BEFORE THE COMMISSIONERS

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of proposed plan change 5A (Lindis catchment integrated management) to the Regional Plan: Water

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EVIDENCE IN CHIEF OF PETER WILSON ON BEHALF OF THE OTAGO FISH AND GAME COUNCIL
18 MARCH 2016

QUALIFICATIONS AND EXPERIENCE

1. My name is Peter Gordon Wilson. I am a resource management planner, holding the degrees of Master of Planning and Bachelor of Science (Physical Geography) from the University of Otago.

2. I have been employed as a planner for seven years, previously as a statutory planner with the Department of Conservation in Southland, with the Waitaki District Council, and currently as an environmental officer with the Otago Fish and Game Council, based out of Dunedin.

3. I have five years experience in the development of minimum flows and water allocation regimes in Otago, the transition from deemed permits to resource consents and in managing collaborative catchment groups.

4. I also have considerable experience in spatial and geospatial analysis, with public and private sector experience.

5. I have been involved with the Lindis River and the minimum flow proposals since June 2011. My involvement has included reviewing ORC published information on the Lindis, engagement with ORC staff, attendance at public meetings, and latterly, consultation and engagement with irrigators and their representatives, in an intensive period from June to August 2015, and regularly since August 2015.

6. In preparing this evidence I have reviewed the s32 report, the s42a officers report from the Otago Regional Council, and other evidence including:

    a. The "Opus Report", hydrological analysis prepared to support an economic assessment of the potential impact of a minimum flow regime for the Lindis River.
    b. The "Berl report", containing an analysis of the economic impacts of minimum flow regimes on the Lindis River.
    c. The "Niwa review", of the ORC science supporting the proposed minimum flow regime for the Lindis River.
    d. The Lindis catchment water resource study, prepared by the Otago Regional Council and covering the period from October 2012 to April 2014.
    e. The updated ORC science report, released in June 2015, further revised in December 2015, and published in January 2016.
    f. The Otago Regional Council's report on water quality in the Lindis catchment, January 2016
    g. The evidence of:
        i. Mr Jens Rekker, groundwater hydrologist
        ii. Mr Morgan Trotter, Fish and Game officer and ecologist
        iii. Mr Paul van Klink, Fish and Game officer
        iv. Mr Rasmus Gabrielson, Ecologist, Cawthron Institute
        v. Mr Aaron Horrell, Field Officer, Clutha Fisheries Trust

7. I have prepared this evidence in compliance with the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2014.

SCOPE OF EVIDENCE

8. This brief of evidence covers the following topics:

    a. An overview of Fish and Game's submission

    b. Commentary on the s42a officers' report.

    c. The planning framework and architecture for plan change 5A and how it gives effect to the Resource Management Act 1991, the National Policy Statement on Freshwater Management 2014, the Regional Plan: Water and other statutory and policy instruments.

    d. A discussion of catchment hydrology, water quantity and use, water quality, and water availability based on my analysis.

    e. Concluding remarks.

OVERVIEW OF FISH AND GAME'S SUBMISSION

9. Otago Fish and Game seek the restoration of a meaningful flow in the middle and lower Lindis Rivers, defined as below Rutherfords intake[1], during the irrigation season from 1 October to 30 April, to restore and then protect fishery values.

10. Whilst the ORC's current proposal 750 lps summer minimum flow, measured at the Ardgour Road flow recorder is an improvement on the previously recommended 450 lps, the expert evidence I have relied upon illustrates that this is still not sufficient to restore a meaningful flow, fish passage, or life-supporting capacity to the middle and lower river ecosystems. It also fails to restore natural character, recreational, amenity, and wildlife values. These aspects will be discussed by our experts.

[1] Evidence of Mr Rasmus Gabrielson

11. Much of the focus of research, monitoring, and effort on the Lindis catchment has focused on the lower river, below the Beggs Stackpoole intake and Ardgour Road flow recorder, to the confluence with the Clutha River.

12. However, the middle sections of the Lindis River from the confluence with Cluden Stream to the Ardgour Road bridge also suffer from reach specific dewatering and drying, with high fish mortality, loss of fish passage, natural character and amenity. This reach has not received the same research and monitoring attention from the ORC. As such the rates and extent of the loss of flow are not as well known. However the Otago Regional Council, and Fish and Game, in conjunction with the University of Otago, have conducted gaugings at various locations in the middle reaches of the river which provide insight into its functioning. I will discuss this in my evidence, and Mr Trotter, Mr Rekker, and Mr Gabrielson will also discuss this.

13. This lack of consideration of the middle reaches of the river undermines what is trying to be achieved by the setting of the minimum flow, and is a flaw in the methodology.

    a. The Ardgour Road flow recorder appears to be within a gaining reach, and flows at the recorder are not representative of flows throughout the middle and lower reaches of the river. Flows in the reach above the flow recorder may be between 200-500 lps higher than in reaches upstream and downstream depending on the season and groundwater conditions. The expected loss of about 440 lps between the Ardgour Road flow recorder and the Clutha Confluence– *once it decouples from groundwater* - is an assumption of this minimum flow setting process.

    b. However, a difference of between minus 200-500 lps in reaches upstream of the flow recorder has not been factored in. This hydrological variability is natural to dynamic riverbeds like the Lindis. Mr Rekker will discuss this further in his evidence.

c. The result of this hydrological variability at the reach scale is that a minimum flow of 750 lps will result in a fragmented and often disconnected river upstream and downstream of the Ardgour Road flow recorder, with approximately 22km of river reach affected with flows substantially below that recorded at the Ardgour Road recorder. These flows are too low to maintain continuity or life-supporting capacity throughout.

d. The concept that fish can detect a declining flow and move upstream or downstream out of the affected reach and out of danger has been disproven through the research of Mr Trotter. The evidence of Mr Trotter and Mr Gabrielson, disproves this concept based on their direct observation of the fishery – which shows the reach those fish were assumed to move into for refuge is not connected to the rest of the river because of the existing of drying reaches above the Ardgour Road flow recorder.

e. The Otago Regional Council's main scientific tool for analysing and determining the amount of physical habitat available for fish at various minimum flow levels has been the use of instream flow incremental methodology (IFIM). However, IFIM is one of a number of models which can be used to assess habitat availability in a river based on life-stages of fish and flow. Every model is a simplification of a complex ecosystem, and relies on assumptions. Mr Gabrielson will discuss the benefits and drawbacks of habitat modelling in his evidence.

f. In short, based on the evidence I have evaluated, I conclude that a proposed summer minimum flow of 750 lps fails to meet the purpose of the Resource Management Act, the NPS-FM, the operative RPS and the proposed RPS, and the objectives and policies of the Regional Plan: Water.

14. As such, Fish and Game oppose the 750 lps summer minimum flow in the notified version of plan change 5A, and instead seeks a minimum flow of 1000 lps.

15. Support for a higher minimum flow is based on new information, including:

    a. An improved understanding of the river's hydrology at the reach level.
    b. Direct observations and studies of fish behaviour in the river at low flow times;
    c. information on spawning and rearing of juvenile trout;
    d. information on the habitat requirements of yearling trout, eels, and upland bullies
    e. Information on wading birds and waterfowl, including endangered species, that rely on flows ;
    f. fish mortality;
    g. temperature data;
    h. specific reach-by-reach photography of the river's visual appearance during low flow times;
    i. a new consideration of the behaviour of the reach of river between Rutherfords and the Ardgour Road flow recorder at low flows;
    j. a deterioration of water quality in the lower river (NNN), and the need to enhance water quality in the lower river, in order to meet Schedule 15 targets;
    k. new fisheries modelling techniques;
    l. new hydrological information;
    m. new information on the availability and accessibility of alternative water sources.

16. A minimum flow of 1000 lps emerges as an appropriate summer minimum flow when considering the range of freshwater values and objectives, particularly:

a. Reversing historical overallocation and restoring life-supporting capacity to the lower river fishery and ecosystem; and

b. Consistency with flow-setting in other Central Otago catchments that are, or have been, dominated by deemed permits; and

c. Consideration of water quality trends, plan requirements and targets, and water temperature; and

d. Recognising the losses to surface expression and to groundwater that occur in the lower river; and

e. Providing for the needs of the fishery and wider aquatic ecosystem whilst also meeting the needs of irrigators who have no access to alternative sources of water.

f. Providing a meaningful connecting flow from below the SH 83 bridge to the Clutha River confluence and;

g. Providing a meaningful connecting flow through the river reach upstream of the Ardgour Road recorder to Cluden Stream; and

h. Providing suitable fish passage through critical riffles both upstream and downstream of the Ardgour Road flow recorder; and

i. Applying the precautionary principle to ensure generally that the river and ecosystem does not bear an unfair proportion of any uncertainty or unreliability in information which guides decisions on flow setting and allocation; and

j. Recognising reality in one of the driest catchments in Otago by advocating for a minimum flow that is well below that recommended by the draft National Environmental Standard on

Flow Setting. 1000 lps is between 54-57% of MALF, depending on which measurement of MALF is used.

17. Fish and Game also seek that the summer minimum flow season is aligned with other summer minimum flow seasons in Otago, and is to occur from 1 October to 30 April, rather than from 1 October to 30 May. The proposed eight month summer low flow period risks a potential lengthy flat-line, with resultant detrimental effects on the river ecosystem, such as the growth of nuisance algae. A seven month period of 1 October to 30 April is fairer, and consistent with the summer minimum flow seasons set on other rivers in Otago, as well as consistency with many resource consent conditions. It also recognises the beginning of spawning season on 1 May. An analysis of the hydrograph undertaken by the Otago Regional Council[2] shows little difference between flows in April and flows in May.

18. Fish and Game conditionally supports the winter minimum flow, winter minimum flow season, supplementary minimum flow, supplementary allocation block size, and the allocation regime and boundaries for the three defined aquifers, and the boundaries for the catchment as a whole. As the management of these surface and groundwater resources is tightly linked to the setting of a summer minimum flow, Fish and Game's support for these is conditional on a higher and meaningful minimum flow being adopted.

"Meaningful" flow

19. It is worthwhile at this point to explain the concept of a meaningful flow.

20. A "meaningful" flow in this context is a flow that provides for life-supporting capacity, fish passage, significantly reduced mortality, with a recognition of natural character and amenity but is well below an optimum flow or flows at the point of inflection using hydraulic habitat modelling. The narrative terms that describe my concept of flows are explained below:

[2] Otago Regional Council, Science Update, December 2015

- *A dry, or disconnected river* – the current situation in summer months in the lower Lindis.

- *A fragmented river*. A river with some flowing and some dry or disconnected reaches. This describes the overall picture of the lower reaches of the Lindis River between Cluden Stream and the confluence during summer months.

