Studio Design & Architectural Acoustics

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Acoustics Report

Harbord Beach Hotel: 29 Moore Road, Freshwater, NSW, 2096.

This proposal was prepared for:

Harbord Hotel
29 Moore Road, Freshwater, NSW, 2096
Attn: Glenn Piper
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glenn@meridianaustralia.com.au

Submission Date: July 27th 2021
Document No.: R-054HBH210717.4

AKA
ACOUSTICS

Acoustics Report - Introductory Letter.

July 27th 2021

Dear Mr. Piper,

On behalf of AKA Acoustics and AKA Music Pty. Ltd., thank you for reaching out to us in regard to the acoustic compliance of the Harbord Beach Hotel at 29 Moore Rd, Freshwater, NSW, 2096.

The heritage-listed hotel, currently operational as a restaurant & bar, is to undergo extensive renovations to the first and second floors.

This acoustics report is intended as an addendum to the development application arranged by Sophie Harris (Senior Associate at Alexander & Co.) and will assist with maintaining the acoustic compliance of the various listed building elements.

A number of preliminary studies were conducted and submitted to Harbord Hotel by other third-party acoustic consultants prior to our engagement on the project. The results of these studies have been provided to AKA Acoustics and will be referred to appropriately. The accuracy of these tests will be verified to the best of our ability, however, any liabilities regarding assumptions drawn from these reports will fall on the original authors.

If you have any questions, or would like to discuss the following report with us directly, please don't hesitate to contact me for further clarification.

Yours sincerely,

Daniel Natoli
(Master of Architectural Science, Audio & Acoustics)
Principal Acoustical Consultant
for and on behalf of AKA Acoustics and AKA Music Pty. Ltd.
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1 Introduction

1.1 Scope of Work

AKA Acoustics were engaged by Harbord Hotel to determine the acoustic compliance of the currently-pending Development Application for The Harbord Hotel (29 Moore Road, Freshwater, NSW). This development application refers to the renovations of the first and second floors of the hotel, and the surrounding outdoor balcony areas.

This commission encompasses the following:

First Floor:

- Provide acoustic barrier (glazing) specifications for the first-floor balcony and heritage balustrade.
- Specify an acoustic door & perimeter seals for the main first-floor entrance (near the main stairwell, lift and amenities) and for the external door leading to the balcony.
- Specify acoustic glazing (fixed or operable windows) in the first-floor patron area.
- Design a two-stage airlock between the first-floor performance space and the balcony, compliant with the heritage design restrictions.
- Determine the capacity and time of trade for first-floor balcony area.
- Specify an outdoor PA system and operable levels for the first-floor balcony area.

Second Floor:

- Review the floor-ceiling composition between the first floor and the attic area, with consideration for airborne sound insulation and structure-borne mechanical vibration between floors.
- Review the ceiling insulation to ensure that sufficient levels of airborne sound insulation are achieved to meet the ambient background noise targets.
- Assess the requirements for additional acoustic treatment required to the attic area.

1.2 List of Referenced Standards & Noise Policies

The site development and this corresponding noise assessment draw compliance from the following documents:

- Australian Standard AS 1055:2018 Acoustics - Description and measurement of environmental noise.
- Australian/New Zealand Standard AS/NZS 2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors.
- NSW Environmental Protection Agency. (2017). Noise Policy for Industry.
- NSW Parliamentary Counsel. (2017). Protection of the Environment Operations (Noise Control) Regulation.

1.3 List of Referenced Consultancy Reports

A number of third-party consultancy reports have been referenced and included in this document submission:

- The Acoustic Group (2020, June 24) Proposed Ground Floor Alterations
- The Acoustic Group (2020, December 14) Certificate of Acoustic Compliance, Occupation Certificate (50.4539.L6:MSC).
- Weir Phillips Heritage and Planning (June 2021) Heritage Impact Statement - Development Application, Harbord Hotel J4146

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2 Site Evaluation

2.1 Site Description

The proposed development site, The Harbord Hotel, is a restaurant/bar located at 29 Moore Road, Freshwateter, NSW. The establishment occupies five development lots (1/1/DP7022 to 5/1/DP7022) and is zoned by Northern Beaches Council as R2 Low Density Residential land with an Additional Use permission.

Figure 1: Properties & zoning areas surrounding the proposed development site (accessed via the NSW Government Planning Portal, July 13th 2020)

The adjacent properties on Moore Road, Charles Street, and Undercliff Road are all zoned as R2 Low Density Residential, with the nearest commercial business (Shaka @ Freshwater) located approximately 50m south-east.

2.2 Noise-Sensitive Receivers & Measurement Locations

For the sake of calculating acceptable noise criterion, the following positions have been marked as the highest-impact noise-sensitive receivers:

Table 1: Noise-Sensitive Receivers

	Receptor and Type	**Address**	**Distance From Site**
1	R2 - Low-Density Residential	22 Moore Road	25m, across Moore Road
2	R2 - Low-Density Residential	29 Moore Road	25m, across Charles Street
3	R2 - Low-Density Residential	64 Undercliff Road	15m, adjacent neighbour
4	R2 - Low-Density Residential	4 Charles Street	30m, across Charles Street

The receptor locations in Table 1 were determined by The Acoustic Group as part of their compliance assessment in December 2020[1].

[1] Appendix A1 from The Acoustic Group (2020, December 14) Certificate of Acoustic Compliance, Occupation Certificate (50.4539.L6:MSC)

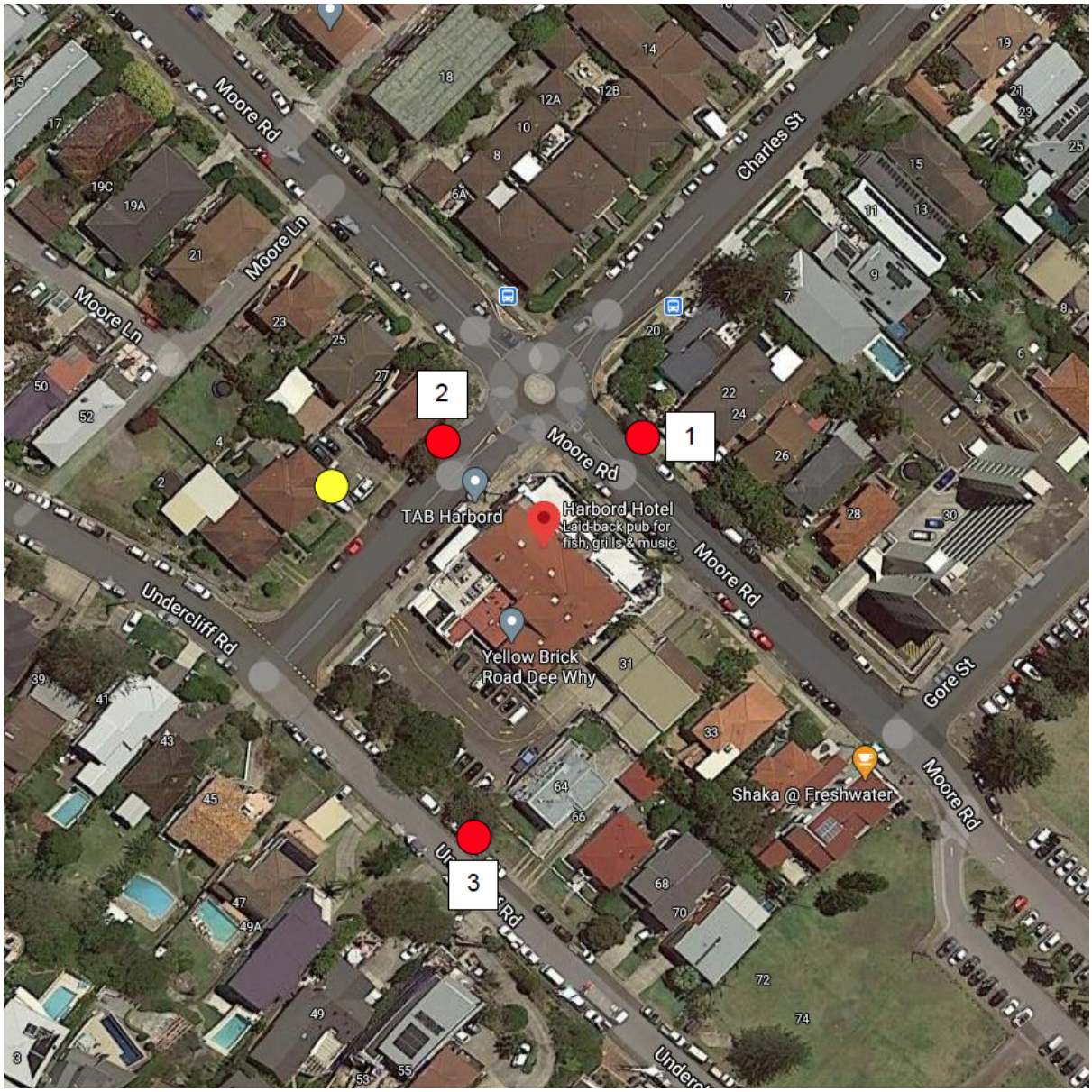

Figure 2: Location of noise-sensitive receivers, as per the The Acoustic Group (2000) Compliance Test of Harbord Hotel report. The red points mark the highest-impact noise-sensitive receivers, the yellow point represents the unattended measurement location.

