(1)

in the matter of: the Resource Management Act 1991

and

in the matter of: an application for resource consent CRC071029 by the South Canterbury Irrigation Trust and Meridian Energy Limited to take and use water from the Waitaki River

Brief of evidence of **Matthew Ryan**

Dated: 23 October 2007

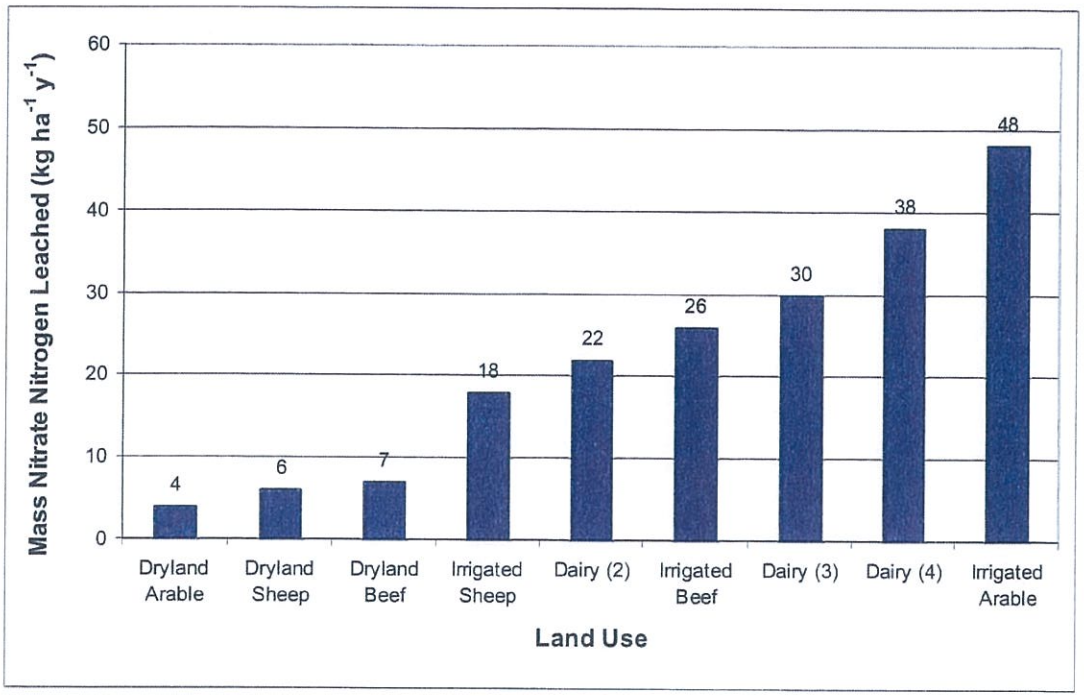

Figure 1: Estimated Annual Mass Nitrate Nitrogen Leached (kg ha^{-1} y^{-1}) from Dryland and Irrigated Farming Scenarios

17. Table 2 shows the estimated nitrate concentrations in drainage waters for each land use which were calculated using the estimated annual drainage values shown in Table 1.

Table 2: Calculated Nitrate Concentrations (g m^{-3}) in Drainage from Dryland and Irrigated Farming Scenarios

Drainage Concentration (g m^{-3})	Land Use								
	Dry Sheep	Irr Sheep	Dry Beef	Irr Beef	Irr Dairy			Dry Arable	Irr Arable
					Cows ha^{-1}				
					2	3	4		
Upper estimate[a]	5	8	7	12	10	14	18	4	22
Mean[b]	4	7	6	10	8	11	14	3	18
Lower estimate[c]	3	5	5	7	6	8	11	3	13

Note:
Highlighted values indicate that the nitrate drainage concentration exceeds the 16 g m^{-3} threshold specified under Rule WQL18 in the PNRRP

