APPENDIX C

Construction Noise and Vibration Management Plan

acousticworks

Construction Noise and Vibration Management
Mamre Road South Precinct
Kemps Creek

NOISE MANAGEMENT PLAN




Client:
Frasers Property and Altis Property Partners

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Disclaimer

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The following report is in response to a request the Frasers Property and Altis Property Partners for a construction noise and vibration management plan for the proposed warehouse/industrial development located at Mamre Road South Precinct, Kemps Creek. This report provides a noise management plan and recommendations for noise control during earthworks and construction of the proposed development as required by in accordance with Penrith City Council requirements and the NSW Department of Planning and Environment's Secretary's Environmental Assessment Requirements (SEARs) (Application Reference: *SSD 9522*) which requires the following matters to be addressed:

Condition	CNVMP Section References
Protection of the Warragamba Pipelines Corridor B34. Detailed design for the development must demonstrate compliance with the WaterNSW publication Guidelines for development adjacent to the Upper Canal and Warragamba Pipelines.	11.3
B48. The Applicant must prepare a Construction Noise and Vibration Management Plan (CNVMP) for the development to the satisfaction of the Planning Secretary. The CNVMP must form part of a CEMP required by condition C2 and must: (a) be prepared by suitably qualified and experienced acoustic engineer(s); (b) be approved by the Planning Secretary prior to the commencement of construction; (c) identify the Mamre Anglican School as a sensitive receiver and include management measures to mitigate daytime construction noise impacts on the operations of the school; (d) describe procedures for achieving the noise management levels in EPA's Interim Construction Noise Guideline (DECC, 2009) (as may be updated or replaced from time to time); (e) describe the measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers; (f) include strategies that have been developed with the community for managing high noise generating works; (g) describe the community consultation undertaken to develop the strategies in condition B48(f); and (h) include a complaints management system that would be implemented for the duration of the development.	a) 12 b) 4 c) 7.1 & 10 d) 11 e) 11 f) 11 & 13.2, refer to CEMP for further information g) 6 h) 11 & 13.2, refer to CEMP for further information
B49 The Applicant must: (a) not commence construction of any relevant stage until the Construction Noise and Vibration Management Plan required by condition B48 is approved by the Planning Secretary; and (b) implement the most recent version of the Construction Noise and Vibration Management Plan approved by the Planning Secretary for the duration of construction.	a) Noted b) Noted
B50 Vibration caused by construction at any residence or structure outside the site must be limited to: (a) for structural damage, the latest version of DIN 4150-3 (1992-02) Structural vibration - Effects of vibration on structures (German Institute for Standardisation, 1999); and (b) for human exposure, the acceptable vibration values set out in the Environmental Noise Management Assessing Vibration: a technical guideline (DEC, 2006) (as may be updated or replaced from time to time).	a) 5.7 b) 5.1
B51 The limits in conditions B50 apply unless otherwise outlined in a CNVMP, approved as part of the CEMP required by condition C2 of this consent.	Condition B50 is applicable

Condition	CNVMP Section References
C1 Management plans required under this consent must be prepared in accordance with relevant guidelines, and include: (a) detailed baseline data; (b) details of: (i) the relevant statutory requirements (including any relevant approval, licence or lease conditions); (ii) any relevant limits or performance measures and criteria; and (iii) the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures; (c) a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria; (d) a program to monitor and report on the: (i) impacts and environmental performance of the development; and (ii) effectiveness of the management measures set out pursuant to paragraph (c) above; (e) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible; (f) a program to investigate and implement ways to improve the environmental performance of the development (g) a protocol for managing and reporting any: (i) incident and any non-compliance (specifically including any exceedance of the impact assessment criteria and performance criteria); (ii) complaint; (iii) failure to comply with statutory requirements; and (h) a protocol for periodic review of the plan. Note: the Planning Secretary may waive some of these requirements if they are unnecessary or unwarranted for particular management plans	a) 8 b) 4 & 5 c) 11 d) 13.3 e) 13.2 f) Refer to CEMP g) 13.2 h) 13.2.7

2. Introduction

This report is in response to a request the Frasers Property and Altis Property Partners for a construction noise and vibration management plan for the proposed warehouse/industrial development located at Mamre Road South Precinct, Kemps Creek. This report provides a noise management plan and recommendations for noise control during earthworks and construction of the proposed development as required by the NSW Department of Planning, Industry & Environment.

3. Site Description

3.1 Site Location

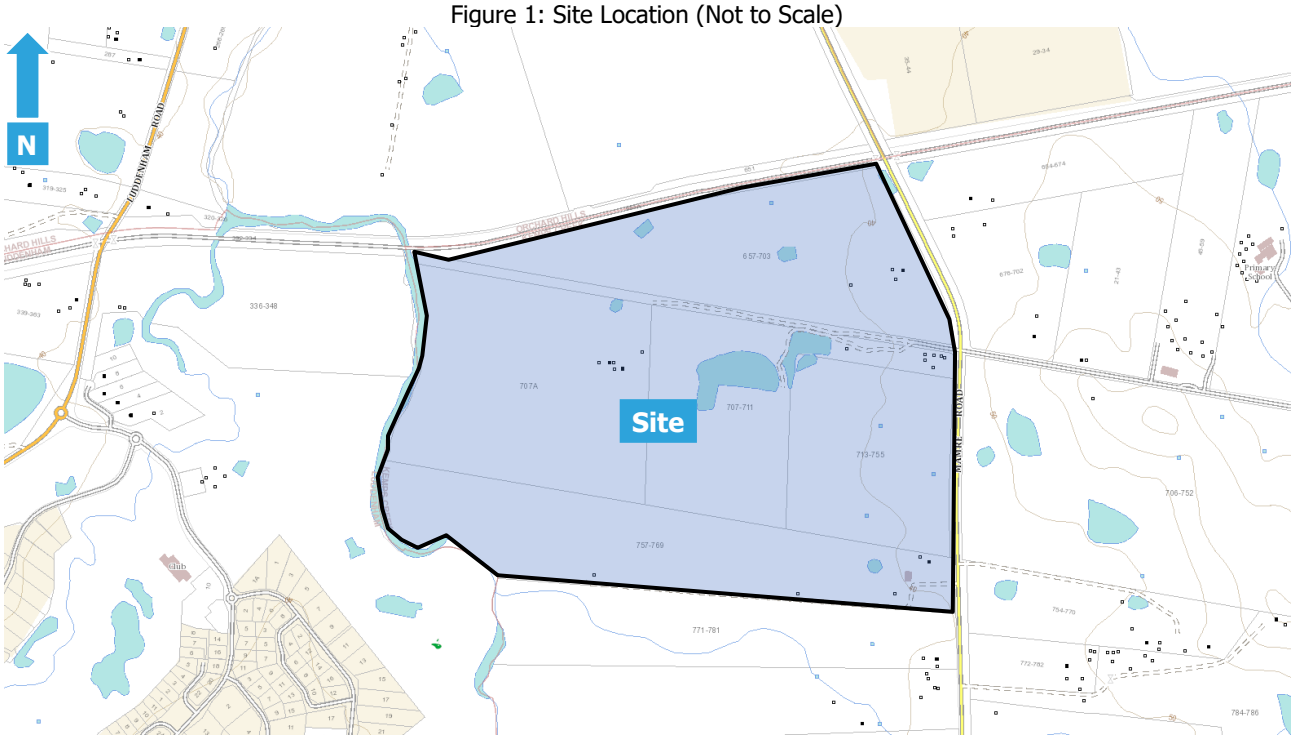
The site is described by the following:

657-769 Mamre Road, Kemps Creek
Lot 34 on DP1118173
Lot X on DP421633
Lot Y on DP421633
Lot 22 on DP258414
Lot 1 on DP1018318

and is located at the western extent of the WSEA within the Penrith LGA.

Refer to Figure 1 for site location.

Figure 1: Site Location (Not to Scale)



The site is bound by the following land uses:

- North – the Water NSW Pipeline and SSD 7173 approved 'First Estate' industrial development, with the Erskine Business Park beyond
- South – rural residential properties
- East – Mamre Road with rural residential properties, schools and aged care beyond
- West – South Creek with rural residential properties beyond.

The site has historically been used for low intensity agriculture and is primarily covered with pasture grass and limited stands of vegetation. The site has several dams in the central area and has a gradual fall from east to west towards South Creek.

3.2 Proposal

The Kemps Creek Warehouse, Logistics and Industrial Facilities Hub (the Yards) is a regional warehouse and distribution complex located at Kemps Creek within the Penrith local government area (LGA) within the Western Sydney Employment Area (WSEA) (see Figure 1).

Frasers Property Australia Pty Ltd (Frasers) and Altis Bulky Retail Pty Ltd (Altis) jointly identified as 'the Proponent' obtained Development Consent SSD (State Significant Development) 9522 on 21 December 2020 from the Department of Planning, Industry and Environment (DPIE) for the 'Kemps Creek Warehouse, Logistics and Industrial Facilities Hub' comprising the construction of eight warehouse buildings over eight lots as the first stage of development, with estate works across the broader site comprising bulk earthworks to create building pads for future development, stormwater infrastructure and an internal road network including a north south distributor road connecting to the adjacent property, intersection upgrades and the widening of Mamre Road.

Specifically, SSD 9522 permits the following development:

- Demolition of existing structures, site-wide earthworks, landscaping, stormwater and other infrastructure and an internal road network;
- Construction and operation of eight warehouses comprising 162,355 m2 of floor space;
- Intersection upgrade works in Mamre Road;
- 744 parking spaces; and
- 21-lot Torrens title subdivision over two stages, being Stage 1 residual lot subdivision (5 lots) and Stage 2 residual and development lot subdivision (17 lots).

3.3 Construction Staging and Activities

The Stage 1 development of the Yards comprises the subdivision of five lots within the site, along with demolition and site wide earthworks, landscaping, utilities, stormwater and the internal road networks. Stage 1 also includes the construction and operation of eight warehouses inclusive of 744 parking spaces and intersection upgrade works on Mamre Road.

The Stage 2 development comprises the subdivision of the remaining portion of the site into a further 17 lots.

Development on these lots is then anticipated to occur over a period of time to meet market demand and would be subject to future development applications.

3.4 Acoustic Environment

The surrounding area is primarily affected by road traffic from Mamre Road and potentially noise from existing nearby commercial/industrial activities.

4. Conditions of Approval

The requirements for the construction of the proposed development are contained in conditions B34 and B45 to B51 of the State-Significant Development consent (ref: SSD-9522, dated 21 December 2020):

"Protection of the Warragamba Pipelines Corridor
B34. Detailed design for the development must demonstrate compliance with the WaterNSW publication Guidelines for development adjacent to the Upper Canal and Warragamba Pipelines.

Hours of Work
B45. The Applicant must comply with the hours detailed in Table 4, unless otherwise agreed in writing by the Planning Secretary.

Table 4: Hours of Work

Activity	*Day*	*Time*
Earthworks and construction	*Monday – Friday* *Saturday*	*7am-6pm* *8am-1pm*
Operation	*Monday – Sunday*	*24 hours*

B46. Works outside of the hours identified in condition B45 may be undertaken in the following circumstances:
(a) works that are inaudible at the nearest sensitive receivers;
(b) works agreed to in writing by the Planning Secretary;
(c) for the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or
(d) where it is required in an emergency to avoid the loss of lives, property or to prevent environmental harm.

Construction Noise Limits
B47. The development must be constructed to achieve the construction noise management levels detailed in the Interim Construction Noise Guideline (DECC, 2009) (as may be updated or replaced from time to time). All feasible and reasonable noise mitigation measures must be implemented and any activities that could exceed the construction noise management levels must be identified and managed in accordance with the Construction Noise and Vibration Management Plan required by condition B48 and mitigation measures in the Appendix 2.

Construction Noise and Vibration Management Plan
B48. The Applicant must prepare a Construction Noise and Vibration Management Plan (CNVMP) for the development to the satisfaction of the Planning Secretary. The CNVMP must form part of a CEMP required by condition C2 and must:
(a) be prepared by suitably qualified and experienced acoustic engineer(s);
(b) be approved by the Planning Secretary prior to the commencement of construction;
(c) identify the Mamre Anglican School as a sensitive receiver and include management measures to mitigate daytime construction noise impacts on the operations of the school;
(d) describe procedures for achieving the noise management levels in EPA's Interim Construction Noise Guideline (DECC, 2009) (as may be updated or replaced from time to time);

(e) describe the measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers;
(f) include strategies that have been developed with the community for managing high noise generating works;
(g) describe the community consultation undertaken to develop the strategies in condition B48(f); and
(h) include a complaints management system that would be implemented for the duration of the development.

B49. The Applicant must:
(a) not commence construction of any relevant stage until the Construction Noise and Vibration Management
Plan required by condition B48 is approved by the Planning Secretary; and
(b) implement the most recent version of the Construction Noise and Vibration Management Plan approved by the Planning Secretary for the duration of construction.

B50. Vibration caused by construction at any residence or structure outside the site must be limited to:
(a) for structural damage, the latest version of DIN 4150-3 (1992-02) Structural vibration - Effects of vibration on structures (German Institute for Standardisation, 1999); and
(b) for human exposure, the acceptable vibration values set out in the Environmental Noise Management Assessing Vibration: a technical guideline (DEC, 2006) (as may be updated or replaced from time to time).
B51. The limits in conditions B50 apply unless otherwise outlined in a CNVMP, approved as part of the CEMP required by condition C2 of this consent.'

Further reference is made to the WaterNSW *Guidelines for Development Adjacent to the Upper Canal and Warragamba Pipelines*.

B2.4.5. Vibration
Vibration impacts from construction activities such as jackhammering, pile driving or earthmoving may cause indirect damage to WaterNSW lands, assets or infrastructure. The Upper Canal is particularly structurally fragile due to its age and the Warragamba Pipelines are fragile due to their inner concrete lining, footings and expansion joints.
At present, no Australian Standards exist for the assessment of damage caused by vibration. WaterNSW accepts Line 3 of Table 3 from the current German Standard DIN 4150 – Part 3 - "Structural Vibration Part 3: Effects of vibration in structures" as the maximum allowable limit of vibration acceptable at WaterNSW assets.

