MACARTHUR MEMORIAL PARK VARROVILLE NSW

ACOUSTIC ASSESSMENT OF OPERATION AND CONSTRUCTION NOISE AND VIBRATION FOR PLANNING APPLICATION

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1 Introduction

The Catholic Metropolitan Cemeteries Trust (CMCT) proposes to develop a landscape cemetery on existing rural land adjacent to St Andrews Road, Varroville NSW.

Acoustic Studio has been commissioned by the CMCT to carry out a noise and vibration impact assessment for the construction and operational phase of the proposed Macarthur Memorial Park (MMP) project.

This acoustic assessment has been prepared in support of the planning application for the proposal and addresses the submission requirements for Campbelltown Town City Council.

The objectives of this assessment are to:

- Identify noise sensitive receivers that will potentially be affected by the operation and construction of the project.
- Carry out noise surveys to determine existing ambient and background noise levels at the nearest noise sensitive receivers that surround the site.
- Establish the appropriate noise assessment criteria in accordance with the relevant standards and guidelines.
- Carry out a quantitative assessment to determine whether the relevant criteria can be achieved based on proposed operations and construction methods. Where applicable, provide recommendations for any necessary acoustic control measures that will need to be incorporated into the development in order to ensure compliance with the assessment criteria.

This report presents the findings of both the construction and operational noise and vibration assessments of the development. It includes measured environmental noise survey data and environmental noise limits based on the measured noise levels in the area. Compliance with these limits will ensure that any noise from the overall development will not impact negatively on the nearest existing receivers and receivers.

2 Project Overview

2.1 Description of the proposal

The CCMT proposes to develop existing rural land that comprises the following lots on St Andrews Road:

- Lot 22 DP 5640465;
- Lot B DP 370979;
- Lot 1 DP 218016.

The proposal would provide a landscape cemetery for the whole community in Sydney's West with the following objectives (as per the Macarthur Memorial Park Masterplan):

- Minimise the impact on existing environment, especially the topography and the Cumberland Plains Woodland, to protect them for future generations;
- Protect the Colonial landscape qualities;
- Provide an environmentally sensitive development;
- Achieve Best Management Practices in all aspects of cemetery provision, including Stormwater Management and Ecologically Sustainable Developments;
- Provide an exceptional open pace for the community, for perpetuity;
- Provide a quality burial ground for the whole community.

The development would be staged over a number of years and includes the provision of landscaped burial areas, memorial gardens, buildings (chapels, offices, administration facilities etc.), passive recreation areas.

This report considers all stages of the development as follows:

- Stage 1 - 2019 to 2104
    - All buildings and services constructed including:
        - 2 Chapels and 1 Condolence room;
        - A depot, office and information booth;
        - Café and function rooms;
    - Outbuildings restoration
    - Entrances to A and C
    - All roads within Stage 1

    - Landscaping and furniture within Stage 1
    - Shelters as required
- Stage 2 – 2105 to 2130
    - All roads within Stage 2
    - Landscaping and furniture within Stage 2
    - Shelters as required
- Stage 3 – 2131 to 2140
    - All roads within Stage 3
    - Landscaping and furniture within Stage 3
    - Shelters as required
- Stage 4 – 2141 to 2155
    - All roads within Stage 4
    - Landscaping and furniture within Stage 4
    - Shelters as required
    - Entrance D
- Stage 5 – 2156 to 2170
    - All roads within Stage 5
    - Landscaping and furniture within Stage 5
    - Shelters as required

Figure 1 below provides a staging plan for the site.

Figure 1: Staging plan for the proposed works (ref: Macarthur Memorial Park Masterplan)

2.2 Opening hours

The proposed opening hours for the MMP have not yet been specified. However, given similar memorial park developments are typically open from dawn to dusk, opening hours between 7am and 8pm have been considered for the purposes of this assessment. We note that the peak opening hours are assumed to be consistent with the anticipated peak traffic generation hours between 10am and 2pm, and remaining opening hours would typically be used by visitors for quiet contemplation.

Twenty-four (24) hour operations have been assumed for activities including cleaning services and the operation of mechanical plant and equipment.

2.3 Site details

The site is approximately 113.37 hectares (ha), and is located within a rural environment of the Campbell town City Council Local Government Area (LGA). The site is characterised by low to medium levels of activity throughout the day and decreasing activity in the evening and night. In the context of the surroundings, the site location is shown in Figure 2 below. Neighbouring properties include rural land, low density housing, places of worship and educational facilities.

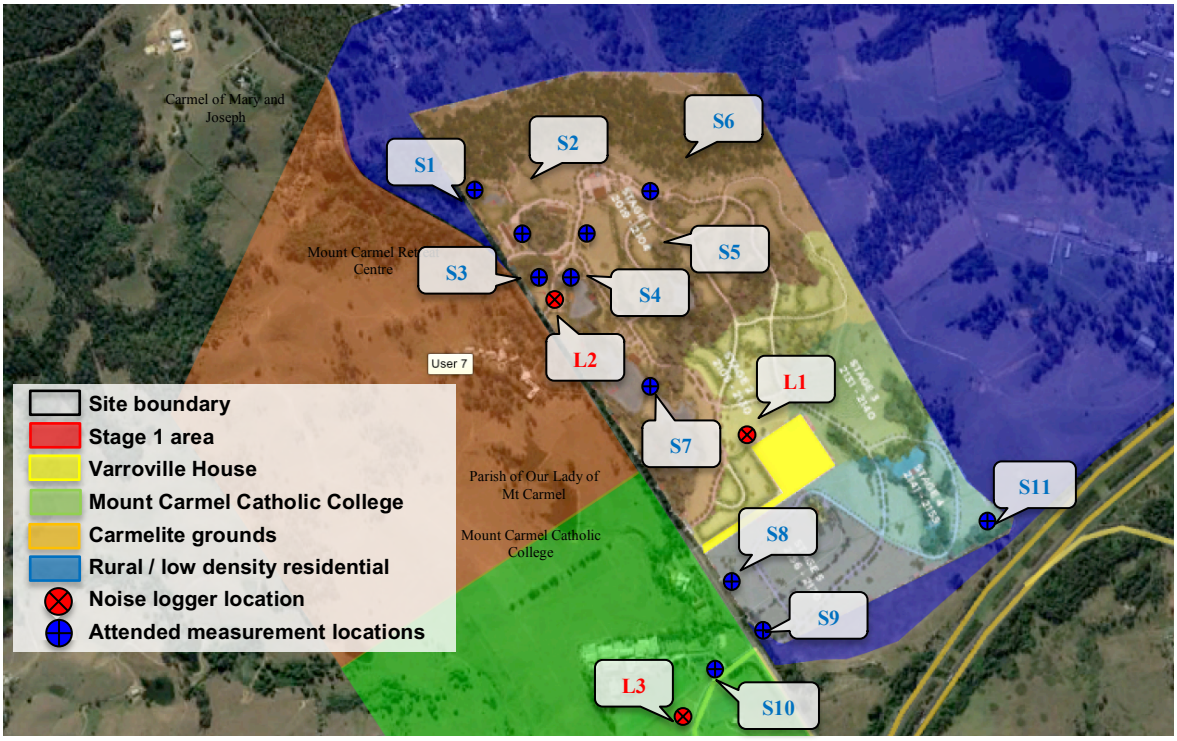

Figure 2: Macarthur Memorial Park site in relation to noise-sensitive receivers and noise monitoring locations.

Existing neighbouring properties that surround the site are as follows:

- The Varroville House (residential heritage house) semi-enclosed within the site boundaries and south of the Stage 1 development area;
- Rural land and the Hume Highway to the south of the site;
- The Parish of Our Lady Mount Carmel to the south west of the site, across St Andrews Road;
- The Mount Carmel Catholic College to the south west of the site, situated on Spitfire Drive;
- Carmelite grounds, including the Mount Carmel Retreat Centre and Carmel of Mary and Joseph to the west of the site;
- Rural/low-density residential land to the north and east of the site.

3 Existing Noise Environment

3.1 General survey information

A survey of the existing noise environment around the MMP site was conducted at three unattended noise monitoring locations used to continuously record the noise levels at the site. Long term noise monitoring was carried out on the following dates to establish the typical range of ambient and background noise levels of the proposed site and surrounds.

- Logger 1 – 3 to 10 February 2017
- Logger 2 – 10 to 23 February 2017
- Logger 3 – 16 to 23 May 2017

Long term noise monitoring was carried out with an RTA Technology Environmental Noise Logger Type 02 (Serial Number 38). The logger recorded L_{A1}, L_{A10}, L_{A90}, and L_{Aeq} noise parameters at 15-minute intervals continuously for a 7-day measurement period for background noise, and an 11-day (St Andrews Road) and 6-day (Spitfire Drive) measurement periods for traffic noise. The calibration of the logger was checked before and after use and no variations were noted.

Operator attended short-term monitoring was also carried out on Monday 23rd January, Friday 3rd February, Friday 10th February and Monday 20th February 2017 16th in order to supplement the long-term outdoor data across the site and at key surrounding receivers, plus to and obtain spectral noise data for traffic noise at the proposed development site.

Short-term measurements were made with a Brüel & Kjær Hand-held Analyser Type 2250 (Serial Number 3010373). The calibration of the analyser was checked before and after the survey and no variation in level occurred.

A windshield was used to protect the microphone of both the logger and the analyser. Weather conditions were calm and dry during the attended noise survey.

Hadi Khairuddin and Saiham Siraj of Acoustic Studio Pty Ltd carried out the surveys.

The long and short-term noise monitoring locations are shown in

Figure 2: Macarthur Memorial Park site in relation to noise-sensitive receivers and noise monitoring locations.

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3.2 Long-term monitoring results

The loggers were located within and around the proposed development site at the following locations:

- **Logger 1** – at the centre of the proposed development site (immediately north of Varroville House) to capture existing ambient and background noise levels at the site.
- **Logger 2** – at the north west boundary of the proposed development site to capture existing traffic noise along St. Andrews Street, in close proximity to the proposed site entrance and across St Andrews Road from the Mount Carmel Retreat Centre.
- **Logger 3** – to south of the Mount Carmel Catholic property boundary to capture existing traffic noise along Spitfire Drive.

These positions were chosen as it represented a secure place to leave the noise loggers unattended whilst obtaining typical representative traffic plus background and ambient noise levels at the nearest noise sensitive receivers. The long-term noise monitoring locations are shown in Figure 2

Figure 2: Macarthur Memorial Park site in relation to noise-sensitive receivers and noise monitoring locations.

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The detailed results of the long-term noise monitoring at each logger location are shown graphically in Appendix A.

Weather patterns were monitored during the survey period and were typically calm and dry during the unattended noise survey.

3.2.1 Traffic Noise

Traffic noise monitoring results are summarised in Table 1 below.

Location	Traffic Noise Levels, dB(A)			
	Period		1 Hour Period	
	Day $L_{eq, (15\ hr)}$	Night $L_{eq, (9\ hr)}$	Day $L_{eq, (1\ hr)}$	Night $L_{eq, (1\ hr)}$
Logger 2 – St Andrews Road Site Boundary	51	45	54	47
Logger 3 – Spitfire Drive	61	55	63	59

Table 1: Long-term traffic noise levels measured (see Figure 2)

3.2.2 Background and Ambient Noise

The logged data shows the background and ambient noise levels representative of the area. The recorded background noise levels have been used to establish a limiting criteria for noise emitted from the operation of the new buildings.

The background sound level is defined as the sound level exceeded 90% of the time, and is designated as the L_{90}. The ambient noise level impacting on the buildings is referred to as the equivalent continuous sound level (L_{eq}). This parameter is commonly used to describe a time varying noise such as traffic noise.

The background sound levels have been established in general accordance with the methodology described in the NSW INP, i.e. the 10th percentile background sound level for each period for each day of the ambient noise survey. The median of these levels is then presented as the background sound level for each assessment period. These background noise levels are shown in Table 2 below together with the L_{Aeq} ambient noise levels measured for each period.

In accordance with the INP, any data likely to be affected by rain, wind or other extraneous noises has been excluded from the calculations.

Location	Background Noise Levels (RBL), dB(A)	L_{eq} Ambient Noise Levels, dB(A)

	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am
Logger 1 Varroville House	36	40	35	51	46	44

Table 2: Long-term background and ambient noise levels

From observations during our site visit, it is noted that both ambient and background noise levels around the proposed development site are generally dominated by industrial noise around the site.

3.3 Short-term monitoring results

Nine (9) short-term noise monitoring locations were chosen as representative of the site and surrounds as follows:

- **Location S1** adjacent to proposed Ground Staff Facilities building;
- **Location S2** adjacent to proposed Administration Office building;
- **Location S3** adjacent to site entrance on St Andrews Road;
- **Location S4** adjacent to proposed Function Room building;
- **Location S5** adjacent to proposed Gatehouse building;
- **Location S6** adjacent to proposed Chapel and Mortuary buildings;
- **Location S7** adjacent to proposed Café building;
- **Location S8** adjacent to St Andrews Road, across from the Parish of Our Lady of Mt Carmel;
- **Location S9** adjacent to the St Andrews and Spitfire Road roundabout;
- **Location S10** adjacent Mount Carmel Catholic College entrance on Spitfire Road;
- **Location S11** south east corner of the site, at the closest point of the site to the Hume Highway with direct line of sight.

The measured values of the short-term traffic, background and ambient noise monitoring around the existing site are shown in Table 3.

Location	Time	Descriptor	Measured sound level, dB re 20 µPa								
			Overall dB(A)	Octave band centre frequency[1], Hz							
				31.5	63	125	250	500	1k	2k	4k	8k
S1	23/1/17	$L_{eq\ 15\ min}$	54	60	54	58	54	45	43	40	47	51

Location	Time	Descriptor	Measured sound level, dB re 20 µPa									
			Overall dB(A)	Octave band centre frequency[1], Hz								
				31.5	63	125	250	500	1k	2k	4k	8k
S2	11:00am to 1:00pm	$L_{90\ 15\ min}$	42	52	50	47	41	33	34	28	29	35
	23/1/17 11:00am to 1:00pm	$L_{eq\ 15\ min}$	50	54	53	51	45	36	34	30	38	48
		$L_{90\ 15\ min}$	45	50	49	48	42	34	32	27	26	40
S3	10/2/17 10:00am to 12:00pm	$L_{eq\ 15\ min}$	53	67	61	54	45	34	30	25	24	41
		$L_{90\ 15\ min}$	39	55	52	49	41	30	27	21	18	36
S4	23/1/17 11:00am to 1:00pm	$L_{eq\ 15\ min}$	50	54	53	51	45	36	34	30	38	48
		$L_{90\ 15\ min}$	45	50	49	48	42	34	32	27	26	40
S5	23/1/17 11:00am to 1:00pm	$L_{eq\ 15\ min}$	48	61	54	52	44	36	34	32	30	47
		$L_{90\ 15\ min}$	39	52	49	49	41	33	31	27	26	34
S6	23/1/17 11:00am to 1:00pm	$L_{eq\ 15\ min}$	40	69	61	53	44	36	30	30	27	36
		$L_{90\ 15\ min}$	38	55	52	49	41	32	28	25	22	33
S7	23/1/17 11:00am to 1:00pm	$L_{eq\ 15\ min}$	44	61	53	52	50	40	34	33	35	39
		$L_{90\ 15\ min}$	38	55	52	49	41	32	28	25	22	33
S8	23/1/17 11:00am to 1:00pm	$L_{eq\ 15\ min}$	53	64	62	62	56	51	45	47	40	49
		$L_{90\ 15\ min}$	46	53	56	57	52	43	33	30	27	40
S9	10/2/17 10:00am to 12:00pm	$L_{eq\ 15\ min}$	60	66	65	68	65	61	55	54	51	51
		$L_{90\ 15\ min}$	47	54	57	59	53	45	39	36	32	40
S10	10/2/17 4:30pm to 5:30pm	$L_{eq\ 15\ min}$	66	70	65	70	71	64	61	62	57	49
		$L_{90\ 15\ min}$	45	59	56	55	50	44	41	39	35	30
S11	10/2/17 10:00am to 12:00pm	$L_{eq\ 15\ min}$	67	70	68	66	63	62	64	60	52	44
		$L_{90\ 15\ min}$	55	61	61	58	54	52	50	47	42	33

Table 3: Short-term traffic, background and ambient noise levels – Day time survey

4 Key Acoustic Considerations

The following acoustic issues are to be addressed as part of the Noise and Vibration Impact Assessment for the MMP project:

External Noise Intrusion - For each of the proposed buildings forming Stage 1 of the works, the building envelope must limit external noise intrusion levels so that appropriate internal noise levels are achieved within the sensitive spaces. In particular, this applies to traffic noise intrusion from the internal loop and adjacent roads (including St Andrews Road and the Hume Highway).

