Before the Hearing Panel
Appointed by the Central Otago District Council

Under	The Resource Management Act 1991
In the matter of	Private Plan Change 14 to the Central Otago District Plan

Evidence of Darran Humpheson

13 May 2020

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Introduction

1 My full name is Darran Humpheson.

2 I am a Senior Acoustics Specialist at Tonkin & Taylor Ltd (**T+T**).

3 I hold a Bachelor of Science degree with Honours in Applied Physics and a Master of Science degree in Environmental Acoustics. I am a Member of the Acoustical Society of New Zealand and a Member of the United Kingdom's Institute of Acoustics. I am a New Zealand representative of the International Standards Organisation (**ISO**) technical committee ISO/TC 43 SC1 "Noise".

4 I have been employed in acoustics since 1991, and I have previously held positions as a consultant for international firms AECOM (Associate Director 2013-2019), Bureau Veritas (Technical Director 2012-2013), RPS Group plc (Technical Director 2002-2012) and as a UK Ministry of Defence scientist working with the Royal Air Force (Head of the RAF's Noise and Vibration Division 1991-2002). I specialise in environmental noise.

5 I have been engaged by New Zealand Cherry Corp (Leyser) Ltd (**NZ Cherry Corp**) to provide acoustic expertise as to noise effects from horticultural activities and reverse sensitivity effects from Plan Change 14 (**PC14**). I have visited the PC14 site (also referred to as Shannon Farm) and I prepared the T+T 'PC14 noise assessment' report dated 15 April 2020.

6 I have previously undertaken noise assessment work for horticulture activities. I am currently providing noise expertise on reverse sensitivity effects from frost fans used on viticulture sites in nearby Gibbston Valley.

7 In preparing this statement of evidence I have considered the following documents:

(a) Town Planning Group 'Request for a change to the operative Central Otago District Plan (28 May 2019);

(b) T+T PC14 noise assessment (the **Report**);

(c) submissions[1]; and

(d) section 42A report.

[1] CODC, PC14 Summary of decisions requested in submissions, January 2020.

Code of Conduct for Expert Witnesses

8 While this is not a hearing before the Environment Court, I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court of New Zealand Practice Note 2014 and that I have complied with it when preparing my evidence. Other than when I state I am relying on the advice of another person, this evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Scope of evidence

9 My evidence describes:

(a) my involvement and role in PC14, including the preparation of the noise assessment;

(b) the noise characteristics of horticultural activities in the Ripponvale area and the measures that NZ Cherry Corp will adopt to address reverse sensitivity effects;

(c) my response to acoustic issues raised by the submissions;

(d) my response to the S42A report of Central Otago District Council's (CODC) planning officer; and

(e) conclusion.

Executive summary

10 I have been engaged by NZ Cherry Corp to assess noise effects from horticultural activities and reverse sensitivity effects from PC14. I am the author of the T+T 'PC14 noise assessment' report dated 15 April 2020 and I have visited the site.

11 Potential noise effects arise from the four most dominant sources of horticulture noise:

(a) frost fans operate during critical frost conditions, which is a seasonal occurrence typically during the early morning period from September to November. Fans will operate until the risk of frost damage has diminished which can mean that fans operate on average for around 5 to 7.5 hours at a time[2];

[2] Data from NZ Cherry Corp

(b) helicopters are used for drying fruit to prevent the fruit swelling and splitting after rain. Helicopters are used during mid-December to end January and from 6 am / sunrise for on average 30 minutes to 2 hours[3]. Helicopters can also be used for frost protection but the closest orchards to the site, including NZ Cherry Corp, do not use helicopters for fighting frost;

(c) audible bird scaring devices, such as gas guns and shot guns, are used during December to January and from dawn until to sunset when fruit is ripening. These devices can operate regularly during the day. The closest orchards to the site, including NZ Cherry Corp, use anti-bird netting for protection and audible deterrents are not used. The nearest orchard that potentially uses audible deterrents is at least 500 m to the south of the PC14 sites as their trees are currently not netted; and

(d) tractors and fan sprayers are used for spraying cherry trees and vines throughout the year. Spraying typically occurs during calm conditions and from sunrise. This activity occurs on all sites, including NZ Cherry Corp.

