BEFORE THE CENTRAL OTAGO DISTRICT COUNCIL

Under	**the Resource Management Act 1991**
And	
In the matter of	**a submission on proposed Plan Change 18: Cromwell Industrial Expansion, to the Central Otago District Plan**

Evidence of Warren Guy Hill Chinn

on behalf of the Director-General of Conservation *Tumuaki Ahurei*

Submitter No. 8

Chafer Beetle Nature Reserve

Dated: 23 June 2023

Department of Conservation | *Te Papa Atawhai*
Private Bag 4715
Christchurch Mail Centre
Christchurch 8140
Solicitor rōia: Pene Williams
Phone waea: 0274083324
Email īmera: pwilliams@doc.govt.nz

Table of Contents

Executive Summary

1. The Director General (D-G) of the Department of Conservation has submitted on the Central Otago District Council's Plan Change-18 proposal. The proposal seeks to re-zone a parcel of land between the existing industrial area of Cromwell and the Cromwell Chafer beetle reserve. The D-G does not oppose the change but has presented a case for a 25-metre-wide buffer to be considered for the north eastern boundary of the chafer beetle reserve.

2. I have provided ecological evidence in general support for the D-G's submission. My evidence summarises ecological and conservation aspects of the Cromwell chafer beetle (*Prodontria lewisi*). The beetle is a threatened species (Nationally Endangered) and is only found in the 81 hectare reserve. The reserve was established in 1982 specifically for the protection of the last known chafer beetle population.

3. The chafer beetle continues to face several threats to its survival. Condition and quality of habitat is an important aspect of the reserve management. The reserve has specific physical characteristics which the beetle requires for larval and adult survival. Although the shape of the reserve is sub-optimal, its total area is probably a major factor in beetle survival. This is because the edge-to-core relationship is important.

4. My evidence presents a case for establishing an ecological buffer between the north eastern boundary of the reserve and lands proposed for re-zoning. Ideas for the design of the buffer are presented. Ideally the maximum desirable width of a buffer would be up to 40 metres.

Introduction

1. My full name is Warren Guy Hill Chinn.

2. I have been asked by the Director-General of Conservation Tumuaki Ahurei (Director-General, D-G) to provide expert evidence on proposed Plan Change 18 – Cromwell Industrial Extension (PC18) to the Central Otago District Plan (CODP, Plan).

Qualifications and experience

3. I am employed by the Department of Conservation (DOC) as a technical advisor specialising in terrestrial ecology and invertebrate conservation. I am based in the Wanaka DOC office although I am part of a nationally distributed science and technical group.

4. I began my entomology career in 1992 with Agresearch, working on pasture pest insects including the grass grub. Following this, I was contracted by HortResearch to investigate pheromone control of orchard pest-insects. I then worked with Landcare Research in forest ecology and went on to a role at Lincoln University working on genetic identification of insect species for biosecurity. In 2005 I began terrestrial invertebrate surveys for DOC, primarily in the South Island high country. I have been in my current role since 2007. I have worked directly with the Cromwell chafer beetle within the reserve at Cromwell.

5. I have a Master of Science degree (1st class hons) in entomology from Canterbury University. I have published a range of scientific papers on New Zealand insects, specialising in biogeography, climate change and genetics. I have published in local and international journals. I have written many reports and local articles about invertebrate ecology.

Code of Conduct

6. I have read the code of conduct for expert witnesses as contained in the Environment Court's Practice Note 2023 (the Code). While this is not an Environment Court hearing, I have complied with the Code when preparing my written statement of evidence.

7. The data, information, facts and assumptions I have considered in forming my opinions are set out in my evidence to follow. The reasons for the opinions expressed are also set out in the evidence to follow.

8. Unless I state otherwise, this evidence is within my sphere of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Scope

9. I have been asked to provide evidence in relation to the notified PC18, the D-G's submission[1], and the section 42A report.

10. My evidence is divided into the following parts:

    (a) Introduction

    (b) The Cromwell Chafer beetle

    (c) Ecological context of the Cromwell Chafer Beetle Nature Reserve (CCBNR)

    (d) Ecological opportunities and matters relating to the proposed re-zoning of lands adjacent to the CCBNR

    (e) Potential solutions to the Director General's concerns

    (f) Conclusion

Material Considered

11. In preparing my evidence I have read and relied upon the following documents:

    (a) Explanatory Statement and Section 32 Report

    (b) The D-G's submission dated 9 December 2021

    (c) The evidence of my colleague Elizabeth Williams

    (d) A range of scientific papers and literature relating to the Cromwell Chafer beetle biology, material relating to the reserve establishment, DOC and Agresearch technical documents and reports, glaciological and climatological data (specifically NIWA's meteorological Cliflo data base) and my own files and information from working in the reserve.

