Construction Noise and Vibration Management Plan

Redevelopment of Hunter Sports High School, Gateshead, NSW.

Prepared for : de Witt Consulting Pty Ltd

July 2016

MAC
Muller Acoustic Consulting

Document Information

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Contents

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by de Witt Consulting Pty Ltd (DWC) to prepare a construction noise and vibration management plan (CNVMP) for the proposed Redevelopment of Hunter Sports High School (HSHS) (the 'project'), situated at 2 Pacific Highway Gateshead, NSW.

The assessment has been prepared to quantify noise and vibration emissions from the project during standard and out of hours periods to surrounding, residential, educational and commercial receivers and will accompany the Environmental Impact Statement (EIS) being prepared for the project by DWC. The primary aims of this CNVMP are to address requirements outlined in the Secretary's Environmental Assessment Requirements (SEARs) that have been released by NSW Department of Planning & Environment (2016). The key objectives of the SEARs are to ensure appropriate environmental controls and management procedures are implemented to protect the environment and community from adverse noise and vibration impacts arising from the project.

Secondly, this assessment provides a qualitative assessment of operational noise from mechanical plant once the project is completed.

This CNVMP has been prepared in accordance with relevant legislative and regulatory requirements, and provides a framework for monitoring, communication, management, reporting and auditing.

The assessment has been undertaken in accordance with the following documents:

- Environment Protection Authority (EPA) 2000, NSW Industrial Noise Policy (INP);
- Department of Environment and Climate Change (DECC) 2009, Interim Construction Noise Guideline (ICNG);
- Australian Standard AS 2436-2010 Guide to Noise Control on Construction, Maintenance and Demolition Sites;
- Standards Australia AS 1055.1:1997 - Acoustics - Description and measurement of environmental noise - General Procedures;
- Department of Environment and Conservation 2006, Assessing Vibration: A Technical Guideline;
- German Standard DIN4150; and
- British Standard BS7385: Part 2–1993.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**. A copy of the SEARs are provided in **Appendix B**.

1.1 Background

The site contains a number of assets that have passed or are nearing the end of their life cycle and require significant upgrade or replacement. The various buildings and infrastructure on site are consistent with that on any school site of this nature, in that they vary in type, materials quality and age, are one, two and three storey buildings of brick, timber and other materials. There is existing signage located at the main entrance associated with school activities and general signage around the school associated with way finding and building notation.

The proposed development will provide the school with state of the art facilities, including new classrooms, administration buildings, sports fields and training facilities to meet ongoing education needs of the community.

NSW Public Works wish to replace existing buildings and facilities at the site. The buildings currently accommodate up to 850 students in a variety of educational settings that are nearing or have passed their economic life. The project has the following objectives:

- provide a long term financially viable solution for ongoing operation of the school
- comply with relevant codes (National Construction Code and Australian Standard)
- erect buildings that provide contemporary educational facilities that meets community expectations
- provide facilities that allow for modern delivery of education to students
- external car parking, driveway and access
- external landscaping and water features
- associated infrastructure and services.

The proposed development provides for long-term education for residents of Lake Macquarie and broader population.

1.2 Assessment Activities

Acoustically significant sources associated with the project are primarily associated with construction and demolition of buildings. The development staging activities for the project are summarised below and have formed the basis of noise assessment scenarios for this assessment. To ensure the continuity of education for the students and staff at Hunter Sports High (and neighbouring schools), some activities listed below may be required to be completed during outside of standard construction hours.

- Activity 1 – Block S - Movement Complex
  a) construction of new driveway crossing off Pacific Highway and associated service road.
  b) preparatory works for new electrical and hydraulic services.
  c) construction of new Movement Complex (Block S).
- Activity 2 – Demolition No.1
  a) demolish Block L and part of Blocks A and B and make good. Construct temporary stair to Block B.
- Activity 3 – Block T
  a) construction of new 2 & 3 storey classroom and admin building (Block T).

  Note: Works associated with the new pedestrian entry and works to the existing visitor carpark are to be scheduled within a school holiday period. Pedestrian and vehicular access in this area is to be maintained during school hours.
- Activity 4 – Demolition No.2
  a) Demolish Blocks A, B, C, E and F.
- Activity 5 – Block U
  a) construct new single storey classroom and library building (Block U), including supply and installation of all furniture and equipment.
- Activity 6 – Demolition No.3
  a) demolish Blocks D, J (to slab level) and H.
- Activity 7 – Tennis Court Establishment
  a) construction of tennis court to Block J slab.

1.3 Receiver Review

The project site is situated at 2 Pacific Highway Gateshead, NSW. Receivers in the locality surrounding the project site are primarily educational, residential and commercial and for assessment purposes have been organised into noise catchments (NCs). **Table 1** summarises the surrounding NCs and receiver types.

Figure 1 provides a locality plan identifying the position of nearest receiver catchments in relation to the project. For assessment purposes existing or future HSHS classroom buildings have been assessed for each activity where relevant, although are not shown in **Table 1.**

Table 1 Sensitive Receivers and Relevant Noise Catchments

NC ID	Name/Address	Receiver Category	Distance to Site Boundary[1]
NC1	9 to 21 Pacific Highway	Commercial	55m
NC2	25 to 39 Pacific Highway	Commercial	50m
NC3	2-6 Macquarie Ave & 1A – 5 The Crescent	Residential	75m
NC4	2 to 16 The Crescent	Residential	110m
NC5	Wiripaang Public School	Educational	30m
NC6	10 to 42 Sydney Street & 54 Goundry Street	Residential	265m

Note 1: Approximate distance to nearest project site boundary.

*Image source:*nearmap.com*

FIGURE 1 - LOCALITY PLAN

MAC160241 - REDEVELOPMENT OF HUNTER SPORTS HIGH SCHOOL

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2 Background Noise Environment

To quantify the existing background noise environment of the area, unattended noise logging was conducted at 54 Goundry Street (L1) and 2 Macquarie Street (L2), Gateshead, NSW. The selected monitoring locations are shown in **Figure 1**. The unattended noise survey was conducted in general accordance with the procedures described in Australian Standard AS 1055-1997, "Acoustics - Description and Measurement of Environmental Noise".

The measurements were carried out using Svantek Type 1, 977 noise analysers from Monday 18 April 2016 to Wednesday 27 April 2016. Observations on-site identified the surrounding locality was typical of a suburban environment, with traffic, birds and suburban noise audible. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ±0.5dBA. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

Data affected by adverse meteorological conditions have been excluded from the results in accordance with methodologies provided in Chapter 3 of the INP. Residential receivers situated in the area have been classified under the EPA's suburban amenity category. This criterion is used in conjunction with the intrusiveness criteria to determine the limiting criteria. The results of long-term unattended noise monitoring are provided in **Table 2**. The noise monitoring charts for the background logging assessment are provided in **Appendix C**.

Table 2 Background Noise Monitoring Summary

Monitoring Location	Period[1]	Measured Background Noise Level (LA_{90}), RBL, dBA	Measured LAeq, dBA
L1	Day	39	58
	Evening	37	51
	Night	29	49
L2	Day	48	61
	Evening	40	59
	Night	33	56

Note 1: Monday to Saturday: Day 7am to 6pm; Evening 6pm to 10pm; Night 10pm to 7am. On Sundays and Public Holidays, Daytime 8am to 6pm; Evening 6pm to 10pm; Night-time 10pm-8am.

Note: excludes periods of wind or rain affected data, meteorological data obtained from the Bureau of Meteorology Nobbys Pilot Station.

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3 Noise Policy and Criteria

3.1 Construction Noise

The ICNG sets out procedures to identify and address the impacts of construction noise on residences and other sensitive land uses. This section provides a summary of noise objectives that are applicable to the assessment. The ICNG provides two methodologies for the assessment of construction noise emissions:

- Quantitative, which is suited to major construction projects with typical durations of more than three weeks; and
- Qualitative, which is suited to short term infrastructure maintenance (<three weeks).

The methodology for a quantitative assessment requires a more complex approach, involving noise predictions from construction activities to the nearest relevant assessment locations.

The qualitative assessment methodology is a more simplified approach that relies on noise management strategies. This study has adopted a quantitative assessment approach and includes identification of potentially affected receivers, description of activities involved in the project, derivation of the construction noise criteria, quantification of potential noise impacts at receivers and, provides management and mitigation recommendations. **Table 3** summaries the recommended standard and out of hours periods for construction. Note, strong justification is required to work outside of normal construction hours.

Table 3 Recommended Hours for Construction

Period	Preferred Construction Hours
Normal construction	Monday to Friday - 7am to 6pm Saturdays - 8am to 1pm Sundays or Public Holidays - No construction
Out of Hours Period 1	Monday to Friday - 6pm to 10pm Saturdays – 7am to 8am and 1pm to 10pm Sundays or Public Holidays - 8am to 6pm
Out of Hours Period 2	Monday to Friday – 10pm to 7am Saturdays – 10pm to 8am Sundays or Public Holidays – 6pm to 7am

These recommended hours do not apply in the event of direction from police, or other relevant authorities, for safety reasons or where required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm.

3.1.1 Construction Noise Management Levels

Table 4 reproduces the ICNG management levels for residential receivers.

Table 4 ICNG Residential Management Levels

Time of Day	Management Level LAeq (15min)[1]	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 + 10dB.	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq(15min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. 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 relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: • times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. • if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours.	Noise affected RBL + 5dB.	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 5dBA above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2.

Note 1: The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the construction NML for noise assessment purposes and is the median of the ABL's.

Table 5 presents the standard construction period noise management levels (NMLs) for residential and non-residential receivers in close proximity to the project in accordance with the ICNG. For the educational receiver, it may be more practical to assess against an external NML. Therefore, the NMLs for educational receivers has been adjusted to an external management level assuming 10dB attenuation for a partially open window.

Table 5 ICNG Noise Management Levels, $LA_{eq(15\text{-}min)}$

NC ID	Receiver Type	Noise Management Level LAeq (15min)
NC1	Commercial	70
NC2	Commercial	70
NC3	Residential	68
NC4	Residential	68
NC5	Educational	45 (internal)/55 (external)
NC6	Residential	49

To minimise construction noise impacts on students and teachers, and to ensure continuity of studies, some activities may need to be completed during out of hours periods. **Table 6** presents the relevant NMLs for OOH periods. It is reiterated that schools or commercial receivers are unlikely to be occupied during the OOH periods. Hence, only residential receivers have been included in the OOH assessment.

Table 6 ICNG Out of Hours Noise Management Levels, $LA_{eq(15\text{-}min)}$

NC ID	Receiver Type	Period	OOH RBL	Noise Management Level LAeq (15min) (RBL+5dB for OOH periods)
NC3	Residential	Evening (OOH1)	40	45
		Night (OOH2)	33	38
NC4	Residential	Evening (OOH1)	40	45
		Night (OOH2)	33	38
NC6	Residential	Evening (OOH1)	37	42
		Night (OOH2)	30 (29)[1]	35

Note 1: Where the RBL is lower than 30dBA, a RBL of 30dBA is applied, the measured RBL is shown in brackets.

3.2 Road Noise Policy

The road traffic noise criteria are provided in the NSW EPA's Road Noise Policy (RNP) (2011).

The 'Freeway/arterial/sub-arterial road' categories as specified in the RNP are adopted for the Pacific Highway for this assessment which is the primary transportation route of construction vehicles to the project. **Table 7** presents the road traffic noise assessment criteria reproduced from he RNP relevant for this road type.

Table 7 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road category	Type of project/development	Assessment Criteria - dBA	
		Day (7am to 10pm)	Night (10pm to 7am)
Freeway/arterial/sub-arterial road	Existing residences affected by additional traffic on existing freeways/sub-arterial/roads generated by land use developments	60dBA, $L_{Aeq(15hr)}$	55dBA, LAeq(9hr)

Additionally, the RNP states where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2dB, which is generally accepted as the threshold of perceptibility to a change in noise level.

In addition to meeting the assessment criteria, any significant increase in total traffic noise at receivers must be considered. Receivers experiencing increases in total traffic noise levels above those presented in **Table 8** due to the addition of construction vehicles on the roads surrounding the project should be considered for mitigation.

Table 8 Relative Increase Criteria for Residential Land Uses

Road Category	Type of Project/Development	Total Traffic Noise Level Increase, dBA	
		Day (7am to 10pm)	Night (10pm to 7am)
Freeway/arterial/sub-arterial roads and transitways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road.	Existing traffic LAeq(15hr) +12dB (external)	Existing traffic LAeq(9hr) + 12dB (external)

3.3 Vibration Assessment Guidelines

3.3.1 Structural Damage Criteria

For structural damage, vibration should be assessed at the foundation of a building or structure. In the absence of an Australian Standard, German Standard DIN 4150 - Part 3: 1999 provides the strictest guideline levels of vibration velocity for evaluating the effects of vibration in structures. The limits presented in this standard are generally recognised to be conservative.

The DIN 4150 values (maximum levels measured in any direction at the foundation, or maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor), are summarised in **Table 9** and shown graphically in **Figure 2** in the case of foundation levels. For residential and commercial type structures, the standard recommends safe limits as low as 5mm/s and 20mm/s respectively. These limits increase with frequency values above 10Hz as shown in **Figure 2**.

Table 9 Structural Damage Guideline

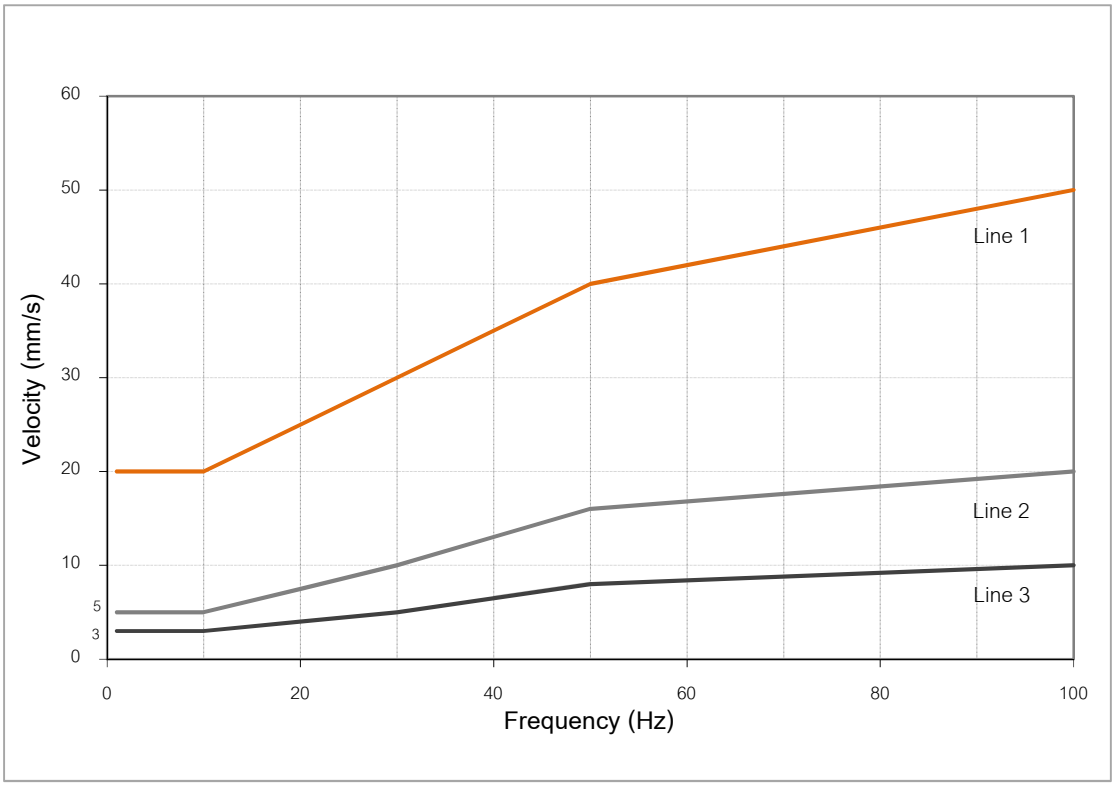
Line	Type of Structure	Vibration Velocity in mm/s			
		At Foundation at a Frequency of			Plane of Floor of Uppermost Storey
		Less than 10Hz	10Hz to 50 Hz	50Hz to 100Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

These levels are “safe limits”, for which damage due to vibration effects is unlikely to occur. “Damage” is defined in DIN 4150 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls.

Should such damage be observed without vibration levels exceeding the “safe limits” then it is likely to be attributable to other causes. DIN 4150 also states that when vibration levels higher than the “safe limits” are present, it does not necessarily follow that damage will occur.

As indicated by the criteria from DIN 4150 in **Table 9**, high frequency vibration has less potential to cause damage than lower frequencies. Furthermore, the “point source” nature of vibration from excavation and construction equipment causes the vibratory disturbances to arrive at different parts of nearby large structures in an out-of-phase manner, thereby reducing its potential to excite in-phase motion of the low order modes of vibration in such structures.

Figure 2 – DIN4150 Structural Vibration Safe Limits



3.3.2 Human Comfort – Assessing Vibration a Technical Guideline

Humans are far more sensitive to vibration than is commonly realised and may detect vibration levels which are well below levels that may cause damage to buildings or structures. Assessing vibration: a technical guideline was published in February of 2006 by the DEC and is based on guidelines contained in BS 6472 – 1992, Evaluation of human exposure to vibration in buildings (1-80Hz) and provides guidance on assessing vibration against human comfort.

The guideline presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended the operator negotiate directly with the affected community.

The guideline defines three vibration types and provides direction for assessing and evaluating the applicable criteria. Table 2.1 of the guideline provides examples of the three vibration types and has been reproduced in **Table 10**.

