

Sydney Opera House

NOISE MANAGEMENT SUB-PLAN
Southern Forecourt and Monumental Steps

EVENT:

Australia Day 2022 – Live at Sydney Opera House

ARTISTS:

A variety of musical and entertainment guests. Including Musical Director John Foreman and the Aussie Pops Orchestra.

As at 21st January 2022





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1 EVENT OVERVIEW AND CONTACTS

1.1 Hirer

- Partnerships and Engagement, Department of Premier and Cabinet (DPC)

1.2 Event Schedule

Date	Activity	Performance	Time
Tues 18 th Jan	Site Mark Up		0800-1730
Wed 19 th Jan	Event Bump-in		0800-0000
Thurs 20 th Jan	Event Bump-in		0800-0000
Fri 21 st Jan	Event Bump-in		0800-0000
Sat 22 nd Jan	Event Bump-in		0800-0000
Sun 23 rd Jan	Event Bump-in, Lighting/Plotting		0800-0000
Mon 24 th Jan	Artists/Band Rehearsals		0800-0000
Tues 25 th Jan	Sound checks/ Full Dress Rehearsal		0800-2130
Wed 26 th	7.30pm Performance	Australia Day – Live At Sydney Opera House 2021	Setup 0800, Gates Open 1800, finish 2130, strike 0000
Thurs 27 th	Event Bump out		0800 - 1500
Fri 28 th	Event Bump out	Final pick ups	0800 - 1700

*Times subject to change. No amplified sound before 10am or after 11pm each day

1.3 Contacts

- External Contacts

Company	Contact	Role	Contact
Five Peas	Craig Borg	Production Manager	0414 741 348
DPC	Catherine Burton	Event Producer	0466 392 171
PA People	Chris Dobbs	Sound Monitoring	02 8755 8700
Auditoria	Luis Miranda	Acoustic Consultant	0406 659 770

- SOH Contacts

Company	Contact	Role	Contact
SOH	Heather Clarke	General Manager, Event Ops	0411 184 340
SOH	Kayne Johnson	Production Manager	0429 161 973
SOH	Rachel Hume	Account Manager (AM)	0421 013 118
SOH	John Lomax	Head Security	0404 830 277



1.4 Persons in Control of Noise

Sydney Opera House Trust retains ultimate control of the noise level, as required under condition 18 of the DA.

For the purposes of conditions 19 and 20, 29 and 30 of the DA, the person who is able to exercise ultimate control of the noise levels from the sound amplification equipment during the Event, who will be contactable throughout the Event is:

Heather Clarke General Manager, Event Operations 0411 184 340

And as a secondary contact;

Kayne Johnson SOH Production Manager 0429 161 973

In addition, the person who will be present at the sound-mixing desk throughout the Event, who will be contactable throughout the Event is:

SOH Sound Supervisor – SOH Radio via Event Control

1.5 Hotline

The following hotline number will be available throughout the Event to receive and pass on complaints to the responsible person:

9250 7113



2 BACKGROUND

2.1 Development approval

The development approval (DA 445-10-2003, as modified) for the use of the Forecourt and Monumental Steps for Temporary Events and Functions at the Sydney Opera House (DA) includes, among other things, a requirement that all events and functions are undertaken in accordance with a tailored Noise Management Sub-Plan (Sub-Plan).

This Sub-Plan for the Event (Event Sub-Plan) is consistent with the overarching Sydney Opera House Noise Management Plan for the Carrying out of Outdoor Events and Functions on the Southern Forecourt and Monumental Steps (Noise Management Plan) and the conditions of the DA. It is prepared as required under condition 66 of the DA.

2.2 Attachments

This Event Sub-Plan includes the following attachments:

- Schedule 1** SOH Forecourt Sound Management Plan_240621 prepared by Auditoria Pty Ltd
- Schedule 2** Ground Plan Australia Day v4 prepared by DPC
- Schedule 3** SOH Eighth Day Audio plan - Australia Day 2021 v2



3 USE OF QUALIFIED EXPERTS

Each element of this Event Sub-Plan has been prepared by a suitably qualified and experienced expert in the each relevant field.

3.1 Auditoria Pty Ltd

Auditoria Pty Ltd combines a vast record in the performance environment with exceptional technical knowledge in audio and acoustics, supported by the qualifications of their staff, led by Scott Willsallen (M.Des.Sc.Hons) and Luis Miranda (Ph.D), who both hold Masters and Honours degrees in Audio and Acoustics with Luis recently graduating with a Ph.D in Acoustics. This allows them to provide practical solutions based on realistic scenarios balancing the needs of noise sensitive receivers while providing the best experience for patrons. Auditoria has been involved in some of the largest events in the world providing audio consultancy services. Auditoria has also been involved in applying their experience in audio systems to sound management solutions. This includes the successful implementation of sound management plans for the Defqon Festival and Secret Garden Festival

3.2 Eight Day Sound (8DS)

Founded in 1980 and driven by customer demand, Eighth Day Sound is a privately owned company operating on three continents and has grown into a global company that routinely provides services to the industry's biggest names. They have successfully managed a wide variety of noise-sensitive outdoors sites, giving them a highly specialised depth of experience and level of knowledge that attracts the attention of top performers and venues.

In the three years 8DS Australia has been operational they have supported almost 300 headline acts and venues across Australia, providing individually-built sound systems for major concert tours, oneoff productions and festivals.



4 EPA REVIEW

4.1 EPA Review

In accordance with condition 66 of the DA, a copy the Noise Management Sub-Plan was provided to the Environment Protection Authority for review on 22 December 2021. . A response was received by Alexandra Pinto, Operations Officer- Regulatory Operations Metro, on 11th January 2022. The EPA had no comments to make on the sub-plan and thanked SOH for the opportunity to provide feedback.



5 EXPERIENCED EXPERT REVIEW

5.1 Review Installation set up

Installation and orientation of the sound amplification equipment will be undertaken using all practical (reasonable and feasible) measures to limit the emission of noise to areas outside of the Event area including:

- (a) use of diffuse speaker array systems to limit main speaker noise output (ie diffuse speaker coverage patters);
- (b) optimisation of the direction and array of speaker to limit noise propagation to sensitive receivers; and
- (c) treatments to the rear of the stage to limit escape of fold back speaker noise.

In accordance with condition 22 of the DA, Auditoria Pty Ltd has been engaged for the purpose of certifying the installation. The certification will take place on site between 10am and 12pm on Monday 25th January 2021.

A copy of the certification will be attached to the Final Compliance Report for the Event, to be provided to the Department of Planning and Environment and the Environment Protection Authority within 28 days after the Event as required under condition 45 of the DA.

5.2 Noise Levels

Condition 42 imposes the following limits, as measured at the Front of House (as adjusted for FOH at 37.5m metres from stage):

- Leq(5minutes) dB(A) 93.2; and
- Leq(5minutes) dB(C) 103.2

*Noise levels confirmed with Auditoria



6 AUDIO OVERVIEW & DESIGN

- In accordance with condition 66(b) of the DA and consistent with the overarching Noise Management Plan, the following arrangements are in place for the Event.
- Condition 2A of the DA specifies a stage configuration for Australia Day. This stage location is no longer able to be utilised due to required compliance with the Infrastructure Zones specified in the SOH Heritage Guidelines for Outdoor Events and Activities - Draft 12. In order to comply with Heritage Guidelines, the large stage configuration will be utilised.

6.1 Noise Management Arrangements

Schedule Reference	Requirements	Event Compliance
Schedule 1 B.5.2	Speaker arrangement	Refer to Schedule 3 ² of this Event Sub-Plan
Schedule 1 B.4.2	Stage configuration	Complies with Typical Large event configuration Refer to Schedule 2 of this Event Sub-Plan ¹
Schedule 1 B.1, B.2, B.4	Front of House location	37.5m metres from FOH to the stage
Schedule 1 B.1, B.2	Noise limits and goals for events	Leq 5min dB(A) = 93.2 Leq 5min dB(C) = 103.2 Adjusted under B.2 No increase will be applied under Condition 43 of the DA.
Schedule 1 B.5	Minimisation measures	Loudspeaker system Design Refer to Schedule 3 of this Event Sub-Plan ¹
Schedule 1 B.3	Early warning and reactive management system	Event will be noise monitored by PA People in accordance with Noise Management Plan
Schedule 1 B.5.5	Bump in and Bump out	To be monitored in accordance with Noise Management Plan

1. Schedule 2 of this Event Sub-Plan contains the stage plan for the Event, including the FOH mixing desk location and all controls to be implemented to ensure compliance with the noise limits under the DA, as required under condition 66 (b) of the DA.
2. Schedule 3 of this Event Sub-Plan contains the detailed equipment list to demonstrates compliance with the overarching Noise Management Plan.
3. The Opera Exemptions in condition 67 do not apply to this event.



7 CERTIFICATION

The appointed experts have confirmed that the Event set up has the ability to comply with all noise limits in the DA. Please refer to Schedule 1 clause B.8 and Schedule 3.



Sydney Opera House

Forecourt Events Sound Management Plan

Client	Sydney Opera House Bennelong Point NSW 2001
Project Manager	Heather Clarke Manager, Event Operations & Planning ☎ +61 2 9250 7426 ✉ HClarke@sydneyoperahouse.com
Document	Forecourt Events Sound Management Plan
Reference	SOH Forecourt Sound Management Plan_240621.docx
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A. Introduction

The Forecourt of the Sydney Opera House hosts several events each year in one of the most recognisable settings in the world. However, this setting possess unique challenges as it is located very near residential areas and, since it is an outdoor venue, provides very little sound attenuation.

This document will form part of the Noise Management Plan required under condition 45A of DA 445-10-2003, as modified. It presents guidelines for the operation and measurement of sound systems during events held at the Forecourt and Monumental Steps of the Sydney Opera House ("Forecourt"). The intention of these guidelines is to allow for the best possible audience experience within the prescribed limits.

This document is guided by an in-depth study of the existing background noise levels in the area, noise logging from previous events and typical sound systems used in the most common stage configurations for this venue. It is based on and consistent with Appendix A of the Sydney Opera House Trust's response to the development application submissions (RTS).

