

BAKEHOUSE QUARTER - SOUTH-EASTERN PRECINCT,
NORTH STRATHFIELD
ACOUSTIC ASSESSMENT FOR PART 3A SUBMISSION

TE708-01F02 (REV 1) ACOUSTIC REPORT FOR PART 3A SUBMISSION

3 JUNE 2010

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DOCUMENT CONTROL

Date	Revision History	Non-Issued Revision	Issued Revision	Prepared By (initials)	Instructed By (initials)	Reviewed & Authorised by (initials)
16.04.2010	Initial draft		0	RC		NT
1.06.2010	Include traffic generation and use		1	RC		GW

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EXECUTIVE SUMMARY

This report presents an assessment of noise intrusion into and operational noise from the proposed re-development of the south-eastern precinct of the Bakehouse Quarter, North Strathfield. The proposed development will consist of commercial buildings, a hotel and entertainment premises including theatres, restaurants and a tavern.

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.

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

- Traffic noise from the M4 motorway, Parramatta Road and George Street intruding into the proposed development.
- Rail noise and vibration intruding from train pass-bys on the Cityrail Northern Railway Line adjacent to the development on the eastern boundary into noise-sensitive areas of the proposed development.
- Aircraft noise from aircraft utilising the Sydney airport parallel runways (departures to the north) impacting on the proposed development
- Noise from existing mechanical plant servicing existing commercial premises intruding into the proposed development.
- Noise emission from the operation of the proposed development including mechanical plant and loading bays impacting upon surrounding existing premises.
- 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 Canada Bay 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 sources were identified as road traffic noise from both the M4 and Parramatta Road and rail noise and vibration from the northern railway line adjacent to the site. Aircraft noise was also investigated but found not to have an adverse 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 and commercial 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.

Noise generated by the tavern, restaurant, hotel function areas and the proposed theatres shall be adequately managed so as to minimise the impact on nearby and proposed residential premises, including the existing Kennard's Storage site.

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 Bakehouse Quarter – South-eastern precinct, North Strathfield to accompany an application for a Part 3A Concept Plan approval.

This report addresses noise impacts to and from:

Building F – Car parking, Drama theatre and Offices

Building G – Tavern

Building O – Restaurant

Building P – Performance Theatre

Building Q – Hotel and Hotel function centres

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 Monday 1st March and Thursday 11th March 2010 at the development site to determine the existing levels of traffic noise and rail noise and vibration 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 noise associated with the M4 motorway, Parramatta Road and George Street.
- Rail noise and vibration associated with the Northern 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 Friday 5th March and Thursday 11th March 2010. 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 hotel construction will incorporate all necessary acoustic controls to comply with the requirements outlined in Part F5 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 is located on either side of the elevated M4 motorway. In addition Parramatta Road is located to the south of the site. Both roads are considered major roads, both having over 40,000 vehicles per day.

George Street is the local road to the west of the proposed development site, with traffic volumes measured by Colston, Budd, Hunt and Kafes as over 1000 vehicles during the morning and afternoon peak hours (2 way).

2.2 Aircraft

The proposed development site is located approximately 10km to the north-west of Sydney Airport and aircraft departing 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 adjacent to the Cityrail northern line, approximately 18m to the commercial component at the northern end of the site and approximately 30m to the proposed hotel development to the south of the site.

The Northern line accommodates Cityrail passenger trains, intercity trains, Countrylink trains and freight trains.

There are 3 lines in use, the main southern bound line, the main northern bound line and a clearway line, used regularly by freight and closest to the development sites.

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 Canada Bay Council DCP 2009

The Annual Average Daily Traffic (AADT) volume for Parramatta Rd and the M4 motorway according to RTA published data for 2005 is approximately 40,000 and 87,000 vehicles per day respectively.

Therefore an acoustic assessment in accordance with the ISEPP is mandatory (>40,000 AADT), in accordance with the RTA Traffic Volume Maps for Infrastructure SEPP and the criteria set out in Clause 102 of the ISEPP has used 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
Hotel Development		
Bedroom	Night time (10pm – 7am)	35 dB(A) LAeq, 9 hour
Living / Dining/ Kitchen Areas	Day time (7am – 10pm)	40 dB(A) LAeq, 15 hour
Commercial Development		
Offices	1 hour peak	45 dB(A)
Retail	1 hour peak	50 dB(A)

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".

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.

Currently, there is no guidance in the above documents regarding commercial buildings. The criteria presented for the commercial areas of the proposed development are based on industry best practice.

Table 3 – Recommended Internal Noise Criteria for Rail Noise

Occupancy	Period	Maximum Noise Level
Hotel Rooms		
Sleeping areas	10pm – 7am	35 dB(A) LAeq, 9hr
Living areas	7am – 10pm	40 dB(A) LAeq, 15hr
Commercial Buildings		
Theatres and function rooms	1 hour	40 dB(A), 1 hour
Offices, commercial, restaurant, tavern	1 hour	45 dB(A), 1 hour

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 VDV_s for intermittent vibration $\text{m/s}^{1.75}$

Period	Preferred VDV $\text{m/s}^{1.75}$
Hotel Rooms	
Day time (7am – 10pm)	0.2
Night time (10pm – 7am)	0.13
Commercial Buildings, Theatres, Restaurant, Tavern, Hotel Function Areas	
Day and Night time	0.64

4 MEASURED EXTERNAL NOISE LEVELS

4.1 Traffic Noise

4.1.1 Long-term Noise Survey

An RTA Technology Environmental Noise Logger was set up for the ambient noise survey from Friday 5th March to Thursday 11th March 2010. The logger was installed on the awning of an existing building, previously Lollipops Playland exposed to M4 Motorway traffic noise and rail noise (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.

4.1.2 Short-term Noise Survey

Traffic noise levels were measured along the boundary of the site facing Parramatta Road and along George Street. These levels were used to predict traffic noise levels at the facade of the proposed hotel building.

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

4.1.3 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.

4.1.4 External Traffic Noise Levels

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

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

The design external traffic noise levels are presented below

Table 5 – External Traffic Noise Levels

Facade	Period	Traffic Noise Level LAeq
Hotel Development (Buildings Q, P, O)		
Facing Parramatta Road	Day time (7am to 10pm)	70
	Night time (10pm to 7am)	66
	1 hour peak	72
Facing M4 Motorway	Day time (7am to 10pm)	77
	Night time (10pm to 7am)	74
	1 hour peak	78
Internal Access Road (predicted noise level at hotel facade)	1 hour maximum	50
Commercial Development (Buildings F,G)		
Facing M4 Motorway	Day time (7am to 10pm)	67
	1 hour peak	68
Internal Access Road (predicted noise level at building facade)	1 hour maximum	59

Note: Traffic noise levels on internal road are based on AM and PM peak hour predictions from Colston, Budd, Hunt and Kafes

4.2 Train Noise and Vibration

4.2.1 Short-term Noise Survey

The proposed development site is located adjacent to the Cityrail northern line, approximately 18m to the commercial component at the northern end of the site and approximately 30m to the proposed hotel development to the south of the site. Operator-attended noise and vibration measurements were conducted on site on Monday 1st March 2010 and Friday 5th March 2010.

Train noise levels were measured at the proposed façade of the hotel development site facing the railway line. These levels were used to predict noise levels at the facade of the buildings.

All instruments were calibrated before and after measurement. No significant drift in calibration was observed.