External Noise Emissions - Noise emissions from Stage 1 of the proposed development will need to be managed to limit environmental noise impacts on nearby receivers resulting from the operation of the proposed development. In particular, this applies to:

- Building services and plant - The impact of mechanical noise generated by any new mechanical. The mechanical plant noise levels are to be assessed against the NSW Noise Policy for Industry (NPI) 2017.
- Traffic noise generation - The impact of traffic noise on surrounding receivers from changes in traffic flow as a result of the new development.
- Operational noise – associated with noisy activities, particularly noise associated with the use of the proposed buildings and traffic noise impacts from internal roads.

Construction Noise and Vibration - The impact of noise and vibration generated during the construction of each stage of the project on surrounding noise sensitive premises.

The development will contribute noise and vibration to the surrounding environment during the construction. Typically, this will result from intermittent noise from construction equipment and plant commonly used on construction sites.

Design noise and vibration limits have been set for the project and construction noise impacts have been anticipated from standard construction procedures.

The construction noise and vibration limits and expected impacts are reported in Section 9 of this report.

5 Relevant Standard and Guidelines

5.1 Guidelines used for the operational acoustic assessment

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

- Campbelltown (Sustainable City) Development Control Plan (DCP) 2015
- Campbelltown Local Environment Plan (LEP) 2015
- Protection of the Environmental Operations (POEO) Act 1997
- NSW *Noise Policy For Industry* (NPI) 2017
- NSW State Environmental Planning Policy (SEPP), Infrastructure 2007
- NSW Department of Planning, *Development Near Busy Roads and Rail Corridors*, 2008
- Australian Standard AS 2107:2016
- NSW EPA Road Noise Policy, 2011
- NSW Environmental Protection Authority (EPA) *Noise Guide for Local Government* (NGLG) 2013.

6 Acoustic Design Criteria

6.1 External Noise Intrusion

6.1.1 Traffic Noise - SEPP INFRASTRUCTURE 2007

Clause 102 of SEPP 2007 outlines requirements related to the assessment of noise impact from non-road developments that are adjacent to road corridors with traffic volumes of more than 40,000 vehicles.

Objective criteria for internal noise levels that must be achieved are provided for residential development only.

In the absence of objective criteria for cemetery developments, reference is made to NSW Department of Planning (DoP), Development Near Busy Roads and Rail Corridors – Interim Guideline and Australian Standard AS2107, which recommend internal design noise levels within occupied spaces.

6.2 External noise emission criteria

6.2.1 General

Local Development and Environment Plans

The Campbelltown City Council DCP (2015) does not provide specific criteria in relation to this MMP development type, however it does require noise levels from a place of public worship to not exceed the background noise by more than 5 dBA $L_{eq\ 15min}$ at the property boundary. The Campbelltown City Council LEP (2015) does not refer to noise impact requirements relevant to this development.

The following sections provide detail on the guidelines and standards relevant to this project, which are used to establish thorough and objective criteria. Compliance with the more stringent project criteria established below will ensure compliance with the requirements as per the Campbelltown City Council DCP (2015).

Environmental Planning and Assessment Act (EP&A) 1979

The Environmental Planning and Assessment Act 1979 (EP&A Act) regulates the majority of planning approval and environmental impact assessment (EIA) requirements in NSW. Section 111 of the Act requires examination and consideration to the fullest extent possible of all matters affecting or likely to affect the environment by reason of its activities. Acoustic impacts are a common community concern to be addressed in an EIA.

6.2.2 Protection of the Environment Operations Act (POEO) 1997

The Protection of the Environment Operations (POEO) Act 1997 defines "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. ..."

Further advice on the assessment of "Offensive Noise" is provided in the Noise Guide for Local Government (NGLG), 2010, which provides a checklist (shown in Table 4 below), of items that may be considered.

Offensive noise test: Checklist of considerations

Q1: Is the noise loud in an absolute sense? Is it loud relative to other noise in the area?

This establishes that the noise is likely to be heard by neighbours. Its volume alone may be annoying. An example would be music being played at a very high volume in a residence so it can be heard over very noisy activity outside, such as construction work. The noise may also be loud relative to the background noise. An example would be loud fireworks set off late at night. Noise measurements using a sound level meter would help to determine how loud the noise is relative to the background noise level in the area.

Q2: Does the noise include characteristics that make it particularly irritating?

The presence of tones, impulses or fluctuations in volume can make people more likely to react to the noise. These can be judged subjectively but noise measurements will help to quantify the extent of these characteristics. Examples might be screeching sounds from poorly maintained equipment or a 'beeper' alarm that uses a pulsed sound made up of one or two alternating frequency tones, usually higher pitched, that are louder than the background noise in the area.

Q3: Does the noise occur at times when people expect to enjoy peace and quiet?

People usually expect their surroundings to be quieter during the evening and at night. Talk to the complainants about how the noise affects them to see if it is interfering unreasonably with their comfort at home. Is it regularly disturbing their sleep, making it difficult to have a conversation, study, read or hear the TV? Noise that regularly disturbs sleep is likely to be considered offensive by complainants and this should be taken into account in your assessment.

Q4: Is the noise atypical for the area?

Where noise from an activity that is causing nuisance is new or unusual for an area, people are more likely to react. Look at the typical uses of the area and determine whether the activity is consistent with the local environmental plan. An example might be a rock drill used on a residential construction site.

Q5: Does the noise occur often?

Noise can be more annoying when it occurs frequently. Examples might be a leaf blower used every morning or a band that practises frequently without regard to the impact on neighbours.

Q6: Are a number of people affected by the noise?

Only one person needs to be affected by the noise for it to be deemed offensive. However, talking to other neighbours likely to be exposed to the same noise about how it affects them may assist in deciding what action to take. Some councils have a policy of requiring a minimum number of complaints from different individuals before taking formal action.

Table 4: NGLG Offensive Noise Checklist

6.2.3 Defining environmental noise criteria

The noise definitions and conditions provided POEO are generally focused around a subjective assessment.

Acoustic Studio recommends determining suitable objective criteria for assessing offensive noise, for noise emissions from mechanical plant, function and visitors.

Compliance with the criteria described in the sections that follow will ensure that the general noise conditions described in this section will be met.

6.2.4 NSW Road Noise Policy

The NSW Road Noise Policy (RNP) provides criteria for traffic noise from new roads or additional traffic generated on roads from land use development.

Table 5 below provides the RNP criteria for additional traffic generated on local roads from land use development in relation to the applicable receiver types surrounding the site.

Receiver	Assessment Criteria (external)	
	Day (7am to 10pm) $L_{Aeq\ (1hr)}$	Night (10pm to 7am) $L_{Aeq\ (1hr)}$
Residential	55	50
Places of worship	50[1]	40[1]
School classrooms	50[1]	-

Table 5: RNP assessment criteria for additional traffic on local roads generated by land use development

When considering land use redevelopment and the impact on sensitive land uses (residential / schools / hospitals / recreational) the guideline states that *"In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB"… (in relation to existing noise levels).. "represents a minor impact that is considered barely perceptible to the average person".*

[1] Non-residential external noise criteria is derived from internal noise criteria, assuming windows are open to adequately opened to provide natural ventilation. This methodology is supported by the NSW INP.

6.2.5 Mechanical plant

New South Wales Noise Policy for Industry (NPI)

The NSW NPI provides guidance on methodology for determining limiting noise criteria for external noise emissions from plant associated with a development.
The criteria have two components:

- Intrusiveness Noise Level – controlling intrusive noise impacts in the short term for residences.
- Amenity Noise Level (ANL) – maintaining noise level amenity for particular land uses for residences and other land uses.

Applying the more stringent of the two criteria provides the Project Noise Trigger Level (PNTL).
The NSW NPI considers the following when establishing the criteria:

- The existing Ambient (L_{eq}) and Background noise levels (L_{90}) that surround the site.
- The time of day that the noise generating development will be in operation, defined by the following:
    - Day (7am to 6pm).
    - Evening (6pm to 10pm).
    - Night (10pm to 7am).
- The type of receivers.
- The type of area that the development site and its nearest receivers are located. The NSW NPI provides recommended noise levels for specific receivers types and the type of area they are located within.
- The type of noise source and its characteristics. The NSW NPI provides modifying factors for noise sources with certain characteristics that may potentially cause greater annoyance than other noise sources of the same level.

Further guidance on establishing the criteria can be found in the NSW NPI.

Although MMP operational hours are assumed to be between 7am and 8pm, it is considered likely that mechanical plant would be operational for 24hrs to accommodate specific building use requirements (e.g. the Mortuary cool room) and after hours maintenance activities (such as cleaning). Therefore, for the purposes of this assessment, all time periods have been considered.

Based on the measured noise levels detailed in Section 6, and in accordance with the methodology outlined in the NPI, Table 6 details the corresponding limits of allowable noise emission from mechanical plant and general maintenance activities associated with the development at the nearest receiver boundaries.

Receiver Type	Period	NPI Criteria			
		Acceptable Noise Level dB(A)	Amenity $L_{eq\ (period)}$, dB(A)	Intrusiveness $L_{eq\ (15\text{-}minute)}$, dB(A)	Project Noise Trigger Level (PNTL) dB(A)[2]
Residential	Day (7am-6pm)	50	48	41	41
	Evening (6pm-10pm)	45	43	41[3]	41
	Night (10pm to 6am)	40	38	40	38
Place of Worship	When in use	50[4]	48	-	48
Educational	Noisiest 1-hour period When In Use	45[4]	43	-	43

Table 6: NPI project specific criteria for external noise emissions from mechanical plant

[2] Project Noise Trigger Level is based on the more stringent of the Project Amenity and Intrusiveness Noise Levels.

[3] The NSW NPI application notes recommends that the intrusive noise level for evening and night-time periods are not to exceed the day-time intrusive noise level where the RBL for evening or night is higher than the RBL for daytime.

[4] The NSW NPI specifies an internal ANL of 35 and 40 for school classroms and places of worship respectively. The NSW NPI also states that where internal noise levels are specified, external noise 10 dB above internal noise levels can be applied which should achieve an internal noise level where a window is adequately opened to provide natural ventilation.

6.2.6 Traffic Noise – Internal Roads

The application of the NPI criteria, discussed in Section 6.2.5 above, is considered appropriate for the assessment of traffic noise impacts from internal roads to the facades of neighbouring sensitive receivers.

6.2.7 Function Noise – Site Buildings (Café, Chapel & Function Room)

There is no state or national equivalent guideline for assessing noise emissions from cemetery facilities and places of worship, such as the Café, Chapel and Function Room.

The relevant criterion applicable to the Café, Chapel and Function Room is *"Offensive Noise",* however this is generally based on a subjective assessment.

Acoustic Studio considers the "Intrusive Noise" criteria (as described in the NSW INP) a suitable objective measure to assess offensive noise in relation to the pre-existing background noise level.

Where the intrusive noise is greater than the pre-existing background noise level, the potential exists for disturbance and annoyance. However, the impact is considered marginal if the difference between the pre-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 7.00 am and midnight.

Often the criterion becomes more stringent after midnight, recognising the increased sensitivity of this late night period in residential neighbourhoods. This has resulted in the commonly used criterion of *"background noise level + 0dB"* between midnight and 7.00 am.

As the use of the Café, Chapel and Function Rooms may include amplified music and patron noise, it is also relevant to consider noise in octave bands.

Liquor and Gaming New South Wales (LGNSW) and the City of Sydney (CoS) both apply similar octave band criteria to assess a licenced premises (LGNSW) and *"Entertainment Use"* (CoS).

Whilst the activities of the MMP do not fall under the authority of the LGNSW or the CoS, the assessment methodology recommended by these authorities is considered appropriate for assessment of activities associated with the Chapel, Café and Function Room, as they relate to the perceived intrusiveness of amplified, live music and patron noise.

The LGNSW and CoS criteria is defined as follows:

- 7am to 12am (midnight): L_{A10} from the premises (in this case the Chapel, Café or Function Room activities and events) is not to exceed the existing background noise level by more than 5dB, in any octave band from 31.5 Hz to 8 kHz inclusive.
- 12am (midnight) to 7am: L_{A10} from the premises (in this case the Chapel, Café or Function Room activities and events) is not to exceed the existing background noise level, in any octave band from 31.5 Hz to 8 kHz inclusive.

Aspects to note regarding the application of the above are:

- A 15-minute measurement period has been adopted for the LGNSW limits.
- The existing background noise level has been determined in accordance with the NSW Industrial Noise Policy (INP) 2000. The Day and Evening background noise levels are used to determine environmental noise criteria in accordance with the proposal hours of operation of the School.

Based on the measured noise levels detailed in Section 6, and in accordance with the methodology outlined above, Table 7 details the corresponding limits of allowable noise emissions from performance noise from the hall at the nearest receiver boundaries.

Note: The following criteria assumes the proposed use of the Chapel, Café and Function Room will be between 7am to 8pm for day and evening periods only, therefore criteria have only been established for these periods.

Location	Time	Descriptor		Measured sound level, dB re 20 µPa									
				Overall dB(A)	Octave band centre frequency[1], Hz								
					31.5	63	125	250	500	1k	2k	4k	8k
Residential / Educational / Places of Worship[5]	Day (7am-6pm)	Background Noise Level	L_{90}	36	48	47	46	41	33	30	27	23	26
		Corresponding Project Criteria (OLGR/CoS)	**$L_{10} \leq L_{90}$ + 5dB**	**41**	**53**	**52**	**51**	**46**	**38**	**35**	**32**	**28**	**31**
	Evening (6pm-10pm)	Background Noise Level	L_{90}	35	47	46	45	40	32	29	26	22	25
		Corresponding Project Criteria (OLGR/CoS)[2]	**$L_{10} \leq L_{90}$ + 5dB**	**40**	**52**	**51**	**50**	**45**	**37**	**34**	**31**	**27**	**30**

Table 7: Function Noise Criteria based on LGNSW and CoS recommendations

It is noted that compliance with the criteria presented above will ensure compliance with the Campbelltown City Council DCP (2015) for places of public worship.

[5] In the absence of criteria for educational properties and places of worship, the residential criteria for entertainment uses has been adopted and is the most conservative.

7 Traffic Noise Intrusion

Noise from St Andrews Road and internal roads may result in potential traffic noise impacts affecting buildings of the development.

Based on long term unattended noise data, a summary of traffic noise levels at St Andrews Road are provided in Table 8.

Location	Traffic Noise Levels, dB(A)			
	Period		1-Hour Period	
	Day $L_{eq, (15\ hr)}$	Night $L_{eq, (9\ hr)}$	Day $L_{eq, (1\ hr)}$	Night $L_{eq, (1\ hr)}$
St Andrews Road Site Boundary	51	45	57	53

Table 8: Day and night traffic noise levels based on attended measurements and logger data

Acoustic Studio has carried out a review of traffic noise impacts with consideration of the following:

- Noise levels are based on measurement data for the worst-case 1-hour noise level
- Internal noise levels for new buildings such as the hall are predicted based on levels incident at the façade of each space, which are based on the unattended measurements presented in Table 8. The measurements are adjusted to consider site-specific factors such as distance attenuation (building setback), shielding and building reflections.
- Attenuation provided by the building envelope construction, with the weakest elements being:
    - Existing external glazing;
    - The building envelope construction for the proposed buildings;
- Internal noise levels have been considered (or measured in existing buildings) for two scenarios:
    - Windows closed;
    - Windows opened sufficiently to provide cross ventilation.

In accordance with AS2107:2016, the following recommended internal design sound levels are adopted for the applicable building types proposed as per Stage 1 of the project:

- Places of Worship: $L_{Aeq,}$ 30 to 40 dBA
- Coffee Shop / Restaurant: L_{Aeq} 40 to 50 dBA

- General office areas / Meeting Rooms: L_{Aeq} 40 to 45 dBA
- Executive Office: L_{Aeq} 35 to 40 dBA
- Function areas L_{Aeq} 40 to 45 dBA

From the assessment, Acoustic Studio has identified that achieving internal noise levels for noise sensitive buildings in accordance with AS2107:2016 will typically require the following:

- Windows and doors to the Administration Office shall be closed when in use, particularly on the southern and eastern facades;
- Windows and doors may be open when in use for all other noise sensitive buildings, including the Function Rooms, Café and Chapel;
- Traffic noise intrusion from internal roads is likely to be intermittent, however windows and doors to all sensitive spaces shall be closed during the predicted MMP midday peak hour between the hours of 11am and 1pm.

Final details and extent of treatments to the façade buildings will be determined with input from an acoustic consultant at the detailed design stage to ensure the requirements of AS2107 are achieved.

Note that traffic noise intrusion impacts from Spitfire Drive have not been assessed as traffic noise from external roads to the site buildings will likely be dominated by St. Andrews Road.

8 Operational Noise Impact Assessment (External Noise Emissions)

8.1 Traffic Noise – Generation on surrounding roads

Acoustic Studio has considered noise associated with additional traffic generation on streets surrounding the proposed development site.

