

Sydney Opera House

NOISE MANAGEMENT PLAN

For the Carrying out of Outdoor Events and
Functions

Southern Forecourt and Monumental Steps

31st December 2021





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1 BACKGROUND & DEFINITIONS

1.1 Development approval

The development approval (DA 445-10-2003) for the use of the Forecourt and Monumental Steps for Temporary Events and Functions at the Sydney Opera House was modified on 14 October 2016 (DA 445-10-2003 MOD 4). Included in the modification, among other things, is a requirement for the Sydney Opera House Trust to prepare and implement an overarching Noise Management Plan for the carrying out of outdoor events and functions (Noise Management Plan).

1.2 Attachments

This Noise Management Plan includes the following attachments:

- Schedule 1** SOH Forecourt Sound Management Plan_210624
- Schedule 2** SOH Sound Monitoring Procedure 21 August 2017
- Schedule 3** Crowd Management Plan 28th July 2017
- Schedule 4** Sydney Opera House Customer Feedback Policy, 2 March 2016

Conditions referred to below are conditions set out in DA 445-10-2003 including MOD 4.

1.3 Definitions

Event can be over one 24 hour period (day) or a number of 24 hour periods, comprising one performance/concert or a number of performances/concerts.

Performance means a performance/concert typically occurring during the daytime or evening and includes rehearsals and sound checks. A performance/concert does not last more than one 24 hour period in which there may be more than one act or band within each performance/concert.



2 USE OF QUALIFIED EXPERTS

2.1 Qualified Experts

In accordance with the requirements of condition 45A(a), Schedules 1 and 2 of this Noise Management Plan have been prepared by suitably qualified and experienced experts in each of the relevant fields.

2.2 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.

2.3 P.A. People

The P.A. People is a specialist integrator and contractor in sound reinforcement, audio visual systems, performance lighting and production communications. Over its 40 year history the company has developed a reputation as a leader in these fields, understanding the rigours of working in a design construct environment and working with other trades and services to ensure delivery of a fully integrated package.



3 EPA REVIEW

3.1 EPA Review

In accordance with condition 45A(b) a draft of this Noise Management Plan dated 7 November 2016 was provided to the Environment Protection Authority (EPA) for review. A further draft was provided on 7 December 2016 and an updated Schedule 1 was provided on 13 December 2016 to EPA. Further review by EPA received on 18th July and updates made to schedules 1,2 and 3.

3.2 Response to EPA Review

The Noise Management Plan was reviewed by the EPA and changes were made to section 3.1 and Schedule 1 to address the EPA's comments. Any further comments received from the EPA will be considered as part of the continuous improvement program set out in section 8 of this Noise Management Plan.



4 NOISE MANAGEMENT

4.1 Consistency with DA

This Noise Management Plan is based on and consistent with Appendix A of the Sydney Opera House Trust's response to the development application submissions (RTS). Refer to section A of Schedule 1.

4.2 Noise Control

Consistent with condition 18, the Sydney Opera House retains ultimate control of the noise levels, including those caused by any sound amplification equipment operated outdoors.

A representative will be appointed for each event who is able to exercise that control. The representative will be available throughout the event to receive calls from the Event Operations Control Room including any complaints received by the hotline and issues raised by key personnel engaged in noise management, to ensure prompt response to any complaints or issues. This person will be the contact for the Acoustic Consultant attending the event who will notify the representative of any perceived risk of exceedances under the process outlined in the applicable Noise Management Sub-Plan.

Real-time communications will be by mobile telephone unless otherwise specified in the applicable Noise Management Sub-Plan.

4.3 Noise Limits

Amplified music will be played only between 10am and 11pm within the limits set out in Condition 42 of the DA, except when Condition 43 applies, as specified in the Noise Management Sub-Plan.

Noise during bump-in and bump-out activities, site pack-up and temporary noise generating plant and equipment between 8am and 12 midnight will not exceed 60 Leq(15 minute) dB(A) outside the nearest residential receivers, as required by condition 44.

Crowd management procedures will be implemented for each event as part of the event-specific Security, Crowd and Risk Management Plan, which is an internal operational document. This plan will include event specific details of procedures to ensure the efficient and orderly departure of patrons with minimum noise. Refer also to section 6.1 below.

4.4 Exemption for Exceedance of Noise Limits

The Sydney Opera House has a system of triggers aimed at preventing levels over the limit which is outlined in B.3.3 of Schedule 1. An exceedance of the noise limit during a performance will not be taken to be a breach of DA conditions 42-44 unless:

- Two (2) consecutive five (5) minute readings of more than 2 dB above the limit occur on three (3) or more occasions; or
- Three (3) consecutive five (5) minute readings of more than 2 dB above the limit occur; or
- A total of eight (8) five (5) minute readings of more than 2 dB above the limit occur; or
- A total of four (4) five (5) minute readings of more than 5 dB above the limit occur.

4.5 Noise Monitoring

Amplified music will be monitored in real time at the Front of House continuously throughout each event by an accredited consultant. A report will be provided to the Department of Planning and Environment and the EPA, including any exceedances, as required by condition 45.



Noise generated by bump in and bump out will be monitored against activity being undertaken to comply with Condition 44. Should any complaints be received a mobile meter will be deployed to monitor noise levels.

4.6 Expert Reports

The Sydney Opera House Trust commits to complying with the experts' recommendations in the attached Schedules 1 and 2 with regard to noise mitigation and management.

The sound amplification equipment setup and noise minimisation measures required in conditions 21 – 23 will be in accordance with each relevant expert's advice.

4.7 Further Measures

Further measures will apply specifically during bump-in, bump-out and site set-up aimed at minimising noise including:

- traffic management to minimise vehicle noise;
- contractor management to minimise noise associated with use of vehicles (including horns) and infrastructure installation and dismantling; and
- scheduling of activities to minimise disruption.