5. Noise and Vibration Standards and Codes

We provide the following summary of noise and vibration standards and codes that may be applicable to the construction works at the site. This may include;

- Protection of the Environment Operations Act 1997
- Protection of the Environment (Noise Control) Regulation 2008
- NSW Noise Policy for Industry
- Assessing Vibration: A Technical Guideline 2006
- NSW Interim Construction Noise Guideline 2009
- Australian Standard AS2107 – *Acoustics-Recommended Design Sound Levels and Reverberation Times for building interiors*
- Australian Standard AS2436 – *Guide to noise control on construction, maintenance and construction sites*.
- Australian Standard AS 2670.2-1990 *Evaluation of Human Exposure to whole body Vibration Part 2 Continuous and shock induced vibration in buildings (1 to 80 Hz)*
- Australian Standard 2187-2006 *SAA Explosives Code, Part 2 - Use of Explosives*
- German Standard DIN 4150-3: 2016 *Vibration in Buildings – Part 3: Effects on Structures*

The application relevance of each of these is summarised as follows;

Table 1: Application of codes and regulations

Code/standard title (abbreviated)	Applicable to construction noise or vibration?	Sets specific noise or vibration goals?	Comments
Protection of the Environment Operations Act 1997	Not mentioned	No	Construction noise and vibration not specifically referenced but may be implied
Protection of the Environment (Noise Control) Regulation 2008	Not mentioned	No	Construction noise and vibration not specifically referenced but may be implied
NSW Noise Policy for Industy2017	No	No	Construction noise is not dealt with by the NPfI as described in Section 1.5 of the policy
Assessing Vibration: A Technical Guideline 2006	Noise - No Vibration - Yes	Yes	Continuous, impulsive and intermittent vibration. Based on BS6472-1992
NSW Interim Construction Noise Guideline 2009	Noise - Yes Vibration - No	Noise - Yes Vibration - No	Primarily for noise from construction works that are regulated by the NSW EPA
Australian Standard AS2107	No	Yes	Not relevant to construction noise
Australian Standard AS2436	Noise - Yes	No	Applicable to noise associated with construction
Australian Standard AS2670.2	Noise - No Vibration - Yes	Specific vibration goals	Used for vibration only
Australian Standard AS2187-2006	Noise - No Vibration - Yes	Specific vibration goals	Relevant to demolition
German Standard DIN 4150 – Part 3	Noise – No Vibration – Yes	Yes	Construction and demolition

Review of the relevant codes and standards listed above is provided in the following sections of this report.

5.1 Assessing Vibration: A Technical Guideline 2006

5.1.1 Types of vibration

There are three types of vibration as classified in the guide;

- Continuous - vibration continues uninterrupted for a defined period (usually throughout daytime and/or night-time). This type of vibration is assessed on the basis of weighted rms acceleration values
- Impulsive - rapid build up to a peak followed by a damped decay that may or may not involve several cycles. The duration is short, typically less than 2 seconds. Impulsive vibration (no more than three occurrences in an assessment period) is assessed on the basis of acceleration values.
- Intermittent - interrupted periods of continuous (e.g. a drill) or repeated periods of impulsive vibration (e.g. a pile driver), or continuous vibration that varies significantly in magnitude. Assessed on the basis of vibration dose values.

5.1.2 Acceptable values for continuous and impulsive vibration (1-80Hz)

The relevant criteria for continuous and impulsive vibration are as follows;

Table 2: Preferred weighted RMS vibration acceleration values

Type	Location	Assessment period	Preferred values m/s^2		Maximum values m/s^2	
			z-axis	x- and y-axes	z-axis	x- and y-axes
Continuous vibration	Critical areas	Day or night time	0.005	0.0036	0.01	0.0072
	Residences	Day time	0.01	0.0071	0.02	0.014
		Night time	0.007	0.005	0.014	0.01
	Offices, schools, educational institutions and places of worship	Day or night time	0.02	0.014	0.04	0.028
	Workshops	Day or night time	0.04	0.029	0.08	0.058
Impulsive vibration	Critical areas	Day or night time	0.005	0.0036	0.01	0.0072
	Residences	Day time	0.3	0.21	0.6	0.42
		Night time	0.1	0.071	0.2	0.14
	Offices, schools, educational institutions and places of worship	Day or night time	0.64	0.46	1.28	0.92
	Workshops	Day or night time	0.64	0.46	1.28	0.92

5.1.3 Acceptable values for intermittent vibration

Intermittent vibration is assessed using the vibration dose value (VDV) root-mean-quad method. VDV accumulates the vibration energy received over the daytime and night-time periods. The vibration dose methodology is as per standard BS 6472–1992.

The relevant criteria for vibration dose values are as follows;

Table 3: Vibration dose values for intermittent vibration

Location	Daytime		Night time	
	Preferred value $m/s^{1.75}$	Maximum value $m/s^{1.75}$	Preferred value $m/s^{1.75}$	Maximum value $m/s^{1.75}$
Critical areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

5.1.4 Short-term works

Short-term works are works that occur for a duration of approximately one week. In accordance with the guide, the reference to short term works is as follows;

In circumstances where work is short term, feasible and reasonable mitigation measures have been applied, and the project has a demonstrated high level of social worth and broad community benefits, then higher vibration values (above the maximum) may apply. In such cases, best management practices should be used to reduce values as far as practicable, and a comprehensive community consultation program should be instituted. An example of a possible management strategy would be to restrict the times during which high vibration values occur to the least sensitive times of the day. Typical issues covered in a consultation program include a public contact point for handling complaints, and early notification of proposed operations and any significant change to operations.

5.2 NSW Interim Construction Noise Guideline 2009

5.2.1 Assessment criteria

The quantitative assessment method involves predicting airborne noise levels and comparing them with the levels in the relevant section of the Guideline. The noise criteria for quantitative assessment are shown below.

5.2.1.1 Residential uses

Noise criteria assessed at residential properties is listed in Section 4.1.1 of the guideline. The relevant criteria and associated notes are as follows;

Table 4: Noise criteria for quantitative assessment - Residential

Time of day	Criterion LAeq(15min) *	How to apply
Recommended standard hours	Noise affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (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 75dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 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 hours	Noise affected RBL + 5dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 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.

* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence.

5.2.1.2 Other sensitive uses

The following table presents management levels for noise at other sensitive land uses. The proponent should also consult with noise sensitive land use occupants potentially affected by noise from the works, to achieve a reasonable noise outcome.

Table 5: Noise criteria for quantitative assessment - Other uses

Land use	Management level LAeq(15min)	Assessment location
Classrooms at schools and other educational institutions	45dBA	Internal
Hospital wards and operating theatres	45dBA	Internal
Places of worship	45dBA	Internal
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	65dBA	External
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	60dBA	External
Community centres	Depends on the use of the centre. Refer to the recommended 'maximum' internal levels in AS2107 for specific uses.	Internal

5.2.1.3 Commercial and industrial properties

Noise management levels for commercial and industrial premises are contained in Section 4.1.3 of the guideline.

Table 6: Noise criteria - Commercial and industrial premises

Land use	Management level LAeq(15min)	Assessment location
Industrial	75dBA	External, most-affected occupied point of the premises
Offices, retail shops	70dBA	External, most-affected occupied point of the premises
Other businesses e.g. theatre, childcare etc	Depends on the use. Refer to the recommended 'maximum' internal levels in AS2107 for specific uses.	Varies, refer to AS2107

Where noise from construction works is above the 'noise affected' levels presented, the proponent should apply all feasible and reasonable work practices to minimise noise. The proponent should also inform potentially affected parties of the activities to be carried out, the expected noise impacts and duration.

If any of the following activities are to be undertaken, they should be factored into the quantitative assessment by adding 5 dB to the predicted levels;

- use of 'beeper' style reversing or movement alarms
- use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or
- steel work
- grinding metal, concrete or masonry
- rock drilling
- line drilling
- vibratory rolling
- rail tamping and regulating
- bitumen milling or profiling
- jackhammering, rock hammering or rock breaking
- impact piling.

5.3 Australian Standard AS2107

Australian Standard 2107-2000 *Acoustics-Recommended design sound levels and reverberation times for building interiors* lists the desired noise levels for residential buildings. This standard includes the assessment of building services noise (i.e. mechanical services, hydraulics etc), and building components that exclude noise external to the building (e.g. traffic noise, industrial noise).

Section 2 *Application* - specifically states that the standard is not intended either for the assessment or prescription of acceptable noise levels from transient or variable noises such as construction.

5.4 Australian Standard AS2436

Australian Standard AS2436-2010 *Guide to noise control on construction, maintenance and construction sites* provides guidance in noise control in respect of engineering construction, maintenance and construction works. This includes guidance in investigation and identification of noise sources, measurement of sound and assessment, with a view to appropriate planning of measures for noise control.

AS2436 also contains a table of typical sound levels from construction plant and equipment, and a discussion of the effectiveness of acoustic treatments and acoustic screens and enclosures. Section 1.5 Regulatory Requirements states that the legislation for the control of noise on construction, maintenance and construction sites is generally the responsibility of the relevant State government or local Council body.

5.5 Australian Standard AS2670.2-1990

Definitions of acceptable perceived vibration criteria can be found in AS 2670.2-1990 Evaluation of Human Exposure to whole body Vibration Part 2 Continuous and shock induced vibration in buildings (1 to 80 Hz). This code provides frequency weighted curves for acceptable vibration levels. These relate to a resultant of vibration in all three axis'; more specifically the x, y and z directions. The curves are based on multiples of a single base curve depending on type of receiver.

Table 7: AS2670.2-1990 vibration multiplying factors

Place	Time	Continuous or intermittent vibration	Transient vibration excitation with several occurrences per day
Critical working areas (for example some hospital operating-theatres, some precision laboratories, etc.)	Day & Night	1	1
Residential	Day	2 to 4	30 to 90
	Night	1.4	1.4 to 20
Office	Day & Night	4	60 to 128
Workshop	Day & Night	8	90 to 128

5.6 Australian Standard AS2187-2006

Australian Standard 2187-2006 *SAA Explosives Code, Part 2 - Use of Explosives* specifies acceptable levels of ground vibration to limit the probability of structural damage and human discomfort. The criteria presented in this Standard are summarised below;

Table 8: AS2187-2006 recommended peak particle velocity

Type of building or structure	Particle velocity (Vp) mm/s
Historical buildings and monuments, and buildings of special value and significance	2
House and low rise residential buildings, theatres, schools and commercial buildings not included in item 3 below	10
Commercial and industrial buildings or structures of reinforced concrete or steel construction	25

While the use of explosives is not expected for the site, the values presented in the table would still form an appropriate guide to reducing the risk of potential structural damage due to vibration from construction processes.

5.7 DIN 4150 – 2016 Part 3

German Standard DIN 4150 – 2016, " *Part 3 - Effects of vibration on structures" stipulates in section 5 the acceptable levels of vibration that can occur* levels of ground vibration to limit the

probability of structural damage and human discomfort. The criteria presented in this Standard are summarised below.

Table 9 – DIN4150 recommend peak particle velocity

Type of building or structure	Particle velocity (Vp) mm/s
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	10
Dwellings and buildings of similar design and/or occupancy	5
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3-5

6. Community Consultation

Consultation meetings were conducted with community stakeholders on the 3rd and 4th February 2021. During the meetings, no concerns were raised with respect to construction noise, with the only concerns tabled relating to traffic impacts on Mamre Road during construction.

Due to the identification of Mamre Anglican School as a sensitive receiver in the State Significant Development consent, further consultation was undertaken in March 2021 with the principal of the school. The principal advised that given the distance between the site and the school they do not believe there will be a discernible impact. They further added they are comfortable with the proposed works proceeding. The principal was provided with contact details should they have any queries or complaints as the development proceeds.

7. Noise Monitoring and Receivers

7.1 Monitoring locations and receivers

The nearest sensitive receiver locations were identified as follows;

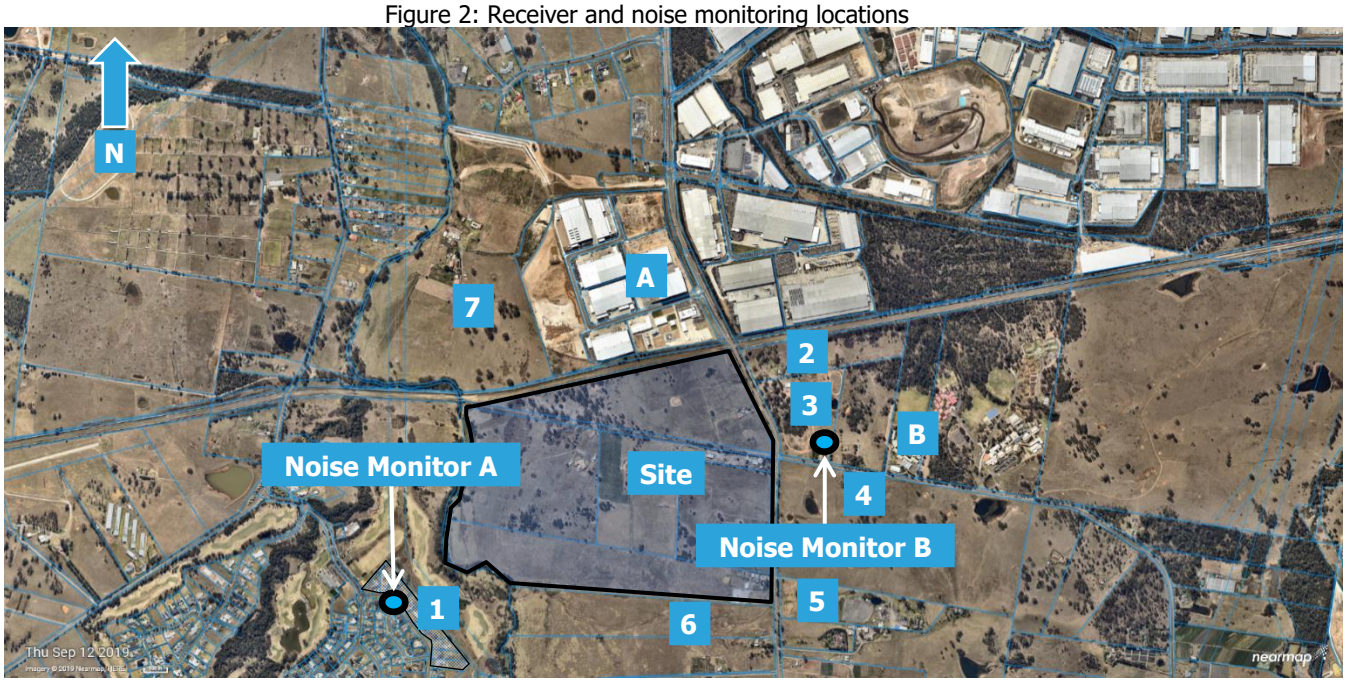
1. Single storey residential dwellings are located south west of the site at Medinah Avenue, Luddenham.
2. A single storey residential dwelling is located east of the site at 654-674 Mamre Road, Kemps Creek.
3. A single storey residential dwelling is located east of the site at 676-702 Mamre Road, Kemps Creek.
4. A single storey residential dwelling is located east of the site at 706-752 Mamre Road, Kemps Creek.
5. A single storey residential dwelling is located east of the site at 754-770 Mamre Road, Kemps Creek.
6. A single storey residential dwelling is located south of the site at 771-781 Mamre Road, Kemps Creek.
7. Residential dwellings are located north of the site at 579 Mamre Road, Orchard Hills.

a) Industrial/warehouses are located north of the site at Mamre Road, Orchard Hills.

b) Mamre Anglican School is located approximately 700m to the east of the site at 45 Bakers Lane.

