Project No: 212177R

Noise Impact Assessment
Proposed Residential Subdivision
Inverness Avenue, Mudgee - NSW

Prepared for:

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1.0 INTRODUCTION

This report presents the results and findings of an acoustic assessment of a proposed 22 lot residential subdivision on land described as Lot 2 D.P. 153695 and Lot 27 D.P. 1165146, Robertson Street, Mudgee.

The assessment addresses issues raised by Mid Western Regional Council (MWRC) in relation to D.A. 0178/2022. MWRC have requested more information in relation to the proposed extension to an acoustic mound and all other acoustic measures required to be implemented within the design of the development to ensure there are no acoustic impacts on future residents of the development from the existing Depot Road industrial precinct.

The assessment has been conducted in accordance with procedures as detailed in the *Noise Policy for Industry* (NPfI).

2.0 BACKGROUND TO THE NIA

The approximate location of the site in relation to the Depot Road industrial precinct is shown indicatively in **Figure 1**. The location lies between the industrial precinct and the golf course, at the extension of an existing cul-de-sac (Inverness Avenue).

Figure 1 – Indicative Site Location (source: Google Earth)

The current proposal is to subdivide the land into residential lots with supplied plans showing single and two storey dwellings.

Spectrum Acoustics previously undertook an acoustic assessment of the theoretical noise emissions from the industrial sheds that are located on the western side of Depot Road, as shown in Figure 1 (noting that Figure 1 is an image from Google Earth which is now outdated and there are to be sheds located along the full length of the Depot Road boundary).

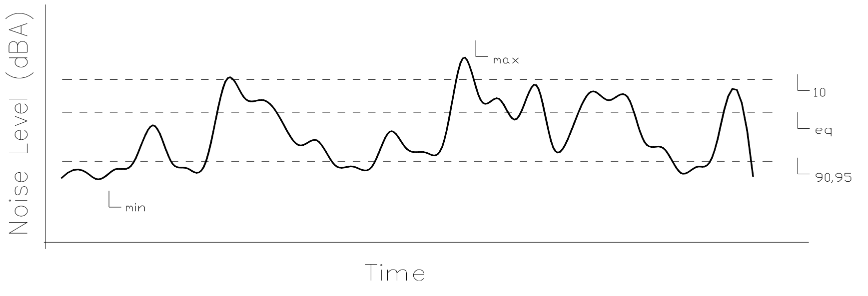
The assessment was detailed in Spectrum Acoustic report number 212122R-29446, dated July 2021. Some results of that assessment are referenced herein.

3.0 DESCRIPTION OF TERMS

Table 1 contains the definitions of commonly used acoustical terms and is presented as an aid to understanding this report.

TABLE 1
DEFINITION OF ACOUSTICAL TERMS

Term	Definition
dB(A)	The quantitative measure of sound heard by the human ear, measured by the A-Scale Weighting Network of a sound level meter expressed in decibels (dB).
SPL	Sound Pressure Level. The incremental variation of sound pressure above and below atmospheric pressure and expressed in decibels. The human ear responds to pressure fluctuations, resulting in sound being heard.
STL	Sound Transmission Loss. The ability of a partition to attenuate sound, in dB.
Lw	Sound Power Level radiated by a noise source per unit time re 1pW.
Leq	Equivalent Continuous Noise Level - taking into account the fluctuations of noise over time. The time-varying level is computed to give an equivalent dB(A) level that is equal to the energy content and time period.
L1	Average Peak Noise Level - the level exceeded for 1% of the monitoring period.
L10	Average Maximum Noise Level - the level exceeded for 10% of the monitoring period.
L90	Average Minimum Noise Level - the level exceeded for 90% of the monitoring period and recognised as the Background Noise Level. In this instance, the L90 percentile level is representative of the noise level generated by the surrounds of the residential area.