[1] Submission on Plan Change 18 to the Central Otago District Plan dated 9 December 2021, submission no. 8.

Introduction

12. The Department of Conservation is an affected party to the Central Otago District Council (CODC) Plan Change 18 proposal. The plan change seeks to re-zone lands adjacent to the Cromwell chafer beetle reserve (Cromwell, Central Otago) from rural to industrial and to allow for subdivision and industrial activities to take place. The Director-General takes a neutral stance toward the re-zoning but has concerns for the long-term welfare of the beetle reserve, particularly along the north-eastern boundary. In my capacity as an invertebrate ecologist, I have prepared the following ecological evidence.

The Cromwell Chafer beetle

13. Chafer beetles are a common and widespread group of insects in the order Coleoptera, family Scarabaeidae. The term chafer refers to feeding damage on plant foliage caused by this group of beetles which are also called scarabs. New Zealand has at least 132 native species of chafer beetle and many of these are familiar to fisher folk and farmers as trout food or pasture pests (the green Manuka beetle and the grass grub are well known examples). Although many native chafer beetles are common, a small number are rare and threatened, primarily due to their large size, the inability to fly and their specific habitat requirements.

14. The Cromwell Chafer beetle (CCB) *Prodontria lewisi*, meets these rarity criteria and has been designated as a Nationally Endangered species by the Department of Conservation (Figure 1). The CCB has also been ranked a ‘Category A’ species – having the highest priority for conservation action. Today, the beetle population faces biotic and abiotic threats to its survival. It is both ironic and biologically informative that many other native New Zealand scarabs are so common and widespread that they are considered pests.

15. The genus *Prodontria* is endemic to the southern South Island with 16 recognised species from the Mackenzie Basin to Stewart Island with Central Otago a species stronghold. Nevertheless, it appears that the CCB is the only species of *Prodontria* with one population reduced to a single location and having strict ecological requirements. In its current form, the CCB has been entirely confined to the Cromwell district since diverging from its last common ancestor.

16. This situation is probably a function of evolutionary heritage, geomorphology and a coupling between the beetle’s ecological traits and landscape history (Watt 1979). Today, the CCB population exists on very old gravels filling a schist basin (a syncline

fold) between the Dunstan and Pisa ranges. Schist is high in quartz - a very hard mineral that remains long after the softer, metamorphic parent rock has eroded away. I will return to the physical characteristics of the reserve gravels in the next section.

17. The larval stage of the CCB lives underground for up to two years, illustrating how important the underground environment is for the population - particularly when compared to the short-lived adult (mating) phase which is surface-active at night. Similarly, the number of individuals available for breeding in any season, will be smaller again than the total population. These issues are accentuated as the reserve slowly drifts off an optimal habitat-peak for the beetle species.

18. Today, the CCB population faces a suite of ecological challenges, including (but not limited to); being naturally rare, of a small population size, being prone to a range of predators (hedgehogs, rodents, little owls, Red Back spiders and possibly cats), habitat stability (i.e. weed encroachment, competitive exclusion of the beetle's host plants by exotic weeds, substrate compaction, changes to soil hydrology) and larval diseases.

19. The Department is responsible for managing the CCB under the Reserves Act 1977 (Section 20) and Schedule 7 of the Wildlife Act 1957 in which *P. lewisi* is listed as a fully protected New Zealand animal. In conjunction with Agresearch, the Department carries out annual estimates of larval population size using a ground corer (behind a tractor). Larvae are recorded and returned to the ground. These data give a rough indication of the CCB population trend but considerable error exists and along with concerns about continually disturbing the habitat.

20. It is worth reminding ourselves why a beetle should receive such intense conservation action and indeed, a reserve of 81 hectares. Protecting and managing the CCB is part of a global enterprise to retain rare and threatened species and restore earth's dwindling biodiversity. Conservation biology calls on many sciences to sustain evolutionary processes which drive genetic, population, species and ecosystem diversity. Today, the CCB has the equivalent threat status of Kea, Kiwi, Rock Wren and other birds. The CCB is also an ambassador for all other indigenous beetle species in New Zealand.

