Appendix 5: Acoustic Assessment

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File Ref: AC14135 – 02 – D3

12 May 2016

Judith Pascoe
c/o
Anna MacKenzie
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Dear Anna

Re: Private Plan Change, Corner of Creyke and Telegraph Roads, Darfield
Assessment of Environmental Noise Effects

Acoustic Engineering Services (AES) have been engaged by the Applicant (Judith Pascoe) to provide acoustic engineering advice in relation to the application for a Plan Change at the above location from Living 2A Deferred to Living 2A. Please find our analysis and recommendations below.

1.0 BACKGROUND

The applicant site is located on the corner of Creyke and Telegraph Roads to the south east of the Darfield township. The site consists of Lot 1 DP 56120, Lot 2 DP 56120, Lot 2 DP 391851 and Lot 1 DP 391851 and is currently zoned Living 2A (deferred). The applicant site currently contains three dwellings on semi-rural lots. Surrounding land is generally used for rural purposes with the exception of the Darfield Gun Club which is located on the opposing corner of Creyke and Telegraph Roads.

The proposed Plan Change site originally formed part of the application for Plan Change 24, Silver Stream Estates. This Plan Change was made operative on the 24th of June 2013 and resulted in the rezoning of the area of land to the north of the site into Living 1 and Living 2A as outlined in figure 1.1. For the area of land in question, reverse sensitivity due to noise from the Darfield Gun Club was raised as a potential issue. The commissioner (John Milligan) elected to retain the Living 2A deferred zoning for this land, reasoning that insufficient information had been provided about whether the consideration of reverse sensitivity was within the scope of the Plan Change given that the land is already zoned L2A deferred and requires both a potable water supply and the inclusion of an Outline Development Plan in the District Plan to remove the deferral. Mr Milligan also stated that insufficient information was made available about the extent that reverse sensitivity could be of concern, and also that none of the submissions suggested any appropriate protection against reverse sensitivity effects.

With regard to the use of the Darfield Shooting Centre, we have been provided with a schedule from Marcel van Leeuwen the Secretary / Treasurer. The Darfield Clay Target Club (DCTC) runs the majority of events at the site using two 'down the line' traps which are oriented so that they face away (to the south or south-west) from the proposed Plan Change area as shown in figure 1.1.

We understand the following covers the extent of events that DCTC may wish to run:

- 14 Club Shoots. These are generally held on the first Sunday of each month between 1 pm and 6 pm, although three of these are full day events held between 10 am and 6 pm. The Club may also host additional weekend events such as the ANZAC Day

Duck Shooters day (1 pm - 6 pm), or National Party Shoot (10 am - 6 pm). The club may also occasionally be asked to host a regional event (10 am - 6 pm).

- 13 Practices. These are held fortnightly in summer between 5 pm and 7 pm.
- 20 School kid shoots. These are held on Monday afternoons between 3 and 6 pm (although may be rescheduled to a Tuesday instead of a Monday).
- 7 Corporate shoots. These could be held on various days and would be between 2 and 3 hours in duration.

The Malvern Deerstalkers Association and Malvern Small Bore Rifle Club also use the DSC grounds and clubrooms. The Deerstalkers Association holds a 'running boar' shoot using .22 calibre rifles on the south side of the site. The Malvern Small Bore Club operates a concrete bunker attached to the DSC clubrooms, although the future of the tunnel has been undecided since the 2012 earthquakes.

Figure 1.1 - Location of site and environs

2.0 ACOUSTIC CRITERIA

While avoidance of noise effects is always the preferred option for greenfield development, there are many factors to consider. In this assessment, AES have focussed on whether a reasonable level of acoustic amenity can be achieved for future residents if development were to proceed at this location.

2.1 District Plan guidance

The Selwyn District Plan provides noise standards which apply to noise received in residential areas from non-residential activities. However, we note that NZS 6802:1991 *Assessment of Environmental Sound*, which the District Plan references, specifically excludes impulsive noise from gunfire from its scope.

In line with the scope of 6802:1991, we consider that the District Plan limits are not suitable for determining potential noise effects of gunshot noise due to its impulsive nature. Many countries have criteria specifically for gunshot noise, usually expressed as either L_{peak} or L_{max}. These criteria are typically more stringent than generic daytime L_{max} values commonly encountered in District Plans throughout New Zealand (including the 85 dB L_{max} limit in the Selwyn District Plan).

