Tabled at Hearing 15/10/14

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

31 January 2014

MEMORANDUM

FROM : DAN CLARK

TO : ALASTAIR PICKEN, TAMI WOODS
CC HELEN SHAW

SUBJECT : UPDATED ALLOCATION METHODOLOGY FOR THE SELWYN WAIHORA CATCHMENT

Introduction

As part of the technical work to support the Selwyn Waihora sub regional chapter of the Land and Water Regional Plan (LWRP) a new approach of setting the allocation limits for water has been used. These are described in Clark (2012) and Williams (2013). The new methodology assumes surface water and groundwater abstractions are from the same resource. This approach has been used to allow better management of the large cumulative effect of the many distant groundwater abstractions on flows in the lowland streams entering Te Waihora.

This methodology was used to propose combined allocation limits for the Rakaia Selwyn allocation zone (RSAZ) and the Selwyn Waimakariri allocation zone (SWAZ). These allocations were proposed at levels so that the cumulative effect of abstractions in the catchment would not reduce the 7 Day Mean Annual Low Flow (7D MALF) by more than 10% of that which would occur naturally (Golder Associates 2012). This reduction was chosen to be acceptable to protect the ecological values within the waterways.

Just as protecting ecological values was an objective of the Selwyn Waihora Zone Committee, so was providing water to maintain the reliability of supply for existing land uses. These objectives are set out in the Selwyn Waihora Zone Implementation Program (ZIP 2011) and the ZIP addendum (2013)

It became apparent that the current catchment water balance was not sufficient to meet both the ecological values and also maintain the reliability for existing land uses (Clark 2013a). To fully meet both of these objectives it was proposed that augmentation of the water balance with alpine water could be part of the solution. This included using alpine water for irrigation of 60,000ha in the upper plains, Adding water to the wider Groundwater system via Managed Aquifer Recharge in the upper plains (MAR) during the winter months and also by Targeted Stream Augmentation (TSA) which infiltrates imported water into pits above stream heads.

Methodology

As the development of the plan recommendations has been a collaborative process it has been the role of the Environment Canterbury science team to provide advice to the Zone Committee to inform their decisions. As part of this process a matrix of proposed allocations

and consequences to the stream, reliability and requirement of additional water was presented (Clark 2013b).
Modelling presented in Clark (2013c) included analysis of a range of scenarios in the catchment. This included some options for meeting values in the lowland streams. One scenario included MAR as a possible option for addressing the over allocation within the catchment.

MAR had only been modelled as 8 m^3/s at the top of the plains so the effects of differing levels was estimated using pro rata based on 8 m^3/s, e.g. 4 m^3/s has ½ the benefit of 8m^3/s to streams. Estimates of the flows under these options were between those predicted for scenario 2 and solution package 1, with larger amounts of MAR producing flows closer to Solution package 1.These data were presented to the Selwyn Waihora Zone Committee in Clark (2013b). This provided a decision space for the Zone Committee to discuss and recommend an approach.

From this discussion the Zone Committee recommended that there should be a compromise between the conflicting values and that there should be some additional water included as MAR and TSA alongside the contributions of Central Plains Water (CPW). This recommendation involves a bottom up approach to setting the allocation limit informed by the existing proposed methodology.

The recommendation includes:

- 2 m^3/s of MAR added at the top of the plains during the winter months
- 900 l/s of TSA above the stream heads
- Sufficient allocation volume to meet demand in 8.5 years out of 10
- CPW providing surface water to 60,000 ha of irrigation in the upper plains.

To model the change in allocation to meet 8.5 years out of 10 the demand in the groundwater modelling was adjusted to limit the maximum abstraction to the 85 percentile volume (based on annual abstraction volumes in scenario 2 modelling). This provided an allocation that represented the volume of water that meets the agreed demand in the areas not provided water by CPW

As abstraction in the model is assumed to represent the allocation in the catchment, the percent reduction form the baseline abstraction represents the reduction in allocation required. The Little Rakaia Allocation Zone (LRAZ) is included in the modelling but the allocation remains at the current levels.

Current allocations have been calculated using full annual volume rather than the historic method of using effective annual volume (EAV), this results in both the current allocations and proposed allocation limits being higher than if EAV was used.

