ACOUSTICS AND AIR

WESTERN SYDNEY STADIUM (BANKWEST)

NOISE IMPACT ASSESSMENT

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VERSION C

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PREPARED FOR

VENUE NSW
15 EDWIN FLACK AVENUE
SYDNEY OLYMPIC PARK NSW 2127

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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.

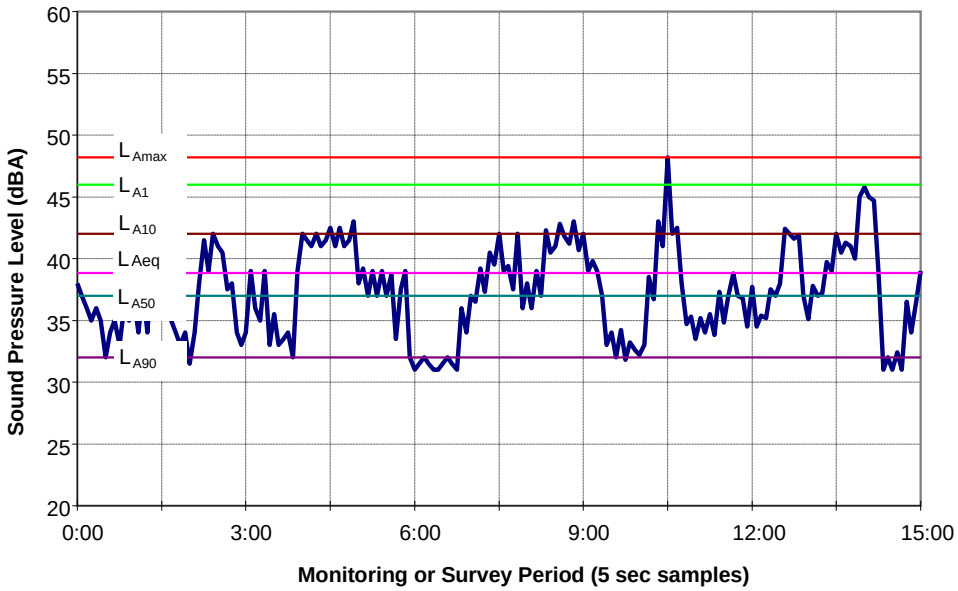
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

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 commissioned by Venues NSW to prepare a noise impact assessment to support a proposal to modify Development Consent SSD 8175 relating to Stage 2 Design and Construction of Western Sydney Stadium (Bankwest). The Western Sydney Stadium (SSD 8175) was approved by the Minister for Planning's delegate on 31 August 2017.

It is proposed to allow for the increased use of available function space within the Stadium on non-event days, catering to a maximum of 2,514 patrons. It is proposed that functions on non-event days will operate between 7.00am to 12.00am, 7 days a week. Parking for non-event days will be limited to the western and northern car parking areas with entry via the southern entry (Gate 1) on O'Connell Street. This noise impact assessment (NIA) presents an assessment of potential impacts associated with increased patronage and usage of function spaces within the stadium on non-event days.

This assessment will refer to the EIS Noise and Vibration Technical Working Paper prepared by AECOM, dated 13 July 2016, and the previous Operational Noise and Vibration Impact Assessment prepared by Acoustic Logic (ALC), dated 13 February 2017. The ALC assessment determined that noise associated with general operation, which includes car park, loading dock, and mechanical services, as well as event noise will comply with relevant guidelines.

This assessment has been conducted in accordance with the NSW EPA's *Noise Policy for Industry* (*NPfI*). It is to be noted that the original NIA was conducted in accordance with the NSW EPA's *Industrial Noise Policy* (*INP*) which precedes the *NPfI*.

2 THE PROJECT

2.1 Proposed Modification

Condition D1 of the current Development Consent stipulates the following:

b) operational and management arrangements for the independent use of the Western Sydney Stadium three function centre spaces, subject to the following limitations:

i. restricted to internal function space only;
ii. restricted to a maximum of 700 patrons across the function spaces;
iii. Sunday to Thursday 9am to 10pm and Friday/Saturday 12 noon to midnight

Following the successful opening and initial operation of the Stadium, Venues NSW has revisited non-event functions including available function space, maximum patron numbers and hours of non-event functions. The review identified a number of spaces across the Stadium suitable for non-event functions that were not been identified in the original EIS.

