Lloyd George Acoustics
PO Box 717
Hillarys WA 6923
T: 9401 7770
www.lgacoustics.com.au

Environmental Noise Assessment

Operations Noise Survey

Lot 41 (#17) Cardup Siding Road

Reference: 16053600-04

Prepared for:
Wormall Civil

Report: 16053600-04

Lloyd George Acoustics Pty Ltd

ABN: 79 125 812 544

PO Box 717
Hillarys WA 6923

www.lgacoustics.com.au

Contacts	General	Daniel Lloyd	Terry George	Matt Moyle
E:	info@lgacoustics.com.au	daniel@lgacoustics.com.au	terry@lgacoustics.com.au	matt@lgacoustics.com.au
P:	9401 7770	0439 032 844	0400 414 197	0412 611 330
Contacts	**Ben Hillion**	**Rob Connolly**	**Daryl Thompson**	**Hao Tran**
E:	ben@lgacoustics.com.au	rob@lgacoustics.com.au	daryl@lgacoustics.com.au	hao@lgacoustics.com.au
P:	0457 095 555	0410 107 440	0420 364 650	0438 481 207

Date:	Rev	Description	Prepared By	Verified
22-Sep-21	0	Issued to Client	Hao Tran	Matt Moyle

Table of Contents

List of Tables

List of Figures

Appendices

1 INTRODUCTION

Smartstream Technology's roto moulding factory operations workshops involves the assembly and production of concrete mouldings (West) and plastic mouldings (East) with the heavy engineering workshop to the northwest are all located within the Cardup Business Park of Lot 41 Cardup Siding Road, Cardup. As part of the approval conditions, operation noise surveys are to be conducted with full capacity operations within the site.

This report assesses the noise from full capacity operations against the prescribed standards of the *Environmental Protection (Noise) Regulations 1997* by way of site measurements. The nearest noise sensitive premises are located to the north, north east and west of the subject site.

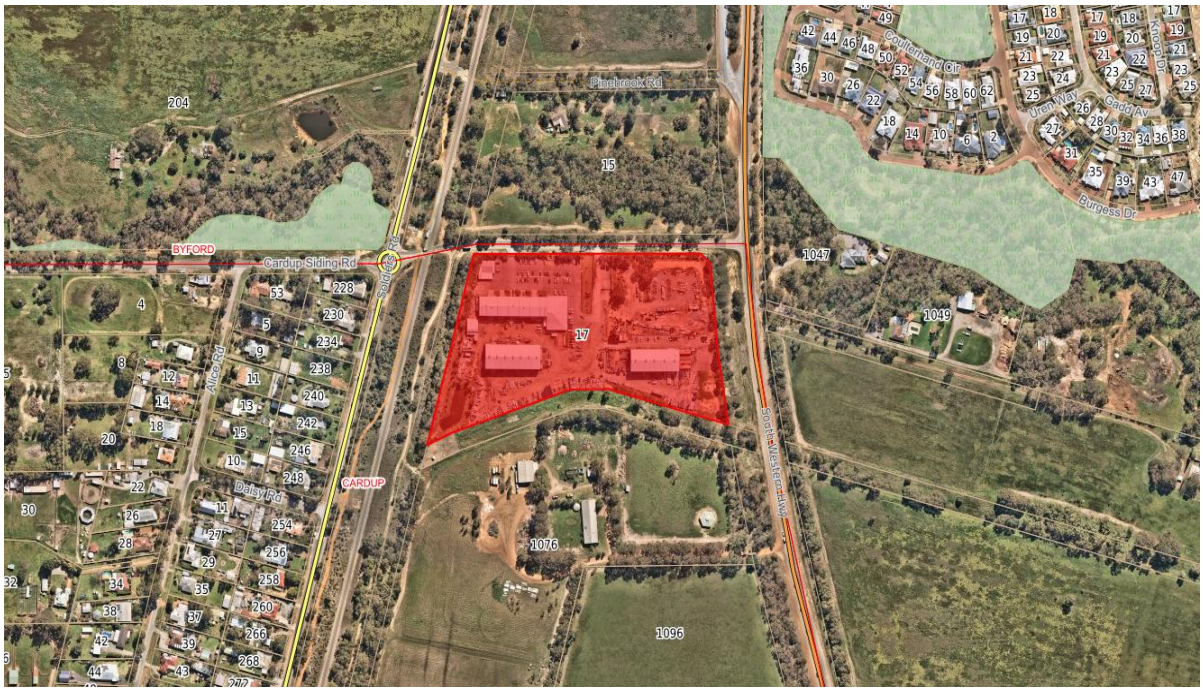


Figure 1-1 Project Locality (Shire of Serpentine-Jarrahdale intramaps)

The facility operates primarily between 7.00am and 7.00pm Monday to Saturday. The site survey was conducted during this period on 24 August 2021.

