



Construction Noise Management
Mamre Road South Precinct
Kemps Creek

NOISE MANAGEMENT PLAN



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1. Introduction

The following report is in response to a request the Frasers Property and Altis Property Partners for a construction noise 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.

2. Site Description

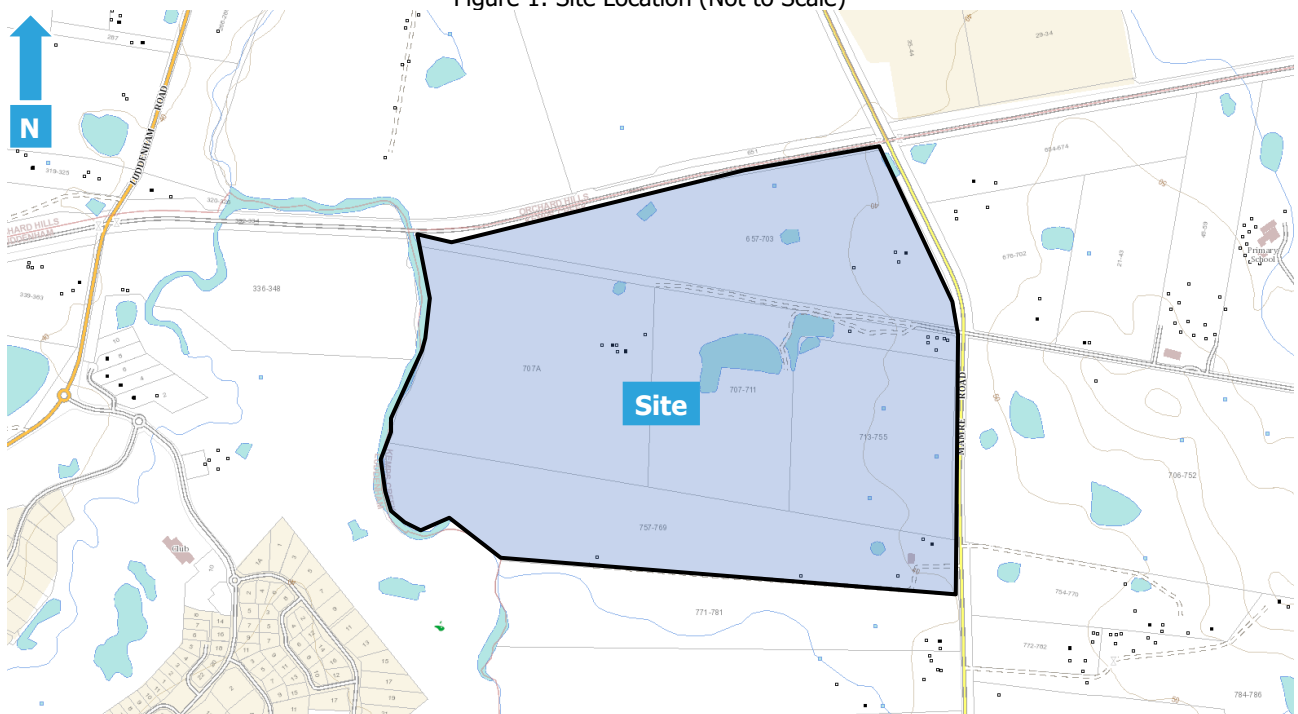
2.1 Site Location

The site is described by the following:

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

Refer to Figure 1 for site location.

Figure 1: Site Location (Not to Scale)



A comprehensive site survey was conducted on the 11th April 2018 which identified the following:

- Single storey residential dwellings currently occupy the site.
- Mamre Road bounds the site to the east separating the development from rural residential land uses, located approximately 165m from the eastern site boundary.
- A single storey rural residential dwelling bounds the site to the south.
- Single storey residential dwellings are located south west of the site in Luddenham.
- Warehouses are currently being constructed adjacent the northern site boundary.

2.2 Proposal

The proposal is the construction of warehouse/industrial buildings. The earthworks period is expected to be conducted over 20 weeks and the overall period of the works is estimated to be approximately 24 months. The earthworks are expected to consist of the following machinery;

- Excavators
- Backhoe Loaders
- Bulldozers
- Skid Steer Loaders
- Motor Graders
- Waste removal trucks

The construction works are expected to consist of the following;

- Concrete trucks
- Compressor
- Forklifts
- Waste removal
- Power tools

The recommended hours of the works are 7am to 6pm Mondays to Fridays and 7am to 1pm Saturdays with no work on Sundays or public holidays.

2.3 Acoustic Environment

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

3. Conditions of Approval

The Secretary's Environmental Assessment Requirements (SEARs) outline the requirements for the construction and operational use of the proposed development. Section 4.11 of SEARs 2015 states the following;

"Noise and Vibration – Amenity

- 1. The Proponent must assess construction and operational noise vibration guidelines. The assessment must include consideration of impacts to sensitive receivers including small businesses, and include consideration of sleep disturbance and, as relevant, the characteristics of noise and vibration (for example, low frequency noise).*
- 2. The Proponent must demonstrate that blast impacts are capable of complying with the current guidelines, if blasting is required.'*

4. 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 Industrial Noise Policy 2000
- 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 2187-1993 *SAA Explosives Code, Part 2 - Use of Explosives*

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 Industrial Noise Policy 2000	No	No	Construction noise is not dealt with by the INP as described in Section 1.3 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 AS2187-1993	Noise - No Vibration - Yes	Specific vibration goals	Relevant to demolition

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

4.1 Assessing Vibration: A Technical Guideline 2006

4.1.1 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.

4.1.2 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

4.1.3 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

4.1.4 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.

4.2 NSW Interim Construction Noise Guideline 2009

4.2.1 Hours for construction work

The recommended standard hours for construction work are shown below in Table 4, however they are not mandatory. There are some situations where construction work may need to be undertaken outside of these hours. The likely noise impacts and the ability to undertake works during the recommended standard hours should be considered when scheduling work.

Table 4: Recommended standard hours for construction work

Work type	Recommended standard hours of work*
Normal construction	Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays
Blasting	Monday to Friday 9 am to 5 pm Saturday 9 am to 1 pm No blasting on Sundays or public holidays

* The relevant authority (consent, determining or regulatory) may impose more or less stringent construction hours.

Work outside of hours may be done under one of the following five categories;

- the delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads
- emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours
- public infrastructure works that shorten the length of the project and are supported by the affected community
- works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

4.2.2 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.

4.2.2.1 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 5: Noise criteria for quantitative assessment - Residential

Time of day	Criterion LAeq(15min) *	How to apply
Recommended standard hours	Noise affected RBL + 10dB	<p>The noise affected level represents the point above which there may be some community reaction to noise.</p> <p>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.</p> <p>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.</p>
	Highly noise affected 75dBA	<p>The highly noise affected level represents the point above which there may be strong community reaction to noise.</p> <p>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:</p> <ol style="list-style-type: none"> 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	<p>A strong justification would typically be required for works outside the recommended standard hours.</p> <p>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.</p> <p>Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.</p> <p>For guidance on negotiating agreements see section 7.2.2.</p>

* 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.

4.2.2.2 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 schedule achieve a reasonable noise outcome.

Table 6: 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

4.2.2.3 Commercial and industrial properties

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

Table 7: 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.

4.2.3 Ground-borne noise

Noise within dwellings resulting from ground vibration from construction processes would be required to comply with the following criteria;

Table 8: Recommended standard hours for construction work

Time	Criterion LAeq(15min) dB(A)
Evening (6pm to 10pm)	40
Night (10pm to 7am)	35

The criteria only apply to evening and night time construction works.

4.3 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.

4.4 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.

