MARSHALL DAY Acoustics

EDEN PARK – TWELVE CONCERTS
ASSESSMENT OF NOISE EFFECTS

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Project: **EDEN PARK – TWELVE CONCERTS**
Assessment of Noise Effects

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1.0 SUMMARY

The Eden Park Trust Board (EPTB) is applying for consent to hold twelve concerts (with a maximum of 6 artists) at Eden Park in a calendar year. It is our opinion that the overall noise effects from 12 concerts per annum (max of 6 artists), is slightly greater than 6 per annum and is approaching the upper limit of acceptability. 12 concerts at 75 dB L_{Aeq} is however, a lower annual noise exposure than some other major venues in Auckland and similar to the AUP Temporary Activity Rules.

Noise monitoring at the residential interface has proved difficult due to interference from extraneous noise such as road traffic. The transfer function (mixing console to residential noise difference) has been established for three different stage configurations. Changes to the conditions of consent are proposed to require noise monitoring at the mixing console to control the noise level at the residential interface.

The current conditions of consent control where and when pack-in/out activity can take place, rather than using an 'effects based approach' of allowing management and mitigation and ensuring that the activity complies with the noise limits. Changes to conditions are proposed to allow this approach.

The background noise level near Eden Park is high due to general noise sources (not Eden Park). In our opinion, the night noise limit of 40 dB L_{Aeq} is unnecessarily low and we recommend it is increased to 45 dB L_{Aeq}.

2.0 INTRODUCTION

2.1 Background

Marshall Day Acoustics (MDA) has been involved with noise at Eden Park since 1993, including:

- The original application for night games in 1993;
- The 2011 RWC hearings;
- Ongoing noise monitoring required by the various conditions of consent;
- Presentation of evidence at the Auckland Unitary Plan Hearings; and
- The successful application for 6 concerts per year in 2019.

On this occasion, MDA has been engaged by EPTB to:

- Examine the noise effects associated with an increase to 12 concerts per year;
- To review the music noise monitoring conditions following the experience of monitoring concerts at Eden Park (as allowed by condition 59); and
- To review the noise related conditions associated with pack-in and pack-out activity.

2.2 Special Event Noise Controls

Community response to amplified music is influenced by a number of factors and varies significantly from individual to individual. However, it is generally agreed that if concerts are limited in frequency, duration and have a clear known cut-off time, they are accepted by the community at considerably higher noise levels than the noise limits applying to 'day to day' activities. A short duration noise impact is generally considered reasonable when balanced against the wider community benefits of a large entertainment event.

The AUP Auckland-wide Temporary Activity rules in E40.6 adopts this 'short duration, infrequent, high noise limit' concept for the control of concerts held in typical parks in residential areas around Auckland. In summary, the rule allows 12 events per year operating at up to 70 dB L_{Aeq} and another 3 events per year up to 80 dB L_{Aeq} at the residential receivers in suburban areas. The duration of events is a maximum of 6 hours (with an extra 2 hours for sound balancing) and the cut-off time is 11pm (all days). These noise limits have been included in the Table 1 summary overleaf.

In our opinion, the Temporary Activity noise provisions form the basis of what the Council regards as a reasonable level of noise exposure from infrequent events for residents near a public park. In our opinion, residents surrounding a nominated recreation facility such as Eden Park, could expect to experience noise levels higher than residents near an Open Space Zone or parkland.

This concept is also reflected in the noise limits and duration controls that apply to stadia around New Zealand. A summary of noise controls for 'high noise events' applying to stadia outside Auckland is attached as Appendix B, and those applying to Auckland stadia are attached as Appendix C. In summary, New Zealand stadia are allowed between 3 to 30 high noise events per year, with noise limits ranging from 75 to 90 dB L_{Aeq} and cut off times from 10pm to 11:30pm.

The Auckland Unitary Plan (AUP) has adopted a 'multi-stage' approach to the setting of noise limits for major recreation facilities in Auckland. This 'multi-stage' approach sets higher noise limits for a small number of events and lower noise limits for a larger number of events. As discussed above, if high noise events are limited in frequency, duration and cut-off time, they are generally accepted by the community at considerably higher noise levels than the noise limits applying to day-to-day activities.

For Eden Park, the AUP rules and the Eden Park concert conditions effectively apply a 'two stage' approach, with normal noise limits for regular activities at the park (entertainment and sporting events) and a higher noise limit for concerts. Table 1 below summarises the noise limits for:

- Recreational parks under the Auckland wide 'temporary activity rule' (E40);
- Outdoor concerts at Auckland stadia; and
- The proposed 12 concerts for Eden Park.

2.3 Annual Noise Exposure

Because the controls on the number of concerts at stadia are based on an annual number, and because this current application is to increase the annual number of concerts from 6 to 12, an 'annual noise exposure' concept is proposed to assist with the assessment of noise effects. The World Health Organisation (WHO) uses an annual average for the evaluation of night noise effects.

The parameter $L_{Aeq,year}$ is proposed to evaluate the annual noise exposure due to concerts. $L_{Aeq,year}$ is the annual average of the daytime noise exposure levels. The $L_{Aeq,year}$ for each stadium has been calculated based on what the noise rules/conditions allow and is included in Table 1 below.

Table 1: Auckland Stadia - Noise Event Controls

Venue	High/Medium Noise Events per year	Duration (Hours)[1]	Cut-off time	Noise Limit (dB L_{Aeq})	Noise Exposure (dB $L_{Aeq,year}$)
Temporary Activity in a suburban park (E40.6.4)	3 12	3 + 1 8 + 2	11:00pm	80 70	56
Temporary Activity in a City Centre park (E40.6.5)	3 15	3 + 1 8 + 2	11:00pm	80 70	57
Western Springs Stadium	6 + 4	6 + 2	10:00/11:00pm	82/70	62
Mt Smart Stadium	6 + 30	6 + 3	10:30pm	75/65	57
North Harbour Stadium	6 + 10	4 + 3	11:30pm	82	65
Eden Park (consented)	6	6 + 3	10.30pm	75	55
Eden Park (proposed)	12	6 + 3	11:00pm	75	58

1. Maximum duration of the concert noise + maximum duration of sound check/rehearsal

Table 1 presents the annual noise exposure from concerts at Eden Park to enable direct comparison with comparable venues. In addition, Eden Park sports events must comply with the day-to-day noise limits in Appendix D. The annual noise exposure contribution from sports events[1] is 45 dB $L_{Aeq, year}$, resulting in a negligible increase in cumulative annual noise exposure levels (if included).

The results of these annual noise exposure calculations in Table 1 are discussed in the assessment of noise effects in Section 6.0.

2.4 Noise Sources

The main noise sources associated with large amplified concerts are:

- Music through the sound system (Section 3.0);
- Pack-in/pack-out noise before and after the event (Section 4.0); and
- Crowd noise during the event and dispersion afterwards (Section 5.0).

3.0 SOUND SYSTEM NOISE

3.1 Sound System Noise Modelling

Computer noise modelling of sound emanating from a concert sound system was carried out at the resource consent application stage using the internationally recognised sound modelling software SoundPLAN. This program utilises the algorithms contained in ISO 9613-2:1996 *"Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation".*

The model is the same one used for the previous concert consent application and was subsequently validated during concert monitoring. The digital terrain and surrounding houses used in the modelling was obtained from the Auckland Council GIS. The dimensions of the Eden Park buildings were obtained from architectural drawings with some areas verified by site inspection and including the acoustic barrier at the rear of the East Stand.

MDA modelled the concert sound emission from the park with three different stage orientations. The following three concert orientations were modelled with different sound levels at the mixing console:

- East Stage – speakers facing west (100 dB L_{Aeq} @ 30m)
- West Stage – speakers facing east (105 dB L_{Aeq} @ 30m)
- Centre Stage – 360 degree speaker arrangement (100 dB L_{Aeq} @ 30m)

The modelling showed that the three stage configurations were predicted to comply with 75 dB L_{Aeq} within the boundary of any site in a residential zoned property. It is also important to note that apart from the most exposed 20 houses exposed to 70 to 75 dB L_{Aeq}, the wider group of houses around the stadium are mostly below 70 dB L_{Aeq}.

Modelling of the West Stage configuration showed that it enabled the highest concert levels within the stadium while complying with the 75 dB L_{Aeq} noise limit. To show the wider noise effects, a separate figure showing the location of the 55 and 50 dB L_{Aeq} noise contours was also provided to Council (included for completeness in Appendix G).

3.2 Sound System Noise Monitoring

Noise monitoring has been carried out in accordance the conditions of consent for all concerts held at Eden Park to date. Detailed reports have been provided to the Council after each concert and a summary is provided in Table 2 overleaf. The results show that the concerts and sound check complied with the noise limits (generally with a margin of safety) except for a small infringement (1

[1] Assumptions: 25 evening games under lights at 55 dB $L_{Aeq\,(4hrs)}$ and 15 daytime game at 55 dB $L_{Aeq\,(13hrs)}$

and 2 dB) during the Ed Sheeran concerts due to a very low transfer function for the central stage and some technical difficulties with the sound equipment.

The measurements also confirmed the noise modelling was accurate with a small degree of conservatism (the modelling slightly over predicted the noise level at the residential interface).