[a]Calculated using the lower drainage estimate (217 mm y^{-1}) from Table 1

[b]Calculated using the mean drainage estimate (288 mm y^{-1}) from Table 1

[c]Calculated using the upper drainage estimate (361 mm y^{-1}) from Table 1

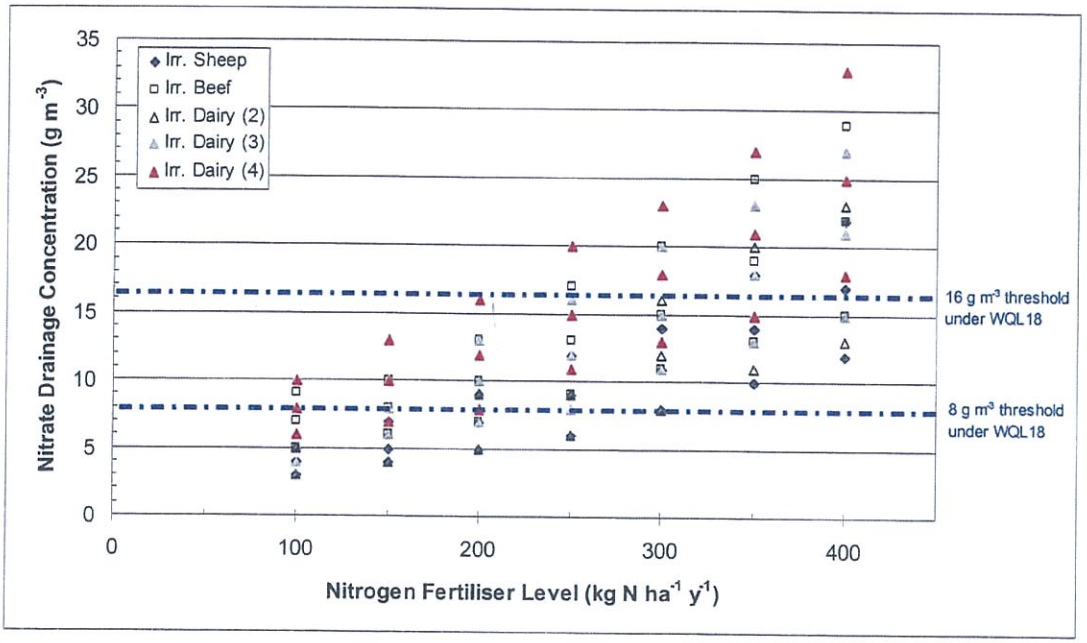

Figure 3: Estimates of Nitrate Concentration (g m^{-3}) in Drainage for Irrigated Grazed Pastoral Farming Systems under Varying Inorganic Nitrogen Fertiliser Inputs (kg ha^{-1} y^{-1})

25. Figure 4 summarises the sensitivity analysis undertaken to examine the effect of variable rainfall inputs on the soil nitrate leaching projections made using the latest version of OVERSEER® (Version 5.2.6) for irrigated grazed pastoral systems. This exercise was undertaken on the basis that the farm systems modelled use typical or moderate amounts (200 kg N ha^{-1} y^{-1}) of nitrogen fertiliser. The general relationship in Figure 4 shows that soil nitrate leaching is projected to increase in higher rainfall years.