Figure 1. *Prodontria lewisi* the Cromwell Chafer Beetle. Insert for scale.

Ecological context of the Cromwell Chafer Beetle Nature Reserve (CCBNR)

21. The current chafer beetle habitat is a triangular-shaped, 81ha reserve located to the south of Cromwell township (Figure 2). Gazetted in 1982, the intention was to provide indefinite habitat protection for the CCB and other natural history values within the area. At the time, the reserve was the first of its kind and has survived but is now showing an increase of exotic plants and new pests.

22. An important aspect of the reserve is substrate composition and the remnant native vegetation. The surface comprises thin loamy soils atop deep quartz sands and fine gravels. The latter were deposited as river-borne outwash gravels from the Northburn and Lowburn glacial advances, nearly one million years ago (during the early-to-mid Pleistocene epoch, Figure 3). Subsequent glacial advances never extended as far as during these early stadials (cooling periods) nevertheless, the outwash surfaces were exposed to peri-glacial conditions for long periods. This meant a cool, dry and windy environment for over 900,000 years during which further glacial cycles came and went. Warmer periods (inter stadials) saw the Clutha / Mata-au and Kawerau rivers down-cutting into their current (but now submerged) channels leaving the old outwash surfaces ‘high and dry’.

23. By the time today's Holocene-warming emerged, windy and semi-arid conditions induced an aeolian (wind-blown) environment of fine gravels and small dunes with mat forming plants, all of which the CCB adapted to, and exploited, for survival. The friable sands afford easy burrowing for larvae and adults, while the mat daisy *Raoulia australis* became an important larval food source. Since quartz is so hard, it takes considerable kinetic energy and time to erode into sand grains and these are invariably spherical or oblate – never flat and the result is a weak compaction of grains. These mechanical properties of the sand in the reserve are an important element of the CCB ecology and an on-going conservation management topic.

24. In addition to the CCB, the reserve supports many other indigenous invertebrates. These include the chunky sand scarab *Pericoptus frontalis*, other scarabs (grass grubs and *Odontria*), ground beetles, grasshoppers, crickets, tussock moths and butterflies, wolf spiders, trapdoor spiders among many others. Today the reserve is an ecological time capsule in a fast-changing landscape and will require continued human-assisted management if we are to maintain an early Holocene condition. Part of that management will be establishing insurance populations for the CCB elsewhere in the district.

25. The Department also maintains a comprehensive predator trapping regime around the periphery of the CCBNR (specifically for hedgehogs, stoats and possibly cats). Rabbits are also controlled by periodic raking of large Warrens, using trained ferrets to catch holed-up rabbits. Poisoning is also used against rabbits. A relatively recent and pernicious issue for the CCB has been the establishment of Australian Red-backed spiders in the reserve. A relative of the native Katipo spider, Red-Backs have been successful at occupying the portals of used rabbit burrows where they make loose webs and catch a wide range of invertebrate species including the CCB. Foot-crushing the rabbit burrow portals can reduce opportunities for the Red-Back spiders to establish however the problem will be an on-going management challenge.

Figure 2. Map of Cromwell Chafer Beetle Nature Reserve and the area proposed for plan change. Arrow is true north.