4.8 Event Limits

Under condition 5 outdoor events on the Forecourt and Monumental Steps are limited to:

- (a) five events per year of a maximum of 11 days each;
- (b) three events per year of a maximum of 20 days each; and
- (c) a total of 99 event days per year.

In addition, for events of 11 days or more Sydney Opera House Trust will consider limiting the number of consecutive performance days to minimise noise impacts on nearby residents, provided the event will remain viable. Any such further limits will be set out in the relevant Noise Management Sub-Plan for each applicable event.

The Sydney Opera House Trust will comply with any further limitations of the number of consecutive performance days as may be required under applicable regulations.



5 EQUIPMENT AND MONITORING

SOHT will comply with the recommendations in the expert reports (Schedules 1 & 2)

5.1 Schedule 1

Schedule 1 contains the following details.

Condition	Details	Schedule 1 Reference
45A(d)	Speaker arrangement	B.5.2
45A(d)	Stage configuration	B.4
45A(d)	Front of House location	B.1, B.2, B.4
45A(e)	Noise limits and goals for events	B.1, B.2
45A(f)	Minimisation strategies	B.5
45A(j)	Early warning and reactive management system	B.3
45A(h)	Bump in and Bump out	B.5.5

5.2 Schedule 2

Schedule 2 contains sound check procedures and the noise monitoring program for events and rehearsals to ensure compliance with the noise limits under the development approval, as required under condition 45A(g) and (i).



6 PATRON MANAGEMENT

6.1 Ingress and Egress of Patrons

Measures to ensure quick and orderly patron departure and minimisation of patron noise are contained in Schedule 3, as required under condition 45A(h).

In addition:

- The Sydney Opera House Trust will erect signs at the perimeter of the precinct to remind patrons to respect our neighbours by keeping noise to a minimum.
- Staff in attendance at outdoor events are briefed to deal with any outbreaks of noise from patrons on a case by case basis as appropriate in the circumstances.



7 COMPLAINTS MANAGEMENT & NOTIFICATION

7.1 Customer Feedback Policy

For outdoor events on the Forecourt and Monumental Steps, the Sydney Opera House Trust will comply with its Customer Feedback Policy contained in Schedule 4. This established complaints management system satisfies the requirements of condition 45A(k).

7.2 Outdoor Event Hotline

Outdoor Events Hotline operates during outdoor events, as required by condition 40.

The number is found on the “Contact Us” page of the Sydney Opera House website

- Hotline: +61 2 9250 7113

7.3 Notification

Notification for all events will be sent to the following recipients at least seven days prior to the event:

- Secretary, Department of Planning and Environment
- City of Sydney Council
- North Sydney Council
- NSW Environment Protection Authority
- Royal Botanic Garden
- Bennelong Residents
- Property NSW

The notifications will include general information about the event, SOH hotline number and a contact name, phone number for enquiries and complaints, as required under conditions 39 (c), 41 and 45A(l). In the event of material changes to event details, updated notifications will be sent.



8 REPORTING & CONTINUOUS IMPROVEMENT

8.1 Final Compliance Report

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

- An Executive summary including
 - o Whether or not there has been compliance or non-compliance with the permitted hours in this DA for the relevant event, including the reasons for any non-conformance(s);
 - o 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;
 - o discussion of whether or not any exceedances of the noise limits in the development consent constituted a “sustained exceedance” as defined in Section 4.4; and
 - o 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:
 - o Date & time of monitoring
 - o Activities occurring on land administered on land during monitoring
 - o Sound pressure levels recorded including exceedances of noise limits
 - o Any other information relevant to the consideration of the noise impact on residents or other sensitive receivers

Please note: The Opera House will seek consent from complainants at the time of collection for their personal details to be provided to third parties for the purposes of complying with the conditions of consent. If that consent is not provided, only the following details will be provided: date, time, nature of the complaint, method by which the complaint was made and action taken by the Opera House

8.2 Review and Updating of Plan

This Noise Management Plan will be reviewed by Sydney Opera House Trust in consultation with suitably qualified experts in each relevant field after each event and as otherwise required under the DA. The Sydney Opera House Trust commits to amending the Noise Management Plan as necessary and appropriate to take into account the results of each event review, as well as the one year and three year reviews required under condition 45B to ensure the plan is kept up-to-date.

8.3 Review after each Event

The review process after each Event will include:

- Debrief notes and lessons from each event
- Key outcomes from Final Compliance reports
- Analysis of monitoring and exceedances by suitably qualified consultant/s
- Analysis of all complaints and customer feedback received, including those received by the hotline.
- Feedback from regulators and government
- Feedback from external hirer, if relevant
- Evaluation of the noise limits and hours of operations
- Analysis of any feedback received from industry professionals who have attended the Event or Function



8.4 Review of Customer Feedback Policy

The Customer Feedback Policy (See schedule 4) will be reviewed and if necessary updated by 2 March 2018.

8.5 Annual Monitoring Reports

Details about noise monitoring, noise levels and any related complaints received by SOHT will be included in the annual monitoring reports to be submitted to the Secretary of the Department of Planning and Environment (or nominee). Any feedback received will be considered as part of the continuous improvement outlined in this section.

8.6 One Year and Three Yearly Review

The EPA will be consulted as part of the reviews in October 2017 and 2020, as required under condition 45B.

8.7 Noise Management Sub-Plans

Each event will have its own Noise Management Sub-Plan that is consistent with this Noise Management Plan and contains further details about noise management standards and procedures for the specific event, including the required notifications and community consultation referred to in condition 41.

Each successive Noise Management Sub-Plan will build on the knowledge gained from the reviews described in this section.



Sydney Opera House

Forecourt Events Sound Management Plan

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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).

