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Riverwood North Residential Renewal Project
Noise Impact Assessment

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1 INTRODUCTION

This report presents an analysis of acoustic impacts associated with the proposed Riverwood North Residential Renewal Project.

In this report we will:

- Conduct an external noise impact assessment (primarily traffic noise) and recommend acoustic treatments to ensure that a reasonable level of amenity is achieved for future tenants.

- Construction noise and vibration impact s during the building of the site.

2 SITE DESCRIPTION / PROPOSED DEVELOPMENT

The Riverwood North Residential Renewal Project seeks approval for a Concept Plan Application to enable the physical redevelopment of properties owned by Housing NSW to accommodate a mixture of private and public dwellings. The application seeks approval for the staged construction of modern well-designed residential flat buildings of up to nine storeys in height and accommodating approximately 650 dwellings.

Potential noise impacts on the site are primarily traffic noise from surrounding roadways, most notably the M5 Motorway which is located within the vicinity of the site to the north as well as Belmore Road to the east. Local roadways carry medium to low traffic volumes, while the M5 carries high traffic volumes and Belmore Road medium to high volumes.

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

Figure 1 – Site plan

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 NOISE IMPACT ASSESSMENT

Significant noise sources in the vicinity of the site are as follows:

- M5 motorway located to the north of the site.
- Belmore Road to the east of the site.

4.1 NOISE MEASUREMENTS

Measurement of traffic noise was conducted using both attended measurements and unattended monitoring.

4.1.1 Attended Measurements

Attended measurements were conducted surrounding the site as indicated in Figure 1 above. Measurements were conducted using a Norsonics Type 140 Precision Sound Level Analyser. The Precision Sound Level Analyser was calibrated at the beginning and the end of the measurement using a Norsonics Type 1251 Precision Sound Level Calibrator. No significant drift was noted. All measurements were conducted on A-weighted fast response mode. There were no significant periods of adverse weather conditions during the measurement period. Traffic noise measurements were conducted on 20th October, 2010. Figure 1 above details the attended measurement position.

4.1.2 Unattended Monitoring

Measurements of traffic noise impacting the site were recorded using an Acoustic Research Laboratories Pty Ltd noise logger. The logger was programmed to store 15-minute statistical noise levels throughout the unmanned 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. Unattended measurements were conducted between 15th and 20th October 2010. Figure 1 above details the unattended monitoring position.

The results of noise logging are included n Appendix A.

4.1.3 Measured Noise Levels

The measured noise levels as a result of attended measurements and unattended monitoring are presented in the table below. The results of measurements presented below will be used as the basis of this report.

Table 1– Measured Traffic Noise Levels

Location	Measurement Type	Time	Measured Noise Level
Riverwood North	Monitoring	24 Hour	58 dB(A)$L_{eq\ (24\ hour)}$
		Night (10pm-7am)	53 $L_{eq\ (9\ hour)}$
	Attended Measurements	4pm	62 $L_{eq\ (15\ min)}$

4.2 ACOUSTIC OBJECTIVES

Traffic noise criteria for the proposed development are shown below. These requirements have been assessed in accordance with AS 2107 (AS/NZS2107:200 “Acoustics-Recommended Design Sound Levels and Reverberation Times for Building Interiors”) and AS3671 (AS3671-1989 “Acoustics – Road Traffic Noise Intrusion – Building Siting & Construction”). Internal requirements are for residential units and are measured internally with windows closed and are based on the levels for developments nears minor roads.

Table 2 details the assessment criteria applicable for the development are provided below.

Table 2 – Internal Noise Level Criteria for Developments near Major Roads

LOCATION	CRITERIA	TIME PERIOD
Bedroom	$L_{eq\ (9\ hour)}$ 35 dB(A)	10pm to 7am
Living Room	$L_{eq\ (24hour)}$ 40 dB(A)	24 hours

4.3 RECOMMENDATIONS

Traffic noise intrusion into the proposed development is assessed using the measured external noise levels reported above as a basis. 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.

A preliminary review of traffic noise intrusion has revealed that compliance with acoustic guidelines is achievable with upgraded single glazing with acoustic seals.

The following table lists the recommended glazing assemblies for this project to achieve the requirements regarding traffic noise intrusion.

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. These additional considerations may require the glazing thickness to be increased beyond the acoustic requirement.

Table 3 – Recommended Glazing

Room Type	Glazing Thickness	Acoustic Seals
Bedrooms	6mm Flaot	Yes
Living Rooms	6mm Flaot	Yes
Wet Areas	4mm Float	No

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 4 for all rooms. Where nominated, this will require the use of acoustic seals around the full perimeter of openable frames and the frame will need to be sealed into the building opening using a flexible sealant. Note that mohair seals in windows and doors are not acceptable where acoustic seals are required.

Table 4 – Minimum STC of Glazing

Glazing Assembly	Acoustic Seals	Minimum STC of Installed Window
6mm float	Yes	28
4mm Float	No	22

5 TRAIN NOISE AND VIBRATION

A preliminary investigation of train noise and vibration impacting the site has been conducted. The investigation was conducted in conjunction with the requirements of the NSW Department of Planning's policy, Development Near Rail Corridors And Busy Roads – Interim Guideline, sets out internal noise level criteria adapted from the State Environmental Planning Policy (Infrastructure) 2007 (the 'Infrastructure SEPP') for developments with the potential to be impacted by rail noise and vibration.

The SEPP states that developments within 60m of train lines are required to be assessed for the potential of noise and vibration impact. As the proposed site is located approximately 800m from the site, which is in excess of the 60m stated within the SEPP, a detailed acoustic assessment os not required to be conducted.

As detailed in the section above the predominant noise source impacting the site is traffic noise from surrounding roadways. The recommended treatments detailed in the section above to mitigate traffic noise impact on the site will be sufficient for the treatment of train noise intrusion.

6 CONSTRUCTION NOISE MANAGEMENT

This section of the report presents the approach to noise management of the construction of the proposed residential development. The study has been undertaken to determine the levels of noise emissions, which will result at the various premises which either border or are in close proximity to the site.

The report identifies that noise levels will vary from the different construction processes and external and internal finishing will generate potential noise impact to surrounding receivers. Noise levels from all activities are calculated to all potentially worst affected receiver locations. If noise levels are acceptable at these locations they will also be acceptable further a field.

The results of the calculations are presented in a tabulated form for each receiver location. The tables identify provide the following information;

1. The time period,
2. The subject construction activity,
3. The resultant noise level at the affected premises, the calculated noise levels also take into account any mitigative measures which will be applied to the construction activities, and represent the attenuated level.
4. The measured background noise levels,
5. The relative magnitude of the activity to the background noise level.
6. The resultant internal noise levels at the receiver location from the subject construction activity,
7. Internal noise criteria based on Australian Standard 2107-2000 “Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors”
8. The relative magnitude of the activity to the nominated internal noise criterion.
9. The construction noise criterion,
10. The nomination whether noise from the construction activity complies with the nominated criterion.

A critical component of this report is the formulation of noise control strategies for all the different construction processes. These strategies include the formulation of site management procedures, whether they can be operational or time based. The formulation of mitigate treatments including the erection of noise barriers, wrapping of hydraulic hammers and the selection of alternate equipment. The practicable achievable noise reduction from the attenuation measures is determined and included in the calculations of noise impact. The level of attenuation which may be potentially provided is either calculated or based on measurements taken on other construction projects. A detailed noise management plan forms part of this report.

The objective of this study in all cases is to minimise noise emissions from the construction process.