4.0 NOISE CRITERIA

4.1 Operational Noise Goals

The previous acoustic assessment determined appropriate noise criteria for industrial noise emissions (from the industrial precinct) based on procedures detailed in the NPfI. These noise criteria are summarised in **Table 2**.

TABLE 2
NOISE CRITERIA

Location	Criterion	Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)	Morning Shoulder (5am-7am)
Depot Rd.	Intrusiveness dB(A),Leq(15-min.)[1]	50	40	36	38
	Amenity dB(A),Leq(15 min)[2]	53	43	38	n/a
	Project Noise Trigger Levels dB(A) Leq (15 min.)	**50**	**40**	**36**	**38**

1 Rating Background Level (RBL) + 5dB. RBL is the median value of each ABL (Assessment Background Level) over the entire monitoring period. The ABL is a single figure representing the "L_{90} of the $L_{90's}$" for each separate day of the monitoring period.
2. Project amenity noise level (ANL) is suburban ANL (NPI Table 2.1) minus 5 dB(A) plus 3 dB(A) to convert from a period level to a 15-minute level

4.2 Sleep Disturbance

It is proposed that some of the industries in the sheds may operate during the night time period. The potential for sleep disturbance from maximum noise level events during the night-time period, therefore, needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

The NPfI states that a detailed maximum noise level event assessment should be undertaken where the subject development/premises night-time noise levels at a residential location exceed:

- Leq (15 min) 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or

- Lmax 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater.

The logger data presented in Table 2 shows that the prevailing RBL is 31 dB(A) L90 and, therefore, the trigger level for a detailed assessment is **40 dB(A) Leq (15 min)** and/or **52 dB(A) Lmax**.

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the NSW Road Noise Policy (RNP).

Other factors that may be important in assessing the extent of impacts on sleep include:

- how often high noise events will occur,
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the subject development,
- whether there are times of day when there is a clear change in the noise environment (such as during early-morning shoulder periods), and
- current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.

The detailed assessment should consider all feasible and reasonable noise mitigation measures with a goal of achieving the above trigger levels.

5.0 NOISE IMPACT ASSESSMENT

5.1 Operational Noise

The proposed layout of the subdivision site is shown in **Figure 2**.

