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128 HERRING ROAD, MACQUARIE PARK - BUILDING A

ACOUSTIC ASSESSMENT FOR PART 3A SUBMISSION

TE701-01F02 (REV 4) ACOUSTIC REPORT FOR PART 3A SUBMISSION.DOC

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DOCUMENT CONTROL

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EXECUTIVE SUMMARY

This report presents an assessment of noise intrusion into and operational noise from the proposed residential development consisting of 5 multi-storey apartment buildings at 128 Herring Road, Macquarie Park. The development is considered a Major Project and will be assessed and determined by the Department of Planning under Part 3A of the Environmental Planning and Assessment Act.

The development will be designed and constructed in stages. This report addresses noise impacts to and from Building A of the proposed development

As a result of our assessment of the proposed development, the following potential acoustic issues were identified;

- Traffic noise from Herring Road intruding into the proposed development.
- Ground-borne rail noise and vibration intruding from train pass-bys in the underground Epping to Chatswood railway line located approximately 250m to the north of the development into noise-sensitive areas of the proposed development.
- Noise emission from the operation of the proposed development including rooftop mechanical plant and HVAC plant located on the building facades impacting upon surrounding existing premises and later stages of the proposed development.
- Noise and vibration generated from construction activities and equipment impacting upon existing premises.

This report presents an assessment of the above acoustic components in terms of the Director-General's Requirements, current Australian Standards, State Environment Planning Policies and Guidelines, NSW Department of Environment, Climate Change and Water (DECCW) Policy and requirements of City of Ryde Council.

External Noise Intrusion into the Development

External noise intrusions into the development have been assessed in accordance with relevant Australian Standards, State Environment Planning Policies, NSW Department of Planning Guidelines and DECCW Policy documents. The major noise intrusion source was identified as road traffic noise. Regenerated noise and vibration from the underground railway lines and aircraft noise were also investigated but found not to be an impact upon the proposed site.

On the basis of the external noise impacting upon the development site, appropriate design of the building envelope is required to achieve a suitable indoor amenity for occupants. Our assessment has established minimum acoustic ratings for elements on external building facades.

Noise Emission Generated by the Development

Noise from mechanical plant such as exhaust systems, air-conditioning, mechanical ventilation and refrigeration associated with the development has the potential to impact on other residential properties within the proposed development and nearby residential, commercial and educational properties. As details of mechanical plant are not available at this stage of the development in-principle noise control advice are present in this report.

Construction Noise

The major construction activities proposed on this site are excavation works, concrete pours and general building works. Construction and building work will be adequately managed so as to minimise disruption to the local community and the environment. As details of construction equipment and operating time are not available at this stage of the project, in-principle noise and vibration measures are provided in this report.

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1 INTRODUCTION

Renzo Tonin & Associates were engaged to assess noise and vibration impacts onto and from the proposed residential development at 128 Herring Road, Macquarie Park to accompany an application for a Part 3A Concept Plan approval. This report addresses noise impacts to and from Building A of the proposed development

This study examines the effects of external noise intrusion on the proposed development from road traffic noise. Noise surveys have been conducted by Renzo Tonin & Associates between 8th and 16th December 2009 at the development site to determine the existing levels of traffic noise affecting the site. These levels were used to predict noise levels within the residential dwellings, and then assessed against the recommended internal noise criteria for the project.

From our assessment of the proposed development, the following potential acoustic issues were identified:

- Traffic and bus noise associated with Herring Road, Macquarie Park
- Noise associated with buses using Herring Road, Macquarie Park
- Rail noise and vibration associated with the Epping to Chatswood line
- Aircraft noise associated with Sydney Airport (Kingsford Smith Airport)

The existing ambient environment at the proposed development site has been established through long-term noise monitoring undertaken between 8th and 16th December 2009. Noise emission from the buildings will be controlled by use of standard silencing treatments to mechanical plant to be located on the rooftop and along the building facade.

The apartment construction will incorporate all necessary acoustic controls to comply with the requirements outlined in Part 5 of the Building Code of Australia 2009.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

2 NOISE SOURCES

2.1 Road Traffic

The proposed development site, Building A is located along Herring Road, which consists of 2 lanes of traffic in both directions. Based on the traffic report prepared by Colston Budd Hunt & Kafes, Herring Road has approximately 31,000 vehicles per day including approximately 2,500 vehicles in both AM and PM peak hours.

In addition, numerous Sydney Bus routes utilise Herring Road, including a bus stop in front of the proposed site.

2.2 Aircraft

The proposed development site is located approximately 20km to the north of Sydney Airport and aircraft departing and landing on main north-south runway have the potential to fly over or near the development site.

Aircraft Noise Exposure Forecast (ANEF) Maps are produced for Sydney Airport. The current map is ANEF 2029, predicting aircraft noise exposure to the year 2029. The map shows contours 20, 25, 30, 35, and 40 where the higher the number the greater the exposure to aircraft noise.

The proposed development lie outside the ANEF 20 contour as shown on the ANEF 2029 map in Appendix D.

2.3 Rail

The proposed development site is located approximately 250m away from the underground rail tunnel known as the “Epping to Chatswood link”. This railway line opened in 2009.

The Epping to Chatswood line is a dedicated passenger service with no freight. The tunnel and tracks have been acoustically treated in such a way as to minimise the impact on the surrounding environment, including vibration isolation of the rail tracks.

3 INTERNAL NOISE CRITERIA

3.1 Road Traffic Noise

A number of documents were taken into account when determining suitable criteria for the proposed development site. These included:

1. Director-General's Requirements for the proposed development
2. State Environment Planning Policy (Infrastructure) 2007 (the "ISEPP')
3. Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008
4. Australian Standard AS2107:2000 "Recommended Design Sound Levels and Reverberation Times for Building Interiors"
5. City of Ryde Council DCP 2006
6. City of Ryde Council Draft LEP 2008

The Annual Average Daily Traffic (AADT) volume for Herring Rd according to RTA published data for 2005 is over 31,000 vehicles per day. In addition, Colston Budd Hunt & Kafes Pty Ltd have measured and predicted AM and PM peak traffic volumes for Herring Road (Refer to report Reference 7085/1 for the development site), which has been used in calculating peak hour traffic noise levels, presented below.

Therefore an acoustic assessment in accordance with the ISEPP is not mandatory (>40,000 AADT), but is recommended (20,000 – 40,000 AADT), in accordance with the RTA Traffic Volume Maps for Infrastructure SEPP.

Therefore, the criteria set out in Clause 102 of the ISEPP has been considered, along with the abovementioned documents, when determining suitable internal traffic noise limits for the proposed development.

Table 1 below summaries the airborne traffic noise criteria recommended for the proposed developments.

Table 1 – Recommended Internal Noise Criteria for Road Traffic Noise

Occupancy	Period	Maximum Noise Level
Bedroom	Night time (10pm – 7am)	35 dB(A) LAeq, 9 hour
	1 hour peak	40dB(A) LAeq, 1 hour
Living / Dining/ Kitchen Areas	Day time (7am – 10pm)	40 dB(A) LAeq, 15 hour
	1 hour peak	45dB(A) LAeq, 1 hour

3.2 Aircraft Noise

Potential aircraft noise affecting the proposed development site has been addressed in accordance with Australian Standard AS2021:2000 "Aircraft Noise – Building Siting and Construction".

Table 2 below, presents the acceptability of the building site, dependent on the type of building proposed and on the ANEF zone in which it is to be located

Table 2 - ANEF Zone of Site

Building Type	ANEF Zone of Site		
	Acceptable	Conditionally Acceptable	Unacceptable
House, home unit, flat, caravan park	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF

The proposed development site lies well outside the ANEF 20 contour for Sydney Airport of ANEF 2029 contour map, therefore the development is considered "Acceptable".

Predictions to the year 2029, from Sydney Airport Masterplan 2029 (Figure 14.4, N70 Contours 2029) indicate that 10-20 aircraft noise events greater than L_{max} 70dB(A) will impact on the proposed development site.

3.3 Rail Noise and Vibration

3.3.1 Airborne Rail Noise

The airborne rail noise criteria for this development are based on the following documents:

1. State Environment Planning Policy (Infrastructure 2007)
2. Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008

The noise criteria outlined in the documents listed were considered and Table 3 below summaries the airborne rail noise criteria determined suitable for this development.

Table 3 – Recommended Internal Noise Criteria for Rail Noise

Occupancy	Period	Maximum Noise Level
Apartments		
Living areas	7am – 10pm	40 dB(A) LAeq, 15hr
Sleeping areas	10pm – 7am	35 dB(A) LAeq, 9hr

3.3.2 Rail Vibration

The Department of Planning publication "Development Near Rail Corridors & Busy Roads – Interim Guideline", Section 3.6.3 outlines the following documents which recommend train vibration criteria for residential buildings.

1. Assessing Vibration: A technical guideline (DECC 2006)
2. German Standard DIN 4150, Part 3 1999
3. British Standard BS 7385 Part 2 1993
4. Australian Standard AS2670.2 1990

The above documents have been reviewed and the criterion for assessment of vibration from train pass-bys affecting the proposed development is quantified using the following Standards:

- Assessing Vibration: A technical guideline (DECC 2006)
- British Standard BS6472:1992 *"Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)"*

The criteria curves presented in BS6472:1992 are identical to those in Australian Standard AS2670.2 1990 and International Standard 2631-2:1989.

In addition, Table 2.4 of the Department of Environment Climate Change and Water's document "Assessing Vibration: A technical guideline (DECCW 2006)" presents acceptable vibration dose values for intermittent vibration.

Table 4 – Acceptable VDVs for intermittent vibration $m/s^{1.75}$

Period	Preferred VDV $m/s^{1.75}$
Day time (7am – 10pm)	0.2
Night time (10pm – 7am)	0.13

3.3.3 Ground-borne Rail Noise

Ground-borne noise, or regenerated noise, is noise propagating through the ground and into the building structure. The vibration of the building structure is then radiated as airborne noise. Ground-borne noise is common in developments adjoining rail tunnels.

Ground-borne rail noise criteria are presented in:

- Planning NSW's publication "Development Near Rail Corridors & Busy Roads – Interim Guideline"

Table 5 below summaries the ground-borne railway noise criteria recommended for the proposed development. Ground-borne noise is calculated as Lmax (slow) for 95% of rail pass-by events.

Table 5 – Recommended Criteria for Ground-Borne Railway Noise in Residential Buildings

Building Occupancy	Period	Maximum Ground-Borne Railway Noise Level L_{AMax}
Sleeping Areas (bedrooms)	Night (10pm – 7am)	35 dB(A)
Other habitable rooms (excluding garages, kitchens, bathrooms and hallways)	At any time	40 dB(A)

4 MEASURED TRAFFIC NOISE LEVELS

4.1 Long-term Noise Survey

Two RTA Technology Environmental Noise Loggers were set up for the ambient noise survey from Tuesday 8th December to Wednesday 16th December 2009. One logger was installed at the boundary of the site facing Herring Road. The other logger was installed at the rear of the site near existing accommodation buildings (refer to Appendix C).

The noise logger records noise levels on a continuous basis and stores data every fifteen minutes. The noise loggers were calibrated before and after measurements and no significant deviation in calibration was noted. The noise monitoring equipment used here complies with Australian Standard 1259.2-1990 "Acoustics - Sound Level Meters" and is designated as Type 2 instruments suitable for field use.

The dates of measurement and the results obtained from the logger surveys are shown in Appendix C.

4.2 Short-term Noise Survey

Traffic noise levels were measured along the boundary of the site facing Herring Road. These levels were used to predict traffic noise levels at the facade of the building.

Details of short-term measurements are presented in Appendix C.

4.3 Calculated Noise Levels

Results from the noise surveys were used to calculate internal noise levels within the proposed development. Noise calculations were performed using glazing design software developed in this office which takes into account external noise levels, facade transmission loss and room sound absorption characteristics.

4.4 External Traffic Noise Levels

Short-term measurements were performed along Herring Road. These noise levels were correlated with the results of long-term monitoring and used to determine traffic noise levels at the facade of the development.

In addition, the traffic noise levels generated by the new boulevard into the site have been predicted at the building facades.

The design external traffic noise levels are presented below

Table 6 – External Traffic Noise Levels

Facade	Period	Traffic Noise Level LAeq
Herring Road	Day time (7am to 10pm)	71 dB(A)
	Night time (10pm to 7am)	63 dB(A)
	1 hour maximum	74 dB(A)
Internal Access Road (predicted noise level at building facade)	1 hour maximum	49 dB(A)*

Note: Traffic noise levels on internal road are based on AM and PM peak hour predictions from Colton Budd Hunt & Kafes Pty Ltd (Reference 7085/1, Table 3.1)

5 CONTROL OF EXTERNAL NOISE

5.1 Traffic Noise Intrusion – Facade/Glazing Design

The following table presents the recommended in-principle glazing selections for facades of the proposed development at Building A - 128 Herring Road, Macquarie Park.

Table 7 – Recommended Acoustic Performance of Glazing Assembly

Façade	Level	Occupancy	Required Acoustic Rating of Glazing Assembly, R_w
Building A			
Eastern Facade facing Herring Road	All levels	Bedrooms	Rw 35
		Living Areas	Rw 35
Northern Facade	All levels	Bedrooms	Rw 35
		Living Areas	Rw 35
Southern Facade	All levels	Bedrooms	Rw 35
		Living Areas	Rw 35
Western Facade	All levels	Bedrooms	Rw 32
		Living Areas	Rw 32

Notes:

The client is advised not to commence detailing or otherwise commit to partition construction systems which have not been tested in an approved laboratory or for which an opinion only is available. Testing of partition construction systems is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested partition construction systems, estimates or opinions. The advice provided here is in respect of acoustics only.

The information in this table is provided for the purpose of Authority approvals process and cost planning and shall not be used for construction unless otherwise approved in writing by the acoustic consultant.

The design in this table is preliminary and a comprehensive assessment shall be conducted prior to Construction Certification.

Before committing to any form of construction or committing to any builder, advice should be sought from an acoustic consultant to ensure that adequate provisions are made for any variations which may occur as a result of changes to the form of construction where only an "estimate" is available for the sound insulation properties of recommended materials.

The glazing supplier shall ensure that installation techniques will not diminish the R_w performance of the glazing when installed on site.