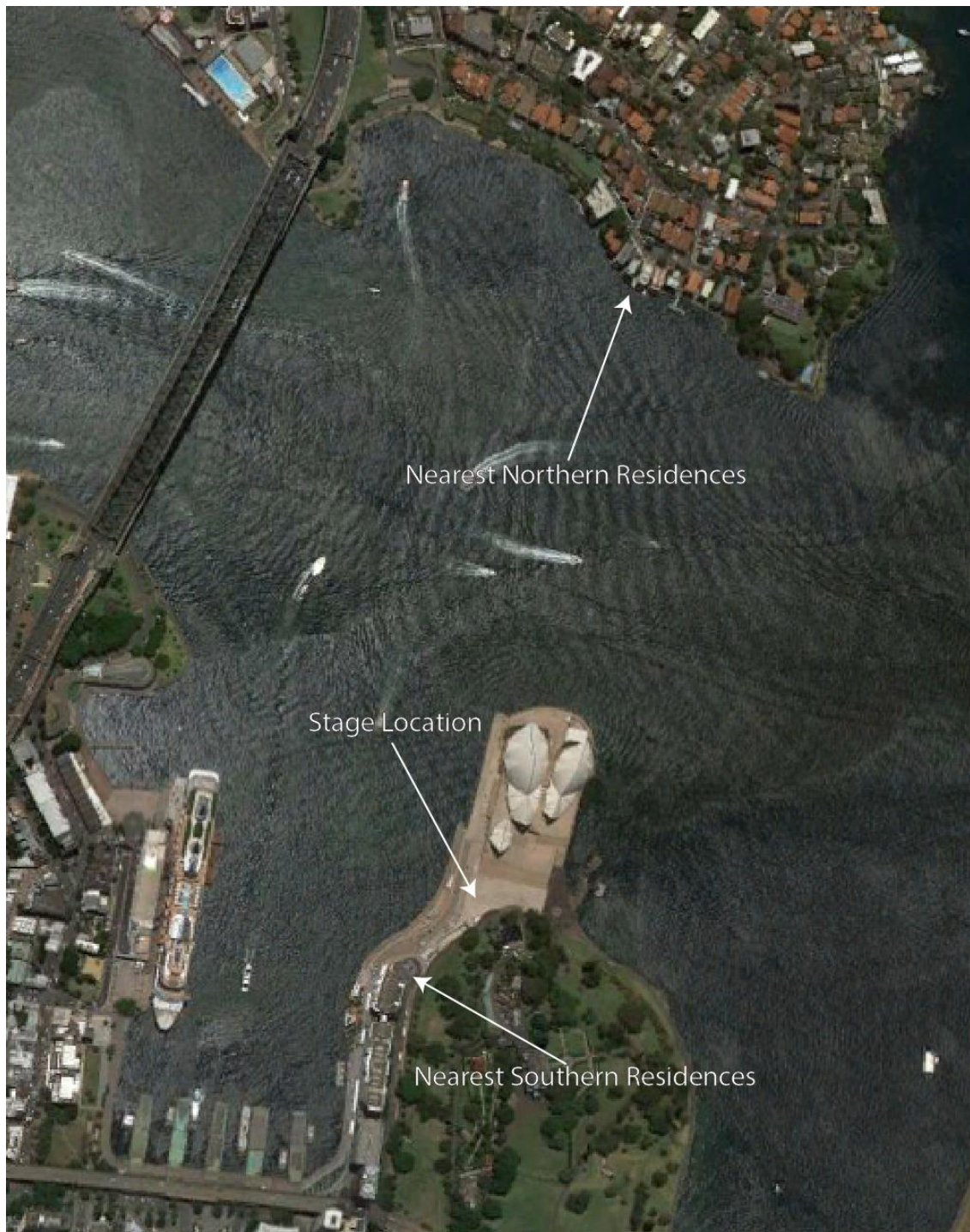
The Sound Management Sub-Plan for each event will be consistent with this document and will inform event's organisers and sound operators (audio and noise logging) to ensure the best possible experience to patrons and residents.

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

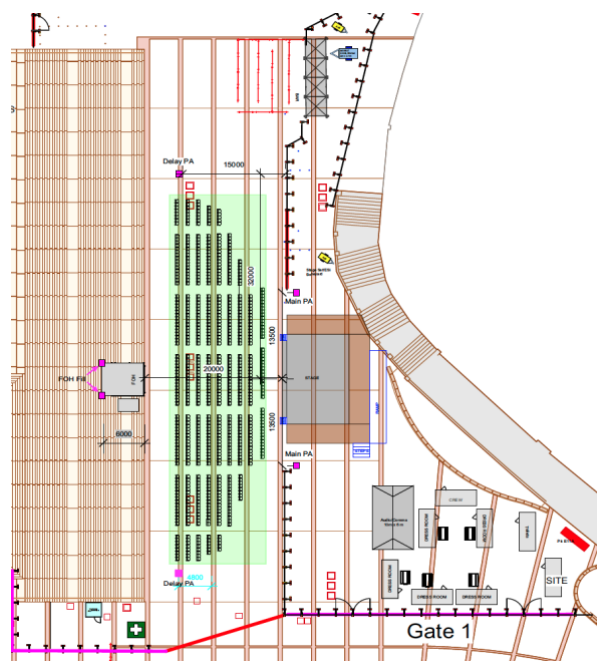
*Please note that every event set up is different and the configurations used to establish sound limits are based on the most common event locations and set ups. However, Australia Day concerts may use the typical Forecourt configuration and other events may use the Australia Day configuration.

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.

