Acoustics Paper Preparation 2024 - Acoustic Testing of JBN Ceiling Speaker System

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Abstract - For the purposes of determining the performance of the JBN Sound Ceiling, RSA measured the noise levels from the speaker system. The main emphasis is to measure the noise level output of the speaker system installed horizontally (ceiling configuration) and at varying distances.

1 INTRODUCTION

To meet the increasing demands of balancing compliant sound systems and in house performance, we have investigated a number of sound system setups. One of the sound systems that stands out with performance and having the potential of meeting regulatory is the JBN Sound Ceiling.

The JBN Sound Ceiling is setup with numerous directional speakers installed in pre assembled modules and installed as ceiling panels. This configuration allows for an even distribution of noise levels directly below the system and a significant reduction in levels outside the system.

In order to conduct this analysis, the system installed at Acacia Ridge Winery Yarra Valley (the venue) was tested. Music and pink noise were measured at locations under the system and outside the system grid.

2 JBN SOUND CEILING

The JBN Sound Ceiling consists of modules with 9 x 6.5 inch perfectly matched, dual cone speakers riveted to a 1.6mm perforated plate with a 25mm compressed fibreglass backing. One layer of Earthwool R3 100mm thick is installed directly above the Jbn modules

Installed at the venue is a series of Jbn modules mounted in a suspended ceiling grid measuring 3.6m wide x 7.8m long. Total coverage is 28.08m2. 78 off - Jbn Modules with 702 off Jbn -dual cone speakers in total, creating a large array of speakers. The Jbn system becomes the ceiling above the dance floor as shown in the photo below.

Figure 1 – Installed JBN Sound Ceiling at Acacia Ridge Winery Yarra Valley

The speaker system is bordered in red in the figure above. Note that the two pairs of loudspeakers marked in yellow were not operational during the evaluation of the Sound Ceiling.

The system is installed in the marquee of the wedding venue. The marquee walls are constructed from commercial grade glass and the roof is constructed from 1 layer of “Z” Lock Coolroom Panels measuring 100mm.

Typical example of this speaker configuration is provided in figure below.