4.5 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 9: 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

4.6 Australian Standard AS2187-1993

Australian Standard 2187-1993 *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 10: AS2187-1993 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: 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. Noise Monitoring and Receivers

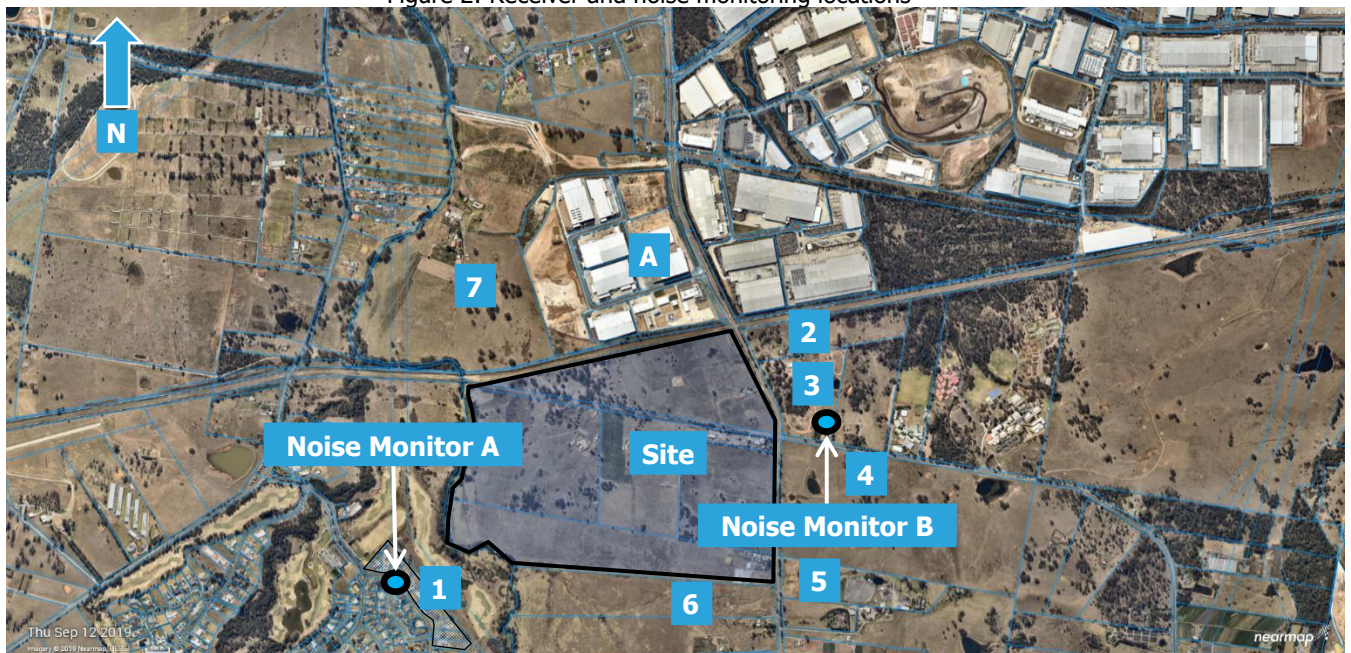
5.1 Monitoring locations and receivers

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 currently being constructed north of the site at Mamre Road, Orchard Hills.

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



5.2 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.

5.3 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.

6. 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.

6.1 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 11 below.

Table 11: 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

6.2 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 12: 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.

7. Project specific criteria

7.1 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 13: Applicable noise limits for construction work

Time	Criterion LAeq(15min)			Assessment location
	Receiver 1	Receivers 2-7	Receiver A	
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

7.2 Construction vibration criteria

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

Table 14: 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	-

8. 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.

The predicted noise impacts of earthworks are summarised as follows;

Table 15: Predicted earthworks noise impacts

Receiver		Description	Receivers						LAeq 15 min Compliance		
			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 ext. dB(A) Night	Noise affected	Highly noise affected	Industrial receiver
1	Criteria							46	75	75	
	Excavator large	99		99	39	39		Yes	Yes	n/a	
	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		Yes	Yes	n/a	
2	Criteria							54	75	75	
	Excavator large	99		99	47	47		Yes	Yes	n/a	
	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		Yes	Yes	n/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

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 ext. dB(A)	Night	LAeq 15 min Compliance		
											Noise affected	Highly noise affected	Industrial receiver
3	Criteria										54	75	75
	Excavator large	99		99	46	46					Yes	Yes	n/a
	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					Yes	Yes	n/a
4	Criteria										54	75	75
	Excavator large	99		99	42	42					Yes	Yes	n/a
	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					Yes	Yes	n/a
5	Criteria										54	75	75
	Excavator large	99		99	36	36					Yes	Yes	n/a
	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					Yes	Yes	n/a
6	Criteria										54	75	75
	Excavator large	99		99	50	50					Yes	Yes	n/a
	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

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

Receiver	Description							LAeq 15 min Compliance		
		Source Leq@1m dB(A)	Correction dB(A)*	Corrected Leq@1m dB(A)	LAeq adj,T ext. dB(A)	Noise affected	Highly noise affected	Industrial receiver		
6	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		No	Yes	n/a
	Criteria							54	75	75
7	Excavator large	99		99	36	36		Yes	Yes	n/a
	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		Yes	Yes	n/a
	Criteria							54	75	75
A	Excavator large	99		99			45	n/a	n/a	Yes
	Backhoe	96		96			46	n/a	n/a	Yes
	Bulldozer	100		100			44	n/a	n/a	Yes
	Grader	102		102			46	n/a	n/a	Yes
	Loader (wheeled)	97		97			41	n/a	n/a	Yes
	Compressor large (silenced)	85	2	87			29	n/a	n/a	Yes
	Truck passby	82		82			20	n/a	n/a	Yes
	Truck reverse alarm	92	5	97			35	n/a	n/a	Yes
	Total						52	n/a	n/a	Yes
	Criteria							54	75	75

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.

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

Table 16: Predicted construction noise impacts

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

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 ext. dB(A) Night	LAeq 15 min Compliance		
								Noise affected	Highly noise affected	Industrial receiver
1	Criteria							46	75	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	92		92	22	22		Yes	Yes	n/a
	Total				46	46		Yes	Yes	n/a
2	Criteria							54	75	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	92		92	33	33		Yes	Yes	n/a
	Total				55	55		No	Yes	n/a
3	Criteria							54	75	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	92		92	32	32		Yes	Yes	n/a
	Total				54	54		Yes	Yes	n/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

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 ext. dB(A) Night	LAeq 15 min Compliance		
								Noise affected	Highly noise affected	Industrial receiver
4	Criteria							54	75	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	92		92	28	28		Yes	Yes	n/a
	Total				50	50		Yes	Yes	n/a
5	Criteria							54	75	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	92		92	21	21		Yes	Yes	n/a
	Total				43	43		Yes	Yes	n/a
6	Criteria							54	75	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	92		92	36	36		Yes	Yes	n/a
	Total				58	58		No	Yes	n/a
7	Criteria							54	75	75
	Concrete truck	95		95	38	38		Yes	Yes	n/a
	Concrete pump	94	2	96	39	39		Yes	Yes	n/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

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 ext. dB(A) Night	LAeq 15 min Compliance		
								Noise affected	Highly noise affected	Industrial receiver
7	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	92		92	22	22		Yes	Yes	n/a
	Total				44	44		Yes	Yes	n/a
A	Criteria							54	75	75
	Concrete truck	95		95			47	n/a	n/a	Yes
	Concrete pump	94	2	96			49	n/a	n/a	Yes
	Power tools (electric)	83	2	85			38	n/a	n/a	Yes
	Compressor large (silenced)	85	2	87			29	n/a	n/a	Yes
	Truck passby	82		82			20	n/a	n/a	Yes
	Truck reverse alarm	92	5	97			35	n/a	n/a	Yes
	Forklift unloading	82	2	84			31	n/a	n/a	Yes
	Concrete pencil vibrator	95		95			48	n/a	n/a	Yes
	Saw	92		92			31	n/a	n/a	Yes
	Total						53	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.

9. Recommended Acoustic Treatments & Management Principles

9.1 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 additional attenuation and/or alternative methods if needed.

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 4.6.

9.2 Noise control

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

1. Recommended 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. 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.
3. Workers or delivery trucks do not congregate at or outside the site before 7am. This is an important factor in managing noise from the site.
4. 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). This person would be responsible for handling noise complaints, and ensuring that work does not commence before the specified allowable times. The name and contact details of the 'responsible person' should be displayed outside the principal construction office.
5. If complaints arise regarding noise, the complaint will be directed to the 'responsible person', who will determine the source of the noise, and take immediate steps to investigate further or mitigate the noise as required. This may involve moving the noise source further away from affected premises, replacing the equipment, installing high performance silencers, or in some cases, engaging a qualified acoustic consultant to provide specialist control advice.
6. The Responsible Person should notify the adjacent residential premises of the intention to commence work that may cause adverse impacts on surrounding residents. If plant is to be operated in close proximity to residential premises, the Responsible Person should advise the occupants of the premises the length of time that the plant will be in operation proximate to the property boundary.
7. Any moveable plant (e.g. compressors) should be located as far as practical from the residential premises.