These locations were chosen as being representative of the nearest sensitive receivers to the proposed development. Refer to Figure 2 for these locations.

Figure 2: Receiver and noise monitoring locations



7.2 Equipment

The following equipment was used to record noise levels:

- Two Rion NL42 Environmental Noise Monitors (SN# 00175548 & SN#01259207))
- Pulsar Model 105 Ltd Sound Calibrator (SN # 57417)

The Environmental Noise Monitors hold current NATA Laboratory Certification and were field calibrated before and after the monitoring period, with no significant drift from the reference signal recorded.

7.3 Monitoring Procedure

Rion NL42 environmental noise monitors were placed at 8 Medinah Avenue, Luddenham and 676-702 Mamre Road, Kemps Creek to measure ambient noise levels. The monitors were located in free field positions with the microphones approximately 1.4 metres above ground surface level. The noise monitors were set to record noise levels between the 11th and 19th April 2018.

Both environmental noise monitors were set to record noise levels in "A" weighting, Fast response using 15 minute statistical intervals. Ambient noise monitoring was conducted in accordance with Australian Standard AS1055:1997 *Acoustics – Description and measurement of environmental noise*. For the unattended noise monitoring locations refer to Figure 2.

Weather conditions were fine for the majority of the monitoring period, with some periods of intermittent wind and rain which had no effect on the measured data.

8. Existing Noise Levels

The following tables present the measured existing ambient noise levels from the unattended noise survey. Any periods of inclement weather or extraneous noise are omitted from the measured data prior to determining the overall results.

8.1 Meteorological conditions

Meteorological observations during the unattended noise monitoring survey were obtained from the Bureau of Meteorology website (http://www.bom.gov.au/climate/data), shown in Table 10 below.

Table 10: Meteorological conditions – Horsley Park

Day	Date	Rainfall (mm)	Wind			
			9am		3pm	
			Speed (km/h)	Direction	Speed (km/h)	Direction
Wednesday	11/04/2018	0	11	N	4	NNE
Thursday	12/04/2018	0	2	NW	15	NW
Friday	13/04/2018	0	11	NNW	15	N
Saturday	14/04/2018	0	19	NNW	31	NW
Sunday	15/04/2018	0.2	24	WNW	20	WNW
Monday	16/04/2018	0	4	N	11	WSW
Tuesday	17/04/2018	0	6	WSW	20	ESE
Wednesday	18/04/2018	0	2	NW	11	E
Thursday	19/04/2018	0	4	WNW	Calm	Calm

8.2 Ambient background noise level

The measured rating background noise levels (RBL) were determined in accordance with the NSW Noise Policy for Industry with levels for the different monitoring locations presented in Table 2.

Table 11: Measured L90 noise levels

Day	Date	Receiver 1			Receivers 2 to 7		
		Background L90 dB(A)			Background L90 dB(A)		
		Day	Evening	Night	Day	Evening	Night
Wednesday	11/04/2018	-	36.1	35.4	-	44.2	38.4
Thursday	12/04/2018	-	32.4	30.4	44.3	47.3	46.9
Friday	13/04/2018	-	33.4	28.0	47.1	46.4	45.4
Saturday	14/04/2018	37.5	33.2	28.4	47.5	45.9	44.1
Sunday	15/04/2018	37.7	28.7	23.6	45.6	37.5	33.5
Monday	16/04/2018	35.0	31.8	24.7	39.9	40.0	33.1
Tuesday	17/04/2018	36.1	30.3	26.8	38.0	36.3	28.8
Wednesday	18/04/2018	36.3	34.8	32.0	41.8	41.6	36.0
RBL		36	33	28	44	43	37

Note Receiver 1 daytime periods on 12th and 13th April 2018 were affected by extraneous noise and were omitted from the measured data.

The night time background level for Receiver 1 is below the minimum RBL as defined in the NSW Noise Policy for Industry (2017), therefore an RBL of 30dBA is applied in accordance with the policy for the night time period.

9. Project specific criteria

9.1 Construction noise criteria

Based on the relevant codes and standards and the measured background noise levels, the applicable construction/earthworks noise limits would be as follows;

Table 12: Applicable noise limits for construction work

Time	Criterion LAeq(15min)				Assessment location
	Receiver 1	Receivers 2-7	Receiver A	Receiver B	
During standard construction hours	46dBA noise affected	54dBA noise affected	75dBA		External
	75dBA highly noise affected	75dBA highly noise affected	-		External
Outside standard construction hours (daytime only)	41dBA	49dBA	-		External
Management Level (Receiver B only)	-	-	-	55/45dBA	External/Internal**

**Note a +10dBA correction is added to the internal amenity criteria for external noise levels as per Section 2.6 of the NSW Noise Policy for Industry 2017 to account for external to internal noise attenuation.

9.2 Construction vibration criteria

Based on the relevant codes and standards, the applicable vibration limits would be as follows;

Table 13: Applicable vibration limits

Type	Measure	Location	Assessment period	Preferred values		Maximum values	
				z-axis	x- and y-axes	z-axis	x- and y-axes
Continuous	RMS acceleration	Residences	Day time	0.01 m/s^2	0.0071 m/s^2	0.02 m/s^2	0.014 m/s^2
Impulsive	RMS acceleration	Residences	Day time	0.3 m/s^2	0.21 m/s^2	0.6 m/s^2	0.42 m/s^2
Intermittent	Vibration dose value	Residences	Day time	0.20 $m/s^{1.75}$	0.20 $m/s^{1.75}$	0.40 $m/s^{1.75}$	0.40 $m/s^{1.75}$
All	Peak particle velocity	Residences	Day time	10 mm/s	-	10 mm/s	-
Continuous	RMS acceleration	Schools	Day time	0.02 m/s^2	0.014 m/s^2	0.04 m/s^2	0.028 m/s^2
Impulsive	RMS acceleration	Schools	Day time	0.64 m/s^2	0.46 m/s^2	1.28 m/s^2	0.92 m/s^2
Intermittent	Vibration dose value	Schools	Day time	0.40 $m/s^{1.75}$	0.80 $m/s^{1.75}$	0.40 $m/s^{1.75}$	0.80 $m/s^{1.75}$
All	Peak particle velocity	Schools	Day time	10 mm/s	-	10 mm/s	-
All	Peak particle velocity	Warragamba Pipeline	Day time	3 mm/s	-	5 mm/s	-

10. Predicted Noise Levels

Predicted noise associated with the earthworks and construction of the proposed development has been assessed based on the source noise levels and procedures contained in AS2436-2010, as well as the results of previous noise measurements and assessments conducted by Acoustic Works. Calculations are done, based on the earthworks and construction activities being at the closest relevant distance to each existing receiver.

It is noted that the calculations assume that all noise sources are operating simultaneously, at the closest point to the receiver in each case. In practice, this will generally not occur as process will be either spread over the site or occur on different days. The predicted noise levels represent the expected worst-case noise emissions due to site works.

10.1 Earthworks

The predicted noise impacts of earthworks are summarised as follows;

Table 14: Predicted earthworks noise impacts (Receivers 1 to 4)

Receivers								LAeq 15 min Compliance		
Receiver	Description	Source Leq@1m dB(A)	Correction dB(A)*	Corrected Leq@ 1m dB(A)	LAeq adj,T ext. dB(A) Noise Affected	LAeq adj,T ext. dB(A) Highly Noise Affected	LAeq adj,T int. dB(A) Mgmt Level	Noise affected	Highly noise affected	Mgmt Level (Internal)
	Criteria							46	75	
	Excavator large	99		99	39	39		Yes	Yes	n/a
1	Backhoe	96		96	40	40		Yes	Yes	n/a
	Bulldozer	100		100	37	37		Yes	Yes	n/a
	Grader	102		102	40	40		Yes	Yes	n/a
	Loader (wheeled)	97		97	33	33		Yes	Yes	n/a
	Compressor large (silenced)	85	2	87	28	28		Yes	Yes	n/a
	Truck passby	82		82	17	17		Yes	Yes	n/a
	Truck reverse alarm	92	5	97	32	32		Yes	Yes	n/a
	Total				46	46	2	**Yes**	**Yes**	**n/a**
	Criteria							54	75	
	Excavator large	99		99	47	47		Yes	Yes	n/a
2	Backhoe	96		96	48	48		Yes	Yes	n/a
	Bulldozer	100		100	46	46		Yes	Yes	n/a
	Grader	102		102	48	48		Yes	Yes	n/a
	Loader (wheeled)	97		97	43	43		Yes	Yes	n/a
	Compressor large (silenced)	85	2	87	29	29		Yes	Yes	n/a
	Truck passby	82		82	28	28		Yes	Yes	n/a
	Truck reverse alarm	92	5	97	42	42		Yes	Yes	n/a
	Total				54	54	2	**Yes**	**Yes**	**n/a**
	Criteria							54	75	
	Excavator large	99		99	46	46		Yes	Yes	n/a
3	Backhoe	96		96	47	47		Yes	Yes	n/a
	Bulldozer	100		100	45	45		Yes	Yes	n/a
	Grader	102		102	47	47		Yes	Yes	n/a
	Loader (wheeled)	97		97	42	42		Yes	Yes	n/a
	Compressor large (silenced)	85	2	87	28	28		Yes	Yes	n/a
	Truck passby	82		82	27	27		Yes	Yes	n/a
	Truck reverse alarm	92	5	97	41	41		Yes	Yes	n/a
	Total				53	53	2	**Yes**	**Yes**	**n/a**
	Criteria							54	75	
	Excavator large	99		99	42	42		Yes	Yes	n/a
4	Backhoe	96		96	42	42		Yes	Yes	n/a
	Bulldozer	100		100	41	41		Yes	Yes	n/a
	Grader	102		102	43	43		Yes	Yes	n/a
	Loader (wheeled)	97		97	38	38		Yes	Yes	n/a
	Compressor large (silenced)	85	2	87	24	24		Yes	Yes	n/a
	Truck passby	82		82	22	22		Yes	Yes	n/a
	Truck reverse alarm	92	5	97	36	36		Yes	Yes	n/a
	Total				49	49	2	**Yes**	**Yes**	**n/a**

Table 15: Predicted earthworks noise impacts (Receivers 5 to B)

Receiver	Description	Source Leq@1m dB(A)	Correction dB(A)*	Corrected Leq@1m dB(A)	LAeq adj,T ext. dB(A) Noise Affected	LAeq adj,T ext. dB(A) Highly Noise Affected	LAeq adj,T int. dB(A) Mgmt Level	LAeq 15 min Compliance: Noise affected	Highly noise affected	Mgmt Level (Internal)
	Receivers: 1. Medinah Avenue; 2. 654-674 Mamre Road; 3. 676-702 Mamre Road; 4. 706-752 Mamre Road; 5. 754-770 Mamre Road; 6. 771-781 Mamre Road; 7. 579 Mamre Road; a. Industrial Mamre Road; b. Mamre Anglican School									
	Criteria							54	75	
	Excavator large	99		99	36	36		Yes	Yes	n/a
5	Backhoe	96		96	36	36		Yes	Yes	n/a
	Bulldozer	100		100	34	34		Yes	Yes	n/a
	Grader	102		102	36	36		Yes	Yes	n/a
	Loader (wheeled)	97		97	31	31		Yes	Yes	n/a
	Compressor large (silenced)	85	2	87	23	23		Yes	Yes	n/a
	Truck passby	82		82	16	11		Yes	Yes	n/a
	Truck reverse alarm	92	5	97	30	25		Yes	Yes	n/a
	Total				42	42	2	**Yes**	**Yes**	**n/a**
	Criteria							54	75	
	Excavator large	99		99	50	50		Yes	Yes	n/a
6	Backhoe	96		96	51	51		Yes	Yes	n/a
	Bulldozer	100		100	49	49		Yes	Yes	n/a
	Grader	102		102	51	51		Yes	Yes	n/a
	Loader (wheeled)	97		97	46	46		Yes	Yes	n/a
	Compressor large (silenced)	85	2	87	29	29		Yes	Yes	n/a
	Truck passby	82		82	30	25		Yes	Yes	n/a
	Truck reverse alarm	92	5	97	45	40		Yes	Yes	n/a
	Total				57	57	2	**No**	**Yes**	**n/a**
	Criteria							54	75	
	Excavator large	99		99	36	36		Yes	Yes	n/a
7	Backhoe	96		96	36	36		Yes	Yes	n/a
	Bulldozer	100		100	34	34		Yes	Yes	n/a
	Grader	102		102	36	36		Yes	Yes	n/a
	Loader (wheeled)	97		97	31	31		Yes	Yes	n/a
	Compressor large (silenced)	85	2	87	25	25		Yes	Yes	n/a
	Truck passby	82		82	14	9		Yes	Yes	n/a
	Truck reverse alarm	92	5	97	30	25		Yes	Yes	n/a
	Total				43	42	2	**Yes**	**Yes**	**n/a**
	Criteria							75	75	
	Excavator large	99		99	45	45		Yes	Yes	n/a
A	Backhoe	96		96	46	46		Yes	Yes	n/a
	Bulldozer	100		100	44	44		Yes	Yes	n/a
	Grader	102		102	46	46		Yes	Yes	n/a
	Loader (wheeled)	97		97	41	41		Yes	Yes	n/a
	Compressor large (silenced)	85	2	87	29	29		Yes	Yes	n/a
	Truck passby	82		82	25	20		Yes	Yes	n/a
	Truck reverse alarm	92	5	97	40	35		Yes	Yes	n/a
	Total				52	52	2	**Yes**	**Yes**	**n/a**
	Criteria									45
	Excavator large	99		99			27	n/a	n/a	Yes
B	Backhoe	96		96			27	n/a	n/a	Yes
	Bulldozer	100		100			25	n/a	n/a	Yes
	Grader	102		102			27	n/a	n/a	Yes
	Loader (wheeled)	97		97			22	n/a	n/a	Yes
	Compressor large (silenced)	85	2	87			21	n/a	n/a	Yes
	Truck passby	82		82			2	n/a	n/a	Yes
	Truck reverse alarm	92	5	97			16	n/a	n/a	Yes
	Total				12	12	33	**n/a**	**n/a**	**Yes**

Earthworks noise levels are predicted to potentially be above the noise affected level of 54dBA at receiver 6 but are predicted to comply with the highly affected noise limit of 75dBA LAeq 15min at each of the receiver locations. Refer to Section 11.2 for mitigation measures.