In the report construction noise criteria are formulated based on the following factors;

1. The sensitivity of the various receiver locations,

2. A consideration of the procedures and requirements set out Australian Standard 2436-1981 *“Guide to Noise Control on Construction, Maintenance and Demolition Sites”*.

3. The fact that no construction site in Sydney can strictly comply with a background + 10dB(A) criterion, whether it is a larger scale construction or the construction of a domestic residence. Note, the operation of a power saw in domestic construction may generate levels of noise which are 10 to 40dB(A) above the background noise level.

4. Practices implemented by the DECC to regulate noise levels where it is not possible to comply with a background + 10dB(A) criterion.

5. The requirements to control noise emissions from the construction site to levels, which does not cause undue disturbance to the identified receiver locations.

6. The noise mitigation measures available.

The calculated noise levels presented in this report will be verified by on-site manned measurements, and a noise monitoring programme. In addition, the implementation of noise control measures as detailed in this report will also be monitored, and an appropriate reporting format will be devised so that this information can be presented to Council on a regular basis.

6.1 NOISE CONTROL STRATEGY

This report presents the strategy which will be followed to regulate noise emissions from the construction of the proposed residential development. This section presents the constraints of the current DECC Conditions and discusses alternative suitable criteria with justification.

6.1.1 CONSTRUCTION NOISE CRITERION

The application of the standard criteria DECC environmental criterion to a major construction site represents a non-workable and unrealistic approach. Activity on a building site takes place over a period of time and involves a series of complicated processes and activities, from, construction, the delivery of materials to site, to the pumping of concrete, and the erection of building structure. All these processes generally occur in the open, and are required for the erection of a building. It is practically impossible to reduce noise emissions from these activities to a standard such as 5dB(A) above background.

It is noted that the DECC apply a +5dB(A) criteria to continuous operating air conditioning and mechanical plant. When DECC noise criteria are applied to operational plant on industrial, commercial and residential premises, design measures can be implemented to reduce noise emissions to within this criterion. These measures generally involve constructing a building or enclosure around the noise source to contain the noise. However, on a building site, this type of approach is totally unrealistic. It is very difficult to implement the degree of noise reduction to construction processes, which would be required by the imposition of such a criterion, i.e. 5dB(A) above background.

In this regard, it is appropriate to note that if the standard DECC criterion of 5 dB(A) above background was applied to building sites throughout Sydney, and was strictly enforced, no building work would take place for the simple reason that it would be impossible to comply. The DECC and Council's would have to halt all building work. Nothing would be built.

This does not only apply to commercial construction but also to small scale domestic work. For example, the noise emission from a single detached dwelling being built in the suburbs would easily exceed 5dB(A) above background. Every time an electric saw or a hammer used, a bobcat brought on-site, or a cement mixer arriving to pour a ground slab, noise levels would exceed background by between 10 to 40dB(A).

Where a specific noise criterion has been applied to a site and has been found to be inappropriate and/ or unworkable, the authorities have exhibited suitable flexibility in amending the criterion to permit construction work to proceed as expeditiously as possible. Appropriate noise management plans have been prepared and submitted to the authorities to satisfy concern that all reasonable construction management techniques are being applied to mitigate noise levels at adjacent residential and/ or business premises.

Examples of such major construction works are:

A. 1 Bligh Street, Sydney

B. Innovation Place, North Sydney

C. 40 Miller Street, North Sydney

D. Broadway Shopping Centre

E. The Sydney Hilton

6.1.2 Suitable Noise Standards for Construction Noise

AS2436-1981 is the standard, which is applied by other city councils for the regulation of construction noise and represents a practical and acceptable application for the control of construction noise. The standard recommends in Section 3, that care be taken in applying criteria that normally would be used to regulate noise emitted from industrial, commercial and residential premises to construction, particularly for those activities which are transitory and of short duration. In other words, AS2436-1981 clearly recommends against the use of highly conservative criteria for construction sites.

For the control and regulation of noise from demolition, excavation and construction sites AS2436 nominates the following:

1. That reasonable suitable noise criterion is established.

2. 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.

3. The undertaking of noise monitoring to assist in the management and control of noise emission from the building site.

6.1.3 Noise management

The finding of this report, which studied the noise impact of the site, indicated that *'the site can work during normal construction hours and fully comply with the above proposed criteria'.*

6.2 STUDY OVERVIEW

This report presents evaluation of potential noise emissions from the construction of the proposed reconfiguration of the residential development at Riverwood North.

The following report presents a number of proposed strategies to be used to reduce *Environmental Noise Impact* and the possibility of complaint.

The aim of this study is to undertake an analysis of noise impact arising from site activities undertaken in normal construction hours, that is typically (or as stated in the conditions of consent):

- Between 7:00am and 6:00pm, Mondays to Fridays inclusive;
- Between 7:00am and 4:00pm, Mondays to Fridays inclusive for vehicles over 8 tonne;
- Between 7:00am and 4:00pm, Saturdays, if inaudible on residential premises and between 8:00am and 1:00pm, Saturdays, if audible on residential premises;
- No work on Sundays and public holidays.

During the above hours it is anticipated that works will fully comply with suitable noise control criteria. These activities will be carefully managed and appropriate noise mitigative measures will be strictly implemented where required. The formulation of noise management plans for the various activities will arise from the assessment carried out in this report and the strict enforcement of all determined control measures.

6.3 CONSTRUCTION NOISE CASE STUDY EXAMPLE

The level of noise generated by a construction site is largely dependent on the activities, which are in progress. It can not be categorically stated that all construction sites emit the same level of noise no matter what stage or part of the construction programme they are at.

The generalisation, that all construction work is noisy is fallacious. The levels of noise generated are dependent on the activities occurring. In addition, it is possible to undertake construction work in a controlled manner so that noise is minimised. This requires the formulation of noise control strategies, and stringent supervision.

A study of a typical construction site is presented below to show the varying levels of noise generation from various activities.

6.3.1 Categorisation of construction activities

The construction activities, which occur during the typical process in constructing a building from start to finish, can be separated into five categories, namely;

1. Demolition

2. Erection of structure

3. Installation of facade/external finishes

4. Internal fit out/internal finishes

The noise levels generated by each of these activities will vary and be largely dependent on the process undertaken. The graph below illustrates typical sound pressure levels resultant at a residential location (approximately 55 metres) from an active construction site. The levels in the table below are derived from measured field attenuation from the GPO Re-Development, No. 1 Martin Place site to a residential receiver. As such these levels represent a real case scenario and are not theoretical. The objective of presenting these sound levels is to present a relative comparison between the five categories of construction activities described above. The comparative levels presented below indicate the maximum noise, which can be generated by the specific activities.

6.4 DEMOLITION

The demolition process will involve the removal of all existing buildings and structures in a single phase of work. The demolition will be undertaken by Housing NSW using the 'development without consent' provisions contained within the Affordable Housing SEPP and as such, does not form part of the Concept Plan application.

