2-4 Cambridge Street, Epping

DA Acoustic Assessment

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1 INTRODUCTION

Acoustic Logic Consultancy (ALC) have been engaged to conduct an acoustic assessment of potential noise and vibration impacts associated with the proposed mixed use development to be constructed at the 2-4 Cambridge Street, Epping.

This document addresses noise impacts associated with the following:

- Traffic noise impacts from Cambridge Street, Epping Road and Oxford Street;
- Train noise impacts from the T1, Central Coast and Newcastle Rail Corridor;
- Train vibration impacts from the T1, Central Coast and Newcastle Rail Corridor;
- Noise emissions from mechanical plant to service the project site;

ALC have utilised the following documents and regulations in the assessment of noise emanating from the development

- City of Parramatta (Formerly Hornsby Shire Council) Development Control Plan 2015;
- NSW Department of Planning and Environment's document – *'State Environmental Planning Policy (SEPP) (INFRASTRUCTURE) 2007'*;
- NSW Department of Planning's – *'Developments near Rail Corridors or Busy Roads – Interim Guideline';*
- Australian and New Zealand AS/NZS 3671:1989 *'Acoustics—Road traffic noise intrusion—Building siting and construction'*;
- Australian and New Zealand AS/NZS 2107:2016 *'Recommended design sound levels and reverberation times for building interiors'*;
- British Standard BS 7385:1990 Part 2 *'Evaluation and measurement for vibration in buildings – part 2'*;
- Australian Standard AS2670:1990 *'Vibration and Shock – Guide to the evaluation of human exposure to whole body vibration';*
- NSW Department of Environment and Conservation's document *'Assessing Vibration: A Technical Guideline';*
- NSW Department of Environment and Heritage, Environmental Protection Agency document - Industrial Noise Policy (INP).

This assessment has been conducted using the Zhinar Architects Pty Ltd architectural drawings for D.A Submission, see details below.

Table 1 – Architectural Drawing List

Architect	Drawing Number	Drawing Title	Date	Revision
Zhinar Architects	DA-A 08	Lower Ground	OCT 2016	DA-A
	DA-A 09	Mezzanine		
	DA-A 10	Upper Ground		
	DA-A 11	Level 1		
	DA-A 12	Typical Level 2-9		
	DA-A 13	Typical Level 10-20		
	DA-A 14	Level 21		
	DA-A 16	Section 1		
	DA-A 17	Section 2		
	DA-A 18	Section 3		
	DA-A 19	North Elevation		
	DA-A 20	South Elevation		
	DA-A 21	East Elevation		
	DA-A 22	West Elevation		

2 SITE DESCRIPTION

The proposed development comprises of three levels of basement parking, lower ground floor will accommodate commercial, lobby, loading dock and car parking. Upper ground floor will accommodate additional car parking. Upper ground floor will accommodate an open plan commercial space. Levels one through to twenty-one will accommodate residential apartments.

Acoustic investigation has been carried out by this office in regards to the developments surrounding the proposed development, which has been detailed below:

- Existing School and Church to the north, further this is the residential developments;
- Existing multi-storey commercial developments to the east, further to the east Oxford Street;
- Existing commercial facility to the south, further this is Langston Place and Epping Road;
- Cambridge Street to the west, further this is the T1, Central Coast and Newcastle Rail corridor, further this is Epping Road and residential developments.

The Epping Road carries a high volume of traffic, mostly light passenger traffic and state transit buses. Cambridge Street, Oxford Street and Langston Place carry a low to medium volume of traffic, mostly light passenger traffic and state transit buses.

The nearest residential noise receivers around the project site include:

- Receiver 1 - Residential development located at 33-35 Oxford Street, Epping, situated to the north east of the site, residential receivers are multi storey;
- Receiver 2 - Residential buildings located at 20-28 Cambridge Street, Epping, situated to the north of the site, residential receivers are multi storey;
- Receiver 3 – Commercial buildings located at 9-27 Oxford Street, Epping, situated along the eastern boundary of the site, commercial receivers are multi storey;
- Receiver 4 - School buildings located at 8 Cambridge Street, Epping, situated along the northern boundary of the site, School building is multi storey;

A site map, measurement description and surrounding receivers are presented in Figure 1 below.

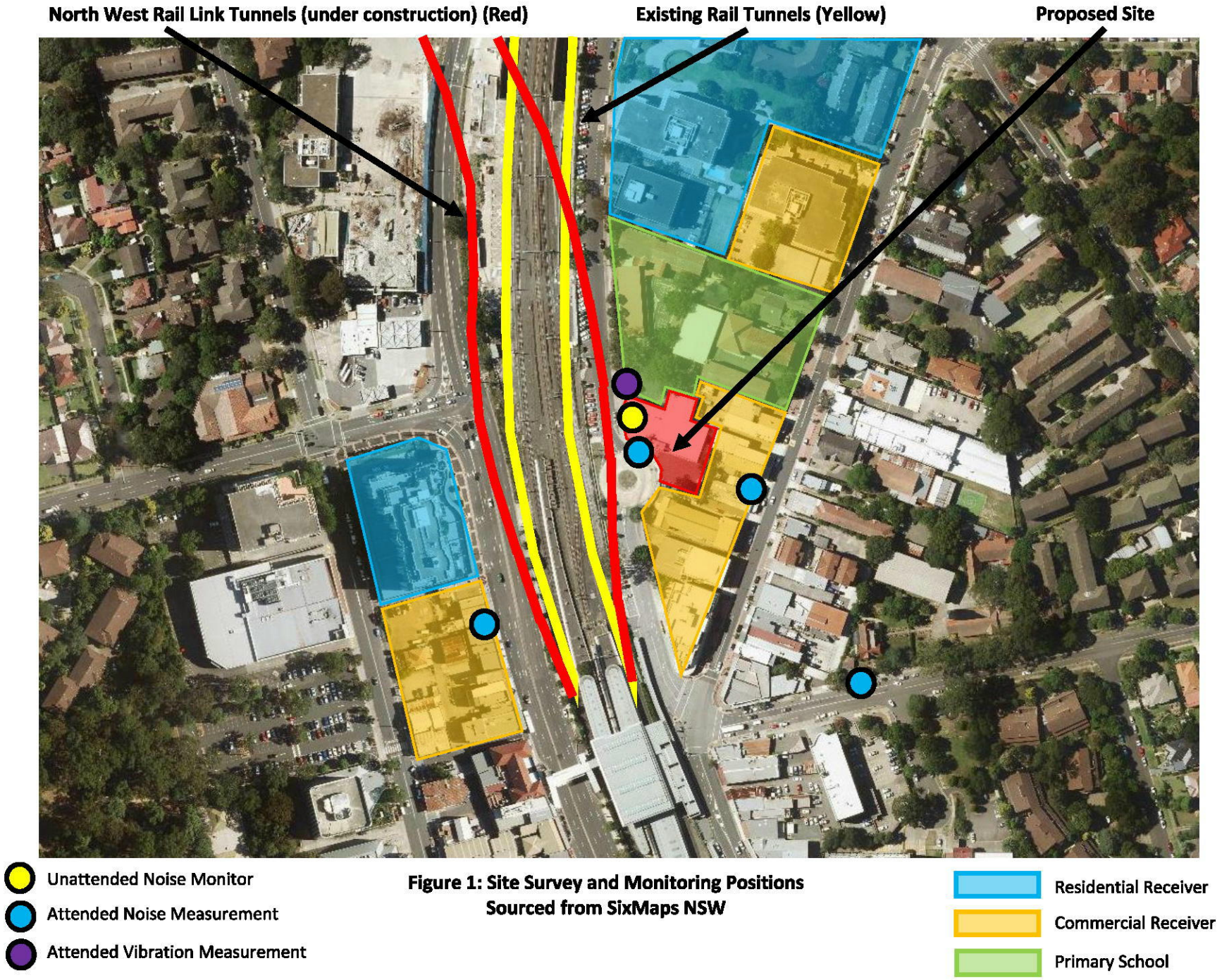


Figure 1: Site Survey and Monitoring Positions
Sourced from SixMaps NSW

3 EXISTING ACOUSTIC ENVIRONMENT

The acoustic environment is categorised by high background noise levels during the day and evening due to traffic and rail movements along Epping Road and the adjacent railway corridor. Low background noise levels during the night as most of the volume of traffic and rail have finished for the day.

Acoustic monitoring was conducted at the site to establish the background noise levels which will be used as basis for this assessment.

3.1 ENVIRONMENTAL NOISE DESCRIPTORS

Environmental noise constantly varies. Accordingly, it is not possible to accurately determine prevailing environmental noise conditions by measuring a single, instantaneous noise level.

To accurately determine the environmental 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.

In analysing 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 intervals.

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 15 minute period. L_{eq} is important in the assessment of environmental noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of environmental noise.

3.2 BACKGROUND NOISE LEVELS

Background noise levels which will be used as a basis for this assessment are detailed in the following sections.

3.2.1 Measurement Equipment

Unattended noise monitoring was conducting using one Acoustic Research Laboratories Pty Ltd noise loggers. The loggers were programmed to store 15-minute statistical noise levels throughout the monitoring period. The equipment was calibrated at the beginning and the end of each measurement using a Rion NC-73 calibrator; no significant drift was detected. All measurements were taken on A-weighted fast response mode.

Attended noise measurements were obtained using a Norsonic 140 Sound Level Analyser, set on 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.

3.2.2 Measurement Location

An unattended noise monitor was installed on the existing western roof of project site, located at 2-4 Cambridge Street, Epping. Detailed location refers Figure 1.

3.2.3 Measurement Period

Unattended noise monitoring was conducted from Friday, 21st October 2016 to Friday 28th, October 2016.

Attended noise measurements were undertaken between the hours of 4:30pm and 6:00pm on Thursday, 27th October 2016.

3.2.4 Measured Background Noise Levels

The background noise levels established from the unattended noise monitoring are detailed in the Table below.

3.2.4.1 Unattended Noise Measurements

NSW EPA's RBL assessment procedure requires determination of background noise level for each day (the ABL) then the median of the individual days as set out for the entire monitoring period.

Appendix 1 provides the results of the unattended noise monitoring. Weather affected data was excluded from the assessment. The processed Rating Background Noise Levels (lowest 10th percentile noise levels during operation time period) are presented in Tables below.

