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Noise Impact Assessment

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1 INTRODUCTION

Acoustic Logic Consultancy has been engaged to conduct an acoustic assessment of potential noise impacts associated with the proposed Katoomba Christian Centre redevelopment master plan. The site is to be constructed in place of the existing centre and incorporate new and existing structures.

This assessment addresses potential noise impacts associated with the following noise sources:

- Breakout noise from the operation of the convention centre;
- Outdoor plaza; and
- Operation of mechanical plant in principle.

Noise emissions from the site have been assessed in accordance with the following:

- NSW Environment Protection Authority Industrial Noise Policy (INP)
- Blue Mountains City Council

Recommendations to control noise emanating from the site have been recommended and discussed in accordance with the aforementioned guidelines.

SoundPlan™ Note

Noise levels have been predicted at the receiver locations using SoundPlan™ modelling software implementing the ISO 9613-2:1996 *“Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation”* noise propagation standard. Noise levels presented in the body of this report are the façade incidence levels and do not include façade reflection.

2 SITE PROPOSAL AND LOCATION

2.1 EXISTING USES AND ROAD NETWORK

The existing Katoomba Christian Centre is located at 119 Cliff Drive, Katoomba. The site is surrounded by the following uses (refer also Figure 1):

- Residential dwellings to the West, Northwest and East;
- National Park across Cliff Drive to the South and East;
- Scenic World to the Northeast.

Access is provided by Cliff Drive. The surrounding road network is generally associated with Cliff Drive, primarily serving residential dwellings and access to and from Scenic World and associated conference centres.

2.2 PROPOSED DEVELOPMENT

The proposed development generally includes the following (refer also Figure 2):

- Redevelopment of the existing convention centre located in the Southern portion of the site;
- Site accommodation facilities;
- Formalisation of the existing outdoor plaza feeding off the convention centre.

