Proposed Hurunui and Waiau River Regional Plan

And Proposed Plan Change 3 to the Canterbury Natural Resources Regional Plan

Section 42A Report

September 2012

Groundwater quantity

Prepared by

David Paulsen

Hydrogeologist

Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

Introduction

1. My full name is David Lars Poulsen. I am a hydrogeologist and I am employed by the Canterbury Regional Council.

Qualifications and experience

2. I hold the qualifications of Bachelor of Environmental Science with First Class Honours in Hydrogeology from Flinders University in Adelaide, Australia, which I attained in 2003.

3. I have been employed by the Canterbury Regional Council since November 2010, during which time I have worked on groundwater quantity investigations and I have provided advice on groundwater quantity issues to the consents planning and resource management (formerly compliance) sections and to external customers. I also provided groundwater quantity advice to the planners developing the proposed Hurunui and Waiau River Regional Plan.

4. Previously I have worked as a hydrogeologist for consulting firms Sinclair Knight Merz Ltd for 2 years in Christchurch and Resource and Environmental Management Ltd for 3 years in Adelaide Australia. During my career to date I have worked on a wide range of projects covering all aspects of groundwater resource evaluation and management.

Code of Conduct for Expert Witnesses

5. I confirm that I have read and am familiar with the Environment Court Consolidated Practice Note (2011) - Expert Witness Code of Conduct. I agree to comply with that Code. I confirm that the issues addressed in this brief of evidence are 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.

Explanation of terms and coding used in the report

6. The following terms and abbreviations are used in this report:

CRC	Canterbury Regional Council or Environment Canterbury (ECan)
HWRRP	Proposed Hurunui and Waiau River Regional Plan
NRRP	Natural Resources Regional Plan

Scope of evidence

7. I have been asked by the CRC to give evidence for the CRC in relation to the following groundwater quantity aspects of the HWRRP, which apply to the Hurunui, Waiau and Jed Catchments:

   (a) The way that groundwater allocation zone boundaries were developed;

   (b) The reasoning and science behind the river zone concept;

   (c) The way that groundwater allocation limits were developed; and

   (d) The size of the groundwater allocation blocks in relation to the number of existing groundwater consents that have been granted.

8. My evidence draws on the work documented in two reports that were prepared by staff in the CRC groundwater section, including myself, to assist the CRC planners developing the HWRRP. These reports are:

   (a) Weeber, J.H. and Smith, M.B., 2011: Groundwater and its influence on surface water in the Waiau River catchments. Environment Canterbury Report U11/3, September 2011.

   (b) Poulsen, D.L. and Smith, M.B., 2011: Groundwater management and allocation in the Hurunui River catchments. Environment Canterbury Report U11/4, September 2011.

Groundwater allocation zone boundaries

9. The current groundwater allocation zone boundaries prescribed in the NRRP represent the areas where most recharge to groundwater is likely to occur. These areas are mainly defined by the extent of the alluvial gravels (Quaternary units) on the geological map. The groundwater allocation limits have been calculated from these groundwater recharge areas.

10. The assumption behind this decision was that these areas would also be where groundwater would be taken from. But we have since found that groundwater takes sometimes occur outside of the recharge area and these can still affect groundwater storage and levels within the recharge area. However, such 'out of area' takes are not automatically subject to the allocation limit for the zone.

11. A recent example of a boundary related management issue was in the Cannington Basin, which is connected to the Pareora Basin via the Pareora River gorge. Groundwater takes in the Cannington Basin were not being

counted in the Pareora Basin groundwater allocation limits even though they directly impact on water availability lower in the catchment.

12. To resolve this type of management issue we have recommended that the NRRP allocation zone boundaries be extended to include the greater surface catchments of each allocation zone. The recharge areas would remain independent of these extended boundaries and still be the basis for calculating the allocation limit. However the allocation limit would apply to the entire surface catchment area rather than just the recharge area, making it impossible to have an 'out of area' take.

13. The key changes between the NRRP and the HWRRP to groundwater allocation zones include division of the Culverden Basin into the Hurunui portion and the Waiau portion, separation of the Waikari catchment and a small piece of the Waipara catchment from the Culverden Basin and division of the Parnassus and Jed catchment areas.

14. New groundwater allocation zones were created for the Waikari catchment and the Domett plains because both of these areas contain an appreciable area of potential aquifers (Quaternary formations) and a few groundwater takes.

River zones

15. In the NRRP, the effect of groundwater takes on surface water is managed by calculation of stream depletion effects (Policy WQN7). The effect is quantified as a percentage of the rate of take, and from this the degree of hydraulic connection is classified as low, moderate, high or direct. The magnitude of the stream depletion effect depends on factors including proximity of the well to the river and the properties of the aquifer and stream bed.

16. Groundwater takes that are assessed as having a direct hydraulic connection are managed as if they are a direct take from the river or stream and are included entirely in the applicable surface water allocation block. Takes having high and moderate hydraulic connection are split between the groundwater and surface water blocks, while takes with low connection are managed independently of surface water.

