical form in Appendix B. The graphs show measured values of L_{Aeq}, L_{A90}, L_{A10} and L_{A1} for each 15-minute monitoring period.

Table 2-2 summarises the noise results, for daytime, evening, night time periods as defined by the NSW EPA. The summary noise descriptors are:

- L_{Aeq} (period) – the equivalent continuous L_{Aeq} noise level measured over the assessment period; and
- RBL – Rating Background Level is a measure of typical background noise levels which are used in determining noise criteria.

Table 2-2 Summary of Measured Noise Levels

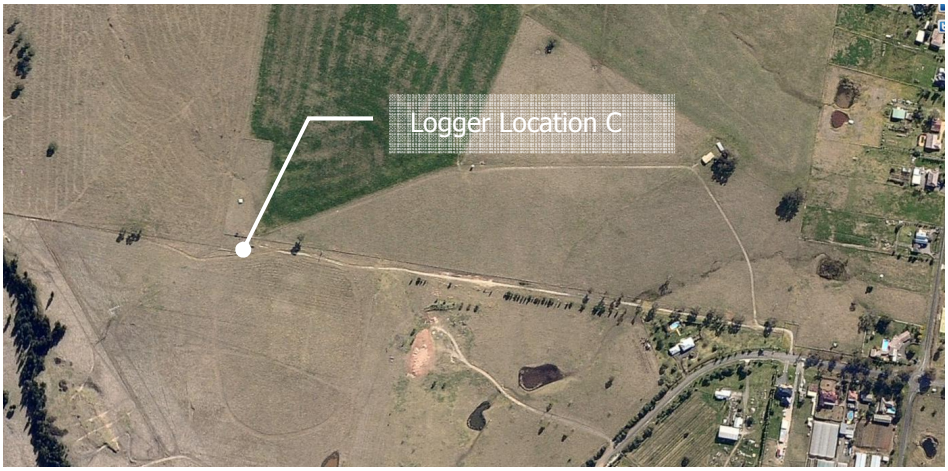
Noise Logging Site	RBL (dBA)				$L_{Aeq,period}$ (dBA)		
	Daytime 7am-6pm	Evening 6pm-10pm	Night Time 10pm-7am	Saturday 8am-1pm	Daytime 7am-6pm	Evening 6pm-10pm	Night Time 10pm-7am
A	33	33	32	32	49	47	40
B	37	33	32	37	55	53	50
C	31	30	31	31	48	45	40

Background levels at all locations were free of the influence of extraneous noise sources, such as plant or construction activities. No industrial noise was detected during visits to the site.

Figure 2-1 Location A – Boundary of Site with 41-43 Greenway Place

Figure 2-2 Location B –1 Greenway Place

Figure 2-3 Location C – SW Corner of Jacfin Site



3 NOISE CRITERIA

The following sections detail the applicable site specific construction and operational noise criteria based on the guidelines from EPA, being;

- *Interim Construction Noise Guideline*, and;
- *NSW Industrial Noise Policy*

3.1 Construction Noise Criteria

The EPA released the "*Interim Construction Noise Guideline*" *(CNG)* in July 2009. The guideline provides noise goals that assist in assessing the impact of construction noise.

For residences, the basic daytime construction noise goal is that the noise should not exceed the RBL (background noise level) by more than 10dBA for standard hours:

- Monday to Friday 7.00am to 6.00pm, and;
- Saturday 8.00am to 1.00pm.

Outside the standard hours, the criterion would be background + 5dBA. A more complete description of the guidelines is in Table 3-1.

Table 3-1 Construction Noise Goals at Residences using Quantitative Assessment

Time of Day	Management Level $L_{Aeq,(15min)}$	How to Apply
Recommended Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Noise affected RBL + 10dBA	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured Leq,(15min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

Time of Day	Management Level $L_{Aeq,(15min)}$	How to Apply
	Highly noise affected 75dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2.

In addition, the following construction noise management levels $L_{Aeq\ (15\ min)}$ are recommended for other receivers and areas as follows.

- Active recreation areas (such as parks) external $L_{Aeq\ (15\ min)}$ 65dBA;
- Industrial premises external $L_{Aeq\ (15\ min)}$ 75dBA; and
- Offices, retail outlets external $L_{Aeq\ (15\ min)}$ 70dBA.

Based on the above guidelines, applicable noise management levels for construction activities are presented in Table 3-2.

Table 3-2 Site Specific Construction Noise Management Levels

Location	Construction Noise Management Level, L_{Aeq} (dBA)			
	Day	Evening	Night	Saturday (8am-1pm)
A – 41-43 Greenway Place	43	38	37	42
B – 1 Greenway Place	47	38	37	47
C – SW Corner of Site	41	35	36	41

3.2 Operational Industrial Noise Criteria

The *NSW Industrial Noise Policy (INP)* recommends two noise criteria, "Intrusiveness" and "Amenity", both of which are relevant for the assessment of noise from the future site operations. In most situations, one of these criteria is more stringent than the other and defines the noise assessment. The criteria are based on the L_{Aeq} descriptor, which is explained in Appendix A.

3.2.1 Intrusiveness Criterion

An intrusiveness criterion applies for residential receivers only.

The intrusiveness criterion requires that the L_{Aeq} noise level from the source being assessed, when measured over 15 minutes, should not exceed the Rating Background Noise Level (RBL) by more than 5dBA. The RBL represents the 'background' noise in the area, and is determined from measurement of L_{A90} noise levels, in the absence of noise from the source. The definition of L_{A90} and RBL is given in the Glossary.

3.2.2 Amenity Criterion

The amenity criterion sets a limit on the total noise level from all industrial noise sources affecting a receiver. Different criteria apply for different types of receiver (e.g. residence, school classroom); different areas (e.g. rural, suburban); and different time periods, namely daytime (7.00am-6.00pm), evening (6.00pm-10.00pm) and night time (10.00pm-7.00am).

The noise level to be compared with this criterion is the L_{Aeq} noise level, measured over the time period in question, due to all industrial noise sources, but excluding non-industrial sources such as transportation.

Where a new noise source is proposed in an area with negligible existing industrial noise, the amenity criterion for that source may be taken as being equal to the overall amenity criterion. However, if there is significant existing industrial noise, the criterion for any new source must be set at a lower value. If existing industrial noise already exceeds the relevant amenity criterion, noise from any new source must be set well below the overall criterion to ensure that any increase in noise levels is negligible. Methods for determining a source-specific amenity criterion where there is existing industrial noise are set out in the *INP.*

3.2.3 Determination of Site Specific Industrial Noise Criteria

Table 3-3 show the relevant operational industrial noise criteria for this project based on suburban and rural area classifications.

Table 3-3 Site Specific Industrial Intrusiveness & Amenity Criteria

Receiver Area	Time Period	RBL (dBA)	Intrusiveness Criterion $L_{Aeq,15min}$ (dBA)*	Project-Specific Amenity Criterion#
A	Daytime (7.00am–6.00pm)	33	38	50
	Evening (6.00–10.00pm)	33	38	45
	Night time (10.00pm–7.00am)	32	37	40
B	Daytime (7.00am–6.00pm)	37	42	50
	Evening (6.00–10.00pm)	33	38	45
	Night time (10.00pm–7.00am)	32	37	40
C	Daytime (7.00am–6.00pm)	31	36	50
	Evening (6.00–10.00pm)	30	35	45
	Night time (10.00pm–7.00am)	31	36	40

*Intrusiveness criteria are based on the RBL plus 5 dBA.
Amenity criteria are based on area classification

In this case, there is insignificant existing industrial noise in the area. Whilst there is a quarry around Location A, no significant noise was observed during a site visit. Traffic noise levels are unlikely to reduce in the future therefore the full amenity criteria are applicable.

3.2.4 Sleep Disturbance Noise Criteria

Intermittent noises due to activities such as trucks starting and loading dock activities during the night time period are not directly addressed by the *Industrial Noise Policy*.

The most recent guidance in relation to sleep disturbance are those contained in the EPA's "Application Notes – *NSW Industrial Noise Policy*" issued in July 2006. The pertinent section of the EPA's Application Notes states the following:

"*DEC reviewed research on sleep disturbance in the NSW Environmental Criteria for Road Traffic Noise (ECRTN) (EPA, 1999). 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, DEC recognised that current sleep disturbance criterion of an $L_{A1, (1\ minute)}$ not exceeding the $L_{A90, (15\ minute)}$ by more than 15 dB(A) is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, DEC 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 the maximum noise level or $L_{A1, (1\ minute)}$, that is, the extent to which the maximum noise level exceeds the background level and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the appendices to the ECRTN. Other factors that may be important in assessing the extent of impacts on sleep include:

- *how often high noise events will occur*
- *time of day (normally between 10pm and 7am)*
- *whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).*

The $L_{A1, (1\ minute)}$ descriptor is meant to represent a maximum noise level measured under 'fast' time response. DEC will accept analysis based on either $LA_{1,(1\ minute)}$ or $L_{A,(Max)}$.

Table 3-4 details established sleep disturbance screening criteria of background noise level plus 15dB.

Table 3-4 Sleep Disturbance Screening Criterion

Receiver Area	Sleep Disturbance Screening Criteria (dBA)
A – 41-43 Greenway Place	47
B – 1 Greenway Place	47
C – SW Corner of Site	46

4 NOISE SOURCE LEVELS

Site noise sources that are likely to be associated with the development are identified in the following sections.

4.1 Construction Noise Sources

Typical Sound Power Levels (SWL) of the constriction plant likely to be used during earthworks and road construction when the site is being established at various stages of the works are identified in Table 4-1. These SWLs have recently been measured at other similar construction sites.

Table 4-1 Typical Construction Plant Sound Power Levels (SWL)

Plant	Sound Power Level (dBA)
Excavator	107
Front End - Low Loader	112
Dump Trucks	112
Tower Crane or Mobile Crane	105
Generators	95
Smooth Drum Roller	107
Scrapers	119
Graders	109
Dozer	119
Concrete Trucks	109
Concrete Paver Roller	121
Water Truck	110
Vibratory Rollers	110
Skid Steer loader	112
Concrete Plant	103
Asphalt Plant	114
Paving machine Asphalt	109

4.2 Operational Noise Sources

Whilst operational noise associated with each particular facility within the site which will be assessed as part of a separate Development Application for each facility, there are a number of sources across the site that are likely to generate noise such as trucks, forklifts and mechanical plant (condensers and fans).

Table 4-2 presents a summary of the sound power levels utilised in the noise prediction model for the various items of plant and mobile equipment.

Table 4-2 Summary of Sound Power Levels Used for Plant and Mobile Equipment

Item	Operating Condition	Overall L_{Aeq} Sound Power Level (dBA)
Semi - trailer	Loading/Unloading	87
Petrol Forklift	Lifting, moving	96
Exhaust Fan	Operating	95
Semi-tailer	Driving through yard	104
Exhaust Fan	Operating	95
Reverse alarm	Reversing	112

The following sections detail an assessment of potential noise impact and mitigation based on noise levels presented in this section.

5 METEOROLOGY

At relatively large distances from a source, the resultant noise levels at receivers can be influenced by meteorological conditions, particularly wind and temperature gradients, and can therefore vary from hour to hour and night to night. Where these factors are a feature of an area their effect on resultant noise levels is required to be taken into account.

The procedures described in the *INP* are directed toward finding a single set of meteorological conditions, representing generally adverse conditions for noise propagation, which should be used in noise assessment.

The procedures of the *INP* have been adopted for this assessment.

5.1 Wind

Wind can increase noise at a receiver when it blows from the direction of the noise source. An increase in wind strength results in a corresponding increase in wind noise at the receiver which masks noise from the source under investigation.

The affectation of noise due to wind should be considered when wind is a feature of the area under consideration. The *INP* defines this as where wind blows at speeds up to 3m/s for more than 30% of the time in any season. In this situation wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

Twelve month weather data for the year 2011 was obtained for the Bureau of Meteorology's monitoring station located at Horsley Park. This data was analysed to determine the frequency of occurrence of seasonal winds up to speeds of 3m/s for the daytime, evening and night periods.

The data was processed for existing and future residences using the EPA's "*Noise enhancement wind analysis program"* and it was determined that the frequency of winds blowing at speeds between 0.5 and 3 m/s in the area does not exceed the 30% requirement of the INP. Therefore no assessment under adverse wind conditions is required.

Figure 5.1 shows a printout of the output of the program for wind analysis from the Jacfin site to 29 Greenway Place.

Figure 5.1 Noise enhancement wind analysis program output for 29 Greenway Place.

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  NOISE ENHANCEMENT WIND ANALYSIS
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Meteorological data file   : P:\PROJ2010\10100-10199\10196 Ropes Creek and Horsely Park\Met 2011 Data\HorselyWind.csv
Noise source location      : 298149, 6253575
Receiver location          : 298652, 6253861
Source to receiver angle   : 60 degrees from north
Source to receiver dist.   : 578.6 same units as grid coordinates
Number of records processed: 17556


RESULTS: (as a percentage)

Percentage occurrence of winds
in the speed range > 0.5 and < 3.0 m/s
and with direction in the range 60 degs. plus and minus 90 degs.

Season    Day   Evening  Night
Summer   013.0   018.5   012.0
Autumn   017.5   018.3   017.3
Winter   019.4   017.2   017.6
Spring   014.4   018.5   015.0

RESULTS: (as counts)

Number of observation of winds
in the speed range > 0.5 and < 3.0 m/s
and with direction in the range 60 degs. plus and minus 90 degs.

Season    Day   Evening  Night
Summer    0256    0131    0186
Autumn    0354    0136    0285
Winter    0407    0130    0291
Spring    0292    0137    0248
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5.2 Temperature Inversion

Temperature inversions can increase noise levels at surrounding receivers by the reflection of sound waves from warmer upper layers of air. Temperature inversions occur predominantly at night. For a temperature inversion to be a significant characteristic of the area it needs to occur for approximately 30% of the total night time during a season, typically winter.

Inversion data, from the Bureau of Meteorology's Horsley Park monitoring station, was assessed for the winter night period where a frequency of 22% was determined for F & G class stability. Therefore it is unnecessary to consider temperature inversion as part of the assessment.

6 CONSTRUCTION NOISE ASSESSMENT

6.1 Construction Noise

Likely airborne noise at surrounding residential receivers has been assessed for construction sites during excavation and construction.

Site related noise emissions were modeled using the CONCAWE algorithms implemented in the "CadnaA" acoustic noise prediction software using ISO 9613 noise prediction algorithm. Factors that are addressed in the noise modeling are:

- Equipment sound level emissions and location;
- Screening effects from buildings;
- Receiver locations;
- Ground topography;
- Noise attenuation due to geometric spreading;
- Ground Absorption; and,
- Atmospheric absorption.

During the initial site consolidation stage the following works are proposed:

- Construction of the required traffic facilities;
- Upgrade of existing roads and construction of new roads in the vicinity of the site;
- Construction (and use) of utility connections to the site;
- Sub-division of the site and associated sub-division works including construction of roads; stormwater drainage systems, sewerage and water works, utilities and services; landscaping and earthworks;
- Works for the site water management strategy; and
- Construction and use of buildings and associated works.

The loudest construction period is expected to be the earthmoving phase and, with perhaps six machines including scrapers, excavators, trucks, a dozer and a grader working around the site simultaneously, a total site L_{Aeq} sound power of 116dBA can be expected. Earthmoving activity is likely to occur during the first stage of the development and given the size of the site it would only be that equipment that is in the vicinity of residences that would be acoustically significant.

Table 6-1 presents the results of initial noise calculations at surrounding residential receivers based on distance attenuation alone allowing for the noise source to be generally on the side of the site located closest to residences. That is, for eastern residences the construction is occurring on the eastern side of the site, for southern residences the construction is located on the southern side of the site.

