Project No: 201993R

Noise Impact Assessment
Oberon Sports Complex
Oberon, NSW

Prepared for:

Oberon Council

Ross Hodge
B.Sc.(Hons) M.A.A.S.
Principal / Director

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1.0 INTRODUCTION

This report provides the results and findings of a noise impact assessment of the proposed development of a new recreational sports facility (Oberon Sports Complex) at Lot 2 DP 1073827 and Lot 5 DP 2364, 63 Lowes Mount Road, Oberon NSW (as depicted with a star on **Figure 1**).

Figure 1. Approximate Site Location (source: Google Earth).

This assessment has been commissioned to accompany a development application to Oberon Council (Council).

2.0 DESCRIPTION OF TERMS

This section of the report aims to convey an understanding of several commonly used acoustical terms to the lay reader. Various terms are explained in clear language and the effects of certain atmospheric phenomena on noise propagation are discussed. Noise level percentiles are explained with the aid of a diagram of a hypothetical noise signal (**Figure 2**).

The descriptions in this section are not formal definitions of the terms. Formal definitions may be found in AS1633-1985 “Acoustics – Glossary of terms and related symbols”.

2.1 General Terms

Sound Power Level

The amount of acoustic energy (per second) emitted by a noise source. Usually written as “Lw” or “SWL”, the Sound Power Level is expressed in decibels (dB) and cannot be directly measured. Lw is usually calculated from a measured sound pressure level.

Sound pressure Level

The “Noise Level”, in decibels (dB), heard by our ears and/or measured with a sound level meter. Written as “SPL”, the sound pressure level generally decreases with increasing distance from a source. Noise levels are often written as dB(A) rather than dB. The “A-weighting” is a correction applied to the measured noise signal to approximate the response of the human ear.

Neutral Atmospheric Conditions

An atmosphere that is at a temperature of approximately 23^{o}C from ground level to an altitude of 200m or more. There are no fluctuations in density or water vapour content and no wind. Such conditions rarely occur, as temperature will usually vary with altitude and there is always movement in various directions in different layers of the atmosphere.

Prevailing Atmospheric Conditions

Atmospheric conditions (with regards to potential effects on noise propagation) which are characteristic of the study area. These will typically include seasonal wind directions and velocities.

2.2 Noise Level Percentiles

A noise level percentile (Ln) is the noise level (SPL) in decibels which is exceeded for “n” % of a given monitoring period. Several important Ln percentiles will be explained by considering the hypothetical time signal in Figure 2.

The signal in Figure 2 has a duration of 2.5 minutes (i.e. 150 seconds) with noises occurring as follows:

- The person holding the instrument is standing beside a road and hears crickets in nearby grass at a level of around 60 dB (A);

- At about the 30 second mark a motorcycle passes on the road, followed by a car;
- At 60 seconds a truck passes;
- After the truck passes it sounds its air horn at the 73 second mark;
- The crickets are frightened into silence and the truck fades into the distance;
- All is quiet until 105 seconds when the crickets slowly start to make noise, reaching full pitch by 120 seconds;
- The measurement stops at 150 seconds, just when an approaching car starts to become audible.

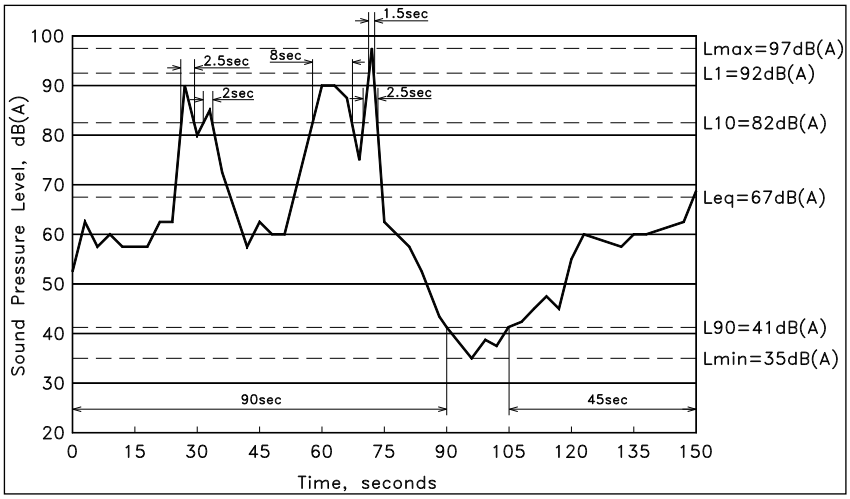


Figure 2. Hypothetical time-trace of 150-second sound signal.

L1 Noise Level

Near the top of Figure 2, there is a dashed line at 92 dB(A). A small spike of 1.5 sec duration extends above this line at around 73 seconds. As 1.5 sec is 1% of the signal duration (150 seconds) we say that the L1 noise level of this sample is 92dB(A). The L1 percentile is often called the *average peak noise level* and is used by the EPA as a measure of potential disturbance to sleep.

L10 Noise Level

The dashed line at 82 dB(A) is exceeded for four periods of duration 2.5 sec, 2 sec, 8 sec and 2.5 sec, respectively. The total of these is 15 sec, which is 10% of the total sample period. Therefore, the L10 noise level of this sample is 82 dB(A). The L10 percentile is called the *average*

maximum noise level and has been widely used as an indicator of annoyance caused by noise.