Ultimately, this modification aims to replace Condition D1 of the Development Consent with the following:

b) operational and management arrangements for the independent use of the Western Sydney Stadium three function centre spaces, subject to the following limitations:

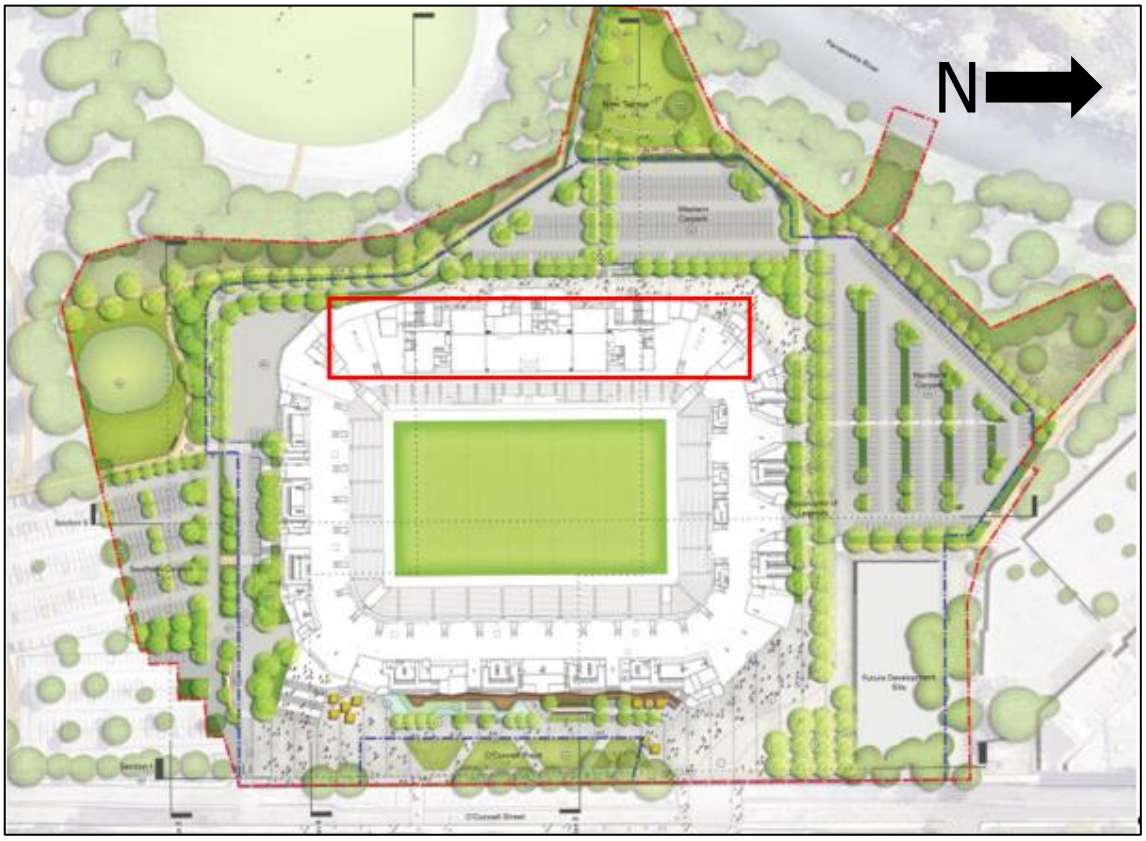
i. restricted to the function space identified in Figure 1;
ii. restricted to a maximum of 2,514 patrons across the function spaces at any one time on non-event days;
iii. operational times being Sunday to Saturday 7am to midnight.

Table 2-1 summarises the proposed function spaces and max capacity, and **Figure 2-1** presents the location of the function spaces relative to the Stadium.

Table 2-1 Proposed Function Spaces

Function Space	Max Capacity
Field Club	120
Cumberland Lounge (currently approved for 700)	1200
Level 2 Corporate Suites (4 x 20 persons)	80
Level 2 Open Suites (2 x 184 persons)	368
Directors' Club	200
Level 3 Corporate Suites (24 rooms)	408
Level 4 Corporate Suites (10 rooms)	138
Total	**2514**