Appendix A contains a description of some of the terminology used throughout this report.

2 CRITERIA

Environmental noise in Western Australia is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

Regulation 7 defines the prescribed standard for noise emissions as follows:

"7. (1) Noise emitted from any premises or public place when received at other premises –

(a) Must not cause or significantly contribute to, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind; and

(b) Must be free of –

i. tonality;

ii. impulsiveness; and

iii. modulation,

when assessed under regulation 9"

A "…noise emission is taken to significantly contribute to a level of noise if the noise emission … exceeds a value which is 5 dB below the assigned level…"

Tonality, impulsiveness and modulation are defined in Regulation 9. Noise is to be taken to be free of these characteristics if:

(a) The characteristics cannot be reasonably and practicably removed by techniques other than attenuating the overall level of noise emission; and

(b) The noise emission complies with the standard prescribed under regulation 7 after the adjustments of *Table 2-1* are made to the noise emission as measured at the point of reception.

Table 2-1 Adjustments Where Characteristics Cannot Be Removed

Where Noise Emission is Not Music			Where Noise Emission is Music	
Tonality	Modulation	Impulsiveness	No Impulsiveness	Impulsiveness
+ 5 dB	+ 5 dB	+ 10 dB	+ 10 dB	+ 15 dB

Note: The above are cumulative to a maximum of 15dB.

The baseline assigned levels (prescribed standards) are specified in Regulation 8 and are shown in *Table 2-2*.

Table 2-2 Baseline Assigned Noise Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area[1]	0700 to 1900 hours Monday to Saturday (Day)	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays (Sunday)	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days (Evening)	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35 + influencing factor	45 + influencing factor	55 + influencing factor
Noise sensitive premises: any area other than highly sensitive area	All hours	60	75	80
Commercial	All hours	60	75	80
Industrial	All hours	65	80	90

1. ***highly sensitive area*** means that area (if any) of noise sensitive premises comprising —
   (a) a building, or a part of a building, on the premises that is used for a noise sensitive purpose; and
   (b) any other part of the premises within 15 metres of that building or that part of the building.

With reference to *Figure 2-1*, the nearest residences are grouped in four areas, being:

A. Multiple Residences along Soldiers Road, Cardup;

B. Single Residence at 15 Pinebrook Road, Byford and boundary position;

C. Multiple Residences at Coulterhand Circle, Byford; and

D. Single Residence at 1047 South Western Hwy, Byford and boundary position.

The influencing factor applicable at the residential groups varies at each location depending on their proximity to industrial land (including that proposed) and to secondary roads. Furthermore, as the influencing factor can vary within the group, a typical influencing factor has been used. For instance, those on Coulterhand Circle are assumed to be greater than 100m from South Western Highway (a secondary road) in order to assess at a more critical location (i.e. a lower influencing factor for a similar noise level). *Tables 2-3 to 2-4* provide the methodology in determining the influencing factor.

Table 2-3 Influencing Factor Calculation – Residences A and B

Description	Within 100 metre Radius	Within 450 metre Radius	Total
Industrial Land	2.1 dB 21 %	3.9 dB 39 %	6 dB
Transport Factor			**0 dB**
Total			**6 dB**

Table 2-4 Influencing Factor Calculation – Residences C and D

Description	Within 100 metre Radius	Within 450 metre Radius	Total
Industrial Land	0 dB 0 %	2.3 dB 23 %	2 dB
Transport Factor			**0 dB**
Total			**2 dB**

Table 2-5 shows the assigned noise levels including the influencing factor at the receiving locations. The receiving noise sensitive premises are identified in *Figure 2-1*.

