APPENDIX E ACOUSTIC REPORT

PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL

Approval no: DEV2022/1307

Date: 25/05/2023

Queensland Government

Acoustic Report

BMW Temp Facility Fit out - 39 Mayne Rd, Bowen Hills

Prepared For:
LMM Holdings as Trustee of the Brisbane BMW Trust unit
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Australia

Prepared By:
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Status

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Contents

1. Introduction

BMW are proposing to be temporarily housed at 39 Mayne Road, Bowen Hills, while their new facility at 800 Ann Street is being built. The temporary facility will serve entirely as a drop off facility, with no current servicing or tyre activity to be undertaken . The new site is to be located on existing commercial land which is bordered by Mayne Rd to the west, Hudd Street to the north, Jamison St and the nearby rail line to the east.

The south is bordered further to the south by Edgar Street. With regards to residential receivers, it was noted that a large multi-storey apartment complex is located at 37 Mayne Road – Panorama Apartments. Additional single and multi-storey residences were noted to the east in Citra Road and north on the corner of Hudd and Jameson Streets. Land use to the south was noted to be predominantly commercial and/or light industrial.

Administrative tasks and a customer waiting lounge will be provided in the enclosed facility. It should be noted that auto wash and cleaning activities will be undertaken off site at a separate location. However it is proposed that the use of vacuum cleaners will be used on site for the purposes of final cleaning, prior to customer handovers.

With regards to mechanical services noise, we understand that the proposed temporary facility will propose to largely reuse existing plant and equipment, with only minimal new additional, including large ventilation fans to the car storage area.

Figure 1: Proposed BMW Temporary Facility at Mayne Rd, Bowen Hills.

The proposed temporary facility will consist of the following, many of which are existing facilities that will be that we will be reused as a part of the new operation.

- Comms Room (Existing)
- Offices x 2
- Foyer Space
- Open Office Area
- Customer Lounge
- Service Reception
- Service Advisor Areas/Desks
- Service Manager Office (Existing)
- Service Workroom (Existing)
- Lunchroom (Existing)
- Proposed New Offices
- Amenities
- Warehouse/Car Storage Area (Existing)
- Open Yard with parking spaces, with provision for 120 Spaces
- Service pickup and drop off bays (provision for 12 Spaces).

