

**BEFORE COMMISSIONERS ON BEHALF OF
THE CANTERBURY REGIONAL COUNCIL**

IN THE MATTER of the Resource Management Act 1991
AND
IN THE MATTER of the hearing of submissions on
Proposed Plan Change 3 to the Land and
Water Regional Plan

BY **OTAIO WATER USERS GROUP**
Submitters

TO **CANTERBURY REGIONAL COUNCIL**
Local Authority

BRIEF OF EVIDENCE OF KERI JOY JOHNSTON

Dated: 25 September 2015

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INTRODUCTION

Qualifications and experience

1. My full name is Keri Joy Johnston.
2. I hold a Bachelor of Engineering in Natural Resources Engineering from the University of Canterbury. I am a Professional Member of the Institute of Professional Engineers New Zealand (MPIENZ) and a Chartered Professional Engineer (CPEng).
3. As a graduate, I worked for Meridian Energy Limited as a civil engineer, before taking up a position with Environment Canterbury (ECan) as a Consents Investigating Officer and then the Environmental Management Systems Engineer with the River Engineering Section of ECan.
4. I left ECan to join RJ Hall Civil and Environmental Consulting Limited as an Environmental Engineering Consultant.
5. Since 2007, I have been a director and principal of Irricon Resource Solutions Limited, a resource management and environmental engineering consultancy, working extensively in the field of water resources management (quantity and quality).
6. I have reviewed the following material:
 - (a) Plan Change 3 (PC3), Land and Water Regional Plan (LWRP);
 - (b) Submissions and further submissions on PC3.
 - (c) The section 32 report of the Canterbury Regional Council.
 - (d) The section 42A report of the Canterbury Regional Council.

Code of Conduct

7. I have read the Code of Conduct for Expert Witnesses within the Environment Court Consolidated Practice Note 2014 and I agree to comply with that Code. This evidence is within my area of expertise, except where I state I am relying on what I have been told by another person. To the best of my knowledge I have not omitted to consider any material facts known to me that might alter or detract from the opinions I express.

SCOPE OF EVIDENCE

8. My evidence will address the following:
 - 8.1 The Proposed Otaio Environmental Flow and Allocation Regime;
 - 8.2 Impacts of Reduced Reliability of Supply;
 - 8.3 The take and use of water for domestic and stock water purposes;
 - 8.4 Updates to Overseer; and
 - 8.5 Nutrient Rules.

THE PROPOSED OTAIO ENVIRONMENTAL FLOW & ALLOCATION REGIME

9. The Otaio Water Users Group (OWUG) was actively involved in the development of the proposed Otaio environmental flow & allocation regime, working with the Canterbury Regional Council and other stakeholders. I was engaged by OWUG to provide technical support, particularly in relation to the implications of the environmental flow and allocation regime. The purpose of this evidence is to provide the Commissioners with some context and reasoning for the proposed regime and recommend some changes to ensure it is more effectively implemented.
10. In Mr De Joux's evidence, he describes the Otaio River catchment. It is important to note from his evidence that only three of the 12 consents to take water are actually surface water abstractions. The remainder are from hydraulically connected groundwater. Mr De Joux also notes that it is an intermittently flowing river with complex groundwater systems.
11. The flow regime is very much a 'package', and was designed with the following objectives in mind, from OWUG's point of view:
 - 11.1 The OWUG consents are currently not subject to any minimum flow restriction. The implementation of a minimum flow will reduce the amount of time water is able to be abstracted which will have adverse effects on their farming businesses.

- 11.2 None of the OWUG consents allow 24/7 (continuous) abstraction at consented flow rates. They are limited by a 7 day volume. Therefore simply extrapolating allocation from consented flow rate does not accurately demonstrate the actual consented allocation volume. The consented allocation volume gives an average flow rate of 343l/s compared with the consented maximum flow rate of 406l/s. This is the sum of the maximum rates of take for surface water abstractions plus the sum of the hydraulically connected portion of the groundwater takes, calculated in accordance with Schedule 9 of the LWRP.
- 11.3 The use of a 7 day volume is a function of the hydrology of the catchment and the fact that the majority of the abstractions come from hydraulically connected groundwater takes.
- 11.4 Providing for a high rate of take complemented by a 7 day volume allows users to manage their water use as a collective over each seven day period. This allows greater water use efficiency to be achieved.
- 11.5 In order to off-set reduced reliability of supply caused by the imposition of the minimum flows, some 'A' permit water will need to be taken into storage, and the creation of a 'B' permit allocation would be necessary to carry water users over when water takes are prohibited due to minimum flows.
- 11.6 An allocation of Deep Groundwater is also necessary. This is the primary mechanism for reducing the 'A' allocation for the Otaio River as any surface water or shallow groundwater permits that are transferred to deep groundwater (either in whole or part) will be surrendered.
- 11.6 Restrictions on transferring water in the catchment that would enable irrigation of extra land is essential to assist in reducing the 'A' allocation and maintaining reliability of supply.

12. Therefore, the final environmental flow and allocation regime for the Otaio River has the following components.

- 12.1 From now until 2019, the maximum rate of abstraction is 406 l/s, with a seven day volume not exceeding 207,386 cubic metres. This is the equivalent of taking water at a continuous rate of 343 l/s, or taking water at a rate of 406 l/s for six out of the seven days. It is important

to note that the allocations calculated are based solely on water permits held in the catchment, which are for irrigation only. Therefore, permitted uses have not been included in these limits (e.g. stock and domestic drinking water).

- 12.2 From 2019, in addition to the abstraction rate and volume regime a minimum flow measured at the Otaio River gorge will apply. This minimum flow is 350 l/s between 1 May and 30 September and 90 l/s between 1 October and 30 April. The higher winter minimum flow of 350 l/s is to ensure that the shallow aquifer is recharged, and to provide for spawning. The summer minimum flow of 90 l/s approximately equivalent to 90% of MALF (which is 96 l/s). This flow rate was agreed by stakeholders as an adequate flow for environmental purposes, including ensuring that some water remains in the Otaio Lagoon.
- 12.3 From 2019 permit holders will also be subject to a partial restriction regime which will require them to progressively reduce their take rates and volumes as river levels drop. This is foreshadowed in Table 15(i) and ensures that permit holders work together to manage flows as they decrease towards the minimum flow.
- 12.4 From 2021, the maximum available rate and seven day volume reduces to 206 l/s and 124,600 cubic metres respectively¹. This is a reduction of 200 l/s, and is the amount of water that OWUG considered could be surrendered off the river in lieu of deep groundwater (Table 15(l)). Allowing until 2021 for those users likely to pursue deep groundwater was considered reasonable given the considerable expense involved with drilling a well.
- 12.5 From 2030, the maximum available rate and seven day volume reduces to 175 l/s and 106,000 cubic metres respectively². This was considered somewhat of a visionary target. This limit will be in place for the first re-consenting process within the catchment assuming that subsequent reviews of the Plan do not change things.
- 12.4 A 'B' allocation block of 1,000 l/s has been created for surface water. Water may begin to be taken when flows are above 780 l/s at the Otaio River Gorge. The full 'B' allocation cannot be taken until flows are above 1,780 l/s (being the sum of the allocation limit plus the

¹ Please note that the seven day volume is a rate of 206 l/s continuously.

² Please note that the seven day volume is a rate of 175 l/s continuously.

minimum flow). The minimum flow of 780 l/s is the mean flow for the Otaio River at the Gorge.

- 12.5 Furthermore, the shallow groundwater aquifer must be sufficiently recharged first by the high flows. Therefore, as well as a minimum flow for the 'B' allocation, a groundwater level of 3m has also been set on bore J39/0255.