The calculation method for each zone allocation is as follows:

Selwyn Waimakariri Water Allocation Zone (SWAZ)
Modelled allocation in Zone Committee Solution Package = 85 percentile of SWAZ annual abstraction volume modelled in Scenario 2

Actual SWAZ allocation limit for Zone Committee Solution Package = (Modelled SWAZ allocation in Zone Committee Solution Package/ Modelled SWAZ allocation in Scenario 1) x Current SWAZ actual allocation

Rakaia Selwyn Water allocation Zone (RSAZ)

Modelled RSAZ allocation in Zone Committee Solution Package = 85 percentile of RSAZ annual abstraction volume modelled in Scenario 2

Actual allocation limit for Zone Committee Solution Package = (Modelled RSAZ allocation in Zone Committee Solution Package/ Modelled RSAZ allocation in Scenario 1) x (Current actual RSAZ allocation + Current actual LRAZ allocation) - Current actual LRAZ allocation

Recommendations

Based on the Zone Committee's recommendations the following water allocations have been derived.

	Rakaia Selwyn	Selwyn Waimakariri
Current Groundwater Allocation (million m^3/year)	273	241
Proposed Allocation limit (million m^3/year)	180	193

Current allocation is expected to be reduced to the proposed limits by the reduction in groundwater abstraction within the CPW command area and by annual volumes on consents to meet demand 8.5 years out of 10 for that land use.

Without additional alpine water being added to the catchment these allocation limits would be lower than the existing limits. Surface water abstractions are also included in these allocation limits, where previously there was no limit set on the surface water and the consented allocation volume for these was 29.7 million m^3/year.

The limits proposed, alongside additional water, are modelled to provide approximately 80% of the natural 7DMALF to the lowland streams.

References

Clark, D. 2012: Cumulative allocation in the Selwyn Catchment; Internal memorandum, Environment Canterbury dated 1st October 2012, 12 p.

Clark, D. 2013a: Summary of water allocation for Selwyn Waihora; Paper to the Selwyn Waihora Zone Committee, dated 17th September 2013, 1 p.

Clark, D. 2013b: Options for water allocation limits for Selwyn Waihora to improve ecological flows while providing reliability of supply; Paper to the Selwyn Waihora Zone Committee, dated 1st October 2013, 3 p.

Clark, D. (2014) Technical report to support water quality and water quantity limit setting process in Selwyn Waihora catchment. Predicting consequences of future scenarios. Surface Water Quantity. Environment Canterbury Technical Report in press

Golder Associates (2012) Te Waihora/Lake Ellesmere catchment flow review: ecological values and flow recommendations at minimum flow sites. Report prepared by Golder Associates (NZ) Limited for Canterbury Regional Council. 28p

Williams, H.R. 2013: Technical work supporting management of water allocation and development of allocation limits for the Selwyn - Te Waihora sub-regional chapter of the Land & Water Regional Plan, 63 p.

ZIP 2011: Selwyn-Waihora Zone Implementation Programme, published for the Canterbury Water Management Strategy by Canterbury Regional Council, Report R11/106, 48 p.

ZIP Addendum 2013: Selwyn-Waihora ZIP Addendum, published for the Canterbury Water Management Strategy by Canterbury Regional Council, 62 p.

Appendix 1

AGENDA ITEM NO:		**SUBJECT MATTER:** Summary of water allocation for Selwyn Waihora
REPORT:	Selwyn Waihora Zone Committee Workshop	**DATE OF MEETING:** 17 September 2013
REPORT BY:	Dan Clark	

This short memo provides a simple explanation of how the proposed allocation methodology fits with the plan, current situation and meeting climate demand.

Currently water in the Selwyn Waihora zone is over allocated, this current allocation is thought of as two parts: used water and unused but allocated water. The ratio of this used water varies from year to year, but is estimated to be on average 40-60% of the allocation (in the 2012-2013 water year metering data indicates that groundwater abstraction was 60% of the allocation).

In dry years consent holders will need more than their average use to meet the climatic demands. 9 year out 10 demand is a measure of how much water will be needed to meet all but the most extreme years.

