Noise Impact Assessment

Area 20 Precinct Project

Report Number 610.7888-R4

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TABLE OF CONTENTS

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

Department of Planning is currently coordinating the rezoning of land for the Area 20 Precinct project.

Heggies Pty Ltd (Heggies) has been commissioned by the Department of Planning to conduct a strategic acoustic assessment of the potential impacts associated with the proposed road traffic noise, rail corridor and train stabling facility. This document is a consolidated report bringing together the three separate reports prepared by SLR/Heggies addressing the potential impacts from the nearby road traffic, proposed rail corridor and proposed stabling yards. It is to be noted that the three SLR/Heggies reports were complied at varying stages of the project's development and consequently there may be slight differences in the layout between the three assessments. These differences are considered relatively minor and would not significantly alter any recommendations contained in this report.

The Area 20 Precinct is approximately 245 hectares and is bounded by Windsor Road and Schofields Road, with Second Ponds Creek flowing through the centre. It sits opposite the Rouse Hill Regional Centre. The Precinct also takes in part of Rouse Hill Regional Park and Rouse Hill House and Farm.

Airborne noise impacts are likely to be one of the key issues, due to the proximity of sensitive receivers to the various transportation corridors. This report may form part of the Precinct Planning Package for Area 20.

2 SITE DESCRIPTION AND STUDY OVERVIEW

The Area 20 boundary is presented graphically in **Figure 1**. It is located within Sydney's North West Growth Centre (NWGC) and is bounded by Windsor Road to the east, Schofields Road to the south with the remaining boundaries running along various cadastral boundaries of a number of semi-rural properties.

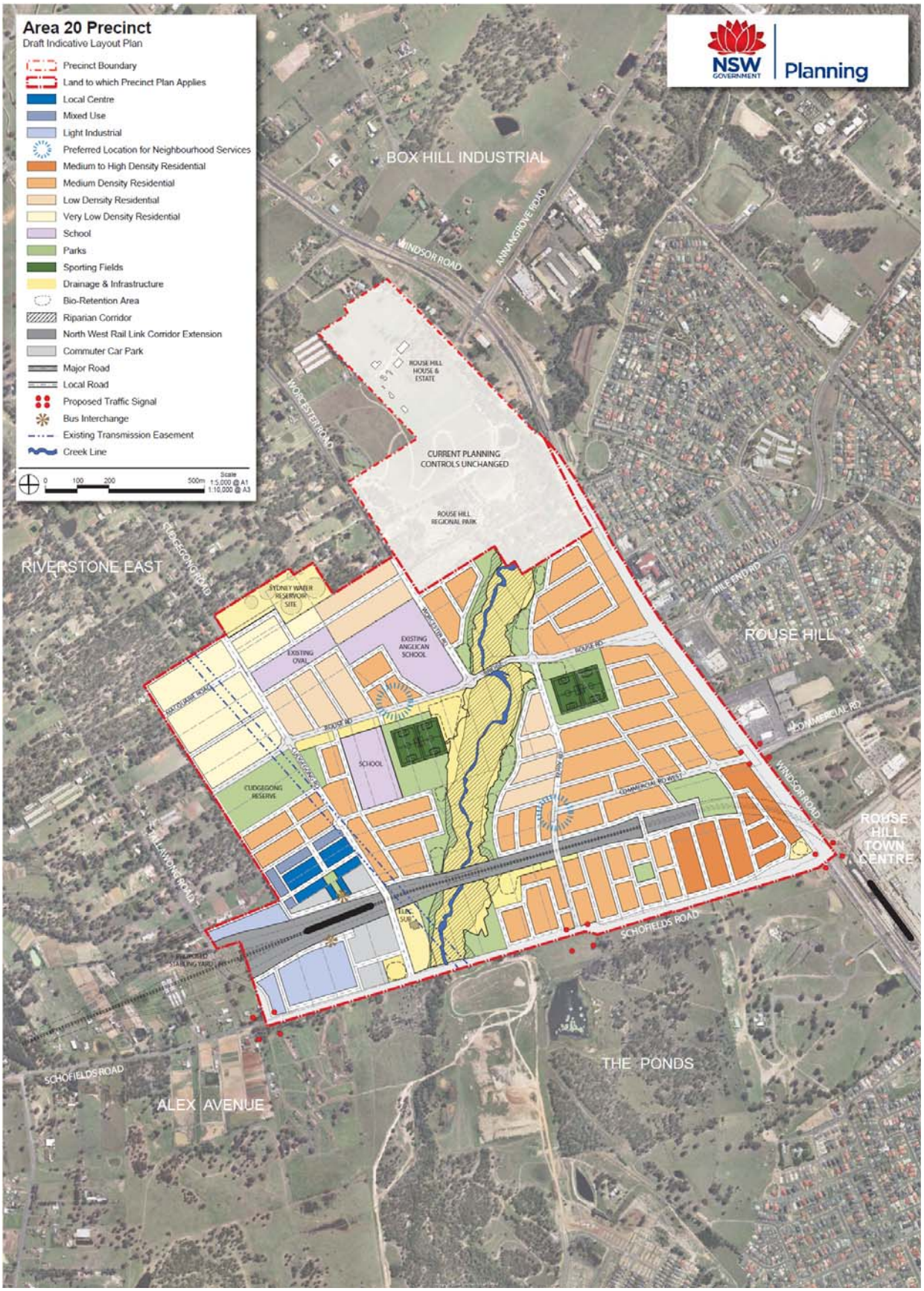
The site is predominantly to be subdivided for 2,500 residential lots and a small number of local-needs service orientated developments and commercial or light industrial developments.

There are a number of noise sources which have the potential to impact on the subject site, these include:

- Traffic noise from the surrounding road corridors;
- Noise from nearby commercial operations;
- Noise from the recently announced North West Rail Link project.

This report provides an overview of the criteria and discussion of possible impacts that require further consideration, as the planning of the development progresses.

Figure 1 Draft Area 20 Layout Plan



3 PRELIMINARY ROAD TRAFFIC NOISE ASSESSMENT

3.1 Noise survey

3.1.1 General

In order to qualify and quantify the prevailing noise environment, a series of noise surveys was conducted supplemented where appropriate from data sourced from other consultant's reports as necessary.

3.1.2 Unattended Noise Monitoring

Methodology

Unattended noise monitoring was conducted at five representative locations around the Area 20 rezoning site between Friday 24 April and Thursday 7 May 2009.

Prior to noise monitoring, Heggies personnel assessed the site and resolved the siting of unattended noise loggers at five locations to allow for the separate assessment of noise intrusion *into* the development.

ARL Type 215 noise loggers were deployed (identified in **Figure 1**) to continuously record ambient noise levels. The loggers were calibrated before and after the noise monitoring with a drift in noise levels not exceeding ±0.5 dBA. The sample time interval was set at 15 minutes and the time weighting function set to "Fast".

Figure 2 Noise Logging Locations

Image Courtesy of Google Earth

3.1.3 Results of Unattended Surveys

The results of the unattended surveys are summarised in **Figure 3**, together with the observations made at the time of setting up (or) picking up the noise loggers.

It is noted that logger at BG 3 failed during the survey, but it was observed that the noise environment was similar to that at BG 4.

Whilst there were clear indications of short-term noise attributable to nearby industrial sources, the major long-term noise at all sites was due to traffic noise from the surrounding road network.

The results of the unattended surveys are presented graphically in **Appendix A**.

Figure 3 Overview of Attended and Unattended Noise Monitoring

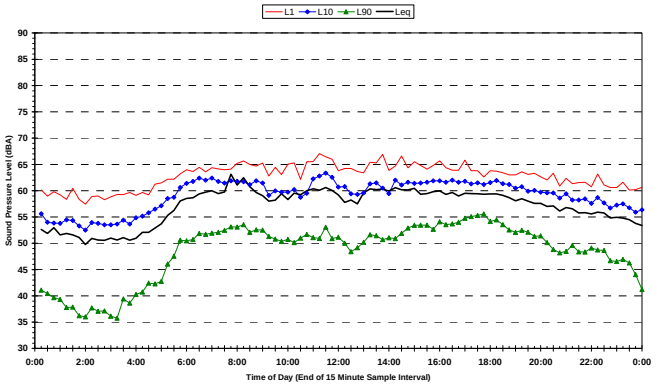
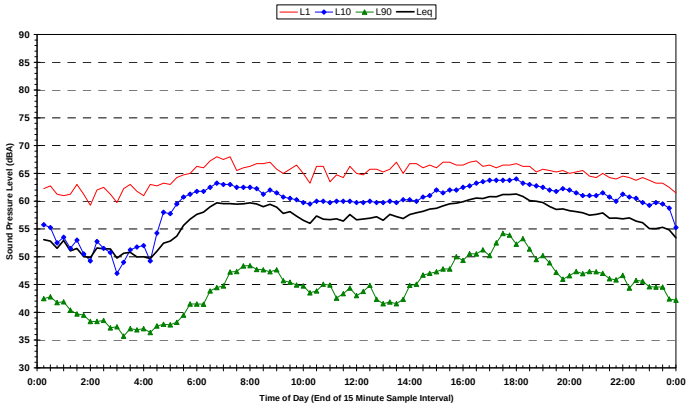
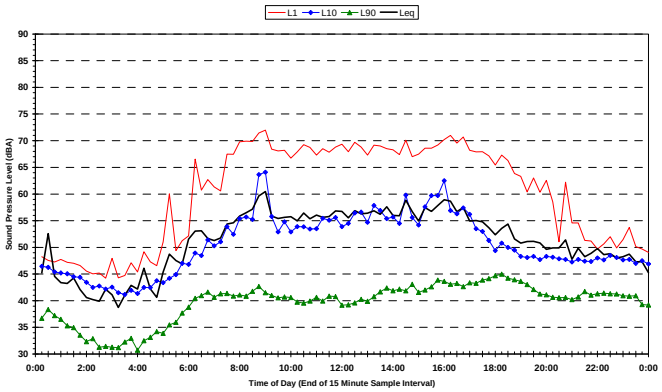
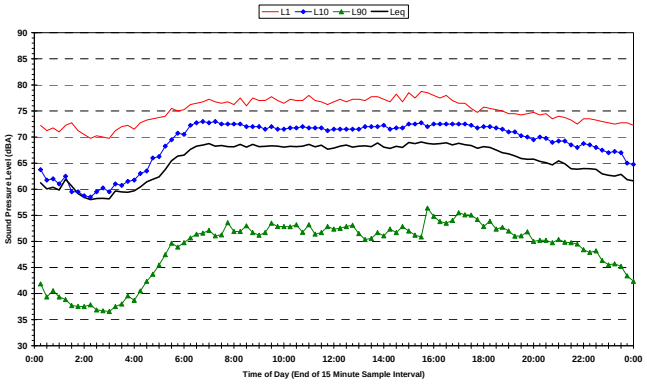
Monitoring Location	Observed Noise Attributes (during attended monitoring)	Long term profile of Statistical Noise Levels
BG1 (Quarry area)	• Excavator 51-60 dBA • Traffic 52 – 64 dBA • Truck unloading 59 dBA Noise at this location was influenced mainly from some distant construction related activities and traffic from Windsor Road and Schofields Road. It is understood that the quarry was not operational during the survey period.	
BG 2 (Schofields Road, east of Cudgegong Road)	• Traffic 57 – 73 dBA • Roller (audible) • FEL 47-51 dBA Noise at this location was influenced mainly from traffic from Schofields Road and distant quarry activities.	
BG 4 (Worchester Road)	• Workshop Noise 47 – 62 dBA • Truck 54 dBA • Excavator 50 – 55 dBA	
BG 5 (Windsor Road, south of Rouse Road)	• Traffic 70 – 81 dBA	

Table 1 Summary of Traffic Noise Indices

Noise Monitoring Location	Main Traffic Noise Indices			
	$L_{Aeq(15hour)}$	$L_{Aeq(9hour)}$	$L_{Aeq(1hour)}$ **Daytime**	$L_{Aeq(1hour)}$ **Night-time**
BG 1 (Quarry area)	59 dBA	55 dBA	62 dBA	59 dBA
BG 2	59 dBA	55 dBA	61 dBA	57 dBA
BG 3	Assumed to be similar to BG 4			
BG 4 (Worchester Road)	56 dBA	48 dBA	58 dBA	51 dBA
BG 5 (Windsor Road, south of Rouse Road)	68 dBA	63 dBA	69 dBA	66 dBA

To assess noise emission from existing or future industrial facilities serving the proposed development, the data obtained from the noise emission logger has been processed in accordance with the procedures contained in the NSW *Department of Environment and Climate Change's* (DECC, formerly EPA) *Industrial Noise Policy* (INP) to establish representative noise levels on site. The results of this analysis are presented in **Table 2**.

Table 2 Measured Ambient Noise Levels Corresponding to Defined INP Periods

Noise Monitoring Location	Measured RBL[1]			Measured LAeq Noise Level		
	Day	**Evening**	**Night**	**Day**	**Evening**	**Night**
BG 1 (Quarry area)	51 dBA	51 dBA	39 dBA	60 dBA	58 dBA	55 dBA
BG 2 (Schofields Road, east of Cudgegong Road)	45 dBA	49 dBA	38 dBA	59 dBA	59 dBA	55 dBA
BG 3	Assumed to be similar to BG 4					
BG 4 (Worchester Road)	44 dBA	43 dBA	34 dBA	57 dBA	51 dBA	48 dBA
BG 5 (Windsor Road, south of Rouse Road)	52 dBA	51 dBA	39 dBA	68 dBA	66 dBA	63 dBA

3.1.4 Statistical Noise Levels

The statistical descriptors shown on the graphs are:

- **L_{A90}** The L_{A90} is the level of noise exceeded for 90% of the sample time (15 minutes). The LA90 noise level is described as the average minimum background sound level or simply the background level.
- **L_{A10}** The noise level exceeded for 10% of the sample time (15 minutes) and is typically described as the average maximum noise level.
- **L_{A1}** The noise level exceeded for 1% of the sample time (15 minutes) and representative of the highest noise level events (eg passing heavy vehicles, aircraft, etc).
- **L_{Aeq}** The L_{Aeq} is the energy-average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.

[1] Rating Background Level

3.2 Noise Criteria

The noise (and vibration) assessment for this project should be undertaken in accordance with the requirements of NSW Department of Planning (DoP), *"Development Near Rail Corridors and Busy Roads – Interim Guideline*".

3.2.1 Airborne Noise – Road and Rail Traffic

The Department of Planning's *Interim Guideline* provides criteria for the internal noise levels due to both road and rail traffic within single dwelling residential buildings, as presented in **Table 3**.

The criteria apply separately to road and rail noise sources.

Table 3 Road and Rail Noise Assessment Criteria

Internal Space	Time period	Internal noise level (Windows closed guideline)
Sleeping area	Night (10 pm to 7 am)	35 dBA
Other habitable room	At any time	40 dBA

Note: Airborne noise is calculated as Leq (9h) (night) and Leq (15h)(day).

The document also provides criteria for internal noise levels due to road and rail noise contribution with windows or doors open. These state:

> *"If internal noise levels with windows or doors open exceed the criteria by more than 10 dBA, the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia".*

3.2.2 Noise Emissions from Local Industry

The noise emission from local industry associated with any nearby development, should be controlled to avoid impacting upon the acoustic amenity of the residences within the development.

Industrial noise emissions should aim to comply with the DECC's *Industrial Noise Policy* (INP), which provides a framework and process for deriving noise criteria. The INP criteria for industrial noise sources from stationary or mobile plant and equipment have two components:

- Controlling the intrusive noise impacts for residents and other sensitive receivers in the short term; and
- Maintaining noise level amenity for particular land uses for residents and sensitive receivers in other land uses.

The times of day referred to in this report for industrial noise sources are defined as:

- day: the period from 7:00 am to 6:00 pm Monday to Saturday; or 8:00 am to 6:00 pm on Sundays and public holidays;
- evening: the period from 6:00 pm to 10:00 pm; and
- night: the remaining periods.

Assessing Intrusiveness (Residential Receivers)

For assessing intrusiveness, the background noise generally needs to be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than 5 dBA above the measured Rated Background Level (RBL), over any 15 minute period.

Assessing Amenity (All Receivers)

The amenity criterion is based on land use and associated activities (and their sensitivity to noise emission). The cumulative effect of noise from industrial sources needs to be considered in assessing the impact. The criteria relate only to other industrial-type noise sources and do not include road, rail or community noise. The existing noise level from industry is measured. If it approaches the criterion value, then noise levels from new industrial-type noise sources, (including air-conditioning mechanical plant) need to be designed so that the cumulative effect does not produce total noise levels that would significantly exceed the criterion. For areas of high road traffic, there are further considerations that influence the selection of the noise criterion.

Area Classification

The project will change the land-use of the area from “semi-rural” to “residential or suburban” in nature. INP characterises the “Suburban” noise environment as an area with an acoustical environment that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry.

Notwithstanding the proximity of the development to Windsor Road (being a major road network), Heggies has deemed this area to fall under the “Suburban” area classification.

3.2.3 Project Specific Criteria

Having defined the area type, the processed results of the unattended noise monitoring have been used to generate project specific noise criteria.

Since the existing noise environment at the monitoring site used to establish industrial noise criteria is not controlled by industrial type noise sources, (it is largely transportation noise), the project specific noise levels, which are shown in bold in **Table 4**, are the lower of the ANL or intrusive criteria.

