IN THE MATTER	**of the Resource Management Act 1991 and the Environment Canterbury (Temporary Commissioners and Improved Water Management) Act 2010**
AND	
IN THE MATTER	**of the hearing of submissions on the Proposed Land and Water Regional Plan**
BY	**IRRIGATION NEW ZEALAND INCORPORATED** and **FEDERATED FARMERS OF NEW ZEALAND INCORPORATED** and **HORTICULTURE NEW ZEALAND INCORPORATED** Submitters
TO	**COMMISSIONERS OF THE CANTERBURY REGIONAL COUNCIL** Local authority

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BRIEF OF EVIDENCE OF IAN MCINDOE ON BEHALF OF IRRIGATION NEW ZEALAND INCORPORATED, FEDERATED FARMERS OF NEW ZEALAND INCORPORATED AND HORTICULTURE NEW ZEALAND INCORPORATED

Dated: 4 February 2013

INTRODUCTION

Qualfications and experience

1. My full name is Ian McIndoe. I am a Soil and Water Engineer and hold the qualifications of BE (Hons) from Canterbury University and Dip Bus Stud (Finance) from Massey University. I am currently employed as Principal Engineer, Aqualinc Research Ltd, of which I am a shareholder and director.

2. I have 34 years' experience in water resources and irrigation related work. I have specialised in water allocation for irrigation and the effect of water restrictions on irrigation reliability and performance.

3. I am also an expert in irrigation design and irrigation efficiency, and have provided information and recommendations to Regional Councils covering several subjects including seasonal allocations, irrigation efficiency and irrigation reliability to help Councils formulate their policies.

4. From 1984-90, I was the Ministry of Agriculture's water resources specialist involved in surface and groundwater allocation and management, including preparing the Ministry of Agriculture submissions on several water plans in Canterbury and other areas in New Zealand.

5. Since 1990, I have been engaged by many client groups to present technical evidence related to preparation of most of the water-related plans in Canterbury, such as the Natural Resources Regional Plan (NRRP), the Waitaki Catchment Water Allocation Plan and more recently the Hurunui Water Plan. I have also been engaged by individual applicants and applicant groups to present evidence related to resource consent applications, both in Canterbury Regional Council hearings and in the Environment Court.

6. I am a Member of the NZ Hydrological Society and a Board Member of Irrigation New Zealand.

Code of Conduct

7. Notwithstanding that this is a Regional Council hearing, I have read the Environment Court Code of Conduct for expert witnesses and agree to comply with it.

8. I confirm that I have not omitted to consider materials or facts known to me that might alter or detract from the opinions I have expressed.

SCOPE OF EVIDENCE

9. For this hearing, I have been engaged by Irrigation New Zealand Incorporated ("Irrigation New Zealand"), Horticulture New Zealand Incorporated ("Horticulture New Zealand") and Federated Farmers of New Zealand Inc. ("Federated Farmers"). They made a number of submissions and the matters discussed in my evidence falls within the scope of those submissions. Aqualinc Research Ltd as a company has also submitted on the Plan. Evidence supporting those submissions is being presented by Mr Matt Bubb. I have discussed the Aqualinc submissions and evidence with Mr Bubb.

10. Evidence has been presented on behalf of Irrigation New Zealand, Horticulture New Zealand and Federated Farmers by Mr Peter Callander from Pattle Delamore Partners Limited. I agree with the evidence presented by Mr Callander and support his conclusions and recommendations. My evidence provides additional technically-based observations to further support some of those conclusions and also provides additional information on matters not covered by Mr Callander.

11. My evidence comments upon specific parts of the proposed Plan relevant to my expertise and experience.

12. My evidence will cover the following matters:

    a. Rule 5.104 makes applying for groundwater allocation in over-allocated zones a prohibited activity. The allocation limits set in the Plan have largely been based on what were originally interim limits that were to be revised as better information became available. Despite the fact that better information has been available and has been used to support granting of consents in excess of those allocation limits, they have not been revised. Specific examples will be used to show how some of the current allocation limits are not appropriate.

    b. Policy 4.73 and Rule 5.107 identify the requirement for a proportion of allocation to be surrendered to facilitate the transfer of allocation to another location. Evidence will be provided to show that the surrender of this allocation is unlikely to have any measurable effect upon groundwater resources.

    c. Schedule 10 outlines methodologies for determining reasonable use. Evidence is provided to support changes to this Schedule, which will remove some of the detail and replace with a set of criteria to be followed to determine reasonable use.

d. Schedule 13 outlines a methodology for determining the amount of water allocated within an allocation block. Evidence is presented to support revisions to the proposed methodology that would take account of the fact that not all water allocated will be fully utilised and to recognise that where allocation is dynamically managed this should not form part of the allocation block.

