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Nepean Green, Penrith Development

Revised Concept Plan Noise Impact Assessment

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1 INTRODUCTION

Acoustic Logic Consultancy Pty Ltd has been engaged to conduct an acoustic assessment for the purpose of assessing the potential impacts on the acoustic amenity of the proposed Master plan for the Nepean Green development located at 164 Station Street, Penrith for both external and internal noise sources as part of the Planning Application submission. The noise sources investigated are as follows:

- Environmental noise impact on the future site, including surrounding traffic noise from surrounding roadways.
- Noise emissions associated with the neighbouring sports ground.
- Noise emissions associated with traffic generated from the site.
- Noise emissions from the site including mechanical plant noise to surrounding receivers.

Environmental noise will be covered first as it will potentially impact the future development. Unattended and attended noise monitoring was conducted in order to determine the existing traffic noise levels around the perimeter of the site.

The final part of the report will address noise generated from the development to surrounding properties. Detailed design of the mechanical plant will be provided as part of the CC submission for each stage of the project. This study will set the goal assessment criteria applicable to the project based on the Environmental Protection Authority (EPA) requirements, other council and relevant statutory/regulatory requirements.

1.1 SITE DESCRIPTION

Figure 1 below illustrates the location of the proposed Nepean Green development site, Penrith and the location of noise monitoring and measurements.

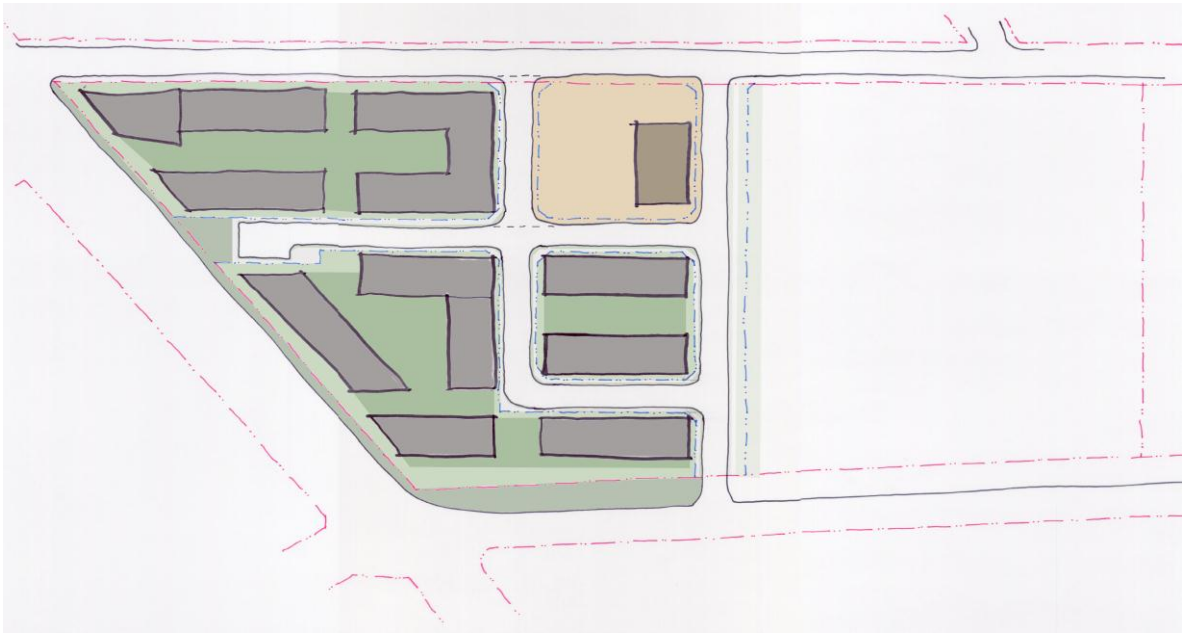


Figure 1 – Site Location

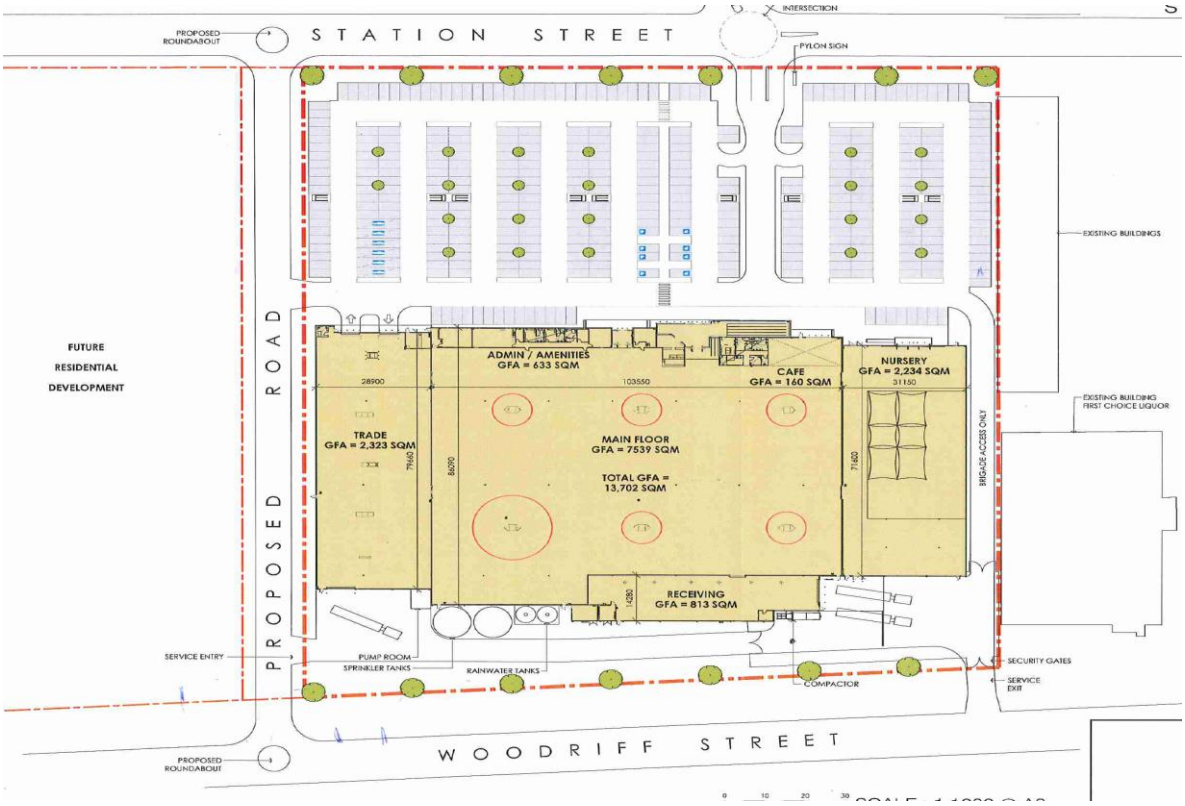


Figure 2 – Proposed Site Plan for Masters Developemnt

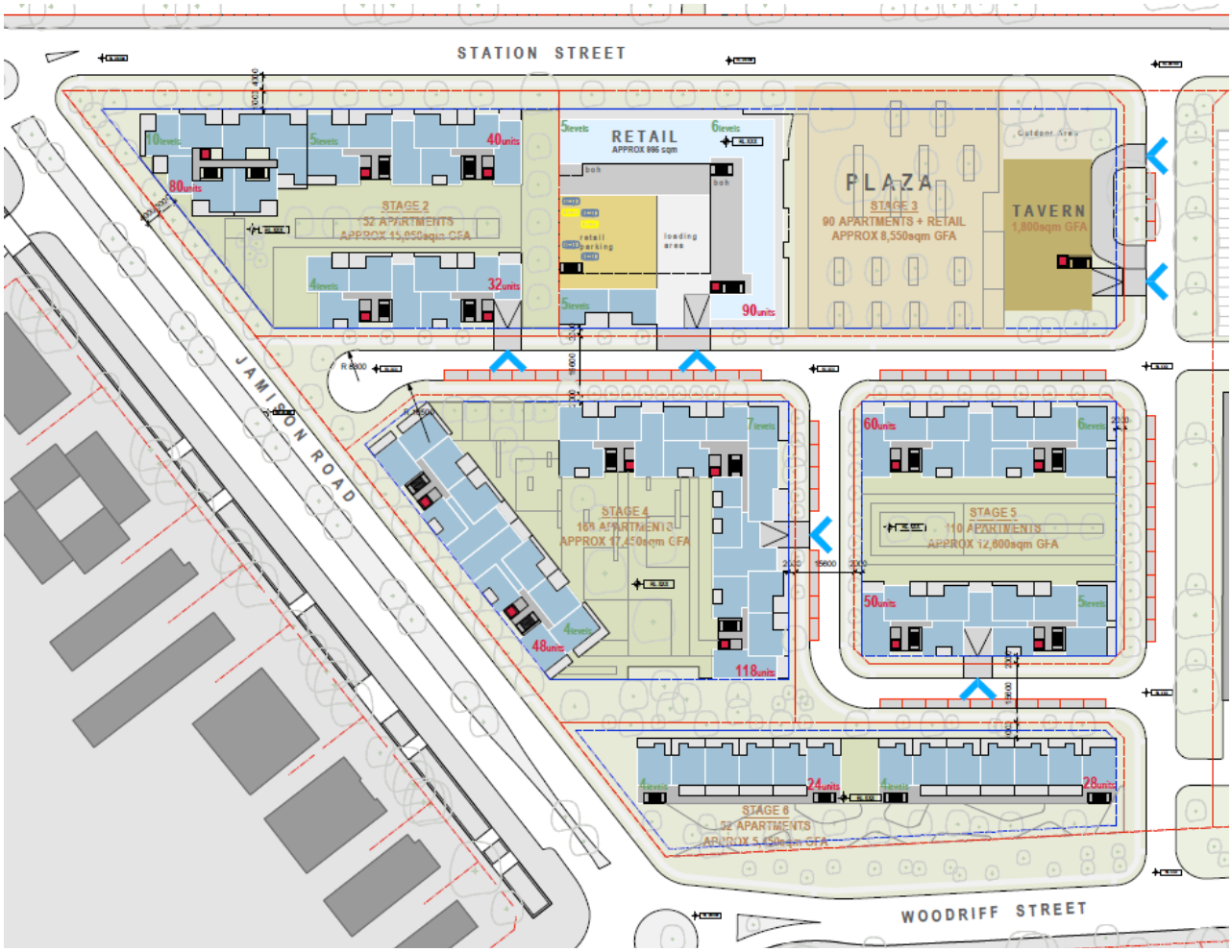


Figure 3- Propsoed Residential Development Layout

Figure 3 – Site Location and Measurement Positions

The existing environmental noise sources affecting the site are as follows:

- The development is affected by environmental noise predominantly from traffic noise from Jamison Road to the south of the site which carries high volumes of traffic.
- Penrith Stadium sporting ground to the west of the site. Games are typically conducted on sporting field every second weekend during the winter seasons of approximately March to September.
- Other surrounding boundaries are neighboured by existing retail commercial including Centro Nepean to the north which includes a tenpin bowling centre.

