

# CURL CURL NORTH PUBLIC SCHOOL

## CONSTRUCTION & OPERATIONAL NOISE REPORT

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**PREPARED FOR**

DEPARTMENT OF EDUCATION  
C/- TKD ARCHITECTS  
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## **APPENDIX A – NOISE MEASUREMENT RESULTS**

## 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.

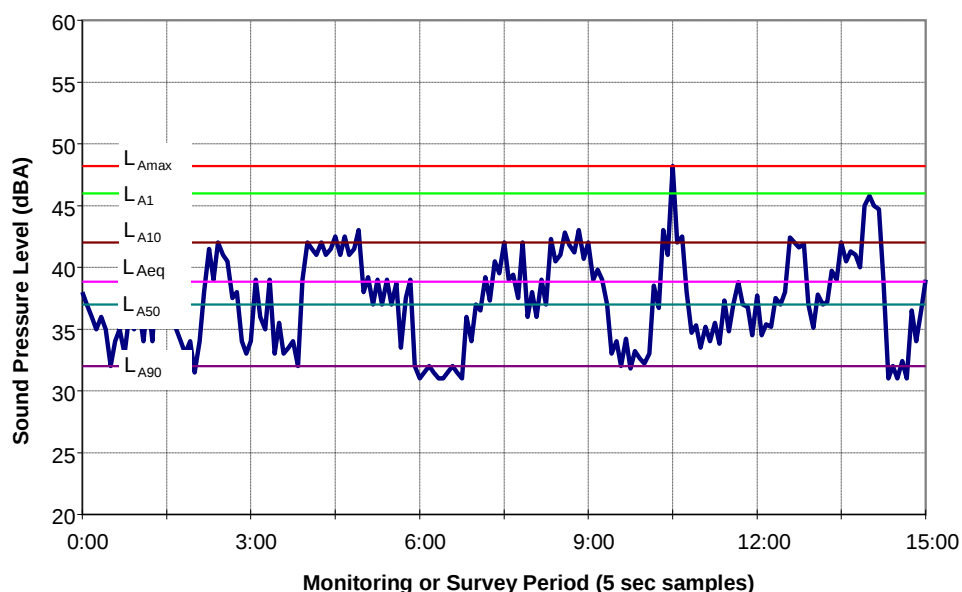
**$L_{A90}$**  – The  $L_{A90}$  level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the  $L_{A90}$  level for 10% of the time. This measure is commonly referred to as the background noise level.

**$L_{Aeq}$**  – 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 10<sup>th</sup> percentile (lowest 10<sup>th</sup> 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

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This report 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 redevelopment of the Curl Curl North Public School. The site is located within the Northern Beaches Council area.

The proposal includes demolition works, alterations and additions to the existing school including the construction of new classrooms, administration and staff building and library. The school proposes to increase student enrolments from the current 950 to a maximum of 1000.

.

The purpose of this assessment is to assess potential noise and vibration impacts associated with construction and operation of the school.

Wilkinson Murray Pty Limited has reviewed and assessed the drawings and relevant documentation prepared in respect of this State Significant Development (SSD 8310) submission.

The acoustic requirements are detailed in item 9 of the SEARs as follow:

### 9 Noise and Vibration

Identify and provide a quantitative assessment of the main noise and vibration generating sources during construction and operation, including consideration of any public address system, school bell and use of any school hall for concerts etc. (both during and outside school hours), and outline measures to minimise and mitigate the 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);*
- *Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Planning 2008)*

It is noted that the site is not located near a rail corridor or busy road, therefore the *Development Near Rail Corridors and Busy Roads-Interim Guideline* is not relevant to this project.

## 2 SITE DESCRIPTION

### 2.1 Location and Context

The school is located on Abbott Road and Playfair Road, Curl Curl, as shown in Figure 2-1.

**Figure 2-1 Location and Context**



Figure 2-2 shows a closer view of the site. Residential premises border the east and northern sides of the site. To the west are residences across Playfair Road. To the south are sports fields across Abbott Road. Figure 2-2 shows representative residential receiver locations (numbered 1 to 6) which will be used to assess noise emission from the school. There are residential receivers on three sides. The location and description of the representative receivers are described in Table 2-1.

No nearby non—residential noise sensitive receivers were also identified.

**Table 2-1 Description of Noise Sensitive Receivers**

| <b>Number and Description</b>      | <b>Potential Noise Source</b> |
|------------------------------------|-------------------------------|
| 1 – Playfair Road                  | Closest to school hall        |
| 2 – Playfair Road                  | Closest west of sports field  |
| 3 – Playfair Road                  | Closest north of sports field |
| 4 - Rear of Ross Street residences | Closest east of sports field  |
| 5 - Rear of Ross Street residences | Near cricket nets             |
| 6 – Rear of Abbott Road residences | Near classrooms and carpark   |

Figure 2-2 also shows the location of a noise logger that has been used to determine the existing ambient background noise levels at residential premises neighbouring the school.

**Figure 2-2     Receivers and Noise Logger**



**2.2     Proposed Design**

An indicative ground level layout is shown in Figure 2-3. Notable elements for noise assessment include:

A hall at the south west of the site adjoining administrative buildings;  
Play ground at the north of the site including a sports field;  
Netball courts and cricket nets to the east of the site.

**Figure 2-3 Proposed Site Plan**



The hall and sports field may be shared with public users. The sports field includes a full size soccer/rugby field that could be rented to public at weekends.

The hall would be mostly used for school purposes, including evening concerts till approximately 10.00pm. The council and community groups may use the Hall during evening when not required for school use.

For assessment purposes, potential use of the hall till midnight is addressed.

### 3 AMBIENT NOISE LEVELS

#### 3.1 Ambient Noise Levels at Site

In order to quantify the existing noise environment, long-term ambient noise levels were monitored from 24 February to 8 March 2017. The logger location was near the eastern boundary as shown on Figure 2-2, representing the receivers impacted by both construction and operation.

The noise monitoring equipment used for the Wilkinson Murray noise measurements consisted of an ARL Type EL-315 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  $L_{Aeq}$  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  $L_{Aeq}$ ,  $L_{A90}$ ,  $L_{A10}$  and  $L_{A1}$  for each 15-minute monitoring period.

The graphs show a loud noise occurs most days at approximately 8.00pm. This is probably a mechanical noise such as a pool pump in the neighbouring residence. The periods have been excluded from the data.

**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)*. A night time shoulder period from 10pm to midnight is also defined to allow assessments of Hall operations beyond 10pm.

**Table 3-1 Summary of Measured Ambient Noise Levels**

| RBL (dBA) |         |            |                   | $L_{Aeq,period}$ (dBA) |         |            |
|-----------|---------|------------|-------------------|------------------------|---------|------------|
| Daytime   | Evening | Night Time | Night Shoulder    | Daytime                | Evening | Night Time |
| 7am-6pm   | 6-10pm  | 10pm-7am   | 10-pm-12 midnight | 7am-6pm                | 6-10pm  | 10pm-7am   |
| 42        | 40      | 36         | 36                | 53                     | 49      | 49         |

## 4 CONSTRUCTION NOISE & VIBRATION ASSESSMENT

This section of the assessment relates to typical construction activities that may occur. Most construction will occur at the eastern end of the site where the hall will be built. Noise from other parts of the site will be due to passage of trucks and equipment through the site, and minor works on the facade and signage.

### 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<br>$L_{Aeq, (15min)}$ | How to Apply                                                                                                                                                                                                                                                            |
|---------------------------------------|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Recommended</b>                    |                                        | The noise affected level represents the point above which there may be some community reaction to noise.                                                                                                                                                                |
| <b>Standard Hours:</b>                |                                        |                                                                                                                                                                                                                                                                         |
| Monday to Friday                      |                                        | 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.                                                                                   |
| 7am to 6pm                            | Noise affected                         |                                                                                                                                                                                                                                                                         |
| Saturday                              | RBL + 10dBA                            |                                                                                                                                                                                                                                                                         |
| 8am to 1pm                            |                                        | 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.                                                                                       |
| No work on Sundays or Public Holidays |                                        |                                                                                                                                                                                                                                                                         |
|                                       |                                        | The highly noise affected level represents the point above which there may be strong community reaction to noise.                                                                                                                                                       |
|                                       | Highly noise affected                  | 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.                                                                                                    |
|                                       | 75dBA                                  | 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<br>$L_{Aeq,(15min)}$ | How to Apply                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------------------|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Outside recommended standard hours | Noise affected<br>RBL + 5 dB          | <p>A strong justification would typically be required for works outside the recommended standard hours.</p> <p>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.</p> <p>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.</p> <p>For guidance on negotiating agreements see section 7.2.2 of the guideline.</p> |

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.