The allocation methodology used to derive the proposed limits for the Selwyn Waihora zone has set an allocation that could be taken every year and still result in 90% of the natural 7DMALF entering Te Waihora. This includes the effect of the additional recharge provided by the additional irrigation in the CPW area but the switch of groundwater takes to surface water do not form part of the limit. These takes that switch to surface water are no longer counted as allocation from the catchment and therefore do not need to fit within the allocation limit. This method protects streams on average; values may not be protected to the same degree in dry years.

Using actual use data from metering it may be possible to reduce the allocation while still maintaining 9/10 year reliability, but this is only removing the unused portion of the allocation. These reductions are likely to greater for arable land uses that have been given pasture based annual volumes. These reductions will not affect the reliability of the consent holders, but will only prevent further abstraction from the catchment.

The proposed allocation limits will provide sufficient water for consent holders to continue taking their average use. For example 2012-2013 demand could be met.

From the modelled analysis of the allocation and abstraction in the catchment is has been identified that maintaining 9/10 year reliability (reducing the unused portion of the allocation) and the addition of CPW does not result in meeting the allocation limit (90% of 7DMALF into Te Waihora). The catchment will remain over allocated, but to a lesser extent than currently.

Appendix 2

AGENDA ITEM NO: 3		**SUBJECT MATTER:** Options for water allocation limits for Selwyn Waihora to improve ecological flows while providing reliability of supply
REPORT:	Selwyn Waihora Zone Committee	**DATE OF MEETING:** 1 October 2013
REPORT BY:	Dan Clark (Environment Canterbury)	

Recommendation
The Zone Committee note that the allocation volume in the ZIP Addendum, based on "average" years, means there is a "gap" as this volume will not deliver stream values (90% 7DMALF) while maintaining 9 out of 10 years reliability for abstractors within the catchment.

The Zone Committee recommends an approach to water allocation that improves ecological flows while providing reliability of supply. This will be modelled for the final solutions package and included in the sub-regional section.

Background
In the ZIP Addendum the allocation volumes for Selwyn-Waimakariri and Rakaia-Selwyn water allocation zones were calculated on the basis of providing improved ecological flows (90% of 7DMALF) for "average" years.

Analysis of the allocation limits proposed for the Selwyn Waihora in the ZIP Addendum has identified that there is a "gap" between the allocation needed to meet 9 years out of 10 demand and the reductions needed to meet the stream values entering Te Waihora (maintain 90% 7DMALF).

Zone Committee members were briefed on the issue at a workshop on 17 September and asked staff to come back with more information that explored "compromise" options.

This paper shows how the "gap" between the stream values and reliability can be filled:

- By changing the allocation volume through either or both of:
  - Reducing the allocation volume in the sub-regional section;
  - Increasing the volume by adding more "alpine" water through MAR (managed aquifer recharge);
- By "relaxing" the ecological flow expectation (that is, less than 90% 7DMALF); or
- By reducing the reliability of supply for abstractors of water

Information to assess options
The graph in Figure 1 shows that the replacement of groundwater takes in the CPW area, the additional recharge from new irrigation and also the reduction in unused allocation is not sufficient to meet the proposed allocation indicated by the purple line. The 9 out of 10 year reliability in Figure

1 shows the abstraction that would meet demand in all but the driest years. This is shown by the blue line.

