
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

Addendum to brief of evidence of **George Anthony Griffiths** (on
catchment hydrology)

Dated: 30 November 2009

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ADDENDUM TO BRIEF OF EVIDENCE GEORGE ANTHONY GRIFFITHS (ON CATCHMENT HYDROLOGY)

INTRODUCTION

- 1 My full name is George Anthony Griffiths.
- 2 My qualifications and experience are set out in the brief of evidence dated the 16 September 2009.
- 3 I have been engaged by Meridian Energy Limited (Meridian) to provide an addendum to my evidence dated the 16 September 2009 on the subject of catchment hydrology in response to caucusing that has occurred with experts engaged by Mackenzie Water Research Limited (MWRL) and Environment Canterbury (ECan) and in response to the supplementary evidence presented by MWRL.
- 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 addendum I outline:
 - 5.1 The outcome of a caucusing meeting I attended with experts representing MWRL to discuss issues arising from the assessment of the mass balance of surface water and nutrient concentration and load assessment.
 - 5.2 Comments on the evidence provided by **Dr Mzila**, dated 6 November 2009.

CAUCUSING

Caucusing meeting of 15 October 2009.

- 6 On 15 October 2009, I caucused with **Dr Bright, Dr McIndoe, Dr Mzila, Dr Gamage** and **Mr Male** representing MWRL, **MWRL** and **Dr Heller** representing ECan. At this meeting I outlined my concerns that are set out in my evidence in chief regarding the mass balance for surface water and the assessment of nutrient concentrations and loads.
- 7 A copy of the agreed minutes from this caucusing meeting are attached as **Annexure A** to this evidence.

EVIDENCE OF DR DOUGLAS MZILA

- 8 In paragraph 60 of **Dr Mzila's** supplementary evidence he gives new estimates of the flows for the Stoney and Tekapo nodes explains how spills from Lakes Tekapo and Pukaki have been treated in the overall mass balance for surface flows.
- 9 I agree with the new estimates and accept the explanation about the treatment of spills provided by **Dr Mzila**. Consequently the objections raised in paragraphs 52 and 53 of my original evidence of 16 September 2009 no longer apply.
- 10 In paragraph 61 of **Dr Mzila's** supplementary evidence he gives an explanation of how flows into the Ahuriri Arm of Lake Benmore were estimated.
- 11 I accept the explanations. Consequently the objection raised in paragraph 55 of my original evidence of 16 September 2009 no longer applies.

CONCLUSION

- 12 Despite the caucusing and the relevant material in the evidence of **Dr Mzila** I am of the view that the conclusions and recommendations in my original evidence of 16 September 2009 still stand..

Dated: 30 November 2009

George Anthony Griffiths

Annexure A**AQUALINC**

AQUALINC RESEARCH LIMITED

Minutes**Date:** 15 October 2009**Start Time:** 8.00am – Opihi Room**Chair:** JB**Minutes:** IM

In Attendance: John Bright (Aqualinc - MWRL), Tom Heller (Environmental Associates – ECan), George Griffiths (NIWA – Meridian), Doug Mzila (GHD), Nimal Gamage (GHD), John Male (GHD), Ian McIndoe (Aqualinc – MWRL)

Hydrology Issues:

1. Lake Residence times. **(TH)**
2. Low flow assessments (MALF assessments) **(TH)**
 - Subcatchments
 - Lake ?
3. Contribution of groundwater to surface water **(TH)**
4. Assessment of nutrients (with respect to flow) (quality & quantity) **(TH)**
5. Mass balance/ Water balance **(GG)**
 - Lake evaporation
 - Spills
 - Climate reference period
 - Standard errors
6. Nutrient load calculation methodology **(GG)**

Lake Residence Time (LRT):

- Flow – ok
- Volumes – different in latest NIWA numbers (cross sections)

- Possibility of difference in Ahuriri Arm **(TH)**
Need to use latest data (NIWA)
GHD need to check and report back
Agree LRT key parameter in overall assessment

(Assume lake issues to be dealt with by lake/ecology group)

MALF versus MAF:

Subcatchments - partitioning of surface water/groundwater
sensitivity of receiving environments
greater proportion of groundwater at low flows

Approach at the moment is to assume full mixing.
Need to know how sensitive is analysis to using low flows.

(TH did approximate mass balance calculation using GHD data).

- Check which catchments are most critical.
- Issue is mostly about methodology/sensitivity.

