EXPERT CONFERENCE —WATER QUALITY AND ECOLOGY (LAKES, INTERMITTENTLY CLOSED AND OPEN LAKES AND LAGOONS (ICOLLs) and ESTUARIES

ENV-2018-CHC — 026, 29, 37, 38, 39, 40, 41, 47, 50
Various s274 parties

Topic: Proposed Southland Water and Land Plan - Southland Regional Council

Date of conference: Thursday 9 May and Friday 10 May 2019

Venue: Kelvin Hotel, 20 Kelvin Street, Invercargill

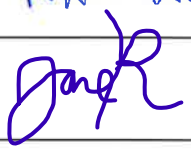
Facilitator: Jim Hodges, Environment Commissioner

Recorder: Dr Kitson

1 The Environment Court directed in its Minute of 7 May 2019 that expert witness conferencing in respect of Water quality and ecology (Lakes) in relation to the appeals against the proposed Southland Water and Land Plan.(**pSWLP**).

Attendees

2 Witnesses who participated and agreed to the content of this Joint Witness Statement (**JWS**):

Name	Employed or engaged by	Signature
Nick Ward	Southland Regional Council	
Dr Jane Kitson	Ngā Rūnanga[1]	

Environment Court Practice Note

3 All participants confirm that they have read the Environment Court Consolidated Practice Note 2014 and in particular Section 7 (Code of Conduct, Duty to the Court and Evidence of an expert witness) and Appendix 3 - Protocol for Expert Witness Conferences and agree to abide by it.

4 Mr Ward acknowledges that he is an employee of the Respondent, Southland Regional Council. Notwithstanding that, Mr Ward confirms that he prepared and will present his evidence as an independent expert and in compliance with the Code of Conduct.

5 Dr Kitson acknowledges she is a member of Te Rūnanga o Oraka-Aparima and also whakapapa to Te Rūnanga o Awarua and Waihopai Runaka. Her expertise is partially derived from those cultural associations. She notes that whilst she is of Ngāi Tahu descent, she is required to be impartial and unbiased in her professional opinions expressed.

Experts' qualifications and experience

6 These are set out in each experts' statement of evidence.

Purpose of expert conference

7 The purpose of the conference is to assist the Court by responding to a series of questions, agreed by the experts as the conference progressed, relating to Lakes water quality and ecology and associated issues. The Lakes experts

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[1] Comprising Waihopai Rūnaka, Hokonui Rūnaka, Te Rūnanga o Awarua, Te Rūnanga o Oraka Aparima, and Te Rūnanga o Ngāi Tahu.

have also included ICOLLs and Estuary water quality and ecology in this JWS for the following reasons:

(a) The River experts JWS stated the need for an integrated approach when describing the state of Southland's water bodies. This requires the incorporation of the state of estuaries. They considered the attributes relating to estuaries as outside their expertise and that this was best considered by the Lake experts.

(b) Lake Waituna (Mataura FMU) which has been categorised as a lake (ICOLL). To assess the state of an ICOLL requires attributes that apply to lakes and estuaries.

8 For each question, the experts state matters on which they agree and on which they do not agree, with reasons.

9 The experts note that rivers and wetlands are addressed in a separate JWS and the two need to be read together.

Key information sources relied on

10 The experts relied on the following key sources of information:

(a) Mr Ward's EIC and references cited within.

(b) MfE/MoH 2009 - Ministry for the Environment and Ministry of Health. 2009. New Zealand Guidelines for Cyanobacteria in Recreational Fresh Waters – Interim Guidelines. Prepared for the Ministry for the Environment and the Ministry of Health by SA Wood, DP Hamilton, WJ Paul, KA Safi and WM Williamson. Wellington: Ministry for the Environment.

(c) Kelly D, Schallenburg M, Waters S, Shearer K, Peacock L. 2016. A calibrated ecological health assessment for Southland. Cawthron Institute. Report prepared for Environment Southland.