Table 2 – Unattended Noise Monitor – Location 1 – Rating Background Noise Level

Date	Measured Rating Background Noise Level dB(A)L_{90}		
	Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am Next Day)
Friday,21st October, 2016	-	53	43
Saturday, 22nd October, 2016	56	54	43
Sunday, 23rd October, 2016	53	53	41
Monday, 24th October, 2016	57	54	42
Tuesday, 25th October, 2016	56	55	43
Wednesday, 26th October, 2016	57	54	42
Thursday, 27th October, 2016	57	57	42
Friday, 28th October, 2016	-	-	-
Median	**56**	**54**	**42**

3.2.4.2 Summarised Rating Background Noise Levels

Summarised rating background noise levels for each receiver are presented below.

Table 3 -Summarised Rating Background Noise Level for Each Receiver

Receiver	Time of day	Rating Background Noise Level dB(A)L_{90}
Nearby noise sensitive development	Day	56
	Evening	54
	Night	42

4 EXTERNAL NOISE INTRUSION ASSESSMENT

Site investigation indicates that the major external noise sources around project site are below:

- Traffic noise along Epping Road, Cambridge Street and Oxford Street;
- Rail noise from the adjacent railway corridor.

4.1 NOISE INTRUSION CRITERIA

A traffic and rail noise intrusion assessment has been conducted based off the requirements of the following acoustic noise criteria/standards;

- City of Parramatta Council DCP and LEP 2011;
- NSW Department of Planning's – *'Developments near Rail Corridors or Busy Roads – Interim Guideline';*
- NSW Department of Planning and Environment's document – *'State Environmental Planning Policy (SEPP) (INFRASTRUCTURE) 2007"*;
- Australian and New Zealand AS/NZS 3671:1989 *'Acoustics—Road traffic noise intrusion—Building siting and construction'*;
- Australian and New Zealand AS/NZS 2107:2016 *'Recommended design sound levels and reverberation times for building interiors'*;

4.1.1 City of Parramatta Development Control Plan (DCP) 2011

Part 3: Development Principals

3.3.3 Acoustic Amenity

P.5 The provisions of the State Environmental Planning Policy (Infrastructure) 2007 and Development near Rail Corridors and Busy Roads Interim Guideline must be taken into consideration, to minimise impacts of busy roads and railway corridors on residential and other sensitive development such as schools, child care centres, places of public worship and health services facilities.

Residential Development

C.1 Internal habitable rooms of dwellings affected by high levels of external noise are to be designed to achieve internal noise levels of no greater than 50dBA.

NOTE: A busy road is defined as carrying an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data available on the Road and Traffic Authority's website).

4.1.2 NSW Department of Planning's 'Development near Rail Corridors and Busy Roads (Interim Guideline)'

Section 3.5 of the NSW Department of Planning's 'Development near Rail Corridors and Busy Roads (Interim Guideline)' states:

"The following provides an overall summary of the assessment procedure to meet the requirements of clauses 87 and 102 of the Infrastructure SEPP. The procedure covers noise at developments for both Road and Rail.

- *If the development is for the purpose of a building for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:*
  - *in any bedroom in the building: 35dB(A) at any time 10pm-7am*
  - *anywhere else in the building (other than a garage, kitchen, bathroom or hallway): 40dB(A) at any time."*

4.1.3 NSW Department of Planning and Environment's document – *'State Environmental Planning Policy (SEPP) (INFRASTRUCTURE) 2007'*

RTA Map No. 11 of the traffic volume maps referenced by the SEPP (INFRASTRUCUTRUE) on the RTA website (see below), classifies the section of Epping Road where the development is located near as a road where a noise intrusion assessment is mandatory under clause 102 of the SEPP Infrastructure 2007. See RTA average annual daily road traffic volume map number 5 and the approximate location of the site below.

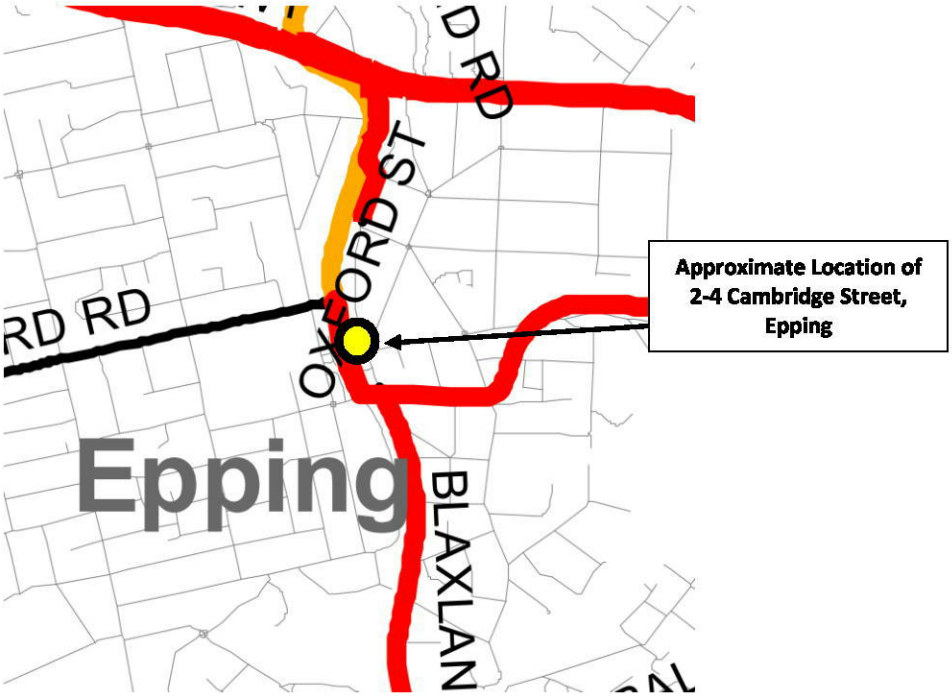


Figure 2 – RTA Map No. 11 and Approximate Location of Proposed Development

Clause 87 - Impact of rail noise or vibration on non-rail development

(1) 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,

(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 L_{Aeq} 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

- *If the development is for the purpose of a building for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded:*
  - *in any bedroom in the building: 35dB(A) at any time 10pm-7am*
  - *anywhere else in the building (other than a garage, kitchen, bathroom or hallway): 40dB(A) at any time."*

4.1.4 Australian and New Zealand AS/NZS 3671:1989 *'Acoustics—Road traffic noise intrusion—Building siting and construction'*

Australian Standard AS 3671-1989 notes the following in relation to traffic noise:

- Internal noise levels should be determined in accordance with the relevant standard.
- Australian Standard AS/NZS 2107:2016 'Acoustics – Recommended design sound levels and reverberation times for building interiors', is the industry adopted standard.
- A suitable descriptor should be adopted relevant to the use of the development. As AS2107:2016 adopts the L_{eq} descriptor, ALC shall also use this descriptor.
- AS3671 does not specifically recommend a time interval. On this basis, ALC have adopted the interval used by the EPA Road Noise Policy for main/arterial roads, that being:
  - Day – 7am to 10pm (15 hour); and

- Night – 10pm to 7am (9 hour).

- ALC have applied the daytime interval to the living areas of the apartment and the night time interval to the bedrooms of the apartment.

Internal noise levels have been selected in accordance with AS 2107:2016.

4.1.5 Australian and New Zealand AS/NZS 2107:2016 *'Recommended design sound levels and reverberation times for building interiors'*

AS2107-2016: Recommended design sound levels and reverberation times for building interiors specifies allowable internal noise levels for internal spaces within residential and commercial buildings. Table 1, in Section 5 of AS2107-2016, gives the following maximum internal noise levels for commercial buildings and residential buildings near major roads.

Table 4 – Recommended Design Sound Level

Space /Activity Type	Recommended Maximum Design Sound Level dB(A) L_{eq}
Living Areas	35-45 dB(A)L_{eq}
Sleeping Areas	35-40 dB(A)$L_{eq(nightime)}$
Bathrooms, Ensuites, Laundry	45 dB(A)L_{eq}
Commercial	35-40 dB(A)L_{eq}

4.1.6 Summarised Internal Noise Criteria

Summarised internal noise criteria for each space is summarised below.

Table 5 – Summarised Internal Noise Criteria

Space /Activity Type	Internal Noise Requirement dB(A) L_{eq}
Living Areas	40 dB(A) $L_{eq(15hour)}$
Sleeping Areas	35 dB(A) $L_{eq(9hour)}$
Bathrooms, Ensuites, Laundry	40 dB(A) $L_{eq(when\ in\ use)}$
Commercial	40 dB(A) $L_{eq(when\ in\ use)}$

4.2 EXTERNAL NOISE MEASUREMENTS

This section of the report details noise measurements conducted at the site to establish traffic, train and surrounding environmental noise levels impacting the development.

4.2.1 Noise Measurements

4.2.1.1 Measurement Equipment

Attended short term measurements of traffic and train noise which were undertaken by this office, to supplement the unattended noise monitoring. Measurements were conducted using a Norsonic 140 Sound Analyser. The analyser was set to fast response and calibrated before and after the measurements using a Norsonic Sound Calibrator type 1251. No significant drift was noted.

Unattended noise monitoring was conducting using one Acoustic Research Laboratories Pty Ltd noise logger. The logger was programmed to store 15-minute statistical noise levels throughout the monitoring period. The equipment was calibrated at the beginning and the end of each measurement using a Rion NC-73 calibrator; no significant drift was detected. All measurements were taken on A-weighted fast response mode.

4.2.1.2 Measurement Location

Unattended noise monitor was installed on the existing western roof of the project site, at 2-4 Cambridge Street, Epping. Detailed location refers Figure 1. Noise monitor location had a partial view of Cambridge Street, Adjacent Rail Corridor and Epping Road and was located 8m from Cambridge Street kerb.

Attended background noise measurements where at the following locations;

- Cambridge Street – Attended background noise measurement conducted in Cambridge Street was located along the western boundary of 2-4 Cambridge Street, Epping. See figure 1 for Measurement location. Noise measurement location had a 180° view of Cambridge Street which was 3m from the kerb.

- Oxford Street – Attended background noise measurement conducted in Oxford Street was located along the eastern boundary of 11-17 Oxford Street, Epping. See figure 1 for Measurement location. Noise measurement location had a 180° view of Oxford Street which was 3m from the kerb.

- Epping Road – Attended background noise measurement conducted in Epping Road was located along the southern boundary of 69-71 Epping Road, Epping. See figure 1 for Measurement location. Noise measurement location had a 180° view of Epping Road which was 3m from the kerb.

