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Environmental Noise Assessment

Keysbrook Motorsports Facility

Reference: 17094123-01J

Prepared for:
Stati Investments Pty Ltd

Report: 17094123-01J

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11/12/17	-	Final Issued to Client for Comment	Daniel Lloyd	Terry George
5/04/18	A	Updated sound power levels to reflect noise limits at trackside and removed reference to V8	Daniel Lloyd	Terry George
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11/10/24	J	Updated Figure 1-2	Terry George	-

Table of Contents

List of Tables

List of Figures

Appendices

1 INTRODUCTION

Stati Investments Pty Ltd is the proponent for the proposed Keysbrook Motorsport facility (the Motorsport Facility) to be located at Lot 78 (No. 732.) Punrak Road, Keysbrook and Lot 400 (No. 146) Wigg Road, Hopeland. The locality of the proposed Motorsport Facility together with the nearby sensitive receivers is provided in *Figure 1-1*.

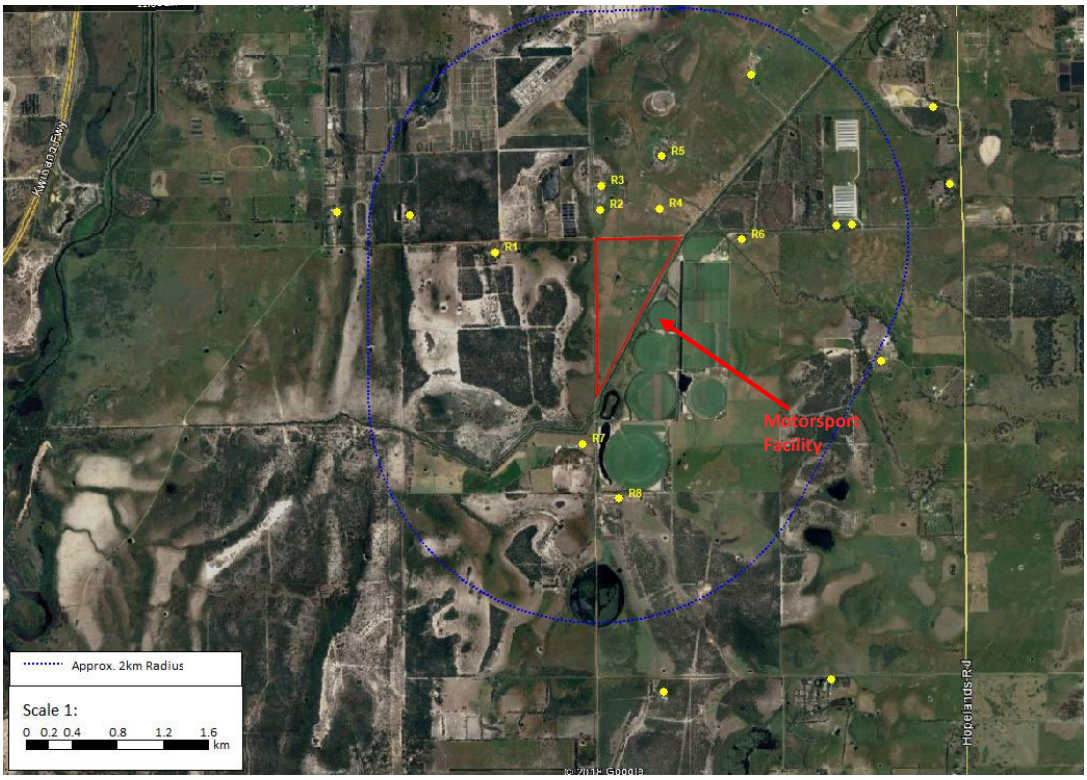


Figure 1-1 Project Locality and Sensitive Receivers

The Motorsport Facility will ultimately have the ability to host national and international sporting events with designed construction to achieve Fédération Internationale de l'Automobile (FIA) and Confederation of Australian Motor Sport (CAMS) standards for cars and motorbikes and Commission Internationale de Karting (CIK) level for Go-Karts.

The main circuit will be designed with the ability to gain FIA accreditation for national and international ratings. Stage 1 of the development of the Motorsport Facility, which is the subject of this assessment, will include local and national racing and a range of activities that promote road and driver safety and opportunities for other significant corporate and private events. Stage 2, of the development will be to obtain accreditation for international racing. The proposed track layout is provided in *Figure 1-2*.

Lloyd George Acoustics has been commissioned to determine the expected noise emissions from the Motorsports Facility, which will be used in the development of the Noise Management Plan for the proposed facility.

Appendix A contains a description of some of the terminology used throughout this report.

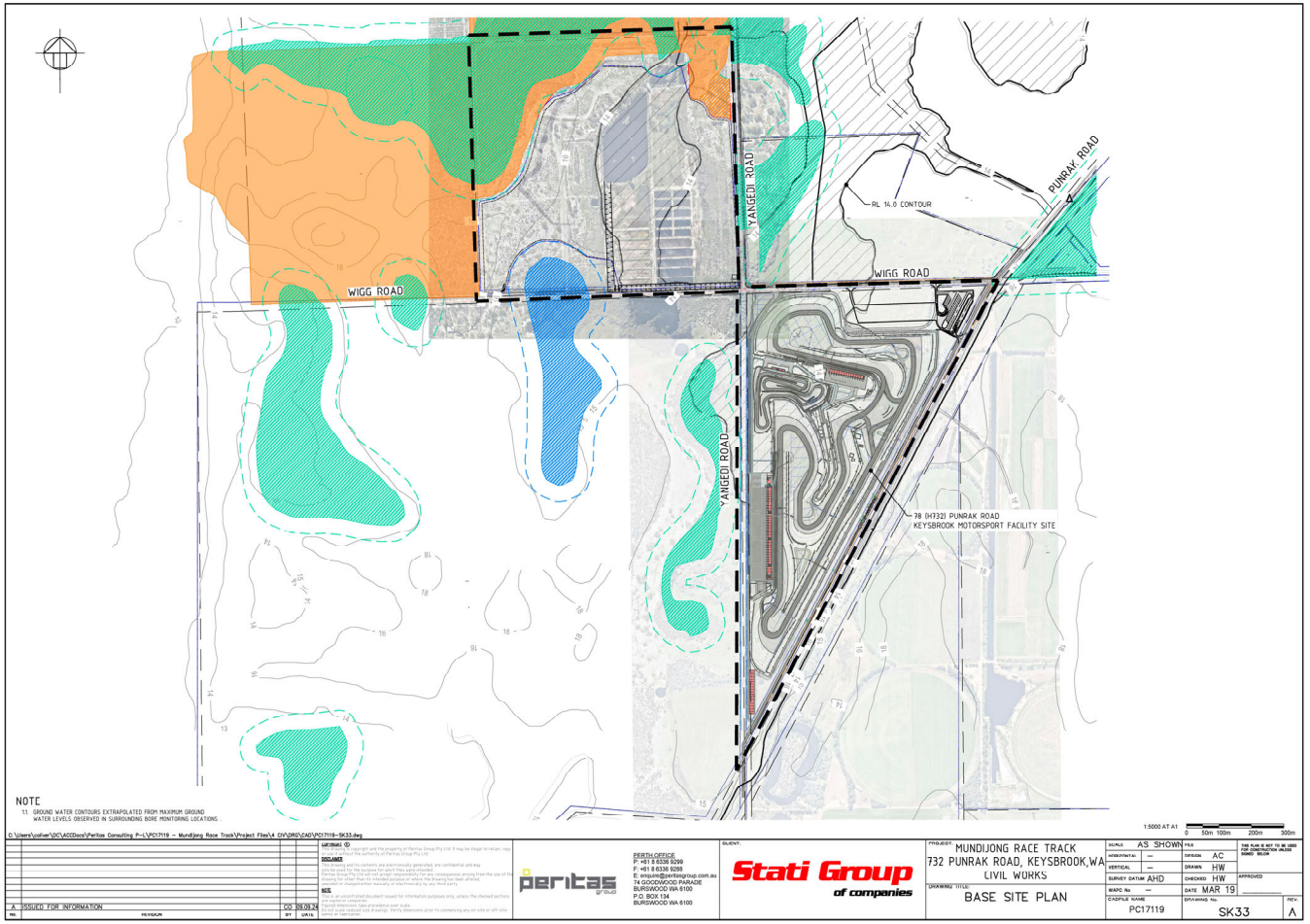


Figure 1-2 Proposed Motorsport Facility Layout

2 CRITERIA

Environmental noise in Western Australia is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

Regulation 7 defines the prescribed standard for noise emissions as follows:

"7. (1) Noise emitted from any premises or public place when received at other premises –

(a) Must not cause or significantly contribute to, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind; and

(b) Must be free of –

i. tonality;

ii. impulsiveness; and

iii. modulation,

when assessed under regulation 9"

A "…noise emission is taken to significantly contribute to a level of noise if the noise emission … exceeds a value which is 5 dB below the assigned level…"

Tonality, impulsiveness and modulation are defined in Regulation 9. Noise is to be taken to be free of these characteristics if:

(a) The characteristics cannot be reasonably and practicably removed by techniques other than attenuating the overall level of noise emission; and

(b) The noise emission complies with the standard prescribed under regulation 7 after the adjustments of *Table 2-1* are made to the noise emission as measured at the point of reception.

Table 2-1 Adjustments Where Characteristics Cannot Be Removed

Where Noise Emission is Not Music			Where Noise Emission is Music	
Tonality	Modulation	Impulsiveness	No Impulsiveness	Impulsiveness
+ 5 dB	+ 5 dB	+ 10 dB	+ 10 dB	+ 15 dB

Note: The above are cumulative to a maximum of 15dB.

The baseline assigned levels (prescribed standards) are specified in Regulation 8 and the relevant assigned levels are shown in *Table 2-2*.

Table 2-2 Baseline Assigned Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area[1]	0700 to 1900 hours Monday to Saturday (Day)	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays (Sunday)	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days (Evening)	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35 + influencing factor	45 + influencing factor	55 + influencing factor
Noise sensitive premises: any area other than highly sensitive area	All hours	60	75	80

1. ***highly sensitive area*** means that area (if any) of noise sensitive premises comprising —
   (a) a building, or a part of a building, on the premises that is used for a noise sensitive purpose; and
   (b) any other part of the premises within 15 metres of that building or that part of the building.

Generally, the influencing factor applicable at the noise sensitive premises in rural areas is 0 dB, so the baseline assigned levels would apply.

The Regulations acknowledge that motor sport activities are an integral part of society and such venues are unlikely to achieve compliance with the assigned levels. To address this, the Regulations specifically provide for motor sport venues in regulation 16A through a process of approval of a noise management plan. Advice from Henry Jackson of Francis Burt Chambers dated 13 February 2019 confirms that regulation 16A can be used for proposed motor sport facilities.

The sections in *regulation 16A* most relevant to this assessment state:

16AA. Approval of noise management plan: motor sport venue

(1) The occupier of a motor sport venue may apply to the CEO for approval of —

(a) a noise management plan for the venue; or

(b) an amendment of an approved noise management plan for the venue.

(3) The CEO may, in writing —

(a) if the application is for the approval of a noise management plan — approve, or refuse to approve, the noise management plan for the motor sport venue; or

(b) if the application is for an amendment of an approved noise management plan — approve, or refuse to approve, the amendment.

(4) Before making a decision under subregulation (3) the CEO —

(a) must give the following a reasonable opportunity to make a submission on whether or not the plan or amendment should be approved —

(i) the occupier of any noise sensitive premises within 1 km of the motor sport venue;

(ii) the local government of each district in which noise emissions received from the venue are likely to fail to comply with the standard prescribed under regulation 7; and

(b) may give any other person the CEO considers appropriate in the circumstances a reasonable opportunity to make a submission on whether or not the plan or amendment should be approved.

(5) An approval of a noise management plan under subregulation (3) —

(a) may be granted subject to conditions imposed by the CEO; and

(b) subject to subregulation (6) and regulation 16AC, has effect for the period specified in the approval.

(7) The CEO must not approve a noise management plan for a motor sport venue unless the plan —

(a) contains a map (current at the time of the application) showing the motor sport venue, including the area where motor vehicles or motor vessels are raced or prepared for racing and car parks used by competitors in races at and visitors to the venue; and

(b) contains a description of the types of racing activities that can reasonably be expected to be conducted at the venue and classes of vehicles or vessels that can reasonably be expected to race at the venue; and

(c) sets out limitations on the racing activities to be conducted and the times during which racing activities may be conducted; and

(d) contains details of reasonable and practicable measures to be implemented to control noise emissions from the venue during the conduct of a racing activity at the venue; and

(e) contains details of when and the manner in which notice of racing activities at the venue is to be published or distributed to members of the public; and

(f) specifies the persons who will be responsible for implementing the approved noise management plan and sets out each person's responsibilities; and

(g) contains a complaint response procedure.

