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Environmental Noise Impact Assessment
St Mary and St John the Beloved
Coptic Orthodox Church Development

12 Waterhouse Avenue,

Lloyd, (Wagga Wagga) NSW 2650

Prepared for: -

The Church of St Mary and St John the Beloved
C/- Icono Building Design
Shop 30 Kooringal Mall
Lake Albert Road
Wagga Wagga NSW 2650

Attention: Mr. Rod McMullen

Reference: 2008018E-R – REVISION B

Prepared by: -

Matthew Harwood MAAS
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CONFIDENTIAL

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In association with: -

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ACOUSTICAL CONSULTING

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Icono Building Design, on behalf of the Church of St Mary and St John the Beloved, commissioned Ray Walsh Acoustics, Noise and Sound, in association with Harwood Acoustics Pty. Ltd., to carry out a noise impact assessment for a place of public worship development to be constructed at 12 Waterhouse Avenue, Lloyd, NSW 2650.

Accordingly, Harwood Acoustics Pty. Ltd. has prepared this report for the exclusive use of the Client identified on the title page. The report is prepared in accordance with the brief and scope of works agreed between the Client, Ray Walsh Acoustics, Noise and Sound and Harwood Acoustics Pty. Ltd. and may not be suitable for use beyond that scope.

Ray Walsh Acoustics, Noise and Sound and Harwood Acoustics Pty. Ltd. undertake no duty nor accept any responsibility to any third party who may rely upon this report.

Advice and recommendations provided in this report are in relation to acoustical issues only. No claims of expertise are made, and no liability is accepted, in relation to issues falling outside the field of acoustical consulting. These may include, but are not limited to, structural and waterproofing considerations, fire rating or thermal rating. Relevant authorities and / or experts should be consulted regarding areas other than acoustics.

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1 INTRODUCTION AND SUMMARY

The Elders of the Church of St Mary and St John the Beloved propose to construct a new Coptic Church development at 12 Waterhouse Avenue, Lloyd, NSW (the Site).

The Site is an 11,800 m^2 block of residential land located in the suburb of Lloyd, approximately 4 kilometres to the south west of the City of Wagga Wagga. The Site is zoned R1 General Residential under Wagga Wagga City Council's Local Environment Plan 2010.

The Site is bound to the north and west by new residences and to the south and east by Ansett Street and Waterhouse Avenue respectively with residences opposite. A location plan is shown in Figure 1.

The overall development will comprise four main components including a new Church (the Church), a multi-purpose hall (the Hall), a services building (the Services Building) and the external areas. The Church will provide seating capacity for up to 400 people and include a baptism room, family rooms and amenities. The Hall will also provide seating capacity for up to 400 persons and include a stage, a commercial kitchen and amenities. The Services Building will include two offices, 13 classrooms, an audio-visual room, computer room, three self-contained units (for residential accommodation), a canteen, book store, store rooms and amenities. The outdoor areas will include a children's playground, a basketball court and four (4) car parking areas.

A Site plan is shown in Figure 2 and full details can be seen in Icono Building Design Building Design Plans for Project No. 20-09, updated November, 2021.

The construction of the development is likely to be staged with the Hall, Services Building and all outdoor areas constructed as part of Stage 1 and the Church constructed later, as Stage 2. This assessment addresses each of the components associated with Stage 1 only.

The Hall will be used for services prior to the construction of the Church and services will include: -

- Sundays – main service Sunday morning, congregation breakfast, Sunday school for children, servant's preparation class, servants meeting and confession,
- Fridays – early morning mass, prayer and bible study in the evening, youth club in the evening,
- Saturday – hymns and Coptic class, vespers, midnight praise,
- General –baptisms, weddings, funerals, children and youth fun days and indoor and outdoor activities.

It is a requirement of Wagga Wagga City Council that an Environmental Noise Impact Assessment be prepared to be submitted with the Development Application. The assessment is to address the potential for noise impact on existing residences in the vicinity of the Site arising from the use and operation of the development.

Project specific noise design goals for noise emission arising from the use of the Site are derived from the EPA's *Noise Guide for Local Government* (2013) for intrusive noise impacts;

the EPA's *Noise Policy for Industry* (2017) for assessment of the potential for sleep disturbance and the NSW EPA's *Road Noise Policy* (2011) for impacts generated by road traffic accessing the Site.

Intrusiveness noise goals are based on background noise levels measured in the vicinity of the closest neighbours and the noise goals are 42 dBA ($L_{eq,\ 15\ minute}$) during the day and evening time periods and 32 dBA ($L_{eq,\ 15\ minute}$) during the night time period and shoulder periods prior to 7 am and after 10 pm.

Noise sources associated with the operation of the development will include adult voice noise, amplified speech and music during services and ceremonies, children's voice noise when at play in the playground and on the basketball court, motor vehicle movements on the Site and any mechanical plant servicing the development as well as attendant motor vehicle movements on the local road network.

The selection of mechanical plant to service the buildings has not been finalised at this stage although it is likely to include air conditioning condenser plant, refrigeration plant and ventilation fans.

Noise modelling was carried out for the various aspects of the development and noise levels were predicted at each of the receptor locations for each of the noise producing areas of the Site. Predictions also include the cumulative effect of the noise emission from different areas of the Site when in use simultaneously, where applicable.

Recommendations are made in Section 7 of this Report to reduce the level of noise from the use of the development to within the noise design goals at each receptor location so far as is reasonably practicable.

Recommendations include erecting sound barrier screens around the basketball court, playground and car parks, restricting openings in the Hall whilst in use, restricting the internal level of amplified music in the Hall during services and restricting the use of the Hall during night time hours.

Providing these recommendations are implemented and continue to be adhered to then the NSW EPA's intrusiveness noise design goals can be complied with for this development at each receptor location as required by Wagga Wagga City Council.

The NSW EPA's *Road Noise Policy* 2011 provides noise assessment criteria for residential land uses and prescribes criteria of 55 dBA ($L_{eq,\ 1\ hour}$) during the day time and 50 dBA ($L_{eq,\ 1\ hour}$) during the night time for existing residences that are affected by additional traffic on existing local roads generated by new land use developments.

The day time criterion of 55 dBA ($L_{eq,\ 1\ hour}$) can be complied with at the closest dwellings to either Ansett Street or Waterhouse Avenue for up to 150 vehicle movements in any given hour between 7 am and 10 pm. The night time noise criterion of 50 dBA ($L_{eq,\ 1\ hour}$) can be complied with for up to 50 vehicle movements in an any given one-hour period between 10 pm and 7 am. A traffic management plan may be implemented to ensure that these numbers are not exceeded and continue to be adhered to.

2 SITE AND DEVELOPMENT DESCRIPTION

2.1 Site Description

The Elders of the Church of St Mary and St John the Beloved propose to construct a new Coptic Church development at 12 Waterhouse Avenue, Lloyd, NSW (the Site).

The Site is an 11,800 m^2 block of residential land located in the suburb of Lloyd, approximately 4 kilometres to the south west of the City of Wagga Wagga. The Site is zoned R1 General Residential under Wagga Wagga City Council's Local Environment Plan 2010.

The Site is bound to the north and west by new residences and to the south and east by Ansett Street and Waterhouse Avenue respectively with residences opposite.

The Site and nearest receptors are shown in Figure 1 below and are located at addresses as follows: -

R1 – 9 Florey Street

R2 – 11 Florey Street

R3 – 6 Fisher Place

R4 – 5 Fisher Place

R5 – 10 Waterhouse Avenue

R6 – 16 Ansett Street

R7 – 3 Ansett Street

R8 – 11 Waterhouse Avenue

Figure 1. Location Plan – 12 Waterhouse Avenue, Wagga Wagga, NSW

(Source: Google Maps ©)

Receptors R7 and R8 are considered representative of neighbouring dwellings in both Ansett Street and Waterhouse Avenue respectively and compliance with the noise goals at these identified receptors will ensure compliance at all other neighbouring dwellings.

2.2 Description of Development and Typical Activities

The overall development will comprise four main components including: -

- a new Church (the Church),
- a multi-purpose hall (the Hall),
- a services building (the Services Building) and
- the external areas (basketball court, playground and car parks).

The Church will provide seating capacity for up to 400 people and include a baptism room, family rooms and amenities. The Hall will also provide seating capacity for up to 400 persons and include a stage, a commercial kitchen and amenities.

The Services Building will include two offices, 13 classrooms, an audio-visual room, computer room, three self-contained units (for residential accommodation), a canteen, book store, store rooms and amenities. The outdoor areas will include a children's playground, a basketball court and four (4) car parking areas.

A Site plan is shown in Figure 2 and full details can be seen in Icono Building Design Building Design Plans for Project No. 20-09, updated March, 2022.