RULE 5.104 – Prohibited status for abstraction in excess of allocation limits

13. Rule 5.104 states:

> *The taking and use of groundwater that does not meet one or more of conditions 2 and 3 in Rule 5.101 is a prohibited activity.*

14. Conditions 2 of Rule 5.101 states:

> *Unless the proposed take is the replacement of a lawfully established take affected by the provisions of section 124 of the RMA, for stream depleting groundwater takes, the take, in addition to all existing resource consented surface water takes, complies with the limits set in Sections 6-15 for that surface water body in accordance with Schedule 9;*

15. and condition 3 states:

> *Unless the proposed take is the replacement of a lawfully established take affected by the provisions of section 124 of the RMA, the seasonal or annual volume of the groundwater take, in addition to all existing resource consented takes, does not exceed the limits for the relevant Groundwater Allocation Zone in Sections 6-15.*

16. Section 87A(6) of the RMA states that if an activity is described in this Act, regulations or a plan as a prohibited activity no application for a resource consent may be made for the activity.

17. I support the setting of interim limits, but my view is that if a prohibited status is going to be implemented, the final limits must be set following detailed and robust assessment of the resources involved and with appropriate consultation. The current limits, most of which have been transferred from the NRRP, have not been determined on that basis. I also think that consideration must be given to the dynamic nature of the resource when setting those final limits. It may be that a single volumetric limit may not be the best approach for providing for sustainable management of the resource, and that other allocation models may be more appropriate. Making the limits non-complying would allow better knowledge to be incorporated into the limit setting process.

18. The Canterbury groundwater system has been divided into 26 groundwater zones for management purposes. Appendix A in my evidence provides a table showing the groundwater allocation limits for each zone set within Sections 6 to 15 of the proposed Plan. It also indicates the method used to determine the allocation limit.

19. The groundwater allocations have all been set using either a “first order” or “second order” approach. The first order approach is based on determining 15% of average

annual rainfall and multiplying that by the zone area to give an annual volumetric limit for each groundwater zone. Rainfall recharge into each zone is about 30% of annual rainfall, so about 50% of the estimated rainfall recharge is allocated for abstraction.

20. The second order approach estimates total land-based recharge, including rainfall recharge and irrigation recharge and allocated 50% of that amount. In that sense, it is similar to the first order approach, but includes a component of the additional recharge under irrigation. Neither method includes river recharge to groundwater.

21. Although these methods of assessing allocation have value as a 'first cut' approach, they do not address the actual effects of abstraction on the groundwater system, on existing users or on surface waterways; they are not directly linked to environmental outcomes. They also take no account of the sensitivity of the zone to abstraction. Currently, catchments sensitive to groundwater level fluctuations, perhaps due to the presence of spring-fed streams, have allocation limits set in exactly the same way as catchments that have no surface water features.

22. First order calculations are easy to carry out as they are simply based on a proportion of rainfall. Second order calculations require a more detailed assessment of the zones recharge components, although are also not difficult to carry out. When groundwater allocation limits were first set by the Canterbury Regional Council in 2004, my understanding was that further work would be done to build upon these relatively coarse assessments so that third order or final limits could be established. Put another way, the intention was that the first and second order assessments were interim limits, providing a holding position until the third order assessments were carried out.

23. However, the proposed Plan is taking a mixture and first and second order assessments and treating those as if they have third order status. All of the groundwater allocation limits identified in the proposed plan are either first or second order, there are no third order limits proposed.

24. Many of the allocation limits in the proposed plan are the same as identified in ECan report U04/97 Groundwater allocation limits: Land based recharge estimates (David Scott, Sept 2004). The allocation limits in the shaded boxes in my Appendix A identify those allocation limits that are the same as given in ECan report U04/97. Many of the boxes that remain un-shaded are not due to more detailed investigations into allocation limits, but rather to changes in zone boundaries.