Figure 2-1 Bankwest Stadium – Locations of all function spaces in Western Stand



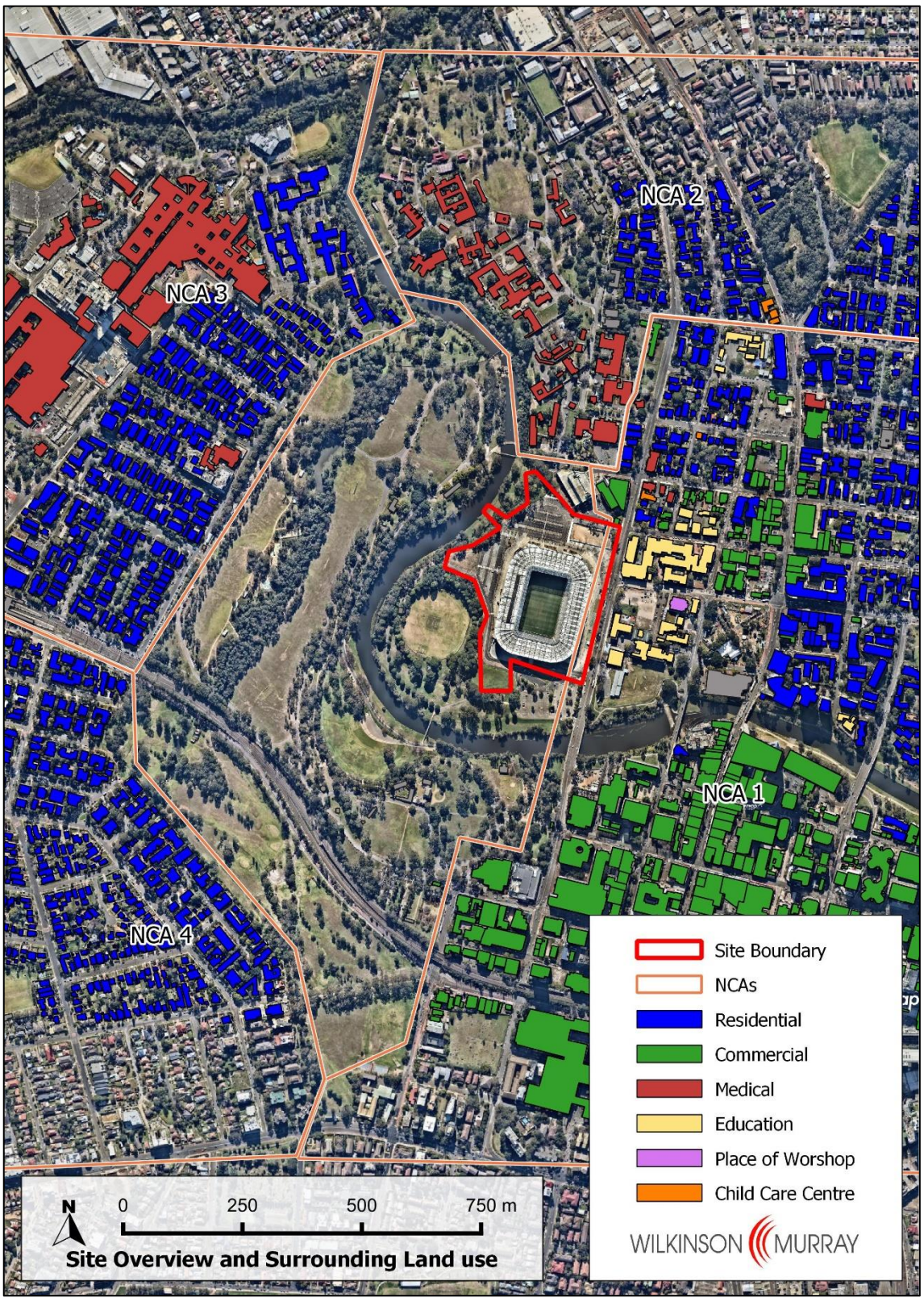
2.2 Site Location and Surrounding Land use

The Western Sydney Stadium is located at 11-13 O'Connell Street, Parramatta, approximately one kilometre north west of Parramatta Station and the Parramatta CBD. It is bound to the west and south by Parramatta Park and Parramatta River. The Parramatta Leagues club is directly adjacent to the north of the site and O'Connell Street runs along the eastern boundary of the site.

The immediate surrounds of the site consist of mainly non-residential receivers with the Our Lady of Mercy College and St Patrick Cathedral across O'Connell Street to the east. The nearest residential receiver is approximately 35m to the north east on the corner of O'Connell Street and Ross St.

NCAs developed in the EIS has been adopted for this assessment. **Figure 2-2** presents the site location and surrounds.

Figure 2-2 Site Overview and Surrounding Land Use



3 OPERATIONAL NOISE TRIGGER LEVELS

3.1 Existing Noise Environment

A background noise study was completed by AECOM in 2016 as part of the EIS. Unattended noise monitoring was completed at four locations, one in each of the identified NCAs. Monitoring occurred between 20 May 2016 and 30 May 2016 at Locations 1-3 and between 23 May to 30 May 2016 at Location 4.

Figure 3-1 presents the noise monitoring locations. **Table 3-1** presents the noise monitoring results extrapolated from the AECOM report for periods relevant to this assessment.

