IN THE MATTER	of the Resource Management Act
AND	
IN THE MATTER	of Applications for Resource Consents to Take and Use Farm Irrigation Water in the Upper Waitaki Catchment of Lake Benmore
AND	
IN THE MATTER	of Stage One: Mackenzie Water Research Limited Submissions and Evidence on the Cumulative Nutrient Effects (and Mitigation thereof) of the Upper Waitaki Applications

Rebuttal Evidence of Brian Thomas Coffey

1.00 Introduction

1.01 My name is Brian Thomas Coffey. My qualifications and experience are as stated in my Evidence in Chief.

1.02 I have read the Code of Conduct for Expert Witnesses (Rule 330A, High Court Rules and Environment Court Practice Note) and agree to comply with it. I have complied with the Code in the preparation of this statement of rebuttal evidence.

1.03 My rebuttal evidence relates to specific aspects of the evidence presented by:

- Dr. Adrian Meredith on behalf of Environment Canterbury for the S42A Report,
- Dr. Michael Freeman of Freeman Environmental Limited, on behalf of Environment Canterbury, for the S42A Report,
- Mr. Johnathan Bray of the Department of Conservation,
- Mr. Richard Turner on behalf of Meridian Energy Limited,
- Dr. Antonius (Ton) Snelder of NIWA on behalf of Meridian Energy Limited, and
- Ms. Donna Sutherland of NIWA on behalf of Meridian Energy Limited.

1.04 I have attached a copy of the caucusing notes from a meeting of Brian Coffey (MWRL), Greg Ryder (MWRL), Ton Snelder (MEL), Donna Sutherland (MEL) and Adrian Meredith (ECan) as Appendix A to this rebuttal evidence.

2.00 Evidence of Dr. Adrian Meredith

2.01 In paragraphs 45 and 46 of his evidence, Dr. Meredith dismissed our two ecological surveys as "*just descriptions of a range of broad ecological indices from single spot sampling occasions over a 2-3 day period in autumn*".

2.02 However, these two reports are precisely what they claim to be. They are descriptive stream surveys conducted during low flow late summer conditions when maximum annual periphyton biomass was expected to be present. Our description of methods stated: "*The survey information in this report relates to late summer / early autumn conditions before significant rainfall and therefore seasonal scouring of periphyton communities had occurred at stream sampling sites during 2008*".

2.03 Dr. Meredith (paragraph 46) claimed his "*examination of hydrographs from <u>several</u> <u>sites</u> in the basin indicate that sampling occurred following a period of almost six months without significant rain and therefore represented a six month hydrograph (low flow) recession period*".

2.04 There are four river guaging sites accessible from the Ecan Web Site that are relevant to the nodes described in our two reports. These are:

- Mary Burn at SH8,
- Tara Hills on the Omarama Stream,

- Wardells on the Omarama Stream, and
- South Diadem on the Ahuriri River.

2.05 Gauging sites for the Tekapo Spillway and for the Ohau below the siphon reflect hydro-elecrtric power generating activities and not prevailing weather conditions.

2.06 Given the size of the Mackenzie Basin and that continuous flow monitoring was only available for the upstream reach of the Ahuriri River and the Omarama Stream, we did not make the assumption that FRE3 was 2 for all nodes that we sampled in 2008. Nor do I accept it is scientifically defensible for Dr. Meredith to do so. There was no flow monitoring at the downstream nodes of the Grays, Tekapo, Stony, Wairepo, Willowburn, Quailburn or Henburn Nodes. Rainfall events and river flow responses could well have occurred in these sub-catchments (but not in the Omarama and Upper Ahuriri sub-catchments) between October 2007 and April 2008.

2.07 Moreover, Dr. Meredith's reference to "*single spot sampling occasions over a 2-3 day period in the autumn*" may be appropriate for chemical water quality sampling but is not appropriate for descriptions of indicator organisms at a stream sampling location. The assemblage of resident indicator organisms at a particular site is taken to show that all water quality conditions have been suitable for their survivial and growth to the size and age they have attained. Biological indicators therefore, are integraters of environmental conditions and in the case of aquatic macroinvertebrates indicate what habitat quality at that site has been like for the previous two to four weeks.

2.08 In his paragraphs 47 and 48, Dr. Meredith has implied that periphyton taxa recorded in our April 2008 survey were generally cyanobacteria that can fix their own nitrogen and grow to nuisance conditions in oligotrophic conditions provided they have a sufficiently long accrual period. However, this is only the case if phosphorus is not limiting growth and not all periphyton recorded during our 2008 survey were oligotrophic cyanobacteria.