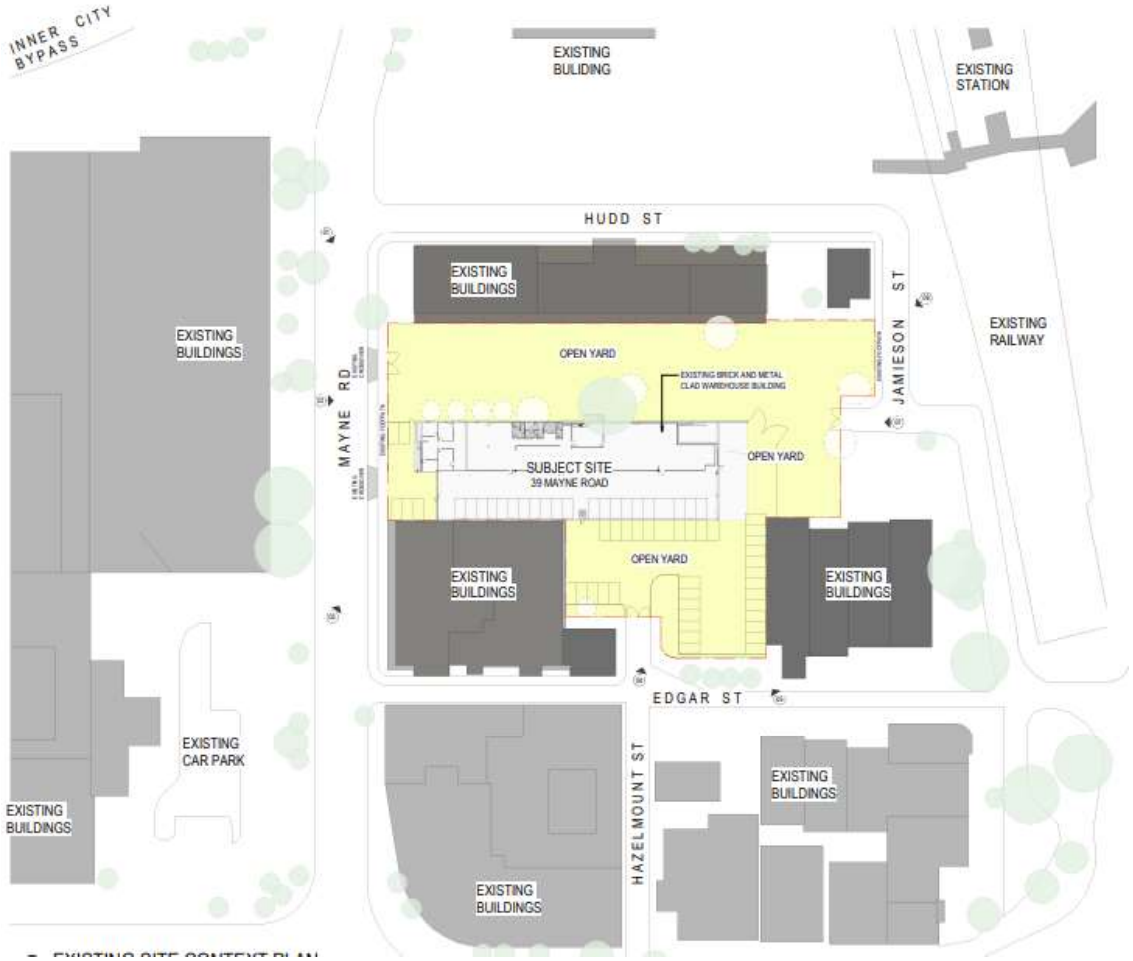


Figure 2: Proposed site and surrounding areas.

2. Acoustic Design Criteria

2.1. Brisbane City Council City Plan (BCC) 2014

We note that the Bowen Hills precinct is subject to special planning considerations by Brisbane City Council. The site is currently zoned EC – Emerging Community by BCC as:

'Land with potential for future development for range of residential uses to detailed planning and provision of infrastructure.'

While the proposed BMW operation is largely light industrial, we anticipate that it may be subject to a noise impact assessment during development application phases of the project, subject to confirmation by BCC of relevant assessment criteria.

2.2. Australian Standards 2017-2016

AS2107-2016 '*Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors (AS/NZS2106-2016).* AS/NZS 2107:2016 recommends the background noise levels for various spaces based on the type of occupancies and activities undertaken inside the space. Table 1 summarises the recommended background noise levels applicable to the project and these are generally based on this standard and our industry experience with similar projects.

Table 1: Recommended internal noise levels, L_{eq}.

Type of Occupancy/Activity	Design Sound Level Range, L_{eq}, dB(A)	Mid frequency reverberation time (t), secs
Corridors and Lobbies	45 to 50	<1.0
General Open Plan Office Areas	40 to 45	0.4 to 0.6
Meeting Rooms (small)	40 to 45	<0.6
Kitchen/Breakout	45 to 55	<0.6
Reception Areas/Open Lounge	40 to 45	0.6 to 0.8
Rest Rooms/Breakout Spaces	40 to 45	0.4 to 0.6
Toilets	45 to 55	-
Specialty Spaces (where detailed discussions is necessary in transactions)	<45	To be minimized for noise control purposes.
Workshop Storage Areas	< 60	To be minimized for noise control purposes.

3. Sound Isolation Requirements

For the purposes architectural and services coordination on this project, we have applied an Acoustic Grading concept to coordinate the required privacy requirements and acoustic detailing for the project. The following sections of the report outline the construction detailing for the project, based upon assumed speech privacy requirements.

Acoustic Gradings consist of a single number as the basis for construction design and future construction co-ordination. Room acoustic requirements for commercial tenancies are ranked from 0 to 5, where 0 is no requirement and 5 is the most stringent acoustic requirement.