Attachments to this JWS

11 To assist the Court, the following maps are attached to and explained in the River JWS and show the spatial extent of areas used for different

environmental management and assessment purposes referred to in this Lakes JWS:

1 Freshwater Management Units (FMU).

3 Physiographic Zones, which reflect the inherent risks to water quality as result of land use, and which takes into account the matters listed in the EIC of Dr Snelder at paragraph 14.

12 In addition, Appendix 1 is attached to this JWS and shows the location of lakes, ICOLLs and estuaries.

13 The following Appendices are attached;

Appendix 1 Location of lakes, ICOLLs and estuaries

Appendix 2 Southland Lakes, ICOLLS and Estuaries by FMU, system type and NPSFM NOF type.

Appendix 3 State of Southland Lakes and ICOLLs according to NOF

Appendix 4 Southland Lakes and ICOLLs by risk management categories

Proposed plan provisions relevant to this conference

14 The draft agenda provided to the experts by counsel for the parties set out the following plan provisions which are stated as being relevant (at a high-level) to this conference and have been included as directed by the Court.

15 The experts were directed by counsel that the plan provisions themselves are not a topic/issue for the experts to consider.

(a) Te Mana o te Wai (page 5 of the Appeals version of the pSWLP).

(b) Purpose and Framework (page 7 of the Appeals version of the pSWLP).

(c) Issues:

(i) Water quality (page 15 of the Appeals version of the pSWLP).

(ii) Surface Water (page 16 of the Appeals version of the pSWLP).

(iii) Indigenous Biodiversity (page 17 of the Appeals version of the pSWLP).

(d) Objectives 1 (noting this objective is not subject to appeal), 3 (noting this objective is not subject to appeal), 6, 7, 14 and 15 (noting this objective is not subject to appeal).

(e) Policies 45 and 47.

(f) Appendix E (noting that the content of Appendix E is outside the scope of the hearing on Topic A and is to be considered as part of the hearing on Topic B).

Definitions

16 The experts agreed and relied on the definitions set out below for the purpose of the topics discussed at this expert conference:

(a) Benthic and epiphytic algae – algae that grows on lake/lagoon bed (benthic) and that grow on the surface of other plants (epiphytic).

(b) Chlorophyll-a is a pigment in plants, which gives a measure of primary production (photosynthetic growth) in the system from photosynthesis.

(c) Cyanobacteria is a group of photosynthetic bacteria, also known as blue green algae and these may produce toxins which can be harmful to ecosystem health, human health and recreational activities.

(d) Ecosystem health as set out in Appendix 1 NPSFM, with additions to extend to brackish and coastal waters.

(e) Macroalgae - larger algae i.e. seaweed.

Preliminary matters discussed by the experts

General approach

17 The Lakes experts have generally followed the structure of the Rivers JWS.

Consideration of Te mana o te wai

18 The Lakes experts agree with paragraph 26 in the River JWS. In addition, the Lakes experts consider the focus on the scientific attributes do not compromise the inclusion of cultural indicators. The focus of the JWS is on science attributes as cultural indicators need further consideration by appropriate cultural experts.

Need for an integrated approach

19 The Lakes experts agree with paragraph 25 in the River JWS about the need to look at ecology and water quality using an integrated approach. Therefore, the Lake experts consider it important that both JWSs are read together.

20 The Lakes experts consider that in order to achieve an integrated approach, a risk management framework and state assessment is needed in conjunction for lakes, ICOLLs and estuaries.

Preliminary comments on management considerations for Lakes, ICOLLs and estuaries

21 A key driver of Lakes, ICOLLs and estuaries are the total nutrient and sediment input from the catchment over a given period of time, usually annual. This varies from concentration which is usually the key focus for riverine environments. However load and concentration are inextricably linked as load is calculated by the total flow multiplied by concentration.

22 The sensitivity of any lake, ICOLL and estuary (system) to catchment inputs is determined by its physical characteristics. Of particular importance with regard environmental degradation (susceptibility) are physical characteristics that determine how a system dilutes (dilution potential) and retains in-flowing nutrients and sediments (flushing potential) that are not flushed to sea or lost to the atmosphere. These two key characteristics influence how long water stays

in the system; the longer time water spends in the system (residence time) the more time for nutrients to be taken up in the system and eutrophic conditions to develop.