As noted by The Acoustic Group, ambient noise levels along Moore Road were slightly elevated due to the influence of surf noise radiating from the south-east. The unattended measurement location at 4 Charles Street was determined as a conservative estimate, and a true representation of the general area.

3 Criteria for Noise Assessment

When noise levels become too loud or obtrusive, they can have significant adverse impacts on our health and wellbeing. Noise can affect our performance, learning, and stress levels, and cause significant disturbance to sleep and communication. The level of annoyance experienced often depends on the level of the noise, type of noise, how often it occurs, the duration, time of day or night, and the individual's personal tolerance.

3.1 Summary of Previous Background Noise Assessments

3.1.1 Unattended Noise Log conducted by The Acoustic Group, December 2020.

A series of noise measurements were taken by Mr. Stephen Cooper from The Acoustic Group and presented in their report dated December 14th 2020[2]. Background noise levels were logged over a twelve-day period (between Monday November 30th and Friday December 11th 2020) to determine the ambient noise levels at the nearest residential receivers.

The comprehensive set of measurement results can be found in the aforementioned report. For convenience, a summary has been included below in Figure 3.

Harbord Hotel

Job Number:	4539
Instrumentation:	SVAN 957 15364
Logger Location:	Front Verandah of 4 Charles St
Free Field:	no
Monitoring Period:	Monday 30 November 2020 to Friday 11 December 2020

BACKGROUND AND AMBIENT NOISE MONITORING RESULTS
NSW EPA's NOISE POLICY FOR INDUSTRY, 2017

Day	L90 Background Noise Levels			Leq Ambient Noise Levels		
	Day 7am - 6pm	Evening 6pm - 10pm	Night 10pm - 7am	Day 7am - 6pm	Evening 6pm - 10pm	Night 10pm - 7am
Monday 30 November 2020	*	44.0	41.1	*	51.7	48.4
Tuesday 1 December 2020	*	*	*	*	*	*
Wednesday 2 December 2020	48.0	44.2	42.6	61.0	51.3	47.5
Thursday 3 December 2020	47.3	41.6	40.1	55.1	49.9	46.6
Friday 4 December 2020	47.1	43.7	41.3	56.6	51.1	46.3
Saturday 5 December 2020	44.3	*	39.0	55.0	*	44.0
Sunday 6 December 2020	*	*	38.7	*	*	44.3
Monday 7 December 2020	45.0	*	38.7	55.1	*	45.3
Tuesday 8 December 2020	47.8	42.3	37.5	57.3	57.8	47.5
Wednesday 9 December 2020	*	42.6	37.5	*	53.6	45.9
Thursday 10 December 2020	*	*	*	*	*	*
RBL Median	**47.2**	**43.2**	**39.0**	-	-	-
Log Average	-	-	-	**57.3**	**53.5**	**46.4**

Figure 3: Unattended ambient noise monitoring results conducted between Monday November 30th and Friday December 11th 2020 at 4 Charles Street, Freshwater.

[2] Appendix B from The Acoustic Group (2020, December 14) Certificate of Acoustic Compliance, Occupation Certificate (50.4539.L6:MSC).

Time Period	dB(A)	Linear Octave Band Centre Frequency (Hz)								
		31.5	63	125	250	500	1k	2k	4k	8k
RBL day	47	50	46	46	44	43	42	38	33	24
RBL evening	43	45	40	43	41	41	39	34	27	20
RBL night	39	39	36	42	38	37	34	29	22	18
RBL 10pm – midnight	40	41	37	42	39	39	35	31	23	19
RBL midnight – 2am	39	39	36	42	39	38	35	29	22	18
RBL 2am – 4am	39	39	36	42	38	37	34	29	22	18
RBL 4am – 6 am	40	41	37	42	39	39	36	30	23	18

Figure 4: Unattended ambient noise monitoring results conducted between Monday November 30$^{\text{th}}$ and Friday December 11$^{\text{th}}$ 2020 at 4 Charles Street, Freshwater by The Acoustic Group. These octave-band measurements should be used as a baseline for all $L_{A,10}$ noise assessments.

Detailed octave-band noise measurements, referenced in Figure 4, can be found in the acoustics report dated December 14$^{\text{th}}$ 2020[3]

[3] Appendix C from The Acoustic Group (2020, December 14) Certificate of Acoustic Compliance, Occupation Certificate (50.4539.L6:MSC).

3.2 Determination of Background Noise Criteria

3.2.1 NSW Environmental Protection Agency Noise Policy for Industry 2017

With reference to the NSW EPA *Noise Policy for Industry (2017)*, the NSW Parliamentary Counsel *Protection of the Environment Operations (Noise Control) Regulation (2017)* and the above measurements, the following noise levels have been determined as being reflective of the actual ambient background noise levels of the surrounding environment, and will be referred to as the noise trigger levels throughout this report.

Table 2: Rating Background Noise Level (RBL), Amenity Criteria and Intrusiveness Noise Levels.

Day	**Day** 7am to 6pm	**Evening** 6pm to 10pm	**Night** 10pm to 7am
RBL Median	**47dB**	**43dB**	**39dB**
Amenity Noise Levels	55dB	45dB	40dB
Intrusiveness Noise Level (RBL + 5dB)	52dB	48dB	-

3.2.2 Liquor and Gaming NSW Hotel Liquor Licence

Under the conditions of Hotel Liquor License No. LIQH400102917 (Harbord Beach Hotel, held by Michael Christopher Ternes) the following acoustic conditions apply:

> "The LA10 noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre (31.5Hz - 8kHz inclusive) by more than 5dB between 07:00 am and 12:00 midnight at the boundary of any affected residence. The LA10 noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5Hz - 8Khz inclusive) between 12:00 midnight and 07:00 am at the boundary of any affected residence. Notwithstanding compliance with the above, the noise from the licensed premises shall not be audible within any habitable room in any residential premises between the hours of 12:00 midnight and 07:00 am. Interior noise levels which, although restricted in accordance with the above condition, still exceed safe hearings levels are in no way supported or condoned by the Authority."

These $L_{A,10}$ noise levels should be use in direct reference to the baseline results presented in FIGURE 4.

4 Acoustic Assessment

4.1 First Floor

4.1.1 Occupancy levels and time of trade for first-floor balcony

To derive an appropriate prediction methodology for patron noise, one must consider the elements that influence the generation of crowd noise; the Lombard effect, crowd size, orientation of individuals within the crowd and whether individuals act together as a synchronised source or behave randomly.

A theoretical prediction model determined by Hayne et. al.[4] is typically used to determine the potential noise emissions generated from patron activity.

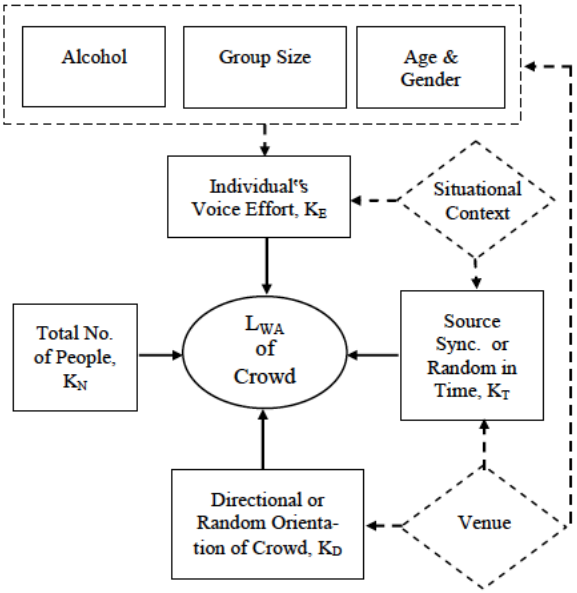

Figure 5: Factors influencing crowd noise (Hayne et al., 2011, p. 2)

The A-weighted sound power levels from a crowd size N, can be approximated by:

$$L_{W,A10} = 15\log N + 67dB_A \tag{1}$$

Using the intrusiveness noise levels from Table 2, and considering barrier attenuation and distance attenuation to the nearest noise-sensitive receivers, the recommended maximum occupancy levels can be determined for the outdoor first-floor balcony. The result of these calculations can be found in Table 3.

The suggested maximum occupancy levels for the first-floor balcony are presented in Table 4.

This prediction model was based on the proposed barrier heights specified in Section 4.1.2.

[4]Hayne et. al. (2011) Prediction of Noise from Small to Medium Sized Crowds, *Proceedings of ACOUSTICS 2011, Paper Number 133.*

Table 3: Maximum crowd sizes, estimated using the Hayne et, al. (2001) algorithm.

Day	**Day** 7am to 6pm	**Evening** 6pm to 10pm	**Night** 10pm to 12am
RBL Median	47dB	43dB	39dB
Amenity Noise Levels	55dB	45dB	40dB
Intrusiveness Noise Level (RBL + 5dB)	52dB	48dB	-
	With Proposed Glass Barriers		
Crowd Size	**100**	**60**	**8**
Predicted Source Sound Power Level ($L_{W,A10}$)	97dB	93dB	80dB
Estimated $L_{A,10}$ Level at Nearest Receiver	52dB	48dB	37dB

Table 4: Maximum occupancy levels for the first-floor balcony, based on theoretical estimations of crowd noise.