2.09 Mesotrophic periphyton taxa occurred at Maryburn Lower (*Gomphonema sp*., *Melosira varians*, *Oedogonium sp*. and *Vaucheria sp*.), Wairepo Lower (*Oedogonium sp*. and *Phormidium sp*.), Twizel Lower (*Gomphonema sp*. and *Zygnema sp*.), Ahuriri at SH8 Road Bridge (*Melosira varians*, *Oedogonium sp*. and *Phormidium sp*.), Little Omarama (*Melosira varians* and *Oedogonium sp*.), Omarama Upper (*Oedogonium sp*., *Phormidium sp*. and *Vaucheria sp*.) and Omarama Lower (*Melosira varians* and *Stigeoclonium lubricum*). Indeed the eutrophic taxa *Cladophora glomerata* was recorded as a dominant at Twizel Lower in April 2008.

2.10 In paragraph 48 of his evidence Dr. Meredith is not correct when he includes the cyanobacterial genus *Phormidium* as an oligotrophoc taxa (quoting Table 6 of Biggs 2000). This taxon occurs in oligotrophoc conditions as a secondary filamentous taxa where periphyton is dominated by species of *Nostoc*, but only dominates canopy cover in mesotrophic conditions.

2.11 Dr. Meredith considered (his paragraph 51) that the periphyton communities we described in April 2008 would not have been "observable as conspicuous or unusual". To refute this contention, I have included photographs of conspicuous growths of long green filamentous algal cover taken during April 2008 in Plates 1 to 4.

2.12 In paragraph 52 of his evidence Dr. Meredith states our April 2009 survey was conducted during sustained wetter conditions. However, this was not the case and our report states the "*surveys were conducted in late summer following a period of dry weather conditions and relatively stable flows that would permit the accrual of periphyton biomass in hard-bottomed waterways*".

2.13 Rainfall records from Dunstan Peaks, McRaes Gorge, Mackenzie and Ahuriri South Diadem indicated the last significant rainfall event prior to 04 – 08 April 2009 was at the end of February 2009 (5 weeks prior to our 2009 survey).

2.14 An annual plot of monitored river flow either side of our 2009 survey at Mary Burn (SH8), the Omarama Stream at Tara Hills, the Omarama Stream at Wardells and the Ahuriri River at South Diadem is plotted in Figures 1 to 4.

2.15 Figure 1 suggests the rainfall recorded at Dunstan Peaks, McRaes Gorge, Mackenzie and Ahuriri South Diadem in late February 2009 did not fall in the catchment of the Upper Mary Burn Stream, as there was no significant flow response in the hydrograph.

Plate 1: Conspicuous growths of *Oedogonium sp.* in the Ahuriri River at SH8, April 2008.

Plate 2: Cover of *Cladophora glomerata* at the Lower Twizel Site, April 2008.

Plate 3: Conspicuous growths of *Vaucheria sp.* and *Oedogonium* at Lower Maryburn, April 2008.

Plate 4: Cover of *Stigeoclonium lubricum* at the Lower Omarama Site, 4/2009.

Figure 1: Plot of Flow (cumecs) in Mary Burn Stream at SH8 between November 2008 and November 2009 (courtesy of ECan web site).

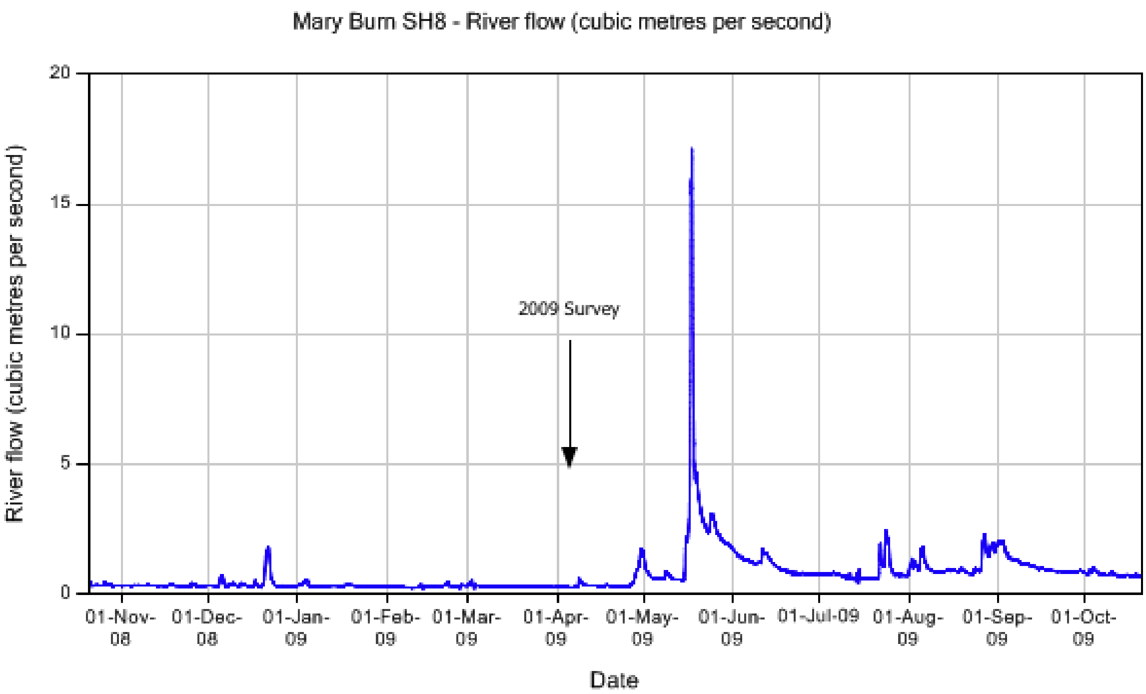


Figure 2: Plot of Flow (cumecs) in Omarama Stream at Tara Hills, November 2008 to November 2009 (courtesy of Ecan web site).