- Pembroke Street – Attended background noise measurement conducted in Pembroke Street was located along the southern boundary of 2-6 Pembroke Street, Epping. See figure 1 for Measurement location. Noise measurement location had a 180° view of Pembroke Street which was 3m from the kerb.

4.2.1.3 Measurement Period

Unattended noise monitoring was conducted from Friday, 21st October 2016 to Friday 28th, October 2016.

Attended noise measurements were undertaken between the hours of 4:30pm and 6:00pm on Thursday, 27th October 2016.

4.2.1.4 Measured Traffic and Rail Noise Measurements

Attended and Unattended noise measurements have been summarised below for each location.

4.2.1.4.1 Unattended Noise Monitoring

Table 6 – Unattended Noise Monitor – Location 1 – Traffic and Rail Noise Measurements

Date	Measured Traffic and Rail Noise Level dB(A)L_{eq}	
	Day (7am-10pm)	Night (10pm-7am)
Friday,21st October, 2016	-	59
Saturday, 22nd October, 2016	61	57
Sunday, 23rd October, 2016	60	58
Monday, 24th October, 2016	62	58
Tuesday, 25th October, 2016	61	59
Wednesday, 26th October, 2016	61	57
Thursday, 27th October, 2016	62	59
Friday, 28th October, 2016	-	-
Logarithmic Average	**61**	**58**

*Note that noise monitor location was 8m from kerb and had a partial view of Cambridge Street, Adjacent Rail Corridor and Epping Road.

4.2.1.4.2 Attended Traffic and Rail Noise Measurements

Attended noise measurements have been summarised below for each location.

Table 7 – Attended Traffic and Rail Noise Measurements

Location	Time of Measurement	Measured Noise Level dB(A)L_{eq}
2-4 Cambridge Street, Epping (See Figure 1) 3m from kerb 180° view of the road	4:30pm – 5:00pm Thursday, 27th October, 2016	65dB(A)$_{(15mins)}$
11-17 Oxford Street, Epping (See Figure 1) 3m from kerb 180° view of the road	5:00pm – 5:30pm Thursday, 27th October, 2016	64dB(A)$_{(15mins)}$

Table 7 – Attended Traffic and Rail Noise Measurements (Cont.)

Location	Time of Measurement	Measured Noise Level dB(A)L_{eq}
69-71 Epping Road, Epping (See Figure 1) 3m from kerb 180° view of the road	5:30pm – 6:00pm Thursday, 27th October, 2016	73dB(A)$_{(15mins)}$
2-6 Pembroke Street, Epping (See Figure 1) 3m from kerb 180° view of the road	6:00pm – 6:30pm Thursday, 27th October, 2016	62dB(A)$_{(15mins)}$

4.2.1.5 Summarised External Noise Levels

The existing traffic and rail noise levels listed in the table below were determined based on the unattended noise monitoring and attended noise measurements.

Table 8 – Measured Existing Traffic and Rail Nosie Levels

Location	Summary of Measured Existing Traffic and Rail Noise Level	
	Daytime (7am-10pm) dB(A) $L_{Aeq\ (15hour)}$	Night time (10pm-7am) dB(A) $L_{Aeq\ (9hour)}$
Cambridge Street (See Figure 1) 3m from kerb 180° view of the road	61dB(A)$L_{eq(15hour)}$	58dB(A)$L_{eq(9hour)}$
Oxford Street (See Figure 1) 3m from kerb 180° view of the road	64dB(A)$L_{eq(15hour)}$	61dB(A)$L_{eq(9hour)}$*
Epping Road (See Figure 1) 3m from kerb 180° view of the road	73dB(A)$_{(15hour)}$	70dB(A)$L_{eq(9hour)}$*
Pembroke Street (See Figure 1) 3m from kerb 180° view of the road	62 dB(A)$_{(15hour)}$	59dB(A)$L_{eq(9hour)}$*

*Adjusted based off unattended noise monitoring

4.3 NOISE INTRUSION ANALYSIS

Traffic and rail noise intrusion into the proposed development was assessed using the measured traffic and rail noise levels presented above.

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

4.4 RECOMMENDED CONSTRUCTIONS

4.4.1 Glazed Windows and Doors

The following constructions are recommended to comply with the project noise objectives. Aluminium framed/sliding glass doors and windows will be satisfactory provided they meet the following criteria. All external windows and doors listed are required to be fitted with Q-lon type acoustic seals. (**Mohair Seals are unacceptable**).

Thicker glazing may be required for structural, safety or other purposes. Where it is required to use thicker glazing than scheduled, this will also be acoustically acceptable.

The recommended constructions are listed in Appendix three – Glazing Mark Up.

It is recommended that only window systems having test results indicating compliance with the required ratings obtained in a certified laboratory be used where windows with acoustic seals have been recommended.

In addition to complying with the minimum scheduled glazing thickness, the R_w rating of the glazing fitted into open-able frames and fixed into the building opening should not be lower than the values listed in Table 9 for all rooms. Where nominated, this will require the use of acoustic seals around the full perimeter of open-able frames and the frame will need to be sealed into the building opening using a flexible sealant.

Table 9 - Minimum R_w of Glazing (with Acoustic Seals)

Glazing Assembly	Minimum R_w of Installed Window
6.38mm Laminate	31
10mm Glazing	33
10.38mm Laminate	35
12.38mm Laminate	37
6.38mm Laminate + 100mm Airgap + 6.38mm Laminate	43

4.4.2 External Roof/Ceiling

External roof construction will be constructed from concrete elements, this proposed structure will not require any further acoustic upgrading. In the event that any penetrations are required thru the external skin, an acoustic grade sealant should be used to minimise all gaps.

4.4.3 External Walls

External wall construction will be constructed from concrete or masonry elements, this proposed structure will not require any further acoustic upgrading. In the event that any penetrations are required thru the external skin, an acoustic grade sealant should be used to minimise all gaps.

4.4.4 Entry Doors

Entry doors will be via internal corridors and as such constructions will be formulated pursuant to the Building Code of Australia.

4.4.5 Mechanical Ventilation

With respect to natural ventilation of the dwelling, the NSW Department of Planning document "Development near Busy Roads and Rail Corridors - Interim Guideline" dictates that:

- *"If internal noise levels with windows or doors open exceed the criteria by more than 10dB(A), the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia."*

With windows open, the allowable internal noise goal is permitted to be 10dB(A) higher than when the windows are closed (ie – allowable level in bedrooms becomes 45dB(A), and 50dB(A) in living rooms).

All habitable spaces along **All Façades** of the development will require to have their windows closed in order to meet acoustic requirements. A mechanical engineer is to confirm if supplementary ventilation (to meet Australian Standard AS1668.2 requirements) will be required to these rooms.

5 RAILWAY VIBRATION ASSESSMENT

Trains induce ground borne vibration that is transmitted through the subsoil. These vibrations can be perceptible close to railways, as tactile vibrations and as structure borne noise.

5.1 PROJECT VIBRATION OBJECTIVES

A rail vibration assessment has been conducted based off the requirements of the following acoustic noise criteria/standards;

- British Standard BS 7385:1990 Part 2 *'Evaluation and measurement for vibration in buildings – part 2'*;
- Australian Standard AS2670:1990 *'Vibration and Shock – Guide to the evaluation of human exposure to whole body vibration';*
- NSW Department of Environment and Conservation's document *'Assessing Vibration: A Technical Guideline';*
- NSW Department of Planning's – *'Developments near Rail Corridors or Busy Roads – Interim Guideline'.*

5.1.1 Tactile Vibration

Human comfort is normally assessed with reference to the British Standard BS 7385 Part 2 1993 or Australian Standard AS 2670.2 1990.

The Interim Guideline references the DECCW *Assessing Vibration- A technical guideline* which recommends that habitable rooms should comply with the criteria therein which is in line with the requirements of British Standard BS 6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)".

British Standard BS 6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)" is recommended by the RIC's and SRA's Interim Guidelines for Councils "Consideration of rail noise and vibration in the planning process" 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.

This 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" (6am-10pm) and "Night time" (10pm-6am). The overall value is then compared to the levels in Table 8. For this project the aim will be for a low probability of adverse comment.

Table 10 - Vibration Dose Values ($m/s^{1.75}$) 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 16hr day (Daytime)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8hr night (Night time)	0.13	0.26	0.51

5.1.2 Structure Borne Noise

The Department of Planning 'Development Near rail Corridors and Busy Road – Interim Guideline' only requires structure borne noise assessment to be conducted where buildings or adjacent lands are over railway tunnels. Section 3.6.2 of the standard states the following:

"...Where building are constructed over or adjacent to land over tunnels, ground-born noise may be present without the normal masking effects of air born noise. In such cases, residential buildings should be designed so that the 95th percentile of train pass-bys complies with a ground-born LAmax noise limit of 40 dB(A)(daytime and 35 dB(A) (nigh time)measured using the "slow" response time setting on a sound level meter."

5.2 RAIL VIBRATION MEASUREMENTS

Rail noise measurements were conducted in line with the future proposed northern façade, which is the potentially worst affected façade.

Attended train vibration measurements were conducted on 27th July 2016. A Svantek 958 Vibration Analyser was used for the vibration measurements. The analyser was fitted with three Svantek SV80 accelerometers.

The measured vibration levels, duration of train passby and the number of rail movements per hour were used to determine the overall vibration dose (VDV) at the proposed development for both daytime and night time periods. The results are presented the table below.

Table 11 - Vibration Dose Values

Time Period	Calculated VDV $m/s^{1.75}$	Criteria VDV $m/s^{1.75}$	Compliance
Day (7am – 10pm)	0.3	0.2 to 0.4	Yes
Night (10pm -7am)	<0.1	0.13	Yes

*See section 5.3 below.

In the event the future train use increases, say by 10%, predicted eVDV will not increase significantly (no more than approximately 0.005 more than the levels predicted in the table above) and will not impact recommended vibration isolation treatments.

5.2.1 Structure borne noise generated by train movements

Vibration measurements were also carried out at locations of the proposed habitable space faces away from rail corridor. The structure borne noise generated by the vibration has been predicted below based on the measured vibration level from 1Hz to 10K Hz.

Table 12 –Predicted Structure Borne Noise dB(A) L_{Max}

Location	Predicted Structure Borne Noise Level	Criteria	Compliance
Level 1 apartments facing away from railway corridor	<35dB(A)L_{Max} (First resident not affected by airborne noise)	35 dB(A) L_{Max}	Yes*

*See section 5.3 below.