These criteria have been established to provide an appropriate level of privacy as defined by Australian Standard AS 2822-1985: '*Acoustics – Methods of assessing and predicting speech privacy and speech intelligibility.*'

Acoustic grading requirements are based on the typical internal noise level in each receiver space and client acoustic privacy requirements for each space. Balancing the level of acoustic privacy in each enclosed space is dependent on the ambient noise levels as well as the room geometry and internal furnishing. Each Acoustic Grade is colour coded and this coding is presented in Table 2.

For the purposes of a car dealership, we understand that acoustic privacy requirements tend to be less critical and have assigned Low to Normal levels of speech privacy for the project. The sound insulation performance for partitions, glazed frontages and doors has been determined based on the background noise levels are detailed below in the subsequent sections of this report.

Table 2: Subjective description of Acoustics Performance and Speech Privacy Levels.

Acoustic Grade	R_w	Subjective privacy level	Suggested example application
0	-	Not important – privacy of speech is not relevant or applicable	Partitions without doors
1 *Green*	35	*"You easily hear and understand loud speech"* **Low** – A privacy level typically experienced in rooms with no attention to acoustic detailing. Some speech communication between rooms is possible, especially if raised voices are used. Loud speech is in general understood and a source of distraction.	Partitions with doors. Utility rooms.
2 *Blue*	40	*"You hear normal speech, but you can't understand."* **Normal** – A typical privacy level experienced in closed rooms. Subjectively, little speech communication is possible although the occupant would be aware of the presence of occupants of the adjoining room.	To corridors / open office areas Standard offices with normal privacy levels.

3.1. In-situ ratings (Dw) versus design ratings (Rw)

Due to site constraints and workmanship field performance sound insulation ratings which can differ from the laboratory rated R_w values. Consequently, field performance values (D_w values) have also been provided in this report to account for in-situ conditions and other factors which might degrade the laboratory rating. The R_w values are provided for design selection, whilst D_w values are used for site verification during construction or post-construction stages.

Typically, D_w ratings relate to the R_w laboratory rating of an element, minus 5dB. For example:

D_w rating = R_w rating – 5dB.

This differential is indicative only and is dependent on:

- The wall area being considered.
- The amount of sound absorption inside the rooms and either side of the partition.
- The extent of site weaknesses or flanking paths such as:

- Penetration's leakages.
- Crosstalk through air conditioning ducts.
- Flanking via the facade elements e.g., transoms, mullions, sills etc.
- Leakages via doors and doors seals.
- Transfer through weak window and door frames (standard aluminium frames prevalent in the fit-out market are usually thin and hollow and not acoustically rated. They are insufficient where speech privacy is required).

To achieve a defined D_w rating, it is therefore necessary to specify constructions with laboratory ratings around 5-10 dB over the D_w rating being sought. It is equally crucial to prevent/treat flanking paths through ceiling voids and raised floors.

In-principle, sound insulation performances which are recommended to achieve the required level of privacy (i.e., confidential level of privacy), are provided in the mark-ups provided in Appendix B for application to exact spaces.

These subjective privacy levels are based on background noise levels to be at a minimum as per the satisfactory noise levels in the applicable Australian Standard. For each increase in Acoustic Grade Rating, one step higher voice effort level can be used whilst maintaining a similar level of privacy providing the background masking noise remains the same. The interpretation of the Acoustic Grade Rating values is as summarised below in Table 3.

Table 3: Recommended Grade Ratings between Occupied Areas

Background Noise Level	Conversational Voice 60dB(A) @1m	Raised Voice 66 dB(A) @1m	Staged Voice 72 dB(A) @1m	Shouting 78dB(A) @1m
NR25 / 30dB(A)	3	4	6	7
NR30 / 35dB(A)	2	3	5	6
NR35 / 40dB(A)	1	2	4	5
NR40 / 45dB(A)	0	1	3	4
NR45 / 50dB(A)	0	0	2	3

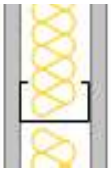
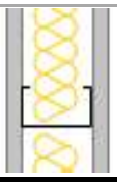
4. Acoustic Gradings

The following sections present the recommended partition constructions for the fit-out and their associated acoustic performance. Refer to the enclosed mark-ups for application of these ratings. It should be noted that actual partition, window, and door constructions may vary and may be subject to review if alternative construction methodologies may be used if preferred. These are presented in the attached mark-up, provided in Appendix B, and further outlined in the sections below.