12 I have assessed the noise from each noise source and considered the magnitude of the noise that will be experienced within the future rural lifestyle areas of Shannon Farm along with the character of the noise generated by each source, the time of day that the noise will be generated and whether future residents are likely to be indoors or outdoors, and the effectiveness of different mitigation measures. I have also considered the proximity of each noise source to the site as sound levels will reduce with distance.

13 As part of the NZ Cherry Corp orchard expansion, four Frost Boss 5-bladed frost fans will be installed. These fans are some of the quietest units currently available and they do not attract a special audible characteristic penalty as required by New Zealand Standard 6802:2008. The location of these fans has also been considered in terms of their noise generation and appropriate setbacks have been specified from the western and southern boundaries of the orchard expansion area. Accordingly, there will be no adverse effects generated by these new fans on existing noise sensitive locations that neighbour the cherry farm expansion.

14 To address potential reverse sensitivity effects when frost fans and helicopters operate, the sound insulation of the future dwellings will be designed to achieve minimum performance requirements. This will depend upon the distance from each boundary, with mechanical ventilation and comfort cooling required in some instances. These sound insulation requirements provide a higher level of amenity than if a dwelling was constructed to the minimum standards of the Building

[3] Data from NZ Cherry Corp

Code. The sound insulation will also reduce internal noise levels for residents when other orchard and viticulture activities take place, for example vehicle movements and spraying.

15 Further mitigation can include future residents designing the layout of their dwellings such that outdoor amenity spaces are positioned in a northerly direction. This will assist with shielding these areas from sources of noise, which are predominantly in a southerly direction during daytime amenity hours.

16 By including these control measures, residential amenity of both future occupiers and existing properties will be protected such that adverse noise effects will be appropriately managed and reverse sensitivity effects mitigated.

Involvement

17 I was engaged by NZ Cherry Corp in February 2020 and I visited the existing cherry orchard and wider Ripponvale area over a period of two days in early March 2020. I met with Mr Ricky Larsen and was provided with a tour of the orchard and shown the extension to the existing cherry orchard. I also undertook observations in the wider area, including existing horticulture activities at other orchard sites. The on-site meeting and subsequent conversations with NZ Cherry Corp informed my assessment of noise.

18 I prepared the Report which addresses the noise effects associated with PC14 from existing sources of noise generation in the local area and from future PC14 land uses, including reverse sensitivity.

Noise emissions and controls

19 Cherry growing is the main horticultural land use surrounding the PC14 site and is located on parts of the southern and eastern boundaries of the site. In my Report I describe the local area, including the results of an ambient sound level survey that was undertaken during my site visit. I consider the general noise environment to be representative of an active rural area with passing road traffic audible from both the State Highway and local traffic on Ripponvale Road.

20 Sources of local horticultural noise include the sound generated by frost fans, helicopters used for drying fruit or frost fighting, audible bird scaring devices and tractors used for spraying, as well as other minor activities such as pruning, irrigation and vehicle movements. Not all orchards and vineyards use the above equipment. For example, NZ Cherry Corp has four existing frost fans and helicopters are not used for frost fighting. Similarly, they do not use audible bird scaring devices as their orchard is protected by anti-bird netting. Some orchards rely on a combination of controls, for example 45 South uses both netting and audible devices to protect against bird damage. I understand that helicopters are

rarely used for frost fighting as it is an inefficient method and may result in tree damage caused by the helicopter's downdraught.

21 The above noise sources generally operate at different times of the year according to the growing season, as shown in Table 1.