5.3 FINDINGS

Measurements above indicated that the overall vibration dose (VDV) at the proposed development for both daytime and night time period fully comply with the requirements of British Standard BS 7385 Part 2 1993 or Australian Standard AS 2670.2 1990. Structure borne noise generated by the train movements to the project site complies with the requirements of The Department of Planning 'Development Near Rail Corridors and Busy Road – Interim Guideline' therefore no additional vibration isolation is required for the proposed development.

6 NOISE EMISSION ASSESSMENT

Noise emissions from the site have been assessed for noise emitted from base building mechanical plant.

The noise emission from plant service project site shall comply with the requirements of City of Parramatta Council Development Control Plan (DCP) 2011 and the NSW EPA Industrial Noise Policy (INP).

6.1 NOISE CRITERIA

6.1.1 City of Parramatta Council Development Control Plan (DCP 2011)

City of Parramatta Council does not contain any applicable acoustic criteria which can be assessed against.

6.1.2 NSW EPA Industrial Noise Policy (INP)

The INP provides guidelines for assessing noise impacts from developments. The recommended assessment objectives vary depending on the potentially affected receivers, the time of day, and the type of noise source. The INP has two requirements which both have to be complied with, namely an amenity criterion and an intrusiveness criterion.

6.1.2.1 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 not exceed the background noise level by more than 5 dB(A).

Table 13 – INP Intrusiveness Criteria

Receiver	Time of day	Background Noise Level dB(A)L_{90}	Intrusiveness Criteria (Background + 5dB(A)
Receiver 1 - 33-35 Oxford Street, Epping (See Figure 1)	Day	56	61
	Evening	54	59
	Night	42	47
Receiver 2 - 20-28 Cambridge Street, Epping (See Figure 1)	Day	56	61
	Evening	54	59
	Night	42	47

6.1.2.2 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 Industrial Noise Policy sets out acceptable noise levels for various land uses. Table 2.1 on page 16 of the policy has four categories to distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface.

For the purposes of a conservative assessment, ALC will assess noise emissions in accordance with the 'urban' category.

Table 14 – INP Amenity Criteria

Type of Receiver	Time of day	Recommended Acceptable Noise Level dB(A) L_{eq}
Residential (urban)	Day	60
	Evening	50
	Night	45

6.1.3 Summarised Plant Noise Emission Criteria

Summary for noise emission criteria for all plant associated with the development has been summarised below.

Receiver	Time of day	Background Noise Level dB(A)L_{90}	Amenity Criteria dB(A) L_{eq}	Intrusiveness Criteria (Background + 5dB(A)
Receiver 1 - 33-35 Oxford Street, Epping (See Figure 1)	Day	56	60	61
	Evening	54	50	59
	Night	42	45	47
Receiver 2 - 20-28 Cambridge Street, Epping (See Figure 1)	Day	56	60	61
	Evening	54	50	59
	Night	42	45	47

6.2 NOISE EMISSION ASSESSMENT

6.2.1 Mechanical Plant Noise

Detailed plant selection has not been undertaken at this stage, as plant selections have not been determined. Detailed acoustic review should be undertaken at CC stage to determine acoustic treatments to control noise emissions to satisfactory levels. Satisfactory levels will be achievable through appropriate plant selection and location and, if necessary, standard acoustic treatments such as duct lining, acoustic silencers and enclosures.

Noise emissions from all mechanical services to the closest residential receiver should comply with the

7 CONCLUSION

This report presents an acoustic assessment of noise impacts associated with the proposed mixed use development to be located at 2-4 Cambridge Street, Epping.

Provided that the treatments set out in section 4 of this report are employed, internal noise levels shall comply with the requirements below:

- City of Parramatta Council Development Control Plan (DCP) 2011;
- NSW Department of Planning's – *'Developments near Rail Corridors or Busy Roads – Interim Guideline';*
- NSW Department of Planning and Environment's document – *'State Environmental Planning Policy (SEPP) (INFRASTRUCTURE) 2007"*;
- Australian and New Zealand AS/NZS 3671:1989 *'Acoustics—Road traffic noise intrusion—Building siting and construction'*;
- Australian and New Zealand AS/NZS 2107:2016 *'Recommended design sound levels and reverberation times for building interiors'*;

Structure borne noise impacts from the rail corridor have been assessed in this report, we can confirm that the proposed building can comply with the following documents below:

- British Standard BS 7385:1990 Part 2 *'Evaluation and measurement for vibration in buildings – part 2'*;
- Australian Standard AS2670:1990 *'Vibration and Shock – Guide to the evaluation of human exposure to whole body vibration';*
- NSW Department of Environment and Conservation's document *'Assessing Vibration: A Technical Guideline';*
- NSW Department of Planning's – *'Developments near Rail Corridors or Busy Roads – Interim Guideline'.*

External noise emissions criteria have been setup in this report to satisfy the requirements from the following documents;

- City of Parramatta Council Development Control Plan (DCP) 2011;
- NSW Department of Environment and Heritage, Environmental Protection Agency document - Industrial Noise Policy (INP);

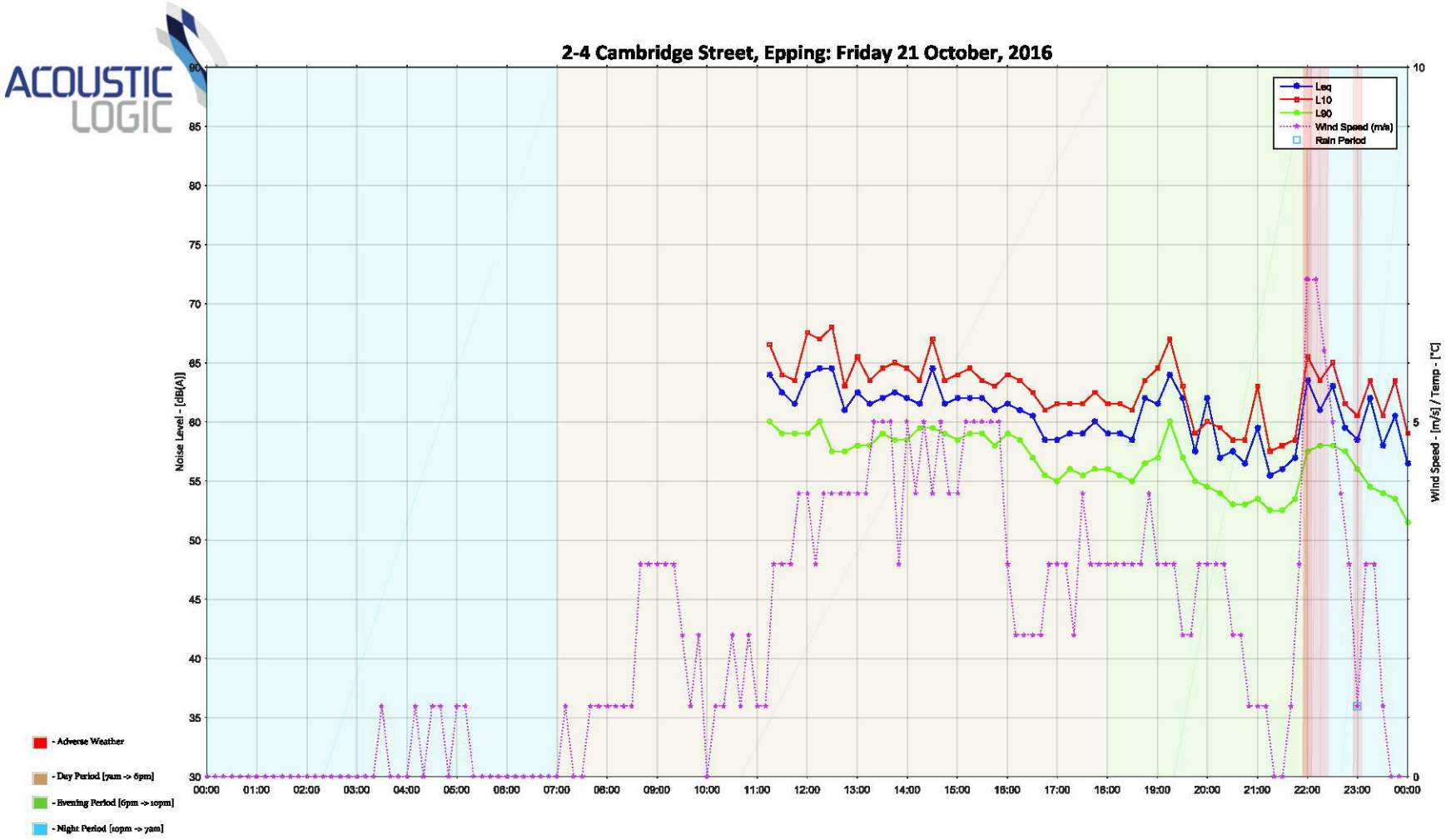
Recommendations for the control of noise from common areas has been detailed in section 6.3.

