Memo

Date	16/03/18
To	Waimakariri Water Zone Committee
cc	
From	Zeb Etheridge

Subject: Groundwater allocation modelling results for Ashley River/Rakahuri /Rakahuri catchment

1 Summary

Current groundwater allocation limits allow for further allocation of groundwater from the Ashley, Kowai, Loburn and Cust Groundwater Allocation Zones (GAZs). In addition to this, groundwater consent holders in the Waimakariri zone generally only use a relatively small proportion of their allocated volume (e.g. 55%[1]). Groundwater abstraction rates could therefore also potentially increase without any additional water being allocated, if consent holders consistently start to use a higher proportion of their contented volume. No groundwater allocation limit has been set for the Lees Valley area, so further consents to take water can also be granted here.

This memo summarises the results of groundwater modelling undertaken to assess the effects of increased groundwater abstraction in the Ashley, Kowai and Cust GAZs. Results indicate that flows in some of the spring-fed streams in the Ashley catchment could decline significantly if further water is allocated and/or if groundwater abstraction increases within the current allocated volume.

Groundwater levels in the Ashley and Kowai GAZs and flows in the Ashley River/Rakahuri are currently declining. Flows in the Ashley spring-fed streams are also likely to be declining. The main driver for this trend is likely to be climate, which has been dryer in the Ashley River/Rakahuri catchment for the last few decades. Further allocation of water or higher usage rates could exacerbate this situation.

Increased abstraction from the Loburn GAZ and/or from the Lees Valley area would further reduce flows in the Ashley River/Rakahuri. This would increase the duration, frequency and length of dry reaches of the lower/mid river to some degree.

The potential effects of reduced stream flows on ecological, cultural and amenity values are discussed in the memo entitled *Environmental flow regime for the Ashley River and its tributaries*.

Increased groundwater abstraction could also reduce the reliability of water supply wells, if this caused groundwater levels to periodically fall below the pump intake level. Modelling results suggest that the number of unreliable wells in a 1/20 year drought could potentially increase from 20 to 25% under the maximum possible groundwater abstraction scenario.

[1] Analysis of water use data presented in the Current State of Groundwater Quantity in the Waimakariri CWMS Zone Waimakariri zone report indicated an average year usage rate of 55% for the Ashley and Kowai GAZs

2 Introduction

This memo assesses the potential effects of increased groundwater abstraction within the current allocation limits on flows in spring-fed streams and rivers, groundwater levels and water supply well reliability within the Ashley catchment

Groundwater allocation limits in the Ashley, Cust, Kowai and Loburn GAZs (see attached Figure 1) currently allow for further water to be allocated, as shown in Table 1. More groundwater could also be taken under the current allocated volumes if consent holders start to use a higher proportion of their allocated water.

No groundwater allocation limit has been defined for the Lees Valley area and hence more groundwater abstraction could potentially occur here, if sufficient resource was found and exploited.

Increased abstraction could have economic benefits for the local and regional economy, but could also have detrimental impacts on the reliability of existing water takes and on the ecological, cultural and amenity values of groundwater-fed streams and rivers.

Table 1 Current allocation (as of 15/12/17)

Groundwater Zone	Allocation Limit (m^3/year)	Total Allocated
Ashley	29,400,000	54%
Cust	56,300,000	30%
Eyre River	99,070,000	110%
Kowai	17,400,000	53%
Loburn	40,800,000	0.5%

3 Current state of groundwater

Trend analysis undertaken for the Waimakariri zone Current State Groundwater Quantity report shows that groundwater levels are declining in the Ashley and Kowai GAZs. The Ashley zone declines are likely to be mainly (roughly 70%) caused by climate-driven declines in Ashley River/Rakahuri flows, with increasing groundwater abstraction making up the balance. Declining Ashley River/Rakahuri flows and Ashley and Kowai GAZ groundwater levels mean that flows in Taranaki Creek, Waikuku Stream and Saltwater Creek are also likely to be declining. We do not have enough monitoring data for these streams to verify this trend directly, but we know from analysis of stream flow and groundwater level data in the Eyre zone and elsewhere in the region that spring-fed stream flows and nearby shallow groundwater levels are usually strongly correlated.

4 Model scenarios

Modelling was undertaken to estimate the effects of increased groundwater abstraction under the scenarios are summarised below. These model scenarios were undertaken using a calibrated peer-reviewed numerical groundwater model.