4.2.2 Predicted Noise Levels

Based on the data measured on site and information from Cityrail passenger, Countrylink and Railcorp freight timetables, along with the results of the long-term noise survey the table below presents the calculated external noise levels impacting on the proposed hotel and commercial development sites.

Table 6 – Predicted Train Noise Levels

Building	Time Period	Predicted Noise Level at Property Boundary
Proposed commercial development (buildings F, G) to the north of the site	Day Time (7am – 10pm)	70 dB(A) LAeq, 15 hour
Proposed hotel development (buildings Q, P, O) to the south of the site	Day Time (7am – 10pm)	68 dB(A) LAeq, 15 hour
	Night Time (10pm to 7am)	64 dB(A) LAeq, 9 hour

4.3 Rail Vibration Survey

Train vibration levels were measured using the Sinus SoundBook multi-channel analyser and Endevco accelerometers. An accelerometer was fixed to a steel spike hammered into the ground at the worst effected boundary of the development site.

The recorded ground vibration levels of train pass-bys are shown in Appendix C together with the vibration criteria derived from British Standard BS6472-1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80 Hz).

The table below shows the measured Vibration Dose Value (VDV) measured at the proposed development site due to existing operations.

Table 7 – Measured Vibration Dose Value (VDV)

Location	Measured VDV m/s ^{1.75}	
	Day Time	Night Time
Proposed hotel development (property boundary facing rail line)	0.19	0.13

The measured VDV for the site complies with the criteria for the commercial and hotel developments for both day time and night time as presented in Table 4.

4.4 Calculated Noise Levels

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

5 CONTROL OF EXTERNAL NOISE

5.1 Traffic Noise Intrusion

Recommended facade design is presented in Section 5.4, below to comply with nominated traffic noise criteria.

5.2 Aircraft Noise Intrusion

The development lies within the "Acceptable" zone in accordance with the Australian Standard AS2021:2000, meaning

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

Rail noise and vibration impacts on both the proposed commercial buildings to the north of the site and the proposed hotel development to the south of the site.

Predicted vibration levels comply with the nominated criteria at both the commercial development and the hotel development, therefore, additional vibration isolation treatment to the proposed buildings is not required.

Acoustic treatment to the facades of the building to prevent airborne rail noise intrusion is presented in Section 5.4 of this report.

5.4 Facade Design

Table 8 presents the recommended in-principle glazing selections for facades of the proposed commercial, retail and hotel buildings within the development

Table 8 – Recommended Acoustic Performance of Glazing Assembly

Façade	Level	Occupancy	Required Acoustic Rating of Glazing Assembly, R_w
Commercial (Buildings F & G)			
Eastern facade facing railway line	All levels	Commercial office	Rw 32
Southern facade facing M4 motorway	All levels	Commercial office/ retail	Rw 32
Western Facade	All levels	Commercial office/ retail	Rw 32
Hotel Building (Buildings Q, P, O)			
Eastern facade facing railway line	All levels	Hotel Suites	Rw 42
		Function areas	Rw 42
Northern Facade facing M4 motorway	All levels	Hotel Suites	Rw 44
		Function areas	Rw 42

Façade	Level	Occupancy	Required Acoustic Rating of Glazing Assembly, R_w
Western Façade facing George Street	All levels	Theatre Lobby	Rw 37
		Hotel Suites	Rw 42
		Theatre Lobby	Rw 37
		Restaurant	Rw 34
Southern façade facing Parramatta Road	All levels	Hotel Suites	Rw 42
		Function areas	Rw 42
		Hotel Restaurant/ lounge	Rw 37

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 hotel rooms 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.

5.4.1 Doors and Window Seals

The glazing designs shall also include special acoustic grade seals installed on windows and perimeter doors exposed to road traffic and rail noise.

6 EXTERNAL NOISE EMISSION

6.1 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 9– 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)	62	67	60	60
Evening (6pm to 10pm)	62	67	50	50
Night (10pm to 7am)	52	57	45	45

Explanatory notes:

Column 3 – Recommended LAeq noise level based on 'Urban' area in Section 2.2, Table 2.1 Amenity Criteria (Recommended LAeq noise levels from industrial noise sources) of the DECCW's INP.

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.

Mechanical plant has the potential to impact on surrounding existing commercial/retail premises, proposed residential/hotel premises, including other buildings within 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".

6.2 Loading Docks

There are two loading docks proposed for the development site. One located at upper ground level of Building F, the other at ground level of Building P. The loading docks will provide for a range of service vehicles, including small, medium and large rigid trucks and courier vans and small commercial vehicles. Two loading bays are proposed within each loading area. The number of deliveries per day is currently unknown.

The following management parameters and in-principle acoustic design measures have been recommended to reduce the potential impact of the loading dock operations onto the proposed hotel suites and to proposed residential premises opposite the site, to the east and on the southern side of Parramatta Road.

- Management procedures for the loading dock operation should be put in place to prevent trucks waiting outside the premises if the loading dock is occupied by another delivery vehicle. This may be managed by allocating book-in times for all deliveries to areas within of the development; and
- Deliveries should be restricted to between the hours of 7am to 10pm Monday to Saturdays and 8am to 10pm Sundays to preclude operations during the standard night time period, as defined by the Department of Environment, Climate Change and Water.

6.3 Use (Restaurant, Tavern, Hotel Function Rooms and Theatre)

The primary noise generating uses within the development are identified as follows;

- Smaller theatre (Building F) – 300 seat capacity
- Larger theatre (Building P) – 450 seat capacity
- Hotel function room (Building Q) – predicted capacity 480 people
- Restaurant (Building O) – floor area 300m²
- Tavern fit-out (Building G) – floor area 800m²

With respect to the theatres and hotel function rooms, noise emission can be appropriately contained through design of the building envelope as there are no external areas, or obvious deficiencies into concept design (in terms of layout, access and relationship to nearby sensitive receiver locations). Furthermore, the governing component for the envelope design is likely to be the control of external noise sources (road and rail traffic) entering the spaces. Such acoustic design requirements are most appropriately determined during the design development stages of the project.

With respect to the Tavern and Restaurant, any noise emission from internal areas of the developments, be it entertainment or simply patron noise, can be appropriately controlled through the design of the building envelope. Given the proposed locations, and with consideration of the existing ambient noise levels, standard building constructions should generally suffice in containing any noise emission from the uses, however more onerous designs may be required where entertainment is proposed and will occur during the night time period. Similarly to the theatres and function rooms, the acoustic design requirements are best determined during the design development stages of the project.

However with regard to the proposed outdoor seating areas for the Tavern and Restaurant, for which physical noise control is more limited, the location and their relationship to nearby sensitive receiver locations is more critical. For the proposed development, the external area for the Tavern is sufficiently removed from any existing or future residential use and therefore considered suitable given the commercial precinct. The restaurant outdoor area is closer to potential future residential development on the southern side of Parramatta Road, however the potential for noise impact is still considered low given the high ambient noise levels, distance to future residents, and considering that the residential development is unlikely to permit open windows. However in contrast to the Tavern outdoor area, the restaurant may require stricter controls for use should after-midnight operation be desired.

From our review, the potential for impact from noise generated by the uses is considered low. Nonetheless the acoustic design of building envelopes will need to be considered and should be assessed during the design development stages of the project.

7 INTERNAL SOUND INSULATION

As a minimum requirement, walls and floors of the hotel development 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 3 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 L_{Aeq} over any other descriptor. As an energy average, L_{Aeq} provides ease of use when measuring or calculating noise levels since a full statistical analysis is not required as when using, for example, the LA_{10} descriptor.

