MANAGING DIRECTORS
MATTHEW PALAVIDIS
VICTOR FATTORETTO

GENERAL MANAGER
MATTHEW SHIELDS

Propped SICEEP W1 Student Accommodation Building Western Development Plot

Noise and Vibration Impact Assessment

SYDNEY
A: 9 Sarah St Mascot NSW 2020
T: (02) 8339 8000
F: (02) 8338 8399

SYDNEY MELBOURNE BRISBANE CANBERRA
LONDON DUBAI SINGAPORE GREECE

www.acousticlogic.com.au
ABN: 11 068 954 343

DOCUMENT CONTROL REGISTER

Project Number	20150964.1
Project Name	SICEEP W1 Student Accommodation Building
Document Title	Noise and Vibration Impact Assessment
Document Reference	20150964.1/1609A/R4/BW
Issue Type	Email
Attention To	Urbanest Pty Ltd Mr Andy Stubbs

Revision	Date	Document Reference	Prepared By	Checked By	Approved By
0	27/07/2015	20150964.1/2707A/R0/BW	BW		BW
1	26/08/2015	20150964.1/2707A/R1/BW	BW		BW
2	3/09/2015	20150964.1/2707A/R2/BW	BW		BW
3	9/09/2015	20150964.1/0909A/R3/BW	BW		BW
4	16/09/2015	20150964.1/1609A/R4/BW	BW		BW

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1 INTRODUCTION

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

The Application (referred to as SSDA 12) follows the approval of a staged SSD DA (SSDA 2) in December 2013. SSDA 2 sets out a Concept Proposal for a new mixed use residential neighbourhood at Haymarket referred to as "Darling Square", previously known as "The Haymarket". Darling Square forms part of the Sydney International Convention, Exhibition and Entertainment precinct (SICEEP) Project, which will deliver Australia's global city with new world class convention, exhibition and entertainment facilities and support the NSW Government's goal to "make NSW number one again".

More specifically this subsequent DA seeks approval for a residential building (student accommodation) within the Western development plot (Darling Drive) of Darling Square and associated public domain works. The DA has been prepared and structured to be consistent with the Concept Proposal DA.

Acoustic treatments for the control of external noise will be determined in order to comply with Central Sydney DCP 2012 guidelines for residential areas (which is suitable for the proposed student housing project), NSW SEPP requirements and Australian Standard 2107:2000.

2 OVERVIEW OF PROPOSED DEVELOPMENT

The proposal relates to a detailed ('Stage 2') DA for a residential building (student accommodation) in the Darling Drive Plot of Darling Square together with associated public domain works. The Darling Square Site is to be developed for a mix of residential and non-residential uses, including but not limited to residential buildings, commercial, retail, community and open space. The Darling Drive Plot is one of six development plots identified within the approved Concept Proposal.

More specifically, this SSD DA seeks approval for the following components of the development:

- Demolition of existing site improvements;
- Associated tree removal and planting;
- Construction and use of one residential building within the Darling Drive Plot, to be used for student accommodation purposes;
- Public domain improvements, including provision of a new urban courtyard space between student accommodation buildings W1 and W2; and
- Extension and augmentation of physical infrastructure / utilities as required.

2.1 BACKGROUND

The NSW Government considers that a precinct-wide renewal and expansion of the existing convention, exhibition and entertainment centre facilities at Darling Harbour is required, and is committed to Sydney reclaiming its position on centre stage for hosting world-class events with the creation of SICEEP.

Following an extensive and rigorous Expressions of Interest and Request for Proposals process, a 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 SICEEP.

Key features of the Preferred Master Plan include:

- Delivering world-class convention, exhibition and entertainment facilities, including:
  - Up to 40,000m^2 exhibition space;
  - Over 8,000m^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 persons.
- Providing a hotel complex at the northern end of the precinct.
- A vibrant and authentic new neighbourhood at the southern end of the precinct, now called 'Darling Square', including apartments, student accommodation, shops, cafes and restaurants.
- Renewed and upgraded public domain that has been increased by a hectare, including an outdoor event space for up to 27,000 people at an expanded Tumbalong Park; and
- 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.

On 21 March 2013 a critical step in realising the NSW Government's vision for the SICEEP Project was made, with the lodgement of the first two SSD DAs with the (now) Department of Planning and Environment. The key components of these proposals are outlined below.

2.2 PUBLIC PRIVATE PARTNERSHIP SSD DA (SSD 12_5752)

The Public-Private Partnership (PPP) SSD DA (SSDA 1) includes the core facilities of the SICEEP Project, comprising the new, integrated and world-class convention, exhibition and entertainment facilities along with ancillary commercial premises and public domain upgrades. SSDA1 was approved on 22 August 2013.

2.3 CONCEPT PROPOSAL (SSD 13_5878)

The Concept Proposal SSD DA (SSDA 2) establishes the vision and planning and development framework which will be the basis for the consent authority to assess detailed development proposals within the Darling Square Site. SSDA2 was approved on 5 December 2013. The Stage 1 Concept Proposal approved the following key components and development parameters:

- Indicative staging of demolition and development of future development plots;
- Land uses across the site including residential and non-residential uses;
- Street and laneway layouts and pedestrian routes;
- Open spaces and through-site links;
- Six separate development plots, development plot sizes and separation, building envelopes, building separation, building depths, building alignments, and benchmarks for natural ventilation and solar access provisions;
- A maximum total gross floor area (non-residential and residential GFA);
- Above ground car parking including public car parking;
- Residential car parking rates;
- Design Guidelines to guide future development and the public domain; and
- A remediation strategy.

In addition to the approval of SSDA2, the following approvals have been granted for various stages of the Darling Square site:

- Darling Drive (part) development plot (SSDA3) for the construction and use of a residential building/W2 (student accommodation) and the provision of associated public domain works approved on 7 May 2014;
- North-West development plot (SSDA4) for the construction and use of a mixed use commercial development and public car park building and associated public domain works approved on 7 May 2014; and
- South-West development plot (SSDA5) – construction and use of a mixed use residential development and associated public domain works approved on 21 May 2014.
- North-East development plot (SSDA7) – construction and use of a mixed use residential development and associated public domain works approved on 16 April 2014.

Approval was also granted on 15 June 2014 for SSDA6 which includes the construction and use of the International Convention Centre (ICC) Hotel and provision of public domain works.

This report has been prepared to support a detailed Stage 2 SSD DA for a residential building/W1 (student accommodation) and associated public domain works within Darling Square (SSDA 12), consistent with the Concept Proposal (SSDA 2).

2.4 SITE DESCRIPTION

The SICEEP Site is located within Darling Harbour. 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 (refer to **Figure 1**). The Darling Square Site is:

- located in the south of the SICEEP Site, within the northern portion of the suburb of Haymarket;
- bounded by the Powerhouse Museum to the west, the Pier Street overpass and Little Pier Street to the north, Harbour Street to the east, and Hay Street to the south; and

- irregular in shape and occupies an area of approximately 43,807m^2.

Figure 1 – Aerial Photograph of the SICEEP Site

The Concept Proposal DA provides for six (6) separate development plots across the Darling Square Site (refer to **Figure 2**):

1. North Plot;
2. North East Plot;
3. South East Plot;
4. South West Plot;
5. North West Plot; and
6. Western Plot (Darling Drive).

The Application Site area relates to the northern portion of the Western Plot and surrounds as detailed within the architectural and landscape plans submitted in support of the DA.

Figure 2 – Concept Proposal Development Plots

3 SITE DESCRIPTION

The subject site is located on the Western Plot of the Darling Square site. The site is located to the south of Pier Street with the light rail to the west and Darling Drive to the east. Pier Street is a five lane road that carries medium to high traffic volumes.

Figure 1 details the proposed development, existing development and noise measurement positions.

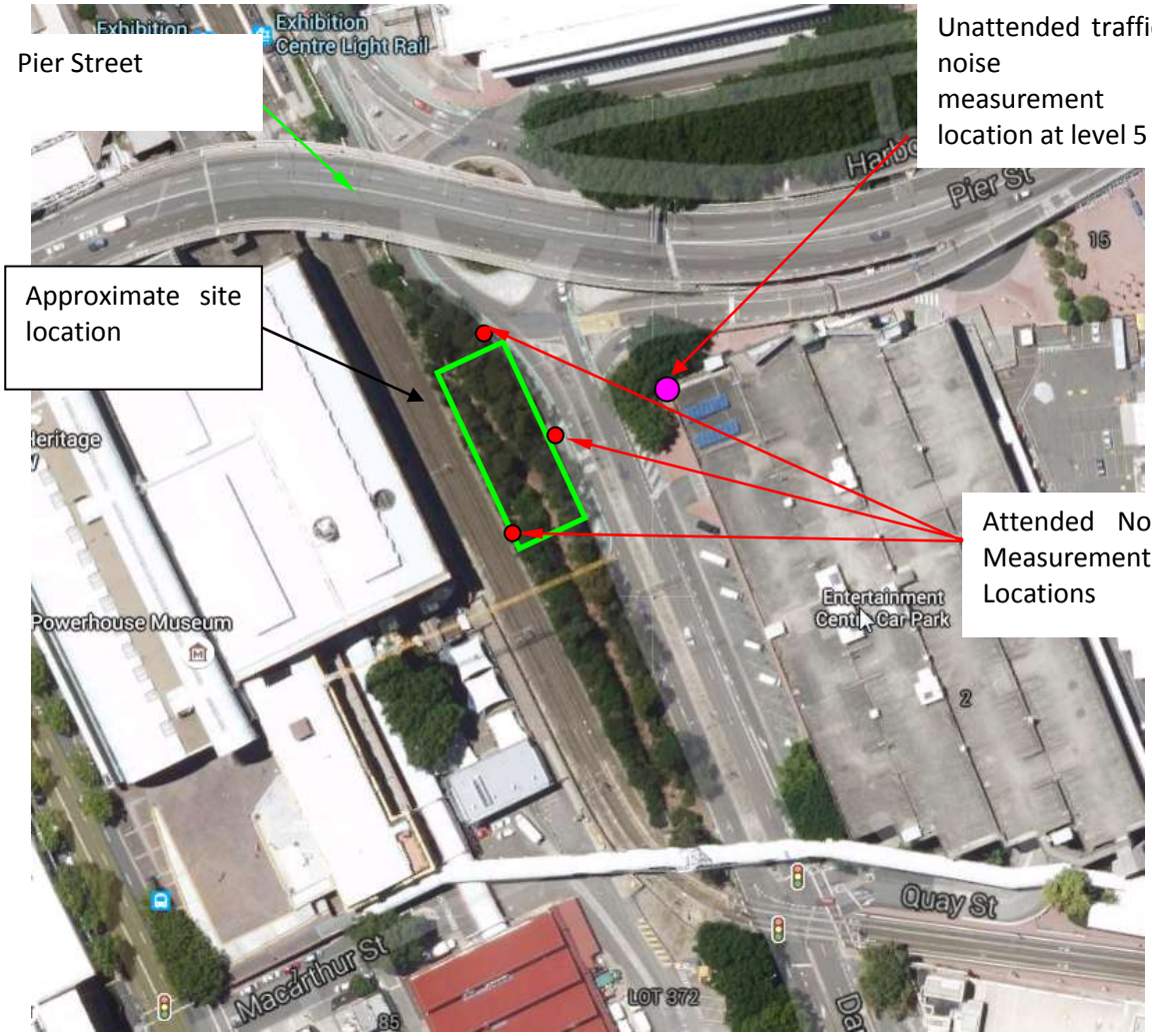


Figure 3: Site Map & Measurement Positions

4 TRAFFIC NOISE INTRUSION ASSESSMENT

This section of the report presents the internal environmental noise assessment conducted into the proposed development.

4.1 NOISE DESCRIPTORS

Traffic noise constantly varies in level, due to fluctuations in traffic speed, vehicle types, road conditions and traffic densities. Accordingly, it is not possible to accurately determine prevailing traffic noise conditions by measuring a single, instantaneous noise level. To accurately determine the effects of traffic noise a 15-20 minute measurement interval is utilised. Over this period, noise levels are monitored on a continuous basis and statistical and integrating techniques are used to determine noise description parameters. These parameters are used to measure how much annoyance would be caused by a particular noise source.

In the case of environmental noise three principle measurement parameters are used, namely L_{10}, L_{90} and L_{eq}.

The L_{10} and L_{90} measurement parameters are statistical levels that represent the average maximum and average minimum noise levels respectively, over the measurement interval.

The L_{10} parameter is commonly used to measure noise produced by a particular intrusive noise source since it represents the average of the loudest noise levels produced by the source.