There is a child care centre adjacent to the Rodborough Avenue Entrance to the site. The ICNG recommends the following NMLs for schools, and they are typically applied to child care centres:

- Internal in class rooms -  $L_{Aeq,15min}$  45dBA. This is approximately equivalent to a level of 55dBA outside, assuming a 10dBA noise reduction through open windows and doors;
- Active Recreation (typically applied to playground areas) –  $L_{Aeq,15min}$  65dBA.

As the playground is only a few meters wide, so an NML of 55dBA is considered appropriate to achieve internal levels of 45dBA.

**Table 4-2 Site-Specific Construction Noise Management Levels**

| Receiver       | Construction Noise Management Level, $L_{Aeq}$ – dBA |                      |                    | Highly Noise-Affected Noise Level, $L_{Aeq}$ dBA |
|----------------|------------------------------------------------------|----------------------|--------------------|--------------------------------------------------|
|                | Day                                                  | Evening <sup>1</sup> | Night <sup>1</sup> |                                                  |
| All Residences | 52                                                   | 45                   | 41                 | 75                                               |

Note 1: Out of hours work is not proposed and would be applied for separately. The NMLs are listed if required in future.

## 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

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<br>(mm/s) |         |
|-------------------------------------------------------------------------------------|-------------------|----------------------------------|---------|
|                                                                                     |                   | Preferred                        | Maximum |
| Critical working areas<br>(e.g. hospital operating theatres precision laboratories) | Day or night time | 0.14                             | 0.28    |
|                                                                                     | Daytime           | 0.28                             | 0.56    |
| Residences                                                                          | Night time        | 0.20                             | 0.40    |
|                                                                                     | Day or night time | 0.56                             | 1.1     |
| Offices                                                                             | Day or night time | 1.1                              | 2.2     |
| Workshops                                                                           | Day or night time |                                  |         |

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 ( $\text{m/s}^{1.75}$ )**

| 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,<br>educational<br>institutions and<br>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                | 50mm/s at 4 Hz and above                      | N/A                           |
| Industrial and heavy commercial buildings      |                                               |                               |
| Un-reinforced or light framed structures       | 15mm/s at 4 Hz increasing to                  | 20mm/s at 15 Hz increasing to |
| Residential or light commercial type buildings | 20mm/s at 15 Hz                               | 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 Schedule

Construction is scheduled to commence in December 2017 and take approximately 76 weeks in total. Construction will be done in 3 stages in general to facilitate the current school operation. The approximate schedule is as follows:

- Stage 1, December 2017 – January 2018 – Relocation of classrooms to north of site to demountable classrooms.
- Stage 2, July 2018 – July 2019 – Demolition, excavation and construction of new building to the South of the site.
- Stage 3, July 2019 – January 2020 – Classes to be held in new building. Demolition of remaining classroom to the north of site. Landscape work to finish.

#### 4.6 Construction Noise Predictions

Assessment of likely construction noise at surrounding receivers has been conducted 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 and equipment                                                                                                                                                                                                                                                                                                                       | Duration                   |
|----------|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| Stage 1  | Relocation of Classrooms                | 2x Cranes, trucks                                                                                                                                                                                                                                                                                                                         | December 2017-January 2018 |
| Stage 2  | Excavation, Demolition and Construction | This scenario assumes work at multiple sites across the southern part of the school.<br>2x excavators, 1 concrete pump, 2 forklifts, 1 compressor, 1 crane, a boom truck are assumed to operate in 15minutes.<br>2 truck movements (concrete or delivery) in 15 minutes assumed: on truck entry by Playfair Road, and one by Abbott Road. | July 2018 – July 2019      |
| Stage 3  | Landscaping North of Site               | 2 x excavators, one roller, 1 x truck movement per 15 minutes, entry by Playfair Road                                                                                                                                                                                                                                                     | July 2019 – January 2020   |

Noise modelling has been conducted for each of the above construction scenarios with plant located across the western side of the 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 –  $L_{Aeq}(15 \text{ min})$  – dBA**

| Receiver | Stage 1           | Stage 2                              | Stage 3     |
|----------|-------------------|--------------------------------------|-------------|
|          | Move Demountables | Excavation, Demolition, Construction | Landscaping |
| 1        | 50-55             | 63-68                                | 61-66       |
| 2        | 44-49             | 60-65                                | 72-77       |
| 3        | 48-53             | 46-60                                | 82-87       |
| 4        | 57-62             | 64-70                                | 80-85       |
| 5        | 47-52             | 64-69                                | 75-80       |
| 6        | 42-47             | 56-71                                | 60-65       |

#### 4.7 Discussion of Results

At all receivers the A. A review of predicted noise levels detailed in Table 4-8 indicates that daytime NML is  $L_{Aeq,15min}$  of 52dB predicted to be exceeded at all representative noise receivers for some or all of the construction phases.

For Stage 1, the moving of demountables to the north of the site, the impact will be for a short period and predicted levels will only exceed the NML by up to 10dBA at relatively few receivers.

For Stage 2, the noise impact is predominantly at receivers at the southern end of the site, as receivers north of the site will be shielded by the newly positioned demountable classrooms.

For Stage 3, the noise impact is predominantly at the north of the site. The higher noise levels occur when equipment is working near the boundaries of the site.

These findings are typical of development sites close to receivers in relatively quiet residential areas. It is important to note that construction noise is variable, and the predictions are intended to show the typical worst case scenarios. 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 Section 4-9 to 4-11.

#### 4.8 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. As the construction method is not yet designed, the actual vibration levels cannot be predicted, and it is unlikely that some of the larger equipment in the table will be used at all.

**Table 4-9 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 |
| Vibratory Roller        | <50 kN (Typically 1-2 tonne)   | 5m                    | 15-20m                       |

- Construction Noise Strategy, 2012, Transportation Construction Authority

It is noted that nearly all construction activities will be more than 10m from any neighbouring building. Given the type of activities proposed, vibration will be below the criteria for cosmetic damage during most of the project. The use of rock-breakers or vibratory rollers should be carefully managed at distances closer than 20 metres from these residences.

#### 4.9 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:

- 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 if out of standard hours work is required; 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.

#### **4.10 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 apprised 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.

#### **4.11 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 school facilities will be from the following:

- Services noise from mechanical plant;
- School announcements and bells;
- Outdoor play;
- Concerts in the hall; and,
- Potential weekend sporting events on the oval.

The school proposes to increase student enrolments from the current 950 to a maximum of 1000. Acoustically -this is an insignificant increase, and, from the point of view of noise emission, the main change from the current situation is that children will play in different parts of the school.

### 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.

Noise criteria for children playing is typically background +10dBA. Depending on the situation, the application of this limit may be time limited, however it is usually seen as appropriate for activities that occur up to 2 hours per day.

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

| Intrusiveness Criterion      |                   |                        |                                     |
|------------------------------|-------------------|------------------------|-------------------------------------|
| L <sub>Aeq,15min</sub> (dBA) |                   |                        |                                     |
| Daytime<br>7am-6pm           | Evening<br>6-10pm | Night Time<br>10pm-7am | Night Shoulder<br>10-pm-12 midnight |
| 52 (children playing)        | 45                | 41                     | 41                                  |
| 47 (other noise)             |                   |                        |                                     |

### 5.2 Operational Mechanical Noise Assessment

Detailed specifications of new 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 on 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 while being directed away from residences. The coverage of the system should be subject of the detail design of the sound 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**

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

The design of the hall is at the concept stage, however the following assumptions were made in order to assess the noise emission.

- Ventilation would be provided by louvres on the facades and rooftop ventilators;
- Facades would be a mix of louvre, glazing and structural material;
- Ventilation openings on the west and northern facades were assumed to be approximately 6m<sup>2</sup> each in area;
- It was assumed that 4x900mm diameter rooftop vents would be required.

