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*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

Supplementary brief of evidence of **Matt Ryan** (on cumulative water  
quality effects)

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Dated: 07 December 2009

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## **ADDENDUM TO BRIEF OF EVIDENCE OF MATTHEW RYAN (ON CUMULATIVE WATER QUALITY EFFECTS)**

### **INTRODUCTION**

- 1 My full name is Matthew Ryan.
- 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 supplementary evidence to my evidence in chief dated the 16 September 2009 on soil nutrient leaching (WQS).
- 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 supplementary evidence I:
  - 5.1 provide additional clarification on the potential error range associated with nitrogen leaching estimates made by the OVERSEER model; and
  - 5.2 comment on the figure presented by Dr Ross Monaghan on OVERSEER nitrogen leaching predictions for four dairy catchments.

### **ACCURACY OF NUTRIENT LOSS PREDICTIONS MADE BY OVERSEER**

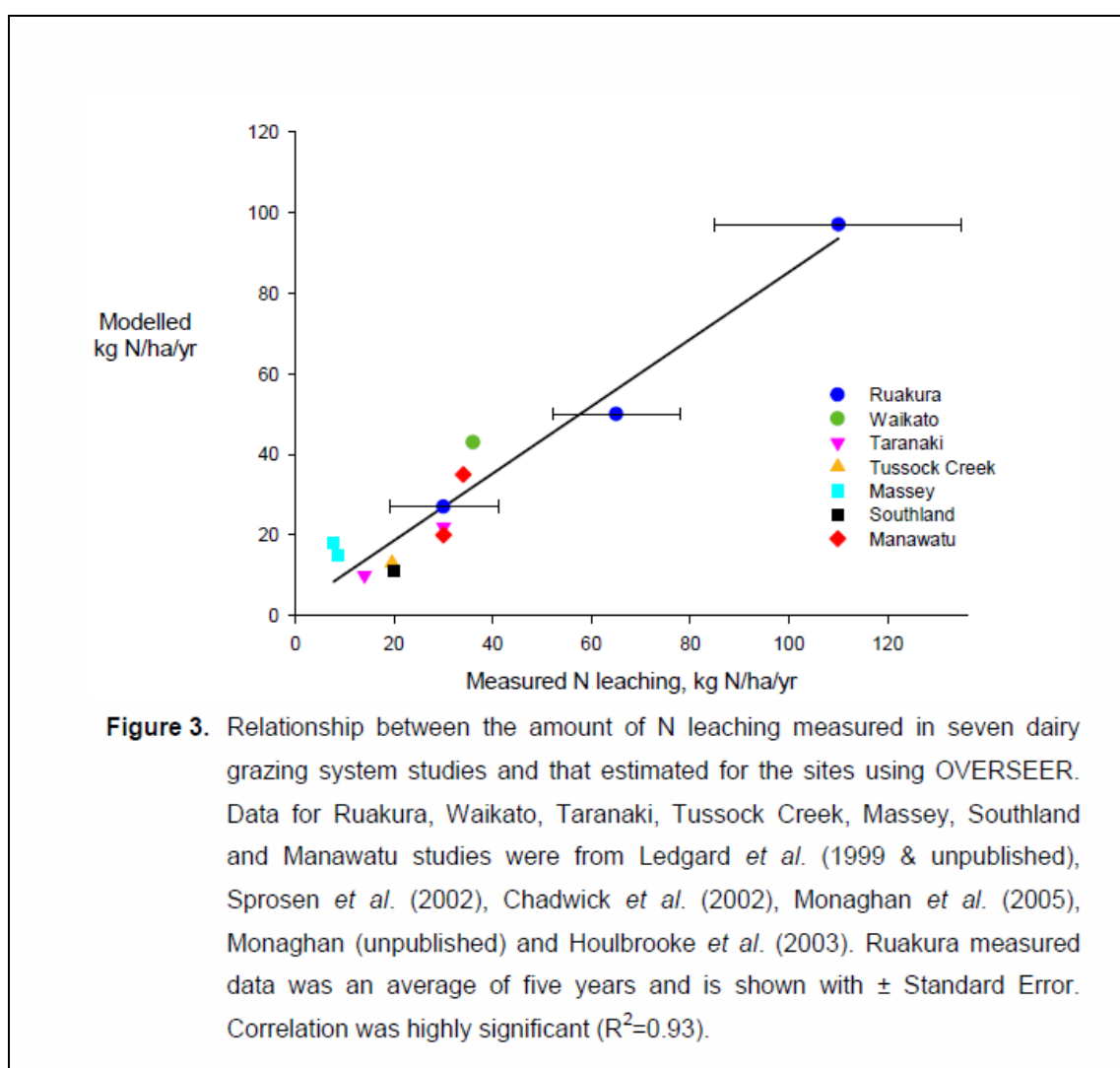
- 6 While presenting my evidence I stated that the errors associated with N leaching from OVERSEER are accepted to be in the order of  $\pm 20\%$ .
- 7 Given the relative absence of information on errors within the OVERSEER model, I have referred to the section 42A Report<sup>1</sup> (Appendix A) for Horizons Regional Council concerning water quality, where Dr Stewart Ledgard of AgResearch Limited (who was actively involved and led the development of the nitrogen cycling model in OVERSEER) made the following statement (see Para 18.iii.b of Sec. 42A Report; **Appendix A**) regarding the accuracy of nutrient loss predictions made by OVERSEER:

