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Project: **COOK ISLAND CHRISTIAN CHURCH**

Prepared for: **Cook Island Christian Church**
34 Dunbeath Crescent
Kew
Invercargill 9812

Attention: **Tina Maine**

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EXECUTIVE SUMMARY

Marshall Day Acoustics has been engaged to perform an assessment of noise effects for the Cook Island Christian Church.

We have measured noise levels at the site boundary while traditional Cook Island drumming was taking place inside the building. The results indicate that the Invercargill City Plan noise limit of 55 dB L_{A10} will be exceeded once the special audible character of the sound is taken into account.

Whilst compliance with the City Plan daytime noise limit can be readily achieved, the character of the drumming sound is such that it is likely to be particularly intrusive within adjacent residences. Therefore we consider that a significant noise level reduction will be required at the site boundary to ensure that noise levels will be acceptable to adjacent residents.

We have provided a series of outline noise control recommendations to provide a noise level reduction of around 15 to 20 dBA. This means that noise emissions from drumming will be in the order of 35 to 40 dB L_{Aeq} at the site boundary and will easily comply with the City Plan daytime noise limit. We anticipate that daytime noise effects will be acceptable at this noise level.

Should resource consent be granted by Invercargill City Council, we recommend a conditioning of consent that requires a review of building consent drawings by an appropriately qualified and experienced acoustic engineer. The engineer shall confirm that the documented design is capable of reducing drumming sound to no greater than 40 dB L_{Aeq} at the site boundaries.

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1.0 INTRODUCTION

Marshall Day Acoustics has been engaged to perform an assessment of noise effects associated with Cook Island Christian Church activities at the site of a former school at 250 McQuarrie Street, Invercargill.

This report discusses the following:

- Noise sources associated with church activities;
- The applicable District Plan noise criteria;
- Proposed noise control recommendations; and
- An assessment of noise effects.

A glossary of acoustical terminology used in this report is provided in Appendix A.

2.0 CHURCH ACTIVITIES

Aside from church services, congregational singing and church social activities, the most significant sound source within the church buildings is traditional Cook Island drumming. The drumming occurs within the hall which is located to the east of the building, approximately 10 and 25 metres from the closest residential boundaries to the north and west respectively.

During our site inspection on 11 August 2015, Marshall Day Acoustics measured sound levels both inside and outside the building with drumming in progress. The internal reverberant sound pressure level was measured as 98 dB L_{Aeq} . At the site boundaries, the measured noise levels were in the order of 57 dB L_{A10} (55 dB L_{Aeq}). The drumming was the dominant noise source at the site boundary and it is considered to have a pronounced and distinctive character.

Based on our measurements at other churches around New Zealand, we expect that sound levels from congregational singing and other church activities will generally be under 85 dB L_{Aeq} and therefore drumming will be the most significant noise source. We understand that the Church will only operate during daytime hours as defined in the District Plan i.e. 7am to 10pm.

3.0 NOISE LEVEL CRITERIA

In assessing noise levels and their potential effects, it is useful to consider a number of reference documents.

3.1 Invercargill City District Plan

For Invercargill City, the noise provisions are contained within Section 4.34 of the District Plan. The Cook Island Christian Church and the adjoining residences are zoned *Domicile Sub-Area* in the District Plan. The full version of the noise provisions are provided in Appendix B.

Rule 4.34.1 requires noise levels to be measured and assessed in accordance with NZS 6801:1991 "*Measurement of Sound*" and NZS 6802:1991 "*Assessment of Environmental Sound*".

Rule 4.34.2 provides noise limits for activities within each sub-area. The noise limits apply on or beyond the site boundary. The applicable noise limits are:

- | | | |
|--------------------------------------|---------------------|---------------------------------------|
| 1. <i>Domicile Sub-Area</i> boundary | 7.00 am to 10.00 pm | 55 dB L_{A10} |
| | 10.00 pm to 7.00 am | 45 dB L_{A10} &
70 dB L_{Amax} |

If an activity does not comply with these limits, it is considered to be discretionary, with Council's discretion restricted to noise.

3.2 World Health Organisation

World Health Organisation (WHO) *Guideline Values for Community Noise* (Berglund and Lindvall, 1999) give guidelines for environmental noise exposure. For community or environmental noise, the critical health effects (those effects which occur at the lowest exposure levels) are:

- Sleep disturbance;
- Annoyance (slight, moderate, high); and
- Speech interference/communication disturbance.