4.1. Partitions

The default design elements of lightweight (plasterboard) partitions are presented in Table 4. Based upon our review, we understand that there is no raised access floor for this project and that no below the floor detailing is required for the project.

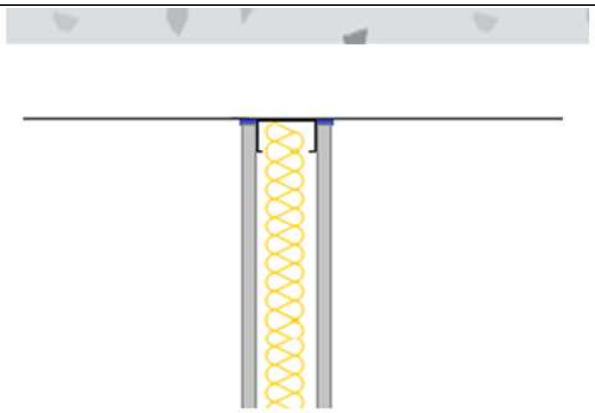
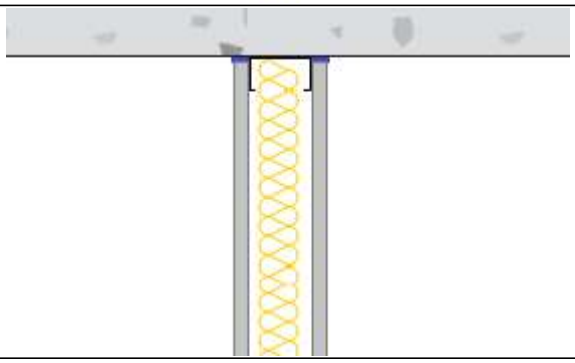
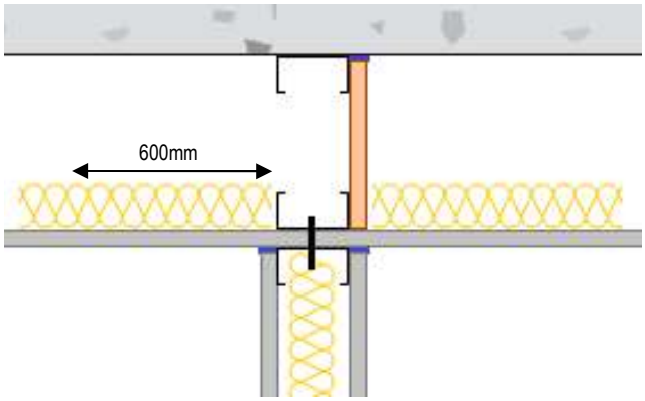
Table 4 Acoustic Grade System – Lightweight drywall partitions (typical)

Acoustic Grade	Sound Insulation Rw (dB)	Construction Description	Schematic
1 *Green*	**35**	− 1 x 13mm plasterboard (8.5 kg/m²) each side. − Min. 64mm steel stud (sized to structural requirements). − 50mm insulation in cavity, min 11kg/m³ density.	
2 *Blue*	**40**	– 1 x 13mm plasterboard (8.5 kg/m²) each side. – Min. 64mm steel stud (sized to structural requirements). – 50mm insulation in cavity, min 11kg/m³ density.	

4.2. Above ceiling constructions

Typical ceiling plenum constructions for each Acoustic Grade is provided in Table 5.

Table 5 Acoustic Grade System – Above ceiling constructions (typical)

Acoustic Grade	Partition height / Ceiling	Construction
1 *Green*	- Partition to extend to the underside of the ceiling with no baffling above the ceiling line.	
2 *Blue*	- Partition must extend to and be sealed to the soffit. - No ceiling or floating ceiling either side of the partition. - No ceiling or floating ceiling either side of the partition.	
2B *Blue*	**MINERAL FIBRE TILE CEILING BOTH SIDES OF THE PARTITION** – Ceiling (tile) screw fixed to the partition and sealed airtight. – 13mm fire-rated plasterboard (10.5kg/m²) ceiling baffle **or** 4kg/m² loaded vinyl. – 50mm insulation (25kg/m³) loose laid over the ceiling min. 600mm on either side of the partition. ***Note that 300mm acoustic baffle block may be used; however, the nominated Dw 35 performance may not be achieved on site (anticipated performance Dw 30-35).***	

Please refer to the attached mark-up in Appendix B for specific locations of recommended wall constructions.