Table 1 : Operating periods of orchard activities

Activity	Months	Time period	Regularity	Activity in proximity to site
Frost protection (frost fans or helicopters)	September to November	Typically from 4 am but can be earlier and later depending upon the severity of the frost	20 occasions (based on 2018 and 2019 NZ Cherry Corp data) – on average 5 to 7.5 hours per fan	Four frost fans proposed on orchard extension, existing fans at 109 and 156 Ripponvale Road. No helicopters for frost protection
Fruit drying (helicopters)	Mid-December to end January	Typically from 6 am - sunrise	8-12 occasions for 30 minutes to 2 hours (NZ Cherry Corp data)	At NZ Cherry Corp and other adjacent properties
Audible bird scaring devices	December to January	From dawn to sunset	When fruit is ripening and regular during the day	Not used at adjacent properties
Spraying	Most of the year – more intense November to January	From sunrise	~2 hours	Occurs at adjacent properties

22 PC14 is located within a Rural Resource Area of the Central Otago District Plan (**CODP**) and horticulture activities are a feature of the local environment and soundscape[4]. The CODP includes the following policy (4.4.9) [my emphasis added]:

> To recognise that some rural activities, particularly those of a short duration or seasonal nature, often generate noise and other effects that can disturb neighbours by ensuring that **new developments locating near such activities recognise and accept the prevailing environmental characteristics associated with production and other activities found in the Rural Resource Area**.

23 There will be an expectation that future occupiers of Shannon Farm will be fully aware that the Ripponvale area is known for horticulture activities and that noise associated with these activities is to be expected. Notwithstanding this statement, effects of noise on Shannon Farm residents and reverse sensitivity effects on NZ Cherry Corp and third-party land will be managed through a combination of:

[4] The acoustic environment as perceived by individuals.

(a) setbacks (between frost fans and dwellings);

(b) location and design of frost fans in the cherry orchard expansion; and

(c) sound insulation of the new dwellings.

24 I will now consider each source of noise and how NZ Cherry Corp will implement the above control measures to manage reverse sensitivity effects.

Frost fans

25 I have considered the combined effect of both existing frost fans and additional frost fans to be installed in the cherry orchard extension on:

(a) existing dwellings in the surrounding area; and

(b) future residents within the PC14 site.

26 I address whether existing and additional frost fans will comply with CODP rules, and whether noise levels experienced by residents will be in accordance with World Health Organisation's (**WHO**) recommendations.

Frost fan operation

27 Frost fans will operate continuously during the growing season when there is a critical frost event. The number of fans blades varies depending upon the manufacturer and/or model type and most of the noise is aerodynamically generated by the rotation of the fans. There is a minor contribution from the diesel engine and gearbox system which are located at the base of the fan tower. Frost fans rotate 360° around the hub to provide coverage across the orchard or vineyard, therefore the sound level fluctuates depending upon the orientation of the blades to the receiving location.

28 Not all frost fans generate the same level of sound or have the same character. Fans with multiple blades are generally quieter than 2-bladed models and less tonal and impulsive[5]. As are blades which are aerodynamically efficient compared to relatively flat and less angular (curved) blades. The sound level produced is therefore a function of the number of blades, the number of revolutions per minute and the efficiency of the blades. In my Report there is a table of sound level data (Table 3.1) which illustrates that the sound levels of different models of frost fans can vary between 61 dB to 64 dB $L_{Aeq(15min)}$ (62 to 66 dB L_{A10}) at a distance of 100 metres.

[5] Impulsive refers to the whack or blade slap which can occur with certain fan types. Blade slap occurs due to a combination of the tip of the blade going supersonic and/or individual blades 'stalling' due to turbulent wake effects.

29 Mr Larsen of NZ Cherry Corp has advised me that four Frost Boss C59 5-bladed fans will be installed as part of the orchard expansion. The Frost Boss C59 fans have a lower overall sound level than other fans currently installed in the local area and have been chosen based on their noise characteristics.

CODP compliance

30 In the CODP, Rule 4.7.6E (noise) the general noise limits do not apply to devices the protect crops from frost. Part (c) of the rule provides specific controls on wind machines for frost control, including an upper cap on the noise that a frost fan should generate. At a distance of 300 metres the sound level from a frost fan shall not exceed 65 dB L_{A10} provided that the frost fan is located no closer than 300 metres to any Residential or Rural Settlement Resource Area, or within 100 metres of a dwelling house not located on the property.

31 At 300 metres from any of the frost fans in the Ripponvale area, the sound level will be approximately 52 to 54 dB L_{A10}, which is substantially less that that allowed for in the CODP. To place this into context, 65 dB L_{A10} at 300 metres would be the equivalent to ~75 dB L_{A10} at 100 metres from an operating frost fan, i.e. at least 10 dB more permissive than the fans currently installed both within the NZ Cherry Corp and neighbouring orchards.