Figure 3-1 Noise Monitoring Locations

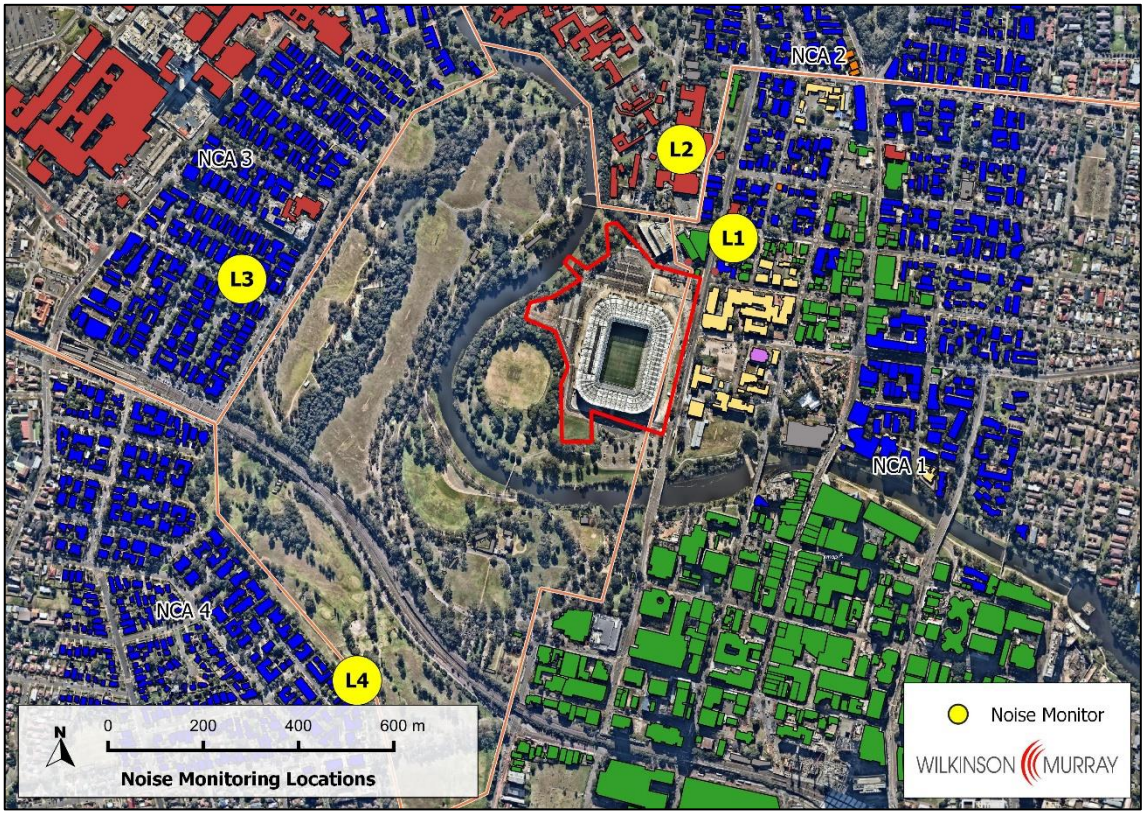


Table 3-1 Unattended Noise Monitoring Results – dBA

Location	Period	$L_{Aeq,period}$	RBL
L1	Day	68	54
	Evening	67	52
	Night	63	47
L2	Day	54	42
	Evening	53	42
	Night	52	39
L3	Day	56	39
	Evening	51	39
	Night	49	37
L4	Day	52	39
	Evening	48	42
	Night	44	38

Note: Day: 7.00am – 6.00pm
Evening: 6.00pm – 10.00pm
Night: 10.00pm – 12.00am
Note: The *NPfI* considers 7am-8am to be within the night period on Sundays

3.2 NPfI Noise Trigger Levels

The emission of noise and potential noise impact from the operation of the proposed development is to be assessed with respect to the site-specific noise trigger levels based on the *NPfI.* The assessment procedure has two components:

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

If the trigger levels are predicted to be exceeded, the *NPfI* indicates that reasonable and feasible noise mitigation should be implemented. The determined trigger levels apply at the most affected point on or within the receiver property boundary.

The intrusiveness noise level requires that the $L_{Aeq,\ 15min}$ noise level from the source being assessed should not exceed the Rating Background Noise Level (RBL) by more than 5dBA.

The amenity noise level set limits on the total noise level from all industrial noise sources affecting a receiver. Different amenity noise levels apply for different types of receivers (e.g. residential, commercial, industrial – or for areas specifically reserved for passive recreation) and different areas (e.g. urban, suburban, rural). The amenity noise level applies to the $L_{Aeq,\ period}$ during the full day (or evening or night). To ensure that industrial noise levels remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise. This is calculated as the recommended amenity noise level for the receiver type minus 5dBA. Where noise sources are intermittent it is allowable to add 3dB to convert from a period level to a 15-minute level.