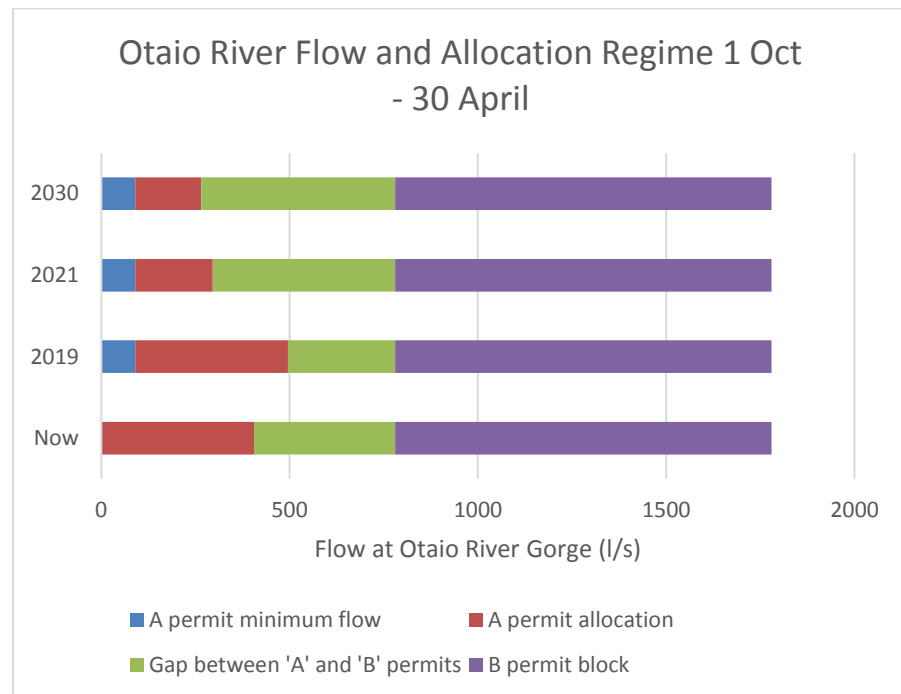


Figure One: The proposed summer flow regime from now until 2030

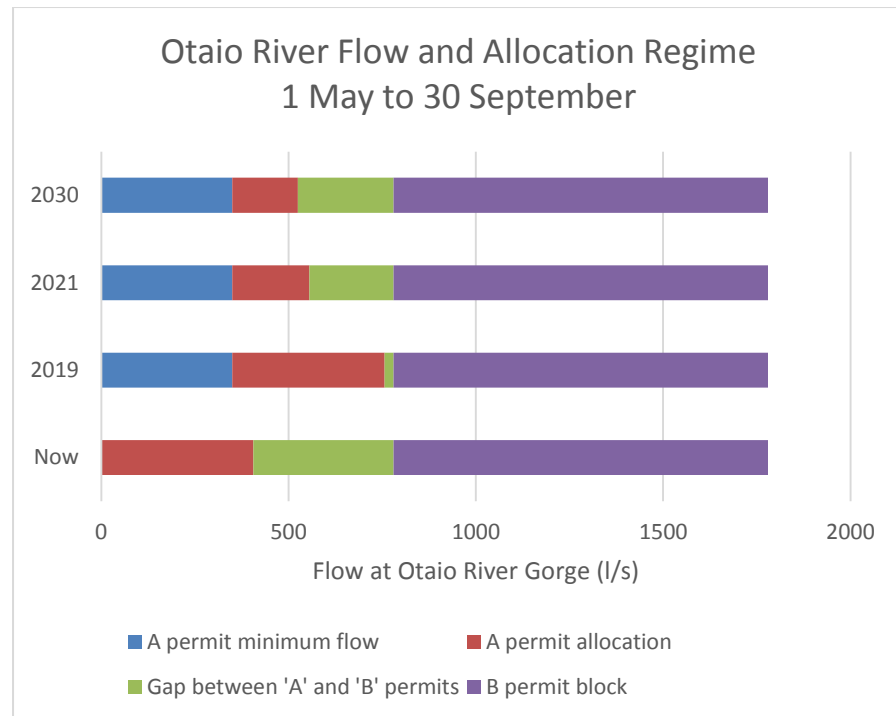


Figure Two: The proposed winter flow regime from now until 2030

13. The implementation of the proposed environmental flow and allocation regime is staged in order to give users time to adjust, and implement any off-set measures that will be required to counter reduced reliability of supply as a result of the minimum flow. In short:

13.1 Users are given until 2019 before the minimum flows and flow sharing regimes apply.

13.2 Allocation does not have to reduce until 2021, and this is done in two stages.

13.3 'B' allocation and Deep Groundwater is available straight away.

14. I would also like to take this opportunity to set out the rationale for the 'B' permit flow and allocation regime. The intention of this block was primarily to be available to existing users to off-set reduced reliability of supply through storage. It could also provide an opportunity for new irrigation to occur in the catchment as well. Hunter Downs Irrigation Scheme is likely to service some of this area, but for properties located in the Blue Cliffs area, it may be physically too far away and too expensive for connection to the Hunter Downs Irrigation Scheme to be viable.

15. Rule 15.5.37 provides an opportunity for 500l/s of this allocation to be taken up by existing 'A' permit holders. These permit holders have until 20 December 2021 to take advantage of this opportunity. 500l/s will also be available for people with no existing permits. Any water not taken by 2021 will be available to any person who may wish to apply.
16. Any abstraction associated with 'B' allocation will inevitably require a water storage pond because the high flows that will allow abstraction do not typically coincide with times of irrigation demand.
17. OWUG submitted on Table 15(j) and requested that the table be amended to include the following advice note:

“All users are to have a minimum flow of 780 l/s, so there is no priority amongst users.”
18. Ensuring there is no priority between 'B' allocation users is an important element of the 'B' flow and allocation regime. The purpose of the block was that water would be shared equally amongst the users. What I have seen occur in other catchments where this hasn't been explicitly provided for is a “stacking system” imposed during consenting. Therefore, for example, the first user applies for a rate of take of 200 l/s, with a minimum flow of 780 l/s. This is granted. The second users also applies for 200 l/s, but this is stacked on top of the first user, so the minimum flow increases for the second user to 980 l/s (being the minimum flow plus the first users rate of take), and on it goes.
19. One issue with the stacking approach is that if the first user's water storage pond is full, and abstraction is not occurring, then other users are still not able to take water until their own minimum flow is reached. OWUG envisaged all of the user's sharing and managing the allocation block by a water user's group to ensure that the 'B' environmental flow and allocation regime was complied with.
20. Ensuring that water can be taken when it is available is important to ensure efficient use of that water. Particularly in times of high flow when 'B' allocation permits can be exercised. Achieving this effectively is a key

component of the allocation package that helps mitigate the loss of reliability as a result of the minimum flow regime.

21. Recognising that the Otaio system is effectively a large complex groundwater system, another important element of the 'B' allocation block was to facilitate aquifer recharge by only allowing the takes to occur during the winter months when flows were above the winter minimum flow, and a corresponding groundwater level trigger. This is detailed in Policy 15.4.28, but has not been carried through to Table 15(j) or the relevant rules. Policy 15.4.28 is as follows:

Facilitate aquifer recharge between 1 September and 30 April by only allowing the abstraction of 'B' allocation block water from the Otaio River when the flow at the Otaio Gorge is above the relevant 'B' allocation block minimum flow limits and the depth to water in bore J39/0255 is higher than 3m below ground level.