All openable glass windows and doors shall incorporate full perimeter acoustic seals equivalent to Q-Lon, which enable the R_w rating performance of the glazing to not be reduced.

In order to achieve and comply with the indoor sound levels outlined in Table 1, windows and doors of apartments facing Herring Road are to be kept closed. This may affect the ventilation requirements for the rooms located on this facade. We recommend that supplementary professional advice from a mechanical consultant be sought to comply with the requirements of AS1668 and the Building Code of Australia.

5.1.1 Doors and Window Seals

Wherever a minimum acoustic rating of Rw 32 is recommended in the tables above, the dwelling design should also include special acoustic grade seals installed on windows and perimeter doors exposed to road traffic noise.

5.2 Aircraft Noise Intrusion

The development lies within the “Acceptable” zone in accordance with the Australian Standard AS2021:2000 and it is predicted that there will be between 10 and 20 aircraft noise events greater than 70dB(A) per day.

Therefore, in compliance with the maximum internal noise levels stipulated by the Australian Standard, the proposed building envelope will prevent aircraft noise intrusion into the proposed development site and no additional acoustic treatment is required.

5.3 Rail Noise and Vibration

From our experience on similar projects with railway tunnels located at distance greater than 60m from noise/vibration sensitive buildings, the impact ground-borne noise and vibration upon occupants is insignificant and requirement for specific building mitigation is highly unlikely.

Due to the location of the site in relation to the underground rail tunnel (approximately 250m) and the exiting vibration isolation treatment to the railway tracks within the tunnel, noise and vibration isolation treatment to the building is not required.

6 EXTERNAL NOISE EMISSION FROM BUILDING SERVICES

The NSW Department of Environment and Climate Change and Water (DECCW) sets out noise criteria in its Industrial Noise Policy (INP) to control the noise emission from industrial sources. This advice is also applicable as a guideline for commercial premises and residential apartment buildings incorporating air-conditioning and ventilation plant.

The applicable noise limits, according to the policy, are determined as follows:

Table 8– LAeq Design Criterion for Noise Production (DECCW INP)

	Column 1	Column 2	Column 3	Column 4
Time of Day	Rating Background Level (RBL) L90	Intrusiveness Criterion (RBL+5)	Amenity Criterion (Acceptable)	Project Specific Design Criterion LAeq
Day (7am to 6pm)	46	51	55	51
Evening (6pm to 10pm)	40	45	45	45
Night (10pm to 7am)	35	40	40	40

Explanatory notes:
1. Column 3 – Recommended L_{Aeq} noise level based on 'Residence – Suburban' area in Section 2.2, Table 2.1 Amenity Criteria (Recommended L_{Aeq} noise levels from industrial noise sources) of the DECCW's INP.
2. Column 4 – Project Specific Design Criterion based on DECCW's INP. Lower of Columns 2 and 3.

Where necessary, noise amelioration treatment will be incorporated in the design to ensure that noise levels comply with the recommended DECCW's INP noise emission criteria noted above.

Proposed mechanical plant for the development includes apartment air conditioning, car park ventilation, apartment ventilation fans, and miscellaneous ventilation fans. Mechanical plant has the potential to impact on surrounding residential, commercial and educational premises, including later stages of the proposed development.

Although at this stage details of mechanical plant have not been finalised, the following in-principal advice are provided.

- Acoustic assessment of mechanical services equipment will need to be undertaken during the detail design phase of the development to ensure that they shall not either singularly or in total emit noise levels which exceed the noise limits in DECCW's Industrial Noise Policy;

- As noise control treatment can affect the performance of the mechanical services system, it is recommend that consultation with an acoustic consultant be made during the initial phase of mechanical services system design in order to reduce the need for revision of mechanical plant and noise control treatment;

    - procurement of 'quiet' plant,

- strategic positioning of plant away from sensitive neighbouring premises, maximising the intervening shielding between the plant and sensitive neighbouring premises,
- commercially available silencers or acoustic attenuators for air discharge and air intakes of plant;
- acoustically lined and lagged ductwork;
- acoustic screens and barriers between plant and sensitive neighbouring premises; and/or
- partially-enclosed or fully-enclosed acoustic enclosures over plant.

- Mechanical plant noise emission can be controllable by appropriate mechanical system design and implementation of common engineering methods that may include any of the following:

- Mechanical plant shall have their noise specifications and their proposed locations checked prior to their installation on site; and

- Fans shall be mounted on vibration isolators and balanced in accordance with Australian Standard 2625 “Rotating and Reciprocating Machinery – Mechanical Vibration”.

7 INTERNAL SOUND INSULATION

As a minimum requirement, walls and floors shall comply with Building Code of Australia (BCA). Soil and waste pipes shall comply with the minimum requirements of the Building Code of Australia (BCA). Appendix B presents a summary of acoustic provisions outlined in Part F5 of the BCA.

7.1 Acoustic Criteria

7.1.1 BCA 2009 Requirements

The acoustic provisions for inter-tenancy walls in Class 2 buildings are outlined in the Building Code of Australia and the following is an extract from the BCA:

F5.2 Determination of airborne sound insulation ratings

A form of construction required to have an airborne sound insulation rating must –

(a) have the required value for weighted sound reduction index (R_w) or weighted sound reduction index with spectrum adaptation term ($R_w + C_{tr}$) determined in accordance with AS/NZS 1276.1 or ISO 717.1 using results from laboratory measurements; or

*(b) comply with **Specification F5.2**.*

F5.3 Determination of impact sound insulation ratings

(a) A floor in a building required to have an impact sound insulation rating must –

(i) have the required value for weighted normalised impact sound pressure level with spectrum adaptation term ($L_{n,w}+C_I$) determined in accordance with AS/ISO 717.2 using results from laboratory measurements; or

*(ii) comply with **Specification F5.2**.*

(b) A wall in a building required to have an impact sound insulation rating must –

(i) for a Class 2 or 3 building be of discontinuous construction; and

(c) For the purposes of this Part, discontinuous construction means a wall having a minimum 20 mm cavity between 2 separate leaves, and

(i) for masonry, where wall ties are required to connect leaves, the ties are of the resilient type; and

(ii) for other than masonry, there is no mechanical linkage between leaves except at the periphery.

F5.4 Sound insulation rating of floors

(a) A floor in a Class 2 or 3 building must have an $R_w + C_{tr}$ (airborne) not less than 50 and an $L_{n,w}+C_I$ (impact) not more than 62 if it separates –

(i) sole-occupancy units; or

(ii) a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification.

F5.5 Sound insulation rating of walls

(a) A wall in a Class 2 or 3 building must –

(i) have an $R_w + C_{tr}$ (airborne) not less than 50, if it separates sole-occupancy units; and

(ii) have an R_w (airborne) not less than 50, if it separates a sole-occupancy unit from a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification; and

*(iii) comply with **F5.3(b)** if it separates:*

(A) a bathroom, sanitary compartment, laundry or kitchen in one sole-occupancy unit from a habitable room (other than a kitchen) in an adjoining unit; or

(B) a sole-occupancy unit from a plant room or lift shaft.

(b) A door may be incorporated in a wall in a Class 2 or 3 building that separates a sole-occupancy unit from a stairway, public corridor, public lobby or the like, provided the door assembly has an R_w not less than 30.

(e) Where a wall required to have sound insulation has a floor above, the wall must continue to –

(i) the underside of the floor above; or

(ii) a ceiling that provides the sound insulation required for the wall.

(f) Where a wall required to have sound insulation has a roof above, the wall must continue to –

(i) the underside of the floor above; or

(ii) a ceiling that provides the sound insulation required for the wall.

8 CONSTRUCTION NOISE

8.1 Construction Noise Guidelines

The Department of Environment Climate Change and Water (DECCW) recently released its *Interim Construction Noise Guideline* (ICNG) in 2009. This document is being referred to as DECCW's standard policy for assessing construction noise on new projects.

The key components of the ICNG that can be incorporated into this assessment include:

1. Use of L_{Aeq} as the descriptor for measuring and assessing construction noise.

In recent years NSW noise policies including DECCW's NSW Industrial Noise Policy (INP) and the NSW Environmental Criteria for Road Traffic Noise (ECRTN) have moved to the primary use of LAeq over any other descriptor. As an energy average, LAeq provides ease of use when measuring or calculating noise levels since a full statistical analysis is not required as when using, for example, the LA10 descriptor.

Consistent with the latest guideline (ICNG) the use of LAeq as the key descriptor for measuring and assessing construction noise may follow a 'best practice' approach.

2. Application of feasible and reasonable noise mitigation measures

As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice, and is practical to build given the project constraints.

Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects, including the cost of the measure.

3. Quantitative and qualitative assessment

The ICNG provides two methods for assessment of construction noise, being either a quantitative or a qualitative assessment.

A quantitative assessment is recommended for major construction projects of significant duration, and involves the measurement and prediction of noise levels, and assessment against set criteria.

A qualitative assessment is recommended for small projects with a short-term duration where works are not likely to affect an individual or sensitive land use for more than three weeks in total. It focuses on minimising noise disturbance through the implementation of feasible and reasonable work practices, and community notification.

Given the significant scale of the construction works proposed for this Project, a quantitative assessment is carried out herein, consistent with the ICNG's requirements.

4. Management Levels

Residences

Table 9 below (reproduced from Table 2 of the ICNG) sets out the noise management levels and how they are to be applied. The guideline intends to provide respite for residents exposed to excessive construction noise outside the recommended standard hours whilst allowing construction during the recommended standard hours without undue constraints.

The rating background level (RBL) is used when determining the management level. The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours).

Table 9 - Noise at Residences Using Quantitative Assessment

Time of Day	Management Level L_{Aeq} (15 min)*	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. 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.
	Highly noise affected 75dB(A)	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 relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5dB(A)	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.

** Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.*

Sensitive Land Use

Table 10 below (reproduced from Table 2 of the ICNG) sets out the noise management levels for various sensitive land use developments.

Table 10- Noise at Other Sensitive Land Uses Using Quantitative Assessment

Land use	Management level, L_{Aeq} (15 min) – applies when land use is being utilised
Classrooms at schools and other educational institutions	Internal noise level 45 dB(A)
Hospital wards and operating theatres	Internal noise level 45 dB(A)
Places of worship	Internal noise level 45 dB(A)
Active recreation areas	External noise level 65 dB(A)
Passive recreation areas	External noise level 60 dB(A)
Community centres	Depends on the intended use of the centre. Refer to the 'maximum' internal levels in AS2107 for specific uses.

8.2 General Construction Noise Control Methods

Implementation of noise control measures, such as those suggested in the *Interim Construction Noise Guideline* (ICNG) and Australian Standard 2436-1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites", are expected to reduce predicted construction noise levels. Reference to Australian Standard 2436-1981, Appendix E, Table E1 suggests possible remedies and alternatives to reduce noise emission levels from typical construction equipment. Table E2 in Appendix E presents typical examples of noise reductions achievable after treatment of various noise sources. Table E3 in Appendix E presents the relative effectiveness of various forms of noise control treatment.

Table 11- Relative Effectiveness of Various Forms of Noise Control, dB(A) below presents noise control methods, practical examples and expected noise reductions according to AS2436 and according to Renzo Tonin & Associates' opinion based on experience with past projects.

Table 11- Relative Effectiveness of Various Forms of Noise Control, dB(A)

Noise Control Method	Practical Examples	Typical noise reduction possible in practice		Maximum noise reduction possible in practice	
		AS 2436	Renzo Tonin & Assoc.	AS 2436	Renzo Tonin & Assoc.
Screening	Acoustic barriers such as earth mounds, temporary or permanent noise barriers	7 to 10	5 to 10	15	15
Acoustic Enclosures	Engine casing lagged with acoustic insulation and plywood	15 to 30	10 to 20	50	30
Engine Silencing	Residential class mufflers	5 to 10	5 to 10	20	20
Substitution by alternative process	Use electric motors in preference to diesel or petrol	15 to 25	15 to 25	60	40

The Renzo Tonin & Associates' listed noise reductions are conservatively low and should be referred to in preference to those of AS2436, for this assessment.

Table 12- Noise Control Measures for Expected Construction Plant below identifies possible noise control measures which are applicable on the construction plant likely to be used on site.

Table 12- Noise Control Measures for Expected Construction Plant

Plant Description	Screening	Acoustic Enclosures	Silencing	Alternative Process
Concrete Saw	✔	✔	x	x
Jack hammers	✔	x	✔	x
Mobile Crane	✔	✔	✔	x
Front End Loader	✔	x	✔	x
Pneumatic Hand Tools (general)	✔	✔	✔	✔
Bulldozer	✔	x	✔	x
Tracked Excavator	✔	x	✔	x
Concrete Trucks	✔	x	✔	x
Delivery Trucks	✔	x	✔	x
Dump Trucks	✔	x	✔	x
Truck (> 20 tonne)	✔	x	✔	x
Welders	✔	✔	x	x
Cherry Picker	✔	x	✔	x
Concrete Pump	✔	✔	✔	✔
Power Generator	✔	✔	✔	x
Light commercial vehicles	✔	x	✔	x
Silenced Air Compressor	✔	✔	✔	✔

To ensure efficient noise attenuation performance is achieved using any of the methods listed above, it is recommended acoustic engineers work closely with the construction contractors and carry out preliminary testing prior to commencement of works.

In addition to physical noise controls, the following general noise management measures should be followed:

- Plant and equipment should be properly maintained
- Provide special attention to the use and maintenance of 'noise control' or 'silencing' kits fitted to machines to ensure they perform as intended
- Strategically position plant on site to reduce the emission of noise to the surrounding neighbourhood and to site personnel
- Avoid any unnecessary noise when carrying out manual operations and when operating plant
- Any equipment not in use for extended periods during construction work should be switched off
- Noise compliance monitoring for all major equipment and activities on site should be undertaken prior to their commencement of work on site.
- In addition to the noise mitigation measures outlined above, a management procedure would need to be put in place to deal with noise complaints that may arise from construction activities. Each complaint would need to be investigated and appropriate noise amelioration measures put in place to mitigate future occurrences, where the noise in question is in excess of allowable limits.
- Good relations with people living and working in the vicinity of a construction site should be established at the beginning of a project and be maintained throughout the project, as this is of paramount importance. Keeping people informed of progress and taking complaints seriously and dealing with them expeditiously is critical. The person selected to liaise with the community should be adequately trained and experienced in such matters.