Table 10 Examples of types of vibration (from Table 2.1 of the guideline)

Continuous Vibration	Impulsive Vibration	Intermittent Vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery)	Infrequent: Activities that create up to three distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990)	Trains, intermittent nearby construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer these would be assessed against impulsive vibration criteria.

Continuous Vibration

Appendix C of the guideline outlines acceptable criteria for human exposure to continuous vibration (1-80Hz), the criteria are dependent on both the time of activity (usually daytime or night-time) and the occupied place being assessed. **Table 11** reproduces the preferred and maximum criteria relating to measured peak velocity.

Table 11 Criteria for Exposure to Continuous Vibration

Place	Time	Peak Velocity (mm/s)[1, 2]	
		Preferred	Maximum
Critical working Areas (e.g. hospital operating theatres, precision laboratories)	Day or Night	0.14	0.28
Residences	Day	0.28	0.56
	Night	0.20	0.40
Offices	Day or Night	0.56	1.1
Workshops	Day or Night	1.1	2.2

Note 1: rms velocity (mm/s) and vibration velocity value (dB re 10^{-9} mm/s)

Note 2: values given for most critical frequency >8Hz assuming sinusoidal motion.

Intermittent Vibration

Intermittent vibration (as defined in Section 2.1 of the guideline) is assessed using the vibration dose concept which relates to vibration magnitude and exposure time.

Intermittent vibration is representative of activities such as impact hammering, rolling or general excavation work (such as an excavator tracking).

Section 2.4 of the Guideline provides acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted rms (root mean square) acceleration levels over the frequency range 1 Hz to 80 Hz.

To calculate VDV the following formula (refer section 2.4.1 of the guideline) was used:

$$VDV = \left[\int_0^T a^4(t)dt \right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, a (t) is the frequency-weighted rms of acceleration in m/s^2 and T is the total period of the day (in seconds) during which vibration may occur.

The Acceptable Vibration Dose Values (VDV) for Intermittent Vibration is reproduced in **Table 12**.

Table 12 Acceptable Vibration Dose Values (VDV) for Intermittent Vibration ($m/s^{1.75}$)

Location	Daytime		Night-time	
	Preferred Value, $m/s^{1.75}$	Maximum Value, $m/s^{1.75}$	Preferred Value, $m/s^{1.75}$	Maximum Value, $m/s^{1.75}$
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

Note: Daytime is 7am to 10pm and Night-time is 10pm to 7am

Note: These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values. The Guideline states that activities should be designed to meet the preferred values where an area is not already exposed to vibration.

3.4 Operational Noise

The EPA released the NSW INP in January 2000. The INP provides a process for establishing noise criteria for consents and licences enabling the EPA to regulate noise emissions from scheduled premises under the Protection of the Environment Operations Act 1997.

The specific policy objectives of the INP are:

- to establish noise criteria that would protect the community from excessive intrusive noise and preserve amenity for specific land uses;
- to use the criteria as the basis for deriving project specific noise levels;
- to promote uniform methods to predict, quantify and assess noise impacts, including a procedure for evaluating meteorological effects;
- to outline a range of mitigation measures that could be used to minimise noise impacts;
- to provide a formal process to guide the determination of feasible and reasonable noise limits for consents or licences that reconcile noise impacts with the economic, social and environmental considerations of developments; and
- to carry out functions relating to the prevention, minimisation and control of noise from premises scheduled under the Act.

3.4.1 Assessing Intrusiveness

The intrusiveness criterion essentially means that the equivalent continuous noise level (LA_{eq}) from the proposal should not be more than 5dB above the existing rating background level (RBL) in any assessment period. Therefore, when assessing intrusiveness, the background noise needs to be measured.

3.4.2 Assessing Amenity

The amenity assessment is based on noise criteria relevant to a specific land use or locality. The criteria relate only to limiting cumulative or combined levels of industrial noise in a locality. Where existing industrial noise approaches the criterion value, then noise levels from proposed industries need meet the amenity criteria so that cumulative noise or 'industrial-creep' is minimised. The amenity assessment methodology takes into consideration areas of high traffic noise when assessing ambient industrial noise.

Private residences and other sensitive receivers potentially affected by the proposal are safeguarded by the EPA's suburban amenity category as per Table 2.1 of the INP. Table 2.1 of the INP for residential receivers is reproduced in **Table 13**.

Table 13 Receiver Locations – Assessing Amenity

Type of Receiver	Indicative Noise Amenity Area	Period	Recommended LAeq(Period) Noise Level, dBA	
			Acceptable	Recommended Max
Residential	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
Commercial Premises	All	When in use	65	70
School classroom	All	Noisiest 1-hour period	35	40

Note : Monday – Saturday Daytime 7am to 6pm; Evening 6pm to 10pm; Night-time 10pm to 7am. On Sundays and Public Holidays, Daytime 8am to 6pm; Evening 6pm to 10pm; Night-time 10pm-8am.

3.5 Project Specific Noise Criteria (Operational Noise)

The daytime operational noise emission criteria for the project have been set in accordance with Section 4.0 of the INP. It is noted that as the school hours are generally between 9am and 3pm, therefore, only the day assessment period is relevant to this project The Project Specific Noise Levels (PSNLs) (project criteria) is the lower of the intrusive or amenity criteria. The PSNLs for the project are presented in **Table 14**.

Table 14 Project Specific Noise Criteria, dBA $LA_{eq(15min)}$

Receiver	Measured RBL LA90, dBA	Intrusiveness Criteria LAeq(15minute), dBA	Amenity Criterion LAeq(period), dBA	PSNL
		Day		
Wiripaang Public School NC5	N/A	N/A	35 (internal)/45 (external)[1] Noisiest 1-hour period	35
Residential NC3 and NC4	48	53	55	53
Residential NC6	39	44	55	44

Note 1: External criteria assumes 10dB for a partially open window.

4 Noise Assessment Methodology

4.1 Noise Modelling Methodology

Brüel and Kjær Predictor Type 7810 (Version 11.00) noise modelling software was used to assess potential noise impacts associated with the proposal. A three-dimensional digital terrain map giving all relevant topographic information was used in the modelling process.

The model calculation method used to predict construction noise levels was in accordance with ISO 9613-1 'Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere' and ISO 9613-2 'Acoustics - Attenuation of sound during propagation outdoors. Part 2: General method of calculation'.

The model incorporated three-dimensional digitised ground contours, the proposed buildings as derived from proposed site plans provided by EJE Architecture, 2016 (see **Appendix D**), any existing or proposed buildings and the surrounding land base topography. Where relevant, modifying factors in accordance with Section 4 of the INP have been applied to calculations.

4.2 Construction Noise Assessment Methodology

Construction works associated with the project are expected to be divided into several activities as discussed in Section 1.2. The activities, plant and duration/occurrence are presented in **Table 15**.

Table 15 Construction Activities	
Activity	Construction Fleet/Plant
Activity 1: Block S - Movement Complex	
Construction of new driveway crossing off Pacific Highway and associated service road	Excavator, bobcat, trucks, whacker, concrete agitator.
Preparatory works for new electrical and hydraulic services	Generator, compressor and hand tools.
Construction of new Movement Complex (Block S)	Excavator, backhoe, front end loader, bobcat, trucks, concrete trucks and pumps, hand tools, jackhammers, crane.
Activity 2: Demolition No.1	
Demolish Block L and part of Blocks A and B	Excavator, backhoe, front end loader, bobcat, trucks, hand tools, jackhammers, crane.
Activity 3: Block T	
Construction of new 2 & 3 storey classroom and admin building (Block T)	Excavator, backhoe, front end loader, bobcat, trucks, concrete trucks and pumps, hand tools, jackhammers, crane.
Activity 4: Demolition No.2	
Demolish Blocks A, B, C, E and F	Excavator, backhoe, front end loader, bobcat, trucks, hand tools, jackhammers, crane.
Activity 5: Block U	
Construct new single storey classroom and library building (Block U)	Excavator, backhoe, front end loader, bobcat, trucks, concrete trucks and pumps, hand tools, jackhammers, crane.
Activity 6: Demolition No.3	
Demolish Blocks D, J (to slab level) and H	Excavator, backhoe, front end loader, bobcat, trucks, hand tools, jackhammers, crane.
Activity 7: Tennis Court	
Construction of tennis court to Block J slab	Concrete trucks and pumps, whacker or roller and hand tools.

Where relevant, the construction noise impact assessment has adopted the items of equipment presented in **Table 16** and associated noise emission data, as obtained from the MAC noise database.

Table 16 Acoustically Significant Sources - Sound Power Levels *(re 10-12 Watts)*

Plant and Equipment	Sound Power Level, LAeq(15min) dBA
Trucks (deliveries, tippers and general movements)	103
Roller	110
Crane	109
Hiab (truck)	95
Power tools (hand tools)	95
Drilling/Grinding (hand tools)	98
Hammering (hand tools)	99
Chainsaw (hand tools)	105
Backhoe	104
Bobcat	100
Concrete trucks/ agitator	108
Concrete pump	105
Whacker	111
Impact Hammer (Small)	112
Concrete agitator	111
Generator	98
Compressor	91

Generally, construction fleet sound power levels (SWLs) range from 102dBA (service works) to 119dBA (construction/demolition) which is representative of the combined noise level for specific construction activities. It should be noted that some items may be interchanged within each fleet and have no influence on the overall noise level of each fleet or predicted noise levels.

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5 Results

5.1 Construction Noise Results

5.1.1 Standard Hours Construction

Noise modelling included the assessment of construction/demolition equipment operating at representative locations for each activity. Results of the modelling for standard construction hours periods are presented in **Table 17** for each assessed NC. Note the results include assessment to relevant HSHS classrooms that are anticipated to be in place and occupied at the time of each activity.

Table 17 Predicted Construction Noise Levels, dBA $LA_{eq(15min)}$

NC ID	Period	Receiver type	Maximum Predicted LAeq(15minute) noise levels, dBA			CNML
Activity 1: Block S - Movement Complex						
			Drive way	Services	Construction	
NC1	Day	Commercial	54	46	66	70
NC2	Day	Commercial	64	51	67	70
NC3	Day	Residential	56	47	60	68
NC4	Day	Residential	51	38	55	68
NC5	Day	Educational	35	38	42	55[1]
NC6	Day	Residential	23	27	33	49
HSHS Block A	Day	Educational	70	74	72	55[1]
HSHS Block B	Day	Educational	65	65	71	55[1]
Activity 2: Demolition No.1						
NC1	Day	Commercial	49			70
NC2	Day	Commercial	67			70
NC3	Day	Residential	63			68
NC4	Day	Residential	47			68
NC5	Day	Educational	41			55[1]
NC6	Day	Residential	34			49
HSHS Block C	Day	Educational	76			55[1]
HSHS Block S	Day	Educational	74			55[1]
Activity 3: Block T						
NC1	Day	Commercial	48			70
NC2	Day	Commercial	66			70
NC3	Day	Residential	62			68
NC4	Day	Residential	46			68
NC5	Day	Educational	40			55[1]
NC6	Day	Residential	33			49
HSHS Block C	Day	Educational	75			55[1]

Table 17 Predicted Construction Noise Levels, dBA $LA_{eq(15min)}$				
NC ID	Period	Receiver type	Maximum Predicted LAeq(15minute) noise levels, dBA	CNML
HSHS Block C	Day	Educational	73	55[1]
Activity 4: Demolition No.2				
NC1	Day	Commercial	43	70
NC2	Day	Commercial	65	70
NC3	Day	Residential	53	68
NC4	Day	Residential	36	68
NC5	Day	Educational	49	55[1]
NC6	Day	Residential	35	49
HSHS Block S	Day	Educational	69	55[1]
HSHS Block T	Day	Educational	79	55[1]
Activity 5: Block U				
NC1	Day	Commercial	41	70
NC2	Day	Commercial	63	70
NC3	Day	Residential	44	68
NC4	Day	Residential	35	68
NC5	Day	Educational	43	55[1]
NC6	Day	Residential	32	49
HSHS Block S	Day	Educational	65	55[1]
HSHS Block T	Day	Educational	78	55[1]
Activity 6: Demolition No.3				
NC1	Day	Commercial	39	70
NC2	Day	Commercial	46	70
NC3	Day	Residential	46	68
NC4	Day	Residential	42	68
NC5	Day	Educational	51	55[1]
NC6	Day	Residential	35	49
HSHS Block U	Day	Educational	64	55[1]
Activity 7: Tennis Court				
NC1	Day	Commercial	27	70
NC2	Day	Commercial	28	70
NC3	Day	Residential	34	68
NC4	Day	Residential	32	68
NC5	Day	Educational	41	55[1]
NC6	Day	Residential	28	49
HSHS Block U	Day	Educational	51	55[1]

Note 1: Assumes external noise level adopting 10dB attenuation for a partially open window.

5.1.2 Out of Hours Construction (OOH)

To ensure the continuity of education of students and staff at the high school, on occasion some noise intensive construction activities may need to be conducted outside of standard construction hours (ie evening or night time). A comparison of noise modelling results and out of hours management levels are presented in **Table 18.** Note OOH1 is evening (6pm to 10pm) and OOH2 is night (10pm to 7am).

Table 18 Predicted Construction Noise Levels, dBA $LA_{eq(15min)}$ (OOH)

NC ID	Receiver type	Maximum Predicted LAeq(15min) Noise Levels, dBA			CNML	
Activity 1: Block S - Movement Complex						
		Drive way	Services	Construction	OOH1	OOH2
NC3	Residential	56	47	60	45	38
NC4	Residential	51	38	55	45	38
NC6	Residential	23	27	33	42	35
Activity 2: Demolition No.1						
NC3	Residential	63			45	38
NC4	Residential	47			45	38
NC6	Residential	34			42	35
Activity 3: Block T						
NC3	Residential	62			45	38
NC4	Residential	46			45	38
NC6	Residential	33			42	35
Activity 4: Demolition No.2						
NC3	Residential	53			45	38
NC4	Residential	36			45	38
NC6	Residential	35			42	35
Activity 5: Block U						
NC3	Residential	44			45	38
NC4	Residential	35			45	38
NC6	Residential	32			42	35
Activity 6: Demolition No.3						
NC3	Residential	46			45	38
NC4	Residential	42			45	38
NC6	Residential	35			42	35
Activity 7: Tennis Court						
NC3	Residential	34			45	38
NC4	Residential	32			45	38
NC6	Residential	28			42	35

5.2 Construction Road Traffic Assessment Results

The United States (US) Environment Protection Agency's road traffic calculation method was used to predict the LAeq noise levels from construction sit vehicles (both heavy and light) travelling past receivers along public roads. This method is an internationally accepted theoretical traffic noise prediction model and is ideal for calculating road traffic noise levels. It is noted that the parking spaces at the project will generally remain the same (McLaren Traffic Engineering, 2015), hence operational road noise levels for the project are anticipated to remain unchanged from the existing situation.

Vehicle movements to the project would be from the south and exit to the north via the Pacific Highway. It is anticipated that the maximum workforce on the project would be up to 150 staff per day (ie 300movements) (EJE, 2016). Furthermore, this assessment has assumed a conservative volume of up to 25 trucks per day (ie 50 movements) that will be required for waste removal and/or delivery of construction materials. The road noise calculations assume that all vehicles travel along the Pacific Highway north past residences that are situated approximately 15m from the road alignment. The results of the traffic noise calculations are presented in **Table 19** and demonstrate the noise levels from construction traffic would remain below the relevant day criteria for receivers at a distance of 15m from the roadway and also satisfy the relevant increase criteria.

Table 19 Construction Road Traffic Noise Levels

Distance to Nearest Receiver(m)	Assessment Criteria	Measured existing road traffic noise (L2)	Predicted Site Noise Contribution	Existing + Future Quarry Combined Total
		Day $LA_{eq(15hr)}$, dBA		
15	60	60.3	52.5[1]	60.9

Note1 : Combined light and heavy construction vehicles.

5.3 Vibration Assessment Results

The major potential sources of construction vibration include impact hammers during demolition of existing buildings. Equipment and plant have the potential to operate at a minimum offset distance of 10m from the nearest existing school classrooms when demolition work occurs. Generally, there is a low probability of adverse comment or disturbance to building occupants for hammering (medium hammer ie 900kg) for distances of up to 30 metres allowing for regular respite periods. Historic data from similar projects identifies that vibration levels within this distance are likely to generate vibration levels above the preferred vibration dose values (VDV) for intermittent vibration (0.4 m/s 1.75).

Table 20 provides safe working distances for the use of various sized hydraulic/impact hammers to nearby buildings.

Table 20 Safe Working Distances for Impact Hammers (m)[1]

Plant Item	Description	Minimum Offset Distance DIN 4150 criteria (m)	Minimum Offset Distance Human comfort criteria (m)
Small Hydraulic Hammer	(300 kg - 5 to 12t excavator)	2 m	7 m
Medium Hydraulic Hammer	(900 kg – 12 to 18t excavator)	7 m	23 m
Large Hydraulic Hammer	(1600 kg – 18 to 34t excavator)	22 m	73 m
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

Note 1: Source, Table 3 of the NSW Government, Transport Construction Authority (TCA) 2012, Construction Noise Strategy (CNS)

5.4 Operational Noise Results

A hypothetical noise modelling assessment of mechanical plant noise has been completed. The model assumed that mechanical air conditioning plant was situated on the northern façade of Block U. Results of the modellings at the nearest receiver NC5 (Wiripaang Public School) predicted noise levels from mechanical plant at <30dBA, and hence satisfies the relevant operational noise criteria for an educational receiver.

