Memo

Date	23/04/18
To	Waimakariri Water Zone Committee
cc	
From	Zeb Etheridge

Subject: Groundwater allocation modelling results for northern Waimakariri tributaries 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. 40%). 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.

Increased irrigation efficiency associated with implementation of Good Management Practice (GMP) will mean that less Waimakariri River water will be applied to the land within the northern Waimakariri River tributaries catchment, and this will reduce drainage to and recharge of the aquifer system. Groundwater levels and flows in some of the spring-fed streams are likely to decline as a results of this.

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

Groundwater levels in the lower Eyre GAZ are currently declining in some areas. Flows in some of the spring-fed streams are also likely to be declining, e.g. Silverstream. The main driver for this trend is likely to be a combination of climate, which has been dryer in the upper parts of the catchment for the last few decades, improved irrigation efficiency (conversion of border dyke to spray irrigation on the land upgradient of Silverstream) and increased groundwater abstraction. Further allocation of water, higher usage rates and/or improved irrigation efficiency for Waimakariri River-fed irrigation schemes could exacerbate this situation.

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.

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 northern Waimakariri tributaries 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.

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

Groundwater Zone	Allocation limit (m^3/year)	Current estimate of total allocated[1]
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%

Waimakariri Irrigation Limited (WIL) shareholders are improving irrigation efficiency in order to meet the industry-agreed Good Management Practice (GMP) standards for land and water management. Increased irrigation efficiency will mean that less Waimakariri River water will be applied to the land, and this will reduce drainage to and recharge of the aquifer system. Groundwater levels and flows in some of the spring-fed streams are likely to decline to some degree as a results of this.

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 and lower part of the Eyre 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. Declining groundwater levels in the lower Eyre GAZ are likely to be reflected in declining flows in the spring-fed streams such as Silverstream. 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.

[1] Note that these estimates are currently being revised as part of a Resource Consents Inventory process

4 Model scenarios

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

Table 2 Model scenarios

Scenario name	Description	Purpose
GMP	Irrigation efficiency assumed to increase by 20%	Evaluate the effects of increased irrigation efficiency associated with implementation of GMP.
Full abs	Full abstraction. Assumes all consented wells use 100% of consented volume. Excludes PA 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 PA 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. 40%) 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 the Cust River and Main Drain are expected to reduce by more than 10% following successful implementation of GMP
- Full usage of current allocated water could cause flows in Ohoka Stream, Cust River and Cust Main Drain to reduce by more than 10%

- Allocation of groundwater up to the current allocation limits combined with full usage of all allocated water could cause significant flow reductions in the Cam River, Ohoka Stream, Cust River, Cust Main Drain and No. 7 Drain.
- Allocation of groundwater up to the current allocation limits but with usage at the current average usage rates could cause flows in Ohoka Stream, Cust River and Cust Main Drain to reduce by more than 10%

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.

Table 3 Model stream flow results

Scenario name	Stream	Median flow decline
GMP	Cam River at Youngs Rd	1%
	CourtenayStream at Neeves Rd	0%
	Greigs Drain	0%
	Northbrook at Marsh Rd	0%
	Ohoka Stream at Island Rd	0%
	Silverstream at Island Rd	0%
	Southbrook at Marsh Rd	1%
	Cust River at Oxford	**16%**
	Cust Main Drain at Threlkelds Rd	**12%**
	No. 7 Drain	1%
full_abs	Cam River at Youngs Rd	4%
	CourtenayStream at Neeves Rd	4%
	Greigs Drain	3%
	Northbrook at Marsh Rd	3%
	Ohoka Stream at Island Rd	**17%**
	Silverstream at Island Rd	5%
	Southbrook at Marsh Rd	8%
	Cust River at Oxford	**11%**
	Cust Main Drain at Threlkelds Rd	**16%**
	No. 7 Drain	5%
full_abs_allo	Cam River at Youngs Rd	**10%**
	CourtenayStream at Neeves Rd	6%
	Greigs Drain	5%
	Northbrook at Marsh Rd	8%
	Ohoka Stream at Island Rd	**30%**
	Silverstream at Island Rd	7%
	Southbrook at Marsh Rd	**21%**
	Cust River at Oxford	**27%**
	Cust Main Drain at Threlkelds Rd	**54%**
	No. 7 Drain	**14%**

[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.

