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

Brief of Evidence of Thomas Brendan Heller

5 June 2020

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Introduction

1 My name is Thomas Brendan Heller and I am a Director of Environmental Associates Limited, an environmental and water resources consultancy based in Dunedin

2 I hold the qualifications of New Zealand Certificate in Engineering (Civil) and a National Diploma of Science majoring in surface water and groundwater resources from the Otago Polytechnic, Central Institute of Technology, and the New Zealand Qualifications Authority. I hold a Certificate in Management from the New Zealand Institute of Management and a Master's Degree in Environmental Science completed with first class honours from the University of Otago.

3 I am a member of the NZ Association of Resource Management and have nearly 40 years' experience working in surface water and groundwater resource evaluation. A considerable amount of that time has been spent on hydro-geologic and water quality assessment relating to water allocation and land use issues. I have also been involved with groundwater and surface water policy development for relevant Regional Plans in the Otago, Canterbury and Southland Regions.

4 I have previously been employed as a hydrologist and hydro-geologist (for 23 years) for the Otago Catchment Board, and Otago Regional Council (**ORC**), before performing a consultant scientist role with Sinclair Knight Merz, BECA, and then Environmental Associates Ltd (for a further 16 years). I served as a technical hearings commissioner at Environment Canterbury from 2004 to 2012, however, post the Christchurch earthquakes I have primarily focused on consulting in water resources and related scientific disciplines.

5 The applicant's site and surrounding area is well known to me, having dealt with many local issues as a consulting water and nutrient specialist for consent applicants, and as a scientist on behalf of the ORC and the former Otago Catchment Board.

Code of Conduct for Expert Witnesses

6 I have been provided a copy of the Environment Court code of conduct for expert witnesses. I have reviewed that document and confirm that this evidence has been prepared in accordance with it and that all opinions that I offer in this evidence are within my expertise. I have not omitted to refer to any relevant document or evidence except as expressly stated.

Scope of evidence

7 This evidence presents the following groundwater information in relation to the requested private Plan Change 14 by New Zealand Cherry Corporation (**NZCC**),

and in response to Minute 4 of the Hearings Panel Commissioners dated 3 June 2020:

(a) Cromwell Terrace Aquifer occurrence, hydrogeology and groundwater allocation;

(b) A review of available aquifer hydraulic information in the vicinity of the NZCC site;

(c) An assessment of the expected groundwater well yield obtainable at the NZCC site;

(d) Assessment of potential environmental effects and consenting requirements in relation to NZCC applying for a groundwater take permit from the ORC; and

(e) Main conclusions of evidence.

Cromwell Terrace Aquifer

8 The Cromwell Terrace Aquifer is reported within the ORC (2012) "Cromwell Terrace Aquifer Study Report" to be 22 km^2 in size. However, taking into account the township of Cromwell, the balance of the aquifer covers an area of approximately 1,780 ha.

9 The aquifer zone location and extent is shown in Figure 1 below, of which has been reproduced from ORC, 2012. The aquifer forms the majority of the Cromwell Terrace and is made up of moderate to highly permeable outwash gravels. Additionally, Lake Dunstan forms a boundary around the aquifer, maintaining aquifer water levels and providing a large source of recharge. Additional recharge to the aquifer does occur from intermittent debouching streams, and land surface sources (rainfall and irrigation losses to the aquifer surface). However, these components of recharge in consideration of the boundary effect of Lake Dunstan, are considered to have a relatively small effect upon the aquifer (ORC, 2012).

10 The ORC Regional Plan: Water for Otago, Schedule 4A, presents the maximum annual groundwater allocation for the Cromwell Terrace Aquifer of 4 Mm^3/annum. This level of groundwater allocation was assessed by ORC within the Plan Change 4C Evaluation Report (ORC, 2014), as commensurate with the boundary effect of Lake Dunstan, and having regard for a low risk of long-term aquifer water table decline with abstraction of 4 Mm^3/annum of groundwater.