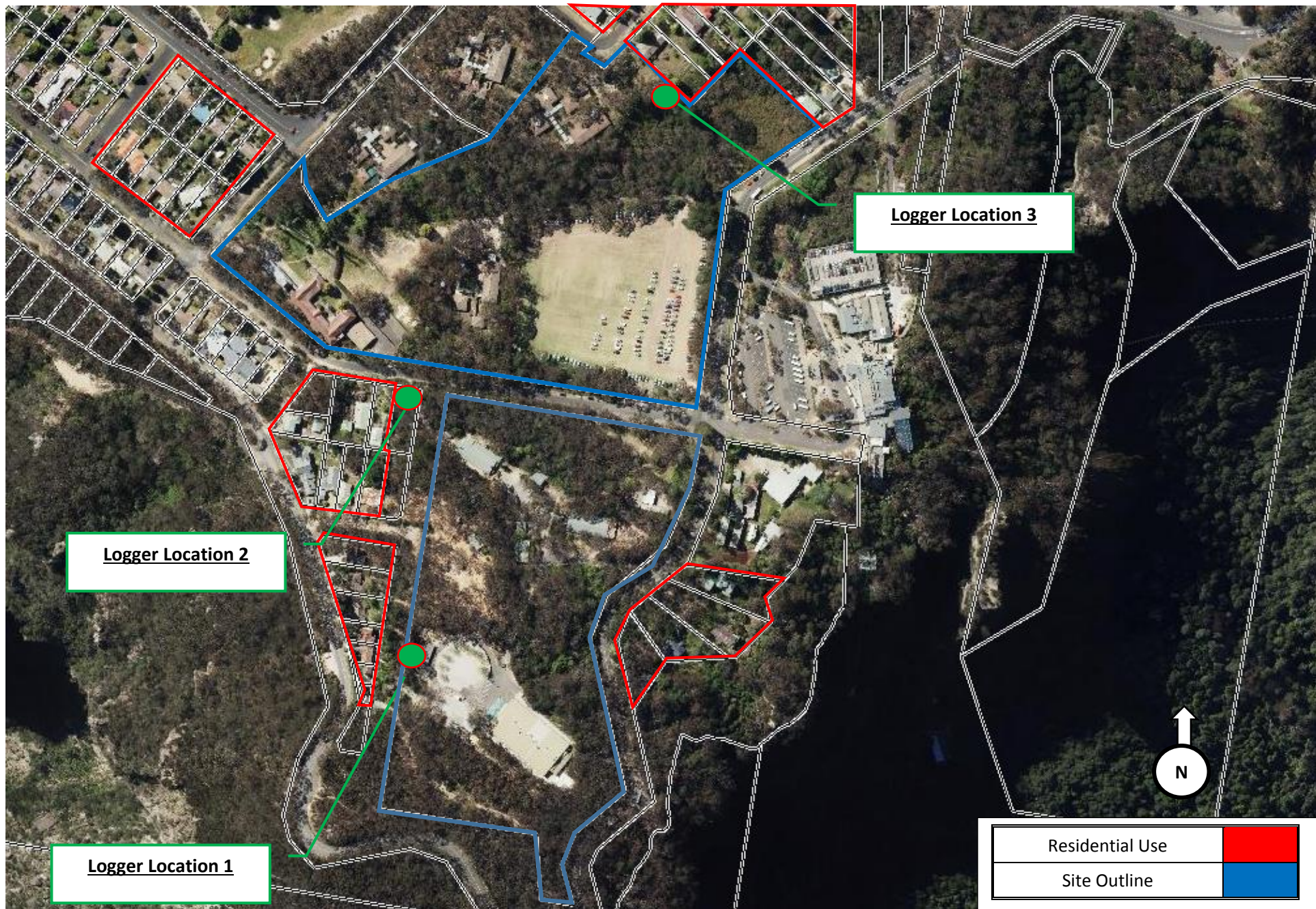


Figure 1: Site Survey and Monitoring Positions

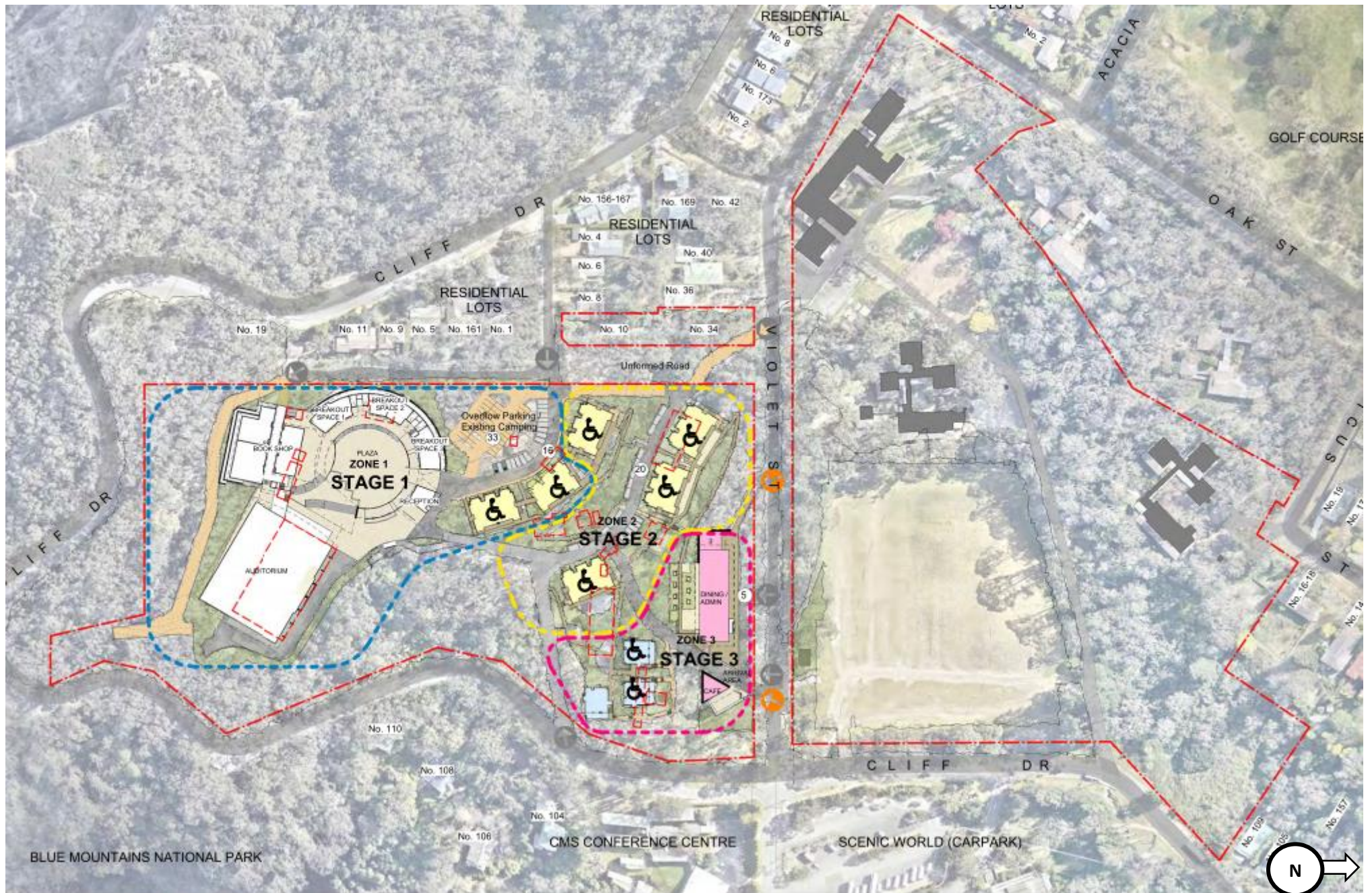


Figure 2: Proposed Masterplan

3 EXISTING ACOUSTIC ENVIRONMENT

The existing acoustic environment is categorised by low background noise levels associated with the national park.

Noise monitoring was conducted at the site to establish typical background and ambient noise levels associated with the surrounding uses.

3.1 ENVIRONMENTAL NOISE DESCRIPTORS

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

To accurately determine the environmental noise a 15-20 minute measurement interval is utilised. Over this period, noise levels are monitored on a continuous basis and statistical and integrating techniques are used to determine noise description parameters.

In analysing environmental noise, three-principle measurement parameters are used, namely L_{10} , L_{90} and L_{eq} .

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

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

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

The L_{eq} parameter represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the 15 minute period. L_{eq} is important in the assessment of environmental noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of environmental noise.

3.2 NOISE MONITORING

A series of unattended noise measurements were conducted at the site to establish the existing ambient noise environment.

3.2.1 Measurement Equipment

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

3.2.2 Measurement Period

Noise monitoring was conducted between 13 April to 27 April, 2017.

3.2.3 Measurement Locations

Unattended noise monitoring was conducted at the site as indicated in Figure 1.

3.3 UNATTENDED NOISE MONITORING RESULTS

Noise levels established from the unattended noise monitoring period are presented below. These have been determined in accordance with the guidelines contained in the INP.

Table 1 – Measured Ambient Noise Levels

Logger Location	Background Noise Level, dB(A) L ₉₀			Average Noise Energy, L _{eq} dB(A)		
	Day	Evening	Night	Day	Evening	Night
1	30	28	22	52	43	37
2	34	32	27	48	42	38
3	37	32	30	50	42	36

4 NOISE EMISSION CRITERIA

Criteria to govern noise emissions generated from the various noise sources as part of the site are summarised in the Table below.

Table 2 – Summary of Noise Emission Regulations and Authorities

Noise Sources	Noise Regulation / Authority
Noise in General	Blue Mountains City Council DCP EPA Industrial Noise Policy

4.1 BLUE MOUNTAINS CITY COUNCIL DCP 2015

The Blue Mountains DCP does not provide specific guidance for noise emissions from places of worship. In the absence of this, noise emission objectives have been adopted from the EPA Industrial Noise Policy.

4.2 EPA - INDUSTRIAL NOISE POLICY

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

Intrusiveness Criterion

The guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the L_{eq} descriptor not exceed the background noise level by more than 5 dB(A).

As per Section 3.1.2 of the INP, where background noise levels are found to be less than 30dB(A), then the rating background noise level is set to 30dB(A).

Table 3 – INP Intrusiveness Criteria

Location	Time of day	Background Noise Level dB(A) L_{90}	Intrusiveness Criteria (Background+5dB(A)) dB(A) L_{eq}
Cliff Street Residences	Day	30	35
	Evening	30	35
	Night	30	35

Amenity Criterion

The guideline is intended to limit the absolute noise level from all noise sources to a level that is consistent with the general environment. The Industrial Noise Policy sets out acceptable noise levels

for various land uses. Table 2.1 on Page 16 of the policy has four categories to distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface.

Pursuant to Section 2.2.1 of the INP, 'Suburban' and 'Urban' are defined as areas which have acoustical environments which incorporate the following characteristics.