The environmental noise source outlined above has varying degrees of impact upon the proposed development which will be outlined in this report.

2 EXISTING ACOUSTIC ENVIRONMENT

Environmental noise impacting the site is a result of traffic noise from the surrounding perimeter roadways and other surrounding land uses including the Centro Nepean and Penrith Stadium.

2.1 TOPOGRAPHY

The topography of the site and surrounding land of the proposed development is generally flat, the acoustic assessment has taken this topography into account.

3 ACOUSTIC SURVEY

As part of this assessment an acoustic survey of the proposed Nepean Green development site has been conducted.

The acoustic survey included attended and unattended noise logging which is detailed in this section of the report.

3.1 ENVIRONMENTAL NOISE LEVELS

Environmental noise constantly varies in level, due to fluctuations in local noise sources including road traffic. Accordingly, a 15 minute measurement interval is normally 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 the case of environmental noise three principle measurement parameters are used, namely L_{10}, L_{90} and L_{eq}.

The L_{10} and L_{90} measurement parameters are statistical levels that represent the average maximum and average minimum noise levels respectively, over the measurement 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 depends on how audible it is above the pre-existing noise environment, particularly during quiet periods, as represented by the L_{90} level.

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

3.2 ATTENDED NOISE MEASUREMENTS

Attended noise level measurements conducted as part of this assessment are detailed in this section of the report.

3.2.1 Measurement Equipment

Attended noise measurements were obtained using a CEL-593 Type 1 Sound Level Analyser, set to A-weighted fast response. The sound level meter was calibrated before and after the measurements using a RION NC-73 Sound Level Calibrator. No significant drift was recorded.

3.2.2 Measurement Period

Noise monitoring was conducted at the locations detailed in Figure 1 in Section 2 above during the following period:

1. Peak afternoon conditions between 4.30pm and 6pm on the 15th of June, 2012.

2. Additional attended measurements were conducted on the evening of the 23rd June, 2012 during a period when a Panthers home game was being conducted.

3. Attended measurements were conducted on the evening of the 23rd June, 2012 during a period when the Centro Nepean facility to the north of the site was in operation, including the tenpin bowling centre and carpark.

3.3 UNATTENDED NOISE MONITORING

Unattended noise monitoring conducted as part of this assessment is detailed in this section of the report. The results of unattended noise logging are included in Appendix A.

3.3.1 Unattended Monitoring Period

Unattended noise monitoring was conducted at the site during the period of 15th to 25th June 2012 in order to measure the existing background and environmental noise levels at the site.

The noise level monitors were located at the following locations:

1. Location 1 – To the south west of the site facing Station Street. This logger will be used for traffic noise levels and background noise levels at the site.

3.3.2 Monitoring Equipment

Unattended noise measurements were obtained using an Acoustic Research Laboratories Pty Ltd noise logger. The logger was programmed to store 15-minute statistical noise levels throughout the monitoring period. The noise monitors were calibrated at the beginning and the end of the measurement using a Rion NC-73 calibrator. No significant drift was detected. All measurements were taken on A-weighted fast response mode. Periods of adverse weather conditions during the during the measurement period have not be used in this assessment.

3.4 RESULTS OF THE ACOUSTIC SURVEY

An acoustic survey was undertaken at the proposed Nepean Green development site in order to determine the existing acoustic environment. The unattended monitor results will be used to determine the variation between day, evening and night time noise levels. Attended measurements will be compared with the unattended monitoring data during the same measurement period so that relative differences between the attended and unattended locations can be formed thereby providing a comprehensive study of existing noise levels around the proposed site.

3.4.1 Existing Background Noise Levels

Background noise levels during day time are dominated by general vehicular traffic movements. The NSW Environmental Protection Authority (EPA) Industrial Noise Policy (INP) details specific steps in determining the background noise level for assessment of the day, evening and night time periods. Table 1 summarises the background determined at the monitoring location, based on the guidelines set out in the INP and the results of unattended noise monitoring.

Table 1 – Measured Ambient Noise Levels

Location	Description	Day Noise Level 7am to 6pm (dB(A))	Evening Noise Level 6pm to 10pm (dB(A))	Night Noise Level 10pm to 7am (dB(A))
Location 1 – Noise Monitoring Location	Background $L_{90,15min}$	44	42	34

In addition to the background levels obtained at the unattended monitoring position presented above, attended noise monitoring was conducted at 2 locations around the perimeter of the subject site as detailed in Figure 1 of Section 1 above. The results of the attended noise measurements are presented in Table 2 below.

Table 2 – Measured Attended Environmental Noise Levels

Location	Time Period	Measured Noise level dB(A) $L_{eq\ (15\ min)}$
Location 1 – Station Street	Peak Afternoon Period 3.30pm to 6pm	67
Location 2 – Jamison Road	Peak Afternoon Period 3.30pm to 6pm	64
Location 3 – Stadium Noise level measurement location	7.45pm-8.30pm During game time	69
Location 4 – Boundary to the Centro Nepean	During operation between 8.00pm-9.00pm	68

4 NOISE EMISSION LIMITS – NOISE GENERATED ON THE SITE

The NSW Environmental Protection Authority (EPA) Industrial Noise Policy (INP) provides guidelines for assessing noise impacts from development sites. The recommended assessment objectives vary depending on the potentially affected receivers, the time of day, and the type of noise source. The EPA's Industrial Noise Policy has two requirements which both have to be complied with, namely an amenity criterion and an intrusiveness criterion. In addition, the EPA in its Environmental Noise Control Manual states that noise controls should be applied with the general intent to protect residences from sleep arousal.

For land use developments with the potential to create additional traffic on local roads the development should comply with the requirements detailed in the Environmental Criteria for Road Traffic Noise (ECRTN).

4.1 EPA INTRUSIVENESS CRITERION

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

4.2 EPA AMENITY CRITERION

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

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

Table 5 of the INP provides the recommended ambient noise levels for the suburban residential receivers for the day, evening and night periods. For the purposes of this condition:

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

Table 3 – EPA Recommended Amenity Noise Levels

Type of Receiver	Time of day	Recommended Acceptable Noise Level dB(A) L_{eq}
Residential	Day	55
	Evening	45
	Night	40

4.3 SLEEP AROUSAL

To minimise the potential for sleep arousal the $L_{1\ (1\ minute)}$ noise level of any specific noise source does not exceed the background noise level (L_{90}) by more than 15 dB(A) outside a resident's bedroom window between the hours of 10pm and 7am. The L_1 noise level is the level exceeded for 1 per cent of the time and approximates the typical maximum noise level from a particular source. Where the typical repeatable existing L_1 levels exceed the above requirement then the existing L_1 levels form the basis for, sleep disturbance criteria.

4.4 SUMMARY OF ASSESSMENT CRITERIA FOR PROPOSED SITE

The EPA's INP intrusiveness, amenity and sleep arousal criteria for this project have been determined using these guidelines and the noise monitoring results. These are summarised below. We note that the formulation of the assessment criteria has been based on the lowest ambient levels determined from all monitoring data.

4.4.1 Day Time Period

The following table sets out the measured L_{eq} amenity and L_{90} background noise levels, and the assessment criteria based on the suburban criteria. The day period applies between 7am and 6pm Monday to Saturday; and 8am to 6pm Sundays and public holidays.

Table 4 – Measured L_{eq} & L_{90} Noise Levels and Criteria - Daytime

Location	Measured L_{eq} Noise Level dB(A)	Measured L_{90} Noise Level dB(A)	Amenity Criterion dB(A) L_{eq}	Intrusiveness Criterion dB(A) L_{eq}
Surrounding Residential Receivers	48	44	55	49

4.4.2 Evening Period

The following table sets out the measured L_{Aeq} and L_{90} background noise levels, and the assessment criteria based on the suburban criteria. The evening period applies between 6pm and 10pm.

Table 5 –Measured L_{eq} & L_{90} Noise Levels and Criteria - Evening Period

Location	Measured L_{eq} Noise Level dB(A)	Measured L_{90} Noise Level dB(A)	Amenity Criterion dB(A) L_{eq}	Intrusiveness Criterion dB(A) L_{eq}
Surrounding Residential Receivers	45	42	45	47

4.4.3 Night Time Period

The night period (that is, between 10pm and 7am) is the period where noise emissions can have the most significant effect on residential amenity. In addition to the quasi-steady state criteria the L_1 noise emission level should not exceed the background noise level by more than 15 dB(A) to prevent sleep arousal from intermittent events. The night time period applies between 10pm and 7am.

Table 6 –Measured L_{eq} & L_{90} Noise Levels and Criteria - Night Time Period

Location	Measured L_{eq} Noise Level dB(A)	Measured L_{90} Noise Level dB(A)	Amenity Criterion dB(A) L_{eq}	Intrusiveness Criterion dB(A) L_{eq}	Night time Sleep Disturbance dB(A) $L_{1\ (1\ Min)}$
Surrounding Residential Receivers	40	34	40	39	49

4.5 RESULTING NOISE LEVEL CRITERIA

The criteria for the various monitoring locations have been considered and assessed for the surrounding receivers. Table 7 below details the noise level criterion for properties surrounding the proposed development. In all cases, if a discrepancy in attended and unattended noise levels were obtained at two nearby locations within a residential grouping the more conservative noise level criterion has been adopted.

Table 7 – Noise Objectives for Surrounding Receivers

Location	Day time Noise Objective dB(A) L_{eq}	Evening Noise Objective dB(A) L_{eq}	Night time Noise Objective dB(A) L_{eq}	Noise Objective for Intermittent Activities dB(A) $L_{1\ (1\ Min)}$ (Background + 15 dB(A))
Surrounding Residential Receivers*	53	45	40	55

*Note: Noise level criteria above includes noise levels impacting the future residential receivers proposed within the Nepean Green development as result of the operation of the proposed facilities within the development.

Noise level criteria are to be applied to commercial traffic levels generated from vehicle movements on the site only, as presented by the Industrial Noise Policy. Noise levels generated from the movement of vehicles entering and exiting the site on ramps are generally required to comply with levels presented in the presented tables for surrounding receivers.

4.6 ASSESSMENT CRITERIA – ADDITIONAL TRAFFIC GENERATION

For land use developments with the potential to create additional traffic on local roads the development should comply with the requirements detailed in the EPA ECRTN. Criteria applicable to the development are detailed below. If existing noise levels exceed those in Table 8 a 2 dB increase in noise is allowed.

The proposed development includes the use of a carpark located to the north west of the site and future roadways within the development site which will be assessed against the criteria detailed in the table below.