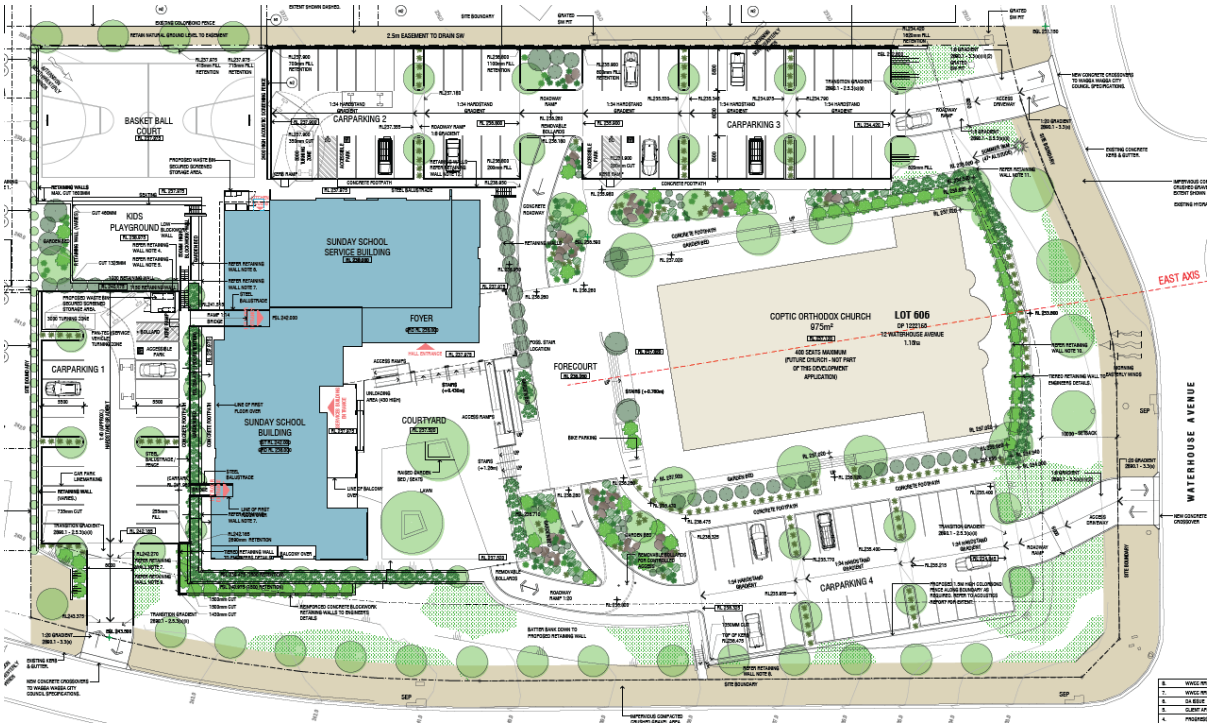

Figure 2. Site Plan

(Source: Icono Building Design Plans for Project No. 20-09, updated November, 2021)

Noise sources associated with the operation of the development will include human voice noise, amplified speech and amplified music from within the Hall, children at play outdoors and vehicle movements in the car park and on the local roads.

The Hall will be used for services prior to the construction of the Church and services will include: -

- Sundays – main service Sunday morning, congregation breakfast, Sunday school for children, servant's preparation class, servants meeting and confession,
- Fridays – early morning mass, prayer and bible study in the evening, youth club in the evening,
- Saturday – hymns and Coptic class, vespers, midnight praise,
- General – baptisms, weddings, funerals, children and youth fun days and indoor and outdoor activities.

The development will be constructed in two stages with the Hall, Services Building and all outdoor areas being constructed first and the Church later, during Stage 2. This assessment considers the noise sources associated with Stage 1; however, recommendations are included in Section 7 with regard to the future use of the Church.

3 NOISE ASSESSMENT CRITERIA

This section outlines the noise guidelines applicable to this proposal and establishes the project specific noise goals.

3.1 NSW EPA's Noise Guide for Local Government (2013)

The Environment Protection Authority (EPA) updated the *Noise Guide for Local Government* (the Guide) in June 2013. The Guide is specifically aimed at assessing noise from light industry, shops, entertainment, public buildings, air conditioners, pool pumps and other noise sources in residential areas.

The Guide is advisory in nature, and council officers are encouraged to use it to develop council procedures or policy to deal with noise issues relevant to local circumstances.

Section 2.2.1 of the *Noise Guide for Local Government* (2013) specifies that a noise source is generally considered to be intrusive if the noise from the source, when measured over a 15-minute period ($L_{eq,\ 15\ minute}$), exceeds the background noise ($L_{90,\ 15\ minute}$) by more than 5 dB.

The assessment methodology and criterion are consistent with the EPA's *Noise Policy for Industry* (2017) intrusiveness project trigger levels and are deemed to be an appropriate guide to determining the potential for noise impact from this proposal.

3.2 Measured Background Noise Levels

In order to establish the intrusiveness noise goals, it is necessary to determine the background noise levels in the vicinity of all potentially affected residential receptors.

The background noise level is defined by the EPA as 'the underlying level of noise present in ambient noise when all unusual extraneous noise is removed' and is considered to be represented by the $L_{A90,\ 15\ minute}$ descriptor. This is a statistical measure of the sound pressure level that is exceeded for 90 % of the time.

The Rating Background Level (RBL) is the single-figure background noise level derived from monitoring $L_{A90,\ 15\ minutes}$ over a representative period of time. The Rating Background Level is established for the day, evening and night time periods and is used for assessment purposes.

When measuring background noise levels, it is important to undertake sufficient monitoring of background noise to allow intrusive noise to be assessed adequately.

The criteria and methodology provided in the guideline is derived from the NSW EPA's *Noise Policy for Industry* (2017). The policy provides minimum rating background noise levels (RBLS) for each period of the day, evening and night.

The minimum assumed RBLs result in minimum intrusiveness noise levels. These are shown in Table 2.1 in the Policy and are replicated in Table 1 below.

Table 1 Minimum Assumed RBLs and Project Intrusiveness Noise Levels (Derived from EPA NPI Table 2.1)

Period / Time of Day	Minimum Assumed Rating Background Level dBA	Minimum Project Intrusiveness Noise Levels ($L_{eq,\ 15\ minute}$, dBA)
Day Time Period (7 am to 6 pm)	**35**	**40**
Evening Time Period (6 pm to 10 pm)	**30**	**35**
Night Time Period (10 pm to 7 am)	**30**	**35**

In this instance a noise logger was installed temporarily on the Site adjacent to 16 Ansett Street (as shown in Figure 1) from Wednesday 5 to Thursday 13 May 2021.

This location is considered representative of all residential receptors in the vicinity of the site. The results of the background noise survey are summarised in Table 2 below and shown in graphical format in the attached Appendix C.

Details of instrumentation used during the noise survey can be seen in the attached Appendix A.

Table 2 Rating Background Levels – Ansett Street, Wagga Wagga

Period / Time of Day	Rating Background Level (L_{90})
Day Time Period (7 am to 6 pm)	**37 dBA**
Evening Time Period (6 pm to 10 pm)	**38 dBA**
Night Time Period (10 pm to 7 am)	**32 dBA**

3.3 Sleep Disturbance Criteria

3.3.1 Noise Policy for Industry (2017)

Section 2.5 'Maximum noise level event assessment' states: -

"The potential for sleep disturbance from maximum noise level events from premises during the night time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

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

- *$L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or*
- *L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, 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. Some guidance on possible impact is contained in the review of research results in the NSW Road Noise Policy."

3.3.2 EPA's Road Noise Policy (2011) (Sleep disturbance)

Section 5.4 of the NSW EPA's Road Noise Policy states: -

> *"Further studies by the enHealth Council (2004) and the guidelines published by the World Health Organisation (1999) were reviewed and analysed in terms of the guidance on noise exposure and sleep disturbance.*
>
> *The enHealth report states that:*
>
> *'as a rule, for planning for short-term or transient noise events, for good sleep over 8 hours the indoor sound pressure level measured as a maximum instantaneous value should not exceed approximately 45 dB(A) L_{Max} more than 10 or 15 times per night'."*

3.3.3 Environmental Criteria for Road Traffic Noise 2009

Appendix B5 of the NSW EPA's *Environmental Criteria for Road Traffic Noise* (ECRTN) reviews the current level of knowledge and concludes that maximum internal noise levels below 50–55 dBA are unlikely to cause awakening reactions, and that one or two noise events per night with maximum internal noise levels of 65 to 70 dBA are not likely to affect health and wellbeing significantly.

3.4 On-Road Traffic Noise Criteria – Road Noise Policy

The NSW EPA published the NSW *Road Noise Policy* in March 2011 and that Policy replaced the *Environmental Criteria for Road Traffic Noise* (ECRTN- 1999) in July 2011.

The Policy contains strategies to address the issue of road traffic noise from, among other things, traffic generating developments.

