AECOM

Sydney International Convention,
Exhibition and Entertainment Precinct

Darling Harbour Live

18 March 2013

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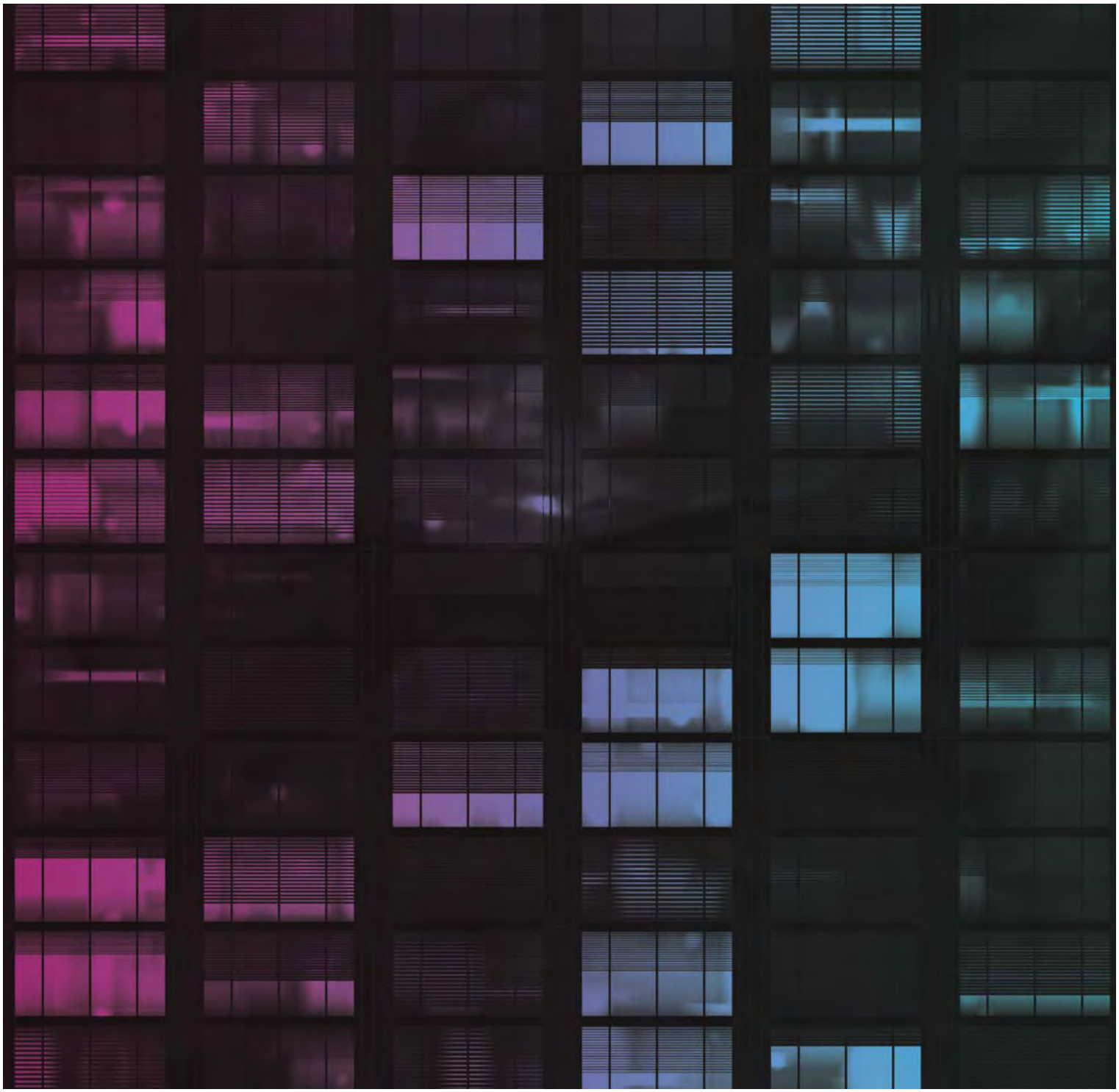
Sydney International Convention, Exhibition and Entertainment Precinct

Environmental Noise and Vibration Impact Assessment for SSDA1



Sydney International Convention, Exhibition and Entertainment Precinct

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Environmental Noise and Vibration Impact Assessment for SSDA1

Prepared for

Darling Harbour Live

Prepared by

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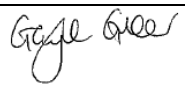
04	18-Mar-2013	For Issue to DoP&I	Gayle Greer Acoustics Team Leader - NSW	

Sydney International Convention, Exhibition and Entertainment Precinct

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Sydney International Convention, Exhibition and Entertainment Precinct

1.0 Introduction

This report supports a State Significant Development Application (SSD 5752 2012) submitted to the Minister for Planning and Infrastructure pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

The Application SSDA1 seeks approval for construction of the Public Private Partnership (PPP) component of the Sydney International Convention, Exhibition and Entertainment Precinct (SICEEP) Project at Darling Harbour.

The SICEEP Project will deliver Australia's global city with world class convention, exhibition and entertainment facilities that can compete effectively in the national and international events markets. The SICEEP Project importantly forms a critical element of the NSW Government's aspiration to "*make NSW number one again*". The SICEEP Project also involves the creation of a new neighbourhood and a community hub to the south of the PPP component.

1.1 Overview of proposed development

The proposed development involves construction of the PPP component of the SICEEP Project, comprising new, integrated and world-class convention, exhibition and entertainment facilities with associated retail and public domain upgrades.

The application more specifically seeks approval for the following development:

- Demolition of existing developments on the site, including existing Sydney Convention Centre (part) and Sydney Exhibition Centre;
- Associated tree removal and replanting;
- Construction of a new, integrated and world-class Convention, Exhibition and Entertainment Centre;
- Public domain improvements, including:
    - Reinvigorating and expanding Tumbalong Park;
    - Provision (part) of a new active north-south pedestrian connection (known as the Boulevard);
    - Provision of new east-west connections, including Harbourside Place and Tumbalong Place;
    - Provision of a pedestrian bridge link from Quarry Street;
    - Retention of the tidal cascade water feature;
    - Reconfiguration and upgrade of Darling Drive (part);
    - Provision of a new square adjoining the Chinese Garden;
    - Provision of a new open space 'event deck' (connected with the Exhibition Centre);
    - Integrated art, play zones, water play and recreation areas; and
    - Provision of retail kiosks.
- Provision of ground level parking within the Exhibition and Entertainment Centre facilities;
- Ground and elevated loading docks (accessed off Darling Drive) for Convention, Exhibition and Entertainment Centre facilities;
- Two vehicle drop off points off Darling Drive;
- Provision of signage; and
- Extension and augmentation of physical infrastructure / utilities as required.

1.2 Background

The existing Convention, Exhibition and Entertainment Centre facilities at Darling Harbour were constructed in the 1980s and have provided an excellent service for Sydney and NSW.

The facilities however have limitations in their ability to service the contemporary exhibition and convention industry which has led to a loss in events being held in Sydney.

The NSW Government considers that a precinct-wide renewal and expansion is necessary and is accordingly committed to Sydney reclaiming its position on centre-stage for hosting world-class events with the creation of the SICEEP Project.

Following an extensive and rigorous Expressions of Interest and Request for Proposals process, Darling Harbour Live (formerly known as 'Destination Sydney' - a PPP consortium comprising AEG Ogden, Lend Lease, Capella Capital and Spotless) was announced by the NSW Government in December 2012 as the preferred proponent to transform Darling Harbour and create the new Sydney International Convention, Exhibition and Entertainment Precinct.

Key features of the Darling Harbour Live Preferred Master Plan include:

- Delivering world-class convention, exhibition and entertainment facilities, including:
  - Up to 40,000 m^2 exhibition space;
  - Over 8,000 m^2 of meeting rooms space, across 40 rooms;
  - Overall convention space capacity for more than 12,000 people;
  - A ballroom capable of accommodating 2,000 people; and
  - A premium, red-carpet entertainment facility with a capacity of 8,000 people.
- Providing up to 900 hotel rooms in a hotel complex at the northern end of the Precinct;
- A vibrant and authentic new neighbourhood at the southern end of the precinct, called 'The Haymarket', home to an IQ Hub focused on the creative industries and high-tech businesses, apartments, student accommodation, shops, cafes and restaurants;
- Renewed and upgraded public domain, including an outdoor event space for up to 25,000 people at an expanded Tumbalong Park;
- Improved pedestrian connections linking to the proposed Ultimo Pedestrian Network drawing people between Central, Chinatown and Cockle Bay Wharf as well as east-west between Ultimo/Pyrmont and the City.

1.3 Site description

The SICEEP Site is located within the Darling Harbour precinct. Darling Harbour is a 60 hectare waterfront precinct on the south-western edge of the Sydney Central Business District that provides a mix of functions including recreational, tourist, entertainment and business.

With an area of approximately 20 hectares, the SICEEP Site is generally bound by the Light Rail Line to the west, Harbourside shopping centre and Cockle Bay to the north, Darling Quarter, the Chinese Garden and Harbour Street to the east, and Hay Street to the south.

The SICEEP Site has been divided into three distinct redevelopment areas (from north to south) – Bayside, Darling Central and The Haymarket. The PPP Application Site area is located within Bayside and Darling Central as shown in Figure 1.

Figure 1 SICEEP site with DA boundaries

1.4 Planning approvals strategy

In response to separate contractual agreements with the NSW Government and staging requirements, Darling Harbour Live is proposing to submit a number of separate development applications for key elements of the overall SICEEP Project.

This application involves the PPP component of the SICEEP Project, comprising the Convention Centre, Exhibition Centre, Entertainment facility, and associated public domain upgrades.

Development of The Haymarket is to be staged and accordingly a staged development application is to be lodged. Detailed development applications will follow seeking approval for specific aspects of The Haymarket.

A separate development application will also be submitted for the Hotel Complex.

Figure 2 Detailed SICEEP site plan

2.0 Environmental noise impact assessment

2.1 Director General's Environmental Assessment Requirements

This Environmental Noise and Vibration Impact Assessment report has been prepared by AECOM Australia Pty Ltd (AECOM) in response to the Director General's Environmental Assessment Requirements (DGEARs) for the Sydney International Convention, Exhibition and Entertainment Precinct issued on 21 January 2013. It specially addresses the DGEARs Key Assessment Requirements 2, 7 and 16 as reproduced below:

> ***2. Policies and Guidelines***
>
> *Address the relevant planning provisions, goals and strategic planning objectives in the following:…*
>
> - *Development Near Rail Corridors and Busy Roads – Interim Guideline…*
>
> ***7. Noise and Vibration***
>
> *Identify the main noise and vibration generating source and activities at all stages of construction (including demolition), and any noise sources during operation. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupies of land.*
>
> *Relevant Policies and Guidelines:*
>
> - *NSW Industrial Noise Policy (EPA, 2000)*
> - *Interim Construction Noise Guideline (DECC, 2009)*
> - *Assessing Vibration: A Technical Guideline (DEC, 2006)*
> - *Environmental Criteria for Road Traffic noise (EPA, 1999)*
>
> ***16. Construction Impacts***
>
> - *Address potential impacts to the surrounding area from noise and vibration, air quality and odour impacts, water quality and construction waste management during demolition and construction;…*

2.2 Environmental noise and vibration impact assessment scope

The scope of the Environmental Noise and Vibration Impact Assessment is to:

- Identify all nearby noise and vibration sensitive receivers potentially affected by the use or construction of SICEEP;
- Establish all applicable environmental noise and vibration criteria for the operation of SICEEP;
- Establish all applicable construction noise and vibration management levels for the construction of SICEEP;
- Analyse likely environmental noise emissions from the use of SICEEP including entertainment and patron activities, building services plant, car parking and loading dock activities;
- Assess impact of traffic generated by the development of the SICEEP;
- Provide indicative noise control recommendations where required to meet the established noise criteria;
- Calculate the likely level of demolition and construction noise and vibration at nearby sensitive receivers including the light railway; and
- Provide indicative construction noise and vibration mitigation and management measures where required.

The operational noise criteria will be determined in accordance with the following documents:

- *NSW Industrial Noise Policy (INP),* 2000, Environment Protection Authority;
- *NSW Road Noise Policy (RNP),* 2011, Department of Environment, Climate Change and Water. The DGEARs references the Environmental Criteria for Road Traffic noise (EPA, 1999), however this document has recently been superseded by the NSW RNP; and
- NSW Office of Liquor, Gaming and Racing (OLGR) *Current noise condition,* as presented in the Noise Guide for Local Government (NGLG), 2010, Department of Environment, Climate Change and Water;

- Noise Guide for Local Government (NGLG), 2010, Department of Environment, Climate Change and Water.

It should be noted that the time periods over which environmental noise emission criteria are derived are different for the INP and the OLGR noise conditions.

The construction noise management levels will be determined in accordance with the following document:

- Interim Construction Noise Guideline (ICNG), 2009, Department of Environment and Climate Change.

The construction vibration criteria will be determined in accordance with the following document:

- *Assessing Vibration: A Technical Guideline, 20006, Department of Environment and Conservation.*

The construction traffic criteria will be determined in accordance with the following document:

NSW Road Noise Policy (RNP), 2011, Department of Environment, Climate Change and Water. The DGEARs references the Environmental Criteria for Road Traffic noise (EPA, 1999), however this document has recently been superseded by the NSW RNP.

Acoustic terminologies used in this report are explained in Appendix A.

2.3 Noise and vibration sensitive receivers

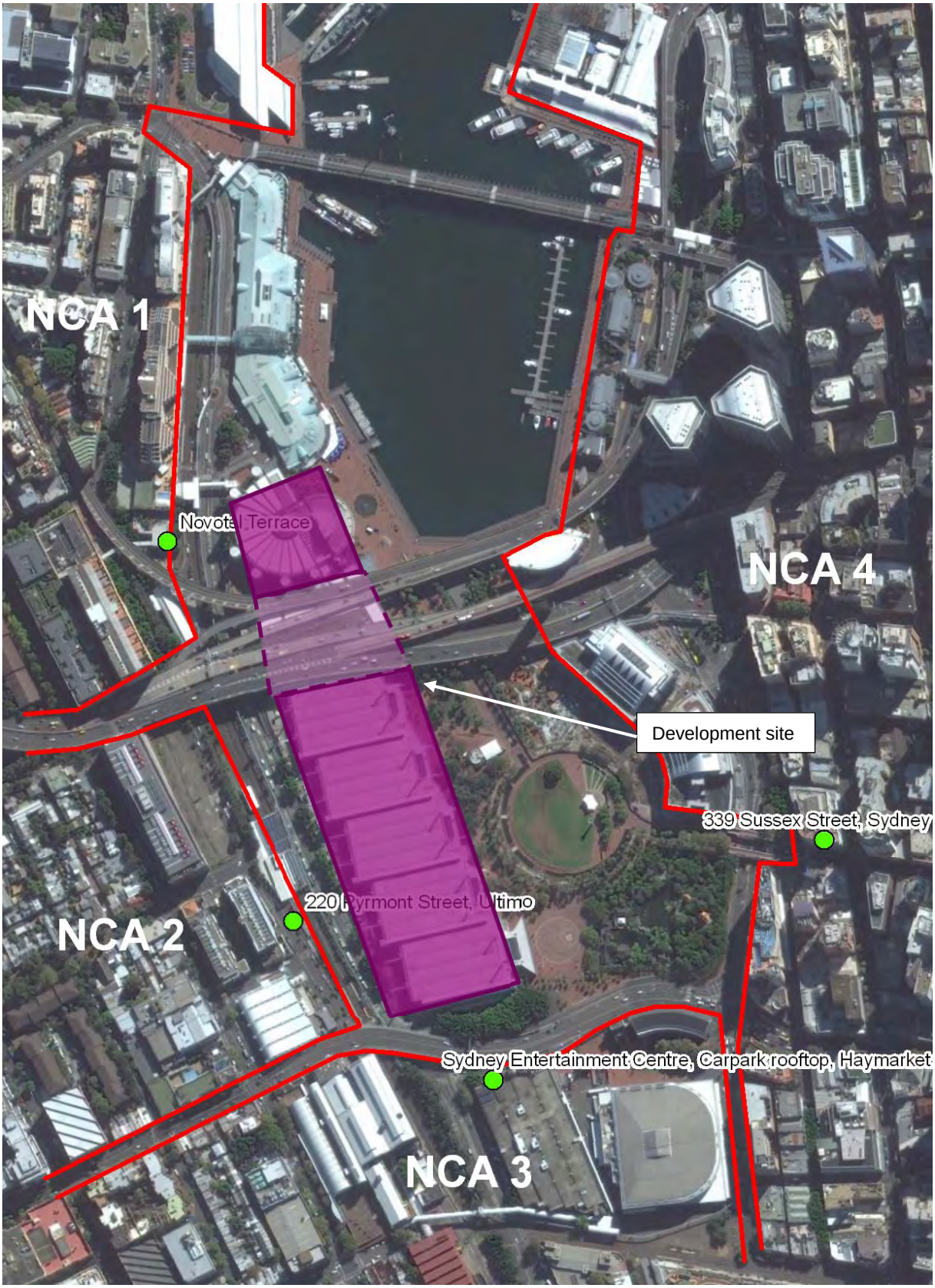
AECOM has identified and established four Noise Catchment Areas (NCAs) for the purpose of this assessment. Typical noise sensitive receivers (NSRs) within each of the NCAs and the representative noise logging location for each NCA are presented in Table 1 and Figure 3.

Table 1 Noise catchment areas

NCA	Noise logging location	Description of noise sensitive receivers
1	Southern Terrace of Novotel Sydney on Darling Harbour	• Novotel Sydney on Darling Harbour (Hotel - residential receiver) • Ibis Sydney Darling Harbour (Hotel - residential receiver) • Oaks Goldsbrough Apartments (residential receiver)
2	220 Pyrmont Street, Pyrmont	• 444 Harris Street (residential receiver) • 287/291A Pyrmont Street (residential receiver) • Ian Thorpe Aquatic Centre (commercial receiver) • 400 Harris Street Data Centre (industrial receiver)
3	Sydney Entertainment Centre rooftop car park	• Novotel Century Sydney (Hotel - residential receiver) • Powerhouse Museum (commercial receiver) • Peak Apartments (residential receiver)
4	339 Sussex Street, Sydney	• Southern Cross on Harbour (residential receiver) • Seasons Darling Harbour Sydney (Hotel - residential receiver) • Park Royal Darling Harbour (Hotel - residential receiver) • Darling Quarter (commercial receiver)

It is noted that there may be schools and places of worship around the proposed site, however due to the closer proximity of residential and commercial development it is unlikely that these will be the controlling sensitive receivers.

Figure 3 SICEEP and noise sensitive receivers location plan



2.4 Environmental noise measurements

2.4.1 Measurements and analysis

In order to quantify the existing noise environment around the SICEEP development site, a noise survey by way of unattended and attended noise measurements was undertaken during May/June 2012 and January 2013. The methodology and processed results of this noise survey are presented in the following sections. In brief, the noise survey results are used to:

- Determine existing background noise levels at nearby noise sensitive receivers. These levels are then used to establish operational noise criteria and construction noise management levels; and
- Determine energy-average noise levels at the SICEEP proposed building's facade locations to establish facade glazing requirements to control external noise intrusion to internal spaces.

Unattended noise logging was conducted at four locations, one location within each of the NCAs. The locations, equipment and dates are summarised in Table 2. The four unattended noise logging locations are shown in Figure 3.

Table 2 Unattended noise logging summary – Location, equipment and dates

NCA	Logger location	Equipment	Serial number	Logging commenced	Logging completed
1	Southern Terrace of Novotel Sydney on Darling Harbour	SVAN 979	27538	25/01/2013	31/01/2013
2	220 Pyrmont Street, Pyrmont	SVAN 957	27538	15/02/2013	22/02/2013
3	Sydney Entertainment Centre rooftop car park	SVAN 949	8197	21/05/2012	29/05/2012
4	339 Sussex Street, Sydney	SVAN 979	21014	22/05/2012	08/06/2012

The loggers measured the noise levels over the sample period and then determined L_{A90} and L_{Aeq} levels of the noise environment.

The L_{A90} levels are the levels exceeded for 90% of the sample period and are taken as the background noise levels. The background noise level is defined in the NSW Industrial Noise Policy (INP) as 'the underlying level of noise present in ambient noise when all unusual extraneous noise is removed'. It can include sounds that are normal features of a location and may include birds, traffic, insects etc. The background noise level is considered to be represented by the L_{A90} descriptor.

The L_{Aeq} levels are the equivalent continuous sound levels and have the same sound energy over the sample period as the actual noise environment with fluctuating sound levels.

2.4.2 INP time period noise levels

The measured noise levels were analysed to determine a single assessment background level (ABL) for each day, evening and night-time period[1] in accordance with the INP, for each monitoring location. The ABL is established by determining the lowest ten-percentile level of the L_{A90} noise data acquired over each period of interest. The background noise level or rating background level (RBL) representing the day, evening and night-time assessment periods is based on the median of individual ABLs determined over the entire monitoring period in accordance with the INP. An overall representative L_{Aeq} noise level is determined by logarithmically averaging each assessment period for the entire monitoring period.

2.4.3 OLGR time period noise levels

To set noise emission criteria in accordance with the OLGR noise condition the data obtained from the loggers were processed to determine a typical daytime (7.00 am until 12 midnight) and night-time (12 midnight until

[1] Daytime is defined as 7 am to 6 pm, Monday to Saturday and 8 am to 6 pm Sundays and Public Holidays; Evening is defined as 6 pm to 10 pm Monday to Sunday and Public Holidays; Night-time is defined as 10 pm to 7 am, Monday to Saturday and 10 pm to 8 am Sundays and Public Holidays.

7.00 am) background noise level, rounded to the nearest 1 dB(A). In addition representative L_{A90} noise spectra were identified.

2.4.4 Noise logging results

Table 3 presents a summary of the noise logger locations, the noise sensitive receivers they represent and the existing noise sources in the area.

Table 3 Noise logger and sensitive receiver locations

NCA	Logger location	Representative of	Existing noise sources
1	Southern Terrace of Novotel Sydney on Darling Harbour, Pyrmont	Residences, hotel and commercial receivers to the north west of the SICEEP development	Traffic noise dominant including noise from Darling Drive, Western Distributor, Pier Street and Pyrmont Street. Noise from Darling harbour activities and from building services plant serving adjacent buildings.
2	220 Pyrmont Street, Pyrmont	Residences and commercial receivers to the west of the SICEEP development	Traffic noise from Pyrmont Street, Pier Street, Western Distributor and Darling Drive. Noise from Darling harbour activities and from building services plant serving adjacent buildings
3	Roof of Sydney Entertainment Centre car park	Residences and commercial receivers to the south of the SICEEP development	Traffic noise from Harbour Street and Pier Street overpass, Darling Drive and Western Distributor. Noise from Darling Harbour activities.
4	14th Storey, 339 Sussex Street, Sydney	Residences, hotel and commercial premises to the east of the SICEEP development	Traffic noise from Harbour Street, Pier Street, Goulburn Street and Liverpool Street. Noise from building services plant serving adjacent buildings.

2.4.5 Ambient noise measurement results – INP time period

Table 4 presents a summary of the measured noise levels.

Table 4 Ambient noise logging summary for residential receiver locations (INP time period)

Logger location	Day		Evening		Night	
NCA1 – Southern terrace of Novotel Sydney on Darling Harbour, Pyrmont						
	L_{A90}	L_{Aeq}	L_{A90}	L_{Aeq}	L_{A90}	L_{Aeq}
Friday 25 January, 2013			59	66	52	62
Saturday 26 January, 2013	56	66	60	70	53	64
Sunday 27 January, 2013	57	67	57	66	52	62
Monday 28 January, 2013	55	67	60	67	53	64
Tuesday 29 January, 2013	58	66	56	65	51	60
Wednesday 30 January, 2013	59	67	-	-	52	62
Thursday 31 January, 2013	60	67	58	66	52	63
RBL	**58**	-	**59**	-	**52**	**-**
Log Average L_{Aeq}	**-**	**67**	**-**	**67**	**-**	**62**
NCA2 – 220 Pyrmont Street, Pyrmont						

Logger location	Day		Evening		Night	
	L_{A90}	L_{Aeq}	L_{A90}	L_{Aeq}	L_{A90}	L_{Aeq}
Friday 15 February, 2013			56	64	52	60
Saturday 16 February, 2013	54	66	57	68	52	62
Sunday 17 February, 2013	54	63	55	63	51	65
Monday 18 February, 2013	57	65	55	63	50	57
Tuesday 19 February, 2013	57	63	56	63	50	59
Wednesday 20 February, 2013	58	63	55	63	51	59
Thursday 21 February, 2013	58	65	56	63	52	60
RBL	**57**	**-**	**56**	**-**	**51**	**-**
Log Average L_{Aeq}	**-**	**64**	**-**	**64**	**-**	**61**
NCA3 - Sydney Entertainment Centre rooftop car park						
	L_{A90}	L_{Aeq}	L_{A90}	L_{Aeq}	L_{A90}	L_{Aeq}
Monday 21 May, 2012			58	66	51	62
Tuesday 22 May, 2012	60	68	58	66	51	63
Wednesday 23 May, 2012	60	69	58	66	50	65
Thursday 24 May, 2012	61	69	60	68	52	64
Friday 25 May, 2012	61	68	59	67	52	63
Saturday 26 May, 2012	58	66			53	65
Sunday 27 May, 2012	57	66	58	66	51	62
Monday 28 May, 2012	60	67	58	67	51	64
RBL	**60**	**-**	**58**	**-**	**51**	**-**
Log Average, L_{Aeq}	**-**	**68**	**-**	**66**	**-**	**64**
NCA4 - 339 Sussex Street, Sydney						
	L_{A90}	L_{Aeq}	L_{A90}	L_{Aeq}	L_{A90}	L_{Aeq}
Tuesday 22 May, 2012			59	61	54	58
Wednesday 23 May, 2012	58	60	58	60	54	59
Thursday 24 May, 2012	58	61	59	61	55	60
Friday 25 May, 2012	58	61	60	61	54	59
Saturday 26 May, 2012	57	61	60	64	55	59
Sunday 27 May, 2012	57	61	59	62	54	58
Monday 28 May, 2012	58	61	59	61	54	58
Tuesday 29 May, 2012	59	61	59	62	54	58
Wednesday 30 May, 2012	58	61	60	62	58	60
Thursday 31 May, 2012	59	62	59	61	54	59
Friday 01 June, 2012	58	61	59	61	55	60
Saturday 02 June, 2012	57	61	59	64	56	60
Sunday 03 June, 2012	58	62	59	61	55	59

Logger location	Day		Evening		Night	
Monday 04 June, 2012	59	61	58	60	54	58
RBL	**58**	**-**	**59**	**-**	**54**	**-**
Log Average, L_{Aeq}	**-**	**61**	**-**	**62**	**-**	**59**

Notes:

- Day is defined as 7 am to 6 pm, Monday to Saturday and 8 am to 6 pm Sundays and Public Holidays.
- Evening is defined as 6 pm to 10 pm, Monday to Sunday and Public Holidays.
- Night is defined as 10 pm to 7 am, Monday to Saturday and 10 pm to 8 am Sundays and Public Holidays
- RBL - Rating Background Noise Level (RBL) is representative of the average minimum background sound level (in the absence of the source under consideration), or simply the background level L_{A90}. The RBL is based on the median of the individual daily background noise levels during each assessment period over the entire monitoring period.
- The L_{Aeq} level is the equivalent continuous sound level and has the same sound energy over the sample period as the actual noise environment with fluctuating sound levels. The overall representative L_{Aeq} noise level is determined by logarithmically averaging each assessment period for the entire monitoring period.

2.4.6 Ambient noise measurement results - OLGR time period

Table 5 presents the existing background noise levels for the day and night-time periods based on the OLGR time periods.

Table 5 Ambient noise logging noise spectra summary for residential receiver locations (OLGR time period)

Measurement	Sound level, dB at Octave band centre frequency, Hz									Overall, dB(A)
	32	63	125	250	500	1k	2k	4k	8k	
NCA1 – Southern terrace of Novotel Sydney on Darling Harbour, Pyrmont										
L_{90} Daytime	57	59	58	57	55	55	52	45	36	59
L_{90} Night-time	52	55	54	53	51	49	45	38	29	53
NCA2 – 220 Pyrmont Street, Pyrmont										
L_{90} Daytime	62	61	58	56	53	53	48	41	34	57
L_{90} Night-time	56	56	56	53	49	47	42	35	31	52
NCA3 - Sydney Entertainment Centre rooftop car park										
L_{90} Daytime	55	57	55	55	54	55	51	42	40	58
L_{90} Night-time	49	52	50	50	48	47	43	40	40	52
NCA4 - 339 Sussex Street, Sydney										
L_{90} Daytime	63	59	58	57	55	54	50	42	31	58
L_{90} Night-time	59	54	53	53	51	49	45	38	28	54

Notes:

- Day is defined as 7 am to 12 midnight.
- Night is defined as 12 midnight to 7 am.

2.4.6.1 Existing road traffic noise levels

Measured noise levels at the logger locations have been processed to determine the $L_{Aeq,1hour}$ 'noisiest one hour' road traffic noise levels during a 24 hour period. The results of this analysis are presented in Table 6.

Table 6 Road traffic noise levels

NCA	Measurement period	$L_{Aeq,1hour}$ dB(A)
NCA 1	Southern terrace of Novotel Sydney on Darling Harbour	68
NCA 2	220 Pyrmont Street, Pyrmont	65
NCA 3	Sydney Entertainment Centre rooftop car park	69
NCA 4	339 Sussex Street, Sydney	62

3.0 Noise and Vibration Criteria

This section specifies the acoustic criteria applicable to the site to control the emission of environmental noise.

The requirements applicable to the development have been established and derived from:

- Director General's Environmental Assessment Requirements, 21 January 2013;
- The Noise Guide for Local Government; and
- NSW Office of Liquor, Gaming and Racing "OLGR current noise condition".

This section presents the detailed criteria based on the above documents.

3.1 Director General's Environmental Assessment Requirements

The Director General's Environmental Assessment Requirements (DGEARs) set out acoustical requirements for the project, the DGEARs are presented in Section 2.1.

3.2 NSW Industrial Noise Policy

The DGEARs, require the INP to be used to assess environmental noise emission from the development. The INP sets out guidelines for the assessment and control of industrial noise. It is noted that the environmental noise emissions from the use of the site are not truly "industrial" in nature, however the assessment approach detailed in the INP is considered generally appropriate for the control of environmental noise emissions and its implementation has been discussed further in the following sections.

The assessment procedure for noise sources has two components:

- Controlling intrusive noise impacts in the short term for residences; and
- Maintaining noise level amenity for particular land uses including residences.

3.2.1 Intrusive noise impacts

The INP states that the noise from any single source should not intrude greatly above the prevailing background noise level. Industrial noise sources are generally considered to be acceptable if the equivalent continuous (energy-averaged) A-weighted level of noise from the source (L_{Aeq}), measured over a 15 minute period, does not exceed the background noise level measured in the absence of the source by more than 5 dB(A). This is often termed the Intrusiveness Criterion.

The 'rating background level' (RBL) is the background noise level to be used for assessment purposes and is determined by the methods given in the INP. Using the rating background noise level approach results in the intrusiveness criterion being met for 90% of the time. Adjustments are to be applied to the level of noise produced by the source that is received at the assessment point where the noise source contains annoying characteristics such as tonality or impulsiveness.

3.2.2 Protecting noise amenity

To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in the INP. That is, the background noise level should not exceed the level appropriate for the particular locality and land use. This is often termed the Background Creep or Amenity Criterion. The main purpose of these criteria is to limit continuing increases in noise levels.

For receivers in an urban area, the recommended amenity criteria are shown in Table 7. Recommended amenity criteria for commercial and industrial receivers are also presented.

Table 7 Recommended L_{Aeq} amenity noise levels

Type of receiver	Indicative noise amenity area	Time of day	Recommended L_{Aeq} noise level , dB(A)	
			Acceptable	Recommended maximum
Residential	Urban	Day	60	65
		Evening	50	55
		Night	45	50
School classroom	Noisiest 1 hour period when in use		45*	50*
Places of worship	When in use		50*	55*
Passive recreation area	When in use		50	55
Active recreation area	When in use		55	60
Commercial	When in use		65	70
Industrial	When in use		70	75

Notes:

- Day is defined as 7:00 am to 6:00 pm Monday to Saturday and 8:00 am to 6:00 pm Sundays and Public Holidays.
- Evening is defined as 6:00 pm to 10:00 pm Monday to Sunday and Public Holidays.
- Night is defined as 10:00 pm to 7:00 am Monday to Saturday and 10:00 pm to 8:00 am Sundays and Public Holidays.
- *The INP presents internal criteria for these receivers, a 10 dB reduction has been assumed between external and internal noise levels based upon a window being open for adequate natural ventilation.