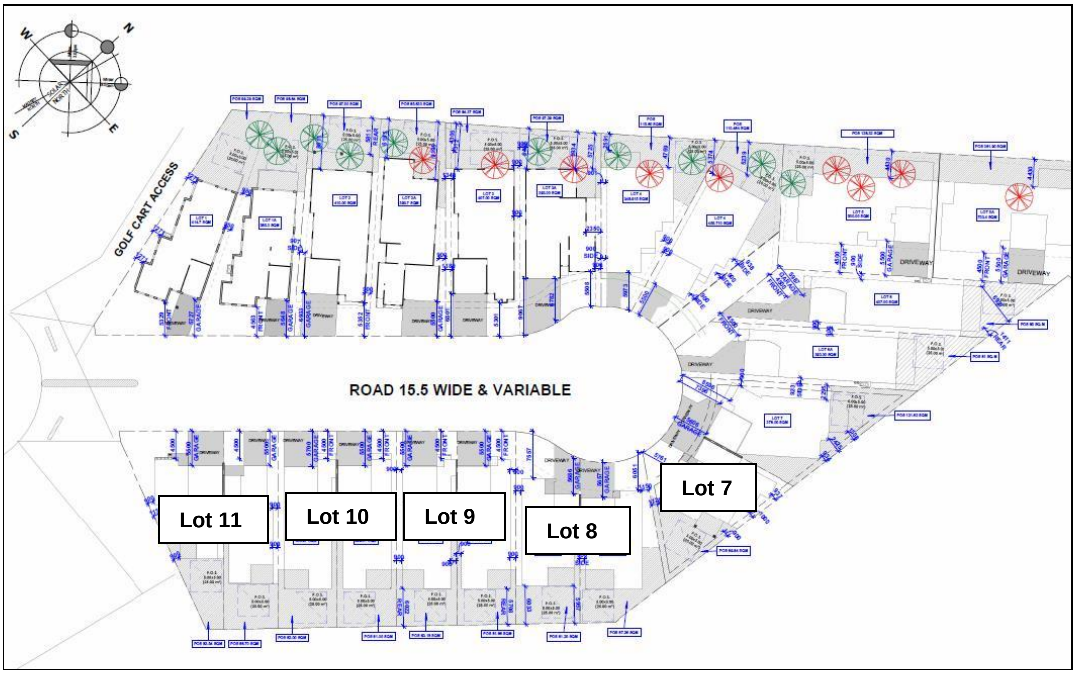


Figure 2 – Site Layout

As shown in Figure 2 it is proposed that the site will be subdivided into separate dual occupancy residential lots. Of the most potentially affected Lots (in relation to the industrial noise) it is proposed to build two storey dwellings on Lots 11 and 10. Lots 9, 8 and 7 will have single storey dwellings.

The previous assessment concluded that acoustic barriers (in the form of appropriate boundary fences) would be required to ensure the operation of the industrial sheds would not impact on the acoustic amenity of the existing residential areas in the vicinity.

The assessment concluded that the barrier adjacent to the yard of Shed No. 1 on Depot Road (the shed at the south west of the row) would have a 5.6m barrier in place and the remainder of the boundary would have a 2.5m barrier.

As part of the current assessment there is to be an acoustic mound in the buffer area between the subdivision and the industrial sheds. This mound is the subject of the MWRC request for information.

Preliminary calculations showed that, to minimise potential noise impacts at the proposed residential receivers, the mound with an acoustic fence on top would need to be constructed to a height of 4m above existing ground level.

That is, an effective acoustic barrier may be constructed of a composite of an earthen mound and acoustically solid fencing to the required height, provided there are no gaps or discontinuities which would allow for the passage of noise. In the current instance, for example, it may be a 2m high earthen mound with a 2m high fence on top of it. The approximate extent of the 4m barrier is shown on **Figure 3**.

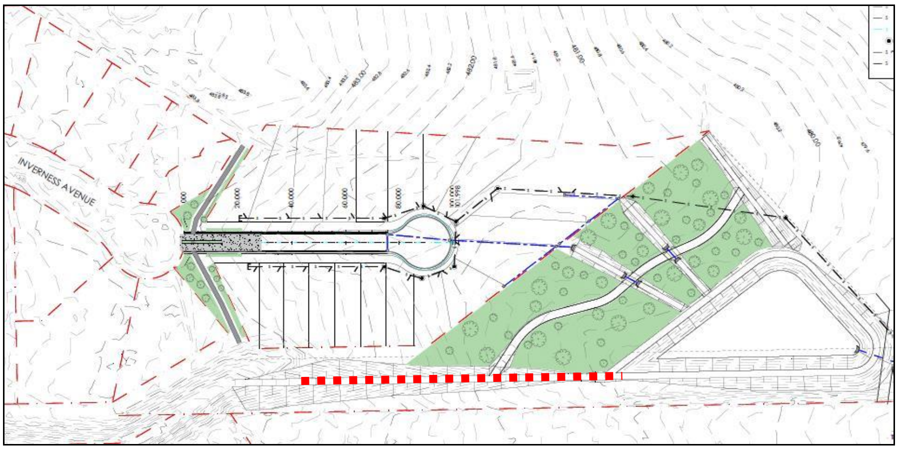


Figure 3 – 4m Acoustic Barrier Location (approximate)

At the time of the current assessment the industrial sheds were under construction and not fully occupied. It is envisaged that the end users may be light industries such as mechanical workshops, fabricators or similar.

Noise from the operation of the existing workshop in Shed number 1 was measured on site in July 2021. All sound levels from various workshop activities were measured with a Bruel & Kjaer Type 2250 Precision Sound Level Analyser with calibration performed before and after the measurements.