(9) Regulation 7 does not apply to noise emitted from a motor sport venue during the conduct of a racing activity at the venue if the racing activity is conducted in accordance with an approved noise management plan, excluding any ancillary measure, for the venue.

The term racing activity is defined as "… means racing of motor vehicles … conducted as part of a competition day, practice or training session, exhibition run, trial, test, entertainment event, promotion or other similar activity." Henry Jackson in the same advice referred to previously, also stated that racing can be against other vehicles or a single vehicle racing against the clock and on this basis, concluded all of the proposed motor vehicle uses as being 'racing activity' thereby being managed under regulation 16A via an approved noise management plan. Only events described as seminars, cycling events and cross country events did not meet the requirements since they do not involve motor vehicles.

The purpose of this assessment is not to produce a noise management plan, however, to determine the impact from the Motorsport Facility to sensitive receivers to determine the actions required for the development of the noise management plan.

3 CURRENT NOISE ENVIRONMENT

To determine the current noise environment, Acoustic Research Laboratories (ARL) Ngara statistical noise data loggers were placed at three locations in the vicinity of the proposed facility. The noise monitoring locations are shown in *Figure 3-1* with Location 1 located near the closest residence to the north and Location 2 near the closest residence to the south.

Under the Regulations, there are certain requirements that must be satisfied when undertaking measurements and are defined in Regulations 19, 20, 22 and 23 and Schedule 4. In undertaking the measurements, these have been satisfied, specifically noting the following:

- All equipment holds current laboratory certificates of calibration that are available upon request. The equipment was also field calibrated before and after the measurement session and found to be within +/- 0.5 dB.
- Each microphone was fitted with a standard windscreen.
- The microphone was at least 1.2 metres above ground level and at least 3.0 metres from reflecting facades (other than the ground plane).

The loggers for locations 1 and 2 remained in place between the 30th August and 11th September 2018. The logger at Location 3 remained in place between 20th and 29th August 2020. *Table 3-2* summarises the weather conditions (Bureau of Meteorology Mandurah Weather Station) during the time of monitoring at Locations 1 and 2.

The results of the monitoring are presented in *Figure 3-2* to *Figure 3-4*.

The true background, to determine whether the facility will be audible, is calculated by taking the L_{A90} noise levels over each 15-minute period and working out the 10th percentile (90% of the noise levels are the same or higher).

Table 3-2 provides the average of the 10th Percentile of the L_{A10} and L_{A90} for the various regulatory time periods.

Table 3-1 Weather Summary During Monitoring at Locations 1 and 2

Date	Weather
30-Aug-2018	No rain. Winds light to moderate and generally southerly direction.
31-Aug-2018	No rain. Winds light and variable.
1-Sep-2018	No rain. Winds light and generally southerly direction.
2-Sep-2018	No rain. Winds light and variable.
3-Sep-2018	Rain 1.2mm at 6pm. Winds light to moderate and generally northeasterly to northwesterly direction.
4-Sep-2018	Rain in the early morning and evening with highest hour of 1.6mm at 5.00am. Winds light to strong and generally westerly direction.
5-Sep-2018	Some rain (0.6mm) in the early morning. Winds light to strong and predominantly southwesterly.
6-Sep-2018	Some rain (0.6mm) in the morning. Winds light to moderate and variable.
7-Sep-2018	Some rain throughout the day (2.4mm) with majority at 3am (1.4mm). Winds light to moderate and predominantly westerly.
8-Sep-2018	Rain in the early morning (1.4mm). Winds light to moderate and predominantly westerly.
9-Sep-2018	No rain. Winds light to moderate and predominantly northerly.

Whilst the monitoring is not undertaken for an entire year, weather conditions were reasonably mild and variable during the monitoring. In this case, there are not significant noise sources in any particular direction that would be influenced by wind direction. Whilst rainfall did occur and some strong winds, the analysis uses the lowest 10% of the measured L_{10} and L_{90} values and are as expected, relatively low. It is therefore considered that the monitoring and subsequent analysis is reasonably representative of the background noise levels throughout the year. Monitoring for a 12 month period is considered unnecessary as the monitoring demonstrates that noise from the venue will be above that of background noise.

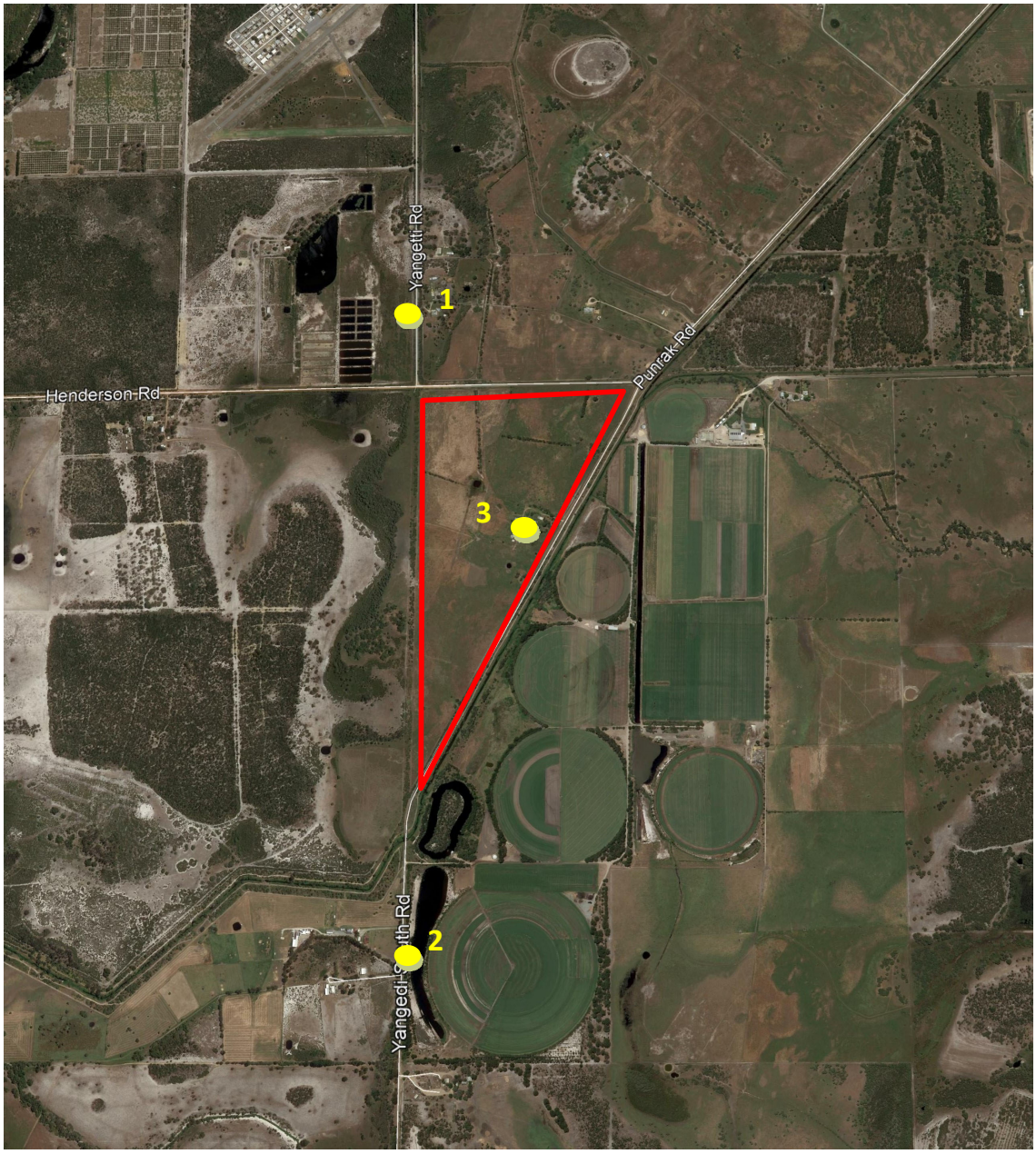


Figure 3-1 Noise Monitoring Locations

Table 3-2 Average 10th Percentile of the Measured Noise Levels

Location	Period	Parameter	
		L_{A10}, dB	L_{A90}, dB
1	Monday to Saturday Day (7am to 7pm)	41	31
	Monday to Saturday Evening (7pm-10pm)	35	30
	Sunday Day (7am to 7pm)	40	29
	Sunday Evening (7pm-10pm)	34	30
2	Monday to Saturday Day (7am to 7pm)	43	32
	Monday to Saturday Evening (7pm-10pm)	41	33
	Sunday Day (7am to 7pm)	40	30
	Sunday Evening (7pm-10pm)	43	34
3	Monday to Saturday Day (7am to 7pm)	40	29
	Monday to Saturday Evening (7pm-10pm)	36	29
	Sunday Day (7am to 7pm)	39	31
	Sunday Evening (7pm-10pm)	37	29

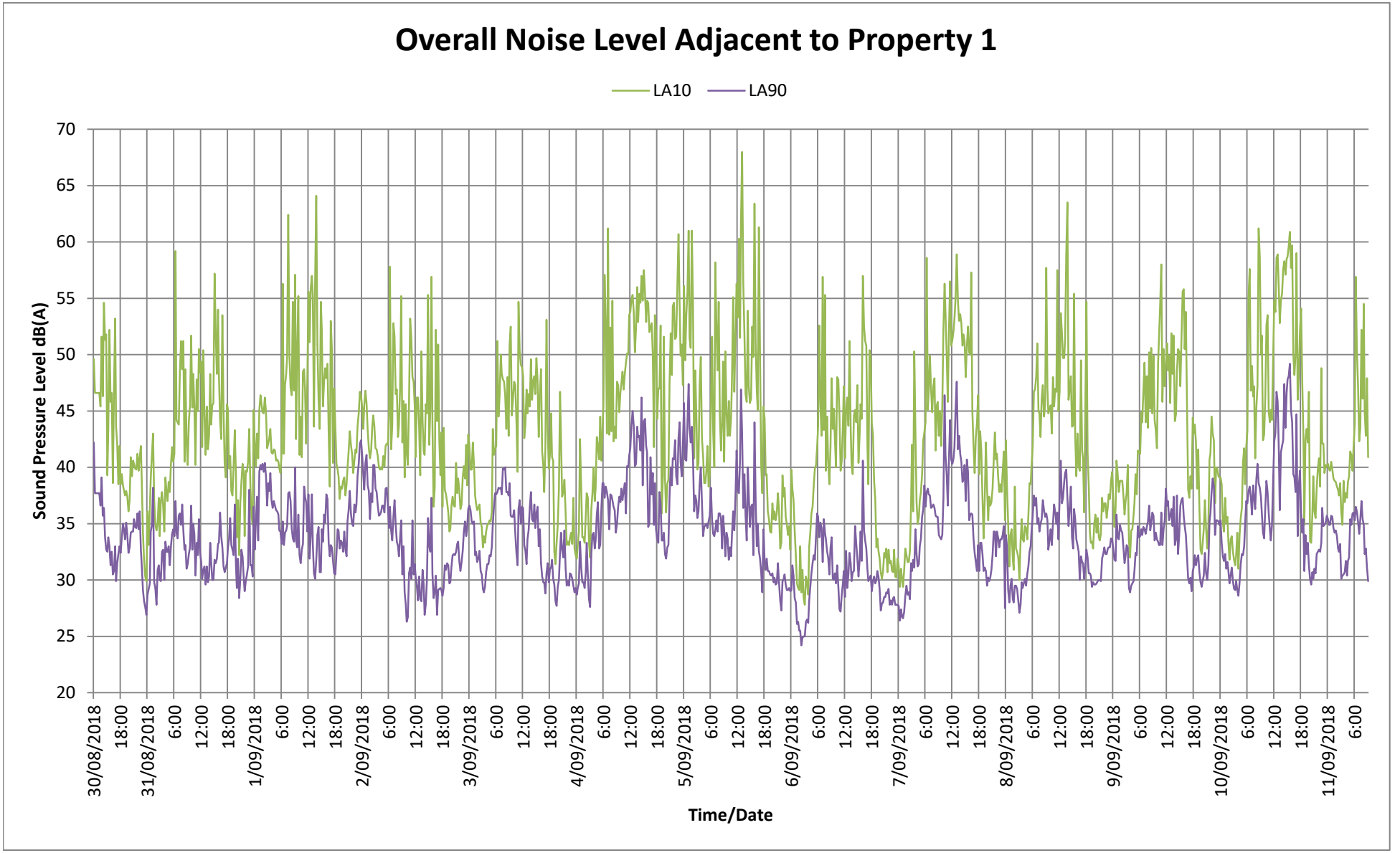
In addition to the overall noise levels, frequency analysis of the 10th percentile L_{90} noise levels (L_{90} of the L_{90}) at Location 3 are presented in *Figure 3-5* to *Figure 3-8*, being for the relevant time periods referred to in the Regulations.

