in the matter of: the Resource Management Act 1991

and

in the matter of: a number of applications to take and use water from the Upper Waitaki catchment

Addendum to brief of evidence of Robert John Potts (on cumulative water quality effects)

Dated: 30 November 2009

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ADDENDUM TO BRIEF OF EVIDENCE OF ROBERT JOHN POTTS (ON CUMULATIVE WATER QUALITY EFFECTS)

INTRODUCTION

1 My full name is **Robert John Potts**.

2 My qualifications and experience are set out in the brief of evidence dated 16 September 2009.

3 I have been engaged by Meridian Energy Limited (Meridian) to provide an addendum to my two briefs of evidence dated 16 September 2009 on water allocation and farming systems in response to caucusing that has occurred with experts engaged by Mackenzie Water Research Limited (MWRL), Environment Canterbury (ECan) and Meridian, and in response to the supplementary evidence presented by MWRL.

4 I confirm that I have read the Environment Court's Code of Conduct for expert witnesses and this evidence has been prepared in accordance with that code. I agree to comply with the code's terms. In that regard, I confirm that the statements made in this evidence are within my area of expertise (unless I state otherwise) and I also confirm that I have not omitted to consider material facts which might alter the opinions stated in this evidence.

SCOPE OF ADDENDUM

5 In this addendum I:

5.1 Briefly outline and confirm that I am the original author of the Sullivan[2] methodology that was signed off by Commissioner Peter Skelton on 22 June 2007;

5.2 Comment on the outcome of the caucusing I have personally been involved in and any changes to my position since my original brief of evidence; and

5.3 Brief comment on the rebuttal evidence of **Mr McIndoe.**

THE SULLIVAN METHOD ON WATER ALLOCATION

6 For my work for the Waitaki Water Allocation Board (WAB) hearings, I undertook a detailed assessment of all existing consents to estimate their annual volumes.

7 Some consents did not have a consented annual volume and this necessitated an estimation based on the available data such as water use efficiency, climatic data and pump hours.

8 From this process, I concluded that:

8.1 Spray irrigation required 0.59 L/s/ha for 118 days/year above the Waitaki Dam;

8.2 Border dyke irrigation is over 155 days/year at the consented rate above the Waitaki Dam if the rate is consistent with the area irrigated, otherwise the allocation was taken as the irrigated area times 1,500 mm annual water application depth (i.e. 15 applications of 100 mm);

8.3 Spray irrigation required 0.45 L/s/ha for 158 days/year below the Waitaki Dam, unless a volume is given on the face of the consent;

8.4 Border dyke irrigation is over 206 days/year at the consented rate below the Waitaki Dam if the rate is consistent with the area irrigated, otherwise the allocation was taken as the area times 1,500 mm annual water application depth (i.e. 15 applications of 100 mm); and

8.5 Community water supply is taken as 365 days per year, 24 hours per day unless the consent gave a limiting volume.

9 Environment Canterbury (ECan) commissioned a peer review of this methodology and assumptions. This was undertaken by Dr Paul Sullivan in January 2007[1] and further documented by Dr Paul Sullivan *et al*[2] in a memo to ECan on 16 March 2007. The method was subsequently accepted and recommended for use by Commissioner Peter Skelton on 22 June 2007.

10 While an application depth of 1,500 mm was used in previous assessments and by Dr Sullivan (2007)[1,2], I have since revised the border dyke value to 1,300 mm for reasons outlined in paragraphs 28.3 to 28.4 of my evidence in chief on water allocation matters (dated 16 September 2009).

11 This new value was discussed and generally agreed to by various experts representing ECan (**Ms Bartlett** and **Ms Ensor**), MWRL (**Mr McIndoe**) and Meridian at a meeting held at Aqualinc on 24 April 2009. It should be noted that while **Mr McIndoe** generally agreed with the methodology and considered the figure was in the right ball-park, he reserved final judgment until he did more detailed assessment.

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[1] *Sullivan, P. Memo - Guide to calculating annual allocation volume for the Waitaki Catchment, January 2007*

[2] *Sullivan, P. Sullivan, B., Page, J. (2007). "Implementation of Waitaki catchment water allocation regional plan: current annual allocation". Report to commissioner, 16 March 2007. Unpublished.*

12 In summary, I therefore confirm that I was the original author of the "Sullivan Method" for water allocation.

COMMENT ON THE RESULT OF THE CAUCASING

13 Since filing my brief of evidence dated 16 September 2009, I have been a part of a number of caucusing meetings to discuss and attempt to resolve some of the concerns I and a number of other experts raised in our respective briefs of evidence.

14 The results of that discussion and the extent to which it addresses my earlier reservations about the modelling is set out below.