32 The nearest existing frost fan to the PC14 site boundary is the 4-bladed fan unit on the Jakimm Orchard, which is approximately 80 metres from the PC14 site boundary. In this location there will be a 25 metre zone boundary setback (RLA4). Therefore the closest a dwelling could be to the nearest fan is 105 metres. The sound level generated by this fan is 65 dB L_{A10} at 100 metres. Accordingly, development of dwellings within the PC14 site will not result in this, or any other, existing frost fan on third party land becoming non-compliant with the CODP frost fan standard (Rule 4.7.6E part c).

33 The location of the new 5-bladed fans will be more than 100 metres to the Ripponvale Road boundary and over 100 metres to the boundary of the orchard expansion and rural lifestyle allotment areas (when combined with setback distances in paragraph 47 below), which is compliant with the CODP frost fan standard.

Noise effects

34 In addition to addressing CODP compliance for frost fans, I have also assessed and proposed measures to ensure that noise levels experienced at existing dwellings and within Shannon Farm meet the WHO recommendations for internal living and resting (bedroom) environments.

35 I have modelled the four new proposed fans and existing fans across all orchard sites and the results are detailed in Table 7.1 of the Report. A maximum sound level of 61 dB $L_{Aeq(15\ min)}$, which is equivalent to 63 dB $L_{A10(15\ min)}$, is predicted to occur at an existing dwelling. The four additional fans contribute less than 1 dB increase in the overall sound level at existing dwellings when frost fans operate.

36 Residents will be indoors and typically asleep when frost fans operate. For that reason, preserving sleep quality and indoor amenity is critical to ensure that reverse sensitivity effects do not occur. Within Shannon Farm, a combination of setback distances, fan choice (see above) and the sound insulation requirements of the dwellings (principally the bedrooms) will assist in minimising sleep disturbance effects. Setback and insulation requirements are addressed in detail in the control measures section of my evidence below, but in summary these will ensure that all new dwellings within the Shannon Farm development achieve indoor noise levels below the WHO's 30 dB L_{Aeq} guideline level while frost fans are operating. I note that the control measures required to address helicopter activity are greater than those that would otherwise be required to address frost fans. As a result, the control measures proposed will provide a very high level of mitigation in relation to frost fans.

Helicopters

37 Helicopters may be used in two situations:

(a) for drying fruit – over the NZ Cherry Corp orchard and other properties in the Ripponvale area; and

(b) for frost protection – helicopters are not used for frost fighting over the NZ Cherry Corp orchard, but may be used on other properties.

Helicopter operations

38 NZ Cherry Corp uses helicopters for drying fruit when there has been overnight rain and the air temperature is rising (typically around sunrise). To prevent the fruit swelling, helicopters overfly the orchard and their downdraught "blow dries" the fruit. A helicopter will fly along each row at a height of approximately 15 metres and will travel at approximately 15 knots (~28 km/h). Helicopters are only used during the fruit harvest season (mid-December to end of January). Helicopters are used infrequently and NZ Cherry Corp advises that helicopters are needed for approximately 8-12 days per year. I understand that other properties in the Ripponvale area may use helicopters for fruit drying in a similar way to NZ Cherry Corp.

Noise effects

39 Unlike frost fans, helicopters will traverse the orchards and the noise generated will fluctuate depending upon their location relative to the receiver, with the highest sound levels being experienced offsite as the helicopter overflys the orchard trees along the southern and western boundaries of the NZ Cherry Corp site. Previously, I have recorded sound levels in the order of 75 to 80 dB L_{Aeq} at 100 metres from a helicopter and maximum levels of 75 to 80 dB L_{Amax} at 250 metres. Table 7.3 of the Report provides predicted sound levels at existing dwellings, which will range from 42 – 58 dB L_{Aeq}. Sound levels will range from 41 to 63 dB L_{Aeq} within the Shannon Farm site when helicopters operate on the orchard extension.