22. The trigger level in bore J39/0255 also needs to be included in Table 15(j) and/or the applicable rules. Policy 15.4.28 also needs to be amended to state "bore J39/0255 is LESS than 3m below ground level". This relief was sought by Ngai Tahu and supported by OWUG. The proposed change accurately reflects the intention of the allocation regime.
23. Given that the following changes are proposed. The purpose of these changes is to acknowledge the link between the catchment rules for taking surface water (Rules 15.5.27 – 15.5.37) and Table 15(j).

Rule 15.5.27 – condition (1) reworded as follows:

The take of water does not result in the exceedance of the allocation limit set out for that waterbody in Tables 15(g) to 15(j) inclusive.

Rule 15.5.27 – add a new condition 1A, to be worded as follows:

The take of water is subject to a condition imposing the minimum flow and partial restrictions set out for that waterbody in Tables 15(g) to 15(j) inclusive.

Rule 15.5.27 – add a new condition 1B, to be worded as follows:

In the Otaio catchment any consent to take and use 'B' allocation water be subject to a condition requiring that no abstraction shall occur until the groundwater level in bore J39/0255 is less than 3 m below ground level.

Rule 15.5.29 – Include condition 1A and 1B: therefore:

The take and use of surface water from a surface waterbody listed in Tables 15(g) to 15(j) inclusive, that does not meet one or more of conditions 1, 1A, 1B, or 2 in Rule 15.5.27, is a prohibited activity.

Rule 15.5.34 - condition (1) reworded as follows:

The take of water does not result in the exceedance of the allocation limit set out for that waterbody in Tables 15(g) to 15(j) inclusive.

Rule 15.5.34 - add a new condition 1A, to be worded as follows:

The take of water is subject to a condition imposing the minimum flow and partial restrictions set out for that waterbody in Tables 15(g) to 15(j) inclusive.

Rule 15.5.34 – add a new condition 1B, to be worded as follows:

In the Otaio catchment any consent to take and use 'B' allocation water be subject to a condition requiring that no abstraction shall occur until the groundwater level in bore J39/0255 is less than 3 m below ground level.

Rule 15.5.36 - Include condition 1A and 1B:

The take and use of surface water to out of river storage from a surface waterbody listed in Tables 15(g) to 15(j) inclusive, that does not meet one or more of conditions 1, 1A, 1B, or 2 in Rule 15.5.34, is a prohibited activity.

24. Rule 15.5.37 also needs to be re-drafted for clarity and to ensure that existing 'A' permit holders have access to the 'B' allocation block, and that water is shared equally amongst those who hold a 'B' allocation consent to take and use water. The proposed re-wording of Rule 15.5.37 is as follows:

The take and use of 'B' allocation water in Table 15(j) from the Otaio River is a restricted discretionary activity provided any one of the following conditions 1-3 in conjunction with condition 4 are met:

1. *Where the applicant holds an existing resource consent to take water from the Otaio River 'A' allocation block and*

- a. *The application for consent is received by the CRC prior to 20 December 2021; and*
- b. *Not more than 500l/s from the 'B' allocation block would be allocated in combination with other water permits granted to consent holders who also hold consent for 'A' allocation.*

Or

2. *Where the applicant does not hold an existing resource consent to take water from the Otaio River 'A' allocation block and*

- a. *The application is received by the CRC prior to 20 December 2021; and*
- b. *Not more than 500l/s from 'B' allocation block would be allocated in combination with other water permits granted to consent holders who do not hold an existing consent for 'A' allocation.*

Or

3. *The application is received by the CRC after 20 December 2021 and the 'B' allocation block is not fully allocated;*

And

4. *In each case consent is also obtained for the take of surface water under Rule 15.5.27, 15.5.28 or 15.5.34, 15.5.35.*

25. Finally there is a footnote at the bottom of Tables (g), (i) and (j) respectively, which provides an explanation for the term 'pro rata'. In my opinion, the use of a pro rata system helps address my concern regarding stacking of consents creating higher de facto minimum flows for some consents. However, it needs to be clear. Unfortunately the current provision is not as clear as it could be. I propose the following amendment for the foot note:

Take rates allowed to be taken by individual consent holders during pro rata restriction flows are calculated using the following formula:

$$\text{Pro rate of take (l/s)} = (\text{actual flow (l/s)} - \text{minimum flow (l/s)}) \times (\text{individual consented rate of take (l/s)} / \text{allocation rate of take (l/s)})$$

'Actual flow' for the relevant waterbody shall be obtained from the CRC website and determined in accordance with Schedule (x)

26. Schedule (x) is a proposed new schedule which will provide certainty for how the actual flow is determined for the purpose of pro rata restrictions. To consistency it could also be applied to the stepped restrictions in Table 15(i). This information is currently available from the Council. In my opinion, this methodology needs to be included in the Plan to provide certainty for all parties. The proposed Schedule (x) is as follows:

River flow and restriction information for the following day will become available:

- *For rivers whose flow is calculated via a telemetered river flow sites at 3pm; and*
- *For rivers whose flow is gauged or assessed by staff in the field at 5pm.*

The actual flow rate shall be equivalent to the 24 hour mean flow for the previous day, being midnight to midnight.

Consent holders operating an irrigation device that requires a manual shut off, may can continue to irrigate until 9 am even though technically water take is on restriction from midnight. This enables consent holders to safely get out and turn off/adjust the device anytime between midnight and 9 am.

When the irrigation restriction is removed or adjusted, a consent holder cannot turn the device on at midnight if it did not cease at midnight. For example, if a consent holder turned their device off at 6am on a restriction day, they must wait until 6am on a non-restriction day to turn it on.

THE IMPACTS OF REDUCED RELIABILITY OF SUPPLY

27. There is no doubt that implementation of the minimum flow restrictions will severely impact on the reliability of supply for existing users.
28. Reliability of supply is of critical importance for irrigation for a number of reasons:
 - it allows for more efficient use of water,
 - it provides for medium and long-term investment certainty, and
 - in otherwise drought-prone areas such as North Otago and South Canterbury it provides stability to the local community through improving outcomes in the social and economic areas of wellbeing.
29. Reliability of water supply is important not only from a farm-economics standpoint, it also drives greater water use efficiency. Farmers that face random restrictions on run-of-river schemes attempt to keep their soil moisture profile as full as they can because they are anxious that they may be restricted at any time. A "just-in-time" approach is the most efficient, as water use is determined according to soil moisture deficit and plant growth requirements, rather than the availability of water. This uses less water and reduces the risk of over-watering leading to wastage of water leaching through the soil. This also reduces the risk of contaminants entering groundwater.
30. It should be noted that reliability of supply is not just about instantaneous rate of take and the availability of water at any given time. It is also about the ability to use water across the entire irrigation season when it is needed. This can be affected by the amount of water able to be abstracted under resource consent conditions relating to annual volume.

31. As a general guide, the following average irrigation season reliability assessments apply:

100%	Very good reliability
94-99%	Good reliability
87-94%	Marginal reliability
<87%	Poor or very poor reliability. ³

32. Reliability of supply for OWUG is currently around 65%, therefore poor to very poor. This is largely caused by the self-limiting nature of the existing water takes. Currently as water levels in the river and aquifer drop permit holders are unable to extract their full allocation (either rate or volume). Their ability to access water is throttled by the nature of the hydrological system.

33. However, their current permits allow them to continue to take water throughout the season. Lower volumes of water still help sustain their pasture and crops. This is in contrast to the proposed allocation package which will completely cut off supply when the river is at 90 l/s. This will reduce the reliability of supply to 51%.

34. The impacts of this reduced reliability of supply were discussed at length throughout the development of the proposed environmental flow and allocation regime. The farmers in the catchment were very reluctant to accept the proposed summer minimum flow of 90 l/s, and initially advocated for a minimum flow of 70 l/s.

