

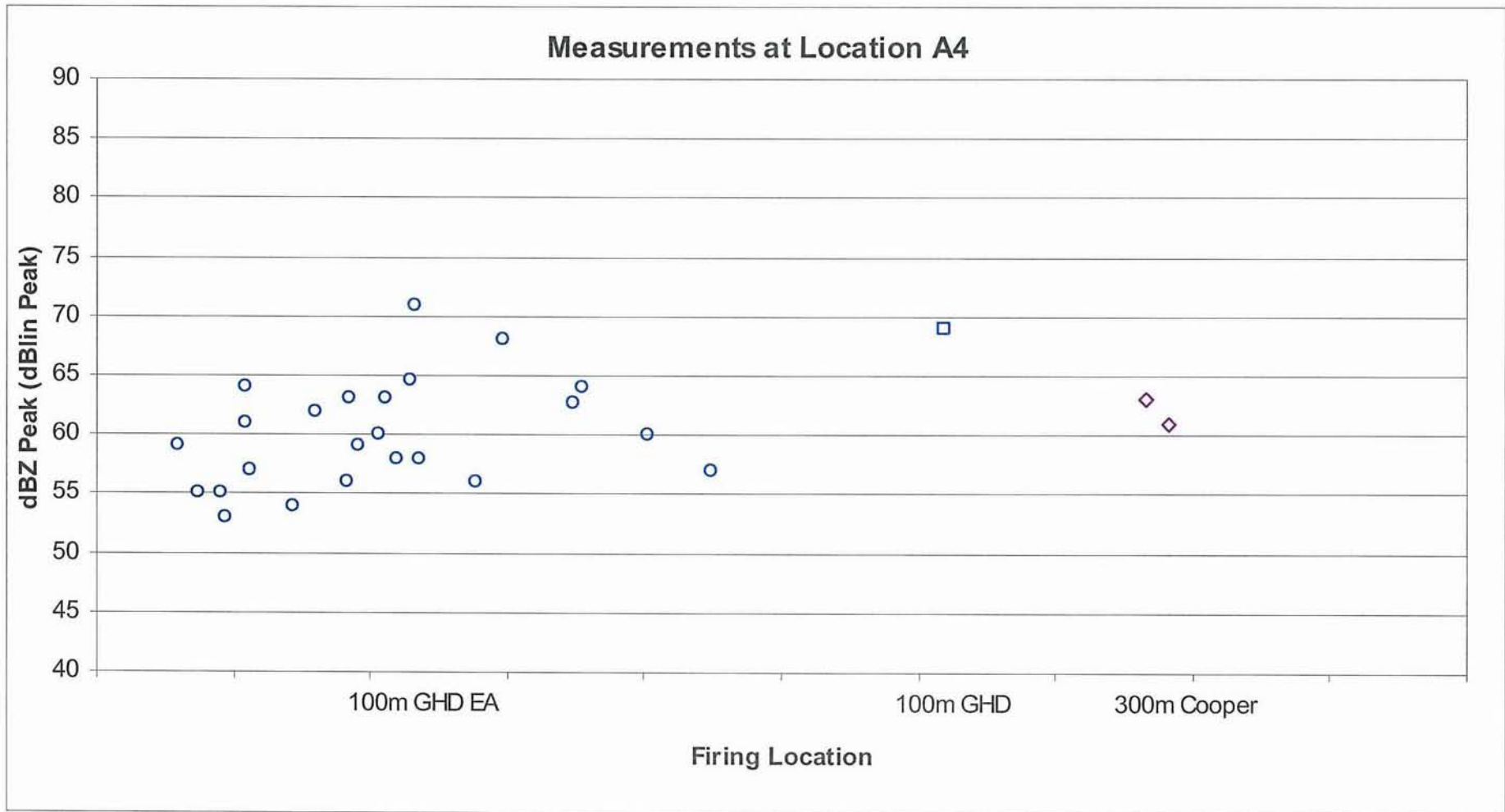


Figure 4: Gunfire Noise Levels Measured at Residential Location A4

Table 1 Description of Firearms and Noise Analysis at Location A1

Consultant	Firing Position	Gun Type	Log Av	% Above
GHD EA	100m	Shotguns – 2 x 12 gauge shotgun, 1 x 20 gauge shotgun Rifles – 4 x .308 rifles, 1 x .310 mm rifles Pistols – 1 x 44 revolver, 1 x 357 Magnum	58.5	13%
GHD	100m	1 x 0.22 G shotgun, 4 x 0.303 rifles, 1 x 7.62 rifle, 1 x 6.5 rifle, 1 x 0.22 Rimfire rifle	70.6	32%
Cooper	100m	Centrefire	72.0	35%
Cooper	200m	Full Bore (.303, .308 and .223), .22,.250	73.9	45%
GHD	800m	0.308 rifle 0.223 rifle	77.4	37%
Cooper	800m	Shotgun, Centrefire, Service Rifle	70.8	10%

