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AUDIBLE BIRD SCARERS

WHAKATANE DISTRICT PLAN

ASSESSMENT OF NOISE EFFECTS

Report No 22037

Prepared for:

Whakatane District Council
Whakatane
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Prepared by: .....

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CONTENTS

1. INTRODUCTION

The Whakatane District Council is reviewing Rule 11.2.6 for audible bird scaring devices. This report considers the use of gas guns, the noise[1] impact from gas guns on the community and recommended changes to the current controls in the Operative District Plan.

2. RESOURCE MANAGEMENT ACT 1991

Section 16 of the Resource Management Act, states:

> *Every occupier of land … and every person carrying out an activity … shall adopt the best practicable option to ensure that the emission of noise from that land … does not exceed a reasonable level.*

Section 17 of the Resource Management Act states:

> *Duty to avoid, remedy, or mitigate adverse effects - (1) Every person has a duty to avoid, remedy, or mitigate any adverse effect on the environment arising from an activity carried out by or on behalf of that person, whether or not the activity is in accordance with a rule in a plan, a resource consent …*

While existing use rights may apply for existing orchards, this does not mean an unreasonable amount of noise may be generated. Regardless of any existing use rights, it is noted that sections 16 and 17 of the Resource Management Act must be satisfied. This should be considered when formulating the new noise rule.

[1] See Appendix A for the definition of noise terms used in this report.

3. EXISTING NOISE RULE

A review has been undertaken of the noise rule in the Operative Whakatane District Plan with respect to the use of gas guns. The current requirements for the control of noise from audible bird scaring devices are set out in Rule 11.2.6 Noise Limits. Rule 11.2.6.2 of the Operative Whakatane District Plan states:

> *The activities in Table 11:2 are exempted from the noise limits of Table 11:1. Subject to clauses 11.2.5.3 and 11.2.5.4 noise from any activity described in this table shall not exceed the limits specified, or where reference is made to a New Zealand Standard, shall not exceed the appropriate sound level limit recommended or specified in the relevant standard. These activities are recognised as having characteristics requiring different assessments methods or noise limits and assessment positions vary.*

The relevant noise limits of Table 11.2, Specific Activity Noise Limits, states for audible bird scaring devices:

> ***General Requirements***
> *Audible bird scaring devices shall only be operated from half an hour before sunrise to half an hour after sunset.*
>
> *A legible notice is to be fixed to the road frontage of the property on which the device is being used, giving the name, address, contact telephone number of the person responsible for the operation of any such device(s).*
>
> ***Devices that Generate Discrete Sound Events***
>
> *Discrete sound events from an audible bird scaring device, including shots or audible sound shall:*
>
> *i. not exceed 100dB L_{Zpeak},*
>
> *ii. not exceed 3 events within a 1 minute period and shall be limited to a total of 12 individual events per hour.*
>
> ***Devices that Generate Short or Variable Sound Events***
>
> *Where audible sound is used over a short or variable time duration, no event may result in a sound level greater than 50dBA SEL.*

Audible bird scaring devices which do not comply with this rule are a restricted discretionary activity.

Rule 11.2.7, Table 11:1 and Table 11:2 Specific Activity Noise Limits states:

11.2.7.1 Assessment positions vary according to the assessment method cited. The following notes specify where an assessment position may be found in a cited reference, or where an assessment position is for a zone or activity: …

h. At any point within the notional boundary of any rural zoned site, or within the site boundary of any other site used for a noise sensitive activity excluding any dwelling/s located on the same site as that on which the device is being operated.

4. MEASUREMENT OPTIONS

Rule 11.2.6 adopts both the L_{Zpeak} and the SEL to assess noise from audible bird scaring devices and as such both are a reasonable measure of the potential annoyance for neighbours. Alternative measurement options include L_{AFmax} and L_{Cpeak}.

To assist in understanding the different numbers, the L_{Zpeak} is the maximum level reached based on a typical response time of 40μs (40 microseconds) compared to 125ms for a maximum level L_{AFmax}. The SEL is a product of the total energy of the sound (L_{Aeq}) and the duration of the measurement period.

From the field measurements undertaken, a level of 110dB L_{Cpeak} is approximately 80dB L_{AFmax} and 73dB SEL. The correlation between the measured L_{Cpeak} and L_{AFmax} values is ±1dBA[2]. This means any of the three values could be used with confidence.

[2] With the exception of one value ±1dBA between L_{Cpeak} and the SEL around the gas gun.

The use of L_{Zpeak} or L_{Cpeak} will provide a similar level. The difference is L_{Cpeak} has reduced reliance in the 10Hz – 25Hz frequency range compared to the L_{Zpeak} measurement. However, gas gun noise is not controlled by these low frequencies and the advantage of using the C-weighting is that the effect of wind noise can be a problem in the 10Hz – 20Hz range if using the Z-weighting. Noise levels below 20Hz are generally inaudible to the average person so any wind effects in these lower frequencies can easily be missed.

The use of L_{Cpeak} would allow Council to measure and enforce L_{Cpeak} accurately with existing monitoring equipment[3].

The use of L_{Cpeak} only sets a level so it is important to include a limit on the number of events to control the potential noise effects for neighbours. As the SEL is a combination of the level plus duration there are advantages to using SEL to control the noise. The SEL can be measured for any number of shots for any selected time period. The difference is that if the noise level is lower more events may occur for the same SEL value. Adopting L_{CPeak} and the number of events for a given time does not encourage the noise maker to reduce the level of noise but the L_{CPeak} can be easily measured. The only disadvantage is that the number of shots in an hour or day also needs to be monitored. Overall, the outcome will be similar regardless of the measurement technique adopted so Council may prefer to retain the current method using a peak measurement and number of shots permitted. The only change proposed is to move from Z-weighting to C-weighting to allow the level to be measured with the sound level meter already owned by Council.

Assuming the same basic format is adopted, as set out in the existing noise rule, both the level and the number of shots has been reviewed. The current values were based on an assessment undertaken in 2000 and since then additional

[3] L_{Zpeak} could be retained without any significant compliance monitoring problems. Prospecting over-blast pressure is currently controlled in the District Plan via L_{Zpeak} (although this could also be changed to L_{Cpeak}) and it would be desirable to have all peak measurements using the same basic control method.

information has become available from Australia as set out below (and generally supported by reports from the United Kingdom).