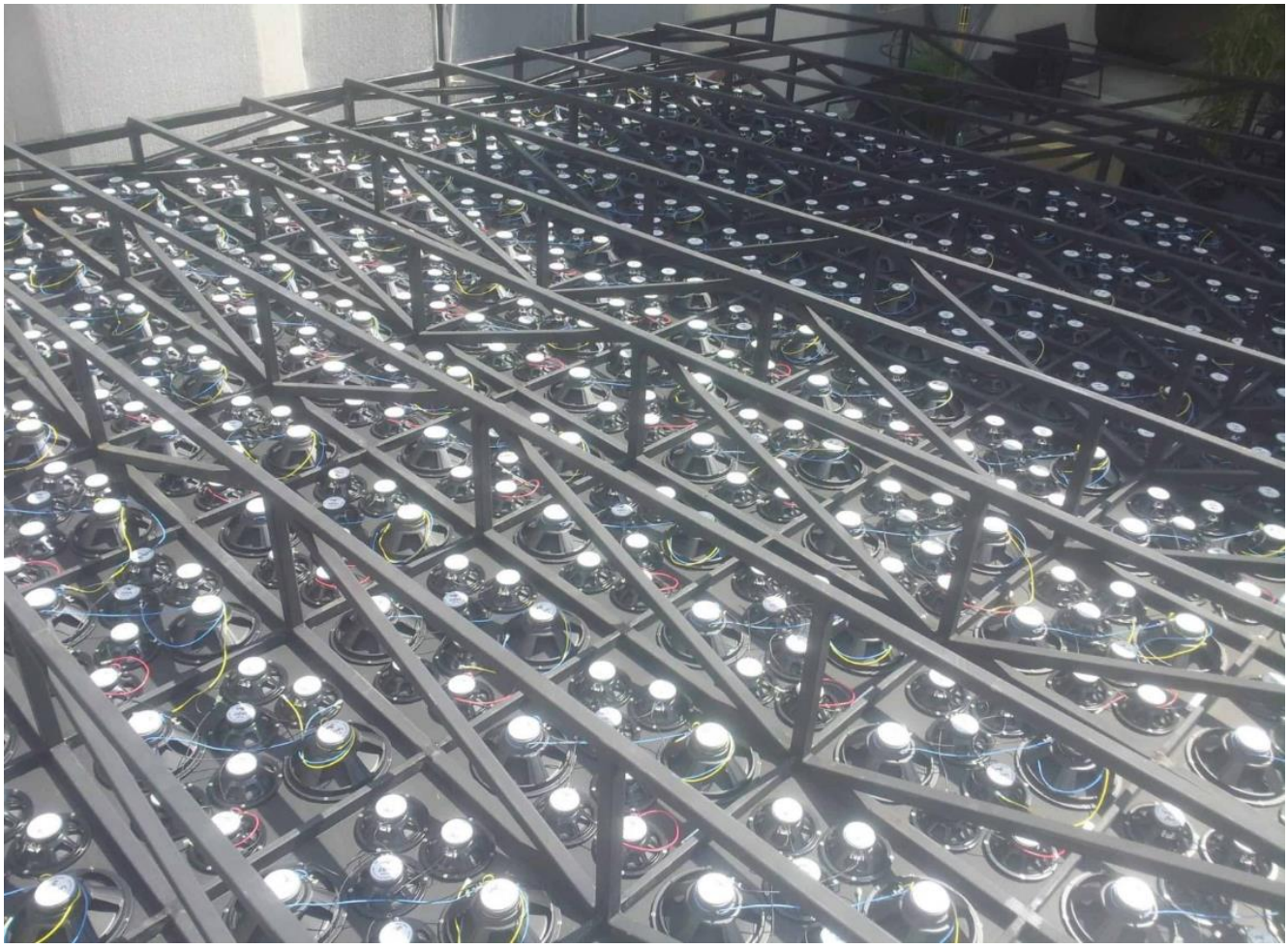

Figure 2 – Typical Speaker Configuration

3 MEASUREMENT PROCEDURE

In order to measure the performance of the speaker system, two types of outputs were measured. *Stumblin' In* by *DJ Cyril* was the played through the system first followed by pink noise generated by a noise generator. Noise levels were measured under each panel and outside of the speaker grid. The parameters of the measurements are presented in table below.

Table 1 – Measurement Parameters

Parameter	Value
Measurement height	1.5 m
Duration	10 s
Descriptor	L_{Aeq}

3.1 Measured Results

The results of the measured noise levels are presented numerical in the tables below. This includes the linear 1/1 octave spectrum and overall dB(A) levels.

Table 2 – Measured Noise Levels – Music

Hz	Average Under Grid	1m from grid (east)	2m from grid (east)	3m from grid (east)	4m from grid (east)	1m from grid (south)	2m from grid (south)	3m from grid (south)	4m from grid (south)	1m above the roof
31.5	81.2	68.7	69.4	67.2	64.5	64.5	77.2	79.5	80	88
63	98.2	88.9	89.3	88.6	84.5	84.5	94.5	94.4	95	95.4
125	108	97.9	96.3	95.3	88.1	88.1	98.1	94	92.6	88.3
250	95.4	87.8	86	84.2	85.9	85.9	87.4	83	82	74.6
500	92.4	80.2	81.4	78.3	79.7	79.7	78.2	78.3	74.4	61.4
1000	87.7	74.6	76.5	73.1	76.4	76.4	76.9	75.8	70.3	61.5
2000	88.8	77.7	81.1	78	83.1	83.1	81.7	82.7	74.7	57.5
4000	81.4	73.5	75.4	71.8	75.6	75.6	76.9	75.1	70.6	49.6
8000	75.8	67.5	70.7	63.9	67.6	67.6	72.5	70	64.4	39.2
Overall (dBA)	97	86.4	86.9	84.3	86.8	87.9	86.6	82	81.9	74.1