Table 2 Description of Firearms and Noise Analysis at Location A2 and B2

Consultant	Firing Position	Gun Type	Log Av	% Above
GHD EA	100m	Shotguns – 2 x 12 gauge shotgun, 1 x 20 gauge shotgun Rifles – 4 x .308 rifles, 1 x .310 mm rifles Pistols – 1 x 44 revolver, 1 x 357 Magnum	66.4	31%
GHD	100m	4 x 0.303 rifles	70.4	34%
Cooper	100m	Rimfire	67.5	26%
Cooper	200m	Full Bore (.303, .308 and .223), .22,.250	76.0	34%
GHD	300m	16 G shotgun 7.62 Nato rifle 0.22 Rimfire rifle	69.3	49%
Cooper	300m	Full Bore (.303, .308 and .223)	72.1	22%
Cooper	500m	Full Bore (.303, .308 and .223)	67.4	23%

Note: Cooper 500m value ignores wind affected levels

Table 3 Description of Firearms and Noise Analysis at Location A3

Consultant	Firing Position	Gun Type	Log Av	% Above
GHD EA	100m	Shotguns – 2 x 12 gauge shotgun, 1 x 20 gauge shotgun Rifles – 4 x .308 rifles, 1 x .310 mm rifles Pistols – 1 x 44 revolver, 1 x 357 Magnum	66.8	12%
GHD	100m	3 x 0.303 rifles, 1 x 6.5 rifle	76.7	59%
Cooper	300m	Full Bore (.303, .308 and .223)	67.4	73%

Table 4 Description of Firearms and Noise Analysis at Location A4

Consultant	Firing Position	Gun Type	Log Av	% Above
GHD EA	100m	Shotguns – 2 x 12 gauge shotgun, 1 x 20 gauge shotgun Rifles – 4 x .308 rifles, 1 x .310 mm rifles Pistols – 1 x 44 revolver, 1 x 357 Magnum	62.6	31%
GHD	100m	4 x 0.303 rifles	69.0	0%
Cooper	300m	Full Bore (.303, .308 and .223)	62.1	44%

The first observation to be made in examining the data is the wide range of measured noise levels even for the same firing position. For example, in Figure 1, the noise levels of the three measurements at the 100m position range from 50dB to over 75dB, a difference of 25dB. In Figure 2, the range for the 100m position is from 55dB to over 75dB, a difference of 20dB.

There is insufficient information provided in the reports to explain whether this difference is a consequence of the type of firearm tested. Examination of the list in the tables above shows a wide range of equipment was tested.

The second observation is that, at least for Figures 1-3, the GHD EA noise levels for the 100m position (the only position tested) are significantly lower than the range in the GHD 2010 Report and in the Cooper reports. The scatter in the noise levels in the GHD EA 100m measurements in Figures 2 and 3 is also much lower than the scatter in the GHD and Cooper measurements.

The third observation is that the 800m firing position does not necessarily produce the highest noise levels. At Location A2/B2, for example, the highest noise levels are produced at the 200m and 300m firing positions. In fact, at the 800m firing position, there are only three firings exceeding 75dB Lin Peak which in my opinion, for the reasons stated in the next section, makes that firing position probably compliant with Condition A9.

The fourth and final observation is that if the limit in condition A9 of the Minister's Approval is an absolute limit, then there are demonstrated exceedences at all firing positions and, with the exception of a small number of firings (and ignoring the wind affected data in Figure 2 previously referred to) the exceedence amounts to approximately 5dB.

These observations will be referred to in the subsequent sections of this report.

3 CONDITION OF APPROVAL A9 - (FIREARM NOISE LIMITS)

Condition of Approval A9 currently provides as follows:

The noise from firearms or use of the site must not exceed 75dB(L) peak hold at the boundary to any existing private property with a residential dwelling, or where this is more than 30 metres from a dwelling, at the most affected location within 30 metres of the dwelling. This is to apply during prevailing weather conditions.

