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

Brief of evidence of **Peter Francis Callander** on individual applications

Dated: 30 November 2009

REFERENCE: JM Appleyard (jo.appleyard@chapmantripp.com)
BG Williams (ben.williams@chapmantripp.com)

Chapman Tripp
T: +64 3 353 4130
F: +64 3 365 4587

119 Armagh Street
PO Box 2510, Christchurch 8140
New Zealand

www.chapmantripp.com
Auckland, Wellington,
Christchurch

BRIEF OF EVIDENCE OF PETER FRANCIS CALLANDER ON INDIVIDUAL APPLICATIONS

INTRODUCTION

1 My full name is Peter Francis Callander.

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 evidence in relation to the evidence of:

- **Dr Bright** on the resource consent applications by Southdown Holdings Limited, Five Rivers Limited and Killermont Station Limited;

- **Mr McIndoe** on the resource consent applications by Simons Pass Station Ltd and Simons Hill Station Ltd, Rosehip Orchards New Zealand Ltd and High Country Rosehip Orchards.

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.

5 In preparing this evidence I have reviewed:

5.1 the statement of evidence of **Dr Bright**;

5.2 the statement of evidence by **Mr McIndoe**;

5.3 the Groundwater Report and Summary Report on Cumulative Water Quality Effects of Nutrients from Agricultural Intensification in the Upper Waitaki Catchment dated August 2009, prepared for Mackenzie Water Research Limited (MWRL); and

5.4 I have also used information provided to me by MWRL experts during meetings that have been held to better understand the assessment they have carried out. In particular, a meeting was held on 8th October attended by **Mr McIndoe** and **Mr Glasson** for Simons Pass/Simons Hill and Rosehip, myself and **Mr Ellwood** and **Mr Riddle** from Meridian.

LOCATION

6 The evidence of **Dr Bright** and **Mr McIndoe** describes the effects of nutrient migration from the farms covered by the consent applications they discuss.

7 As part of my review of this evidence, I found it helpful to plot the location of these properties on maps that were included in the MWRL Groundwater Report and Summary Report and I will refer to these throughout this evidence. For each of these Figures, there is a following Figure version "a", which shows the unmarked MWRL version so the information on each Figure can be seen more clearly. Figure 1 shows the farm locations on the plan of future irrigation areas (Figure 28 of the MWRL Groundwater Report).

8 **Dr Bright's** evidence describes effects arising from:

– Ohau Downs;

– Glen Eyrie Downs;

– WHL Killermont;

– Killermont Station.

Comments on these farms are presented in paragraphs 10 - 32 of my evidence.

9 **Mr McIndoe's** evidence describes effects arising from:

– Simons Pass;

– Simons Hill;

– Rosehip Orchards;

– High Country Rosehip Organics.

My comments on these farms are presented in paragraphs 34 - 52.

COMMENTS ON DR BRIGHT'S EVIDENCE

10 For each of these farms, **Dr Bright** describes the potential nutrient effects in a generic manner, and I have structured my evidence to comment on those key generic topics as they relate to effects associated with groundwater related effects.

THE LOCAL GROUNDWATER ENVIRONMENT

11 The groundwater sub-catchments with which each of the irrigated farm area is located are described by **Dr Bright** and shown in Figure 2 of my evidence (which uses a base map from Figure 1 of **Dr Mzila's** evidence). These are:

Farm	**Groundwater Sub-Catchments**
Ohau Downs	Ohau and Wairepo
Glen Eyrie Downs	Wairepo and Quail Burn
WHL Killermont	Ahuriri and Omarama
Killermont Station	Ahuriri and Omarama

12 The partitioning of soil drainage water and groundwater flow into each of the groundwater sub-catchments has been determined by observations of surface flow patterns and from the groundwater flow model that was developed as part of the MWRL groundwater assessment.

13 However, as noted in my original evidence, there will be a large degree of uncertainty associated with how that partitioning of water into each sub-catchment has been carried out due to the lack of data with which to calibrate the groundwater model.