- *Continuity of flow* – A moving flow passes continually throughout the river, but is little more than wetted stones. There is no fish passage.

- *Flows for fish passage* – A flow that provides for fish passage with suitable depth and distance over riffles that will be the most shallow parts of the river. The depth required over riffles differs depending on the life stage of the fish and the species. Juvenile trout require less depth than adult trout for instance. However, whilst passage is available, habitat for fish is limited – it can be considered as a hostile reach that fish will move through but not linger, or fish may only choose to move through it at times when threats are more limited, such as at night.

- *A meaningful flow* – A flow that provides connection, fish passage, and life-supporting capacity for aquatic life, but at levels that are a fraction of the optimum. A meaningful flow also provides some of the aspects of natural character, amenity, and the intrinsic value of the river.

- *Flows at the point of inflection* – The point of inflection is an approach used to interpret hydraulic habitat modelling in order to recommend a flow. Habitat availability for a life stage of a fish species falls off dramatically below the point of inflection. For juvenile trout in the Lindis, the point of inflection is 750 lps.

- *An optimum flow*. Habitat availability for a life stage of a fish is at its optimum. However, the assessment of optimum levels differ depending on the modelling or assessment approach taken. Optimum flows often approach median flows for trout.

- *High flows or floods*. Self-explanatory.

21. The summer minimum flow of 1000 lps proposed by Fish and Game is a recognition of the severe historical over-allocation within the Lindis, and of the difficulty of restoring a true environmental flow. A flow of 1000 lps is far from ideal. However, this flow does restore connectivity, fish passage, and some semblance of habitat, amenity, and natural character to a reach of a river that is currently dry or fragmented in most years at the height of the irrigation season.

<u>Transitional matters and process</u>

22. There is a need for this plan change to address the general issue of transition from deemed permits to resource consents, regardless of water source. I consider that the section 32 report does not adequately address matters of transition. It only addresses transition times under Policy 6.4.5 of the RPW. However, the section 32 report does provide some scope for a wider consideration.

23. These transition matters include:

a. A possible phased implementation of the final minimum flow to provide time for irrigators to shift to alternatives. This is of particular importance for small holders fully reliant on the Tarras race. I acknowledge that this may take some time, and may need to be extended beyond 2021 with a phased implementation. Provided the final outcome is a higher minimum flow for the river, above 750 lps, I consider this to be appropriate.

b. Facilitating the shifting of deemed permits to resource consents from alternative sources;

c. The possible potential for small scale gravel management and extraction in locations where there are substantial deposits to improve fish passage;

d. Changing methods of take to restore fish passage and prevent ingress of small fish and elvers. This is required regardless of what level the summer minimum flow is ultimately set at.

e. Providing for variable rates of take through consents to mimic flushing flows and to enable the fine-tuning of water management.

f. Providing certainty and a process to facilitate the fair break-up and reallocation of large deemed permits held by existing irrigation companies into individual or smaller components. This may also include the reallocation of former Lindis rights to alternative sources.

24. I consider that the degree of challenge and change facing the Lindis irrigators is such that the Commissioners should actively consider how the Regional Plan: Water can provide as much certainty and incentive as is possible.

ANALYSIS OF S42A OFFICERS REPORT

25. I have read the section 42A officers report.

26. I wish to point out one error within the report. On page 14, section 2.1.2.3 it states that "*increasing the minimum flow to 1,000 l/s is unlikely to provide significant additional benefits to ecosystem values (due to high temperatures in the Lower Lindis), while further reducing reliability of supply for irrigators*"

27. I don't wish to discuss the merits of a 1000 lps vs 750 lps minimum flow here. However, the statement above contradicts the ORC's most recent publication on water quality in the Lindis catchment ("Water quality in the Lindis River catchment 2015", January 2016). Pg 47 of this report summarises water temperature in the Lindis catchment. It states:

    Water temperatures recorded at Lindis Peak and Ardgour Road were wel within the acute thermal thresholds for brown and rainbow trout (Table 7.2). The maximum weekly average temperature at Ardgour Road was within the chronic thermal threshold for all species considered, while the maximum weekly average observed at the Lindis Peak [sic] was within the chronic thermal thresholds for brown trout and the native species considered, but exceeded the chronic threshold for rainbow trout (Table 7.2). These results suggest that thermal conditions in these sections of the Lindis are generally suitable for brown trout, longfin eel and common bully, but that water temperatures in the vicinity of Lindis Peak may be unsuitable for rainbow trout at times"

28. This confirms that high temperatures affecting trout and other species in the lower Lindis River are not an issue. This is also consistent with the evidence of Mr Gabrielsson who will discuss water temperature in detail, based off both the ORC's own monitoring and work undertaken by Fish and Game and the Clutha Fisheries Trust.

29. The issue appears to be an earlier ORC publication (Update of scientific work in the Lindis catchment 2008-2015) that reaches a different conclusion, albeit, not backed up by more recent assessments.

30. I also note another point. Table 4 of the s42A report looks at the water availability and expected days of rationing and shortfall for various minimum flow options. However, this table does not analyse an efficient allocation scenario (of 1146 lps) and a minimum flow of 1000 lps. It only analyses the 2,084lps option. I consider this to be a significant omission, and my evidence will address this omission in part later.

ANALYSIS OF POLICY AND PLANNING FRAMEWORK

31. The intent of this part of my evidence is to compare the relevant operative and proposed statutory planning documents, developed under the Resource Management Act 1991 (RMA), with proposed plan change 5A (Lindis River Integrated Management) to the Regional Plan: Water, hereafter referred to as the Lindis plan change, or the plan change. I have aimed to assess the plan change against the following instruments:

    a. The Resource Management Act 1991
    b. National Environmental Standards and National Policy Statements produced under s43 and s45 of the Act.
    c. The proposed and operative Regional Policy Statement for Otago
    d. The existing policy settings for the river, provided, primarily by the Regional Plan: Water
    e. The proposed and operative Conservation Management Strategy for Otago
    f. The Sports Fish and Gamebird Management Plan for Otago

<u>Analysis of consistency with Part 2 RMA</u>

32. A summary of Part II of the RMA is reproduced below

    a. Purpose:

        i. Safeguarding the life supporting capacity of... water, soil, and ecosystems (section 5(2)(b)), and

    b. Matters of national importance:

        i. the preservation of the natural character of …. wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development (section 6(a));

        ii. the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna (section 6(c));

    c. Other matters such as:

i. *Ensuring that resource use (including the taking of water and use of the assimilative capacity of water) is necessary, reasonable and efficient (section 7(b)).*

ii. *The maintenance and enhancement of recreational values, amenity values, and the intrinsic values of ecosystems (section 7(c) and (d)).*

iii. *The recognition of the finite characteristics of freshwater (section 7(g))*

iv. *Maintenance and enhancement of the quality of freshwater environments, including wetland environments, as habitats for sports fish and game birds (section 7(f)).*

v. *Protection of the habitat of trout and salmon (section 7(h));*

An overview of the National Policy Statement – Freshwater Management 2014

33. All subsidiary policies, such as the Regional Policy Statement for Otago (the RPS) and the Regional Plan: Water (RPW) must give effect to the requirements of the NPS.

34. The NPS-FM focuses on both water quality and quantity. I address the provisions in respect of quantity first:

35. Objective B1 states to "*safeguard the life-supporting capacity, ecosystem processes and indigenous species including their associated ecosystems of fresh water, in sustainably managing the taking, using, damming, or diverting of fresh water*".

    Life supporting capacity and ecosystem processes are the main two tests within the Objective for the Lindis. The current situation of a dry or disconnected lower river fails these twin tests in many ways. Obviously, a river with no water, de-oxygenated pools, limited or no fish passage, and the presence of dead or dying introduced and indigenous fish, caused either directly by the loss of water or the secondary pressure of predators fails these tests. Ecosystem processes, would include the migratory pathways for fish, which would otherwise be provided by a flowing river with sufficient depth for fish passage.

36. Objective B2 states the need– *"to avoid any further over-allocation of fresh water and phase out existing over-allocation"*

    The Lindis plan change is clearly consistent with this Objective. It includes summer and winter minimum flows, and an allocation regime that covers primary and supplementary allocation from both surface water and groundwater to phase out existing historical over-allocation that is longstanding.

    However, this Objective needs to be read concurrently with Objective B1, which requires both a definition of the over-allocation and a focus

on the levels and limits that are set through regional policy to avoid or phase out the over-allocation. A dry river (where the frequency of occurrence of that drying out is unnatural) is perhaps the starkest effect of water quantity over-allocation.

I note also the strong terms in the policy. The test set by the Objective is "avoid", with the possibility existing of a timeframe to "phase out" the overallocation. For the Lindis plan change, this timeframe is 2 October 2021, or approximately 6 years from the date that the plan change was notified.

37. I now move to the policies. Policy B1 states how to give effect to the Objectives – *"By every regional council making or changing regional plans to the extent needed to ensure the plans establish freshwater objectives in accordance with Policies CA1-CA4 and set environmental flows and/or levels for all freshwater management units in its region (except ponds and naturally ephemeral water bodies) to give effect to the objectives in this national policy statement, having regard to at least the following:*

    a. *The reasonably foreseeable impacts of climate change;*
    b. *The connection between water bodies; and*
    c. *The connections between freshwater bodies and coastal water*

38. Policy B1 references a number of subsidiary policies, which I will discuss below:

    a) Policy CA1, referenced above, requires the regional council to define freshwater management units. I consider that the Lindis plan change does this, by using the natural watershed for the Lindis River itself, from its source to its confluence with the Clutha River. Whilst not explicitly specified as a freshwater management unit, this is consistent with the definition of other catchments across Otago.

    b) Policy CA2 sets out a process for developing freshwater objectives. The Lindis plan change does not explicitly define

freshwater objectives for the river, but is in effect, undertaking much of the same process implicitly. However, the NPS provides compulsory values that must be included in the set of freshwater objectives that are provided by the Lindis. These are:

i. Te Hauora o te Wai - Ecosystem health
ii. Te Hauora o te Tangata - Human health for recreation

Additional national values include:

- Natural form and character (this includes flow)
- Mahinga kai
- Fishing
- Irrigation and food production
- Animal drinking water
- Wai tapu
- Wai Maori - Water supply
- Economic or commercial development
- Navigation

I note that generic narrative values are the only ones provided by the NPS. It does not include any quantitative values for flow setting water quantity. The proposed National Environmental Standard on Ecological Flows and Water Levels and supporting documents provide some guidance here, and I will discuss that shortly.