Consistent with the latest guideline (ICNG) the use of L_{Aeq} 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 10 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 10 - 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 L _{Aeq} (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 11 below (reproduced from Table 2 of the ICNG) sets out the noise management levels for various sensitive land use developments.

Table 11- 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 12- 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 12- 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 13- 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 13- 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 rail noise and vibration impacts onto the proposed commercial/retail development, including a hotel at Bakehouse Quarter, North Strathfield.

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, mechanical plant and use of the proposed buildings.

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).

<i>Decibel [dB]</i>	<p>The units that sound is measured in. The following are examples of the decibel readings of every day sounds:</p> <p>0dB The faintest sound we can hear</p> <p>30dB A quiet library or in a quiet location in the country</p> <p>45dB Typical office space. Ambience in the city at night</p> <p>60dB Martin Place at lunch time</p> <p>70dB The sound of a car passing on the street</p> <p>80dB Loud music played at home</p> <p>90dB The sound of a truck passing on the street</p> <p>100dB The sound of a rock band</p> <p>115dB Limit of sound permitted in industry</p> <p>120dB Deafening</p>
<i>dB(A):</i>	<p>A-weighted decibels</p> <p>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.</p>
<i>Frequency</i>	<p>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.</p>
<i>Impulsive noise</i>	<p>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.</p>

<i>Intermittent noise</i>	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.
<i>L_{max}</i>	The maximum sound pressure level measured over a given period.
<i>L_{min}</i>	The minimum sound pressure level measured over a given period.
<i>L₁</i>	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
<i>L₁₀</i>	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
<i>L₉₀</i>	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L ₉₀ noise level expressed in units of dB(A).
<i>Leq</i>	The “equivalent noise level” is the summation of noise events and integrated over a selected period of time.
<i>Reflection</i>	Sound wave changed in direction of propagation due to a solid object obscuring its path.
<i>SEL</i>	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.
<i>Sound</i>	A fluctuation of air pressure which is propagated as a wave through air.
<i>Sound Absorption</i>	The ability of a material to absorb sound energy through its conversion into thermal energy.
<i>Sound Level Meter</i>	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
<i>Sound Pressure Level</i>	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.

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

BCA Part F5 Terminology

$L_{n,w}$	<p>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.</p> <p>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.</p>
$L_{nT,w}$	<p>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.</p> <p>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.</p>

C_i	<p>A value used to modify the measured impact sound pressure level, $L_{n,w}$ or $L_{nT,w}$.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>Positive C_i values are more favourable than negative values.</p>
R_w	<p>A measure of the sound insulation performance of a building element. It is measured in very controlled conditions in a laboratory.</p> <p>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</p>

$D_{nT,w}$	<p>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.</p> <p>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 R_w laboratory measurement. The higher the number the better the insulation performance.</p>
C_{tr}	<p>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.</p> <p>The value is referred to as a spectrum adaptation value and is added to either the R_w or $D_{nT,w}$.</p> <p>AS/NZS 1276 sets out testing methodologies for the sound insulation properties of building elements and incorporates these factors and explains their use.</p> <p>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,</p> <p>Smaller negative C_{tr}, values are more favourable than large negative values.</p>

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 shall address the issue of noise and vibration impacts from the railway corridor and the M4 Motorway and Parramatta Road 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 "*Development near Rail Corridors and Busy Roads – Interim Guidelines*".

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	At 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 Canada Bay Council DCP

Visual & Acoustic Privacy

New development is to ensure adequate visual and acoustic privacy levels for neighbours and residents.

New development containing dwellings along a major road or along a railway corridor should incorporate noise attenuation measures.

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 14 – Australian/New Zealand Standard AS/NZS 2107:2000 “Acoustic – Recommended design sound levels and reverberation times for building exteriors”

Type of Occupancy Activity	Recommended Design Sound Level dB(A)	
	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 15– 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 16– Internal Design Sound Levels dB(A) (Table 3.3 AS2021)

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

Occupancy	Max Noise Level, Lmax dB(A)
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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 Traffic Monitoring Results

Measurement Location	Date	Period	Measured LAeq
Corner of Parramatta Road and George Street	5 th March 2010	9:45am – 10:00am	71.4 dB(A)
Corner of George Lane and Railway Street	5 th March 2010	10:30am – 10:45am	62.2 dB(A)
George Street (40m from Parramatta Road)	5 th March 2010	10:55am – 11:10am	67.5 dB(A)
Pedestrian overpass on M4 (900m west of site)	5 th March 2010	12:00pm – 12:15pm	76.8 dB(A)

C.2 Short-term Train Monitoring Results

C.2.1 Airborne Noise

Train Type	Direction (bound)	L _{AMax}	L _{AE}
Silver suburban	South (City)	77.2	85.5
Silver suburban	South (City)	79.2	84.6
Silver suburban	North (Epping)	82	88.5
Silver suburban	South (City)	72.2	82.3
Freight train	South	98.3	99.5
Silver suburban	North (Epping)	81.1	88.8
Silver suburban	South (City)	73.1	82.6
Freight train	South	100	101.5
Silver	South (City)	72.6	81.1
Intercity	South (City)	78.9	86.0
Countrylink XPT	North	84.8	88.1
Silver	North (Epping)	79.6	87.5
Intercity	North	84.7	87.1
Millennium	South (City)	72.2	81.2
Millennium	North (Epping)	82.3	88.6
Tangara	South (City)	73.8	80.2
Intercity	South (City)	79.9	85.4
Silver	South (City)	74.5	82.0
Intercity	South (City)	81.9	89.5
Intercity	South (City)	86.5	91.8

C.2.2 Rail Vibration

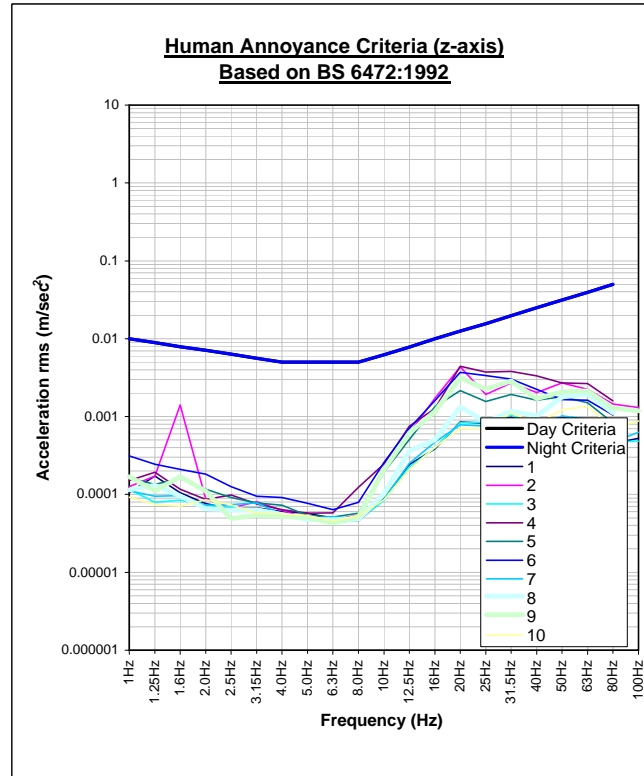


Renzo Tonin & Associates

Vibration Survey Results

Vibration Assessment for Human Annoyance BS6472-1992 & DECCW

Project No.:	TE708-01				
Location:	Bakehouse Quarter South-East Precinct - Railway Street				
Source:	Trains				
Assessment Location:	Critical work areas (eg. precision labs)			Axis	Z
Type of Vibration:	Intermittent			Dur'n of Vibration (secs), Day:	54,000
				Dur'n of Vibration (secs), Night:	32,400