2.2 Other guidance

A body of guidance is available with regard to reasonable maximum noise emissions associated with shooting ranges. A review of international shooting noise regulations[1] outlines that typical noise limits at residential receivers generally fall between 50 to 60 dB L_{AFmax}, with some exceptions (both higher and lower limits). Other guidance[2] seems to indicate that the threshold for annoyance is in the order of 60 - 65 dBA L_{AFmax}. AES has undertaken work relating to noise emissions from several existing gun clubs in NZ and have typically recommended noise limits of between 50 - 55 dB L_{AFmax} at residential receivers.

Other guidance from the UK Chartered Institute of Environmental Health regarding Clay Target Shooting[3], uses a Shooting Noise Level (SNL) to quantify noise effects, which is the average L_{AFmax} of the 25 loudest shots. This guidance states that annoyance is less likely to occur at a mean SNL of below 55 dBA and highly likely to occur at a mean SNL above 65 dBA. This guidance quotes the following:

"*At shooting noise levels below the mid 50's dB(A) there is little evidence of significant levels of annoyance at any site, whereas for levels in the mid to high 60's, significant annoyance is engendered in a majority of sites. For levels in between however, the extent of the annoyance varies considerably from site to site. Thus a level of, say, 60 dB(A) may be deemed acceptable at one site, but not at another.*"

The studies reviewed generally indicate that the range in acceptable noise levels from gun club activities is dependent on local conditions, including community attitude to the club, cumulative shooting time, number of shooting days, time at which shooting occurs, predominant meteorological conditions and how the site is managed. In this case we consider the following factors which to be relevant:

- The Applicant has drafted a 'no complaints covenant' which will ensure that new residents in the area will be aware of the Gun Club and level of activity before moving into the area.

- There are relatively few 'shooting days' per year, with major shoots operating during the daytime and finishing by 6 pm. There are a number of 'off' weekend days, with gun club activity occurring perhaps 1 or 2 weekend days per month, for a limited duration.

2.3 Proposed limits of acceptability

Considering all of the above, there would be significant risk of reverse sensitivity effects if residential development is to proceed where noise levels at dwellings will exceed 60 dB

[1] V. Desarnaulds *et al. Shooting noise regulation review of various national practices.* Proceedings of Internoise 98, Christchurch.
[2] Sorensen, S. and Magnurror, J. *Annoyance caused by noise from shooting ranges*. Journal of Sound and Vibration, 62(3), pp 437 – 442, 1979.
[3] Chartered Institute of Environmental Health (2003) *Clay Target Shooting, Guidance on the Control of Noise* [online]

L_{AFmax}, whereas at 50 dB L_{AFmax} there will be little risk of reverse sensitivity effects. Between 50 - 60 dB L_{AFmax} specific mitigation will need to be considered to ensure potential noise effects are appropriately managed. With this in mind we note the following:

- A typical dwelling will provide a reduction in the order of 15 dB with windows open. Therefore, an external criterion of 50 dB L_{AFmax} would result in internal noise levels of 35 dB L_{AFmax}. If new dwellings are constructed to achieve this internal noise target, then we would consider internal noise levels to be appropriately controlled.

- Noise received in outdoor areas would be a key concern where noise levels are above 50 dB L_{AFmax}. If a primary outdoor area can be included which is screened from gunshot noise to achieve a level of 50 dB L_{AFmax} then we would consider this sufficient to ensure noise effects will be appropriately mitigated. We note that the concept of providing a screened primary outdoor area is consistent with the approach considered in the NZTA Draft Reverse Sensitivity Guidelines with regard to road traffic noise.

3.0 NOISE LEVELS

3.1 Measurement of noise generated by DSC

Russell Malthus was engaged by Selwyn District Council to provide an environmental health assessment for Plan Change 24. As part of this assessment, Russell Malthus undertook measurements of a Darfield Clay Target Club (DCTC) shoot on the 10th of December 2010.

Mr Malthus recorded levels at the existing dwelling at 193 Creyke Road, 200 metres from the Gun Club. When both traps were operating continuously and approximately 150 gunshots in 10 minutes levels of 55 - 65 dB L_{Amax} were recorded.

To confirm the measurements undertaken by Mr Malthus, AES also undertook measurements of activity during a DCTC shoot at the site in December 2015. Details of the measurements completed in general accordance with NZS 6801:2008 Acoustics - Measurement of Environmental Sound are as follows:

Operator: *George van Hout, Acoustic Engineering Services*
Measurement period: *1350 to 1420 hours, 6th December 2015*
Weather: *Overcast, light SE breeze, 13 °C*
Equipment: *Bruel & Kjaer Type 2250 Class 1 Sound Analyser* *(Serial Number 2630291, last calibrated 24 April 2014)* *Bruel & Kjaer Type 2250 Class 1 Sound Analyser* *(Serial Number 3008199, last calibrated 28 June 2015)* *Bruel & Kjaer 4231 Acoustic calibrator* *(Serial Number 3011404, last calibrated 23 February 2015)*
Notes: *Analyser calibrated before and after measurements. No significant variation observed.* *Measurement settings: A-frequency weighting (dBA), fast response*

Measurements were undertaken at 315 metres from the closest trap, and at various distances along Creyke Road. At 325 metres from the closest trap, noise levels of 60 dB L_{AFmax} were recorded, which accords with the earlier measurements of Mr Malthus.