Preliminary calculations have been conducted based on internal noise levels of between 90-95dBA which is considered the upper limit of typical events in primary schools. Table 5-2 presents predicted noise levels at residences during these events with louvres and doors open or closed.

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

| Receivers | Windows / Doors |                  | Criterion, $L_{Aeq}$ |                                  |
|-----------|-----------------|------------------|----------------------|----------------------------------|
|           | Hall closed     | Ventilation Open | Evening (6pm-10pm)   | Night shoulder (10pm-12midnight) |
| 1         | 33-38           | 55-60            | 45                   | 41                               |
| 2         | 22-27           | 41-46            | 45                   | 41                               |
| 3         | 15-20           | 34-39            | 45                   | 41                               |
| 4         | 15-20           | 33-38            | 45                   | 41                               |
| 5         | 16-21           | 27-32            | 45                   | 41                               |
| 6         | 15-20           | 28-33            | 45                   | 41                               |

A review of the above noise levels indicates that doors and windows on the west and north facades of the hall should be closed during major events to protect the acoustic amenity of surrounding existing and future residences. Some openings would be permissible on the eastern side of the building, depending on the internal activity and time of day.

Based on the assumptions noise will comply at all receivers till midnight. However if the hall is to be used after 10pm, noise limits should be placed on activities. The following assumptions concerning materials should be reviewed at detailed design stage:

- Doors and windows should be able to be closed and have a minimum acoustic rating of  $R_w$  30. Indicative glazing of 10mm monolithic glass should be allowed.
- Any glass ventilation louvres should have an indicative rating of  $R_w$  30, for example the Jalousie Louvred Window System from Safetyline Jalousie.
- Place ventilation openings on the eastern side of the building where possible.
- 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 Noise from Outside Play

The outdoor play area will take up approximately the northern half of the site, as well as the courtyard between the classrooms in the southern half of the site. Fixed facilities include a full size soccer field, two netball courts and a cricket net.

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<br>( $L_{Aeq,15min}$ ) |
|-------------------------------------------------|------------------------------------|
| ≈ 15 children playing outside during lunch time | 95dBA                              |

| Activity                                            | Typical SWL<br>( $L_{Aeq,15min}$ ) |
|-----------------------------------------------------|------------------------------------|
| ≈ 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                              |

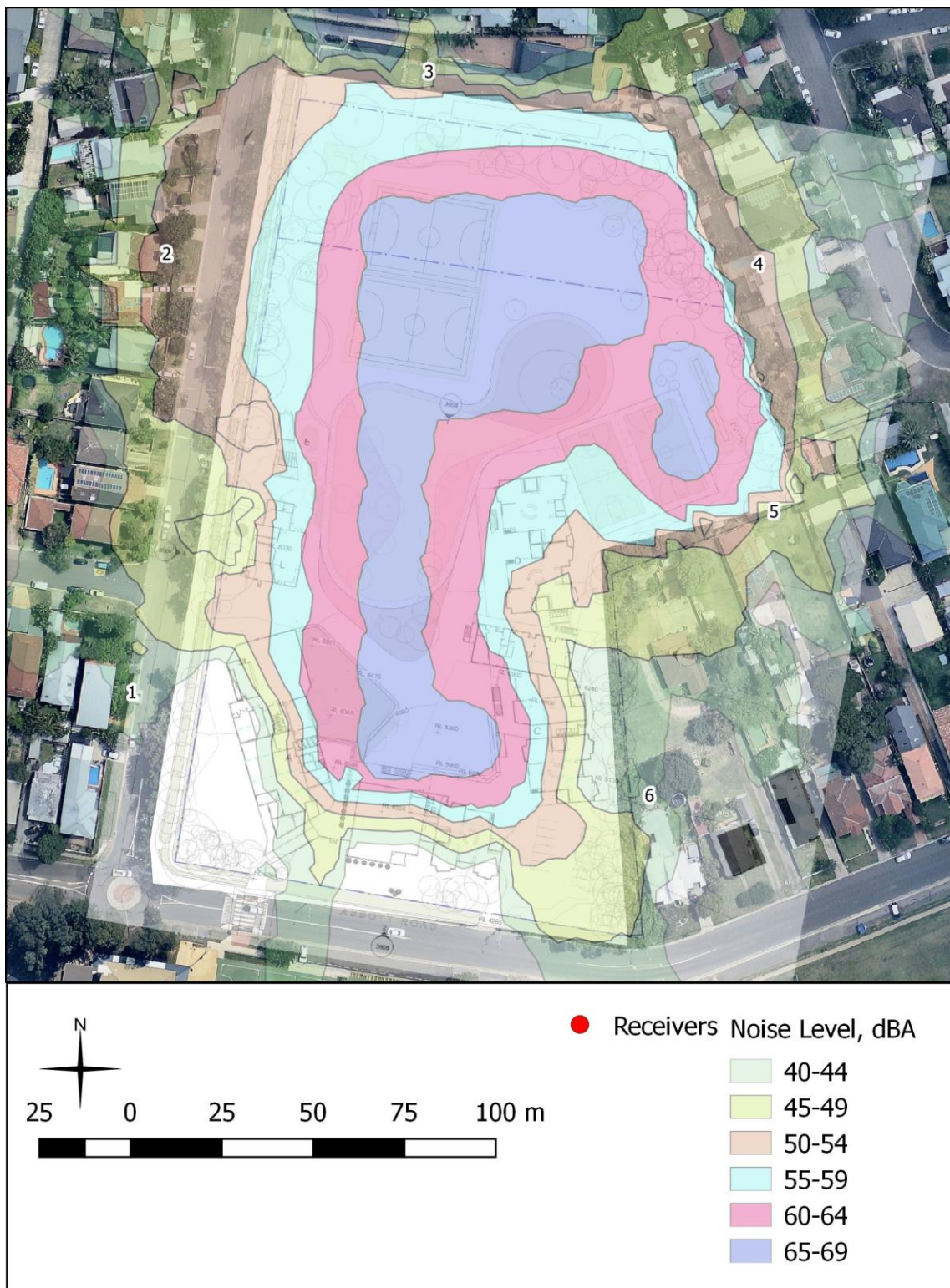
To assess outdoor play it was assumed that 500 children of mixed ages would be playing simultaneously in all areas of the school. The predicted levels at the representative receivers are shown in Table 5-2, which gives the range to be expected during lunchtime play.

Under the assumptions stated, noise is predicted to comply at all surrounding receivers. Occasional exceedances could occur if groups of children congregate near a particular house. Note that this is also the case at the existing school. A noise contour of the site from this scenario is shown in Figure 5-1.

**Table 5-2 Predicted Level from Children Playing,  $L_{Aeq,15min}$  dBA**

| Receiver | Noise Level | Criterion |
|----------|-------------|-----------|
| 1        | 37-42       | 52        |
| 2        | 45-50       | 52        |
| 3        | 44-49       | 52        |
| 4        | 46-51       | 52        |
| 5        | 45-50       | 52        |
| 6        | 34-39       | 52        |

**Figure 5-1 Noise from 500 Children Playing,  $L_{Aeq,15min}$  dBA**



## 5.6 Weekend Sporting Activities

The school proposes to rent out the soccer field at weekends to local clubs for competition play. The predicted noise levels from a club game are shown in Table 5-3. Minor exceedances are predicted at the closest receivers at the north of the site.

**Table 5-3 Predicted Level from Club Soccer or Rugby Game,  $L_{Aeq,15min}$  dBA**

| Receiver | Noise Level | Criterion |
|----------|-------------|-----------|
| 1        | 28-33       | 47        |
| 2        | 46-51       | 47        |
| 3        | 45-50       | 47        |
| 4        | 38-43       | 47        |
| 5        | 37-42       | 47        |
| 6        | 26-31       | 47        |

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

- Limit the use of the sporting fields on weekends.
- Schedule any sporting contests during daytime.
- Encourage supporters to congregate at the southern end of the field.
- Noise from PA should be controlled by locating any sports related PA on the western side of the oval facing the oval and the school.

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

## 6 CONCLUSION

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A development application construction and operational noise and vibration assessment of the proposed Curl Curl North Public School has been conducted. Site-specific noise criteria that are applicable to the entire project have been established.

A noise and vibration 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.