Table 6-1 Predicted L_{Aeq} Construction Noise Levels at Residential Receivers – dBA

Receiver Area	Predicted Construction Noise (dBA)	Construction Noise Objective (dBA)*
A – 41-43 Greenway Place	53	43 / 42
B – 1 Greenway Place	43	47 / 47
C – SW Corner of Site	50	41 / 41

*Normal construction hours and Saturday criteria are shown.

These initial noise predictions indicate that the construction noise criterion is likely to be exceeded during the earthmoving phase at rural residences immediately to the east of the site when the eastern side of the site is being developed. A similar situation would occur when the southern side of the site is developed.

Exceedances of construction noise criteria are quite common for construction projects and given the relatively short duration of construction work compared to the life of the development, some tolerance is usually expected.

While it is impractical to require strict compliance with the construction noise criteria at all times, the following noise mitigation measures are considered reasonable and feasible:

- Construction activities that are likely to be audible at any residence must not occur outside the usual hours of 7.00am-6.00pm Monday to Friday and 8.00am-1.00pm on Saturday.
- Noisy activities such as earthworks in close proximity to residences should ideally be programmed to avoid early mornings and Saturdays. While this may not be always practical, consideration should be given to surrounding residential receivers when planning the construction program.
- Diesel powered machines such as trucks, bobcats and excavators should be switched off if not required for more than a few minutes rather than left idling unnecessarily.
- Machines used on site should be maintained in good condition, particularly considering the exhaust system on diesel powered machines, to minimise noise emissions. Excessively loud machines should be repaired, modified or removed from the site. Sound pressure level measurements should be conducted on all plant prior to works beginning on-site.
- A representative from the construction contractor should be available to respond to questions and complaints from the community in a professional, considerate and timely manner.
- Reverse alarms should be controlled to the minimum sound level consistent with safety by, where feasible, replacing, shielding or relocating the alarm unit on noisy machines.

The above noise control recommendations may not necessarily result in the construction noise criteria being met at all times, although they will result in the lowest possible noise impacts consistent with efficient and safe construction work on the site.

7 BUSINESS PARK OPERATIONAL NOISE ASSESSMENT

The site is located in a mixed industrial and rural area and subsequently, ambient noise levels are relatively low. As a result, noise emissions associated with proposed facilities will need to be managed to protect the acoustic amenity of the surrounding residences. This is particularly important on the southern and eastern boundaries where the site is closest to residences.

7.1 Facility Noise

Noise associated with warehouse and manufacturing type facilities consist of internal noise and external yard noise. Associated stationary noise sources such as fans, air-conditioning and refrigeration plant, compressors and operations within buildings can be controlled by planning, engineering noise control (silencers, acoustic louvers, enclosures etc.) or selection of building components (masonry walls etc).

These strategies must be implemented during the plant selection and installation process to optimise the control of noise emission from the mechanical plant and equipment, based on detailed spectral noise data to assess the need for possible tonality corrections in accordance with the *INP*.

External noise typically associated with warehouse / distribution facilities, being truck movements and yard activities are not able to be controlled as easily as fixed plant and internal noise. Therefore a noise assessment of the whole site that assumes all buildings have yard and dock facilities operating simultaneously has been conducted as a "worst case" noise scenario.

Site related cumulative noise emissions were modeled using the "Cadna A" acoustic noise prediction software. Factors that are addressed in the noise modeling are:

- Equipment sound level emissions and location;
- Screening from mounds and fences;
- Receiver locations;
- Ground topography;
- Noise attenuation due to geometric spreading;
- Ground Absorption; and,
- Atmospheric absorption.

7.2 Operational Noise

Operational site noise will be mainly associated with roof fans, truck movements and associated dock activities. These activities are proposed to occur on a 24 hour, 7 day a week basis.

Accordingly, assessment of a "worst case" operating scenario has been conducted. The assessment is based on previous measurements conducted at similar facilities including warehouses and storage facilities.

7.2.1 Noise Model Scenario

Noise emanating from fans, loading and unloading yard activities that will be associated with the facilities was modelled based on the proposed building layout as presented in Figure 1-2. The modelled noise levels are considered representative of a worst case scenario. A review of the indicative resultant noise levels at surrounding residences has been conducted based on the concept building layout operation being:

- All buildings operating 24-hours, i.e. day and night operation;
- 1 truck per site manoeuvring for one minute in the 15-minute assessment period;
- Two to three trucks per warehouse unloading depending on warehouse size;
- One to three forklifts operating at each warehouse depending on warehouse size;
- One to two reversing alarms at each warehouse operating for 10 seconds; and
- Two to four roof top fans operating at each warehouse depending of warehouse size,

A bund on the southern and eastern side of the site as illustrated in the concept plan; and,

- Three trucks on the central road.

The design of warehouses along the eastern boundary and the southern portion of the site purposely locate truck loading / unloading on the western and northern sides, respectively to maximise shielding of noise to existing and future residences to the east and south. Mound barriers are proposed to shield noise to surrounding properties.

Based on the above scenario noise levels at surrounding receivers has been predicted. In the case of future residences the assessment locations were based on indicative building locations shown in Figure 1.2. Figure 7.1 shows the predicted noise levels from the site to surrounding receivers.

Figure 7-1 Noise Emissions from Proposed Site

Table 7-1 presents predicted noise levels at surrounding individual residences. In the case of future residences to the south of the site these have been nominally named as residences South 1 to 6.

Table 7-1 Predicted noise levels at Existing and Future Residences

Receiver Name	Predicted Noise	Intrusive Noise Goals dBA	
		Day	Night
14 Capitol Hill Drive	35	42	37
1 Greenway Place	33	42	37
10-13 Greenway Place	36	42	37
14-20 Greenway Place	38	42	37 (1dB exceedance)
21-28 Greenway Place	37	42	37
29 Greenway Place	36	38	37
30-32 Greenway Place	37	38	37
33-37 Greenway Place	37	38	37
38 Greenway Place	35	38	37
41-43 Greenway Place	36	38	37

Receiver Name	Predicted Noise	Intrusive Noise Goals dBA	
		Day	Night
South 1	33	36	36
South 2	33	36	36
South 3	36	36	36
South 4	34	36	36
South 5	34	36	36
South 6	32	36	36

It is noted that compliance with established intrusive noise criteria is indicated at all residences during the day and night periods. The exception to this is during the night period at 14-20 Greenway Place where a marginal exceedance of 1 dBA is predicted. This level of exceedance is not considered acoustically significant. It is also worth noting that the 1 dBA exceedance is predicted at 30 metres from the residence whilst noise levels at the actual dwelling on this site at night are predicted to comply.

It is also noted that compliance with the intrusive noise criteria means that compliance with amenity criteria will be achieved.

7.3 Sleep Disturbance

In the case of noise from events such as reversing alarms, there is the potential for sleep disturbance from areas that potentially operate in the night period. The L_{Amax} noise levels due to reversing alarms have been predicted at surrounding residences. Each predicted noise level is based on an alarm operating on the site closest to each assessed residence thereby representing a "worst case" scenario.

A review of predicted noise levels is presented in Table 7-1.

Table 7-1 Predicted Truck Reversing Alarm Noise Levels at Residences – dBA

Receiver Name	Predicted L_{Amax} Noise Level (dBA)	Sleep Disturbance Screening Criterion (dBA)	Compliance with Screening Criterion
14 Capitol Hill Drive	35	47	Yes
1 Greenway Place	37	47	Yes
10-13 Greenway Place	44	47	Yes
14-20 Greenway Place	40	47	Yes
21-28 Greenway Place	40	47	Yes
29 Greenway Place	40	47	Yes
30-32 Greenway Place	41	47	Yes
33-37 Greenway Place	40	47	Yes
38 Greenway Place	40	47	Yes
41-43 Greenway Place	41	47	Yes

Receiver Name	Predicted L_{Amax} Noise Level (dBA)	Sleep Disturbance Screening Criterion (dBA)	Compliance with Screening Criterion
South 1	38	46	Yes
South 2	35	46	Yes
South 3	46	46	Yes
South 4	38	46	Yes
South 5	38	46	Yes
South 6	31	46	Yes

A review of results indicates compliance with Sleep Disturbance screening noise objectives will be achieved at all residences.

7.4 Management of Noise Emissions

The noise assessment of the precinct has been based on the concept design whereby an assumed worst case scenario has been assessed. When the actual use of each facility on the site is known a separate project application, accompanied by a site specific acoustic assessment, will be required addressing the specific use and associated noise emissions likely to be emitted from the facility.

In order to manage noise emissions from the site the following recommendations are made:

- Noise generated within buildings will need to be contained within building envelope. Indicatively, where internal noise levels are likely to exceed 65-70 dBA then treatment to the building façade and roof may be required. The actual treatment will need to be determined at the project application stage. These guideline values apply particularly to buildings on the eastern and southern sides of the site.
- Any fixed external plant should be located such that the building acts as a noise barrier between the equipment and residences. In addition appropriate noise controls should be adopted as necessary. These may consist of barriers, enclosures or silencers.
- Roof Fans should be acoustically treated as determined necessary.
- Loading docks on the NE and SW buildings should be restricted to the southern and eastern sides of these buildings respectively.
- Reversing alarms on forklifts should be fitted with broadband "quacker" type reversing alarms.

7.5 Cumulative Noise Impact

The *INP* has been designed to provide the means to manage noise from multiple developments with the object of attaining the best possible balance between noise and other relevant socio-economic factors. Applying the principles of the *INP* at the planning stage can avoid future land use conflicts over noise.

In developing the noise control requirements for the new industrial estate, a strategic approach can be set out within the planning instrument.

As the number of residences potentially affected by noise from the operation of the proposed business park are relatively few it is proposed to adopt the "Greystanes" approach (Langgons D, 2001). The approach that was adopted to deal with noise control for the industrial component at the Greystanes site can be summarised as follows:

1. Appropriate amenity noise levels are determined for the residences surrounding the various precincts. The *INP's* "rural" amenity area category noise levels of 50dB(A), 45dB(A) and 40dB(A) levels for daytime, evening and night time respectively are adopted.
2. The industrial land was divided into four zones, in this case corresponding to the four precincts.
3. A noise limit for each zone applies at the nearest residential area. The combined limits for all four zones complied with the adopted noise objectives for the residential area.

The approach aims to minimise the potential for exceedance of the amenity goals, allow for a more equitable share of the noise "budget" and allow some flexibility to the land developer.

In this case the allowable noise emissions for future sites should be assessed with a specific noise model at each development application taking into account the extent of the development at that time.

8 BUSINESS PARK TRAFFIC NOISE

A link road will be developed by the RTA to service this development and others. Criteria for the assessment of the link road traffic noise are set out in the NSW Government's *Road Noise Policy (RNP)*.

The traffic assessment prepared by Halcrow concludes the following:

- The regional road proposed in the SEPP will transverse the site in an 'S' shape from the north to south;
- The road will extend from Old Wallgrove Road through the site to approximately the mid point of the western boundary;
- The road will be eventually extended to Bakers Lane by others; and
- Local roads will be provided to access the proposed lots.

Therefore the RTA forecasts are consistent with the development of the site. The impact of noise on the Erskine Park Link Road will be assessed by the RTA in the project application stage which is consistent with RTA commitment detailed in the link road concept plan environmental assessment. A separate traffic noise assessment is not required here.

It is noted that the proposed SEPP regional road is a sufficient distance from residential properties so as to not generate adverse noise impacts.

9 SUMMARY OF BUSINESS PARK RECOMMENDATIONS

Based on our investigations of the site at the revised Concept Plan stage of the development, the following recommendations have been established.

9.1 Noise Criteria

Noise management objectives applying to construction of the business park have been established. In addition noise criteria for operation of the entire development have been established based on noise measurements processed in accordance with EPA.

The following operational noise criteria are applicable at surrounding existing and future residences.

Table 9-1 Site Specific Operational Intrusiveness & Amenity Criteria

Receiver Area	Time Period	Intrusiveness Criterion $L_{Aeq,15min}$ (dBA)*	Project-Specific Amenity Criterion#
A	Daytime (7.00am–6.00pm)	38	50
	Evening (6.00–10.00pm)	38	45
	Night time (10.00pm–7.00am)	37	40
B	Daytime (7.00am–6.00pm)	42	50
	Evening (6.00–10.00pm)	38	45
	Night time (10.00pm–7.00am)	37	40
C	Daytime (7.00am–6.00pm)	36	50
	Evening (6.00–10.00pm)	35	45
	Night time (10.00pm–7.00am)	36	40

*Intrusiveness criteria are based on the RBL plus 5 dBA.

It is recommended, as part of the noise management process, that each development take into account emissions from nearby developments within the precinct to ensure that the cumulative noise levels comply with the overall criteria.

As a screening process, noise goals which are below overall site criteria may be applied initially to each proposed development to ensure that at full development of the site, it complies with the overall site specific noise criteria.

9.2 Construction Noise

Construction noise will potentially exceed established noise goals at residences to the south and east of the site. Therefore, the planning and management of construction activities should take into account the sensitivities of surrounding residences to minimise the impact of construction noise at these receivers.

The control of construction noise should form a part of the site Environmental Management Plan where best practice procedures and community consultation is employed.

9.3 Operational Noise

It is predicted that operational noise, including intermittent noise from the use of reversing alarms at night (sleep disturbance), will comply with established site specific noise criteria at all residences. It is noted that the predicted 1 dBA exceedance at the yard 14-20 Greenway Place at night is not acoustically significant and compliance is predicted at the actual residential building.

Noise from future fixed plant and buildings can be controlled by the implementation of engineering noise controls such as enclosures, silencers and acoustic louvers. These can be adequately addressed at the detailed design stage of the project.

Assessment of each individual development will be required as part of the Development Application process. The assessment should take into account the site specific noise criteria and the findings of this assessment. These include:

- Noise generated within buildings will need to be contained within buildings. Indicatively where internal noise levels exceed 65-70 dBA treatment to the building façade and roof may be required. The actual treatment will need to be determined at the detailed design stage. These guideline values apply particularly to buildings on the eastern and southern side of the site.
- Any fixed external plant should be located such that the building acts as a noise barrier between the sites. In addition appropriate noise controls should be adopted as necessary. This may consist of barriers, enclosures or silencers.
- Roof fans should be acoustically treated as determined necessary.
- Loading docks on the NE and SW buildings should be restricted to the southern and eastern side respectively.
- Reversing alarms on forklifts should be fitted with broadband "quacker" type reversing alarms.

10 CONCLUSION

This noise assessment establishes that site specific noise criteria would be met during operation of the revised Horsley Park Concept Plan. It is recommended that each individual development take into account emissions from nearby developments within the park to ensure that the cumulative noise levels comply with the overall criteria.

In the case of the revised concept plan, compliance with established noise criteria is predicted based on the adoption of design measures aimed at managing noise emissions from the site. The details of the specific noise control measures should be determined at the project application stage.

Construction activities are likely to exceed established noise objectives at surrounding properties; accordingly management of this issue will require particular attention in minimising the acoustic impact at residences.

RTA traffic forecasts are consistent with the development of the site. The impact of noise from the link road will be assessed by the RTA in the project application stage which is consistent with RTA commitment detailed in the link road concept plan environmental assessment.

It is noted that the proposed SEPP regional road is a sufficient distance from residential properties so as to not generate adverse noise impacts.