23 The dilution potential is the capacity to dilute nutrients, where more water provides more dilution (e.g. bigger systems such as New River estuary can dilute more). The flushing potential is determined by the balance of the tidal action and the amount of freshwater flowing in from its tributaries. In most cases, if the water (and therefore nutrients) are flushed quickly, there is insufficient time for eutrophic conditions to develop (i.e. low susceptibility). However, if a system has a long residence time, there is time for nutrients to be taken in the system and eutrophic conditions to develop.

24 Lakes, ICOLLs and Estuaries can broadly be seen as a continuum of sensitivity to catchment inputs (specifically sediment, Nitrogen and Phosphorus). Lakes tend to have longer residence time than ICOLLs followed by estuaries. For all systems in New Zealand there is likely to be some cross over sensitivity between adjacent groups. The sensitivity of a system to catchment nutrient and sediment pressure increases from Lakes to ICOLLS to Estuaries with subtypes (and further differences in sensitivities) in each. However, the contemporary pressure from the catchment needs to be considered also.

25 The resultant ecosystem health of a system is a reflection of the capacity of a system to process contaminants (which may be altered due to a reduction in the size of a system e.g. reclamation and sediment infill) and the pressure on the system i.e., nutrient/sediment contribution due to land use. Therefore, an inherently more resilient system to pressure may still experience ecological degradation if the pressure exceeds the capacity of that system.

26 By the way of explanation, the primary pressure of ecosystem health is catchment input of nutrient and sediment loads. There are modifying factors that need to be taken into account, including climate change and invasive species. These modifying factors can influence the susceptibility of systems, and the pressures, and thereby influence the state of these systems.

27 In the context of an integrated management approach the lake experts consider there to be four risk management categories for lakes, ICOLLs and Estuaries:

(a) Low risk

(b) At risk

(c) Assimilative capacity exceeded

(d) Assimilative capacity exceeded and beyond ecological thresholds

28 Assimilative capacity is the ability of the system to process contaminants without deleterious ecological consequences. An ecological threshold is the point at which the recovery of a system becomes exceedingly difficult. For example, a system where it has been stressed enough to mean that internal loading from past catchment input becomes an additional stressor that combines with contemporary catchment loadings, which requires significantly more management effort for improvement.

29 By way of explanation,

(a) low risk systems are considered to be systems with high indigenous vegetation cover and low anthropogenic inputs and considered near pristine condition.

(b) At risk systems are considered to be those that have catchments where land use modification has occurred, but eutrophic conditions have not developed.

(c) Systems where the assimilative capacity has been exceeded are considered to be those that have catchments where land use modification has occurred, and eutrophic conditions have developed.

(d) Systems where the assimilative capacity has been exceeded and are beyond ecological thresholds are considered to be those that have catchments where land use modification has occurred, and eutrophic conditions have developed to an extent which makes recovery difficult. Systems within this category would require catchment load reductions to a greater extent than when the assimilative capacity has been exceeded alone. In addition, remediation would be required to improve the system.

However, there is a significant knowledge gap around timing of response to any changes to catchment load inputs and remediation, and the success of either. To determine if a system has crossed an ecological threshold is very difficult and so has been labelled as 'potentially' in this category hereafter.

(e)

30 The principles above apply to lakes, ICOLLs, and estuaries.

Assessment of the state of the Lakes, ICOLLs and estuaries

31 The location of Lakes, ICOLLs and Estuaries named in this JWS can be found in Appendix 1.

32 The different system names, FMUs, system types and NOF types (Stratified or polymictic for Lakes and ICOLLs) can be found in Appendix 2.

33 The results of applying the integrated management approach for Lakes and ICOLLS can be found in Appendix 3 and paragraph 47 for estuaries.

Lakes and ICOLLs

34 The lakes in this JWS assessment are those monitored by Environment Southland (Appendix 2). There are numerous other lakes not monitored in this region with the majority being in Fiordland and Rakiura National parks (Fiordland and Islands FMU).