8. The Responsible Person maintain a record of complaints, which records the following details (refer to the example complaint record sheet in the appendix to this plan):
 - The time and date of lodgement of the complaint;
 - The name and telephone number of the complainant;
 - The nature of the complaint, including a description of the noise (e.g. likely noise source, duration of the noise event - is the noise continuous, or of a short duration);
 - The outcome of the investigation.
9. If a complaint is raised regarding a particular piece of plant, the plant shall be inspected for working condition, with particular attention given to the condition of engine covers or enclosures, and exhaust system. If machinery is in good condition, a high performance silencer should be installed.

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

9.3 Vibration Control

As previously discussed, due to the proximity of 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 warning 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.

10. 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 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.

Report Compiled by:



Matthew Bechara
Acoustic Consultant
acousticworks)))

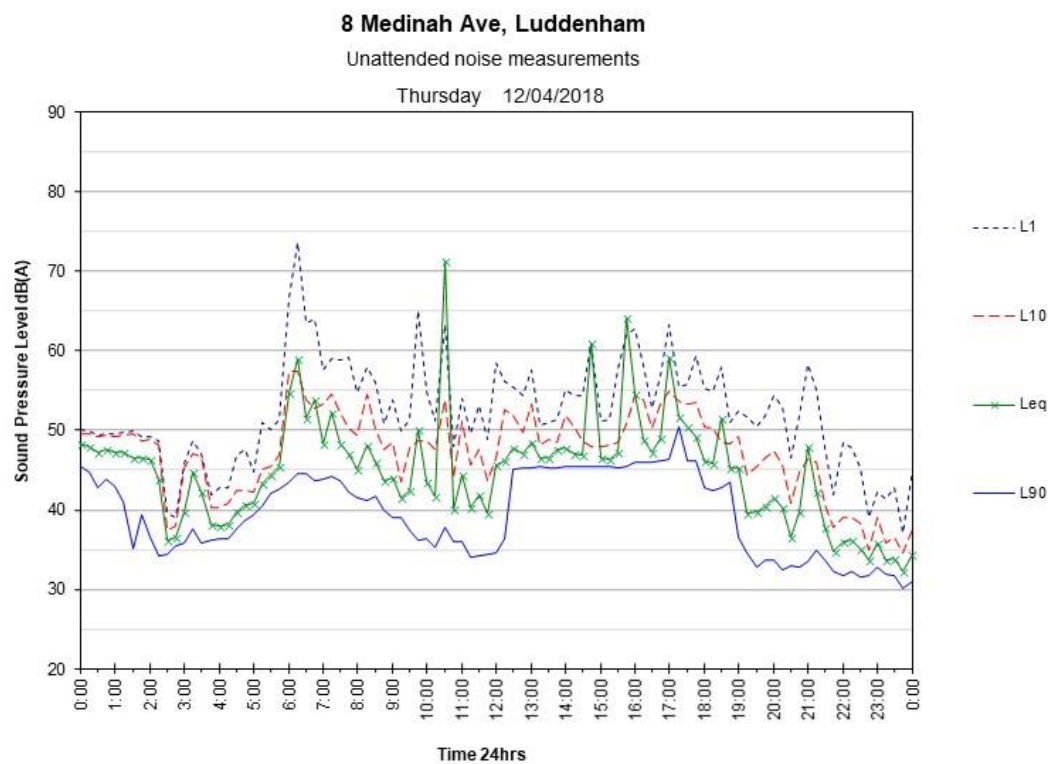
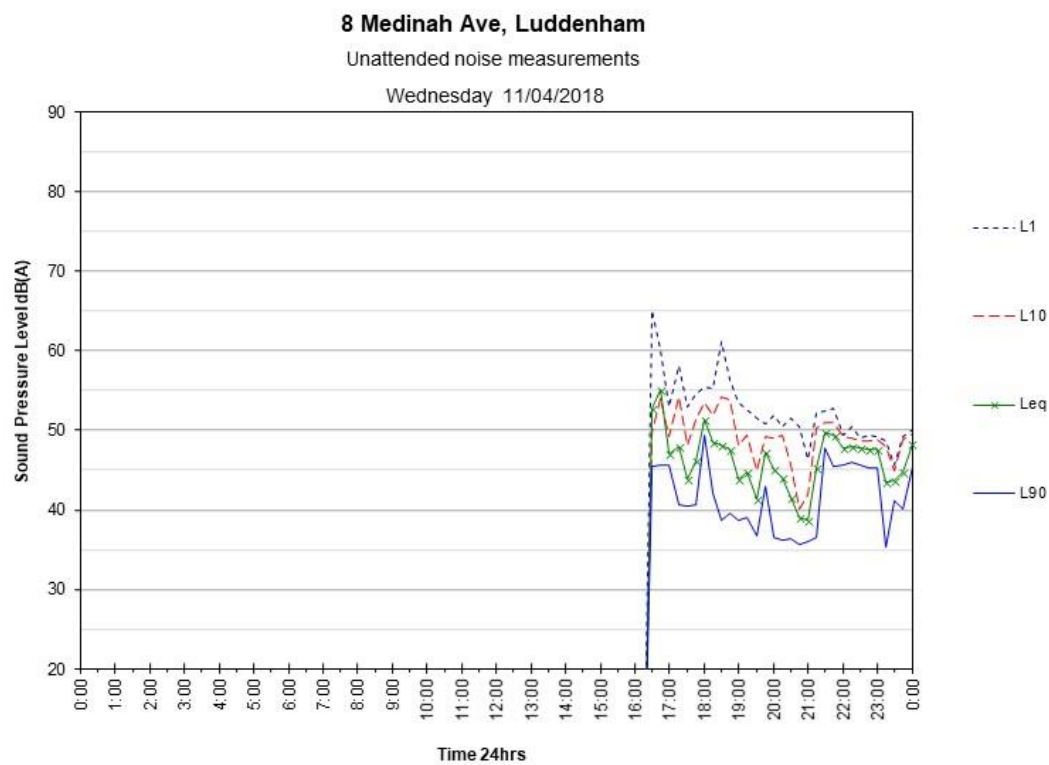
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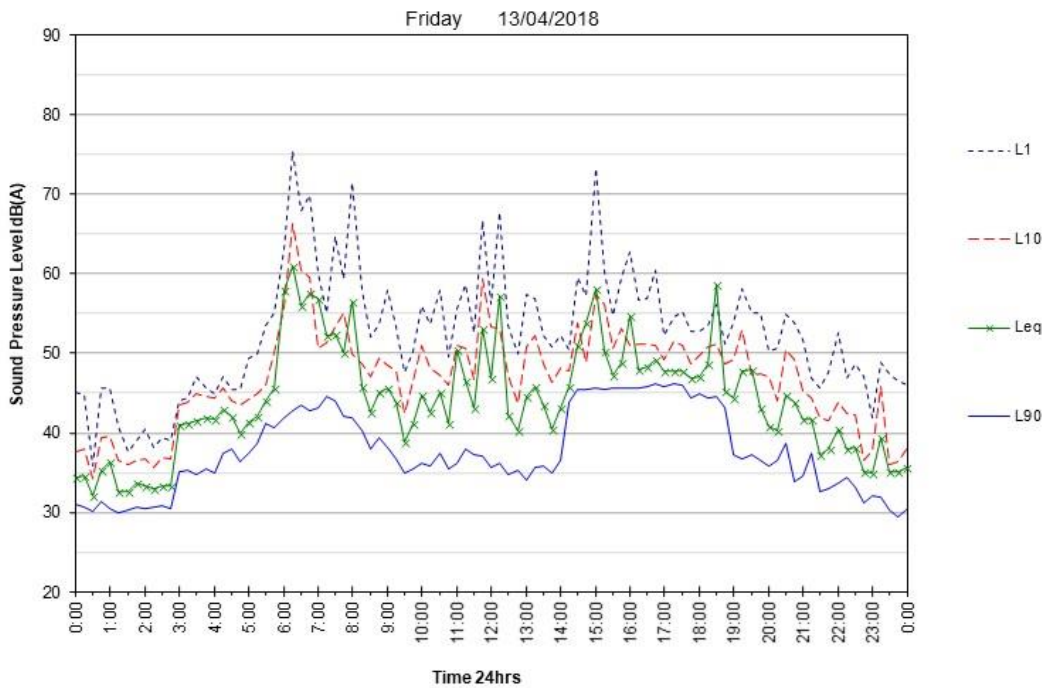
Greg Pearce B.Eng (Mech)
Director
acousticworks)))