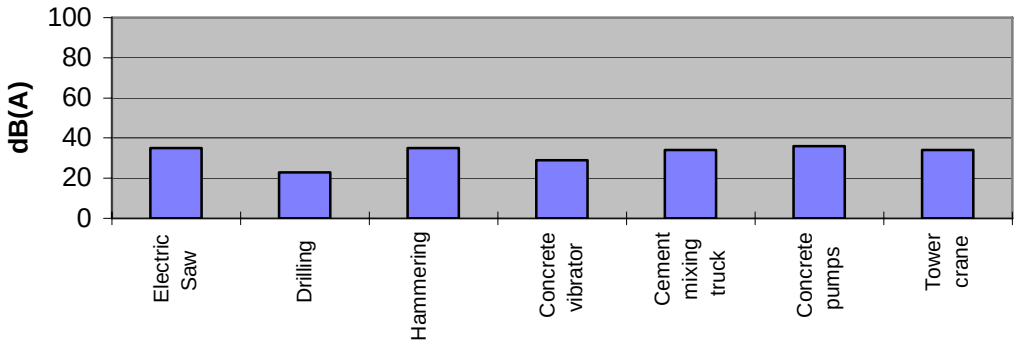
Demolition will be conducted using small demolition equipment such as hand held hammers etc. The period of the process will potentially generate the highest levels of noise during the proposed construction period.

6.5 ERECTION OF STRUCTURE

This activity refers to the erection of the structure of the building, which includes lift cores, and general building structure. Lift cores are generally constructed in advance of the remainder of the building structure using either jump or slip forms.

The general processes involved in this activity include the delivery of materials, erection of formwork, installation of structural steel, pouring of concrete, and stripping of formwork. All materials for form working and structural steel are transported to the work face using the site tower cranes and man/material hoist. Concrete is pumped up the building using concrete pumps.

COMPARISON OF NOISE LEVELS EMITTED BY DIFFERENT PROCESSES DURING ERECTION OF STRUCTURE



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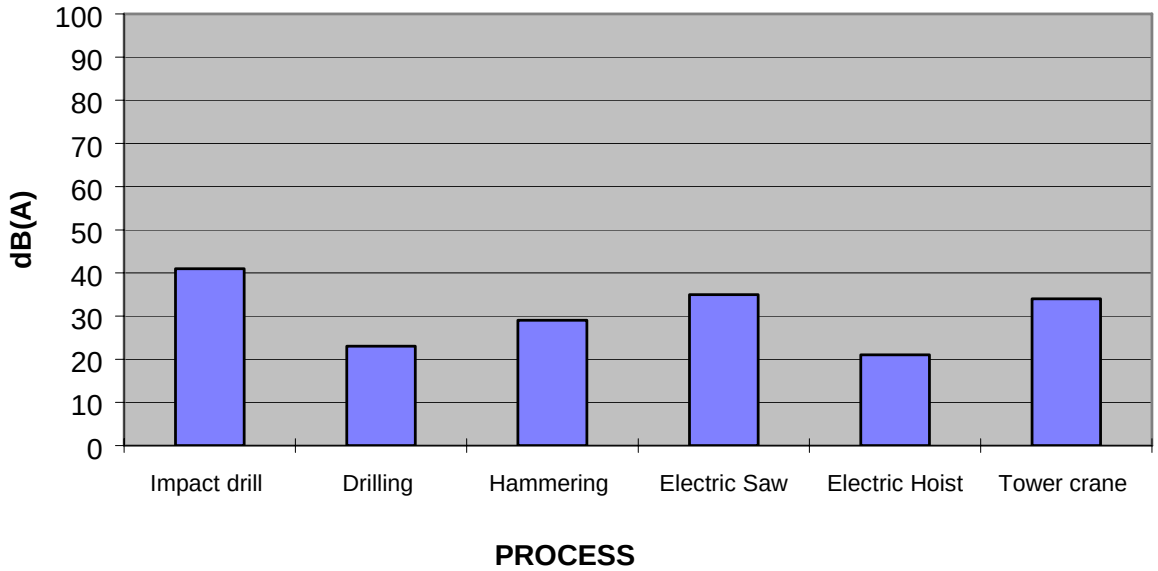
6.6 EXTERNAL FINISHES

This can involve processes ranging from the erection of facade systems, curtain walls pre-cast etc, to the installation of windows and the fixing of stone. Typical noise levels, which may be generated by this activity, are illustrated in the chart, which follows.

COMPARISON OF NOISE LEVELS EMITTED BY DIFFERENT PROCESSES DURING EXTERNAL FINISHES



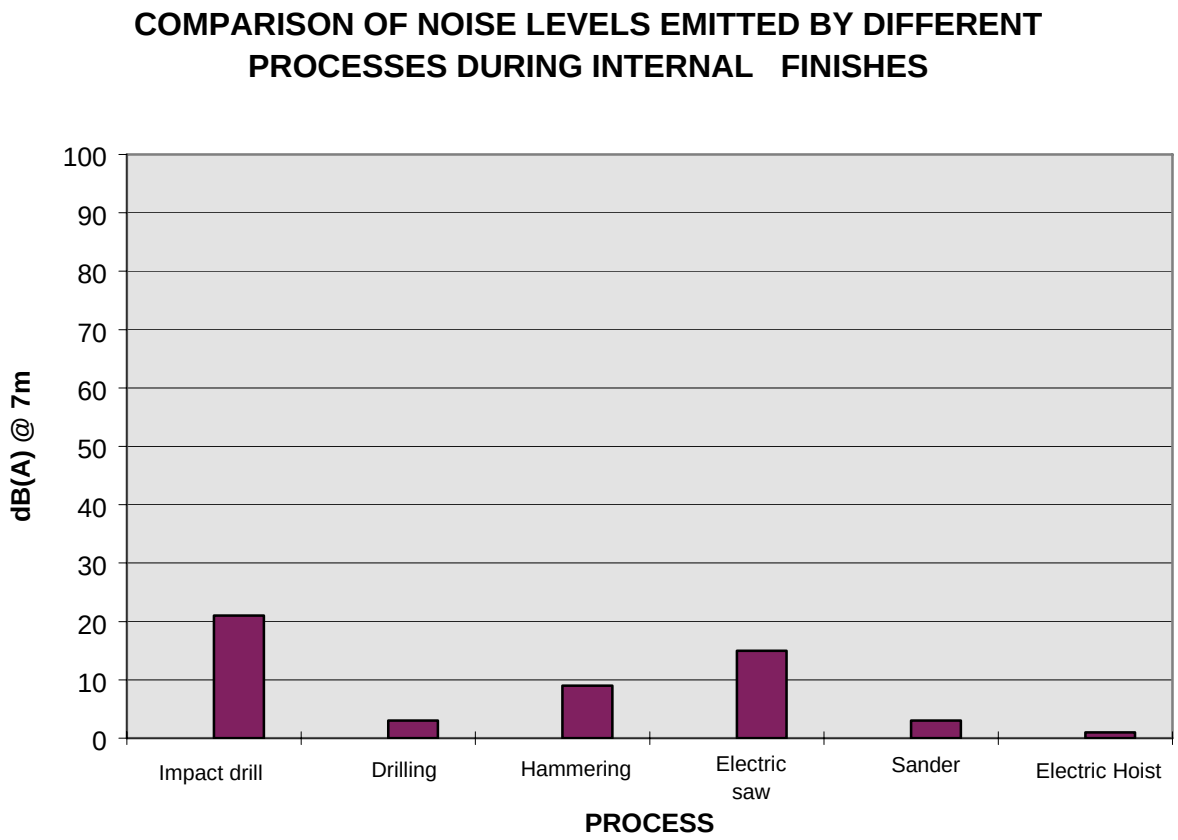
6.7 INTERNAL FINISHES

This involves all internal fit out work including painting, partitioning joinery and the laying of carpet and other finishes, as well as the installation of services.

This work is generally carried out once the facades have been erected. All work covered under this section will be contained within the building, with the facade providing a barrier to the direct transmission of noise to the exterior.

The services work includes plumbing mechanical, lifts, fire and electrical.

