ENVIRONMENTAL NOISE ASSESSMENTS IN NEW SOUTH WALES, AUSTRALIA

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1. INTRODUCTION

New South Wales (NSW) is the fourth-largest State in Australia. It occupies an area of just over 800,000 km^2, which is approximately seven times the size of England. The population is over 6,200,000 with approximately 4,000,000 based in the greater Sydney area. About one-third of Australia's manufacturing activity takes place in NSW. Major mining and steel manufacturing occurs in the Coastal Lowland areas between Newcastle and Wollongong whilst major agricultural industries are carried out in the western plains area between Griffith and Broken Hill (See Figure 1 below).

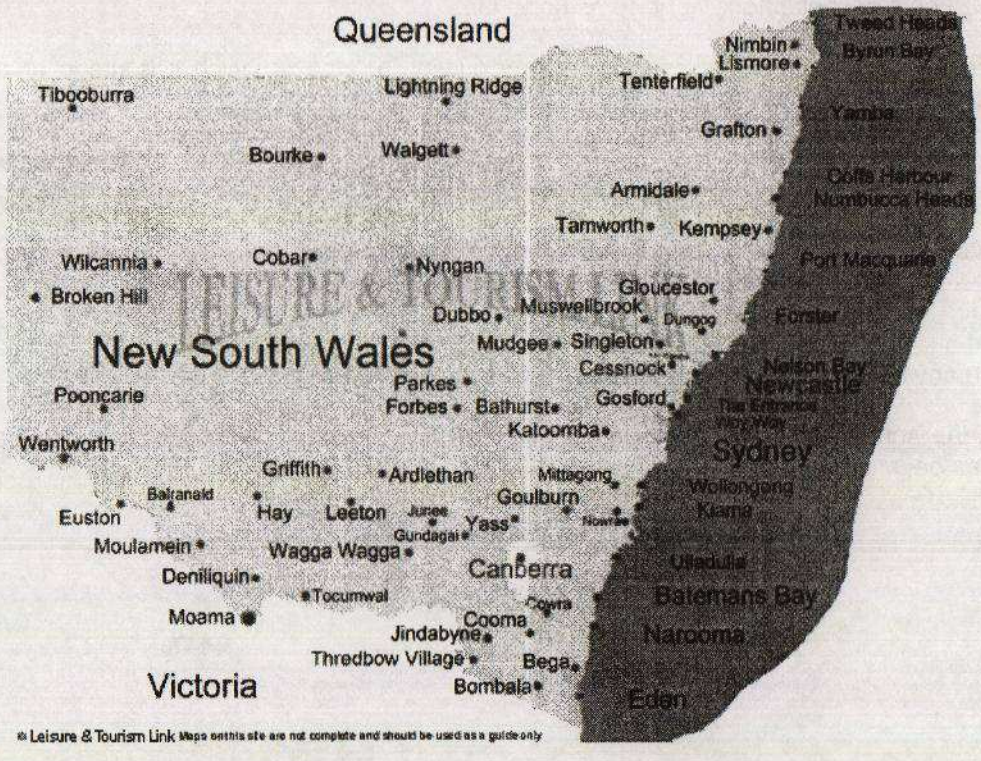

Figure 1. A Map of New South Wales, Australia. The area is about seven times the size of England.

As with all industrialised areas, with densely populated cities, NSW has a wide range of environmental noise issues emanating from mines and other large industrial complexes to pubs and equipment in domestic premises. Legislation is put in place to control the effect of noise in the environment.

2. PROTECTION OF THE ENVIRONMENT OPERATIONS ACT 1997

In NSW noise regulations are made under the **Protection of the Environment Operations Act 1997** (POEO) with the objective of controlling noise in residential areas ('neighbouring noise'). One of the main features of the Act is to allocate powers of enforcement for the Environment Protection Authority (EPA), councils, the police and the Waterways Authority of NSW and to prevent and minimise pollution including the emission of offensive noise.

The POEO Act prohibits the:

- sale of articles emitting more than prescribed noise levels (s 136). Articles and Limits are prescribed in the noise control regulations;
- sale of articles not fitted with the prescribed noise control equipment (s 137). Articles and Limits are prescribed in the noise control regulations;
- emission of noise through the operation of plant, unless the plant is maintained in an efficient condition and operated in a proper and efficient manner (s 139);
- emission of noise through processing or otherwise dealing with materials (including raw materials) except where those materials are dealt with in a proper and efficient manner (s 140);

The POEO Act defines offensive noise as noise that:

(a) by reason of its level, nature, character or quality, or time at which it is made or any other circumstances:

  i. is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or

  ii. interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or

(b) is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in any circumstances prescribed by the regulations.