When the existing noise level from *industrial noise sources* is close to the "Acceptable Noise Level" (ANL) given above, noise from the new source must be controlled to preserve the amenity of the area in line with the requirements of the INP.

Where existing road traffic noise is high enough to render stationary noise sources effectively inaudible, the ANL can be modified so that the amenity criteria is not unduly stringent in an environment where traffic noise is the dominant source of environmental noise. If all the conditions below are satisfied, the ANL becomes $L_{Aeq,traffic}$ minus 10 dB(A). The conditions are:

- The road traffic noise is the dominant noise source;
- The existing noise is 10 dB(A) or more above the acceptable ANL for the area; and
- It is highly unlikely the road traffic noise levels would reduce in the near future.

Observations on and around the site indicate that noise at all receiver locations is dominated by general traffic, urban hum and other sources which would not be classified as industrial. Therefore, it has been assumed that the L_{Aeq} levels from industrial noise is more than 10 dB below the designated amenity criterion during any time period. Therefore, no corrections to the amenity criteria are warranted.

3.2.3 Total environmental noise emission criteria

A summary of the measurements, and intrusive and amenity criteria is given in Table 8. The amenity criteria apply to environmental noise emissions from sources such as building services plant as these sources will run continuously and therefore will have the potential to contribute to background noise creep. Environmental noise emissions from car park and loading dock activities will not be continuous and therefore it is considered more appropriate to assess these sources using intrusive criteria only. Assuming these noise sources do not contain "annoying" characteristics, this will ensure that noise at nearby residential receivers is not offensive. In addition, it is noted that during the evening and night-time periods the amenity criteria are 12-19 dB below the existing L_{Aeq} noise levels, these levels are considered to be unduly restrictive for activities which will not occur continuously. This is considered a reasonable approach given that the development is within a defined entertainment precinct. Criteria applicable to entertainment and patron activities are discussed later in this report.

The amenity criteria apply over the entire daytime, evening or night-time period, whereas intrusive criteria apply over any 15 minute period. All criteria must be applied at the most affected boundaries.

Table 8 Summary of environmental noise emission criteria for residential receivers

Period	RBL $L_{A90,\ 15\ minute}$	Intrusiveness criteria $L_{Aeq,\ 15\ minute}$	Amenity criteria $L_{Aeq,\ period}$
NCA1			
Day	58	63	60
Evening	59	63[1]	50
Night	52	57	45
NCA2			
Day	57	62	60
Evening	56	61	50
Night	51	56	45
NCA3			
Day	60	65	60
Evening	58	63	50
Night	51	56	45
NCA4			
Day	58	63	60
Evening	59	63[1]	50
Night	54	59	45

Notes:

1 Intrusiveness criterion for evening/night-time has been set to no greater than daytime/evening criterion in accordance with the INP application notes.

3.2.4 Tonality and INP modifying factors

The INP provides additional guidance and criteria for assessing noise emission from sources with “annoying characteristics” such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content. Penalties of up to a maximum of 10 dB(A) may be applied where the subject noise has such characteristics at the receiver.

3.2.5 Sleep disturbance criteria

Application notes to the INP discuss sleep disturbance and its objective assessment. To minimise the risk of sleep disturbance as a result of industrial type operations during the night-time period, the INP Application notes recommend that, the $L_{A1(1\ minute)}$ noise level outside a bedroom window should not exceed the L_{A90} background noise level by more than 15 dB(A) during the night-time period (10.00 pm to 7.00 am). EPA considers it is appropriate to use this metric as a screening criterion to assess the likelihood of sleep disturbance. If this screening criterion is found to be exceeded then a more detailed analysis must be undertaken and include the extent that the maximum noise level exceeds the background noise level and the number of times this is likely to happen during the night-time period.

Based on the measured background noise levels during the night, the sleep disturbance criteria for the nearest noise sensitive residential receivers are presented in Table 9.

Table 9 Night-time sleep disturbance criteria

Location	Measured RBL $L_{A90,\ 15\ minute}$ dB(A)	Sleep disturbance criteria Screening level $L_{A1,\ (1\ minute)}$
NCA1	**52**	67
NCA2	**51**	66
NCA3	**51**	66
NCA4	**54**	69

3.2.6 Operational noise limits – Emergency operations

Noise criteria for the site have been derived in accordance with the NSW INP. It is understood that brown-outs and black-outs are extremely rare for the area and therefore standby emergency equipment (e.g. standby generators) is unlikely to be in frequent use. For this reason and in the absence of any relevant NSW guideline for emergency generators and equipment, it is recommended that noise limits for intrusive noise from emergency plant equipment be relaxed by 5 dB(A). This relaxation applies to daytime, evening and night-time criteria. Therefore, the noise emission from emergency plant and equipment has been set to 10 dB(A) above the background (RBL). Table 10 presents operational noise limits for emergency operations.

In addition, it is recommended that all emergency plant and equipment be tested during the daytime period (i.e. 7 am to 6 pm).

Table 10 Operational noise limits – Emergency operations

Location	Measured RBL $L_{A90,\ 15\ minute}$ dB(A)	Emergency operations criteria $L_{Aeq,\ 15\ minute}$ dB(A)
NCA1	**52**	62
NCA2	**51**	61
NCA3	**51**	61
NCA4	**54**	64

3.3 Noise Guide for Local Government

As aforementioned, it is proposed that outdoor events take place on the rooftop event deck, these events may range from outdoor exhibitions such as the International Boat Show to banquets and cocktail parties. A temporary marquee-like structure will be erected, from time to time, on the event deck to facilitate banquets and similar activities. Given that the development will form part of a premier NSW 'entertainment' precinct it is considered appropriate that alternative criteria be applied to large events which will occur a limited number of times per year.

The Noise Guide for Local Government (NGLG) notes that the Protection of Environment Operations (General) Regulation 1997 makes the EPA the responsibility authority for environmental noise emissions from outdoor concerts, festivals and cinematic or theatrical events using sound amplification equipment with 200 or more

people at Darling Harbour. As a nominated venue, there is a requirement for Darling Harbour to develop and implement a Noise Management Plant (NMP).

In order to adequately address environmental noise issues it is recommended that the NMP comprise the following three elements:

1) Preventive management – details of mitigation of noise impacts prior to the event such as stage and speaker orientation, barriers, sound limitation devices, crowd management, staff training and effective community consultation before the event.

2) Reactive management – noise monitoring in real time (travellers and fixed locations), use of trigger levels set below noise emission limits, modes of communication between monitors and operators, noise mitigation in real time, complaints handling in real time and communication modes between complaints handling and operators.

3) Review mechanism – assessing the performance of:

   - community consultation (before/during /after);
   - monitoring in real time; and
   - mitigation.

   The results of reviews should be used to inform the development and implementation of recommendations that will improve performance over time (continuous improvement).

An integral part of the NMP will be to recommend appropriate environmental noise emission criteria for large entertainment events. Based on a review of noise limits in place for other Sydney venues and concert noise management guidelines from other Australian States and the UK, the following criteria have been determined as being appropriate to manage large event noise from the development and in particular the use of the event deck.

Table 11 Environmental noise emission criteria for entertainment events

All events	Up to 6 events per year
$L_{Aeq,\ 15\ minute} \leq RBL + 5\ dB$ & $L_{Ceq,\ 15\ minute} \leq RBL + 20\ dB$	$L_{Aeq,\ 15\ minute} \leq RBL + 15\ dB$ & $L_{Ceq,\ 15\ minute} \leq RBL + 30\ dB$

These criteria are to be applied at residential boundaries and apply over a 15 minute period. The L_{Ceq} level is used to control low frequency noise to ensure environmental noise emissions do not contain “annoying” characteristics as defined in the INP.

The project specific environmental noise emission criteria for ‘large entertainment events’ applicable at residential receivers are presented in Table 12.

The NMP will be prepared with input from the Operator, infrastructure NSW (iNSW), and the Sydney Harbour Foreshore Authority (SHFA) prior to the commencement of operations in late 2016.

Table 12 Summary of environmental noise emission criteria for entertainment events applicable at residential receivers

Period	RBL (L_{A90})	All events		'Large entertainment events'	
		L_{Aeq} criteria	L_{Ceq} criteria	L_{Aeq} criteria	L_{Ceq} criteria
NCA1					
Day	58	63	78	73	88
Evening	59	63[1]	78	73[1]	88
Night	52	57	72	67	82
NCA2					
Day	57	62	77	72	87
Evening	56	61	76	71	86
Night	51	56	71	66	81
NCA3					
Day	60	65	80	75	90
Evening	58	63	78	73	88
Night	51	56	71	66	81
NCA4					
Day	58	63	78	73	88
Evening	59	63[1]	78	73[1]	88
Night	54	59	74	69	84

Notes:

1 Criterion for evening/ night-time has been set to no greater than daytime/evening criteria

In addition it is recommended that 10 dB be added to the INP criteria for commercial, industrial and recreational receivers (refer to Table 7) for 'large entertainment events'.

3.4 NSW Office of Liquor, Gaming and Racing "Current noise condition"

Under the Liquor Act 2007, Police, local councils and residents can make a disturbance complaint to the Director of Liquor and Gaming. The Director has a range of statutory powers and enforcement functions under the liquor laws including the power to deal with disturbance complaints against licensed venues.

Complaints to the Director can relate to noise emitted from licensed premises and registered clubs from within the physical structure of the premises and disturbance from patrons, especially when departing.

One of the ways in which the Director can deal with noise is by imposing licence conditions on licensees, this may include the standard condition reproduced below.

> *The L_{A10}* noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz – 8 kHz inclusive) by more than 5 dB between 7:00 am and 12:00 midnight at the boundary of any affected residence.*
>
> *The L_{A10}* noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz – 8 kHz inclusive) 12:00 midnight and 7:00 am at the boundary of any affected residence.*
>
> *Notwithstanding compliance with the above, the noise from the licensed premises shall not be audible within any habitable room in any residential premises between the hours of 12:00 midnight and 7:00 am.*
>
> **For the purpose of this condition, the L_{A10} can be taken as the average maximum deflection of the noise emission from the licensed premises.*
>
> *This is a minimum standard. In some instances the Director may specify a time earlier than midnight in respect of the above condition.*

Interior noise levels which still exceed safe hearing levels are in no way supported or condoned by the Director.

In order for noise generated by entertainment activities and patrons within the SICEEP to be inaudible at any residential premises it should be 15 dB less than the existing background noise level in every octave band when measured at the facade of those residential premises.

These criteria apply to environmental noise emissions from entertainment activities within SICEEP and on the event deck and patrons.

Table 13 presents the environmental noise criteria for entertainment and patron sources.

Table 13 Patron noise criteria

Criterion	L_{10} sound level, dB at Octave band centre frequency, Hz									L_{A10} Overall, dB(A)
	32	63	125	250	500	1k	2k	4k	8k	
NCA1										
Daytime	62	64	63	62	60	60	57	50	41	64
Night-time (Inaudibility)	37	40	39	38	36	34	30	23	14	38
NCA2										
Daytime	67	66	63	61	58	58	53	46	39	62
Night-time (Inaudibility)	41	41	41	38	34	32	27	20	16	37
NCA3										
Daytime	60	62	60	60	59	60	56	47	45	63
Night-time (Inaudibility)	34	37	35	35	33	32	28	25	25	37
NCA4										
Daytime	68	64	63	62	60	59	55	47	36	63
Night-time (Inaudibility)	44	39	38	38	36	34	30	23	13	39

Notes:

- Day is defined as 7 am to 12 midnight.
- Night is defined as 12 midnight to 7 am.

3.5 Road Noise Policy

It is acknowledged that the DGEARs specify that the Environmental Criteria for Road Traffic Noise (EPA, 1999) (ECRTN) to be used for the assessment of road traffic noise associated with the SICEEP Project. However, AECOM advises that the ECRTN document has been superseded by the EPA's NSW Road Noise Policy (RNP) in 2011.

Therefore, noise from traffic movements to and from the SICEEP site including truck and car movements will be assessed using the RNP. The main vehicle access points to the SICEEP development are to be located on Darling Drive. The Darling Drive accesses will provide access to all public car parking spaces for the SICEEP development and the site's various loading dock facilities.

The main roads surrounding the SICEEP development are:

Arterial/Sub-arterial roads

- M4 Western Distributor Freeway;
- Darling Drive;
- Pier Street;

- Harbour Street;
- Pyrmont Bridge Road;
- Hay Street;
- Sussex Street; and
- Pyrmont Street.

Local roads

- Murray Street.

Table 14 presents the RNP's road traffic noise assessment criteria for residential land use developments with potential to create additional traffic on existing roads. The external criteria are assessed at 1 metre from the affected residential building façades and at a height of 1.5 metres from the floor.

Table 14 Road traffic noise assessment criteria for residential land uses

Road category	Type of project/land use	Assessment criteria - dB(A)	
		Day (7 am – 10 pm)	Night (10 pm – 7 am)
Freeway/arterial /sub-arterial roads	3. Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq, (15\ hour)}$ 60	$L_{Aeq, (9\ hour)}$ 55
Local roads	6. Existing residences affected by **additional traffic** on existing local roads generated by land use developments	$L_{Aeq, (1\ hour)}$ 55	$L_{Aeq, (1\ hour)}$ 50

In cases where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce these through feasible and reasonable measures to meet the assessment criteria. In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

These criteria are applicable to operational and construction traffic.

3.6 Interim Construction Noise Guideline

The NSW *Interim Construction Noise Guideline* (ICNG) (DECCW, 2009) is the principal guidance used for assessing and managing construction noise impacts. This document has been used as the basis for establishing construction noise management levels (NMLs) for the proposed development.

Construction noise management levels (NMLs) must be defined for adjacent sensitive receivers including residential and non-residential land uses. All feasible and reasonable noise mitigation measures should be implemented where construction noise is expected to exceed these levels.

The ICNG defines what is considered to be feasible and reasonable as follows:

Feasible

> *A work practice or abatement measure is feasible if it is capable of being put into practice or of being engineered and is practical to build given project constraints such as safety and maintenance requirements.*

Reasonable

> *Selecting reasonable measures from those that are feasible involves making a judgment to determine whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the measure.*

The construction noise management levels for the residential and other sensitive land uses in proximity to the site are detailed below.

3.6.1.1 Residential receivers

Guidance in the ICNG for setting construction noise management levels for residential receivers is summarised in Table 15 below.

Table 15 Setting and applying noise at residences

Time of day	NML, $L_{Aeq,15min}$, dB(A)[1]	How to apply
Recommended standard hours[2] Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	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 75 dB(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: 1. 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 2. 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 + 5 dB	- A strong justification would typically be required for works outside the recommended standard hours. - The proponent should apply all feasible and reasonable work practices to meet the noise affected level. - Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. - For guidance on negotiating agreements see section 7.2.2 (ICNG).

Notes:

1. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m 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.

2. It is noted that the ICNG states that these standard hours are not mandatory. As noted in section 5.1.1 preferred construction hours for the project are 7 am to 7 pm for weekdays and 7 am to 5 pm on Saturdays.

The above guidance has been utilised to define NMLs applicable to residences adjacent to the development. The project specific NMLs are summarised in Table 16 below.

Table 16 Construction noise management levels – Residential receivers

Residential receivers location	Daytime RBL, dB(A)	Work period	Recommended noise management levels L_{Aeq} dB(A)	Highly noise affected level L_{Aeq} dB(A)
NCA 1	58	SHW	68	75
		OOHW	63	
NCA 2	58	SHW	68	
		OOHW	63	
NCA 3	60	SHW	70	
		OOHW	65	
NCA 4	58	SHW	68	
		OOHW	63	

Notes:

- SHW – Standard hours of work.
- OOHW – Out-of-hours work.

3.6.1.2 Other sensitive land uses and commercial receiver noise management levels

Noise management levels for non-residential receivers located adjacent to the site have been determined using the recommended levels in the ICNG for other sensitive land uses and commercial buildings. The NMLs are presented in Table 17.

Table 17 Noise at sensitive land uses (other than residences) and commercial buildings

Land Use	External noise levels, $L_{Aeq,15min}$ (applies when properties are in use)
Commercial Premises (including cafés, bars, restaurants and retail stores)	70 dB(A)
Industrial Premises	75 dB(A)

3.7 Assessing Vibration: A Technical Guideline

The EPA's *Assessing vibration: A Technical Guideline* (DEC, 2006) has been designed to be used in evaluating and assessing the effects on amenity of vibration emissions from industry, transportation and machinery. The guideline is used in the assessment of vibration impacts caused by the construction and operation of new developments.

Vibration criteria are set primarily according to whether the particular activities of interest are continuous in nature or intermittent, whether they occur during the daytime or night-time and the type of receiver to be assessed e.g. industrial, commercial or residential.

The effects of vibration in buildings can be divided into three main categories:

- Those in which the occupants or users of the building are inconvenienced or possibly disturbed, i.e. human disturbance or discomfort;
- Those in which the integrity of the building or the structure itself may be prejudiced; and
- Those where the building contents may be affected.

Therefore, vibration levels at sensitive receiver locations must be controlled so as to prevent discomfort and regenerated noise, and in some extreme cases, structural damage.

The Assessing Vibration: A Technical Guideline provides criteria for human comfort only. Criteria to avoid structural damage is detailed in DIN 4150 and BS7385 and are summarised below.

The German Standard *DIN 4150-Part 3 'Structural vibration in buildings – Effects on Structures'* provides recommended maximum levels for short-term vibration (Table 18). The standard states that experience has shown that if these values are not exceeded, damage that reduces the serviceability of the structure will not occur.

Table 18 DIN4150 structural damage vibration criteria

Group	Type of structure	Guideline values for velocity in mm/s			
		Vibration at the foundation			Vibration at the horizontal plane of highest floor and all frequencies
		1 H to 10 Hz	10 H to 50 Hz	50 H to 100 Hz	
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20-40	40-50	40
2	Dwellings and buildings of similar design and/or use	5	5-15	15-20	15
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under Group 1 or 2 and are of great intrinsic value (e.g. listed buildings under a preservation order)	3	3-8	8-10	8

The British Standard *BS 7385 'Evaluation and measurement for vibration in buildings'* also provides a structural damage criteria. This relates to transient vibrations such as vehicle pass-bys.

Table 19 BS7385.2 1993 transient vibration guide for cosmetic damage

Group	Type of structure	Peak component particle velocity, mm/s	
		Vibration at the foundation	
		4 H to 15 Hz	15 H and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50	
2	Unreinforced or light framed structures. Residential or light commercial type buildings	15-20	20-50

Notes:

- Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values may need to be reduced by up to 50 %.

The impact assessment of tactile vibration is based on BS 6472-1:2008 "Guide to evaluation of human exposure to vibration in buildings – Part 1: Vibration sources other than blasting". BS 6472-1:2008 assesses the probability of adverse comment from vibration by means of vibration dose values (VDVs). Project VDV goals are presented in Table 20 below.

Table 20 Tactile vibration criteria summary

Receiver space	Criterion	Comments
Theatre, Exhibition Halls	VDV over any 8 hour period not to exceed 0.2 $m/s^{1.75}$	Applicable for light rail movement, footfalls inside the Theatre. Not applicable for rhythmic crowd movement.
Plenary, Ballroom	VDV over any 8 hour period not to exceed 0.1 $m/s^{1.75}$	Assessed for all activities within Theatre.

Table 21 recommends safe working distances to minimise disturbance to occupants of nearby buildings and is based on *British Standards BS6472 and BS7385*. (Construction Noise Strategy, 2012, Transportation Construction Authority)

Table 21 Recommended safe working distances for vibration intensive plant

Plant	Rating/Description	Safe working distance	
		Cosmetic damage	Human response
Vibratory Roller	< 50 kN (Typically 1-2T)	5 m	15-20 m
	< 100 kN (Typically 2-4T)	6 m	20 m
	< 200 kN (Typically 4-6T)	12 m	40 m
	< 300 kN (Typically 7-13T)	15 m	100 m
	> 300 kN (Typically 13-18T)	20 m	100 m
	> 300 kN (> 18 T)	25 m	100 m
Small Hydraulic Hammer	(300 kg – 5-12T excavator)	2 m	7 m
Medium Hydraulic Hammer	(900 kg – 12-18T excavator)	7 m	23 m
Large Hydraulic Hammer	(1,600 kg – 18-34T excavator)	22 m	73 m
Vibratory Pile Driver	Sheet piles	2–20 m	20 m
Pile Boring	≤ 800 mm	2 m	N/A
Jackhammer	Handheld	1 m nominal	Avoid contact with structure

4.0 Operational noise and vibration assessment and recommendations

The cumulative operational noise impacts from the use of the SICEEP development have been calculated and assessed. Contributions have been calculated from noise break out from the main spaces, building services plant, loading dock activities and the event deck activities. In addition, traffic noise generated by the SICEEP project has been assessed.

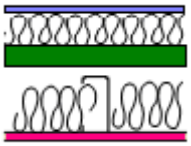
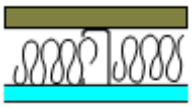
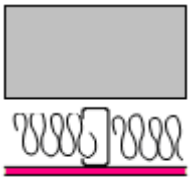
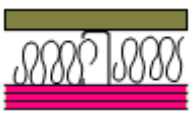
4.1 External building fabric

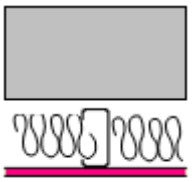
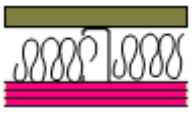
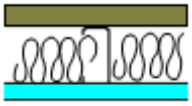
Noise transferring through the roof and external walls has been considered and included in the environmental noise assessment. The noise levels associated with venue break out noise is based on typical noise rating (NR) curve levels and the acoustic performance of the wall and roof system.

4.1.1 Roof

The roof construction for various key spaces where typical activity noise levels are anticipated to be high are required to control noise breaking out and emitting to nearest sensitive receivers to comply with the OLGR entertainment activities and patron environmental noise emission criteria set out in section 2.4 for the four NCAs identified for this report. In addition, the roof constructions also serve to mitigate traffic, general ambient and rain noise intruding into the various spaces. AECOM provides the following minimum sound reduction indices for the key spaces, the typical activity noise levels prescribed for these key spaces, and light-weight construction options which have been modelled and assessed to comply with the criteria.

Table 22 Minimum sound reduction indices for roof construction key spaces

Key spaces	Typical activity noise levels	R_w	Roof construction options	
Theatre	L_{eq} – NR 95 L_{max} – NR 110	65	- 0.48 mm thick sheet metal roof (minimum surface density 5.3 kg/m^2) - 90 mm stud with 50 mm acoustic insulation in cavity (14 kg/m^3) - 600 kg Speedpanel - 200 mm air gap - 64 mm steel purlin with 100 mm acoustic insulation in cavity (24 kg/m^3) - 16 mm fire rated plasterboard	
Exhibition halls	L_{eq} – NR 65 L_{max} – NR 80	45	- Kingspan 1000 RW Insulated Roof Panel (40 mm thick) - 140 mm spacer support system with 120 mm acoustic insulation (60 kg/m^3) in cavity. - 10 mm thick dense particle board (minimum surface density11.7 kg/m^2)	
			- 200 mm thick concrete	
Ballroom	L_{max} – NR 105	55	- 200 mm thick concrete - 20 mm air gap - 64 mm steel purlin with 50 mm thick acoustic insulation in cavity (14 kg/m^3) - 16 mm fire rated plasterboard	
			- Kingspan KS1000 LP Insulated Roof Panel (45 mm thick) - 140 mm spacer support system with 60 mm acoustic insulation (60 kg/m^3) in cavity. - 3 layers of 13 mm fire rated plasterboard	

Key spaces	Typical activity noise levels	R_w	Roof construction options	
Plenary	L_{eq} – NR 90 L_{max} – NR 105	55	- 200 mm thick concrete - 20 mm air gap - 64 mm steel purlin with 50 mm thick acoustic insulation in cavity (14 kg/m^3) - 16 mm fire rated plasterboard	
			- Kingspan KS1000 LP Insulated Roof Panel (45 mm thick) - 140 mm spacer support system with 60 mm acoustic insulation (60 kg/m^3) in cavity. - 3 layers of 13 mm fire rated plasterboard	
Pre-function areas		45	- Kingspan 1000 RW Insulated Roof Panel (40 mm thick) - 140 mm spacer support system with 120 mm acoustic insulation (60 kg/m^3) in cavity. - 10 mm thick dense particle board (minimum surface density 11.7 kg/m^2)	

4.1.2 Façade

The façade construction for various spaces, especially the acoustically critical spaces, is required to both mitigate external noise such as traffic noise intruding into the various spaces and to control noise breaking out affecting the nearest sensitive receivers. The building facades will be constructed from materials providing the minimum sound reduction indices as detailed in Table 23.

Table 23 Minimum sound reduction indices for façade construction of key spaces

Key spaces	R_w
Theatre	65
Plenary spaces	60
Exhibition halls	45
Ballroom	60
Pre-function areas	45

4.2 Building services noise emission

Building services noise emissions include all mechanical equipment servicing the building. Mechanical equipment selection will take place during the detailed design stage of the project. Therefore the following assumptions of equipment have been based on cost estimates and bid phase of the project:

- 6 cooling towers located on level 6 of the Convention Centre;
- 8 chillers and 8 hot/cold water pumps in the central thermal plant; and
- All other plant rooms within the SICEEP development have been assumed to have 2 air handling units and 1 exhaust air fan.

The above units have been assigned a sound power level based on preliminary selections and AECOM's previous experience. The sound power levels have been presented below in Table 24.

Table 24 Mechanical services sound power levels

Equipment type	Sound power level dB, per octave band Hz							Total SWL dB(A)
	63	125	250	500	1000	2000	4000	
Cooling Tower	109	110	105	98	95	90	84	113
Chiller	101	102	103	99	106	106	101	111
Pump	-	-	-	-	-	-	-	86
Air Handling Unit	85	87	88	87	85	84	80	70
Exhaust Air Fan	90	85	76	71	66	57	52	90

The following assumptions have also been made:

- Cooling towers to be fitted with acoustic attenuator to give minimum insertion loss presented in Table 25;
- Central thermal plant to have minimum 10 m of ductwork with one bend and 25 mm internal acoustic lining before first intake or discharge point;
- All plant rooms will be treated to reduce reverberation times to 1.0 s; and
- All plant rooms adjacent to an external façade will have an open area of maximum size 10 m^2. The open area will be treated with louvres with a minimum insertion loss provided in Table 25.

The minimum insertion losses for recommended acoustic treatments are presented below in Table 25.

Table 25 Acoustic treatment insertion loss

Equipment	Insertion loss, dB per octave band, Hz						
	63	125	250	500	1000	2000	4000
Cooling tower attenuator	5	12	19	26	24	16	14
Acoustic louvres	4	7	9	13	14	12	12

Equipment selection and location is likely to be confirmed during detailed design stage, however the assumptions made for this stage are considered reasonable.

4.2.1 Standby generator

Environmental noise emission from standby generators will be addressed during the detailed design phase of the project. Typical treatments to meet the emergency noise emission criteria presented in Section 3.2.6, will involve the use of acoustic louvres and intake/exhaust silencers.

4.3 Loading dock activities

The likely environmental noise emissions from trucks entering and exiting the elevated loading dock, in conjunction with loading and unloading activities has been considered in the assessment. Noise sources modelled include:

- 3 truck movements per peak 15 minutes (derived from truck movement data provided by AEG Ogden); and
- Reversing alarms.

The design of the loading dock includes a barrier which will be effective in reducing noise levels. The barrier must be free from all gaps and should be lined on the internal side with an absorptive material with a noise reduction coefficient (NRC) of 0.7 minimum.

Options for the acoustic absorptive treatment which will achieve the required NRC of 0.7 and are suitable for external use are provided below.

- Pyrotek Reapor panel, or equivalent, with nominal thickness of 24.5 mm direct fixed on the required side of the noise barrier as specified above; or

- Bradford Glasswool SUPERTEL, or equivalent, with nominal thickness of 50 mm faced with one layer of acoustic microfilm (Dupont Melinex^{TM} or equivalent) as vapour barrier and one layer of HD Perforated. Foil acoustic facing as outer layer. Perforated metal sheets or metal wire mesh shall be installed to protect the absorptive material from damage and shall have a minimum 40% open area.

The ground level loading dock is afforded significant acoustic shielding to nearby sensitive receivers. The majority of the loading dock activities will take place at the ground level loading dock.

Assuming the noise mitigation measures listed above are implemented, environmental noise emissions from loading dock activities associated with the proposed development are likely to be reduced from the existing situation.

4.4 Outdoor event deck

Noise emission from the outdoor event deck (5,700 m^2 area with 5,000 m^2 occupiable) has been considered under six operating scenarios:

- **Scenario 1 - Major event set up (Bump in Bump out)** – This will comprise tent and other facilities set up including banging and connecting of aluminium supports, connections to base places, bracing, shouting etc. It has been assumed that in any 15 minute period there may be three truck movements, two forklifts and two cranes operating. It is likely that this scenario will occur during the daytime period only, however quieter set up activities may occur into the evening.
- **Scenario 2 - Event at the Oxygen Bar (e.g. Conference pre-dinner drinks) –** It has been assumed that during an event at the Oxygen Bar 25% of the deck will be in use and a maximum of 1,500 people will attend. The noise model has included 750 people talking with raised voices and music playing at approximately 80 dB(A) on the deck. An area of the Oxygen Bar will be covered with a roof at approximately 4.5 m above the deck level. It is understood that these types of events are likely to end by 11 pm.
- **Scenario 3 - Outdoor exhibition –** It has been assumed that during an exhibition event on the deck the spatially averaged noise level will be approximately 70 dB(A) including noise from A/V presentations and exhibition attendees. It is understood that exhibitions are likely to be closed by 11 pm.
- **Scenario 4 - Conference dinner with background music** – It has been assumed that during an event such as a conference dinner there may be low level background music playing (65 dB(A)), approximately 2,500 in attendance with 1,250 people talking with raised voices. This scenario was modelled as taking place adjacent to the Oxygen Bar area. An area of 3,750 m^2 was assumed as this represents the largest tent likely to be erected on the deck. A reduction of 3 dB was included to account for attenuation provided by the tent assuming that the western façade is free from all gaps. It is understood that these types of events are likely to end by 11 pm.
- **Scenario 5 - Conference dinner with live music**– It has been assumed that during an event such as a conference dinner there may be live entertainment with an approximate noise level of 85 dB(A), a maximum of 2,500 people in attendance with 1,250 people talking with raised voices. This scenario was modelled as taking place adjacent to the Oxygen Bar area. An area of 3,750 m^2 was assumed as this represents the largest tent likely to be erected on the deck. A reduction of 3 dB was included to account for attenuation provided by the tent. It is understood that the live music component of these types of events is likely to end by 10 pm and that background music may then play until 11 pm as per Scenario 4.
- **Scenario 6 - Large celebratory event (e.g. New Year's Eve, Australia Day etc.)** – It has been assumed that during an event such as this there may be entertainment with an approximate noise level of 90 dB(A). A maximum of 5,000 people may be in attendance with 50% talking with loud voices. It is understood that such events will occur up to 6 times per year and while some of these events may run until after 12 midnight (such as the New Year's Eve Celebration) others will end by 10 pm. This scenario was modelled as taking place over the entire event deck area. It is noted that the sleep disturbance criteria may be exceeded with large celebratory events, such as a New Year's Eve Celebration, however given the frequency of such events a degree of leniency would be reasonable**.**

4.5 Other modelling inputs

All modelling has been conducted in SoundPlan v7.0. The propagation algorithm chosen is the General Prediction Method which is suitable for the situation given the close proximity of nearby residents. Included in the model are the following:

- Natural ground terrain;
- Ground absorption of 0.2;
- Air absorption; and
- All buildings at appropriate heights.

Modelling assumes all equipment operating simultaneously for a full 15 minute period. This is a conservative assessment as there will regularly be times where no event is taking place. This assessment assumes that when events are taking place the facility will be operating at maximum capacity.

Given the close proximity to the nearest receivers, adverse weather conditions are unlikely to have an effect on the assessment and have therefore not been included in the assessment.

4.6 Modelling results

The presented modelling result summaries assume that all building services are in operation, breakout noise from the theatre, exhibition centre and the convention centre, operations in the loading dock and one of each scenario for the event deck. The worst affected residential and commercial receivers in each NCA are presented below assuming an event is ongoing. Full results are presented in Appendix C. It should be noted that in the absence of an event on the event deck all other environmental noise emissions from the development meet the INP criteria at all receivers. Environmental noise emissions from the building services and carpark and loading docks are not likely to contain any ‘annoying’ characteristics, therefore no penalties have been applied in the assessment.