L90 Noise Level

In similar fashion to L1 and L10, Figure 2 shows that the noise level of 41 dB(A) is exceeded for 135 seconds (90 + 45 =135). As this is 90% of the total sample period, the L90 noise level of this sample is 41 dB(A). The L90 percentile is called the *background noise level*.

Leq Noise Level

Equivalent continuous noise level. As the name suggests, the Leq of a fluctuating signal is the continuous noise level which, if occurring for the duration of the signal, would deliver equivalent acoustic energy to the actual signal. Leq can be thought of as a kind of 'average' noise level. Research suggests that Leq is the best indicator of annoyance caused by industrial noise and the *NSW Industrial Noise Policy* (INP) takes this into consideration.

Lmax and Lmin Noise Levels

These are the maximum and minimum SPL values occurring during the sample. Reference to Figure 2 shows these values to be 97 dB(A) and 35 dB(A), respectively.

3.0 BACKGROUND TO THE PROPOSAL

The sports complex is proposed to be located in the Oberon Industrial area within the Oberon Council Local Government Area (LGA), approximately 800 metres north-west of Oberon Township.

The site adjoins residential land to the south along Scotia Avenue, with vacant land located immediately the east. The site is bordered by Albion Street to the north, with the Highland Pine Products facility located beyond that which forms part of the Oberon Timber Complex. To the west of the site is predominantly rural land.

The subject land is currently used for low scale grazing and horse agistment.

The proposed development is for the construction and operation of a Recreation Facility - Outdoor. It is to include;

- Sports Clubhouse with tiered seating, change rooms and amenities (including licensed club facilities),
- 2 x Rectangular fields for rugby league, rugby, soccer,

- 3 x Netball courts,
- 1x Hockey Field,
- Children's Playground area,
- Associated roads and car parking, and
- Pedestrian footpath loop around the site with fitness stations.

The proposed layout of the sports complex is shown in **Figure 3**.

Figure 3. Proposed Site Layout.

The proposed licensed club facilities will house the Oberon Rugby Leagues Club (Club) which will be located within the grandstand.

The operation of the Club will depend on level of patronage but it is anticipated that the premises may be in use, at times, between the hours of 10am to 12am over seven days.

The Club will have indoor bar and dining areas as well as an outdoor smoking area. There are to be approximately 160 car parking spaces at the sports complex, which may be utilised by club patrons.

4.0 THE EXISTING ACOUSTIC ENVIRONMENT

The existing acoustic environment of the residential areas near the proposed facility has been quantified as part of other studies undertaken in the area (by Spectrum Acoustics and by others).

Unattended noise logging has previously been undertaken at the locations shown in **Figure 4**. Each of the loggers was programmed to continuously register environmental noise levels over 15 minute intervals with internal software calculating and storing L_n percentile noise levels for each sampling period.

Noise logging was conducted in accordance with relevant EPA guidelines and AS 1055-1997 "Acoustics – Description and Measurement of Environmental Noise". The noise logger used complies with the requirements of AS 1259.2-2004 "Acoustics – Sound Level Meters", and has current NATA calibration.

Figure 4. Noise Logging Locations.

The relevant metrics taken from the logger measurements are shown in **Tables 1**, **2** and **3**.

Logger 1 was located in the grounds of Oberon High School to the east of the site (see Figure 4) for the period from 7 to 13 October, 2016. The relevant measured noise levels from Logger 1 are shown in **Table 1**.

TABLE 1 MEASURED AMBIENT NOISE LEVELS dB(A) LOGGER 1 – HIGH SCHOOL		
Period	L90	Leq (15 min)
Day	45	56
Evening	47	51
Night	49	51

Logger 2 was located in the grounds of Jenolan Holiday Park which is also east of the site for the period from 2 to 5 May, 2016. The relevant measured noise levels from Logger 2 are shown in **Table 2**.

TABLE 2 MEASURED AMBIENT NOISE LEVELS dB(A) LOGGER 2 – HOLIDAY PARK		
Period	L90	Leq (15 min)
Day	42	49
Evening	44	48
Night	42	46

Logger 3 was located in the front yard of the residence at number 3 Stevenson Close for the period from 17 to 25 October, 2018. The relevant measured noise levels from Logger 3 are shown in **Table 3**.

TABLE 3 MEASURED AMBIENT NOISE LEVELS dB(A) LOGGER 3 – STEVENSON CLOSE		
Period	L90	Leq (15 min)
Day	40	60
Evening	42	57
Night	41	54

5.0 NOISE CRITERIA

5.1 Operational Noise

Table 1.3 in the Noise Guide for Local Government (NGLG) deals with "Approaches to managing common neighbourhood noise issues". This table outlines the noise from sporting facilities should be assessed in accordance with the "offensive noise test".

The offensive noise test is a series of questions relating to such things as the level, time, duration and character of a noise source or event. It is a somewhat subjective test which relies, in part, on an individual's response to a noise. It is a test that relates to existing noise and doesn't quantify noise criteria which may be used as a planning tool.

In the absence of any specific noise criteria for the assessment of noise from sporting events, therefore, guidance has been taken from the Noise Policy for Industry (NPfI).

In setting noise goals for a particular project, the NPfI considers both "Amenity" and "Intrusiveness" criteria. The former is set to limit continuing increase of noise from industry, whilst the latter is set to minimise the intrusive impact of a particular noise source.