39. The latter half of Policy B1 requires plan change 5A to set an <u>environmental flow and/or level</u>, through the regional plan. An environmental flow and/or level is defined as the setting of at least one minimum flow (or other flow/s) and an allocation limit. Policy B1 requires specific consideration of the following:

a) The reasonably foreseeable impacts of climate change
b) The connection between water bodies; and
c) The connection between water bodies and coastal water

Of these three clauses, b) is the most relevant for the Lindis. This specifically requires consideration of connection between the Lindis River and the Clutha River.

40. The nature of "connection" is worthy of further explanation. Connection within a water body can be thought of from the perspective of aquatic organisms, which may experience a disconnection well before humans see a dry river or a disconnected reach:

    a) When physical flows stop entirely or where passage for an organism between one section of a river and another becomes impossible or harmful to that fish.

    b) When temperatures or chemical conditions within bodies of water prevent passage.

    c) The existence of a barrier which prevents physical passage of a fish species.

41. Policy B2 states the mechanism of action for implementing the NPS –FM

    "*By every regional council making or changing regional plans to the extent needed to provide for the efficient allocation of fresh water to activities, within the limits set to give effect to Policy B1*".

    This is the process being followed by the ORC, and needs no further discussion. It is consistent with the NPS. I note however a difference in language between the "environmental flows and/or levels" used in Policy B1 and the use of the term "limits" above. In the context of the NPS, environmental flows and/or levels are a type of limit.

42. Policy B3-*By every regional council making or changing regional plans to the extent needed to ensure the plans state criteria by which applications for approval of transfers of water take permits are to be decided, including to improve and maximise the efficient allocation of water.*

The existing Regional Plan: Water contains objectives, policies, rules, and methods for the approval of transfers of water take permits (under section 136). However, this regime for transfers applies mainly to intra-catchment transfers, rather than the inter-catchment transfers that are needed in the case of the Lindis. I consider that the Lindis plan change needs further detail to assist and enable a transition away from Lindis water for those that have access to other sources, such as Clutha water or groundwater. Fish and Game's submission supports this.

Proposed National Environmental Standard on Ecological Flows and Water Levels (2008)

43. This proposed national environmental standard has not been advanced since 2008, however, it and its supporting documents provide useful guidance.

44. The proposed NES recommends interim limits for rivers and streams[3]. For the Lindis, a minimum flow of 90% of MALF would be recommended, as the river has a median flow of below 5 cumecs. Assuming a naturalised MALF at the Ardgour Road flow recorder of 1864 lps[4], a 90% minimum flow would be 1491 lps.

45. Obviously, given the extent of the overallocation in the Lindis catchment, setting a minimum flow at these levels would be challenging. However, many regional plans do set default and specific minimum flows at these levels, and the proposed NES levels should be thought of as a benchmark against which to assess the degree of overallocation.

46. The companion technical document to the proposed NES – the Draft Guidelines for the Selection of Methods to Determine Ecological Flows and Water Levels provides a more detailed process for determining ecological flows within rivers.

47. When assessed against this framework, the risk of deleterious effects (Table 1) is determined to be "high", the assessment of the degree of hydrological alteration (Table 2), is also determined to be "high" (a high risk and low baseflow scenario, as well as the existing primary allocation of more than 40% of MALF).

48. Table 3 then recommends methods for assessment of ecological flows based on the results of the previous tables. In this case, the recommended methods and models for flow assessment are:

[3] Item 5.1.3, pg 26, Proposed National Environmental Standard on Ecological Flows and Water Levels: Discussion Document, Ministry for the Environment (2008)
[4] Otago Regional Council, 2014

a. Entrainment model
b. 1D hydraulic habitat model
c. 2D hydraulic habitat model
d. Bank stability
e. Dissolved oxygen model
f. Temperature models
g. Suspended sediment
h. Fish bioenergetics model
i. Inundation modelling
j. Groundwater model
k. Seston flux
l. Connectivity / fish passage
m. Periphyton biomass model
n. Flow variability analysis.

49. My understanding is that only the 1D hydraulic habitat model (IFIM, using RHYHABSIM), a groundwater model (ORC, 2010), and something of a flow variability analysis have been undertaken by the ORC. The other recommended methods to inform flow setting have not been undertaken by the ORC.

50. Mr Gabrielsson, Mr Trotter, Mr Rekker, and Mr Horrell will provide information on temperature, dissolved oxygen, fish bioenergetics, connectivity/fish passage, and flow variability, however, given the degree of overallocation and longstanding issues with flows in the Lindis catchment, this arguably should have been undertaken by the ORC as recommended by the draft NES.

51. My overall assessment against the draft NES and supporting documents is that the baseline scientific and modelling information required to inform flow-setting have not been undertaken. This impairs the flow-setting process that this hearing has been tasked with and has added a substantial burden to submitters. Fish and Game and allied organisations have undertake over two years worth of detailed investigations on the river, and

I understand that the irrigators have also undertaken substantial further work.

Analysis of consistency with the operative Otago RPS

52. The operative Regional Policy Statement for Otago provides a number of objectives and policies that relate to flow setting. In the case of the operative Otago RPS, the narrative explanation for the objective or policy is as important as the policy wording itself. These are:

53. Objective 6.4.1 states the need *"To allocate Otago's water resources in a sustainable manner which meets the present and reasonably foreseeable needs of Otago's people and communities.*

Explanation:

> *To be able to meet the economic, social and cultural well being of Otago's people and communities, the present and reasonably foreseeable needs of those people and communities for suitable quantities of quality water will have to be met. The demands placed on available water resources are increasing and must be managed to ensure that sufficient water of high quality is available for the future needs of the Otago region. In some cases, where water is in short supply, this will require careful allocation decisions.*
>
> This objective appears to place a primacy on supplying sufficient quantities of quality water for the economic, social, and cultural well being of Otago's people and communities. It seems to assume abstractive or out-of-stream uses for that water, although it does state the need for careful allocation decisions where water is in short supply.

54. Objective 6.4.3 states the need – *"to safeguard the life-supporting capacity of Otago's water resources through protecting the quantity and quality of those water resources"*

Explanation:

The life-supporting capacity of a water resource refers to its ability to support life. Life-supporting capacity can be adversely affected by chemical, biological, physical and thermal contamination. The safeguarding of this capacity requires that the water resource be protected from the adverse effects of activities which could result in contamination or depletion to the extent that its ability to support life is threatened.

The definition of life-supporting capacity is consistent with that in the Act and the NPS-FM, however, it adds further definition of the term with respect to water quality and quantity and defines the types of adverse effects – chemical, biological, physical, and thermal contamination. This covers the range of existing and possible future threats to the Lindis River. It also states that "protection" is necessary when adverse effects are likely to contaminate or deplete a river to the extent that its ability to support life is threatened.

55. *Objective 6.4.4 – "To maintain and enhance the ecological, intrinsic, amenity and cultural values of Otago's water resources".*

Explanation: The ecological, intrinsic, amenity and cultural values of Otago's water resources are important elements of those water resources which must be recognised in the management of those resources. They provide much of the character of the water resource. The Otago community and visitors to the region readily identify with Otago's water areas as integral elements of Otago's landscapes. Tourism relies on the inherent quality of the water resources in Otago. These resources must be protected or enhanced for the benefit of the region's economy as well as for the aesthetic advantages they provide.

I consider this important, as it defines natural character of the water resource, including rivers, and the value of that natural character. It specifically states that natural character is as important for economic reasons – i.e. tourism – as it is for aesthetic and intrinsic values. Given

that the Lindis River is on a major tourism route, I consider this objective adds weight to the minimum flow setting process.

56. *Objective 6.4.8 – "To protect areas of natural character, outstanding natural features and landscapes and the associated values of Otago's wetlands, lakes, rivers and their margins"*

    Explanation: Otago's lakes, rivers and wetlands are made up of a variety of different landscapes and natural features which make them unique. People appreciate the natural beauty and character of these water bodies and wish to retain that character. The preservation and protection of the natural character and the outstanding natural features and landscapes of lakes, rivers, wetlands and their margins is a matter of national importance under Section 6 of the Resource Management Act and important in achieving integrated management of the region's water resources.

    This essentially restates section 6(a) of the RMA.

57. *Objective 6.5.2 - To allocate water in areas of Otago where there is or potentially will be insufficient water supplies through:*
    (a) Considering the need to protect instream amenity and habitat values; and
    (b) Considering the needs of primary and secondary industry; and
    (c) Considering Kai Tahu cultural and spiritual values; and
    (d) Considering the extent to which adverse effects can be avoided, remedied or mitigated.

    Explanation: Water is required for many uses within Otago and within some areas the supply of water is limited. In these areas it will be necessary to allocate water on the basis of considering the importance of competing needs. The Resource Management Act already requires that the domestic and stock drinking water requirements of communities be met where this does not have an adverse effect on the environment. The needs of primary and secondary industry are of importance as are instream amenity and habitat values. They are

important to the continued ecological well being of any water resource and to the social, economic and cultural needs of those communities that use those resources for recreational or other purposes. These competing needs will need to be considered together, while also considering the cultural and spiritual values that Kai Tahu place on that water resource.

I consider that this potentially conflicts with Objectives 6.4.3, 6.4.4, 6.4.8 in that it appears to say that the needs of industry and instream amenity and habitat need to be considered together, whilst also considering Ngai Tahu values. This objective may be intended to be read after 6.4.3, in that once life-supporting capacity has been provided for, instream amenity and habitat values can be considered alongside the needs of primary and secondary industry, but even then, it is hard to reconcile this objective with more recent interpretations of Part II of the Act and policy instruments written under the Act which take an environmental bottom line approach for matters as critical as minimum flows.

I find it hard to reconcile this Objective with its equivalent in the proposed RPS – Policy 2.1.1, which clearly states an environmental bottom line:

58. *Objective 6.5.3 - To promote efficient consumptive water use through: (a) Promoting water use practices which minimise losses of water before, during and after application; and*
(b) Promoting water use practices which require less water; and
(c) Promoting incentives for water users to use less water.

Explanation: Traditional management techniques and methods of irrigation or reticulation, including urban and rural domestic uses, may not provide the most efficient method of water use. Casual attitudes towards water conservation may not encourage efficient use, further reducing the amount of available water among competing users. Attitudes towards water wastage will eventually impact on the ability of Otago's water supplies to meet the needs of future generations.

I consider that this is consistent with the Lindis plan change.

59. *Objective 6.5.4 - To investigate and, where appropriate, set minimum flow levels and flow regimes for Otago water bodies and maximum and minimum lake levels to protect any of the following:*
(a) The needs of Otago's communities;
(b) Kai Tahu cultural and spiritual values;
(c) Lake margin stability;
(d) The natural character of the water body;
(e) Habitats of indigenous fauna and flora;
(f) Amenity values;
(g) Intrinsic values of ecosystems;
(h) Salmon or trout habitat;
(i) Outstanding natural features or landscapes.

