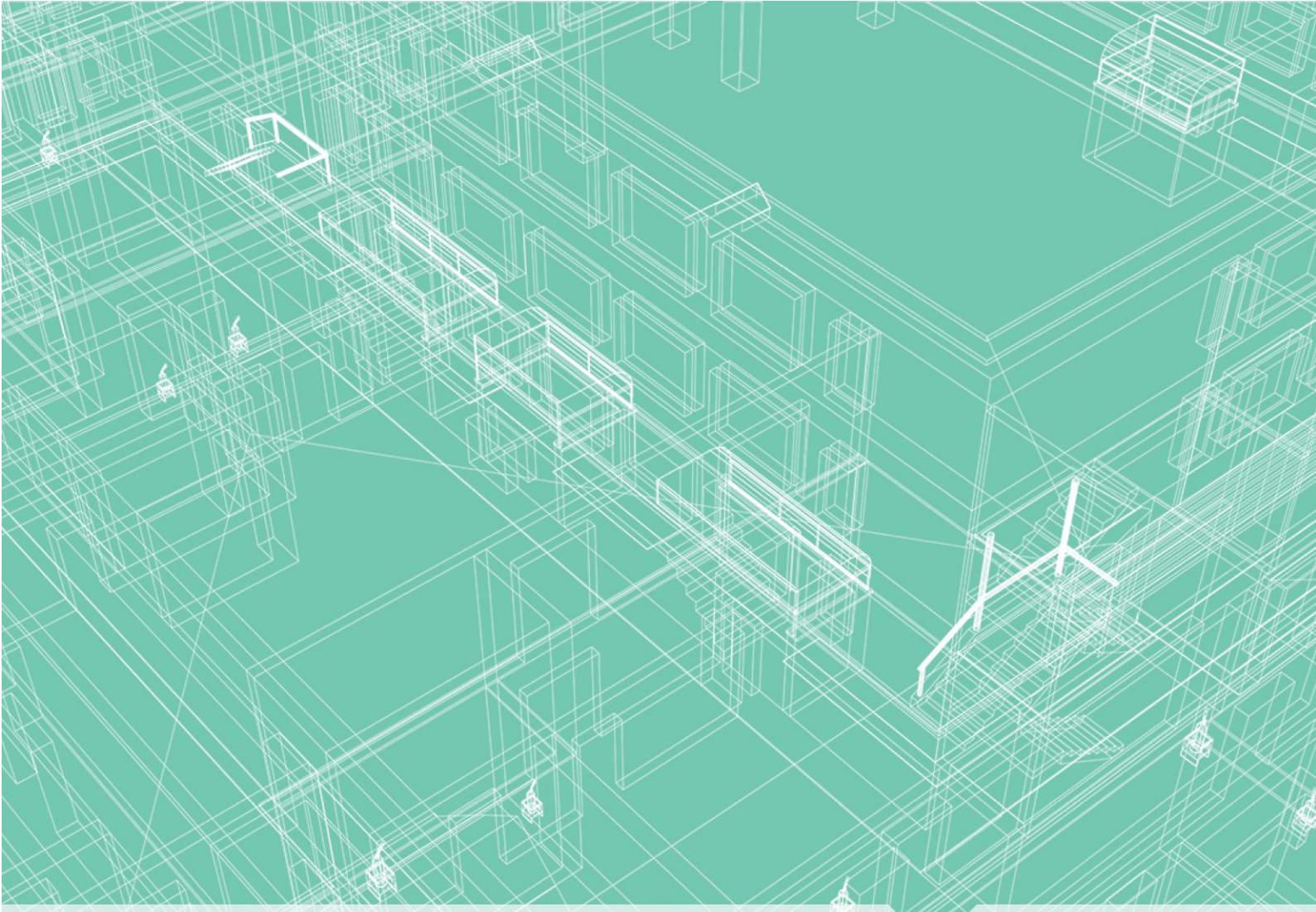

NOISE IMPACT ASSESSMENT FOR DEVELOPMENT APPLICATION

BROKEN HILL POLICE STATION

JHA

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1 INTRODUCTION

JHA Consulting Engineers has been engaged to provide acoustic services for a proposed development of a new NSW Police Station in Broken Hill, NSW.

The proposal involves a new two-stories building, including offices, open plan offices, meeting rooms, stores, custodial area, etc. The proposed development includes a courtyard car-park.

An acoustic assessment has been undertaken and it is detailed in this report along with the findings and recommendations. It has been prepared as part of the Development Application to be submitted to the City of Broken Hill Council.

The objectives of this acoustic assessment are:

- Identify noise sensitive receivers that will potentially be affected by the operation of the proposed development.
- Establish the appropriate noise level and vibration criteria in accordance with the relevant standards, guidelines and legislation for the following noise emissions:
  - External mechanical plant from the development to the surrounding receivers.
  - Traffic generated by the Police Station.
  - Emergency Generator.
  - Building operations.
- Determine whether the relevant criteria can be achieved based on proposed operations. Where applicable, provide recommendations for any necessary acoustic control measures that will need to be incorporated into the development or use in order to ensure with the assessment criteria.
- Provide recommendations for Construction Noise and Vibration Planning.

This report provides:

- A statement of compliance with the relevant statutory criteria for the use of the proposed development within the vicinity of the nearest potentially affected receivers.
- Recommendations for noise mitigation measures for the proposed development in order to meet the relevant criteria when compliance is not achieved.

The following documentation has been used for the preparation of this report:

- Architectural drawings of the proposed development prepared by Gardner Wetherill.

This document and related work has been prepared following JHA Consulting Engineers Quality and Environmental Management Systems, which are based on AS/NZS ISO 9001:2015 and ISO 14001:2015 respectively.

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2 DESCRIPTION OF THE PROPOSAL

Broken Hill is a city in the far west of New South Wales, located 1150 kilometres from Sydney and 500 kilometres from Adelaide. It belongs to the Local Government Area of City of Broken Hill.

The proposed Police Station site is located at 51 Bromide Street, being the site located within an urban environment characterised by medium levels of activity during the day time. The proposed Police Station will operate 24 hours per day, 7 days per week.

The site is located in the south-western half of a block surrounded by Bromide Street to the north-east, Blende Street to the south-east, Kaolin Street to the south-west and Beryl Street to the north-west. The other half of the block is occupied by the "Kintore Headframe" park and public car-park.

The area is considered the town centre and contains facilities and services. Site is surrounded by single-storey residential receivers, the Railway and Historical Museum, Broken Hill High School, TAFE facility and commercial receivers.

Figure 1 shows the existing site location and nearest noise sensitive receivers.