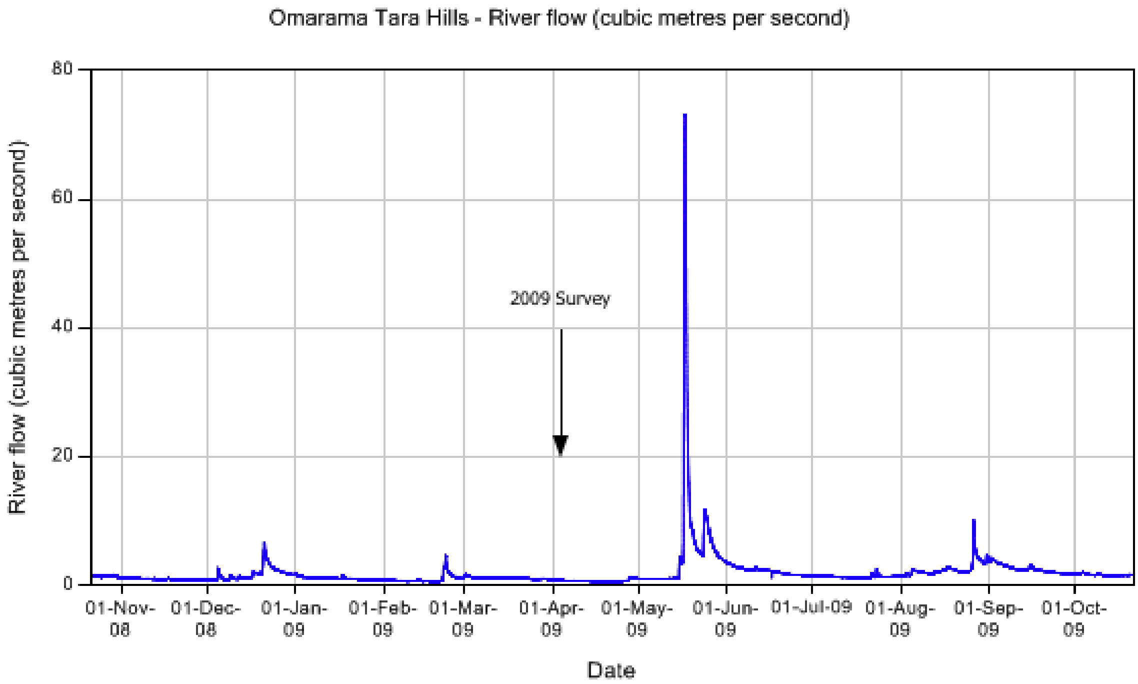
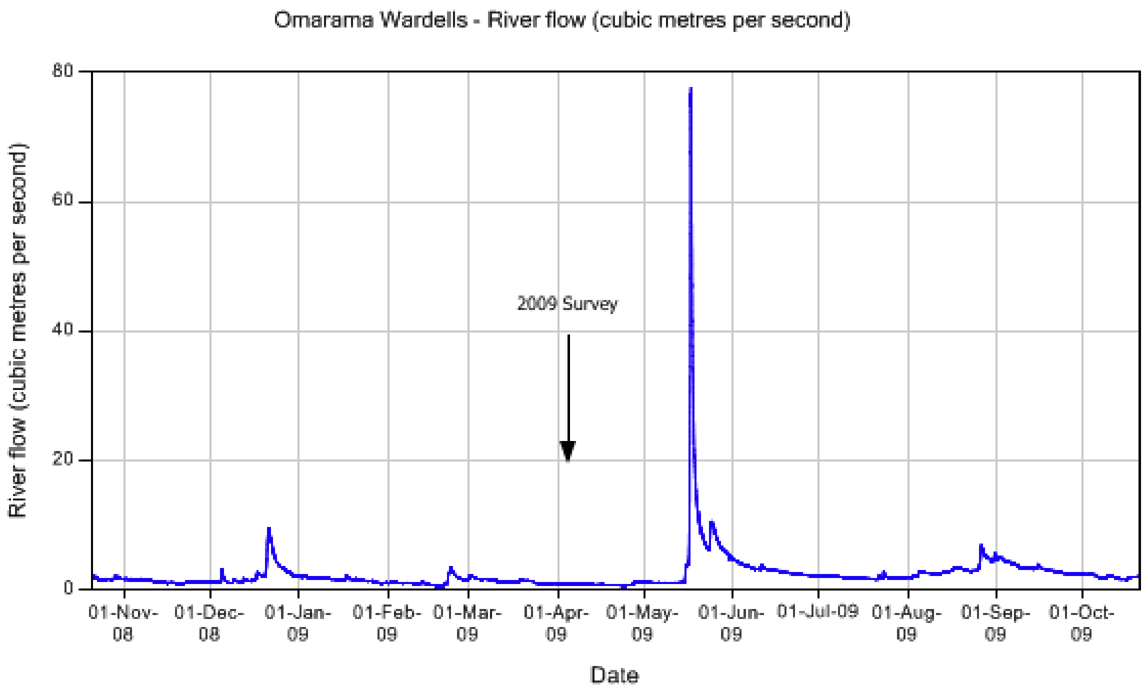


