ACOUSTICS AND AIR

KELLYVILLE SOUTH PUBLIC SCHOOL DEVELOPMENT APPLICATION

CONSTRUCTION & OPERATIONAL NOISE REPORT

REPORT NO. 15227-KS
VERSION C

FEBRUARY 2017

PREPARED FOR

DEPARTMENT OF EDUCATION
C/- TKD ARCHITECTS
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DOCUMENT CONTROL

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TABLE OF CONTENTS

GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

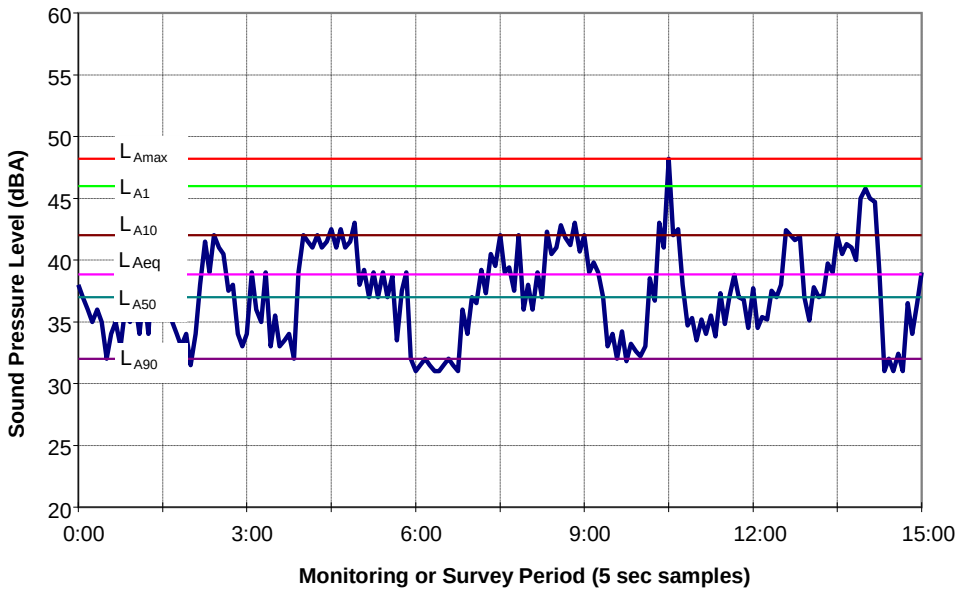
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

This has been prepared by Wilkinson Murray on behalf of the New South Wales Department of Education (the 'Applicant'). It accompanies an Environmental Impact Statement (EIS) prepared in support of State Significant Development Application SSD 16_7787 for the development of 'Kellyville South Public School' at Nos. 21-23 Fairway Drive, Kellyville (the 'site').

The site, Lot 11 DP 247442 and Lot 501 DP 1130020 is located within the Hills Shire Local Government Area at the Balmoral Road Release Area. The site is rectangular in shape, has a total area of 35,004m2 and contains a 180m street frontage to Fairway Drive to the east.

Kellyville South Public School (the 'School') is proposed to facilitate up-to 1000 students to take enrolment pressure off surrounding primary schools exceeding student capacity. The primary school will contain high quality classrooms, collaborative learning spaces, open play spaces, sports courts and associated facilities.

The purpose of this assessment is to assess potential noise and vibration impacts as detailed within the EIS.

This application seeks development approval comprising primary school buildings and shared enlarged facilities which include the following:

Shared Facility	Comments
Multi-purpose Sports Hall	Sports Hall to be upgraded from the schools minimum EFSG required hall 550m^2 in order to accommodate 2x basketball courts
Sports Field	Additional 600m x 68m soccer pitch in order to accommodate minimum adult sized soccer
Sports Field Amenities	Additional amenities that can be incorporated with the Sports Hall but accessed from the Sports Field

Wilkinson Murray Pty Limited has reviewed and assessed the drawings and relevant documentation prepared in respect of this State Significant Development (SSD 7787) submission.

The acoustic requirements are detailed in item 10 of the SEARs as follow:

> 10 Noise and Vibration
>
> Identify and provide a quantitative assessment of the main noise and vibrating sources during construction and operation (including any public-address system, school bell and use of School Hall for concerts etc.) and outline measures to minimise and mitigate potential noise impacts on surrounding occupiers of land.
>
> Provide a noise impact of nearby rail corridors and busy roads.
>
> Relevant Policies and Guidelines
>
> - *NSW Industrial Noise Policy (EPA);*
> - *Assessing Vibration: A technical guideline (EPA);*
> - *Interim Construction Noise Guideline (DECC);*

- *Bella Vista Station Precinct – Transport Plan (TfNSW 2015); and*
- *Development near Rail Corridors and Busy Road – Interim Guideline (Department of Planning.)*

It is noted that the site is not located near a rail corridor or busy road, therefore this issue is not relevant. It is also noted that the site is located on Fairway Drive which is classified as a local Road in the *Bella Vista Station Precinct – Transport Plan.*

2 SITE DESCRIPTION

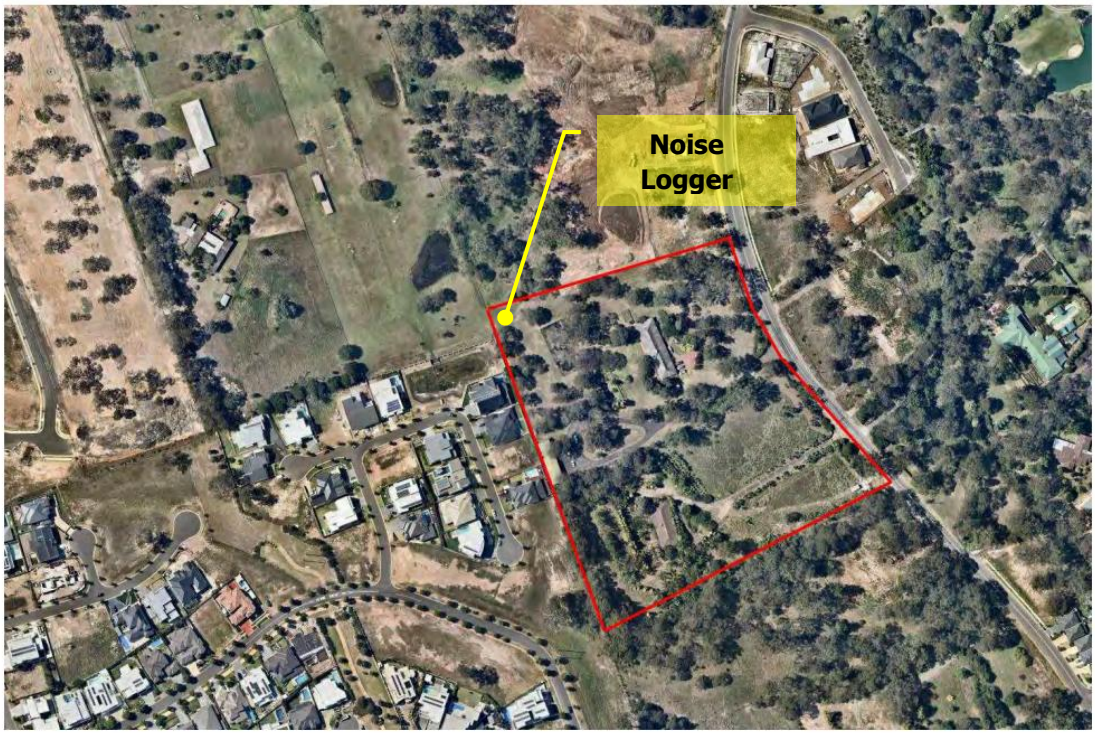
The site is located at 21-23 Fairway Drive, Kellyville and located over the following sites:

- Lot 11 DP 247442 & Lot 501 DP 1130020

The site is located 33km north-west of the Sydney central business district in the local government area of The Hills Shire. The existing site is approximately 3.5 hectares in area. The site is on the eastern site of the Bella Vista Station Precinct. Whilst the area is currently under development, it is envisaged that there will be significant residential development around the site in the future under the Precinct Plan.

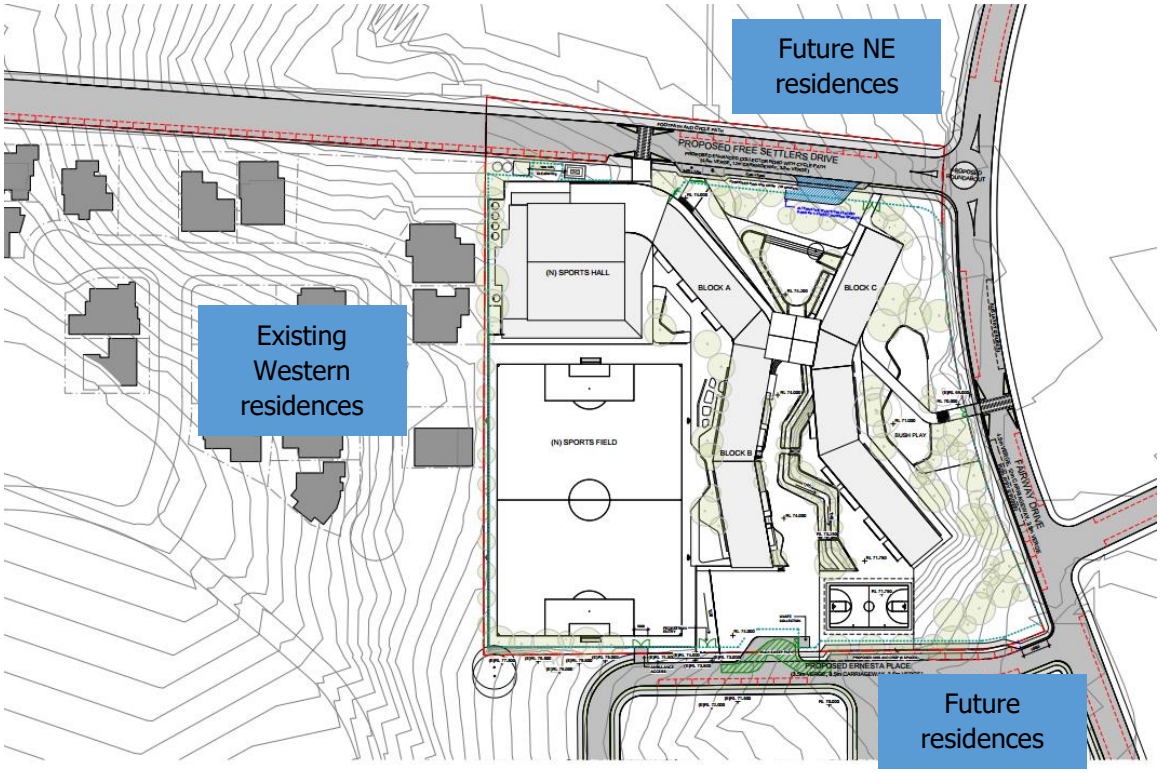
The site and nearest residences, which are to the west of the proposed shared Hall and Sport Facilities, are shown in Figure 2-1.

Figure 2-1 Site Layout



The Sports Hall and Sports Field along with the school layout are shown in **Figure 2-2**.

Figure 2-2 Proposed Site Plan



Proposed operating hours of the shared facilities.

Sports Field

- Operating Hours for the Facility - 7am to 11pm each day.
- On school days the school uses the field between 7am to 4pm and Council uses it from 4pm to 11pm.

Sports/Community Hall

- Operating Hours for the Facility - 7am to 11pm each day.
- On school days the school uses the hall from 7am to 6:30pm and Council uses it from 7pm to 11pm.

3 AMBIENT NOISE LEVELS

3.1 Ambient Noise Levels at Site

Residential receivers surrounding the site that may be affected by construction and operational noise are those located immediately to the west of the Hall and Sporting Field. These are the most potential affected residences. In addition, residences are located to the east of the school site on Fairway Drive. Future residences are proposed to the north of the site.

In order to quantify the existing noise environment, long-term ambient noise levels were monitored for a week from Thursday 9th February 2017 adjacent to existing residences on the Western side of the site surrounding the site as shown in Figure 2-1.

The noise monitoring equipment used for the Wilkinson Murray noise measurements consisted of an ARL Type EL-215 environmental noise logger set to A-weighted, fast response, continuously monitoring over 15-minute sampling periods. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted.

The logger determines L_{A1}, L_{A10}, L_{A90} and L_{ea} levels of the ambient noise. L_{A1}, L_{A10} and L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Glossary for definitions). The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional pass-by of a heavy vehicle. The L_{A90} level is normally taken as the background noise level during the relevant period.

Detailed results for each monitoring location are shown in graphical form in Appendix A. The graphs show measured values of L_{ea}, L_{A90}, L_{A10} and L_{A1} for each 15-minute monitoring period.

Table 3-1 summarises the noise results, for daytime, evening and night time periods as defined in the EPA's *Interim Construction Noise Guidelines (ICNG)* and the NSW *Industrial Noise Policy (INP)*.