Conversely, the L_{90} level (which is commonly referred to as the background noise level) represents the noise level heard in the quieter periods during a measurement interval. The L_{90} parameter is used to set the allowable noise level for new, potentially intrusive noise sources since the disturbance caused by the new source will depend on how audible it is above the pre-existing noise environment, particularly during quiet periods, as represented by the L_{90} level.

The L_{eq} parameter represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the measurement period. L_{eq} is important in the assessment of traffic noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of traffic noise.

Current practice favours the L_{eq} parameter as a means of measuring traffic noise, whereas the L_{10} parameter has been used in the past and is still incorporated in some codes. For the reasons outlined above, the L_{90} parameter is not used to assess traffic noise intrusion.

4.2 INTERNAL TRAFFIC NOISE CRITERIA

Noise from the surrounding noise sources has been assessed in compliance with the following.

4.2.1 NSW SEPP Requirements

Clause 87 of the NSW SEPP for rail traffic noise stipulates,

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

(a) a building for residential use,

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

> *(a) in any bedroom in the building--35 dB(A) at any time between 10.00 pm and 7.00 am,*
>
> *(b) anywhere else in the building (other than a garage, kitchen, bathroom or hallway)--40 dB(A) at any time.*

Clause 102 of the NSW State Environmental Planning policy states (and includes the requirements of *'Developments Near Major Roadways and Railway Lines')*:

> *"(1) This clause applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transit way or any other road with an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data published on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration:*
>
> > *(a) a building for residential use,*
> >
> > *(b) a place of public worship,*
> >
> > *(c) a hospital,*
> >
> > *(d) an educational establishment or child care centre.*
>
> *(2) Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.*
>
> *(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 LAeq levels are not exceeded:*
>
> > *(a) in any bedroom in the building--35 dB(A) at any time between 10 pm and 7 am,*
> >
> > *(b) anywhere else in the building (other than a garage, kitchen, bathroom or hallway)--40 dB(A) at any time"*

4.2.2 Summarised Internal Traffic Noise Criteria

The summarised internal traffic noise criteria have been presented as below.

Table 1 – Internal Traffic Noise Criteria

LOCATION	CRITERIA
Bedrooms	$35dB(A)_{\text{Mean Logarithmic}}\ L_{eq(\text{Night 9 hr})}$ (SEPP)
Living areas	$40dB(A)_{\text{Mean Logarithmic}}\ L_{eq\ (24\ hr\ )}$ (SEPP)

4.3 ATTENDED TRAFFIC NOISE MEASUREMENTS

As part of the noise impact assessment attended traffic noise measurements were conducted at the site at the locations shown above in Figure 1.

The noise measurements were obtained using a Norsonic 140 Sound Level Analyser, set to A-weighted fast response. The sound level meter was calibrated before and after the measurements using a Norsonic 1251 Sound Level Calibrator. No significant drift was recorded.

4.4 UNATTENDED TRAFFIC NOISE MEASUREMENTS

Unattended traffic noise measurements have previously been conducted at the site on the old carpark to the east of the site above the level of Pier Street to the north.

As this carpark no longer exists the results of the previously conducted logging have been used as part of this assessment as they include the more accurate noise level than that which could be obtained at the ground level at time of this report being undertaken.

Unattended noise measurements were obtained using an Acoustic Research Laboratories Pty Ltd noise logger. The logger was programmed to store 15-minute statistical noise levels throughout the monitoring period. The noises monitors were calibrated at the beginning and the end of the measurement using a Rion NC-73 calibrator. No significant drift was detected. All measurements were taken on A-weighted fast response mode. There were no significant periods of adverse weather conditions during the measurement period.

The unattended noise level measurements were conducted between from 5th to the 12th July 2012. The results of unattended noise logging are included in Appendix A.

Additional attended noise measurements have been conducted at the site to confirm the results of the previously obtained noise monitoring.

4.4.1 Meteorological conditions during monitor period

Section 3.4 of the NSW Environment Protection Authority (EPA) Industrial Noise Policy document outlines the following with regards to meteorological impacts on noise monitoring;

"Noise monitoring should not be conducted (or the data should be excluded) when average wind speeds (over 15-minute periods or shorter) at microphone height are greater than 5 m/s, or when rainfall occurs."

However, the same section of this policy also outlines that;

"Exceptions to this rule are allowed, provided the proponent is able to show that the wind-induced noise on the microphone, and sound levels due to rain, are at least 10 dB below the noise levels (that is, background and/or ambient) under investigation."

Weather conditions during the monitoring period have been assessed and the periods of inclement weather are highlighted in Appendix 1. The periods of inclement weather have been excluded from the monitoring data in calculation of noise levels.

Exceedances of the 5m/s average wind speed limit was noted on different days of the monitoring period, with these periods also excluded from the monitoring data in calculation of the rating background noise levels (RBL's).

Additionally, it should be noted that the subject site is located in a built-up area with multi-storey buildings, flat terrain and considerable less flora fauna in comparison to Observatory Hill, which is an elevated terrain, not obstructed by surrounding structures and will be primarily affected by noise generated by wind blowing through leaves.

4.4.2 Resultant Noise Levels

The following table presents the resultant noise levels at the proposed façade of the development. The noise levels are based on both the attended and unattended noise measurement results conducted by this office.

Table 2 – Measured Traffic Noise Levels

Locations	Traffic Noise Levels	
	Daytime (7am-10pm)	Night-time (10pm- 7am)
Pier Street	70dB(A) $L_{eq(1\ Hour)}$ 68dB(A) $L_{eq(15\ Hour)}$	65dB(A) $L_{eq(1\ Hour)}$ 64dB(A) $L_{eq(15\ Hour)}$
Darling Drive	67dB(A) $L_{eq(1\ Hour)}$ 64dB(A) $L_{eq(15\ Hour)}$	64dB(A) $L_{eq(1\ Hour)}$ 62dB(A) $L_{eq(15\ Hour)}$

5 LIGHT RAIL NOISE ASSESSMENT

This section of the report details the acoustic assessment into noise associated with the light railway located to the north west of the proposed site.

5.1 ACOUSTIC CRITERIA

5.1.1 State Environmental Planning Policy (SEPP Infrastructure) 2007

Clause 87 of the NSW SEPP for rail traffic noise stipulates,

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

(a) a building for residential use,

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

> *(a) in any bedroom in the building--35 dB(A) at any time between 10.00 pm and 7.00 am,*
>
> *(b) anywhere else in the building (other than a garage, kitchen, bathroom or hallway)--40 dB(A) at any time.*

5.2 SUMMARY OF ACOUSTIC OBJECTIVE

Table 3 – Internal Light Rail Noise Criteria

LOCATION	CRITERIA
Bedrooms	35dB(A) $L_{eq(Worst\ 1\ hr\ 10pm\ to\ 7am)}$ (City of Sydney)
	35dB(A)$_{Mean\ Logarithmic}$ $L_{eq(Night\ 9\ hr)}$ (SEPP)
Living areas	45dB(A) $L_{eq(Worst\ 1\ Hour\ 24hr)}$ (City of Sydney)
	40dB(A) $_{Mean\ Logarithmic}$ $L_{eq\ (24\ hr\ )}$ (SEPP)

5.3 LIGHT RAIL NOISE MEASUREMENTS

5.3.1 Attended Noise Measurements

The noise measurements were obtained using a Norsonic 140 Sound Level Analyser, set to A-weighted fast response. The sound level meter was calibrated before and after the measurements using a Norsonic 1251 Sound Level Calibrator. No significant drift was recorded.

Noise monitoring was conducted along the boundary of the site facing the light rail line and include noise associate with train noise from the station to the north of the site. Measured Noise

Levels applicable for the western façade of the proposed development on the 16th July, 2015 are presented in the table below.

Table 4 – Rail Noise Measurements on the North Western boundary of Site

Location/Time of Day	Measured Noise Level dB(A)
North Western boundary facing light railway line	55 dB(A) average maximum

6 EVALUATION OF EXTERNAL NOISE INTRUSION

Internal noise levels will primarily be as a result of noise transfer through the windows and doors as these are relatively light building elements that offer less resistance to the transmission of sound and include treatments for all surrounding noise sources including roadways and the light rail.

All external walls are proposed to be curtain wall which will comply with acoustic requirements detailed in this section of the report.

Calculations were performed taking into account the orientation of windows, barrier effects (where applicable), the total area of glazing, facade transmission loss and the likely room sound absorption characteristics. In this way the likely interior noise levels can be predicted.

In all cases, the selected glazing type (refer below) reduces internal noise levels to within the nominated criteria for the various space types for both traffic noise and light rail noise intrusion.

6.1 RECOMMENDED GLAZING

The following tables list the recommended glazing assemblies for this project to achieve the internal traffic noise requirements. All external windows and doors listed are required to be fitted with Q-lon type acoustic seals (Mohair Seals are unacceptable) and all the windows shall be closed.

The typical glazing thicknesses recommended are those needed to satisfy acoustic requirements and do not take into account other requirements such as structural, safety or other considerations. These additional considerations may require the glazing thickness to be increased beyond the acoustic requirement. The detailed glazing thickness have been marked up and attached to this report. Details of glazing to be installed on the project will be provided as part of the CC submission.

Table 5 – Recommended Glazing Construction

FAÇADE LOCATION	ROOM TYPE	RECOMMENDED GLAZING	ACOUSTIC SEALS
Eastern Façade facing the light rail	Student room	6mm float / 12mm air / 10mm float 10.38mm laminated	Yes
	Ground Floor Commercial areas	10.38mm laminated	Yes
Northern faced façade facing Pier Street	Student room	6mm float / 12mm air / 10mm float 10.38mm laminated	Yes
	Ground Floor Commercial areas	10.38mm laminated	Yes
Eastern façade	Student room	6mm float / 12mm air / 10mm float 10.38mm laminated	Yes
	Ground Floor Commercial areas	10.38mm laminated	Yes
Southern façade	Student room	6mm float / 12mm air / 6mm float 6.38mm laminated	Yes
	Ground Floor Commercial areas	6.38mm laminated	Yes

In addition to meeting the minimum glazing thickness requirements given, the design of the window mullions, perimeter seals and the installation of the windows/doors in the building openings shall not reduce the STC rating of the glazing assembly below the values nominated in the table above. Note that mohair type seals will not be acceptable for the windows requiring acoustic seals.

The window/door suppliers should provide evidence that the systems proposed have been tested in a registered laboratory with the recommended glass thicknesses and comply with the minimum listed STC requirements. Also, the glazing installer should certify that the window/doors have been constructed and installed in a manner equivalent to the tested samples.

Table 6 – Minimum STC of Glazing (with Acoustic Seals)

GLAZING ASSEMBLY	MINIMUM STC OF INSTALLED WINDOW
6mm float / 12mm air / 10mm float	35
6mm float / 12mm air / 6mm float	30
6.38mm laminated	35
10.38mm laminated	30

Noise intrusion through masonry or concrete masonry walls or external roof/ceiling constructions will be negligible and will not contribute to internal noise levels. Similarly, noise intrusion through the concrete slab roof construction will not be significant.

7 LIGHT RAILWAY VIBRATION

Trains induce ground born vibration that is transmitted through the subsoil. This vibration can be perceptible close to railways, both a tactile vibration.

7.1 TACTILE VIBRATION CRITERIA

As the site is located within 60m of the light railway line to the west of the site, a vibration assessment is recommended by the Rail Infrastructure Corporation "Interim Guidelines for Councils - Consideration of rail noise and vibration in the planning process". This Guideline recommends that habitable rooms should comply with the criteria in British Standard BS 6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)" as this standard includes guidance for the assessment of human response to building vibration including intermittent vibrations such as that caused by trains.

Human response to vibration has been shown to be biased at particular frequencies which are related to the orientation of the person. This standard provides curves of equal annoyance for various orientations. These curves are applied as correction filters such that an overall weighted acceleration level is obtained. As the orientation of the resident is unknown or varying the weighting filter used is based on the combined base curve as given in ISO 2631 & Australian Standard 2670 "Evaluation of Human Exposure to Vibration and Shock in Buildings (1 to 80Hz)" which represents the worst case of the X, Y and Z axes. Filtered measurements are made in all three co-ordinate axes and the highest value axis used.

The standard assesses the annoyance of intermittent vibration by using the Vibration Dose Value (VDV). Alternatively the VDV may be estimated by the eVDV which is derived by a simpler calculation using an empirical factor. The VDV or eVDV is calculated for the two periods of the day being the "Daytime" (7am-10pm) and "Night time" (10pm-7am). The overall value is then compared to the levels in Table 1. For this project the aim will be for a low probability of adverse comment.

