IN THE MATTER OF: The Resource Management Act 1991
AND
IN THE MATTER OF: Applications by Central Plains Water Trust to:

Canterbury Regional Council for resource consents to take and use water from the Waimakariri and Rakaia Rivers and for all associated consents required for the construction and operation of the Central Plains Water Enhancement Scheme.

Selwyn District Council for resource consents to construct and operate the Central Plains Water Enhancement Scheme.

AND
IN THE MATTER OF: A Notice of Requirement by Central Plains Water Limited to:

Selwyn District Council for the designation of land for works associated with the construction and operation of the Central Plains Water Enhancement Scheme.

SUPPLEMENTARY BRIEF OF EVIDENCE OF:-
RICHARD SPENCER ENGLISH

Qualifications and experience.

1. My full name is Richard Spencer English.

2. I am professional civil engineer. My tertiary qualification is BSc (Hons) Civ. Eng. I am a Member of the Institution of Professional Engineers New Zealand and The Institution of Civil Engineers (London)

3. I have had both a direct and indirect involvement with the local aquifers for over twenty years. Over the last three years I have conducted a personal investigation into the hydrology of the Avon River and its tributaries.

Introductory Comments

4. I provided evidence to the Hearing in 2008 where I stated that, in principal, I neither supported nor opposed the Central Plains Water Enhancement Scheme. Rather my concerns revolved around the level of understanding we have of the hydrology of the aquifers that will be impacted upon by the Scheme. Over the following months I attended a number of the Hearing days and studied all of the relevant reports. However despite the evidence presented by both the applicant and Environment Canterbury staff my concerns remained. The recent supplementary evidence provided by the Applicant and the subsequent Officers S42A reports have failed to allay my concerns, if not indeed served to reinforce them.

5. Further research is urgently needed to reduce these uncertainties to acceptable levels, if we are to make resource management decisions that will provide us with sustainable outcomes. I wish to repeat that the lack of timely action by those authorities (i.e. local and central government.) who might have otherwise led and funded the requisite research is a significant failure on their behalf. Consequently I also wish to re-iterate that I seek to have this matter recorded in the Decision of the Hearing.

Background.

6. In order to be able to predict the impacts of schemes such as that proposed by CPWT (for example on Christchurch's water supply) it is important that a clear understanding exists of the hydrology of the local aquifers. Unfortunately present knowledge of the hydrology of the central Canterbury Plains aquifers is limited. This has been amply demonstrated, by the often divergent views expressed by expert witnesses in the evidence to this Hearing.

7. This is particularly the situation with respect to the quantum and locations of the losses, in the form of recharge into the aquifers, from the Waimakariri and Rakaia Rivers. May I remind you that inputs into the aquifers from these two rivers are uncertain (estimates vary widely between 1/3 to 2/3 - or more - of the total recharge for the area under consideration) In addition the inter-relationship between flow loss into the aquifers and the underlying levels of those aquifers is at best ill-defined. It is of considerable concern therefore that crucial aspects of the data under-pinning the Aqualinc model - on which much of the applicant's Evidence on the scheme's impacts depend – are, through no fault of theirs, little better than "guesstimates".

Eigenmodels.

8. I can therefore understand the reasoning behind Aqualinc's recent attempt to model the aquifer system by use of Eigenmodels. Unfortunately the outcome of this work has led to yet another difference of opinion between Aqualinc and Environment Canterbury professional staff.

9. It should be noted that whilst Environment Canterbury staff appear, in this case, to support the use of Eigenmodels in preference to the Aqualinc numerical model, I have concerns over the assumptions that may have been used in the Eigenmodels with respect to the quantum and form of the loss as recharge into the aquifers from the Waimakariri River.

10. An earlier research paper on the local use of Eigenmodels by Dr Bidwell indicated that, if I have interpreted it correctly, in order to achieve satisfactory aquifer level calibrations, the Waimakariri was required to loose (an approximate) 30 cumecs on a constant basis. This loss is of the order of 4 times that postulated by the locally "conventional", but questionable theory. (i.e. 7 – 8 cumecs.) Further, I understand, Dr Bidwell's model assumed that half of the river loss flows through the north bank and half to the south. This is in contrast to the local "conventional" theory (or rather assumptions) that all the loss flows to the south. (It is worth noting that there appears to be little evidence to support either assumption.)