APPENDIX A

NOISE MEASUREMENT RESULTS

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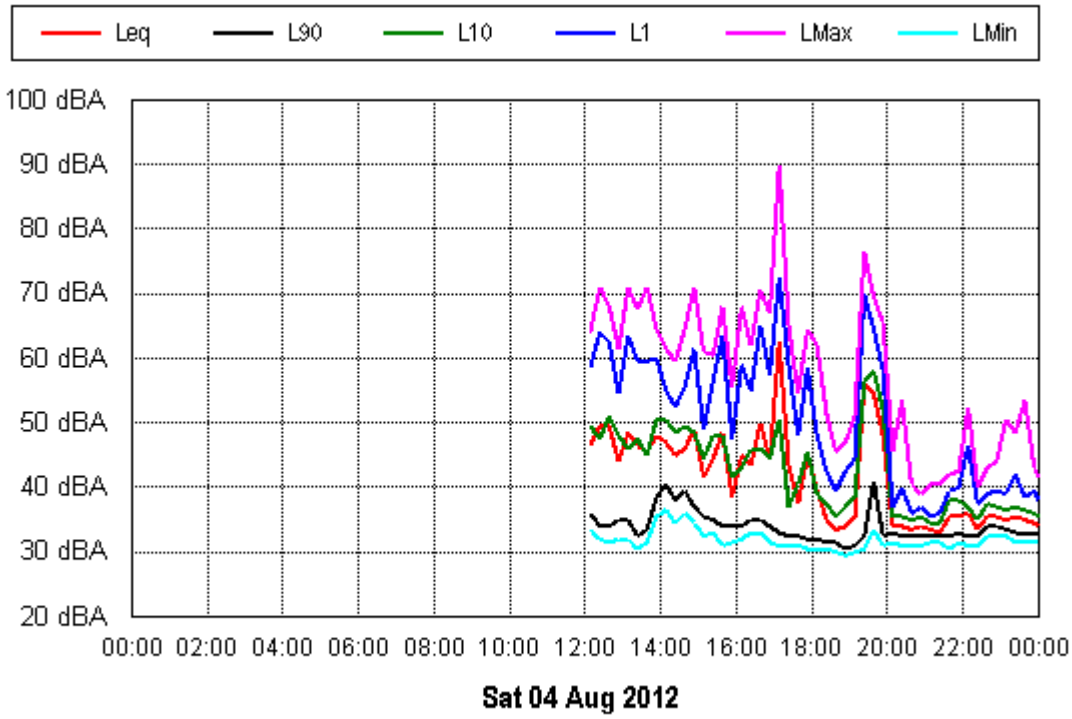

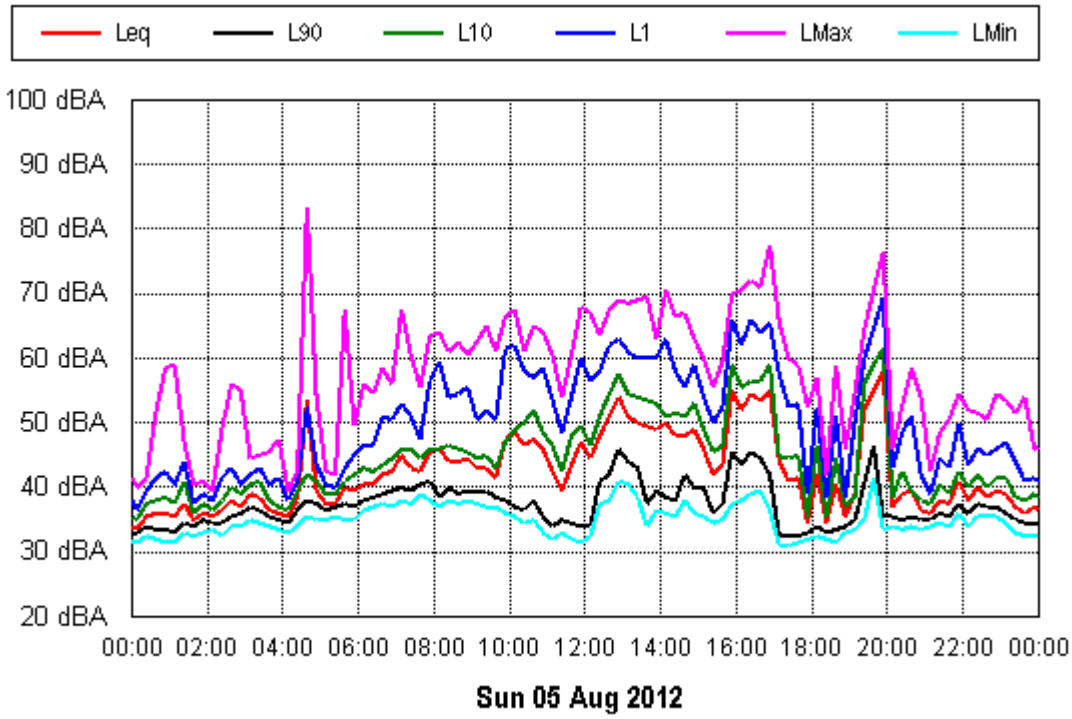

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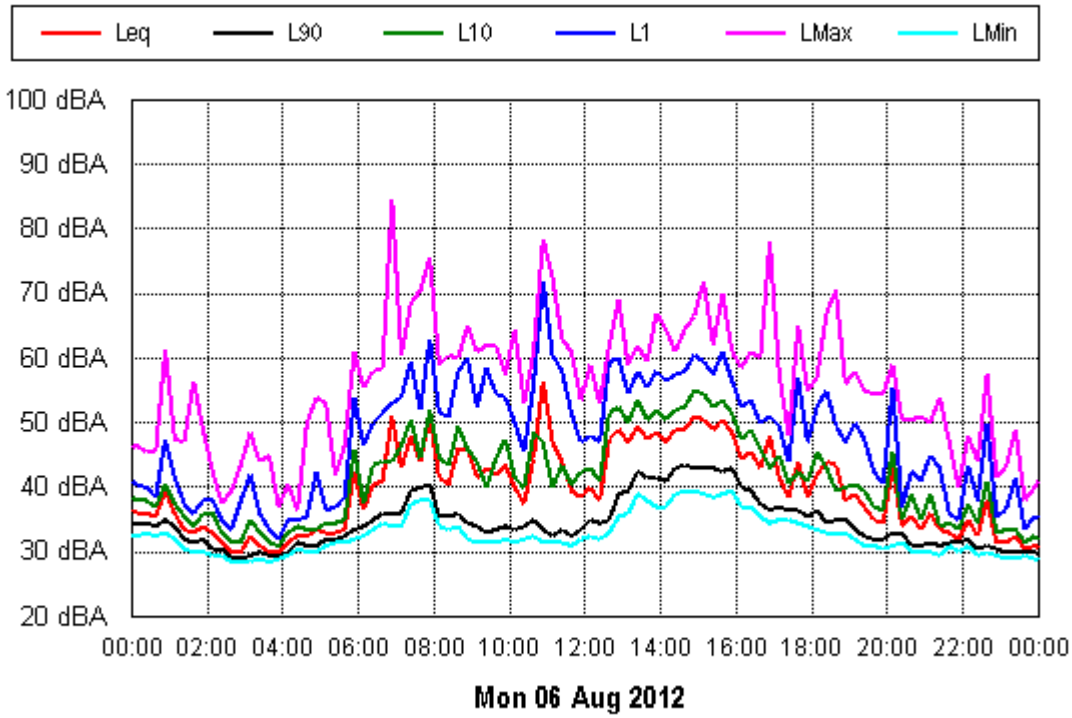

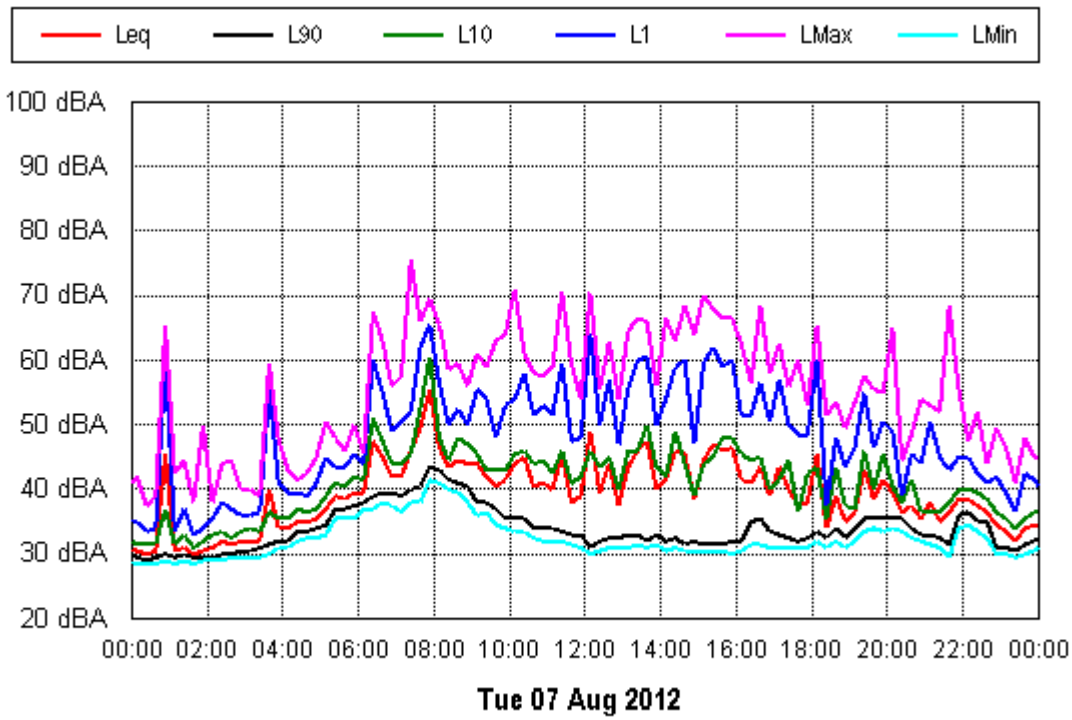

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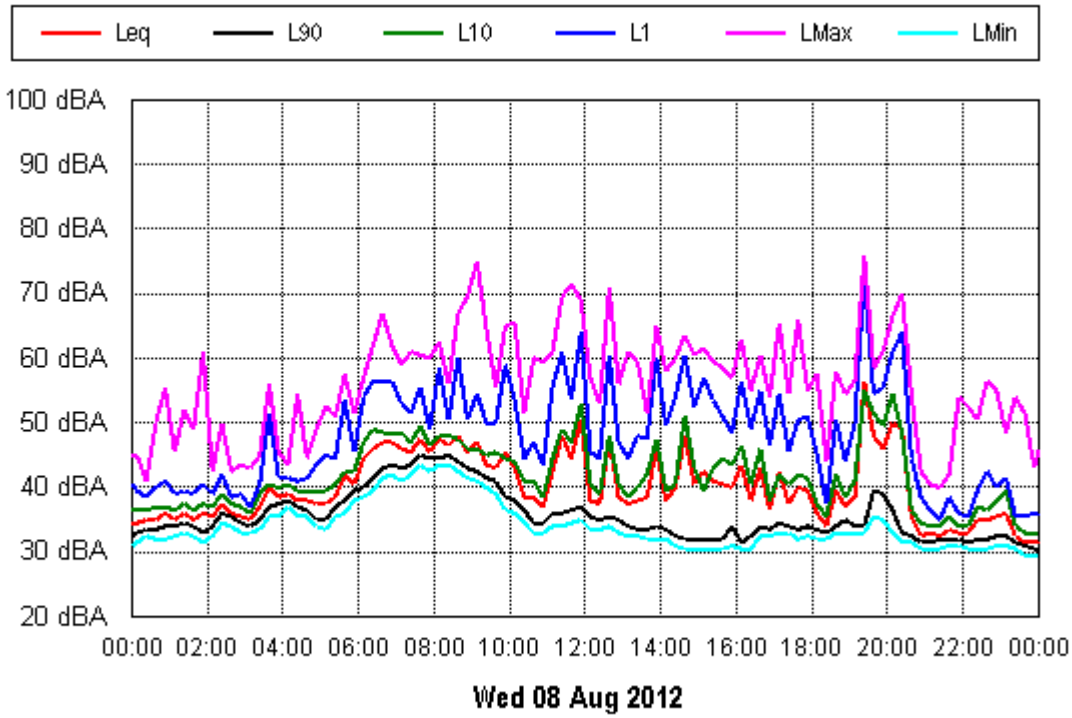

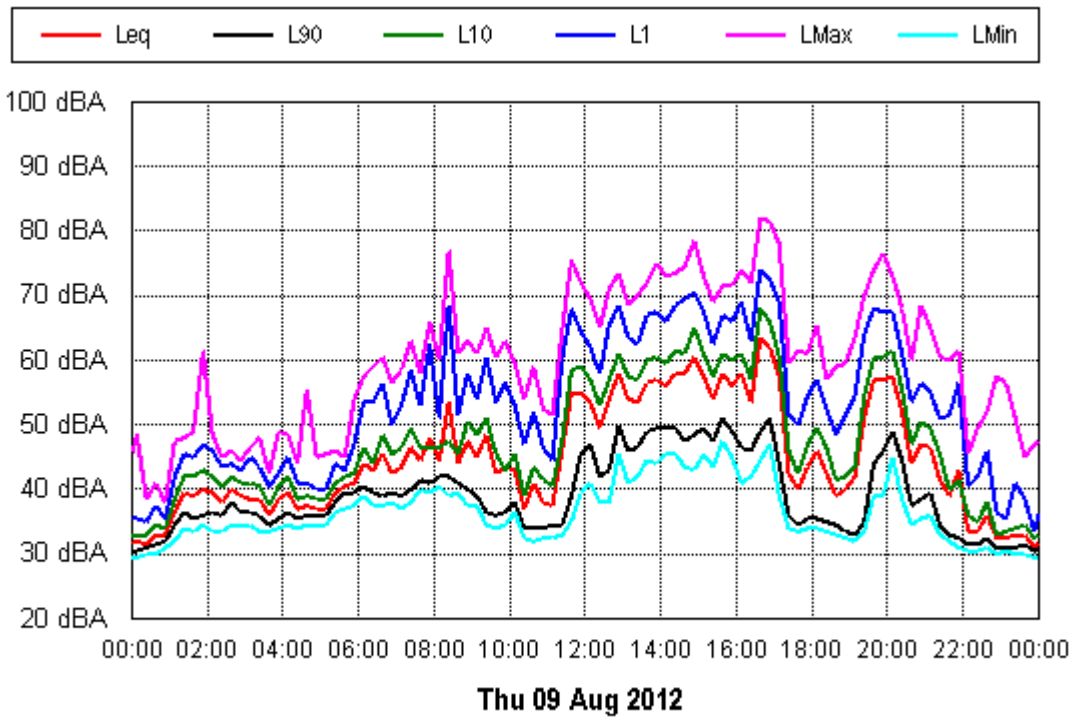

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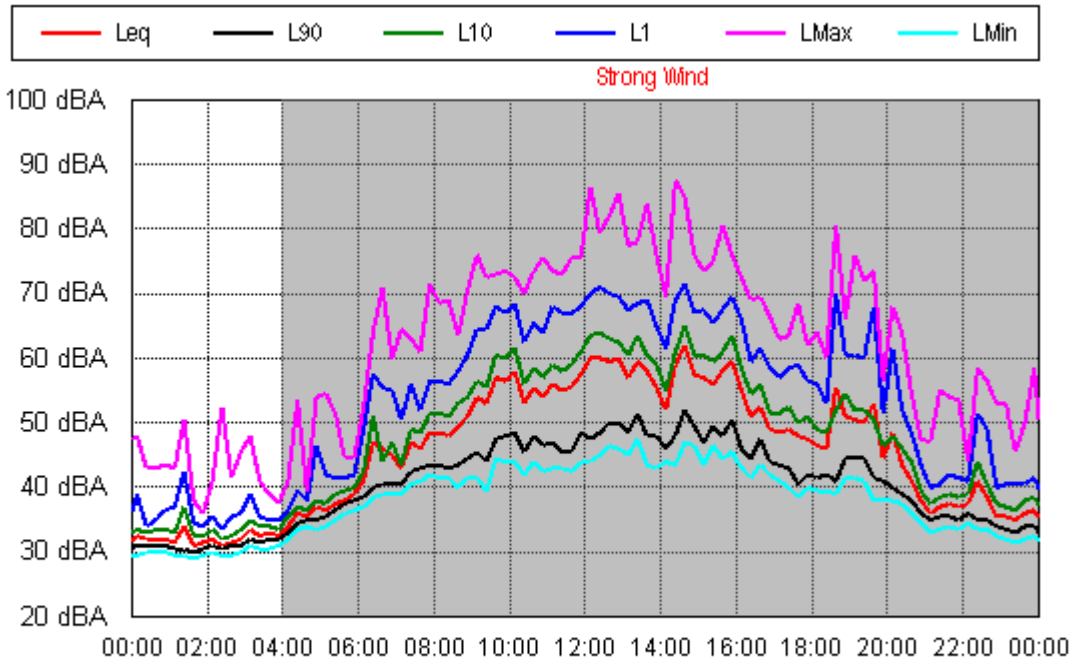