Urban - an area with an acoustical environment that:

- Is dominated by 'urban hum' or industrial source noise
- Has through traffic characteristically heavy and continuous traffic flows during peak periods
- Is near commercial districts or industrial districts
- Has any combination of the above,

Where 'urban hum' means the aggregate sound of many unidentifiable, mostly traffic-related sound sources.

Suburban - An area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristics:

- Decreasing noise levels in the evening period (1800-2200); and/or
- Evening ambient noise levels defined by the natural environment and infrequent human activity.

Rural – An area with an acoustical environment that is dominated by natural sounds, having little or no road traffic. Such areas may include:

- An agricultural area, except those used for intensive agricultural activities
- A rural recreational area such as resort areas
- A wilderness area or national park
- An area generally characterised by low background noise levels (except in the immediate vicinity of industrial noise sources).

ALC would determine the site generally suburban given:

- The area is generally defined by the natural environment; and
- There are decreasing noise levels in the evening period.

The corresponding Amenity Criteria noise emission goals are presented below.

Table 4 – INP Amenity Acceptable Noise Levels

Type of Receiver	Indicative Noise Amenity Area	Time of day	Recommended Acceptable Noise Level dB(A) L_{eq}
Residence	Suburban	Day	55
		Evening	45
		Night	40
Commercial premises	All	When in use	65
Active recreation area	All	When in use	55

5 ASSESSMENT OF NOISE IMPACTS

Noise emissions from the site have been addressed for the following noise sources:

- Noise breakout from amplified speech and music within the auditorium
- Mechanical plant in principle.

5.1 AUDITORIUM NOISE

The auditorium will be utilised for religious conventions which may entail amplified speech and music. Given proximity to surrounding residential dwellings and the low background noise levels in the area, acoustic treatment to the auditorium is required to ensure compliance with noise emission objectives.

The operation of the convention centre has been assessed under two modes, namely:

- Naturally ventilated mode with façade openings to the South. Activities within the convention centre are restricted with the façade open.
- Fully enclosed mode for loud amplified music events.

The following source noise levels have been assumed for each mode of operation.

5.1.1 Naturally Ventilated Mode

Noise emissions during this mode have been predicted based on the following assumptions:

- 120m² of the Southern façade may be open at low level. Refer to Figure 3. All other façades and openings (i.e. doors and windows) are to be closed.
- Acoustic treatments to the roof and façade as per Section 6.1.

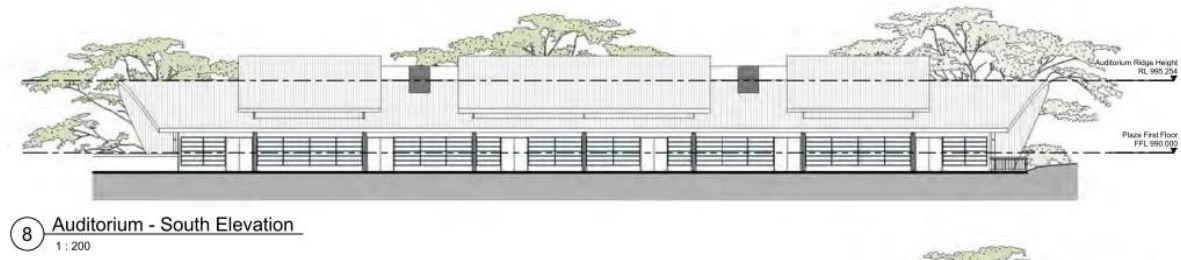


Figure 3: Ventilation Openings

- Internal sound pressure level is not to exceed 90dB(A) L_{eq} 15min
- Internal sound pressure level is based on the following normalised spectrum.

63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
0	4	-4	1	-6	-12	-15	-21

5.1.2 Fully Enclosed Mode

Noise emissions during this mode have been predicted based on the following assumptions:

- All façade openings are to be closed.
- Acoustic treatments to the roof and façade as per Section 6.1.
- Internal sound pressure level is not to exceed 95dB(A) L_{eq} 15min
- Internal sound pressure level is based on the following normalised spectrum.

63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
0	4	-4	1	-6	-12	-15	-21

5.1.3 Predicted Noise Levels

Noise predictions from internal operations within the convention centre are provided in the following Table.

Table 5 – Predicted Noise Levels

Operation	Internal Sound Pressure Level, dB(A) L_{eq} 15min	Receiver Location	Predicted Noise Level, dB(A) L_{eq} 15min	Noise Criteria, dB(A) L_{eq} 15min
Ventilation Openings	90	11 Cliff Street	34	35
		9 Cliff Street	33	35
		5 Cliff Street	34	35
		110 Cliff Drive	32	35
Closed Façade	95	11 Cliff Street	34	35
		9 Cliff Street	32	35
		5 Cliff Street	31	35
		110 Cliff Drive	31	35

5.2 OUTDOOR PLAZA

The existing outdoor plaza is currently used for the informal congregation of patrons outside of the auditorium. There is no proposed change to the use of this area.

It is noted that the incorporation of breakout facilities surrounding the plaza will provide some additional acoustic benefit to surrounding receivers.

5.3 NOISE FROM MECHANICAL PLANT

Detailed acoustic design of mechanical plant cannot be undertaken at approval stage as plant selections and locations are not finalised. However, the following is provided in principle to address noise impacts from plant equipment.

5.3.1 Convention Centre Fans

Ventilation fans are expected to be incorporated to the convention centre. Discharge attenuators or internally lined duct work may be required to ensure compliance with the noise emission requirements. Mechanical air reticulation paths should also consider noise breakout from amplified music and speech within the centre.

5.3.2 Air-conditioning Condensers

Air-conditioning condenser locations should be selected such that building structures screen the plant from surrounding receivers.

5.3.3 Compliance with Noise Emission Criteria

Compliance with INP acoustic criteria as set out in Section 4.2 will be achievable provided that detailed acoustic review of plant items is undertaken once plant is selected and acoustic treatments and design principles outlined above are adopted.

6 RECOMMENDATIONS

6.1 ACOUSTIC TREATMENTS

The following acoustic treatments are recommended to ensure compliance with noise emission objectives.

6.1.1 Convention Centre

- All glazing to be 10mm float or toughened with a minimum installed R_w /STC 33.
- External walls to be constructed from tilt concrete panel. Light weight infills are to be acoustically treated to maintain the acoustic integrity of the façade system.
- The recommended roof/ceiling construction is shown in Figure 2 below. Penetrations in all ceilings (such as for light fittings etc.) must be acoustically treated and sealed gap free with a flexible sealant.
- All penetrations in the acoustic ceiling are to be acoustically treated to maintain the acoustic integrity of the ceiling construction. This includes (but limited to) light fittings, sprinkler heads, supply and return air grilles.