Legend		1	2	3	4	5	6	7	8	9	10	Preferred DECCW Criterion	Maximum DECCW Criterion
Measurement													
Acceleration rms (m/sec ²)	1Hz	0.0001	0.0001	0.0001	0.0002	0.0002	0.0003	0.0001	0.0001	0.0002	0.0001		
	1.25Hz	0.0002	0.0002	0.0001	0.0002	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001		
	1.6Hz	0.0001	0.0014	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0002	0.0001		
	2.0Hz	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001		
	2.5Hz	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0001		
	3.15Hz	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001		
	4.0Hz	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001		
	5.0Hz	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0001	0.0001		
	6.3Hz	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000		
	8.0Hz	0.0000	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000	0.0000	0.0001	0.0001		
	10Hz	0.0001	0.0002	0.0001	0.0002	0.0002	0.0003	0.0001	0.0001	0.0002	0.0001		
	12.5Hz	0.0002	0.0006	0.0002	0.0008	0.0005	0.0007	0.0003	0.0004	0.0006	0.0002		
	16Hz	0.0004	0.0017	0.0004	0.0013	0.0013	0.0016	0.0005	0.0005	0.0012	0.0004		
	20Hz	0.0009	0.0044	0.0008	0.0044	0.0022	0.0037	0.0008	0.0013	0.0031	0.0007		
	25Hz	0.0008	0.0019	0.0008	0.0037	0.0016	0.0034	0.0008	0.0009	0.0022	0.0007		
	31.5Hz	0.0010	0.0027	0.0010	0.0038	0.0019	0.0030	0.0009	0.0012	0.0029	0.0011		
	40Hz	0.0008	0.0020	0.0008	0.0033	0.0016	0.0022	0.0007	0.0010	0.0017	0.0008		
	50Hz	0.0010	0.0027	0.0009	0.0027	0.0018	0.0017	0.0010	0.0018	0.0021	0.0012		
	63Hz	0.0008	0.0022	0.0009	0.0027	0.0015	0.0016	0.0009	0.0019	0.0021	0.0014		
	80Hz	0.0005	0.0014	0.0005	0.0016	0.0008	0.0011	0.0005	0.0011	0.0013	0.0007		
	100Hz	0.0005	0.0013	0.0005	0.0012	0.0008	0.0009	0.0006	0.0011	0.0012	0.0009		
Weighted rms	Day												
	Night												
eVDV	Day	0.01	0.05	0.01	0.06	0.03	0.05	0.01	0.02	0.04	0.01	0.10	0.20
	Night	0.01	0.05	0.01	0.05	0.03	0.04	0.01	0.02	0.04	0.01	0.10	0.20

NOTE: Red indicates exceedence of Preferred DECCW Criterion

QTS-01 (rev 10) Human Annoyance Vibration Assessment BS6472-DEC - z axis

C.3 Long-term Monitoring Results

Noise Logger Location 1: Awning of site previously Lollypops Playland (north of the M4 Motorway).

Survey Period: Friday 5th March to Thursday 11th March 2010



RENZO TONIN & ASSOCIATES *inspired to achieve*

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AAC Member of the Association of Australian Acoustical Consultants

Title: Monitoring locations and site surrounds

Project: TE708-01 Bakehouse Quarter, North Strathfield

Date: 03/06/10

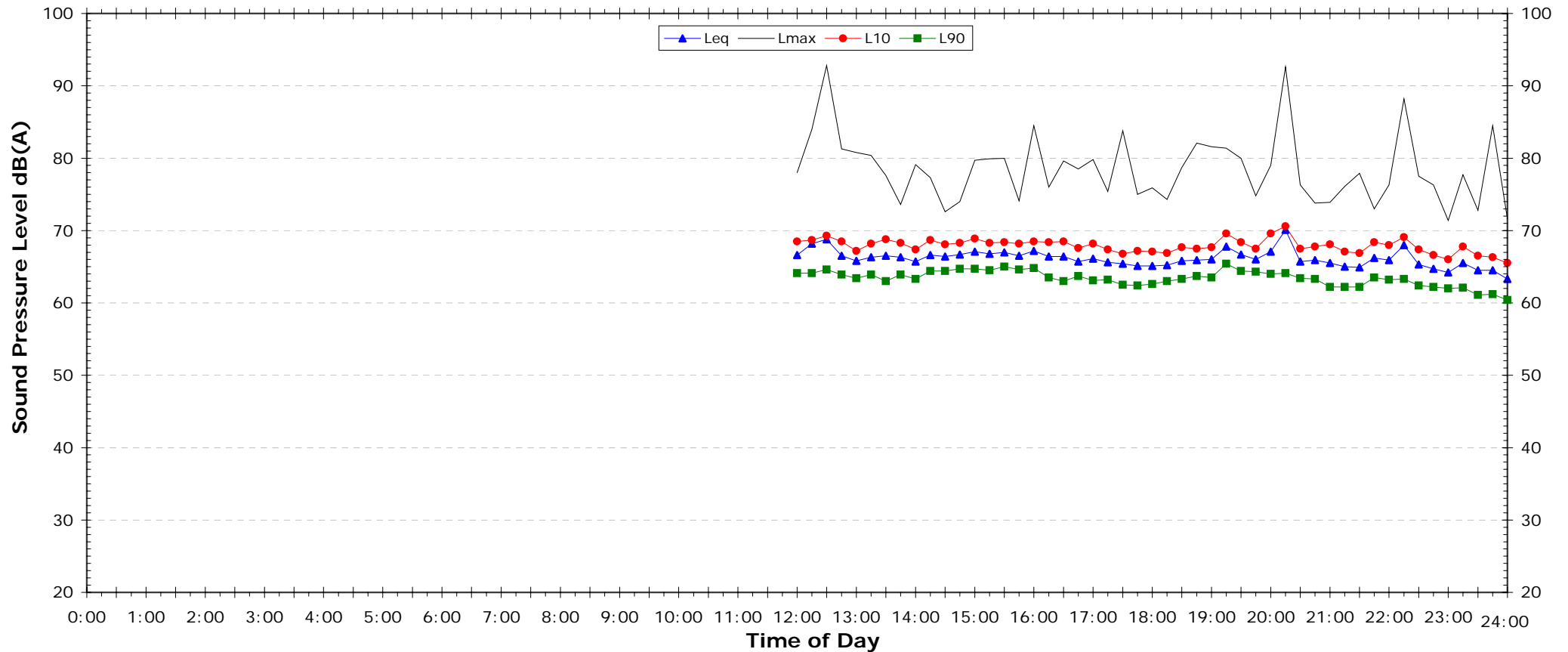
Scale: NTS

Ref : TE708-01P01 (rev 0)

EXISTING AMBIENT NOISE LEVELS

Bakehouse Quarter (previous Lollipops Playland site)

Friday, 5 March 2010



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night ²
	7am-6pm	6pm-10pm	10pm-7am
L ₉₀	-	62.2	53.5
Leq (see note 3)	-	63.9	61.4

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 1m from facade; tabulated results free-field corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