Typical noise levels, which may be generated by this activity, are illustrated in the chart, which follows.



The above histogram clearly shows that noise levels emitted from this activity are significantly quieter than the four previously discussed activities

6.8 DISCUSSION

From the information presented in the above section it can be clearly seen that the noise emitted from a construction site will be dependent on which activities are taking place. More specifically, the particular process within those activities. For example there is a difference of 16dB(A) between using a hydraulic hammer and loading a truck.

6.9 SITE DESCRIPTION AND POTENTIALLY AFFECTED LOCATIONS

The site of the subject site at Riverwood North is set amongst adjoining residential land uses. The following are the residential and other noise sensitive locations in close proximity to the site.

Location 1. The nearest residences are situated adjacent to the site to the south and west.

As construction will be carried out during 7:00am to 6:00 pm Monday to Friday and 7:00am to 4:00pm on Saturdays the above listed premises will not be affected at night

6.10 NOISE CRITERIA

The criteria, which are proposed for this study, are aimed at maintaining comfort levels within the surrounding residential buildings. The criteria as nominated in Section 3 of this report is the adoption of criteria presented in the DA Condition B14 along with the principles of AS2436.

6.11 VIBRATION CRITERIA

Canada Bay Council in its Determination of Major Project Application proposes two sets of vibration criteria in Condition D10, namely:

- German Standard DIN 4150-3 (1999-02): *"Structural Vibration – Effects of Vibration on Structures"*; and
- British Standard BS 6472:1992 *"Guide to Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)*.

The criteria and the application of these Standards are discussed in separate sections below.

6.11.1 German Standard DIN 4150-3 (1999-02)

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria presented in DIN 4150-3 (1999-02) are presented in Table 1.

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 5– 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
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (eg buildings that are under a preservation order)	3	3 to 8	8 to 10	8

6.11.2 British Standard BS 6472:1992

British Standard BS 6472:1992 develops criteria relating to levels of building vibration that may be expected to give rise to *"adverse comment"*, in the frequency range most applicable to impacts associated with construction, which is 1 to 80Hz. These threshold values are used as criteria for assessing the loss of amenity and are presented below in Table 6.

Table 6– BS 6472:1992 Criteria to Avoid *"Adverse Comment"*

Type of Occupancy	Time of Day	Peak Particle Velocity (mms^{-1}) between 1Hz to 80Hz Likely to Cause *"Adverse Comment"*			
		Continuous Vibration		Intermittent Vibration and Impulsive Vibration Excitation with Several Occurrences per day	
		Vertical	Horizontal	Vertical	Horizontal
Residential	Day	0.3 to 0.6	0.8 to 0.6	8.4 to 12.6	24 to 36
	Night	0.2	0.6	2.8	8
Offices	Day	0.6	1.6	18	51
	Night	0.6	1.6	18	51
Workshops	Day	1.2	3.2	18	51
	Night	1.2	3.2	18	51

The limits indicate that people in buildings are significantly less susceptible to horizontal vibration than to vertical vibration. Furthermore, Section 4.1 of BS 6472 notes that situations can exist where vibration magnitudes above those generally corresponding to minimal *"adverse comment"* levels can be tolerated, particularly for temporary disturbances and infrequent and intermittent events such as those associated with construction projects.

6.12 DETERMINATION OF CONSTRUCTION NOISE IMPACT

Using the noise levels presented in Table 4 below, the resultant noise impact was determined at the worst affected locations. These locations were identified in the Section above. If noise levels comply with the criteria at these locations, then they will be acceptable at all other locations.

All construction noise sources were assumed to be located at the nearest point on the construction site to the receiver locations under study. In this way the worst and majority case noise level situations are determined, with noise levels arising from an activity occurring on any other part of the site being equal to or lower than those determined for the nearest point scenario.

The calculations determine the $L_{A,avmax}$ noise levels over a 15-minute period, from all sources, which may operate simultaneously. Noise emanating from the respective activities will comply with the required criterion, provided all noise from all individual plant and equipment comply.

6.13 SOUND POWER LEVELS

Noise impact will be determined from all processes and equipment, which are involved in the activities outlined below by defining the levels of sound, which they generate.

The A-weighted sound power levels for all the component parts of the above-described activities are outlined in the tables below.

Table 7: Sound Power Levels

CONSTRUCTION ACTIVITY	EQUIPMENT /PROCESS	SOUND POWER LEVEL - dB(A)
Construction	Angle Grinders	114
	Electric Saw	111
	Drilling	94
	Hammering	110
	Concrete Vibrator	100
	Cement Mixing Truck	105
	Concrete Pumps	107

The noise levels presented in the above table are derived from the following sources, namely:

1. On-site measurements
2. Table D2 of Australian Standard 2436-1981
3. Data held by this office from other similar studies.

6.13.1 Degree of Sensitivity

In performing the assessment of noise impact, a rating of sensitivity was formulated for the receiver locations. The rating system involves the ranking of receiver locations into one of three categories. The categories are labelled as RC1 (Residential Receiver 1).

Where noise generation potential exceeds noise sensitivity ratings assuming installation of reasonable work practices to mitigate the noise, then the recommendation will be that these activities be confined to shorter extensions of hours.

6.13.2 noise generation potential

In addition to the aforementioned sensitivity ratings, a rating class system was formulated for the proposed activities. The class system is as follows;

HN: High noise generating activity.
MN: Medium noise generating activity.
LN: Low noise generating activity.

6.13.3 Construction Noise Impact Assessment

This section presents an assessment of potential noise impacts arising from the activities described above.

The assessment takes the form of a series of matrices which present;

- the noise source and its respective noise generation potential,
- the receiver location and its respective noise sensitivity rating, and
- Mitigation strategies to minimise and manage noise emissions from the works.

The following tables present a summary matrix at the various receiver locations from the proposed site activities.

Table 8 - Weekdays

LOCATION 1			
Activity	Noise Generation Potential	Receiver Category	Noise Mitigation Strategies
Piling	MN – HN	*RC1*	1,2,4,6
Excavation and Detailed Excavation	MN		1,2,4,6
Construction	LN – MN		1,2,3,4,5,6

Table 9 - Weekends

LOCATION 1			
Activity	Noise Generation Potential	Receiver Category	Noise Mitigation Strategies
Piling	MN - HN	*RC1*	1,3,4,6
Excavation and Detailed Excavation	MN		1,3,4,6
Construction	LN - MN		1,2,3,4,5,6

The mitigation strategies are presented as a series of numbers which will be explained later in this report in Section 6.14.**1 to .6** below.

6.14 SELECTION OF ALTERNATE APPLIANCE OR PROCESS FOR PILING

It is noted that CFA/Bored piling will be utilised where practical to minimize impact driven piling and thus reduce noise levels at the receivers by up to 15dB(A).

6.14.1 SELECTION OF ALTERNATE APPLIANCE OR PROCESS FOR EXCAVATION

Where practical alternative quieter process will be utilised in order to limit noise emissions to receivers.

6.14.2 PROVISION OF ACOUSTIC BARRIER

Noise barriers or screens can be an effective means of reducing noise. Noise barriers can be located either at the source or receiver.

The placement of barriers at the source is generally only effective for static plant (tower cranes). Equipment which is on the move or working in rough or undulating terrain cannot be effectively attenuated by placing barriers at the source.

Barriers can also be placed between the source and the receiver.

The degree of noise reduction provided by barriers is dependant on the amount by which line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15 dB(A) can be effected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8 dB(A) may be achieved. Where no line of sight is obstructed by the barrier, generally no noise reduction will occur.