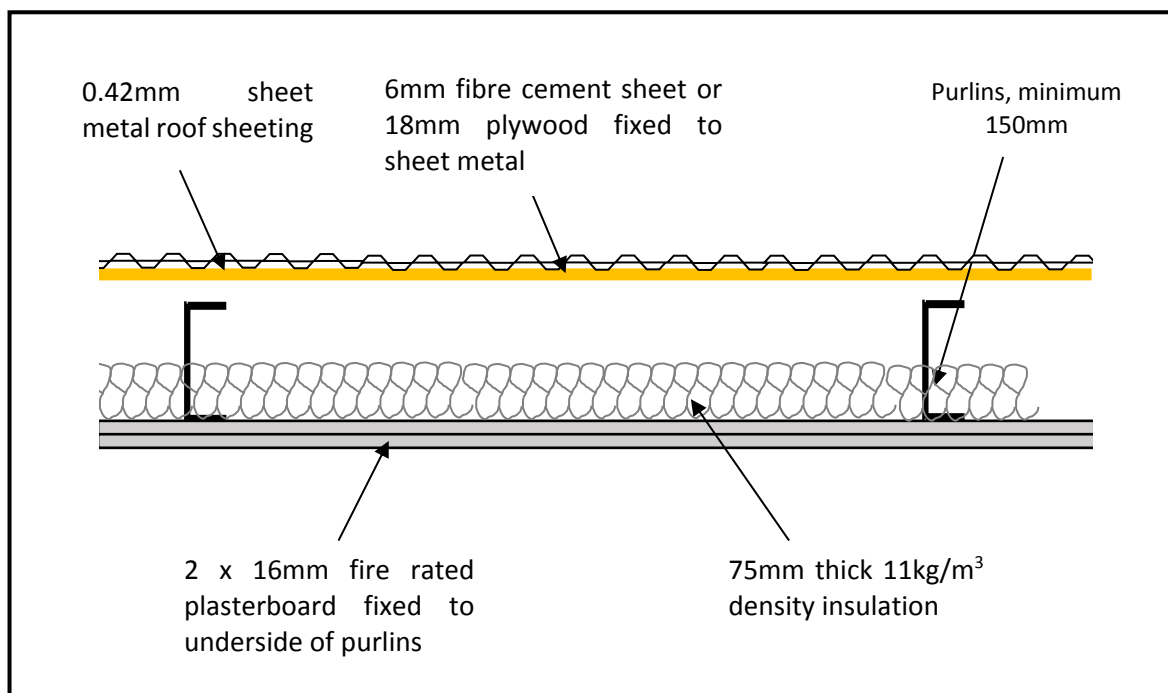


Figure 4: Roof / Ceiling Construction

6.2 MANAGEMENT CONDITIONS

The following management conditions are recommended.

- Internal noise levels should not exceed the following.

Table 6 – Maximum Internal Noise Levels

Scenario	Maximum Internal Noise Level
120m ² open on the Southern facade	90dB(A) L _{eq}
Closed façade	95dB(A) L _{eq}

- Consideration should be given to the noise spectrum allowance to ensure noise breakout complies with recommended noise emission criteria. Refer to the assessment spectrum in Section 5.1.2.
- All doors and openings are to be closed as per the operational assumptions of this report.
- The operation of the convention centre is not recommended after 10pm in the evening.
- No amplified equipment is to be utilised in the outdoor plaza.

7 CONCLUSION

This report presents the assessment of the proposed redevelopment of the Katoomba Christian Convention project. Noise emissions have been addressed in accordance with the recommendations of the EPA Industrial Noise Policy.

ALC conclude:

- Noise emissions from the operation of the convention centre will comply with the project noise emission requirements on the proviso that the recommended acoustic treatment and management controls of this report are adopted.
- The formalisation of the existing outdoor plaza is not expected to result in an increase of noise levels on the assumption that the operation of this area remains the same. The implementation of the breakout space structures will provide some acoustic benefit to the residential dwellings to the West of the site.
- Detailed acoustic review of mechanical plant will be undertaken once the design is further progressed (plant selections finalised etc.). Notwithstanding, the in-principle review indicates that noise emissions are capable of complying with EPA Industrial Noise Policy and Council requirements with appropriate equipment selections and acoustic treatments.