The noise control guidelines published by EPA Victoria (May 2021) reflect the typical approach undertaken to minimise gas gun noise and states:

> *Scareguns, when used as the sole bird deterrent, are likely to become significantly less effective after a few days. This is due to the birds becoming accustomed to the noise. For scareguns to remain effective it is necessary to vary and enforce the frightening effect. Methods which do this include the relocating of the scaregun every day or so and the use of 'birdfright' explosive cartridges.*
>
> *The rate of firing the scaregun must be carefully considered. If the firing rate is set too high, the birds will very quickly become accustomed to the noise. However, if set too low, the birds will return from cover after being frightened away and will have time to feed.*
>
> *For the guns to be most effective they should be used when the birds are most actively feeding. This will normally be in the early morning and late afternoon; but this could be dependent on the species.*
>
> *Scareguns are not the only method of bird control available. Where scareguns cannot be used, other bird controls should be considered by the producer. These include:*
>
> - *kites, shaped like birds of prey*
> - *chemical sprays that are unpalatable to some species of small birds*
> - *plastic strips that hum in the wind*
> - *nets and plastic mesh*

- *noise generators such as 'Av-alarm', 'Pestaway Agricultural Noise Generator' or a 'white noise' generator. (The first two produce a high level of noise which may cause annoyance to residents if living nearby. The last-mentioned device produces a cicada-like sound and has been found to be particularly effective with silvereyes).*

The guidelines go on to say:

- *A scaregun must not be used if the distance between the scaregun and any complainant's house is less than 300m.*
- *The scaregun must not emit more than 70 blasts/day.*
- *The scaregun must not be used earlier than 7 am or later than sunset. Earlier starting times will be allowed if this is agreed to by the complainants.*
- *The total time of operation of a scaregun must not exceed 12 hours in any one day. However, the time of operation may be divided into two separate periods, provided the interval between blasts is not less than six minutes.*

These guidelines are based on an average maximum level of 100dB L_{ZPeak} of the loudest 20 per cent of blasts measured at the complainant's house when the weather favours noise propagation.

A report on audible bird scaring devices published by the Environment Protection Authority South Australia in October 2007 adopted a similar approach with the maximum value associated with a single device being 100dB L_{Zpeak}. This report stated that a typical gas gun located more than 500m from a residence in a residential, country township, or rural living zone (or similar) and is restricted in operation to six shots per hour for 10 hours of the day, should achieve the performance-based objective.

5. PROPOSED NOISE CONTROL

While it is expected there will be some variation in the noise from various gas guns, the level of noise from the Zon Bird Scare Gun tested is understood to be representative of gas guns available in the country. The gas guns are often operated so they rotate between shots. As noise from gas guns is dependent on the direction the gun is pointing this will provide some degree of noise control to neighbours in the area.

The annoyance from the noise of a gas gun is dependent on the time of the day when the noise occurs, the level of the noise and the number of events that occur. Reported information (and set out above) states that if the firing rate of the gas gun is set too high, the birds will very quickly become accustomed to the noise. Conversely, if set too low the birds will return from cover after being frightened away and will have time to feed. In addition, the effectiveness of gas guns is partly dependent on alternative scare techniques to reinforce the scaring of birds. The sole reliance on gas guns is not a recommended practice to control bird damage.

Considering the above, it is recommended the current rule 11.2.6.2 in Table 11:2 should be modified to read:

Audible bird scaring devices (see Note h).	General Requirements A legible notice is to be fixed to the road frontage of the property on which a device is being used, giving the name, address, contact telephone number of the person responsible for the operation of any such device(s). **Devices that generate non-impulsive sound events** Noise from non- impulsive **audible bird scaring device**s (such as ultrasonic sound repellers) shall comply with the following noise levels at any point within the notional boundary of any

	rural dwelling not on the same site or the site boundary in any residential zone: i. 07:00am – 10:00pm 50dB L_{Aeq}, ii. 10:00pm – 07:00am 40dB L_{Aeq} and 70dB L_{Amax}. **Devices that generate impulsive sound events** Noise from impulsive **audible bird scaring devices** (such as LPG guns) are permitted where the noise does not exceed 85dB L_{Cpeak} at any point within the notional boundary of any rural dwelling not on the same site or site boundary in any residential zone there is no restriction on the number of individual events between 07:00am – 07:00pm. Noise from impulsive **audible bird scaring device**s are a restricted discretionary activity (see criteria in Rule 11.4.5) where the noise exceeds 85dB L_{Cpeak} at any point within the notional boundary of any rural dwelling not on the same site or site boundary in any residential zone the noise must: i. not exceed 3 events within a 1 minute period and shall be limited to a total of 70 individual events per day, and ii. shall operate between 07:00am to 07:00pm. **Advice Note:** Existing use rights may apply where audible bird scaring devices have been lawfully established and continuous seasonal operation has complied with permitted standards prior to the notification date {insert date} of Plan Change 6.

To support the restricted discretionary activity status for impulsive sound events from audible bird scaring devices, it is recommended rule 11.4.5.1 be modified to read:

Council shall restrict its discretion to the following:

a. consideration of the best practicable option, including alternative types of bird scaring devices, alternative options for crop protection and effectiveness of those alternative options.
b. an acoustic report from a suitable qualified acoustics expert that identifies the 85dB L_{Cpeak} contour.
    i. identifying affected persons.
c. the noise level generated and the effect of the noise level on those persons who will experience the noise and any proposed mitigation
d. the location or exclusion areas of any device in an orchard
e. the number of devices the frequency, timing, time of year and the operating conditions when they may operate
f. the proximity to significant indigenous biodiversity sites
g. the General Information Requirement in Rule 3.5.4

The notification provisions in the RMA shall apply to any application.

Non-impulsive audible bird scaring devices

Where an orchard adopts one of the electronic bird scarers on the market the noise needs to be controlled with an alternative measurement unit. The implication of the noise rule in the Operative District Plan is that for this type of bird deterrent a level of 50dBA SEL should be adopted with no assessment duration included. If it is assumed the noise occurs for five minutes in an hour a 50dBA SEL equates to a level of 39dB L_{Aeq}, which is an unnecessarily restrictive control for such an activity.

It is recommended that the current noise limit for the rural zone of 50dB L_{Aeq} during the daytime should be adopted. This allows a 5dB L_{Aeq} averaging over the daytime period although if the electronic noise has a special audible characteristic there is also a -5dB L_{Aeq} adjustment to the measured level. As the level of noise from the electronic bird scarers is not known it would be reasonable to considered increasing the level to 55dB L_{Aeq} as the noise only occurs for a

limited period of the year. However, this would need to be subject to a rigorous assessment before any increase could be adopted, as the proposed change is less restrictive than the controls already in place.