Table 7 – Vibration Dose Values (m/s1.75) above which various degrees of adverse comment may be expected in residential buildings

Place	Low Probability of adverse comment	Adverse comment possible	Adverse comment probable
Residential buildings 15hr day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 9hr night	0.13	0.26	0.51

7.2 STRUCTURE BORNE NOISE

As the light railway line is not located within a tunnel no additional acoustic assessment of structure borne noise is required based on the Rail Infrastructure Corporation "Interim Guidelines for Councils - Consideration of rail noise and vibration in the planning process".

7.3 LIGHT RAIL TRAFFIC VIBRATION MEASUREMENTS

Train vibration measurements were untaken on undisturbed ground on a number of locations on site, as marked in the attached plan at ground level.

The manned measurements were carried out from 12:00pm to 1:30pm on 16th July 2015 at the location detailed on Figure 1 to the west of the proposed site adjacent to the light rail.

Equipment used consisted of:

- A Svan 958 AE Sound and Vibration Analyser was used for the vibration measurements. The analyser was connected to a SV08 four channel input module fitted with a Dytran triaxial accelerometer (tri-axial measurements)

7.4 MEASUREMENT RESULTS: VIBRATION DOSE VALUES

The maximum light train passby ground vibration acceleration, the typical passby period (gained from both the noise and vibration measurements) and the estimated number of train passbys were used calculate the overall eVDV values for each period of the day. The results are presented in table 3.

eVDV values were determined based on the daily train timetable information. The VDV per train used in the eVDV calculation was determined by using the highest measured vibration level during a passby.

Table 8 – Internal Railway Noise Level Criteria

Test Location	Time Period	Calculated eVDV $m/s^{1.75}$	Criteria eVDV $m/s^{1.75}$	Complies
Location 1	Day (7am – 10pm)	>0.05	0.2	Yes
	Night (10pm -7am)	>0.05	0.13	Yes

In the event the future train use increases, say by 10%, predicted eVDV will not increase significantly (no more than approximately 0.02 more than the levels predicted in the table above) and will not impact recommended vibration isolation treatments.

7.5 DISCUSSION

Based on the results of the vibration impacts from the adjacent light railway line to the proposed development no additional acoustic or vibration treatments are required to be conducted to the proposed development to ensure compliance with the relevant standards as presented within this report.

8 EXTERNAL NOISE EMISSION ASSESSMENT

Noise emissions from the site should be assessed to ensure that the amenity of nearby land users is not adversely affected.

Potential noise sources which should be assessed are:

- Noise generated by mechanical plant.

The nearest potentially affected noise receivers are:

- Commercial properties to the east, west, north and south of the proposed building.

Noise emissions noise will be assessed to the following criteria:

- The NSW EPA Industrial Noise Policy

8.1 BACKGROUND NOISE MONITORING

Unattended noise monitoring was conducted using an Acoustic Research Laboratories Pty Ltd series 315 noise monitor. The monitor was programmed to store 15-minute statistical noise levels throughout the unmanned monitoring period. Equipment was calibrated at the beginning and the end of the measurement using a Rion NC-74 calibrator; no significant drift was detected. All measurements were taken on A-weighted fast response mode.

8.1.1 Meteorological conditions during monitor period

Section 3.4 of the NSW Environment Protection Authority (EPA) Industrial Noise Policy document outlines the following with regards to meteorological impacts on noise monitoring;

"Noise monitoring should not be conducted (or the data should be excluded) when average wind speeds (over 15-minute periods or shorter) at microphone height are greater than 5 m/s, or when rainfall occurs."

However, the same section of this policy also outlines that;

"Exceptions to this rule are allowed, provided the proponent is able to show that the wind-induced noise on the microphone, and sound levels due to rain, are at least 10 dB below the noise levels (that is, background and/or ambient) under investigation."

Weather conditions during the monitoring period have been assessed and the periods of inclement weather are highlighted in Appendix 1. The periods of inclement weather have been excluded from the monitoring data in calculation of the rating background noise levels (RBL's) for the daytime, evening and night-time periods.

Exceedances of the 5m/s average wind speed limit was noted on different days of the monitoring period, with these periods also excluded from the monitoring data in calculation of the rating background noise levels (RBL's).

Measured background noise levels are presented below. Refer to Appendix 1 for unmanned noise monitoring data.

Table 9 - Measured Background Noise Levels

Description	Day Noise Level 7am to 6pm (dB(A))	Evening Noise Level 6pm to 10pm (dB(A))	Night Noise Level 10pm to 7am (dB(A))
Minimum Repeatable Background $L_{90,15min}$	58	55	51

8.2 NOISE EMISSION OBJECTIVES

Noise emissions from the development will have to achieve the following requirements.

8.2.1 NSW EPA Industrial Noise Policy

The NSW EPA Industrial Noise Policy, has two criteria which need to be satisfied namely Intrusiveness and Amenity. These are described below:

- *Intrusiveness Criteria* - This guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the L_{eq} descriptor not exceed the background noise level by more than 5 dB(A). Where applicable, the intrusive noise level should be penalised (increased) to account for any annoying characteristics such as tonality.

- *Amenity Criteria* - This guideline is intended to limit the absolute noise level from all "industrial" noise sources such as mechanical plant to a level that is consistent with the general environment.

The EPA's Industrial Noise Policy sets out acceptable noise levels for various localities. Table 2.1 on page 16 of the policy indicates 4 categories to distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface.

Noise levels are to be assessed at the property boundary or nearby dwelling, or at the balcony or façade of an apartment.

8.2.1.1 Intrusiveness Criterion

The guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the L_{eq} descriptor do not exceed the background noise level by more than 5dB(A). Where applicable, the intrusive noise level should be penalised (increased) to account for any annoying characteristics such as tonality.

Background noise levels adopted are presented in Section 5.1. Noise emissions from the site should comply with the noise levels presented below when measured at nearby property boundary.

Table 10 – Intrusiveness Noise Emission Goals

Location	Period/Time	Intrusiveness Noise Emission Goal dB(A) $L_{eq(15min)}$
Nearby Residences	Day (7am-6pm)	63
	Evening(6pm-10pm)	60
	Night(10pm-7am)	56

8.2.1.2 Amenity Criterion

The guideline is intended to limit the absolute noise level from all noise sources to a level that is consistent with the general environment.

The EPA Industrial noise policy sets out acceptable noise levels for various localities. Table 2.1 on page 16 of the policy indicates 4 categories to distinguish different areas. They are rural, suburban, urban and urban/industrial interface. This site is categorised by suburban receivers.

For the purposes of this condition:

- Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and Public Holidays;
- Evening is defined as the period from 6pm to 10pm.
- Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sunday and public holidays.

Table 11 – Amenity Noise Emission Goals

Location	Period/Time	Amenity Noise Emission Goal dB(A) $L_{eq(Period)}$
Nearby Residences	Day (7am-6pm)	60
	Evening(6pm-10pm)	50
	Night(10pm-7am)	45
Commercial premises	When in use	65

8.2.1.3 Sleep Disturbance

the EPA in its Environmental Noise Control Manual states that noise controls should be applied with the general intent to protect residences from sleep arousal. The criteria for the potential of sleep arousal is nominated as the $L_{1\ (1\ minute)}$ noise level of any specific noise source and should not exceed the background noise level (L_{90}) by more than 15 dB(A) outside a resident's bedroom window between the hours of 10pm and 7am. The L_1 noise level is the level exceeded for 1 per cent of the time and approximates the typical maximum noise level from a particular source. Where the typical repeatable existing L_1 levels exceed the above requirement then the existing L_1 levels form the basis for, sleep disturbance criteria.

Based on the results of background noise level monitoring at the site the sleep disturbance criteria is 66 dB(A) L_1 when measured at a potentially affected residential receiver.

8.3 NOISE EMISSION ASSESSMENT - MECHANICAL PLANT

Mechanical plant items are not typically selected at DA stage.

Detailed review of all external mechanical plant should be undertaken at construction certificate stage (once plant selections and locations are finalised). Acoustic treatments should be determined in order to control plant noise emissions to the levels set out in section 5.2 of this report.

All plant can be satisfactorily attenuated to levels complying with noise emission criteria through appropriate location and (if necessary) standard acoustic treatments such as noise screens, enclosures, in-duct treatments (silencers/lined ducting) or similar.

8.4 PROPOSED PUBLIC DOMAIN AREAS

This section of the report details the acoustic assessment of the proposed public domain area and specifically the central courtyard between the buildings which will be used as an outdoor cinema.

The proposed located of the public domain areas is detailed in Figure 4 below.

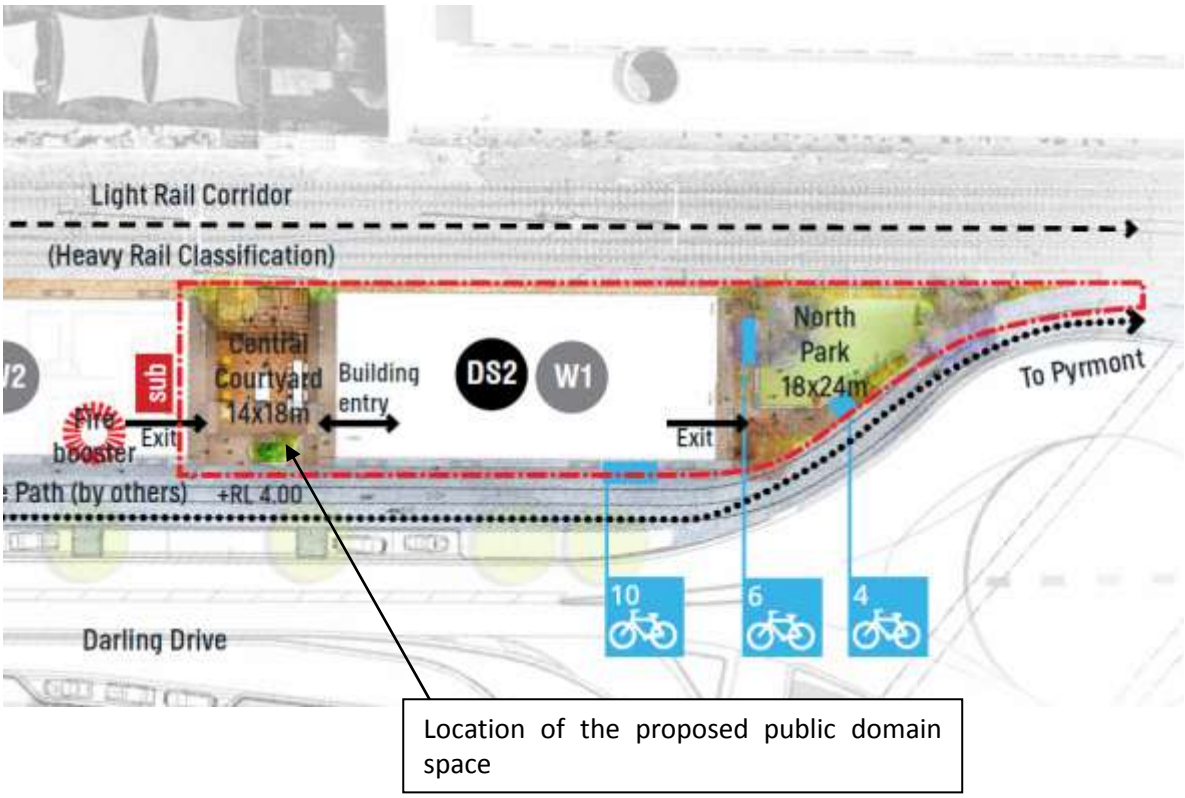


Figure 4 – Location of the public domain space

The potentially worst case noise operation of the space includes the used of the public domain area for a outdoor cinema. The proposed option of which will include the following:

1. Maximum capacity of up to 50 patrons.

2. Hours of operation 9am – 10pm 7 days Monday to Thursday and, 9am – 11pm Friday to Sunday.

3. Playing of the sound track associated with the cinema will be conducted via Wifi headphone sound access only to be provided through a Crestron' AV management system and will not be conducted via speakers.

The proposed public domain layout is detailed in Figure 5 below.