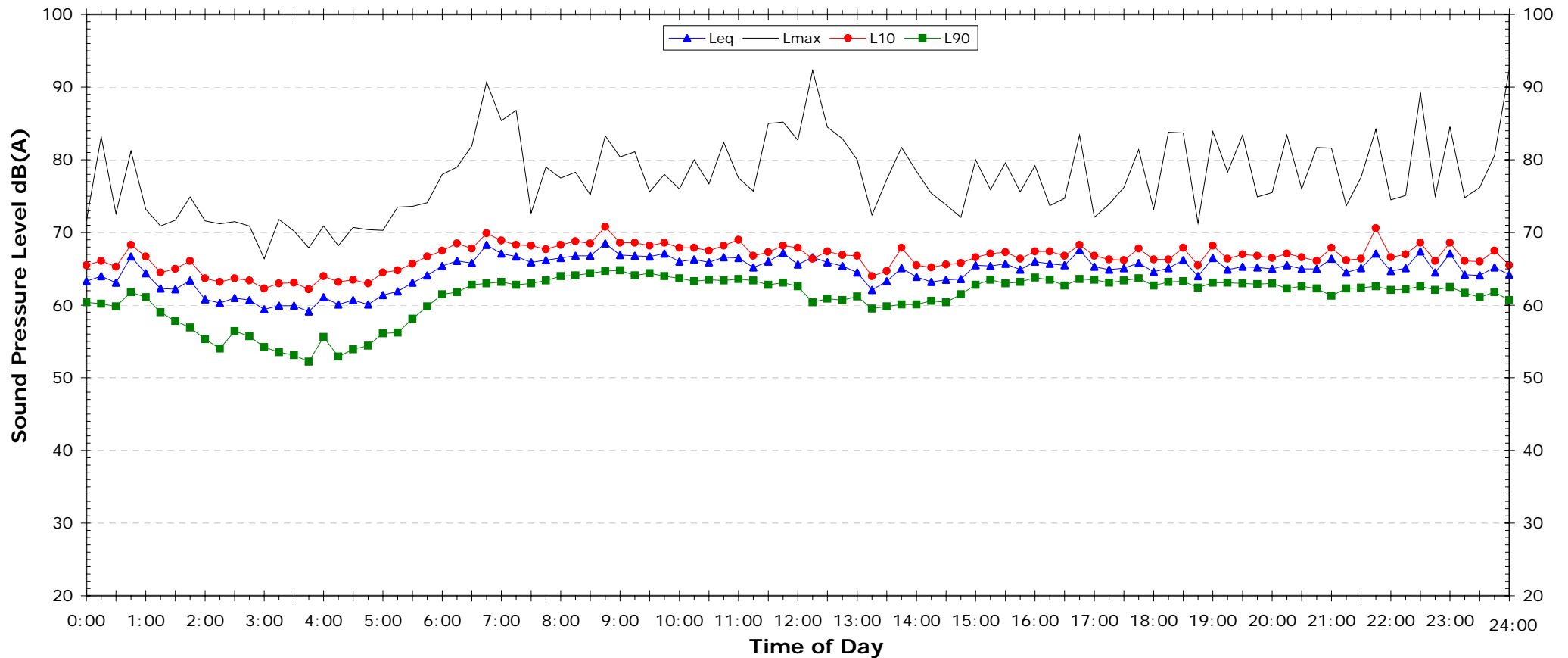
NSW ECRTN Policy (1m from facade)			(see note3)
Descriptor	Day	Night ²	
	7am-10pm	10pm-7am	
L _{eq} 15 hr and L _{eq} 9 hr	66.5	63.9	
L _{eq} 1hr upper 10 percentile	67.5	66.9	
L _{eq} 1hr lower 10 percentile	65.3	60.1	

Night Time Maximum Noise Levels				(see note 4)
Lmax (Range)	83.2	to	90.7	
Lmax - Leq (Range)	18.4	to	23.8	

EXISTING AMBIENT NOISE LEVELS

Bakehouse Quarter (previous Lollipops Playland site)

Saturday, 6 March 2010



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night ²
	7am-6pm	6pm-10pm	10pm-7am
L ₉₀	60.4	62.1	54.0
Leq (see note 3)	63.3	62.9	60.4

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 1m from facade; tabulated results free-field corrected
4. Night time L_{max} values are shown only where L_{max} > 65dB(A) and where L_{max}-Leq ≥ 15dB(A)

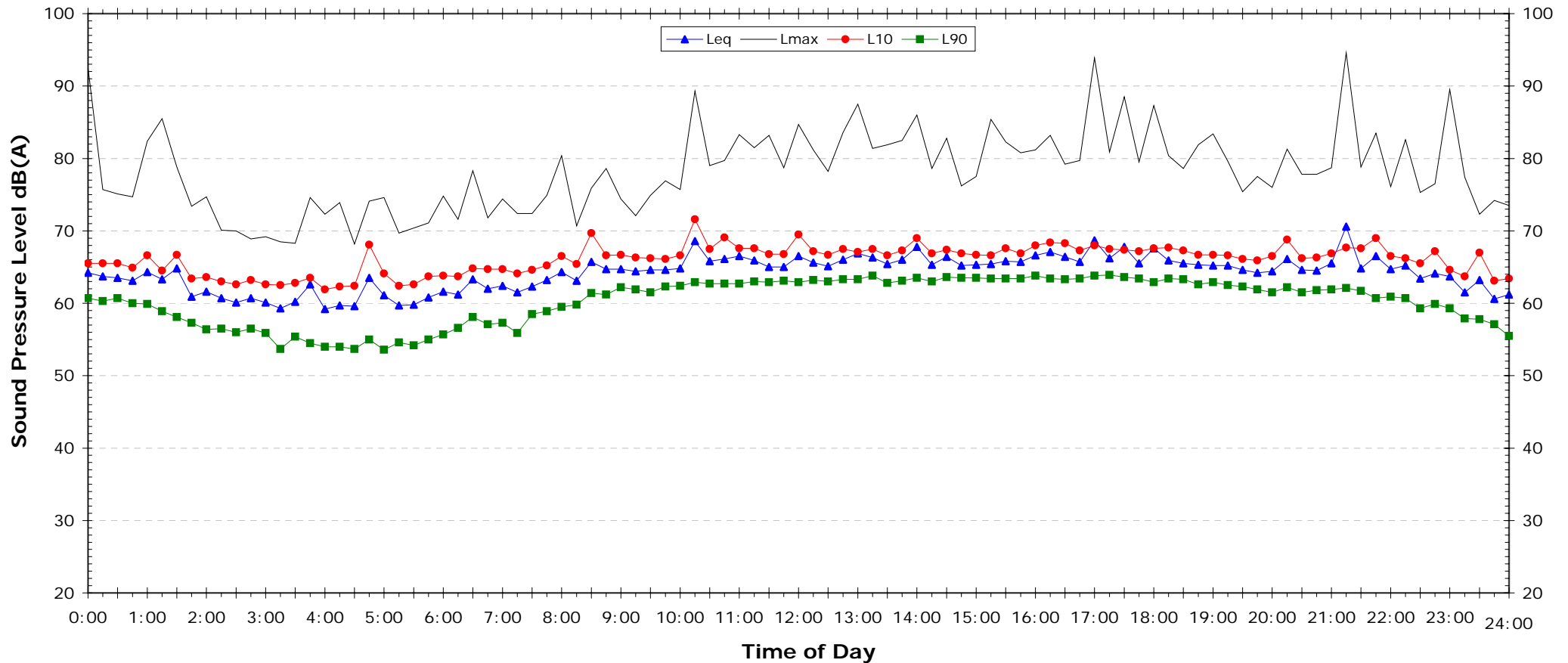
NSW ECRTN Policy (1m from facade) (see note3)		
Descriptor	Day	Night ²
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	65.7	62.9
L _{eq} 1hr upper 10 percentile	67.0	66.2
L _{eq} 1hr lower 10 percentile	63.9	60.4