35 There are no standards for lakes and ICOLLs in the pSWLP, but there are standards in the NPSFM.

36 Some of the key attributes to describe ecosystem stress and eutrophication on lakes are described in Mr Ward's EIC table 2 and paragraphs 80 – 82. Additional attributes could include macrophyte (aquatic plants not including algae), oxygen levels in water, pest plants and animals, fish, food chain links, marginal vegetation and habitat, lake levels and variability (this can be more varied in ICOLLs). The experts wish to highlight the interconnective nature of

some of these attributes and they may under certain conditions influence each other.

37 The Lake experts agreed the primary attributes to assess lake ecosystem health are chlorophyll a (defined above), benthic and epiphytic algae cover, and cyanobacteria blooms (occurrence and frequency) and macrophyte extent and biomass[2]. These attributes relate directly to ecosystem response.

38 The Lake experts agreed that the secondary attributes to assess lake ecosystem health are nutrient concentrations (Total Nitrogen and Total Phosphorous), the level of oxygen in sediments and clarity. The secondary attributes are some of the drivers of ecological health and should be used to assist in the use and interpretation of the primary attributes.

39 In Mr Ward's EIC paragraph 82 table 2 there are explanations for primary attributes of Chlorophyll *a* and the secondary attributes of nutrient concentration, level of oxygen in sediment and clarity. For clarity we provide explanations for attributes additional to those in Mr Wards EIC below:

(a) Cyanobacteria blooms are reflective of severely eutrophic conditions. Cyanobacteria may produce toxins that impact on wildlife and recreation.

(b) Excessive growth of benthic and epiphytic algae cover is indicative of nutrient enrichment.

(c) Macrophyte extent and biomass is an attribute of primary production in the system as they utilise nutrients for growth.

40 The attributes that the experts were confident to use (based on availability and robustness of data) in their assessment of lake state were Chlorophyll *a*, Total Nitrogen and Total Phosphorous (sourced from Hodson et al. 2016) and cyanobacteria bloom occurrence (sourced from EIC Mr Ward). This is summarised in Appendix 3. The lakes experts agreed on Appendix 3. The small discrepancies between the respective EIC has been addressed by Appendix 3.

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[2] LTG 2013

41 To determine the criteria for the four risk management categories in Appendix 4, chlorophyll *a* and cyanobacteria attributes were used only because these are considered the primary attributes and therefore relate more directly to ecological health.

Estuaries

42 The state of estuaries in Southland has been documented in EIC Mr Ward (Paragraphs 40-72). Dr. Kitson agrees with the assessment of estuaries in this EIC.

43 There are numerous estuaries across Southland that are not monitored.

44 There are no national standards for estuaries or within Southland regional plans.

45 The Lake experts have provided the following risk management assessment for estuaries in order to show state and risk management in order to address the River experts requested integrated management approach. (paragraph 25 River JWS). This assessment is based on the information provided in Mr Ward's EIC.

46 This preliminary assessment is intended to be a comparative risk management approach not a specific system management approach which would require more site-specific detailed information.

47 In the context of an integrated management approach the Lake experts consider there to be four risk management categories for **estuaries**:

(a) Low Risk:
Freshwater Estuary – No development of eutrophic conditions and is in near pristine condition.

(b) At risk:

Waikawa – Development of small gross eutrophic area, soft mud area in upper estuary, shallow oxygen layer but no excessive macroalgal growth is not currently being expressed. System susceptibility type renders this system, in conjunction with current mud situation, as sensitive to changes in catchment nutrient inputs.

Haldane - Some muddiness has increased over time but eutrophication conditions are not being expressed. System susceptibility type renders this system, in conjunction with current mud situation, as sensitive to changes in catchment nutrient inputs.

(c) Assimilative capacity exceeded:
Toetoes (Fortrose) – This system is naturally less susceptible to catchment pressure due to its typology but it is expressing eutrophic responses. If relieved of nutrient and sediment stress this system is likely to respond positively and more swiftly than other systems, such as New River and Jacobs River Estuary.

(d) Assimilative capacity exceeded and *potentially* beyond ecological thresholds:
New River and Jacobs River Estuary - Development of large eutrophic areas and self-reinforcing feedback mechanisms involving sediment, nutrient and macroalgae are evident. Remediation may be required in order to achieve improvement.