The POEO Act provides for a range of notices that may be issued when an unacceptable level of noise has been emitted.

2.1 Notices For Noise Control

2.1.1 Noise Control Notices

Authorised officers may issue a notice that specifies a noise limit for a particular article or activity. The notice may also specify a particular time during which the restriction applies or does not apply. For example, a notice issued on a commercial premises might require that sound levels do not exceed a 15 minute energy average ($L_{Aeq,15\ min}$) of 45 dBA at any boundary of the premises between 10.00 pm and 8:00 am on any day. The sound levels that are specified may be determined by reference to council or EPA noise control guidelines, taking into account any special circumstances of the case. Appeals are normally settled in the Land and Environment Court, Sydney.

2.1.2 Prevention Notices

A prevention notice may be issued by an authorised officer to control an article or activity that is being operated or conducted in an 'environmentally unsatisfactory manner'. In practical terms, a notice may be issued where equipment is emitting unreasonable noise because it has not been adequately maintained or reasonable noise mitigation measures have not been applied. Compliance cost notices may be issued to recover costs associated with issuing a prevention notice.

2.1.3 Noise Abatement Direction

An authorised officer may issue a direction to require the emission of offensive noise to stop immediately. These directions are designed for 'one-off' problems such as noisy parties. A direction may be issued verbally or in writing.

2.1.4 Noise Abatement Orders

Citizens may apply for an order from a local court to direct a person to cease emissions of offensive noise.

2.1.5 Licensing

Certain premises listed in the schedule attached to the POEO Act are required to hold an Environment Protection Licence. These licences can, among other things, prescribe noise limits and other noise conditions such as hours of operation for a licence holder.

2.2 Protection Of The Environment Operations Regulation (Noise Control)

A noise control regulation, the ***Protection of the Environment Operations (Noise Control) Regulation 2000 [1]*** came into effect in NSW on 1 September 2000.

The object of this Regulation is to repeal and consolidate the 1995 Noise Control Regulations made for motor vehicles, marine vessels and miscellaneous articles.

The Regulation makes provision for the following matters:

a) A maximum noise level in relation to certain classes of motor vehicles and motor vehicle accessories, such that vehicles and accessories capable of emitting those noise levels cannot be sold,
b) The use of motor vehicles on roads and other places.
c) The use of motor vehicle horns and motor vehicle intruder alarms,
d) The times during which it is not permissible to use certain motor vehicles if they emit noise that can be heard in other residential premises,
e) The sounding of sirens and similar devices on vessels,
f) The emission of noise from engines or exhausts of vessels,
g) The times during which it is not permissible to use certain sound systems on vessels if they emit noise that can be heard in any residential premises,
h) The maintenance of noise control equipment on motor vehicles and vessels,
i) The issue of defective vehicle notices and defective vessel notices
j) The maximum noise levels in relation to certain classes of articles, such as those articles capable of emitting noise levels cannot be sold,
k) The obligation to label certain articles,
l) the times during which it is not permissible to use certain articles if they emit noise that can be heard in any residential premises,
m) the inspection and testing procedures for the purpose of determining noise emission levels of certain motor vehicles, motor vehicle accessories, vessels, articles or equipment.

A person must not sell (new) equipment prescribed in the Table below unless it has a noise label securely attached to it in a conspicuous position. A summary of the Regulations for miscellaneous articles is shown in the Table 1 below.

TABLE 1 – PRESCRIBED NOISE LEVELS

Type of Equipment		Noise Level	Measurement Details or Conditions
Lawn mowers	Cutting width 620 mm to 950 mm	80 dBA	The average of maximum level ('slow' time weighting) in four directions at 7.5 metres
	Ride-on	80 dBA	
Edge cutters		75 dBA	
String-trimmers		80 dBA	
Brush cutters		85 dBA	
Other grass-cutting machines		75 dBA	
Chainsaws		Maximum Sound power level ('fast' time weighting)	
Domestic air conditioners		Maximum Sound power level ('fast' time weighting)	
		Must not be audible within neighbour's habitable room between 10 pm and 8 am (8 am on Sunday or Public Holiday)	
Mobile air compressors		Mean sound level	
Pavement Breaker		Mean sound level	
Mobile garbage compacters		The average of maximum level ('slow' time weighting) in four directions at 15 metres.	
Building Intruder alarms		Automatically ceases to sound after 5 minutes - manual reset.	
Swimming Pool, Power Tools and equipment		Must not be audible within neighbour's habitable room between 7 pm and 8 am (8 am on Sunday or Public Holiday)	
Musical instruments and sound equipment		Must not be audible within neighbour's habitable room between Midnight and 8:00 am.	