3.2 Predicted noise levels

SoundPlan computational noise modelling based on ISO 9613 *Acoustics – Attenuation of sound outdoors – Part 2: General method of calculation* has been used to calculate the propagation of noise from the site, based on measured noise levels and conservatively assuming downwind conditions in all directions.

A sound power of 123 dB L_{AFmax} has been used in the modelling which includes an allowance for variation in the type of guns used. A point source is located at each trap position and a spectrum for a 12 gauge shotgun has been used.

The resulting 60 dB L_{Amax} and 55 dB L_{Amax} contours have been provided to the surveyor and are shown on a concept subdivision layout as shown in figure 3.1 below. We understand that the Applicant is willing to offer a rule prohibiting the construction of new dwellings within the 60 dB L_{AFmax} contour. Our analysis has therefore been provided on this basis.

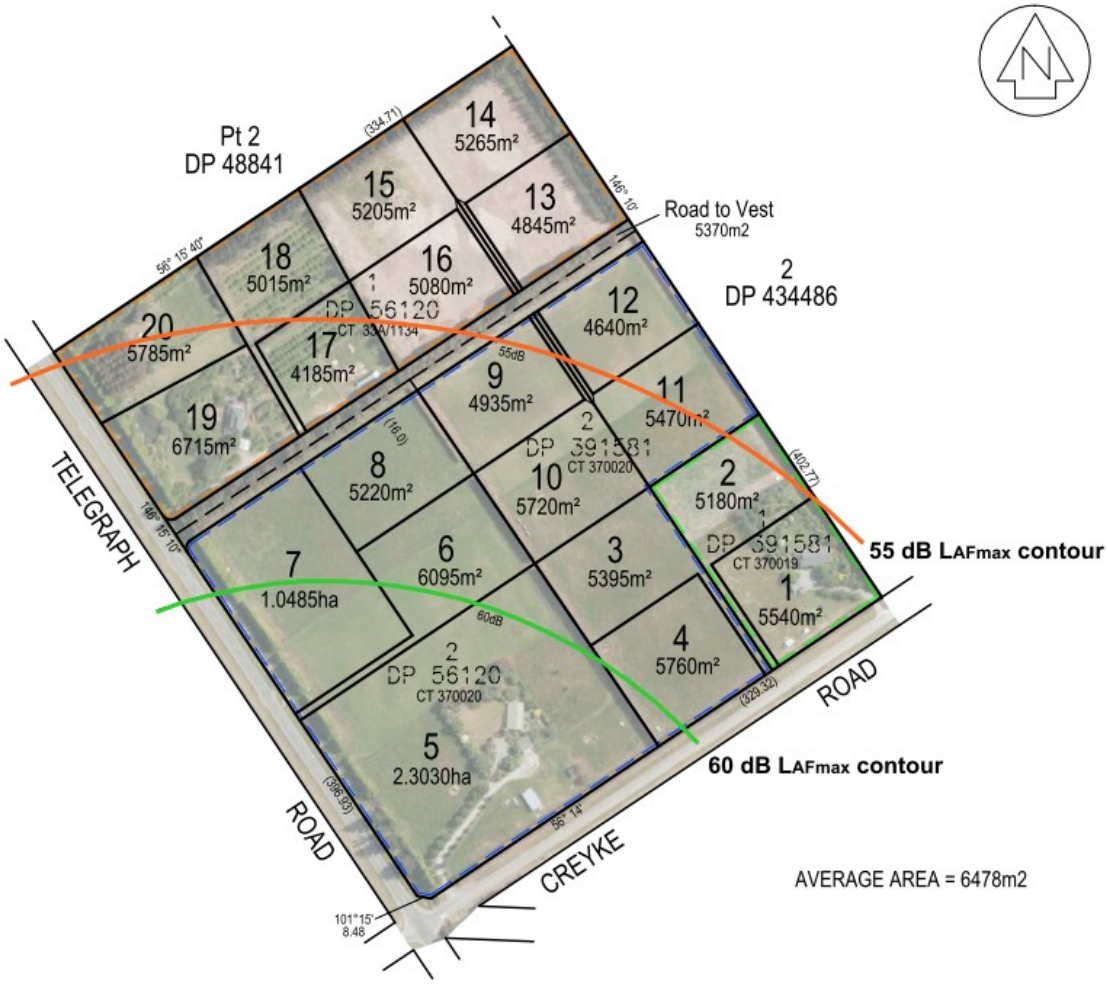

Figure 3.1 - L_{AFmax} contours from DCTC shown on a conceptual subdivision layout