Based on the noise monitoring results in Section 3.1, noise trigger levels for all relevant receivers have been developed in accordance with the requirements of the *NPfI*. **Table 3-2** and **Table 3-3** presents noise criteria for residential and non-residential receivers, respectively.

Table 3-2 Project Noise Trigger Levels – Residential receivers

NCA	Period	Intrusiveness $L_{Aeq, 15min}$	Amenity $L_{Aeq, 15min}$	Project $L_{Aeq, 15min}$
NCA1 (urban)	Day	59	58	**58**
	Evening	57	48	**48**
	Night	52	43	**43**
NCA2 (suburban)	Day	47	53	**47**
	Evening	47	43	**43**
	Night	44	38	**38**
NCA3 (suburban)	Day	44	53	**44**
	Evening	44	43	**43**
	Night	42	38	**38**
NCA4 (suburban)	Day	44	53	**44**
	Evening	47	43	**43**
	Night	43	38	**38**

Table 3-3 Project Noise Trigger Levels – Non-residential receivers

Receiver	Receiver Type	Time of day	Amenity $L_{Aeq, 15min}$
Our Lady of Mercy College	School Classroom	When in use	30 (internal)#
O'Connell Street Public School*	School Classroom	When in use	30 (internal)#
Kiddie Garden Child Care and Preschool	Child Care Centre	When in use	30 (internal)#
Parramatta Park	Passive Recreation Area	When in use	45
Old Kings Oval	Active Recreation Area	When in use	50
Parramatta Leagues	Commercial	When in use	60
Parramatta District Men's Shed	Medical	When in use	45

\# a conservative 10dB external to internal correction will be used for this assessment.
* O'Connell Street Public School will be known as Bayanami Public School as of September 2019.

3.3 Sleep Disturbance

The previous NIA prepared by ALC in 2016 completed a sleep disturbance assessment for the operation of the Stadium. This assessment considered short term noise events from the usage of the car parks and loading dock which is consistent with this assessment. The ALC assessment determined that predicted noise emissions from these events will comply with the sleep disturbance screening criteria.

It should be noted that the assessment was conducted in accordance with the *INP* which employs a $L_{1(1min)}$ screening criteria whereas the *NPfI* employs a L_{max} screening criteria. However, as the predicted levels in the ALC report are considerably below the noise criteria, it is likely that predicted levels will comply when assessed for a L_{max} criterion. On this basis, a sleep disturbance assessment is not required and has not been completed for this assessment.

4 OPERATIONAL NOISE ASSESSMENT

This section will address the potential noise impact from the proposed modification on existing receivers. It is expected that the main noise sources from the proposed modification would include:

- Patron noise from within the function spaces; and
- Use of car parking spaces.