6 Noise Mitigation of Construction Activities

The results of the noise assessment demonstrate that levels during standard hours construction periods would satisfy relevant NMLs at all offsite catchments. Notwithstanding, are predicted to impact existing onsite classrooms adjacent to the construction/demolitions areas. External exceedances range from 1dB to 24dB above relevant NMLs at several classrooms in close proximity to works, assuming the classrooms have a partially opened window. It is noted that received internal noise levels would reduce by an additional 10dB (ie 20dB attenuation overall) if classroom windows remained closed.

Construction noise levels are predicted to be above the highly noise affected criteria of 75dBA LAeq(15min) at Block C during Activity 2 and at Block T during Activity 5. It may be feasible to implement mobile noise screens (which can achieve noise reductions of up to 8dBA), optimise the positioning of plant and equipment to minimise line of site to receivers or substitute noisy equipment in order to reduce the noise impact at nearby receivers for these activities.

Where it is not feasible to implement noise controls, conducting particular construction activities during out of hours periods should be considered. Notwithstanding, priority should be given to conduct work during OOH period 1 (ie 6pm to 10pm) and where possible, works between OOH period 2 (10pm to 7am) should be avoided.

Given the potential for the predicted noise exceedances, noise mitigation strategies should be implemented wherever feasible and practicable during standard or OOH construction works. Wherever possible, subject to feasibility and reasonability, the quietest plant and equipment should be utilised in combination with management measures in order to minimise noise impacts.

The primary objective of the noise and vibration management strategy is to minimise noise impacts on the HSHS classrooms and surrounding community. The project manager may adopt the following hierarchical strategy to achieve this objective:

- ensure that construction activities meet construction noise management levels within the allowable hours of operation as far as practicable;
- where noise levels are above relevant noise management levels, implement reasonable and feasible best practice noise controls to minimise noise emissions and/or exposure duration at affected receivers; and
- where the use of best practice noise controls does not adequately address exceedance of noise management levels, adopt alternative measures to minimise impacts on the community.

Australian Standard AS 2436-2010 "*Guide to Noise Control on Construction, Maintenance and Demolition Sites"* sets out numerous practical recommendations to assist in mitigating construction noise emissions. These recommendations include operational strategies, source noise control strategies, noise barrier control strategies, and community consultation. Employing these strategies could potentially result in noise level reductions ranging:

- up to 10 dBA in instances where space requirements place limitations on the attenuation options available; or
- to potentially over 20 dBA where equipment controls (enclosures, silencers, etc) can be combined with noise barriers and management techniques (eg avoidance of clustering).

Should compliance noise monitoring indicate exceedances of the noise criteria, a combination of comprehensive noise mitigation treatments (i.e. noise barriers, equipment enclosures, silencers, regular equipment maintenance, etc) and consultation with the local community will be considered to manage exceedances. Further descriptions of management measures and mitigation options are provided for specific construction activities and work areas in the following sections.

6.1 Noise Management Recommendations

During construction and demolition activities, the following mitigation strategies to manage noise include:

- toolbox and induction of personnel prior to shift to discuss noise control measures that may be implemented to reduce noise emissions to surrounding receivers;
- training (of employees to conduct quieter work practices);
- equipment which is used intermittently is to be shut down when not in use;
- undertake noise intensive construction or demolition activities outside of school hours, or in school holiday periods;
- where work is undertaken outside of school hours, noise mitigation options should be thoroughly investigated by the contractor prior to these works and validated by attended noise monitoring;
- where possible, machinery will be located / orientated to direct noise away from the closest sensitive class rooms;

- undertake regular maintenance of machinery to minimise noise emissions. Maintenance will be confined to standard daytime construction hours and where possible, away from noise sensitive receivers;
- the quietest suitable machinery reasonably available will be selected for each work activity;
- the offset distance between noisy items of plant/machinery and nearby sensitive receivers and classrooms will be maximised;
- queuing of vehicles is not to occur adjacent to any occupied classroom;
- where queuing is required, for example due to safety reasons, engines are to be switched off to reduce their overall noise impacts on receivers;
- where practicable, ensure those noisy plant/machinery are not working simultaneously in close proximity to classrooms;
- where possible, all plant are to utilise a broad band reverse alarm in lieu of the traditional hi-frequency type reverse alarm;
- minimising the need for reversing or movement alarms; and
- conduct noise monitoring throughout the proposal work.

6.2 Consultation and Notification for Out of Hours Works

6.2.1 General

- Inform affected residents and other sensitive land use occupants the levels of impacts, the associated duration of each activity and what is being adopted at the project to minimize noise impacts to the community. This information should be provided to the community seven days before commencement.
- Provide information to neighbours before and during construction through media such as letterbox drops, meetings or individual contact. A website could also be established for the project to provide information.
- Implement a site information board at the front of the site with the name of the organisation responsible for the site and their contact details, hours of operation and regular information updates. This signage should be clearly visible from the outside and include standard and after hours emergency contact details.

- Maintain good communication between the community and project staff.

6.2.2 Complaints Handling

- Provide a readily accessible contact point, for example, through a 24-hour toll-free information and complaints line and give complaints a fair hearing
- Have a documented complaints process, including an escalation procedure so that if a complainant is not satisfied there is a clear path to follow
- Records of all community complaints will be maintained on an up-to-date complaints register. The records will include:
    - date and time of the complaint;
    - the means by which the complaint was made (telephone, mail or email);
    - any personal details of the complainant that were provided, or if no details are provided, a note to that effect;
    - the nature of the complaint;
    - any actions taken by the site supervisor/construction contractor in relation to the complaint, including any follow up contact with the complainant and the timing for implementing action; and
    - if no action was taken by site supervisor/construction contractor in relation to the complaint, the reason why no action was taken.
- Community complaints will be allocated to a responsible contractors representative immediately to facilitate the implementation of corrective actions. The details of the complaint will also be circulated to the applicable construction personnel for action, where required.

6.3 Vibration Management Recommendations

It is recommended that to satisfy the human comfort criteria, small hydraulic hammers or hand held jackhammers be used when in close proximity to adjoining classrooms (ie when at distances of 7m to 23m).

In general, to minimise vibration impacts during construction/demolition activities, it is recommended that vibrating plant selection takes into account relevant offset distances to receivers to achieve both the human comfort and structural damage criteria.

For newly constructed buildings, it is recommended that vibration monitoring should be considered so that vibration levels from the project can be quantified and proactively managed against relevant structural criteria.

6.4 Noise Monitoring

A noise monitoring program has been developed to guide, manage, quantify and control noise emissions from standard and out of hours construction activities. Where monitoring indicates exceedances, additional mitigation measures and controls may be considered to minimise impacts to nearby sensitive receptors.

The objectives of the noise monitoring program are as follows:

- assess construction noise levels against derived NMLs presented in Section 3.1.1 of this report, with consideration given to non-site related ambient and background noise at the time of measurements;
- identify potential noise sources and their relative contribution to noise impacts from construction;
- specify appropriate intervals for noise monitoring to evaluate, assess and report the noise contribution due to construction;
- outline the methodologies to be adopted for monitoring construction noise, including justification for monitoring intervals or triggers, weather conditions, monitoring location selection and timing; and
- incorporate noise management and mitigation strategies outlined in this plan.

The noise measurement procedures employed throughout the monitoring programme shall be guided by the requirements of AS 1055 1997 “Acoustics - Description and Measurement of Environmental Noise” and the EPA’s Industrial Noise Policy (INP), 2000. Noise monitoring will be undertaken by a suitably qualified acoustic specialist or suitably qualified and trained environment officer.

Operator attended noise measurements and recordings shall be conducted to quantify the intrusive noise emissions from construction/demolition as well as the overall level of ambient noise.

The operator shall quantify and characterise the maximum (LAmax) and the energy equivalent (LAeq) intrusive noise level from construction/demolition over a 15-minute measurement period. In addition, the operator shall quantify and characterise the overall levels of ambient noise over the 15-minute measurement interval. It is recommended that instrumentation used during the monitoring be equivalent to a Type 1 meter with 1/3 octave band analysis and have audio recording functionality for post processing source identification. It is noted that 1/3 octave band analysis is required to establish if modification factors in accordance with Section 4 of the NSW Industrial Noise Policy are applicable.

All acoustic instrumentation used as part of the attended monitoring program must been designed to comply with the requirements of AS IEC 61672.1-2004, “Electroacoustics - Sound level meters - Specifications” and shall have current NATA or manufacturer calibration certificates. All instrumentation shall be programmed to record continuously statistical noise level indices in 15 minute intervals which may include the LAmax, LA1,LA5, LA10, LA90, LA99, LAmin and the LAeq.

The statistical noise exceedance levels (LAN) are the levels exceeded for N% of the 15-minute interval. The LA90 represents the level exceeded for 90% of the interval period and is referred to as the average minimum or background noise level. The LAeq is the equivalent continuous sound pressure level and represents the steady sound level which is equal in energy to the fluctuating level over the interval period. The LAmax is the maximum noise level recorded over the interval.

Instrument calibration shall be checked before and after each measurement survey, with the variation in calibrated levels not exceeding ±0.5 dBA. The measurement position(s) should be selected taking into account:

- the weather, rain, wind, noise and insect noise;
- the location and direction of any noise source/s;
- the most sensitive position at the affected receiver; and
- the need to avoid reflecting surfaces (where possible).

6.4.1 Data Presentation and Reporting

The measured LAeq(15minute) noise level contributions from construction/demolition operations as well as the overall ambient noise levels together with the weather and construction/demolition activities at the time of the measurement shall be reported on a regular basis.

In the event of an exceedance of the relevant NMLs, the Project Manager shall be promptly informed of the location, the margin of exceedance and the source of emission. The noise, meteorological conditions at the time of the survey and plant operating data shall be documented and forwarded to the Project Manager so that an appropriate response can be made with respect to conformance.

Reporting of monitoring will include the following:

- monitoring location(s);
- list of operating plant and equipment;
- measured noise and/or vibration levels from construction;
- overall ambient noise levels;
- comparison of results with relevant NMLs;
- monitoring equipment details;
- weather conditions; and
- comments specific to each site.

Compliance reports, discussing compliance against the NMLs, will be prepared and submitted to the Project Manager as required. Compliance reports will include a summary of the information listed in the preceding sections, specifically issues or non-compliances and the response or management of the issues and non-compliances.

7 Conclusion

MAC has completed a construction noise and vibration management plan (CNVMP) for the proposed Redevelopment of Hunter Sports High School (HSHS), situated at 2 Pacific Highway Gateshead, NSW.

The assessment quantified construction/demolition noise and vibration emissions on surrounding receivers and HSHS classrooms, offsite road noise and operational emissions. The results of the assessment demonstrate that construction noise levels would satisfy the relevant NMLs at all offsite noise catchments during standard construction hours. Onsite noise levels at HSHS classrooms were identified to be above the relevant NMLs, although the CNVMP provides prescriptive reasonable and feasible recommendations that can be implemented to reduce potential impacts. In particular, it is recommended that noise intensive activities be completed outside of school hours to minimise the disruption to students. Where construction activities are completed outside of standard hours, reasonable and feasible noise controls will be implemented to minimise offsite noise impacts on the surrounding community and will be validated via attended measurements.

With respect to vibration, careful selection of the size of the impact hammers should be made taking into consideration human comfort and vibration damage criteria at adjacent classrooms.

Worst case road noise emissions associated with construction vehicles are expected to satisfy relevant EPA criteria for receivers at a minimum offset distance of 15m from the Pacific Highway.

Operational noise emissions from mechanical plant are expected to satisfy relevant operational noise criteria at the nearest affected receivers.

In summary, it is recommended that during construction and demolition, noise control and management measures provided in this report are adopted to minimise impacts on the adjoining school classrooms and the surrounding community, especially if works are required during out of hours periods to minimise impacts on students and staff.

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Appendix A - Glossary of Terms

A number of technical terms have been used in this report and are explained in the Table A1.

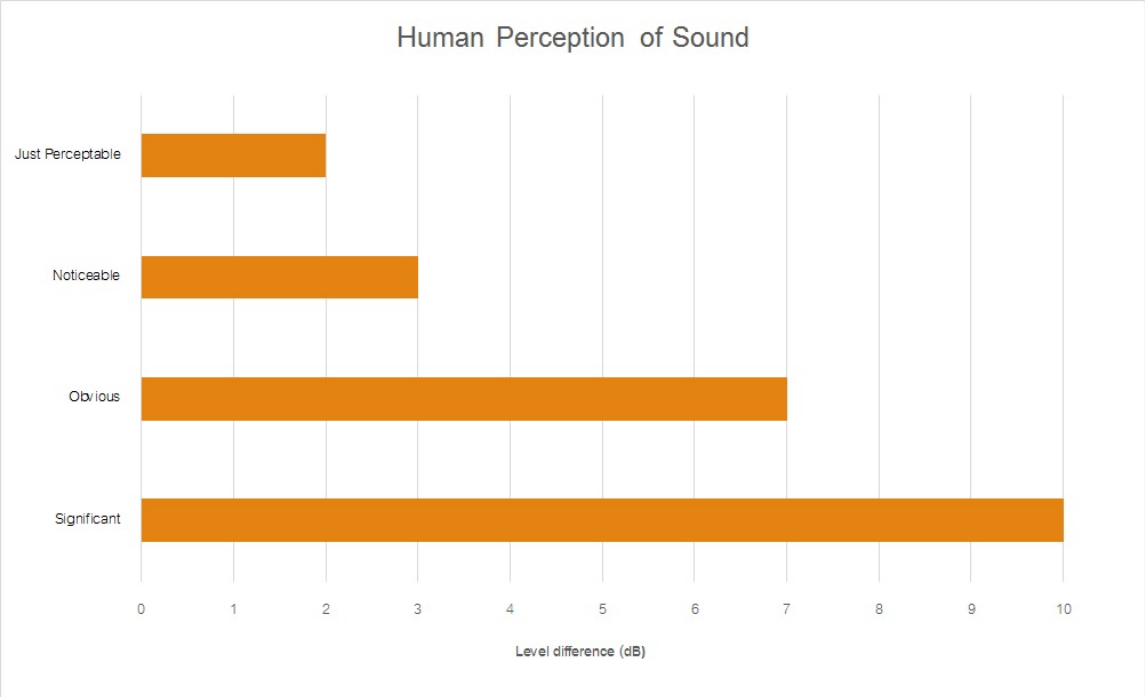
Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the INP as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAmax	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : = 10.log10 (W/Wo) Where : W is the sound power in watts and Wo is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA

Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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Appendix B - Secretary's Environmental Assessment Requirements

Prior to the commencement of any works on the site, a Construction Management Plan (CMP) shall be submitted to the Principal Certifying Authority or Council, for approval, that addresses, but not limited to, the following information.

- Hours of work;
- Contact details of Site Manager;
- Traffic management during construction;
- Noise and vibration management during construction;
- Waste management during construction;
- Erosion and sedimentation control during construction.

The plan is to include details of ingress and egress of construction vehicles to the site. The provision of loading and unloading and construction zones. Details of the predicated traffic volumes, types and routes, and pedestrian and traffic management methods.

The Plan should provide measures to mitigate potential pedestrian and vehicle conflicts along the Pacific Highway street frontage and internal access driveway(s), particularly for construction and ongoing service vehicle movements to be undertaken during school hours.

For the duration of work being carried out as part of this development, the Applicant shall ensure that traffic control is undertaken in accordance with the requirements of Australian Standards AS 1742 - Manual Uniform Traffic Control Services – Parts 1, 2 and 3.

The CMP shall also detail construction timetabling to minimise noise impacts, including time and duration restrictions, respite periods and frequency. Procedures for notifying adjacent properties of construction activities that are likely to affect their amenity through noise and vibration. Contingency plans to be implemented in the event of non-compliance and/or noise complaints. And a description of specific mitigation treatments, management methods and procedures that will be implemented to control noise and vibration during construction.

Any approvals required from Council with regard to redirection of pedestrian and vehicular traffic, shall be required prior to work commencing.

An electronic and paper copy of the approved construction management plan shall be forwarded to Council for records two days prior to work commencing on-site.

9. Parking Areas and Access Ways

All parking areas and access ways shall be designed, constructed, sealed and drained in accordance with the standards nominated in DCP 2014 Guidelines - Engineering Guidelines and the Australian Standard AS2890. All parking areas and access ways, line marking and signage shall be completed prior to the issue of an Occupation Certificate.

Construction site safety fencing and/or hoarding shall be provided in accordance with WorkCover requirements. Such fencing and/or hoarding shall be erected wholly within the property boundary unless prior approval from Council is obtained.

Council approval is required to install hoarding, site fencing or overhead protective structures over or adjoining a public place i.e. a footpath or a Public Reserve. No work shall commence until written approval is obtained.

28. Noise - Construction Sites

The operating noise level of construction site operations, including machinery, plant and equipment when measured at any affected premises, shall be evaluated and comply with the requirements of the NSW Office of Environment and Heritage publication "Interim Construction Noise Guideline" July 2009.

Approved Construction Times

The approved hours for construction of this development are –

Monday to Friday - 7.00am to 6.00pm.

Saturday – 8am to 1pm.

No construction work shall take place on Sundays or Public Holidays.

Construction Periods in Excess of 26 Weeks

If the construction period is in excess of 26 weeks, a Noise Management Plan (NMP) shall be provided to Council prior to the issue of the first construction certificate. Such plan shall be prepared with the assistance of a suitably qualified acoustic engineer, indicating whether the use of machinery, plant and equipment during those operations can be completed without causing offensive noise (as defined in the *Protection of the Environment Operations Act* 1997) in the neighbouring area. The NMP shall be complied with at all times during the construction period and shall identify any mitigation measures to control noise, noise monitoring techniques and reporting methods, likely potential impacts from noise and a complaints handling system.