Scenario name	Stream	Median flow decline
full_allo_cur_use	Cam River at Youngs Rd	3%
	CourtenayStream at Neeves Rd	1%
	Greigs Drain	1%
	Northbrook at Marsh Rd	2%
	Ohoka Stream at Island Rd	**11%**
	Silverstream at Island Rd	1%
	Southbrook at Marsh Rd	6%
	Cust River at Oxford	**11%**
	Cust Main Drain at Threlkelds Rd	**23%**
	No. 7 Drain	5%

5.2 Groundwater levels and well reliability

Modelling of well reliability in the 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.

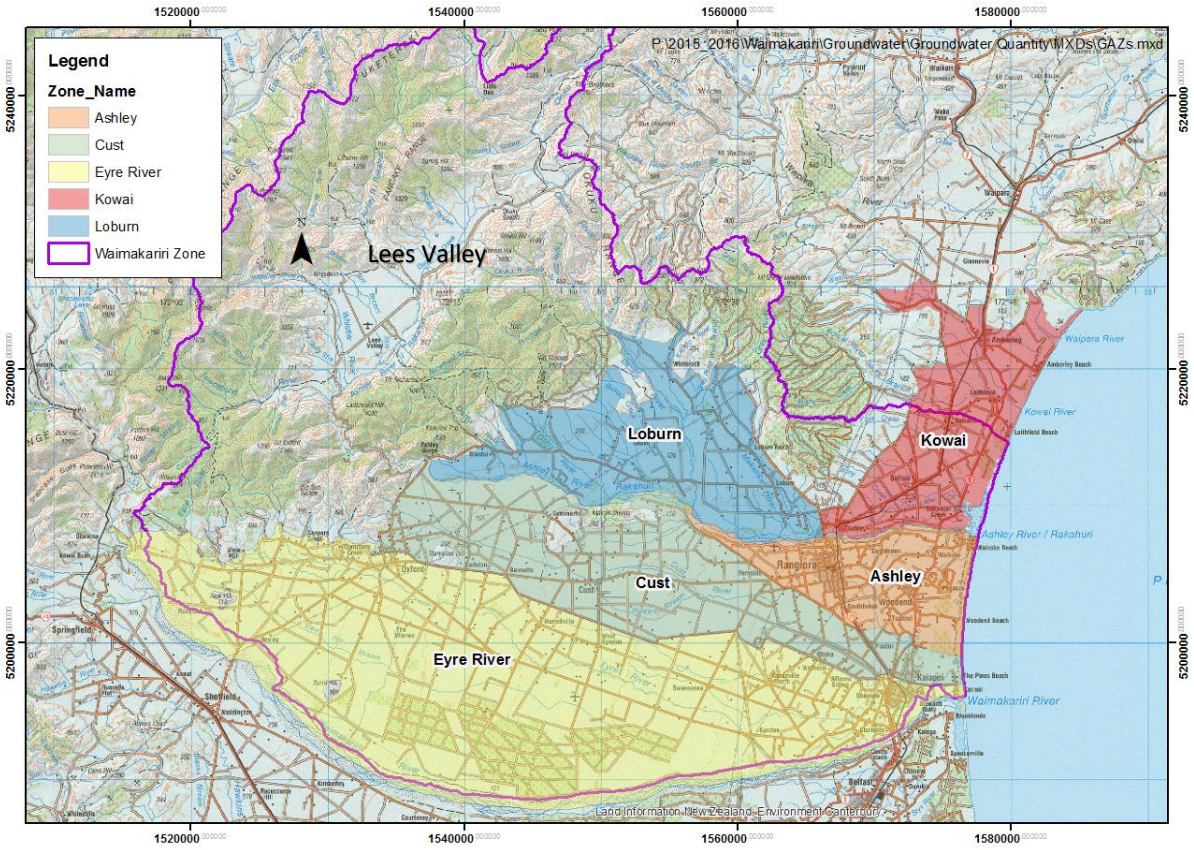

Figure 1 GAZ boundaries