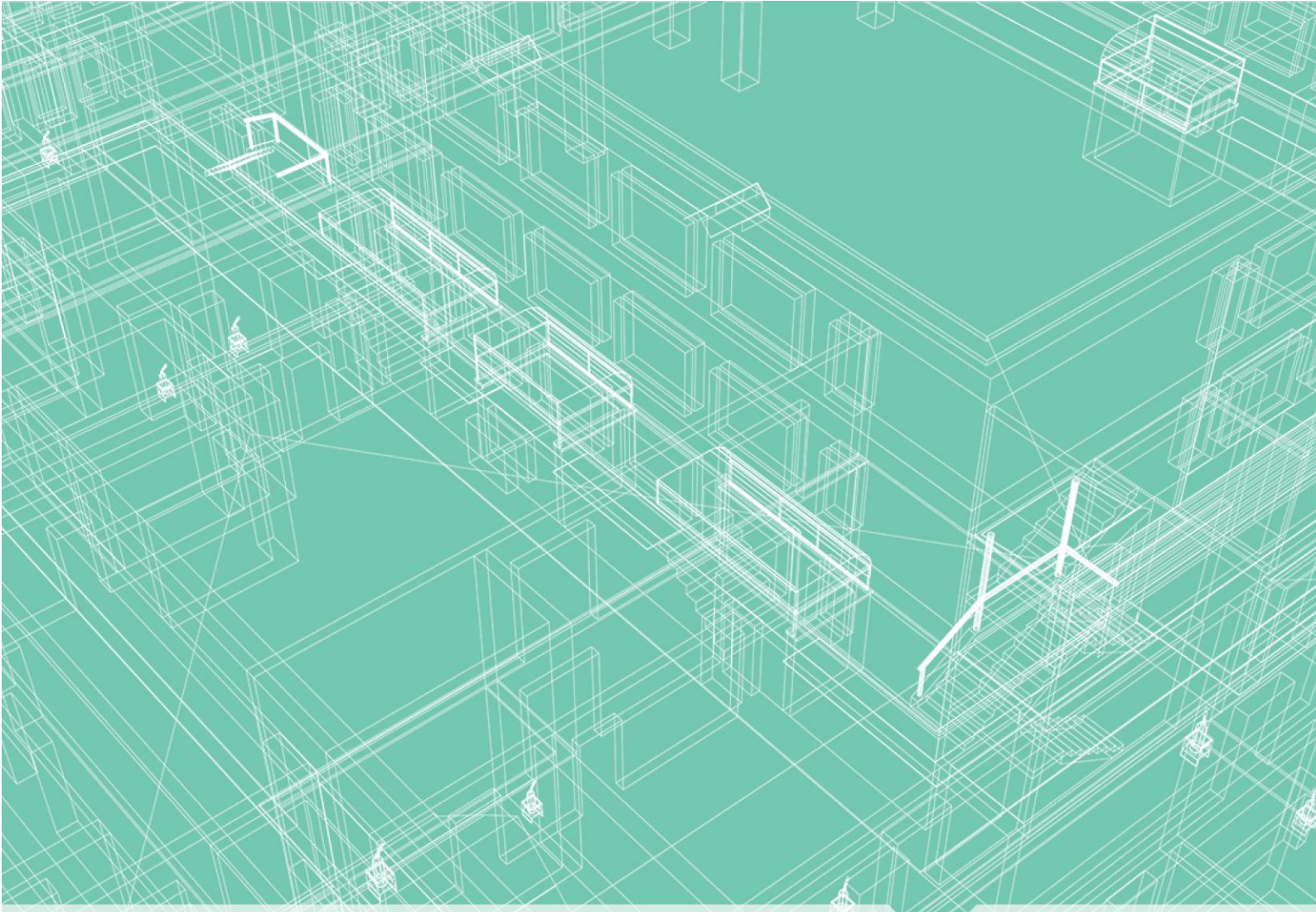

NOISE & VIBRATION IMPACT ASESSEMENT FOR SSDA (SSD 10352)

MORIAH COLLEGE REDEVELOPMENT, QUEENS PARK

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1 INTRODUCTION

1.1 OVERVIEW

This acoustic report has been prepared by JHA Consulting Engineers on behalf of the Moriah College c/Aver Management Pty Ltd (the Applicant).

The acoustic report accompanies an Environmental Impact Statement (EIS) in support of State Significant Development Application (SSD 10352) for the new Moriah College Redevelopment on Lot 3 DP 701512 (3 Queens Park Road) and Lot 22 DP 879582 (101 York Road) in Queens Park, NSW.

The school currently has a capacity for 1680 students with a current enrolment of 1530 students from the Early Learning Centre (ELC) to high school. The proposed redevelopment will increase the schools capacity to 1970 students. The redevelopment will additionally increase the schools current full time equivalent staff from 276 to 302 staff plus an additional 13 ELC staff.

The proposal seeks consent for the demolition of existing buildings and the relocation of two existing tennis courts in order to accommodate two new buildings. The two new buildings will consist of a four storey STEAM building and a three storey new ELC respectively. The proposed works will be undertaken over multiple stages with Phase 1 involving the STEAM building and Phase 2 involving the ELC building.

The redevelopment will include:

- STEAM Building:
  - 240 seat lecture theatre
  - Library
  - Independent Learning Centre (ILC)
  - STEAM wet labs and general learning areas
  - Seminar rooms
  - Collaborative and break-out spaces
- ELC Building
  - Early years learning spaces
  - Outdoor area
  - High tech hub
  - Administration areas

Additionally, the redevelopment will host 68 at-grade and 31 basement car parking spaces.

The purpose of this acoustic report is to demonstrate compliance with the SEARs. This report shall be read in conjunction with the Architectural design drawings and other consultant design reports submitted as part of the application. The objectives of this acoustic assessment are:

- Identify noise sensitive receivers that will potentially be affected by the operation and construction of the proposed development.
- Carry out noise surveys to determine existing ambient and background noise levels on site.
- Establish the appropriate noise level and vibration criteria in accordance with the relevant standards, guidelines and legislation for the following noise emissions:
  - Mechanical plant from the development to the surrounding receivers.
  - Public address and school bell systems.

- Out-of-school-hours activities within the lecture theatre and other school facilities.
- Outdoor playgrounds.
- Child care centre.
- Road traffic and carpark

- Determine whether the relevant criteria can be achieved based on the proposed operations and construction methods. Where applicable, provide recommendations for any necessary acoustic control measures that will need to be incorporated into the development or use in order to ensure with the assessment criteria.
- Provide recommendations for Construction Noise and Vibration Planning.

The following documentation has been used for the preparation of this report:

- Site drawings of the proposed development.
- Noise data collected on site through the use of noise loggers and a hand held spectrum analyser.
- Moriah College Plan of Management (draft) dated 5th September 2019.

This document and related work has been prepared following JHA Consulting Engineers Quality and Environmental Management Systems, which are based on AS/NZS ISO 9001 and ISO 14001.

1.2 RESPONSE TO SEARS

The acoustic report is required by the Secretary's Environmental Assessment Requirements (SEARs) for SSD 10352. This table identifies the relevant SEARs requirements and corresponding references within this report.

SEARs Item	*Report Reference*
4. Built Form and Urban Design	
• *Demonstrate good environmental amenity including access to natural daylight and ventilation, acoustic separation, access to landscape and outdoor spaces and future flexibility*	Section 5
5. Environmental Amenity	
• *Assess amenity impacts on the surrounding locality, including solar access, visual privacy, overshadowing and acoustic impacts.*	Section 5
• *Identify any proposed use of the school outside of school hours (including weekends) and assess any resultant amenity impacts on the intermediate locality and proposed mitigation measures.*	Section 5.3 & 5.6.2
• *Detail amenity impacts including solar access, acoustic impacts, visual privacy, view loss, overshadowing and wind impacts. A high level of environmental amenity for any surrounding residential land uses must be demonstrated.*	Section 5
11. Noise and Vibration	
• *Identify and provide a quantitative assessment of the main noise and vibration generating sources during demolition, site preparation, bulk excavation, construction. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.*	Section 6
• *Identify and assess operational noise, including consideration of any public address system, school bell, mechanical services (e.g. air conditioning plant), use of any school hall for concerts etc. (both during and outside school hours) and any out of hours community use of school facilities, and outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.*	Section 5
Relevant Policies and Guidelines: • *NSW EPA Noise Policy for Industry (2017)* • *Interim Construction Noise Guideline (DECCW)* • *Assessing Vibration: A Technical Guideline 2006* • *Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Planning 2008)* • *Australian Standard 2363:1999 Acoustics – Measurement of noise from helicopter operations*	Section 4

Table 1: SEARs and relevant references.

2 DESCRIPTION OF THE PROPOSAL

Queens Park is a suburb in the eastern suburbs of Sydney approximately 6 km south-east of the Sydney CBD in the local government area of Waverley Council. The Moriah College campus is located within the east end of Queens Park and is predominately surrounded by park land.

The existing site is a currently a school catering from early learning to high school. The Moriah College campus is bordered by Queens Park Road, Baronga Ave, York Road and an environmental conservation area. A map of the Moriah College campus (red outline) and the surrounding areas is presented in Figure 1.

The surrounding land uses are as follows:

- *North*: North of the site is a low-density suburban residential area.
- *East*: To the east of the site is Queen's Park. Queen's Park is an active recreation area with multi-use sporting fields equivalent in area to 21 touch football fields and two combination rugby / soccer fields.
- *South*: Land immediately to the south of the site is part of Centennial Park Lands with an environmental conservation area abutting the site to the south west. Land further to the south consists of low and medium density suburban residential area.
- *West*: The bulk of Centennial Parkland lays to the west of the site.

Figure 1: Moriah College campus (red outline).

The Moriah College redevelopment will include a gross building area of 13,300 m^2 across two buildings built over two stages:

- Phase 1 will contain the four storey STEAM building including an ILC and library encompassing a total area of approximately 9900 m^2 over four storeys plus lower and upper ground levels; and
- Phase 2 will contain the early childhood learning of floor space across two storeys plus a lower ground level of 3400 m^2 inclusive.

Figure 2 shows the proposed development layout and footprint as per the latest architectural drawings.

Figure 2: Site layout of the proposed development and its boundary.

At this stage, it is understood that Moriah College will continue to operate within typical school hours. The following operating hours have been used for the noise assessment purposes:

- School hours: 8am to 4pm.
- Recess time: 10:30am to 11am.
- Lunch bell time: 1pm to 1:45pm.
- Out of hours: 7am to 9am & 4pm to 10pm.
- ELC: 7am to 6pm.

3 SITE MEASUREMENTS

3.1 GENERAL

Attended and unattended noise surveys were conducted in the locations shown in Figure 3 in order to establish the ambient and background noise levels of the site and surrounds. The locations were found to be representative of the acoustic environment on the site and at the surrounding noise sensitive receivers.

Three short-term noise monitoring locations were chosen as representative as follows:

- Location M1: Baronga Avenue at the proposed site boundary.
- Location M2: Queens Park Road at the boundary of 40 Queens Park Road.
- Location M3: Corner of Baronga Avenue and York Road

One long-term noise monitoring location that was found to be secure and representative of the acoustic environment of the site and surrounds was chosen as follows:

- Location L1: Baronga Avenue at the proposed site boundary.

Noise surveys have been carried out in accordance with the method described in the AS/NZS 1055:1997 *'Acoustics – Description and measurement of environmental noise, parts 1 and 2'*.

Figure 3: Noise monitoring locations and the nearest noise sensitive receivers.

