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ACOUSTIC ASSESSMENT

SCHOOL OPERATIONAL NOISE IMPACT ASSESSMENT

AMITY COLLEGE LEPPINGTON CAMPUS

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AMITY COLLEGE LEPPINGTON CAMPUS

1.0 INTRODUCTION

Koikas Acoustics Pty Ltd was commissioned by Amity College to undertake an acoustic assessment of the potential noise impact from the proposed school (also known as the Amity College Leppington Campus) to be located at 85 Byron Road, Leppington and assess against the relevant noise policies and guidelines stated in Secretary's Environmental Assessment Requirements (SEAR) (Application Number SSD 9227).

In completing this assessment report, Koikas Acoustics measured the ambient noise profile pertaining to the surrounding area. Detail noise calculations followed to ascertain whether the operation of the school impacts upon surrounding premises.

This report presents our results and findings, and where appropriate, recommended noise mitigation measures to attenuate noise to the surrounding premises. This acoustic assessment is based on the maximum capacity operation of the school and consists of five components:

- **Part 1: Noise Impact of Students to Surrounding Premises**

  The noise impact from the proposed school operations to the surrounding residential premises was assessed in accordance with Camden Council's Environmental Noise Policy. The following components were considered:

  - 1,000 children (maximum capacity) occupying the playground areas during recess/lunchtime.
  - Noise impact from outdoor teaching area along the south-eastern side of the proposed school. Koikas Acoustics has been advised that only one class is to occupy the outdoor teaching area with a maximum of 25 students.
  - Noise impact from the use of the school halls during after-hours.

- **Part 2: Car Park Noise Impact to Surrounding Premises**

  Assessing the car park noise impact during morning/afternoon peak hours and after-hours to surrounding residential premises in accordance with Camden Council's Environmental Noise Policy.

- **Part 3: Traffic Generation of the Development to Surrounding Premises**

  Traffic noise impact assessment in accordance with the NSW Road Noise Policy. This assessment considers the increased traffic volumes arising from the proposed development and the potential noise impacts to surrounding residential premises.

- **Part 4 (Construction Noise & Vibration Assessment / Plan of Management)**

  An assessment of construction noise and vibration in accordance with the Department of Environmental Climate Change and Water's (DECCW) Interim Construction Noise Guidelines (also known as the EPA's ICNG) which is assessed quantitatively in conjunction with reasonable and feasible noise and vibration mitigation measures for the duration of the construction period.

- **Part 5 (Acoustic Privacy Between Classrooms)**

  Airborne sound isolation between classrooms through operable walls and the open teaching areas.

2.0 THE PROPOSAL / DEVELOPMENT

The school development is proposed to occupy the site at 85 Byron Road, Leppington.

The school will include a total of 1,000 primary and secondary school students, and 82 staff members.

The assessment site is surrounded by residential properties to the east, north and south, and a recreational reserve to the west. The subject site and surrounding properties are identified on the aerial photograph included as **Figure 1**.

The current development design was prepared by Gran Associates Australia Pty Ltd (master plan 2018). All calculations and noise modelling undertaken for this acoustic assessment was based on architectural drawings provided by Gran Associates Pty Ltd.

The site of the proposed school is specifically zoned for the purposes of a school, namely SP2 Infrastructure (Educational Establishment) under the provisions of the State Environmental Planning Policy (Sydney Region Growth Centres) 2006. Properties fronting Ingelburn Road are zoned R3 Medium Density Residential, with a section zoned B7 Business Park to the immediate north of the project site. Abutting the project site to the west is land zoned for public open space (RE1). The Leppington precinct was released for urban development in 2015 and is currently in the process of undergoing transition from rural residential to urban residential and urban-related uses. An approved 84-allotment subdivision is currently being developed on land adjoining the southern boundary of the proposed school.

As the project site is zoned specifically for the purposes of an educational establishment (school), there is an expectation in the planning process for Leppington that a school would be established on the project site, with attendant noise impacts. The Land and Environment Court has held that schools and residential areas can co-exist as part of a community per *Trustees of the Christian Brothers v Waverley Council [2004] NSWLEC 210 at [8].*"

Prevailing ambient noise conditions on-site and in the local area are generally the result of typical environmental noise such as rustling of leaves, birds chirping, insect noise (seasonally), distant traffic and light local traffic.

Figure 1. Aerial photo of the subject site and surrounding area (Image source – Google Earth)

3.0 NOISE CRITERIA

3.1 DISCUSSION OF THE SEAR (SSD 9227)

The aim of this acoustic impact assessment is to address the potential key issues listed in part 8 of the Secretary's Environmental Assessment Requirements SEAR (SSD 9227) document related to the subject school development for DA submission. The relevant section is extracted and presented below:

8. Noise and Vibration

Identify and provide a quantitative assessment of the main noise and vibration generating sources during construction and operation, including consideration of any public-address system, school bell and use of any school hall for concerts etc. (both during and outside school hours). Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.

→ Relevant Policies and Guidelines:

- *Noise Policy for Industry 2017 (EPA);*
- *Interim Construction Noise Guideline (DECC);*
- *Assessing Vibration: A Technical Guideline 2006;*
- *Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Planning 2008).*

The noise impact assessment, discussion and recommended noise mitigation measures relating to each relevant policy/guideline as per the SEAR are included in various sections of this acoustical report:

- Noise Policy for Industry 2017 (EPA)
    - Discussion: The noise policy is discussed in Section 3.6 of this report and relates to future mechanical plant noise impact only (if any) of this acoustic assessment. The school proposal does not constitute a Scheduled Activity under Schedule 1 of the Protection of the Environment Operations Act 1997. As such, the proposed school will not require an Environment Protection Licence (EPL). Moreover, the NSW Land & Environment Court has held that the EPA Noise Policy for Industry 2017 is not applicable to schools.
    - Noise Criteria: The derivation of noise criteria is included in Section 6.1 and 6.2 of this report.
    - Noise impact assessment: Refer to noise model Scenario 1 and 2 in Section 8.2 of this report.
    - Recommendation: Recommended noise mitigation measures are included in Section 9.0 of this report.

- **Interim Construction Noise Guideline (DECC)**
    - Discussion: The noise guideline is discussed in Section 3.4 of this report and relate to potential noise and vibration impact during construction period (Part 4 of this acoustic assessment).
    - Noise Criteria: The derivation of noise criteria is included in Section 6.4 of this report.
    - Noise impact assessment and recommendations: Refer to noise model Scenario 10.0 of this report.
- **Assessing Vibration: A Technical Guideline 2006 & Development Near Rail Corridor and Busy Roads – Interim Guideline (Department of Planning 2008)**

    The project site is neither on nor adjacent to any freeway, transit way or any other road as described in the above guidelines. The proposed school has a frontage to a local road only, with relatively small AADT traffic flows. Ingelburn Road also has only modest traffic flows. It is estimated that in 2008 Camden Valley Way had an AADT of just over 20,000 vehicles (source: AECOM (2014) Leppington Precinct – Transport and Access Strategy). Therefore, the project does not activate any relevant trigger under these guidelines. For the same reason, an assessment of vibration impacts in accordance with the assessment procedures outlined in Assessing Vibration: A Technical Guideline 2006, is not warranted.

3.2 CAMDEN COUNCIL'S ENVIRONMENTAL NOISE POLICY – PART 1 & 2

In the absence of a state noise policy criterion, Camden Council's Environmental Noise Policy is one reference document that can be used to measure noise from schools. The noise criterion of+10dB(A) for two hours has also been applied in a number of Land & Environment Court decisions relating to school developments per Pain J in Meriden School v Pedavoli [2009] NSWLEC 183 at [40] and Roseth SC in Mohamad El Dana v Bankstown City Council [2008] NSWLEC 1484, however, in a more recent decision of the Court in Al–Faisal College Limited v Canterbury Bankstown Council [2018] NSWLEC 1467 an exceedance of +14dBA was found to be an acceptable noise impact for school children playing outdoors. It reflects the reduced duration of noise from schools, in comparison to the day long duration of noise experienced from industrial uses- the latter land use being subject to the Noise Policy for Industry (2017).

As per the Camden Council's Environmental Noise Policy, the noise criterion related to noise impact from students/children occupying the outdoor areas of the subject school to surrounding residential premises is as follows:

> As a guide the $L_{Aeq(15\ minutes)}$ noise level from children in the outdoor areas of the site should not exceed the background $L_{A90\ (15minutes)}$ sound level by more than 10dB(A) when measured at the boundary of the nearest or most affected residential premises, or if the boundary is more than 30 metres from a residential dwelling, at the most affected point within 30 metres of a residence.

The Land and Environment Court previously considered a similar school development. Justice Pain's judgement regarding this matter was that noise from school children playing outdoors being 18 dB above the background was not considered to be offensive noise under the Protection of the Environment Operations Act 1997 (Meriden School v Pedavoli [2009] NSWLEC 183 at [46]). The L&EC have adopted an assessment criterion of background +10dB for two hours. Camden Council's Environmental Noise Policy considers a background +10dB as being a reasonable noise criterion.

The above also applies for vehicular noise impact within the car park areas and pick-up/drop-off areas.

3.3 NSW ROAD NOISE POLICY - PART 3

The document entitled "NSW Road Noise Policy" has replaced the "Environmental Criteria for Road Traffic Noise" (ECRTN) for assessment procedures and criteria for traffic noise and effective from 1st of July 2011.

An extract of Table 3 and Table 6 of NSW Road Noise Policy from Environmental Climate Change & Water (ECCW) is provided below:

Table 3 Road traffic noise assessment criteria for residential land uses

Road category	Type of project/land use	Assessment criteria – dB(A)	
		Day (7 a.m.–10 p.m.)	Night (10 p.m.–7 a.m.)
Freeway/ arterial/ sub-arterial roads	1. Existing residences affected by noise from **new** freeway/arterial/sub-arterial road corridors	$L_{Aeq, (15\ hour)}$ 55 (external)	$L_{Aeq, (9\ hour)}$ 50 (external)
	2. Existing residences affected by noise from **redevelopment** of existing freeway/arterial/sub-arterial roads 3. Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq, (15\ hour)}$ 60 (external)	$L_{Aeq, (9\ hour)}$ 55 (external)
Local roads	4. Existing residences affected by noise from **new** local road corridors 5. Existing residences affected by noise from **redevelopment** of existing local roads 6. Existing residences affected by **additional traffic** on existing local roads generated by land use developments	$L_{Aeq, (1\ hour)}$ 55 (external)	$L_{Aeq, (1\ hour)}$ 50 (external)

Note: Land use developers must meet internal noise goals in the Infrastructure SEPP (Department of Planning NSW 2007) for sensitive developments near busy roads (see **Appendix C10**).

In this case, type 4 and 6 of the above for local roads will be applicable for Part 3 of this assessment.

Table 6 Relative increase criteria for residential land uses

Road category	Type of project/development	Total traffic noise level increase – dB(A)	
		Day (7 a.m.–10 p.m.)	Night (10 p.m.– 7 a.m.)
Freeway/arterial/ sub-arterial roads and transitways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road	Existing traffic $L_{Aeq, (15\ hour)}$ + 12 dB (external)	Existing traffic $L_{Aeq, (9\ hour)}$ + 12 dB (external)

It is noted that the night-time noise criterion does not apply as the school will only operate during the daytime period.

Furthermore, Section 3.4 of NSW Road Noise Policy states the following:

3.4 Applying the assessment and relative increase criteria

The process for applying the criteria involves firstly defining a study area. This helps ensure that noise is assessed and any necessary mitigation applied at those locations most affected. The *UK Design Manual for Roads and Bridges* (United Kingdom Highways Agency 2008) adopts a distance of 600 metres from a project as being adequate for this purpose.

Where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce these through feasible and reasonable measures to meet the assessment criteria. A secondary objective is to protect against excessive decreases in amenity as the result of a project by applying the relative increase criteria.

In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

Section 3.4.1 provides a step-by-step procedure for applying the noise criteria to each type of project and development covered by the RNP.

Where the existing traffic noise levels are above the NSW Road Noise Policy (ECCW) assessment criteria, the increase in traffic noise levels due to the proposed development are not to exceed **2 dB**.

A more rigorous analysis can be carried out at a later stage when a more detailed road traffic report is available which includes future traffic volumes along surrounding roads with and without the subject school development.

3.4 INTERIM CONSTRUCTION NOISE GUIDELINES 2009 (ICNG) – PART 4

Noise and vibration generated during excavation and construction works is assessed at surrounding residential receivers in accordance with the Interim Construction Noise Guidelines (NSW DECCW, 2009).

3.4.1 Construction Noise

The guideline recognises that construction and excavation works will at times generate noise that is clearly audible at neighbouring sites. The primary focus is to provide a means of determining the severity of noise impacts at surrounding affected receiver locations and a framework for managing construction noise, generally through implementing best practice noise minimisation principles and facilitating communication between construction workers and the local community.

Small-scale construction projects/works generally do not require detailed calculations of noise emission.

For ongoing projects where surrounding receivers may be exposed to construction noise for periods exceeding three weeks, a more detailed assessment approach is adopted. In this case, a receiver is categorised by the likely community reaction to the level of noise, where some community reaction is expected at 10 dB above the background level and, strong community reaction is expected at levels exceeding 75 dB(A).

For this noise assessment, surrounding the development site, 10 dB above the existing EPA minimum daytime background level is 44 dB(A) and 46 dB(A) for Location 1 (eastern end) and 2 (western end) respectively. Refer to **Figure 1** for Site Locations 1 and 2 and Section 5.1 of this report for a summary of the ambient background noise survey results. These noise levels are defined by ICNG as the *Noise Affected Level*. Above 75 dB(A) noise levels are defined by the ICNG as *Highly Noise Affected Level.*

The above noise criteria apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

3.4.2 Construction Vibration

Section 4.4 of the ICNG states that "Human comfort vibration from construction works, including continuous, intermittent or impulsive vibration from construction, but excluding blasting, is to be assessed in accordance with Section 2.5 'Short-term works' in *Assessing Vibration – a technical guideline (DEC 2006)*".

The DEC vibration standard has been sourced from *British Standard 6472-1992 Evaluation of human exposure to vibration in buildings (1Hz to 80Hz).* The referenced table nominates preferred and maximum vibration dose values (VDV) that correlate with human annoyance at receiver sites of different classifications such as residential, education facilities etc.

Table 1. Acceptable vibration dose value for intermittent vibration ($m/s^{1.75}$), BS6472:1992				
Location	Daytime		Night-time	
	Preferred values	Maximum values	Preferred values	Maximum values
Critical areas	0.1	0.2	0.1	0.2
Residences	0.2	0.4	0.13	0.26
Offices, schools, educational institutions and places of worship	0.4	0.8	0.4	0.8
Workshops	0.8	1.6	0.8	1.6

A more critical assessment of vibration impacts may be related to structural damage of surrounding buildings. It is expected that the geotechnical engineer will specify a peak particle velocity limit not to be exceeded at the site boundary. Where this is not available, a guide to applicable structural damage criteria can be taken from *British Standard 7385-2:1993* and/or *German Standard DIN4150-3.*

BS7385-2:1993 recommends a maximum peak component particle velocity when measured at the base of the building of:

- 50 mm/s for reinforced or framed structures – Industrial and heavy commercial buildings.
- 15 mm/s for unreinforced or light framed structures – Residential or light commercial type buildings.

It is noted, spectral levels are not considered by this standard.

German standard DIN4150-3 recommends a maximum peak particle velocity of:

Table 2. DIN4150-3 guideline values for assessing short-term vibration effects					
Line	Type of structure	Vibration velocity, v_i, in mm/s			
		Foundation			Plane of floor of uppermost full storey
		At a frequency of			Frequency mixture
		Less than 10Hz	10 to 50Hz	50 to 100Hz	
1	Buildings used for 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 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

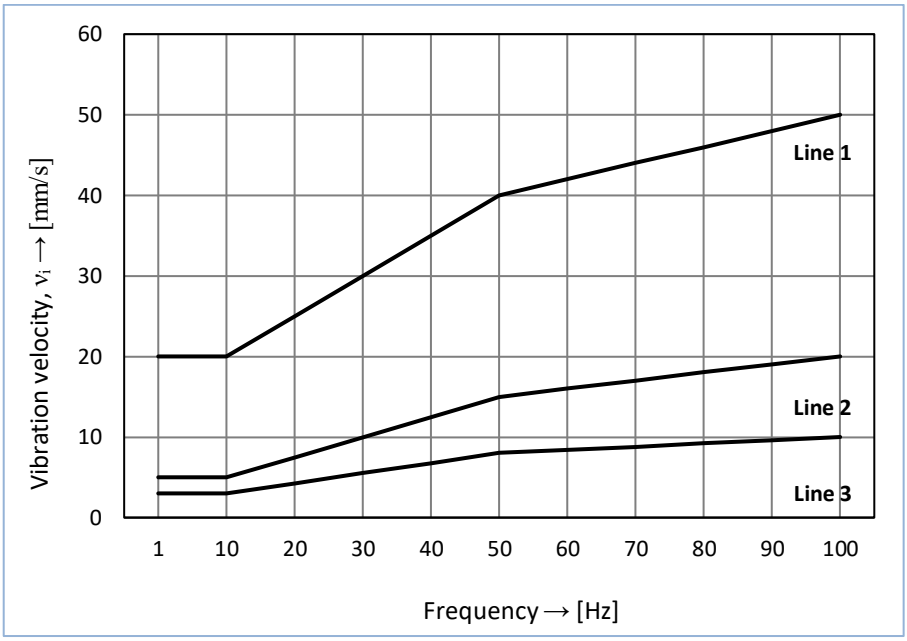


Figure 2. DIN4150-3 Curves representing guideline vibration velocity values at the building foundation

The *British Standard 7385-2:1993* and *German Standard DIN4150-3* discussed above are guidelines for preventing structural damage to surrounding buildings during construction of the proposed school. In this case, the construction vibration is unlikely to be an issue as there is no attached building to the subject site and no bulk excavation is proposed.

3.5 ACOUSTIC PRIVACY BETWEEN CLASS ROOMS

As a guide, a design reverberation time (reverberation time) and indoor design noise levels for the school classrooms and open plan teach area are referenced from *AS2107-2016 – Acoustics: Recommended design sound levels and reverberation times for building interiors*.

Extracted from AS2107-2016

Item	Type of occupancy/activity	Design sound level ($L_{Aeq,t}$) range	Design reverberation time (T) range, s
1	EDUCATIONAL BUILDINGS		
	Art/craft studios	40 to 45	< 0.8
	Assembly halls up to 250 seats	30 to 40	0.6 to 0.8
	Assembly halls over 250 seats	30 to 35	Curve 1*
	Audio-visual areas	35 to 45	0.6 to 0.8
	Computer rooms—		
	Teaching	40 to 45	0.4 to 0.6
	Laboratories	45 to 50	0.4 to 0.6
	Conference rooms	35 to 40	0.6 to 0.7
	Corridors and lobbies	< 50	< 0.8
	Drama studios	35 to 40	Curve 1*
	Engineering workshops—		
	Teaching	< 45	See Note 1
	Non-teaching	< 60	See Note 1
	Weight training/Fitness room	< 50	< 1.0
	Interview/counselling rooms	40 to 45	0.3 to 0.6
	Laboratories—		
	Teaching	35 to 45	0.5 to 0.8
	Working	40 to 50	0.5 to 0.8
	Lecture rooms up to 50 seats	30 to 35	Curve 3*
	Lecture theatres—		
	Without speech reinforcement	30 to 35	Curve 3*
	With speech reinforcement	30 to 40	Curve 3*
	Libraries—		
	General areas	40 to 50	< 0.6
	Reading areas	40 to 45	< 0.6
	Manual arts workshops	< 45	< 0.8
	Medical rooms (First Aid)	40 to 45	0.6 to 0.8
	Music practice rooms	40 to 45	0.7 to 0.9
	Music studios	30 to 35	Curve 2* (see Note 3)
	Office areas	40 to 45	0.4 to 0.7
	Professional and administrative offices	35 to 40	0.6 to 0.8
	Teaching spaces/single classroom—		
	Open plan teaching spaces	35 to 45	Curve 3* (see Note 1)
	Primary schools	35 to 45	Curve 3* (see Note 2)
1	Staff common rooms	40 to 45	< 0.6
(cont)	Staff studies/collegiate	40 to 45	0.4 to 0.6
	Sports hall	< 50	Curve 4*
	Toilet/change/showers	< 55	—

NOTES:

1 Reverberation time should be minimized for noise control.

2 Certain teaching spaces, including those intended for students with learning difficulties and students with English as a second language, should have reverberation times at the lower end of the range.

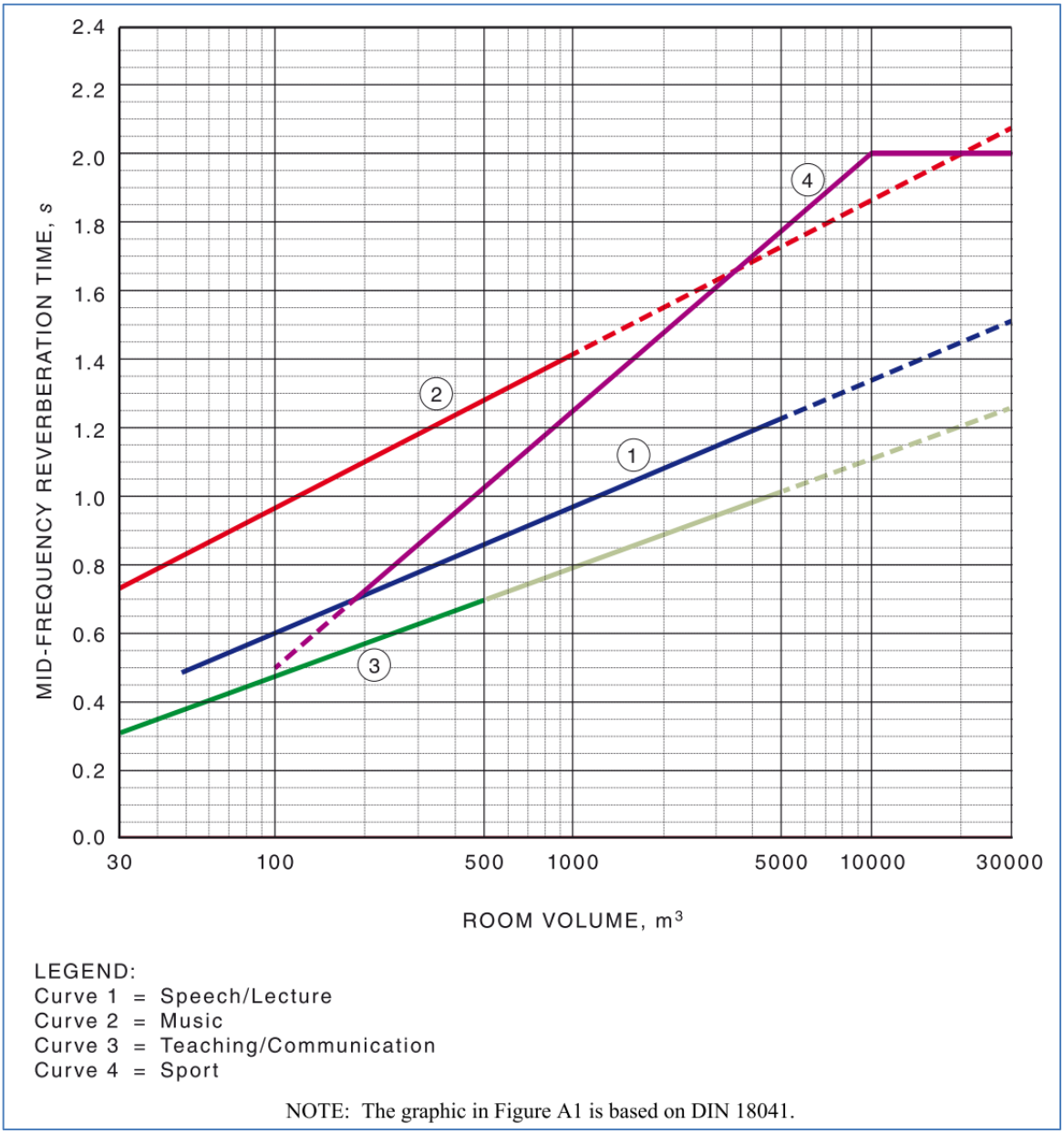


Figure 3. Design curves for reverberation time (extracted from AS2107:2016)

3.6 EPA NOISE POLICY FOR INDUSTRY – FOR MECHANICAL PLANT NOISE

The NSW Government has no specific standard, under a noise policy or guideline that governs the appropriate noise level arising from schools. The only such policy is the *Noise Policy for Industry (NPfI) (2017)* which applies to industrial noise sources from listed activities. Schools and Child Care facilities are not such a listed activity - although fixed mechanical plant and equipment noise in a school would be covered by this Policy. The noise from children playing is a low impact noise. It is not industrial in nature and not covered by the Policy. It is also relevant to note that noise from play is often audible in residential areas near any school."