25. This suggests that there has been little progress made since 2004 to incorporate the additional knowledge gained since 2004 about the groundwater resources. In fact, a significant amount of work has been done in some groundwater allocation zones,

although that work has not filtered through to alter the Plan groundwater allocation limits. The following provides examples of where more information is available to update the second order calculations that could be used to alter the existing allocation limits.

Chertsey Groundwater Allocation Zone

26. The pLWRP sets this zones allocation limit at 112.4 million cubic metres per year. This limit is the same as determined by Canterbury Regional Council groundwater scientist David Scott in 2004, and is based on a second order calculation.

27. A consent hearing for 16 applications for groundwater in this zone was held in 2011. (Canterbury Regional Council Hearing Decision for 16 applications for groundwater in the Chertsey Groundwater Allocation Zone, by Commissioners Dunningham, Christmas & Ellison, October 2011).

28. Evidence presented by Julian Weir, Aqualinc hydrogeologist at the hearing identified that the second order calculation did not include all sources of potential groundwater recharge that were occurring in 2004 i.e. the original second order calculation was not complete. His evidence showed that subsequent development of the Acton Irrigation Scheme and the Barrhill Chertsey Irrigation Scheme meant that there is now as much as 50 million cubic metres per year of additional land surface recharge occurring in this zone and that this should be accounted for in the second order assessment.

29. As the second order method allocates 50% of land surface recharge, correct application of the method potentially increases the allocation limit from 112.4 million cubic metres per year to 138 million cubic metres per year. This shows that the NRRP limit, (which is the same as that now being proposed in the pLWRP), is overly conservative.

30. The commissioners for this hearing concluded that they were satisfied that the NRRP allocation limit for the Chertsey Zone was too conservative and that additional water could safely be allocated, particularly taking account of recharge from the new irrigation schemes in the area. The consents were therefore granted.

Ashburton-Lyndhurst Groundwater Allocation Zone

31. The pLWRP sets this zones allocation limit at 126.6 million cubic metres. This limit is the same as identified by David Scott in 2004, and is based on a second order calculation.

32. A consent hearing for 15 applications for groundwater in this zone was held in November 2010. (Canterbury Regional Council Hearing Decision for 15 applications for groundwater in the Ashburton Lyndhurst Groundwater Allocation Zone, by Commissioners Dunningham, Christmas & Ellison, March 2011).

33. The applicants were seeking groundwater allocation in excess of the allocation limit that appears in the pLWRP. These consents were granted. and the following outlines some of the key points from the hearing decision that relate to the potential for cumulative effects in this zone:

    - *Allocation limits were set for each of the groundwater allocation zones as set out in Table WQN29 of the Variation 4 to the PNRRP (now Schedule WQN4 of the Operative NRRP), which in turn was based on Technical Report U04/97. However, since that initial report was undertaken, the further Technical Report R09/55 has been released which updates and revises the 2004 report.*
    - *The purpose of the second report was to advance the technical understanding of the groundwater system in the Rakaia/Ashburton area, both to inform resource management decisions, and to provide further information for stakeholders about how groundwater would respond to various irrigation development scenarios.*
    - *The water balance review completed in R09/55 differs from the 2004 report, in that it has nearly doubled the amount of recharge which is assumed to come from surface water irrigation across the Ashburton Lyndhurst Irrigation Scheme (ALIS). The explanation given by Mr Thorley (ECan Officer) is that this is "due to more specific and tailored calculations and updates of irrigated area". As a consequence it identifies that there is more water available in some parts of the groundwater allocation zone than is identified in the allocation limit in the PNRRP. Indeed, assuming the same 50% threshold for recharge as was applied previously, he considers that the annual groundwater allocation limit would increase in the order of 10 million cubic metres. As Mr Thorley notes, the additional land surface recharge caused by the ALIS is significant when compared with other areas across the Rakaia/Ashburton plains.*
    - *The evidence of Mr Thorley has satisfied us that there is currently sufficient groundwater available in this zone to grant the current applications even though it means the allocation limit specified in the PNRRP is exceeded. However, there are some caveats on this conclusion. The first being that consents should not be granted for a period in excess of 10 years and secondly that a mitigating condition was necessary relating to the potential for saltwater intrusion for consents granted downstream of State Highway 1.*

34. Despite the availability of this additional information, which came from more detailed investigations carried out by Canterbury Regional Council, the allocation limit proposed by the pLWRP remains the same as calculated in 2004.

