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1 INTRODUCTION

This report presents an acoustic assessment to accompany the development application for the proposed residential development at Lots 3-10 of 53C Warriewood Road, Warriewood.

In this report we have:

- Conducted an external noise intrusion assessment from the surrounding environment to determine the acoustic treatments required to achieve a reasonable level of amenity for future occupants.
- Conducted background noise monitoring to determine noise emission goals for future use of the development to meet the requirements of NSW EPA Industrial Noise Policy.

This noise assessment is based on the following preliminary architectural drawings issued by Stephen Bowers Architects, issue P5 and dated 1/12/2015.

2 SITE DESCRIPTION / PROPOSED REDEVELOPMENT

The site is located at Lots 3-10, 53C Warriewood Road, Warriewood. The proposed development involve a subdivision of the site into eight lots and construction of seven 3 storey townhouses and a three storey residential building with six units.

The nearest roads to the project site are Warriewood Road, which is approximately 80m north-east of the project site. There is a proposal to extend the road Lorikeet Grove to the north-west of the project site, which will provide vehicular access to the project site.

The project site is bound to the west by two storey residential development, and further to the north and north-east by a mix of one and two storey residential development.

Refer to Figure 1 below, which is an aerial photo of the existing site.

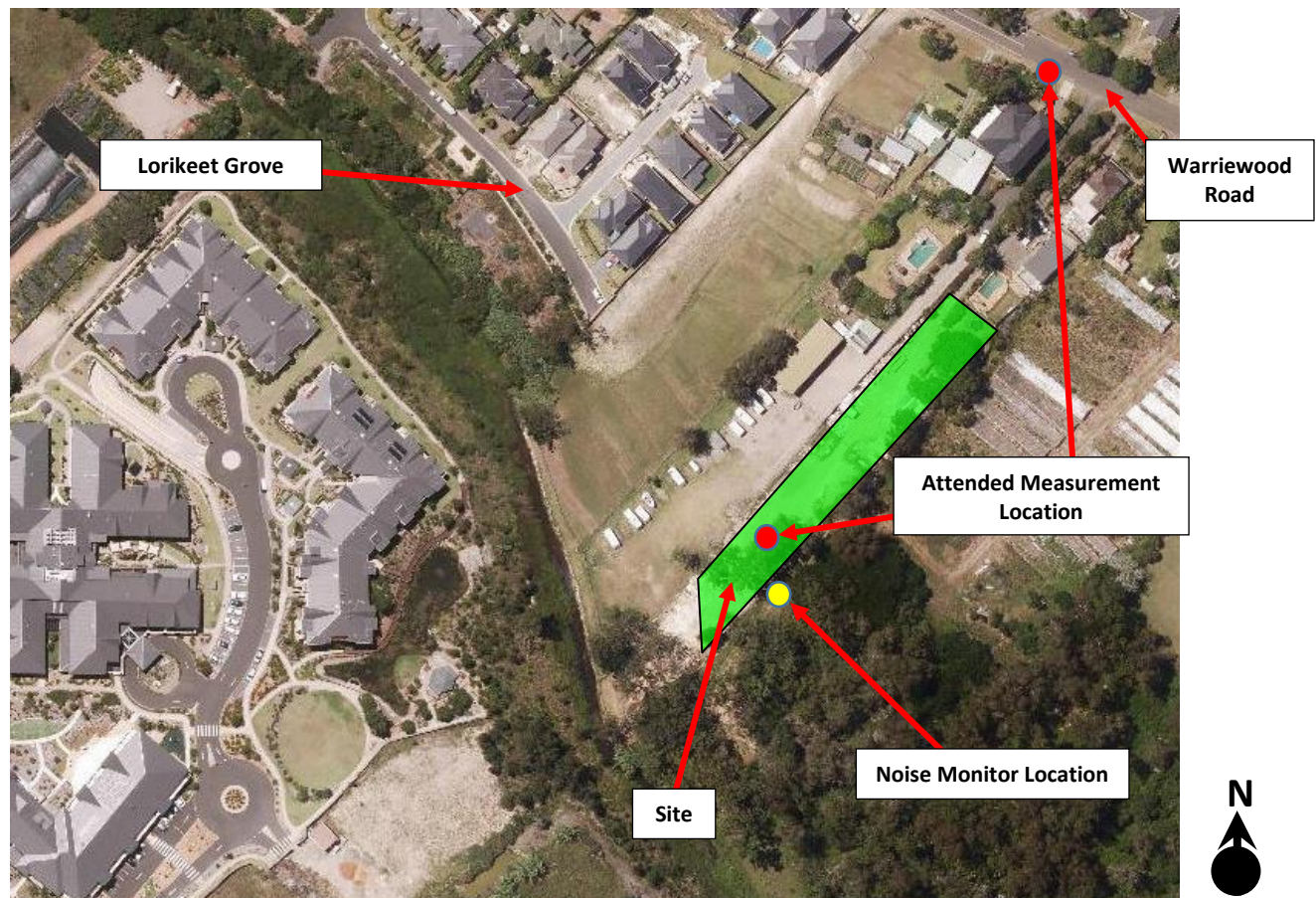


Figure 1 – Site Map

3 NOISE DESCRIPTORS

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

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

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

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

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

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

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

4 EXTERNAL NOISE INTRUSION ASSESSMENT

The nearest road to impact the amenity of the future occupants of the proposed development is Warriewood Road, to the north-east of the site.

4.1 ASSESSMENT OBJECTIVES

The determination of an acceptable level of noise within the residential spaces requires consideration of the activities carried out within the space and the degree to which noise will interfere with those activities.

As sleep is the activity most affected by environmental noise, bedrooms are the most sensitive rooms. Higher levels of noise are acceptable in living areas without interfering with activities such as reading, listening to television, etc. Noise levels in utility spaces such as kitchens, bathrooms, laundries, etc can be higher.

This development will be assessed against the requirements of the Pittwater City Council DCP and Australian Standard AS2107:2000 'Recommended design sound levels and reverberation times for building interiors'.

4.1.1 Pittwater City Council DCP

The Pittwater City Council DCP has no specific design goals for external noise intrusion into residential developments. Given this, the proposed development will be assessed against the requirements of Australian Standard AS2107:2000 'Recommended design sound levels and reverberation times for building interiors'.