The WHO guideline values for these three critical health effects for community or environmental noise are presented in Table 1 for continuous noise sources. In relation to sleep disturbance and indoor speech intelligibility, the guideline values typically correspond to the lowest effect level for general populations. By contrast, guideline values for outdoor annoyance have been set at 50 or 55 dB L_{Aeq} , representing daytime levels below which a majority of the adult population will be protected from becoming moderately or seriously annoyed, respectively.

Table 1: WHO guideline values for the critical health effects of community or environmental noise

Specific Environment	Critical health effect(s)	dB L_{Aeq}	Time base (hours)	dB L_{Amax}
Outdoor living area	Serious annoyance, daytime & evening	55	16	-
	Moderate annoyance, daytime & evening	50	16	-
Dwellings, indoors	Speech Intelligibility and moderate annoyance, daytime & evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values) night-time	45	8	60

On the basis of this guidance, Table 1 indicates that during the day and in the evening, moderate or serious annoyance begins to occur at 50 or 55 dB L_{Aeq} respectively for continuous noise sources. No guidance is provided for noise sources with distinctive character such as drumming.

3.3 NZS 6802:2008 guideline residential upper noise limits

The 2008 version of NZS 6802:2008 “*Acoustics - Environmental Noise*” makes reference to the following guideline upper limits of sound exposure at or within the boundary of any residential land use:

- Night-time: 45 dB L_{Aeq} and 75dB L_{Amax}
- Day-time: 55 dB L_{Aeq}

The District Plan refers to the 1991 version of the same standards, which provides essentially the same guidance.

3.4 Resource Management Act (RMA) - Section 16

Section 16 of the RMA places a general duty to adopt the “*best practicable option to ensure that the emission of noise from that land or water does not exceed a reasonable level*”. Whilst the Act does not prescribe what a reasonable level is, our experience is that compliance with the limits given in the above guidance documents, and reflected in the District Plan noise provisions, are an appropriate starting point.

However, for drumming, we anticipate that the sound would be considered reasonable at much lower noise levels than considered appropriate by the above guidance.

3.5 Discussion of Noise Criteria

Based on our review of the above guidance, an activity complying with the applicable Invercargill City Plan daytime noise limit of 55 dB L_{A10} would be considered to result in acceptable adverse noise effects. However, in this case we are assessing a drumming noise source that contains a distinctive character and, even if it were to nominally comply with the City Plan noise limits, it is likely to result in adverse noise effects at adjacent residences.

To minimise the likelihood of complaints from adjacent neighbours, our recommendation is the sound level from drumming should be in the order of 35 to 40 dB L_{Aeq} at the site boundary. Drumming sound at this level will easily comply with the noise rules of the Invercargill City Plan and noise effects are likely to be acceptable. [We propose that the metric L_{Aeq} is used instead of L_{A10} for the purposes of this assessment in order to be consistent with the proposed City Plan and current best practice].

4.0 NOISE CONTROL RECOMMENDATIONS

In order to achieve the desired level of drumming noise at the site boundary, significant additional noise control upgrades to the external building fabric will be required. Indicative noise control options for these building elements are provided in Table 2 and shown in Appendix C.

Table 2: Indicative noise mitigation measures

Element	Proposed work
External doors	<p><u>Northern Door</u> must be removed and the wall constructed to match the build-up described below for external walls.</p> <p><u>Western and Southern Doors</u>. Remove one or other of these doors if practical, otherwise, construct a sound lock lobby. Both the internal and external doors shall be proprietary acoustic doorsets such as Pacific Doors AD200-E. The new external doors should be directed towards the south as far as practical. The lobby walls should be:</p> <ul style="list-style-type: none"> >200mm filled concrete block >150mm cavity with 75mm fibrous insulation 1 x 13mm Gib Standard internal lining. <p>The lobby roof should be:</p> <ul style="list-style-type: none"> >75mm thick concrete >150mm cavity with 75mm fibrous insulation 1 x 13mm Gib Standard on metal ceiling batten (e.g, Rondo).
External Glazing	All external glazing to the hall should be removed and a replacement wall constructed to match the existing.
All external walls (both blockwork veneer and lightweight)	<p>Construct internal independent plasterboard wall lining with the following construction:</p> <ul style="list-style-type: none"> Existing internal wall lining 20mm clear gap >90 mm timber stud with 75mm fibrous insulation in the cavity 2 x 13mm layers Gib Noiseline.