11.Appendices

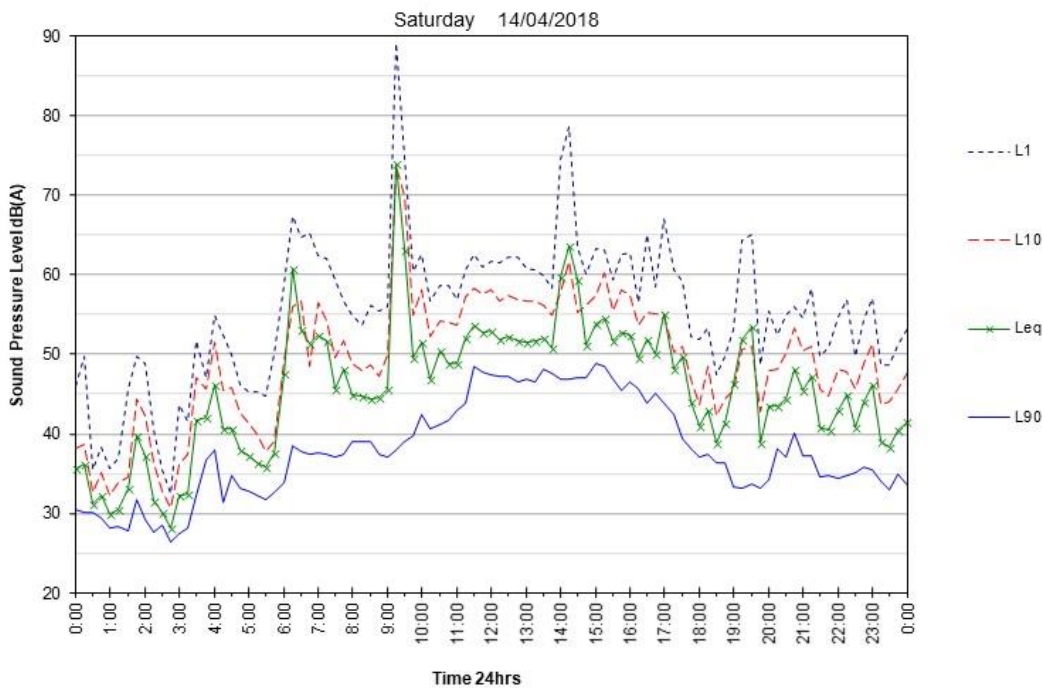
11.1 Noise monitoring charts



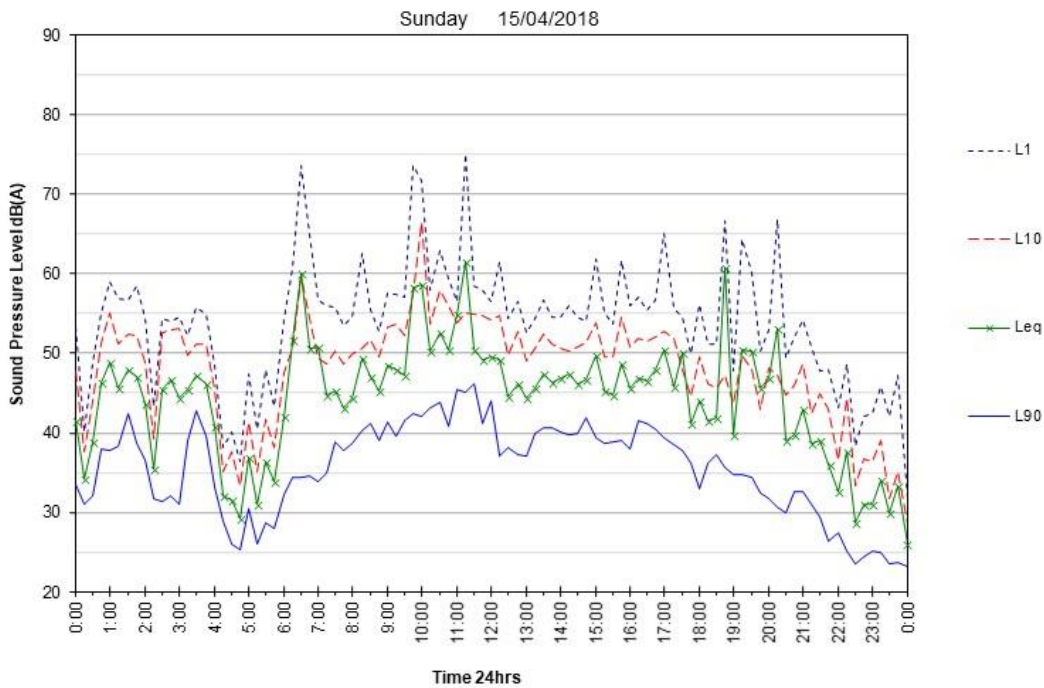
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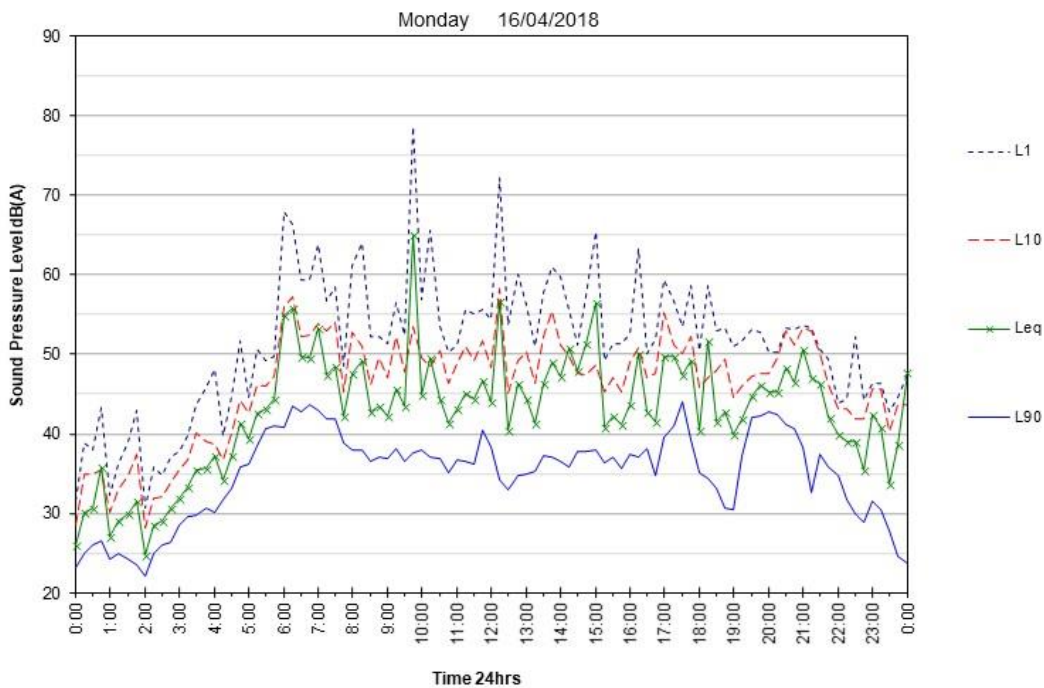
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Unattended noise measurements