12 October 2009 – Nutrient Caucus (Attended by - Brent Clothier, Matt Ryan, Ross Monaghan, Rob Potts, Val Snow, Melissa Robson)

15 In paragraph 20 of my farming systems evidence (dated 16 of September 2009) I expressed some concern over the potential disconnect between the water balance modelling assumptions and the eventual consent conditions should the Commissioners grant these consents. The proposed list of consent conditions offered by **Mr Kyle** in his evidence for Southdown Holdings, Five Rivers Limited and Killermont Station goes a long way to address many of my concerns. However. the conditions do not account for the profile available water application depths and the trigger soil moisture levels assumed in the models. My concerns were not addressed during any of the caucusing meetings that I attended. However, I have made recommendations to revise the consent conditions proposed by **Mr Kyle** to include a table with the application depths and the irrigation trigger levels. These recommendations are captured in my evidence on individual applications dated the 30th of November 2009.

16 In paragraphs 58 and 59 of my farming systems evidence I commented on the importance of adequate monitoring to address my concerns regarding the inadequacies and unknowns in water quality modelling. **Dr Bright** and **Dr Robson's** joint statement of evidence proposed a monitoring programme in Table 12 of that statement.

17 Further agreement was reached during the caucus meeting that measuring, as well as modelling nutrient losses from farms (such as through the use of lysimeters and soil monitoring) would be useful and this has been offered by way of proposed conditions by Southdown Holdings, Five Rivers Limited and Killermont Station.

18 It was also agreed at caucusing that such monitoring need not be on all farms and that representative monitoring on some farms across soil types and farm management systems could be interpreted for use throughout the catchment on similar farms.

19 One of my earlier concerns with respect to the nutrient loss modelling was the accounting for temporal variations of farm losses. During the caucusing it was agreed that those temporal variations would be much less of an issue if there was 'smoothing' in the groundwater caused by lag times.

20 In paragraphs 34 – 42 of my evidence I described how I thought the denitrification rates assumed in the water quality modelling done on behalf of MWRL had been over-estimated. I raised similar concerns during the caucusing meeting on 12 October 2009. **Mr Monaghan** stated that losses of this scale (although not necessarily just through denitrification) were in his opinion reasonable and probably low. I am still not convinced that the denitrification rates stated are realistic. In my opinion, values in the order of 1 – 3% are more realistic as I stated in paragraph 38 of my brief of the farming systems evidence.

21 A copy of the agreed notes from the caucusing on the 12th of October 2009 is attached as Annexure One to this evidence.

16 October 2009 – Hydrogeology Caucus (Attended by – John Bright, Ian McIndoe, John Male, Douglas Mzila, Nimal Gamage, Tom Heller, Carl Hanson, Peter Callander)

22 I note at the outset that that I did not attend this causing, thus my comments below are from Mr Callander's notes. I nevertheless refer to it here as it is relevant to my evidence in chief.

23 In paragraph 40 of my farm systems evidence, I reproduced Figure 9 from Mr Callander's evidence and drew the conclusion that most of the N carries on through to the surface waterways, apart from perhaps the Pukaki, Tekapo and Omarama groundwater zones but that this was dependant on which set of leaching data was used.

24 I have reviewed Mr Callander's notes on the caucusing meeting held on the 16th of October 2009 and he states that "*the transfers of water and nitrate between groundwater and surface water happens within sub-node reaches that are not presented in the MWRL reports, and this apparently accounts for the inconsistencies in the overall groundwater mass numbers. As a result the comparison between N inputs and outputs in Figure 9 of my evidence does not represent the total picture about N movement and losses in groundwater because there are other intermediate transfers between groundwater and surface water that are occurring within each catchment, but are not reported*"

25 Mr Callander draws the conclusion that the mass balance should be re-done in order to provide an accurate reflection of the nitrate fluxes.

26 In summary, I have, provided comment on the caucusing between MWRL and Meridian and the extent to which this process has addressed my concerns - and while many of my original concerns have been addressed as I highlighted in paragraphs 15 - 25 above, the majority of the issues I raised in my evidence are still outstanding following caucusing, mainly due to a lack of information or lack of sensitivity analysis

27 I therefore recommend that if consents are granted, sufficient guarantees be placed to ensure that the applicants will operate within the limits of the modelling assumptions. This will be achieved by way of consent conditions to cover:

27.1 The design and operation of the irrigation systems;

27.2 Nutrient management;

27.3 Land use; and,

27.4 Adherence to the specific toolkit measures assessed for each sub-catchment.

28 I have made recommendations to revise the consent conditions proposed by **Mr Kyle** in my evidence on individual applications dated 30 of November 2009. My proposed changes take these factors (listed in paragraph 27 above) into account.