40 Helicopters used for drying fruit will operate in the summer months and typically after sunrise (6 am) for between 30 minutes to 2 hours. Residents are likely to be indoors and may have bedroom windows open when helicopters operate. To address reverse sensitivity effects, sound insulation of dwellings is required to preserve the quality of indoor noise amenity. Windows would have to be closed, which will, for some dwellings, require the addition of mechanical ventilation to ensure that adequate air changes occur.

41 I understand that helicopters are rarely used for frost fighting on other properties. However, to address the potential that this may occur, similar control measures should be adopted, noting that it is expected that residents will have windows closed when helicopters are used for frost fighting.

Bird scaring devices

42 Audible bird scaring devices are used by some orchards in the Ripponvale area although they are not used on the NZ Cherry Corp site and it is understood from Mr Larsen that the three adjacent orchards to the PC14 site do not use audible bird scaring devices either. The nearest potential orchard that may use these audible devices is approximately 500 to 600 metres from the PC14 boundary along Ripponvale Road, with 45 South being the primary user of bird scaring devices at over 1 kilometre to the south of the site.

Noise effects

43 Audible devices can operate at any time and external sound levels will be in the order of 60 to 65 dB L_{Ae} at approximately 500 to 600 metres from a gas powered Vinetech bird scarer. Given this spatial separation and likely level of noise (less than 65 dB L_{Ae}), operation of audible bird scaring devices would be 'compliant' with the CODP noise rule at PC14 (Rule 4.7.6E part b).

44 Again, similar control measures, as proposed for frost fans and helicopters, will be appropriate for managing reverse sensitivity effects from audible bird scaring devices.

Other sources

45 The noise that will be experienced from other sources of horticulture noise will be significantly less than that generated by the three main sources I have described above. Spraying may have the potential to generate high levels of localised noise around the perimeter of the orchards, but again similar controls measures as I will outline in the next section will address any reverse sensitivity effects.

Control measures

46 The proposed rural lifestyle development area of Shannon Farm will experience noise from a variety of sources; with frost fans, helicopters and audible bird scaring devices being the most dominant. Each of these will operate at different times and it is unlikely that they will occur cumulatively. Sound levels will be experienced both internally within the dwellings and externally within outdoor amenity spaces depending upon when the noise occurs (both seasonally and time of day).

47 I have already stated that as part of the NZ Cherry Corp expansion four new frost fans will be installed. NZ Cherry Corp proposes to install the quiet Frost Boss C59 5-bladed frost fan and that the setback distance to any dwelling (existing and new) will be over 100 metres. These two measures will address in part possible adverse noise effects.

48 In addition to the setback distances to the new frost fans, I understand that the following setback distances from the Shannon Farm site boundary to buildings in the rural lifestyle development will be achieved under the proposed rules:

(a) adjacent to the cherry orchard extension, in the RL3 area - 21 metres;

(b) adjacent to the cherry orchard extension, in the RL1, 2 and 4 areas - 25 metres;

(c) adjacent to Ripponvale Road – 30 metres from road boundary; and

(d) adjacent to 146 Ripponvale Road in the RL4 area – 30 metres from property boundary (increased from the 25 metres proposed in the PC14 Request).

49 Although these buffer distances are the minimum distance from the boundary to where a building could be located, they do not necessarily mean that a dwelling will be constructed at these distances.

50 The use of setback distances and the sound insulation of dwellings are effective measures to reduce the potential effects of reverse sensitivity. They apply to many different sources of environmental noise such as road traffic on state highways and airport noise. The design of the building is also an important design feature, for example orientating noise sensitive spaces away from the noise source and I understand that a design guide for PC14 may consider locating primary outdoor amenity spaces by positioning these spaces in a northerly orientation.

51 To ensure a good internal noise environment within the PC14 dwellings, the internal sound level, as recommended by the WHO, within living areas should be no greater than 40 dB L_{Aeq} and within bedrooms, no greater than 30 dB L_{Aeq}. These performance standards cannot be achieved for those dwellings within approximately 350 metres of the orchard expansion if residents choose to have windows open for ventilation or cooling when frost fans or helicopters are operating. While it is unlikely that residents would have windows open when frost fighting occurs, this may be the case during the limited occasions when helicopters are used for drying fruit. In this situation an alternative means of ventilation is required to minimise the need to open windows for summer cooling and ventilation.