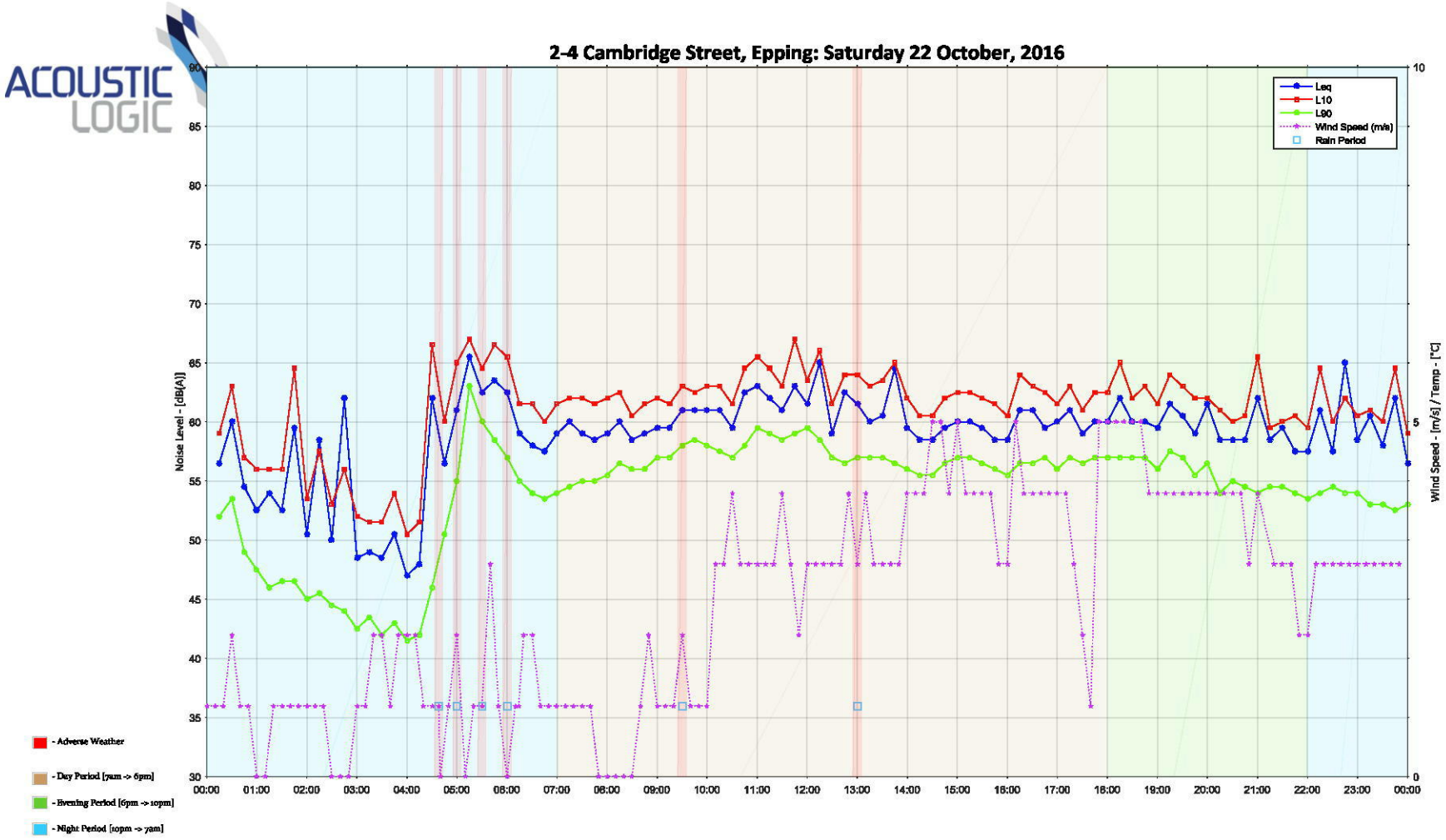
Please contact us should you have any further queries.

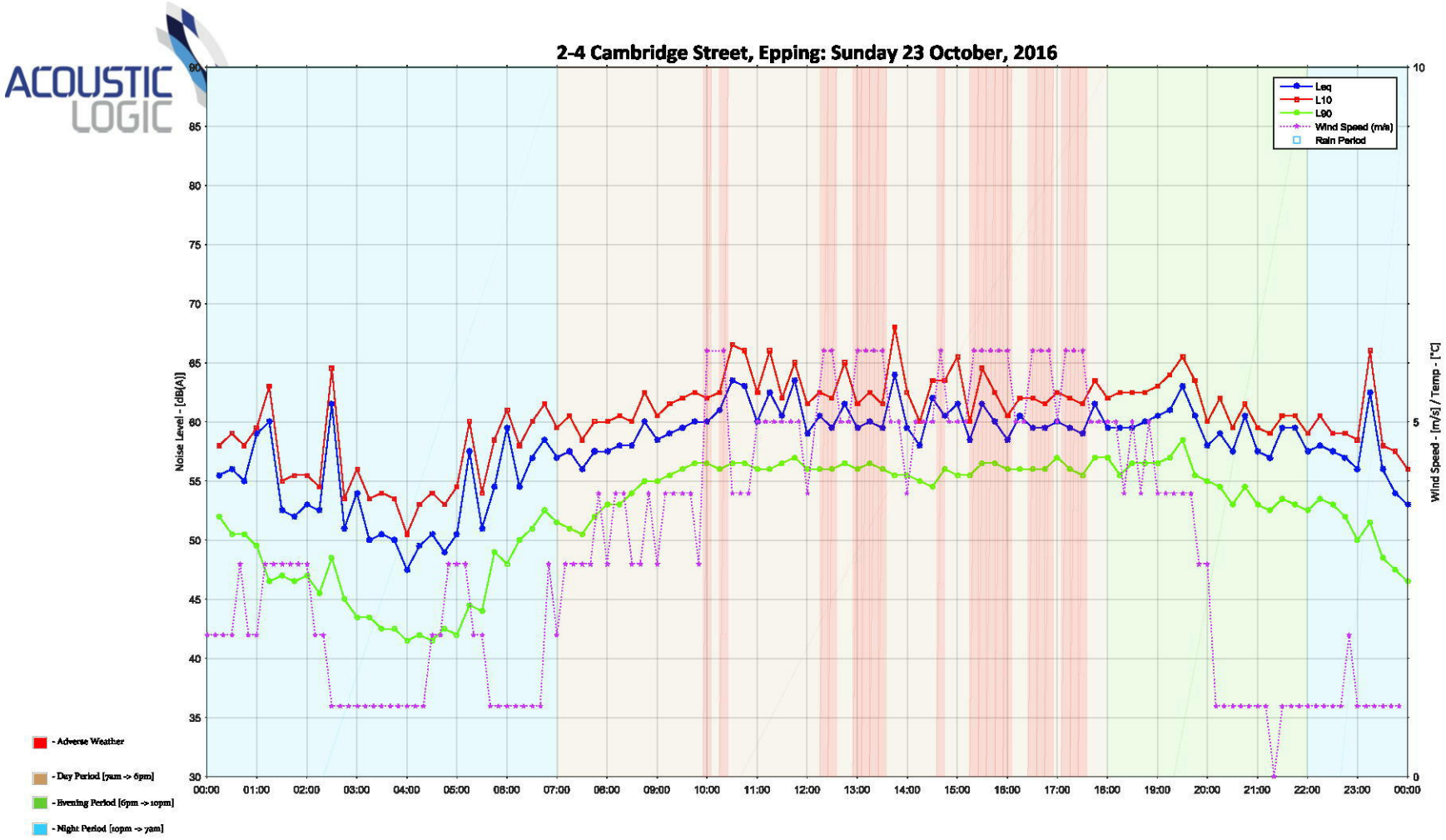
Yours faithfully,

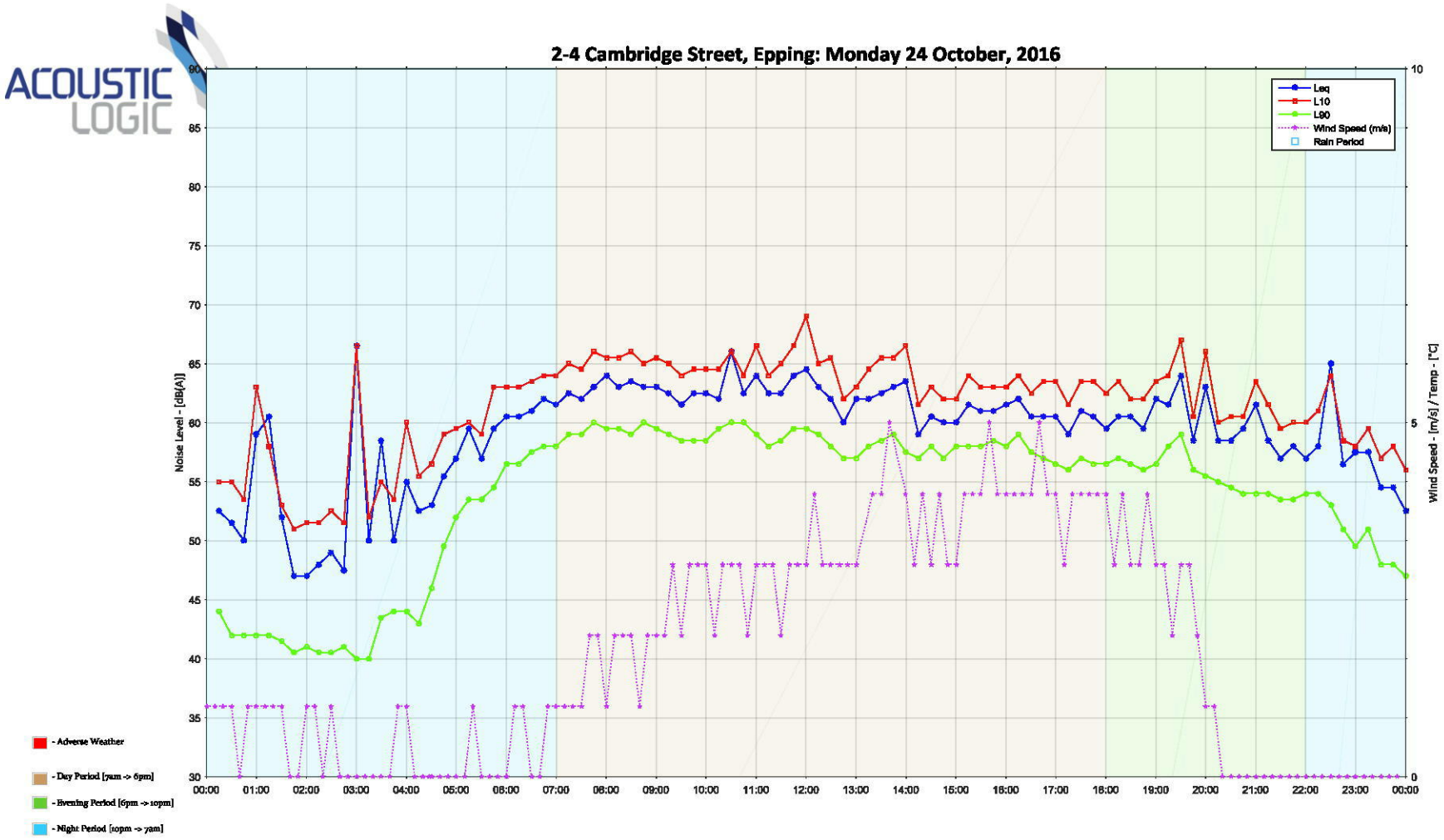
Acoustic Logic Consultancy Pty Ltd
Matthew Furlong

APPENDIX ONE – UNATTENDED NOISE MONITORING DATA


2-4 Cambridge Street, Epping: Friday 21 October, 2016
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


2-4 Cambridge Street, Epping: Saturday 22 October, 2016
Leq
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