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

Yours faithfully,

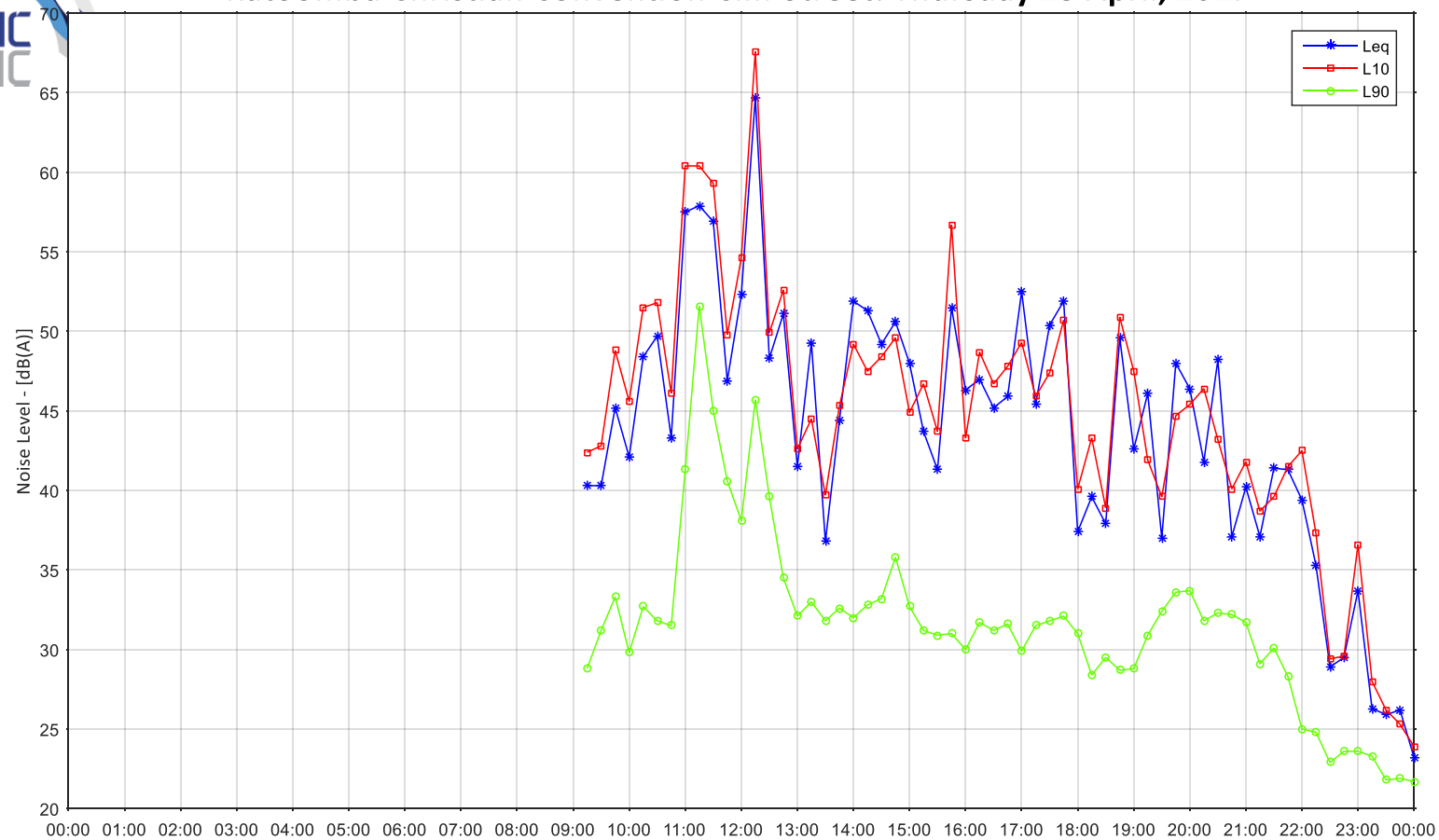


James Small
Acoustic Logic Consultancy

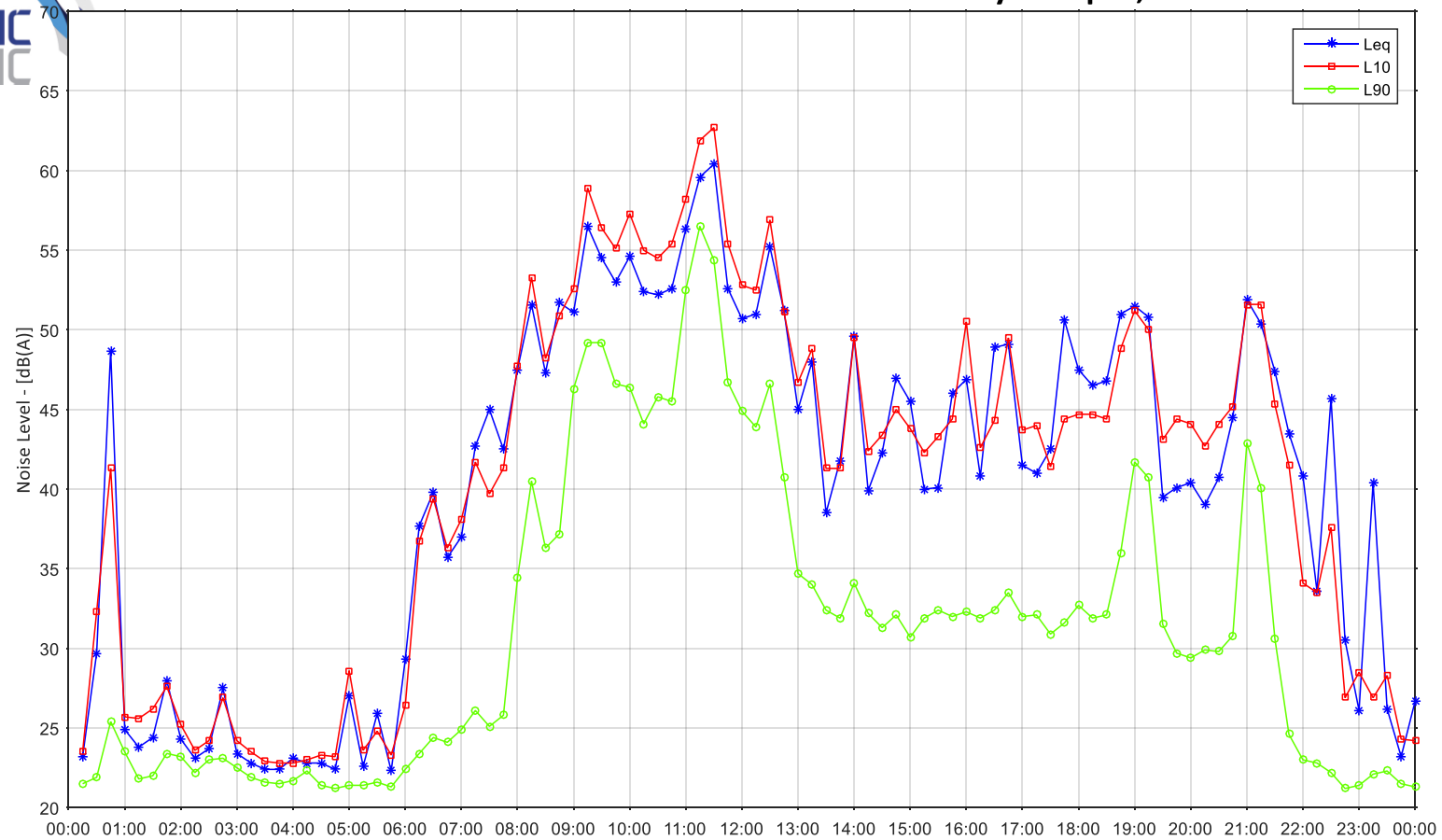
APPENDIX ONE – NOISE MONITORING DATA

Note: Noise monitoring data for Cliff Street residences (noise monitor location 1) is presented being the quietest of monitoring positions. Additional noise monitoring data for other locations available on request.