Table 4 Residential Criteria for Mechanical Noise (based on current noise environment)

Location	Time of Day	Noise Level dBA re 20 µPa				
		ANL[1] L_{Aeq} (period)	Measured RBL[2] $L_{A90(15minute)}$	Criteria for New Industrial Sources		
				Amenity Criteria	Intrusive	Limiting Criteria [4]
				$L_{Aeq\ (per\ period)}$	$L_{Aeq(15minute)}$	
BG 1	Day	55	51	**55**	56	55 dBA (11 hour)
	Evening	45	51	**45**	56	45 dBA (4 hour)
	Night	40	39	**40**	44	40 dBA (9 hour)
BG 2	Day	55	45	55	**50**	50 dBA (15minutes)
	Evening	45	49	**45**	54	45 dBA (4 hour)
	Night	40	38	**40**	43	40 dBA (9 hour)
BG 3, 4	Day	55	44	55	**49**	49 dBA (15 minutes)
	Evening	45	43	**45**	48	45 dBA (4 hour)
	Night	40	34	40	**39**	39 dBA (15 minutes)
BG5	Day	55	52	**55**	57	55 dBA (11 hour)
	Evening	45	51	**45**	56	45 dBA (4 hour)
	Night	40	39	**40**	44	40 dBA (9 hour)

Note 1: ANL Acceptable Noise Level for a suburban area
Note 2: RBL Rating Background Level
Note 3: Assuming existing noise levels unlikely to decrease in the future, and assuming no existing industrial noise
Note 4: Project Specific Criteria are shown in bold
Note 5: Assumes relatively constant noise source, otherwise mitigation is to be designed for both criteria

The criteria provided on the right-hand column of **Table 4**, will apply to noise contribution from industrial sources (and specifically excludes noises from transportation relate sources) – should such activities be incorporated as part of the development. It should be noted that this criteria is provided for immediate guidance, and may need to be reviewed depending where on the site the industrial source is located (if at all).

It is to be noted that during detailed design stage of the works, additional noise monitoring may be warranted and an adjustment made the ambient levels to account for the future noise environment, once the precinct has been developed. It would seem reasonable that future assessment be based on RBL levels increased by 3dBA for those locations further than say, 100 m from Windsor Road (ie BG2 to BG4).

Table 5 Residential Criteria for Mechanical Noise (based on likely future noise environment)

Location	Time of Day	Noise Level dBA re 20 µPa				
		ANL[1] L_{Aeq} (period)	Measured RBL[2] $L_{A90(15minute)}$	Criteria for New Industrial Sources		
				Amenity Criteria	Intrusive	Limiting Criteria [4]
				L_{Aeq} (per period)	$L_{Aeq(15minute)}$	
BG 1	Day	55	51	**55**	56	55 dBA (11 hour)
	Evening	45	51	**45**	56	45 dBA (4 hour)
	Night	40	39	**40**	44	40 dBA (9 hour)
BG 2	Day	55	48	55	**53**	50 dBA (15minutes)
	Evening	45	52	**45**	57	45 dBA (4 hour)
	Night	40	41	**40**	46	40 dBA (9 hour)
BG 3, 4	Day	55	47	55	**52**	52 dBA (15 minutes)
	Evening	45	46	**45**	51	45 dBA (4 hour)
	Night	40	37	**40**	42	40 dBA (9 hour)
BG5	Day	55	52	**55**	57	59 dBA (11 hour)
	Evening	45	51	**45**	56	45 dBA (4 hour)
	Night	40	39	**40**	44	40 dBA (9 hour)

Note 1: ANL Acceptable Noise Level for a suburban area
Note 2: RBL Rating Background Level
Note 3: Assuming existing noise levels unlikely to decrease in the future, and assuming no existing industrial noise
Note 4: Project Specific Criteria are shown in bold
Note 5: Assumes relatively constant noise source, otherwise mitigation is to be designed for both criteria

3.2.4 Internal Acoustic Isolation – BCA

The internal acoustic isolation requirements must, as a minimum, comply with those of the BCA.

The numerical requirements (in-situ where possible) contained in BCA Section F5, are summarised in **Table 6**.

Table 6 BCA Acoustic Ratings

Issue	BCA Requirements
Floors	
Sound Insulation between Units	**$D_{nT,w} + C_{tr}$ not < 45**
	$L'_{nT,w} + C_I$ not > 62
Walls	
Unit to Unit	
Unit to plant, lift shaft, stairway, public corridor or hallway or the like	**DnT,w + Ctr not < 45**
Between, laundry or kitchen and habitable room in adjoining units	**(Plus impact isolation)**
Doors	
Unit and a stairway, public corridor, public lobby or the like	**$D_{nT,w}$ not < 25**
Soil and Waste Pipes	
Habitable rooms	**Rw + Ctr not < 40**
Kitchens and other rooms	**Rw + Ctr not < 25**

3.3 Noise Modelling and Discussion of Impacts

3.3.1 Quarry

Council currently operate a quarry at LOT A DP 379470 Schofield Road, located on the north-western corner of the Schofield Road / Windsor Road intersection.

The quarry can operate between 7:00am to 4:00pm Monday to Friday and 7:00am to noon Saturdays – though was not operational during the noise survey period.

The location of the quarry is currently within the Area 20 development site and potentially, may result in future residences located immediately adjacent to the north, east and/or west of the existing property boundary.

It is understood the quarry has an expected life of up to 25 years. It will be continue to be excavated before being progressively backfilled and rehabilitated. It is possible/likely that residential developments will be occurring around the quarry before rehabilitation is complete.

For planning purposes, it is assumed that the quarry may remain operational in which case, the following measures would be required to be considered to minimise noise impacts (in view of the practicalities, cost and project objectives):

- The incorporation of a buffer zone to separate the operations of the quarry to the future residences should be considered. This land could be used for many purposes, including forms of approved "light commercial" operations, a golf course (or the like). These buffer spaces should wrap around the northern, eastern and western boundaries of the quarry to assist in the attenuation of noise; or
- If the buffer zone is not a practical solution then an acoustic property fence may be considered in conjunction with the possible need for architectural mitigation (which is outlined in **Section 3.3.5** of this report). Preliminary calculations indicate that a full barrier would need to be 5 m or 6 m tall, as a barrier of this height would have high levels of visual impacts to this predominant location, a lower height property fence (nominally around 2 m high) may be considered to supplement the required architectural treatments to residential developments in the vicinity.

Note - the recommendations above are of a general nature, based on preliminary calculations considering the current operations observed at site. They do not consider any plant modification, replacement, management or plant design changes that may occur into the future.

It is understood that there is no blasting from the site and rock-hammering is not regularly used on site. Assuming there is offset distances of approximately 50 m from any major plant items to the adjoining residences, the potential for impacts from vibration to surrounding residences would be expected to be low – though this would be required to be examined in more detail during as the site planing is refined.

3.3.2 Landscape Supplies

Given the nature of the rezoning, it is possible that the business will be relocated in the future. On this basis, it is unlikely that further consideration of noise mitigation will be warranted from this site.

For planning purposes only, the implications of the impacts to surrounding residences are described below, in case the Landscape supplies were to remain operational. The following measures would be required to be considered having consideration of the practicalities, cost and project objectives.

The current operations of the Worchester Road depot are such that it could be entirely surrounded with residential properties. It is understood that the current operations has given rise to complaints from existing residences regarding the noise emission. Based on the independent studies, a 4 m high boundary acoustic wall was recommended to assist with the mitigation of on-site traffic and operational noise.

The operations currently require the use of trucks, front end loaders and the like around the site. The final acoustic impacts (if any) will depend on the location of future dwellings, their height (ie one story or two stories), the hours of operation of the site and the extent and intensity of future operations.

Assuming that future operations are similar to that currently being undertaken, the 4 m wall would seem to be a reasonable and practical limit to noise containment. Noise walls greater than 4 m would likely induce high levels of visual impact, result in overshadowing and the like. Other options that exist, (if the wall does provide sufficient attenuation) include; consideration to the hours when impact is scheduled, reduction to plant numbers and the use of "low-noise" kits to mobile plant and trucks. As some of these options restrict the facilities operations, any residual impacts would be best treated by 'architectural treatments' to the first or maybe second row of residences, and/or the use of low-noise kits fitted to mobile plant.

3.3.3 Road Traffic Noise from Windsor Road and Schofields Road

Based on the ultimate plan for the site, expected to be finished in 2036 it predicted[2] that there would be an AADT[3] of ~48,000 vehicles (11% heavy vehicles), travelling in both directions along Windsor Road. This is an increase of about 8,000 from 2005 levels[4], and is equivalent to a 1 dBA increase over existing traffic levels.

It is noted that the existing levels of traffic noise on the future Windsor Road facades are greater than 65dBA (during the day) and 60 dBA (at night) and would be classified as 'acute' by the current policies of the RTA and mitigation will need to be incorporated to protect the amenity of future residents. Significant noise reductions of between 27 dBA to 32 dBA will be required to be achieved from the noise mitigation strategy. Similarly, less stringent noise reductions of between 16 dBA to 21 dBA will be required to be achieved to future residences along Schofields Road.

From a road classification perspective both Windsor Road and Schofields Road would be considered an arterial (or at least sub-arterial) roadway. A simple noise model of the project area was carried out using SoundPLAN noise modelling software. The program implements the UK Department of Transport, *"Calculation of Road Traffic Noise"* (CoRTN 1988) algorithms. The modelling allows for traffic volume and mix, type of road surface, vehicle speed, road gradient (based on the 3D ground terrain data supplied), ground absorption and any shielding from ground topography.

The modelling indicates that without any barriers, an offset or buffer distance of more than 300 m (for traffic from Windsor Road) and approximately 70 m from Schofields Road would be required to achieve the relevant criterion. The use of offset distances as the primary means of noise mitigation is clearly not a viable option and the incorporation of other forms of noise mitigation is required.

Whilst barriers can be an effective form of mitigation to the lower levels of developments, they can offer little benefit to the higher story levels and result in high visual impacts.

The project team has considered the use of roadside noise barriers and concluded that they will have high visual impacts and will only protect a portion of the future residents, has decided to focus on other strategies which will provide acoustic benefit – other than barriers. These may include (but not limited to);

[2] Refer Figure 24, Preliminary Draft Transport and Access Study, Road Delay Solutions, July 2009
[3] Average Annual Daily Traffic
[4] Section 3.2 , Area 20 Transport and Access Study, Draft Report, June 2009

- Architectural design of the future development (building orientation, setback and use of the building themselves to provide noise reduction to other portions of the development);
- Architectural layout of the development;
- The use of private open space;
- The use of 'architectural treatments' as guided within the ENMM,
- etc.

Chapter 3.3.5 provides further guidance on 'architectural treatments' to the facades of future buildings across the site.

Sourced from Figure 10, *Preliminary Draft Transport Access Study*, May 2009, Road Delay Solutions

3.3.4 Traffic Noise from Internal Roads

There are a number of internal roads within the development; Rouse Road, Commercial Road, Schofields Roads, Tallawang Road that are likely to carry traffic of sufficiently high volumes that the resulting levels of traffic noise exceed the appropriate criterion. These roads would be classified as collector roads, in terms of the road definitions contained with the ECRTN[5].

The degree of any exceedance is ultimately determined by the final design of road network, traffic volumes (and mix), flow speed, offset to residences, number of lanes, road surface finish etc.

Where possible, it would be beneficial if the rear of the properties face these collector roads, allowing for the incorporation of slightly higher and aesthetically designed "rear fences" to provide the degree of noise attenuation required, in combination of the use of 'architectural treatments' to the buildings which show residual impact.

These other forms of noise mitigation should also be considered by the project team:

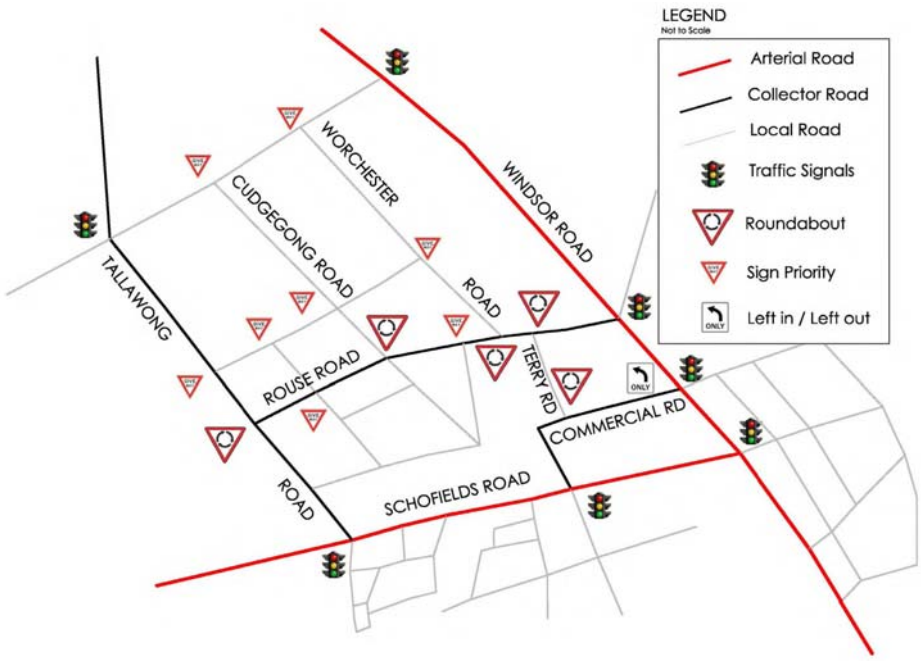
Low-noise -or at least not high noise road surface treatment;

The lowering of the RL of the collector roads as much as practical – this acts to increase the attenuation of the rear 'fence' (being located on the RL of the dwelling);

Lower speed levels etc.

[5] *Environmental Criteria for Road Traffic Noise*, EPA 1999

Figure 4 Preliminary Road Hierarchy, within Area 20



Sourced from Figure 11, *Preliminary Draft Transport Access Study*, May 2009, Road Delay Solutions

3.3.5 Architectural Facade Treatments - Overview

Architectural mitigation measures are designed to achieve internal noise levels that would have normally prevailed if the external noise criteria were achieved. The typical outdoor to indoor noise reductions provided by most standard dwellings (ie without special acoustical treatment) is generally accepted as being 10 dBA with windows open (allowing for natural ventilation) and 25 dBA with windows closed.

Architectural treatments designed and incorporated during the project's detailed design phase and installed as part of the buildings construction works should be capable of achieving noise reductions of around 25 dBA and up to 35 dBA in some cases – without undue cost implications.

Architectural mitigation measures can vary dramatically depending upon the degree of noise reduction required. In its simplest form, it may involve only the provision of mechanical ventilation to enable windows to be kept shut as a means of controlling noise intrusion or in the case of high levels of road traffic noise, one or more of the following design principles may be required:

- thicker single laminate or double glazing
- the sealing of gaps and openings around windows and doors by fitting appropriate seals
- the upgrading of doors (which overlook the roadway) from hollow-core to solid-core construction;
- the use of podiums (designed into the ground floor) which act as a (partial) barrier to the lower floors of the building
- incorporation of acoustically designed balconies (maybe including louvres and/or some absorption) to front the main roadway;
- placement of less noise sensitive room to front the main roadway etc.

Noise ingress generally involves several pathways, and is most common via the windows, doors, ventilation openings and roofs. The overall sound reduction of a building element is dependent upon the mass of the construction, the effective area and the extent of any gaps or openings. Glazing on facades exposed to traffic noise usually represents the "weak acoustic link" in any building construction.

The selection of enhanced glazing should be made at the detailed design stage when house envelope and construction details are known. When determining glazing requirements for affected residences, the following parameters need to be considered:

- Typical traffic noise spectrum measured on site.
- Calculated road traffic noise at the assessment locations.
- Room dimensions and internal finishes.

A description of the RTA's approach to architectural treatments is provided in Chapter IV(a) of the ENMM[6], reference should also be made to *Development near Rail Corridors and Busy Roads – Interim Guideline* (NSW Department of Planning, December 2008).

3.3.6 Typical Project Noise Reductions Required

The ultimate noise reductions required will be highly dependent on the location, height, orientation, glazing area, offset of the future residential buildings to the adjacent roadways.

Given the preliminary development plans, the following noise reductions may be required

- Residences along Windsor Road – facade noise reduction of between 27 dBA to 32 dBA;
- Residences along Schofields Road – facade noise reduction of between 17 dBA to 22 dBA.

Residences along Windsor Road will require extensive acoustical design, incorporating as much of the design principles (discussed earlier) as is possible, so as to reduce the reliance of heavy glazing.

Future developments along Schofields Road (away from Windsor Road), will require only moderate noise reduction of up to 22 dBA, and would be expected to be easily achievable – depending on the design and layout. Whilst heavier glazing and the supply of mechanical air would be a requirement, careful design could minimise any undue mitigation and costs.

[6] *Environmental Criteria for Road Traffic Noise*, RTA 2001

Typical Costs

By way of guidance, the limit per residence on the funding provided by the RTA for acoustic screen walls and/or building treatments for individual dwellings is:

- $15,000 where the external noise level exceeds the target noise level by up to 10 dBA, and
- $20,000 where the external noise level exceeds the target noise level by more than 10 dBA.

The RTA allowance can be assumed it applies to costs associated with upgrading existing dwellings, rather than (new construction costs). For this project, any noise mitigation works would be installed during the building construction works. Consequently, the Area 20 project costs would be expected to be significantly lower than that quoted by the RTA.

Ventilation

For naturally ventilated dwellings, the average noise reduction provided by an open window or door is typically accepted as being 10 dBA. Where the design internal noise goals cannot be achieved within the dwellings with windows and/or doors open a system of "comfort ventilation" would be required to enable openings in the external facade to remain tightly closed during noisy periods.

The following in-principle measures may be adopted to provide ventilation to affected dwellings:

- Option 1: Ducted Air with a Fresh Air Intake

  A fresh air intake consisting of fresh air grille housed in the eaves of the house, connected by flexible or rigid ducting to the return-air plenum of an existing air-conditioning unit.

- Option 2: Propriety Acoustic Wall Ventilators

  Indicative units are the Aeropac -available from Acoustica Ph: (02) 9550 2900 or the PD-019 unit is available from Pro-duct Ph: (02) 9758 1377 (though other brands are likely to be available).