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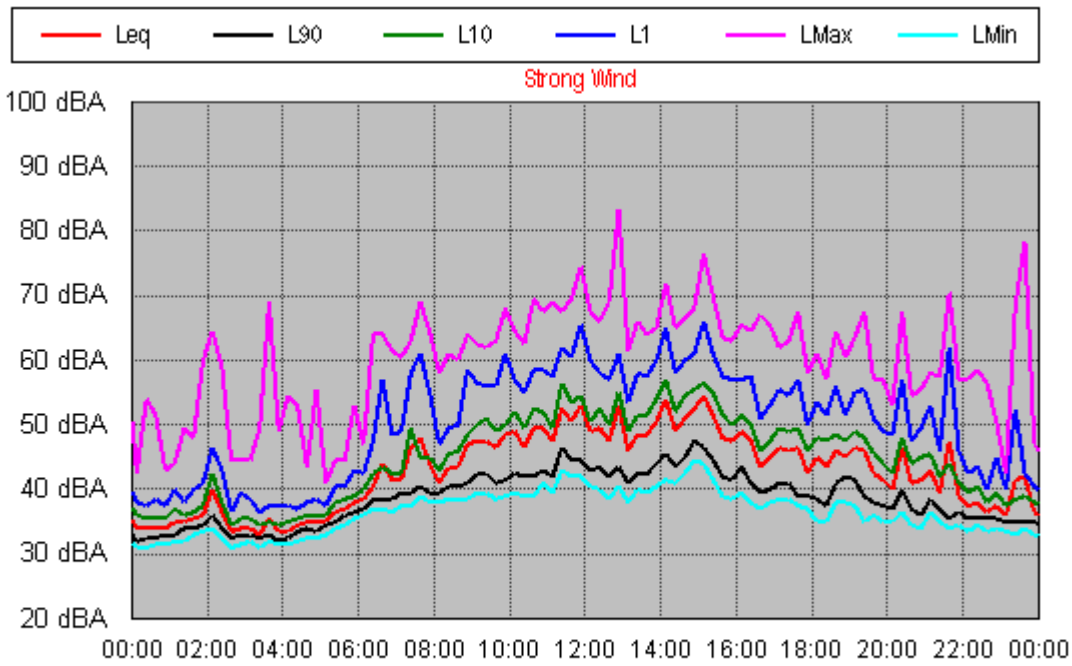

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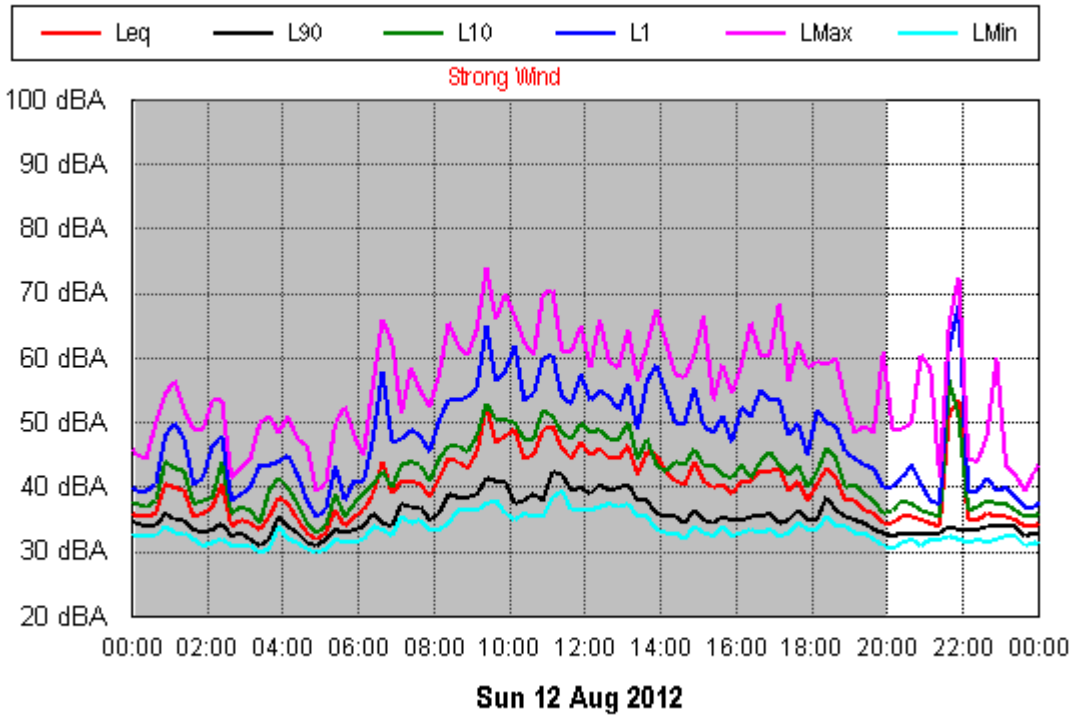

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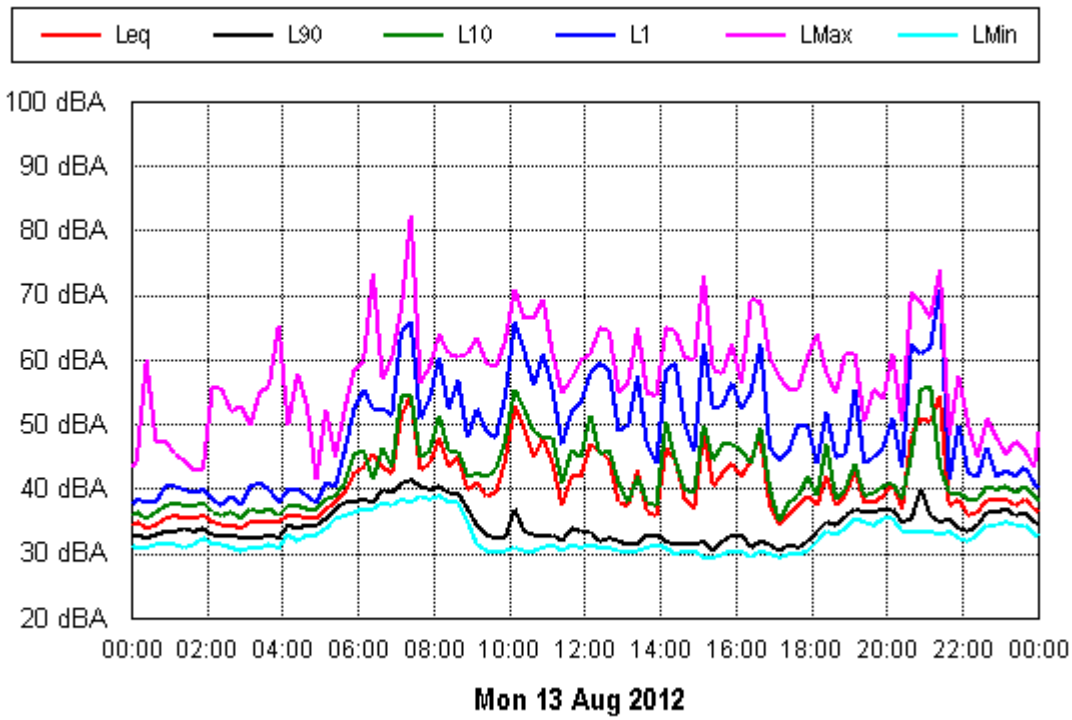

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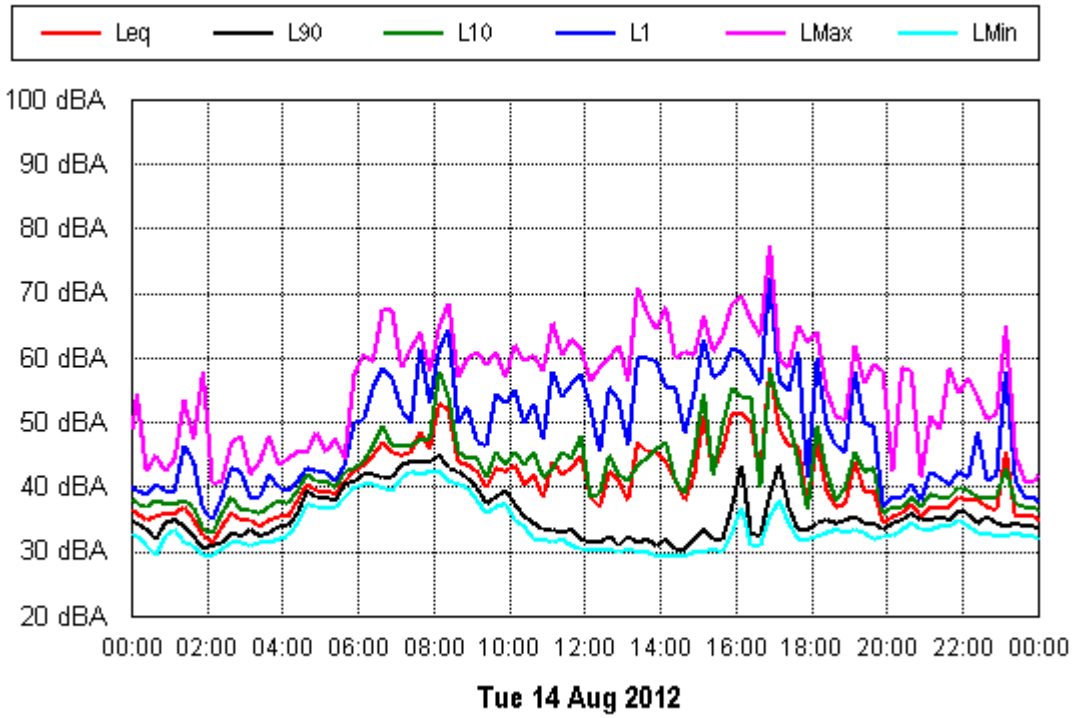