Operational times may be amended with the written advice of Council's General Manager or delegate.

29. Construction Site Vibration

Vibration on surrounding land from construction site operations shall comply with the Office of Environment and Heritage publication "Assessing Vibration: a technical guideline" February 2006.

30. Demolition

Demolition may only be carried out between 7.00 am and 5.00 pm on Monday to Saturday and no demolition is to be carried out at any time on a Sunday or a public holiday.

No trees shall be removed from the site unless they are shown for removal on the approved plans, or separately approved by Council.

Erosion and sediment control measures shall be installed prior to any demolition works and maintained in accordance with DCP 2014 Guidelines - Erosion Prevention and Sediment Control Guidelines.

Temporary toilet facilities shall be provided during the course of demolition at a ratio of one toilet, plus one additional toilet for every 20 persons employed at the site.

All demolition work shall be carried out strictly in accordance with *Australian Standard AS 2601—1991: The Demolition of Structures* and as in force at 1 July 1993.

Waste materials (including excavation, demolition and construction waste materials) must be managed on the site and then disposed of at a waste management facility. During construction all vehicles entering or leaving the site must have their loads covered, and must be cleaned of dirt, sand and other materials, to avoid tracking these materials onto public roads.

At the completion of the works, the work site must be left clear of waste and debris and the site shall be grassed or otherwise rendered erosion resistant.

31. Building Waste

Prior to any construction work commencing, containment of building waste materials shall be provided within the boundaries of the building site, above natural or excavated ground level, by a screened area of silt stop fabric or shade cloth, having minimum dimensions of 2.4 x 2.4 x 1.2 metres high OR equivalent size waste disposal bin.

The enclosure or bin shall be maintained for the term of the construction to the completion of the development.

The enclosure or bin shall be regularly cleaned to ensure proper containment of the building wastes generated on the site.

Appropriate provision is to be made to prevent wind blown rubbish escaping from the containment.

32. Asbestos

If asbestos is encountered during construction or demolition work, even if the works are partial demolition (eg one wall), measures must be in place in accordance with WorkCover NSW guidelines and the *Occupational Health & Safety Regulations* 2001 NSW. Work shall not commence or continue until all the necessary safeguards required by WorkCover NSW are fully in place.

Only contractors who are appropriately licensed for asbestos disposal by WorkCover NSW may carry out the removal and disposal of asbestos from demolition and construction sites.

Prior to commencing demolition of buildings containing asbestos, a commercially manufactured sign containing the words “DANGER ASBESTOS REMOVAL IN

WATER MANAGEMENT

The EIS must provide sufficient information to demonstrate that the proposed development can be operated whilst complying with the *Protection of the Environment Operations Act 1997*, in particular, the protection of water quality during construction and operation of the facility.

The methodology, data and assumptions used to design any pollution control works and assess the potential impact of the proposal on water quality (ground and surface waters), must be fully documented and justified.

The EIS must include an adequacy assessment of stormwater controls. This assessment must determine sediment basins are adequately sized based on relevant guidelines and that discharges to waters from any sediment basins or other treatment systems comply with the requirements of the Protection of the Environment Operations Act.

The EIS must identify any fuel or chemical storage areas to be established on the site and describe the measures proposed to minimise the potential for leakage or the migration of pollutants into the soil/waters or from the site.

The EIS should also describe the sewage treatment and effluent management processes used on site including the proposed numbers of occupancy using the premises.

NOISE AND VIBRATION IMPACTS

The EIS must include a noise assessment of the existing environment, potential impacts and proposed noise amelioration measures. EPA's "*New South Wales Industrial Noise Policy*" (EPA, 2000) provides a guide to the methodology and assessment criteria used by EPA to determine noise limits or levels.

The evaluation should take into account the ground-based operational phases of the development over the "operating" hours proposed and take into account adverse weather conditions including temperature inversions. Sound power levels measured or estimated for all plant and equipment should be clearly stated and justified.

The EIS should include an assessment of cumulative noise impacts, having regard to existing developments and developments which have received development consent in the area but which have not commenced.

The EIS must identify the transport route(s) to be used, the hours of operation and quantify the noise impacts. The EPA's publication `*NSW Road Noise Policy'* describes the methods generally used by EPA to determine noise planning levels for road traffic noise in locations of varying sensitivity.

AIR QUALITY

The EIS must include an Air Quality Impact Assessment (AQIA). The AQIA must identify and describe in detail all possible sources of air pollution and activities/processes with the potential to cause air pollutants including odours and fugitive dust emissions beyond the boundary of any premises proposed to be licenced by an EPL. This should cover both the construction and operational phases of the development. The AQIA should include cumulative impacts associated with existing developments and any developments having been granted development consent but which have not commenced.

The EIS should demonstrate that the facility will operate within EPA's objectives which are to minimise adverse effects on the amenity of local residents and sensitive land uses and to limit the effects of emissions on local, regional and inter-regional air quality.

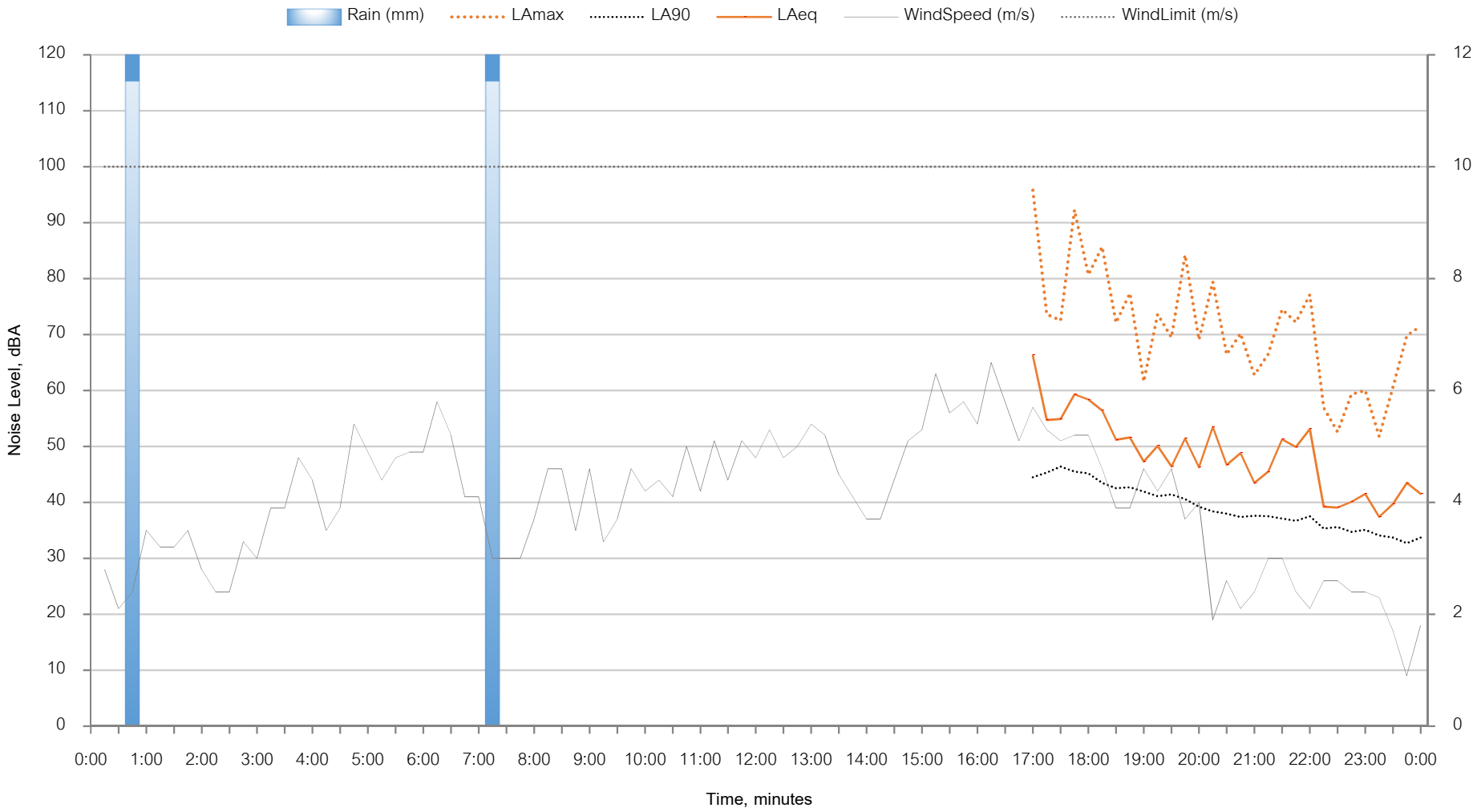
The EIS must describe in detail the measures proposed to mitigate the impacts and quantify the extent to which the mitigation measures are likely to be effective in achieving the relevant environmental outcomes.