3.2 SHORT-TERM NOISE MONITORING

On Monday 5th August 2019, short-term noise measurements were carried out during the day-time period to obtain representative octave band noise levels of the site and the nearest noise sensitive receivers. The short-term noise measurements were carried out with a NTI XL-2 hand-held Sound Level Meter (SLM) (Serial Number A2A-13742-E0). The SLM was used with a NTI M2230 Class 1 Measurement Microphone (Serial Number 7204 / A15226). The calibration of the SLM was checked before and after each use with a Larson Davis Cal 200 Class 1 Calibrator (Serial Number 15054) and no deviations were recorded.

The SLM microphone was mounted 1.5 metres above the ground and a windshield was used to protect the microphone. Measurements were undertaken in the free-field – i.e. more than 3.5 metres away from any building façade or vertical reflective surface. Weather conditions were calm and dry during the attended noise monitoring.

From observations during the site visit, it is noted that at location M1, M2, and M3 the background and ambient noise levels are dominated by traffic noise. A summary of the results of the short-term noise monitoring are presented in Table 2.

Location	*Date and Time*	*Parameter*	*Sound Pressure Level, dB re 20μPa*							
			Overall dB(A)	*Octave Band Centre Frequency, Hz*						
				63	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
M1	05/08/2019 10:18–10:33	$L_{90,15min}$	**52**	59	54	48	46	49	45	35	24
		$L_{eq,15min}$	**60**	70	63	58	55	56	53	47	41
		$L_{10,15min}$	**62**	71	65	61	57	58	54	47	37
M2	05/08/2019 10:47–11:02	$L_{90,15min}$	**53**	59	55	52	47	48	46	41	32
		$L_{eq,15min}$	**64**	70	64	61	57	59	58	55	47
		$L_{10,15min}$	**67**	72	67	63	61	62	61	57	49
M3	05/08/2019 11:06–11:21	$L_{90,15min}$	**57**	62	57	55	53	54	50	43	33
		$L_{eq,15min}$	**67**	75	68	65	62	63	60	52	46
		$L_{10,15min}$	**70**	75	70	66	65	66	63	55	48

Table 2: Results of the short-term noise monitoring.

3.3 LONG-TERM NOISE MONITORING

Long-term noise monitoring was carried out from Monday 5th August to Tuesday 13th August 2019 with a Rion NL-52 noise logger (Serial Number 1254316). The noise logger recorded L_{A1}, L_{A10}, L_{Aeq} and L_{A90} noise parameters at 15-minute intervals during the measurement period. The calibration of the noise logger was checked before and after use and no deviations were recorded.

This location was secure and considered to be representative of the typical ambient and background noise levels. The microphone was mounted 1.5 meters above the ground and a windshield was used to protect the microphone.

The detailed results of the long-term noise monitoring are presented graphically in Appendix A. Weather conditions were monitored for the duration of the noise survey and were typically calm and dry with some wind events having been noted to occur during the measurement period. As stated in the NPI 2017, any data likely to be affected by rain, wind or other extraneous noise has been excluded from the calculations (shadowed in the Appendix A graphs).

Background noise levels (L_{A90}) are presented in Table 3, together with the ambient noise levels (L_{Aeq}) measured for each period.

Location	*L_{A90} Background Noise Levels, dB(A)*			*L_{Aeq} Ambient Noise Levels, dB(A)*		
	Day 7am-6pm	*Evening 6pm-10pm*	*Night 10pm-7am*	*Day 7am-6pm*	*Evening 6pm-10pm*	*Night 10pm-7am*
L1	53	45	37	61	58	53

Table 3: Results of the long-term noise monitoring.

4 RELEVANT NOISE STANDARDS AND GUIDELINES

4.1 STANDARDS AND GUIDELINES

The following standards and guidelines are considered relevant to the project and have been referenced in developing the project noise level criteria.

- Regulatory Framework
  - Environmental Planning and Assessment (EP&A) Act 1979.
  - Protection of the Environmental Operations (POEO) Act 1997.
- Planning
  - Waverley Local Environmental Plan (W-LEP) 2012.
  - Randwick Local Environmental Plan (R-LEP) 2012.
  - Waverley Development Control Plan (W-DCP) 2012.
- Noise Emissions and Intrusive Noise
  - NSW EPA Noise Policy for Industry (NPI) 2017.
  - Association of Australasian Acoustical Consultants (AAAC) 'Guideline for Child Care Centre Acoustic Assessment' v2.0 2013.
- Traffic Noise
  - NSW Department of Planning (DoP) 'Development Near Rail Corridors or Busy Roads – Interim Guideline' 2008.
  - NSW EPA Road Noise Policy (RNP) 2011.
  - Australian Standard AS 2363:1999 '*Acoustics – Measurement of Noise from Helicopter Operations*'.
- Construction Noise and Vibration
  - NSW DECCW Interim Construction Noise Guideline (ICNG) 2009.
  - NSW DEC Assessing Vibration: A Technical Guideline 2006.
  - NSW Road Maritime Service (RMS) Construction Noise and Vibration Guideline 2016.
  - Australian Standard AS 2436:2010 '*Acoustics – Guide to Noise Control on Construction, Maintenance & Demolition Sites*'.

4.2 REGULATORY FRAMEWORK

4.2.1 ENVIRONMENTAL PLANNING AND ASSESSMENT (EP&A) ACT 1979

The Environmental Planning and Assessment Act 1979 (EP&A Act) provides the regulatory framework for the protection of the environment in NSW. The EP&A Act is relevantly about planning matters and ensuring that "environmental impact" associated with the proposed development is properly considered and reasonable before granting development consent to develop.

The assessment of "environmental impact" relies upon the identification of acceptable noise criteria which may be defined in a Development Control Plan, or derived from principles using guidelines like NSW EPA Noise Policy for Industry (NPI) 2017 or Noise Guide for Local Government (NGLG 2013).

4.2.2 PROTECTION OF THE ENVIRONMENTAL OPERATIONS (POEO) ACT 1997

The Protection of the Environment Operations (POEO) Act 1997 has the objective of protecting, restoring and enhancing the quality of NSW's environment. Abatement of noise pollution is underpinned by the definition of "offensive noise" as follows:

"...

(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:

> *(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or*
>
> *(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or*

(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulations.

..."

4.3 PLANNING

4.3.1 WAVERLEY LOCAL ENVIRONMENTAL PLAN 2012

The Waverley Local Environmental Plan (W-LEP 2012) sets the land zoning for the site and surrounds to the north and east, plus land adjacent to the south. Figure 4 shows the land zoning map of the proposed development site (red outline) and surrounds as per the W-LEP 2012 Land Zoning Map (8050_COM_LZN_001_010_20140521).

The proposed development site is located in the Waverley Council limits and is zoned SP2 Infrastructure (Educational Establishment). R2 Low Density Residential land is to the north of the proposed development site; RE1 Public Recreation land is to the east and south of the site; and E2 Environmental Conservation land abuts the site to the south-west.

Land zoning under W-LEP 2012 determines the noise amenity of the areas surrounding the site under the NPI 2017.

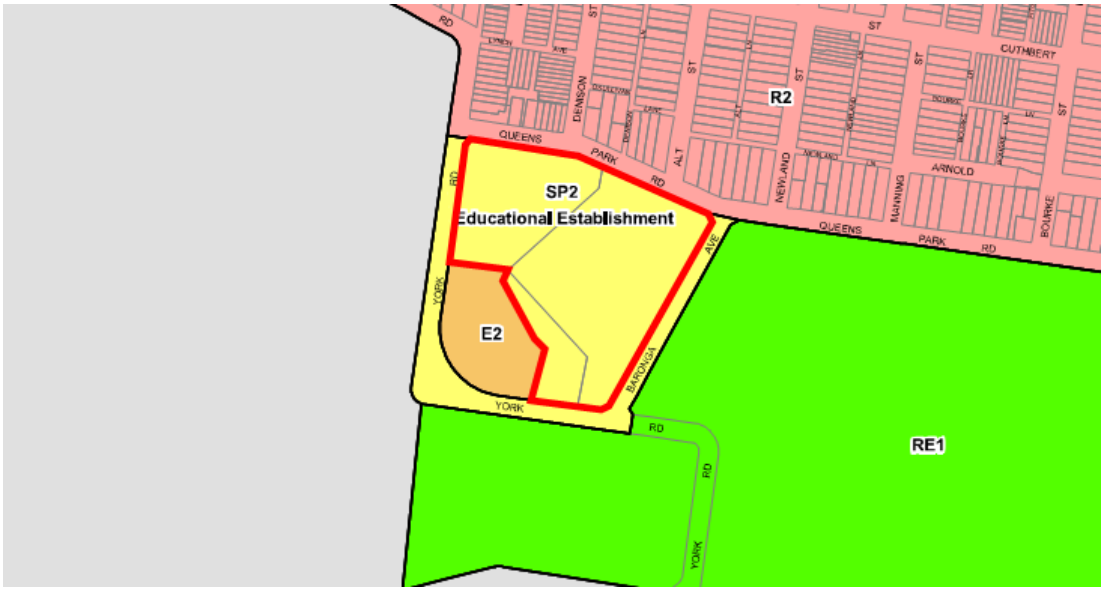


Figure 4: W-LEP 2012 land zoning map with the proposed site outlined in red.

4.3.2 RANDWICK LOCAL ENVIRONMENTAL PLAN 2012

The Randwick Local Environmental Plan (R-LEP 2012) sets the Land Zoning to the west and further to the south of the site. Figure 5 shows R-LEP land zoning map (6550_COM_LZN_006_010_20120615) with the proposed development site (red outline) and surrounds.

RE1 Public Recreation land is to the east of the site and R2 Low Density Residential land is to the south of the site. Land zoning under the Local Environmental Plan determines the noise amenity of the areas to the west and further south of the site under the NPI 2017.

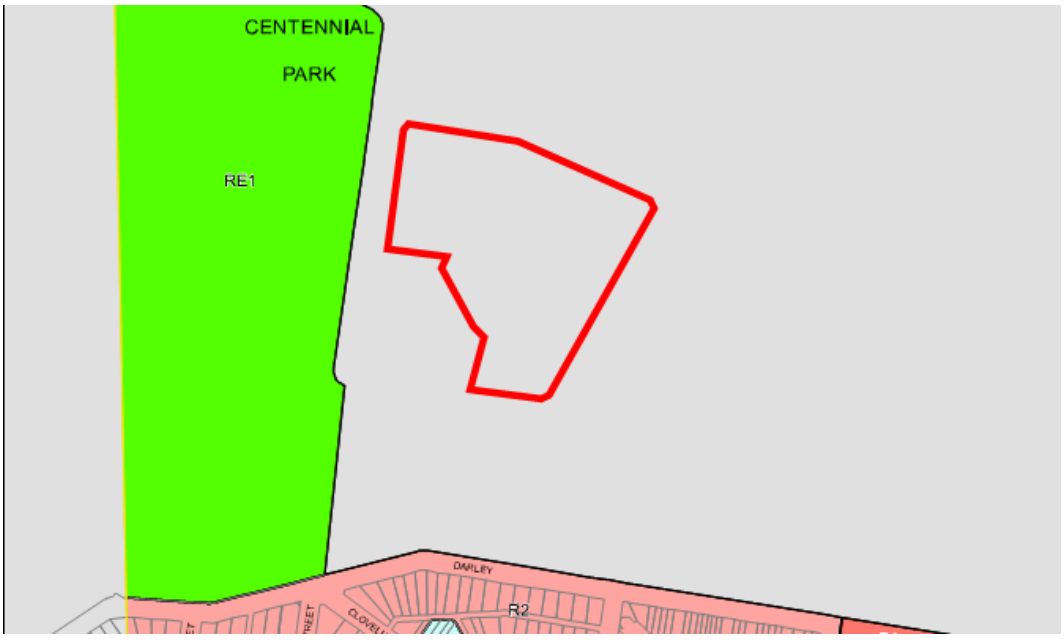


Figure 5: R-LEP 2012 land zoning map with the proposed site outlined in red.