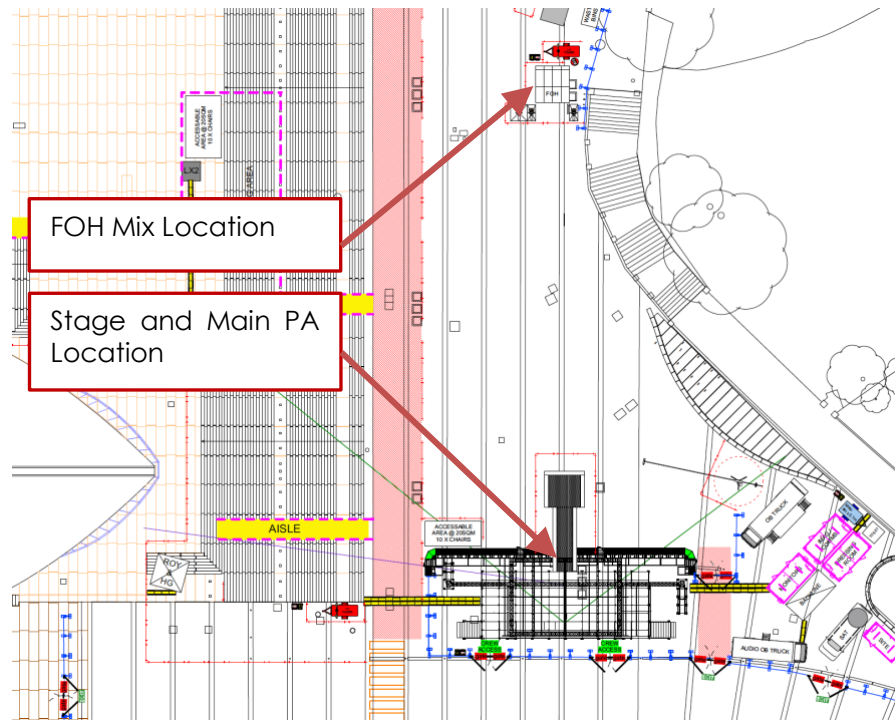
An indicative table based on the event layout and measurements conducted for the Barrabuwari event during April, 2021 using the configuration shown in section B.1.1 is included below. The FOH tent in that case was 20 m from the edge of the stage. The limits set for that event were 95 dB (A) and 105 dB(C).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

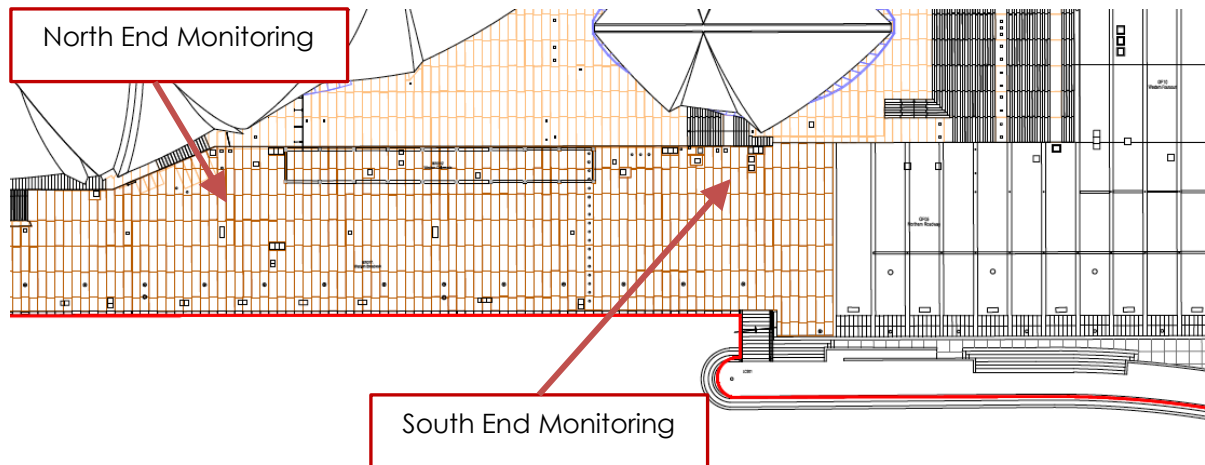
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Events that are televised and/or benefit from the inclusion of the Harbour Bridge as a backdrop, generally use the configuration shown below. This was named the 'Australia Day configuration' as it was historically used for the major Australia Day concert.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

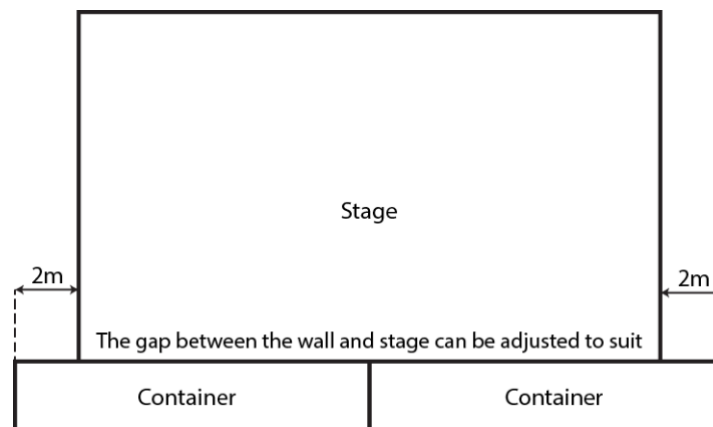
B.5.1 Container Wall Sound Barrier

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.