10.2 Construction

The predicted noise impacts of construction works are summarised as follows;

Table 16: Predicted construction noise impacts (Receivers 1 to 4)

Receivers
1. Medinah Avenue
2. 654-674 Mamre Road
3. 676-702 Mamre Road
4. 706-752 Mamre Road
5. 754-770 Mamre Road
6. 771-781 Mamre Road
7. 579 Mamre Road
a. Industrial Mamre Road
b. Mamre Anglican School

Receiver	Description	Source Leq@1m dB(A)	Correction dB(A)*	Corrected Leq@1m dB(A)	LAeq adj,T ext. dB(A) Noise Affected	LAeq adj,T ext. dB(A) Highly Noise Affected	LAeq adj,T int. dB(A) Mgmt Level	LAeq 15 min Compliance: Noise affected	Highly noise affected	Mgmt Level (Internal)
1	Criteria							46	75	
	Concrete truck	95		95	41	41		Yes	Yes	n/a
	Concrete pump	94	2	96	42	42		Yes	Yes	n/a
	Power tools (electric)	83	2	85	32	32		Yes	Yes	n/a
	Compressor large (silenced)	85	2	87	32	32		Yes	Yes	n/a
	Truck passby	82		82	8	8		Yes	Yes	n/a
	Truck reverse alarm	92	5	97	27	27		Yes	Yes	n/a
	Forklift unloading	82	2	84	23	23		Yes	Yes	n/a
	Concrete pencil vibrator	95		95	40	40		Yes	Yes	n/a
	Saw (cutoff)	92		92	22	22		Yes	Yes	n/a
	Total				46	46	2	**No**	**Yes**	**n/a**
2	Criteria							54	75	
	Concrete truck	95		95	49	49		Yes	Yes	n/a
	Concrete pump	94	2	96	51	51		Yes	Yes	n/a
	Power tools (electric)	83	2	85	40	40		Yes	Yes	n/a
	Compressor large (silenced)	85	2	87	29	29		Yes	Yes	n/a
	Truck passby	82		82	24	24		Yes	Yes	n/a
	Truck reverse alarm	92	5	97	37	37		Yes	Yes	n/a
	Forklift unloading	82	2	84	33	33		Yes	Yes	n/a
	Concrete pencil vibrator	95		95	50	50		Yes	Yes	n/a
	Saw (cutoff)	92		92	33	33		Yes	Yes	n/a
	Total				55	55	2	**No**	**Yes**	**n/a**
3	Criteria							54	75	
	Concrete truck	95		95	48	48		Yes	Yes	n/a
	Concrete pump	94	2	96	50	50		Yes	Yes	n/a
	Power tools (electric)	83	2	85	39	39		Yes	Yes	n/a
	Compressor large (silenced)	85	2	87	28	28		Yes	Yes	n/a
	Truck passby	82		82	22	22		Yes	Yes	n/a
	Truck reverse alarm	92	5	97	36	36		Yes	Yes	n/a
	Forklift unloading	82	2	84	32	32		Yes	Yes	n/a
	Concrete pencil vibrator	95		95	49	49		Yes	Yes	n/a
	Saw (cutoff)	92		92	32	32		Yes	Yes	n/a
	Total				54	54	2	**No**	**Yes**	**n/a**
4	Criteria							54	75	
	Concrete truck	95		95	44	44		Yes	Yes	n/a
	Concrete pump	94	2	96	45	45		Yes	Yes	n/a
	Power tools (electric)	83	2	85	34	34		Yes	Yes	n/a
	Compressor large (silenced)	85	2	87	24	24		Yes	Yes	n/a
	Truck passby	82		82	17	17		Yes	Yes	n/a
	Truck reverse alarm	92	5	97	32	32		Yes	Yes	n/a
	Forklift unloading	82	2	84	28	28		Yes	Yes	n/a
	Concrete pencil vibrator	95		95	44	44		Yes	Yes	n/a
	Saw (cutoff)	92		92	28	28		Yes	Yes	n/a
	Total				50	50	2	**Yes**	**Yes**	**n/a**

Table 17: Predicted construction noise impacts (Receivers 5 to A)

Receivers
1. Medinah Avenue
2. 654-674 Mamre Road
3. 676-702 Mamre Road
4. 706-752 Mamre Road
5. 754-770 Mamre Road
6. 771-781 Mamre Road
7. 579 Mamre Road
a. Industrial Mamre Road
b. Mamre Anglican School

Receiver	Description	Source Leq@1m dB(A)	Correction dB(A)*	Corrected Leq@1m dB(A)	LAeq adj,T ext. dB(A) Noise Affected	LAeq adj,T ext. dB(A) Highly Noise Affected	LAeq adj,T int. dB(A) Mgmt Level	LAeq 15 min Compliance: Noise affected	Highly noise affected	Mgmt Level (Internal)
5	Criteria							54	75	
	Concrete truck	95		95	38	38		Yes	Yes	n/a
	Concrete pump	94	2	96	39	39		Yes	Yes	n/a
	Power tools (electric)	83	2	85	28	28		Yes	Yes	n/a
	Compressor large (silenced)	85	2	87	23	23		Yes	Yes	n/a
	Truck passby	82		82	11	11		Yes	Yes	n/a
	Truck reverse alarm	92	5	97	25	25		Yes	Yes	n/a
	Forklift unloading	82	2	84	21	21		Yes	Yes	n/a
	Concrete pencil vibrator	95		95	38	38		Yes	Yes	n/a
	Saw (cutoff)	92		92	21	21		Yes	Yes	n/a
	Total				43	43	2	**Yes**	**Yes**	**n/a**
6	Criteria							54	75	
	Concrete truck	95		95	52	52		Yes	Yes	n/a
	Concrete pump	94	2	96	54	54		Yes	Yes	n/a
	Power tools (electric)	83	2	85	43	43		Yes	Yes	n/a
	Compressor large (silenced)	85	2	87	45	45		Yes	Yes	n/a
	Truck passby	82		82	9	9		Yes	Yes	n/a
	Truck reverse alarm	92	5	97	40	40		Yes	Yes	n/a
	Forklift unloading	82	2	84	36	36		Yes	Yes	n/a
	Concrete pencil vibrator	95		95	53	53		Yes	Yes	n/a
	Saw (cutoff)	92		92	36	36		Yes	Yes	n/a
	Total				58	58	2	**No**	**Yes**	**n/a**
7	Criteria							54	75	
	Concrete truck	95		95	38	38		Yes	Yes	n/a
	Concrete pump	94	2	96	39	39		Yes	Yes	n/a
	Power tools (electric)	83	2	85	28	28		Yes	Yes	n/a
	Compressor large (silenced)	85	2	87	25	25		Yes	Yes	n/a
	Truck passby	82		82	9	9		Yes	Yes	n/a
	Truck reverse alarm	92	5	97	25	25		Yes	Yes	n/a
	Forklift unloading	82	2	84	21	21		Yes	Yes	n/a
	Concrete pencil vibrator	95		95	38	38		Yes	Yes	n/a
	Saw (cutoff)	92		92	22	22		Yes	Yes	n/a
	Total				44	44	2	**Yes**	**Yes**	**n/a**
A	Criteria							75	75	
	Concrete truck	95		95	47	47		Yes	Yes	n/a
	Concrete pump	94	2	96	49	49		Yes	Yes	n/a
	Power tools (electric)	83	2	85	38	38		Yes	Yes	n/a
	Compressor large (silenced)	85	2	87	29	29		Yes	Yes	n/a
	Truck passby	82		82	20	20		Yes	Yes	n/a
	Truck reverse alarm	92	5	97	35	35		Yes	Yes	n/a
	Forklift unloading	82	2	84	31	31		Yes	Yes	n/a
	Concrete pencil vibrator	95		95	48	48		Yes	Yes	n/a
	Saw (cutoff)	92		92	31	31		Yes	Yes	n/a
	Total				53	53	2	**Yes**	**Yes**	**n/a**
B	Criteria									45
	Concrete truck	95		95			29	n/a	n/a	Yes
	Concrete pump	94	2	96			30	n/a	n/a	Yes
	Power tools (electric)	83	2	85			19	n/a	n/a	Yes
	Compressor large (silenced)	85	2	87			21	n/a	n/a	Yes
	Truck passby	82		82			2	n/a	n/a	Yes
	Truck reverse alarm	92	5	97			16	n/a	n/a	Yes
	Forklift unloading	82	2	84			12	n/a	n/a	Yes
	Concrete pencil vibrator	95		95			29	n/a	n/a	Yes
	Saw (cutoff)	92		92			12	n/a	n/a	Yes
	Total				12	12	35	**n/a**	**n/a**	**Yes**

Construction noise levels are predicted to potentially be above the noise affected level of 54dBA at receivers 2 and 6 but are predicted to comply with the highly affected noise limit of 75dBA LAeq 15min at each of the receiver locations. Refer to Section 11.2 for mitigation measures.

11. Recommended Acoustic Treatments & Management Principles

11.1 General comments

For the majority of the works it is expected that noise will generally comply with the highly noise affected limit of 75dB(A) LAeq 15min for residential receivers. There is the potential for the works to exceed the noise affected limit of 54dBA LAeq 15min. In particular, noise from concrete trucks and pumps are calculated to have the highest potential impact to receiver locations. Therefore close liaising with nearby residences would be recommended, with unattended noise monitoring to be conducted at receivers 1, 2, 3 & 5 for a period of two weeks.

Due to proximity of Sydney Water pipeline, vibration levels should be continually monitored during the works to ensure vibration levels remain generally compliant with the criteria nominated in Section 5.6.

11.2 Noise control

The following general acoustic treatments and management principles are recommended for the project:

1. The conditioned construction hours would be as follows:

   Monday to Friday 7 am to 6 pm
   Saturday 8 am to 1 pm
   No work on Sundays or public holidays
2. Unattended noise monitoring shall be conducted at Receivers 1, 2, 3 & 5 for a period of 2 weeks. If noise levels are found to be below "Noise Affected" limit as nominated in Section 9 and no complaints are received, no further monitoring is required. If noise levels are above the "Noise Affected" limit, additional mitigation measures shall be implemented, with their effectiveness to be confirmed by further unattended noise monitoring at the receivers where exceedances of the criteria were measured.
3. If further noise mitigation is required, acoustic barriers around the perimeter of the site can be installed during the works. If further noise reductions are required, install additional screening around noise sensitive areas.
4. Workers or delivery trucks shall not congregate at or outside the site before 7am. This is an important factor in managing noise from the site.
5. Assign the task of managing noise emissions to a person (the 'responsible person') that is likely to be present on-site most of the time that activity is occurring (usually the Site Manager).
6. Complaints will be handled in accordance with the Community Consultation Strategy (CCS) and Construction Environmental Management Plan (CEMP).
7. Noise mitigation measures shall be periodically reviewed and updated, with the effectiveness of any changes confirmed by unattended noise monitoring at affected receivers.

The noise management plan is described in more detail in the Appendices.

11.3 Vibration Control

In accordance with Condition B34 and the proximity to Sydney Water Pipeline, vibration is predicted to be an issue if not managed.

Therefore we recommend continued vibration monitoring at the northern site boundary with SMS waning system issued to the responsible persons onsite. The Responsible Person shall cease works that may be causing the vibration intrusion, and engage a qualified person to determine suitable management and physical controls to reduce excessive vibration to compliant levels from earthworks. If excessive vibration is determined, works generating the vibration cannot resume until satisfactory mitigation treatment is implemented.

11.4 Contingency Management Plan

If monitoring, inspections and/or auditing indicate that mitigation measures are not effective, Table 26 of the CEMP shall be consulted.

When additional mitigation measures are implemented, further unattended noise monitoring shall be conducted at receivers where exceedances were measured to confirm the effectiveness of the new mitigation measures.

12. Conclusion

A noise assessment has been conducted for the proposed industrial/warehouse construction at Mamre Road South Precinct, Kemps Creek. Specific criteria have been referenced for construction noise and vibration as required by the development approval. A management strategy has been recommended that ensures attention to noise complaints and includes a system for achieving reasonable outcomes.

With respect to vibration, the processes to be used during works may impact the nearby water pipeline and should be continually monitored throughout the works as noted in section 9.3. The essence of the construction noise and vibration management plan is to ensure good communication between the site manager and the nearby residents, and to limit the operational hours of machinery activities in accordance with regulatory requirements.

If you should have any queries please do not hesitate to contact us.