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<sup>1</sup> In the matter of the hearings on submissions concerning the Proposed One Plan notified by the Manawatu-Wanganui Regional Council.

"There has been some confusion over the "accuracy" of estimates from OVERSEER. Accuracy is associated with: 1) Input information, and 2) Comparison with measured values. A report by Ledgard and Waller (2001)<sup>2</sup> indicated that there is variability in estimates of the amount of N leaching from OVERSEER associated with uncertainty around values for inputs, and that in total this is of the order of  $\pm 20\%$ ". [emphasis added]

- 8 Dr Ledgard also provides a number of examples (see Paras 18.iii.d – h of Sec. 42A Report; **Appendix A**) which show nitrogen leaching estimates by OVERSEER for a range of grazed pastoral system studies in New Zealand. I have copied Figure 3 and Tables 1 and 2 from his Section 42A report below.



<sup>2</sup> Ledgard S.F. and Waller J.E. (2001). Precision of estimates of nitrate leaching in OVERSEER. Report to FertResearch. AgResearch Ruakura. 16 p.

**Table 1.** Effect of winter management practices on N leaching estimated using the OVERSEER model compared to field data (average of two years) from a beef cow grazing system study in the Lake Taupo catchment (Betteridge *et al.*, 2005).

Winter management	N leaching (kg N/ha/yr)	
	Modelled	Measured
All-grazing	15	16
Winter-off (April-Aug)	8	7

**Table 2.** N leaching estimated using the OVERSEER model compared to field data from a sheep grazing system study in the Manawatu (Parfitt *et al.*, 2009). The low fertility farmlet carried eight stock units/ha while the high fertility farmlet had 16 stock units/ha.

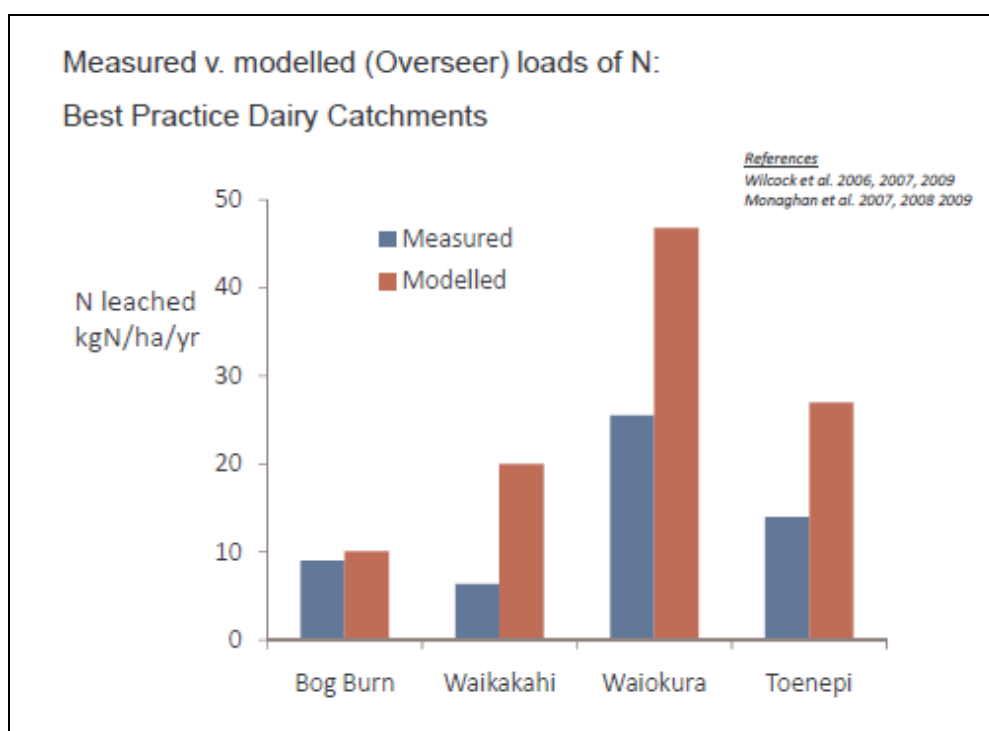
	N leaching (kg N/ha/yr)	
	Modelled	Measured
Low fertility	7	6
Low fertility +300 kg N/ha	21	18
High fertility	26	24
High fertility +300 kg N/ha	116	114