The logger data, presented in Tables 1 to 3, show that the background noise levels tend to decrease to the east in those parts of suburban Oberon. This, most likely, indicates the decrease in ambient noise with increasing distance from the main industrial noise sources. Based on this, a background noise level of 40 dB(A) L90 has been adopted for the current assessment. Being equal to the lowest of the measured background noise levels, this is considered to represent the worst case.

The project noise trigger levels developed in accordance with procedures in the NPfI are detailed in **Table 4**.

TABLE 4
NOISE CRITERIA

Time	Details	Criteria
Day (7am-6pm)	Intrusiveness dB(A),Leq(15-min.)[1]	45
	Amenity dB(A),Leq(15 min)[2]	58
	Project Noise Trigger Level	**45 (15 min.)**
Evening (6pm-10pm)	Intrusiveness dB(A),Leq(15-min.)[3]	45
	Amenity dB(A),Leq(15 min)[2]	48
	Project Noise Trigger Level	**45 (15 min.)**
Night (10pm – 7am)	Intrusiveness dB(A),Leq(15-min.)[3]	45
	Amenity dB(A),Leq(15 min)[2]	42
	Project Noise Trigger Level	**42 (15 min.)**

1 Rating Background Level (RBL) + 5dB.
2. Project amenity noise level (ANL) is urban ANL (NPI Table 2.1) minus 5 dB(A) plus 3 dB(A) to convert from a period level to a 15-minute level.
3. RBL for evening and night cannot be higher than that for day, per NPfI.

5.2 Licensed Premises

In relation to the operation of the Club, premises which are licensed under the Liquor Act 1982 may be a source of offensive noise for neighbouring residents as a result of such things as patron and entertainment noise. The control and limitation of this noise is usually governed by the noise criteria defined by the Office of Liquor, Gaming and Racing (OLGR).

Based on the measured noise levels from the loggers, a background noise level of 40 dB(A) L90 has been adopted for the current OLGR assessment, this being equal to the lowest of the measured background noise levels. This is considered to represent the worst case for all time periods.

The OLGR specifically relate to noise in octave band centre frequencies. The L90 background noise level, used to derive the appropriate OLGR criteria, is shown in **Table 5**. Table 5 also shows the adopted octave band spectrum adapted from noise measurements made in a typical suburban environment.

TABLE 5
OCTAVE BAND BACKGROUND NOISE LEVELS

		Octave Band Centre Frequency, Hz							
	dB(A)	31.5	63	125	250	500	1k	2k	4k
L90	40	20	25	27	28	34	35	32	30

Premises which are licensed under the Liquor Act 1982 may be a source of offensive noise for neighbouring residents as a result of such things as patron and entertainment noise. The control and limitation of this noise is usually governed by the following Standard Noise Conditions imposed by the OLGR;

"The LA10 noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz - 8 kHz inclusive) by more than 5 dB between 7.00 a.m. and 12.00 midnight at the boundary of any affected residence.

The LA10 noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz - 8 kHz inclusive) between 12.00 midnight and 7.00 a.m. at the boundary of any affected residence.

Notwithstanding compliance with the above, the noise from the licensed premises shall not be audible within any habitable room in any residential premises between the hours of 12:00 midnight and 07:00 a.m."

The intent of the OLGR criteria is to limit the potential impacts of entertainment and patron noise. As such, potential noise generating activities relating to this part of the operation of the licensed premises are to be assessed here with regard to the requirements of the OLGR.

The adopted OLGR noise criteria are shown in **Table 6** (determined as the background level from Table 5 plus 5dB in each octave band,

TABLE 6
OLGR CRITERION NOISE LEVELS

		Octave Band Centre Frequency, Hz							
Time	dB(A)	31.5	63	125	250	500	1k	2k	4k
Pre Midnight	45	25	30	32	33	39	40	37	35

5.3 Sleep Disturbance

The NPfI states that a detailed maximum noise level event assessment should be undertaken where the received night time noise emissions from the subject development/premises at a residential location exceed:

- Leq (15 min) 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater,and/or
- Lmax 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,

The adopted RBL for night is 40 dB(A) L90 and, therefore, the trigger level for a detailed assessment is **45 dB(A) Leq (15 min)** and/or **55 dB(A) Lmax**.

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the *NSW Road Noise Policy* (RNP).

Other factors that may be important in assessing the extent of impacts on sleep include:

- how often high noise events will occur;
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the subject development;
- whether there are times of day when there is a clear change in the noise environment (such as during early-morning shoulder periods); and
- current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.

Maximum noise level event assessments should be based on the Lmax descriptor on an event basis under 'fast' time response.

The detailed assessment should consider all feasible and reasonable noise mitigation measures with a goal of achieving the detailed trigger levels.

5.4 Road Traffic Noise

Noise generated by road traffic associated with the proposed development is assessed separately to site noise using the OEH Road Noise Policy (RNP).

The RNP, as adopted by Roads and Maritime Services of NSW (RMS), recommends traffic noise criteria for different road developments and uses.

Based on definitions in the RNP, O'Connell Road would be classified as an arterial road. An extract of the relevant section of the RNP relating to land use developments with the potential to create traffic on arterial roads is shown in **Table 7**.

TABLE 7
BASE TRAFFIC NOISE OBJECTIVE

Situation	Recommended Criteria	
	Day - (7am - 10pm)	Night – (10pm – 7am)
6. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	60 Leq(15hr) (external)	55 Leq(9hr) (external)

6.0 PREDICTED NOISE IMPACTS

6.1 Sporting Events

Noise sources associated with sporting events include crowd noise, raised voices, referee whistles, full-time sirens and public address (PA) systems.