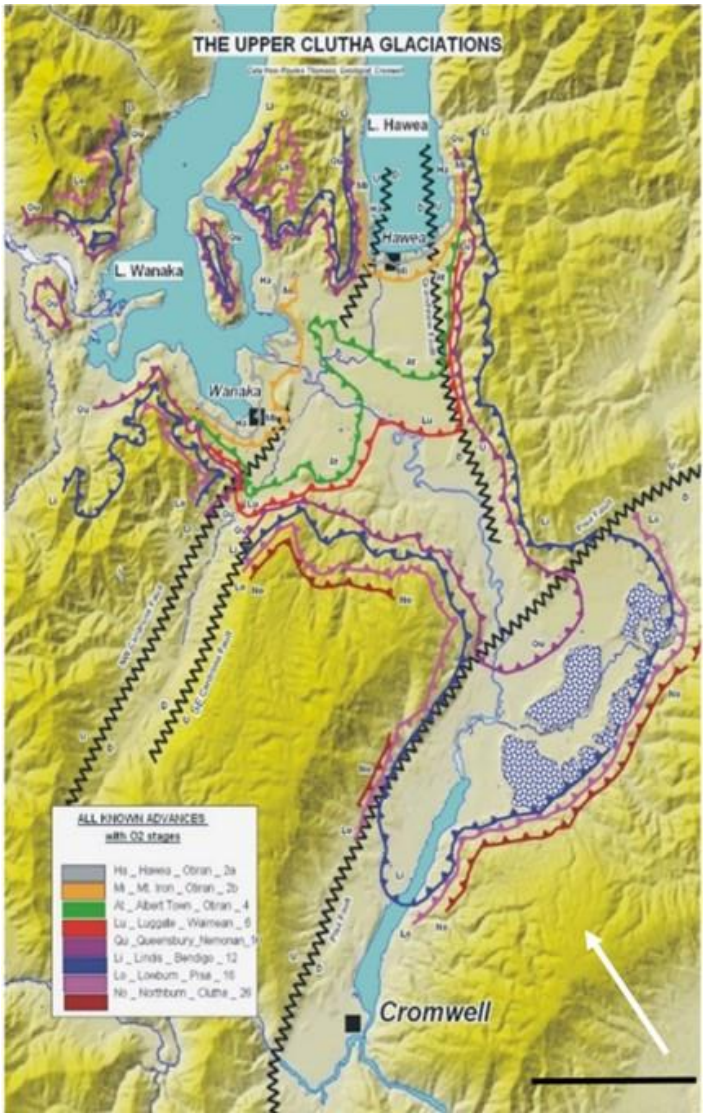

Figure 3. Map showing historical glaciations in the Clutha / Mata Au basin. Cromwell (and today's chafer reserve) were once very close to the terminus of the largest glacial advance (The Northburn), approximately 900,000 years before present. Arrow is true north. Scale bar = 10km.T. Chinn and R. Thompson 2018. Unpublished.

Edge effects and reserve shape

26. The edges of the CCBNR are an important part of the reserve management. Ecological communities usually show changes in species composition and abundance between the core and periphery of a habitat. Known as the edge effect, this transition is driven by an abrupt or subtle change in any number of environmental conditions that form an ecological boundary. In most cases there will be species that can tolerate the edge effect and these may differ markedly in character from the core species.

27. Edges can be high-risk environments for core populations, but they may also be a source of diversity and ecological resilience, depending on many factors. In general, a 'hard edge' (severe change) is a high-risk, high vulnerability environment and tends to be occupied by opportunistic, disturbance-adapted organisms – especially plants that we generally call weeds. The problem here is that these species tend to be more successful under stressful conditions and this creates a new peripheral community that further compromises the original core species. Ideally, reserves require 'soft edges' which provide an ecological buffer for core communities to persist. Currently, a noticeable strip of exotic weeds and grasses exists along most of the reserve boundaries, particularly the north-eastern boundary.

28. The ideal reserve shape for maximum community survival, is a large circle. This is because the ratio between the perimeter and the core is minimal, that is, most of the community is spaced well away from the edge. A low perimeter-to-area ratio (P/A) is desirable for a reserve while a high perimeter-to-area ratio is sub-optimal. Reserves with high P/A ratios would include narrow rectangles, or triangles specifically acute, right or scalene triangles. The Cromwell Chafer Reserve is strictly an irregular pentagon but on a large scale, it is an acute triangle (having three angle less than 90 degrees). This is not an optimal shape - but at least the reserve does exist.

29. The current area and perimeter of the CCBNR is 0.82 km^2 and 4.33 km respectively. This gives the reserve a perimeter-to-area ratio of 5.28:1 that is, there are 5.28 units of perimeter to one unit of reserve area. If we were to convert the reserve into a circle using the same area, we would get a perimeter length (circumference) of 3.21 km with a P/A of 3.91:1, considerably lower than the present CCBNR. Finally, the corners of the CCBNR represent long 'peninsulas' which have higher P/A ratios than the entire reserve, and reducing the ecologically effective area of the reserve. Collectively, these factors mean the reserve is ecologically smaller and more compromised than the calculated area and maintaining the best possible edge-scenario for the reserve is a high priority for the Department.

Ecological opportunities and matters relating to the proposed re-zoning of lands adjacent to the CCBNR

30. This section of my evidence discusses the potential negative and effects and positive opportunities of industrial development and activity adjacent to the north-eastern boundary of the CCBNR. The northern boundary of the CCBNR has a north-west/south east orientation of approximately 1.1 kms and is the shortest side of the reserve. The main concerns of the Department with the land re-zoning include:

Possible shading (or at least reduced direct sun light hours) along the reserve boundary, due to building height.