Appendix C - Noise Logging Charts

Measured Ambient Noise Levels

Location 1 - 54 Groundry Street

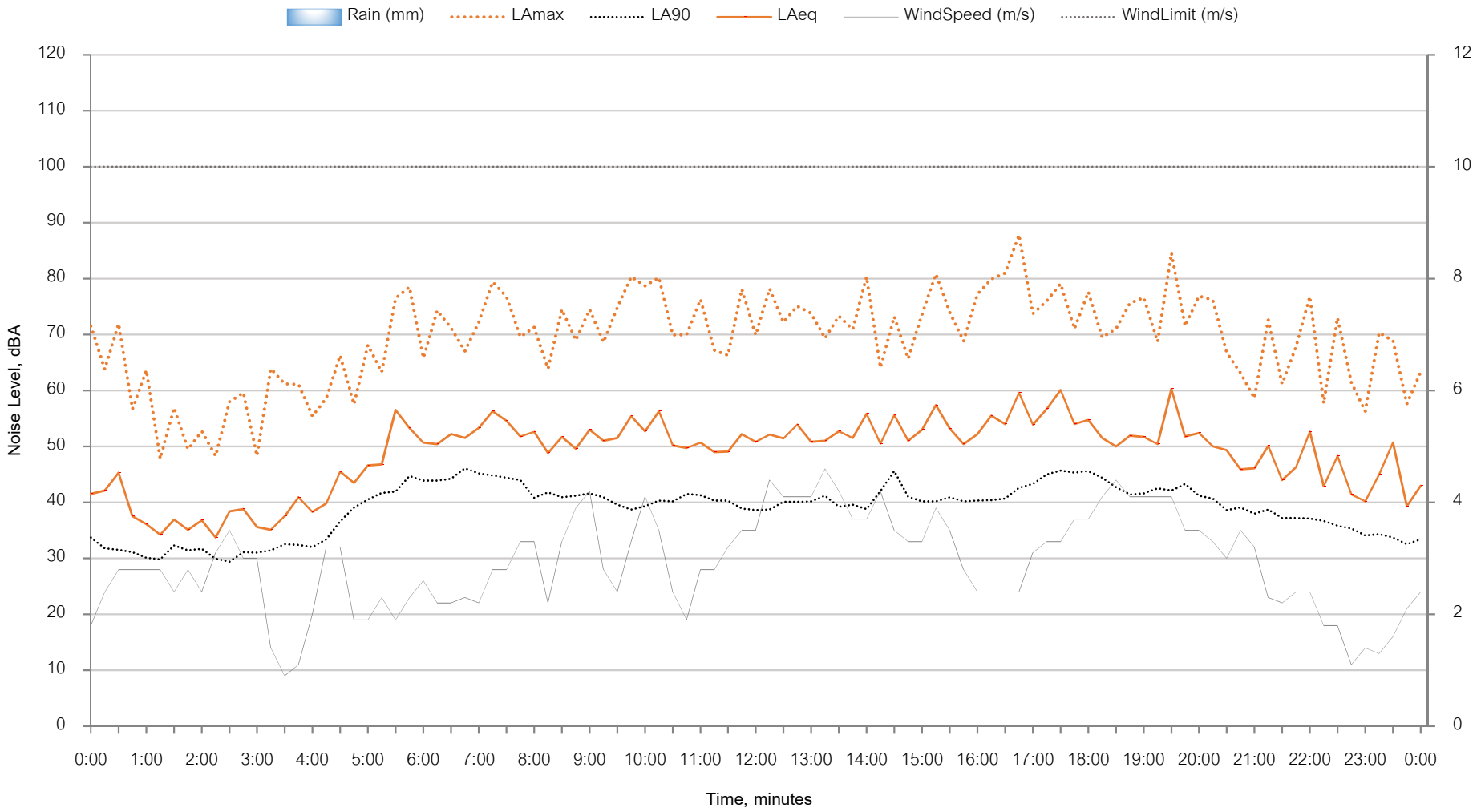
Monday, 18-04-16



Measured Ambient Noise Levels

Location 1 - 54 Groundry Street

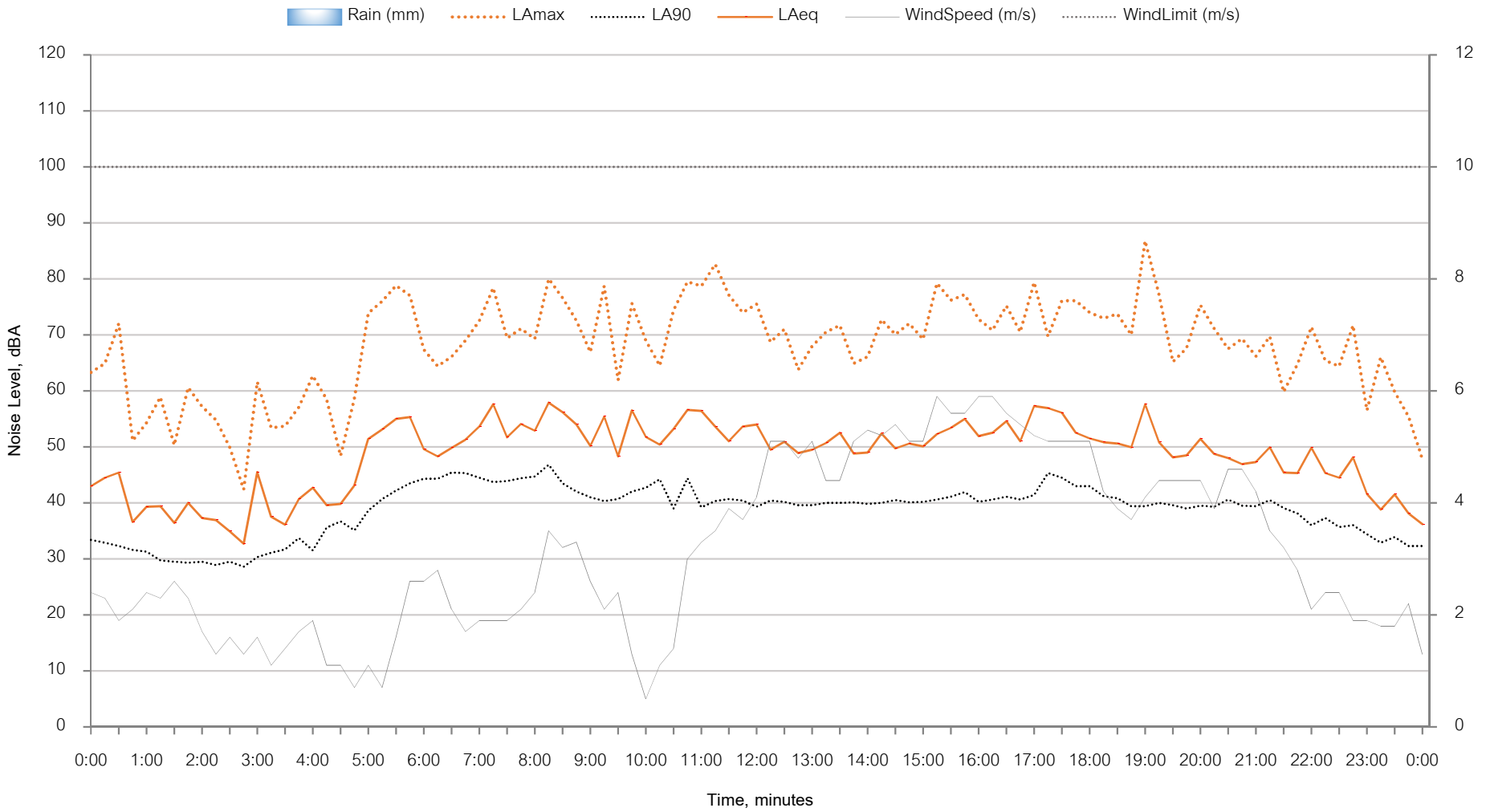
Tuesday, 19-04-16



Measured Ambient Noise Levels

Location 1 - 54 Groundry Street

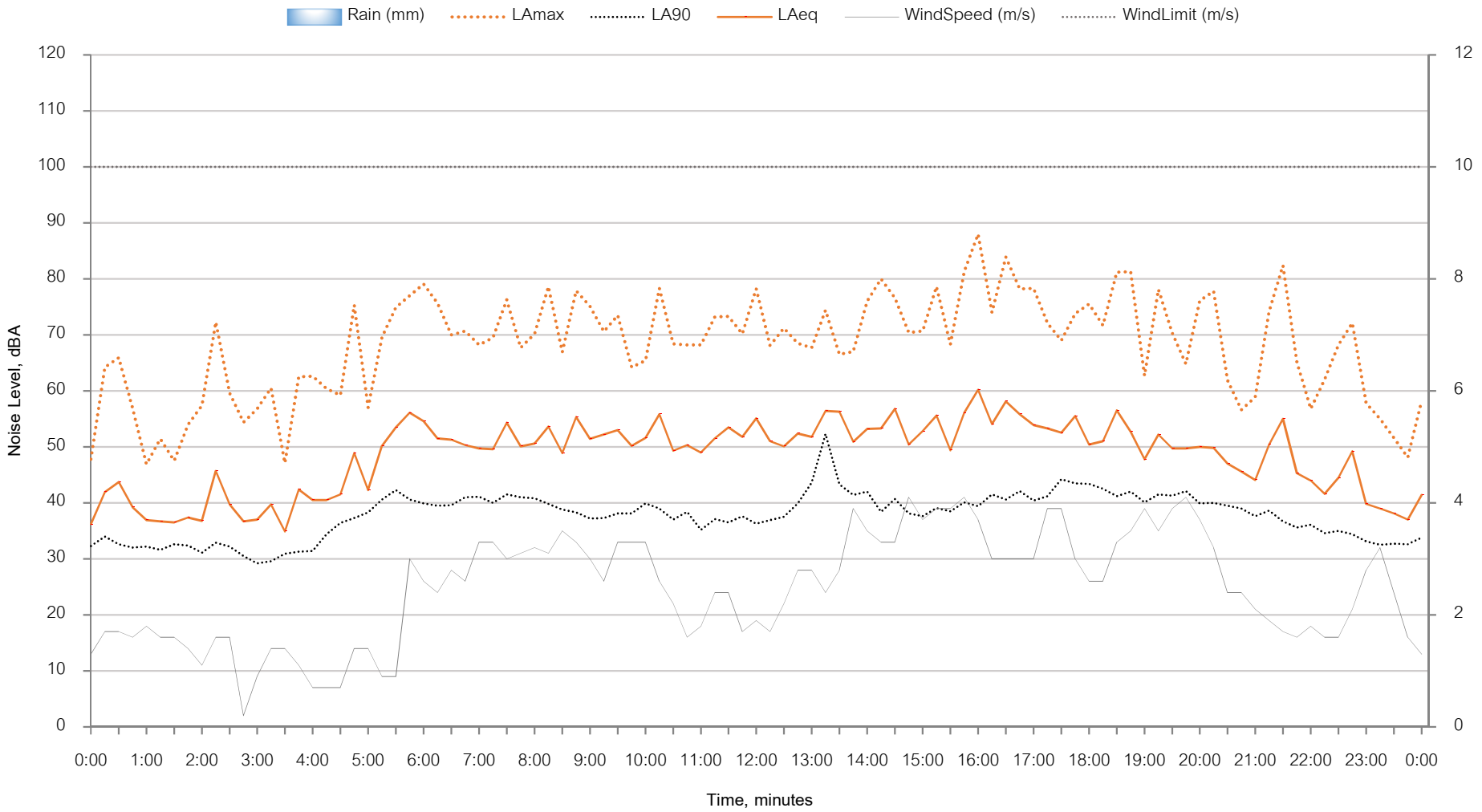
Wednesday, 20-04-16



Measured Ambient Noise Levels

Location 1 - 54 Groundry Street

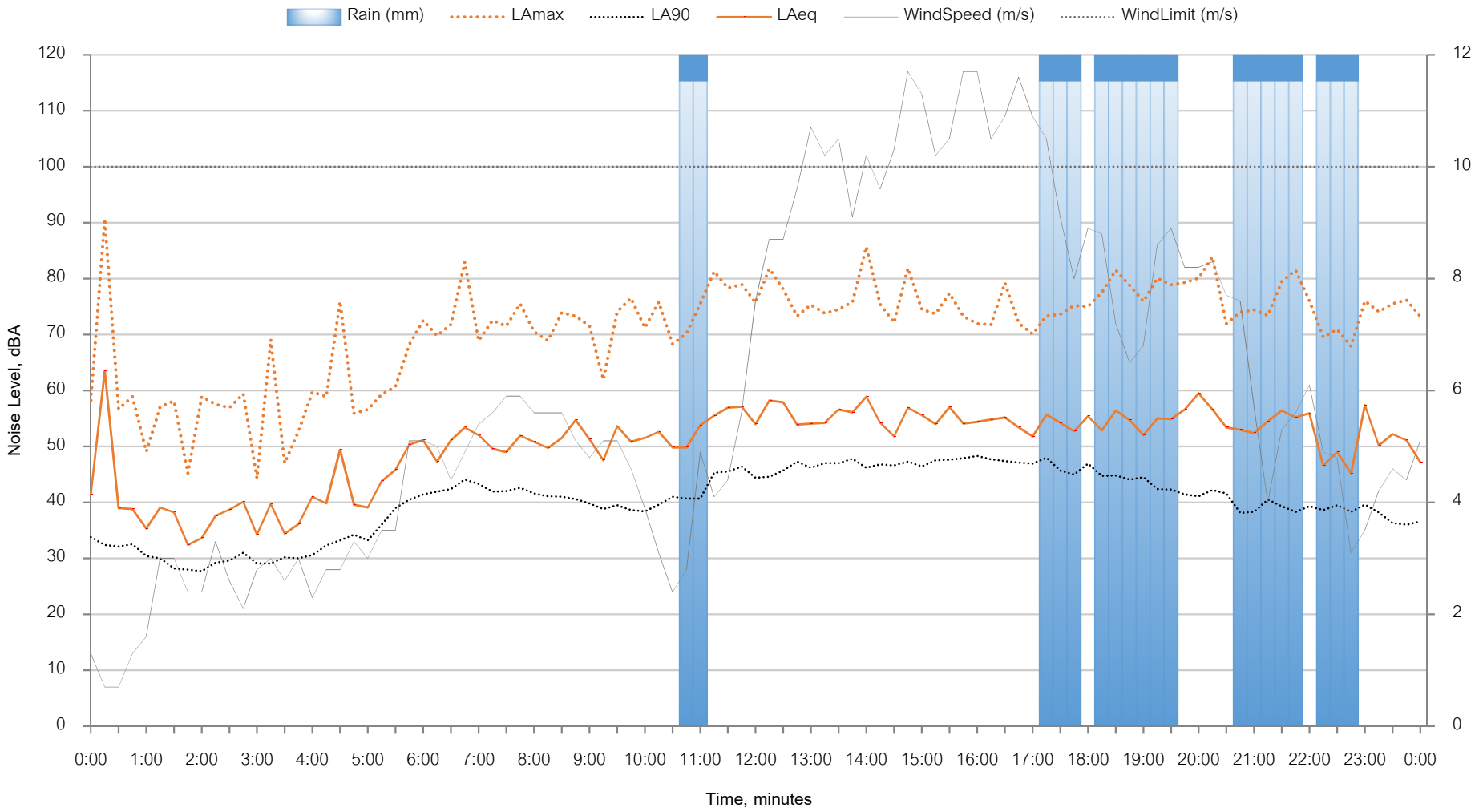
Thursday, 21-04-16



Measured Ambient Noise Levels

Location 1 - 54 Groundry Street

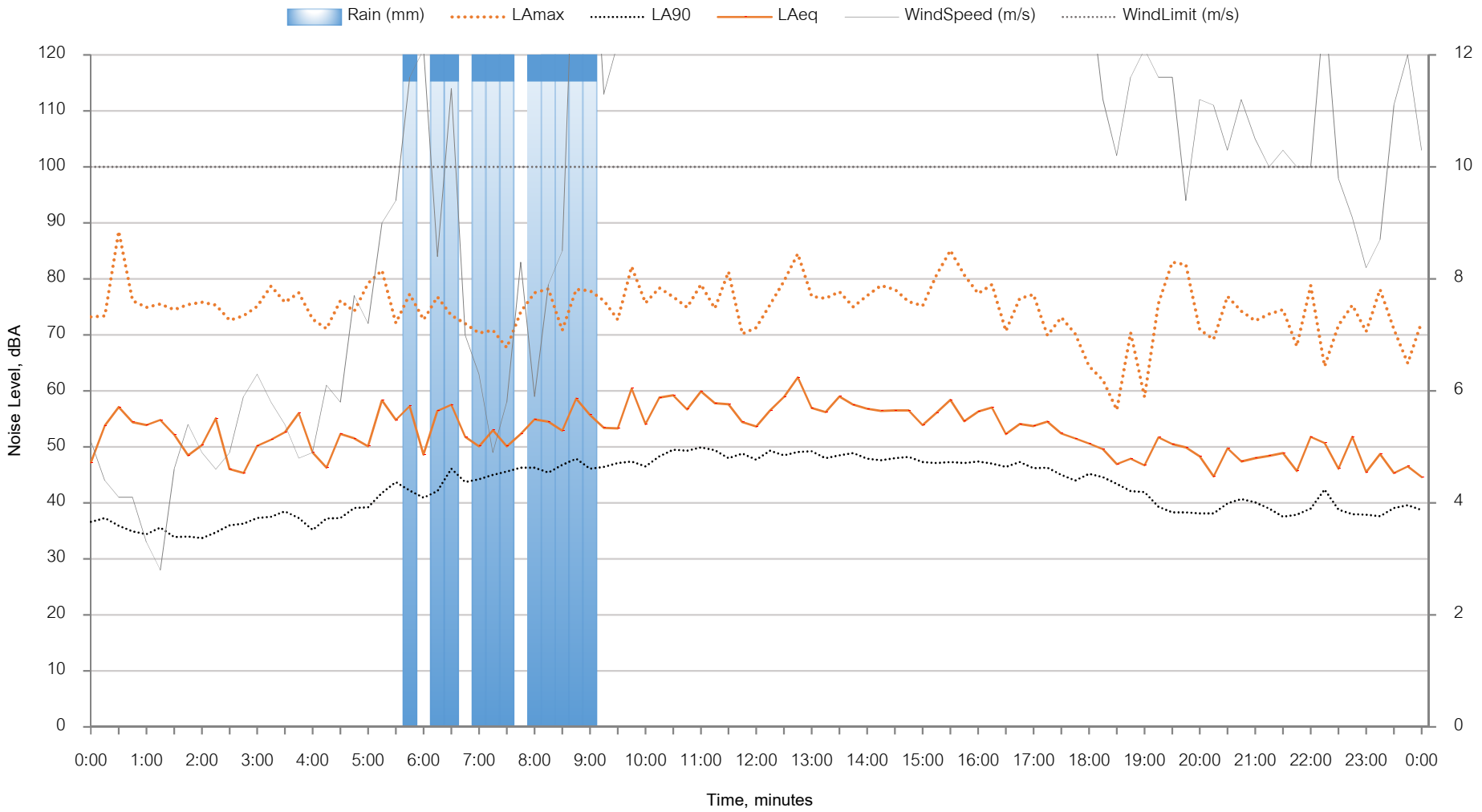
Friday, 22-04-16



Measured Ambient Noise Levels

Location 1 - 54 Groundry Street

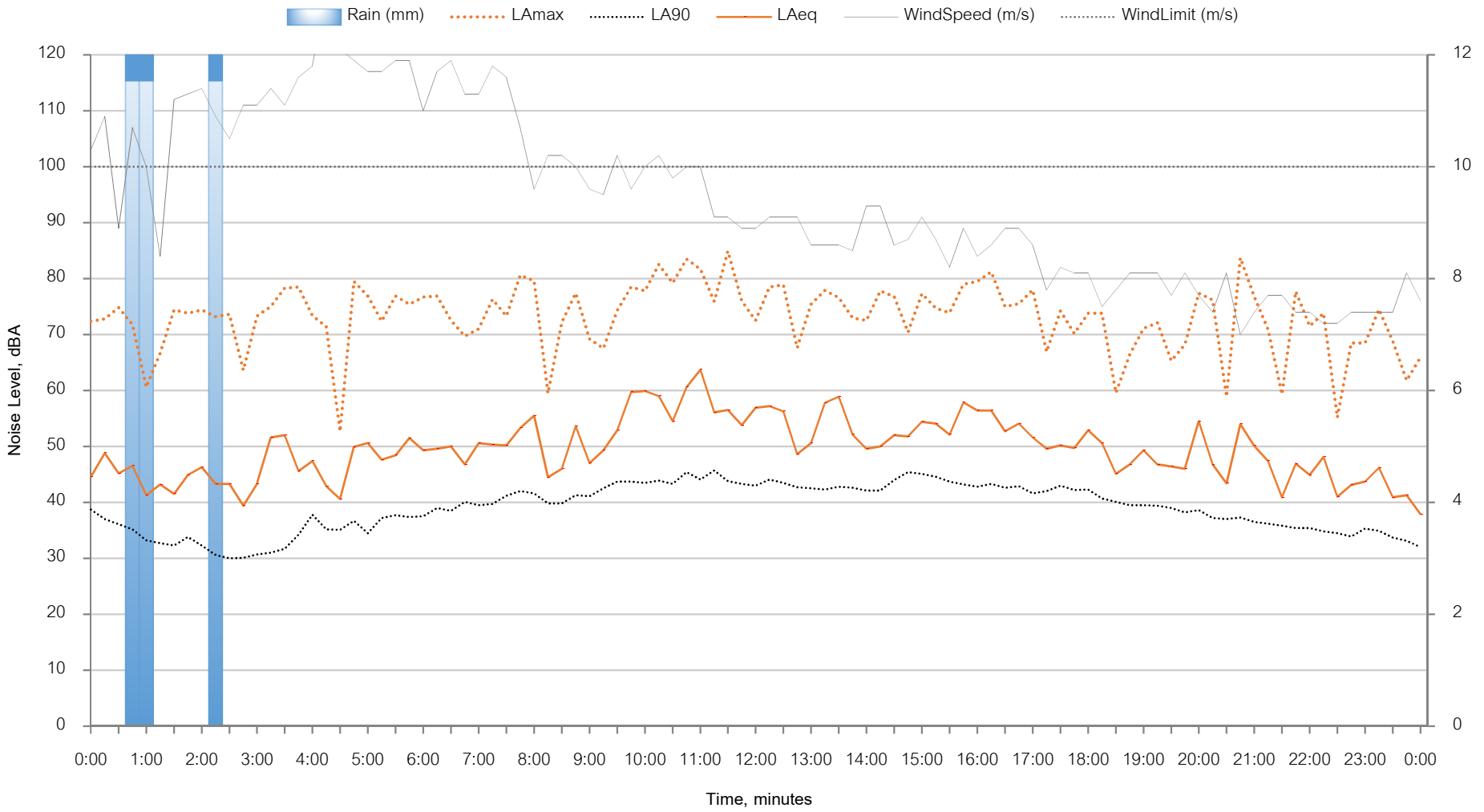
Saturday, 23-04-16



Measured Ambient Noise Levels

Location 1 - 54 Groundry Street

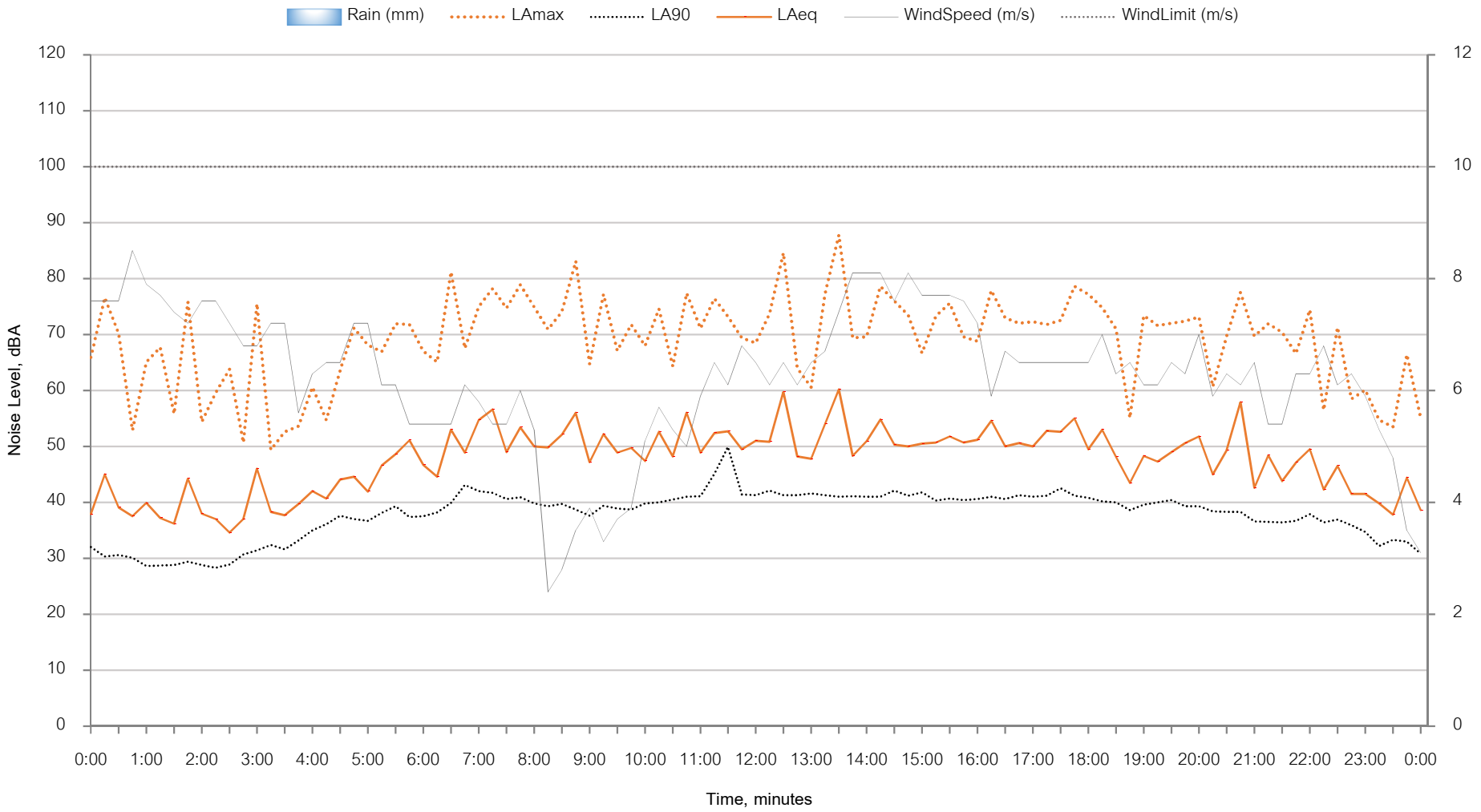