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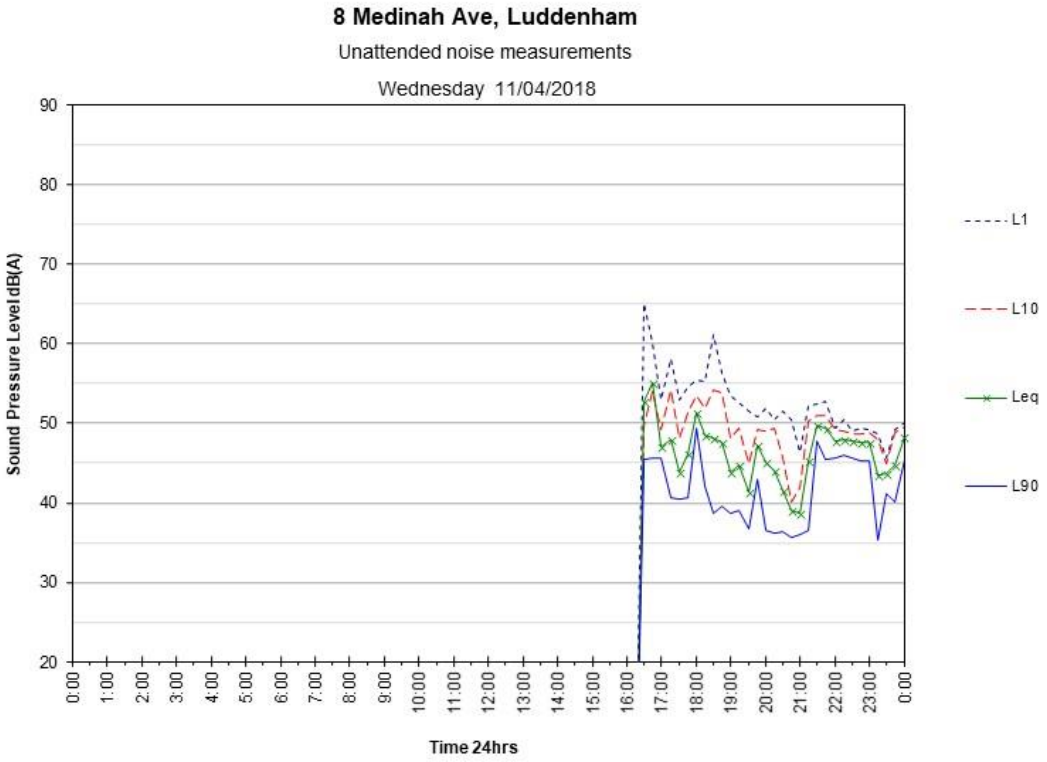
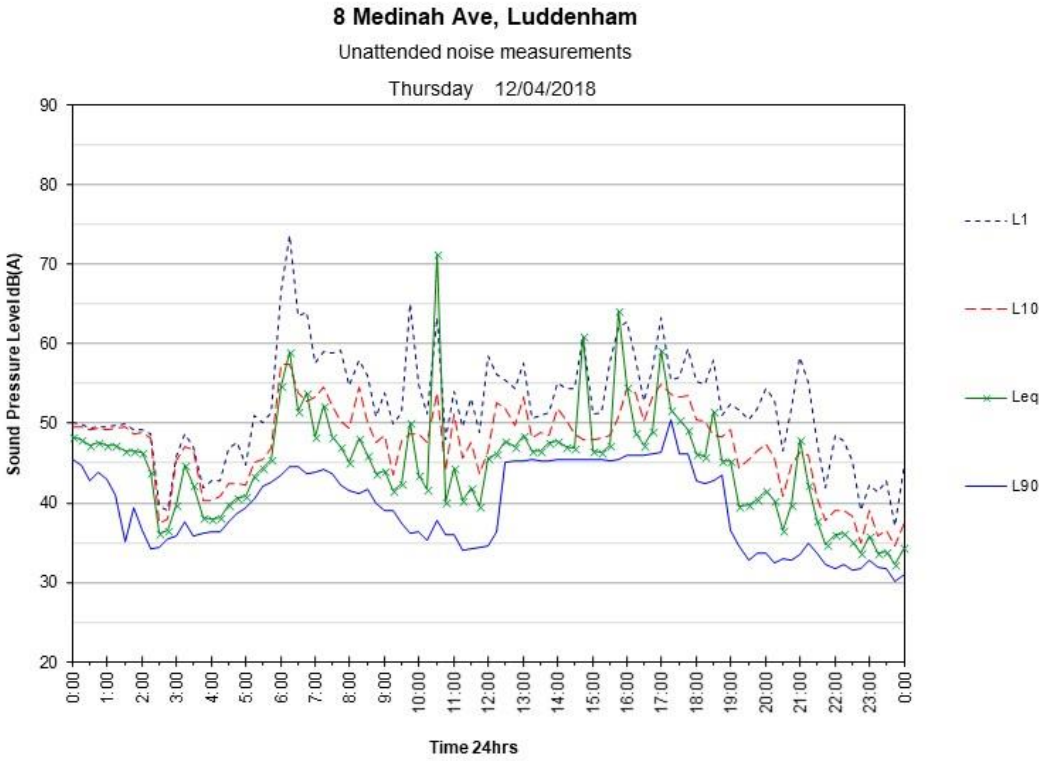
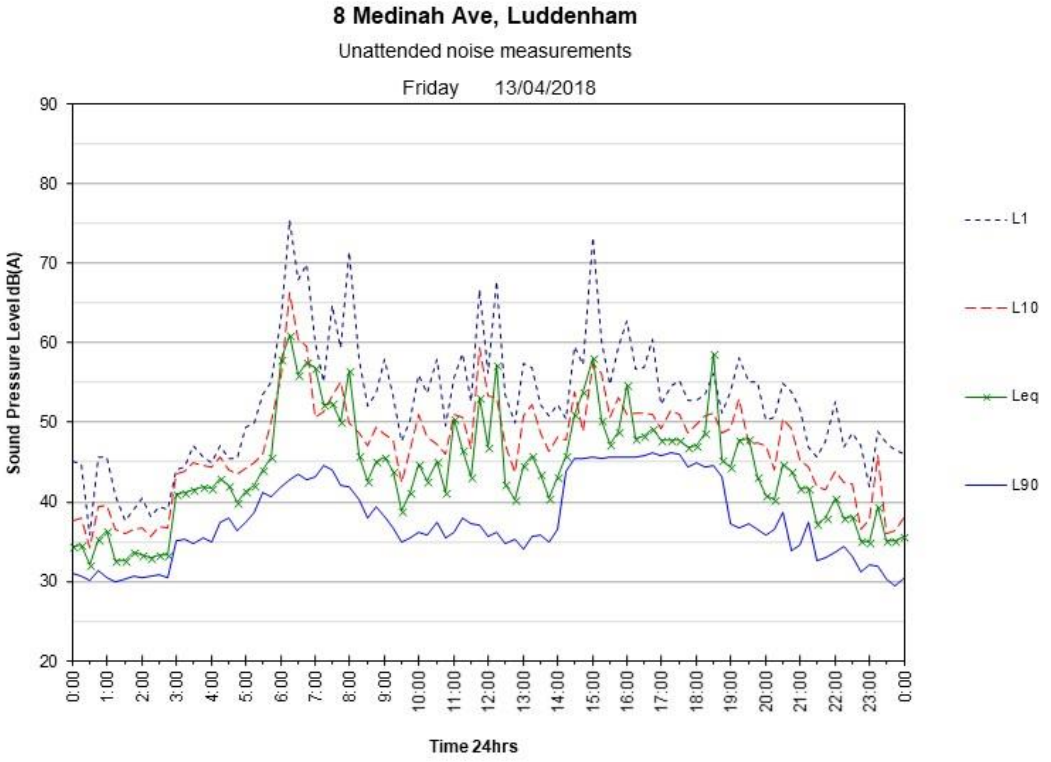
13. Appendices

