Carter Street Lidcombe
Urban Activation Precinct

Appendix H
Noise Assessment

February 2014

NSW NOW

NSW GOVERNMENT Planning & Infrastructure

ACOUSTICS AND AIR

CARTER STREET URBAN ACTIVATION PROJECT

NOISE IMPACT ASSESSMENT

REPORT NO. 13197
FINAL VERSION

OCTOBER 2013

PREPARED FOR

NSW DEPARTMENT OF PLANNING & INFRASTRUCTURE
23-33 BRIDGE STREET
SYDNEY NSW 2000

WILKINSON MURRAY

DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	Draft	6 September 2013	David Borella	Rob Bulllen
B	Draft	24 September 2013	David Borella	Rob Bullen
C	Draft	1 October 2013	David Borella	Rob Bullen
D	FINAL	10 October 2013	David Borella	Rob Bullen

Note

All materials specified by Wilkinson Murray Pty Limited have been selected solely on the basis of acoustic performance. Any other properties of these materials, such as fire rating, chemical properties etc. should be checked with the suppliers or other specialised bodies for fitness for a given purpose. The information contained in this document produced by Wilkinson Murray is solely for the use of the client identified on the front page of this report. Our client becomes the owner of this document upon full payment of our **Tax Invoice** for its provision. This document must not be used for any purposes other than those of the document's owner. Wilkinson Murray undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.

Quality Assurance

We are committed to and have implemented AS/NZS ISO 9001:2008 "Quality Management Systems – Requirements". This management system has been externally certified and Licence No. QEC 13457 has been issued.

AAAC

This firm is a member firm of the Association of Australian Acoustical Consultants and the work here reported has been carried out in accordance with the terms of that membership.

Celebrating 50 Years in 2012

Wilkinson Murray is an independent firm established in 1962, originally as Carr & Wilkinson. In 1976 Barry Murray joined founding partner Roger Wilkinson and the firm adopted the name which remains today. From a successful operation in Australia, Wilkinson Murray expanded its reach into Asia by opening a Hong Kong office early in 2006. 2010 saw the introduction of our Queensland office and 2011 the introduction of our Orange office to service a growing client base in these regions. From these offices, Wilkinson Murray services the entire Asia-Pacific region.

TABLE OF CONTENTS

APPENDIX A - Sydney Olympic Park Authority Amendment Bill (2010)

APPENDIX B - Predicted External-to-Facade Noise Levels from Traffic

APPENDIX C - Predicted External-to-Facade Noise Levels from Traffic and Sydney Olympic Park Events

GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

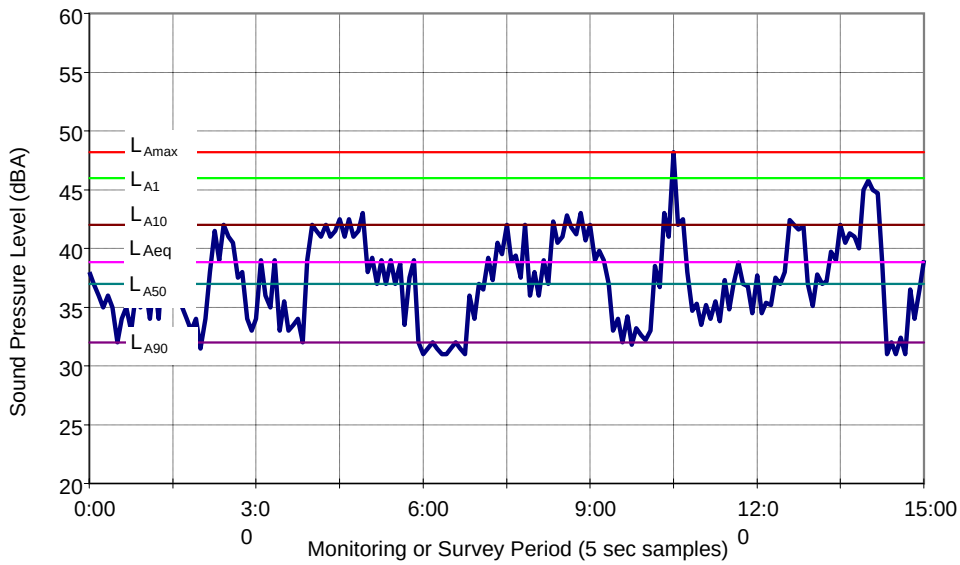
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

Wilkinson Murray has been engaged to investigate acoustic design constraints on the proposed Carter Street Urban Activation Precinct ("The Precinct") in Lidcombe, Sydney.

The urban renewal of the Precinct will include approximately 5,000 dwellings, corporate offices, a business and technology park and a retail centre.

The proposed development would be located in a high noise environment, potentially affected by traffic noise from major arterial roads and noise from Sydney Olympic Park (SOP) events including music concerts and sporting events.

This report details the assessment of the potential impacts upon the acoustic amenity of the Precinct, and outlines in-principle noise mitigation strategies.

This report does not address noise arising from the development itself (eg, traffic generated by new residences).

2 PROJECT DESCRIPTION

The Carter Street Precinct is located directly south west of Sydney Olympic Park, north of the M4 motorway and east of Haslams Creek. Carter Street is the main east-west road through the precinct while Uhrig Road links with the SOP town centre and the railway station to the north.

The Precinct is to include residential, business, retail and recreation uses, as well as transport upgrades.

The proposed development will comprise a number of low- medium- and high-rise residential and commercial buildings including:

- Low rise townhouses and 4-storey apartments generally on east-west streets;
- Medium rise 6-8-storey apartments on the main streets and parks;
- Tall landmark towers at key locations, entries and important corners.

The Precinct's proposed concept design is illustrated Figure 2-1.

Figure 2-1 Proposed Precinct Site Layout

The major sources of noise impinging on the Precinct would be:

- Traffic noise from the M4, Parramatta Road, Carter Street, Hill Road, Edwin Flack Avenue and Birnie Avenue;
- Noise from events held in Sydney Olympic Park including concerts and sporting events.

This assessment does not consider the potential for train and aircraft noise intrusion (as the site is removed from rail and flight corridors), or noise generated by the project itself (eg, from development-generated traffic). Nor does this assessment consider the potential for impacts from operational noise sources (eg, the idling of buses servicing events at ANZ Stadium, or waste removal services) as these are managed by the SOPA.

3 ACOUSTIC PERFORMANCE CRITERIA

3.1 Principles Guiding the Acoustic Glazing Design

The design approach adopted by this assessment is based on seeking to achieve suitable acoustic amenity for the Precinct's future residential and commercial spaces while recognising that those premises will be sited within an "entertainment precinct". Further, the acoustic design will seek to control noise from all regularly-occurring entertainment events within SOP - including international concerts and sporting events – as well as traffic noise on public roads, but not also noise from very-high noise level events (eg, high-performance street car racing) which are hosted at SOP occasionally.

3.2 Noise Criteria

This section outlines the derivation of acoustic performance criteria that would apply to future residential development within the Precinct based on relevant planning instruments. The criteria ultimately adopted for the project are summarised in Section 3.3.

As their architectural details have yet to be defined, this assessment presents the feasibility of building facade glazing designs in-principle and with focus on the treatments required for residential rather than commercial premises as these determine the acoustic viability of the Carter Street Urban Activation Project. Specific acoustic design specifications would be determined for both residential and commercial spaces at the Detailed Design stage of the Project.

There are several guidelines and planning instruments that give instruction on acceptable noise levels within residences potentially affected by major external noise sources. These are discussed below.