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

Operational noise criteria for mechanical services, school 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 that stage, any necessary noise mitigation can be determined and included in the detailed design of mechanical service so that compliance with site specific noise criteria is achieved.

Operation of the Hall outside of normal school hours for major concerts will require doors and windows on western and northern facades to be closed. In addition, walls and roof areas will require improved constructions that should be determined at detailed design stage. Preliminary allowances have been recommended in the report.

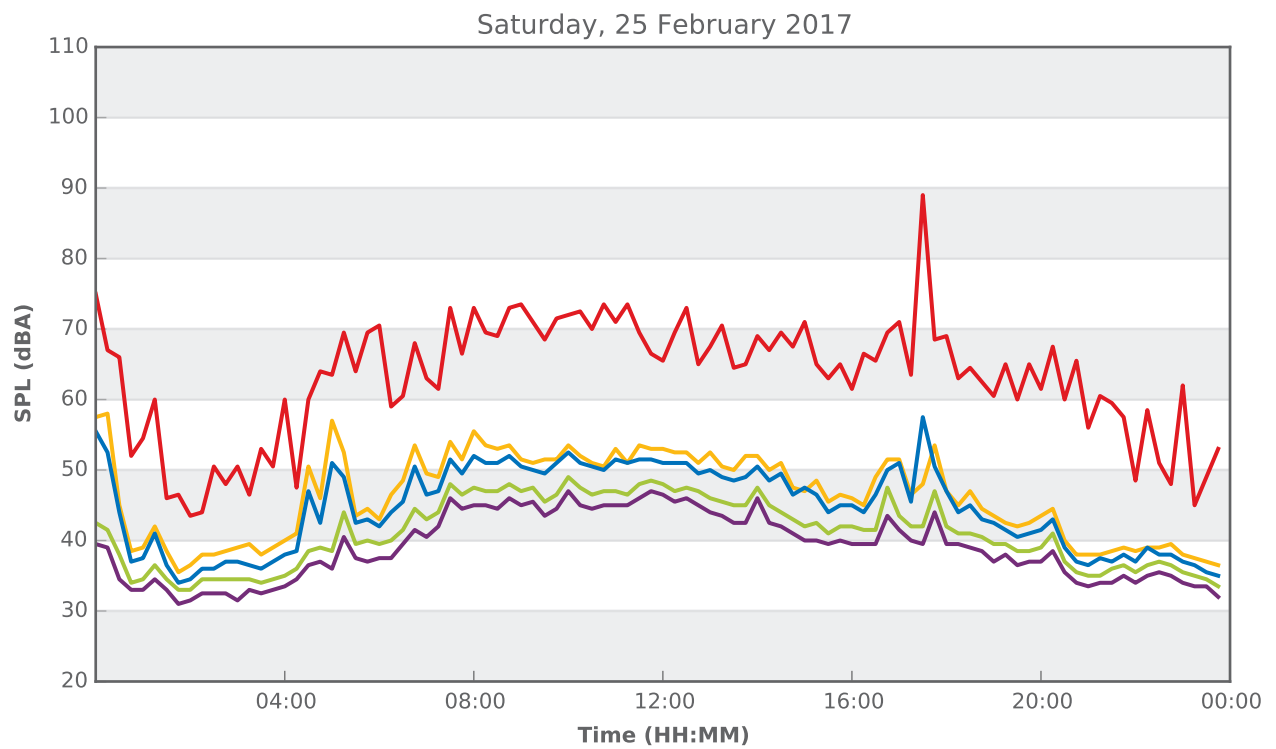
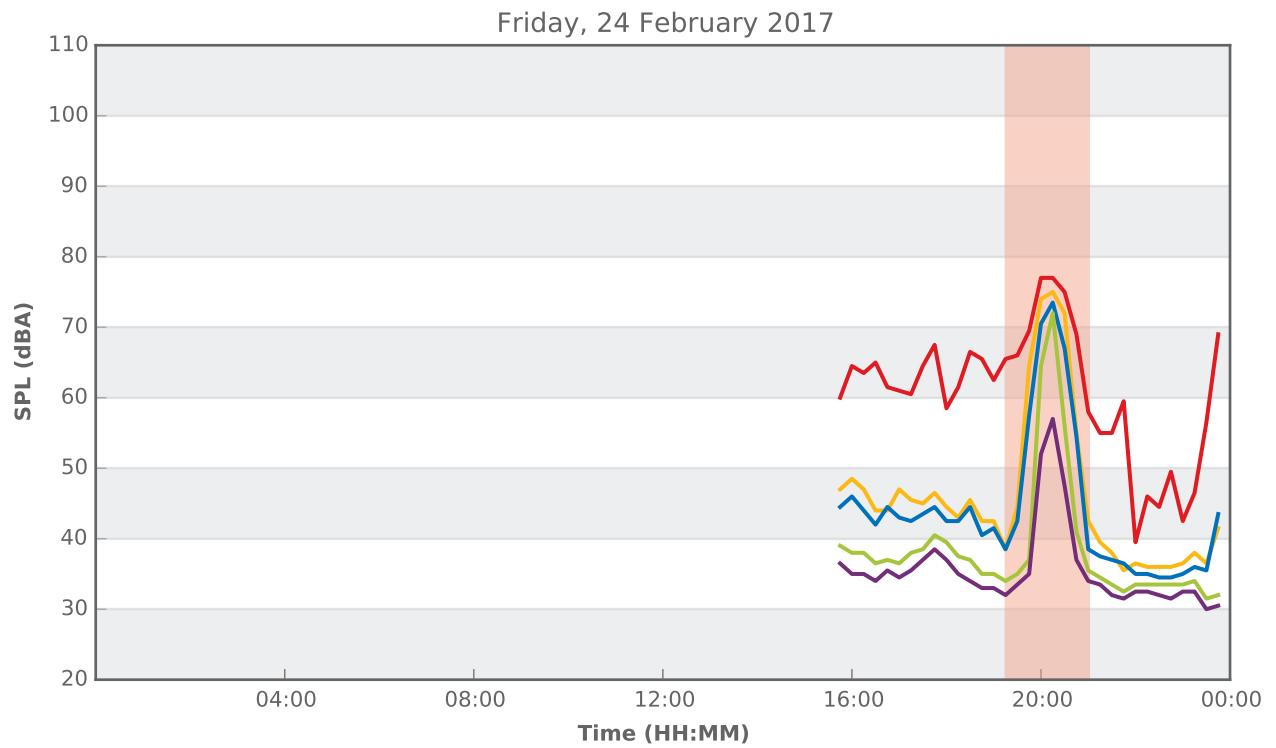
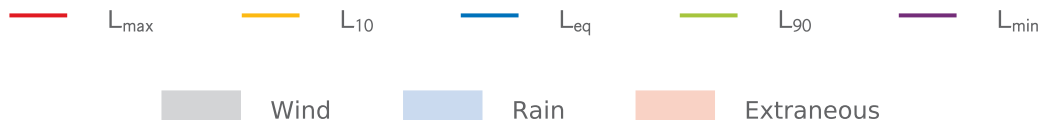
Other school related noise producing activities have been reviewed and recommendations for management of these sources has been provided.