The modification sought in the Application is as follows:

- *The noise from firearms or use of the existing 800m range must not exceed 85dB(Lin) Peak Hold at the boundary to any existing private property with the residential dwelling, or where this is more than 30m from a dwelling, at the most affected location within 30m of the dwelling or an equivalent position when access to the property is not available;*
- *The noise from firearms or use of the new ranges must not exceed 75dB(Lin) Peak Hold at the boundary to any existing private property with the residential dwelling, or where this is more than 30m from a dwelling, at the most affected location within 30m of the dwelling or an equivalent position when access to the property is not available; and*
- *For the purpose of this Condition, the noise limit associated with the existing range and new ranges is a logarithmic average of the measured levels. Such monitoring is to occur under still wind or light wind conditions so as to avoid the sound level meters recording wind rather than noise from the rifle range.*

I now turn to each of the contentions raised in the Application in respect of the proposal to modify this condition.

3.1 Contention 1: GHD Environmental Noise Assessment was Flawed

I understand that the proposition advanced by the Application is *inter-alia* that the GHD EA was flawed because the measured and predicted noise levels from gunfire were significantly lower than what is now evident in the recent testing by GHD and Cooper. The Application states as follows:

It is clear to the Office of Communities (Sport and Recreation) that the initial 2007 GHD noise assessment - subsequently confirmed by NDY - has underestimated the range of firearm noise levels generated at varying firing points on the existing 800m multi-purpose range.

Reference to Figures 1-3 indicates this observation is correct. However, this does not necessarily make the GHD EA flawed triggering a re-evaluation of the noise conditions. Rather,

it triggers, because of Condition A2, the commitments made in Section 4 of the Submissions Report.¹

The noise impacts, including traffic noise, of any proposal to increase site usage would be subject to detailed investigation once the new ranges have been built. This would involve noise measurements, at the nearest sensitive receivers, of all firearms (recreational and military) used and fired in their respective ranges. Measurement results may trigger additional measures such as:

- » *Altering the acoustic design at the ranges;*
- » *Restriction of firearms used on the site; and*
- » *Restriction of the use of certain firearms to specific ranges.*

Condition A9 must therefore be read together with these commitments. The Cooper Reports have omitted any reference to Condition A2 and the commitments which throw light on how A9 is to be implemented.

Instead, the Cooper Reports criticise the GHD noise assessment. The purpose of a noise assessment is to derive noise criteria specific to the project taking into account generally accepted noise goals which are set out in, for example, the Industrial Noise Policy, Noise Guide for Local Government, Australian Standards, Council policy, legislation and common law principles. It is not to back fit noise criteria around the maximum noise likely to be generated by a project, but that appears to be the approach implicit in the Cooper Reports.

Where noise from the project exceeds the criteria, the approach universally adopted in NSW is to modify the project so as to reduce the noise received at sensitive receptors, or if that cannot be done, to buy out the receptors. That approach is reflected in the Statement of Commitments which requires alterations to the acoustic design at the ranges, such as the introduction of noise barriers, and other restrictions if noise levels exceed the criteria. For that reason, it is unnecessary to change the criteria simply because noise in excess of it is generated by the range. That possibility was presumably foreseen - indeed, it may have been likely - and the solution to it is contained in the conditions themselves.

It is not unusual in my experience for developments to commence operation and find the resulting noise levels or environmental impacts exceed the predictions in the environmental assessment. In those cases, noise mitigation works were undertaken to make the developments comply. A classic example is the notorious Sydney Third Runway EIS which triggered an enormous public outcry including a Senate enquiry.² In that instance, the ANEF noise exposure limits were not increased but instead dwellings, churches and schools were

¹ GHD Submissions Report July 2008 Page 67

² 1995 Senate Inquiry into Aircraft Noise "Falling on Deaf Ears?"

acoustically insulated and the air traffic was redistributed to create a more equitable noise sharing arrangement to lessen those impacts.

Now turning to the subject proposal, the Director General's Requirements state the following was required in respect of acoustics and noise:

Noise impacts associated with the future proposal (e.g. noise from gun fire) should be assessed against NSW DECC (EPA) guidelines and other relevant legislation.