Table 2 Model scenarios

Scenario name	Description	Purpose
Full abs	Full abstraction. Assumes all consented wells use 100% of consented volume. Excludes Permitted Activity wells.	Explores potential effects of increased abstraction within current consent limits. This scenario could potentially eventuate as a result of climate change, for instance, if drought length and severity increases.
Full abs allo	Full abstraction, full allocation. Assumes all consented wells use 100% of consented volume in all GAZs bar Loburn, which is not included in the model. There is also no GAZ for Lees Valley, so the effects of any additional abstraction from this area have not been assessed. The additional allocation volume is taken from existing consented wells in the model (i.e. modelling assumes same spatial distribution of abstraction as current). Excludes Permitted Activity wells.	Explores the maximum likely effects of groundwater abstraction that could potentially occur under current LWRP rules
Full allo cur use	Full allocation at current usage rates. As per full_abs_allo scenario but assumes consent holders use same % of consent volume (e.g. 55%[1]) as currently used based on metering data	Assesses the effects of increased groundwater allocation up to the current LWRP limits, assuming that usage rates remain the same as present (assumes no increase in water usage due to climate change etc.)

5 Model results

5.1 Stream flows

Model results for stream flows (Table 3) have been classified as follows:

≥10% decline = significant decline in stream flow

<10% decline = minor decline in flows, within modelling error margin

Using this classification:

- Flows in Taranaki Creek could decline significantly if all consent holders consistently take their full currently consented groundwater take flow rates
- Flows in Taranaki Creek and Waikuku Stream could decline significantly if water is allocated up to the current Waimakariri zone limits and if all consent holders consistently take their full currently consented flow rates
- Flows in Taranaki Creek could decline significantly if water is allocated up to the current Waimakariri zone limits and if groundwater is abstracted at current usage rates.

These flow declines are assumed to apply at all stream flow rates[2]; e.g. mean, median and low flows are all assumed to decline by the percentages shown in Table 3. The effects of these potential flow

[2] We made this assumption because we have no information to assess whether increased abstraction is likely to effect low flows more than median flows, for instance.

reductions on ecological, cultural and amenity values are discussed in the memo entitled *Environmental flow regime for the Ashley River and its tributaries*.

Table 3 Model stream flow results (excludes Loburn GAZ)

Scenario name	Stream	Median flow decline
full_abs	Ashley River/Rakahuri	1%
	Saltwater Creek	5%
	Taranaki Creek	**14%**
	Waiuku Stream	8%
full_abs_allo	Ashley River/Rakahuri	3%
	Saltwater Creek	9%
	Taranaki Creek	**33%**
	Waiuku Stream	**21%**
full_allo_cur_use	Ashley River/Rakahuri	1%
	Saltwater Creek	2%
	Taranaki Creek	**10%**
	Waiuku Stream	7%

As noted above, modelling results do not account for the effects on stream flow which could occur if groundwater abstraction in the Loburn Fan increased. The current Loburn GAZ allocation limit is equivalent to 1.3 m^3/s, of which 0.5% (65 L/s) is currently allocated. The following information is relevant when considering whether this allocation limit is appropriate:

- Groundwater from the Loburn GAZ is likely to mainly discharge to the Ashley River/Rakahuri.
- The lower/mid reaches of Ashley River/Rakahuri dry-out when flows at the Gorge recorder site fall below 2.5 m^3/s
- The effect of increased groundwater abstraction from the Loburn GAZ on the Rakahuri would be greatest at low flows, when the river is sustained by groundwater discharge
- If increased groundwater abstraction from the Loburn GAZ up to the current allocation limit (1.3 m^3/s) caused an equivalent decline in low flows in the Rakahuri, this would have a very significant impact on the duration, frequency and length of dry reaches
- Flows in the Rakahuri are currently declining due to dryer climatic conditions in recent decades
- Information provided in the memo entitled *Environmental flow regime for the Ashley River and its tributaries* shows that surface water is either fully or over-allocated in Saltwater Creek, Waikuku Stream and Taranaki Creek. Additional allocation is currently available in the Little Ashley stream[3] and within the Ashley River/Rakahuri B and C blocks.
- Further allocation of Rakahuri B and C block water could aggravate the current flow decline in the river, although the effects of this would occur at higher flows. The A Block is over-allocated and hence no additional surface water takes will be granted under the LWRP rules. Any declines in Rakahuri low flows associated with increased groundwater abstraction from the Loburn GAZ would therefore not be compounded by increased surface water abstraction.

[3] The Little Ashley was not included in our groundwater model because we did not have sufficient information on flows to calibrate the model for this watercourse.

- Well yields in the Loburn GAZ are very low, typically < 1L/s. The potential for the current allocation limit to be utilised is therefore limited.

Based on the above, increased groundwater abstraction from the Loburn GAZ up to the current allocation limits could have a very significant effect on low flows in the Rakahuri if a substantial groundwater resource was found and exploited. Capping the allocation limit at or close to the current allocated volume is unlikely to have a significant effect on the local economy because low well yields discourage exploitation of the groundwater resource.

