

**Before the Commissioners appointed by
Canterbury Regional Council**

IN THE MATTER OF The Resource
Management Act 1991

AND

IN THE MATTER OF Applications by the
Central Plains Water
Trust and Central Plains
Water Ltd. to Take and
Use Water for Irrigation
in the Central Plains
area.

Section 42A Officer's Report

Date of Hearing: August 2008

Supplementary report of Carl Robert Hanson

A. INTRODUCTION

1. My full name is Carl Robert Hanson. Details of my qualifications and experience have been documented in my main Section 42A report.
2. This supplementary report provides information and advice related to the potential effects of the proposed Central Plains Water (CPW) irrigation scheme on nitrate contamination in groundwater. Primarily, it addresses evidence presented by Clifford Tipler, but it also includes some brief comments on evidence presented by Claire Mulcock and Ian Brown.
3. I acknowledge that I have read the code of conduct for expert witnesses contained in the Environment Court's Practice Note dated 31 March 2005. I have complied with it when preparing my report and I agree to comply with it when I give oral evidence.

B. EVIDENCE OF CLIFFORD TIPLER

4. Mr. Tipler's main written brief of evidence regarding the potential effects of the proposed irrigation scheme on nitrate contamination in groundwater was dated 1 February 2008. He also submitted a supplementary written brief of evidence dated 29 February 2008. In addition to these written briefs, he made an oral presentation to the commissioners on Thursday 13 March 2008.
5. I did not see Mr. Tipler's evidence until after I had completed my Section 42A report. Therefore, my report was not based on Mr. Tipler's evidence, but on an earlier report by URS, dated November 2007. That report was very similar to Mr. Tipler's main brief of evidence, but there were two differences that I will highlight.

6. First, in paragraphs 81-82 of his written evidence, Mr Tipler presented a simple mass balance calculation that suggested that the median nitrate concentration across the scheme area could increase by 1.2 mg/L, from 3.7 to 4.9 mg/L. This calculation was not included in the November 2007 report.
7. Second, the 2007 report included the statement (in the second sentence of the first paragraph of section 3.6 of that report) "...it is likely that the mixing depth will increase slightly...". Paragraph 95 of Mr. Tipler's evidence includes the same statement, but without the word "slightly".
8. In addition, in his oral presentation at the hearing, Mr. Tipler showed the commissioners a schematic cross section to demonstrate a layer of "dirty" (his word) groundwater from soil drainage overlying "clean" groundwater from the Rakaia and Waimakariri rivers. In this cross section, he showed how the thickness of the "dirty" layer would increase as a result of the scheme, both with the water table rising and with the base of the layer lowering.
9. These differences are important because without them, I interpreted the main conclusion of the URS report to be that the proposed irrigation scheme would cause no increase in nitrate concentrations in groundwater. I disagreed with this conclusion, and much of my report was given over to demonstrating that the scheme would indeed cause increases in nitrate concentrations.
10. Based on Mr. Tipler's evidence, I now understand his conclusion to be that nitrate concentrations in groundwater will increase as a result of the CPW scheme, and that the thickness of the zone of shallow, contaminated groundwater will also increase, but that these increases will not be significant.
11. Therefore, as Mr. Tipler states in paragraph 6 of his supplementary evidence, he and I are largely in agreement about the potential effects of the scheme, and the main difference in our opinions is whether we think the effects will be significant.
12. In Mr. Tipler's opinion, an overall median increase of about 1 mg/L in the shallow groundwater beneath the scheme area would not be significant. I agree that for most groundwater users within the scheme area, this increase would not be significant. However, as I wrote in my main report, the effects of the scheme will not be uniform across the scheme area, and there could be significant concentration increases for some groundwater users.
13. In addition, the increase in concentration is only part of the effect. The mass of nitrate entering the shallow groundwater zone, and the thickness of the zone, will also increase.
14. From paragraph 81 of Mr. Tipler's supplementary evidence, the mass of nitrate leached will increase by more than 75% as a result of the scheme. In paragraphs 75 to 80 of my main report, I estimated the thickness of the contaminate shallow groundwater zone would increase on the order of 15% to 20%. While this may not result in a significant increase in the median concentration beneath the scheme area as a whole, it could result in significant concentration increases in shallow groundwater down-gradient of the scheme, and in spring-fed lowland streams. As I discussed in paragraphs 83 to 88 of my main report, concentrations in shallow groundwater down-gradient of the scheme are diluted by mixing with groundwater from the scheme area. If the

scheme groundwater has more nitrate in it, there will be less dilution, and concentrations down-gradient will increase.