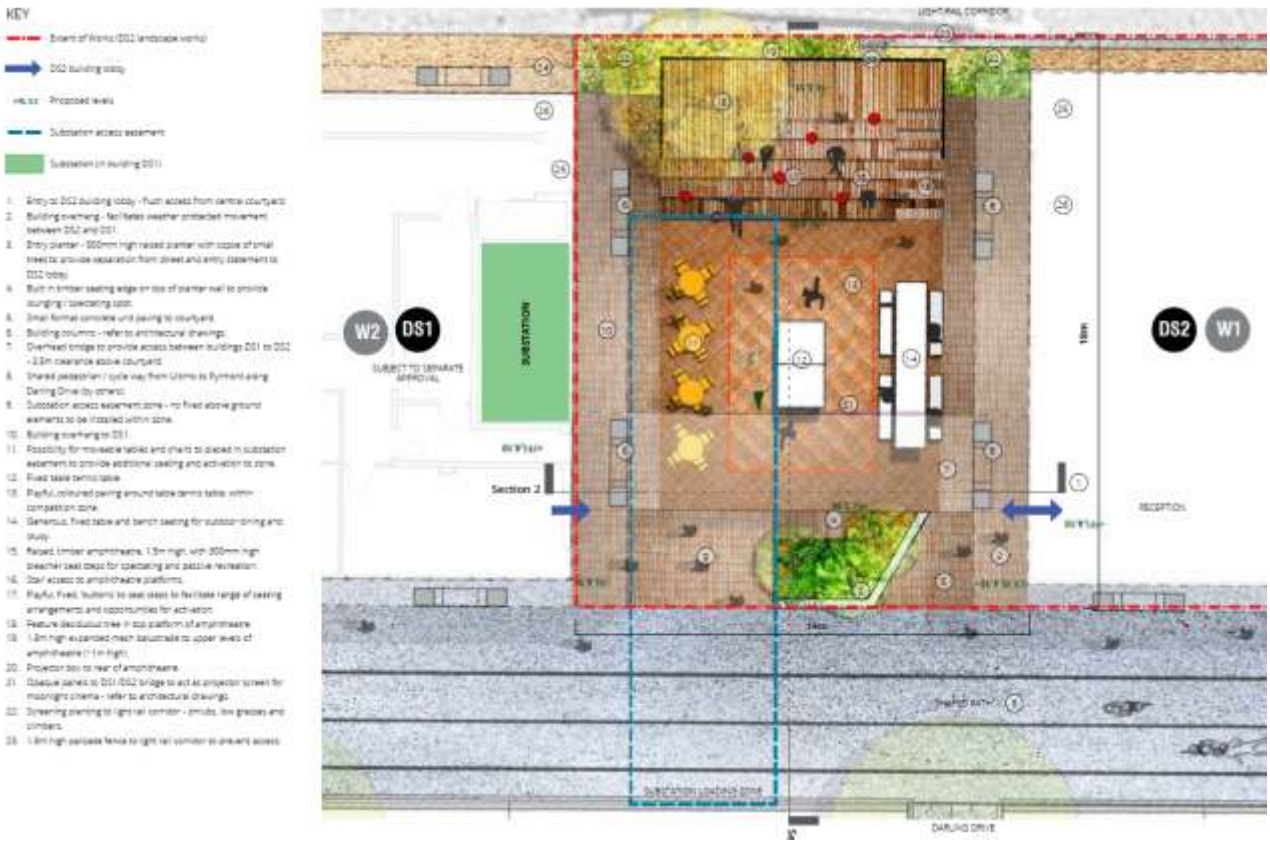


Figure 5 – Public Domain Space configuration

An assessment of the potently worst case operation as an outdoor cinema has been undertaken to ensure noise levels from the proposed public domain are complaint with the NSW EPA INP at the potentially worst affected residential receiver.

Based on the location of the site the potentially worst affected residential receiver within proximity to the site is located to the west of the site with an approximate distance of 130m on Harris Street.

8.4.1 Cinema Noise Source

The primary noise sources associated with the proposed outdoor cinema, with the potential to cause impacts on surrounding sensitive receivers are;

- Although the cinema includes WIFI head phones the greatest noise source will be as a result of patrons talking prior and post a showing or laughing during a cinema period.

- This assessment has assumed that the noise emission predictions to the identified surrounding sensitive receivers are based on the following;

- Noise created by patrons:

    - Typical patron noise would be from normal conversation (before or after the film). It is assumed that the average sound power level created by a patron would be 75dB(A)L_{10}, with one in three speaking at any one time.

    - Peak noise events (the L_1 noise level) is assumed to be from patron laughter, with an assumed sound power level of 84dB(A)L_1 (one in two laughing at any one time).

    - Typical noise level generation at the audience during a screening is 85dBL_1 (which is equivalent to an A-weighted level of approximately 79dB(A)L_{eq}).

8.4.2 Predicated Cinema Noise Levels

Predicted noise levels from the option of the proposed out door cinema at the potentially worst affected residential receiver are presented below (based on cinema operating at capacity). Predictions take into account:

- The acoustic treatments recommended in this section of the report are adopted.

Table 12 –Cinema Noise Calculations

Receiver Location	Time Period	Noise Source	Predicted Noise Level	Acoustic Criteria	Complies?
Potentially worst affected residential receiver	Prior to 10pm	79 dB(A) L_{eq}	29 dB(A) Leq	45 dB(A) Leq	Yes
	10pm – 11pm	85 dB(A) L1	35 dB(A)L_1	66 dB(A)L_1	Yes

8.4.3 Sample Calculations

Sample calculations for the operation of the outdoor cinema are detailed below:

Prior to 10pm

1. Cinema noise generation (Sound Pressure Level): 79 dB(A) Leq
2. Distance Correction (130m): -50 dB
3. Resultant Noise level at façade (Criteria 45 dB(A) L_{eq} worst case): 29 dB(A) L_{eq}

10pm to11pm (sleep disturbance)

1. Cinema a noise generation (Sound Pressure Level): 85 dB(A) L_1
2. Distance Correction (130m): -50 dB
3. Resultant Noise level at façade (Criteria 66 dB(A) L_1 worst case): 35 dB(A) L_1

Based on the result of the assessment noise from the operation of the public domain area during the worst case period when being operated as an external cinema will comply with the relevant noise level criteria of the NSW EPA INP and therefore acoustically acceptable.

9 CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

An assessment of noise, vibration and dust associated with construction activities proposed for SICEEP W1 Student Accommodation Buildingis presented within this section of the report. The site is indicated in Figure 1.

In recognition of their requirement to minimise noise and vibration impacts from the site to adjacent land uses, have commissioned this study. The principal objective of this study is to undertake an evaluation of equipment/processes proposed during the excavation and construction stages of the project, based on the requirements of the City of Sydney Council. The evaluation will be used to formulate and streamline effective regulation and mitigation measures.

The principal issues, which will be addressed in this report, are:

- Identification of noise and vibration standards which will be applicable to this project.
- Formulation of a strategy for construction to comply with the standards identified in the above point.
- Establishment of direct communication networks between affected groups namely City of Sydney Council, the building contractor and Acoustic Logic Consultancy Pty Ltd.

9.1 ACTIVITIES TO BE CONDUCTED AND ASSOCIATED NOISE SOURCES

The proposed excavation and construction activities are based on advice provided to this office regarding the anticipated processes on similar projects. A description of each of these noise producing processes and the associated equipment is presented below:

- **Early Works and Excavation Stage**

This stage is proposed to extend over a maximum 4 month period. It will include site establishment works followed by bulk and detailed excavation works. Detailed excavation will include trimming the perimeter of the excavation, excavating pits and trenches for footings and services.

The main noise sources may include;

  - Excavator (up to 30 tonnes).
  - Piling rig and anchoring rig.
  - Shotcrete pump and concrete mixer for basement and ground level works.
  - Trucks to clear the excavated material. All construction traffic will access the site via Darling Drive.

- **Construction Stage**

The construction stage is proposed to run for approximately 15 months.

This will include erection of concrete, brick and blockwork structure, followed by internal fitout works. Typical activities during this stage may include;

- Mobile cranes
- Hand tools – Impact drills, electric drills, hammering (jack hammers), power saw and angle grinders.
- Concrete pump
- Concrete ruck
- Trucks and trailers delivering materials and removing spoil from site.

9.2 AUSTRALIAN STANDARD 2436-1981 "GUIDE TO NOISE CONTROL ON CONSTRUCTION MAINTENANCE AND DEMOLITION SITE"

Noise emissions to be managed in accordance with principles in AS2436:

- That reasonable suitable noise criterion is established.
- That all practicable measures be taken on the building site to regulate noise emissions, including the siting of noisy static processes on parts of the site where they can be shielded, selecting less noisy processes, and if required regulating construction hours.
- The undertaking of noise monitoring where non-compliance occurs to assist in the management and control of noise emission from the building site.

Based on these the following procedure will be used to assess noise emissions:

- Predict noise levels produced by typical construction activities at the sensitive receivers.
- If noise levels exceed "background + 10 dB(A)" noise goal at sensitive receiver locations, investigate and implement all practical and cost effective techniques to limit noise emissions. A background + 10 dB(A) criterion has been applied because, due to the size of the whole site, impacts at any one sensitive receiver are unlikely to occur for a greater period than 6 months.
- If the noise goal is still exceeded after applying all practical engineering controls to limit noise emissions investigate management and other techniques to mitigate noise emissions.

9.3 VIBRATION

Vibrations caused by any proposed activities on site, at the façade or incident on the structure of any surrounding sensitive receivers, will be assessed against the following provisions:

- For structural damage vibration, German Standard DIN 4150-3 *Structural Vibration: Effects of Vibration on Structures; and*
- For human exposure to vibration, the evaluation criteria presented in NSW Environmental Protection Authority (EPA) "*Assessing Vibration: A Technical Guideline*" guideline.

The criteria and the application of these guidelines are discussed in separate sections below.

9.3.1 Structure Borne Vibrations

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria presented in DIN 4150-3 (1999-02) are presented in Table 2.

It is noted that the peak velocity is the absolute value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

Table 13 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

TYPE OF STRUCTURE		PEAK PARTICLE VELOCITY (mms^{-1})			
		At Foundation at a Frequency of			Plane of Floor of Uppermost Storey
		< 10Hz	10Hz to 50Hz	50Hz to 100Hz	All Frequencies
1	Buildings used in commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

9.3.2 Assessing Amenity

The NSW Environment Protection Authority's (EPA) publication "*Assessing Vibration: A Technical Guideline*" (Feb 2006), outlines vibration criteria to assess the effects on human exposure to vibration from industry, transportation and machinery. This will ensure the amenity of tenants within surrounding residential properties is not adversely impacted.

This document classifies vibrations in buildings into continuous (with magnitudes varying or remaining constant with time), impulsive (such as shocks) or intermittent (with the magnitude of each event being either constant or varying with time). Criteria stipulated in this publication is based on the type of vibrations generated by the source.

Criteria relevant to the proposed excavation and construction activities on site are detailed below.

Table 14 – EPA Recommended Human Comfort Vibration Criteria

		RMS acceleration (m/s^2)		RMS velocity (mm/s)		Peak velocity (mm/s)	
Place	**Time**	**Preferred**	**Maximum**	**Preferred**	**Maximum**	**Preferred**	**Maximum**
Continuous Vibration							
Residences	Daytime	0.01	0.02	0.2	0.4	0.28	0.56
Offices		0.02	0.04	0.4	0.8	0.56	1.1
Workshops		0.04	0.08	0.8	1.6	1.1	2.2
Impulsive Vibration							
Residences	Daytime	0.3	0.6	6.0	12.0	8.6	17.0
Offices		0.64	1.28	13.0	26.0	18.0	36.0
Workshops		0.64	1.28	13.0	26.0	18.0	36.0

9.4 CONSTRUCTION NOISE EMISSION GOALS

Noise generated by plant and equipment throughout the duration of the project will be managed to generally comply with the COS noise emission criteria, and where these noise goals may be exceeded, noise levels will be managed in strict compliance with AS2436.

Existing background noise levels in the area have previously been measured by this office, for the development application assessment of 87 Bay Street, Glebe. An unattended noise monitor was installed at the rear of the property at 87 bay Street (refer Figure 1), from the 15th to 26th May, 2015. The noise levels measured by this monitor will be representative of the ambient noise level on site. Monitoring was conducted using an Acoustic Research Laboratories noise monitor set to A-weighted fast response. The monitor was calibrated at the start and end of the monitoring period using a Rion NC-73 calibrator. No significant drift was noted.

Refer to Appendix 1 for detailed noise logging data with highlighted regions where wind exceeds 5m/s.

Table 15 – Measured Daytime Rating Background Noise Level

Measurement Location	**Measured Rating Background Noise Level dB(A) $L_{90(period)}$**	**Noise Goal dB(A) $L_{eq\ (15minutes)}$**
Affected receivers	58	7am-8am (BG + 5dB) = 63 dB(A) 8am-7pm (BG +10dB) = 68 dB(A)

9.5 ASSESSMENT OF POTENTIAL NOISE EMISSIONS

9.5.1 Activities to be Conducted and the Associated Noise Sources

We have been advised of the typical equipment/processes anticipated to be used for the construction of the subject development. Noise impacts from these activities on the amenity of the surrounding identified sensitive receivers, will be predicted in this section. .

The A-weighted sound power levels for the anticipated equipment/processes are outlined in the tables below.