Following a review of the Traffic Impact Assessment prepared by The Transport Planning Partnership (TTPP) (ref: 166-176 *St Andrews Road, Varroville, MacArthur Memorial Park, Transport Impact Assessment, August 2017*) and subsequent volume counts undertaken at Rockwood Cemetery and St. Andrews Road in June 2017, it is understood that peak traffic generation hours are likely to be between 10am and 2pm.

Traffic noise impacts associated with the 'No Build' and 'Build' options have been predicted based on information in the traffic report and additional information for traffic generation provided by the Catholic Cemeteries as follows.

"… Years 1 to 5

Funeral services:

- *500 per annum (estimated)*
- *Average attendance per funeral service 50-75 people.*
- *Vehicles: 2 persons per vehicles 500 x 37.5 vehicles = 18,750 vehicles per annum; 360 vehicles per week; 51 vehicles per day; 10.3 vehicles per hour (between 10.00am & 3.00pm)*

Visitations:

- *2500 people per annum*
- *2 people per visitation: 1 vehicle*
- *1250 vehicles per annum*
- *24 vehicles per week*
- *3.5 vehicles per day*
- *0.7 vehicles per hour*

Café & Function Centre

- *30-50 people per day*
- *25 vehicles per day.*
- *3-5 vehicles per hour*

Years 5 to 10

Volume of funerals and traffic is expected to double

Years 10 to 100 years

Volume of traffic is expected to plateau to maximum number of funerals of 2000 per annum. (estimated): 7-8 funerals per day

…"

The traffic noise predictions at the nearest and potentially worst affected receivers for both St. Andrews Road and Spitfire Drive are provided in Tables 9 and 10 below.

Location and Construction Activity		Traffic Noise Levels at Surrounding Community Receivers, L_{Aeq} dB(A)				
		Mt Carmel Retreat Centre	Parish of Our Lady of Mt Carmel	Varroville House	Mount Carmel Catholic College (classrooms)	Mount Carmel Catholic College (residences)
Criteria	Day (1hr External)	50	50	55	50	55
	Relative Increase Criteria[6]	< 2	< 2	< 2	< 2	< 2
Current 'No Build'	Day (1hr External)	45	49	41	42	42
Stage 1 (Years 1 to 5)	Predicted Day (1hr External)	48	**52**	44	45	45
	Relative Increase to Current	**+3**	**+3**	**+3**	**+3**	**+3**
	Noise mitigation to be considered?	No	**Yes**	No	No	No
Stage 1 (Years 5 to 10)	Predicted Day (1hr External)	49	**53**	45	46	46
	Relative Increase to Current	**+4**	**+4**	**+4**	**+4**	**+4**
	Noise mitigation to be considered?	No	**Yes**	No	No	No
Full Development	Predicted Day (1hr External)	**51**	**55**	48	49	49
	Relative Increase to Current	**+6**	**+6**	**+6**	**+6**	**+6**
	Noise mitigation to be considered?	**Yes**	**Yes**	No	No	No

Table 9: St Andrews Road Predicted Traffic Noise Generation – **bold** & highlighted values indicate traffic noise levels greater than the relevant criteria - noise mitigation should be considered where both criteria are exceeded.

[6] Applies where the absolute Day criteria is exceeded.

Location and Construction Activity		Traffic Noise Levels at Surrounding Community Receivers, L_{Aeq} dB				
		Mt Carmel Retreat Centre	Parish of Our Lady of Mt Carmel	Varroville House	Mount Carmel Catholic College (classrooms)	Mount Carmel Catholic College (residences)
Criteria	Day (1hr External)	50	50	55	50	55
	Relative Increase Criteria[7]	< 2	< 2	< 2	< 2	< 2
Current 'No Build'	Day (1hr External)	-	**51**	47	**52**	52
Stage 1 (Years 1 to 5)	Predicted Day (1hr External)	-	**51**	47	**52**	52
	Relative Increase to Current	-	0	0	0	0
	Noise mitigation to be considered?	No	No	No	No	No
Stage 1 (Years 5 to 10)	Predicted Day (1hr External)	-	**52**	48	**53**	53
	Relative Increase to Current	-	+1	+1	+1	+1
	Noise mitigation to be considered?	No	No	No	No	No
Full Development	Predicted Day (1hr External)	-	**53**	49	**54**	54
	Relative Increase to Current	-	+2	+2	+2	+2
	Noise mitigation to be considered?	No	No	No	No	No

Table 10: Spitfire Drive Predicted Traffic Noise Generation – **bold** & highlighted values indicate traffic noise levels greater than the relevant criteria - noise mitigation should be considered where both criteria are exceeded.

In accordance with the RNP, consideration of mitigation is triggered when additional traffic on existing local roads generated by land use developments fails to comply with both the absolute noise level criteria provided in Table 5 AND exceeds the 'No Build' scenario noise levels by more than 2 dB(A).

[7] Applies where the absolute Day criteria is exceeded.

8.1.1 Consideration of Mitigation

Based on the noise predictions presented in Tables 9 and 10, consideration of mitigation is required for the following:

- St. Andrews Road traffic road generation at:
    - Parish of Our Lady of Mount Carmel for all Stages between 2 and 5 dB above the absolute criteria.
    - Mount Carmel Retreat Centre at full development only and only by 1 dB above the absolute criteria, which is considered marginal.

The RNP provides examples of strategies to mitigate noise from traffic-generating developments on existing roads, including the following, where considered reasonable and feasible:

1. Location of private access roads;
2. Regulating times of use;
3. Noise barriers;
4. Property treatment.

Items 1 to 2 are generally not considered practical or feasible measures for the limited number of affected properties.

Property treatment is a consideration for the Parish of Our Lady of Mount Carmel where providing an alternative means of ventilation (such as mechanical ventilation or air conditioning should it not already exist) such that windows can be kept closed in order to achieve the relevant criteria. This would allow for the internal noise levels to be met.

Notwithstanding the predicted traffic noise values greater than the relevant criteria, it is considered that noise mitigation be considered with some circumspection. This is because:

- During the early stages of the development traffic noise levels from St Andrews Road are predicted to exceed the maximum limiting criteria of 50 L_{Aeq} dB by approximately 2 to 3 dB at the Parish of Our Lady of Mount Carmel in the first ten years. This increase is typically the noise level difference where someone may start to perceive a change in level, rather than recognise this change as a significant increase.
- The prediction of traffic noise levels for the full development (beyond 100 years) is considered unreliable, given the significant changes in transportation and technology that are likely to occur over this period. Any assumptions made today as to the way in which a community might travel to the development beyond the foreseeable future cannot, in our view, be used as the basis for establishing a noise mitigation treatment that might be relevant for the full development.

As a consequence of these factors, it is recommended that:

- That within 5 years of the commencement of operations within Stage 1, a review of actual traffic noise levels be undertaken at the Parish of Our Lady of Mount Carmel. Mitigation - provision of an alternative means of ventilation (such as mechanical ventilation or air conditioning should it not already exist) enabling windows to be kept closed in order to achieve the relevant criteria could then be proposed and negotiated with the property owners.
- Subsequent 5 yearly traffic noise reviews be implemented throughout the stages of the development to confirm whether or not traffic noise levels do increase and the extent of the actual impact. The need for further mitigation should be considered within these reviews.

8.2 Traffic Noise – Internal Roads

A worst-case scenario traffic noise assessment of internal roads impacting on Varroville House has been carried out according to the following methodology:

- Predicted worst case peak traffic generation between 10am and 3pm (as per information in Section 8.1.
    - Stage 1 (Year 1 to 5) - 16 vehicles per hour.
    - Stage 1 (Year 5 to 10) – 32 vehicles per hour.
    - Full Development – 64 vehicles per hour.
- Assuming a maximum of 50% of vehicles would be access internal roads in closest proximity to the Varroville House;
    - Stage 1 (Year 1 to 5) - 8 vehicles per hour / 2 per 15min period.
    - Stage 1 (Year 5 to 10) – 16 vehicles per hour / 4 per 15 minute period.
    - Full Development – 32 vehicles per hours / 8 per 15 minute period.
- A worst-case distance of 30m from the nearest road[8].
- The predicted internal traffic noise is based on a sound pressure level of 60 dB(A) @ 7m for a 10 second pass by of a slow-moving vehicle (20km/hr)
- The assessment adopts the project specific NPI criteria for assessment.

Based on the above, the calculations and predicted noise levels at the receiver are presented in Table 11 below.

Receiver	Stage	Predicted Noise Level Leq (15-minute), dBA	INP Project Specific Criteria – Day (7am to 6pm) Leq (15-minute), dBA	Complies?
Varroville House	Stage 1 (Years 1 to 5)	31	41	Yes
	Stage 1 (Years 5 to 10)	34		Yes
	Full Development	37		Yes

Table 11: Internal roads – Predicted Operational Noise Levels

[8] Where the NPI states "*at the reasonably most affected point on or within the residential property boundary or, if that is more than 30m from the residence, the moist affected point within 30m of the residence*"

Table 11 indicates that internal traffic noise impacts at the nearest sensitive receiver, Varroville House, are compliant with the relevant criteria. Compliance at the Varroville House indicates compliance at all other receivers.

8.3 Mechanical Plant

Plant associated with the operation of the MMP site buildings should be controlled to ensure external noise emissions are not intrusive and do not impact on the amenity of neighbouring receivers with the relevant criteria in Section 6 of this report.

At this stage, final plant selections have not been made, therefore, a detailed assessment has not been carried out. Any plant selections will be reviewed to ensure that noise emissions meet the applicable environmental noise criteria.

In the absence of preliminary plant noise data or final locations, Acoustic Studio makes the following general comments:

- Air conditioning is proposed for all Stage 1 buildings. We understand no additional plant is proposed for Stage 2 to Stage 5;
- The nearest potentially affected receivers are Varroville House to the south and the Carmelite grounds to the west (including the Mount Carmel Retreat Centre and Carmel of Mary and Joseph);
- The plant will potentially operate into the evening and night periods to accommodate functions and specific operational requirements (e.g. the Mortuary cool room), maintenance and cleaning;
- The most restrictive criterion for the plant operating between 10pm and 6am is 37 dB(A) at the nearest sensitive receivers to the individual suite buildings. Achieving this criterion for each building will ensure compliance with the relevant criteria at all other receivers;
- The most restrictive night time criterion for 24hrs plant operations is 34 dB(A) at the nearest residential receivers. Achieving this criterion for each building will ensure compliance with the relevant criteria at all other receivers;
- Enclosure, attenuation and / or internally lined ductwork may be required for fans in order to meet both the internal and environmental noise criteria.

During the detailed design stage, Acoustic Studio will provide detailed design advice to the architect and mechanical engineer to ensure that noise emissions from mechanical plant are effectively controlled to meet the relevant criteria at the nearest receiver boundaries.

Noise emissions from general maintenance and cleaning activities may need management controls such as time restrictions particularly for external area maintenance activities, and keeping doors and windows closed during internal maintenance at more sensitive early morning and late night hours.

General design considerations and controls that may need to be implemented typically include, but are not limited to:

- Strategic selection and location of plant to ensure the cumulative noise contribution at the receiver boundary is achieved, and/or
- Noise control measures to be put in place to minimise noise impacts such as:
  - Noise enclosures as required
  - Noise barriers as required
  - Acoustic louvres as required
  - In-duct attenuation

8.4 Building Use

Acoustic Studio has carried out a preliminary assessment of noise emissions associated with key activities within the proposed new buildings:

- Café – operational hours likely between 7am and 8pm, and noise sources may include patron noise and background music. Maximum capacity of 50 people;
- Chapel – operational hours likely between 7am and 8pm, and noise sources may include live amplified music. Maximum capacity of 500 people;
- Function Room – operational hours likely between 7am and 8pm, and noise sources may include live amplified music and patron noise. Maximum capacity of 500 people.

8.4.1 Assessment methodology

The acoustic assessment has considered the following:

- Use of the specific building during typical operational hours as per Section 8.4 above. The assessment considers the worst-case evening/night-time criteria.
- Noise levels from the use are considered over a worst-case – 15-minute period.
- The assessment considers the nearest and potentially most affected receiver, specific to each individual building. Therefore, compliance at this location will result in compliance at all other locations.
- The assessment considers external activities (where applicable) and internal activities with diffuse reverberant field breaking out thorough the weakest building elements, namely the roof, doors or glazing for internal noise sources and
- Acoustic performance of the proposed building envelope is based on the required constructions to control traffic noise intrusion, which is noted to be the determining factor in the acoustic design for the hall.
- The assessment considers distance attenuation, shielding and reflections plus directivity.

8.4.2 Source Noise Levels

Based on the key activities and operational detail discussed in Section 8.4, the following source noise levels associated with the Café, Chapel and Function Room have been estimated below.

Café

The assessment generally assumes a worst-case scenario as per the following:

- Male patrons talking with "normal" voices to provide a worst-case scenario;
- At maximum capacity of 50 patrons (internal and external) with windows and doors open;
- Vocal effort of patrons communicating within the Café will generally be "normal" speech.;
- For every two patrons only one person will be speaking at any given time with a "normal" voice (i.e. 25 people speaking with a "normal" voice).

The L_{10} noise source spectra (at 1 m) of 25 patrons talking simultaneously are shown below in Table 12.

Description	*Overall dB(A)*	*Sound Pressure Level, dB re 20µPa*								
		Octave Band Centre Frequency, Hz								
		31.5	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
L_{10} of 25 patrons talking "normally" at 1m	**72**	52	55	60	70	72	66	61	58	52

Table 12: Sound levels likely to be generated by 50 patrons at the Café

It is assumed that amplified music at any time within the Cafe would be limited to background music. On this basis, we have assumed that typical L_{10} music noise levels within the Café will be at least 10 dB below the sound levels of patrons speaking normally (Table 12).

Therefore, if compliance is achieved for noise levels from patrons speaking, then compliance will also be achieved for amplified background music.

Chapel

The assessment generally assumes a worst-case scenario as per the following:

- Live amplified music of low to moderate noise levels;
- Noise levels from visitors attending the Chapel woud likely be minimal and not contribute to the worst-case noise level;
- Windows and doors open;

The L_{10} noise source spectra for live amplified music is shown below in Table 13.

Description	*Overall dB(A)*	*Sound Pressure Level, dB re 20µPa*								
		Octave Band Centre Frequency, Hz								
		31.5	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Reverberant noise level from live performance with amplified sound	**80**	51	79	76	78	78	76	69	61	53

Table 13: Amplified music source noise level

It is assumed that noise from visitors attending the Chapel will be at least 10 dB below the sound levels of live amplified music (Table 13).

Therefore, if compliance is achieved for noise levels from live amplified music, then compliance will also be achieved for people attending the Chapel.

Function Room

The assessment generally assumes a worst-case scenario as per the following:

- A combined source noise level of live amplified music (moderate) and male patrons talking with "normal" voices;
- At maximum capacity of 500 patrons with windows and doors open;
- For every two patrons only one person will be speaking at any given time with a "normal" voice (i.e. 250 people speaking with a "normal" voice).
- Windows and doors open;

The L_{10} noise source spectra for combined live amplified music and patron noise is shown below in Table 14.

Description	*Overall dB(A)*	*Sound Pressure Level, dB re 20µPa*								
		Octave Band Centre Frequency, Hz								
		31.5	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Reverberant noise level from live performance with amplified sound and patron noise	**83**	62	79	77	82	83	79	73	68	62

Table 14: Combined amplified music source and patron noise level

8.4.3 Noise Emission Predictions

The following tables detail the predicted noise levels at the nearest affected receiver associated with the operation of the Café, Chapel and Function Room.

Predictions are based on a worst-case scenario where the lowest measured existing background noise level and likely highest noise source levels are assessed at the boundary of the nearest and potentially most affected commercial receiver. The assessment, therefore, represents a worst-case scenario and shows that all operational scenarios are expected to comply with the criteria at all times for any of the surrounding receivers.

Calculation	Sound pressure level, dB re 20µPa								
	Octave band centre frequency, Hz								
	31.5	63	125	250	500	1k	2k	4k	8k
25 patrons talking "normally" at 1m	52	55	60	70	72	66	61	58	52
Distance Attenuation / Building attenuation / shielding / reflections / directivity	-44	-44	-44	-44	-44	-44	-44	-44	-44
Resulting level at the residential boundary	11	14	19	29	31	25	20	17	11
COS/OLGR Criteria - External (6pm to 8pm)	**52**	**51**	**50**	**45**	**37**	**34**	**31**	**27**	**30**
Complies?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Table 15: Noise assessment at nearest receivers from worst case evening event within the Café

Calculation	Sound pressure level, dB re 20µPa								
	Octave band centre frequency, Hz								
	31.5	63	125	250	500	1k	2k	4k	8k
Reverberant noise level from live performance with amplified sound	51	79	76	78	78	76	69	61	53
Distance Attenuation / Building attenuation / shielding / reflections / directivity	-47	-47	-47	-47	-47	-47	-47	-47	-47
Resulting level at the residential boundary	4	32	29	31	31	29	22	14	6
COS/OLGR Criteria - External (6pm to 8pm)	**52**	**51**	**50**	**45**	**37**	**34**	**31**	**27**	**30**
Complies?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Table 16: Noise assessment at nearest receivers from worst case evening event within the Chapel

Calculation	Sound pressure level, dB re 20µPa								
	Octave band centre frequency, Hz								
	31.5	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Combined reverberant noise level performance with amplified sound and patron noise	62	79	77	82	83	79	73	68	62
Distance Attenuation / Building attenuation / shielding / reflections / directivity	-47	-47	-47	-47	-47	-47	-47	-47	-47
Resulting level at the residential boundary	15	32	30	34	35	31	25	21	14
COS/OLGR Criteria - External (6pm to 10pm)	**52**	**51**	**50**	**45**	**37**	**34**	**31**	**27**	**30**
Complies?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Table 17: Noise assessment at nearest receivers from worst case evening event within the Function Room

8.5 Cemetery Operational / Maintenance Site Activities

There is potential for oeprational site activites to impact on surrounding neghbouring recievers. These include:

- Grave digging
- Lawn mowing
- Hedge trimming

The following provides an assessment based the above operational / maintenance activities.