4.3. Doors

The Acoustic Rating system is based on doors providing a R_w performance within 10 dB of the respective partition, to which the door is adjoined. In all but the most specialist acoustic spaces it would be impractical to require the door performance to match that of the base partition. The following acoustic Grade door requirements are summarised in Table 6 below.

Table 6 Acoustic Rating System – typical door schedule.

Acoustic Grade	Indicative Sound Insulation Dw-Rw (dB)	Door Type		Typical Door Seal Arrangement
		Solid Door / Frame Requirements	Glazing/Viewing Panel (as required)	
1 *Green*	20-25	Solid Core Timber 35mm Surface weight: 23kg/m^2	6.38mm laminate	Perimeter seal: Raven RP120 seals, RP10 or RP47 seals
2 *Blue*	25-30	Solid core timber: 40mm Surface weight: 23kg/m^2	10.38mm laminate minimum	Perimeter seal: Raven RP120 seals, RP10 or RP47 seals Drop down bottom seal: Raven RP8Si or RP35Si Meeting Stile (where applicable): Rebated meeting stile with Raven RP16Si Threshold: Minimal floor clearance (approx.5mm)

4.4. Internal glazed walls

For glazed frontages (i.e., occupied spaces to corridors, lobbies, and other transitory spaces) it is often acceptable to degrade the required Rw.

This is because the following factors assist with the acoustic privacy in these circumstances:

- The receiver space (corridor) is a transitory space and typically has higher background noise levels.
- The visual connection between the spaces allows the talker to determine if any potential listeners are outside the room through the glass frontage and can therefore adjust the level of their voice accordingly.

Table 7 below illustrates the default case where the glass partition matches the performance of the corresponding Acoustic Grade of the partition.

Table 7 Acoustic Rating System – glazed walls/glazed frontages.

Acoustic Grade	Sound Insulation Performance Rw (dB)	Glazing	
		Type	Typical glazing thickness
1 *Green*	36	Single laminated. No baffle above	10.38mm laminate
2 *Blue*	38	Single laminated with baffle above	12.76mm Laminate

5. Services Requirements

5.1. Mechanical Services

The following design recommendations are provided as co-ordination guidance to appropriate acoustic design to control noise impacts within the fit-out to achieve the project acoustic criteria.

- All ductwork which will be part of the fit-out infrastructure will need to be internally lined (with minimum 50 mm thick insulation).
- Base building to supply and install acoustic treatment to mechanical equipment, ducts, pipes, and valves where required to comply with specified noise levels in Table 1 of this brief, this may include external lagging with loaded vinyl wrap, internally lined duct, or plasterboard enclosures.
- Vibration isolate equipment and systems nominated as nominated in Section 5.2.
- Indoor units (such as packaged units, FCUs, etc) and fans should be located outside enclosed noise sensitive spaces and above generally noisy areas.
- Indoor units and fans may require treatment for case radiated and break-out noise. Therefore, it is these units will, as a minimum, be externally wrapped in loaded vinyl material, where there is no continuous set plasterboard ceiling.

5.1.1. Duct Velocities

In relation to duct velocities, the following duct velocities (m/s) should apply for all mechanical ducts. All mechanical systems, including base building mechanical systems must be checked for internal duct to comply with the values in Table 8. It is required that all supply and return air systems are balanced to take account of fit out rooms and duct velocities adjusted where required to meet the duct velocities.

Table 8: Air Conditioning Ducts – Recommended Duct Velocities m/s (Nonoys 1970).

Design Criteria	Max Velocity (m/s)			
dBA	Main Risers	Run Outs	Grill Necks	Grill Slot
30	3.2	2.5	2.5	1.0
35	4.1	3.2	2.5	1.3
40	5.1	4.1	3.2	1.6
45	6.4	5.1	4.1	2.0
50	8.1	6.4	5.1	2.5

5.2. Vibration Isolation

Vibration isolate equipment and systems nominated as follows in Table 9 and Table *10* below.