In addition to the results detailed below it should be noted that a similar facility currently exists on the proposed development area and noise levels are not expected to increase as a result of the proposed development. The area is recognised as an ‘entertainment precinct’ and as such nearby residents are expected to cognisant of this fact and have reasonable expectations of their noise environment.

4.6.1 Major event set up assessment

Modelling results for environmental noise from the development with the major event set up (Bump in, Bump out) taking place are presented below in
Table 26.

Table 26 Noise modelling results – Scenario 1 - major event set up (Bump in, Bump out)

NCA	Receiver	Receiver type	Predicted $L_{Aeq\ (15min)}$ dB(A)	Criteria, Day / Evening dB(A)	Exceedance, Day / Evening dB(A)
1	243 - 271 Pyrmont Street, Pyrmont	Residential	46	63 / 63	- / -
1	Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	41	65 (when in use)	-
2	287 Pyrmont Street, Ultimo	Residential	60	62 / 61	- / -
2	220 Pyrmont Street, Sydney	Commercial	63	65 (when in use)	-
3	Novotel (17 Little Pier Street, Haymarket)	Residential	50	65 / 63	- / -
3	Power House Museum (500 Harris Street, Ultimo)	Commercial	51	65 (when in use)	-
4	1 Dixon Street, Sydney	Residential	50	63 / 63	- / -
4	Commonwealth Bank, North Building	Commercial	53	65 (when in use)	-
-	Darling Quarter Play area	Active recreational	52	55 (when in use)	-
-	Chinese Gardens	Passive recreational	47	50 (when in use)	-
-	Tumbalong Park	Passive recreational	56	50 (when in use)	6

Results of the modelling show that environmental noise emissions from the major event set up are predicted to comply with the event criteria during the day and evening periods for all residential receivers. The assessment also indicates compliance with all commercial criteria. Noise levels will comply with the recreational noise criterion in the Darling Quarter Play area, and the passive recreational noise criterion in the Chinese Gardens, however the noise criterion is likely to be exceeded in Tumbalong Park. It is noted that the exceedance is 6 dB(A), however this is only 1 dB(A) over the recommended maximum noise criterion in the INP (refer to Table 7) and is therefore unlikely to have a major impact.

4.6.2 Oxygen bar event assessment

Modelling results for environmental noise from the development with an event at the Oxygen Bar taking place are presented below in Table 27.

Table 27 Noise modelling results – Scenario 2 - event at the Oxygen Bar

NCA	Receiver	Receiver type	Predicted $L_{Aeq, 15\ minute}$ dB(A)	Criteria, Day / Evening / Night dB(A)	Exceedance, Day / Evening / Night dB(A)
1	243 - 271 Pyrmont Street, Pyrmont	Residential	46	63 / 63 / 57	- / - / -
1	Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	41	65 (when in use)	- / - / -
2	287 Pyrmont Street, Ultimo	Residential	47	62 / 61 / 56	- / - / -
2	220 Pyrmont Street, Sydney	Commercial	46	65 (when in use)	-
3	Novotel (17 Little Pier Street, Haymarket)	Residential	45	65 / 63 / 56	- / - / -
3	Power House Museum (500 Harris Street, Ultimo)	Commercial	43	65 (when in use)	-
4	1 Dixon Street, Sydney	Residential	48	63 / 63 / 59	- / - / -
4	Commonwealth Bank, North Building	Commercial	49	65 (when in use)	-
-	Darling Quarter Play area	Active recreational	42	55 (when in use)	-
-	Chinese Gardens	Passive recreational	41	50 (when in use)	-
-	Tumbalong Park	Passive recreational	50	50 (when in use)	-

Results of the modelling show that environmental noise emissions from an event at the Oxygen bar are predicted to comply with the event criteria during all periods of the day for all residential, commercial and recreational receivers.

This scenario will comply with the applicable OLGR criteria.

4.6.3 Outdoor exhibition assessment

Modelling results for industrial noise from the development with an outdoor exhibition taking place are presented below in Table 28.

Table 28 Noise modelling results – Scenario 3 - outdoor exhibition

NCA	Receiver	Receiver type	Predicted $L_{Aeq, 15\ minute}$ dB(A)	Criteria, Day / Evening / Night dB(A)	Exceedance, Day / Evening / Night dB(A)
1	243 - 271 Pyrmont Street, Pyrmont	Residential	45	63 / 63 / 57	- / - / -
1	Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	41	65 (when in use)	-
2	287 Pyrmont Street, Ultimo	Residential	50	62 / 61 / 56	- / - /-
2	220 Pyrmont Street, Sydney	Commercial	47	65 (when in use)	-
3	Novotel (17 Little Pier Street, Haymarket)	Residential	40	65 / 63 / 56	- / - / -
3	Power House Museum (500 Harris Street, Ultimo)	Commercial	45	65 (when in use)	-
4	1 Dixon Street, Sydney	Residential	41	63 / 63 / 59	- / - / -
4	Commonwealth Bank, North Building	Commercial	42	65 (when in use)	-
-	Darling Quarter Play area	Active recreational	35	55 (when in use)	-
-	Chinese Gardens	Passive recreational	33	50 (when in use)	-
-	Tumbalong Park	Passive recreational	41	50 (when in use)	-

Results of the modelling show that environmental noise emissions from an outdoor exhibition are predicted to comply with the event criteria during all periods of the day for all residential, commercial, industrial and recreational receivers.

The above scenario will also comply with the applicable OLGR criteria.

4.6.4 Conference dinner (Background music) assessment

Modelling results for industrial noise from the development with a conference dinner taking place are presented below in Table 29.

Table 29 Noise modelling results – Scenario 4 - conference dinner with background music

NCA	Receiver	Receiver type	Predicted $L_{Aeq, 15\ minute}$ dB(A)	Criteria, Day / Evening / Night dB(A)	Exceedance, Day / Evening / Night dB(A)
1	243 - 271 Pyrmont Street, Pyrmont	Residential	46	63 / 63 / 57	- / - / -
1	Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	41	65 (when in use)	-
2	287 Pyrmont Street, Ultimo	Residential	55	62 / 61 / 56	- / - /-
2	220 Pyrmont Street, Sydney	Commercial	48	65 (when in use)	-
3	Novotel (17 Little Pier Street, Haymarket)	Residential	44	65 / 63 / 56	- / - / -
3	Power House Museum (500 Harris Street, Ultimo)	Commercial	53	65 (when in use)	-
4	1 Dixon Street, Sydney	Residential	48	63 / 63 / 59	- / - / -
4	Commonwealth Bank, North Building	Commercial	48	65 (when in use)	-
-	Darling Quarter Play area	Active recreational	41	55 (when in use)	-
-	Chinese Gardens	Passive recreational	40	50 (when in use)	-
-	Tumbalong Park	Passive recreational	49	50 (when in use)	-

Results of the modelling show that environmental noise emissions from a conference dinner with background music are predicted to comply with the event criteria during all periods of the day for all residential, commercial and recreational receivers. This scenario will comply with the applicable OLGR criteria.

4.6.5 Conference dinner (Live entertainment) assessment

Modelling results for industrial noise from the development with an outdoor conference dinner with live entertainment taking place are presented below in Table 30.

Table 30 Noise modelling results – Scenario 5 - Conference dinner with live entertainment

NCA	Receiver	Receiver type	Predicted $L_{Aeq, 15\ minute}$ dB(A)	Criteria, Day / Evening / Night dB(A)	Exceedance, Day / Evening / Night dB(A)
1	243 - 271 Pyrmont Street, Pyrmont	Residential	49	63 / 63	- / -
1	Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	41	65 (when in use)	-
2	287 Pyrmont Street, Ultimo	Residential	61	62 / 61	-/ -
2	220 Pyrmont Street, Sydney	Commercial	54	65 (when in use)	-
3	Novotel (17 Little Pier Street, Haymarket)	Residential	49	65 / 63	- / -
3	Power House Museum (500 Harris Street, Ultimo)	Commercial	59	65 (when in use)	-
4	1 Dixon Street, Sydney	Residential	55	63 / 63	- / -
4	Commonwealth Bank, North Building	Commercial	54	65 (when in use)	-
-	Darling Quarter Play area	Active recreational	47	55 (when in use)	-
-	Chinese Gardens	Passive recreational	46	50 (when in use)	-
-	Tumbalong Park	Passive recreational	56	50 (when in use)	6

Results of the modelling show that environmental noise emissions from a conference dinner with live entertainment are predicted to comply with the event criteria during the daytime and evening periods for all residential receivers and during all periods of the day for commercial receivers.

Noise levels will comply with the recreational noise criteria in the Darling Quarter Play area and Chinese Gardens, however the criterion is likely to be exceeded in Tumbalong Park. It is noted that the exceedance is 6 dB(A) however this is only 1 dB(A) over the recommended maximum noise criterion in the INP and is therefore unlikely to have a major impact.

This scenario will comply with the applicable OLGR criteria.

4.6.6 Large celebratory event assessment

Modelling results for environmental noise emissions from the development with a large celebratory event with live entertainment taking place are presented below in Table 30.

Table 31 Noise modelling results – Scenario 6 - large celebratory event

NCA	Receiver	Receiver type	Predicted $L_{Aeq, 15\ minute}$ dB(A)	Criteria, Day / Evening / Night dB(A)	Exceedance, Day / Evening / Night dB(A)
1	243 - 271 Pyrmont Street, Pyrmont	Residential	54	73 / 73 / 67	- / - / -
1	Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	41	75 (when in use)	-
2	287 Pyrmont Street, Ultimo	Residential	70	72 / 71 / 66	- / - / 4
2	220 Pyrmont Street, Sydney	Commercial	67	75 (when in use)	-
3	Novotel (17 Little Pier Street, Haymarket)	Residential	54	75 / 73 / 66	- / - / -
3	Power House Museum (500 Harris Street, Ultimo)	Commercial	65	75 (when in use)	-
4	1 Dixon Street, Sydney	Residential	60	73 / 73 / 69	- / - / -
4	Commonwealth Bank, North Building	Commercial	58	75 (when in use)	-
-	Darling Quarter Play area	Active recreational	52	65 (when in use)	-
-	Chinese Gardens	Passive recreational	51	60 (when in use)	-
-	Tumbalong Park	Passive recreational	61	60 (when in use)	1

Results of the modelling indicate that this scenario meets the ‘large entertainment event’ criteria at all residential and commercial receivers during the daytime and evening periods, with an exceedance occurring within NCA2 during the night-time period.

The Tumbalong Park criterion is exceeded by 1 dB(A), this is considered an insignificant impact.

It is noted that this scenario does not comply with the applicable OLGR criteria, however as discussed previously in this report it is considered appropriate to apply the ‘large entertainment event’ criteria only. It should also be noted that this scenario will only occur up to 6 times per year. During the event planning stage, where an event is scheduled to end after 10 pm, consideration should be given to the implementation of suitable noise mitigation measures, in accordance with the NMP (as noted in section 3.3). It is likely that these noise mitigation measures will include preventative management controls, community consultation and noise monitoring.

4.7 Traffic noise assessment

The existing and future traffic flows provided by Hyder Consultants in their Traffic Assessment report dated February 2013 have been reviewed. It has been concluded that if the proposed development were to go ahead, traffic volumes and associated traffic noise on surrounding roads would increase as detailed in Table 32 and Table 33 below. It should be noted that the traffic flows presented below are for the whole precinct and not just the PPP component. Net increases and therefore noise level increases due to the PPP component will be significantly lower than those presented in the tables below.

Table 32 Summary of traffic flow increase in the pm peak periods (vehicles/hr)

Location	Existing	Development + Existing	Net increase	Percentage increase	Increase in noise level, dB(A)
Darling Drive					
North of Site Access	1146	1961	815	71%	2.3
South of Site Access	1142	1957	815	71%	2.3
North of Pier St	1217	1874	657	54%	1.9
South of Pier St	674	1046	372	55%	1.9
North of Monorail line	674	1046	372	55%	1.9
South of Monorail line	693	1011	318	46%	1.6
Harbour Street					
North of Day St	2392	2618	226	9%	0.4
South of Day St	2665	2891	226	8%	0.4
North of Liverpool St	2603	2829	226	9%	0.4
South of Liverpool St	2970	3217	247	8%	0.3
North of Goulburn St	2898	3145	247	9%	0.4
South of Goulburn St	468	538	70	15%	0.6
Pyrmont Bridge Road					
East of Murray St	1163	1978	815	70%	2.3
West of Murray St	974	1789	815	84%	2.6
Murray Street					
North of Pyrmont Bridge Rd	670	670	0	0%	0.0
South of Pyrmont Bridge Rd	627	627	0	0%	0.0
Pier Street					
East of Darling Dr	987	1314	327	33%	1.2
West of Harbour St	2503	2836	333	13%	0.5
Goulburn Street					
East of Harbour St	1979	2039	60	3%	0.1
West of Sussex St	2122	2182	60	3%	0.1
East of Sussex St	2686	2746	60	2%	0.1
West of George St	2693	2753	60	2%	0.1
East of George St	2773	2811	38	1%	0.1

Location	Existing	Development + Existing	Net increase	Percentage increase	Increase in noise level, dB(A)
Hay Street					
West of Sussex St	465	667	202	43%	1.6
East of Sussex St	323	525	202	63%	2.1
West of George St	318	520	202	64%	2.1
Sussex Street					
North of Goulburn St	1834	1834	0	0%	0.0
South of Goulburn St	950	950	0	0%	0.0
North of Hay St	396	396	0	0%	0.0
Thomas Street					
South of Hay St	254	254	0	0%	0.0
George Street					
North of Goulburn St	2751	2751	0	0%	0.0
South of Goulburn St	2539	2561	22	1%	0.0
North of Hay St	2425	2447	22	1%	0.0
South of Hay St	2743	2966	223	8%	0.3

Table 33 Summary of traffic flow increase in the Saturday peak periods (vehicles/hr)

Location	Existing	Development + Existing	Net increase	Percentage increase	Increase in noise level dB(A)
Darling Drive					
North of Site Access	1178	1977	799	68%	2.2
South of Site Access	1174	1973	799	68%	2.3
North of Pier St	1345	1987	642	48%	1.7
South of Pier St	728	1046	318	44%	1.6
North of Monorail line	693	1011	318	46%	1.6
South of Monorail line	712	990	278	39%	1.4
Harbour Street					
North of Day St	1995	2169	174	9%	0.4
South of Day St	2418	2592	174	7%	0.3
North of Liverpool St	2585	2759	174	7%	0.3
South of Liverpool St	2442	2651	209	9%	0.4
North of Goulburn St	2412	2621	209	9%	0.4
South of Goulburn St	493	564	71	14%	0.6
Pyrmont Bridge Road					
East of Murray St	1352	2151	799	59%	2.0
West of Murray St	1418	2217	799	56%	1.9
Murray Street					

Location	Existing	Development + Existing	Net increase	Percentage increase	Increase in noise level dB(A)
North of Pyrmont Bridge Rd	1035	1035	0	0%	0.0
South of Pyrmont Bridge Rd	821	821	0	0%	0.0
Pier Street					
East of Darling Dr	1175	1500	325	28%	1.1
West of Harbour St	2241	2571	330	15%	0.6
Goulburn Street					
East of Harbour St	1512	1594	82	5%	0.2
West of Sussex St	1579	1661	82	5%	0.2
East of Sussex St	2014	2096	82	4%	0.2
West of George St	2020	2102	82	4%	0.2
East of George St	2080	2127	47	2%	0.1
Hay Street					
West of Sussex St	465	635	170	37%	1.4
East of Sussex St	323	493	170	53%	1.8
West of George St	318	488	170	53%	1.9
Sussex Street					
North of Goulburn St	1376	1376	0	0%	0.0
South of Goulburn St	713	713	0	0%	0.0
North of Hay St	396	396	0	0%	0.0
Thomas Street					
South of Hay St	254	254	0	0%	0.0
George Street					
North of Goulburn St	2064	2064	0	0%	0.0
South of Goulburn St	1904	1939	35	2%	0.1
North of Hay St	1819	1854	35	2%	0.1
South of Hay St	2137	2342	205	10%	0.4

Traffic noise impacts on arterial roads are to be assessed against the 15-hour (7am – 10pm) period, however this information was not available at the time of writing this report, therefore 1-hour data has been used to represent a conservative approach.

Generally changes in road traffic noise levels for the surrounding roads are minor, being within the 2.0 dB(A) allowable increases. However increases of slightly more than 2 dB(A) are predicted on some sections of Hay Street, Darling Drive an, Pyrmont Bridge Road.

There are no residential receivers located along Hay Street near the Sussex Street intersection, and road traffic noise measurements indicate that the road traffic noise criteria for commercial developments are not exceeded in this area.

The section of Darling Drive which is affected by an increase in traffic noise of slightly over 2 dB(A) occurs comprises hotel developments. The developments are multi-storey and noise barriers are unlikely to provide the required noise mitigation, in addition the sign-posted speed limit is 50 km/h, therefore little benefit would be

gained from the installation of a ‘low noise’ road surface. Given that the increase in noise levels only slightly exceeds the 2 dB(A) allowance, is likely to affect transient hotel patrons only and noise controls will be difficult to implement, therefore, the increase is considered acceptable.

The section of Pyrmont Bridge Road which is affected by an increase in traffic noise of slightly over 2 dB(A) comprises a mixture of residential and commercial developments. The developments are multi-storey and noise barriers are unlikely to provide the required noise mitigation, in addition the sign-posted speed limit is 50 km/h, therefore little benefit would be gained from the installation of a ‘low noise’ road surface. It should also be noted that the increase of slightly more than 2 dB occurs only during the pm peak and will only occur when large events are being held at the SICEEP development, at other times it is likely that the increase in noise levels will be less than 2 dB(A). Given that the increase in noise levels only slightly exceeds the 2 dB(A) allowance in the pm peak and standard mitigation measures would provide little benefit, the increase is considered acceptable.

4.8 Operational Vibration Assessment

4.9 Vibration issues

The critical vibration issues identified with the SICEEP development can broadly be grouped into three groups:

1) Vibration generated within the development can propagate to nearby noise and vibration sensitive receivers and can adversely impact on these receivers;

2) Excessive vibration can be generated in large structures when crowds synchronise their movements with music. Rhythmic crowd movements can excite one of the low-frequency modes which in turn can cause resonant behaviour. In addition to line item 1), this may also cause adverse response within the crowd; and

3) Vibration generated outside the complex (such as light rail pass-bys) can cause regenerated noise inside the complex and can interfere with some of the planned uses of the complex such as concerts or conferences.

4.10 Mitigation measures

Post-construction fixes which address regenerated noise and vibration issues are known to be very costly and often only a limited number of options can be retrofitted. Accordingly, mitigation solutions need to be considered and if necessary implemented in the early design phase.

Mitigation options typically rely on breaking up the vibration transmission path between source and receivers. In practice this is very often achieved by joining structural systems with resilient elements such as rubber pads or springs. It is likely that the current SICEEP development design will not require this level of mitigation however if the design were to substantially change then the use of vibration isolation bearings under supporting structural elements should be considered.

Excessive vibratory response of the SICEEP development in response to dynamic crowd excitation will require careful investigation. Mitigation options typically involve tuning of the dynamic response of structural elements so their natural frequencies are well separated from footfall vibration spectra.

5.0 Construction noise and vibration assessment and recommendations

The noise and vibration assessment detailed in this section of the report have been assessed against the established noise management levels detailed in Section 0

5.1 Construction noise assessment

The planned scheduling and duration of each stage of demolition and construction works is presented below in Table 34.

Table 34 Construction schedule

Stage	Indicative timing	Description of works
1	12/13 - 9/14	Internal demolition of Convention Centre, Theatre, Exhibition Centre
2	8/14	Demolition of existing Convention Centre and Exhibition Centre
3	7/14 - 4/15	Construction of Exhibition Centre, Theatre and Convention Centre
4	4/15 - 12/15	Construction of Exhibition Centre, Theatre, Convention Centre and Public Domain (Boulevard)
5	1/16 - 6/16	Construction of Exhibition Centre, Theatre, Convention Centre and Public Domain (Tumbalong Green)
6	7/16 - 8/16	Construction of Exhibition Centre, Theatre, Convention Centre and Public Domain (Entrance to Chinese Garden)
7	19/16	Final Commissioning

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Presented below in Table 35 are the proposed work stages and equipment for each package of works. Table 35 also presents the typical sound power levels of the construction equipment to be used. These sound power levels are typical values taken from Australian Standard AS2436-2010, "*Guide to noise and vibration control on construction, demolition and maintenance sites*" and the UK Department for Environment, Food and Rural Affairs (DEFRA) "*Update of noise database for prediction of noise on construction and open sites*" and assume equipment is modern and in good working order. It has been assumed that as a minimum 2.4 m high hoarding will be constructed around the site perimeter.

Table 35 Equipment and associated sound power level

Works description	Works location	Equipment	Quantity	Total sound power level, dB(A)
Internal demolition	Convention Centre	5t Rubber Tracked Excavator	1	98
		Bobcats	3	109
		Truck and Dog	3	103
Internal demolition	Theatre (Hall 4 and 5 of existing Exhibition Centre)	5t Rubber Tracked Excavator	1	98
		Bobcats	3	109
		Truck and Dog	3	103
Internal demolition	Exhibition Centre (Hall 1, 2 and 3 of existing Exhibition Centre)	5t Rubber Tracked Excavator	1	98
		Bobcats	3	109
		Truck and Dog	3	103
Demolition	Convention Centre	70t Excavator with Ripper	2	110

Works description	Works location	Equipment	Quantity	Total sound power level, dB(A)
		30t Excavator	3	110
		15t Excavator	1	97
		Truck and Dog	1	98
		Bobcats	2	107
		Front End Loader	1	108
		Jack Hammers	2	111
		Water Cart	1	100
		Rock Breaker	1	112
		Mechanical Broom	1	98
Demolition	Theatre (Hall 4 and 5 of existing Exhibition Centre)	70t Excavator with Ripper	2	110
		30t Excavator	3	110
		15t Excavator	1	97
		Truck and Dog	1	98
		Bobcats	2	107
		Front End Loader	1	108
		Jack Hammers	2	111
		Water Cart	1	100
		Rock Breaker	1	112
		Mechanical Broom	1	98
Demolition	Exhibition Centre (Hall 1, 2 and 3 of existing Exhibition Centre)	70t Excavator with Ripper	2	110
		30t Excavator	3	110
		15t Excavator	1	97
		Truck and Dog	1	98
		Bobcats	2	107
		Front End Loader	1	108
		Jack Hammers	2	111
		Water Cart	1	100
		Rock Breaker	1	112
		Mechanical Broom	1	98
Construction	Convention Centre, Theatre and	Electric Crane	5	106
		400t Mobile Crane	6	114

Works description	Works location	Equipment	Quantity	Total sound power level, dB(A)
	Exhibition Centre	Concrete Trucks	10	116
		Concrete Pumps	4	112
		Concrete Leveller	4	111
		Concrete Vibrator	4	103
		Cherry Picker	2	100
		Compressor	4	115
		Generator	4	107
		Power Tools	2	111
		Concrete Saw	1	110
		Welder	2	104
Public domain works	Boulevard	12t Excavator	3	104
		Bobcats	4	110
		Truck and Dog	2	101
		Vibratory Roller	2	112
		Wacker Packer	2	107
		Backhoe	2	105
Public domain works	Tumbalong Green	12t Excavator	3	104
		Bobcats	4	110
		Truck and Dog	2	101
		Vibratory Roller	2	112
		Wacker Packer	2	107
		Backhoe	2	105
Public domain works	Chinese Garden Entrance	12t Excavator	3	104
		Bobcats	4	110
		Truck and Dog	2	101
		Vibratory Roller	2	112
		Wacker Packer	2	107
		Backhoe	2	105
Final Commissioning	Convention Centre, Theatre and Exhibition Centre	Hand Tools	2	97
		Power Tools	2	111

5.1.1 Construction modelling methodology

Noise levels due to the construction activities shown in Table 35 have been predicted at nearby sensitive receivers using SoundPLAN noise modelling software v7.0. The modelling includes ground topography, all nearby buildings and representative construction noise sources provided by Lend Lease. Neutral weather conditions were assumed.

It can be expected that there may be differences between predicted and measured noise levels due to variations in instantaneous operating conditions, plant in operation during the measurement and also the location of the plant equipment and acoustic shielding.

Lend Lease have nominated construction times of 7 am to 7 pm during weekdays and 7 am to 5 pm during Saturdays. These slightly extended hours will enable the construction activities to be carried out in a more efficient manner, thereby shortening the construction period during which receivers will be exposed to construction noise.

Although 6 pm to 7 pm weekdays are strictly evening works, logged noise levels indicate that the background noise levels during this period are consistent with daytime noise levels, therefore works during this period have been assessed against daytime criteria. It is also likely that during the period the intensity of construction activity will be less.

5.1.2 Construction noise modelling results

Construction noise modelling results are presented in Table 43 to Table 49 of Appendix D. Each scenario presents the worst case scenario where all listed equipment will be operating for a full 15 minute period. A summary of the results of the construction noise modelling, including the number of receiver locations where exceedances may occur are presented below in Table 36.

Table 36 Construction noise results summary

Summary Table	Number of residential receiver locations where noise management level exceedances may occur	Number of commercial receiver locations where noise management level exceedances may occur	"Highly noise affected" receivers
Stage 1	-	1	-
Stage 2	8	4	-
Stage 3	7	3	-
Stage 4	7	8	-
Stage 5	7	6	-
Stage 6	6	5	1
Stage 7	4	3	-

Results are also presented as noise contours in Appendix E. The results show that there is a significant impact at numerous receivers. Noise from the demolition stages are the most noise intensive due to the use of large plant and nature of these activities. Noise from construction activities are less noise intensive and will affect fewer locations. There are still, however, expected exceedances of NMLs at some locations. In particular, the "highly noise affected" receiver, Novotel (17 Little Pier Street, Haymarket). Although this receiver will be highly noise affected, the most affected façade of the building has small non-openable windows. Given the closed proximity of the hotel to Pier Street, the hotel is likely to have a high performing façade system. Therefore the impacts on the patrons of the hotel are likely to be considerably reduced.

It is expected that careful selection of well-maintained and quiet plant will result in some noise reduction. However even after application of these reasonable and feasible measures exceedances are still expected.

5.1.3 Recommendations

Given that NMLs are likely to be exceeded at times and at certain receivers, the implementation of reasonable and feasible noise mitigation measures and work practices will need to be considered. Furthermore it should be noted that this assessment is only intended to be preliminary and it is recommended that a detailed assessment be completed and a Construction Noise and Vibration Management Plan (CNVMP) be developed prior to construction commencing. Preliminary recommendations on such measures are given below.

Standard mitigation measures

All construction and operational activities associated with the site should be subject to the standard noise and vibration mitigation measures described below:

Where reasonable and feasible, apply best practice noise mitigation measures including:

- Maximise the offset distance between noisy plant items and nearby noise sensitive receivers;
- Avoid the coincidence of noisy plants working simultaneously close together and adjacent to sensitive receivers would be avoided, where practicable;
- Where possible, orientate equipment with directional noise emissions away from sensitive receivers;
- Locate noisy plant away from potentially noise affected neighbours or behind barriers, such as sheds or walls;
- Load and unload away from sensitive receivers, where practicable;
- Select site access points taking into account the proximity of noise sensitive receivers;
- Carry out maintenance work on construction plants with the potential to generate noise impacts away from noise sensitive receivers and confine to standard daytime construction hours, where possible;
- Minimise consecutive works in the same locality, where practicable;
- Turn off plant that is not being used;
- Examine, and implement where feasible and reasonable, alternative work practices which generate less noise – for example, use electric equipment instead of diesel or petrol powered equipment;
- Examine, and implement where feasible and reasonable, the use of silenced equipment and noise shielding around stationary plant (such as generators), subject to manufacturers' design requirements;
- Ensure plant is regularly maintained, and repair or replace equipment that becomes noisy;
- Arrange the work site to minimise the use of movement alarms on vehicles and mobile plant;
- The use of broadband reversing alarms or other non-tonal vehicle movement and warning alarms is recommended. The potential noise impact associated with reversing alarms can also be managed and minimised via a combination of proactive driver/operator training and operational procedures including where feasible; and
- Implement a community consultation programme with timely notifications.

Respite periods

- Respite periods should be negotiated with the community for construction activities expected to generate noise levels at or in excess of 75 dB(A).

Equipment selection and maintenance

When carrying out construction works the contractor should select equipment taking into account noise emissions, such as (but not limited to):

- Smaller equipment options or rubber-tracked equipment where equipment is fit-for-purpose and economically feasible;
- All equipment would be maintained and operated in an efficient manner, in accordance with manufacturer's specifications, to reduce the potential for adverse noise and vibration impacts; and

- Regular checks of equipment noise levels would be made to ensure that noise levels do not increase as a result of poor maintenance practice or say the replacement of individual items of equipment with alternatives which have higher noise emissions.

5.1.4 Construction vibration

Vibration impacts have been considered as part of the assessment. The following equipment has been identified as vibration intensive:

- Rock Breaker;
- Jack hammer;
- Vibratory roller; and
- Wacker packer.

For this development site, there are some receivers located within the recommended safe working distances in Table 21. It is possible that any buildings or occupants located within these set back may be adversely affected by construction vibration. Any such work will have to be carefully managed to mitigate the effects of vibration. For vibration intensive activities that occur within the buffer zones, management methods to mitigate are likely to include:

1) Source controls

- Use of less noise and vibration intensive equipment; and
- Respite periods;

2) Management methods

- Community communications;
- Complaint management and response;
- Site planning and layout;
- Avoiding where practical work during sensitive time periods;
- Attended vibration monitoring should be completed to verify safe working distances; and
- Vibration monitoring with suitable early warning device should be utilised to protect buildings at risk of structural damage. Work practices carried out at properties inside the safe working distances

5.1.5 Construction traffic

The existing traffic flows provided by Hyder Consultants in their Traffic Assessment report dated February 2013 and the proposed construction traffic movements have been reviewed and used to assess construction traffic noise impact during the demolition and construction phases.

The existing road traffic noise levels at receiver locations surrounding the site are presented in Table 6. These noise levels already exceed the road traffic noise assessment criteria. As the existing traffic noise levels are above the noise assessment criteria, feasible and reasonable measures should be implemented to meet the assessment criteria. In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB(A) represents a minor impact that is considered barely perceptible to the average person.

Construction traffic noise impacts on arterial roads are to be assessed against the 15-hour (7am – 10pm) period. Based on the construction programme and volume of concrete required for construction activities, it is estimated that there would be an increase of 3-4 trucks per hour above the existing traffic volumes for the duration of the development. It is likely that concrete supply plants will be located within 1km of the development which will aid in minimising any congestion to the surrounding traffic network. The increase in traffic as a result of demolition and construction activities would result in an increase in traffic noise levels less than 1 dB(A) and would not be considered perceptible to the average person.

6.0 Conclusion

This Environmental Noise and Vibration Impact Assessment report has been prepared in support of a State Significant Development Application (SSD 5752 2012) submitted to the Minister for Planning and Infrastructure pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act). The Application seeks approval for construction of the Public Private Partnership (PPP) component of the Sydney International Convention, Exhibition and Entertainment Precinct (SICEEP) Project at Darling Harbour.

The proposed development involves construction of the PPP component of the SICEEP Project, comprising new, integrated and world-class convention, exhibition and entertainment facilities with associated retail and public domain upgrades.

This Environmental Noise and Vibration Impact Assessment report has been prepared in response to the Director General's Environmental Assessment Requirements (DGEARs) for the Sydney International Convention, Exhibition and Entertainment Precinct issued on 21 January 2013.

The assessment has identified nearby noise and vibration sensitive receivers potentially affected by the use or construction of SICEEP.

All applicable environmental noise and vibration criteria for the operation and construction of SICEEP have been determined based on background noise measurements, relevant EPA and other applicable guidelines in accordance with the DGEARs.

The likely environmental noise emissions from the use of SICEEP including entertainment and patron activities, building services plant, car parking and loading dock activities have been calculated. Noise mitigation measures to reduce environmental noise emissions from the operation of SICEEP have been recommended.

The impact of traffic generated by the development of the SICEEP on surrounding roads has also been assessed. Generally changes in road traffic noise levels for the surrounding roads are minor, being within the 2.0 dB

The likely level of construction noise and vibration at nearby sensitive receivers has been calculated. Exceedances of the construction noise management levels are likely at times, reasonable and feasible noise mitigation controls have been recommended to reduce and manage the impact of construction noise. Recommendations have also been presented to reduce and manage the impact of construction vibration on nearby sensitive receivers.