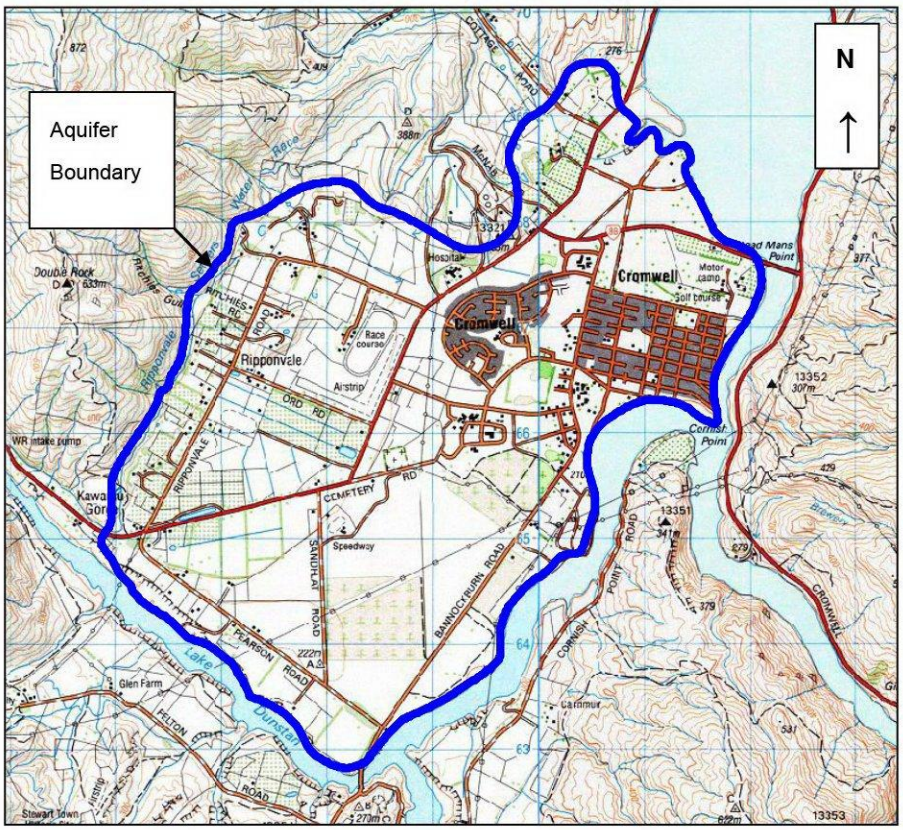

Figure 1 Extent of Cromwell Terrace Aquifer

11 Within the assessed 4 Mm^3/annum of groundwater allocation (availability) for the Cromwell Terrace Aquifer, there was no inclusion of water race or other infrastructure water leakage, or inefficient irrigation practices (comprising greater land infiltration losses). This was as current irrigation practices were moving toward greater efficiencies with infrastructure and water application methodology (ORC, 2012).

12 The current ORC groundwater allocation table for the Cromwell Terrace Aquifer shows that of the 4 Mm^3/annum allocation limit, there is 611,922 m^3/annum of allocation still available within the aquifer zone (as of 19 May 2020).

13 This groundwater allocation is available to be taken up by any landowner within or adjacent to the Cromwell Terrace Aquifer. That is, the allocation is available primarily on the basis of the position of the groundwater take being within the aquifer zone. Once the remaining groundwater allocation is taken up, any further allocation is prohibited by the Regional Plan: Water for Otago.

14 ORC (2012) reported that the Cromwell Terrace Aquifer (land surface area), was partially irrigated with surface water (700 ha) and groundwater (100 ha), with the assessed groundwater allocation of 1.7 Mm^3/annum at that time. That was irrigation of approximately 45% of the available land within the aquifer zone (exclusive of Cromwell Township). Considering the balance of the Schedule 4A allocation limit of 4 Mm^3/annum, this implies that conservatively about up to 1,000

ha of land may be irrigated (in total) with the existing surface water abstraction and the remaining groundwater allocation. That represents irrigation of approximately 55% of the available land within the aquifer zone. On this basis, it appears most unlikely that the available land area within the Cromwell Terrace Aquifer Zone would be able to be irrigated solely with the remaining groundwater allocation.