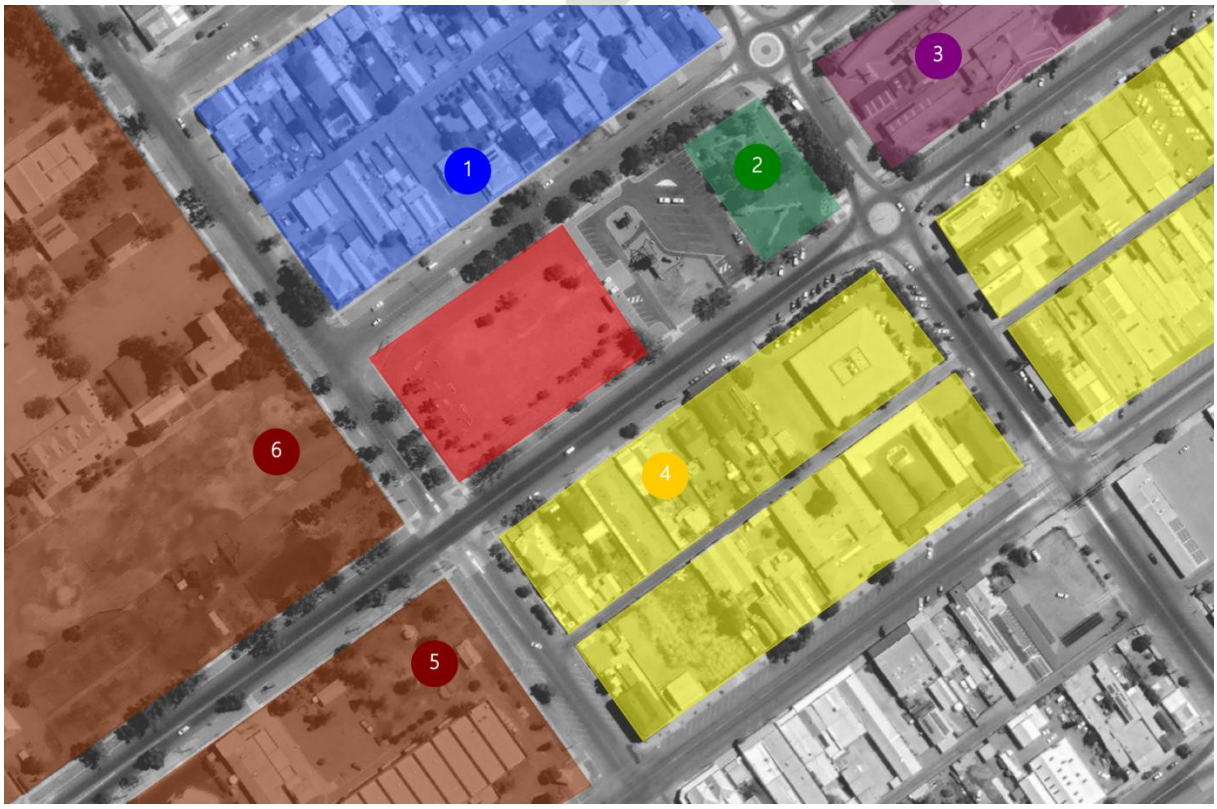

Figure 1: Aerial view of site showing the location of the site (red shadow), residential receivers(blue shadow), commercial receivers (yellow shadow), public park (green shadow), Museum (purple shadow) and Educational Establishments (brown shadow).

A summary of the nearest sensitive receivers surrounding the site location is shown in Table 1, including the approximate distances from the boundary site.

ID	Sensitive Receiver	Receiver Type	Distance (m)
01	Residential receivers	Residential	25
02	Kintore Headframe Park	Passive Recreational	60
03	Railway and Historical Museum	Museum	120
04	Local Centre	Residential / Commercial	30
05	TAFE	Educational	40
06	Broken Hill High School	Educational	30

Table 1: Nearest sensitive receivers surrounding the site location plus distances.

It is noted that if noise impacts associated with the proposed development are controlled at the nearest noise sensitive receivers, then compliance with the recommended noise criteria at all noise sensitive receivers will be achieved.

The proposed Police Station involves a new two-stories building, including the following:

- General areas including offices, change rooms, training / meeting rooms, storage areas, custodial area, group areas, local command area, etc.
- Plantroom area on first floor.
- Courtyard car park. The carpark will be accessed via Blende Street and Beryl Street and it will provide 23 car spaces.

Figure 2 and Figure 3 show the proposed layout of the Police Station.

Figure 2: Proposed Police Station layout – Ground Floor.

Figure 3: Proposed Police Station layout – First Floor.

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3 SITE MEASUREMENTS

3.1 GENERAL

Attended and unattended noise surveys have been retrieved from Broken Hill Library and Community Hub Development Application[1]. These were conducted by JHA Engineers on August 2019 and distance between noise survey locations and proposed Police Station site is approximately 500m. Therefore, JHA notes that results have been found to be representative of typical site ambient and background noise levels.

3.2 ATTENDED NOISE MONITORING

Short-term noise monitoring was carried out to obtain representative octave band noise levels of the site and noise levels from the site.

On Wednesday 14 August 2019 and Thursday 15 August 2019, short-term noise measurements were carried out with a NTI XL-2 hand-held Sound Level Meter (SLM) (Serial Number A2A-13742-E0). The calibration of the SLM was checked before and after each use with a Larson Davis Cal 200 Class 1 Calibrator (Serial Number 15054) and no deviations were recorded.

The SLM microphone was mounted 1.5 metres above the ground and a windshield was used to protect the microphone. Measurement was undertaken in the free-field – i.e. more than 3.5 metres away from any building façade or vertical reflective surface. Weather conditions were calm and dry during the attended noise monitoring.

A summary of the results of the short-term noise monitoring are shown in Table 2.

Location	*Date and Time*	*Parameter*	*Sound Pressure Level, dB re 20μPa*							
			Overall dB(A)	*Octave Band Centre Frequency, Hz*						
				63	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
S1	14/08/2019 12.49 –13.04	$L_{90,15min}$	**48**	57	50	48	44	44	40	33	26
		$L_{eq,15min}$	**55**	61	56	53	51	51	47	39	32
		$L_{10,15min}$	**61**	67	61	59	57	58	53	45	37
S3	15/08/2019 00.56 – 01.11	$L_{90,15min}$	**38**	49	44	37	34	34	30	22	16
		$L_{eq,15min}$	**42**	51	46	39	37	36	35	29	20
		$L_{10,15min}$	**47**	55	51	45	43	42	40	34	25
S4	14/08/2019 22.07-22.22	$L_{90,15min}$	**43**	50	49	43	40	39	34	26	20
		$L_{eq,15min}$	**54**	57	55	52	53	49	45	40	35
		$L_{10,15min}$	**60**	61	61	58	58	56	52	45	37

Table 2: Results of the short-term noise monitoring.

[1] *"Broken Hill Library and Community Hub – Noise Impact Assessment for DA"*, dated 06/12/2019. Prepared by JHA Consulting Engineers.

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3.3 UNATTENDED NOISE MONITORING

Long-term noise monitoring was carried out from Wednesday 14th August 2019 to Thursday 15th August 2019 with a Rion NL-52 noise logger (Serial Number 1254316). The noise logger recorded L_{A1}, L_{A10}, L_{Aeq} and L_{A90} noise parameters at 15-minute intervals during the measurement period. The calibration of the noise logger was checked before and after use and no deviations were recorded.

The noise logger location was in 248 Blende Street – Fire and Rescue NSW Broken Hill Fire Station. It was secured location and considered to be representative of the typical ambient and background noise levels for the area. The microphone was mounted 1.5 meters above the ground and a windshield was used to protect the microphone.

The results of the unattended noise monitoring are summarised in Table 3 as the Rating Background Level (RBL) and the equivalent noise levels (L_{Aeq}) for daytime, evening and night-time periods – as per NSW NPI methodology. The results of the long-term noise monitoring are presented graphically in Figure 4.

Weather conditions were monitored for the duration of the noise survey and were typically calm and dry during the measurement period. As stated in the NSW NPI methodology, any data likely to be affected by rain, wind or other extraneous noise has been excluded from the calculations.

Rating Background Levels, dB(A)			*Equivalent Noise Levels (L_{Aeq}), dB(A)*		
Day 0700-1800	*Evening 1800-2200*	*Night 2200-0700*	*Day 0700-1800*	*Evening 1800-2200*	*Night 2200-0700*
42	39	33	58	53	50

Table 3: Results of long-term noise monitoring at Location L1.