8.5.4 Noise Sources

The following noise sources are considered to be typical plant and equipment used during earthworks and the construction of buildings.

Activity	Equipment / Item	Noise Level L_{eq} dB(A)	
		SWL	SPL @ 10m dB(A)
Grave Digging	Excavator (8 tonne)	97	69
Maintenance	Lawn Mowing	116	88
	Hedging / Chain Saw	105	77

Table 18: Anticipated airborne sound power levels for equipment/plant used during operational / maintenance site activities

8.5.5 Sensitive receivers

Nearest sensitive receivers to the project site that will be potentially affected by noise associated with proposed operational /maintenance site activities are surrounding places of worship, residential and educational premises as presented in Section 2.3.

Table 19 outlines the approximate distances to the nearest noise sensitive receivers in the vicinity of the project.

Receiver	Location	Approximate Distance from construction site	
		Closest Construction Site Boundary (m)	Centre of Construction Site (m)
Mount Carmel Retreat Centre	St Andrews Road	30	450
Parish of Our Lady of Mount Carmel	St Andrews Road	30	500
Varroville House	250m east of St Andrews Road	100	400
Mount Carmel Catholic College (classrooms)	Corner of St. Andrews Road and Spitfire Drive	250	850
Mount Carmel Catholic College (residences)	Corner of St. Andrews Road and Spitfire Drive	250	850

Table 19: Noise sensitive receivers and approximate distance to site

Operational / Maintenance Noise Assessment Methodology

An assessment of likely noise impacts from various operational / maintenance activities has been carried out to identify where the relevant criteria may be exceeded during the works.

The assessment has considered the following:

- Typical equipment as outlined above.
- For the purposes of the assessment, the noise impact at each noise sensitive receiver has been carried out based on the expected worst case construction noise impacts as follows:
    - Project specific criteria at each sensitive receiver location as outlined in Table 6.
    - Noise level predictions are calculated using the noise data provided in Table 18.

- Noise level predictions consider the following.
  - Distance attenuation.
  - Ground and building reflections.

- The predictions consider the impacts from individual pieces of equipment provided as range which considers the nearest and furthest location within the site from the nearest affected receiver.
- The predictions assume continuous operation of equipment / plant over the 15-minute assessment period, unless otherwise stated.

8.5.6 Assessment Results

Surrounding Receivers

Table 20 presents the results for the construction noise assessment at surrounding community receivers based on typical plant and equipment outlined in Table 18.

Location and Construction Activity	Predicted equipment noise levels at surrounding community receivers, in $dBL_{A10,15min}$				
	Varroville House	Carmel Retreat Centre	Parish of Our Lady of Mt Carmel	Mount Carmel Catholic College (classrooms)	Mount Carmel Catholic College (residences)
	Criteria, dB(A)				
	41	43	48	43	41
Grave Digging	37 / **60**	36 / **60**	35 / **60**	30 / 41	30 / 41
Hedge Trimming	**56 / 80**	**55 / 80**	**54 / 80**	**49 / 60**	**49 / 60**
Lawn Mowing	**45 / 68**	**44 / 68**	43 / **68**	38 / **49**	38 / **49**

Table 20: Noise assessment at nearest receivers from cemetery operational maintenance site activities

Practical noise treatments that should be incorporated include:

- Limit these works to the day period and where practical carry out works nearest to the noise sensitive receivers at the least sensitive time of the day.
- Upgrading façade (usually glazing which is the weakest element in the façade).

  and / or
- Noise barriers located at the affected property, negotiated with the property owner.

Quantifying the exact constructions would require a detailed review of the existing residence (review of existing constructions) that should be carried out for the detailed design stage of the project.

8.6 Offensive Noise

From the preliminary assessment and details provided in the previous sections, we make the following comments with respect to offensive noise.

- The primary noise emissions from the proposal will likely be traffic noise generation associated with visitors accessing and departing the site on external roads;
- Measures to mitigate traffic noise are recommended to ensure impacts to surrounding receivers are minimised;
- Mechanical plant for site buildings will be selected and noise controls implemented to ensure that the noise emitted is not loud in an absolute sense and not loud relative to the pre-existing ambient and background noise levels that surround the site.
- Noise from mechanical plant is generally broadband, and will be controlled so that there are no characteristics that will make it particularly irritating.
- Noise associated with the functions or events held within the proposed buildings (e.g. Chapel, Function Rooms or Café) may result in annoyance from low frequency noise emitted from amplified music however, given the distance and shielding provided, this should neither intrude or impact on the amenity of surrounding receivers. In addition, noise emitted from use of the aforementioned buildings is likely to be similar with the typical noise emitted from neighbouring properties such as the Mount Carmel College and the Parish of Our Lady of Mount Carmel, and therefore consistent with the existing environment.
- By controlling noise emissions (associated with the operation of the proposed development) in accordance with the relevant criteria, amenity of noise sensitive receivers will be maintained and noise emissions should not be intrusive, therefore it is not expected that people and noise sensitive receivers will be adversely affected by the development.

Based on the comments above, the development is able to satisfy the requirements of the POEO for "Offensive Noise" provided the relevant criteria outlined in Section 6 are achieved.

9 Construction Noise and Vibration Assessment

The following provides a preliminary construction noise and vibration assessment based assumed typical construction activities likely to be undertaken as part of the project, and will be developed further once a contractor is appointed to confirm methodology and equipment.

9.1 Relevant codes and standards

In preparing this construction noise and vibration assessment, the following legislation, codes and standards have been found to be relevant for the project:

- NSW Department of Environment and Climate Change, *Interim Construction Noise Guideline*, 2009.
- NSW Department of Environment and Conservation (DEC), *Assessing Vibration: A Technical Guideline*, 2006
- Australian Standard, *AS 2436 : Guide to Noise Control on Construction, Maintenance & Demolition Sites*, 1981
- Australian Standard, *AS 1055 : Acoustics – Description and Measurement of Environment Noise*, 1997
- Australian Standard, *AS 2670.2 : Evaluation of human exposure to whole-body vibration – Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz)*, 1990
- British Standards Institution, *BS 6472 – Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)*, 1992
- German Institution for Standardisation, *DIN 4150.3 : Structural vibration – Effects of vibration on structures*, 1999
- Protection of the Environment Operations Act 1997

9.2 Criteria and limits

9.2.1 Airborne noise

DECC Interim Construction Noise Guideline (ICNG)

The relevant guideline applied for the assessment of construction noise is the Department of Environment and Climate Change (DECC), Interim Construction Noise Guideline (ICNG), 2009. This guideline provides construction noise criteria for Residential, Commercial and Industrial noise receivers as follows.

Residential Receivers

Section 4 of the ICNG provides recommendations for standard hours of work and suggests construction noise management levels that aim to minimise the likelihood of annoyance caused to noise sensitive receivers. These consider both airborne and ground borne noise level impacts.

Table 21 below outlines the methodology for determining construction noise criteria at nearby residential receivers surrounding the development site based on existing background noise levels.

Time of Day	Management level L_{Aeq} (15 min)	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL[9] + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq\ (15\ min)}$ 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 75dB(A)	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: 1. 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 2. 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 + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see Section 7.2.2.

Table 21: Residential construction noise criteria for airborne noise

[9] The RBL is the overall single figure background dlevel representing each assessment period (day/evening/night) over the whole assessment period. This is the level used for assessment purposes and is further described in the Environmental Protection Authority (EPA) "*NSW Industrial Noise Policy, 2000*"

Based on the requirements detailed in Table 21 above and the measured data of existing conditions at the site (Section 3), the RBL has been calculated over the relevant periods and the corresponding project specific noise criteria levels for residential airborne noise has been determined. These are detailed in Table 22 below.

Location	Period		Rating Background Level RBL, dBA	Criteria $L_{eq\ (15\ min)}$ dBA	
Residential Receivers	Recommended Standard Hours	Monday to Friday 7am-6pm	36	RBL + 10	46
		Saturday 8am-1pm	36		46
	Outside Recommended Standard Hours	Saturday 1pm-6pm	37	RBL + 5	37

Table 22: Project specific residential noise criteria for airborne noise

Other Sensitive Land Uses

OEH's "Interim Construction Noise Guideline" suggests construction noise management levels for other sensitive land uses surrounding construction sites. They are as follows:

- Classrooms: $L_{Aeq,15min}$ 45dBA (internal)
- Places of Worship: $L_{Aeq,15min}$ 45dBA (internal)

Where reference is made to an internal noise level, an external noise level 10 dB above the internal noise levels are applied which should achieve the internal noise level where a window is adequately opened to provide natural ventilation. The INP supports this methodology.

9.2.2 Ground-borne noise and vibration

Due to the distances between the site and anticipated construction activities associated with Stage 1 of the project, ground-borne noise and vibration impacts to neighbouring sensitive receivers are considered unlikely.

9.3 Construction noise assessment

At this stage a contractor has not yet been engaged for the construction of the proposed development. Therefore, a detailed assessment of construction noise and vibration has not been carried out.

The following sections provide a high level review based on assumptions about plant and equipment that may typically be used.

It allows for a broad assessment of the potential noise and vibration impacts to identify where the relevant criteria may be exceeded during the works.

It is recommended that a Construction Noise and Vibration Management Plan (CNMVP) is prepared further to this assessment at the detailed design stage. The contractor would be required to prepare a final Construction Noise and Vibration Management Plan based on their proposed plant, equipment and construction methodology.

9.3.1 Proposed Hours

Proposed construction hours for the project are anticipated as follows:

- 7am to 6pm Monday to Friday
- 8am to 6pm Saturday

9.3.2 Noise Sources

The following noise sources are considered to be typical plant and equipment used during earthworks and the construction of buildings.

Equipment Type	Item	Noise Level L_{eq} dB(A)	
		SWL	SPL @ 10m dB(A)
Heavy Vehicles	Dump Truck (20 tonne)	107	79
	Concrete Mixer Truck	109	81
Site Machinery/Vehicles	Excavator (20 tonne)	107	79
	Bobcat	107	79
	Compactor	110	82
	Grader	107	79
	Vibratory Roller	107	79

Table 23: Anticipated airborne sound power levels for equipment/plant used during the different stages of the Project

9.3.3 Sensitive receivers

Nearest sensitive receivers to the project site that will be potentially affected by noise associated with proposed construction works are surrounding places of worship, residential and educational premises as presented in Section 2.3.

Table 24 outlines the approximate distances to the nearest noise sensitive receivers in the vicinity of the project.

Receiver	Location	Approximate Distance from construction site	
		Closest Construction Site Boundary (m)	Centre of Construction Site (m)
Mount Carmel Retreat Centre	St Andrews Road	30	450
Parish of Our Lady of Mount Carmel	St Andrews Road	30	500
Varroville House	250m east of St Andrews Road	100	400
Mount Carmel Catholic College (classrooms)	Corner of St. Andrews Road and Spitfire Drive	250	850
Mount Carmel Catholic College (residences)	Corner of St. Andrews Road and Spitfire Drive	250	850

Table 24: Noise sensitive receivers and approximate distance to Project construction site

Construction Noise Assessment Methodology

A preliminary assessment of likely noise impacts from various construction activities has been carried out to identify where the relevant criteria may be exceeded during the works.

The assessment has considered the following:

- Typical construction equipment as outlined above.
- For the purposes of a preliminary assessment, the noise impact at each noise sensitive receiver has been carried out based on the expected worst case construction noise impacts as follows:
    - Project specific criteria at each sensitive receiver location as outlined in Section 9.2.1
    - Noise level predictions are calculated using the noise data provided in Table 23.
    - Noise level predictions consider the following.
        - Distance attenuation.
        - Ground and building reflections.
- The predictions consider the impacts from individual pieces of equipment provided as range which considers the nearest and furthest location within the site from the nearest affected receiver.
- The predictions assume continuous operation of equipment / plant over the 15-minute assessment period, unless otherwise stated.

9.3.4 Assessment Results

Surrounding Receivers

Table 25 presents the results for the construction noise assessment at surrounding community receivers based on typical plant and equipment outlined in Section 9.3.2.

Location and Construction Activity	Predicted equipment noise levels at surrounding community receivers, in $dBL_{A10,15min}$				
	Varroville House	Carmel Retreat Centre	Parish of Our Lady of Mt Carmel	Mount Carmel Catholic College (classrooms)	Mount Carmel Catholic College (residences)
	Criteria, dB(A)				
	46[10]/ 37[11]	45	45	45	46[8]/ 37[9]
Dump Truck (20 tonne)	47 to 70	46 to 70	45 to 70	40 to 51	40 to 51
Concrete Mixer Truck	49 to 72	48 to 72	47 to 72	42 to 53	42 to 53
Excavator (20 tonne)	47 to 70	46 to 70	45 to 70	40 to 51	40 to 51
Bobcat	47 to 70	46 to 70	45 to 70	40 to 51	40 to 51
Compactor	50 to 73	49 to 73	48 to 73	43 to 54	43 to 54
Grader	47 to 70	46 to 70	45 to 70	40 to 51	40 to 51
Vibratory Roller	47 to 70	46 to 70	45 to 70	40 to 51	40 to 51

Table 25: Predicted equipment/plant noise levels at the nearest surrounding community receiver locations – Levels predicted to exceed the residential criteria are in **blue** (outside of standard hours) and **green** (standard and outside of standard hours); Levels predicted to exceed criteria for other receiver types are in **red**.

For any activities/equipment that exceed the relevant criteria, including those identified in Table 25, the control measures discussed in Section 9.4.1 shall be considered and implemented wherever reasonable and feasible. In addition, the construction best practices presented in Section 9.4.2 shall be considered to minimise the noise impacts on the neighbourhood.

9.4 Control elements

9.4.1 Noise

As a general rule, prevention should be applied as universal work practice at any time of day, but especially for the occasional construction works to be undertaken at critical times outside normal daytime/weekday periods.

It is noted that the reduction of noise 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 residences or other sensitive land uses should only be considered as a last resort. Construction noise shall be managed by implementing the strategies listed below:

[10] Project specific "*Recommended Standard Hours*" criteria for Monday to Friday and Saturday
[11] Project specific "*Outside Recommended Standard Hours*" for Monday to Friday and Saturday

- Plant and equipment
  - Use quieter methods.
  - Use quieter equipment.
  - Operate plant in a quiet and effective manner.
  - Where appropriate, limit the operating noise of equipment.
  - Maintain equipment regularly.
  - Where appropriate, obtain acoustic test certificates for equipment.
- On site noise management
  - Strategically locate equipment and plant.
  - Avoid the use of reversing alarms or provide for alternative systems.
  - Maximise shielding in the form of existing structures or temporary barriers.
  - Schedule the construction of barriers and structures so they can be used as early as possible.
- 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.
- Work scheduling
  - Schedule activities to minimise noise impacts.
  - Ensure periods of respite are provided in the case of unavoidable maximum noise levels events.
  - Keep truck drivers informed of designated routes, parking locations and delivery hours.

9.4.2 Additional noise 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 presented in Section 9.4.1, 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. For example, residential receivers are likely to be more sensitive to noise before 9 am than the educational receivers.
- Consider implementing equipment-specific screening.

- 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 (generators, hand tools, etc.) not specifically identified in this plan incorporates silencing/shielding equipment as required to meet the noise criteria.

9.5 Noise monitoring

The Contractor should consider implementing environmental noise monitoring at the nearest property boundaries of the sensitive receivers detailed in Section 9.3.3, particular for any works during outside of standard construction hours.

An allowance of 1.5 days per week, at least, should be dedicated to monitoring of noise for the first four weeks of construction. Further monitoring should be reviewed after this time or sooner should it be deemed necessary by the Acoustic Consultant and the Project Manager. This should take place mainly at the above locations although other locations and plant and equipment monitoring should take place as and when necessary.

The Contractor should prepare a noise monitoring report each month for review by the Project Manager. The reports should summarise and interpret the results of the noise monitoring carried out during the past month.