14 In particular, Figure 3 attached to this evidence comes from Figure 3 of the MWRL Groundwater assessment report. It shows the bores used to calibrate the water levels determined from the groundwater flow model. It indicates no information is available for the Ohau, Wairepo and Quail Burn groundwater catchments, with some information available for the Ahuriri and Omarama groundwater areas. In areas with no water level data it must be concluded that there has been no calibration of the groundwater flow patterns and so the partitioning of drainage water from farms into the groundwater sub-catchments can only be defined with a large degree of uncertainty. Similarly, the information on current groundwater quality conditions is not well defined.

15 The migration of nutrients from these farms into local surface waterways has been assessment from an evaluation of gaining and losing reaches of streams, as shown in Figure 4 (which comes from Figure 12 of the MWRL Groundwater Report). The conclusions presented by **Dr Bright** are:

Farm	**Migration of Nutrients**
Ohau Downs (Figure 5, which comes from Figure 24 of the MWRL Groundwater report)	– Nutrients drain to groundwater and do not enter Wairepo Creek because Wairepo Creek flows can be explained by runoff generated from Highland areas. – Nutrients are considered to emerge from groundwater into either the Lower Ohau River and Lower Ohau groundwater and then to Lake Benmore (**Bright**, para 9.3) or to enter Lake Ruataniwha and discharge via the Ohau C Canal, Lower Ohau River and Lower Ohau groundwater into Lake Benmore (**Bright**, para 9.5).
Glen Eyrie Downs, North of the DoC Reserve (Figure 5)	– Nutrients drain to groundwater, they do not enter the local streams and the groundwater discharges into the Wairepo Arm of Lake Ruataniwha (**Bright** para 5.4).
Glen Eyrie Downs, South of the DoC Reserve (Figure 6, which comes from Figure 20 of the MWRL report)	– Nutrients discharge directly to surface flow in the gaining reach of the Quail Burn in its mid and lower reaches.
WHL Killermont and Killermont Station (Figure 7, which comes from Figure 18 of the MWRL Groundwater Report).	– Nutrients drain to groundwater due to a deep water table and measured surface flow losses between the Clay Cliffs and SH8. This groundwater will contribute to surface flow in the lower gaining reaches of the Ahuriri River.

The farms are therefore predicted to contribute to the following nodes, which are shown in Figure 8.

Farm	**Groundwater Nodes**	**Surface Water Nodes**
Ohau Downs	– Wairepo – Ohau	– Wairepo Creek – Northern Arm of Lake Benmore
Glen Eyrie Downs	– Wairepo – Quail Burn	– Wairepo (omitted from **Bright** para 5.13, but included in para 5.18) – Quail Burn – Ahuriri River at Ahuriri Arm of Lake Benmore – Ahuriri Arm of Lake Benmore
WHL Killermont	– Ahuriri	– Ahuriri River at Ahuriri Arm of Lake Benmore – Ahuriri Arm of Lake Benmore
Killermont Station	– Ahuriri	– Ahuriri River at Ahuriri Arm of Lake Benmore – Ahuriri Arm of Lake Benmore

Based on the following information, I would have expected the nutrient losses from these farms to also contribute to the following nodes.

– Ohau Downs and the northern part of Glen Eyrie Downs will contribute to the Ohau Canal surface node (Figure 8);

– WHL Killermont and Killermont Station will contribute to the Omarama groundwater nodes (given that part of those farms occur within the Omarama groundwater sub-catchment, Figure 2);

– It might also be prudent to consider that WHL Killermont and Killermont Station may at times partly contribute to the Omarama surface water node given that it gains flow over the reach between Swamp Outlet to Wardells Bridge (paragraph 6.5 of **Dr Bright's** evidence) and also given the uncertainties in the groundwater flow direction.

Unless there is good reason to exclude those nodes, it would seem appropriate for them to be included in the consideration of the acceptable nutrient limits from each farm.