- Option 3: Ceiling or Bulkhead-Mounted In-line Ducted Fan

  An (appropriately sized) in-line fan in the ceiling space or bulkhead, connected via acoustic flexible duct to an intake grille (and filter) and an outlet grille installed in each rooms to be ventilated.

The above requirements may be negated if it can be shown that there is sufficient cross-ventilation, in accordance with the requirements of the BCA.

3.4 Conclusion

A noise impact assessment has been conducted in relation to Area 20, the proposed rezoning of land at west of Windsor Road and north of Schofields Road, Rouse Hill.

The rezoning will lead to higher residential density which may be potentially impacted by the existing and future road networks, local industry and future transport corridors.

A number of noise mitigation strategies will be required to help protect the future acoustical amenity of the development. The project team has considered the use of roadside noise barriers and concluded that they will have high visual impacts and will only protect a portion of the future residents, has decided to focus on other strategies which will provide acoustic benefit – other than barriers. These may include (but not limited to);

- Architectural design of the future development (building orientation, setback and use of the building themselves to provide noise reduction to other portions of the development);

- Architectural layout of the development;
- The use of private open space;
- The use of 'architectural treatments' as guided within the ENMM etc

Details of the requirements of the *Industrial Noise Policy* (which apply to any remaining industrial/commercial operations within the site) are provided for future reference.

4 STABLING YARD ASSESSMENT

4.1 ASSESSMENT CRITERIA

In reviewing the appropriate criteria that would apply in some future License Conditions, reference is made to the 'draft' conditions that apply to the *South West Rail Link – Glenfield to Leppington rail line* project and the NSW Department of Environment, Climate Change and Water's (DECCW's) common acoustic requirements.

4.1.1 South West Rail Link – Glenfield to Leppington Rail Line Licence Conditions

The draft Licence conditions for the South West Rail Link imposes a number of noise-related requirements that relate to the operation of the train stabling facility. It is acknowledged that these conditions may be subject to some clarification or review and are thus subject to possible change. They are considered however, to be a reasonable document for the possible conditions that may be required for this project.

In summary, the most relevant conditions that apply to this assessment are:

(a) Noise limits are to be determined in accordance with the requirements of the *New South Wales* INP (*Industrial Noise Policy*, EPA, 2000);

(b) Not withstanding the findings in (a) above, the licence conditions impose differing noise criteria for existing and future residences. This facility is to be surrounded by a future land release, it is therefore considered reasonable that the noise levels be based on the 'future residences' (rather than the 'existing residences'). It is to be noted that the noise limits for the 'future' residences are 5 dBA to 20 dBA higher than would otherwise apply to 'existing' residences.

Table 7 Noise Limits for Future Residences (extracted from SWRL DRAFT Conditions of Approval)

Period	Intrusiveness $L_{Aeq(15min)}$ dBA	Amenity $L_{Aeq(period)}$ (dBA)	Sleep disturbance L_{Amax} (dBA)
Daytime (7am to 6pm)	50	55	n/a
Evening (6pm to 10pm)	45	45	n/a
Night-time (10pm to 7am)	40	40	50-65

The criteria and all noise measurements apply to the 'free field'; ie no facade reflection is applied.

It is also noted that the background levels at Rouse Hill would intuitively be higher at Rouse Hill area than for Leppington, as Leppington is in a rural environment, thus higher Consent Conditions may also be expected.

4.1.2 DECCW Requirements

As the proposed train stabling and maintenance depot are regarded as fixed facilities, the airborne noise assessment is required to be undertaken in accordance with the requirements of the DECCW's INP.

The INP sets two separate noise criteria to meet environmental noise objectives: one to account for intrusive noise and the other to protect the amenity of particular land uses. In addition, the DECCW normally requires the risk of sleep disturbance to be assessed.

Assessing Intrusiveness

In order to assess the intrusiveness of a particular noise source, the background noise needs to be measured. The intrusiveness criterion dictates that the L_{Aeq} noise level, measured over a period of 15 minutes should not be more than 5 dBA above the Rating Background Level (RBL) during the daytime, evening and night-time periods.

A review of previous noise studies has been conducted, with the following ambient noise surveys considered relevant:

- SKM - 2002. Though eight years old, these measurements are still considered to be reasonably representative of the prevailing noise environment. Of the 20 locations measured as part of a preliminary study for the NWRL project, the most relevant locations are 9 Terry Road and 109 Rouse Hill Road, as shown in **Figure 5**; and
- Heggies - 2010. Measurements conducted by Heggies as part of the Road Traffic Nose Assessment for Area 20 in 2010. Reference is made to BG1 to BG4 in **Figure 5**.

A summary of the relevant measurements is presented in **Table 8**:

Table 8 Summary of Ambient Noise Levels

	SKM 2002 Survey	Heggies 2010 Survey	Rating Background Level (RBL)		
			Daytime 7 am to 6 pm	Evening 6 pm to 10 pm	Night-time 10 pm to 7 am
9 Terry Road	✓		41	41	37
109 Rouse Hill Road	✓		37	36	32
BG1 Near Schofields Road		✓ (note 1)	51	51	39
BG 2 Schofields Road, east of Cudgegong Road		✓	45	49	38
BG 4 Worchester Road		✓	44	43	34

Note: 1 This location is not used in any subsequent analysis, as it is too close to Windsor Road

Figure 5 Noise Monitoring Locations

The train stabling facility is some distance from Windsor Road, and therefore measurements that were taken close to Windsor Road (particularly BG1) are not subsequently considered.

The data was processed in accordance with the procedure in the INP to determine the RBL's for the project The area in the vicinity of the stabling facility is currently 'semi-rural' in nature but will be urban/residential around the time when the facility is operational. Therefore to account for the increased noise at that time, a conservative 3 dBA has been added to the measured noise levels.

Table 9 Summary of Ambient Noise Survey

		Rating Background Level (RBL)		
		Daytime 7 am to 6 pm	Evening 6 pm to 10 pm	Night-time 10 pm to 7 am
9 Terry Road		41	41	37
109 Rouse Hill Road		37	36	32
BG 2	Schofields Road, east of Cudgegong Road)	45	49	38
BG 4	Worchester Road	44	43	34
	Lowest 10th Percentile Levels	39	38	33
	Project Rating Background Levels [1]	42	41	36
	Proposed Intrusiveness Criteria	47	46	41

Note 1: The 10th Percentile Levels have been conservatively increased by 3 dBA to better estimate the future Rating Background Levels, based on the change in landuse in the area.

Assessing Amenity

The amenity assessment is based on the existing noise environment and noise criteria specific to land use and associated activities. If the noise emissions from the new sources approach the criterion value, the new sources need to be designed so that the cumulative effect does not produce levels that would significantly exceed the criterion.

A summary of the recommended L_{Aeq} noise levels for different receiver types and noise amenity areas is provided in **Table 10** (as reproduced from the INP).

As the proposed facility is likely to be located adjacent a 'commercial/industrial area', with residential properties in relatively close proximity, consequently, the urban amenity area is applicable. As such, for residential receivers, the acceptable L_{Aeq} noise levels are 60 dBA (daytime), 50 dBA (evening) and 45 dBA (night-time).

Table 10 Recommended L_{Aeq} Amenity Noise Levels

Recommended L_{Aeq} noise levels from industrial noise sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level, dB(A) *(see Note 8 in Section 2.2.1)*	
(see Notes in Section 2.2.1)			Acceptable *(See Note 11)*	Recommended Maximum *(See Note 11)*
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Urban	Day	60	65
		Evening	50	55
		Night	45	50
	Urban/Industrial Interface – for existing situations only	Day	65	70
		Evening	55	60
		Night	50	55
School classroom—internal	All	Noisiest 1-hour period when in use	35 *(See Note 10)*	40
Hospital ward —internal —external	 All All	 Noisiest 1-hour period Noisiest 1-hour period	 35 50	 40 55
Place of worship—internal	All	When in use	40	45
Area specifically reserved for passive recreation (e.g. National Park)	All	When in use	50	55
Active recreation area (e.g. school playground, golf course)	All	When in use	55	60
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

4.1.3 Assessing Sleep Disturbance

The most recent guidance in relation to sleep disturbance is those contained in the DECCW's *"Application Notes - NSW Industrial Noise Policy"*. The pertinent section of the DECCW's Application Notes states the following:

> *"DECC*[W] *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, DECC[W] *recognised that current sleep disturbance criterion of an LA1, (1 minute) not exceeding the LA90, (15 minute) by more than 15 dBA is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, DECC*[W] *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 LA1, (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 LA1, (1 minute) descriptor is meant to represent a maximum noise level measured under "fast" time response. DECC*[W] *will accept analysis based on either LA1, (1 minute) or LAmax"*

For airborne noise associated with the proposed train stabling and maintenance facility during the 10 pm to 7 am night-time period, the RBL + 15 dBA criterion will be adopted as a **screening criterion**. If the sleep disturbance screening criterion is exceeded, consideration of the maximum noise levels, the number of potential events and the maximum noise levels from existing noise sources will be investigated to determine the potential noise impacts and the requirement for additional mitigation measures,

Based on the ambient night-time noise survey presented in **Table 9**, the LAmax sleep noise criterion would be set to 51 dBA.

4.1.4 Project Specific Noise Criteria

Table 11 summarises the overall criterion that applies to this project. It is acknowledged that during the design development of the project, further noise surveys would be undertaken and the criteria suggested in this report maybe reviewed. It is likely that the intrusiveness criteria may increase, but the levels presented below are considered appropriate for assessment purposes.

Table 11 Project Specific Criterion

Period	Intrusiveness $L_{Aeq(15min)}$ dBA	Amenity $L_{Aeq(period)}$ (dBA)	Sleep Disturbance Screening Criterion L_{Amax} (dBA)
Daytime (7am to 6pm)	47	55	n/a
Evening (6pm to 10pm)	46	45	n/a
Night-time (10pm to 7am)	41	40	51

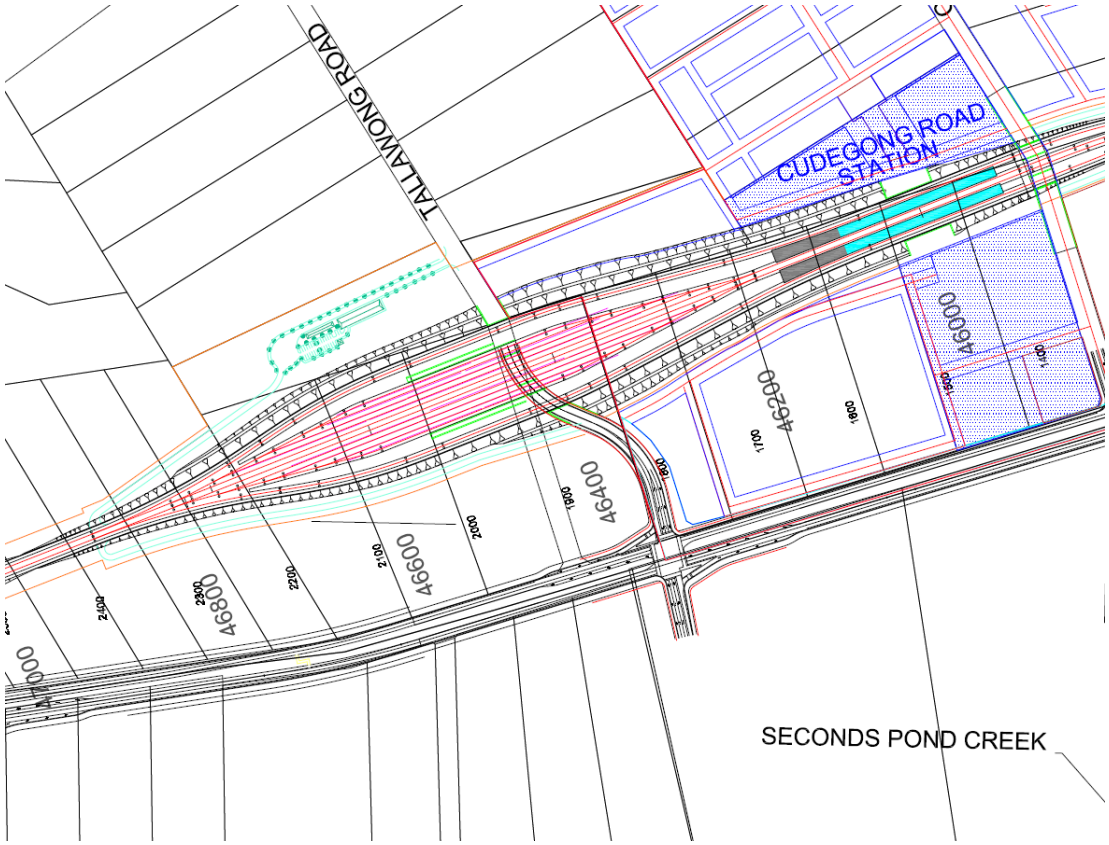
It is noted that the evening and night-time intrusiveness criterion, is a very marginal 1 dBA higher than the noise limits for future residential receivers (extracted from SWRL Conditions of Approval), with the sleep disturbance screening criterion set just above the lowest of the suggested range.

4.2 Airborne Noise Modelling

4.2.1 Base Assumptions for Train Stabling Noise Assessment

There is a preliminary design for the proposed stabling facility, but detailed design is yet to be commenced. The general location and layout of the facility is presented in **Figure 1** and **Figure 6**.

Figure 6 General Layout of Proposed Stabling Facility



In modelling the noise emissions from the operation of the proposed stabling facility, the following assumptions have been made:

- The capacity of the train stabling facility is 20 eight car sets;
- The formation level is in a cutting that is typically 8 m to 14 m below the general ground level on the site;
- Train horn testing is required within the stabling facility;
- All train electrical systems (air conditioners, compressors, invertors, etc) could be operational during night-time periods. This is a conservative assessment, as air-conditioners are unlikely to operate into the night-time;
- Maximum Train Speed in depot area is assumed low, say up to a maximum of 30 km/h;
- There is no maintenance facilities on site;

Attended noise measurements were undertaken by Heggies for the Cronulla Line Upgrade and Duplication Project and Macdonaldtown Train Stabling Project. The purpose of the measurements was to survey the stabling operations and measure typical noise sources. On the basis of the attended measurements, the Sound Power Levels in **Table 12** have been used in the SoundPLAN noise model to predict the L_{Aeq} and $L_{A1(60second)}$ noise levels adjacent to the proposed stabling area.

The L_{Aeq} sound power levels in **Table 12** are representative of the equivalent steady noise level when trains are stabled powered up. The L_{A1} sound power levels are representative of the compressed air discharges and horn operation.

For the compressed air cycle on Tangara and Double Deck Suburban trains, the source of noise emission would occur at two locations for each 4-car set (Cars 1 and 4). The Tangara inverter noise would also be generated at two locations for each 4-car set (Cars 1 and 4).

The type of trains which are likely to use the stabling facility are unknown at tis stage. For assessment purposes, a worst case scenario has been assumed.

During the day, air conditioning noise may occur at two locations on each Tangara car, with a typical duty cycle of less than 50% with the cars unoccupied. At night-time temperatures (ie after 10 pm), it is likely that air conditioning units would not normally operate, other than in air circulation/ventilation mode.

Table 12 Sound Power Levels for Stabling Noise

Train Type	Noise Source	Sound Power Level	Location of Noise Source
Tangara	Full Compressed Air Cycle [a]	90 dBA – L_{Aeq} 107 dBA - $L_{A1(60\ second)}$	Under floor
Tangara	Inverter Noise	83 dBA – L_{Aeq}	Top of Train
Tangara	Air Conditioner	80 dBA - L_{Aeq} 50% duty <62 dBA - L_{Aeq} Ventilation only	Top of Train
Tangara	Brake Test	120 dBA - $L_{A1(60second)}$	End of train, under floor
Double Deck Suburban	Full Compressed Air Cycle [a]	93 dBA – L_{Aeq} 107 dBA - $L_{A1(60\ second)}$	Under floor
Double Deck Suburban	Brake Test	120 dBA - $L_{A1(60second)}$	End of train, under floor
Tangara and Double Deck Suburban	Horn [b]	115 to 145 dBA - $L_{A1(60second)}$	End of train, under floor

a. The term “Compressed Air Cycle” refers to the air compressor plus the cyclic air discharge noise associated with the air dryers, valves, etc.

b. Horn noise is dependent on how the drivers operate the horns and the level of noise may also vary depending on whether a horn test was being undertaken as a safety warning.

Brake testing and horn testing are undertaken at both ends of trains prior to trains entering service. This would typically occur in the early hours of the morning as trains start up and prior to the afternoon peak.

4.2.2 Noise Modelling Scenarios

In order to assess the operational noise emissions from the proposed stabling operations, representative ‘worst case’ noise modelling scenarios have been considered, incorporating the existing ground terrain and proposed stabling operations. The noise model includes all 20 trains located at the Stabling Facility, 75% of which are assumed to be Tangara or Millennium sets (based on previous NWRL studies, but subject to change as the project develop).

Predictions of the resulting noise emissions were made using a computer noise model developed in SoundPLAN V 7 and using the prediction algorithms of ISO 9613-2: 1996. The use of the ISO standard (rather than CONCAWE) is considered a conservative assessment procedure and ensures the extent of impacts are readily identified.

Four operating conditions have been assessed. These include:

- The simultaneous day-time operation of the air-conditioning system, ventilation and compressor – termed "Air Conditioning System" in the contour plots;
- The simultaneous night-time operation of the ventilation and compressor – termed "Ventilation System" in the contour plots;
- The night-time operation of the brake – termed "Brake Test" in the contour plots; and
- The night-time operation of the horn – termed "Horn Test" in the contour plots.

Noise emissions during the evening period have not been modelled as a large number of trains would still be operational on the rail network. The night-time period therefore represents a worst-case scenario.