Element	Proposed work
Entire roof	<p>Provide a suspended plasterboard ceiling below the existing ceiling lining with the following construction:</p> <p>Existing ceiling lining</p> <p>300mm cavity with 75mm fibrous insulation</p> <p>Suspended lightweight metal ceiling batten system (e.g, Rondo)</p> <p>2 x 13mm layers Gib Noiseline</p>

We note that the noise control measures in Table 2 are outline in nature and will require development into a full working drawing set, coordinated with other engineering disciplines (e.g. structure and fire) as required.

5.0 CONSENT CONDITIONS

Should resource consent be granted, we recommend a condition along the line of the following:

Prior to the issue of building consent, that architectural drawings are reviewed by an appropriately qualified and experienced acoustic engineer to ensure that the desired level of sound insulation performance can be achieved. The acoustic engineer shall certify that the documented design is capable of reducing sound from drumming at a reverberant sound pressure level of 98 dB L_{Aeq} to be no greater than 40 dB L_{Aeq} when assessed at the site boundary.

APPENDIX A GLOSSARY OF TERMINOLOGY

Ambient/residual Noise	The total sound remaining at a given position in a given situation when the specific sounds under consideration are suppressed, or an insignificant part of the total sound.
Special Audible Characteristics	Distinctive characteristics of a sound which are likely to subjectively cause adverse community response at lower levels than a sound without such characteristics. Examples are tonality (e.g. a hum or a whine) and impulsiveness (e.g. bangs or thumps).
Notional boundary	A line 20 metres from any side of a dwelling, or the legal boundary where this is closer to the dwelling.
dB	<u>Decibel</u> The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of $P_r=20 \mu\text{Pa}$ i.e. $\text{dB} = 20 \times \log(P/P_r)$
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear. dBA is now largely superseded, with the "A" moving to the measurement parameter. Hence, 55 dBA L_{eq} has now become 55 dB L_{Aeq} .
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
$L_{\text{Aeq}}(t)$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
$L_{\text{A90}}(t)$	The A-weighted noise level equalled or exceeded for 90% of the measurement period. This is commonly referred to as the background noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
$L_{\text{A10}}(t)$	The A-weighted noise level equalled or exceeded for 10% of the measurement period. This is commonly referred to as the average maximum noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{Amax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.

APPENDIX B INVERCARGILL CITY DISTRICT PLAN NOISE PROVISIONS

ENVIRONMENTAL STANDARDS

4.34 NOISE

4.34.1 Noise Measurement

Sound levels shall be measured in accordance with the provisions of NZS 6801:1991: Measurement of Sound and assessed in accordance with the provisions of NZS 6802:1991: Assessment of Environmental Sound, except where expressly provided elsewhere in the Plan.

4.34.2 Noise Levels from Activities

(A) All activities shall be designed and operated so that the following noise limits, measured on or beyond the site boundary, are not exceeded:

	7.00 am - 10.00 pm L10 dBA	10.00 pm - 7.00 am L10 dBA	Lmax dBA
URBAN AREA			
Domicile Sub-Areas	55	40	70
Enterprise Sub-Areas	65	65	80
Suburban Service Sub-Areas	65	65	75
Business and Business A Sub-Areas	65	65	80
City Centre Sub-Area	65	65	85
Hospital Sub-Area	55	45	75
COUNTRY AREA			
Rural Sub-Area	55	45	70
Otatara Sub-Area	55	40	70
Airport Protection Sub-Area	55	45	75
Rural Service Sub-Area	65	45	70

(B) Within the Smelter and Industry Sub-Areas all activities shall be designed and operated so that the following noise limits are not exceeded:

	L10 dBA	Lmax dBA
Industrial and Industrial A Sub-Areas – Measured on or beyond the Sub-Area boundary	65	85
Industrial and Industrial A Sub-Areas – Measured at any point within the notional boundary of any residence located outside the Sub-Area.	Noise limit of relevant Sub-Area referred to in paragraph 4.34.2(A) above	
Smelter Sub-Area – Measured on or beyond the Sub-Area boundary	No limit	No limit
Smelter Sub-Area – Measured at any point within the notional boundary of any residence located outside the Sub-Area.	Noise limit of relevant Sub-Area referred to in paragraph 4.34.2(A) above	

4.34.3 Noise levels at Sub-Area Boundaries

At the boundaries of Sub-Areas referred to in paragraph 4.34.2(A) above the sound emissions shall be the lesser of the two limits.