Table 8 - Criteria for Traffic Noise for New Developments

Time of day	Criteria for Acceptable Traffic Noise Level dB(A)
Day (7am to 10pm)	60 $L_{Aeq(1hr)}$ – Collector Road 55 $L_{Aeq(1hr)}$ – Local Road
Night (10pm to 7am)	55 $L_{Aeq(1hr)}$ – Collector Road 50 $L_{Aeq(1hr)}$ – Local Road

Attended and unattended traffic noise levels measurements were conducted at a number of locations surrounding the development including locations as detailed in the table below. The resulting noise levels have been used to generate the resulting noise level criterion for additional traffic movements which been used in this assessment.

Table 9 - Criteria for Traffic Generation

Location	Criteria for Acceptable Traffic Noise Level dB(A) $L_{eq\ (1hr)}$	
	Day (7am to 10pm)	Night (10pm to 7am)
Jamison Road	68	63
Woodriff Street	65	61

Note: Noise levels calculated to potentially worst affected residential facades from results of on site testing.

5 ADDITIONAL TRAFFIC NOISE GENERATION ASSESSMENT

The proposed development includes carpark spaces as follows:

- Stage 2 basement – 163 car parking spaces, access via Station Street
- Stage 3 Basement – 97 residential Car parking spaces and 83 commercial/retail car spaces, access via Station Street
- Stage 4 Basement – 178 Car parking spaces, access via Station and Woodriff Streets
- Stage 5 Basement – 118 Car parking spaces, access via Station and Woodriff Streets
- Stage 6 Basement – 56 Car parking spaces, access via Woodriff Street
- Total number of carparking space on the site is 695.

Potential noise impacts from traffic movements generated by the development on public roads have been assessed for residents surrounding the site and future tenancies within the development, including the potential for noise impact generated from the proposed additional roadways on the perimeter of the site. The assessment is based on the maximum traffic flow periods using FHWA and CORTN traffic noise prediction models and noise level measurements conducted at the site and presented in this report.

5.1 ADDITIONAL TRAFFIC NOISE ON LOCAL STREETS

Traffic noise generated by the proposed development was assessed using current and predicted traffic numbers based on the additional traffic numbers previously provided within the Colston Budd Hunt & Kafes, Traffic and Accessibility impact Study for proposed Nepean Green Development report. The predicted additional traffic numbers are detailed in the table below as reported in the Traffic and Accessibility impact Study for proposed Nepean Green Development report and have been used as the basis of this assessment.

Table 3.1: Existing two-way peak hour traffic flows plus development traffic

Road	Location	Weekday PM		Saturday midday	
		Existing	Plus development	Existing	Plus development
Mulgoa Road	North of Jamison Road	2,855	+40	2,955	+100
	South of Jamison Road	3,215	+100	3,135	+260
Jamison Road	West of Mulgoa Road	500	-	500	-
	East of Mulgoa Road	1,680	+100	1,580	+160
	East of Station Street	1,330	+20	1,505	+20
	East of Woodriff Street	1,245	+130	1,405	+260
Station Street	North of Jamison Road	910	+120	1,170	+180
	North of Ransley Street	1,250	+75	1,420	+140
	North of Derby Street	1,300	+75	1,370	+140
Woodriff Street	North of Jamison Road	1,005	+125	1,140	+250
	North of Derby Street	770	+25	755	+60
York Road	South of Jamison Road	1,460	+15	1,390	+10
Derby Street	East of Station Street	760	-	575	-
	East of Woodriff Street	770	-	675	-
Ransley Street	West of Station Street	375	+170	395	+360

Additionally the assessment has assumed upto 15 service vehicles which will be accessing the site from Woodriff Street into New Street 1 to enter the North Side of masters for deliveries and disposal to exit the premises from the north western corner onto Station Street on any given day. These additional movements have also been included in this assessment.

It is noted that currently there are only 6 service vehicles expected for the site and the assessment undertaken is conservative based on current expectations.

The predicted worst case noise increases on each of the streets surrounding the development are summarised in the following table.

The calculated potential noise from additional traffic movements from the site are displayed in the table below at the potentially worst affected residential receivers located on Woodriff Street to the west and Jamison Road to the south of the site.

Table 10 – Calculated Noise Associated with Traffic Generation

Roadway	Time Period	Current Traffic Noise Levels	Criteria for Acceptable Traffic Noise Level dB(A) $L_{eq\ (1hr)}$	Calculated Future Traffic Noise $L_{eq\ (1\ hr)}$	Compliance
Jamison Road to the south	Day (7am to 10pm)	66	68	Approximately 65.9 dB(A)	Yes
	Night (10pm to 7am)	61	63	Approximately 61 dB(A)	Yes
Woodriff Street to the west	Day (7am to 10pm)	63	65	Approximately 64.2 dB(A)	Yes
	Night (10pm to 7am)	59	61	Approximately 59.8 dB(A)	Yes

Note: All calculations were conducted using FHWA and CORTN traffic modelling.

The investigation into noise associated with additional traffic movements revealed that any increased traffic flows will cause either no noise increase to existing roadways or compliance with INP criteria for increased traffic volumes on surrounding roadways and would not adversely impact on the acoustic amenity of surrounding residential receivers.

6 INTERNAL ENVIRONMENTAL ACOUSTIC OBJECTIVES

6.1 INTERNAL ENVIRONMENTAL NOISE OBJECTIVES

As the development is located adjacent to surrounding roadways internal noise levels from traffic noise will be assessed in conjunction with recommended maximum noise levels within the Australian Standard AS2107:2000 'Acoustics - Recommended design sound levels and reverberation times for building interiors' for developments nears major roads. AS/NZS 2107:2000 nominates the L_{eq} descriptor as the noise descriptor. The L_{eq} descriptor is commonly used and recognised as the most appropriate descriptor to assess external noise intrusion as it more closely corresponds with human perception of a changing noise environment; such as character of traffic noise. Based on the above, the following criteria will be applied for external noise intrusion.

Table 11 – Internal Environmental Noise Assessment Criteria

LOCATION	Required Internal Noise Levels / Time of Day	
	Day Time dB(A) $L_{eq\ (1hr)}$ (7am – 10pm)	Night Time dB(A) $L_{eq\ (1hr)}$ (10pm – 7am)
Bedrooms	45	40
Living rooms	45	N/A

6.2 COMPLIANCE WITH INTERNAL NOISE LEVELS

Experience with similar projects indicates that compliance with internal noise level criteria detailed in this section of the report is both possible and practical. The external façade of the future development will be acoustically treated where necessary to ensure internal noise levels comply with specified noise levels.

Acoustic treatment will include the upgrading of glazing and other façade elements based on noise level measurements conducted at the site. Typically the required upgraded glazing for acoustics will include 6.38mm laminated or 10.38mm laminated glazing.

Masonry and other high mass elements of the façade will not require additional acoustic treatments. Light weight wall constructions will include acoustic insulation and the like to ensure internal noise level criteria are achieved.

6.3 INTERNAL SPORTS GROUND NOISE LEVELS

Internal noise levels within the future development as a result of sporting events conducted within Penrith Stadium to the west of the site will be assessed in conjunction within the recommended maximum noise levels within the Australian Standard AS2107:2000 'Acoustics - Recommended design sound levels and reverberation times for building interiors' for developments near minor roads. AS/NZS 2107:2000 nominates the L_{eq} descriptor as the noise descriptor. The L_{eq} descriptor is commonly used and recognised as the most appropriate descriptor to assess external noise intrusion as it more closely corresponds with human perception of a changing noise environment; such as character of traffic noise. Based on the above, the following criteria will be applied for external noise intrusion.

Table 12 – Internal Sports Ground Noise Assessment Criteria

LOCATION	Required Internal Noise Levels / Time of Day	
	Day Time dB(A) $L_{eq\ (1hr)}$ (7am – 10pm)	Night Time dB(A) $L_{eq\ (1hr)}$ (10pm – 7am)
Bedrooms	40	35
Living rooms	40	N/A

6.4 COMPLIANCE WITH INTERNAL NOISE LEVELS

Experience with similar projects indicates that compliance with internal noise level criteria detailed in this section of the report is both possible and practical. The external façade of the future development will be acoustically treated where necessary to ensure internal noise levels comply with specified noise levels.

Acoustic treatment will include the upgrading of glazing and other façade elements based on noise level measurements conducted at the site. Typically the required upgraded glazing for acoustics will include 6.38mm laminated or 10.38mm laminated glazing.

Masonry and other high mass elements of the façade will not require additional acoustic treatments. Light weight wall constructions will include acoustic insulation and the like to ensure internal noise level criteria are achieved.

6.5 TYPICAL EXTERNAL GLASS SELECTIONS

As part of this assessment an assessment of internal noise levels within future apartments has been conducted and typical façade constructions selected which would be required to comply with criteria detailed in this report for both environmental (traffic noise and noise from the Centro Nepean Centre) and sports ground noise levels.

The following constructions are typical constrictions only, details of window to be used will be provided as part of the Constriction Certificate.

Table 13 – Typical Glazing Requirements

Location	Room	Glazing Requirements	Acoustic Seals
Stage 2 and 4 Units facing south toward Jamison Road	Bedrooms	10.38mm laminated	Yes
	Living rooms	6.38mm laminated	Yes
Stage 3, 5 and 6 Units facing North	Bedrooms	6.38mm laminated	Yes
	Living rooms	6.38mm laminated	Yes
Stage 2 and 3 Units facing Station Street	Bedrooms	10.38mm laminated	Yes
	Living rooms	6.38mm laminated	Yes
Stage 4 and 6 Units facing Woodriff Street	Bedrooms	10.38mm laminated	Yes
	Living rooms	6.38mm laminated	Yes
All other facades	Bedrooms	6mm Float	Yes
	Living rooms	6mm Float	Yes

Thicker glazing may be required for structural, safety or other purposes. Where it is required to use thicker glazing than scheduled, this will also be acoustically acceptable. Glazing to all units not listed in the table may be 6mm thick, float or toughened glass for windows and doors.

In addition to complying with the minimum scheduled glazing thickness, the STC rating of the glazing fitted into openable frames and fixed into the building opening should not be lower than the values listed in Table 13 for all rooms.

Table 14 - Minimum STC of Glazing

Glazing Assembly	Acoustic Seals	Minimum STC of Installed Window
6mm Float	Yes	29
6.38mm laminated	Yes	30
10.38mm laminated	Yes	35

6.6 INTERIM GUIDELINES FOR DEVELOPMENT NEAR RAIL CORRIDORS

As the development is not located with 60m of a railway corridor no additional acoustic assessment of noise or vibration impact from train passbys is required.

7 MECHANICAL PLANT TREATMENTS

A detailed mechanical noise assessment will be conducted once plant selections and services drawings have been finalised as part of the construction documentation to ensure noise levels comply with the criteria detailed in this report. Details will be provided as part of the CC submission of the project.

Based on experience with similar development acoustic treatments are both possible and practical using acoustic treatments such as lining of ductwork, acoustic silences, variable speed controllers, time switches, acoustic screens etc. General requirements for a number of potential plant items on the site are expanded on below.

