

**Before the commissioners appointed by the
Canterbury Regional Council**

In the matter of The Resource Management Act
1991

and

In the matter of 60 water permit applications to
take and use water, 29 land use
consent applications and 21
discharge permit applications, for
agricultural and horticultural
activities in the upper Waitaki
catchment

Section 42A Report – Cumulative Water Quality Assessment

Date of hearing: September 2009 – February 2010

**Clarification of the Relationship between Original and Addendum s42A
Reports - Thomas Brendan Heller**

INTRODUCTION

1. The following table (Table 1) sets out the relationship between the matters considered in my original s42A report and those of which I make comment on in my Addendum report.
2. This information is provided to the commissioners to enable an improved understanding of the original audit issues that remain unresolved, are referred to in other reporting officer's evidence, or that have been addressed in Addendum evidence.
3. The issues highlighted in **bold** (in Table 1) indicate those which remain unresolved.

Table 1 Relationship between Original and Addendum s42A Reports

Original s42A report paragraph number	Issue	Status
1 - 12	Background, Qualifications and Scope of Report	Same as s42A report
13 - 16	Summary of the applicants proposal	Background information
17	Leaching losses to groundwater	Background information
18	N-leaching through soils may be under-predicted	Unresolved – Refer to evidence of Dr Clothier
19	N-drainage concentrations	Background – addressed by Mr Hanson
20	Unclear how application of soils N-leaching vulnerability is applied to overall N-flux given. Dr Clothier considers soils in the upper Waitaki are inconsistent with the applicants description of soils in which significant denitrification may take place	Unresolved – Refer to Dr Clothiers evidence
21 - 22	Denitrification applied to specific riparian groundwater discharges – Unable to determine how nitrate attenuation multipliers have been applied, concerned there is a large degree of uncertainty in application of the N attenuation factor	Unresolved – Addressed in more detail in Dr Clothier and Dr Meredith evidence
23	Groundwater Basins in agreement with existing data	Background information confirmed
24	Surface Water Catchments and Surface water nodes	Background information
25	Application of individual sub-basin N-flux only attributed to specific surface water nodes – GHD acknowledge that on some occasions there will be a by-passing of nodes by a percentage of groundwater flow and nutrient loads	Background Information
26	Modeled groundwater quality (for the existing environment) for the Wairepo and Chain Hill sub catchments appears inconsistent with monitoring data. Level of detail in report is insufficient to audit the outcome.	Unresolved – Refer evidence of Mr Hanson

27	Little sensitivity in the mean flow values utilised for stream flows and groundwater input to Lake Benmore given large percentage of input is via Ohau Canal	Background discussion
28	The applicant provides no assessment of other forms of N, in particular, organic N in waterways.	Unresolved – Refer to evidence of Dr Meredith
29 - 30	Residence time in Ahuriri Arm and Northern Arm	Superseded by Addendum report
31	Irrigation development scenarios	Background/Context
32	Under the proposed irrigation development surface water and groundwater balances will be subject to alteration from abstraction. Any significant changes to surface water flow statistics should be accounted for. An adjustment of the water balance for sub-catchment effects analysis has not been undertaken.	Superseded by Addendum report
33 - 34	Groundwater nitrate concentrations expected to have a less than minor effect upon Lake Ohau, Lake Ruataniwha or the Ohau River	Background information – Refer to evidence of Mr Hanson
35	Unable to audit projected increases to sub-catchment groundwater N concentrations as insufficient detail of balances provided	Superseded by Addendum report
36	Northern Arm of Lake Benmore has the greatest assimilative capacity for nutrient loads	Confirmed /agreed information
37	Overall Study Methodology	Background information
38	Set up of groundwater model	Background information
39	Irrigation application depths used in the Irricalc methodology	Background information
40	Groundwater model set up – unclear from modeling work what layer geometry has been employed in the model and how the deep groundwater system behaves independently to that of the water table aquifer	Unresolved and unexplained in terms of the mass balances – considered a minor issue in relation to mass balances
41	Quaternary gravels photograph - commentary on stream reach losses/gains	Background information
42	Lack of hydraulic parameter scale and distribution with regard to groundwater model inputs – unable to audit the model functionality	Unresolved and unexplained in terms of the mass balances – considered a minor issue in relation to mass balances
43	Absence of groundwater model methodology reporting – could not provide a detailed audit of the certainty of model predictions made for inclusion into the water and nutrient balance reporting	Unresolved and unexplained in terms of the mass balances – considered a minor issue in relation to mass balances