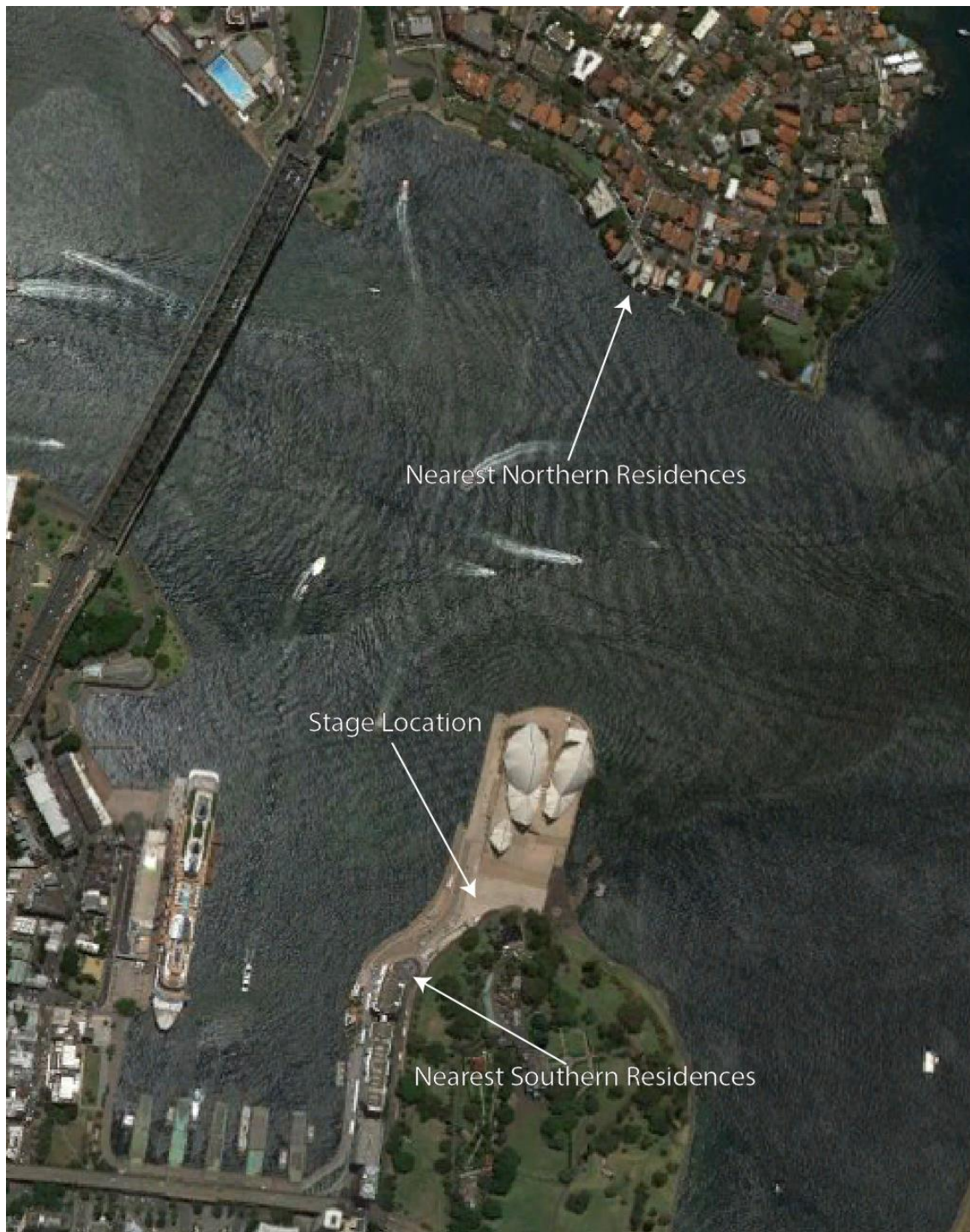
The Sound Management Sub-Plan for each event will be consistent with this document and will inform event's organisers and sound operators (audio and noise logging) to ensure the best possible experience to patrons and residents.

The Plans are intended to be used:

- By organisers in the planning stages as a guideline to understand expected sound levels in the audience area and different loudspeaker system choices.
- By audio companies in the design phase to aid in the design of loudspeaker systems including subwoofer arrays.
- By noise monitoring companies to understand best practices and level limits during an event.
- By everyone involved in the event to prepare post-event reports aimed to improve sound management practices.

A.1 Site Overview

A site overview is presented in the following figure. The figure includes locations of interest including the nearest residences to the north and south, as well as the typical stage location. The southern residences are approximately 120 m from the back of the stage. The northern residences are located approximately 800 m from the front of the stage. The recommendations in this document are based on these two residential areas as they have been identified as the most susceptible to be impacted by the events held at the Forecourt.



B. Sound Management Plan

The purpose of the sound management plan presented in this document is to provide guidelines to limit the impact of the different sound sources from the events held in the forecourt. We believe the recommendations specified in this section provide a good balance between acceptable impact to the nearby residents and the ability to provide a good quality event for the audience.

B.1 Sound Limits at FOH Location (40m from stage)

The permissible limits for events held at the Forecourt have been recently revised. The limits are summarised in the following table. All limits are to be measured at the FOH location for all configurations with the exception of the Western Broadwalk events where the measurements are to be made at the site's boundary. All FOH levels have been prepared with the assumption of a FOH location 40 m from stage.

Event Type	Leq 5min dB(A)	Leq 5min dB(C)
Typical Forecourt Configuration	92	102
Australia Day Configuration*	88	98
Western Broadwalk – North End	90	100
Western Broadwalk – South End	85	95

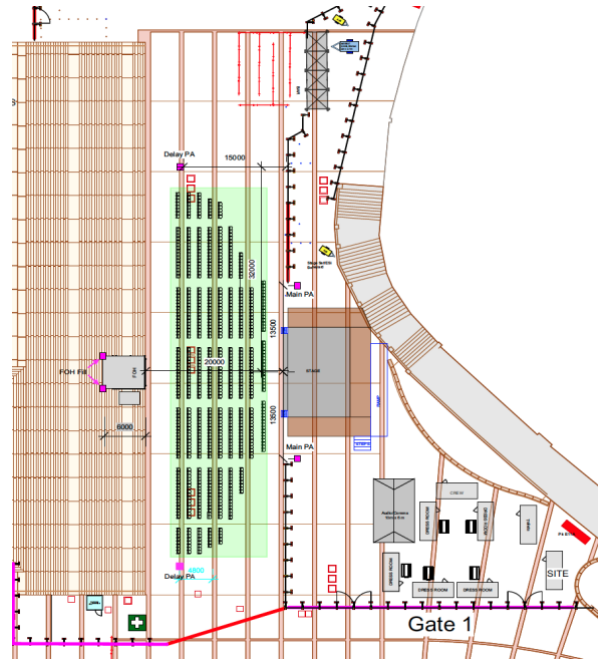
*Please note that every event set up is different and the configurations used to establish sound limits are based on the most common event locations and set ups. However, Australia Day concerts may use the typical Forecourt configuration and other events may use the Australia Day configuration.

Additionally, the levels for the typical forecourt event configuration can be increased by 5 dB if the total duration of the performance is no more than 4 hours, if all amplified music ceases by 10 pm and if the organiser in conjunction with the SOH consider that a reasonable patron experience cannot be achieved using the limits contained in the table above, as outlined in condition 43 of DA 445-10-2003. A decision to invoke condition 43 must be made in the planning stages of an event and incorporated in the Noise Management Sub Plan.

B.1.1 Special Setups and Associated Limits

It could be the case that a different setup to the ones outlined above is desired. This gives the Sydney Opera House and hirers additional flexibility to stage events with smaller crowds or different backdrop options. As no extensive data for different setups exists, the event would require a calibration procedure to provide similar output levels at the residences as the levels that have been used as targets to derive the levels in section B.1. The method used to derive the levels is included in section B.3.6.

An example of this setup is show below.



B.2 Corrections for FOH to Stage Distance – B.1 Table

If the FOH to stage distance is different to 40 m the following table contains adjustments for the values in the table shown in section B.1.

Distance (m)	Adjustment (dB)
20	6
22	5.2
25	4.1
30	2.5
35	1.2
40	0
45	-1
50	-1.9
55	-2.8
57	-3
60	-3.5
65	-4.2
70	-4.9

B.3 Measurement and Adjustment Methodology

B.3.1 Measurement Instruments

All the loggers and handheld measurement instruments shall be Class 1 loggers within recent calibration. The calibration shall be approved by a certified body such as NATA.

B.3.2 Location and Intervals

Sound logging shall be performed at the following locations:

- FOH Mix Location.
- If the event is an event held at the western Broadwalk, logging locations change to positions shown in section B.4.3.

To reduce the effect of crowd noise, the microphone shall be located at a height of a minimum of 2.7 m from the audience area level. The microphone shall be placed at the front of the FOH mixing tent location and the maximum height shall not exceed 2.6 m from the mixing platform.

The following acoustic descriptors shall be captured and made available for further processing:

- $L_{eq-5min}$ A and C-weighted
- L_{fast} A and C-weighted (with at least 8 data entries per second)
- L_{fast} octave bands (with at least 8 data entries per second)

The following acoustic descriptors shall be continually monitored by the sound monitoring team:

- $L_{eq-5min}$ A and C-weighted
- $L_{eq-1min}$ A and C-weighted

B.3.3 Adjustments

The sound monitoring team shall give warning to the FOH mix engineer at:

- 5 dB(C) before reaching the limit
- 2 dB(C) before reaching the limit
- At any breach

The event organisers and the SOH remain in control of the output levels at all times.

An experienced operator is preferred as early warning can be noticed and acted upon from the $L_{eq-1min}$ measurements.

The noise monitoring operator will also provide spectrum information to the FOH operator, relating information of frequency bands that could be providing a disproportionate contribution to the overall readings. For this reason, a calibrated sound instrument providing octave band data is essential.

B.3.4 FOH Monitoring

As part of the monitoring system, the FOH location shall include the following displays:

- A and C-weighted $L_{eq-1min}$ measurements at the FOH location.
- A and C-weighted $L_{eq-5min}$ measurements at the FOH location

This is to be used for guidance and does not exclude the noise monitoring operator from being primarily responsible for monitoring levels during events.

B.3.5 Mobile Sound Level Meter

As part of the monitoring system, a mobile sound level meter shall be included in the noise measurement package. This mobile device shall be used to provide quick measurements at locations near the Forecourt not covered by the equipment specified in section B.3.2. This device shall also be used to investigate complaints as explained in section B.6.1.