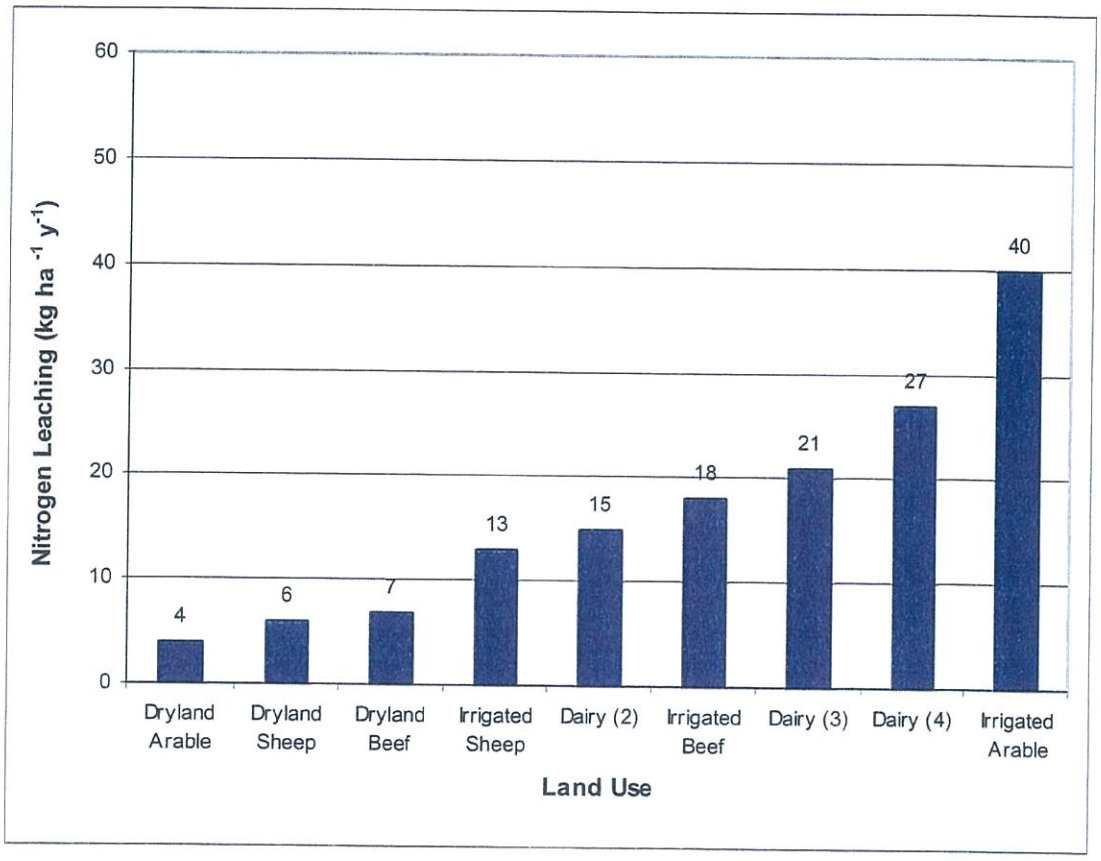

Figure 7: Estimated Annual Mass Nitrate Nitrogen Leached (kg ha^{-1} y^{-1}) from Dryland and Irrigated Farming Scenarios with Mitigation Measures

Table 5: Calculated Nitrate Concentrations (g m^{-3}) in Drainage from Dryland and Irrigated Farming Scenarios with Mitigation Measures Imposed

Drainage Concentration (g m^{-3})	Land Use								
	Dry Sheep	Irr Sheep	Dry Beef	Irr Beef	Irr Dairy			Dry Arable	Irr Arable
					Cows ha^{-1}				
					2	3	4		
Upper estimate	5	6	7	8	7	10	12	4	18
Mean	4	5	6	7	6	8	10	3	14
Lower estimate	3	3	5	5	4	6	7	3	11

Note: Highlighted values indicate that the nitrate drainage concentration exceeds the 16 g m^{-3} threshold specified under Rule WQL18 in the PNRRP

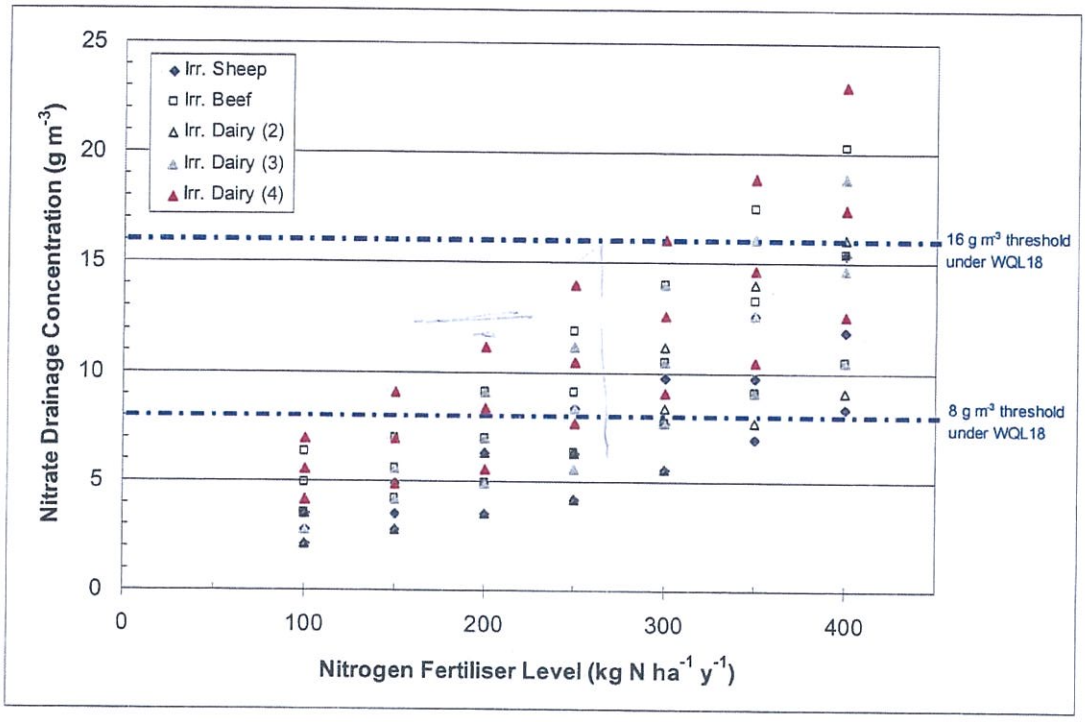

Figure 8: Estimates of Nitrate Concentration (g m^{-3}) in Drainage for Irrigated Grazed Pastoral Farming Scenarios under Varying Inorganic Nitrogen Fertiliser Inputs (kg ha^{-1} y^{-1}) with Implementation of the Nitrification Inhibitor Mitigation Measure

DISCUSSION ON THE PROJECTED NITRATE LEACHING RESULTS IN RELATION TO THE PROPOSED NATURAL RESOURCES REGIONAL PLAN

41. In the report[31] used to derive the nitrate drainage concentration thresholds in Rule WQL18, it is acknowledged that for the majority of pastoral land use situations, the average annual nitrate concentration in soil drainage will not exceed 16 g m^{-3}. The exceptions to this being a small number of dairy operations under very high stocking rates (> 5 cows ha^{-1}) and some arable and vegetable cropping systems depending upon management practices employed. Although as mentioned earlier, Rule WQL18 of the PNRRP states that arable systems that use winter cover crops in at least one year in six will not exceed the 16 g m^{-3} threshold for nitrate concentration in drainage.