Table 9 Vibration Isolation Mount Static Deflection, mm for Fans

Motor Power (kW)	Fan Speed (Revs/Sec)	Structural Floor Span		
		Slab on Ground	Up to 10m Span	Over 10m Span
Up to 3.5 kW	24	6	12	12
	16	12	12	25
	12	12	25	25
	9	25	40	45
	6	25	67	75
3.5 to 30 kW	24	12	25	25
	16	25	25	25
	12	12	25	40
	9	25	45	50
	6	25	75	90
Over 30 kW	24	25	25	25
	16	25	25	40
	12	25	25	45
	9	25	65	75
	6	25	90	110

Table 10: Vibration Isolation Mount Static Deflection, mm for Compressors and Pumps.

Motor Power (kW)	Speed (Revs/Sec)	Structural Floor Span		
		Slab on Ground	Up to 10m Span	Over 10m Span
Up to 1.5 kW	48	6	6	6
	24	6	6	6
	12	12	25	25
1.5 to 3.5 kW	48	6	6	6
	24	6	12	12
	12	12	25	25
3.5 to 7.5 kW	48	6	12	12
	24	6	12	25
	12	12	40	50
Over 7.5 kW	48	25	25	25
	24	25	25	25
	12	25	50	70

5.3. Hydraulic Services

The following measures should be taken into consideration for acoustic attenuation of hydraulic services over acoustically sensitive areas:

- Where practicable, pipe systems should be located away from noise sensitive areas to minimise penetrations in acoustically rated walls and minimise noise impacts.
- Plumbing service piping to fittings should be sized to provide flow velocity of not greater than 2.5 metres per second; or 1.5 m/s, if piping is located adjacent to any noise sensitive area.
- Waste pipes located within ceiling plenums above noise sensitive areas may need to be externally lagged with loaded vinyl wrap. e.g., Soundlag 4525' 4.5kg/m² loaded-vinyl sheeting with 25 mm open-cell polyester foam internal facing, or equivalent. Alternative 'heavy reinforced' polymer piping systems to avoid acoustic lagging may be considered on specific application.
- There should be no rigid contact between the pipe and building structure and a 20 mm clearance is recommended with isolation elements manufactured from neoprene rubber. Partitions to noise sensitive spaces with hydraulic services in the cavity should have a double or staggered stud configuration to reduce impact noise to noise sensitive spaces.
- Hydraulic services waste pipes passing through acoustically rated walls will need to be treated based on the acoustic rating of the wall and ceiling partition. Further details are to be provided to specific areas.

6. Specific Acoustic Design Considerations

The following list of issues will be developed further, following liaison with the project design team. A preliminary summary of design considerations is provided below in Table 11.

Table 11 Acoustic Issues and Recommendations.

Rooms	Issue	Recommendations
Open Plan Workspaces and Customer Reception Areas	- Reverberation Control	- Carpet and ceiling tiles are recommended for these spaces.
Warehouse	- Mechanical Services	- We note that the Workshop Area will be serviced by large ventilation fans. - Our current calculations have estimated that the operation of these fans will meet AS2107-2016 design noise levels.
Service Workroom	- Noise ingress from warehouse.	- We have specified Grade 2 sound isolation to the doors (45mm thick doors + perimeter and drop seals), however thicker doors (50-70mm thick door leaf) could be considered if noise and activity from these spaces is anticipated to be intrusive.