Table 3-2 Average 10th Percentile of the Measured Noise Levels

Location	Period	Parameter	
		L_{A10}, dB	L_{A90}, dB
1	Monday to Saturday Day (7am to 7pm)	41	31
	Monday to Saturday Evening (7pm-10pm)	35	30
	Sunday Day (7am to 7pm)	40	29
	Sunday Evening (7pm-10pm)	34	30
2	Monday to Saturday Day (7am to 7pm)	43	32
	Monday to Saturday Evening (7pm-10pm)	41	33
	Sunday Day (7am to 7pm)	40	30
	Sunday Evening (7pm-10pm)	43	34
3	Monday to Saturday Day (7am to 7pm)	40	29
	Monday to Saturday Evening (7pm-10pm)	36	29
	Sunday Day (7am to 7pm)	39	31
	Sunday Evening (7pm-10pm)	37	29

In addition to the overall noise levels, frequency analysis of the 10th percentile L_{90} noise levels (L_{90} of the L_{90}) at Location 3 are presented in *Figure 3-5* to *Figure 3-8*, being for the relevant time periods referred to in the Regulations.

Figure 3-2


Overall Noise Level Adjacent to Property 1
LA10
LA90
Sound Pressure Level dB(A)
70
65
60
55
50
45
40
35
30
25
20
30/08/2018 18:00
31/08/2018 6:00
31/08/2018 12:00
31/08/2018 18:00
1/09/2018 6:00
1/09/2018 12:00
1/09/2018 18:00
2/09/2018 6:00
2/09/2018 12:00
2/09/2018 18:00
3/09/2018 6:00
3/09/2018 12:00
3/09/2018 18:00
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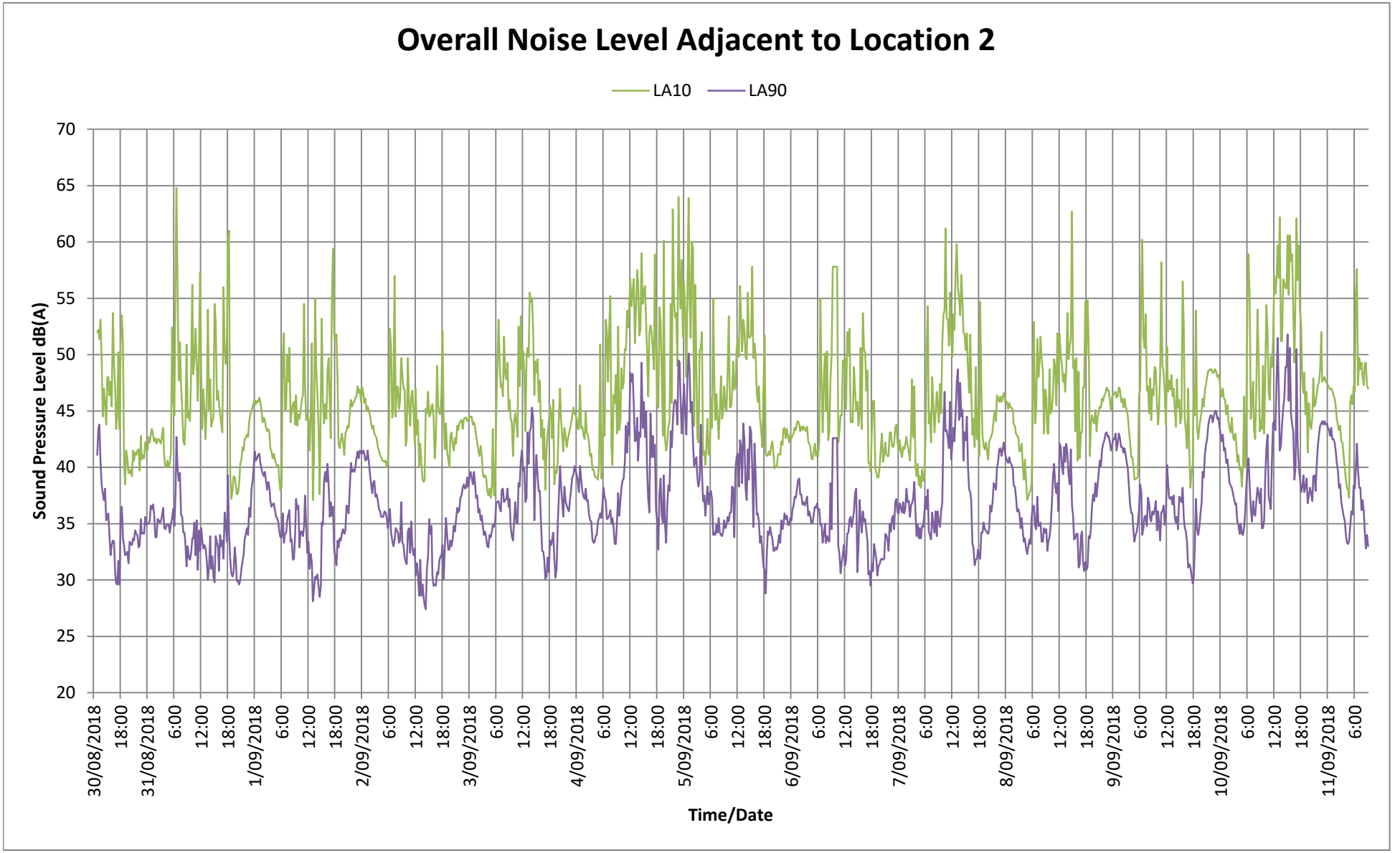
6/09/2018 6:00
6/09/2018 12:00
6/09/2018 18:00
7/09/2018 6:00
7/09/2018 12:00
7/09/2018 18:00
8/09/2018 6:00
8/09/2018 12:00
8/09/2018 18:00
9/09/2018 6:00
9/09/2018 12:00
9/09/2018 18:00
10/09/2018 6:00
10/09/2018 12:00
10/09/2018 18:00
11/09/2018 6:00
Time/Date