(e) Unable to be determined:
Waimatuku. There is insufficient information to determine a category.

Trend analysis

48 The Lake experts consider that there is insufficient data to conduct trend analysis for Lakes and ICOLLs with the exception of Waituna Lagoon. However, such analysis has not occurred.

49 The Lakes experts consider that there is insufficient data to conduct trend analysis for estuaries.

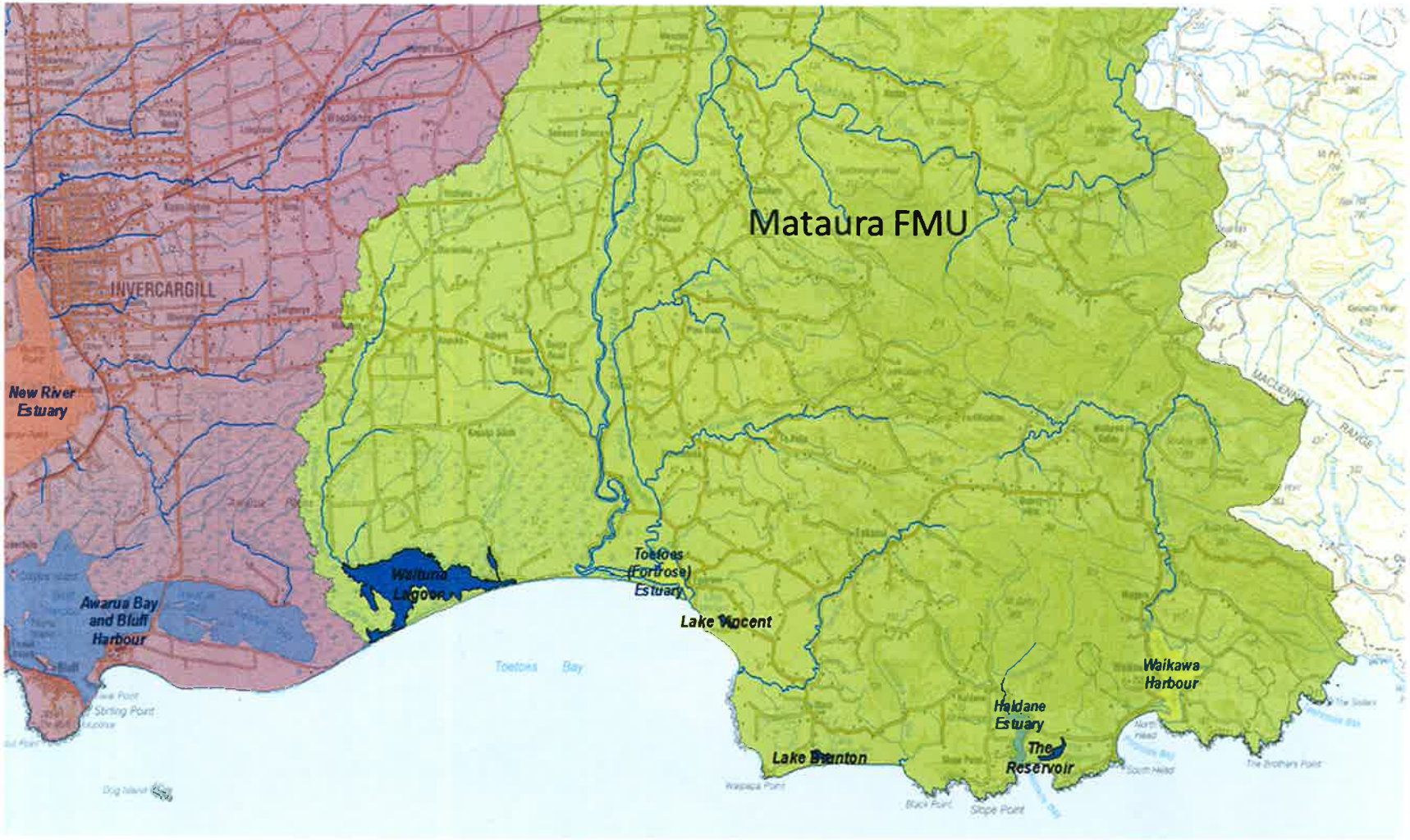
50 The Lakes experts consider that there is insufficient data to conduct statistical trend analysis for estuaries.