Table 3 – Measured Noise Levels – Pink Noise

Hz	Average Under Grid	1m from grid (east)	2m from grid (east)	3m from grid (east)	4m from grid (east)	1m from grid (south)	2m from grid (south)	3m from grid (south)	4m from grid (south)	1m above the roof
31.5	73.5	61.5	63	59.3	62.8	70.8	69	69.8	67	74.2
63	89.1	78.4	78.9	78.2	78.2	84	82	82.5	81	80.6
125	100	93.1	88.8	88.8	86.4	89.1	85.2	82.5	77.4	79.8
250	90.6	81.9	78.1	77.7	77.6	78.7	77.6	77.6	74.7	67.5
500	87	78.9	75.1	77	75.4	72.5	73.3	73.3	71.7	56.5
1000	89.9	79.5	77.5	76.5	77.1	77.4	76.7	75.3	74.6	62.8
2000	92.5	85.7	85.8	85.9	85.5	85.5	83.8	83.4	81.7	60.2
4000	89.5	84.2	83.9	84.4	84.2	84	81.1	81	80.7	55.7
8000	83.2	79.2	77.7	77.5	77.6	78.9	76.7	75.9	73.9	43
Overall (dBA)	96.8	90.4	89.9	90.0	89.7	89.7	87.7	87.3	86.1	68.5

To provide a graphical performance of the JBN Sound Ceiling, the measured levels measured under the grid, were inputted into a noise modelling software (Soundplan 9.0) as point sources. The output of the model as the noise emissions from the Sound Ceiling grid presented for the music and the pink noise below.