3.2.1 Sydney Olympic Park Noise Management Plan

The control of noise emissions from SOP events is managed in accordance with the SOP *Noise Management Plan* which specifies limits for at receivers both within and external to SOP. The *Noise Management Plan* does not specify a cap on the number of events that may occur at SOP. Its noise criteria are discriminated according to the scale of the noise-producing event considered. These categories are identified in Table 3-1.

Table 3-1 Major Event Categories

Category Type	Criteria
Category 1	Attendance in excess of 50,000 patrons
Major Events	Usually a "one off" event and unlikely to recur in the short to medium term
World Tour Events	Use of high output amplified sound system
Category 2	Attendance in excess of 20,000 patrons
Major Events	A "one off" event or annually recurring event
Major Entertainment	Use of high output amplified sound system
Category 3	Attendance in excess of 10,000 patrons
Major Events	One off or recurring events
Sports & Cultural	Limited use or medium level output of amplified sound system

Table 3-2 outlines the noise criteria stipulated in the SOP *Noise Management Plan* for receivers external to SOP potentially affected by noise from SOP events. These criteria are expressed as limits to be met at the external facade of receivers *external* to SOP.

Table 3-2 Noise Criteria for Residences EXTERNAL to Sydney Olympic Park

Event Category	Noise Criteria	
Category 1 Major Events	85dB($L_{A10,15min}$)	
Category 2 Major Events	65dB (L_{Amax})	60dB($L_{A10,15min}$)
Category 3 Major Events	60dB (L_{Amax})	55dB ($L_{A10,15min}$)

The Event Category 1 limit of 85dBA $L_{A10,\ 15min}$ measured external to residential facades, is prescribed by the *Sydney Olympic Park Authority Amendment Bill (2010)* (attached as Appendix A). This noise limit is significantly higher than those conventionally applied to protect residential amenity. It is understood that SOPA intends this limit to apply only to noise emissions from very high-noise level SOP events (eg, high-performance street car racing) rather than to all events.

Designing internal residential spaces such as bedrooms to a level of acoustic amenity commonly expected where noise external to the bedroom facade is 85 dBA would typically not be achievable using openable glazing options.

While SOPA has not specified how often – if at all – such high-noise level events may occur, this assessment has assumed that they would occur not more frequently than twice a year, and as such, the Precinct's glazing design should not attempt to mitigate noise from these high noise level events.`

3.2.2 State Environmental Planning Policy (Infrastructure) 2007

Section 102(3) of the NSW State Infrastructure SEPP presents the following internal traffic noise criteria:

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

a) in any bedroom in the building – 35 dB(A) at any time between 10.00pm and 7.00am,

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

As clarified elsewhere in the document, these criteria should be interpreted as 35 dBA $L_{Aeq,9hr}$ and 40 dBA $L_{Aeq,15hr}$ respectively.

3.2.3 Local Planning Controls

There are no local planning instruments – including the local Development Control Plan (DCP) - that specify noise controls for developments. Given the scale of the Carter Street Urban Activation Project, it is feasible that the local Development Control Plan may be modified to include noise criteria for habitable spaces that are drawn from Australian Standard AS2107: 2000 (discussed below).

3.2.4 Australian Standard AS2107: 2000

Australian Standard AS2107: 2000 *Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors.*

This standard recommends the following L_{Aeq} internal noise levels for "*Houses and apartments near major roads*".

- Living 35 dBA (Satisfactory) 45 dBA (Maximum)
- Sleeping 35 dBA (Satisfactory) 40 dBA (Maximum)
- Work Areas 35 dBA (Satisfactory) 45 dBA (Maximum)

3.3 Recommended Internal Noise Criteria for Residential Developments within the Carter Street UAP

Based on a review of the above criteria and guidelines, the following site-specific internal noise goals with windows closed are recommended for the residential spaces of the Precinct.

Table 3-3 Recommended Site Specific Internal Noise Criteria

Area	Recommended	Maximum[1]
Sleeping	35 dBA	40 dBA
Living	40 dBA	45 dBA
Work Areas	40 dBA	45 dBA

1. Subject to Council approval.

4 PREDICTION OF TRAFFIC NOISE LEVELS

4.1 Traffic Data

This assessment is based on traffic data supplied by traffic consultants Parsons Brinkerhoff Transport Planning Associates. The prediction of noise impacts is based on year 2031 traffic projections using 2008 Roads and Maritime Services traffic counts. Table 4-1 presents the traffic data used in our noise modelling. The following assumptions were used in the prediction of traffic noise impacts in this report:

Traffic volumes on Arterial Roads such as Parramatta Road and the M4:

Proportion of daily traffic during 15hr daytime period (7.00am-10.00pm): 85%,
Proportion of daily traffic during 9hr night time period (10.00pm-7.00am): 15%.

Traffic volumes on Other Roads in the Precinct:

Proportion of daily traffic during 15hr daytime period (7.00am-10.00pm): 92%,
Proportion of daily traffic during 9hr night time period (10.00pm-7.00am): 8%.

Quantification of Heavy Vehicles:

For 2031 'With Carter Street UAP' scenarios, reduce heavy vehicle percentage by 1.5%

Table 4-1 Year 2031 Traffic Data used in Noise Modelling

Roadway	Road Speed (km/h)	Average Daily Traffic		Percentage Heavy Vehicles	
		Day[1]	Night[1]	Day[1]	Night[1]
M4 Motorway	90	51000	9000	7%	10%
M4 Off-Ramp	60	8864	1564	7%	10%
M4 On-Ramp	60	10431	1841	7%	10%
Parramatta Rd (east of Hill Rd)	60	43914	7750	7%	10%
Parramatta Rd (east of Uhrig Rd)	60	50597	8929	7%	10%
Carter St (east of Hill Rd)	60	16870	1667	7%	10%
Carter St (east of Uhrig Rd)	60	12128	1055	7%	10%
Uhrig Rd (north of Parra Rd)	60	9589	834	7%	10%
Uhrig Rd (north of Carter St)	60	11351	987	7%	10%
Uhrig Rd (north of UAP Access Rd)	60	11351	987	7%	10%
Dawn Fraser Ave	60	12471	1084	7%	10%
Edwin Flack Ave (west of Birnie Ave)	60	7937	690	7%	10%
Edwin Flack Ave (west of Uhrig Rd)	60	8007	696	7%	10%
Old Hill Link	60	15307	1331	7%	10%
Hill Rd (north of Parra Rd)	60	48254	4196	7%	10%
Hill Rd (north of Carter St)	60	31850	2770	7%	10%
Hill Rd (north of UAP Access Rd)	60	34800	3026	7%	10%
Birnie Ave (north of Parra Rd)	60	12959	1127	7%	10%
Birnie Ave (north of Carter St)	60	17220	1497	7%	10%

Note: 1. For the purpose of noise modelling, day is taken to be the period 7.00am-10.00pm and night is the period 10.00pm-7.00am.

4.2 Cadna Noise Model

The prediction of traffic noise was undertaken using the Cadna (Computer Aided Noise Abatement) noise prediction software which takes account of:

- Noise attenuation due to geometric spreading;
- Ground topography;
- Ground and atmospheric absorption;
- Screening effects from buildings;
- Reflections from building facades;
- The location and number of lanes of all surrounding roadways;
- The different heights of tyre, motor and truck exhaust traffic noise sources.

4.3 Noise Modelling Assumptions

While the internal layouts of apartments are unknown at this stage of the project, this assessment presents glazing designs based on the following generic living room and bedroom dimensions and fitouts:

Bedrooms

- Size 4.2m x 4m x 2.7m
- Glazing 4.2m x 2.7m high (full-height and full-width glazing with sliding doors area)
- Carpeted floors and bed

Living / Work Rooms

- Size 4.2m x 5m x 2.7m
- Glazing 4.2m x 2.7m high (full-height and full-width glazing with sliding doors area)
- Carpeted floors and furnishings

Internal noise levels were predicted at the centre of rooms

4.4 Predicted Traffic Noise Levels for year 2031

Predictions of Year 2031 traffic noise levels impinging on the Project for both day and night periods are presented in **Appendix B** and again in Table 5-2 below in abbreviated form (refer Section 5.3).