44	Absence of model water balance reporting for sub-catchments and unable to identify individual groundwater and surface water sub-catchments water inputs and outputs	Superseded by Addendum report
45	Applicants consultants have not correctly associated groundwater sub-catchment flows to surface water nodes	Superseded by Addendum report
46	Identification of individual reach or key sub-catchment cumulative effects considered deficient as groundwater volumes and N loads may by-pass individual stream nodes	Superseded by Addendum report
47	Wairepo catchment anomaly not considered within sub-catchment delineation but has been identified within the mass balance calculations	Background information
48	Unable to identify where and how soil and riparian attenuation has been applied to the groundwater N balance	Unresolved – Refer to evidence of Dr Clothier
49	Major proportion of recharge from highland area becomes regional flow. Unable to identify how this is apportioned and what effect this may have on sub-catchment water and nutrient balances	Partially resolved – proportion of groundwater discharge to surface water is unresolved. Refer to Addendum report.
50	Cumulative water quality assessment	Background
51	Cumulative water quality impact of irrigation should have been undertaken at MALF to better represent critical stream flows	Superseded – Refer to Addendum report
53	Surface water flows reported by applicants consultants are mostly consistent with recorded or evaluated data	Background/Context - Agreed
54	Sampling undertaken in January 2009 appeared to be during a low flow period, however the data obtained has only been utilised in providing for average stream nutrient concentrations and mean flow	Unresolved – refer to evidence of Dr Meredith. Also discussed in Addendum report
55	Flood event information	Background information
56	FRE3 estimate at Grays River is assumed to be equal to the Maryburn. This estimate is inconsistent with the comparatively higher mean flow for the Grays River at Maryburn	Unresolved – minor issue in context of mass balances
57	FRE3 value for the Quailburn node appears high	Background information - no further information provided
58	Mass balances	Background commentary
59	Level of deep groundwater recharge in the Ahuriri groundwater sub-catchment appears high in comparison to other groundwater sub-catchments and may result in groundwater by-passing critical stream nodes	Superseded – Refer to Addendum report

60	Unclear of where the groundwater component of the water balance fits with surface waters, however overall the catchment total water flux to the Ahuriri Arm is considered to be appropriate	Background information confirmed
61	Tekapo node portion of the water balance	Background information confirmed
62	Consistency with Lake Benmore outflows for the total water balance, however given the Ohau Canal provides approx. 75% to the lake there may be errors contained within individual sub-catchment flows whilst maintaining a reasonable overall water balance for the lake	Background information confirmed
63	No analysis of the seasonality of the relationship between the Ahuriri Arm and Northern Arm inflows and therefore no provision of variability in cumulative effects of water quality on Lake Benmore	Superseded – Refer to Addendum report
64	Reported evaporation from Lake Benmore considered high, however component has little impact on water quality assessment	Background /Comment
65 - 70	Verification of mass balances	Superseded – Refer to Addendum report
71 - 79	Lack of mass balance component reporting on a sub-catchment level	Superseded – Refer to Addendum report
80 – 83	Review of groundwater sub-catchments	Background information
84 - 88	Review of groundwater model	Background information
89	Chain Hills sub catchment does not have appropriate groundwater flow vectors which may introduce errors to the sub-catchment mass balance analysis	Unresolved and unexplained in terms of the mass balances
90	Lack of hydraulic parameter detail for model generation and output. Unable to undertake a detailed audit of the model due to inadequate reporting of the model data	Unresolved and unexplained in terms of the mass balances – considered a minor issue for mass balances
91	Groundwater Environment – Deep groundwater flows inconsistent with applicants provision of relatively small saturated thicknesses for each groundwater sub-catchment	Unresolved and unexplained in terms of the mass balances
92	Calculation of highland recharge	Superseded – Refer to Addendum report
93	Dryland drainage	Background/Context
94	Irrigation drainage. S42A report considers drainage depths to be conservative however specific calculations of groundwater flow and nutrient input are not transparent and are unable to be audited	Unresolved for individual farms and sub catchments – refer evidence of Mr Hanson

95	Stream or lake leakage contributions to aquifer sub-catchment recharge not provided	Superseded – Refer to Addendum report
96	Aquifer saturated thicknesses and storage values. Unsure how thicknesses utilised within groundwater models	Unresolved and unexplained in terms of the mass balances – considered minor issue for mass balances
97	Groundwater flow vectors	Background information
98	Lack of detail Cumulative effects assessment	Unresolved – Refer to evidence of Mr Hanson
99 – 100	Lack of assessment for low scenario in stream reaches or nodes	Superseded – Refer to Addendum report
101	Unsure how N multipliers (used for riparian N attenuation purposes) have been utilised with respect to sub-catchment water and nutrient balances	Unresolved – Refer to evidence of Mr Hanson
102 – 105	Review of background information in GHD Lakes and Rivers Report	Background information
106 - 108	Flow gains and losses consistent with current data however this has not been provided for the lower Ohau and lower Tekapo Rivers	Background information
109	Unable to validate if flow losses and gains are within adequate limits for each sub-catchment or surface water node	Superseded – Refer to Addendum report
110	Mass balances – Differences in surface water N concentrations at mean annual low flow (MALF)	Superseded – Refer to Addendum report
111	N concentrations in lakes – consistent with reconstructed mass balance	Background information

Signed:



Thomas Brendan Heller
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Date: 25 January 2010