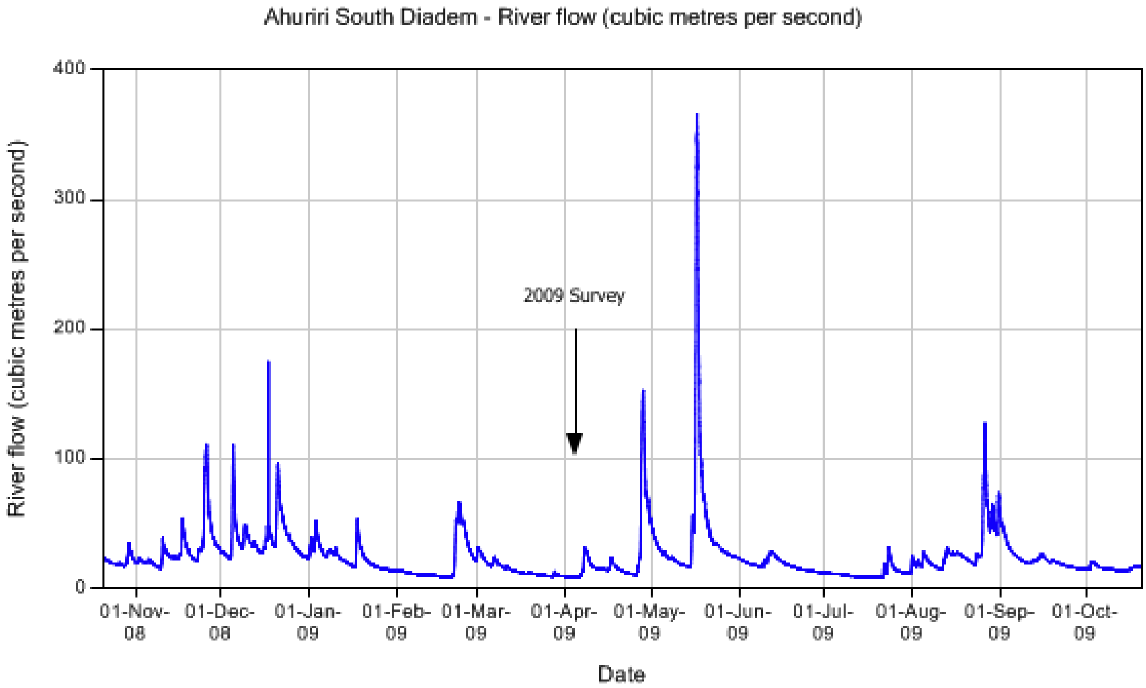
Figure 3: Plot of Flow (cumecs) in Omarama Stream at Wardells, November 2008 to November 2009 (courtesy of Ecan web site).



2.16 However, there was an instream flow response to this late February rainfall event in the Omarama Stream (see Figures 2 and 3) and in the Ahuriri River (see Figure 4) five weeks prior to our 2009 survey.

2.17 Reference to Figures 1 to 4 illustrate that between November 2008 and November 2009 there were six FRE3 flood events in the Mary Burn Stream, 4 FRE3 events in the Omarama Stream and 7 FRE3 events in the Ahuriri River. The mid May 2009 flood event was highly significant at all monitored sites.

Figure 4: Plot of Flow (cumecs) in Ahuriri River at South Diadem, November 2008 to November 2009 (courtesy Ecan web site).



2.18 Prior to our 2009 survey therefore, the Mary Burn sites would have had some 14 weeks of stable flows for periphyton biomass to accrue whereas the Omarama and Ahuriri sites would only have had five weeks of stable flow following a FRE3 event in late February. Other sampling sites were likely to have had between 5 and 14 weeks of stable flow prior to our April 2009 survey.