Figure 3-3


Overall Noise Level Adjacent to Location 2
LA10
LA90
Sound Pressure Level dB(A)
70
65
60
55
50
45
40
35
30
25
20
30/08/2018 18:00
31/08/2018 6:00
31/08/2018 12:00
31/08/2018 18:00
1/09/2018 6:00
1/09/2018 12:00
1/09/2018 18:00
2/09/2018 6:00
2/09/2018 12:00
2/09/2018 18:00
3/09/2018 6:00
3/09/2018 12:00
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6/09/2018 6:00
6/09/2018 12:00
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7/09/2018 6:00
7/09/2018 12:00
7/09/2018 18:00
8/09/2018 6:00
8/09/2018 12:00
8/09/2018 18:00
9/09/2018 6:00
9/09/2018 12:00
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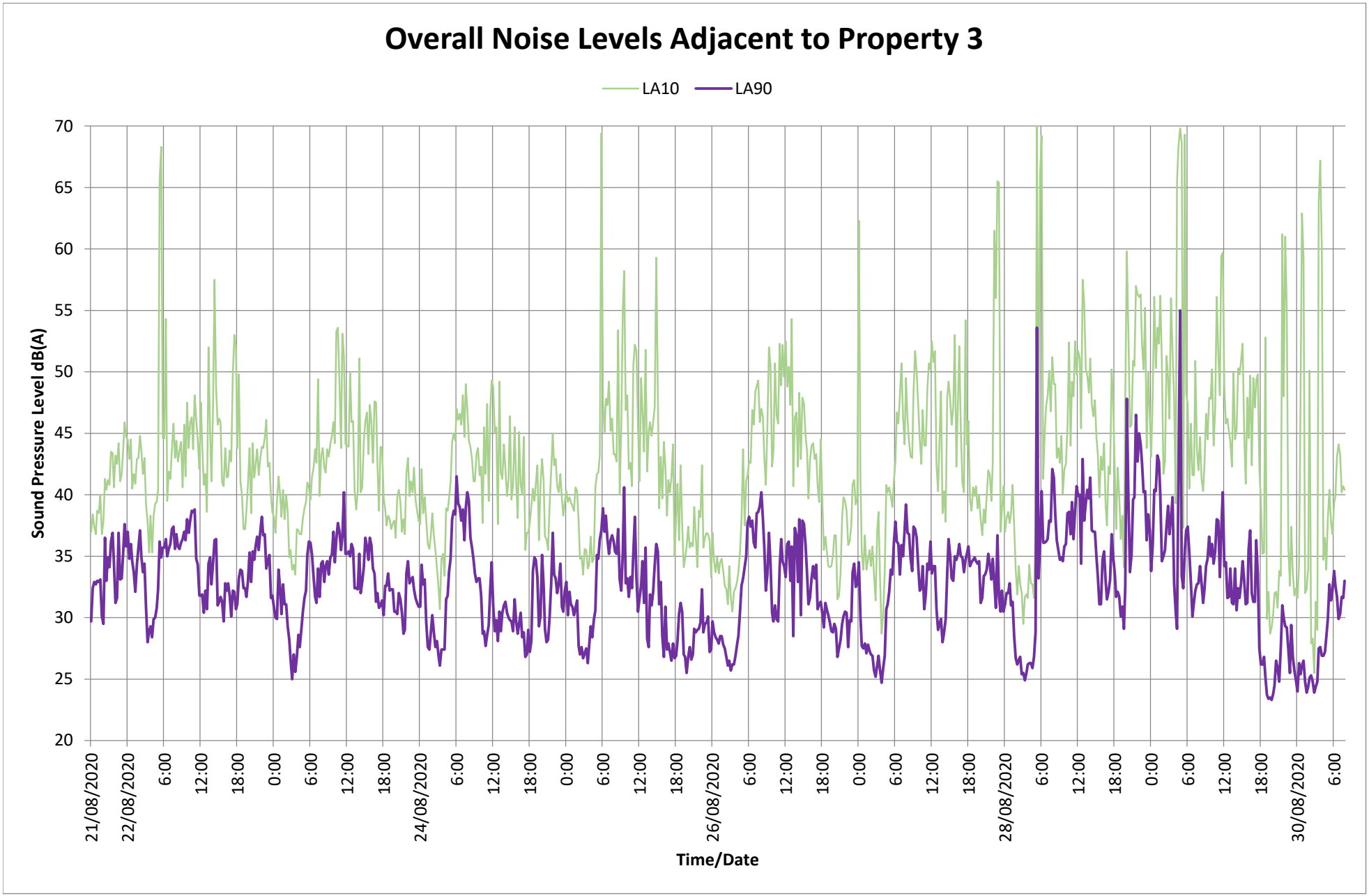
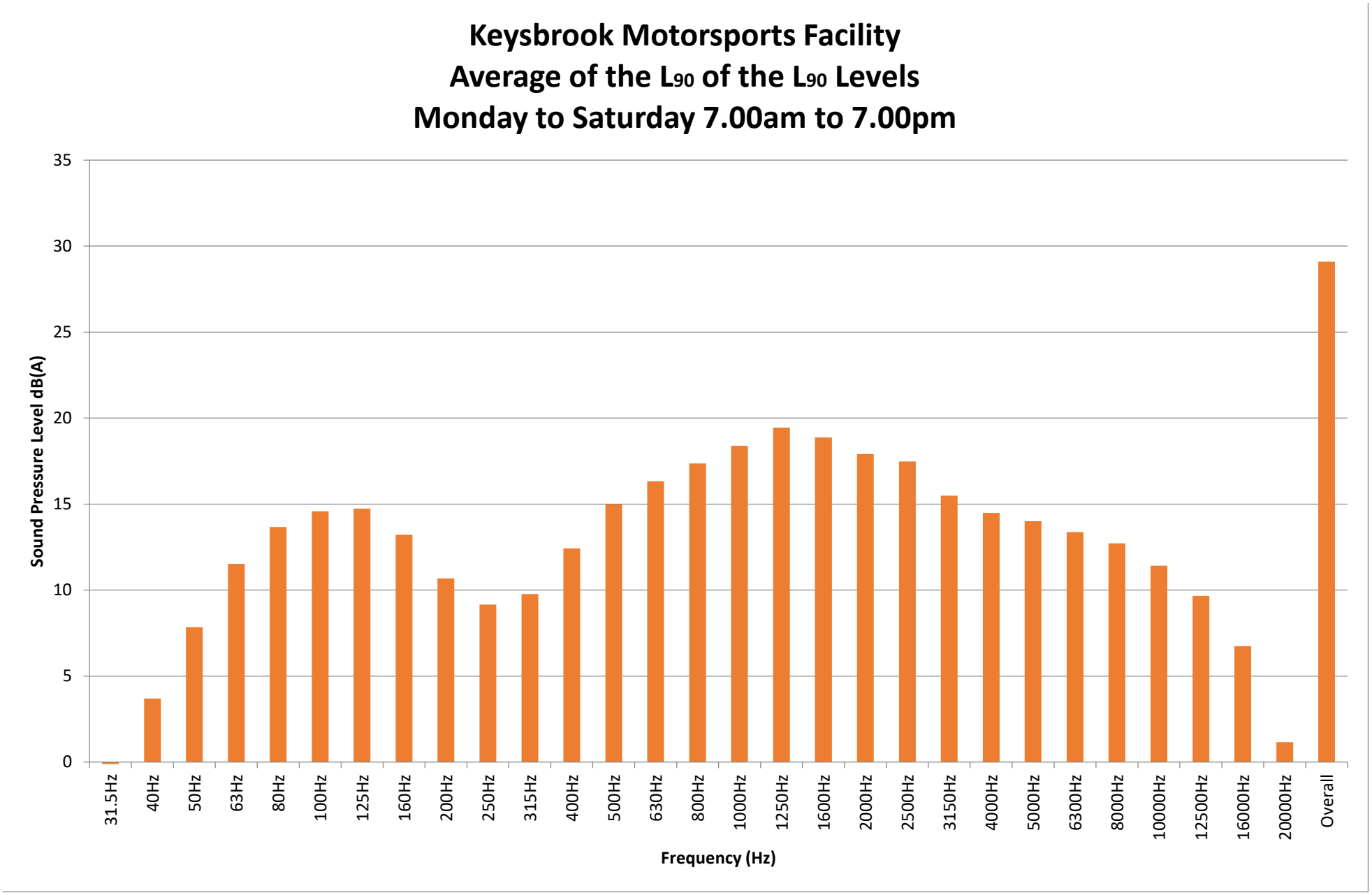
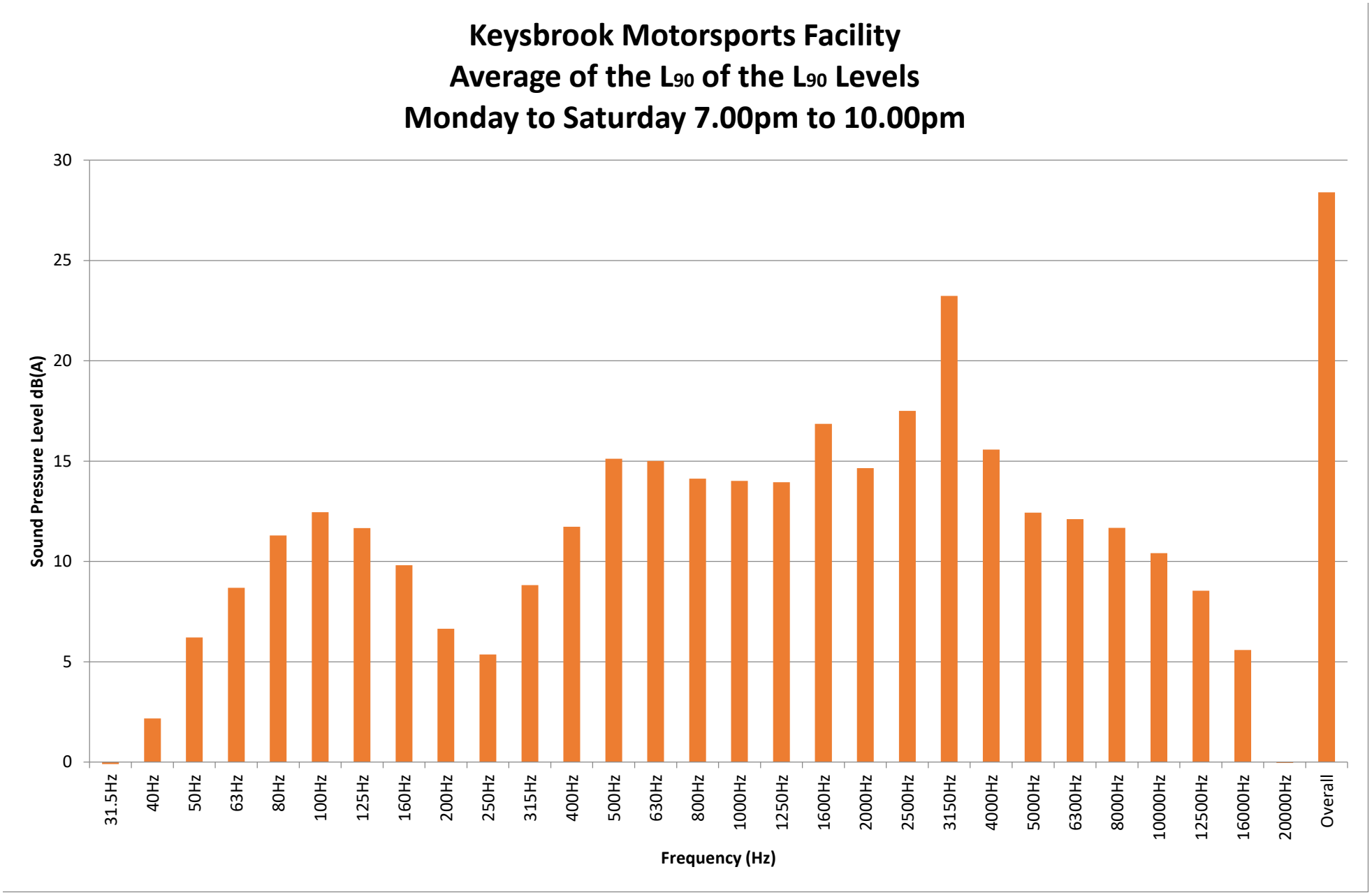
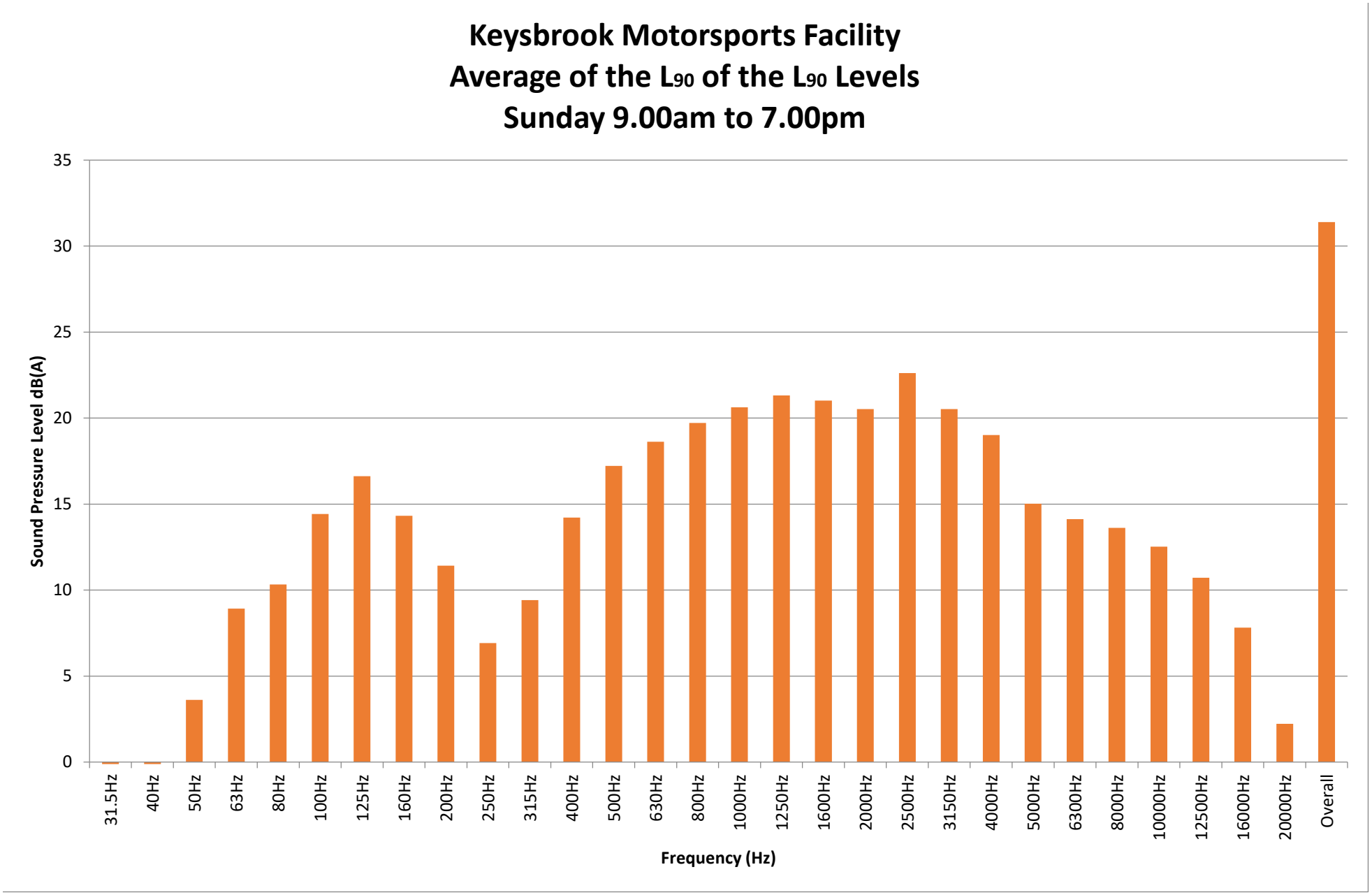
10/09/2018 6:00
10/09/2018 12:00
10/09/2018 18:00
11/09/2018 6:00
Time/Date

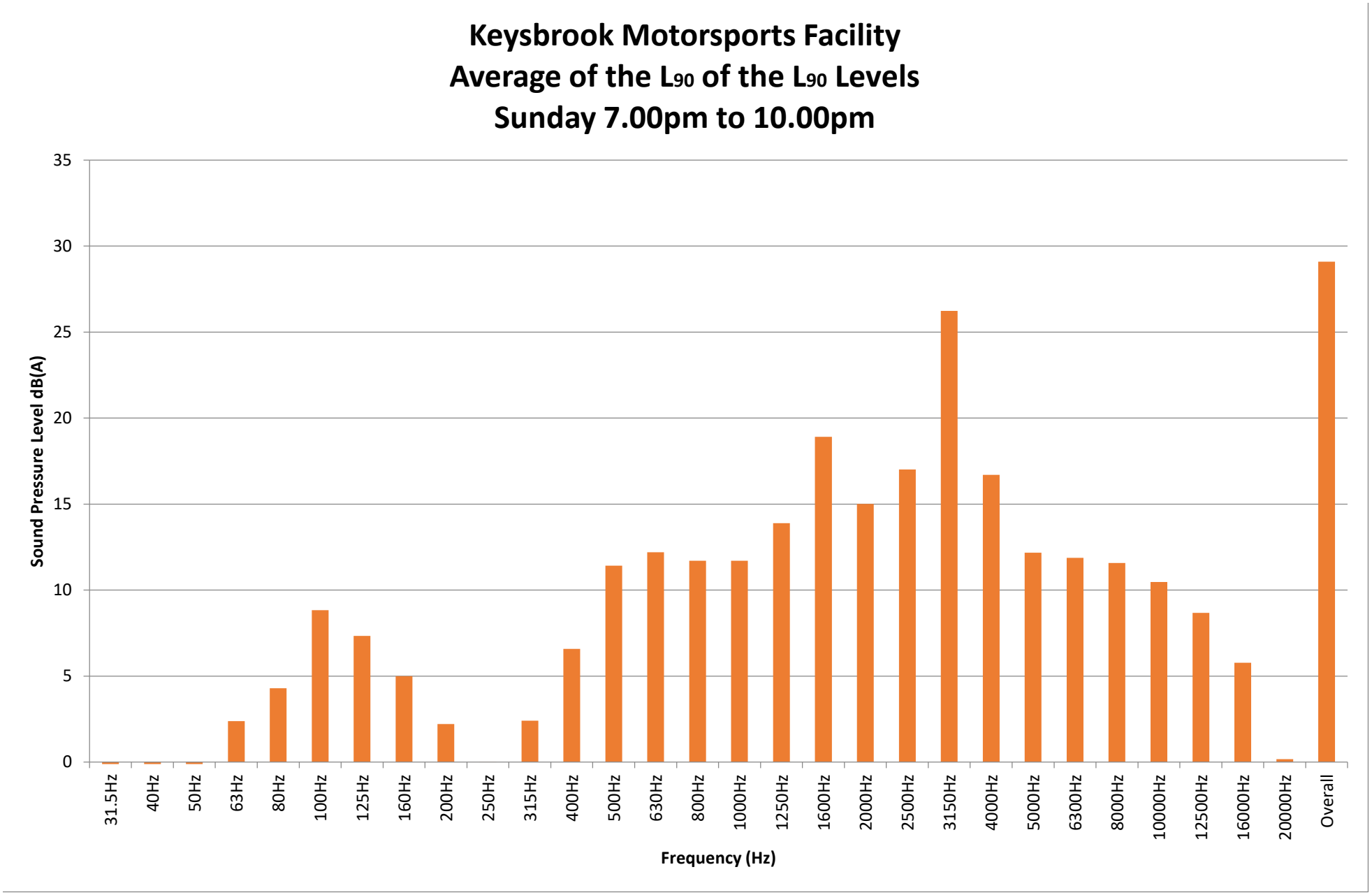
Figure 3-4


Overall Noise Levels Adjacent to Property 3
LA10
LA90
Sound Pressure Level dB(A)
70
65
60
55
50
45
40
35
30
25
20
21/08/2020
22/08/2020
24/08/2020
26/08/2020
28/08/2020
30/08/2020
6:00
12:00
18:00
0:00
Time/Date