Day 7am to 6pm	**Sunset** 6pm to 8pm	**Evening** 8pm to 10pm	**Night** 10pm to 12am	**Late Night** 12am to 7am
90	80	60	8	-

A number of simulated noise mapping projections have also been included in Appendix A to support this theoretical calculation. The first-floor occupancy levels have been modelled under the assumption that the ground-floor outdoor area will be occupied at "Raised" to "Loud" levels simultaneously, although it was found that the noise levels generated by ground-floor courtyard patrons had little-to-no affect on the sound pressure levels experienced at the residential boundaries.

It is recommended that the balcony not be used for general patron activity from 10:00pm onwards (staff activity or smoking in small numbers is acceptable).

4.1.2 Acoustic barrier specifications for the first-floor balcony and heritage balustrade

The low-height, open masonry balustrade on the first-floor provides an almost-negligible amount of barrier attenuation for standing patron activity.

To manage the reverberant build-up of energy beneath the balcony, the following acoustic treatment is recommended:

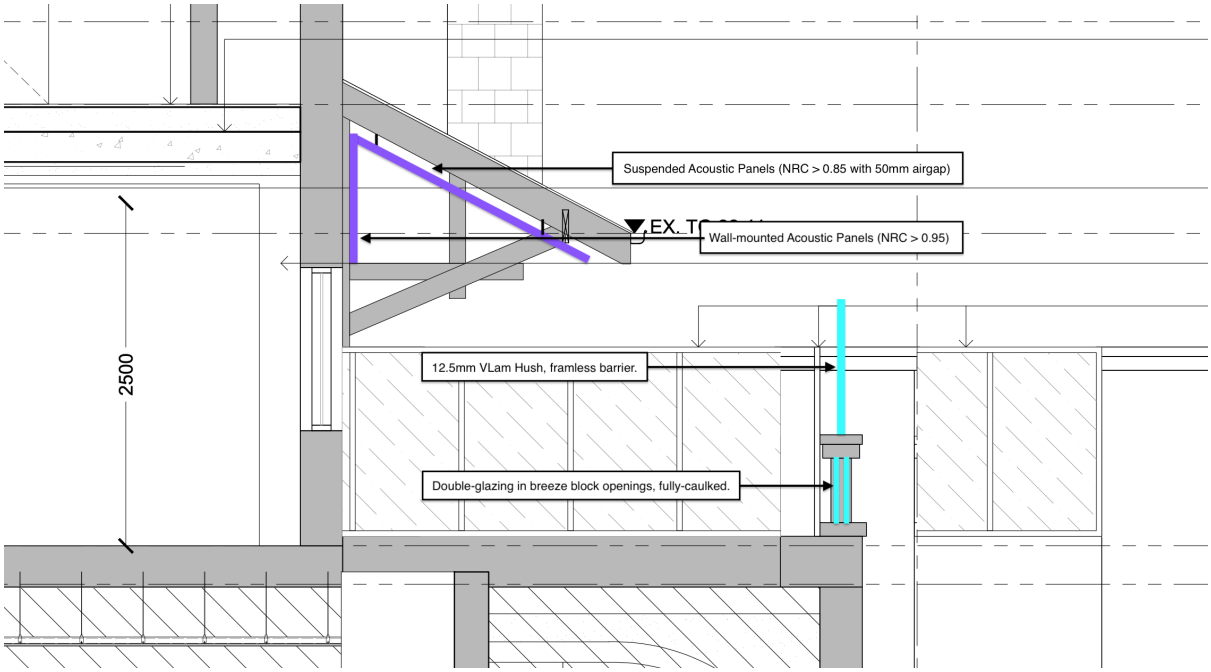

Figure 6: First-floor balustrade acoustic treatment and glass barrier.

- Suspend a number of absorptive acoustic panels with an NRC rating of > 0.85 (i.e. 50mm Quietspace by Autex or 30mm FilaSorb by Acoufelt) to the underside of the balcony eaves, with a 50mm airgap between the face of the panel and the timber slats. At least 80% of the available surface area should be covered.
- Install a number of absorptive acoustic panels with an NRC rating of ≥ 0.95 (i.e. 75mm Quietspace by Autex) to the facade beneath the eaves.
- Install double-glazing (12.5mm/10.5mm VLam Hush) in the openings of the balustrade breeze block.
- Install a single-glaze (12.5mm VLam Hush) frameless glass barrier above the balustrade to the heights noted in FIGURE 7. Please ensure that there are no gaps in this barrier (between the glazing and masonry, or between adjacent panels), as the consistency of this barrier is key to achieving the recommended barrier attenuation levels.

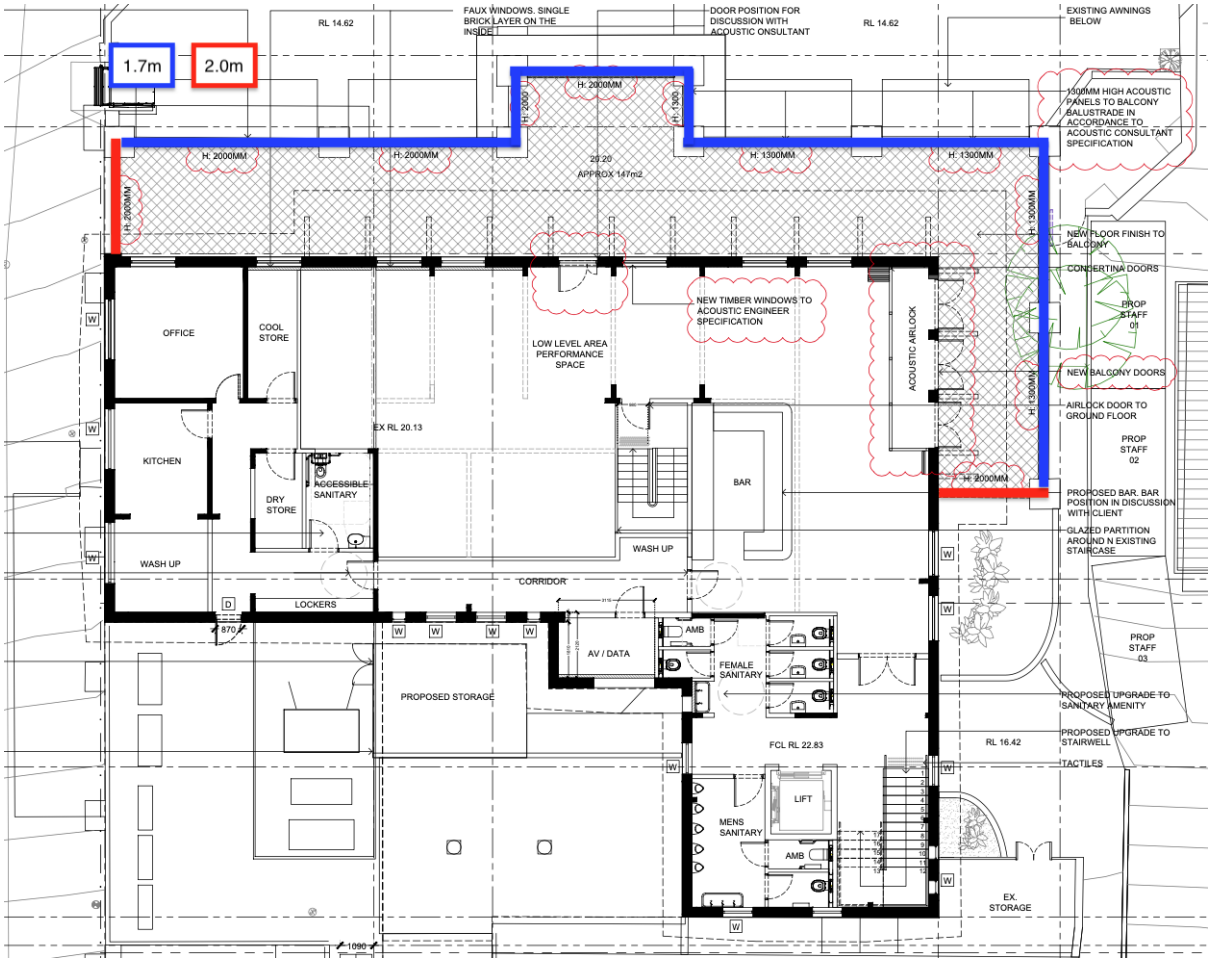

Figure 7: Suggested barrier heights to meet the requirements outlined by Alexander & Co.