4.3.3 WAVERLEY COUNCIL DEVELOPMENT CONTROL PLAN 2012

The Waverley Development Control Plan (W-DCP) 2012 contains no specific noise or vibration criteria applicable to the proposed development.

4.4 NOISE EMISSIONS AND INTRUSIVE NOISE

4.4.1 NSW EPA NOISE POLICY FOR INDUSTRY

The NSW EPA Noise Policy for Industry (NPI) 2017 assesses noise from industrial noise sources – scheduled under the POEO. Mechanical noise from the development shall be addressed following the recommendations in the NPI 2017.

The assessment is carried out based on the existing ambient and background noise levels addressing the following:

- Intrusiveness Criteria, to control intrusive noise into nearby sensitive receivers.
- Amenity Criteria, to maintain the noise level amenity for particular land uses.

These criteria are established for each assessment period (day, evening, and night) and the more stringent sets the Project Noise Trigger Level (PNTL's). However, it is understood that the proposed development will be operational only during the day-time, therefore only a day-time assessment is undertaken. The intrusiveness and amenity criterions are presented in Table 4 and Table 5 respectively.

The NPI 2017 defines the intrusiveness criteria as follows:

"The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15 minute period, does not exceed the background noise level by more than 5 dB when beyond a minimum threshold."

Indicative Noise Amenity Area	*Period*	*Measured Rating Background Level, ($L_{A90,15min}$) dB(A)*	*Intrusiveness Criterion, ($L_{Aeq,15min}$) dB(A)*
Suburban Residential (R2)	Day (7am–6pm)	53	58
	Evening (6pm–10pm)	45	50
	Night (10pm–7am)	37	42

Table 4: Determination of the Intrusiveness Criterion.

The NPI 2017 states the following to define the amenity criteria:

"To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 2.2 where feasible and reasonable. The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance."

Indicative Noise Amenity Area	*Period*	*Recommended Amenity Noise Level, (L_{Aeq}) dB(A)*	*Adjusted Amenity Criterion, ($L_{Aeq,15min}$) dB(A)*
Suburban Residential (R2)	Day (7am–6pm)	55	53 (55-5+3)
	Evening (6pm–10pm)	45	43 (45-5+3)
	Night (10pm–7am)	40	38 (40-5+3)
Active Recreation (RE1)	When in use	55	53 (55-5+3)
Passive Recreation (RE1)	When in use	50	48 (50-5+3)

Table 5: Determination of the Amenity Criterion.

The PNTL's are determined in Table 6 (grey shading) and have been obtained in accordance with the requirements of the NPI 2017. These shall be assessed to the most affected point on or within the noise sensitive receiver boundary.

Indicative Noise Amenity Area	*Period*	*PNTL $L_{Aeq,15min}$ dB(A)*	
		Intrusiveness Criterion	*Amenity Criterion*
Suburban Residential (R2)	Day (7am–6pm)	58	**53**
	Evening (6pm–10pm)	50	**43**
	Night (10pm–7am)	42	**38**
Active Recreation (RE1)	When in use	---	**53**
Passive Recreation (RE1)	When in use	---	**48**

Table 6: Determination of the Project Noise Trigger Levels.

4.4.2 OPERATIONAL NOISE EMISSION CRITERIA

Council legislation does not establish any noise level criteria for noise emissions from the use of the premises. Given that the activities within the school will only operate during day-time and evening-time, a noise criterion of "background noise level + 5dB" has been adopted for this assessment. This noise level limit is assessed at the boundary of the neighbouring residential properties.

This noise criterion is based on the premise that if intrusive noise is greater than the existing background noise level, there is a potential risk of disturbance and annoyance. However, the noise impact is considered marginal if the difference between the existing background noise level and the intrusive noise is 5 dB(A) or less. This concept has resulted in the commonly used criterion of "background noise level + 5dB" – applicable between 7am and midnight.

This criterion is more stringent during midnight and 7am, being the commonly used criterion of "background noise level + 0dB".

The background noise levels from Table 3 are used in order to establish the operational noise emission criteria. Table 7 establishes the operational noise criteria.

Noise Area Category	*Period*	*$L_{Aeq,15min}$ dB*
Suburban Residential (R2)	Day (7am–6pm)	58
	Evening (6pm–10pm)	50
	Night (10pm–7am)	42

Table 7: Operational noise emission criteria.

The worst-case scenario for operational noise emissions from the school premises will be during the evening – 6pm to 10pm – from the College premises. Therefore, the evening noise level criterion is set to L_{Aeq} 50 dB.

4.4.3 AAAC GUIDELINE FOR CHILD CARE CENTRE

There are no prescribed regulations or legislation that apply to noise from child care centres or outdoor playgrounds. Therefore, there is no prescribed noise criteria that can be used. Furthermore, we understand that the common approach of "offensive noise" criteria is not appropriate for a planning situation such as this proposal.

Our noise assessment approach is based on:

- NSW tribunal decisions when assessing noise from the use of child care centres.
- 'Guideline for Childcare Centre Acoustic Assessment' v2.0 2013 prepared by the Association of Australasian Acoustical Consultants (AAAC).

The AAAC guideline's assessment of childcare centres and the applicable noise level criterion for outdoor spaces has been considered as adequate by NSW tribunal decisions. As children do not play outdoors continuously for long periods of time, and as the duration of time for children playing outside is reduced, the overall noise annoyance reduces. Therefore, it is reasonable to allow a higher level of noise impact for a shorter duration.

Whilst the AAAC guideline does not apply for schools, there are similarities in noise emissions from uses of outdoor playground areas for schools and child care centres. Therefore, we recommend that the following noise criteria shall be applied to noise impacts arising from the school's outdoor playgrounds.

Table 8 shows the noise level criteria proposed by the AAAC guideline for assessing noise from outdoor spaces. These are the noise levels at which it is considered that complaints are unlikely.

Use of outdoor area	*Noise Level Criteria*	*Criteria, $L_{Aeq,15min}$ dB*
Up to 2 hours (total) per day	$L_{Aeq,15min}$ noise level from outdoor area not to exceed the existing background noise level ($L_{A90,15min}$) plus 10 dB $L_{Aeq,15min} \leq L_{A90,15min} + 10$ dB	≤ 63
More than 2 hours (total) per day	$L_{Aeq,15min}$ noise level from outdoor area not to exceed the existing background noise level ($L_{A90,15min}$) plus 5 dB $L_{Aeq,15min} \leq L_{A90,15min} + 5$ dB	≤ 58

Table 8: Noise level criteria for the playground areas as per the AAAC guideline for the daytime period.

4.5 TRAFFIC NOISE

4.5.1 DEVELOPMENT NEAR RAIL CORRIDORS OR BUSY ROADS – INTERIM GUIDELINE

The guideline details the application of clauses 85, 86, 87, 102 and 103 of the Infrastructure State Environmental Planning Policy (SEPP) which is required to be used when a development is adjacent to a rail corridor, a freeway, a toll-way, a transit-way or a road with an annual average daily traffic volume (AADT) of more than 40,000 vehicles.

At this stage, there are no rail corridors or busy roads adjacent to the proposed development site therefore, this guideline does not apply to the proposal.

4.5.2 NSW ROAD NOISE POLICY

The NSW Road Noise Policy (RNP) 2011 establishes criteria for traffic noise from:

- Existing roads,
- New road projects,
- Road development projects,
- New traffic generated by developments.

For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited up to 2.0 dB above the existing noise levels. An increase of up to 2.0 dB represents a minor impact that is considered barely perceptible to the average person.

4.5.3 HELICOPTER NOISE

The Australian Standard 2363:1999 *'Acoustics – Measurement of noise from helicopter operations'* has been included in the relevant policies and guidelines from the SEARs. This standard provides methods for the measurement of noise from existing or proposed helicopter landing sites and helicopter overflights.

The nearest helicopter landing sites are the Prince of Wales Hospital (≈2.0km) to the South. Based on the distance between the site and the helicopter landing site plus the helicopter flying paths, we understand that helicopter noise will not impact in the proposed development and therefore, this standard does not apply to the project.

4.6 CONSTRUCTION NOISE AND VIBRATION

4.6.1 NOISE CRITERIA

The NSW DECCW Interim Construction Noise Guideline (ICNG) 2009 suggests construction noise management levels that may minimise the likelihood of annoyance being caused to noise sensitive residential receivers depending on the duration of works. The management levels for long-term duration works are as follows:

- Within recommended standard hours.

  Noise Affected Level ($L_{Aeq,15min}$): Measured at the most exposed boundary of any affected residential receiver when the construction site is in operation, the background noise level (RBL) should not be exceeded by more than 10 dB(A). This noise level represents the point above which there may be some community reaction to noise.

Highly Noise Affected Level ($L_{Aeq,15min}$): Measured at the most exposed boundary of any affected residential receiver when the construction site is in operation, the noise level should not exceed 75 dB(A). This level represents the point above which there may be strong community reaction to noise.

- Outside recommended standard hours.

  Noise Affected Level ($L_{Aeq,15min}$): Measured at the most exposed boundary of any affected residential receiver when the construction site is in operation, the background noise level (RBL) should not be exceeded by more than 5 dB(A). It is noted that a strong justification is required for works outside the recommended standard hours.

ICNG 2009 additionally suggests construction noise management levels for noise sensitive land other than residential surrounding construction sites. Table 9 below summarises the airborne construction noise criteria for most affected noise sensitive receivers surrounding the development site.

Sensitive Receiver	*Airborne Construction Noise Criteria, $L_{Aeq,15m}$ dB(A)*	
	Within Standards Hours	*Outside Standard Hours*
Residential – Noise Affected	63	RBL[1] + 5
Residential – Highly noise affected	75	N/A
Active Recreation Area	65	
Passive Recreation Area	60	
Note: [1] See Table 3 for the applicable period.		

Table 9: ICNG 2009 construction airborne noise criteria for sensitive receivers surrounding the site.

The ICNG 2009 recommends internal ground-borne noise maximum levels at residences affected by nearby construction activities. Ground-borne noise is noise generated by vibration transmitted through the ground into a structure and can be more noticeable than airborne noise for some sensitive receivers. The ground-borne noise levels presented below from the ICNG are for residential receivers during evening and night-time periods only, as the objective is to protect the amenity and sleep of people when they are at home.

- Evening: $L_{Aeq,15min}$ 40 dB(A) – internal
- Night: $L_{Aeq,15min}$ 35 dB(A) – internal

The internal noise levels are assessed at the centre of the most affected habitable room.

4.6.2 VIBRATION CRITERIA

4.6.2.1 Human Comfort

The Department of Environment and Climate Change (DEC) developed the document '*Assessing Vibration: A Technical Guideline*' in February 2006 to assist in preventing people from exposure to excessive vibration levels within buildings. It is based on the guidelines contained in BS 6472.1:2008. The guideline does not address vibration induced damage to structures or structure-borne noise effects. Vibration and its associated effects are usually classified as continuous (with magnitudes varying or remaining constant with time), impulsive (such as shocks) or intermittent (with the magnitude of each event being either constant or varying with time). Vibration criteria for continuous and impulsive vibration are presented in Table 10 below, in terms of vibration velocity levels.