These noise sources are all intermittent with relatively high maximum levels but considerably lower Leq (15 min) levels. The noise from each of the sources will also vary depending on the time and location of the play at the various grounds and on the type of event being held (e.g. club game, junior game, team training etc.).

The typical sound power level from a raised adult male voice ranges from about 85 to 90 dB(A),Lmax. Similar noise levels are produced from a referee or umpires whistle.

Modern sporting venues do not have a single, centrally located speaker for the PA system. Rather, smaller speakers are distributed throughout spectator areas, often mounted to lighting poles, and directed towards the ground. Maximum noise levels in the order of 75 to 80 dB(A) are typical with intermittent use implying much lower Leq (15 min) levels.

Previous measurements conducted by Spectrum Acoustics at various sporting events have found 15-minute average levels from sporting fields to be between 15 and 20 dB below the maximum level, due to the non-constant nature of the noise source. A worst case sound power level of 75 dB(A),Leq (15 min) has, therefore, been estimated during general play for, say, a rugby league, hockey or netball games.

A scenario has been assessed where there are games being played at the same time at each ground at the venue. The theoretical noise sources (games) are represented as dots on **Figure 5**. A small crowd with a sound power level of 80 dB(A) Leq (15 min) was also considered to be in the grandstand.

Figure 5. Noise Source Locations.

Received noise levels were determined for each noise source and the combined result calculated for the most potentially affected receiver in Scotia Avenue ("R" on Figure 5). Note that "R" is the boundary of the residence, and that, as the residence at receivers along Scotia Avenue are more than 30m from the (affected) boundary, the noise was calculated for a theoretical reception point at 30m from the residence (as per procedures in the NPfI).

The results of the assessment of this sporting noise are shown in **Table 8**.

TABLE 8 CALCULATED SPL AT SCOTIA AVENUE SPORTING NOISE – Leq (15 min)			
Noise Source Number	Sound Power	Distance Loss (m)	Received Noise
1	75	52 (150m)	23
2	75	57 (270m)	18
3	80	55 (220m)	25
4	75	54 (190m)	21
5	75	54 (190m)	21
Total Leq (15 min)	**29**		
Criterion Leq (15 min)	**45**		

The results in Table 8 show that, under the assessed conditions, the noise from the sports complex will not exceed the criterion at the most potentially affected receiver location.

The worst case for noise generation from the sports complex is considered to be from a large crowd cheering or yelling at a major event. This will only occur occasionally, both during the year and also during an individual game or event.

The noise from crowds is influenced by many factors, including, the type of event, the make up of the crowd (dominantly male crowds may be up 7dB(A) louder than females crowds), the effects of alcohol (which influence an individual's voice effort), the orientation of each voice in relation to a receiver (i.e. either facing towards, or away from, the receiver) which determine whether the noise would be directional or if it has a diffused orientation.

A crowd of 200 people all cheering loudly would have sound power level of between 108 and 113 dB(A) Lmax. Assuming a worst case of the whole crowd facing the receiver and cheering at the maximum level for two minutes out of a 15 minute assessment period, this would equate to a level of between 99 and 104 dB(A) Leq (15 min).

The received noise from such a crowd, calculated as above, is shown in **Table 9**. The noise from the other noise sources are also shown to depict the worst case.

TABLE 9 CALCULATED SPL AT SCOTIA AVENUE CROWD NOISE – Leq (15 min)			
Noise Source Number	Sound Power	Distance Loss (m)	Received Noise
1	75	52 (150m)	23
2	75	57 (270m)	18
3	99 - 104	55 (220m)	44 - 49
4	75	54 (190m)	21
5	75	54 (190m)	21
Total Leq (15 min)	**44 - 49**		
Criterion Leq (15 min)	**45**		

The results in Table 9 show that, under the assessed conditions, the noise from a loudly yelling crowd may have the potential to exceed the adopted criterion. It is noted, however, that the assessed noise is based on the worst case specific conditions which may only occur occasionally throughout any sporting season.

Half and full time sirens may be heard around sporting grounds. There are options available in relation to the sirens or alarms. For example, a single hand-held air horn (EcoBlast or similar) has a sound power level of about 110 dB(A). When activated for 3 seconds this equates to a sound power level of 85 dB(A) Leq (15 min).

To minimise any potential impacts from the timekeeping at the various games it is recommended that the end of period sirens be sounded through the P.A. system. Having multiple noise sources, rather than a single one, allows for the reduction in sound power of each source. In this way the siren can still be loud enough to be readily audible on the playing fields whilst having minimum impacts outside of the site.

As detailed above, it is recommended that all speakers for the P.A. system(s) at the various grounds be mounted on light poles, or similar, and at a height that is no more that 4m above ground level.

The system should be set up with several speakers, spread throughout the general crowd areas and each speaker must be oriented downwards towards the ground at a minimum 45° angle. This is the best orientation in terms of noise impact minimisation.

Noise levels should be set such that announcements are effectively audible throughout the grounds and spectator areas but are not intrusive at the boundaries of the site.

6.2 Licensed Premises - Live Entertainment

It is anticipated that the most potential for adverse noise impacts due to the operation of the Club would come from emissions from amplified music in the venue (at, say, a function or post match celebration).

The layout of the Club is shown in **Figure 6**.