9.6 Communication and complaints

The Contractor should establish a communications register for recording incoming complaints. The registration of a particular item will remain open until the complaint has been appropriately dealt with.

In addition, the following procedures are an example of the procedures that should be specifically adopted for complaints relating to noise.

Upon receipt of a complaint The Contractor should:

- Try to ascertain from the complaint which appliance is causing the problem i.e. inside or outside the site and in what position.
- Establish from the monitoring equipment if the allowable noise levels have been complied with.
- Establish if the appliance positioning has previously been highlighted as a problem area. If not and the noise levels are above the allowable limit, then the equipment and its position shall be noted.

- Move machinery if the allowable levels have been exceeded or take other acoustic remedial action.

If the activity is occurring outside normal working hours, the activity should be immediately stopped. Where stopping the activity would create a safety issue the activity may be permitted to continue only as long as is necessary to make the area safe. The activity should then cease.

Any activity which is directed to cease due to excessive noise should not recommence until the Project Manager is satisfied that the noise and vibration limits requirements can be met and has given permission to recommence the activity.

The Site Supervisor should ensure that a report of any incident is provided to the Project Manager.

The Project Manager should provide a report on the incident to the relevant stakeholders.

The Contractor should provide a 24 hour telephone contact number and this number should be prominently displayed on the site.

9.7 Non-compliances

Non-compliance reports can be used as appropriate to deal with failures to meet the construction vibration management and control requirements.

10 Summary and Conclusions

A noise and vibration assessment report has been produced to establish the potential impacts of operational and construction noise for the proposed MMP project.

The existing noise environment has been established based on long-term and short-term monitoring data.

Appropriate criteria for both noise and vibration have been established based on relevant guidelines and standards.

A summary of the outcomes and recommendations of this noise and vibration assessment are as follows:

- Traffic Noise Intrusion

  Traffic noise intrusion to new buildings including the Chapel, Functions Rooms and Café have been assessed to ensure that levels will meet applicable criteria for educational buildings. Recommendations for controls have been provided where required to achieve the relevant criteria.

- Operational Noise Impact

  Traffic Noise Generation

  Based on the traffic generation estimates associated with the MMP, traffic noise generation along St. Andrews Road is expected to exceed the relevant criteria at the following locations:

  - Parish of Our Lady of Mount Carmel for all Stages between 2 and 5 dB above the absolute criteria.
  - Mount Carmel Retreat Centre at full development only and only by 1 dB which is considered marginal.

  Property treatment to the Parish of Mount Carmel to include alternative means of ventilation such that windows can remain closed should be considered and will required a more detailed review.

  Mechanical Plant

  At this stage, final plant selections have not been made, therefore, a detailed assessment has not been carried out. Any plant selections will be reviewed to ensure that noise emissions meet the applicable environmental noise criteria. During the detailed design stage, the acoustic consultant shall provide detailed design advice to the architect and mechanical engineer to ensure that noise emissions from mechanical plant are effectively controlled to meet the relevant criteria at the nearest receiver boundaries.

Operational use of Chapel, Café and Function Rooms

There are no adverse noise impacts expected as a result of the operational noise from the typical use of the Chapel, Café or Function Rooms, and noise emissions are expected to comply with the relevant criteria.

- Operational / Maintenance Noise

  Operational noise is predicted to exceed the relevant criteria at the nearest boundaries significantly.

  Practical noise treatments that should be incorporated in the detailed design are:

  - Limit these works to the day period and where practical carry out works nearest to the noise sensitive receivers at the least sensitive time of the day.
  - Upgrading façade (usually glazing which is the weakest element in the façade). and / or
  - Noise barriers located at the affected property.

- Construction Noise

  There will be times / situations when demolition and new-build works are likely to exceed stated criteria, particularly when works occur in the areas closer to sensitive receivers
  If, during construction works, an item of equipment exceeds the stated airborne noise criteria at any sensitive location, the additional noise control measures presented in Section 9.4.2, together with construction best practices presented in Section 9.4.1, shall be considered to minimise the noise impacts on the neighbourhood.

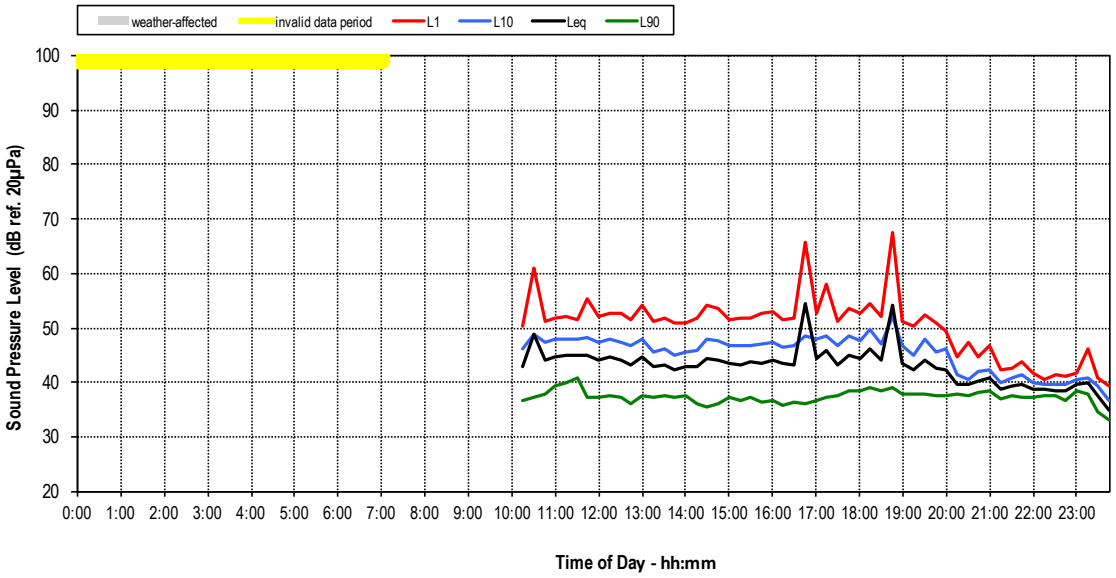
- Construction Vibration

  At this stage, we anticipate that construction works will result in no adverse vibration impacts at surrounding receivers.

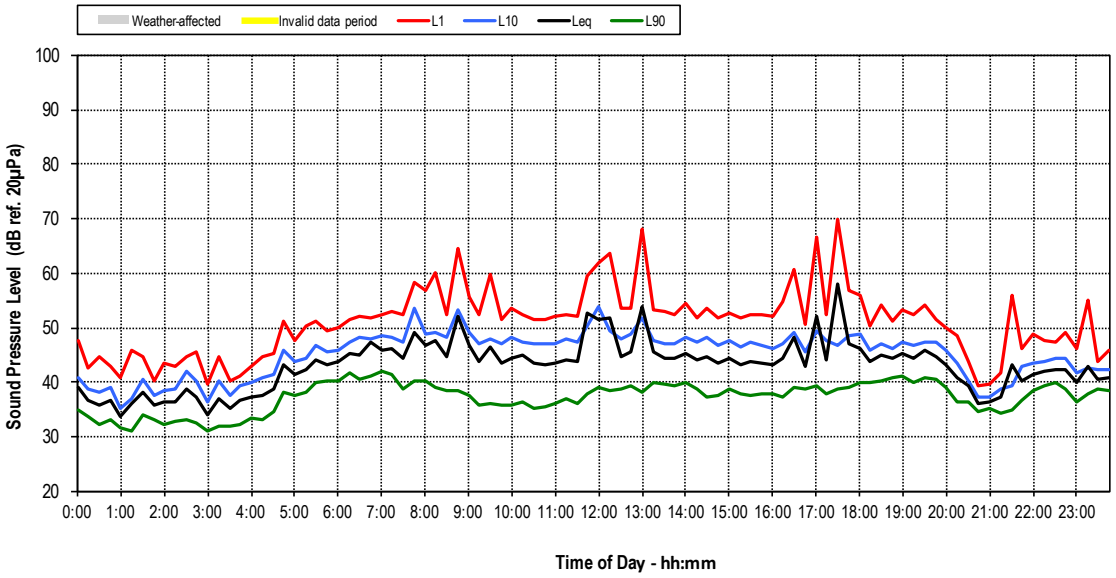
Appendix A : Noise Logger Data

Location 1 – Varroville House (Backgournd Noise Logger)

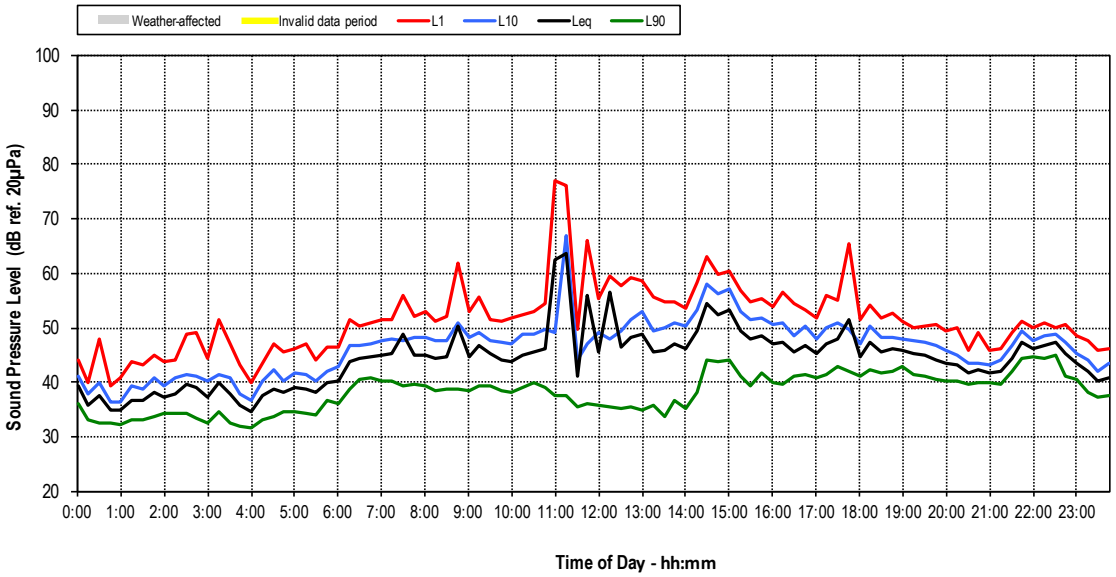
MacArthur Memorial Park, Background Varoville House - Friday 03 February 2017



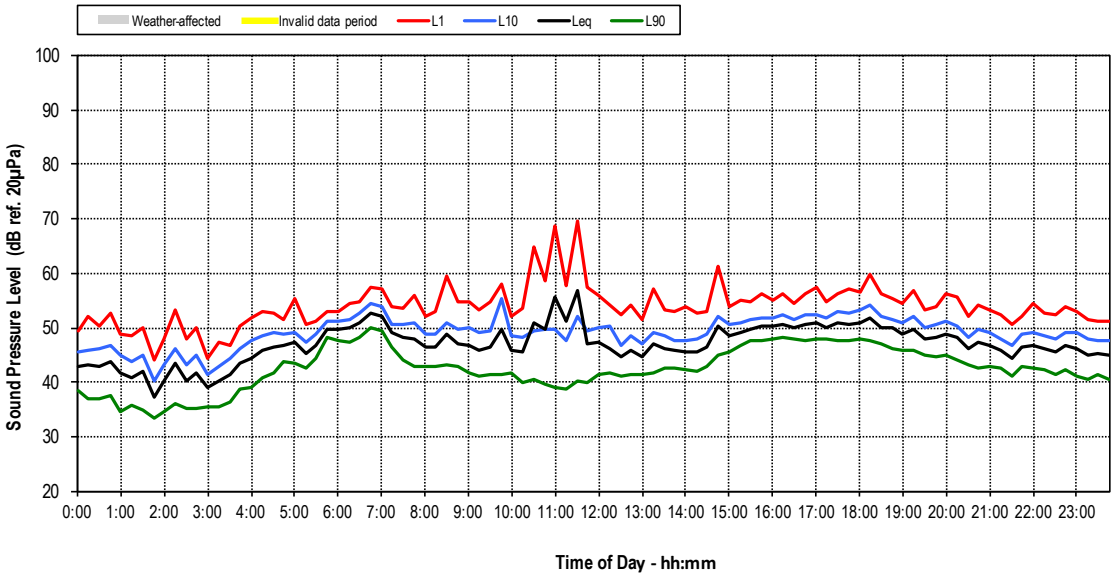
MacArthur Memorial Park, Background Varoville House - Saturday 04 February 2017



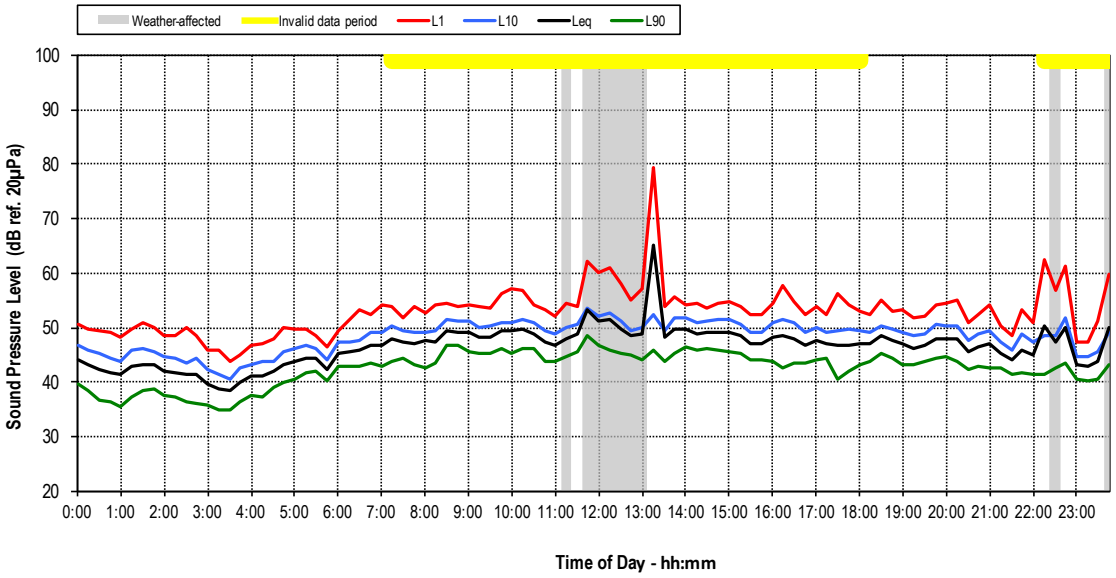
MacArthur Memorial Park, Background Varoville House - Sunday 05 February 2017



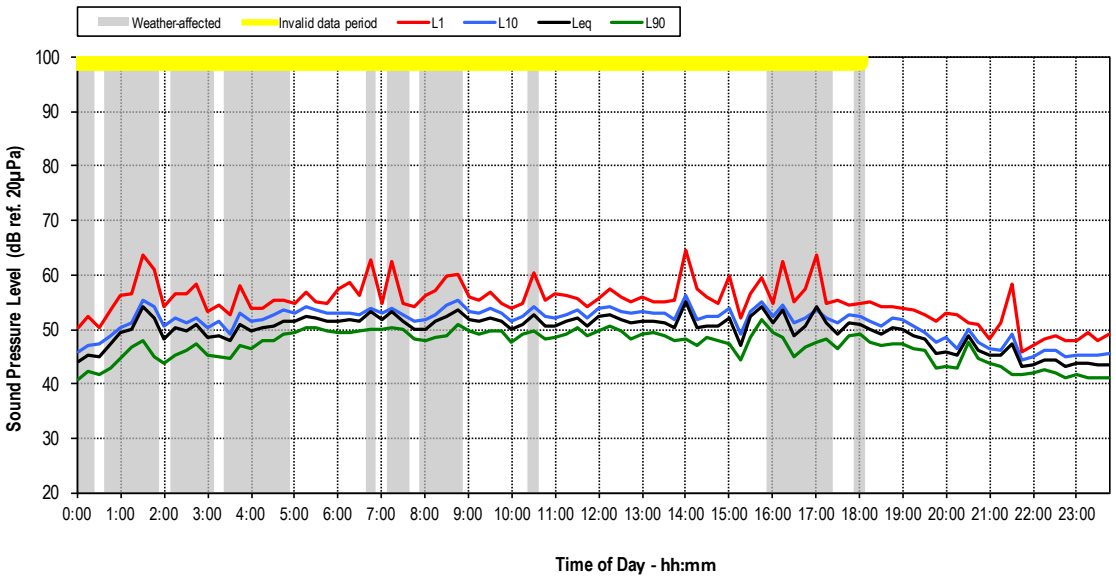
MacArthur Memorial Park, Background Varoville House - Monday 06 February 2017