2-4 Cambridge Street, Epping: Sunday 23 October, 2016
Leq
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


2-4 Cambridge Street, Epping: Monday 24 October, 2016
Leq
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
- Adverse Weather
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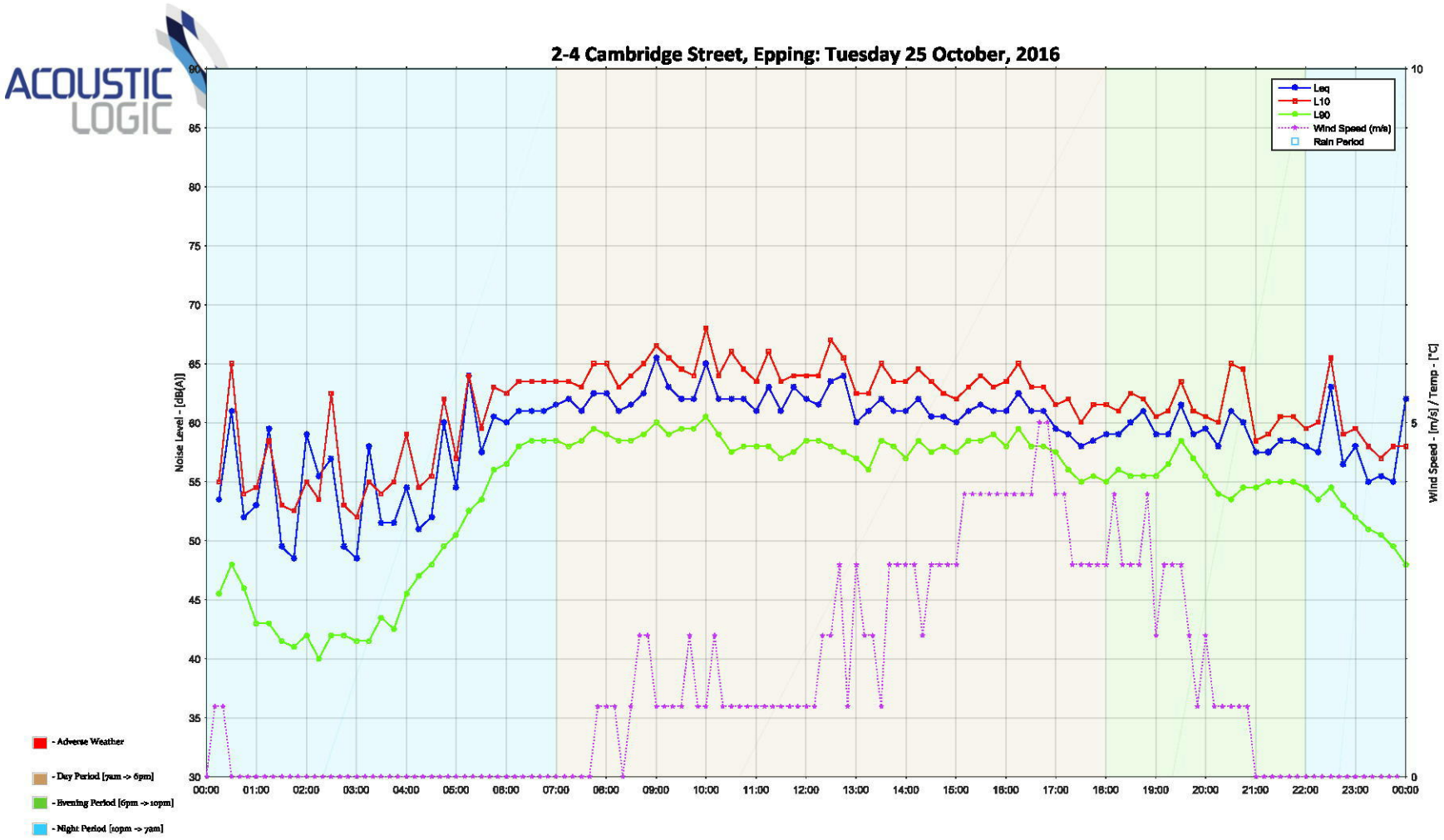
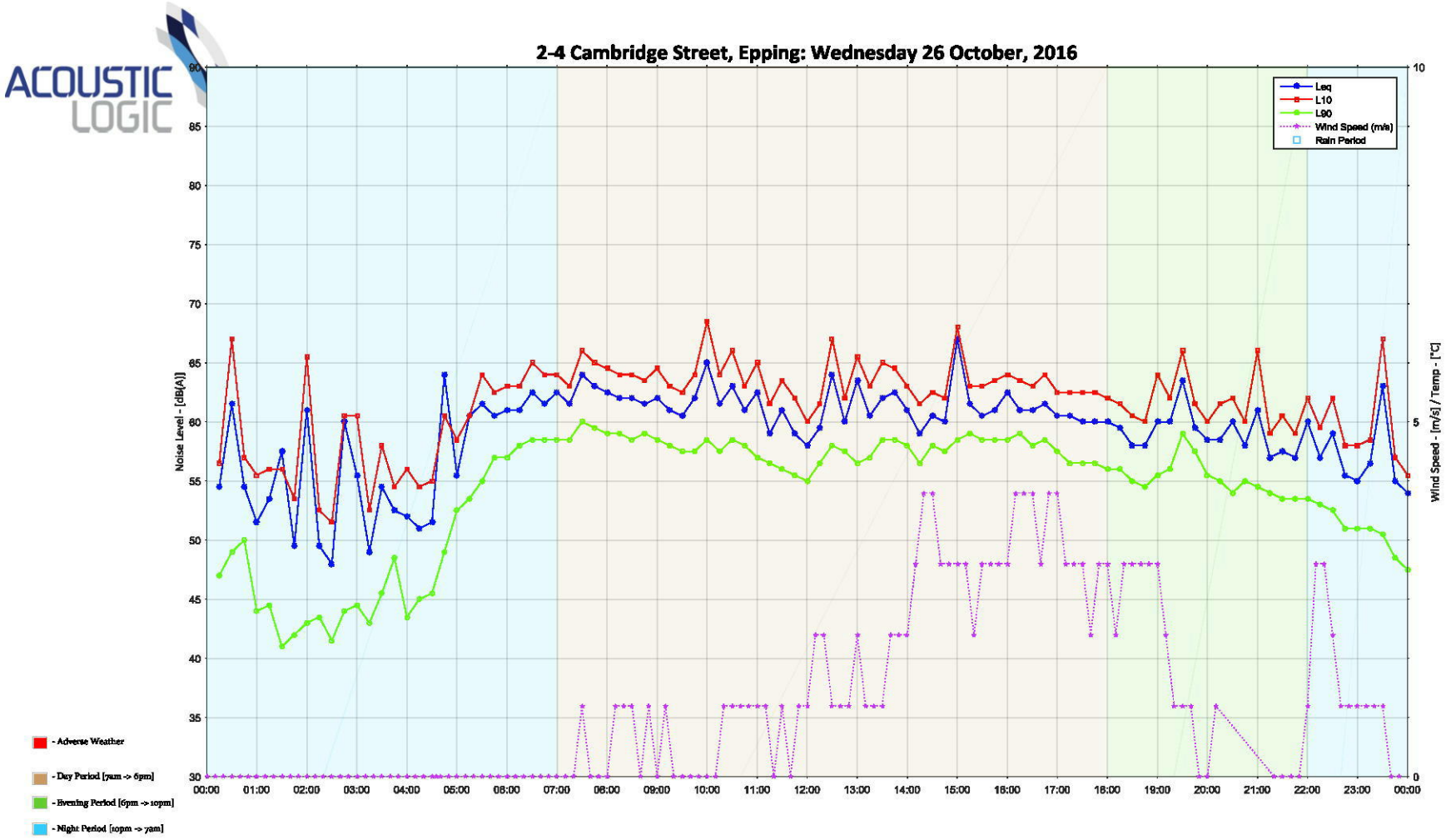
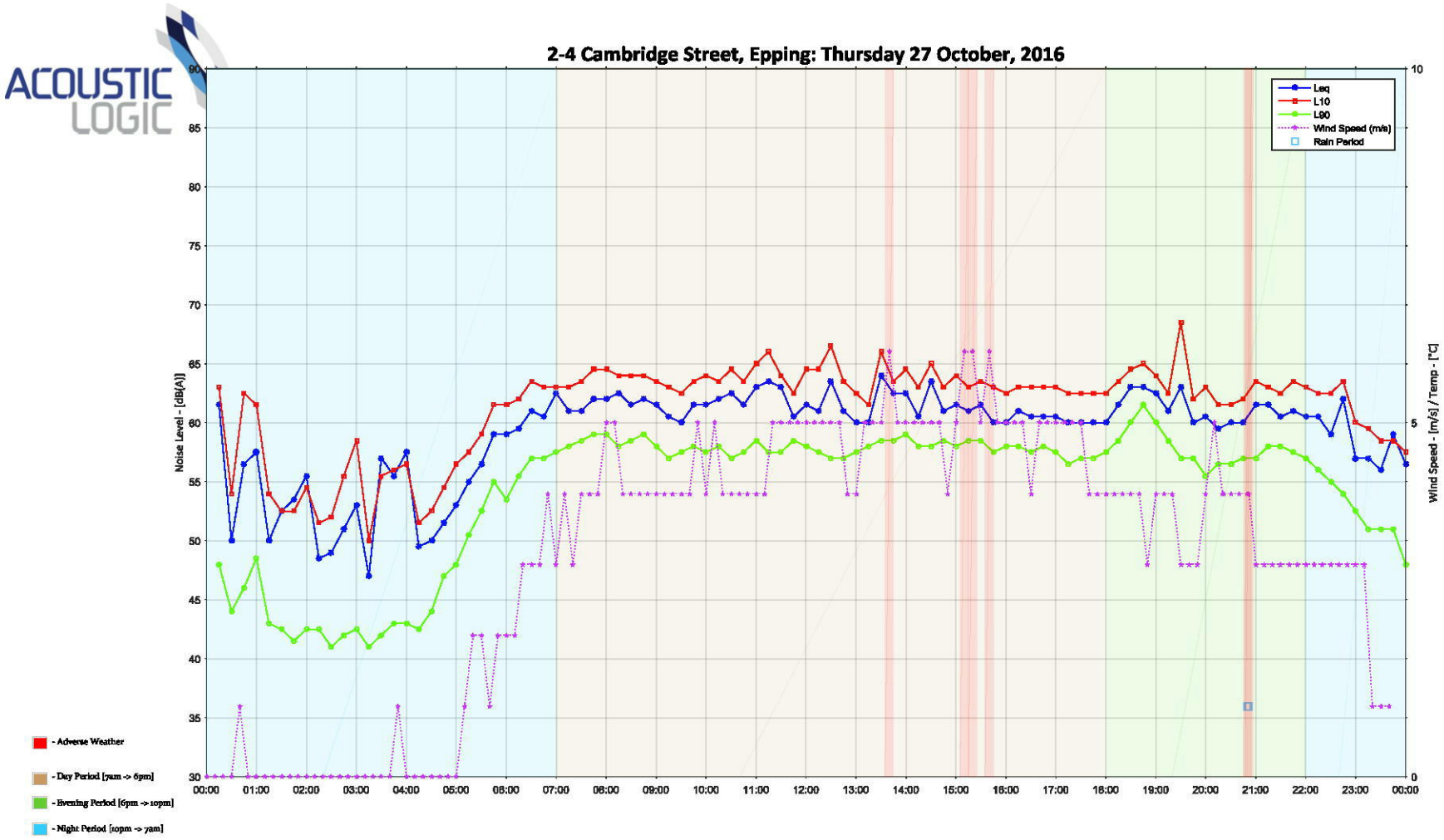
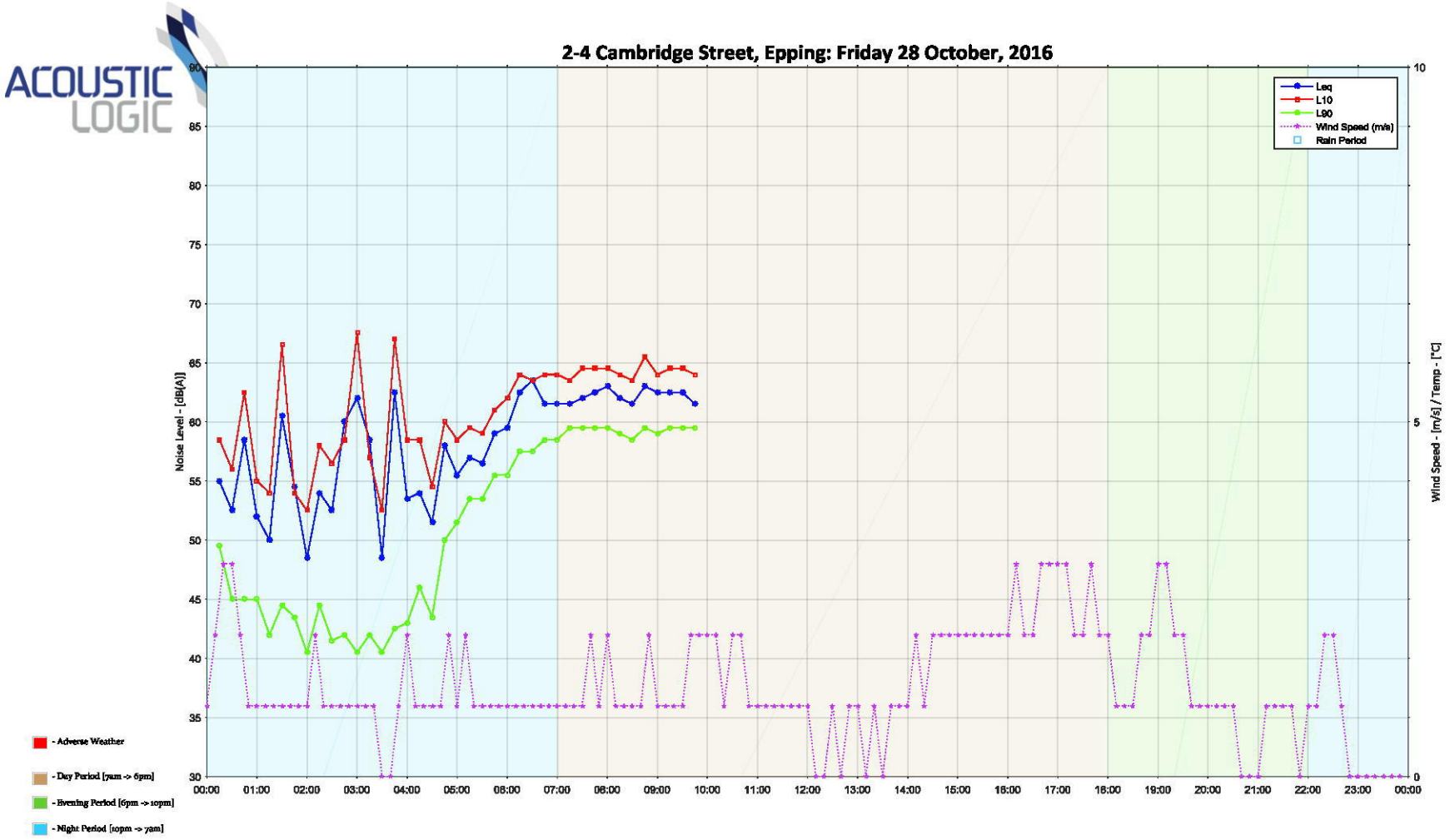
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