4.1.2 Australian Standard AS2107:2000

The internal noise goals for residential development outlined in Australian Standard AS2107:2000 are presented in the table below:

Table 1 - AS2107:2000 Internal Noise Criteria

Type of Occupancy	Space	Recommended Design Sound Level
Houses and apartments near minor roads	Sleeping Areas (Night time only 10pm – 7am)	35dB(A) _{Leq (1hr)}
	Living Areas (24 hours a day)	40dB(A) _{Leq (1hr)}

4.2 EXTERNAL NOISE MONITORING

4.2.1 Noise Monitoring

As part of this assessment, unattended noise monitoring and attended measurements were conducted in the vicinity of the project site to determine the existing environmental noise levels at the site. The results of these measurements will be used to determine the treatments required to reduce noise levels to the internal spaces of the project site.

4.2.2 Measurement Locations

Attended noise measurements were conducted on the 9th July 2014 around the proposed development location between 11am and 12pm and on the 1st December between 8am and 9am. Measurements were undertaken using a Norsonics Type 140 precision sound level analyser, set to A-weighted fast response. The precision sound level analyser was calibrated before and after the measurements using a Norsonics 1251 sound level calibrator. No significant drift was recorded.

4.2.3 Unattended Noise Measurements

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 monitor 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. There were no significant periods of adverse weather conditions during the measurement period. The logger was on site from the 9th to the 16th July 2014 (refer to figure 1 for location). Refer to Appendix 1 for the unmanned noise monitoring data of the site.

4.2.4 Measured Noise Levels

The following table presents the resultant noise levels at the proposed site location.

Table 2 - Traffic Noise Levels at Proposed Site Location

Location	Period	Noise Level
North Eastern Façade of Lot 3	Day (7am – 10pm)	58dB(A) $L_{eq(1hr)}$
	Night (10pm – 7am)	53dB(A) $L_{eq(1hr)}$

4.3 RECOMMENDATIONS

External noise intrusions into the proposed development were assessed using the measured noise levels reported above as a basis.

Calculations were performed taking into account the orientation of windows, the total area of glazing, facade transmission loss and room sound absorption characteristics. In this way the likely interior noise levels can be predicted. Acoustic treatment required to ensure compliance with the assessment criteria are detailed in this section.

Internal noise levels will primarily be as a result of noise transfer through the windows and doors as these are relatively light building elements that offer less resistance to the transmission of sound. Noise transfer through the masonry elements will not be significant and need not be considered further.

The constructions necessary to achieve the noise levels are detailed below. The predicted noise levels have been based on the expected level and spectral characteristics of the external noise, the area of building elements exposed to traffic noise, the absorption characteristics of the rooms and the noise reduction performance of the building elements.

4.3.1 Glazed Windows and Doors

The standard glazing recommendations for this project are presented in the table below. These glazing recommendations will achieve the internal noise goals outlined in section 4.1. Aluminium framed/sliding glass doors and windows will be satisfactory provided they meet the following criteria listed below.

Table 3 - Glazing Recommendations

Room	Glazing Thickness	Acoustic Seals
All glazing	5mm float	Yes

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

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

Table 4 - Minimum STC/R_w of Glazing (with Acoustic Seals)

Glazing Assembly	Minimum STC/R _w of Installed Window	Acoustic Seals
5mm float	28	Yes

4.3.2 External Walls

The proposed masonry external wall construction for the development will be acoustically acceptable and will not require any acoustic treatment.

4.3.3 External Entry Doors

Timber external entry doors are to be constructed of minimum 40mm thick solid core timber. Glazed doors are to have glazing at least 5mm thick.

All external entry doors are to be installed with all gaps minimised.

4.3.4 Roof / Ceiling construction

4.3.4.1 Concrete Roof

Proposed concrete roof over the multi-apartment building will not require any extra treatment for acoustic purposes.

4.3.4.2 Lightweight Roofs

The recommended roof/ceiling construction for the top level of the townhouses is shown below in Figure 2.

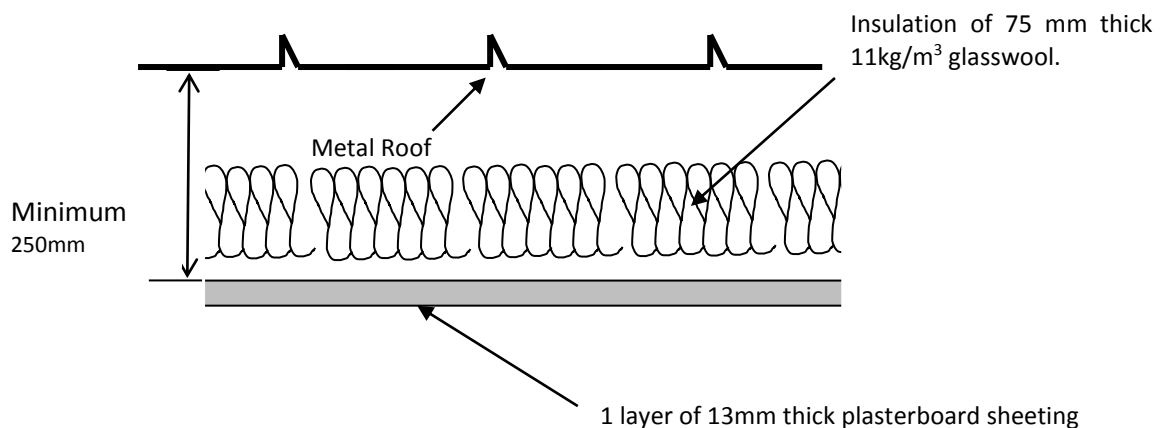


Figure 2 - Roof / Ceiling Construction Below Light Weight Roof

Penetrations in ceilings (such as for light fittings etc.) must be sealed gap free with a flexible sealant. Any ventilation openings in the ceilings would need to be acoustically treated to maintain the acoustic performance of the ceiling construction.