Where noise level exceedances cannot be avoided, then consideration should be given to implementing time restrictions and/or providing periods of repose for neighbouring receptors.

9 CONCLUSION

Renzo Tonin & Associates have completed an acoustic assessment of road traffic noise, aircraft noise and ground-borne rail noise and vibration impacts onto the proposed residential development site at 128 Herring Road, Macquarie Park, Building A.

The study of external noise and vibration intrusion into the subject development has found that appropriate controls can be incorporated into the building design to achieve a satisfactory accommodation environment consistent with the intended quality of the building and relevant standards.

In principle acoustic advice and noise management measures have been provided to appropriately address potential impact from construction equipment and mechanical plant located on the rooftop and facades of the building.

APPENDIX A - GLOSSARY OF ACOUSTIC TERMS

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period	The period in a day over which assessments are made.
Assessment Point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background Noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).

Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB Martin Place at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A):	A-weighted decibels The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the “A” filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.

Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
Lmax	The maximum sound pressure level measured over a given period.
Lmin	The minimum sound pressure level measured over a given period.
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L10	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L90	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
Leq	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound Absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.

Sound Power Level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

BCA Part F5 Terminology	
$L_{n,w}$	A measure of the noise impact performance of a floor. It is measured in very controlled conditions in a laboratory and is characterised by how much sound reaches the receiving room from a standard tapping machine. The term is referred to as the Weighted Normalised Impact Sound Pressure Level. It is a laboratory measure of the amount of impact sound reaching a space via the ceiling/floor overhead. The lower the number the better the performance.
$L_{nT,w}$	A measure of the noise impact performance of a floor. It is characterised by how much sound reaches the receiving room from a standard tapping machine. It is measured in the field and is therefore subject to the inherent inaccuracies involved in such a measurement. The term is referred to as Weighted Standardised Impact Sound Pressure Level. It is a field measure of the amount of impact sound reaching a space via a floor. The equivalent field measurement to $L_{n,w}$, laboratory measurement. The lower the number the better the performance.

C_I	A value used to modify the measured impact sound pressure level, $L_{n,w}$ or $L_{nT,w}$. Impact sound is generated by a laboratory grade tapping machine placed on the floor to be tested. This tapping machine does not accurately simulate the noise below of a person's footsteps on the floor above, so the C_I value was developed to more closely simulate foot step noise. The value is referred to as a spectrum adaptation value and is defined in ISO 717-2. The $L_{n,w}$ or $L_{nT,w}$ alone is sufficient to characterise concrete floors covered with carpet. Other types of floors such as timber joist floors, bare concrete floors or polished timber or tiles laid on concrete floors require the C_I value to properly characterise footstep noise. Timber joist floors can have a C_I, value slightly positive. Concrete floors with an effective covering such as carpet have C_I values approximately equal to 0dB. Concrete floors with a hard, or less effective covering, can have C_I values varying between -15dB and 0 dB. Positive C_I values are more favourable than negative values.
R_w	A measure of the sound insulation performance of a building element. It is measured in very controlled conditions in a laboratory. The term is referred to as the Weighted Sound Reduction Index and is a laboratory measurement similar to STC. All BCA references to STC have been removed and upgraded to refer to either R_w or R_w + C_{tr}. R_w is measured and calculated using the procedures from AS/NZS 1276 and AS 1191. The related field measurement is the $D_{nT,w}$ The higher the number the better the performance

$D_{nT,w}$	A measure of the sound insulation performance of a building element. It is characterised by the difference in noise level on each side of a wall or floor. It is measured in the field and is therefore subject to the inherent inaccuracies involved in such a measurement. The term is referred to as the Weighted Standardised Field Level Difference and it indicates the level of speech privacy between spaces. It is a field measurement that relates to the Rw laboratory measurement. The higher the number the better the insulation performance.
C_{tr}	A value used to modify the measured sound insulation performance of a wall or floor. This sound insulation performance can be described by the R_w or the $D_{nT,w}$ terms but these are not accurate for all noises, especially for low frequency bass noise from modern stereo systems. The value is referred to as a spectrum adaptation value and is added to either the R_w or $D_{nT.w}$. AS/NZS 1276 sets out testing methodologies for the sound insulation properties of building elements and incorporates these factors and explains their use. The C_{tr}, for a building element varies according to the insulating material employed. For example, a 90 mm cavity brick masonry wall has a C_{tr}, value of -6, as does a wall constructed of 150 mm core-filled concrete blocks. By contrast, a brick veneer wall may have a C_{tr}, of -12, Smaller negative C_{tr}, values are more favourable than large negative values.

APPENDIX B - ASSESSMENT AND DESIGN METHODOLOGY

B.1 NSW Department of Planning Director-General's Requirements

The DGR's for the proposed development site identify the following issues relating to noise:

- The EA should address the issue of noise impacts and provide details of how these will be managed and ameliorated through the design of the building, in compliance with relevant Australian Standards and the Department's Interim Guidelines for Development near Rail Corridors and Busy Roads.
- The EA shall address noise impacts during the construction phase of the development and address how these will be managed and mitigated in accordance with the "Interim Construction Noise Guideline" (DECCW, 2009)

B.2 SEPP (Infrastructure) 2007

87 Impact of rail noise or vibration on non-rail development

(1) This clause applies to development for any of the following purposes that are on land in or adjacent to a rail corridor and that the consent authority considers is likely to be adversely affected by rail noise or vibration:

a) a building for residential use,

b) a place of public worship,

c) a hospital,

d) an educational establishment or child care centre.

(1) Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.

(2) If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:

(a) in any bedroom in the building—35 dB(A) at any time between 10 pm and 7am,

(b) anywhere else in the building (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.

102 Impact of road noise or vibration on non-road development

(3) This clause applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transitway or any other road with an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data published on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration:

(a) a building for residential use,

(b) a place of public worship,

(c) a hospital,

(d) an educational establishment or child care centre.

(4) Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.

(5) If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:

(c) in any bedroom in the building—35 dB(A) at any time between 10 pm and 7am,

(d) anywhere else in the building (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.

(6) In this clause, freeway, tollway and transitway have the same meanings as they have in the Roads Act 1993.

B.3 Department of Planning – Development near Rail Corridors and Busy Roads – Interim Guideline

The Guideline provides direction for developments that may be impacted by rail corridors and/or busy roads and consideration for the Guideline is a requirement for development specified under the Infrastructure SEPP.

Table 3.1 of the Guideline summaries noise criteria for noise sensitive developments

Residential Buildings		
Type of occupancy	**Noise Level dBA**	**Applicable time period**
Sleeping areas (bedroom)	35	Night 10 pm to 7 am
Other habitable rooms (excl. garages, kitchens, bathrooms & hallways	40	Al any time
Non–Residential Buildings		
Type of occupancy		**Recommended Max Level dBA**
Educational Institutions including child care centres		40
Places of Worship		40
Hospitals	- wards	35
	-other noise sensitive areas	35

Note: airborne noise is calculated as Leq (9h) (night) and Leq (15h)(day). Ground-borne noise is calculated as Lmax (slow) for 95% of rail pass-by events.

B.4 Ryde Council DCP 2006

12.4 Noise

Buildings should be designed so as to minimise noise transmission between dwellings and between the development and that adjoining. Buildings are to comply with the requirements of Part F5 of the Building Code of Australia (Noise Transmission & Insulation).

Walls and ceilings should be adequately insulated, both thermally and acoustically. All water supply, sewerage and sullage drainage facilities must be insulated to the satisfaction of Council against the unreasonable transmission of sound between dwellings.

All noise producing plant such as ventilation equipment, swimming pool motors, air conditioners and the like are to be acoustically treated to the satisfaction of the Director of Environmental Health and Property Services in order to ensure that no noise nuisance is likely to arise.

B.5 Australian/New Zealand Standard AS/NZS 2107:2000

As traffic noise levels are not constant, an L_{eq} noise level descriptor is used when assessing this type of noise source. The L_{eq} is the mean energy level of the noise being measured, and has been found to accurately describe the level of annoyance caused by traffic noise.

This standard provides recommended noise levels for steady state such as noise from building services and quasi-steady state sounds, such as traffic and industrial noise. The noise levels recommended in AS/NZS 2107:2000 take into account the function of the area and apply to the sound level measured within the space unoccupied although ready for occupancy.

This standard recommends the following noise levels for residential and commercial buildings.

Table 13 – Australian / New Zealand Standard AS / NZS 2107:2000 "Acoustic – Recommended design sound levels and reverberation times for building exteriors"

Type of Occupancy	Recommended Design Sound Level dB(A)	
Activity	**Satisfactory**	**Maximum**
Houses in areas with negligible transportation		
Sleeping Areas	25	35
Houses and apartments near minor roads		
Living areas	30	40
Sleeping areas	30	35
Work areas	35	40
Apartment common areas (eg foyer, lift lobby)	45	55
Houses and apartments near major roads		
Living areas	35	45
Sleeping areas	30	40
Work areas	35	45
Apartment common areas (eg foyer, lift lobby)	45	55

B.6 Australian Standard AS 2021:2000

Table 2.1 of Australian Standard AS2021-2000 – "Acoustics – Aircraft Noise Intrusion – Building Siting and Construction" provides zoning information for sites subjected to aircraft noise. The table lists three ANEF Zones, namely, Acceptable, Conditionally Acceptable and Unacceptable, and recommends suitable ANEF levels for different types of buildings.

Table 14– Building Site Acceptability based on ANEF Zones (Table 2.1AS2021)

Building Type	ANEF Zone of Site		
	Acceptable	**Conditionally Acceptable**	**Unacceptable**
House, home unit, flat, caravan park	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25 to 30 ANEF	Greater than 30 ANEF
School, university	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Public building	Less than 20 ANEF	20 to 30 ANEF	Greater than 30 ANEF
Commercial building	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than 30 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

Note: within 20 ANEF to 25 ANEF, some people may find that land is not compatible with residential or educational uses. Land use authorities may consider that the incorporation of noise control features in the construction of residences or schools is appropriate.

In **Acceptable** zones there is usually no need for the building construction to provide protection specifically against aircraft noise.

In **Conditionally Acceptable** zones the maximum aircraft noise levels for the relevant aircraft and the required noise reduction should be determined from the procedures of Clause 3.1 and 3.2, and the aircraft noise attenuation to be expected from the proposed construction should be determined in accordance with Clause 3.3.

In **Unacceptable** zones – construction of the proposed development should not normally be considered.

Table 3.3 of Australian Standard AS2021-2000 also recommends the following internal design noise levels for residential development:

Table 15– Internal Design Sound Levels dB(A) (Table 3.3 AS2021)

Occupancy	Max Noise Level, Lmax dB(A)
Houses, home units, flats, caravan parks	
Sleeping areas, dedicated lounges	50
Other habitable spaces	55
Bathrooms, toilets, laundries	60

Notes:

The above internal sound design levels are the maximum levels from an aircraft flyover which, when heard inside the specified area by the average listener, will be judged as not intrusive or annoying by that listener while carrying out the specified activity. Owing to the variability of subjective responses to aircraft noise, these figures will not provide sufficiently low interior noise levels for occupants who have a particular sensitivity to aircraft noise.

Some of these levels, because of the short duration of individual aircraft flyovers, exceed some other criteria published by Standards Australia for indoor background noise levels (See AS 2107).

APPENDIX C - LOCATION AND RESULTS OF THE NOISE SURVEYS

C.1 Short-term Monitoring Results

Measurement Location	Date	Period	Measured LAeq
Footpath at Herring Road boundary of the site	8/12/2009	4.00pm to 4:15pm	68dB(A)
	16/12/2009	4.00pm to 4:15pm	70dB(A)

C.2 Long-term Monitoring Results

Noise Logger Location 1: 128 Herring Road, Macquarie Park – front of site at boundary facing Herring Road.

Noise Logger Location 2: 120-126 Herring Road, Macquarie Park - rear of site, near existing accommodation buildings.

Survey Period: Monday 7th December to Friday 11th December 2009

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Member of the Association of Australian Acoustical Consultants

Title : Figure 1 - Site Location & Logger Locations

Date : 05/03/10

Scale: NTS

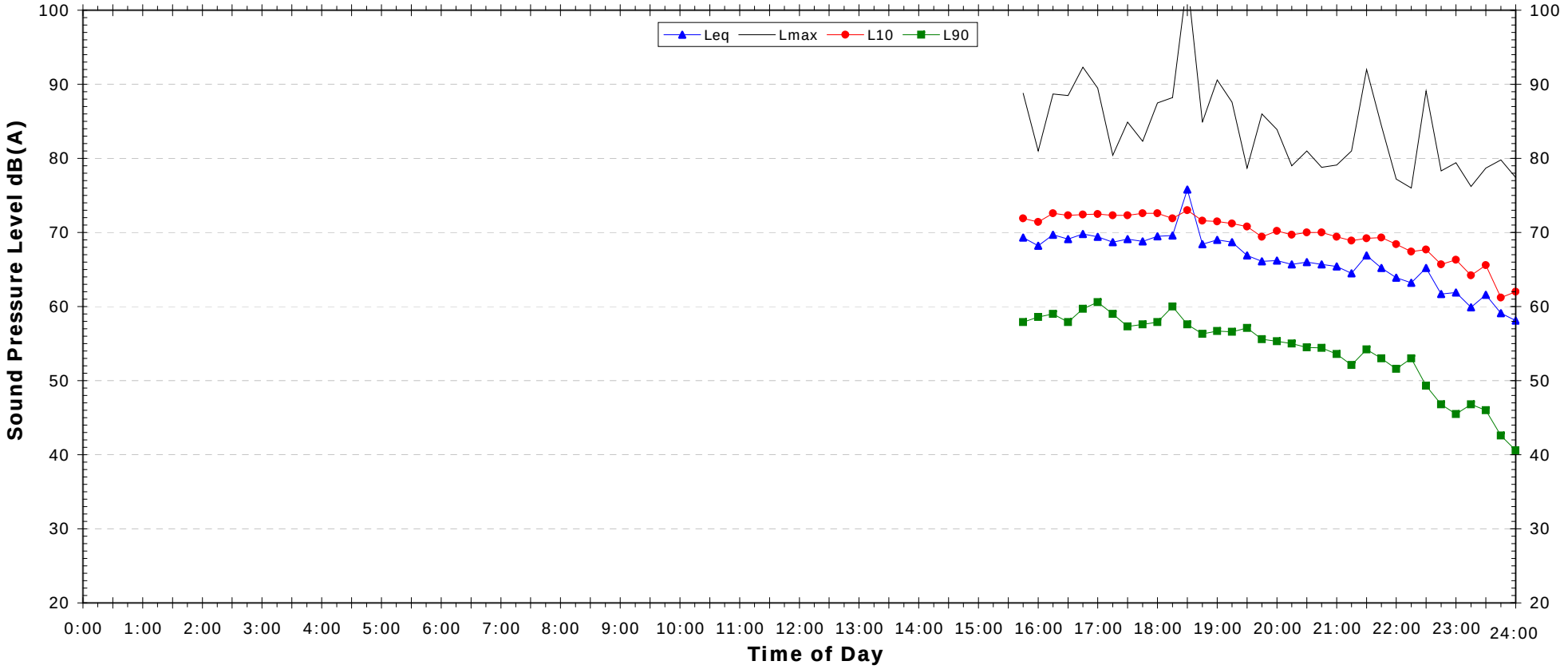
Project: TE701-01 128 Herring Road, Macquarie Park