Table 3-1 Summary of Measured Ambient Noise Levels

RBL (dBA)			$L_{Aeq,period}$ (dBA)		
Daytime 7am-6pm	**Evening 6-10pm**	**Night Time 10pm-7am**	**Daytime 7am-6pm**	**Evening 6-10pm**	**Night Time 10pm-7am**
38	40	36	48	47	42

4 CONSTRUCTION NOISE & VIBRATION ASSESSMENT

This section of the assessment relates to typical construction activities that are to occur on the western side of the site, which would represent the greatest impact on identified western residences.

4.1 Construction Noise Criteria

The following sections detail the applicable site-specific noise and vibration criteria based on the EPA *Interim Construction Noise Guideline*.

4.1.1 Construction Noise Management Levels

The EPA released the "*Interim Construction Noise Guideline*" *(ICNG)* in July 2009. The guideline provides noise goals that assist in assessing the impact of construction noise.

For residences, the basic daytime construction noise goal is that the $L_{Aeq,\ 15min}$ noise management level should not exceed the background noise by more than 10dBA. This is for standard hours Monday to Friday 7.00am-6.00pm, and Saturday 8.00am-1.00pm. Outside the standard hours, where construction is justified, the noise management level would be background + 5dBA. Table 4-1 details the *ICNG* noise management levels.

Table 4-1 Construction Noise Management Levels at Residences using Quantitative Assessment

Time of Day	Management Level $L_{Aeq,(15min)}$	How to Apply
Recommended Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Noise affected RBL + 10dBA	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq,(15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided.

Time of Day	Management Level $L_{Aeq,(15min)}$	How to Apply
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the guideline.

Based on the above, Table 4-2 presents the applicable noise management levels for construction activities at surrounding receivers that have been adopted for all applications.

Table 4-2 Site-Specific Construction Noise Management Levels

Construction Noise Management Level, L_{Aeq} – dBA			Highly Noise-Affected Noise Level, L_{Aeq} dBA
Day	Evening	Night	
48	45	41	75

4.2 Hours of Operation

The proposed working hours for this project, detailed in the Construction Management Plan are as follows:

- Monday to Friday 7.00am to 5.00pm
- Saturdays 8.00am to 1.00pm
- Sundays and Public Holidays No work

It is noted that standard EPA hours for Saturday are 8 am to 1 pm, however an additional hour is sought to ensure that effective work can be conducted on site during this shorter work day, thereby optimising the total construction period.

If required, after hours' permits will be sought from the relevant authorities.

4.3 Vibration Criteria

Criteria for assessment of the effects of vibration on human comfort are set out in British Standard 6472-1992. Methods and criteria in that Standard are used to set "preferred" and "maximum" vibration levels in the document "*Assessing Vibration: A Technical Guideline*" (2006) produced by the NSW DECCW.

Acceptable values of human exposure to continuous vibration, such as that associated with drilling, are dependent on the time of day and the activity taking place in the occupied space (e.g. workshop, office, residence or a vibration-critical area). Guidance on preferred values for continuous vibration is set out in Table 4-3.

Table 4-3 Criteria for Exposure to Continuous Vibration

Place	Time	Peak Particle Velocity (mm/s)	
		Preferred	Maximum
Critical working areas (e.g. hospital operating theatres precision laboratories)	Day or night time	0.14	0.28
Residences	Daytime	0.28	0.56
	Night time	0.20	0.40
Offices	Day or night time	0.56	1.1
Workshops	Day or night time	1.1	2.2

In the case of intermittent vibration, which is caused by plant such as rock breakers, the criteria are expressed as a Vibration Dose Value (VDV) and are presented in Table 4-4.

Table 4-4 Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

Location	Daytime		Night Time	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Critical areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Calculation of VDV requires knowledge of the number of events and their duration in the relevant time period.

4.3.1 Building Damage

In terms of the most recent relevant vibration damage objectives, Australian Standard AS 2187: Part 2-2006 *"Explosives – Storage and Use – Part 2: Use of Explosives"* recommends the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 *"Evaluation and measurement for vibration in buildings Part 2"*, as they "are applicable to Australian conditions".

The British Standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

The recommended limits (guide values) from BS7385 for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 4-5.

Table 4-5 Transient Vibration Guide Values – Minimal Risk of Cosmetic Damage

Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
	4 Hz to 15 Hz	15 Hz and Above
Reinforced or framed structures Industrial and heavy commercial buildings	50mm/s at 4 Hz and above	N/A
Un-reinforced or light framed structures Residential or light commercial type buildings	15mm/s at 4 Hz increasing to 20mm/s at 15 Hz	20mm/s at 15 Hz increasing to 50mm/s at 40 Hz and above

The Standard states that the guide values in Table 4-5 relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

The British Standard goes on to state that *"Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity"*. In addition, a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.

4.4 Construction Equipment & Noise Source Levels

Sound Power Levels (SWLs) for typical construction plant are identified in Table 4-6. These SWLs have been measured at other similar construction sites. The table gives both Sound Power Level and Sound Pressure Levels (SPL) at 7m for the equipment. Sound Power Level is independent of measurement position.

Table 4-6 Typical Construction Plant Sound Levels – dBA

Plant	Sound Power Level	Sound Pressure Level at 7m
Concrete Truck	109	84
Angle Grinder	109	84
Concrete Pump – 120 mm diameter / 50 bar	112	87
Mobile Crane	98	73
Dump Truck	108	83
Compressor	100	75
Bobcat	103	78
Hand Tools	90	65
Bulldozer	114	89
Auger Piling Rig	112	87
Crawler Crane	98	73
Front End Loader	112	87
Excavator	107	82

4.5 Construction Noise Predictions

Assessment of likely construction noise at surrounding receivers has been undertaken for the proposed construction works.

Site-related noise emissions were modeled with the "CadnaA" noise prediction program using the ISO 9613 noise prediction algorithms. Factors that are addressed in the noise modeling are:

- Equipment sound level emissions and location;
- Receiver locations;
- Ground topography;
- Noise attenuation due to geometric spreading;
- Ground absorption; and
- Atmospheric absorption.

Modelling has been conducted for a number of construction scenarios. The three works scenarios considered are summarised in Table 4-7.

Table 4-7 Construction Scenarios for Construction Works

Scenario	Description	Works
A	Western Piled Retaining Wall	Auger piling rig, excavator and mobile crane
B	Bulk Excavation	Bulk Excavation including weathered shale bedrock – mainly using excavators with dozers. Truck movements – loaded into trucks sent off site.
C	Building Construction	This scenario includes concreting and lifting. 1 concrete pump, 2 forklifts, 1 compressor, 1 crane, a boom truck are assumed to operate in 15minutes. Also, concrete trucks and normal delivery trucks.
D	Façade / Fitout	In the event that the construction of the facade occurs in isolation. Forklift, truck, mobile crane and power tools assumed. 2 truck movements in 15 minutes assumed.