Keysbrook Motorsports Facility
Average of the L90 of the L90 Levels
Monday to Saturday 7.00am to 7.00pm
Sound Pressure Level dB(A)
35
30
25
20
15
10
5
0
31.5Hz
40Hz
50Hz
63Hz
80Hz
100Hz
125Hz
160Hz
200Hz
250Hz
315Hz
400Hz
500Hz
630Hz
800Hz
1000Hz
1250Hz
1600Hz
2000Hz
2500Hz
3150Hz
4000Hz
5000Hz
6300Hz
8000Hz
10000Hz
12500Hz
16000Hz
20000Hz
Overall
Frequency (Hz)


Keysbrook Motorsports Facility
Average of the L90 of the L90 Levels
Monday to Saturday 7.00pm to 10.00pm
Sound Pressure Level dB(A)
30
25
20
15
10
5
0
31.5Hz
40Hz
50Hz
63Hz
80Hz
100Hz
125Hz
160Hz
200Hz
250Hz
315Hz
400Hz
500Hz
630Hz
800Hz
1000Hz
1250Hz
1600Hz
2000Hz
2500Hz
3150Hz
4000Hz
5000Hz
6300Hz
8000Hz
10000Hz
12500Hz
16000Hz
20000Hz
Overall
Frequency (Hz)


Keysbrook Motorsports Facility
Average of the L90 of the L90 Levels
Sunday 9.00am to 7.00pm
Sound Pressure Level dB(A)
35
30
25
20
15
10
5
0
31.5Hz
40Hz
50Hz
63Hz
80Hz
100Hz
125Hz
160Hz
200Hz
250Hz
315Hz
400Hz
500Hz
630Hz
800Hz
1000Hz
1250Hz
1600Hz
2000Hz
2500Hz
3150Hz
4000Hz
5000Hz
6300Hz
8000Hz
10000Hz
12500Hz
16000Hz
20000Hz
Overall
Frequency (Hz)


Keysbrook Motorsports Facility
Average of the L90 of the L90 Levels
Sunday 7.00pm to 10.00pm
Sound Pressure Level dB(A)
35
30
25
20
15
10
5
0
31.5Hz
40Hz
50Hz
63Hz
80Hz
100Hz
125Hz
160Hz
200Hz
250Hz
315Hz
400Hz
500Hz
630Hz
800Hz
1000Hz
1250Hz
1600Hz
2000Hz
2500Hz
3150Hz
4000Hz
5000Hz
6300Hz
8000Hz
10000Hz
12500Hz
16000Hz
20000Hz
Overall
Frequency (Hz)

4 NOISE PREDICTION METHODOLOGY

Computer modelling has been used to predict noise levels from the proposed Motorsports Facility. For this assessment the noise prediction software used was *SoundPLAN 8.0* with the CONCAWE algorithms selected. These algorithms have been specifically selected as they include the influence of wind, atmospheric stability and the effect of ground conditions. Input data required in the model are:

- Topographical data;
- Ground Absorption;
- Meteorological Information; and
- Source sound power levels.

4.1 Topographical Data

Topographical data was based on that publicly available from *Google* in the form of spot heights, noting the topography is relatively flat with no significant natural/manmade features between the proposed Motorsports Facility and receivers.

4.2 Ground Absorption

Ground absorption varies from a value of 0 to 1, with 0 being for an acoustically reflective ground (e.g. water or bitumen) and 1 for acoustically absorbent ground (e.g. grass). In this instance, as the area is predominantly rural, a value of 1.0 has been used as an average across the study area. Whilst there may be areas or times of lesser absorption, the noise modelling is considered conservative being downwind conditions with no foliage attenuation such that 1.0 ground absorption is considered appropriate.

4.3 Meteorological Information

Meteorological information utilised is provided in *Table 4-1* and is considered to represent worst-case conditions for noise propagation. At wind speeds greater than those shown, sound propagation may be further enhanced, however background noise from the wind itself and from local vegetation is likely to be elevated and tends to mask out intrusive noise to some degree.

Table 4-1 Modelling Meteorological Conditions

Parameter	Night (1900-0700)	Day (0700-1900)
Temperature (°C)	15	20
Humidity (%)	50	50
Wind Speed (m/s)	3	4
Wind Direction*	All	All
Pasquil Stability Factor	F	E

* Note that the modelling package used allows for all wind directions to be modelled simultaneously.

4.4 Source Sound Levels

The sound power levels used in the modelling to represent the various types of racing are provided in *Table 4-2*. The data was obtained from publically available data, specifically, a report assessing the noise impacts associated with the Ruapuna Park Motorsport Complex and Kart Club in Christchurch New Zealand (courtesy of Marshall Day Acoustics) and measurements of hire go-karts operating at the Wanneroo go-kart facility. It should be noted that in some circumstances the sound power levels have been reduced to align with CAMS trackside sound limits of L_{Amax} 95 dB at 30m.

Where noise sources are located on straights, the "Straight" sound power level has been used. Where the noise source is located on a bend, then the "Braking" sound power level has been used.

The public address (PA) system is also included in the assessment for all racing events. While the design of the public address system has yet to be determined, which does have a significant effect on the noise emissions from this source, for the purposes of the assessment it is assumed that there will be a number of directional speakers facing towards the grandstand areas. The sound level from the public address system has been set to 85 dB(A) at 3 metres, which it is believed is a reasonable assumption. The PA would not be used for the hire go-karts or during the manufacturer car days.

Table 4-2 Source Sound Power Levels L_{max}

Description		Octave Band Centre Frequency (Hz)								Overall dB(A)
		63	125	250	500	1k	2k	4k	8k	
Formula Ford	Straight	121	137	135	131	126	118	113	104	**132**
	Braking	126	138	130	116	116	109	107	108	**126**
Porsche GT3	Straight	120	133	132	131	128	124	115	108	**132**
	Braking	130	140	133	122	125	120	116	118	**131**
Superbikes	Straight	112	120	126	132	126	119	116	113	**132**
	Braking	121	123	127	128	124	113	107	107	**128**
125cc Rotax Kart	Straight	112	123	123	120	114	107	108	98	**121**
	Braking	101	112	112	109	103	96	97	87	**110**
Hire Kart	Straight	110	107	105	97	93	92	91	87	**101**
	Braking	103	100	98	90	86	85	84	80	**94**
Manufacturer Car	Straight	110	93	96	102	105	105	97	90	**110**
	Braking	95	89	89	97	100	100	93	85	**105**
Public Address/Speaker	-	73	81	86	101	99	93	85	70	**103**

As a note, the table above provides the sound power level for each type of racing vehicle and for each of the public address speakers. As a general guide, the measured sound pressure level, at 30 metres from a vehicle, would be 37 dB less than the overall sound power level.

The site may host other events, however these would not fall under the regulation 16A approval (e.g. cycling, cross country etc). The one event that would fall under the regulation 16A that has not been specifically considered would be the racing of electric vehicles, which may be a future use, however would be of significantly less noise impact given these are electrically powered, thus leaving only tyre and aerodynamic noises.

5 RESULTS

The predicted noise levels for each of the race types to each receiver located within 1 km of the proposed venue (see *Figure 1-1*) are presented in *Table 5-1* and as noise level contour plots in *Figure 5-1* to *Figure 5-6.* The noise level contour plots represent the L_{A10} noise levels expected from the racing event types. It is assumed that once the race vehicles are spread out, the maximum (L_{Amax}) noise level would be approximately 2 dB more than the L_{A10} noise level shown. Table 5-2 provides the predicted levels, including an adjustment of + 5 dB for tonality, which may be applicable for comparison with the assigned levels

Table 5-1 Predicted L_{A10} Noise Level to Each Receiver Within 1km

Race Type	L_{A10} dB Noise Level at Each Receiver Location							
	R1	R2	R3	R4	R5	R6	R7	R8
Formula Ford	65	72	69	72	66	67	66	62
Porsche GT3	66	74	70	73	67	68	67	63
Superbikes	66	73	70	72	67	68	66	63
125cc Rotax Kart	52	58	54	55	49	52	48	45
Hire Kart	31	37	34	35	29	31	27	24
Manufacturer Car Day	40	48	45	49	41	43	40	36

Table 5-2 Predicted L_{A10} Noise Level to Each Receiver Within 1km Including Tonality

Race Type	L_{A10} dB Noise Level at Each Receiver Location							
	R1	R2	R3	R4	R5	R6	R7	R8
Formula Ford	70	77	74	77	71	72	71	67
Porsche GT3	71	79	75	78	72	73	72	68
Superbikes	71	78	75	77	72	73	71	68
125cc Rotax Kart	57	63	59	60	54	57	53	50
Hire Kart	36	42	39	40	34	36	32	29
Manufacturer Car Day	45	53	50	54	46	48	45	41

It should be noted that when multiple events occur at the same time, the cumulative effect would only influence the overall noise levels when the difference between the two individual noise sources is less than 10 dB. For example, assuming hire karts and manufacturer day was held at the same time, the overall noise level at receiver R1 would be raised by 0.5 dB (40 + 31 dB), however, if the hire karts and Rotax karts were held at the same time (52 + 31 dB), the noise from the Rotax karts would dominate at receiver R1 (being more than 10 dB above the hire karts) and there would be no overall increase in noise levels.

The predicted noise level from the public address system alone is 25 dB(A) at the closest receiver (R4) for all scenarios except Hire Kart and Manufacturer Car Day, where there is not expected to be any public address system in use. Noise levels from the public address system are shown in *Figure 5-7*. Note that this is indicative only and will be subject to detailed design.

Table 5-3 and *Table 5-4* compare the predicted noise levels, including tonality (from *Table 5-2*) to the assigned levels during Monday to Saturday daytime (7.00am to 7.00pm) and Sunday and public holidays daytime (9.00am to 7.00pm).

Table 5-3 Calculated Exceedance above Monday to Saturday Daytime (7.00am to 7.00pm) Assigned Level

Race Type	L_{A10} dB Exceedance Level at Each Receiver Location							
	R1	R2	R3	R4	R5	R6	R7	R8
Formula Ford	25	32	29	32	26	27	26	22
Porsche GT3	26	34	30	33	27	28	27	23
Superbikes	26	33	30	32	27	28	26	23
125cc Rotax Kart	12	18	14	15	9	12	8	5
Hire Kart	-	-	-	-	-	-	-	-
Manufacturer Car Day	-	8	5	9	1	3	-	-

Table 5-4 Calculated Exceedance above Sunday and Public Holidays Daytime (9.00am to 7.00pm) Assigned Level

Race Type	L_{A10} dB Exceedance Level at Each Receiver Location							
	R1	R2	R3	R4	R5	R6	R7	R8
Formula Ford	30	37	34	37	31	32	31	27
Porsche GT3	31	39	35	38	32	33	32	28
Superbikes	31	38	35	37	32	33	31	28
125cc Rotax Kart	17	23	19	20	14	17	13	10
Hire Kart	-	2	-	-	-	-	-	-
Manufacturer Car Day	5	13	10	14	6	8	5	1

As expected, the racing events in particular exceed the assigned levels, however it is acknowledged that motor sport venues cannot reasonably and practicably meet these levels. When the Noise Regulations were amended in 2013, specific management provisions were introduced for motor sport venues (as well as concert venues, shooting venues and for waste collection) since there is a degree of acceptance due to the temporary nature and/or the perceived community benefit. The predicted levels indicate that the proposed venue would need to develop and operate in accordance with a management plan.