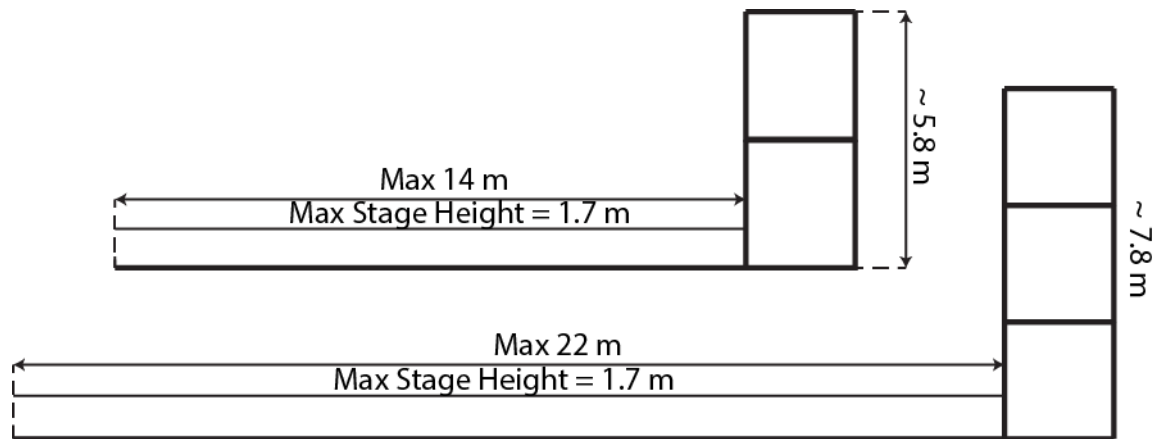
A container wall shall be installed when feasible and reasonable to block line of sight between the front edge of the stage and nearby residences.

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

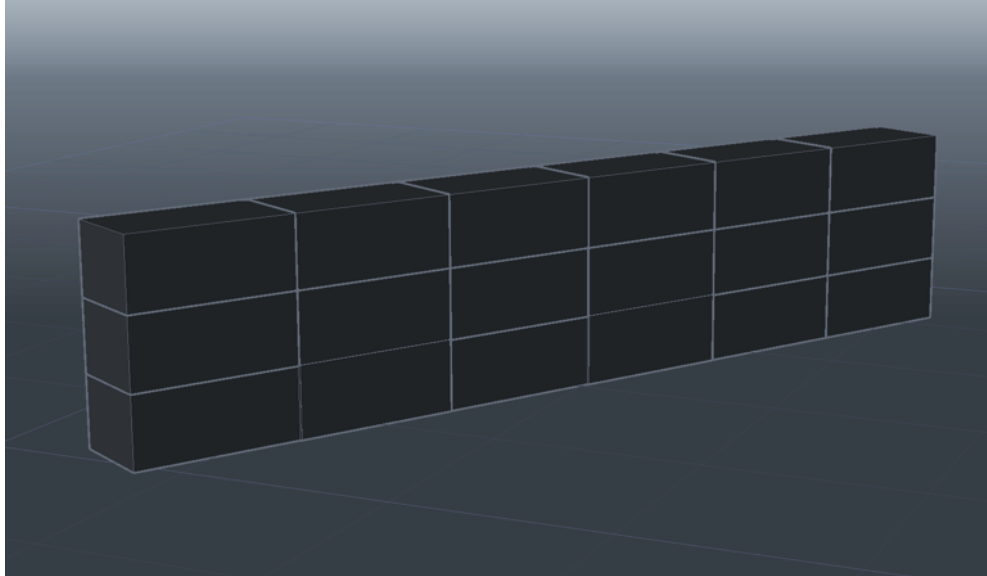
The ground stacked subwoofer system methodology is recommended to provide consistent coverage of the audience area and reduce the risk of exceeding the level limits due to beaming or poor pattern control. The subwoofer system deployed for a Forecourt concert is to be deployed in a cardioid configuration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

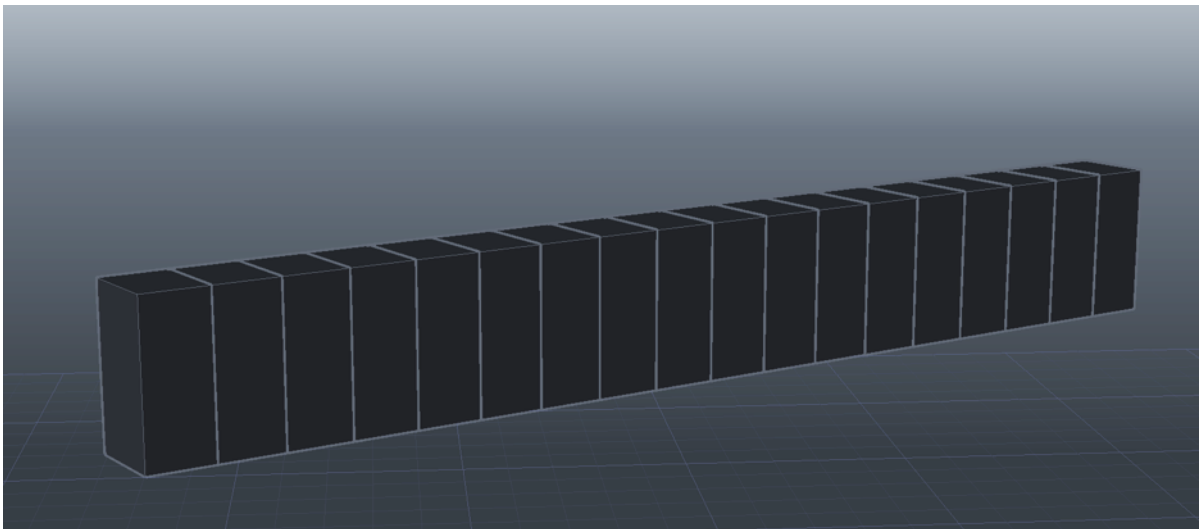
Indicative system configurations are provided to communicate design intent only and are not given as mandatory for a Forecourt event. The stage layout, stage height, audience area, music style and many other factors are significant in the design of a subwoofer array for a Forecourt event.

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.