Noise contour plots for receiver heights 1.5 m above ground (representing ground floor receiver locations) are presented in **Table 13.**

Table 13 Noise Contours – Operational Phase (Reference Scheme)

Contour Height	Air Conditioning System	Ventilation System	Brake Test	Horn Test
1.5 m above the ground with no additional noise Barrier	Appendix B	Appendix C	Appendix D	Appendix E

For the daytime and night-time stabling operations, the $L_{Aeq(15minute)}$ predictions represent the typical maximum noise levels averaged over a 15-minute period. Since the intrusive noise goals are more stringent than the amenity noise goals, compliance with the $L_{Aeq(15minute)}$ intrusive noise goals would also result in compliance with the amenity noise goals.

For the brake and horn tests, the predicted $L_{A1(60second)}$ noise levels represent the typical maximum noise levels that occur during the tests. These tests are usually undertaken prior to the train entering service.

The results of the computer noise modelling are discussed in the following section.

4.2.3 Noise Modelling Results and Assessment for Train Stabling

The final layout of Area 20 and the form and nature of the residential and commercial precincts is yet to be finalised. Consequently, the modelling does not include any shielding by intervening buildings.

Noise Impacts from the Air Conditioning Systems

Noise impacts from the air conditioning systems appears to only marginally extend outside the rail stabling facility (within the Area 20 precinct) and is limited to the first blocks which abut the rail facility. Potential impacts would be considered minimal and easily mitigated.

Noise Impacts from the Ventilation Systems

Noise impacts from the ventilation systems appear to be contained entirely within the rail stabling facility area, and the potential for acoustical impacts would be considered negligible.

Noise Impacts from Horn Testing

For the proposed stabling operations without noise mitigation, $L_{A1(60second)}$ noise emission levels due to full horn blasts are predicted to exceed the DECCW's sleep disturbance screening criterion of 51 dBA across a significant portion of the site. It is noted that impacts are also significant south across The Ponds and Alex Avenue development areas.

The horn noise is dependent on the purpose for use and can vary from a short "toot" to a louder, longer "blast". This assessment assumes that some horn events would be long enough to develop the full noise level.

In accordance with the current RailCorp train preparation procedures, the testing of horns at both ends of the train is required before a train enters service. Additionally, it is necessary to operate the horn as a warning of imminent train movement. The horn tests would occur anywhere along the siding area with most of testing conducted during the very early morning / night-time period.

The predicted $L_{A1(60second)}$ noise levels from a full horn blast are predicted to be in the range 75 dBA to 80 dBA at the nearest future receiver locations to the south of the stabling facility. This represents a significant exceedance of the DECCW's sleep disturbance screening criterion (assuming no additional mitigation).

In addition to mitigation measures employed within the stabling site, opportunities should be explored in the precinct plan to house higher buildings and/or less sensitive receivers close to the stabling yard, which will act to minimise the noise ingress into the future Area 20 residential areas.

Noise Impacts from the Brake Testing

Noise impacts from the brake testing operations appears to extend outside the rail stabling facility (within the Area 20 land) and is limited to the first block which abuts the rail facility. Exceedances of the 51 dBA sleep disturbance screening criterion may be up to 10 dBA with the main impacts to future lots between the stabling facility (to the south) and Schofields Road. Potential impacts would be considered small and relatively easily mitigated.

4.3 Mitigation Options

It is unlikely that one specific form of noise mitigation will provide sufficient attenuation to all future receivers. The best means is likely to be a combination of the various noise controls discussed below.

4.3.1 Barriers

Barriers can be an effective form of mitigation to the lower levels of developments however; they offer little benefit to the higher story levels and may result in high visual impacts.

Barriers are likely to provide a cost effective solution to lower levels of future buildings to the south of the stabling facility (towards Schofields Road) where, due to the topographic profile, noise spill from the stabling facility into the adjacent land occurs more to the south than it does to the north. Consideration of barriers would be dependent on the proposed land use, building height and potential for visual impacts.

Consideration of the use of earth mounds may be a technical solution in some areas, where noise spillage out of the stabling yards land occurs. Specific contouring f the land around the stabling facility may be combined with landscaping treatments.

4.3.2 Landuse Planning

All opportunities should be explored in the precinct plan to design high rise (or low rise) commercial or light industrial buildings which will act to minimise the noise ingress into the future Area 20 residential areas. Apartment buildings may also be an effective means of minimising noise ingress, provided they are suitably treated for noise control at the facade.

The highest impacted area is the area between the stabling facility and Schofields Road (ie to the west of the proposed station). This area would be more suited for non-residential use, demand (for commercial space) and layout permitting.

4.3.3 Architectural Facade Treatments - Overview

Architectural mitigation measures are designed to achieve internal noise levels that would have normally prevailed if the external noise criteria were achieved. The typical outdoor to indoor noise reductions provided by most standard dwellings (ie without special acoustical treatment) is generally accepted as being 10 dBA with windows open (allowing for natural ventilation) and 25 dBA with windows closed. It is noted that these measures do not benefit outdoor areas (ground floor and balconies). Property fences can be used to assist in minimising to the ground floor areas, but do nothing for the external balcony space of high-rise buildings, unless they are fully enclosed.

Architectural treatments designed and incorporated during the project's detailed design phase and installed as part of the buildings construction works should be capable of achieving noise reductions of around 25 dBA and up to 35 dBA in some cases – without undue cost implications. Architectural mitigation measures can vary dramatically depending upon the degree of noise reduction required. In its simplest form, it may involve only the provision of mechanical ventilation to enable windows to be kept shut as a means of controlling noise intrusion or in the case of high levels of intrusive noise, one or more of the following design principles may be required:

- Thicker single laminate or double glazing
- The sealing of gaps and openings around windows and doors by fitting appropriate seals
- The upgrading of doors (which overlook the source of noise) from hollow-core to solid-core construction;
- The use of podiums (designed into the ground floor) which act as a (partial) barrier to the lower floors of the building;
- Incorporation of acoustically designed balconies (maybe including louvres and/or some absorption) to front the main stabling yard;
- Placement of less noise sensitive room to front the main stabling facility, etc.
- Noise ingress generally involves several pathways, and is most common via the windows, doors, ventilation openings and roofs. The overall sound reduction of a building element is dependent upon the mass of the construction, the effective area and the extent of any gaps or openings; and
- Glazing on facades exposed to traffic noise usually represents the "weak acoustic link" in any building construction.

4.3.4 Horn Testing Improvements

RailCorp is currently investigating the feasibility of a low level horn test mode for trains. If this proves to be feasible, the predicted noise levels could be up to 30 dBA quieter than predicted for a full horn blast and hence compliance with the noise goals may be possible at future residential receiver locations on all sides of the stabling facility. Improvements in the horn testing procedures have the potential to offer the most significant benefits of all the available mitigation options.

The feasibility of testing the horns in a custom built building could be examined (by others) during detailed planning. Such buildings have previously proved not to be a cost effective solution, however in this unique situation, given the railway sidings are in a deep cutting and there are road bridges over and across the stabling facility, the feasibility of having a super-structure roof over key parts of the facility may prove to be a more cost effective option.

4.4 Conclusion

Noise modelling has been undertaken to determine the potential noise impacts of the proposed train stabling facility located within Area 20 immediately to the west of the proposed Cudegong Road Station, west of Rouse Hill.

The noise modelling indicates that within the Area 20 precinct, the noise sources from the stabling facility comply or result in minor exceedances of the likely criteria at all future residential receiver locations - except for noise from the horn testing which potentially impacts a sizeable portion of Area 20 and the proposed The Ponds and Alex Avenue precincts.

Depending on the final layout of the Area 20 development, buildings located close to the stabling facility have the potential to provide a 'barrier effect' to residences that are located further away. Thus the predictions in this report must be considered conservative.

Several mitigation options are discussed in **Section 4.3**, which involve consideration of:

- Best planning practices within the Area 20 precinct;
- The use of Architectural treatments to future dwellings;
- RailCorp's investigation into the use of low-level horn test mode for trains; and
- Enclosures around the areas where horn-testing is being conducted;
- Barriers or earth mounds to specific areas.

Considering the number of future dwellings that would benefit, there is a clear case for further exploring the adoption of low-level horn tests.

The extent of the potential exceedances and mitigation measures is dependent on a number of factors including the following:

- The existing Rating Background Noise Levels adjacent to the facility need to updated, which will influence the noise design goals;
- The source noise levels for the future rollingstock may be lower than that assumed;
- Confirmation of the base noise modelling and operational assumptions in **Section 4.2.1**;
- Details of the proposed land use within the Area 20 precinct;
- Details of the building heights for buildings located close to the stabling yards; and
- Stabling of the first trains on the outermost eastern tracks so that they form a noise barrier for other trains.

Though the planning is at an early stage and subject to on-going design refinement the vertical layout detailed in **Figure 7** appears to be the most likely arrangement.

5 ELIMINARY RAIL NOISE ASSESSMENT

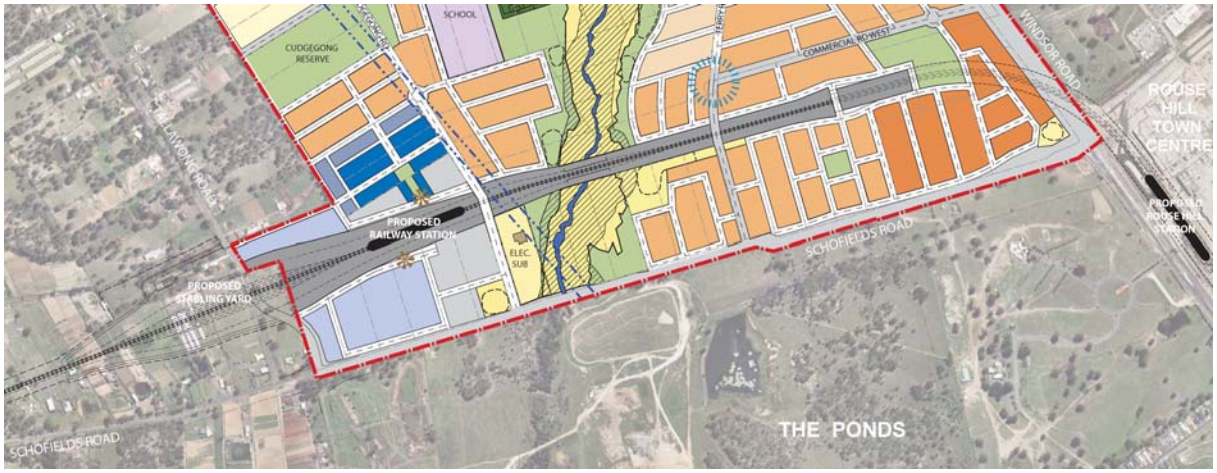
5.1 Overview

This report provides an overview assessment of the acoustical impacts that may occur as a result of rail noise arising from the North West Corridor Extension Project ("The Project"). The Project is only in its early design phases, and this report is to provide broad guidance on the possible rail noise related impacts and mitigation options that may be anticipated.

The rail corridor is a 60m wide. Heggies have been advised that the line would be restricted to passenger trains only, as the relatively high gradients and numerous tunnels (further along the track), may restrict the ability to run freight trains.

Though the planning is at an early stage and subject to on-going design refinement the layout detailed in **Figure 7** appears to be the most likely arrangement.

Figure 7 Horizontal Alignment Details



This report provides an overview of the current assessment criteria and a discussion of potential impacts that may require further consideration, as the planning of the development progresses.

5.2 ASSESSMENT CRITERIA

The airborne noise assessment is required to be undertaken in accordance with the requirements of the Department of Environment and Climate Change's (DECC's) *"Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects"* (2007). The noise design goals are expressed as non-mandatory "trigger levels", which if exceeded will trigger the need to consider feasible and reasonable mitigation measures.

A summary of the noise trigger levels for residential receivers is provided in **Table 14**.

Table 14 Airborne Noise Trigger Levels for Residential Receivers

Type of development	Noise trigger levels dB(A)		
	Day (7 am–10 pm)	Night (10 pm–7 am)	Comment
New rail line development	Development increases existing rail noise levels ***and*** resulting rail noise levels exceed:		These numbers represent external levels of noise that trigger the need for an assessment of the potential noise impacts from a rail infrastructure project. An 'increase' in existing rail noise levels is taken to be an increase of 2 dB(A) or more in L_{Aeq} in any hour or an increase of 3 dB(A) or more in L_{Amax}.
	60 $L_{Aeq(15h)}$ 80 L_{Amax}	55 $L_{Aeq(9h)}$ 80 L_{Amax}	
~~Redevelopment of existing rail line~~	~~Development increases existing rail noise levels ***and*** resulting rail noise levels exceed:~~		
	~~65 $L_{Aeq(15h)}$ 85 L_{Amax}~~	~~60 $L_{Aeq(9h)}$ 85 L_{Amax}~~	

The noise levels in **Table 14** refer to noise from the proposed rail operations only and do not include ambient noise from other sources such as major roads and industry. The noise levels are evaluated externally at a distance of 1 m from the most affected building facade. "Residential" typically means any residential premises located in a zone as defined in a planning instrument that permits new residential land use as a primary use. The L_{Amax} noise level refers to the 95th percentile train passby event (ie, 5% of train passbys are permitted to exceed the noise trigger levels). For new rail projects, the noise trigger levels apply immediately after operations commence and for projected traffic volumes over an indicative period into the future that represents the expected typical level of rail traffic usage (e.g. 10 years or a similar period into the future).

The guideline also states:

> *"Where noise above the noise trigger levels continues even after all feasible and reasonable mitigation measures have been applied to a project, other long-term strategies need to be applied to minimise impacts. These include reducing noise emissions from rolling stock by applying noise standards to new rolling stock; managing noise emissions from rolling stock already in use; and improved planning, design and construction of adjoining land-use developments."*

As The Project represents an entirely new rail infrastructure project incorporating new rollingstock and track form designs, the noise trigger levels should be viewed as "design goals" which are to be achieved at all locations through feasible and reasonable mitigation design measures.

It is also possible that The Department of Planning's *Interim Guideline* may apply – either in parallel with, or as a replacement to DECC criteria. However at this stage, the assessment is conducted against standard DECC criteria.

5.2.1 Rollingstock Noise Levels

Noise emission limits from new trains are normally specified in terms of the $L_{Amax\ (fast)}$ noise level at a particular speed, measured at a distance of 7.5 m, 15 m or 25 m from the track centreline. The roughness of the track is generally not specified, but it is required that the track must be in "good condition" regarding the roughness.

The reference noise levels are typically expressed for straight ballast and sleepered track, with measurements being undertaken at grade or on low embankment. In keeping with other studies Heggies has undertaken, the source noise levels for the proposed Project rollingstock with wheels in good condition are assumed to be $L_{Amax\ (fast)}$ 80 dBA at 80 km/h, measured at 15 m distance from ballasted track at grade.

For a rail system with well maintained track and rollingstock, it is anticipated that there will be a normal distribution of noise levels with a standard deviation of ± 2 dBA giving a 95th percentile noise level 3 dB higher than the reference noise level. An additional allowance of +2 dB has been made for modelling uncertainty, resulting in a reference L_{Amax} noise level of 85 dBA for the 95th percentile train.

In order to calculate the $L_{Aeq(15hour)}$ daytime and $L_{Aeq(9hour)}$ night-time noise levels, it is also necessary to determine the L_{AE} noise level (a noise parameter which represents the total noise energy of the train passbys). The 80 dBA $L_{Amax\ (fast)}$ reference train travelling at 80 km/h gives an L_{AE} of 85.5 dBA. The energy average of normally distributed noise levels gives a +0.5 dBA correction relative to the median noise level and a further +1 dBA was included for modelling uncertainty. This results in a reference L_{AE} of 87 dBA at 15m.

For initial modelling purposes, it is assumed that:

- The trains could be travelling at speeds up to 100 km/h though, it is acknowledged that they may not reach this speed (or at least stay at this speed for a long distance) due to the relatively small distance between Rouse Hill and Tallawong Stations. Never-the-less, it is a reasonable and conservative design consideration to assume this speed, at this stage of the project;
- The tracks would be ballasted;
- The topography outside the corridor is generally flat;
- Impact noise from rail discontinuities such as turnouts and mechanical joints or uneven welded joints also has an effect on the level of wheel-rail noise emission, as impulsive noise is emitted as each wheel of the train impacts the discontinuity. It is assumed that there are no turn-outs in the study area.

5.2.2 Train Numbers

At this stage no timetabling or train frequencies have been identified. For this assessment, it would seem reasonable to adopt the following very conservative train movements:

- Every 15 mins at start-up/shut down;
- 6 mins between peak hours(s); and
- 3 mins at peak hour(s);
- Trains services operate between:
    - 05:30 - 00:00 Sunday to Thursday
    - 05:30 - 01:00 Friday and Saturday

On the basis of the above information, it is estimated that there will be 95 train movements in each direction during the 7.00 am to 10.00 pm daytime period and 16 train movements in each direction during the 10.00 pm to 7.00 am night-time period (assuming 20 trains per hour during peak periods).

On the basis of the ratio between the proposed daytime and night-time train movements, it is anticipated that the daytime $L_{Aeq(15hour)}$ noise goal of 60 dBA will be more stringent than the night-time $L_{Aeq(9hour)}$ noise goal of 55 dBA.

5.2.3 NOISE MODELLING RESULTS

In calculating the noise levels a number of modelling assumptions has needed to be made, and hence the predictions are considered to be approximate, but never-the-less considered correct for this "first-cut" assessment.