- A possible change to the surface and sub-surface hydrology along the boundary (due to modified run-off, channelling, piping etc).
- Light pollution which may have an effect on the nocturnal activity of the CCB.
- An increased risk of fire.
- The potential for new weeds to spread along the boundary and possibly into the reserve, from the boundary.
- An increase in pest animals and potentially new animal pests.
- The potential for more litter to arrive in the reserve (from new industrial activities neighbouring the reserve).
- A general increase in the probability of un-desirable human interaction and activity in the reserve.

31. On the other hand, the plan change offers an excellent opportunity to establish an ecologically improved buffer for the CCBNR than currently exists while enhancing awareness and the relationship between the community and the CCBNR. The next section provides a range of ideas and preferences for protecting the reserve within the proposed plan change.

Potential solutions to the Director-General's concerns

32. In my opinion establishing an ecological buffer (adjacent to the current north-east reserve boundary) is preferred. Ideally, the buffer could be planted in three strips of native vegetation as a species sequence from the current reserve fence-line to any industrial buildings. The buffer cross-section could include; The current reserve fence (necessary for reserve management), a strip of mat plants, a gravel foot track for public access and reserve observation (perhaps with interpretation information), a second strip of appropriate vegetation, a service access road and taller native shrub species against any industrial buildings. From my ecological point of view, the buffer would need to be no less than 30-40metres in width (Figure 4). I recommend this width as being sufficient to equilibrate hard edges between buildings and the reserve. Air movements, humidity, water run-off, sound and light pollution are more likely to dissipate across that distance coupled with the layering effect of vegetation. The goal is to produce the same microclimate either side of the reserve fence thus preventing a corridor of weeds and unsuitable beetle habitat.

33. Preventing artificial night lighting to illuminate any part of the reserve is also important for the CCB and other invertebrates (e.g. moths) that reside in the reserve. Some might argue this creates a security risk for the southern side of any local business premises, however such risks exist already in any town and are managed.

34. It would also be preferable for business adjacent to the reserve buffer be 'ecologically sensitive' – that is, to have a long-term neutral impact on the reserve. This might include a stipulation of no chemical or solvent use (particularly agrichemicals), no bright lighting, no atmospheric pollution, no industrial water, soil or organic material discharged into the buffer zone, minimal low-frequency sound and vibration output (no seismic activity) and a negligible heat profile (to prevent local air eddies). There may also be some ecological benefit to replicating, as close as possible, a similar albedo (reflectivity) to that of the reserve surface. The intention being to ameliorate air currents and light scatter across the reserve boundary.