As barriers are used to provide shielding and do not act as an enclosure, the material they are constructed from should have a noise reduction performance which is approximately 10dB(A) greater than the maximum reduction provided by the barrier. Where the barrier obscures the line of sight, noise reduction of approximately 5 to 10 dB(A) will be achieved at the locater site.

6.14.3 SILENCING DEVICES

All main appliances used will be fitted with silencing devices. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts. Noise reductions in the order of 10-20 dB(A) will result.

6.14.4 MATERIAL HANDLING

The material handling areas will be located away from residential receiver areas.

6.14.5 TREATMENT OF SPECIFIC EQUIPMENT

In certain cases it may be possible to specially modify a piece of equipment to dramatically reduce the sound levels emitted.

6.14.6 ESTABLISHMENT OF SITE PRACTICES

This involves the formulation of work practices to reduce noise generation. A noise plan will be developed for this project outlining work procedures and methods for minimising noise. This plan will target work practices and worker behaviour.

6.15 DISCUSSION

The above section presented a discussion on the measures which will be implemented to minimise noise emissions on this project. Note these measures are initial, as further measures may be devised and implemented during the course of the project once construction is underway.

To determine the requirement for silencing devices on machinery it is proposed to undertake a fortnightly noise check. Noise levels will be measured of all machines on site and if they are found to be higher than nominated for that equipment type, items such as mufflers and engine shrouds will be examined to ensure they are in good working order.

A record of these measurements will be kept on a form similar *"Construction Appliance Compliance Certificate"* presented in the Appendix.

This measure is expected to maintain noise at constant levels, and prevent any increases.

6.16 ESTABLISHMENT OF DIRECT COMMUNICATION WITH AFFECTED PARTIES

In order for any construction noise management programme to work effectively, continual communication is required between all parties, which may be potentially impacted upon, the builder and the regulatory authority. This establishes a dynamic response process, which allows for the adjustment of control methods and criteria for the benefit of all parties.

The objective in undertaking a consultation process is to:

Inform and educate the groups about the project and the noise controls being implemented.

Increase understanding of all acoustic issues related to the project and options available.

Identify group concerns generated by the project, so that they can be addressed.

6.17 COMMUNITY INTERACTION AND COMPLAINTS HANDLING

6.17.1 Establishment of Direct Communication with Affected Parties

In order for any construction noise management programme to work effectively, continual communication is required between all parties which may be potentially impacted upon, the builder and the regulatory authority. This establishes a dynamic response process which allows for the adjustment of control methods and criteria for the benefit of all parties.

The objective in undertaking a consultation processes is to:

- Inform and educate the groups about the project and the noise controls being implemented.
- Increase understanding of all acoustic issues related to the project and options available.
- Identify group concerns generated by the project, so that they can be addressed.
- Ensure that concerned individuals or groups are aware of and have access to the Complaints Register which will be used to address any construction noise related problems should they arise.

To ensure that this process is effective, regular scheduled meetings will be required for a finite period, until all issues have been addressed and the evidence of successful implementation is embraced by all parties.

An additional step in this process is to produce a newsletter informing nearby residents of upcoming activities that are likely to generate higher noise/vibration levels.

6.17.2 Dealing with Complaints

Should ongoing complaints of excessive noise or vibration criteria occur immediate measures shall be undertaken to investigate the complaint, the cause of the exceedances and identify the required changes to work practices. In the case of an exceedances of the vibration limits all work potentially producing vibration shall cease until the exceedance is investigated.

The effectiveness of any changes shall be verified before continuing. Documentation and training of site staff shall occur to ensure the practices that produced the exceedances are not repeated.

If a noise complaint is received the complaint should be recorded on a Noise Complaint Form. The complaint form should list:

- The name and address of the complainant (if provided).
- The time and date the complaint was received.
- The nature of the complaint and the time and date the noise was heard.
- The name of the employee who received the complaint.
- Actions taken to investigate the complaint, and a summary of the results of the investigation.
- Required remedial action, if required.

- Validation of the remedial action.
- Summary of feedback to the complainant.

A permanent register of complaints should be held.

All complaints received should be fully investigated and reported to management. The complainant should also be notified of the results and actions arising from the investigation.

The investigation of a complaint shall involve where applicable, noise measurements at the affected receiver, an investigation of the activities occurring at the time of the incident, inspection of the activity to determine whether any undue noise is being emitted by equipment, and whether work practices being carried out either within established guidelines or outside these guidelines.

Where an item of plant is found to be emitting excessive noise, the cause is to be rectified at soon as possible. Where work practices within established guidelines are found to result in excessive noise being generated then the guidelines should be modified so as to reduce noise emissions to acceptable levels. Where guidelines are not being followed the additional training and counselling of employees should be carried out.

The results of any corrective actions arising from a complaint shall be validated by measurement or other method where applicable.

6.17.3 Dealing with Exceedences

Should exceedances of the noise or vibration criteria occur immediate measures shall be undertaken to investigate the cause of the exceedances and identify the required changes to work practices. In the case of exceedances of the vibration limits all work potentially producing vibration shall immediately cease until the exceedances is investigated.

The effectiveness of any changes shall be verified before continuing. Documentation and training of site staff shall occur to ensure the practices that produced the exceedances are not repeated.

6.18 STATEMENT OF INTENT TO COMPLY

The calculation procedure used to predict the noise levels above has been verified with field measurements on building sites in the inner city including the Grace Plaza, GPO, 400 George Street, Aston and Sydney Central Plaza projects.

In addition, a contact number of the Liaison Officer will be advertised outside the building site, so that residents and other interested parties may contact him, should they believe a noise breech is occurring.

7 CONCLUSION

This report provides the results of Environmental Noise Study for the proposed Riverwood North Residential Renewal project. Noise at the site has been measured and noise goals have been set in accordance with the requirements of the local council and relevant statutory/regulatory authorities.

Traffic noise has been assessed and acoustic criteria for internal noise levels have been presented in Section 4.