At the time of the noise measurements the workshop was operating under typical conditions. The measurements included the general operation of the workshop (grinding, welding hammering etc.) as well as specific measurements made of gouging.

The plans for the development show that proposed Lots 11 and 11A, 10 and 10A will be adjacent to the rear yard of Shed No. 1.

Calculations of potential noise impacts from activity in Shed 1 were undertaken to the rear yard and the first floor of Lot 11A, assuming the insertion loss for a 5.6m high solid acoustic barrier.

Table 3 shows a calculation of the measured general workshop noise propagated from the opening at Shed 1 and impacting on the proposed residential receiver to the south west at 11A Inverness

Avenue. The noise criteria are applicable externally and, therefore, the calculation has been undertaken to a theoretical receiver standing in the yard of the proposed residence at 5m from the boundary.

TABLE 3
SHED 1 WORKSHOP NOISE as dB(A) Leq (15 min)
11A INVERNESS AVE (YARD) – SHED DOOR OPEN

	TOTAL	Octave Band Centre Frequency, Hz							
Propagation Elements	dB(A)	63	125	250	500	1k	2k	4k	8k
Source Lw	106	71	84	86	90	91	91	103	101
Average distance loss (35m)		39	9	39	39	39	39	39	39
Barrier Insertion Loss (5.6m)		10	13	16	19	22	24	24	24
SPL in Yard	44	22	32	31	33	32	28	40	38

The proposed residences at Lots 11 and 10 are to be two storey. **Table 4** shows a similar calculation to that in Table 3 but with impacts determined to the outside of the first floor windows.

TABLE 4
SHED 1 WORKSHOP NOISE as dB(A) Leq (15 min)
11A INVERNESS AVE (FIRST FLOOR) – SHED DOOR OPEN

	TOTAL	Octave Band Centre Frequency, Hz							
Propagation Elements	dB(A)	63	125	250	500	1k	2k	4k	8k
Source Lw	106	71	84	86	90	91	91	103	101
Average distance loss (40m)		40	40	40	40	40	40	40	40
Barrier Insertion Loss (5.6m)		7	10	12	15	18	21	24	24
SPL at First Floor Window	45	24	35	34	35	35	30	40	38

The results in Tables 3 and 4 show that, under the assessed conditions, and with the 5.6m acoustic barrier in place, the received noise will not exceed the adopted day time criterion at the theoretical reception points at Lot 11A, either in the yard or at the first floor windows.

The results in Tables 3 and 4 show that, under the assessed conditions, the noise from Shed 1 will exceed the evening and night criteria. It has been proposed that the doors in the industrial sheds be closed during the evening and night. **Table 5**, therefore, shows a calculation of the workshop noise propagated through the walls, with the operable wall and doors closed, and impacting on the receiver at 11A Inverness Avenue.

The calculation takes into account the effects of transmission loss through building elements, with the wall closed, and hemispherical spreading (distance loss) to the receiver. From consideration of the dimensions and orientation of the various building elements, the sound pressure levels immediately outside these were propagated to the nearest receiver using an equation[1] giving the sound field due to an incoherent plane radiator.

The barrier insertion loss assumes the 5.6m barrier in place and a source height for the shed at 3m.

TABLE 5
SHED 1 WORKSHOP NOISE as dB(A) Leq (15 min)
11A INVERNESS AVE – SHED DOOR CLOSED

	TOTAL	Octave Band Centre Frequency, Hz							
Propagation Elements	dB(A)	63	125	250	500	1k	2k	4k	8k
Source Lw	106	71	86	85	89	92	90	102	100
Average distance loss in shed (10m)		18	18	18	18	18	18	18	18
STL of wall (0.4mm steel)		13	11	14	18	21	26	24	23
Exterior SPL	65	40	57	53	53	53	46	60	59
Barrier Insertion Loss		7	8	10	12	15	18	21	24
SPL at First Floor Window	30								

The results in Table 5 show that, under the assessed conditions, with all doors closed, the noise emissions from the assessed activities in Shed 1 will not exceed the adopted evening or night time criteria at a theoretical reception point on the first floor of the residence at Lot 11A.