B.3.6 Calibration Procedure for Special Events (as Outlined in Section B.1.1)

A calibration procedure for the setup in section B.1.1 is to be followed if a different setup is to be used. The calibration procedure will be according to the following steps:

1. Ensure all parts of the system are in place and commissioned/tuned as they will be for the show. This includes sub system setup, arrays setup, balance between low and high elements, delay towers, etc. In essence, all frequency and delay settings should be in place. Additionally, all monitoring system should be setup on stage as close as the final setup as possible.
2. Ensure the FOH measurement system is setup and calibrated. This will be used to setup levels at the FOH location.
3. Select a test signal. An important point in the selection of the signal is that it correctly represents the frequency spectrum of the content that will be played during the event. Pink noise or a similarly shaped noise signal could be used but it is understood that this type of signal can have high levels of annoyance to the people occupying the Forecourt and vicinity and the residents. A section of music content with adequate frequency content and low dynamics (i.e. steady level) could be used in lieu of noise. We would recommend that a section with continuous levels (e.g. no more than a 4 dB crest factor) is looped for the duration of the tests.
4. Set a handheld logger at the residential area (typically, 1 Macquarie Street). Test the signal and ensure that the measured levels are above the existing background levels. A higher output than usual could be used for a reduced time if the noise is too high while keeping the measurements to less than 2 minutes.
5. Set the levels at the FOH mixing desk so that the readings at the residential area equal 80 dB(C) when measured as an $L_{eq-1min}$ ¹. It has been found that A-weighted levels are usually impossible to measure with the existing background noise. The levels measured at FOH for the 1 minute measurement are to be setup as the $L_{eq-5min}$ target. It should be ensured that the levels are verified with a 1 minute measurement after it has been setup.
6. We recommend that the A-weighted levels are set 10 dB lower than the C-weighted levels to provide adequate musical balance.
7. If the existing background noise is too high, a higher level can be used and then subtracted. For example, set the levels to measure 85 dB(C) and then subtract 5 from the FOH measurement.

¹ The $L_{eq-1min}$ 80 dB(C) level has been derived from the studies conducted when developing this sound management plan. It was found that when aiming to limit levels at this location to an L_{max} of 90 dB(C) (prior DA condition) the typical maximum L_{eq} would correspond to 80 dB(C). Thus, this sound management plan aims to provide a similar output level at the residences.

We recommend that this procedure is carried out with the supervision of an independent party and included as part of the required sound system certification.

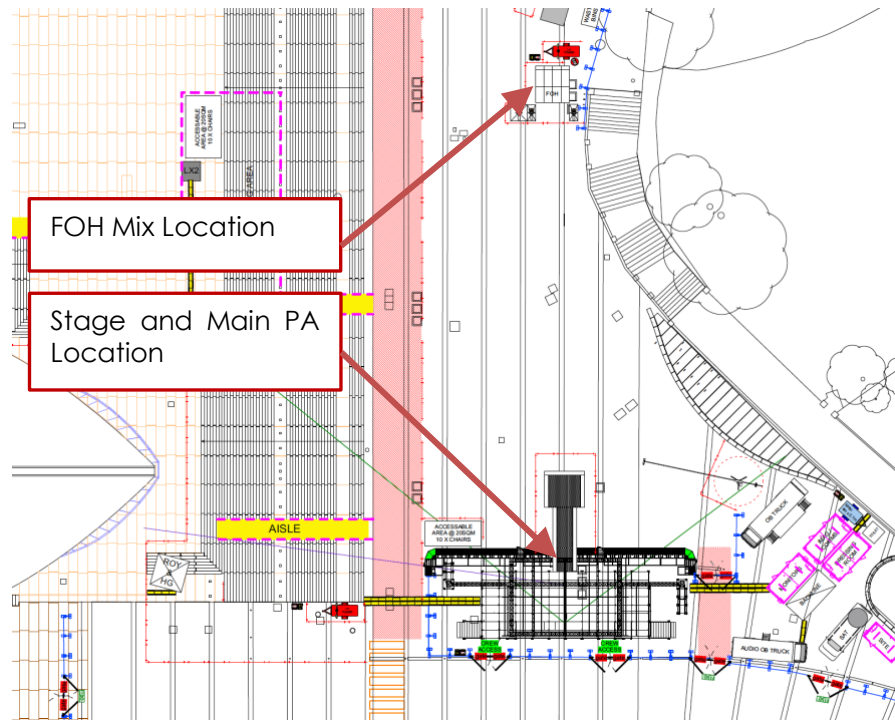
An indicative table based on the event layout and measurements conducted for the Barrabuwari event during April, 2021 using the configuration shown in section B.1.1 is included below. The FOH tent in that case was 20 m from the edge of the stage. The limits set for that event were 95 dB (A) and 105 dB(C). We recommend using this table as a guideline and still using the recommended calibration procedure.

Distance (m)	Adjustment (dB)
10	6
15	2.5
20	0
25	-1.9
30	-3.5
35	-4.9
40	-6
45	-7
50	-8

B.4.1 Typical Large Events Configuration

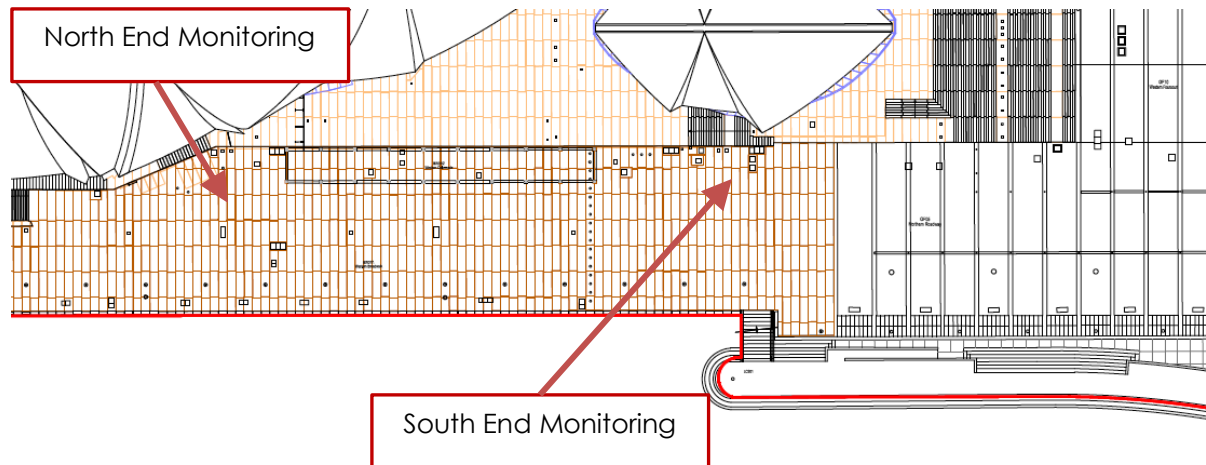
[illegible]

Events that are televised and/or benefit from the inclusion of the Harbour Bridge as a backdrop, generally use the configuration shown below. This was named the 'Australia Day configuration' as it was historically used for the major Australia Day concert. However, Australia Day events may also use the typical Forecourt configuration and other events may use the Australia Day configuration.



B.4.3 Western Broadwalk Configuration

The western Broadwalk does not have a typical layout in terms of FOH and audience area. The logging locations are shown in the figure below.



B.5 Mitigation Strategies

The strategies presented in this section are intended for events under the typical large events configuration with the configuration shown in section B.4.1. This is due to the higher output systems used in this configuration, the larger permissible output and the stage configuration. The combination of these present higher risk of higher sound levels at the Macquarie Street residences.

Depending on the specifics and nature of each performance a range of mitigation strategies are presented below as options.

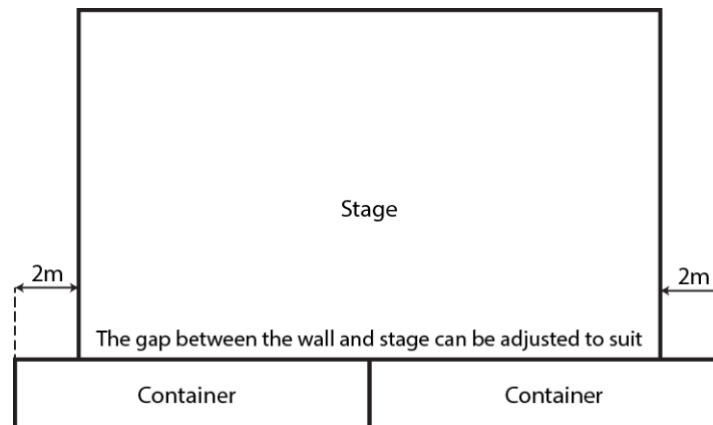
B.5.1 Container Wall Sound Barrier

The stage sound sources are a noticeable contributor of levels at the nearby residents. A container wall can be placed behind the stage as a mitigation strategy when instruments and monitors are placed on stage.

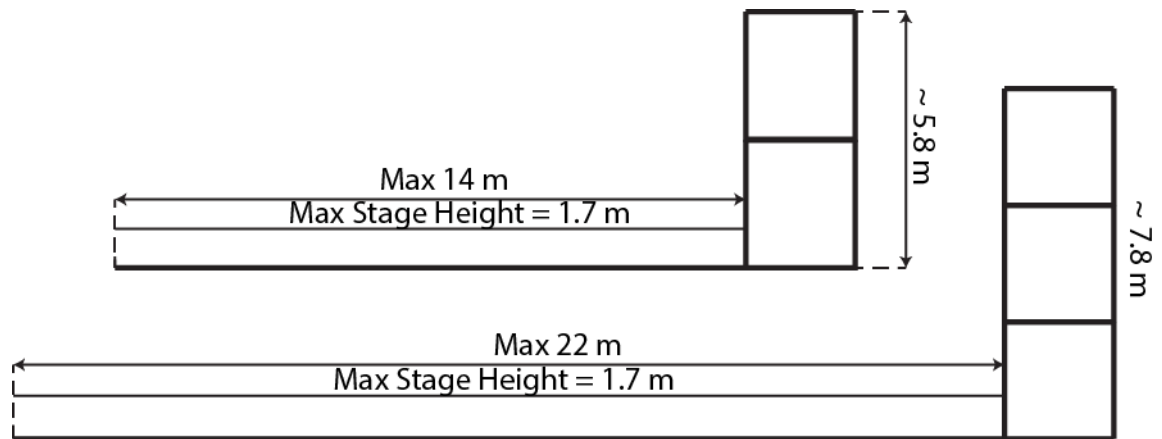
A container wall shall be installed when feasible and reasonable to block line of sight between the front edge of the stage and nearby residences.

The container wall would ideally observe the following guidelines:

- The container wall would preferably overhang the stage by 2 m on each side as shown in the indicative plan view figure below. As an example, if the typical stage is 20 m wide, two 40' (12.192 m) containers can be arranged on their sides to provide the adequate attenuation.



- The container wall would preferably be as tall as to impede direct line from the lip of the stage to the residences. This is a direct result of the placement of the wall in relationship to the stage. For a maximum total depth of 14 m including the stage and the gap between stage and container wall, we recommend a minimum height of 5.78 m (equal to two high cube containers). For stages longer than 14 m we recommend a minimum height of 7.8 m (equal to three standard containers) to a maximum stage depth of 22 m.