4.3.5 Plasterboard Corner Details

The recommended plasterboard ceiling/wall corner construction options over the top floor rooms of the townhouses are shown in Figure 3

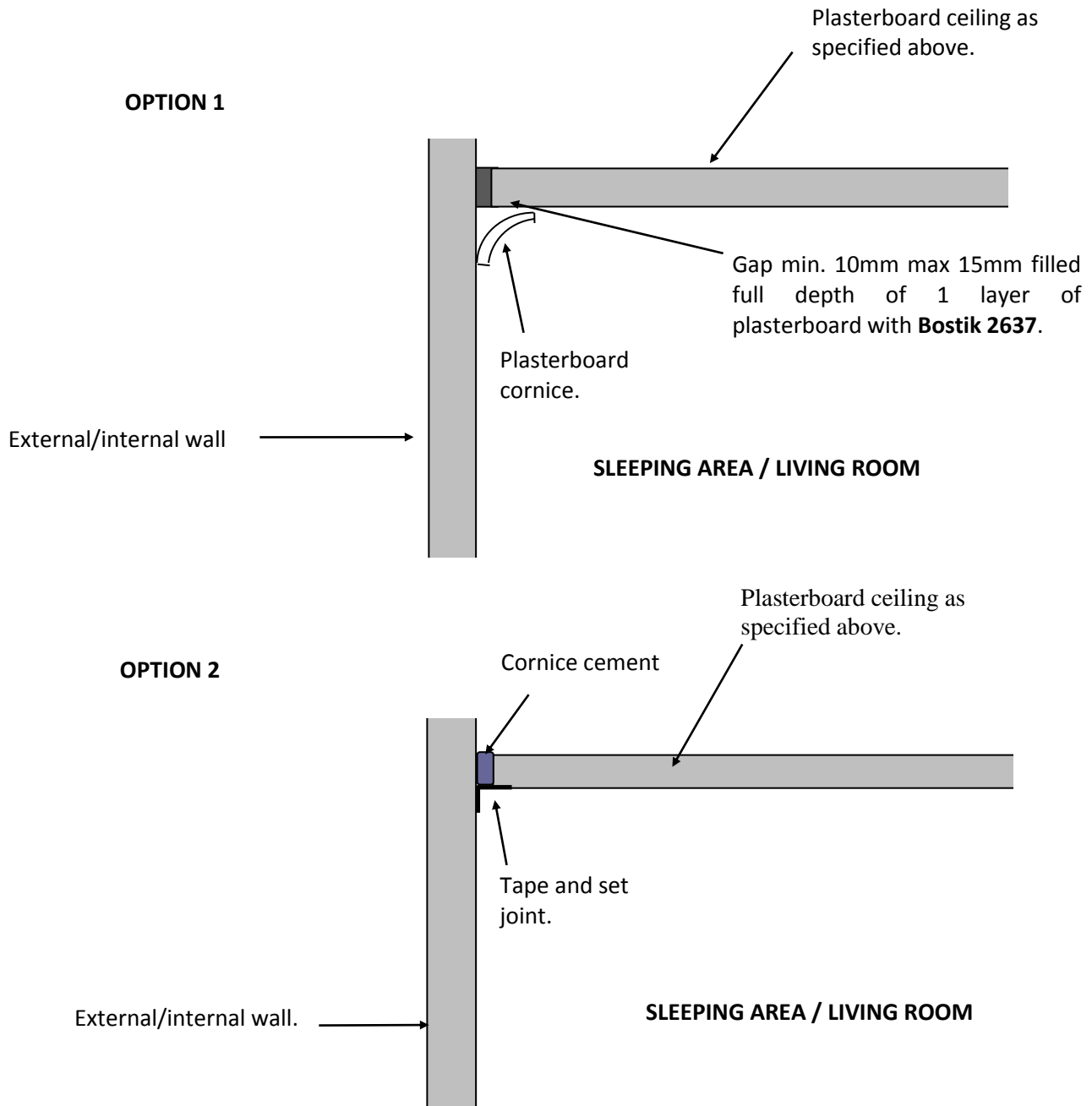


Figure 3 - Plasterboard Corner Details.

4.3.6 Ventilation requirements

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

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

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

All habitable rooms within the development will be able to achieve the internal noise goals with their windows open.

5 NOISE EMISSION ASSESSMENT

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

Potential noise sources which should be assessed are:

- Noise generated by mechanical plant (typically air-conditioning).

Noise emission criteria will be determined based on the following documents:

- NSW EPA Industrial Noise Policy
- Protection of Environmental Operation Act Regulation 2000
- Pittwater City Council DCP

5.1 BACKGROUND NOISE MONITORING

Background noise levels for the site were obtained using an unattended noise logger and attended measurements around the project site.

Attended noise measurements were conducted on the 9th July 2014 around the proposed development location between 11am and 12pm. Measurements were undertaken using a Norsonics Type 140 precision sound level analyser, set to A-weighted fast response. The precision sound level analyser was calibrated before and after the measurements using a Norsonics 1251 sound level calibrator. No significant drift was recorded.

The unattended monitoring was conducted using an Acoustic Research Laboratory's noise logger. The logger was set to A-weighted fast response and was programmed to store 15-minute statistical noise levels throughout the monitoring period. The monitor was calibrated at the start and end of the monitoring period using a Rion NC-73 calibrator. No significant drift was noted.

The unattended measurement was conducted from the 9th to the 16th July 2014. Refer to the aerial photo in figure 1 for the noise monitor location and attended measurement locations.

The measured background noise levels are summarised in the table below.

Table 5 - Measured Background Noise Levels

Description	Day Noise Level 7am to 6pm (dB(A))	Evening Noise Level 6pm to 10pm (dB(A))	Night Noise Level 10pm to 7am (dB(A))
Minimum Repeatable Background $L_{90,15min}$	39	35	33

5.2 NOISE EMISSION OBJECTIVES

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

5.2.1 NSW EPA Industrial Noise Policy

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

- *Intrusiveness Criteria* - This guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the L_{eq} descriptor not exceed the background noise level by more than 5 dB(A). Where applicable, the intrusive noise level should be penalised (increased) to account for any annoying characteristics such as tonality.
- *Amenity Criteria* - This guideline is intended to limit the absolute noise level from all “industrial” noise sources such as mechanical plant to a level that is consistent with the general environment.