AECOM advises that the noise and vibration impact of the construction and operation of the SICEEP development is considered acceptable. Assuming the implementation of recommended noise and vibration mitigation measures adverse impacts are unlikely at nearby sensitive receivers. Noise mitigation measures include the careful design and selection of building envelope materials and construction techniques, the use of attenuators and other standard noise controls on external building services plant, lined noise barriers around the loading dock area and the implementation of a Noise Management Plan for the use of the event deck.

Sydney International Convention, Exhibition and Entertainment Precinct

Appendix A

Acoustic Terminology

Appendix A Acoustic Terminology

The following is a brief description of acoustic terminology used in this report.

Sound power level	The total sound emitted by a source
Sound pressure level	The amount of sound at a specified point
Decibel [dB]	The measurement unit of sound
A Weighted decibels [dB(A])	The A weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1kHz and 4 kHz) which the human ear is most sensitive to, and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A).
Decibel scale	The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows:
	0dB(A) Threshold of human hearing
	30dB(A) A quiet country park
	40dB(A) Whisper in a library
	50dB(A) Open office space
	70dB(A) Inside a car on a freeway
	80dB(A) Outboard motor
	90dB(A) Heavy truck pass-by
	100dB(A) Jackhammer/Subway train
	110 dB(A) Rock Concert
	115dB(A) Limit of sound permitted in industry
	120dB(A) 747 take off at 250 metres
Frequency [f]	The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high pitched sound and a low frequency to a low pitched sound.
Equivalent continuous sound level [L_{eq}]	The constant sound level which, when occurring over the same period of time, would result in the receiver experiencing the same amount of sound energy.
L_{max}	The maximum sound pressure level measured over the measurement period
L_{min}	The minimum sound pressure level measured over the measurement period
L_{10}	The sound pressure level exceeded for 10% of the measurement period. For 10% of the measurement period it was louder than the L10.
L_{90}	The sound pressure level exceeded for 90% of the measurement period. For 90% of the measurement period it was louder than the L90.
Ambient noise	The all-encompassing noise at a point composed of sound from all sources near and far.

Background noise	The underlying level of noise present in the ambient noise when extraneous noise (such as transient traffic and dogs barking) is removed. The L90 sound pressure level is used to quantify background noise.
Traffic noise	The total noise resulting from road traffic. The L_{eq} sound pressure level is used to quantify traffic noise.
Day	The period from 0700 to 1800 h Monday to Saturday and 0800 to 1800 h Sundays and Public Holidays.
Evening	The period from 1800 to 2200 h Monday to Sunday and Public Holidays.
Night	The period from 2200 to 0700 h Monday to Saturday and 2200 to 0800 h Sundays and Public Holidays.
Assessment background level [ABL]	The overall background level for each day, evening and night period for each day of the noise monitoring.
Rating background level [RBL]	The overall background level for each day, evening and night period for the entire length of noise monitoring.

*Definitions of a number of terms have been adapted from Australian Standard AS1633:1985 “Acoustics – Glossary of terms and related symbols”, the EPA’s NSW Industrial Noise Policy and Road Noise Policy.

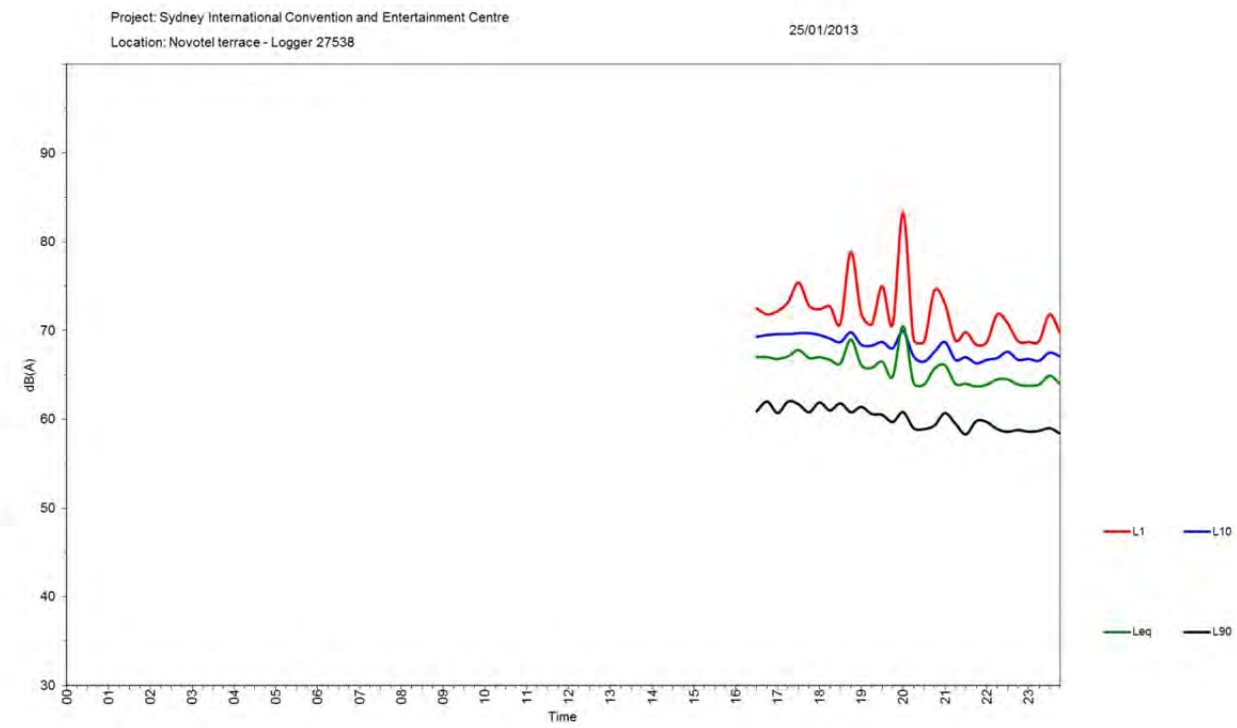
Sydney International Convention, Exhibition and Entertainment Precinct

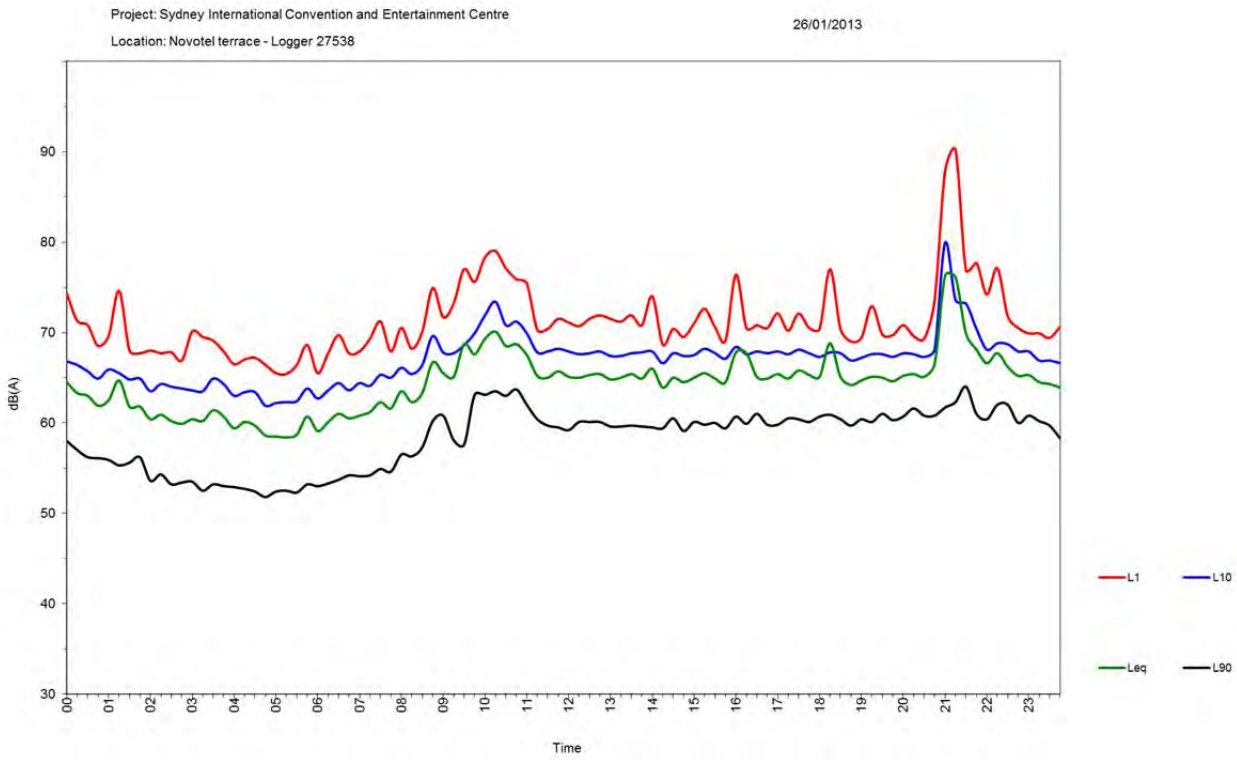
Appendix B

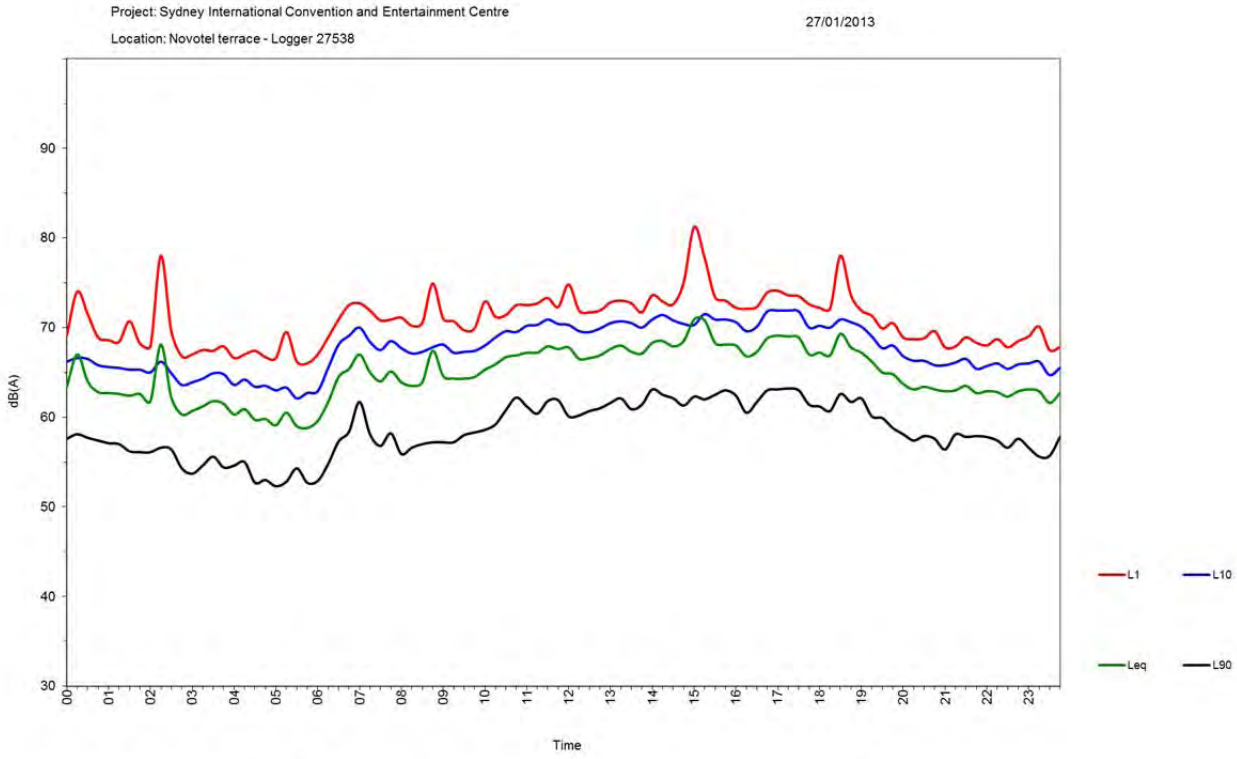
Noise Logging Results

Appendix B Noise Logging Results

NCA1 – Southern terrace of Novotel Sydney on Darling Harbour, Pyrmont



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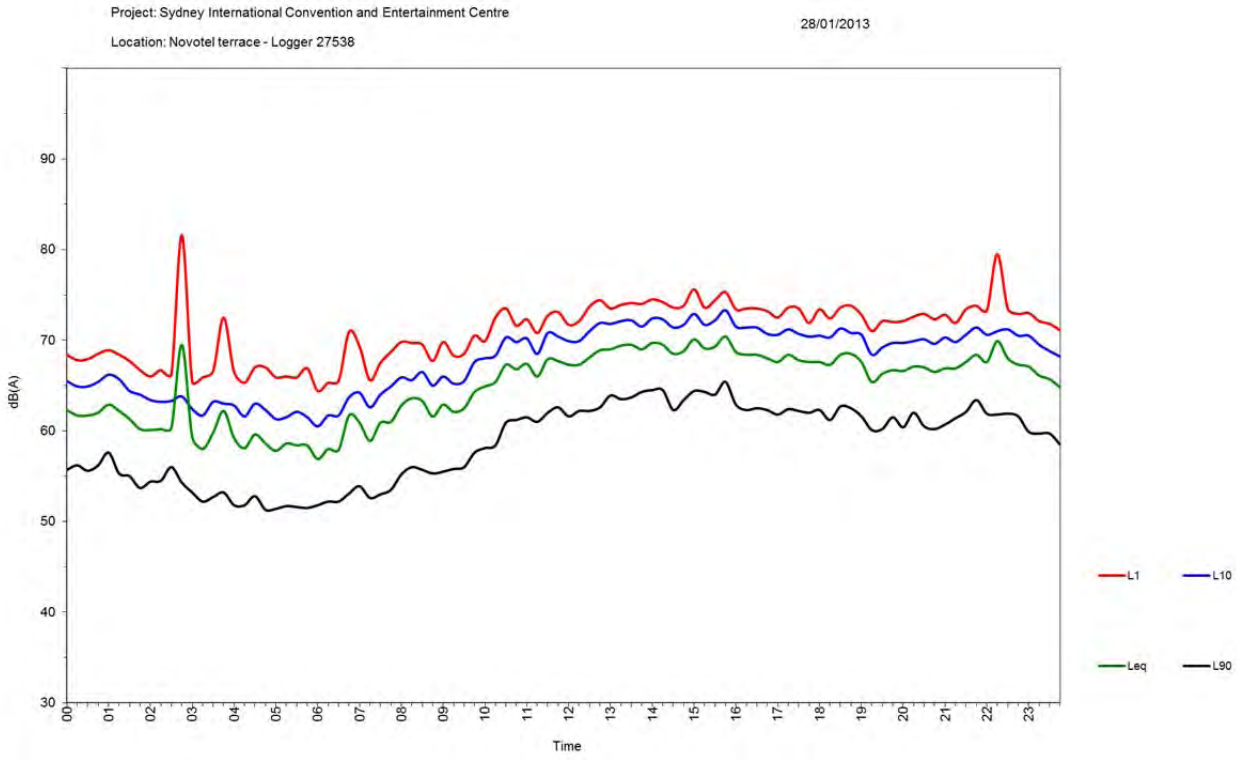
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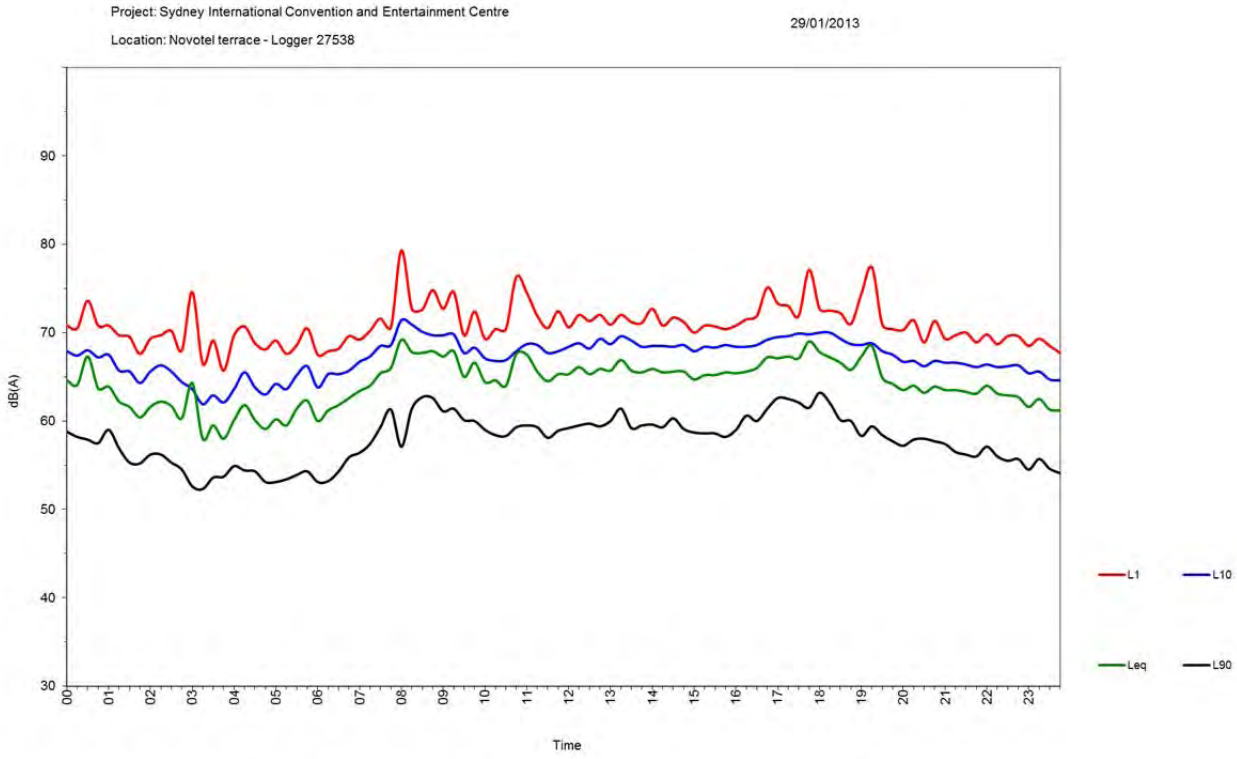
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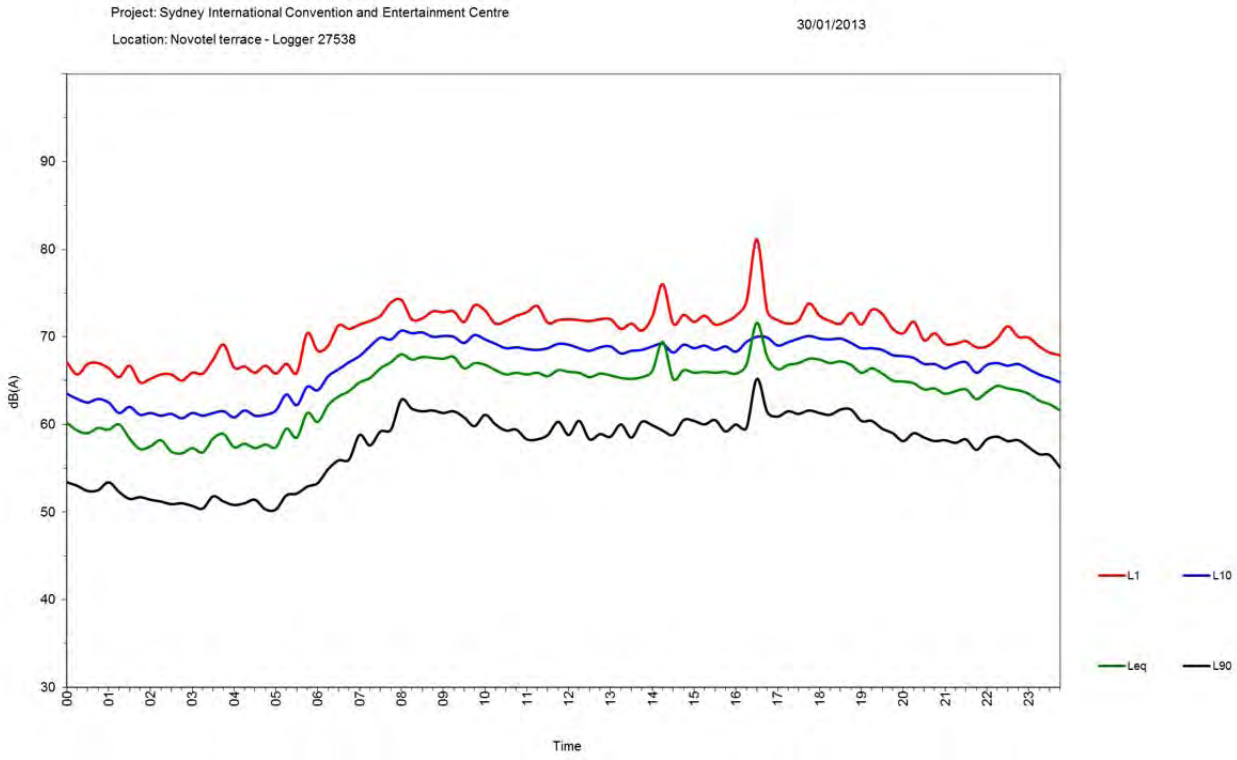
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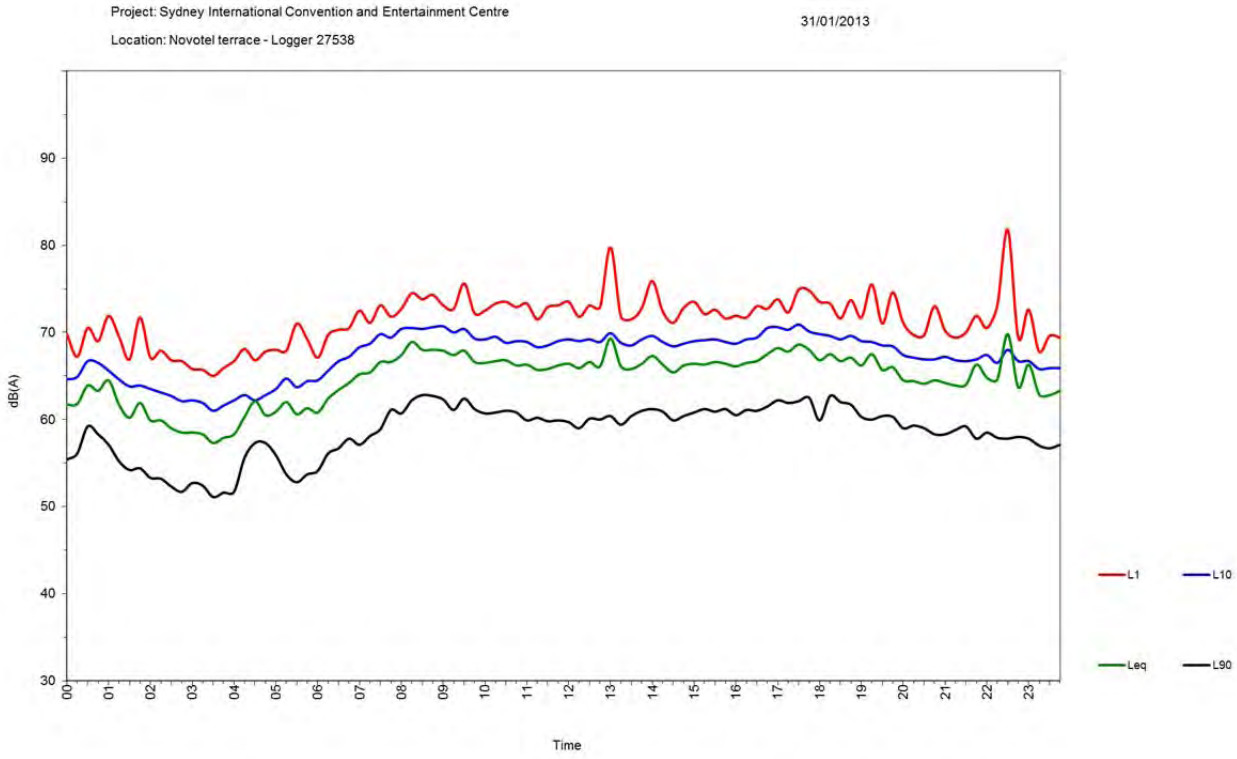
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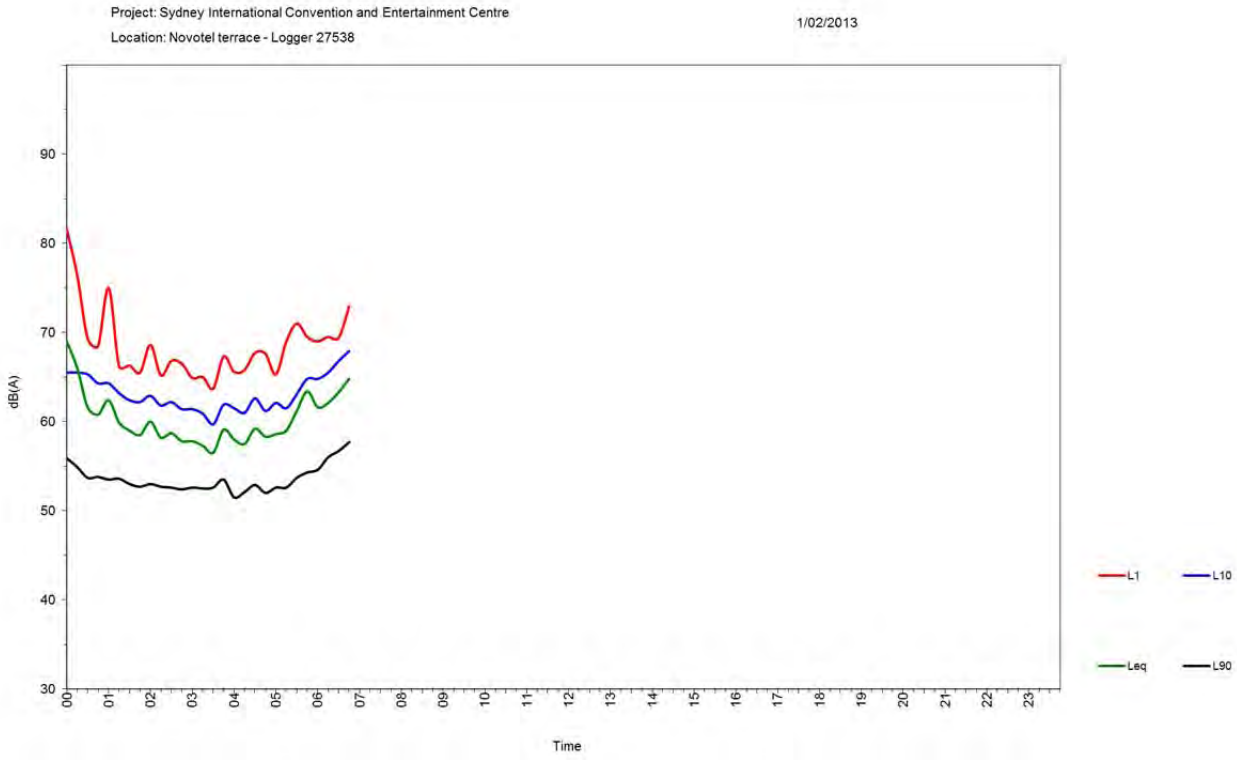
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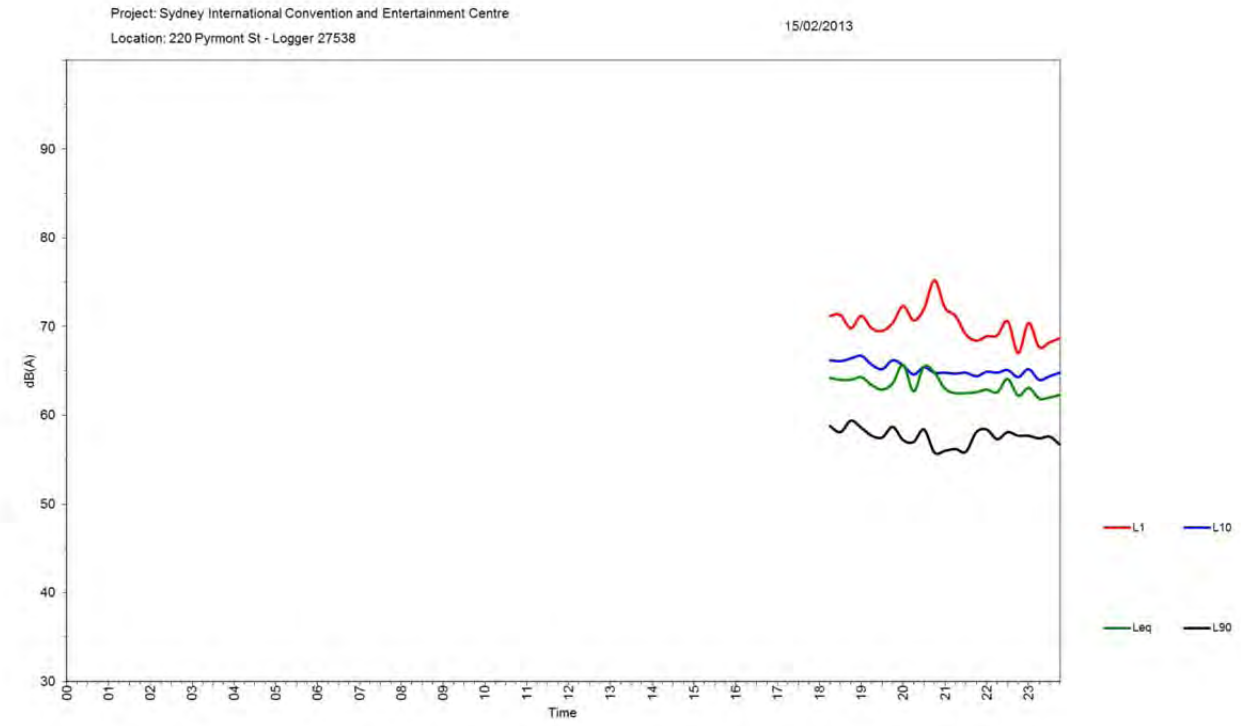
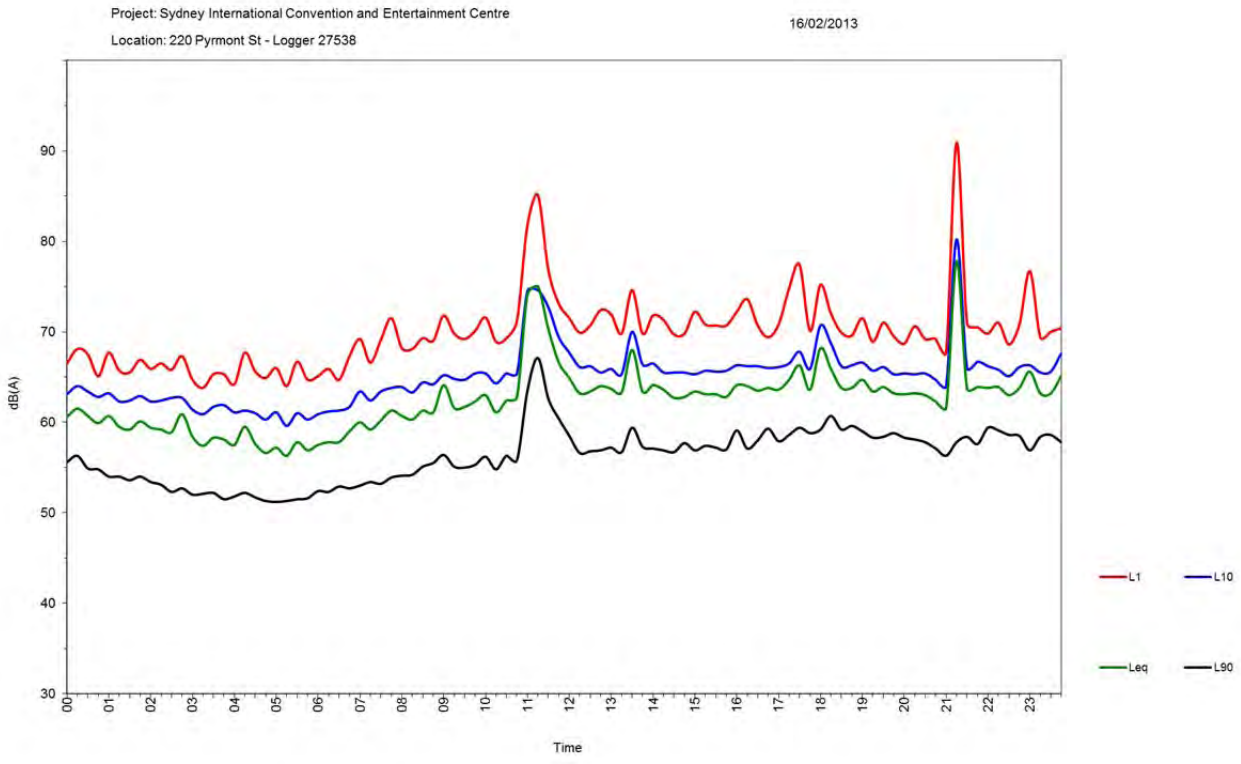
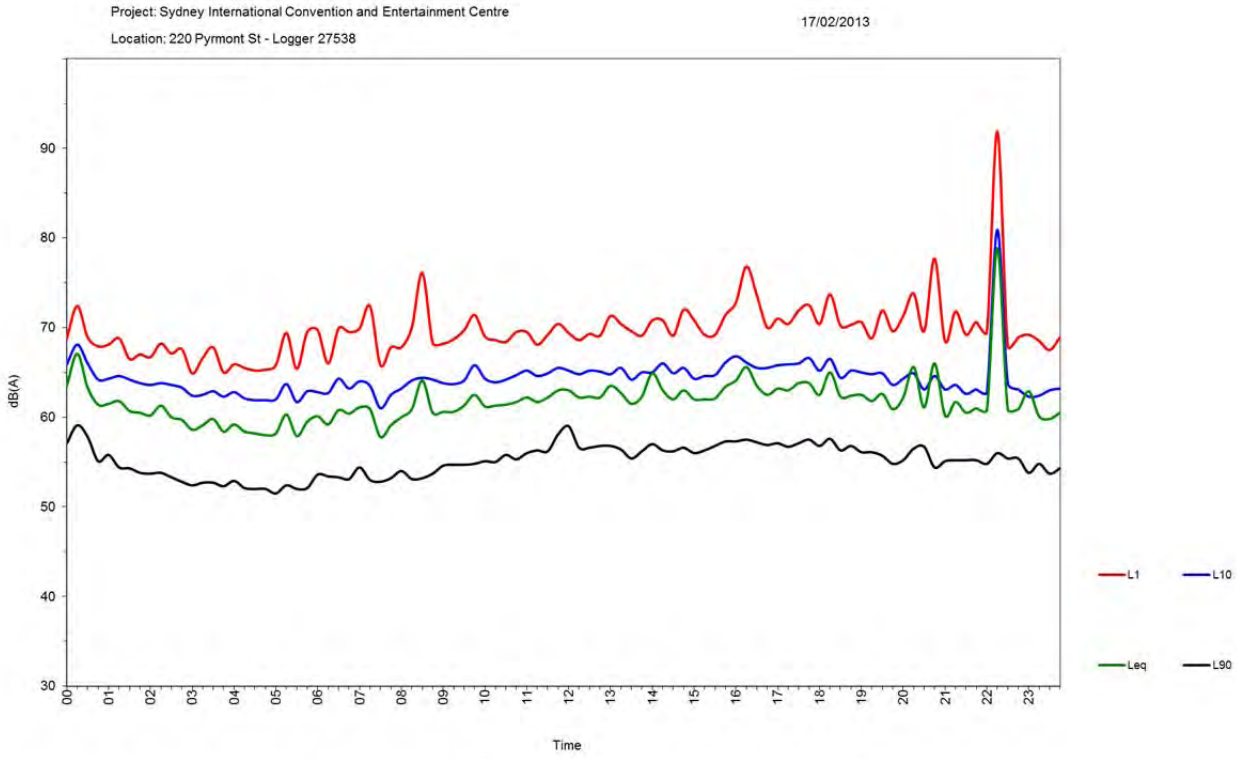
NCA2 – 220 Pyrmont Street, Pyrmont