The calculation assumes all activities are being undertaken inside the shed during the evening and night and that there is no activity outside in the yard.

The noise from gouging in Shed 1 was measured to be approximately 6 dB(A) louder than that of the general workshop. Based on the results in Tables 3 and 4 this would indicate that the combined noise from gouging plus the general workshop would be in compliance with the external day time criterion with the doors in the shed open.

Under similar circumstances to those detailed above, the noise from gouging would be higher than the evening and night time criteria.

It is previously been recommended that, if gouging is to be undertaken during the evening the wall must be closed. Gouging should not be undertaken at night.

The results in Tables 3, 4 and 5 are considered applicable to the theoretically predicted noise at proposed residences on Lots 11, 11A, 10 and 10A, which would be most significantly impacted by noise from

[1] Equation (5.104), DA Bies and CH Hansen, _Engineering Noise Control_, E & FN Spon, 1996.

the operation of Shed 1. The other proposed residences are exposed to noise from the other sheds in the industrial precinct.

Other Lots in the proposed subdivision may be impacted by noise from the other sheds in the industrial precinct, particularly Sheds 2 and 3. The sheds may be leased or sold to various users.

The designs for Sheds 2 and 3 are shown in **Figure 4**.

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Figure 4 – Sheds 2 and 3 Design

Sheds 2 and 3 are designed with roller door openings in the southern and western facades. These roller doors will face towards the proposed receivers in the subdivision. Noise emissions from the open roller doors, particularly those in the southern facade will be partially shielded from the receivers by the acoustic barrier effects of the intervening sheds and/or the orientation of the doors with respect to the receiver boundaries.

The layout of both sheds is such that parking areas for each are located "behind" the sheds with respect to the proposed subdivision. The building elements of the sheds will provide good acoustic shielding in the direction of those receivers.

To determine any potential noise impacts at residences in proposed Lots 9, 8 and 7, a noise source similar to that measured in Shed 1 was considered to be operating in Shed 3.

Table 6 shows a theoretical calculation of the noise from Shed 3 with the roller doors to the shed assumed to be open.

The calculation has been made to the proposed receiver at Lot 8 Inverness Avenue. A 4m composite barrier was assumed to be in place in the buffer zone. For an assumed noise source height of 3m (for the top section of the open roller door), the insertion loss for a 4m high barrier and with a 1.5m high receiver standing in the yard of the proposed residence has been included in the results shown in Table 6.

TABLE 6
SHED 3 NOISE as dB(A) Leq (15 min)
8 INVERNESS AVENUE – SHED DOORS OPEN

	TOTAL	Octave Band Centre Frequency, Hz							
Propagation Elements	dB(A)	63	125	250	500	1k	2k	4k	8k
Source Lw	106	71	86	85	89	92	90	102	100
Distance Loss		40	40	40	40	40	40	40	40
Barrier Loss (4m)		7	8	10	13	15	18	21	24
SPL at Receiver	46	24	36	36	37	36	36	42	37

The results in Table 6 show that, under the assessed conditions, and with roller doors open, the received noise would not exceed the day time noise criterion in the yard of the receivers at Lots 9, 8 and 7.

With the roller doors closed the noise emissions will be reduced by at least 15 dB(A) which will equate to received noise of less than 31 dB(A) Leq (15 min) during the evening and night. This is in compliance with the adopted evening and night time criteria.

The calculations in Table 6 are based on the noise levels from the existing workshop in Shed 1 but are considered likely to be representative of most typical machinery or light fabrication workshops.

The operation of other commercial activities in the other sheds would require specific assessment but, as a general indication, the noise from workshops as measured is at the upper end of expected noise levels for any activities that may occur in industrial sheds like those to be constructed.