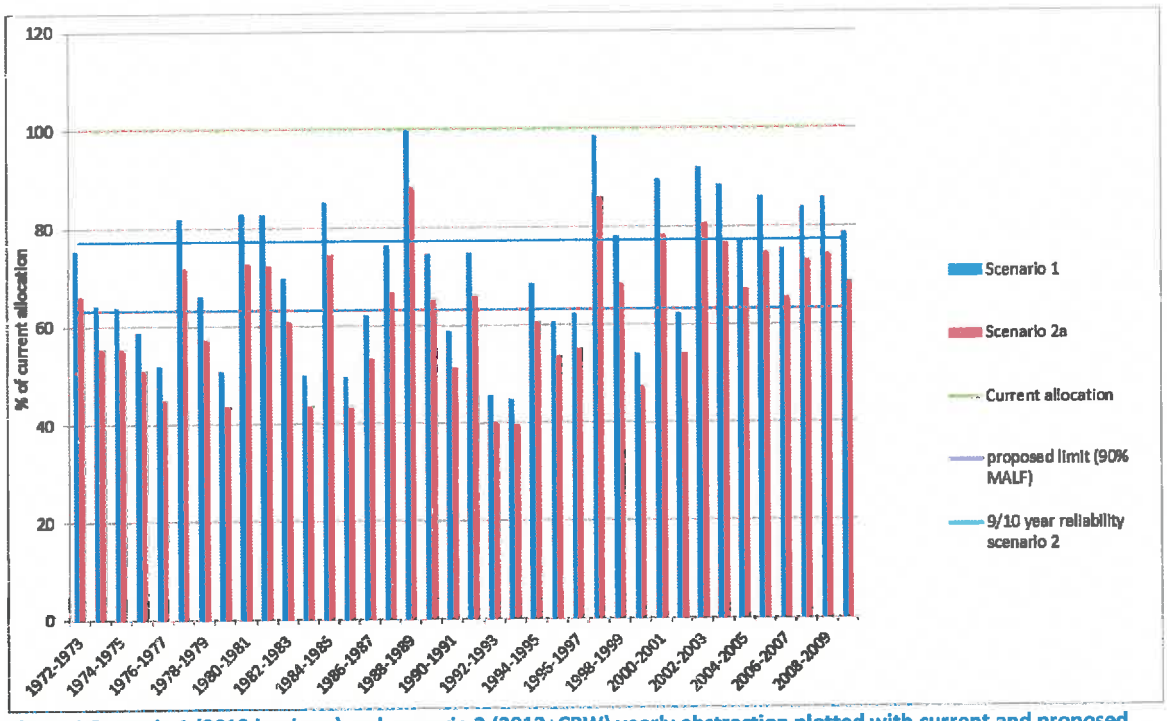

Figure 1 Scenario 1 (2012 land use) and scenario 2 (2012+CPW) yearly abstraction plotted with current and proposed allocation limits. All figures are shown as a percentage of current allocation

To find a solution and fill the gap between the purple line (proposed limit (90% MALF) and blue line (9 out of 10 years reliability) I have calculated how changing the proposed limit (i.e. changing % of 7DMALF achieved for the streams) and the addition of Managed Aquifer Recharge (MAR) can affect reliability of supply. Table 1 presents a range of options of balancing these three variables. Choosing the lowest percentage of 7DMALF (70%) and adding 8m^3/s of MAR results in more water than required to meet a 9 out of 10 year demand. In the other corner choosing the highest level of protection for the streams (90% 7DMALF) and adding no water the catchment results in the demand being meet less than half the time (4 out of 10 years).

Table 1 Matrix of how reliability, additional water and stream values interact with allocation limits set in the Selwyn Waihora zone .The internal numbers in the matrix represent the availability to meet demand out of ten years.

		Additional water (MAR)				
		No MAR	2 m^3/s	4 m^3/s	6 m^3/s	8 m^3/s
% of Natural 7DMALF retained	90%	4.2	6.7	8.8	>9	>9
	85%	6.8	8.9	9.0	>9	>9
	80%	9.0	>9	>9	>9	>9
	75%	>9	>9	>9	>9	>9
	70%	>9	>9	>9	>9	>9

Using the information in Table 1 a range of solutions can be assessed. Each of these come with differing consequences or benefits, be they in stream or out of stream.

Due to the nature of climate and the data available I am unable to rate any combination of options as having 100% reliability and have classified high reliability as >9 out of 10 year reliability. These combinations should result in consent holders having enough water to meet more than the demand in 9 out of 10 years. The modelling completed for this analysis is based on the scenario assessments already completed and the differing MAR inputs are variation on the modelled effect of $8m^3/s$ for 5 months of the year, added in the upper plains.

Targeted Stream Augmentation (TSA) has been discussed as part of a solution package; this has not been modelled as part of this assessment and is considered as being additional to an allocation solution. TSA presents a way to augment streams that may be more sensitive and may not meet their desired flow outcomes through wide scale allocation.

Another option that has been identified but not fully investigated is the potential to have allocations volumes that are calculated over multiple years. This may result in the reliability of consent holders being maintained while reducing the duration of effects on the streams. Having a multi-year allocation will result in lower flows in streams than would occur with a constant allocation at the average volume of the multiple years.