15 A further option to abstract additional surface water or connected groundwater (within 100 m of Lake Dunstan) does exist, as allocation from these sources is not attributed to the Cromwell Terrace Aquifer allocation limit. However, that option is limited to landholdings and access to areas in close proximity of the lake, and is unavailable for the majority of landholdings within the Cromwell Terrace Aquifer.

Aquifer Hydraulic Information

16 All available aquifer hydraulic information has been reviewed for the Cromwell Terrace Aquifer in vicinity of the NZCC site. This includes review of the ORC Wells Database and the Cromwell Terrace Aquifer Study report prepared by ORC in 2012.

17 Aquifer hydraulic testing has been undertaken on 3 wells located in vicinity of Ripponvale Road which are pertinent to a consideration of groundwater conditions at the NZCC site. Figure 2 provides a summary of the wells tested, the resulting aquifer hydraulic parameters, and well yield obtained. In relation to a potential groundwater take site for NZCC (Figure 2), expected values are provided for aquifer hydraulics and well yield. Further discussion on NZCC well placement and yield is provided below.

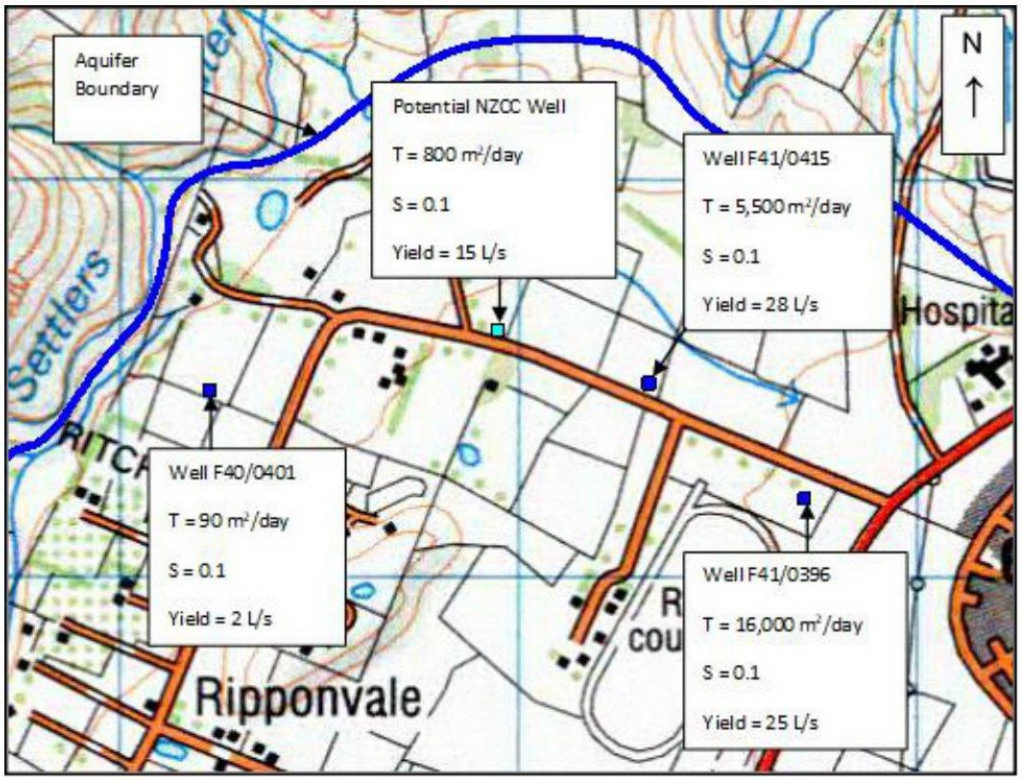

Figure 2 Available Aquifer Hydraulic Information

18 For both wells F41/0396 and F41/0415 to the east of the NZCC site, the well yield obtained from the ORC Wells Database (Figure 2) relates to the aquifer test rate, and represents a conservative long-term sustainable yield from those wells. The actual and potential yields at those sites are solely constrained by the well diameter and submersible pump utilised, and are in excess of that indicated. However, well F40/0401 to the west of the NZCC site has a sustainable long-term well yield of only 2 L/s (as indicated on Figure 2), that is limited by the small saturated thickness of the aquifer, nearer to the boundary of the aquifer zone. That well displays a saturated thickness of only 4 m in comparison to wells F41/0396 and F41/0415 which display a 12+ m and 10 m saturated thickness respectively.

19 The aquifer Transmissivity (T) values obtained from aquifer testing at the aforementioned wells, confirm an exponential-type reduction in value from east to west along Ripponvale Road. Transmissivity is the product of aquifer permeability (or hydraulic conductivity) multiplied by saturated thickness. This result is also consistent with ORC (2012) where it was reported that a transition from the higher yielding Albert Town Outwash gravels to a relatively lower yielding Luggate Outwash Gravels occurred at about the easterly extent of Ripponvale Road at the State Highway 6 intersection. Storage values (S) are only informed by the aquifer test undertaken at well F41/0396 and have been applied consistent at all wells/sites.