The results indicate:

- Where the track is located at-grade or on embankment/viaduct, the design goal noise levels extend out a distance of approximately 50 m beyond the closest track (at the ground floor).
- Where the track is located within a cutting, the design goal noise contours are generally within the 60 m wide railway corridor. (at te ground floor residences)
- In order to maintain quiet noise levels over time, a maintenance regime designed to maintain smooth wheels and rails would be required and may include a permanent wayside noise monitoring station.
- Barriers are an effective source of noise mitigation:
    - Incorporating vehicle side skirts and low height (approximately 1 m high) noise barriers located close to the train (ie within 0.5 m). This would result in a potential noise reduction of about 5 dBA in $L_{Amax,95\%}$ and L_{Aeq} noise levels;
    - Incorporating 4 m barriers at a distance 6 m from the nearside track (the 6 m distance allows vehicle access, if required) may provide between and additional 5 dBA to 10 dBA attenuation (depending on local topography). A 3m to 4 m barrier may provide compliance; to those living on the ground floor, but the attenuation diminishes quickly on the upper levels of the building. It is acknowledged that barriers will generally not be used on this project, and mitigation will therefore need to be in the form of architectural treatments.
- Architectural treatments to the facades of the houses/buildings along the rail corridor. This may prove the only feasible option if multi-level apartment buildings are to be constructed along the rail corridor. Where possible the orientation of the apartment blocks should try to maximise the acoustical shielding it can provide to the wider community.
- Land-use planning ie restrict residential (or other noise sensitive buildings) to be constructed immediately adjacent to the rail corridor.
- During the detailed design phase of the rail corridor, it would be envisaged that the viaducts be designed so as to minimise the potential for structure-borne noise impacts (eg the use of concrete structures rather than open transom steel structure). In addition, the detailed design could consider whether the viaducts could be designed to include parapets etc. Though

On the basis of the results (presented above) and the preliminary profile presented in **Figure 7, Appendix E** presents the "complying" rail noise contours throughout the Area 20 precinct.

5.3 Conclusion

A noise impact assessment has been conducted in relation to a potential railway line cutting through the Area 20 precinct, located immediately to the west of Windsor Road and north of Schofields Road, Rouse Hill.

The rail corridor is in a cut-and-cover or tunnel as it passes under Windsor Road, and quickly comes to grade across the site. Whilst at grade (or on slight fill), compliance levels are achieved at a distance of approximately 50 m from the nearside track. Barriers are very effective in reducing the noise levels at the ground floor apartments, but are less effective at the higher levels. In such cases, the higher-level apartments should be designed to achieve the equivalent internal noise levels through material selection of suitable materials that form the building envelope, and allowing the shape of the building itself to maximise noise attenuation throughout the wider community.

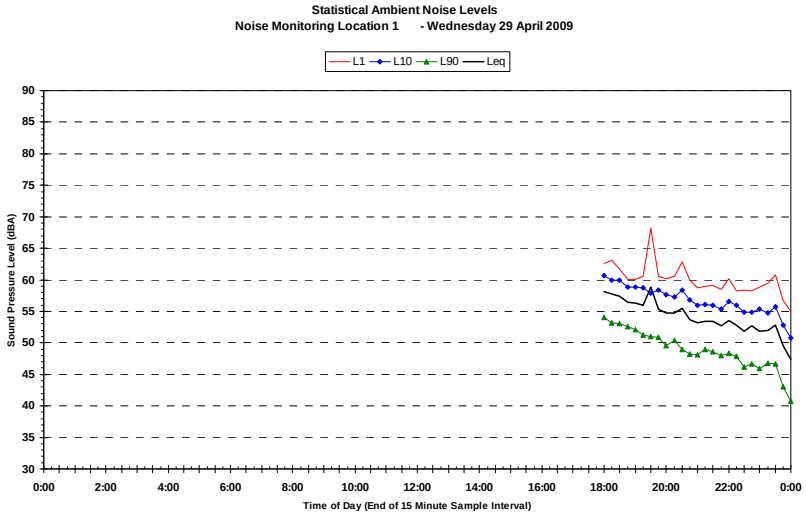
6 CLOSURE

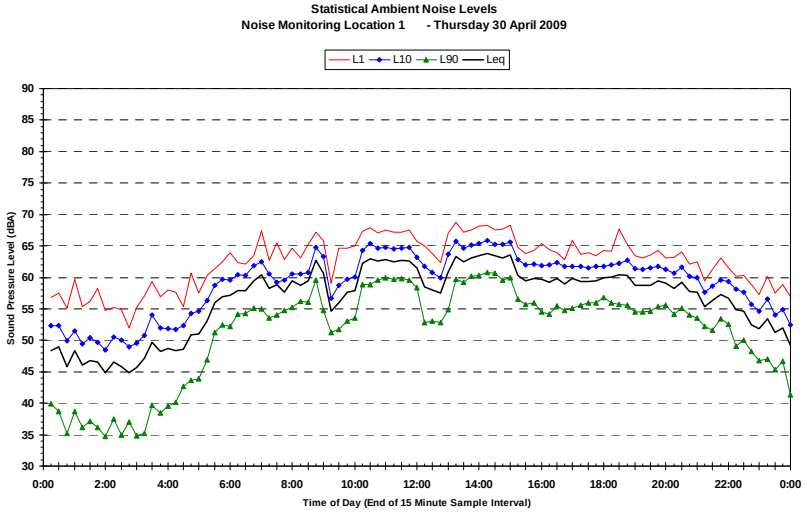
This report has been prepared by Heggies Pty Ltd with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

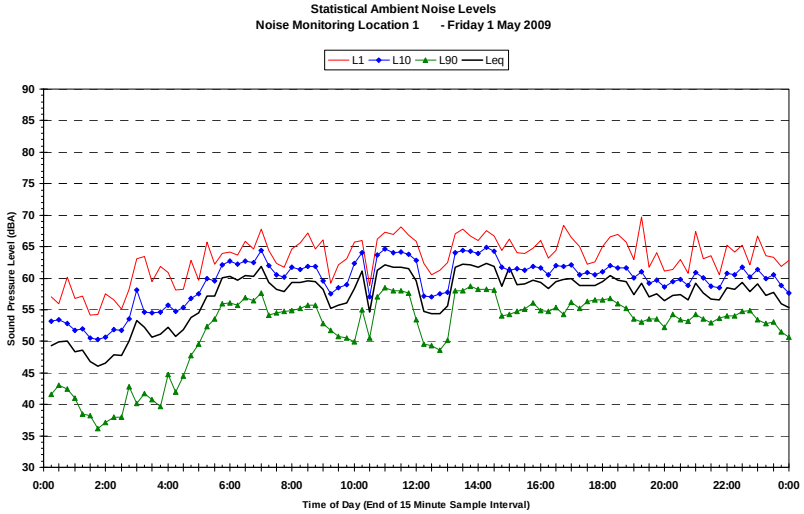
This report is for the exclusive use of Department of Planning; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from Heggies.

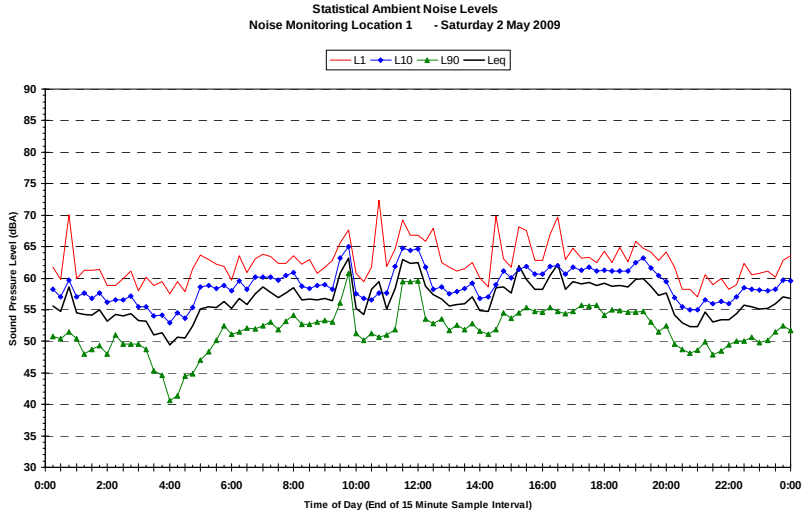
Heggies disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

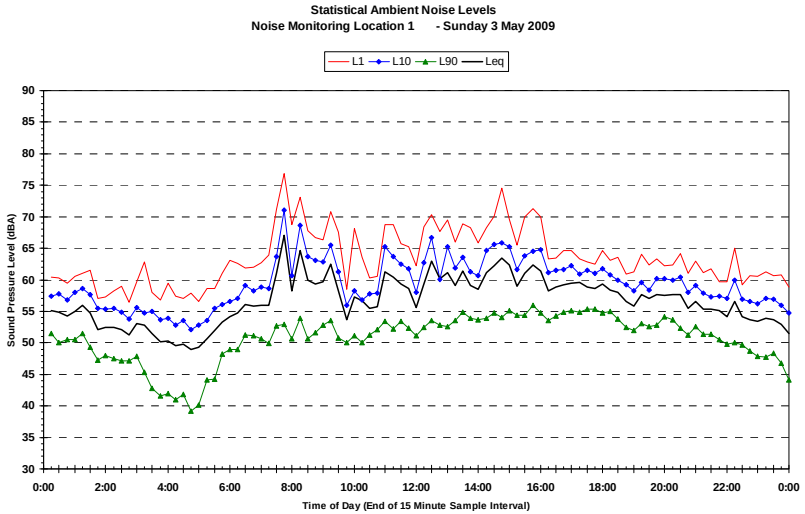
Ambient Noise Levels







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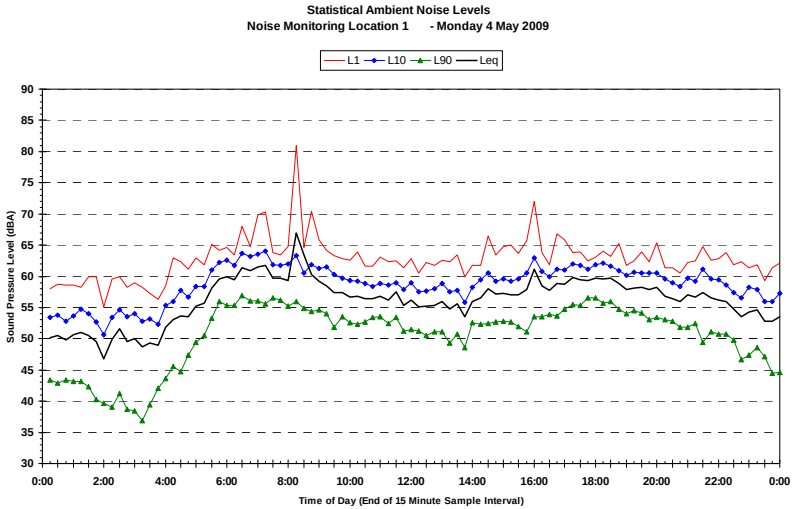
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)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Sound Pressure Level (dBA)
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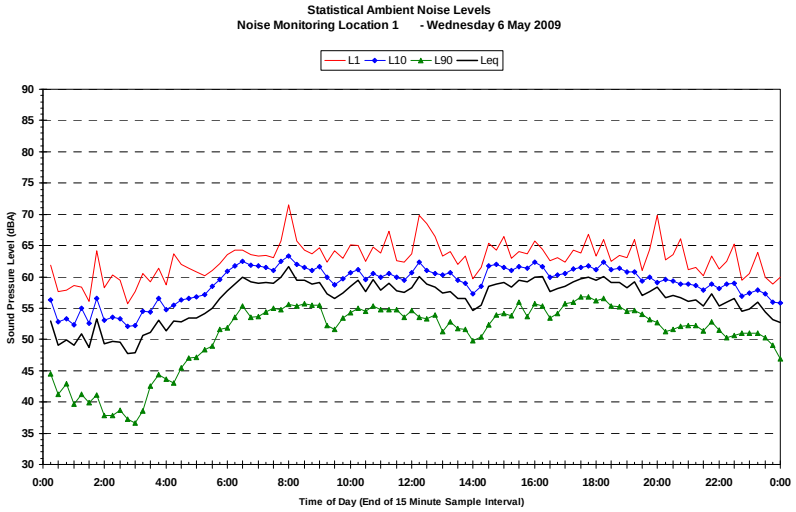
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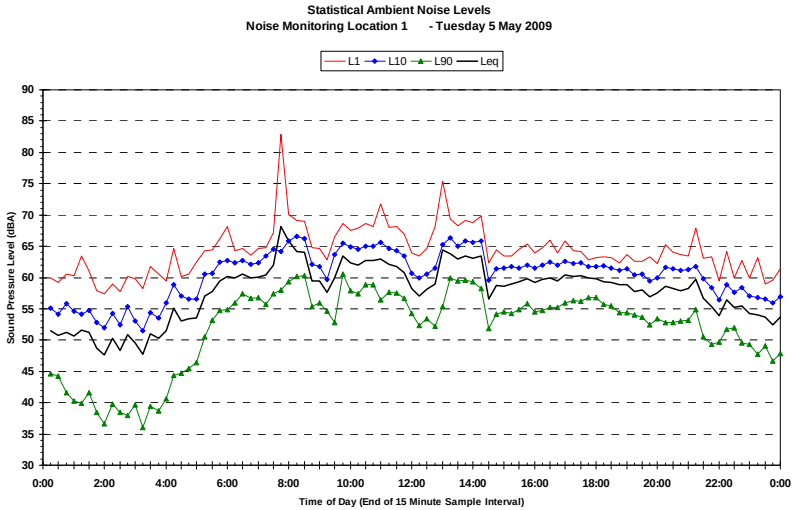
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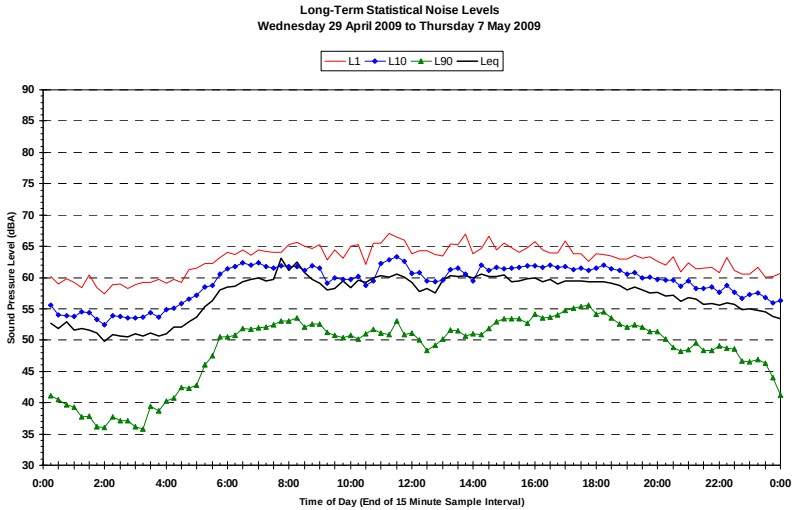
Time of Day (End of 15 Minute Sample Interval)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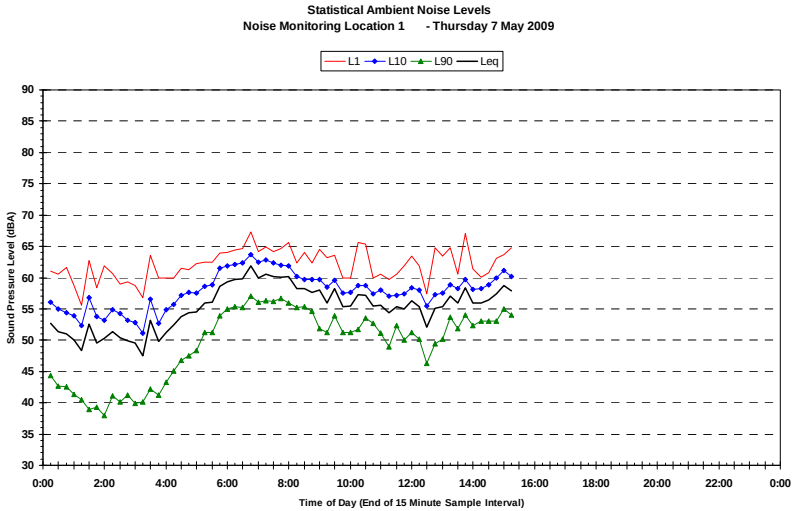
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)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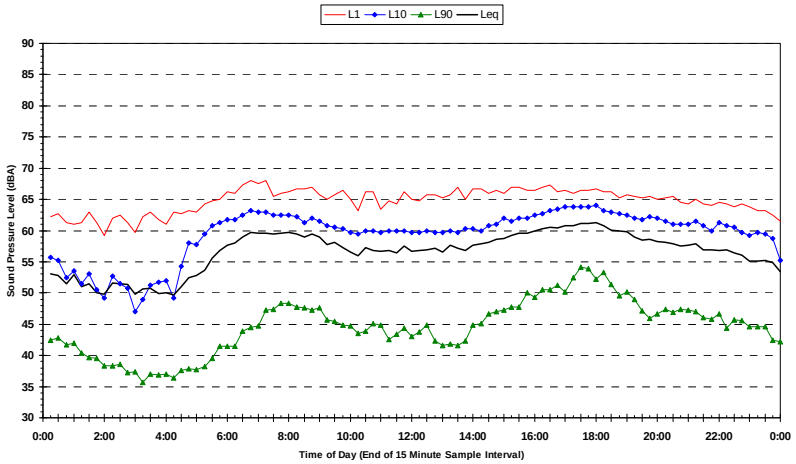
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)

Ambient Noise Levels

Long-Term Statistical Noise Levels
Wednesday 29 April 2009 to Thursday 7 May 2009



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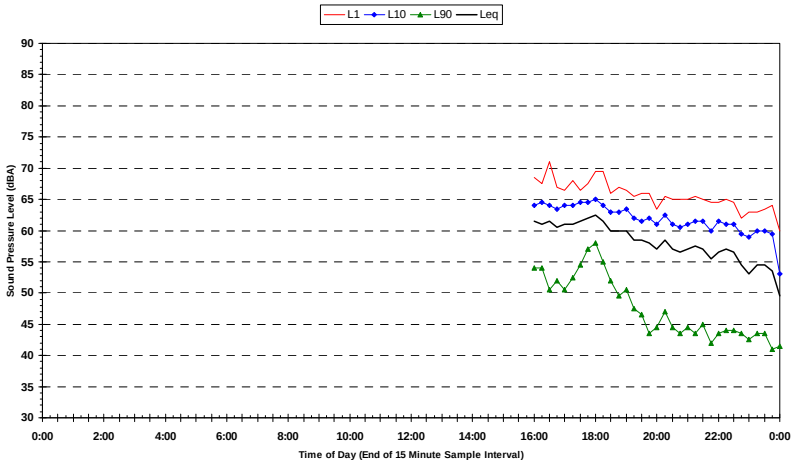