Explanation:
In some water short areas, it may be necessary to establish minimum flow levels and flow regimes for rivers and water bodies to protect significant values associated with them. Minimum and maximum lake levels may similarly need to be set. The setting of such levels and regimes will depend on the particular water resource and the values associated with it. In investigating the need or otherwise to set and apply minimum flows through the Regional Plan: Water, recognition will be given to the effects of Mining Privileges for water resources (now called deemed permits) and the options available for addressing any adverse effects. Because Mining Privileges will expire in 2021, provision will need to be made to manage this change through the implementation and review of the Regional Plan: Water.

I consider that whilst making provision for the needs of Otago's communities, this Objective places primacy on the environment.

<u>Proposed Otago RPS</u>

60. The proposed Otago RPS greatly simplifies policy assessments. One objective and one policy are directly relevant:

a) Objective 2.1 – "The values of Otago's natural and physical resources are recognised, maintained, and enhanced"

b) "Policy 2.1.1 - Managing for freshwater values:

Recognise freshwater values, and manage freshwater, to:
a) Support healthy ecosystems in all Otago aquifers, and rivers, lakes, wetlands, and their margins; and
b) Retain the range and extent of habitats provided by freshwater; and
c) Protect outstanding water bodies and wetlands; and
d) Protect migratory patterns of freshwater species, unless detrimental to indigenous biodiversity; and
e) Avoid aquifer compaction, and seawater intrusion in aquifers; and
f) Maintain good water quality, including in the coastal marine area, or enhance it where it has been degraded; and
g) Maintain or enhance coastal values supported by freshwater values; and
h) Maintain or enhance the natural functioning of rivers, lakes, and wetlands, their riparian margins, and aquifers; and
i) Retain the quality and reliability of existing drinking water supplies; and
j) Protect Kāi Tahu values; and
k) Provide for other cultural values; and
l) Protect important recreation values; and
m) Maintain the aesthetic and landscape values of rivers, lakes, and wetlands; and
n) Avoid the adverse effects of pest species, prevent their introduction and reduce their spread; and
o) Mitigate the adverse effects of natural hazards, including flooding and erosion; and
p) Maintain the ability of existing infrastructure to operate within their design parameters."

I consider that this objective and policy place a primacy on environmental and natural values, rather than consumptive values (apart from drinking water). In particular, it requires the migratory patterns of freshwater species to be

protected, and for the natural functioning of rivers to be maintained or enhanced. This policy is relevant.

Regional Plan: Water (RPW)

61. The Regional Plan: Water provides objectives, policies, rules, and methods for managing water quantity and recognising natural and human use values of rivers. The primary objectives that relate to the Lindis are as follows:

5.3.1 To maintain or enhance the natural and human use values, identified in Schedules 1A, 1B and 1C, that are supported by Otago's lakes and rivers.

This is the key NPS-FM type 'freshwater objective', and plan change 5A must maintain or enhance these listed values.

a) The species values and cultural values that apply for the Lindis River are those identified in Schedule 1A, 1B, and 1C. Without being exhaustive, these values are as follows:

- *Pgravel – The most important substrate for biota is gravel*
- *Weedfree - Largely weed free*
- *Hspawn(t) – Significant trout spawning*
- *Hjuve(t) – Significant habitat for juvenile trout*
- *Eel – Significant presence of eels*
- *Trout - Significant presence of trout*

I noted that the values for the Lindis river recognise trout spawning, juvenile trout, and adult trout, as well as eels.

To this it would be appropriate to add significant presence of upland bully and wading birds as new values. This addition to Schedule 1A was requested in Fish and Game's submission and Mr van Klink will provide evidence on this point.

b) Recreational values have no specific schedule within the water plan although they are recognised as a result of successful Water Conservation Order applications. The Sports Fish and Gamebird Management Plan for Otago has more detailed information on the recreational values of the Lindis River.

c) For flow setting itself, the water plan objectives and policies provide the following guidance, although it is noted that there are few specific objectives and policies within the plan that give an overall context to minimum flow setting. The particular significance of the objective or policy with respect to the Lindis has been added underneath each one in italics.

The lower Lindis River currently goes dry during summer months due to over allocation and the lack of a minimum flow. When the river dries, significant numbers of native and introduced fish are killed. If the current management regime results in significant fish mortality, then it cannot be reasonably argued that the values listed in schedule 1A are maintained or enhanced.

5.3.3 To protect the natural character of Otago's lakes and rivers from inappropriate subdivision, use, or development.

Explanation: The natural character of Otago's lakes and rivers and their margins is made up of a range of physical, ecological and cultural qualities. These relate to the lake's or river's topography, including the setting and bed form, natural flow and level characteristics, ecology, and the extent of development within the catchment. The degree of natural character and what is considered to be inappropriate subdivision, use and development, will vary from place to place

I consider that this provides a useful description of the natural character of a river, which includes setting, bed form, natural flow,

and ecological values. Of course, natural character and the degree to which use and development will vary from catchment to catchment, as stated in the objective, but the non-exclusive list of characteristics of natural character provided by the policy is useful for assessment.

Within the lower Lindis River, the morphology is that of a delta of a small braided river, albeit with greatly reduced flow due to irrigation. A natural feature of deltas and braided rivers is a moveable and sometimes multiple channels.

5.3.4 To maintain or enhance the amenity values association with Otago's lakes and rivers and their margins

Explanation The amenity values associated with Otago's lakes and rivers and their margins are the natural and physical qualities and characteristics that contribute to people's appreciation and enjoyment of the water body. This appreciation and enjoyment relates to the pleasantness, aesthetic coherence and cultural and recreational attributes of a lake or river. The ability to appreciate amenity values may be facilitated by physical development such as structures and through access provisions.

Principle reasons for adopting
This objective is adopted to ensure that activities that use land or water do not remove or reduce opportunities for the enjoyment or appreciation of Otago's lakes and rivers, and where appropriate to provide for the enhancement of amenity values. This reflects the importance of amenity values to the region's people and communities.

The principle reasons for adopting this objective state clearly that the purpose of it is to ensure that amenity is not degraded, and due to the existence of the word "enhance" in the objective,

improving amenity is necessary where it has been degraded. This is also consistent with Policy 2.1.1 of the proposed RPS.

The amenity of a river is closely related to the level of flow within the river. For the Lindis, I consider that this means establishing a meaningful flow that resembles people's perceptions of a healthy river – riffles, runs, pools, and its braided character in the lower reaches rather than a warm discontinuous trickle or pools with the remains of dead fish within a large area of dusty dry stones, to excuse the slightly emotive language. It also means ensuring appropriate riparian management. A flowing river is also an important component of the overall landscape.

5.3.5 - To maintain or enhance public access to and along the margins of Otago's lakes and rivers.

Public access and ready access to the Lindis is highly important for public recreation including angling, gamebird hunting, and other recreational uses like camping and picnicking. Ready access is also a value, as most of the middle and lower reaches of the Lindis are close to roads. I don't consider public access to the Lindis to be at threat or unavailable.

5.3.6 To provide for the sustainable use and development of Otago's water bodies, and the beds and margins of Otago's lakes and rivers.

This policy enables the sustainable use and development of water resources, but for this policy to be consistent with those in the hierarchy above or below it, the test of sustainability, under both section 5 and any subsidiary policy instruments such as the NPS-FM and RPS must be met. This means, using the terms of the NPS-FM, that use and development of water can occur, subject to limits and allocation that are set to protect both the river's life-

supporting capacity and to maintain the natural and human use values specified in Objective 5.3.1 and Schedule 1A.

5.3.8- To avoid the exacerbation of any natural hazard or the creation of a hazard associated with Otago's lakes and rivers.

The minimum flow proposals will not exacerbate any natural hazard.

62. The specific policies of the regional plan that are directly to the Lindis plan change, from the evidence I have seen to date, are:

Policy 5.4.1- To identify the following natural and human use values of lakes and rivers as expressed in Schedule 1:

(a) Outstanding natural features and landscapes;
(b) Areas with a high degree of naturalness;
(c) Areas of significant indigenous vegetation, significant habitats of indigenous fauna, and significant habitats of trout and salmon;
(d) Ecosystem values;
(e) Water supply values;
(f) Registered historic places; and
(g) Spiritual and cultural beliefs, values, and uses of significance to Kai Tahu

It is not clear how Schedule 1 is to be updated when new or updated values are identified. The logical way of updating the values in Schedule 1 is through a catchment specific plan change, such as this one. Fish and Game has requested amendments to Schedule 1 based on the values identified through recent research in the catchment, and these amendments are necessary in my opinion to give effect to policy 5.4.1.

63. I consider Policy 5.4.2 to be instructive. It places a priority on "avoiding, rather than remedying or mitigating, adverse effects" when managing water. The list of adverse effects is as follows:

(a) Natural values identified in Schedule 1A;
(b) Water supply values identified in Schedule 1B;
(c) Registered historic places identified in Schedule 1C, or archaeological sites in, on, under or over the bed or margin of a lake or river;
(d) Spiritual and cultural beliefs, values and uses of significance to Kai Tahu identified in Schedule 1D;
(e) The natural character of any lake or river, or its margins;
(f) Amenity values supported by any water body; and

(2) Causing or exacerbating flooding, erosion, land instability, sedimentation or property damage.

These clauses within Policy 5.4.2 are also NPS-FM type freshwater objectives.

Within the Lindis, this provides further emphasis on the objectives in that priority must be given in flow setting to avoiding adverse effects on natural values, cultural values, natural character, and amenity. I consider that the preference to "avoid" means that a precautionary approach should be taken when setting minimum flows, and that a meaningful flow, which includes cultural values, natural character and amenity stated in (d-f) above, rather than bare connecting flow should be provided for.

64. *Policy 5.4.8 – To have particular regard to the following features of lakes and rivers and their margins, when considering adverse effects on their natural character:*

(a) The topography, including the setting and bed form of the lake or river;
(b) The natural flow characteristics of the river;
(c) The natural water level of the lake and its fluctuation;
(d) The natural water colour and clarity in the lake or river;
(e) The ecology of the lake or river and its margins; ad
(f) The extent of use or development within the catchment, including the extent to which that use and development has influenced matters (a) to (e) above.

5.4.9- To have particular regard to the following qualities or characteristics of lakes and rivers, and their margins, when considering adverse effects on amenity values:

(a) Aesthetic values associated with the lake or river; and
(b) Recreational opportunities provided by the lake or river, or its margins.