COMMENTS ON MR McINDOE'S REBUTTAL

29 In this section I briefly address some of the comments raised by **Mr McIndoe** in his rebuttal evidence to clarify any misunderstandings or misconceptions with respect to my farming systems and water allocation evidence.

Water Allocation

30 In paragraph 12 of his rebuttal evidence, **Mr McIndoe** refers to my paragraph 10 and states that *"the term reasonable use does not and did not represent the volume that was actually used".*

31 The important point in my Paragraph 10 is that the 77 million m^3/yr was reported to (by **Mr McIndoe**) and adopted by the WAB (Page 16, Chapter 4). This volume was considerably lower than the "Consented Annual Volume" of 148.9 million m^3/yr that **Mr**

McIndoe estimated in Table 1 in McIndoe (2004)[3]. In the report (McIndoe, 2004) **Mr McIndoe** then provides a justification for adopting the 77 million m^3/yr by stating that:

> "….*consented peak takes and volumes do not provide a realistic assessment of allocation as they assume water is taken continuously, with all takes being exercised at the same time*. *Because of the change in the way water is used, for example the use of spray irrigation rather than border-strip irrigation, it is no longer realistic to use peak rates of take as a method of assessing use. Volumes of water taken or used per season must be considered"*

32 In paragraph 16, Mr McIndoe states the 77 million m^3/yr was not based on existing use but an amount allowed for existing allocation. However, in his memorandum[4] to **Mr Kemble**, **Mr McIndoe** writes:

> *"McIndoe (2004) assessed current allocation for existing operational consents (including renewals at the time) of 77 Mm^3/y, assuming reasonable use of water (600 mm for spray and 900 mm for borderdyke) over 10,600 ha. Other demands such as stockwater and the Upper Waitaki Irrigation Company take were added to the assessed use figure by Potts (2005) to bring the total 123.85 Mm^3/y. This was rounded to 125 Mm^3/y by the Waitaki Allocation Board.*
>
> *The 77 Mm^3/y did not and was never intended to represent the sum of theoretical paper allocations on individual consents in the Upper Waitaki Basin. Rather, it represented a figure for reasonable use of existing consents over 10,600 ha of the Upper Waitaki Basin.*

33 **Mr McIndoe** justified the use of the 77 million m^3/yr but unfortunately, it appears that the definition or reasons for the 77 million m^3/yr keeps changing depending on the context and this seems to result in the confusion across Aqualinc reports the figure is reported.

34 The important conclusion from the foregoing is that the 77 million m^3/yr was recommended to the WAB and was adopted. Unfortunately, the volume was a significant underestimate of the actual entitled volume, which really should have been used for allocation purposes for existing consents. However, I do agree with **Mr McIndoe** that efficiency gains will be necessary by existing consent holders (when they renew their consents), in order that

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[3] *McIndoe, I. (2004) "Mackenzie basin irrigation takes – consent review". Report prepared for Mackenzie Farmers Group by Aqualinc Research Ltd. Report no. L05112. Unpublished*

[4] *McIndoe, I.2009. "Upper Waitaki Allocations". Memo to Gavin Kemble. 16 March 2009.*

applicants are within the allocation limits and that the Waitaki Catchment Water Allocation Regional Plan requires these gains through its objectives and policies.

35 In paragraphs 18 - 20, **Mr McIndoe** comments on paragraph 28.4 of my water allocation evidence, in that Omarama Station has already undertaken efficiency gains as well as Benmore Irrigation Company (BIC). However, I used Omarama as an example of the progress that has been made towards improving water use efficiency. Not mentioning BIC or any other scheme or property does not make them less important.

36 In paragraph 20, **Mr McIndoe** states that "*it was (Benmore Irrigation Company) consented on the basis of 4,000 ha of border dyke irrigation, when in fact it was using spray irrigation (pivots and K Line). I don't think that 1,300 mm/yr is appropriate for that*".

37 BIC is consented to take 51.6 million m^3/yr. In paragraph 28 of my evidence that **Mr McIndoe** refers to, I clearly explained that where consents had a face value annual volume this was adopted rather than a calculation based on assumptions. This is also the approach that **Mr McIndoe** described in the 2004 Aqualinc Report. Therefore, it would be inappropriate to use the estimated 600 mm/yr for spray and/or 1,300 mm/yr borderdyke for BIC as the consent has a definite annual volume. However, if the annual volume is taken over 4,000 ha, then it equates to 1,290 mm/year. If BIC are not intending to expand their command area (contrary to the fact I understand they are), then the consented volume is not reasonable use and this could be reduced when their consent is reviewed or renewed. Until then, their entitlement is 51.6 Mm^3/yr and this is what needs to go into the allocation assessment.