Sunday, 24-04-16



Measured Ambient Noise Levels

Location 1 - 54 Groundry Street

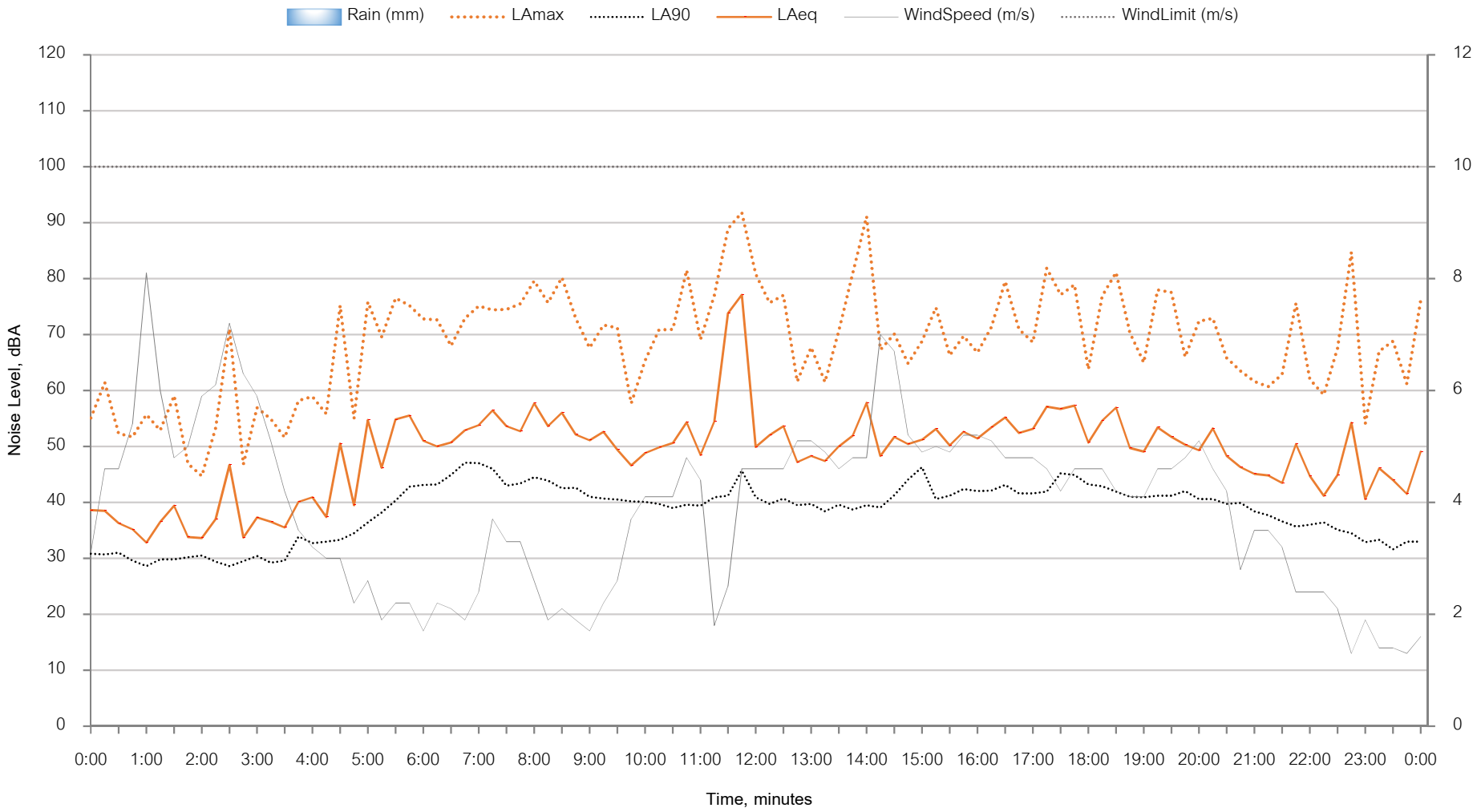
Monday, 25-04-16



Measured Ambient Noise Levels

Location 1 - 54 Groundry Street

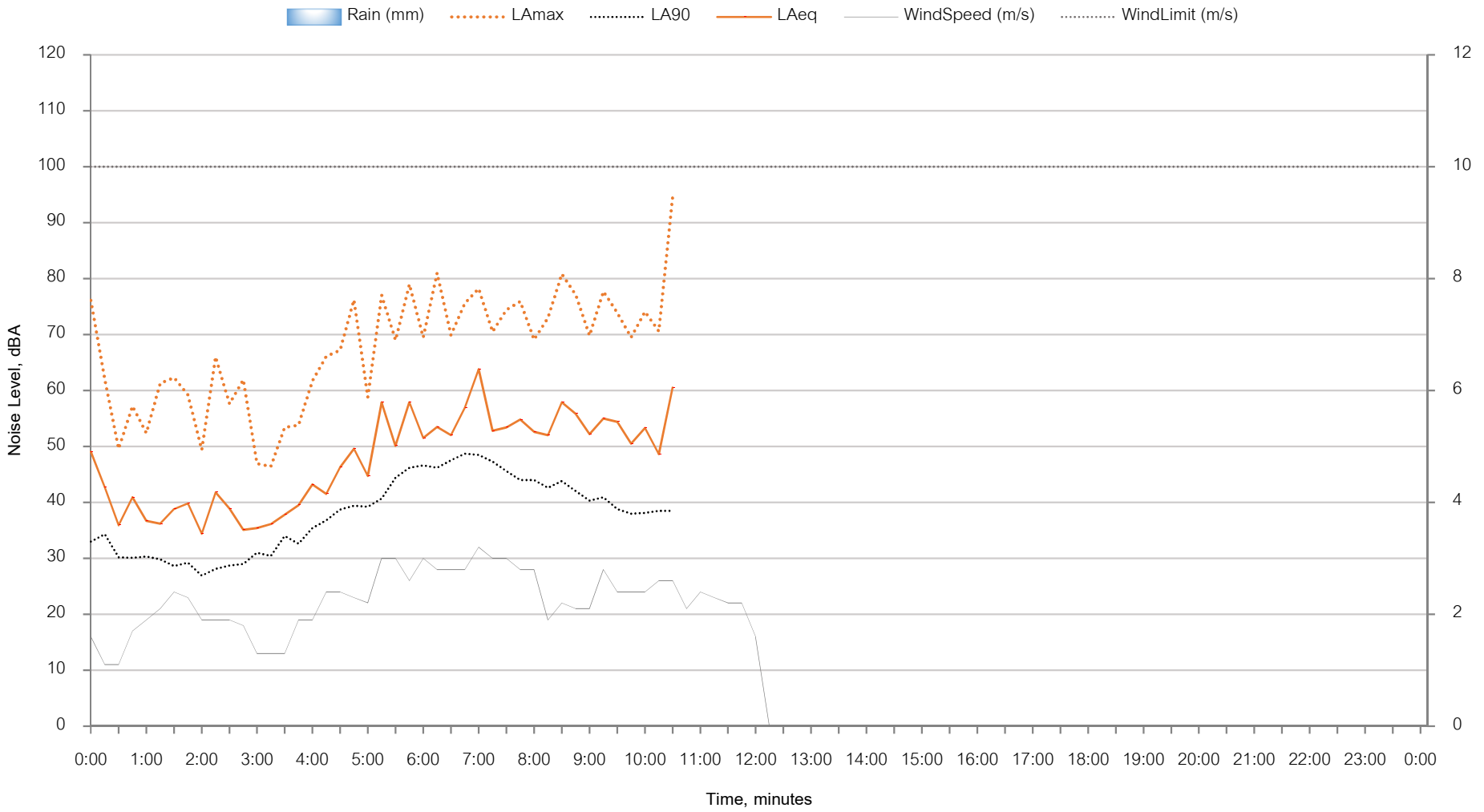
Tuesday, 26-04-16



Measured Ambient Noise Levels

Location 1 - 54 Groundry Street

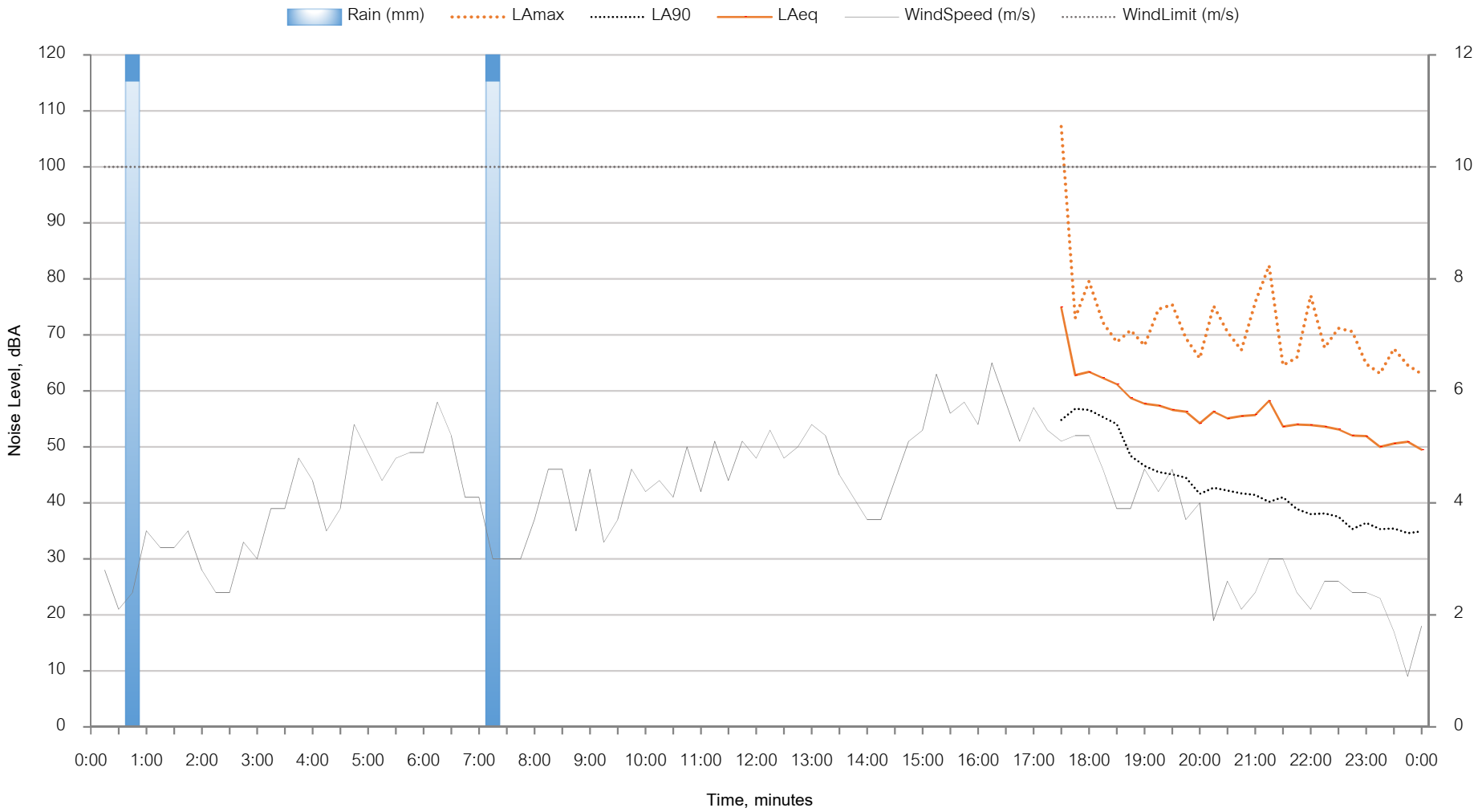
Wednesday, 27-04-16



Measured Ambient Noise Levels

Location 2 - 2 Maquarie Avenue

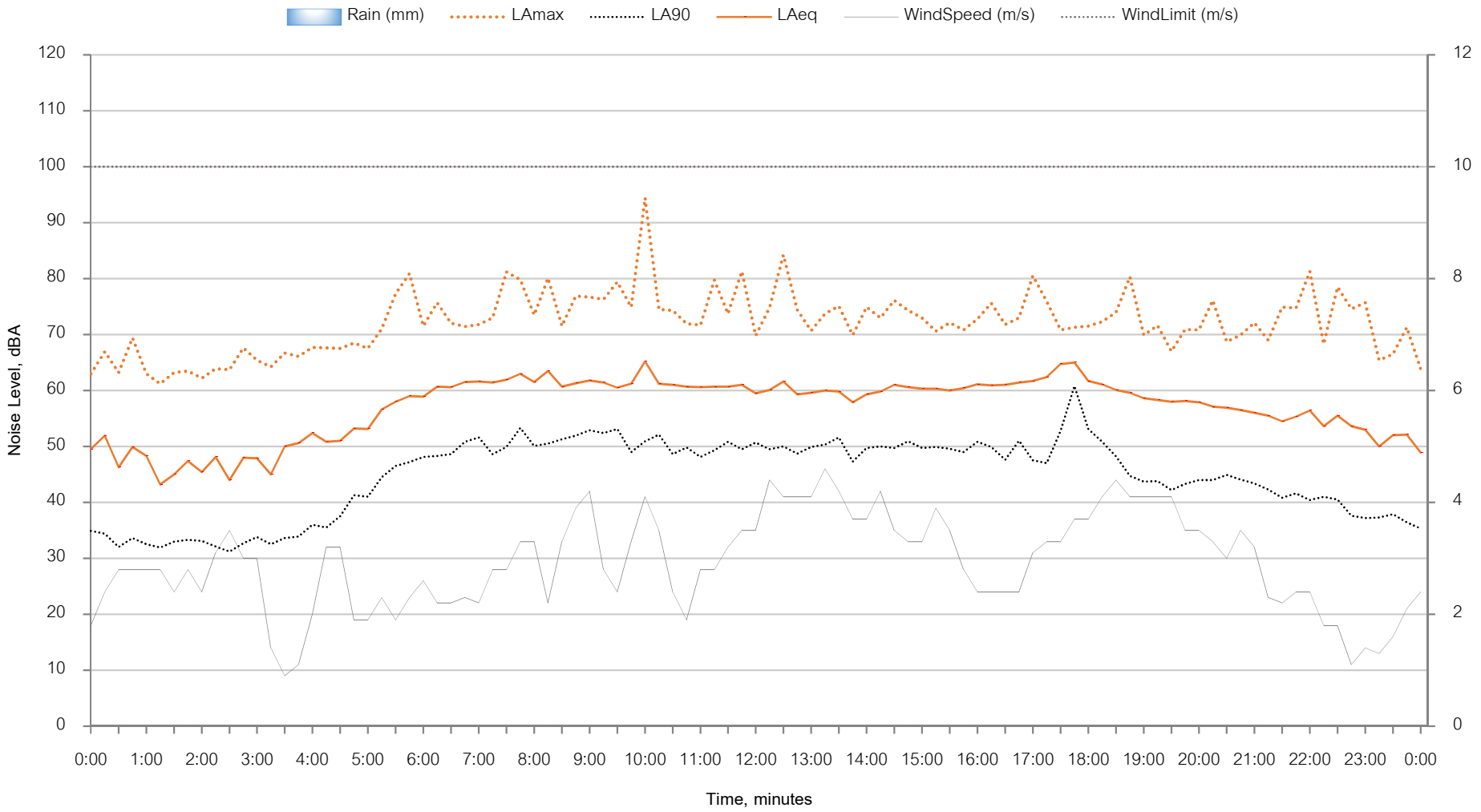
Monday, 18-04-16



Measured Ambient Noise Levels

Location 2 - 2 Maquarie Avenue

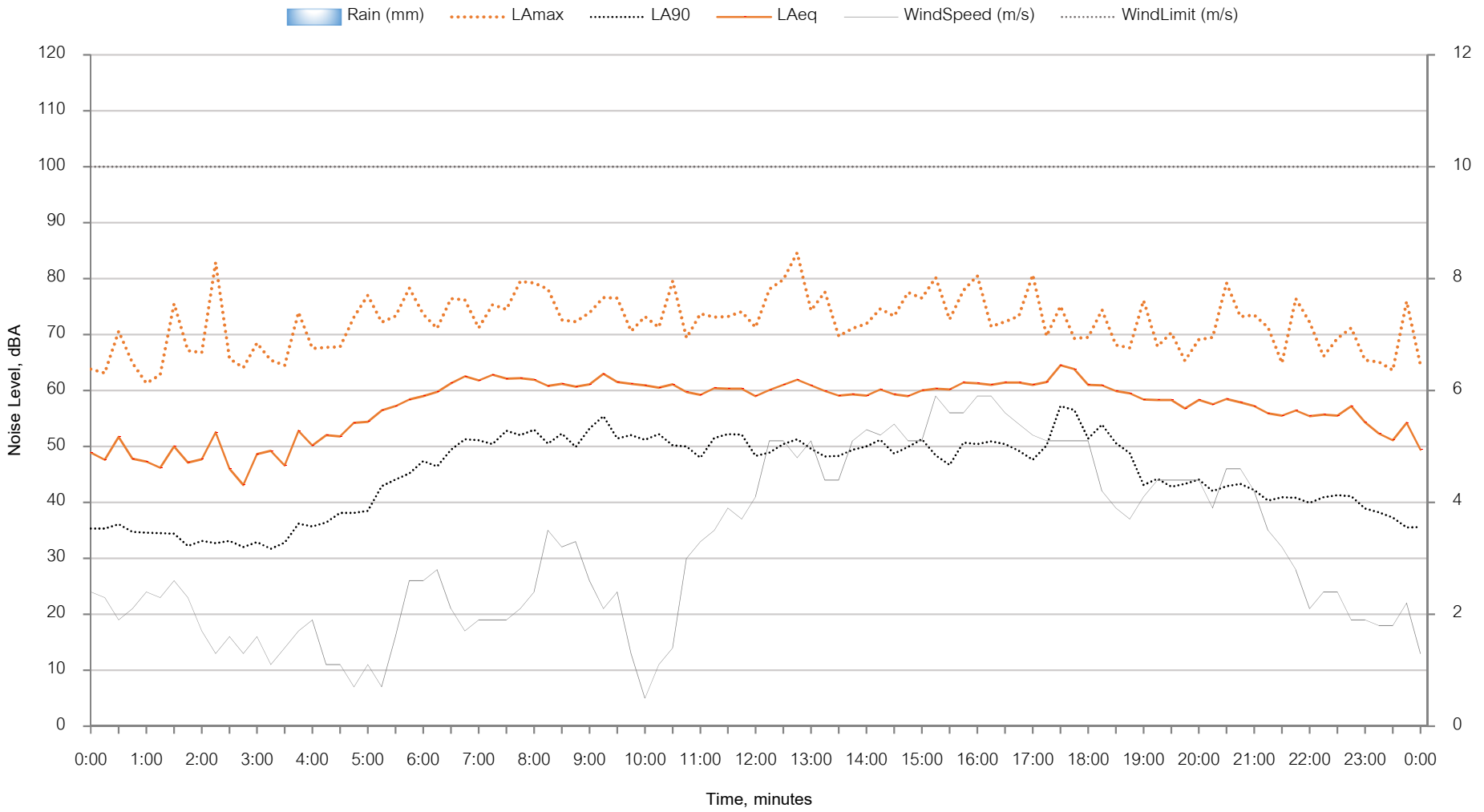
Tuesday, 19-04-16



Measured Ambient Noise Levels

Location 2 - 2 Maquarie Avenue

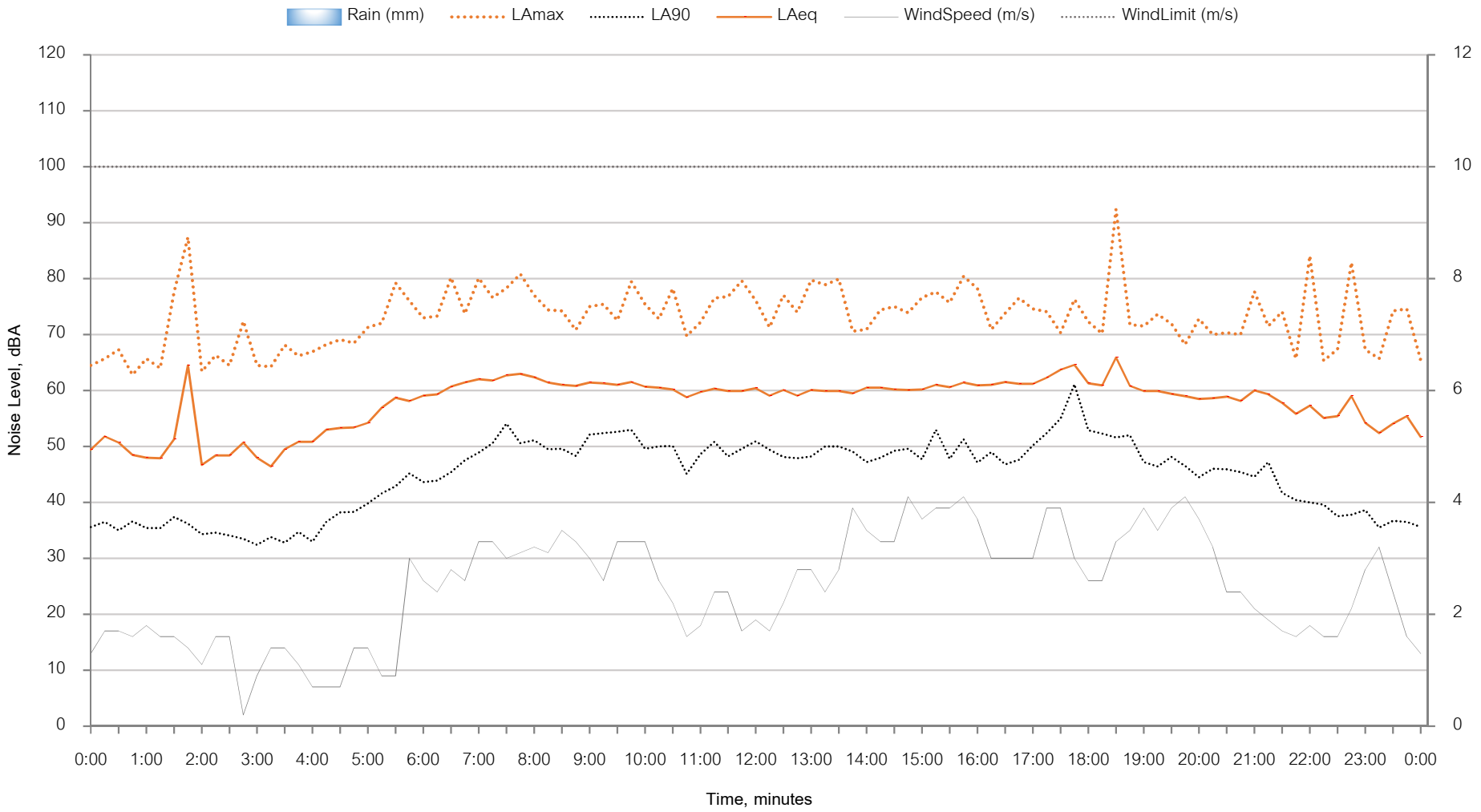
Wednesday, 20-04-16



Measured Ambient Noise Levels

Location 2 - 2 Maquarie Avenue

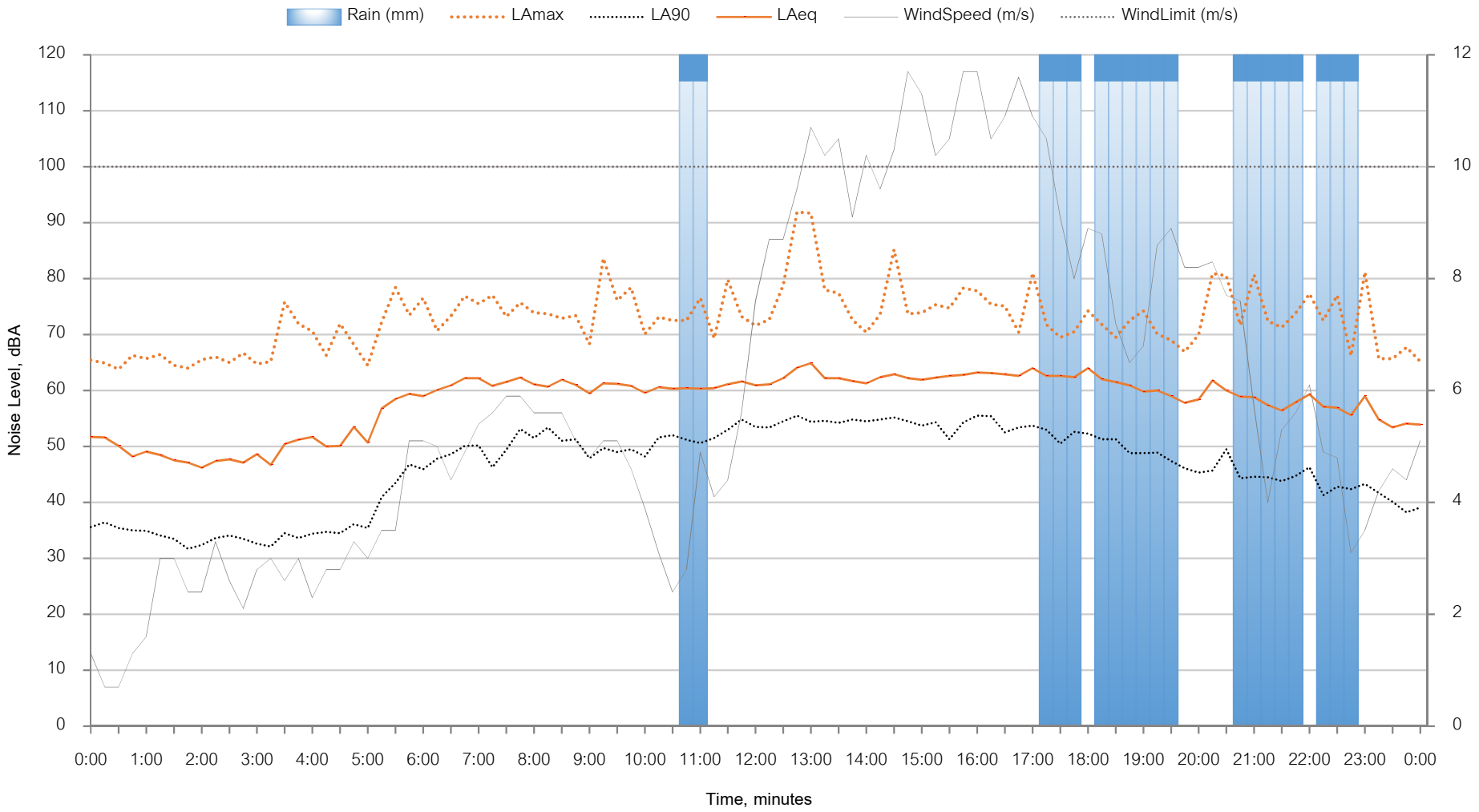