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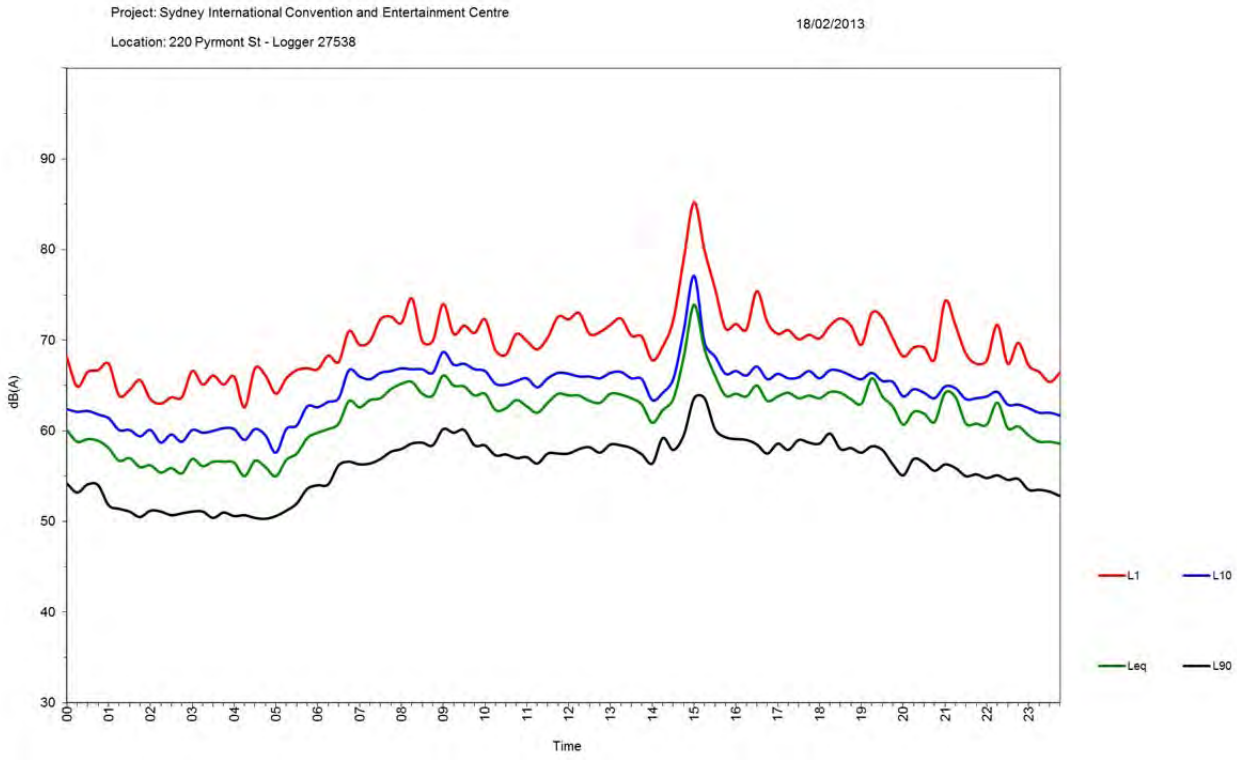
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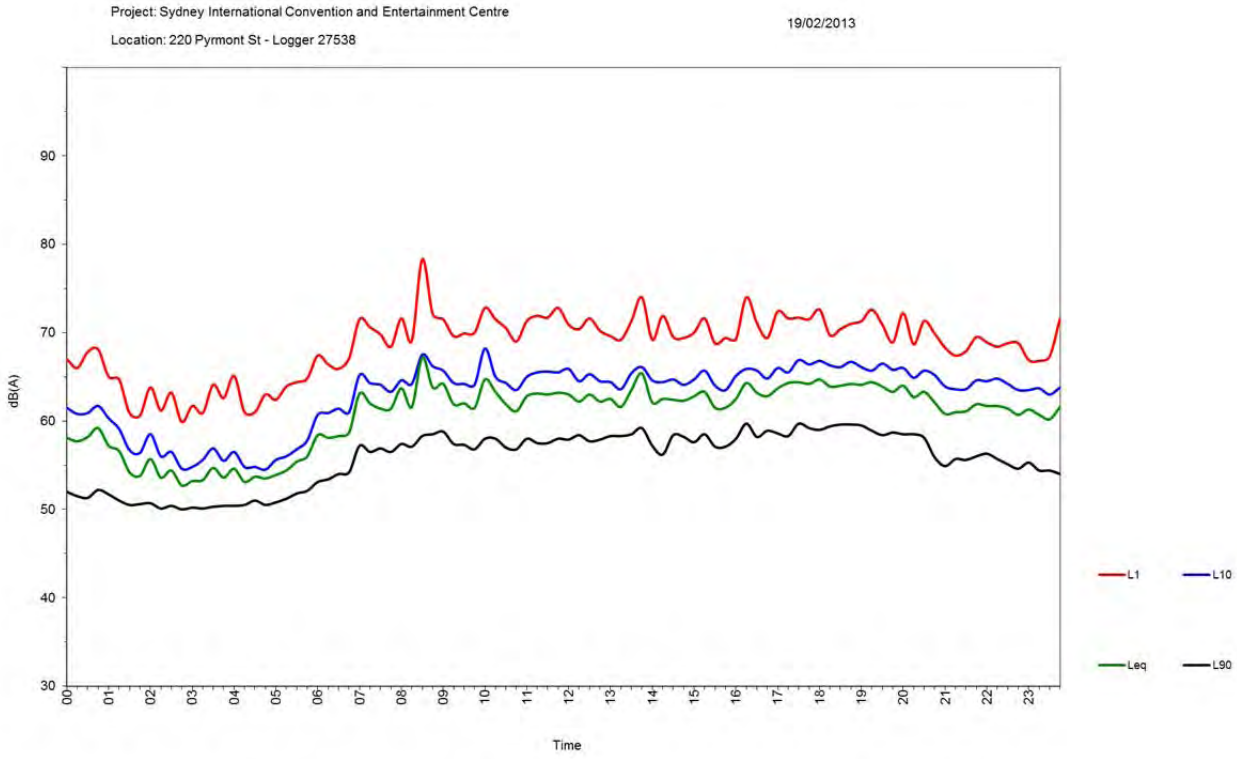
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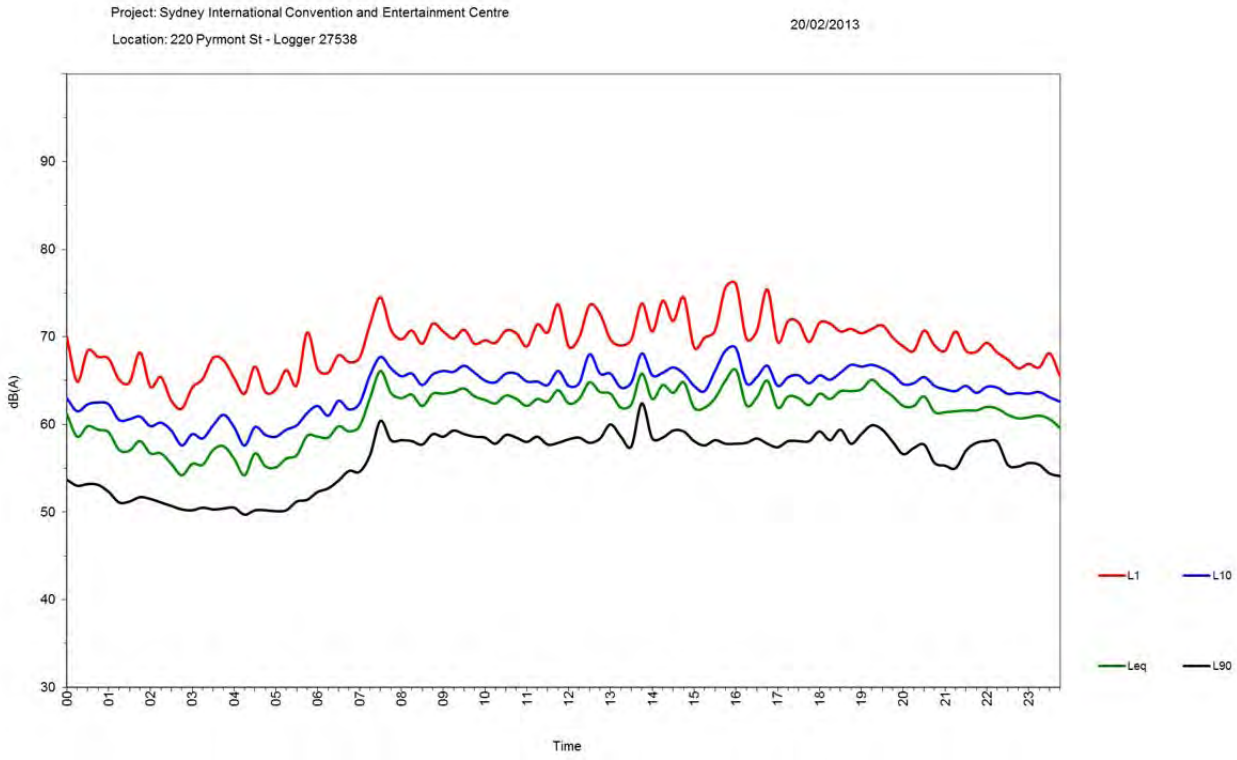
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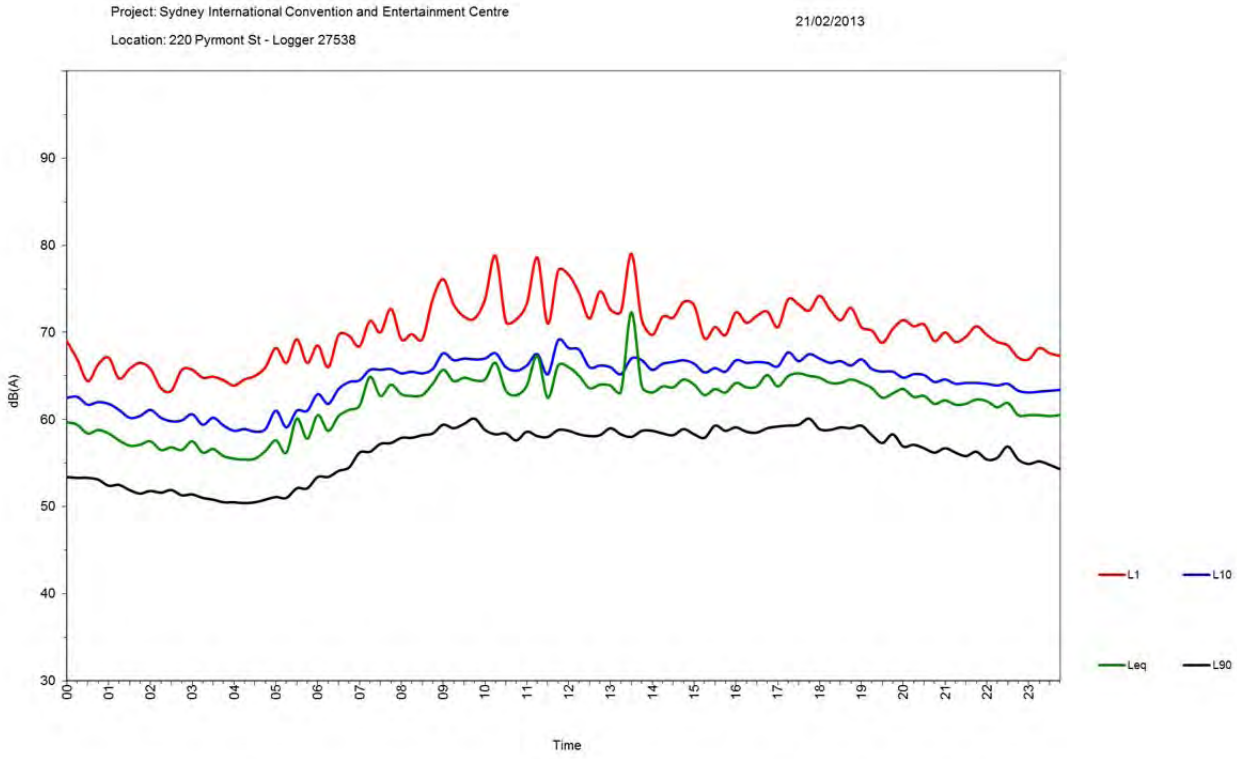
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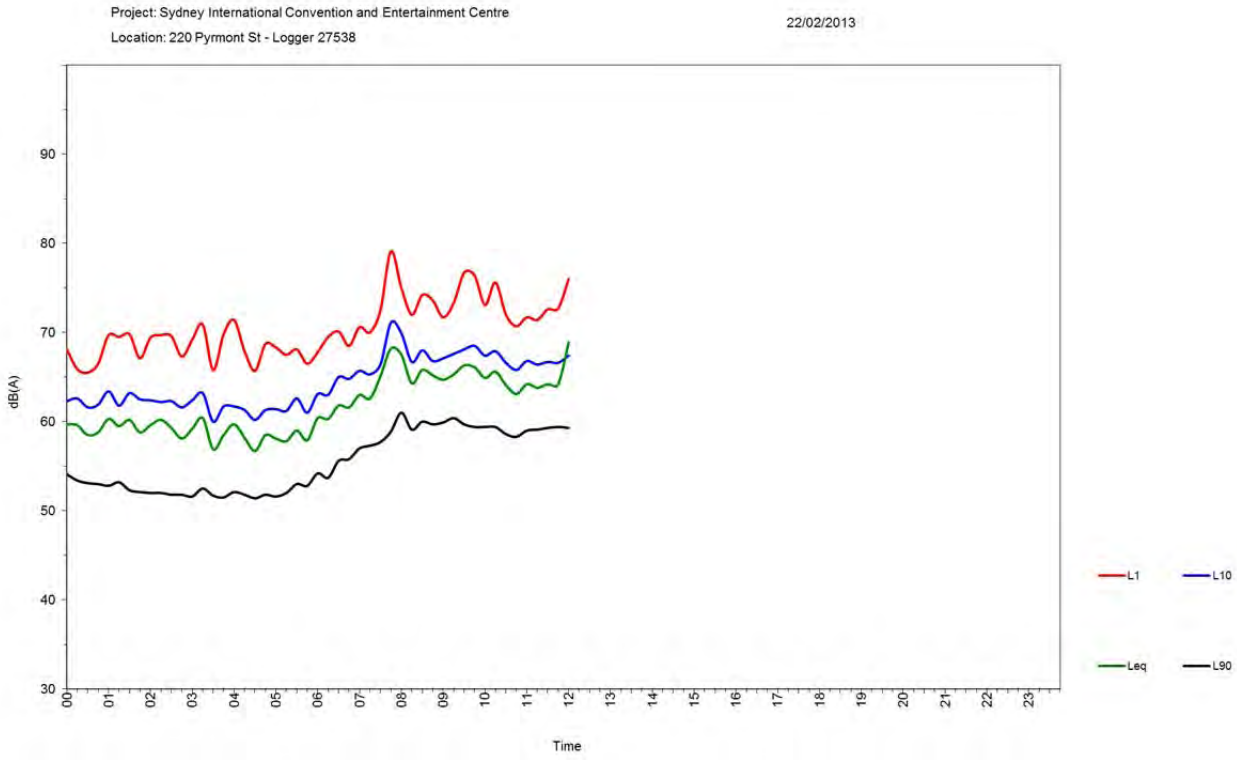
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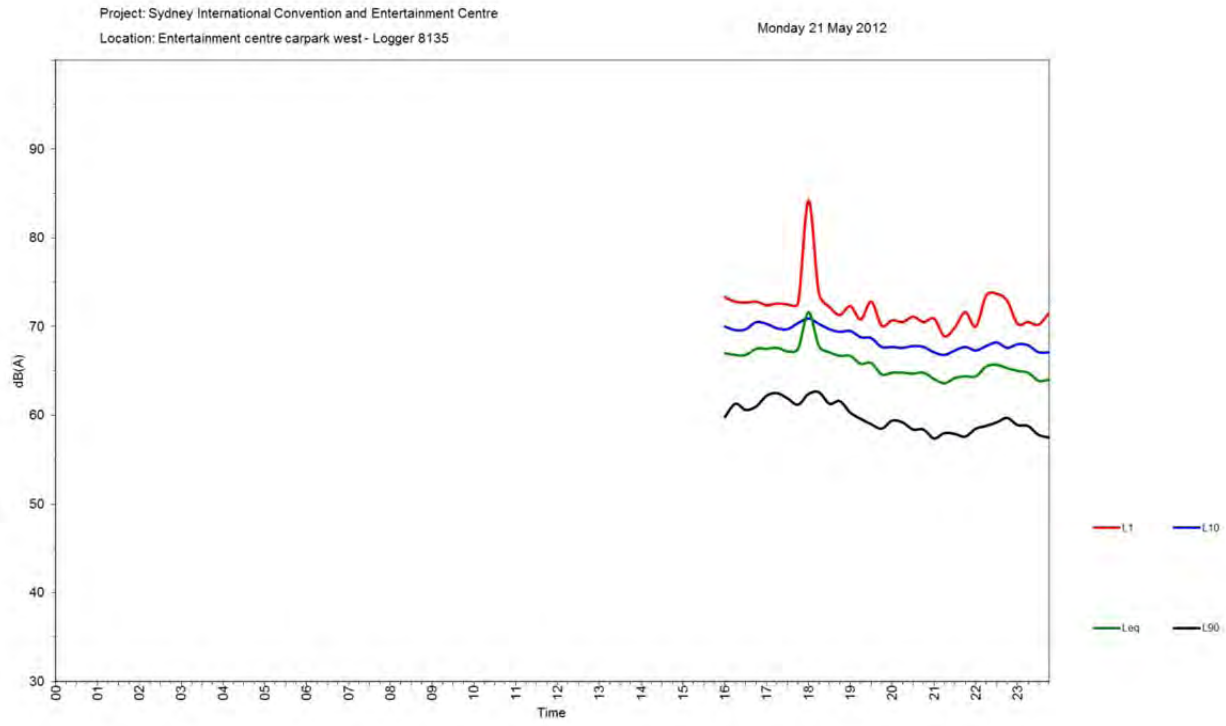
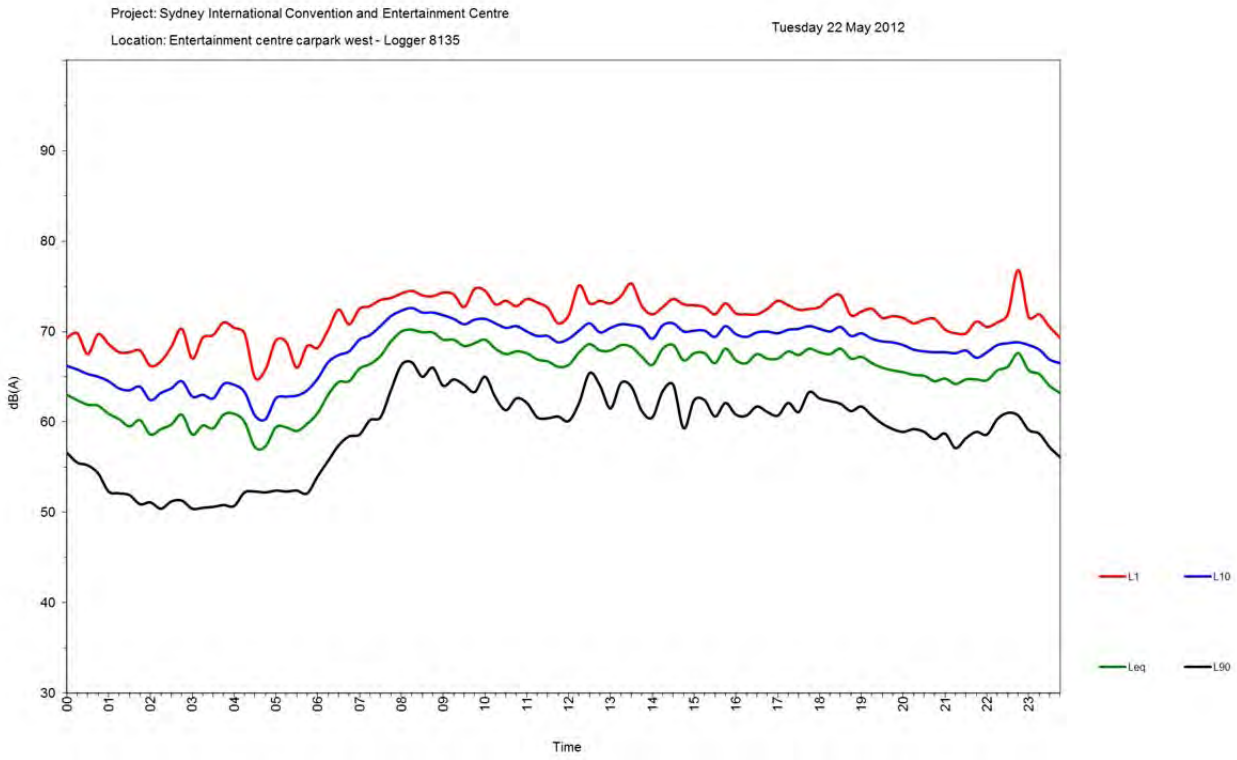
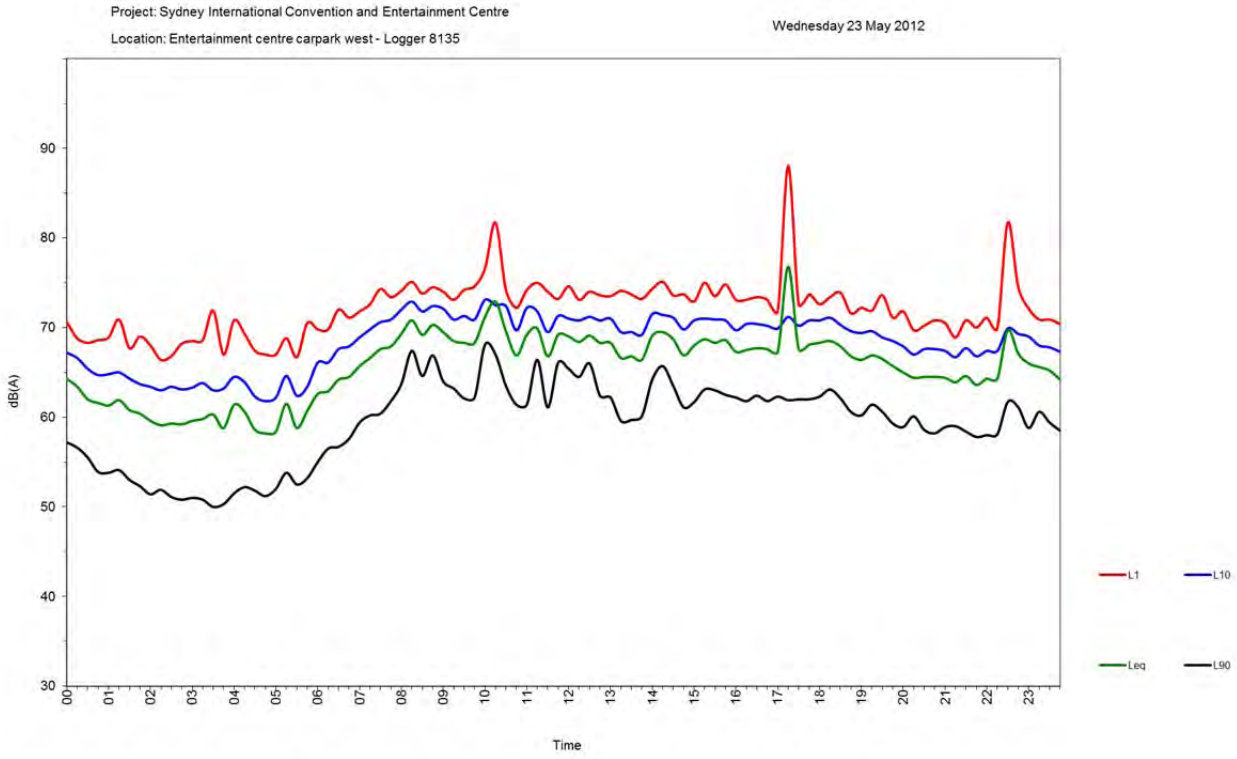
L90