7.1 CHILLERS / AIR HANDLING UNITS

Units can be located on roof tops with an acoustic screen or in basement areas, with acoustic treatment to intake and exhaust as necessary.

These units would predominantly operate during the day, with the potential to operate with extended hours. Acoustic treatment to these units may be required to ameliorate noise impact to the surrounding residents and to comply with the criteria specified in this report and verified at CC stage.

7.2 SUPPLY / EXHAUST FANS

Supply and exhaust fans may be located within the underground plant rooms or in rooftop plant areas. These units typically emit high noise levels and require acoustic treatment such as silencers and internal lined ductwork. Silencer requirements would be determined once fan selections have been completed at CC stage.

7.3 CONDENSER UNITS

Condensing units typically emit relatively low noise levels and with careful selection, it is possible that no further acoustic treatment would be necessary.

7.4 MINOR PLANT

Other minor plant items, such as bathroom or kitchen exhaust fans, will be required. These items typically emit relatively low noise levels and may require minimal acoustic treatment of a standard nature, such as internally lining of ductwork.

8 ASSESSMENT OF LOADING DOCK ACTIVITIES

This section of the report presents the assessment of noise associated with the operation of the loading docks associated with the Masters area of the proposal. The assessment was conducted in conjunction with the EPA criteria presented in this report.

Loading dock deliveries would generally occur as follows;

- Monday to Friday 6.00am to 10.00pm
- Saturday/Sunday 6.00am to 8.00pm

During the evening period the allowable level of noise emissions based on the EPA criterion and the measured background noise level is 45 dB(A). This applies to the 15 minute period having the highest level of noise emissions. The amenity criterion allows up to 50 dB(A) over the whole period between 6 pm and 10 pm. Given that only minimal loading dock activity is expected during this period, the L_{eq} noise level over the full evening period would be less than 50 dB(A) provided the noise level during the worst 15 minute interval is less than 45 dB(A). Measured noise intrusion obtained for each location on each level of the development will be the basis for the relevant analysis.

8.1 POTENTIAL LOADING DOCK NOISE SOURCES

The potentially significant loading dock noise sources are listed in Table 15 below long with noise emission levels. The emission levels in Table 15 have been obtained from noise monitoring carried out at similar warehouse and retail loading dock facilities. Noise measurements were obtained using a Norsonics SA 110 sound level meter, set to fast response. The sound level meter was calibrated before and after the measurements using a Rion NC-73 calibrator. No significant drift was recorded.

Table 15 - Noise Source Emission Levels

Noise Source	Sound Emission Level dB(A) at 7m	Type of Noise Source
Small Truck Reversing alarm	75(1)	Quasi-Steady, tonal
Trucks Manoeuvring/Reversing	75	Quasi-Steady
Truck Air Brakes	89	Transient
Truck Door Closing	75	Transient
Truck Starting	72	Transient

(1) A 5 dB(A) penalty has been applied to this source to account for the tonal characteristic of noise produced.

8.2 PREDICTED NOISE LEVELS AT MOST AFFECTED RECEIVERS

Noise levels at the residences were predicted based on the noise emission levels in Table 15, which are typical for this type of development.

Table 16 summaries the predicted noise levels at the nearest residence on Woodriff Street to the south east of the proposed loading dock and within the proposed development. The noise levels below assume the acoustic treatments detailed in this report are adopted.

Table 16 – Assessment of Loading Dock Noise Emissions

Location/Activity	Receiver	Predicted Noise Level at Residence $L_{eq,15min}$	Allowable Noise Level at Residence $L_{eq,15min}$
Truck Loading/Unloading(1) Within the Loading Dock	Residences on Woodriff Street	42 dB(A) Day 42 dB(A) Evening	53 dB(A) Day 45 dB(A) Evening
Truck Loading/Unloading(1) Within the Loading Dock	Future Residence Within the development	< 40 dB(A) Day < 40 dB(A) Evening	53 dB(A) Day 45 dB(A) Evening

1 - These activities include activities such as the delivery truck being idle in the dock, movement of pallet trucks, operation of compactors, etc.

8.3 TRANSIENT NOISE ASSESSMENT

Activities associated with the loading dock would be required to cease completely after 10pm. Therefore, loading dock, or service vehicle activities would not produce adverse sleep arousal impact.

8.4 RECOMMENDED LOADING DOCK DEVELOPMENT CONTROLS

It is recommended that the following management and physical controls be implemented into the design and operation of the proposed loading dock associated with the Masters project:

- Operating hours for the loading docks, deliveries, garbage removals, etc to be between 6am and 10pm.
- Bail and/or garbage compactors are to be used only within the building fabric.
- Loading dock receiver area walls to fully enclosed from external environment access doors will be opened only for deliveries entry and exit and will be closed while goods are being moved within the facility without a truck serving the area.
- Neoprene rubber buffers should be installed on the vertical face of the loading dock where vehicles park to absorb impacts.
- A detailed assessment of noise emissions from plant and equipment associated with the loading dock is required to be conducted prior to installation in conjunction with Penrith council requirements.
- Vehicle engines should be switched off during loading and unloading within the dock.

9 CONSTRUCTION NOISE AND VIBRATION

A construction noise and vibration plan has been prepared and is provided under a separate cover. The noise and vibration plan has been developed in conjunction with the following:

- Australian Standard AS2436:1981 "Guide to noise control on construction, maintenance and demolition sites
- EPA - Construction Noise Guideline

The detailed construction noise and vibration management plan will be provided as part of the CC submission once a construction (including demolition, excavation and construction) programs and required activities methodologies have been developed.

9.1 EPA INTERIM CONSTRUCTION NOISE GUIDELINE

This guideline nominates acceptable external and internal management levels for noise emissions from construction activities, based on the existing background noise level in the area and type of receiver. For projects within the recommended standard hours, the guideline recommends a noise level of 10 dB(A) above the background – this level is referred to as the "noise effected level", for residential receivers. The noise emission goals for the nearby affected receivers are presented below:

Table 17 – Noise Emission Goal – Residential Properties

LOCATION	TIME OF DAY	MEASURED BACKGROUND LEVELS – dB(A)L_{90}	NOISE EFFECTED LEVEL BACKGROUND + 10dB(A)$L_{eq(15min)}$
Surrounding Residential Properties	Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	44	54

Where noise from the construction works is above the "noise affected level", the proponent should apply any feasible and reasonable work practices to minimise noise.

If noise emissions are likely to exceed 75 dB(A)$L_{eq(15min)}$, the receiver is deemed to be "highly noise affected". Introduction of management controls such as scheduling of noisy periods, or respite periods is recommended.

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

Where compliance with OEHW cannot be achieved, noise emissions are to be managed in accordance with principles in AS2436:

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

9.3 CONSTRUCTION VIBRATION

Vibration caused by construction should be limited to:

- For structural damage vibration, German Standard DIN 4150-3 *Structural Vibration: Effects of Vibration on Structures; and*
- For human exposure to vibration (amenity), the evaluation criteria presented in the British Standard BS 6472:1992 *Guide to Evaluate Human Exposure to Vibration in Buildings (1Hz to 80Hz)* for low probability of adverse comment

The criteria and the application of this standard are discussed in separate sections below.

9.3.1 Structure Borne Vibrations

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria outlined in DIN 4150-3 (1999-02) are presented in Table 18.

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

Table 18 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

TYPE OF STRUCTURE		PEAK PARTICLE VELOCITY (mms^{-1})			
		At Foundation at a Frequency of			**Plane of Floor of Uppermost Storey**
		< 10Hz	**10Hz to 50Hz**	**50Hz to 100Hz**	**All Frequencies**
1	Buildings used in commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15

9.3.2 Assessing Amenity

The EPA's "Assessing Vibration: A Technical Guideline" (Feb 2006) is based on the guidelines contained in BS 6472:1992. This guideline provides procedures for assessing tactile vibration and regenerated noise within potentially affected buildings.

The recommendations of this guideline should be adopted to assess and regulate vibration within the construction site.

Table 19 – OEHW Recommended Vibration Criteria

		RMS acceleration (m/s^2)		RMS velocity (mm/s)		Peak velocity (mm/s)	
Place	Time	Preferred	Maximum	Preferred	Maximum	Preferred	Maximum
Continuous Vibration							
Residences	Daytime	0.01	0.02	0.2	0.4	0.28	0.56
Impulsive Vibration							
Residences	Daytime	0.3	0.6	6.0	12.0	8.6	17.0

9.4 COMMENT / ASSESSMENT

Potential noise and vibration impacts are reviewed below.

9.4.1 Noise impacts

Noise impacts from the Nepean Green development works on nearby receivers will be dependant on the type of construction activities and the relative location of the works on site. Work close to the eastern and southern boundaries will have greatest impact on the surrounding residences.

Noise impacts can be minimised using the following:

- Selection of equipment and process.
- Location of static plant (particularly concrete pumps and compressors).
- Use of screens or enclosures (typically only feasible for static plant).
- Scheduling of noisy activities and provision of respite periods.

Detailed construction noise planning is typically undertaken after engagement of a builder and a construction program is prepared (i.e. – after DA stage) and therefore, detailed planning is not possible at this stage.

In light of the above, we recommend:

- On completion of the construction program, acoustic review of proposed construction activities and plant/methods should be undertaken to identify work items likely to exceed EPA guidelines.

- For those noise intensive activities, the analysis should identify where on the construction site are the areas likely to result in high noise levels. This will then assist in determining the likely time period for which high noise levels will occur at nearby properties.

- Identify feasible acoustic controls or management techniques (use of screens, scheduling of noisy works, notification of adjoining land users, respite periods) when excessive levels may occur.

- For activities where acoustic controls and management techniques still cannot guarantee compliant noise levels, implement a notification process whereby nearby development is made aware of the time and duration of noise intensive construction processes.

Through adoption of the above, noise impacts on nearby development can be suitably managed to prevent excessive impact.

9.5 VIBRATION IMPACTS

Due to its proximity, vibration impacts on the residential properties to the west are unlikely to exceed detailed criteria above. We recommend:

- Where practicable, excavation in rock should be done using ripping as opposed to pneumatic hammers.

10 CONCLUSION

This report provides the results of Environmental Noise Study for the proposed Nepean Green Master plan development. Noise at the site has been measured and noise goals have been set in accordance with the requirements of the relevant statutory/regulatory authorities including Local Council and the Environmental Protection Authority.

Determination of noise assessment criteria based on the EPA's Industrial Noise Policy and ECRTN have been determined based on both unattended and attended noise monitoring conducted at the proposed development.

Additionally in principal treatments have been provided to ensure internal noise levels from surrounding noise sources (namely surrounding roadways, Centro Nepean and Penrith Stadium) comply with the relevant Australian Standards.

Based on the assessment detailed in this report the proposed development will comply with all relevant noise and vibration criteria.