5 PREDICTION OF NOISE FROM SYDNEY OLYMPIC PARK EVENTS

SOP presents many potential sources of noise to the future residences of the Carter Street Urban Activation Project: noise from large scale concerts and sporting events in particular.

5.1 Sydney Olympic Park Venues

This section describes the major SOP noise sources that will dictate the in-principle facade glazing design of future developments within the Precinct. Noise emissions from the smaller SOP venues and events not listed below will not exceed noise levels from the venues considered below.

5.1.1 Commentary on Category 1 outdoor events

There is no public guideline determining the scheduling and number of Category 1 type events – such as V8 Super Car series racing events – hosted at SOP, although it is usually the case that no more than two such events are held each year. Category 1 noise events are approved on a per-event basis. Given their infrequency and that it is likely that it is for these types of events that the SOPA would seek to implement an 85dBA noise criterion at residential facades, this assessment excludes consideration of such very high noise level events in order that the glazing design of the Project not be unduly penalised.

5.1.2 ANZ Stadium

ANZ Stadium is the largest venue at Sydney Olympic Park for sporting and entertainment events. It has seating capacity for up to 83,500 patrons and is approved to host rock concerts and major sporting events up to 11pm. The main noise generating events include:

- Rock concerts and
- Major football matches.

It is the hosting of rock concerts within ANZ Stadium that would dictate the glazing design of the Project.

5.1.3 Sydney Showground

The Showground complex comprises the Main Arena, the Carnival Area, the Exhibition Halls and a range of Pavilion buildings which can be used for various purposes. The Showground Main Arena can host Category 2 and 3 events, but not Category 1 events. It is presently approved for uses including the annual Sydney Royal Easter Show (attended by almost one million people over 14 days), exhibitions, public entertainment and recreational and sporting activities, as well as being the home of the Royal Agricultural Society of New South Wales.

The main noise generating events in the Showground Main Arena would include:

- rock concerts, festivals and other musical entertainment (eg, Big Day Out);
- sporting events, eg, AFL and cricket matches, and
- the Carnival during the Sydney Royal Easter Show.

These uses generate crowd and public address noise from the Showground Main Arena and – in the case of the Sydney Royal Easter Show – also from the external Carnival area. Of these events, it is the hosting of rock concerts within the Showground and Easter Show that would dictate the glazing design of the Project.

5.1.4 Athletics Centre

The Athletics Centre is approved to host sporting events, although, in practice, it is used almost exclusively for athletics competitions. The Centre has the capacity to seat 15,000 spectators (5,000 in the grandstand and 10,000 on landscaped surrounds). Noise emissions from this facility are mostly contained to noise from crowds and the public address system.

5.1.5 AllPhones Arena

AllPhones Arena is a fully enclosed venue, which has approval to host major sporting events, concerts, conferences and a number of ancillary uses. Seating capacity in sports mode is approximately 17,500, and in concert mode approximately 21,000 seated patrons. The loudest noise from the venue results from crowds and amplified music during rock concerts and all-night dance parties.

Late night events (occurring 11.00pm-6.00am) within Sydney Olympic Park such as dance parties require specific planning approvals and are permitted to occur only in venues designed to manage noise impacts on adjacent land uses.

The future detailed design of developments within the Precinct would need to take account the potential for low-frequency noise impacts (at 63Hz and 125Hz frequencies) from dance parties. Noise from all-night dance parties is not considered in this assessment as they occur only infrequently, and therefore can be reasonably expected to have their noise emissions managed by the event managers as required. (SOPA records indicate that only one late-night dance party has been held within SOP during the 15-month period 1 July 2012 – 30 September 2013.)

5.2 Event Noise Levels

Wilkinson Murray was commissioned by the SOPA to guide the development the SOP *Noise Management Plan*. As part of that commission, our office undertook modelling of noise emissions from major SOP events based on historical event noise monitoring results.

Separately, Wilkinson Murray was also commissioned to investigate noise impacts from the operation of the refurbished Sydney Showground complex.

The sound power level data for SOP events used in this assessment are drawn from these previous assessments and are summarised in Table 5-1.

Table 5-1 Sound Power Levels used in Noise Modelling of SOP Events

Event	Sound Power Level (dBA L_{Aeq})
ANZ Stadium Events	
ANZ Stadium Sport Events (80,000 people) Crowd & PA Noise	136
ANZ Stadium Rock Concert + Crowd Noise	145
Sydney Showground Events	
Showground Rock Concert On-axis power level for single speaker stack	142
Showground Rock Concert Crowd Noise	128
Showground AFL/Cricket (25,000 people in Main Arena) Crowd & PA Noise	131
Royal Easter Show – Main Arena event, Crowd & PA	125
Royal Easter Show – Carnival rides external to Main Arena	118
Athletics Centre	
Athletics Event Crowd & PA Noise	129
AllPhones Arena	
(Indoor) Rock Concert	120 (external to arena)

5.3 Prediction of Traffic and Event Noise Levels to the Project

The predicted noise levels external to the facade of all Project buildings resulting from traffic and SOP major events are presented for all buildings in Appendix B (traffic only) and Appendix C (traffic + SOP Events). For clarity, these results are summarised for a select group of critical receivers – those most exposed to each of the considered noise sources - in Table 5-2, Table 5-3 and Table 5-4.

The numbering of buildings adopted for this assessment is indicated in Figure 5-1.

Figure 5-1 Building Numbering adopted for this Assessment

Table 5-2 presents noise levels impinging on Precinct buildings from future traffic (Year 2031) on public roads. The presentation of traffic noise impacts in isolation of other noise sources serves to indicate the minimum facade glazing requirements. Table 5-2 includes the relevant internal noise criteria and the level of noise reduction required of the facade glazing to achieve these internal noise criteria.

Note that Receivers 30–40 will be commercial rather than residential premises. The noise source dictating the acoustic design of the facades of these buildings is traffic noise rather than SOP event noise.

Table 5-2 Predicted Noise Levels at Building Facades from Traffic only

Building ID	Noise external to Building Facade from 2031 Traffic		Criterion		Noise Reduction Required of Facade
	Day dBA $L_{eq,}$	Night dBA $L_{eq,}$	Day dBA $L_{eq,}$	Night dBA $L_{eq,}$	dBA
1	62.3	54.7	40	35	22
5	62.1	54.4	40	35	22
7	65.7	57.9	40	35	26
10	58.9	51.2	40	35	19
12	70.1	60.6	40	35	30
16	67.4	59.1	40	35	27
19	60.7	53	40	35	21
23	60.5	52.9	40	35	21
24	60	52.4	40	35	20
25	66.8	59.3	40	35	27
26	66.6	58.7	40	35	27
27	66.7	58.9	40	35	27
28	65.5	58	40	35	26
29	67.2	59.4	40	35	27
30	61.6	56.6	40	35	22
31	69.8	65	40	35	30
32	69.1	64	40	35	29
33	71	66.2	40	35	31
34	70.9	66	40	35	31
35	71.8	67	40	35	32
36	71.5	66.7	40	35	32
37	72.2	67.4	40	35	32
38	72.2	67.4	40	35	32
39	72.9	68.1	40	35	33
40	72.7	67.9	40	35	33
41	64.9	60	40	35	25
42	56.5	51.2	40	35	17
43	64.4	56.7	40	35	24
44	72.5	64.7	40	35	33
90	67.5	60.1	40	35	28

Building ID	Noise external to Building Facade from 2031 Traffic		Criterion		Noise Reduction Required of Facade
	Day dBA $L_{eq,}$	Night dBA $L_{eq,}$	Day dBA $L_{eq,}$	Night dBA $L_{eq,}$	dBA
98	70.5	62.7	40	35	31
135	70.3	62.4	40	35	30
139	70.8	63.3	40	35	31
144	70.6	63	40	35	31
145	70.5	62.9	40	35	31
146	71	63.3	40	35	31
147	55.3	50.5	40	35	16
148	72.2	64.4	40	35	32
153	67.4	62.6	40	35	28

Note: 1. Daytime (7.00am-10.00pm), Night time (10.00pm-7.00am).