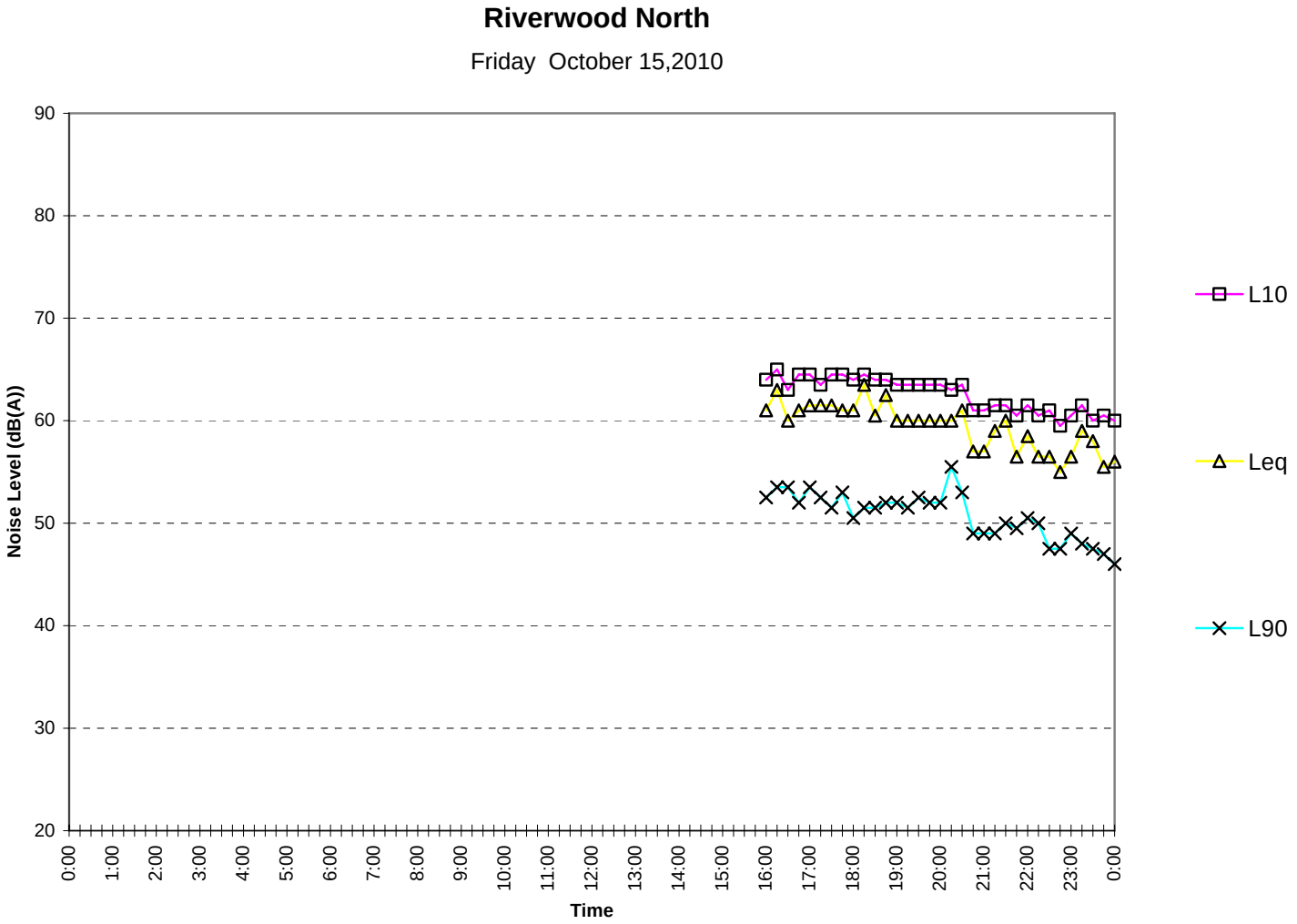
An assessment of train noise and vibration was conducted and no additional acoustic treatments are required due to the sites proximity to the nearest train line.

Section 6 of the report presents a study into the potential for construction noise and vibration impacts to surrounding sites and presents a methodology for the management of noise imcpat to surrounding receivers.

Report prepared by

Acoustic Logic Consultancy Pty Ltd
Ben White

Appendix A – Noise Logging Results


Riverwood North
Friday October 15,2010
Noise Level (dB(A))
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70
60
50
40
30
20
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
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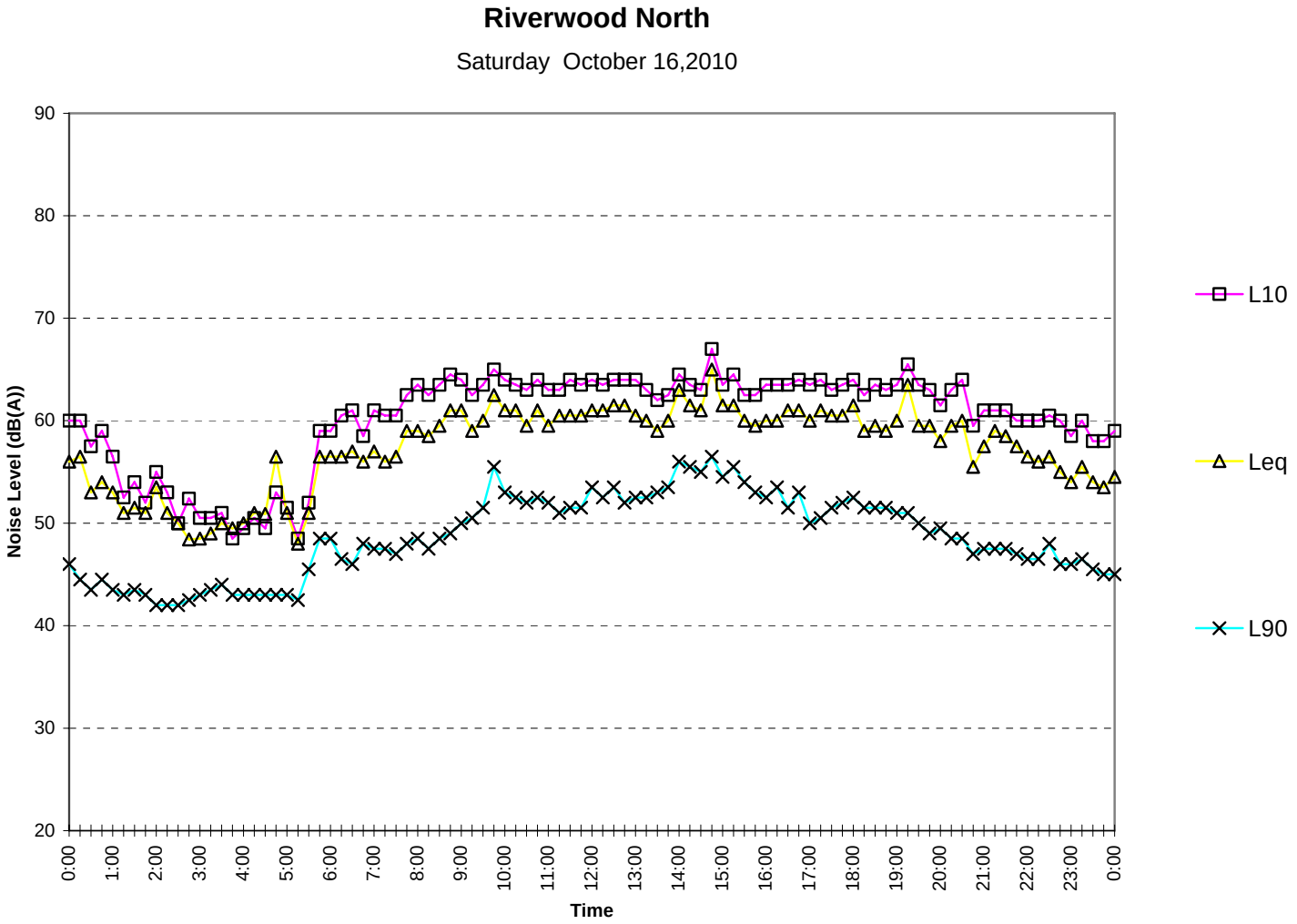
Time
L10
Leq
L90