Ref : TE701-01P01 (rev 0)

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - front of site

Tuesday, 8 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	-	52.1	35.5
Leq (see note 3)	-	68.4	60.7

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	71.2	63.2
$L_{eq\ 1hr}$ upper 10 percentile	74.4	68.9
$L_{eq\ 1hr}$ lower 10 percentile	67.8	53.2

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	73.0	to	89.1
Lmax - Leq (Range)	17.5	to	27.0

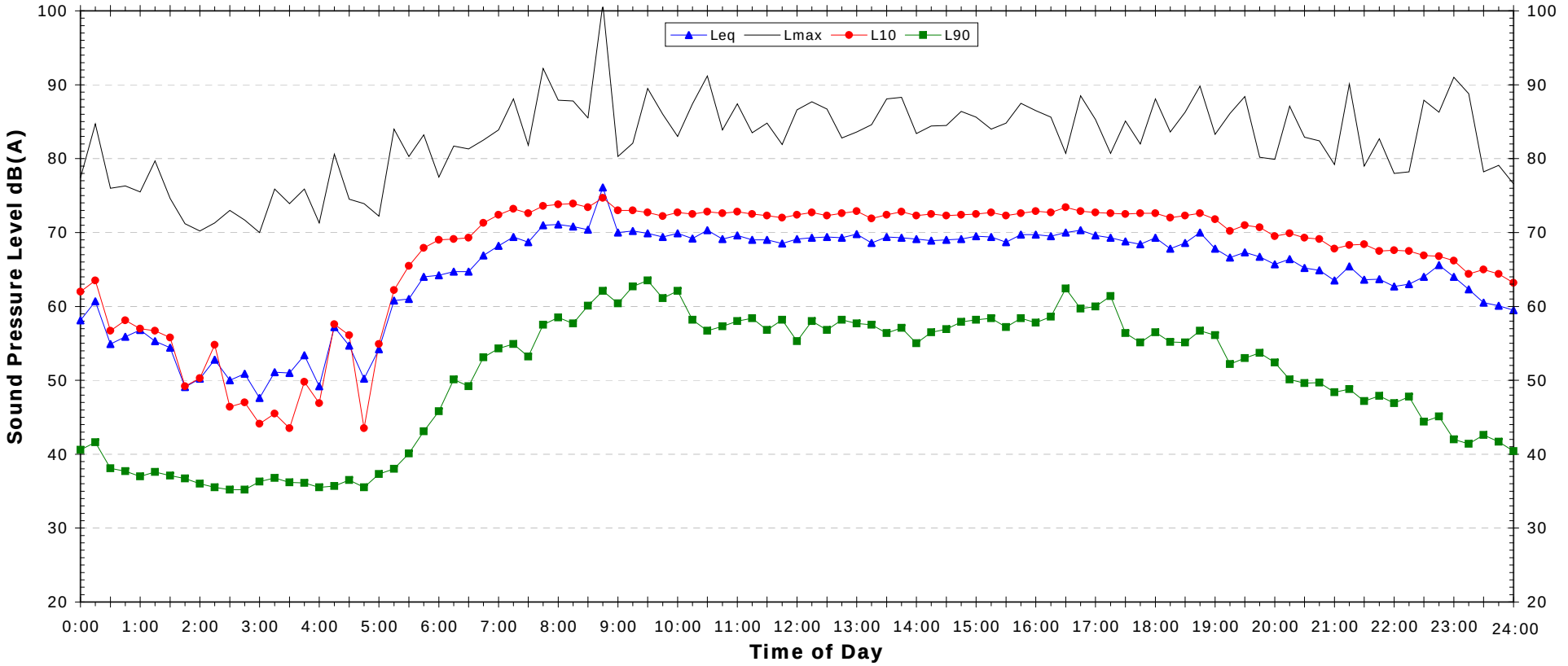
Data File: front of site.xls

Template QTT-01 (rev 55) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - front of site

Wednesday, 9 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	55.3	47.2	36.2
Leq (see note 3)	69.9	66.4	61.3

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	71.7	63.8
$L_{eq\ 1hr}$ upper 10 percentile	74.1	69.2
$L_{eq\ 1hr}$ lower 10 percentile	67.1	54.1

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	78.9	to	91.0
Lmax - Leq (Range)	19.8	to	32.3

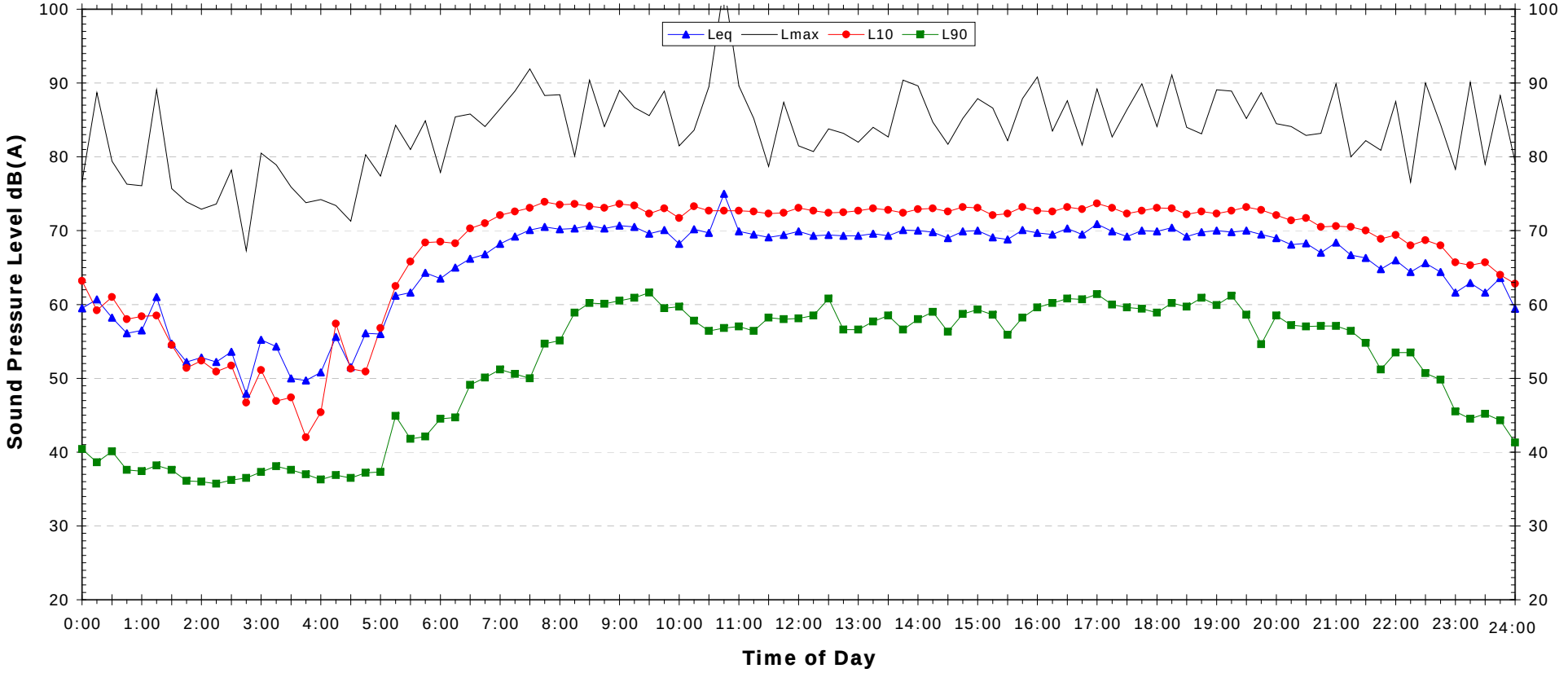
Data File: front of site.xls

Template QTT-01 (rev 55) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - front of site

Thursday, 10 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	55.9	53.5	37.0
Leq (see note 3)	70.0	68.6	61.8

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	72.2	64.3
$L_{eq\ 1hr}$ upper 10 percentile	73.7	69.5
$L_{eq\ 1hr}$ lower 10 percentile	69.6	55.2

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	74.9	to	90.4
Lmax - Leq (Range)	20.8	to	33.4

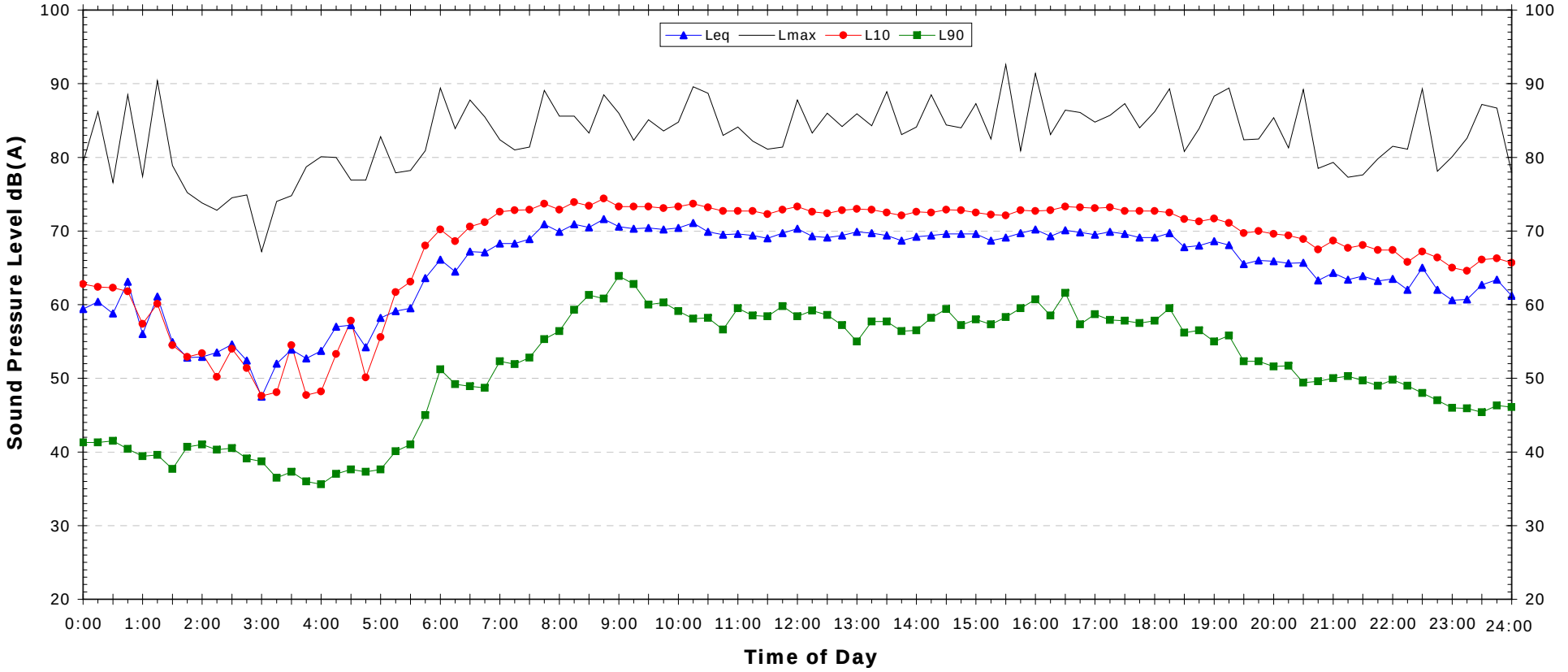
Data File: front of site.xls

Template QTT-01 (rev 55) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - front of site

Friday, 11 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	56.4	49.4	40.8
Leq (see note 3)	69.8	66.3	60.0

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	71.6	62.5
$L_{eq\ 1hr}$ upper 10 percentile	73.1	65.3
$L_{eq\ 1hr}$ lower 10 percentile	66.7	56.4

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	75.5	to	89.3
Lmax - Leq (Range)	19.8	to	28.6