Table 5-3 (Daytime) and Table 5-4 (Night time) present cumulative noise levels external to building facades for the same selection of receivers arising from traffic and the loudest of SOP events - in general, rock concerts hosted within ANZ Stadium. As above, these tables include the relevant internal noise criteria (for living rooms and bedrooms) and the level of noise reduction required of the facade glazing to achieve the internal noise criteria.

Table 5-3 Predicted Noise Levels at Building Facades from DAYTIME Traffic and Worst Case DAYTIME SOP Events

Building ID	Traffic Noise Plus Loudest SOP Event Noise Level at Facade	Criterion – Living Rooms (Daytime)	Maximum Noise Reduction Required of Facade
	dBA $L_{eq,}$	dBA	dBA
1	62.7	40	23
2	62.4	40	22
3	63.4	40	23
4	63.7	40	24
5	65.2	40	25
6	67.0	40	27
7	70.0	40	30
8	65.8	40	26
9	65.0	40	25
10	65.3	40	25
11	65.3	40	25
12	70.3	40	30
13	70.3	40	30
14	70.3	40	30
15	70.3	40	30
16	68.6	40	29

Building ID	Traffic Noise Plus Loudest SOP Event Noise Level at Facade	Criterion – Living Rooms (Daytime)	Maximum Noise Reduction Required of Facade
	dBA $L_{eq,}$	dBA	dBA
17	65.8	40	26
18	68.8	40	29
19	64.3	40	24
20	64.0	40	24
21	63.9	40	24
22	61.6	40	22
23	65.3	40	25
24	67.1	40	27
25	68.7	40	29
26	69.4	40	29
27	69.0	40	29
28	67.9	40	28
29	68.8	40	29
30	61.8	40	22
31	69.8	40	30
32	69.2	40	29
33	71.1	40	31
34	70.9	40	31
35	71.8	40	32
36	71.5	40	32
37	72.2	40	32
38	72.2	40	32
39	72.9	40	33

Note: 1. Daytime (7.00am-10.00pm), Night time (10.00pm-7.00am)

Table 5-4 Predicted Cumulative Noise Levels at Building Facades from NIGHT TIME Traffic and Worst Case NIGHT TIME SOP Events

Building ID	Noise Level at Facade from Loudest SOP Event + Traffic	Criterion – Bedrooms (Night time)	Maximum Noise Reduction Required of Facade
	dBA $L_{eq,}$	dBA	dBA
1	56.7	35	22
2	61.5	35	27
3	61.6	35	27
4	62.2	35	27
5	63.4	35	28
6	64.4	35	29
7	69.4	35	34

Building ID	Noise Level at Facade from Loudest SOP Event + Traffic	Criterion – Bedrooms (Night time)	Maximum Noise Reduction Required of Facade
	dBA $L_{eq,}$	dBA	dBA
8	64.6	35	30
9	64.2	35	29
10	64.4	35	29
11	64.2	35	29
12	64.4	35	29
13	64.4	35	29
14	64.4	35	29
15	64.4	35	29
16	66.7	35	32
17	63.3	35	28
18	64.5	35	30
19	62.4	35	27
20	62	35	27
21	61.9	35	27
22	61.2	35	26
23	64	35	29
24	66.3	35	31
25	66.7	35	32
26	67.4	35	32
27	66.2	35	31
28	65.7	35	31
29	65.2	35	30
30	58.9	35	24
31	65.1	35	30
32	64.1	35	29
33	66.3	35	31
34	66.1	35	31
35	67	35	32
36	66.8	35	32
37	67.4	35	32
38	67.5	35	33
39	68.1	35	33

Note: 1. Daytime (7.00am-10.00pm), Night time (10.00pm-7.00am).

5.4 In-Principle Acoustic Facade Design

The acoustic design of a building facade – particularly where full-width and/or full-height glazing is preferred - is dictated by the acoustic performance of its glazing.

The design of any acoustically-rated facade can only be confirmed at the detailed design stage once building parameters, such as building orientation, glazing dimensions, room furnishings and decisions on including additional acoustic building elements, such as soffit absorption, blade wall or baffles are known. The in-principle façade treatments below are based on assuming the generic design details outlined in Section 4.3. The identification of such generic treatments is for the purpose of establishing the feasibility of siting residential buildings in the chosen locations.

Table 5-5 outlines typical in-principle glazing treatments that will provide the level of noise reduction required for each building facade.

Table 5-5 In-Principle Facade Treatments for Project Buildings

Glazing Option	Description	Noise Reduction dBA for Relevant Sources
Option 1	Openable sliding door - 6.38mm glass + acoustic seals	< 26
Option 2	Openable sliding door - 10.38mm glass + acoustic seals	26 – 30
Option 3	Single-Leaf, double-glazed sliding door – 12.38mm laminated glass + 7.52 laminated glass + 22mm air gap + acoustic seals	30 – 32
Option 4	Acoustically-enclosed balcony	> 32

Note: 1. Noise reductions are specified with regard for dominant noise source, eg, ANZ Rock Concert, Athletics Crowd or traffic respectively.

Based on the noise reduction requirements calculated in Section 5.3, Table 5-6 presents the in-principle facade treatments required to achieve the internal noise criteria for the most exposed apartments within each building of the Project. Many apartments with in the Project will have reduced facade glazing requirements due to being shielded from the SOP venues and roadways considered in this assessment.

Table 5-6 In-Principle Facade Treatments for Project Buildings

Building ID	Worst Case Facade Noise Reduction Required [1]	In-principle Glazing Treatments [1]				Comments relating to Dictating Sources of Noise
	dBA	Option 1	Option 2	Option 3	Option 4	
1	23	✔				
2	27		✔			
3	27		✔			
4	27		✔			
5	28		✔			
6	29		✔			
7	34				✔	Evening Rock Concerts at ANZ Stadium
8	30		✔			
9	29		✔			
10	29		✔			
11	29		✔			
12	30		✔			
13	30		✔			
14	30		✔			
15	30		✔			
16	32			✔		Evening Rock Concerts at ANZ Stadium
17	28		✔			
18	30		✔			
19	27		✔			
20	27		✔			
21	27		✔			
22	26		✔			
23	29		✔			
24	31		✔			Exposure to two traffic corridors
25	32		✔			Exposure to two traffic corridors
26	32		✔			Exposure to two traffic corridors
27	31		✔			Exposure to two traffic corridors
28	31		✔			Exposure to two traffic corridors
29	30		✔			
30	24	✔				
31	30		✔			
32	29		✔			
33	31		✔			Exposure to M4 Motorway Traffic
34	31		✔			Exposure to M4 Motorway Traffic