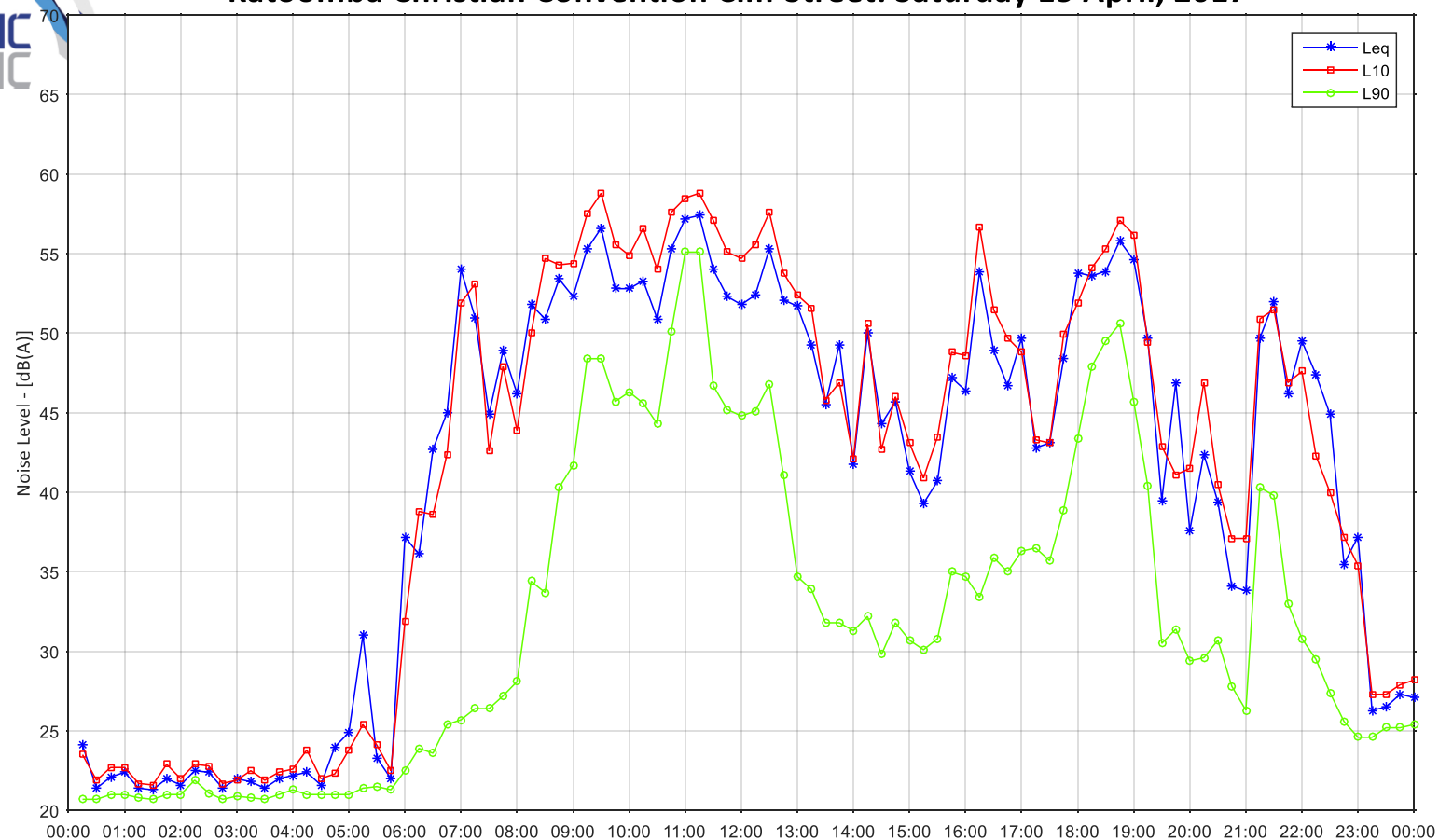
Katoomba Christian Convention Cliff Street: Thursday 13 April, 2017



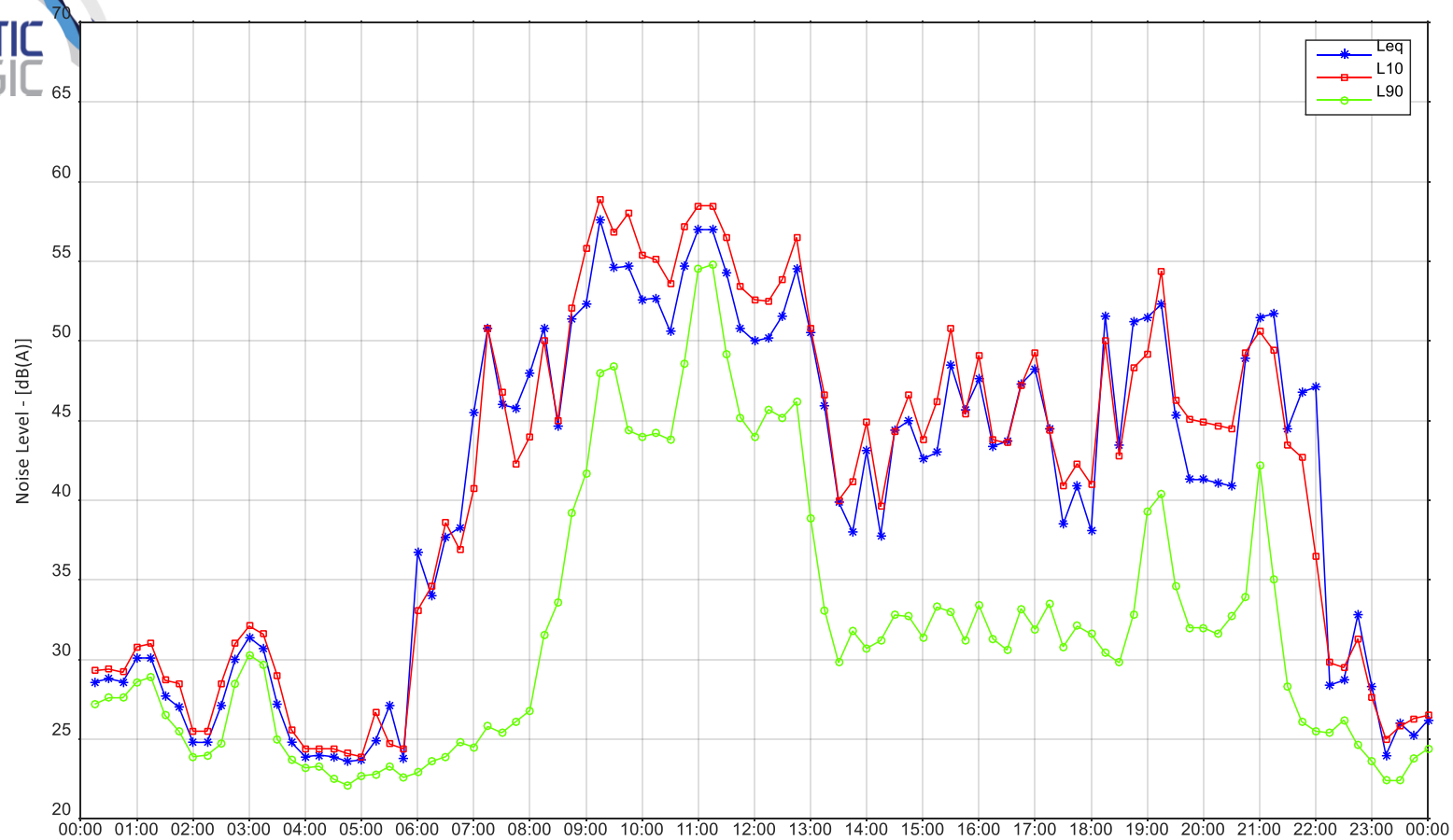
Katoomba Christian Convention Cliff Street: Friday 14 April, 2017