16 **Dr Bright's** evidence presents tables for each farm which defines allowable losses of N and P from that farm based on their contribution to the total nutrient allowance at each of the nodal points. My understanding is that these allowable nutrient losses for each farm have been defined by GHD in a spreadsheet that tallies the accumulating nutrient losses from all the land that contributes

overland flow or groundwater seepage to each node. However, I understand that the information in that spreadsheet is considered to be confidential and has not been released either to this hearing process or to **Dr Bright**. That would seem to place a significant limitation on the audit of the GHD work that **Dr Bright** has been allowed to carry out.

17 However, through the caucusing process, we have been provided with a spreadsheet that defines the way in which nitrogen has been assessed between the various nodes of gaining or losing stream reaches. For the three main groundwater catchments that **Dr Bright** has considered to be affected by the farms in this assessment, I have used the spreadsheets provided to me to tabulate the changes in nitrogen mass in the following table for the change from existing irrigation (Scenario 1) to one of the proposed future irrigation Scenarios (Scenario 2).

	Mass of N Draining Through Soils	**Discharge Pathway for N**		
		Groundwater	**Surface Water**	**Denitrification**
Wairepo Creek				
Scenario 1	58,551	57,164	6 (965 kg diverted to Wilowburn)	417
Scenario 2	157,602	155,906	5	1,691
Quail Burn				
Scenario 1	24,024	23,505	423	96
Scenario 2	30,406	24,743	484	5,179
Ahuriri (upstream of SH8)				
Scenario 1	16,252	13,572	2,343	337
Scenario 2	44,158	40,236	3,307	615

18 From this information, I think the following observations are helpful to understand the type of change that may occur and the type of assessment process that has been used:

– the major increases in nitrogen caused by irrigation in the Wairepo catchment has been assumed to discharge via groundwater. Therefore, it is important to understand the final destination of this groundwater, as will be discussed in paragraphs 21 - 27 of this statement;

– the Quail Burn catchment is an example of where the de-nitrifying soil process has been used to remove a large proportion (80%) of the additional N generated from the increased irrigation. This is a non-conservative assessment because the effectiveness of this process is not well proven;

– for the Ahuriri catchment the majority of the nitrogen is considered to discharge via groundwater.

I have been advised by the MWRL consultants that the Scenario 2 calculations I have been provided with do not include the effects of the proposed mitigation measures and those mitigation calculations have not been provided to me.

19 **Dr Bright's** evidence does not provide any detail about phosphorous migration. My understanding is that the phosphorous losses from soil were assumed to go into surface waterways, but have been scaled back to match the sampled surface water concentrations. Although for the lake assessment, all the P lost from the soils (calculated from Overseer) has been assumed to reach Lake Benmore even though the migration pathway for the P that isn't included in the stream assessment is not defined or assessed. It would be helpful to more clearly understand this process if the P that is generated from each farm was clearly stated, along with the degree of scaling back for input to surface waterways, and a description of the fate and transport of the residual P that doesn't enter the surface waterways.

MONITORING COMPLIANCE WITH FARM ENVIRONMENTAL MANAGEMENT PLANS (FEMPS)

20 In Section 8 of **Dr Bright's** evidence, he describes monitoring for compliance with the FEMPS through monitoring of soil drainage by lysimeters. This could be a useful check on Overseer modelling, but represents a very small scale localised measurement and may not always be representative of the total farm discharge. Therefore, monitoring of groundwater and surface water is also required, as will be discussed in paragraph 32 of this evidence.

21 In **Dr Bright's** discussion of the lysimeter monitoring (paragraphs 8.10-8.13), he only mentions the monitoring of N from the lysimeters. In my opinion, the leaching of P should also be included in the lysimeter evaluation and in the assessment of that monitoring data.