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

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

5.2.1.1 Intrusiveness Criterion

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

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

Table 6 - Intrusiveness Noise Emission Goals

Location	Period/Time	Intrusiveness Noise Emission Goal dB(A) $L_{eq}(15min)$
Nearby Residences	Day (7am-6pm)	44
	Evening (6pm-10pm)	40
	Night (10pm-7am)	38

5.2.1.2 Amenity Criterion

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

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

For the purposes of this condition:

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

Table 7 - Amenity Noise Emission Goals

Location	Period/Time	Amenity Noise Emission Goal dB(A) $L_{eq}(\text{Period})$
Nearby Residences – Suburban Receiver	Day (7am-6pm)	55
	Evening(6pm-10pm)	45
	Night(10pm-7am)	40

5.2.2 Protection of the Environmental Operation Act Regulation 2000

Protection of the Environmental Operations regulation limits the noise levels associated within the operation of domestic air conditioning criteria during night time periods which is presented below:

Protection of the Environmental Operations (Noise Control) Regulation 2000-Sect 52

52 *Air Conditioners*

(1) A person must not cause or permit an air conditioner to be used on residential premises in such a manner that it emits noise that can be heard within a habitable room in any other residential premises (regardless of whether any door or window to that room is open):

- (a) before 8 am or after 10 pm on any Saturday, Sunday or public holiday, or*
- (b) before 7 am or after 10 pm on any other day.*

5.2.3 Pittwater City Council DCP

Section C1.6 of the Pittwater City Council DCP states the following with regard to noise emissions from mechanical services associated with residential development:

“C1.6 Acoustic Privacy

Noise generating plants including pool/spa motors, air conditioning units and the like shall not produce noise levels that exceed 5dBA above the background noise when measured from the nearest property boundary.”

5.2.4 Resultant Project Noise Emission Criteria

Based on the requirements stated in the sections above, table 8 provides a summary of the assessment criteria applicable to the future residential development at the project site. The assessment criteria are also based on the background noise monitoring data conducted at the proposed development location.

Table 8 - Environmental Noise Emission Criteria

Time Period	Assessment Background Noise Level dB(A)_{L90}	Amenity Criteria dB(A) L_{eq}	Intrusiveness Criteria Background + 5 dB(A) L_{eq}(15min)	EPA Criteria for Residential Condensers
Day	39	55	44	N/A
Evening	35	45	40	N/A
Night	33	40	38	Inaudible within neighbouring premises

5.3 MECHANICAL PLANT

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

Noise emissions from all mechanical services plant to the closest residential receiver should comply with the noise emission criteria in Section 5.2.

6 CONCLUSION

This report presents our acoustic assessment of the proposed residential development at Lots 3-10, 53C Warriewood Road, Warriewood.

Noise intrusion from external noise impacts onto the future occupants of the development have been assessed in accordance with the Pittwater City Council DCP and Australian Standard AS2107:2000. Provided the acoustic treatments in Section 4 are adhered to, the internal noise levels will satisfy the requirements of the criteria.

Noise emission criteria for the development site have been determined based on background noise logging data, the NSW EPA Industrial Noise Policy and the Protection of the Environment Operations Act Regulation 2000 and the Pittwater City Council DCP. The resultant criteria are presented in Section 5.2.4. Noise from mechanical plant items associated with the proposed development should comply with these criteria. Detailed design of mechanical plant items should be carried out during the CC stage.

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

Yours faithfully,

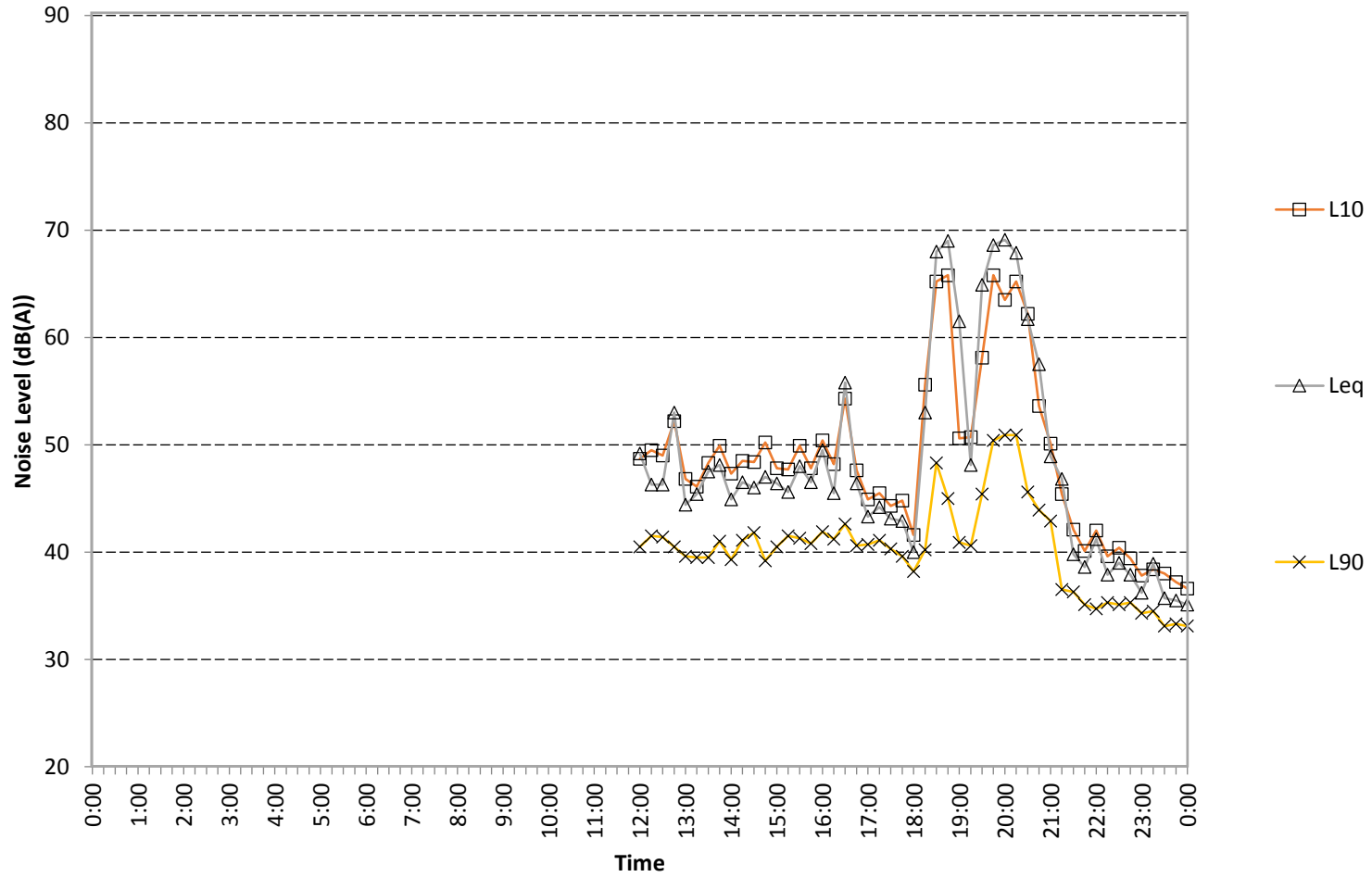
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Acoustic Logic Consultancy Pty Ltd
Justin Leong