Building ID	Worst Case Facade Noise Reduction Required [1]	In-principle Glazing Treatments [1]				Comments relating to Dictating Sources of Noise
	dBA	Option 1	Option 2	Option 3	Option 4	
35	32		✔			Exposure to M4 Motorway Traffic
36	32		✔			Exposure to M4 Motorway Traffic
37	32		✔			Exposure to M4 Motorway Traffic
38	33		✔			Exposure to M4 Motorway Traffic
39	33		✔			Exposure to M4 Motorway Traffic
40	33		✔			Exposure to M4 Motorway Traffic
41	25	✔				
42	23	✔				
43	25	✔				
44	33		✔			Exposure to Traffic on Hill Rd
45	25	✔				
46	26		✔			
47	25	✔				
48	26		✔			
49	24					
50	27		✔			
51	25	✔				
52	25	✔				
53	24	✔				
54	27		✔			
55	27		✔			
56	28		✔			
57	26	✔				
58	25	✔				
59	26		✔			
60	24	✔				
61	22	✔				
62	30		✔			
63	27		✔			
64	27		✔			
65	27		✔			
66	27		✔			
67	25	✔				
68	25	✔				
69	27		✔			
70	27		✔			

Building ID	Worst Case Facade Noise Reduction Required [1]	In-principle Glazing Treatments [1]				Comments relating to Dictating Sources of Noise
	dBA	Option 1	Option 2	Option 3	Option 4	
71	24	✔				
72	27		✔			
73	26		✔			
74	30		✔			
75	24	✔				
76	23	✔				
77	28		✔			
78	29		✔			
79	30		✔			
80	22	✔				
81	27		✔			
82	27		✔			
83	26		✔			
84	27		✔			
85	28		✔			
86	27		✔			
87	30		✔			
88	26		✔			
89	28		✔			
90	31		✔			Exposure to two traffic corridors
91	23	✔				
92	20	✔				
93	24	✔				
94	24	✔				
95	24	✔				
96	25	✔				
97	26	✔				
98	31		✔			Exposure to two traffic corridors
99	29		✔			
100	29		✔			
101	29		✔			
102	29		✔			
103	29		✔			
104	29		✔			
105	28		✔			
106	28		✔			

Building ID	Worst Case Facade Noise Reduction Required [1]	In-principle Glazing Treatments [1]				Comments relating to Dictating Sources of Noise
	dBA	Option 1	Option 2	Option 3	Option 4	
107	28		✔			
108	28		✔			
109	25	✔				
110	27		✔			
111	23	✔				
112	27		✔			
113	24	✔				
114	27		✔			
115	26		✔			
116	27		✔			
117	22	✔				
118	25	✔				
119	25	✔				
120	25	✔				
121	20	✔				
122	26	✔				
123	21	✔				
124	21	✔				
125	26	✔				
126	26	✔				
127	25	✔				
128	22	✔				
129	24	✔				
130	24	✔				
131	20	✔				
132	24	✔				
133	21	✔				
134	19	✔				
135	30		✔			
136	30		✔			
137	30		✔			
138	19	✔				
139	31		✔			Exposure to Traffic on Hill Rd
140	24	✔				
141	20	✔				
142	15	✔				

Building ID	Worst Case Facade Noise Reduction Required [1]	In-principle Glazing Treatments [1]				Comments relating to Dictating Sources of Noise
	dBA	Option 1	Option 2	Option 3	Option 4	
143	18	✔				
144	31		✔			Exposure to Traffic on Hill Rd
145	31		✔			Exposure to Traffic on Hill Rd
146	31		✔			Exposure to Traffic on Hill Rd
147	17	✔				
148	32		✔			Exposure to Traffic on Hill Rd
149	19	✔				
150	17	✔				
151	28		✔			
152	27		✔			
153	28		✔			

Note: 1. Glazing options are identified in Table 5-5.

Table 5-6 indicates that with the exception of Buildings 7 and 16, noise to all apartments of the Project may be controlled by means of single-leaf façade glazing (as opposed to double glazing). Due to their exposure to the ANZ Stadium, some apartments of Building 16 may require double glazed façades, while some apartments of Building 7 may require purpose-built acoustically-treated façade designs, likely involving enclosed balconies (depending on the final architectural design).

With a view to guiding the detailed design of buildings within the Project for improved acoustic outcomes, Section 6.6 presents in-principle noise reduction planning and construction measures.

5.5 Best Practice Acoustic Design

5.5.1 Controlling Noise at the Source or Sound Transmission Path

The level of SOP events and traffic noise received at apartments may be mitigated by:

- Introducing physical structures such as roadside barrier;
- Maximising the buffer distance between the external noise sources and building facades.

5.5.2 Apartment Design

The design of apartments themselves can serve to mitigate noise from external sources by:

- Designing building layouts to maximise the number of residences screened from roadways and SOP stadia;
- Planning apartment layouts to face away from roads and SOP stadia as far as practicable;

- Employing enclosed balconies such as “wintergardens” to act as noise buffers;
- Designing balconies with acoustically-treated soffit and blade walls where practicable;
- Locating bedrooms and private open space away from facades exposed to external noise sources. Designing to have corridors or utility areas serving as noise buffers;
- Locating commercial uses on noise-exposed facades.

5.5.3 Improved Glazing

The following principles should be adopted to optimise the acoustic performance of glazing:

- Minimise the area of glazing;
- Maximising air gaps between panes of double-glazed systems. Where double glazing is required allow for air gaps of at least 25 -50 mm;
- The use of laminates (glass interlayers) greater than 10.38mm can result in improved acoustic isolation however the issue of serviceability of the system should be considered. In addition some occupants may find windows and doors difficult to use due to weight;
- All acoustic glazing systems should incorporate acoustically-rated seals.

5.5.4 Noise Criteria Modification

Given the location of Project site immediately adjacent to the SOP entertainment precinct, there exist grounds for requesting of Council a relaxation of 35 dBA internal noise criterion which is adopted above for residential apartments.

6 CONCLUSION

This report details the assessment of the potential impacts upon the acoustic amenity of the Carter Street Urban Activation Project. The assessment considers the impact of noise from entertainment events held in Sydney Olympic Park (including major rock concerts and sporting events) and traffic conveyed on nearby arterial roads (M4 Motorway, Parramatta Road, Hill Road).

The assessment presents noise criteria for the internal spaces of residences proposed for the project, predicts noise levels from the aforementioned environmental noise sources and outlines in-principle noise mitigation strategies.

The report concludes that noise from all traffic and Sydney Olympic Park sources can suitably be mitigated by means of feasible acoustic glazing designs.

APPENDIX A

SYDNEY OLYMPIC PARK AUTHORITY AMENDMENT BILL (2010)

Passed by both Houses

New South Wales

Sydney Olympic Park Authority Amendment Bill 2010

Contents

I certify that this public bill, which originated in the Legislative Assembly, has finally passed the Legislative Council and the Legislative Assembly of New South Wales.

Clerk of the Legislative Assembly.
Legislative Assembly,
Sydney, , 2010

New South Wales

Sydney Olympic Park Authority Amendment Bill 2010

Act No , 2010

An Act to amend the *Sydney Olympic Park Authority Act 2001* to make provision with respect to noise management at major events carried on at Sydney Olympic Park; to make provision with respect to the functions of the Sydney Olympic Park Authority in relation to residential facilities; and for other purposes.

I have examined this bill and find it to correspond in all respects with the bill as finally passed by both Houses.

Assistant Speaker of the Legislative Assembly.

The Legislature of New South Wales enacts:

1 Name of Act

This Act is the *Sydney Olympic Park Authority Amendment Act 2010*.

2 Commencement

This Act commences on a day or days to be appointed by proclamation.

Schedule 1 Amendment of Sydney Olympic Park Authority Act 2001 No 57

[1] Section 3 Objects

Omit "town" from section 3 (a).

[2] Section 3 (c)

Insert "accessibility standards and" after "practice".

[3] Section 4 Definitions

Omit the definition of ***Environmental Guidelines*** from section 4 (1).