3.3 Internal noise levels

A typical modern dwelling with windows closed will achieve an outdoor to indoor reduction in the order of 25 dB. Therefore, for dwellings with external noise levels of up to 60 dB L_{AFmax}, an internal level of 35 dB L_{AFmax} is easily achieved.

Given that activities at DSC occur during daytime hours, we consider that noise received in living spaces (not bedrooms) is most likely to be of concern. We note that the orientation of

habitable spaces used during the daytime period will also likely face to the north (away from the gun club). Therefore the required outdoor to indoor reduction may be achieved with windows open. However if windows must be closed to achieve the required reduction, then an alternative fresh air ventilation system will need to be provided.

3.4 Outdoor areas

In order to determine whether a reasonable level of outdoor amenity can be provided, we have investigated the shielding provided by a typical dwelling on the proposed site.

We have modelled the construction of a square dwelling with 150m^2 floor area on the closest locations where development may occur, being lots 3, 4 and 6 shown in the conceptual subdivision layout. A dwelling has also been modelled on lot 16 to show the effect of a dwelling further from the DSC.

As shown in figure 3.2, lower noise levels will be received on the north to north east sides of the dwelling, depending of the location of the dwelling relative to the DSC. It is likely that principal living and outdoor areas will be desirable on northern aspects for warmth and natural light. Based on this analysis, we consider that a sheltered area of 100 m^2 could be provided without difficulty. With specific acoustic design such as fencing or by considering a different dwelling shape (for example an L-shaped dwelling) this outdoor area could be optimised.

We note that dwellings constructed on the closer lots may to some extent provide screening to dwellings further away, depending on relative locations.

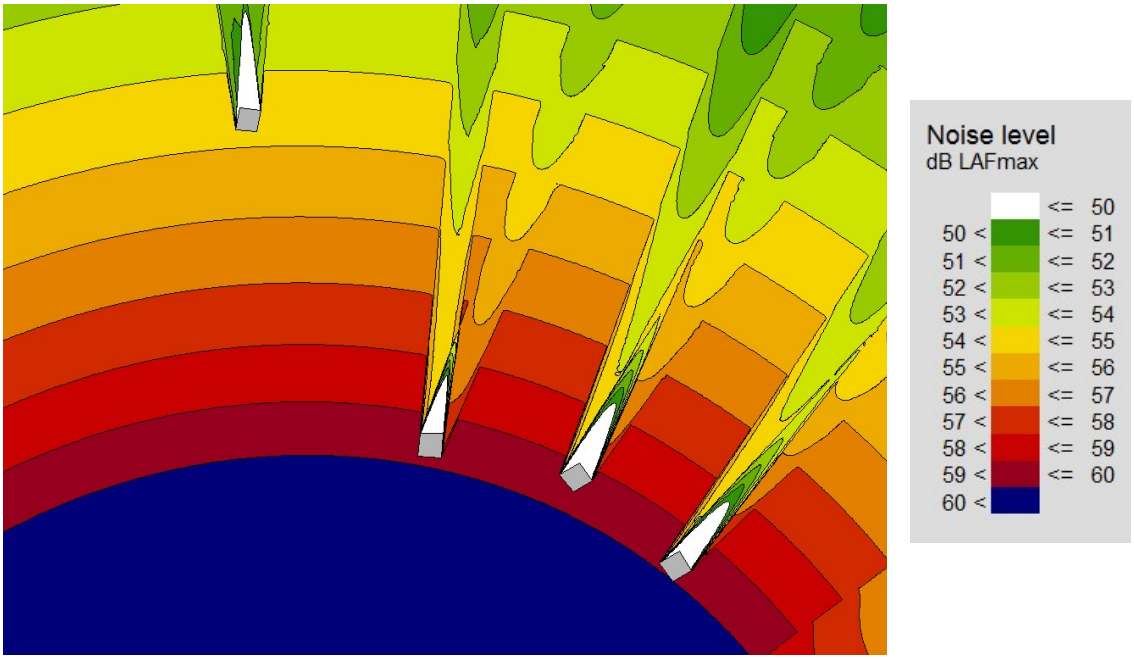

Figure 3.2 - Acoustic shielding provided by dwellings

4.0 CONCLUSIONS AND RECOMMENDATIONS

When considering noise sensitive development in noise affected areas, AES is mindful of the need to proceed with caution, consider mitigating factors, and make an on-balance decision including acoustic and non-acoustic issues regarding the acceptability of a site for development.