A groundwater allocation limit has not been set for the Lees Valley area. This means that new groundwater take consents could potentially be granted here. The following information is relevant when considering whether an allocation limit should be set for this area:

- Groundwater from Lees Valley discharges to the Ashley River/Rakahuri above the Ashley Gorge
- Any increase in groundwater abstraction would therefore reduce river flows at and below the Gorge. This could increase the duration, frequency and length of dry reaches in the lower/mid reaches of the Rakahuri.
- Well yields appear to be low in Lees Valley area. The potential for increased groundwater abstraction is therefore likely to be limited.

As per the Loburn Fan, increased groundwater abstraction from the Lees Valley area could have a significant effect on low flows in the Rakahuri. Capping the allocation limit at or close to the current allocated volume is unlikely to have a significant effect on the local economy because the existing low well yields are likely to discourage exploitation of the groundwater resource. A new GAZ would need to be defined or an existing GAZ (e.g. Loburn Fan) extended in order to cap groundwater allocation.

5.2 Groundwater levels and well reliability

Modelling of well reliability in the broader Waimakariri zone indicates that:

- Up to 20% of wells could potentially be unreliable in a 1/20 year drought at present
- This could increase to around 25% if water was allocated up to the current limits and if all consent holders consistently abstracted their full consented flow rates
- Reliability would only reduce marginally (by a few percentage points) under the full allocation scenario if all consent holders consistently abstracted their currently consented flow rates. A marginal reduction in reliability would also occur if consent holders consistently took their full consented volumes.

The economic impact of these reliability changes are discussed in the memo entitled *Waimakariri land and water solutions programme: Economic assessment of the Impacts of changes in flow and N management in the Ashley sub-zone*

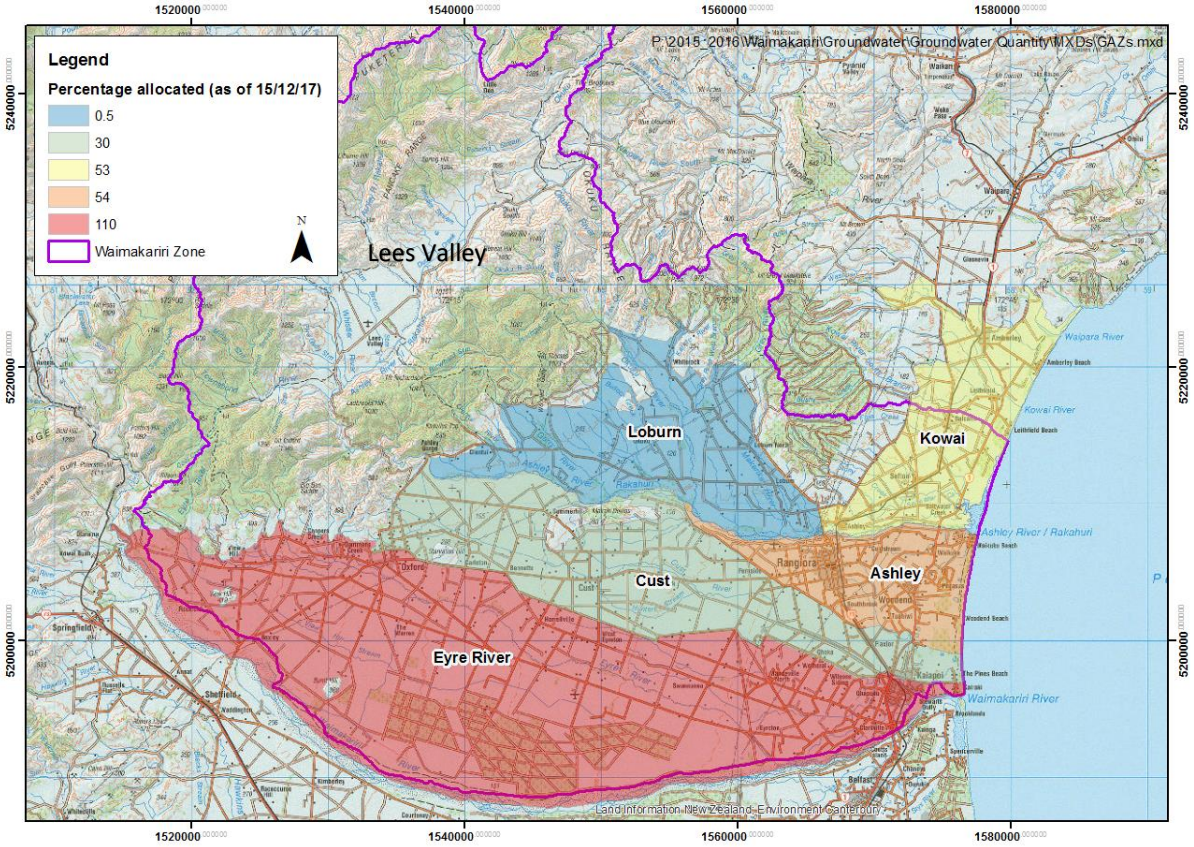

Figure 1 GAZ boundaries