Noise emission design targets (for mechanical plant) have been referenced from the *NSW Environmental Protection Authority Noise Policy (EPA) for Industry (NPfI)*. The NPfI replaces the former Industrial Noise Policy, also prepared by the EPA.

The NPfI is designed to assess environmental noise impacts associated with scheduled activities prescribed within the *Protection of the Environment Operations Act 1997, Schedule 1*. It is also commonly used as a reference tool for establishing suitable planning levels for noise generated by mechanical plant and equipment and noise emission from commercial operations.

The guideline applies limits on the short-term intrusive nature of a noise or noise generating development (project intrusive noise level), as well as applying an upper limit on cumulative industrial noise emissions from all surrounding development/industry (project amenity noise level).

The most stringent of the project intrusive noise level and project amenity noise level is applied as the **project noise trigger level**. The project noise trigger level is the point, above which noise emission from a source or development site would trigger a management response.

To be able to define the more stringent of the intrusive and amenity noise levels, the underlying noise metrics must be the same. As the intrusive noise level is defined in terms of a $L_{Aeq\ 15\ minutes}$ and the amenity noise level is defined in terms of a $L_{Aeq\ Period}$, a correction +3dB correction is applied to the project amenity noise level to equate the $L_{Aeq\ Period}$ to $L_{Aeq\ 15\ minutes}$.

4.0 NOISE AND VIBRATION SURVEYS

4.1 NOISE MONITORING PROCEDURES

All noise methodologies and equipment used comply with the following Australian Standards:

- *AS1259.2-1990 "Acoustics - Sound Level Meters - Integrating - Averaging", and*
- *ISO 1996-2007 "Acoustics – Description, measurement and assessment of environmental noise" Part 2: Determination of environmental noise levels*

4.2 UNATTENDED NOISE SURVEY

4.2.1 Site Location of Unattended Noise Monitoring

Two unattended noise monitoring surveys were conducted by Koikas Acoustics to determine the existing ambient noise conditions pertaining to surrounding area. From the ambient noise surveys the applicable noise criteria was derived.

The unattended noise surveys were conducted at:

- **Monitoring Location 1**: Front boundary of 85 Byron Road, Leppington, and
- **Monitoring Location 2**: Rear bushland of 85 Byron Road, Leppington.

Refer to **Figure 1** that includes the two noise monitoring Site Locations superimposed over an aerial photo.

The microphones were placed at approximately 1.5 metres above the natural ground level.

Details of the noise surveys and calculated noise metric results are attached in **Appendix A.**

4.2.2 Survey Dates and Duration

The surveys were conducted between Thursday 21st and Friday 27th June 2018 inclusive. The survey results were derived from seven (7) whole days.

4.3 METEOROLOGICAL CONDITIONS PERTAINING DURING NOISE & VIBRATION SURVEY

Over the period of the noise survey, meteorological conditions were fine and did not affect the noise survey results.

4.4 SURVEY INSTRUMENTATION AND CALIBRATION

The following noise instruments were used:

- **Monitoring Location 1**: Type 1 Svantek 977 octave band sound level meter data loggers serial numbers 34134.
- **Monitoring Location 2**: Type 1 Svantek 977 octave band sound level meter data loggers serial numbers 34131.

All equipment used for taking noise level measurements carry current NATA certification and were field calibrated before and after measurements with a Type 1 Larson Davis field calibrator. No system drifts were noted.

4.5 LOGGER FUNCTION AND DESCRIPTORS

The sound level meter was programmed to record noise data at consecutive 15 minutes intervals on the quarter hour. The data for each 15 minutes period was stored in the data logger memory.

The data stored included the following noise metrics:

- L_{eq} known as the continuous equivalent noise level
- L_{max} the maximum hold sound pressure level
- L_{1} the noise that was exceeded for 1 percentile of the measurement period
- L_{10} the noise that was exceeded for 10 percentile of the measurement period
- L_{90} the noise that was exceeded for 90 percentile of the measurement period
- L_{min} the minimum sound pressure level

The Svantek 977 sound level meter data logger also measured and stores the above information in octave bands. This information was used for calculation purposes with the CadnaA noise model.

5.0 NOISE MEASUREMENT RESULTS

5.1 UNATTENDED NOISE SURVEY RESULTS

The measured noise levels obtained from the unattended noise survey follows:

Table 3. Summary of unattended noise survey results

NOISE METRICS	PERIOD [hhmm-hhmm]	Noise Level [dB]	
		Location 1 (Front)	Location 2 (Rear)
$L_{A90, daytime}$	0700-1800 0800-1800 (Sunday/Public Holiday)	34	36
$L_{A90, evening}$	1800-2200	37	42
$L_{A90, night-time}$	2200-0700 2200-0800 (Sunday/Public Holiday)	32	37
$L_{Aeq, daytime}$	0700-1800 0800-1800 (Sunday/Public Holiday)	47	48
$L_{Aeq, evening}$	1800-2200	46	48
$L_{Aeq, night-time}$	2200-0700 2200-0800 (Sunday/Public Holiday)	44	46
$L_{Aeq, 15 hours}$	0700-2200	46	48
$L_{Aeq, 9 hours}$	2200-0700	44	46

The above rated background levels (RBL) were calculated as per the EPA's Noise Policy for Industry (NPfI) assessment procedures.

Attached as **Appendix A** are the complete logger graphs for the entire measurement period including the summary sheets.

6.0 NOMINATED NOISE CRITERIA

6.1 SCHOOL OPERATIONAL NOISE CRITERIA – PART 1 & 2

The school operational noise criteria was derived from measured background noise levels. The adopted noise criteria of $L_{Aeq,15minutes} \leq L_{A90,daytime} + 10$ dB as per the Camden Council's Environmental Noise Policy discussed in Section 3.2 of this report. Therefore, the school operational noise criteria are:

Daytime period between 0700 and 1800 hours (Background + 10 dB)

- $L_{Aeq,15\ min\ (daytime)} \leq 44$ dB, for residential premises near monitoring **Site Location 1** (east), and
- $L_{Aeq,15\ min\ (daytime)} \leq 46$ dB, for residential premises near monitoring **Site Location 2** (west).

Evening period between 1800 and 2200 hours (Background + 10 dB)

- $L_{Aeq,15\ min\ (evening)} \leq 47$ dB, for residential premises near monitoring **Site Location 1** (east), and
- $L_{Aeq,15\ min\ (evening)} \leq 52$ dB, for residential premises near monitoring **Site Location 2** (west).

6.2 MECHANICAL PLANT NOISE CRITERIA

The determination of the mechanical plant noise criteria is summarised in Table 4 below. This includes the calculated EPA's Intrusive and Amenity noise criteria that is to be achieved to surrounding residential receivers from the new development.

Table 4. NPfI residential planning levels									
Period, T (Note 1)		Intrusive		Amenity					
		RBL	RBL + 5	Area classification	Recommended amenity noise level	High traffic corr.	Project amenity noise level	+3dB correction	Project noise trigger level
Location 1	Day	34	39	Rural	50	No	45	48	39
	Evening	37	42	Rural	45	No	40	43	42
	Night	32	37	Rural	40	No	35	38	37
Location 2	Day	36	41	Rural	50	No	45	48	41
	Evening	42	47	Rural	45	No	40	43	43
	Night	37	42	Rural	40	No	35	38	38
Notes	1. EPA time periods Day = 7am to 6pm, Evening = 6pm to 10pm, Night = 10pm to 7am 2. The amenity criterion is based on the area classification of the site as being 'urban' and has been corrected for an assessment in areas of high traffic and for existing industrial noise where applicable. 3. Project noise amenity level = recommended noise amenity level – 5dB, except where specific circumstances are met, such as high traffic.								

The adopted mechanical plant noise criteria are:

Daytime period between 0700 and 1800 hours

- $L_{Aeq,15\ min\ (daytime)}$ ≤ 39 dB, to surrounding residential premises adjacent to Byron Road (Site Location 1);
- $L_{Aeq,15\ min\ (daytime)}$ ≤ 41 dB, to surrounding residential premises at the rear of the subject school (Site Location 2);

Evening period between 1800 and 2200 hours

- $L_{Aeq,15\ min\ (evening)}$ ≤ 42 dB, to surrounding residential premises adjacent to Byron Road (Site Location 1), and
- $L_{Aeq,15\ min\ (evening)}$ ≤ 43 dB, to surrounding residential premises at the rear of the subject school (Site Location 2).

The above noise criteria are applicable to future installation of any mechanical plant (most commonly AC units). As the mechanical plant design layout and selection are not available at the time of preparing this report, a rigorous mechanical plant noise impact assessment should be considered as required at a later stage to verify any potential noise impacts and consider appropriate noise mitigation measures to comply to surrounding residential premises.

Noise from any mechanical plant should be specified and controlled to meet the criteria when assessed at the nearest affected noise-sensitive location. Typical noise mitigation strategies include:

- selection of low noise outdoor equipment,
- locating plant to take advantage of shielding from building elements, and
- the use of plant enclosures or screens where necessary.

Furthermore, noise generated by waste collection or other service vehicles should be controlled by management of the collection/delivery times to ensure that disturbance to nearby residents during typical sleeping hours is avoided.

6.3 TRAFFIC NOISE IMPACT ARISING FROM THE PROPOSED SCHOOL TRAFFIC – PART 3

According to NSW Road Noise Policy, the following noise criteria apply:

Noise Mode Scenario	Space	Noise Criteria	Period
Scenario 3A	Residential	$L_{Aeq,(1hr)}$ = 55 dB - External	Daytime (0700-2200)
Scenario 3B	Residential	$L_{Aeq,(1hr)}$ = 55 dB - External	Daytime (0700-2200)

Furthermore, the relative increases in traffic noise levels arise from the proposed school development are not to exceed 2 dB may also be applicable for residential premises (Part 3).

As several documents, policies and guidelines may be applicable to each part of the acoustic assessment, the most stringent noise criteria has been adopted.

6.4 CONSTRUCTION NOISE & VIBRATION CRITERIA – PART 4

Construction noise criteria were also derived from measured background noise levels. This is based on $L_{Aeq,15minutes} \leq L_{A90,daytime} + 10$ dB during the recommended standard hours*. The applicable construction noise criteria are therefore:

- $L_{Aeq,15\ min\ (daytime)} \leq 44$ dB, for residential premises near Site Location 1 (east), and
- $L_{Aeq,15\ min\ (daytime)} \leq 46$ dB, for residential premises near Site Location 2 (west).

The above construction noise criteria apply during *Recommended Standard Hours** at the surrounding

residential premises.

**** Recommended Standard Hours are:***	*Monday to Friday*	*7 am to 6 pm,*
	Saturday	*8 am to 1 pm and*
	no work on Sundays or public holidays.	

Also refer to Section 3.4.2 for vibration criteria.

6.5 ACOUSTIC PRIVACY BETWEEN CLASS ROOMS – PART 5

For general class room teaching, the recommended indoor design noise levels are between L_{Aeq} 35 and 45 dB for both primary and secondary schools, and the recommended reverberation time range is between 0.3 and 0.55 seconds for room volumes between 30 m^3 to 200 m^3. The design recommendations provided in this acoustic report are based on achieving the above specifications.

7.0 SOURCE SOUND POWER LEVELS

7.1 SOUND SOURCE POWER LEVELS OF STUDENTS WITHIN THE SCHOOL GROUNDS - PART 1

The noise sources considered for this part of the acoustic assessment include:

Scenario 1A (recess/lunchtime):

- Noise generated by 500 students on the school grounds (assumed 50% of the students are talking with raised vocal effort) for primary school;
- Noise generated by 500 students on the school grounds (assumed 50% of the students are talking with raised vocal effort) for secondary school, and
- Noise generated by 82 staff members (50% of the staff members were assumed to be indoors and 50% of the staff outdoors are assumed to be talking at normal vocal effort on the school ground).

Scenario 1B (outdoor teaching):

- Noise generated by 25 students occupying the outdoor teaching area (assumed only 2~3 students/staff are talking with raised vocal effort).

Scenario 1C (noise breakout from the school halls during after-hours operation):

- Noise generated by 360 people within the primary school hall and 560 people within the secondary multi-purpose hall. Each school hall has a performing stage and loudspeaker system.

Table 5. Sound power levels of students/staff on playground – dB(A)

Frequency [Hz]	31.5	63	125	250	500	1000	2000	4000	8000	Total
Speech level Normal vocal effort L_{WAeq}	32	39	43	53	62	60	56	51	42	66
Speech level Raised vocal effort L_{WAeq}	34	40	45	57	68	69	64	58	46	72
Spatial averaged sound pressure level within a hall (approximately 400~500 people with a performance stage and loudspeaker system) L_{Aeq}	-	-	-	-	-	-	-	-	-	70~80

The above sound power levels were derived from the noise measurements undertaken by Koikas Acoustics for similar sound sources.

7.2 VEHICULAR NOISE DURING THE MORNING ARRIVAL PEAK PERIOD AND AFTER-HOURS – PART 2

Based on the Traffic & Transport Assessment report provided by Traffix (Ref: 18.300r01v02 and dated March 2019), the calculated 15-minute period traffic volumes, student number and associated noise sources used for this assessment are:

Scenario 2A (peak hour drop-off):

- Number of vehicle movements during morning peak period (15-minutes):
    - 200 vehicles entering and leaving for student drop-offs.
    - 13 staff vehicles entering the underground car park area.
- Opening and closing of 320 vehicle doors. This figure was calculated by assuming 1.5 vehicle doors opening/closing for each vehicle. This calculation methodology has been adopted by many traffic engineers/consultants
- Noise generated by 500 students/children on the school field (assuming half of total number of students/children have arrived and playing and talking on the school grounds and sporting fields).
- In addition, noise generated from a maximum of 1 school bus/15minutes in and out of the school was also considered.

Scenario 2B (After-hours operation):

- Number of vehicle movements during after-hours operation (15-minutes):
    - 200* vehicles entering and leaving for student drop-offs.
    - 13* staff vehicles entering the underground car park area.
- Opening and closing of 320* vehicle doors. This figure was calculated by assuming 1.5 vehicle doors opening/closing for each vehicle. This calculation methodology has been adopted by many traffic engineers/consultants
- Noise generated by 250 students/children on the school ground (assuming one quarter of total number of students/children are walking towards the school halls to attend the after-hours events).

* It is assumed that similar operation will apply to after-hours car park use with maximum capacity and both school halls are to be used at full capacity.

Table 6. Sound Power Levels of Vehicular Noise Sources										
Frequency [Hz]	**31.5**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**Total**
Speech level Normal vocal effort L_{WAeq}	32	39	43	53	62	60	56	51	42	66
Vehicle travelling in the car park @ 5-10 km/hr[1] L_{WAeq}	46	57	60	66	70	72	71	68	59	77
Opening/closing of one vehicular door (average level of several vehicles) Lw adjusted for duration $L_{WAeq,15min}$	23	35	44	43	49	47	49	42	31	55
Bus arriving/departing (Corrected to $Lw_{Aeq,15min}$)	36	46	52	58	62	68	67	61	54	72

1. The sound power levels for vehicle travelling were calculated based on the noise measurements undertaken at approximately 3 metres from the vehicle with microphone moving at the same speed as the vehicle. The noise source is therefore a stationary noise source and was used in CadnaA noise model as a moving stationary sound source.

7.3 FUTURE TRAFFIC ARISING FROM THE SCHOOL ALONG NEARBY ROADS - PART 3

The sound power level of the road traffic noise source was determined based on traffic volume data stated in the Traffic & Transport Assessment report provided by Traffix (Ref: 18.300r01v02 and dated March 2019) in conjunction with the use of CadnaA, a software package developed by DataKustik. The CadnaA software program is described in Section 8.0 of this report.

Traffic noise source levels are dependent on several input factors such as the road surface, road gradient/slope, vehicular speed, percentage of heavy vehicles and traffic volumes along each road carriageway. The future hourly traffic volumes during peak hours along surrounding roads are illustrated in the figures below (extracted from the report prepared by Traffix):

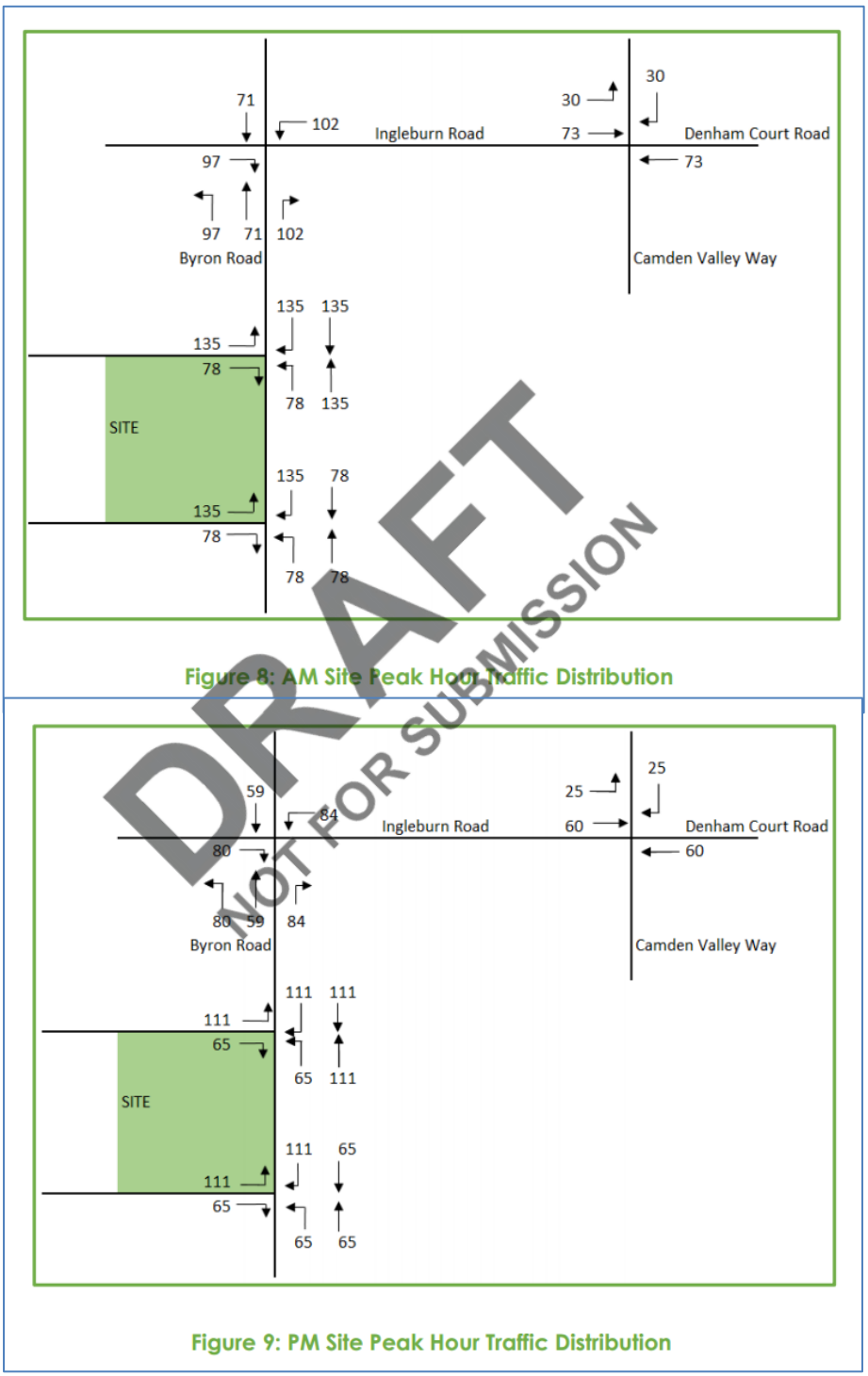


Figure 4. Project traffic volumes arising from subject school development (extracted from traffic report prepared by Traffix)

As a worst-case scenario, the morning peak hours traffic volumes illustrated in Figure 8 of the traffic report shown above have been considered in this acoustic assessment.

7.4 CONSTRUCTION NOISE SOURCES AND SOUND LEVELS – PART 4

Refer to Section 10.1.1 of this report for details.

7.5 ACOUSTIC PRIVACY BETWEEN CLASS ROOMS – PART 5

The averaged sound pressure levels within a class can vary depending the activities carrying out. Based on our recent noise survey of a tutorial class room of 20~25 students, the averaged sound pressure level is L_{Aeq} 65~70 dB. This noise level is used to determine the required noise reduction of the classroom common party walls (or operable walls) along the red dotted lines illustrated in Figure 5 below.

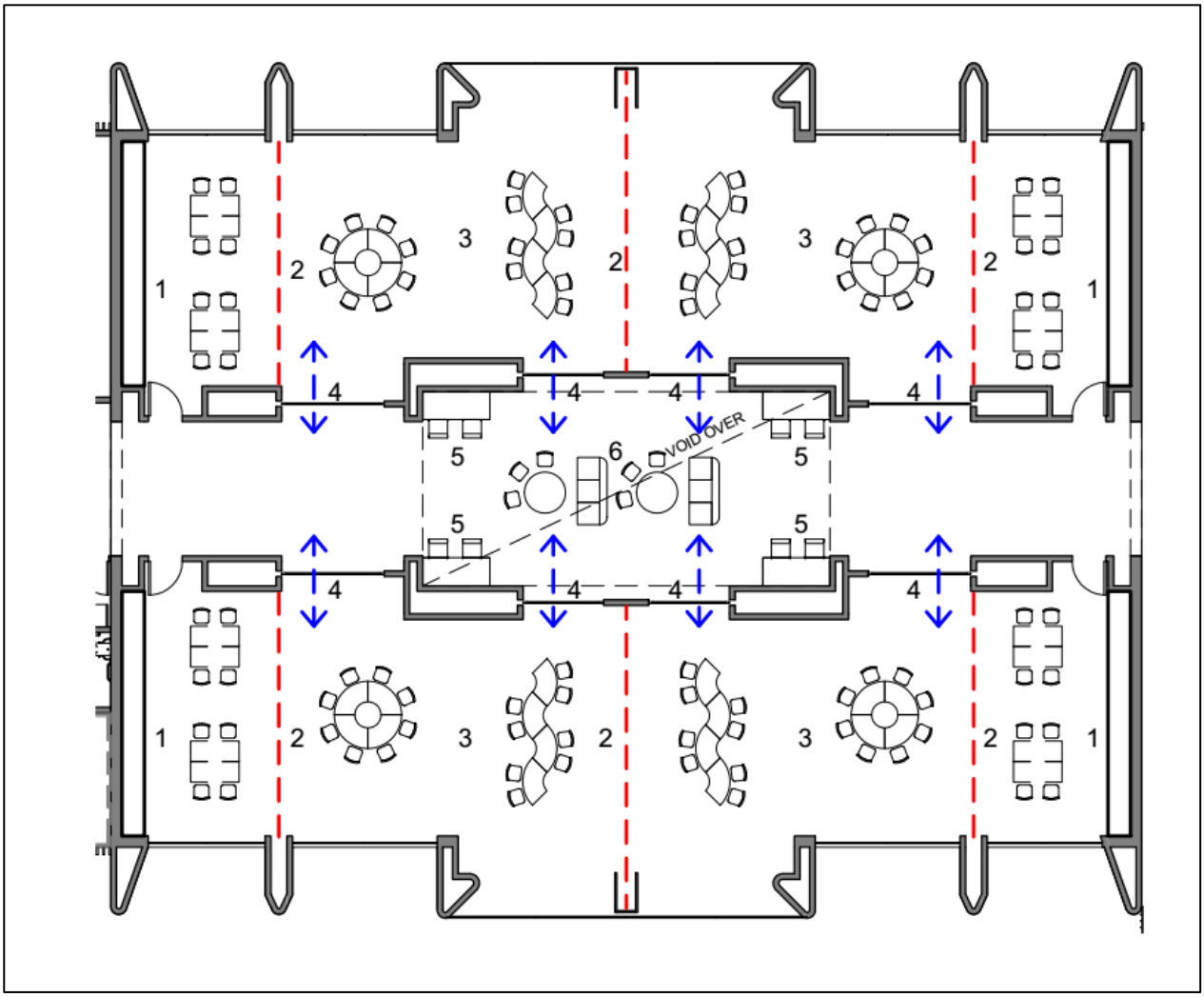


Figure 5. Floor plan of a typical modular classrooms

8.0 NOISE LEVEL CALCULATIONS WITH THE CADNA/A NOISE MODEL–PART 1, 2 & 3

8.1 CADNA (A) NOISE MODEL

The noise sources (for parts 1, 2 and 3) were modelled in a computer program called CadnaA, which is a software package developed by DataKustik. CadnaA incorporates a computer aided drafting (CAD) program that utilises the height of the ground, the position of buildings and other structures to run through a set of algorithms and calculate at user defined grid points and user input receiver locations the overall sound pressure level and frequency dependant noise level spectrum. It then interpolates the calculated noise levels at each of the grid points to produce noise level contours.