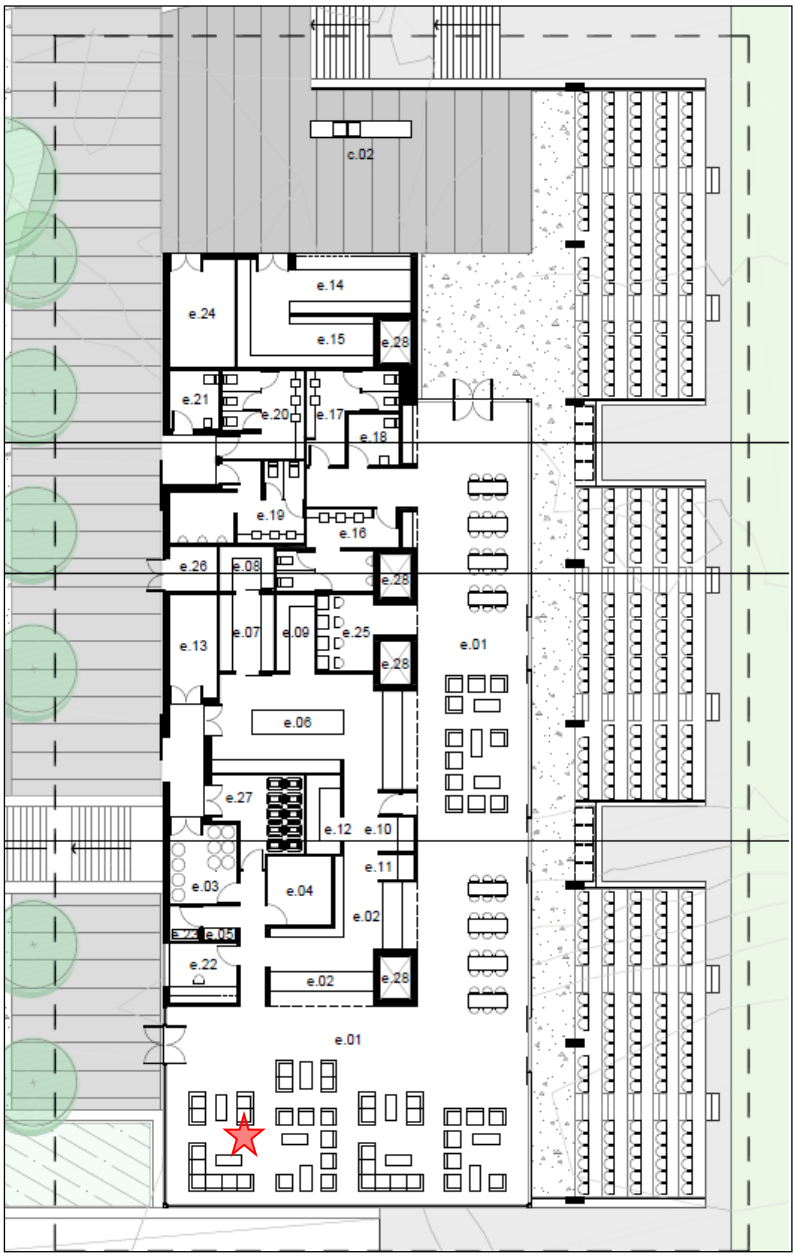


Figure 6. Club Layout.

It is envisaged that entertainment at the venue may take the form of a live band or DJ style performance (although this will not likely be a regular occurrence). To assess the potential noise impacts from such events, the Lw of typical entertainment for a function, in a similar style venue to that proposed, has been sourced from the Spectrum Acoustics technical database.

This noise source was assumed to be located at a possible performance area inside the main lounge area at the approximate location depicted with a star on Figure 6. Note that the location is not a defined

entertainment area but, rather, was chosen to allow for the assessment of the worst case.

For the calculation of potential impacts the end (southern) and front (eastern) walls of the Club at this point was assumed to be glazed and the STL of the glass was based on 6 mm safety glass with no gaps at the joins or at the walls. The calculation for the roof/ceiling was based on the STL of corrugated steel sheeting lined with 10mm plasterboard and insulation infill in the cavity.

The noise from the entertainment, as described above, located as shown as “S” on **Figure 7**, was theoretically propagated to the most potentially affected residential receiver (“R” on Figure 7) taking into account the effects of reverberant field loss in the venue, transmission loss through building elements and hemispherical spreading (distance loss) to the receiver.

From consideration of the dimensions and orientation of the various building elements, the sound pressure levels immediately outside these were propagated to the nearest receiver using an equation[1] giving the sound field due to an incoherent plane radiator.