The noise assessment in the GHD EA examined noise impacts based on the 100m firing point measurements and assumed this was the worst case situation. We now know based on the data presented in Figures 1-3 that the noise levels from gun fire are much higher than originally predicted, at least at three of the four residential locations tested.

Presumably that possibility was foreseen and the work prescribed in condition A6 was contemplated for the purpose of minimising that risk.

The uncertainty in the noise levels is documented in the Director General's Report: ³

Given the increase in use of the 800m range from 2 to 4 days per week, and that it is the closest range to existing residences, it is considered reasonable for noise monitoring to be undertaken for the use of this range. Therefore it is recommended that attended noise monitoring be undertaken on the first 3 occasions of use of the 800m range for 4 days per week, from the date of this approval, and thereafter, quarterly in the first twelve months of operation (aligned with each season) and annually thereafter to confirm noise levels from firearms measured at residences comply with appropriate limits (ie 75dB(L) peak hold). The monitoring must include that of the noisiest firearms being used on the 800m range.

In the event that noise levels do not comply with condition A9 then, consistent with proponent's undertakings, this would trigger the introduction of noise mitigating measures in accordance with the commitment given in Section 4 of the proponent's Submissions Report referred to earlier.

In my opinion, this commitment does not only apply to the new firing ranges proposed on the site but to any increase in site usage including the intensification of use of the 800m range.

Given the observation in the previous section that a 5dB noise reduction is necessary to comply with condition A9, I am of the opinion this could be achieved by the installation of conventional acoustic barriers or acoustic shelters which in any event is contemplated in Condition D4 for the 800m firing point. A noise reduction of 5dB is not an insurmountable target and should be achievable in my opinion.

³ Director General's Report Pg 22

Finally, it is my view that even if the Minister had known of the information in Figures 1-4, he would have had two options available – either to reject the proposal or to approve it subject to noise mitigation measures being adopted or imposing more restrictive constraints in the operating hours in order to comply with the SPCC Guidelines.

In my opinion, the option of now setting a noise limit in excess of the Minister's Approval should only be contemplated if all other reasonable and feasible measures have been exhausted. In the event of that occurring, any application should be delayed until the revised criteria are developed and accepted. Clearly, this is not contemplated in the Application.

It is therefore my opinion that Contention 1 should fail for these reasons.

3.2 Contention 2: Imposition of Condition A9 Reduces 800m Range to 400m

The modification application states as follows in the second page of Attachment A:

The practical outcome of the failure by GHD to accurately record, measure, identify and report the range of noise levels generated on that range is the imposition – through Condition of Approval A9 – of an operating noise limit that effectively reduces the 800m range to four firing points (100m through to the 400m firing points). Certain firearm discharges from the remaining four firing points will, in all likelihood, exceed the outright 75dB (L) peak hold limit, reducing not insignificantly the extent of shooting disciplines that can be enjoyed on the range.

This contention is not consistent with the observations made in the previous section. Those observations are that noise levels from the 800m firing point are not the highest, in fact the 200m and 300m firing points produce higher noise levels.

In any event, ameliorative measures are readily available to reduce noise emissions from the site.

This contention must therefore fail.

3.3 Contention 3: Use of Logarithmic Averaging Not Absolute Maximum Level

The third contention is stated as follows: ⁴

It has also come to the Office of Communities (Sport and Recreation) attention that the application of the Chapter 164 Guidelines utilised a logarithmic average of the noise levels to accord with socio-acoustic survey material for rifle ranges. The use of an absolute maximum level does not accord with Environmental Protection Authority practice, whilst a logarithmic average (rather than an arithmetic average) uses the EPA/DECCW 'Leq' concept (i.e. equivalent continuous sound pressure level).

⁴ Modification Application – Attachment A Pg 3

This contention relates to whether the SPCC Guideline should be interpreted as implying an absolute noise limit or averaging of the noise levels.

It was established in the previous section that the range of measured noise from gunfire is in the order of 20-25dB for the different receptor locations. The issue is whether the SPCC Guideline relates to the maximum noise level or an average of the noise levels measured from the mixed use of the site or an average of specific firearms at specific firing locations.

The EPA Memo at point 2 states that arithmetic averaging should be used. In point 3, the number of measurements is to be "sufficient to determine a noise level that is representative of the type of firearm being used". I interpret this to mean that the averaged noise level should be of each specific firearm at a specific firing location and not of a mixture of firearms at mixed firing locations. The average noise level of the loudest firearm at any specific firing location should therefore comply with the limit.