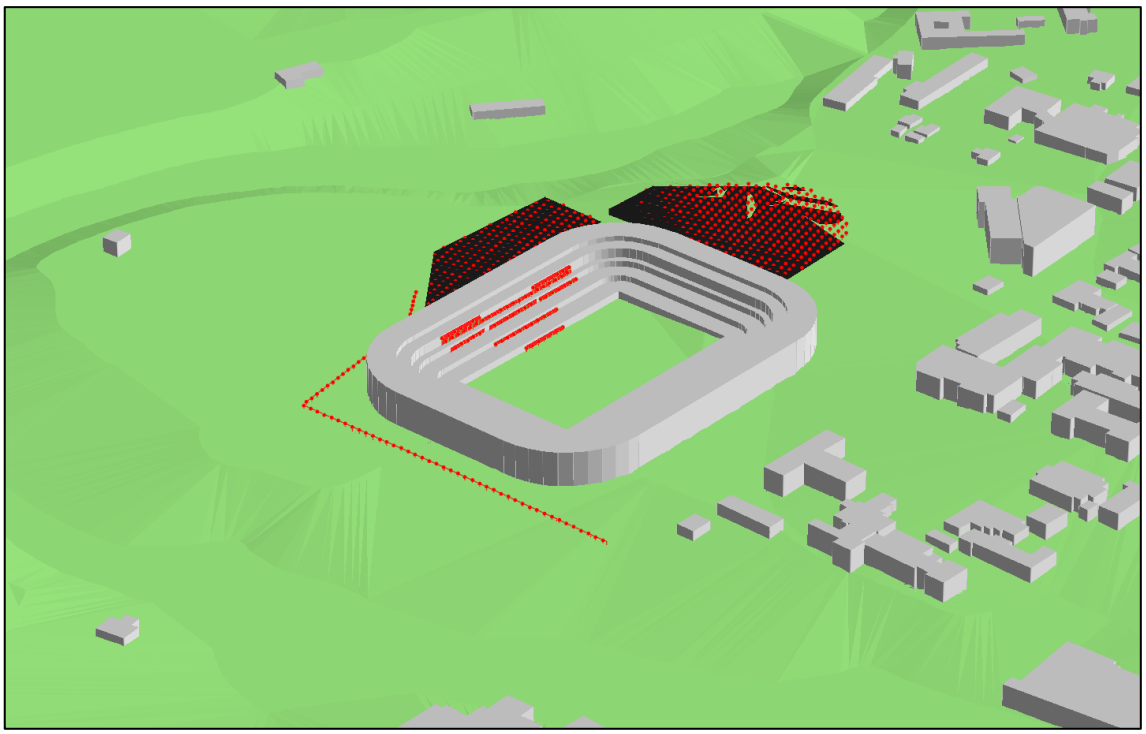
4.1 Noise Modelling Methodology

To predict the potential noise impacts from the proposed modification, an acoustic model, implementing the ISO9613 1/2 algorithms, has been prepared using the EMS Brüel & Kjær Predictor environmental noise modelling software. Factors addressed in the noise model are:

- Source noise emissions and locations;
- Shielding from structures;
- Noise attenuation due to geometric spreading;
- Ground absorption; and
- Atmospheric absorption.

Figure 4-1 presents an image of the noise model with noise source locations.

Figure 4-1 3D Noise Model with noise sources



4.2 Patron Noise Assessment

Noise modelling has been completed to determine the potential impact of patron noise from within the function spaces.

Table 4-1 presents sound power levels of people voice efforts and ambient music level. These levels were measured by Wilkinson Murray for previous projects.

Table 4-1 Source Sound Power Level – $L_{Aeq,15min}$ dBA

Type	dBA	Octave Band Centre Frequency (Hz) dBZ								
		31.5	63	125	250	500	1K	2K	4K	8K
Normal Voice Effort - Male	71	50	55	64	68	69	67	61	54	44
Raised Voice Effort - Male	78	50	55	64	72	76	75	69	60	50
Ambient Music	85	78	83	85	82	80	80	78	74	65

The indoor to outdoor façade levels were predicted based on the below assumptions.

- Max capacity in all proposed function spaces at one time;
- 50% of patrons speaking at raised voice;
- Operable facades are open; and
- Ambient music level of 85dBA being played in function spaces.

These façade levels were then incorporated into the noise model at appropriate locations (see **Figure 4-1**). **Table 4-2** summarises the façade noise levels implemented.

Table 4-2 Façade Sound Power Level – $L_{Aeq,15min}$ dBA

Floor	Function Room	No. of Patrons	Façade Level
Ground	Field Club	120	89
Level 1	Cumberland Lounge	1200	94
Level 2	Directors Club	200	91
Level 2	Level 2 South	224	91
Level 2	Level 2 North	224	91
Level 3	Level 3	408	96
Level 4	Level 4 South	70	89
Level 4	Level 4 North	70	89

Figure 4-2 and **Table 4-3** presents the predicted noise emissions from the function spaces. The modelling demonstrates that noise levels at nearby receivers will be less than 38dBA and will comfortably comply with all noise triggers when assessed at all receivers.

