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Environmental Noise Assessment

Mindarie Marina Hotel
"Lifeboat" Outdoor Bar Area

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1 INTRODUCTION

Mindarie Marina Hotel is located at the end of Ocean Falls Boulevard (refer *Figure 1-1*) and currently consists of hotel operations as well as function rooms. Other than the hotel rooms themselves, the nearest noise sensitive properties are residences, with the closest being to the east. Those properties are located on Boston Quays, which are zoned mixed use with the bottom floor being of a commercial use and the upper floor residential apartments.

Figure 1-1 Site Locality

It is proposed to utilise the beach volleyball court as an outdoor bar area during peak times. The outdoor bar area would have a capacity of 150 people and operate until 10.00 p.m. on a weekday or weekend. The proposed bar layout is provided in *Figure 1-2*.

Lloyd George Acoustics has been commissioned to assess the noise emissions and to compare them against the *Environmental Protection (Noise) Regulations 1997*. Where these criteria are exceeded, recommendations on noise mitigation have been provided.

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

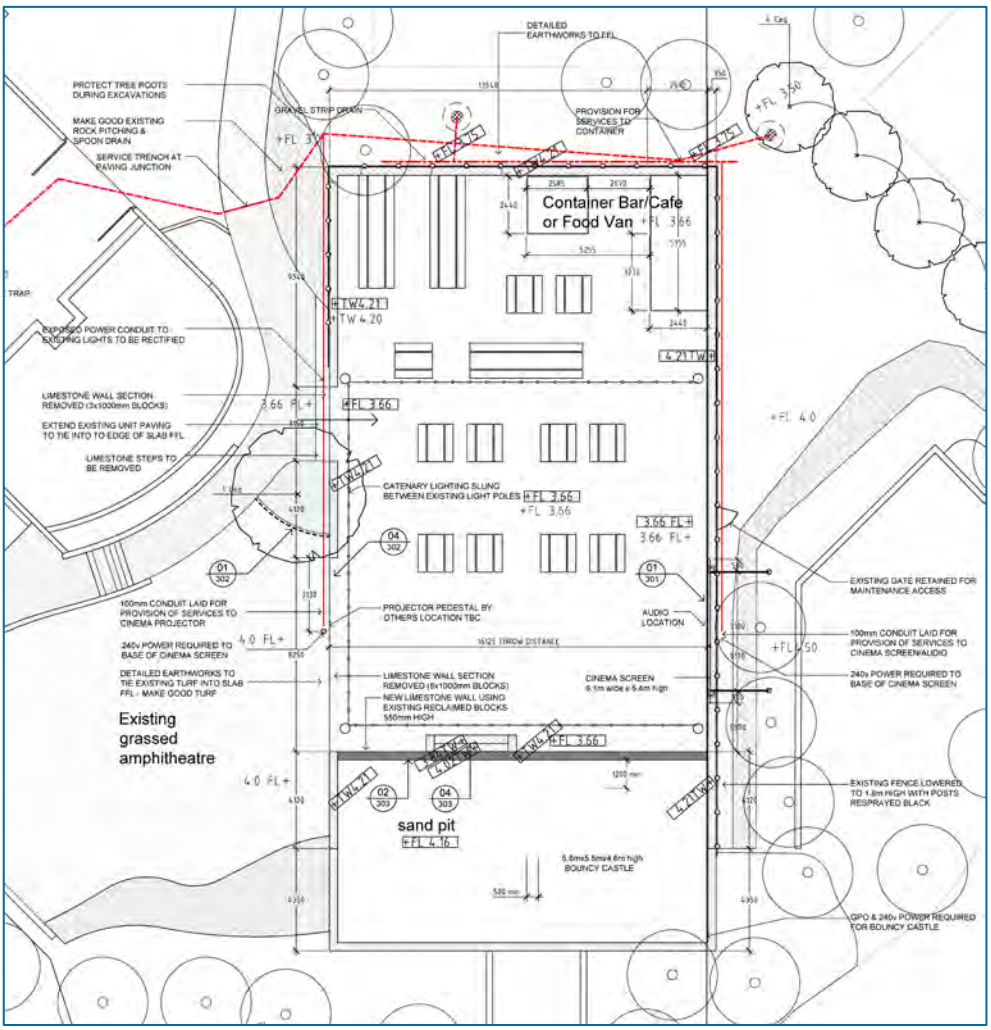


Figure 1-2 Proposed Outdoor Bar Area

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".