35. The fact that no water may be extracted below 90l/s has significant implications and is a stark contrast between the current self-limiting arrangement and the proposed allocation regime.

36. However, in keeping with the collaborative nature of the process, a summer minimum flow of 90 l/s was adopted. However the acceptability of this

³ Ian McIndoe, Aqualinc, on behalf of the Waitaki Irrigators Collective, WCWARP PC3

minimum flow is dependent on a suite of other mechanisms that allow OWUG to mitigate against the reduced reliability.

37. These off-set measures, and the need to recognise them as part of the overall solutions package, are detailed further in this evidence, and are as follows.

Enabling the use of the Deep Groundwater

38. Table 15(l) creates a new allocation of deep groundwater. It is intended that holders of permits for surface water or stream depleting ground water could 'swap' to deep groundwater. This is one of the off-set options available to some OWUG members. Table 15(l) sets the allocation available from deep groundwater at 2.65 million m³ per year. There is no explanation for how this allocation has been calculated.
39. It must be noted, that in the same way that Hunter Downs Irrigation Scheme is not a viable alternative for some users, deep groundwater is the same. Deep groundwater resources in the catchment are geographically limited, with the chances of finding a reasonable rate and volume most likely in the area within a few kilometres of State Highway One. Therefore this may be available for some OWUG members lower in the catchment, but unlikely to be an option for those users around Blue Cliffs and Esk Valley.
40. As stated earlier in this evidence, the first allocation reduction at 2021 is 200 l/s. When looking at the consents in the catchment, and with advice from OWUG, it was considered that the reduction in allocation was possible with some permit holders transferring their takes to deep groundwater. Bearing in mind that this option is the primary mechanism for reducing the surface water 'A' allocation.
41. It must be acknowledged at this point that surface water and groundwater are allocated differently. Surface water is allocated on an 'l/s' basis, and groundwater is allocated on a 'volume per year basis'. Therefore, groundwater allocation is not dependant on rate of take. Rate of take from groundwater is more of a matter to be managed between the consent holders and addressing drawdown effects.

42. Currently rule 15.5.32, condition (4) requires that the point of abstraction is within the same groundwater allocation zone as the existing take and there is no increase in annual volume (emphasis added). Condition (6) states that the annual volume and maximum rate of take has been calculated in accordance with Method 1 of Schedule 10⁴, moderated to take into account climatic data.
43. Method 1 of Schedule 10 is as follows:
- “Records of past use, moderated to ensure the annual volume is sufficient to meet demand conditions that occur in nine out of ten years for a system with an irrigation application efficiency of 80%.”
44. Policy 15.4.23 provides further directive on this and clause (c) states that the rate and annual volume are based upon reasonable or demonstrated use calculated in accordance with Schedule 10. In my view condition (6) does not implement policy 15.4.23 as it focusses only on past use, not reasonable use
45. Paragraph 12.70 (page 226) of the section 42A report provides comments on submissions and states that the policy is to enable a simple swap from surface water to deep groundwater. If that is the case the volumes and rates should be the same as the existing permit (so long as the existing permit represents reasonable use (i.e. efficient use of water)).
46. The approach stated in the section 42A report does not incentivise a consent holder to swap from surface water to deep groundwater. In fact the effect is probably a disincentive to swap because it requires transfer to a more expensive water source for no improved reliability.
47. All of the irrigation permits in the Otaio Catchment were granted following a hearing in 1992. Unlike a resource consent granted today, which would have a plan attached to it showing the area to be irrigated, these consents

⁴ Of the LWRP.

only reference a land area to be irrigated in the descriptor. The only other restriction they have is a seven day volume.

48. Records of past use alone can present significant difficulties for determining annual volume. In 1992 when the Otaio consents were granted, there was no requirement for takes to be metered, therefore, these takes have only been metered since 2013. Two years' worth of data is not adequate to determine a volume that is sufficient to meet demand conditions that occur in nine out of ten years. Also, past use on self-limiting takes, with already poor reliability of supply, is not a reflection of actual demand or the volume required for optimal efficiency.
49. Therefore the volume that can be transferred to deep groundwater should be based on efficient water demand going forward. This is Method Three of Schedule 10.
50. It must also be noted that if a user was to apply for surface water 'B' allocation, then the same restriction of 'demonstrated use' does not apply to them. The only comment on this in point (3) in the matters of discretion for Rule 15.5.37 which is:

“Whether the amount of water to be taken and used is reasonable and demonstrates efficient use of water for the proposed use”.
51. This is a significant discrepancy as the surface water 'B' allocation could, in time, be taken up by a new user who would obtain a higher level of reliability than an existing water user who has gone to deep groundwater. This is a perverse outcome. Particularly when the transfer to deep groundwater is the mechanism that results in the surface water 'A' allocation actually being reduced. Therefore, it is critical that transfers to deep groundwater are facilitated in order to achieve implementation of the flow and allocation package.
52. One matter I do accept is that the intention of transferring to deep groundwater is not to enable wholesale expansion of irrigation area. The transfer to deep groundwater should be to enable the same area of land to be irrigated reliably and efficiently.

53. Therefore I consider that condition (6) of Rule 15.5.32 should be amended as follows:

The annual volume has been calculated in accordance with methods 1, 2, or 3 of Schedule 10, for the area of land to be irrigated using deep groundwater, which must be no greater than the area specified on the existing lawfully established surface water or stream depleting groundwater permit.

54. Policy 15.4.23 should be amended to read:

Surface water flows are improved by enabling an applicant to take deep groundwater provided the applicant holds a lawfully established surface water take or stream depleting groundwater take permit. A deep groundwater take may only be authorised for the area of land, or a portion of the area of land, specified on the existing lawfully established surface water or stream depleting groundwater permit, and the surface water take or stream depleting groundwater take for the area to be irrigated by deep groundwater is surrendered provided:

- (a) there are no stream depletion effects; and*
- (b) the allocation limit described in Table 15(1) is not exceeded; and*
- (c) the annual volume and maximum rate of take is based upon reasonable or demonstrated use calculated in accordance with Schedule 10; and*
- (d) the term of the consent aligns with Policy 15.4.35.*

55. An example of this is as follows:

CRC920689

To take up to 34,927 cubic metres of water per week at a maximum rate of 63 litres per second from water holes adjacent to the Otaio River, at or about map reference J39:610-291 for spray irrigation of 200 hectares of crop, pasture and horticulture.

Subject to the following conditions:

1 The hours and rate at which water is taken shall be measured and recorded weekly in a log book kept for that purpose, and a copy of the records submitted to the Canterbury Regional Council before 31 January and 31 May, for the periods August-December inclusive and January-April inclusive respectively.

2 The conditions of this permit may be reviewed by the Canterbury Regional Council for the purposes of:(a) Dealing with any adverse effect on the environment which may arise from the exercise of this permit which is appropriate to deal with at a later stage, or (b) Enable a water sharing regime, as determined by the Otaio River Water Users Committee and the Canterbury Regional Council, to be implemented. A decision on whether or not the conditions will be reviewed will be made on the last working day of June each year.

56. The specified irrigation area is 200 hectares. Using Method Three of Schedule 10, I have calculated an annual volume of 768,899 cubic metres per year. To efficiently irrigate this area, a rate of take of 93 l/s is required. Therefore, if this user drills a bore that is capable of yielding 93 l/s, then they should be able to seek a consent for this rate, with an associated volume for the 200 hectares able to be irrigated by CRC920689.

57. Allowing 93 l/s to be abstracted from deep groundwater does not affect the deep groundwater allocation (as it is based on cubic metres per year), but it does provide the user with the incentive to go to deep groundwater and fully utilise the water that the bore yields and most efficiently using the resource that comprises the bore infrastructure.