11. I am not suggesting that Dr Bidwell's assertions about the size of the loss, its form or the paths it takes are incorrect, although I will discuss the issue of constancy later. Rather I am demonstrating a very significant divergence in assumptions and outcomes, as a direct result of our lack of even basic knowledge, between the position taken by Environment Canterbury staff, and others, and equally plausible scenarios painted by an equally qualified hydrologist using an agreed modeling methodology.

12. Overall I am not sure that the Eigenmodel exercise has advanced our knowledge much other than to clearly demonstrate how poorly we understand the system. As with Aqualinc's numerical model I am therefore unconvinced as to the Eigenmodel's appropriateness as a decision making tool given its present state of development and the uncertainty surrounding its under-pinning assumptions.

Losses from the Waimakariri River - Constant or Varying?

13. This conundrum could well be described as "the elephant in the room". Decisions regarding the outcomes of resource consent applications for the use of water from the Waimakariri River, by schemes such as CPWT's, and the potential consequent impacts on the interlinked sustainability of the local aquifers should not be taken until the issue is resolved.

14. As the Commissioners are aware, there has been considerable discussion recently concerning the impacts on aquifer recharge for the various scenarios being proposed for the potential new extraction regimes from the Waimakariri River.

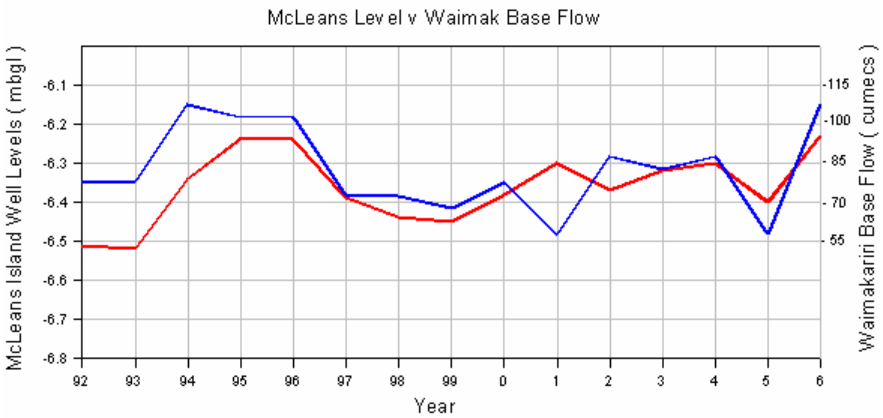
15. David Scott of Environment Canterbury has been looking at the matter of the constancy of the losses from the river and has repeated some of the outcomes of this work in his S42A report on this scheme. Mr. Scott argues that the loss from the Waimakariri is constant (i.e. independent of flow.)

16. I contend that this statement may be correct when considering periods of several years or more provided that one only looks on an annual median basis. Over these longer time scales the annual instantaneous median flow in the Waimakariri generally remains fairly constant so it is not surprising that one could conclude that the loss is also constant.

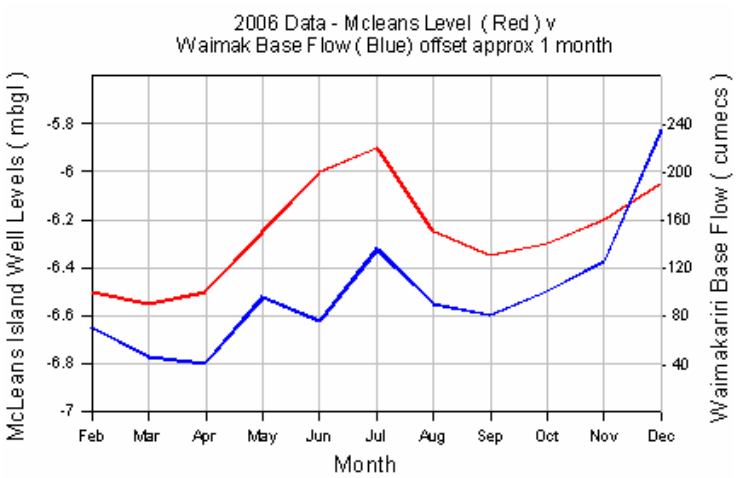
17. This statement is of course equally applicable to the notion that the loss varies with the flow. (e.g. in the case of constant flow there will be a constant loss.) However if the flow regime is changed and the median flow is lowered, such as by the CPWT scheme, then it can equally readily be argued that the recharge will decrease. (The question of "by how much?" then remains.)