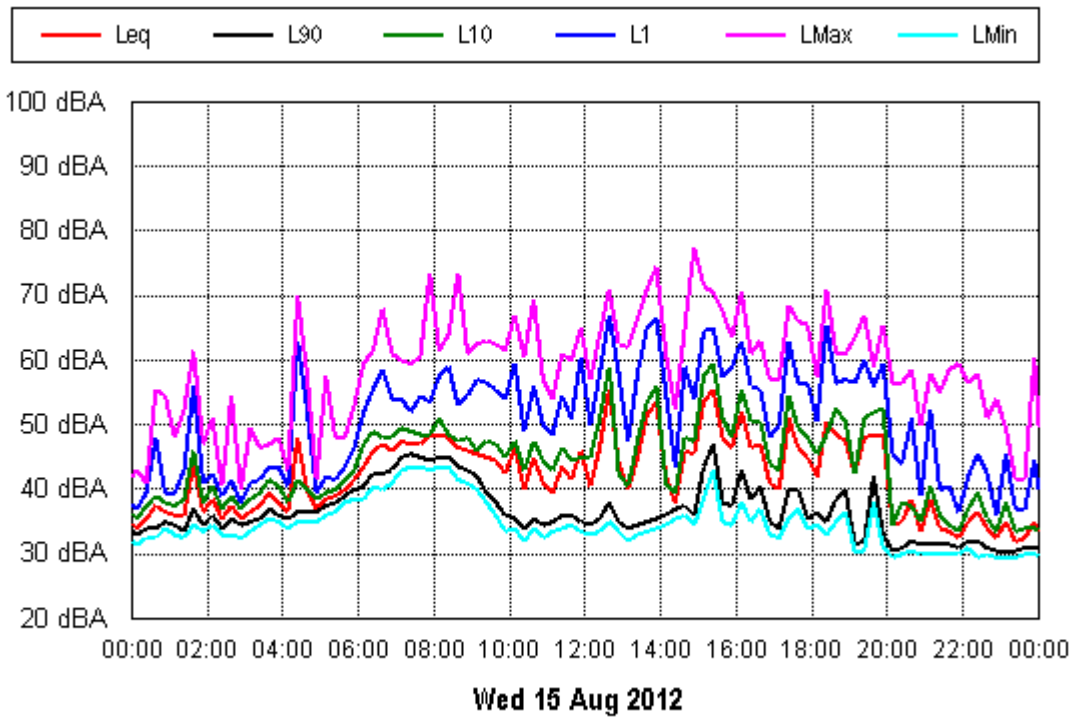

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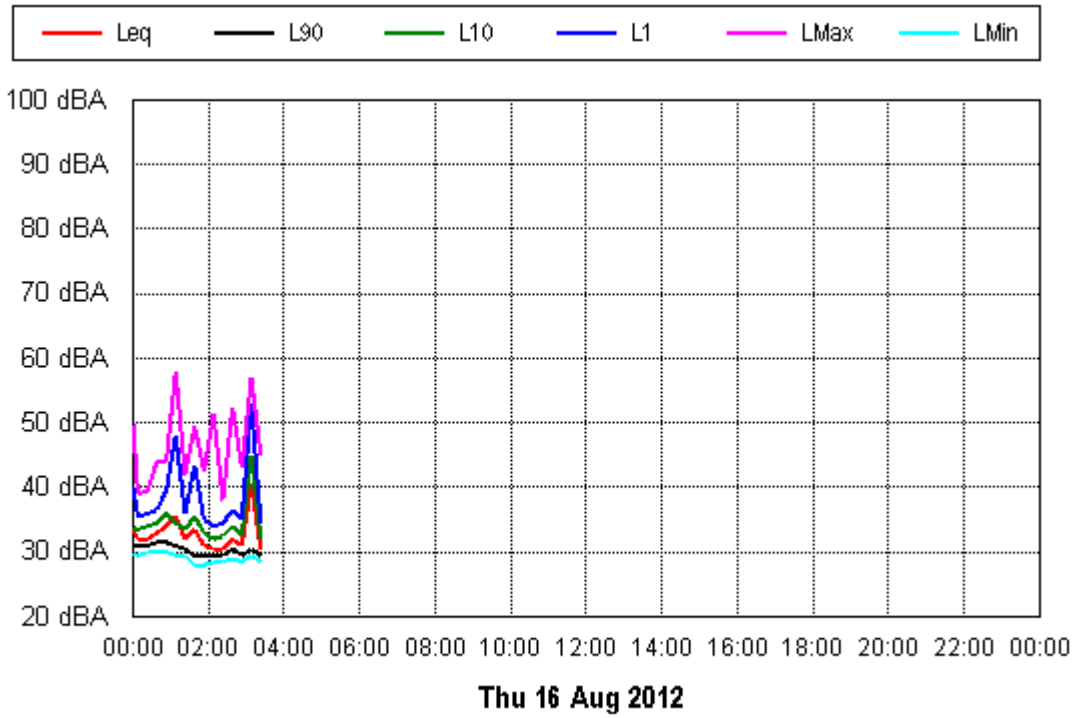
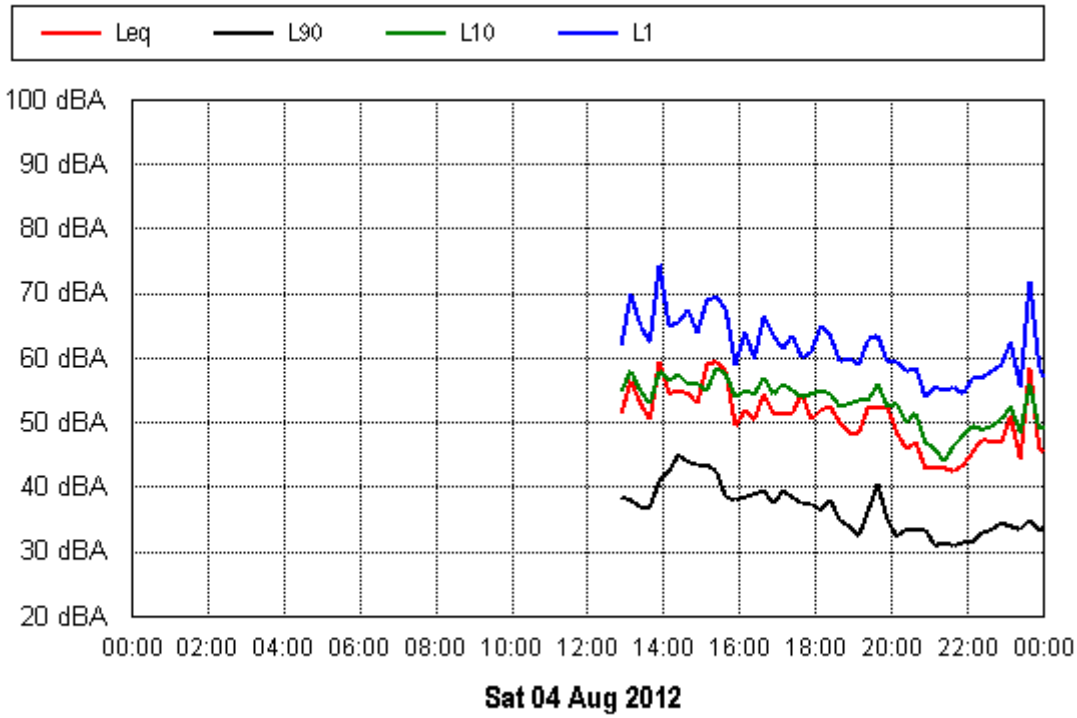
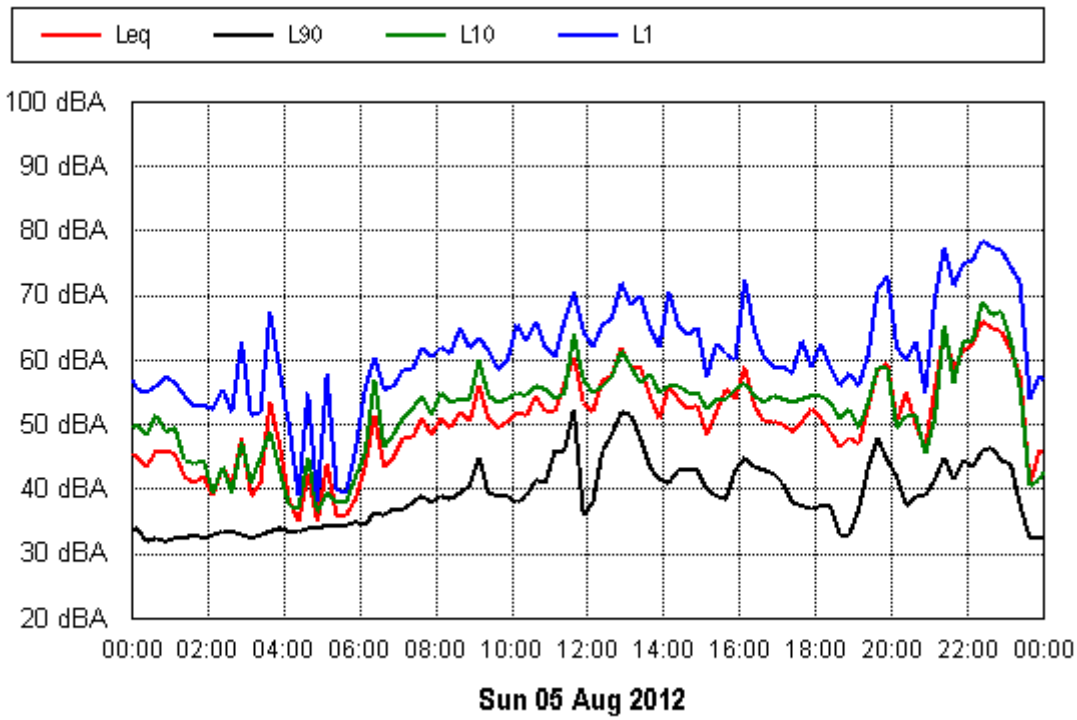


Project: Jacfin
Location: 1 Greenway Place





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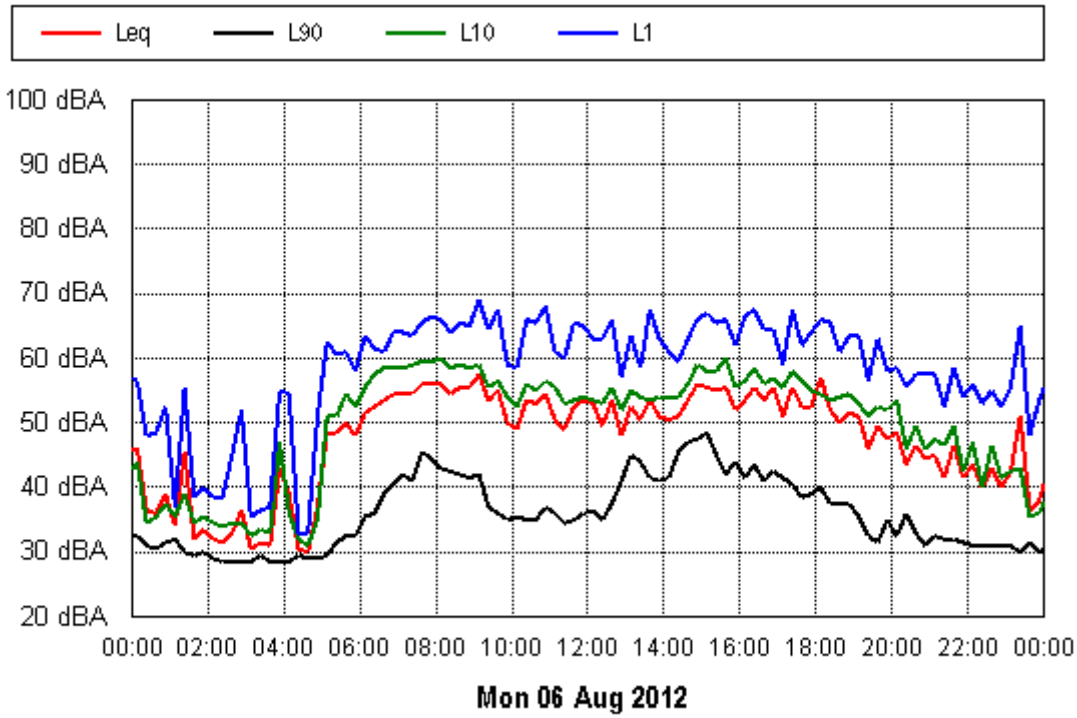

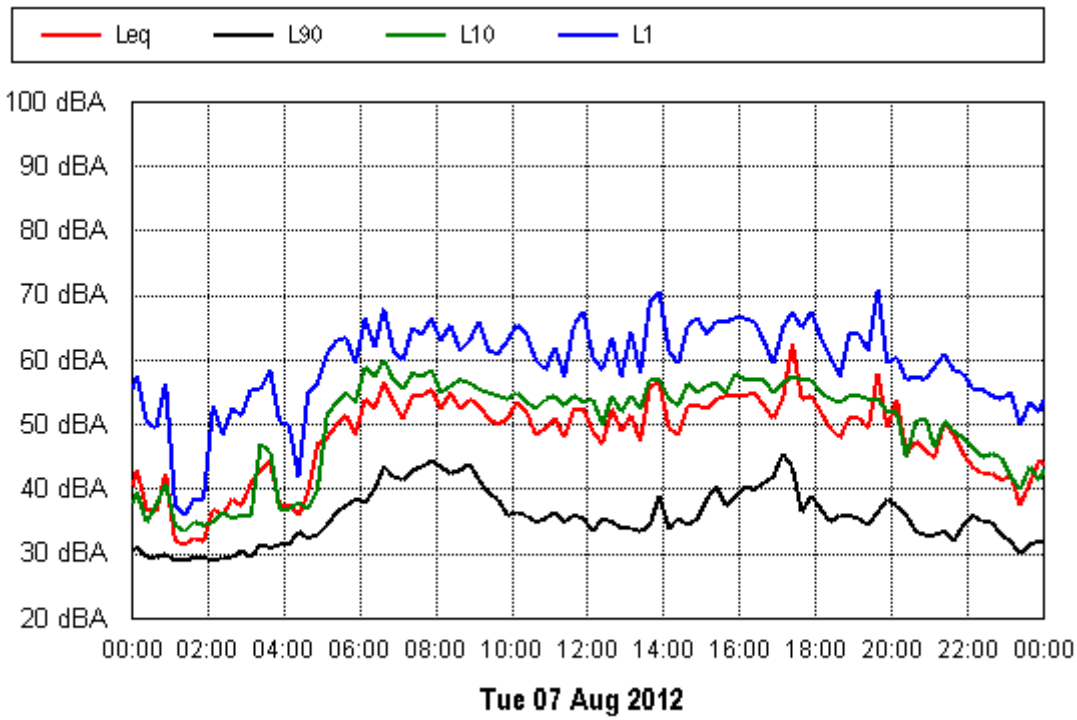

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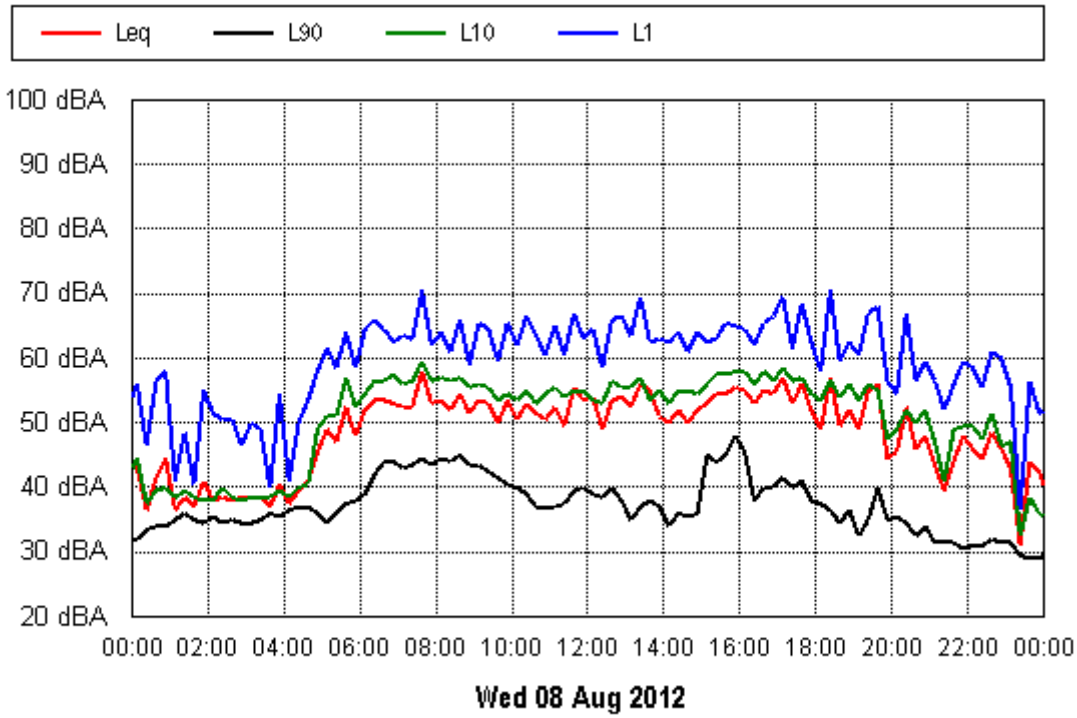
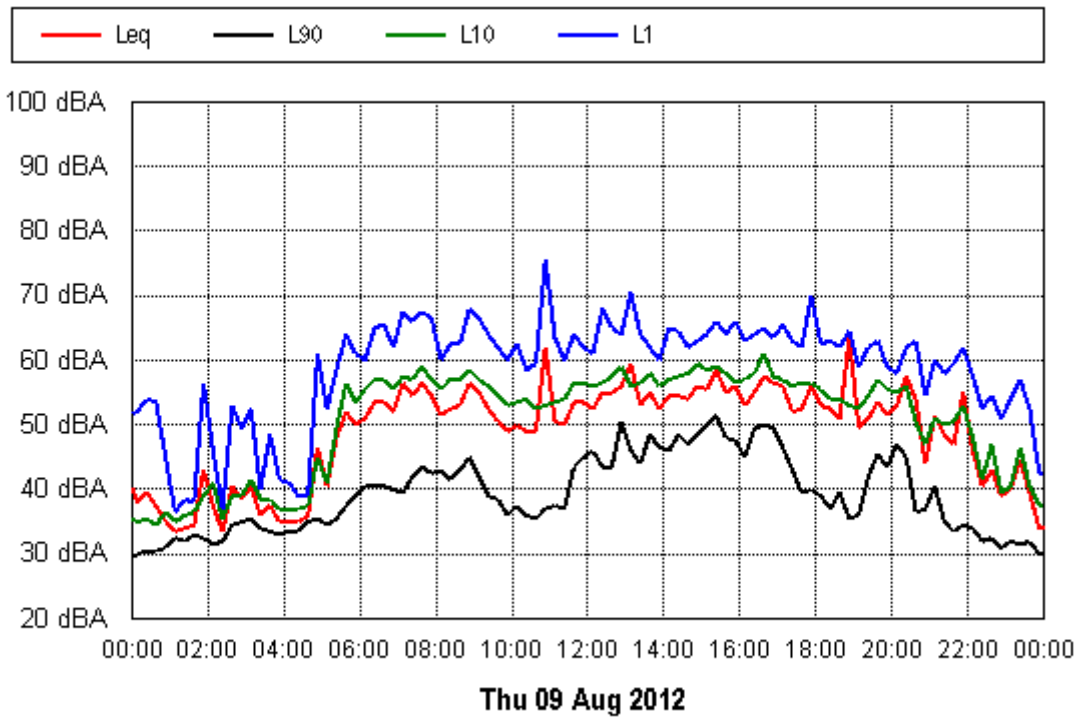
Location: 1 Greenway Place