3.4.1 Noise Assessment Criteria – Residential Land Uses

Table 3 of Section 2.3.1 of the Policy *'Noise assessment criteria – residential land uses'* sets out the assessment criteria for residences to be applied to particular types of project, road category and land use.

The relevant parts of RNP Table 3 are replicated in Table 3 below.

Table 3 Road Traffic Noise Assessment Criteria

Road Category	Type of Project / Land Use	Assessment Criteria, dBA	
		Day (7 am – 10 pm)	Night (10 pm – 7 am)
Local Roads	6. Existing residences affected by **additional traffic** on existing local roads generated by land use developments	$L_{Aeq\ (1\ hour)}$ 55 (external)	$L_{Aeq\ (1\ hour)}$ 50 (external)

3.5 Project Specific Noise Goals

The most relevant criteria* are as follows: -

All residential receptors

- (37 + 5 =) **42 dBA** $L_{eq,\ 15\ minute}$ during the day and evening time periods*,
- (32 + 5 =) **37 dBA** $L_{eq,\ 15\ minute}$ during the night time period (including prior to 7 am for Friday early morning mass and after 10 pm for Saturday midnight mass),
- (32 + 15 =) **47 dBA** $L_{1,\ 1\ minute}$ as an external screening test for sleep disturbance at night,
- **45 dBA** to **55 dBA** $L_{1,\ 1\ minute}$ inside residential dwellings for further sleep disturbance assessment,
- **55 dBA** ($L_{eq,\ 1\ hour}$) from on-road traffic noise during the day time period, and
- **50 dBA** ($L_{eq,\ 1\ hour}$) from on-road traffic noise during the night time period.

* The noise goal design for the evening period is set to the same level as the day time period despite the rating background noise level during the evening period being 1 dB higher than that in the day time period. This is in line with EPA methodology which recognises that the community expectation is generally for greater control of noise in the more sensitive evening and night time periods than in the less sensitive day time period. Consequently, it is generally recommended that the noise goal for the evening time period is set no higher than the noise goal for the day time period.

Assessment locations

All new dwellings surrounding the Site are single storey dwellings and the assessment location is therefore at the most affected point on or within the residential property boundary for intrusive noise impacts. For sleep disturbance external assessment and on-road traffic noise, the assessment location is at 1 metre from the closest façade of the dwelling to the noise source.

4 PLACE OF PUBLIC WORSHIP NOISE EMISSION

4.1 People Talking

A noise model has been developed for the calculation of noise generated by people indoors or outdoors. This is based on sound pressure level data for one person as given in Kryter[1], Harris[2] and from the author's database compiled over many years of similar assessments.

Table 5 below shows the calculated sound power levels for human voice noise used in the noise modelling.

Table 5 L_{eq} Sound Power Levels – Worshippers Talking / Praying / Singing

Type of Voice	Sound Power Level (dBA)	Estimated Time Spent Utilising Each Type of Voice Level (minutes in 15)	Resultant Sound Power Level 15-Minute Average ($L_{Aeq,\ 15\ minute}$) dBA
Casual	61	3	54
Normal	64	5	61
Raised	73	6	69
Loud	83	1	71
15-minute average for 1 Person			74
15-minute average for 400 people inside singing (assumes 50% vocal)			97
Amplified speech inside Hall			90
Amplified music inside Hall			100

4.2 Children at Play

A similar noise model has been developed to establish the noise level of children at play. This model is based on measurements taken of children at play in groups undertaken during previous assessments of childcare centres by the author as well as sound pressure level data for children given in Kryter as detailed in Section 4.1 above.

The data was used to establish the sound power levels for individual children shown in Table 6 below. These levels are in line with the sound power levels provided in the AAAC '*Guideline for Child Care Centre Acoustic Assessment*'.

[1] *'The Effects of Noise on Man'* by Karl Kryter, Academic Press (1985)

[2] *'Handbook of Acoustical Measurements and Noise Control'* 3rd Edition by Cyril M. Harris, McGraw-Hill Inc (1991)

Table 6 Children at Play - L_{eq} Sound Power Levels

No. of Children / Age / Description	L_{eq} Sound Power Levels (dBA)
1 child 0 to 2 years	69
1 child 2 to 3 years	75
1 child 3 to 4 years	75
1 child 4 to 5 years	77
15 children 0 to 2 years	81
15 children 2 to 4 years	87
15 children 4 to 5 years	89

Table 7 below shows previously measured noise levels from basketball activity shown in terms of short term, 'A' frequency weighted, energy average (L_{Aeq}) sound pressure level in decibels (dBA) measured courtside. The basketball court at the Church will be used more like a playground for children than a dedicated basketball court where genuine matches would be played.

Table 7 Basketball Game - L_{eq} Sound Pressure Levels

Basketball Game Type / Description	$L_{eq, 15\ minute}$ Sound Pressure Levels (dBA)
Practice game / playing	64 – 67

4.3 Motor Vehicle Noise

The L_{eq} sound power level of cars is given in Table 8 below. Table 8 also shows the $L_{1, 1\ minute}$ sound power level of vehicle activity for sleep disturbance assessment.

Table 8 L_{eq} and L_1 Sound Power Levels of Typical Motor Vehicle Movements

Motor Vehicle Movements / Description	Sound Power Levels dBA
$L_{eq, 15\ minute}$ level of one car passing	69
$L_{1, 1\ minute}$ level of a car door closing	84
$L_{1, 1\ minute}$ level of one car passing	89

4.4 Mechanical Plant

At the time of writing this report, it is not known what specific mechanical plant will be associated with the development.

Mechanical plant is likely to include: -

- Kitchen exhaust fan (for the commercial kitchen in the Hall),
- Air conditioning condenser units (both buildings), and
- Refrigeration plant (cool room condenser or compressor, potentially).

Recommendations are made in Section 7.7 of this report to ensure that noise emission from any new mechanical plant servicing the building does not exceed the acceptable noise limits at receptor locations.

5 NOISE LEVEL PREDICTIONS

5.1 Modelling Equations

The levels of noise emission from voice noise, amplified speech and music from within the building/s were calculated from the formula: -

$$Lp_2 = Lp_1 - R_w + 10\,Log_{10}\,S - 20\,Log_{10}\,r - 14 + DI\ dBA$$

Where:

Lp_2	is the predicted noise level at the receiver,
Lp_1	is the internal noise level,
R_w	is the weighted sound reduction index of the building element (wall, roof, windows, openings, etc),
S	is the area of the building element (m^2),
r	is the distance between the receiver and the building element,
DI	is the directivity index of the façade.

Outdoor noise sources including people talking outside, children playing, basketball sports and motor vehicle movements were modelled using the formula: -

$$L_{eq} = L_w + Dc - A$$

Where:

L_w	is the sound power level of the noise source,
Dc	is directivity correction, and
A	is the attenuation that occurs during the propagation from source to receiver.

The term A in the equation includes attenuation from geometric divergence (distance loss), atmospheric absorption, ground absorption, barrier effects and other miscellaneous effects.

This model derives from the International Standard ISO 9613-2 (1996(E)) *'Acoustic – Attenuation of sound during propagation outdoors Part 2 General method of calculation'*. The method described in the Standard is general in the sense that it may be applied to a wide variety of noise sources and covers the major mechanism of sound attenuation. The method allows for worst case propagation conditions with the wind blowing from the source to the receiver.

5.2 Noise Modelling Predictions

The predicted noise levels at each receptor are shown in the following Tables, where: -

Table 9 – shows the predicted level of noise emission from use of the hall, service building and outdoor areas during the day and evening time periods,

Table 10 – shows the predicted level of noise emission from use of the hall, service building and outdoor areas during the night time period,

Table 11 – shows the predicted level of noise emission from on-site motor vehicle activity for assessment against the screening test level for Sleep Disturbance outside each residential façade during the night and early morning.

Table 9 Predicted L_{eq} Noise Levels – Day Time and Evening Time Periods

Activity / Description	Predicted Noise Level $L_{eq, 15\ minute}$ (dBA) at Receptor Locations							
	R1	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**
Day & Evening Noise Goal	**42**	**42**	**42**	**42**	**42**	**42**	**42**	**42**
Basketball Court & Playground	40	40	37	33	30	39	<20	<25
Hall (service with music, etc)	35	36	37	37	32	35	27	25
Service Building	<30	<30	<30	<30	<25	<25	<20	<20
Car Parks	14	16	20	24	23	20	19	16
All Combined	41	41	40	39	34	40	29	27
Complies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The predicted noise levels in Table 9 consider / are predicated on the following: -

- Fifteen (15) 4 to 5-year-old aged children in the playground at any given time,
- Basketball being played on the basketball court to reflect the sound pressure levels shown in Table 7 of Section 4.2 of this Report (equivalent to another 20 children),
- Hall in use with 400 worshippers, amplified music and singing, and
- Ten (10) cars manoeuvring in each of the four car parks simultaneously, in any given 15 minutes (40 cars total),
- Recommendations made in Section 7 of this Report are implemented and continue to be adhered to.