18. Mr. Scott also argues that the aquifer gradients away from the river have remained relatively constant and hence the loss from the river is constant. I would agree at first glance that the aquifer levels local to the river appear to be relatively constant. What I think is missing from this argument however is an appreciation as to how sensitive the system is to small changes in levels and flows.

19. The levels at the well I have been using for my study at McLeans Island has a, "small", average range, since the mid 1980's, of approx +/- 300mm (There are a few readings outside this range but these are generally the result of the influence of the underlying aquifer levels, for example after the heavy snowfall in 1992.) As you may remember however my work has shown a close agreement between aquifer levels adjacent to the Waimakariri and, at least, median flows in the river. (The Lincoln University research I referred to in my earlier evidence clearly demonstrated a direct relationship between flows and adjacent aquifer levels.) For convenience I have reproduced below two of the graphs from my original evidence.

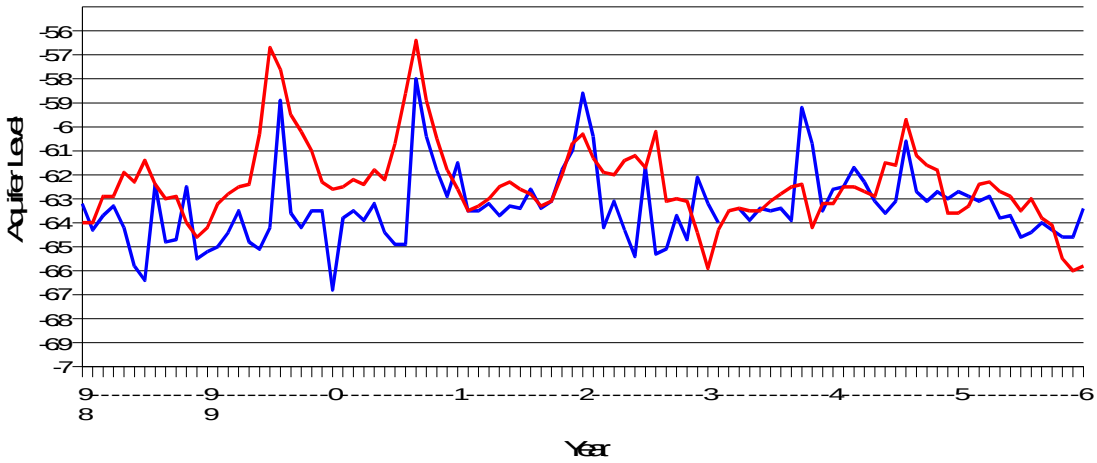


Graph 1: Waimakariri Base Flow (Blue) v Aquifer Level at Mcleans Island (Red)



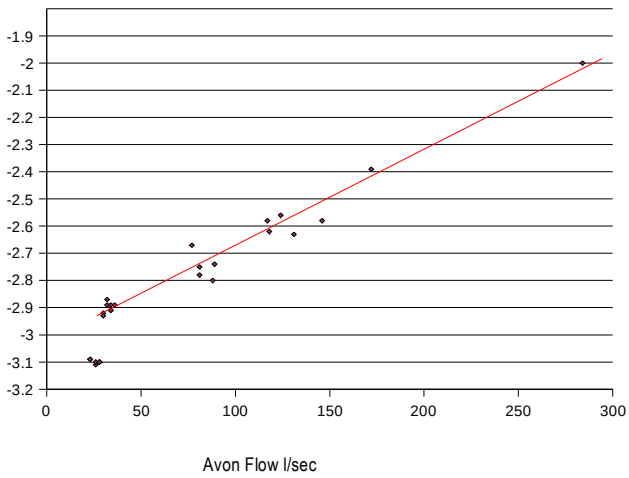
Graph 5: Waimakariri Base Flow (Blue) v Aquifer Level at Mcleans Island (Red) - 2006

20. My work also shows that there is a clear link, with about a two month time lag, between aquifer levels at Mcleans Island and flows in the Avon. I have reproduced below two graphs showing the inter-relationship between aquifer levels at McLeans Island and at the Ilam Homestead near the headwaters of the Avon and the relationship between flows in the Avon and aquifer levels at Ilam. (The form of this latter relationship is similar to that derived by Aqualinc as reproduced in Julian Weir's supplementary evidence Appendix J.)