Insert instead:

Environmental Guidelines means the *Environmental Guidelines for Sydney Olympic Park* prepared by the Sydney Olympic Park Authority and dated February 2008, as amended from time to time under this Act.

[4] Section 4 (1)

Insert in appropriate order:

Minister for Planning means the Minister administering the *Environmental Planning and Assessment Act 1979*.

ranger means a person appointed as a ranger under section 65 (1).

[5] Section 13 Functions—generally

Insert ", residential" after "commercial" in section 13 (1) (b).

[6] Section 18 Master plan

Insert after section 18 (2):

(2A) Provisions of the master plan may apply to the whole or any part of Sydney Olympic Park.

[7] Section 48A

Insert after section 48:

48A Legal proceedings and other noise abatement action

(1) No criminal proceedings, no civil proceedings (whether at law or in equity) and no noise abatement action may be taken against any person with respect to the emission of noise from Sydney Olympic Park in relation to a major event.

(2) The emission of such noise from Sydney Olympic Park does not constitute a public or private nuisance.

(3) This section does not apply to or in respect of noise that exceeds the maximum permissible noise level at the closest residential facade.

(4) This section does not limit or otherwise affect:

(a) the operation of the *Environmental Planning and Assessment Act 1979* or any instrument under that Act in its application to land comprising any part of Sydney Olympic Park, except section 121B of that Act to the extent the functions conferred by that section are not exercised by the Authority, or

(b) the functions of the Authority under sections 19 and 25 of this Act.

(5) For the purposes of this section:

closest residential facade, in relation to noise, means:

(a) the residential facade closest to the source of the noise, or

(b) if there is more than one source of noise, the residential facade closest to where the noise is loudest,

where a reference to a residential facade is a reference to an outside wall of a building containing residential accommodation.

major event means a business-oriented occasion or a cultural, social or sporting related occasion occurring on a single day, including an exhibition, a festival, a show and other like happening:

(a) designed for more than 10,000 patrons or participants at a single major event venue, or

(b) designed for more than 20,000 patrons or participants at two or more major event venues, or

(c) that involves a total floor area of temporary tents or marquees of more than 1,000 square metres, or

(d) that involves a total floor area of a temporary stage or platform of more than 300 square metres.

maximum permissible noise level means:

(a) a noise level of 85dB (A) ($L_{A10,\ 15mins}$), or

(b) if some other noise level is prescribed by the regulations, that other level,

being, in either case, a noise level determined in accordance with:

(c) Australian Standard AS 1055.1—1997, *Acoustics—Description and measurement of environmental noise, Part 1: General procedures*, as in force from time to time, or

(d) Australian Standard AS 1259.1—1990, *Acoustics—Sound level meters, Part 1: Non-integrating*, as in force from time to time, or

(e) Australian Standard AS 2659.1—1988, *Guide to the use of sound-measuring equipment, Part 1: Portable sound level meters*, as in force from time to time.

noise abatement action means:

(a) the issuing of a noise control notice, noise abatement order or noise abatement direction under section 264, 268 or 276 of the *Protection of the Environment Operations Act 1997*, or

(b) the issuing of an order with respect to noise under section 121B of the *Environmental Planning and Assessment Act 1979* by a person other than the Authority, or

(c) action of the kind that may be taken following a complaint under section 79 of the *Liquor Act 2007*, or

(d) any other action of a kind prescribed by the regulations.

[8] Section 79 Penalty notices

Omit section 79 (1). Insert instead:

(1) An authorised officer may serve a penalty notice on a person if it appears to the officer that the person has committed an offence against:

(a) section 67, being an offence prescribed by the regulations as a penalty notice offence, or

(b) the regulations, being an offence prescribed by the regulations as a penalty notice offence.

[9] Section 79 (6) (b)

Omit "the offence". Insert instead "an offence".

[10] Schedule 8 Savings, transitional and other provisions

Insert at the end of clause 1 (1):

Sydney Olympic Park Authority Amendment Act 2010

Schedule 2 Amendment of Protection of the Environment Operations (General) Regulation 2009

Clause 95A

Insert after clause 95:

95A Noise control—Sydney Olympic Park

(1) Activities carried out at Sydney Olympic Park are exempt from the following provisions of the Act:

(a) Part 4.3 (but only in so far as the provisions relate to the emission of noise),

(b) section 139,

(c) Part 8.6.

(2) Subclause (1) applies only if the Director-General has approved a noise management plan for Sydney Olympic Park and the activities are carried out in accordance with that noise management plan.

(3) In this clause:

Sydney Olympic Park has the same meaning as in the *Sydney Olympic Park Authority Act 2001*.

APPENDIX B

PREDICTED EXTERNAL-TO-FACADE NOISE LEVELS FROM TRAFFIC

Table B-1 Predicted Noise Levels at Project Building Facades from Traffic only (All Receivers)

Building ID	Noise external to Building Facade from 2031 Traffic		Criteria within Rooms of Apartment		Maximum Noise Reduction Required of Facade
	Day dBA $L_{eq,}$	Night dBA $L_{eq,}$	Living Areas dBA $L_{eq,}$	Bedrooms dBA $L_{eq,}$	dBA
1	62.3	54.7	40	35	22
2	61.7	54.1	40	35	22
3	59.6	51.9	40	35	20
4	59.2	51.5	40	35	19
5	62.1	54.4	40	35	22
6	64.5	56.7	40	35	25
7	65.7	57.9	40	35	26
8	60.5	52.7	40	35	21
9	58	50.3	40	35	18
10	58.9	51.2	40	35	19
11	59.9	52.2	40	35	20
12	70.1	60.6	40	35	30
13	70.1	60.6	40	35	30
14	70.1	60.6	40	35	30
15	70.1	60.6	40	35	30
16	67.4	59.1	40	35	27
17	63	55.3	40	35	23
18	67.9	59.4	40	35	28
19	60.7	53	40	35	21
20	60.3	52.7	40	35	20
21	60.4	52.8	40	35	20
22	52.2	45.5	40	35	12
23	60.5	52.9	40	35	21
24	60	52.4	40	35	20
25	66.8	59.3	40	35	27
26	66.6	58.7	40	35	27
27	66.7	58.9	40	35	27
28	65.5	58	40	35	26
29	67.2	59.4	40	35	27
30	61.6	56.6	40	35	22

Building ID	Noise external to Building Facade from 2031 Traffic		Criteria within Rooms of Apartment		Maximum Noise Reduction Required of Facade
	Day dBA $L_{eq,}$	Night dBA $L_{eq,}$	Living Areas dBA $L_{eq,}$	Bedrooms dBA $L_{eq,}$	dBA
31	69.8	65	40	35	30
32	69.1	64	40	35	29
33	71	66.2	40	35	31
34	70.9	66	40	35	31
35	71.8	67	40	35	32
36	71.5	66.7	40	35	32
37	72.2	67.4	40	35	32
38	72.2	67.4	40	35	32
39	72.9	68.1	40	35	33
40	72.7	67.9	40	35	33
41	64.9	60	40	35	25
42	56.5	51.2	40	35	17
43	64.4	56.7	40	35	24
44	72.5	64.7	40	35	33
45	62.8	55.3	40	35	23
46	65.9	58.3	40	35	26
47	64.3	56.7	40	35	24
48	52	45.1	40	35	12
49	51.4	44	40	35	11
50	51.2	43.9	40	35	11
51	48.1	41.1	40	35	8
52	50.5	43.7	40	35	11
53	44.5	37.7	40	35	5
54	47.7	41.8	40	35	8
55	47.7	41.8	40	35	8
56	48.6	42.2	40	35	9
57	52.6	45.5	40	35	13
58	56.8	49.9	40	35	17
59	54.9	48.5	40	35	15
60	45.1	38.7	40	35	5
61	49.3	42.8	40	35	9
62	56.3	50.4	40	35	16
63	52.8	46.5	40	35	13