The noise monitoring included calculations of the 'Transfer Function' – the difference between the sound level at the mixing console and the sound level at the 'most affected' residentially zoned house. The transfer function was found to be reasonably consistent for each stage orientation:

- East stage: Transfer function was 23 dB and the most affected site was 67 Sandringham Road
- Centre stage: Transfer function was 15 dB and the most affected site was 67 Sandringham Road
- West stage: Transfer function was 25 to 27 dB and the most affected site 35 Walters Road

Table 2: Concert noise monitoring summary

Concert	Stage Orientation	Average level at Residential Boundary (dB $L_{Aeq,t}$)	Highest level at Residential Boundary (dB $L_{Aeq,10mins}$)	Noise Level at Mixing Console (dB $L_{Aeq,10mins}$)	Transfer Function (dB)
Noise Limit	N/A	75	80	N/A	N/A
Six60: Nov 2022	East	72	77	100	23
Billy Joel: Dec 2022	East	71	73	96	23
Guns n Roses: Dec 2022	East	72	77	100	23
Ed Sheeran: 10 Feb 2023	Centre 360	75	**81**	96	15
Ed Sheeran: 11 Feb 2023	Centre 360	**76**	**82**	97	15
PINK: 8 March 2024	West	68	72	99	25 - 27
PINK: 9 March 2024	West	68	73	99	25 - 27

Noise monitoring in accordance with the conditions of consent has been very time consuming, with three people required on site for 1 to 3 days depending on the extent of sound calibration. Modifications to the monitoring procedures are proposed in Section 7.0 to reduce the time and cost of monitoring while maintaining confidence the noise limits are being complied with.

4.0 PACK-IN AND PACK-OUT NOISE

The process of pack-in and pack-out (pack-in/out) is described in detail by others (AEE and the traffic report). In terms of noise sources, the pack-in/out can usefully be divided into three main activities:

- Pack-in/out activity inside the stadium;
- Pack-in/out activity outside the stadium (in areas known as the 'boneyard'); and
- Trucks accessing the site and departing at night.

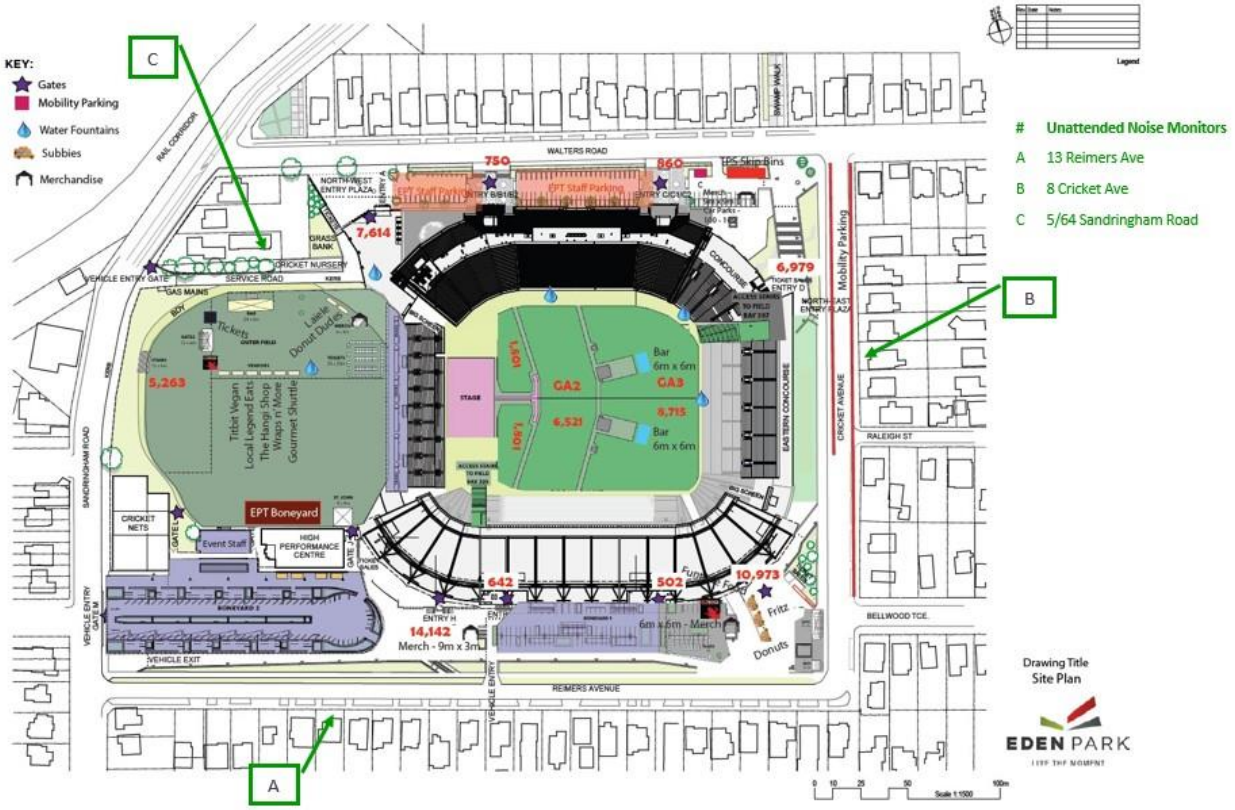
Each of these activities is discussed separately below, including measurements made at recent concerts and recommendations for changes to the conditions in Section 7.0.

A lot of Pack-in/out activity takes place during the daytime, is similar to other activities that currently occur at Eden Park, and has no difficulty complying with the daytime noise limits (refer AUP rule I310.6.1.1 included in Appendix D). However, due to tour schedules, some components of the work must also take place through the night. The larger concert acts often need to pack-out immediately after the end of the concert, through the night, to head for their next venue.

Night-time activity must comply with Condition 18 of the concerts consent – *"Pack-in and pack-out activities occurring between the hours of 10.30pm and 8.00am, shall comply with noise limits of 40dB L_{Aeq} and 75dB L_{AFmax}"*.

Detailed noise monitoring of pack-in/out noise was carried out over the period surrounding the two PINK concerts in March 2024. This involved three unattended noise loggers at the locations shown in Figure 1 below. In addition, shorter duration attended measurements were carried out at the logger positions and other locations.

Figure 1: – Noise Logger Locations - PINK Pack-in/out (west stage configuration)



4.1 Pack-in/out activity – inside the stadium

The monitoring showed that noise from activity within the stadium complied with the night noise limits, but some aspects of construction of the stage would be right on the 40 dB L_{Aeq} limit when the noise included the presence of special audible character components (i.e. audible tonal reversing alarms/beepers and impact wrenches/rattle guns).

In our opinion, night-time activities within the stadium can comply with the night-time noise limits subject to the adoption of simple noise management measures for the stage construction. Proposed wording to be added to the Pre and Post Event Management Plan is attached as Appendix F to directly address matters listed in Condition 34. The wording includes the avoidance of tonal reversing alarms (beepers) on equipment and use of impact wrenches (rattle guns) at night.

On this basis, Condition 46 which prohibits steelwork from taking place inside the stadium at night, can be deleted and the effects of noise can be controlled by compliance with the noise limits – as for other activities.

Modifications to the conditions relating to night-time pack-in/out activity inside the stadium are recommended in Section 7.4.

4.2 Pack-in/out activity – outside the stadium

Noise monitoring of pack-in/out noise carried out over the two PINK concerts in March 2024. The results showed that if those activities were undertaken at night in the boneyard areas adjacent to Reimers Ave, they would infringe the night noise limit 40 dB L_{Aeq}.

The noise monitoring allowed the sound power output (L_{WA}) of pack-in/out to be established. This L_{WA} data was used in SoundPLAN to model the boneyard activity located at the rear of the West Stand. The results are shown in detail in Figure 2. In summary, the predicted noise levels at the closest residential buildings in Reimers Avenue, Sandringham Road and Walters Road are 43 to 45 dB L_{Aeq}.

Figure 2: Boneyard noise modelling (behind west stand)

The noise monitoring during the period surrounding the PINK concerts allowed the background noise level to be measured also. The median night-time background noise level (L_{A90}) at the three logger positions was as follows;

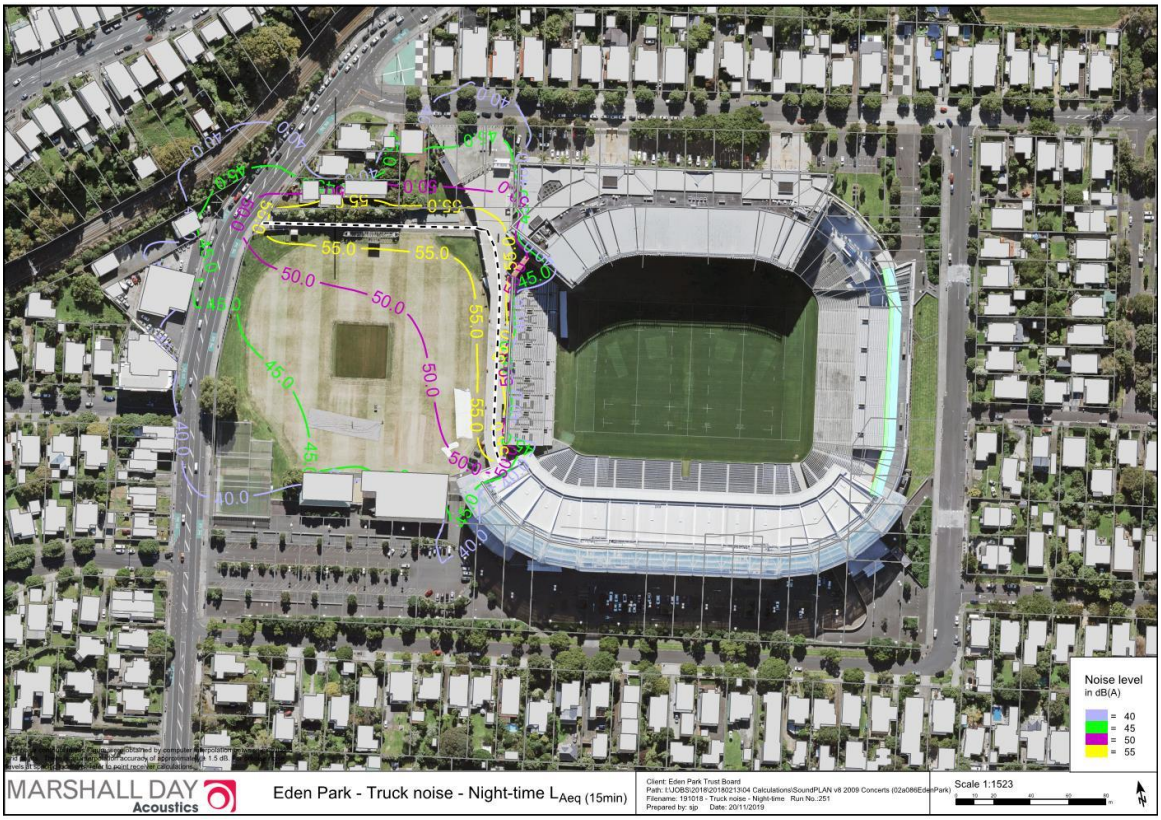
- 13 Reimers Ave 40 dB L_{A90}
- 5/64 Sandringham Rd 45 dB L_{A90}
- 8 Cricket Ave 41 dB L_{A90}