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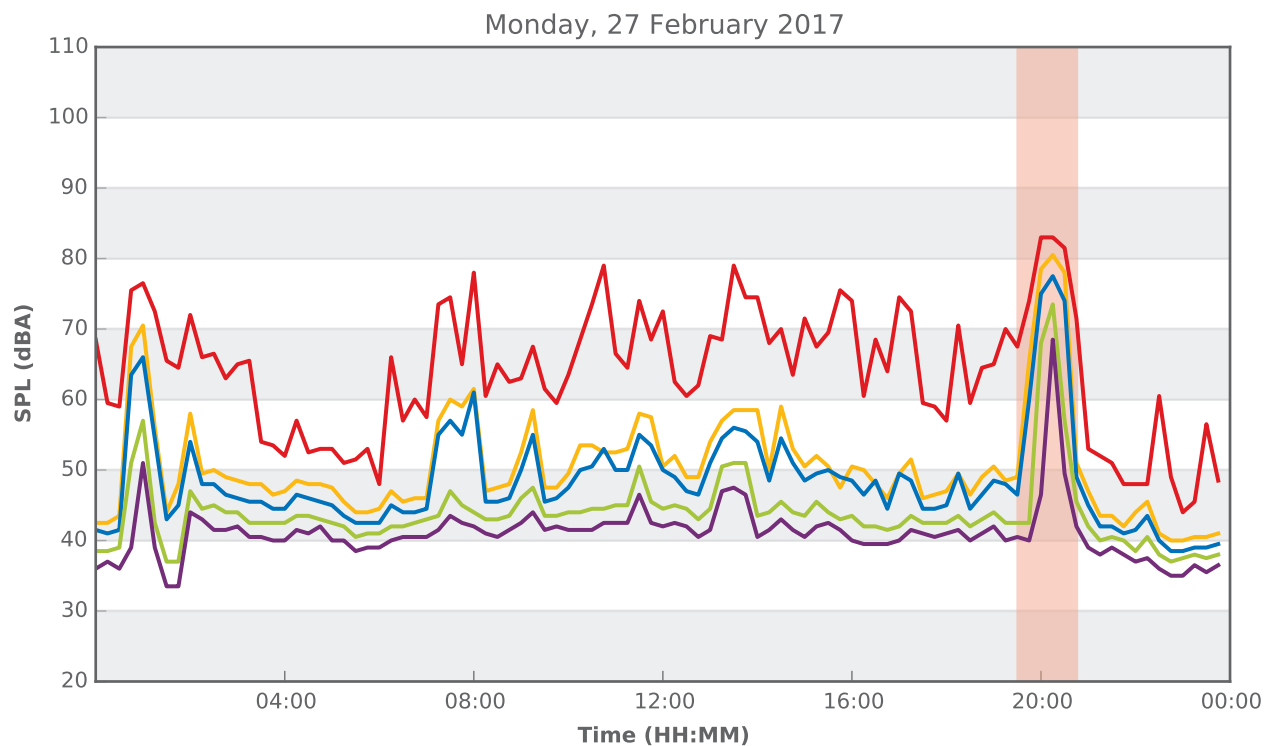
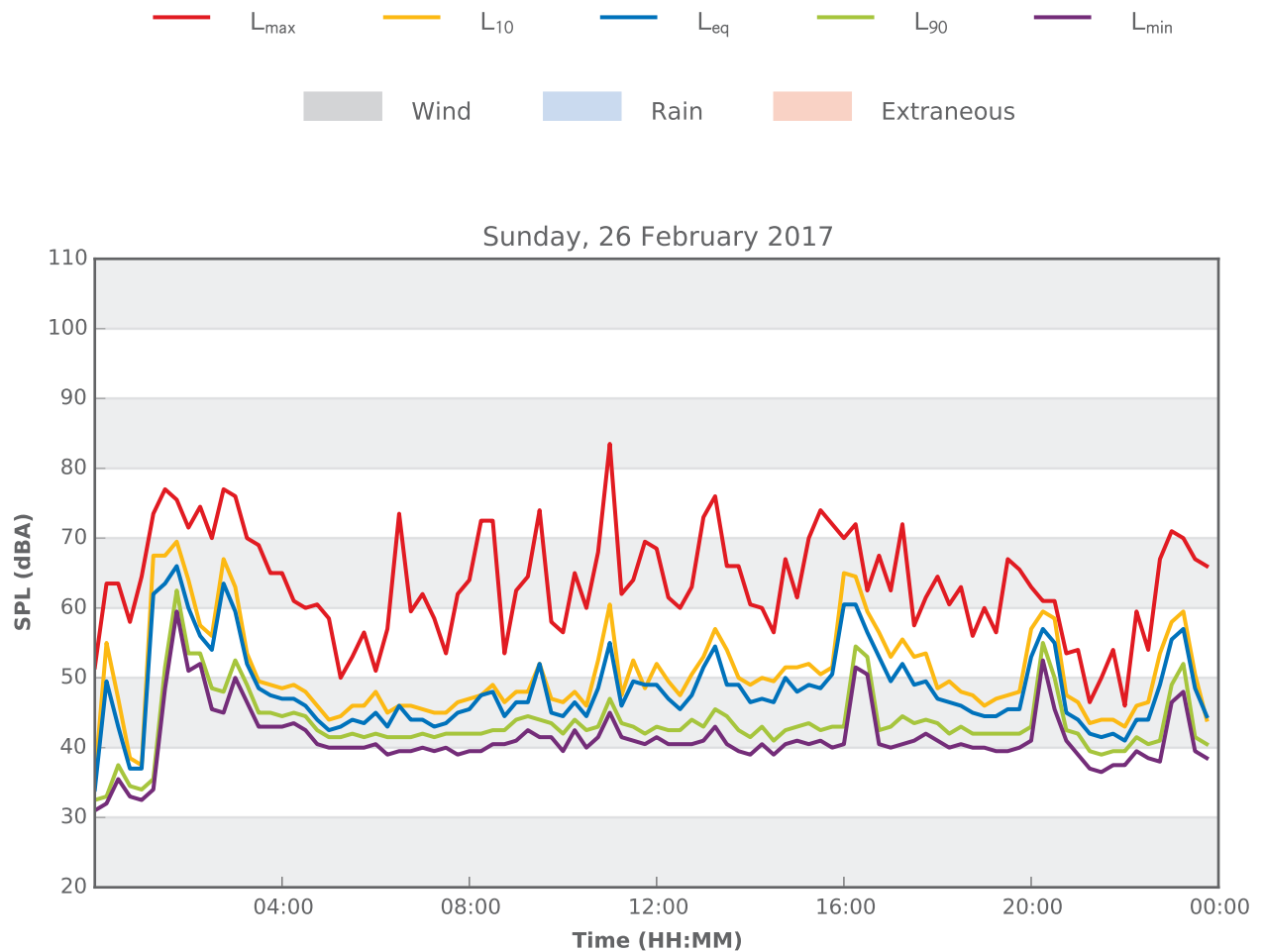
## APPENDIX A