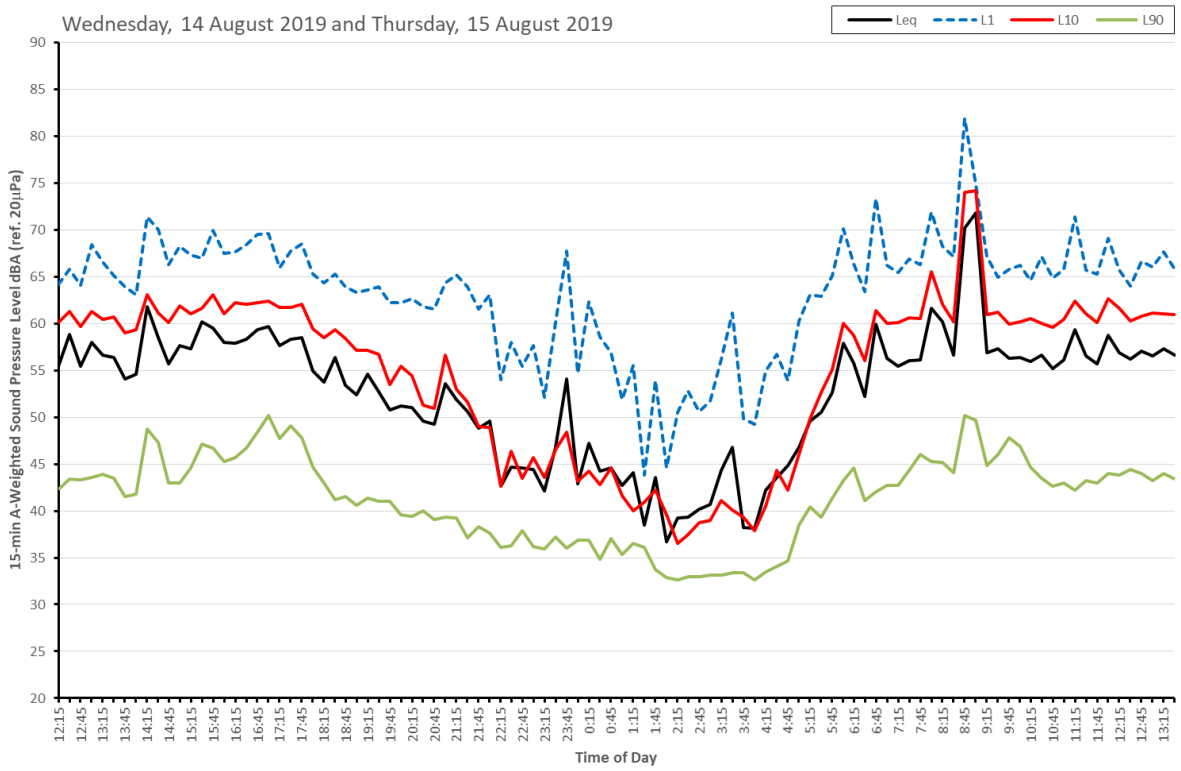

Figure 4: Unattended noise results at Location L1.

4 RELEVANT NOISE STANDARDS AND GUIDELINES

4.1 STANDARDS AND GUIDELINES

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

Regulatory Framework:

- Environmental Planning and Assessment (EP&A) Act 1979.
- Protection of the Environmental Operations (POEO) Act 1997.
- NSW DECCW Noise Guide for Local Government (NGLG) 2013.

Planning:

- City of Broken Hill Local Environment Plan 2013.
- City of Broken Hill Development Control Plan 2016.

Operational Noise:

- NSW EPA Noise Policy for Industry (NPI) 2017.
- NSW DECCW Road Noise Policy (RNP) 2011.
- Protection of the Environmental Operations (Noise Controls) Regulation 2017.

External Noise Intrusion:

- NSW Police Building Code.
- Australian Standard AS 3671:1989 *'Acoustics – Road Traffic Noise Intrusion – Building sitting and construction'*.

Construction Noise and Vibration:

- NSW DECCW Interim Construction Noise Guideline (ICNG) 2009.
- NSW DEC 'Assessing Vibration: A Technical Guideline' 2006.
- Australian Standard AS 2436:2010 *'Acoustics – Guide to Noise Control on Construction, Maintenance & Demolition Sites'*.

4.2 REGULATORY FRAMEWORK

4.2.1 ENVIRONMENTAL PLANNING AND ASSESSMENT (EP&A) ACT 1979

The Environmental Planning and Assessment Act 1979 (EP&A Act) provides the regulatory framework for the protection of the environment in NSW. The EP&A Act is relevantly about planning matters and ensuring that "environmental impact" associated with the proposed development is properly considered and reasonable before granting development consent to develop.

The assessment of "environmental impact" relies upon the identification of acceptable noise criteria which may be defined in a Development Control Plan, or derived from principles using guidelines like NSW EPA Noise Policy for Industry (NPI 2017) or Noise Guide for Local Government (NGLG 2013).

4.2.2 PROTECTION OF THE ENVIRONMENTAL OPERATIONS (POEO) ACT 1997

The Protection of the Environment Operations (POEO) Act 1997 has the objective to protect, restore and enhance the quality of the NSW environment. Abatement of noise pollution is underpinned by the definition of "offensive noise" as follows:

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"...

(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:

(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or

(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or

(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulations.

..."

Noise Guide for Local Government (NGLG) 2013, provides a consideration checklist to determine an "offensive noise".

4.2.3 NOISE GUIDE FOR LOCAL GOVERNMENT

NGLG 2013 is a guideline that it is aimed at councils and planners to provide guidance in the management of local noise problems and in the interpretation of existing policy and legislation. Table 1.3 of NGLG 2013 contains the management for common neighbourhood / power tools noise issues and describes the responsibilities of Council as the Appropriate Regulatory Authority (ARA).

NGLG 2013 provides a consideration checklist to determine an "offensive noise". The "offensive noise" test aids in making a systematic judgment about the offensive nature of noise emissions. The NGLG 2013 offensive noise test considers that noise may be offensive in three ways, according to:

- Audibility.
- Duration.
- Inherently offensive characteristics.

4.3 CITY OF BROKEN HILL COUNCIL LEGISLATION

Relevant Planning Documents of City of Broken Hill Council Legislation have been reviewed for any noise requirement or criteria.

The City of Broken Hill Council Local Environmental Plan (CBH-LEP 2013) sets the Land Zoning as shown in Figure 5 as per information extracted from the CBH-LEP map 1250_COM_LZN_005A_010_20140910. The site is categorized as Local Centre (B2) adjacent to General Residential (R1) – North and West.

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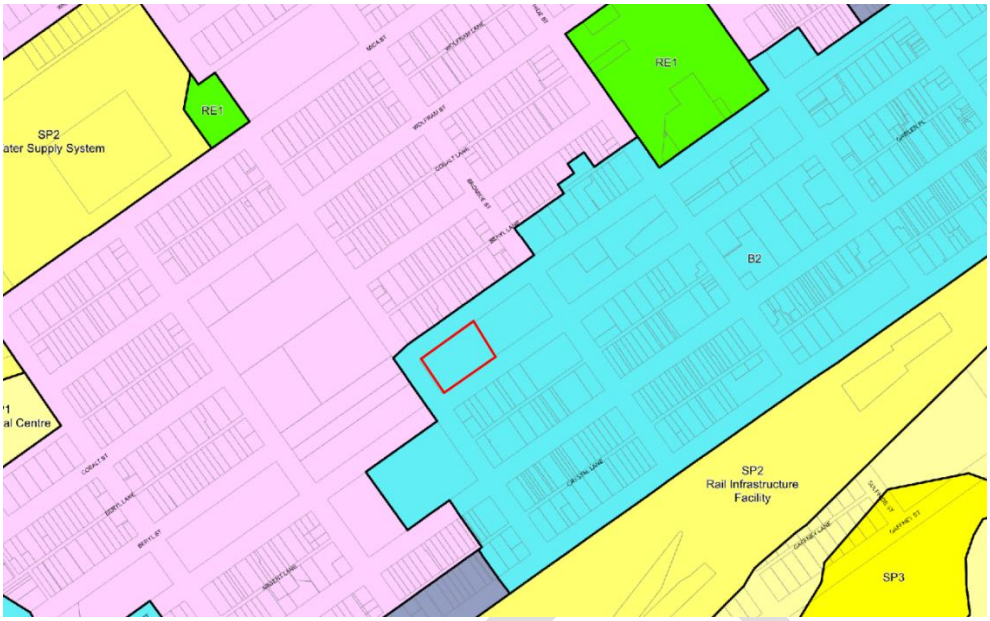

Figure 5: Land Zoning of the site (red outline) and surroundings.