13.1 Noise monitoring charts



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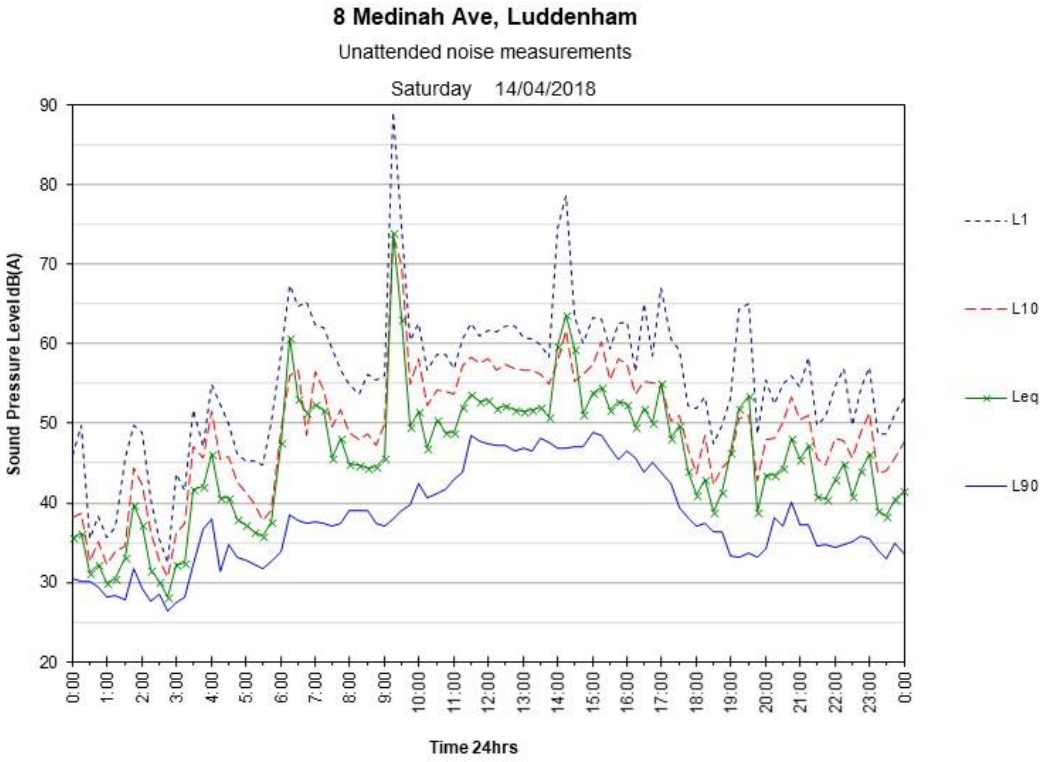
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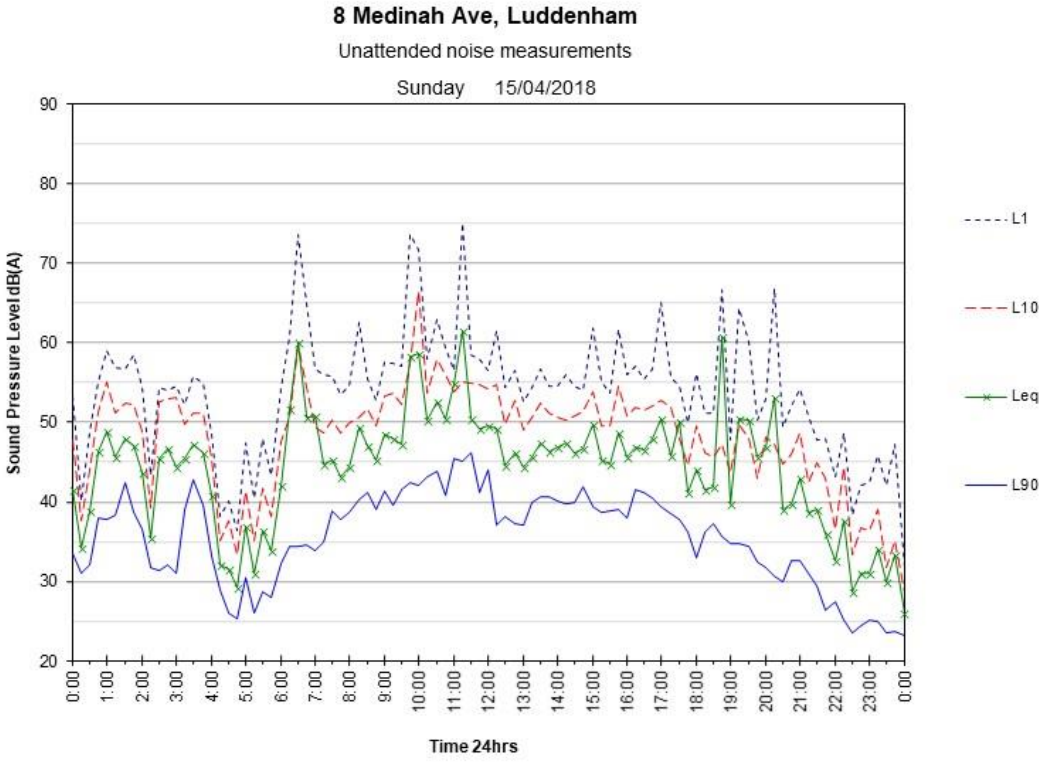
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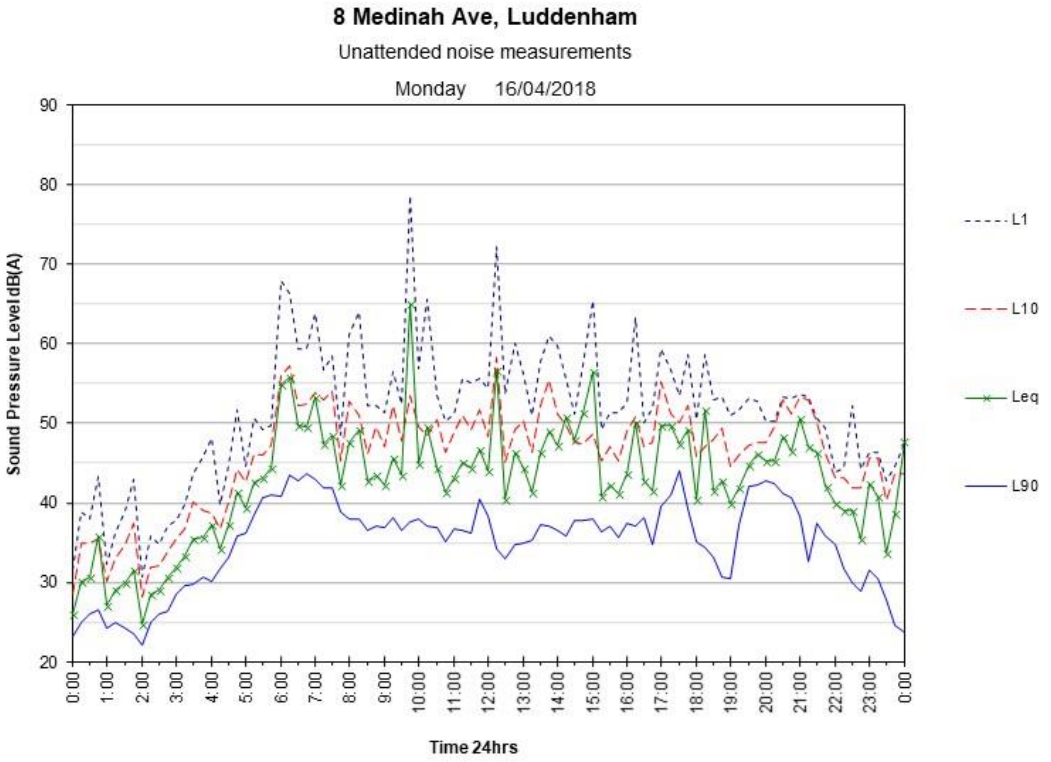
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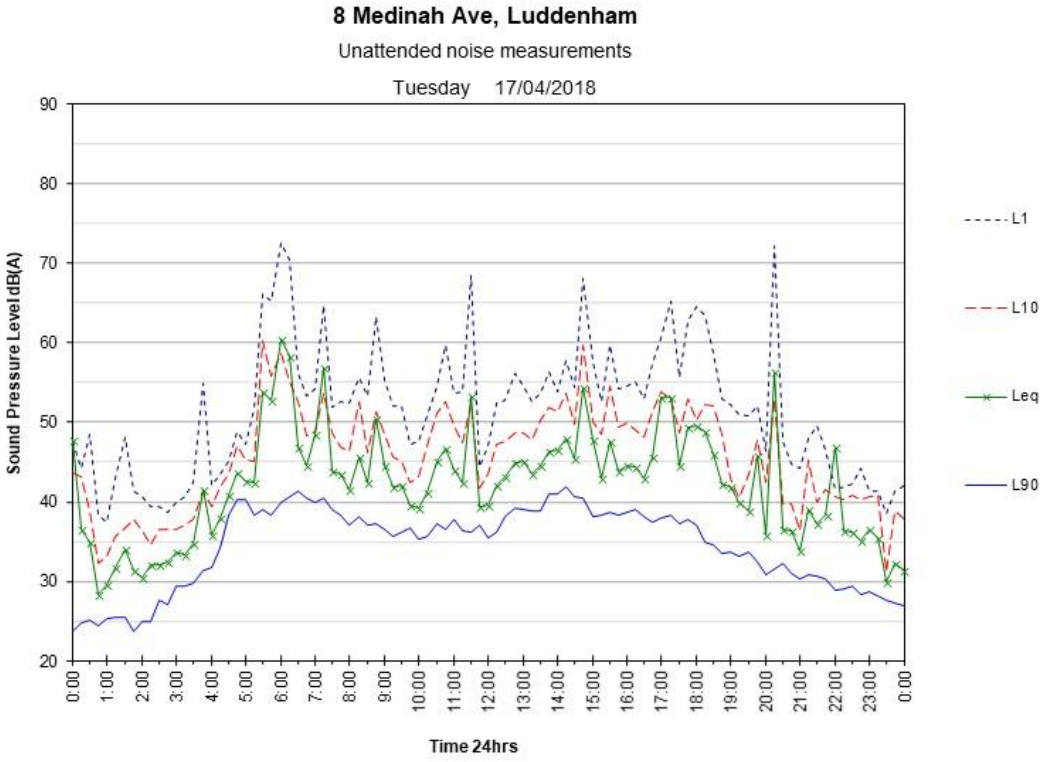
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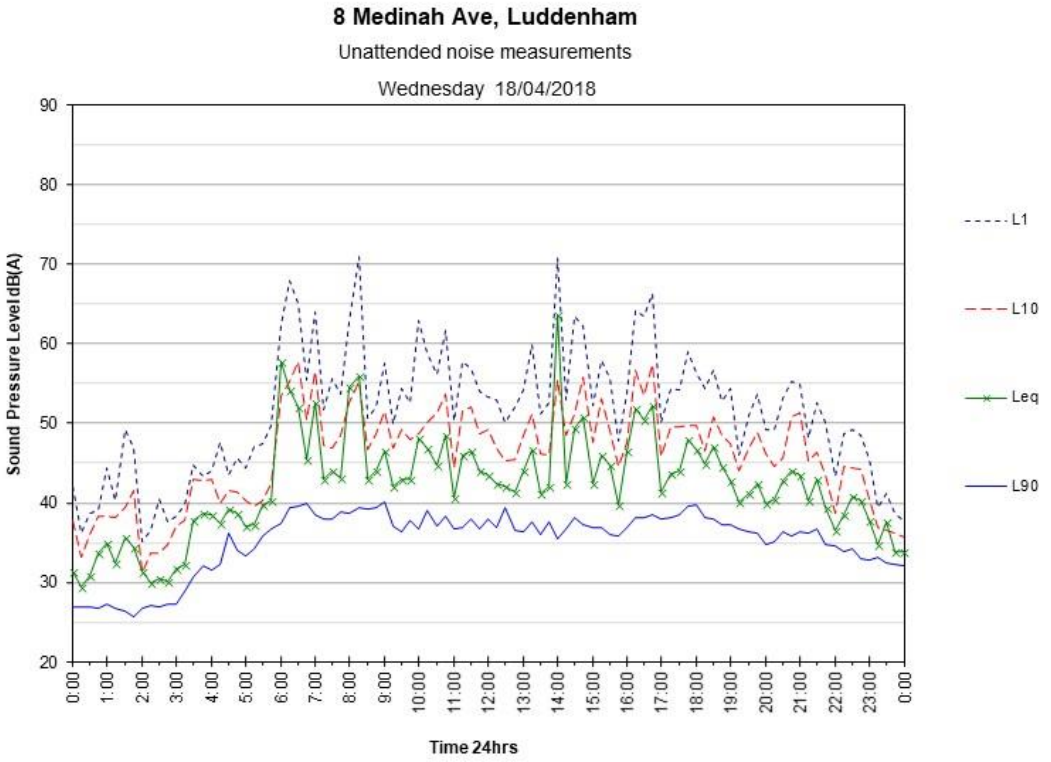
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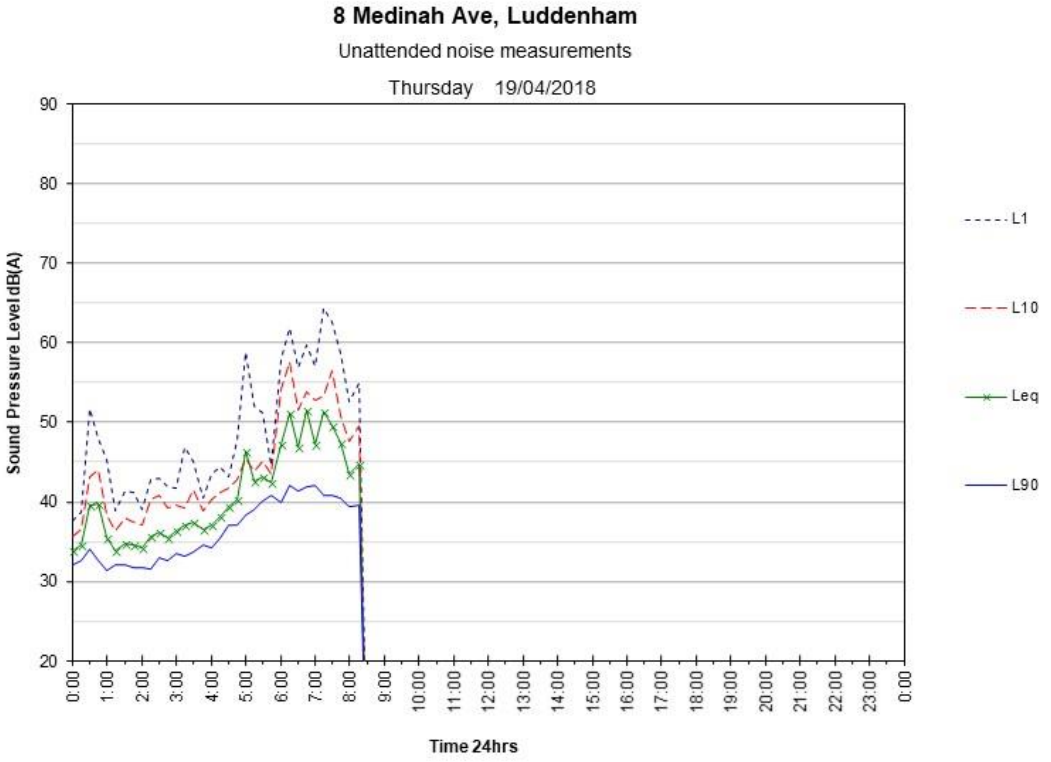
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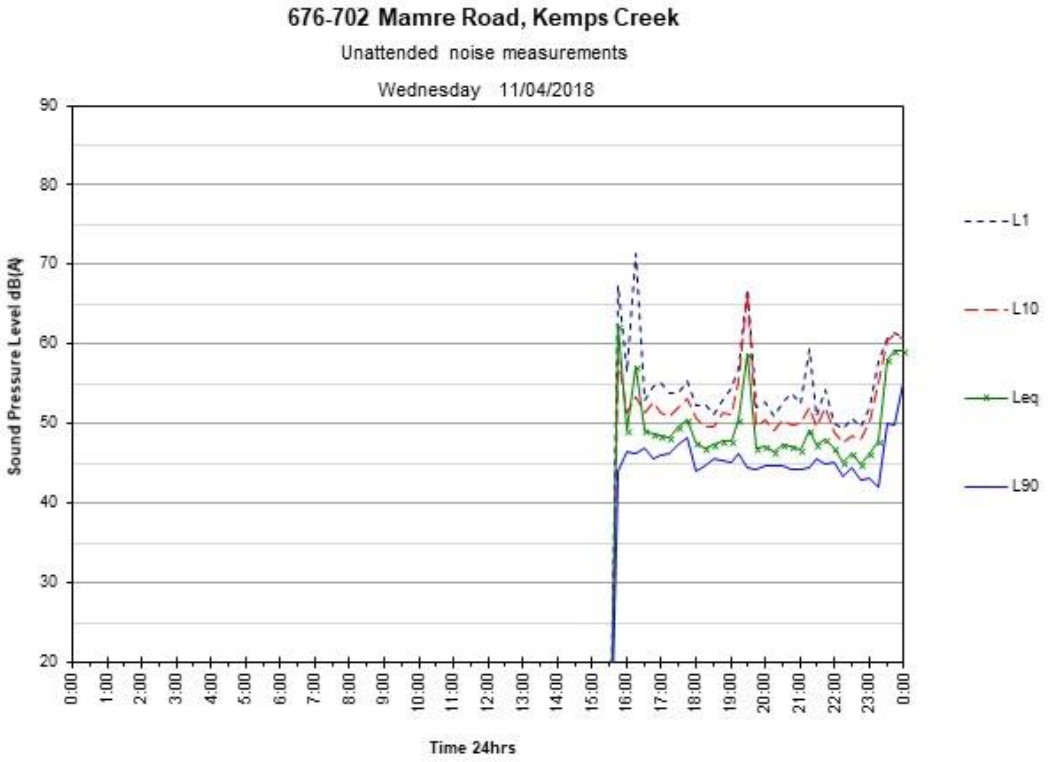
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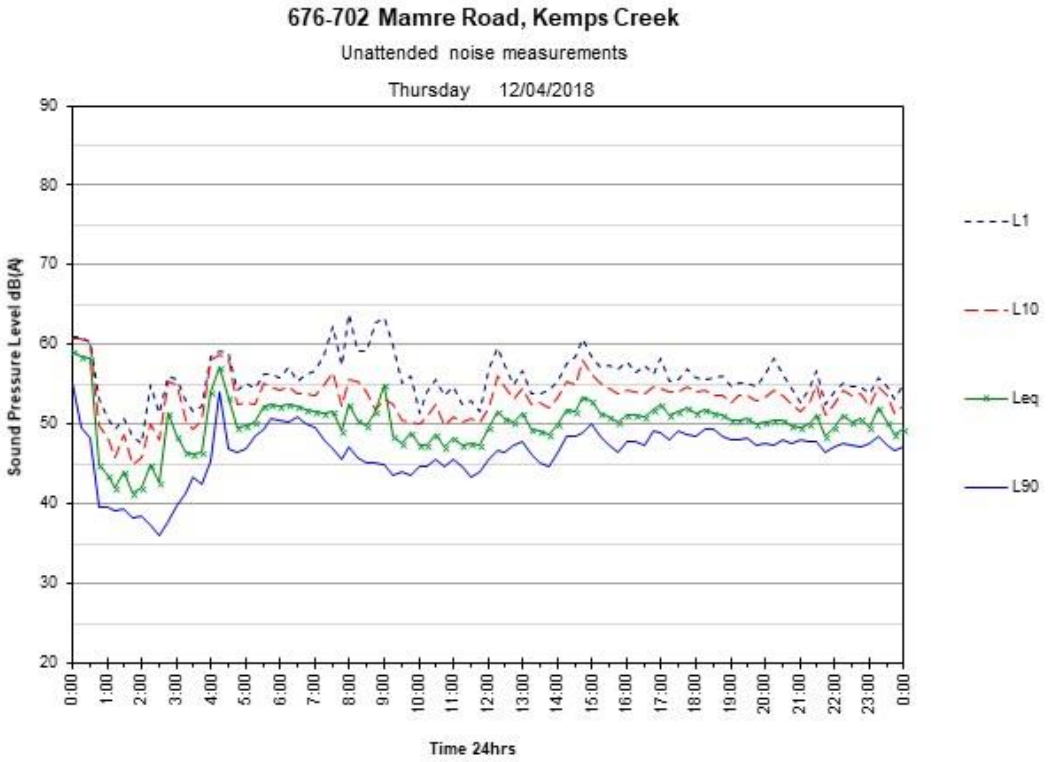