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 after the adjustments of *Table 2-1* are made to the noise emission as measured at the point of reception.

Table 2-1 Adjustments for Intrusive Characteristics

Tonality	Modulation	Impulsiveness	Music Where impulsiveness is not present	Where impulsiveness is present
+ 5dB	+ 5dB	+ 10dB	+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 are shown in *Table 2-2*.

Table 2-2 Baseline Assigned Noise 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

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;

The influencing factor, applicable at the noise sensitive premises has been calculated as 2 dB, due to the marina and mixed use being considered commercial under the Noise Regulations. *Table 2-3* shows the assigned noise levels including the influencing factor at the receiving locations.

Table 2-3 Assigned Noise Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area	0700 to 1900 hours Monday to Saturday (Day)	47	57	67
	0900 to 1900 hours Sunday and public holidays (Sunday)	42	52	67
	1900 to 2200 hours all days (Evening)	42	52	57
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	37	47	57

3 METHODOLOGY

Computer modelling has been used to predict noise emissions to surrounding areas. The software used was *SoundPLAN 8.0* with the CONCAWE algorithms selected. These algorithms have been selected as they are one of the few that include the influence of wind and atmospheric stability. Input data required in the model are:

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

3.1 Meteorological Information

Meteorological information utilised (*Table 3-1)* is based on that specified in the *draft EPA Guidance for the Assessment of Environmental Factors No.8 Environmental Noise*. These conditions are considered the worst-case 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 dominate the ambient noise levels.

Table 3-1 Modelling Meteorological Conditions

Parameter	Night (1900-0700)
Temperature (^{o}C)	15
Humidity (%)	50
Wind Speed (m/s)	3
Wind Direction*	All
Pasquil Stability Factor	F

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

The EPA policy is that compliance with the assigned noise levels needs to be demonstrated for 98% of the time, during the day and night periods, for the month of the year in which the worst-case weather conditions prevail. In most cases, the above conditions occur for more than 2% of the time and therefore must be satisfied.

3.2 Topographical Data

Topographical data was based on that obtained from *GoogleEarth* and the site plans.

3.3 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).

3.4 Source Sound Levels

The sound power levels used in the modelling are provided in *Table 3-2*.

Table 3-2 Source Sound Power Levels, dB(A)

Description	One Third/Octave Band Centre Frequency (Hz)							Overall dB(A)
	63	125	250	500	1k	2k	4k	
Beer Garden 150 People	-	75	74	81	73	72	70	**89**
	61	76	80	82	72	70	67	
	64	72	79	80	74	70	63	
Small Refrigeration Condensing Unit		83	77	77	73	64	55	**78**
Background Music	58	73	74	78	83	74	68	**85**
Roof Mounted Exhaust Fan	59	68	73	76	74	70	66	**80**

With regards to *Table 3-2*, please note the following:

- Typical beer garden noise level assumes 50% of patrons (male voice) are talking at a sound power level of 70 dB(A);
- Background music set at 70 dB(A) at one metre from a speaker.
- Exhaust fan located on top of food/drinks container;
- Refrigeration condensing unit located behind the food/drinks container;
- Refrigeration condensing unit is assumed to be an Actrol ACPAC AP8.8M2.

4 ASSESSMENT RESULTS

The results of the assessment to the worst affected receiver, being the 3rd floor of the apartments located on Boston Quays, and assuming 150 patrons is detailed in *Table 4-1*.

Table 4-1 Predicted Noise Level at Noise Sensitive Receiver

Noise Source	Predicted Noise Level L_{A10} dB
Patrons (150)	44
Kitchen Exhaust Fan	36
Music	34
Refrigeration Condensing Unit	27
Total	**45**

The results show that the overall noise level from the venue would exceed the assigned level of 42 dB L_{A10} by 3 dB. Therefore the noise levels will need to be reduced to achieve compliance.