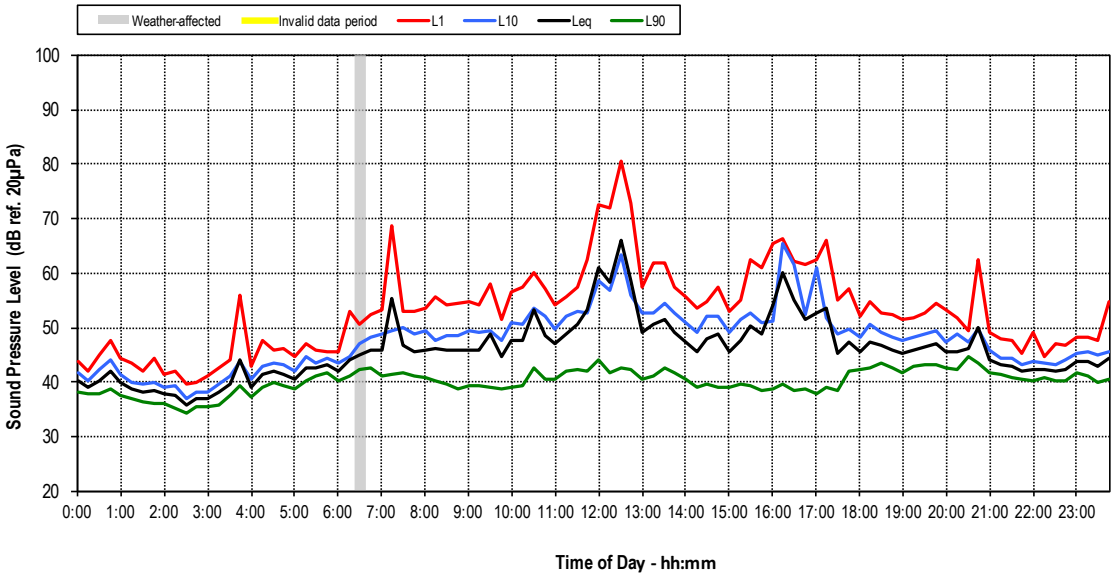
MacArthur Memorial Park, Background Varoville House - Tuesday 07 February 2017



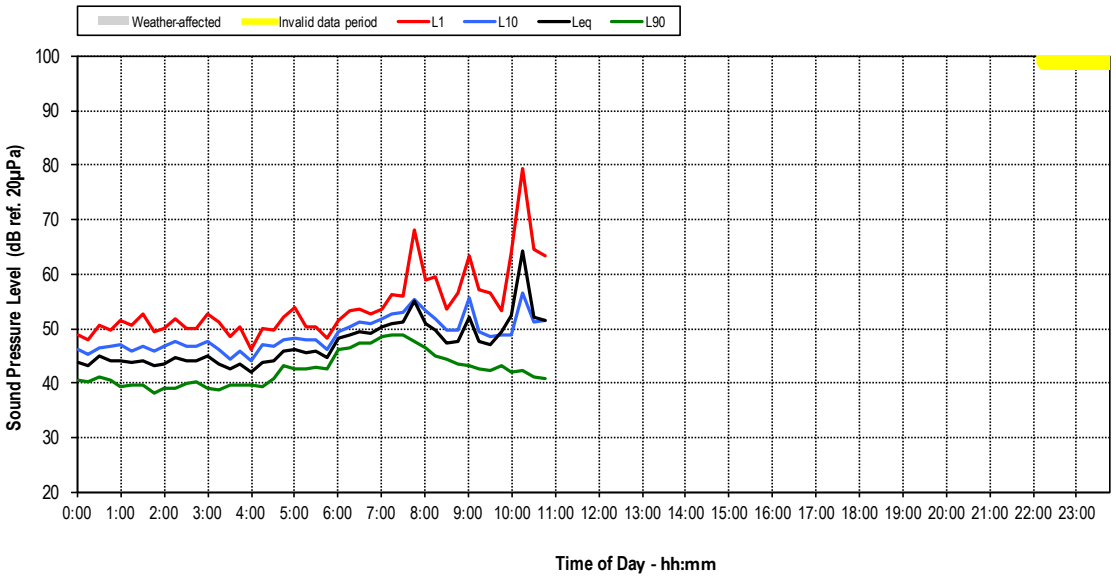
MacArthur Memorial Park, Background Varoville House - Wednesday 08 February 2017



MacArthur Memorial Park, Background Varoville House - Thursday 09 February 2017

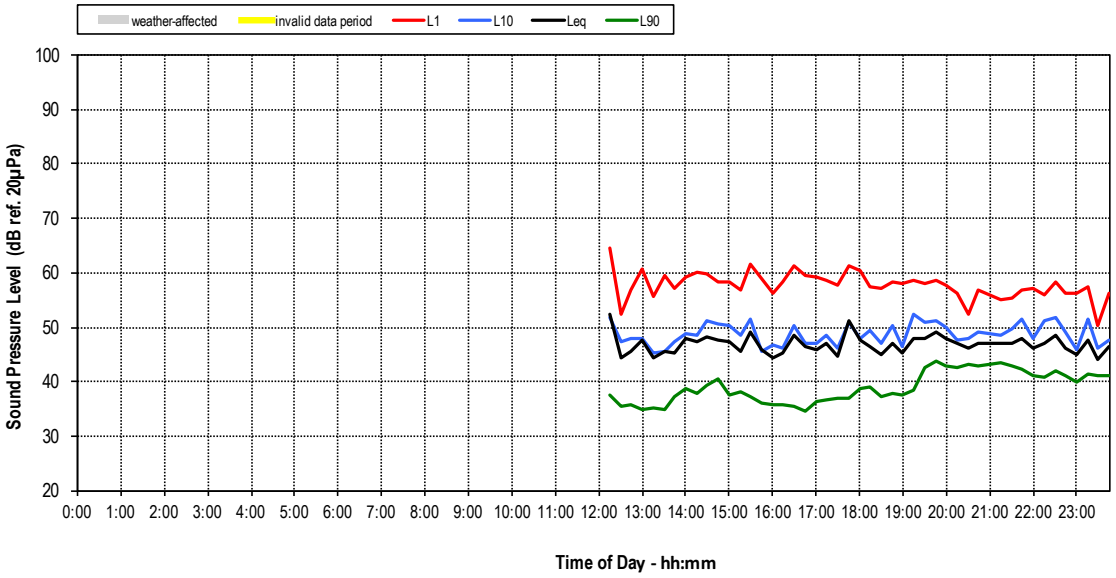


MacArthur Memorial Park, Background Varoville House - Friday 10 February 2017

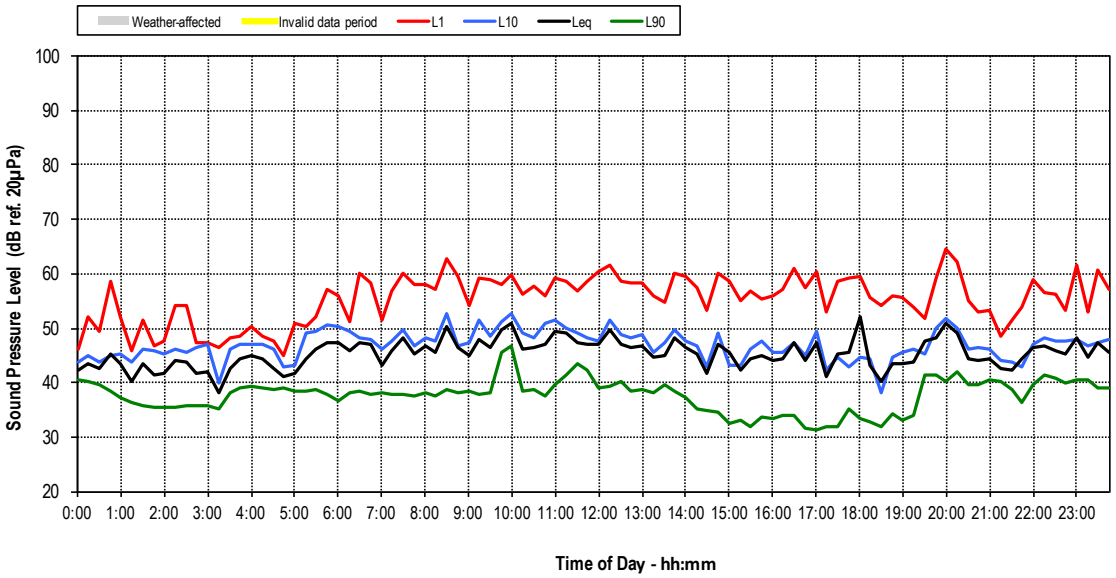


Location 2 – St Andrews Road (Traffic Noise Logger)

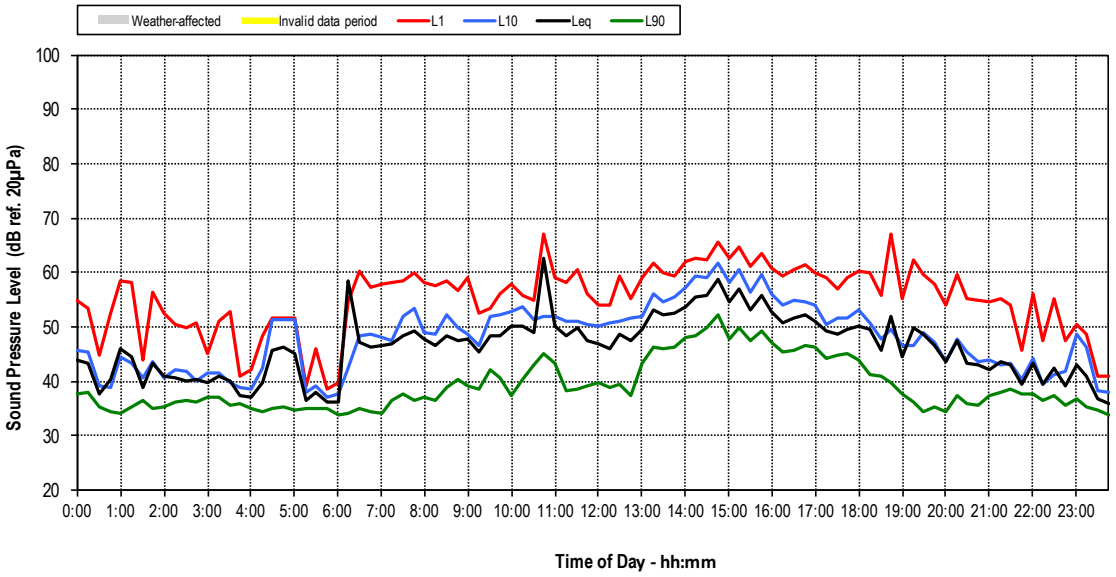
MacArthur Memorial Park, Traffic Logger at St Andrews St - Friday 10 February 2017



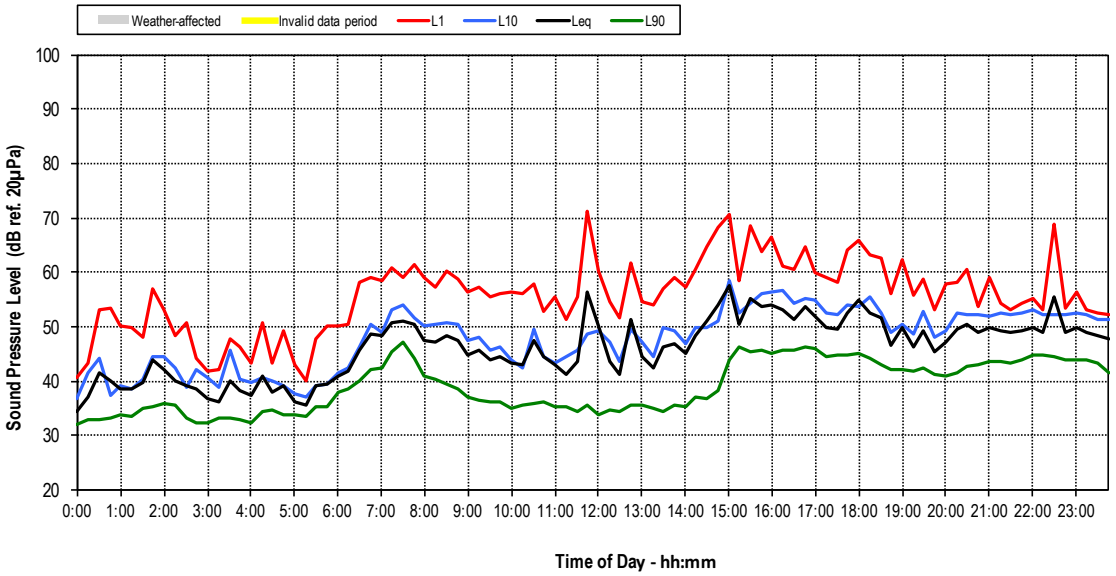
MacArthur Memorial Park, Traffic Logger at St Andrews St - Saturday 11 February 2017



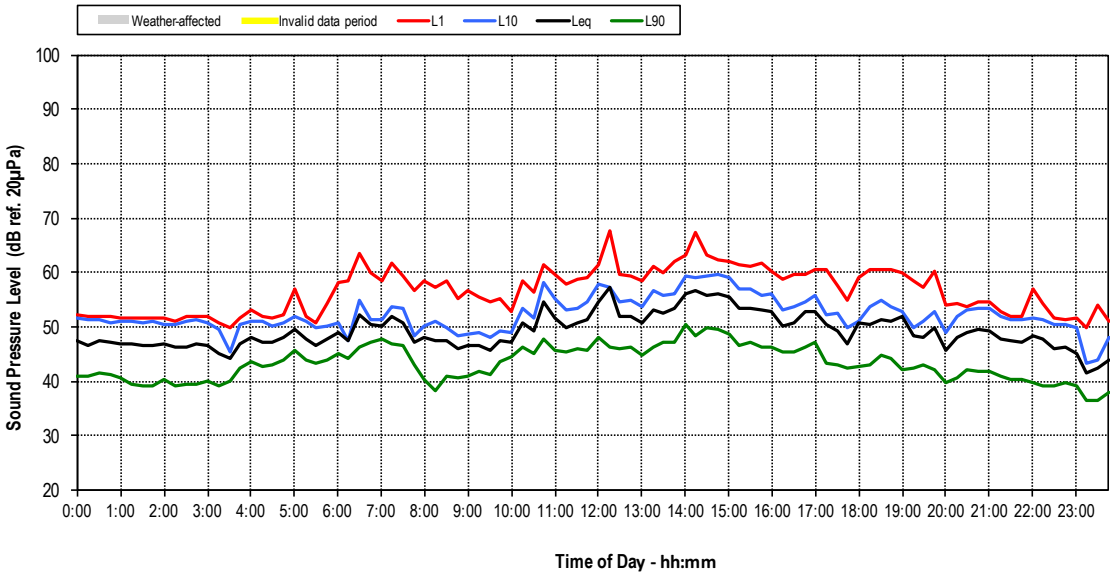
MacArthur Memorial Park, Traffic Logger at St Andrews St - Sunday 12 February 2017



MacArthur Memorial Park, Traffic Logger at St Andrews St - Monday 13 February 2017



MacArthur Memorial Park, Traffic Logger at St Andrews St - Tuesday 14 February 2017