Is the allocation deep groundwater allocation for the Otaio Zone sufficient?

58. I have previously assessed the required deep groundwater allocation for OWUG members. I did this during the zone committee process. I suggested an allocation of 3 million m³ per year. This assessment was provided to the

Canterbury Regional Council. The draft plan allocates 2.65 million m³ per year. There is no explanation as to how that allocation was determined.

59. It is my view that the allocation of 2.65 million m³ per year in Table 15(l) is not a sufficient volume for the transfer of surface water permits to deep groundwater. The allocation should be 3.00 million m³ per year as per my assessment. I understand that the evidence of Mr de Joux confirms that such an allocation volume is available within the deep groundwater resource. My assessment of this is appended to this evidence as **Attachment Two**.

The Otaio Groundwater Allocation – Table (k)

60. The Otaio Groundwater Allocation is considered by the Canterbury Regional Council to be fully allocated. I undertook a detailed desktop assessment of the allocation for the zone during the zone committee process and this was provided to the Council.
61. It is noted that the allocation inserted into Table 15(k) for the Otaio Groundwater Allocation zone is 6.95 million m³ per year, and on page 309 of the section 42A report, it is referenced that my assessment of allocation was used. However, my assessment determined a current total allocation of 4.61 million m³ per year. Once again I cannot determine from the information available to me why there is a discrepancy in these numbers.
62. My desk top assessment is appended to this evidence as **Attachment Three**.

Rule 15.5.30 – To Take and Use Groundwater

63. Rule 15.5.30 is specific to the take and use of groundwater. With the exception of the Waihao Groundwater Allocation Zone, there is no condition in this rule that requires takes from other groundwater allocation zones to comply with the allocation limits or minimum flows set in Table 15(k). This is surely an oversight as the intention of the Table 15(k) limits is to cap allocation at current levels.

64. As it stands, this rule does not prevent the Table (k) limits from being exceeded. This does not seem to be consistent with the scheme set out in the Plan.

Restrictions on Site to Site Transfers

65. Aside from allowing surface water and shallow groundwater permits to be transferred to deep groundwater, restrictions on site to site transfers is the only other mechanism that will help reduce the 'A' allocation for the Otaio River. The reasons for restricting transfers are simple – to prevent presently unused water being transferred to another site, where is then fully utilised. Preventing transfers allows some allocated but under-utilised water to be clawed back.

66. OWUG was clear however, that if prohibition was adopted, it would only be until such time as the 'A' allocation was back within plan limits. This was the approach taken in the Orari River Catchment and is as follows:

“The temporary or permanent transfer, in whole or in part, of a water permit to take or use surface water or groundwater in the Orari catchment, except for Upper Coopers Creek, identified in Map 2 - Orari Catchment, including stream depleting groundwater, is a prohibited activity until allocation limits in Table 15 are met.”

67. Rule 15.5.40, as originally notified, resulted in a blanket prohibition of site to site transfers for all takes unless the transfer is to be used for community supply.

68. There were several submissions received on this rule. In the section 42A report, the Canterbury Regional Council concluded that perhaps a blanket prohibition was not an appropriate solution, and that restricting the volume able to be transferred to that which has been abstracted over the past two years had merit. The balance (unused portion) is then surrendered.

69. I agree that restricting transfers rather than a blanket prohibition does have merit.

70. In my view, before any transfer is authorised the following matters need to be addressed:

70.1 That the use of water at the new site is reasonable for its intended purpose;

70.2 All potential effects at the new site are addressed, including effects such as well interference; and

70.3 The transfer will not give rise to any cumulative adverse effect, including reducing the reliability of supply for any other lawfully established water take.

71. I therefore propose the following wording for Rule 15.5.40.

The permanent or temporary transfer, in whole or in part (other than to a new owner of the site to which the take and use of water relates and where the location of the take and use of water does not change) of a water permit to take and use surface water or groundwater, is to be considered as if it is a discretionary activity where the following conditions are met:

- 1. The reliability of supply for any other lawfully established water take is not reduced; and*
- 2. The water permit has been exercised by the permit holder within the last two years; and*
- 3. The maximum amount of water to be transferred does not exceed the lesser of the volume of water which is reasonable for the intended use calculated in accordance with Schedule 10, or the volume that the permit holder has demonstrated that they have abstracted on average each year over the last two years; and*
- 4. In the case of surface water, the point of take remains within the same surface water allocation zone catchment and the take complies with the allocation limits and minimum flows and partial restrictions set in Tables 15(i) to 15(j); and*
- 5. In the case of groundwater:*

- (a) *the point of take is within the same groundwater allocation zone; and*
- (b) *the bore interference effects as set out in Schedule 12 of the Land and Water Regional Plan are acceptable; and*
- (c) *in addition for stream depleting groundwater takes:*
 - (i) *the transfer is within the same surface water allocation zone catchment; and*
 - (ii) *the take complies with the allocation limits and minimum flows and partial restrictions set in Tables 15(i) to 15(j); and*
 - (iii) *the stream depletion effect is no greater in the transferred location than in the original location*

Rule 15.5.40A - The permanent or temporary transfer of water permits which does not comply with Rule 15.5.40 is a prohibited activity.

THE TAKE AND USE OF WATER FOR DOMESTIC AND STOCKWATER PURPOSES

72. As stated earlier in this evidence, the allocation limits for the Otaio River have been determined by calculating the rates allocated by existing resource consents to take and use water. Therefore, permitted uses (such as those taking water for domestic and stock water, relying on the provisions of S14(3)(b) of the RMA) have not been included within the allocation limits.
73. Also all of the discussions that have taken place between Ecan and stakeholders regarding the allocation regime is on the basis that the allocation limits relate to irrigation supply only, all of which are consented takes. It is noted that during the allocation discussions, a conscious decision was made not to include CRC981876.1 held by Waimate District Council in the allocation calculations because it is for community supply purposes and should not be made to comply with allocation limit and minimum flow and partial restriction flow regime.

74. Adding stock and domestic supply into the mix at this point represents a dramatic change to the regime.
75. The Canterbury Regional Council has also indicated how it considers the provisions of S14(3)(b) apply, and in many instances, council's interpretation would mean that, if the rate and volume required exceeded permitted activity limits, resource consent would be required.⁵ Once again this is a significant departure from the previously understood situation.
76. As it stands, there are no permitted activity rules in relation to the take and use of water for small rates and volumes in Plan Change 3. In paragraph 12.176 of the section 42A report, it is stated that Regional Rules 5.113 – 5.115 still apply in the area covered by Plan Change 3. On my reading of the Plan Rule 5.111 and 5.112 will also apply where relevant.
77. However, there is some ambiguity over which Regional Rules actually do apply. Taking the approach outlined in the section 42A report, for the Otaio Catchment, a rate of take of not more than 5 l/s, with a volume not exceeding 10 m³ per day is permitted under Rule 5.111 for a surface water take. In contrast, a rate of take of not more than 5 l/s, with a volume not exceeding 100 m³ per day is permitted under Rule 5.114 for groundwater takes, provided the property is greater than 20ha in area.
78. Is a shallow groundwater take a groundwater take for the purposes of the permitted activity, or is it a surface water take? The difference in permitted volumes is significant.
79. It is also noted that the interpretation notes that accompany these rules in the Regional Plan state that:
- Nothing in this Plan affects an individual's right to take water in accordance with section 14(3)(b) of the RMA.
80. Requirements vary greatly depending on the size of the farm and the number of houses being serviced on farm. The Lincoln University Farm Technical Manual specifies the following domestic and stock water requirements for farms:

⁵ As set out in Section 6 (paragraphs 6.255 – 6.258) of the S42a report.