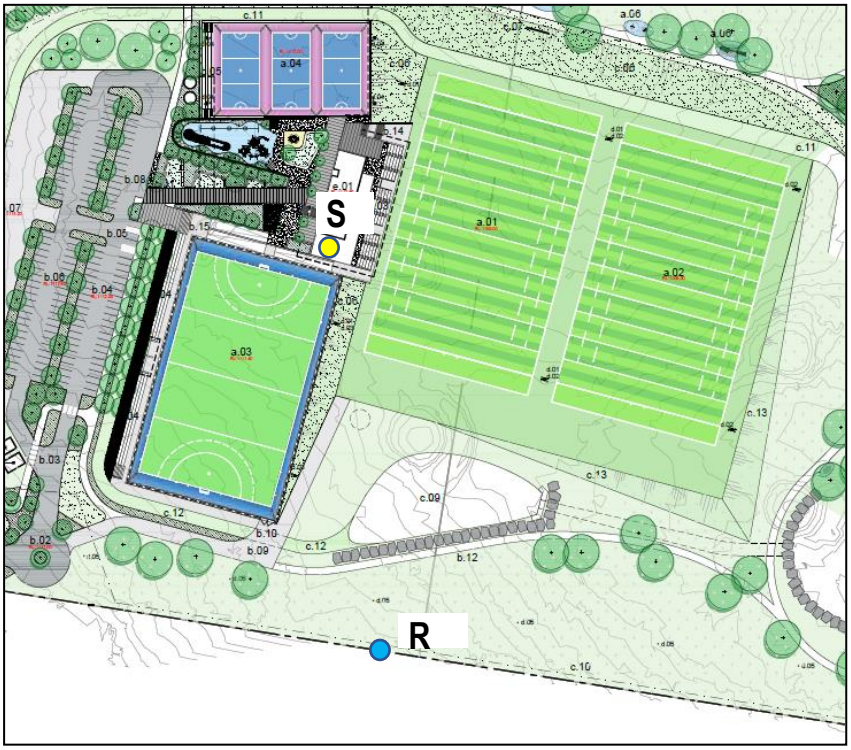


Figure 7. Entertainment Noise Assessment.

[1] Equation (5.104), DA Bies and CH Hansen, *Engineering Noise Control*, E & FN Spon, 1996.

The results of the calculations are shown in **Table 10**. The results in Table 9 are based on propagation through glazing (6mm safety glass) in the southern and eastern façades and the roof/ceiling.

For the calculation the noise source (band or DJ) was considered to be set up at the southern end of the building at an average distance of 5m from the centre of the glazing at the southern facade. Similarly, the average distances to the acoustic centre of the other significant noise leakage paths (east wall and ceiling) are as shown in Table 10.

TABLE 10
CALCULATED SPL AT SCOTIA AVENUE
ENTERTAINMENT IN VENUE as dB(A) L10

		Octave Band Centre Frequency, Hz							
Item	*dB(A)*	31.5	63	125	250	500	1K	2K	4K
Source Lw	108	45	75	87	96	102	104	100	95
Reverberant field loss to south wall (5m)		16	16	16	16	16	16	16	16
Lp at south wall	92	29	59	71	80	86	88	84	79
STL of glazing		14	17	19	25	30	27	32	34
External SPL (walls)	64	15	42	52	55	56	61	52	45
SPL @ receiver Leq (walls)	**24**	**<0**	**2**	**12**	**15**	**16**	**21**	**12**	**5**
Reverberant field loss to east wall (12m)		20	20	20	20	20	20	20	20
Lp at east wall	88	25	54	67	76	82	84	80	75
STL of glazing		14	17	19	25	30	27	32	34
External SPL (walls)	60	11	38	48	51	52	57	48	41
SPL @ receiver Leq (walls)	**23**	**<0**	**1**	**11**	**14**	**15**	**20**	**11**	**4**
Reverberant field loss to roof (10m)		19	19	19	19	19	19	19	19
Lp at inner surface (roof)		30	60	72	81	87	89	85	80
STL of Roof		9	13	17	18	21	25	23	20
External SPL (roof)	67	17	43	51	59	62	60	58	56
SPL @ receiver Leq (roof)	**20**	**<0**	**<0**	**4**	**12**	**15**	**13**	**11**	**9**
Total Received Noise	**27**	**<0**	**3**	**15**	**18**	**21**	**24**	**17**	**11**
Criterion	45	25	30	32	33	39	40	37	35
Impact		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

The results in Table 10 show that, under the assessed conditions, there will be no adverse noise impacts at the most potentially affected receiver due to entertainment noise inside the Club.

Further calculations show, that with a similar noise source to that detailed in Table 10 within the venue, there is a potential for the noise criteria to be exceeded if the glass doors in the eastern façade (to the grandstand) are open. It is recommended that these doors be closed at all times when there is a band or DJ style entertainment playing in the venue.

6.3 Licensed Premises - Outdoor Areas

The Club is to have outdoor areas that it is assumed may be used, at times, as seating and/or smoking areas

To assess the worst case it was assumed that there may be up to 50 people sitting or standing in small groups on the concourse area outside of the glass doors at the southern end of the Club.

It has been assumed that of these people, approximately 25% or, say, 12 to 13 people may be conversing loudly at any one time. Note that whilst there may be more patrons than that present, it is not anticipated that more than this will have their voices raised simultaneously, and all facing in the same direction, to constitute an L10 noise emission level in the direction of any particular receiver.

Table 11 shows the Lw of the combined raised speech of 13 people standing in the (described) outdoor area, propagated to the most potentially affected residential receiver (R on Figure 7). The calculation takes into account the loss for hemispherical spreading (distance loss). There is no allowance in the calculations for any shielding from any elements of the building or balustrades, this providing a degree of conservatism to the results.

TABLE 11
CALCULATED SPL AT SCOTIA AVENUE
PATRON NOISE - OUTDOOR AREAS as dB(A) L10

		Octave Band Centre Frequency, Hz							
Item	dB(A)	63	125	250	500	1k	2k	4k	8k
Lw 13 people – raised speech	90	40	59	72	86	85	82	74	65
Distance Loss (210 m)		54	54	54	54	54	54	54	54
SPL at Boundary	**36**	**<0**	**5**	**18**	**32**	**31**	**28**	**20**	**11**
Criterion (night)	45	30	32	33	39	40	37	35	30
Impact		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

The results in Table 11 show that, under the assessed conditions, the adopted night time noise criterion will not be exceeded due to noise from patrons in the outdoor areas.