Noise modelling has been conducted for each of the above scenarios with plant located across the western side of the construction site.

The modelling assumes a "typical worst-case" scenario whereby all plant, is running continuously. As such, the modelling represents likely noise levels that would occur during intensive periods of construction. Therefore, the presented noise levels can be considered in the upper range of noise levels that can be expected at surrounding receivers when the various construction scenarios occur.

Once noise sources have been applied to the model, the resultant noise levels at identified surrounding receivers are predicted. These results are then compared with established site-specific noise criteria.

Table 4-8 details results of construction noise modelling for each scenario.

Table 4-8 Predicted Construction Noise Levels at Residence – $L_{Aeq(15\ min)}$ – dBA

Residential Receiver	Predicted Noise Level	Day NML*	Exceedance
Scenario A – Western Wall Piling	70-80	48	22-32
Scenario B – Bulk Excavation	55-70	48	7-22
Scenario C – Building Construction	50-60	48	2-12
Scenario D – Façade / Fitout	50-60	48	2-12

4.6 Discussion of Results

The greatest potential impact from construction is during the construction of the western wall when piling occurs. This is due to the close proximity of these works to the nearest residences to the east of the site. The greatest noise will be from piling rigs when adjacent to residences. Whilst piling is expected to take up to 15 days, careful management will be required to minimise impact at residences.

It would be prudent to adopt localised mobile barriers where feasible.

A review of noise levels of other construction indicates exceedances of up to 22 dBA may occur particularly during bulk excavation. The highest noise levels are when works occur adjacent to the western residences. This magnitude of exceedance is not unusual for construction works in a relatively quiet residential area and can be managed by construction noise management procedures detailed in the following sections.

Based on these findings, the adoption of reasonable and feasible noise management and mitigation will be required. These measures should be determined in detail when a contractor, with defined construction techniques, has been engaged on the project. However, "in-principle" mitigation measures are detailed in the following sections.

4.7 Construction Vibration Assessment

Operation of piling rigs or rock breakers and the like generate ground vibration that has the potential to transmit to nearby buildings.

Table 4-10 sets out the typical ground vibration levels at various distances for safe working distances.

Table 4-10 Recommended Safe Working Distances for Vibration-Intensive Plant

Item	Description	Safe Working Distance	
		Cosmetic Damage	Human Response
Small Hydraulic Hammer	(300kg – 5 to 12t excavator)	2m	7m
Medium Hydraulic Hammer	(900kg – 12 to 18t excavator)	7m	23m
Large Hydraulic Hammer	(1600kg – 18 to 34t excavator)	22m	73m
Vibratory Pile Driver	Sheet piles	2m to 20m	20m
Pile Boring	≤ 800mm	2m (nominal)	N/A
Jackhammer	Hand held	1m (nominal)	Avoid contact with structure

- Construction Noise Strategy, 2012, Transportation Construction Authority

The highest vibration levels will occur when construction equipment is located on the western side of the site near residences on the eastern boundary.

A review of the site plant and surrounding receivers indicates that the minimum distance between the vibration generating activities and surrounding residences will be in the order of 8-10 metres. Therefore, the use of medium to any rock-breakers or vibratory rollers should be carefully managed at distances closer than 20 metres from these residences.

It is recommended that trial testing of vibration levels when piling occurs be conducted where identified equipment having the potential to exceed the human comfort criteria is proposed.

Structural damage vibration criteria in residential buildings are much higher than human comfort criteria, and predicted vibration levels are within these criteria under most circumstances. The exception, should heavy rock-breakers be used, is for areas near western residences on. Therefore, the uses of alternative excavation measures, such as rock-saws on excavators are recommended. If hammers are required, test vibration monitoring is recommended to ensure

that vibration levels at residences are not excessive.

4.8 Construction Noise & Vibration Mitigation Measures

Without mitigation, noise levels from construction activities have been predicted to exceed the noise management levels nominated in the guidelines at some surrounding receivers. Therefore, noise control measures are recommended to ensure that noise is reduced where feasible.

The following project-specific mitigation measures are recommended:

- Installation of localised noise barriers between piling rigs and western residences;
- Selection of quietest feasible construction equipment;
- Use of rock saws and ripping in preference to rock breakers if rock removal is required;
- Localised treatment, such as barriers, shrouds and the like around fixed plant, such as pumps, generators and concrete pumps;
- Provision of respite periods, particularly on Saturdays; and
- Trial testing of vibration levels is conducted where equipment is identified as having the potential to exceed the human comfort criteria.

In addition, the following measures should be included in a Noise and Vibration Management Plan.

- *Plant Noise Audit* – Noise emission levels of all critical items of mobile plant and equipment should be checked for compliance with noise limits appropriate to those items prior to the equipment going into regular service. To this end, testing should be established with the contractor.
- *Operator Instruction* – Operators should be trained in order to raise their awareness of potential noise problems and to increase their use of techniques to minimise noise emission.
- *Equipment Selection* – All fixed plant at the work sites should be appropriately selected, and where necessary, fitted with silencers, acoustical enclosures and other noise attenuation measures in order to ensure that the total noise emission from each work site complies with EPA guidelines.
- *Site Noise Planning* – Where practical, the layout and positioning of noise-producing plant and activities on each work site should be optimised to minimise noise emission levels.

The adoptions of the above measures are aimed at working towards achieving the noise management levels established at surrounding receivers.

4.9 Community Liaison & General Approaches to Mitigation

An effective community relations programme should be put in place to keep the community that has been identified as being potentially affected appraised of progress of the works, and to forewarn potentially affected groups (e.g. by letterbox drop, meetings with surrounding owners / tenants, etc.) of any anticipated changes in noise and vibration emissions prior to critical stages of the works, and to explain complaint procedures and response mechanisms. This programme should include a *Community and Stakeholder Engagement Strategy* developed specifically for the Project.

Close liaison should be maintained between the communities overlooking work sites and the parties associated with the construction works to provide effective feedback in regard to perceived emissions. In this manner, equipment selections and work activities can be coordinated where necessary to minimise disturbance to neighbouring communities, and to ensure prompt response to complaints, should they occur.

4.10 Noise & Vibration Management Plan

A construction Noise and Vibration Management Plan, consistent with the preliminary construction management plan, for the site is recommended which should be prepared by the successful contractor. The plan should reference the findings of this assessment. Areas that should be addressed in plan include:

- Noise and vibration mitigation measures
- Noise and vibration monitoring;
- Response to complaints**;**
- Responsibilities;
- Monitoring of noise emissions from plant items;
- Reporting and record keeping;
- Non-compliance and corrective action; and
- Community consultation and complaint handling.