4.34.4 Agricultural Activities

Agricultural activities (excluding forestry between 10.00 pm and 7.00 am the following day, factory farming and bird scaring devices) on sites within the Rural, and Otatara Sub-Areas where agriculture is the dominant activity, are exempt from the noise limits detailed in paragraph 4.34.2(A) above.

4.34.5 Aircraft

(A) Aircraft operations, including take-offs and landings, flight operations, routine engine testing or ground running, and the running of auxiliary power units (being the subject of designations by Invercargill Airport Limited) are exempt from the noise limits detailed in paragraph 4.34.2(A) above.

(B) Notwithstanding paragraph 4.34.5(A) above, the maximum levels of noise that shall be generated from aircraft operations are as follows:

(1) Airnoise Boundary: 65 Ldn dBA at or outside the Airnoise Boundary as detailed on the District Planning Maps. Noise shall be measured in accordance with New Zealand Standard NZS 6805:1992 Airport Noise Management And Land Use Planning.

(C) Acoustic Insulation

All new noise sensitive activities and additions to existing noise sensitive activities within the Single Event Sound Exposure boundary as shown on the District Planning Maps shall comply with the insulation requirements of Appendix IV. Alternatively a certificate of compliance from an acoustic engineer stating that the new noise sensitive activities or additions to existing noise sensitive activities meet the required internal noise environment should be provided.

4.34.6 Seaport Sub-Area

(A) Long-term Noise Limit

The night-weighted sound exposure from activities undertaken in the Seaport Sub-Area shall not exceed:

(1) an average sound level of 65dBA L_{dn} beyond the Inner Control Boundary calculated over five consecutive days.

(2) an average sound level of 68dBA L_{dn} beyond the Inner Control Boundary calculated over any continuous 24 hour period.

(B) Short-term Noise Limits

Sound from activities undertaken shall not exceed the following noise limits at any point beyond the Inner Control Boundary:

10.00 p.m. to 7.00 a.m. the following day 60dBA $L_{eq(9hr)}$ provided that:

(1) no single 15 minute sound measurement shall exceed 65dBA L_{eq}

(2) no single sound measurement shall exceed 85dBA L_{max}

For the purpose of this rule:

(3) Sound shall be measured using a representative 15 minute L_{eq} value when calculating the L_{dn} or 9 hour L_{eq} values.

(4) Sound shall be measured and assessed in accordance with the provisions of NZS 6809:1999 Acoustics–Port Noise: Management and Land Use Planning

4.34.7 Temporary Military Training

Temporary military activities shall not exceed the following noise levels when measured at the notional boundary:

Time on any day	L 10 dBA	L(max) dBA
0730 – 1800	75	90
1800 – 2000	70	85
2000 – 0730 the following day	55	75

Provided the limits for impulsive noise arising from any use of explosives ammunition, or pyrotechnics at any time, shall not exceed a peak non-frequency weighted sound pressure level of 122 dBC (peak).

4.34.8 Emergencies

- (A) Aircraft operations for defence purposes, civil defence, search and rescue, human organ transplant, transport of medical personnel in a medical emergency or patient transport either by airplane or helicopter, or during any emergency landing of any aircraft, shall be exempt from all noise limits.
- (B) Sound from warning devices used by emergency vehicles shall be exempt from all noise limits.

4.34.9 Non-Compliance With Rules

- (A) Where an activity does not comply with the noise limits specified in subsections 4.34.2, 4.34.3, 4.34.5, 4.34.6 or 4.34.7 above the activity shall be a discretionary activity.

The matter over which Council shall exercise its discretion is:

- (1) The adverse environmental effects of the matter(s) with which there is non-compliance

4.35 ELECTRICAL INTERFERENCE

4.35.1 No land use activities shall create electrical interference at the boundary of the property, or to navigation equipment for transportation networks.

4.35.2 Where there is non-compliance with subsection 4.35.1 above, the activity shall be a discretionary activity.

The matter over which Council shall exercise its discretion is:

- (A) The adverse environmental effects of the matter(s) with which there is non-compliance

4.36 LIGHTSPILL

4.36.1 All activities shall be designed, constructed and operated to comply with the following maximum levels of lightspill:

- (A) Lightspill shall be measured and assessed in accordance with the Interim Australian Standard AS 4282 (Int) 1995: Control of the Obtrusive Effects of Outdoor Lighting

APPENDIX C PLAN AND ELEVATION INDICATING EXTENT OF NOISE CONTROL REQUIREMENTS