- All the containers shall be appropriately stacked using their coupling holes to minimise gaps between containers. The inclusion of small gaps between containers has been included in modelling transmission loss through the container wall. However, these should be kept to a minimum with appropriate stacking practices.
- To minimise break in noise and break out from containers, any container used would have only one door if feasible.
- If practical, we recommend that any structure used as a roof on stage (e.g. tarp) to be fixed to the container wall, sealing the stage at the top of the containers. This would allow for additional attenuation over the container barrier.

B.5.2 Loudspeaker System Design Alternatives

B.5.2.1 Main System

The main system is one of the main contributors of sound at the residences. We have conducted an analysis to aid organisers in understanding the maximum achievable levels with different commercially available rental loudspeaker systems. It should be noted that this advice is only relevant when the stage is at the typical location.

All systems have a different frequency dependent polar pattern that dictates the difference between sound directed to the front, and sound radiating from the back of the loudspeaker. We have performed an acoustic analysis of different commercially available loudspeaker systems taking into account their polar characteristics. The following table provides an indicative level difference between systems taking into account their proprietary sub bass systems and equal output from sources on stage. The table expresses the level difference as the projected maximum levels at FOH when producing the same level at the residents' locations.

It should be noted that this table is indicative and the overall output can change depending on sources on stage and additional noise sources on the day. **This table is only intended as a comparison between systems and not as an overall predictor of maximum permissible levels at FOH. The maximum level is based on the recommendations included in this document.**

Make	Configuration	Equivalent Level at Measurement Pos.	Predicted level at FOH
L`Acoustics	10 x K1	L _{Ceq-5min} 86 dB	L _{Ceq-5min} 104 dB
L`Acoustics	12 x K2	L _{Ceq-5min} 86 dB	L _{Ceq-5min} 103 dB
L`Acoustics	10 x VDOSC	L _{Ceq-5min} 86 dB	L _{Ceq-5min} 102 dB
L`Acoustics	15 x KUDO	L _{Ceq-5min} 86 dB	L _{Ceq-5min} 101 dB
d&b	12 x J-Series	L _{Ceq-5min} 86 dB	L _{Ceq-5min} 101 dB
Meyer	16 x MILO	L _{Ceq-5min} 86 dB	L _{Ceq-5min} 99 dB

It is important to note, that only the level limit at the typical measurement location is to be used to regulate sound levels, the level available at FOH is provided here simply as a guide.

B.5.2.2 Subwoofers

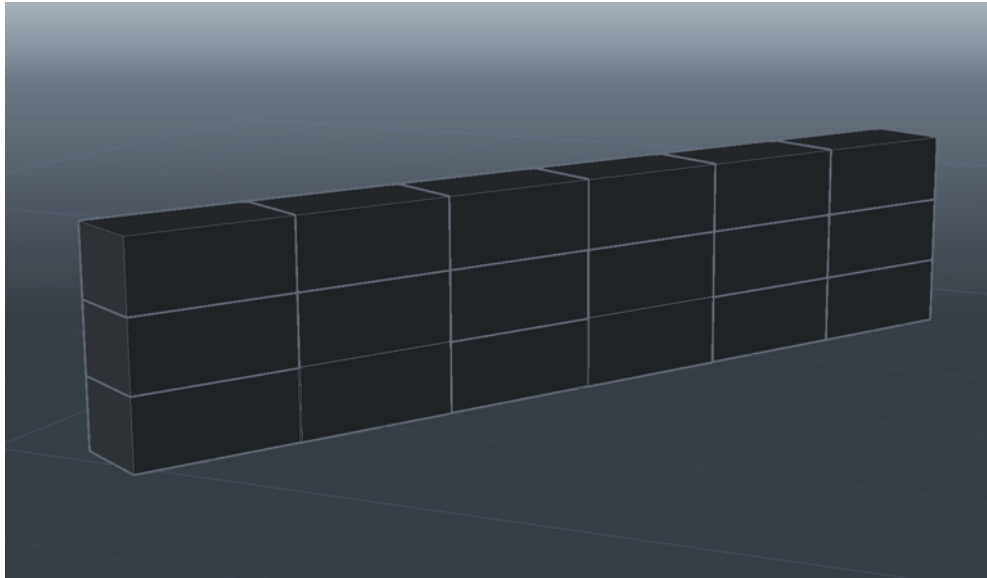
The ground stacked subwoofer system methodology is recommended to provide consistent coverage of the audience area and reduce the risk of exceeding the level limits due to beaming or poor pattern control. The subwoofer system deployed for a Forecourt concert is to be deployed in a cardioid configuration to cancel the energy behind the array in the direction of 1 Macquarie Street.

We further suggest that the subwoofer system be built as a horizontal line array to provide horizontal pattern control and deliver a more consistent coverage throughout the audience area.

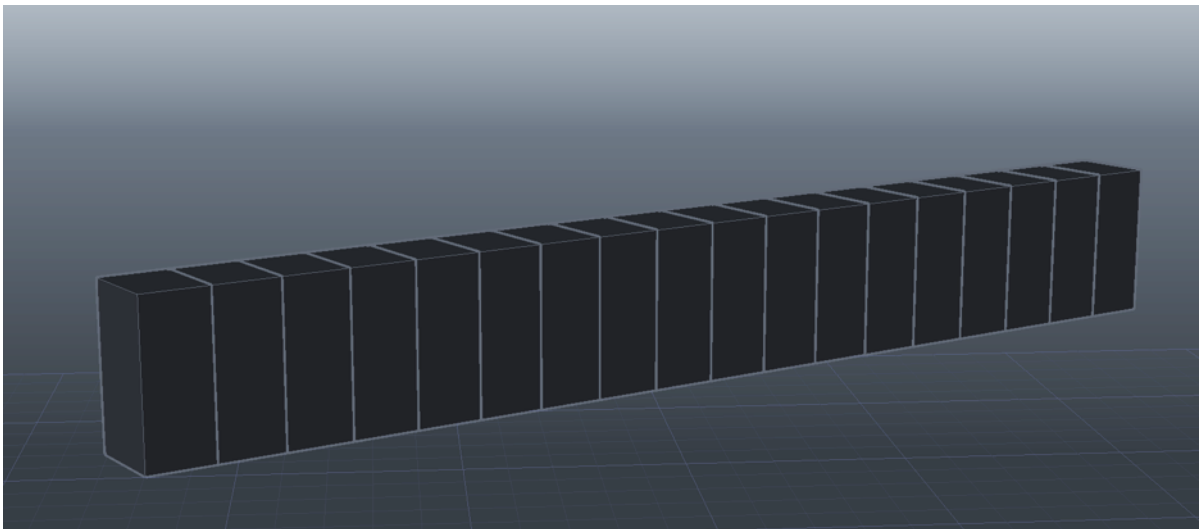
Indicative system configurations are provided to communicate design intent only and are not given as mandatory for a Forecourt event. The stage layout, stage height, audience area, music style and many other factors are significant in the design of a subwoofer array for a Forecourt event.

All indicative designs are presented using generic boxes indicating subwoofers.

The first indicative design is a single block of 18 subwoofers as shown in the image below. As an example, the bottom row of subs would be reversed to enable cardioid operation if using L`Acoustics products or configured as cardioid if using d&b products.

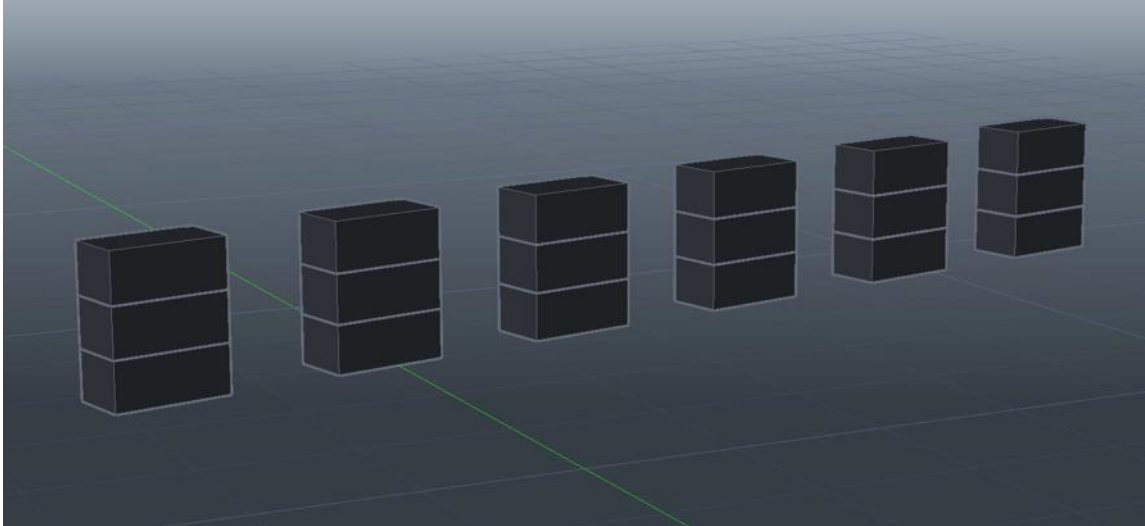


The second indicative design, pictured below, uses the same quantity of subwoofers, arranged in a single block on-end as would be required for a lower stage height. In this arrangement sub numbers 3, 4, 9, 10, 15 and 16 are reversed for cardioid operation if using an L'Acoustics product or configured as cardioid if using d&b products.



These first two options are very fast to deploy and have little room for error, however require usage of a large area directly in front of the stage which may not suit if a catwalk is part of the stage design.

The final indicative design breaks the subs up into smaller columns at regular spacing to provide a gap between columns as shown in the image below. This array also uses 18 subwoofers in six stacks of three with the bottom unit reversed for cardioid operation if using an L'Acoustics product or configured as cardioid if using d&b products.



This is an option that can work but requires additional modelling by the supplier to customise the overall width. The size of the gaps between stacks should be designed to meet the requirements of the stage build. Once the array size is known, modelling must be used to determine the time-domain processing of the array to deliver even sound pressure level throughout the audience area.

Both L`Acoustics and d&b have well established and highly effective cardioid programs in their proprietary amplifier platforms that make deploying a well-designed subwoofer array far simpler than in the past.

B.5.2.3 Delay Systems

Delay systems following typical configurations for audience coverage at the forecourt do not pose a noise risk. This assessment is based on the configuration of this type of loudspeaker array as used in previous events under the configurations previously described. However, it should be noted that these loudspeakers should not be directed towards the residences at Macquarie Street or Kirribilli under any circumstances.