Figure 5-1

Legend

Point source

Sensitive Receiver

N

Length Scale

0 0.10.2 0.4 0.6 0.8 1 1.2 1.4 km

Keysbrook Motorsports Facility - Formula Ford Race

L_{A10} Predicted Noise Levels - Assumes 36 Cars Racing and Wind from All Directions

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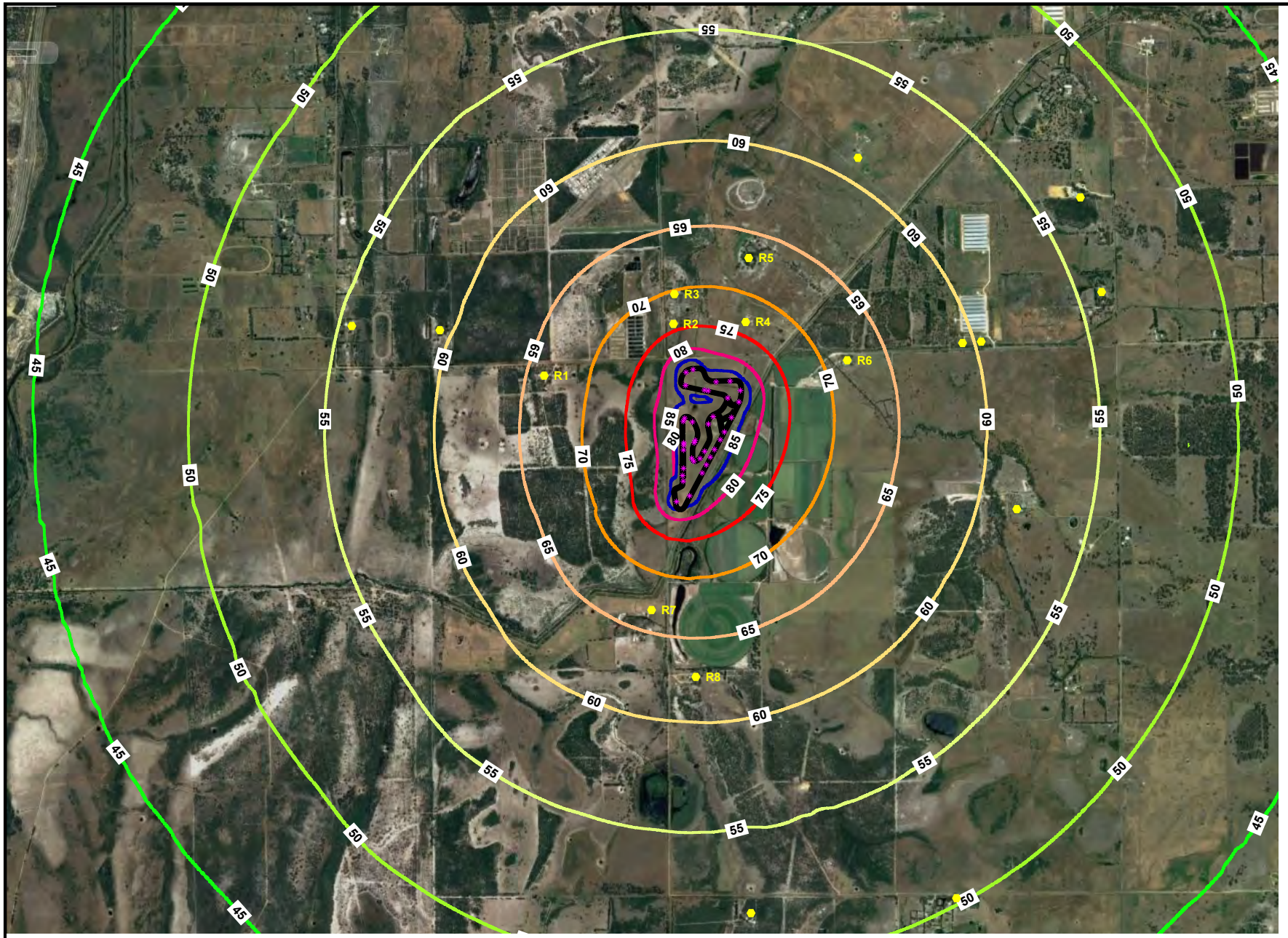
Figure 5-2



Legend

Point source

Sensitive Receiver

N

Length Scale

0 0.10.2 0.4 0.6 0.8 1 1.2 1.4 km

Keysbrook Motorsports Facility - Porsche GT3 Race

L_{A10} Predicted Noise Levels - Assumes 36 Cars Racing and Wind from All Directions

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Figure 5-3

Legend

Point source

Sensitive Receiver

N

Length Scale

0 0.10.2 0.4 0.6 0.8 1 1.2 1.4 km

Keysbrook Motorsports Facility - Superbike Race

L_{A10} Predicted Noise Levels - Assumes 36 Bikes Racing and Wind from All Directions

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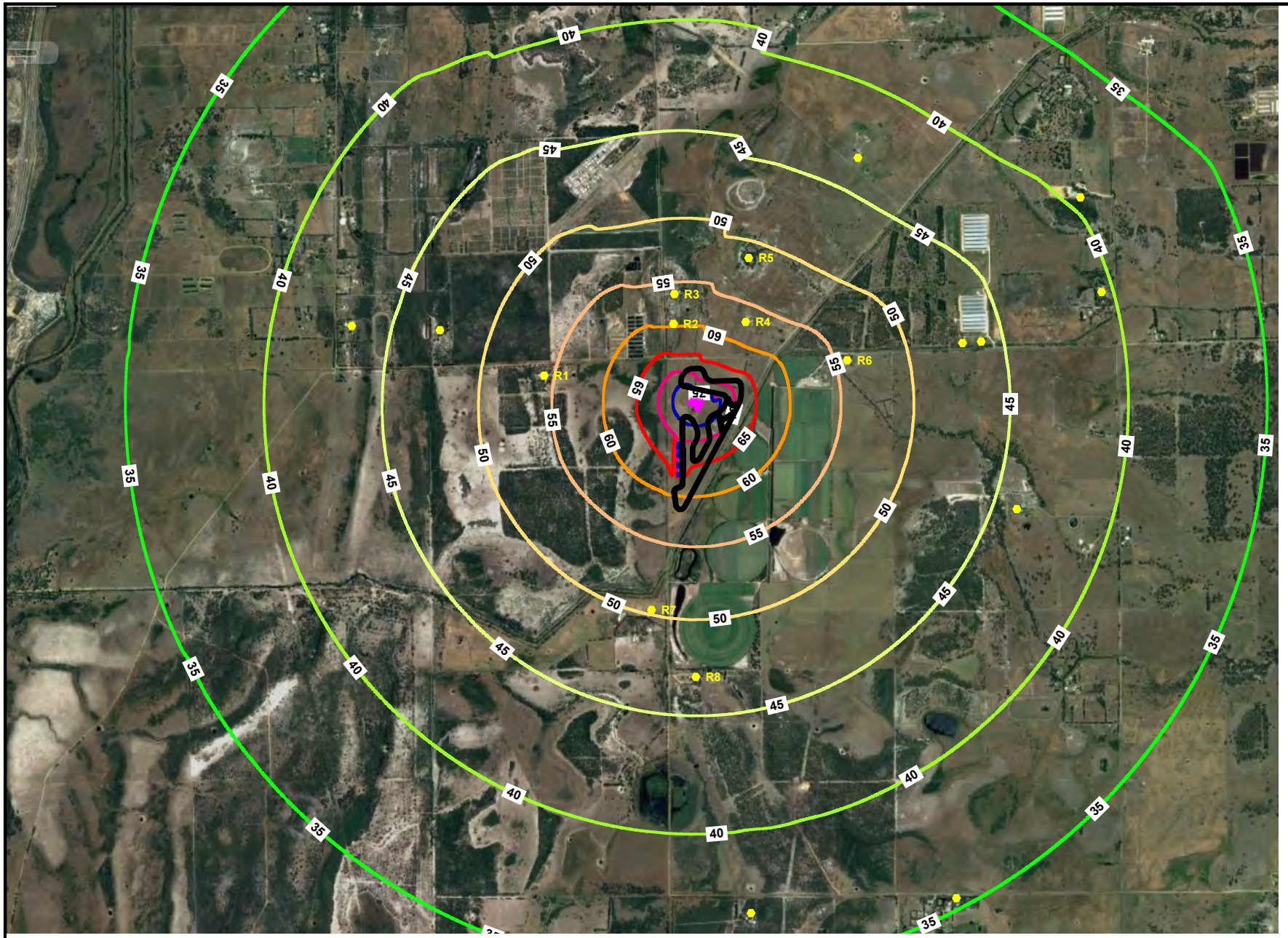
Figure 5-4



Keysbrook Motorsports Facility - 125cc Rotax Kart Race

L_{A10} Predicted Noise Levels - Assumes 20 Karts Racing and Wind from All Directions

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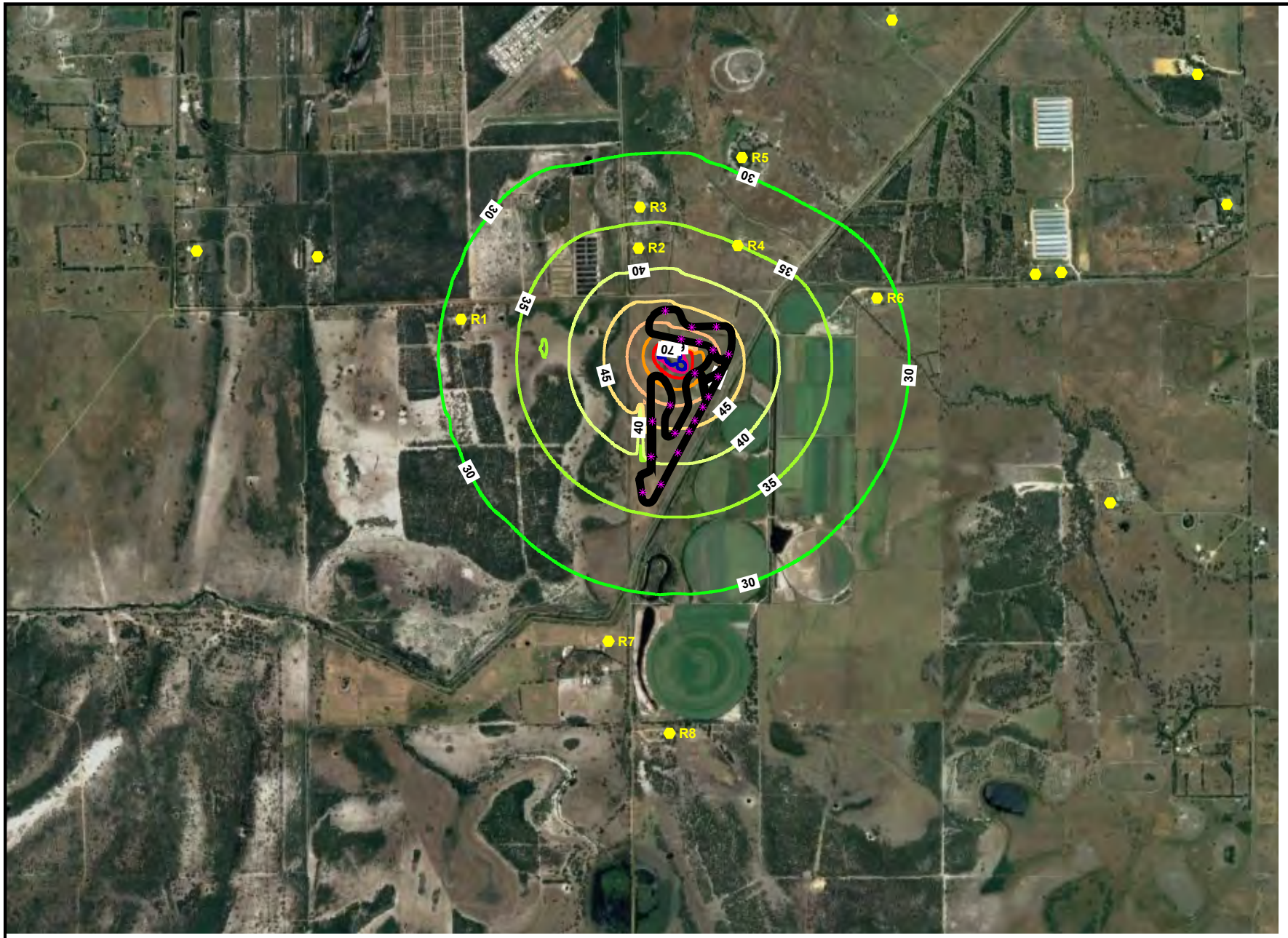
Figure 5-5