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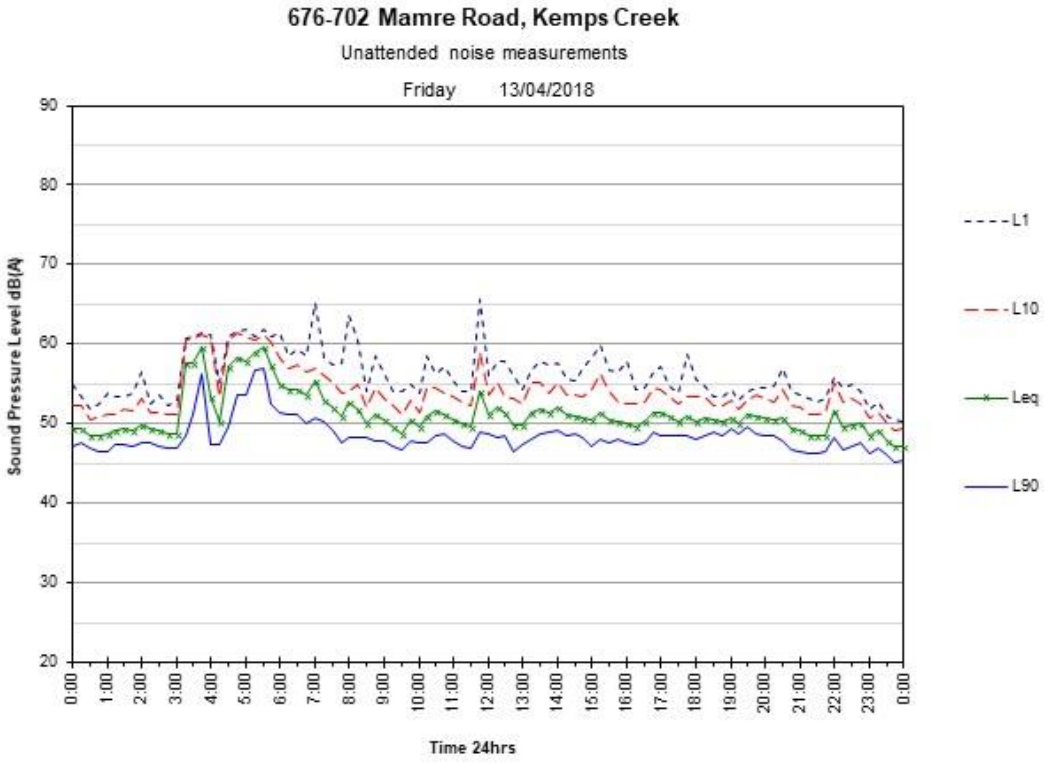
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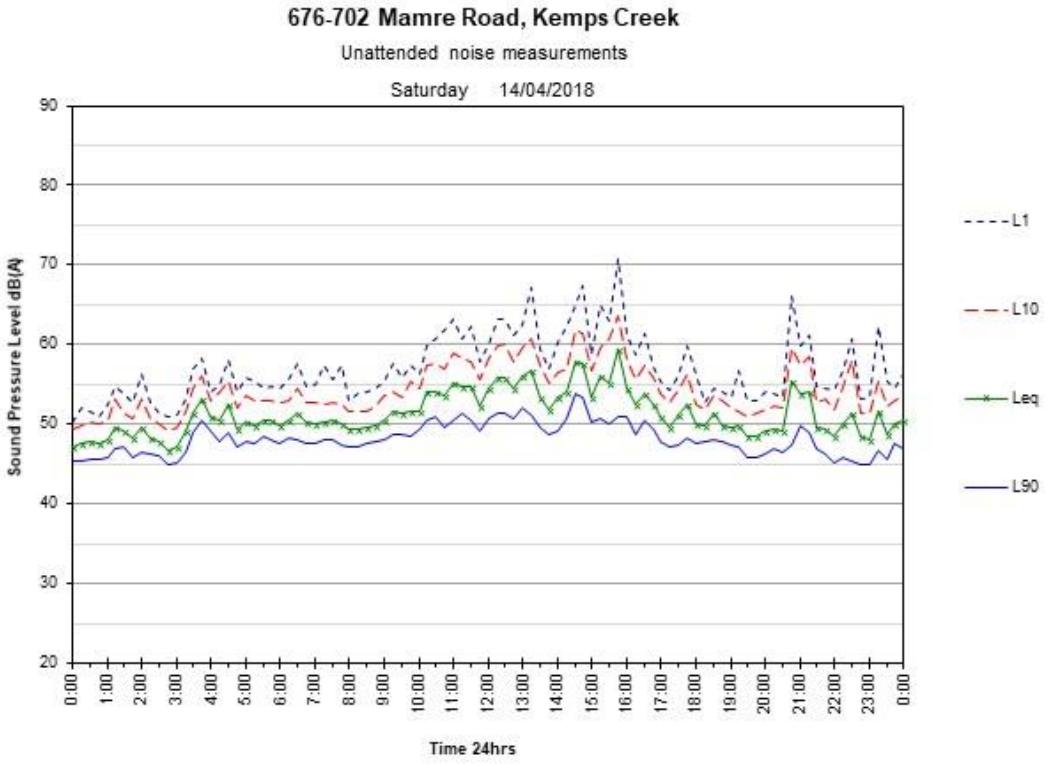
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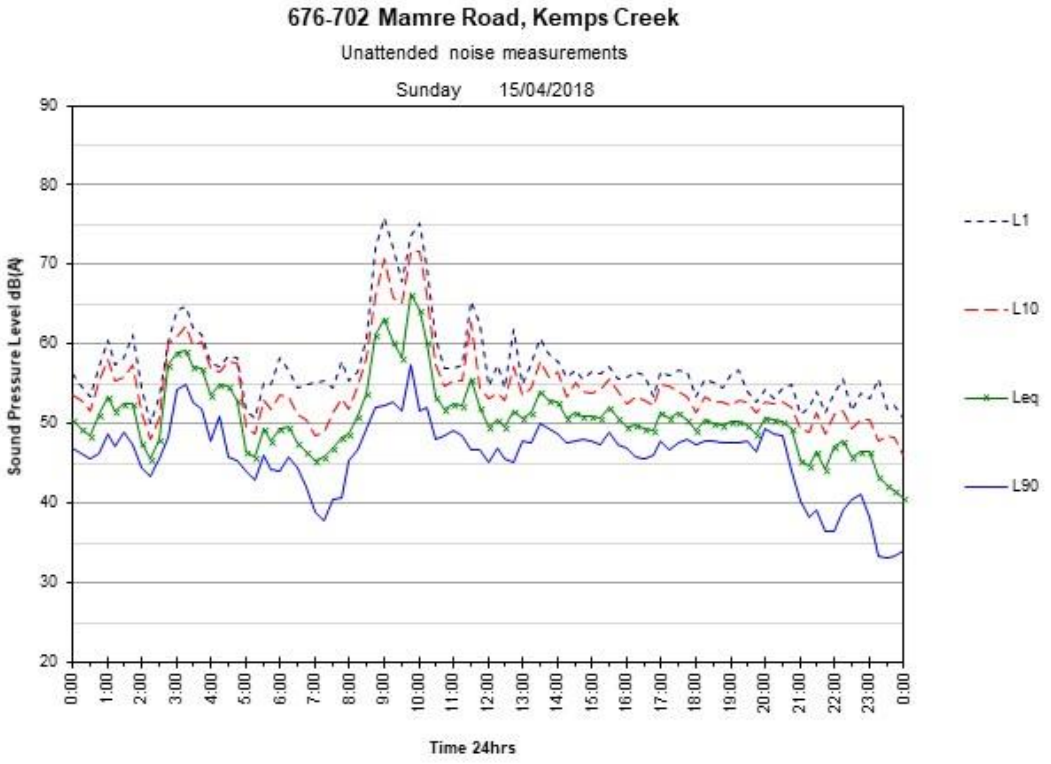
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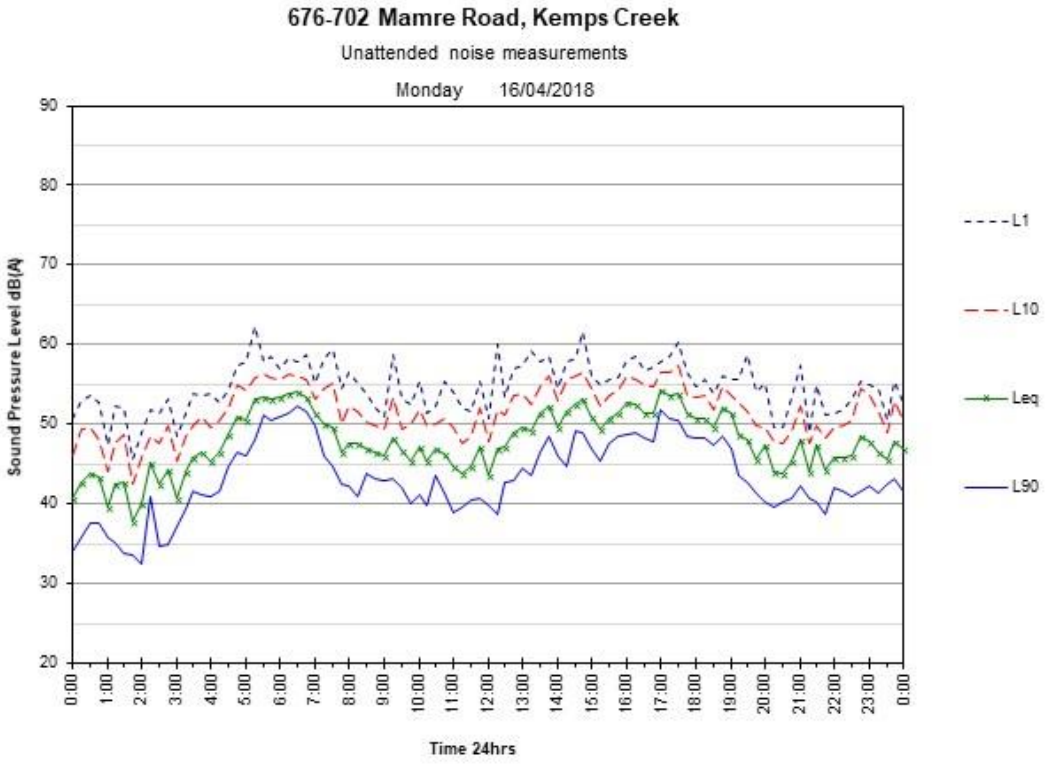
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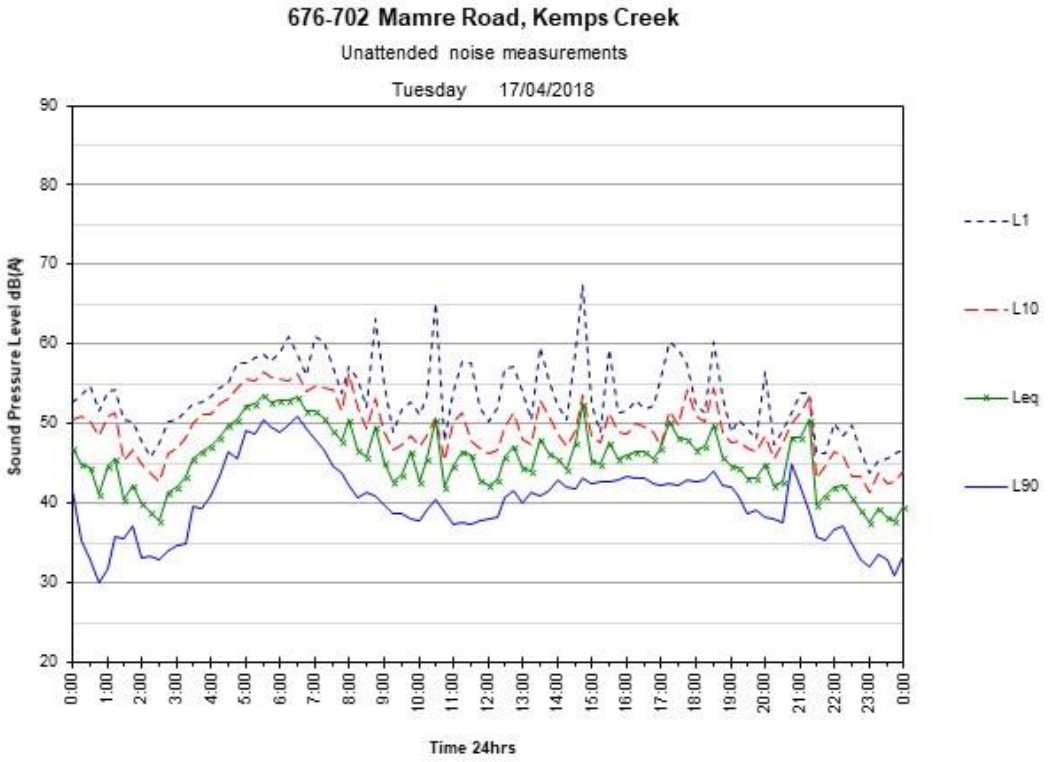
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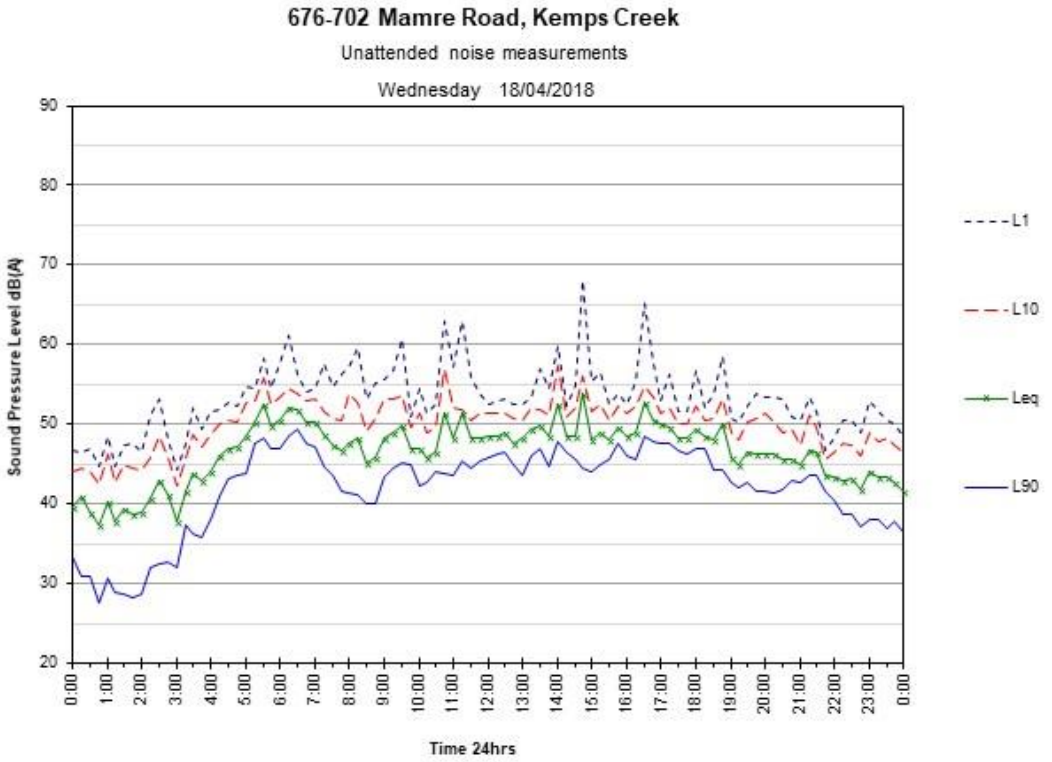
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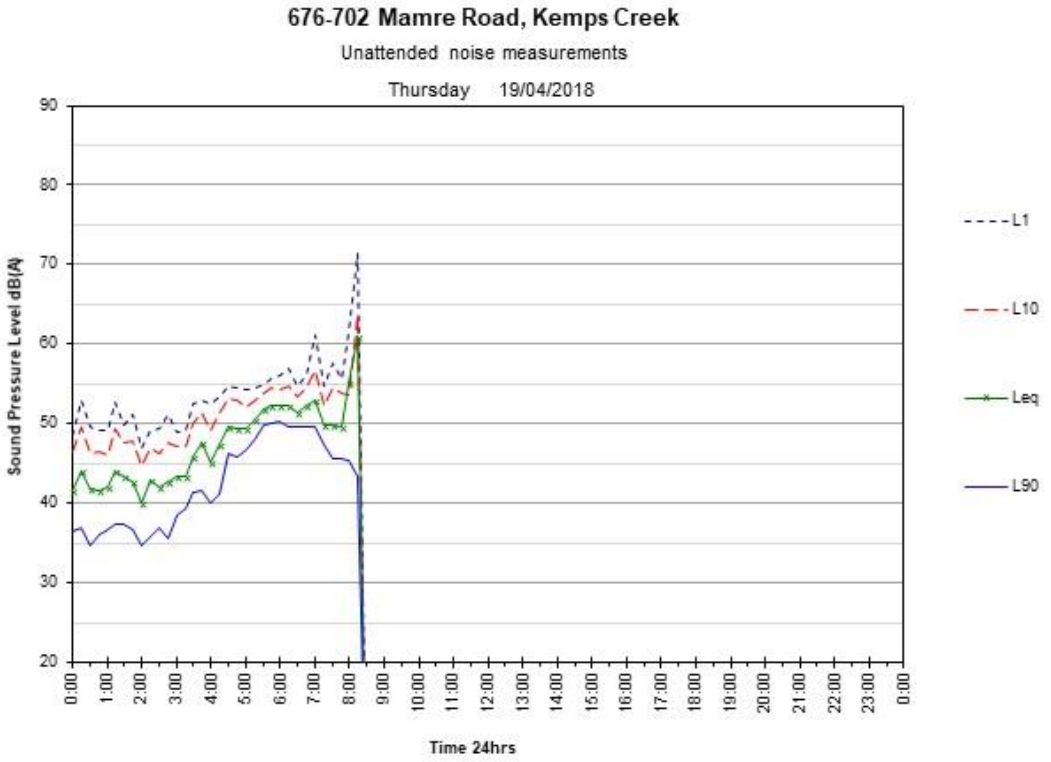
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13.2 Noise Management Plan