These background noise levels suggest the night noise limit of 40 dB L_{Aeq} in condition 18 is overly/unnecessarily stringent. We recommend raising the night-time noise limit to 45 dB L_{Aeq}. This issue is discussed further in Section 7.5.

4.3 Truck Noise

During the original concert application, noise measurements and modelling of trucks using Gate Q (north-west corner), predicted that compliance with the 40 dB L_{Aeq} night noise limit could be achieved at residences along Walters Road and Reimers Avenue – the closest "residentially-zoned sites". Figure 3 below shows the results of that modelling based on 1 truck per 15 minutes.

Figure 3: One Night-time Truck Movement $L_{Aeq(15min)}$



The residences in the north-west are not 'residentially-zoned' as they are within the Eden Park Precinct. Nevertheless, the noise effects on them need to be considered, hence Condition 43 contained the clause that heavy vehicle movements were restricted to *"no less than 15 minute intervals by a marshal at the departure point under the West Stand unless approval is obtained from all residents adjoining the Gate Q driveway to alternative egress arrangements"*.

A noise logger was located at 5/64 Sandringham Road (the most exposed residence in the NW group) during the period either side of the two PINK concerts in March 2024. The noise logger was located on the south balcony overlooking the truck path.

We understand Eden Park obtained written approval from this group of residents for 'alternative egress arrangements' for the PINK concerts. The approval was to allow several trucks per 15-minute interval. We understand at least one of the residents has expressed a preference for the truck movements to be 'over and done with' in a concentrated burst rather than spread out through the night with 1 truck per 15 minutes.

Micro analysis of the noise logger at 5/64 Sandringham Rd, along with visual observations of the truck activity, showed there were 6 truck movements between 12:00am and 12:15am on the 10 March 2024. The noise level from the 6 truck movements was 59 dB $L_{Aeq(15min)}$. This measurement confirms our original analysis in Figure 3 (1 truck/15 min) was conservative by approximately 4 dB in this case.

Our revised truck movement noise level predictions at the residential interface are:

- 1 truck/15 min: 36 dB $L_{Aeq\ (15min)}$
- 6 trucks/15 min (observed): 44 dB $L_{Aeq\ (15min)}$

We understand that Eden Park has received written approval from the north-west residents for dropping the restriction of 1 truck per 15 minutes from the consent conditions. This approach is included in the proposed amendments to conditions in Sections 7.5 and 7.6.

5.0 CROWD NOISE

Crowd noise was addressed in detail by the noise assessment[2] for the initial 6 concerts. The assessment is unchanged, so not repeated in full. Instead, the key points are summarised below.

Crowd noise is specifically exempt from the Eden Park Precinct noise rules (refer Appendix D). A crowd noise exemption is consistently applied at stadia because it cannot be controlled with a limit. Compliance aside, the crowd noise effects are discussed below.

Crowd noise levels have previously measured 65 to 68 dB at the residential interface when a try was scored during a large rugby match (crowd size of approximately 40,000). The cumulative duration of the crowd cheering above the 55 dB limit has previously been estimated to be 5 to 10 minutes for a rugby game and 20 to 40 minutes for a One Day International cricket game. A concert crowd is generally expected to produce lower vocal effort but could rise to similar levels near the end of a show. Therefore, concert crowd noise levels are predicted to be similar to a rugby or one day cricket match. The annual noise exposure contribution from crowd noise would result in a negligible increase in cumulative annual noise exposure (if included Section 2.3).

There is some additional noise from patrons dispersing in the streets after sports and concert events that might last for up to an hour. This remains unchanged by this proposal. Crowd noise is intermittent, of short duration and the concerts are infrequent. The proposed change from 6 to 12 concerts per year would increase the cumulative number of crowd noise events during the evening from 31 to 36 (i.e. 25 'night' games plus the change from 6 to 12 concerts).

6.0 ASSESSMENT OF NOISE EFFECTS

The assessment of noise effects submitted with the original concert consent application included an assessment of music noise, crowd noise, and load/in/pack down noise associated with 6 concerts per annum. These effects were deemed 'reasonable' by the Commissioners, subject to conditions. This section concentrates on the effects of increasing the number of concerts from 6 to 12. The effects on the other changes to conditions, which are predominantly practical and pragmatic, are discussed in Section 7.0.

Assessing the noise effects associated with increasing the number of concerts from 6 to 12 is not an easy task due to the lack of research into the acceptability of concerts. However, the Eden Park Residents Association survey, which is analysed in the Social Impact Assessment prepared by Dr Peter Phillips, provides some insight of the extent to which local residents are affected by concerts and has some bearing on this assessment. We understand that over 90% of respondents are supportive of 12 concerts per annum.

There is no New Zealand standard for controlling noise from outdoor events, nor any local guideline, and the controls for New Zealand stadia vary significantly as shown in Table 1 and Appendix B. We are not aware of any international standard on stadia noise, however, the UK have a guideline prepared originally in 1976 for the Greater London Council. The 1976 guideline has been revised on a number of occasions and the latest version was prepared by the Noise Council (UK), *"Code of practice on environmental noise control at concerts, 1995"*, and is generally referred to as the "Pop Code".

In summary, the Pop Code sets a maximum of 3 events per year at 75 dB L_{Aeq} and an additional maximum of 12 events with a noise limit at +15 dB(A) above background.

We understand from colleagues in the UK that the Pop Code has no statutory status and is well behind much of the current custom and practice in the UK when it comes to setting noise limits and the number days/events.

Our colleagues in the UK are of the opinion that the annual number of events recommended in the pop code were subjectively established and are essentially random. Experience since the code was

[2] MDA report: "*Eden Park – Concert Application, Assessment of Noise effects*", Sections 2.2 and 3.2, dated 13 Dec 2019

published is that the number of events can be increased above the suggested value in the code without unduly increasing adverse community response. Numerous outdoor venues in the United Kingdom which provide regular concerts and festivals lasting up to 14 hours each day have operated, and continue to operate, successfully with offsite noise limits up to 10 dBA more than the guidelines recommended in the Pop Code, and with a greater number of events, as shown in Table 3.

Table 3: Recent United Kingdom - High Noise Event Controls[3]

Venue	Number of days	Limit	Reference year
Crystal Palace Park	Not fixed. In 2022 there were over 20 days	Friday to Sunday 75 dBLAeq,15min & 90 dB LCeq,15 min. Mid-week no more than 65 dBLAeq,15min	2023
Hyde Park	6	75dBLAeq,5min	2023
Victoria Park	6	75dBLAeq,15min & 90 dB LCeq,15 min.	2023
MK Bowl Milton Keynes	6	75dB LAeq,15min & 90 dB LCeq,15 min.	2023
Alexandra Palace Park	3/4/23	75dB/65dB/55dB LAeq,15min	2023
Clapham Common	8	75dBLAeq,15min & 90 dB LCeq,15 min.	2023
Kennington Park	8	75dBLAeq,15min & 90 dB LCeq,15 min.	2023
Streatham Common	8	75dBLAeq,15min & 90 dB LCeq,15 min.	2023
Brockwell Park	8	75dBLAeq,15min & 90 dB LCeq,15 min.	2023
Norwood Park	8	75dBLAeq,15min & 90 dB LCeq,15 min.	2023
Heaton Park, Manchester	4	75dBLAeq,15min	2023
Godiva Festival, Coventry War Memorial Park	3	75dBLAeq,15min & 90 dBC Leq,15 min	2023
South Park, Oxford	Unknown	75dBLAeq,15min	2017
Bellahouston Park, Glasgow	3	75dBLAeq,15min	2019
Southsea common, Portsmouth	3	75dBLAeq,15min	2018
Otterspool Park, Liverpool	2	75dBLAeq,15min	2018
Isle of Wight Festival	3	75dBLAeq,15min	2023
Bestival	3	75dB LAeq,15min	2016
Cardiff Principality stadium	Unknown	75dB LAeq,15min	2018
Central park, East Ham	4	75dB LAeq,15min	2007
Plat fields	2	75dB LAeq,15min	2012
Edgeley Park, Stockport	2	75dB LAeq,15min	2019
Lloyd Park, Croydon	4	75dB LAeq,15min	2019
Beckenham Place Park	6	75dB LAeq,15min	2022

Clearly a relationship between number of events and the noise limit comes out in most of this analysis. As all the controls on the number of events are specified in terms of the number of events per annum, and this application is to increase the annual number from 6 to 12, we introduced the

[3] Table provided by Vanguardia UK – consultants who specialsie in Stadia acoustics.