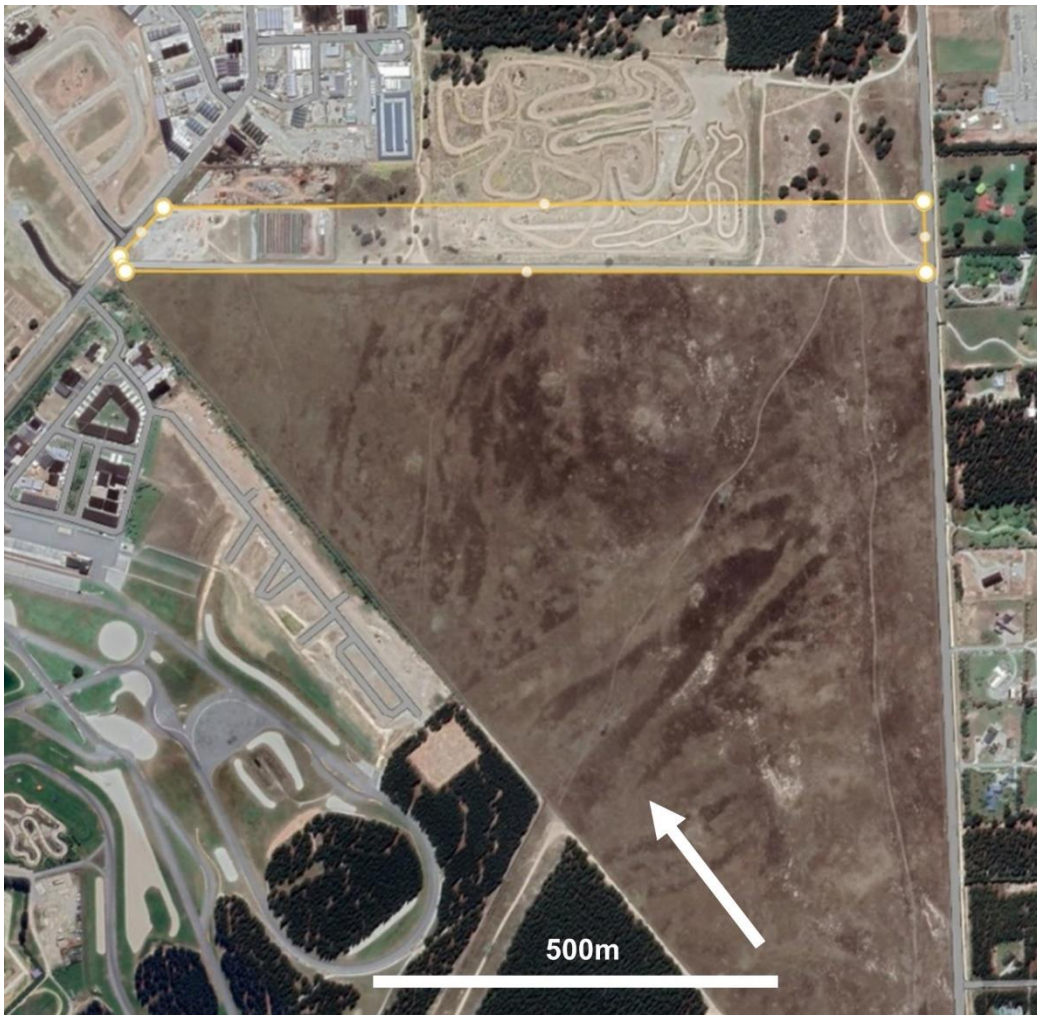

Figure 4. Image showing the ideal location and size of an ecological buffer for the north-eastern boundary of the Cromwell chafer beetle reserve. The yellow polygon is 40 meters across the shortest span. Arrow is true north.

The Director-General's Submission

35. D-G's submission opposed Plan Change 18 in part. Although the D-G was not opposed to the expansion of the industrial resource area the submission sought to limit industrial development adjacent to the CCBNR. The reasons given were the potential adverse effects on, and across, the reserve boundary.

36. The D-G's submission itemised potential effects on the reserve, including; modification of the microclimate as a function of shading and sheltering from buildings and structures. Wind direction and air currents are part of the microclimate. During the preparation of this evidence there has been general discussion of 'prevailing' winds at the CCBNR and that these will be affected by tall buildings and structures adjacent to the north boundary of the reserve. I have investigated available wind data for direction, speed and frequency at Cromwell and note that the average wind direction is from the south-east quarter not, as is often thought, the northwest. The key issue with buildings and tall structures (on the north-eastern boundary of the CCBNR) is shading of direct sunlight (winter and summer) on the reserve boundary. Shade retains ground moisture and alters soil and substrate density.

37. Artificial lighting was another concern, given that the chafer beetle is nocturnally active. As discussed in my evidence, I agree with this concern.

38. Changes to the local hydrology and the potential for weed incursion and establishment. I agree with these concerns, again covered in my evidence.

39. The potential for weeds and pests to encroach into the reserve as a result of industrial development, leading to an increase in management requirements for DOC at the reserve. I agree.

40. The D-G also sought a 25-metre-wide strip of land (a buffer) at the boundary with the reserve be removed from the proposed industrial zone for the purpose of avoiding cross boundary effects. Alternatively, it was recommended that a no-building restriction be provided to limit development close to the boundary of the reserve. I agree with these proposals however in my opinion, the buffer needs to be ideally a third wider again.

Conclusion

41. I consider that edge effects (on the north-east boundary) are the most significant aspect of the Plan Change proposal for the CCBNR. Nature reserves can be difficult to

establish and manage and the Cromwell chafer Beetle reserve is remarkable in its formation and longevity. In my opinion, it is important that we collectively work to retain the values in this reserve despite a growing population and land use change.

Warren Chinn

Date: June 26, 2023.

Appendix 1

References

Watt, J. C. (1979). Conservation of the Cromwell Chafer *Prodontria lewisi* (Coleoptera: Scarabaeidae). New Zealand Journal of Ecology (2): 22 – 29.