Valetta Groundwater Allocation Zone

35. The pLWRP sets this zone's allocation limit at 96.6 million cubic metres per year. This limit is based on a second order calculation.

36. A consent hearing for 78 applications for groundwater was held in 2010. The hearing considered applications within both the Valetta (55 applications) and Ashburton River

(23 applications) groundwater allocation zones. (Canterbury Regional Council Hearing Decision for 78 applications for groundwater in the Ashburton River and Valetta Groundwater Allocation Zones, by Commissioners Rogers & Heller, June/ August 2010). The applicants were seeking groundwater allocation in excess of the allocation limit. Despite the allocation limit at the time being exceeded, the commissioners from this hearing, based on the evidence presented at the hearing, concluded that they could grant further consents.

37. The commissioners concluded that the allowable groundwater allocation for the Valetta zone should be 114.7 million cubic metres per year. (para 1816 of decision). This is an increase of 18.1 million cubic metres per year of base allocation beyond the allocation limit in place at the time of the hearing (which is the same limit proposed in the pLWRP). In addition to this, the decision allocated 8.514 million cubic metres per year of additional allocation subject to the state of the groundwater system at the start of each irrigation season.

38. The additional allocation was not sufficient to enable all 78 applications to be granted. Most of the applicants whose applications were declined appealed the decision to the Environment Court. Although my understanding is that a mediated settlement has been reached, I am unsure of whether a decision has been formally issued by the Court.

39. There are a number of other examples that can be used to highlight that the provision of additional information frequently indicates that the first and second order allocation limits do not appropriately reflect what groundwater resources may be available.

40. Because of this, allocation limits set using the first or second order approach need to be treated as interim allocation limits. Making the proposed pLWRP limits hard limits and reducing allocation to meet those limits is unwarranted in my opinion. The information used by hearing commissioners since 2004 to grant consents above those allocation limits has already shown that to be the case.

41. Page 289 of the Section 42A Report states that Rule 5.104 should be retained without amendment. The Report states that the Rule is based upon known limits and Canterbury Regional Council's existing knowledge of the aquifers and groundwater allocation zones. I disagree. The examples I have provided show some allocation limits have not been calculated correctly and the limits are not set based on Canterbury Regional Council's existing knowledge of the aquifers and groundwater allocation zones. Canterbury Regional Council have more up-to-date information that should feed into the calculations to determine allocation limits.

Changes to recharge

42. In some groundwater allocation zones, changes to land-surface recharge are expected or have already occurred. An example is in the Central Plains area of Canterbury. Central Plains Water Ltd (CPW) holds consents (CRC061814 and 30 others) to take water to irrigate 60,000 ha of land between the Rakaia and Waimakariri Rivers. Irrigation from the scheme is expected to begin within two years.

43. The CPW scheme will introduce substantially more recharge into the groundwater system than is currently accounted for under the existing zone allocation limits. Julian Weir (Aqualinc hydrogeologist) presented evidence on this in the CPW hearings (Decision Central Plains Water, by Commissioners Milne, Fenemor, Nixon & OCallaghan, May 2010). He showed that the additional recharge would increase groundwater levels. That raised issues of potential flooding in the lowland catchment.

44. In my opinion, an appropriate and realistic way to manage the effects of higher recharge and higher groundwater levels is to allow more groundwater abstraction. Fortuitously, the highest additional recharge will occur in the highest irrigation demand years, so balancing that with additional groundwater abstraction is a logical approach to mitigating the effects of higher recharge.

45. Additional recharge is also occurring due to new irrigation occurring south of the Rakaia River. In addition, irrigation schemes such as the Ashburton-Lyndhurst irrigation scheme are in the process of piping laterals and converting to spray irrigation. That impacts on recharge.

46. Whether changes due to irrigation efficiency improvements will cause a rise or fall in groundwater levels depends on what happens to the “saved” water. If that water is retained at source, such as in a river, recharge and groundwater levels will reduce. If it is used to irrigate more land, recharge may be relatively unchanged.

47. The point that I wish to emphasis is that inputs into and outputs from the groundwater system in Canterbury have been and will continue to change. The limit setting process needs to accommodate those changes.

Dynamic allocation

48. The current methods of setting groundwater allocation limits, i.e. first order and second order methods, do not recognise that the groundwater system and abstraction of groundwater is highly dynamic. As well, the current allocation methods (first order and second order) do not properly account for the state of the environment and the effects of abstraction on that environment.