The overall aim of the noise management plan is to provide a program of actions and practices to minimise potential noise annoyance associated with onsite activities impacting adjacent properties.

Unattended noise monitoring is recommended at receivers 1, 2, 3 & 5 for a period of 2 weeks during construction to determine the effectiveness of the implemented mitigation measures. If noise levels are below the "Noise Affected" criteria and no complaints are received, no further monitoring is required. If noise levels are above the criteria, additional mitigation measures shall be implemented, with their effectiveness to be confirmed by further unattended noise monitoring at the receivers where exceedances were measured.

Site management are to elect a "Responsible Person" who is responsible for implementation of the Noise Management Plan to ensure the aims and objectives are achieved. The "Responsible Person" should ensure actions are being carried out by management, staff and subcontractors and that it is reviewed at appropriate times.

Where possible, performance indicators should be used to ensure noise annoyance from onsite activities is minimised. The most apparent performance indicator is the number of complaints made with regards to noise annoyance. Complaints shall be handled in accordance with the Community Consultation Strategy (CCS) and Construction Environmental Management Plan (CEMP).

The effectiveness and time taken to act and remediate noise issues, if complaints are made, is also considered a performance indicator for the site.

The various elements, aims and actions of the noise management plan are as follows;

13.2.1 All activities

Element	Operation of site works
Aim	To limit the times of potentially noisy onsite activities
Action	Allowed hours as follows: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays Workers or delivery trucks do not congregate outside the site before 6.45am.

13.2.2 Implementation of Management Plan

Element	Responsible Person
Aim	Provide a personnel contact for the Noise Management Plan
Action	The head contractor is to elect a "Responsible Person" who is onsite during construction hours and who has sufficient time and authority to implement the management plan. The Responsible Person is to keep record of performance indicators and feedback from management, staff, subcontractors and adjacent noise receivers as appropriate. The person would also be responsible for documenting changes/modifications to the Noise Management Plan.

13.2.3 Active Involvement

Element	Responsible Person
Aim	All management, staff and sub-contractors actively support and implement the noise management plan.
Action	The management, staff and Responsible Person should show active support and implementation for the management plan so that all are aware of the importance of the plan. Notify staff and subcontractors of the importance of the management plan. Actions and practices of the management plan, where relevant, should also be placed in appropriate locations. Responsible Person to implement notification new staff or subcontractors with respect to the Noise Management Plan.

13.2.4 Deliveries

Element	Deliveries
Aim	Minimise noise impacts from vehicle activities delivering to the site.
Action	Deliveries only between; Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No deliveries on Sundays or public holidays Delivery trucks do not congregate outside the site before 6.45am.

13.2.5 Onsite Mechanical Plant

Element	New equipment
Aim	Ensure new onsite equipment does not cause annoyance to noise sensitive receivers.
Action	All fixed onsite mechanical plant (e.g. air conditioning for site sheds) must be designed and installed to satisfy noise requirements.

13.2.6 Complaints

Element	Response to complaints
Aim	Provide a friendly and immediate response to complaints.
Action	Refer to the Community Consultation Strategy for complaint handling.

13.2.7 Review

Element	Schedule for the Review Process
Aim	To review the incidents/ complaints register and to ensure the Noise Management Plan remains relevant to the operations/activities of the site.
Action	Management is to review the incident/complaints register on a regular basis (at least fortnightly) to determine any common or recurring issues to be addressed. The plan should be reviewed if processes or activities onsite are change/modified or new activities are introduced. The plan should also be reviewed if noise complaints are being made with regards to a single activity or type of noisy activity occurring onsite. Document all changes/modifications to the Noise Management Plan.

13.3 Noise monitoring

Initial unattended noise monitoring shall be conducted over a period of two weeks at receivers 1, 2, 3 & 5 to determine the effectiveness of mitigation measures. If levels are found to be below the "Noise Affected" level and no complaints are received, no further monitoring is required. If levels are found to be above the "Noise Affected" level, additional mitigation measures shall be implemented, with their effectiveness to be confirmed by further unattended noise monitoring at the receivers where exceedances were measured.

13.3.1 Equipment

Sound level meters must have an accuracy at least equivalent to a Type 1 meter as described in Australian Standard AS1259. The sound level meter must be fitted with a windshield and must have a current laboratory calibration certificate or label in accordance with calibration requirements outlined in AS1259 and AS2659. Equipment should also be calibrated in the field in accordance with these standards.

The sound level meter must be capable of L_{eq} measurement and statistical L_n measurement (e.g. L_{10}, L_{90} etc), using the broadband 'A' scale frequency weighting.

13.3.2 Parameters

For measurement of ambient noise (without site noise), the sound level meter must be set to the following parameters;

- 15 minute measurement duration.
- Broadband
- 'Fast' time response.
- 'A' frequency weighting.

The measured descriptors of ambient noise are background noise $L_{A90,15min}$ and $L_{Aeq,15min}$.

For measurement of noise from construction activities at the site, the sound level meter must be set to the following parameters;

- 15 minute measurement duration.
- 'Z' (Linear) frequency weighting for 1/3 octave frequency spectrum.
- 'A' frequency weighting for overall broadband result.
- 'Fast' time response.

The measured descriptors of site noise should include (when available on a sound meter); L_{eq}, Lp, and 1/3 octave spectrum (to establish any tonal characteristics).

Measurement duration may change depending on the duration of each relevant source.

13.3.3 Procedure for measuring noise

13.3.3.1 Where to measure noise

In accordance with the code, noise levels should be measured at the property boundary that is most exposed to construction noise, at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Typically this would be an outdoor location in the most exposed position in a receivers' yard. The address of locations for assessment should be those locations where complaints have been received.

The sound level meter should be held at arm's length or set up on a tripod so the microphone is 1.5 metres above the ground. Where possible the measurement position should be 3 to 5 metres from walls, buildings and other reflecting surfaces.

The location of vegetation also needs to be considered, because noise levels can be increased locally by even a light breeze rustling leaves. Noise due to wind in vegetation can make accurate measurement difficult. Where possible, move away from nearby plants if rustling noise is present.

13.3.3.2 When to measure ambient noise

Ambient noise should be measured when it is representative of minimum levels that would occur during the time the activity would typically be conducted. Suitable times may include;

- Prior to commencement of daily activities.
- During smoko or lunchbreak (if site activities are ceased).
- On RDO's (rostered days off).
- After completion of daily activities.

Ideally, a number of ambient noise measurements should be taken at various times of day. Ambient noise measurement should only be done at times or locations unaffected by noise from the site.

13.3.3.3 When to measure noise from construction

Measurements of construction noise should be taken at the time(s) when the noise is representative of the current maximum level of noise emanating from the site, or at times when a complaint has been received.

13.3.3.4 What to avoid

The following conditions shall be avoided during the noise assessment;

- Average wind speed (at the microphone height) greater than 5m/s (approximately 20km/h). Typically at a wind speed of 5 m/s, leaves and branches would be in constant motion and the wind would extend a small flag.
- Rain periods (if intermittent, any affected data can be excluded).
- Other extraneous noise, such as train passby etc.
- Noise such as talking or physically bumping the sound level meter in a manner that will affect the readings.

13.3.3.5 Steps for measurement

The steps for performing a noise measurement are as follows;

1. Calibrate the sound level meter before commencing noise measurements. The sound pressure level shown on the meter should match the stated sound pressure level for the calibrator being used. The equipment should not vary by more than 1 dB. If it has then the measurements may be invalid.
2. Ensure the meter is set to 'Fast' time weighting, 'A' frequency weighting for broadband measurement, 'Z' weighting for 1/3 octave measurement. Descriptors include L_{90}, L_{eq}, and LpA.
3. Measure the ambient noise level continuously for 15 minutes (where possible), excluding all distinct extraneous noises. If extraneous noise is present, pause the meter when this occurs or choose another measuring time or restart the measurement at another location. If more than one valid noise measurement of the ambient noise for a location is obtained, use the lowest level as the ambient noise level. Note the $L_{A90,15min}$ value and other relevant values as described above. Where it is not possible to continuously measure over a 15-minute period, then note the duration of the measurement.
4. Measure the noise emanating from the site, excluding all distinct extraneous noises. Note the duration of the measurement. Note the relevant measured values and description of the types of noise that were audible/measurable from the site.
5. Note whether the measured noise appears to contain tonal or impulsive characteristics and apply correction factors where appropriate.
6. Check the field calibration at the end of the monitoring period in accordance with Australian Standard IEC 61672.1-2004 and Australian Standard 2659. Re-monitoring may be required where there is a calibration drift greater than that allowed by the standards.

13.3.3.6 Information to be reported

Any reporting should be concise. The minimum requirements to be included in a report are;

- Date of measurements.
- Time of measurements.
- Person(s) performing measurements.
- Equipment used for measurements.
- Location of measurements.
- Measured values.
- Corrected values (where applicable).
- Notes regarding audibility of noise sources.
- Notes regarding any extraneous sources that may have influenced measurements.
- Detail of instrumentation and calibration.
- Meteorological conditions.

13.4 Construction vibration monitoring

The preferred measurement technique is one which records unfiltered data from which any desired values can later be determined, including frequency-weighted RMS and peak values.

Vibration monitoring equipment should be calibrated in accordance with relevant Australian or standards.

Vibration should be measured on a structural surface designed to support a person, with the floor or ground as the preferred reference surface. The z-axis (vertical) shall be measured. Ideally more than two points in a receiver location should be measured at one time to obtain space average vibration levels. If the above is not practicable, one position of the receiver location is chosen where, in the opinion of an authorised officer, the vibration level is the greatest. The locations should be either clearly marked or clearly defined on a diagram for later identification. The transducer should not be attached to a flexible floor covering which may damp the vibration. The transducer shall be firmly fixed in the position, and the method of fixing shall be reported.

Items to be reported include;

- Date and time of measurement.
- Location of measurements (including diagram of measurement positions).
- Equipment used for measurements (including calibration details).
- Method of fixing of transducer.
- Description of the type of equipment or source of vibration (where possible).
- One-third octave band frequency analysis (1Hz to 80Hz) reported as z-axis r.m.s acceleration in units of ms^{-2}. For each measurement this should include starting and ending time and brief description of events occurring within the measurement time frame.
- Overall broadband peak particle velocity (ppv) reported as z-axis velocity in units of ms^{-1}. For each measurement this should include starting and ending time and brief description of events occurring within the measurement time frame.
- The results of the one-third octave band analysis and peak particle velocity analysis should be compared with the vibration limits.
- Statement of whether the vibration complies with the recommended limits.