20 Albert Town Outwash Gravels at Cromwell exhibit a permeability of 1,000 m/day, whilst Luggate Outwash Gravels are an order of magnitude less, at 100 - 120 m/day. Together with the reducing aquifer saturated thickness, this provides an explanation as to why Transmissivity declines rapidly moving west along Ripponvale Road.

21 Exponential extrapolation of aquifer saturated thickness and Transmissivity values provides for conservatively estimated aquifer hydraulic values applicable to the NZCC site (Figure 2) of 800 m^2/day and 6.5 m for Transmissivity and saturated thickness respectively. I consider that this provides for an appropriate estimate of aquifer hydraulics at the indicated NZCC site in respect of existing information and the proximity of the site to the aquifer boundary.

22 Given the exponential-type reduction in aquifer Transmissivity moving west along Ripponvale Road, an appropriate degree of conservatism should be employed when predicting potential groundwater yield at the NZCC site indicated.

Expected Groundwater Well Yield

23 In my opinion the optimal location for an NZCC groundwater take is at the southeast extent of the NZCC property on the northern side of Ripponvale Road. This location is furthest to the east and provides the greatest distance from the boundary of the Cromwell Terrace Aquifer (referring to Figure 1 and Figure 2).

24 In that location, and considering the assessed reduction in both Transmissivity and saturated thickness for the aquifer in a westerly direction along Ripponvale Road, it is estimated that aquifer Transmissivity, Storage and saturated thickness would be in the order of 800 m^2/day, 0.1 and 6.5 m respectively.

25 Utilising the currently known aquifer hydraulic information available, indicates that a well(s) yield of 15 L/s at the indicated NZCC site would reasonably be expected. The calculation of available yield considers the saturated thickness of the aquifer of 6.5 m, a natural variation in water table levels of 2 m (including existing cumulative groundwater abstraction), a seasonal drawdown in the well from a 15 L/s abstraction of 2.5 m, and a screened interval of 2 m at the base of the aquifer. It is also expected that the submersible pump would be located or "sumped" below the well screens (base of aquifer) to maximise working drawdown.

26 On the basis of the above assessment, the potential well(s) yield at the indicated NZCC site is limited by both the aquifer saturated thickness and the predicted aquifer Transmissivity value.

27 I accept the broad concerns raised in Mr Dymock's evidence in relation to potential constraints upon a new groundwater take for NZCC, and acknowledge

that only well drilling and testing can confirm a groundwater yield at the indicated site. However, all information from existing aquifer hydraulics in the surrounding area of the NZCC site, confirms a reasonable expectation of a 15 L/s groundwater abstraction being available.