52 To protect future occupiers of the rural lifestyle dwellings and to achieve the internal sound levels set out above, the following sound insulation and ventilation standards should be incorporated into the future district plan noise rules for the PC14 site:

(a) at distances less than 200 metres from the PC14 orchard extension site boundary the sound insulation of habitable spaces should achieve 40 dB Rw+Ctr with the addition of mechanical ventilation to bedroom spaces;

(b) at distances between 200 metres and 350 metres from the PC14 orchard extension site boundary and at distances less than 250 metres from the Ripponvale Road site boundary the sound insulation of habitable spaces should achieve 35 dB Rw+Ctr with the addition of mechanical ventilation to bedroom spaces; and

(c) at distances greater than 350 metres from the PC14 orchard extension site boundary and at distances greater than 250 metres from the Ripponvale Road site boundary the sound insulation of habitable spaces should achieve 30 dB Rw+Ctr.

53 The spatial application of these requirements is shown on the plan in Figure 1 below.

54 The windows of a typical new build dwelling are the weak point of the building envelope. To achieve better than 30 dB Rw+Ctr requires the fitment of acoustic glazing which typically comprises a thermally insulated glazing unit fitted with a combination of heavy glass (greater than 6 mm in thickness) and/or laminated glass. The exact glazing makeup will vary between manufacturers.