49. This has been understood and reflected in a number of hearing decisions. Resource consents have therefore been granted with dynamic allocation conditions within four

groundwater allocation zones (Selwyn-Waimakariri, Rakaia-Selwyn, Ashburton River and Valetta).

50. Conditions applied to recent consents granted in the Selwyn-Waimakariri and Rakaia-Selwyn groundwater zones make the taking of water conditional on groundwater levels exceeding an agreed bottom line at the beginning of the irrigation season. If groundwater levels are below these limits, water may not be able to be taken for that season.

51. Conditions applied to recent consents granted in the Valetta and Ashburton River groundwater zones provide a 50% certain allocation and 50% dynamic allocation. The dynamic portion of the allocation is conditional on groundwater levels exceeding an agreed bottom line at the beginning of the irrigation season.

52. My main point is that consents have been granted with conditions that do recognise the dynamic nature of groundwater supply and demand. My view is that the pLWRP proposal to retain single fixed limits based on only part of the information available today is a backward step. Other alternatives are possible and desirable.

Reliability

53. Reliability of supply of water is a critical issue to most if not all water users. Reliability is affected by the rules used to set the level of risk that consent holders are subject to, e.g. for irrigation on-farm, that full demand be able to be met in 9 out of 10 years, and the level of supply reliability, which incorporates the impact of water supply restrictions.

54. High reliability of water supply allows for high levels of efficient use, as water is able to be used when it is needed. For that reason, I support the Plan change for allocation to be changed from 8 out of 10 year allocations to 9 out of 10 year allocations.

55. In setting Zone allocation limits, clearly, the higher the limit, the greater potential use that can be made of the resource. However, for groundwater, higher use means lower groundwater levels, with potential effects on some existing users increased.

56. In looking forward, two approaches are possible. One is to retain single fixed allocation limits as the Plan now proposes. The current limits provide some certainty to users with respect to reliability, but don't allow best use to be made of the resource. The second is to allow for lower reliability in some years. The risk of lower reliability can be spread over all users or can be staggered using A, B C permits or similar.

57. It may be that a core allocation could be retained that provides the high reliability afforded to existing consent holders not subject to dynamic allocation conditions. Although I hold the view that additional water can be granted in most groundwater zones in most years, it may be that the additional water has little or no core allocation and is subject to dynamic allocation conditions (as for the later grants in the Rakaia-Selwyn groundwater zone). There will be a point where, although the environment is protected through those conditions, the lower reliability will make it less desirable to take water. I don't believe that we have the information to properly assess that relationship, and I strongly recommend that further work be carried out to fill the information gap.

58. There is also the issue about who is entitled to A, B or C permit water, where a stepped regime is implemented. The Plan policy is to provide highest reliability water to specific users. That raises the question about what are essential uses, or more essential than other uses as far as reliability of supply is concerned.

59. The point I wish to emphasise here is that setting allocation limits and allocation mechanisms is highly complex, and should account for a range of factors. Setting permanent limits should not be based on simple criteria, such as that provided by current first and second order processes.

Transfers of water permits

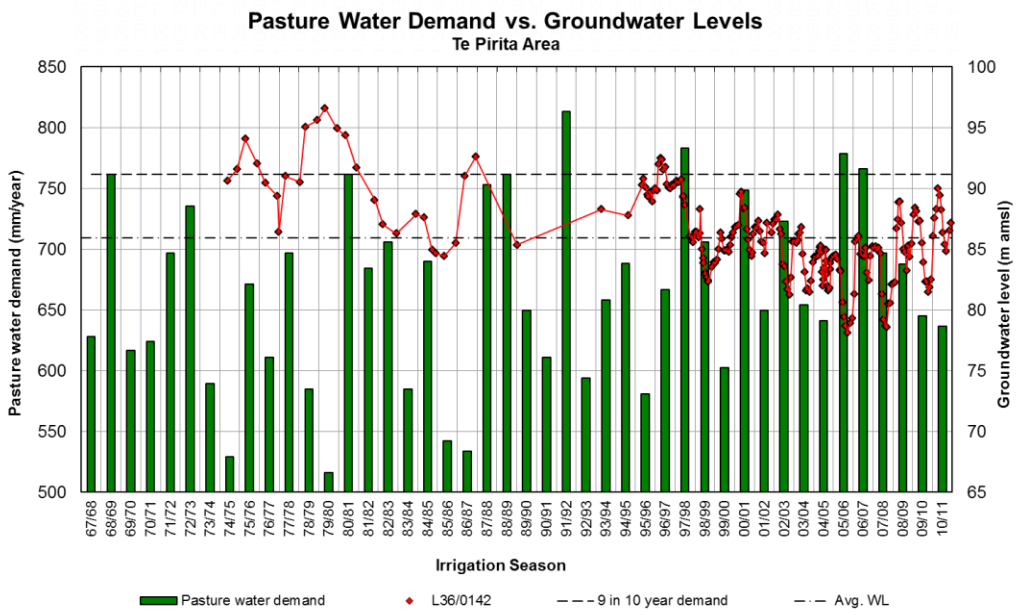
60. Evidence presented by Mr Callander has outlined why he believes the surrender of a proportion of allocation upon transfer of allocation to another location, as required by Policy 4.73 and Rule 5.107, is not appropriate. I agree with the comments made by Mr Callander and add the following further comments.