APPENDIX 1: UNATTENDED NOISE MEASUREMENTS

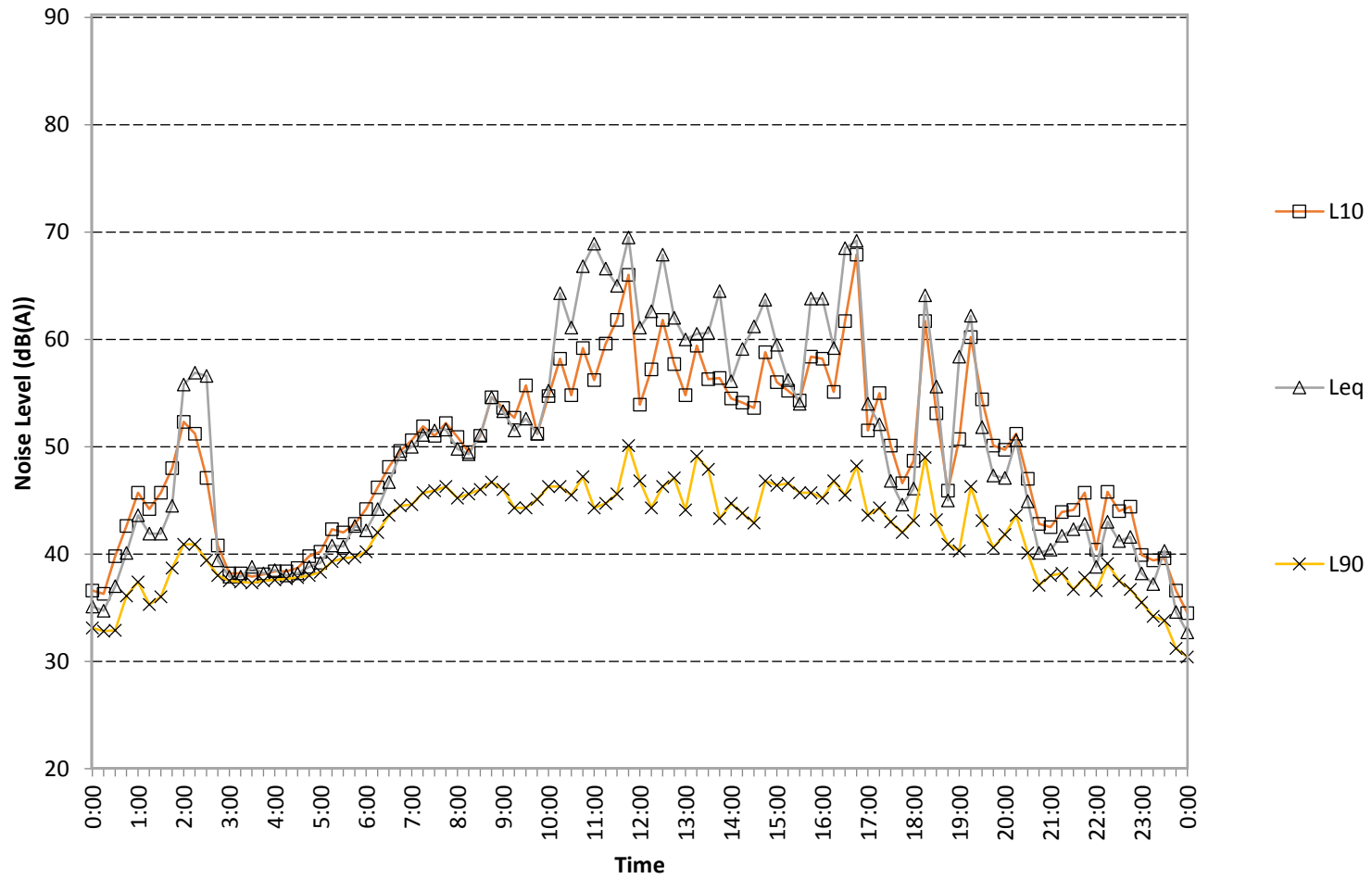
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Wednesday July 9, 2014