Figure 2-1 Receiving Noise Sensitive Premises

Table 2-5 Assigned Noise Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Residences A and B	0700 to 1900 hours Monday to Saturday (Day)	51	61	71
	0900 to 1900 hours Sunday and public holidays (Sunday)	46	56	71
	1900 to 2200 hours all days (Evening)	46	66	61
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	41	51	61
Residences C and D	0700 to 1900 hours Monday to Saturday (Day)	47	57	67
	0900 to 1900 hours Sunday and public holidays (Sunday)	42	52	67
	1900 to 2200 hours all days (Evening)	42	52	57
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	37	47	57

1. ***highly sensitive area*** means that area (if any) of noise sensitive premises comprising —
   (a) a building, or a part of a building, on the premises that is used for a noise sensitive purpose; and
   (b) any other part of the premises within 15 metres of that building or that part of the building.

It should be noted the assigned noise levels above apply outside the receiving premises and at a point at least 3 metres away from any substantial reflecting surfaces.

It is further noted the assigned noise levels are statistical levels and therefore the period over which they are determined is important. The Regulations define the Representative Assessment Period (RAP) as *a period of time of not less than 15 minutes, and not exceeding 4 hours*, which is determined by an *inspector* or *authorised person* to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission. An *inspector* or *authorised person* is a person appointed under Sections 87 & 88 of the *Environmental Protection Act 1986* and include Local Government Environmental Health Officers and Officers from the Department of Environment Regulation. Acoustic consultants or other environmental consultants are not appointed as an *inspector* or *authorised person*. Therefore, whilst this assessment is based on a 4 hour RAP, which is assumed to be appropriate given the nature of the operations, this is to be used for guidance only.

Noise from an industrial park is somewhat unique in that each individual industry must not significantly contribute to the assigned noise levels at a residence. This is deemed as being satisfied if each individual industry is 5 dB below the assigned noise level. For example, each industry operating during the day, must be 46 dB L_{A10} at a residence on Soldiers Road, being 5 dB less than

the 51 dB L_{A10} assigned noise level. The purpose of this requirement is to limit the cumulative effect of multiple industries noise at a residence. When this requirement is satisfied, noise levels are low enough that intrusive characteristics are unlikely to be audible and therefore no further penalties (as per *Table 2-1*) need be applied. As such, this assessment considers the emissions from the proposed workshop as an isolated facility.

3 METHODOLOGY

3.1 Site Measurements

Under the Regulations, there are certain requirements that must be satisfied when undertaking measurements and are defined in Regulations 19, 20, 22 and 23 and Schedule 4. In undertaking the measurements, these have been satisfied, specifically noting the following:

- The sound level meter used was:
    - Bruel & Kjaer Type 2250 (S/N: 3011946);
- All equipment holds current laboratory certificates of calibration that are available upon request. The equipment was also field calibrated before and after and found to be within +/- 0.5 dB.
- Microphone was fitted with a standard wind screen.
- The microphone was at least 1.4 metres above ground level and at least 3.0 metres from reflecting facades (other than the ground plane).

Measurements were recorded on 24 August 2021 between 10.30am and 2.00pm. Meteorological conditions at the time, recorded at the Bureau of Meteorology's Jandakot site, were:

- Temperature 17°C
- Humidity 42%
- Wind Speed 6m/s
- Wind Direction Easterly

Background noise could not be directly measured, as the noise source (workshop) could not be turned off. As such, measurements were undertaken at the nearest boundary, noting that traffic noise influenced background noise at this time.

The measurement durations were between 10 and 20 minutes as background noise fluctuated significantly due to traffic. Nevertheless, the measured value is deemed to be consistent over time and as such, comparison with the 3dB tonality clause has been undertaken, since it is considered the measured value would be present for more than 10% of the minimum representative assessment period (15-minutes).

Background noise was influenced by road traffic, wind noise, wildlife.

Noise measurements were taken at the nearest point on the boundaries of Residences A, B and D. Location C was observed briefly but noise from the workshops was inaudible.

Figures 3-1 to 3-3 below show photographs of the measurement equipment. It was not possible to measure at the dwellings of Residence A, B or D as it would have required access to those properties.