5 OPERATIONAL NOISE

Operational noise from the proposed facilities will be from the following activities:

- Services noise from plant;
- School announcements and bells;
- Sporting events and concerts in the Hall;
- Sporting activities on the sports field.

5.1 Operational Noise Objectives

Noise impact from the general operation of the proposed facilities is to be assessed with respect to the site-specific noise criteria based on site monitoring and the NSW *Industrial Noise Policy (INP)* intrusive noise criteria.

Table 5-1 presents the intrusiveness criteria for all surrounding residential receiver areas. This was calculated by adding 5dB to the period background noise levels.

Table 5-1 Operational Intrusive Noise Criteria (All residences)

Intrusiveness Criterion $L_{Aeq,15min}$ (dBA)		
Daytime	**Evening**	**Night Time**
7.00am to 6.00pm	**6.00pm to 10.00pm**	**10.00pm to 7.00am**
43	43	41

5.2 Operational Mechanical Noise Assessment

Detailed specifications of mechanical services equipment that would otherwise allow an acoustic assessment of noise emission from the site are not available at this stage of the project as selection and design is conducted after project approval. In line with the approvals for other development, detailed assessment of operational noise emission should form a conditional requirement of the development to be satisfied prior to the issue of the construction certificate.

To mitigate noise from mechanical plant, silencers could be incorporated in the outlets of the exhaust fans and any possible roof top plant would be housed in a louvered acoustic barrier if required. The mechanical plant noise emission would be designed to meet the criteria presented in Table 5-1 at the closest receivers.

5.3 School Announcements & Bells

Announcements and school bells are typical activities associated with school operations. Typically, these are produced by the school PA system and can vary significantly depending on the final volume settings of the system.

At this stage, no design of the PA system has been determined. However, the following measures should be adopted to ensure that their impact at all surrounding residences is minimised:

- Speakers should be located and orientated to provide good coverage of the school areas whilst being directed away from residences. The coverage of the system should be subject of the detail design of the system.
- The volume of the system should be adjusted on site so that announcements and bells are clearly audible on the school site without being excessive. The system should initially be set so that noise at surrounding residences does not exceed the ambient noise levels by more than 5dBA.
- Once the appropriate level has been determined on site, the system should be limited to the acceptable level so that staff cannot increase noise levels.
- The system bell should be set so that it only occurs on school days.

5.4 Noise from Hall Operations

It is noted that the utility areas of the hall are to be located on the western and northern sides of the buildings that will act as a noise buffer to the closest existing and future residences in these directions.

Noise from normal school activities in class hours are not considered to be acoustically significant however the use of the hall for major events, such as concerts and sporting contests, particularly outside school hours, has the potential to adversely impact on residences.

Preliminary calculations have been conducted based on internal noise levels of between 95-100dBA which is considered typical noise levels for major events. Table 5-2 presents predicted noise levels at residences during major events with windows and doors open or closed.

Table 5-2 Predicted Noise Levels at Residences from Major Events in the Hall – $L_{Aeq,15min}$ dBA

Receivers	Windows / Doors	
	Open	Closed
Western Residences	60-65	35-40
North-Eastern Residences	50-55	30-35

A review of the above noise levels indicates that doors and windows of the hall should be closed during major events to protect the acoustic amenity of surrounding existing and future residences. The following allowances should be made, subject to detail design:

- Doors and windows should be able to be closed and have a minimum acoustic rating of R_W 34. Indicative glazing of 10.38mm laminated glass should be allowed.
- Walls and roof should have an acoustic rating of at least R_W 45.
- The sound system should have a noise limiter included in the system control so that internal noise levels, particularly low frequency noise, can be controlled.

5.5 Sporting Activities on the Oval

Sporting activities on the proposed oval will generate noise from players, spectators, whistles and announcements.

The noise from these activities are expected to be no different for any residences that are located next to similar sporting facilities. It is worth noting that some shielding of spectator noise will be provided by the western cutting when spectators are located on the western side of the oval.

Noise from PA should be limited by locating any sports related PA on the western side of the oval facing the oval and the school.

Table 5-3 is a summary of sound power levels associated with sports activities.

Table 5-3 Summary of Sound Power Levels

Activity	Typical SWL ($L_{Aeq,15min}$)
≈ 15 children playing outside during lunch time	95dBA
≈ 15 adults training rugby union	91dBA
≈ 15 adults playing rugby union with a small crowd	98dBA
≈ 15 children playing on a court with a small crowd	96dBA

Noise Levels when a small crowd and a match is occurring can be expected to be in the order of 55 dBA at upper levels of residences facing the sporting oval. When training occurs noise levels can be expected to be below 50 dBA. These levels are above noise objectives of 45 dBA (evening) and 40 dBA night.

In order to minimise reduce the potential impact at residences the following recommendations made:

- Limit the use of the sporting fields to the evening period between 6 pm and 10 pm
- Schedule any sporting contests to the early evening hour 6 pm – 8 pm where feasible.
- Avoid the use of whistles after 8 pm.

It is recommended that management of noise be included in any site management plan.

6 CONCLUSION

A construction and operational noise and vibration assessment of the Kellyville South Public School and shared facilities has been conducted. Site-specific noise criteria that are applicable to this entire project have been presented. A noise assessment has been conducted for the proposed construction activities associated with the development to determine the potential for noise and vibration impact at surrounding receivers. Exceedances of noise management levels are expected at nearby surrounding receivers.

Vibration associated with on-site construction activities has the potential to impact on residences to the west of the site should large equipment, such as rock breakers be used. Trial monitoring and selection of less vibration intensive equipment is recommended.

Accordingly, management of noise from construction activities will be required to be included in the Site Construction Environmental Management Plan.

Operational noise criteria for mechanical services and hall operations have been determined for the project. A review of all plant with respect to site specific noise criteria is required at detailed design stage. At this stage, any necessary noise mitigation should be determined and included in the detailed design of mechanical design.