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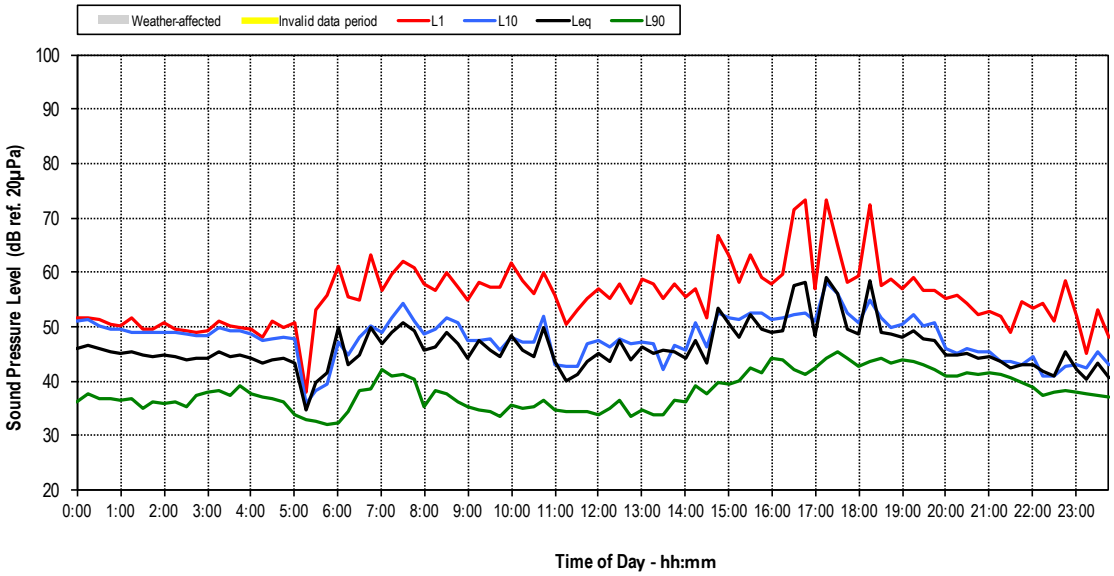
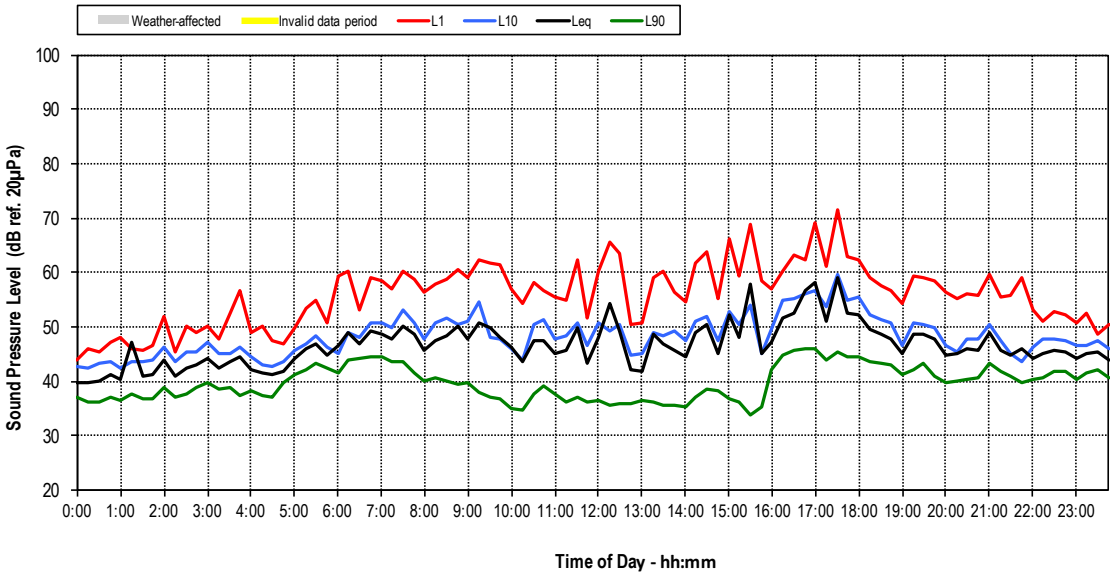
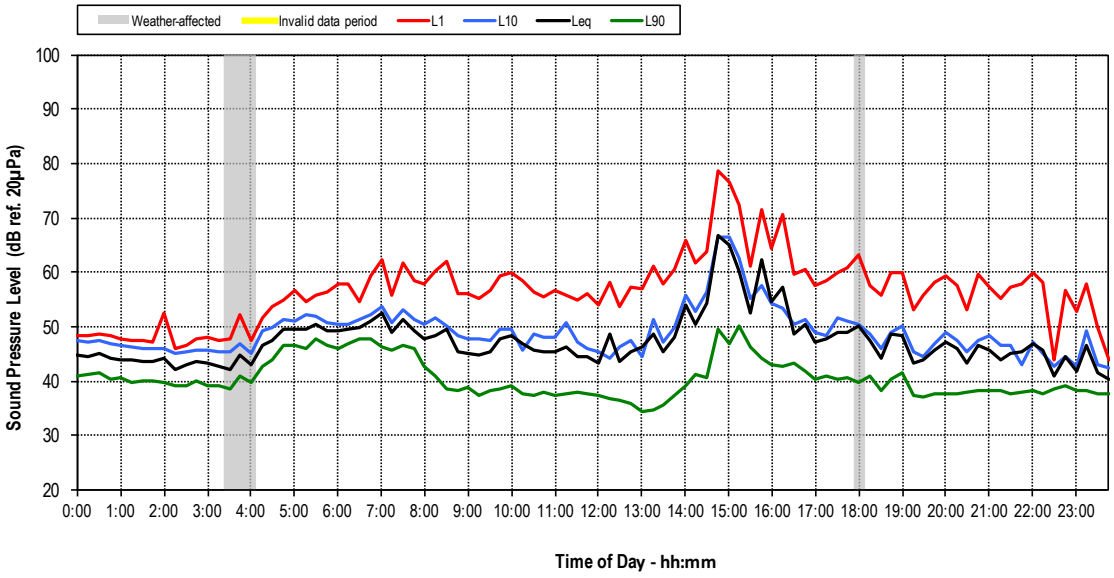


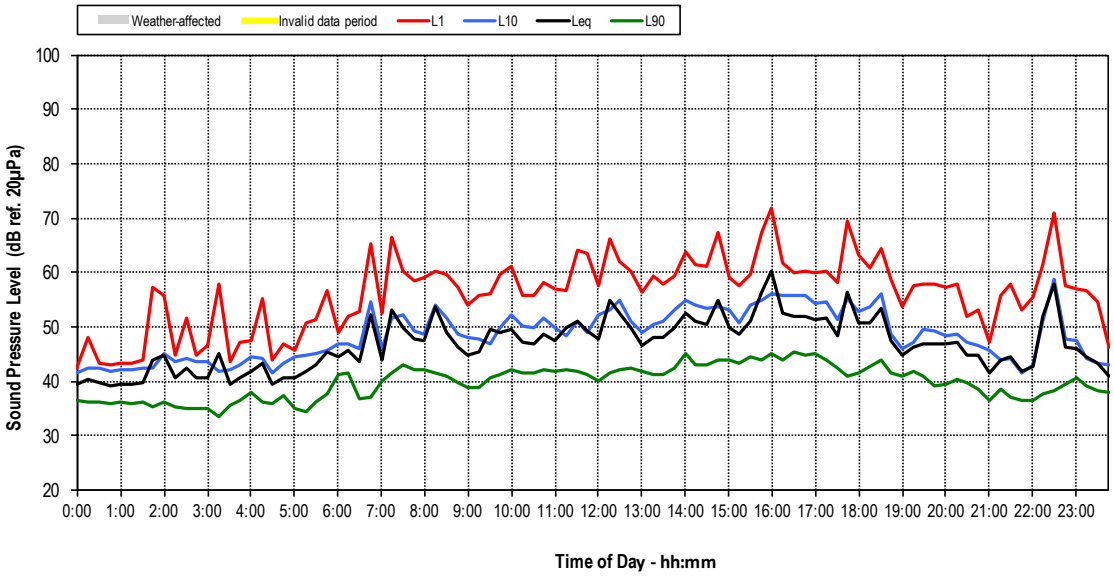
MacArthur Memorial Park, Traffic Logger at St Andrews St - Thursday 16 February 2017



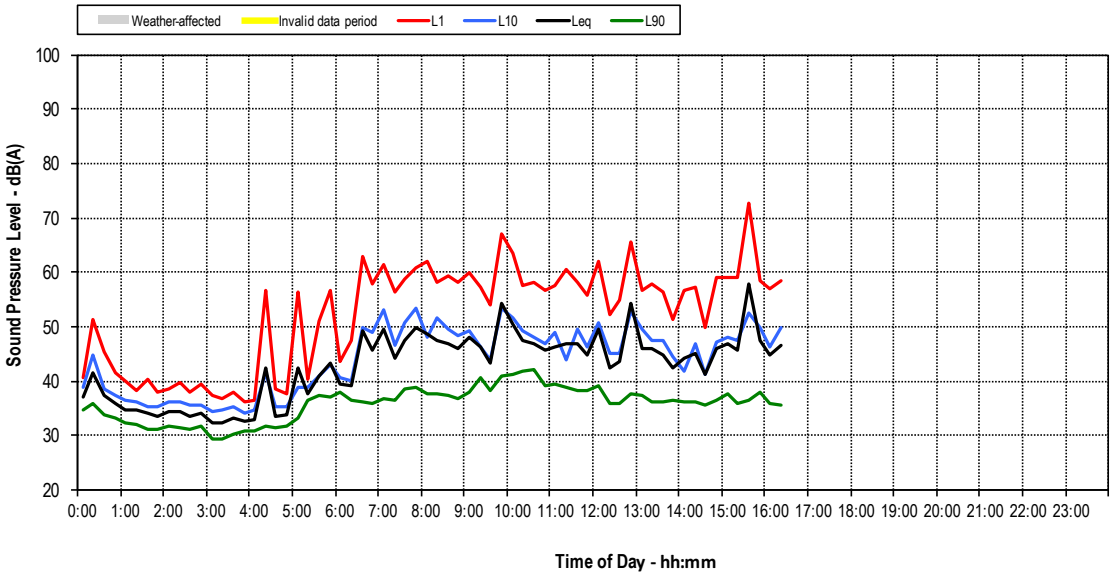
MacArthur Memorial Park, Traffic Logger at St Andrews St - Friday 17 February 2017



MacArthur Memorial Park, Traffic Logger at St Andrews St - Saturday 18 February 2017

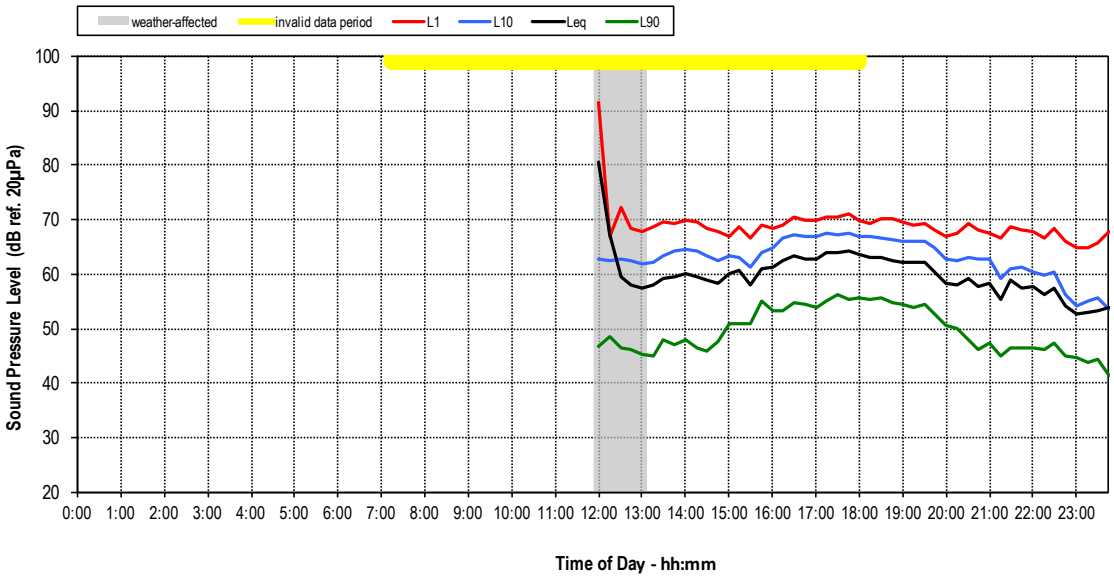


MacArthur Memorial Park, Traffic Logger at St Andrews St - Monday 20 February 2017

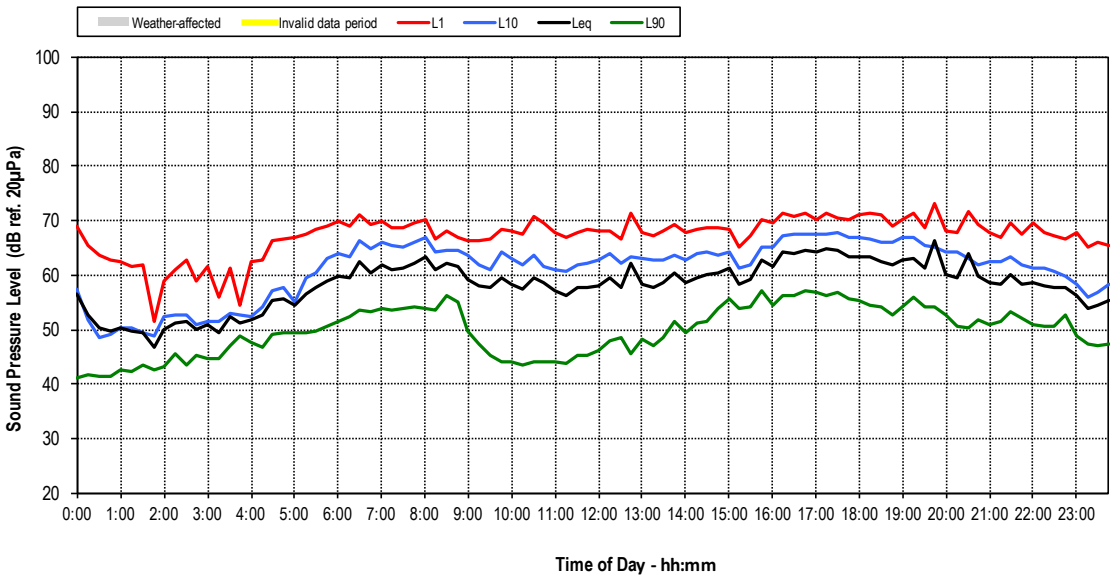


Location 3 – Spitfire Drive (Traffic Noise Logger)

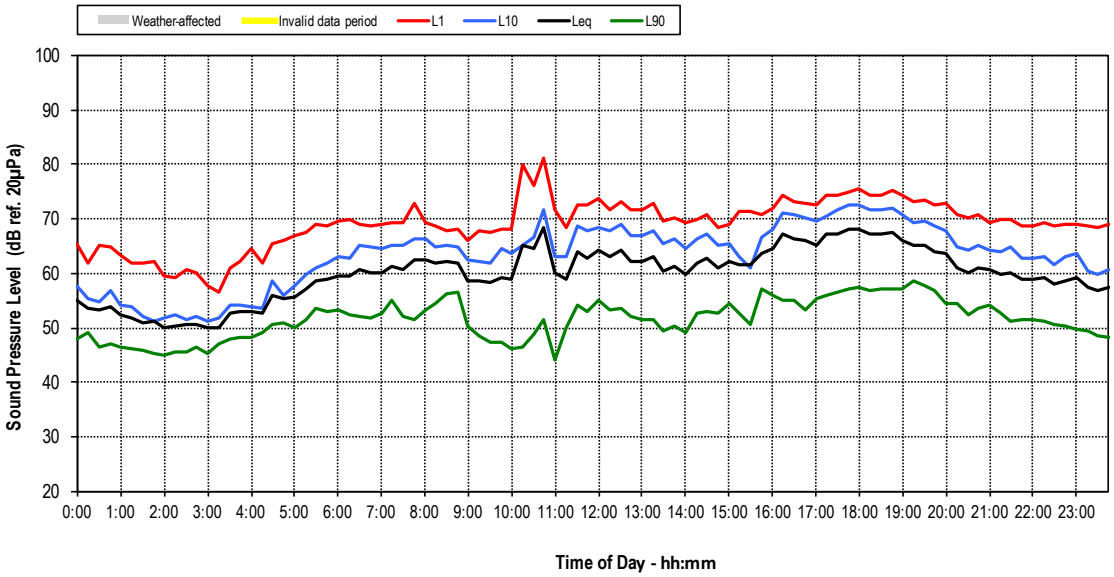
MacArthur Memorial Park, Traffic Logger at Spitfire Drive - Wednesday 17 May 2017



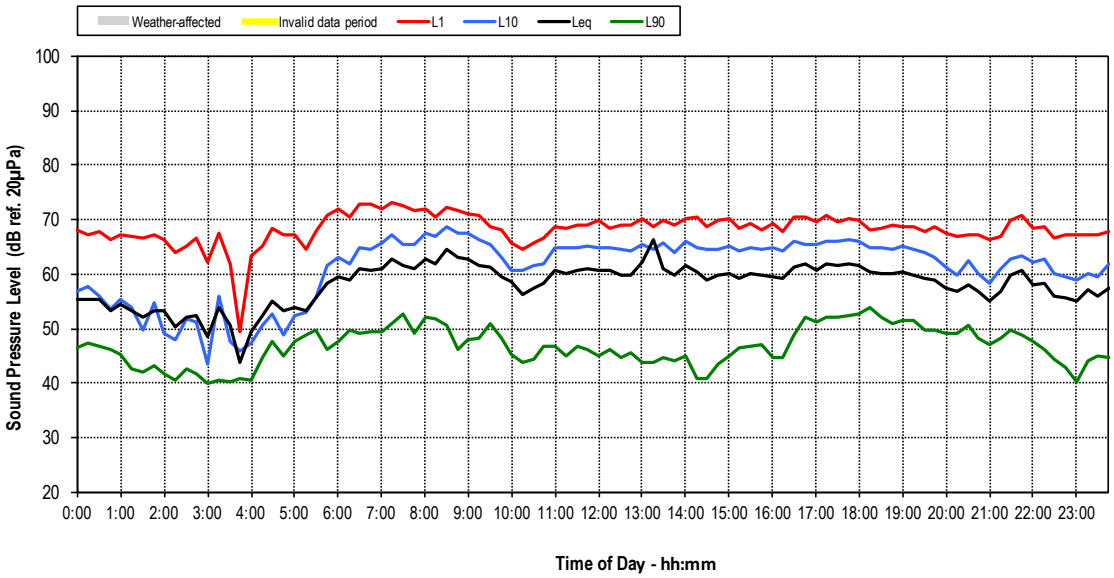
MacArthur Memorial Park, Traffic Logger at Spitfire Drive - Thursday 18 May 2017