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

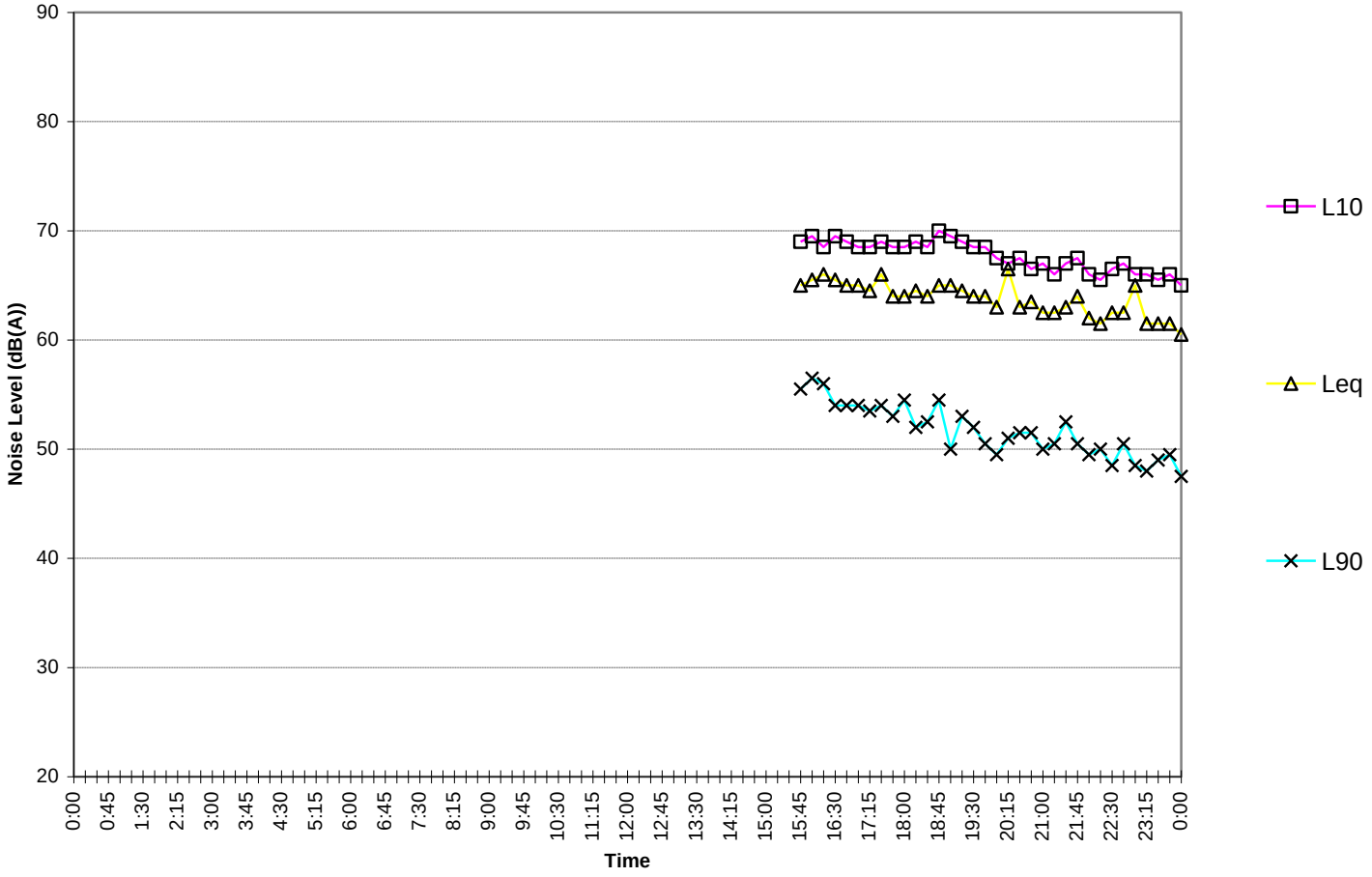
Report prepared by,

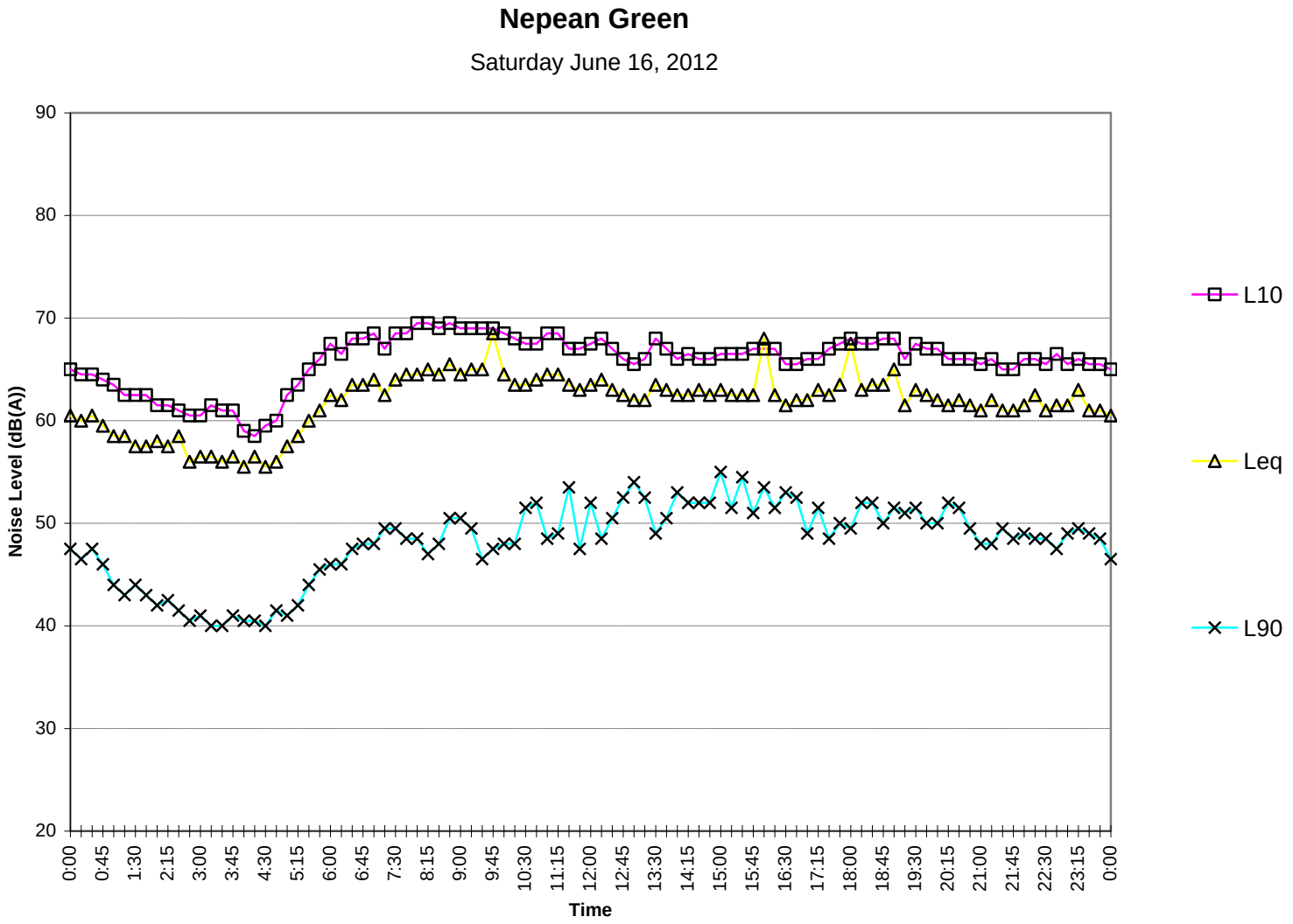
ACOUSTIC LOGIC CONSULTANCY PTY LTD
Ben White