EFFECTS ON OHAU C CANAL

22 In Section 9 of his evidence, **Dr Bright** describes potential nutrient effects on the Ohau C Canal, which is of particular concern to Meridian. He has previously concluded that all the nutrients leaving the farms in the Wairepo catchment will enter groundwater and not enter Wairepo Creek. He considers that the groundwater might either bypass Lake Ruataniwha on its way to Lake Benmore (para 9.3 of his evidence), or it might enter the lake and mix fully with it (para

9.5 of his evidence). These two options indicate some of the uncertainty that is associated with the assessment of groundwater migration pathways.

23 In either case, **Dr Bright's** calculations assume that the result is no adverse effect on water quality in the Ohau C Canal. Although despite stating that conclusion, **Dr Bright** does seem to acknowledge in paragraph 5.4 that drainage from the northern part of Glen Eyrie Downs will discharge to the Wairepo Arm. Referring to Figure 5 of my evidence it would seem that conclusion must also apply to the Ohau Downs drainage water.

24 Furthermore, the assumption that the Wairepo groundwater might bypass Lake Ruataniwha is not consistent with the conclusion that would be drawn from the groundwater flow model that he has used to partition flows from the individual farms. Figures 9 and 10 of the MWRL Groundwater Report show all of the Wairepo catchment groundwater flow entering the Wairepo Arm and Lake Ruataniwha with a southerly groundwater flow occurring on the northern side of the lake.

25 Assuming even groundwater flow across the downstream end of the Wairepo catchment, a simple comparison of the cross-sectional areas would indicate that at least 40% of the groundwater flow could enter the Wairepo Arm. This would correspond to around 23,000 kg of N at present (Scenario 1) and 62,000 kg of N under MWRL's proposed Scenario 2.

26 Based on the topographic map in Figure 11 I would expect most of the nutrients entering Wairepo Arm would flow into the Ohau C Canal.

27 Therefore, whilst the calculations in **Dr Bright's** evidence might be correct, I am not sure that the assumption of groundwater either bypassing these surface water bodies, or fully mixing with Lake Ruataniwha is correct and, given the uncertainty in groundwater flow paths, they are not conservative assumptions.

28 The assumption of full mixing of the surface water and groundwater discharges from the Wairepo Creek catchment with Lake Ruataniwha is something that is also presented in the flow and mass balance diagrams of Appendix CC of the MWRL Summary Report. In reality my understanding is that any surface flow and groundwater seepage that enters the Wairepo Arm will be able to enter the Ohau C Canal and does not mix with the water in Lake Ruataniwha.

OVERVIEW OF DR BRIGHT'S EVIDENCE

29 Based on my review, I consider that **Dr Bright's** evidence presents a generalised description of a possible migration of nutrients that has been provided to him by GHD. But he does not appear to have critically reviewed that information and has not described the uncertainties associated with it. These uncertainties include:

- The lack of data with which to calibrate the groundwater flow model, which in turn has been used to partition the nutrient drainage between catchments;
- The lack of detail about how the allowable nutrient discharges from each farm contribute to the cumulative total at each nodal point;
- The possible contribution that these farm discharges may make to other nodes identified in paragraph 14;

- The possible reduced effectiveness of the assumed denitrifying soil processes;

- The scaling back that may have been applied to phosphorous concentrations and the migration of that scaled back phosphorous;

- A non-conservative approach about the possible contribution of nutrients to the Wairepo Arm.

30 It is recognised that these uncertainties are largely due to a lack of reliable field data rather than any basic errors in the assessments. However, due to that lack of data it would be appropriate to present either a conservative analysis (which isn't the current MWRL approach) or a sensitivity analysis to consider a range of possible nutrient generation and migration scenarios that could arise within the constraints of the information that we have.