'annual noise exposure' concept in Section 2.3. Table 4 is a simplified version of Table 1 with two columns deleted – duration and cut-off time, as most of their values were the same.

Table 4: Auckland Stadia - Annual Noise Exposure

Facility	High/Medium Noise Events per year	Noise Limit (dB L_{Aeq})	Noise Exposure (dB $L_{Aeq,year}$)
Temporary Activity in a suburban park (E40.6.4)	3/12	80/70	56
Temporary Activity in a City Centre park (E40.6.5)	3/15	80/70	57
Western Springs Stadium	6/4	82/70	62
Mt Smart Stadium	6/30	75/65	57
North Harbour Stadium	6/10	82	65
Eden Park (consented)	6	75	55
Eden Park Proposed	12	75	58

Table 4 shows that the annual noise exposure from the proposed 12 concerts per year at Eden Park is less than some other large stadia in Auckland and similar to the AUP Temporary Activity Rules.

This annual noise exposure doesn't take into account the pack-in/out noise. The proposed increase to effectively 6 pairs of concerts, enables more concerts without changing the number of pack-in/out events allowed by the current consent (i.e. 6). Mr Vinall will propose alterations to the conditions to align with this '6 pairs of concerts' approach.

AUP I310.8.2.(1) parts (a) to (c) set relevant assessment criteria. In summary, and subject to proposed amendments to the existing event conditions detailed in Section 7.0, we set out our response below:

a) Reasonableness:

   i. The overall noise effects from 12 concerts per annum (max of 6 artists), is slightly greater than 6 per annum and is approaching the upper limit of acceptability. 12 concerts at 75 dB L_{Aeq} is however, a lower annual noise exposure than some other major venues in Auckland and similar to the AUP Temporary Activity Rules.

   ii. Pack in/out activities should be enabled at night and controlled by a 45 dB L_{Aeq} noise limit

b) Notice: Residents will be given reasonable notice of scheduled events via existing conditions.

c) Duration and hours:

   i. The duration and hours of concerts will be managed appropriately via existing conditions

   ii. The pack in/out activities will be managed appropriately with the inclusion of recommended wording to be added to the Pre and Post Event Management Plan

7.0 PROPOSED AMENDMENTS TO NOISE CONDITIONS

Appendix E reproduces the Conditions of that Consent (LUC60351212) that are relevant to the control of concert noise effects:

- Conditions 6 – 14 control the number, frequency, timing, duration and location of scheduled concerts; and
- Conditions 15 – 26 detail the noise limits and noise monitoring requirements during concerts.

This section explains the proposed changes to the noise conditions, however the final wording of the proposed conditions should be taken from Mr Vinall's report.

7.1 Condition 17 & 24 – monitor at the mixing console

Noise monitoring at the residential boundary at the 7 concerts to date has been difficult due to interference from road traffic noise. This was particularly the case with the 67 Sandringham Road location (the most exposed location for the East and Centre stage orientations). During the sound check, Sandringham Road remains open to road traffic which means getting 'clean' measurements of the music noise is particularly difficult. During the concerts, Sandringham Road is generally closed which makes it slightly easier to measure music noise but there are still difficulties. An alternative noise monitoring procedure is thus proposed and included in the following changes to conditions.

As discussed earlier, the noise monitoring at concerts included measurement of the 'Transfer Function' – the difference between the sound level at the mixing console and the sound level at the 'most affected property'. The transfer function was found to be consistent for each stage orientation. As the transfer function is established, compliance monitoring can then be carried out at the mixing console knowing what the associated level will be out at the most affected location.

Accordingly, we recommend conditions 17 and 24 be modified as follows (alterations in red):

17. The noise level from use of sound systems associated with concerts, sound checks and the balancing of sound systems and any pyrotechnics displays that form part of the concert performance shall not cumulatively exceed 75 dB $L_{Aeq(t)}$ and 80 dB $L_{Aeq(10min)}$ when measured/calculated within the boundary of any residentially-zoned site not owned by the Eden Park Trust.

24. The consent holder shall engage a suitably qualified and experienced acoustic expert to carry out noise monitoring of every concert, except as provided by Condition 26 below. The objective of the monitoring shall be to accurately determine whether or not compliance with the noise limits in Condition 17 is achieved within the boundary of residentially zoned sites not owned by the Eden Park Trust that are most exposed to the noise from the concert, ~~and to provide feedback to the concert Front of House (FoH) team /~~ by measuring at the mixing desk in real time to ensure that compliance is achieved. The noise limits in (a) below have been calculated using the established transfer function for the three representative stage configurations. The transfer function must be measured if a different stage configuration is used (e.g. south or north).

The noise monitoring shall involve:

(a) Noise level measurements at the mixing console that must not exceed ~~boundary of properties in the residential zone that are the most exposed to noise from the concert during sound checks and during the main concert. The measurement locations shall be varied initially or as necessary to determine the most exposed property to continue measurements from for the remainder of the sound check and concert.~~;

East Stage (facing west):	98 dB $L_{Aeq(t)}$ and 103 dB $L_{Aeq(10min)}$
West Stage (facing east):	100 dB $L_{Aeq(t)}$ and 105 dB $L_{Aeq(10min)}$

(b) ~~The use of equipment and methods that comply~~Measurement and assessment must be in accordance with ~~the requirements of~~ NZS6801:2008 and NZS6802:2008, except where varied by ~~and~~ the conditions of this consent ~~where they vary the requirements of either standard~~.

(c) There shall be no adjustments for special audible character or meteorological effects.

(d) The requirement for the acoustic expert ~~person undertaking noise monitoring outside the venue~~ to communicate directly with a nominated person at ~~FoH /~~ the mixing console ~~desk~~ inside the venue who has the authority to reduce noise levels ~~at source if necessary, on the advice of the noise expert conducting the monitoring~~ to ensure ~~that~~ compliance with the noise limits in Condition 17 ~~is achieved at all times~~.

(e) Noise level measurements shall be conducted in contiguous 10 minute samples to determine the $L_{Aeq(10min)}$ for each 10 minute period, and the $L_{Aeq(t)}$ value shall be calculated in real time to allow for any reduction in the noise levels that might be necessary to achieve compliance with the $L_{Aeq(t)}$ noise limit in Condition 17.

(f) The acoustic expert shall establish the maximum sound system level at the mixing console for any stage configuration that is not represented in Condition 24 (a) by monitoring at the mixing console and at the most affected residential interface simultaneously (e.g. for a Centre Stage arrangement).

7.2 Monitoring during sound check

Sound check for the large overseas acts generally involves two separate parts. The first is the sound system calibration and balancing which involves a series of low sound level audio test signals of short duration (10 to 30 seconds). The sound level is often below 70 dB L_{Aeq} inside the stadium, which would mean that the external level at the residential interface would be complying with the 'day-to-day' District Plan noise limits. Later on, a full band sound check is normally carried out with music at full show level. For most large acts, this is of short duration (e.g. typically a few minutes at a time – they do not need to rehearse).

Monitoring the overall sound check is thus very complicated, particularly for the short duration of the test signals.

For the above reasons, we recommend that the sound check should also be monitored at the mixing console and calculated out to the residential boundary using the established transfer functions. The proposed modifications to conditions 17 and 24 (above) resolve this.

7.3 Averaging period 't' during no amplified sound

Condition 22(a) states that short gaps in music (i.e. less than 15 minutes of "no amplified sound") can be included in the averaging period 't'. It implies that gaps of more than 15 minutes should not be included in the averaging period. The Rating Noise Level assessment method in NZS 6802 requires averaging over a prescribed time frame. The prescribed time frames for the concerts and sound checks are detailed in conditions 10 (d), 11 (d), 12 (d), 15 (a) and 16 (b). The NZS 6802 approach is sensible, as the noise effects are reduced when there are large gaps of no sound, compared with the sound running continuously for 15 hours.

We thus recommend that Condition 22 be modified as follows:

22. Noise levels shall be measured in accordance with 'NZS 6801:2008 Acoustics – Measurement of Environmental Sound' and assessed in accordance with 'NZS 6802:2008 Acoustics – Environmental Noise', except that:

(a) where $L_{Aeq(t)}$ is specified, 't' is the duration in conditions 10(d), 11(d), 12(d), 15(a) and 16(b)

~~• the total duration amplified sound generated during sound checks and balancing of sound systems where gaps of no amplified sound of up to 15 minutes are included in the measurement; or~~

~~• the total duration of live or pre-recorded amplified sound and pyrotechnic displays (that are not 'fireworks' subject to standard I310.6.13) generated during the concert event where gaps of no amplified sound of up to 15 minutes are included in the measurement.~~

(b) for the duration of 't' as applied in Condition 17, there shall be no adjustment for special audible character (in accordance with section 6.3 of NZS6802:2008) for amplified music, and or amplified voice and no further adjustment for duration (in accordance with section 6.4 of NZS6802:2008) for amplified music or amplified voice.

7.4 No construction allowed in the stadium at night

Condition 46 prohibits steelwork from taking place inside the stadium at night (no matter what noise levels). In our understanding, this is contrary to the 'effects based approach' of the RMA. In our opinion, the effects from activity should be controlled by appropriate noise limits rather than a blanket ban on particular activities, especially now that we have noise monitoring data for this activity on which to base our assessment.