The potential concern of adopting the current noise rule for a rural zone is that the daytime period is between 7:00am – 10:00pm while the operators of the bird scarers may wish to commence prior to 7:00am. It is noted the EPA document that is referred to above adopts 7:00am as the time to commence any such noisy events. Subject to new information that may become available, it is recommended that the use of such warning signals should be limited to 45dB L_{Aeq} prior to 7:00am (which is still relaxation on what the current rule permits). Based on information from the Royal Astronomical Society of New Zealand the earliest sunrise time is around 5:40am with the latest sunset time at around 8:40pm. Rather than adopting a time relating to sunrise and sunset, which many people do not know, and the operator is unlikely to change equipment settings daily, a fixed time period is proposed. It is recommended this part of the noise rule should be:

Devices that generate non-impulsive sound events

*Noise from non-impulsive **audible bird scaring device**s shall comply with the following noise levels at any point within the notional boundary of any rural dwelling not on the same site or the site boundary in any residential zone:*

i. 07:00am – 10:00pm 50dB L_{Aeq},
ii. 10:00pm – 07:00am 40dB L_{Aeq} and 70dB L_{Amax}

The above controls assume Rule 11.2.7, Table 11:1 and Table 11:2 Specific Activity Noise Limits will remain in place.

Devices that generate *impulsive audible bird scaring devices*

From the above, it is clear the noise levels in the District Plan are not fully understood by the orchard operators. Therefore, it is recommended that rather

than stating only activities that do not comply with rules, the noise limits should be treated as a restricted discretionary activity. Therefore, all activities that use any form of impulsive audible bird scaring device should be a restricted discretionary activity. This will ensure the orchard operator understands and complies with the relevant noise limits.

The current rule provides for the hours of operation from half an hour before sunrise to half an hour after sunset. The EPD document quoted above (section 4) recommends that gas guns should not be used earlier than 7:00am or later than sunset, which is a noticeably shorter period than currently adopted. As there are alternative methods for gas guns to protect crops, any new orchard operator could reasonably be expected to adopt the electronic bird scarers or similar prior to 7:00am. This would also be a reasonable expectation in terms of section 16 of the Resource Management Act, with the emphasis on best practicable options to manage noise emissions (section 2).

6. EXAMPLES OF PREDICTED NOISE FROM IMPULSIVE AUDIBLE BIRD SCARING DEVICES (GAS GUNS)

To understand the potential area of influence of the proposed L_{Cpeak} controls the noise has been predicted using the Brüel & Kjær Predictor programme v2022.11 which is a powerful environmental noise calculation software package. The calculations have been undertaken in accordance with the requirements of ISO 9613-1/2 Acoustics – Attenuation of Sound during Propagation Outdoors. The calculations assume a slightly positive meteorological effect at the receiver position with a ground absorption of 0.8 and a receiver height of 1.5m to satisfy the requirements of NZS 6801:2008 Acoustics - Measurement of Environmental Sound.

The predicted noise contour model with the gas gun in a fixed position pointing north are shown on Figure 1.

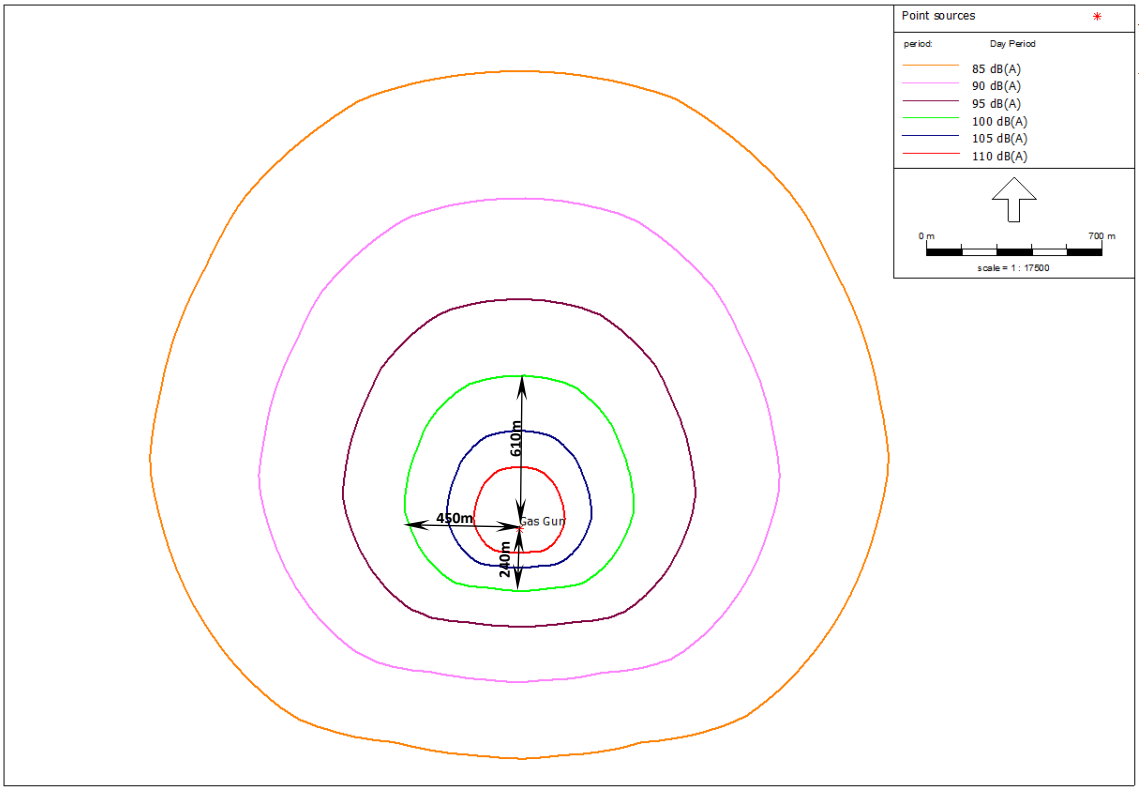


Figure 1. Example of the gas gun directivity effects, dB L_{CPeak}

Figure 1 shows the effects assuming the ground is flat, which is not always the case. Figure 2 shows the noise with a gas gun located at 271 Rewatu Road with a 1m ground contour of the area included in the modelling and the gas gun free to rotate during firing. Figure 3 has the gas gun is the same location with the only difference being the gas gun is firing in one direction (to the south west).