Table 16 – Sound Power Levels

EQUIPMENT /PROCESS	SOUND POWER LEVEL dB(A)
Excavation/demolition	
Excavator (upto 20 tonnes)	108
Piling Rig (CFA Piles)	103
Anchoring Rig	100
Bobcat	105
Trucks (upto 12 tonnes)	100
Concrete Pump	107
Cement Mixing Truck	105
Construction	
Mobile Crane	104
Trucks (upto 12 tonnes)	100
Large Trailers	116
Drilling	94*
Hammering (jackhammers)	120*
Angle grinders	114*
Power Saw	115*
Impact drill	110*
Concrete/Shortcrete Pump	107
Cement Mixing Truck	105

* - includes 5 dB(A) addition for characteristics of noise source.

The noise levels presented in the above table are derived from the following sources:

1. On-site measurements;

2. Table D2 of Australian Standard 2436-1981 & Table A1 of Australian Standard 2436-2010; and

3. Data held by this office from other similar studies.

9.6 NOISE EMISSION PREDICTIONS

9.6.1 Methodology

Noise generated by plant and equipment will be managed to generally comply with the nominated acoustic criteria, and where this noise goal may be exceeded, noise will be managed based on principles consistent with Australian Standard 2436.

Predictions of noise levels at the sensitive receivers identified have been made of the construction processes with the potential to produce significant noise.

It is noted that:

- Many of the noise sources are present over a small period of the day or may be present for a few days with a significant intervening period before the activity occurs again.
- The distance between the noise source and the receiver.
- The screening effect provided by any remaining building structure or building shell. In particular, noise from works done on higher level will be substantially screened by the remaining building structure to receivers located on lower levels.

9.6.2 Commercial Receivers

Predicted noise levels to the commercial receivers surrounding the site follows:

Table 17– Predicted Noise Level – Commercial Receivers

Equipment / Process	External Noise Goal dB(A) $L_{eq\ (15min)}$	Predicted Level at Receiver dB(A)$L_{eq(15mins)}$	Complies
Early Works or Excavation Stage			
Excavator (upto 20 tonnes)	7am-8am (BG + 5dB) = 63 dB(A) 8am-7pm (BG +10dB) = 68 dB(A) 75 dB(A) (EPA construction noise goal)	77 – 80	Exceedances predicted. Refer section below 8.3, 11 & 10.
Piling Rig (CFA Piles)		72 – 75	
Anchoring Rig		69 – 72	
Bobcat		74 – 77	
Trucks (upto 12 tonnes)		65 – 72	
Concrete/Shortcrete Pump		82 – 89	
Cement Mixing Truck		80 – 87	
Construction Stage			
Mobile Crane	7am-8am (BG + 5dB) = 63 dB(A) 8am-7pm (BG +10dB) = 68 dB(A) 75 dB(A) (EPA construction noise goal)	73 – 76	Exceedances predicted. Refer section below 8.3, 11 & 10.
Trucks (upto 12 tonnes)		65 – 72	
Large Trailers		81 – 88	
Drilling		63 – prior to the construction of building shell 43 – after construction of building shell	Exceedances predicted, however will generally occur over limited periods and predominantly during internal works, when it will comply.
Hammering (jackhammers)		89 – prior to the construction of building shell 69 – after construction of building shell	Exceedances predicted. Refer section below 8.3, 11 & 10.

Table 17 – Predicted Noise Level – Commercial Receivers

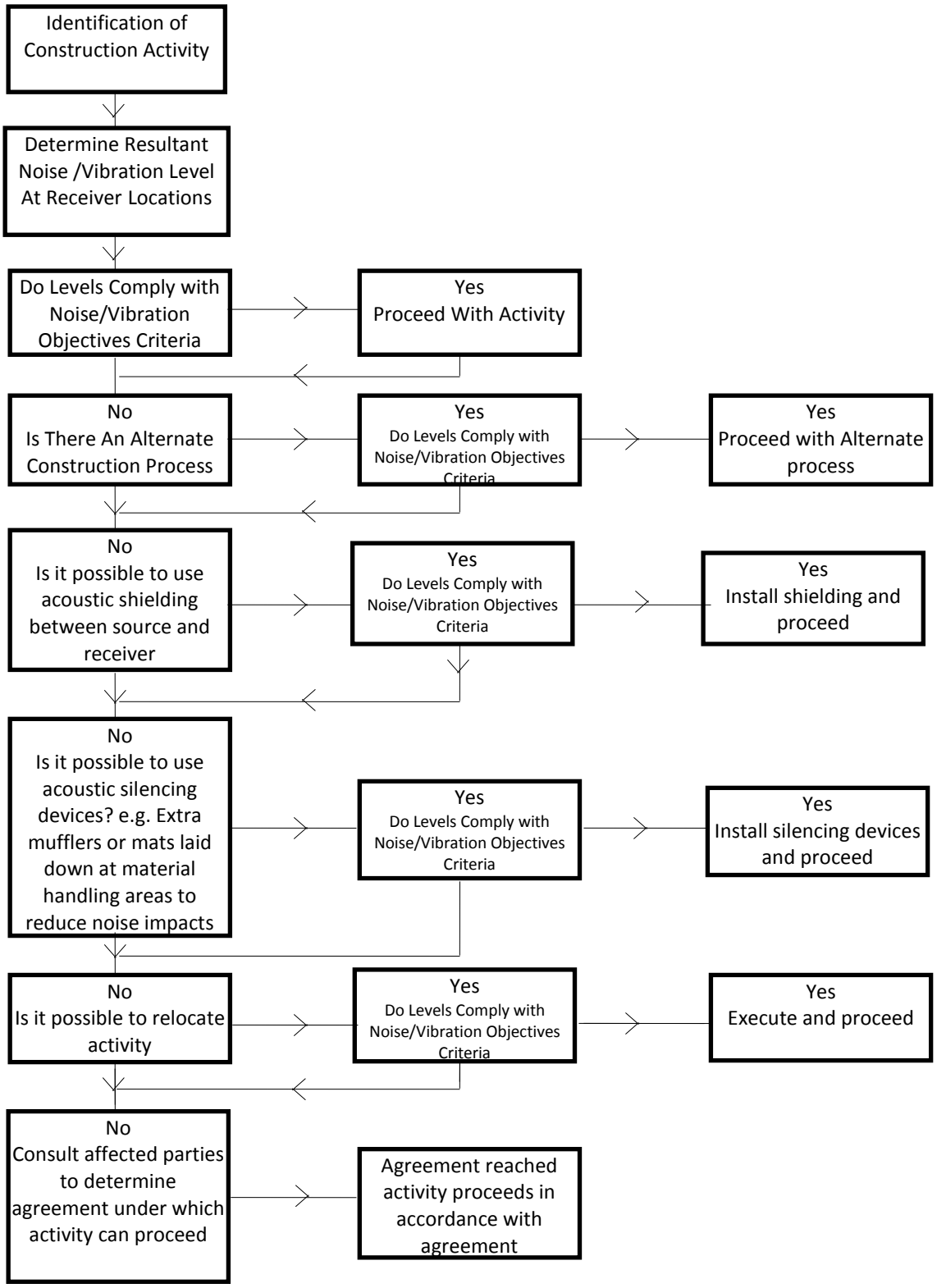
Equipment / Process	External Noise Goal dB(A) $L_{eq\ (15min)}$	Predicted Level at Receiver dB(A)$L_{eq(15mins)}$	Complies
Angle grinders	7am-8am (BG + 5dB) = 63 dB(A) 8am-7pm (BG +10dB) = 68 dB(A) 75 dB(A) (EPA construction noise goal)	83 – prior to the construction of building shell 63 – after construction of building shell	Exceedances predicted. Refer section below 8.3, 11 & 10.
Power Saw		84 – prior to the construction of building shell 64 – after construction of building shell	
Impact drill		79 – prior to the construction of building shell 59 – after construction of building shell	Exceedances predicted, however will generally occur over limited periods and predominantly during internal works, when it will comply.
Concrete/Shortcrete Pump		82 – 89	Exceedances predicted. Refer section below 8.3, 11 & 10.
Cement Mixing Truck		80 – 87	

9.7 ASSESSMENT OF VIBRATION

Based on the proximity of receivers to the site vibration is not expected to exceed suitable limits for both structural and architectural damage at any surrounding receiver.

9.8 CONTROL OF CONSTRUCTION NOISE

As a part of this management plan a detailed study has been undertaken of each of the proposed activities which will occur as a part of the proposed excavation and construction works on this project. This facilitates the formulation of noise control strategies for this project. The flow chart which follows illustrates the process which will be followed in assessing construction activities.


Identification of Construction Activity
Determine Resultant Noise /Vibration Level At Receiver Locations
Do Levels Comply with Noise/Vibration Objectives Criteria
Yes
Proceed With Activity
No
Is There An Alternate Construction Process
Yes
Do Levels Comply with Noise/Vibration Objectives Criteria
Yes
Proceed with Alternate process
No
Is it possible to use acoustic shielding between source and receiver
Yes
Do Levels Comply with Noise/Vibration Objectives Criteria
Yes
Install shielding and proceed
No
Is it possible to use acoustic silencing devices? e.g. Extra mufflers or mats laid down at material handling areas to reduce noise impacts
Yes
Do Levels Comply with Noise/Vibration Objectives Criteria
Yes
Install silencing devices and proceed
No
Is it possible to relocate activity
Yes
Do Levels Comply with Noise/Vibration Objectives Criteria
Yes
Execute and proceed
No
Consult affected parties to determine agreement under which activity can proceed
Agreement reached activity proceeds in accordance with agreement

9.9 AMELIORATIVE MEASURES

9.9.1 Site specific recommendations

Site specific recommendations as follows:

- Piling
    - Proposed bored piling is the least noise and vibration generating piling option available and hence will result in the lowest potential impacts to surrounding receivers.
- All transient plant should be selected to be wheeled (rubber wheels) not tracked.
- All plant/equipment shall be maintained as per noise control methods and procedures outlined in section below.
- Locate concrete pump at maximum distance from the southern and western boundaries of the site.
- Vehicle Noise:
    - If possible, locate site loading and unloading point at the north-east corner of site, to reduce impact to surrounding residential receivers. Hence all excavation and construction traffic (including concrete trucks) will remain at maximum distance from the surrounding residential receivers.
    - Truck movements should not commence prior to 7:30am.
    - All vehicles (excavators, bobcats, trucks, concrete trucks etc.) must turn off their engines during idling, to reduce impacts on surrounding receivers (unless truck ignition needs to remain on during concrete pumping).
- Additionally, for the duration of the excavation stage and for concrete pumping operations during the construction stage, we recommend appropriate notification to the surrounding identified sensitive receivers (letter box drops). This should include a detail description of the proposed works, equipment/machinery proposed for the phase of works, duration of this phase of works and respite periods during the day.

9.9.2 Dealing with Offensive Noise Levels

Should ongoing complaints of excessive noise occur, immediate measures shall be undertaken to investigate the complaint, the cause of noise exceedances and identify the required changes to work practices.

The effectiveness of any changes shall be verified before continuing. Documentation and training of site staff shall occur to ensure the practices that produced the exceedances are not repeated.

All complaints or offensive noise received should be fully investigated and reported to management. The complainant should also be notified of the results and actions arising from the investigation.

The investigation of offensive noise shall involve where applicable;

- noise measurements at the affected receiver;
- an investigation of the activities occurring at the time of the incident;
- inspection of the activity to determine whether any undue noise is being emitted by equipment; and
- Whether work practices were being carried out either within established guidelines or outside these guidelines.

Where an item of plant is found to be emitting excessive noise, the cause is to be rectified as soon as possible. Where work practices within established guidelines are found to result in excessive noise being generated then the guidelines should be modified so as to reduce noise emissions to acceptable levels. Where guidelines are not being followed, the additional training and counselling of employees should be carried out.

Measurement or other methods shall validate the results of any corrective actions arising from a complaint where applicable.

9.9.3 General recommendations

9.9.3.1 Selection of alternate appliance or process

Where a particular activity or construction appliance is found to generate excessive noise levels, it may be possible to select an alternative approach or appliance. For example; the use of a hydraulic hammer on certain areas of the site may potentially generate high levels of noise. By carrying this activity by use of pneumatic hammers, bulldozers ripping and/or milling machines lower levels of noise will result.

9.9.3.2 Acoustic Barrier

Barriers or screens can be an effective means of reducing noise. Barriers can be located either at the source or receiver.

The placement of barriers at the source is generally only effective for static plant (tower cranes). Equipment which is on the move or working in rough or undulating terrain cannot be effectively attenuated by placing barriers at the source.

Barriers can also be placed between the source and the receiver.