City of Broken Hill Development Control Plan (CBH-DCP 2016) has been reviewed and no relevant requirements for noise have been found for the proposed development.

4.4 OPERATIONAL NOISE

4.4.1 NSW EPA NOISE POLICY FOR INDUSTRY

The NSW EPA Noise Policy for Industry 2017 assesses noise from industrial noise sources - scheduled under the POEO. Mechanical noise from the development shall be addressed following the recommendations in the NSW NPI.

The assessment is carried out based on the existing ambient and background noise levels addressing the following:

- Intrusiveness Criteria, to control intrusive noise into nearby sensitive receivers.
- Amenity Criteria, to maintain the noise level amenity for particular land uses.

These criteria are established for each assessment period (day, evening and night) and the more stringent sets the Project Noise Trigger Level (PNTL's).

4.4.1.1 Intrusiveness Criteria

The NSW NPI defines the intrusiveness criteria as follows:

"The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15 minute period, does not exceed the background noise level by more than 5dB when beyond a minimum threshold."

Based on the intrusiveness criteria definition and the measured background noise levels, Table 4 shows the intrusiveness criteria for the noise sensitive receivers.

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Indicative Noise Amenity Area	*Period*	*Measured Rating Background Level (L_{A90}), dB(A)*	*Intrusiveness Criteria, $L_{Aeq,15min}$ dB(A)*
Local Centre (B2) Residential (R1)	Day	42	47
	Evening	39	44
	Night	33	38

Table 4: Determination of the intrusiveness criteria for noise sensitive receivers.

4.4.1.2 Amenity Criteria

The NSW NPI states the following to define the amenity criteria:

"To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 2.2 where feasible and reasonable. The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance."

Based on the amenity criteria definition and the land zoning, Table 4 shows the amenity criteria for the noise sensitive receivers.

Indicative Noise Amenity Area	*Period*	*Recommended Amenity Noise Level (L_{Aeq}), dB(A)*	*Amenity Criteria, $L_{Aeq,15min}$ dB(A)*
Local Centre (B2) Residential (R1)	Day	60	58 (60-5+3)
	Evening	50	48 (50-5+3)
	Night	45	43 (45-5+3)
Educational	Noisiest 1-hour period when in use	35 (Internal)	43 (45-5+3) (External)[2]
Commercial	When in use	65	63 (65-5+3)
Passive Recreational	When in use	50	48 (50-5+3)

Table 5: Determination of the amenity criteria for noise sensitive receivers.

[2] Amenity criterion has been adjusted to external noise level considering a minimum sound transmission loss of 10dB for open windows.

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4.4.1.3 Project Noise Trigger Levels

The PNTL's are shown in Table 6 and have been obtained in accordance with the requirements of the NSW NPI. These shall be assessed to the most affected point on or within the noise sensitive receiver boundary.

Indicative Noise Amenity Area	*Period*	*Intrusiveness Criterion, $L_{Aeq,15min}$ dB(A)*	*Amenity Criterion, $L_{Aeq,15min}$ dB(A)*
Local Centre (B2) Residential (R1)	Day	47	58
	Evening	44	48
	Night	38	43
Educational	Noisiest 1-hour period when in use	---	43
Commercial	When in use	---	63
Passive Recreation	When in use	---	48

Table 6: Determination of PNTL's (light grey highlight) for noise sensitive receivers.

4.4.2 NSW ROAD NOISE POLICY

Road traffic noise impact is assessed in accordance with the NSW OEH Road Noise Policy (RNP) 2011. The NSW RNP establishes criteria for traffic noise from:

- Existing roads.
- New road projects.
- Road development projects.
- New traffic generated by developments.

For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2.0dB above the existing noise levels. An increase of up to 2.0dB represents a minor impact that is considered barely perceptible to the average person.

In cases where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce these through feasible and reasonable measures to meet the assessment criteria.

4.4.3 SLEEP DISTURBANCE

The potential of sleep disturbance from short-duration noise events from the proposed development – police car departures – during the night-time period needs to be considered. Sleep disturbance occurs through changes in sleep state and awakenings. For continuous traffic flow, L_{Aeq} appears to be acceptably correlated with sleep disturbance.

However, for intermittent traffic flow, which often occurs at night-time ($L_{AFmax} - L_{Aeq}$) or ($L_{AFmax} - L_{A90}$) are better correlated with sleep disturbance.

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NSW EPA NPI recommends the following criteria:

"Where the subject development night-time noise levels at a residential location exceed:

- *$L_{Aeq,15min}$ 40dB(A) or the prevailing RBL plus 5dB, whichever is the greater, and/or*
- *L_{AFmax} 52dB(A) or the prevailing RBL plus 15dB, whichever is the greater,*

A detailed maximum noise level event assessment should be undertaken.

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."

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 RNP as follows:

- Maximum internal noise levels below 50–55dB(A) are unlikely to cause awakening reactions.
- One or two noise events per night, with maximum internal noise levels of 65–70dB(A), are not likely to affect health and wellbeing significantly.

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).
- Current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.

Table 7 summarises the noise level criteria for sleep disturbance based on the NSW EPA NPI recommendations and highlight the stringer criteria to apply.

	Sleep Arousal Noise Criteria
Condition 1	$L_{Aeq,15min}$ **40dB(A)** || RBL + 5 = 38dB(A)
Condition 2	L_{AFmax} **52dB(A)** || RBL + 15 = 48dB(A)

Table 7: Sleep Arousal noise criteria.

These values apply shall be achieved external to the bedroom window of the noise residential sensitive receivers, as opposed to the receiver boundary – which is applied for most other criteria.

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4.4.4 POEO (NOISE CONTROLS) REGULATION

The POEO (Noise Controls) Regulation controls noise from motor vehicles and marine vessels and sets community standards on acceptable noise intrusion in homes from such appliances as intruder alarms, music amplifiers, air conditioners and powered garden tools.

The Regulation includes provisions to manage noise of different neighbourhood noise problems. These controls are:

- Sets time limits for the use of certain articles on residential property including gardening equipment, air conditioners, tools and pumps, where the noise caused can be heard in a habitable room of another residence.
- Prevents the use of certain articles where they can be heard during noise sensitive periods (e.g. night time).

4.5 NSW POLICE BUILDING CODE

Section 4.12 of the NSW Police Building Code provides acoustic criteria for internal noise levels, reverberation times plus sound insulation performances that should be achieved within the Police Station spaces. However, operational noise level criteria and design guidelines to minimise noise emissions are not provided.

4.6 CONSTRUCTION NOISE AND VIBRATION

4.6.1 NOISE CRITERIA

The noise criteria in this section are for guidance only and do not form part of any legal obligation on the part of the project proponent. However, compliance with these criteria is considered best practice.