Keysbrook Motorsports Facility - Hire Kart Race
L_{A10} Predicted Noise Levels - Assumes Karts On Track and Wind from All Directions

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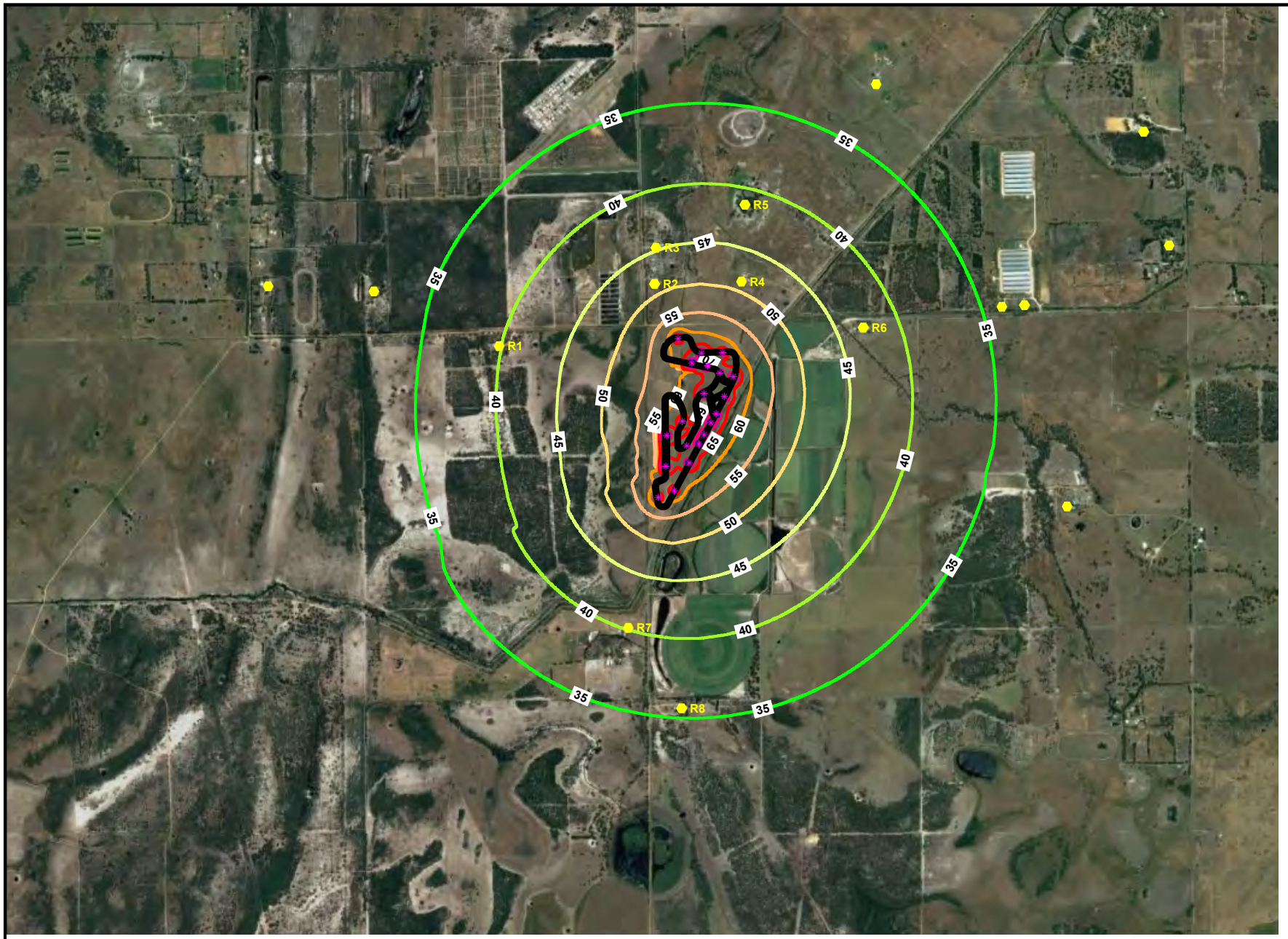

Figure 5-6

Keysbrook Motorsports Facility - Manufacturer Car Day

L_{A10} Predicted Noise Levels - Assumes 20 Cars On Track and Wind from All Directions

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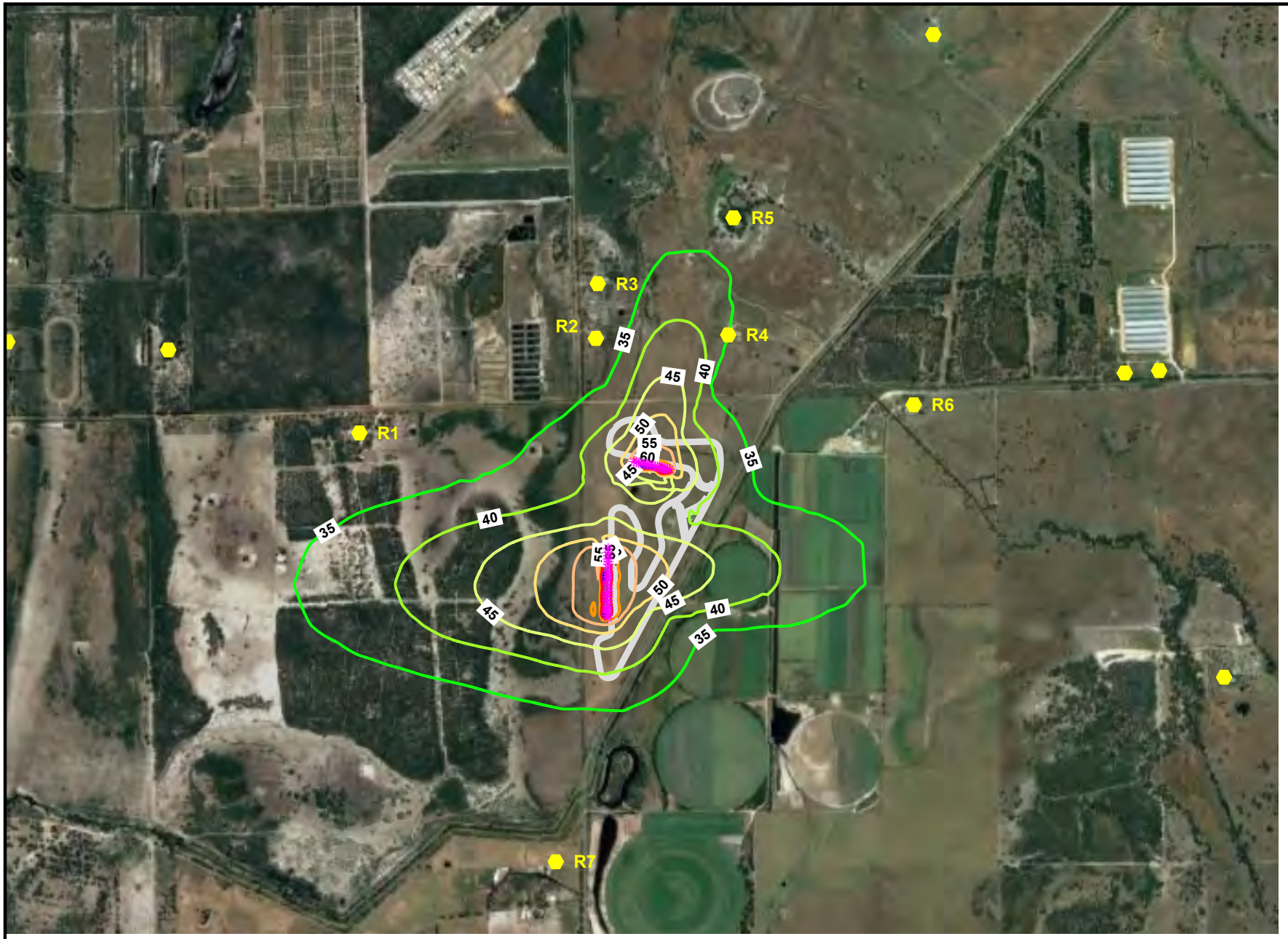
Figure 5-7



Keysbrook Motorsports Facility - Public Address System
L_{A10} Predicted Noise Levels - Assumes PA Operating But No Racing - Wind from All Directions

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6 DISCUSSION

The management of noise from a Motorsport Facilities is addressed in the Regulations (*regulation 16A)* through a process of the approval of a noise management plan. Once approved, the assigned levels under *regulation 7* of the Regulations no longer apply, providing the facility is operated in accordance with the approved plan.

As detailed in *Section 2* of this assessment, the CEO may approve a management plan for a motorsports venue providing it:

(a) contains a map (current at the time of the application) showing the motor sport venue, including the area where motor vehicles are raced or prepared for racing and car parks used by competitors in races at and visitors to the venue; and

(b) contains a description of the types of racing activities that can reasonably be expected to be conducted at the venue and classes of vehicles that can reasonably be expected to race at the venue; and

(c) sets out limitations on the racing activities to be conducted and the times during which racing activities may be conducted; and

(d) contains details of reasonable and practicable measures to be implemented to control noise emissions from the venue during the conduct of a racing activity at the venue; and

(e) contains details of when and the manner in which notice of racing activities at the venue is to be published or distributed to members of the public; and

(f) specifies the persons who will be responsible for implementing the approved noise management plan and sets out each person's responsibilities; and

(g) contains a complaint response procedure.

While the preparation of a noise management plan is outside the scope of this assessment, the mitigation of noise using physical barriers has been investigated, in particular, the construction of a 4-metre high earth bund on the northern section of the track. A comparison of the predicted noise levels with and without the bund is provided in *Table 6-1*. It can be seen the difference in the predicted noise levels is only up to 1 dB and therefore this method of noise mitigation is not considered practicable.

Table 6-1 Predicted L_{A10} Noise Level to Each Receiver With and Without Mitigation

Scenario	L_{A10} dB Noise Level at Each Receiver Location							
	R1	R2	R3	R4	R5	R6	R7	R8
Formula Ford Without Bund	65	72	69	72	66	67	66	62
Formula Ford With Bund	65	71	68	71	65	67	66	62
Difference	0	-1	-1	-1	-1	0	0	0

The control of noise emissions will be addressed through compliance with vehicle noise limits that are set by the various racing bodies, which will be enforced through the Noise Management Plan. This noise mitigation strategy would be considered as typical for a motor racing venue.

In addition to the above, the operators of the facility will commit to installing permanent noise monitoring equipment on-site, for the ongoing compliance monitoring.

One of the factors in assessing the noise impact from a proposed motorsports facility is the expected noise level above the existing background noise level. To illustrate this, *Figure 6-1* shows a typical noise profile of a major event that would be held at the proposed facility together with data obtained from background noise monitoring adjacent to the closest noise sensitive receiver. The predicted noise levels assume worst-case wind conditions of blowing from the facility towards the receiver and for illustrative purposes show noise from Porsche GT3 scenario and 125cc Rotax Karts. What the chart shows is that when vehicles are racing, as expected, this will be audible above background noise.