The EPA Memo also states that "measured levels that are clearly not representative should be excluded". I interpret this to mean that abnormally high or abnormally low noise levels that are not close to the arithmetic average should be excluded. I understand that the EPA Memo contemplates that the variation in the noise levels measured for each firearm at each firing location ought to be within a narrow range to enable the averaging to include only "representative" noise levels. As stated in the EPA Memo, *"this relies on the person conducting the assessment having a level of acoustic expertise"*.

I therefore interpret condition A9 to mean that non-regular or limited exceedences of the limit may nevertheless be compliant.

The EPA Memo further states at point 2 that of the alternatives – arithmetic averaging or energy averaging – the former should be used.

In the Cooper Reports, the concept of logarithmic averaging is advanced and involves the averaging of all measurements including inaudible measurements. This includes the logarithmic averaging of a mixture of firing equipment, a concept which I believe the EPA Memo does not endorse.

In my opinion, the reason can be seen by reference to the last column in Tables 1-4 of the previous section. This column shows the percentage of noise measurements which lie above the logarithmic average value proposed in the Cooper Reports. The median of the numbers in the last column is 32% which means that about one third of all measurements will have a greater noise level than the logarithmic value adopted in the Cooper Reports. I have determined from Figures 1-4 that these exceedences are in the range 5-10dB above the logarithmic average which is a significant exceedence.

I therefore conclude that if the logarithmic averaging advocated in the Cooper Reports is adopted, the resulting noise levels would represent an unacceptable impact on the residents in the immediate vicinity of the subject development.

Furthermore, the assessments in the Cooper Reports are insufficient for the following reasons:

- i) they do not have regard to the prevailing wind conditions (as required in Condition A9) and how those wind conditions may in certain circumstances impact on noise from the use of the range; and,
- ii) they do not identify the firearm associated with each shot to determine a "representative" level as required in the EPA Memo.

If a new method of assessment is to be adopted, as urged by Mr Cooper, then new noise goals and criteria will be necessary, properly based on socio-acoustical surveys or national standards, which seek to achieve the purpose of noise assessment - to produce an acceptable level of amenity for residents having regard to ambient conditions

For these reasons it is my opinion that the modification sought to Condition A9 should fail.

4 CONDITION OF APPROVAL A6 (D) – ATTENDED NOISE MONITORING 800M RANGE

Conditions A6(c) and (d) require as follows:

(c) Attended noise monitoring to be undertaken on the first 3 occasions of use of the 800m range from the date of this approval, thereafter, quarterly in the first twelve months of operations (aligned with each season) and annually thereafter to confirm noise levels from firearms measured at residences comply with appropriate limits. The monitoring must include that of the known noisiest firearms being used on the 800m range.

(d) Compliance monitoring results for the shooting complex to be posted within 7 days on a website and submitted to the Department of Planning and to Council to allow for public access to this information.

The modification sought in the Application is to allow thirty days from the completion of testing for the lodgement of reports.

I have no objection to this.

5 CONDITION OF APPROVAL D4 - ACOUSTIC SHELTERS

Condition D4 requires as follows:

Acoustic shelters shall be provided for the existing range (at the 800m firing point) and the new outdoor ranges. The shelters shall be constructed of an acoustically absorptive material and in accordance with the measures outlined in the detailed plans provided in the Preferred Project Report.

The modification sought in the Application is to vary this condition by deleting the requirement to construct an acoustic shelter at the 800m firing point of the 800m range.

The observations in Section 2 of this report are that an acoustic shelter at the 800m firing point is probably not required.

However, it is also an observation that acoustic shelters or acoustic barriers or moundings are required for other firing positions.

I conclude that the proposed amendment to Condition D4 is premature given the extent of the identified noise non-compliances.

6 CONDITION OF APPROVAL A6(C) – FREQUENCY OF NOISE MONITORING

Although not specifically identified in the application for modification, the supporting letter to the Department also requests the removal of any further obligation by Communities NSW to comply with condition A6(c) of future monitoring. This is set out at the last page of Communities NSW's letter to the Department and states as follows:

"Additional matters for consideration

(a) The office of Communities confirm that attended noise monitoring was carried out in June 2010 (over three days), October 2010 and January 2011 of the 800m range. A strict reading of the terms of condition A6(c) would require another attended noise monitoring test in April 2011 under the quarterly monitoring regime and then annually.