Figure 4-2 Patron Noise Emissions

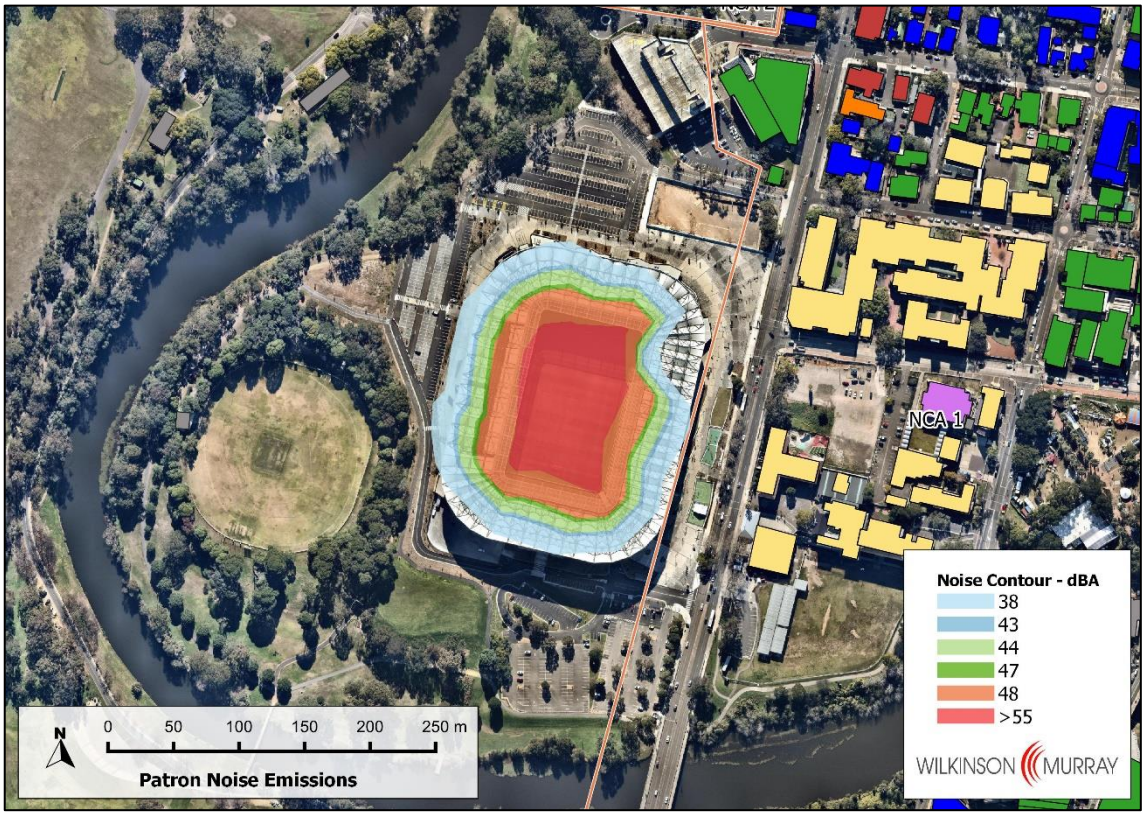


Table 4-3 Received Noise Levels, Patron Noise – $L_{Aeq,15min}$ dBA

Receiver	Receiver Type	Received Level	Criteria
40 O'Connell Street	Residential	32	43
Our Lady of Mercy College	School Classroom	32	40
O'Connell Street Public School	School Classroom	29	40
Kiddie Garden Child Care and Preschool	Child Care Centre	34	40
Parramatta Park	Passive Recreation Area	26	45
Old Kings Oval	Active Recreation Area	29	50
Parramatta Leagues	Commercial	33	60
Parramatta District Men's Shed	Medical	27	45

4.3 Car Park Noise

Car park noise emission predictions were based on the methodology outlined in *"Recommendations for the Calculation of Sound Emissions of Parking Areas, Motorcar centres and Bus Stations as well as of Multi-Storey Car Parks and Underground Car Parks 6th Edition"* (*BayLfU*) for outdoor car parks at grade. For this assessment it has been assumed that:

- 100% capacity will be achieved within 1 hour (478 movements in 1 hour, 120 movements in 15 minutes);
- One movement consists of one vehicle either entering or exiting a parking space;
- Vehicle movements are evenly spaced throughout the hour; and
- The Sound Power Level for one vehicle movement is L_{eq} 64dBA per hour.

Figure 4-3 presents predicted noise emissions from the car parking areas. Note that the only residential receivers within the 38dBA contour are in NCA1 which has a night-time noise trigger level of 43dBA. **Table 4-4** presents the predicted received noise levels at the nearest receivers and compares it against the respective external noise criteria.

The modelling predicts that noise from the use of the car parks during non-event day functions will comply with the noise trigger levels outlined in **Table 3-2** when assessed at all receivers.