### NOISE MEASUREMENT RESULTS

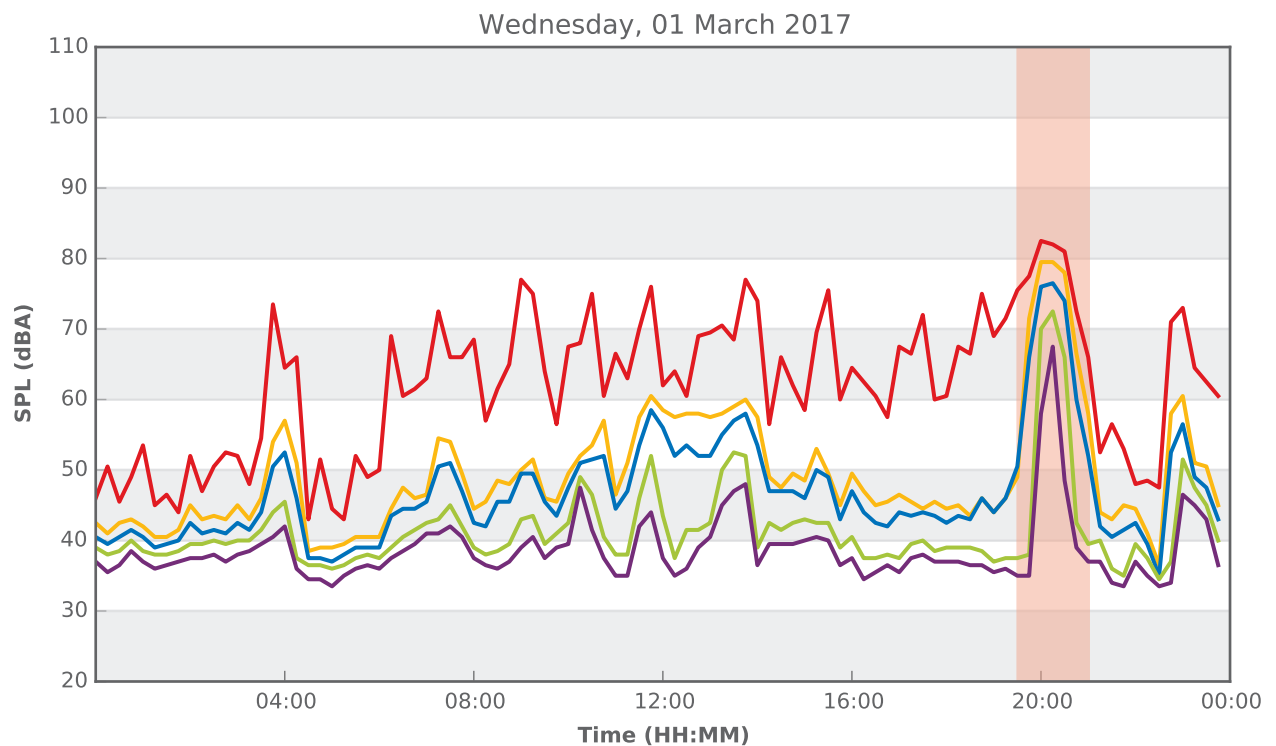
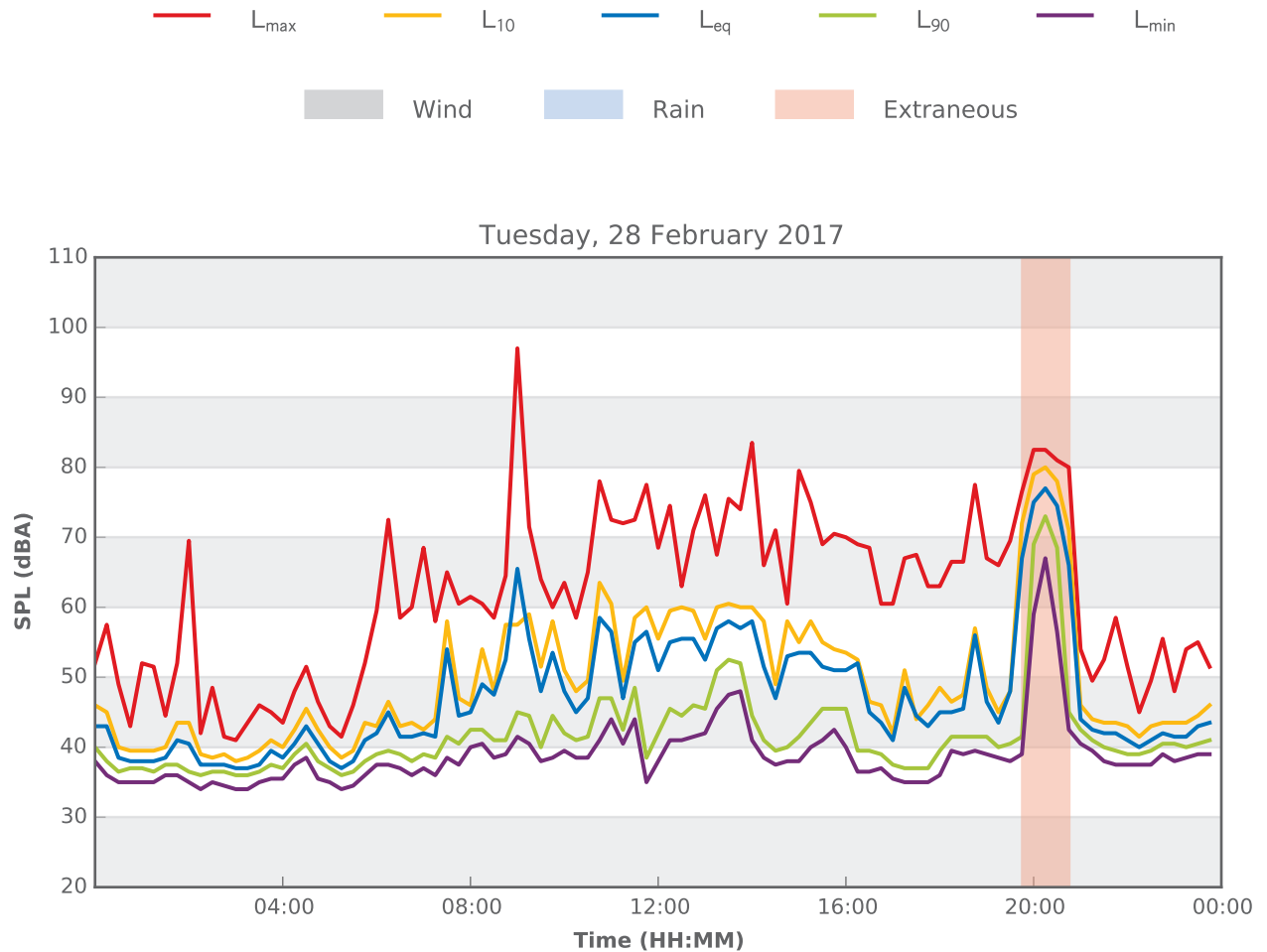
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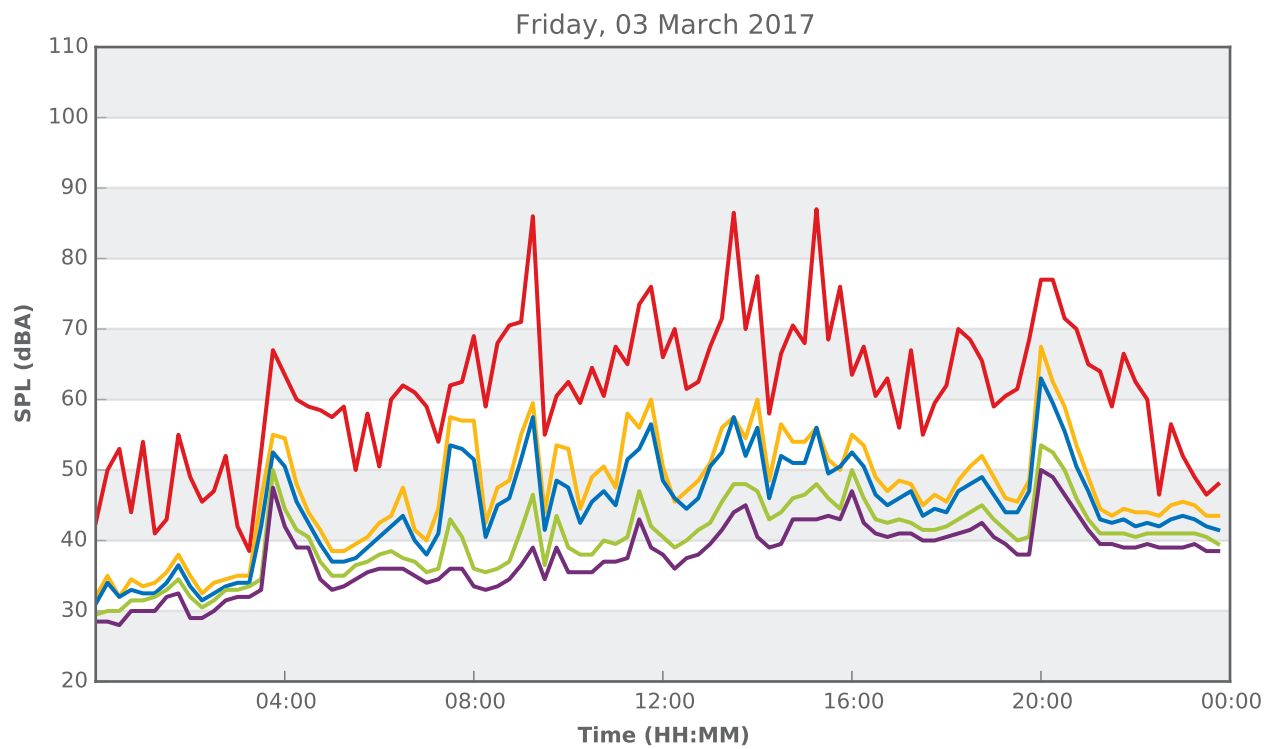