2.19 In paragraph 55 of his evidence, Dr. Meredith again asserts that the periphyton that we would have described would have been oligotrophic taxa as of April 2009 and that *"Any equivalent biomass resulting from significant land use development and corresponding increase in nutrient loads would be composed of very conspicuous 'mesotrophic' or 'eutrophic' taxa (as in Table 6 of Biggs 2000), and would correspondingly likely to be very conspicuous and detrimental to human perceptions"*. We recorded both the biomass and component taxa in our 2009 survey and this was simply not the case at the downstream nodes that we sampled in the Twizel, Tekapo, Mary Burn, Grays and Wairepo waterways.

2.20 Mesotrophic taxa that dominated at Twizel sampling sites included *Phormidium sp*. at Twizel Upper, *Gomphonema sp*. and *Phormidium sp*. at Twizel Middle and *Stigeoclonium lubricum* at Twizel Lower. At the Tekapo Node *Tabellaria flocculosa*, *Stigeoclonium lubricum*, *Phormidium sp*., *Melosira varians* and *Cladophora glomerata* were variously dominant across the river profile. *Phormidium sp*. and *Stigeoclonium sp*. were dominant at sites across the Mary Burn SH8 profile. *Vaucheria sp*., *Stigeoclonium sp*. and *Gomphonema sp*. were dominant at Grays Node. *Phormidium sp*. was dominant at Wairepo Upper and *Stigeoclonium sp*. was dominant at Wairepo Lower. *Gomphonema sp*. was dominant at Quailburn Upper and *Stigeoclonium / Phormidium sp*. were dominant at Quailburn Node. These are mesotrophic to eutrophic taxa.

2.21 Photographs of examples of conspicuous green filamentous taxa taken during our April 2009 survey are shown in Plates 5 to 12. Plate 6 in particular shows very dense periphyton in the downstream reach of the Grays sub-catchment in which there was no current irrigation.

2.22 Despite Dr. Meredith's pre-conceived opinion that the watercourses described in the Water Quality Study were expected to be relatively pristine and oligotrophic, "nuisance" growths of mesotrophic and eutrophic periphyton were found at downstream nodes in these watercourses during two consecutive late summer periods. In paragraph 54 of his evidence, Dr. Meredith contends these growths resulted from extreme '"natural perturbations" rather than existing nutrient loss from non point source discharges. I disagree with his opinion.

Plate 5: Long green filamentous algae (*Stigeoclonium sp.*) at Grays Upper, April 2009.

Plate 6: A complete cover of *Vaucheria sp*. and *Stigeoclonium sp*. at Grays Node, April 2009.

Plate 6: *Stigeoclonium sp.* and *Vaucheria sp*. on the ford blocks at Grays Node, April 2009.

Plate 7: Long filaments of *Stigeoclonium sp*. at Quailburn Node, April 2009.

Plate 8: View of large stones under the bridge at Twizel Node that were covered in long filaments of *Cladophora glomerata* and *Stigeoclonium sp.*, April 2009.

Plate 9: Long filaments of *Stigeoclonium sp*. at Wairepo Lower, April 2009.

2.23 In Dr. Meredith's paragraph 57, which refers to work undertaken by Wilks and Norton (in prep.) during 2007, he states that periphyton communities described by these workers in the Mackenzie Basin were all composed of oligotrophic taxa. However, no floristic description of periphyton communities was included in this document.

2.24 Dr. Meredith also dismisses our description of macroinvertebrate metrics (MCI, QMCI, EPT, %EPT) as being more degraded than might be expected in this environment. He considered it was "unfortunate that sampling occurred at sub-optimal and non-representative times". However, the point Dr. Meredith has chosen to ignore is that the downstream sections of the watercourses we described were degraded relative to upstream reaches of these watercourses.

2.25 The only available models for estimating the response of periphyton in streams to nutrient concentration and the frequency of flood events (Biggs, 2000) predict maximum benthic algae biomass, not normal or average periphyton biomass. Indeed, Dr. Meredith's concept of normal or average periphyton biomass is flawed as periphyton biomass is reduced to virtually zero after a significant flood event and then progressively increases until the next biomass scouring flow occurs or browsing pressure limits / reduces biomass accrual. The water quality report correctly models the annual maximum chlorophyll-a concentration rather than an "average" condition.

2.26 Dr. Meredith appears unwilling to accept that the downstream nodes of a number of the waterways we have described are modified, they are subject to adverse existing land use effects and that they would benefit greatly from the establishment and maintenance of functional riparian margins. This is a significant oversight as it fails to describe the current state of waterways that would be affected by land use intensification.

3.00 Evidence of Dr. Mike Freeman of Freeman Environmental Limited on behalf of ECan

3.01 Dr. Freeman's evidence relating to periphyton and stream surveys is based on the opinions expressed by Dr. Meredith.

3.02 I agree with Dr. Meredith that in general the upstream reaches of the watercourses we have described are generally oligotrophic and where significant accrual of periphyton occurs in response to long accrual periods, periphyton communities are generally dominated by oligotrophic cyanobacteria that are capable of fixing nitrogen into plant available forms.