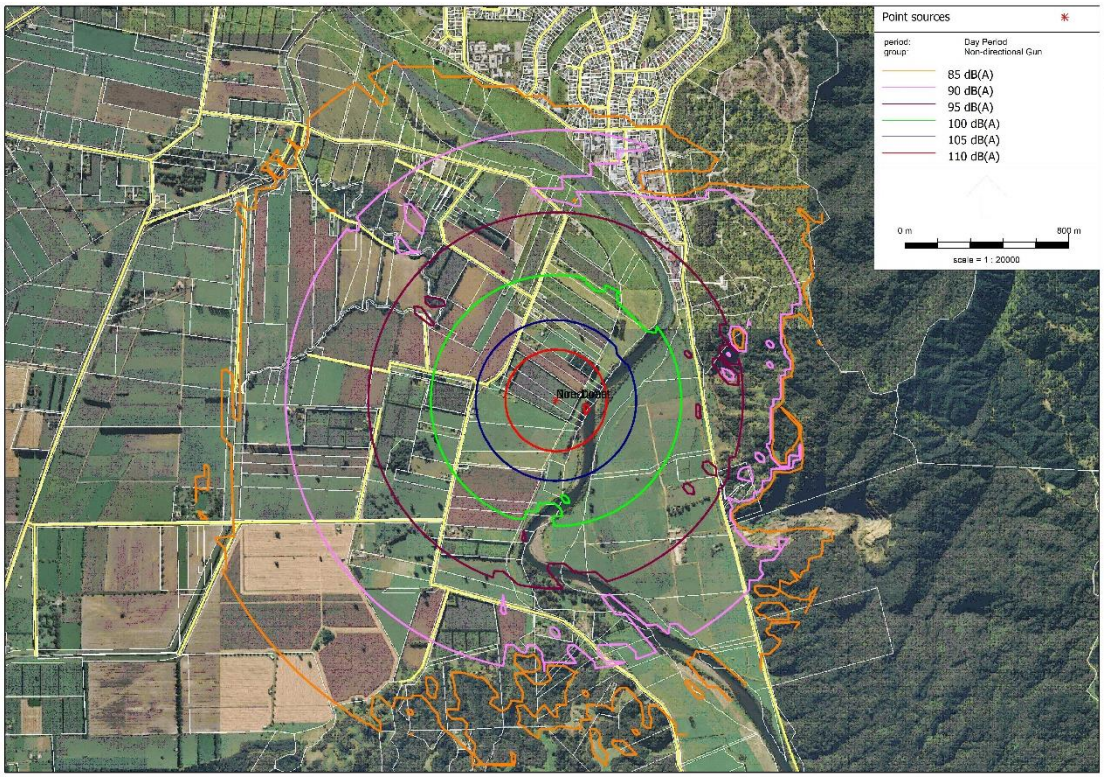


Figure 2. Gas gun at 271 Rewatu Road and free to rotate during firing

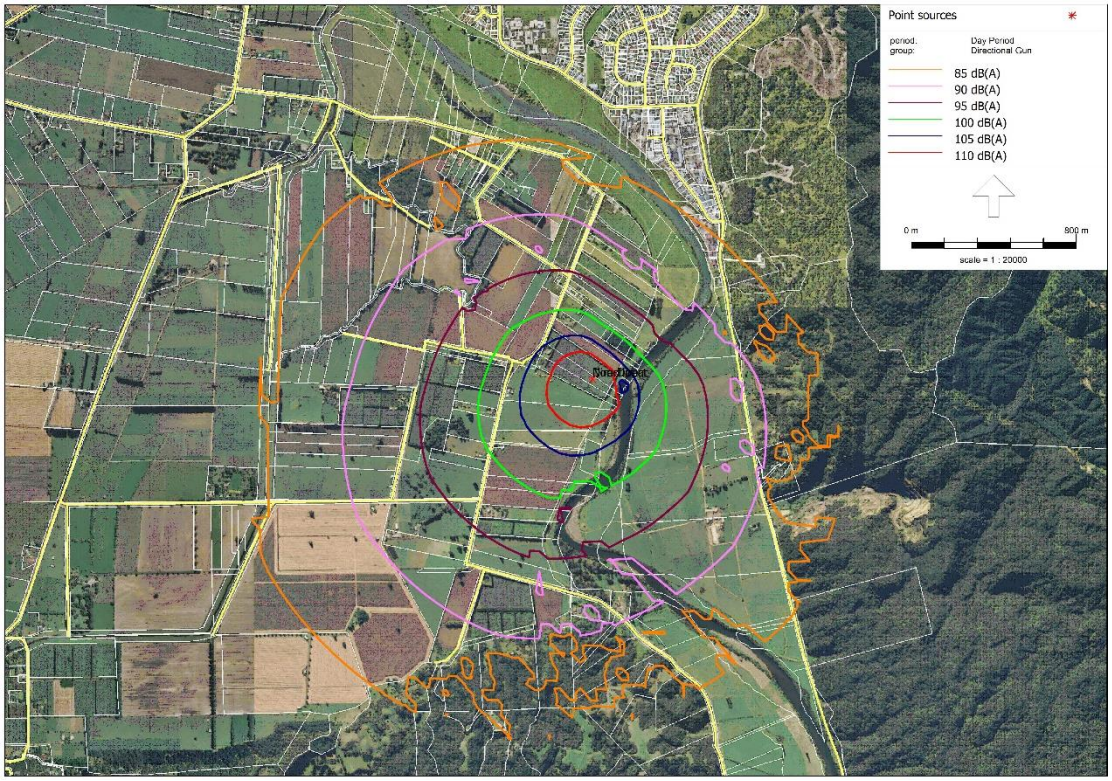


Figure 3. Gas gun at 271 Rewatu Road firing in one direction

Figure 4 shows the noise with a gas gun located at 60 Orchard Road rotating during firing and Figure 5 with the gas gun firing in one direction (to the south) when including the effects of the existing 1m ground contour.