4.1.3 Outdoor PA system & noise limits for background music.

An audio system was designed with the following components to deliver ambient background music on the first-floor balcony:

- 3 x JBL Control 25AV Shielded Outdoor Speakers
- 4 x JBL Control 29AV-1 Premium Outdoor Speakers
- 2 x Crown CDi 4300 4-Channel Amplifiers
- 2 x dbx ZC1 Wall-Mounted Zone Controller - Volume Controller
- 1 x dbx ZC3 Wall-Mounted Zone Controller - Input Selector
- 1 x dbx 1260 12x6 Digital Zone Processor

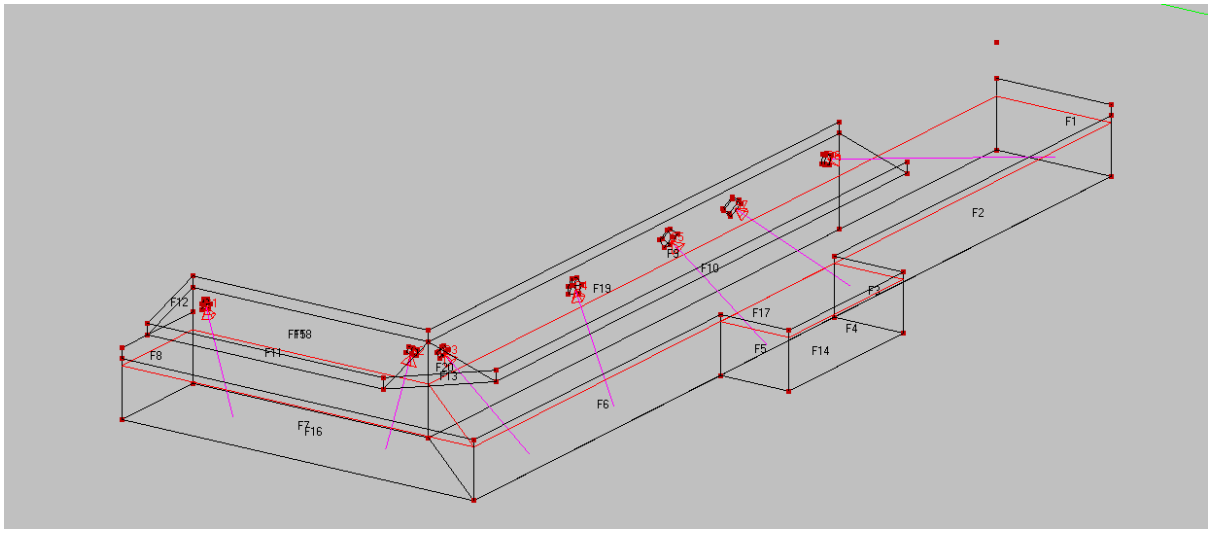

Figure 8: First-floor balcony loudspeaker configuration.

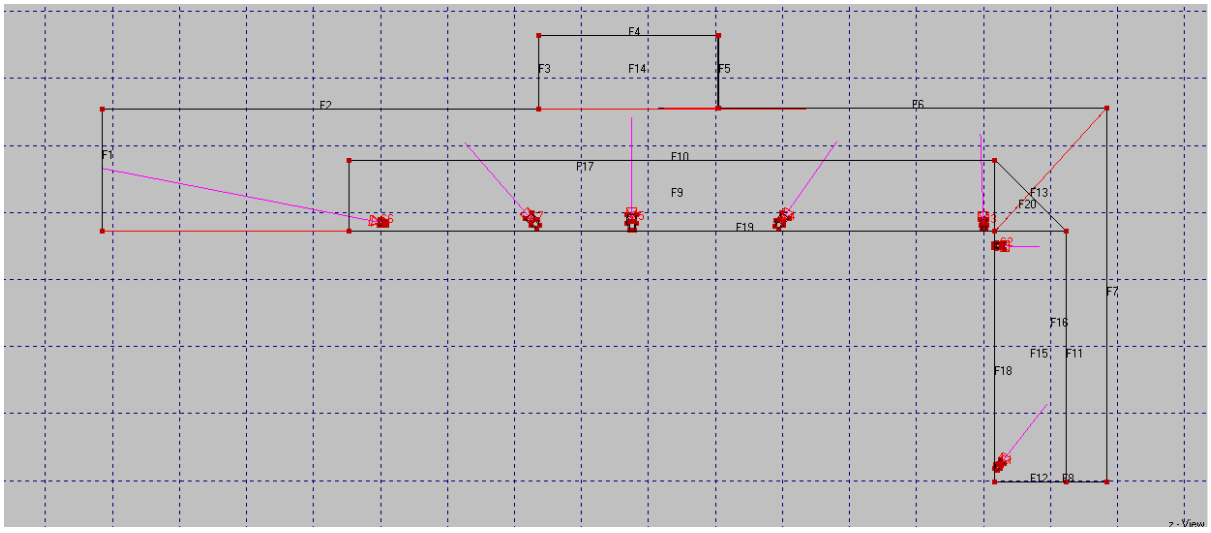

Figure 9: First-floor balcony loudspeaker configuration.

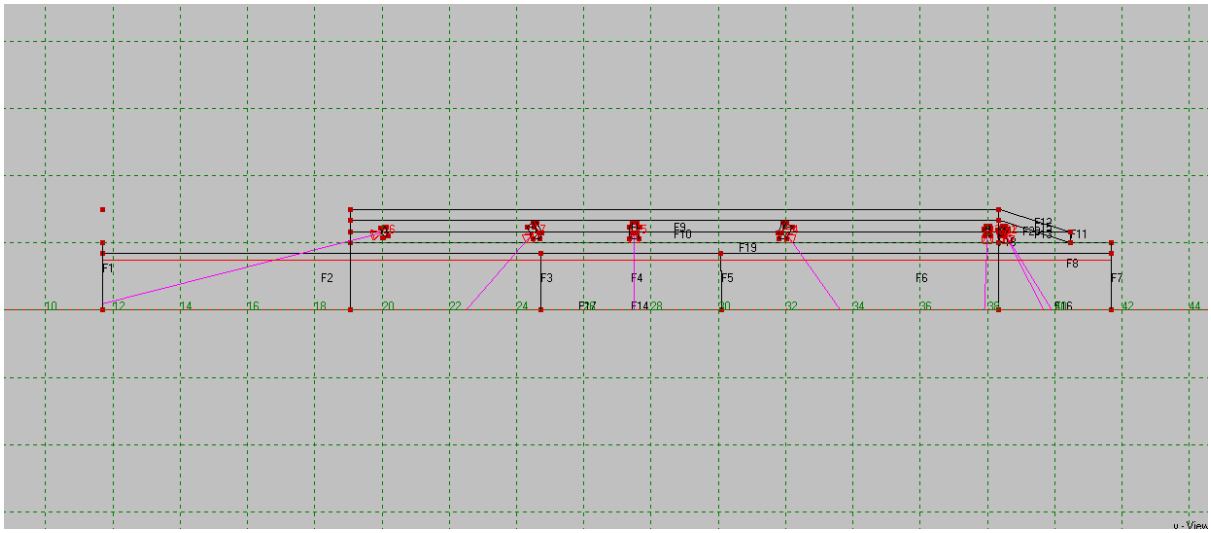

Figure 10: First-floor balcony loudspeaker configuration.

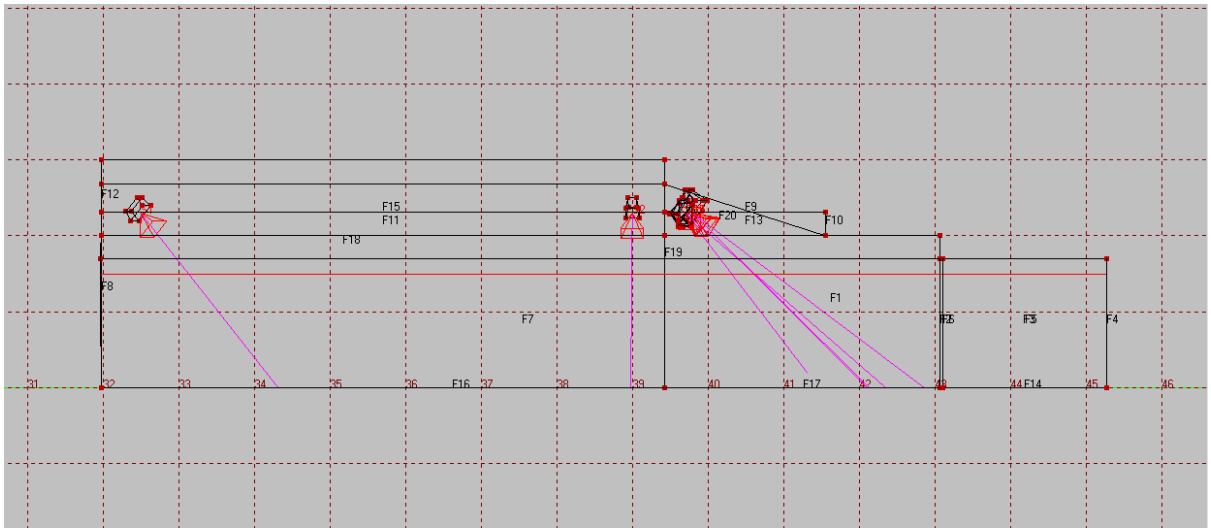

Figure 11: First-floor balcony loudspeaker configuration.

The following sound power (SWL) & sound pressure levels (SPL) have been determined as the maximum allowable levels for the outdoor PA system. These maximum levels are to be controlled by a DSP limiter (in the dbx 1260 Digital Zone Processor) and programmed during installation.