In this case, with regard to noise effects, there are several mitigating factors, including the limited use of the DSC, which will typically be once a week, with a number of 'off' weekend

days and evenings where the club will not be used. The 'no complaints' covenant will also have some impact on the type and attitude of resident who will chose to live in the area.

Based on our review of international guidance with regard to appropriate criteria for gunshot noise, it appears conservative to conclude that if an internal noise level of 35 dB L_{AFmax} is met, and a primary outdoor area provided where noise levels are less than 50 dB L_{AFmax} then reverse sensitivity effects will be appropriately mitigated.

If development were to proceed, then to give confidence that noise emissions associated with the operation of the DSC will not give rise to reverse sensitivity noise effects, we would recommend the following conditions of consent are adopted for any development on this site:

(1) No additional dwellings are to be constructed within the extent of the 60 dB L_{AFmax} contour shown on the ODP as the 'no additional dwellings' area.

(2) The primary outdoor area associated with any new residential dwelling must be screened from gun club noise to achieve a level not exceeding 50 dB L_{Amax}

(3) Any dwelling on the site must be designed, constructed and maintained to achieve a design noise level of 35 dB L_{Amax} from gun club noise inside all habitable spaces excluding bedrooms

If you have any queries, please do not hesitate to contact us.

Kind Regards,

William Reeve
B.E.(Hons.) Mech, MASNZ

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File Ref: AC14135 – 03 – D1

15 July 2016

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Dear Anna

Re: Private Plan Change, Corner of Creyke and Telegraph Roads, Darfield Response to Council queries – Addendum to report

As requested, we have reviewed the questions provided via email from Anna of Anavzar on June 1 2016. Please find our responses to each item as follows:

1. *The acoustic report's findings and associated proposed noise mitigation is based on the scale of activity, including shoot times, identified in the report. Would the mitigation measures still be effective if the scale of activity increased and/or shoot times occurred after 6pm?*

   Our thinking and conclusions are based on the level of activity described in section 1.0 of our report. Changes in the scale or hours of the gun club may influence our conclusions. This doesn't mean that we would no longer support the proposal if something changed with the gun club – but we would reconsider our position. I do note that ultimately our conclusions in 2.3 are conservative, and I expect we could tolerate some moderate changes in the gun club activity without too many issues. The extension of their activities after 6 pm into the evening period would however potentially be concerning. We have also placed some reliance on the gun club not operating in the night time (for example we have not required bedrooms to be acoustically treated). Night time operation (after 10 pm) would therefore change our conclusions significantly.

2. *Is the Gun Club operating within the district plan noise limits (Rule 9.16 – Table C9.2)? Your acoustic advisor should be able to advise on this (please only answer this if you have done the work to know the answer – thanks Anna)*

   The Gun Club would comply during the daytime (7.30 am to 8.00 pm). If they operated during the night time, they may just exceed the night time 70 dB L_{max} noise limit at the notional boundary of the nearest dwelling.

3. *With respect to noise mitigation measures could reliance be placed on the Building Act to achieve the internal noise level requirement? The acoustic report, to me, seems to indicate that new buildings achieve this in any event.*

   Refer to section 3.3 of our AENE. You are correct that a typical modern dwelling built in accordance with the current Building Code would provide a sufficient noise reduction with windows closed. The issue is open windows. If windows which must be open for ventilation to satisfy Clause G.04 of the New Zealand Building Code face towards the Gun Club, compliance will not be achieved. Hence the need to review each dwelling to ensure this is not the case, and if it is, to install mechanical ventilation so those windows do not need to be opened.

4. *Is the internal noise requirement simply duplicating the requirements under the Building Act and if not what additional measures are needed to achieve the requirement? What additional build costs will this impose?(please only answer this last part about costs if you already have some idea – you don't need to do a whole heap more work to find an answer to this) You might need to get your acoustic expert to provide this.*

   See above. The NZTA document *State Highway guide to acoustic treatment of buildings* provides an indicative cost of $1000 - $10,000 per household (2011 costs) for various ventilation systems, depending on the situation and system selection. As the requirement here would only apply to habitable spaces which are not bedrooms, and which have opening windows orientated towards the gun club, costs may be at the lower end of this range.

Please do not hesitate to contact us to discuss further as required.

Kind Regards,

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Acoustic Engineering Services

15 July 2016