The ICNG suggest construction noise management levels that may minimise the likelihood of annoyance being caused to noise sensitive residential receivers depending on the duration of works. The Noise Management Levels (NMLs) for long-term duration works are as follows:

- Within recommended standard hours.

  The $L_{Aeq,15min}$ level measured at the most exposed boundary of any affected residential receiver when the construction site is in operation must not exceed the background noise level by more than 10dB(A). This noise level represents the point above which there may be some community reaction to noise.

  However, in the case of a highly noise affected area, the construction noise level ($L_{Aeq,15min}$) at the most exposed boundary of any affected residential receiver when the construction site is in operation should not exceed 75dB(A). This level represents the point above which there may be strong community reaction to noise.

- Outside recommended standard hours.

  The $L_{Aeq,15min}$ level measured at the most exposed boundary of any affected residential receiver when the construction site is in operation must not exceed the background level by more than 5dB(A). It is noted that a strong justification is required for works outside the recommended standard hours.

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ICNG suggests construction noise management levels for other sensitive land uses surrounding construction sites. They are as follows:

- Retail outlets: $L_{Aeq,15min}$ 70dB(A) (external).
- Classrooms at schools and other educational institutions: $L_{Aeq,15min}$ 45dB(A) (internal).
- Passive recreation areas: $L_{Aeq,15min}$ 60dB(A) (external).

In order to establish the airborne construction noise criteria, noise levels from the unattended noise monitoring have been used for the noise sensitive receivers– refer to Section 3.3. Table 8 below summarises the airborne construction noise criteria for most affected noise sensitive receivers surrounding the development site.

Sensitive Receiver		*Noise Management Level, $L_{Aeq,15min}$ dB(A)*	
		Within Standard Hours	*Outside Standard Hours*
Local Centre (B2) General Residential (R1)	Noise affected / External	52	47
	Highly noise affected / External	75	N/A
Educational	External	55	55
Commercial	External	70	70
Passive Recreation	External	60	60

Table 8: ICNG construction airborne noise criteria (NMLs) for noise sensitive receivers surrounding the site.

For Educational receivers, the NML has been adjusted to external noise level considering a minimum sound transmission loss of 10dB for an adequately opened window to provide natural ventilation.

The ICNG recommends internal ground-borne noise maximum levels at residences affected by nearby construction activities. Ground-borne noise is noise generated by vibration transmitted through the ground into a structure and can be more noticeable than airborne noise for some sensitive receivers. The ground-borne noise levels presented below from the ICNG are for residential receivers during evening and night-time periods only, as the objective is to protect the amenity and sleep of people when they are at home.

- Evening: $L_{Aeq,15min}$ 40dB(A) (internal).
- Night: $L_{Aeq,15min}$ 35dB(A) (internal).

The internal noise levels are assessed at the centre of the most affected habitable room.

4.6.2 VIBRATION CRITERIA

The Department of Environment and Climate Change (DECC) developed the document *'Assessing Vibration: A Technical Guideline'* in February 2006 to assist in preventing people from exposure to excessive vibration levels within buildings. It is based on the guidelines contained in BS 6472.1:2008 *'Guide to evaluation of human exposure to vibration in buildings – Vibration sources other than blasting'*.

The guideline does not however address vibration induced damage to structures or structure-borne noise effects.

Vibration criteria for continuous and impulsive vibration are presented in Table 9, in terms of vibration velocity levels. When assessing intermittent vibration comprising a number of events, it is recommended that the Vibration Dose Value (VDV) is used. Table 10 shows the acceptable VDV values for intermittent vibration.

Place	Time	r.m.s. velocity, mm/s [dB ref 10^{-9}mm/s]			
		Continuous Vibration		Impulsive Vibration	
		Preferred	Maximum	Preferred	Maximum
Residences	Day-time	0.20 [106 dB]	0.40 [112 dB]	6.00 [136 dB]	12.00 [142 dB]
	Night-time	0.14 [103 dB]	0.28 [109 dB]	2.00 [126 dB]	4.00 [132 dB]
Offices, schools	When in use	0.40 [112 dB]	0.80 [118 dB]	13.00 [142 dB]	26.00 [148 dB]

Table 9: Continuous and impulsive vibration criteria applicable to the site. *Note: Day-time is 07:00 to 22:00 and night-time is 22:00 to 07:00.*

Place	Time	Vibration Dose Values, $m/s^{1.75}$	
		Preferred	Maximum
Residences	Day-time	0.20	0.40
	Night-time	0.13	0.26
Offices, schools	When in use	0.40	0.80

Table 10: Intermittent vibration criteria applicable to the site.

Ground vibration from construction activities can damage surrounding buildings or structures. For unoccupied buildings, or during periods where the buildings are unoccupied, the vibration criteria for building damage suggested by German Standard DIN 4150.3:1993 *'Structural Vibration – Effects of Vibration on Structures'* and British Standard BS 7385.2:1993 *'Evaluation and Measurement for Vibration in Buildings'* are to be adopted. Guideline values from DIN 4150.3:1993 and BS 7385.2:1993 are presented in Table 11 and Table 12 respectively.

Structural type	r.m.s. velocity, mm/s			
	Foundation			Plane of floor uppermost full storey
	Less than 10Hz	10 to 50Hz	50 to 100Hz	Frequency mixture
Dwellings or similar	5	5 to 15	15 to 20	15
Particularly sensitive	3	3 to 8	8 to 10	8

Table 11: DIN 4150.3:1993 Guideline values of vibration velocity for evaluating the effects of short-term vibration.

Structural type	Peak particle velocity, mm/s	
	4 to 15Hz	15Hz and above
Unreinforced or light framed structures *Residential or light commercial type buildings*	15mm/s @ 4Hz increasing to 20mm/s @ 15Hz	20mm/s @ 15Hz increasing to 50mm/s @ 40Hz and above

Table 12: BS 7385.2:1993 Guideline values of vibration velocity for evaluating cosmetic damage.

5 NOISE EMISSIONS ASSESSMENT

Noise break-out from the proposed Broken Hill Police Station building has the potential to impact on existing noise sensitive receivers. For the purpose of this noise impact assessment, the noise sources are assumed as follows:

- External mechanical plant to the surrounding receivers.
- Traffic generated by the proposed development.
- Emergency generator.
- Building operations.

Each of these noise sources has been considered in the noise impact assessment. The acoustic assessment has considered the following:

- Noise levels have been considered as continuous over assessment time period to provide the worst-case scenario.
- Lowest background noise levels at the nearest noise sensitive receiver have been used to provide a worst-case scenario.
- Distance attenuation, building reflections and directivity.

5.1 EXTERNAL MECHANICAL PLANT

Noise from proposed development mechanical plant rooms should be controlled to ensure external noise emissions are not intrusive and do not impact on the amenity of the noise sensitive receivers.

Mechanical plant will operate continuously during all day time periods. At this stage, final mechanical plant selections have not been made; therefore, it is not possible to undertake a detailed assessment of the mechanical plant noise emissions. However, a preliminary assessment has been carried out for the external mechanical plant.

Considering the distance from the proposed location of the external mechanical plant (northern boundary) to the nearest noise sensitive receiver (residential receivers), at this stage, maximum allowable cumulative noise emissions from the external mechanical plant have been predicted to be limited to $L_{Aeq,15min}$ 71dB(A) at 1 metre from the plant boundary.

Noise controls will need to be incorporated with the design of the mechanical plant rooms to ensure that the cumulative noise levels from plant to the nearest noise sensitive receivers meets the NSW NPI noise level criteria – refer to Table 6.