2-4 Cambridge Street, Epping: Tuesday 25 October, 2016
Leq
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


2-4 Cambridge Street, Epping: Wednesday 26 October, 2016
Leq
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


2-4 Cambridge Street, Epping: Thursday 27 October, 2016
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


2-4 Cambridge Street, Epping: Friday 28 October, 2016
Leq
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

APPENDIX TWO – NOISE MONITOR LOCATION – PHOTO

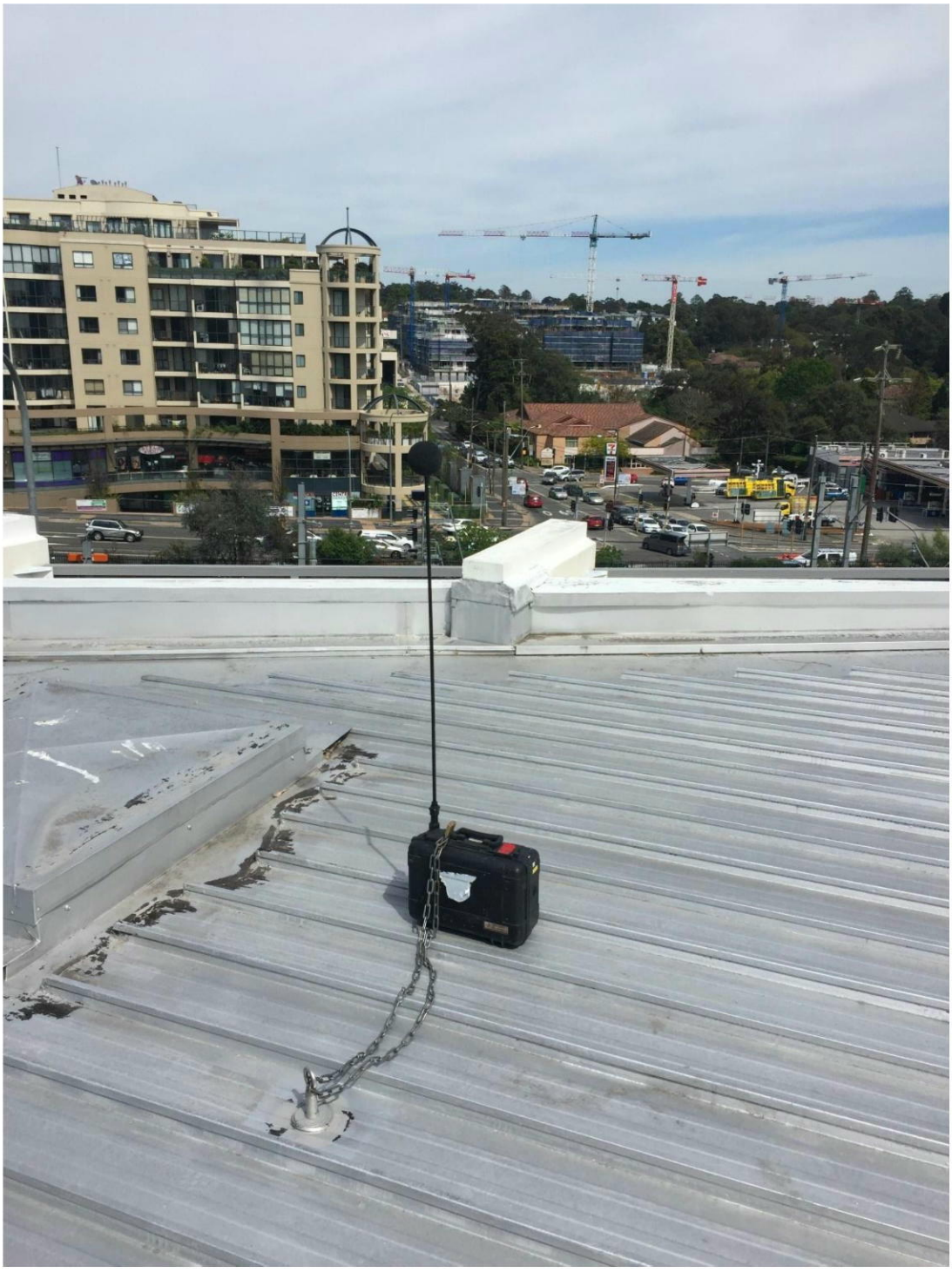


Figure 2 – Unattended Noise Monitor Location – Roof

APPENDIX THREE – GLAZING MARK UP

1 Level 1
Scale: 1:100 @ A1
1:200 @ A3

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6.38mm Laminate
10mm Float
10.38mm Laminate
12.38mm Laminate
6.38mm Laminate + 100mm Airgap + 6.38mm Laminate

109° 49' 46" 15.241m
199° 49' 36" 20.116m
199° 49' 49" 20.116m
109° 49' 36" 23.764m
109° 49' 47" 15.252m
352° 54' 36" 22.555m
109° 50' 0" 6.051m
199° 49' 44" 20.111m
199° 49' 52" 15.237m
289° 49' 42" 25.150m