3.03 However, Dr. Meredith rejects the database we have documented that the downstream sections of most of the watercourses we described were degraded relative to upstream reaches of these watercourses. The downstream nodes of these waterways are modified, they are subject to adverse existing land use effects and that they would benefit greatly from the establishment and maintenance of functional riparian margins.

3.04 As Dr. Freeman's ecological evidence relating to streams is based only on the opinions expressed by Dr. Meredith, he has also failed to acknowledge that the downstream sections of most of the watercourses we described were degraded relative to upstream reaches of these watercourses. As highlighted in paragraph 2.22, this is a significant oversight as it fails to describe the current state of waterways that would be affected by land use intensification.

4.00 Evidence of Mr. Johnathan Bray of the Department of Conservation

4.01 In paragraph 58 of his evidence, Mr. Bray incorrectly states our periphyton reports do not mention sampling dates and proffers the following opinion. "*During the middle of summer within an autochthonously driven system such as these are, that are currently undergoing a low flow period, with resulting high temperatures and stable flows, may naturally have high biomass to the level that such growths could be considered conspicuous or nuisance. This is however natural and occurs every summer and in many instances is a natural process (Biggs and Kilroy 2000). This information is realised by phycologists and I believe raises doubt as to the validity of using the Periphyton guidelines (Biggs 2000)*".

4.02 The fact that nuisance growths of periphyton can develop under low flow summer conditions is entirely consistent with the current periphyton guidelines (Biggs, 2000) and Mr. Bray's paragraph 58 is not correct.

4.03 Moreover, in paragraph 64 of his evidence Mr. Bray has incorrectly criticised our use of macroinvertebrate indices because he considered our survey results at a number of nodes indicated lower ecosystem quality than may be expected. Mr. Bray has clearly misread our reports as we did use appropriate indices for hard-bottomed and soft-bottomed sampling sites in both of our reports.

4.04 Mr. Bray's misreading, misinterpretation and lack of understanding of our technical reports has resulted in the flawed conclusions he has reached in paragraph 65 of his evidence.

5.00 Evidence of Mr. Richard Turner for Meridian Energy Limited

5.01 In paragraphs 60, 61, 101, and 103 of his evidence, Mr. Turner has criticised and challenged the basis for my nominating a proposed threshold for instream nutrient increases at nodes nominated in the Water Quality Study.

5.02 My rationale for proposing that the cumulative effects of land use intensification should not result in more than a 25% increase in annual average maximum periphyton biomass at nominated nodes was clearly stated in paragraph 7.15 of my evidence in chief.

5.03 I have no issue with Mr. Turner proposing and rationalising alternative threshold values. However, as a result of reading his comments, I remain of the opinion that the combinations of the lake and river threshold responses adopted in the Water Quality Study are defensible and appropriate.

5.04 It is also important to re-emphasise that the instream threshold would not apply if nutrient loads entering Lake Benmore were calculated or shown to potentially compromise the oligotrophic state of the lake.

5.05 GHD (2009[1]) have calculated that for the Ahuriri Arm of Lake Benmore to remain oligotrophic, nutrient losses must be reduced by 10.7 kg N and 1.1 kg P for every hectare of proposed or renewed irrigation in the catchments that drain to the Ahuriri Arm. This means there would need to be a reduced nutrient concentration in streams and rivers draining into the Ahuriri Arm of Lake Benmore. Therefore, the proposed threshold of a permissible 25% increase in annual maximum periphyton biomass would not apply for watercourses in the Ahuriri catchment.

6.00 Evidence of Dr. Antonuis Snelder of NIWA on behalf of Meridian Energy Limited

6.01 Dr. Snelder has raised five concerns with regard to the MWRL approach to the calculation of the nutrient concentration thresholds for rivers. The first four relating to modelled nutrient concentrations, the specific locality of modelling nodes, the adequacy of water quality data and the range rather than the average nutrient concentrations that have been used for periphyton response modelling will be addressed in the evidence of Drs. Gamage and Mzila.

6.02 Dr. Snelder's fifth concern relates to the use of the Biggs (2000) models. In his opinion (his paragraph 29.5) the models were developed in hill country fed rivers where FRE3 values (annual periphyton scouring floods) were generally greater than 7 and they may be less reliable where flood events are less frequent. In my opinion, the importance of periphyton grazing by invertebrates is likely to increase in more hydraulically stable water courses and hence the Biggs (2000) models are likely to over-estimate periphyton biomass accrual where FRE3 is considerably less than seven.

6.03 In short, the Biggs (2000) models are the current industry standards in New Zealand and they are the best and only models available for the predictions made in the Water Quality Study. Monitoring work recommended in the Water Quality Study and by Dr. Ryder in his evidence in chief has the potential to validate / calibrate these current models at nodes where FRE3 is less than seven.