Section 4.1 showed that most activities within the stadium can comply with the night noise limits and the others can comply with appropriate management or mitigation.

On this basis, we recommend that Condition 46 be deleted and the recommended management procedures (Appendix F) be added to the Pre and Post Event Management Plan to directly address the matters listed in Condition 34. Recommended measures include avoidance of tonal reversing alarms (beepers) on machinery and no use of impact wrenches (rattle guns) at night.

7.5 Pack-in/out activity outside the stadium

As discussed in Section 4.2, the existing background noise levels are in the range of 41 to 45 dB L_{A90} (detailed data in Appendix H). The generally accepted practice for establishing noise limits is to set an L_{Aeq} limit at 5 to 10 dB above the background noise level L_{A90}.

On this basis we recommend the night noise limit in Condition 18 is changed from 40 dB L_{Aeq} to 45 dB L_{Aeq}. This proposed limit is also consistent with the AUP 'Business to Residential' night noise limit of 45 dB L_{Aeq}.

7.6 Limitations on truck activity

Conditions 40 to 43 restrict the activity of trucks in terms of where and when they can operate.

Condition 40 is reasonable because it prevents heavy vehicles associated with concerts from using Walters Road or Reimers Avenue at any time. However, we recommend Conditions 41, 42 and 43 are deleted because the noise effects on residents located in the Residential Zone are protected by the noise limits, and residents in the NW corner of the Eden Park Precinct have given written approval. The proposed modifications are shown below.

> 40. Heavy vehicles associated with concerts shall access and egress from Sandringham Road only, using Gate Q, the bus hub or temporary gates. No heavy vehicles associated with concerts may access, park or idle on Walters Road or Reimers Avenue.
>
> ~~41. Heavy vehicles may only enter the site between 8:00am and 10:30pm on any day, and on the day of the concert must be parked inside the tunnel under the south stand, or down the ramp forming the entrance to the south tunnel by 10:30pm.~~
>
> ~~42. No heavy vehicles may exit the site between 10:30pm and 8:00am, except as provided for by Condition 43.~~
>
> ~~43. Where pack-out activities commence immediately following the conclusion of a concert, no more than 17 heavy vehicles may exit the site between the hours of 10:30pm and 8:00am the next day. Any such heavy vehicle movements shall be controlled to exit the site, via the western end of the South Stand and onto Sandringham Road through the gate at the northwest corner of the Eden Park site, at no less than 15 minute intervals by a marshal at the departure point under the West Stand unless approval is obtained from all residents adjoining the Gate Q driveway to alternative egress arrangements.~~

APPENDIX A GLOSSARY OF TERMINOLOGY

dB	Decibel The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 μPa i.e. dB = 20 x log(P/Pr)
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
$L_{Aeq\,(t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{AFmax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
SEL or L_{AE}	Sound Exposure Level The sound level of one second duration which has the same amount of energy as the actual noise event measured. Usually used to measure the sound energy of a particular event, such as a train pass-by or an aircraft flyover
NZS 6801:2008	New Zealand Standard NZS 6801:2008 *"Acoustics – Measurement of environmental sound"*
NZS 6802:2008	New Zealand Standard NZS 6802:2008 *"Acoustics – Environmental Noise"*

APPENDIX B NZ STADIA NOISE CONTROLS (EX AUCKLAND)

Venue	Events per year	Total Duration per annum (hours)	Cut-off Time	Residential Zone Noise Limit (dB L_{Aeq})
Arena Manawatu	30	435 (permitted between 8.00 am – 10.30pm)	2230	75
Waikato	5	20 hrs	11:00 pm	80
Napier	5	63 hrs	10:30/12:00pm/1:00 am	90
Wellington Stadium	6	84 hrs	11:00 pm	75
New Plymouth Rugby Park	52	260 hrs	10:00 pm	60
Rodney District	N/A	13 hrs	9:00 am /6:00 pm 6:00 pm /1:00 pm	80 75
Okara Stadium Whangarei	5	25 hrs	10:30 pm 11:00 pm	3 @ 85 75
Rotorua	5	55 hrs	3 @ 11:00 pm 2 @ 10:45 pm	3 @ 90 2 @ 85
Hamilton MF Zone	5	3 + 4 hrs	11:00 pm	75
The Hub Hawera	6	Total 6 Single 3	7.00 am 10.00 pm	80

APPENDIX C AUP SPECIAL EVENT NOISE CONTROLS

Venue	AUP Rule	Noise Event	Events per year	Duration (Hours)[4]	Cut-off time	Noise Limit (dB L_{Aeq})
Western Springs Stadium **62 dB $L_{Aeq,year}$**	I335.6	High	6	6 + 2	10:00/11:00pm	82
		Medium	4	6 + 2	10:00pm	70
		Low	4	6 + 2	10:00pm	55
Mt Smart Stadium **57 dB $L_{Aeq,year}$**	I321.6	High	6	6 + 3	10:30pm	75
		Medium	30	6 + 3	10:30pm	65
		Low	50	6 + 3	10:30pm	55
North Harbour Stadium **65 dB $L_{Aeq,year}$**	I524.6	High	6	4 + 3	11:30pm	82
		Medium	10	4 + 3	11:00pm	82
Ellerslie Racecourse, ASB Showgrounds, Bruce Pulman Park, ECOlight Stadium **54 dB $L_{Aeq,year}$**	I313.6 I301.6 I407.6 I411.6	High	5	6 + 0	10:30pm	75
		Medium	15	6 + 0	10:30pm	65
Temporary Activity in a suburban park **56 dB $L_{Aeq,year}$**	E40.6.4	High	3	3 + 1	11:00pm	80
		Medium	12	8 + 2	11:00pm	70
Temporary Activity in a City Centre park **57 dB $L_{Aeq,year}$**	E40.6.5	High	3	3 + 1	11:00pm	80
		Medium	15	8 + 2	11:00pm	70

[4] Maximum duration of the concert + maximum duration of sound check/rehearsal

APPENDIX D EDEN PARK PRECINCT NOISE RULES

I310.6.1. Noise

(1) The noise (rating) level from any activity as measured within the boundary of any site in a residential zoned property (not owned by the Eden Park Trust) must not be greater than the noise limits in Table I310.6.1.1 Noise standards.

Table I310.6.1.1: Noise standards

Time, day, duration and frequency	Noise limit
All days between 8:00am and 10:30pm	55dB $L_{A10\ (13hr)}$ 60dB $L_{A10\ (10min)}$ 85dB L_{Amax}
At all other times	40dB L_{A10} and 75dB L_{Amax}

(2) Noise limits must be measured in accordance with NZS 6801:2008 Acoustics – Measurement of Environmental Sound and assessed in accordance with NZS 6802:2008 Acoustics – Environmental Noise.

(3) For noise events an adjustment must not be applied to amplified music or amplified voice sounds containing special audible characteristics (with respect to section 6.3 of NZS6802:2008) but other sources of sound may have an adjustment applied if necessary in accordance with the same section.

(4) The prescribed time frames for the purpose of assessment according to NZS6802:2008 must be the timeframe for which any particular noise limit applies.

(5) Crowd noise is to be excluded from any assessment of compliance with these limits.

(6) Where $L_{Aeq\ (10min)}$ is specified, no 10 minute measurement sample can exceed the stated limit.

(7) A computer based measurement system (including electronic limiter) attached to the sound system output must be used as the preferred method of measurement for sound system noise except for any 75 dB noise events.

(8) Professional fireworks displays and helicopter flights are excluded from this standard.

APPENDIX E EDEN PARK CONCERTS CONSENT CONDITIONS (LUC60351212)

Conditions 6 – 26 are reproduced below for ease of reference. Refer to decision for full set of conditions.

Number and frequency of Concert Events

6. No more than six concert events may be held in any 12-month period.

7. No more than four concerts may be held in any four-week period.

8. There shall be at least one weekend (inclusive of Friday night) in every 35-day period that is free of any concert or organised sports and recreation undertaken during the night-time on the number 1 field.

Advice note:

For the purposes of condition 8 a concert event includes the pack in and pack out dates either side.

Night-time activities are defined in I310.4 of the AUP as those activities that are undertaken between 30 minutes before sunset on one day and 30 minutes before sunrise on the following day. For clarity, any activity that continues longer than 30 minutes before sunrise remains defined as a night time activity.

Days of the Week

9. Concerts may take place on Monday to Saturday (inclusive) and any Sunday that precedes a Public Holiday.

Concert on a weekday (other than a public holiday)

10. Any concert held on a weekday (other than a public holiday) is restricted as follows:

(a) The gates to the number 1 field shall not open before 5:00pm;

(b) The concert shall not start before 6:30pm for supporting acts and 7:30pm for the main act;

(c) The concert shall finish no later than 10:30pm;

(d) The total duration of the concert, being time between the commencement of the first (or single) performance/act and the conclusion of the last (or single) performance/act, shall not exceed four (4) hours; and

(e) The crowd size shall not exceed 50,000 persons.

Concert on a Saturday or a Sunday preceding a public holiday

11. Any concert held on a Saturday or a Sunday preceding a public holiday is restricted as follows:

    (a) The gates to the number 1 field shall not open before 8:30am;

    (b) The concert shall not start before 10:00am;

    (c) The concert shall finish no later than 10:30pm;

    (d) The total duration of the concert, being time between the commencement of the first (or single) performance/act and the conclusion of the last (or single) performance/act, must not exceed six (6) hours; and

    (e) The crowd size shall not exceed 60,000 persons.

