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

---

EVIDENCE IN REPLY BY TIMOTHY JOHN MCMORRAN
5/09/08

BUDDLE FINDLAY
Barristers and Solicitors
Christchurch

Solicitor Acting: **Rachel Dunningham**
Counsel: **Dr E D Wylie Q C**
Tel 64-3-379 1747 Fax 64-3-379 5659 PO Box 322 DX WP20307 Christchurch

1. My full name is Timothy John McMorran.

2. My professional qualifications and experience were presented in my brief of evidence presented during the earlier hearings.

3. I have read the code of conduct for expert witnesses set out in Environment Court practice note, and confirm that I have complied with the code in the preparation of my evidence.

4. I have been asked to present evidence commenting on a submission prepared by Jocelyn Campbell supporting a submission from Colin Morris of Malvern Hills Protection Society. The submission from Jocelyn Campbell relates to "the reliability of seismic hazard assessment and geotechnical aspects of safety concerning the dam and related canals". The current evidence in reply addresses issues raised in Mrs Campbell's submission.

Seismic Hazard

5. The evidence presented by Mrs Campbell describes how earthquake magnitude and the average interval between large earthquakes (recurrence interval) are estimated from fault length, width and slip-rate in the New Zealand National Seismic Hazard Model (NZNSHM). She indicates that this approach simplifies the characteristics of the elements contributing to local seismic hazard. I agree with Mrs Campbell that the interval between large earthquakes and earthquake magnitude are variable for individual faults, and that models typically simplify this relationship.

6. Mrs Campbell also indicates that the time since the last large earthquake on some faults is known to be approaching the average recurrence interval for the fault so there is a higher than average probability of the fault generating a large earthquake during the lifetime of the proposed scheme.

7. Mrs Campbell indicates in paragraphs 10, 11 and 12 that she disagrees with some of the fault locations and average recurrence intervals presented in my evidence and that some faults are not mentioned. Figure 4 of my evidence shows the locations of active faults compiled from various sources including the ECan active fault database, Geotech Consulting Ltd and GNS Science. Figure 4 also shows the approximate locations of large earthquake sources in the NZNSHM that model the known faults (shown in yellow).

8. Probabilistic seismic hazard models are usually based on simplified geological data. The NZNSHM has been developed by leading seismologists and geologists and has been well reviewed. The model has been used in

seismic hazard evaluation of many large dams in New Zealand. In my experience small changes in fault location, average recurrence interval or earthquake magnitude within the model make little difference to the predicted hazard. I consider that the NZNSHM is a suitable tool for predicting the ground motion for the operating basis earthquake (1/150 year annual exceedance probability) for the proposed scheme at a conceptual design stage.

9. The faults that Mrs Campbell has described that are not included in my evidence make little difference to the seismic hazard within the scheme. This is because rupture of those faults is unlikely to generate ground motions that are larger than the proposed maximum design earthquake, which we have defined as a maximum earthquake on the Hororata Fault. None of the postulated faults are closer to the damsite or expected to generate larger earthquakes than the proposed maximum design earthquake.

10. During the design process additional geological information will undoubtedly become available. Any new data will be considered in the design of the dam, canals and tunnel. This philosophy is normal in the design process for large schemes.

11. Under the heading “Aspects of dam foundations (b)”, concern is expressed that we have assumed the dam site conforms to Class C (shallow soil) site conditions. Based on our knowledge of the dam site, I believe that Class C (shallow soil) is the most appropriate classification. Estimations of peak ground acceleration using the method of McVerry et al (2006) are influenced by the ground conditions of the site. The method predicts that Class C sites will experience higher peak ground accelerations than stiffer site conditions (Class A or B) or deep or soft soil site conditions (Class D or E). For this reason, I consider it unlikely that we have significantly underestimated the ground shaking hazard at the site. However, a more thorough assessment of ground conditions and design ground motions will be undertaken as part of the dam design.

Dam Foundations

12. Under the heading “Aspects of dam foundations (d)”, concern is raised that the proposed SCB cutoff wall will not adequately cut off the gravels beneath the dam. The method and configuration of foundation seepage cut off will be an important aspect of the detailed design. Site investigations identified gravels to a depth of 38 m beneath the valley mouth. The cut off may locally

need to extend through these gravels. Cut off walls of this depth are not uncommon in modern dams, and I am aware of much deeper cut off walls.

13. Under the heading “Aspects of dam foundations (e)”, Mrs Campbell indicates the possibility of encountering bentonite clays within the dam site. While I consider this to be a possibility, I have not found any evidence of bentonite during the site investigation to date. The area of the dam foundation most likely to be underlain by bentonite-containing rocks is the left abutment. I believe appropriate engineering design could adequately mitigate the effects of any bentonite in this area. For example, the conceptual design for the spillway assumes that the spillway will be anchored to rock.

14. Under the heading “Aspects of dam foundations (f)”, it is suggested that geophysics could be used to investigate the possible presence of a fault near to the damsite. I agree that geophysics would be an appropriate investigation technique to be used during detailed design investigations.

Evidence of Canterbury Coal Limited

15. In paragraph 8 Canterbury Coal Limited indicate that 250,000 to 300,000 tonnes of coal will be rendered inaccessible to mining due to inundation by the reservoir. This appears to be possible. However, Canterbury Coal Limited have not provided any information to confirm the feasibility of mining this coal, nor do they detail the extent to which the coal reserves have been mined underground in the past. Further, they do not acknowledge that the coal seams and underground workings beneath Bush Gully are already below the water table.

16. In paragraph 11 Canterbury Coal Limited indicate the presence of a fault, that they consider could be an active fault, that has been exposed during mining. This observation is consistent with evidence of a possible active fault encountered during investigations for a possible regional landfill (refer to paragraphs 23, 24 and 25 in my brief of evidence). I do not believe that rupture of a fault in this location would generate stronger ground motions at the proposed dam site than our assumed Controlling Maximum Earthquake (rupture of the Hororata Fault).

17. In paragraph 12 Canterbury Coal Limited indicate that ‘it cannot be assumed that reservoir slope instability will not occur’. I agree with this statement and that loessial soils and weathered mudrocks, where present, may become unstable when saturated. This is described in paragraphs 70 and 71 and Appendix D of my evidence. Slope instability caused by the reservoir will

include erosion of surficial material and establishment of a new beach around the reservoir rim. In addition, some local slumping or shallow sliding could occur where bedding within the Tertiary age sedimentary rocks dips towards the lake. I believe this will be restricted to minor areas around the lake.

Conclusions

18. In conclusion, I largely agree with Mrs Campbell's evaluation. She has pointed out a number of potential geological and seismic hazard issues that should be considered during the dam design process. Her conclusions do not alter the hazard rating of the dam or reduce the level of safety presented in the dam safety report of 2006.

19. The concerns raised by Canterbury Coal Limited do not affect the feasibility of the proposed reservoir. We have insufficient information to assess the validity of the claim that 250,000 - 300, 000 tonnes of coal will be rendered inaccessible to mining by the proposed reservoir.

Timothy McMorran