Table 5: Recommended maximum sound power levels for the outdoor PA system

	Day 7am to 6pm	**Sunset** 6pm to 8pm	**Evening** 8pm to 10pm	**Night** 10pm to 12am	**Late Night** 12am to 7am
Sound Power Level	$81dB_W$	$76dB_W$	$71dB_W$	-	-
Sound Pressure Level @ 1m	$75dB_{A,eq}$	$70dB_{A,eq}$	$65dB_{A,eq}$	-	-

4.1.4 Acoustic door & perimeter seals for the main first-floor entrance

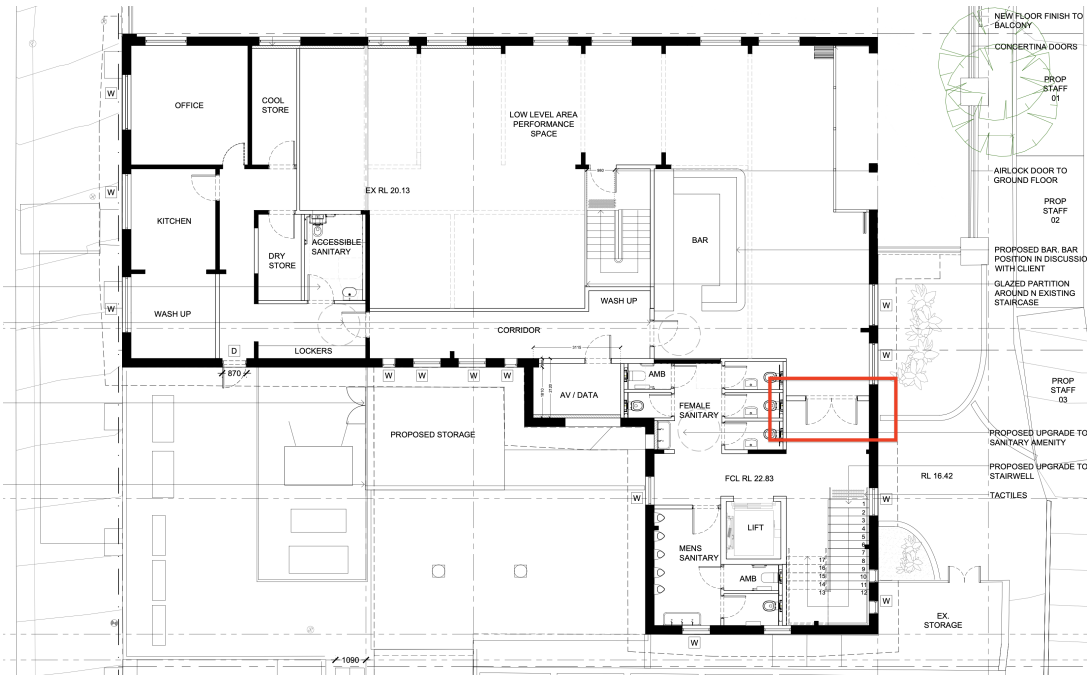

Figure 12: First-floor entrance doorway location.

Door Type:
Equal double door pair (see Figure 13).

Door Composition:
60mm metal door, no transparent partitions.

Perimeter Seals, Drop Seals & Astragal Seals:
Raven RP78Si, RP2004F, RP8Si, RP120, RP71 (with RP393Si gasket)

+ Heavy-duty gas strut or pneumatic door hinge.

Estimated R_W: 49dB

The Australian Standard AS/NZS 2107:2016 recommends a maximum background noise level of $50dB_{A,eq}$ in restaurant and bar areas. Assuming a maximum ambient level of 108dB from amplified performance, this door will ensure that propagated airborne sound will be $\approx$ 59dB on the outer-side of the partition, and no greater than 50dB at the base of the stairwell (assuming that the door is properly closed, and the stairwell is treated with absorptive panels).

If greater than R_w 50dB is required from this partition, then a high-performance acoustic door from a manufacturer such as IAC Acoustics (i.e. the Noise-Lock Door[5] series) is recommended.

[5]IAC Acoustics Noise-Lock Door Brochure: `http://www.iac-australia.com.au/wp-content/uploads/2020/09/IAC-Noise-Lock-Doors.pdf`

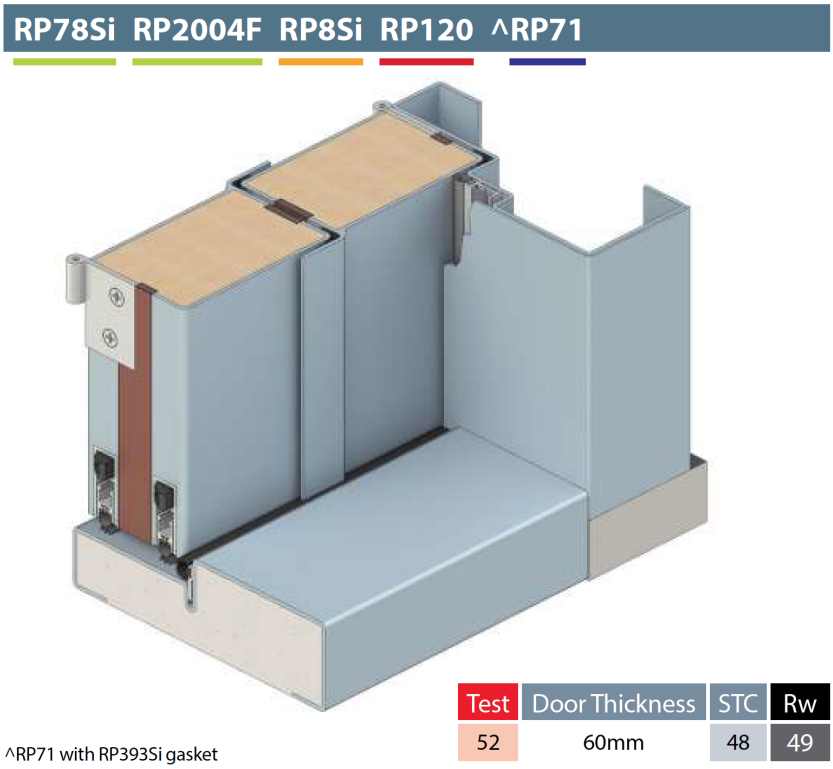

Figure 13: Proposed construction of first-floor entrance doorway.

4.1.5 Acoustic door & perimeter seals for balcony entrance

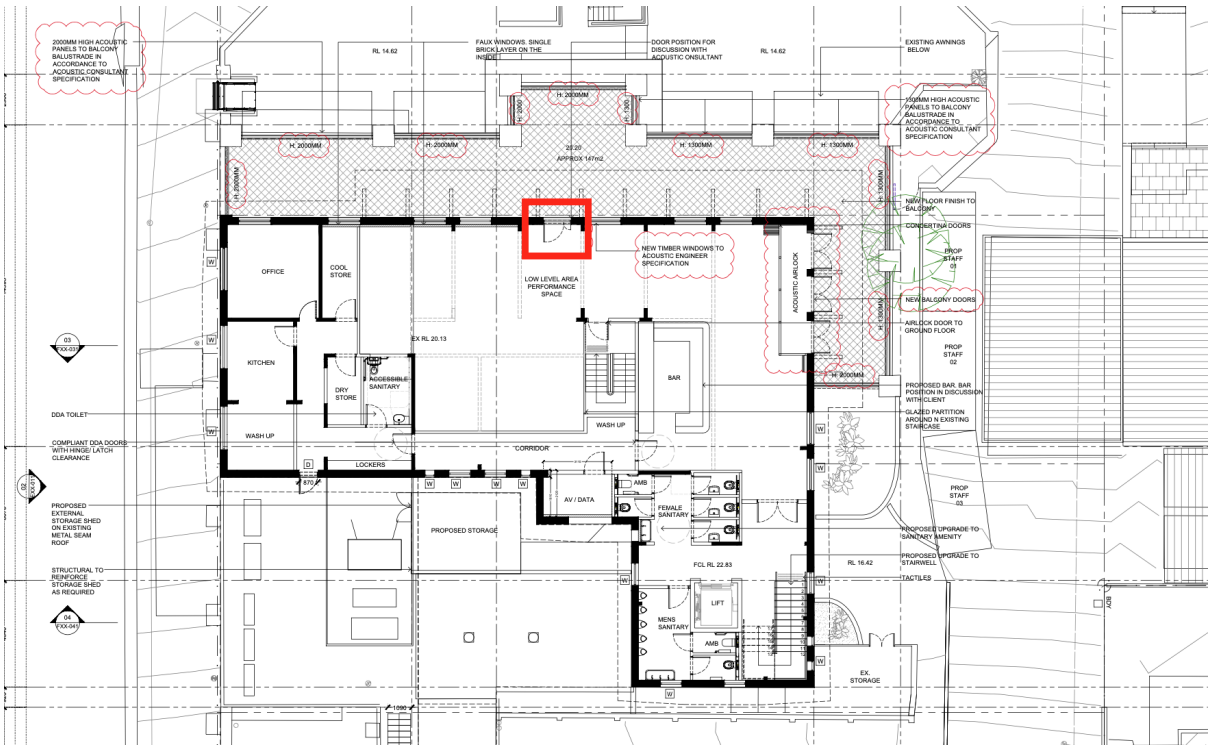

Figure 14: Proposed construction of first-floor entrance doorway.

Door Type:
Single, hinged door.

Door Composition:
Thermally-broken & double-glazed (VLam Hush 12.5mm/10.5mm configuration with the maximum-permissible airgap).

Perimeter Seals and Drop Seals:
Raven RP10Si, RP124, RP127Si & RP127Si

+ Fitted with a self-closing mechanism.

Estimated R_W: 46dB

Assuming a maximum ambient level of 108dB from amplified performance, this door will ensure that propagated airborne sound will be $\approx$ 62dB on the outer-side of the partition.