6.04 I agree with Dr. Snelder that the on-going monitoring required to validate / calibrate current periphyton models and to set a robust baseline for adaptive management should include monthly sampling of periphyton, nutrient concentrations and river flow at selected nodes for a 12 month period prior to irrigation commencing.

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[1] GHD Limited, 2009: Cumulative Water Quality Effects of Nutrients from Agricultural Intensification in The Upper Waitaki Catchment. Summary Report.
A report prepared for Mackenzie Water Research Ltd., August 2009.

7.00 Evidence of Ms. Donna Sutherland of NIWA on behalf of Meridian Energy Limited

7.01 In paragraph 89 of her evidence, Ms. Sutherland has paraphrased a statement I made in paragraph 6.5 of my evidence. Paragraph 6.5 of my Evidence in Chief stated "*On the assumption there is no internal cycling of nutrients in Lake Benmore, it is possible therefore to calculate an existing nutrient budget for the lake and to nominate a maximum increase in nitrogen and phosphorous load from the intensification of landuse in the catchment of Lake Benmore that could be tolerated without compromising a particular trophic state that is considered acceptable for the lake*."

7.02 Ms Sutherland then goes on (her paragraph 89) to describe the completely separate concept and process of nutrient recycling within a lake.

7.03 The concept of internal cycling that I was referring to involves the development of an anoxic[2] hypolimnion[3] in a lake and the release of nutrients (particularly phosphorus) that have historically been "lost" from the water column and incorporated into lakebed sediments. These nutrients remain in the lakebed and are not available for plant production in the lake provided the hypolimnion remains aerobic[4].

7.04 It is possible to manage the nutrient budget of lakes (in terms of catchment inputs) where there is no internal cycling of nutrients but it is not necessarily possible to mange the nutrient budget of a lake where hypolimnetic oxygen depletion rates are such that anoxic conditions develop in the hypolimnion before annual mixing of the epilimnion[5] and hypolimnion in monomictic lakes such as Lake Benmore (lakes where the warmer upper water column mixes with the colder lower water column once a year).

7.05 Lake Benmore is currently an oligotrophic monomictic lake. Oligotrophic monomictic lakes are characterised by a hypolimnion that is not deoxygenated, and support low concentrations of chlorophyll a. Eutrophic monomictic lakes where the hypolimnion becomes anoxic and blue green algae (cyanobacteria) dominate the summer phytoplankton assemblage are characterised by a positive feedback loop; high rates of phytoplankton sedimentation increase oxygen depletion in the hypolimnion, which leads to significant internal loading (sediment release) of nutrients that further enhances phytoplankton production and sedimentation. The dominance of phosphorus over nitrogen in nutrients sourced from the bottom sediments leads to a competitive advantage for cyanobacteria, both nitrogen - fixing and non-nitrogen - fixing taxa.

7.06 In paragraph 47 of her evidence Ms. Sutherland quotes a study (Champion and Burns, 2001) of Lake Omapere to suggest that anoxic conditions (and hence internal cycling of nutrients) are likely to develop under the canopy of submerged macrophyte beds on the littoral zone of Lake Benmore. Lake Omapere is a small, shallow, eutrophic lake in Northland where grass carp have been used to eradicate oxygen weeds (*Egeria densa*) and that is dominated by algal blooms. In my experience and opinion, this is a most unlikely scenario in a large oligotrophic lake such as Lake Benmore.

7.07 The statement in paragraph 6.5 of my evidence in chief remains a critical pre-condition to the management strategy proposed in the Water Quality Study, and I am not aware of any evidence to suggest there is currently any internal cycling of nutrients in Lake Benmore or any other oligotrophic lake in New Zealand.

7.08 Donna Sutherland has also contended in paragraph 37 of her evidence that "*While the Haldon Arm is less sensitive to increased nutrient loads, due to the flushing effect of the Ohau C canal water, localised effects at the river mouth may occur. During sampling visits I observed that an area of approximately 1 km^2 at the Tekapo-Pukaki and Ohau River mouths does not mix with inflows received from the Ohau C Canal. As the Tekapo-Pukaki Rivers are anticipated to receive the majority of increased nutrient loading from the Haldon Arm catchment, it is possible that algal blooms could occur in the 1 km^2 region. This may cause localised impacts to biota, including foraging fish, and have consequences for recreational fishing, as described in the evidence of Mr. Greenaway*".

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2 Lack of oxygen.

3 Deep layer of colder water in the basin of a thermally stratified lake.

4 Contains dissolved oxygen.

5 Surface layer of warmer water in a thermally stratified lake.

7.09 In my opinion, whilst such an outcome is possible, I consider there are compelling reasons to suggest a localised algal bloom within the mixing zone for the three inflows to the head of the Haldon Arm of Lake Benmore is unlikely to be probable.

7.10 The three inflows are the:

- tailrace of Ohau C Power Station,
- residual Ohau River, and
- combined flow from Pukaki and Tekapo Rivers.