61. It is clear to me that the allocation limits proposed in the pLWRP should be interim limits and further work is necessary to have confidence that appropriate allocation limits have been set. If some groundwater zones are in fact over-allocated, then a range of solutions is available to reduce allocation. These will be outlined by other witnesses.

62. I also believe that surrendering of allocation to facilitate a site-to-site transfer may not necessarily lead to improved environmental outcomes. If such transfers lead to increased use of the resource i.e. more of the consented allocation is actually used, this will only matter during seasons of high irrigation demand. This is because over-allocation of groundwater, if it exists, under an allocation regime that is based on a single allocation limit, will only be "over-allocated" in years when irrigation demand is high (such as in a 1:10 year event) at the same time as groundwater levels are already low or will be driven to low levels by abstraction.

63. The water allocated to a consent represents the volume of water required to meet full irrigation demand in 9 years out of 10, although I recognise that some consents still have volumes based on being sufficient to meet full irrigation demand in 4 years out of 5. The pLWRP has standardised the approach so that volumes are calculated to meet irrigation demand in 9 years in 10. Clearly the full volume of water allocated will not be used every year.

64. I have looked at the relationship between irrigation water use and groundwater levels to assess the likely impact of a reduction in allocation on groundwater levels. The following figure has been prepared by Julian Weir (Aqualinc) under my instructions. This figure compares irrigation water use with groundwater levels taken from bore L35/0142 in the Te Pirita area.



65. This shows that the correlation between high demand irrigation years and low groundwater levels is poor. I know from my investigation carried out to prepare evidence for the Rakaia-Selwyn groundwater hearing that climate, particularly winter rainfall, has the greatest effect on groundwater levels. Low winter recharge results in low groundwater levels. Irrigation demand is driven by rainfall and by evapotranspiration through the irrigation season.

66. On only one occasion in the figure above does high irrigation demand coincide with low groundwater levels. Years of high pumping, such as 1991/92, have not coincided with critically low groundwater levels. Lowest groundwater levels have generally been followed by irrigation demand years below the 9/10 year limits.

67. Although this is only one example of the relationship between groundwater levels and groundwater abstraction for irrigation, the principle of clawing back allocation by whatever method is proposed under a fixed allocation regime may not achieve the desired environmental outcomes, while allowing best economic use of the resource. The main benefactor will be the 'paper allocation' and there should be no rush to reduce paper allocation until there is confidence that the allocation limits have been set appropriately.

68. Page 293 of the Section 42A Report states that the surrender of water is a mechanism to address over-allocation and it is not considered appropriate to remove this condition from the Rule. This is based upon the assumption that zones are in fact over-allocated. Until robust allocation limits have been set it is not appropriate to have any form of allocation claw-back mechanism.

Schedule 10 – Reasonable Use Test

69. With respect to Schedule 10 and determination of reasonable use, I agree with the evidence on this matter given by Dr Tony Davoren and Mr Andrew Curtis.

70. My view is that the specific methodology used to determine reasonable use does not need to be specifically listed in the Plan. That includes what was known as the WQN9 method. I see no reason to retain that method at all, as it has been shown to be deficient in several areas.

71. What needs to be done is to set out very clearly what criteria should be used in the calculation of reasonable use. In my Appendix B, I have outlined the criteria I would expect to be used. This criteria is similar to that proposed by Irrigation NZ.