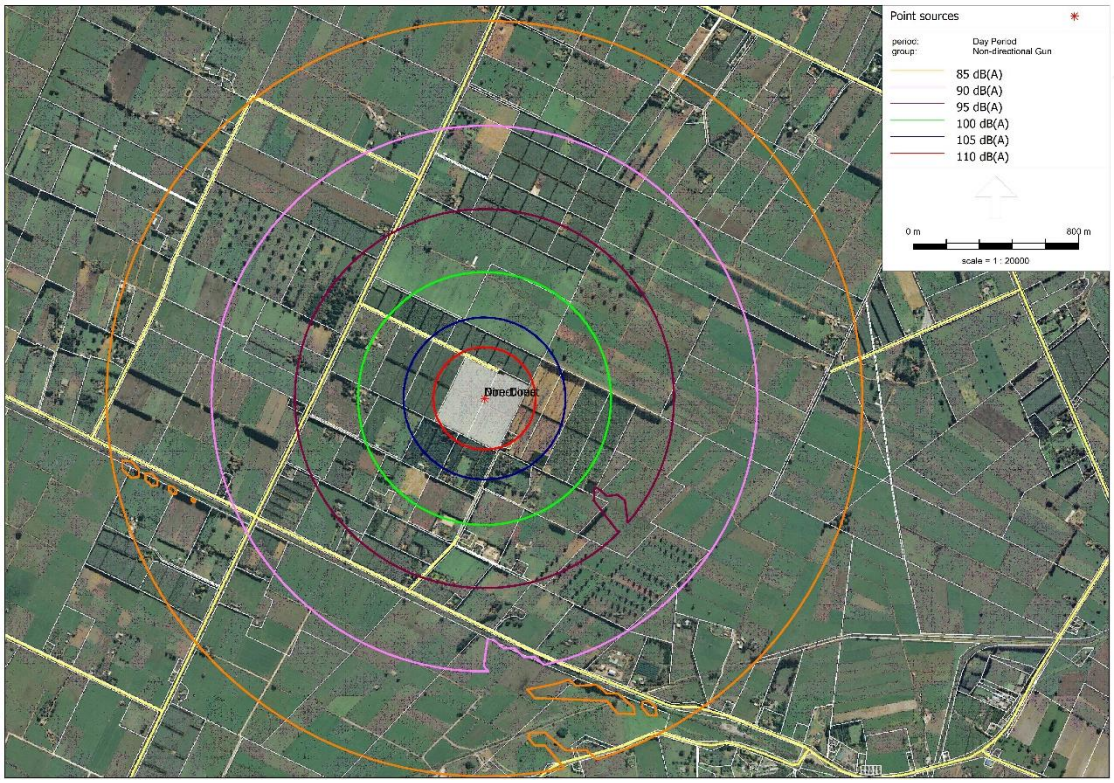


Figure 4. Gas gun at 60 Orchard Road and free to rotate during firing

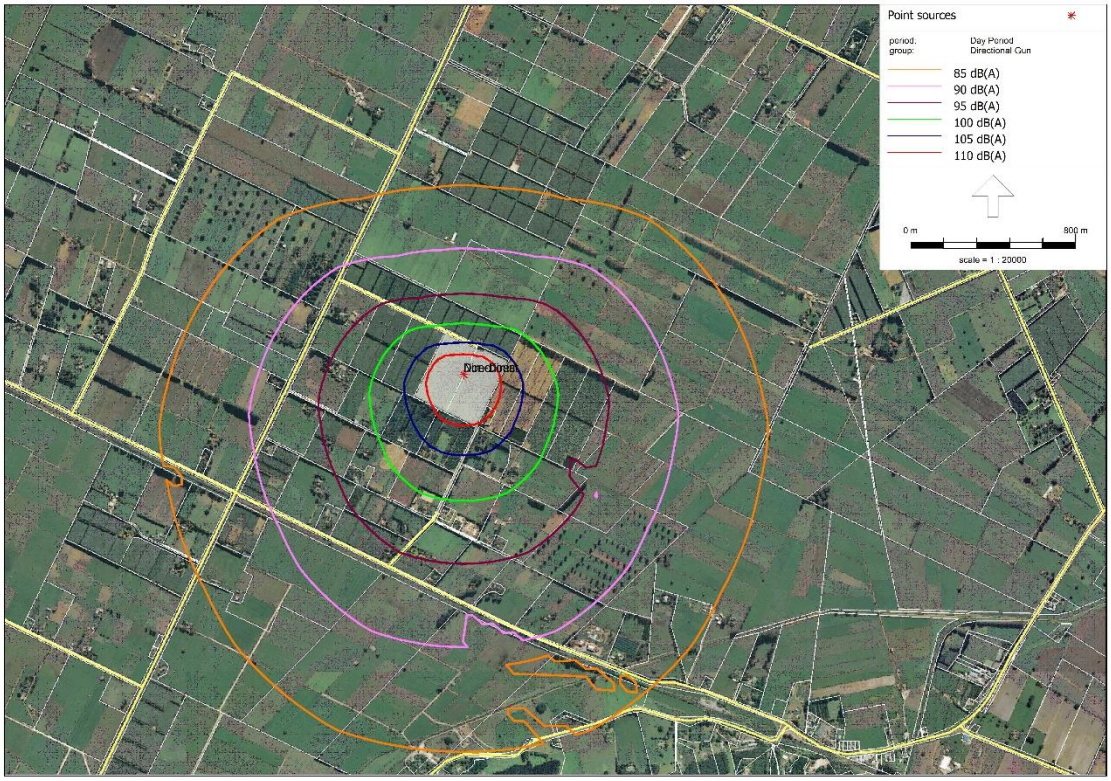


Figure 5. Gas gun at 60 Orchard Road firing in one direction

Figure 6 shows the noise with a gas gun located at 565 West Bank Road rotating during firing and Figure 7 with the gas gun firing in one direction (to the west) when including the effects of the existing 1m ground contour.