Usual design noise controls that may need to be implemented will typically include, but are not limited to:

- Strategic location and selection of mechanical plant to ensure the cumulative noise levels at the receiver boundaries is met.
- Selection of appropriate quiet plant.
- Acoustic noise control measures to be put in place to minimise noise impacts such as:
  - In-duct attenuation.
  - Noise enclosures as required.
  - Sound absorptive panels.
  - Acoustic louvres as required.
  - Noise barriers as required.

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Acoustic assessment of all mechanical plant shall continue during the detailed design phase of the project in order to confirm any noise control measures to achieve the relevant noise criteria at the nearest noise sensitive receivers.

5.2 VEHICLES NOISE EMISSIONS

The potential noise sources associated with the proposed vehicles operations will be:

- Noise generated by vehicles movements.
- Police cars dispatched for emergencies during night-time.
- Noise generated by police car sirens.

It is expected that generally vehicle movements will be moving slowly and the number of vehicles movement will be low compared with the existing traffic flows. Therefore, it has been assumed that worst-case scenario will be with a police car departing the Police Station during an emergency incident in night-time period.

As per architectural drawings, exit path of vehicles is proposed to be via Blende Street. Therefore, noise sensitive receivers on Blende Street are the most likely to be impacted for police car movements during night-time.

Figure 6: Police car exit path.

5.2.1 TRAFFIC NOISE DUE TO THE PROPOSAL

A low number of vehicle movements – as per number of car-park spaces, indicates that there will be no significant increase in road traffic flows as a result of the development.

As noted in Section 4.4.2, when considering land use development and the impact on sensitive land uses, the NSW RNP states that an increase up to 2.0dB in relation to existing noise levels is anticipated to be insignificant.

Therefore, traffic noise associated with the development is expected to meet the NSW RNP recommendations.

5.2.2 POLICE CAR SIRENS

Regarding the use of police car sirens on site – when police cars depart to attend incidents – it is not specifically addressed in relevant regulations.

As per NSW Police Force '*Safe Driving Policy*', police car sirens shall be used as a warning only when responding to an emergency call or pursuing a suspected offender. The NSW Police Handbook advises the use of discretion in certain circumstances regarding the use of sirens such as in "traffic jams and near hospitals, churches, theatres and other public places where people are likely to assemble".

Whilst it is acknowledged that this aspect of the ongoing Police Station operation may give rise to noise impacts, for safety reasons it is not appropriate to impose a mitigation measure limiting the use of sirens in a manner that would conflict with the NSW Police Force Handbook and '*Safe Driving Policy*'.

5.2.3 POLICE CAR MOVEMENTS DURING NIGHT-TIME

For the noise assessment purpose, departing police cars noise impact from the Police Station are likely to generate the following noise level range.

Noise Source	*Maximum Sound Power Level dB(A), ref 1pW*
Police car accelerating	91-96

Table 13: Noise level range for police car departures from the Police Station.

The sleep arousal noise assessment has considered the following assumptions:

- The Police Station will operate 24 hours a day 7 days per week. Therefore, there will be police car movements at any time period.
- Noise levels have been considered as continuous over a 15-minute assessment period to provide the worst-case scenario.
- Police car noise level are based on the highest value of the maximum sound power level range for a worst-case scenario.
- Noise predictions are based on distance attenuation, ground reflection, building reflections / shielding and directivity.
- Noise level criteria is based on the lowest measured background noise level in order to provide a worst-case scenario.

Results of sleep disturbance noise assessment are shown in Table 14 and Table 15.

Calculation	*Overall A-weighted noise level, in dB(A)*
L_{Aeq} of police car accelerating at 1 m	82
Distance (27 m) attenuation, dB	-29
One 30 second event over 15 minutes operation correction, dB	-15
$L_{Aeq,15min}$ resulting at noise sensitive receiver façade	**38**
NPI Sleep Arousal Nigh-time Criteria residential receiver / Complies?	**40** / Yes

Table 14: Sleep arousal noise assessment at residential receiver from police car departure during night-time. Condition 1.

Calculation	*Overall A-weighted noise level, in dB(A)*
L_{Amax} of police car accelerating at 1 m	88
Distance (27 m) attenuation, dB	-29
L_{Amax} resulting at residential receiver façade	59
NPI Sleep Arousal Nigh-time Criteria residential receiver / Complies?	52 / No

Table 15: Sleep arousal noise assessment at residential receiver from police car departure during night-time. Condition 2.

Based on the above, the predicted $L_{Aeq,15\ min}$ noise level at the nearest noise sensitive receiver façade is expected to meet the Condition 1 NPI Sleep Arousal Criteria.

The predicted L_{Amax} noise level at the nearest residential receiver façade exceeds the Condition 2 NPI Sleep Arousal Criteria by 7dB(A). However, as per Section 4.4.3, the following comments are made:

- One or two events per night, with maximum internal noise levels of 65dB(A) to 70dB(A), are not likely to affect health and wellbeing significantly.
- Maximum internal noise levels below 50dB(A) to 55dB(A) are unlikely to awaken people from sleep. It is generally accepted that internal noise levels in a dwelling with the windows open (likely during warm nights) are 10dB lower than external noise levels – being opened sufficiently to provide adequate ventilation. Based on this, these noise levels are equivalent to external maximum noise levels of 60dB(A) to 65dB(A).

Based on the above, internal noise levels are at a level that according to NSW RNP are unlikely to cause awakening reactions.

5.3 WASH BAY

It is noted that a wash-bay for cleaning the police cars it will be located in the courtyard car-park. It is expected that a pressure washer will be used and will not operate continuously.

NSW POEO (Noise Controls) Regulations establishes that noise from power tools (i.e. pressure washer) shall not be audible within a habitable room in any residential premises outside the following operation time periods:

- 7am to 8pm Monday to Saturday.
- 8am to 8pm on Sundays.

Therefore, it is recommended, whenever possible, the pressure washer shall only be used during these hours.

5.4 EMERGENCY GENERATOR

It is proposed to install an emergency generator that will be located next to the vehicle entry / exit of the street level. It is understood that the new emergency generator will operate only during a loss of power supply in the Police Station. The proposed location is shown in Figure 7.

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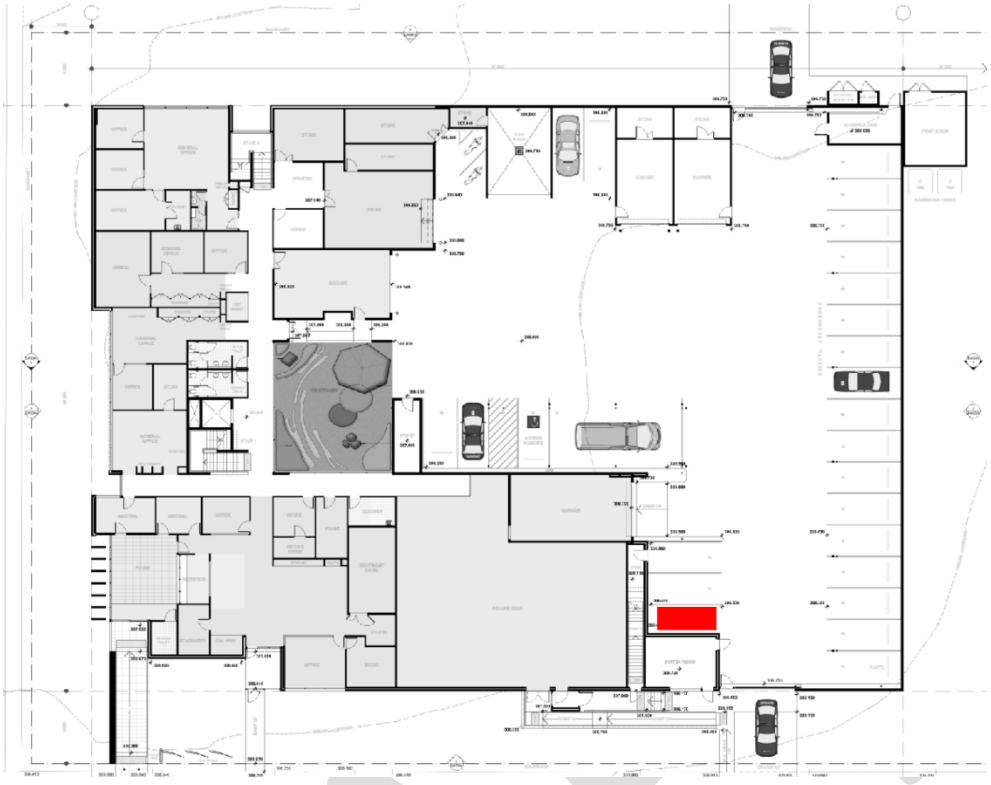

Figure 7: Proposed location of emergency generator in courtyard carpark.