Policies 5.4.8 and 5.4.9 provide further emphasis that for flow setting, natural flow characteristics, ecological values, aesthetic, and recreational values must be considered. This is in addition to the Objectives in the RPS and RPW. For the Lindis, this means providing for angling,

swimming, and the natural character of a flowing river and its braided character in the lower reaches. It also means considering the natural flow characteristics when setting minimum flows.

Policy (f) reflects that humans have heavily influenced the functioning of rivers. Whilst there may be instances where use and development has improved rivers, or could improve rivers in the future, for example, through the use of transport water, in the case of the lower and middle reaches of the Lindis under the current regime, an assessment of (a)-(e) under (f) reveals negative effects.

5.5.3- Areas of significant indigenous vegetation, significant habitats of indigenous fauna, and significant habitats of trout and salmon are protected.

The lower Lindis has significant habitats for trout and eels, as identified within Schedule 1A of this Plan.

5.5.4- Aquatic community health and diversity in lakes and rivers are maintained or enhanced.

At the moment with the river going dry due to abstraction there is no maintenance of aquatic community health or diversity. Given the variabilities present in groundwater conditions, the proposed summer minimum flow of 750 l/s cannot guarantee the maintenance of aquatic community health and diversity.

5.5.5- People and communities can continue to access the resources of lakes and rivers and their margins.

A dry river precludes the entire reason (to get to recreational and food resources) many people and communities would want to access a river. An irrigator would also need access to a river but I consider that this AER is not aimed at abstraction. Even if it does this anticipated environmental result cannot be taken in isolation from the other anticipated results which all hinge on meaningful continuous flows in the river.

5.5.7- The natural character of Otago's lakes and rivers is protected from the inappropriate use and development of water and land resources.

The current and proposed water allocation regimes do not protect the natural character of the river. In fact the natural character is first degraded as flows drop over summer and then destroyed altogether in reaches where the flow ceases.

5.5.8- People and communities can continue to enjoy and appreciate the amenity values of Otago's lakes and rivers.

The amenity of the lower Lindis River is severely compromised at present by abstraction for irrigation, and the proposal to establish a minimum flow of 450 l/s would do little to maintain or enhance this amenity. The only reasonable option to meet this anticipated environmental result is to establish a meaningful minimum flow that provides for a functioning healthy river ecosystem as well as amenity values. A flowing river is a clearly defined amenity value. As stated above, I consider that a flow of 750 lps cannot be guaranteed to provide a meaningful flow in the lower Lindis River at all times, and as such, this proposed flow fails the expected outcome in 5.5.8 above.

5.5.9- Public access to and along Otago's lakes and rivers is maintained or enhanced.

This is not currently an issue. The river is very accessible. The issue is that there is often no water in the bed of the river to access or enjoy.

65. Chapter 6 of the Regional Plan: Water deals with the specifics of managing water quantity. Its objectives and policies should be read concurrently with the objectives and policies of chapter 5, although Chapter 6 appears to be more permissive in terms of supporting abstraction than Chapter 5.

6.3.1- To retain flows in rivers sufficient to maintain their life-supporting capacity for aquatic ecosystems, and their natural character.

I consider that there is a difference between “maintain life-supporting capacity for aquatic ecosystems, and their natural character” and the equivalent objective in 5.3.1 which is to “maintain and enhance natural and human use values”. The linkage may be in the concept of natural character, which for the lower Lindis River is that of a small braided river that currently lacks a connecting flow in summer months.

Life supporting capacity for aquatic ecosystems is well defined for trout, native fish, including eels, and invertebrates, based on their physiology and habitat requirements, but this is not currently provided for in the lower Lindis. The current management regime also does not provide for the life supporting characteristics of the Lindis River in relation to wading birds that live and breed on the river bed and require river braids to provide protection from predators currently provided for.

I consider that the proposed summer minimum flow of 750 lps cannot be guaranteed to maintain the life-supporting capacity of the river, given both the uncertainty about whether this flow is sufficient to maintain connection, and, if it does connect at various times, the flow will not be sufficient to maintain habitat for aquatic species.

6.3.2- To provide for the water needs of Otago’s primary and secondary industries, and community domestic water supplies.

I consider that this objective is somewhat conflicted by the approach taken in Chapter 5 for the maintenance and enhancement of human use values, as the objective is not restricted by any reference to sustainability. It appears to place a priority on consumptive uses of water, rather than on the environmental flow needs of the river. My approach is to see this as just one part of the overall puzzle of integrated management because there is nothing in this objective to say it overrides any other objective within the plan.

6.3.2A- To maintain long term groundwater levels and water storage in Otago’s aquifers.

This appears to be in contrast to objective 6.3.2 above in that the water plan appears to anticipate the need to set maximum allocation volumes in order to ensure the sustainability of Otago's groundwater resources. No similar objective appears to exist for surface water sustainability.

6.3.3- To minimise conflict among those taking water.

This objective supports a holistic and integrated approach being taken when setting minimum flows. It is particularly important to ensure that there is coherence between the primary allocation limit and the minimum flow. It is also important to review – *and to provide a process for review* - all deemed permits on a catchment wide basis to minimise conflict if they were reviewed on an ad-hoc, first come, first served basis.

6.3.4- To maximise the opportunity for diverse consumptive uses of water which is available for taking.

Within the Lindis catchment itself it is not clear how this objective would be met, as almost all consumptive use is for irrigation on farms, plus a small amount of domestic water supply. There is not likely to be any competing demands for that water, apart from irrigators themselves. All water in the Clutha catchment upstream of the Clyde Dam has a value for hydroelectricity generation, however, the net effect of a higher minimum flow in the Lindis River on hydroelectricity generation is likely to have minimal effect on the Clyde operation, given that takes that once came from the Lindis will be transferred to the Clutha or groundwater.

6.3.6- To minimise any adverse downstream effect of managed flows.

There are no large upstream sources of water in the Lindis which provide or augment flows, but the effects of the proposed minimum flows and allocation regime are in effect a managed flow that will have a profound adverse downstream effect if these are set too low and maintained at a low level for too long without variability.

Policy 6.4.0- To recognise the hydrological characteristics of Otago's water resources,
including behaviour and trends in:

(a) The levels and flows of surface water bodies; and
(b) The levels and volumes of groundwater; and
(c) Any interrelationships between adjoining bodies of water, when managing the taking of water.

This policy requires the hydrological characteristics of the Lindis River to be studied and recognised. Mr Rekker discusses this in detail in his evidence, and I will only discuss it generally.

The middle and lower reaches of the Lindis River are strongly influenced by groundwater, and the levels of groundwater influence flows at both the reach and overall river level. This explains much of the variability in flow in the lower river. When groundwater levels are high, the amount of flow required to achieve both a connection and a meaningful flow will be lower than when groundwater levels are low – and vice-versa.

I do not believe it is possible to set and maintain a fair and meaningful minimum flow without a linkage to groundwater conditions in real time, as the levels of flow required, as measured at the Ardgour Road flow recorder will change throughout the spring, summer, and autumn seasons as groundwater levels change.

66. *Policy 6.4.0A – to ensure that the quantity of water granted to take is no more than that required for the purpose of use taking into account*

    a) *How local climate, soil, crop, or pasture type and water availability affect the quantity of water required;*

    b) *The efficiency of the proposed water transport, storage, and application system*

    In dry catchments, such as the Lindis, Policy 6.4.0A is especially important. I believe that this policy works in both directions, both to ensure that water is efficiently applied based on end use, and also to assess, by use of the term "climate" in the policy, if that farm system

is appropriate for the area. This consideration is especially important in the Lindis catchment, where climate influences may be a greater limiting factor on water availability for farming systems than the influence of a minimum flow.

67. *Policy 6.4.0B – to promote and support shared used and management of water that:*
    a) *Allows water users the flexibility to work together, with their own supply arrangements; or*
    b) *Utilises shared water infrastructure which is fit for purpose;*

    Clause a) is the current situation within the Lindis, with almost all irrigators working together through the Lindis Irrigation Company.

    Clause b) would require an upgrade of infrastructure and a move away from long races in order to be fit for purpose, given that a higher minimum flow is proposed for the river. This will likely still be under the auspices of a corporate structure for coordination purposes, which is likely to be Lindis Catchment Group Incorporated.

68. *Policy 6.4.0C – to promote and give preference, as between alternative sources, to the take and use of water from the nearest practicable source.*

    For parts of the Lindis catchment where alternative sources are available, such as groundwater or piped Clutha water, this policy provides the basis for transitioning existing Lindis irrigators to a more sustainable source of water. The policy does require, due to the use of the word "practicable" a comparison of the effects of taking from the alternative source/s.

69. It is noted that the original Tarras Water Scheme consents for up to 4.5 cumecs of Clutha water have now been given effect to and are being utilised by Ardgour Pipeline Limited. This scheme is authorised by consent RM13.362.

70. Most of the Beggs-Stacpoole permit holders have shifted to groundwater from the Bendigo aquifer.

71. There are also several schemes operating on the Tarras flats that use groundwater.

72. There are no existing rules within the RPW which govern the setting of minimum flows.

73. There are no existing methods within the RPW that govern the setting of minimum flows. The RPW does contain methods in Chapter 15 for the determination of primary allocation, supplementary allocation, the mean annual low flow, and the siting of flow recorders and staff gauges.

The proposed and operative Otago Conservation Management Strategies and the Otago Sports Fish and Gamebird Management Plan

74. Both of these strategies and plans are written under the Conservation Act 1987 and any relevant general policies also written under that Act. These are matters for the Commissioners to consider under section 66(2)(c)(i).

75. The current Conservation Management Strategy for Otago was made operative in December 1996. It is still the operative CMS for Otago, although a revised CMS will likely be made operative later this year. The purpose of a conservation management strategy is the "integrated management of natural and historic resources" (section 17D(1), Conservation Act 1987)

76. The current Otago Sports Fish and Gamebird Management Plan was made operative in 2015. It sets out the strategic and operational priorities for the Otago Fish and Game Council, which has the statutory responsibility for the management of sports fish and gamebird resources throughout much of Otago. This responsibility includes advocacy in the interests of anglers and hunters, including their interests in habitats" (section 26Q(e)(i) and (vii), Conservation Act 1987).

77. These strategies and plans have relevance for the commissioners under section 66(2)(a)(i) as "management strategies prepared under any other Act".

78. The current Conservation Management Strategy for Otago is primarily focused on terrestrial conservation issues and native fish, however, it does provide some guidance for the Lindis. It states, in Chapter 7, for the Central Otago Place, that the "reduction in river and stream flows due to water abstraction for irrigation"[5] is a threat.