7.11 As Plate 2 of Ms. Sutherland's evidence shows, the only reason she could see the mixing zone for these three inputs is that the clearest flow from the Lower Ohau River is sandwiched in between the slightly more turbid / translucent water from the Ohau C tailrace and the considerably more turbid / translucent water from the combined Pukaki - Tekapo Rivers discharge. It does not follow from Plate 2 that there is no mixing occurring at depth within the 1 km^2 region she has observed due to underflows of waters of different temperatures and therefore densities.

7.12 Given the most turbid / translucent water from the Tekapo-Pukaki Rivers did have measurably higher nutrient concentrations than the Ohau C tailrace, it would be equally reasonable to postulate that available light would be expected to potentially limit a phytoplankton response until this water mixes with the clearer Ohau C tailrace discharge.

7.13 Phytoplankton requires a given residence time in relatively calm and quiescent conditions to form blooms and the headwater delta of the Haldon Arm of the lake is a relatively high energy environment because it is the mixing zone for three difference inflows.

7.14 Moreover, it is a relatively windy environment that generates water currents and the dominant discharge from the Ohau C tailrace would set up counter rotating currents at the head of the lake, even if the discharge did by-pass a pocket of water on the other side of the bay.

8.00 Conclusions

8.01 Having read the evidence of Dr. Meredith, Dr. Freeman Dr. Snelder, Mr. Bray, Mr. Turner and Ms. Sutherland, I remain of the view that the nominated thresholds for watercourses and Lake Benmore in terms of additional nutrient loads that might be generated from land use intensification that is proposed in the Mackenzie Basin are defensible and appropriate.

8.02 I remain of the view therefore that the Water Quality Study as prepared by GHD is a defensible basis for the granting of consents sought.

Appendix A: **EXPERT CAUCUSING – 24 September 2009**

In attendance: Brian Coffey, Greg Ryder (MWRL): Ton Snelder, Donna Sutherland (MEL); Adrian Meredith (ECan)

Meeting started with Ton outlining Meridian's concerns with the technical work presented in the applicant's case. Ton stated Meridian was concerned that in due course it may come under pressure to provide flushing flows in the Tekapo and Ohau rivers if algal growths in them increase significantly. Meridian was also concerned with the implications of increased didymo, macrophytes, periphyton and phytoplankton growth in the canals and lakes to their operations.

Ton noted the GHD study was similar to the synoptic study NIWA undertook in 2005.

Ton expressed concerns with the calibration of the GHD modelling and the application of the Biggs 2000 chlorophyll *a* equations. Adrian noted that it was modelling based on modelled input data so had considerable uncertainty.

Brian considered that the estimates of periphyton biomass are over-estimates, although he stated he hadn't yet read the NIWA hearing evidence.

We all agreed that clarification of the biomass estimates and node nutrient limit targets were needed and that more monitoring/data would improve assessment of the model outputs.

Greg and Brian agreed that

- the applicant's case for periphyton biomass in rivers has a strong reliance on the Biggs model results and that little effort had gone into model verification.
- there was poor understanding of the relationship between the actual and modelled – water quality.
- there was poor clarity about the critical information in the applicant's reports.

We all agreed that there were key requirements

- More effective packaging what we currently have in order to increase clarity. Adrian suggested in particular a table that allowed comparison of modelled wq and periphyton biomass, and measured wq and periphyton biomass (as was presented as Table 1 in the NIWA sub-report of the GPF report in 2005) would allow more focused consideration.
- Working from the above, an assessment of the required information needs (monitoring) to increase confidence in estimates.

Adrian added that the applicant's reports also had a degree confusion relating to habitat degradation under existing land use, and that that should not be confused with nutrient increase which may yet to be realised.

Information request

Brian – sought clarification from Adrian as to the source of information used to classify rivers in the upper Waitaki Catchment. Was this from an ECan database and was the accompanying water quality and ecological information available?

Adrian – Classifications were done at a fairly 'high level' as for the NRRP, and data are available.

Lakes

Donna outlined the Meridian evidence concerning Lake Benmore including:

The Ahuriri Arm last summer was found to be already in excess of TLI that MWRL propose.
There are discrepancies between MWRL and NIWA nutrient load data for both Arms
The applicants's reports miss-use the TLI, for example, not including chl*a*
The applicant's assessment of lake tophic status has serious shortcomings, for example, not considering in-lake processes, particularly for determining future nutrient loads.

The applicant's reports lack clarity around the use of the TLI. For example it is unclear if this is a never to be breached level or annual average or summer average.

Greg and Brian Coffey could not respond to this. They have had insufficient involvement in the lake work.

We all agreed that MWRL need to bring in their lake/WQ team to explain what they did and how they get the numbers they did.

Donna: Summer TLI in Ahuriri Arm is 2.9 existing – based on integrated sampling to 15 m.

We agreed we need greater clarity on figures – not much more that could be said.

Summary

We reached agreement that greater clarity is needed around much of the lakes and rivers work.