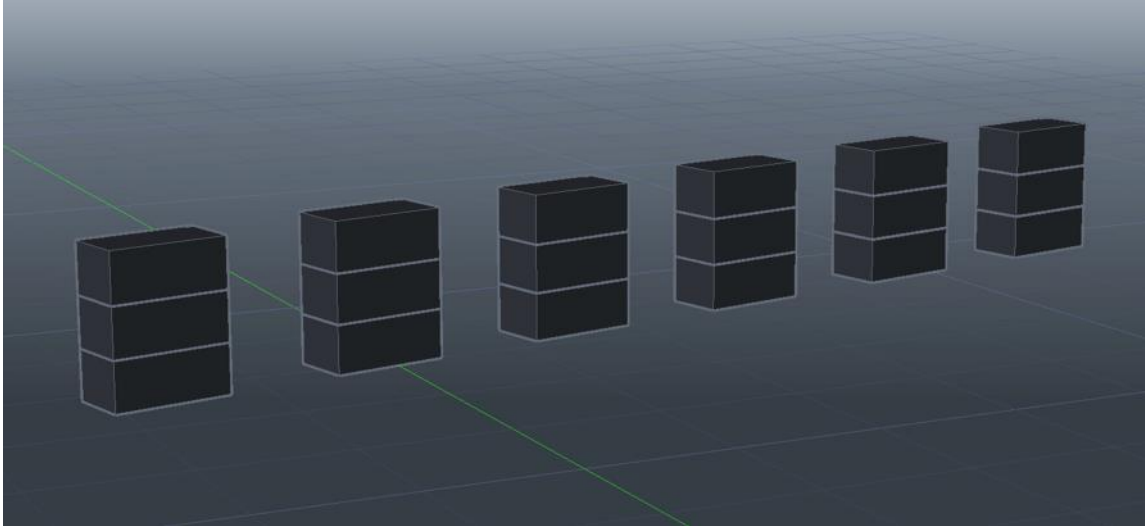


The second indicative design, pictured below, uses the same quantity of subwoofers, arranged in a single block on-end as would be required for a lower stage height. In this arrangement sub numbers 3, 4, 9, 10, 15 and 16 are reversed for cardioid operation if using an L'Acoustics product or configured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



Sydney Opera House - Sound Monitoring Procedure

The following is an outline procedure for monitoring of sound pressure levels (SPL) at the Sydney Opera House for outdoor events deemed to require compliance with:

- SOH Forecourt Sound Management Plan _220817 (SMP)
- Southern Forecourt DA 455-10-2003 and (DA)
- DA 455-10-2003 MOD 4 (MOD)

1. Personnel

The Opera House will appoint an internal Event Manager for each event.

The Opera House Event Manager will appoint a suitably qualified and experienced sound expert to monitor amplified noise for all events. They in turn will appoint an SPL Engineer for each event.

The Artist will provide an Audio Operator for each event.

2. Responsible Person

The SPL Engineer and Audio Operator will operate under the authority of and report to the Opera House appointed Event Manager.

All communication about sound processes, reporting and breaches will be through and with the Event Manager or their delegate. The Event Manager shall be responsible for any enforcement of SPL levels or limits, however the SPL Engineer is responsible to ensure the Event Manager is fully briefed at all times.

Communication between the SPL Engineer and the Event Manager will be either through an agreed channel on the Event Radios or by Mobile phone. Both personnel will ensure that phone numbers are exchanged prior to the event, and that contact is made upon arrival of the SPL Engineer on site.

3. Equipment Details

Compliance with these documents requires monitoring of sound pressure levels at:

- FOH Mix Location for all Southern Forecourt events (Refer SMP B.4.1 and B.4.2); or
- The South End and North End monitoring locations for Western Broadwalk Events (Refer SMP B.4.3)

Each monitoring location will be provided with a pair of SPLnet M100 meters, one to monitor and record 'A' levels, and the second to monitor and record 'C' levels.



Each meter will carry a current NATA certified calibration certificate, and will be locally calibrated at installation.

Each meter will capture:

- $L_{eq-5min}$ 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 meters will be monitored in real time on PC interfaces both at event control and at the FOH position.

Information for all descriptors will be captured for future use and analysis.

In addition, sound monitoring staff will also be able to monitor L_{eq1min} for both A and C descriptors to assist with anticipating a breach and providing early informal warnings to the Audio Operator and the Event Manager.

The SPL Engineer will also have available a hand held Class 1 SPL meter for spot measurements as required.

Additional monitoring tools to supplement use of meters could include a range of contemporary technologies (e.g. smartphone applications for spot monitoring).

4. Communications with Audio Operator

It is imperative that the Audio Operator has read, understood and accepted the SMP prior to the event.

Prior to any Sound Check, the Event Manager shall facilitate a briefing for the Audio Operator with the SPL Engineer to ensure clarity of the levels and processes, including operational training on the displays and text based messaging system. This briefing should be scheduled for a maximum duration of 30 minutes.

During any sound checks and the performance(s), in accordance with the SMP, the SPL Engineer shall give a warning through text based messaging to the Audio operator at:

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

The SPL Engineer will also inform the Event Manager if the latter reached.

The primary means of communication with the Audio Operator during the event will be the text based messaging system that forms part of the SPLnet system. A secondary communications mechanism will be established on an event specific basis. This may be required for escalation or where text messaging proves ineffective. This secondary mechanism may be radio communications with an Audio Assistant or Systems Engineer or other similar process. The secondary communication established for the event will be recorded (e.g. logged) for future reference.



Sydney Opera House - Crowd Management Plan

Ingress of Crowds

For all outdoor events, the Sydney Opera House will develop a specific *Security, Crowd and Emergency Management Plan*. Minimising the impact on neighbours and other event patrons of crowds ingressing and egressing the site is paramount.

The following factors have been identified, which could affect crowd management:

- Ticket holders arriving late or just before the scheduled start time;
- Security bag-check reduces the rate at which people are processed; and
- Security incident which delays loading.

The following strategies will assist to ensure that patron loading has finished by the scheduled event start time.

- Opening gates in sufficient time to reduce crowd queuing (approximately 2hrs before scheduled start time);
- Separate ticket check from security check operations;
- Appropriate number of bag check lanes;
- Allocating lanes based on the input of patrons (i.e. General Admission vs Seated);
- Ensure there are no bottle necks and sufficient entry widths;
- Separate loading points for the Forecourt and Monumental Stairs;
- Express lane;
- Signage that informs patrons of what to expect on approach;
- Support acts to encourage patrons to arrive early; and
- Ticket holder communications.