Notes: *Y Axis Aquifer level (m. below ground level)*
Ilam readings include a constant 3.5m deduction and a two month off-set to readings to enhance visual comparison

Graph 3: Aquifer Levels at Mcleans Island (Blue) and Ilam Homestead (Red)



Notes: *Y Axis: Aquifer level (m below Ground Level)*
The discontinuity at approx 30l/sec is the point at which the upper springs stop flowing

Graph 4: Avon Flow (Ilam) v Aquifer Level (Ilam)

21. It is evident from Graphs 1 and 2 that as flows in the Waimakariri rise so do the adjacent aquifer levels, and importantly vice-a-versa. From Graph 3 it can be seen that, with a time lag of approximately two months, these aquifer level changes impact on aquifer levels at Ilam. In turn Graph 4 shows that these level changes then directly impact on flows in the Avon.

22. It is probable therefore that the underlying changes in the flow in the Avon are a result of changes in the quantum of flow within the aquifer system and hence recharge from the Waimakariri (with of course due regard to the relatively small and short term influences of local rainfall recharge.) It is also clear therefore that changes in the flow in the Waimakariri do impact on aquifer recharge and that losses from the river do vary with flow.

23. To place this in context, with respect to the present A and B block and gap abstraction proposals for the Waimakariri, I have calculated the impact on aquifer recharge under the various scenarios. (I have not had time to calculate the specific impact of the CPWT scheme but I understand that the proposed abstraction regime is not disimilar to the Environment Canterbury proposals.) If the allowable allocations under the proposed regimes are fully taken up then the reduction in aquifer recharge in comparison to that for the existing river flows is a minimum of 25%. On an annual basis this reduction is greater than the total yearly amount of water abstracted for public water supply purposes by Christchurch City Council. The possible reductions in recharge are therefore significant.

24. It is interesting to note that worldwide experience shows that river losses vary with flow. Widely accepted hydrological theory (e.g. D'Arcy's Law) which is based on the outcomes of practical experiments (i.e. rather than assumptions.) support this contention. Despite an extensive search I have been unable to find any examples where the losses from a river do not vary with flow. If Environment Canterbury's assertions on the constancy of loss are correct then one could therefore conclude that the Waimakariri may be unique. I find this very difficult to accept and to be highly unlikely – although of course not impossible.

Groundwater Mounding.

25. I recognise Aqualinc's reasoning for using the truncated time simulation to evaluate the revised scheme. This is an unfortunate outcome of the complexity of the numerical model which was criticised by a number of submitters and expert witnesses at the earlier part of the Hearing. However I agree that with respect to groundwater mounding the period chosen by Aqualinc is likely to provide a possible worst case scenario.

26. As expected the mounding near the centre of the scheme has reduced but it is somewhat surprising to see that there was not much reduction at the margins. (e.g. well M35/1080 indicates a maximum mounding of 1.7m for the original CPWT scheme and 1.6m maximum mounding for the revised scheme. - refer Table 5 Julian Weir's supplementary evidence)

27. Accordingly this quantum of mounding in the areas of both existing and potential future gravel extraction remains of considerable concern. (I understand that both the Christchurch City Council and the Gravel Extractors Group may be submitting evidence on this topic.)

Concluding Comments.

28. I am therefore unconvinced as to the Aqualinc's model's appropriateness as a decision making tool given its present state of development and the uncertainty surrounding its under-pinning assumptions. Nor am I convinced of the proprietary of the notion that the losses from the Waimakariri are constant. (i.e. irrespective of flow)

29. My opinion remains that these uncertainties are of such magnitude that the scheme should not be permitted to proceed at this time given in particular the potential uncertain, hydrological changes in increasing:-

- the potential for reduced confined aquifer pressures under Christchurch and a consequential increase in the potential for surface contamination to penetrate into the aquifers.

- the potential for negative impacts on the Avon and its tributary streams.

- the potential for reduced volumes in the aquifers below Christchurch and contamination to Christchurch City's drinking water supply.

- the potential for nitrate contamination of the existing water supplies for the rapidly developing urban areas in the eastern sector of Selwyn District.

- groundwater levels and the consequent reduction in the availability of aggregate resources for Christchurch City and the eastern sector of Selwyn District.

30. I would not like to be recorded in history as the one who permitted the destruction of the local aquifers, our iconic River Avon and its tributaries and the pristine public water supplies that are reliant on them. Without the requisite knowledge we meddle with the Waimakariri river's flow regime at our peril.

Richard English

2nd October 2009.