From *Table 4-1* it can be seen that the dominant noise source is from the patrons.

5 RECOMMENDATIONS

The achieve compliance with the assigned levels, the following noise control is recommended.

5.1 Patron Noise

Patron noise is calculated based on the number of patrons within the enclosed space. It is determined from assuming a sound power level of 70 dB(A), which would be for a slightly raised voice, and assuming 50% of the patrons are talking at once. Using this formula shows that with the proposed number of patrons at 150, the assigned levels are marginally exceeded (2 dB). To achieve compliance using this prediction methodology, the number of patrons would need to be reduced to 110. As the exceedance for 150 patrons is marginal, it may be prudent to measure the noise levels over a typical day to determine whether the desired 150 patrons does result in compliance with the Regulations.

5.2 Exhaust Fan

Any exhaust fan used should be located on the side of the food/drinks building facing the Marina or shielded from view of the apartments on Boston Quays using a cowling. Any tonal components associated with a fan are likely to be masked by the background noise in this area.

5.3 Music Volumes

We would recommend small directional speakers angled down towards the ground. The volume should be set at 70 dB(A) at one metre form the speaker box. The speakers should be installed in such a way that they do not point towards the apartments on Boston Quays. Music does require

adjustment by +10 dB, however, maintaining the volume at this level would still result in compliance with the assigned levels.

The predicted noise levels incorporating the noise control recommendations are detailed in *Table 5-1* and shown graphically in *Figure 5-1*.

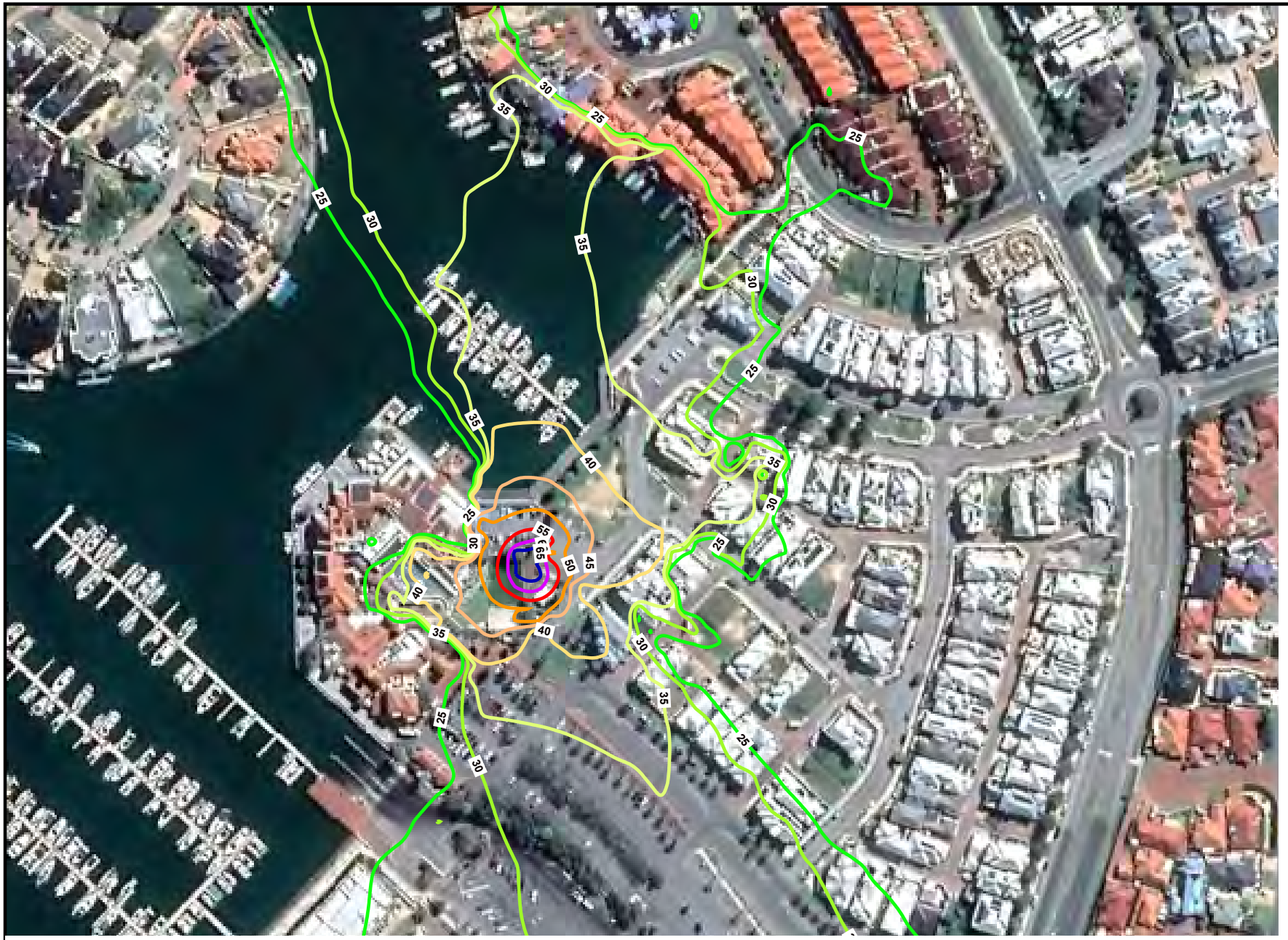
Table 5-1 Predicted Noise Level at Noise Sensitive Receiver Incorporating Noise Control