Riverwood North
Saturday October 16,2010
Noise Level (dB(A))
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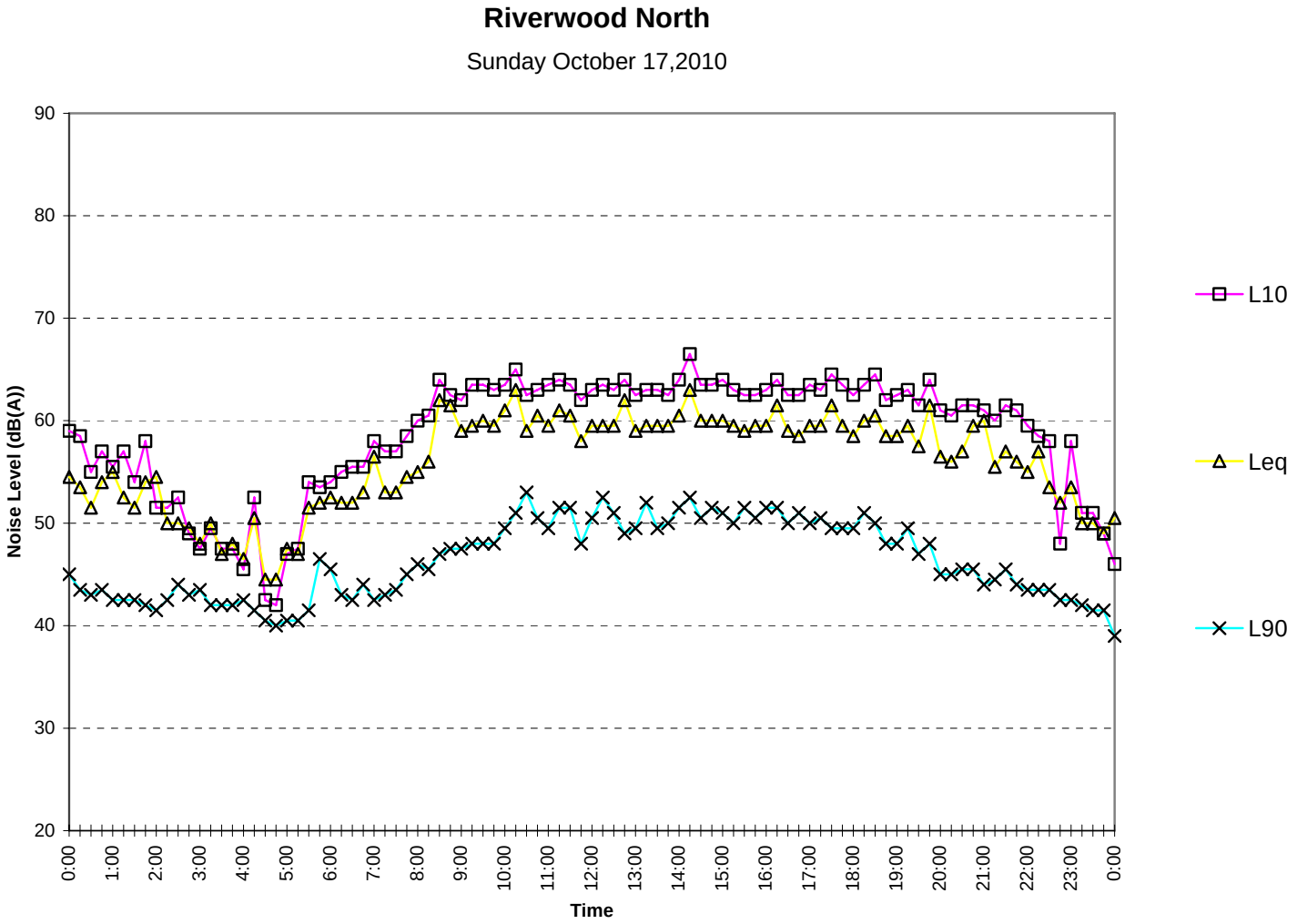
Riverwood North
Sunday October 17,2010
Noise Level (dB(A))
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50
40
30
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0:00
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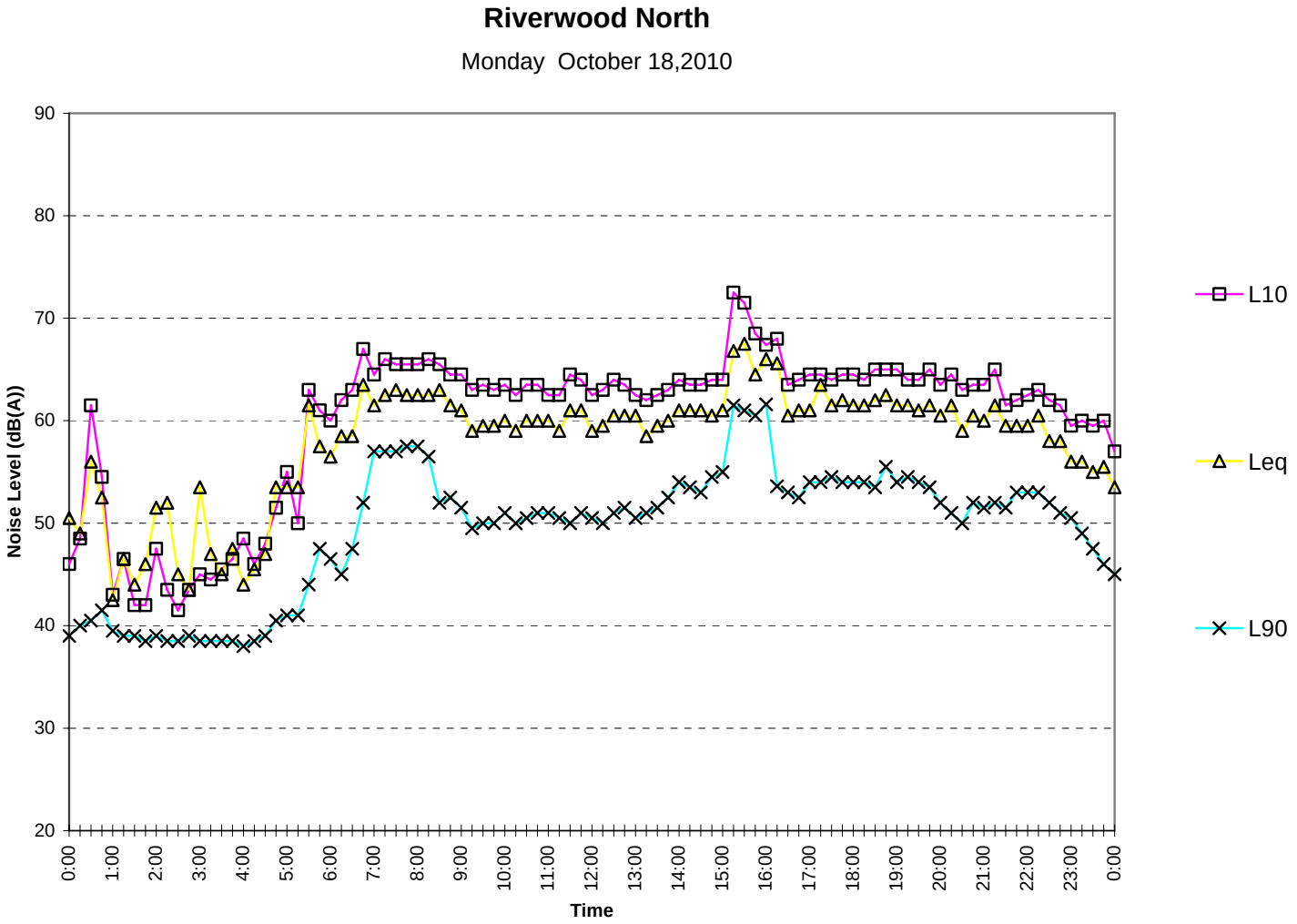
Riverwood North
Monday October 18,2010
Noise Level (dB(A))
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40
30
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0:00