The degree of noise reduction provided by barriers is dependent on the amount by which line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15 dB(A) can be effected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8 dB(A) may be achieved. Where no line of sight is obstructed by the barrier, generally no noise reduction will occur.

As barriers are used to provide shielding and do not act as an enclosure, the material they are constructed from should have a noise reduction performance which is approximately 10 dB(A) greater than the maximum reduction provided by the barrier. In this case the use of a material such as 10 or 15mm plywood would be acceptable for the barriers.

The identified surrounding receivers are all multi-storey, hence installation of acoustic barriers on the site will be largely ineffective. Erection of a barrier along the eastern boundary of the site (assuming a 1.8m-2m high standard barrier) will shield the ground level tenancies of commercial receiver 2 from the subject site, however the upper levels of this receiver will still have a clear unrestricted view of the site. Similarly the residential tenancies of residential receiver 1 start at level 1, and will overlook any acoustic barrier of standard height.

9.9.3.3 Silencing Devices

Where construction process or appliances are noisy, the use of silencing devices may be possible. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

9.9.3.4 Material Handling

The installation of rubber matting over material handling areas can reduce the sound of impacts due to material being dropped by up to 20dB(A).

9.9.3.5 Treatment of Specific Equipment

In certain cases it may be possible to specially treat a piece of equipment to reduce the sound levels emitted. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

9.9.3.6 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. This includes locating fixed plant items as far as possible from residents as well as rotating plant and equipment to provide respite to receivers.

Construction vehicles accessing the site should not queue in residential streets and should only use the designated construction vehicle routes. Loading of these vehicles should occur as far as possible from any sensitive receiver.

9.9.4 Strategic Positioning of Processes On-Site

Where practicable, particular processes of activities can be located in particular positions on site to minimise noise to surrounding sensitive receivers.

For example, stationary plant may be positioned where direct line of sight shielding can be achieved using natural barriers or temporary screens, or may maximise the distance to the nearest sensitive receiver. This may also be applicable to the demolition of building structures where the

façade closest to residential receivers is left until last to provide barrier screening for the demolition of the other parts of the building.

9.10 COMMUNITY INTERACTION AND COMPLAINTS HANDLING

9.10.1 Establishment of Direct Communication with affected Parties

In order for any construction noise management programme to work effectively, continuous communication is required between all parties, which may be potentially impacted upon, the builder and the regulatory authority. This establishes a dynamic response process which allows for the adjustment of control methods and criteria for the benefit of all parties.

The objective in undertaking a consultation processes is to:

- Inform and educate the groups about the project and the noise controls being implemented;
- Increase understanding of all acoustic issues related to the project and options available;
- Identify group concerns generated by the project, so that they can be addressed; and
- Ensure that concerned individuals or groups are aware of and have access to the Site Complaints Register which will be used to address any construction noise related problems should they arise.

To ensure that this process is effective, regular scheduled meetings will be required for a finite period, until all issues have been addressed and the evidence of successful implementation is embraced by all parties.

An additional step in this process is to produce a newsletter informing nearby residents of upcoming activities that are likely to generate higher noise/vibration levels.

The building contractor will undertake the required community consultation with the community within the vicinity of the site as required.

9.10.2 Dealing with Complaints

Should ongoing complaints of excessive noise or vibration criteria occur immediate measures shall be undertaken to investigate the complaint, the cause of the exceedances and identify the required changes to work practices. In the case of exceedances of the vibration limits all work potentially producing vibration shall cease until the exceedance is investigated.

The effectiveness of any changes shall be verified before continuing. Documentation and training of site staff shall occur to ensure the practices that produced the exceedances are not repeated.

If a noise complaint is received the complaint should be recorded on a Noise Complaint Form. The complaint form should list:

- The name and address of the complainant (if provided);
- The time and date the complaint was received;
- The nature of the complaint and the time and date the noise was heard;
- The name of the employee who received the complaint;
- Actions taken to investigate the complaint, and a summary of the results of the investigation;
- Required remedial action, if required;
- Validation of the remedial action; and
- Setup vibration monitoring system at the location represents the nearest vibration receiver location with alarm device which can inform the project manager on site if the vibration exceedance happened.
- Summary of feedback to the complainant.

A permanent register of complaints should be held.

All complaints received should be fully investigated and reported to management. The complainant should also be notified of the results and actions arising from the investigation.

The investigation of a complaint shall involve where applicable;

- noise measurements at the affected receiver;
- an investigation of the activities occurring at the time of the incident;
- inspection of the activity to determine whether any undue noise is being emitted by equipment; and
- Whether work practices were being carried out either within established guidelines or outside these guidelines.

Where an item of plant is found to be emitting excessive noise, the cause is to be rectified as soon as possible. Where work practices within established guidelines are found to result in excessive noise being generated then the guidelines should be modified so as to reduce noise emissions to

acceptable levels. Where guidelines are not being followed, the additional training and counselling of employees should be carried out.

Measurement or other methods shall validate the results of any corrective actions arising from a complaint where applicable.

9.11 CONTINGENCY PLANS

Where non-compliances or noise complaints are raised the following methodology will be implemented.

1. Determine the offending plant/equipment/process.

2. Locate the plant/equipment/process further away from the affected receiver(s) if possible.

3. Implement additional acoustic treatment in the form of localised barriers, silencers etc. where practical.

4. Selecting alternative equipment/processes where practical

5. Setup noise monitoring devices at locations represent nearest noise receivers and provide noise data for each complain time period. Analysis is required and determine suitable noise mitigation measures.

Complaints associated with noise and vibration generated by site activities shall be recorded on a Noise Complaint Form. The person(s) responsible for complaint handling and contact details for receiving of complaints shall be established on site prior to construction works commencing. A sign shall be displayed at the site indicating the Site Manager to the general public and their contact telephone number.

10 CONCLUSION

This report presents an assessment of potential external noise intrusion into the proposed SICEEP W1 Student Accommodation Building development.

The assessment included the potential noise impact associated with traffic and light rail noise on the site.

Potential noise impact assessment from noise associated with traffic and light rail noise was conducted. Provided the recommendations in the report are implemented then potential adverse impact will be ameliorated and as such the development will fully comply with the requirements of the NSW SEPP.

Suitable noise level criteria from operation of the building once completed have been presented based on the requirements of the NSW EPA's industrial Noise Policy. The assessment includes the assessment of the proposed public domain space and its use as an external cinema and concludes that noise levels will comply with the requirements of the NSW EPA and is therefore acoustically acceptable.

Additionally noise impact from the construction of the site has been assessed and suitable construction noise and vibration mitigation strategies have been presented.

We trust this information is satisfactory. Please contact us should you have any further queries.

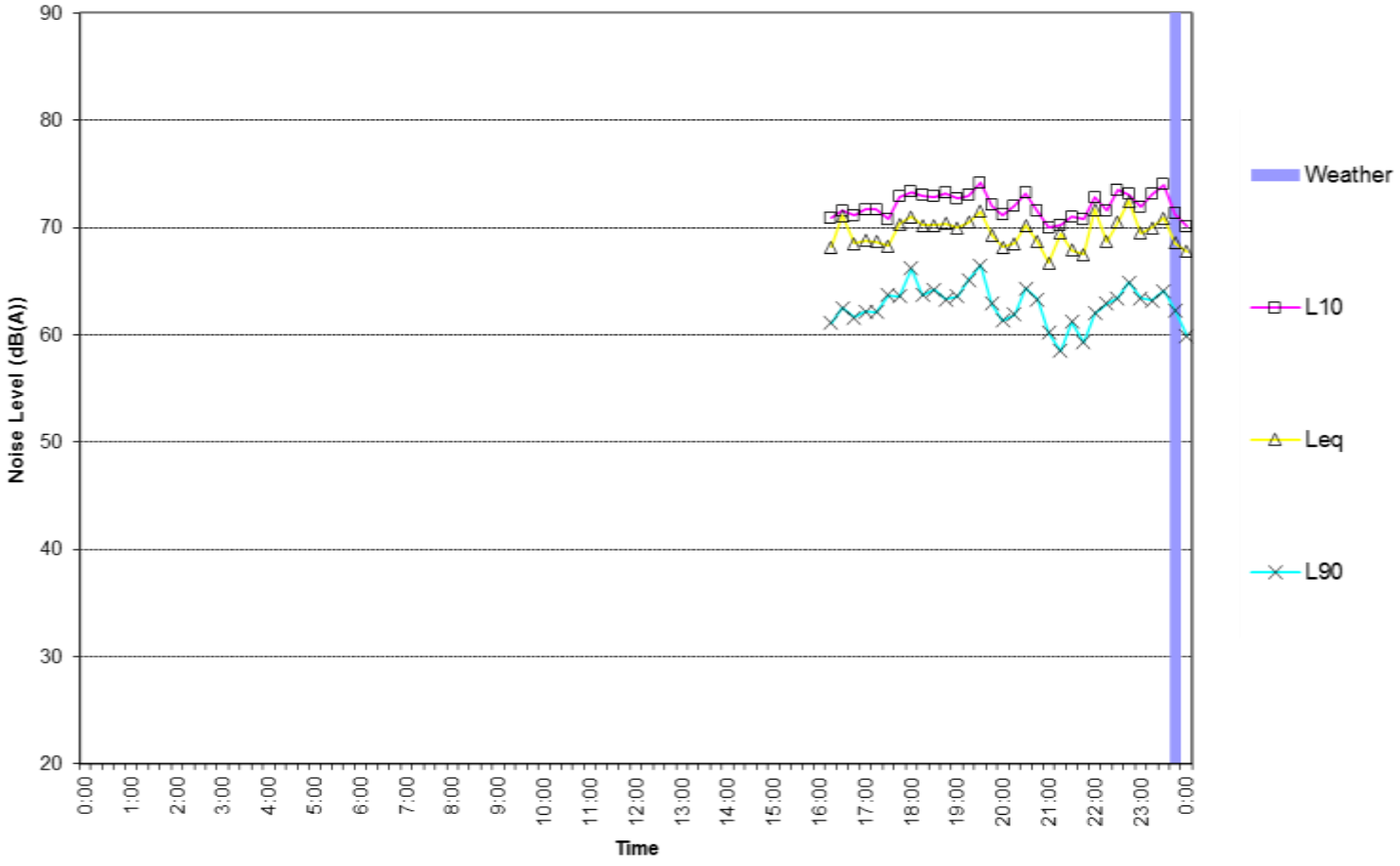
Yours faithfully,

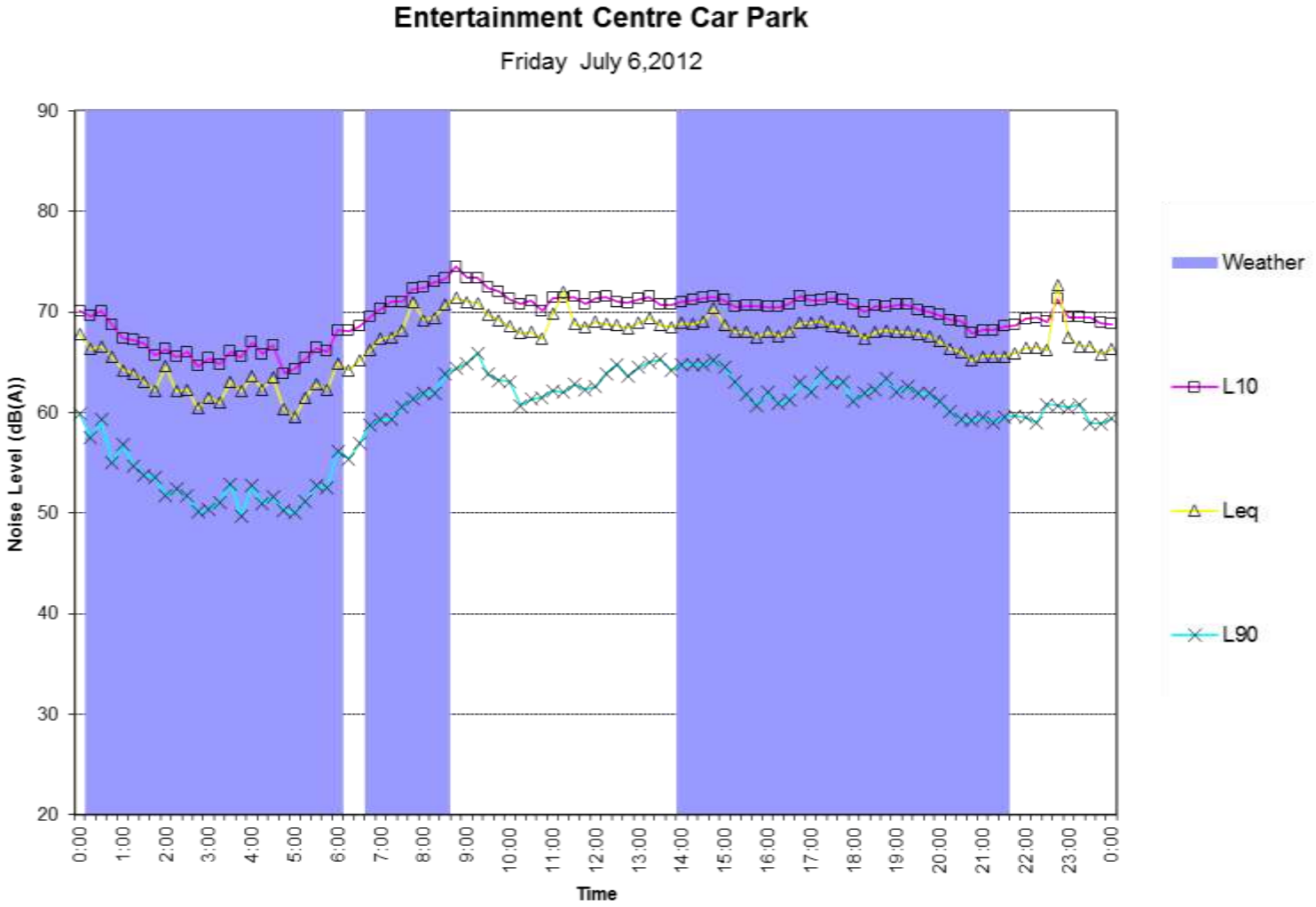
Acoustic Logic Consultancy Pty Ltd
Ben White