NCA3 - Sydney Entertainment Centre rooftop car park






Project: Sydney International Convention and Entertainment Centre
Location: Entertainment centre carpark west - Logger 8135
Wednesday 23 May 2012
dB(A)
90
80
70
60
50
40
30
00
01
02
03
04
05
06
07
08
09
10
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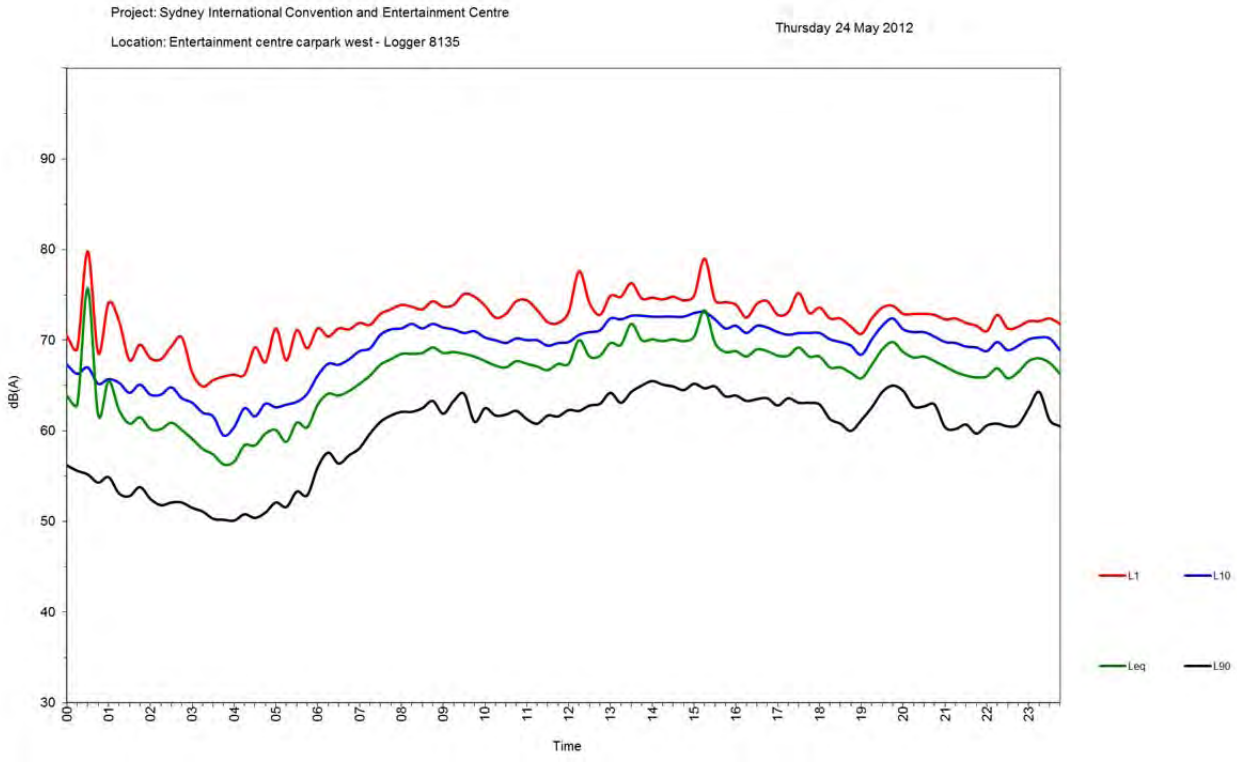
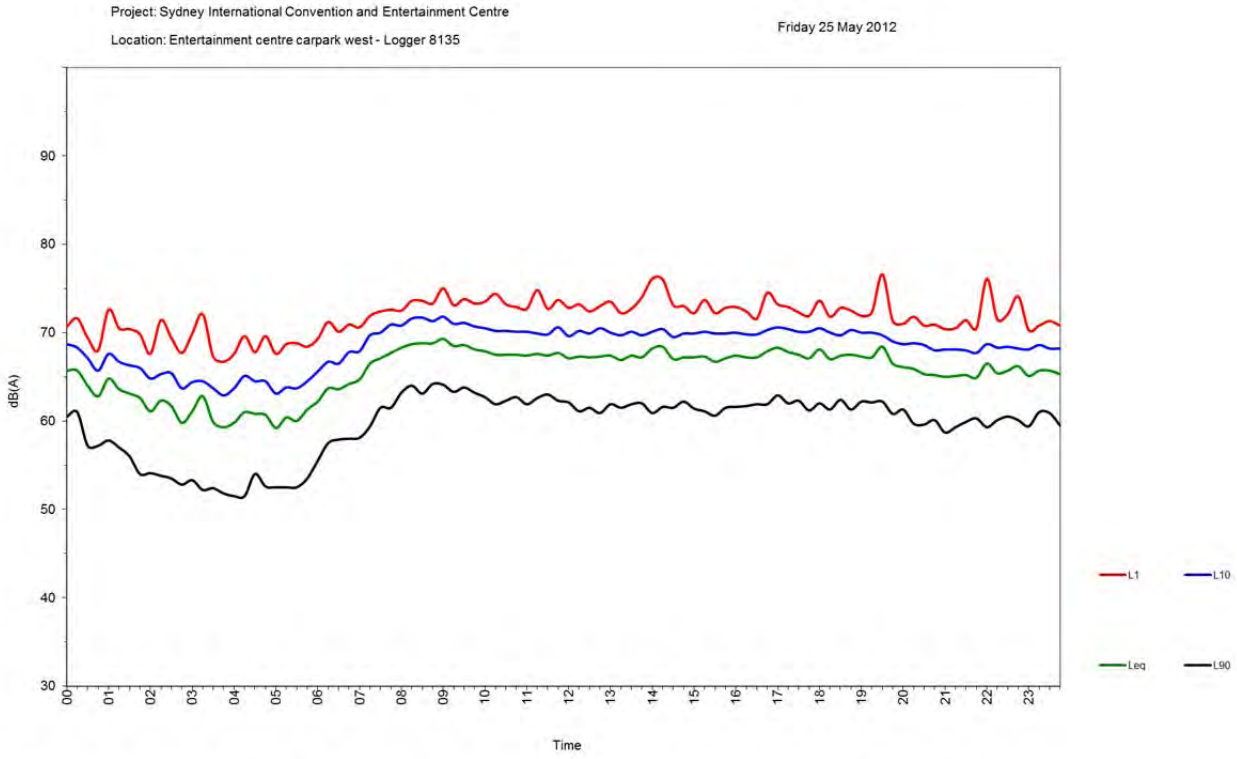
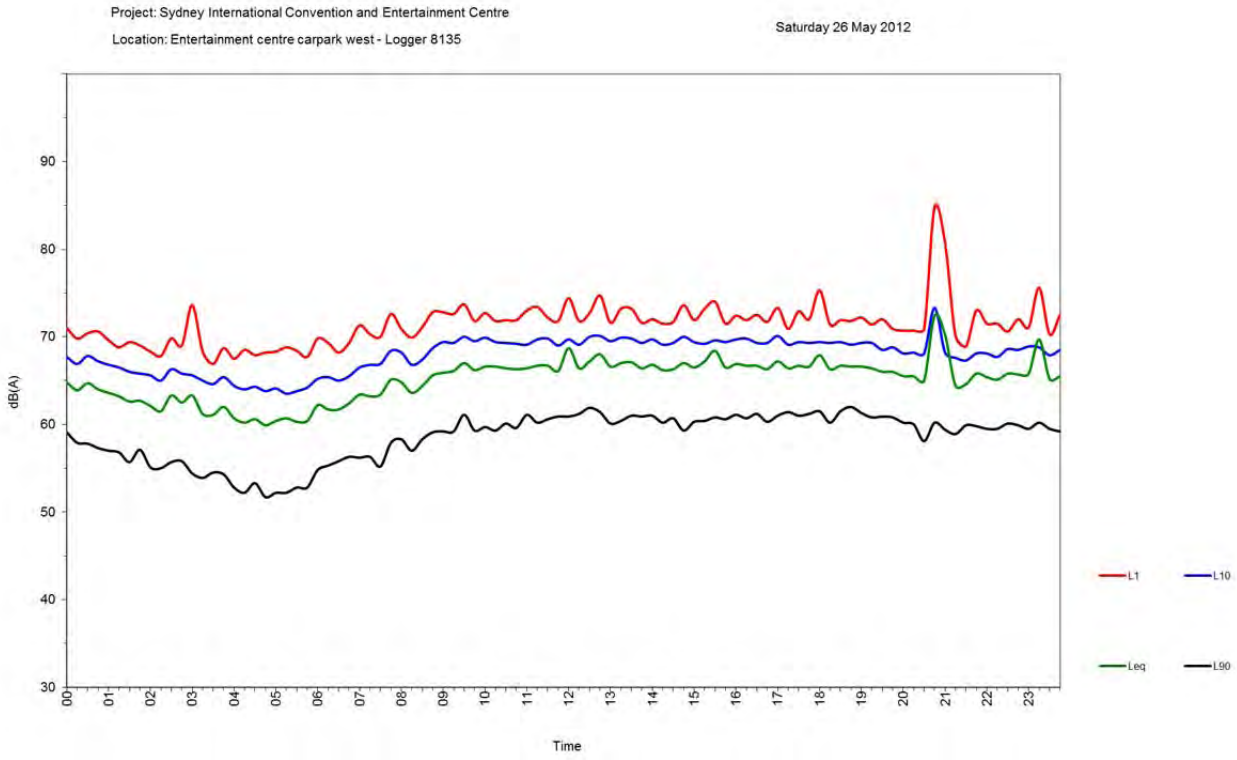
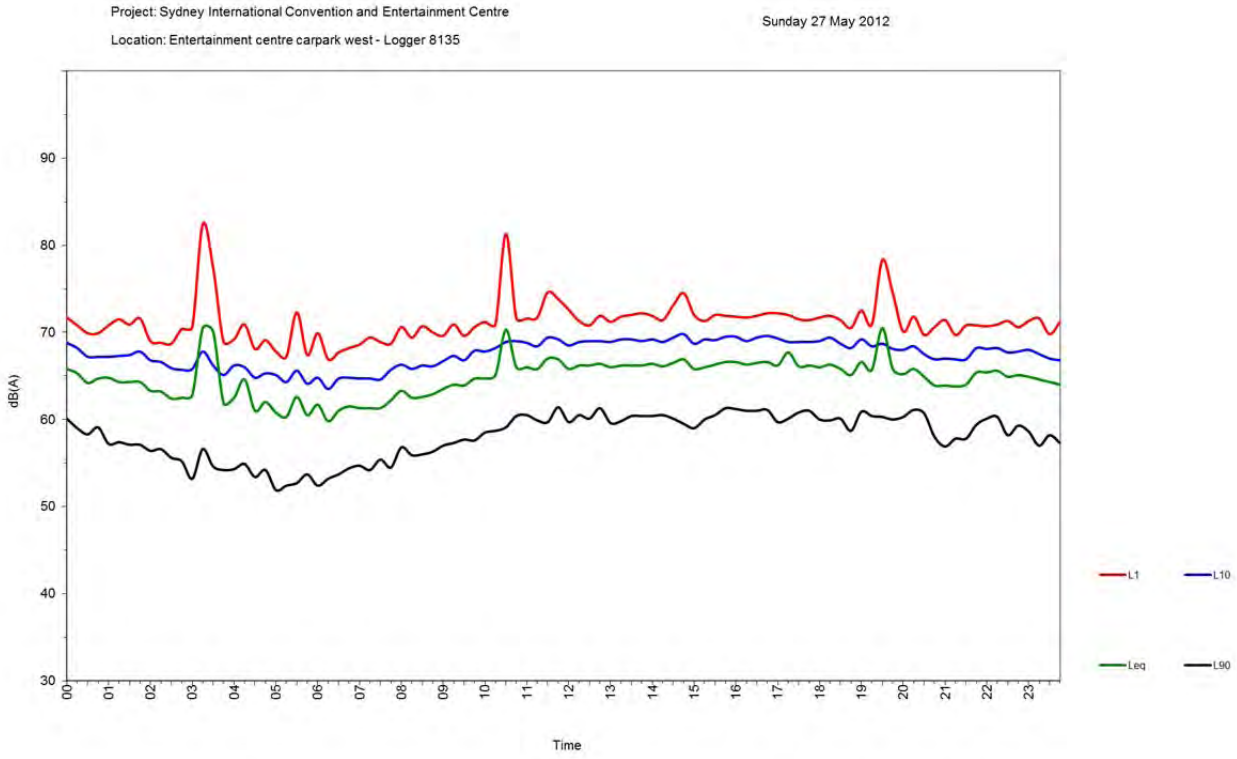
16
17
18
19
20
21
22
23
Time
L1
L10
Leq
L90


Project: Sydney International Convention and Entertainment Centre
Location: Entertainment centre carpark west - Logger 8135
Thursday 24 May 2012
dB(A)
90
80
70
60
50
40
30
00
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Time
L1
L10
Leq
L90


Project: Sydney International Convention and Entertainment Centre
Location: Entertainment centre carpark west - Logger 8135
Friday 25 May 2012
dB(A)
90
80
70
60
50
40
30
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90


Project: Sydney International Convention and Entertainment Centre
Location: Entertainment centre carpark west - Logger 8135
Saturday 26 May 2012
dB(A)
90
80
70
60
50
40
30
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90


Project: Sydney International Convention and Entertainment Centre
Location: Entertainment centre carpark west - Logger 8135
Sunday 27 May 2012
dB(A)
90
80
70
60
50
40
30
00
01
02
03
04
05
06
07
08
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11
12
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14
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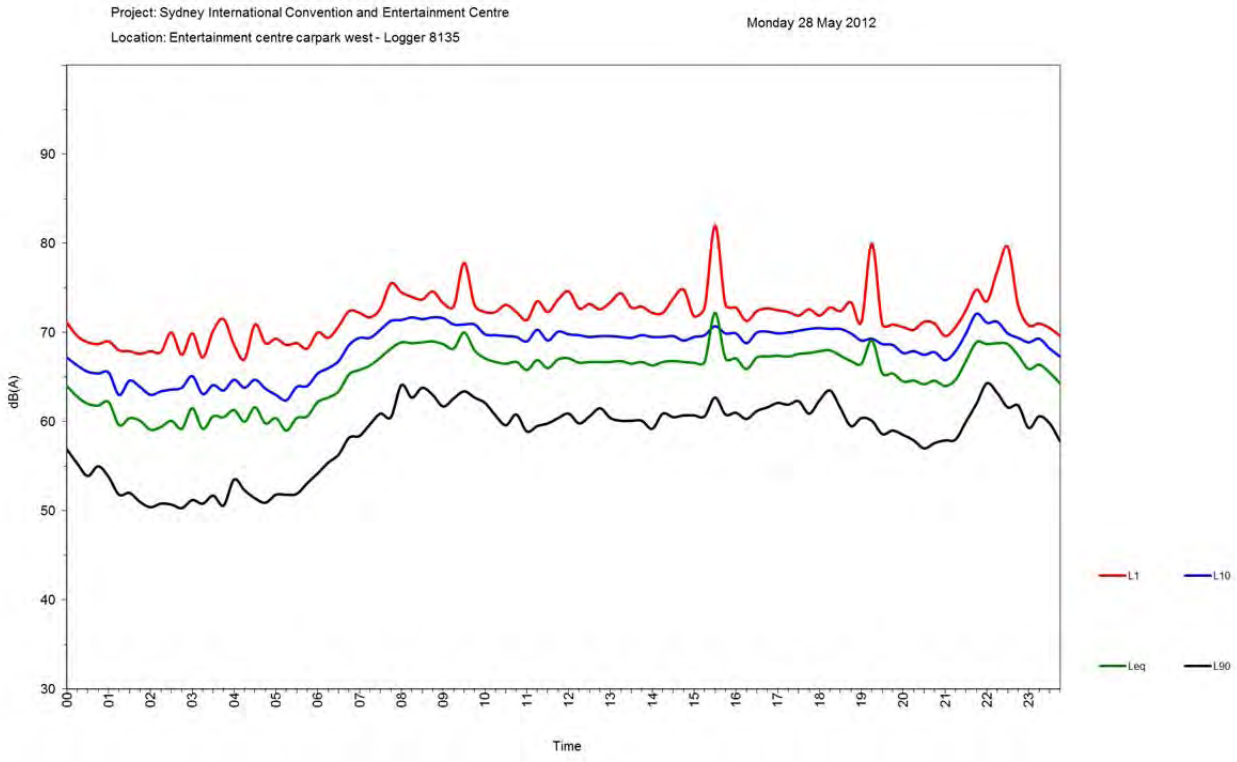
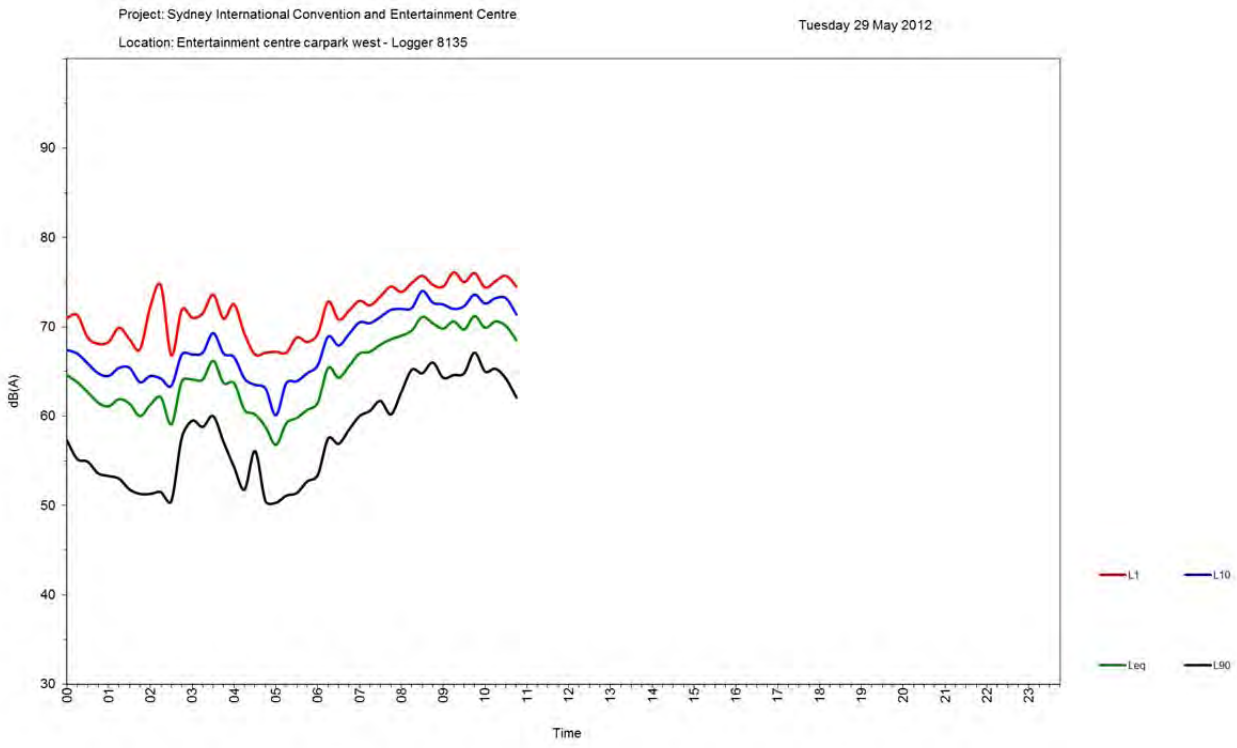
16
17
18
19
20
21
22
23
Time
L1
L10
Leq
L90


Project: Sydney International Convention and Entertainment Centre
Location: Entertainment centre carpark west - Logger 8135
Monday 28 May 2012
dB(A)
90
80
70
60
50
40
30
00
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Time
L1
L10
Leq
L90


Project: Sydney International Convention and Entertainment Centre
Location: Entertainment centre carpark west - Logger 8135
Tuesday 29 May 2012
dB(A)
90
80
70
60
50
40
30
00
01
02
03
04
05
06
07
08
09
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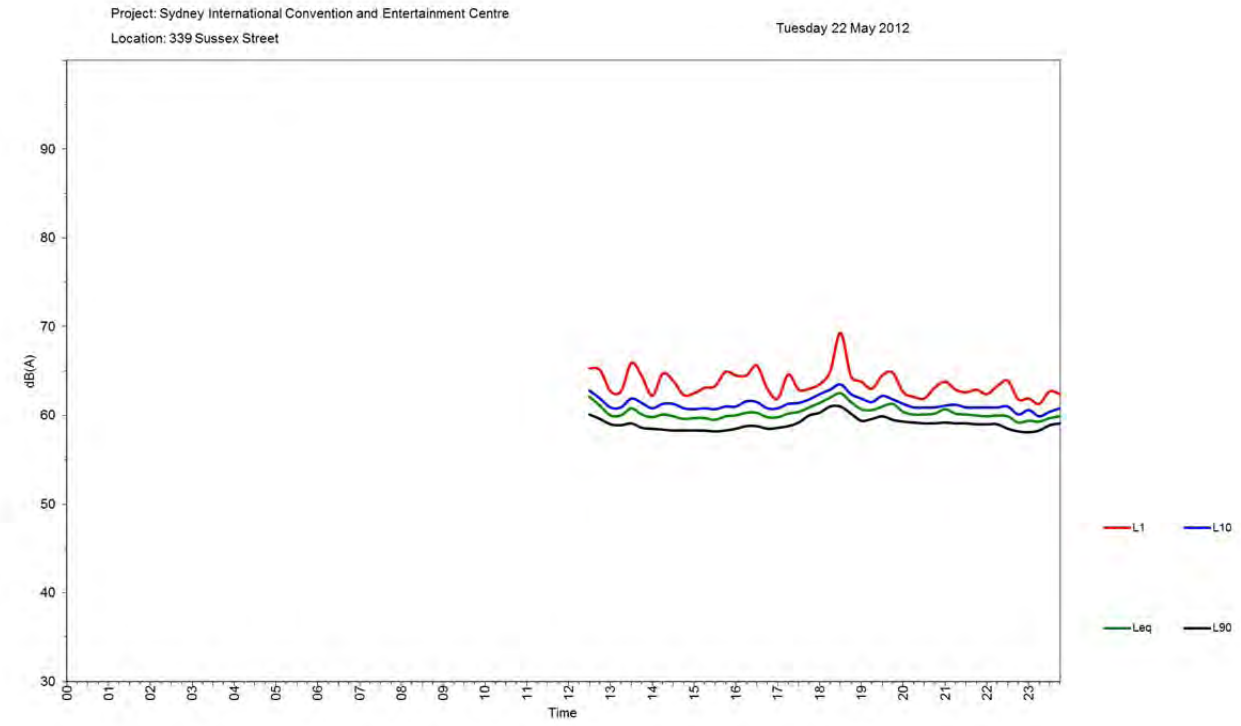
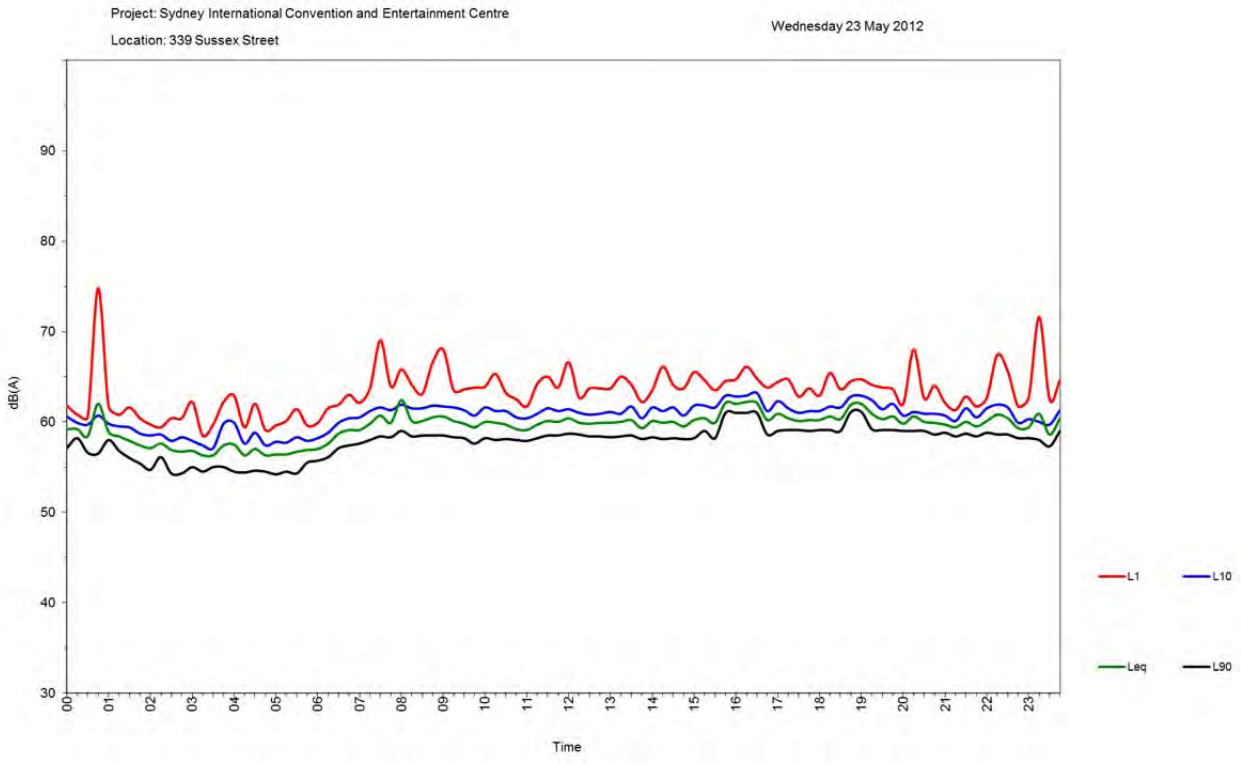
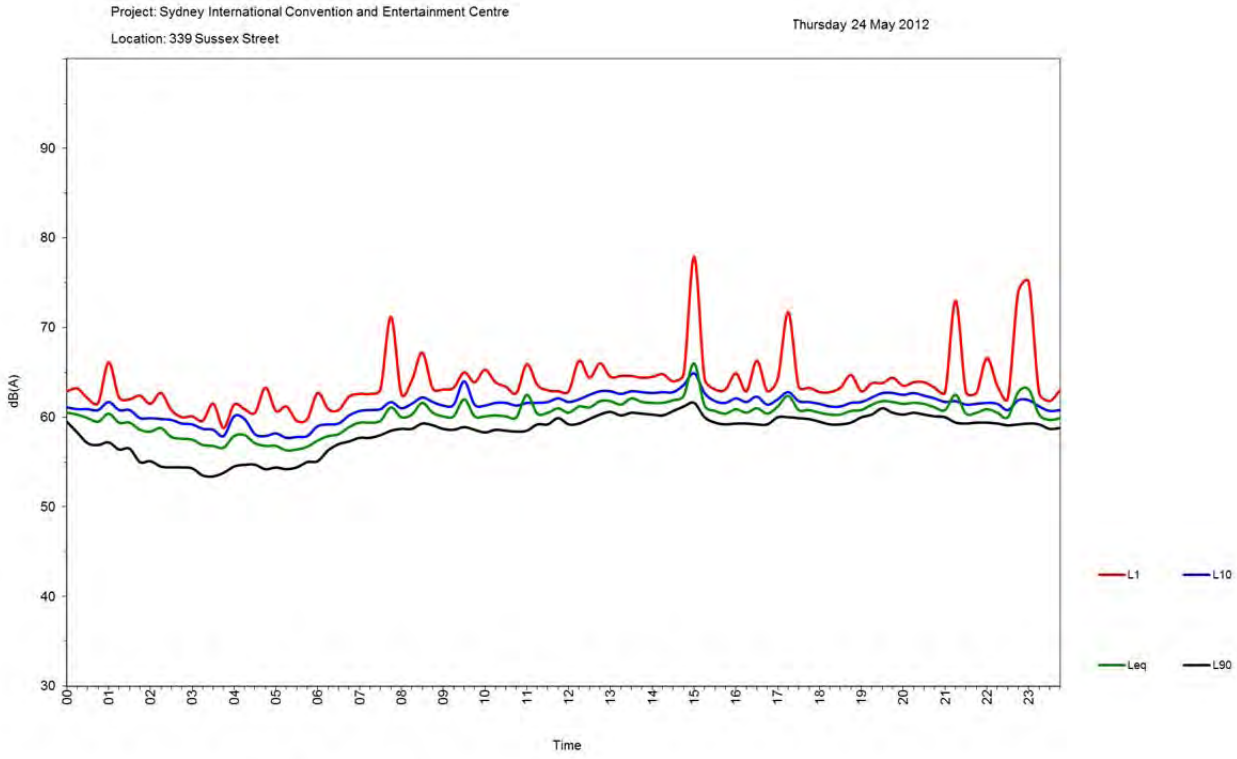
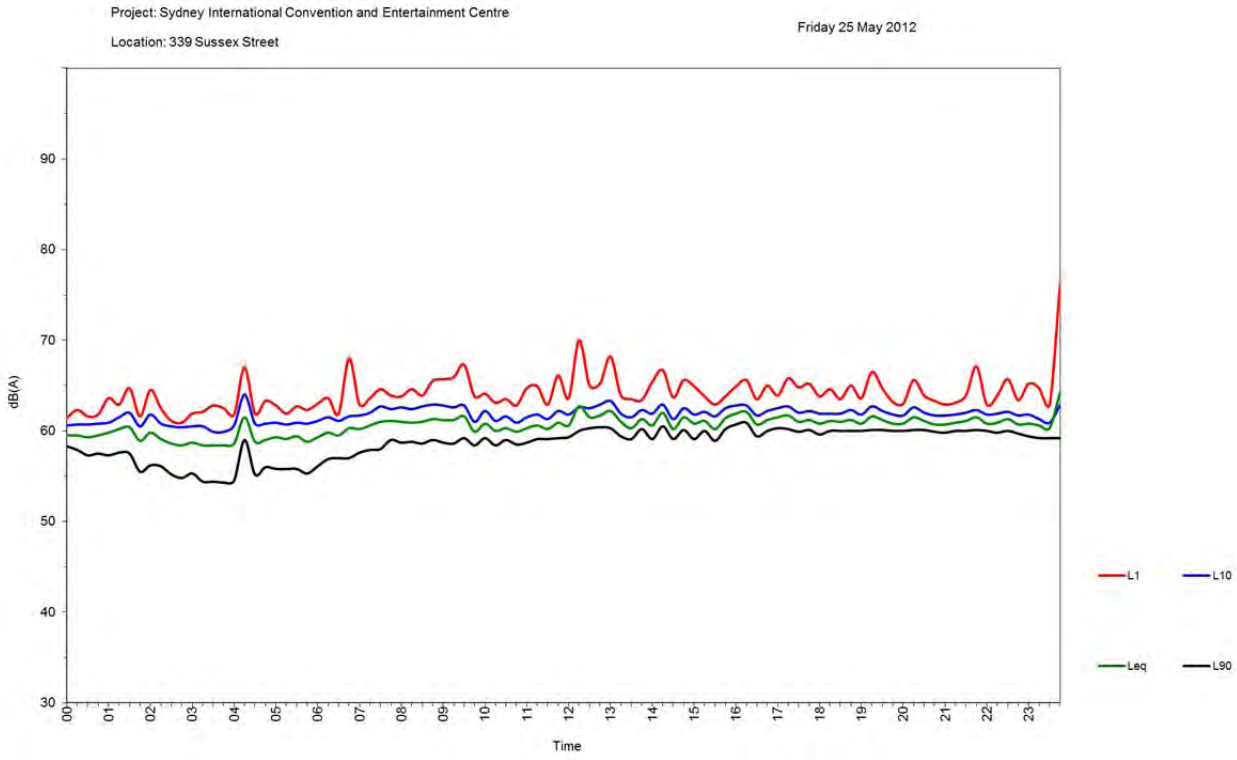
21
22
23
Time
L1
L10
Leq
L90