Given the requirements for the delay towers to be positioned close to the audience, they may be positioned in or near primary view lines to the Sydney Opera House. The Opera House's heritage architect has advised that these structures should not be covered in screening material to enable views through the structure to the podium and sails. This is to minimize the visual impact of arrays, in line with condition 54 of the DA 445-10-2003.

B.5.3 Other Mitigation Strategies

Additional mitigation strategies include:

- Using in ear monitoring when possible if it fits the performance on stage. This could replace the inclusion of container walls as a sound mitigation solution.
- Add baffling to sources on stage such as drums and monitors if adequate for the type of performance.

B.5.4 Other Sources

A Forecourt event requires various overlay services, some of which increase the noise floor on an event day. These sources include generators, truck movements, increased foot traffic and increased local vehicle traffic.

As a general advice, to limit the impact of this type of sources, it is recommended that generators are baffled and where possible fitted with silencers.

It is understood that the SOH has a crowd management plan in place during these events. Crowd management is an effective way of dealing with crowd noise as patrons leave the building.

B.5.5 Bump In/Out Management

Noise from bump in/out activities should be minimised. When measured at the nearest residential receiver, between the hours of 8 am and 12 am, noise from bump in/out activities and noise from temporary plant and equipment should meet the requirements presented in the following table.

Location	Leq 15min dB(A)
Nearest residential receivers (external)	60

B.6 Community Engagement

SOH notifies nearby residents in advance of Forecourt events. Also, as part of the community engagement the SOH provides a hotline on the days of the events. An integral part of the post event reporting includes collecting data from any complaints received through the hotline that relate to noise. These complaints are to be analysed, cross related to measurements and included in the report.

B.6.1 Complaint Response

As part of managing the event impact on the surrounding community, a mobile sound level meter will form part of the noise monitoring system. The response to any noise related complaint on the day will include an in-situ measurement using the mobile sound level meter. The complaint shall be logged along with any data obtained and, if necessary, sound level adjustments shall be communicated to the event's organisers.

B.7 Post Event Reporting

In accordance with condition 45, following the completion of each event (events may include multiple performances), the Sydney Opera House will provide a report to EPA and DPE within 28 days. The report will include the below information.

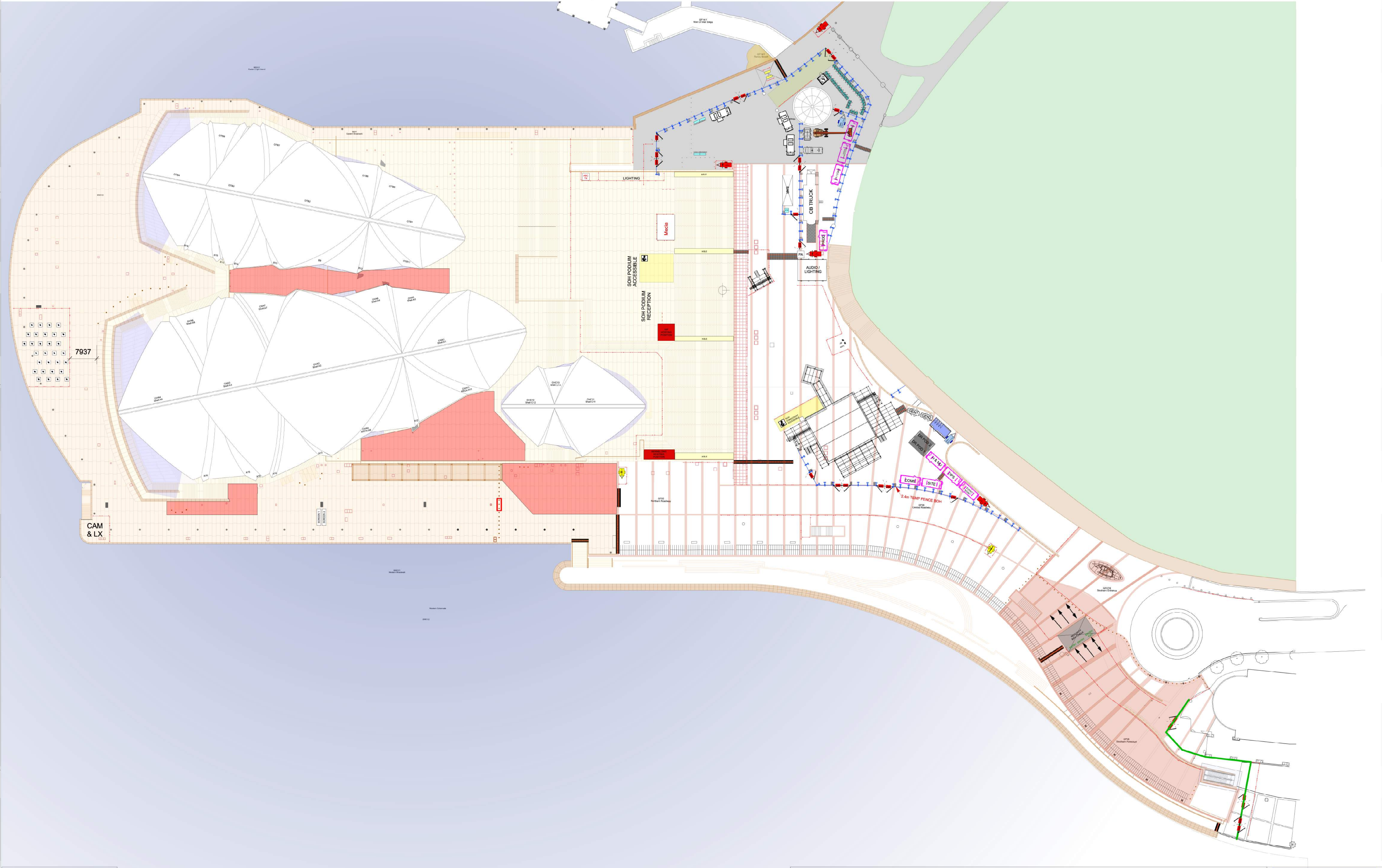
- An Executive summary including:
 - Whether or not there has been compliance or non-compliance with the permitted hours in the DA for the relevant event, including the reasons for any non-conformance(s);
 - The times and details of any exceedance(s) of the noise level limits in this DA for the relevant event, why the exceedance(s) occurred and what measures were implemented to ensure that the exceedance(s) did not occur; and
 - The number, location and times of any complaints recorded by the Sydney Opera House in accordance with Conditions 35 to 38 of this DA.
- Supporting information including:
 - Date & time of monitoring
 - Activities occurring on land administered on land during monitoring
 - Sound pressure levels recorded including exceedances of noise limits
 - Any other information relevant to the consideration of the noise impact on residents or other sensitive receivers

B.8 Certification

I certify that the specifications in this sound management plan, correctly implemented as documented, will enable an event setup to comply with all noise limits set out in DA 445-10-2003 as modified.



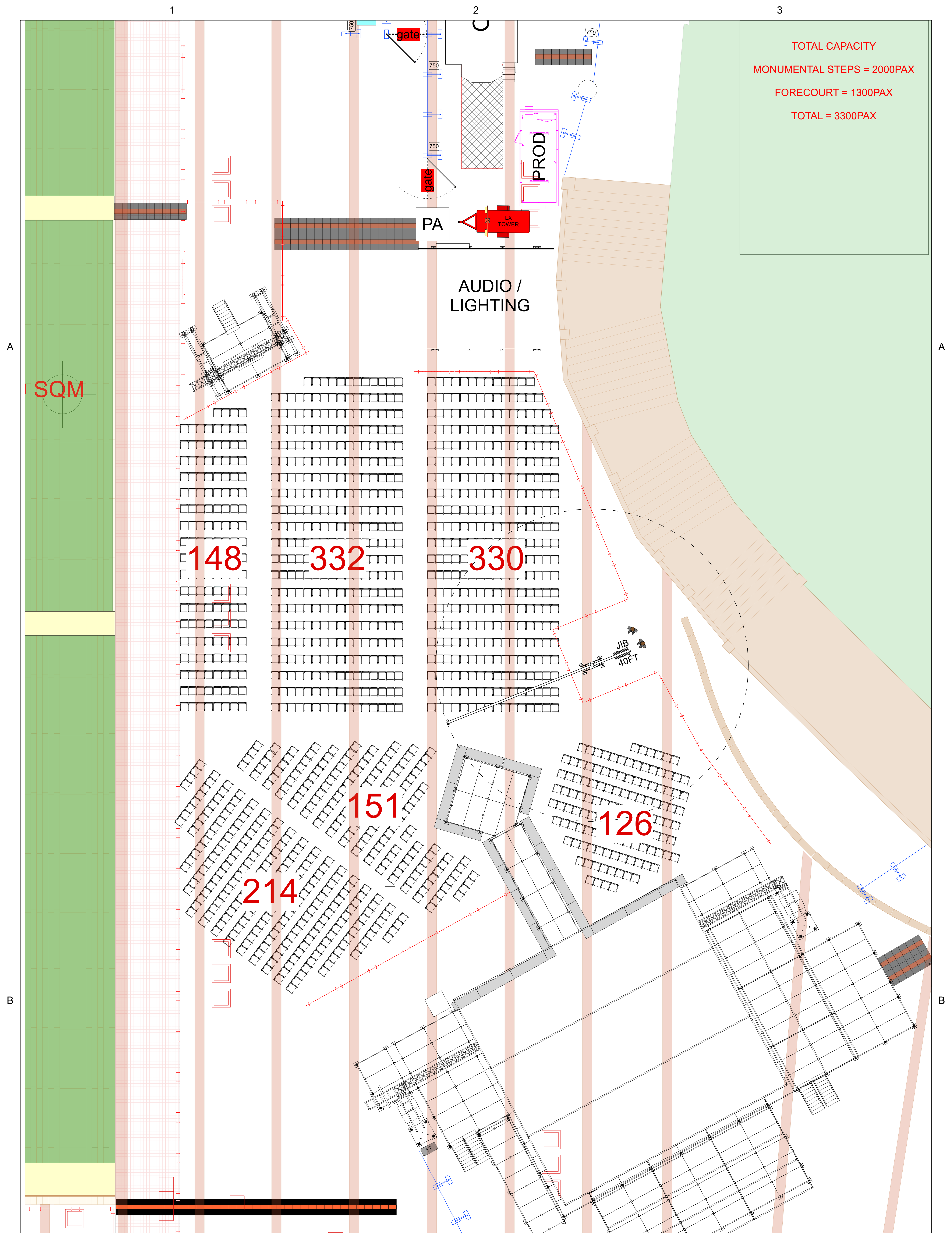
Scott Willsallen M.Des.Sc.Hons
Principal Consultant
Auditoria Pty Ltd