The noise level calculations take into account the propagation of sound from a sound source as a function of its distance, the shielding effects of barriers and buildings, the attenuation and reflection off the ground and buildings.

Receiver locations were assigned in the computer model at representative positions to determine the resultant noise levels at surrounding premises. The predicted noise levels at these locations were used to provide recommendations on appropriate building noise mitigation measures that would achieve the required noise reductions so as to comply with the nominated noise criterion.

8.2 NOISE MODEL SCENARIOS

Noise contours are presented at 1.5 metres above the ground, for each of the following scenarios in **Appendix B**.

Scenario 1A (Part 1):

Part 1 (Student Noise Impact During Recess/Lunchtime)

External Noise Criteria $L_{Aeq,\ 15\ min} \leq 44\sim46$ dB

Assessed over one 15-minute period

This noise impact model for noise emanating during recess/lunch break consists of 1,000 students (assumes that 50% of the students are talking at raised vocal effort) and 43 staff members (i.e. 50% of the staff members located outdoors are talking at normal vocal effort). The public address system and school bells are used for short periods and can be electronically controlled to ensure that their use does not add to the noise of children playing outdoors.

Scenario 1B (Part 1):

Part 1 (Noise Impact from Outdoor Teaching Area)

External Noise Criteria $L_{Aeq,\ 15\ min} \leq 44\sim46$ dB

Assessed over one 15-minute period

This noise impact model of a class of 25 students consists of 2 to 3 school pupils talking at raised vocal effort.

Scenario 1C (Part 1):

Part 1 (Break-out Noise from School Halls)

External Noise Criteria $L_{Aeq,\ 15\ min} \leq 47\sim52$ dB

Assessed over one 15-minute period

This noise impact model consists of 360 people within the primary school hall and 560 people within the secondary multi-purpose hall. Each school hall has a performing stage and loudspeaker system and windows/doors are open for ventilation purpose. It is assumed that the opening surface area of windows/doors are approximately 40 m^2 and 90 m^2 for primary and secondary school halls respectively.

Scenario 2A (Part 2):

Part 2 (Car Park Noise Impact – Within the Subject School During AM Peak Hour)

External Noise Criterion $L_{Aeq,\ 15\ min} \leq$ 44~46 dB

Assessed over one 15-minute period

The following noise sources were considered in this noise model scenario for any one 15-minutes periods during AM peak hour:

- 200 vehicles entering the school pick-up/drop-off area;
- 200 vehicles leaving the school pick-up/drop-off area;
- 13 staff vehicles entering the underground car park area;
- 320 car doors opening/closing;
- 500 students/children (i.e. assumed 50% of the total have already arrived at talking at raised vocal effort) staying outdoors, and
- 1 bus entering and leaving the school.

Scenario 2B (Part 2):

Part 2 (Car Park Noise Impact – Within the Subject School During After-Hours Event)

External Noise Criterion $L_{Aeq,\ 15\ min} \leq$ 47~52 dB

Assessed over one 15-minute period

The following noise sources were considered in this noise model scenario for any one 15-minutes periods during after-hours events (before 10pm):

- 200 vehicles entering the school pick-up/drop-off area;
- 200 vehicles leaving the school pick-up/drop-off area;
- 13 staff vehicles entering the underground car park area;
- 320 car doors opening/closing, and
- 250 students/children/parents/staff (i.e. assumed 25% of the total number of people are walking towards the halls and talking at normal vocal effort).

Scenario 3 (Part 3):

Part 3 (Future Traffic Noise Impact to Surrounding Premises)

External Noise Criterion $L_{Aeq,\ 1\ hr} \leq 55$ dB(A) or ≤ 2 dB Increase

Assessed over one-hour period

As a worst-case scenario, the morning peak hour traffic volumes for local and future roads illustrated in Figure 8 of the traffic report (prepared by Traffix) have been included in this noise model scenario.

8.3 CALCULATED NOISE LEVELS

Scenario 1A (Part 1):

Part 1 (Student Noise Impact During Recess/Lunchtime)

External Noise Criteria $L_{Aeq,\ 15\ min} \leq 44$~46 dB

Assessed over one 15-minute period

The maximum resultant noise level at the surrounding residential premise is found to be $L_{Aeq,15minutes}$ 45 dB during break (lunchtime or recess) and will meet the nominated noise criterion.

The public address system and school bells are used for short periods and can be electronically controlled to ensure that their use does not add to the noise of children playing outdoors. The cumulative noise of children, bells and PA systems will comply with the nominated criterion.

All outdoor play areas (games courts on the upper levels and play field on the lower level near the reserve area) are to be located in and around the central area. These areas are shielded by school buildings, and as such, noise emanating from students playing outdoors, the use of the PA system and bells will comply with the nominated criterion.

Scenario 1B (Part 1):

Part 1 (Outdoor Teaching Area)

External Noise Criteria $L_{Aeq,\ 15\ min} \leq 44$~46 dB

Assessed over one 15-minute period

The maximum noise levels at the surrounding residential dwellings from outdoor teaching was found to be $L_{Aeq,15mins}$ 38 dB and comply with the nominated noise criterion. No further noise mitigation measures or operating restrictions are required for the outdoor teaching area.

Scenario 1C (Part 1):

Part 1 (Break-out Noise from School Halls during After-Hours)

External Noise Criteria $L_{Aeq,\ 15\ min} \leq 47$~52 dB

Assessed over one 15-minute period

The maximum noise level at the surrounding residential dwellings from the use of the school halls during after-hours event was found to be $L_{Aeq,15mins}$ 52 dB with all windows/doors open (assuming 40m^2 and 90m^2 opening surface area for primary and secondary school halls respectively) and comply with the nominated noise criterion. No further noise mitigation measures are required to the school halls.

Scenario 2A (Part 2):

Part 2 (Car Park Noise Impact – Within the Subject School During AM Peak Hour)

External Noise Criterion $L_{Aeq,\ 15\ min} \leq 44$~46 dB

Assessed over one 15-minute period

Car park noise impact during school morning peak hours is expected to exceed the nominated noise criteria by up to 2 dB at the future residential dwellings to the south. It is the opinion of Koikas Acoustics that an exceeding sound level of 2 dB is acceptable because:

- For a continuous noise source, a 3 dB is perceptible and for an intermittent sound source a 5 dB is just perceptible. The maximum exceeding level is less than 3 dB and would only occur during peak hours.
- The worst case scenario was considered in this assessment, but in reality, noise level is likely to be less for typical use of the car park drop-off and pick-up area.

Scenario 2B (Part 2):

Part 2 (Car Park Noise Impact – Within the Subject School During After-Hours Event)

External Noise Criterion $L_{Aeq,\ 15\ min} \leq 47$~52 dB

Assessed over one 15-minute period

The maximum expected car park noise impact during school after-hours is $L_{Aeq,15\ minutes}$ 48 dB and will comply with the nominated noise criterion. Furthermore, it is expected that some cars (mostly those for staff and senior students) would be parked underground and therefore, lesser number of vehicles are expected to be parked above ground. The resultant vehicular noise is therefore expected to be lower.

Scenario 3 (Part 3):

Part 3 (Future Traffic Noise Impact to Surrounding Premises)

External Noise Criterion $L_{Aeq,\ 1\ hr} \leq 55$ dB or ≤ 2 dB Increase

Assessed over one hour period

The maximum calculated road traffic noise level to the surrounding residential premise is found to be $L_{Aeq,1hour}$ 62 dB and exceeds the traffic noise criterion by 7 dB. This predicted noise level was based on 40 km/hr during the peak hours. Refer to Section 9.3 of this report for further discussion.

9.0 RECOMMENDATIONS (PART 1, 2 & 3)

9.1 CONSTRUCTION OF SCHOOL BUILDINGS

The following building materials are recommended for the new school external building envelope:

9.1.1 Ceiling / Roof System

The ceiling roof system of the school can be constructed of standard building materials. No special acoustic materials are required. Most ceiling/roof systems include insulation batts, cavity not less than 200 mm depth, 13 mm thick plaster board and corrugated metal roofing (0.42 mm thick galvanised steel).

9.1.2 External Walls

There are no special acoustic materials required for the external walls of classrooms. However, in order to reduce noise impacts to and from classrooms and other outdoor school areas, adding an additional layer of plasterboard for internal walls or an additional layer of fibre cement sheeting for external walls would reduce noise by 3 to 4 dB for each treatment and a maximum of 6 to 8 dB for treatment to both internal and external walls. The above recommendations are not required but would only be considered if deemed necessary by the school staff.

9.1.3 Common Party Wall System Between Classrooms

Similarly, there is no special acoustic requirements for common party systems between classrooms. However, in order to reduce noise transmission between classrooms, an acoustic rating not less than Rw 50 may be considered. This will entail the following:

- One layer 16 mm thick plasterboard fixed to
- 90 mm timber stud framing or 92 mm steel stud framing with one layer of 75 mm thick (14kg/m3) insulation batts fitted between stud framing;
- 20 mm air-gap separation;
- Secondary framing system with 90 mm timber stud framing or 92 mm steel stud framing and one layer of 75 mm thick (14kg/m3) insulation batts fitted between stud framing, and
- One layer 13 mm thick plasterboard.

Refer to Section 11.3 for details of operable wall system between classrooms.

9.1.4 TIMBER ENTRY DOORS

Solid core, 40 mm thick timber doors are recommended for the external classroom doors. These doors should be fitted with perimeter and threshold drop seals. Where glazing is fitted to timber doors, a minimum of 6.38 mm thick glazing is recommended.

9.2 SCHOOL HALLS

The compliant noise levels calculated for school halls (Scenario 1C) were based on the opening of windows/doors with surface area of 40 m^2 and 90 m^2 for primary and secondary school halls respectively. This is a worst-case scenario.

In addition, acoustic absorptions to the internal walls and ceiling should be considered for the school halls as per Section 11.2 of this report.

9.3 SCHOOL ROAD TRAFFIC

Although the increase of road traffic from proposed school will exceed the EPA's Road Noise Policy guidelines, the duration of these activities occurs only during peak hours (morning and afternoon), and as such is not reasonable nor feasible to consider a noise barrier.

Furthermore, the exceeding road traffic noise level during peak hour periods is considering acceptable on account of:

1. Future planning of the Leppington Precinct with an overall capacity about 7,200 homes and a population of around 24,000 people. Byron Road is planned to be a Collector Road and Ingleburn Road a Sub-Arterial Road, therefore expected increase in road traffic noise levels by the existing and future residents.
2. As a part of the master planning process for Leppington, existing and future roads were planned based on expected future traffic levels. According to the Traffix impact assessment of traffic, the traffic levels resulting from the school can be readily absorbed into the planned road system without exceeding any of the assumed capacities.
3. The site of the proposed school site is specifically zoned for the purposes of a school, namely *SP2 Infrastructure (Educational Establishment) under the provisions of State Environmental Planning Policy (Sydney Region Growth Centres) 2006*.There is a community expectation that a school-with

its attendant impacts- will be established on the site.

4. The Leppington precinct is undergoing transition from a sparsely populated rural smallholdings area to that of a fully developed urban area accommodating business, commercial and low/medium density housing uses. Already, the land to the south of the school site is currently being developed for the purposes of a 84 allotment residential housing estate. Development applications for a 19 allotment subdivision (at No.66 Byron Road) and a 148 unit medium density housing development (at No. 47 Ingleburn Road) have been lodged on lands directly opposite the site. If approved and developed, the character of the area, including attendant background noise levels, will change (increase) significantly the acoustic environment over that currently being experienced. The future anticipated character of the locality is an important consideration in noise impact assessment given that the school is to be developed in stages over the next 15 years. During that time the nature of the locality is expected to become fully urbanised.

10.0 COSTRUCTION NOISE AND VIBRATION PLAN OF MANAGEMENT (PART 4)

A copy of the Outline Planning Consultants preliminary Construction Management Plan was provided which refers to recommended hours of operation of various construction activities- understood to be the standard adopted by the EPA for other recently approved SSD schools.

10.1 CONSTRUCTION NOISE

10.1.1 Construction Noise Sources and Sound Levels

Construction noise levels can vary depending on the number of plant and equipment being used, and their location on the construction site. Typical noise levels of construction plant and equipment are provided in:

- *Australian Standard 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites* and
- *Department for Environment, Food and Rural Affairs (DEFRA – UK) Update of Noise Database for Prediction of Noise on Construction and Open Sites, December 2004.*

Table 7. Construction activity typical sound levels, [dB]

Equipment	Typical sound power level – L_w	Reference noise level – L_{Aeq} at 10m
Circular saw	112	84
Angle grinder	108	80
Hand tools (pneumatic)	116	88
Trucks (dump)	117	89
22-tonne excavator	99	71
Excavator loading truck	107	79
Concrete pump	103	75
Concrete truck and pump	95	67

10.1.2 Calculated Construction Noise Levels

The level of noise predicted at a specific receiver location is governed by the source noise level, the distance between the source and receiver, and the presence of any screening objects along the propagation path. The location of plant and equipment on construction sites are not always at a fixed point.

Koikas Acoustics has assessed each of the identified construction noise sources at a central location on

the development site. This results in the following distances to nearby residential properties:

- 20 metres to the front site boundary of 66 Byron Road, Leppington to the south-east.
- 20 metres to the front site boundary of 76 Byron Road, Leppington to the east.
- Less than 5 metres to the site boundary shared with the residential property to the north.
- Less than 5 metres to the site boundary shared with the residential property to the south.

Construction noise levels were calculated at the residential boundary for each of the nearest residential receivers. Construction noise levels will vary at times from those predicted in this report on account of plant and equipment being located at varying locations within the development site.

Table 8. Estimated construction noise levels to surrounding receivers – $L_{Aeq\ 15\ min}$ [dB]

Equipment	Noise assessment receiver location			
	66 Byron Rd	76 Byron Rd	Residential property to the north	Residential property to the south
Circular saw	78	78	≥ 90	≥ 90
Angle grinder	74	74	≥ 96	≥ 96
Hand tools (pneumatic)	82	82	≥ 94	≥ 94
Trucks (dump)	83	83	≥ 95	≥ 95
22 tonne excavator	65	65	≥ 77	≥ 77
Excavator loading truck	73	73	≥ 85	≥ 85
Concrete pump	69	69	≥ 81	≥ 81
Concrete truck and pump	58	58	≥ 73	≥ 73

Notes 1. Predicted construction noise levels are estimates only due to the large variance in noise level generated by comparable plant performing similar tasks on different construction sites. Should complaints arise it may be necessary to survey noise being generated on-site to determine the actual working noise levels.

Estimated construction noise levels in Table 8 do not consider acoustic screening from any existing boundary fences. Receivers that are screened from construction equipment by a boundary fence of approximately 1.8 m in height, noise levels may reduce by up to 5dB below those predicted in Table 8.

Noise from construction is predicted to, at times, exceed the Noise Affected level of the ICNG at nearby premises. This is due to the proximity of the adjoining residences in relation to the assessment site and the typical nature of noise associated with construction equipment.

It should be noted that the predicted levels consider construction noise levels being constant over a 15 minutes assessment period with the equipment operating at maximum capacity. Therefore, calculated noise levels above should be considered as conservative. Given typical respite periods, we could reasonably expect construction noise levels to be up to 3 to 5dB lower than predicted.

10.2 VIBRATION ASSESSMENT

Ground vibration during excavation and earthworks for the below-ground floor levels may impact adjoining building and the occupants within. The highest anticipated vibration levels will result from rock breaking or other impulsive-type excavation works (depending on the local geology).

The proximate location of the adjoining dwelling to the north and south may require alternative work practices to rock breaking along the northern/southern boundaries of the development site. Concrete sawing is an alternative to rock breaking that generates far less vibration and should be used for removal of the existing concrete structure along the affected boundaries.

A guide to safe work distances for typical vibration generating construction works is given in Table 2 of the *Construction Noise and Vibration Guideline (RMS, 2016)*.

Table 9. Reproduced in part from Table 2 of the RMS construction noise and vibration guide

Plant item	Rating / Description	Minimum working distance	
		Cosmetic damage (BS7385)	Human response (Assessing vibration: A technical guideline)
Vibratory roller	< 50kN (Typically 1-2 tonnes)	5m	15m to 20m
	< 100kN (Typically 2-4 tonnes)	6m	20m
Small hydraulic hammer	300kg – 5 to 12t excavator	2m	7m
Medium Hydraulic Hammer	900kg – 12 to 18t excavator	7m	23m
Jackhammer	Handheld	1m (nominal)	2m

The vibration generated from an excavator removing site soil during earthworks for the basement is not expected to result in structural damage or human annoyance to nearby receivers.

10.3 NOISE & VIBRATION CONTROLS

The NSW Department of Environment, Climate Change and Water (DECCW) recognise that there is a need to balance the existing noise amenity of residents along with the necessity to continue growth within the region. The fundamental principle involved with the development and success of each noise policy is maintaining open and free channels of communications between developers and residents alike.

Construction noise policies are implemented to limit noise exposure for premises surrounding construction sites. Noise controls and mitigation strategies must be reasonable and feasible and applied on a case-by-case basis to ensure the best possible outcome for all parties involved.
In rural areas background noise levels are generally very low and although construction sites are not always in close proximity to residential dwellings, construction noise levels will exceed the construction noise criteria. For this particular development, construction noise levels are expected to significantly exceed the Noise Affected Level of the ICNG at times.

Minimising the impact of noise from construction sites to surrounding land uses can be achieved through treatment of the noise sources, treating noise along its propagation path and/or by consulting with the community and scheduling noise intensive works during less noise sensitive times of the day. Consideration needs to be given to each source in identifying the most practical and efficient noise controls where treatment is necessary.

Table C3 in AS2436-2010 states the relevant effects of various types of noise control measures typically employed on construction sites.

Table 10. AS2436-2010 Table C3 – Relative effectiveness of various forms of noise control

Control by	Nominal noise reduction possible, in total A-weighted sound pressure level L_{pA} [dB]
Distance	Approximately 6 for each doubling of distance
Screening	Normally 5 to 10, maximum 15
Enclosure	Normally 15 to 25, maximum 30
Silencing	Normally 5 to 10, maximum 20

For this project, the following noise and vibration controls could be implemented to help maintain suitable noise and vibration amenity for surrounding land uses:

- The use of moveable screens for specific work practices could achieve the noise reductions of Table 10. The screens would have to be moveable where noise sources are not stationary within the construction site.
- Providing an acoustic type hoarding along the site boundary will also lower noise levels, however the benefit would only be realised by residents on the ground floor level of adjoining buildings.
- Exhaust silencers could be considered to motorised plant and equipment such as the excavators. Silenced plant and equipment could lower noise emission from the exhaust system by 5 to 10dB.
- Undertake construction works during standard hours as defined in the ICNG.
- Use appropriately sized plant and equipment.
- Identify when high noise generating activities are likely to take place and conducting this work during times of least noise sensitivity as agreed through community consultation. Having open lines of communication with residents and appropriate scheduling of works on construction sites are processes recommended in the NSW ICNG.
- To minimise vibration from rock breaking, it is recommended that a hydraulic hammer attachment with a pointed 'cone' type hammer is used in place of a flat 'block' type hammer.
- The minimum work distances as tabled within this report should be observed at all times, especially regarding structural damage guidelines.
- Continuous vibration monitoring surveys may be considered during excavation to ensure vibration levels do not reach a point where the structural integrity of surrounding buildings is compromised. Vibration monitors can be set to measure either the peak particle velocity or r.m.s. acceleration at the site boundary where a design vibration limit is specified by the Geotech engineer or as a Vibration Dose Value within adjoining residential buildings. Measuring vibration within adjoining residential building will require significant cooperation from the tenants/occupants.
- Progress noise monitoring could also be conducted during construction works to provide feedback to site managers as to the level of noise being emitted from the site.

10.4 COMPLAINTS HANDLING

A site contact and phone number should be distributed to all surrounding premises and displayed on the site notice-board for any complaints arising due to noise and/or vibration generated during construction works. The site should have clear complaints handling procedure and staff who are well-versed in the complaints handling procedures.

A register of all complaints must be kept on-site and be readily available. Details within the complaints register should include, but not be limited to:

- Date and time of the complaint,
- The person receiving a complaint,
- Complainant phone number,
- Site contact who the complaint was referred to for action,
- Description of the complaint,
- Action to be taken,
- The time frame for action to be implemented.

All complaints should be given a fair hearing and adequately investigated. This may involve scheduling a relevant consultant to substantiate or refute any received complaint, and/or verifying any remedial action taken by the site manager by way of on-site testing.

11.0 ACOUSTIC PRIVACY BETWEEN CLASSROOMS & ARCHITECTURAL ACOUSTICS – PART 5

11.1 REVERBERATION TIME WITHIN CLASSROOMS & OPEN PLAN LEARNING AREA

The reverberant time within the classrooms are to be kept between 0.4 and 0.6 second. As the floor is to be carpeted for general classrooms, this can be easily achieved and no further acoustic treatments would be required.

On the other hand, the central open plan learning area with vinyl flooring requires additional absorptions. The following is recommended:

- Install a layer of absorptive material such as Acoufelt AP 25 (or any other acoustic panels listed in Table 11 or 12) along the walls where practically possible. Refer to "aqua" lines marked in Figure 6 and 7 below.
- Install absorptive panelling hanging from ceiling such as Supawood products (or other materials listed in Table 12) where practically possible without interfering with natural light. Acoustic panels can also be installed on the underside of the ceilings, or they may be hung as suspended panels. It is recommended that the absorptive panels are evenly distributed. Refer to Figure 6 and 7 below.