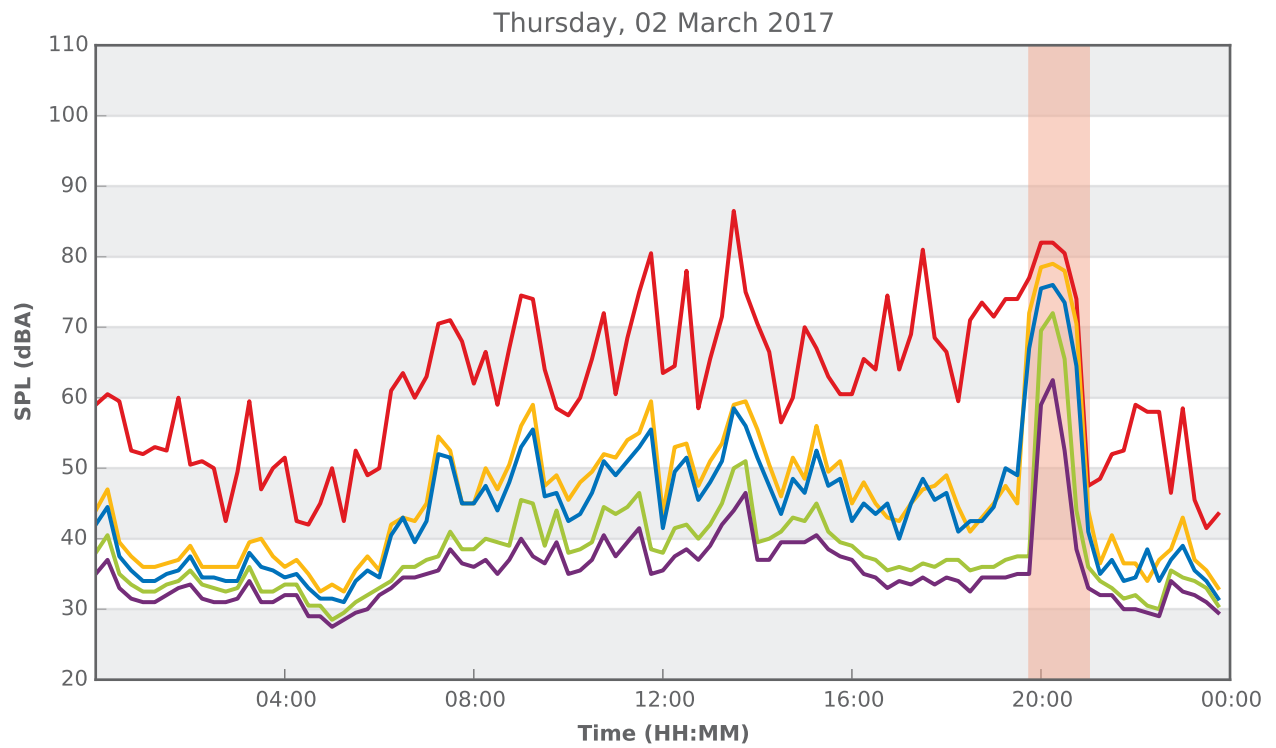
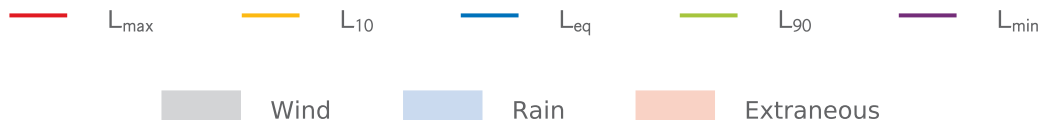
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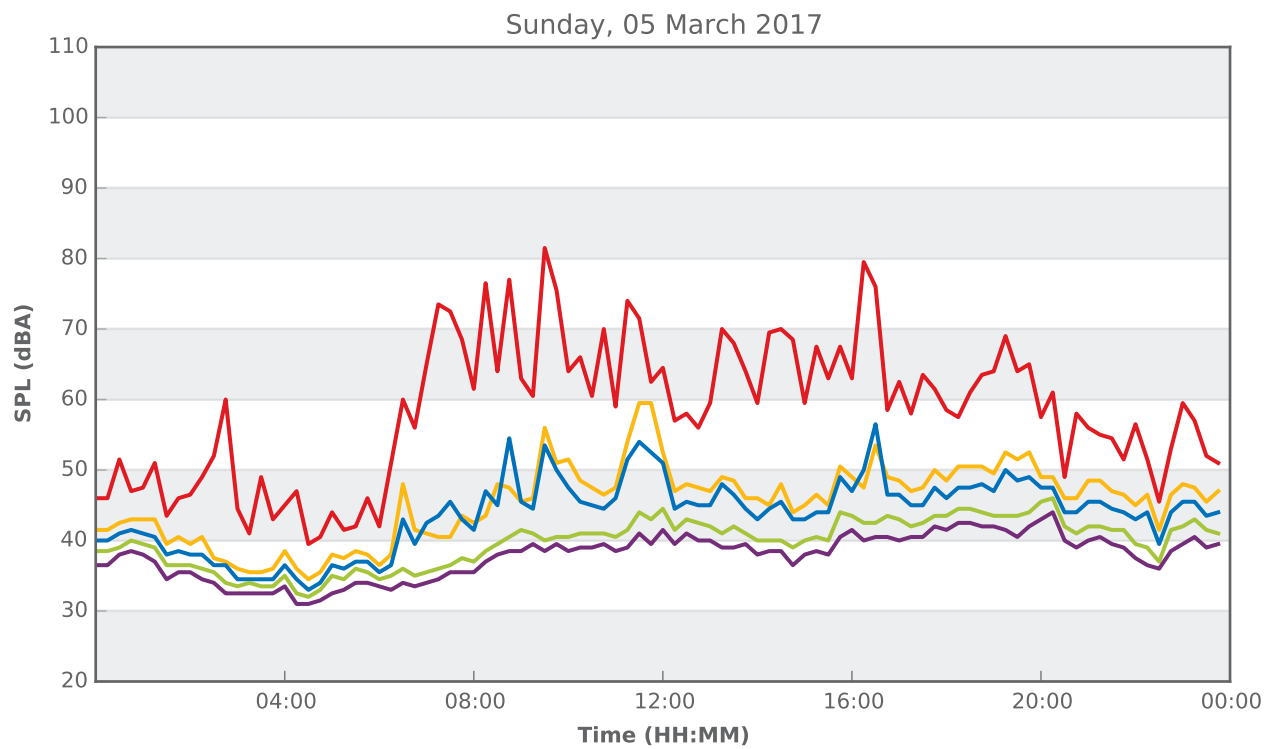
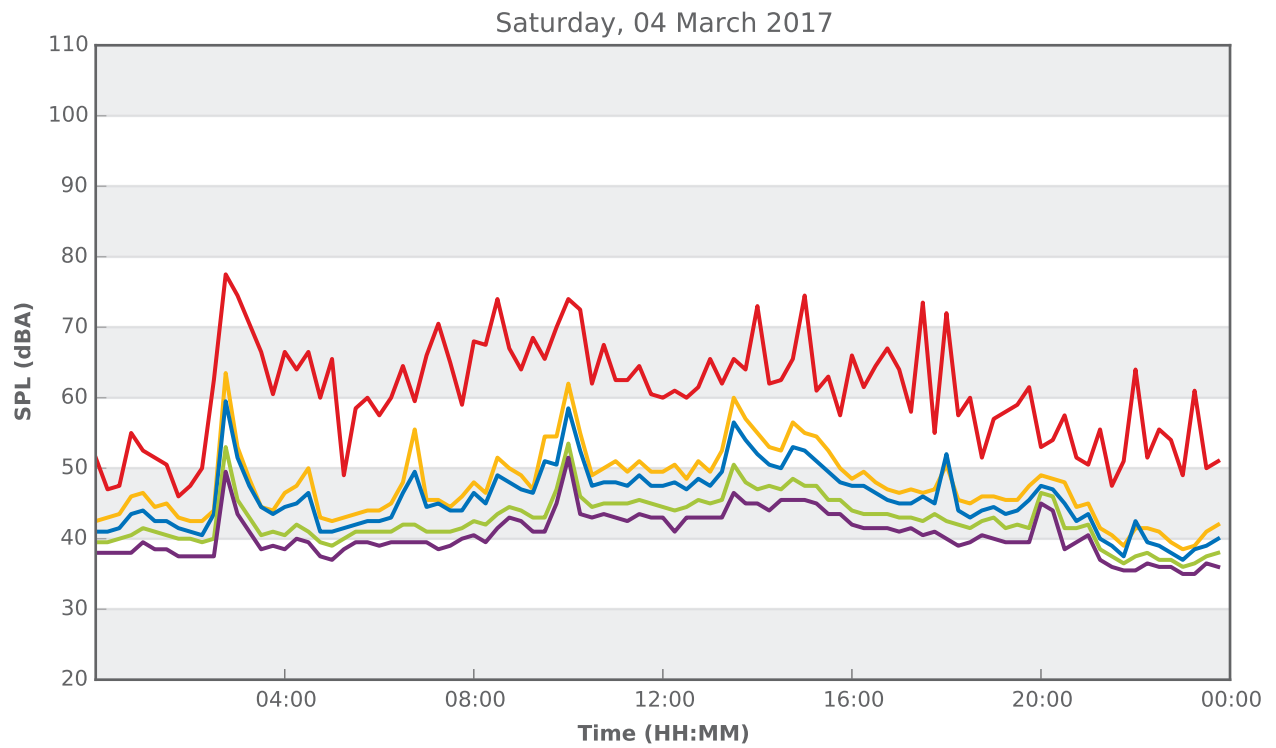