[31] Discharge of Nitrate-Nitrogen to Groundwater from land Use Activities – Recommendations for a Permitted Activity Rule. Environment Canterbury Technical report U03/27 (2003).

2

REPORT

HUNTER DOWNS IRRIGATION SCHEME – SUPPLEMENTARY REPORT

Mass Balance Modelling Assessment

Prepared for

Meridian Energy Limited

PO Box 2454

Christchurch

28 June 2007

42159567-02000

Section 4 Sensitivity Analysis

Table 4.9 Summary of Changes to Water Quality from HDI Scheme With and Without BMP

	Existing Environment (average)	Modelled existing	Future under HDIS (no BMP)	Future under HDIS (with BMP)	%age increase (no BMP)	%age increase (with BMP)
Nitrogen as nitrate + nitrite nitrogen (NOx-N), used also as estimate of dissolved inorganic nitrogen (DIN) –g/m3						
Pareora G/W	5.0-5.5	4.9	8.6	7.1	75	44
Hook River G/W	2.0-2.5	1.5	4.2	3.4	280	226
Hook River S/W	0.9	1.7	4.7	3.7	276	217
Wainono area G/W	2.5-3.5	3.4	7.3	5.9	215	173
Wainono Lagoon S/W	0.1-1.2	1.1	4.7 2.9	3.8 2.3	427 263	345 209

The above results show that the application of BMP results in a reduction in post scheme NO_3-N concentrations in groundwater of between 0.8 -1.5 g/m^3. Varying the leaching input concentration of only irrigated arable land from 18 g/m^3 to 14 g/m^3 i.e. by around 22% results in a significant variation in the modelled output. This analysis confirms the sensitivity of the model to variations in input leaching concentrations. This is particularly the case for irrigated arable land use, which whilst comprising only 20-30% of the post scheme land use areas within each catchment, has the highest NO_3-N leaching concentration.

4.6 Summary

The results of the sensitivity analysis for both the Pareora and Wainono catchments have demonstrated that the key parameters controlling the output concentrations are the post scheme nitrate drainage concentrations utilised. As a result application of BMPs present the potential for significant reductions in post scheme NO_3-N concentrations in both surface water and groundwater receptors.

The calculation of the input groundwater flux volume i.e. aquifer properties also has a significant effect on the modelled output. The model is not particularly sensitive however to changes in background groundwater concentration or to changes in drainage allocations within the catchment.

The aquifer properties used in the modelling have been based on published data where available, however it is recognised that this data is limited and may not reflect the likely heterogeneity within the catchment areas. In order to constrain this issue, URS have endeavoured to calibrate the model by using the best available measured groundwater quality concentrations at the lower points of each catchment.

892. We are uncertain whether any improvements to waterways (including Wainono Lagoon) and their associated terrestrial flora and fauna are anticipated in the absence of HDI. We received no evidence to suggest this was the case. Ms Robertson stated that she did not anticipate that there will be any adverse effects on the indigenous terrestrial habitat values of the lowland streams of the HDI scheme area, but supported best farm management practices as a means of minimising any chance of adverse effects and providing some environmental enhancements for habitat for indigenous species. She also considered that the changes in water quality and quantity with the HDI proposal would not cause significant adverse effects on the wetland vegetation, birds or fish of Wainono Lagoon, and went so far as to consider that increased water flow into the lagoon during summer would benefit the lagoon's ecology. Other submitters in opposition were not so confident.

893. HDI does provide a pathway for developing an integrated management approach to land use activities and water bodies at a catchment-wide scale. If appropriately implemented through the consent process, management plans will provide a strong incentive for land owners to manage their activities with environmental outcomes in mind. To this end, we consider it essential that management plans include mechanisms that deter and control irrigators whose activities are adversely affecting the receiving environment.

894. The issue of effects of land use activities on land in these catchments not under HDI control has been raised by some witnesses. We are powerless to address this issue through this consent process, and would expect the Regional Council to take the lead on related catchment management issues, particularly where they may affect aquatic environments.

895. While we accept there are likely to be some effects on water quality associated with HDI we agree with HDI's ecological experts that these effects are unlikely to change the general character of local water bodies provided scheme and farm management plans of the type outlined to us are implemented.