4.1.6 Acoustic glazing for the first-floor patron area.

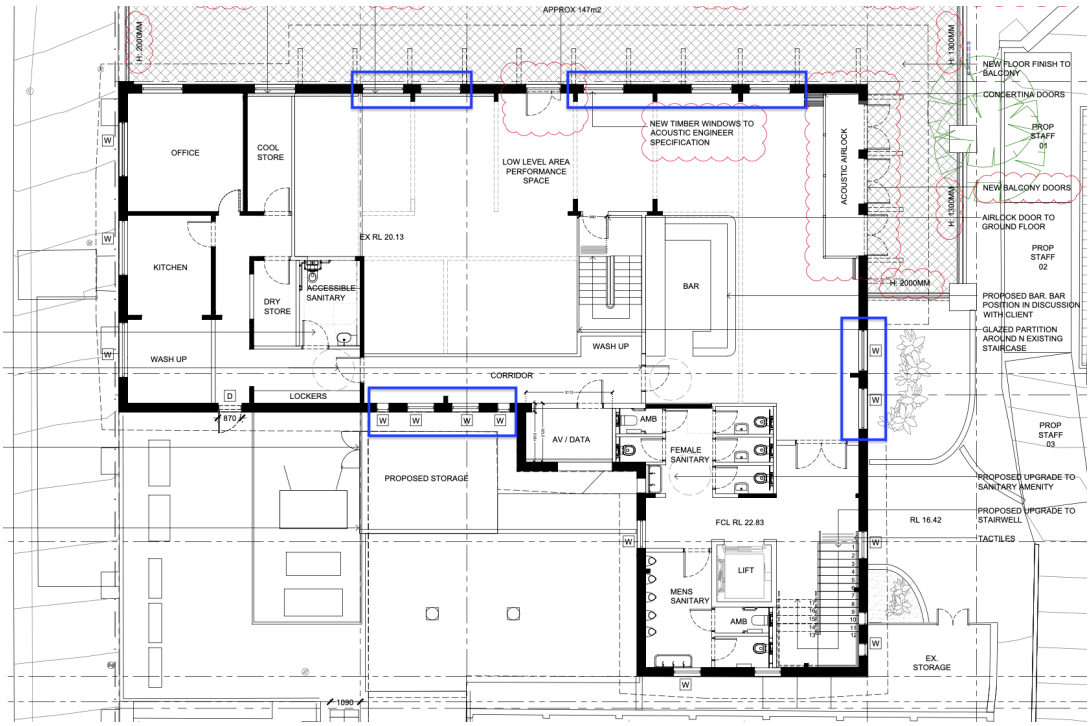

Figure 15: First-floor glazing & operable window location.

Glazing along the north-eastern facade should remain inoperable (fully-sealed) if the requirements for natural ventilation can be met by other window openings.

> SoundOUT FrontGLAZE framing system 12.5mm/10.5mm VLam Hush with maximum permissible airspace ($\geq$ 100mm) as offered by Architectural Window Systems Australia[6]. Predicted R_w = 50dB.

If operable windows are required (as noted on the south-eastern facade), an awning or casement window should be employed to ensure that adequate pressure can be applied to the perimeter seals. The following system is recommended:

> SoundOUT Casement with primary 6.50mm VLam Hush, 100mm air gap and 10.38mm Viridian VLam Hush, as offered by Architectural Window Systems Australia[7]. Predicted R_w = 48dB.

Assuming a maximum ambient level of 108dB from amplified performance, this glazing system will ensure that propagated airborne sound will be $\approx$ 60dB on the outer-side of the partition, at a level comparable to normal speech. This transmitted sound will then be subject to a secondary stage of absorption and barrier attenuation on the balcony area (Section 4.1.2).

[6]SoundOUT FrontGLAZE FRAMING Brochure: `https://www.awsaustralia.com.au/Content/cms/awscdn/files/646_ProductSheet.pdf`

[7]SoundOUT Casement Window Brochure: `https://www.awsaustralia.com.au/Content/cms/awscdn/files/532_ProductSheet.pdf`

Referring to an acoustics report from The Acoustic Group in June 2020[8]

> "Operable double glazing introduces issues with management having to ensure the windows are closed. The reliance upon the human element presents problems - hence the suggestion for fixed glazing.
>
> However, I am instructed the client seeks to have the windows operable to provide natural ventilation when entertainment is not provided.
>
> If the client requires the windows to be open (when entertainment is not provided) then there will have to be reed switches on the windows that cause a relay to switch the limiter settings to a lower value. This automatically ensure that if the windows are open then the maximum level of music that can occur is significantly lower and maintains compliance with the liquor license conditions."

To prevent accidental non-compliance (i.e. an operable window is left open during amplified performance) this condition is recommended, and a reed-switch/noise limiter system should be installed as per The Acoustic Group guidelines[9].

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[8] Page 2 of The Acoustic Group (2020, June 24) Proposed Ground Floor Alterations (50.4539.L3A:MSC).

[9] Page 3 of The Acoustic Group (2020, December 14) Certificate of Acoustic Compliance, Occupation Certificate (50.4539.L6:MSC).

4.1.7 Airlock between the first-floor patron area and outdoor balcony

Following a discussion with Sophie Harris (Senior Associate at Alexander & Co.) it was suggested that two stages of operable partitions be considered as an "airlock" between the first-floor patron area, and the outdoor balcony.

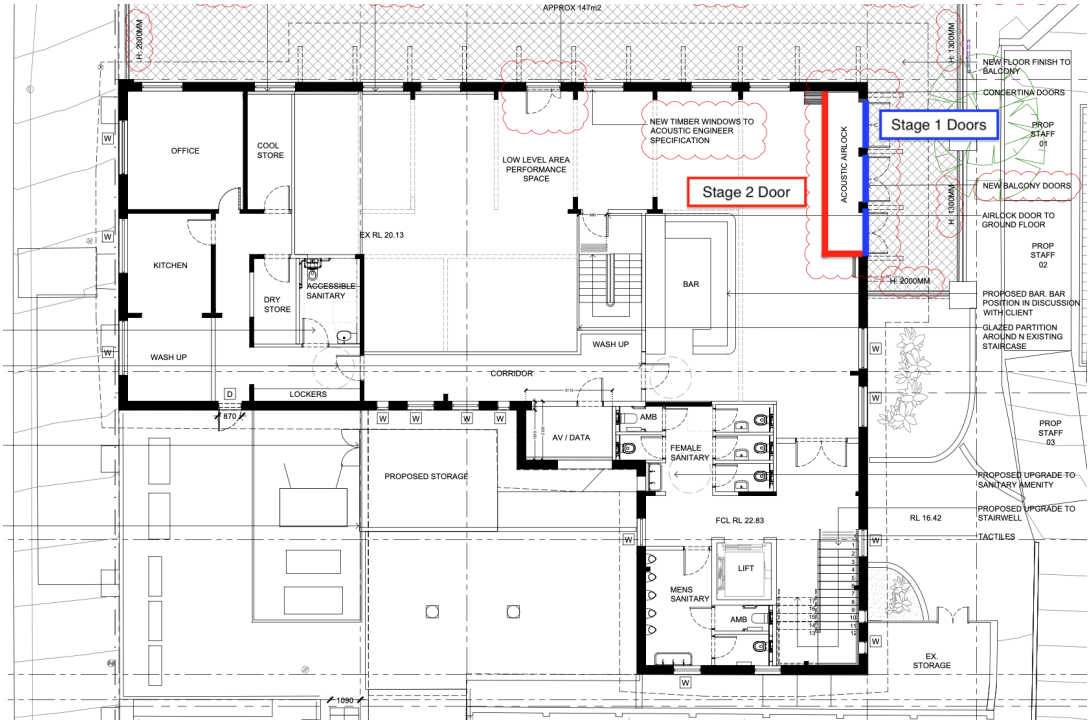


Figure 16: First-floor internal airlock.

The primary stage of the partition (outdoor) comprises double-glazed hinged double door sets - at the architect's discretion - and must achieve a minimum R_w of 35dB.

The secondary stage of the partition (indoor) will remain open during normal operation, and will be closed at night, or during all times when amplified entertainment is offered in the main patron area. A few optional partition styles have been listed below:

- Double Glazed Bifold Door[10] at $R_w = 45$dB.
- Thermally Broken Sliding Door (Series 731)[11] at $R_w = 37$dB (with 8.5mm Vlam Hush/10mm Air/6.5 Vlam Hush).
- SlideMASTER Internal Sliding Door[12] at $R_w = 35$dB (with 12.88mm VLam Hush).

Closed and fully-sealed, the performance of this airlock can be estimated at approximately 65-70dB. The performance of the airlock can further be improved by installing high-NRC absorptive panels (i.e. $\geq$ 0.85) to the ceiling between the void.

[10] Double Glazed Bifold Door:
`https://www.doubleglazedwindows.net.au/Acoustic-Windows-and-Doors-Bifold-Door.html`
[11] Thermally Broken Sliding Door Series 731:
`https://www.awsaustralia.com.au/Content/cms/awscdn/files/731_ProductSheet.pdf`
[12] SlideMASTER Internal Sliding Door Brochure:
`https://www.awsaustralia.com.au/Content/cms/awscdn/files/704_ProductSheet.pdf`

4.2 Second Floor

4.2.1 Floor-ceiling system between the first and second floor

Considering the potential mechanical and airborne sound generated by the amplification system on the first-floor, and the high-sensitivity nature of the music production studio on the second-floor, a high-performance floor/ceiling system must be employed to ensure sufficient isolation between building layers.