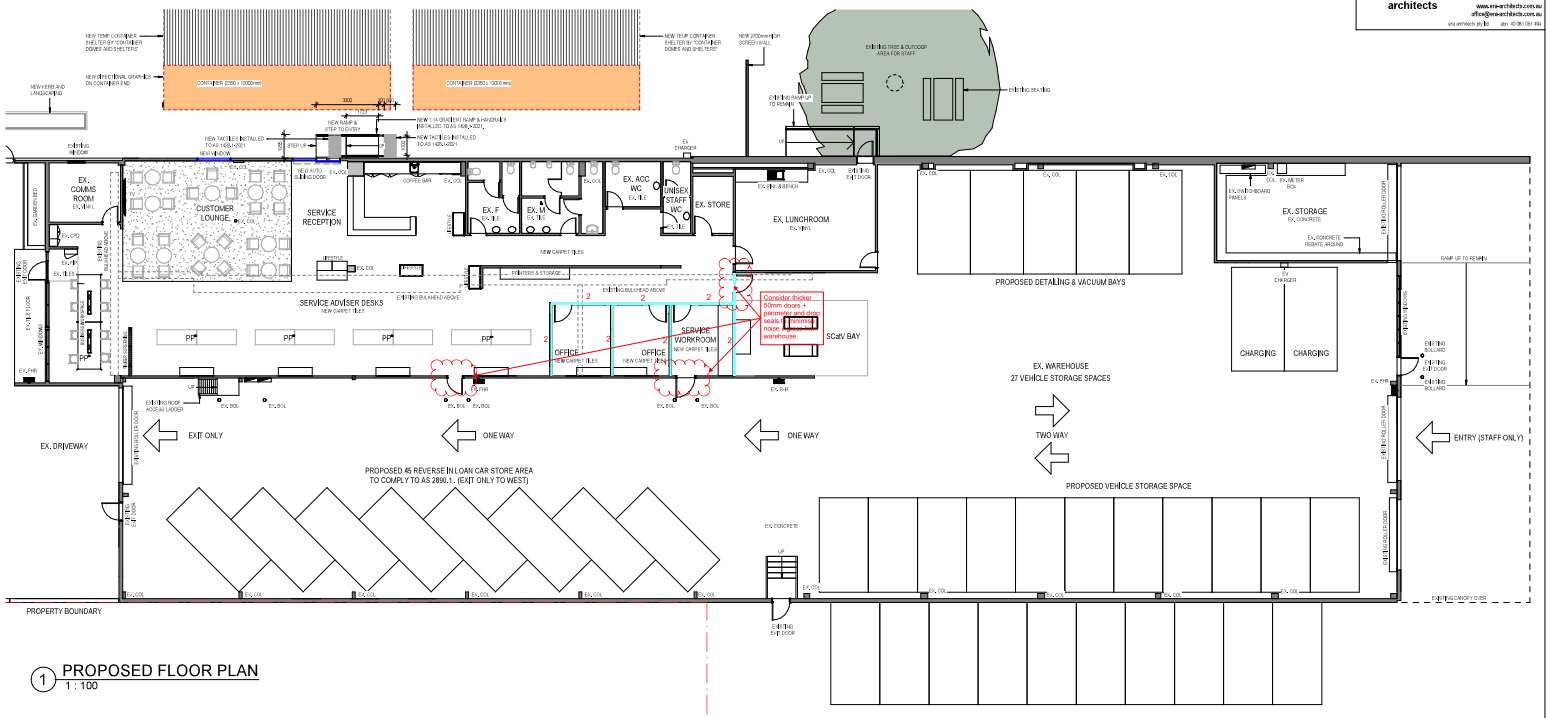
A. Appendix A – Acoustic Terminology

'A' Weighted	Frequency filter applied to a noise spectrum that adjusts ('weights') each frequency differently. The 'A' weighting very roughly corresponds with subjective assessments of noise levels.
Ambient Sound	The overall noise level associated with an environment or space. It is usually a composite of sounds from many sources, both near and far. Usually taken to mean the L_{Aeq} value.
Background Noise Level	The average of the lowest measured noise levels in an affected area, in the absence of noise from occupants and/or unwanted external noise sources. Usually taken to mean the L_{A90} value.
dB(A)	The overall 'A' Weighted sound pressure level.
Decibel, dB	Unit of acoustic measurement. Measurements of power, pressure and intensity may be expressed in dB relative to standard reference levels.
L_{90}, L_{10}, etc	A statistical measurement giving the sound pressure level which is exceeded for the given percentile over a measurement period, i.e., L_{90} is the level which is exceeded for 90% of the measurement period. Likewise, the L_{10} level is the noise level exceeded for 10% of the measurement time. The L_{A90}, L_{A10} (etc) levels are the A-weighted noise levels exceeded for the respective percentile.
$L_{Aeq, T}$	Equivalent continuous A-weighted sound pressure level. The equivalent continuous A-weighted sound that, within a measurement time interval T, has the same A-weighted sound energy as a time-varying sound.
Noise Reduction	The difference in sound pressure level between any two areas. The term 'noise reduction' does not specify any grade or performance quality unless accompanied by a specification of the units and conditions under which the units apply.
R_W	Weighted Sound Reduction Index. A single number value of the acoustic performance of a partition or building element. Calculation procedures for R_W are defined in ISO 140-2:1991 "*Measurement of Sound Insulation in Buildings and of Building Elements Part 2*". The R_W is function of the level difference between two spaces separated by the building partition or element, surface area of the building partition or element, room volume and area of absorption in the receiver room (generally measured by the reverberation time).
Sound Isolation	A reference to the degree of acoustical separation between any two areas. Sound isolation may refer to sound transmission loss of a partition or to noise reduction from any unwanted noise source. The term 'sound isolation' does not specify any grade or performance quality and requires the units and measurement conditions to be specified.