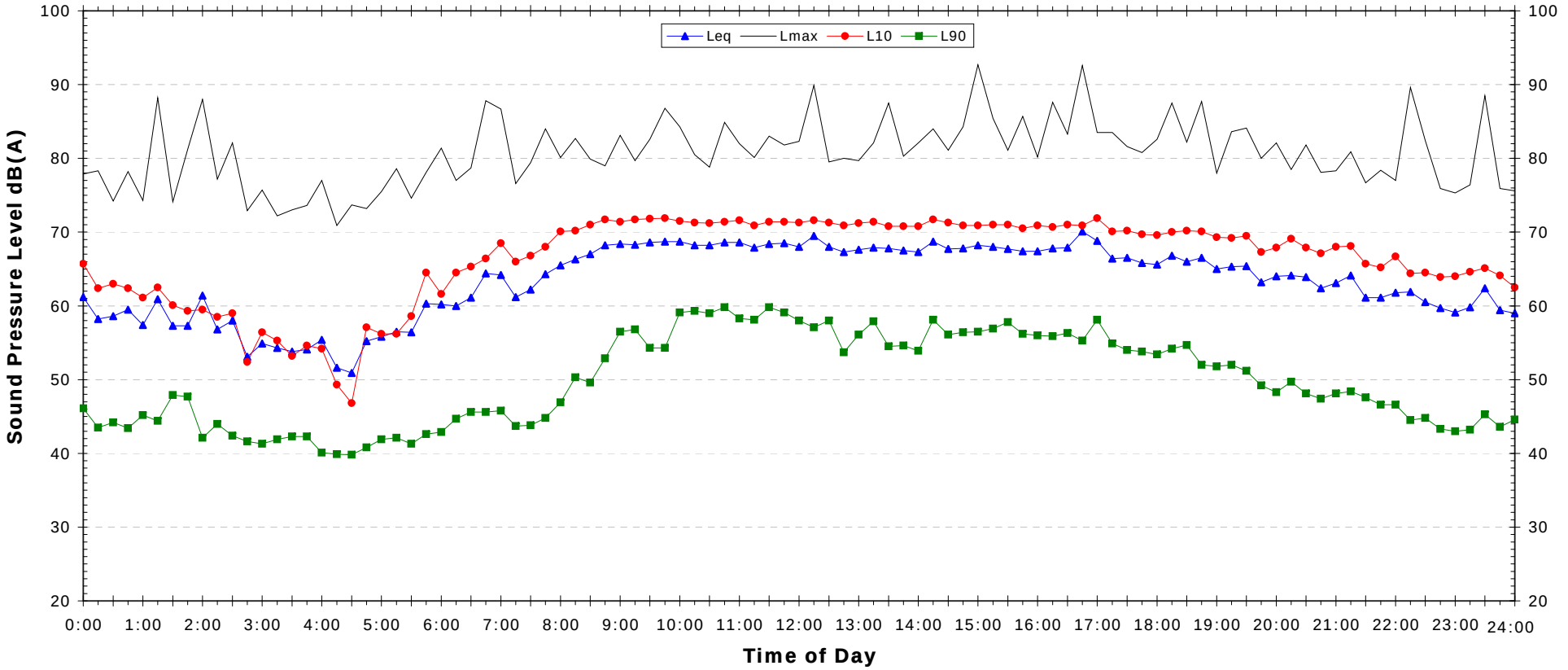
Data File: front of site.xls

Template QTT-01 (rev 55) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - front of site

Saturday, 12 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	49.6	46.6	39.7
Leq (see note 3)	67.7	64.3	58.1

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	69.5	60.6
$L_{eq\ 1hr}$ upper 10 percentile	71.2	62.9
$L_{eq\ 1hr}$ lower 10 percentile	65.4	53.5

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	77.1	to	89.6
Lmax - Leq (Range)	21.0	to	32.1

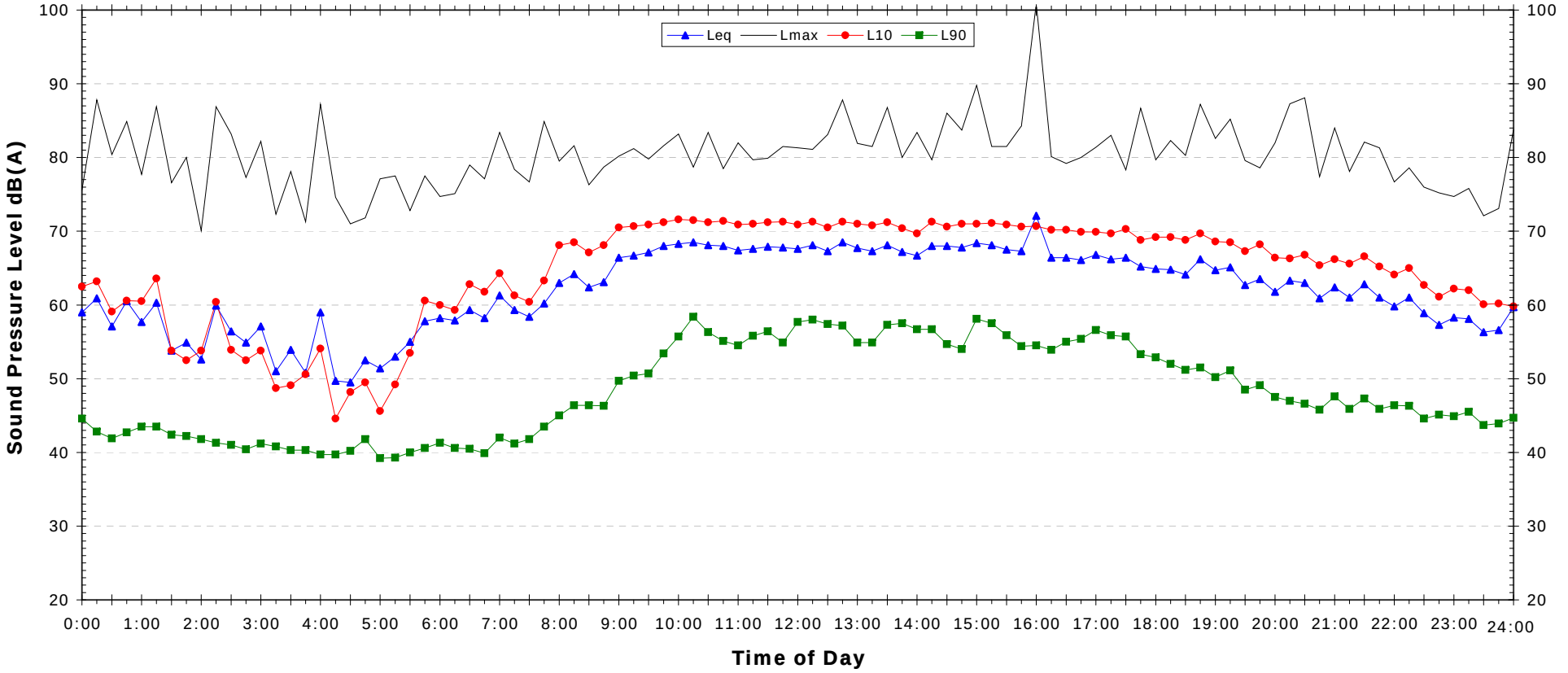
Data File: front of site.xls

Template QTT-01 (rev 55) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - front of site

Sunday, 13 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	46.3	45.9	40.9
Leq (see note 3)	67.1	63.3	58.8

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	68.9	61.3
$L_{eq\ 1hr}$ upper 10 percentile	71.2	67.8
$L_{eq\ 1hr}$ lower 10 percentile	63.5	51.9

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	73.6	to	85.8
Lmax - Leq (Range)	19.5	to	27.4

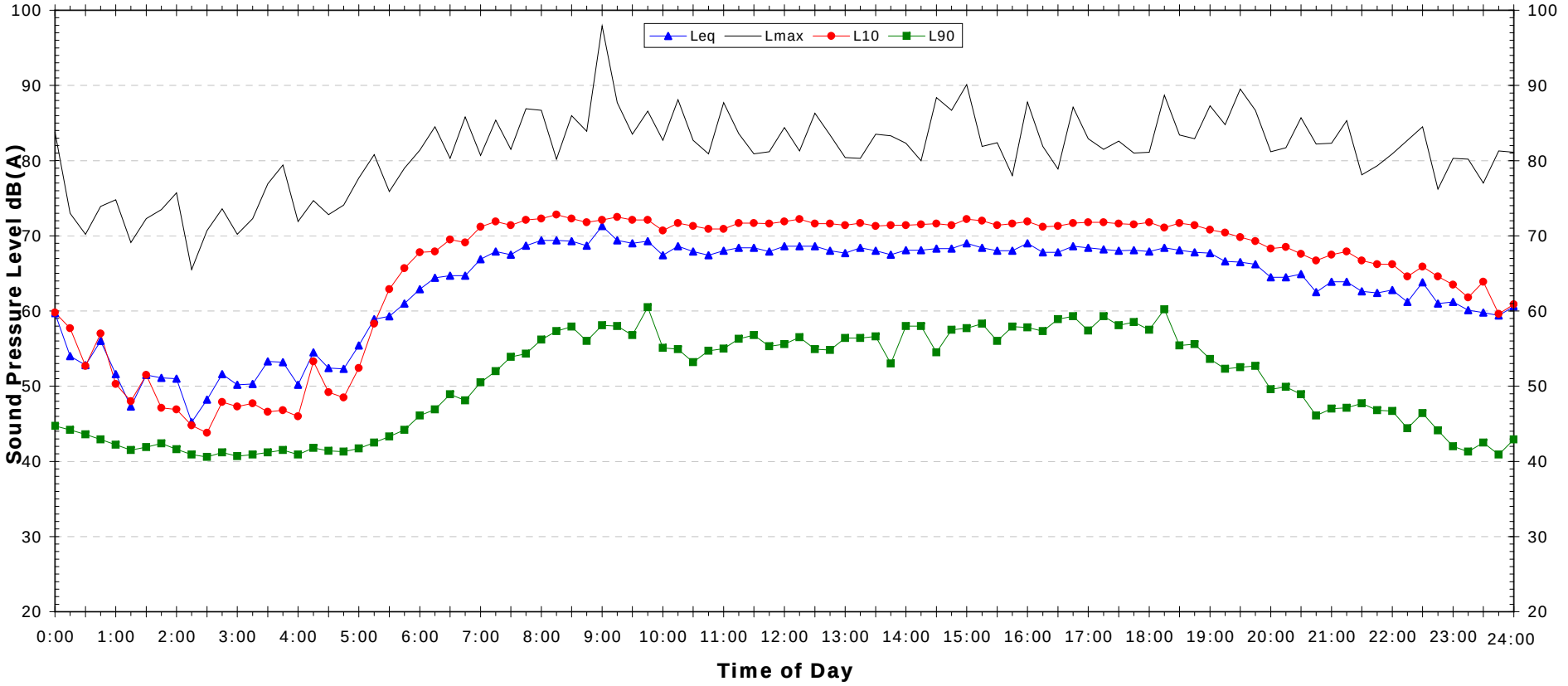
Data File: front of site.xls

Template QTT-01 (rev 55) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - front of site

Monday, 14 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	54.3	46.7	38.1
Leq (see note 3)	68.5	65.7	59.7

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	70.4	62.2
$L_{eq\ 1hr}$ upper 10 percentile	71.8	67.4
$L_{eq\ 1hr}$ lower 10 percentile	66.0	53.3

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	78.4	to	84.8
Lmax - Leq (Range)	19.9	to	29.2

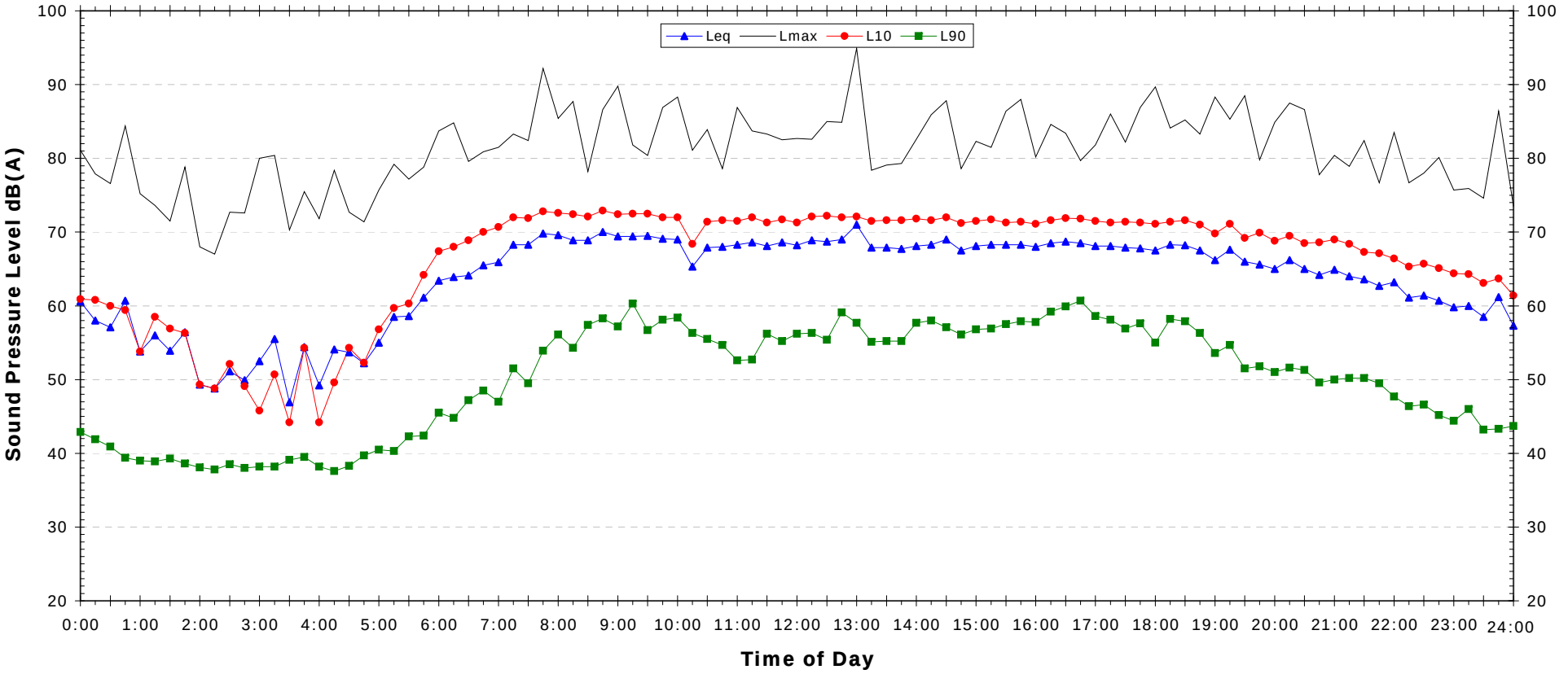
Data File: front of site.xls

Template QTT-01 (rev 55) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - front of site

Tuesday, 15 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	53.9	49.5	40.1
Leq (see note 3)	68.6	65.8	59.7

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	70.5	62.2
$L_{eq\ 1hr}$ upper 10 percentile	71.9	68.0
$L_{eq\ 1hr}$ lower 10 percentile	66.9	53.5

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	71.1	to	86.5
Lmax - Leq (Range)	17.7	to	30.5