We believe the compliance noise testing on the 800m multi purpose range should now avert to an annual test."

Condition A6(c) requires as follows:

(c) Attended noise monitoring to be undertaken on the first 3 occasions of use of the 800m range from the date of this approval, thereafter, quarterly in the first twelve months of operations (aligned with each season) and annually thereafter to confirm noise levels from firearms measured at residences comply with appropriate limits. The monitoring must include that of the known noisiest firearms being used on the 800m range.

In my opinion, given the exceedences of condition A9 demonstrated in section 2 above, it is premature to reduce the frequency of testing. I therefore cannot support this proposition.

7 CONCLUSION

I have completed an assessment of the application by Communities NSW to modify the Minister's approval dated 1st March 2011 for a Regional Shooting Complex at Hill Top on the Southern Highlands.

In respect of each proposal, I conclude as follows:

- i) The proposed amendment to modify Condition A9 in respect of new noise limits for the firearms use cannot be supported because there is a commitment from the applicant to apply noise mitigation measures in the event that noise levels are demonstrated not to comply;
- ii) I have no objection to the proposal to amend condition A6(d) relating to the time limit for publication of results for tests at the 800m range;
- iii) The proposed amendment to delete condition D4 relating to the provision for acoustic shelters for the 800m range is not supported and is premature given the extent of the identified noise non-compliances; and,
- iv) Given the exceedences of condition A9 demonstrated in this report, I am of the opinion that it is premature to reduce the frequency of testing.

I therefore conclude, with the exception of Condition A6(d), there is no merit in the proposal by Communities NSW to modify the Minister's approval dated 1st March 2011 for a Regional Shooting Complex at Hill Top on the Southern Highlands.

APPENDIX A - GLOSSARY OF ACOUSTIC TERMS

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period	The period in a day over which assessments are made.
Assessment Point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background Noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A):	A-weighted decibels. The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
Lmax	The maximum sound pressure level measured over a given period.
Lmin	The minimum sound pressure level measured over a given period.
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.

L10	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L90	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
Leq	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound Absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B - CURRICULUM VITAE RENZO TONIN



RENZO TONIN

Ph.D. (Mech Eng), B.Sc (Hons.) University of Adelaide

DIRECTOR

PROFESSIONAL MEMBERSHIP

F.I.E.Aust. NPER, RPEQ, NATA Accredited Signatory, M.A.S.A.,
M.A.A.S.

APPOINTMENTS

Senior Honorary Research Associate - Woolcock Institute of
Medical Research

Standards Committee AV-002 Acoustics – Instrumentation
and Measurement Techniques.

PROFESSIONAL EXPERIENCE

- 1982 - Director and Principal, Renzo Tonin & Associates Pty Ltd
- 1979-1982 - Associate Director and Sydney Office Manager, Vipac & Partners Pty Ltd
- 1976-1978 - Post graduate studies, University of Adelaide Mechanical Engineering Department

1 RELEVANT EXPERIENCE

Dr Tonin's belief that high technology acoustics and dynamics engineering should form part of every day consulting has found acceptance with many clients. This is reflected in a strong company growth rate from private practice in November 1982 to one of the largest consulting companies specialising in acoustics engineering today.

His sponsored studies encompass such diverse activities as radio and TV studios, commercial buildings, ships, motor vehicles, trains, industrial complexes, power stations, product development, material handling plant, machine health monitoring, coal washeries, public buildings and auditoria.

His special interest is in the use of computer technology to solve problems in the fields of acoustics and dynamics.

He is a contributing author to the book "Environmental Modeling" which is a publication designed to bring together current expertise on modeling of the environment using computer based techniques.

His doctoral thesis addressed the use of laser 3D holography for the study of vibration. A distinguished international journal honored his work in this field by presenting one of his papers as a featured article.

His sponsored studies include the following;

ROADS AND MOTORWAYS

M5 and M5 East EIS, M4 motorway, Silverwater Road Extension, Princes Highway - Oak Flats to Dunmore EIS, Tomerong Bypass EIS, F2 Castlereagh Freeway, Phillip Parkway EIS, Liverpool to Hornsby Highway Strategy Study, Elizabeth Drive Upgrade, Western Sydney Orbital and Badgery's Creek Highway, M2 Motorway Noise Barriers, Albury Wodonga National Highway, M4 Western Motorway Via-Duct, Church Street to James Ruse Drive, Granville.