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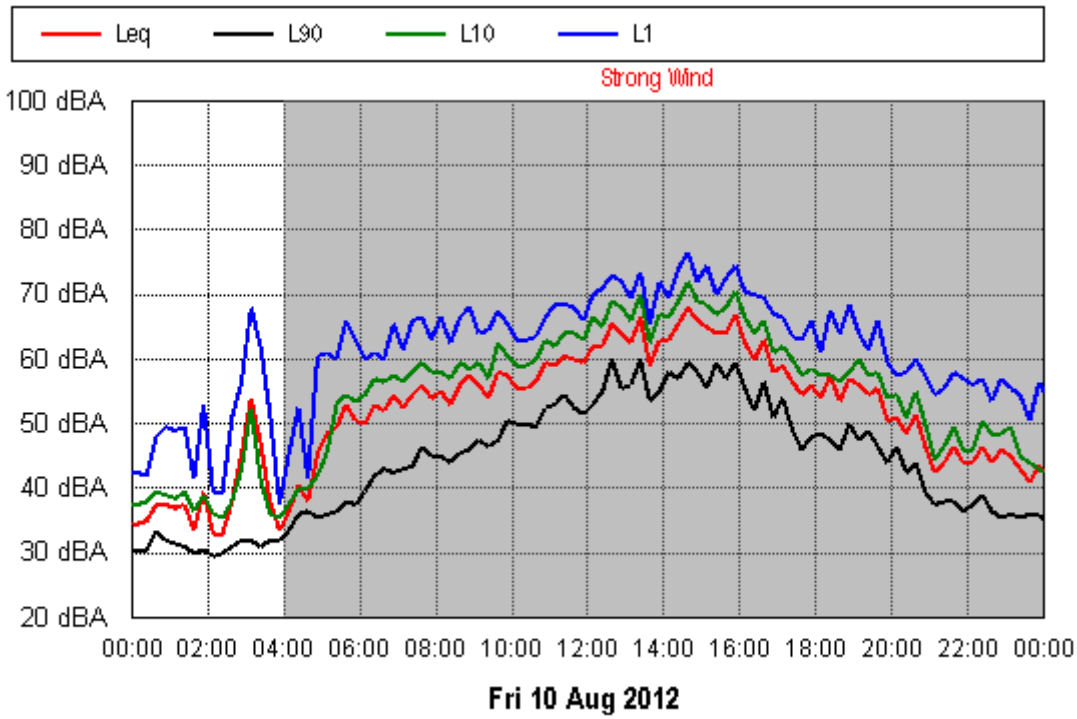

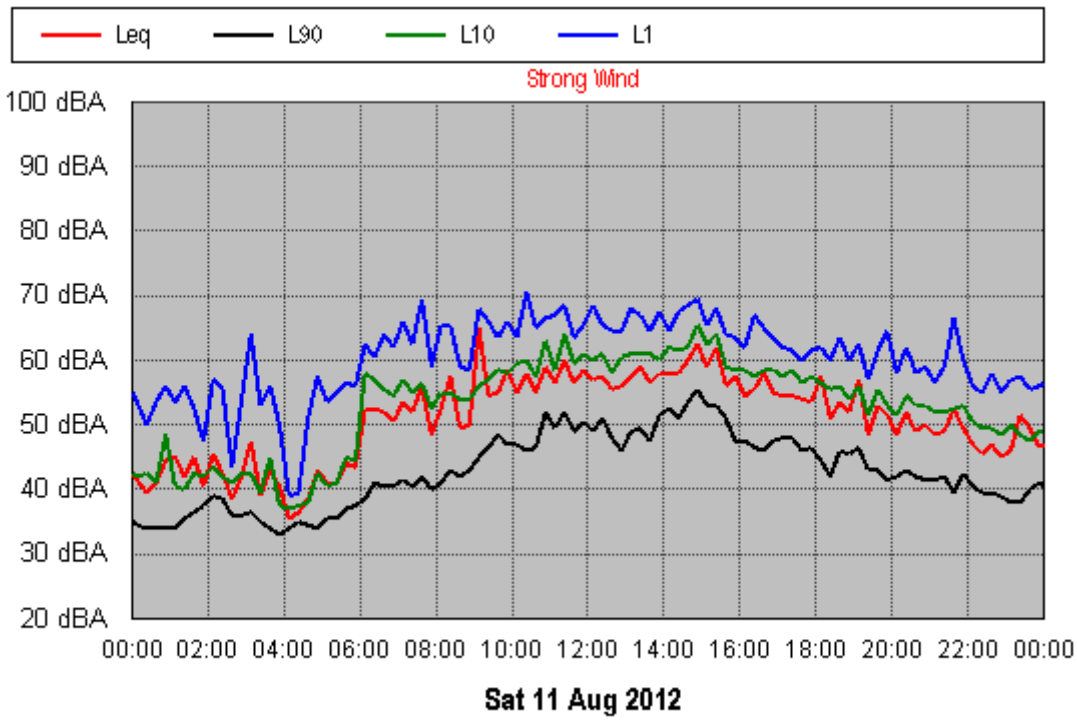

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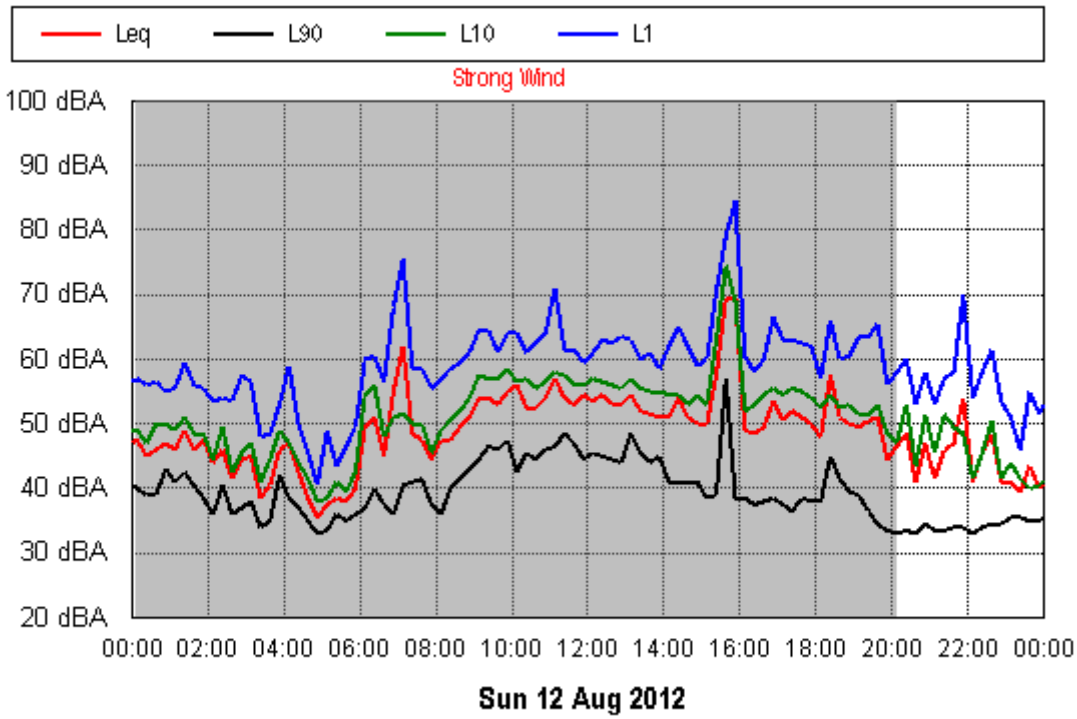
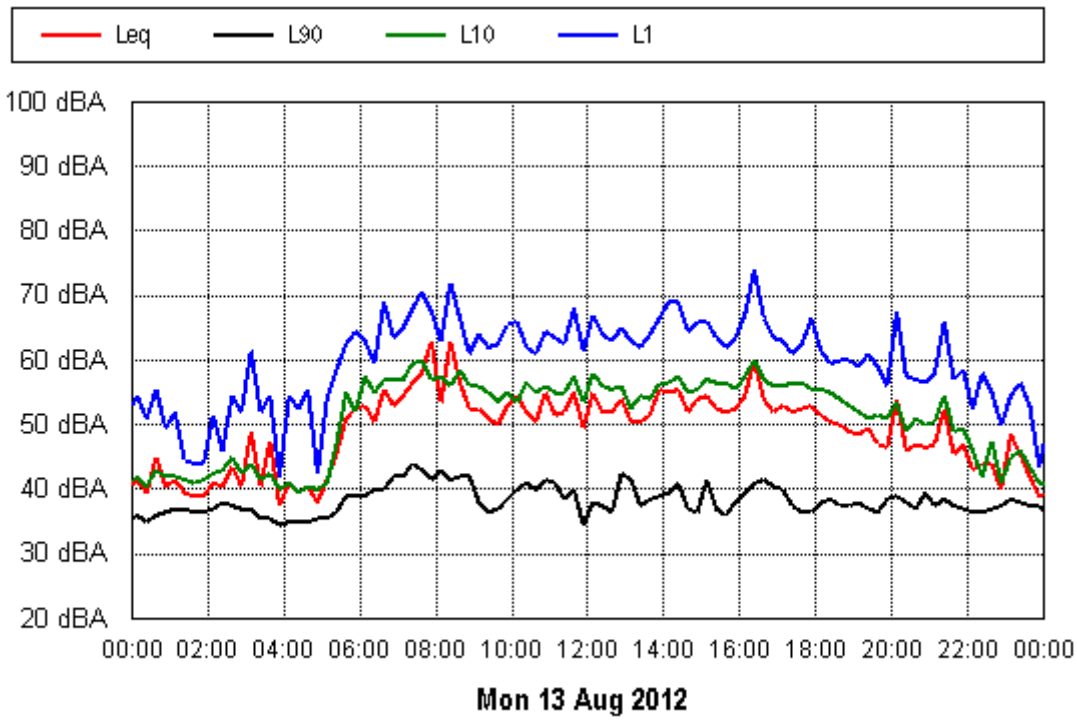
Location: 1 Greenway Place





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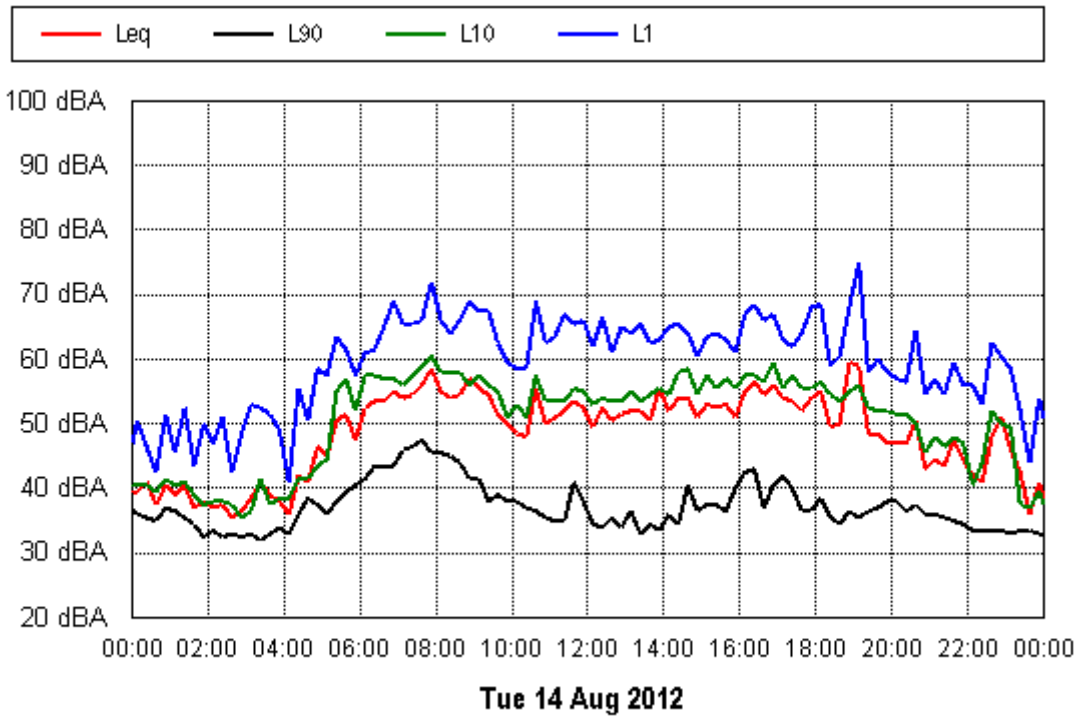
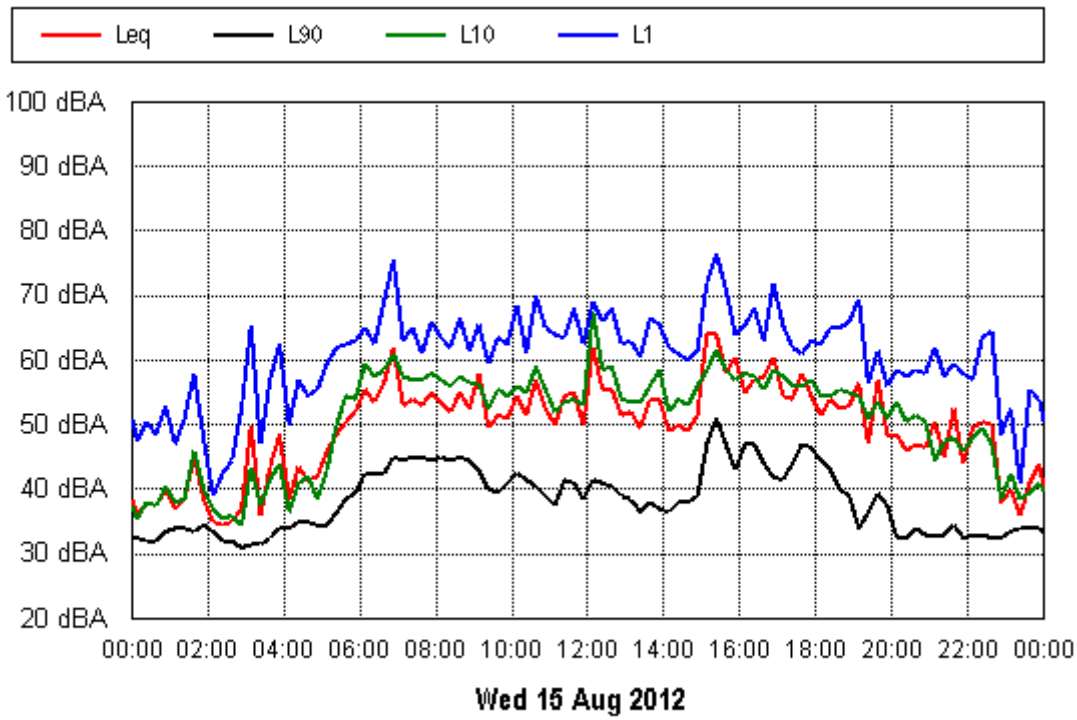
Location: 1 Greenway Place