Discussion on combined noise source

It is unlikely that all scenarios outlined above will occur simultaneously.

Worst-case cumulative noise levels will occur when the playground and basketball court are used together with each of the car parks simultaneously. When the Hall is full to capacity during a service, the outdoor areas will not be in full use; as such the predicted noise level from the Hall during a full capacity service is unlikely to be significantly higher due to the abovementioned cumulative impacts.

Table 10 Predicted L_{eq} Noise Levels – Night Time Period

Activity / Description	Predicted Noise Levels $L_{eq,\ 15\ minute}$ (dBA) at Receptor Locations							
	R1	R2	R3	R4	R5	R6	R7	R8
Night Time Noise Goal	**37**	**37**	**37**	**37**	**37**	**37**	**37**	**37**
Car Parks combined	14	16	20	24	23	20	19	16
Complies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hall (service, NO music)	32	33	35	35	29	32	25	23
Complies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The predicted noise levels in Table 10 consider / are predicated on the following: -

- Five (5) cars manoeuvring in each of the four car parks simultaneously in any given 15 minutes (20 cars total) – a traffic management plan may be required to ensure these numbers are not exceeded (refer Section 7),
- Hall in use but without amplified music,
- Recommendations made in Section 6 of this Report are implemented and continue to be adhered to,
- 3D Noise model contours prepared using SoundPLAN Essential version 5.1 are provided in Appendices D and E.

Table 11 Predicted $L_{1,\ 1\ minute}$ Noise Levels – Motor Vehicle Activity On-Site (Potential for Sleep Disturbance Initial External Assessment)

Vehicle Activity / Description	Predicted Noise Level $L_{eq,\ 15\ minute}$ (dBA) at Receptor Locations							
	R1	R2	R3	R4	R5	R6	R7	R8
Sleep Disturbance Assessment Trigger Level	**47**	**47**	**47**	**47**	**47**	**47**	**47**	**47**
Motor vehicle movements Cars moving – car doors closing, etc	42	46	46	46	46	46	47	46
At or below trigger level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

The predicted noise levels in Table 11 consider / are predicated on the following: -

- The highest noise level produced from the noisiest activity in the closest car park to any give receptor,
- Recommendations made in Section 7 of this Report are implemented and continue to be adhered to.

6 ON-ROAD TRAFFIC NOISE

Consideration was given to on-road traffic noise for people arriving or leaving the Site along the local road network.

Formulae are given in the *Calculation of Road Traffic Noise* (CoRTN) from the UK Department of Transport and Welsh Office (1988) for the calculation of on-road vehicle noise. However, the calculation procedure given in CoRTN is untested for small traffic flows (under 200) and typically yields lower levels than occur in practice.

Therefore, a calculation based on the sound exposure level for various vehicles was carried out. The sound exposure level (L_{Ae}) is a summation of the sound energy produced during a single event (i.e. a motor vehicle pass-by, train pass-by, etc).

The author has previously measured the level of noise emission from numerous vehicle types including cars, four-wheel drives, etc.

The average maximum measured sound exposure levels of a of range vehicles, normalised to a distance of 10 metres is as follows: -

- Car – 69 dBA, and
- 4WD – 72 dBA.

Once established, a sound exposure level (L_{Ae}) can be used to calculate an energy average, sound pressure level ($L_{eq,\ time}$) using the following formula: -

$$L_{eq,\ 1\ hour} = L_{ae} - 10\log_{10}(T) + 10\log_{10}(N)$$

Where T is the time in seconds (1 hour in this instance – in accordance with the assessment criteria, see Table 2) and N is the number of vehicle trips. The calculated level can then be adjusted to various distances from the 10-metre assessment location.

In this instance the closest houses to either Ansett Street or Waterhouse Avenue are at a distance of 15 metres.

The Hall will hold up to 400 people and it is unclear how many arrive for each service in any given one-hour period, particularly before, during or after the midnight or early morning masses.

This assessment therefore provides the 'allowable' number of vehicle movements that will comply with the noise goals during the day time and evening time periods.

A traffic management plan may need to be implemented to ensure that the allowable number of vehicle movements are not exceeded.

These are: -

- 150 (maximum) vehicle movements during the day time period between 7 am and 10 pm, and
- 50 (maximum) vehicle movements during the night time period between 10 pm and 7 am.

A vehicle movement is a vehicle passing a dwelling, it is assumed that each service or activity will last at least one hour and so the number of allowable movements can equate to the number of allowable vehicles attendant to the Site. If a service lasted less than one hour and there was potential for the same vehicle to pass the same dwelling in the same one-hour period, then the allowable number of "vehicles" would need to be halved to ensure the allowable number of movements was not exceeded.

The predicted noise level from on-road vehicle movements during the times that people may arrive, or leave is shown in Table 12 below.

Table 12 Predicted $L_{eq,\ 1\ hour}$ Noise Levels – Motor Vehicles (On-Road Traffic)

Vehicle Movements / Period / Description	Predicted Noise Level $L_{eq,\ 1\ hour}$ (dBA) at Receptor Locations
	Closest house at 15 metres
Acceptable Noise Level (day time period)	**55**
On-road traffic noise (**150** movements)	55
Complies	Yes
Acceptable Noise Level (night time period)	**50**
On-road traffic noise (**50** movements)	50
Complies	Yes

7 RECOMMENDED NOISE CONTROLS

To reduce the level of noise emission from the operation of the site to meet the noise design goals so far as is reasonably practicable, the following recommendations are made.

7.1 Sound Barrier Screening

Erect sound barrier screens along the northern and western boundaries of the Site, to the east of the basketball court and to the southern side of car park 4, as detailed below: -

- Erect a sound barrier screen around the northern, western and eastern side of the basketball court to a minimum height of **2.4 metres** (refer Figure 3),
    - The height of 2.4 metres is relative to the finished ground level of the basketball court,
- The 2.4 metre screen should extend along the western side of the outdoor playground and then reduce to a height of **2.1 metres** to cover the extent of car park 1 (refer Figure 3),
    - The height of 2.1 metres is relative to the finished ground level of car park 1,

- Erect a sound barrier screen between the northern boundary of the site and car parks 2 and 3 to a minimum height of 1.8 metres (refer Figure 3),
    - The height of 1.8 metres is relative to the finished ground level of car parks 2 and 3,
- Erect a screen along the entire southern side of car park 4 to a minimum height of 1.5 metres, as shown in Figure 3 below,
- Screens may be constructed from any impervious material such as corrugated sheet steel, lapped and capped timber, masonry, 10 mm thick (minimum) polycarbonate or a combination of materials without holes or gaps,
- With car park 4, the screen can be constructed on top of the proposed retaining wall providing the minimum height of 1.5 metres is achieved relative to the ffl of the car park and there are no gaps where the retaining wall meets the additional screening (if and where required).

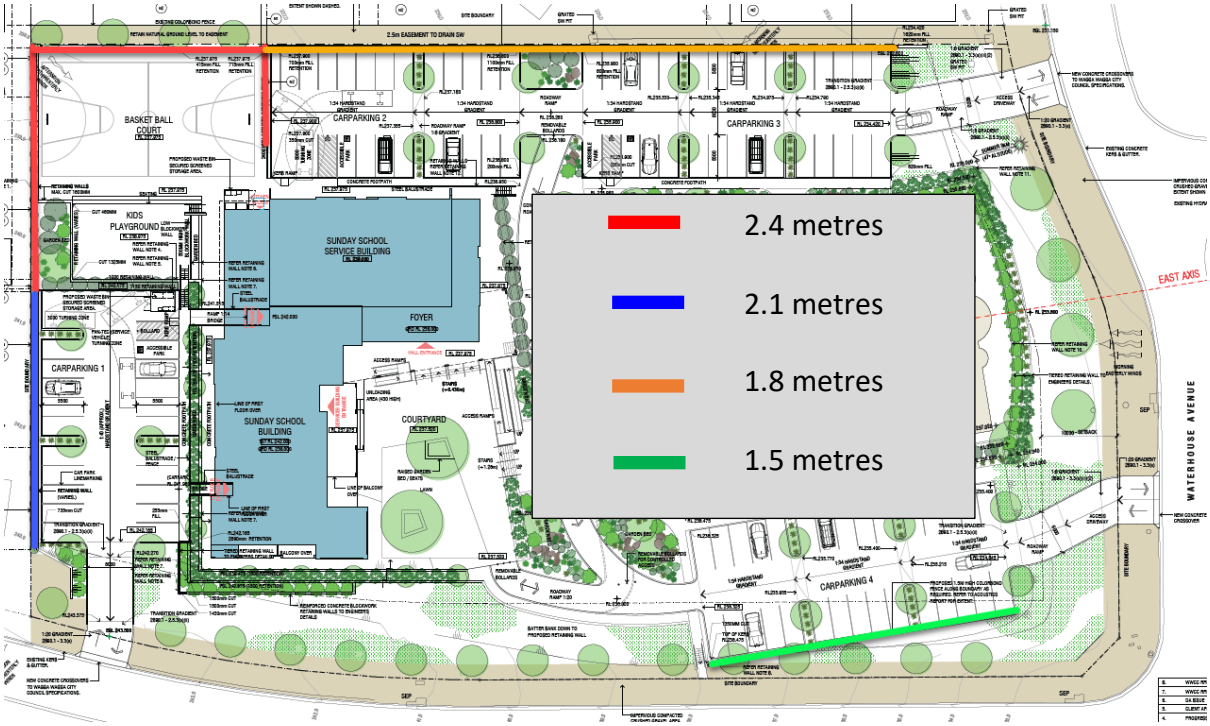

Figure 3. Recommended Sound Barrier Screening

7.2 Building Construction

The predicted levels of noise emission from services held within the Hall assume the following minimum construction materials and methods.