3,000 litres per day for a dwelling

<u>Animal</u>	<u>litres/head/day</u>
Dairy cattle – lactating	70
Dairy cattle – dry	45
Beef cattle	45
Calves	25
Horses – working	55
Horses – grazing	35
Breeding ewes	3
Sows	25
Pigs	11
Poultry – per 100 birds per day	30
Turkeys – per 100 birds per day	55

81. For a station at the head of the Otaio Gorge, with seven dwellings, 2,771 cattle, 25,112 sheep, 60 horses and 200 goats, the daily domestic and stock water requirement is a maximum rate of 4.9 l/s, with a volume of 238 m³ per day. For this property, there are no alternative supplies of water to the property as groundwater is not available in the area, and there are no existing community water schemes. The station has been in the same family ownership for over 100 years.
82. The station owners trade as a limited liability company, and therefore under Council's interpretation of an 'individual' section s14(3)(b), cannot be relied upon to supply water to the farm.
83. Its supply is surface water from the Otaio River. The volume required exceeds the permitted volume specified in regional rule 5.111, therefore consent is required.
84. Rule 15.5.29 of Plan Change 3 states prohibits any application to take and use surface water in the instance where the take exceeds the limits set out for the waterbody listed in Tables 15(g) to 15(j) inclusive.
85. The limit of 406 l/s for the Otaio River only includes currently consented water takes (i.e. irrigation supply). Therefore, to grant such an application for 4.9 l/s and 231 m³/day for domestic and stock water purposes, even

though the owners has previously been abstracting this water under the provisions of s14(3)(b), is prohibited as it would result in the allocation limit of 406 l/s being exceeded by 4.9 l/s.

86. To use another example, another Otaio property uses a shallow groundwater take for domestic and stock water purposes. This has been occurring for at least 20 years under the current ownership of the farm. The farm is owned by a family trust, and therefore under Council's interpretation of an 'individual' s14(3)(b), cannot be relied upon to supply water to the farm.
87. It only has a single dwelling, and with stock water requirements for 150 calves and 150 beef heifers, the daily demand is only 2 l/s, with a volume of 13.5 m³/day. The property is 80ha in area.
88. Under regional rule 5.114 for groundwater takes, given the property is greater than 20ha, the permitted rate and volume is 5 l/s and 100 m³ per day respectively. Therefore, the take would meet the permitted activity conditions and no resource consent is required. But the take is highly hydraulically connected to the Otaio River. Therefore is it a stream depleting take that would count against the allocation for surface water? If so, it exceeds the permitted volume for surface water of 10 m³ per day and consent is required. This is prohibited under plan change 3, as it would result in the allocation of 406 l/s being exceeded by 2 l/s.
89. In the Otaio Catchment alone, I estimate domestic and stock water requirements to be between 1,000 m³ and 1,100 m³ per day, with a rate of between 39 l/s and 65 l/s, which is being abstracted currently. This is based on my knowledge of the farms in the catchment, their land use, and applying the Lincoln Manual domestic and stock drinking water requirements to those properties.

UPDATES TO OVERSEER

90. There is considerable discussion on the topic of updates to Overseer in the section 42A report (commencing at paragraph 10.28, page 111). Submitters have raised concerns regarding the changes to Overseer versions resulting in different nitrogen leaching rates, such that targets or limits specified in the Plan are unable to be met despite improvements in farming practices. The

consequence of this is that it may increase the number of consents required, and prohibit a wider range of farming activities than is necessary or was anticipated.

91. I understand from Ecan that the nitrogen limits in Tables 15(m) and 15(n) have been updated using the latest version of Overseer (6.2) and that this resulted in very little change to the load limits calculated in the previous version of Overseer (6.1.3).
92. In the Section 42A report, it has been recommended that a new policy be added to provide direction to those implementing the plan. This is set out at paragraph 10.42 of the Section 42A report. The purpose of the new policy is to provide some discretion over the absolute loss number, taking into consideration updates to the Overseer model. In my view, a policy of this nature places unjust onus on an applicant to demonstrate that such limits are being exceeded as a result of a version change in Overseer, a circumstance which has occurred and is completely out of an applicant's control. I have further concerns with the use of such a policy to address Overseer version changes, and I will address these as follows.

The change from Overseer 6.1.3 to Overseer 6.2 in respect of Table 15(m) and 15(n)

93. The Overseer model has been developed by New Zealand scientists over the past 25 years to assist farmers and farm advisors to understand nutrient use and movement within the farm system so production is optimised and environmental impacts are minimised.
94. Because Overseer is a model, it provides estimates of nutrient use and movement, not absolute and exact measures. It's a model driven by production primarily because production is a straightforward parameter for farmers and farm advisors to either predict or to measure. As Overseer evolves, those estimates of nutrient use and movement also change. The need to continue to refine Overseer and recognise the uncertainty inherent in an evolving model must be accommodated in any application of Overseer output.

95. The other critical factor to acknowledge is that Overseer does not predict nutrient losses to ground water. It predicts losses below the root zone.
96. Overseer 6.2 was released in April 2015. Whilst previous version changes with the prefix 6 were primarily to fix bugs within the model (and therefore resulted in insignificant changes to outputs), Overseer 6.2 over-hauled how irrigation was modelled within Overseer.
97. The consequence of that has been a significant increase in modelled losses from Overseer, with the largest increases being seen on light soils and under rotorainer, k-line and border-dyke irrigation.
98. Literature states that losses have increased by at least 25% and greater. For farms that Irricon has carried out Overseer modelling for, the average increase between the versions was 39%. I refer you to **Attachment Four** of this evidence for the results of the Irricon modelling.
99. The use of Overseer 6.2 requires significantly more detail on the type of irrigation and how it is managed. The section 42A report states that, to update the load limits in Tables 15(m) and 15(n), they were guided by the narrative requirement to “operate at good management practice as set out in Schedule 24b” of Plan Change 3.
100. The only clause in Schedule 24b that would affect Overseer 6.2 inputs is the requirement for irrigation applications to be undertaken in accordance with property specific soil moisture monitoring, or a soil water budget, or an irrigation scheduling calculator. It does not specify irrigation type.
101. From Table in **Attachment Four**, you can see that all systems selected met the requirements of Schedule 24b in that either soil moisture monitoring or a soil water budget were used to determined irrigation applications. However, it is the type of irrigation is different in the farming systems above, and this clearly has an impact on the calculated losses in Overseer 6.2.
102. Figure three below shows a Decision Tree for Overseer 6.2. On the right hand side, for those who monitor soil moisture, there are two options stemming from “how soil moisture data is used”. These two options are to “use defaults” or to “enter management data”, for which there are three options.