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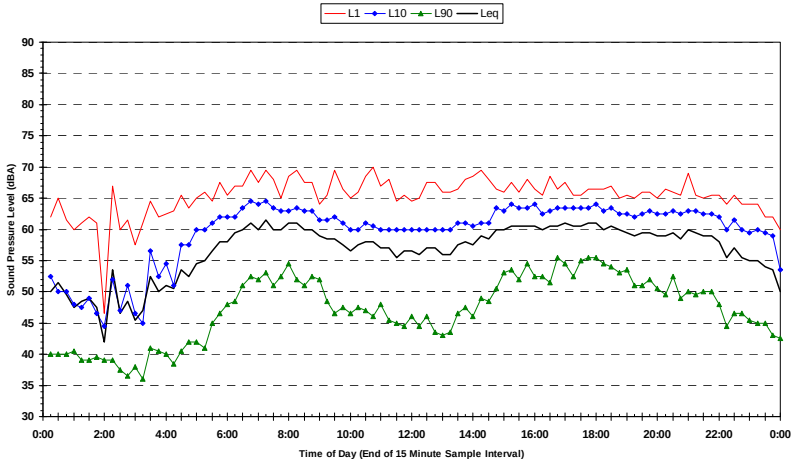

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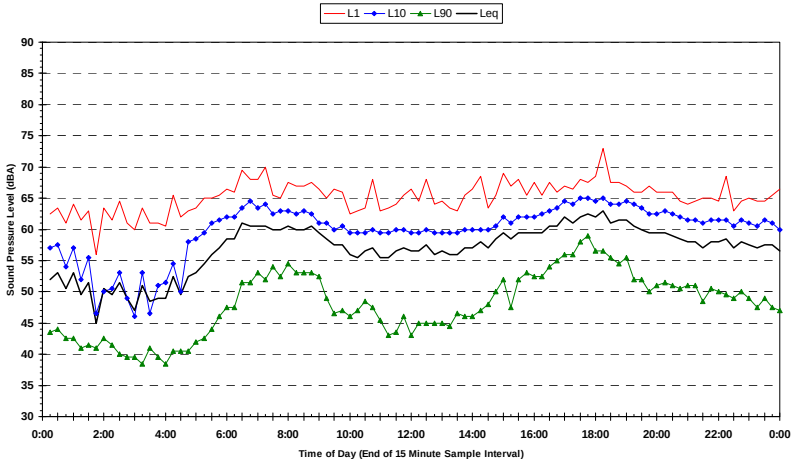

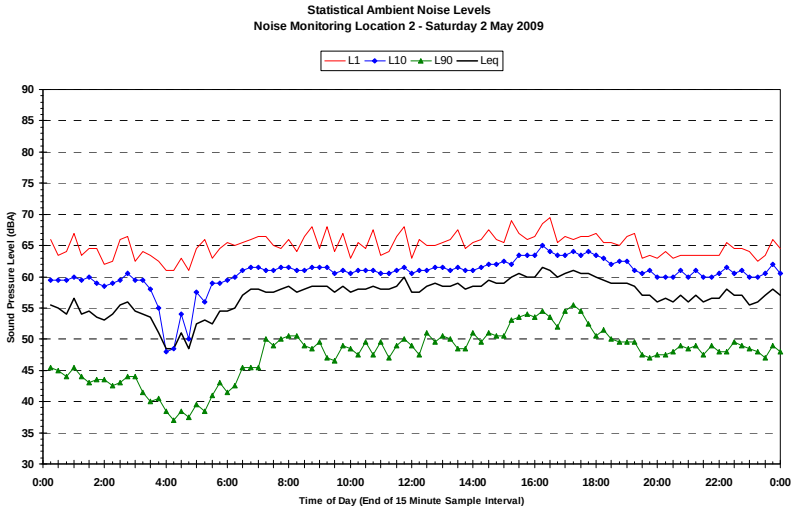
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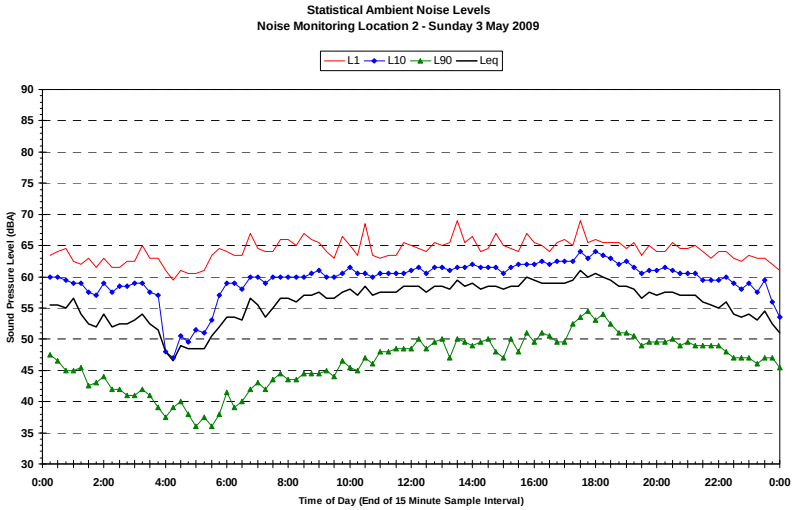
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)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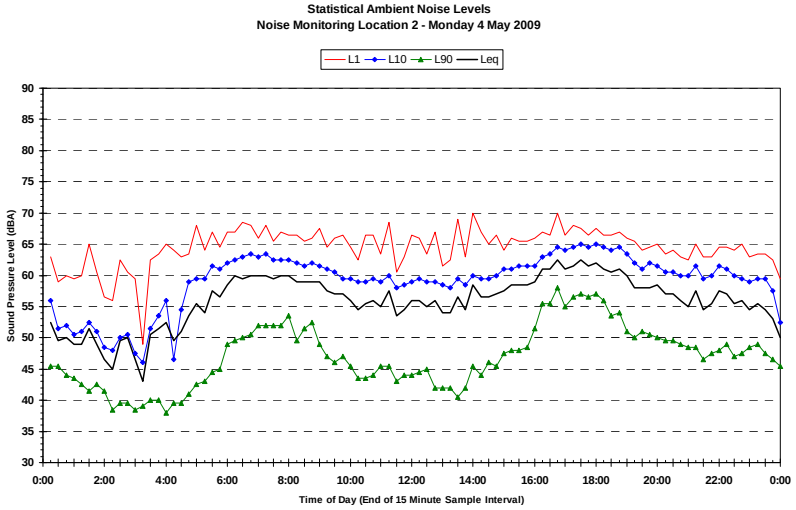
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)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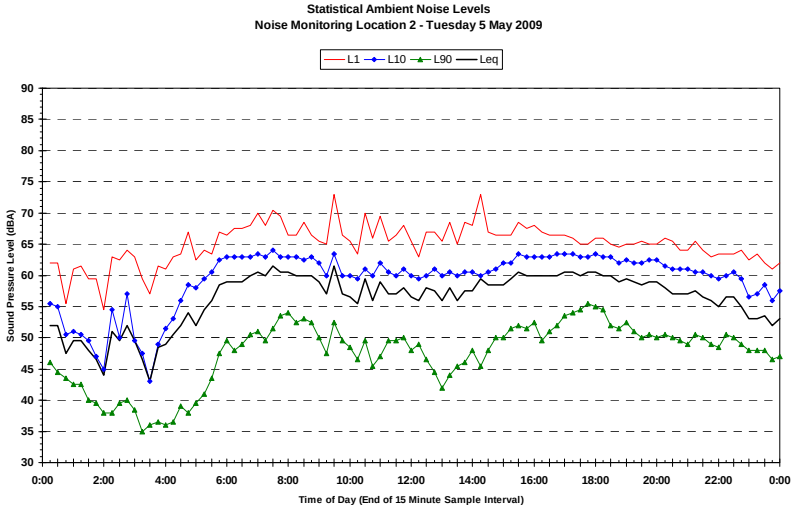
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)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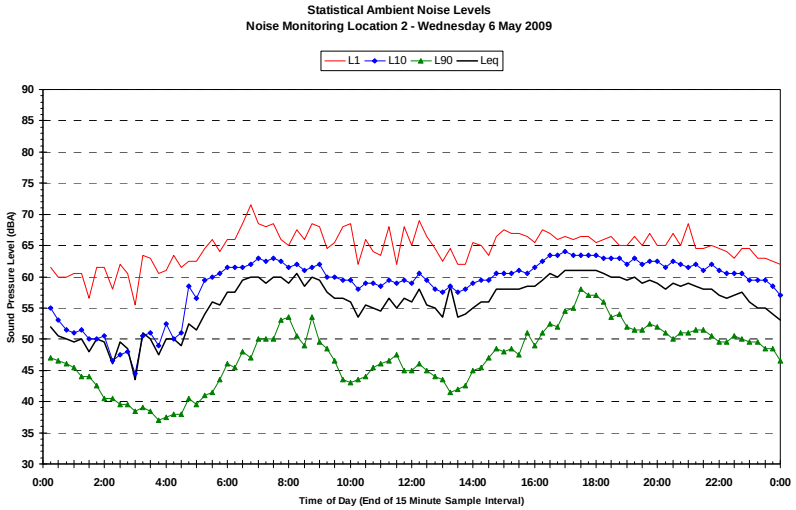
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)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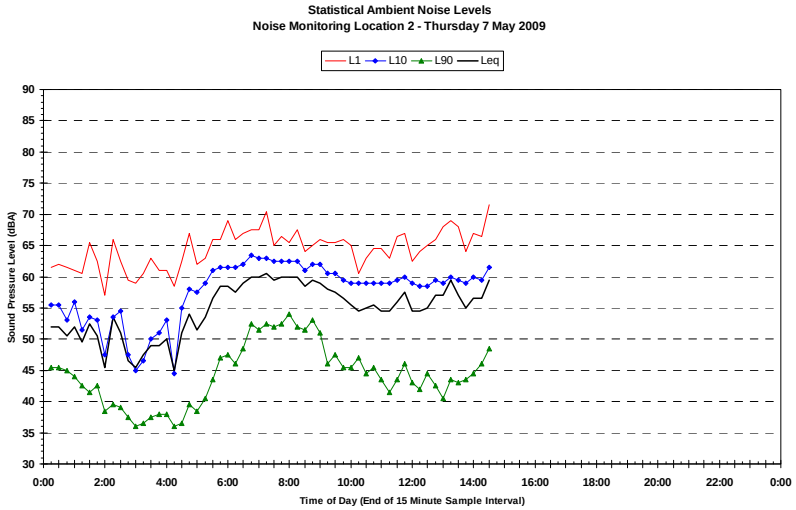
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)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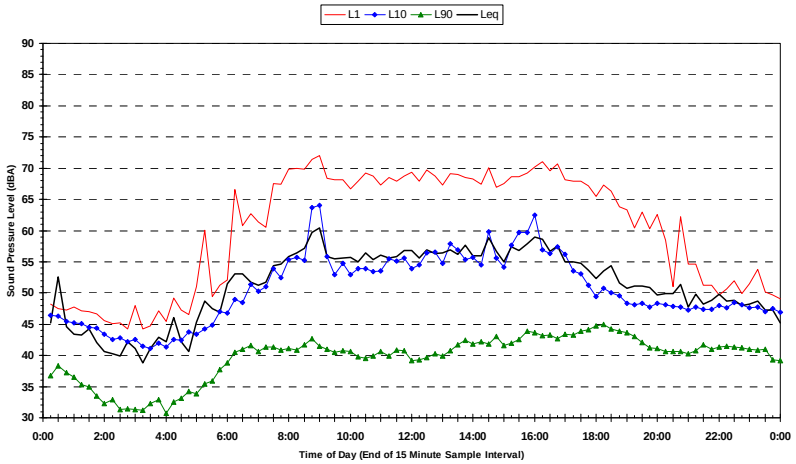
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)

Ambient Noise Levels

Long-Term Statistical Noise Levels
Wednesday 29 April 2009 to Thursday 7 May 2009



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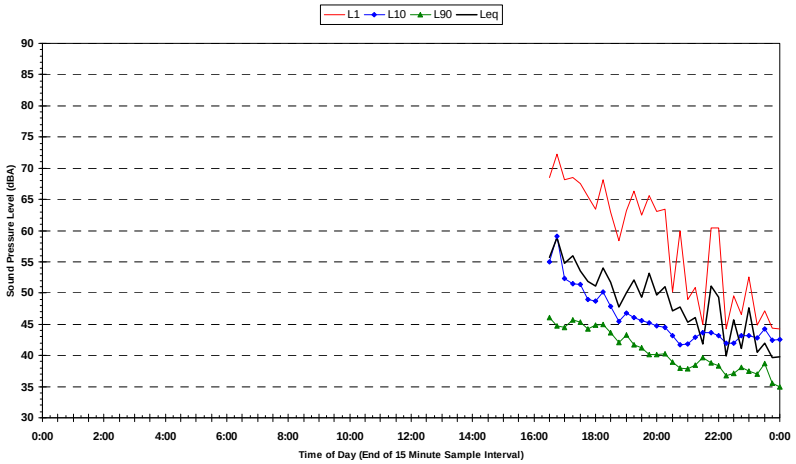

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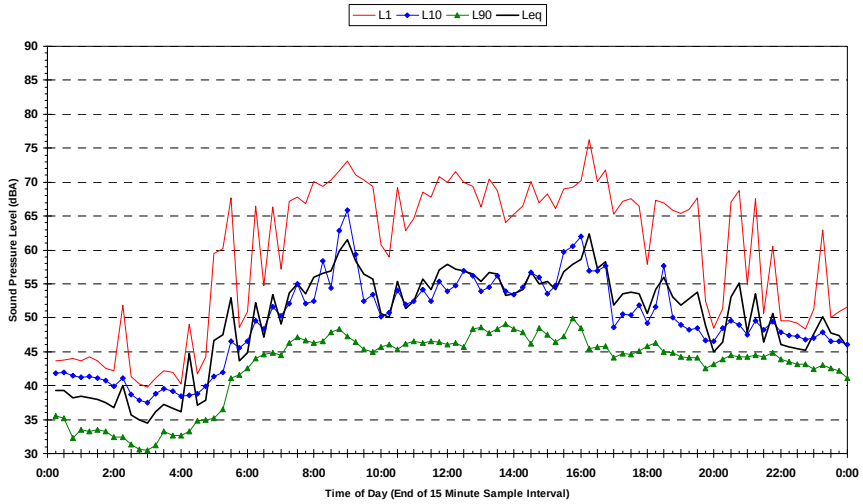

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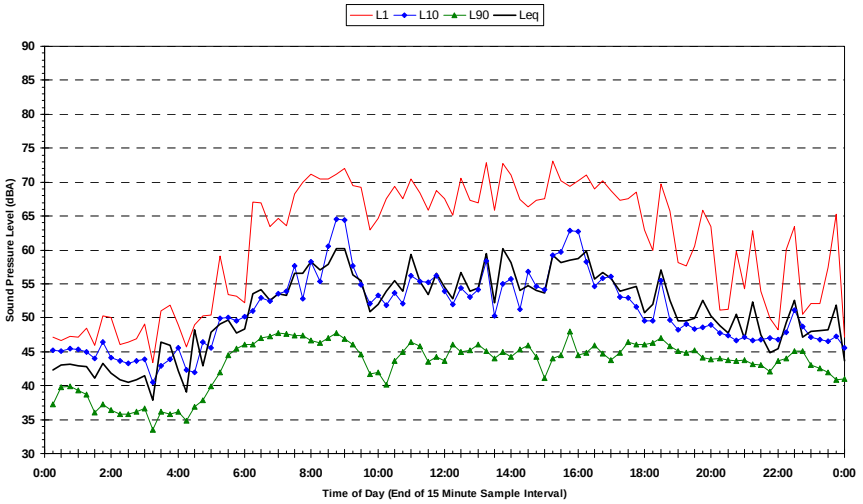