38 With regard to **Mr McIndoe's** paragraphs 23 - 26 regarding the Lake Ohau limit being exceeded, he points out in paragraph 26 that Simons Hill/Simons Pass have three alternative supply points and only one will be used. From my perspective, for the purpose of water allocation, I can only work with the information available at the time, as consented or as applied for, rather than making assumptions about the applicants' future intentions. Therefore as things stand, Lake Ohau is still over-allocated and therefore any application from this reach is currently considered non-complying.

39 In paragraph 29 **Mr McIndoe** writes:

> "*I think Mr Potts' comments that if MIC shareholders apply for resource consent for the remaining 9,000 ha, they will not comply with the 275 Mm^3/yr allocation limit is premature. My view is that if allocation to existing irrigation was based on reasonable and efficient use i.e. if efficiency improvements are implemented, there will be sufficient water for all MIC*

shareholders, plus capacity to expand the existing areas assigned allocations for border dyke irrigation"

40 I do not fully agree with **Mr McIndoe**. The current status is that if the remaining 9,000 ha were to apply now, they would not comply. **Mr McIndoe** makes the assumption that efficiency improvements will release more water in future. I agree that this may occur, however, there is no immediate requirement or enforcement for this except on a few resource consents such as the Omarama Station consent that I alluded to earlier. It is also possible that any gains from efficiency improvements will not necessarily be reallocated or available to those who need the water the most, with system changes from border dyke to spray within the same title typically allowing approximately double the area to be irrigated.

41 In paragraph 30, **Mr McIndoe** correctly points out that the WAB allocation allowed the Upper Waitaki Community Irrigation Company an allocation of 19.4 million cubic metres and that more recently Meridian had given derogation approval for the scheme for 26.3 million cubic metres. The original figure provided by me did not account for the operational difficulties of a long and narrow scheme and with further information from the scheme, I have modified my assessment of the required annual volume. I do agree with **Mr McIndoe**, that over time, improvements in operational efficiencies may and should occur, however, the scheme is likely to reap these benefits through expanded command area.

Farm Management

42 In his paragraph 37, **Mr McIndoe** misses the point of my analysis. In the final MWRL reports, there was conflicting information on the areas provided. My analysis was meant to highlight these inconsistencies. The table provided by Mr McIndoe in paragraph 41 does assist in understanding the areas.

43 After reading paragraphs 45 to 49 of Mr McIndoe's rebuttal I think we are in general agreement regarding the application depths. My concerns were around existing systems finding it difficult to apply the small application depths recommended in the modelling scenarios developed by Mr McIndoe[5].

44 The point I was making is that the modelling that was undertaken by Aqualinc assumed that the values in Table 1 of the Aqualinc report[5] were applicable to both existing and new systems. While new systems may, if appropriate conditions are specified, be designed and operated as modelled, there is no legal requirement, framework or motivation for existing systems to be operated as modelled. As a consequence, the modelling methodology (of using

[5] Irrigation & Drainage Modelling of Upper Waitaki Basin - Aqualinc Groundwater Report, 2009, – GHD

the same parameters for existing and new irrigation) and the output sensitivity need quantifying.

45 In response to **Mr McIndoe's** assertions in paragraphs 49 and 51, I can confirm that information on the IrriCalc was not made available to either ECan or myself at the time I undertook this work. Below is an extract from the minutes of a meeting (on 24 April 2009 at Aqualinc) of the technical experts involved in water allocation assessments for the Upper Waitaki Catchment.

> *Gillian[6] agreed that the WCWARP allowed the approach, but pointed out that ECan had not had the opportunity to explore the model and determine the validity of its results. Ian Mc[7] replied that ECan would not be given access to the IrriCalc model, but would be* ***provided with peer reports from David Painter and Hector Milano*** *(Melbourne University), indicating the superiority of the model when compared with WQN9* [emphasis added]

46 I however note that a basic description of the programme was given in **Mr McIndoe's** evidence - although not enough detail was provided to give a proper critique and for me to draw conclusions about its usefulness.

47 With respect to the comment on sensitivity analyses, modelling work typically involves making assumptions about many variables. It is always important to have an understanding of the effect of changes to these assumptions and thus a sensitivity analyses is undertaken when variables are not 100% certain.

SUMMARY

48 **Mr McIndoe** has made a number of minor criticisms and assertions in his rebuttal evidence, most of which I consider do not warrant a response. However, should the Commissioners require me to address specific issues that they think need clarification I would be happy to oblige.

49 As I discussed earlier in Paragraph **Error! Reference source not found.**, above, the applicants have addressed some of my original concerns. However, the majority of the issues I raised in my evidence are still outstanding, and therefore, the majority of my original conclusions and concerns still stand.

[6] Gillian Ensor – Environment Canterbury

[7] Ian McIndoe

Dated: 30 November 2009

Robert John Potts