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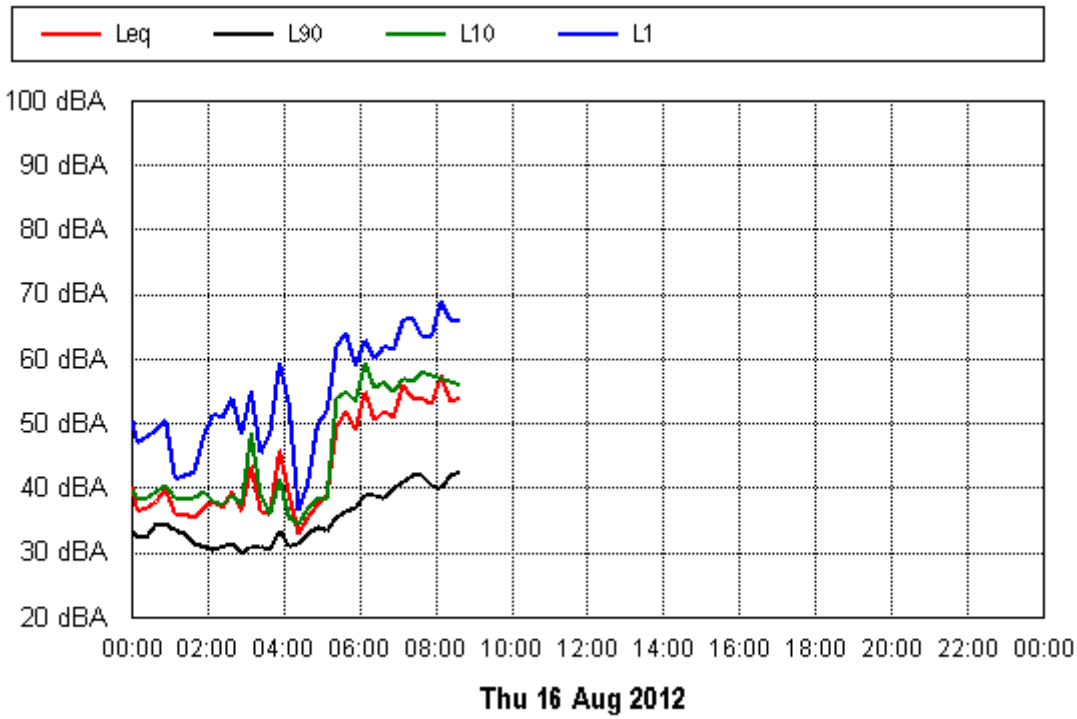

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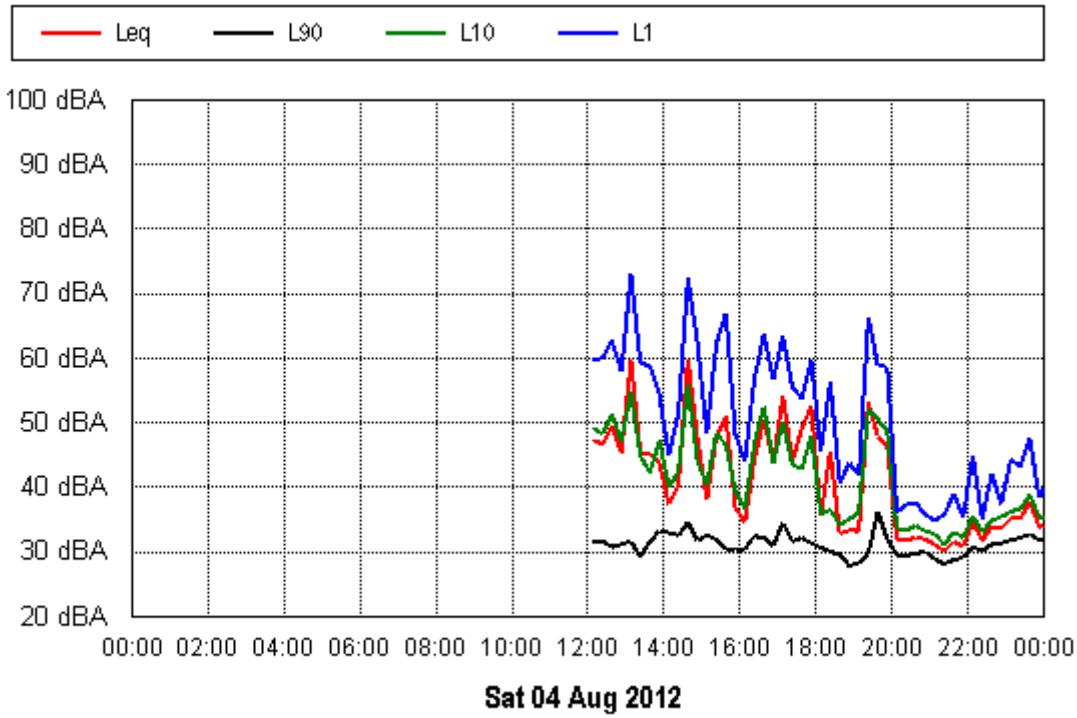
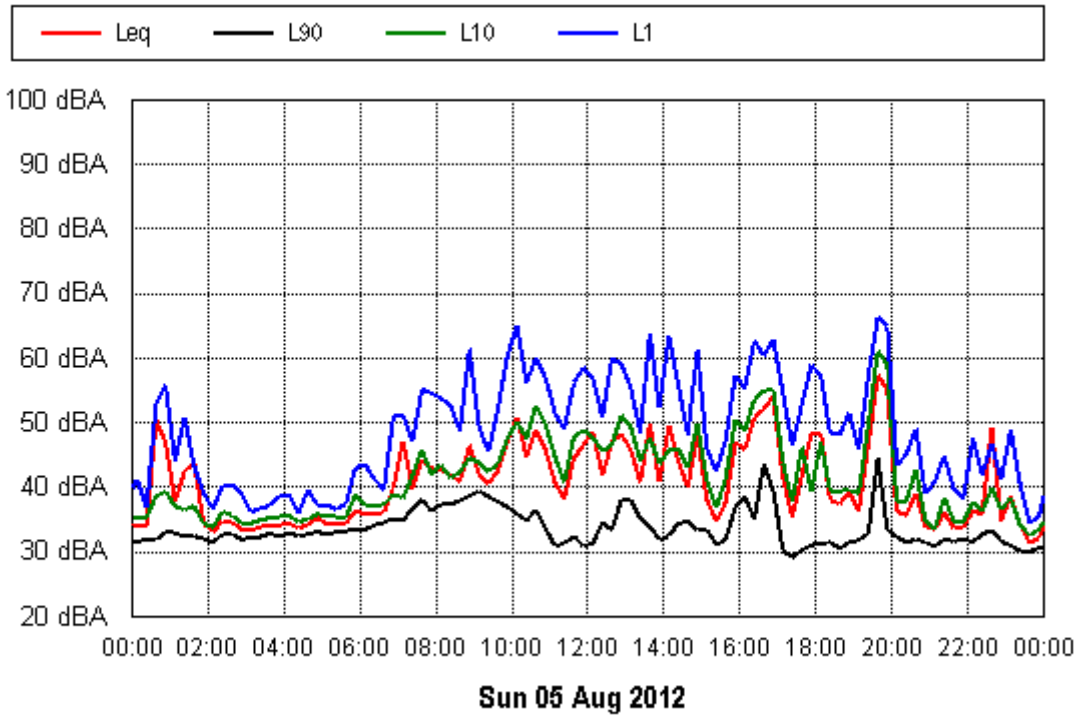
Location: SW Site Corner





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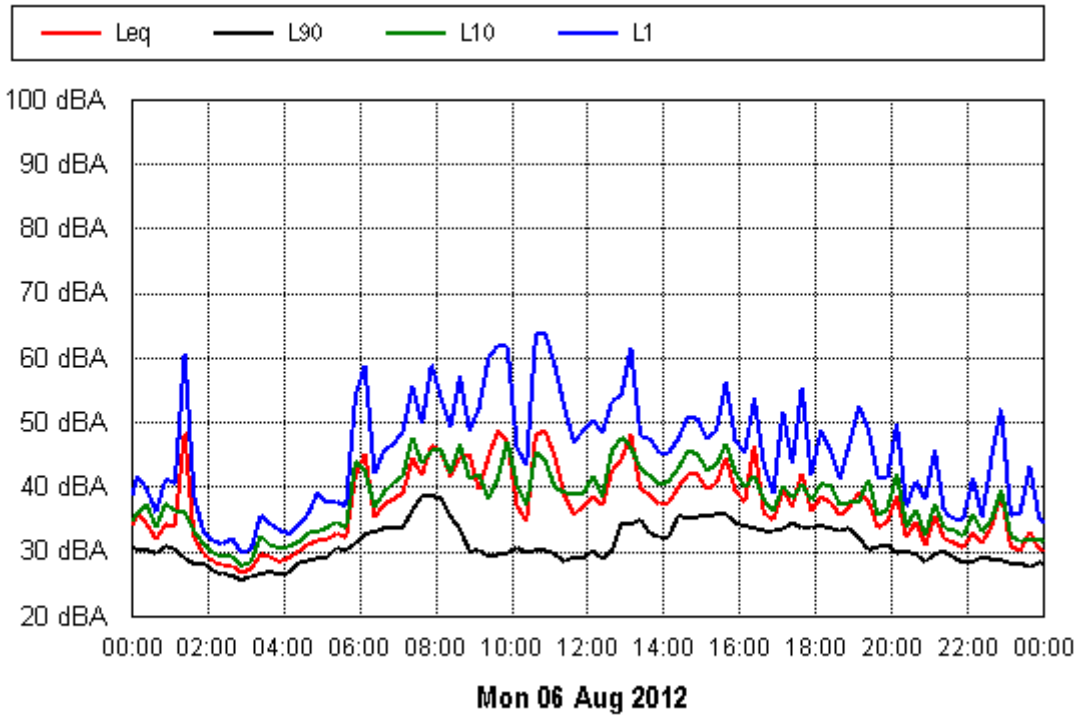

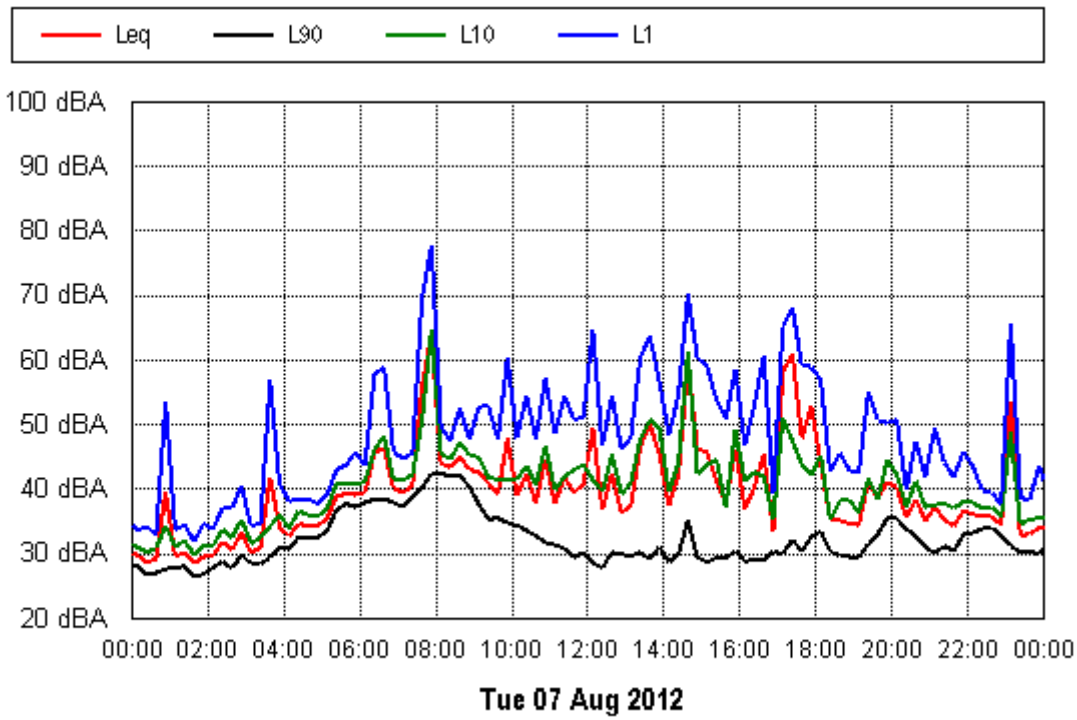

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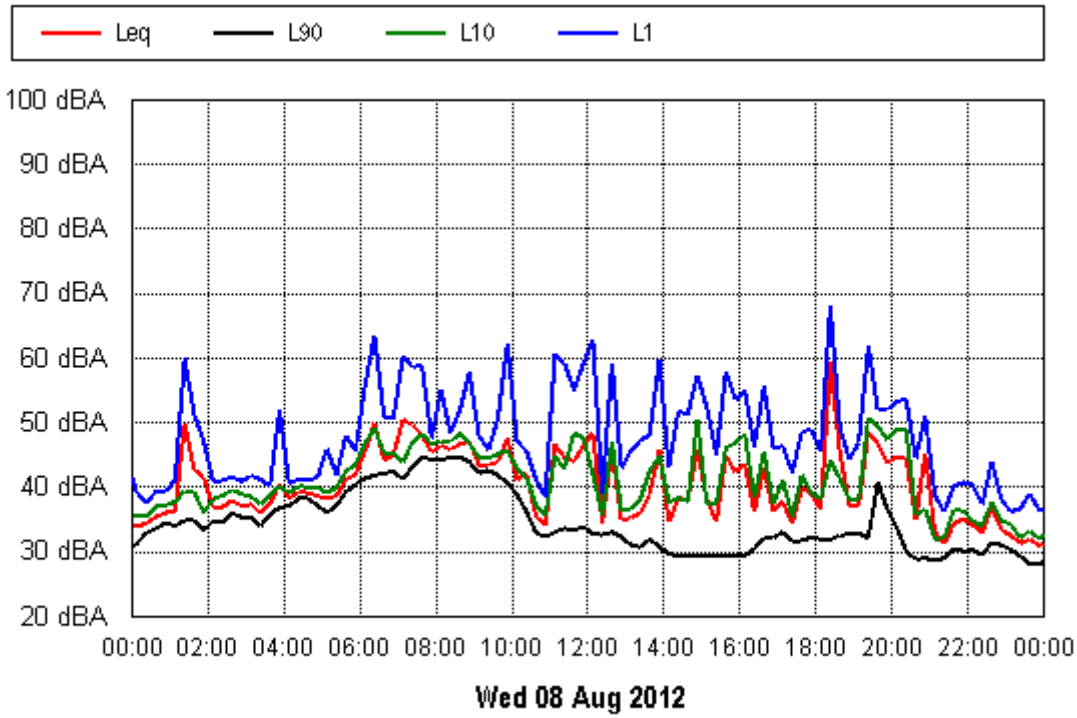
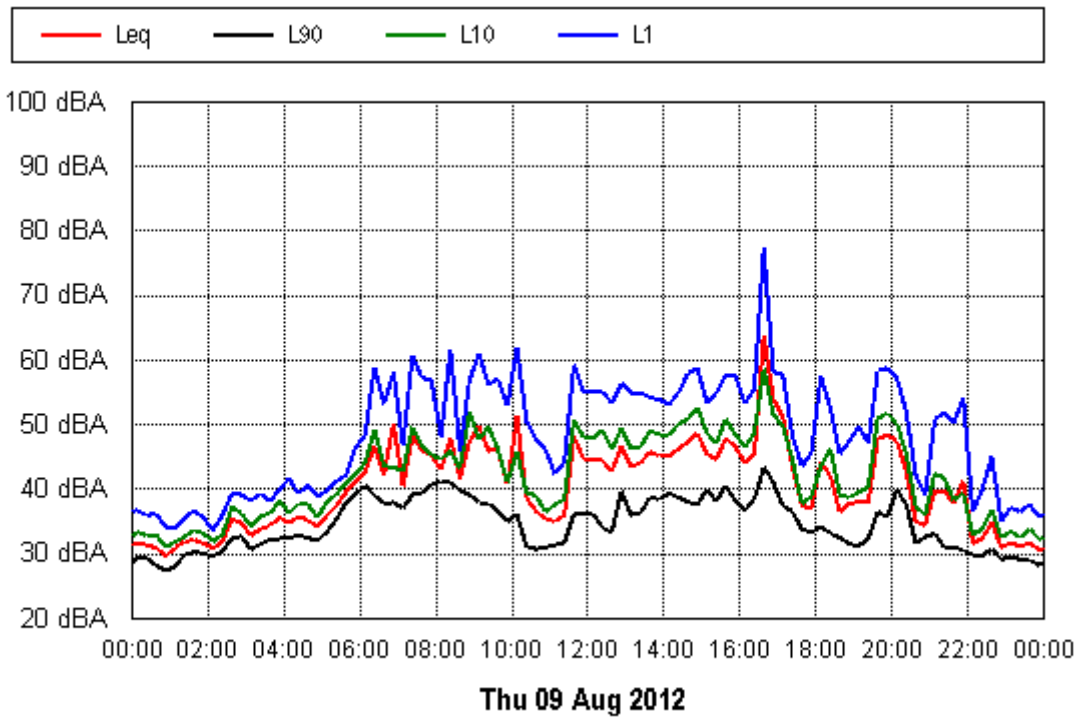
Location: SW Site Corner