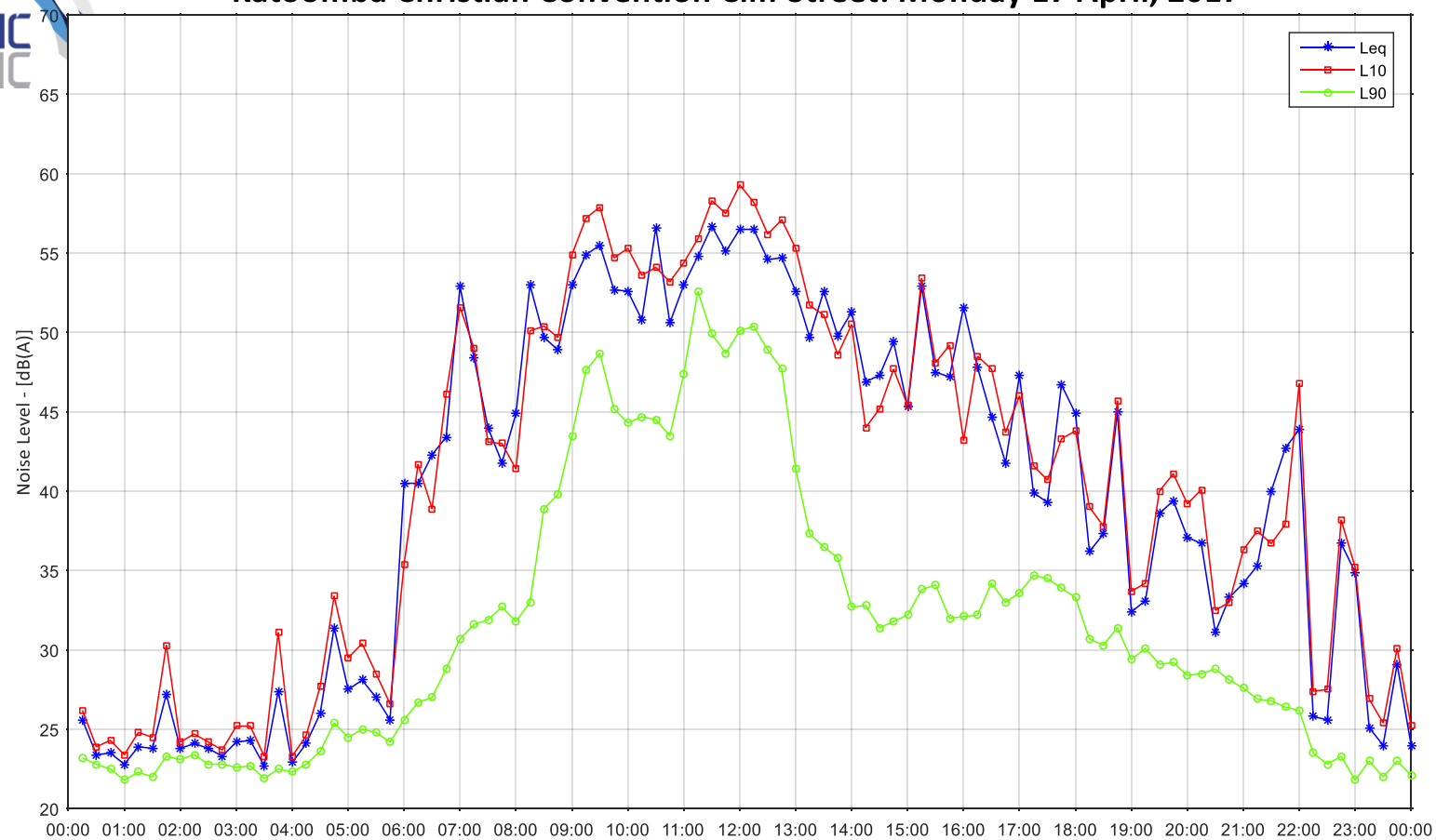
Katoomba Christian Convention Cliff Street: Saturday 15 April, 2017