Appendix A – Noise Logging Results

Nepean Green

Friday June 15, 2012




Nepean Green
Saturday June 16, 2012
Noise Level (dB(A))
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50
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20
0:00
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2:15
3:00
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Time
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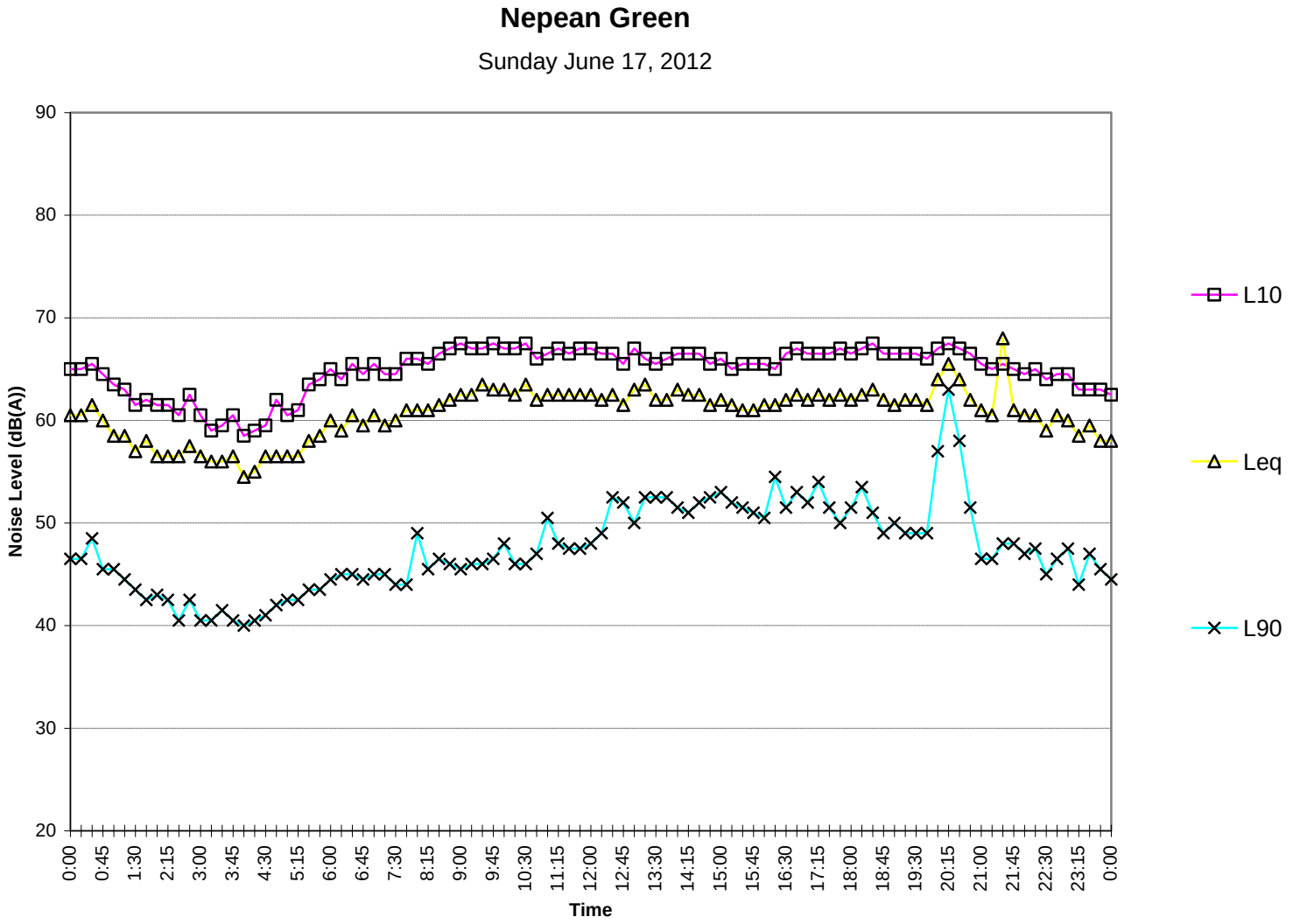
Leq
L90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Sunday June 17, 2012
Noise Level (dB(A))
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80
70
60
50
40
30
20
0:00
0:45
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3:00
3:45
4:30
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6:45
7:30
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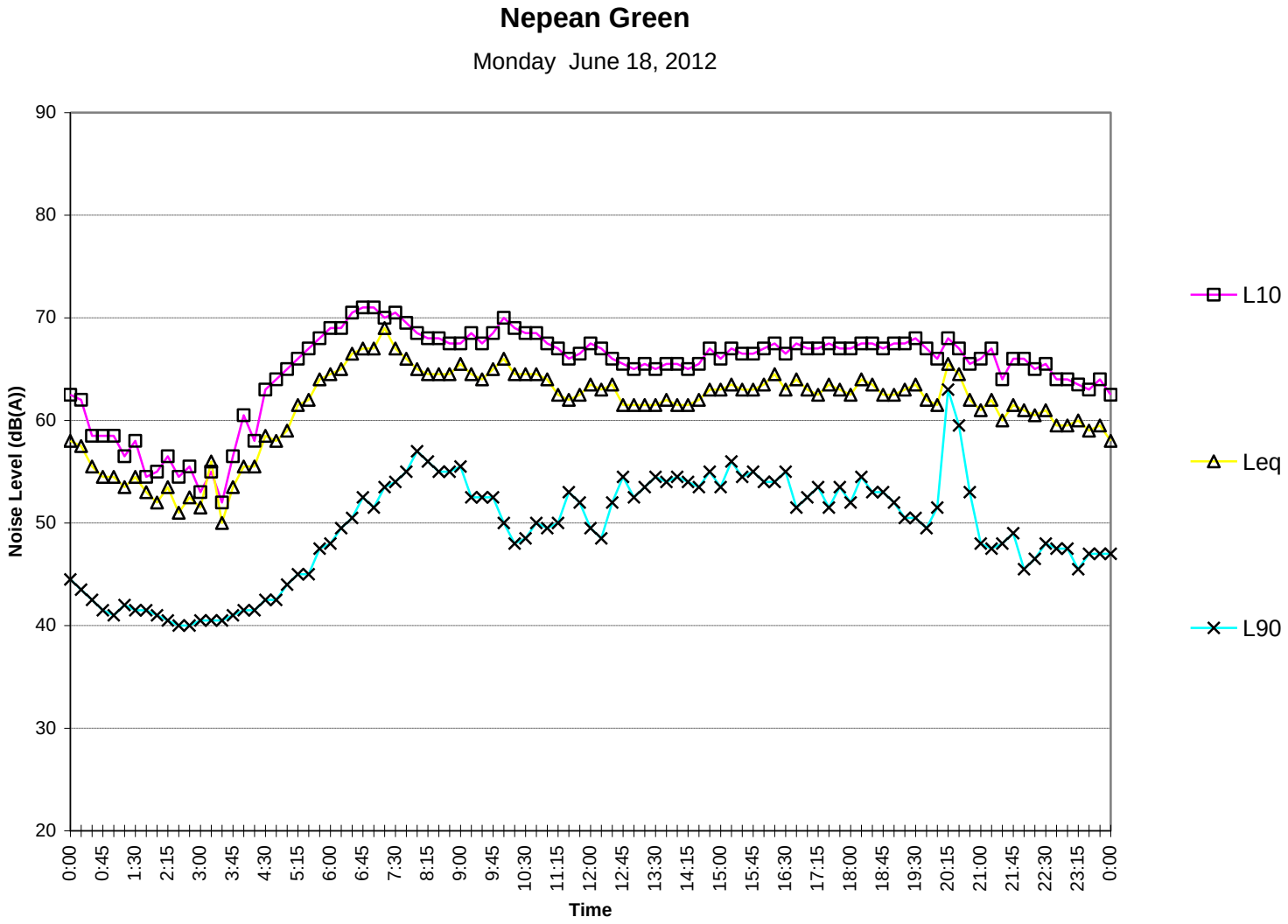
Nepean Green
Monday June 18, 2012
Noise Level (dB(A))
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70
60
50
40
30
20
0:00
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3:00
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23:15
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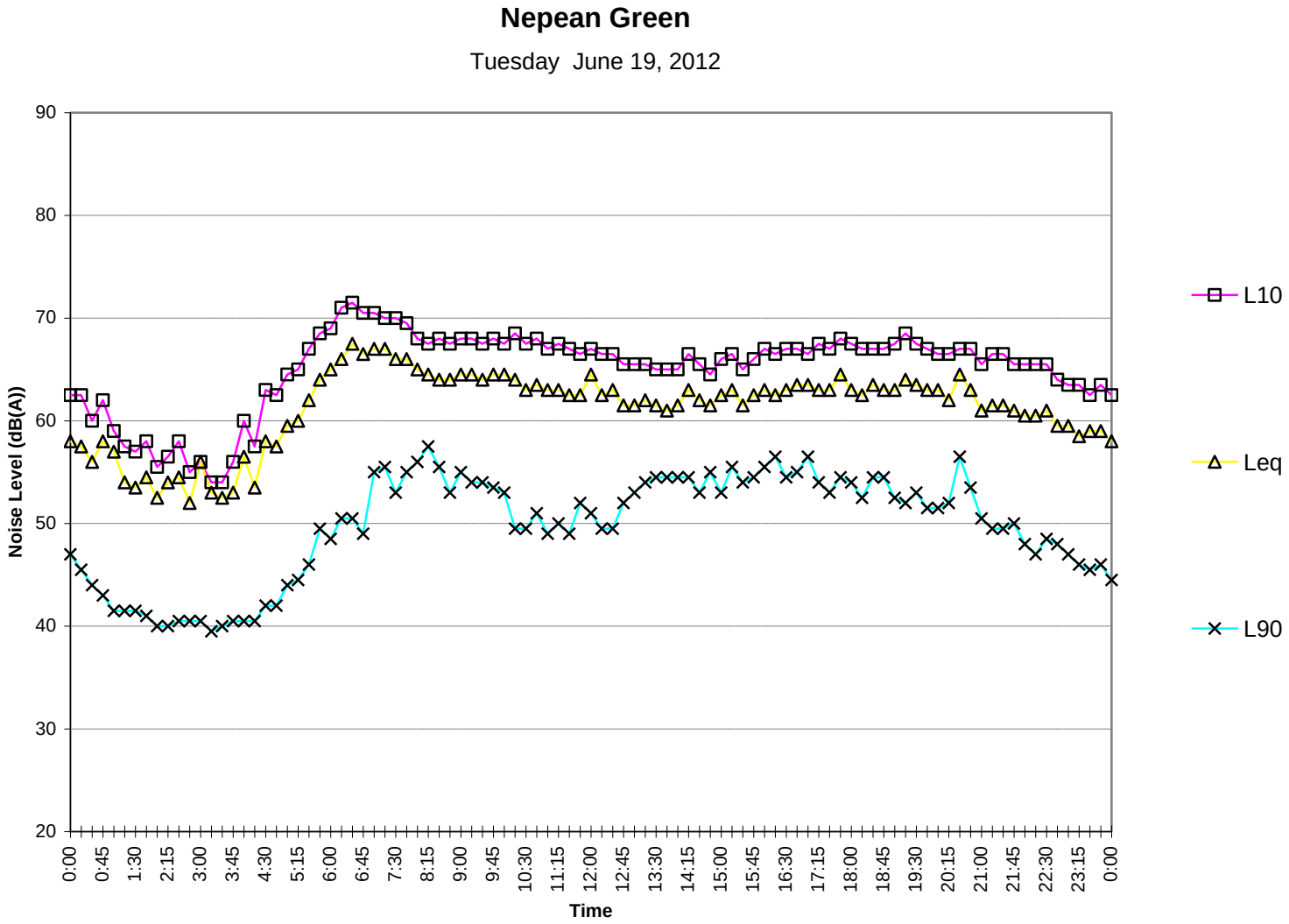
Time
L10
Leq
L90


Nepean Green
Tuesday June 19, 2012
Noise Level (dB(A))
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50
40
30
20
0:00
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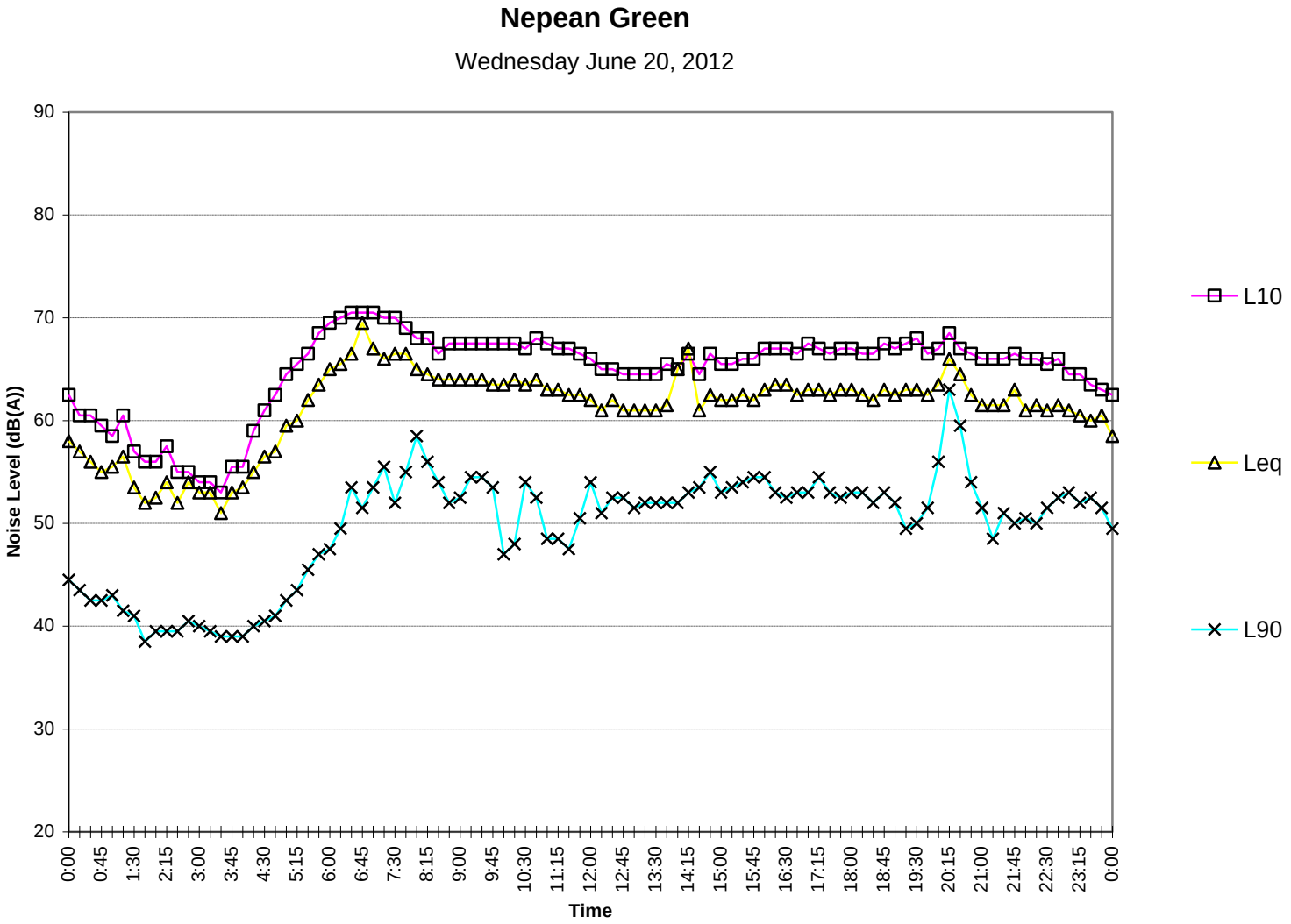
23:15
0:00
Time
L10
Leq
L90