Concert on a public holiday

12. Any concert held on a public holiday is restricted as follows:

    (a) The gates to the number 1 field shall not open before 8:30am;

    (b) The concert shall not start before 10:00am;

    (c) The concert shall finish no later than 10:30pm;

    (d) The total duration of the concert, being time between the commencement of the first (or single) performance/act and the conclusion of the last (or single) performance/act, shall not exceed six (6) hours; and

    (e) The crowd size shall not exceed 60,000 persons.

Multiple Concerts

13. No more than one concert may be held on any one day.

    Advice note:

    A concert may feature one or multiple artists of equal or lesser billing.

Concert stage

14. The concert stage shall be on the Number 1 field. There are no other limitations on stage configurations.

Testing and balancing

15. Testing and balancing of all sound systems involving PA and/or vocal checks and/or rehearsals by performers for a concert shall:

    (a) not cumulatively exceed 3 hours;

    (b) not commence before 5pm on any weekday (other than a public holiday);

    (c) not commence before 10am on any Saturday, Sunday or public holiday;

    (d) be completed by 7pm; and

    (e) comply with the noise levels in Condition 17.

16. Where testing and balancing of sound systems involving PA and/or vocal checks and/or rehearsals by performers cannot be practicably undertaken after 5pm on any weekday, this may be undertaken between 10am and 5pm provided that:

    (a) the consent holder informs the Council and any care centre and education facilities in the vicinity of Eden Park of the start time for any such testing and balancing, no less than 24 hours before it commences; and

    (b) it does not cumulatively exceed 90 minutes; and

    (c) complies with the noise limit specified in Condition 17.

    Advice note:

    "The vicinity of Eden Park" is defined for the purposes of this consent as those properties bound by New North Road, Onslow Road, Dominion Road, Paice Avenue/Kenneth Avenue/Leslie Avenue and Morningside Drive, and any other property located adjacent to a TMP restriction.

Noise limits

17. The noise level from use of sound systems associated with concerts, sound checks and the balancing of sound systems and any pyrotechnics displays that form part of the concert performance shall not cumulatively exceed 75 dB $L_{Aeq(t)}$ and 80 dB $L_{Aeq(10min)}$ when measured within the boundary of any residentially-zoned site not owned by the Eden Park Trust.

18. Pack-in and pack-out activities occurring between the hours of 10.30pm and 8.00am, shall comply with noise limits of 40dB L_{Aeq} and 75dB L_{AFmax}. Pack-in and pack-out activities occurring at all other times must comply with the noise limits contained in the Eden Park Precinct Noise Standards in I310.6.1.1.

    Advice note:

    Pack-in and pack-out includes the delivery of equipment, construction of the necessary infrastructure including turf protection, security fencing, staging, production infrastructure, temporary toilet and food and beverage facilities, post-event deconstruction, loading and removal of all concert-related infrastructure.

20. Professional fireworks displays that include an air-burst where the detonation or burst occurs in an airborne situation shall be excluded from any assessment of compliance with the noise limits specified in Condition 17, and shall instead be in compliance with Standard I310.6.13 of the AUP. Any such professional fireworks display associated with a concert must conclude by 10:30pm.

21. The noise level from all other activities (not covered by Conditions 17 to 20), including pack-in and pack-out activities, shall comply with the noise limits contained in the Eden Park Precinct Noise Standards in I310.6.1.1.

22. Noise levels shall be measured in accordance with 'NZS 6801:2008 Acoustics – Measurement of Environmental Sound' and assessed in accordance with 'NZS 6802:2008 Acoustics – Environmental Noise', except that:

    (a) where $L_{Aeq(t)}$ is specified, 't' is:

        - the total duration amplified sound generated during sound checks and balancing of sound systems where gaps of no amplified sound of up to 15 minutes are included in the measurement; or
        - the total duration of live or pre-recorded amplified sound and pyrotechnic displays (that are not 'fireworks' subject to standard I310.6.13) generated during the concert event where gaps of no amplified sound of up to 15 minutes are included in the measurement.

    (b) for the duration of 't' as applied in Condition 17, there shall be no adjustment for special audible character (in accordance with section 6.3 of NZS6802:2008) for amplified music or amplified voice and no adjustment for duration (in accordance with section 6.4 of NZS6802:2008) for amplified music or amplified voice.

23. Crowd noise shall be excluded from any assessment of compliance with the noise limits specified in Condition 17.

Noise Monitoring

24. The consent holder shall engage a suitably qualified and experienced acoustic expert to carry out noise monitoring of every concert, except as provided by Condition 26 below. The objective of the monitoring shall be to accurately determine whether or not compliance with the noise limits in Condition 17 is achieved within the boundary of residentially zoned sites not owned by the Eden Park Trust that are most exposed to the noise from the concert, and to provide feedback to the concert Front of House (FoH) team / mixing desk in real time to ensure that compliance is achieved.

    The noise monitoring shall involve:

    (a) Noise level measurements at the boundary of properties in the residential zone that are the most exposed to noise from the concert during sound checks and during the main concert. The measurement locations shall be varied initially or as necessary to determine the most exposed property to continue measurements from for the remainder of the sound check and concert.

    (b) The use of equipment and methods that comply with the requirements of NZS6801:2008 and NZS6802:2008 and the conditions of this consent where they vary the requirements of either standard.

    (c) There shall be no adjustments for special audible character or meteorological effects.

    (d) The requirement for the person undertaking noise monitoring outside the venue to communicate directly with a nominated person at FoH / mixing desk inside the venue who has the authority to reduce noise levels at source if necessary, on the advice of the noise expert conducting the monitoring to ensure that compliance with the noise limits in Condition 17 is achieved at all times.

    (e) Noise level measurements shall be conducted in contiguous 10 minute samples to determine the $L_{Aeq(10min)}$ for each 10 minute period, and the $L_{Aeq(t)}$ value shall be calculated in real time to allow for any reduction in the noise levels that might be necessary to achieve compliance with the $L_{Aeq(t)}$ noise limit in Condition 17.

25. The results of all noise monitoring shall be provided to the Council for its certification. The report must be prepared by a suitably qualified and experienced expert in acoustics and the report must be provided to the Council within one week of the concert occurring. The report shall detail the results of all $L_{Aeq(10min)}$ and $L_{Aeq(t)}$ measurements, including locations, meteorological conditions and all adjustments made for crowd noise or any extraneous noise sources. The report shall also record the results of all noise measurements of professional fireworks displays to determine compliance or otherwise with the relevant noise limits in I310.6.13 of the AUP.

26. Following the monitoring of at least five concerts in accordance with Conditions 24-25, the Council may waive the requirement to monitor any individual concert where the consent holder can demonstrate to the Council's satisfaction in advance, in writing, and at least 15 working days prior to the concert, that the particular size, character or nature of an individual concert means that it is likely to comply with the relevant noise limits in the precinct standards and in Condition 17 with a high degree of certainty.

APPENDIX F PACK-IN/OUT NOISE MANAGEMENT PROCEDURES

General management measures

Complaints can arise even if the noise levels comply with the consented noise limits. To minimise noise complaints, the following common mitigation measures are recommended:

- Avoid unnecessary noise. This means managing the site to ensure:
  - No shouting
  - No unnecessary use of horns - consider use 2-way radio, spotters, cameras, proximity sensors etc to minimise use of horns
  - No loud site radios at night
  - No rough handling of material and equipment
  - No unnecessary steel on steel contact (e.g. loading/unloading of scaffolding) – consider mandating the use of rubber or timber mallets for scaffold construction)
  - No high engine revs. This includes choosing the right sized equipment, turning engines off when idle, and ensuring forklift operators are skilled and use their machine considerately.
- Locate stationary equipment (e.g. generators) away from noise sensitive receivers and/or screen them behind site buildings using noise matts / barriers. More detail on the construction and use of noise barriers below.
- When selecting equipment (e.g. forklifts):
  - Use electric motors rather than diesel / LPG engines where practicable
  - Use equipment that is suitably sized for the task to balance efficiency and noise emissions
  - Maintain equipment well to minimise rattles, squeaks etc
  - Avoid tonal reversing or warning alarms (beepers). Alternatives include broadband alarms (squawkers/quackers), flashing lights, proximity sensors, reversing cameras and spotters.
- Avoid the use of rattle guns at night.