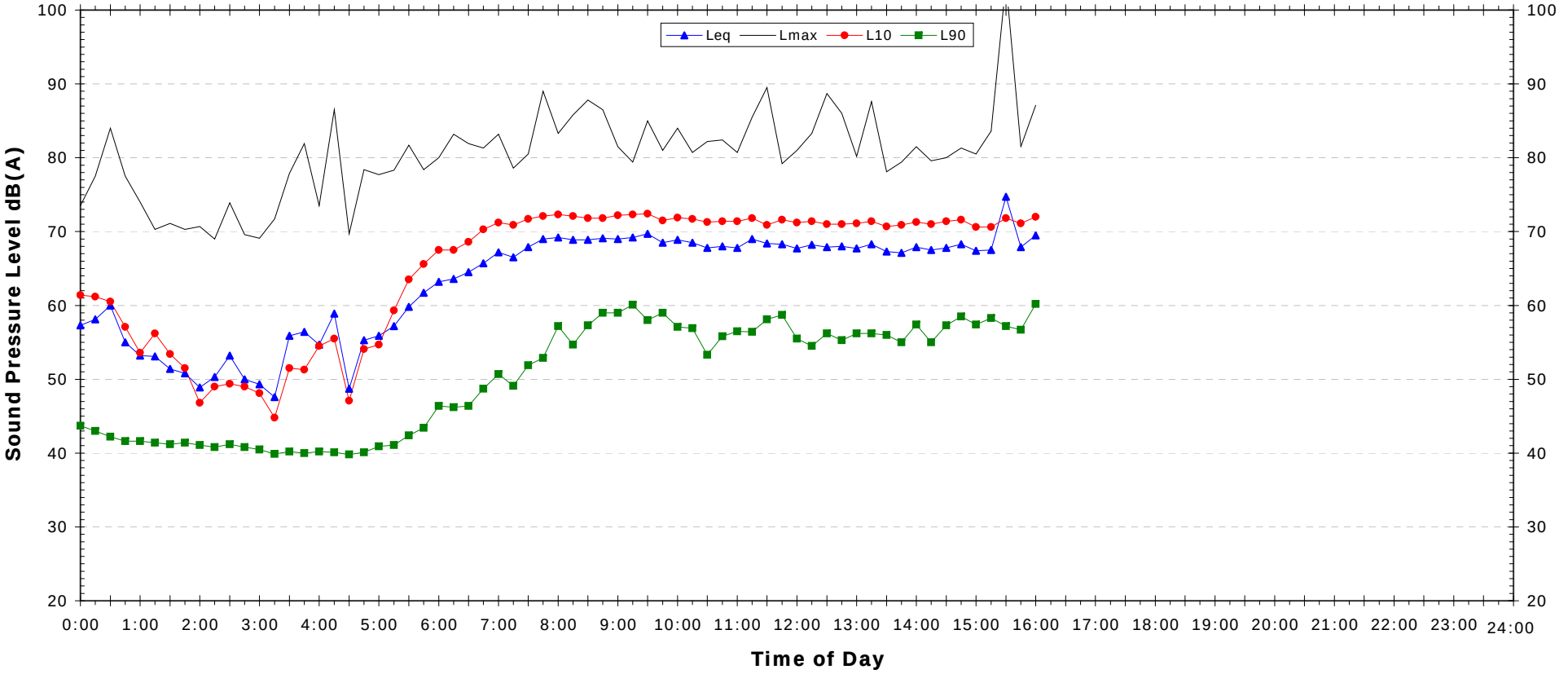
Data File: front of site.xls

Template QTT-01 (rev 55) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - front of site

Wednesday, 16 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	53.3	-	-
Leq (see note 3)	68.7	-	-

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	71.2	-
$L_{eq\ 1hr}$ upper 10 percentile	73.5	-
$L_{eq\ 1hr}$ lower 10 percentile	70.2	-

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	-	to	-
Lmax - Leq (Range)	-	to	-

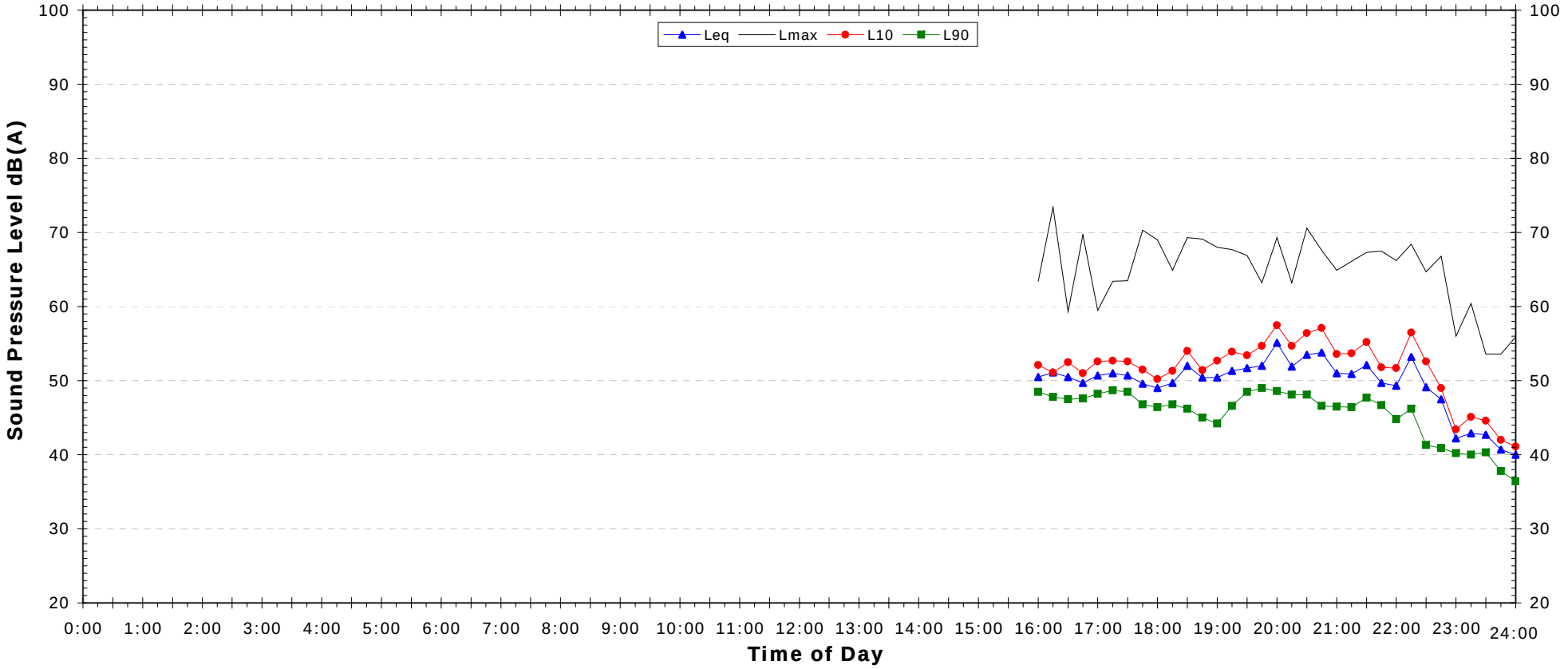
Data File: front of site.xls

Template QTT-01 (rev 55) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - rear of site

Tuesday, 8 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	-	44.8	33.4
Leq (see note 3)	-	51.8	45.8

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	53.9	48.3
$L_{eq\ 1hr}$ upper 10 percentile	55.3	55.3
$L_{eq\ 1hr}$ lower 10 percentile	52.6	37.9

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	65.3	to	71.5
Lmax - Leq (Range)	18.6	to	27.7

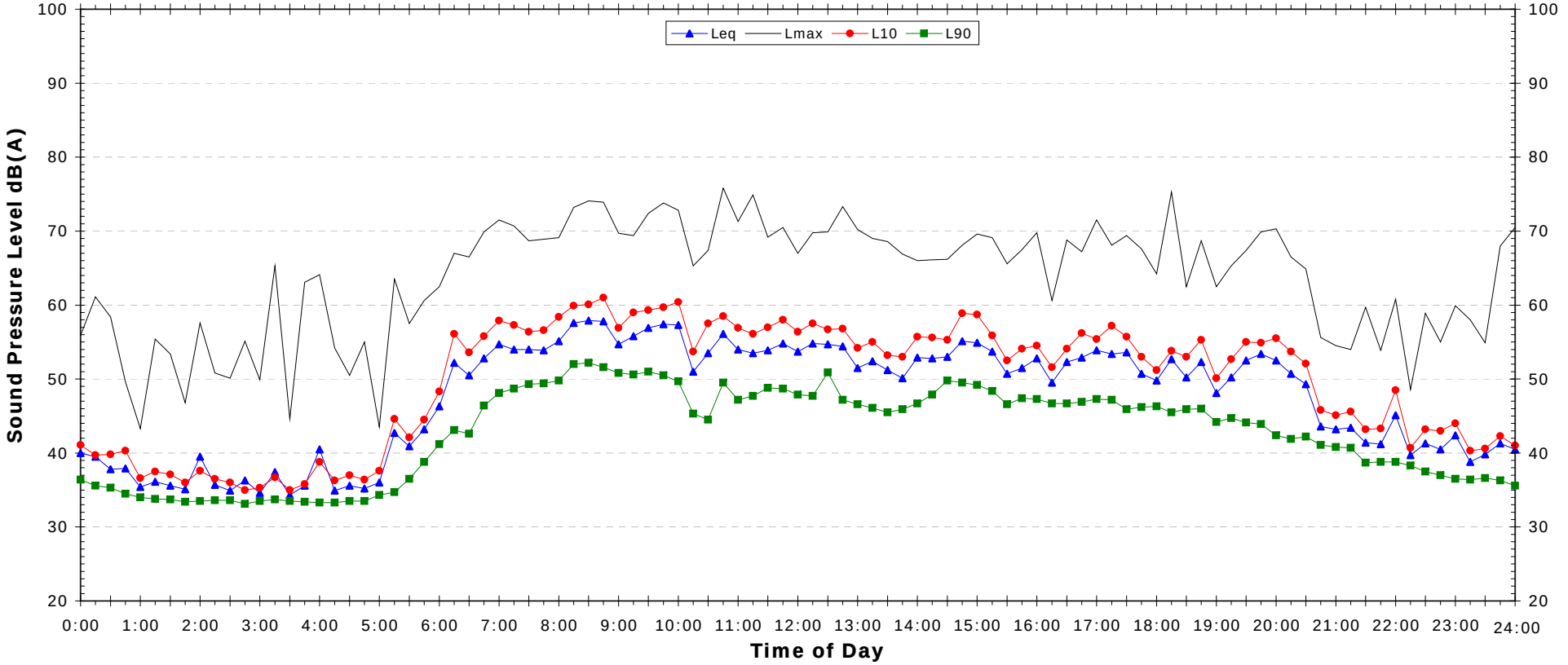
Data File: rear of site.xls

Template QTT-01 (rev 55) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - rear of site

Wednesday, 9 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	45.9	38.8	34.5
Leq (see note 3)	54.3	49.8	42.6

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	56.0	45.1
$L_{eq\ 1hr}$ upper 10 percentile	59.5	51.7
$L_{eq\ 1hr}$ lower 10 percentile	48.6	39.8

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	67.0	to	72.7
Lmax - Leq (Range)	17.8	to	30.3

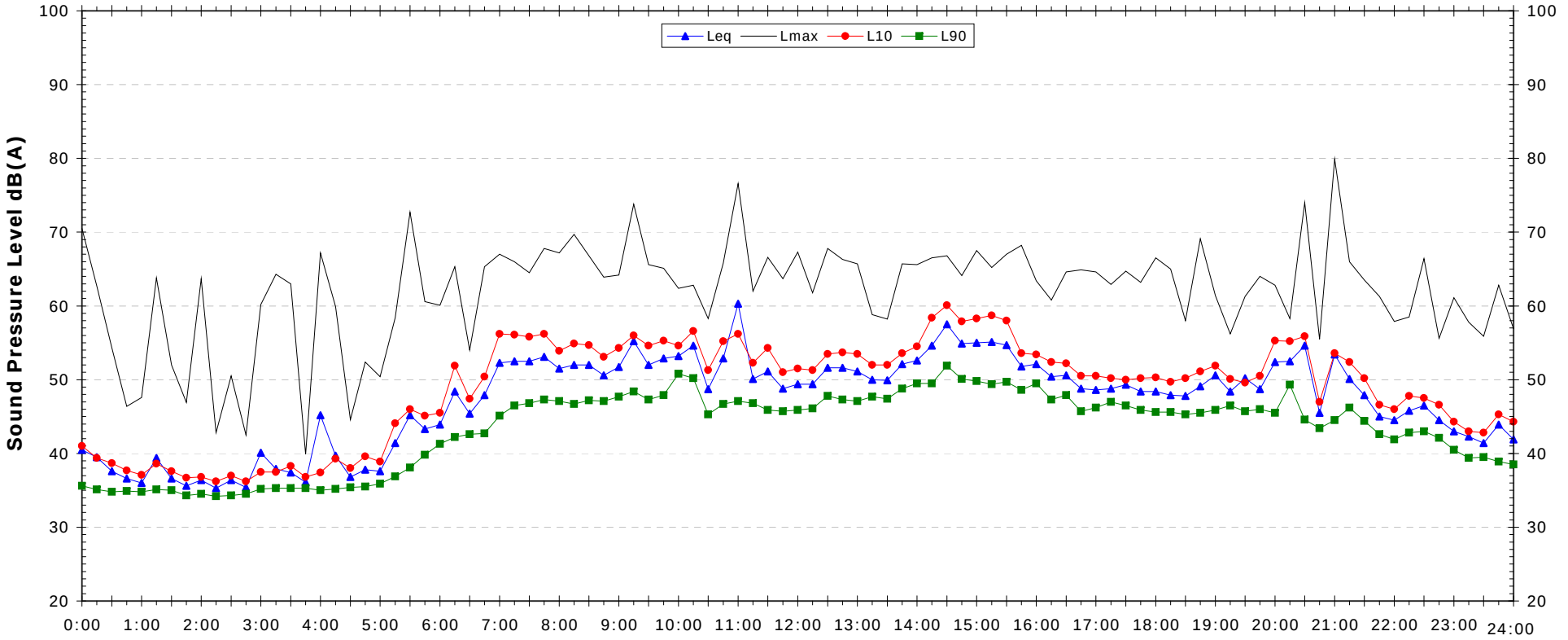
Data File: rear of site.xls

Template QTT-01 (rev 55) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - rear of site