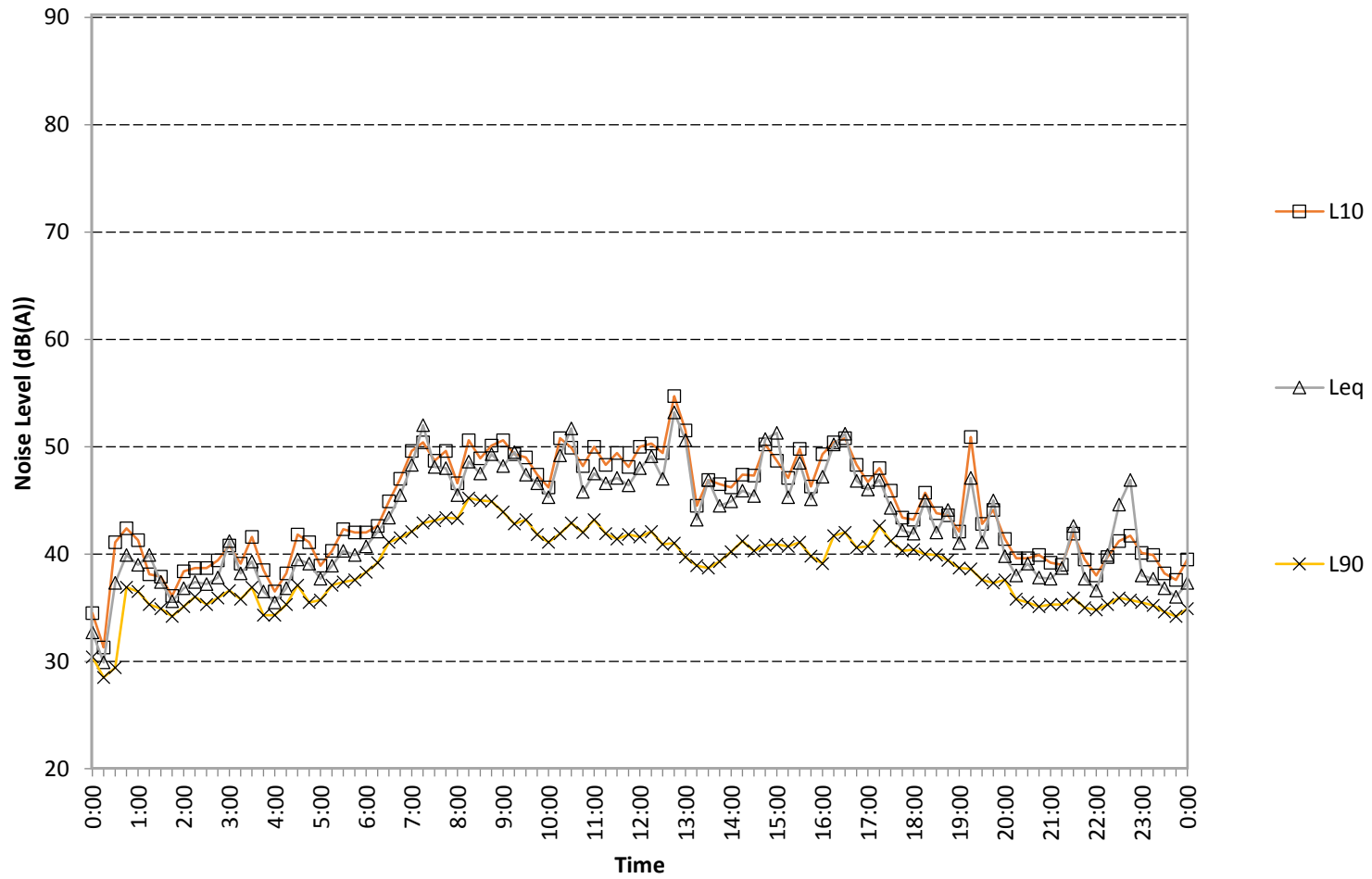
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Thursday July 10, 2014