Figure 4-3 Car Park Noise Emissions

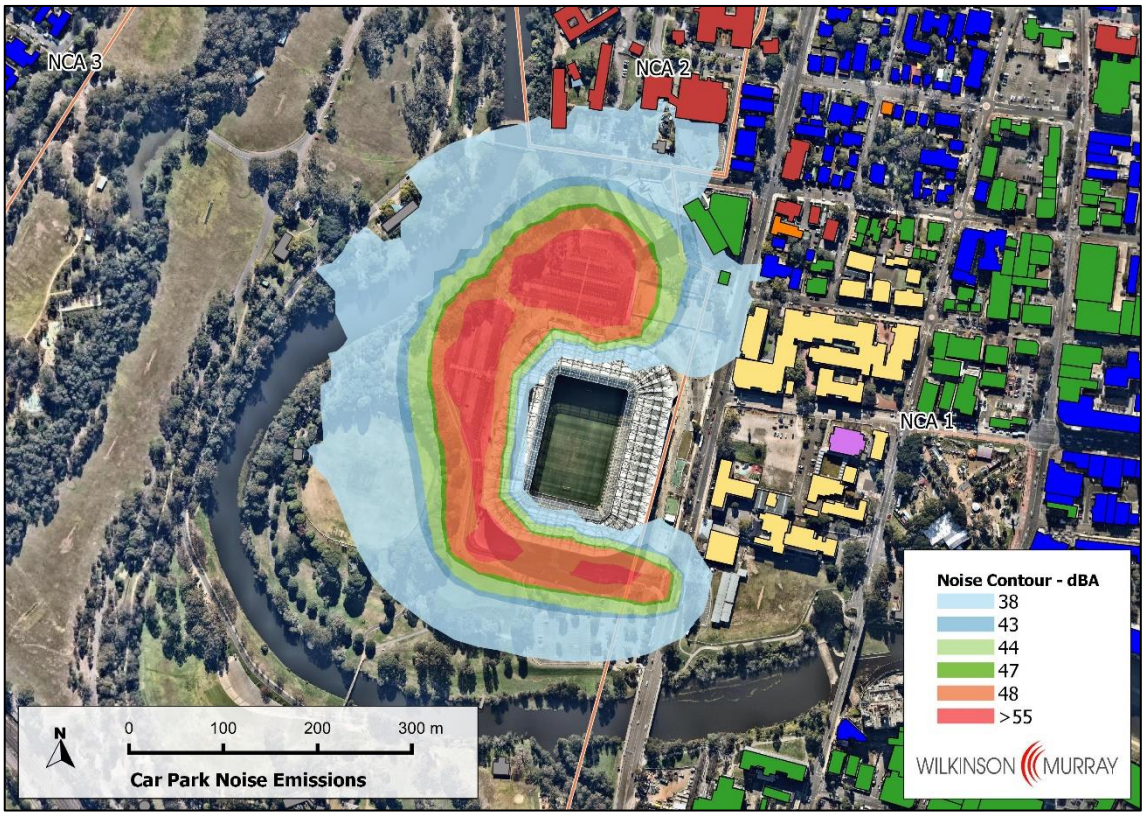


Table 4-4 Received Noise Levels, Car Park Noise – $L_{Aeq,15min}$ dBA

Receiver	Receiver Type	Received Level	Criteria
40 O'Connell Street	Residential	37	43
Our Lady of Mercy College	School Classroom	39	40
O'Connell Street Public School	School Classroom	39	40
Kiddie Garden Child Care and Preschool	Child Care Centre	27	40
Parramatta Park	Passive Recreation Area	40	45
Old Kings Oval	Active Recreation Area	46	50
Parramatta Leagues	Commercial	47	60
Parramatta District Men's Shed	Medical	40	45

4.4 Cumulative Noise Impact

Due to the expected peak period of activities, receivers are unlikely to receive worst case car park noise and patron noise simultaneously. Nonetheless, an assessment has been completed and **Table 4-5** presents the predicted received noise levels. Predicted levels comply with relevant noise trigger levels.

Table 4-5 Received Noise Levels, Cumulative Noise – $L_{Aeq,15min}$ dBA

Receiver	Receiver Type	Received Level	Criteria
40 O'Connell Street	Residential	38	43
Our Lady of Mercy College	School Classroom	40	40
O'Connell Street Public School	School Classroom	40	40
Kiddie Garden Child Care and Preschool	Child Care Centre	35	40
Parramatta Park	Passive Recreation Area	40	45
Old Kings Oval	Active Recreation Area	46	50
Parramatta Leagues	Commercial	47	60
Parramatta District Men's Shed	Medical	40	45

5 CONCLUSION

Wilkinson Murray has completed a Noise Impact Assessment for the proposed Modification to the approved Western Sydney Stadium.

The Modification proposes to increase the usage of available function spaces within the Stadium, allowing for up to 2,514 patrons across the function spaces at any one time. Operational times for these function spaces will be from 7.00am to 12.00am, 7 days a week. Car parking will be limited to the northern and western car parks

The assessment has considered noise breakout from the function spaces and emissions to nearest receivers. The assessment has concluded that unacceptable noise impacts will not result from internal usage of function spaces. Even under the highly unlikely scenario of there being 2,514 patrons attending functions on site at the same time on a non-event day, operations will comply will all relevant noise assessment guidelines.

The assessment has also considered noise emissions from the use of the car parks. The assessment has considered a worst case of 100% capacity within 1 hour, that is 478 movements within the hour. The assessment concludes that for a worst-case scenario, noise emissions from the car park will comply with all relevant noise assessment guidelines and will not have an unacceptable impact on nearest receivers.

Although unlikely, an assessment has been completed for received noise levels when both the car park and function spaces are operating at worst case scenarios. The assessment has confirmed that received noise levels will comply with all relevant noise assessment guidelines and will not have an unacceptable impact on nearest receivers.