EVENT	AUSTRALIA DAY LIVE 2022	
LOCATION	SYDNEY OPERA HOUSE FORECOURT	
DWG	AD22_SOH_ENTIRE SITE	

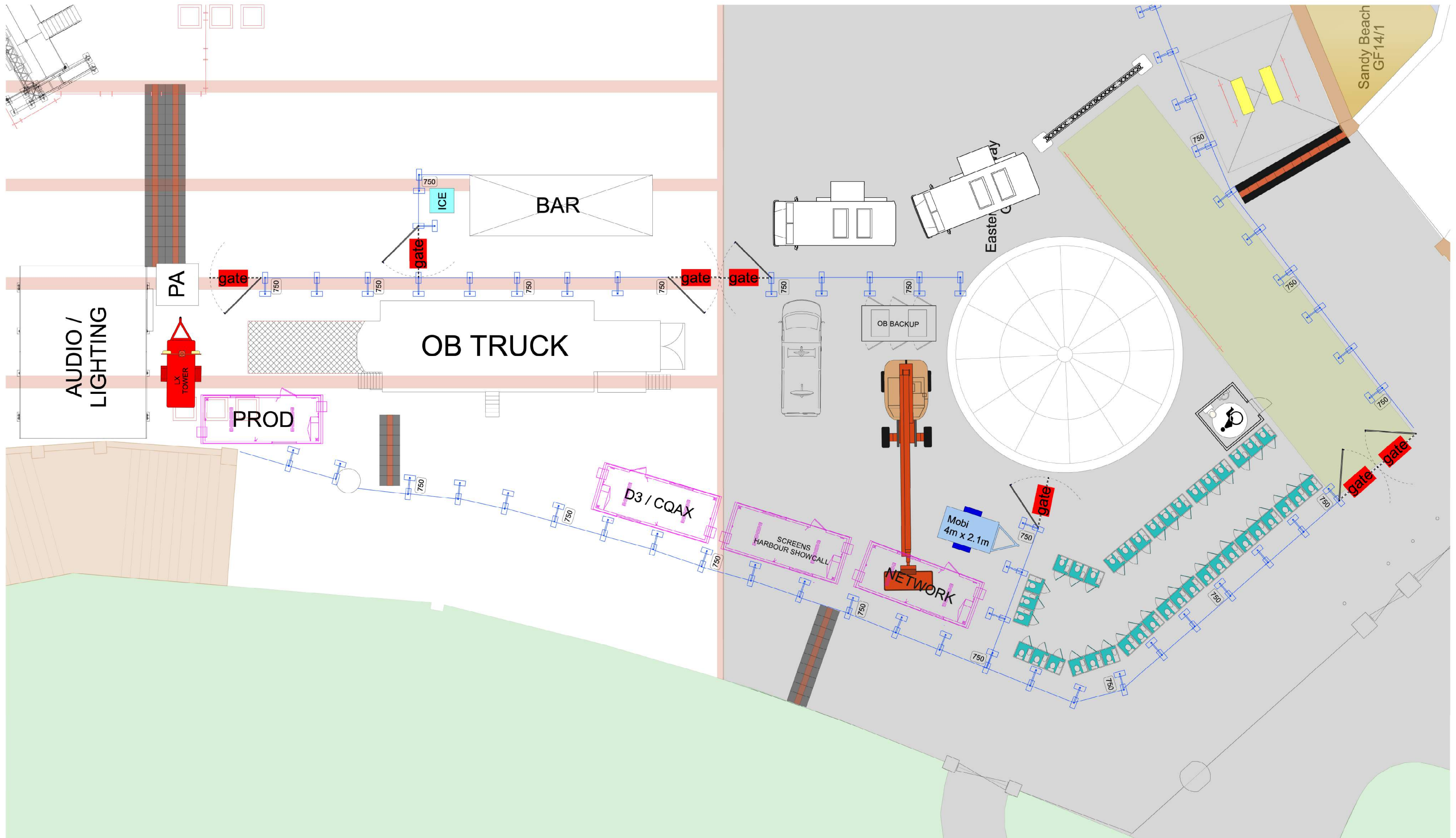
DATE 13/12/2021
SCALE @ A1 1:500
DRAWN BY C.BORG
VERSION 4





EVENT			AUSTRALIA DAY LIVE 2022
LOCATION			SYDNEY OPERA HOUSE FORECOURT
DWG			AD22_SOH_FORECOURT_SEATING
DATE 13/12/2021		SCALE @ A1 1:220	
DRAWN BY C.BORG		VERSION 4	





EVENT		AUSTRALIA DAY LIVE 2022	
LOCATION	SYDNEY OPERA HOUSE FORECOURT	DATE 13/12/2021	
		SCALE @ A1 1:150	
DWG	AD22_SOH_OB COMPOUND	DRAWN BY C.BORG	
		VERSION 4	





Eighth Day Sound Australia Pty Ltd

A3 350 Parramatta Road
Homebush West NSW 4120
www.8thdaysound.com

Heather Clarke
Manager, Event Operations & Planning
Australia Day 2022

15th December 2021

Dear Heather,

Supply of Sound Services for Australia Day Sydney Opera House Steps 2021

Eighth Day Sound Australia (8DS) thanks you for the opportunity to supply audio services at the scheduled January 26th Australia Day Concert to be held on the Opera House Forecourt Steps. Please find attached supporting documentation for our services. As Outlined in the SOH Noise Management Plan, 8DS understands sound management of db levels on and off-site are of paramount importance and we have paid particularly close to attention to these in our design and delivery plan.

Our comprehensive, well-considered proposal provides for the use of the d&b KSL to coincide with the Opera House's preference of d&b in-house, using the new software programs *Array Processing*, *ArrayCalc* and *NoizCalc*. We are confident that through the combination of our inventory and in-depth staff experience, the 8DS system configuration will give you the best possible sound results on the Forecourt, and at the nearest residences.

I have every confidence that 8DS will deliver sound results far superior to any previously experienced on the Forecourt, delighting audiences and Sydney Opera House management alike.

Please feel free to contact me at any time to discuss our submission in further detail. I am more than happy to do so on the phone or in person, on-site.

Kind regards

A handwritten signature in blue ink, appearing to read "Damo Pryor", with a stylized flourish at the end.

Damo Pryor Global Sales
On behalf of Eighth Day Sound Australia

EIGHTH DAY SOUND



AUDIO SYSTEM FOR
JANUARY 26th 2022
SOH FORECOURT
AUSTRALIA DAY

EIGHTH DAY SOUND – AUSTRALIA DAY SOH FORECOURT 2022

Eighth Day Sound Pty Ltd

ABN 59 600 368 849

A3 350 Parramatta Road

Homebush West 4120

Contact: Damo Pryor

E: damo@8thdaysound.com.au

P: 02 8607 8700

M: 0475 885 952

Executive summary

Eighth Day Sound (8DS) is delighted to provide audio services for the national Australia Day events at the Sydney Opera House and Circular Quay Spectacular. 8DS is confident we have the skillset, complete inventory, fully experienced senior staff and superior db level recording equipment to fulfil the requirements and expectations of the NSW DP&C.

After a thorough review of the SOH Noise Management Plan and consequent Noise Management Sub-plan it is clear that, the guarantee of optimum sound levels for patrons in all sections of the designated listening area and consideration for nearby sensitive receivers is of paramount importance.

We fully understand your needs in this regard. We have paid particularly close attention to our d&b PA system design and configuration to provide a superior listening experience for all event attendees, whilst keeping overall dba and dbc weighted frequencies to a minimum at the specific noise-sensitive areas.

8DS has had the privilege to provide audio on the Forecourt Steps on many occasions now. Most notably We gained invaluable experience during the 3 x weeks of shows and have documented many answers to the challenges faced in this sound environment. Our staff have significant experience working in the space now and we will use these same technicians for Australia Day.

Last month, 8DS Australia will celebrate its seventh year of operation in this country. During that time we have successfully managed many noise-sensitive outdoor sites around Australia, including artists and events such as:

- Taylor Swift – ANZ and AAMI stadiums
- Bryan Adams – Bimbadgen and Sirromet wineries
- Flight Facilities & the SSO – The Domain
- Field Day Festival – The Domain
- Harbourlife – Fleet Steps
- Australia Day Celebrations 2018, 2019, 2020 & 2021.

Using the guideline detailed in the SOH Noise Management Plan, our proposal to provide the best possible audience experience within the prescribed limits is attached.

1. The importance of Quality Audio

We view our involvement in such a prestigious event such as Australia Day not only an excellent opportunity to strengthen our working relationship with NSW DP&C, but as 8DS' own contribution to making the reputation of such a monumental annual event flourish for the many thousands of concert goers who enjoy the wonderful program of entertainment available.

Of particular importance for the success of this undertaking is acknowledging and understanding the proximity of the SOH to noise-sensitive commercial and residential buildings. Our proposed system design has taken this into careful consideration and allows us to provide optimum audio levels across the entire listening area, whilst keeping sound spill to an absolute minimum.

For example, a key element of our design is the cardioid sub pattern we use for the low end frequencies. This has the effect of pushing the majority of these frequencies forward only, rather than allowing any spill behind the sub placement. This strategic planning makes a significant, measurable difference to the listening experience. There is no doubt that our sub configuration will provide the best outcome possible for everyone.

As outlined in the comprehensive supporting documentation, 8DS has used both *Array Processing* and *NoizCalc* to calculate frequency levels offsite. We have had considerable success with these programs already when using them in venues which present similar challenges to the SOH and have no hesitation in recommending their use for Australia Day.

Convenience and flexibility for the NSW DP&C.

8DS understands that there are often last-minute changes relating to the venue or to the requirements of the performing artists and we happily take these in our stride.

We look upon these adjustments as part and parcel of the overall contract and willingly do whatever is necessary to ensure the best possible outcomes for performer, venue and audience. We do not look for financial gain or seek to recover any extra costs for accommodating such changes.

2. Site Overview

8DS prediction and system design has been carefully calculated to take into consideration the noise-sensitive areas nearest north and south residences. This has been accounted for in both the dba and dbc weightings.

Having successfully implemented the d&b software, *NoizCalc*, into an extensive range of noise-sensitive outdoor areas around Sydney and Australia, we can confirm the program is accurate and, when used correctly, can be of great value when predicting frequency levels offsite. Supporting documents will show the estimated db levels at the southern residence approximately 120m directly behind the stage, and the northern residence approximately 800m from the downstage edge.

3. Sound Management Plan

8DS has used the provided SOH Forecourt Events Sound Management Plan guideline as the basis for our proposal and believe we can deliver optimum results within these limitations.