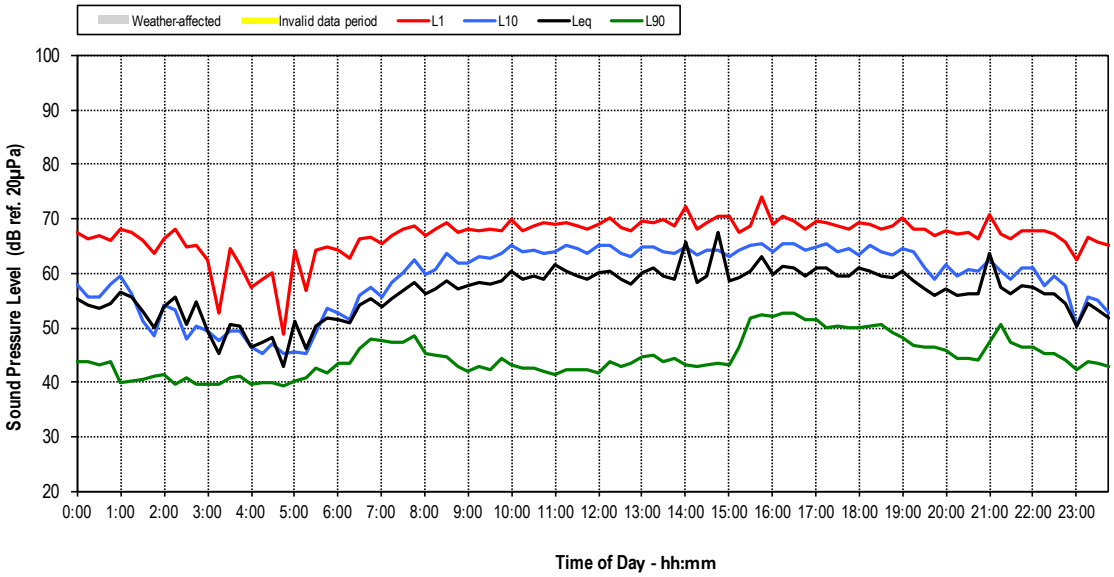
MacArthur Memorial Park, Traffic Logger at Spitfire Drive - Friday 19 May 2017



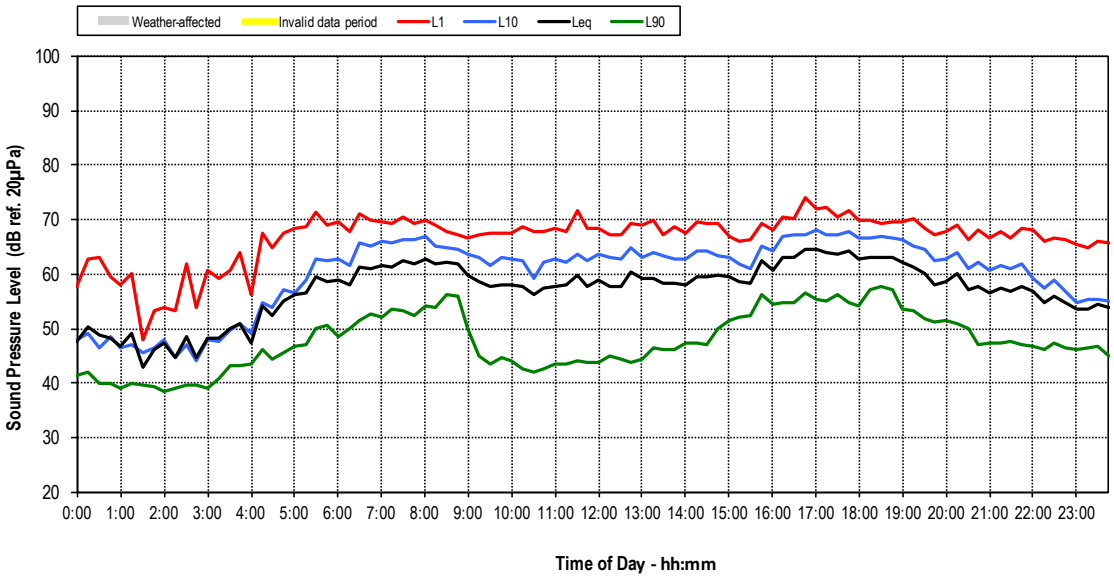
MacArthur Memorial Park, Traffic Logger at Spitfire Drive - Saturday 20 May 2017



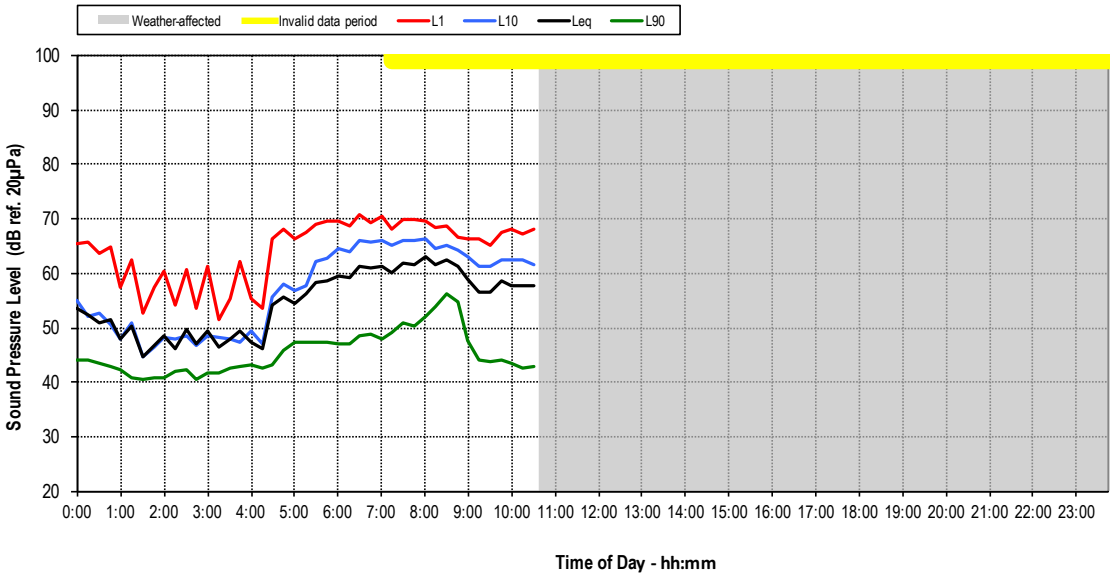
MacArthur Memorial Park, Traffic Logger at Spitfire Drive - Sunday 21 May 2017



MacArthur Memorial Park, Traffic Logger at Spitfire Drive - Monday 22 May 2017



MacArthur Memorial Park, Traffic Logger at Spitfire Drive - Tuesday 23 May 2017



Appendix B : Derivation of Environmental Noise Break-out Limits (NSW INP)

The NSW INP sets two separate noise criteria to meet environmental noise objectives: one to account for intrusive noise and the other to protect the amenity of particular land uses. Both are used to derive the project specific noise level.

Assessing intrusiveness

The intrusiveness criterion essentially means that the equivalent continuous noise level of the source should not be more than 5 dB above the measured existing background noise level.

Assessing amenity

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise, including plant. The existing noise level from industry (or plant) is measured - if it approaches the criterion value, then the noise levels from new plant need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion.

The cumulative effect of noise from all industrial or plant sources is considered in assessing impact.

Project specific noise level

The derivation of the project specific noise levels is provided below.

B.1 Existing Background and Ambient Noise Levels

The rating background level (RBL) has been determined from $L_{A90,15min}$ measured during the long-term noise survey in accordance with the methodology prescribed in NSW INP.

Three time periods are considered (consistent with the operating times of the plant associated with the development and the time of day classifications in the Policy):

- Day - 7 am to 6 pm
- Evening - 6 pm to 10 pm
- Night - 10 pm to 7 am

From the noise logger data presented in Appendix A, the calculated RBL's and measured ambient noise levels are shown below in Table B1.

Location	Background Noise Levels (RBL), dB(A)	Leq Ambient Noise Levels, dB(A)

	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am
Logger 1 Varroville House	36	40	35	51	46	44

Table B1: Long-term background and ambient noise levels measured around the MMP site

From observations during our site visit, it is noted that both ambient and background noise levels around the proposed development site is generally dominated by traffic noise around the site.

B.2 Determination of intrusiveness criterion

The intrusiveness criterion is defined as:

$$L_{Aeq,15minute} = \text{RBL plus 5 dB(A)} \quad \text{(Equation 1)}$$

The intrusiveness criterion has been determined from the RBL's presented in Table B.1 for each period and from the short-term measurements presented in Section 3.3. The intrusiveness criterion is established for residential receivers and in this instance, is based on Logger location L2.

- Day Intrusiveness criterion of 36 + 5 = **41 dB(A)**
- Evening Intrusiveness criterion of 40 + 5 = **41 dB(A)**[12]
- Night Intrusiveness criterion of 35 + 5 = **40 dB(A)**

B.3 Determination of amenity criterion

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 is to remain below the recommended Amenity Noise Levels (ANL) specified in Table 2.2 of the NSW NPI where feasible and reasonable. The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance.

The recommended ANL represents the objective for total industrial noise at a receiver location, whereas the project ANL represents the objective for noise from a single industrial development at a receiver location.

To ensure that industrial noise levels (existing plus new) remain within the recommended ANL for an area, a project ANL applies for each new source of industrial noise from an industrial development as follows:

$$\text{Project ANL} = \text{Recommended ANL minus 5 dB(A)} \quad \text{(Equation 2)}$$

The nearest residential receivers to the project are considered to be – as per NSW NPI Table 2.3 – in a Noise Amenity Area characterised by the NSW NPI as urban.

The recommended ANLs relevant to this project are specified in Table B2.

[12] The NSW INP application notes recommends that the intrusive noise level for evening and night-time periods are not to exceed the day-time intrusive noise level where the RBL for evening or night is higher than the RBL for daytime.

Indicative Noise Amenity Area	Period	Recommended $L_{Aeq, period}$ Noise Level (ANL)	
		Acceptable	Recommended Maximum
Residential (Rural)	Day	50	55
	Evening	45	50
	Night	40	45
School Clasroom - Internal	Noisiest 1 hour period	35	40
Places of Worship – Internal	When in use	50	45

Table B2: Recommended LAeq noise levels from industrial noise sources at residential and commercial receivers

The following exceptions to the above method to derive the project ANL apply:

- **Exception A – In areas with high traffic noise levels**

  The level of transport noise, road traffic noise in particular, may be high enough to make noise from an industrial source effectively inaudible, even though the LAeq noise level from that industrial noise source may exceed the project amenity noise level. In such cases the project amenity noise level may be derived from the $L_{Aeq, period(traffic)}$ minus 15 dB(A).

  This high traffic project amenity noise level may be applied only if all the following apply:

  - traffic noise is identified as the dominant noise source at the site,
  - the existing traffic noise level (determined using the procedure outlined in Section A2, Fact Sheet A of NSW NPI, measuring traffic instead of industrial noise) is 10 dB or more above the recommended ANL for the area, and
  - it is highly unlikely traffic noise levels will decrease in the future,

  for each assessment period where these traffic noise provisions apply, the High Traffic Project ANL is to be used for industrial development, derived from the $L_{Aeq,period(traffic)}$ as:

  High Traffic Project ANL = $L_{Aeq,period(traffic)}$ minus 15 dB(A) (Equation 3)

- **Exception B – In proposed developments in major industrial clusters**

  The recommended amenity noise level from Table B3 represents the total industrial noise level from all sources (new and proposed) that is sought to be achieved using feasible and reasonable controls.

  The approach of deriving the project amenity noise level resulting from a new development on the basis of the recommended amenity noise level minus 5 dB is

based on a receiver not being impacted by more than three to four individual industrial noise sources.

Where an existing cluster of industry, for example, an industrial estate or port area, is undergoing redevelopment and/or expansion and the development constitutes a single premises addition or expansion, with no other redevelopment planned in the foreseeable future, the project amenity noise level approach procedure in Section B.3 can be applied.

However, where a greenfield or redevelopment of an existing cluster of industry consisting of multiple new noise-generating premises is proposed, the approach for determining the project amenity noise level in Section B.3 is not applicable and the approach below is to be applied.

For the new multiple premises or redevelopment of existing clusters of industry, for each individual premise,

$$\text{Individual Project ANL} = 10\text{Log}_{10}(10^{(L - 5\text{ dB}/10)}/N)\text{ dB(A)} \quad \text{(Equation 4)}$$

where L is the relevant recommended ANL from Table B3 and N is the number of proposed additional premises.

Where a greenfield development is proposed and it can be demonstrated that existing L_{Aeq} industrial noise levels are more than 5 dB lower than the relevant recommended ANL, the above equation can be modified to reflect "L" in lieu of "L – 5 dB".

- **Exception C**

  Where the resultant project ANL is 10 dB or more lower than the existing industrial noise level. In this case the project ANL can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.

- **Exception D**

  Where cumulative industrial noise is not a necessary consideration because no other industries are present in the area, or likely to be introduced into the area in the future. In such cases the relevant ANL is assigned as the project ANL for the development.

Where the project ANL applies and it can be met, no additional consideration of cumulative industrial noise is required. However, in circumstances where this level cannot be feasibly and reasonably met, an assessment of existing industrial noise, and the combined resulting noise level from existing and the proposed industries, is required so the impact of the residual noise levels can be determined in accordance with Section 4.2 of the NSW NPI.

For this project, Exception A applies to the UNSW Classroom receiver during the day time periods. Exception C applies to the Catchment A and Catchment B residential receivers during the night time periods plus the Passive Recreation Area receivers during the day time period. Furthermore, Exception B applies to all other receivers. These considerations are detailed below:

Exception A – it was observed that the day time ambient noise levels for the UNSW classroom receiver were dominated by traffic noise from nearby roads and distant traffic in general. Therefore the ANL in areas of high traffic noise are to be adapted for this receiver. In such cases the Project ANL may be derived from the following equation:

$$\text{Project ANL} = L_{Aeq,period(traffic)} \text{ minus } 15\text{ dB(A)}$$

Exception B – as the proposed development consists of multiple (potentially three) new premises to be developed in the foreseeable future, the following equation is to be applied:

$$\text{Individual Project ANL} = 10\text{Log}_{10}(10^{(L - 5\ dB/10)}/N)\ dB(A)$$

Exception C – as the recommended ANL for Catchment A and Catchment B Residential receivers during night time plus Passive Recreation Area receivers during the day time, according to Table B2, are more than 10 dB lower than the existing industrial noise level presented in Table B1, existing industrial noise level minus 10 dB is adapted as the project ANL.

For all other receivers, none of the exceptions apply, therefore Equation 2 is used for determining the project ANL.

The project ANL for each receiver type has been determined considering the above information, for each period as presented in Table B3.

Indicative Noise Amenity Area	Period	Existing L_{Aeq}	ANL	Adjustment[13]	Amenity Criterion
Residential	Day	51	50	ANL minus 5 plus 3	48
	Evening	46	45	ANL minus 5 plus 3	43
	Night	44	40	ANL minus 5 plus 3	38
Places of Worship	When in use	51	50	ANL minus 5 plus 3	48
Educational	Noisiest 1-hour period When in Use	51	45	ANL minus 5 plus 3	43

Table B3: Determination of amenity criterion for residential receivers

[13] As outlined in the NPI *"To standardise the time periods for intrusiveness and amenity noise levels, this policy assumes that the $L_{Aeq,\ 15\ min}$ will be take to the equal to the $L_{Aeq,\ period}$ + 3 decibels (dB)"*

B.4 Project specific noise level

The Project Specific Noise Level is defined as the lower of the intrusiveness and the amenity criteria. On this basis, the Project Specific Noise Levels (PNLs) for noise emissions associated with the site are shown in Table B4 below (PNLs shown shaded in grey).

Receiver Type	Period	INP Criteria			
		Acceptable Noise Level	Amenity $L_{eq\ (period)}$, dBA	Intrusiveness $L_{eq\ (15\text{-}minute)}$, dBA	INP Project Specific
Residential	Day (7am-6pm)	50	48	41	41
	Evening (6pm-10pm)	45	43	41	41
	Night (10pm to 6am)	40	38	40	38
Place of Worship	When in use	50	48	-	48
Educational	Noisiest 1-hour period When In Use	45	43	-	43

Table B4: Determination of project specific noise levels for the MMP project