Night Time Maximum Noise Levels (see note 4)			
L _{max} (Range)	78.3	to	92.5
L _{max} - Leq (Range)	16.0	to	28.1

EXISTING AMBIENT NOISE LEVELS

Bakehouse Quarter (previous Lollipops Playland site)

Sunday, 7 March 2010



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night ²
	7am-6pm	6pm-10pm	10pm-7am
L ₉₀	59.8	60.9	50.0
Leq (see note 3)	63.3	63.3	60.9

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 1m from facade; tabulated results free-field corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

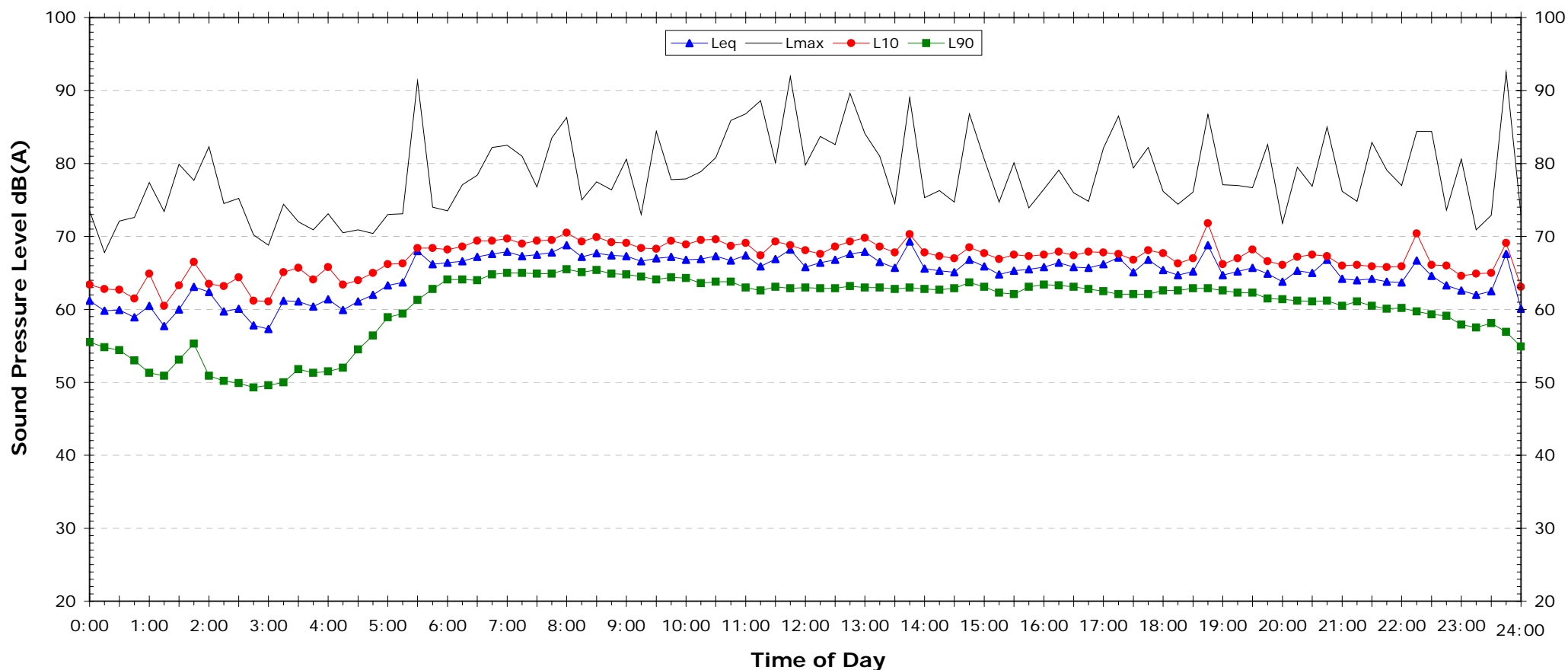
NSW ECRTN Policy (1m from facade) (see note3)		
Descriptor	Day	Night ²
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	65.8	63.4
L _{eq} 1hr upper 10 percentile	67.3	67.4
L _{eq} 1hr lower 10 percentile	63.9	58.9

Night Time Maximum Noise Levels (see note 4)			
Lmax (Range)	75.2	to	91.3
Lmax - Leq (Range)	15.1	to	25.3

EXISTING AMBIENT NOISE LEVELS

Bakehouse Quarter (previous Lollipops Playland site)

Monday, 8 March 2010



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night ²
	7am-6pm	6pm-10pm	10pm-7am
L ₉₀	62.3	60.2	50.4
Leq (see note 3)	64.3	62.7	61.0

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 1m from facade; tabulated results free-field corrected
4. Night time Lmax values are shown only where Lmax > 65dB(A) and where Lmax-Leq ≥ 15dB(A)

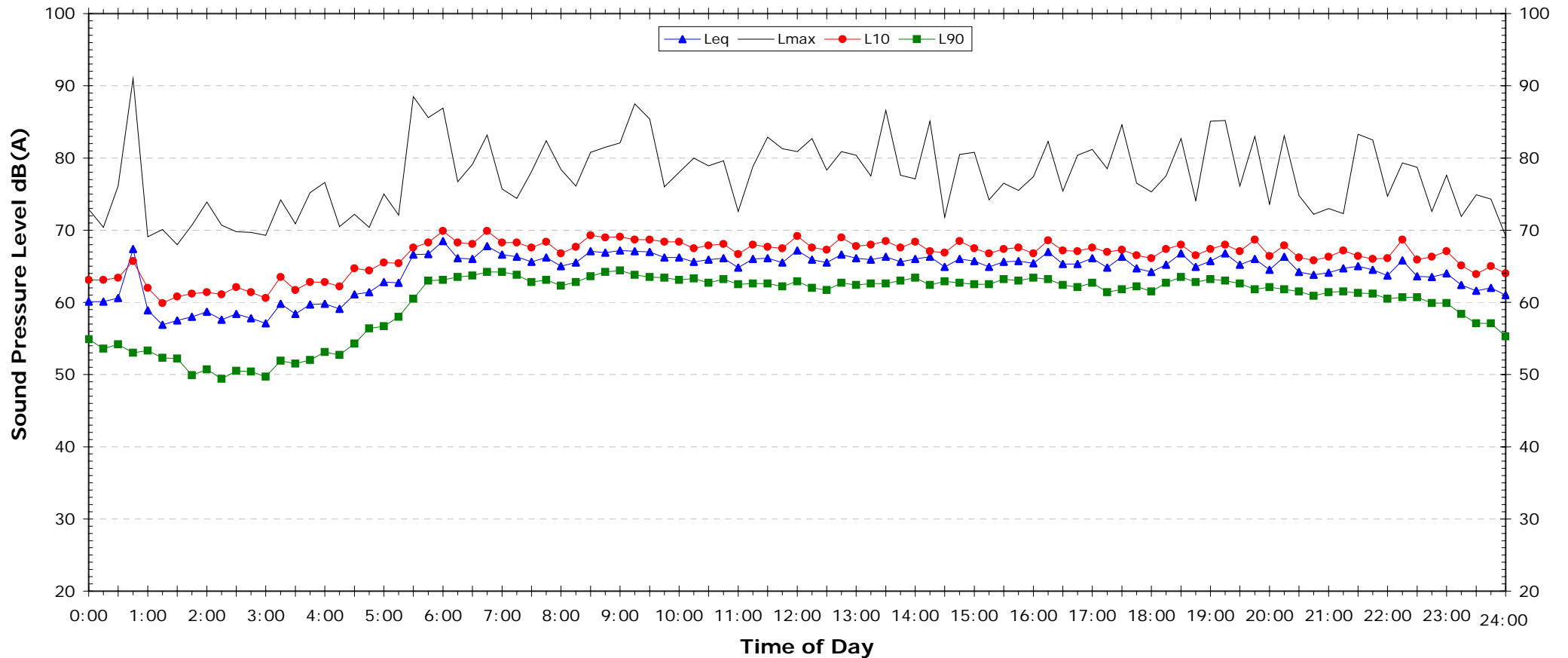
NSW ECRTN Policy (1m from facade) (see note3)		
Descriptor	Day	Night ²
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	66.4	63.5
L _{eq} 1hr upper 10 percentile	67.7	66.7
L _{eq} 1hr lower 10 percentile	64.5	57.8