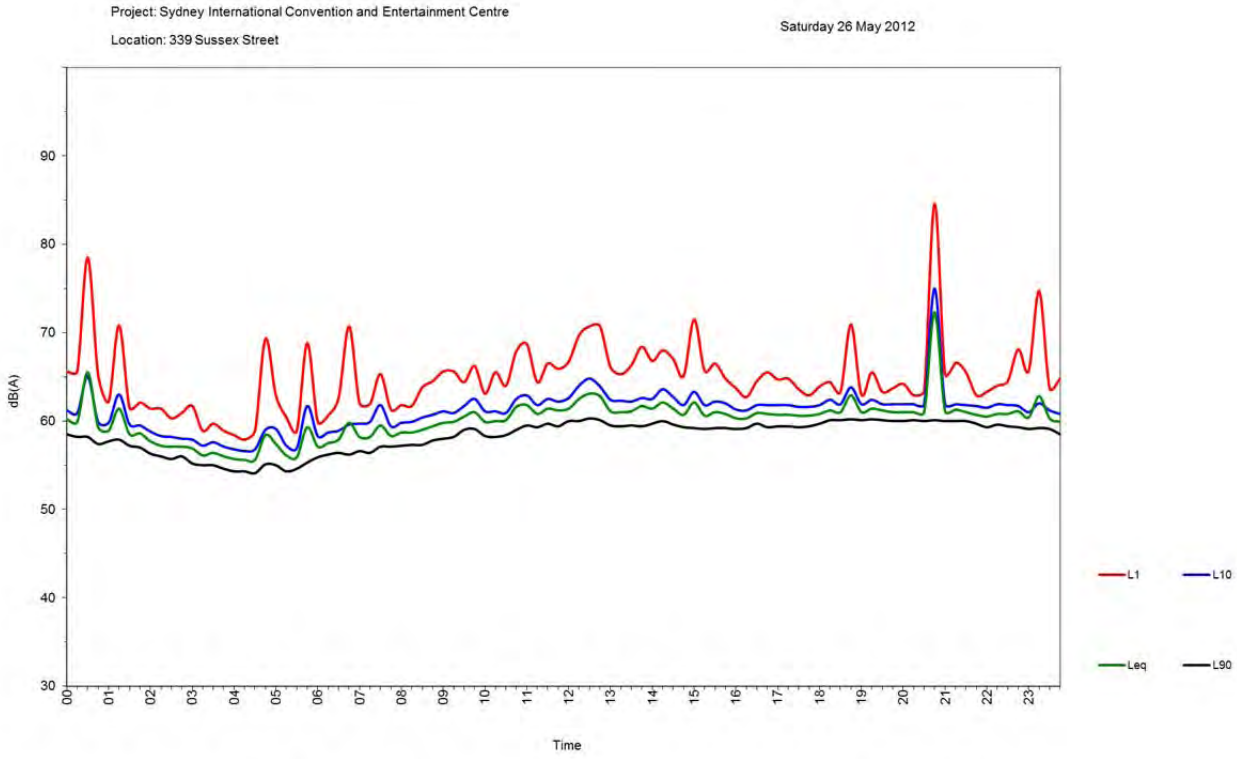
NCA4 - 339 Sussex Street, Sydney

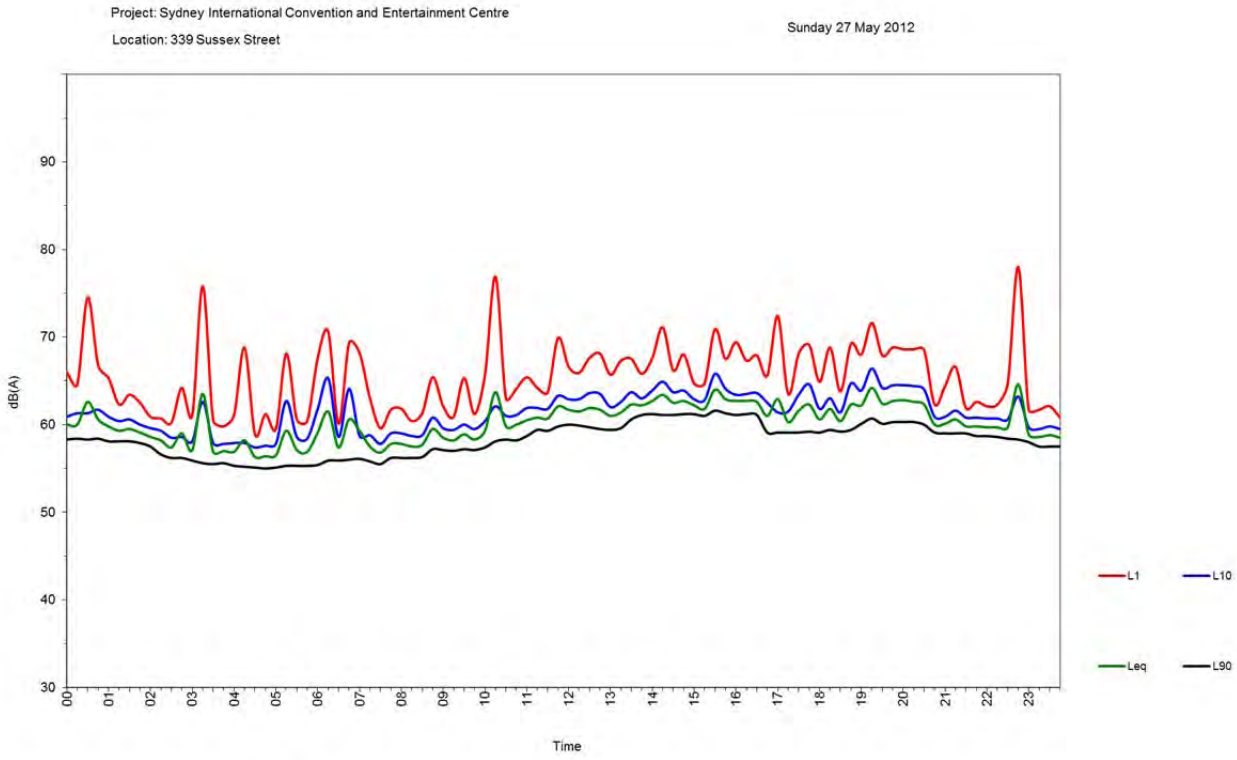


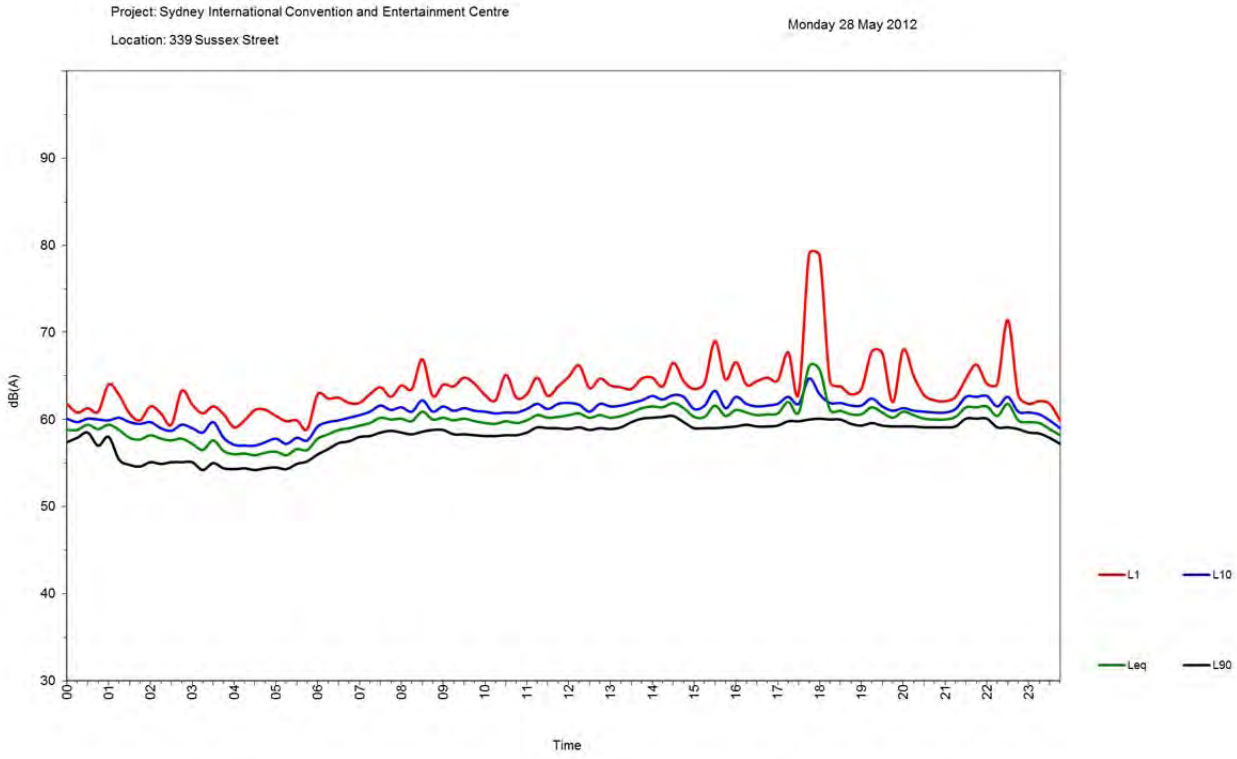


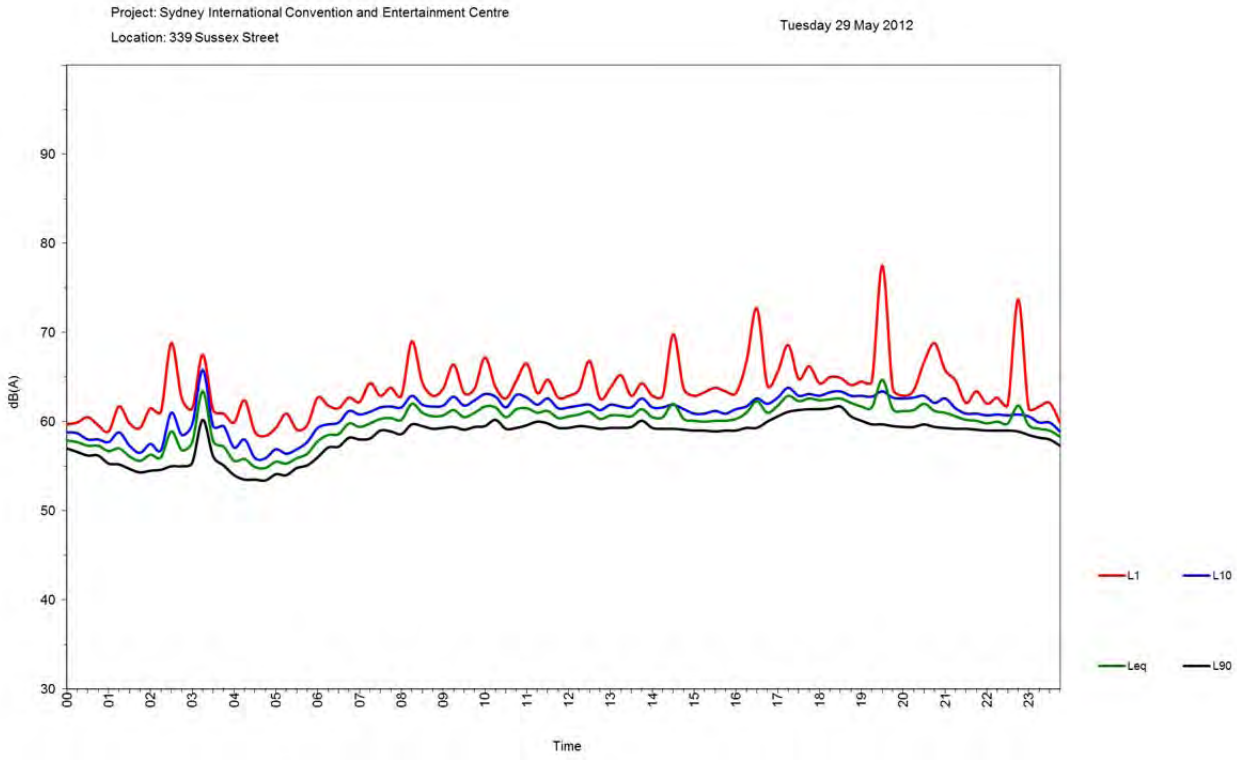

Project: Sydney International Convention and Entertainment Centre
Location: 339 Sussex Street
Thursday 24 May 2012
dB(A)
90
80
70
60
50
40
30
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90

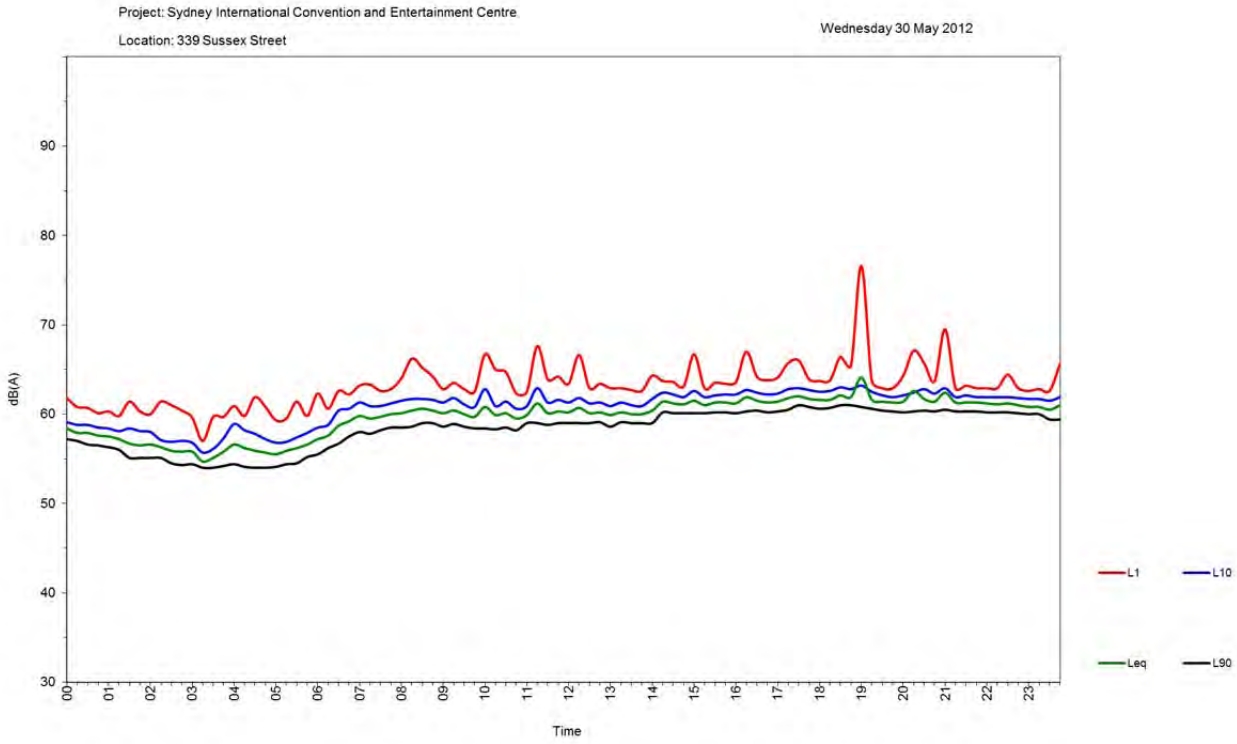

Project: Sydney International Convention and Entertainment Centre
Location: 339 Sussex Street
Friday 25 May 2012
dB(A)
90
80
70
60
50
40
30
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90

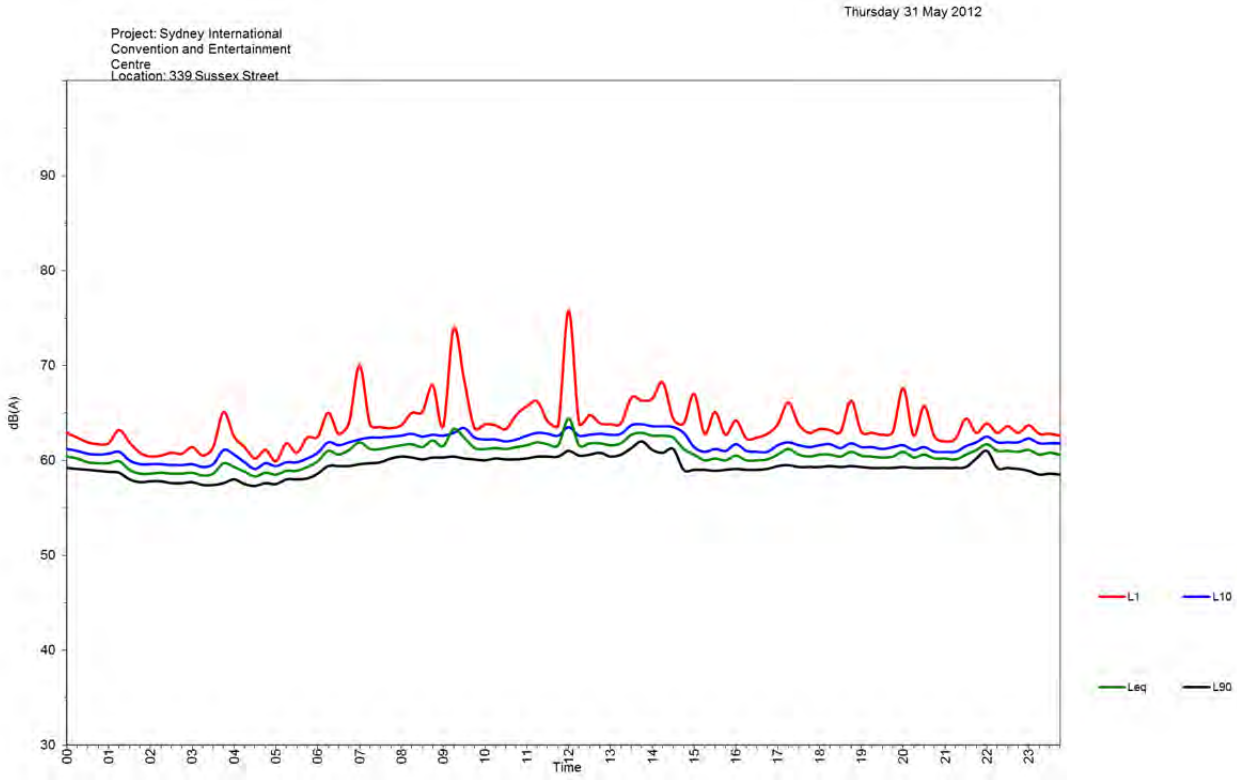

Project: Sydney International Convention and Entertainment Centre
Location: 339 Sussex Street
Saturday 26 May 2012
dB(A)
90
80
70
60
50
40
30
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90

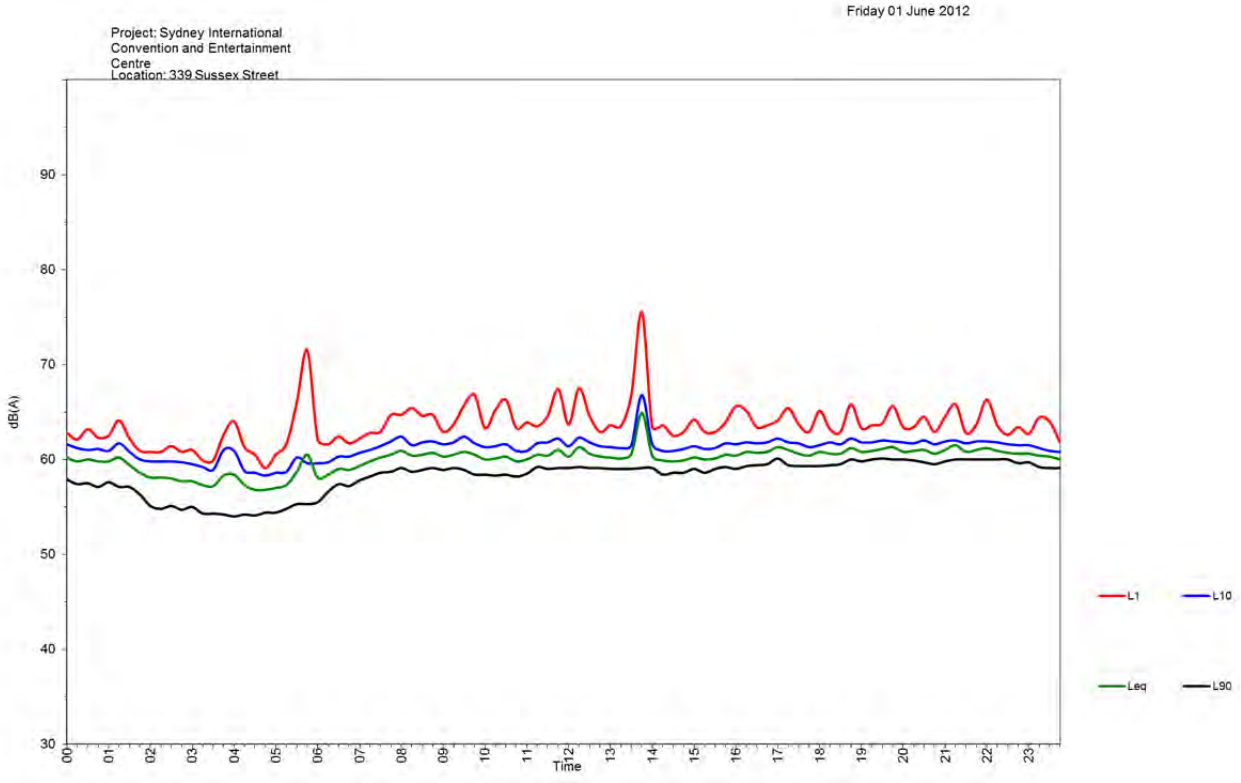

Project: Sydney International Convention and Entertainment Centre
Location: 339 Sussex Street
Sunday 27 May 2012
dB(A)
90
80
70
60
50
40
30
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90

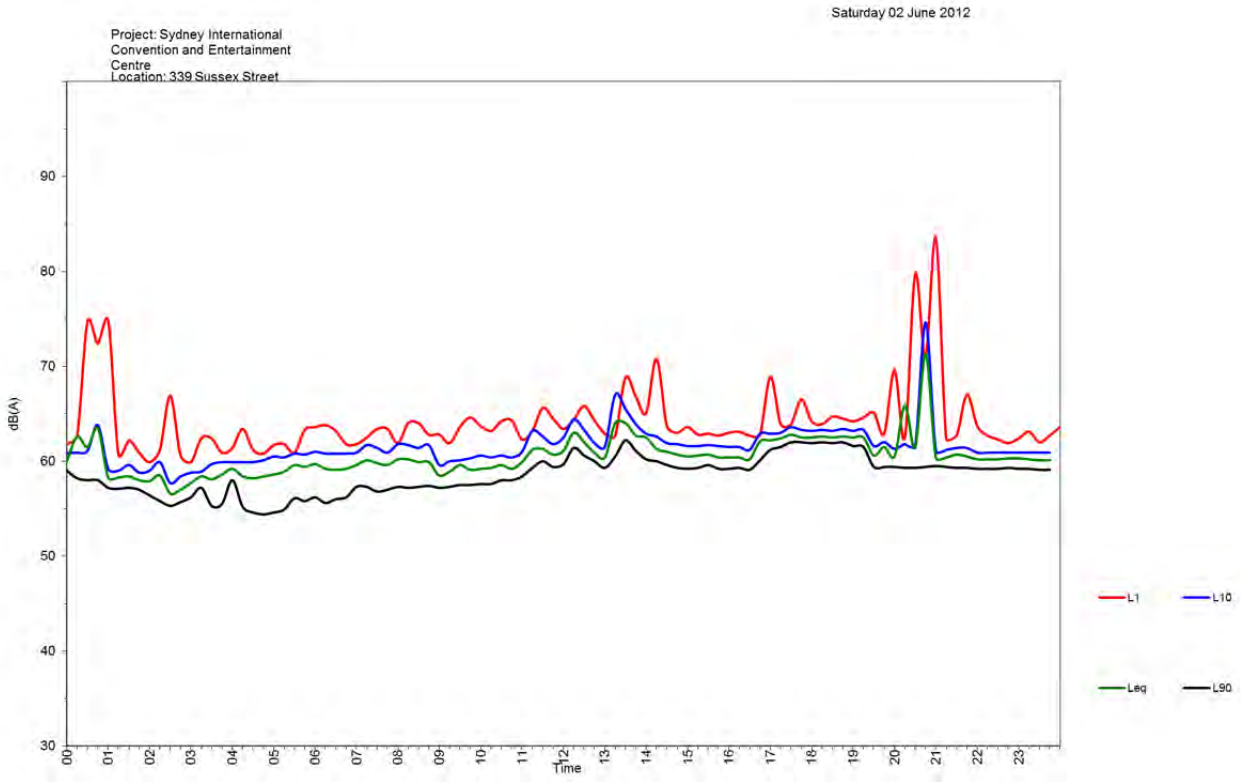

Project: Sydney International Convention and Entertainment Centre
Location: 339 Sussex Street
Monday 28 May 2012
dB(A)
90
80
70
60
50
40
30
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90

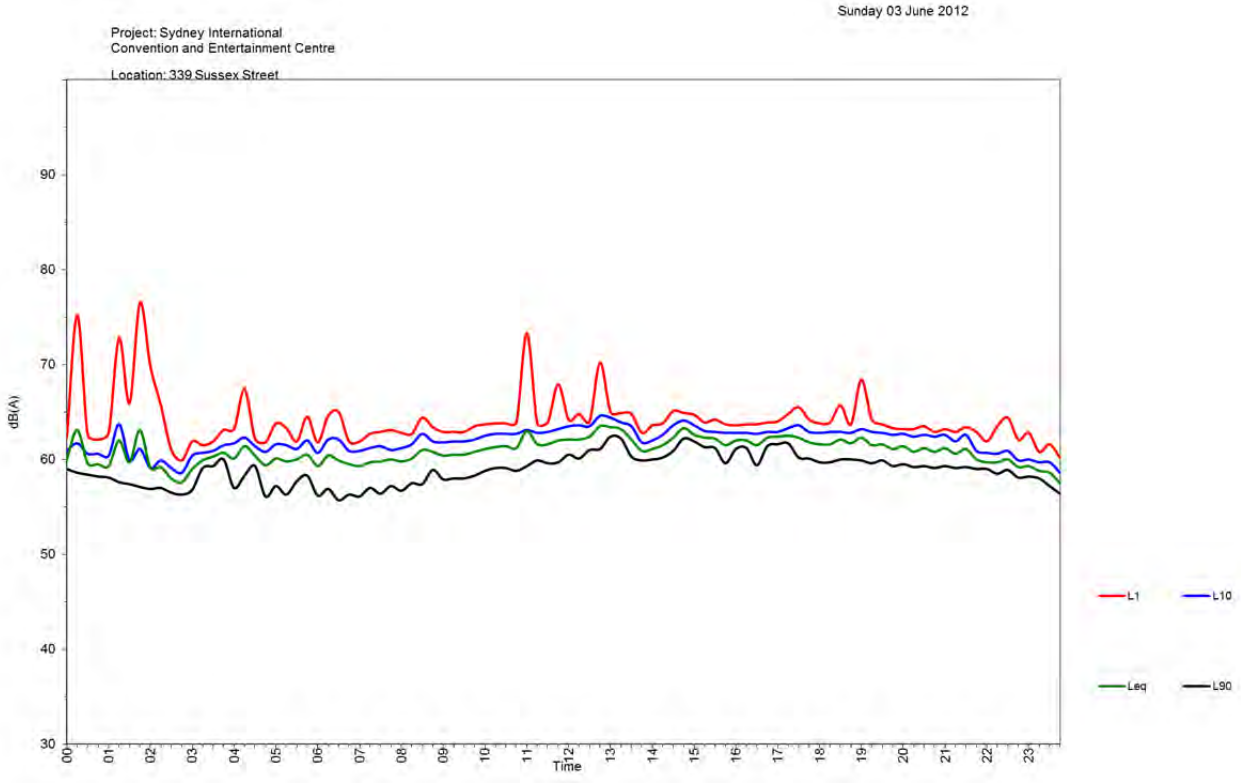

Project: Sydney International Convention and Entertainment Centre
Location: 339 Sussex Street
Tuesday 29 May 2012
dB(A)
90
80
70
60
50
40
30
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90

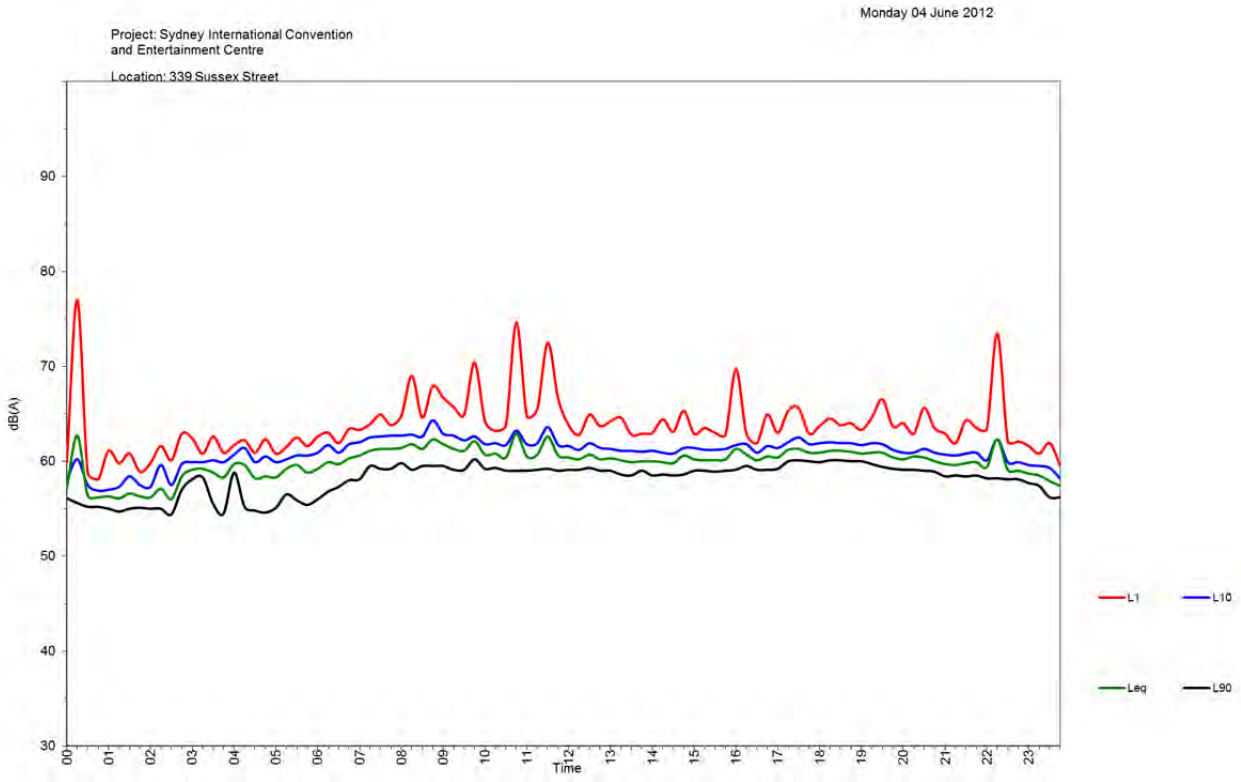

Project: Sydney International Convention and Entertainment Centre
Location: 339 Sussex Street
Wednesday 30 May 2012
dB(A)
90
80
70
60
50
40
30
00
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Time
L1
L10
Leq
L90


Thursday 31 May 2012
Project: Sydney International Convention and Entertainment Centre
Location: 339 Sussex Street
dB(A)
90
80
70
60
50
40
30
00
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Time
L1
L10
Leq
L90


Friday 01 June 2012
Project: Sydney International Convention and Entertainment Centre
Location: 339 Sussex Street
dB(A)
90
80
70
60
50
40
30
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90


Saturday 02 June 2012
Project: Sydney International Convention and Entertainment Centre
Location: 339 Sussex Street
dB(A)
90
80
70
60
50
40
30
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90


Sunday 03 June 2012
Project: Sydney International Convention and Entertainment Centre
Location: 339 Sussex Street
dB(A)
90
80
70
60
50
40
30
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90


Monday 04 June 2012
Project: Sydney International Convention and Entertainment Centre
Location: 339 Sussex Street
dB(A)
90
80
70
60
50
40
30
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Time
L1
L10
Leq
L90

Appendix C

Operational Noise Results

Appendix C Operational Noise Results

Table 37 Noise modelling results – major event set up (Bump in, Bump out)

Receiver	Receiver type	Predicted $L_{Aeq\ (15min)}$ dB(A)	Criteria, Day / Evening dB(A)	Exceedance, Day / Evening dB
1 Dixon Street, Sydney	Residential	50	63 / 63	- / -
25 - 29 Dixon Street, Haymarket	Commercial	46	65 (when in use)	-
243 - 271 Pyrmont Street, Pyrmont	Residential	46	63 / 63	- / -
287 Pyrmont Street, Ultimo	Residential	60	62 / 61	- / -
291A Pyrmont Street, Ultimo	Residential	55	62 / 61	- / -
380 Harris Street, Pyrmont	Residential	45	63 / 63	- / -
390 - 422 Harris Street, Ultimo	Industrial	52	70 (when in use)	-
Ian Thorpe Aquatic Centre (460 - 492 Harris Street, Ultimo)	Commercial	54	65 (when in use)	-
241 - 249 Sussex Street, Sydney	Commercial	33	65 (when in use)	-
Commonwealth Bank, North Building	Commercial	53	65 (when in use)	-
Commonwealth Bank, South Building	Commercial	53	65 (when in use)	-
Sydney Entertainment Centre	Commercial	44	65 (when in use)	-
Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	41	65 (when in use)	-
Home Bar (241 - 249 Sussex Street, Sydney)	Commercial	34	65 (when in use)	-
Hotel Ibis (50 Murray Street, Pyrmont)	Residential	40	63 / 63	- / -
IMAX Theatre Sydney (31 Wheat Road, Sydney)	Commercial	49	65 (when in use)	-
220 Pyrmont Street, Sydney	Commercial	63	65 (when in use)	-
190 Pyrmont Street, Sydney	Commercial	36	65 (when in use)	-
Novotel (17 Little Pier Street, Haymarket)	Residential	50	65 / 63	- / -
Novotel (18 Murray Street, Sydney)	Residential	44	63 / 63	- / -
Power House Museum (500 Harris Street, Ultimo)	Commercial	51	65 (when in use)	-
Pump House (17 Little Pier Street, Haymarket)	Commercial	49	65 (when in use)	-
Rabobank (241A - 249C Sussex Street, Sydney)	Commercial	42	65 (when in use)	-

Receiver	Receiver type	Predicted $L_{Aeq\ (15min)}$ dB(A)	Criteria, Day / Evening dB(A)	Exceedance, Day / Evening dB
Darling Quarter Play area	Active recreational	52	55 (when in use)	-
Chinese Gardens	Passive recreational	47	50 (when in use)	-
Tumbalong Park	Passive recreational	56	50 (when in use)	6

Table 38 Noise modelling results – event at the Oxygen Bar

Receiver	Receiver Type	Predicted $L_{Aeq(15min)}$ dB(A)	Criteria, Day / Evening / Night dB(A)	Exceedance, Day / Evening / Night dB
1 Dixon Street, Sydney	Residential	48	63 / 63 / 59	- / - / -
25 - 29 Dixon Street, Haymarket	Commercial	42	65 (when in use)	-
243 - 271 Pyrmont Street, Pyrmont	Residential	46	63 / 63 / 57	- / - / -
287 Pyrmont Street, Ultimo	Residential	47	62 / 61 / 56	- / - / -
291A Pyrmont Street, Ultimo	Residential	47	62 / 61 / 56	- / - / -
380 Harris Street, Pyrmont	Residential	43	63 / 63 / 57	- / - / -
390 - 422 Harris Street, Ultimo	Industrial	46	70 (when in use)	-
Ian Thorpe Aquatic Centre (460 - 492 Harris Street, Ultimo)	Commercial	46	65 (when in use)	-
241 - 249 Sussex Street, Sydney	Commercial	33	65 (when in use)	-
Commonwealth Bank, North Building	Commercial	49	65 (when in use)	-
Commonwealth Bank, South Building	Commercial	50	65 (when in use)	-
Sydney Entertainment Centre	Commercial	39	65 (when in use)	-
Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	41	65 (when in use)	-
Home Bar (241 - 249 Sussex Street, Sydney)	Commercial	34	65 (when in use)	-
Hotel Ibis (50 Murray Street, Pyrmont)	Residential	40	63 / 63 / 57	- / - / -
IMAX Theatre Sydney (31 Wheat Road, Sydney)	Commercial	46	65 (when in use)	-
220 Pyrmont Street, Sydney	Commercial	46	65 (when in use)	-
190 Pyrmont Street, Sydney	Commercial	35	65 (when in use)	-
Novotel (17 Little Pier Street, Haymarket)	Residential	45	65 / 63 / 56	- / - / -
Novotel (18 Murray Street, Sydney)	Residential	45	63 / 63 / 57	- / - / -