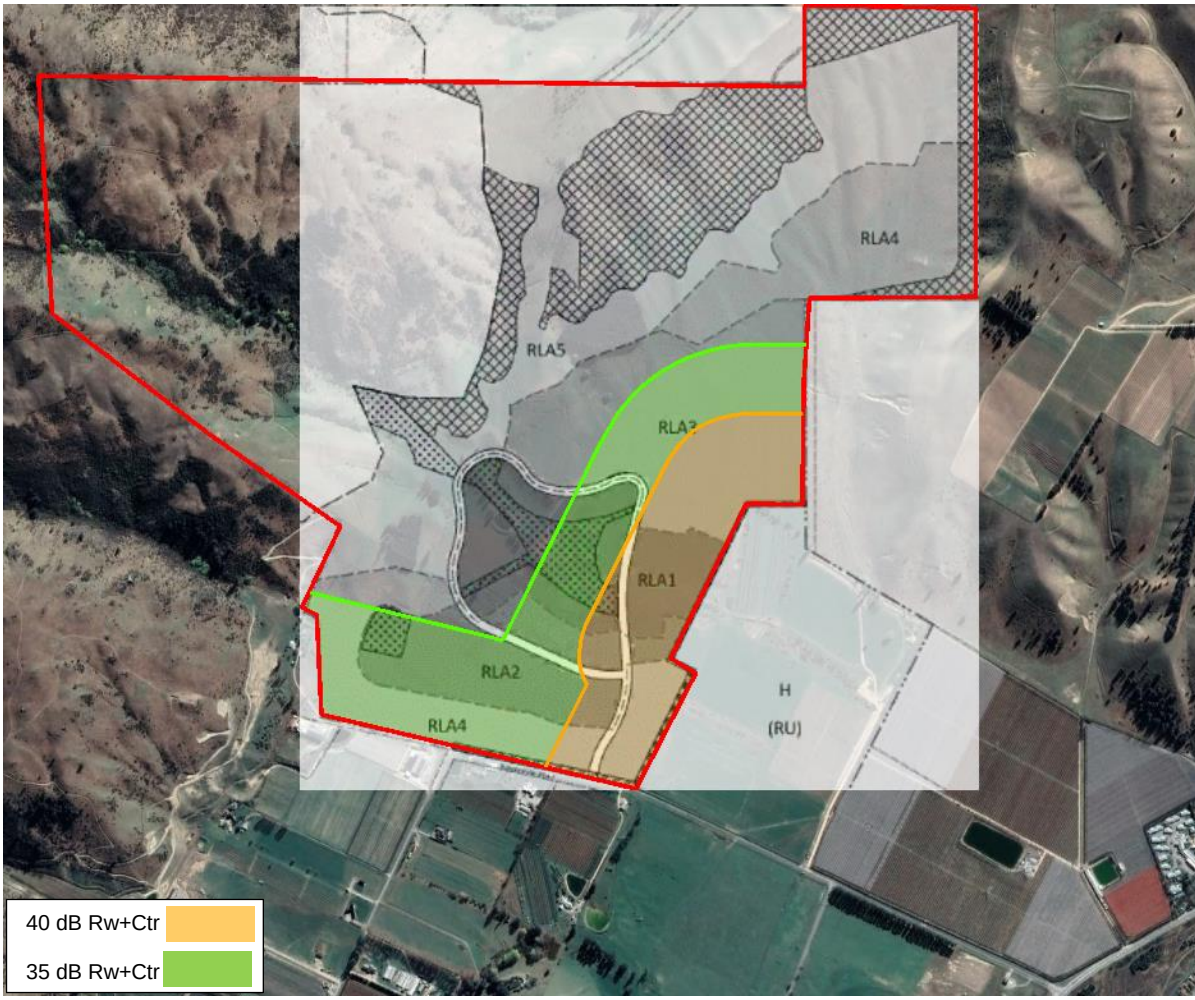

Figure 1: PC14 Structure Plan with sound insulation zones highlighted

Submissions

55 I have reviewed the Council's summary of submissions document, which was prepared in January 2020, i.e. prior to my involvement with PC14. Many of the submissions mention that reverse sensitivity effects had not been adequately assessed and likewise mitigation measures to address reverse sensitivity effects have not been adequately identified or assessed.

56 Rather than addressing each submission individually, I have reviewed the submissions which raise noise and reverse sensitivity effects. The noise assessment Report that I prepared address concerns:

(a) by assessing noise from horticulture activities in the Ripponvale area, including noise from the NZ Cherry Corp orchard expansion; and

(b) identifies appropriate mitigation measures to address noise and reverse sensitivity effects as part of PC14.

57 One of the submissions requests that no complaint covenants are included to protect existing agriculture activities. I do not consider that this is necessary as the control measures I have outlined above will ensure that future residents are protected from adverse noise effects.

Section 42A report

58 I have read the S42A report that has been prepared by Mr David Whitney on behalf of CODC. I understand that the noise section of the report (Section 8.5.1) was written by Mr Whitney and that a noise expert was not engaged by Council.

59 The S42A reports identifies that several submitters, who live at Letts Gully and O'Neill Lane near Alexandra, have referred to their experience living near existing cherry growing areas. Due to concerns of excessive noise from frost fans, CODC commissioned acoustic advice from Novo Group with respect to noise from a cherry orchard operating at 91 Rock View Road, Alexandra. An initial report was prepared by Novo Group, dated 17 October 2019 and an addendum prepared on 7 November 2019. The Addendum concluded that:[6]

> … the current noise effect from the Leaning Rock Cherries Ltd frost fans in terms of the RMA section 16 is unreasonable due to the calculated exceedance of the World Health Organisation's indoor level guideline for bedrooms…

60 This conclusion is reached after the Addendum reconsidered the applicability of special audible characteristics (**SAC**), which is the addition of a +5 dB penalty for tonality and impulsivity or other noticeable features of a noise source. The S42A report notes that:[7]

> While the Letts Gully/O'Neill Lane example and Novo reports relating to that situation are not directly applicable to the frost fans proposed at the [PC14] site…; they do highlight the difficulties that can arise with respect to noise and reverse sensitivity effects.

61 The Novo Group main report identifies that there are 2 and 3 bladed fans at Leaning Rock Cherries Ltd and based on information from another assessment

[6] Alexandra Frost Fan: 91 Rock View Road, Alexandra Noise Assessment Addendum, Novo Group, 7 November 2019, at [8].

[7] Section 42A Report, at p 37.

conducted in Marlborough by another acoustic consultant (Malcolm Hunt Associates), Novo Group reach the conclusion that all frost fans require the application of a SAC correction. Modern frost fans, which include the 5-bladed Frost Boss C59 model, have been designed to minimise:

(a) the dominance of the blade passing frequency (derived from the rotational speed of the fan and the number of fan blades) (tonality);

(b) the effects of adverse turbulence being created which can cause blade slap (impulsivity); and

(c) overall noise levels by being aerodynamically more efficient, i.e. they require less power whilst performing similar, if not better, than flat bladed fans.