Night Time Maximum Noise Levels (see note 4)			
Lmax (Range)	73.9	to	92.5
Lmax - Leq (Range)	16.1	to	28.5

EXISTING AMBIENT NOISE LEVELS

Bakehouse Quarter (previous Lollipops Playland site)

Tuesday, 9 March 2010



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night ²
	7am-6pm	6pm-10pm	10pm-7am
L ₉₀	62.0	60.9	51.1
Leq (see note 3)	63.5	62.7	62.1

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 1m from facade; tabulated results free-field corrected
4. Night time L_{max} values are shown only where L_{max} > 65dB(A) and where L_{max}-Leq ≥ 15dB(A)

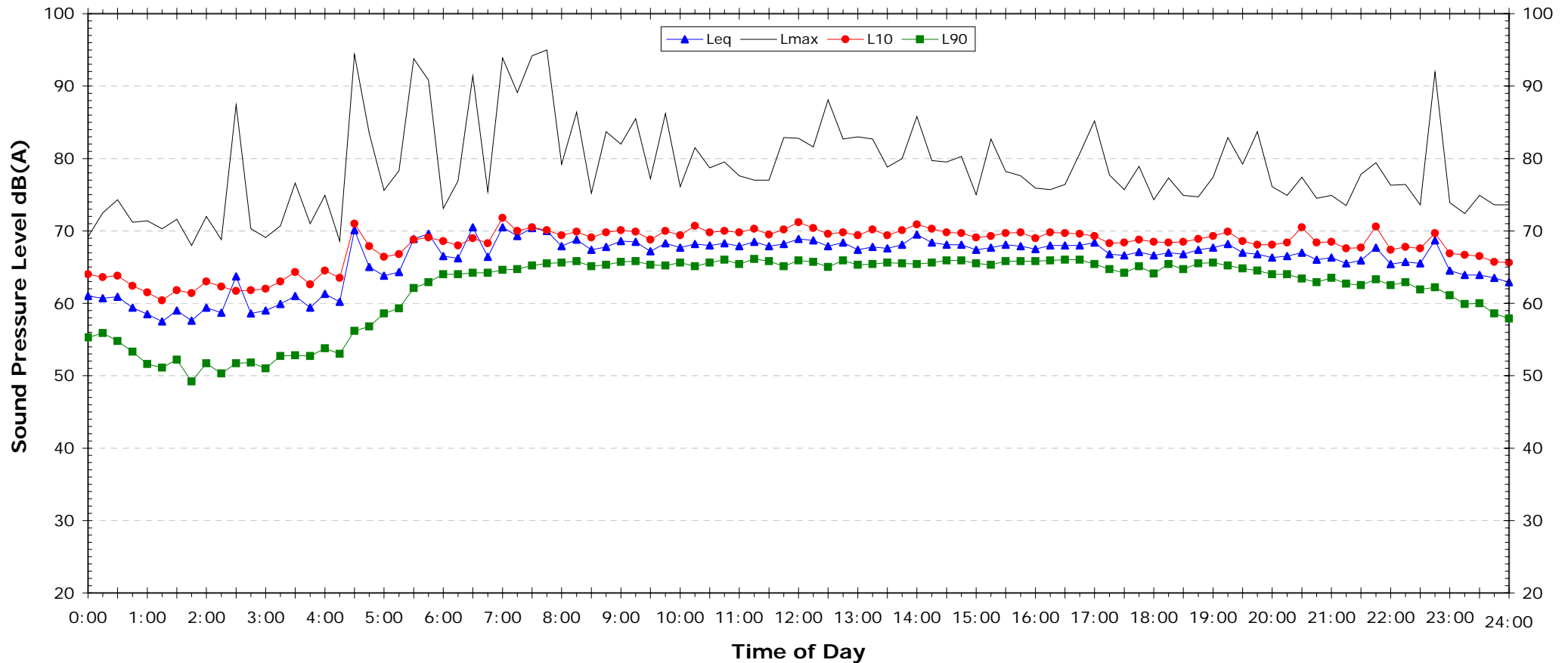
NSW ECRTN Policy (1m from facade) (see note3)		
Descriptor	Day	Night ²
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	65.8	64.6
L _{eq} 1hr upper 10 percentile	66.7	68.9
L _{eq} 1hr lower 10 percentile	64.6	58.5

Night Time Maximum Noise Levels (see note 4)			
L _{max} (Range)	76.6	to	94.4
L _{max} - Leq (Range)	16.1	to	28.2

EXISTING AMBIENT NOISE LEVELS

Bakehouse Quarter (previous Lollipops Playland site)

Wednesday, 10 March 2010



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night ²
	7am-6pm	6pm-10pm	10pm-7am
L ₉₀	65.0	62.5	52.7
Leq (see note 3)	65.7	64.3	62.7

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 1m from facade; tabulated results free-field corrected
4. Night time L_{max} values are shown only where L_{max} > 65dB(A) and where L_{max}-Leq ≥ 15dB(A)