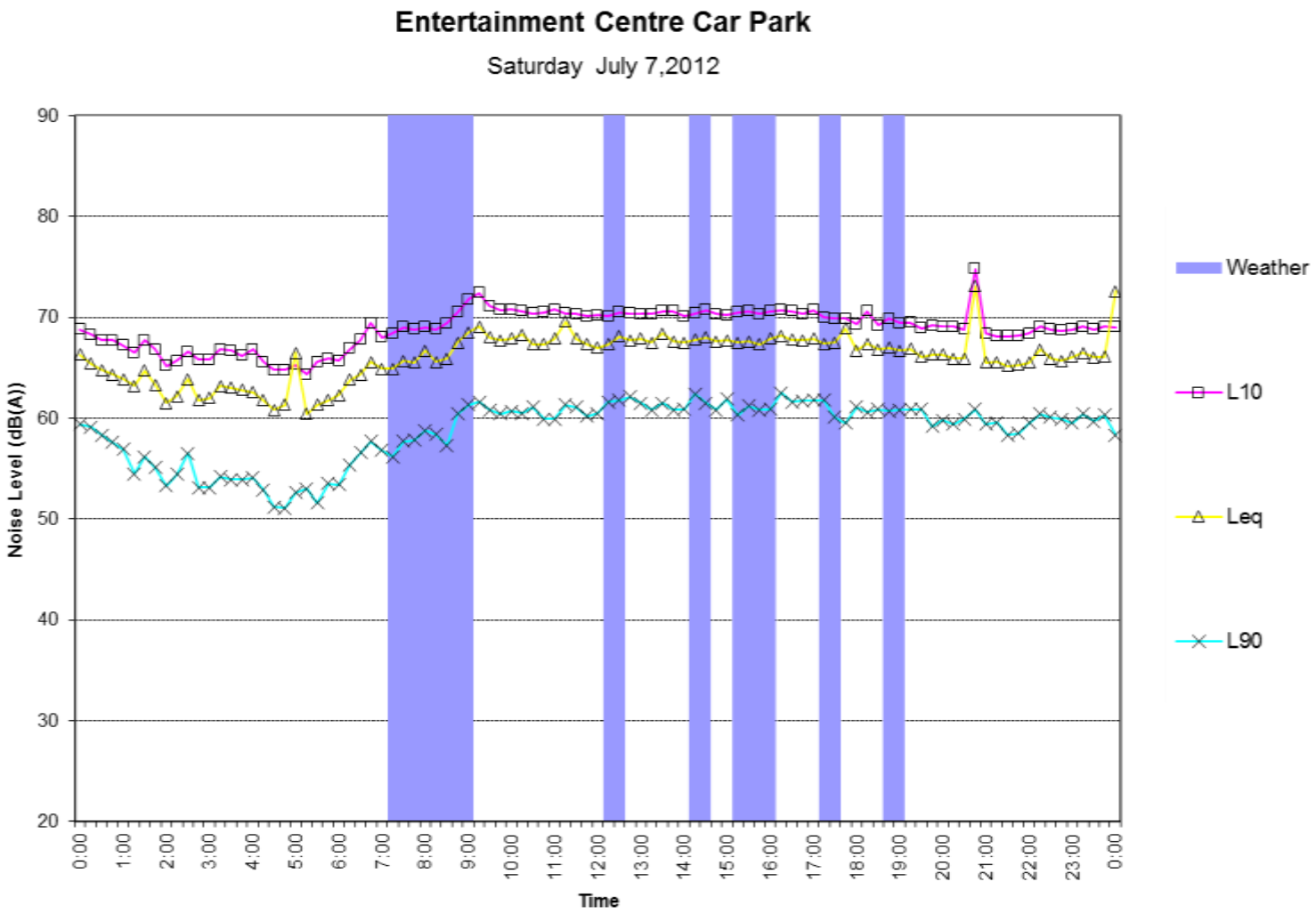
Appendix A - Unattended Noise Monitoring Data

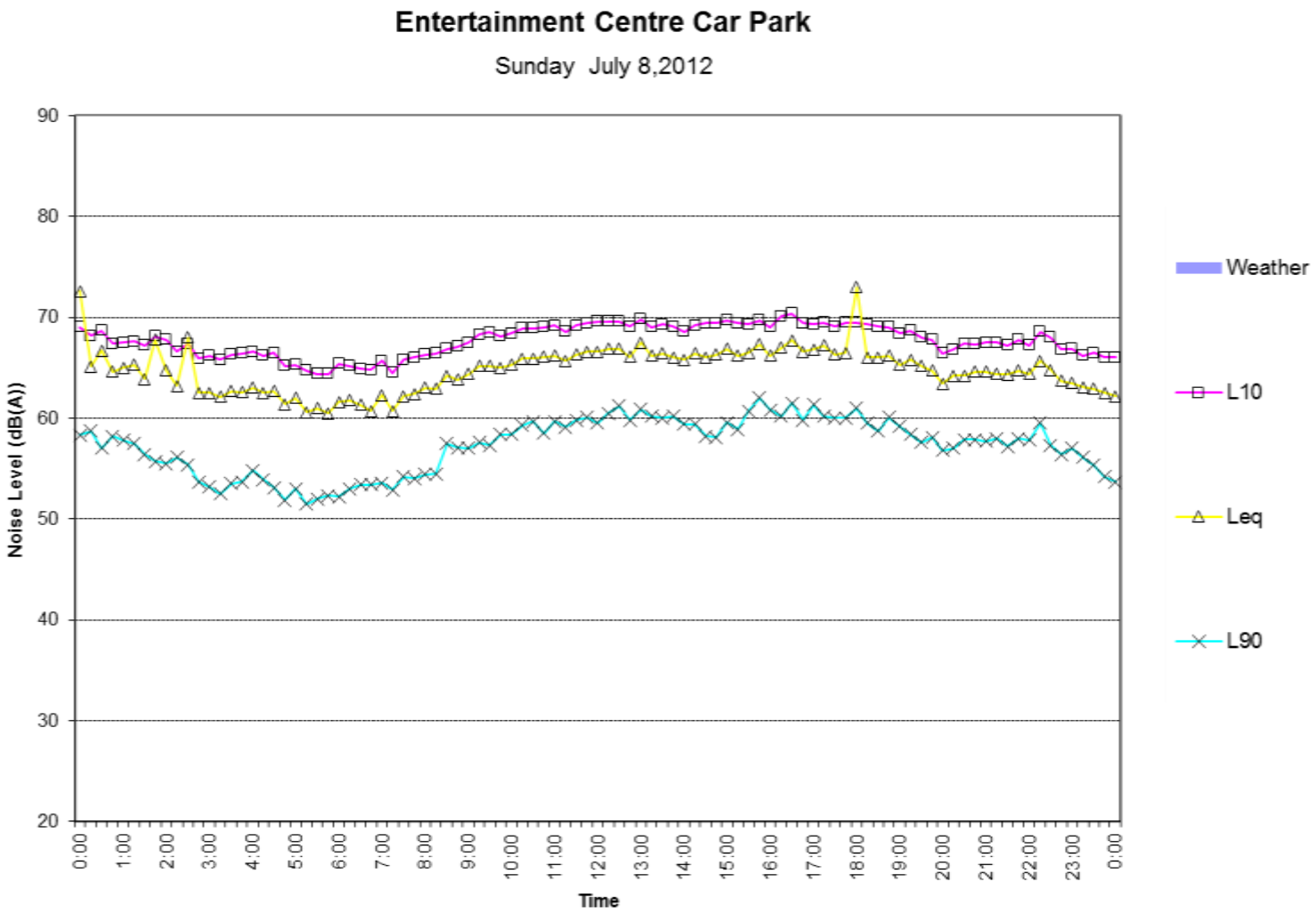
Entertainment Centre Car Park

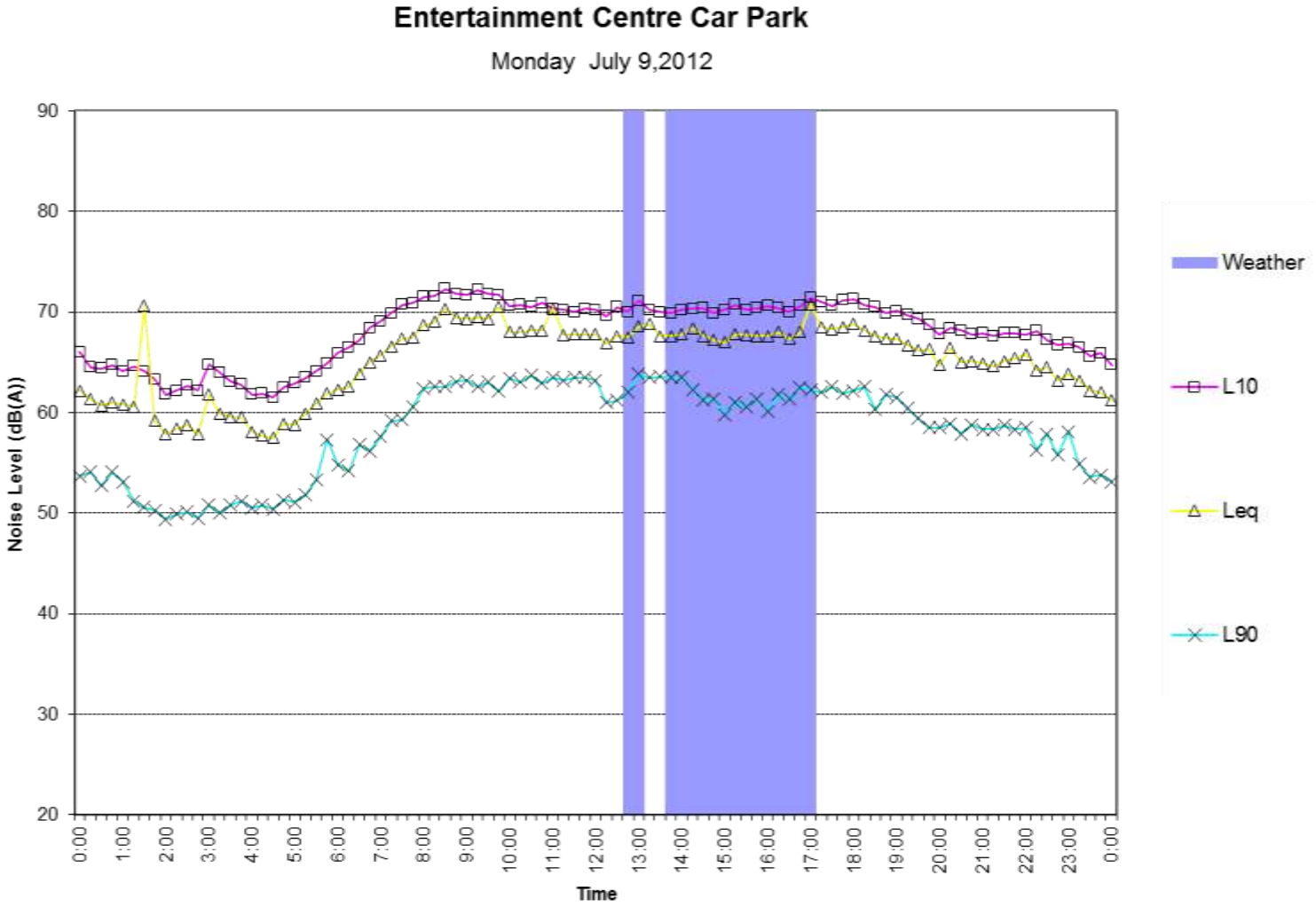
Thursday July 5,2012




Entertainment Centre Car Park
Friday July 6,2012
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
Weather
L10
Leq
L90