Figure 3-1 Sound Level Meter at Boundary Residence A looking East to Site

Figure 3-2 Sound Level Meter at Boundary Residence A looking East to Site

Figure 3-3 Boundary Residence D looking West to Shed

4 RESULTS AND ASSESSMENT

4.1 Noise Measurements

The results of the noise measurements are summarised below in *Table 4-1* with the L_{A10} level being the most relevant critical parameter. The predicted levels from the original environmental assessment have also been included in the table for comparison purposes.

Table 4-1 Measured and Predicted Noise Levels, dB L_{A10}

Location	Predicted Level, dB L_{A10}	Measured Level, dB L_{A10}	Measured Level, dB L_{A1}	Measured Level, dB L_{Amax}	Day Assigned Level, dB L_{A10}	Exceedence
Residence A (230 Soldiers Road)	46	49*	53	59	51	*Complies*
Residence A (238 Soldiers Road)	46	49*	55	59	51	*Complies*
Residence B Boundary	42	47	48	55	60	*Complies*
Residences C	38	Inaudible	Inaudible	Inaudible	47	*Complies*
Residence D Boundary	49	47	48	55	60	*Complies*

*Noise levels were influenced by South West Hwy traffic noise – which was audible throughout the measurement.

The worst case noise level is at Residence A boundary where a level of 49 dB L_{A10} is measured, dominated by noise from frequent road traffic from both South Western Highway and Soldiers Road. With the occasional movement of forklifts and hammering from mould stripping process within the site. The measured levels comply with the assigned levels for daytime and with roller doors open for workshops.

Analysis of the measurements revealed that the noise source was from the movement of the forklift and the rattle from the empty forks when driving on uneven ground.

4.2 Observed Operations

Post the noise survey, brief site visit was attended to observe the operations within the workshops and to ensure all work was occurring as normal. At the concrete moulding plant, three South roller doors were observed to be open. Use of the powered crane to lift the concrete moulds into position and impact noises throughout, including hammering of cured moulds (mould stripping). While at the roto-moulding plant, two roller doors to the South were observed to be open. The roto-moulding plant was operating on a repeat cycle and staff were seen working in all areas as normal. The only noise source heard was the humming noise of the oven within the plant, but this was not audible unless you are within the plant. Whilst on-site, observations revealed that the movement of forklifts on uneven ground within the site made the forks rattle (metal clang) if the forklift was empty and not carrying anything.

5 CONCLUSION

The measured noise impacts resulting from the fully operational concrete moulding plant and Smartstream Technologies workshop at the site of Lot 41 Cardup Siding Road, Cardup have been assessed in accordance with the *Environmental Protection (Noise) Regulations 1997*. Noise levels are assessed as compliant with the assigned noise levels, determined in accordance with these Regulations, and not significantly contribute to neighbouring industrial noise during the day. The facility was observed to be operating under normal conditions.

Appendix A

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)
The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting
An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

Sound Power Level (L_w)
Under normal conditions, a given sound source will radiate the same amount of energy, irrespective of its surroundings, being the sound power level. This is similar to a 1kW electric heater always radiating 1kW of heat. The sound power level of a noise source cannot be directly measured using a sound level meter but is calculated based on measured sound pressure levels at known distances. Noise modelling incorporates source sound power levels as part of the input data.

Sound Pressure Level (L_p)
The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

L_{ASlow}
This is the noise level in decibels, obtained using the A frequency weighting and the S (Slow) time weighting as specified in IEC 61672-1:2002. Unless assessing modulation, all measurements use the slow time weighting characteristic.

L_{AFast}
This is the noise level in decibels, obtained using the A frequency weighting and the F (Fast) time weighting as specified in IEC 61672-1:2002. This is used when assessing the presence of modulation only.

L_{APeak}
This is the greatest absolute instantaneous sound pressure in decibels using the A frequency weighting as specified in IEC 61672-1:2002.

L_{Amax}
An L_{Amax} level is the maximum A-weighted noise level during a particular measurement.

L_{A1}
An L_{A1} level is the A-weighted noise level which is exceeded for one percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{A10}
An L_{A10} level is the A-weighted noise level which is exceeded for 10 percent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{Aeq}
The equivalent steady state A-weighted sound level ("equal energy") in decibels which, in a specified time period, contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the "average" noise level.