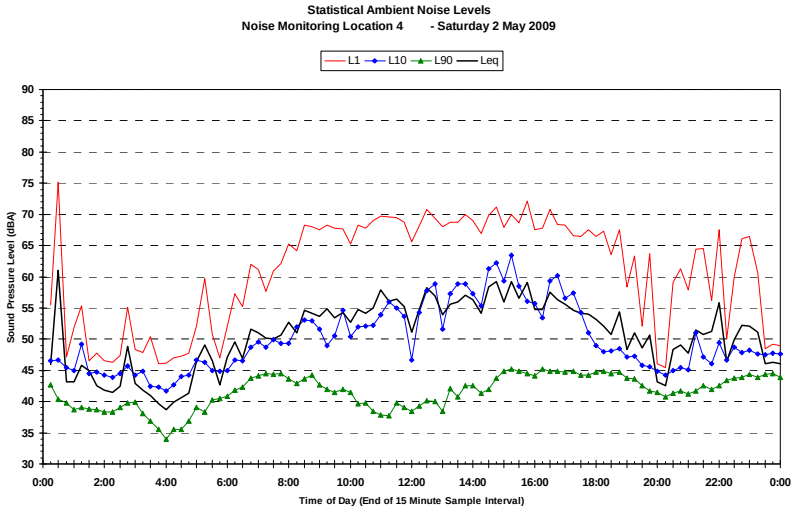
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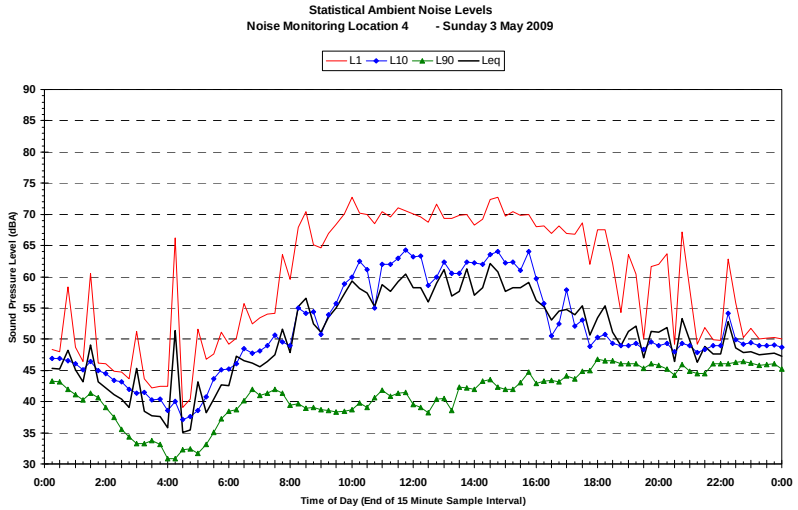
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)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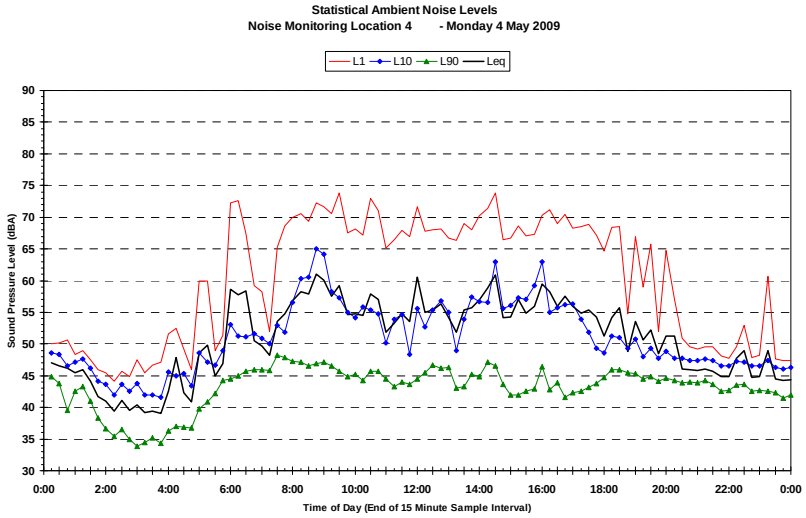
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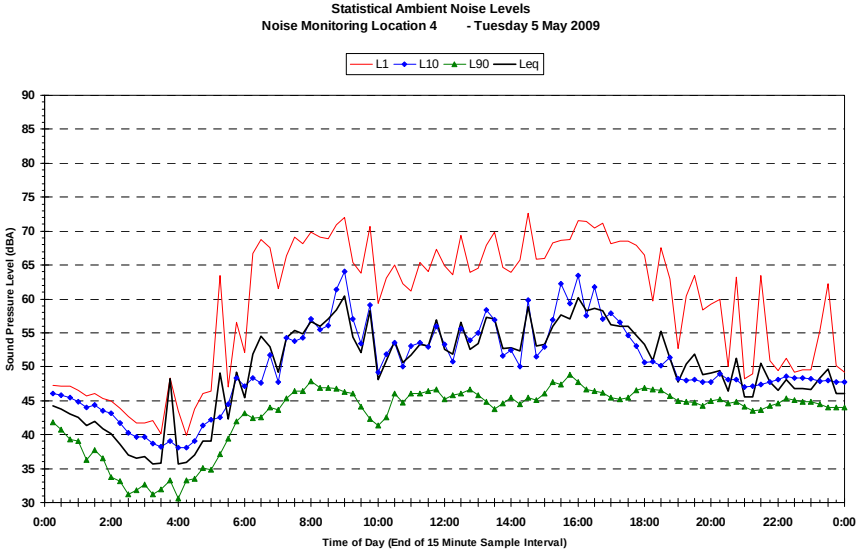
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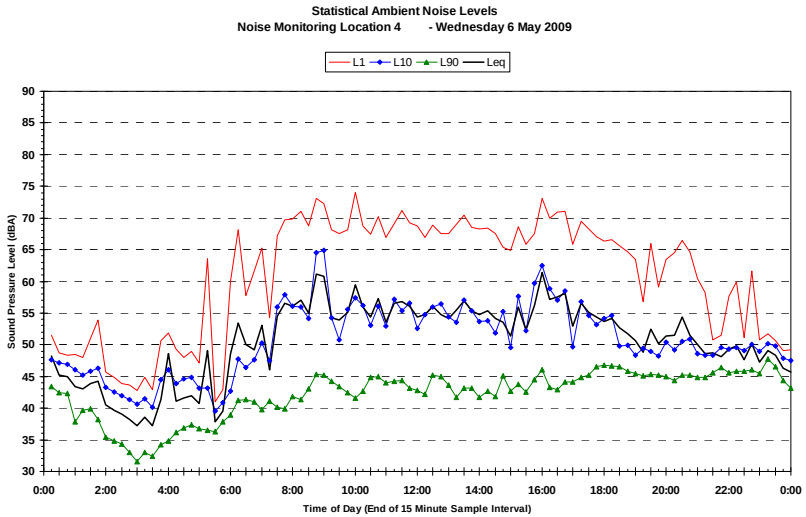
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)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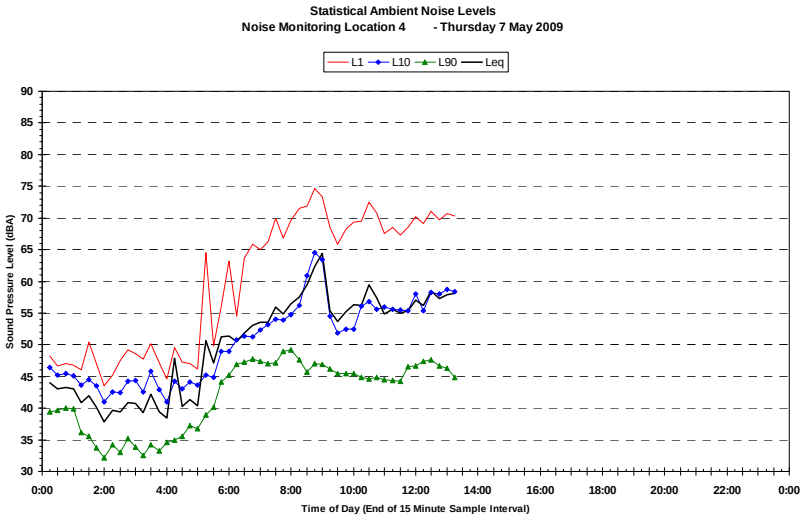
Leq
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Noise Monitoring Location 4 - Thursday 7 May 2009
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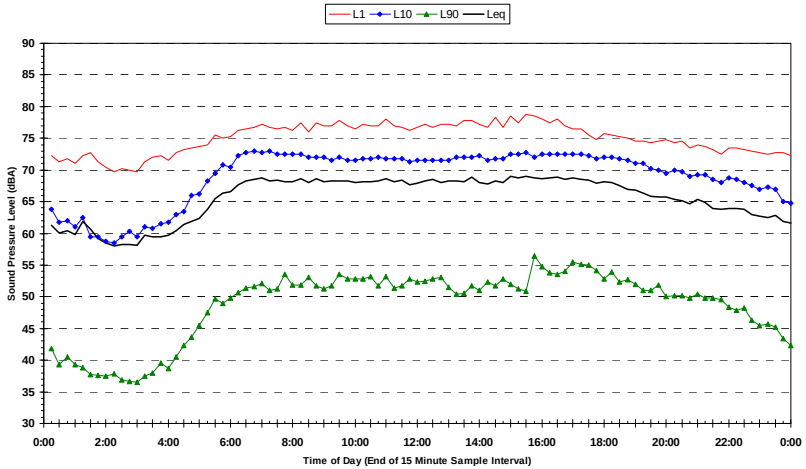
Leq
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)

Long-Term Statistical Noise Levels
Wednesday 29 April 2009 to Thursday 7 May 2009



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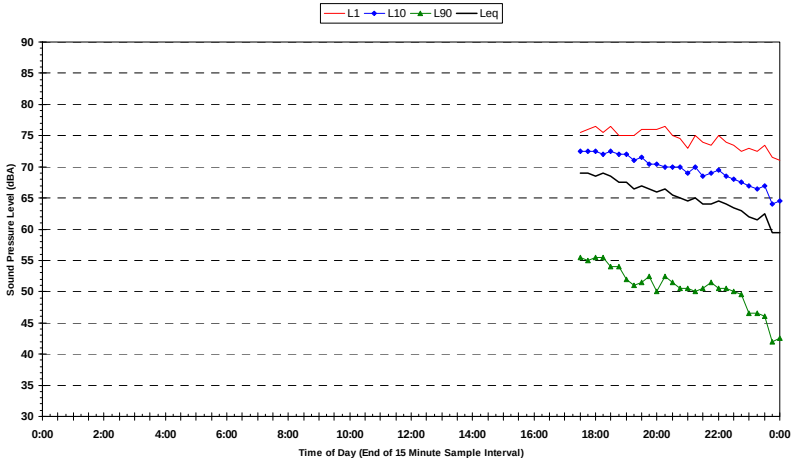

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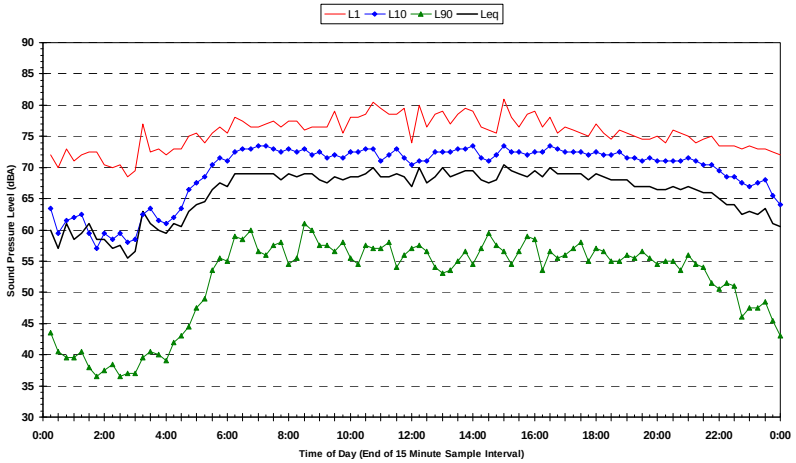

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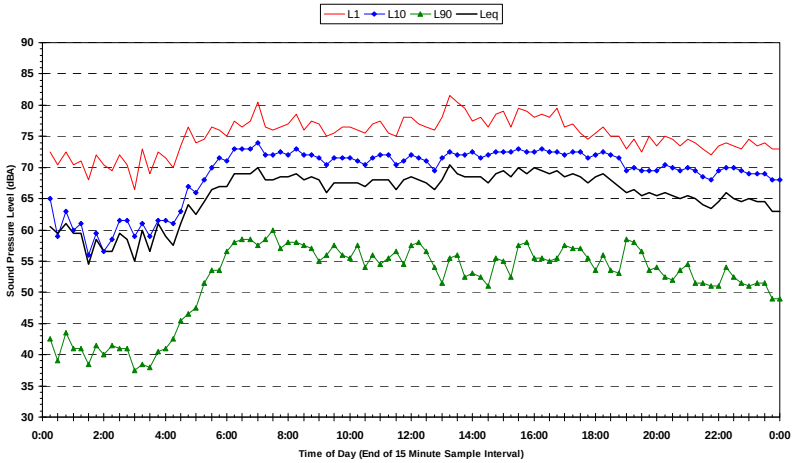

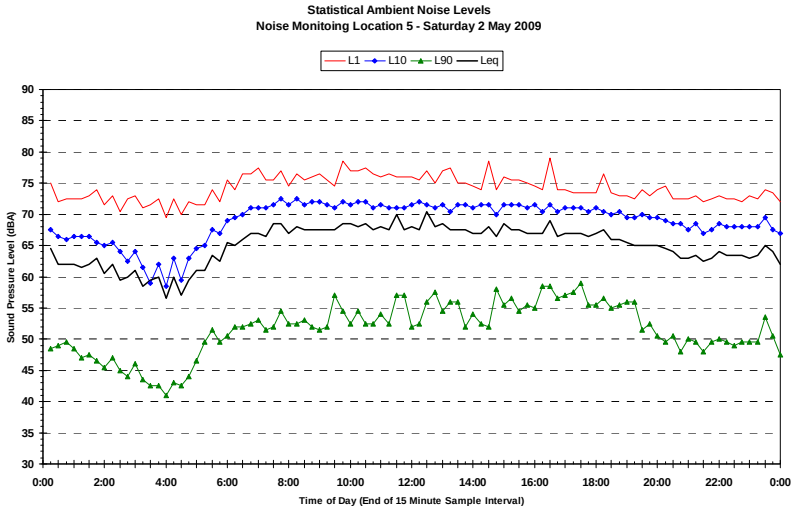
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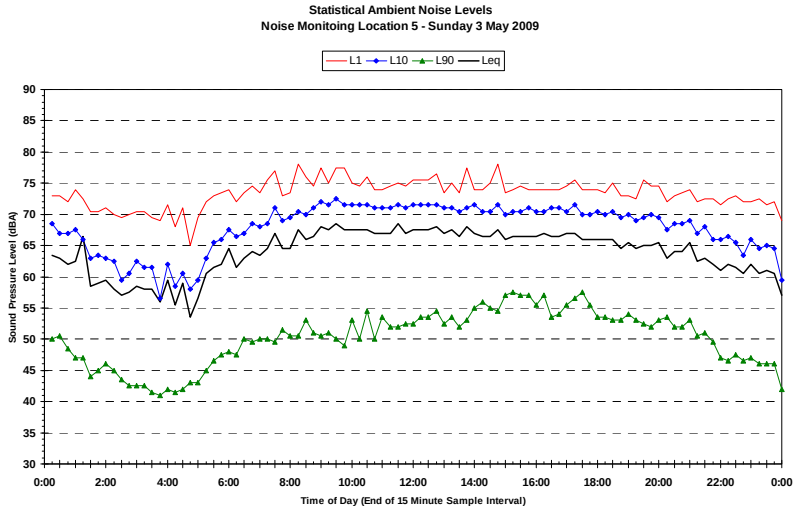
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)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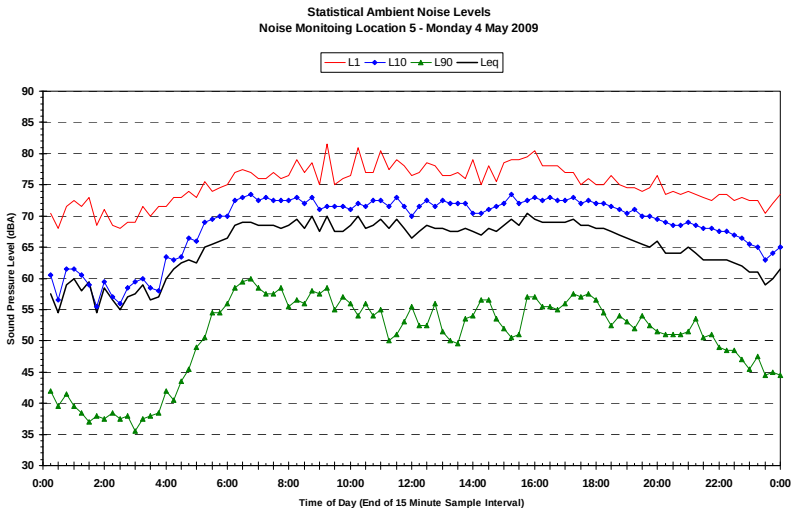
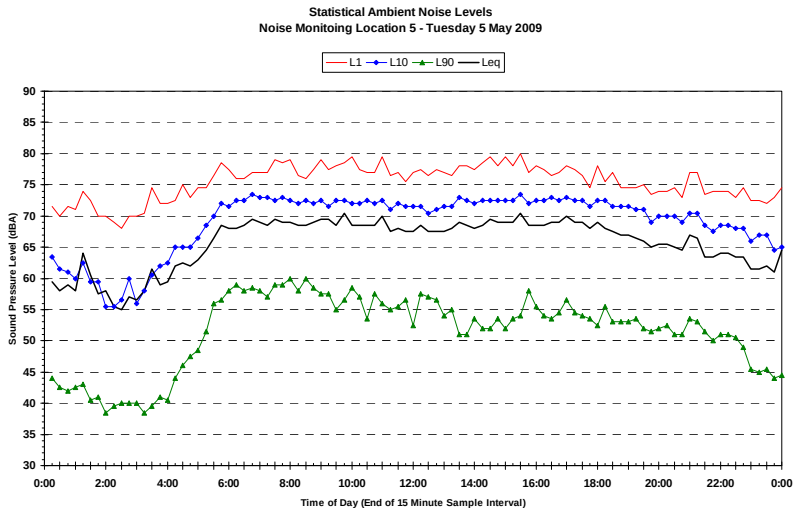
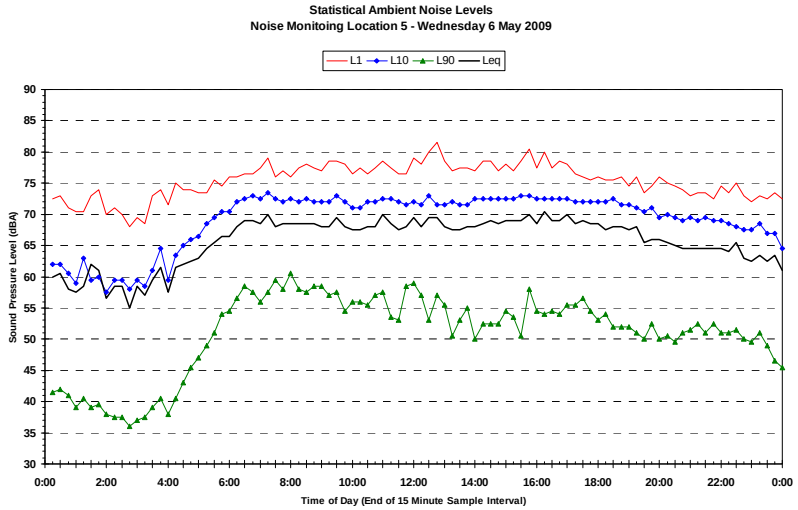
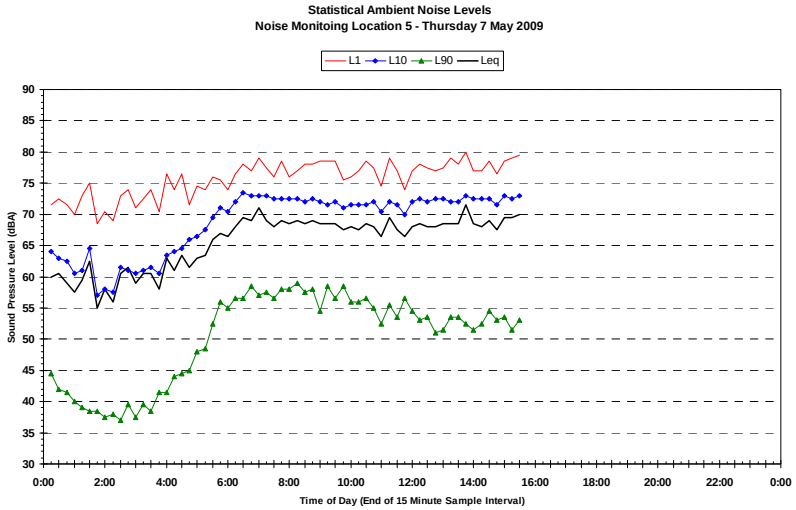
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)