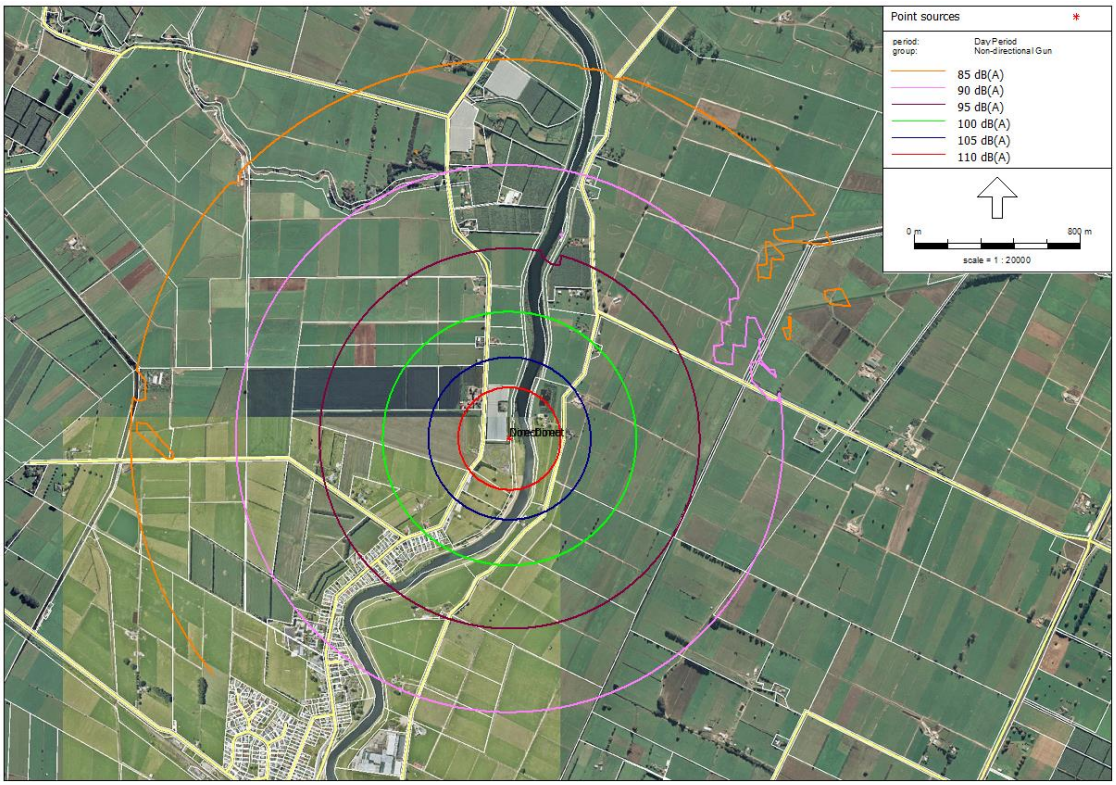


Figure 6. Gas gun at 565 West Bank Road and free to rotate

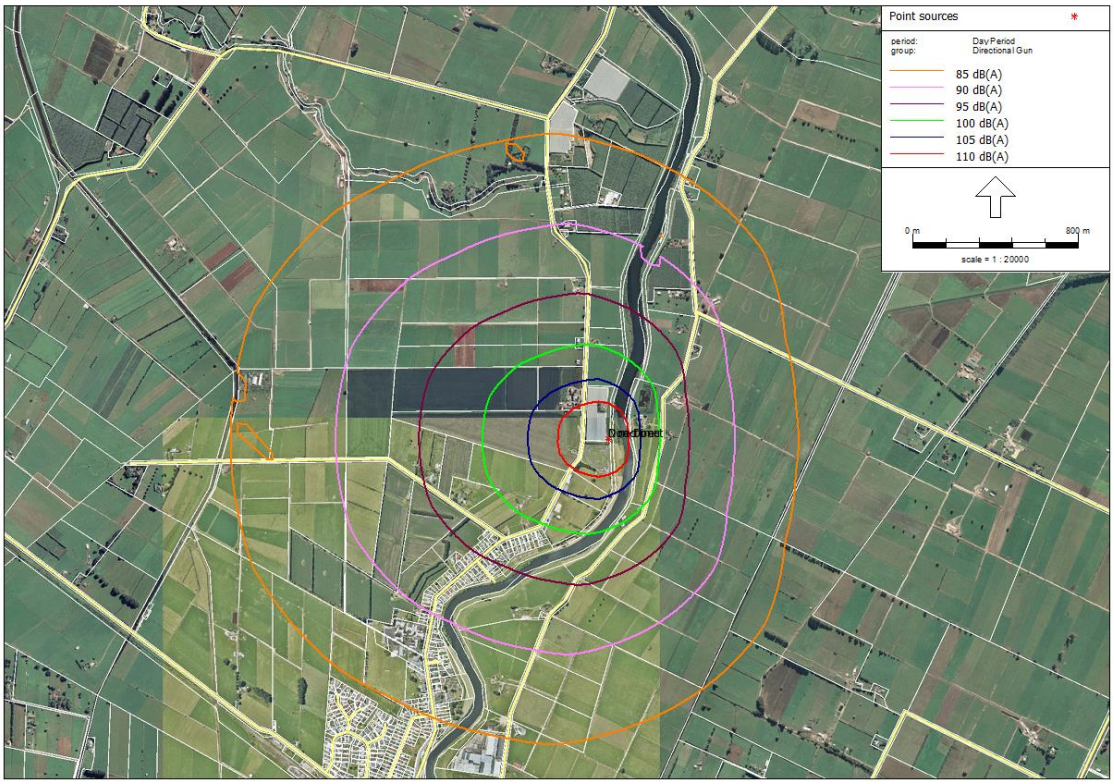


Figure 7. Gas gun at 565 West Bank Road firing in one direction

7. CONCLUSIONS

The above noise contours (section 6) assume the slightly positive design meteorological effects are occurring outward from the noise source. This does not actually occur in practice, but it does show the design criteria for all directions on a single figure. The noise predictions with the gas gun pointing in one direction (which has been randomly selected), demonstrates how the operator could attempt to manage the noise by the orientation of the gas gun.

What these contours do indicate is that few orchards are expected to comply with the existing 100dB L_{Zpeak} (or proposed L_{Cpeak}) criteria at the notional boundary. Although with the appropriate onsite management the noise level and the number of neighbours affected could be reduced by;

i. directing the gas gun firing direction, the noise contours around an orchard can be controlled with the appropriate orientation of the gas gun.
ii. limiting the hours of use, a specific time when the gas guns may be used would provide more certainty for everyone rather than adopting the variable times of sunrise and sunset.
iii. limiting the frequency of use,
iv. using other deterrents, further control may be achieved by using a combination of gas guns and alternative methods such as electronic bird scarers, reflective tape and spray deterrents.

To ensure the noise from the use of impulsive bird scaring devices is both understood and is the best practicable option to ensure that the emission of noise is reasonable for the neighbours, it is recommended the use of any form of impulsive audible bird scaring devices should be a restricted discretionary activity.

By adopting a restricted discretionary activity approach for all new impulsive audible bird scaring devices this will enable the noise to the neighbours to be assessed. Where this level is no more than 85dB L_{Cpeak} the noise may be considered to be within a reasonable level without the need to limit events.

8. RECOMMENDATIONS

To control the noise from impulsive audible bird scaring devices it is recommended the following rules are considered.

Rule 11.2.6.2 in Table 11:2, be amended to read;

Audible bird scaring devices (see Note h).	General Requirements A legible notice is to be fixed to the road frontage of the property on which a device is being used, giving the name, address, contact telephone number of the person responsible for the operation of any such device(s). **Devices that generate non-impulsive sound events** Noise from non-impulsive **audible bird scaring devices** (such as ultrasonic sound repellers) shall comply with the following noise levels at any point within the notional boundary of any rural dwelling not on the same site or the site boundary in any residential zone: iii. 07:00am – 10:00pm 50dB L_{Aeq}, iv. 10:00pm – 07:00am 40dB L_{Aeq} and 70dB L_{Amax}. **Devices that generate impulsive sound events** Noise from impulsive **audible bird scaring devices** (such as LPG guns) are permitted where the noise does not exceed 85dB L_{Cpeak} at any point within the notional boundary of any rural dwelling

	not on the same site or site boundary in any residential zone there is no restriction on the number of individual events p between 07:00am – 10:00pm. Noise from impulsive **audible bird scaring device**s are a restricted discretionary activity (see criteria in Rule 11.4.5) where the noise exceeds 85dB L_{Cpeak} at any point within the notional boundary of any rural dwelling not on the same site or site boundary in any residential zone the noise must: i. not exceed 3 events within a 1 minute period and shall be limited to a total of 70 individual events per day, and *ii.* shall operate between 07:00am to 07:00pm **Advice Note:** Existing use rights may apply where a bird scaring device has been lawfully established and continuous seasonal operation complied with the permitted standards prior to the notification date {insert date} of Plan Change 6.