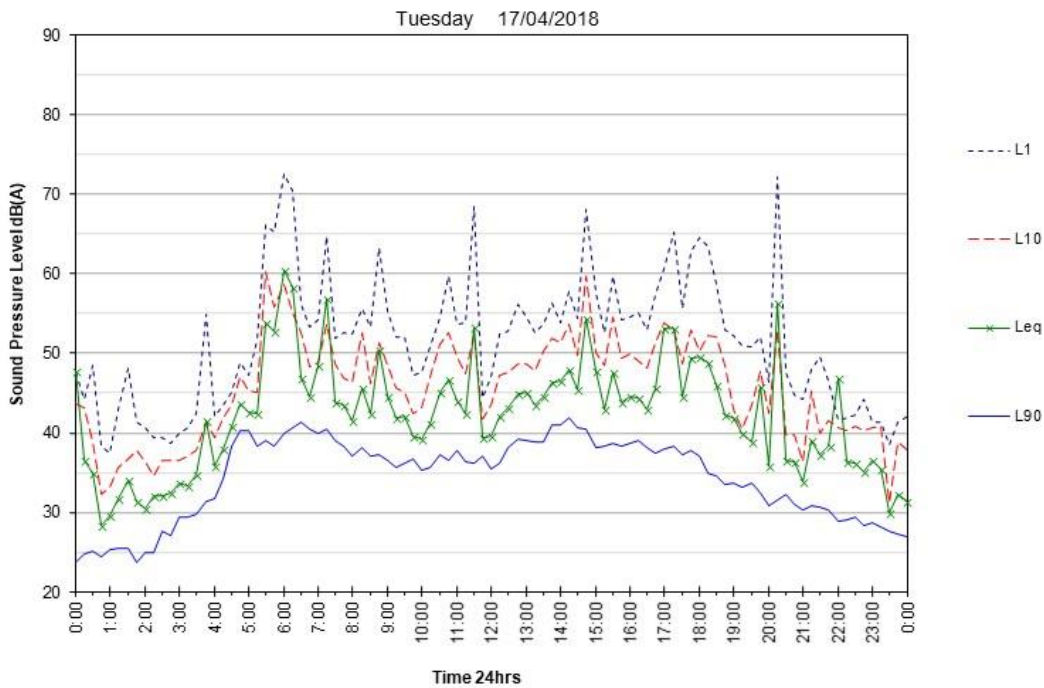
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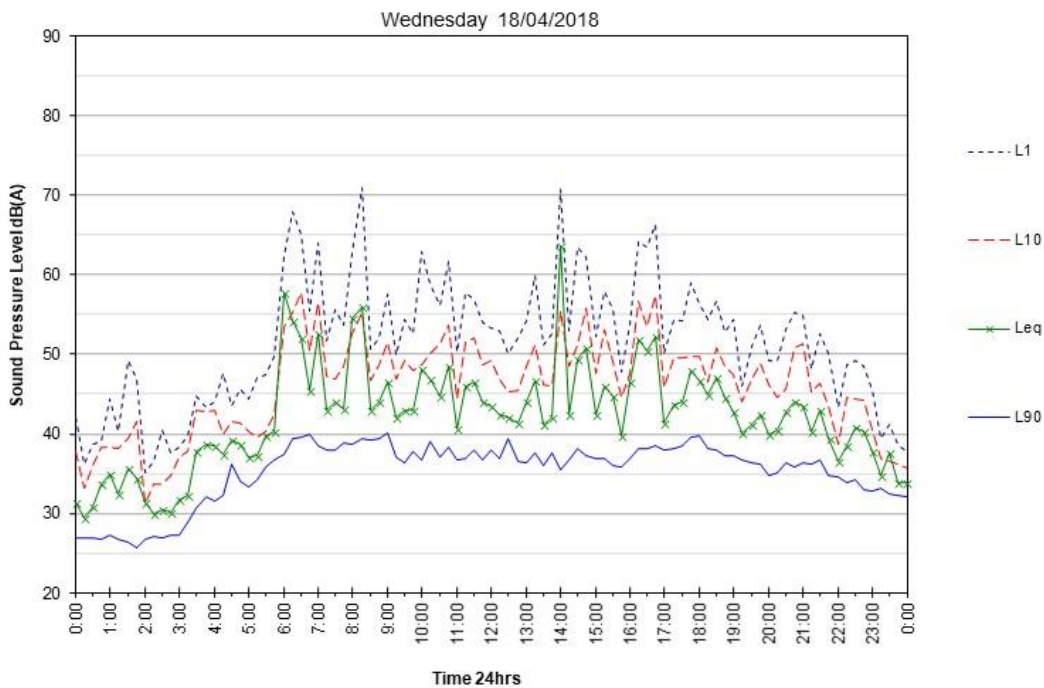
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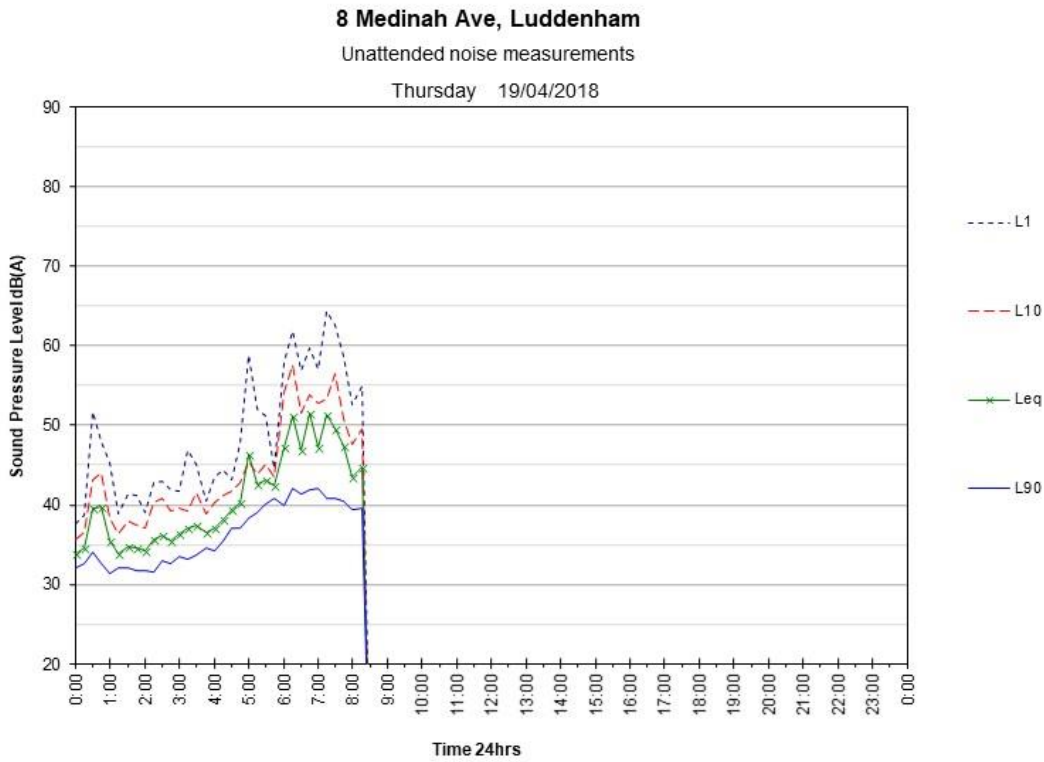