3. LIQUOR ACT 1982

Where the amenity of the local neighbourhood is unduly disturbed by the conduct of licensed premises and registered clubs (and/or their patrons) an informal mechanism for complaints can be made by residents, police, local consent authorities and others under section 104 of the Liquor Act 1982 and section 17AA of the NSW Registered Clubs Act 1976 (the Acts) [2].

A complaint against a licensed premises or a registered club can be made if the quiet and good order of the neighbourhood has been unduly disturbed as a result of the manner in which the business is conducted or the behaviour of persons leaving the club or both.

A complaint can only be made under the Acts by:-

a) A person authorised in writing by three or more persons residing in the neighbourhood of the licensed premises/registered club or a person who is such a resident and is authorised in writing by two or more other such residents;

b) The commissioner of police or an appointed delegate;

c) A person authorised by the local consent authority (such as a local council) in relation to the licensed premises/registered club;

d) A person who satisfies the Liquor Administration Board that his or her interests, financial or other are adversely affected by the undue disturbance;

e) The Director of the Liquor and Gaming Board or an appointed delegate.

3.1 Liquor Administration Board Standard Noise Condition

The Liquor Administration Board (the Board) have produced standard conditions for noise emissions from licensed premises as follows:-

"*The L_{A10} noise level emitted from the licensed premise shall not exceed the background noise level in any octave band frequency (centred on 31.5 Hz to 8 kHz inclusive) by more than 5 dB between 07:00 am and midnight at the boundary of any affected residence.*

The L_{A10} noise level emitted from the licensed premise shall not exceed the background noise level in any octave band frequency (centred on 31.5 Hz to 8 kHz inclusive) between midnight and 07:00 am at the boundary of any affected residence.

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

This is a minimum standard. In some instances the Board may specify a time earlier than midnight in respect of the above condition. "

4. INDUSTRIAL NOISE SOURCES

The EPA assessment procedure for industrial noise sources has two components. One component is aimed at controlling intrusive noise impacts in the short term for residences and the second component is aimed at maintaining particular noise level amenity for various land uses.

4.1 Criteria

Criteria for noise sources from industrial and commercial premises are provided by the Environment Protection Authority, NSW (EPA) which are generally in line with criteria given in other States of Australia and many Countries of the World. This includes the EPA Environmental Noise Control Manual (1994) and the Industrial Noise Policy (2000). These cover noise in urban, suburban and rural areas. Although specific local conditions can affect the criteria, convincing justification must be given for any variation to EPA guidelines.

The assessment procedure for industrial noise sources given in the EPA's Industrial Noise Policy (2000) [3] has two components:-

- **Controlling intrusive noise impacts; and**
- **Maintaining noise level amenity;**

In assessing the noise impact of industrial or commercial noise sources all components must be taken into account for residential receivers, but, in most cases, only one will become the limiting criterion. The project-specific noise goals reflect the most stringent noise level requirement. It is derived from intrusive and amenity criteria and this is used to set a benchmark against which noise impacts and the need for noise mitigation are assessed.

4.2.1 Intrusive Noise Impacts

In the Industrial Noise Policy (2000) the EPA states that:- *'The intrusiveness of an industrial noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq} descriptor) measured over a 15 minute period, does not exceed the background noise level measured in the absence of the source by more than 5 dB.'* Thus, when considering the environmental consequence of noise from a specific source, any increase above the background sound pressure level, which exceeds 5 dB, may be offensive.

The perception of noise and its level of offensiveness depends greatly on the broader situation within which it occurs. Noise that might intrude into a resting or sleeping place may be offensive whereas the same noise occurring in a market place or noisy working area may pass unnoticed. The concept of *'background + 5 dB'* derives from this consideration.

The EPA state that where the existing background noise level at the receptor is less than 30 dBA, as may occur in a quiet suburban or rural area, then 30 dBA should be assumed to be the existing background noise level.