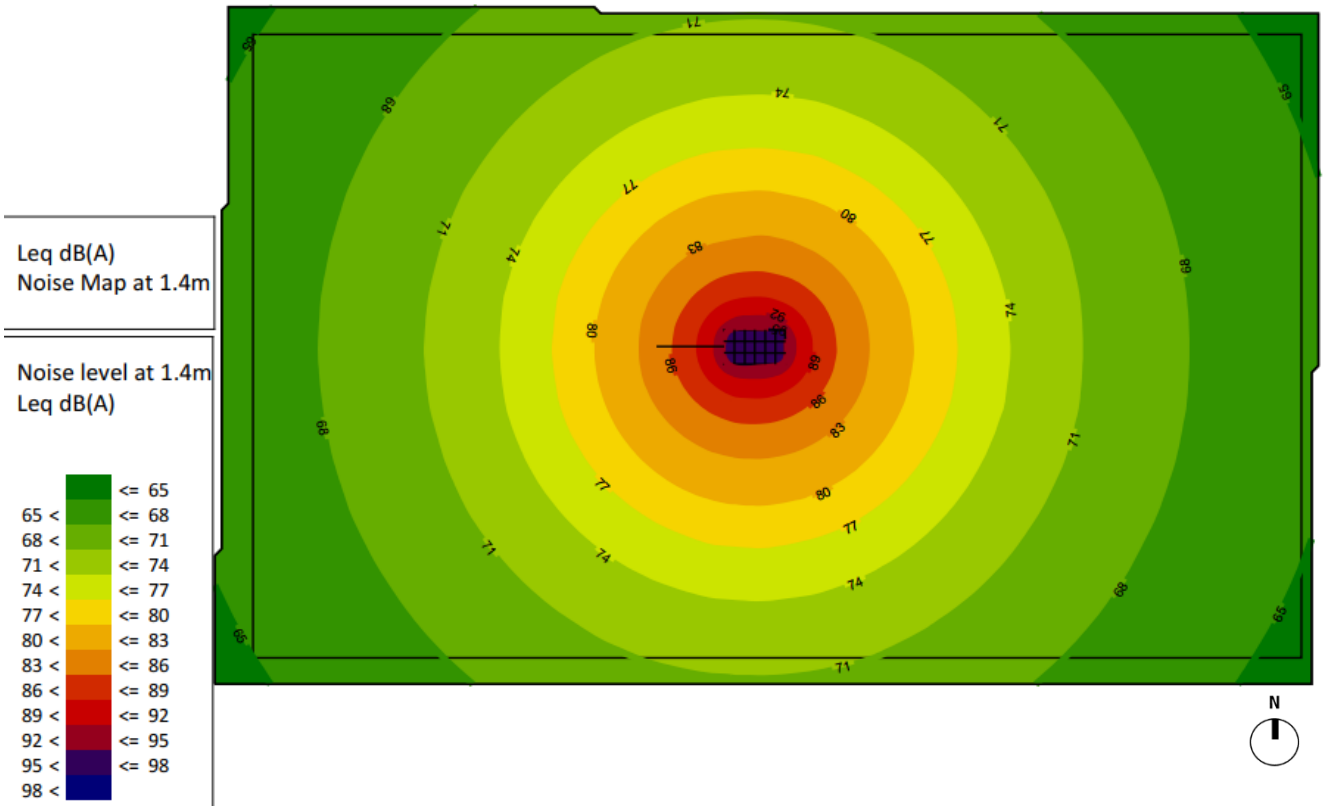

Figure 3 – Noise Map Music

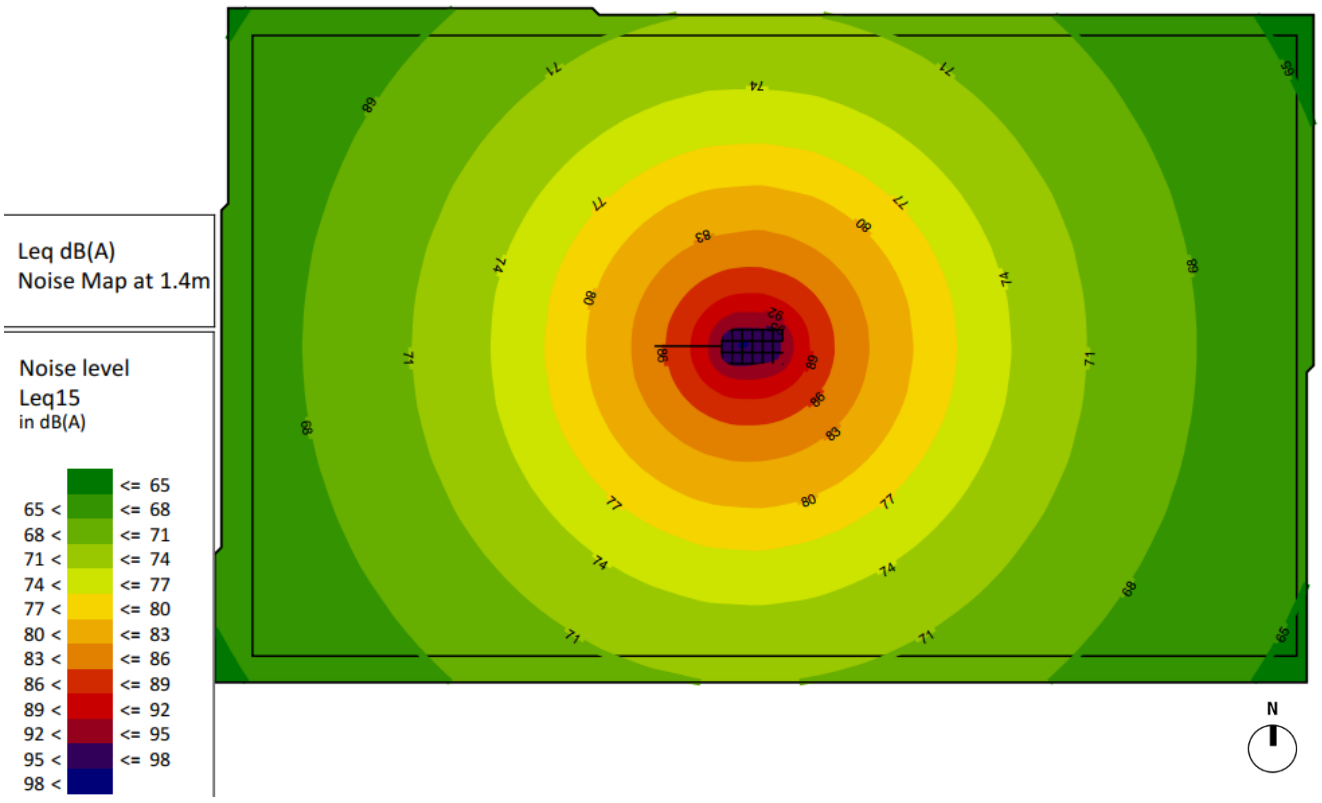

Figure 4 – Noise Map Pink Noise

4 SUBJECTIVE ASSESSMENT

The benefits of the Sound Ceiling can be measured from a subjective perspective, the perceived quality of the system can be easily judged by the end user. The system provides a significant improvement in sound quality when compared to conventional sound systems. While a multiple array of speakers mounted on walls or stands is commonly used as the industry standard, the sound quality in a space can vary significantly based on the following:

- Number of speakers
- Dynamic response and directivity of speakers
- Location
- Coverage

While calibrating a conventional sound system can provide some control over the parameters such as frequency and amplitude, the listening experience in a space (venue) can change dramatically depending on the location of the end user. Patrons close to the speakers will be exposed to high sound levels while patrons standing away from the speakers may not experience the intended full range of sound

The Sound Ceiling provides a steady sound spread through the area it is installed in, avoiding the need to set high decibel levels to reach all areas of the space (venue). This is achieved by the symmetry of each speaker module panel and by patrons standing at the same distance from the ceiling area.