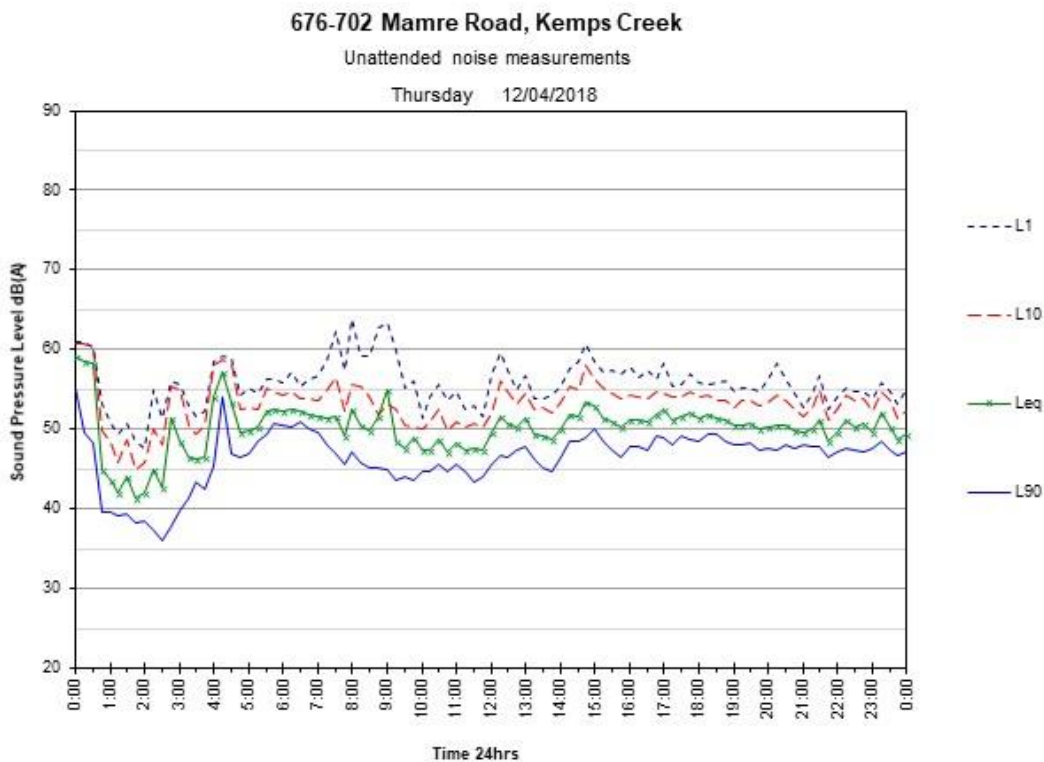
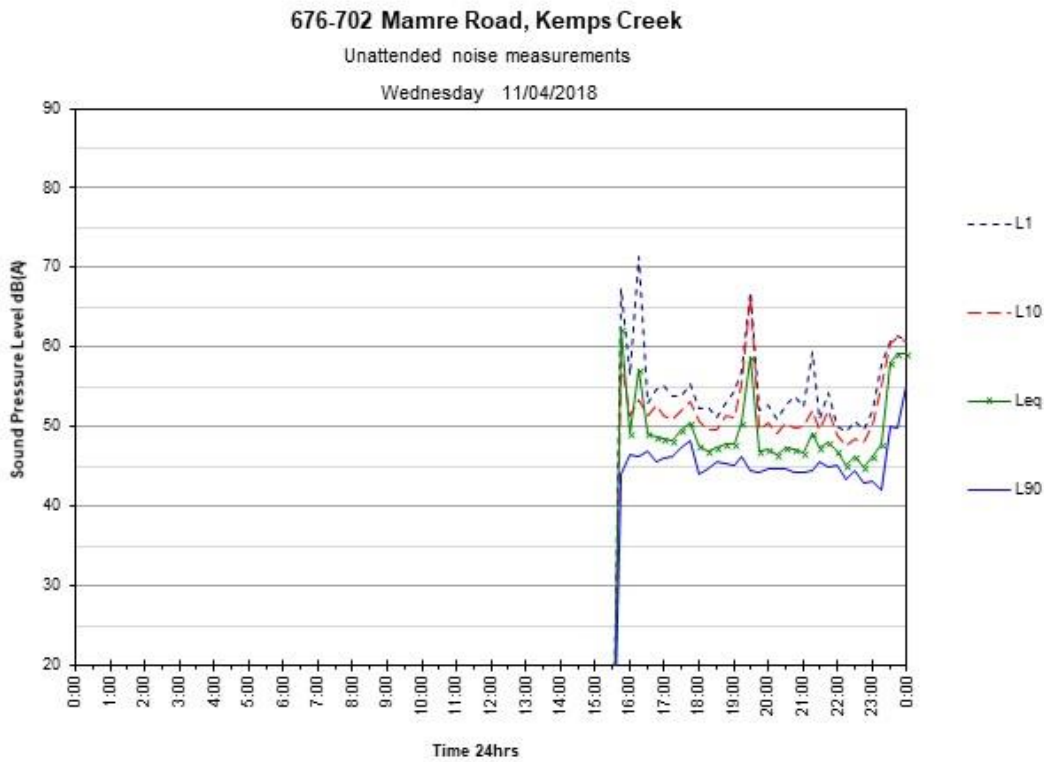
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Unattended noise measurements

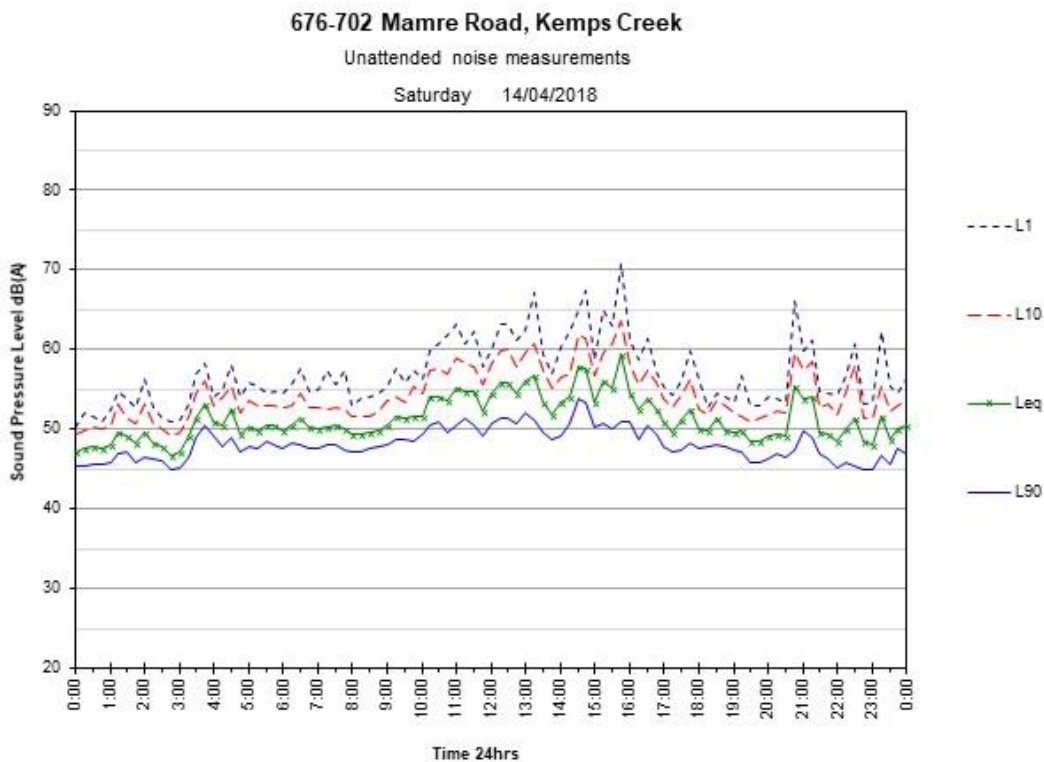
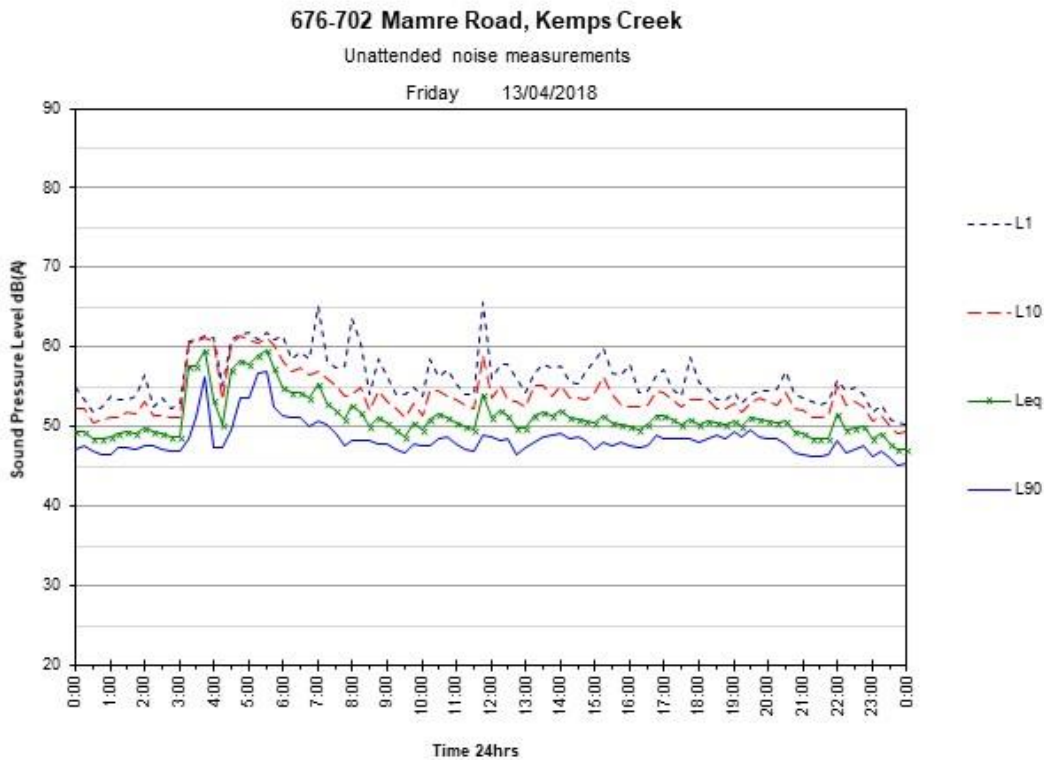