Place	Time	r.m.s. velocity, mm/s [dB ref 10^{-6}mm/s]			
		Continuous Vibration		Impulsive Vibration	
		Preferred	Maximum	Preferred	Maximum
Residences	Day-time	0.20 [106 dB]	0.40 [112 dB]	6.00 [136 dB]	12.00 [142 dB]
	Night-time	0.14 [103 dB]	0.28 [109 dB]	2.00 [126 dB]	4.00 [132 dB]
Offices, schools, educational	When in use	0.40 [112 dB]	0.80 [118 dB]	13.00 [142 dB]	26.00 [148 dB]

Table 10: Continuous and impulsive vibration criteria applicable to the site

When assessing intermittent vibration comprising a number of events, the Vibration Dose Value (VDV) is recommended to be used. Table 11 shows the acceptable VDV values for intermittent vibration.

Place	Time	Vibration Dose Values, $m/s^{1.75}$	
		Preferred	Maximum
Residences	Day-time	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational	When in use	0.40	0.80

Table 11: Intermittent vibration criteria applicable to the site.

4.6.2.2 Structural Building Damage

Ground vibration from construction activities can damage surrounding buildings or structures. For unoccupied buildings, or during periods where the buildings are unoccupied, the vibration criteria for building damage suggested by German Standard DIN 4150.3:1993 and BS 7385.2:1993 are to be adopted. Guideline values from DIN 4150.3:1993 and BS 7385.2:1993 are presented in Table 12 and Table 13 respectively.

Structural type	r.m.s. velocity, mm/s			
	Foundation			Plane of floor uppermost full storey
	Less than 10Hz	10 to 50Hz	50 to 100Hz	Mixture of Frequencies
Dwellings or similar	5	5 to 15	15 to 20	15
Particularly sensitive	3	3 to 8	8 to 10	8

Table 12: DIN 4150.3:1993 Guideline values of vibration velocity for evaluating the effects of short-term vibration.

Structural type	Peak particle velocity, mm/s	
	4 to 15Hz	15Hz and above
Unreinforced or light framed structures *Residential or light commercial type buildings*	15mm/s @ 4Hz increasing to 20mm/s @ 15Hz	20mm/s @ 15Hz increasing to 50mm/s @ 40Hz and above

Table 13: BS 7385.2:1993 Guideline values of vibration velocity for evaluating cosmetic damage.

5 OPERATIONAL NOISE EMISSIONS ASSESSMENT

Noise break-out from the proposed development has the potential to impact on existing noise sensitive receivers. For the purpose of this noise impact assessment, the noise sources are assumed as follows:

- Noise emissions from mechanical plant.
- Noise emissions from recess and lunch bells, public address systems.
- Noise emissions from indoor activities – i.e. use of the lecture theatre for out-of-school-hours events.
- Noise emissions from outdoor playgrounds.
- Noise emissions from child care centre (ELC).
- Road traffic noise generated by the development.

Each of these noise sources have been considered in the noise impact assessment. The noise impact assessments have also considered the following:

- Noise levels have been considered as continuous over assessment time period to provide the worst-case scenario.
- Distance attenuation, building reflections and directivity.
- Worst-case time period assessment.

5.1 EXTERNAL MECHANICAL PLANT

Noise from proposed development mechanical plant rooms should be controlled to ensure external noise emissions are not intrusive and do not impact on the amenity of the noise sensitive receivers.

At this stage, mechanical plant selections have not been made; therefore, it is not possible to undertake a detailed assessment of the mechanical plant noise emissions.

Noise controls will need to be incorporated with the design of the mechanical plant rooms to ensure that the cumulative noise levels from plant to the nearest noise sensitive receivers meets the NPI 2017 noise level criteria – refer to Table 6.

Usual design noise controls that may need to be implemented will typically include, but are not limited to:

- Strategic location and selection of mechanical plant to ensure the cumulative noise levels at the receiver boundaries are met.
- Selection of appropriate quiet plant.
- Acoustic noise control measures to be put in place to minimise noise impacts such as:
  - In-duct attenuation
  - Noise enclosures as required
  - Sound absorptive panels
  - Acoustic louvres as required
  - Noise barriers as required

Acoustic assessment of all mechanical plant shall continue during the detailed design phase of the project in order to confirm any noise control measures to achieve the relevant noise criteria at the nearest noise sensitive receivers.

5.2 PUBLIC ADDRESS AND SCHOOL BELL SYSTEMS

Noise from proposed development public address and school bell systems should be controlled to ensure external noise emissions are not intrusive and do not impact on the amenity of noise sensitive receivers.

At this stage, public address and school bell systems selections have been not made; therefore, it is not possible to undertake a detailed assessment of the public address and school bell noise emissions.

The EPA notes numerous reports of community concern arising from inadequate design and installation as well as inappropriate use of school public address and bell systems. EPA considers that appropriate design, installation and use of those systems can both:

- Meet the proponent's objectives of proper administration of the school and ensuring safety of students, staff and visitors, and
- Avoid interfering unreasonably with the comfort and repose of occupants of nearby residences.

The Public Address and School Bell Systems shall be designed, installed and operated such that the systems do not interfere unreasonably with the comfort and repose of occupants of nearby residences. It is anticipated that the noise impact to the nearest sensitive receivers will be negligible if following measures are implemented:

- Low-powered horn-type speakers shall be located and orientated to provide a good coverage of the school areas whilst being directly away from residences and near sensitive receivers. System coverage shall be reviewed during the detailed design phase.
- Speakers shall be mounted with a downward angle and as close to the floor as possible.
- The noise level of the systems shall be adjusted on site so they will be clearly audible on the school site without being excessive. The systems shall initially be set so that the noise at nearby residences and sensitive receivers do not exceed noise level criteria.
- Once the appropriate noise level has been determined on site, the systems shall be limited to these noise levels so that staff cannot increase the noise levels.
- The systems shall be set so that it only occurs on school days.

5.3 LECTURE THEATRE NOISE

The lecture theatre is anticipated to occasionally host events that include amplified music during out of hours. The expected noise impacts from the lecture theatre have been assessed at the nearest sensitive receiver, using the methodology and assumptions given below.

The noise assessment was made considering the proposed layout as shown on the architectural drawings. The following assumptions have been made for the assessment:

- Events occurring during evening time hours as per the Moriah College Plan of Management (draft) dated 5th September 2019.
- Doors and windows closed during events.
- Typical sound power levels for music and events.

The noise levels inside the lecture theatre with amplified music form the basis of the expected worst-case noise emission from the proposed use, expected to be 85 dB(A).

The predicted noise level from the use of the proposed lecture theatre at the most affected noise sensitive receivers is presented in Table 14. Based on the assessment, the lecture theatre is expected to meet the operational noise criteria for the evening for the evening period.

Calculation	$L_{Aeq,15min}$, dB(A)	
	Active Recreation Receiver	Residential Receiver
Reverberant Internal Noise Level $L_{Aeq,15min}$ at 1 m	85	85
Façade Attenudation	-10	-10
Distance attenuation, m	-32 [40 m]	-44 [150 m]
Noise Level Criterion (evening), $L_{Aeq,15min}$	50	50
Predicted Noise Level at Receiver / Complies?	43 / Yes	31 / Yes

Table 14: Predicted noise at the noise level at the most affected noise sensitive receivers .

5.4 OUTDOOR PLAYGROUNDS

Noise break-out from the outdoor playgrounds has the potential to impact on the nearest noise sensitive receivers. The outdoor playgrounds are spread along the campus and therefore, students will not gather in the same area.

The key source will be students in the outdoor playgrounds during recesses or before and after school. Moriah College currently has a capacity of 1680 Students with a proposed increase of 290 students over the next 10-15 years. This proposed increase in the number of students would results in an increase in noise levels of approximately 0.7 dB. This noise increase is considered negligible.

Further, the outdoor playgrounds are only likely to be close to full capacity during recess and lunch times with ELC students breaking at different times to the school students. It is assumed that the vocal effort of the students communicating will be generally 'normal' speech. A noise assessment has assumed the following:

- Students talking at 'normal' speech levels to provide a worst-case scenario (70dB(A) Sound Power Level per student)
- For every two students only one will be speaking at any given time with a 'normal' voice.
- A maximum number of 1840 (760 Primary plus 1080 College) students will be out at the same time during recess and lunch times with the ELC students breaking at different times to the school students.
- The students will be evenly distributed along the different outdoor playgrounds.
- The most stringent AAAC Guideline criterion with students using outdoor playgrounds for more than two hours per day is applicable for the residential receivers.

The predicted noise level at the most affected residential receiver is shown in Table 15.

Calculation	Noise Level dB(A)
L_{wA} of 920 students with 'normal' vocal effort	110
Directivity / Shielding, dB	-3
Assumed average distance (150m) attenuation, dB	-44
Resulting level at 40 Queens Park Road	52
Noise Level Criterion Day-Time (more than 2 hours) / Complies?	58 / Yes

Table 15: Noise assessment at nearest residential sensitive receiver for the outdoor playgrounds.

5.5 EARLY LEARNING CENTRE (ELC)

Noise break-out from the proposed ELC building to the south of the site has the potential to impact on the nearest noise sensitive receivers. The key noise source will be children playing in the ground floor and level 1 outdoor play areas annotated in Figure 6. The ELC centre will operate from 7am to 6pm. Therefore, the noise assessment shall be carried out only for the day-time period.

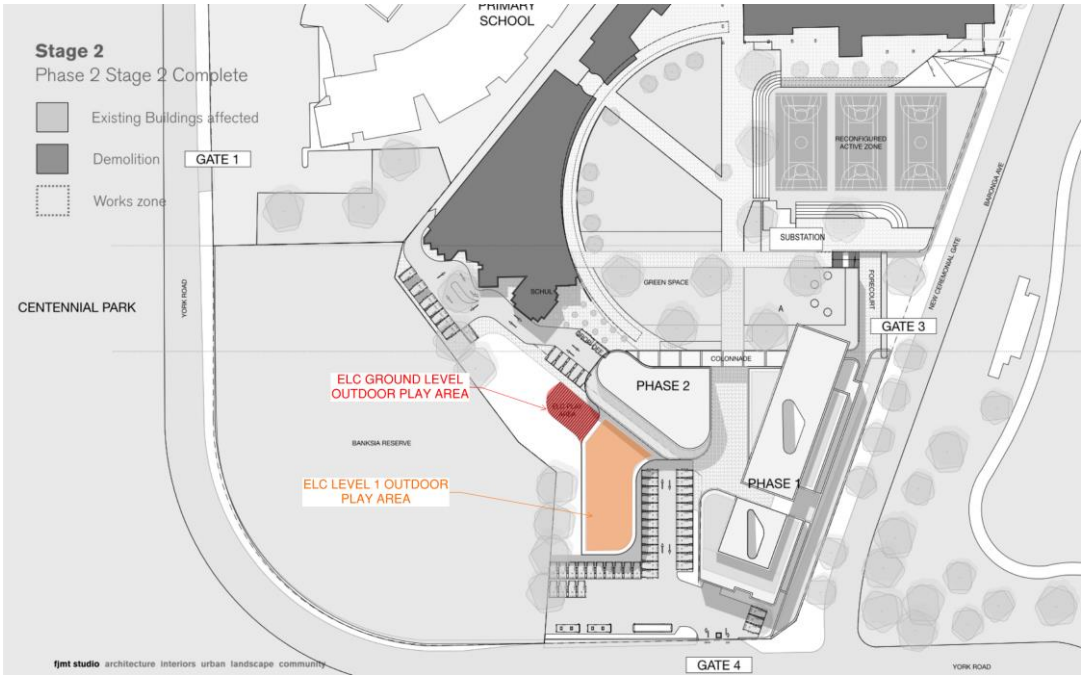


Figure 6: ELC outdoor play areas.