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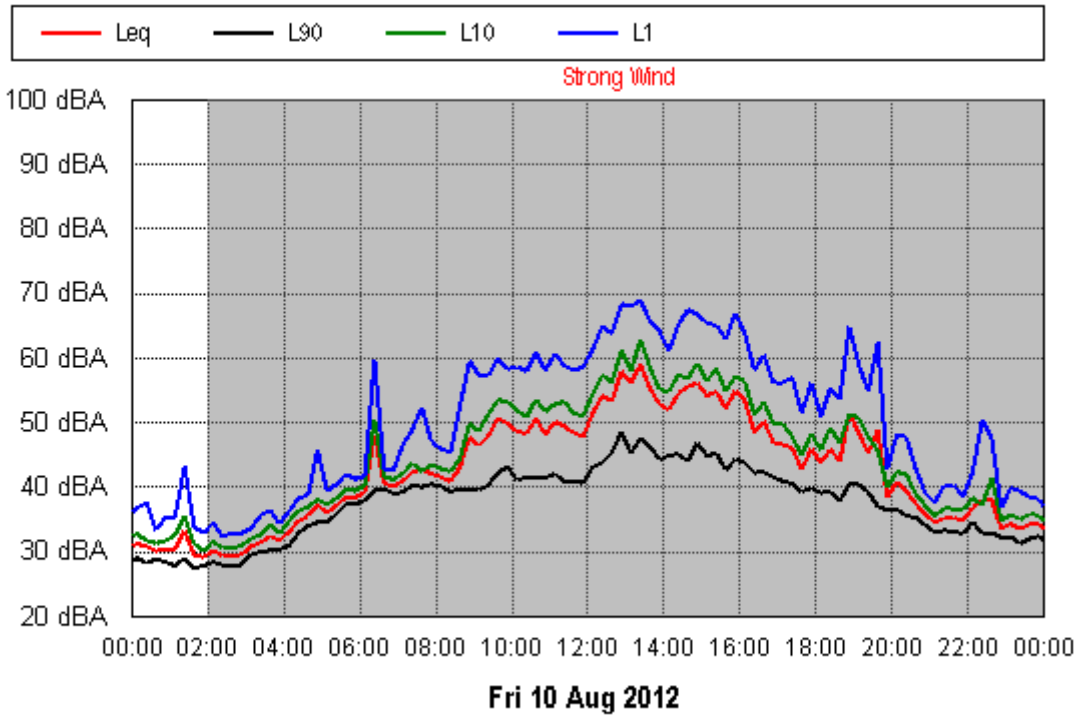
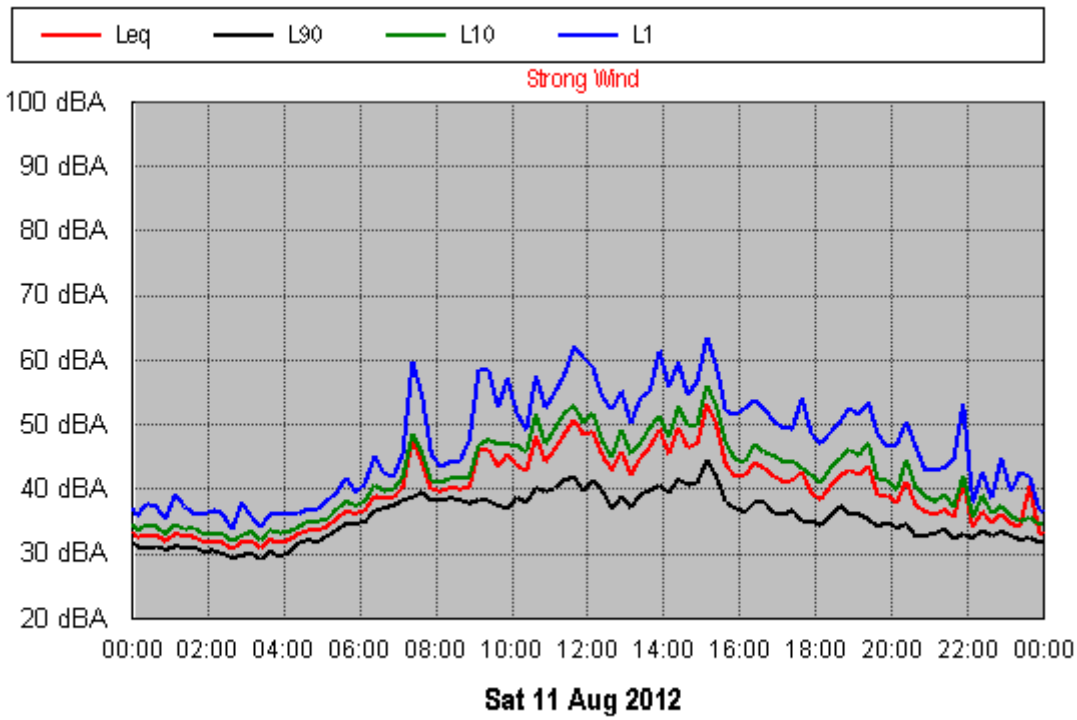
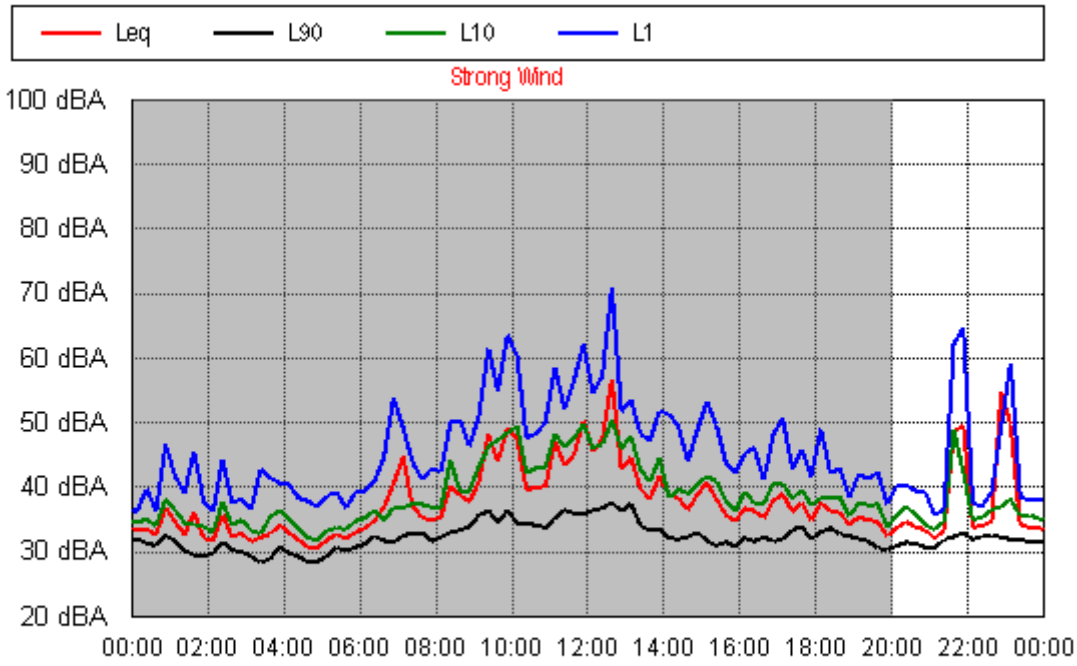
Location: SW Site Corner

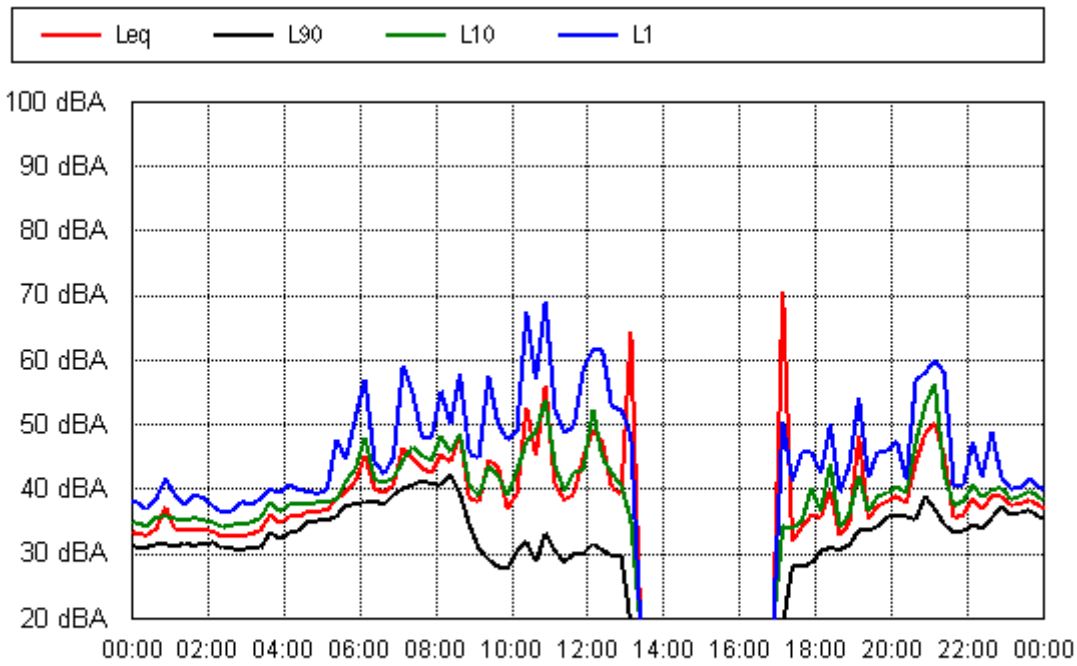




Project: Jacfin
Location: SW Site Corner

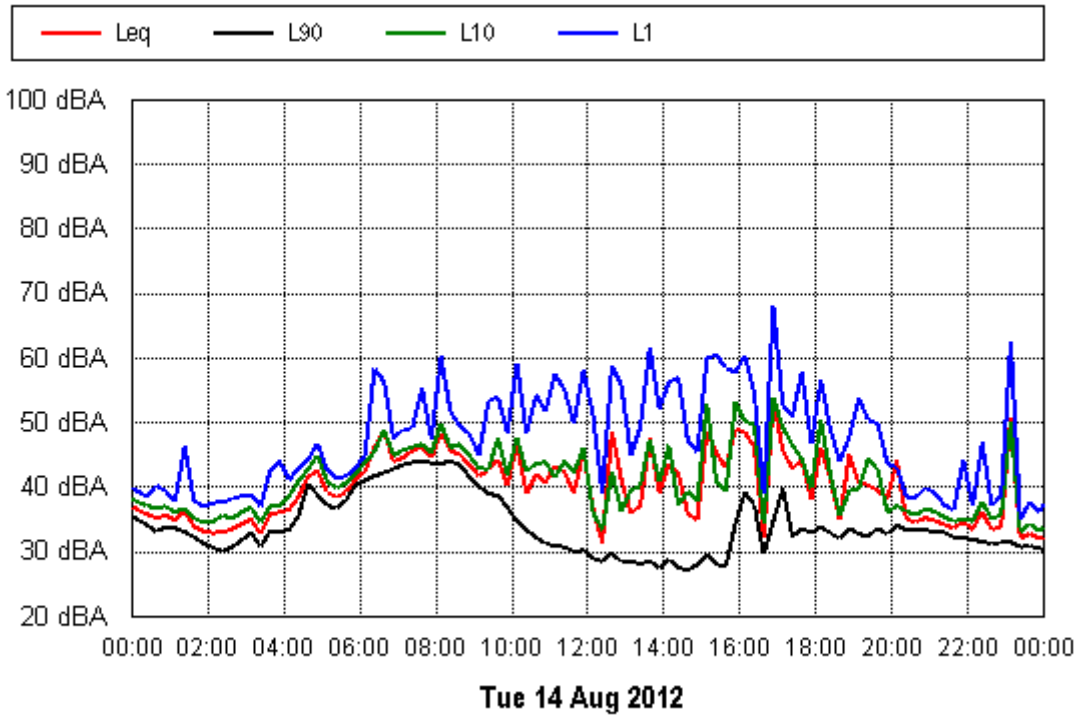


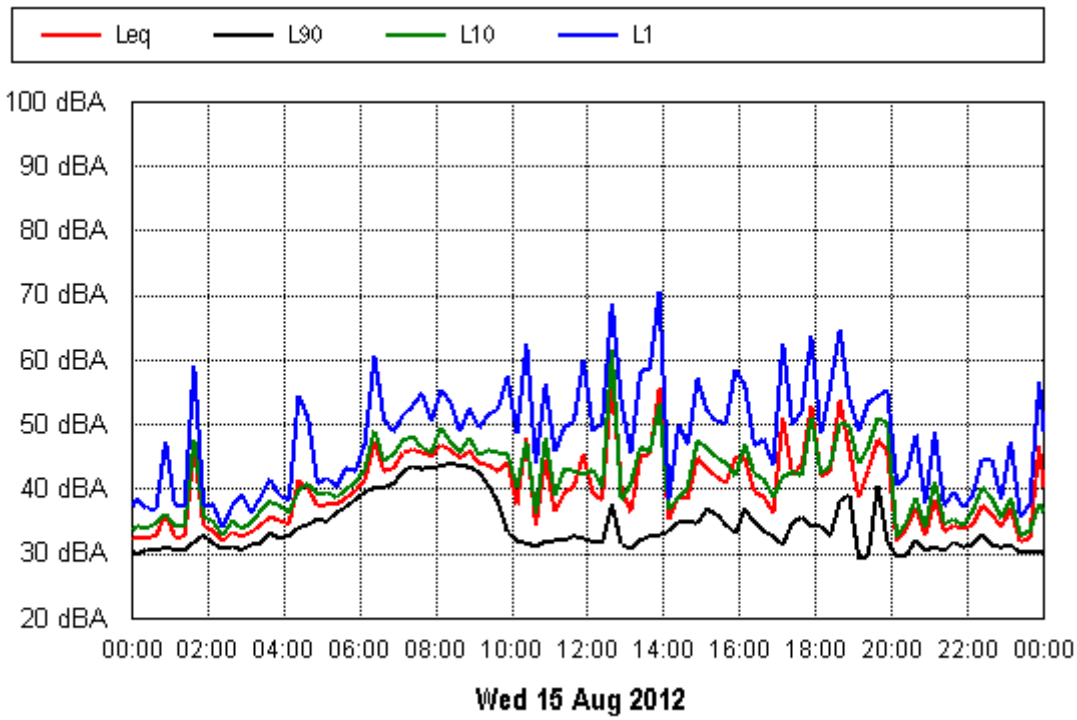
Sun 12 Aug 2012



Mon 13 Aug 2012

Project: Jacfin
Location: SW Site Corner





Project: Jacfin
Location: SW Site Corner