Noise Source	Predicted Noise Level L_{A10} dB
Patrons (110)	41
Music	32
Kitchen Exhaust Fan	30
Refrigeration Condensing Unit	27
Total	**42**

6 CONCLUSION

With the implementation of noise control as recommended in Section 5 of this assessment, the noise from the proposed venue is able to achieve compliance with the assigned level under the Regulations between 7.00 a.m. and 10.00 p.m. Monday to Saturday and on Sunday and Public Holidays between 9.00 a.m. and 10.00 p.m.

Figure 5-1



Mindarie Marina Hotel "Lifeboat" Outdoor Bar Area
Predicted L_{A10} Noise Levels Assuming Recommended Noise Control
Wind from All Directions

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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 a100m 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 a100m 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.

Ambient Noise

Means the level of noise from all sources, including background noise from near and far and the source of interest.

Specific Noise

Relates to the component of the ambient noise that is of interest. This can be referred to as the noise of concern or the noise of interest.

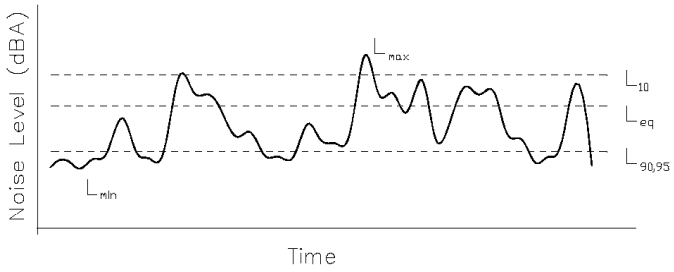
R_w

This is the weighted sound reduction index and is similar to the previously used STC (Sound Transmission Class) value. It is a single number rating determined by moving a grading curve in integral steps against the laboratory measured transmission loss until the sum of the deficiencies at each one-third-octave band, between 100 Hz and 3.15 kHz, does not exceed 32 dB. The higher the R_w value, the better the acoustic performance.

C_{tr}

This is a spectrum adaptation term for airborne noise and provides a correction to the R_w value to suit source sounds with significant low frequency content such as road traffic or home theatre systems. A wall that provides a relatively high level of low frequency attenuation (i.e. masonry) may have a value in the order of –4 dB, whilst a wall with relatively poor attenuation at low frequencies (i.e. stud wall) may have a value in the order of -14 dB.

Chart of Noise Level Descriptors



Typical Noise Levels