62 The Hegley Report dated June 2015, that I rely on for the source sound levels from the Frost Boss C59 fan, states that:

> there is no tonal characteristic to the sound that warrants an adjustment to the measurements. In addition, there are no other characteristics, such as whacking sound [blade slap] often associated with frost fans, which would attract a 5dB penalty due to special audible characteristic to the sound.

63 Accordingly, the new frost fans proposed for the NZ Cherry Corp extension will not require the application of a SAC correction.

64 The closest frost fans to the PC14 site are the proposed NZ Cherry Corp fans and the 4-bladed fans on the two closest sites (109 and 156 Ripponvale Road). Four bladed frost fans similarly do not require the application of SAC[8].

65 I am aware that older 2 and 3-bladed fans require the application of a SAC correction due to the inefficient design of the blades and higher rotational fan speed. While there are 2-bladed fans on other orchard sites at greater distance from the PC14 site, only the closest 4 and 5-bladed fans will dominate the local frost fan noise environment. This can be seen from Figure 7.2 of my Report. Hence, there is no need to apply a SAC correction.

66 The Novo Group report considered that frost fan noise at the Alexandra orchard was unreasonable due to the calculated exceedance of the WHO indoor level guideline for bedrooms. Unlike the dwellings in Alexandra, and notwithstanding

[8] Hegley Acoustic Consultants, Frost Boss C49 Frost Fan Field Testing Report dated September 2010. Conclusion states *'Based on field testing there are no special audible characteristics to the frost fan noise'*. As the Defender 4 blade frost fans are of a similar design to the C49 model, I have assumed that the Defender frost fans also does not generate SAC.

that a SAC correction is not required, the sound insulation performance of the Shannon Farm dwellings will ensure that indoor sound levels will be less than 30 dB L_{Aeq}, which is the guideline level recommended by the WHO.

67 The S42A report states that noise effects and potential reverse sensitivity effects associated with the Rockburn Winery have not been assessed. The S42A report notes that the submission raises concerns that during the vintage, trucks and heavy machinery must access the winery at all hours of the night. I have considered the effects of orchards and viticulture activities in my Report. Whilst not specifically identifying individual sites, the potential for adverse noise generation from sites neighbouring PC14 has been considered. In the case of Rockburn Winery, there will be day time and night time noise generated. At night (as raised in the submission) there is the potential for sleep disturbance. In developing the sound insulation performance requirements of the future dwellings I have considered the required level of sound insulation along the western area of Shannon Farm and a sound insulation standard of 30 dB Rw + Ctr would be appropriate to protect future residents at night.

68 The S42A report (page 38) states that there is a discrepancy between the hours of operation for the frost fans referred to in Section 3.1.1 of the Report. Frost fans operate when there is a critical frost and the trees/vines are susceptible to damage. Frost fans do not operate every night and will vary between seasons. The duration of a frost will vary depending upon weather conditions, especially when conditions are relatively calm, and operation within the period of 4am – 6am is particularly common. NZ Cherry Corp informed me that frost fans will operate on average between 5 to 7.5 hours. The proposed mitigation measures appropriately address this anticipated frost fan operation.

Conclusion

69 I confirm my conclusions at Section 8.0 of the Acoustic Assessment Report.

70 To address the noise when frost fans and helicopters operate, the sound insulation of the future dwellings will be designed to achieve minimum specified acoustic requirements (with mechanical ventilation and comfort cooling required in some instances) depending upon the distance from each boundary. These recommendations also address the concerns of several submitters who have raised concerns regarding reverse sensitivity effects from existing horticultural activities on future residents of Shannon Farm

71 I have also addressed the comments raised in the Section 42A report by Mr Whitney. Unlike the issues raised in the Alexandra example which he cites, frost fans will not create special audible characteristics and the sound insulation requirements of the Shannon Farm dwellings will be enhanced such that when frost fans operate internal sound levels will be lower than the guideline standard

of the WHO for bedrooms. This enhancement will protect occupiers from adverse noise from horticulture activities and will mitigate reverse sensitivity issues.

Dated this day 13 May 2020

Darran Humpheson