31 The MWRL Summary report identifies that nutrient reductions are required for no change in trophic state in the Wairepo Arm, Kellands Pond and the Ahuriri Arm of Lake Benmore. It is therefore surprising that the proposed scale of increased irrigation can occur that is described in **Dr Bright's** evidence whilst achieving an overall reduction in nutrient input. Uncertainties that remain in this regard are:

- The overall nutrient reduction that is achieved for each nodal point presumably relies on a wide range of farms implementing mitigation measures and it is unclear how these will be controlled or monitored, particularly given that the individual farm information is considered to be confidential and cannot be disclosed to us;

- The acceptable nutrient limits to avoid a change in the trophic state for the Wairepo Arm have presumably been calculated on the basis that the contributions from the Ohau Downs farm and the northern part of the Glen Eyrie Downs farm pass underneath the Wairepo Arm, or are diluted by full mixing with Lake Ruataniwha.

32 Based on the information I have available to me I cannot conclude that those developments will not ultimately contribute to an addition of nutrients to those surface waterbodies, over and above what is currently occurring.

CONSENT CONDITIONS

33 I have briefly reviewed the consent conditions that have been proposed by **Mr Kyle** for MWRL for the Ohau Downs and Killermont properties. These will be discussed in detail in the evidence of **Mr Gimblett** for Meridian. However, I have the following overview comments from a groundwater perspective:

- the monitoring, setting of trigger levels and proposed mitigation measures seem to be based on a rapid cause and effect relationship of nutrient exceedances at surface water nodes throughout the catchment. In terms of groundwater contributions to nutrient issues that is unlikely to be appropriate. I have not seen any regular groundwater monitoring data that shows the seasonal pattern of nitrogen concentrations in groundwater. However, Figure 12 shows the rainfall and evapotranspiration pattern for the Upper Waitaki basin. Rainfall is fairly evenly distributed throughout the year, although evapotranspiration shows a marked seasonal variation. Therefore, we would expect most leaching of nutrients into groundwater to

occur during the months of May to October due to land use activities in the previous summer, or several years previously. As noted in my main brief of evidence, the rate of movement of water through the groundwater system is on the order of years. Therefore, a possible situation could be created whereby there is a seasonal breach of nutrient conditions, which then resolves itself over a period of weeks or months as climatic conditions change, but this situation continues year after year because the groundwater contribution to the problem is not resolved;

- the proposed conditions seem to be based around mass loads from modelled Overseer output. However, measured concentrations of nutrients in surface water, groundwater and lysimeters would provide a desirable criteria to monitor changes in the environment in response to the increased irrigation area. With regard to groundwater, it is very difficult to determine what these thresholds should be due to the lack of available data. Therefore, as noted in paragraph 96 of my main evidence, it would be prudent to undertake 12 months of monitoring to establish a seasonal baseline against which future changes can be assessed and relevant thresholds could be assessed;

- groundwater monitoring should be carried out at quarterly intervals. If a threshold is breached, it should be checked by a repeat sample. If the repeat sample confirms the breach, then the groundwater sampling interval should be increased to monthly. In my view, weekly sampling, which is the interval currently proposed for threshold breaching, is too frequent for groundwater, which tends to show changes at a much slower rate;

- if lysimeter and/or groundwater thresholds are exceeded, then mitigation measures need to remain in place until at least a 12 month monitoring period to demonstrate that there is not a recurring seasonal breach;

- furthermore, if groundwater concentrations increase above a threshold level, then there will need to be a corresponding reduction in the allowable nutrient discharges via a surface migration pathway, so that the overall nutrient input to surface waterways is controlled.

COMMENTS ON THE GROUNDWATER ASSESSMENT IN MR MCINDOE'S EVIDENCE

34 The key focus of **Mr McIndoe's** groundwater evidence is a consideration of whether the adjacent and lower reaches of the Tekapo, Pukaki, Twizel and Ohau Rivers are likely to receive inflows of soil drainage water from beneath the irrigated properties, or whether the drainage water (and nutrients) will migrate beneath the rivers and enter Lake Benmore directly, thereby avoiding any nutrient contribution to the rivers.