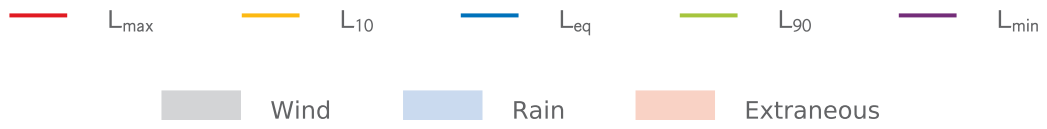
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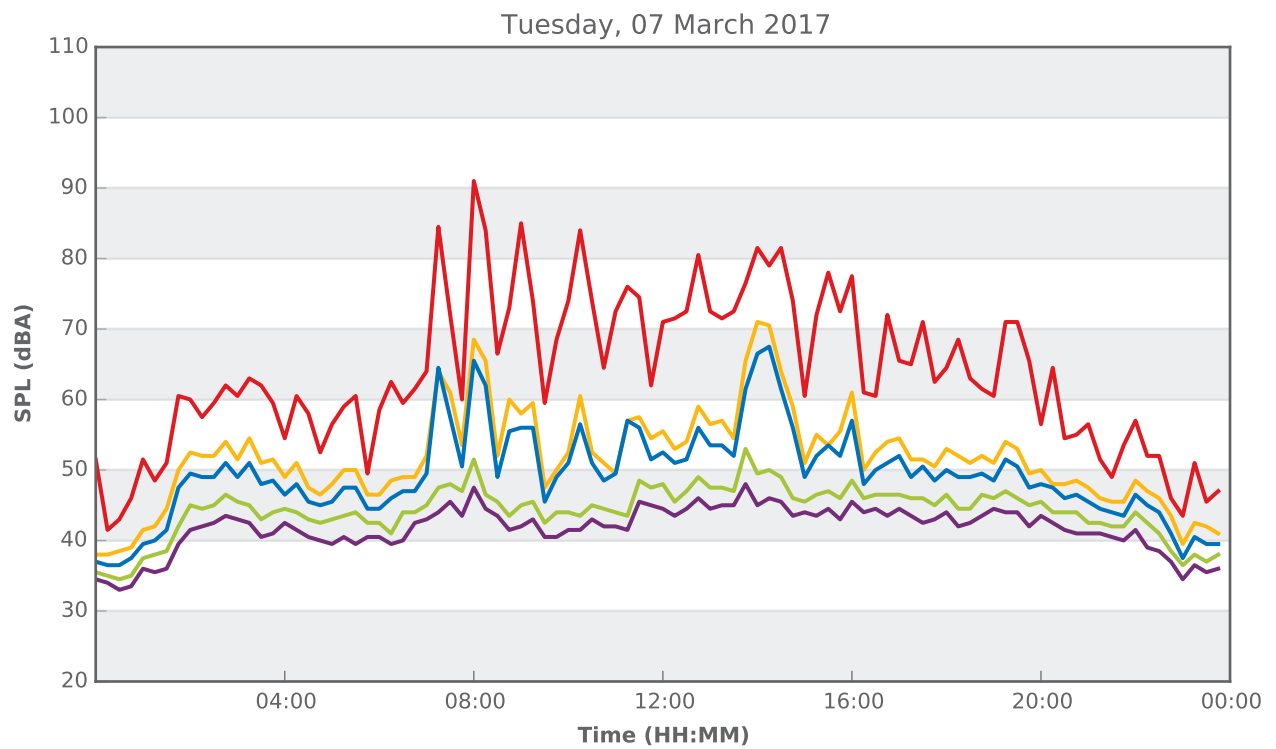
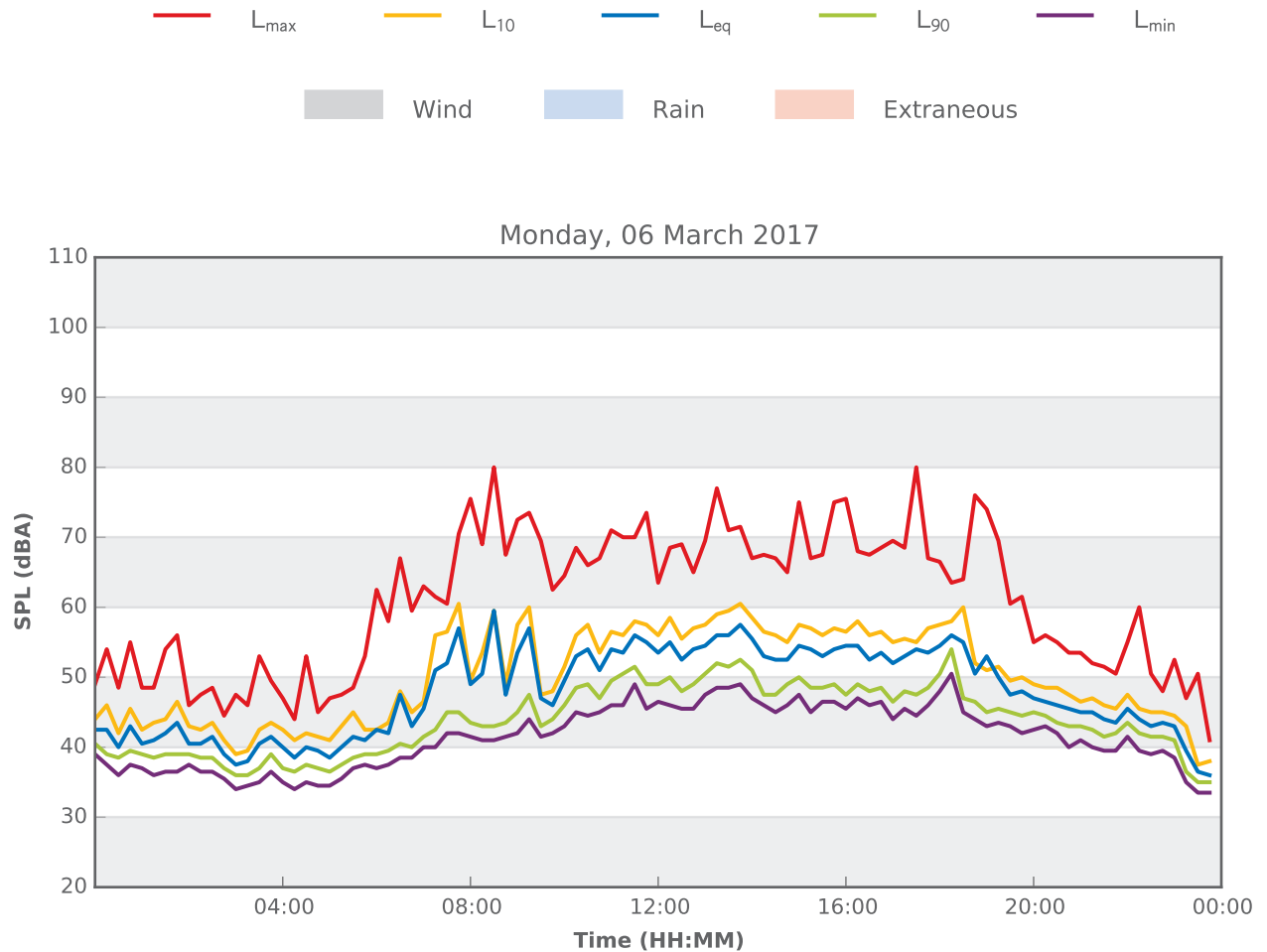
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