Rule 11.4.5.1 be amended to read:

Council shall restrict its discretion to the following:

a. consideration of the best practicable option, including alternative types of bird scaring devices, alternative options for crop protection and effectiveness of those alternative options.

b. an acoustic report from a suitable qualified acoustics expert that identifies the 85dB L_{Cpeak}:

ii. identifying affected persons.

c. the noise level generated and the effect of the noise level on those persons who will experience the noise and any proposed mitigation

d. the location or exclusion areas of any device in an orchard
e. the number of devices the frequency, timing, time of year and the operating conditions when they may operate
f. the proximity to significant indigenous biodiversity sites
g. the General Information Requirement in Rule 3.5.4

The notification provisions in the RMA shall apply to any application.

* * *

APPENDIX A
Guide to Noise Terms

The following sets out an explanation of the acoustic terms that are referred to throughout this report. The aim is not to necessarily provide technical definitions, but to enable a basic understanding of what is meant.

The setting of specific noise levels to control any adverse effects does not necessarily mean that noise will not be heard. Audibility depends on the level of a sound, the loudness of the background sound and any special frequency composition or characteristics that a sound may have.

Research suggests that a small number of people (approximately 10%) will find any noise not of their own making unacceptable. Conversely, there are approximately 25% of the population that are essentially immune to any noise. Neither of these two extremes is normally designed for. In establishing the appropriate noise levels the aim is to try and represent the typical expected community reaction, this will generally be approximately 90% of the people.

To reflect community response to noise it is necessary to establish a measure that reflects our attitude to the sounds that we hear. Due to the variability of many sounds (level, tone, duration, intrusiveness above the existing sound, etc) no single descriptor will totally describe the potential community reaction to a sound. For this reason, there are a number of terms that need to be understood.

dB

The basic unit to quantify a sound is the decibel. The A-weighted sound level (such as L_A), is a good environmental noise descriptor because of the similarity between A-weighting and the frequency response of the human ear at moderate sound levels. However, it provides no indication of tonal frequency components

or unusual frequency distributions of sound that may be the cause of annoyance. Where appropriate, this must be assessed separately.

We can hear a change in sound pressure that varies from 1 (taken as the threshold of hearing) through to 1,000,000,000,000 (taken as the threshold of pain). To bring these numbers to a more manageable size a logarithmic scale is normally adopted. This reduces the above values to 0 and 12 respectively. The decibel is then described as 10 times the logarithm of the ratio of the pressure level of interest, to a reference pressure level. Thus, the scale becomes 0 to 120dB.

Some typical subjective changes in noise levels are:

A change of 3dB is just perceptible
A change of 5dB is clearly perceptible
A change of 10dB is twice (or half) as loud

As a logarithmic scale is used when adding sound levels two equal noise sources raises the level of one source by 3dB. It takes 10 equal noise sources to raise the level of one source by 10dB. ie 60dB + 60dB = 63dB and 60dB x 10 = 70dB.

Ambient Sound

The ambient sound is normally used to describe the total noise environment. The ambient sound is often measured as the 24 hour L_{Aeq}, which is an average value over the 24 hour period. Shorter times are often used, such as the daytime period

Background Sound L_{A90}

The sound level which is equalled or exceeded for 90% of the measurement time. This level is adopted in NZS 6802:2008 - Acoustics – Environmental noise to measure the background sound. This level may be considered as the average minimum sound level and is the component of sound that subjectively is perceived as continuously present.

Equivalent Sound Level (L_{Aeq})

The L_{Aeq} may be considered as the continuous steady noise level that would have the same total A-weighted acoustic energy as a fluctuating noise over the same time period.

Impulsive Sound

Transient sound having a peak level of short duration, typically less than 100 milliseconds

Maximum Sound Level (L_{Amax})

This unit equates to the highest sound level for a defined measurement period. It is adopted in NZS 6802:2008 - Acoustics – Environmental noise as a method of protecting sleep disturbance. L_{Amax} this is not the same as L_{Zpeak} or L_{Cpeak}.