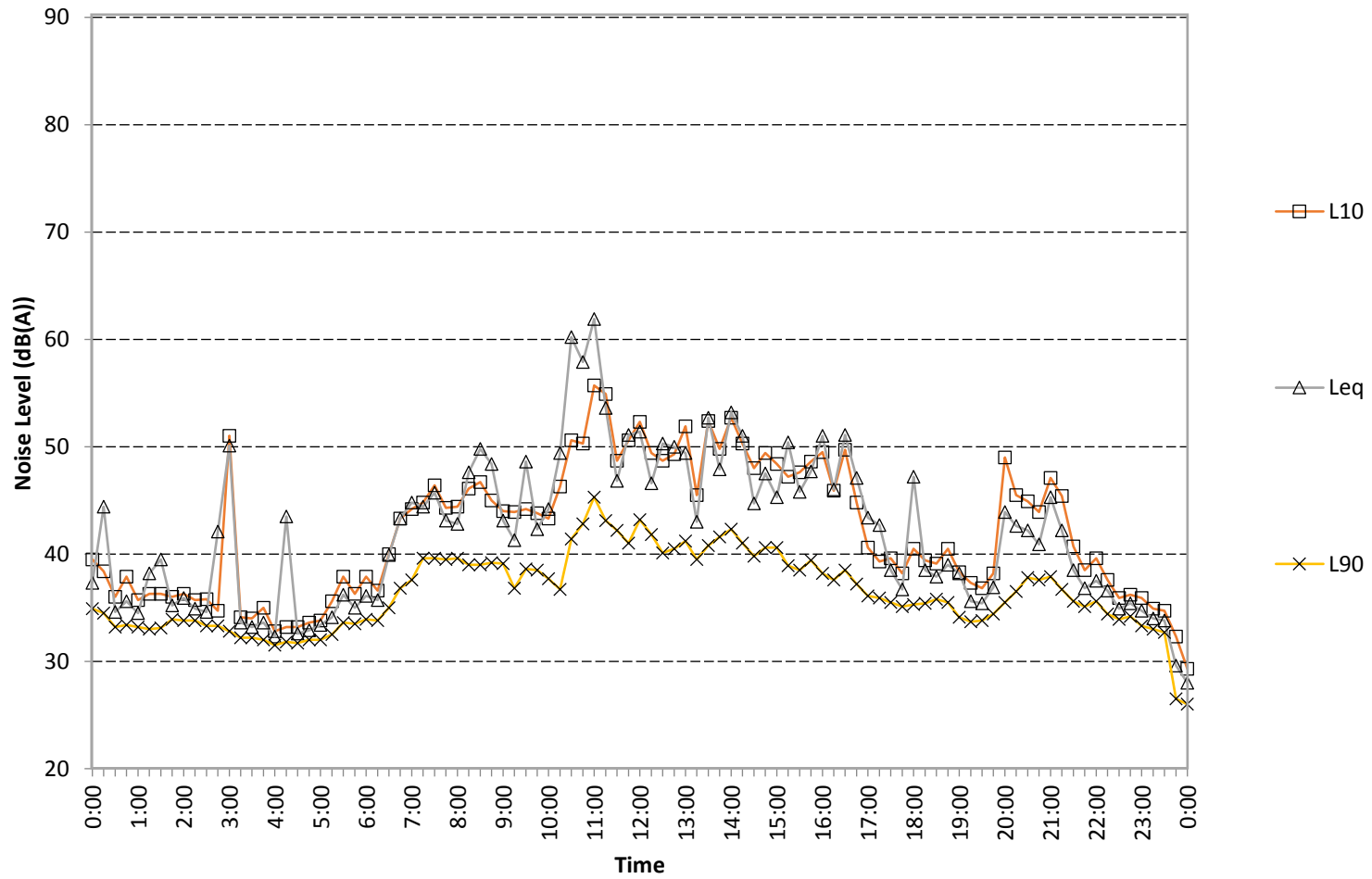
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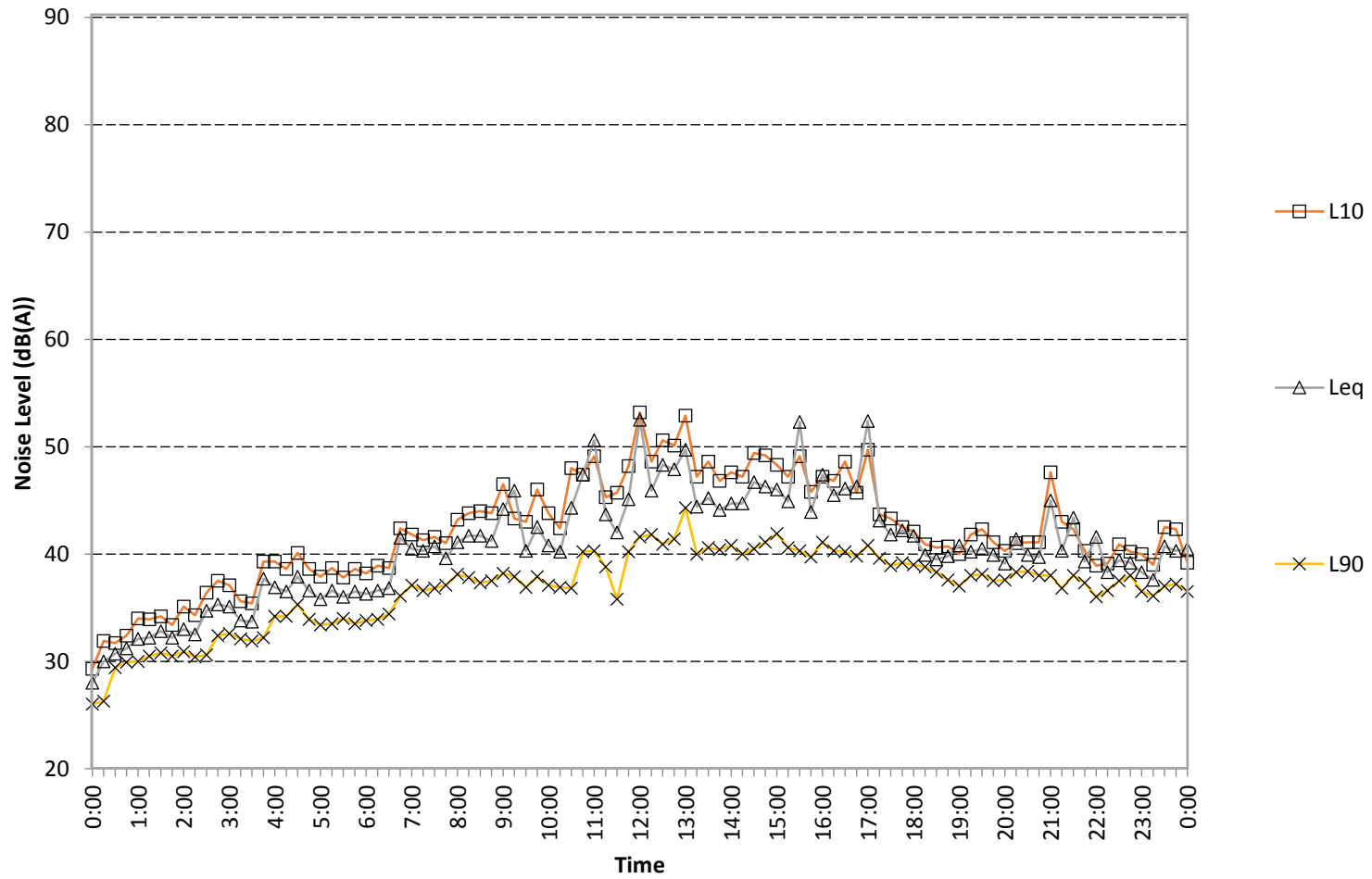
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Saturday July 12, 2014