Thursday, 10 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	45.9	42.6	35.4
Leq (see note 3)	52.8	50.2	45.5

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	54.7	48.0
$L_{eq\ 1hr}$ upper 10 percentile	58.4	54.7
$L_{eq\ 1hr}$ lower 10 percentile	50.7	42.1

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	66.0	to	67.8
Lmax - Leq (Range)	16.1	to	27.2

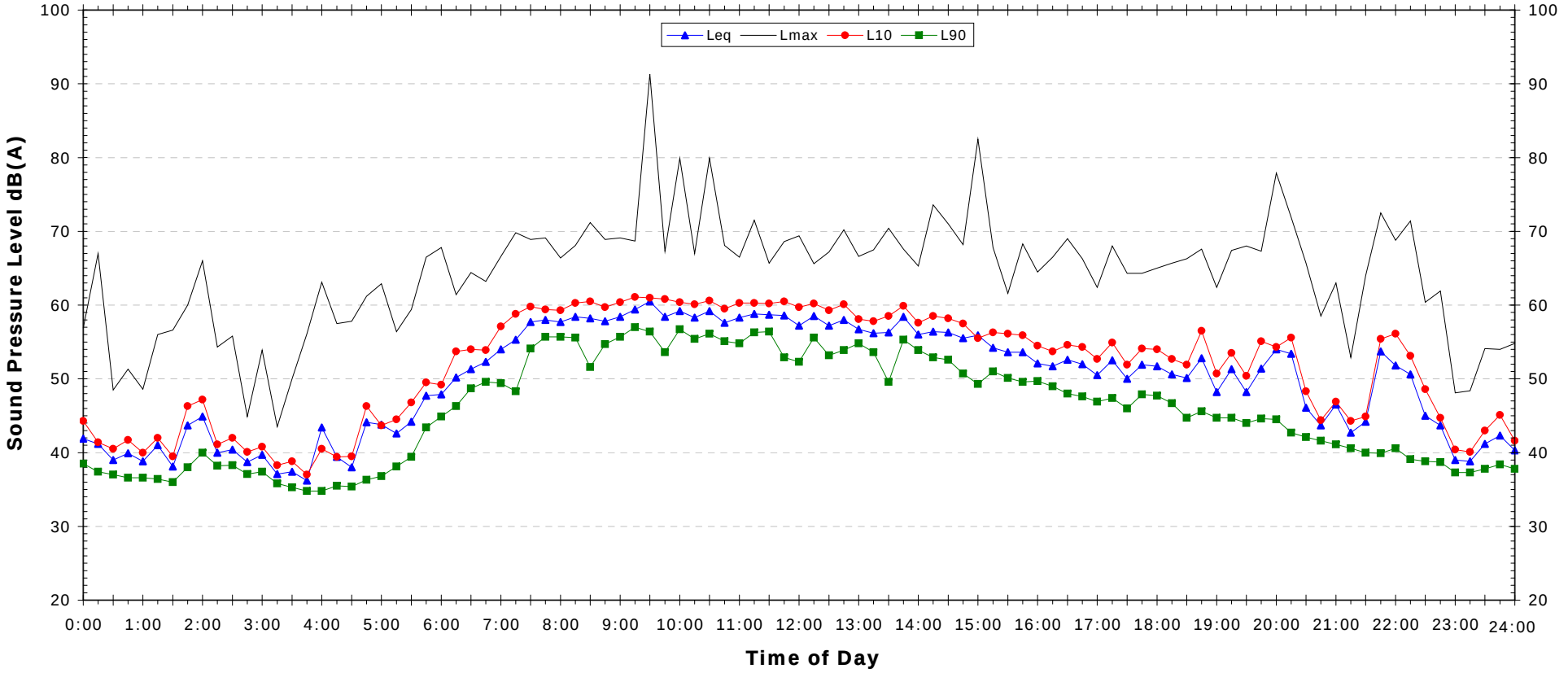
Data File: rear of site.xls

Template QTT-01 (rev 55) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - rear of site

Friday, 11 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	47.7	40.0	35.5
Leq (see note 3)	56.9	50.6	43.9

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	58.4	46.4
$L_{eq\ 1hr}$ upper 10 percentile	61.4	50.9
$L_{eq\ 1hr}$ lower 10 percentile	52.3	41.0

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	68.9	to	75.0
Lmax - Leq (Range)	20.5	to	34.3

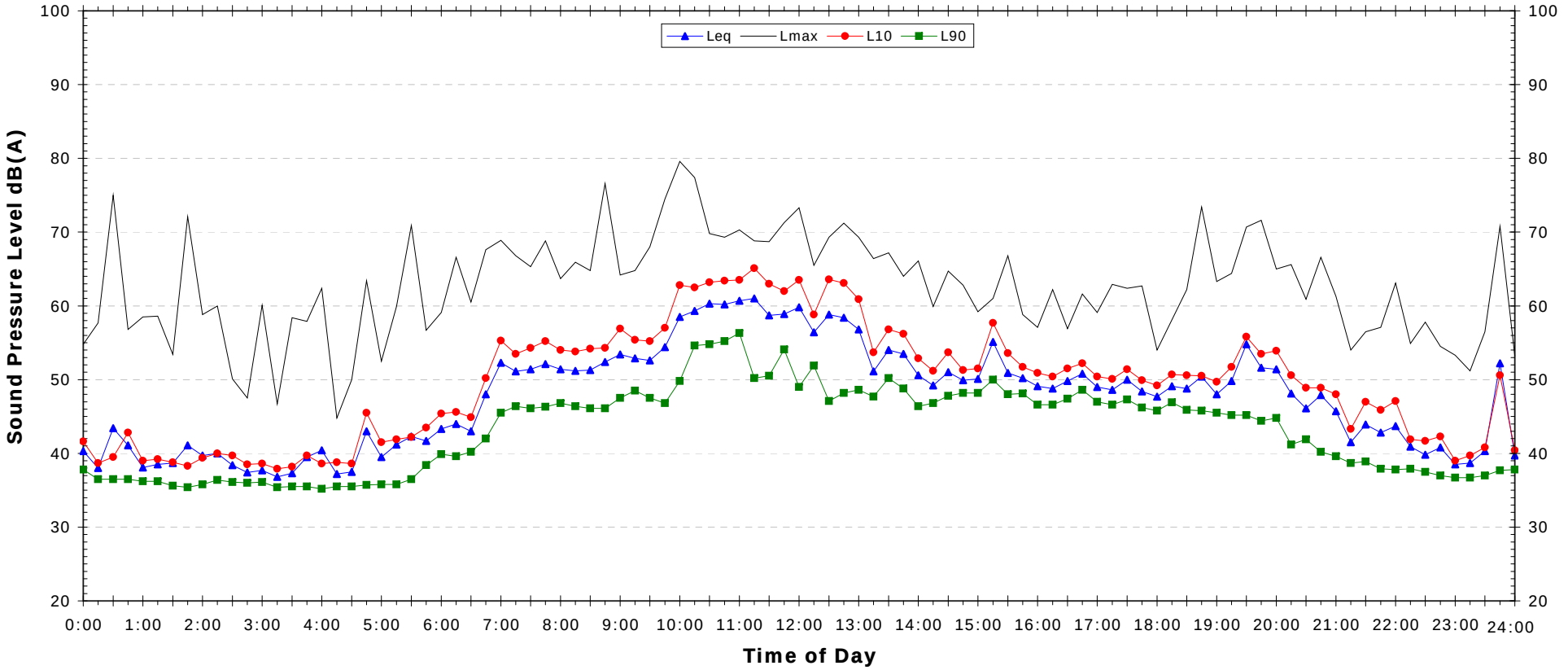
Data File: rear of site.xls

Template QTT-01 (rev 55) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - rear of site

Saturday, 12 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	46.2	37.9	33.8
Leq (see note 3)	55.4	49.1	43.3

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	56.9	45.8
$L_{eq\ 1hr}$ upper 10 percentile	62.4	49.5
$L_{eq\ 1hr}$ lower 10 percentile	48.0	39.4

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	70.8	to	74.5
Lmax - Leq (Range)	15.7	to	27.5

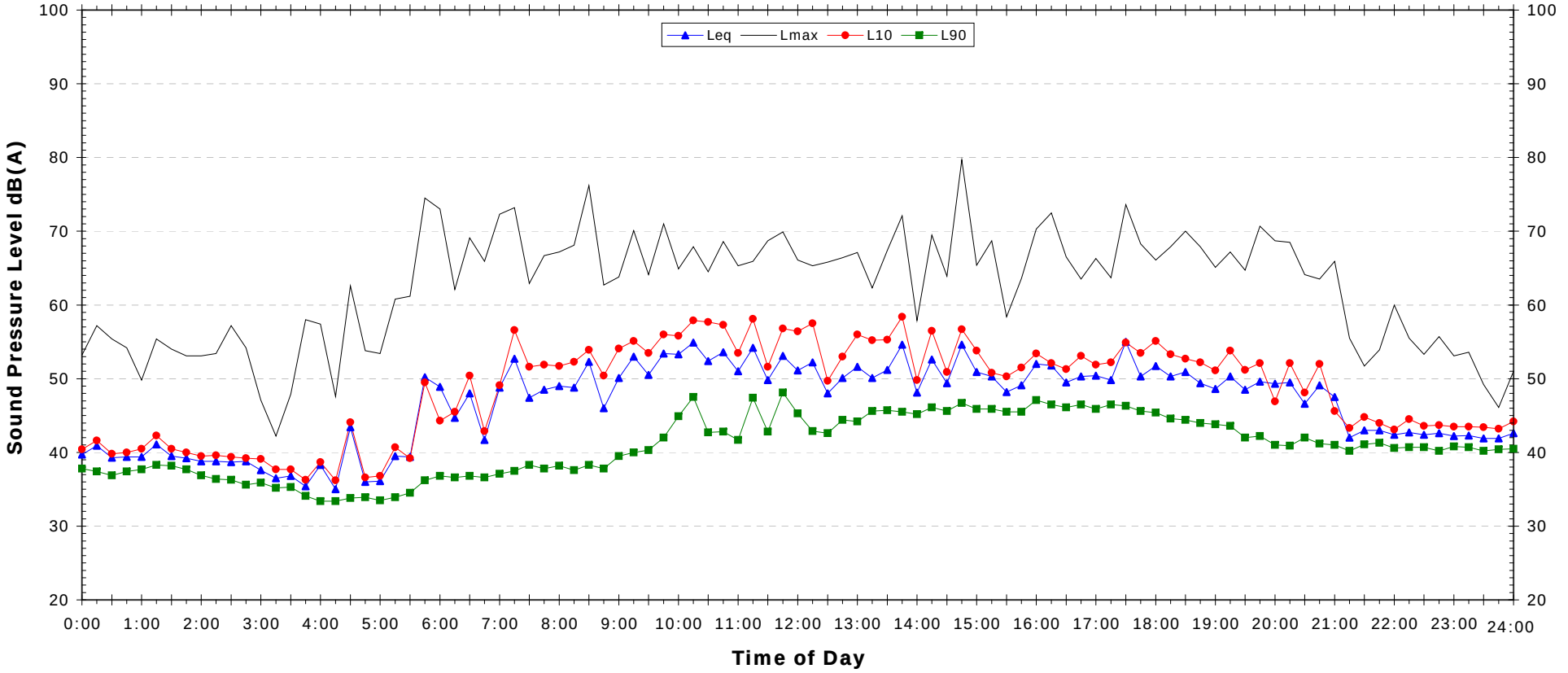
Data File: rear of site.xls

Template QTT-01 (rev 55) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - rear of site

Sunday, 13 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	38.2	40.6	37.1
Leq (see note 3)	51.6	48.3	43.9

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	53.4	46.4
$L_{eq\ 1hr}$ upper 10 percentile	55.5	52.7
$L_{eq\ 1hr}$ lower 10 percentile	48.9	40.8

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	68.4	to	70.3
Lmax - Leq (Range)	18.1	to	22.7

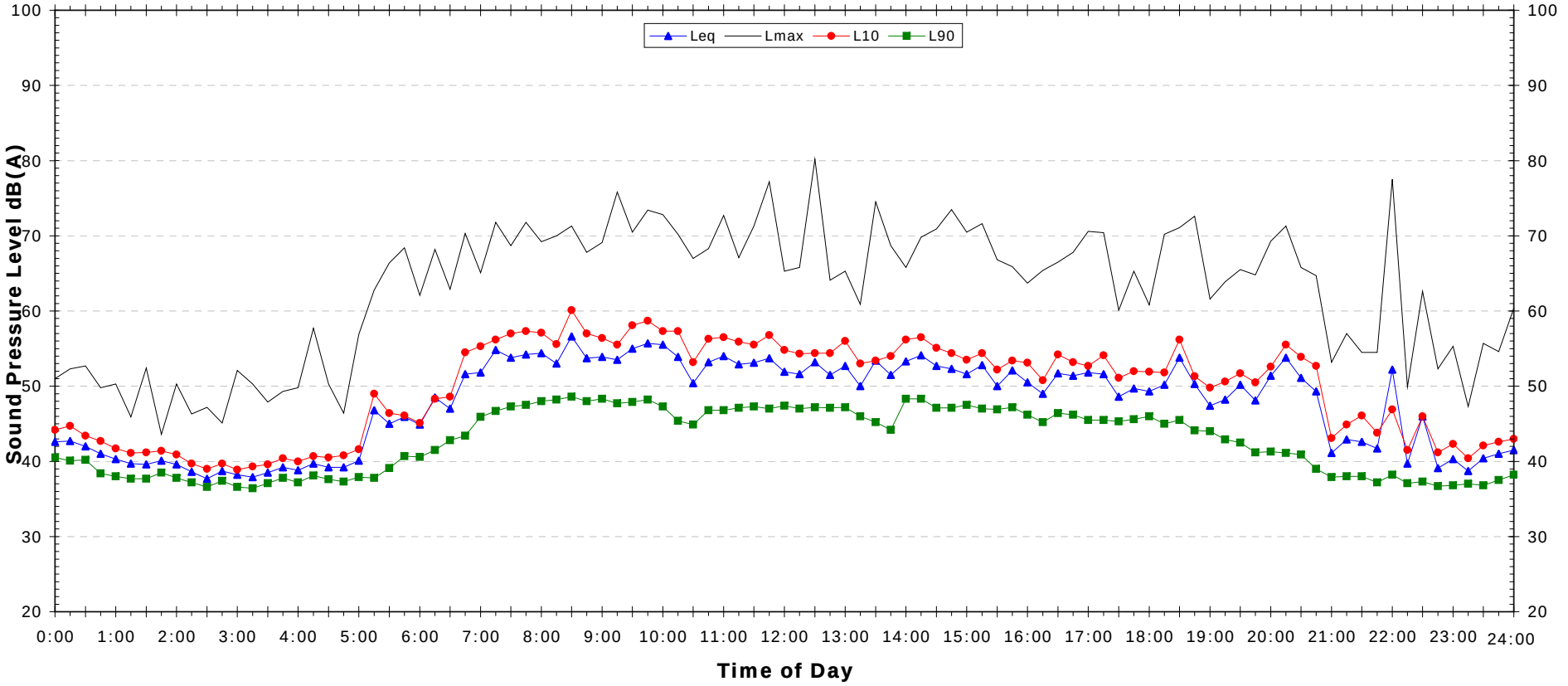
Data File: rear of site.xls

Template QTT-01 (rev 55) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - rear of site