Other sheds on the site are further away from any residences and are also further shielded from receivers by the structure of the intervening buildings.

5.2 Sleep Disturbance

The discussion of operational noise during the evening and night indicates that during the night time period all significant noise generating activities should be undertaken inside the various sheds and with all external doors and openings closed.

The potential for sleep disturbance impacts is, therefore most likely to come from loud noise associated with people arriving or departing work (car doors, engine revs etc.) or from noise associated with the delivery or transport of parts or machinery. All of these events have relatively loud maximum noise levels which, when averaged out over a 15 minute period have an acceptable Leq noise level.

A scenario has been assessed where a noise source representing an impact from a truck being unloaded in the yard of Shed 3 is potentially impacting on the receiver at 8 Inverness Avenue at a distance of approximately 40m.

Table 7 shows a calculation of the maximum noise levels propagated from the yard at Shed 3 and impacting on the proposed receiver at 8 Inverness Avenue. The calculation assumes the 4m high barrier in place in the buffer zone. The noise source was considered to be at 1.5 high and the receiver height was assumed to be at a ground floor bedroom window at 2m above existing ground level.

TABLE 7
SHED 3 NOISE as dB(A) Lmax
8 INVERNESS AVENUE

	TOTAL	Octave Band Centre Frequency, Hz							
Propagation Elements	dB(A)	63	125	250	500	1k	2k	4k	8k
Source Lw	115	94	95	102	108	109	109	106	98
Average distance loss (40m)		40	40	40	40	40	40	40	40
Barrier Insertion Loss (4m)		8	10	13	16	19	22	24	24
SPL at Bedroom Window	57								

The results in Table 7 show that, under the assessed conditions, noise from loud impacts in the yards of the sheds could exceed the adopted sleep disturbance screening criterion. Under such circumstances the NPfI indicates that a detailed assessment of potential impacts be undertaken.

In assessing the potential for adverse sleep disturbance noise impacts reference is made to practise notes accompanying the NPfI. The sleep disturbance criteria specifically relate to Lmax noise levels.

The practise notes lead to the following conclusions;

- *Maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions.*

- *One or two noise events per night, with maximum internal noise levels of 65-70 dB(A), are not likely to affect health and wellbeing significantly.*

It can be assumed from the above conclusions that disturbance to sleep may be minimised by ensuring that internal maximum noise levels do not exceed 50 to 55 dB(A). It is also accepted by EPA, and generally, that the noise loss through an open window to the centre of a room is at least 10 dB.

Under these circumstances the maximum acceptable external noise level, to prevent disturbing people from their sleep, would therefore be in the range 60 to 65 dB(A) at the facade of a bedroom.

The results in Table 7, therefore, indicate that, with the 4m acoustic barrier in place, the received maximum noise levels would be unlikely to create adverse sleep disturbance impacts.

Table 8 shows a calculation of internal noise within the bedroom, if the windows, fitted with standard glass, were closed.

TABLE 8
SHED 2 NOISE as dB(A) Lmax
8 INVERNESS AVENUE

	TOTAL	Octave Band Centre Frequency, Hz							
Propagation Elements	dB(A)	63	125	250	500	1k	2k	4k	8k
External Noise	57	42	43	49	53	52	49	43	32
STL 3mm Float Glass		24	22	24	27	30	31	34	32
Internal Noise	30	18	21	25	26	22	18	9	0

The results in Table 8 show that, under the assessed conditions, with the bedroom windows, the internal Lmax noise levels would not create any sleep disturbance impacts.

6.0 CONCLUSION

An assessment has been conducted to determine the potential for adverse noise impacts at a proposed 22 lot residential subdivision on land described as Lot 2 D.P. 153695 and Lot 27 D.P. 1165146, Robertson Street, Mudgee.

The assessment has shown that, with a 4m high acoustic barrier in place, noise from the nearby Depot Road industrial precinct will not create adverse impacts at proposed receivers in the subdivision.