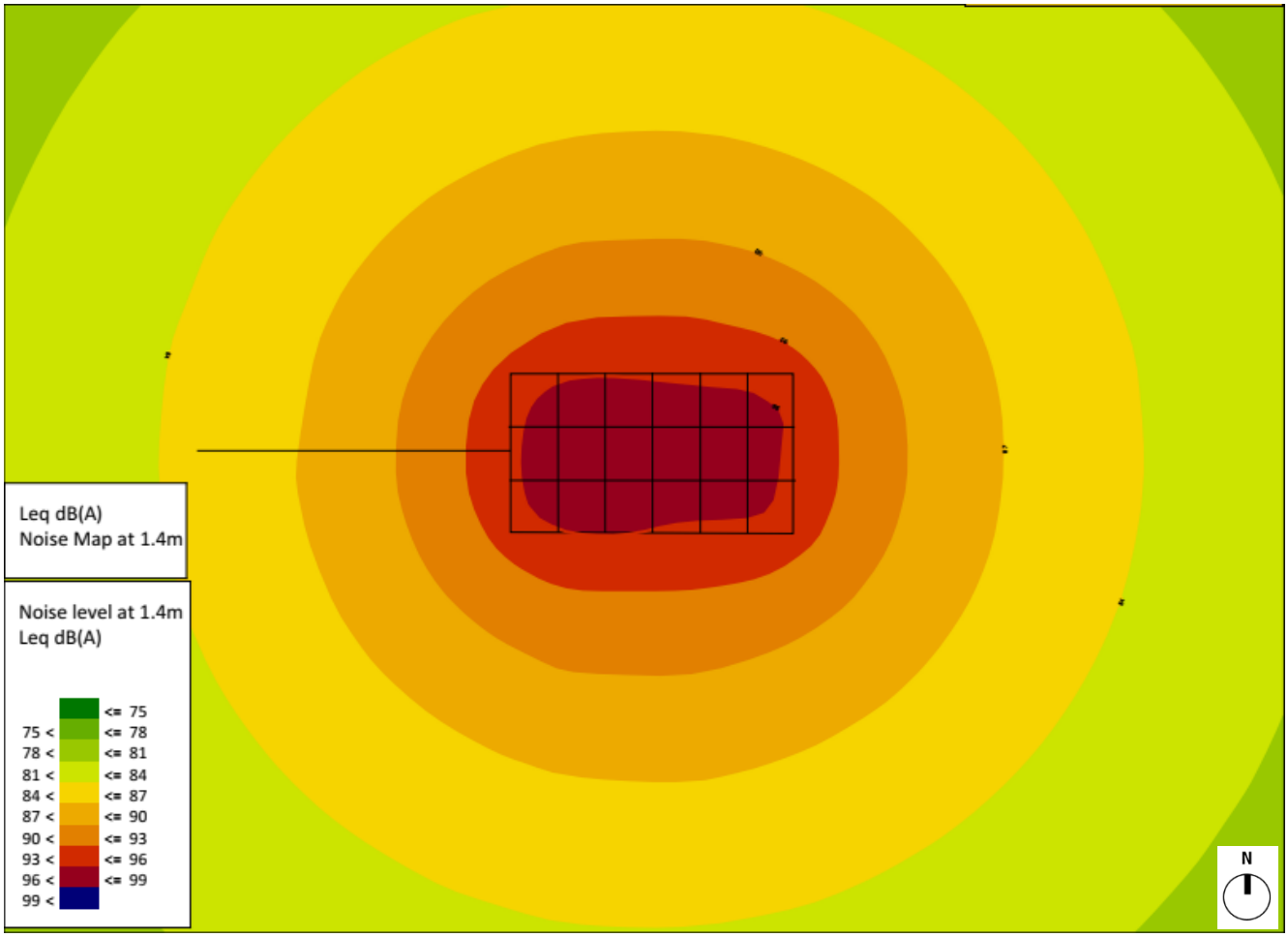

Figure 5 – Sound Spread - Music

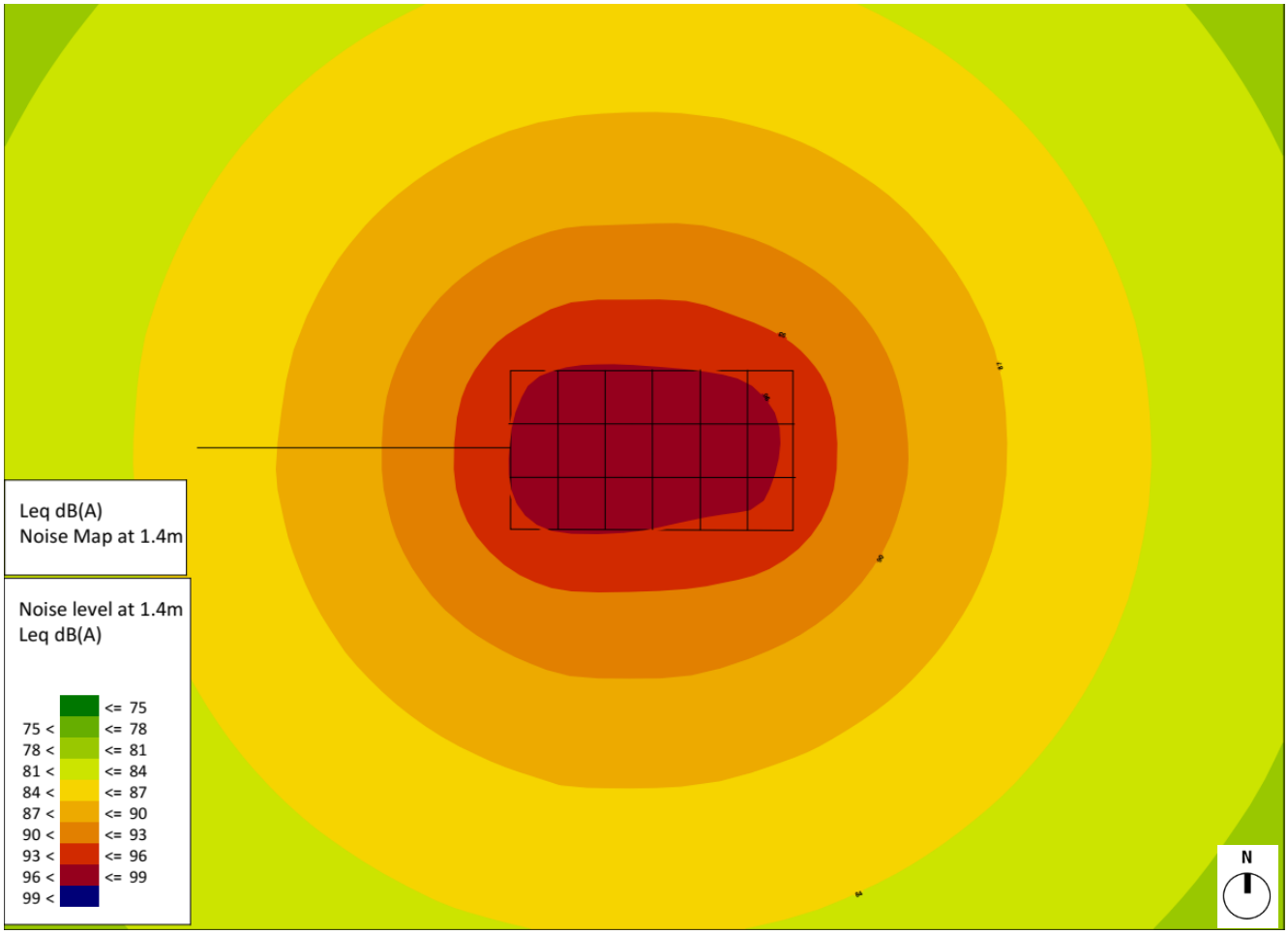

Figure 6 – Sound Spread – Pink Noise

The figures above show that the sound field under the sound ceiling is evenly distributed providing the end user with a more engaging experience while maintaining a better sound quality overall when compared to conventional sound systems. The main advantages of using a sound ceiling system include:

- Even distribution of the sound field
- Greater control of sound quality and amplitude
- Reduction of noise generation outside the direct sound filed
- Customizable sound zones

5 CONCLUSIONS

The acoustic performance of the *JBN Sound Ceiling* speaker system has been determined as part of preparing this paper. The purpose of this paper was to determine the performance of the speaker system. Particular emphasis was placed on the sound reduction at locations outside of the speaker grid.

From the measured levels, it can be concluded that there is a 9 dB reduction 1m east away from the grid when music is play and 6 dB reduction with pink noise. The noise levels further reduce at measurement points at 2m (9dB & 7dB) and at 4m (12dB & 7dB). At 3m away from the grid, there is an expectation that the levels would

reduce. However, the levels are almost similar to the readings at 2m. This is due to the configuration of the Marquee at east side of the speaker grid. There are large windows and sliding glass door at approximately 3m to the measurement location. This can cause reflection at the measurement points.