Table 11. Acoustic panels

Manufacturer	Product description	Published NRC
Woven Image	EchoPanel 12 – 12mm with 20mm air gap – 2400g/m2 EchoPanel 12 – 12mm with 50mm air gap – 2400g/m2	0.55 0.75
Woven Image	EchoPanel 24 – 24mm direct stick – 3000g/m2	0.65
Acoufelt	AP24 Acoustic Panel (rigid) – 25mm thick direct stick – 4800g/m2	0.6
Acoufelt	AP25 Acoustic Panel – 25mm thick direct stick – 2400g/m2	0.75
Embleton	Embelsorb Image/Colour acoustic panel – 30mm thick direct stick	0.8
Autex	Quietspace Panel – 25mm direct stick	0.8
Pyrotech	EchoHush Panel – 25mm thick direct stick	0.8
Pyrotech	EchoHush Panel – 50mm thick direct stick	1.0
Instyle	Ecoustic panel 50 mml	1.0

Table 12. Acoustic ceiling tiles		
Manufacturer	Product description	NRC
Armstrong	ANF RH90	0.5
Armstrong	Dune	0.5
USG Boral	Eclipse ClimaPlus	0.65-0.7
USG Boral	Radar ClimaPlus	0.6
Himmel	Excel Tone MR New NDF	0.55
Himmel	OWA Alto	0.65
Knauf AMF	Thermatex Acoustic	0.7

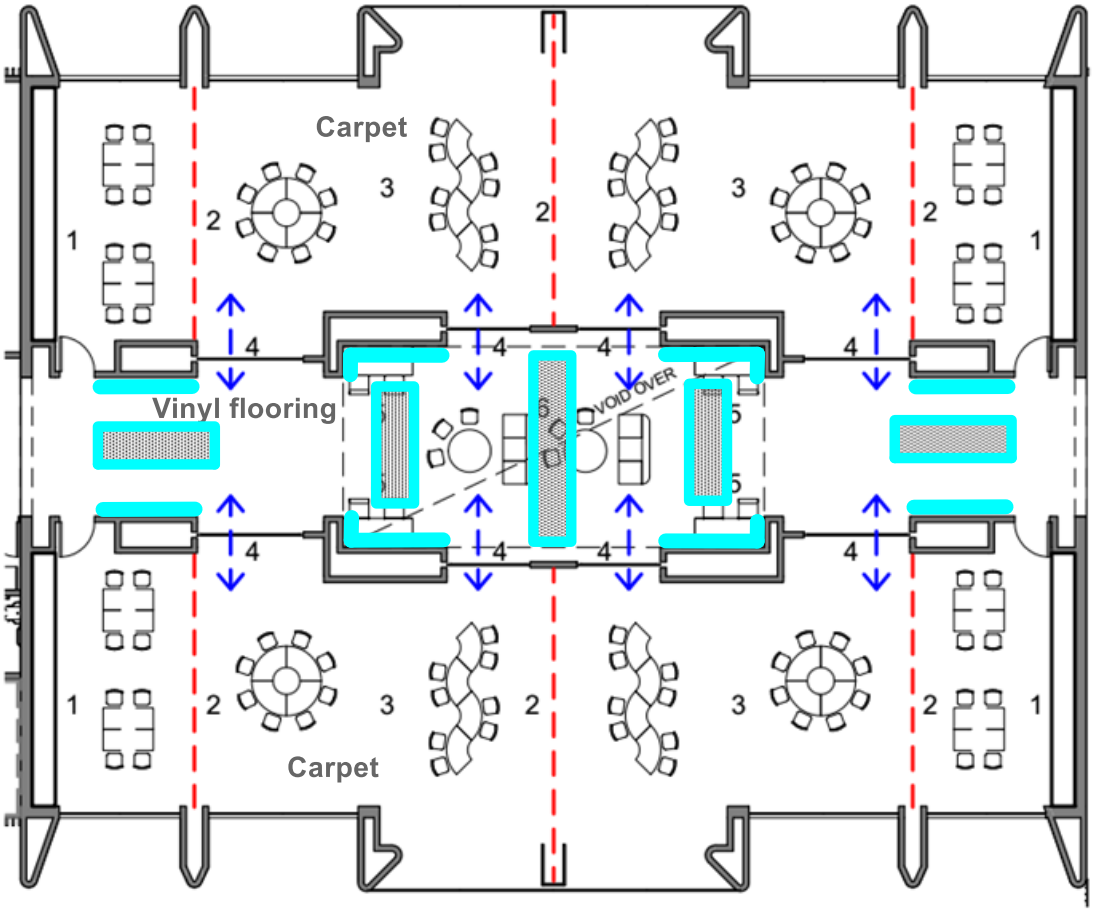


Figure 6. Acoustic absorptions to open plan learning area (plan view)

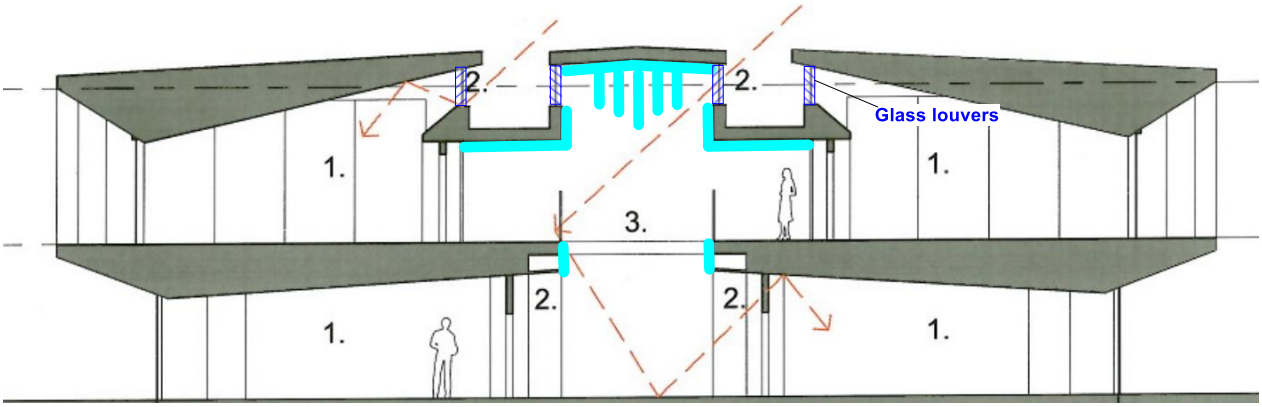


Figure 7. Acoustic absorptions to open plan learning area (section view)

In addition, the operable glass louvered window is recommend to the top section of the modular classrooms on 1st floor level (refer to Figure 7). These areas are partially open for the purpose of nature light and borrowed air. When the glass louvers are closed the additional noise reduction of approximately 15~20 dB is expected.

11.2 ACOUSTIC ABSORPTIONS TO SCHOOL HALLS

The similar acoustic absorptive materials and ceiling panelling listed in Table 11 and 12 respectively can also be applied to the school halls. Refer to Figure 8 and 9 below for the extent of acoustic absorption.

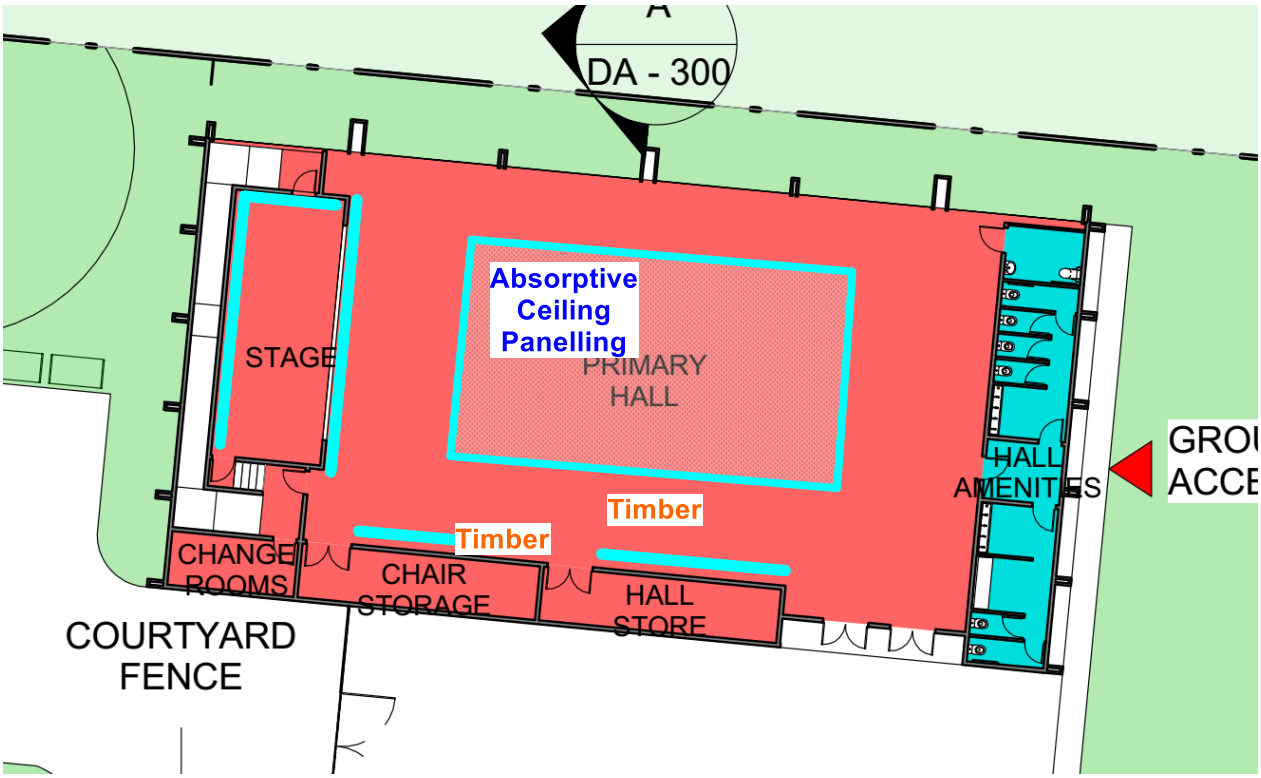


Figure 8. Acoustic absorptions to primary hall

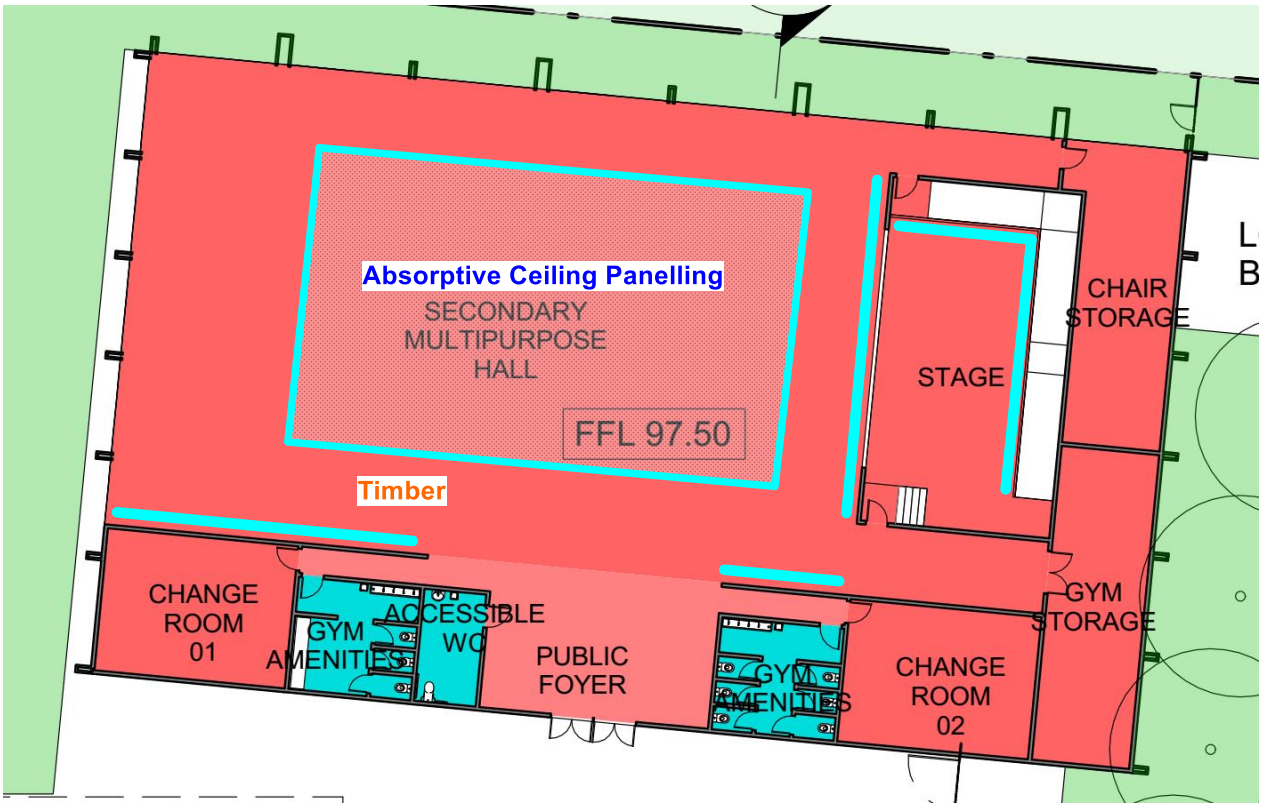


Figure 9. Acoustic absorptions to secondary multipurpose hall

11.3 OPERABLE WALL SYSTEMS BETWEEN CLASS ROOMS

Koikas Acoustics recommend using **Dorma Variflex 100 K Rw 55** for all operable door systems within modular classrooms (along the red dotted line illustrated in Figure 6 in Section 11.1). A lower acoustic rated operable wall system will give rise to greater sound transmission and therefore speech interference between classrooms.

Further, a secondary removable wall panelling can be considered as a reserve option and it can be used if the primary operable wall system does not provide a satisfactory for acoustic privacy between classrooms (especially if one side one the classroom is much more spacious with a lot more students compared to the adjacent room). A secondary tracks can be built along the green dotted lines illustrated in Figure 10 below and the removable type wall panels can then be added for additional acoustic privacy (if desire).

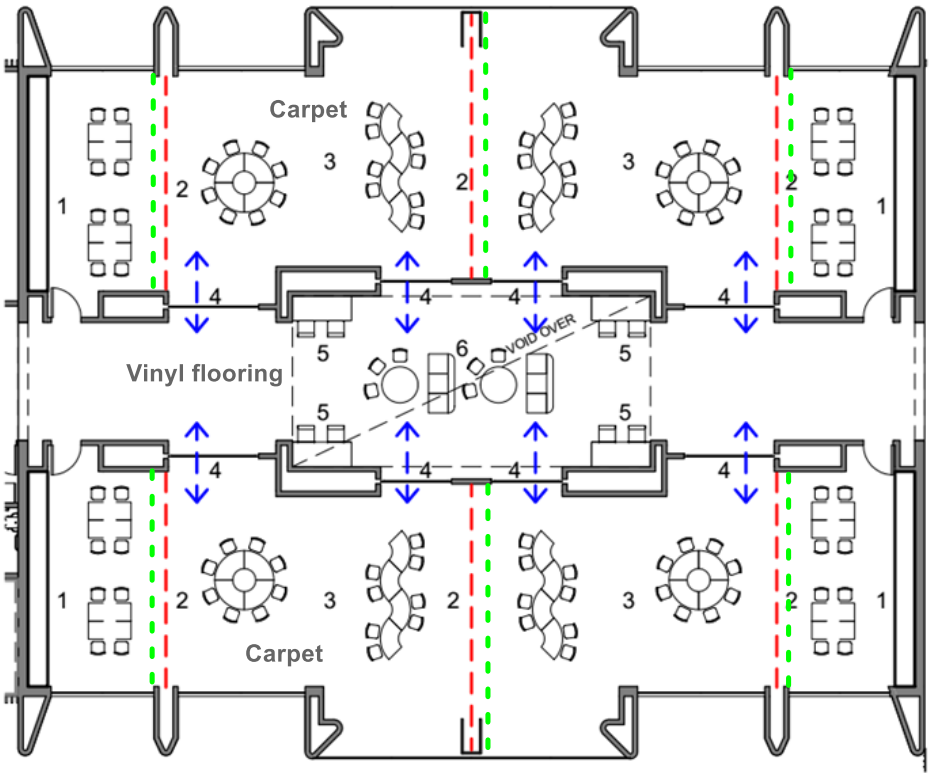


Figure 10. Floor plan of a typical modular classrooms with recommended secondary tracks for removable wall panels

Any glazed wall separating the classrooms and central open plan learning area is recommended to be minimum 10.38 mm thick laminated glass.

12.0 CONCLUSIONS

Koikas Acoustics was requested to undertake an acoustic assessment of the proposed new school (primary and secondary). The new building, building to be constructed of light-weight or masonry materials is to facilitate for classrooms, offices, cafeteria, library, two indoor multi-purpose halls and toilet/wash areas to accommodate a total of approximately 1,000 students. This acoustic assessment is consisting of four parts and include the following:

Part 1 & 2: Student Noise Impact & Vehicular Noise Impact

- Two unattended noise surveys were conducted by Koikas Acoustics to determine the existing ambient noise levels and results were used to determine the noise criteria. The nominated school operational noise criteria adopted for this assessment are:
  - $\mathbf{L_{Aeq,15\ min(daytime)} \leq 44\sim46\ dB}$ during daytime period, and
  - $\mathbf{L_{Aeq,15\ min(evening)} \leq 47\sim52\ dB}$ during evening period.

- The noise impact to surrounding residential premises from the proposed school operation with a maximum student capacity was found to be $L_{Aeq,15minutes}$ 45 dB during recess/lunchtime (Scenario 1A), $L_{Aeq,15minutes}$ 38 dB for outdoor teaching area (Scenario 1B), $L_{Aeq,15minutes}$ 52 dB during for the use of school halls during after-hours with windows/doors open (Scenario 1C). The recommended noise mitigation measured stated in Section 9.1 and Section 11 of this report are required to be implanted to achieve the full compliance for Part 1 and Part 2 of this report.

- These adopted mechanical noise criteria for future planning are $\mathbf{L_{Aeq,15\ min(daytime)} \leq 39\sim41\ dB}$ during daytime period and $\mathbf{L_{Aeq,15\ min(evening)} \leq 42\sim43\ dB}$ during evening period. There are many noise mitigation measures available to ensure that noise compliance can be achieved. This would include selecting quiet outdoor plant, locating away from residential premises, noise barriers and the use of buildings to shield noise propagation.

Part 3: Traffic Generation from the Proposed School

- Based on the results of the analysis in noise model scenario 3, the future project road traffic noise level with inclusion of the subject school development is found to be $L_{Aeq,1hr}$ 62 dB and will exceed the nominated noise criterion by 7 dB. Erecting noise barriers adjacent to the roads is

not reasonable nor feasible, considering that the general area will experience an **increase** in traffic over the years as the population density of the general area increases.

Part 4 (Construction Noise & Vibration Assessment / Plan of Management)

- Based on the unattended noise survey results and ICNG's assessment procedures, the adopted construction noise criteria are $\mathbf{L_{Aeq,15\ min\ (daytime)} \leq 44 \sim 46\ dB}$.
- In most cases, the predicted construction noise levels from subject development for the proposed construction activities will not comply with the nominated construction noise criterion. This is consistent with the DECCW's expectation of generated construction noise levels adjacent to residential premises. Reasonable and feasible noise and vibration mitigation measures as stated in **Section 10.3** of this report will be required to be implemented (where applicable and practically possible) in order to minimise impacts to surrounding premises.

Part 5 (Acoustic Privacy Between Classroom & Architectural Acoustics)

- Recommendations for sound insulation between classrooms, open plan learning areas and acoustic absorptions have been provided in Section 11 of this report.
- The recommendations for secondary operable walls are not mandatory, but are included only if the teaching staff deem it necessary to improve the sound insulation between two adjacent classrooms.

The key noise-related issues in the Secretary's Environmental Assessment Requirements (SEAR) (Application Number SSD 9227) have been addressed in this acoustical assessment. The noise mitigation measures required to achieve the noise policies and guidelines are provided in this report.

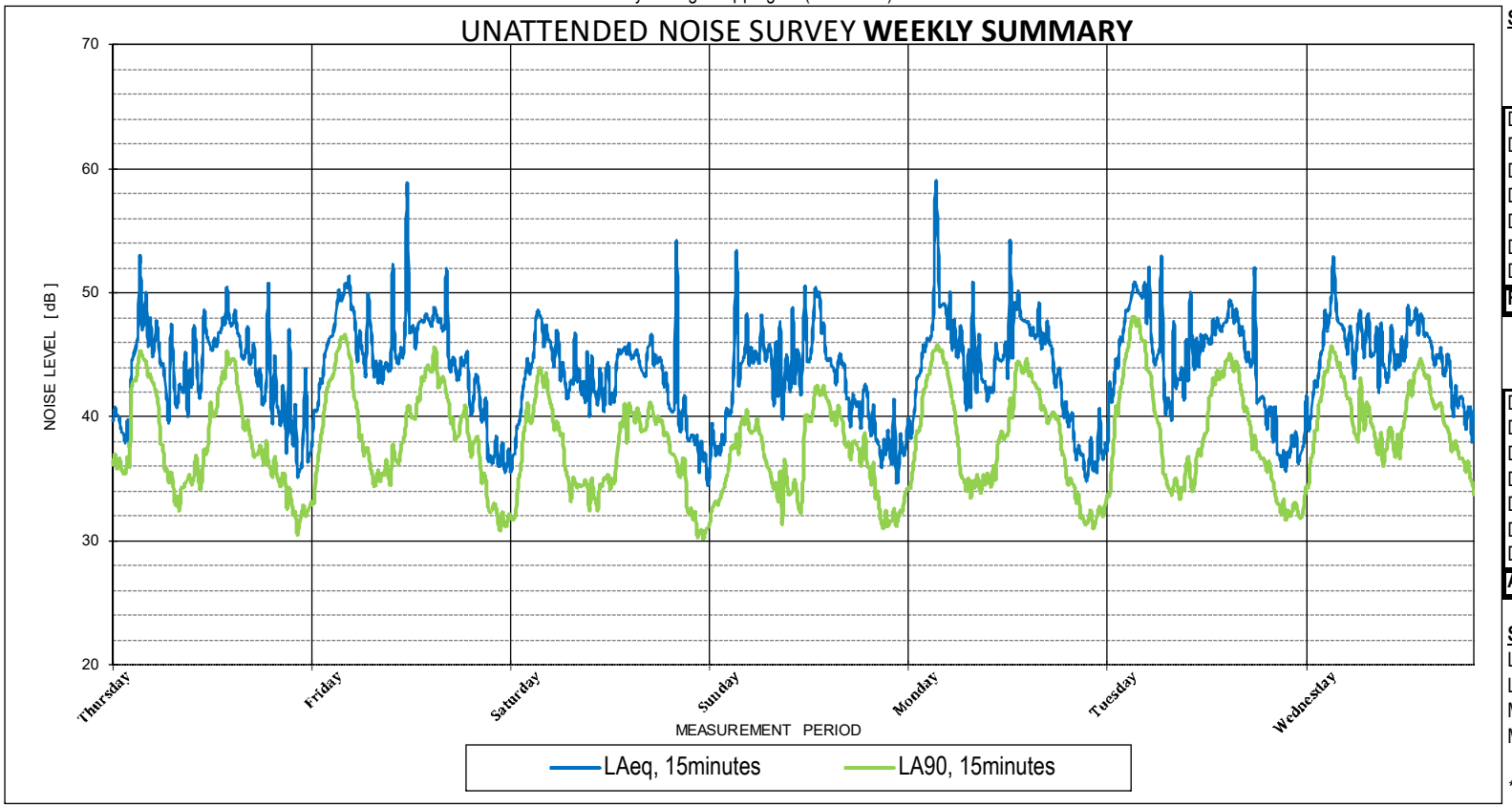
Koikas Acoustics certifies that the proposed school development at 85 Byron Road, Leppington (also known as Amity College Leppington Campus) will satisfy the intent of Council's requirements as discussed in this report. Koikas Acoustics is therefore supportive of this development.