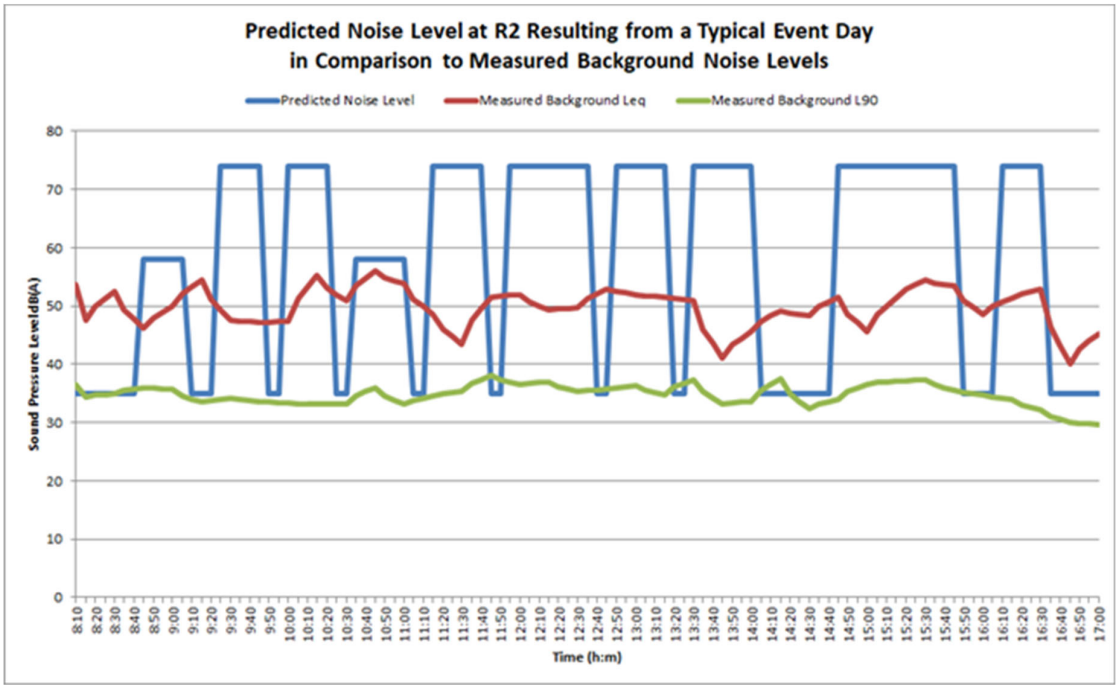
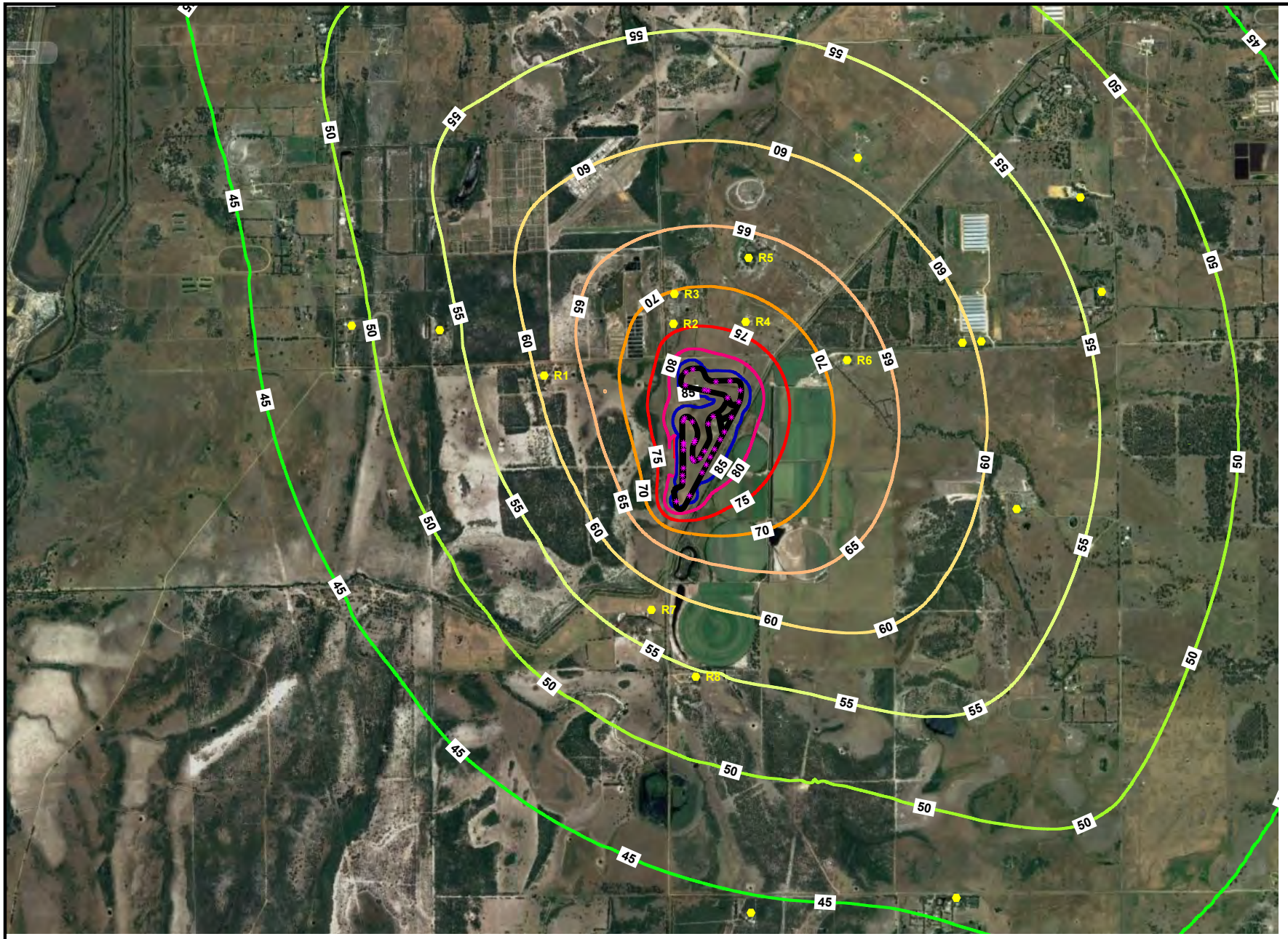


Figure 6-1 Noise Predictions from Typical Major Event Compared to Background Noise Levels

What the above shows is that noise from the race track is expected to be nominally 20 dB higher than the existing average (L_{Aeq}) noise at R2. An increase of 10 dB would generally be described as sounding twice as loud and therefore 20 dB could be described as four times as loud as the existing average noise level.

The wind direction will influence the noise levels received at a noise sensitive premises during a race and while it is acknowledged that an assessment of noise impact is made assuming the worst-case scenario of wind blowing from the facility towards the receiver, for information purposes, *Figure 6-2* and *Figure 6-3* illustrates the variation in noise levels under two opposing wind directions, being a southwest and northeast wind. It can be seen that a variation of around 4 dB can be expected for the different wind directions.

Figure 6-2



Legend

- Point source
- Sensitive Receiver

N

Length Scale

0 0.10.2 0.4 0.6 0.8 1 1.2 1.4 km

Keysbrook Motorsports Facility - Porsche GT3 Race

L_{A10} Predicted Noise Levels - Assumes 36 Cars Racing and Wind from the SW Direction

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Figure 6-3

Legend

Point source

Sensitive Receiver

N

Length Scale

0 0.10.2 0.4 0.6 0.8 1 1.2 1.4 km

Keysbrook Motorsports Facility - Porsche GT3 Race

L_{A10} Predicted Noise Levels - Assumes 36 Cars Racing and Wind from the NE Direction

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Appendix A

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)
The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting
An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

Sound Power Level (L_w)
Under normal conditions, a given sound source will radiate the same amount of energy, irrespective of its surroundings, being the sound power level. This is similar to a 1kW electric heater always radiating 1kW of heat. The sound power level of a noise source cannot be directly measured using a sound level meter but is calculated based on measured sound pressure levels at known distances. Noise modelling incorporates source sound power levels as part of the input data.

Sound Pressure Level (L_p)
The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

L_{ASlow}
This is the noise level in decibels, obtained using the A frequency weighting and the S time weighting as specified in AS1259.1-1990. Unless assessing modulation, all measurements use the slow time weighting characteristic.

L_{AFast}
This is the noise level in decibels, obtained using the A frequency weighting and the F time weighting as specified in AS1259.1-1990. This is used when assessing the presence of modulation only.

L_{APeak}
This is the maximum reading in decibels using the A frequency weighting and P time weighting AS1259.1-1990.

L_{Amax}
An L_{Amax} level is the maximum A-weighted noise level during a particular measurement.

L_{A1}
An L_{A1} level is the A-weighted noise level which is exceeded for one percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{A10}
An L_{A10} level is the A-weighted noise level which is exceeded for 10 percent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{Aeq}
The equivalent steady state A-weighted sound level ("equal energy") in decibels which, in a specified time period, contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the "average" noise level.

L_{A90}
An L_{A90} level is the A-weighted noise level which is exceeded for 90 percent of the measurement period and is considered to represent the "*background*" noise level.

One-Third-Octave Band
Means a band of frequencies spanning one-third of an octave and having a centre frequency between 25 Hz and 20 000 Hz inclusive.

L_{Amax} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded at any time.

L_{A1} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 1% of the representative assessment period.

L_{A10} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 10% of the representative assessment period.

Tonal Noise
A tonal noise source can be described as a source that has a distinctive noise emission in one or more frequencies. An example would be whining or droning. The quantitative definition of tonality is:

the presence in the noise emission of tonal characteristics where the difference between -

(a) the A-weighted sound pressure level in any one-third octave band; and

(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$ levels.

This is relatively common in most noise sources.

Modulating Noise
A modulating source is regular, cyclic and audible and is present for at least 10% of the measurement period. The quantitative definition of modulation is:

a variation in the emission of noise that —

(a) is more than 3 dB $L_{A\ Fast}$ or is more than 3 dB $L_{A\ Fast}$ in any one-third octave band;

(b) is present for at least 10% of the representative.

Impulsive Noise

An impulsive noise source has a short-term banging, clunking or explosive sound. The quantitative definition of impulsiveness is:

a variation in the emission of a noise where the difference between $L_{A\ peak}$ and $L_{A\ Max\ slow}$ is more than 15 dB when determined for a single representative event;

Major Road

Is a road with an estimated average daily traffic count of more than 15,000 vehicles.

Secondary / Minor Road

Is a road with an estimated average daily traffic count of between 6,000 and 15,000 vehicles.

Influencing Factor (IF)

$$= \frac{1}{10}(\%\ \text{Type A}_{100} + \%\ \text{Type A}_{450}) + \frac{1}{20}(\%\ \text{Type B}_{100} + \%\ \text{Type B}_{450})$$

where:

$\%\ \text{Type A}_{100}$ = the percentage of industrial land within a 100m radius of the premises receiving the noise

$\%\ \text{Type A}_{450}$ = the percentage of industrial land within a 450m radius of the premises receiving the noise

$\%\ \text{Type B}_{100}$ = the percentage of commercial land within a 100m radius of the premises receiving the noise

$\%\ \text{Type B}_{450}$ = the percentage of commercial land within a 450m radius of the premises receiving the noise

+ Traffic Factor (maximum of 6 dB)

= 2 for each secondary road within 100m

= 2 for each major road within 450m

= 6 for each major road within 100m

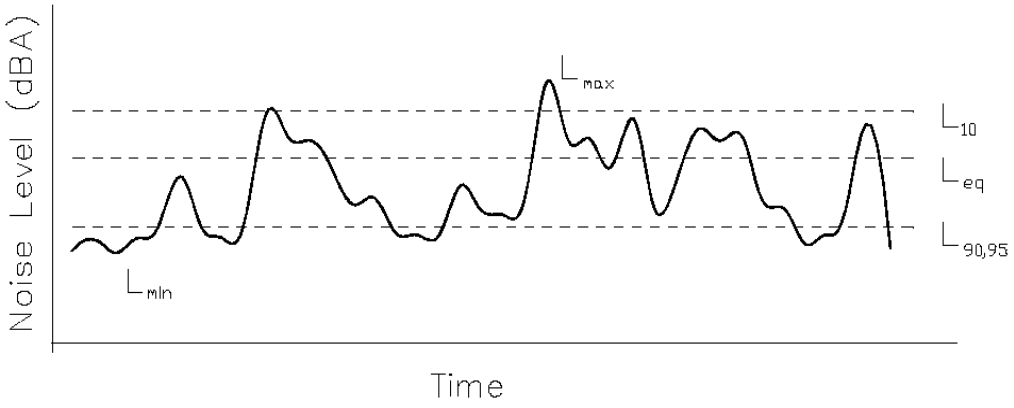
Representative Assessment Period

Means a period of time not less than 15 minutes, and not exceeding four hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission.

Background Noise

Background noise or residual noise is the noise level from sources other than the source of concern. When measuring environmental noise, residual sound is often a problem. One reason is that regulations often require that the noise from different types of sources be dealt with separately. This separation, e.g. of traffic noise from industrial noise, is often difficult to accomplish in practice. Another reason is that the measurements are normally carried out outdoors. Wind-induced noise, directly on the microphone and indirectly on trees, buildings, etc., may also affect the result. The character of these noise sources can make it difficult or even impossible to carry out any corrections.

Chart of Noise Level Descriptors



Typical Noise Levels