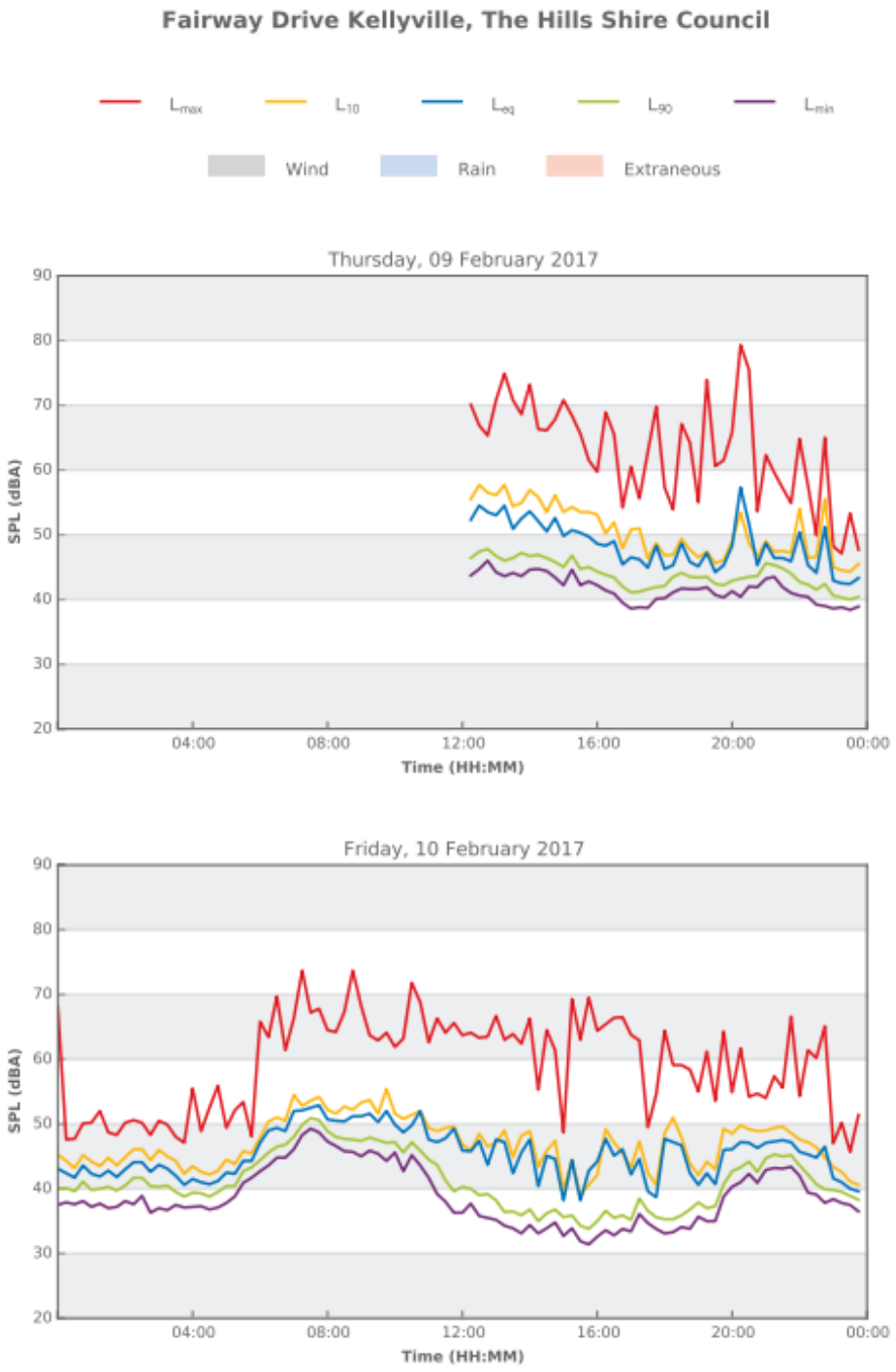
Operation of the Hall outside school hours for major sporting activities and concerts will required door and windows to be enclosed. In addition, walls and roof areas will require improved constructions that should be determined at detailed design stage.

The operation of the outdoor sporting fields should be limited to 10 pm and be managed to minimise noise emissions to nearby residences by measures such as scheduling contests to the early evening and limiting the use of whistles (where feasible).

Other school related noise producing activities have been reviewed and recommendations for management of these sources has been provided.