APPENDIX A

APPENDIX A

APPENDIX A

WEEKLY SUMMARY **LOGGER LOCATION:** Amity College Leppington (Location 1) **PERIOD:** 21st to the 27th June 2018



SUMMARY OF AMBIENT NOISE LEVELS

	LA90 Daytime	*LA90* Evening	*LA90* Nighttime
Day 1	34	37	35
Day 2	35	38	32
Day 3	34	39	32
Day 4	34	37	31
Day 5	34	40	31
Day 6	34	37	32
Day 7	37	37	32
RBL	**34**	**37**	**32**

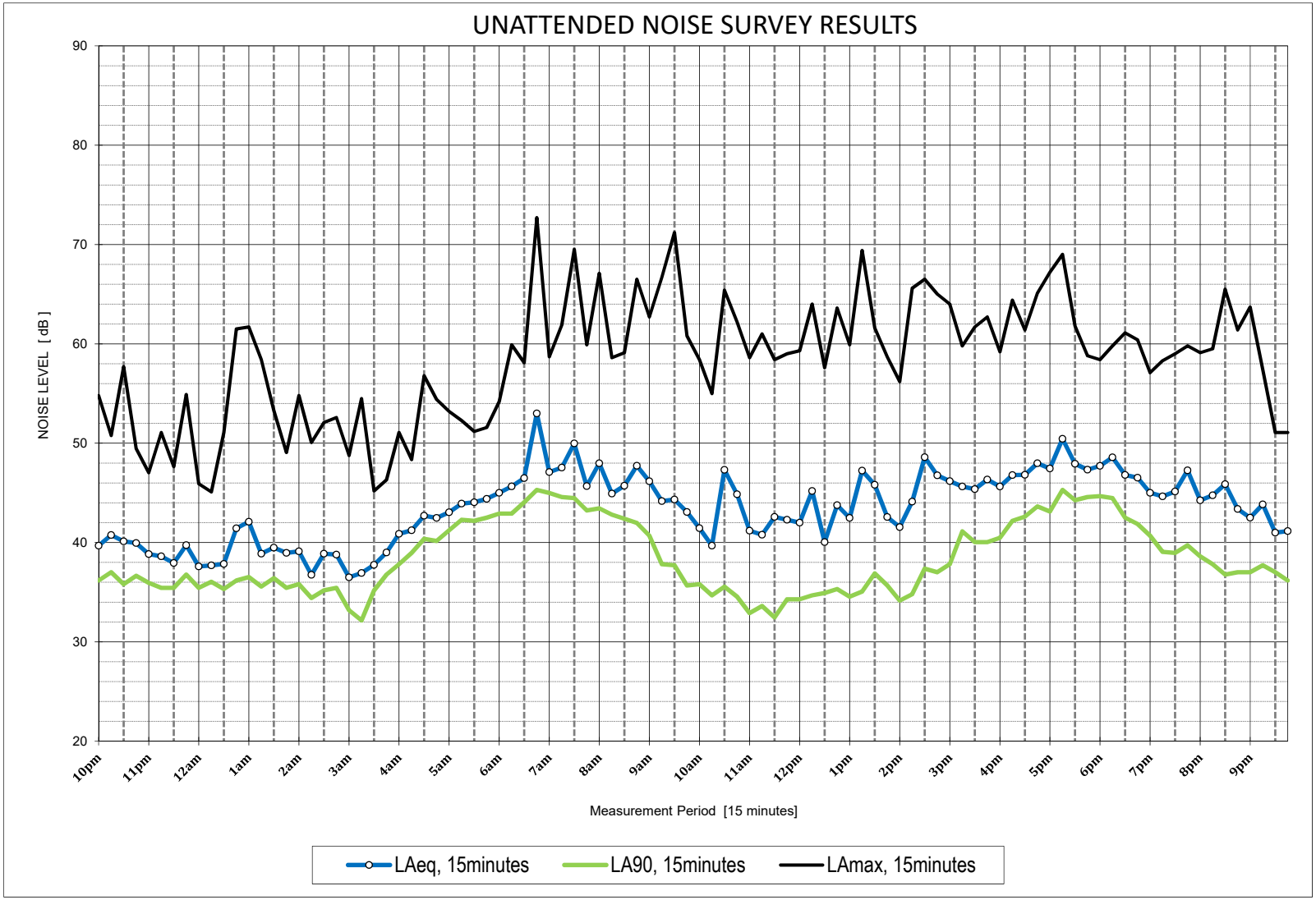
	LAeq Daytime	*LAeq* Evening	*LAeq* Nighttime
Day 1	46	45	43
Day 2	48	47	44
Day 3	44	45	42
Day 4	46	43	44
Day 5	48	46	46
Day 6	47	47	44
Day 7	47	44	44
Average	**47**	**46**	**44**

SUMMARY OF TRAFFIC & MISC. NOISE LEVELS

LAeq 15 hrs	0700-2200	46	dB
LAeq 9 hrs	2200-0700	44	dB
Max LAeq 1 hr	0700-2200	49	dB
Max LAeq 1 hr	2200-0700	46	dB

* *Sundays and Public Holidays the hours change to 0800*

DAY 1 **LOGGER LOCATION:** Amity College Leppington (Location 1) **DATE:** Thursday, 21 June 2018



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	34	dB
LA90 Evening	1800-2200	37	dB
LA90 Nighttime	2200-0700	35	dB

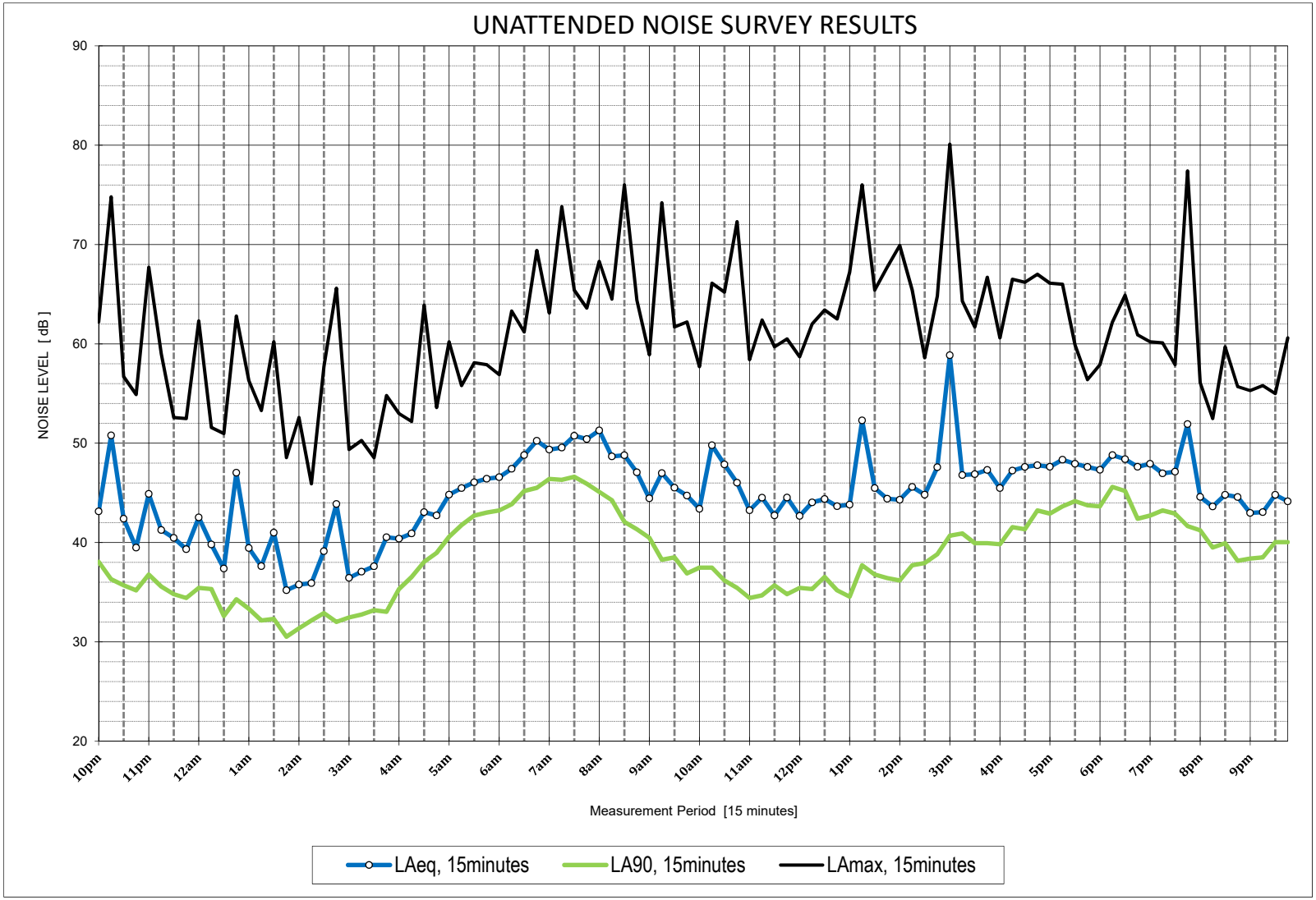
AMBIENT NOISE METRICS

LAeq Daytime	0700-1800	46	dB
LAeq Evening	1800-2200	45	dB
LAeq Nighttime	2200-0700	43	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	46	dB
LAeq 9 hours	2200-0700	43	dB
Max LAeq 1 hour	0700-2200	48	dB
Max LAeq 1 hour	2200-0700	44	dB

DAY 2 **LOGGER LOCATION:** Amity College Leppington (Location 1) **DATE:** Friday, 22 June 2018



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	35	dB
LA90 Evening	1800-2200	38	dB
LA90 Nighttime	2200-0700	32	dB

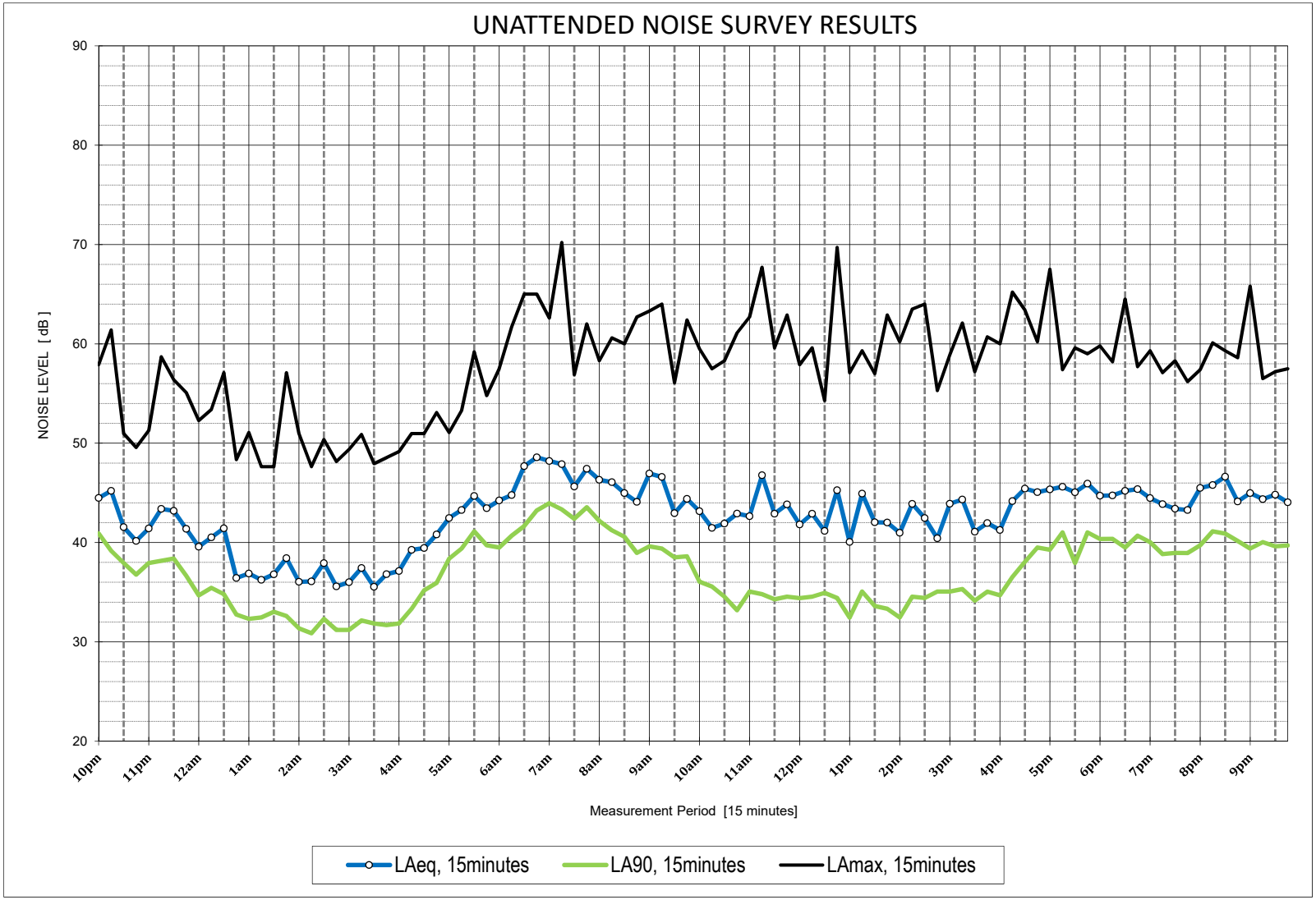
AMBIENT NOISE METRICS

LAeq Daytime	0700-1800	48	dB
LAeq Evening	1800-2200	47	dB
LAeq Nighttime	2200-0700	44	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	48	dB
LAeq 9 hours	2200-0700	44	dB
Max LAeq 1 hour	0700-2200	50	dB
Max LAeq 1 hour	2200-0700	46	dB

DAY 3 **LOGGER LOCATION:** Amity College Leppington (Location 1) **DATE:** Saturday, 23 June 2018



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	34	dB
LA90 Evening	1800-2200	39	dB
LA90 Nighttime	2200-0700	32	dB

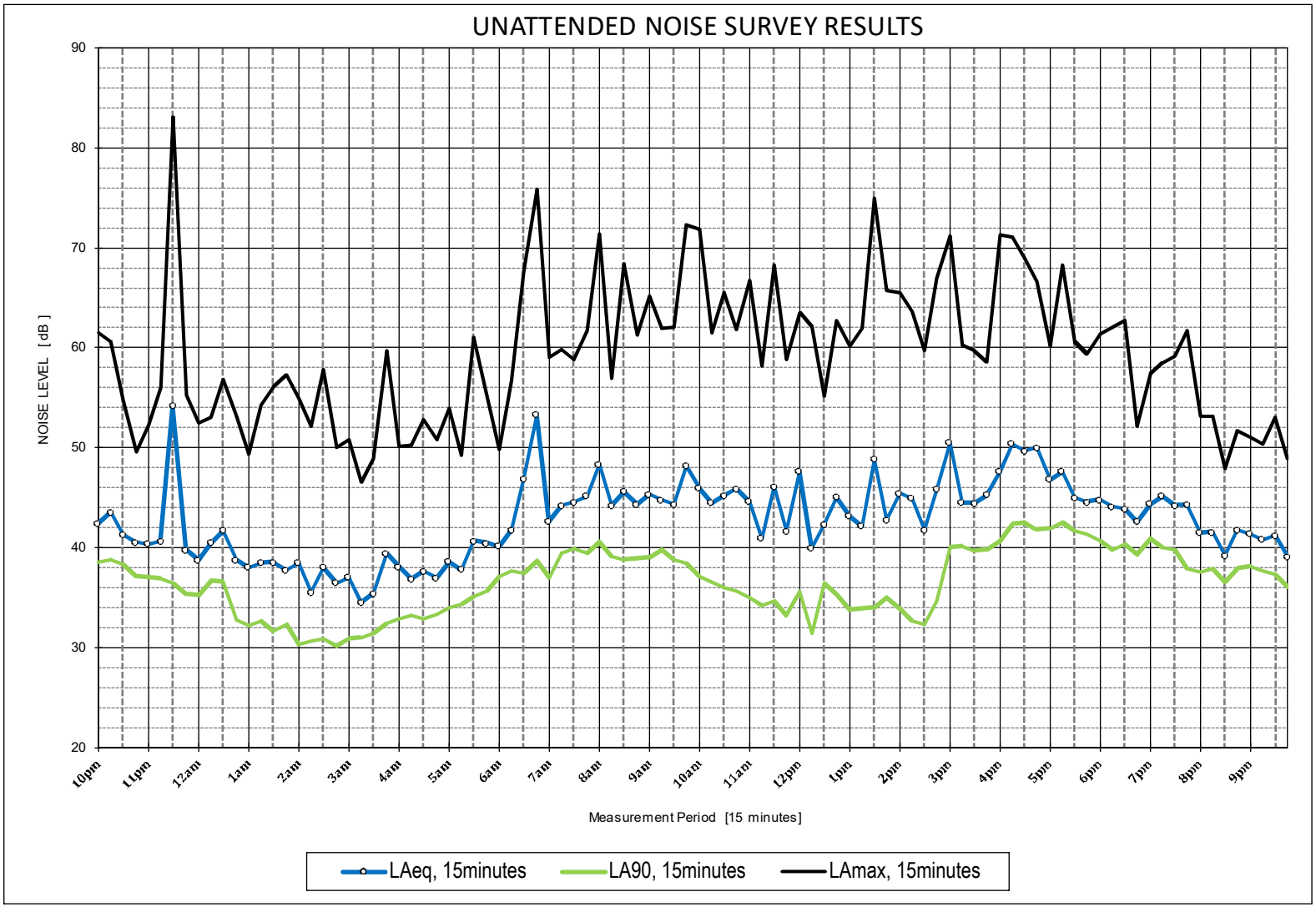
AMBIENT NOISE METRICS

LAeq Daytime	0700-1800	44	dB
LAeq Evening	1800-2200	45	dB
LAeq Nighttime	2200-0700	42	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	45	dB
LAeq 9 hours	2200-0700	42	dB
Max LAeq 1 hour	0700-2200	46	dB
Max LAeq 1 hour	2200-0700	44	dB

DAY 4 **LOGGER LOCATION:** Amity College Leppington (Location 1) **DATE:** Sunday, 24 June 2018



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0800-1800	34	dB
LA90 Evening	1800-2200	37	dB
LA90 Nighttime	2200-0800	31	dB

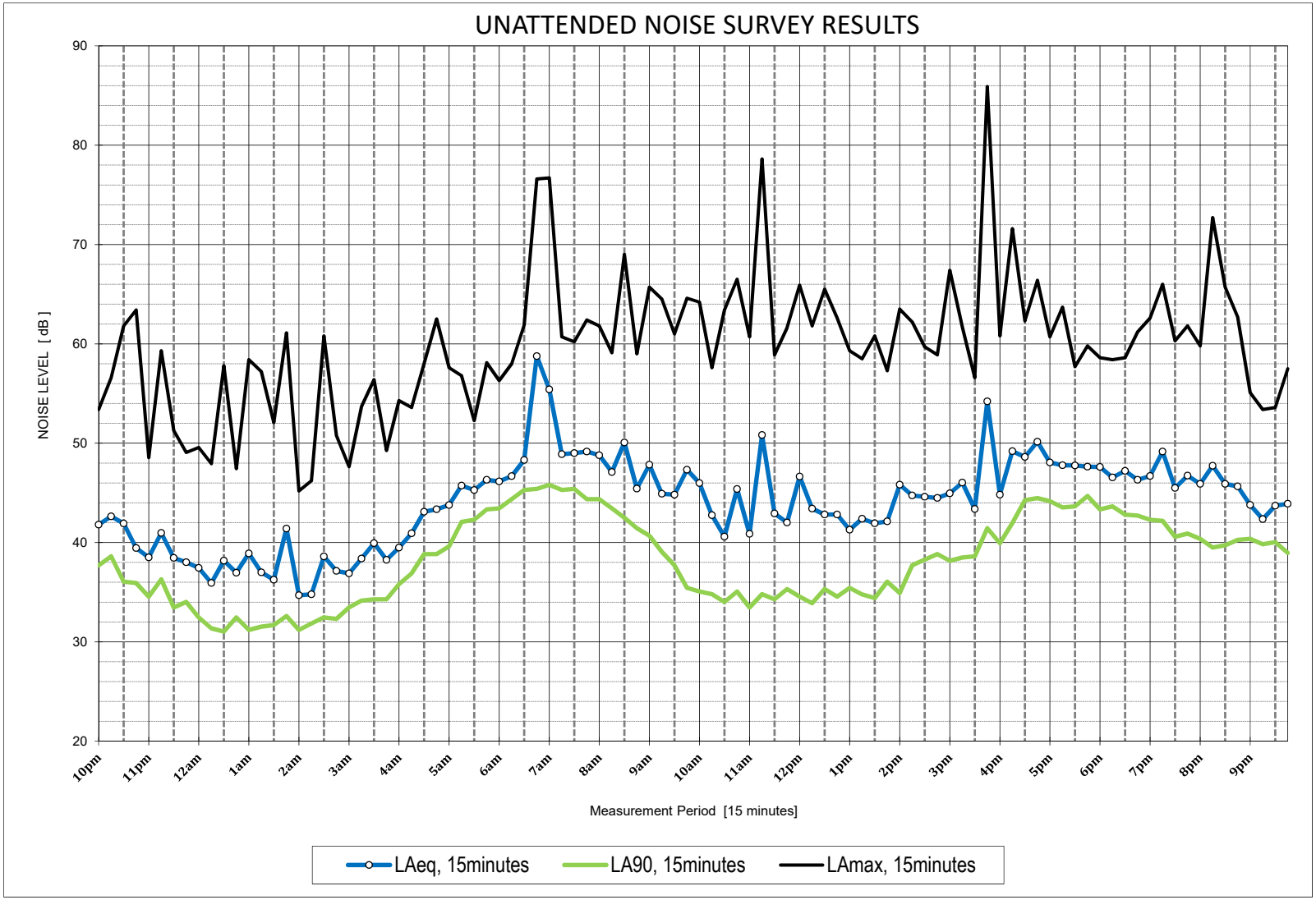
AMBIENT NOISE METRICS

LAeq Daytime	0800-1800	46	dB
LAeq Evening	1800-2200	43	dB
LAeq Nighttime	2200-0800	44	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	45	dB
LAeq 9 hours	2200-0700	44	dB
Max LAeq 1 hour	0700-2200	49	dB
Max LAeq 1 hour	2200-0700	49	dB

DAY 5 **LOGGER LOCATION:** Amity College Leppington (Location 1) **DATE:** Monday, 25 June 2018



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	34	dB
LA90 Evening	1800-2200	40	dB
LA90 Nighttime	2200-0700	31	dB

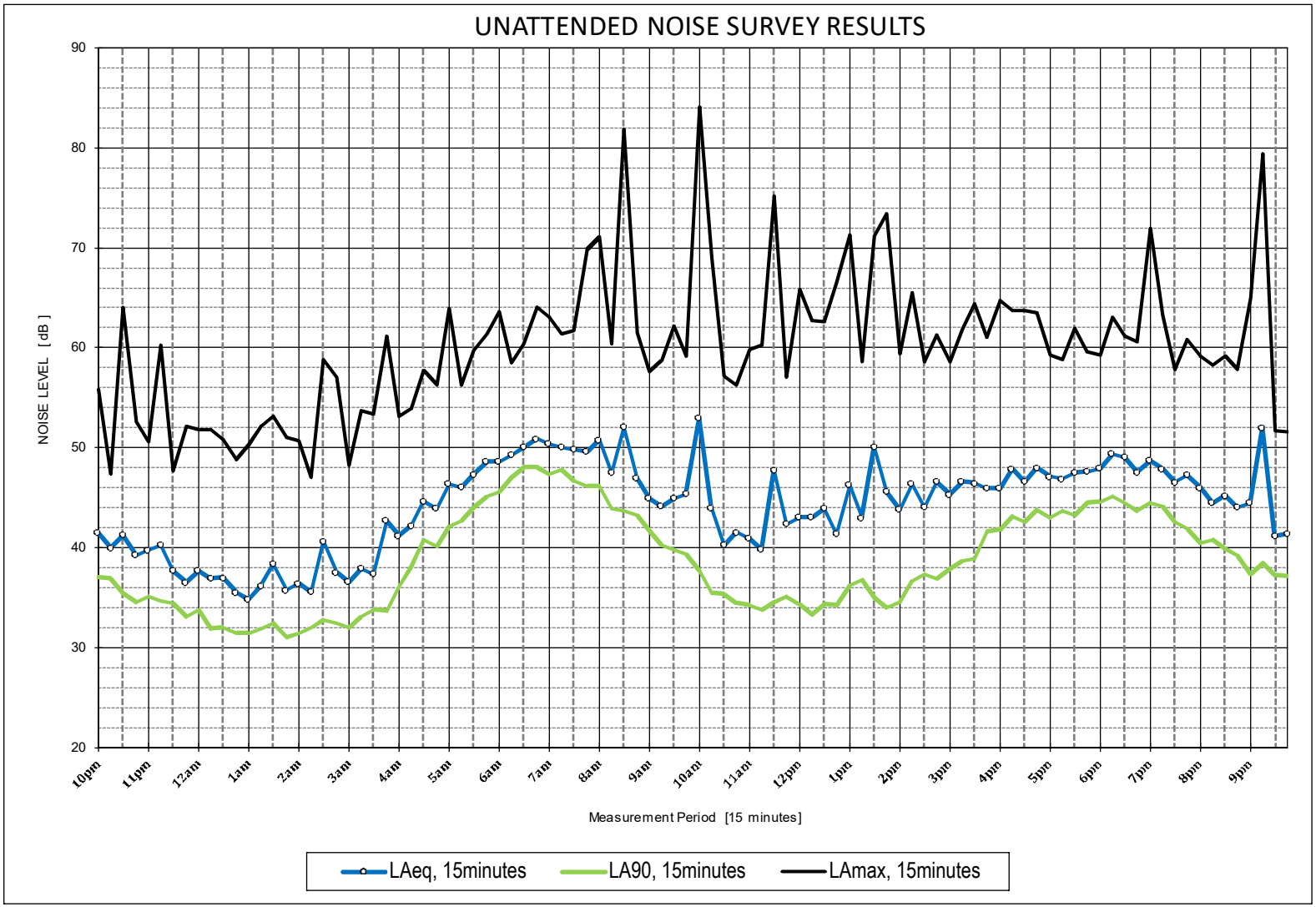
AMBIENT NOISE METRICS

LAeq Daytime	0700-1800	48	dB
LAeq Evening	1800-2200	46	dB
LAeq Nighttime	2200-0700	46	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	47	dB
LAeq 9 hours	2200-0700	46	dB
Max LAeq 1 hour	0700-2200	50	dB
Max LAeq 1 hour	2200-0700	46	dB