35 In paragraphs 128 and 276, **Mr McIndoe** identifies three possible migration pathways:

a) drainage via deep groundwater direct to Lake Benmore;

b) drainage via shallow groundwater into the Tekapo and Pukaki Rivers above the Pukaki-Tekapo confluence and into the Twizel River for the Rosehip properties;

c) drainage into deeper groundwater that emerges into the Tekapo River above Lake Benmore for Simons Hill/Simons Pass or into the Lower Ohau River for Rosehip.

36 He refers to additional field investigations that have been carried out for the Simons Hill/Simons Pass properties that are reported in Appendix D of his evidence.

37 It is not possible to review the field observations in **Mr McIndoe's** groundwater assessment in Appendix D, because none of his groundwater and river level elevation data is presented, and he does not present a groundwater contour map, although the text of the Appendix describes the conclusions he draws from such a map. His comments include the following:

- Shallow piezometers along the Tekapo River from the Mary Range down to the confluence with the Pukaki River show groundwater levels above the riverbed and a hydraulic gradient that allows groundwater to discharge into the river;

- Groundwater fed pools in the riverbed are apparent in the areas of bores I38/0090 and I38/0091, i.e. the west-east flowing section of the Tekapo River to the south of the Simons Hill property;

- Groundwater chemistry supports a connection between groundwater and surface water flow in the Tekapo River;

- There is visible evidence of the Pukaki River gaining from groundwater in its lower reaches;

- Flow gauging data indicates increases in flow.

38 In paragraphs 136 and 137, he describes piezometric flow contours from the GHD groundwater modelling (Figure 10 of my evidence in chief) and suggests that most of the groundwater from the Pukaki Flats does not enter the Tekapo River. It is not obvious to me how he reaches such a conclusion. The arrows in the plot indicate the direction of groundwater flow. I understand that the red arrows in Figure 10 indicate a downward hydraulic gradient, the blue arrows indicate an upward gradient. By following the arrows from beneath the irrigated properties they tend to end up in an area of upward hydraulic gradient beneath the rivers. Furthermore, the bends in the contours indicate areas where the rivers are gaining flow from groundwater.

39 **Mr McIndoe** advises that the Simons Hill/Simons Pass development has designed its irrigation system to increase the buffer distance to the rivers to help the drainage water pass beneath the rivers. Such a strategy may be helpful, but only if there is a downward hydraulic gradient in the area that extends to a flow path going directly to Lake Benmore.

40 The natural orientation of the strata, including any more permeable preferential flow paths will be horizontal. Under such conditions the most likely flow path for nutrients in drainage water will primarily be a lateral flow path at shallow depth thereby placing the nutrient in a location where they could contribute to surface waterways that receive a contribution of their flow to groundwater. This includes the Mary Burn and Tekapo River at the Mary Burn range (as acknowledged by **Mr McIndoe**), the lower reaches of the Tekapo, Pukaki and Ohau Rivers and may also include the Twizel River and parts of the section of

the Tekapo River between the Mary Burn Range depending on the local groundwater and river level elevations. As **Mr McIndoe** observes, the recent monitoring of the release of water down the Pukaki River indicated a good hydraulic connection between the river and the surrounding shallow groundwater and that a good degree of hydraulic connection is likely to be the case for all the rivers in the vicinity of this property.

41 The surface flow patterns and water level information described by **Mr McIndoe** is based on existing conditions. In paragraphs 113-122 and 269-273, he describes potential water table rise due to the increased irrigation. It is to be expected that such rises may well contribute to increased groundwater flow into the neighbouring rivers. It is not apparent that the changes created by this extra groundwater flow have been assessed.

42 **Mr McIndoe** recognises that the Mary Burn and Tekapo at the Mary Range gain from groundwater and most drainage water and nutrients will enter the Mary Burn and Tekapo River (paragraph 156), which appears to be a correct assessment. He relies on the GHD assessment, although my reading of their toolkit spreadsheet is that they show a large proportion of N still in the groundwater in this location, which is a conclusion that does not appear to be consistent with **Mr McIndoe's** comments.