Where the noise source contains characteristics such as prominent tonal components, impulsiveness, intermittency, irregularity or dominant low-frequency content, adjustments to the measured level are applied to allow for the increase in the annoyance value.

4.2.2 Protecting Noise Amenity

In the EPA's Industrial Noise Policy it is stated that *'To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.1."*

The relevant parts of the EPA recommended levels are given in Table 2 below:-

TABLE 2 – RECOMMENDED NOISE LEVELS FROM INDUSTRIAL NOISE SOURCES.

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level (dBA)	
			Acceptable	Extreme
Residence	Rural	Day Evening Night	50 45 40	55 50 45
Residence	Suburban	Day Evening Night	55 45 40	60 50 45
Residence	Urban	Day Evening Night	60 50 45	65 55 50
Residence	Urban/Industrial Interface – for existing situations only	Day Evening Night	65 55 50	70 60 55
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

Hence the acceptable noise level ANL (L_{Aeq}) for example in urban areas is **60 dBA** day time; **50 dBA** evening time and **45 dBA** night time. Day time is defined as 07:00 to 18:00 hours, evening is 18:00 to 22:00 hours and night time is defined as 22:00 hours to 07:00 hours. Modifications are made to the ANL to account for the existing level of industrial noise.

4.2.3 Modifying Factor Adjustments

Where the existing noise level from industrial noise sources is close to the acceptable noise level, the noise level from any new noise source must be controlled to preserve the amenity of the area. If the total noise level from industrial noise sources already exceeds the acceptable noise level for the area in question, the LAeq noise level from any new source should not be greater than 10 dB below the existing level (assuming th existing levels are not likely to decrease in the foreseeable future). Table 3 below sets out the implications of this requirement for various other noise levels.

TABLE 3. MODIFICATIONS TO THE ACCEPTABLE NOISE LEVEL TO ACCOUNT FOR THE EXISTING LEVEL OF INDUSTRIAL NOISE.

Total existing L_{Aeq} noise level from industrial sources, dBA	Maximum L_{Aeq} noise level from new sources alone, dBA
≥Acceptable noise level plus 2	Existing noise level minus 10
Acceptable noise level plus 1	Acceptable noise level minus 8
Acceptable noise level	Acceptable noise level minus 8
Acceptable noise level minus 1	Acceptable noise level minus 6
Acceptable noise level minus 2	Acceptable noise level minus 4
Acceptable noise level minus 3	Acceptable noise level minus 3
Acceptable noise level minus 4	Acceptable noise level minus 2
Acceptable noise level minus 5	Acceptable noise level minus 2
Acceptable noise level minus 6	Acceptable noise level minus 1
< Acceptable noise level minus 6	Acceptable noise level

Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same sound pressure level. A correction should be applied to both the intrusive and the amenity measurement before a comparison is made with the criteria. An abbreviated version of the correction factors is shown in Table 4 below:-

TABLE 4 – MODIFYING FACTOR CORRECTIONS

Factor	Assessment/ Measurement	When to Apply	Correction	Comments
Tonal Noise	One-third octave band or narrow band analysis	Level of one third octave band exceeds the level of the adjacent bands by 5 dB or more (above 400 Hz) 8 dB - 160 Hz to 400 Hz and 15 dB below 160 Hz	+ 5 dB	Narrow band frequency analysis may be required to precisely detect occurrence
Low frequency noise	Measurement of C-weighted and A-weighted Level	Measure/assess C and A-weighted levels over same time period. Correction to be applied if the difference between the two is 15 dB or more	+ 5 dB	C-weighted is designed to be more responsive to low frequency noise
Impulsive noise	Time weighting fast and impulse	If the difference in the A weighted maximum levels between 'fast' and 'impulse' are greater than 2 dB	Apply the difference in measured levels as the correction up to a maximum of 5 dB	Impulse time weighting is characterised by a short rise time (35msec) compared to 125msec for 'fast'.
Intermittent Noise	Subjectively Assessed	Level varies by more than 5 dB	+ 5 dB	Adjustment to be applied for night time only

4.2 Background Noise Levels

The assessment is based on a *'background plus'* basis. . For large developments the background level (L_{A90}) is required to be measured in 15 minutes samples over a full week in good weather conditions. This obviously requires the use of remote noise 'loggers' to obtain the data and Australian manufacturers have been able to offer a variety of rugged devices to fulfil the need. A single number background level is then, for the first time in NSW, defined specifically. This is the value at the lowest 10 percentile of the 15-minute L_{A90} samples for each period (day/evening and night) and is known as the assessment background level (ABL). Day is defined at 07:00 hours until 18:00 hours; evening as 18:00 hours until 22:00 hours and night from 22:00 hours until 07:00 hours. The Policy then defines the Rating Background Level (RBL) as the overall single figure background level represented by the median of each day and each assessment period over the whole monitoring period.