DAY 6 **LOGGER LOCATION:** Amity College Leppington (Location 1) **DATE:** Tuesday, 26 June 2018



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	34	dB
LA90 Evening	1800-2200	37	dB
LA90 Nighttime	2200-0700	32	dB

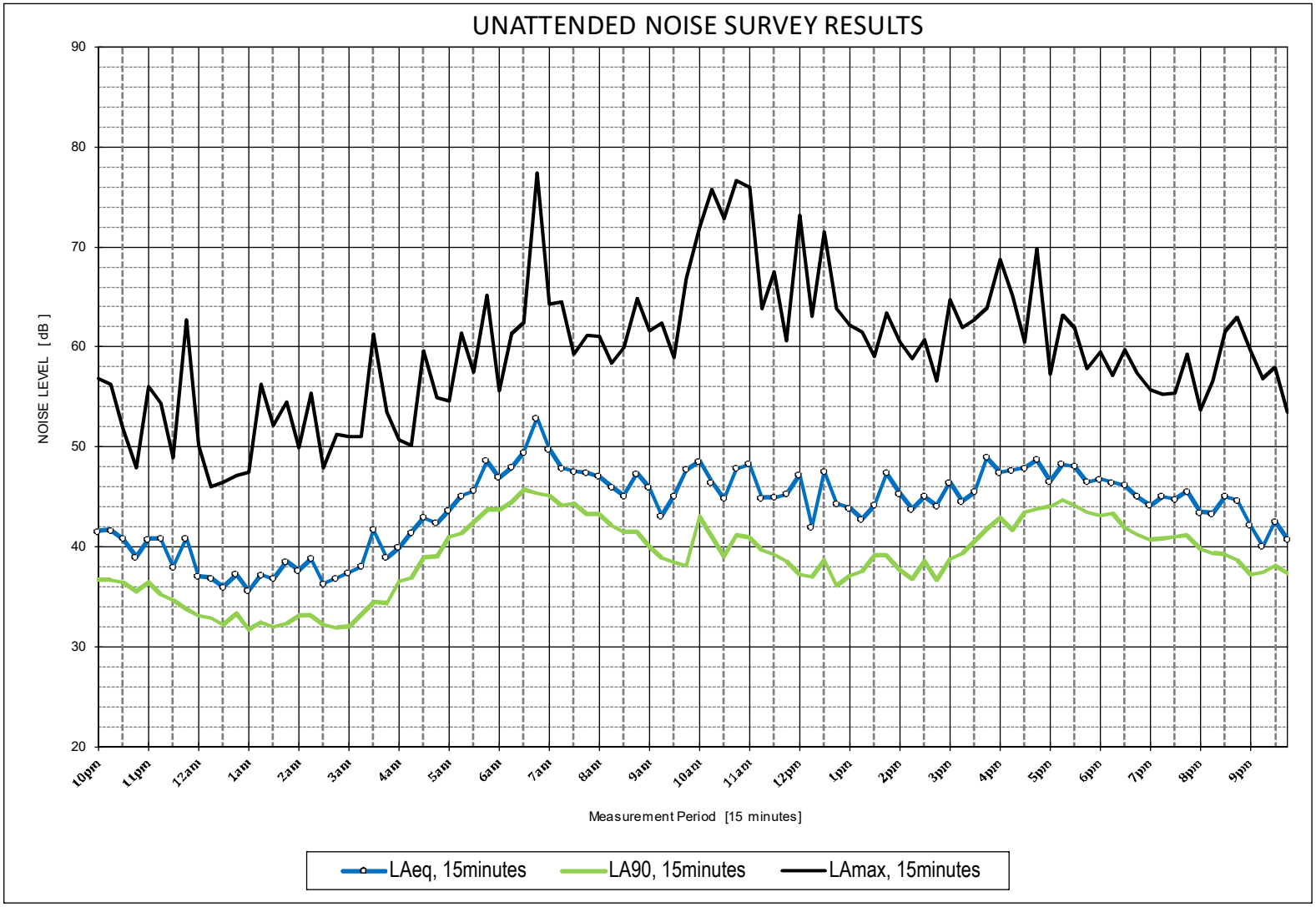
AMBIENT NOISE METRICS

LAeq Daytime	0700-1800	47	dB
LAeq Evening	1800-2200	47	dB
LAeq Nighttime	2200-0700	44	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	47	dB
LAeq 9 hours	2200-0700	44	dB
Max LAeq 1 hour	0700-2200	50	dB
Max LAeq 1 hour	2200-0700	48	dB

DAY 7 **LOGGER LOCATION:** Amity College Leppington (Location 1) **DATE:** Wednesday, 27 June 2018



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	37	dB
LA90 Evening	1800-2200	37	dB
LA90 Nighttime	2200-0700	32	dB

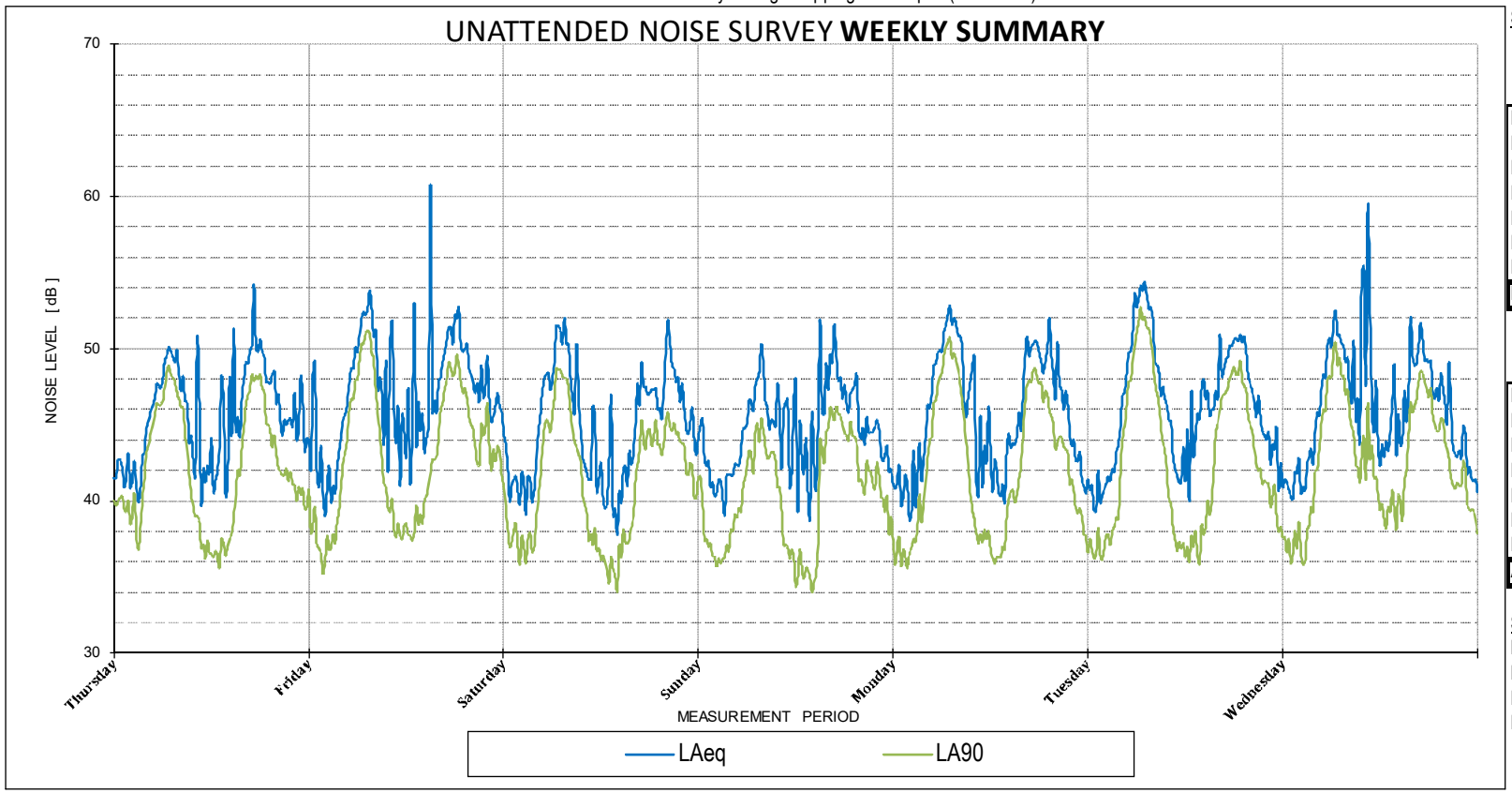
AMBIENT NOISE METRICS

LAeq Daytime	0700-1800	47	dB
LAeq Evening	1800-2200	44	dB
LAeq Nighttime	2200-0700	44	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	46	dB
LAeq 9 hours	2200-0700	44	dB
Max LAeq 1 hour	0700-2200	48	dB
Max LAeq 1 hour	2200-0700	47	dB

WEEKLY SUMMARY **LOGGER LOCATION:** Amity College Leppington Campus (Location 2) **PERIOD:** 21st to 27th June 2018



SUMMARY OF AMBIENT NOISE LEVELS

	LA90 Daytime	*LA90* Evening	*LA90* Night-time
Day 1	36	42	39
Day 2	38	43	37
Day 3	36	44	37
Day 4	35	41	36
Day 5	36	43	36
Day 6	37	42	37
Day 7	39	41	37
RBL	**36**	**42**	**37**

	LAeq Daytime	*LAeq* Evening	*LAeq* Night-time
Day 1	47	48	45
Day 2	50	50	47
Day 3	46	48	46
Day 4	47	46	44
Day 5	48	49	46
Day 6	47	49	49
Day 7	50	47	46
Average	**48**	**48**	**46**

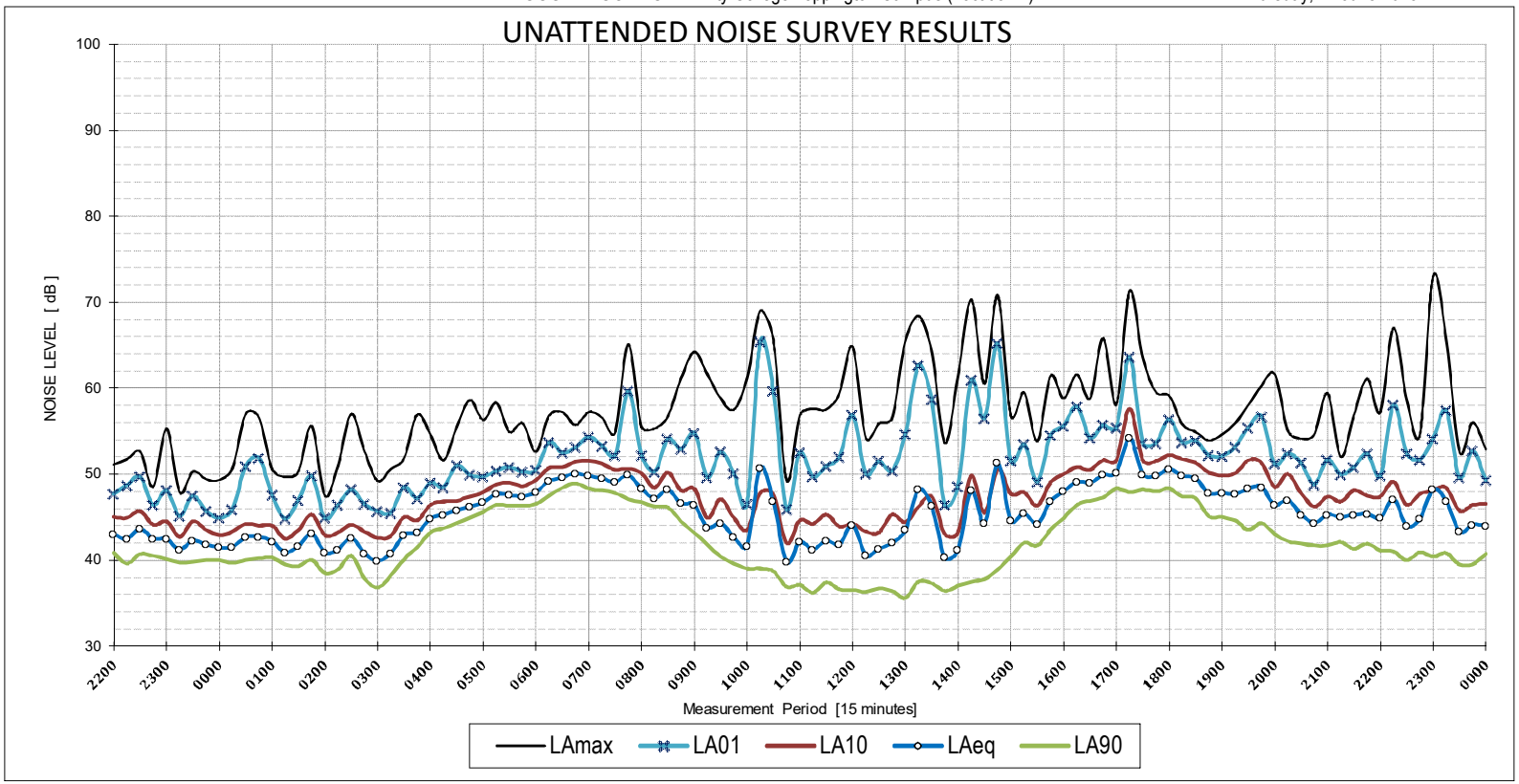
SUMMARY OF TRAFFIC & MISC. NOISE LEVELS

LAeq 15 hrs	0700-2200	48	dB
LAeq 9 hrs	2200-0700	46	dB
Max LAeq 1 hr	0700-2200	51	dB
Max LAeq 1 hr	2200-0700	49	dB

**Sundays and Public Holidays hours change to 0800*

KOIKAS ACOUSTICS PTY LTD

DAY 1 **LOGGER LOCATION:** Amity College Leppington Campus (Location 2) **DATE:** Thursday, 21 June 2018



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	36	dB
LA90 Evening	1800-2200	42	dB
LA90 Night-time	2200-0700	39	dB

AMBIENT NOISE METRICS

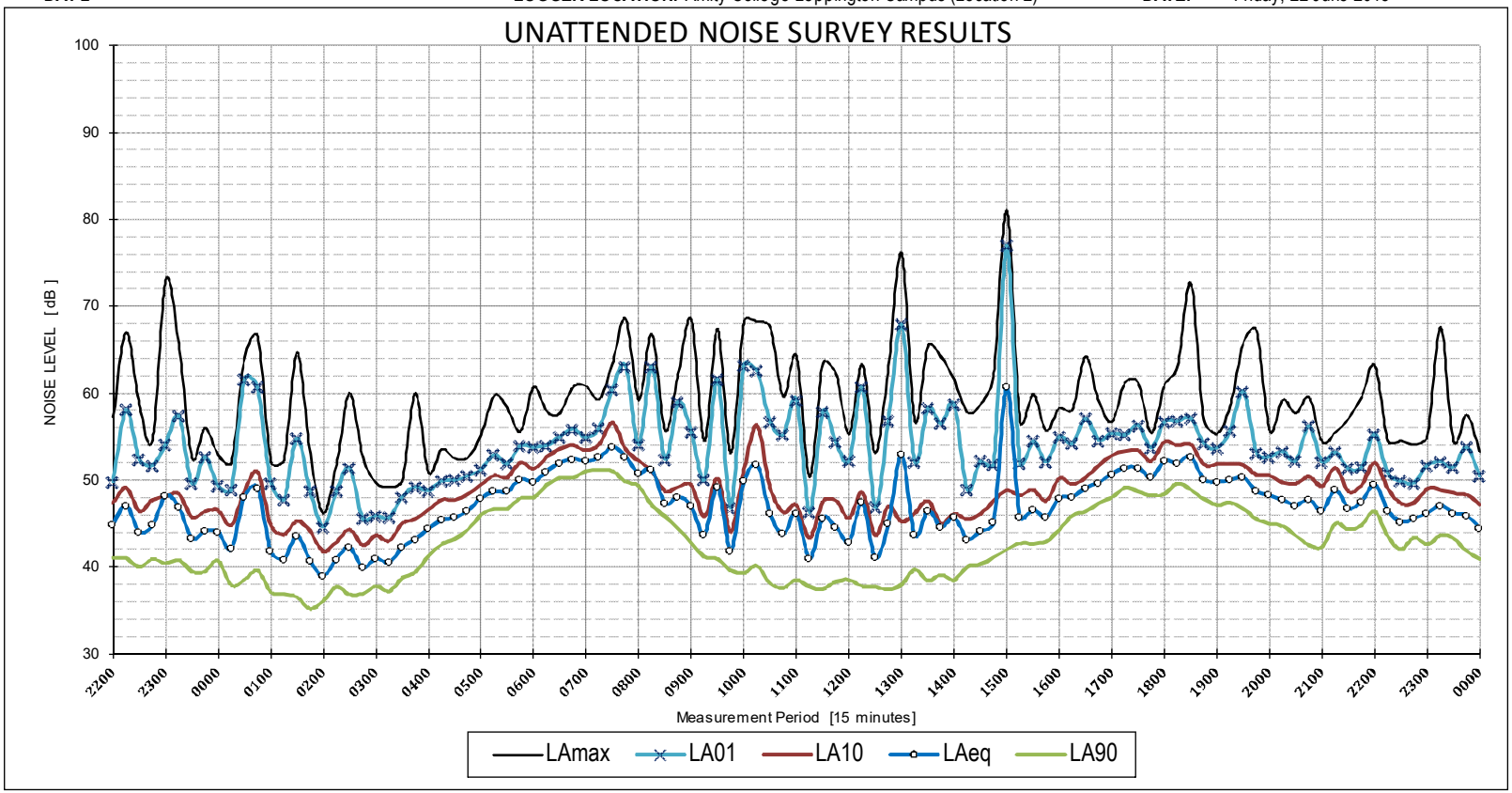
LAeq Daytime	0700-1800	47	dB
LAeq Evening	1800-2200	48	dB
LAeq Night-time	2200-0700	45	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	47	dB
LAeq 9 hours	2200-0700	45	dB
Max LAeq 1 hour	0700-2200	50	dB
Max LAeq 1 hour	2200-0700	48	dB

KOIKAS ACOUSTICS PTY LTD

DAY 2 **LOGGER LOCATION:** Amity College Leppington Campus (Location 2) **DATE:** Friday, 22 June 2018



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	38	dB
LA90 Evening	1800-2200	43	dB
LA90 Night-time	2200-0700	37	dB

AMBIENT NOISE METRICS

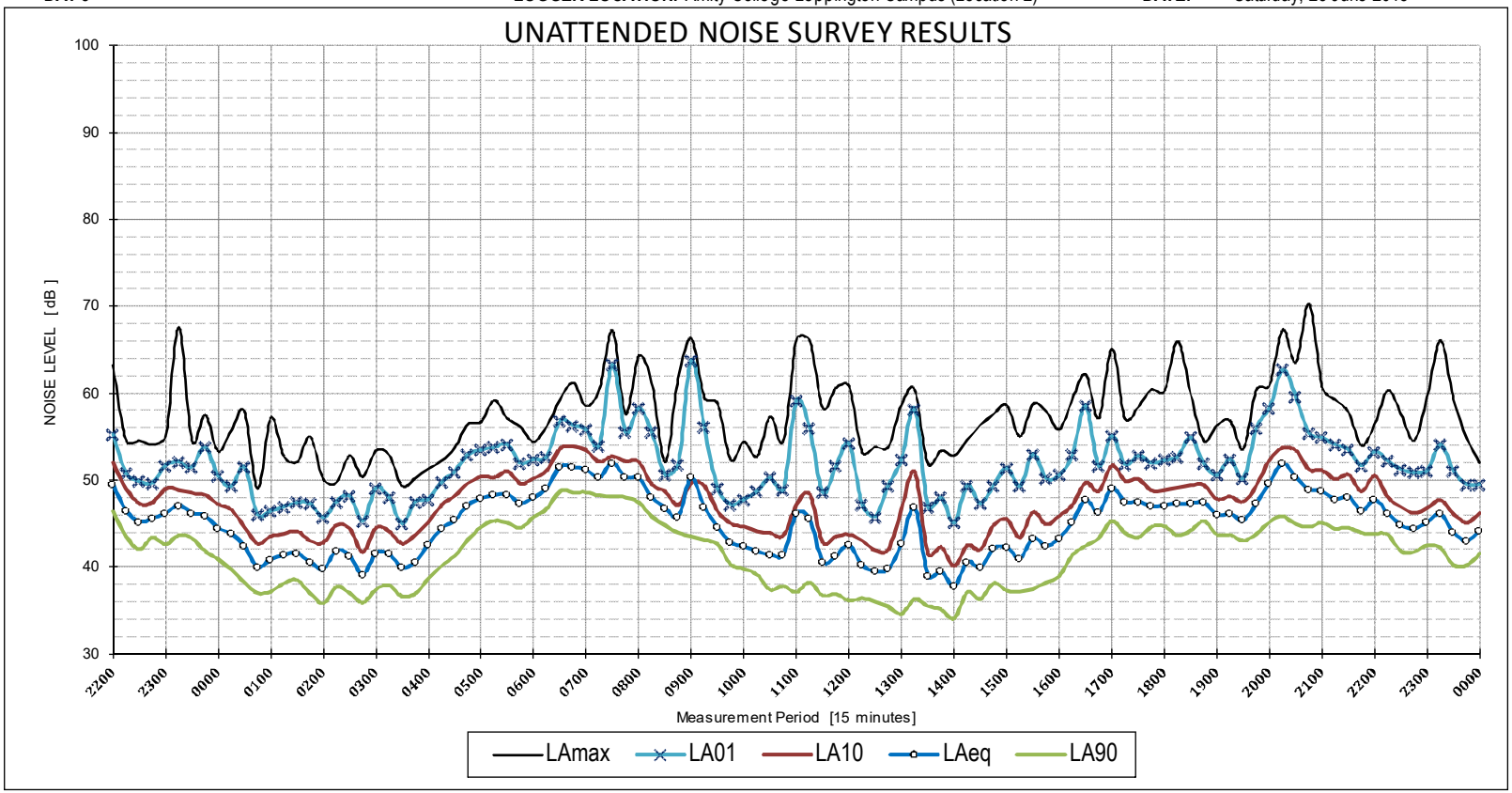
LAeq Daytime	0700-1800	50	dB
LAeq Evening	1800-2200	50	dB
LAeq Night-time	2200-0700	47	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	50	dB
LAeq 9 hours	2200-0700	47	dB
Max LAeq 1 hour	0700-2200	52	dB
Max LAeq 1 hour	2200-0700	49	dB