7.2.1 Walls

- All external walls of masonry construction will be acoustically acceptable,
- External cement composite cladding will be an acceptable alternative providing any selected product has a minimum mass of 12.5 kg/m^2, for example *Hardies Newport, Scyon range or CSR Cemintel EDGE,* or approved equivalent,
- Internal wall linings should comprise one layer of 10 mm (minimum) thick standard plasterboard, and
- All wall cavities lined with 50 mm (minimum) thick glass wool or polyester insulation (minimum R 2.0 rating) or approved equivalent.

7.2.2 Ceiling and Roof System

- The roof may be of corrugated sheet steel (*Colorbond*) or concrete tile construction,
- Heavy duty vapour barrier is to be laid below the roof,
- Ceilings in the Hall should comprise 13 mm (minimum) thick standard plasterboard,
- Ceilings in all other rooms in the services building may comprise 10 mm (minimum) thick standard plasterboard,
- 75 mm (minimum) thick glass wool or polyester insulation should be laid between the ceiling joists (min. density 10 kg/m^3) or approved equivalent.

7.2.3 Windows and Glazed Doors

Glazing

- Windows and glazed doors may be fixed, sliding, awning or double hung style in aluminium or timber frames,
- Table 13 below specifies minimum sound reduction index (R_w) ratings required for various windows and glazed doors. Glazing other than those specified in Table 13 may be of standard thickness with a minimum R_w **25**.
- An **example** glazing specification is given in Table 13, however an alternative construction may be used providing the minimum R_w rating is achieved.

Table 13 Recommended Window Schedule – Standard Ceilings

Unit / Room / Glazing	Min R_w	Example Glazing Specification
Hall (all windows and glazed doors in the northern facade)	**29**	5 mm glass

All glazed doors in Table 13 should be fitted with acoustic foam weather seals (e.g. Q-Lon from Schlegel or similar).

7.2.4 Allowable Openings

- All external doors and windows must remain closed whilst the Hall is in use

7.2.5 Reverberant Build Up of Sound

In order to minimise the reverberant build-up of sound within the Hall, acoustical absorptive material should be applied to as much of the surface area of the room as is practicable.

Compliance with the noise design goals at each receptor externally are dependent on the level of noise emission generated within the Hall, including people singing and amplified music, and it is imperative to minimise reverberant sound, to ensure that the internal noise levels are not significantly increased.

This may be done by, for example: -

- Install acoustic ceilings:
    - **NB** - The acoustical absorptive ceiling is to be installed below a set ceiling constructed with 10 mm (minimum) thick plasterboard,
    - Fit 50 mm (minimum) thick glass wool or polyester insulation (minimum density 32 kg/ m^3) between ceiling joists, or 50 mm timber battens, or top hat sections, or furring channel for example, which have been installed below the set ceiling in the room,
    - Fix 10 mm thick perforated plasterboard (minimum 13 % open area) to the underside of the joists,
- Alternatively, consideration may also be given to adhering or fixing acoustical absorptive material directly to the ceilings,
    - Any acoustical absorptive material should achieve a minimum Noise Reduction Coefficient (NRC) rating of 0.75,
- Details of acoustical treatment to minimise reverberant sound can be finalised under separate cover prior to the issue of a Construction Certificate and may also include carpet on floors and soft furnishings.

7.3 Amplified Music Noise Level - Hall

Amplified music should not exceed an energy-average sound pressure level ($L_{eq,\ 15\ minute}$) when measured over a 15-minute period at 3 metres from the acoustic centres of the loudspeakers within the Hall, as follows: -

- **86 dBA** $L_{eq,\ 15\ minute}$.

All amplified music should be controlled through an in-house sound system with levels pre-set to ensure compliance with the relevant criterion where practicable. This may apply for amplified music but not for acoustic music without amplification or singing of hymns.

If necessary, an electronic noise limiting device may be installed within the Hall. The device may be calibrated and set to a level that ensures the noise limits are achieved. The device will provide a warning to the management or band via sequential lighting that the maximum noise level is close to being reached.

7.4 Night Time Use of the Development

- There must be no use of the playground or basketball court prior to 7 am Monday to Saturday or prior to 8 am on Sundays or Public Holidays or after 10 pm on any day,
- There must be no gathering of people attendant to the site in outdoor areas outside of the above stated hours, this includes gathering in the car parks or courtyard to talk, particularly during midnight mass,
- There must be no music played within the Hall prior to 7 am Monday to Saturday or prior to 8 am on Sundays or Public Holidays or after 10 pm on any day. Low level amplified singing of hymns is permitted.

7.5 Traffic Management Plan

- Compliance with the noise design goals from motor vehicle movements **on-site** are contingent on the following maximum number of vehicle movements and the boundary fencing construction as outlined in Section 7.1
    - 40 vehicle movements (maximum) on the Site in any given 15-minute period during the day and evening time periods (assume an average of 10 vehicles per car park), and
    - 20 vehicle movements (maximum) on the Site in any given 15-minute period during the night time periods (assume an average of 5 vehicles per car park), and
- Compliance with the EPA noise limits for attendant **on-road** traffic are contingent on not exceeding the following maximum number of vehicle movements as below:
    - 150 vehicle movements (maximum) during the day between 7 am and 10 pm, and
    - 50 vehicle movements (maximum) during the night between 10 pm and 7 am.

A vehicle movement is a vehicle passing a dwelling, it is assumed that each service or activity will last at least one hour and so the number of allowable movements can equate to the number of allowable vehicles attendant to the Site. If a service lasted less than one hour and

there was potential for the same vehicle to pass the same dwelling in the same one-hour period, then the allowable number of "vehicles" would need to be halved to ensure the allowable number of movements was not exceeded.

It is to be incumbent on the management of the facility to establish a traffic management plan in consultation with the congregation as to how these vehicle movement numbers are to be achieved and not exceeded.

The traffic management may include the option for mini busses, car-pooling, etc and will be provided to the Council prior to the issue of a construction certificate.

7.6 Noise Management Plan

- A general Noise Management Plan should be prepared by the leaders of the management of the development outlining the need to be conscious of noise generation at the Site,
- The plan should contain the procedures for, for example: -
    - Ensuring children only play in the designated playground or basketball court and not in the car parks,
    - Ensuring the restricted times of use for outdoor play areas and music within the Hall are implemented and continue to be adhered to,
    - Inclusion of, or reference to, the Traffic management Plan required under Section 7.5 above,
    - Inclusion of signage around the Site informing members about the importance of minimising noise generation in the outdoor areas.

7.7 Mechanical Plant

Any mechanical plant associated with the proposal must not exceed the noise design goals established in Section 3.5 of this Report when measured at the nearest residence over a period of 15 minutes.

The predicted level of mechanical plant noise will depend upon the type of plant, location, sound power level and times of operation.

All plant should be located as far from the neighbouring residences as practicable and / or acoustically treated to ensure the design noise goals are complied with at all times.

A final assessment will be required once mechanical plant selections have been made. However, the acceptable noise limits can be achieved from mechanical plant noise for this proposal through judicious placement and selection of plant.

8 CONCLUSION

An assessment of the potential noise impact arising from the use the Church of St Mary and St John the Beloved to be constructed at 12 Waterhouse Avenue, Wagga Wagga, NSW was undertaken.

Recommendations are made in Section 7 of this report to ensure that the use and operation of the development is within the EPA's and Council's standard noise design goals at all receptors at all times of the day, evening, night and early morning.

Providing these recommendations are implemented and continue to be adhered to, the EPA's and Council's standard noise design goals can be complied with for this development.

Matthew Harwood, MAAS
Principal Acoustical Consultant and Director
Harwood Acoustics Pty. Ltd.

Note:
This Revision B report, dated 14 March, 2022 supersedes any / all previous versions of the report.

Attachments: -

Important note and Disclaimer

Appendix A – Noise Survey Instrumentation

Appendix B – Glossary of Technical Terms.