The noise impact assessment has considered the following:

- Noise level emissions as per Table 16, being the highest value of the noise level ranges from the AAAC guideline.
- There will be 130 children aged from 3 to 5 years.
- The children will be divided evenly between each play area – i.e. 65 in each play area.
- Background noise levels at the nearest noise sensitive receiver have been used to provide worst-case scenario.
- Greater than 2 hours per day is spent in the outdoor play areas to provide a further worst-case scenario

The L_{WAeq} Sound Power Levels of 1 child with different ages are shown below in Table 16.

Calculation	*Sound Power Level dB(A), re 1pW*
L_{wAeq} of 10 child aged 3 to 6 years	90

Table 16: Sound Power Level likely to be generated by a child as per AAAC Guideline.

Due to the upper levels of the Phase 1 and Phase 2 buildings shielding the nearest residential receivers to the north, the nearest noise sensitive residential receiver is approximately 220 metres to the south of the outdoor play areas on Darley Road. Predicted noise levels at the nearest noise residential receiver associated with the ELC outdoor play areas is shown in Table 17.

Calculation	Outdoor Playground, dB(A)
L_{wAeq} of 130 children aged 3 to 6 years	101
Distance (220m) attenuation, dB	47
Resulting level at residential receivers, 131–149 Darley Road	43
Noise Level Criterion day-time (greater than 2 hours) / Complies?	58 / Yes

Table 17: Noise assessment at nearest noise sensitive receiver to the south from the outdoor playground – children aged 3 to 6 years.

5.6 ROAD TRAFFIC NOISE

5.6.1 ON-ROAD TRAFFIC NOISE IMPACT

The student and staff member population following the construction of the development will increase the number of vehicles on the surrounding roads, with a potential increase in traffic noise exposure for the residential receivers located along these roads.

The Transport and Accessibility Impact Assessment report[1] provides an analysis of the additional traffic generated by the proposed development. The existing Peak Hour Traffic Volumes during the AM (7:45am-8:45am) and PM (3:00-4:00pm) peaks are presented in Figure 7. The peak traffic volumes for the completed development (Stage 1 + Stage 2) in the year 2030 have been provided in Figure 8. Based on the traffic data provided in Figure 7 and Figure 8, the predicted ultimate noise level increase due to traffic movements is presented in Figure 9.

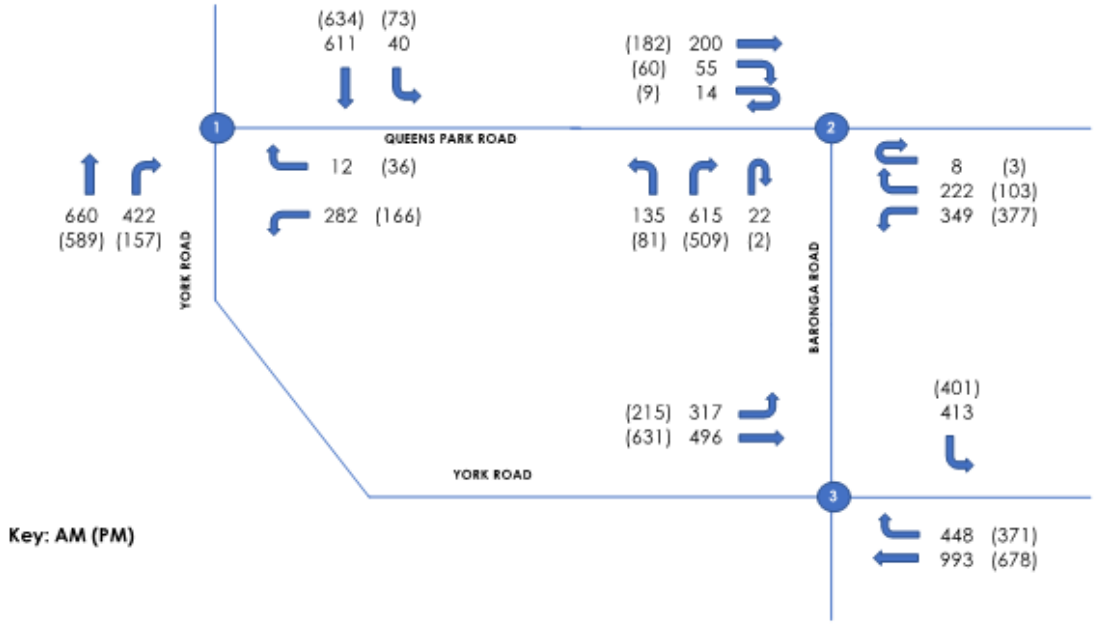


Figure 7: Existing Peak Hour Traffic Volumes.

[1] Moriah College – Transport and Accessibility Impact Assessment. v02. TTPP. 16th September 2019

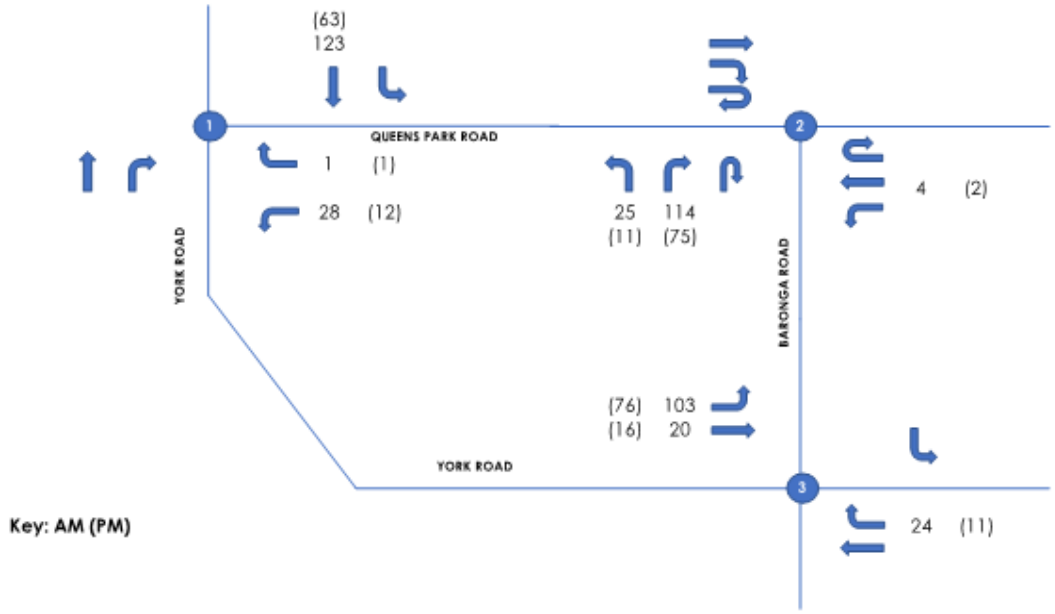


Figure 8: Peak traffic volumes for the completed development (Year 2030).

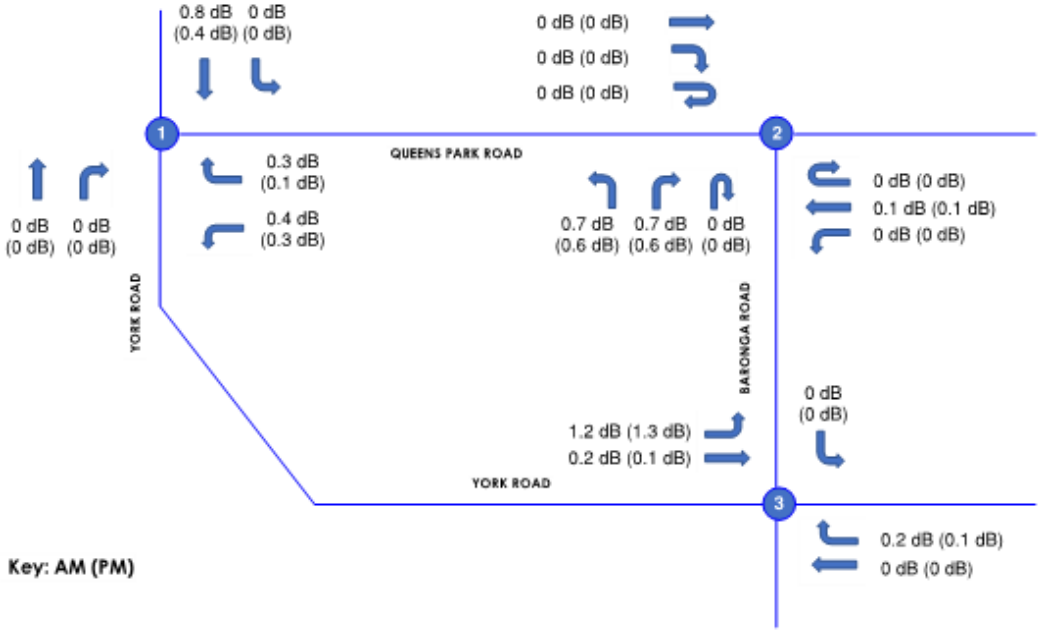


Figure 9: Predicted noise level increase due to traffic movements from the proposed development.

As noted in Section 4.5.2, when considering land use redevelopment and the impact on sensitive land uses (residential / schools / hospitals / recreational) the NSW Road Noise Policy (RNP) states that an increase of up to 2.0 dB in relation to existing noise levels is anticipated to be insignificant.

As demonstrated in Figure 9, the increase in traffic noise levels in the year 2030 due to the proposed development, is less than the maximum allowable increase of 2.0 dB(A).

Therefore, the traffic increase due to the proposed development will not result in any noticeable change in traffic noise levels and is expected to meet the NSW EPA Road Noise Policy 2011 recommendations.

5.6.2 OUT OF HOURS CARPARK NOISE IMPACT

Based on the Moriah College Plan of Management (draft) dated 5th September 2019, the largest existing event to occur out of hours on the Moriah College Campus is the annual 'HSC Art Show Exhibition Event' with an approximate attendance of 800 people over the period from 9am to 10pm. The second largest existing event to occur after hours on the Moriah College campus is the 'HSC Music On Show' with an approximate attendance of 600 people over the period from 6:30pm to 8:30pm.

With the construction of the new auditorium (lecture theatre), the biggest proposed out of hours events that are additionally expected to occur on the Moriah College Campus will involve 150 people for the 'HSC Update Evening' from 7:00am to 8:30pm and 150 people for a 'Meeting for Musical' from 7pm to 8pm. It shall be noted that each event will occur on separate days.

Based on the above, the proposed after hours use of the new lecture theatre is expected to have less attendees and shorter periods of use than existing events occurring on the Moriah College Campus Therefore, it is expected that there will be no additional noise impact on neighbouring noise sensitive receivers for after hour use of the school carparks.

6 CONSTRUCTION NOISE AND VIBRATION PLANNING

Currently the project is at an early design stage and a detailed construction program is not yet full defined. This section of the Construction Noise and Vibration Planning provides general recommendations only and provides applicable criteria together with best noise and vibration control practices to be observed during the construction of the proposed development.

This preliminary advice in relation to construction noise and vibration management shall form the basis for the Contractor's Construction Noise and Vibration Management Plan.

Any noise from demolition and construction activities to be carried out on site must not result in *'offensive noise'* to any noise sensitive receiver. To this end, the Contractor employed to undertake the demolition and/or construction works is responsible for ensuring that any site noise and, in particular, any complaints shall be monitored, investigated, managed and controlled.

6.1 RELEVANT STANDARDS FOR CONSTRUCTION NOISE AND VIBRATION CRITERIA

Section 4.6 of this report contains the relevant legislation, codes and standards plus construction noise and vibration criteria for this project.