Decision tree

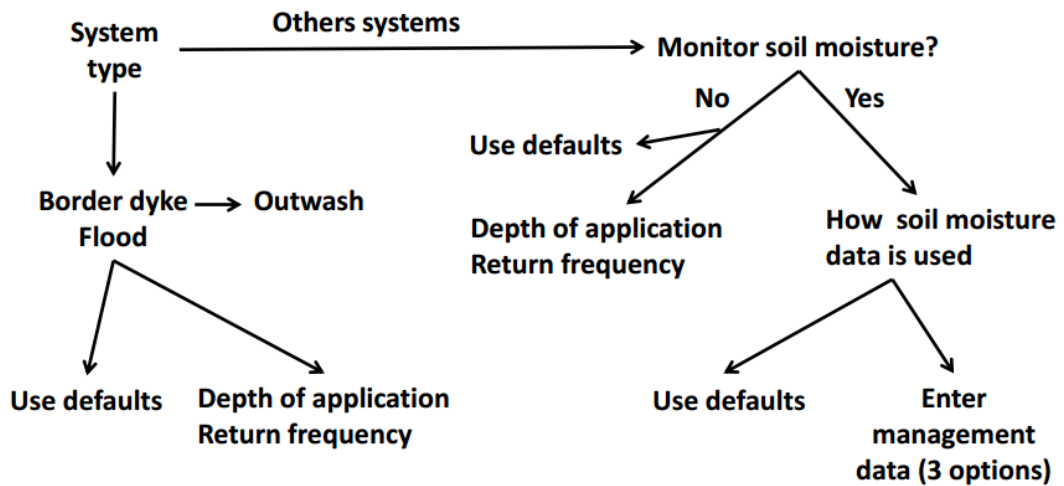


Figure Three: Overseer 6.2 Decision Tree

103. The management options are varied, ranging from fixed depth applied at a trigger point (which can be a percentage of Profile Available Water (PAW) or deficit (mm), to a depth applied to achieve a target, with a trigger point.
104. Therefore, Overseer 6.2 outputs are sensitive not only to the type of irrigation system, but to the also the soil moisture management options.
105. Given this, I have concerns about the fact that Council states that the limits in Tables 15(m) and 15(n) “resulted in very little change” between Overseer 6.1.3 and Overseer 6.2.
106. This is then been exacerbated by the fact that load limits in Table 15(p) have not been updated to account for the new N loss figures. I understand the load limits have been calculated by extrapolating losses predicted by Overseer (using version 6.0) minus an adjustment for attenuation. Again, the solution promoted in the section 42A report is to provide for a new policy that acknowledges version changes and that this should be taken into account when testing exceedance of the load limits.

107. This means a disconnect in the models used to determine the load limits set for the farms and the catchments, which if updated, would change significantly from the current limits specified in Plan Change 3.

The impacts of a fixed limit from a consenting point of view

108. In my opinion a policy is not sufficient to address the issues with the changing versions of Overseer. This approach is not robust. Particularly in the context of this plan where the consequence of a breach of the limits may be prohibited activity status. No policy can overcome that.
109. To highlight this point, I would like to refer you to Rule 15.5.11, which is specific to the discharge of nutrients onto it into land within the command area of an irrigation scheme. The first condition of the rule is that the nitrogen load limits in Table 15(p) are not to be exceeded.
110. Rule 15.5.12 then makes the activity prohibited in the instance that any of the conditions of Rule 15.5.11 are not met. Given that the load limits in Table 15(p) are still numbers derived from Overseer 6.0, it is a very real possibility that the catchment loads could be exceeded when they are calculated using the latest version of Overseer. Having said that it is very difficult to understand how the catchment loads have been calculated.
111. From a compliance point of view, fixing the limits means that every time Overseer changes (and the next update is due in November 2015), every farmer will have to re-run Overseer for their farm, and as a result of the change in modelled N loss, the need for a consent is triggered because the limits in Tables 15(m) or 15(n) are now exceeded. This is despite the fact that their activity has not changed. This framework creates significant uncertainty.
112. A farmer is then put in a position where they are operating in breach of the Plan until they obtain consent (although in some instances this may be impossible). The onus is then on the farmer, as the applicant, to justify to the Council, that its exceedance of the load limits is in fact acceptable, because it has occurred as a result of a model change.

Solution

113. OWUG submitted that load tables (15(m), 15(n) and 15(p)), need to be updated every time Overseer is updated. This can be done through the establishment of benchmark files, which are effectively the original Overseer files used to determine the limits in the first instance. The load limit tables are maintained and updated by the Council. For transparency the benchmark files could be incorporated into a schedule within the Plan.
114. This is the approach that will be taken for Plan Change 5, which will update GMP loss figures with every update of Overseer.

NUTRIENT RULES

115. I have reviewed the nutrient rules within the Plan and suggest some minor changes to improve clarity.
116. Rule 15.5.3 - The format of the nutrient management rules generally uses the terminology "...that does not meet one or more of conditions..." However, Rule 15.5.3 uses the terminology "...that does not meet any of the conditions of Rule 15.5.2 excluding conditions 1(a), 1(c), or 4 of Rule 15.5.2."
117. I suggest it be redrafted as follows:
- "...that does not meet conditions 1(b), 2, 3, or 5 of Rule 15.5.2, is a restricted discretionary activity provided the following condition is met."*
118. Rule 15.5.5 then applies to applications that do not comply with conditions 1(a), 1(c) or 4 of rule 15.5.2.
119. Defined terms, where they are used in rules or policies, have a capital letter at the start of each word. In the effort of maintaining consistency, the term Nitrogen Baseline, which is also a defined term, requires capitalisation throughout the plan. This will improve clarity for plan users by signalling to them that they must refer to the definitions.

CONCLUSIONS

The Proposed Otaio Environmental Flow and Allocation Regime

120. Throughout my evidence, I have highlighted areas where changes are required to ensure that the intentions of the agreed 'solutions package' for the

Otaio River are actually reflected in the plan, are articulated clearly and provide certainty.

121. This is important for the members of OWUG who have agreed to a flow and allocation regime that will, undoubtedly affect their reliability of supply. The members are reliant on the package options available to them, such as the ability to transfer to deep groundwater, or take surface water 'B' allocation into storage, in order to offset reduced reliability of supply.
122. I also believe that there is an issue with how The Canterbury Regional Council has indicated it considers the provisions of s14(3)(b) apply, and in many instances, council's interpretation would mean that, if the rate and volume required exceeded permitted activity limits, resource consent would be required. However, in the instance that the catchment limits (Table 15(h)) or groundwater allocation zone limits (Table 15(k) or 15(l)) are exceeded, then it is prohibited to apply for resource consent. The implications of stock and drinking water being included within the allocation blocks for the catchment has not been adequately assessed as it was not the intention during the zone committee process.

Overseer and Nutrient Management

123. My evidence brings to the Commissioners attention the issues with Overseer being updated regularly. From a regulatory perspective, the solution proffered in the Section 42A report to address this issue, being the inclusion of a new policy, does not adequately address the uncertainty that changing versions creates in a resource consent environment, and the onus that such an approach places on an applicant to "prove their case".
124. I also have questioned the fact that the updated Table 15(m) and 15(n) N loss figures, are unchanged as a result of changing from Overseer 6.1.3 to Overseer 6.2. Results obtained indicate that the differences between the two models are significant, with increases in the order of 38%.
125. A disconnect exists between the load limit tables in the plan and the version of Overseer used to determine that limit. This is the case for Table 15(p) whose limits were determined using Overseer 6.0, whereas Tables 15(m) and 15(n) have used Overseer 6.2.

126. It is my view that the where Overseer limits are used in the plan, they must be updated every time that Overseer changes. If they are not, operators who may be permitted one day may become prohibited the next. This level of uncertainty is untenable.

Keri Johnston

A handwritten signature in black ink, appearing to be 'KJ', written over a faint, illegible background.