Receiver	Receiver Type	Predicted $L_{Aeq(15min)}$ dB(A)	Criteria, Day / Evening / Night dB(A)	Exceedance, Day / Evening / Night dB
Power House Museum (500 Harris Street, Ultimo)	Commercial	43	65 (when in use)	-
Pump House (17 Little Pier Street, Haymarket)	Commercial	39	65 (when in use)	-
Rabobank (241A - 249C Sussex Street, Sydney)	Commercial	40	65 (when in use)	-
Darling Quarter Play area	Active recreational	43	55 (when in use)	-
Chinese Gardens	Passive recreational	42	50 (when in use)	-
Tumbalong Park	Passive recreational	51	50 (when in use)	1

Table 39 Noise modelling results – outdoor exhibition

Receiver	Receiver Type	Predicted $L_{Aeq(15min)}$ dB(A)	Criteria, Day / Evening / Night work dB(A)	Exceedance, Day / Evening / Night dB
1 Dixon Street, Sydney	Residential	41	63 / 63	- / -
25 - 29 Dixon Street, Haymarket	Commercial	34	65 (when in use)	-
243 - 271 Pyrmont Street, Pyrmont	Residential	45	63 / 63	- / -
287 Pyrmont Street, Ultimo	Residential	50	62 / 61	- / -
291A Pyrmont Street, Ultimo	Residential	49	62 / 61	- / -
380 Harris Street, Pyrmont	Residential	43	63 / 63	- / -
390 - 422 Harris Street, Ultimo	Industrial	47	70 (when in use)	-
Ian Thorpe Aquatic Centre (460 - 492 Harris Street, Ultimo)	Commercial	47	65 (when in use)	-
241 - 249 Sussex Street, Sydney	Commercial	33	65 (when in use)	-
Commonwealth Bank, North Building	Commercial	42	65 (when in use)	-
Commonwealth Bank, South Building	Commercial	44	65 (when in use)	-
Sydney Entertainment Centre	Commercial	36	65 (when in use)	-
Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	41	65 (when in use)	-
Home Bar (241 - 249 Sussex Street, Sydney)	Commercial	33	65 (when in use)	-
Hotel Ibis (50 Murray Street, Pyrmont)	Residential	39	63 / 63 / 57	- / -
IMAX Theatre Sydney (31 Wheat Road,	Commercial	40	65 (when in use)	-

Receiver	Receiver Type	Predicted $L_{Aeq(15min)}$ dB(A)	Criteria, Day / Evening / Night work dB(A)	Exceedance, Day / Evening / Night dB
Sydney)				
220 Pyrmont Street, Sydney	Commercial	47	65 (when in use)	-
190 Pyrmont Street, Sydney	Commercial	35	65 (when in use)	-
Novotel (17 Little Pier Street, Haymarket)	Residential	40	65 / 63 / 56	- / -
Novotel (18 Murray Street, Sydney)	Residential	44	63 / 63 / 57	- / -
Power House Museum (500 Harris Street, Ultimo)	Commercial	45	65 (when in use)	-
Pump House (17 Little Pier Street, Haymarket)	Commercial	37	65 (when in use)	-
Rabobank (241A - 249C Sussex Street, Sydney)	Commercial	37	65 (when in use)	-
Darling Quarter Play area	Active recreational	35	55 (when in use)	-
Chinese Gardens	Passive recreational	33	50 (when in use)	-
Tumbalong Park	Passive recreational	41	50 (when in use)	-

Table 40 Noise modelling results – conference dinner with background music

Receiver	Receiver Type	Predicted $L_{Aeq(15min)}$ dB(A)	Criteria, Day / Evening / Night work dB(A)	Exceedance, Day / Evening / Night dB
1 Dixon Street, Sydney	Residential	48	63 / 63 / 59	- / - / -
25 - 29 Dixon Street, Haymarket	Commercial	39	65 (when in use)	-
243 - 271 Pyrmont Street, Pyrmont	Residential	46	63 / 63 / 57	- / - / -
287 Pyrmont Street, Ultimo	Residential	55	62 / 61 / 56	- / - / -
291A Pyrmont Street, Ultimo	Residential	53	62 / 61 / 56	- / - / -
380 Harris Street, Pyrmont	Residential	45	63 / 63 / 57	- / - / -
390 - 422 Harris Street, Ultimo	Industrial	50	70 (when in use)	-
Ian Thorpe Aquatic Centre (460 - 492 Harris Street, Ultimo)	Commercial	53	65 (when in use)	-
241 - 249 Sussex Street, Sydney	Commercial	33	65 (when in use)	-
Commonwealth Bank, North Building	Commercial	48	65 (when in use)	-
Commonwealth Bank, South Building	Commercial	52	65 (when in use)	-
Sydney Entertainment Centre	Commercial	38	65 (when in use)	-

Receiver	Receiver Type	Predicted $L_{Aeq(15min)}$ dB(A)	Criteria, Day / Evening / Night work dB(A)	Exceedance, Day / Evening / Night dB
Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	41	65 (when in use)	-
Home Bar (241 - 249 Sussex Street, Sydney)	Commercial	33	65 (when in use)	-
Hotel Ibis (50 Murray Street, Pyrmont)	Residential	40	63 / 63 / 57	- / - / -
IMAX Theatre Sydney (31 Wheat Road, Sydney)	Commercial	43	65 (when in use)	-
220 Pyrmont Street, Sydney	Commercial	48	65 (when in use)	-
190 Pyrmont Street, Sydney	Commercial	35	65 (when in use)	-
Novotel (17 Little Pier Street, Haymarket)	Residential	44	65 / 63 / 56	- / - / -
Novotel (18 Murray Street, Sydney)	Residential	44	63 / 63 / 57	- / - / -
Power House Museum (500 Harris Street, Ultimo)	Commercial	53	65 (when in use)	-
Pump House (17 Little Pier Street, Haymarket)	Commercial	38	65 (when in use)	-
Rabobank (241A - 249C Sussex Street, Sydney)	Commercial	38	65 (when in use)	-
Darling Quarter Play area	Active recreational	41	55 (when in use)	-
Chinese Gardens	Passive recreational	40	50 (when in use)	-
Tumbalong Park	Passive recreational	49	50 (when in use)	-

Table 41 Noise modelling results – conference dinner with live entertainment

Receiver	Receiver Type	Predicted $L_{Aeq(15min)}$ dB(A)	Criteria, Day / Evening / Night work dB(A)	Exceedance, Day / Evening / Night dB
1 Dixon Street, Sydney	Residential	55	63 / 63 / 59	- / - / -
25 - 29 Dixon Street, Haymarket	Commercial	44	65 (when in use)	-
243 - 271 Pyrmont Street, Pyrmont	Residential	49	63 / 63 / 57	- / - / -
287 Pyrmont Street, Ultimo	Residential	61	62 / 61 / 56	- / - / 5
291A Pyrmont Street, Ultimo	Residential	59	62 / 61 / 56	- / - / 3
380 Harris Street, Pyrmont	Residential	49	63 / 63 / 57	- / - / -
390 - 422 Harris Street, Ultimo	Industrial	56	70 (when in use)	-
Ian Thorpe Aquatic Centre (460 - 492	Commercial	59	65 (when in use)	-

Receiver	Receiver Type	Predicted $L_{Aeq(15min)}$ dB(A)	Criteria, Day / Evening / Night work dB(A)	Exceedance, Day / Evening / Night dB
Harris Street, Ultimo)				
241 - 249 Sussex Street, Sydney	Commercial	33	65 (when in use)	-
Commonwealth Bank, North Building	Commercial	54	65 (when in use)	-
Commonwealth Bank, South Building	Commercial	58	65 (when in use)	-
Sydney Entertainment Centre	Commercial	41	65 (when in use)	-
Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	41	65 (when in use)	-
Home Bar (241 - 249 Sussex Street, Sydney)	Commercial	35	65 (when in use)	-
Hotel Ibis (50 Murray Street, Pyrmont)	Residential	43	63 / 63 / 57	- / - / -
IMAX Theatre Sydney (31 Wheat Road, Sydney)	Commercial	47	65 (when in use)	-
220 Pyrmont Street, Sydney	Commercial	54	65 (when in use)	-
190 Pyrmont Street, Sydney	Commercial	36	65 (when in use)	-
Novotel (17 Little Pier Street, Haymarket)	Residential	49	65 / 63 / 56	- / - / -
Novotel (18 Murray Street, Sydney)	Residential	45	63 / 63 / 57	- / - / -
Power House Museum (500 Harris Street, Ultimo)	Commercial	59	65 (when in use)	-
Pump House (17 Little Pier Street, Haymarket)	Commercial	41	65 (when in use)	-
Rabobank (241A - 249C Sussex Street, Sydney)	Commercial	41	65 (when in use)	-
Darling Quarter Play area	Active recreational	47	55 (when in use)	-
Chinese Gardens	Passive recreational	46	50 (when in use)	-
Tumbalong Park	Passive recreational	56	50 (when in use)	6

Table 42 Noise modelling results – large celebratory event

Receiver	Receiver Type	Predicted $L_{Aeq(15min)}$ dB(A)	Criteria, Day / Evening / Night work dB(A)	Exceedance, Day / Evening / Night dB
1 Dixon Street, Sydney	Residential	60	73 / 73 / 69	- / - / -
25 - 29 Dixon Street, Haymarket	Commercial	49	75 (when in use)	-
243 - 271 Pyrmont Street, Pyrmont	Residential	54	73 / 73 / 67	- / - / -

Receiver	Receiver Type	Predicted $L_{Aeq(15min)}$ dB(A)	Criteria, Day / Evening / Night work dB(A)	Exceedance, Day / Evening / Night dB
287 Pyrmont Street, Ultimo	Residential	70	72 / 71 / 66	- / - / 4
291A Pyrmont Street, Ultimo	Residential	69	72 / 71 / 66	- / - / 3
380 Harris Street, Pyrmont	Residential	56	73 / 73 / 67	- / - / -
390 - 422 Harris Street, Ultimo	Industrial	66	80 (when in use)	-
Ian Thorpe Aquatic Centre (460 - 492 Harris Street, Ultimo)	Commercial	68	75 (when in use)	-
241 - 249 Sussex Street, Sydney	Commercial	35	75 (when in use)	-
Commonwealth Bank, North Building	Commercial	58	75 (when in use)	-
Commonwealth Bank, South Building	Commercial	63	75 (when in use)	-
Sydney Entertainment Centre	Commercial	46	75 (when in use)	-
Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	41	75 (when in use)	-
Home Bar (241 - 249 Sussex Street, Sydney)	Commercial	39	75 (when in use)	-
Hotel Ibis (50 Murray Street, Pyrmont)	Residential	49	73 / 73 / 67	- / - / -
IMAX Theatre Sydney (31 Wheat Road, Sydney)	Commercial	51	75 (when in use)	-
220 Pyrmont Street, Sydney	Commercial	67	75 (when in use)	-
190 Pyrmont Street, Sydney	Commercial	38	75 (when in use)	-
Novotel (17 Little Pier Street, Haymarket)	Residential	54	75 / 73 / 66	- / - / -
Novotel (18 Murray Street, Sydney)	Residential	46	73 / 73 / 67	- / - / -
Power House Museum (500 Harris Street, Ultimo)	Commercial	65	75 (when in use)	-
Pump House (17 Little Pier Street, Haymarket)	Commercial	45	75 (when in use)	-
Rabobank (241A - 249C Sussex Street, Sydney)	Commercial	46	75 (when in use)	-
Darling Quarter Play area	Active recreational	52	65 (when in use)	-
Chinese Gardens	Passive recreational	51	60 (when in use)	-
Tumbalong Park	Passive recreational	61	60 (when in use)	1

Appendix D

Construction Noise Results

Appendix D Construction Noise Results

Presented in Table 43 is the noise modelling results for stage 1 of the construction.

Table 43 Construction noise results - Stage 1

Receiver	Receiver type	Predicted $L_{Aeq\ (15min)}$ dB(A)	Criteria, Standard hours / Out of hours work dB(A)	Exceedance, Standard hours / Out of hours work dB
1 Dixon Street, Sydney	Residential	52	68 / 63	- / -
25 - 29 Dixon Street, Haymarket	Commercial	45	70 / 70	- / -
243 - 271 Pyrmont Street, Pyrmont	Residential	56	66 / 61	- / -
287 Pyrmont Street, Ultimo	Residential	58	68 / 63	- / -
291A Pyrmont Street, Ultimo	Residential	55	68 / 63	- / -
380 Harris Street, Pyrmont	Residential	53	66 / 61	- / -
390 - 422 Harris Street, Ultimo	Industrial	56	75 / 75	- / -
Ian Thorpe Aquatic Centre (460 - 492 Harris Street, Ultimo)	Commercial	56	70 / 70	- / -
241 - 249 Sussex Street, Sydney	Commercial	50	70 / 70	- / -
Commonwealth Bank, North Building	Commercial	53	70 / 70	- / -
Commonwealth Bank, South Building	Commercial	53	70 / 70	- / -
Sydney Entertainment Centre	Commercial	50	70 / 70	- / -
Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	74	70 / 70	4 / 4
Home Bar (241 - 249 Sussex Street, Sydney)	Commercial	53	70 / 70	- / -
Hotel Ibis (50 Murray Street, Pyrmont)	Residential	51	66 / 61	- / -
IMAX Theatre Sydney (31 Wheat Road, Sydney)	Commercial	56	70 / 70	- / -
220 Pyrmont Street, Sydney	Commercial	62	70 / 70	- / -
190 Pyrmont Street, Sydney	Commercial	62	70 / 70	- / -
Novotel (17 Little Pier Street, Haymarket)	Residential	55	70 / 65	- / -
Novotel (18 Murray Street, Sydney)	Residential	60	66 / 61	- / -
Power House Museum (500 Harris Street, Ultimo)	Commercial	61	70 / 70	- / -
Pump House (17 Little Pier Street, Haymarket)	Commercial	52	70 / 70	- / -

Receiver	Receiver type	Predicted $L_{Aeq\ (15min)}$ dB(A)	Criteria, Standard hours / Out of hours work dB(A)	Exceedance, Standard hours / Out of hours work dB
Rabobank (241A - 249C Sussex Street, Sydney)	Commercial	50	70 / 70	- / -

The results in Table 43 show that for stage 1 of construction, 1 receiver will experience an exceedance of the noise management levels. The exceedance of 4 dB during daytime will occur at a commercial receiver. The construction will comply with the noise management levels at all residential receivers.

Presented in Table 44 is the noise modelling results for stage 2 of the construction.

Table 44 Construction noise results - Stage 2

Receiver	Receiver type	Predicted $L_{Aeq915min)}$ dB(A)	Criteria, Standard hours / Out of hours work dB(A)	Exceedance, Standard hours / Out of hours work dB
1 Dixon Street, Sydney	Residential	65	68 / 63	- / 2
25 - 29 Dixon Street, Haymarket	Commercial	58	70 / 70	- / -
243 - 271 Pyrmont Street, Pyrmont	Residential	69	66 / 61	3 / 8
287 Pyrmont Street, Ultimo	Residential	71	68 / 63	3 / 8
291A Pyrmont Street, Ultimo	Residential	68	68 / 63	- / 5
380 Harris Street, Pyrmont	Residential	66	66 / 61	- / 5
390 - 422 Harris Street, Ultimo	Industrial	69	75 / 75	- / -
Ian Thorpe Aquatic Centre (460 - 492 Harris Street, Ultimo)	Commercial	69	70 / 70	- / -
241 - 249 Sussex Street, Sydney	Commercial	63	70 / 70	- / -
Commonwealth Bank, North Building	Commercial	66	70 / 70	- / -
Commonwealth Bank, South Building	Commercial	67	70 / 70	- / -
Sydney Entertainment Centre	Commercial	63	70 / 70	- / -
Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	87	70 / 70	17 / 17
Home Bar (241 - 249 Sussex Street, Sydney)	Commercial	65	70 / 70	- / -
Hotel Ibis (50 Murray Street, Pyrmont)	Residential	64	66 / 61	- / 3
IMAX Theatre Sydney (31 Wheat Road, Sydney)	Commercial	69	70 / 70	- / -
220 Pyrmont Street, Sydney	Commercial	74	70 / 70	4 / 4
190 Pyrmont Street, Sydney	Commercial	74	70 / 70	4 / 4

Receiver	Receiver type	Predicted $L_{Aeq915min)}$ dB(A)	Criteria, Standard hours / Out of hours work dB(A)	Exceedance, Standard hours / Out of hours work dB
Novotel (17 Little Pier Street, Haymarket)	Residential	68	70 / 65	- / 3
Novotel (18 Murray Street, Sydney))	Residential	73	66 / 61	7 / 12
Power House Museum (500 Harris Street, Ultimo)	Commercial	74	70 / 70	4 / 4
Pump House (17 Little Pier Street, Haymarket)	Commercial	65	70 / 70	- / -
Rabobank (241A - 249C Sussex Street, Sydney)	Commercial	63	70 / 70	- / -

The results in Table 44 show that for stage 2 of construction, 12 receivers will experience an exceedance of the noise management levels. The exceedance of up to 17 dB during daytime will occur at a commercial receiver. An exceedance of 12 dB of the noise management levels will occur at a residential receiver during out of hours work during the daytime.

Presented in Table 45 is the noise modelling results for stage 3 of the construction.

Table 45 Construction noise results - Stage 3

Receiver	Receiver type	Predicted $L_{Aeq915min)}$ dB(A)	Criteria, Standard hours / Out of hours work dB(A)	Exceedance, Standard hours / Out of hours work dB
1 Dixon Street, Sydney	Residential	61	68 / 63	- / -
25 - 29 Dixon Street, Haymarket	Commercial	58	70 / 70	- / -
243 - 271 Pyrmont Street, Pyrmont	Residential	67	66 / 61	1 / 6
287 Pyrmont Street, Ultimo	Residential	68	68 / 63	- / 5
291A Pyrmont Street, Ultimo	Residential	65	68 / 63	- / 2
380 Harris Street, Pyrmont	Residential	63	66 / 61	- / 2
390 - 422 Harris Street, Ultimo	Industrial	65	75 / 75	- / -
Ian Thorpe Aquatic Centre (460 - 492 Harris Street, Ultimo)	Commercial	68	70 / 70	- / -
241 - 249 Sussex Street, Sydney	Commercial	59	70 / 70	- / -
Commonwealth Bank, North Building	Commercial	63	70 / 70	- / -
Commonwealth Bank, South Building	Commercial	63	70 / 70	- / -
Sydney Entertainment Centre	Commercial	64	70 / 70	- / -
Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	78	70 / 70	8 / 8
Home Bar (241 - 249 Sussex Street,	Commercial	61	70 / 70	- / -

Receiver	Receiver type	Predicted $L_{Aeq915min)}$ dB(A)	Criteria, Standard hours / Out of hours work dB(A)	Exceedance, Standard hours / Out of hours work dB
Sydney)				
Hotel Ibis (50 Murray Street, Pyrmont)	Residential	59	66 / 61	- / -
IMAX Theatre Sydney (31 Wheat Road, Sydney)	Commercial	65	70 / 70	- / -
220 Pyrmont Street, Sydney	Commercial	72	70 / 70	2 / 2
190 Pyrmont Street, Sydney	Commercial	74	70 / 70	4 / 4
Novotel (17 Little Pier Street, Haymarket)	Residential	67	70 / 65	- / 2
Novotel (18 Murray Street, Sydney))	Residential	69	66 / 61	3 / 8
Power House Museum (500 Harris Street, Ultimo)	Commercial	72	70 / 70	2 / 2
Pump House (17 Little Pier Street, Haymarket)	Commercial	68	70 / 70	- / -
Rabobank (241A - 249C Sussex Street, Sydney)	Commercial	59	70 / 70	- / -

The results in Table 45 show that for stage 3 of construction, 10 receivers will experience an exceedance of the noise management levels. The exceedance of up to 8 dB during daytime will occur at a commercial receiver. An exceedance of 8 dB of the noise management levels will occur at a residential receiver during out of hours work during the daytime.

Presented in Table 46 is the noise modelling results for stage 4 of the construction.

Table 46 Construction noise results - Stage 4

Receiver	Receiver type	Predicted $L_{Aeq915min)}$ dB(A)	Criteria, Standard hours / Out of hours work dB(A)	Exceedance, Standard hours / Out of hours work dB
1 Dixon Street, Sydney	Residential	64	68 / 63	- / 1
25 - 29 Dixon Street, Haymarket	Commercial	59	70 / 70	- / -
243 - 271 Pyrmont Street, Pyrmont	Residential	67	66 / 61	1 / 6
287 Pyrmont Street, Ultimo	Residential	68	68 / 63	- / 5
291A Pyrmont Street, Ultimo	Residential	65	68 / 63	- / 2
380 Harris Street, Pyrmont	Residential	63	66 / 61	- / 2
390 - 422 Harris Street, Ultimo	Industrial	65	75 / 75	- / -
Ian Thorpe Aquatic Centre (460 - 492 Harris Street, Ultimo)	Commercial	68	70 / 70	- / -
241 - 249 Sussex Street, Sydney	Commercial	61	70 / 70	- / -

Receiver	Receiver type	Predicted $L_{Aeq915min)}$ dB(A)	Criteria, Standard hours / Out of hours work dB(A)	Exceedance, Standard hours / Out of hours work dB
Commonwealth Bank, North Building	Commercial	73	70 / 70	3 / 3
Commonwealth Bank, South Building	Commercial	71	70 / 70	1 / 1
Sydney Entertainment Centre	Commercial	67	70 / 70	- / -
Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	78	70 / 70	8 / 8
Home Bar (241 - 249 Sussex Street, Sydney)	Commercial	64	70 / 70	- / -
Hotel Ibis (50 Murray Street, Pyrmont)	Residential	59	66 / 61	- / -
IMAX Theatre Sydney (31 Wheat Road, Sydney)	Commercial	71	70 / 70	1 / 1
220 Pyrmont Street, Sydney	Commercial	72	70 / 70	2 / 2
190 Pyrmont Street, Sydney	Commercial	74	70 / 70	4 / 4
Novotel (17 Little Pier Street, Haymarket)	Residential	70	70 / 65	- / 5
Novotel (18 Murray Street, Sydney))	Residential	69	66 / 61	3 / 8
Power House Museum (500 Harris Street, Ultimo)	Commercial	72	70 / 70	2 / 2
Pump House (17 Little Pier Street, Haymarket)	Commercial	72	70 / 70	2 / 2
Rabobank (241A - 249C Sussex Street, Sydney)	Commercial	62	70 / 70	- / -

The results in Table 46 show that for stage 4 of construction, 15 receivers will experience an exceedance of the noise management levels. The exceedance of up to 8 dB during daytime will occur at a commercial receiver. An exceedance of 8 dB of the noise management levels will occur at a residential receiver during out of hours work during the daytime.

Presented in Table 47 is the noise modelling results for stage 5 of the construction.

Table 47 Construction noise results - Stage 5

Receiver	Receiver type	Predicted $L_{Aeq915min)}$ dB(A)	Criteria, Standard hours / Out of hours work dB(A)	Exceedance, Standard hours / Out of hours work dB
1 Dixon Street, Sydney	Residential	70	68 / 63	2 / 7
25 - 29 Dixon Street, Haymarket	Commercial	63	70 / 70	- / -
243 - 271 Pyrmont Street, Pyrmont	Residential	67	66 / 61	1 / 6
287 Pyrmont Street, Ultimo	Residential	68	68 / 63	- / 5

Receiver	Receiver type	Predicted $L_{Aeq915min)}$ dB(A)	Criteria, Standard hours / Out of hours work dB(A)	Exceedance, Standard hours / Out of hours work dB
291A Pyrmont Street, Ultimo	Residential	65	68 / 63	- / 2
380 Harris Street, Pyrmont	Residential	63	66 / 61	- / 2
390 - 422 Harris Street, Ultimo	Industrial	65	75 / 75	- / -
Ian Thorpe Aquatic Centre (460 - 492 Harris Street, Ultimo)	Commercial	68	70 / 70	- / -
241 - 249 Sussex Street, Sydney	Commercial	59	70 / 70	- / -
Commonwealth Bank, North Building	Commercial	71	70 / 70	1 / 1
Commonwealth Bank, South Building	Commercial	83	70 / 70	13 / 13
Sydney Entertainment Centre	Commercial	64	70 / 70	- / -
Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	78	70 / 70	8 / 8
Home Bar (241 - 249 Sussex Street, Sydney)	Commercial	61	70 / 70	- / -
Hotel Ibis (50 Murray Street, Pyrmont)	Residential	59	66 / 61	- / -
IMAX Theatre Sydney (31 Wheat Road, Sydney)	Commercial	65	70 / 70	- / -
220 Pyrmont Street, Sydney	Commercial	72	70 / 70	2 / 2
190 Pyrmont Street, Sydney	Commercial	74	70 / 70	4 / 4
Novotel (17 Little Pier Street, Haymarket)	Residential	67	70 / 65	- / 2
Novotel (18 Murray Street, Sydney))	Residential	69	66 / 61	3 / 8
Power House Museum (500 Harris Street, Ultimo)	Commercial	72	70 / 70	2 / 2
Pump House (17 Little Pier Street, Haymarket)	Commercial	68	70 / 70	- / -
Rabobank (241A - 249C Sussex Street, Sydney)	Commercial	59	70 / 70	- / -

The results in Table 47 show that for stage 5 of construction, 13 receivers will experience an exceedance of the noise management levels. The exceedance of up to 13 dB during daytime will occur at a commercial receiver. An exceedance of 8 dB of the noise management levels will occur at a residential receiver during out of hours work during the daytime.

Presented in Table 48 is the noise modelling results for stage 6 of the construction.

Table 48 Construction noise results - Stage 6

Receiver	Receiver hype	Predicted $L_{Aeq915min)}$ dB(A)	Criteria, Standard hours / Out of hours work dB(A)	Exceedance, Standard hours / Out of hours work dB
1 Dixon Street, Sydney	Residential	68	68 / 63	- / 5
25 - 29 Dixon Street, Haymarket	Commercial	63	70 / 70	- / -
243 - 271 Pyrmont Street, Pyrmont	Residential	65	66 / 61	- / 4
287 Pyrmont Street, Ultimo	Residential	67	68 / 63	- / 4
291A Pyrmont Street, Ultimo	Residential	64	68 / 63	- / 1
380 Harris Street, Pyrmont	Residential	61	66 / 61	- / -
390 - 422 Harris Street, Ultimo	Industrial	64	75 / 75	- / -
Ian Thorpe Aquatic Centre (460 - 492 Harris Street, Ultimo)	Commercial	66	70 / 70	- / -
241 - 249 Sussex Street, Sydney	Commercial	58	70 / 70	- / -
Commonwealth Bank, North Building	Commercial	64	70 / 70	- / -
Commonwealth Bank, South Building	Commercial	69	70 / 70	- / -
Sydney Entertainment Centre	Commercial	71	70 / 70	1 / 1
Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	75	70 / 70	5 / 5
Home Bar (241 - 249 Sussex Street, Sydney)	Commercial	59	70 / 70	- / -
Hotel Ibis (50 Murray Street, Pyrmont)	Residential	57	66 / 61	- / -
IMAX Theatre Sydney (31 Wheat Road, Sydney)	Commercial	63	70 / 70	- / -
220 Pyrmont Street, Sydney	Commercial	76	70 / 70	6 / 6
190 Pyrmont Street, Sydney	Commercial	72	70 / 70	2 / 2
Novotel (17 Little Pier Street, Haymarket)	Residential	78	70 / 65	8 / 13
Novotel (18 Murray Street, Sydney))	Residential	67	66 / 61	1 / 6
Power House Museum (500 Harris Street, Ultimo)	Commercial	70	70 / 70	- / -
Pump House (17 Little Pier Street, Haymarket)	Commercial	78	70 / 70	8 / 8
Rabobank (241A - 249C Sussex Street, Sydney)	Commercial	57	70 / 70	- / -

The results in Table 48 show that for stage 6 of construction, 11 receivers will experience an exceedance of the noise management levels. The exceedance of up to 8 dB during daytime will occur at a commercial receiver. An

exceedance of 13 dB of the noise management levels will occur at a residential receiver during out of hours work during the daytime. Novotel (17 Little Pier Street, Haymarket) will be highly affected.

Presented in Table 49 is the noise modelling results for stage 7 of the construction.

Table 49 Construction noise results - Stage 7

Receiver	Receiver type	Predicted $L_{Aeq915min)}$ dB(A)	Criteria, Standard hours / Out of hours work dB(A)	Exceedance, Standard hours / Out of hours work dB
1 Dixon Street, Sydney	Residential	59	68 / 63	- / -
25 - 29 Dixon Street, Haymarket	Commercial	55	70 / 70	- / -
243 - 271 Pyrmont Street, Pyrmont	Residential	65	66 / 61	- / 4
287 Pyrmont Street, Ultimo	Residential	67	68 / 63	- / 4
291A Pyrmont Street, Ultimo	Residential	64	68 / 63	- / 1
380 Harris Street, Pyrmont	Residential	61	66 / 61	- / -
390 - 422 Harris Street, Ultimo	Industrial	64	75 / 75	- / -
Ian Thorpe Aquatic Centre (460 - 492 Harris Street, Ultimo)	Commercial	66	70 / 70	- / -
241 - 249 Sussex Street, Sydney	Commercial	58	70 / 70	- / -
Commonwealth Bank, North Building	Commercial	62	70 / 70	- / -
Commonwealth Bank, South Building	Commercial	60	70 / 70	- / -
Sydney Entertainment Centre	Commercial	62	70 / 70	- / -
Harbourside Shopping Centre (2 - 10 Darling Drive, Sydney)	Commercial	75	70 / 70	5 / 5
Home Bar (241 - 249 Sussex Street, Sydney)	Commercial	59	70 / 70	- / -
Hotel Ibis (50 Murray Street, Pyrmont)	Residential	57	66 / 61	- / -
IMAX Theatre Sydney (31 Wheat Road, Sydney)	Commercial	63	70 / 70	- / -
220 Pyrmont Street, Sydney	Commercial	76	70 / 70	6 / 6
190 Pyrmont Street, Sydney	Commercial	72	70 / 70	2 / 2
Novotel (17 Little Pier Street, Haymarket)	Residential	65	70 / 65	- / -
Novotel (18 Murray Street, Sydney))	Residential	67	66 / 61	1 / 6
Power House Museum (500 Harris Street, Ultimo)	Commercial	70	70 / 70	- / -
Pump House (17 Little Pier Street, Haymarket)	Commercial	66	70 / 70	- / -
Rabobank (241A - 249C Sussex Street,	Commercial	57	70 / 70	- / -

Receiver	Receiver type	Predicted $L_{Aeq915min)}$ dB(A)	Criteria, Standard hours / Out of hours work dB(A)	Exceedance, Standard hours / Out of hours work dB
Sydney)				

The results in Table 49 show that for stage 7 of construction, 7 receivers will experience an exceedance of the noise management levels. The exceedance of up to 6 dB during daytime will occur at a commercial receiver. An exceedance of 6 dB of the noise management levels will occur at a residential receiver during out of hours work during the daytime.

Appendix E

Construction Noise Contours

AECOM

N

$L_{Aeq(15min)}$ dB(A)

- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- 80 - 85
- 85 - 90
- > 90

SICEEP

Predicted construction noise levels - Stage 1

Source:

Mar 2013

60263715

0 50 100 200 300 400 m

Fig. **1**

AECOM

N

$L_{Aeq(15min)}$ dB(A)

- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- 80 - 85
- 85 - 90
- > 90

SICEEP

Predicted construction noise levels - Stage 2

Source:

Mar 2013

60263715

0 50 100 200 300 400 m

Fig. **2**

AECOM

N

$L_{Aeq(15min)}$ dB(A)

- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- 80 - 85
- 85 - 90
- > 90

SICEEP

Predicted construction noise levels - Stage 3

Source:

Mar 2013

60263715

Fig. **3**

0 50 100 200 300 400 m

AECOM

N

$L_{Aeq(15min)}$ dB(A)

- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- 80 - 85
- 85 - 90
- > 90

SICEEP

Predicted construction noise levels - Stage 4

Source:

Mar 2013

60263715

0 50 100 200 300 400 m

Fig. **4**

AECOM

N

$L_{Aeq(15min)}$ dB(A)

- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- 80 - 85
- 85 - 90
- > 90

SICEEP

Predicted construction noise levels - Stage 5

Source:

Mar 2013

60263715

0 50 100 200 300 400 m

Fig **5**

AECOM

N

$L_{Aeq(15min)}$ dB(A)

- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- 80 - 85
- 85 - 90
- > 90

SICEEP

Predicted construction noise levels - Stage 6

Source:

Mar 2013

60263715

0 50 100 200 300 400 m

Fig. **6**

AECOM

N

$L_{Aeq(15min)}$ dB(A)

- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- 80 - 85
- 85 - 90
- > 90

SICEEP

Predicted construction noise levels - Stage 7

Source:

Mar 2013

60263715

Fig. **7**

0 50 100 200 300 400 m