Schedule 13 – Requirements for implementation of water allocation regimes

72. Groundwater allocation regimes Part 1 states:

    The amount of water allocated within a groundwater allocation block is the sum of each seasonal or annual volume of each groundwater take, less any contribution from surface water calculated in accordance with Schedule 9;

73. This differs from the approach within the NRRP in the following two ways;

    a) The current proposal specifically identifies that some water taken from bores may include an element of surface water. There was no such allowance in the NRRP.

    b) The current proposal requires that all of the consented groundwater allocation is included in the calculation. Schedule WQN4 of the NRRP required that only 85%

of the annual volume allocated to each take for irrigation was included to determine an "effective" allocation.

74. Allocation for irrigation is calculated based on providing sufficient water to meet irrigation demand in 9 years in 10. In the majority of years consent holders therefore will not abstract their maximum consented volume. Also, there will always be some consents that are not fully exercised at any point in time for a range of reasons. We are seeing clear evidence of that in water meter use records (see Canterbury Region Water Use Report 2011/12, November 2012). A similar result is seen in water use in pipe irrigation schemes where maximum scheme demand is never reached.

75. The NRRP effective allocation of 85% of a 9:10 year demand worked out to be close to what would be an average demand over time, which is consistent with allocation limits based on average recharge (as for first and second order limits). Because only a proportion of recharge is being allocated (in the order of 20-25% of total recharge in a zone), and because all of the consented allocation is not used, that to me seemed to be a conservative approach.

76. Because the pLWRP proposes that the actual allocation be the sum of each seasonal or annual allocation volume, the 85% has become 100%. That in itself is not a problem. In fact using 100% may be more administratively simple to manage. The problem is that allocation limits have not been adjusted according to that change and application of the 100% rule has made groundwater zones appear to be more highly or over-allocated than they were previously.

77. Taking the Ashburton Lyndhurst zone as an example, the ECan on-line service currently shows that the effective allocation in this zone is 133.548 million cubic metres per year. This is based on including 85% of the consented seasonal volumes, which implies that the consents currently issued in this zone have a combined seasonal volume of approximately 157. million cubic metres per year. The allocation limit in the pLWRP for this zone is 126.6 million cubic metres per year.

78. The pLWRP proposes that the hydraulically connected proportion of takes with surface water is moved from the groundwater allocation block to the surface water allocation block. To me, that makes sense as it more clearly defines the source of the take . For zones that have groundwater takes that are hydraulically connected to surface water features there will be a reduction in the amount of groundwater allocated, but an increase in the volume of surface water allocated.

79. Where zones have little or no groundwater connected to surface water, the implementation of the proposed plan will mean that such a zone will be considered

significantly more over-allocated. For example, in Ashburton-Lyndhurst, the only surface water feature in this zone that may have some contribution is Hardings Creek, although any such contribution will be small. This means that the pLWRP proposals will mean that the effective allocation in this zone will increase from the current estimate of 133.548 million cubic metres to over 150 million cubic metres.

80. In this case, nothing has physically changed and in fact this status of gross over-allocation is contrary to conclusions drawn in ECan Technical Report R09/55 and evidence presented by ECan staff for this zone as previously outlined in my evidence.

81. The Section 42A Report states that by only including 80% or 90% of the consented annual volume in an allocation limit or block, there is the potential for adverse effects on surface water bodies and groundwater users in years that the full consented annual volume is abstracted. As I have outline above, abstraction of the full seasonal volume of all consents within a groundwater allocation zone will never happen. The conclusion outlined in the Section 42A Report is therefore overly conservative. The application of 100% implies that zones are more highly or over-allocated, but in reality it is nothing more than a paper reallocation.

82. This issue can be dealt with by either setting zone allocation limits that take into account the factors that influence the amount of abstraction and the objectives of setting limits, or, adjusting allocation to an effective amount to recognise the influence of those factors as per the NRRP approach.

83. Schedule 13 also fails to recognise that a number of existing consents have 'adaptive management' conditions which prevent some, or all abstraction authorised by the consent during periods when the groundwater resource may be under stress.

84. Allocation limits are set to try to ensure that the effects of abstraction remain within acceptable limits, with the critical time being during periods of low resource availability. If abstraction authorised by a consent has to reduce or cease because of reduced resource availability, the effects of that authorised abstraction will not be contributing to any further reduction in water levels. Because of this, any groundwater allocation that is adaptively managed should not be included in calculations to determine how much water has been allocated within an allocation block.