In the absence of any relevant NSW guideline for emergency generators and equipment, it is recommended that noise limits for emergency plant equipment be relaxed by 5dB, in accordance with the duration correction in Table C3 of the NSW NPI. Therefore, the noise level criteria is established as per Table 16.

Period	*PNTLs, dB(A)*	*Emergency Generator Criteria, dB(A)*
Day	47	52
Evening	44	49
Night	38	43

Table 16: Emergency generator criteria for noise sensitive receivers (highligthed stringest noise level criteria).

At this stage the emergency generator has not been selected, therefore, it is not possible to undertake a detailed assessment of the emergency generator noise emissions. A preliminary assessment has been undertaken to quantify the maximum allowable noise emissions from the emergency generator.

Based on the emergency generator location, the noise criteria at the nearest sensitive receivers as per above plus distance from the emergency generator to the receiver; noise emissions from the emergency generator shall be limited to L_{Aeq} 74dB(A) at 1 metre from the emergency generator boundary to meet the noise levels criteria.

Noise controls will need to be incorporated to ensure that the noise levels from the emergency generator to the nearest noise sensitive receiver meet the noise level criteria. Usual design noise controls that may need to be implemented will typically include, but are not limited to:

- Selection of appropriate quiet emergency generator.
- Acoustic noise control measures to be put in place to minimise noise impacts such as:
  - Noise enclosure as required.
  - Mufflers for intake / exhaust.
  - Anti-vibration systems.
  - Noise barriers as required.

Acoustic assessment of the emergency generator shall continue during the detailed design phase of the project in order to confirm any noise control measures to achieve the relevant noise criteria at the nearest noise sensitive receivers.

5.5 NOISE EMISSIONS FROM BUILDING ACTIVITY

Other noise sources associated with the building activity could have a noise impact at the nearest noise sensitive receivers. In order to limiting the noise nuisance, following strategies should be considered:

- Waste / recycling disposal should be limited to the least sensitive periods (i.e. day time period) where possible.
- Written submissions regarding noise complaints as a result of police operations may be forwarded to the Local Area Commander and dealt with appropriately on a case by case basis.

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6 NOISE INTRUSION

6.1 INTERNAL DESIGN NOISE LEVELS

The total noise level within the spaces will be a result of the combination of external noise and noise from the building services.

Noise generated by building services, particularly the air-conditioning and ventilation systems, needs to be considered to ensure that the internal noise levels for each space of the Police Station meet the ambient noise levels as per NSW Police Force Building Code.

In order to achieve these internal noise levels for each space, noise control treatments will need to be incorporated into the mechanical systems as required.

6.2 TRAFFIC NOISE INTRUSION

Surrounding roads can be categorised as a local roads as per the NSW RNP. Based on the likely traffic noise levels on the development site, we consider that traffic noise break-in will not be an issue if a typical façade design is proposed for the new police station building façade.

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7 CONSTRUCTION NOISE AND VIBRATION PLANNING

Currently the project is at an early design stage and a detailed construction program is not yet full defined. This section of the Construction Noise and Vibration Planning (CNVP) provides general recommendations only and provides applicable criteria together with best noise and vibration control practices to be observed during the construction of the proposed development.

This preliminary advice in relation to construction noise and vibration management shall form the basis for the Contractor's Construction Noise and Vibration Management Plan (CNVMP).

Any noise from demolition and construction activities to be carried out on site must not result in *'offensive noise'* to any noise sensitive receiver. To this end, the Contractor employed to undertake the demolition and / or construction works is responsible for ensuring that any site noise and, in particular, any complaints shall be monitored, investigated, managed and controlled.

7.1 RELEVANT CODES AND STANDARDS FOR CONSTRUCTION NOISE AND VIBRATION CRITERIA

Section 4.6 of this report contains the relevant legislation, codes and standards plus construction noise and vibration criteria for this project.

7.2 CONSTRUCTION NOISE AND VIBRATION PLANNING

At this stage, there is no information regarding construction plant / equipment plus work activities / duration. However, a preliminary construction noise and vibration assessment has been carried out in order to identify the likely potential impact of various generic construction plant / equipment on sensitive receivers surrounding the site. The Contractor will be responsible for preparing a Works Plan and Schedule which include all relevant noise and vibration information.

The key noise sources on site during demolition and construction stages of the Police Station will be from heavy plant / equipment such as excavators, bulldozers, hand held pneumatic tools, grinders, etc. It is anticipated that the key construction activities to occur are as follows:

- Site establishment.
- Demolition, excavation, foundation and piling.
- Structure, façade and fit-out works.
- Landscaping.

Table 17 shows the maximum allowable sound pressure level at the boundary of the construction site in order to meet the applicable construction noise level criteria at the nearest noise sensitive receivers during standard construction hours. Allowances have been made for distance attenuation, shielding and reflections.

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ID	Sensitive Receiver	Noise Criteria, dB(A)	Distance, m	Maximum Noise Level ($L_{Aeq,15min}$) at the site boundary
01	Residential receivers	52	25	80
02	Kintore Headframe Park	60	60	95
04	Local Centre	52	30	81
05	TAFE	55	40	87
06	Broken Hill High School	55	30	84

Table 17: Maximum allowable construction noise level at the construction boundary.

A detailed noise assessment shall be carried out for the Construction Noise and Vibration Management Plan when details for the construction plant / equipment plus activities / duration will be known.

The NSW RMS *'Construction Noise and Vibration Guideline'* provides safe working distances for vibration intensive plant and are quoted for both 'cosmetic' damage (in accordance with BS 7385.2:1993) and human comfort (in accordance with DEC's *'Assessing Vibration: A Technical Guideline'*). The recommended safe working distances for typical construction plant are provided in Table 18.

Plant Item	Description	Cosmetic Damage	Human Response
Small Hydraulic Hammer	5-12 tonne	2m	7m
Medium Hydraulic Hammer	12-18 tonne	7m	23m
Large Hydraulic Hammer	18-34 tonne	22m	73m
Vibratory Pile Driver	Sheet piles	2-20m	20m
Pile Boring	<800mm	2m	N/A
Jackhammer	Hand held	1m	Avoid Contact with Structure

Table 18: Recommended minimum working distances for vibration intensive plant from sensitive receivers

If Contractor has concerns for the disruptions at nearest sensitive receivers due to vibration intensive plant use, it is recommended that prior to the commencement of the works, to undertake a preliminary vibration survey on each key vibration generating activity / equipment.

The preliminary vibration survey and assessment will determine whether the vibration levels might exceed the relevant criteria then vibration mitigation and management measures will need to be put in place to ensure vibration impacts are minimised as far possible.