6.2 WORKING HOURS

The following construction hours are proposed based on the ICNG 2019 as follows:

- Monday to Friday: 7am to 6pm.
- Saturday: 8am to 1pm.
- Sundays and Public Holidays: No excavation or construction works

6.3 PRELIMINARY CONSTRUCTION NOISE ASSESSMENT

A preliminary construction noise assessment has been carried out based on typical plant and machinery expected throughout the construction stages. The preliminary noise assessment has considered average worst-case scenario distances of construction activities to the nearest noise sensitive receivers.

The construction noise levels are based on the database published by the UK Department for Environmental, Food and Rural Affairs (DEFRA) & Australian Standard AS2436:2010 *'Guide to Noise Control on Construction, Maintenance & Demolition Sites'* for a 15-minute period.

The expected construction noise sources are summarised below in Table 18. The noise levels based on average worst-case scenario distances to the nearest residential receivers (~120 m), active recreation area (~50 m), and passive recreation area (~50 m) are presented in Table 19.

Based on the results of the preliminary assessment, the noise associated with normal construction works is expected to meet the noise limits for standard hours at the nearest residential receivers. There are expected to be criteria exceedances for the local active and passive recreation areas. It is recommended that when these areas are in use, that the contractor implements the control elements as advised in Section 6.4.

Item	Typical Power Noise Level L_{A10} (dB ref 1 pW)	Typical Noise Level $L_{A1,15min}$ at 7 m (dB ref 20 µPa)
Angle grinders	104	76
Truck	108	80
Circular saw	115	87
Piling rig	120	92
10-40 t Excavator	117	89
Truck	114	86
40-50 t Mobile crane	111	83
Concrete pump	114	86
Concrete truck	110	82
Drill	94	66

Table 18: Anticipated airborne noise levels for equipment / plant used during construction works.

Maximum Construction Noise Levels at Receivers $L_{Aeq,15m}$ dB(A)			
Receiver	Nearest Residential	Active Recreation	Passive Recreation
Stages of Works	Overall / Complies?	Overall / Complies?	Overall / Complies?
Angle grinders	51 / Yes	59 / Yes	59 / Yes
Truck	55 / Yes	63 / Yes	63 / No
Circular saw	62 / Yes	70 / No	70 / No
Piling rig	67 / Yes	75 / No	75 / No
10-40 t Excavator	64 / Yes	72 / No	72 / No
Truck	61 / Yes	69 / No	69 / No
40-50 t Mobile crane	58 / Yes	66[1] / Yes	66 / No
Concrete pump	61 / Yes	69 / No	69 / No
Concrete truck	57 / Yes	65[1] / Yes	65 / No
Drill	41 / Yes	49 / Yes	49 / Yes

Notes:

1. *Compliance will be achieved through a qualitative assessment. The Contractor shall implement the general controls shown in Section 6.4.1 as well as any other feasible and reasonable measures in order to minimise any noise impact.*

Table 19: Summary of predicted airborne noise levels for equipment / plant used during the noisiest stages of the construction works.

6.4 CONTROL ELEMENTS

In order to meet the noise and vibration requirements of the site, the Contractor will be required to engage a qualified acoustic consultant to assist in the compilation of a Construction Noise and Vibration Management Plan, and undertake noise and vibration monitoring for the duration of the project.

6.4.1 GENERAL CONTROL ELEMENTS

As a general rule, minimising noise and vibration should be applied as universal work practice at any time of day, but especially for any construction works to be undertaken at critical times outside normal day-time/weekday periods. Therefore, it is recommended that noisy construction works will not be undertaken between 6am and 7am in order to minimise any sleep disturbance to the nearest residential receivers.

It is noted that the reduction of noise and vibration at the source and the control of the transmission path between the construction site and the receiver(s) are the preferred options for noise minimisation. Providing treatments at the affected receivers should only be considered as a last resort. Construction noise and vibration shall be managed by implementing the strategies listed below:

- *Plant and equipment*. In terms of both cost and results, controlling noise and vibration at the sources is one of the most effective methods of minimising the impacts from any work site activities. Work practices that will reduce noise and vibration at the source include:
  - Employing quieter techniques for all high noise activities such as rock breaking, concrete sawing, and using power and pneumatic tools.
  - Use quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks.
  - Selecting plant and equipment with low vibration generation characteristics.
  - Operate plant in a quietest and most effective manner.
  - Where appropriate, limit the operating noise of equipment.
  - Regularly inspecting and maintain plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively.
- *On site noise management*. Practices that will reduce noise from the site include:
  - Maximising the distance between noise activities and noise sensitive receivers. Strategically locate equipment and plant.
  - Undertaking noisy fabrication work off-site where possible.
  - Avoid the use of reversing beeping alarms or provide for alternative systems, such as broadband reversing alarms, particularly during night or out-of-hours works.
  - Maintaining any pre-existing barriers or walls on a demolition or excavation site as long as possible to provide optimum sound propagation control.
  - Constructing barriers that are part of the project design early in the project to afford mitigation against site noise.
  - Using temporary site building and material stockpiles as noise barriers. These can often be created using site earthworks and may be included as a part of final landscape design.
  - Installing purpose built noise barriers, acoustic sheds and enclosures.
- *Work scheduling*. Scheduling work during periods when people are least affected is an important way of reducing adverse impacts. The following scheduling aspects may reduce impacts:
  - Provide respite periods, including restricting very noisy activities to day-time, restricting the number of nights that after-hours work is conducted near residences, or by determining any specific requirements, particularly those needed for noise sensitive receivers.

- Scheduling activities to minimise impacts by undertaking all possible work during hours that will least adversely affect sensitive receivers and by avoiding conflicts with other scheduled events.
- Scheduling work to coincide with non-sensitive periods.
- Scheduling noisy activities to coincide with high levels of neighbourhood noise so that noise from the activities is partially masked and not as intrusive.
- Planning deliveries and access to the site to occur quietly and efficiently and organising parking only within designated areas located away from sensitive receivers.
- Optimising the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours.
- Designating, designing and maintaining access routes to the site to minimise impacts.
- Including contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling.

- *Consultation, notification and complaints handling.*
  - Provide information to neighbours before and during construction.
  - Maintain good communication between the community and Project staff.
  - Have a documented complaints process and keep register of any complaints.
  - Give complaints a fair hearing and provide for a quick response.
  - Implement all feasible and reasonable measures to address the source of complaint. Implementation of all reasonable and feasible mitigation measures for all works will ensure that any adverse noise impacts to surrounding receivers are minimised when noise goals cannot be met due to safety or space constraints.

6.4.2 ADDITIONAL NOISE AND VIBRATION CONTROL MEASURES

If, during construction, an item of equipment exceeds ether the noise criteria at any location or the equipment noise level limits, the following noise control measures, together with construction best practices, shall be considered to minimise the noise impacts on the neighbourhood.

- Schedule noisy activities to occur outside of the most sensitive times of the day for each nominated receiver.
- Consider implementing equipment-specific screening or other noise control measures recommended in Appendix C of AS 2436:2010.
- Limit the number of trucks on site at the commencement of site activities to the minimum required by the loading facilities on site.
- When loading trucks, adopt best practice noise management strategies to avoid materials being dropped from height into dump trucks.
- Avoid unnecessary idling of trucks and equipment.
- Ensure that any miscellaneous equipment (extraction fans, hand tools, etc) not specifically identified in this plan incorporates silencing/shielding equipment as required to meet the noise criteria.

Implementation of all reasonable and feasible mitigation measures for all internal and underground works will ensure that any adverse noise impacts to surrounding residential and recreational receivers are minimised when noise goals cannot be met due to safety or space constraints.

The NSW RMS '*Construction Noise and Vibration Guideline*' provides safe working distances for vibration intensive plant and are quoted for both 'cosmetic' damage (in accordance with BS 7385.2:1993) and human comfort (in accordance with DEC's '*Assessing Vibration: A Technical Guideline*'). The recommended safe working distances for typical construction plant are provided in Table 20.

Plant Item	*Rating/Description*	*Cosmetic Damage*	*Human Response*
Small Hydraulic Hammer	5–12 t	2 m	7 m
Medium Hydraulic Hammer	12–18 t	7 m	23 m
Large Hydraulic Hammer	18–34 t	22 m	73 m
Vibratory Pile Driver	Sheet piles	2–20 m	20 m
Pile Boring	< 800 mm	2 m	N/A
Jackhammer	Hand held	1 m	Avoid Contact with Structure

Table 20: Recommended minimum working distances for vibration intensive plant from sensitive receivers.

If Contractor has concerns for the disruptions at nearest sensitive receivers due to vibration intensive plant use, it is recommended that prior to the commencement of the works, to undertake a preliminary vibration survey on each key vibration generating activity / equipment.

The preliminary vibration survey and assessment will determine whether the vibration levels might exceed the relevant criteria then vibration mitigation and management measures will need to be put in place to ensure vibration impacts are minimised as far as practicable.

7 CONCLUSION

A noise & vibration impact assessment has been carried out for the proposed redevelopment of Moriah College at Queens Park. This report forms part of the documentation package to be submitted to the Department of Planning as part of the State Significant Development Application.

This report establishes relevant noise level criteria, details the acoustic assessment and provides comments and recommendations for the proposed development. Ambient and background noise surveys have been undertaken at the existing site to establish the appropriate noise criteria in accordance with the relevant guidelines.

The noise assessment has adopted methodology from relevant guidelines, standards and legislation to assess noise impact. The noise impacts have been predicted at the nearest noise sensitive receiver boundaries.

At this stage, mechanical plant selections have not been made. Therefore, recommendations have been provided to minimise the impact of external noise emissions associated with the mechanical plant of the proposed development to the nearest sensitive receivers.

At this stage, public address and school bell systems have not been selected. Therefore, recommendations have been provided to minimise the impact of external noise emissions associated with the public address and school bell systems of the proposed development to the nearest sensitive receivers.

The expected noise impact from the use of the 240 seat lecture theatre is expected to meet the established noise level criteria at the nearest noise sensitive receivers.

The expected noise impact from the use of the outdoor playgrounds are expected to meet the established noise level criteria at the nearest noise sensitive receiver.

The ELC outdoor playground areas' noise impact has been assessed and is expected to meet the established criteria at the most affected residential receivers.

The traffic noise impact due to number of vehicles due to the proposed development – based on the information provided in the traffic report – is anticipated to be insignificant, as the noise levels will not increase more than 2dB at the sensitive noise receivers.

Noise impact of out of hours carpark usage has been analysed. It is expected that there will be no additional noise impact on neighbouring noise sensitive receivers for after hour use of the school carparks.

A preliminary construction noise assessment has been carried out. Based on the results of the preliminary assessment as shown above, the noise associated with the normal construction works are expected to meet the noise limits for standard hours at the nearest residential receivers in accordance with the NSW DEC Interim Construction Noise Guideline. However, there are expected to be noise criteria exceedances for the local active recreation and passive recreation areas.

Based on the information presented in this report, relevant objectives will be satisfied and therefore approval is recommended to be granted.