Patrons are generally queued on the western concourse where a ticket check point will be located for patrons to proceed through security bag check. There will generally be five bag check lanes and one express lane.

The above strategies also ensure that there is limited impact on East Circular Quay and Macquarie street and that queues are kept to a minimum.

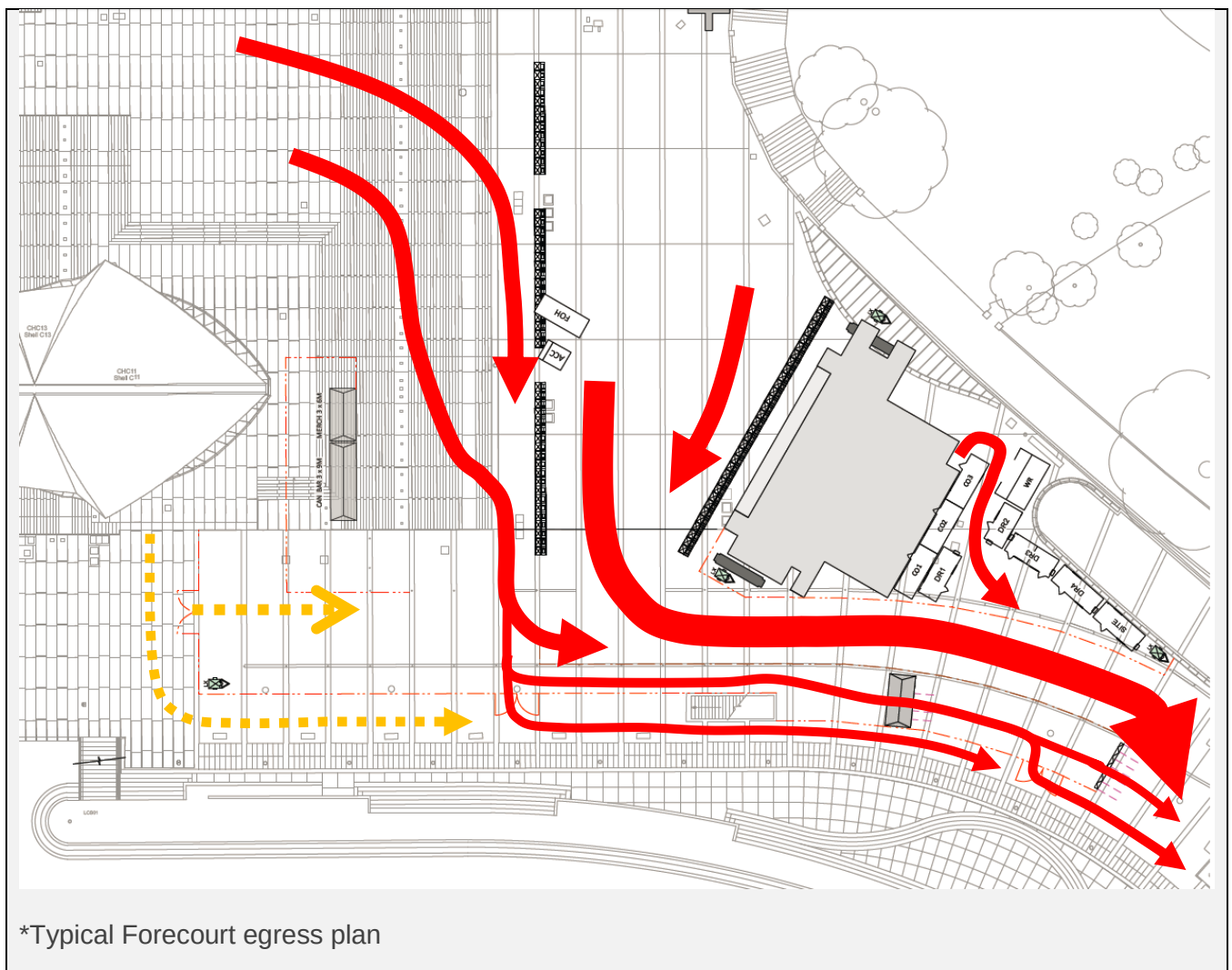
To manage crowds arriving early before gate open time, plans will be put in place to pre-check tickets and undertake security bag checks to move patrons onto SOH land. Patrons will then be held near the event entry point until the event site is ready to be opened. This limits possible queue build up down East Circular Quay.



Egress of Crowds

In order to minimise site impact, event patrons will be exited down the closed Opera House roadway and directed off the roadway just before the gatehouse onto the western concourse. This will ensure that the egress is done in a timely and safe manner. Designated breaks in the fencing along the western concourse will be in place to take pressure off the main roadway. There may also be instances where other Opera House performances are exiting at or around the same time as the outdoor concert is finishing. Those patrons will egress down the western concourse

The Security marquee will have the northern wall opened to allow internal Opera House shows exiting to transit through and maximise usage of the western broadwalk.





In order to minimise impacts on our neighbours and ensure patrons leave the site in an orderly fashion with minimum noise, the following will occur.

Ten minutes prior to egress, Security staff and/or Police will be deployed to the following areas.

- SOH Roadway
- Macquarie Street roundabout
- Macquarie Street up to Albert Street
- East Circular Quay

Key responsibilities for the officers will include:

- Ensure patrons leave the site and continue off site in an orderly fashion;
- Ensure alcohol is not taken outside the licensed area;
- Display signs reminding patrons to keep noise to a minimum
- Manage traffic on Macquarie Street to ensure there are minimal delays;
- Ensure patrons remain on the footpath at all times;
- Monitor and respond to noisy or anti-social behaviour;
- Work closely with NSW Police, City of Sydney, Property NSW and the relevant transport operators (SOH Security Control will notify the relevant stakeholders prior to egress);
- Assist patrons and direct crowd;
- Conduct a final sweep at the end of the night, ensuring all patrons have left and any glass bottles or rubbish left behind are collected and disposed of accordingly; and
- Conduct a final sweep of Macquarie Street, Albert Street and East Circular Quay.