Date 25 September 2015

Attachment One – Otaio Catchment ‘A’ permit allocation

Consent	Holder	Allocation to be included (Ecan) (L/s)	Comment	SW 7 day average rate, or GW hydraulically connected rate (L/s)	Seven day volume (m3)	Full Annual Volume
CRC150947	AL McAlwee	12	Hydraulically connected groundwater	12	7,258	241,828
CRC093171	Murphy Farms	13.7	Hydraulically connected groundwater. Has deep GW consent, but large enough area for there to be no overlap.	13.7	8,286	207,433
CRC921001 C.1	McIlraith	55	Max rate of 55 L/s. 7 day rate average = 45.9 L/s, From a tributary of the Otaio. Irrigation of 133 hectares. Also has deep GW consent.	45.9	27,760	582,528
CRC920659.1	Stoneleigh	22.9	Waterhole 145m from Otaio, so hydraulically connected.	25	15,120	395,385
CRC920689	Gary Johnston	37.3	Max rate of 63 L/s. Waterholes 198m from Otaio, so hydraulically connected. Irrigation of 200ha - also has deep GW consent.	37.3	22,559	768,899
CRC146437	Otaio Farm Limited	30	7 day rate average = 24.8 L/s, From the Otaio. Was CRC920905. Irrigate 60 hectares. Area = 69.4 ha and AV = 437676. Therefore, 60/69.4 x 437676 = 378394	24.8	14,999	378,394

CRC144170	Scott	60	AV = 7 day rate average = 50 L/s. From tribs of the Otaio. Has deep GW consent but enough land area for there to be no overlap. This consent irrigates 108ha.	50	30,240	661,045
CRC920866 B.2	Porter	30	7 day average = 16.5 L/s. From tribs of the Otaio. Irrigate 81 hectares. AV calculated using legal descriptions on consent. AV for total area of 120 ha = 732582, therefore, $81/120 \times 732582 = 494493$	16.5	9,979	494,493
CRC920874	Rathgen	60	7 day average = 53.7 L/s. From the Otaio. Irrigate 130 hectares. Also has deep GW consent which overlaps this area, and allows 204 ha to be irrigated. AV for 204ha = 791525, so $130/204 \times 791525 = 504403$	53.7	32,478	504,403
CRC920906. 1	Ritchie	30	7 day average = 18.2 L/s. From the Otaio. Enough water to irrigate 39 hectares. AV whole farm of 84.41ha = 517252, therefore $39/84.41 \times 517252 = 238986$	18.2	11,007	238,986
CRC981876. 1	WDC	0	7 day average = 10.75 L/s. From the Otaio. AV daily volume x 365 days. Agreed rate not be included in allocation.	0	0	0
CRC136604	Glen River Farm	55	7 day average = 45.8 L/s. From tribs of the Otaio. Irrigation of 113ha.	45.8	27,700	691,508
TOTAL		405.9		342.9	207,386	5,164,90 2

Attachment Two – Calculation of Deep Groundwater Allocation Required (Table 15(I))

Current allocation 406 l/s, but restricted by seven day volume, therefore average rate of take 343 l/s.

Reduction required to reduce allocation to 206 l/s = 200 l/s. Seven day restrictions do not apply when allocation is 206 l/s.

Volume taken from Otaio – 5,164,069 cubic metres per year.

Therefore:

$200 / 343 \times 5,164,069 = 3,011,119$ cubic metres, rounded to 3,000,000 cubic metres for ease.

Attachment Three – Deep Groundwater Table 15(k) allocation

ConsentNo	Holder	Max rate	Max volume	consec days	Consented annual volume	Comment	LWRP Annual Volume (m3)	Amount to be allocated from the GW block (m ³)
CRC011511.1	Mr & Mrs T J & K M Ritchie	25	28,980	14		Has a combined 7 day volume with CRC920906 of 21,445 cubic metres. This is a 7 day rate of 35.5 L/s. So not a non-current condition at all, but a combined condition. No map found, but CRC920906 does contain legal descriptions. Deep GW. Has low system capacity at 2.62 mm per ha per day. Therefore, need to apply system reduction factors. Total AV is 717,391. With system reduction factored in, its likley to be in the order of 510,000 cubic metres. Then need to apportion between SW and GW. Both consents are for 25L/s, but combined cannot exceed 35.5 L/s. Would be fair to say that 25 L/s could be taken under this consent, with balance from SW and vice versa, so $25/35.5 \times 510000$ is 359,155 cubic metres.	359,155	359,155
CRC011840.1	N & R Porter	53.2	4,596	1		SW-CRC920866b.2 the same legal parcel of land. CRC920866b.2 specifes an area of 81 hectares. Have used emap to determine land owned by porters. AV calv done on entire farm area of 121.57ha. This is 527685 cubic metres. Adjustment for only 81 hectares irrigated =	351,587	351,587

						80/121.5 x 527685 = 351587		
CRC021383.2	Tree Hugger Organic Limited	1.3	393	7		- Allocation: This client has another consent, CRC051076, which is held under a company name. This consent has not been included in effective allocation, because it has the smaller irrigation area. - Prev Record: CRC021383.1	See comment	0
CRC021861	Gary Charles Johnston	70	84,672	14		Already calculated. See Keri's other work. This consent and SW consent CRC920689 irrigate a 200 hectares. Between two consents, have a total available of 127 L/s, therefore, 70/127 x 768899 = 421315, but then need to include GW allocation associated with SW consent and this is 192225	613,540	613,540
CRC040053	Ashbourne Farm Limited	62	48,211	9		Consent says 133 hectares irrigated. Whole farm AV is 740862 for 169.15 ha. Adjust for 133 ha irrigated = 133/169.15 x 740862 = 582528. This is also McIlraiths Farm and there is a SW consent for 55 L/s (average 45.9 L/s), which irrigates the same area of land.	582,528	582,528
CRC051076.1	Tree Hugger Organic Limited	10	2,130	7		Already calculated. Combined with CRC021383.2 above. Moderate connection. Full AV - 55519 cubic metres.	55,519	13,880
CRC074123.1	Ross Edward Rathgen	100	7,781	1	1,031,001	Consented AV. Can't see a link with any other consent.	1,031,001	1,031,001
CRC080535.2	Murphy Farms Limited	60	31,500	7	550,000	Consented AV. Also has SW consent, but large enough area for there to be no overlap.	550,000	550,000

CRC152629	Ross Edward Rathgen	94	8,100	1	791,525	Corrected consent number - had CRC080961.1. Consented AV of 761525 - that abstracted under CRC920874.	761525	222,265
CRC080751	Mr J J & Mrs T M Scott	60	5,185	1	258,010	Consented AV. Irrigation of 160 hectares. Whole farm is 248 hectares. Also has SW consent, but area large enough for no overlap.	258,010	258,010
CRC093171	Murphy Farms Limited	25	1,440	1	207,433	Consented AV.	207,433	51,858
CRC136602	Glen River Farm Limited	22.5	22,680	15		Irrigation of 36 hectares. Used emap and Ecan GS to work out area. No overlap with other consents.	222,265	222,265
CRC150947	Alexander Leslie McAlwee	25	1,665	1	241,828	Consented AV. Hydraulically connected GW.	241,828	60,457
						Total	5,234,391	4,316,546

PLUS hydraulically connected GW not accounted for above

291071

GRAND TOTAL

4,607,617

Attachment Four - Differences in modelled losses between Overseer 6.1.3 and Overseer 6.2

Farm	Soils	Irrigation	N loss v6.1.3	N loss v 6.2	% increase
Half irrigated, dairy support, young stock only and beef cattle	Heavy	K-line, 2 x per day shift, soil water budget, trigger point and depth applied to achieve target	5	9	80
Fully irrigated dairy, cows wintered off	Heavy/Light	Rotorainer, Centre-pivots – soil moisture probes, fixed rate of return	29	41	41
Partially irrigated dairy support	Heavy/Medium/Light	Centre-pivots – soil moisture probes, fixed rate of return	23	34	48
Fully irrigated dairy farm, cows wintered off	Heavy	Centre-pivot/k-line – soil water budget, fixed rate of return	26	32	23
Full irrigated Dairy farm, cows wintered off	Light	centre pivot – soil moisture probes, trigger point and depth applied to achieve target	34	35	3
				Average Increase (%)	39