APPENDIX A

NOISE MEASUREMENT RESULTS


Fairway Drive Kellyville, The Hills Shire Council
L_{max}
L_{10}
L_{eq}
L_{90}
L_{min}
Wind
Rain
Extraneous
Thursday, 09 February 2017
SPL (dBA)
90
80
70
60
50
40
30
20
04:00
08:00
12:00
16:00
20:00
00:00
Time (HH:MM)
Friday, 10 February 2017
SPL (dBA)
90
80
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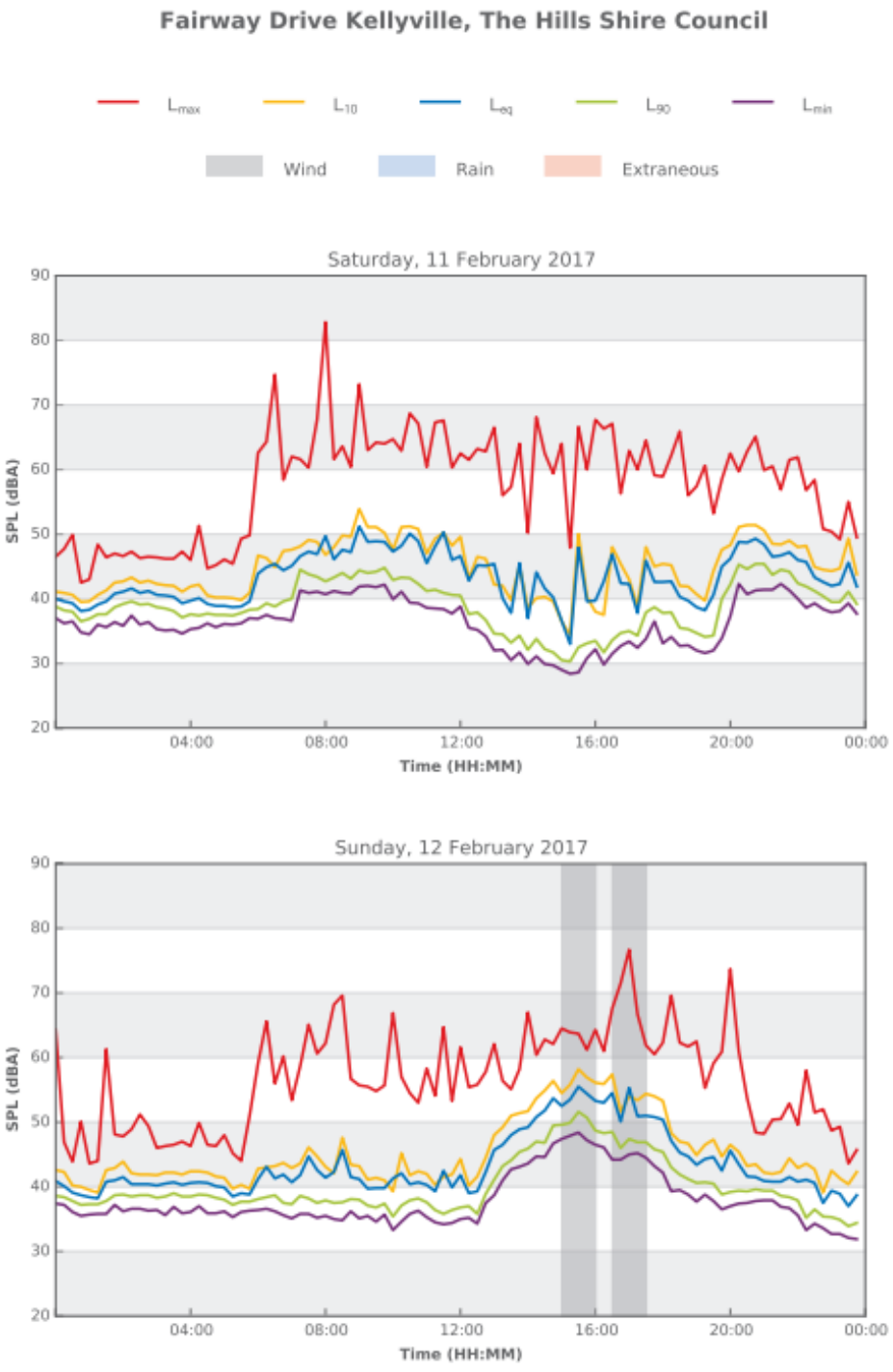
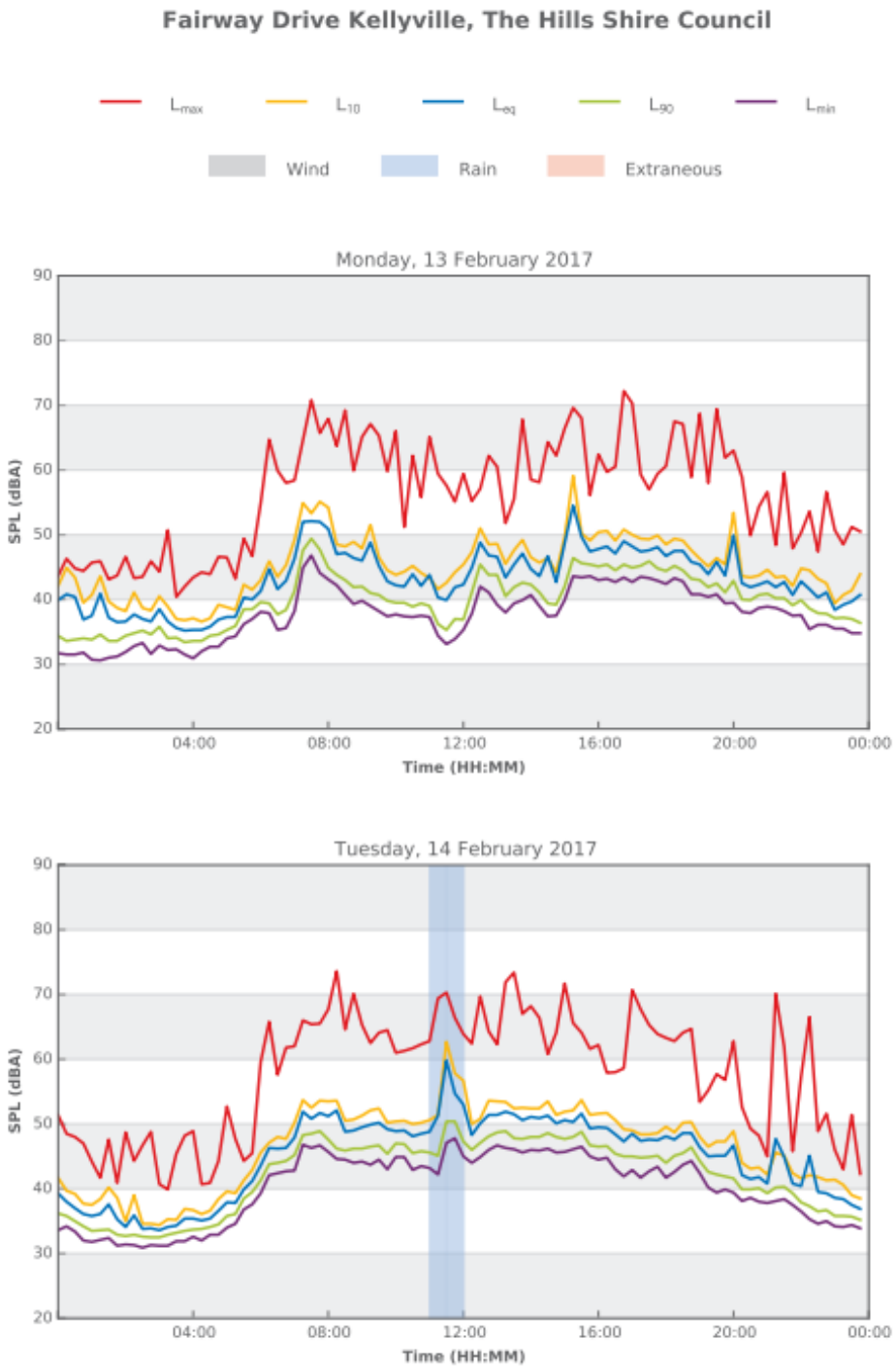
60
50
40
30
20
04:00
08:00
12:00
16:00
20:00
00:00
Time (HH:MM)


Fairway Drive Kellyville, The Hills Shire Council
L_{max}
L_{10}
L_{eq}
L_{90}
L_{min}
Wind
Rain
Extraneous
Saturday, 11 February 2017
SPL (dBA)
Time (HH:MM)
Sunday, 12 February 2017
SPL (dBA)
Time (HH:MM)