Noise barriers

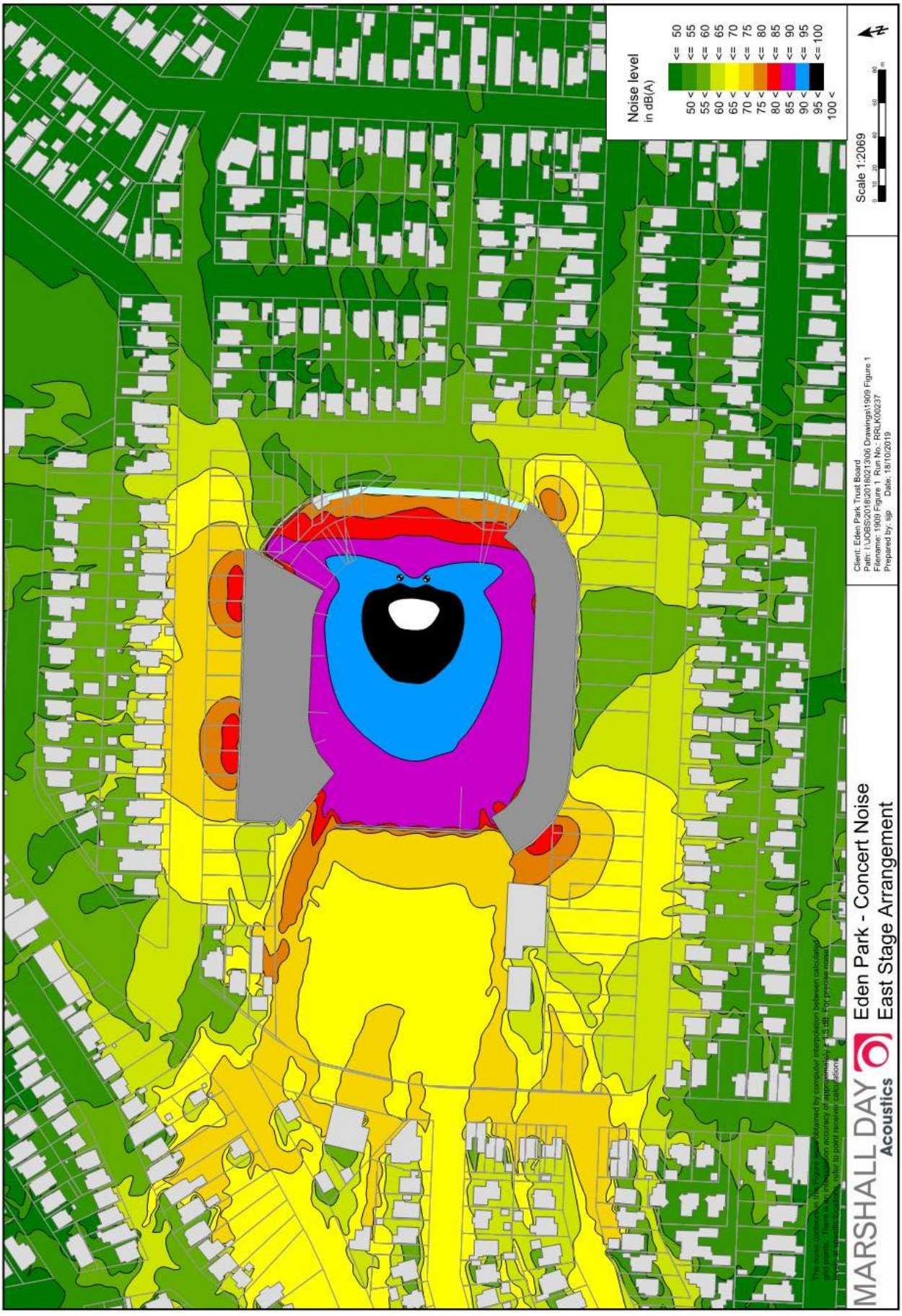
Temporary noise barriers should be used where an activity is predicted to exceed the noise limits. They should be installed prior to works commencing and maintained for the duration of the activity. Effective noise barriers typically reduce the received noise level by 10 decibels.

Where practicable, the following guidelines will be used in designing and installing temporary noise barriers:

- The panels will have a minimum surface mass of 6.5 kg/m2. Suitable panels include 12 mm plywood or the following proprietary ‘noise curtains’:
  - SealedAir ‘WhisperFence 24dB’ (www.sealedair.com)
  - Hushtec ‘Premium Series Noise Barrier’ (www.duraflex.co.nz)
  - Soundbuffer ‘Performance Acoustic Curtain’ (soundbuffer.co.nz)
  - Hoardfast ‘Fast Wall Premium PVC partition panels' (www.ultimate-solutions.co.nz)
  - Safesmart ‘Acoustic Curtain 6.5kg/m2’ (www.safesmartaccess.co.nz)
- Alternatives will be approved by a suitably qualified and experienced acoustic specialist
- The panels should be a minimum height of 2 m, and higher if practicable to block line-of-sight

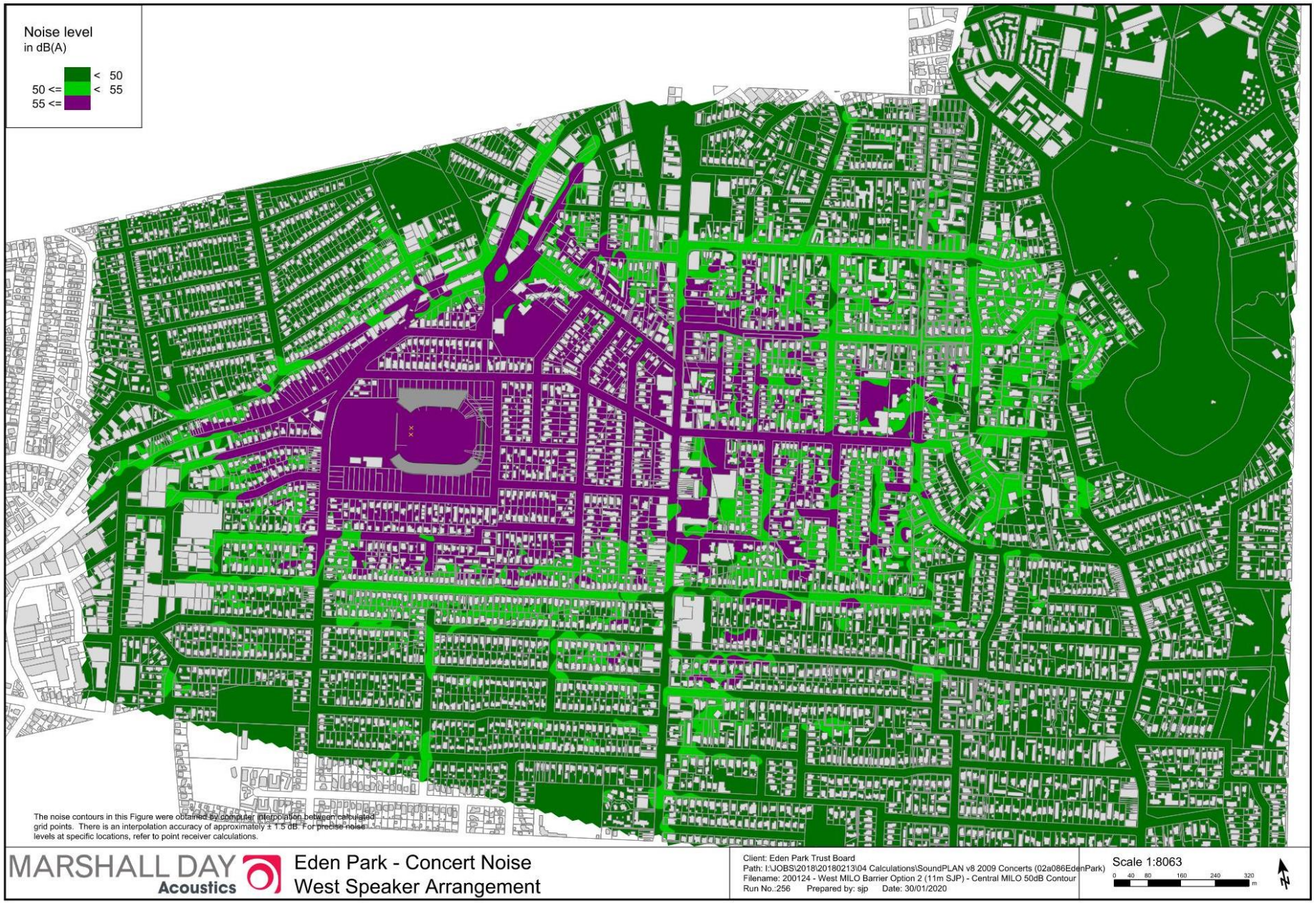
- The panels should be abutted, battened or overlapped to provide a continuous screen without gaps at the bottom or between panels
- Barriers should be positioned as close as practicable to the high-noise activity to block line-of-sight between the activity and noise sensitive receivers. A site hoarding at the boundary may not be effective for all receivers. In such cases, add extra barriers close to high-noise activities to ensure effective mitigation for sensitive receivers on upper floors.

APPENDIX G CONCERT NOISE MODELLING (3 STAGE CONFIGURATIONS)