Sound Pressure Level L_p, dB	A measurement obtained directly using a microphone and sound level meter. Sound pressure level depends on the distance from a source and on the measuring environment. Sound pressure level equals twenty times the logarithm to the base 10 of the ratio of the rms. sound pressure to the reference sound pressure of 20 microPascals - $20\log_{10}$(measured rms pressure/2 x 10^{-6})
Sound Power Level L_w, dB	Sound power level is a measure of the sound energy emitted by a source. It does not change with distance and is not directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with appropriate corrections for distance and/or environmental conditions. Sound power level is equal to 10 times the logarithm to the base ten of the ratio of the sound power of the source to the reference sound power of 1 picoWatt. - $10\log_{10}$(Sound Power/1 x 10^{-12}).

B. Appendix B – Mechanical Services Data

Equipment	Type	Location	Service Area	Status	No Off	Estimated Sound Pressure Level @3m dB(A)	
						Outdoor	Indoor
Packaged Unit	Rooftop	Roof	Open Office Area	Existing to be reused	1	66	-
Packaged Unit	Rooftop	Roof	Open Office Area	Existing to be reused	1	66	-
Air Conditioner	Wall Mounted	Comms Room	Comms Room	Existing to be reused	1	50	45
Exhaust Fan	Rooftop	Roof	Toilets	Existing to be reused	1	60	-
Exhaust Fan	Inline	Storage	Switch Board	New	1	-	40
Bigass Fan	Ceiling	Workshop	Workshop	New	3	-	45

C. Appendix C – Acoustic Markup



1 PROPOSED FLOOR PLAN
1 : 100

ACOUSTIC GRADINGS
Wall/Door/Frontage

- Grade 1 Rw 35/25/35
- Grade 2 Rw 40/30/40
- Grade 3 Rw 45/35/45
- Grade 4 Rw 50/40/50
- Grade 5 Rw 55/45/55

Drawn: David Luck
Verification:
Date:

BSE TRUE PARTNERS

LEGEND

- EXISTING WALLS TO REMAIN
- EXISTING WINDOWS TO REMAIN
- NEW 92mm STUD WALLS
- NEW WINDOWS
- EX. COL — EXISTING COLUMN TO REMAIN
- EX. FHR — EXISTING FIRE HOSE REEL TO REMAIN
- EXISTING SWITCHBOARD
- EX. FIP — EXISTING FIRE INDICATOR PANEL TO REMAIN
- PP ● — NEW POWER POLE

0m 2m 4m 6m 8m 10m
VISUAL SCALE 1:100 @ A1

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TP1 15.06.22 TOWN PLANNING ISSUE SR

TOWN PLANNING

PROJECT NORTH TRUE NORTH

PROJECT
BRISBANE BMW-TEMP SERVICE
39 MAYNE ROAD, BOWEN HILLS
Part SHME DARBY

DRAWING TITLE
PROPOSED FLOOR PLAN

DATE 06/06/2022
DRAWN DVA
SCALE As indicated @ A1
DRAWING NO TP-06
REV TP1