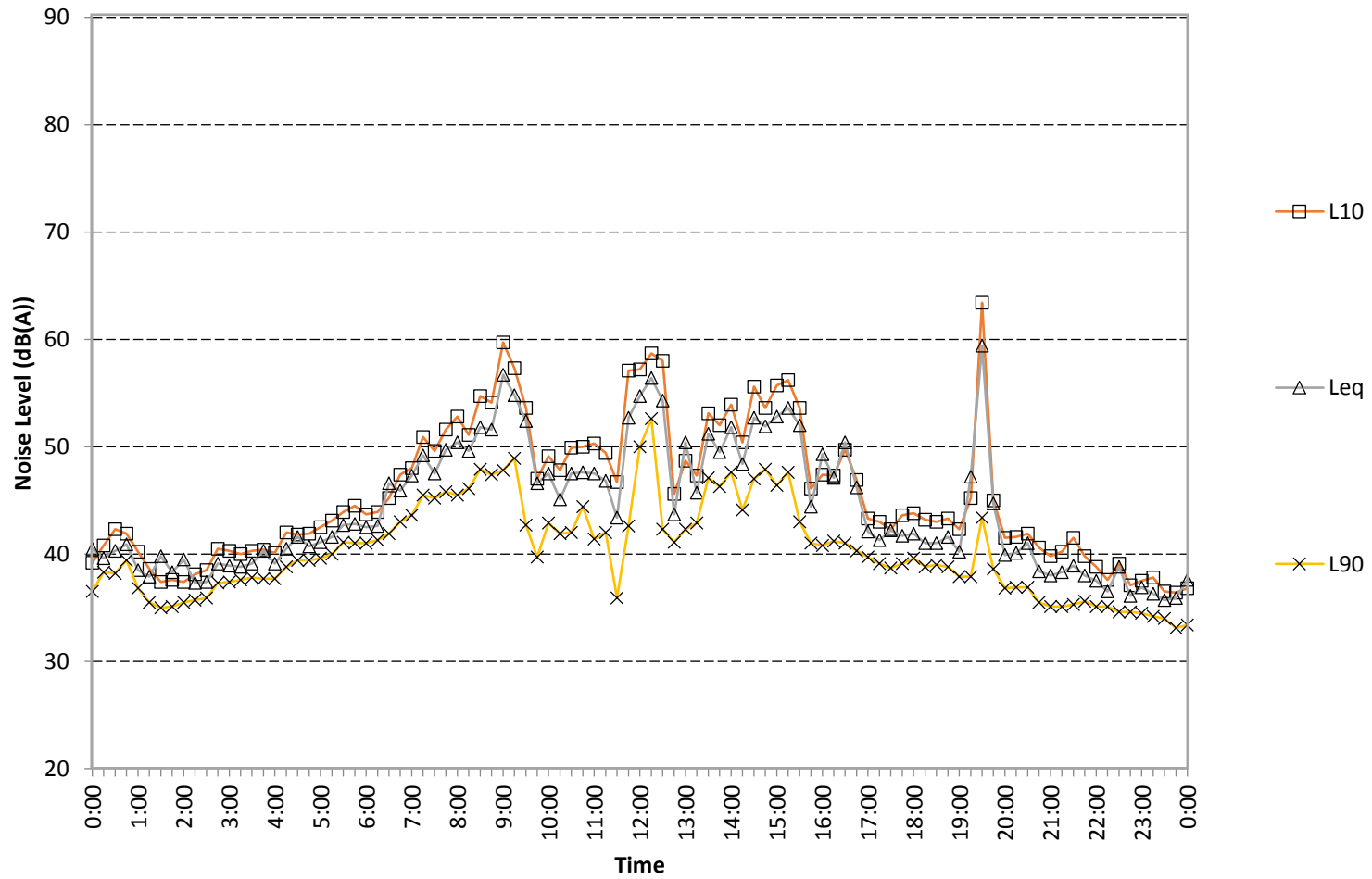
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Sunday July 13, 2014



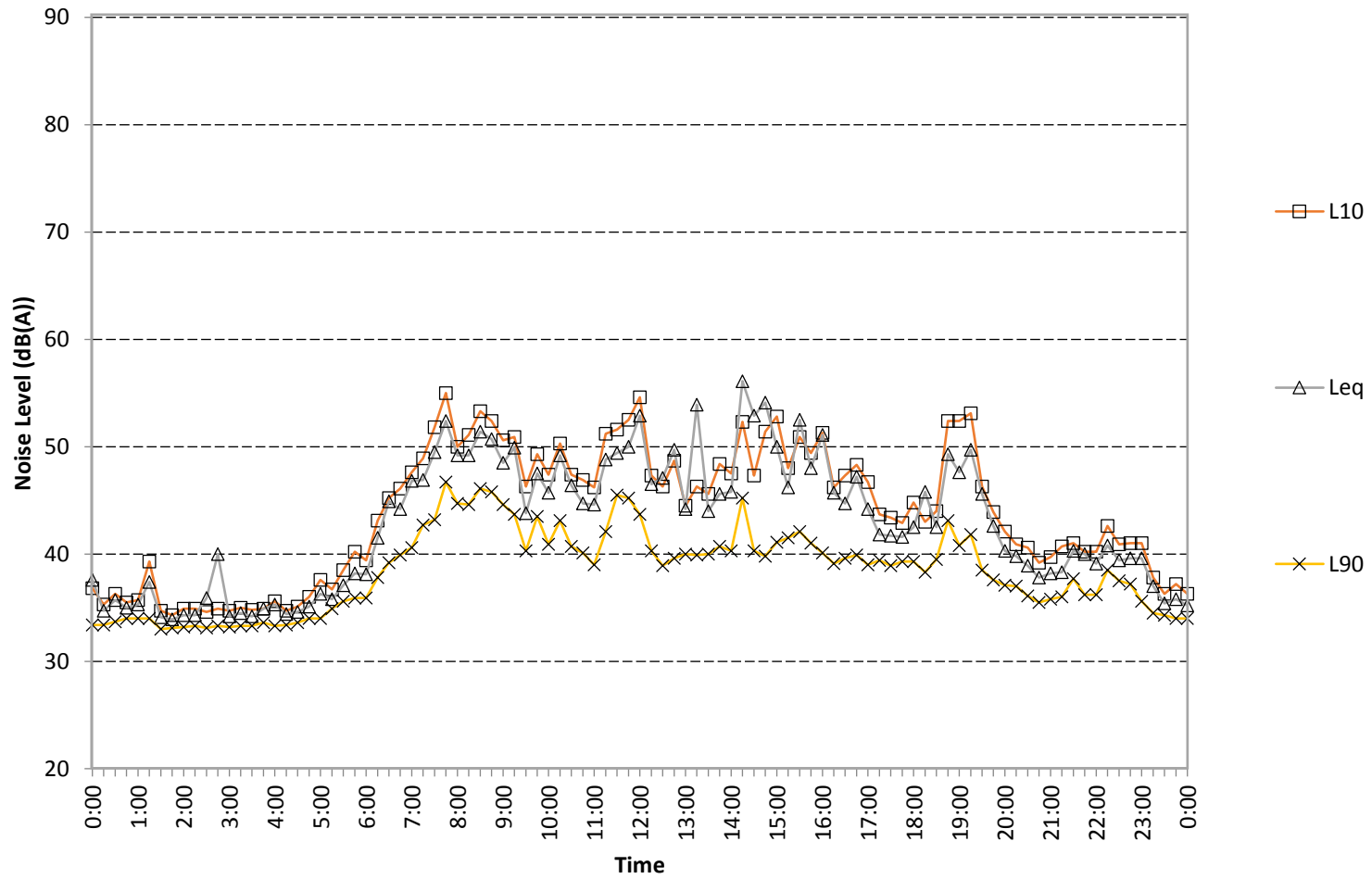
53C Warriewood Road, Warriewood

Monday July 14, 2014



53C Warriewood Road, Warriewood

Tuesday July 15, 2014



53C Warriewood Road, Warriewood

Wednesday July 16, 2014