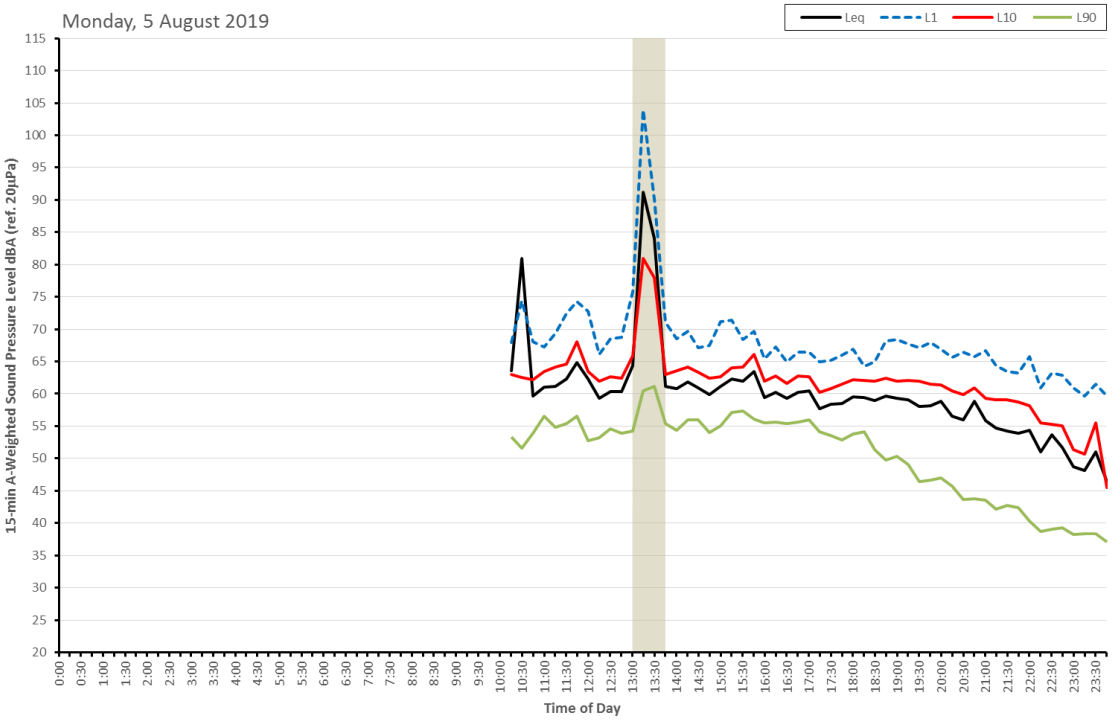
APPENDIX A: LONG-TERM NOISE MONITORING RESULTS

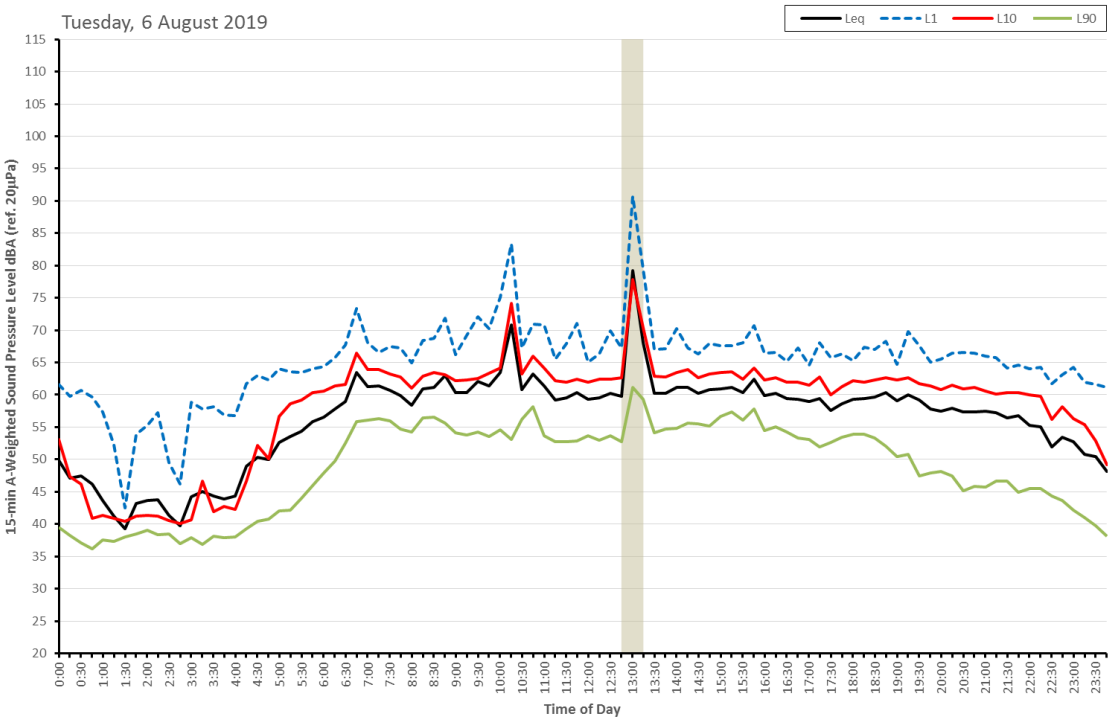
L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

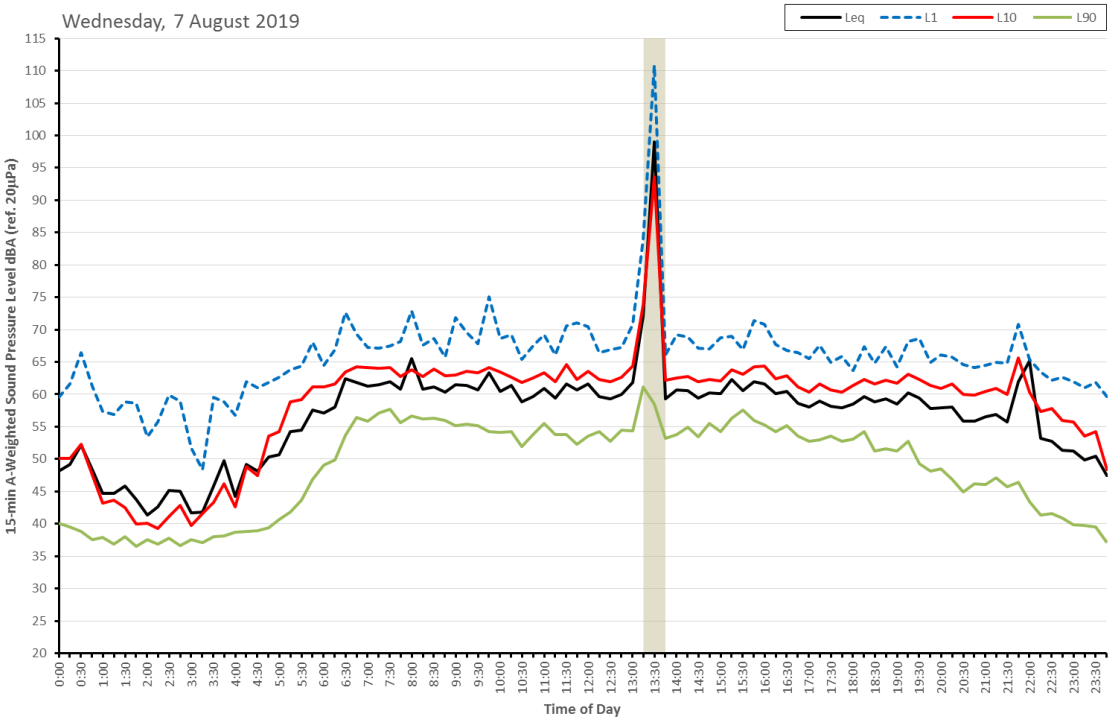
L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

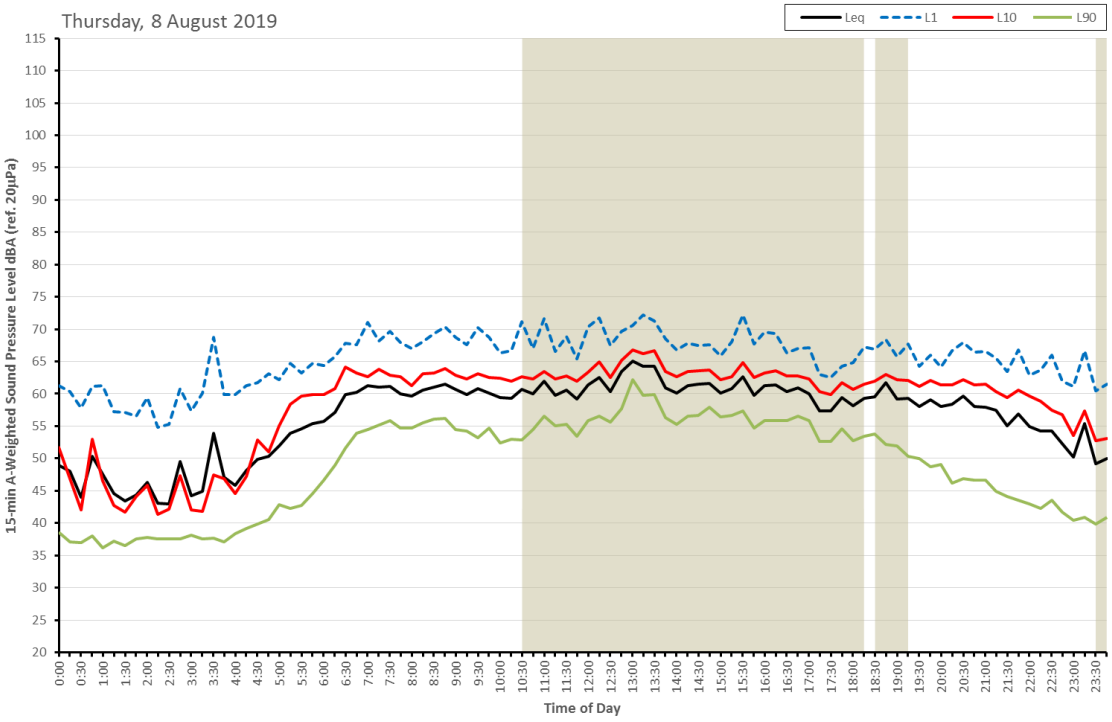
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

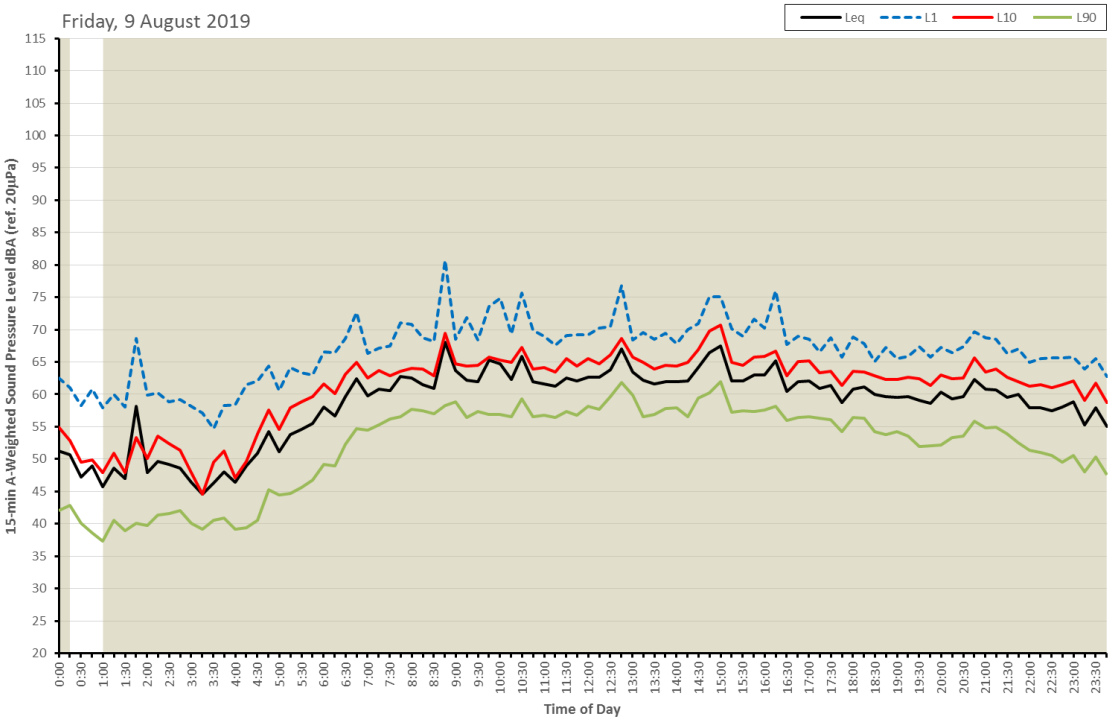
L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise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