Monday, 14 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	45.3	37.9	34.8
Leq (see note 3)	52.9	49.9	47.3

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	54.8	49.8
$L_{eq\ 1hr}$ upper 10 percentile	57.3	57.8
$L_{eq\ 1hr}$ lower 10 percentile	51.2	40.2

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	65.8	to	76.2
Lmax - Leq (Range)	15.4	to	27.8

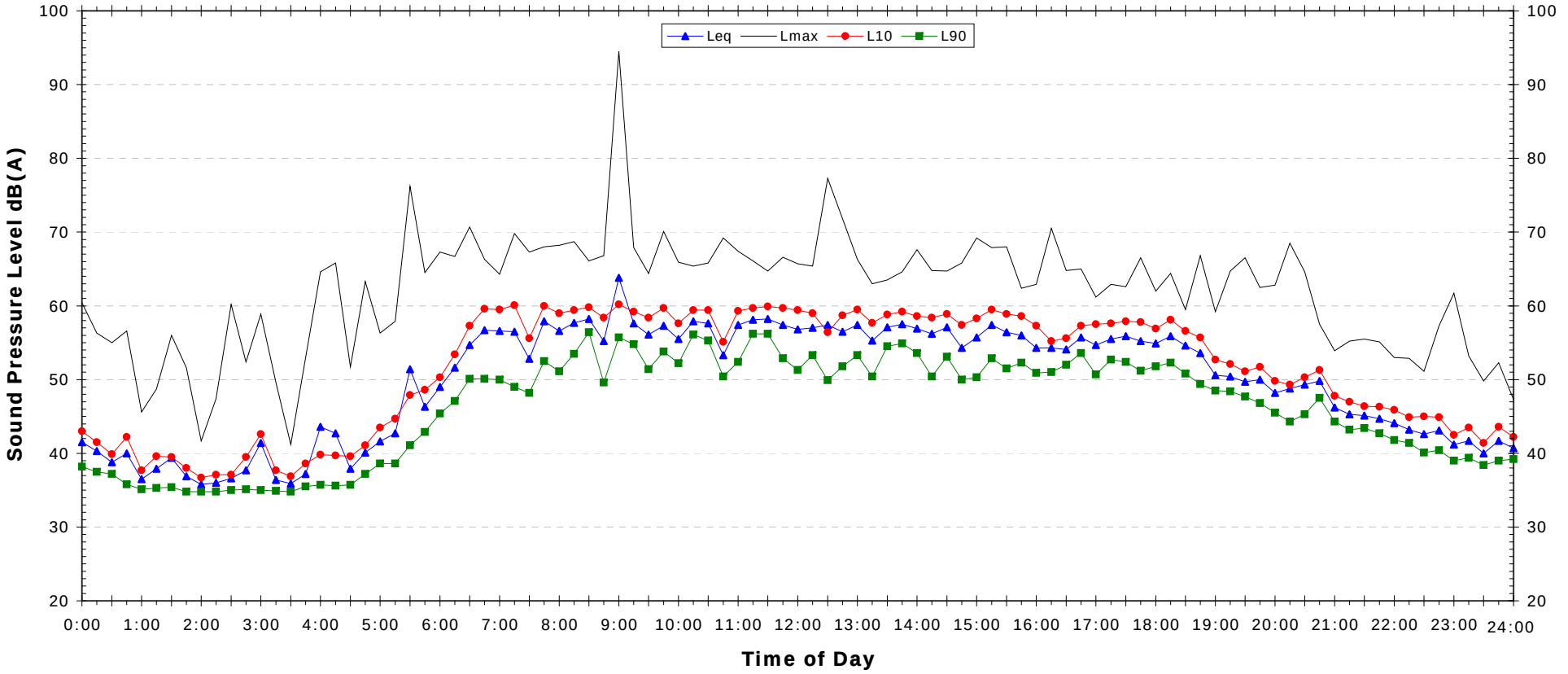
Data File: rear of site.xls

Template QTT-01 (rev 55) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - rear of site

Tuesday, 15 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	50.0	42.7	36.6
Leq (see note 3)	56.9	50.5	42.9

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	58.4	45.4
$L_{eq\ 1hr}$ upper 10 percentile	61.5	50.2
$L_{eq\ 1hr}$ lower 10 percentile	49.7	41.0

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	68.2	to	74.7
Lmax - Leq (Range)	19.1	to	29.1

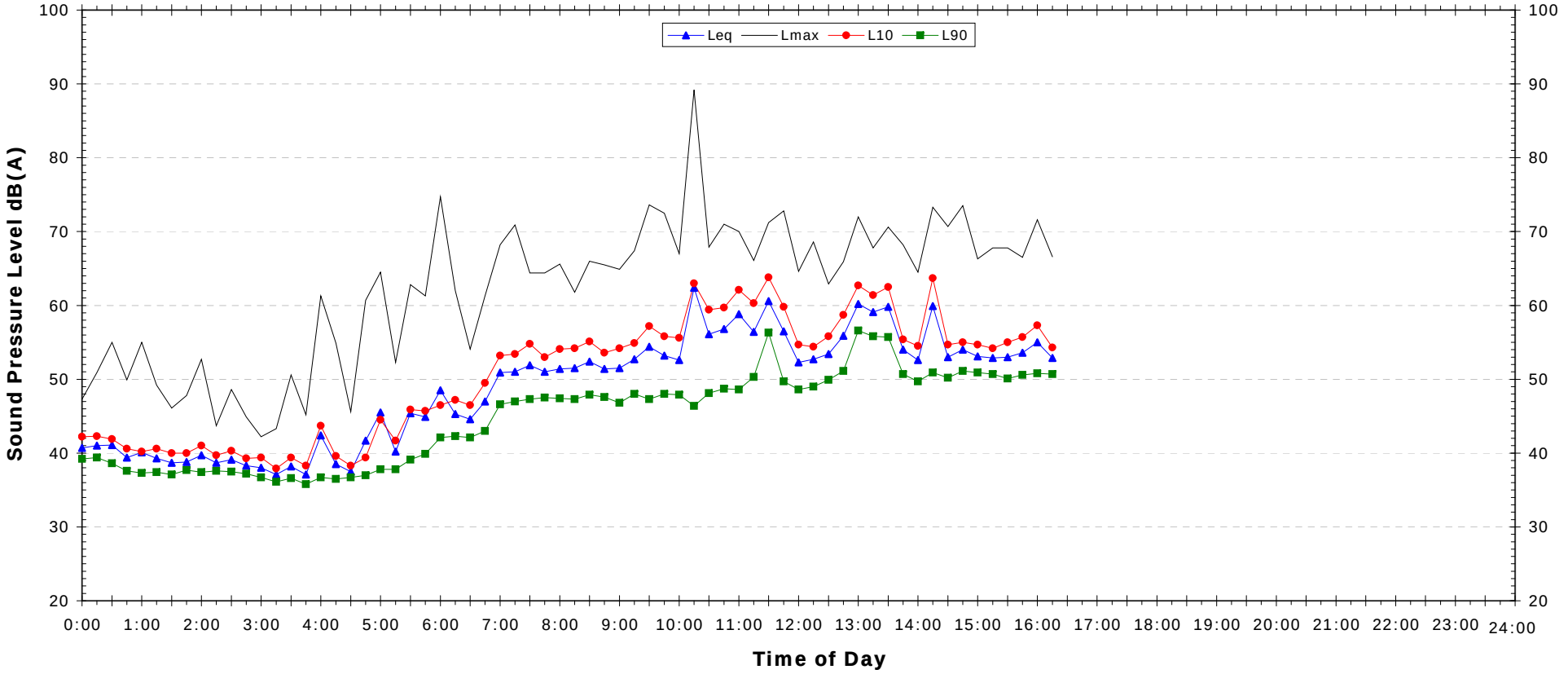
Data File: rear of site.xls

Template QTT-01 (rev 55) Logger Graphs

EXISTING AMBIENT NOISE LEVELS

128 Herring Road, Macquarie Park - rear of site

Wednesday, 16 December 2009



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night[2]
	7am-6pm	6pm-10pm	10pm-7am
L_{90}	47.3	-	-
Leq (see note 3)	55.9	-	-

NOTES:

1. Shaded periods denote measurements adversely affected by rain, wind or extraneous noise - data in these periods are excluded from calculations.

2. "Night" relates to period from 10pm on this graph to 7am on the following graph.

3. Graphed data measured in free-field; tabulated results facade corrected

4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

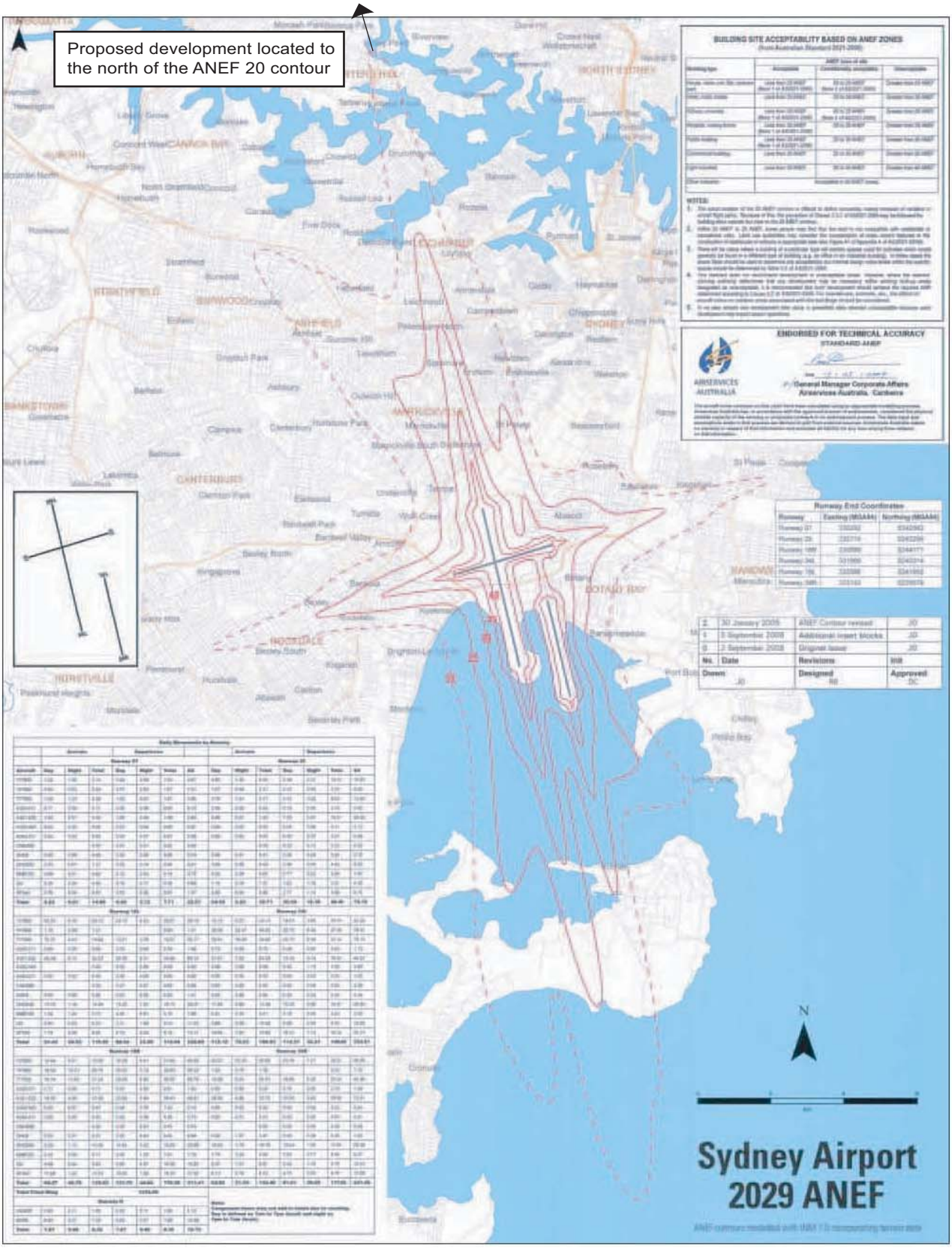
NSW ECRTN Policy (1m from facade)		(see note3)
Descriptor	Day	Night[2]
	7am-10pm	10pm-7am
$L_{eq\ 15\ hr}$ and $L_{eq\ 9\ hr}$	58.4	-
$L_{eq\ 1hr}$ upper 10 percentile	61.8	-
$L_{eq\ 1hr}$ lower 10 percentile	53.8	-

Night Time Maximum Noise Levels			(see note 4)
Lmax (Range)	-	to	-
Lmax - Leq (Range)	-	to	-

Data File: rear of site.xls

Template QTT-01 (rev 55) Logger Graphs

APPENDIX D - ANEF 2029 CONTOUR MAP



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Title : Figure 2a - Site Location

Project: TE701-01 128 Herring Road, Macquarie Park

Date : 05/03/10 | **Scale:** NTS | **Ref :** TE701-01P02a (rev 0)