43 In paragraphs 143-147, **Mr McIndoe** uses an assessment of groundwater throughflow to conclude that only a very small proportion of the groundwater contributing to the rivers. Such water balance estimates are helpful, although **Mr McIndoe's** values are of a very approximate nature, particularly given that his hydraulic conductivity value for the calculation is estimated from a single specific capacity value from a bore screened from 71.6-113.4 m deep, which is not a depth where most nutrient migration would occur. The highest nutrient concentrations will occur in the shallowest groundwater, which is the groundwater that seeps into the surface waterways. This factor is conservatively allowed for in the GHD assessment, where they route drainage water directly to gaining reaches of surface waterways, but where groundwater is added, they use a non-conservative assessment of bulk average values.

44 Whether or not the allowance for the Simons Hill/Simons Pass and Rosehip nutrient migration is conservative or not depends on what proportion of those nutrients have been assigned to surface waterways. That information has not been provided to me, and therefore, I cannot determine that issue. However, based on the comments in **Mr McIndoe's** evidence, I suspect the assessment may not be conservative.

45 In paragraph 125, **Mr McIndoe** reports and supports the MWRL conclusion that there is insignificant nutrient drainage to the Tekapo River from Pukaki Flats and all of the nutrient load and groundwater discharges directly to Lake Benmore.

46 In my opinion, the groundwater level data he presents does not support such a definitive conclusion. The stream gauging data is helpful to try and quantify the potential gains from groundwater but that information only represents the net change between gauging points. Between those gauging points there could be further interaction between groundwater and the river that is not defined by the gauging measurements.

47 Whilst some nutrients will likely migrate directly to the Lake, I expect that a proportion will contribute to the Tekapo River and the lower reaches of the Pukaki River. The assessment by **Mr McIndoe** appears to disregard, or at the

very least minimise, this contribution from the Simons Hill/Simons Pass properties.

48 For the Rosehip properties, **Mr McIndoe** acknowledges gains in flow in the Twizel River and Lower Ohau River, and accepts there is uncertainty as to how much groundwater contribution there might be (paragraph 283). He relies on the GHD assessment to conclude that the effects are likely to be minor. However, recognising the lack of data described in his paragraph 283, this is not a conservative conclusion.

OVERVIEW OF MR MCINDOE'S EVIDENCE

49 **Mr McIndoe's** evidence identifies gaining sections of flow in the Tekapo River at the Mary Burn range and in the lower reaches of the Tekapo, Pukaki, Twizel and Ohau rivers feeding into Lake Benmore. Such gaining sections of river are likely to receive increased groundwater flow due to the extra groundwater recharge and raised groundwater levels caused by an increase in irrigation.

50 **Mr McIndoe** concludes that for the Mary Burn area, any land surface drainage will find its way into the Mary Burn and then into the Tekapo River. That seems to be a correct assessment, although may not be fully represented in the GHD Toolkit spreadsheet.

51 For the Pukaki Flats, **Mr McIndoe** concludes that drainage water bypasses the river and goes direct to Lake Benmore. He considers the same situation may apply to the Rosehip properties, although he acknowledges there is less certainty regarding the Rosehip situation. I agree that some drainage water will follow that pathway, but I consider that the available data indicates that shallow groundwater (which will have the highest nutrient concentrations) from beneath the Simons Hill/Simons Pass and Rosehip properties also has the potential to contribute flow and nutrients to the flowing sections of the adjacent rivers in the vicinity of those properties. That contribution to the rivers appears not to have been considered with an appropriate level of conservatism.

52 **Mr McIndoe's** conclusions are then used by **Dr Robson** to calculate acceptable nutrient discharges for each of these properties. I expect that the determination of these loads has not been conservatively assessed based on the potential groundwater and nutrient seepages into the streams. In my view, given the absence of clearcut and robust field data it would be appropriate to carry out a conservative assessment, which does not seem to be the case in this instance.

Dated: 30 November 2009

Peter Francis Callander