Building ID	Noise external to Building Facade from 2031 Traffic		Criteria within Rooms of Apartment		Maximum Noise Reduction Required of Facade
	Day dBA $L_{eq,}$	Night dBA $L_{eq,}$	Living Areas dBA $L_{eq,}$	Bedrooms dBA $L_{eq,}$	dBA
64	51.5	45.1	40	35	12
65	47.7	40.9	40	35	8
66	50.3	44.1	40	35	10
67	46.1	39.4	40	35	6
68	47.8	40.9	40	35	8
69	46	39.3	40	35	6
70	53.9	47.1	40	35	14
71	50.2	42.9	40	35	10
72	53.9	46.4	40	35	14
73	60.9	53.4	40	35	21
74	70	60.7	40	35	30
75	63.6	55.1	40	35	24
76	55.5	47.9	40	35	16
77	67.7	59.1	40	35	28
78	69	59.7	40	35	29
79	69.4	59.6	40	35	29
80	53.5	46.9	40	35	14
81	58.5	52.1	40	35	19
82	52.3	44.9	40	35	12
83	52.2	45.6	40	35	12
84	67.2	59.5	40	35	27
85	66.6	59	40	35	27
86	62.3	55.6	40	35	22
87	70.4	62.6	40	35	30
88	51.3	44.1	40	35	11
89	67.1	59.7	40	35	27
90	67.5	60.1	40	35	28
91	62.3	56.5	40	35	22
92	59.8	52.3	40	35	20
93	63.6	56.1	40	35	24
94	63.4	55.9	40	35	23
95	63.5	56	40	35	24
96	62.8	55.4	40	35	23

Building ID	Noise external to Building Facade from 2031 Traffic		Criteria within Rooms of Apartment		Maximum Noise Reduction Required of Facade
	Day dBA $L_{eq,}$	Night dBA $L_{eq,}$	Living Areas dBA $L_{eq,}$	Bedrooms dBA $L_{eq,}$	dBA
97	65.8	60	40	35	26
98	70.5	62.7	40	35	31
99	69	61.4	40	35	29
100	68.7	60.9	40	35	29
101	68.7	60.9	40	35	29
102	68.7	60.8	40	35	29
103	68.7	60.8	40	35	29
104	68.7	60.7	40	35	29
105	68.4	60.5	40	35	28
106	68.1	60.2	40	35	28
107	68.1	60.2	40	35	28
108	68.1	60.3	40	35	28
109	64.4	57	40	35	24
110	56.3	49.5	40	35	16
111	53.5	47.3	40	35	14
112	53.3	47.9	40	35	13
113	50.1	44.1	40	35	10
114	52	46.6	40	35	12
115	49.5	43.1	40	35	10
116	53.7	47	40	35	14
117	53.9	47.2	40	35	14
118	53.6	47.3	40	35	14
119	56.4	48.7	40	35	16
120	60.9	53.3	40	35	21
121	57	49.7	40	35	17
122	52.8	46.9	40	35	13
123	48.2	41.4	40	35	8
124	44.8	39	40	35	5
125	48.2	42.4	40	35	8
126	50	44.2	40	35	10
127	50.9	45	40	35	11
128	54	46.8	40	35	14
129	52.3	45	40	35	12

Building ID	Noise external to Building Facade from 2031 Traffic		Criteria within Rooms of Apartment		Maximum Noise Reduction Required of Facade
	Day dBA $L_{eq,}$	Night dBA $L_{eq,}$	Living Areas dBA $L_{eq,}$	Bedrooms dBA $L_{eq,}$	dBA
130	53.6	47.1	40	35	14
131	54.4	48.1	40	35	14
132	55.2	48.3	40	35	15
133	56.8	49.6	40	35	17
134	57.9	51.1	40	35	18
135	70.3	62.4	40	35	30
136	69.9	62.1	40	35	30
137	70.3	62.5	40	35	30
138	58.5	52	40	35	19
139	70.8	63.3	40	35	31
140	63.9	58.9	40	35	24
141	59.6	54.8	40	35	20
142	54.3	47.1	40	35	14
143	57.4	49.9	40	35	17
144	70.6	63	40	35	31
145	70.5	62.9	40	35	31
146	71	63.3	40	35	31
147	55.3	50.5	40	35	16
148	72.2	64.4	40	35	32
149	58.6	51	40	35	19
150	54.1	47.2	40	35	14
151	47.3	41.4	40	35	7
152	66.5	61.6	40	35	27
153	67.4	62.6	40	35	28

Note: 1. Daytime (7.00am-10.00pm), Night time (10.00pm-7.00am).

APPENDIX C

PREDICTED EXTERNAL-TO-FACADE NOISE LEVELS FROM TRAFFIC & SYDNEY OLYMPIC PARK EVENTS

Table C-2 Predicted Noise Levels at Building Facades from DAYTIME Traffic and Worst Case DAYTIME SOP Events (All Receivers)

Building ID	Loudest SOP Event Noise Level at Facade	Criterion – Living Rooms (Day time)	Maximum Noise Reduction Required of Facade
	dBA $L_{eq,}$	dBA	dBA
1	62.7	40	23
2	62.4	40	22
3	63.4	40	23
4	63.7	40	24
5	65.2	40	25
6	67.0	40	27
7	70.0	40	30
8	65.8	40	26
9	65.0	40	25
10	65.3	40	25
11	65.3	40	25
12	70.3	40	30
13	70.3	40	30
14	70.3	40	30
15	70.3	40	30
16	68.6	40	29
17	65.8	40	26
18	68.8	40	29
19	64.3	40	24
20	64.0	40	24
21	63.9	40	24
22	61.6	40	22
23	65.3	40	25
24	67.1	40	27
25	68.7	40	29
26	69.4	40	29
27	69.0	40	29
28	67.9	40	28
29	68.8	40	29
30	61.8	40	22
31	69.8	40	30
32	69.2	40	29

Building ID	Loudest SOP Event Noise Level at Facade	Criterion – Living Rooms (Day time)	Maximum Noise Reduction Required of Facade
	dBA $L_{eq,}$	dBA	dBA
33	71.1	40	31
34	70.9	40	31
35	71.8	40	32
36	71.5	40	32
37	72.2	40	32
38	72.2	40	32
39	72.9	40	33
40	72.7	40	33
41	64.9	40	25
42	58.7	40	19
43	65.3	40	25
44	72.6	40	33
45	63.1	40	23
46	66.1	40	26
47	64.5	40	25
48	61.1	40	21
49	59.8	40	20
50	62.6	40	23
51	60.1	40	20
52	59.9	40	20
53	58.6	40	19
54	62.4	40	22
55	62.4	40	22
56	62.7	40	23
57	61.0	40	21
58	59.8	40	20
59	61.3	40	21
60	59.5	40	20
61	56.7	40	17
62	64.6	40	25
63	61.8	40	22
64	62.0	40	22
65	62.5	40	23
66	62.2	40	22
67	59.7	40	20

Building ID	Loudest SOP Event Noise Level at Facade	Criterion – Living Rooms (Day time)	Maximum Noise Reduction Required of Facade
	dBA $L_{eq,}$	dBA	dBA
68	59.6	40	20
69	62.2	40	22
70	62.2	40	22
71	59.1	40	19
72	61.8	40	22
73	61.8	40	22
74	70.2	40	30
75	64.3	40	24
76	60.0	40	20
77	68.0	40	28
78	69.2	40	29
79	69.6	40	30
80	58.3	40	18
81	62.1	40	22
82	62.2	40	22
83	61.7	40	22
84	67.3	40	27
85	66.7	40	27
86	62.8	40	23
87	70.4	40	30
88	61.6	40	22
89	67.2	40	27
90	68.4	40	28
91	62.6	40	23
92	60.4	40	20
93	64.1	40	24
94	63.8	40	24
95	63.8	40	24
96	63.9	40	24
97	65.9	40	26
98	70.5	40	31
99	69.1	40	29
100	68.8	40	29
101	68.8	40	29
102	68.8	40	29