RAILWAYS AND ROLLING STOCK

Epping to Chatswood Rail Line (ECRL); Very Fast Train (VFT); Perisher SkiTube; Tangara double-deck train acoustics; assessment and design of noise and vibration isolation systems of multiple suburban and inner city residential and commercial developments alongside or above railway lines and railway tunnels.

PUBLIC HEARINGS AND INQUIRIES

Possum Brush Quarry Inquiry, Mt Arthur South Inquiry, Rix's Creek Inquiry, F2 Castlereagh Freeway Inquiry, Bulga Mine Inquiry, Mt Flora Quarry Hearing, Cleary Bros Sand Mine Hearing.

SOUND SYSTEM DESIGN

Sydney Entertainment Centre, Darling Harbour Convention Centre and Exhibition Halls, Darling Harbour Park Sound System, Baulkham Hills Entertainment Centre, Sydney Sports Stadium, Hallstrom Park Sports Complex, Homebush Sports Centre, NSW.

GOVERNMENT BUILDINGS

Sydney Entertainment Centre sound reinforcement system, the Glebe Remand Centre floating floor project, Applied Arts & Sciences Stage II expansion, Geological & Mining Museum, the Mint and Barracks building refurbishment, Sydney Football Stadium and the Darling Harbour Development.

HOTELS

Observatory Hotel, Sydney Hilton, Sydney Regent, Ritz/Carlton, Sheraton Hyde park, Country Comfort Central, World Square, Hyde Park Plaza, Sheraton Hobart, Campbell St Hotel, Novotel Darling Harbour, Bullecourt place, La Galleria Kings Cross, Bayswater Hotel, Park Hyatt, Parramatta Hotel, Sheraton Airport Central, Chatswood Connection.

COMMERCIAL TOWERS

QV1 development Perth, Robt Jones Tower Auckland NZ, 135 King St, Australia Square refurbishment, Landmark, 545 Kent St, Metroplaza North Sydney, Airport Central Commercial, Chatswood Connection, Chatswood Interchange, 45 Clarence St.

APARTMENT/RESIDENTIAL

Raleigh Park, Quay West, Frenchs Forest, Port Jackson Tower, HighGate Kent St, Northborne Ave Canberra, Crown Street Apartments, Crown Gardens, Villa Development, 19-21 George St North Strathfield, Mark Foys Warehouse Apartments, Frenchs Forest Medium Density, Linda St Hornsby, Camden Retirement Village, The Elan, 37 Glen St Milsons Point, Hawthornden Estate, Rockwall Apartments, Pavilion On The Harbour.

2 AWARDS

- Australian Acoustical Society Award for Excellence in Acoustics 1988 . "New Studios for Radio 2EA"
- Australian Acoustical Society Award for Excellence in Acoustics 1992. "Victoria Barracks 2nd Military District Band Practice Facility"

3 BOOKS

- Environmental Modeling - Vol 1. Chapter 7. Environ-mental Noise Modeling. P Zannetti ed. Computational Mechanics Publications. 1993.

4 PUBLICATIONS

1. Time-Averaged Holography For The Study of Three-Dimensional Vibrations. Journal of Sound and Vibration (1977) 52 (3), 315-323.
2. General Theory of Time-Averaged Holography for the Study of Three- Dimensional Vibrations at a Single Frequency. Journal of the Optical Society of America (1978) 68 (7), 924-931.
3. Analysis of 3-D Vibrations from Time-Averaged Holograms. Applied Optics (1978) 17 (23), 3713-3721. (Featured Article).
4. Free Vibration of Circular Cylinders of Variable Thickness. Journal of Sound and Vibration (1979) 62 (2), 165-180.
5. Determination of Ambient Noise Levels in the Presence of a Disturbing Noise Source Using a Directional Microphone. 10th International Congress on Acoustics (1980).
6. Acoustic Requirements to Curb Rain Noise from Metal Deck Roofs. Bulletin Acoustics Australia (1985) 13 (1), 16.
7. Estimating Noise Levels from Petrochemical Plants, Mines and Industrial Complexes. Acoustics Australia (1985) 13 (2), 59-67.
8. Application of Modelling Techniques to Resolving a Dynamics Problem in a Building Structure. The First Australasian MSC Users Conference, June 1987.
9. Vibration Isolation of Impacts in High-Rise Structures. The Second Australasian MSC Users Conference, Nov 1988.
10. Future Noise and Vibration Control Methods for Building Services. 2nd CIBSE Australian Conference, Nov 26-28, 1991.
11. Acoustic and Vibration Insulation in Buildings. Building Science Forum of Australia Seminar. 'Insulation, Thermal, Acoustic'. Aug 25, 1993.