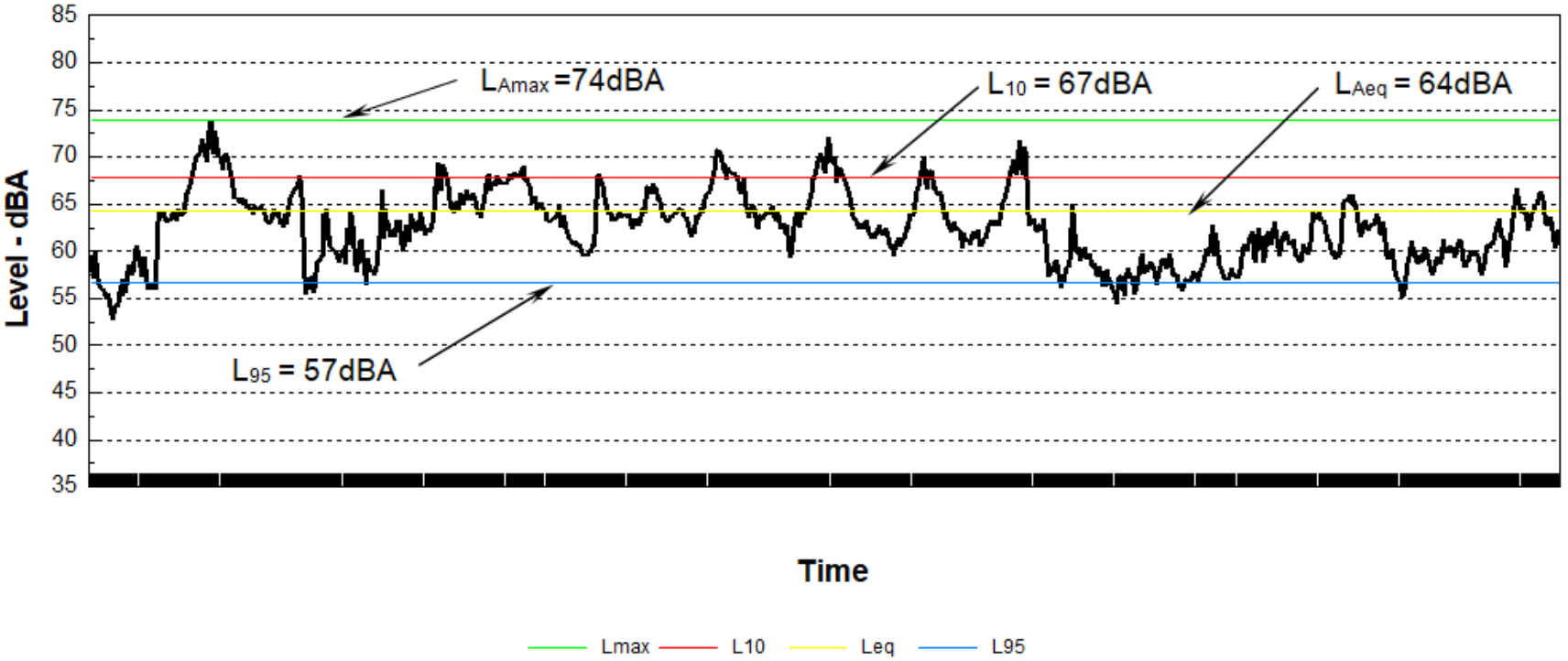
Notional Boundary

The notional boundary is defined as a line 20 metres from the facade of any rural dwelling or the legal boundary where this is closer to the dwelling.

Peak Noise Level (L_{Zpeak} or L_{Cpeak})

Peak Sound Level is the highest peak of the original pressure wave and used to measure impulse noise. It is formally defined as twenty times the logarithm to the base ten of the ratio of a peak sound pressure to the reference sound pressure, peak sound pressure being obtained with a standard frequency weighting. To give some idea of scale. The time constant for the maximum level (L_{Amax}) response is 125millisec. The maximum permitted acquisition time of Peak is 100 microseconds (0.1 millisec).

Figure A1 shows a noise trace with the relationship of L_{max}, L_{10}, L_{95} and L_{eq} values when including all events over the 15 minute measurement period and Figure A2 some typical noise levels.



L_{Amax} is the maximum noise level
L_{10} is the noise level that is equaled or exceeded for 10% of the measurement period
L_{95} is the noise level that is equaled or exceeded for 95% of the measurement period
L_{Aeq} is the noise level that contains the same energy as the time varying noise

Figure A1

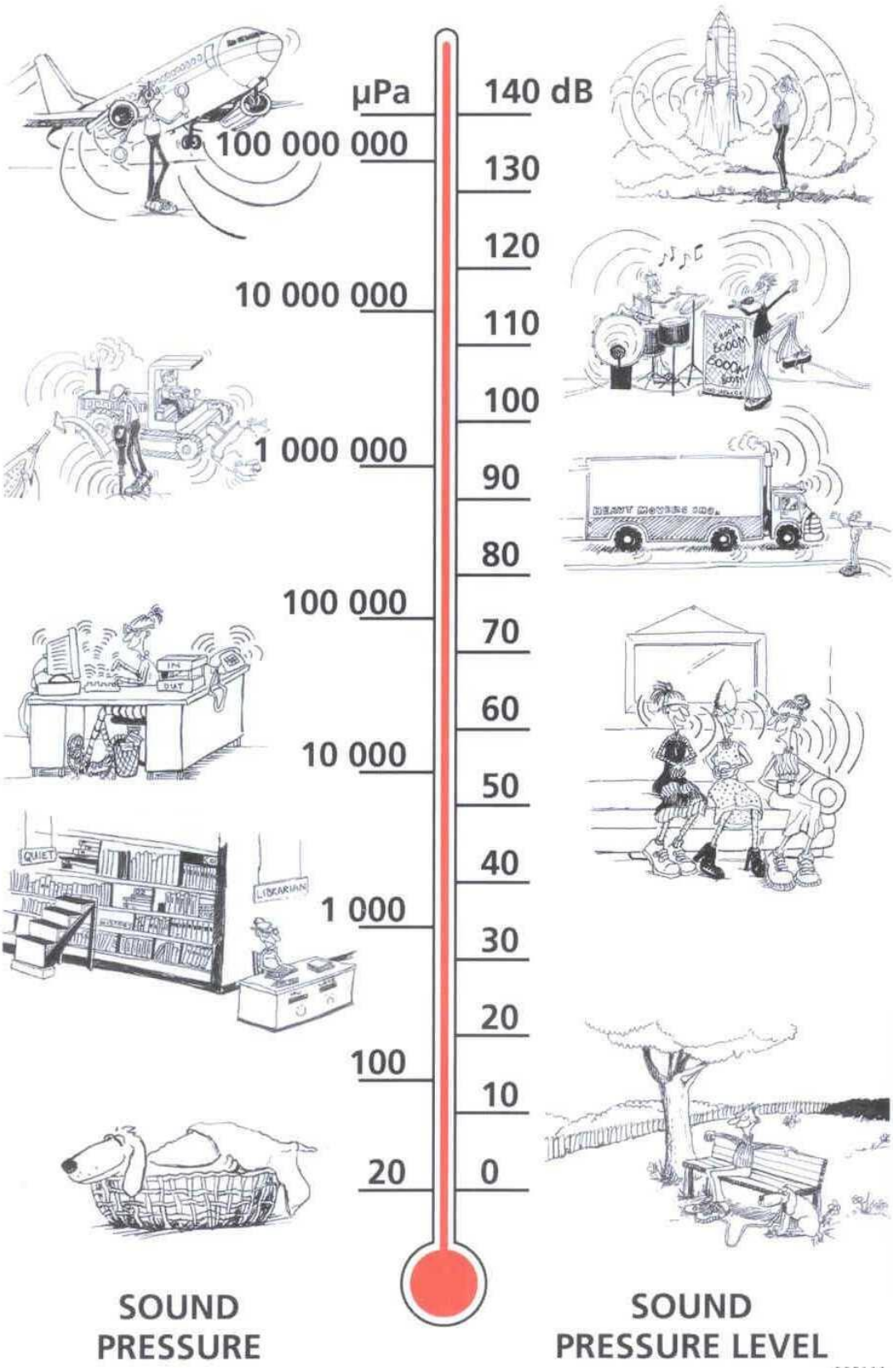

μPa
100 000 000
10 000 000
1 000 000
100 000
10 000
1 000
100
20
140 dB
130
120
110
100
90
80
70
60
50
40
30
20
10
0
QUIET
LIBRARIAN
SOUND PRESSURE
SOUND PRESSURE LEVEL

Figure A2