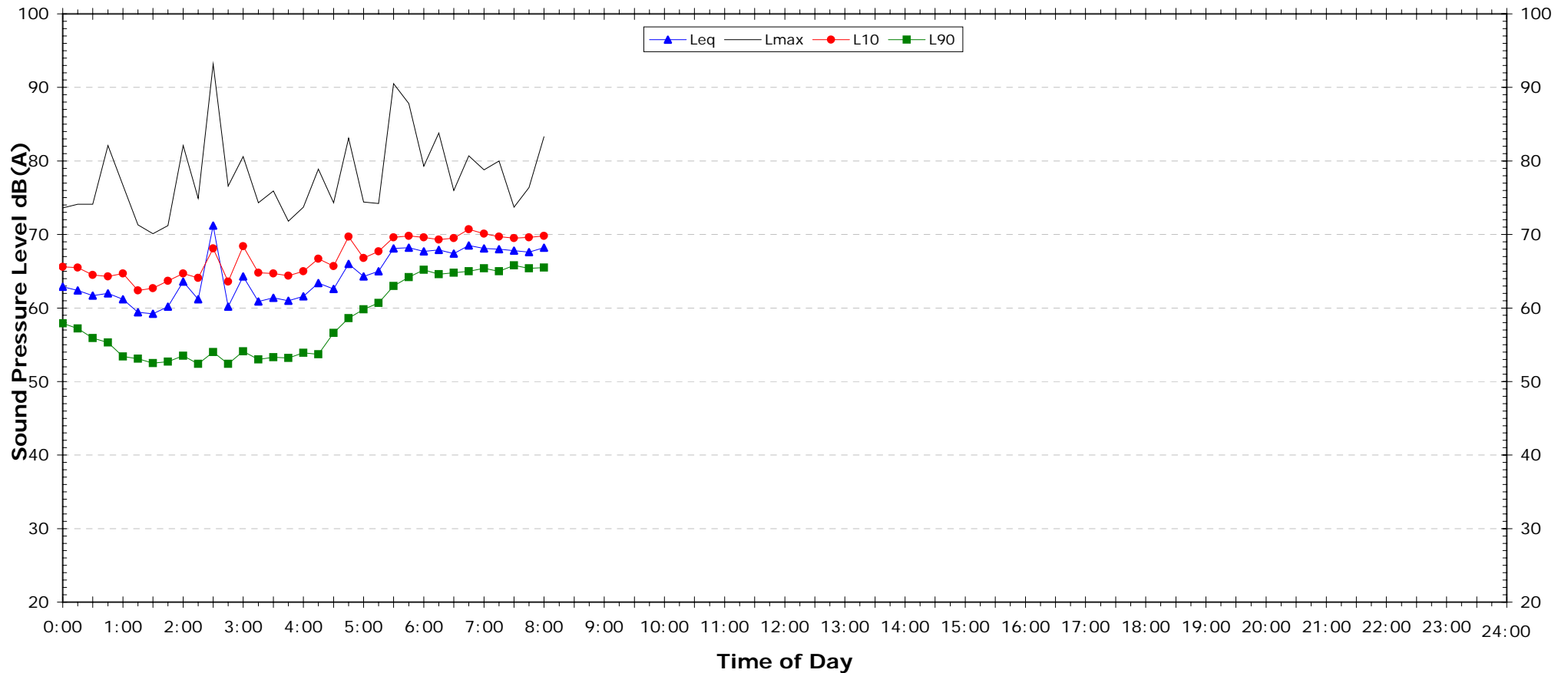
NSW ECRTN Policy (1m from facade) (see note3)		
Descriptor	Day	Night ²
	7am-10pm	10pm-7am
L _{eq} 15 hr and L _{eq} 9 hr	67.8	65.2
L _{eq} 1hr upper 10 percentile	69.0	68.0
L _{eq} 1hr lower 10 percentile	66.3	61.0

Night Time Maximum Noise Levels (see note 4)			
L _{max} (Range)	82.1	to	93.2
L _{max} - Leq (Range)	15.8	to	26.6

EXISTING AMBIENT NOISE LEVELS

Bakehouse Quarter (previous Lollipops Playland site)

Thursday, 11 March 2010



NSW Industrial Noise Policy (Free Field)			
Descriptor	Day	Evening	Night ²
	7am-6pm	6pm-10pm	10pm-7am
L ₉₀	-	-	-
Leq (see note 3)	-	-	-

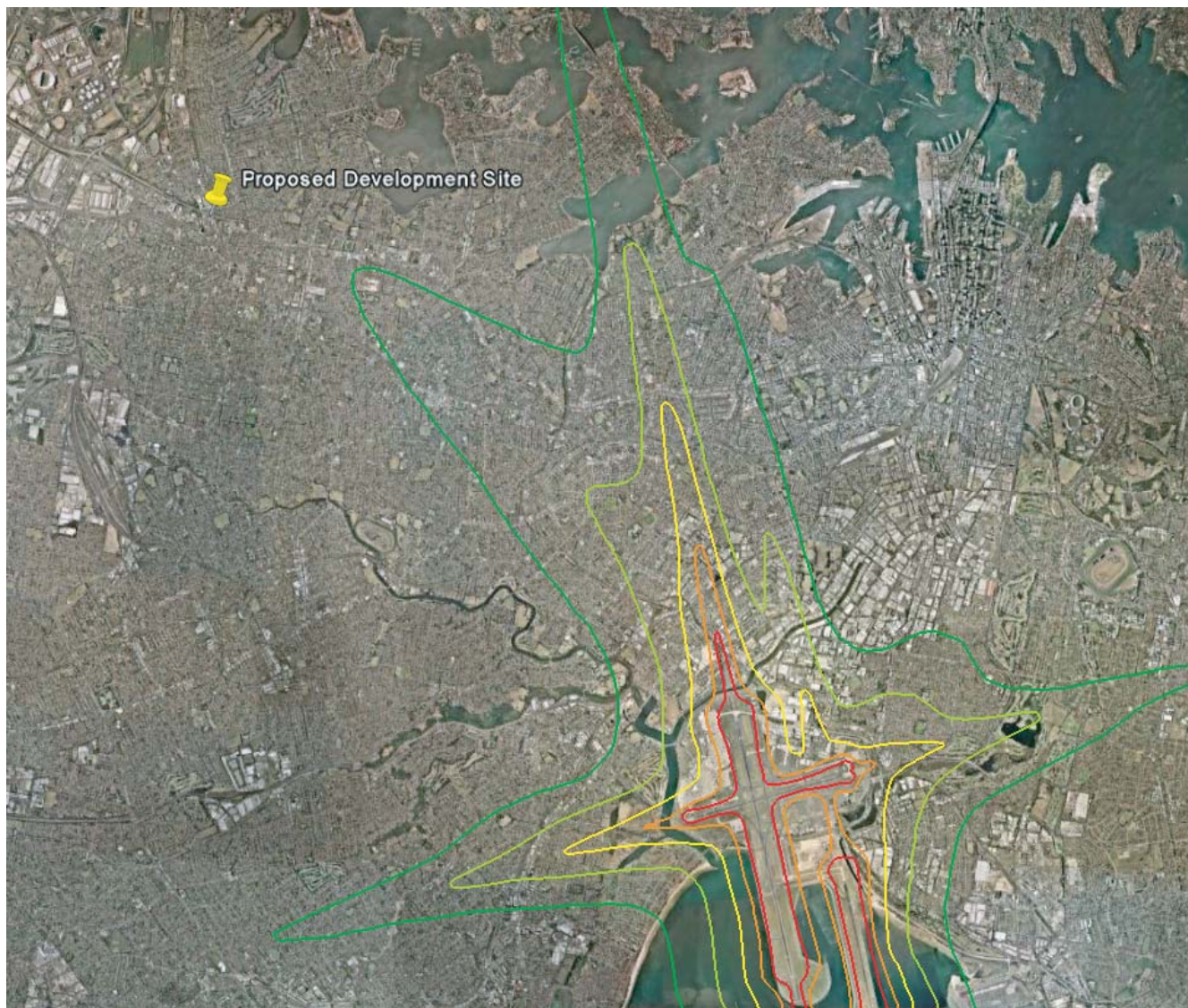
NOTES:

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 1m from facade; tabulated results free-field 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	67.9	-
L _{eq} 1hr upper 10 percentile	67.9	-
L _{eq} 1hr lower 10 percentile	67.9	-

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

APPENDIX D - ANEF 2029 CONTOUR MAP



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AAC Member of the Association of Australian Acoustical Consultants

Title: Site Location & Sydney Airport ANEF 2029 Contours

Date: 03/06/10

Scale: NTS

Project: TE708-01 Bakehouse Quarter, North Strathfield

Ref : TE708-01P02 (rev 0)