Opera House Policy

Title:	Customer Feedback Policy		
Policy Number:	SOH107		
Effective Date:	2 March 2016	Next Review:	2 March 2018
Authorisation:	Chief Executive Officer		
Authorisation Date:	18 December 2015		
Superseded Policy:	SOH107		
Accountable Director:	Director, Visitor Experiences		
Responsible Officer:	Head of Ticketing Services		

1. CORE PROPOSITION

The Opera House is committed to achieving excellence in customer service through effective management of customer feedback. The Opera House welcomes and values complaints, compliments and suggestions as positive tools for change and to improve visitor experiences.

2. SCOPE

- 2.1 This Policy applies to all Sydney Opera House staff (including permanent, temporary and casual employees), contractors and persons otherwise engaged to undertake work on behalf of the Opera House.
- 2.2 This Policy does not apply to business to business feedback or informal feedback as described below.

3. WHAT IS CUSTOMER FEEDBACK?

- 3.1 Customer feedback is an unsolicited communication received from patrons, visitors and guests, including complaints, compliments and suggestions for improvement. This feedback may be provided face-to-face or via telephone calls, letters, email or the Sydney Opera House website.
- 3.2 Customer feedback does not include:
 - informal feedback (including anecdotal comments and general comments posted on Opera House social media pages) received from patrons, visitors and guests; or
 - business to business feedback (whether solicited or unsolicited) received from suppliers, resident companies, presenting organisations, venue hirers or sponsors. Feedback received from commercial hirers is managed in accordance with the [Feedback and Complaints Handling Guidelines for Commercial Hirers](#).

4. HANDLING AND RESPONDING TO CUSTOMER FEEDBACK

- 4.1 When handling customer feedback, staff should be courteous and helpful. Whenever possible, staff should endeavour to resolve issues that are the subject of feedback at the first point of contact. This may involve direct discussion between the customer and the staff member and an agreed resolution.
- 4.2 Where feedback cannot be dealt with at the first point of contact, the staff member must acknowledge receipt of feedback and refer the feedback to their supervisor or responsible manager as listed on the internal "Referral List" within **24 hours** of receipt of the feedback.
- 4.3 The supervisor or responsible manager must respond and resolve any issues that are the subject of feedback within **5 working days** of receipt of the feedback. If this timeframe cannot be complied with, the supervisor responsible manager must notify the customer **within 5 working days** of receipt of the feedback that additional time is required to respond or resolve the issue.
- 4.4 The Head of Ticketing Services should be contacted for guidance on the content and style of response or if staff are concerned about the sensitive nature of a particular subject matter. In order to ensure consistency and maintain the quality of customer correspondence, where appropriate, written responses will utilise the suite of template responses maintained by the Head of Ticketing Services.
- 4.5 Where appropriate, the supervisor or responsible manager responding to the customer feedback should also notify the relevant business unit in order to raise awareness of customer concerns or suggestions that are being received in relation to that business unit.

5. RECORDING CUSTOMER FEEDBACK

- 5.1 All customer feedback must be recorded as a customer service issue (**CSI**) in the Opera House's customer relationship management system – *Tessitura*. At a minimum, the following information must be recorded:
- the name of the customer;
 - the nature of the feedback (including conduct or practices identified in the feedback);
 - the form of the feedback (for example, face to face, phone, email); and
 - the relevant business unit that the feedback relates to.
- 5.2 Once resolved, CSIs should be "closed" in *Tessitura* within **24 hours** of resolution. A summary of the action taken must be recorded against the CSI prior to closing.
- 5.3 If the content of the customer feedback and/or the response contains sensitive or confidential information (for example, potential legal issues or personal or health information), the accessibility of the CSI in *Tessitura* should be restricted in consultation with the Head of Ticketing Services.

6. REVIEWING AND REPORTING ON CUSTOMER FEEDBACK

- 6.1 All customer feedback will be reviewed by the Head of Ticketing Services on a regular basis to:
- ensure that suggestions and actions are implemented and that issues are resolved in an appropriate manner;
 - maintain the consistency and quality of customer correspondence;
 - collate information on the nature, scale and frequency of issues important to Opera House customers; and
 - enable improved reporting of customer feedback across the organisation.
- 6.2 The Head of Ticketing Services will prepare a report summarising the nature, scale and frequency of issues that are the subject of feedback. This report will be circulated to the Executive Team and responsible managers every two months.

7. RESPONSIBILITIES

Staff

- 7.1 All staff have a responsibility to comply with this Policy.

Host Team

- 7.2 The Host Team is responsible for:
- monitoring all online customer feedback received via the "Contact Us" page on the Opera House website or via email to infodesk@sydneyoperahouse.com;
 - assigning feedback to the responsible manager for action using the internal Referral List to; and
 - supporting the Head of Ticketing Services in the overall management of customer feedback.

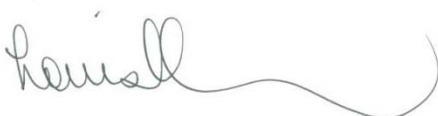
Head of Ticketing Services

- 7.3 The Head of Ticketing Services is responsible for:
- overall management of customer feedback (including maintaining template responses);
 - maintaining the Referral List;
 - oversight of CSI recording and development in *Tessitura*; and
 - reporting to the Executive Team in relation to customer feedback.

8. SUPPORTING DOCUMENTS AND RELEVANT LEGISLATION

Sydney Opera House *Customer First Commitment Statement*

APPROVED



Chief Executive Officer

Date: 18 December 2015