Appendix C – Background Noise Survey Results

Appendix D – 3D Noise model contours over Site Plan

Appendix E – 3D Noise model contours over map image.

Important Note

All products and materials suggested by Jamboral Pty. Ltd. T/as Ray Walsh Acoustics Noise & Sound and harwood Acoustics Pty Ltd are selected for their acoustical properties only.

Recommendations made in this report are intended to resolve acoustical problems only, therefore all other properties such as aesthetics, air flows, chemical, corrosion, combustion, construction details, decomposition, expansion, fire rating, fumes, grout or tile cracking, loading, shrinkage, smoke, ventilation etc. are outside Ray Walsh Acoustics Noise & Sound's and Harwood Acoustics Pty. Ltd.'s fields of expertise and ***must*** *be checked with the supplier or suitably qualified specialist before purchase.*

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Opinions and judgements expressed herein, which are based on our understanding and interpretation of current regulatory standards, should not be construed as legal opinions.

Noise Survey Instrumentation	Appendix A

The instrumentation used during the noise survey consisted of the following: -

Description	Model No.	Serial No.
ARL Ngara Noise Logger	Ngara V2	878150
ARL Noise Logger	EL-315	15-199-417
Brüel & Kjaer Acoustical Calibrator	4231	1839108

The ARL Ngara logger conforms to Australian Standard AS1259.1:1990, and AS1259.2:1990 “Acoustics - Sound Level Meters”, as a Type 1 sound level meter. The Ngara logger also conforms to IEC 61672.3:2006 Standard as a Class 1 sound level meter and has an accuracy suitable for field and laboratory use.

The ARL EL-315 logger conforms to Australian Standard AS1259 “Acoustics - Sound Level Meters”, (1990) as a Type 2 sound level meter and has an accuracy suitable for field use.

The calibration of the noise loggers was checked before and after the measurement periods. No significant system drift occurred over the measurement periods.

The noise loggers and calibrator were previously checked, adjusted and aligned to conform to the factory specifications and issued with conformance certificates as required by the regulations.

'A' Frequency Weighting – The most widely used sound level frequency filter is the A scale, which roughly corresponds to the inverse of the 40 dB (at 1 kHz) equal-loudness curve. Using this filter, the sound level meter is less sensitive to very high and, in particular, very low frequencies. Sound pressure level measurements made with this filter are commonly expressed as **dBA.**

Ambient Sound – The all-encompassing sound associated with that environment being a composite of sounds from many sources, near and far.

Decibel (dB) – The logarithmic ratio of any two quantities and relates to the flow of energy (power). Scale used for acoustic measurement related to power, pressure and intensity. Expressed in dB, relative to standard reference levels.

Energy Average Levels ($L_{Aeq, T}$). The L_{Aeq} level represents the average noise energy during the measurement period (T). This level is used to describe the source noise and when the source noise is not present it is used to describe the 'ambient' noise level.

'Fast' Time Weighting – The root-mean-squared energy averaging of the sound pressure with time. 'Fast' time weighting is 125 milliseconds.

MAXIMUM NOISE LEVEL, L_{Amax} – The rms maximum sound pressure level measured on the "A" scale of a sound level meter during a noise survey is the L_{Amax} noise level. It may be measured using either the Fast or Slow response time of the meter. This should be stated.

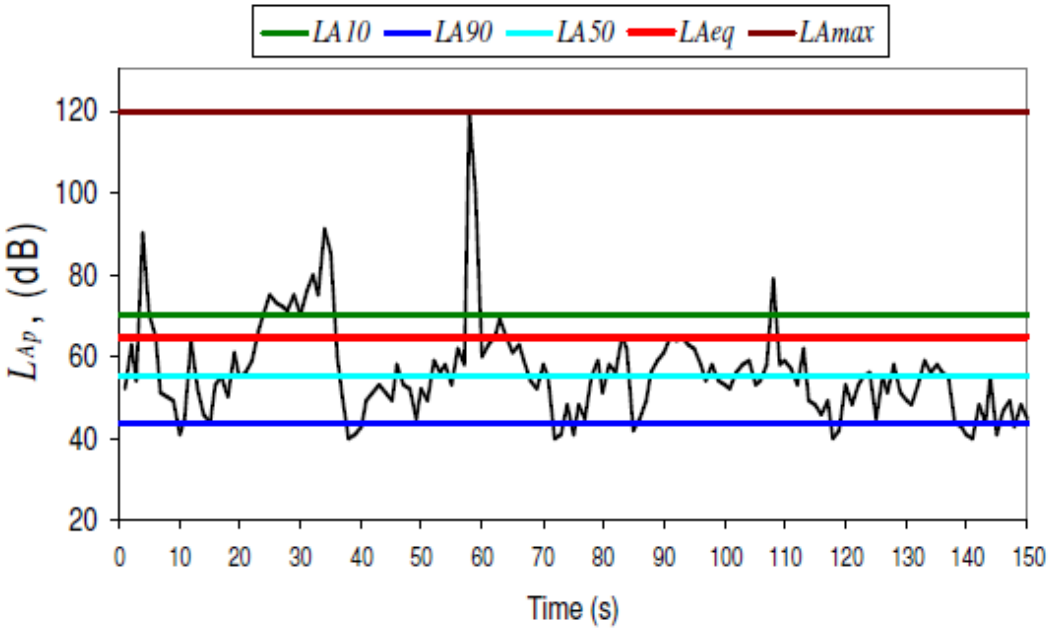
Percentile Levels (L_{AF10}, L_{AF10}, L_{AF90}) - Environmental noise levels can vary considerably with time; therefore, it is not adequate to use a single number to fully describe the acoustic environment. The preferred, and now generally accepted, method of recording and presenting noise measurements is based upon a statistical approach. For example, the L_{AF10} noise level is the 'A' frequency weighted and 'fast' time weighted level exceeded for 10% of the time, and is approximately the average maximum noise level. The L_{AF90} level is the level that is exceeded for 90% of the time, and is considered to be approximately the average of the minimum noise level recorded. This level is often referred to as the 'background' noise level.

Sound Power - Sound power is the energy rate - the energy of sound per unit of time (J/s, Watts in SI-units) from a sound source.

Sound Power Level (L_W) – Sound power level is a logarithmic measure of the sound power in comparison to a specified reference level (10^{-12} Watts). The unit less decibel term is a measure of the sound emission of a source independent of distance. When 'A' frequency weighted the symbol becomes **L_{WA}.**

Sound Pressure - Sound Pressure is the force (N) of sound on a surface area (m^2) perpendicular to the direction of the sound. The SI-units for the Sound Pressure are N/m^2 or Pa.

Sound Pressure Level (L_p) - Sound pressure level is a logarithmic measure of the square of the sound pressure in comparison to a specified reference level (20 µPa). The unit less decibel term is a measure of the sound emission of a source at a specified distance. When 'A' frequency weighted the symbol becomes **L_{PA}.**


LA10
LA90
LA50
LAeq
LAmax
120
100
80
60
40
20
L_{Ap}, (dB)
0
10
20
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40
50
60
70
80
90
100
110
120
130
140
150
Time (s)

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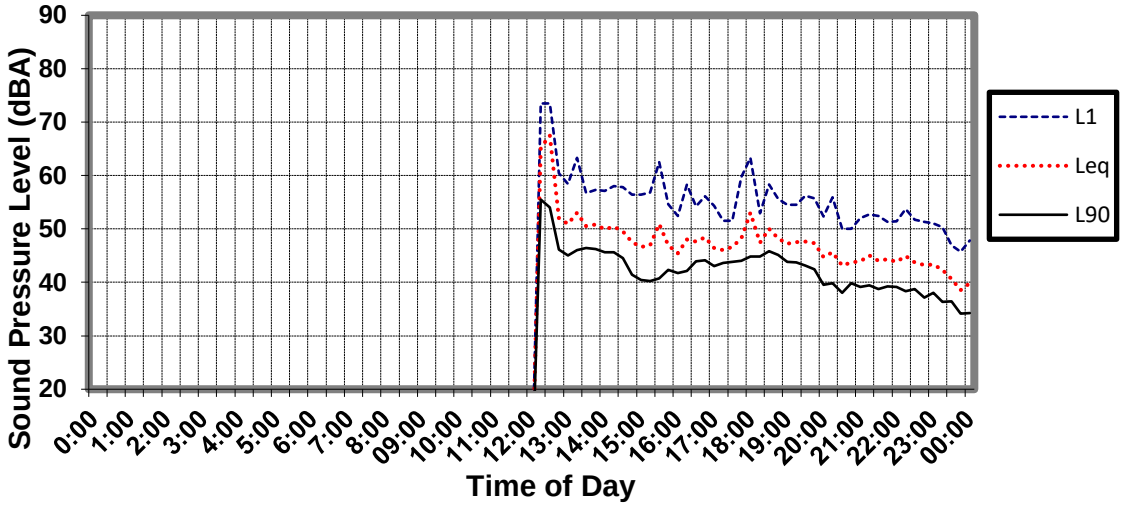