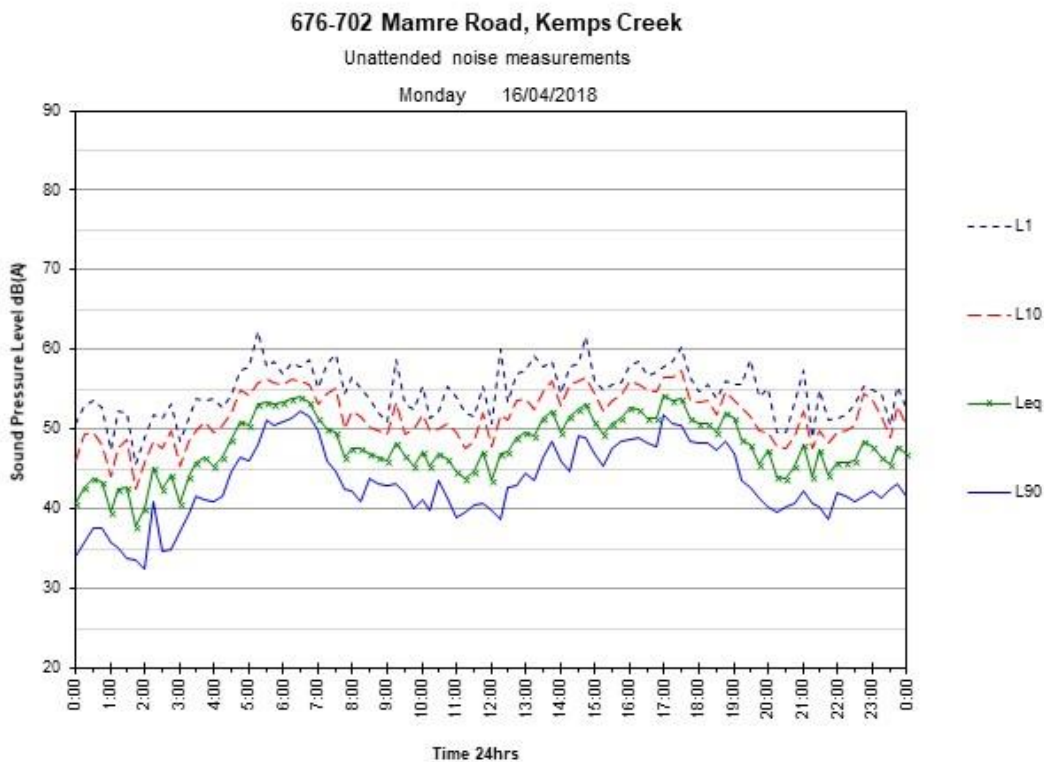
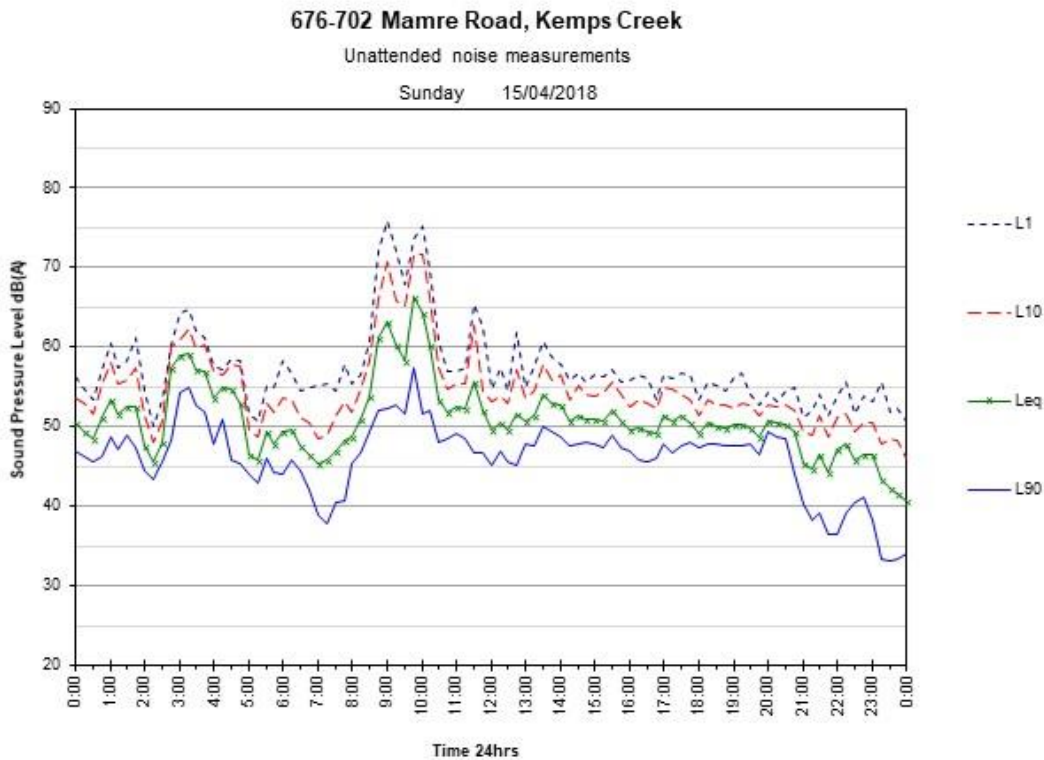
8 Medinah Ave, Luddenham
Unattended noise measurements