BBQ AREA
HC/WC
Podium
COS
659.25 m²
Terrace
25.76 m²
+105 900
RAMP 1:20
+106 000
+106 000
bedroom
10.20 m²
UNIT 2
1 BED
50.02 m²
UNIT 1
2 BED
75.04 m²
Terrace
55.99 m²
bedroom (master)
11.54 m²
ensuite
bedroom
11.76 m²
bath
Foyer Level 1
20.62 m²
Services
3.61 m²
Screen
AC Plant
Screen
Terrace
16.85 m²
bedroom
10.33 m²
UNIT 3
1 BED
50.20 m²
store
4 m²
bath
Terrace
15.01 m²
Skylight below
UNIT 4
1 BED
50.04 m²
bedroom (master)
10.00 m²
bath
store
1 m²
bedroom
9.60 m²
UNIT 5
2 BED
75.02 m²
Terrace
53.81 m²
terrace
25.08 m²
bedroom (master)
10.01 m²
ensuite
store
3 m²
9 000
9 000

CAMBRIDGE STREET

ISSUE	AMENDMENT	DATE	DRAWN	CHECKED
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Figured dimensions shall be taken in preference to scaling.
Drawing to be read in conjunction with information on first page.
Check all dimensions and levels on site before commencing work or ordering materials.
All existing ground lines & trees location are approximate, therefore to be verified on-site by the builder.
Any discrepancies to be verified back to Zhinar Architects before proceeding.
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2 Rowe Street
Eastwood NSW 2122
+61 2 8893 8888 / p
+61 2 8893 8833 / f
www.zhinar.com.au / w
28 495 869 790 / abn

PROJECT STATUS :
Development Application

PROJECT NAME
Mix-Use Development
2-4 Cambridge Street
Epping NSW 2121

L.G.A : Paramatta City Council

NORTH:

DIAL BEFORE YOU DIG www.1100.com.au

SHEET TITLE:
Level 1

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08468 JOB No.
DA-A 11 DRAWING No.
A ISSUE

PRINT DATE: Wednesday, 2 November 2016 4:06 pm

1 Typical L2-9

Scale: 1:100 @ A1
1:200 @ A3

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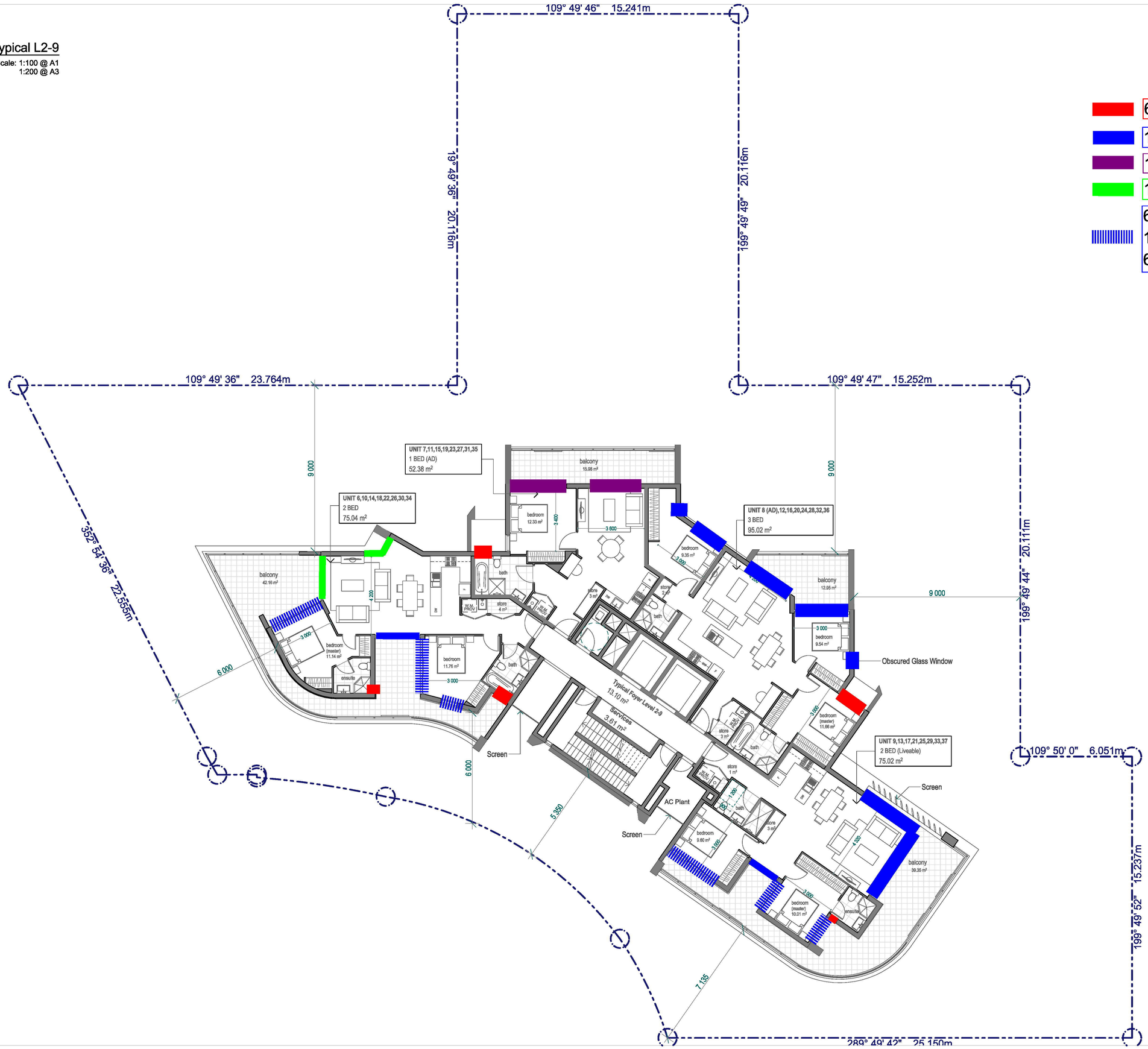
10mm Float
10.38mm Laminate
12.38mm Laminate
6.38mm Laminate + 100mm Airgap + 6.38mm Laminate



ISSUE	AMENDMENT	DATE	DRAWN	CHECKED
DA-A	ISSUED FOR DEVELOPMENT APPLICATION	OCT 16	AH	IC

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PRINT DATE: Thursday, 3 November 2016 2:52 pm

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1:200 @ A3

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- 10mm Float
- 10.38mm Laminate
- 12.38mm Laminate
- 6.38mm Laminate + 100mm Airgap + 6.38mm Laminate

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08468	DA-A 13	A

PRINT DATE: Thursday, 3 November 2016 2:52 pm

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1 Level 21

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12.38mm Laminate
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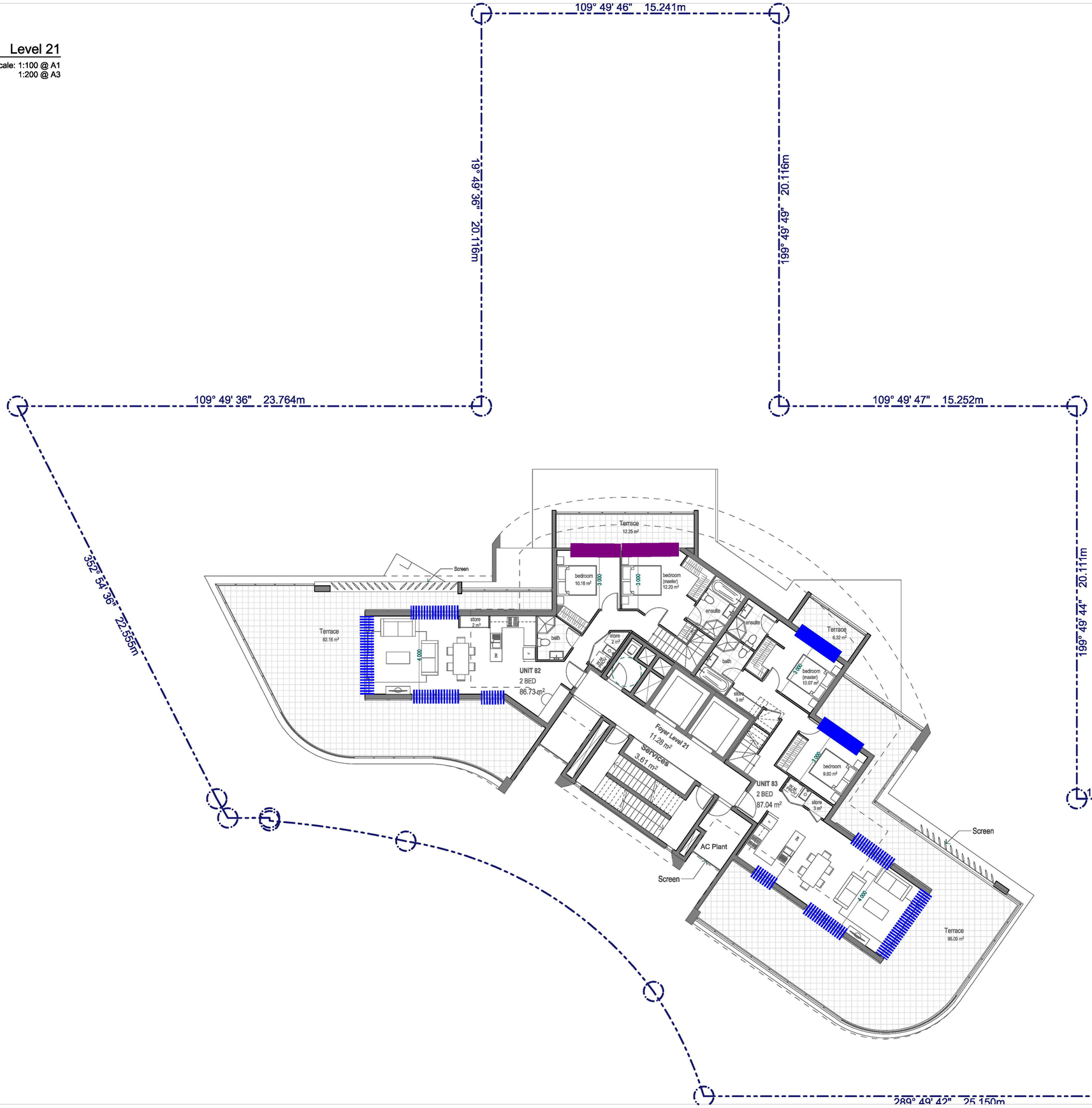

ISSUE	AMENDMENT	DATE	DRAWN	CHECKED
DA-A	ISSUED FOR DEVELOPMENT APPLICATION	OCT 16	AH	IC

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