Fairway Drive Kellyville, The Hills Shire Council
L_{max}
L_{10}
L_{eq}
L_{90}
L_{min}
Wind
Rain
Extraneous
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SPL (dBA)
90
80
70
60
50
40
30
20
04:00
08:00
12:00
16:00
20:00
00:00
Time (HH:MM)
Tuesday, 14 February 2017
SPL (dBA)
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80
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50
40
30
20
04:00
08:00
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16:00
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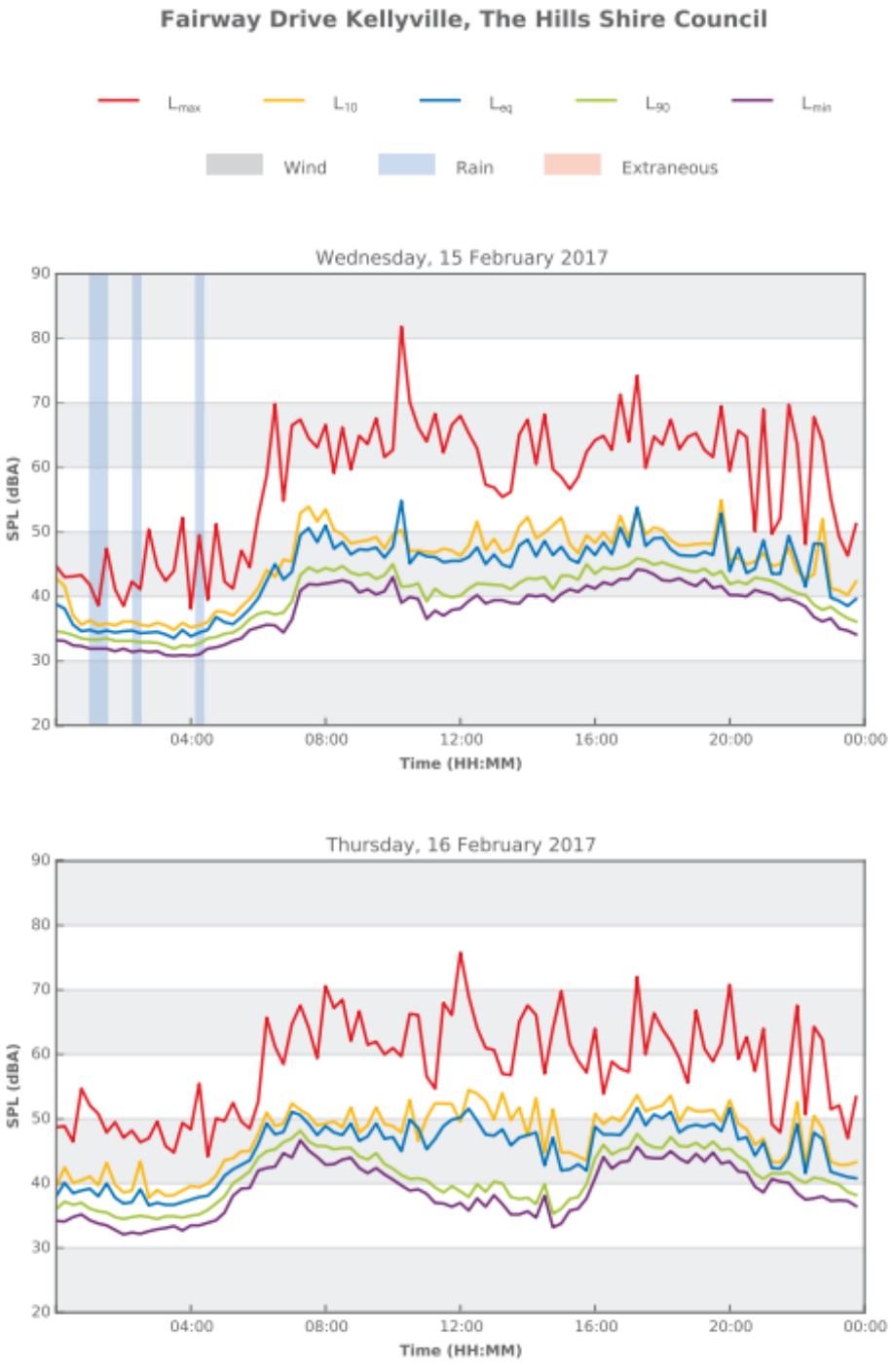
00:00
Time (HH:MM)


Fairway Drive Kellyville, The Hills Shire Council
L_{max}
L_{10}
L_{eq}
L_{90}
L_{min}
Wind
Rain
Extraneous
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SPL (dBA)
90
80
70
60
50
40
30
20
04:00
08:00
12:00
16:00
20:00
00:00
Time (HH:MM)
Thursday, 16 February 2017
SPL (dBA)
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80
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08:00
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16:00
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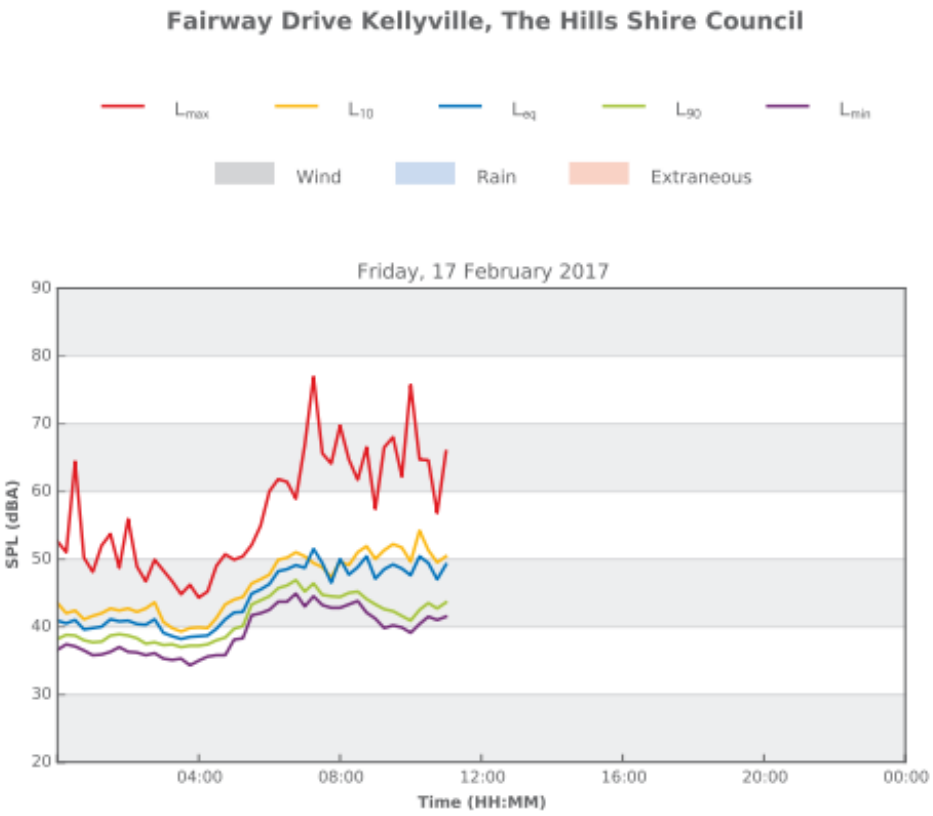
Time (HH:MM)


Fairway Drive Kellyville, The Hills Shire Council
L_{max}
L_{10}
L_{eq}
L_{90}
L_{min}
Wind
Rain
Extraneous
Friday, 17 February 2017
SPL (dBA)
90
80
70
60
50
40
30
20
04:00
08:00
12:00
16:00
20:00
00:00
Time (HH:MM)