Thursday, 21-04-16



Measured Ambient Noise Levels

Location 2 - 2 Maquarie Avenue

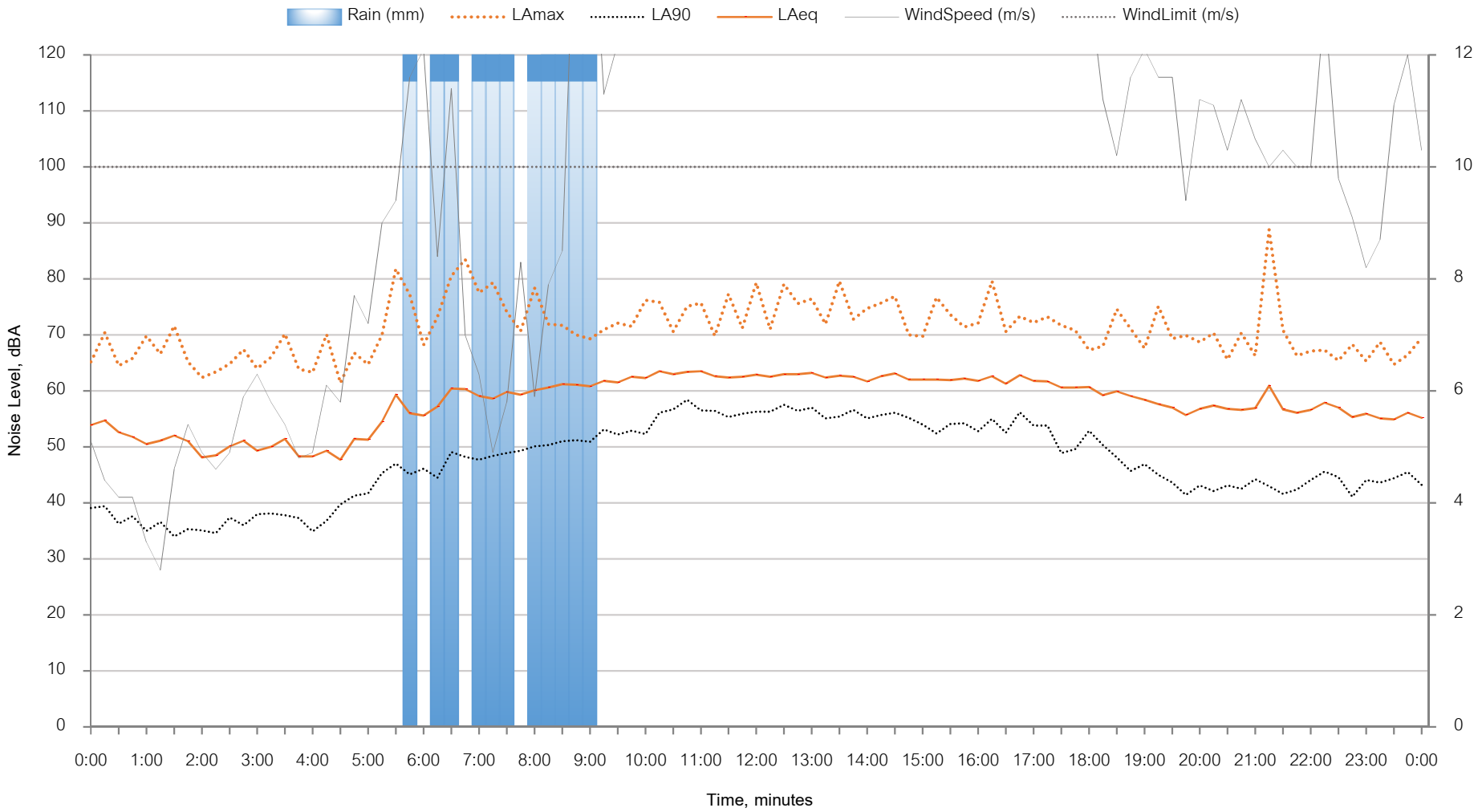
Friday, 22-04-16



Measured Ambient Noise Levels

Location 2 - 2 Maquarie Avenue

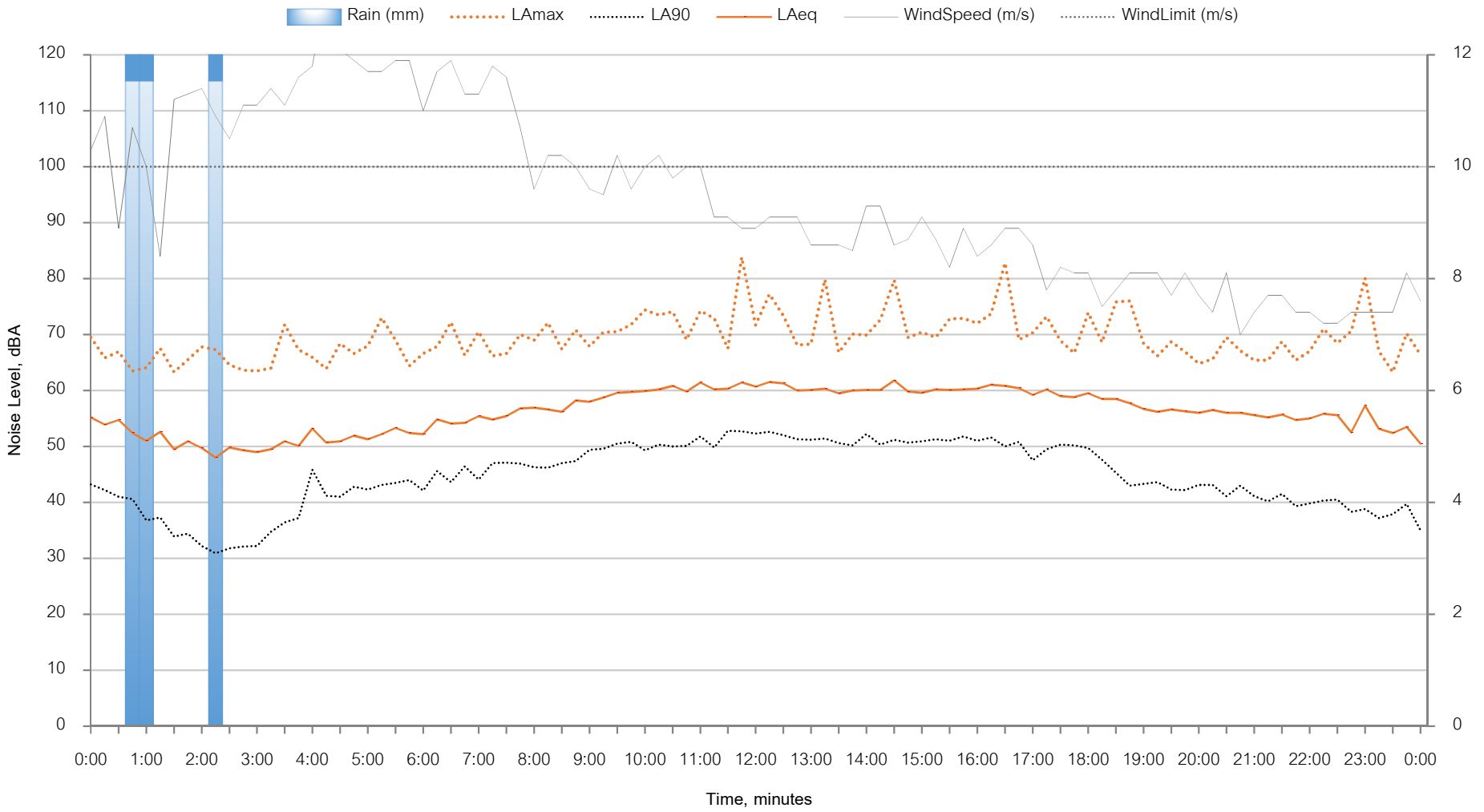
Saturday, 23-04-16



Measured Ambient Noise Levels

Location 2 - 2 Maquarie Avenue

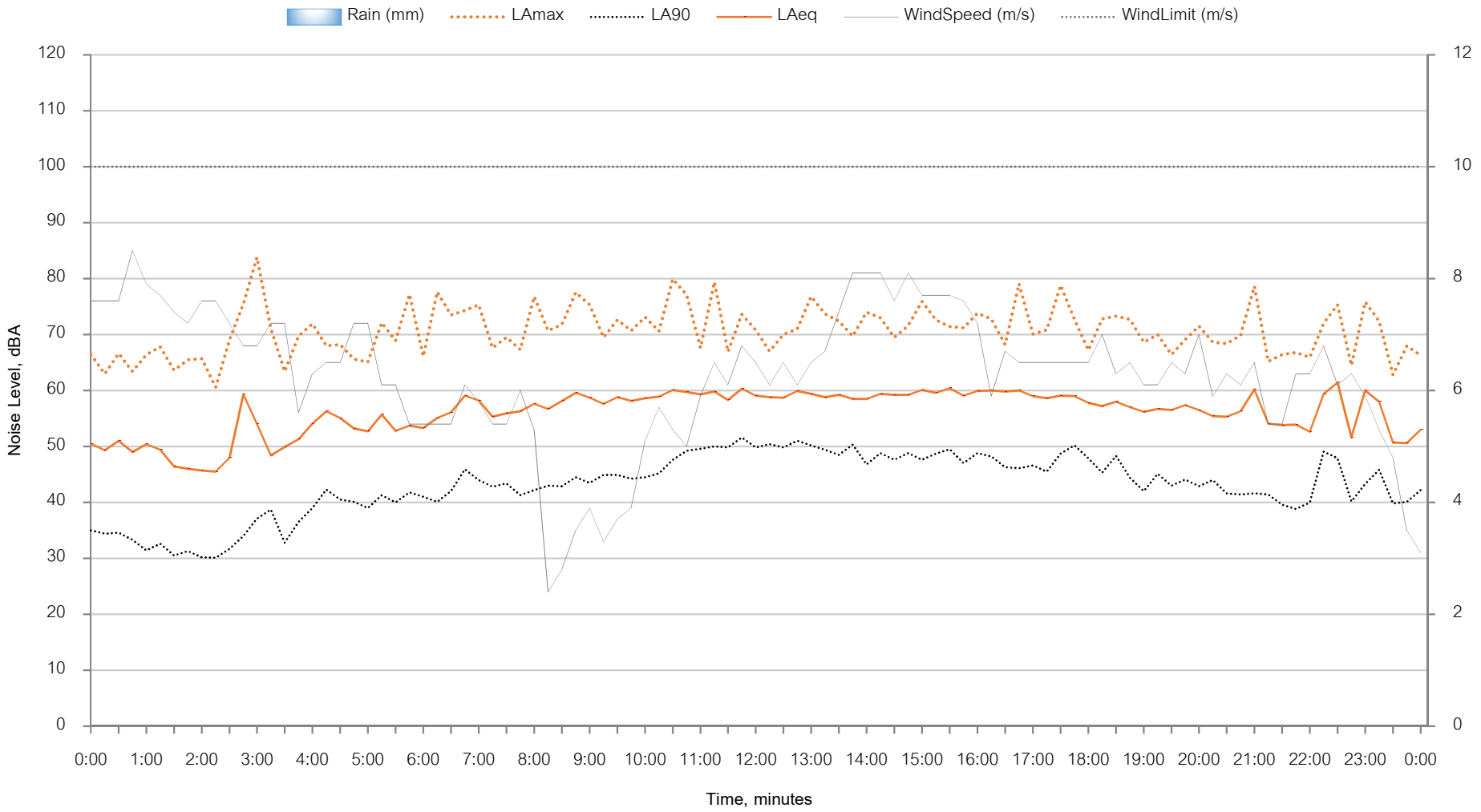
Sunday, 24-04-16



Measured Ambient Noise Levels

Location 2 - 2 Maquarie Avenue

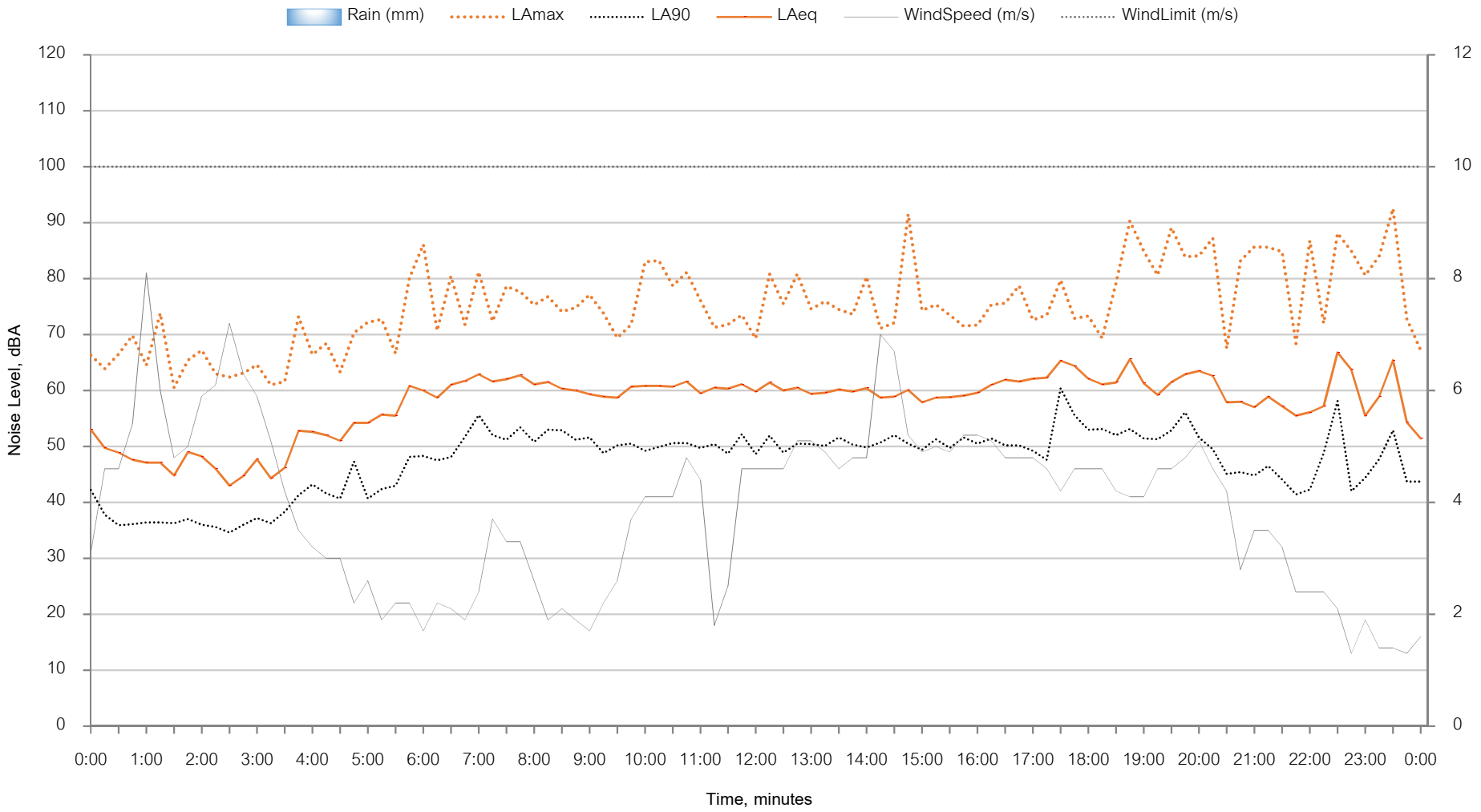
Monday, 25-04-16



Measured Ambient Noise Levels

Location 2 - 2 Maquarie Avenue

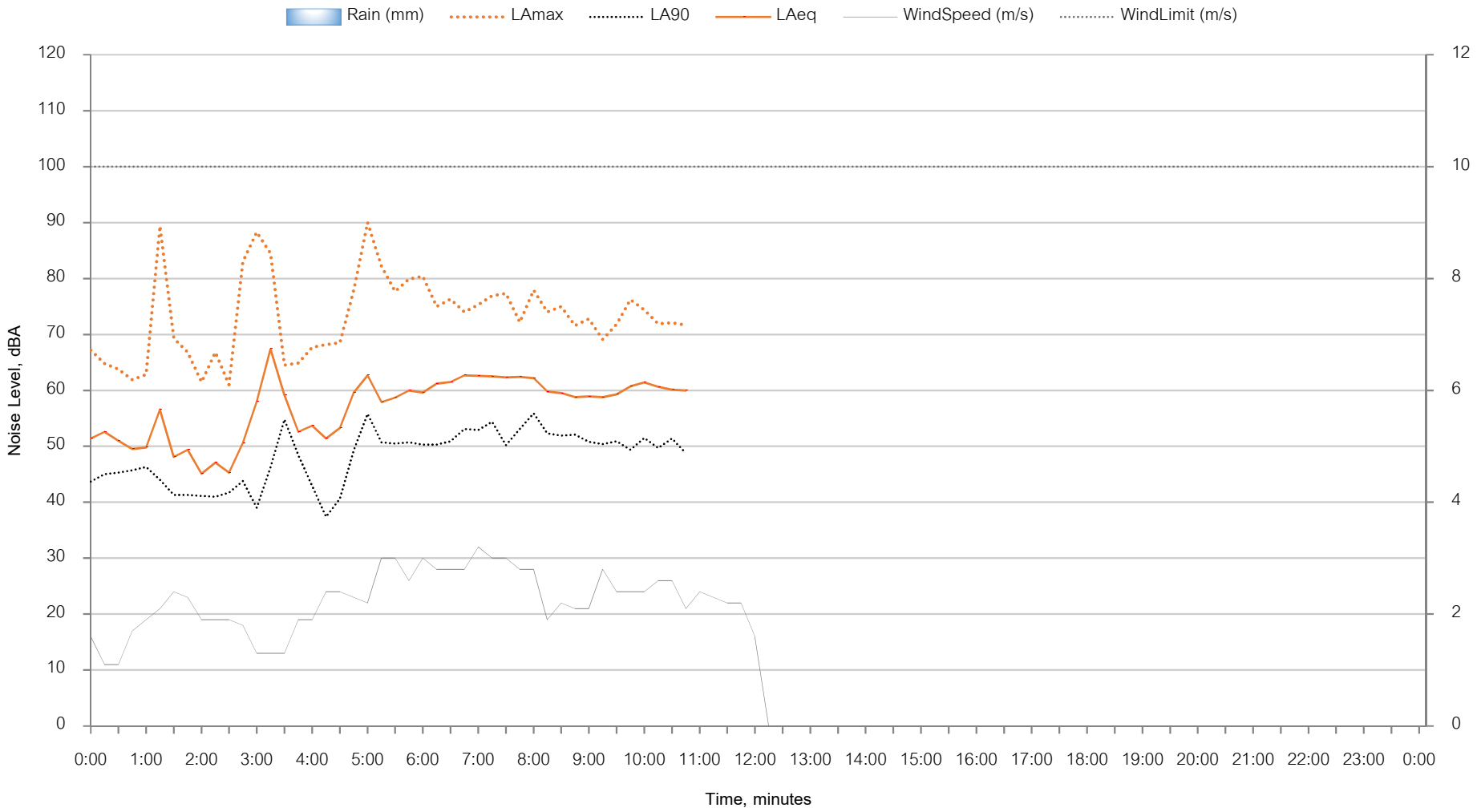
Tuesday, 26-04-16



Measured Ambient Noise Levels

Location 2 - 2 Maquarie Avenue

Wednesday, 27-04-16



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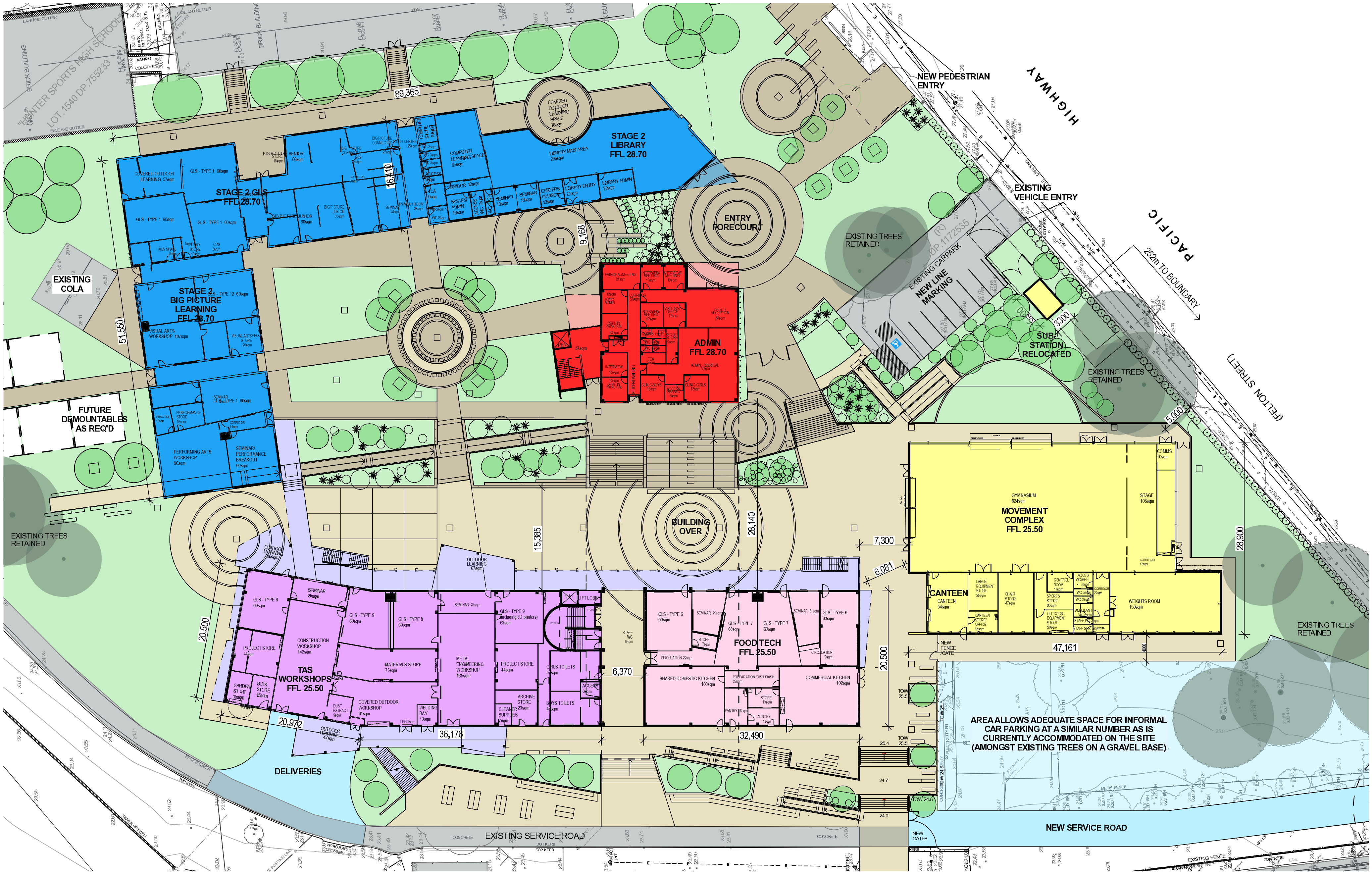
Appendix D – Site Plans



EJE ARCHITECTURE
ACN 002 912 843 | ABN 82 644 649 849