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7.3 CONTROL ELEMENTS

In order to meet the noise and vibration requirements of the site, the Contractor will be required to engage a qualified acoustic consultant to assist in the compilation of a CNVMP, and undertake noise and vibration monitoring for the duration of the project.

7.3.1 GENERAL CONTROL ELEMENTS

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

It is noted that the reduction of noise and vibration at the source and the control of the transmission path between the construction site and the receiver(s) are the preferred options for noise minimisation. Providing treatments at the affected receivers should only be considered as a last resort.

Construction noise and vibration shall be managed by implementing the strategies listed below:

- *Plant and equipment*. In terms of both, cost and results, controlling noise and vibration at the sources is one of the most effective methods of minimising the impacts from any work site activities. Work practices that will reduce noise and vibration at the source include:
  - Employing quieter techniques for all high noise activities such as rock breaking, concrete sawing, and using power and pneumatic tools.
  - Use quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks.
  - Selecting plant and equipment with low vibration generation characteristics.
  - Operate plant in a quietest and most effective manner.
  - Where appropriate, limit the operating noise of equipment.
  - Regularly inspecting and maintain plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively.
  - Where appropriate, obtain acoustic test certificates for equipment.
- *On site noise management.* Practices that will reduce noise from the site include:
  - Maximising the distance between noise activities and noise sensitive receivers. Strategically locate equipment and plant.
  - Undertaking noisy fabrication work off-site where possible.
  - Avoid the use of reversing beeping alarms or provide for alternative systems, such as broadband reversing alarms, particularly during night or out-of-hours works.
  - Maintaining any pre-existing barriers or walls on a demolition or excavation site as long as possible to provide optimum sound propagation control.
  - Constructing barriers that are part of the project design early in the project to afford mitigation against site noise.
  - Using temporary site building and material stockpiles as noise barriers. These can often be created using site earthworks and may be included as a part of final landscape design.
  - Installing purpose built noise barriers, acoustic sheds and enclosures.

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- *Work scheduling.* Scheduling work during periods when people are least affected is an important way of reducing adverse impacts. The following scheduling aspects may reduce impacts:
  - Provide respite periods, including restricting very noisy activities to daytime, restricting the number of nights that after-hours work is conducted near residences, or by determining any specific requirements, particularly those needed for noise sensitive receivers.
  - Scheduling activities to minimise impacts by undertaking all possible work during hours that will least adversely affect sensitive receivers and by avoiding conflicts with other scheduled events.
  - Scheduling work to coincide with non-sensitive periods.
  - Scheduling noisy activities to coincide with high levels of neighbourhood noise so that noise from the activities is partially masked and not as intrusive.
  - Planning deliveries and access to the site to occur quietly and efficiently and organising parking only within designated areas located away from sensitive receivers.
  - Optimising the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours.
  - Designating, designing and maintaining access routes to the site to minimise impacts.
  - Including contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling.
- *Consultation, notification and complaints handling.*
  - Provide information to neighbours before and during construction.
  - Maintain good communication between the community and Project staff.
  - Have a documented complaints process and keep register of any complaints.
  - Give complaints a fair hearing and provide for a quick response.
  - Implement all feasible and reasonable measures to address the source of complaint. Implementation of all reasonable and feasible mitigation measures for all works will ensure that any adverse noise impacts to surrounding receivers are minimised when noise goals cannot be met due to safety or space constraints.

7.3.2 ADDITIONAL NOISE AND VIBRATION CONTROL MEASURES

If, during construction, an item of equipment exceeds either the noise criteria at any location or the equipment noise level limits, the following noise control measures, together with construction best practices, shall be considered to minimise the noise impacts on the neighbourhood.

- Schedule noisy activities to occur outside of the most sensitive times of the day for each nominated receiver.
- Consider implementing equipment-specific screening or other noise control measures recommended in Appendix C of AS 2436:2010.
- Limit the number of trucks on site at the commencement of site activities to the minimum required by the loading facilities on site.
- When loading trucks, adopt best practice noise management strategies to avoid materials being dropped from height into dump trucks.
- Avoid unnecessary idling of trucks and equipment.
- Ensure that any miscellaneous equipment (extraction fans, hand tools, etc) not specifically identified in this plan incorporates silencing/shielding equipment as required to meet the noise criteria.

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Implementation of all reasonable and feasible mitigation measures for all internal works will ensure that any adverse noise impacts to surrounding residential, commercial and recreational receivers are minimised when noise goals cannot be met due to safety or space constraints.

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8 SUMMARY AND CONCLUSIONS

A noise assessment has been carried out for the new NSW Police Force Station in Broken Hill. This report forms part of the documentation package to be submitted to the Council as part of the Development Application.

This report establishes relevant noise level criteria, details the acoustic assessment and provides comments and recommendations for the proposed development.

The noise assessment has adopted methodology from relevant guidelines, standards and legislation to assess noise impact. The noise impacts have been predicted at the nearest noise sensitive receiver boundaries, taking in account distance attenuation, building reflections and directivity.

A summary of the noise assessments and their outcomes is listed below:

External Mechanical Plant: At this stage, mechanical plant selections have not been made. Therefore, a detailed noise assessment has not been able to be carried out. However, a preliminary noise assessment has been carried out, based on the location of the mechanical plantroom. The maximum allowable noise emissions from the proposed development's external mechanical plant shall be limited to 71dB(A) at 1 meter in order to meet the NSW NPI noise level criteria for all time periods. Recommendations have been provided to minimise the impact of external noise emissions associated with the mechanical plant of the proposed development to the nearest sensitive receivers.

Vehicles Noise Emissions: Traffic noise impact due to the likely generated vehicle movements of the proposed development – based on the information provided in the traffic report – is anticipated to be insignificant, as the noise levels will not increase more than 2.0dB at the sensitive noise receivers.

For noise from use of police car sirens, it is recommend that their operation within the development and surroundings shall be addressed in the Management Plan and minimised whenever possible.

A sleep arousal assessment for departing police cars during night-time has been undertaken. Results indicate that the predicted $L_{Aeq,15min}$ noise level will meet the noise level criterion. However, the predicted L_{Amax} noise levels are expected to exceed the established noise level criterion by 7dB(A). Internal noise levels within the bedroom of the affected residential receivers due to police car departures are likely to not cause awakening reactions, neither to have an impact on health and wellbeing of receivers.

Wash Bay: It is recommended that use of power tools in the wash bay to be restricted to 7am and 8pm during Monday to Saturday and between 8am and 8pm on Sundays whenever possible.

Emergency Generator: Emergency generator selection has not been made. Therefore, a detailed assessment has not been able to be carried out. A preliminary review has been carried out for the emergency generator, and based on the distance to the closest noise sensitive receiver, noise emissions form the emergency generator shall be limited to 74dB(A) at 1 meter.

Noise Intrusion: The final façade design is not yet resolved. Traffic break-in noise levels are not expected to exceed the established noise criteria within the premises if a typical façade design is proposed. The building façade design has to be solved during the detailed design stage.

Construction Noise and Vibration: Potential construction noise and vibration impacts on the surroundings have been presented in this report and recommendations based on the relevant guidelines are provided. If, during construction works, an item of equipment exceeds the stated airborne noise and / or vibration criteria at any sensitive location, the additional noise / vibration control measures presented in this report,

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together with construction best practices, shall be considered to minimise noise and vibration impacts on the sensitive receivers.

The information presented in this report shall be reviewed if any modifications to the features of the development specified in this report occur, including and not restricted to selection of mechanical plant, modifications to the building and introduction of any additional noise sources.

Based on the information presented in this report, relevant objectives will be satisfied and therefore approval is recommended to be granted.

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