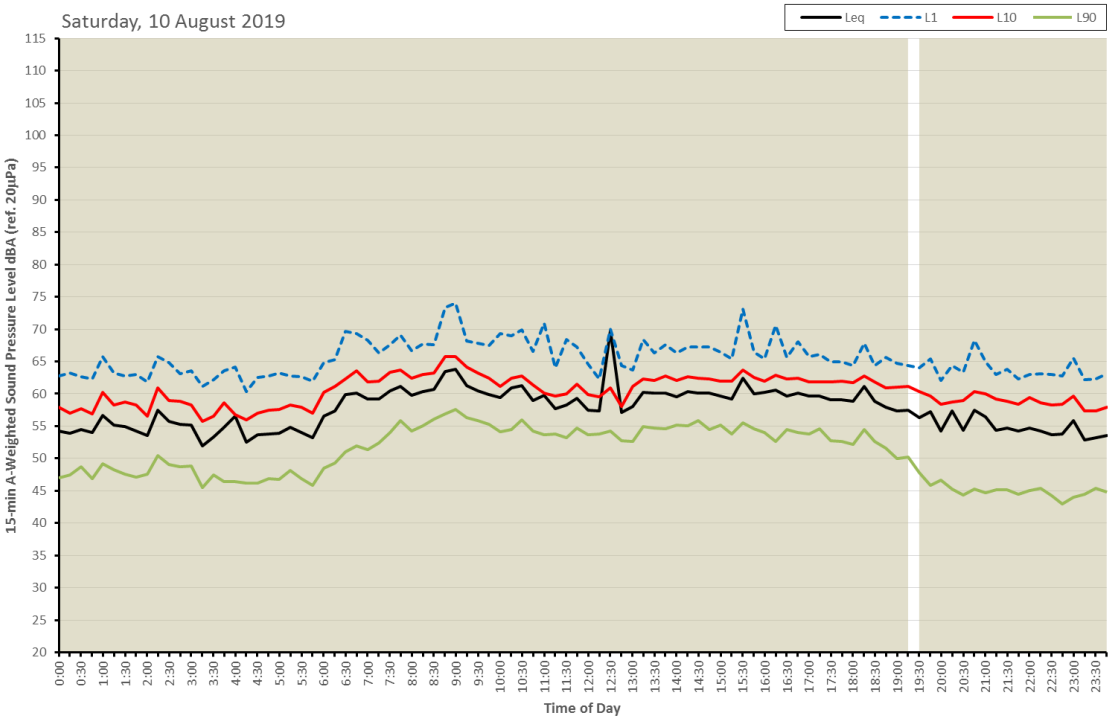

Monday, 5 August 2019
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day

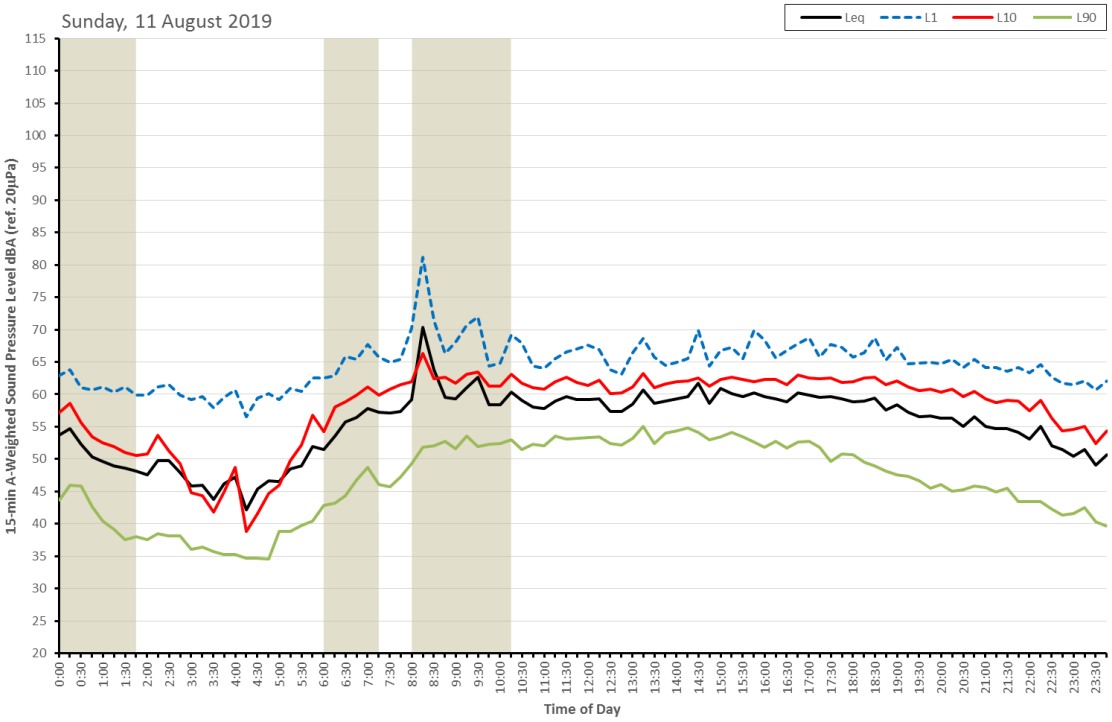

Tuesday, 6 August 2019
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day

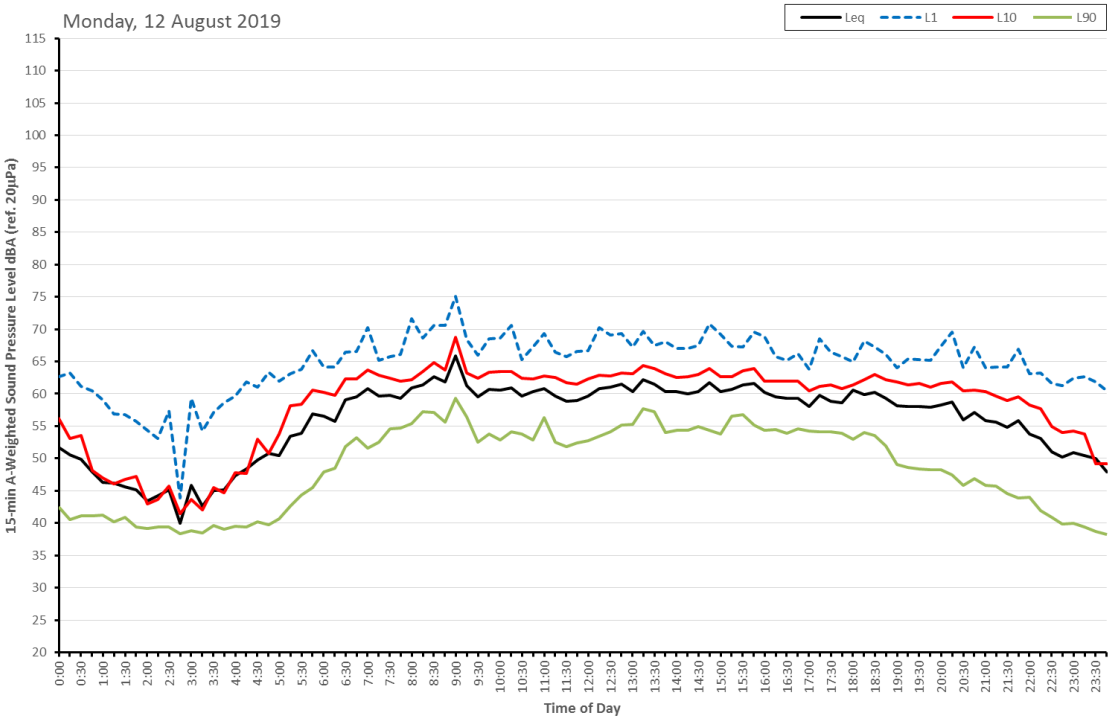

Wednesday, 7 August 2019
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day

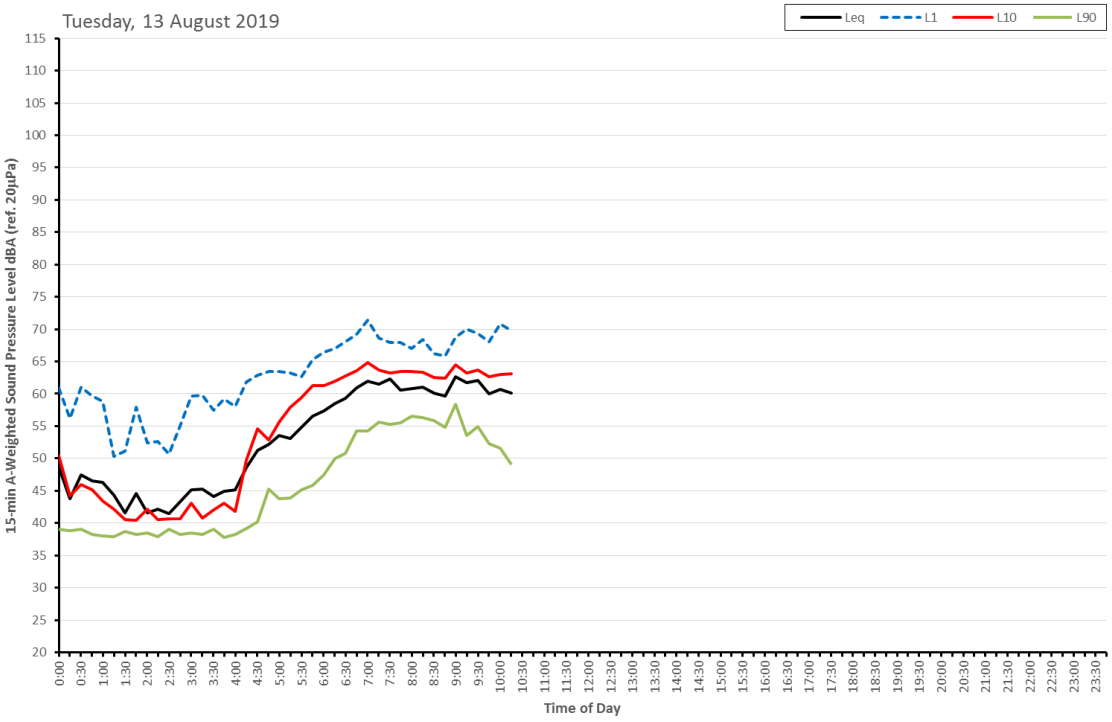

Thursday, 8 August 2019
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day


Friday, 9 August 2019
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day


Saturday, 10 August 2019
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day


Sunday, 11 August 2019
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day


Monday, 12 August 2019
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day


Tuesday, 13 August 2019
Leq
L1
L10
L90
15-min A-Weighted Sound Pressure Level dBA (ref. 20µPa)
Time of Day