6.4 Mechanical Plant

Mechanical plant items associated with the Club will include refrigeration and air conditioning equipment. The locations, model and capacity of the plant to be used was not finalised at the time of the current assessment.

Refrigeration plant will be located mostly within the building and noise emissions will be minimal and no further assessment is considered warranted here.

Due to the size and configuration of the building it is likely that the air conditioning condensers could be located at the car park side of the building.

Condenser units for this type of application, typically, have sound power levels in the range 65 to 70 dB(A) when they are operating at full capacity.

For three such condensers, each operating at 70 dB(A), this would equate to a combined Lw of 75 dB(A). Compliance with the (most stringent) night time criterion of 42 dB(A) Leq (15 min) would be achieved at distances of greater than 17m from the units (unshielded).

It is considered reasonable that there the a/c plant can be located such that it doesn't create adverse impacts at any receivers.

6.5 Car Park

There are to be approximately 160 car parking spaces at the sports complex. These parking spaces may also used by patrons visiting the Club.

Noise in car parks typically comes from people walking to and from cars, doors opening and closing etc., as well as vehicles moving at slow speeds. Each noise event is characterised by a brief peak which when averaged out over a 15 minute period has a relatively low Leq. The impact of each noise event on any single receiver is also variable depending upon the location of individual cars within a car park and as they move in and out.

During most days the use of the car park will be limited. The majority of use will usually coincide with the period before, and after, the various Club or sporting events. Even so, people arriving and departing such events do so at various rates.

A scenario has been assessed where 50% of the car parks would be used in a single 15 minute period. That is, 80 car parks spread throughout the entire parking area.

Typical noise levels from car parks have been sourced from the Spectrum Acoustics technical database. This contains noise measurements from a series of vehicles arriving and departing a car park with people moving to and from vehicles. The measurements were made over a representative period to ascertain a typical noise level from these activities. The measurements were made at varying distances from each car to approximate the situation in relation to an adjacent residence over a 15 minute interval. That is, at any time throughout each 15 minute interval various car parks, at different distances from the nearest residences, will be in use.

The measurements in the database show a noise level of 53 dB(A) Leq measured over a 5 minute period where up to 6 vehicles moved in and out of a car park. The measurements were made at an average distance of 7m.

Assuming the noise from the 6 vehicles is consistent for a full 15 minutes at a distance of 7m this equates to a sound power level of 73 dB(A) Leq (15 min) for car park noise.

Due to the layout of the car park, individual parking spaces will be at various distances from receivers. To assess potential impacts the car park has been considered to be 10 separate "banks" of 8 parking spaces, each with a sound power level of 74 dB(A) Leq (15 min).

Received noise levels were determined for each "bank" and the combined result calculated for the theoretical reception point at receiver "R" in Scotia Avenue.

A summary of the results of the assessment of car park noise, as described above, is shown in **Table 12**. Car park numbers referred to in the tables are as shown diagrammatically in **Appendix I**.

TABLE 12
CALCULATED SPL FROM CAR PARK
Leq (15 min)

Car Park Number	Distance Loss (m)	Received Noise
1	53 (180m)	21
2	54 (190m)	20
3	54 (190m)	20
4	55 (200m)	19
5	56 (240m)	18
6	52 (160m)	22
7	53 (180m)	21
8	53 (195m)	21
9	55 (230m)	19
10	56 (240m)	18
Total Leq (15 min)	**30**	
Criterion Leq (15 min)	**45**	

The results in Table 12 show that, under the assessed conditions, there the day and evening time noise criterion would not be exceeded due to noise emissions from the car park.

6.6 Sleep Disturbance

Noise from patrons leaving the Club after 10pm has the potential to create sleep disturbance. This may include noise from the raised speech of patrons or the loud closing of car doors etc. Noise associated with this sort of activity would have noise levels in the range from approximately 95 to 100 dB(A) Lmax.

For this assessment a noise source representing a car door closing at the end of a function (at 100 dB(A) Lmax) was considered to be located at the southern end of the car park ("bank" number 6 of the car park as per the car park annotations referred to above and shown in Appendix I).

The noise was theoretically propagated to the façade of Receiver R. The results are shown below in **Table 13**.

TABLE 13
CALCULATED SPL AT SCOTIA AVENUE
SLEEP DISTURBANCE (as Lmax)

Propagation Element	dB(A)
Car Door	100
Distance loss (190 m)	54
SPL bedroom window	46
Screening Criterion (night) dB(A)	55
Impact	0

The results in Table 13 show there will be no adverse sleep disturbance impacts as a result of the assessed noise emissions.

The assessed Lmax noise from a loud male voice is, typically, lower than that of a car door closing and a car starting up and the calculations shown in Table 13 are considered representative of the worst case.

6.7 Road Traffic Noise

The design of the car park means that all vehicles must arrive and depart via O'Connell Road. There are approximately 160 parking spaces at the facility, but it is not envisaged that all would be in use at the same time.

For a conservative (worst case) assessment a total of 100 vehicles were considered to leave the cark in an hour at, say, the end of a major match. Of these vehicles, 75% of them were considered to travel south along O'Connell Road and from there into the local road network. All vehicles were considered to be travelling at 60 kph.

Due to the non-continuous nature of the traffic flow the assessment of potential impacts is undertaken using the accepted Intermittent Traffic Noise guidelines.