Potential Effects and Consenting Requirements

28 The environmental effects assessed within a Resource Consent application to ORC for a groundwater take of 15 L/s at the indicated NZCC site, encompasses groundwater allocation, efficiency of use, interference drawdown and surface water interaction.

29 The ORC has identified that there is 611,922 m^3/annum of available groundwater allocation for use within the Cromwell Terrace Aquifer. A 15 L/s groundwater take would comfortably fit within that allocation.

30 An efficiency of groundwater use is able to be demonstrated by NZCC in respect of any current or future water requirements.

31 Considering expected aquifer hydraulic parameters at the identified NZCC site for groundwater abstraction of 15 L/s, the predicted direct interference effect upon the nearest neighbouring well (F40/0401 – 740 m west), is calculated to be at or within 0.2 m. A 0.2 m drawdown is the acceptable limit identified in Schedule 5 of the Regional Plan: Water for Otago. Additional interference beyond that limit would require affected party written approval and/or demonstration that Well F40/0401 would not be adversely affected by the groundwater take. Well F40/0401 appears to be already constrained by current aquifer water levels and the small saturated thickness in that location.

32 Well F41/0415 is the nearest well to the identified NZCC site, which is currently owned by NZCC and would not require approval. However, based on the significantly increasing aquifer Transmissivity value in an easterly direction, the predicted level of seasonal drawdown interference from the potential 15 L/s groundwater take, would either be less than 0.2 m, and/or would not compromise the normal operation of that well.

33 Surface water interaction effects are assessed as being very low to not-measureable, as a stream depletion analysis for the potential NZCC groundwater take indicates a less than 1 L/s effect upon the Lake Dunstan surface water boundary.

34 It is acknowledged that there are potential consenting risks associated with a possible NZCC take of groundwater, which are alluded to within Mr Dymock's evidence. Groundwater allocation may be taken up by other prospective applicant's and/or there may be inconsistencies in the current ORC allocation

table. Additionally, any significant variation in predicted aquifer hydraulics at the identified NZCC groundwater take site, may result in changes to the expected scale of effects of the abstraction. However, in consideration of the above, it is my professional opinion that resource consent for such a groundwater take would reasonably be able to be authorised by ORC as a discretionary activity on a non-notified or limited notified basis.

Main Conclusions

35 The Cromwell Terrace Aquifer is generally considered a high-yielding groundwater resource. The aquifer is sustained by the large boundary effect of Lake Dunstan, and to a much lesser extent, stream flow and land surface recharge (including rainfall and irrigation return). However, Schedule 4A of the Regional Plan: Water for Otago places a 4 Mm^3/annum maximum allocation restriction upon the aquifer zone. That allocation takes into account the Lake Dunstan boundary effect, whilst maintaining minimal risk to long term aquifer head decline with groundwater abstraction of up to 4 Mm^3/annum. Additional allocation beyond 4 Mm^3/annum from the Cromwell Terrace Aquifer is prohibited. There is currently 611,922 m^3/annum of groundwater allocation available from within the Cromwell Terrace Aquifer.

36 The aquifer hydraulic information available in vicinity of the NZCC site indicates high Transmissivities in the east of Ripponvale Road toward State Highway 6. However, there is an exponential-type reduction in Transmissivity in a westerly direction along Ripponvale Road from the State Highway. Aquifer saturated thicknesses also reduce in that direction (westerly), and diminish at the aquifer boundary.

37 Based on existing aquifer hydraulic information, a well(s) located at the south-eastern corner of the NZCC property would be reasonably expected to obtain a yield of 15 L/s from groundwater. An estimate for the aquifer of 800 m^2/day Transmissivity, 0.1 Storage and a 6.5 m saturated thickness, would most likely be encountered at that location.

38 Resource Consent (water permit) for an associated groundwater take of 15 L/s from a well(s) located on NZCC property, would be expected to be authorised by ORC on the basis of existing available groundwater allocation, the efficiency of water use, the required limit of drawdown upon neighbouring wells, and the small to not measureable quantum of surface water interaction.

Thomas Brendan Heller
5 June 2020