79. Within the implementation section, for the Central Otago place, a priority is placed on the following areas:

[5] Otago Conservation Management Strategy, section 7.3.8, pg 102

"The establishment and adherence to suitable minimum flows and streams that have more or less intact indigenous aquatic ecosystems will be advocated" – implementation point (g)

"Provision of fish passage will be advocated through RMA processes or sought where necessary under the Freshwater Fisheries Regulations" – implementation point

80. The CMS also includes a section on "special species" within Central Otago. For those species affected by flows in the Lindis, aside from non-migratory galaxids, only the black fronted tern (*Chlidonias albostriatus,* a new Linnean name) is listed. Black fronted terns are nationally endangered. However, the evidence of Mr van Klink states the presence of black-billed gulls (*Larus bulleri*) within the lower Lindis as well. This species has a threat status of nationally critical.

81. Given that non-migratory galaxids are largely confined to tributary streams behind barriers which protect them from native and introduced predators, it is the impact of low flows on native waterfowl that is of the most concern, and the current CMS gives some, but not much, guidance on this matter.

82. The current version[6] of the proposed CMS is more specific. It states a need to:

"2.10.2 - Prioritise statutory advocacy for:
c) district and regional plan provisions to address freshwater water and estuarine ecosystems functioning and protection"

"2.10.6 – Work collaboratively with Ngai Tahu and the community (including regional and territorial authorities and the Fish and Game Councils" to increase awareness of freshwater values and issues and to

[6] The current version of the proposed CMS is that adopted by the Otago Conservation Board prior to it being approved by the New Zealand Conservation Authority. It may change further but not materially.

achieve agreed ecological flow regimes in Otago's waterways that ensure ongoing protection of freshwater species"

83. Furthermore, the description of the Freshwater/Wai Maori place, which covers all waterways in Otago, states:

"Of particular concern are the ongoing pressures on rivers flowing through drier eastern catchments of North Otago and in Central Otago rivers such as the Manuherikia and Lindis. Intensive farming and forestry, burning or wilding treepine invasions reduce water quantity and quality and diminish natural, scenic and recreational values of waterways." – pg 125, proposed Otago CMS

84. This indicates a clear desire by the Department to advocate to restore ecosystem functioning to river systems in central Otago under pressure, and to achieve that improvement through the setting of ecological flow regimes. This protection extends to all freshwater species.

85. The Sports Fish and Gamebird Management Plan for Otago provides guidance for decision-makers through a set of issues, objectives, and policies.

Issue 6.2.4 – "Multiple stressors on waterways are exacerbated by the many and often conflicting systems for resource administration that exist, such as different types of resource consent, subsequent minimum flow provisions, and differing interpretations on existing resource consents. There is an urgent need for a holistic consideration of catchments"

Issue 6.2.7 – Some rivers in Otago are fully or over allocated in terms of water abstraction for out of stream uses, resulting in degradation of aquatic habitats. Examples include the Shag, Manuherikia, Cardrona, and Lindis Rivers… [The use of mining privileges] has serious adverse effects on aquatic ecosystems in some river reaches and their existence constrains sustainable water resource management"

Objective 6.3 – To protect, maintain, and enhance the quality and extent of fish and game habitats in Otago as a priority, with advocacy as the primary tool"

Policy 6.4.17 – "Protect fish and game habitats and amenity values of rivers, streams, and lakes in Otago by way of:

a) involvement in consent and permission processes
b) involvement in the development of RMA policies and plan changes …"

Policy 6.4.18 – "To ensure that water quality standards and flow regimes reflect the requirements of healthy and productive sports fish and game populations and the different stages in their life cycles"

6.4.19 – "Place a priority on resolving over allocation issues in Central Otago rivers relating to deemed permits in order to restore habitats for sports fish. The potential of on-farm storage should be considered in resolving over-allocation issues"

86. The emphasis of these issues, objectives, and policies is on resolving over-allocation in order to restore and protect fish and game habitats, particularly where they have been degraded through over allocation.

<u>Determination of fishery significance</u>

87. The Sports Fish and Gamebird Management Plan also provides information on the value of fisheries within a national or regional context. Section 4.7 provides the basis for the assessment of fishery significance, which is undertaken considering a variety of factors.

88. As a discrete fishery, the Lindis River would be classified as locally significant, as it receives less than 2000 angler visits per year, it is degraded habitat requiring restoration of flows, and is primarily a spawning and juvenile recruitment stream, supporting only a limited and small adult trout

population. However, section 4.7.1 of the assessment criteria states that any "habitat that provides a migratory pathway or corridor, spawning, breeding, or rearing areas for a nationally significant fishery or game habitat" can also be considered as nationally significant. The Upper Clutha river fishery, in particular, Lake Dunstan, to which the Lindis is the most important spawning and juvenile recruitment stream, is identified as nationally significant[7].

89. In this light, I consider that the best way to treat the significance of the Lindis fishery is as both. In itself, the adult fishery in the river is locally significant, due to the small population, but its proximity and connection to the Upper Clutha fishery makes its spawning and recruitment of juvenile trout nationally significant. The restoration of a meaningful flow in the lower river will both enhance its own local fishery status, as well as ensuring that the full extent of the Lindis' spawning and juvenile rearing recruitment potential is available to the wider fishery.

90. I note that this is a similar overall assessment, using different criteria, to the values of the river contained in Schedule 1A of the Regional Plan: Water.

<u>Conclusion of policy assessment</u>

91. I conclude that the NPS-FM, draft NES, proposed and operative RPS, the existing Regional Plan: Water, and other statutory plans take a moderate to strong protective approach when considering the setting of limits and levels within rivers. Some of the objectives within the Regional Plan: Water, for example, Objective 5.3.6 appear to place an emphasis on abstraction rather than instream values, but where these policies do exist, they are well out-weighed by other policies, both above them in the hierarchy, and in a similar position to them within that hierarchy.

92. However, whilst I consider that these policy instruments require a protective approach to be taken when setting the levels of a minimum flow, the policies themselves do not define the level. The restoration of the life supporting capacity of the river is the minimum requirement required

[7] Page 20, Otago Sports Fish and Gamebird Management Plan

by the policies assessed, and this would logically mean a flowing river at all times of the year with a meaningful flow to maintain the species within it.

93. The first step therefore is to identify specifically the values to be protected, and then to set the flows needed to protect the identified values. The draft NES and companion documents provide guidance for this exercise, by recommending technical assessment methods for flow setting based on various river characteristics. However, for the Lindis, the ORC have only undertaken three of the recommended fourteen assessments.

94. Given this lack of assessment, I consider that an added importance is placed on the values, scientific and technical information presented to this hearing by experts. This is needed to complete the understanding of the Lindis River's behaviour.

95. Almost all the policies assessed above take a river as the whole unit – freshwater management unit - of assessment. They do not attempt, or recommend, to divide a river into individual reaches for the purposes of achieving the policies. Whilst the NPS-FM does make it theoretically possible to consider reach specific management units, this is not current practice in Otago. I consider that this means that accordingly, the effects of a minimum flow proposal on the whole river need to be considered. To me means the following:

    a. A renewed consideration and collation of the values of the river, adding on new evidence presented to the hearing.

    b. A consideration of flow continuity, fish passage, and provision of aquatic habitat throughout the river.

    c. A consideration of the differences between flows measured at the recorder and the likely flow, or flow range, experienced in individual river reaches as a result of the considerable variance in river behaviour at the reach level.

d. A consideration of how representative the flow measuring sites are to the overall river.

Assessment of flow proposals against a hydrological understanding of the river

96. Mr Rekker has provided evidence on the functioning of surface and groundwater within the river. The levels of groundwater have a substantial impact on surface flows in the lower river, with low groundwater levels requiring higher surface flows to maintain connection, and vice versa. Mr Rekker has also explained how groundwater conditions in the river vary based on the season and also on the level of abstraction.

97. The difference in flows measured at the flow recorder at Ardgour Road and that experienced in the rest of the river also needs to be considered. There are reaches of variable flow upstream of the Ardgour Road bridge, as discussed by Mr Gabrielsson. In these reaches, flows and the habitat sustained by them are likely to be between 300-500 litres per second lower than the flows recorded at the flow recorder. The flow recorder sits in a gaining reach. This is a major factor for consideration when flow setting.

98. The ORC propose a summer minimum flow of 750 lps. I consider that this will provide continuity of flow through the to the Clutha confluence in most years, albeit with not much of a buffer for times when losses to groundwater may be higher.

99. However, I consider that providing connectivity alone does not give effect to the Act, the NPS-FM, the RPS, and the RPW. Fish passage, life-supporting capacity, and some semblance of habitat is required. Mr Gabrielsson will explain that there is no fish passage with reach specific flows of below 500 lps. Given that some reaches of the Lindis are between 400-500 lps below that recorded at the Ardgour Road recorder, the overall minimum flow needs to be at least 1000 lps in order to provide the minimum of fish passage through critical reaches.

Assessment of flow proposals against aquatic habitat requirements within the river

100. The Lindis River supports many aquatic species. Invertebrates, fish, eels, and wading birds all rely on river flows to sustain life.

101. Mr Gabrielsson and Mr Trotter have discussed the approaches for assessing habitat requirements of aquatic species, in particular, for trout. It is noted that when using IFIM methodology, that the point of inflection, i.e, the point at which habitat availability for brown spawning and juvenile trout falls away sharply – for the lower Lindis River it is 750 lps, the same as the minimum flow proposal. However, this flow will only exist at the flow recorder. Upstream and downstream of the flow recorder habitat availability will be well less than this, and may be below life supporting capacity for these species in the worst affected reaches, with flows of around 250-350 lps, given that flows are 400-500 lps lower in these reaches. Fish and Game's proposed minimum flow of 1000 lps provides greater security, as it would result in flows and thus habitat availability in these reaches of about 500-600 lps, which is closer to the point of inflection as determined by IFIM modelling.

102. This isn't a small matter, approximately 12 km of the lower Lindis River is affected by low flows, and setting a minimum flow at 750 lps may result in flows that are so low that no life-supporting capacity for trout is provided in all but the reach near the flow recorder.

103. The effect of flows on predation also needs to be considered. As Mr Trotter has stated, as flows reduce, predation on fish within the channel increases, both by other fish and by birds. Predation on endangered river birds also increases, as the protection provided to them by a body of water is no longer there. Mr van Klink has discussed this in his evidence. Within the lower river where black fronted terns and black billed gulls are present, there may be a significant difference in predation pressure between site-specific flows of 600 lps, and 350 lps, which is the expected difference in

lower river flows based on the 1000 lps Fish and Game proposal and the 750 lps ORC proposal

Water quality

104. An assessment of the effects of the flow regime on water quality is also required. NNN (nitrate-nitrite-nitrogen) levels in the Lindis River, as measured at Ardgour Road, exceed the targets in Schedule 15 of the RPW. The target for the Lindis River is 0.075 mg/L, to be measured as an 80th percentile value when flows are at or below reference (median) flow, of 3.50 cumecs.