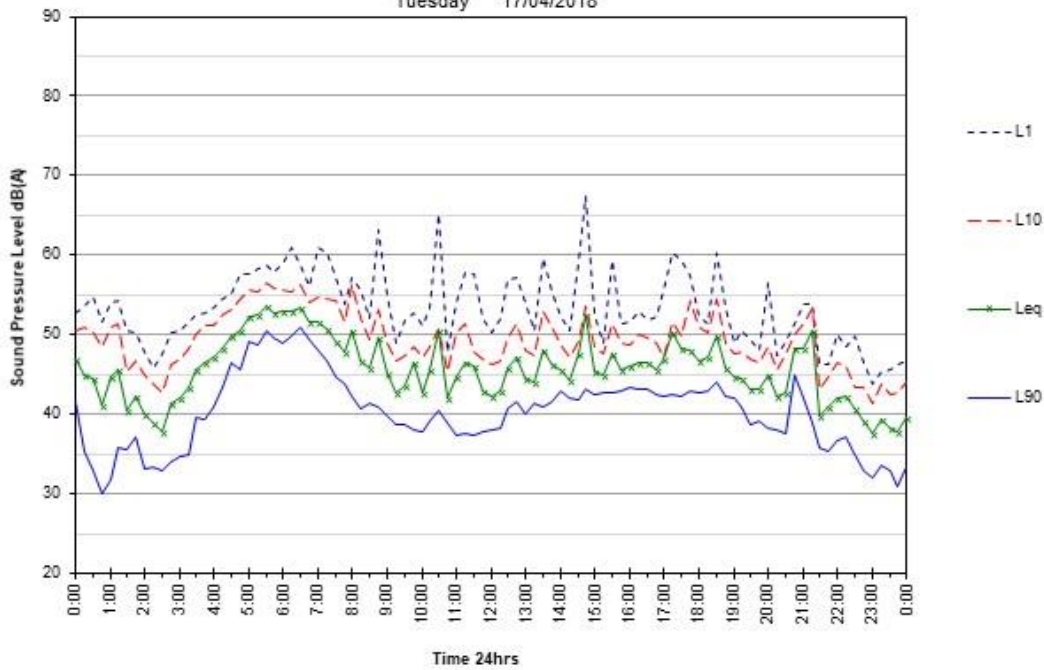




676-702 Mamre Road, Kemps Creek

Unattended noise measurements

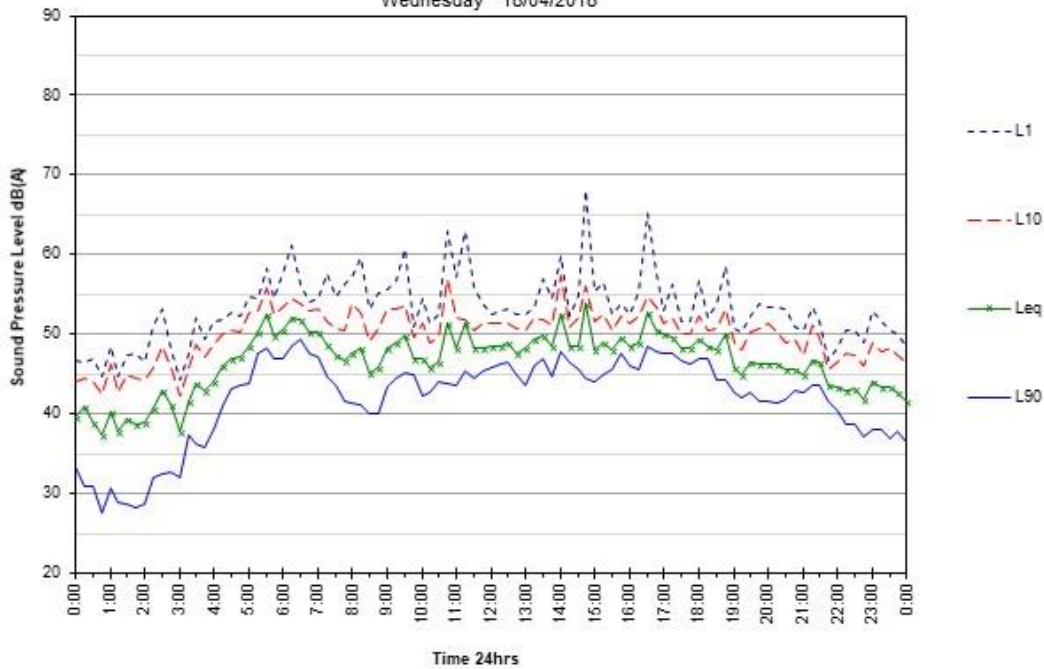
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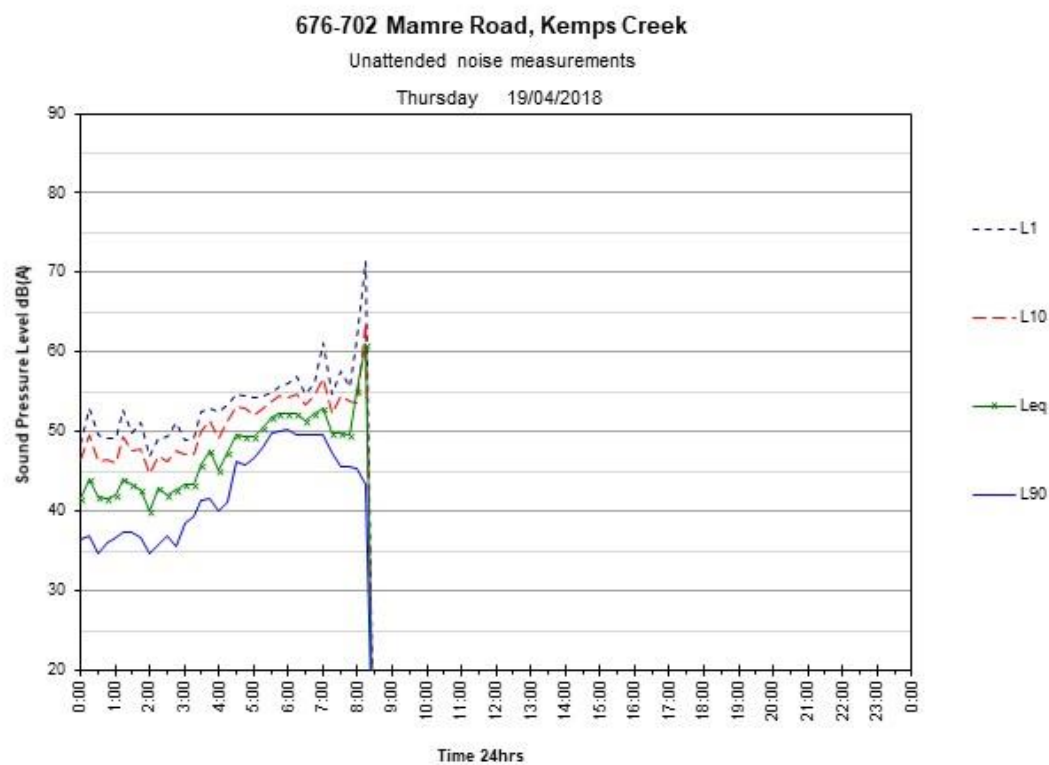


676-702 Mamre Road, Kemps Creek

Unattended noise measurements

Wednesday 18/04/2018





11.2 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.

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.

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

The "Responsible Person" should also document comments by others on the performance of the Noise Management Plan and provide his/her own performance overview during reviews of the plan.

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

11.2.1 All activities

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

11.2.2 Implementation of Management Plan

Element	Responsible Person
Aim	Provide a personnel contact for the Noise Management Plan
Action	<p>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.</p> <p>The Responsible Person will be required to receive, document and respond in an appropriate manner to complaints made against the centre with regards to noise.</p> <p>The Responsible Person is to keep record of performance indicators and feedback from management, staff, subcontractors and adjacent noise receivers as appropriate.</p> <p>The person would also be responsible for documenting changes/modifications to the Noise Management Plan.</p>

11.2.3 Active Involvement

Element	Responsible Person
Aim	All management, staff and sub-contractors actively support and implement the noise management plan.
Action	<p>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.</p> <p>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.</p> <p>Responsible Person to implement notification new staff or subcontractors with respect to the Noise Management Plan.</p>

11.2.4 Deliveries

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

11.2.5 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.

11.2.6 Complaints

Element	Response to complaints
Aim	Provide a friendly and immediate response to complaints.
Action	<p>Occupants of surrounding commercial premises should be provided with a telephone number for the "Responsible Person" in the event of a noise complaint.</p> <p>If a complaint is made, the "Responsible Person" responds to it in an appropriate and friendly manner and investigates the source of the complaint, and takes action to immediately reduce the noise level, if it is reasonable complaint.</p> <p>The "Responsible Person" maintains a record of complaints, which records the following details (refer to the example noise complaint record sheet):</p> <ul style="list-style-type: none"> -The time and date of lodgement of the complaint; -The name and telephone number of the complainant; -The nature of the complaint, including a description of the noise (e.g. likely noise source, duration of the noise event - is the noise continuous, or of a short duration); <p>If the complaint is on-going, an investigation by a qualified acoustical consultant may be necessary to determine if the complaint is bona-fide (i.e. noise is occurring beyond the limits set out in the approved acoustic assessment), and if so, recommend noise controls to achieve the approved noise limits.</p> <p>In cases where a complaint has been determined to be bona-fide, the "Responsible Person" should contact the complainant (if the complainant wishes) to advise on noise control measures, if any, adopted to reduce the noise impact. The noise control measures may include behavioural or physical, or a combination of the two.</p>

11.2.7 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	<p>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.</p> <p>The plan should be reviewed if processes or activities onsite are change/modified or new activities are introduced.</p> <p>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.</p> <p>Document all changes/modifications to the Noise Management Plan.</p>

11.3 Example noise complaint record sheet

COMPLAINT LODGEMENT INFORMATION	
Date of complaint	
Time of complaint	
Name of complainant (if given)	
Contact telephone number of complainant	
Description of noise (e.g. mechanical plant, vehicle noise)	
Duration of noise event (e.g. did it last a short time, or is it continuous)	

ACTION TAKEN	
Identification of noise source by Responsible Person	
Immediate action taken	
Previous similar complaints	
Contact with complainant after noise control implemented (e.g. is noise still an issue?)	
Is further action required (e.g. is an Acoustical Consultant required?)	

11.4 Noise monitoring

If required, short-term operator-attended noise measurements will be suitable for investigating 'spot-checks' of noise complaints in most situations. The methodology must establish the level of noise from the noise source being investigated and check for compliance.

11.4.1 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.

11.4.2 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} , L_p , and 1/3 octave spectrum (to establish any tonal characteristics).

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

11.4.3 Procedure for measuring noise

11.4.3.1 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.

11.4.3.2 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.

11.4.3.3 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.

11.4.3.4 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.

11.4.3.5 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 L_pA .
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.

11.4.3.6 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.

11.5 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.