3.1 Sound Limits at FOH Location

Using the revised permissible limits, 8DS has used the site plan, 'AD22 – ADL – Attachment 1 – SOH Concert detail' with a FOH distance of 35.5m from the stage. Our predictions and design are based on this distance.

Our proposal will show db level readings at the south and north residences at both the 93.2dba limit and 103.2dbc over a 5 min LEQ at FOH.

3.2 Corrections for FOH to Stage Distance

The 93.2dba and 103.2dbc over a 5 min LEQ calculation is derived from the chart, and using the 'AD22 – ADL – Attachment 1 – SOH Concert detail' site plan. We have used this distance in our calculations.

3.3 Measurement and Adjustment Methodology

3.3.1 Measurement Instruments



MeTrao

8DS will provide its own sound measurement instrument at FOH, *MeTrao* and will work alongside the SOH contracted Noise Monitoring company. This unit and its software can offer recordings as required in the guideline, providing A and C weight recordings, octave recordings, LEQ period recordings and overall levels throughout the event period.

We have had great success with *MeTrao*, using it as a reference to stay within limits and as a visual marker for operators to know when they are at a peak level.

3.3.2 Location and Intervals

8DS' will work with SOH third party contractor who will be responsible for sound logging and monitoring at FOH and at noise-sensitive positions. As you would expect, we will work together to achieve optimum results. 8DS will provide a dedicated technician to liaise with the noise monitoring operator for each event.

3.3.3 Adjustments

All adjustments required during a performance can be relayed to our dedicated technician working with the noise monitoring operator. These will either be implemented upon request to the FOH operator at the time, or directly through our drive processing system. The event organizer and SOH will have direct access to the FOH output levels at all times.

3.3.4 FOH Monitoring

Guideline is for noise monitoring operator.

3.3.5 Mobile Sound Level Meter

Guideline is for noise monitoring operator.

3.4 Event Configurations – Stage and Front Of House Location

3.4.1 Typical Large Event Configuration

Yes Australia Day 2022 is using a Typical Large Event configuration for this years event.

8DS has made calculations using the 'AD22 – ADL – Attachment 1 – SOH Concert detail' site plan which has the stage and PA system orientation the same position as a typical large event configuration, and therefore we are using the recommended chart calculations given in the SOH Forecourt Sound Management Plan _041017 for a typical forecourt configuration.

3.4.3 Western Boardwalk Configuration

Not Applicable

3.5 Mitigation Strategies

3.5.1 Container Wall Sound Barrier

Whilst NSW DP&C is not deploying container wall barriers, as the audio provider we will do everything we can to mitigate sound spill from the listening and performance areas. Some of these factors include, Deploying d&b Array Processing Software. This enables us to focus the coverage only where it is required, and there is a steep drop in level once outside of the coverage area.

The d&b Noizcalc program enables us to predict spill in surrounding areas based on wind direction and humidity.

Our Cardioid sub configuration pushes low end frequencies forward rather than unwanted sound spill behind the sub stacks.

We will use In Ear Monitoring wherever possible on stage for performers and musicians which provide a huge advantage in avoiding fold back speakers facing the nearest residence.

3.5.2 Loudspeaker System Design Alternatives

3.5.2.1 Main System

8DS' main system comprises 12 x KSL per hang, using *Array Processing* software. A complete breakdown of the equipment being supplied can be found in the supporting technical documents.

3.5.2.2 Subwoofers

Our recommended sub configuration uses a cardioid pattern with the latest d&b SL subs. They are a purpose-built cardioid speakers and we would configure 4 x stacks of 2 x high off centre to avoid impeding on sightlines and the downstage edge. We have contacted d&b Germany to ask for their recommendations for the best possible sub configuration given the boundaries, guidelines and noise-sensitive positions and believe we now have the best option.

3.5.2.3 Delay Systems

Our system design uses 4-6 x V series in each delay hang or stacked position, deploying *Array Processing* for more control.

3.5.3 Other Mitigation Strategies

Where 8DS has a choice on the type of foldback we are able to offer the performing artist, we will use in-ear monitors, and avoid wedges, sidefills & drumfills.

3.5.4 Not applicable

3.5.5 Bump in / out Management

8DS will comply with all noise level limits in place for the set up and pack down procedures.

3.6 Community Engagement

8DS will gladly take part in all post-event meetings to review any feedback in order to look at ways to improve sound levels, and to discuss any complaints made to the hotline by nearby residents.

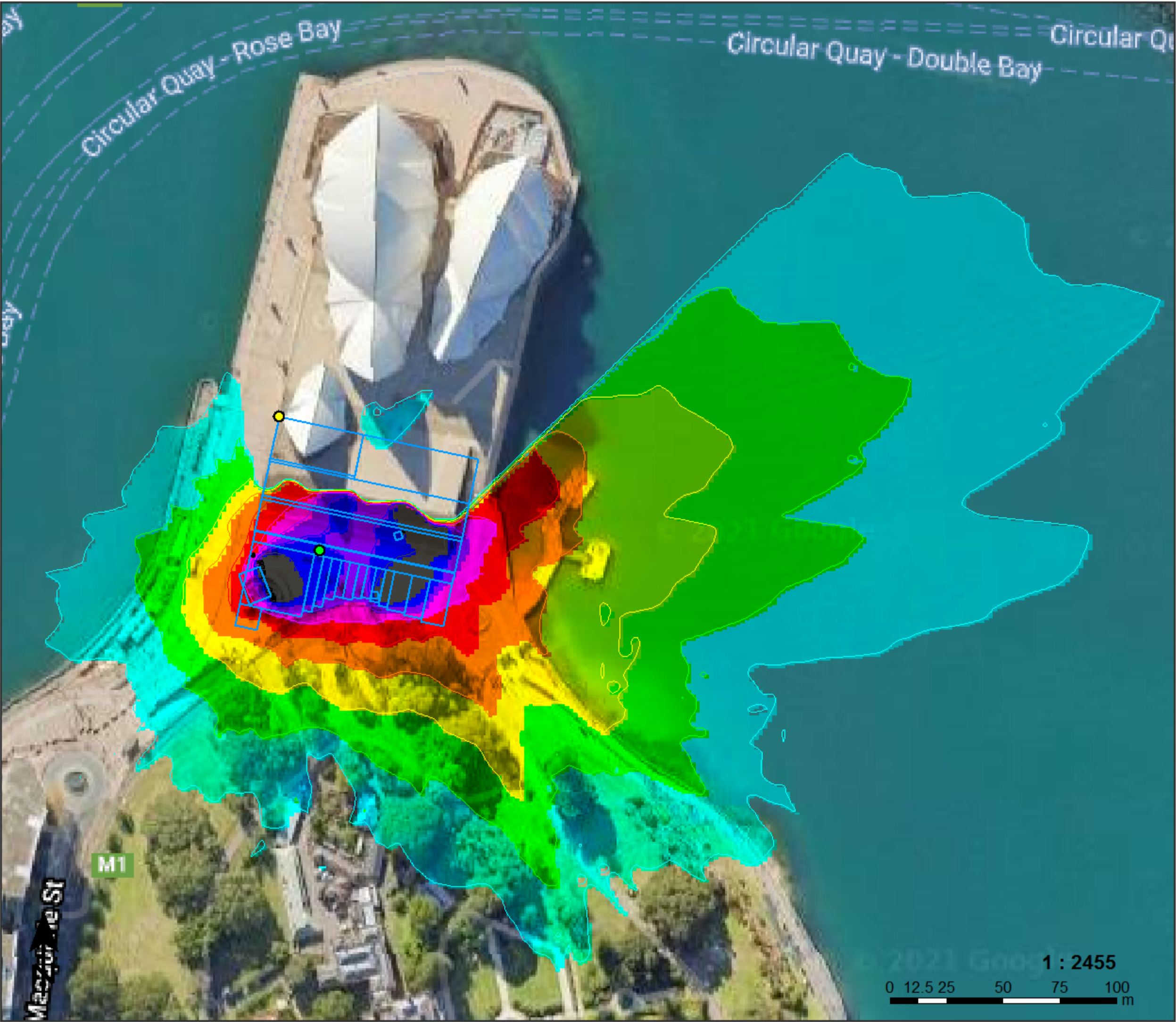
3.6.1 Complaint Response

Our dedicated technician will interact immediately with the noise monitoring operator, ensuring a quick and effective response to any noise complaints should we exceed any db limits at the time.

3.7 Post Event Reporting

It is also the responsibility of our dedicated technician to compile our own report to the SOH for review and analysis. Items included in such a report will include:

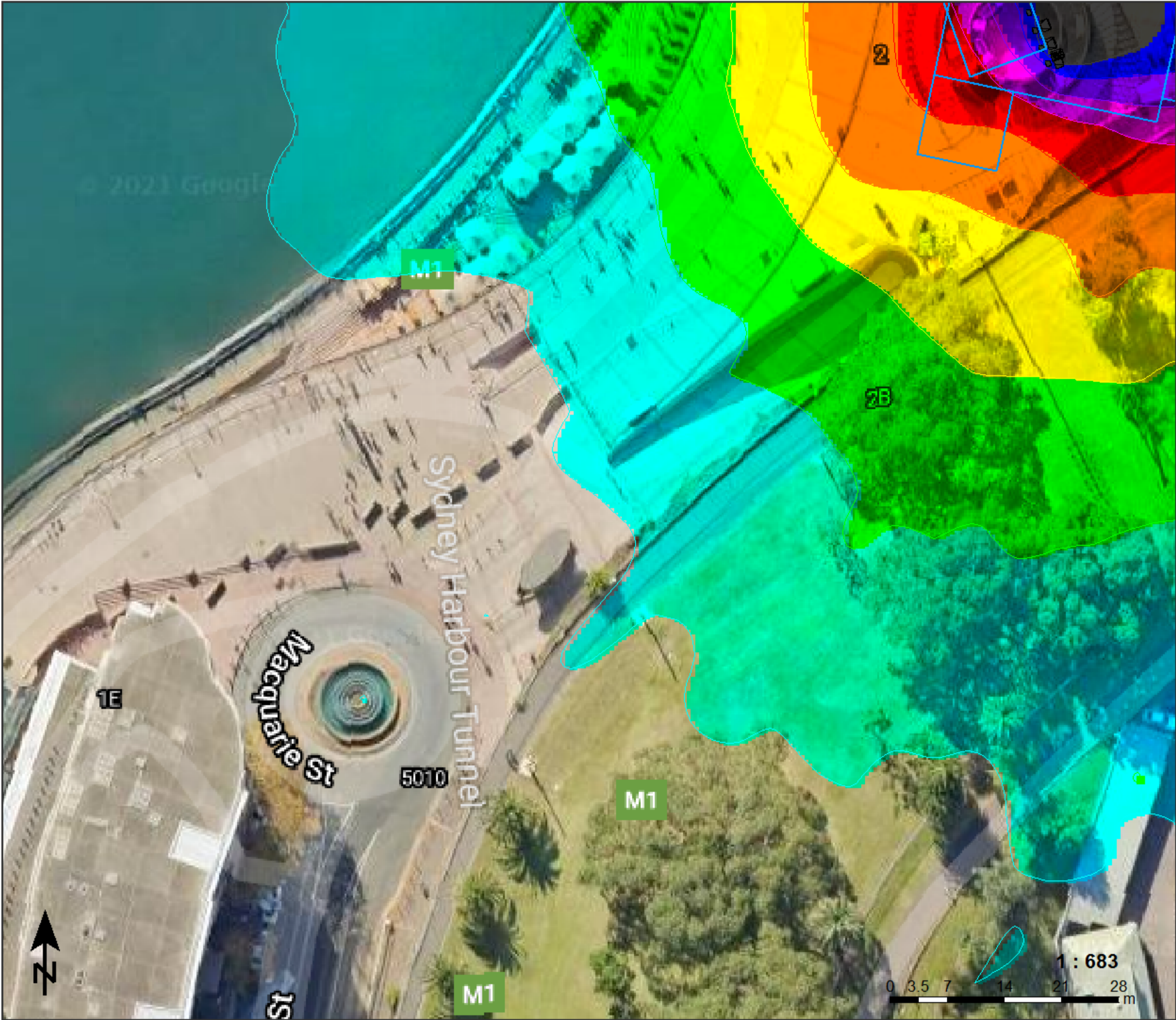
- All recorded data from our monitoring system at FOH, *MeTrao*.
- An in-depth report on each performance, and the sound levels recorded on- and off-site, from an 8DS perspective.
- Thoughts and suggestions to improve audio performance for future events.