105. The current 80th percentile value, measured from July 2010 to June 2015, is 0.1812 mg/L[8]. This is more than double the target value, and the trend is upwards, as a result of land use intensification. The trend for P and E coli is down, which is consistent with a move from flood irrigation to spray.

106. It is not clear what the current concentrations of N are within groundwater. No limit has been set for groundwater nutrient concentrations in the Lindis catchment.

107. Land use intensification may increase in the Lindis, particularly if alternative sources are used in the future and they are more expensive and the land has to be made more productive as a consequence.

108. Whilst there is currently no water quality monitoring at the Clutha confluence (although this monitoring is required as a condition of consent for Ardgour Pipeline Limited), as flows diminish, the concentration of NNN within the lower river can be expected to increase further.

109. Whilst potentially the solution to pollution, and the intent of plan change 6A, is not to dilute the concentration of instream nutrients with higher flows, there is no doubt that in the Lindis catchment that artificially

[8] "Water quality and ecosystem health in Otago", Otago Regional Council, http://www.orc.govt.nz/Documents/Publications/Research%20And%20Technical/surface-water-quality/2015/2015%20SOE%20report%20card-Updated%20September.pdf

low flows in the lower reaches will result in higher concentrations of nutrients than would otherwise be the case.

110. I consider that a minimum flow of 1000 lps, combined with the implementation of N leaching limits on land within the Lindis catchment, will increase the ability of the Lindis catchment to meet its Schedule 15 target by 2025.

Assessment of alternatives

111. Of critical importance with the setting of a minimum flow in a dry catchment such as this is the consideration of alternative sources of water. The Otago Regional Council has commissioned two reports that look at alternatives. These are:

a. The BERL report;
b. The Opus report, which informs the BERL report with hydrological information.

112. I generally accept the conclusions reached by these reports, namely:

a. That climate variability has a greater impact on water availability in the catchment than policy settings such as minimum flows and the allocation regime.

b. That the added, or marginal economic impact from a minimum flow is a small extra addition to the economic impact already incurred by the climate.

113. I am not an expert in economics, however, I suggest that these other economic assumptions could be of assistance:

a. The extra cost incurred on irrigators in the Lindis catchment who have no access to alternatives may be less than the variability imposed on farmers by changes in commodity prices.

b. That the extra cost may also be able to be mitigated by farm system changes and improvements, such as a move to more dry-tolerant pastures, such as lucerne. I accept that these system improvements require investment and time to take effect however.

c. The replacement of deemed permits with resource consents adds certainty for those that hold them. This may add to land value, because the water is more secure, even if the availability of water is slightly reduced as a result of a minimum flow, or it is more expensive as a result of sourcing it from an alternative supply. I note that the availability of supplementary water is greater than the default Otago regime as a result of the Lindis plan change, which should enable on-farm storage.

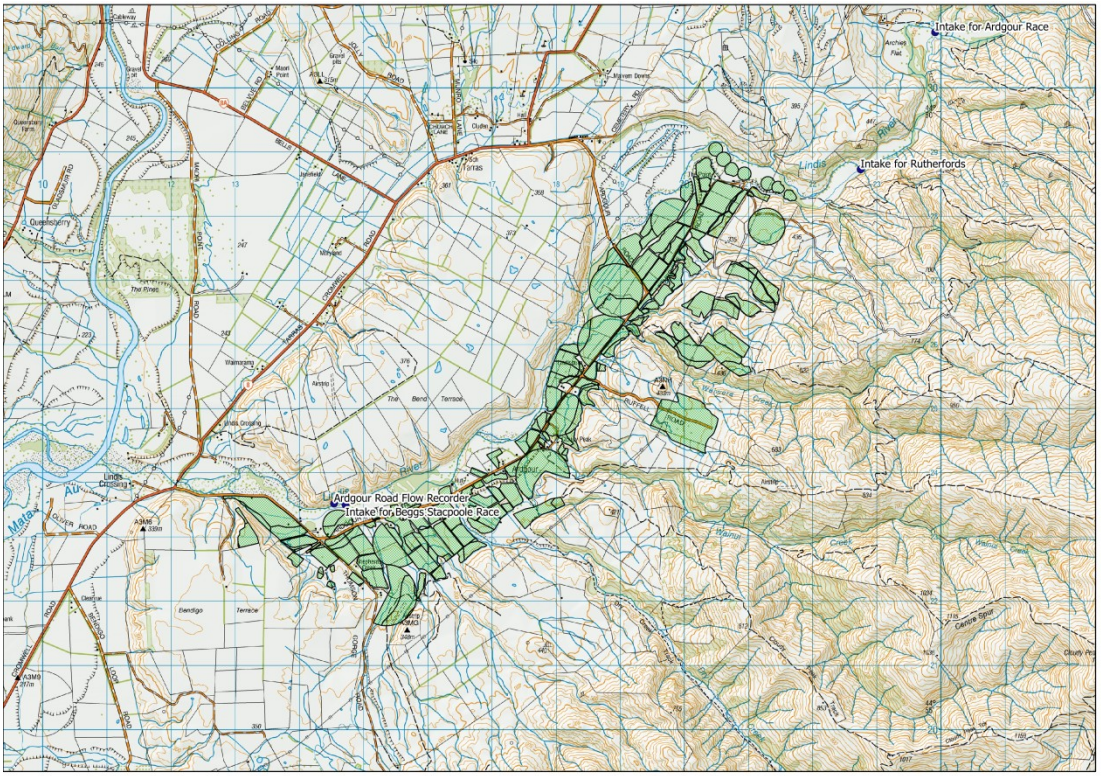
d. With efficiency improvements and a shift away from the Lindis River to groundwater or surface water there may be a slight net gain in water that is returned to the Clutha. This may have a slightly positive effect on improved hydroelectric production at Clyde Dam, although, given increases in abstraction throughout the Upper Clutha catchment, the effect may be difficult to measure. Policy D of the NPS on Renewable Electricity Generation 2011 does require a consideration of reverse sensitivity effects on existing renewable electricity generation activities.

e. The cost, and benefit, of on-farm water storage has not been considered. Given the rapid growth of constructed storage ponds in other parts of Otago, this could be an option within the Lindis catchment as well.

114. I agree that it is difficult to obtain one clear and accepted definition of security of supply. This means different things in different contexts, and often to different people, and the lack of a clear definition makes discussions about this concept difficult.

115. In my non expert observation the Opus report, which informs the BERL report, takes a conservative assessment of the area of land which is irrigable from alternatives. It only uses the command areas of existing consented alternatives to Lindis water, rather than potential areas that have access to alternatives that are essentially on the same contour.

116. I undertook a geospatial analysis of irrigation requirements using the same methodology in the Opus repor. However, I limited the area of irrigation to land entirely within the newly defined lower Lindis catchment and without easy access to alternatives. This is different to the analysis undertaken in the Opus report, which assumed some parcels of land on the Tarras race would need to remain supplied with Lindis water. The following map shows the area of land assessed for its water requirements:



Fish and Game assessment of areas of land in lower Lindis catchment with no easy access to alternatives, based on spatial data supplied by Lindis catchment group in June 2015.

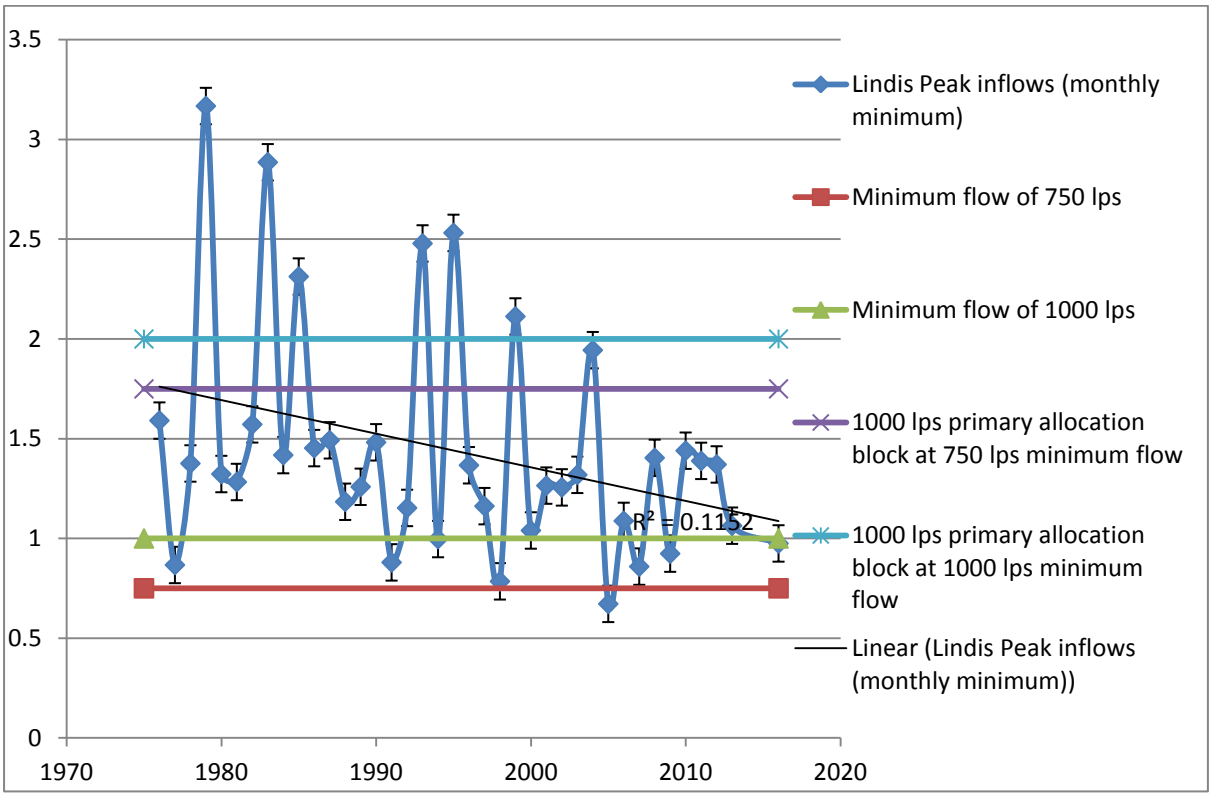
117. The volume of water required to irrigate this land to the appropriate depth based on crop/pasture requirements and soil conditions (Aqualinc 2006), on an instantaneous basis and assuming efficient application

methods, is 700 lps. This is 446 lps lower than the 1146 lps calculated in the Opus report for 'Efficient irrigation – Lindis only'.