If using MALF, need time and appropriate loads for the time. **(JB)**

Could use SPASMO (monthly) and proportion the Overseer values **(JB)**

Time delay between land activities and entering waterways is problematic. **(JB)**

Could get approx estimate using centroid of land and getting estimate of delay. **(TH)**

If higher loads in winter – less of an issue. Need to demonstrate to commissioners **(JB)**

GHD have done MALF/MAF **(DM)**

Observed, matched reasonably well to MAF not MALF.

Question of when water quality testing was done (MALF or MAF). **(JB)**

Range of data available. **(DM)**

What flow conditions provide the worst case conditions? **(JB)**

Calibrating models using MAF to data based on MALF is very conservative **(TH)**

How has data been used for calibration? (using only MAF data?) **(JB)**

Relationship between flow and concentration required

Needs to link into ecological response. **(JM)**

Site specific - sources of water vary. **(DM)**

e.g. winter flows higher N concentrations initially then drops off through summer.

Late winter more up catchment sourced so is lower concentration.

Could occur in some catchments but not others. Depends on what happens to snowmelt for example. **(JB)**

What difference will the extra area of irrigation make? Especially if biggest proportion comes from existing area (larger catchment mass balance). Needs to be put into perspective. **(TH)**

Some background work has been done. **(JM)**

Is it now over complicated? Info isn't there to assess effects. **(TH)**

Total catchment	800,000ha	low concentration
irrigation	+ 20,000ha	???

Summary report **(JB)**

- Needs sensitivity analysis – test sensitivity.
- Are low flows critical or not?
- Which subcatchments?
- Presentation need to be clearer.
- Big picture hard to see.

GW/ SW interactions

Need to have the numbers to be able to trace things through the system. **(TH)**

Meridian asked him to say if work looked right. **(GG)**

Meridian

- nuisance growths causing problems?
- Flows / concentrations / loads

Mass Balance:

- Papers / reports already done so should compare recent work to previous work.
- Benmore outflow – agreed.
Some nodes seemed correct, others different.
- Diagram with numbers on very hard to check because approach is slightly different.

How much recognition to give previous work. GHD worked from base data. **(JM)**

Should use previous work. Need to have confidence. **(GG)**

Inflow to Ahuriri Arm?

If mass balance ok for important MEL catchments, is that enough? **(JB)**

If most are right, remainder in standard error. **(GG)**

Used data from MEL. Table 4 from Freestone report – similar to GHD numbers. **(DM)**

Difficulty getting data from Meridian. **(JM)**

Data not fully comprehensive. **(JB)**

Ahuriri flows include groundwater component? **(DM)**

Need to explain differences / clarity. **(GG)**

Averaging period issue (seen in spills). **(DM)**

- Different flow diagrams

Use same time period as WWAP. **(JB)**

Grays river has reduced over time. **(DM)**

Straight forward – need to explain, spell it out. **(JB)**

Spills - Not clear how spills have been accounted for, explanation needed. **(GG)**

Lake evaporation 0.63m (Tait/woods)

1.1m GHD

Rain on lake – how is it accounted for?

Inflows – need to be clearly partitioned into surface flow & groundwater. **(TH)**

Reference period – Found mean flows vary according to IPO – shifting. **(GG)**

- 1978 - 99 different to 1944 – 47 for example.
- Next decade, means flows lower than 1978 – 99 by 15%, need to explain how it is handled.

If had more data could more easily split spills & generation **(DM)**

Standard errors **(GG)**

- How confident that estimates are correct?
- Should be discussion on errors in key data.

95% confidence – standard error. **(GG)**

- Gauging sites - questionable
- Power stations - good

Overall mass balance for catchment should be good.

Issue is in sub catchments – errors in flows.

Hard to see how calculations were done on concentration / loads. **(GG)**

- Annual Load = mean concentration x mean flow. (GHD)
- Issue – distribution of concentration skewed, should use median.

Need plot of concentration versus discharge and integrate to give load $c \times q$

Problem: **(GG)**

- sampling at low flows
- most load carried by high flows (for P)

GHD wrong – GHD methodology will underestimate annual loads.

How relevant is it in terms of relativity. **(TH)**

Depends on critical point. **(JM)**

Use overseer for on-farm estimates / land cover database to calculate total loads (steady state) (used as a check). **(JB)**

Why then used measured concentration **(GG)**

GHD to check methodology & alternatives. **(JB)**

Is it material? **(JM)**

Seepage past dam? **(JB)**

Use Darcy's law - minor. **(GG & TH)**

Key Actions (JM)

- Different report presentation – to make it more easily understood.
- Put all information in context
- Rework where necessary
- Use existing data in calculations – to give more confidence
- Standard error analysis– again, confidence
- Sensitivity analysis needs to be carried out.