15. Moreover, it is my opinion that Mr. Tipler's prediction is subject to a great deal of uncertainty, and that the actual increases could be greater than those presented by Mr. Tipler. I have discussed the sources of uncertainty in the URS model in my main report, and I will not repeat them here, but I will respond to some comments that Mr. Tipler made in his supplementary evidence.
16. In my main report, I suggested that the distributions of leaching rates used in the model (Appendix A to Mr. Tipler's main evidence) were too narrow. Mr. Tipler responded (paragraph 21 of his supplementary evidence) that if the distributions were wider, the extreme events would be more extreme but just as unlikely. I disagree. Mr Tipler's distributions have a strong central tendency, but in my opinion, there is not enough data to support any central tendency in leaching rates. Instead, I would favour a horizontal distribution across a range, and such a distribution would make higher leaching rates no less likely than lower rates.
17. In paragraph 22 of his supplementary evidence, Mr. Tipler wrote that it may be beyond the present state of knowledge to include a relationship between drainage rate and nitrate loading in the URS model. I agree, but this highlights another area of uncertainty in predicting nitrate leaching rates.
18. In Paragraph 23, regarding the uncertainty about leaching rates from dairy farms, Mr. Tipler dismissed the higher leaching rates from the Ledgard *et al.* (1999) study on the grounds that they were associated with fertiliser N applications of 400 kg/ha/yr. I agree with Mr. Tipler that such high rates are not commonly used in Canterbury, but in my opinion, it is conceivable that they could become common in the future as farms push for greater production.
19. In paragraph 24, Mr. Tipler dismissed the higher leaching rates from the Di and Cameron (2002) study on the grounds that the study simulated flood irrigation, which will not be used in the CPW scheme. I agree that the irrigation method was different, but I also repeat that the study used similar soils to those in the CPW area and measured soil drainage rates similar to those used in the URS model. Therefore, I conclude that similar nitrate leaching rates are possible.
20. In paragraphs 27-29, Mr. Tipler discusses the effects of winter grazing of dairy cattle. He argues that these effects are accommodated within the areal losses assumed in the URS model. However, even considering his discussion, it appears to me that the loss rates the model uses for dryland farms are the same for the pre- and post-scheme scenarios. It is my assertion that the dryland rate should be higher for the post-scheme scenario to account for the extra winter grazing of dairy cows that will be required when the scheme is in place.
21. In paragraph 36, Mr. Tipler addresses my question about how much new irrigated land will result from the scheme, and he states that there is no guarantee that 24,000 hectares currently irrigated by groundwater will convert to the scheme supply. I therefore repeat that the amount of land to be irrigated under the scheme is another area of uncertainty.
22. Related to this last issue is a discussion in paragraph 80 of Mr. Tipler's main evidence, where he states that the maximum concentrations that can occur as

a result of the scheme are limited because the irrigation will be used for pastoral land (which I understand to include dairy). First, it is my opinion that the maximum concentrations could increase even under dairy. Second, although I acknowledge that most of the irrigation from the CPW scheme will be used for dairy farms in the short term, it is conceivable that the irrigation could be used for more cropping in the future, which could result in greater leaching rates than under dairy.

23. Finally, I comment on a remark that Dr. Glyn Francis made in response to a question from a commissioner. Dr. Francis said that nitrate leaching losses from crops could range from zero to very high depending on when it rains. This is consistent with data from our groundwater quality monitoring programmes, which commonly show large increases in nitrate concentrations after large rainfall events. I do not believe that leaching from large drainage events is generally factored into estimates of typical or long-term-average leaching rates from different land uses, and yet it is possible that this is when most nitrate leaching actually occurs.

C. EVIDENCE OF CLAIRE MULCOCK AND IAN BROWN

24. In paragraph 133 of my main report, I concluded that the increases in nitrate contamination as a result of the CPW scheme might be within acceptable limits, and that the chance for this outcome would be greatest if nutrients on farms are managed to minimise nitrate leaching.
25. Claire Mulcock and Ian Brown presented evidence in relation to a proposal for an environmental management system for the CPW scheme. I cannot comment on the workability or enforceability of the system, but I agree that if the system works the way it is planned, it will result in improvements in nutrient management and reductions in nitrate leaching.
26. In my opinion, the most important aspects of the system are the requirements for good record keeping and the emphasis on continual improvement. If farmers are to identify ways that they can change their management practices to reduce nitrate leaching, they must develop a clear understanding of their existing practices, and good records will be essential to this understanding.
27. In addition, scientific understanding of nitrate leaching is an evolving process, and models and other tools to help farmers manage nitrate leaching will improve over time. However, in order to be effective, these tools will need good input data, which can only come from good record keeping.