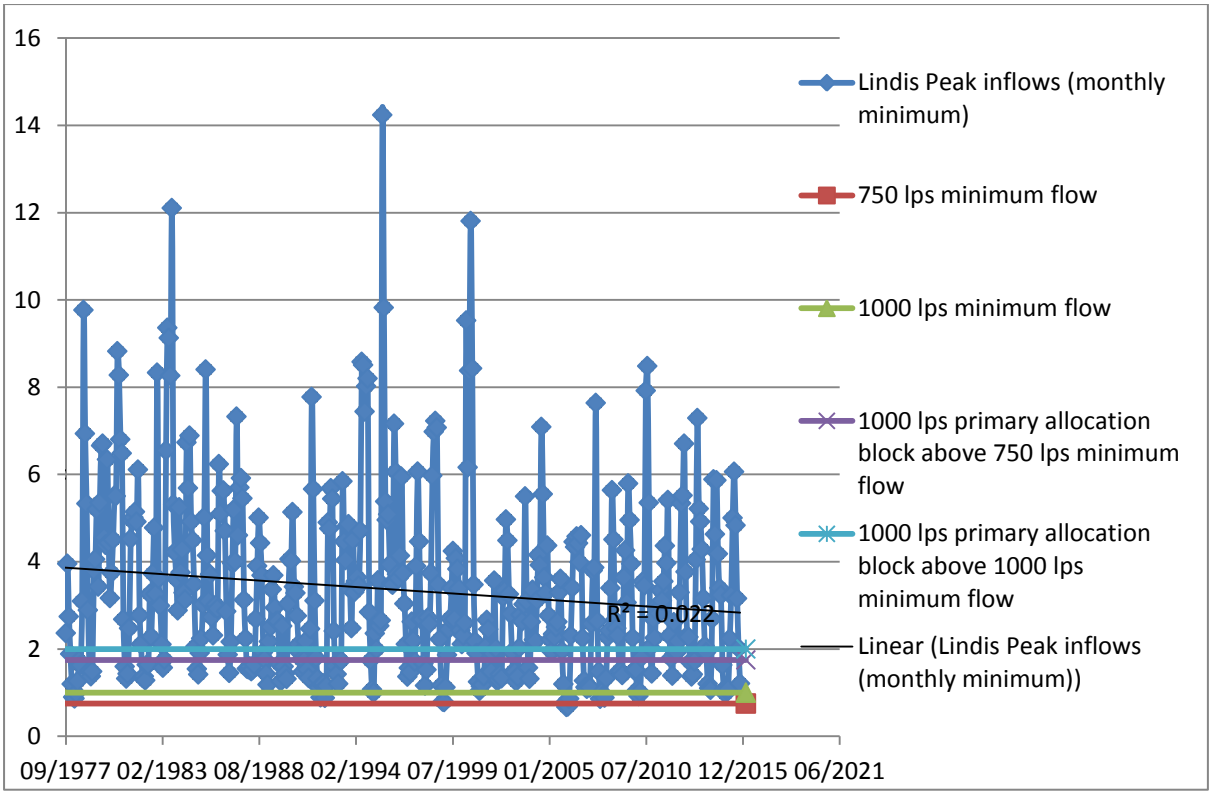
118. I note that this assessment does not include irrigated land in the upper and middle reaches of the Lindis.

119. I offer this assessment to confirm that the assumptions in the Opus report are conservative, and to also reinforce the Opus report's assumptions on primary allocation.

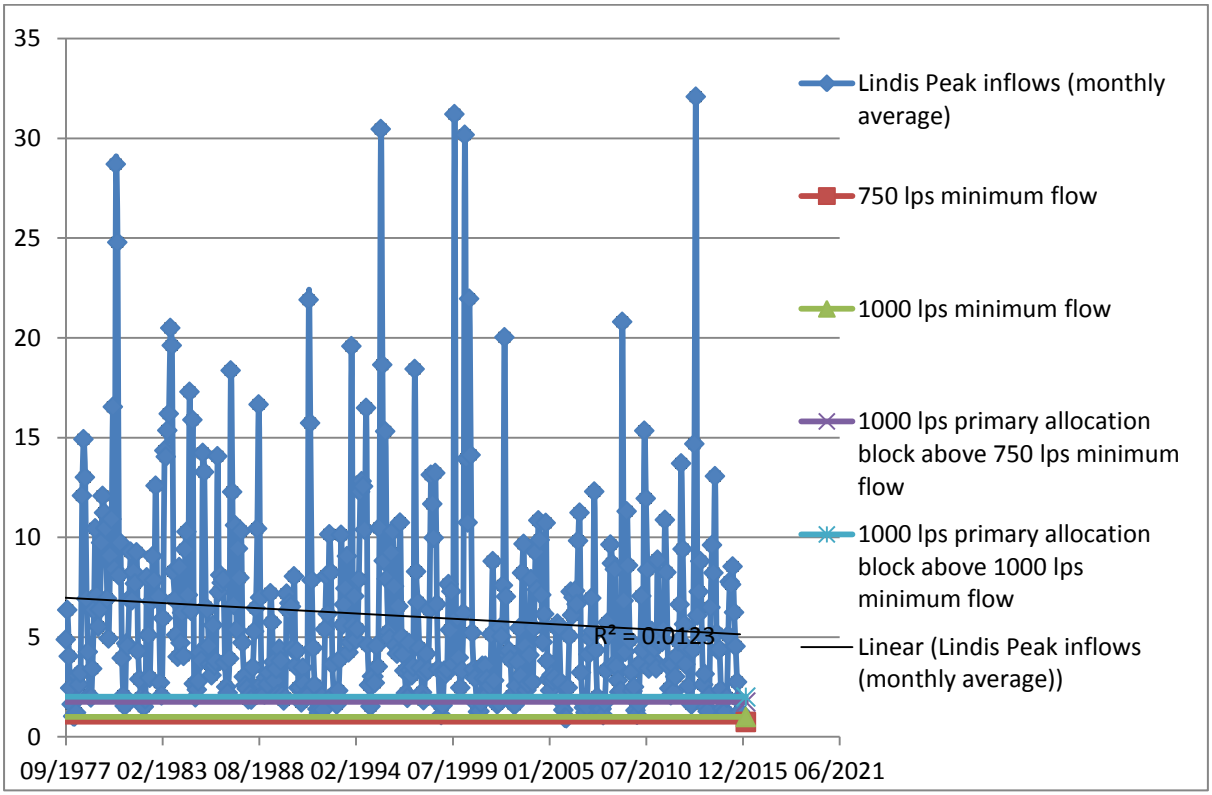
120. I have also undertaken a simple analysis of inflows into the catchment, as measured at the Lindis Peak flow recorder. I accept that there is some taking upstream of this recorder, however, it does give a good overview of the water resources available, over a long period, dating back to 1976.



Lindis Peak – yearly minimum inflows



Lindis Peak – monthly minimum inflows



Lindis Peak – monthly average inflows

121. The above three charts show that on a monthly minimum and monthly average basis, that there is plenty of water available in almost all years to meet both Fish and Game's proposed minimum flow of 1000 lps (which corresponds to actual flows of between 400-1000lps depending on reach) and a reasonable block of primary allocation on top of this minimum flow.

122. However, there will also be periods when primary allocation is constrained and rationing is necessary. This is no different to any other catchment in Otago.

123. I also note some drought years (n=6) when inflows drop significantly, and when little or no irrigation could take place. The river would also suffer, as inflows may drop to the point when habitat and potentially fish-passage and connection is lost.

124. The potential exists, for a 'drought minimum' flow to apply in these years, which would be triggered by flows at the Lindis Peak recorder dropping to a sustained low level. This would enable irrigation to continue at a reduced level to ride out the drought, but at a cost to the river and fishery during those years. Given that this does not occur often (6 times in 40 years, or a roughly 6% chance), and is a natural event, Fish and Game is prepared to consider this as an option if it assists in the setting of a higher minimum flow in all other years.

125. Another point to note is that the trend lines show that inflows in the catchment are reducing steadily. This may be due to a drying climate or a reduction in upper catchment water yield, or a combination of both. I consider shows the need for long term thinking and wise investment in both water storage and more dry tolerant farming systems.

<u>Final conclusions</u>

126. I have considered proposed plan change 5A in the context of the RMA, national policy instruments, the operative and proposed RPS, the Regional Plan: Water, and other policy instruments. I consider that these policy

provisions, when read together provide the policy basis for a protective approach to flow setting, in order to provide for not just connectivity, but also fish-passage, and the maintenance of some habitat, albeit at levels that are below both the point of inflection recommendations (IFIM), and the optimum.

127. I do not consider the proposed minimum flow of 750 lps to be in accordance with these policies.

128. On hydrological and ecological grounds, Mr Rekker, Mr Gabrielson, and Mr Trotter agree that a higher minimum flow than 750 lps is required. Mr Rekker supports a flow of higher than 900 lps to achieve certainty of connection. Mr Gabrielsson supports a flow of 1200 lps, on the basis of his fish passage assessment. Mr Trotter recommends a flow of 1000 lps.

129. I have also considered the economic effects, in a general sense based primarily on water availability. My assessment concurs with the assessment undertaken by Opus on behalf of the Otago Regional Council, in that there is enough water in the catchment to meet both a higher minimum flow and still provide a suitable block of primary allocation at reasonable security of supply for irrigators in the Lindis catchment with no access to alternatives.

130. I consider that a summer minimum flow of 1000 lps is necessary, but also represents the bottom end of the range to provide suitable fish passage. On the basis of the evidence presented, I do not believe it is possible to reasonably set a minimum flow at a level lower than this.

131. There also appears to be no hydrological or economic reason to keep the end date of the summer minimum flow period at 31 May. I consider that the winter minimum flow of 1600 lps should be extended into May.

132. On other related aspects of the plan change, I consider that the primary allocation limit of 1000 lps is also at the bottom end of the acceptable envelope, and that it may be possible to increase this slightly, perhaps to

1100 lps, if it was as part of an overall package of changes to the notified plan that included a higher minimum flow.

133. This is no doubt a challenging and stressful time for irrigators, and detailed policies and mechanisms that handle the transition from the current regime to a new regime are needed to provide certainty of process to irrigators. Fish and Game support these transition provisions in principle, but wish to discuss the detail of these provisions with the irrigators, once all expert evidence has been heard, to see if agreement can be reached.

Peter Gordon Wilson
18 March 2016