Nepean Green
Wednesday June 20, 2012
Noise Level (dB(A))
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70
60
50
40
30
20
0:00
0:45
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17:15
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Time
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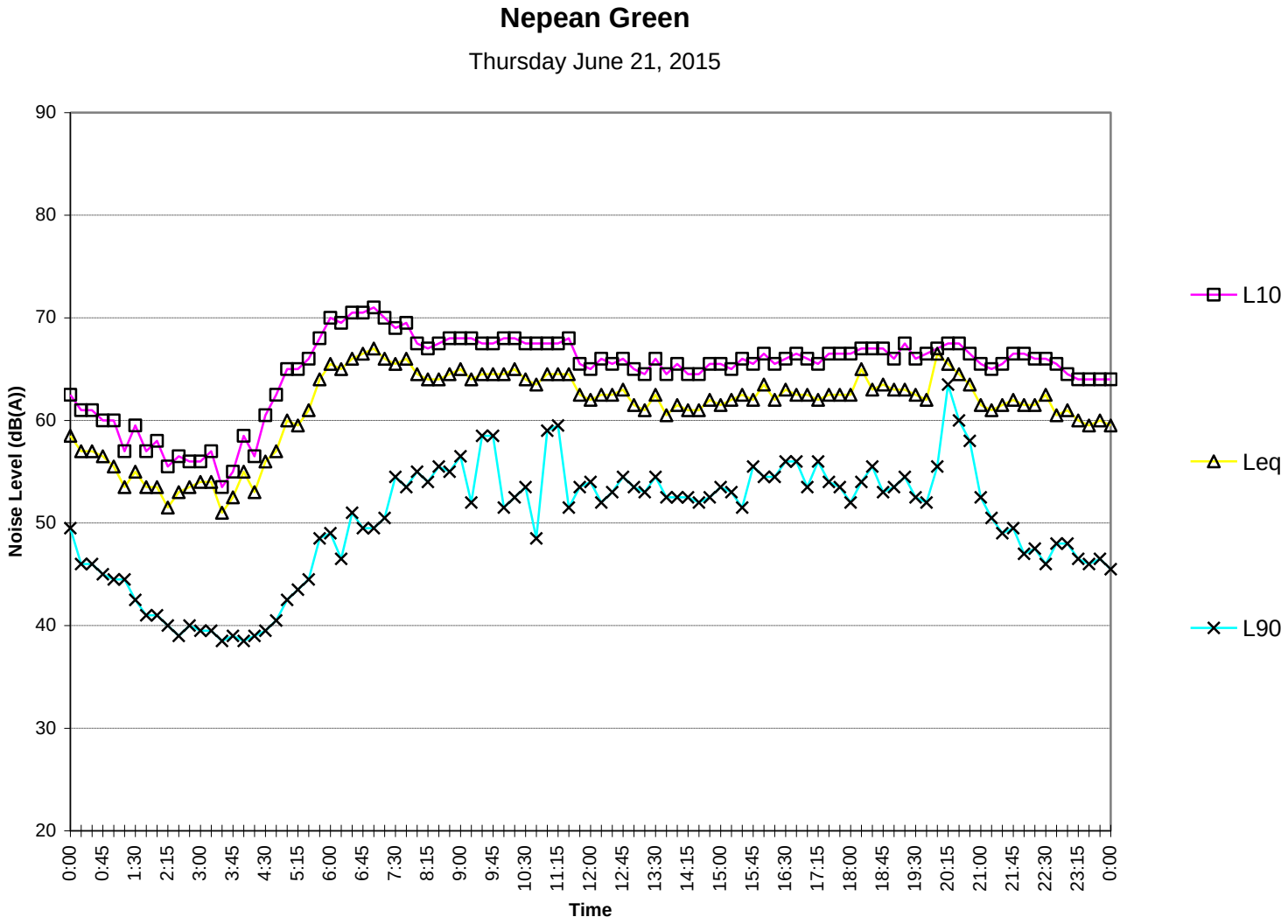
Nepean Green
Thursday June 21, 2015
Noise Level (dB(A))
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50
40
30
20
0:00
0:45
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3:00
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17:15
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Time
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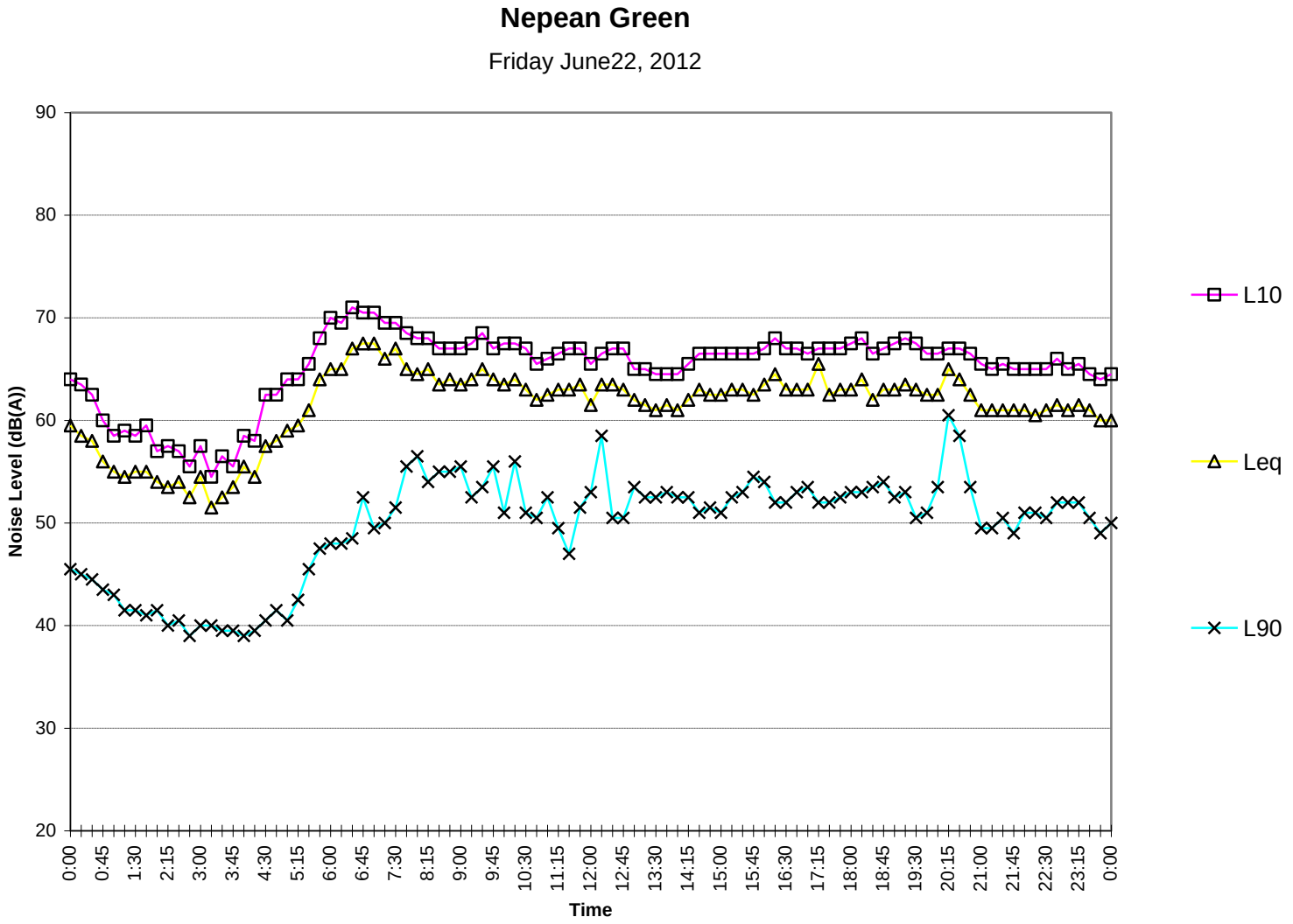
Leq
L90