KOIKAS ACOUSTICS PTY LTD

DAY 3 **LOGGER LOCATION:** Amity College Leppington Campus (Location 2) **DATE:** Saturday, 23 June 2018



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	36	dB
LA90 Evening	1800-2200	44	dB
LA90 Night-time	2200-0700	37	dB

AMBIENT NOISE METRICS

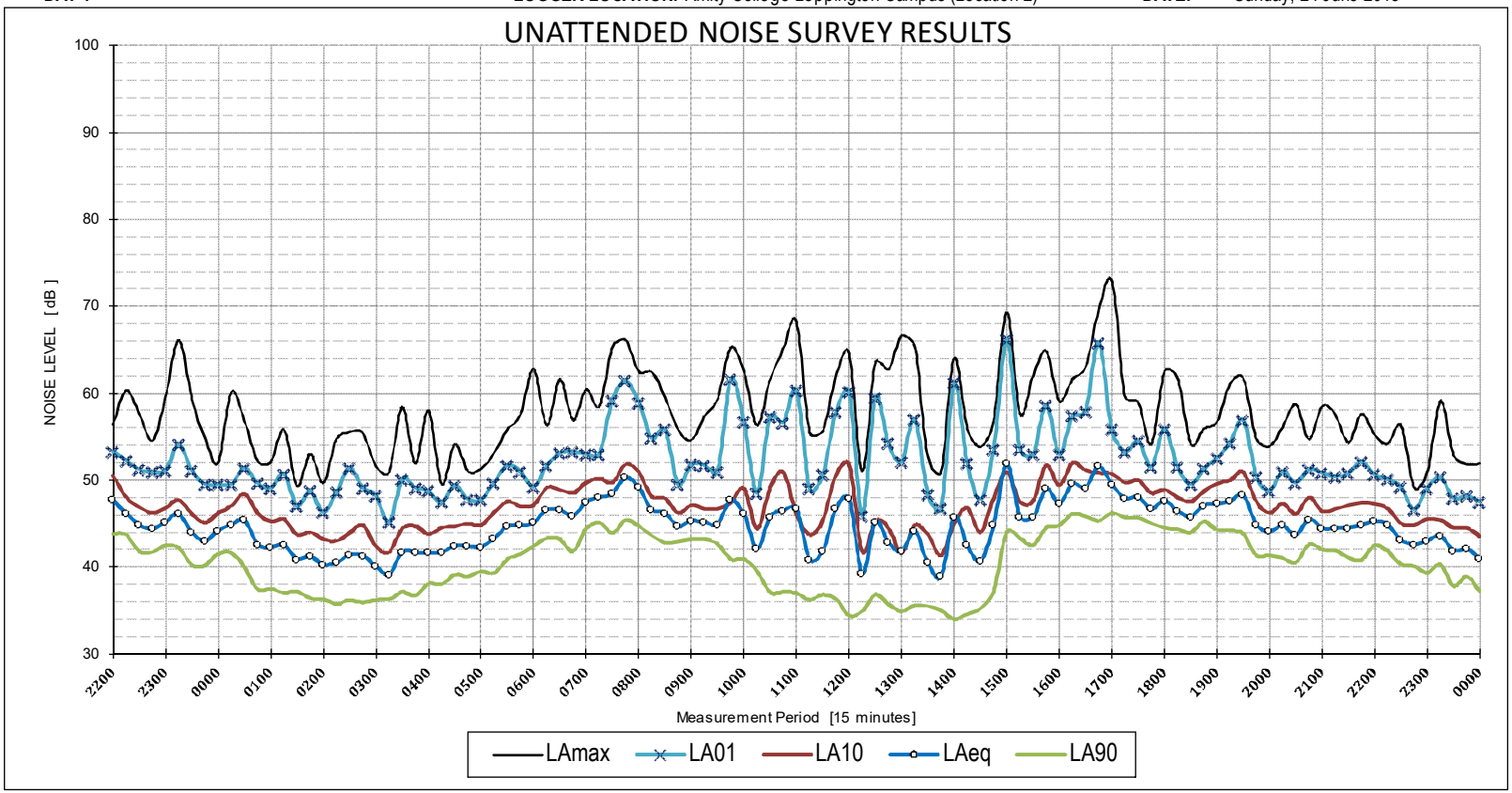
LAeq Daytime	0700-1800	46	dB
LAeq Evening	1800-2200	48	dB
LAeq Night-time	2200-0700	46	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	47	dB
LAeq 9 hours	2200-0700	46	dB
Max LAeq 1 hour	0700-2200	50	dB
Max LAeq 1 hour	2200-0700	48	dB

KOIKAS ACOUSTICS PTY LTD

DAY 4 **LOGGER LOCATION:** Amity College Leppington Campus (Location 2) **DATE:** Sunday, 24 June 2018



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	35	dB
LA90 Evening	1800-2200	41	dB
LA90 Night-time	2200-0700	36	dB

AMBIENT NOISE METRICS

LAeq Daytime	0700-1800	47	dB
LAeq Evening	1800-2200	46	dB
LAeq Night-time	2200-0700	44	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	47	dB
LAeq 9 hours	2200-0700	44	dB
Max LAeq 1 hour	0700-2200	49	dB
Max LAeq 1 hour	2200-0700	45	dB

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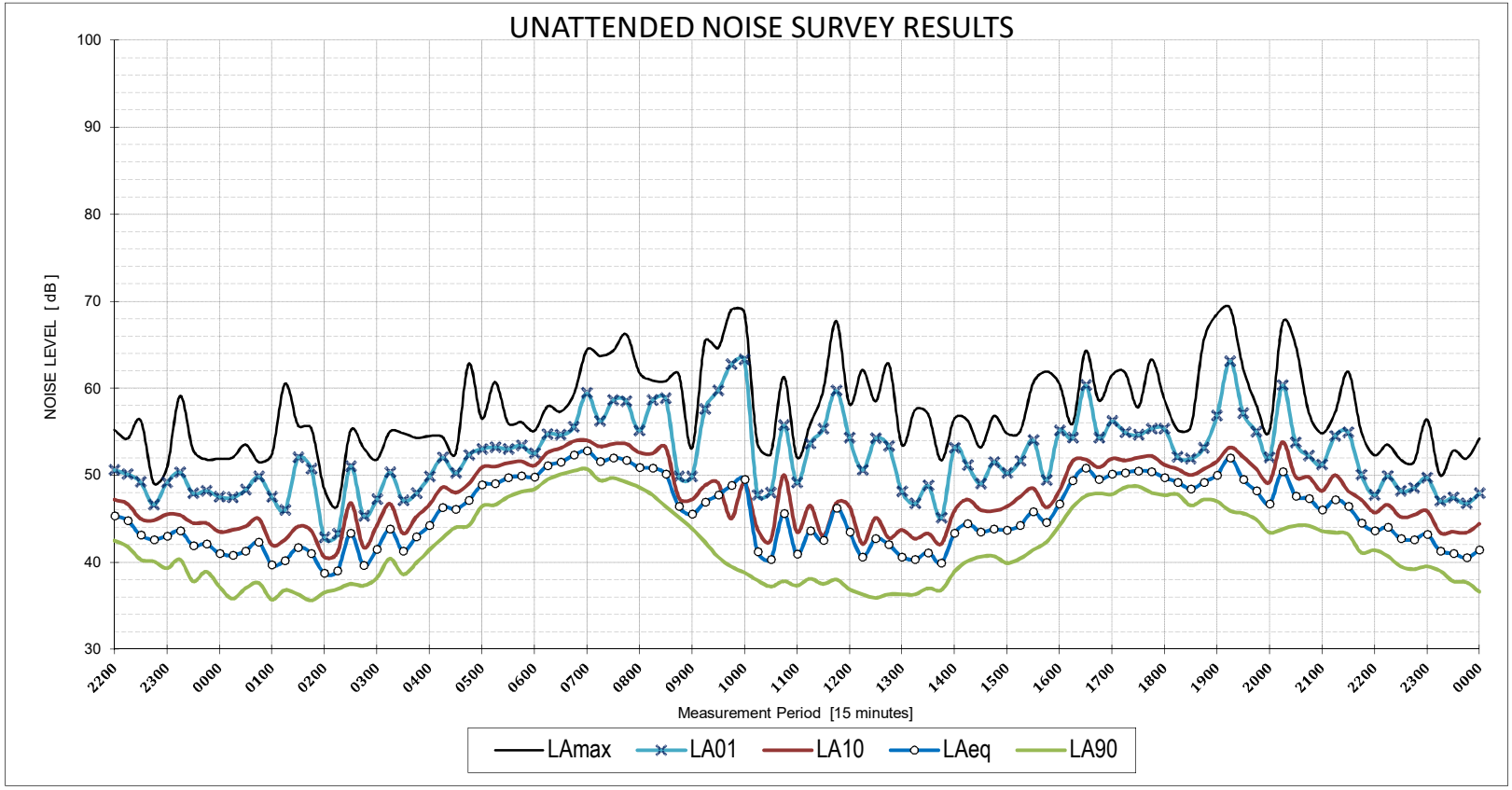
DAY 5 **LOGGER LOCATION:** Amity College Leppington Campus (Location 2) **DATE:** Monday, 25 June 2018



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	36	dB
LA90 Evening	1800-2200	43	dB
LA90 Night-time	2200-0700	36	dB

AMBIENT NOISE METRICS

LAeq Daytime	0700-1800	48	dB
LAeq Evening	1800-2200	49	dB
LAeq Night-time	2200-0700	46	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	48	dB
LAeq 9 hours	2200-0700	46	dB
Max LAeq 1 hour	0700-2200	50	dB
Max LAeq 1 hour	2200-0700	50	dB

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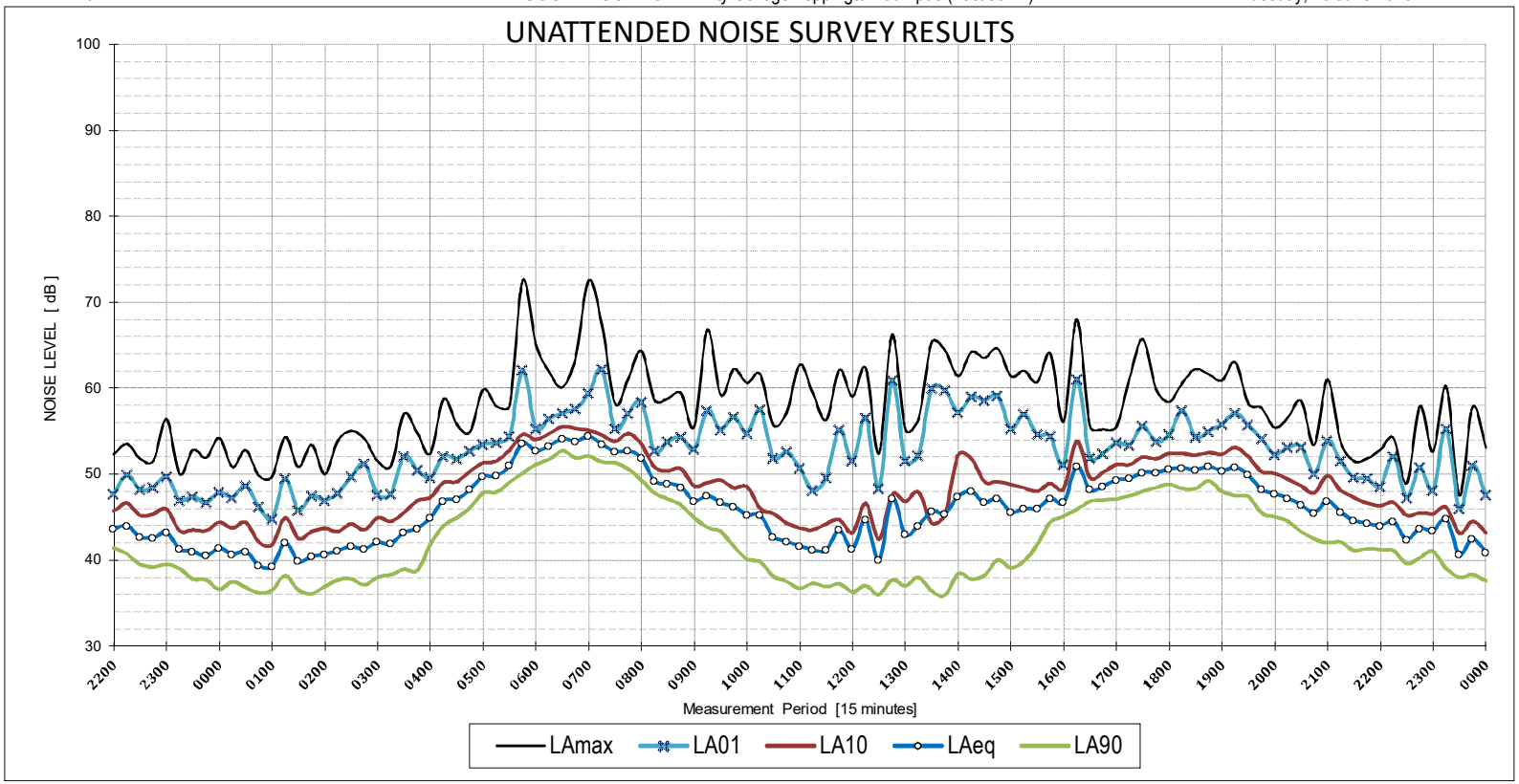
DAY 6 **LOGGER LOCATION:** Amity College Leppington Campus (Location 2) **DATE:** Tuesday, 26 June 2018



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0800-1800	37	dB
LA90 Evening	1800-2200	42	dB
LA90 Night-time	2200-0800	37	dB

AMBIENT NOISE METRICS

LAeq Daytime	0800-1800	47	dB
LAeq Evening	1800-2200	49	dB
LAeq Night-time	2200-0800	49	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	48	dB
LAeq 9 hours	2200-0700	47	dB
Max LAeq 1 hour	0700-2200	51	dB
Max LAeq 1 hour	2200-0700	52	dB

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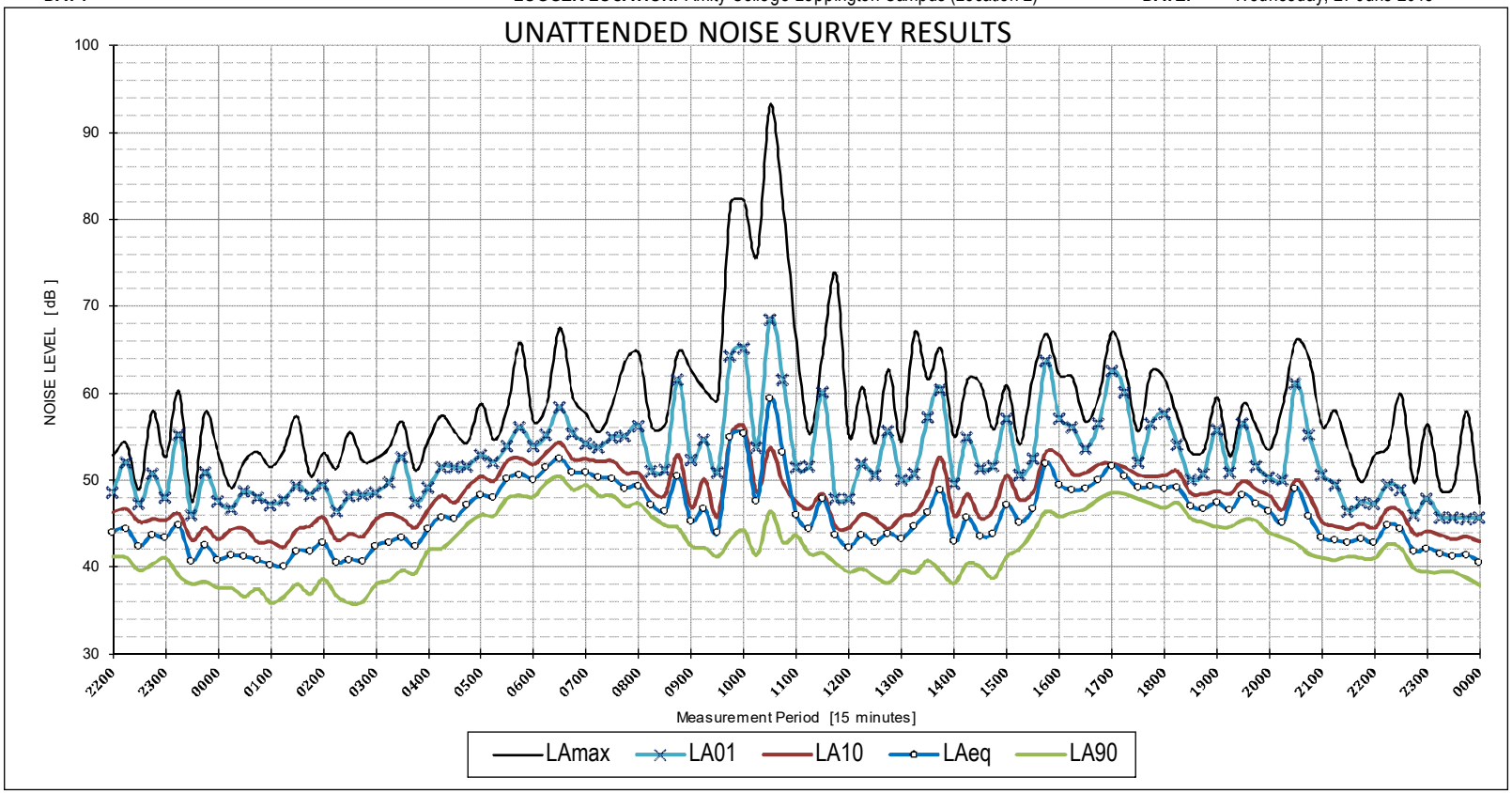
DAY 7 **LOGGER LOCATION:** Amity College Leppington Campus (Location 2) **DATE:** Wednesday, 27 June 2018



AMBIENT BACKGROUND NOISE METRICS

Descriptor	Period	Level	Units
LA90 Daytime	0700-1800	39	dB
LA90 Evening	1800-2200	41	dB
LA90 Night-time	2200-0700	37	dB

AMBIENT NOISE METRICS

LAeq Daytime	0700-1800	50	dB
LAeq Evening	1800-2200	47	dB
LAeq Night-time	2200-0700	46	dB

TRAFFIC & MISC. NOISE METRICS

LAeq 15 hours	0700-2200	49	dB
LAeq 9 hours	2200-0700	46	dB
Max LAeq 1 hour	0700-2200	51	dB
Max LAeq 1 hour	2200-0700	50	dB

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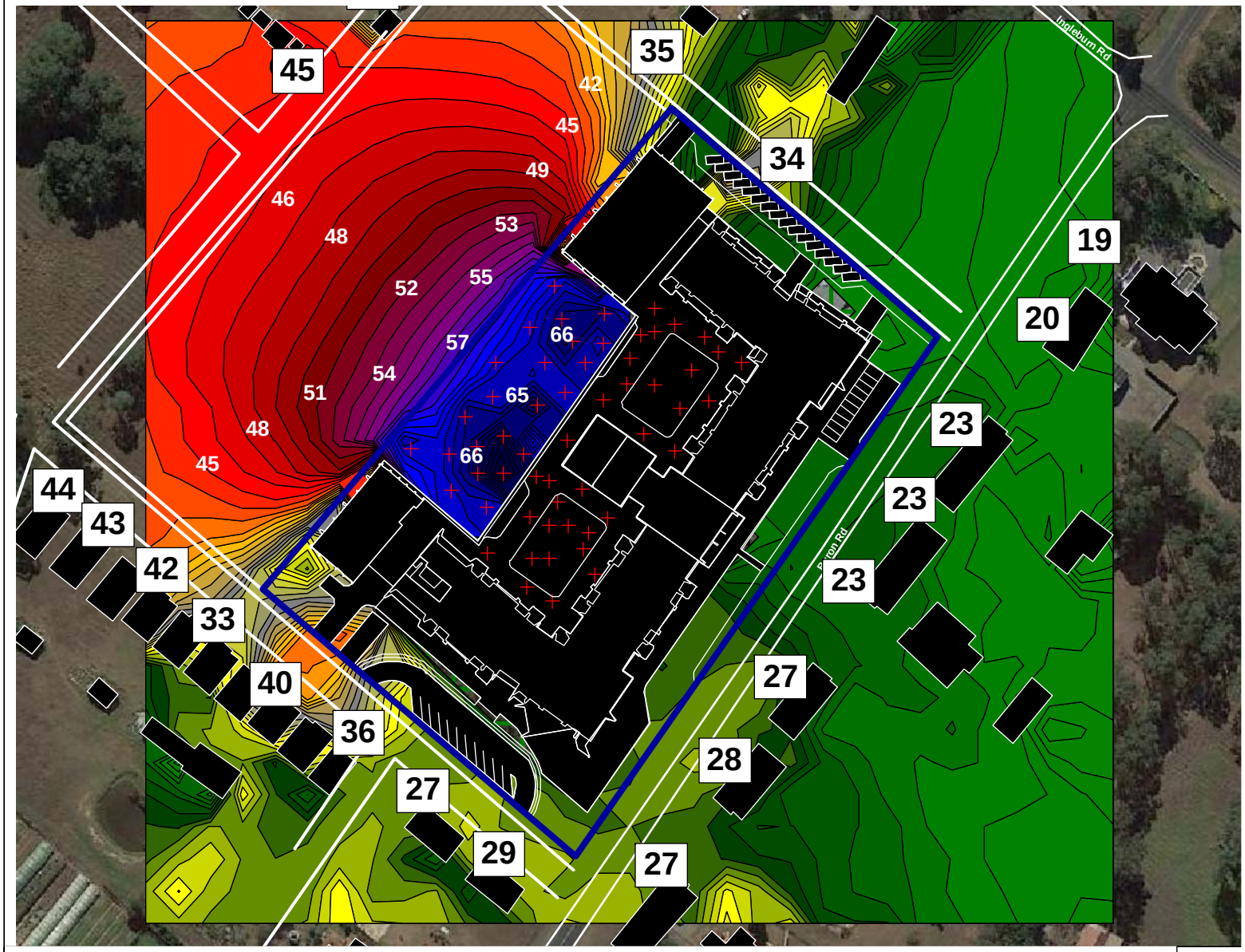
APPENDIX B

APPENDIX B

APPENDIX B



**** SCENARIO 1A****
STUDENT NOISE IMPACT DURING BREAK

NOISE SOURCES

~ 1,000 students on playground (assming 50% talking).

~ 23 staff members on playground.

Note:

- LAeq,15mins noise level shown are at 1.5 m above the natural ground level of the surrounding residential premise.

- The maximum reading at the surrounding residential premise is LAeq,15mins 45 dB.