Referring to the development plans 0487FH-DA-FXX-011 by Alexander & Co., a 200mm concrete slab is to be installed between the first and second floor, with 200mm allocated for underfloor insulation and 100mm allocated beneath the slab for ceiling insulation.

In order to determine the appropriate rating for the floor/ceiling system, the minimum/maximum design sound levels must be assessed:

First Floor - Maximum: 108dB$_A$

Recommended Ambient Noise Level of Commercial Recording Studio: 25dB$_A$

Required Airborne Sound Insulation: R_w = 83dB

Underfloor System:

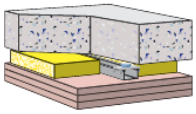
CSR 6348 	• 3 x 16mm Gyprock Fyrchek Plasterboard.	(a) Nil	63/**54**	65 – 70	**40 – 45**
		(b) 50 GW Acoustigard 11kg	67/**59**	58 – 62	**35 – 40**
		(c) MSB2 Polyester	65/**57**	58 – 62	**35 – 40**

Figure 17: Floor/Ceiling - Concrete with Resilient Mounted Furring

A CSR 6348 (or similar) system is recommended to achieve R_w = 67dB (R_{w+Ctr} = 59dB with low-frequency correction applied).

- 150mm min. concrete slab (the proposed system is modelled with a 150mm concrete slab; the additional 50mm can attribute to a further 2-3dB of performance)
- Gyprock Resilient Mounts direct fixed to concrete slab at 1200mm centres.
- Rondo Furring Channel No. 129 at 600mm maximum centres. To increase low-frequency performance, Regupol sonusclip SC1000 resilient isolation clips can also be used.
- 3 x 16mm Gyprock Fyrcheck Plasterboard.
- 50mm Acoustigard Glasswool 11kg^{m2}

Total height from ceiling to base of slab = 98mm.

Flooring System:

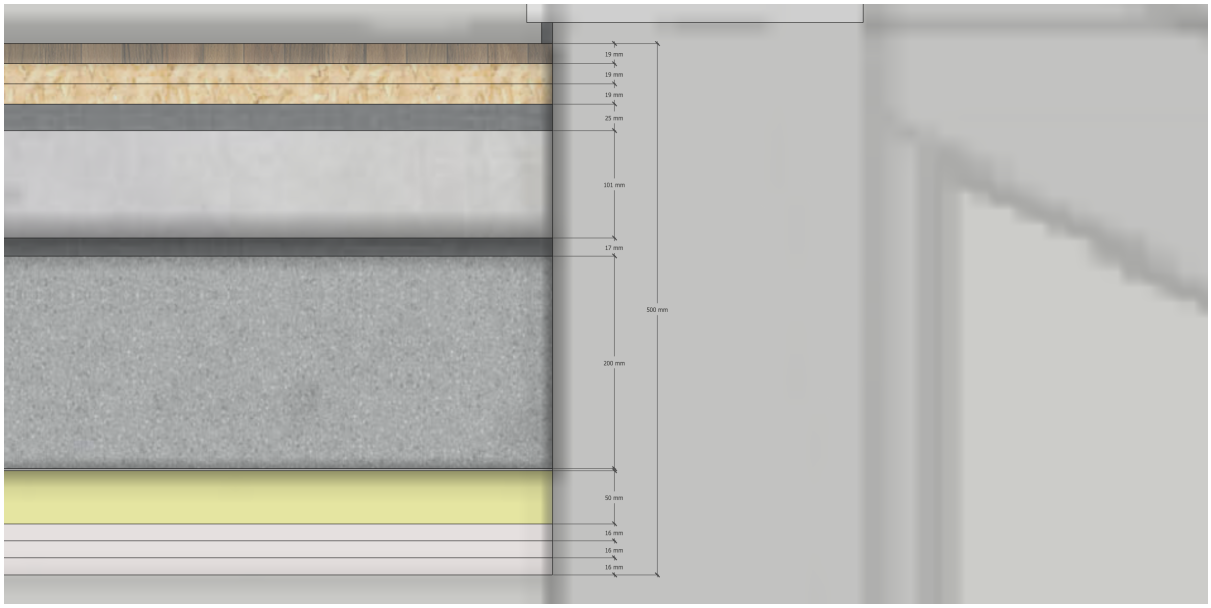


Figure 18: Resilient flooring system.

- Hardwood Floor
- 2 x 19mm Yellow Tongue STRUCTAflor Boards
- Regupol Sill Isolation Pads[13] and Perimeter Isolation Strips[14].
- Regupol Sonus Curve 25[15] dimpled flooring underlayment
- 100mm Screed (a 75mm layer will also be acceptable).
- Regupol Sound 17[16] impact sound insulation layer
- Concrete Subfloor

Total height from concrete slab to floor = 200mm.

Total floor height (including underfloor ceiling system) = 500mm.

Note: AKA recommend discussing these options with your structural engineer and a Regupol *representative to determine the most appropriate method of evaluating load-bearing construction.*

[13] Regupol Sill Isolation Pads:
`https://www.regupol.com/us/acoustics/products/regupol-sill-isolation-pad`
[14] Regupol Perimeter Isolation Strips:
`https://www.regupol.com/us/acoustics/products/accessories`
[15] Regupol Sonus Curve 25:
`https://www.regupol.com/uk/acoustics/products/product/detail/regupol-sonus-curve-25`
[16] Regupol Sound 17:
`https://www.regupol.com/uk/acoustics/products/product/detail/regupol-sound-17`

Walls, Flanking and Mechanical Coupling:

Care must be taken to ensure that all partition joints, walls and skirting have the appropriate resilient connections to ensure no mechanical coupling or vibration transmission between floating layers. Regupol Perimeter Isolation Strips and acoustic-rated mastic are typically used in these cases.

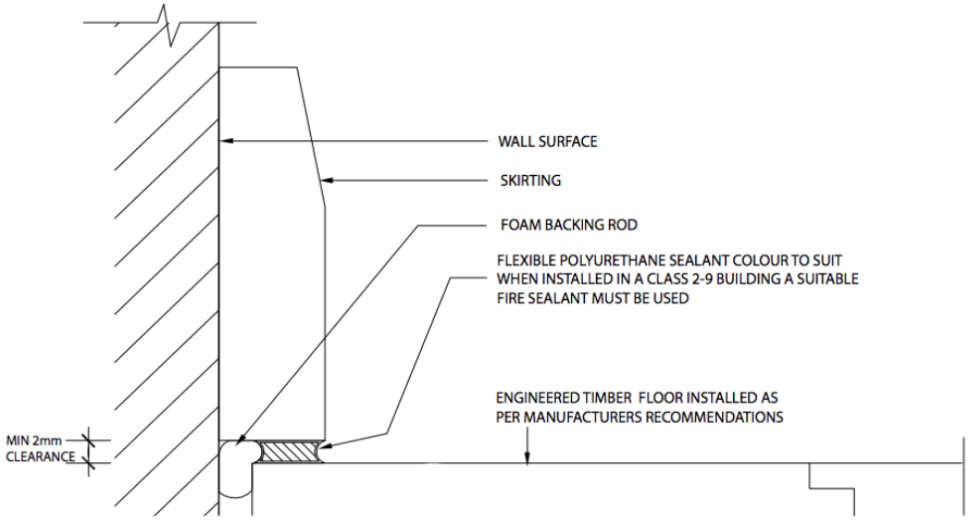


Figure 19: Cross-sectional drawing of isolated skirting.

4.2.2 Ceiling insulation system

The ceiling insulation system should perform bi-directionally; reducing external noise from outdoor sources and preventing indoor-to-outdoor sound transmission.

Considering the heritage significance of the roofing system, the following ceiling has been modelled to R_w = 57dB (R_{w+Ctr} = 51dB), although it is assumed that additional acoustic panelling will be installed on the under-side of the ceiling to control internal background noise levels and reverberation (see SECTION 4.2.3).

- Ceramic Roof Tiles
- Foil sarking, such as Bradford Thermoseal.
- Bradford Gold R7.0(HP) 290mm Hi-Performance Ceiling Insulation.
- Rondo Furring Channel clipped to Gyprock Resilient Mounts or suspension system. Furring channels at 600mm maximum centres.
- 3 x 16mm Gyprock Fyrchek Plasterboard.

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5 Conclusion

5.1 Conclusion Disclaimer

Recommendations made in this report are intended to resolve acoustical problems only. We make no claims of expertise in other areas of legislation or building construction and therefore the recommended noise control suggestions should be implemented in consultation with other specialists to ensure they meet the structural, fire or other aspects of construction. We encourage clients to check with us before using any materials or equipment that are alternative to those specified in our report.

5.2 Concluding Statement

An acoustic evaluation was conducted regarding the proposed developments to the first and second floor of the Harbord Beach Hotel at 29 Moore Road, Freshwater, NSW.

With the aid of third-party acoustic reports, an environmental noise assessment was undertaken to determine the compliance of the ground floor courtyard, and first floor balcony. With the appropriate mitigation strategies, any potential adverse impacts on nearby residents will be significantly minimised.

An acoustic design assessment was also conducted for the first-floor patron area, and the second-floor bar/lounge. The appropriate design strategies were presented to ensure that the developments comply with the NSW EPA Noise Policy for Industry, the Protection of the Environment Operations (Noise Control) Regulations, and the relevant Australian Standards regarding indoor sound levels and reverberation times.