The noise measurements conducted at the south of grid was more open than the east of the grid. These locations led to the dining area. At these locations, there was an 8dB & 7dB reduction at 1m with music and pink noise respectively. The noise levels further reduce at measurements points at 2m (9dB & 9dB) and 3m (by 15dB & 9dB). At 4m, the noise levels are expected to reduce further, however there is only a 1dB reduction when compared to the measurement at 3m. This can also be attributed to reflections from the hard flooring surfaces and overall noise energy from the Marquee.

The external measurement conducted directly above the roof of the Marquee had a 22dB reduction from music and 28dB reduction from pink noise. The construction above the Sound Ceiling consisted of one layer of 25mm compressed fibreglass, one layer of Earthwool R3 and 100mm thick cool room panels (0.6mm steel sheet with expanded polystyrene core EPS-FR).

In conclusion, there is significant reduction in noise levels from the operation of the JBN Sound Ceiling to the measurement points outside of this grid. This is highly beneficial when requiring a speaker system that performs at high SPL and provides reduction to allow for compliance at nearby sensitive receptors.

ACKNOWLEDGEMENTS

We would like to thank Bryan Said from *JBN Sound Ceiling* for providing the information and technical specifications of the Sound Ceiling.

We would also like to thank *Acacia Ridge Winery* in Yarra Valley in Victoria for providing access to the speaker system and the wedding venue.