PRINT DATE: 09/05/19

+ Point Source
Building
3D-Reflector
Foliage
Ground Absorption
Contour Line
Receiver
Calculation Area

> -99.0 dB
> 20.0 dB
> 25.0 dB
> 30.0 dB
> 35.0 dB
> 40.0 dB
> 45.0 dB
> 50.0 dB
> 55.0 dB
> 60.0 dB
> 65.0 dB
> 70.0 dB

KOIKAS ACOUSTICS PTY LTD
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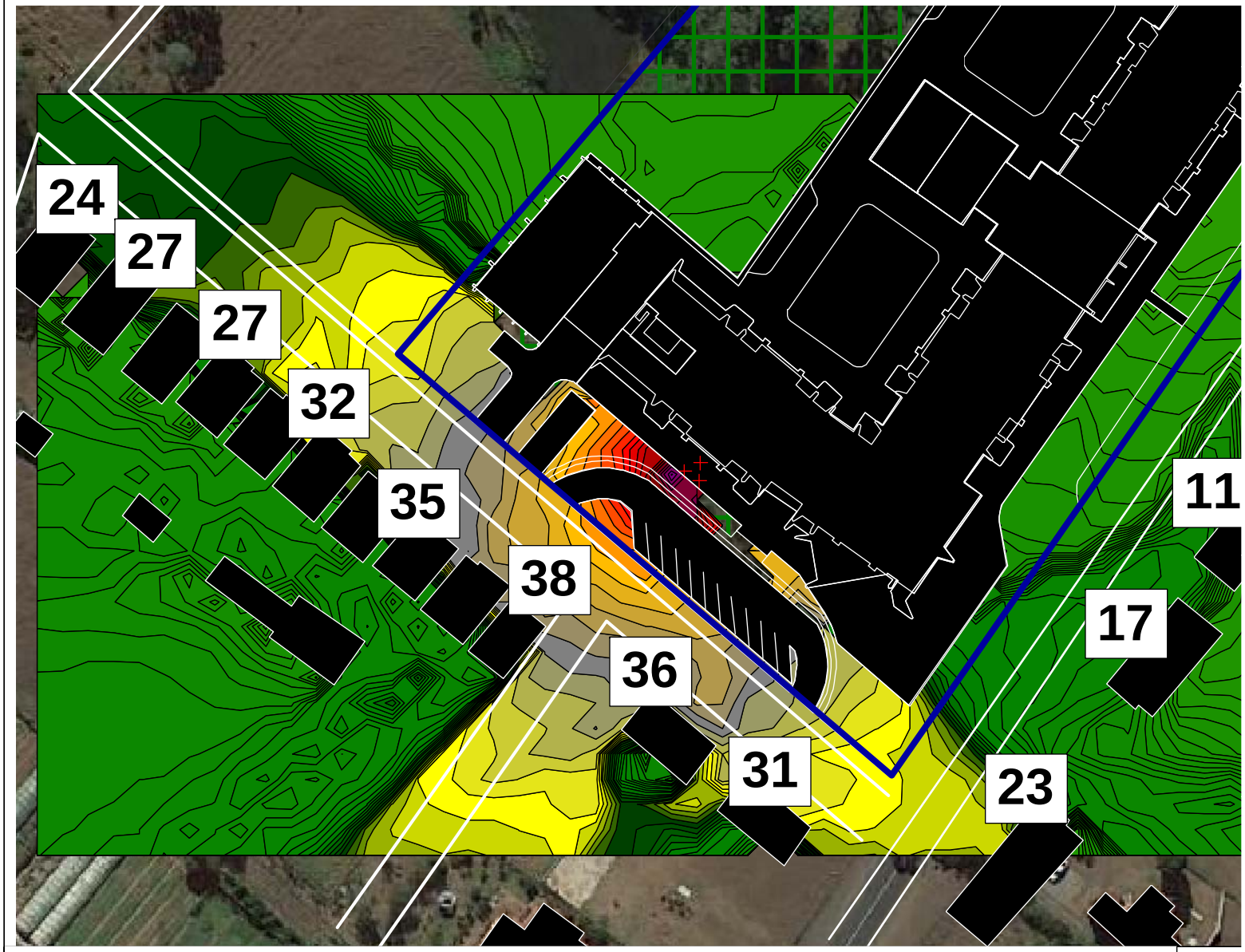
SCENARIO 1A: STUDENT NOISE IMPACT DURING BREAK

JOB NUMBER: 3456
LOCATION: AMITY COLLEGE LEPPINGTON CAMPUS
ASSESSED TO: Camden Council's Environmental Noise Policy
LIMITING CRITERIA: LAeq,15mins 44~46 dB (External)

W



**** SCENARIO 1B****
NOISE IMPACT FROM OUTDOOR TEACHING AREA

NOISE SOURCES

~ A class of 25 students in the outdoor teaching area. (only 2~3 people talking at a raised vocal effort).

Note:

- LAeq,15mins noise level shown are at 1.5 m above the natural ground level of the surrounding residential premise.

- The maximum reading at the surrounding residential premise is LAeq,15mins 38 dB.

PRINT DATE: 09/05/19

+ Point Source
Building
3D-Reflector
Foliage
Ground Absorption
Contour Line
Receiver
Calculation Area

> -99.0 dB
> 20.0 dB
> 25.0 dB
> 30.0 dB
> 35.0 dB
> 40.0 dB
> 45.0 dB
> 50.0 dB
> 55.0 dB
> 60.0 dB
> 65.0 dB
> 70.0 dB

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SCENARIO 1B: NOISE IMPACT FROM OUTDOOR TEACHING AREA

JOB NUMBER: 3456
LOCATION: AMITY COLLEGE LEPPINGTON CAMPUS
ASSESSED TO: Camden Council's Environmental Noise Policy
LIMITING CRITERIA: LAeq,15mins 44~46 dB (External)

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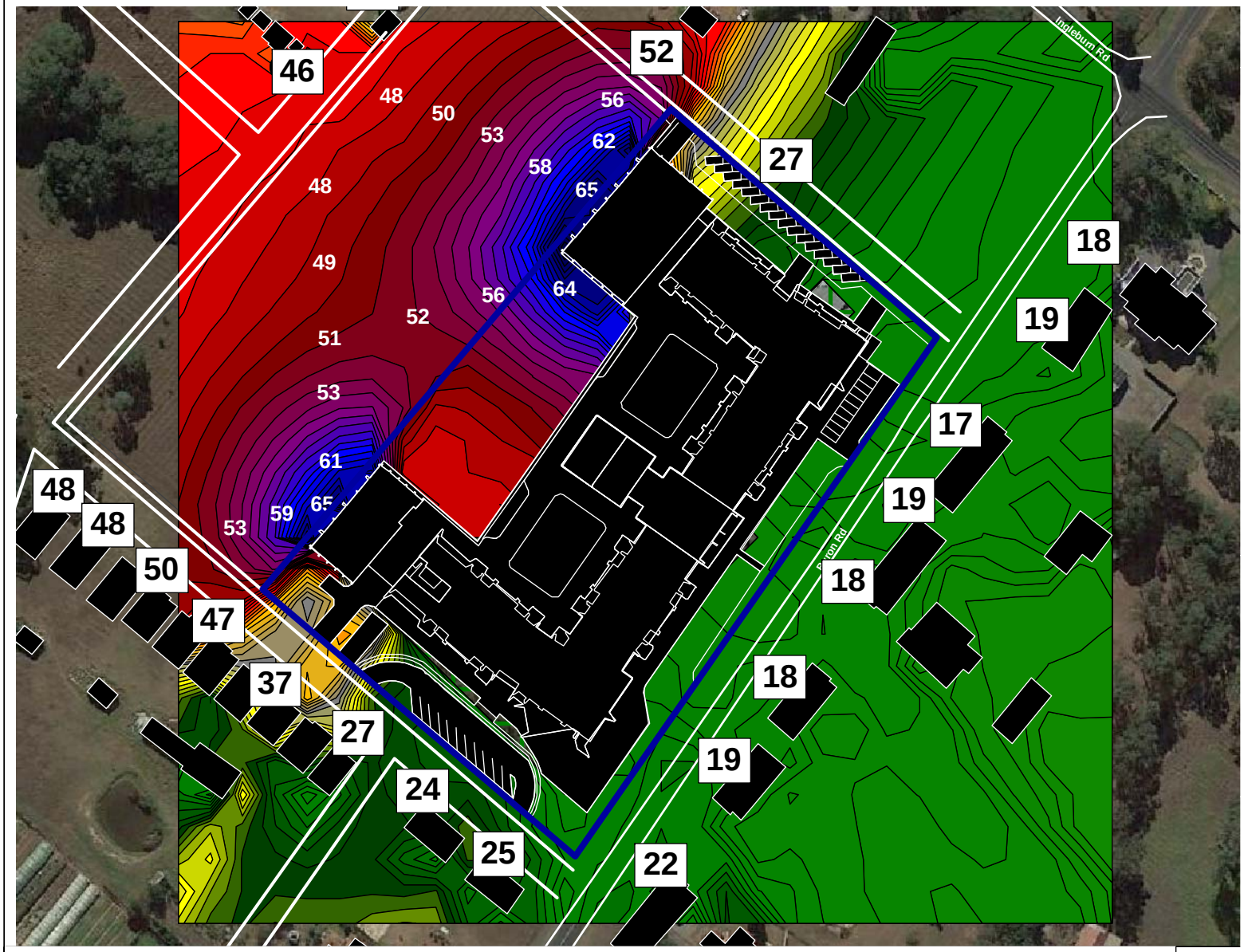

**** SCENARIO 1C****
NOISE IMPACT FROM SCHOOL HALLS (AFTER-HOURS)

NOISE SOURCES
~ 360 people occupying the primary school hall with 40m2 of opening surface area (windows/doors).
~ 560 people occupying the secondary school hall with 90m2 of opening surface area (windows/doors).

Note:
- LAeq,15mins noise level shown are at 1.5 m above the natural ground level of the surrounding residential premise.
- The maximum reading at the surrounding residential premise is LAeq,15mins 52 dB.

PRINT DATE: 21/05/19

- vert. Area Source
- Building
- 3D-Reflector
- Foliage
- Ground Absorption
- Contour Line
- Receiver
- Calculation Area

- > -99.0 dB
- > 20.0 dB
- > 25.0 dB
- > 30.0 dB
- > 35.0 dB
- > 40.0 dB
- > 45.0 dB
- > 50.0 dB
- > 55.0 dB
- > 60.0 dB
- > 65.0 dB
- > 70.0 dB

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SCENARIO 1C: NOISE IMPACT FROM SCHOOL HALLS (AFTER-HOURS)
JOB NUMBER: 3456
LOCATION: AMITY COLLEGE LEPPINGTON CAMPUS
ASSESSED TO: NPfI
LIMITING CRITERIA: LAeq,15mins 47~52 dB (External)

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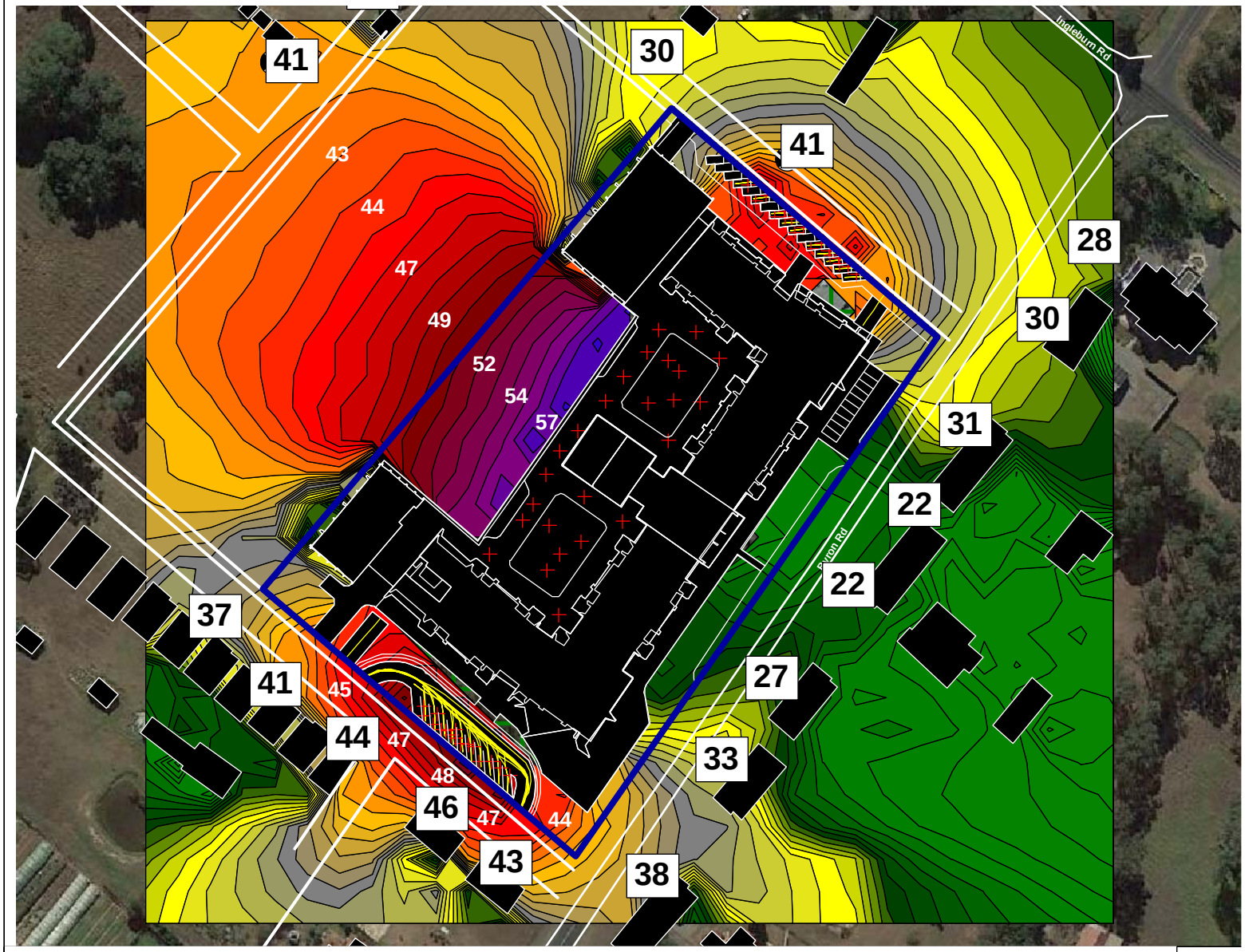

**** SCENARIO 2A****
MORNING PEAK-HOUR DROP-OFF

NOISE SOURCES

~ 200 vehicles entering/leaving.
~ 13 staff vehicles entering.
~ 1 bus entering/leaving.
~ 500 students on playground.

Note:

- LAeq,15mins noise level shown are at 1.5 m above the natural ground level of the surrounding residential premise.

- The maximum reading at the surrounding residential premise is LAeq,15mins 46 dB.

PRINT DATE: 21/05/19

+ Point Source
Line Source
Building
3D-Reflector
Foliage
Ground Absorption
Contour Line
Receiver
Calculation Area

> -99.0 dB
> 20.0 dB
> 25.0 dB
> 30.0 dB
> 35.0 dB
> 40.0 dB
> 45.0 dB
> 50.0 dB
> 55.0 dB
> 60.0 dB
> 65.0 dB
> 70.0 dB

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SCENARIO 2A: MORNING PEAK HOUR DROP-OFF

JOB NUMBER: 3456
LOCATION: AMITY COLLEGE LEPPINGTON CAMPUS
ASSESSED TO: NPfI
LIMITING CRITERIA: LAeq,15mins 44~46 dB (External)

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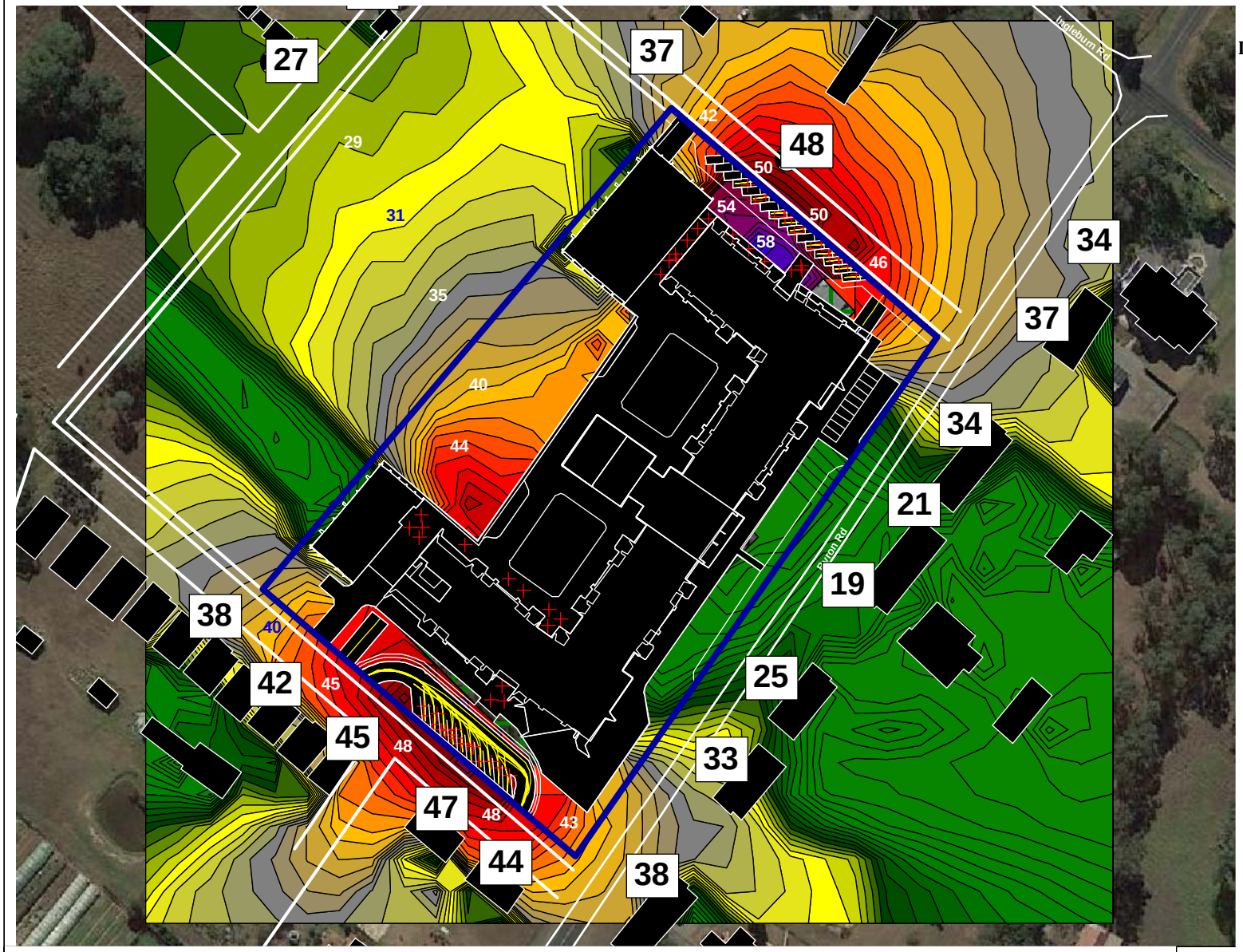

**** SCENARIO 2B****
CAR PARK NOISE IMPACT DURING AFTER-HOURS EVENT

NOISE SOURCES

~ 200 vehicles entering/leaving.
~ 13 staff vehicles entering.
~ 250 walking or standing outdoors.

Note:

- LAeq,15mins noise level shown are at 1.5 m above the natural ground level of the surrounding residential premise.

- The maximum reading at the surrounding residential premise is LAeq,15mins 48 dB.

PRINT DATE: 21/05/19

- Point Source
- Line Source
- Building
- 3D-Reflector
- Foliage
- Ground Absorption
- Contour Line
- Receiver
- Calculation Area

- > -99.0 dB
- > 20.0 dB
- > 25.0 dB
- > 30.0 dB
- > 35.0 dB
- > 40.0 dB
- > 45.0 dB
- > 50.0 dB
- > 55.0 dB
- > 60.0 dB
- > 65.0 dB
- > 70.0 dB

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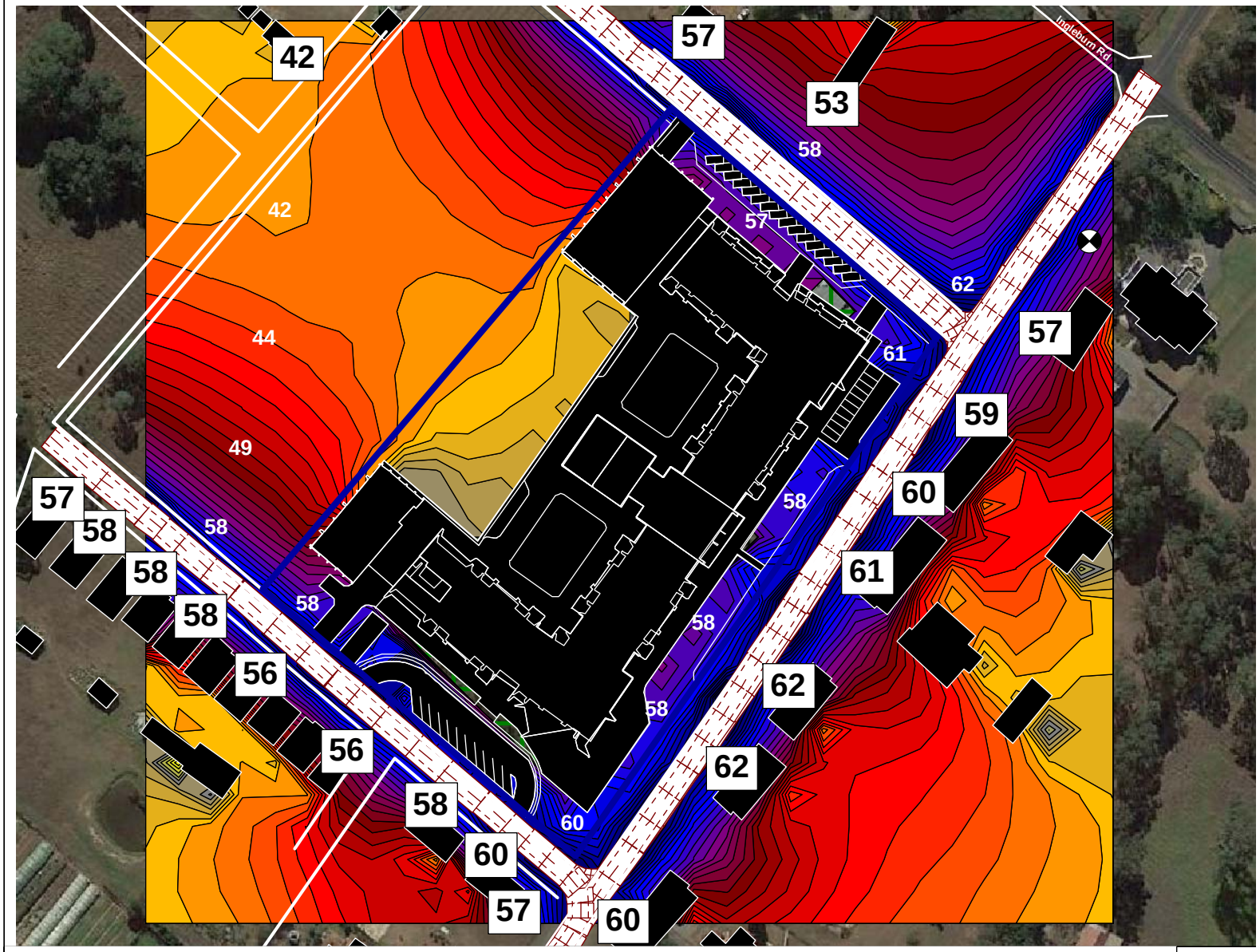
SCENARIO 2B: CAR PARK NOISE DURING AFTER-HOURS EVENT

JOB NUMBER: 3456
LOCATION: AMITY COLLEGE LEPPINGTON CAMPUS
ASSESSED TO: NPfI
LIMITING CRITERIA: LAeq,15mins 47~52 dB (External)

W



**** SCENARIO 3****
ROAD TRAFFIC NOISE
MORNING PEAK-HOUR

NOISE SOURCES

~ Refer to Figure 8 of the traffic report prepared by Traffix..

Note:

- LAeq,1hr noise level shown are at 1.5 m above the natural ground level of the surrounding residential premise (1 m from the most noise-affected building facades).

- The maximum reading at the surrounding residential premise is LAeq,1hr 62 dB.

PRINT DATE: 09/05/19

- Road
- Building
- 3D-Reflector
- Foliage
- Ground Absorption
- Contour Line
- Receiver
- Calculation Area

- > -99.0 dB
- > 25.0 dB
- > 30.0 dB
- > 35.0 dB
- > 40.0 dB
- > 45.0 dB
- > 50.0 dB
- > 55.0 dB
- > 60.0 dB
- > 65.0 dB
- > 70.0 dB

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SCENARIO 3: ROAD TRAFFIC NOISE MODEL (MORNING PEAK HOUR)

JOB NUMBER: 3456
LOCATION: AMITY COLLEGE LEPPINGTON CAMPUS
ASSESSED TO: NPfI
LIMITING CRITERIA: LAeq,1hr 55 dB (External) or 2 dB increase

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