- 9 On the basis of the information presented above, I therefore consider that there is good general agreement between OVERSEER nitrogen leaching estimates and actual measured values for New Zealand grazed pastoral systems.

#### **DR MONAGHAN'S EVIDENCE**

- 10 In his evidence in chief, Dr Monaghan presents some of the above examples to demonstrate the accuracy of the OVERSEER model in modelling nitrogen leaching and concludes that the OVERSEER model has a high degree of credibility for describing grazed pastoral systems in New Zealand.

- 11 The figure Dr Monaghan presented in his rebuttal/supplementary evidence (Figure 1 below) shows the nitrogen leaching estimates made by OVERSEER scaled up to a catchment scale and the estimated nitrogen leached from four dairy catchments back-calculated from water quality monitoring data. From **Figure 1** below, it appears to show that OVERSEER has significantly over-estimated nitrogen leaching losses across three of the four dairy catchments.



**Figure 1: Figure presented by Dr Monaghan in his evidence**

- 12 However, this simple conclusion is misleading as the OVERSEER model is a root-zone nitrogen leaching model at the paddock/farm scale only, and is not a catchment scale model. The OVERSEER model cannot quantify nitrogen leaching losses on the catchment scale simply because it has no ability to quantify complex hydrological and/or hydro-geological settings that may be present at the catchment scale.
- 13 It is my understanding that by presenting **Figure 1** above, Dr Monaghan is not indicating that OVERSEER has a tendency to over-estimate nitrogen leaching losses, but rather, the graph indicates the degree of possible “attenuation” of the nitrogen leaching load from the farm and transmission to surface water bodies monitored.

- 14 In effect, **Figure 1** demonstrates that it is possible that of the nitrogen leached from farms, not all will end up in surface water bodies, with attenuation likely occurring via denitrification as the nitrogen leaching load in groundwater passes through riparian margins, or by-passes monitored surface water bodies down-gradient altogether. However the degree of this *attenuation* within a catchment will obviously depend upon hydro-geology and respective soils present in the riparian margins around surface water bodies.
- 15 In addition to the likely *attenuation* that is occurring, there is also the possibility of hydro-geological "lag" in the system where the increased nitrogen leaching load from activities in the catchment have yet to reach surface water bodies monitored. A prime example of this "lag" effect is for the Lake Taupo catchment where the transmission time for soil nitrogen leached to the Lake is estimated to take decades.
- 16 It conclusion, I'm of the opinion that Dr Monaghan's graph (**Figure 1**) does not support the proposition that OVERSEER typically over-estimates catchment nitrogen leaching losses. The OVERSEER model is a paddock/farm scale model and is not designed for, nor constructed in a manner to produce soil nitrogen loss estimates on the catchment scale.
- 17 However the model when used in conjunction with catchment monitoring data (such as in **Figure 1**), can be used to provide an indication of the degree of possible attenuation or lag time in the system of the nitrogen leaching load from the root-zone and transmission to receiving surface water-bodies. For the Upper Waitaki scenario, the degree of attenuation or lag time likely cannot be determined due to lack of water quality monitoring data and the current gaps in knowledge of the hydro-geological system present (see evidence of **Mr Peter Callander**).

Dated: 7<sup>th</sup> December 2009



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**Matthew Ryan**