12. ENM Windows - Environmental Noise Model. Euro-noise '95 Software for Noise Control Conference. Lyon, France 21-23 March 1995.
13. Modelling Virtual Noise for the Real Environment. Noise & Vibration Worldwide. June 1995. pp 10-12.
14. A Method of Strategic Traffic Noise Impact Analysis. Proceedings of Internoise 96, August 1996, Liverpool UK, pp 2395-2400.
15. ENM Windows – Environmental Noise Model. Air & Waste Management Association's 90th Annual Meeting & Exhibition, Toronto, Ontario, Canada, 1997.
16. Validation of Environmental Noise Model (ENM Windows). Acoustics Australia Vol 25 (1997) No 2 pp 75-79.
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ATTACHMENT 2

Chapter 164 of ENCM and Associated Memo.

CHAPTER 164

NOISE CONTROL GUIDELINE

TARGET SHOOTING RANGES

Air rifle and air pistol competitions are not scheduled since the projectile is not propelled by an explosion.

Such competitions are usually held indoors and seldom present a noise problem. They are lawful sporting activities and the EPA is the responsible authority for any noise investigation.

This guideline specifies criteria for assessing the effect on nearby residences of pistol, rifle or gun club shooting ranges when the propellant is explosive. Criteria may be used for guideline and less stringent figures could be used if site details and topography are very favourable.

Measurement should be made at the worst affected location and consideration should be given to any neighbouring vacant land zoned as residential.

Note that any premises used for competitive shooting where the propellant is explosive are scheduled premises under the Act.

Times of Day Restrictions

Daytime operation is considered as being from 10 a.m. to 5 p.m. Night operation normally extends from 5 p.m. to 10 p.m. To cater for special events such as state or national championships or charity shoots, the EPA may consider an extension of the times on both nights in one weekend provided such events occur no more than two or three times a year.

Restricted Number of Days

Peak Hold (Linear) readings are taken at the most affected residential boundary. The number of days and nights usage of the range should be limited to correspond with the measured level as shown in the table on page 164-2.

A concession has been made in the case of existing ranges and is included in the table. This may be subject to future review by the EPA.

Alterations to existing ranges should incorporate a movement towards the "Future Range" figures whenever possible.

164-2
10-5-85

	RESIDENTIAL LEVEL dB (Lin) Peak Hold										
	60	65	70	75	80	85	90	95	100	105	over 105
	MAXIMUM USAGE Days (Nights) per wk										
Existing Range Daytime Use	7	7	7	7	7	7	5	4	3	2	1
Existing Range Night-time Use	3	3	2	2	2	1	-	-	-	-	-
Future Range Daytime Use	7	5	5	4	3	2	1	-	-	-	-
Future Range Night-time Use	3	2	1	-	-	-	-	-	-	-	-

Environment Protection Authority

TO Regional Managers DATE 25 January 1993
CC DANT, N&T staff

FROM Head Noise Investigations FILE 708022

SUBJECT Noise Control Guideline on Shooting Noise

PURPOSE

To advise Regional staff of how the Noise Control Guideline on Target Shooting Ranges should be interpreted.

CURRENT POSITION

1. If measured level is between levels contained in table which days per week band should be used?

The days per week band that applies is the one where the measured level is less than the noise level shown. For example a measured level of 72 dBL for existing range daytime use would fall into the 75 dBL column with 7 days allowed.

2. Is an arithmetic or energy averaging technique used to determine the measured noise level?

Arithmetic averaging is used.

3. How many measurements are required to determine a final noise level?

The number of noise measurements should be sufficient to determine a noise level that is representative of the type of firearm being used. In the past assessments have been based on up to 50 shots. In determining the final noise level, measured levels that are clearly not representative should be excluded. This relies on the person conducting the assessment having a level of acoustic expertise.

The above advice was prepared in response to a request from the National Acoustics Laboratory and in the interest of consistency has been prepared for issuing to all affected staff.

FUTURE ACTIONS/RECOMMENDATIONS

Please forward this on to your staff who may be involved with assessing noise from target shooting ranges.