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4:00
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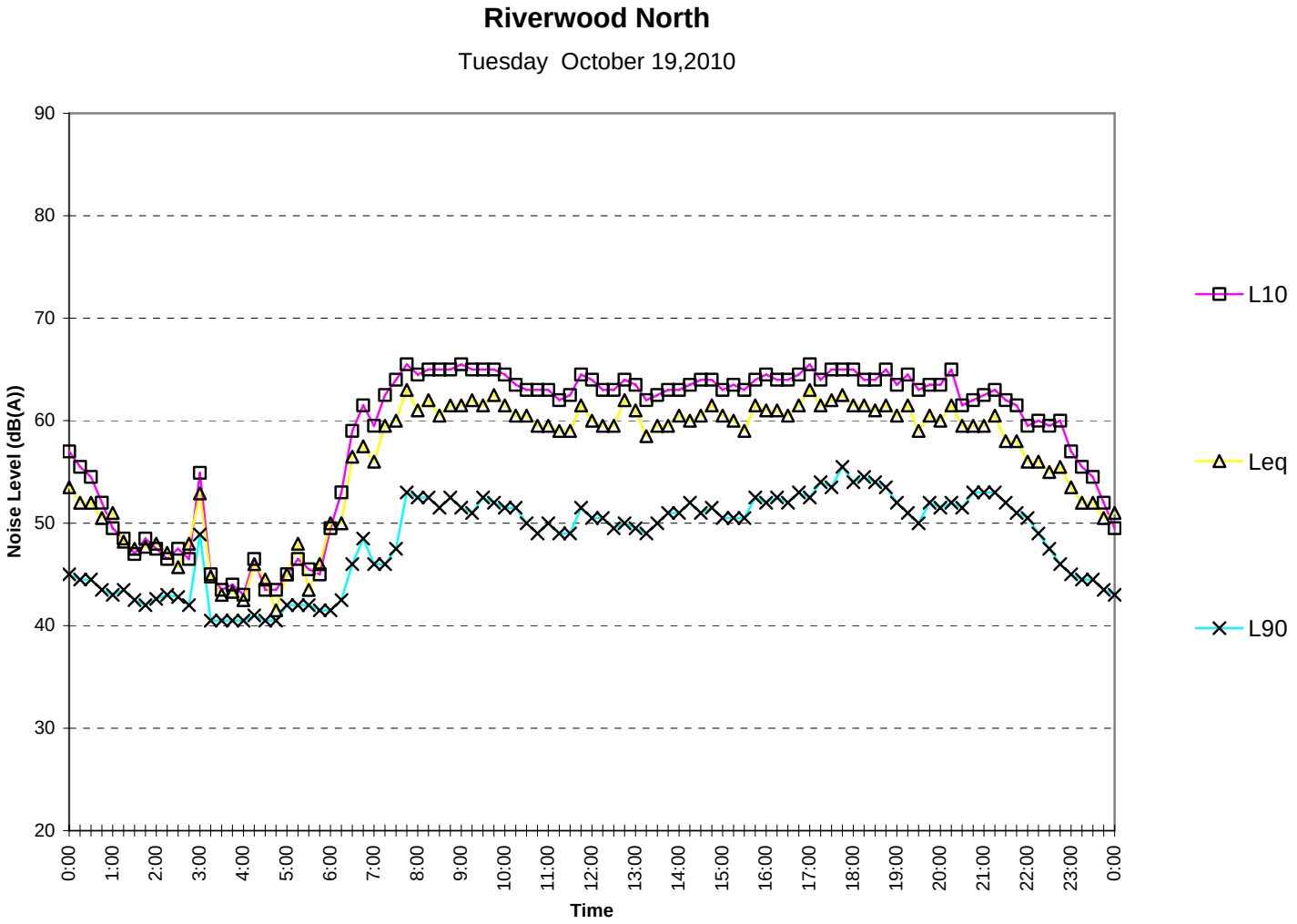
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Tuesday October 19,2010
Noise Level (dB(A))
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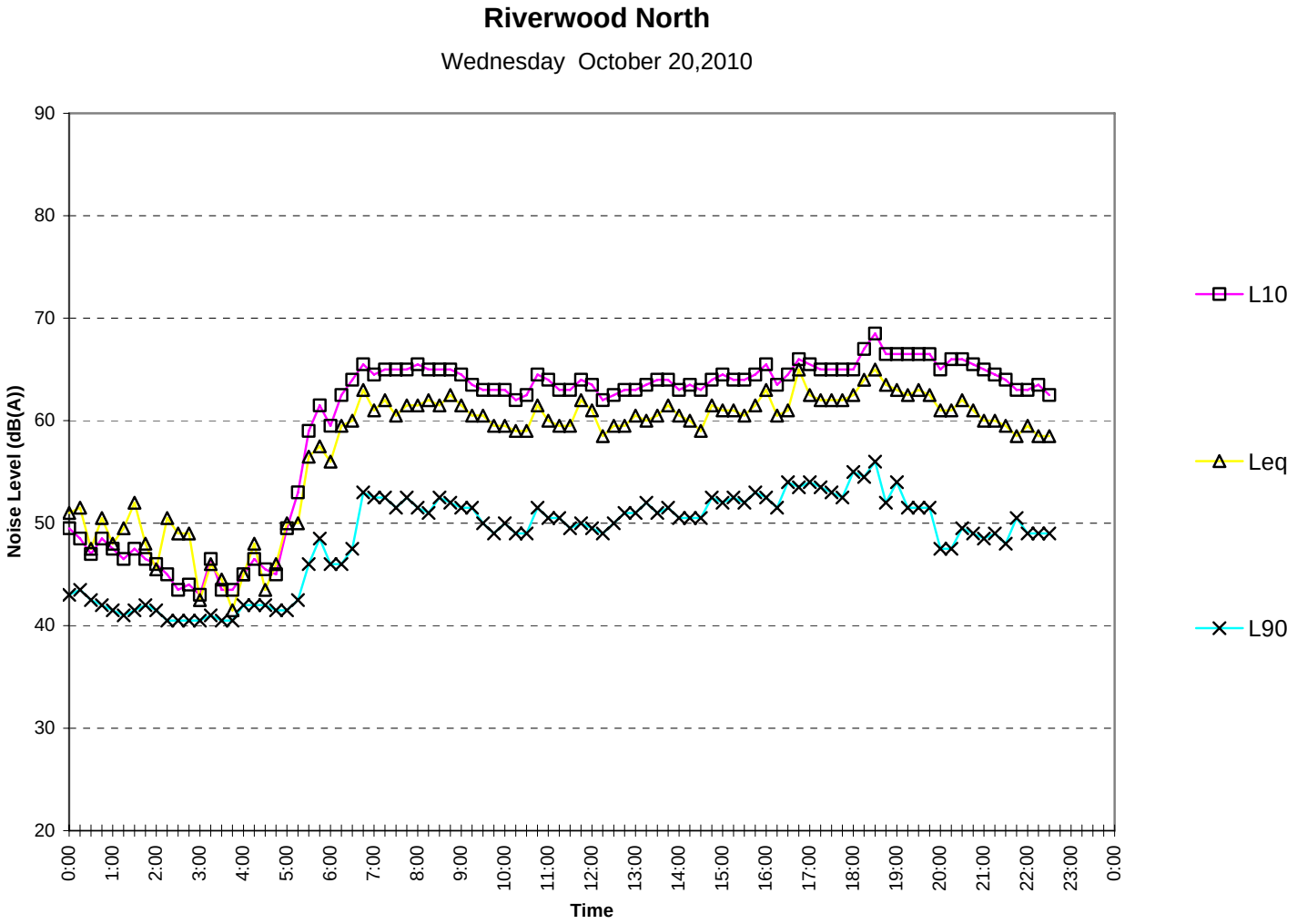
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Noise Level (dB(A))
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3:00
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0:00
Time
L10
Leq
L90