L_{A90}
An L_{A90} level is the A-weighted noise level which is exceeded for 90 percent of the measurement period and is considered to represent the "*background*" noise level.

One-Third-Octave Band
Means a band of frequencies spanning one-third of an octave and having a centre frequency between 25 Hz and 20 000 Hz inclusive.

L_{Amax} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded at any time.

L_{A1} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 1% of the representative assessment period.

L_{A10} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 10% of the representative assessment period.

Tonal Noise
A tonal noise source can be described as a source that has a distinctive noise emission in one or more frequencies. An example would be whining or droning. The quantitative definition of tonality is:

the presence in the noise emission of tonal characteristics where the difference between -

(a) the A-weighted sound pressure level in any one-third octave band; and

(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$ levels.

This is relatively common in most noise sources.

Modulating Noise
A modulating source is regular, cyclic and audible and is present for at least 10% of the measurement period. The quantitative definition of modulation is:

a variation in the emission of noise that —

(a) is more than 3 dB $L_{A\ Fast}$ or is more than 3 dB $L_{A\ Fast}$ in any one-third octave band;

(b) is present for at least 10% of the representative.

Impulsive Noise
An impulsive noise source has a short-term banging, clunking or explosive sound. The quantitative definition of impulsiveness is:

a variation in the emission of a noise where the difference between $L_{A\ peak}$ and $L_{A\ Max\ slow}$ is more than 15 dB when determined for a single representative event;

Major Road
Is a road with an estimated average daily traffic count of more than 15,000 vehicles.

Secondary / Minor Road
Is a road with an estimated average daily traffic count of between 6,000 and 15,000 vehicles.

Influencing Factor (IF)

$$= \frac{1}{10}(\%\ \text{Type A}_{100} + \%\ \text{Type A}_{450}) + \frac{1}{20}(\%\ \text{Type B}_{100} + \%\ \text{Type B}_{450})$$

where:

$\%\ \text{Type A}_{100}$ = the percentage of industrial land within a100m radius of the premises receiving the noise

$\%\ \text{Type A}_{450}$ = the percentage of industrial land within a 450m radius of the premises receiving the noise

$\%\ \text{Type B}_{100}$ = the percentage of commercial land within a100m radius of the premises receiving the noise

$\%\ \text{Type B}_{450}$ = the percentage of commercial land within a 450m radius of the premises receiving the noise

+ Traffic Factor (maximum of 6 dB)

= 2 for each secondary road within 100m

= 2 for each major road within 450m

= 6 for each major road within 100m

Representative Assessment Period
Means a period of time not less than 15 minutes, and not exceeding four hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission.

Background Noise
Background noise or residual noise is the noise level from sources other than the source of concern. When measuring environmental noise, residual sound is often a problem. One reason is that regulations often require that the noise from different types of sources be dealt with separately. This separation, e.g. of traffic noise from industrial noise, is often difficult to accomplish in practice. Another reason is that the measurements are normally carried out outdoors. Wind-induced noise, directly on the microphone and indirectly on trees, buildings, etc., may also affect the result. The character of these noise sources can make it difficult or even impossible to carry out any corrections.

Ambient Noise
Means the level of noise from all sources, including background noise from near and far and the source of interest.

Specific Noise
Relates to the component of the ambient noise that is of interest. This can be referred to as the noise of concern or the noise of interest.

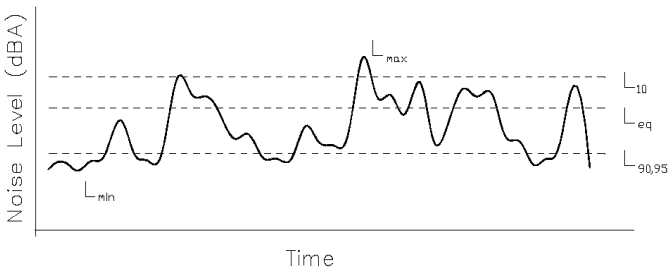
Peak Component Particle Velocity (PCPV)
The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x, y or z) measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

Peak Particle Velocity (PPV)
The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

RMS Component Particle Velocity (PCPV)
The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x, y or z) measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

Peak Particle Velocity (PPV)
The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

Chart of Noise Level Descriptors



Typical Noise Levels