Ian McIndoe

4 February 2013

Appendix A – PLWRP Groundwater Allocation Limits

Zone name	pLWRP GW Allocation (million m^3/yr)	Method used to determine allocation
Ashburton River/Hakatere	69.7 + 35 B allocation	First Order
Ashburton-Lyndhurst	126.6	Second Order
Ashley	29.4	Second Order
Chertsey	112.4	Second Order
Cust	56.3	Second Order
Eyre	99.07	Second Order
Fairlie	37.0	Second Order
Hook	2.49	?
Kaikoura Kowhai	19.2	First Order
Kaikoura Mt Fyffe	10.1	First Order
Kowai	17.4	Second Order
Loburn Fan	40.8	Second Order
Makikihi	18.05	Second Order
Mayfield-Hinds	148.0	Second Order
Orari-Opihi	71.10	First Order
Otaio	4.93	Second Order
Pareora	7.19	Second order
Rakaia-Selwyn	215.0	Second Order
Rangitata-Orton	42.50	Second Order
Selwyn-Waimakariri	121.3	Second Order
Timaru	4.24	Second Order
Valetta	96.6	Second Order
Waihao	7.73	Second Order
Waimate	8.18	Second Order
Waipara North	2.9	Second Order
Whitneys Creek	15.44	Second Order

Note: shaded cells identify where the allocation limit is the same as identified in ECan Report U04/97 Groundwater Allocation Limits: Land based recharge estimates; David Scott, September 2004.

Appendix B – Outline of criteria for Schedule 10 – Reasonable Use Test

Proposed set of requirements for a water balance model and data

1. The model must be able to predict irrigation requirements for a specified:
    - Irrigation system efficiency (80%) (Note: not application efficiency)
    - Risk profile (9 years out of 10, or 90 percentile year)
    - Land cover (pasture)
    - Soil type/ water holding capacity
    - Climate

2. The model must provide sufficient outputs to enable a third party to verify that the estimated irrigation water requirement and water use limit are based on policy-compliant inputs.
3. The documentation must:
    a. Specify the assumptions, equations and time-steps used in the model
    b. Specify the data inputs, parameters and data outputs
    c. Specify the sources of data, and the date range of all time-series data inputs used.
    d. Model documentation must explain how the water supply adequacy is determined.

4. Model Parameters and Testing
    a. The model parameters must either be internationally accepted parameters (for example the FAO crop factors) or be calibrated and validated using Canterbury data.
    b. Set out the calibration and verification procedure and results.
    c. If parameters are developed from Canterbury data, the model documentation must comment on the applicability of the calibration across the whole of Canterbury and the applicability in years outside the calibration/verification period.

5. Input data
    a. Describe the QA procedures used to verify that input data is fit for purpose.
    b. If using standard input data or factors (as listed in Annex 1), then QA procedures are not required for the particular standard input or factor used.

Reporting of Model Application

1. Model application reporting must include the irrigation system efficiency used in the estimation of seasonal irrigation water use and the water supply adequacy used to determine the seasonal irrigation water use limit.
2. Model application reporting must outline the irrigation practices (management rules) and comment on their appropriateness for types of irrigation equipment.

3. Model application reporting must specify soil type, climate data and land-cover.
4. Model outputs must be reported or supplied in sufficient detail to enable a third party to verify that the modelled irrigation applications that the irrigation water use estimates are based on comply with Policy standards for application efficiency and water supply adequacy, are practical and result in soil moisture levels being maintained within best-practice limits.

Annex 1: Approved standard inputs

Soils Data

1. Soil maps and plant available water for soils on a property can either be obtained from the most recent publicly available version of the Landcare Soils Database or obtained from site specific measurements
2. If site specific maps/measurements, the documentation must outline the soil survey work, and include photos and a description the texture analysis undertaken.

Climate Data

1. Daily climate data from -
    - NIWA Tier 1 or Tier 2 climate station data or
    - Data from NIWA Virtual Climate Station Network or
    - Site specific data for rainfall in combination with climate data from the nearest climate station that meets or exceeds NIWA Tier 2 standards.
2. If data record is for less than 30 years, then a correlation with either the VCS or climate sites with 30 years must be carried out and used as part of determining the 90 percentile year.

Crop Data

1. Crop Factors in FAO 56