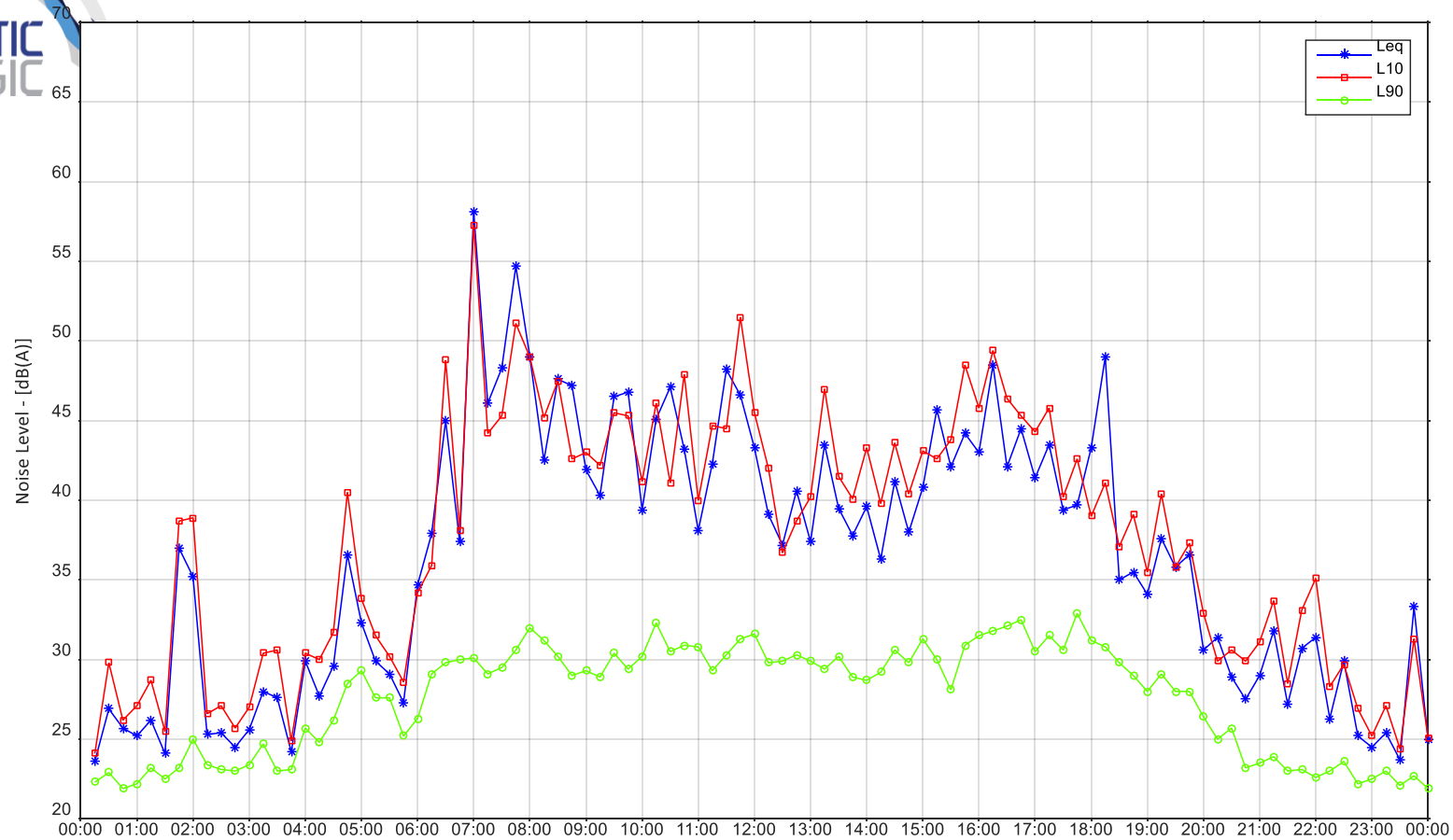
Katoomba Christian Convention Cliff Street: Sunday 16 April, 2017



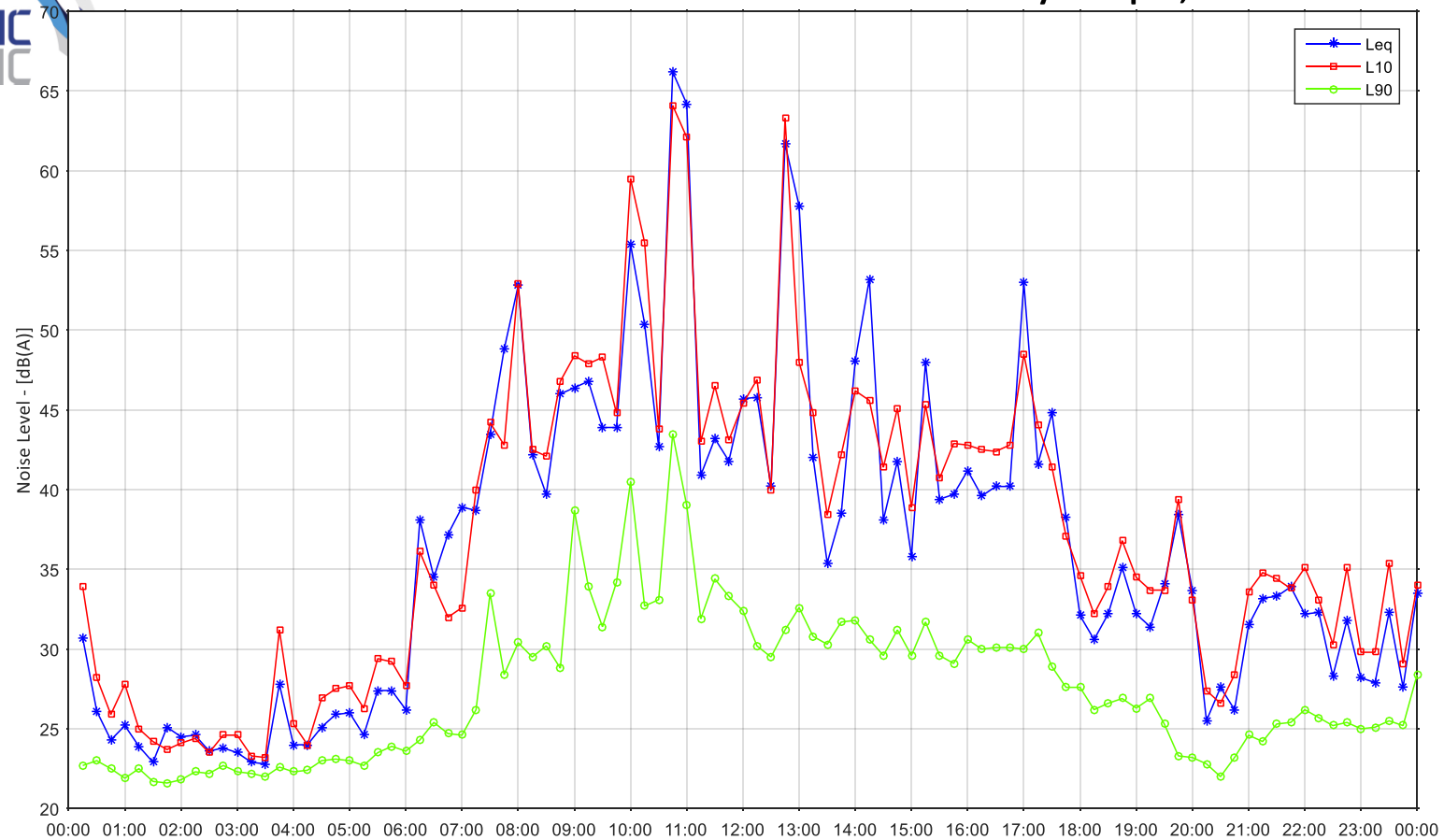
Katoomba Christian Convention Cliff Street: Monday 17 April, 2017



Katoomba Christian Convention Cliff Street: Tuesday 18 April, 2017



Katoomba Christian Convention Cliff Street: Wednesday 19 April, 2017



Katoomba Christian Convention Cliff Street: Thursday 20 April, 2017