It is assumed that the following actions will be taken following the successful submission of this Development Application:

- Post-construction acoustic measurements to determine the appropriate type & location of interior acoustic treatment.
- Detailed acoustic analysis & design of the second-floor PA system.
- Detailed acoustic analysis & design of the music production studio.

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Appendix A Noise Propagation from First-Floor Balcony

Figure A.1: Theoretical noise propagation map, assuming 100 patrons on the first-floor balcony (with ground-floor courtyard speaking at "Raised" to "Loud" levels).

Figure A.2: Theoretical noise propagation map, assuming 80 patrons on the first-floor balcony (with ground-floor courtyard speaking at "Raised" to "Loud" levels).

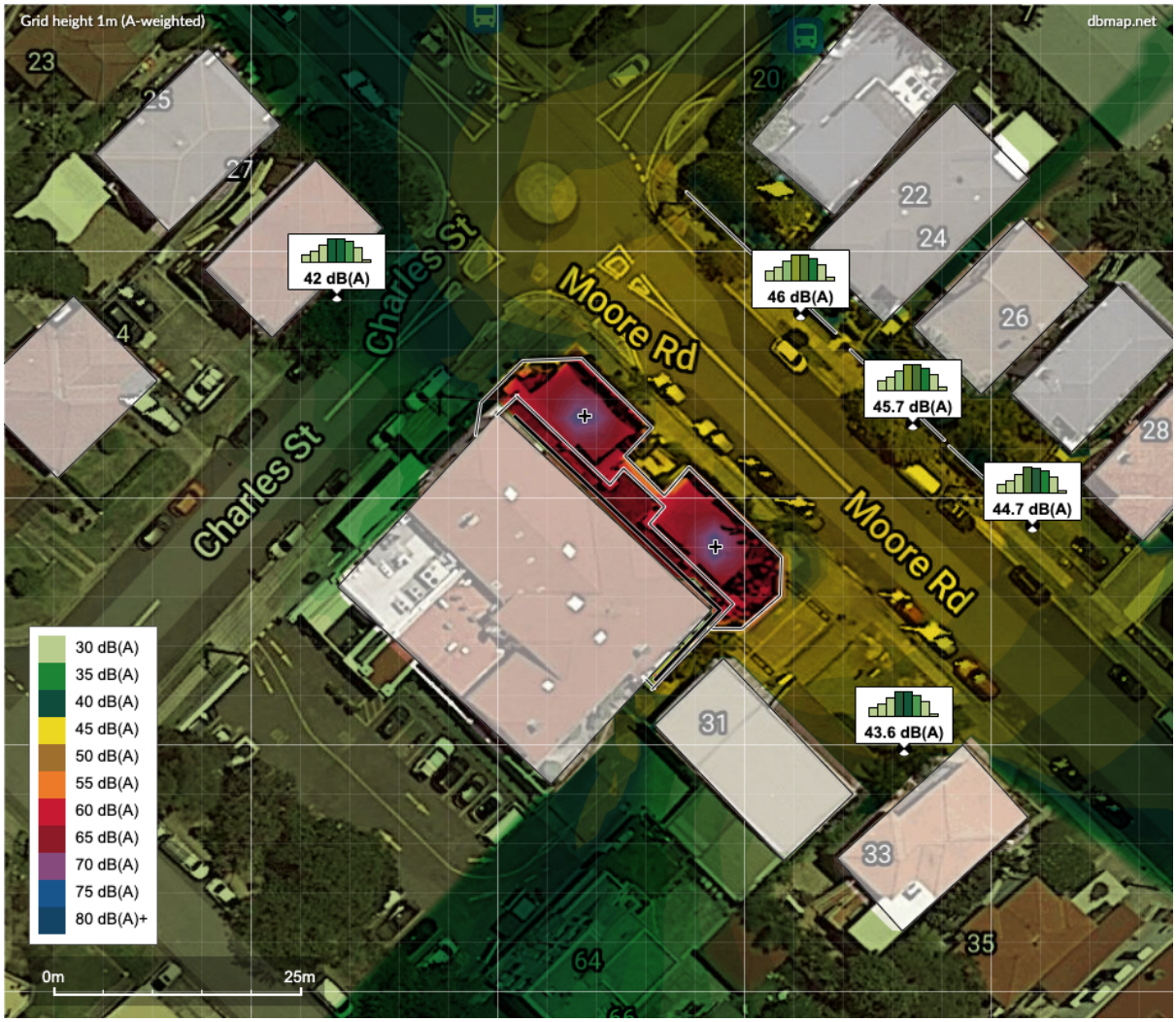

Figure A.3: Theoretical noise propagation map, assuming 60 patrons on the first-floor balcony (with ground-floor courtyard speaking at "Raised" to "Loud" levels).

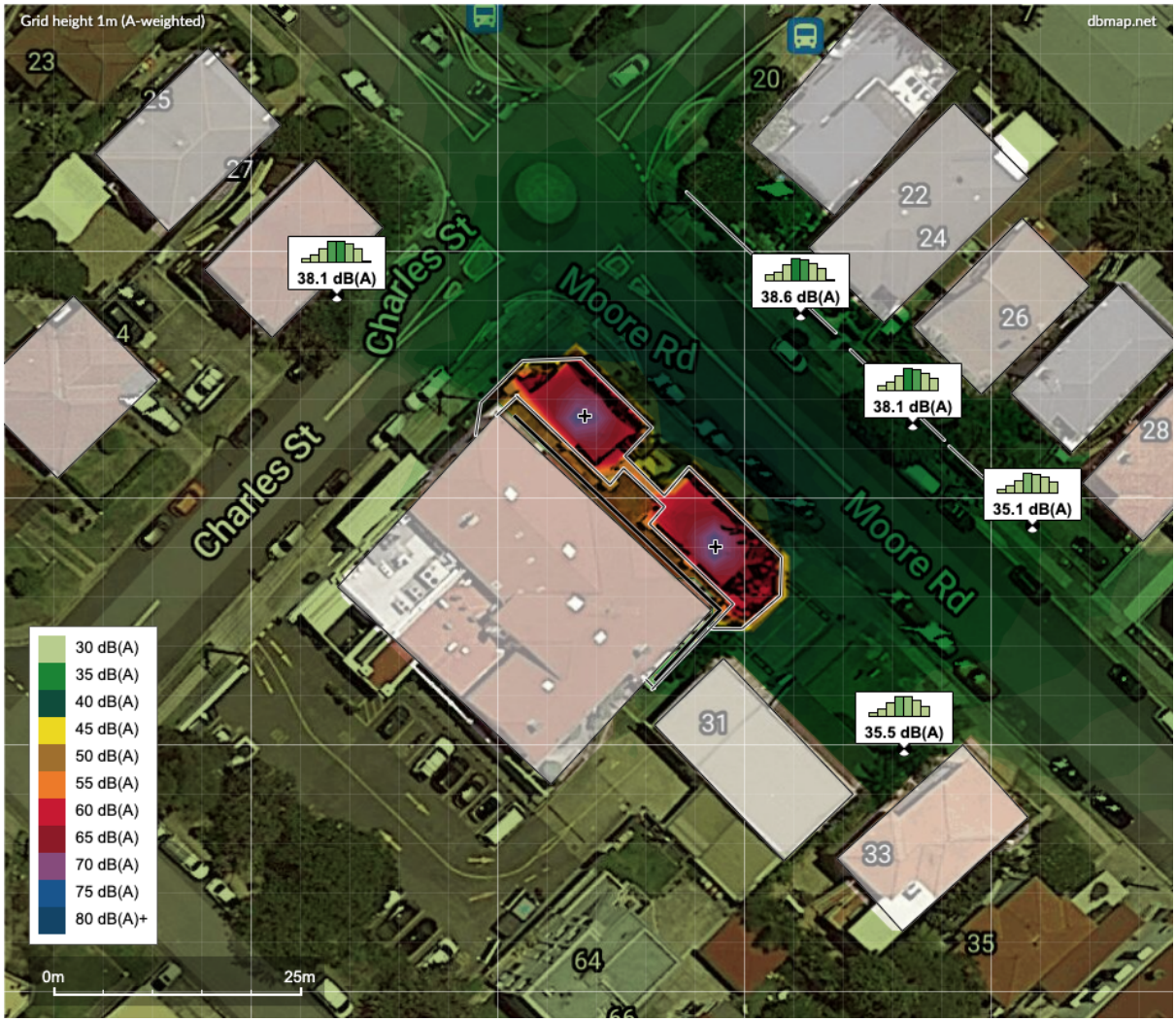

Figure A.4: Theoretical noise propagation map, assuming 8 patrons on the first-floor balcony (with ground-floor courtyard speaking at "Raised" to "Loud" levels).

Assumptions used in calculations:

- Noise sources behave as a point/line and are far-field, where inherent directivity is minimal (to simulate random speaker direction).
- The ground is of a continuous type (a single ground factor)
- Barriers are flat with no transmission of sound through or under the screen. i.e. not floating off the ground or with empty sections or perforations.
- Meteorological conditions are for moderate downwind propagation. Strong winds or temperature inversion that could affect the propagation path are not accounted for.
- Computer modelling requires a simplification of real-world conditions into basic components. For each simplification there will be a degree of error added to the model.

End of Document