Equation 1, below, outlines the mathematical formula used in calculating the Leq,T noise level for intermittent traffic noise;

$$L_{eq},T = L_b + 10\log\left[1+\frac{ND}{T}\left(\frac{10^{(L\max - Lb)/10}-1}{2.3}-\frac{(L_{\max}-L_b)}{10}\right)\right]$$

Equation 1

Where

L_b is background noise level, dB(A)

L_{MAX} is vehicle noise, dB(A)

T is the time for each group of vehicles (min)

N is number of vehicle trips

D is duration of noise of each vehicle (min)

Noise levels from the vehicles have been assessed to a point 1m from the facade of residences in O'Connell Road at a nominal distance of 15m from the centre of the southbound lane. Results are shown in **Table 14**.

TABLE 14
ROAD TRAFFIC NOISE – O'CONNELL ROAD

Element	dB(A)
No. of Vehicle movements (peak hourly period)	75
Lw per vehicle @ 60 kph	92
Distance Loss (15m)	32
Received Noise (Leq 1 hour) from eqn. 1	**48**
Criterion – Day (Leq 1 hour)	**60**

The results shown in Table 14 show that, under the assessed conditions, noise from traffic generated by the proposal will not exceed the RMS criterion.

7.0 CONCLUSION

A noise impact assessment has been undertaken into the operation of the proposed Oberon Sports Complex, located of O'Connell Road, Oberon, NSW has been conducted.

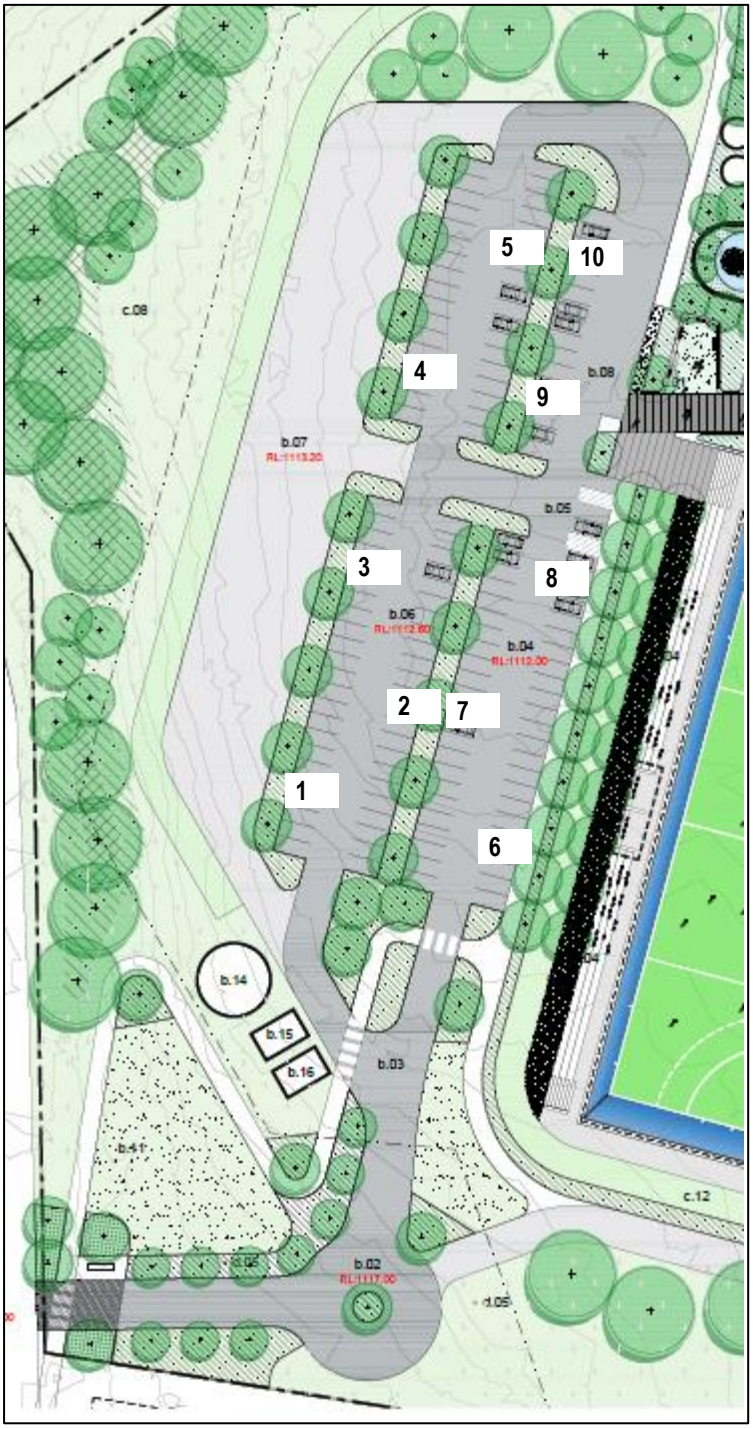
The assessment has considered noise emissions from typical and worst case noise generation at the sports complex and licensed club.

The report contains a number of recommendations in relation to sirens and P.A. systems which are aimed at minimising noise emissions.

The assessment has found there will be no adverse noise impacts from the operation of the facility or associated traffic.

Appendix I

Car Park Noise Source Locations


5
10
4
9
3
8
2
7
1
6
c.08
b.08
b.07
b.05
b.06
b.04
b.14
b.15
b.16
b.03
b.41
c.12
b.02
c.05