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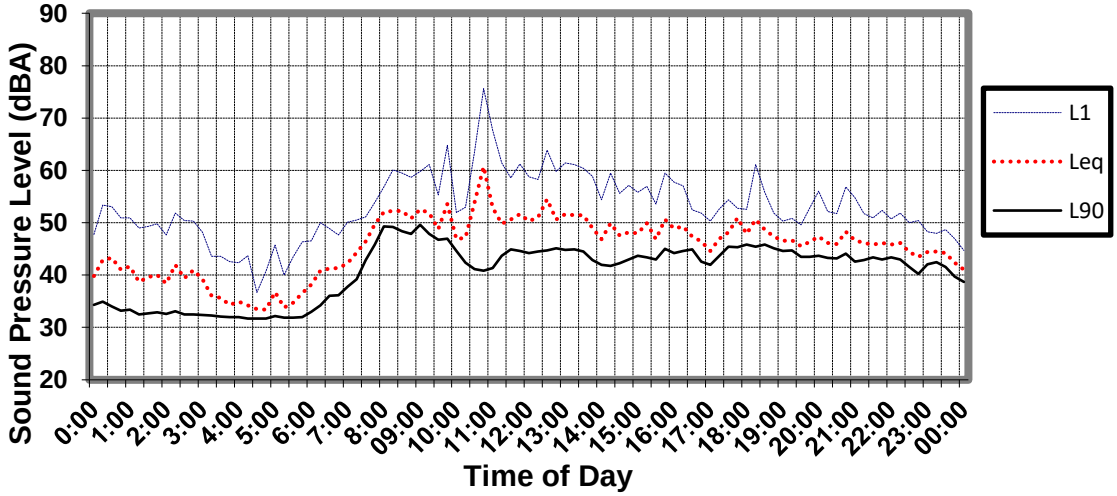

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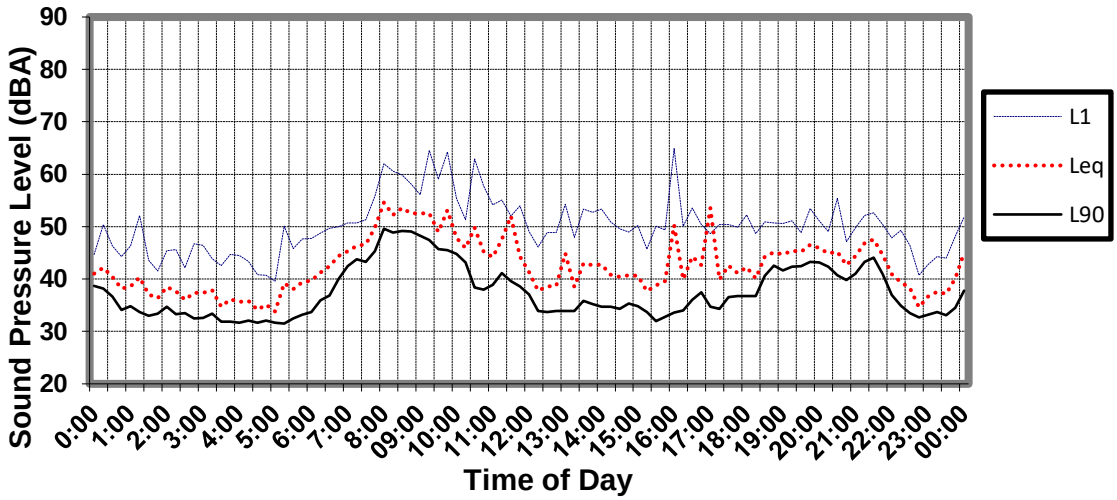

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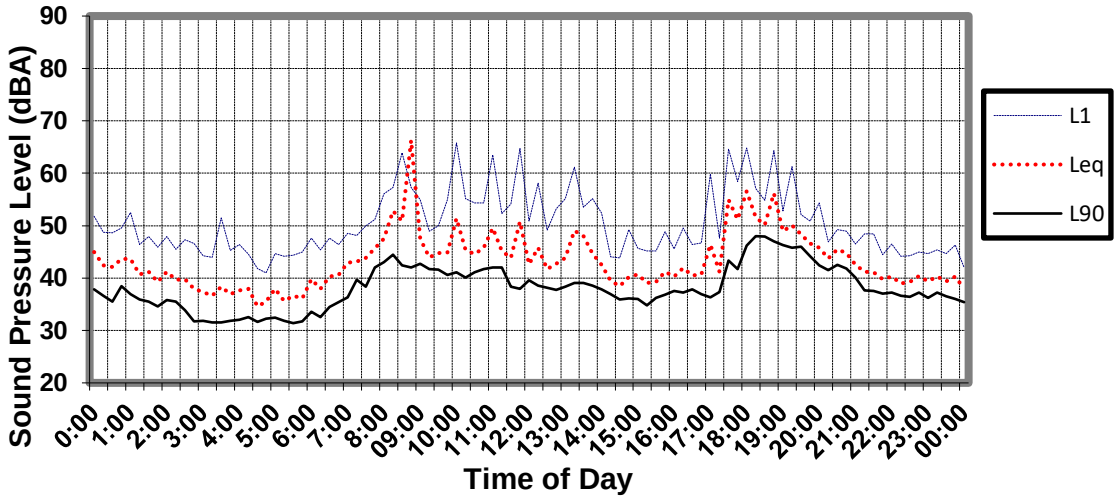

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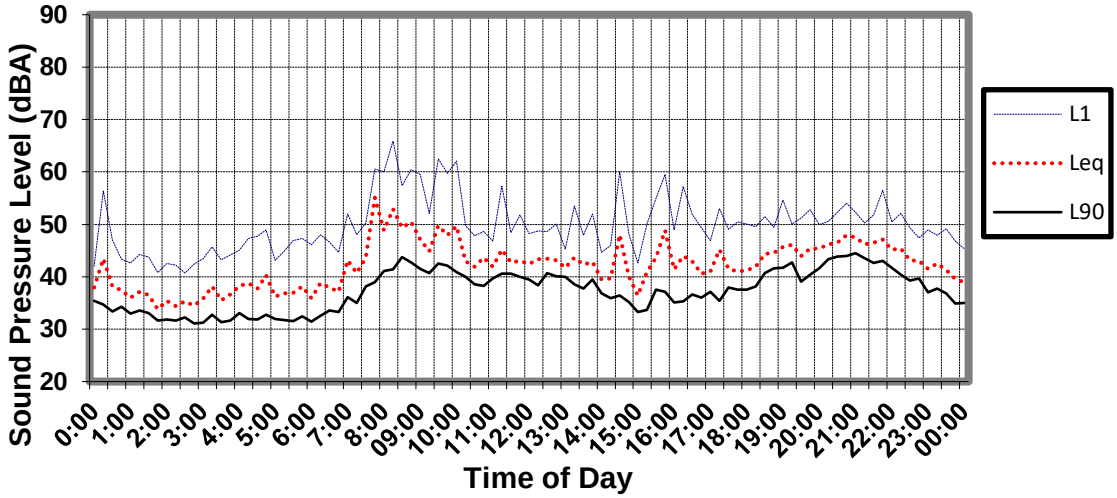

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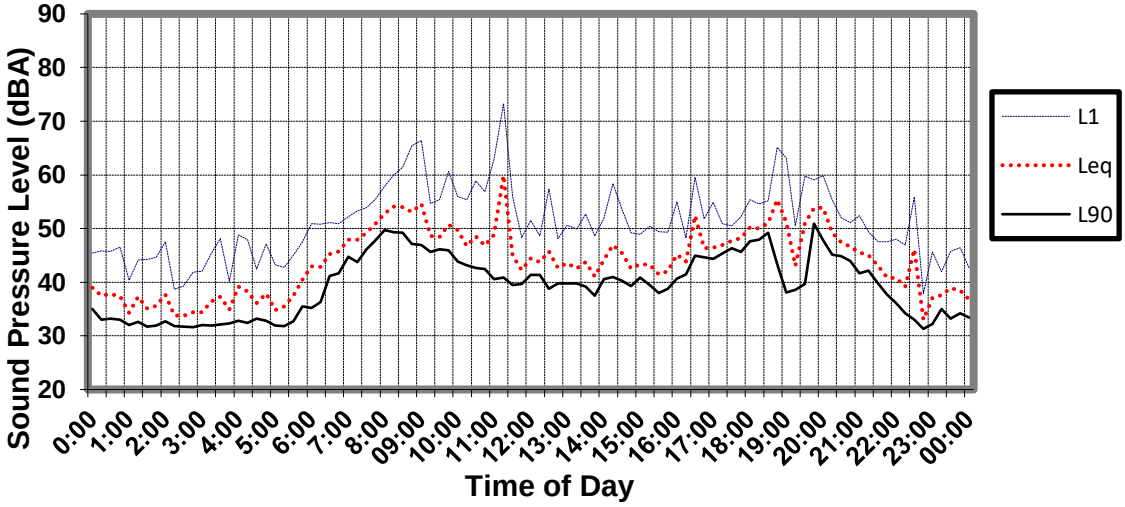