Building ID	Loudest SOP Event Noise Level at Facade	Criterion – Living Rooms (Day time)	Maximum Noise Reduction Required of Facade
	dBA $L_{eq,}$	dBA	dBA
103	68.8	40	29
104	68.8	40	29
105	68.4	40	28
106	68.2	40	28
107	68.2	40	28
108	68.2	40	28
109	64.8	40	25
110	62.5	40	23
111	58.8	40	19
112	62.4	40	22
113	58.8	40	19
114	62.2	40	22
115	61.4	40	21
116	62.0	40	22
117	58.2	40	18
118	60.4	40	20
119	61.5	40	22
120	61.6	40	22
121	58.2	40	18
122	60.7	40	21
123	56.9	40	17
124	56.5	40	17
125	61.0	40	21
126	60.8	40	21
127	60.4	40	20
128	58.3	40	18
129	59.7	40	20
130	59.6	40	20
131	56.9	40	17
132	60.2	40	20
133	58.1	40	18
134	58.5	40	19
135	70.3	40	30
136	69.9	40	30
137	70.4	40	30

Building ID	Loudest SOP Event Noise Level at Facade	Criterion – Living Rooms (Day time)	Maximum Noise Reduction Required of Facade
	dBA $L_{eq,}$	dBA	dBA
138	59.1	40	19
139	70.8	40	31
140	64.0	40	24
141	59.8	40	20
142	55.1	40	15
143	57.9	40	18
144	70.6	40	31
145	70.6	40	31
146	71.0	40	31
147	55.9	40	16
148	72.2	40	32
149	59.1	40	19
150	55.8	40	16
151	62.9	40	23
152	66.5	40	27
153	67.5	40	28

Note: 1. Daytime (7.00am-10.00pm), Night time (10.00pm-7.00am).
2. In these cases, highest event noise level at building facade results from events hosted at Athletics Centre (rather than at ANZ Stadium).

Table C-3 Predicted Cumulative Noise Levels at Building Facades from NIGHT TIME Traffic and Worst Case NIGHT TIME SOP Events (All Receivers)

Building ID	Noise Level at Facade from Loudest SOP Event + Traffic	Criterion – Bedrooms (Night time)	Maximum Noise Reduction Required of Facade
	dBA $L_{eq,}$	dBA	dBA
1	56.7	35	22
2	61.5	35	27
3	61.6	35	27
4	62.2	35	27
5	63.4	35	28
6	64.4	35	29
7	69.4	35	34
8	64.6	35	30
9	64.2	35	29
10	64.4	35	29
11	64.2	35	29
12	64.4	35	29
13	64.4	35	29
14	64.4	35	29
15	64.4	35	29
16	66.7	35	32
17	63.3	35	28
18	64.5	35	30
19	62.4	35	27
20	62	35	27
21	61.9	35	27
22	61.2	35	26
23	64 [2]	35	29
24	66.3 [2]	35	31
25	66.7 [2]	35	32
26	67.4 [2]	35	32
27	66.2 [2]	35	31
28	65.7 [2]	35	31
29	65.2 [2]	35	30
30	58.9	35	24
31	65.1	35	30
32	64.1	35	29

Building ID	Noise Level at Facade from Loudest SOP Event + Traffic	Criterion – Bedrooms (Night time)	Maximum Noise Reduction Required of Facade
	dBA $L_{eq,}$	dBA	dBA
33	66.3	35	31
34	66.1	35	31
35	67	35	32
36	66.8	35	32
37	67.4	35	32
38	67.5	35	33
39	68.1	35	33
40	67.9	35	33
41	60.2	35	25
42	57.5	35	23
43	60.2	35	25
44	65.4	35	30
45	60.2	35	25
46	60.7	35	26
47	58	35	23
48	61	35	26
49	59.2	35	24
50	62.3	35	27
51	59.9	35	25
52	59.9	35	25
53	58.5	35	24
54	62.3	35	27
55	62.3	35	27
56	62.6	35	28
57	60.8	35	26
58	59.7	35	25
59	61.2	35	26
60	59.4	35	24
61	56.5	35	22
62	64.5	35	30
63	61.7	35	27
64	61.9	35	27
65	62.4	35	27
66	62.2	35	27
67	59.6	35	25

Building ID	Noise Level at Facade from Loudest SOP Event + Traffic	Criterion – Bedrooms (Night time)	Maximum Noise Reduction Required of Facade
	dBA $L_{eq,}$	dBA	dBA
68	59.5	35	25
69	62.1	35	27
70	62.1	35	27
71	58.8	35	24
72	61.5	35	27
73	61.2	35	26
74	62.1	35	27
75	58.4	35	23
76	58.4	35	23
77	61.6	35	27
78	63.9	35	29
79	61.3	35	26
80	57	35	22
81	61.7	35	27
82	61.9	35	27
83	61.4	35	26
84	60.4	35	25
85	62.8	35	28
86	62.4 [2]	35	27
87	63.5	35	29
88	61.2	35	26
89	62.5 [2]	35	28
90	65.9 [2]	35	31
91	57.4	35	22
92	55	35	20
93	58.4	35	23
94	57.6	35	23
95	58.7	35	24
96	59.5	35	25
97	60.3	35	25
98	62.8	35	28
99	61.6	35	27
100	61.3	35	26
101	61.3	35	26
102	61.1	35	26

Building ID	Noise Level at Facade from Loudest SOP Event + Traffic	Criterion – Bedrooms (Night time)	Maximum Noise Reduction Required of Facade
	dBA $L_{eq,}$	dBA	dBA
103	61.3	35	26
104	61.5	35	27
105	60.9	35	26
106	60.8	35	26
107	60.8	35	26
108	60.9	35	26
109	58.8	35	24
110	61.5	35	27
111	58.4	35	23
112	62.1	35	27
113	58.5	35	24
114	62	35	27
115	61.3	35	26
116	61.8	35	27
117	56.9	35	22
118	60.3	35	25
119	60.4	35	25
120	59.8	35	25
121	54.7	35	20
122	60.5	35	26
123	56.4	35	21
124	56.3	35	21
125	60.9	35	26
126	60.6	35	26
127	60.1	35	25
128	57.3	35	22
129	59.1	35	24
130	59.4	35	24
131	54.7	35	20
132	59.3	35	24
133	55.6	35	21
134	53.4	35	18
135	62.6	35	28
136	62.3	35	27
137	62.7	35	28

Building ID	Noise Level at Facade from Loudest SOP Event + Traffic	Criterion – Bedrooms (Night time)	Maximum Noise Reduction Required of Facade
	dBA $L_{eq,}$	dBA	dBA
138	54.2	35	19
139	63.5	35	29
140	59.2	35	24
141	55.4	35	20
142	50.2	35	15
143	51.9	35	17
144	63.2	35	28
145	63	35	28
146	63.4	35	28
147	52.1	35	17
148	64.6	35	30
149	53.4	35	18
150	52.3	35	17
151	62.8	35	28
152	61.7	35	27
153	62.7	35	28

Note: 1. Daytime (7.00am-10.00pm), Night time (10.00pm-7.00am).
2. In these cases, highest event noise level at building facade results from events hosted at Athletics Centre (rather than at ANZ Stadium).