Entertainment Centre Car Park
Saturday July 7,2012
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
Weather
L10
Leq
L90


Entertainment Centre Car Park
Sunday July 8,2012
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
Weather
L10
Leq
L90


Entertainment Centre Car Park
Monday July 9,2012
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
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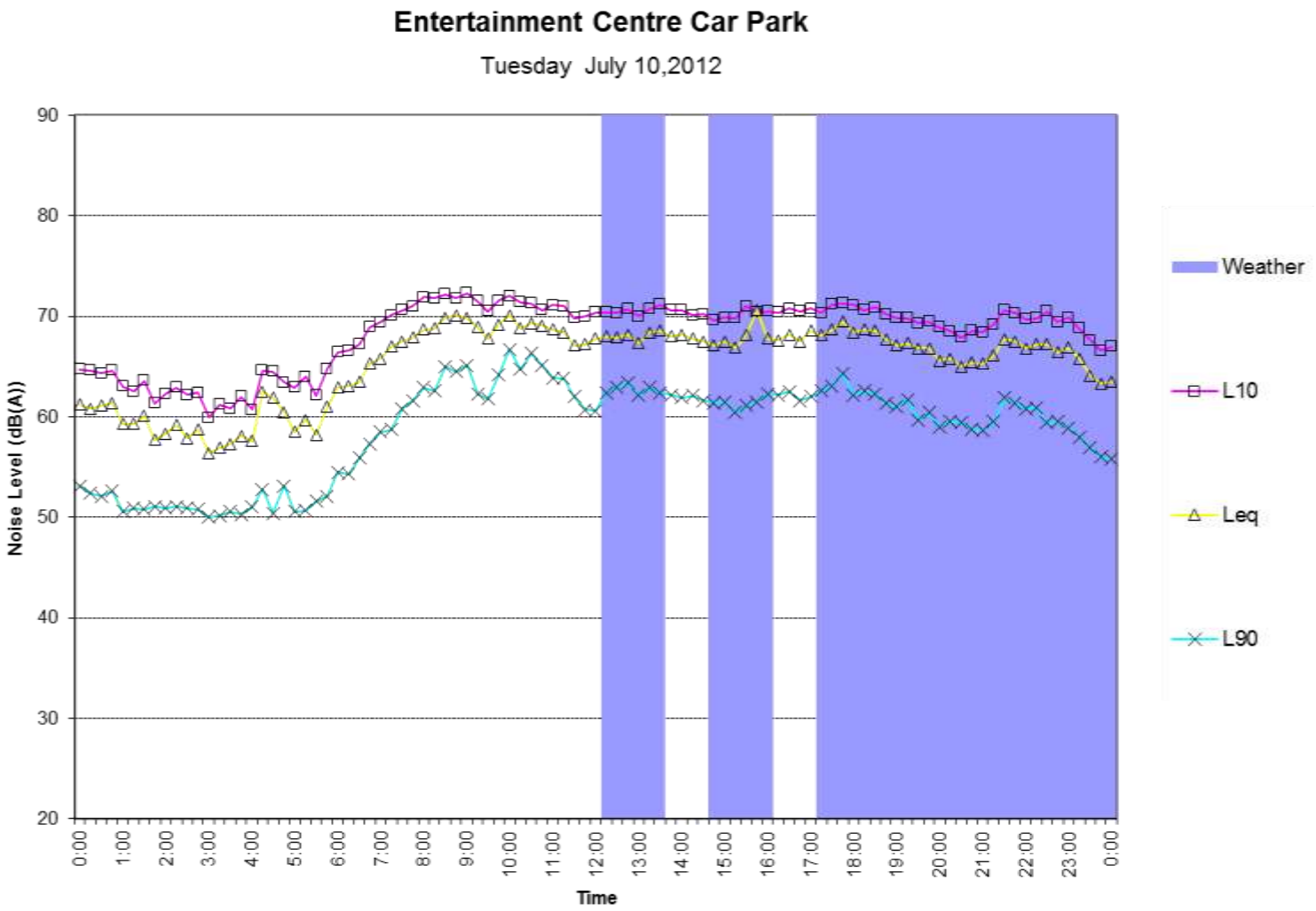
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
Weather
L10
Leq
L90


Entertainment Centre Car Park
Tuesday July 10,2012
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
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13:00
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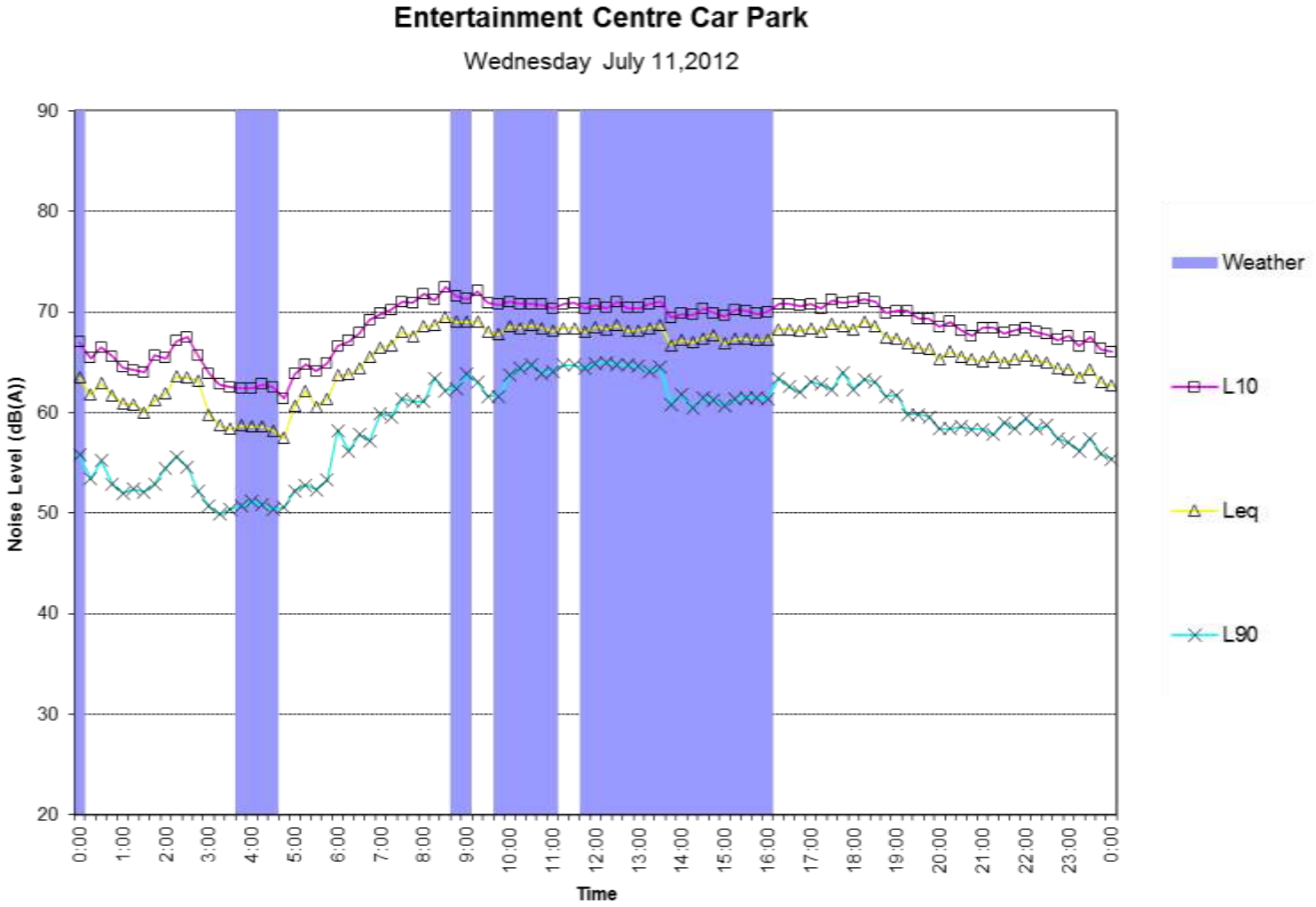
21:00
22:00
23:00
0:00
Time
Weather
L10
Leq
L90


Entertainment Centre Car Park
Wednesday July 11,2012
Noise Level (dB(A))
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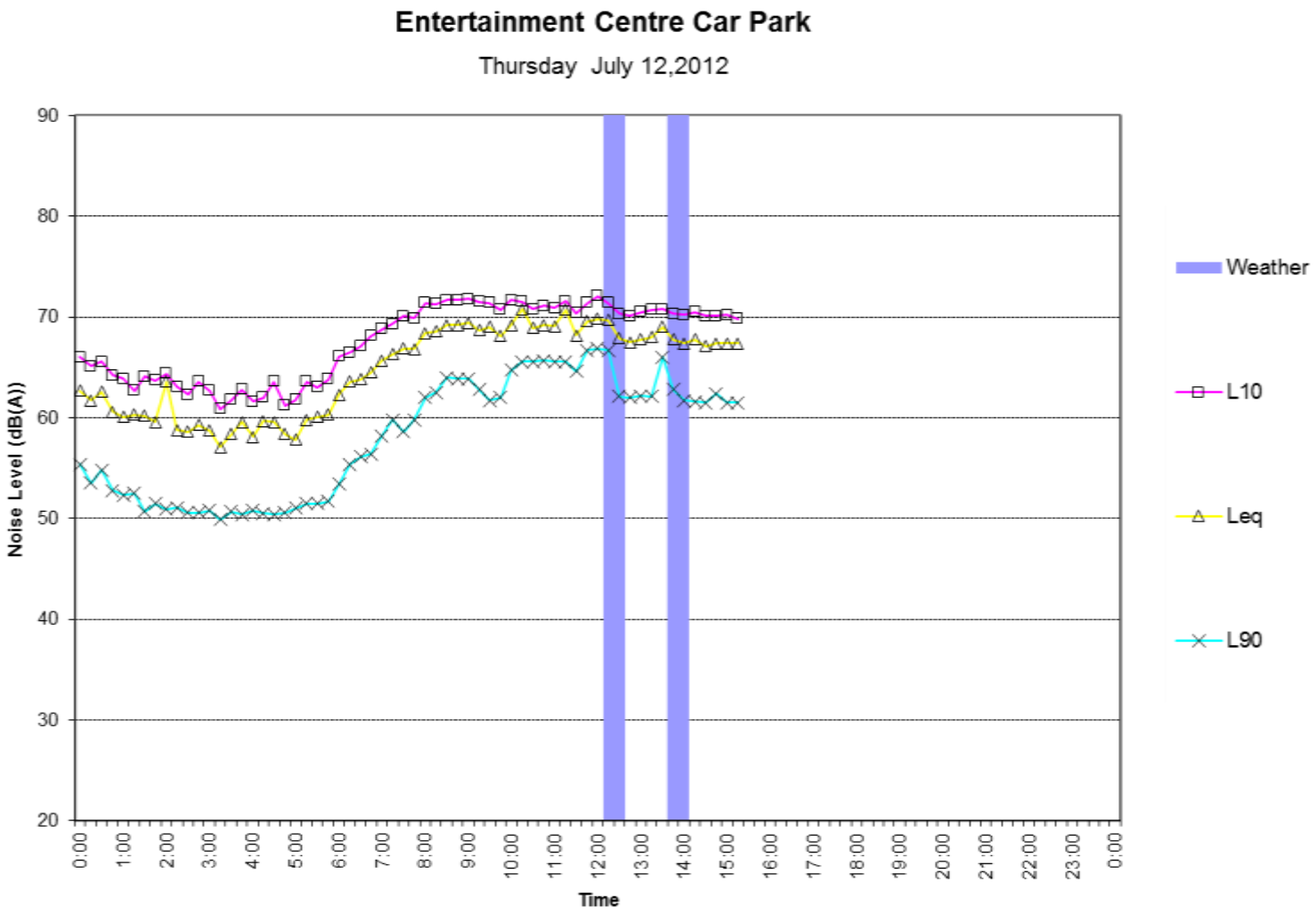
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
Weather
L10
Leq
L90


Entertainment Centre Car Park
Thursday July 12,2012
Noise Level (dB(A))
90
80
70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
Weather
L10
Leq
L90