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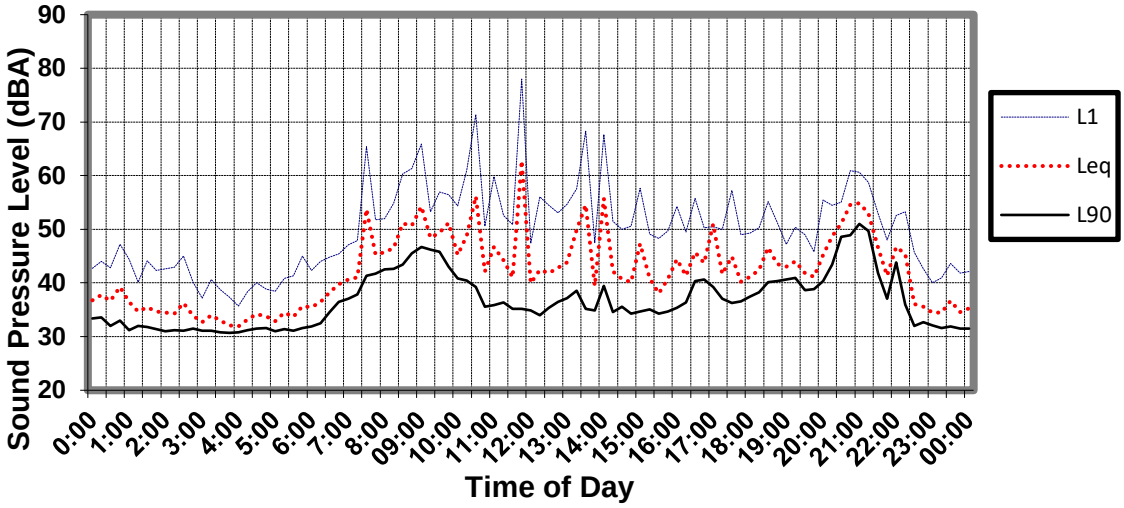

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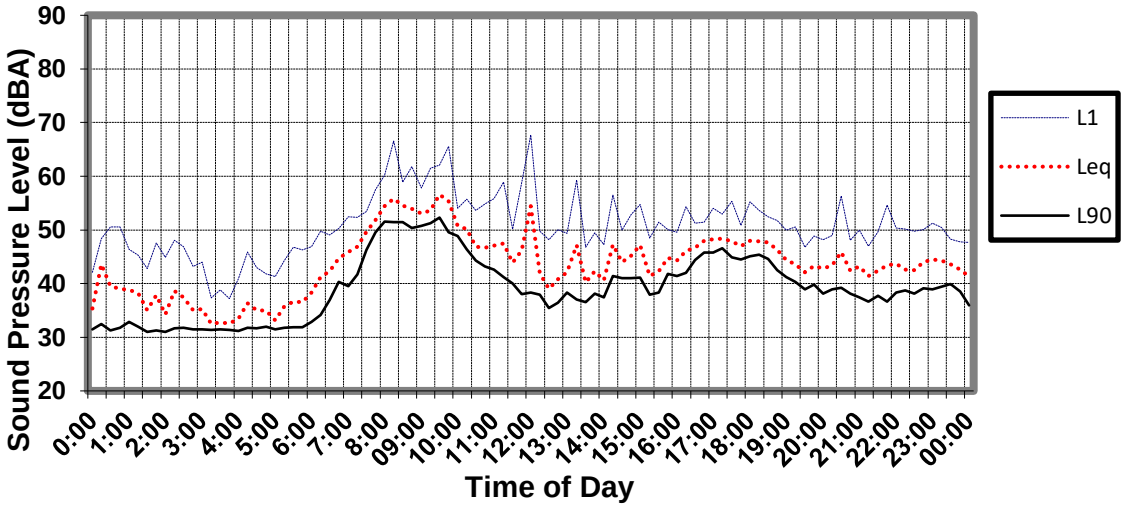

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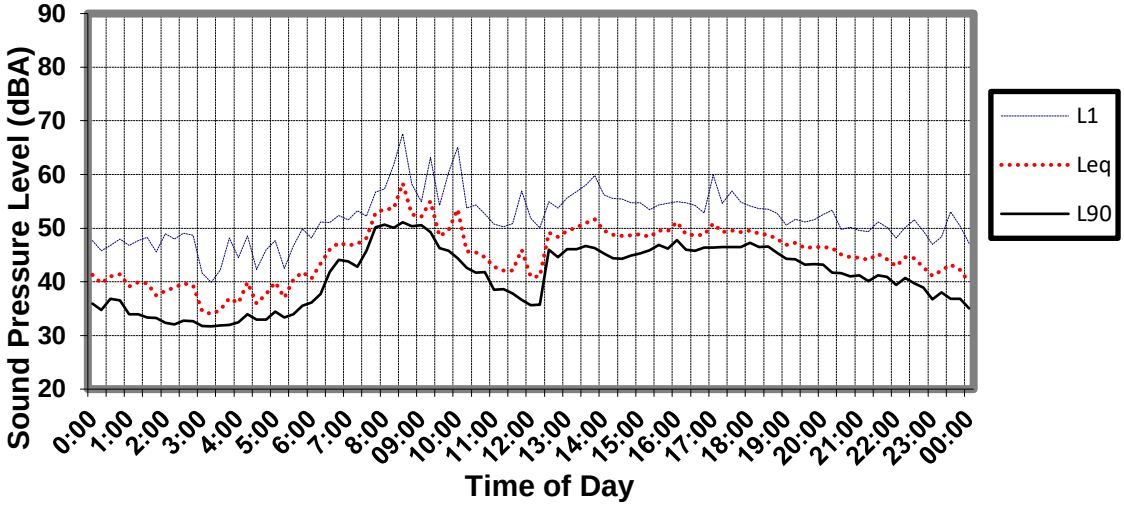

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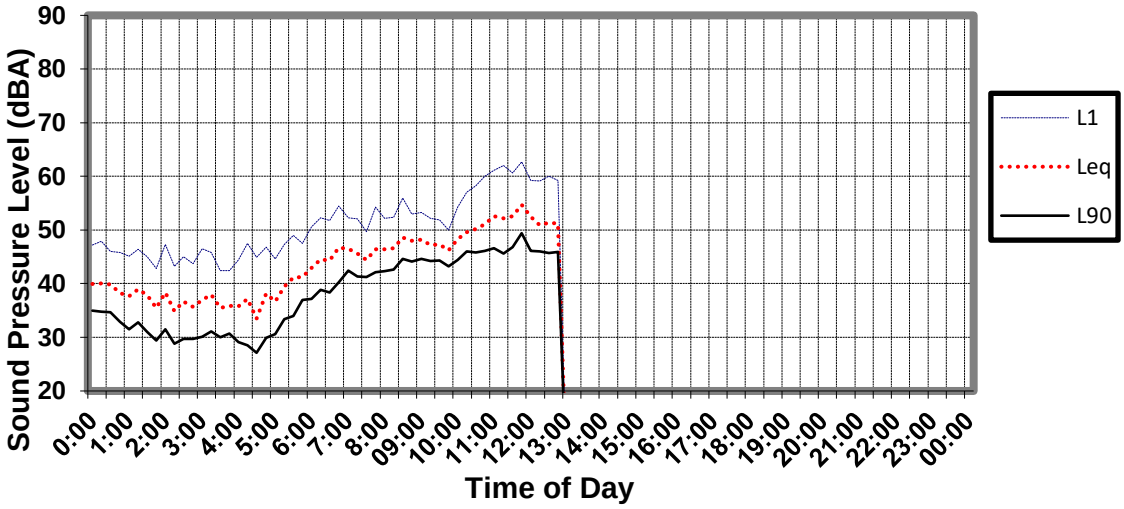

Outdoor play areas
and car parks
Leq, 15 minute

Signs and symbols

- Recommended screening
- Multi purpose building
- Motor vehicles
- Playground and basketball court

Levels in dB(A)

- = 30
- = 32
- = 34
- = 36
- = 38
- = 40
- = 42
- = 44
- = 46
- = 48
- = 50
- = 52
- = 54
- = 56
- = 58

1 : 917

0 4.5 9 18 27 36 m

HARWOOD ACOUSTICS
ACOUSTICAL CONSULTING

Outdoor play areas
and car parks
Leq, 15 minute

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- = 48
- = 50
- = 52
- = 54
- = 56
- = 58

1 : 917

0 4.5 9 18 27 36 m

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