Nominated Architect - Bernard Collins

REV	DATE	COMMENTS	DRN	CHKD	VRFD
A	11.02.2016	ISSUE FOR CONSULTANT CO-ORDINATION	JJM	JPC	
B	19.02.2016	ISSUE FOR 90% COORDINATION REVIEW	JJM	JPC	
C	02.03.2016	REVISED ISSUE FOR 90% COORDINATION REVIEW	JJM	JPC	

PROJECT: HUNTER SPORTS HIGH SCHOOL MAJOR CAPITAL WORKS UPGRADE

CLIENT: NSW Public Works / NSW Education

SITE: PACIFIC HIGHWAY GATESHEAD 2290

DRAWING: DETAIL SITE PLAN

WORK IN FIGURED DIMENSIONS IN PREFERENCE TO SCALE. CHECK DIMENSIONS AND LEVELS ON SITE PRIOR TO THE ORDERING OF MATERIALS OR THE COMMENCEMENT OF WORKSHOP DRAWINGS. IF IN DOUBT ASK. REPORT ALL ERRORS AND OMISSIONS.

FILENAME: 11029_Site-Proposed_v17 (working).pln | DATE PRINTED: 2/03/2016

DRAWN:	DATE:	SCALES:
JJM	FEB 2016	1:250

PROJECT No:	PHASE:	DRAWING No:	REV:
11029	WD	A010	C

EJE architecture

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