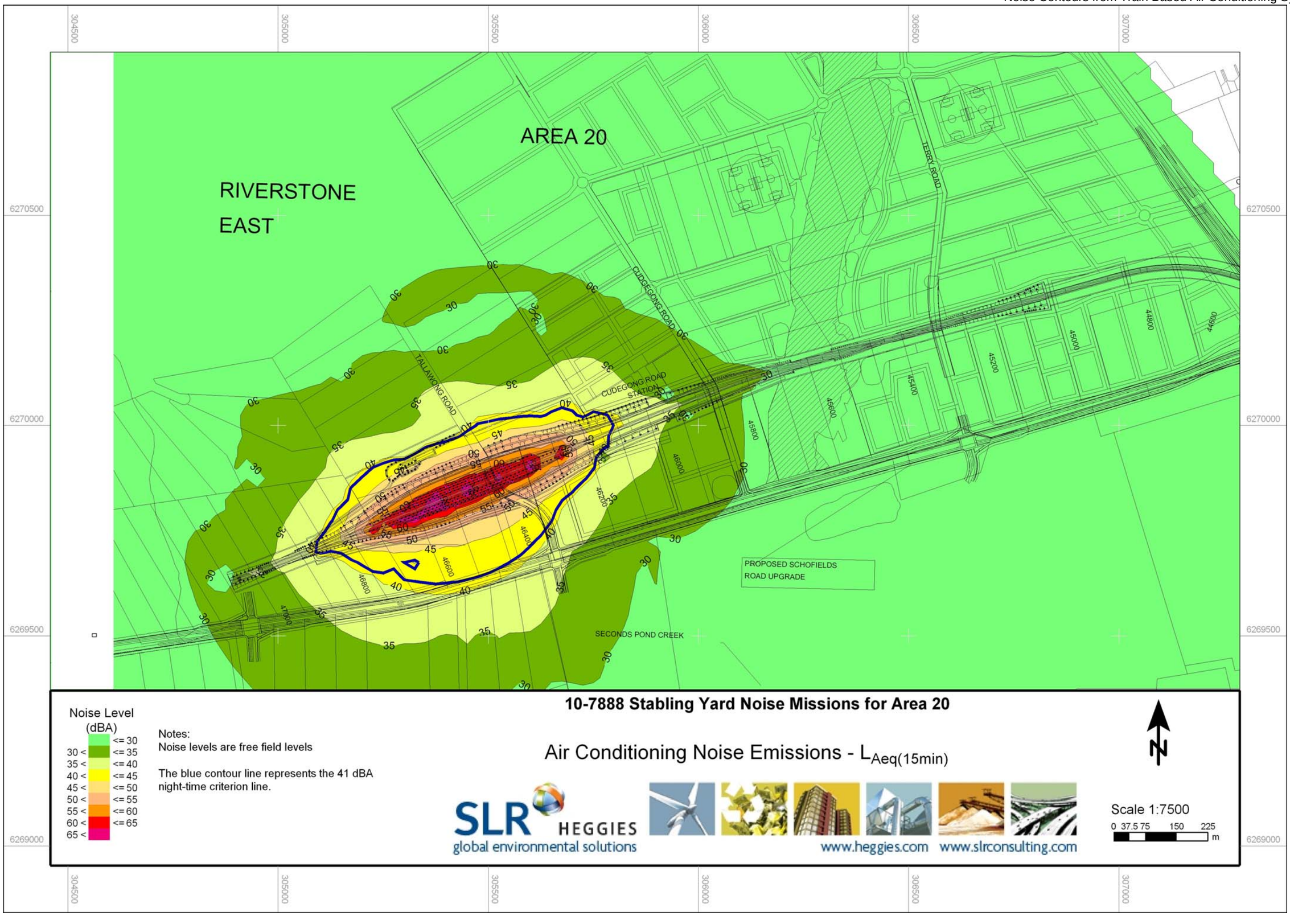

Statistical Ambient Noise Levels
Noise Monitoing Location 5 - Monday 4 May 2009
L1 L10 L90 Leq
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Noise Monitoing Location 5 - Tuesday 5 May 2009
L1 L10 L90 Leq
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)

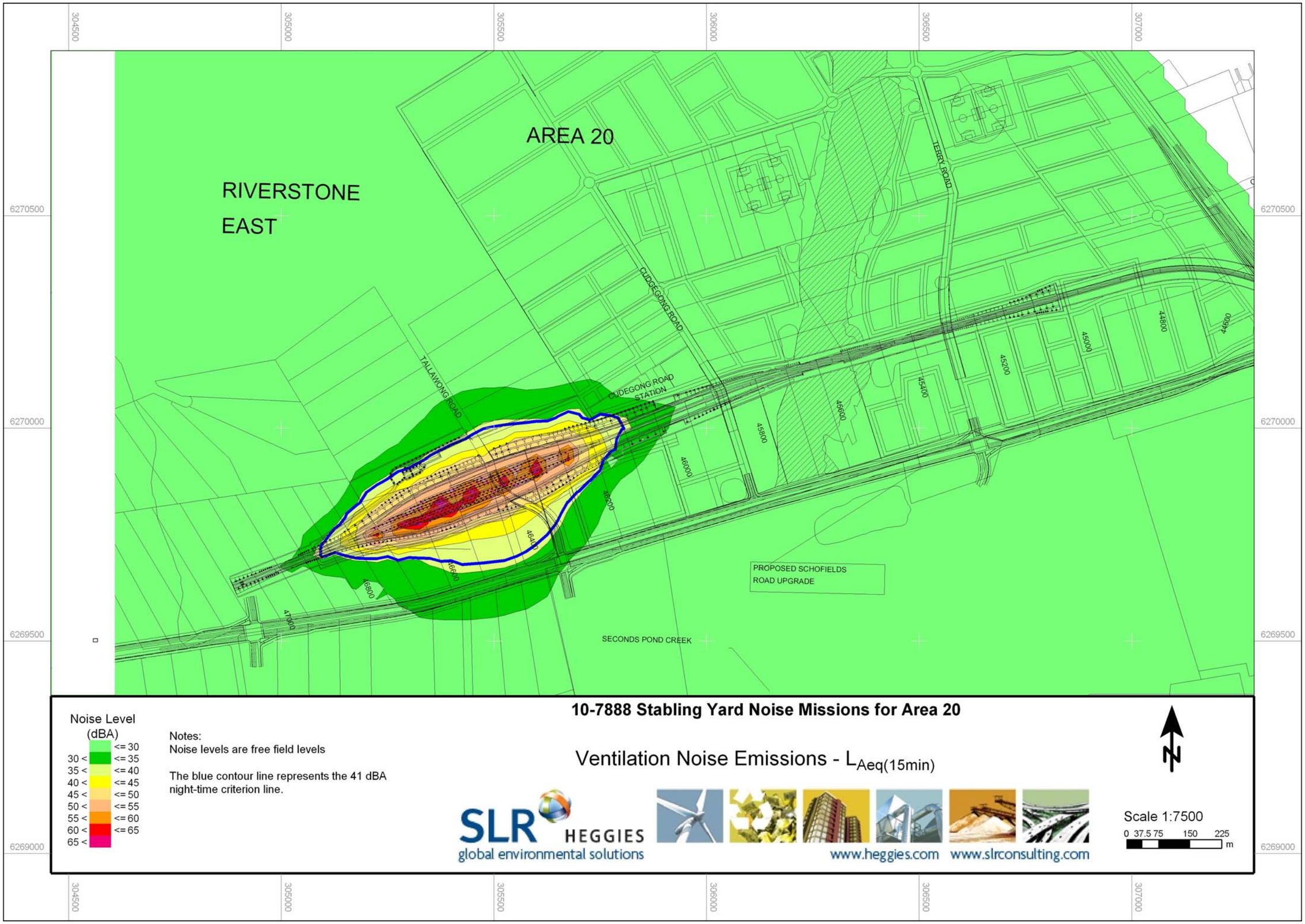

Statistical Ambient Noise Levels
Noise Monitoing Location 5 - Wednesday 6 May 2009
L1
L10
L90
Leq
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Noise Monitoing Location 5 - Thursday 7 May 2009
L1
L10
L90
Leq
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)

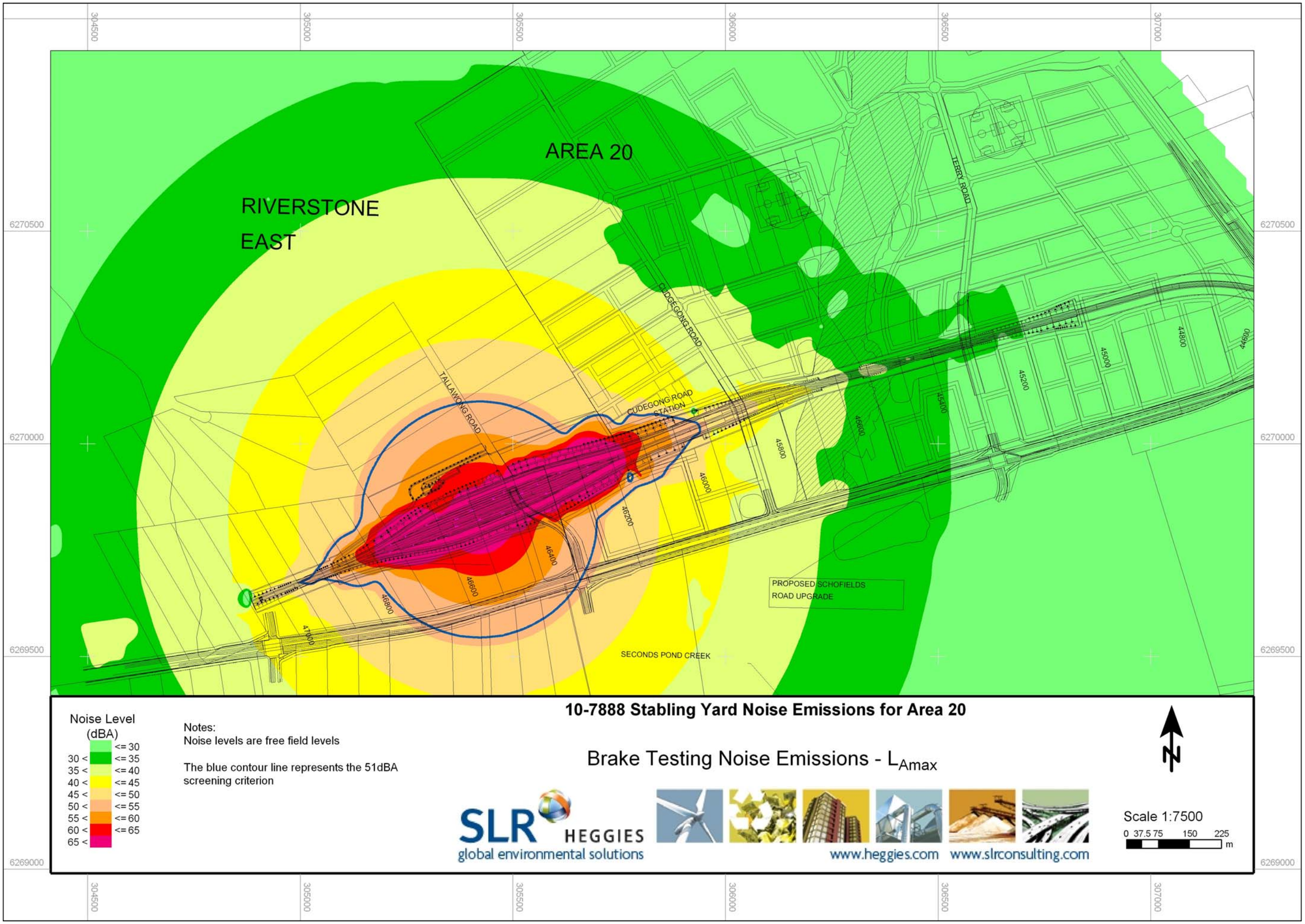
Noise Contours from Train Based Air Conditioning Systems



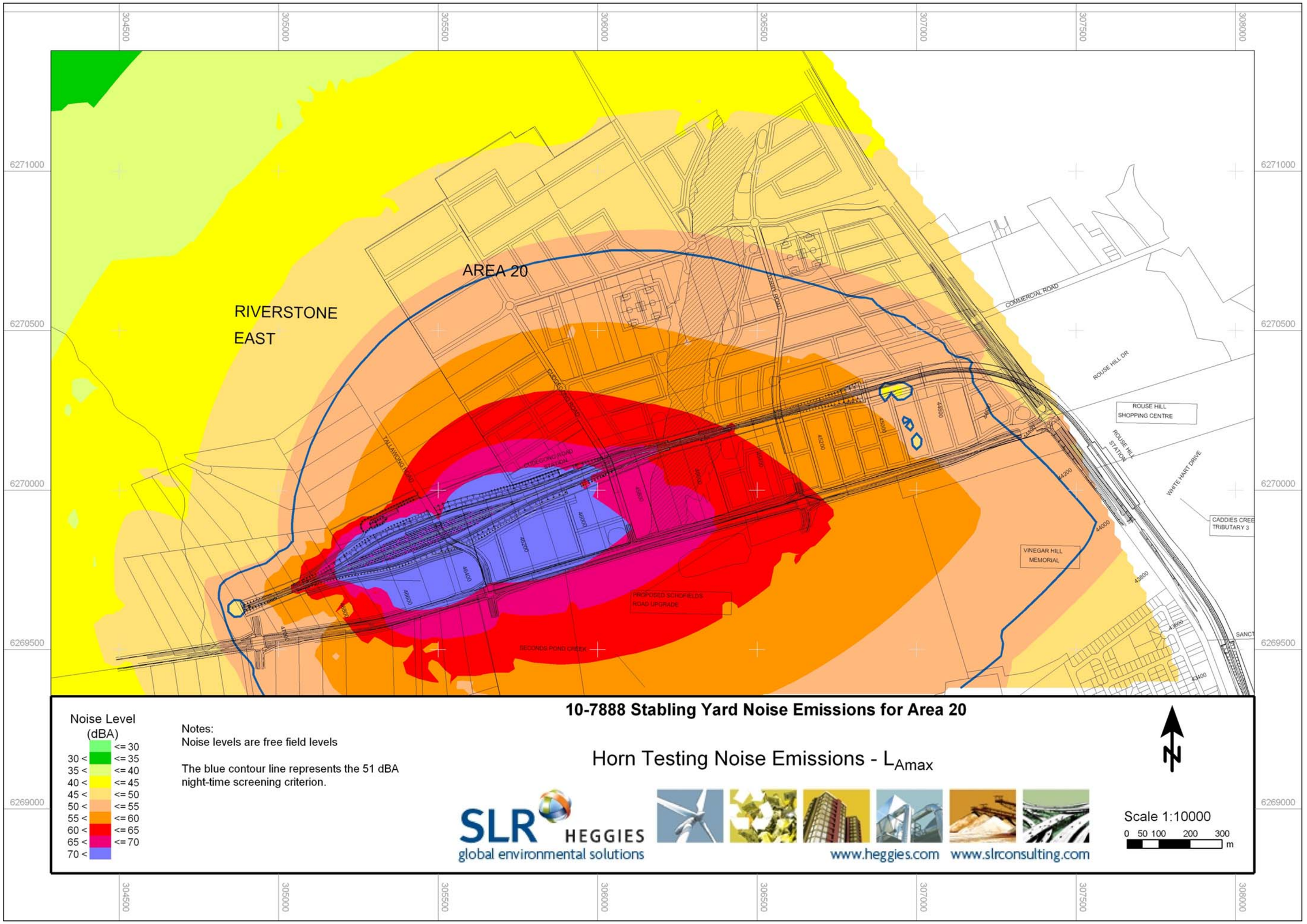
Noise Contours from Train Based Ventilation Systems



Noise Contours from Brake Testing



Noise Contours from Horn Testing



Noise Contours from Train Movement