4.3 Sleep Disturbance

The EPA recognises that many short-term high-level noises which occur at night may comply with longer-term criteria and yet be undesirable because of the sleep disturbance or arousal effect.

Sleep arousal is a function of both the noise level and the duration of the noise. Not all people are affected to the same degree by noise and, at different times, a person will be more or less affected by the same noise. Even in cases where a person is not awoken by noise that person's sleep may be affected. The effects of noise on sleep cannot, at the present time, be predicted with any degree of accuracy and further research is required on this subject.

Noise control should be applied with the general intent to protect people from sleep disturbance. To achieve this, the EPA suggests that the noise level that is exceeded for 1% of any one minute period ($L_{A1,1\ min}$) of any specific noise source should not exceed the background level ($L_{A90,\ 15min}$) when the source noise is not present, by more than 15 dB when measured outside of the bedroom window. In practice this criterion is stringent and regularly exceeded without causing complaint of sleep disturbance.

5. Weather Conditions

When modelling noise propagation outdoors in community environments, the International Standard ISO 9613-2 (1996(E)) *'Acoustic – Attenuation of sound during propagation outdoor'* is often used. The method described in the Standard is general in the sense that it may be applied to a wide variety of noise sources, and covers the major mechanism of attenuation. The method allows for downwind propagation conditions namely:-

- wind direction within an angle of ± 45° of the direction connecting the centre of the dominant sound source and the centre of the specified receiver region with the wind blowing from source to receiver, and
- wind speed between approximately 1 m/s and 5 m/s measured at a height of 3 m to 11 m above the ground.

However, in many Australian environments, temperature inversion can have a highly significant (+20 dBA) effect on the predicted noise levels. This generally limits the effectiveness of acoustic modelling software development in Europe, which relies solely on ISO 9613-2.

6. Limitations

As with the British Standard BS 4142: 1997 [5] or any document of its kind, the NSW EPA Industrial Noise Policy has its limitations. The document gives no advice or allowance for situations where an industry is only noisy for part of the year. This occurs regularly, in NSW for example in the agricultural industry in the western plains area of NSW where food crops are harvested and processed in three or four months of the year. One particularly difficult noise source, to set limits for, in these areas, is wind machines which are used to protect crops from winter frosts [6]. Here a 5.5 metre diameter propeller fan blows warmer air from the upper atmosphere on to crops when the temperature drops below about –2ºC. This normally occurs in the early hours of the morning and can produce noise levels at neighbouring residences of background plus 30 dB. The problem is that this is seen as essential use for the farmer and may occur only 4 or 5 nights per year in mild conditions. However, it could occur 30 or more nights per year during a cold winter and sleep disturbance become a major problem.

7. Conclusion

NSW have developed a range of policies to control noise in the environment. The Industry Noise Policy (2000) [3] is a well thought-out and provides detailed guidance on setting realistic noise goals. The policy is limited as it does not cover sleep disturbance or situation where an industry is only noisy for part of the year.

References

1. Protection of the Environment Operations of the Environment Operations (Noise Control) Regulation (September 2000). Published in NSW Government Gazette No 112 of 1 September 2000 page 9316.

2. The NSW Liquor Act 1982 (section 104) and the NSW Registered Clubs Act 1976 (section 17AA). From *'Fact Sheet 8 - Complaints'* Published by the Department of Gaming and Racing on Behalf of the Liquor Administration Board (May 1999).

3. NSW Environment Protection Authority 'Environmental Noise Management – NSW Industrial Noise Policy EPA 00/1 (January 2000) www.epa.nsw.gov.au.

4. International Standard ISO 9613-2 (1996(E)) *'Acoustic – Attenuation of sound during propagation outdoors Part 2 General method of calculation'*

5. British Standard BS 4142: 1997 'Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas'. BSi, London.

6. Scannell, K *'Frost Fan Noise Policy - The Issues'* Proceeding of 'Acoustics 2001 Noise and Vibration Policy – The Way Forward'. November 2001 Canberra, ACT, Australia.