7 SOH STEPS
Spectrum: Live bands
SPL at reference point: 92.4 dB(A)

Signs and symbols	Levels in dB(A)
● Stage origin	> 89
● Reference point	86 - 89
■ Loudspeaker	83 - 86
□ Audience area	80 - 83
	77 - 80
	74 - 77
	71 - 74
	68 - 71
	65 - 68
	< 65

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7 SOH STEPS

Spectrum: Live bands

SPL at reference point: 92.4 dB(A)

Signs and symbols

● Stage origin

● Reference point

■ Loudspeaker

□ Audience area

Levels in dB(A)

> 89

86 - 89

83 - 86

80 - 83

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71 - 74

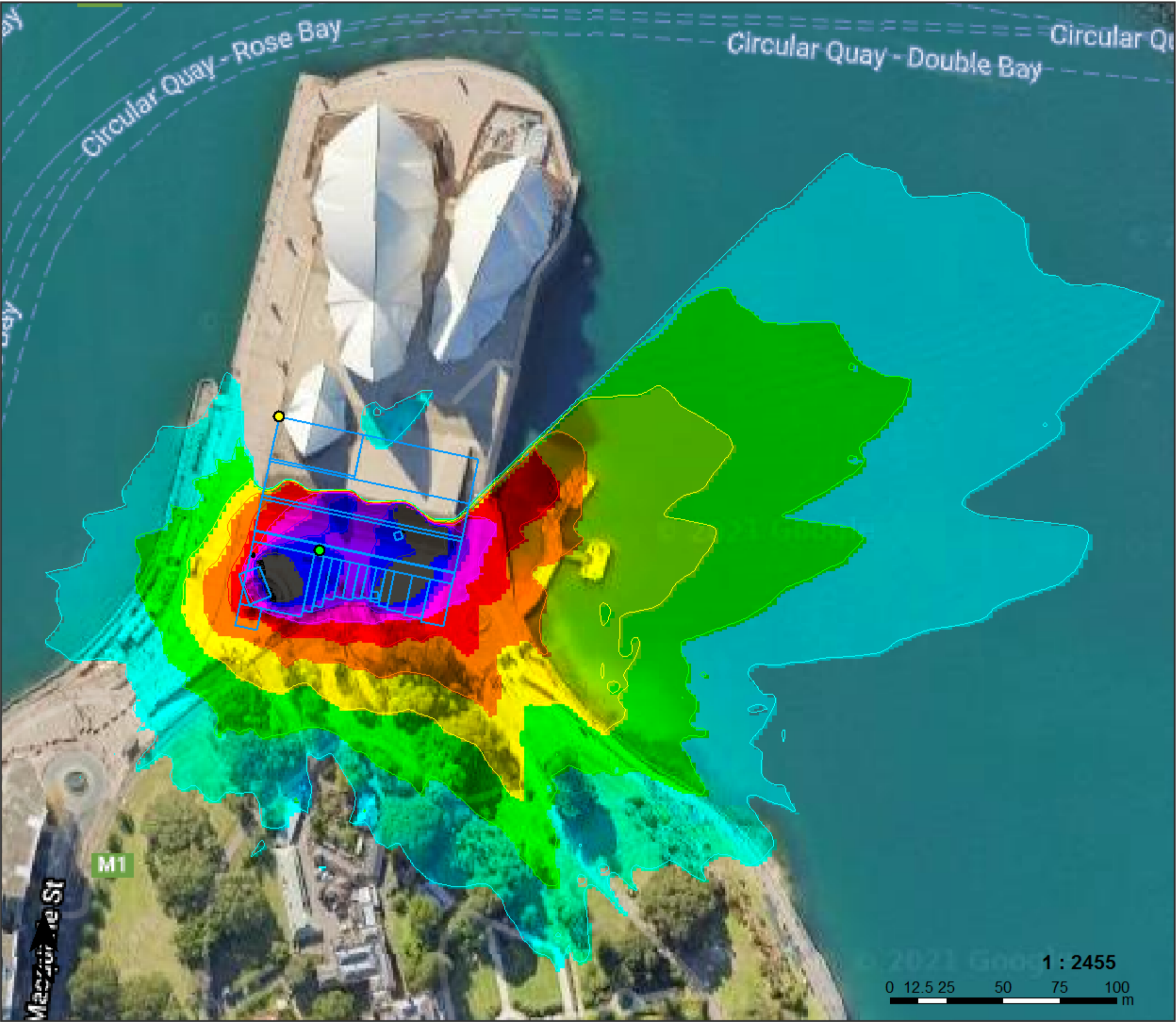
68 - 71

65 - 68

< 65

d&b

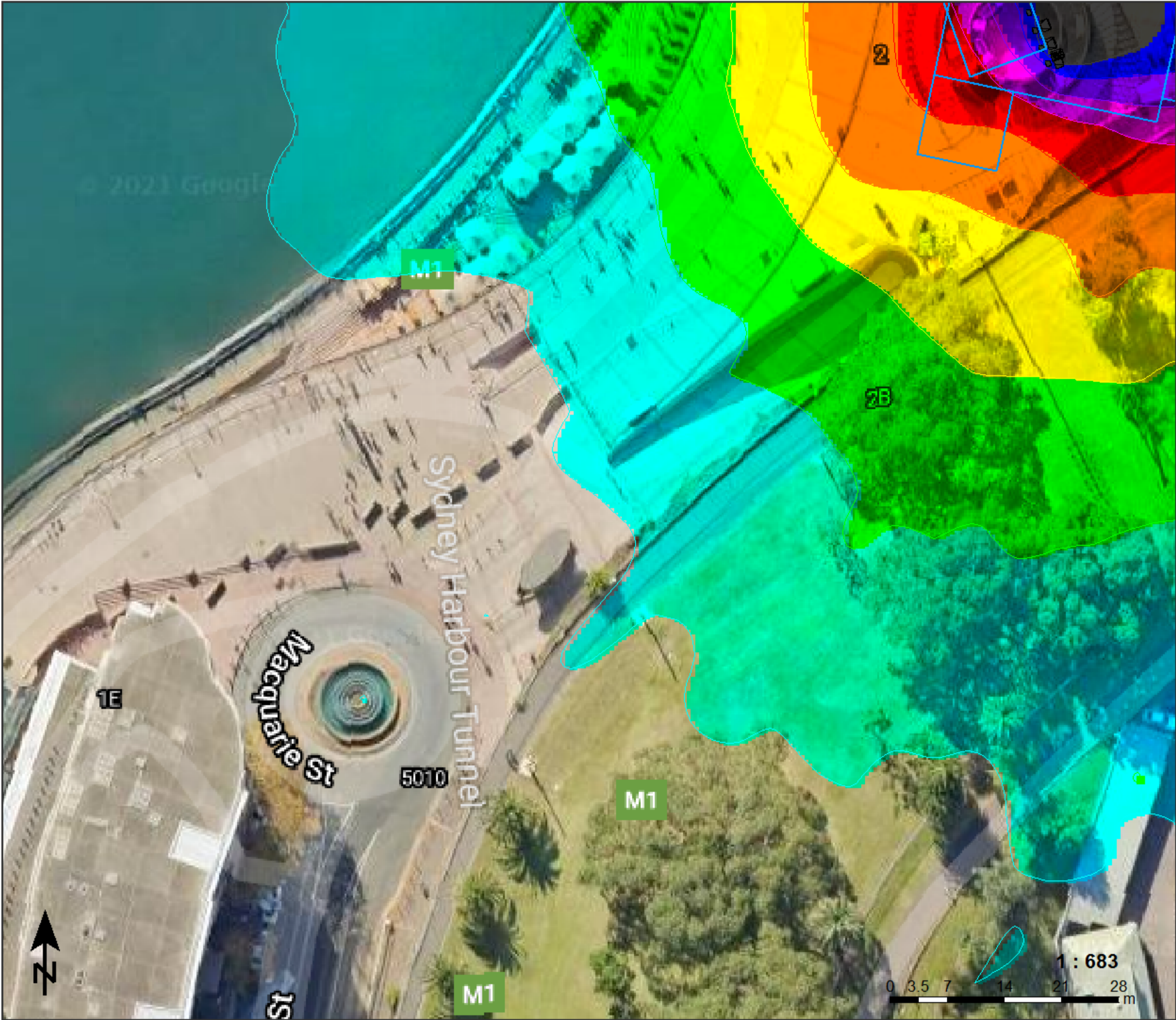
audiotechnik



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d&b audiotechnik



7 SOH STEPS

Spectrum: Live bands

SPL at reference point: 92.4 dB(A)

Signs and symbols

●

Stage origin

●

Reference point

■

Loudspeaker

□

Audience area

Levels in dB(A)

> 89

86 - 89

83 - 86

80 - 83

77 - 80

74 - 77

71 - 74

68 - 71

65 - 68

< 65

d&b

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