17. Through my work in assessing stream depletion effects I have realised that there are areas where it is highly likely that a groundwater take will be in 'direct' hydraulic connection to surface water. Therefore I thought it would be worthwhile exploring how this understanding might be included in the management of our natural water resources.

18. I have proposed a “river zone” concept to simplify managing shallow groundwater takes in areas I think the physical setting is predictable enough to assume direct hydraulic connection to the river.

19. I think the river zone is applicable to situations with characteristics including:

    (a) A clearly defined ‘riparian zone’ in which river water is the primary source of shallow groundwater and groundwater levels change in direct response to river stage height.

    (b) A zone of enhanced permeability in the river floodplain compared to surrounding formations. I am thinking of the major alpine rivers whose high energy tends to wash away much of the finer sediment and whose braided nature results in wide gravel beds and floodplain area.

    (c) A catchment water balance that is dominated by river flows. I am thinking of areas such as the inland basins of north Canterbury, where a relatively large volume of river water enters a bounded basin via a gorge and exits via another gorge. This part of the water balance is in addition to, and much larger than, the amount of land surface recharge occurring within the basin. The groundwater gradient through the entire basin is controlled by the groundwater levels at both gorges.

20. I have recommended that river zones are defined by the extent of the most recent alluvial deposits along the major alpine rivers that are predominantly gravel bedded. This geological unit is identified on the geological map with the symbol Q1al, which means the youngest (1) Quaternary (Q) aged alluvial (al) deposits, which are described as river gravel and sand, including along modern river beds. Whilst this definition might not perfectly capture the zone of direct connection, it does have a physical basis and I am of the opinion that it is an appropriate choice at a regional scale.

21. To test the suitability of this delineation, shallow wells were instrumented along the Waitohi, Hurunui, Pahau and Waiau rivers to record groundwater levels at a high resolution over a period of five months between December 2010 and May 2011. Groundwater levels were then compared to local rainfall and flows in the respective rivers. The water level in most wells situated within the proposed river zone (as defined by the Q1al geological unit) showed a direct response to changes in river flow. This gave me confidence that the proposed river zone is an appropriate form of management.

22. The river zone is intended as a default position to capture most ‘groundwater’ takes that are actually surface water takes. This would simplify the consenting process by removing the need to do a stream depletion assessment for applications within the river zone. However, the presumption could be rebutted if

an applicant demonstrates, through site-specific investigation, that a lower degree of hydraulic connection to a river is more appropriate.

23. I have not studied the depth to which a direct connection between rivers and groundwater occurs, but in my opinion, a 30 metre depth would be a reasonable cut-off depth for the river zone unless site specific data is available to demonstrate a different depth is more appropriate.

24. Given that groundwater within the river zone is essentially considered as surface water I have recommended removing the river zone areas from the recharge area used to calculate the groundwater allocation limits (which I describe in more detail below).

25. For the inland basins of north Canterbury I recommend using the river zone for the main-stem and all tributaries of the Hurunui and Waiau Rivers.

Groundwater allocation

26. I re-calculated the groundwater allocation limit for each zone in the Hurunui and Waiau catchments to take into account changes to the recharge areas due to adjusting the boundaries and excluding the river zones. The limits were assigned as 15 % of average annual rainfall in all areas except for the Culverden Basin where soils data (profile available water) were readily available and I estimated and assigned 50 % of land surface recharge. This is consistent with the approach adopted in some other areas of Canterbury.

27. Removal of the river zone area has reduced the size of groundwater recharge areas, particularly in smaller basins where river floodplains make up a larger proportion of the total area. In my opinion this reduction gives a more realistic estimate of the available groundwater resource in each area.

28. The re-calculated groundwater allocation limits are set out in the table below. These numbers and the underlying calculations and assumptions have been reviewed and approved by Matt Smith in the CRC consents team.

Allocation zone	Allocation limit (million m^3)	Allocated groundwater (million m^3)	Allocated groundwater as a per cent of allocation limit	Stream depletion due to groundwater takes (million m^3)
Hanmer	8.59	3.67	43%	0.14
Culverden - Waiau	33.4	1.22	4%	24.08
Culverden - Hurunui	52.8	9.09	17%	8.56
Parnassus	6.54	0.51	8%	6.89
Jed	2.62	0.00	0%	0.00
Waikari	7.14	0.10	1%	0.06
Domett	3.72	0.00	0%	1.95

29. The currently allocated groundwater as a per cent of the allocation limit excludes the portion of takes calculated to be stream depletion. These amounts are counted in the relevant surface water allocation block as indicated in the table as stream depletion due to groundwater takes. I note also that springs are not counted in the groundwater allocation or in stream depletion due to groundwater takes because the water from a spring is surface water and is counted as such.

30. And finally, I do not expect there to be much of a groundwater resource outside of the recharge area that is not directly connected to surface water. However, in the unlikely event that the groundwater allocation limit for a zone is reached and someone wants to take groundwater outside of the recharge area then I recommend they be required to complete a recharge study and quantify the amount and source of any additional available water.

David Poulsen

September 2012