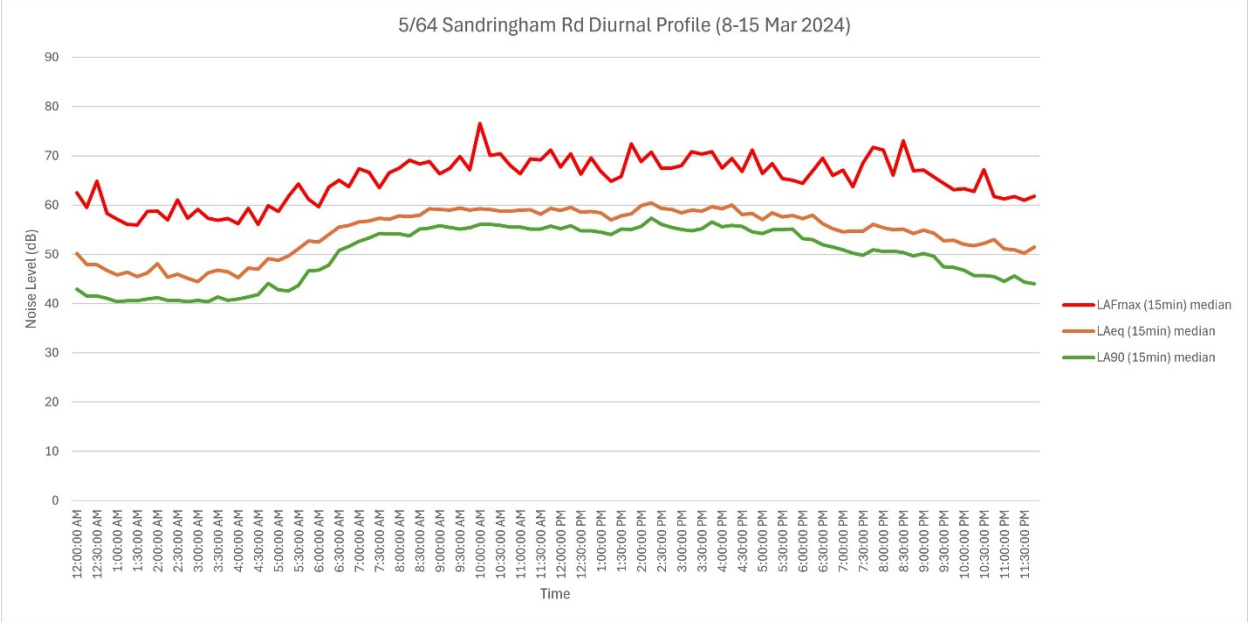


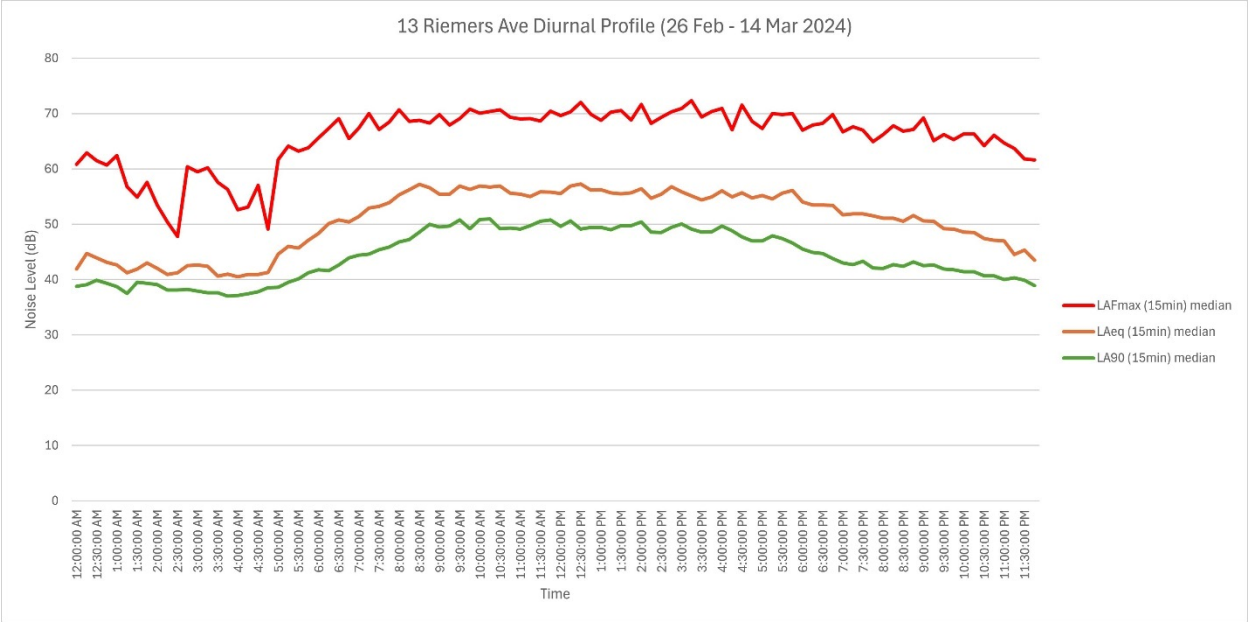
Noise level
in dB(A)
<= 50
<= 55
<= 60
<= 65
<= 70
<= 75
<= 80
<= 85
<= 90
<= 95
<= 100
50 <
55 <
60 <
65 <
70 <
75 <
80 <
85 <
90 <
95 <
100 <
Scale 1:2069
Client: Eden Park Trust Board
Path: I:\JOBS\2018\20180213\06 Drawings\1909 Figure 2
Filename: 1909 Figure 2 Run No.: RRLK00238
Prepared by: sjp Date: 18/10/2019
MARSHALL DAY Acoustics
Eden Park - Concert Noise
West Stage Arrangement

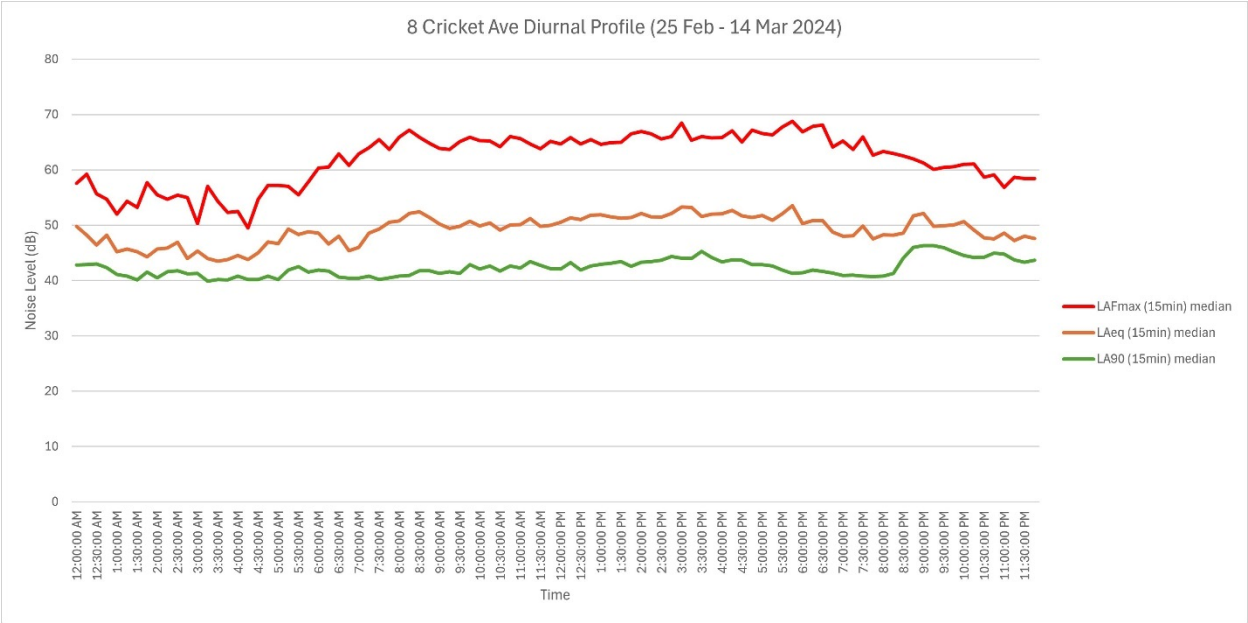
Noise level
in dB(A)
<= 50
<= 55
<= 60
<= 65
<= 70
<= 75
<= 80
<= 85
<= 90
<= 95
<= 100
50 <
55 <
60 <
65 <
70 <
75 <
80 <
85 <
90 <
95 <
100 <
Scale 1:2069
MARSHALL DAY Acoustics
Eden Park - Concert Noise
Centre Stage Arrangement
Client: Eden Park Trust Board
Path: I:\JOBS\20180213\6 Drawings\1909 Figure 3
Filename: 1909 Figure 3 Run No.: RRLK00238
Prepared by: sjp Date: 18/10/2019
The noise contours in this Figure were obtained by computer interpolation between calculated grid points. There is an interpolation accuracy of approximately ± 5 dB. For precise noise levels at specific locations, refer to point receiver calculations.


Noise level
in dB(A)
< 50
50 <= < 55
55 <=
The noise contours in this Figure were obtained by computer interpolation between calculated grid points. There is an interpolation accuracy of approximately ± 1.5 dB. For precise noise levels at specific locations, refer to point receiver calculations.
MARSHALL DAY Acoustics
Eden Park - Concert Noise
West Speaker Arrangement
Client: Eden Park Trust Board
Path: I:\JOBS\2018\20180213\04 Calculations\SoundPLAN v8 2009 Concerts (02a086EdenPark)
Filename: 200124 - West MILO Barrier Option 2 (11m SJP) - Central MILO 50dB Contour
Run No.:256 Prepared by: sjp Date: 30/01/2020
Scale 1:8063
0 40 80 160 240 320 m
N

APPENDIX H NOISE MONITORING DIURNAL PROFILES






8 Cricket Ave Diurnal Profile (25 Feb - 14 Mar 2024)
Noise Level (dB)
80
70
60
50
40
30
20
10
0
12:00:00 AM
12:30:00 AM
1:00:00 AM
1:30:00 AM
2:00:00 AM
2:30:00 AM
3:00:00 AM
3:30:00 AM
4:00:00 AM
4:30:00 AM
5:00:00 AM
5:30:00 AM
6:00:00 AM
6:30:00 AM
7:00:00 AM
7:30:00 AM
8:00:00 AM
8:30:00 AM
9:00:00 AM
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10:00:00 AM
10:30:00 AM
11:00:00 AM
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12:00:00 PM
12:30:00 PM
1:00:00 PM
1:30:00 PM
2:00:00 PM
2:30:00 PM
3:00:00 PM
3:30:00 PM
4:00:00 PM
4:30:00 PM
5:00:00 PM
5:30:00 PM
6:00:00 PM
6:30:00 PM
7:00:00 PM
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8:00:00 PM
8:30:00 PM
9:00:00 PM
9:30:00 PM
10:00:00 PM
10:30:00 PM
11:00:00 PM
11:30:00 PM
Time
LAFmax (15min) median
LAeq (15min) median
LA90 (15min) median