Nepean Green
Friday June22, 2012
Noise Level (dB(A))
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60
50
40
30
20
0:00
0:45
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17:15
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Time
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Leq
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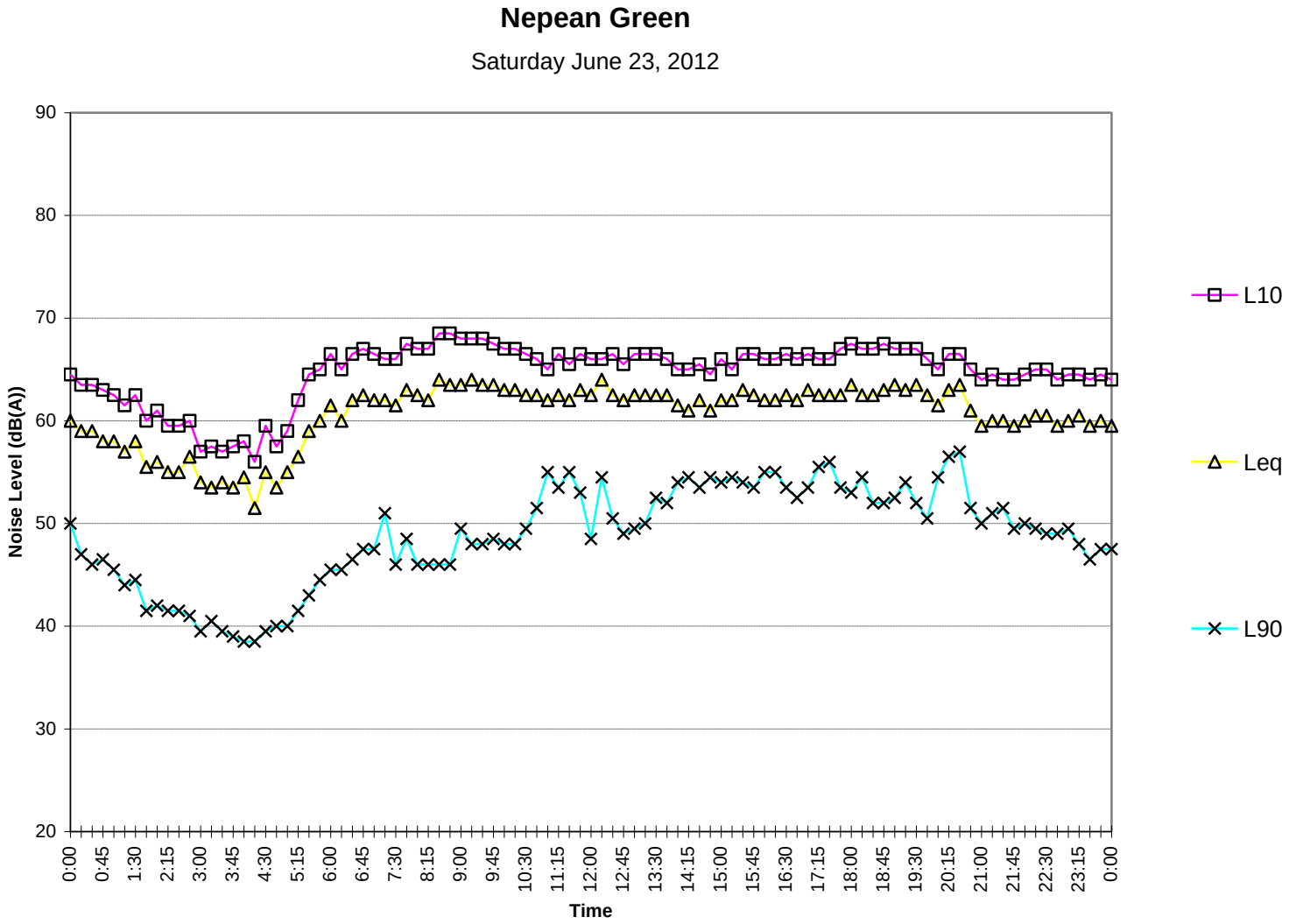
Nepean Green
Saturday June 23, 2012
Noise Level (dB(A))
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70
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50
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0:00
0:45
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Time
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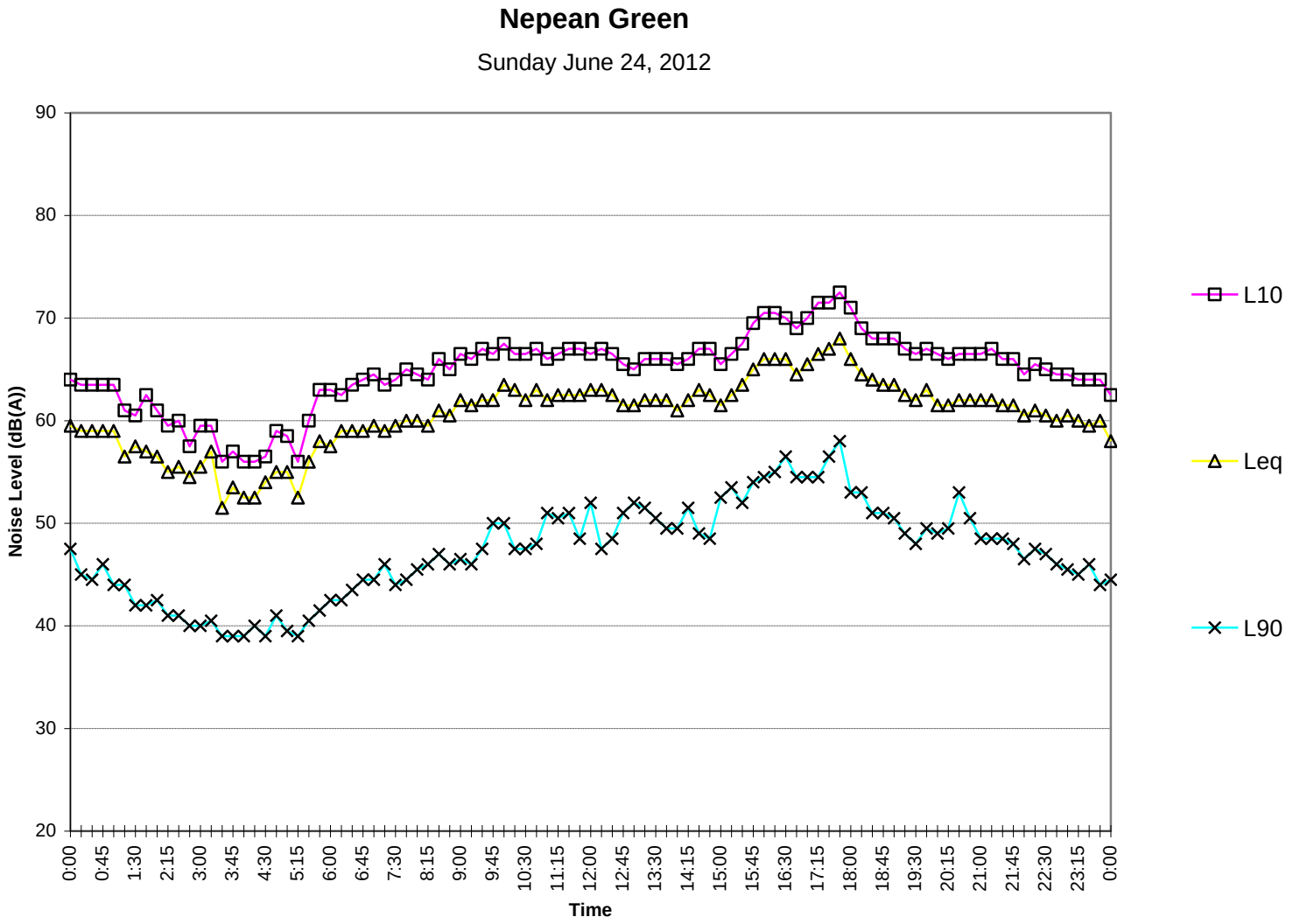
Leq
L90


Nepean Green
Sunday June 24, 2012
Noise Level (dB(A))
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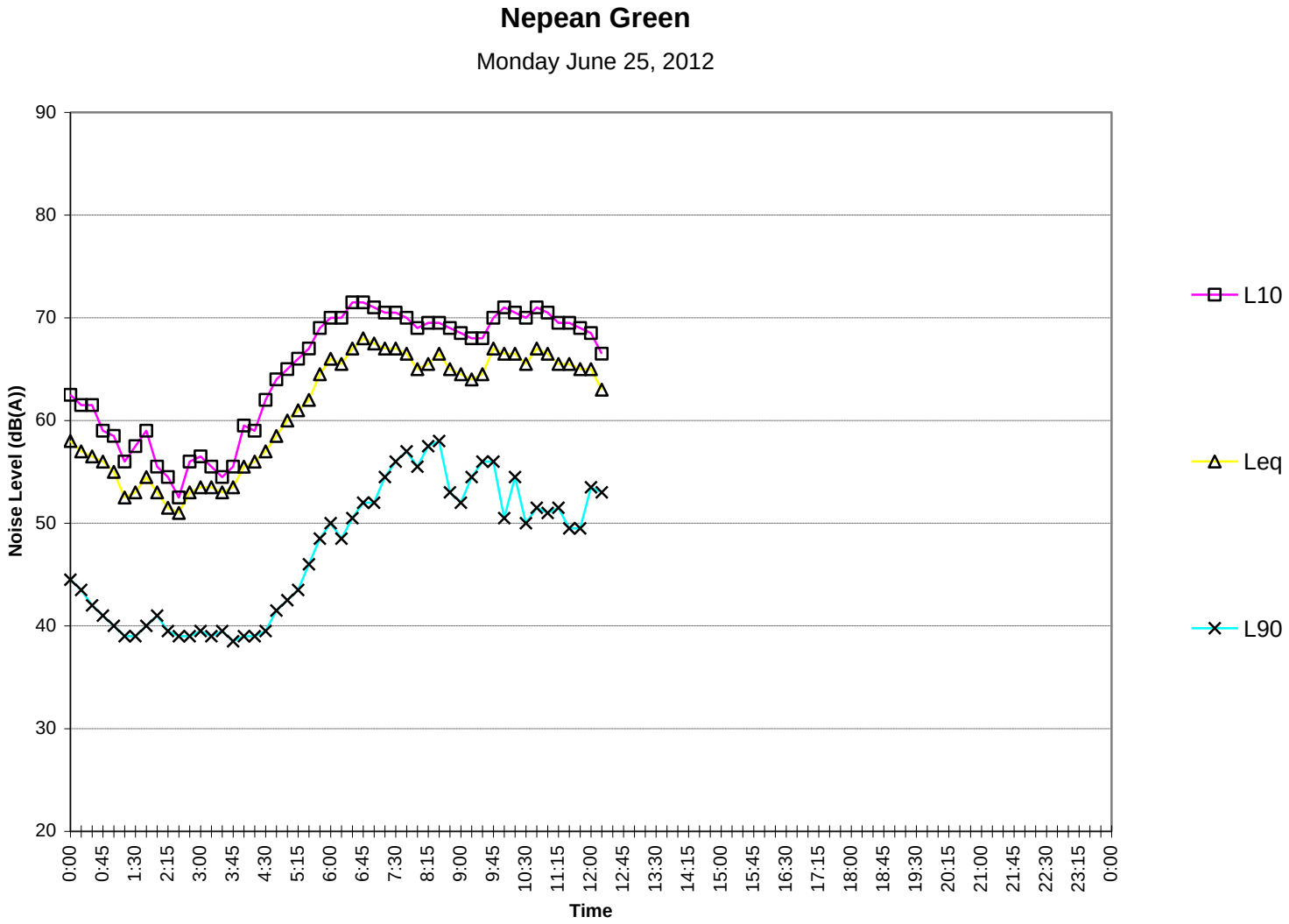
Time
L10
Leq
L90


Nepean Green
Monday June 25, 2012
Noise Level (dB(A))
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Time
L10
Leq
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