51 The change in state attributes (i.e. Gross eutrophic zones, muddiness, macroalgae cover and biomass and area with low sediment oxygenation) have been used in the risk/state approach above to determine if change has occurred.

Appendices

Appendix 1. Map 1 of 2: Location of lakes, ICOLLs and estuaries (the Mataura FMU is provided as an insert below)

Appendix 1. Map 2 of 2: Location of lakes, ICOLLs and estuaries in the Mataura FMU.



Appendix 2. Southland Lakes, ICOLLS and Estuaries by FMU, system type and NPSFM NOF type.

FMU	Name	System Type	NPSFM NOF type
Fiordland and Islands	Lake Calder (near Lake Sheila)	Shallow Lakes	Polymictic
	Lake Sheila	Shallow Lakes	Polymictic
	Freshwater Estuary	Estuary	NA
Waiau	Te Waewae (Waiau) Lagoon	ICOLL	NA
	Lake Manapouri	Deep Lake	Seasonally Stratified
	Lake Te Anau	Deep Lake	Seasonally Stratified
Aparima	Jacobs River Estuary	Estuary	NA
	Waimatuku Estuary	Estuary	NA
	Uruwera (Lake George)	Shallow Lake	Seasonally Stratified
Oreti	New River Estuary	Estuary	NA
	Lake Murihiku	Shallow Lake	Polymictic
	Awarua Bay/Bluff Harbour	Estuary	NA
Mataura	Waituna Lagoon	ICOLL	Lakes and lagoons intermittently open to the sea
	Toetoes (Fortrose Estuary)	Estuary	NA
	Lake Vincent	Shallow Lake	Polymictic
	Lake Brunton	ICOLL	Lakes and lagoons intermittently open to the sea
	Haldane Estuary	Estuary	NA
	Waikawa Estuary	Estuary	NA
	The Reservoir	Shallow Lake	Polymictic

Appendix 3. State of Southland Lakes and ICOLLs

	Primary Attribute		**Secondary Attribute (NPSFM NOF bands)**	
Lake	Chlorophyll *a* (NPSFM NOF bands)	Cyanobacteria bloom	Total Nitrogen	Total Phosphorous
Te Anau	A	No	A	A
Manapouri	A	No	A	A
Waituna – closed	C	Yes	C/D	C
Uruwera/George	B	No	C	C
The Reservoir	C/D	Yes	C	C
Vincent	B	No	D	C
Te Waewae (Waiau) Lagoon	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Murihiku	No data	No data	No data	No data
Brunton	No data	No data	No data	No data
Shelia	No data	No data	No data	No data
Calder	No data	No data	No data	No data

Waituna (ICOLLs) when it is closed to the sea has only been considered as this is when it behaves more like a lake.

The Cyanobacteria bloom column is populated with information from Mr Ward's EIC which is based on monitoring for human health. This data is likely to be conservative when applied to an ecosystem health context. The table indicated whether a cyanobacteria bloom has occurred

Appendix 4. Southland Lakes and ICOLLs by risk management categories

State category	Level of Catchment Modification	Lake	FMU
Low risk	High native vegetation cover	Te Anau	Waiau
		Manapōuri	Waiau
At risk	Modified	Uruwera/George	Aparima
		Vincent	Mataura
Assimilative capacity exceeded	Modified		
Assimilative capacity exceeded and potentially beyond ecological thresholds	Modified	Waituna-closed	Mataura
		The Reservoir	Mataura
Unable to be determined	High native vegetation cover	Shelia	Fiordland and Islands
	High native vegetation cover	Calder	Fiordland and Islands
	Modified	Murihiku	Oreti
	Modified	Brunton	Mataura
	Modified	Te Waewae (Waiau) Lagoon	Waiau

Explanation:

This table is intended to be a comparative risk management approach not a specific system management approach which would require a more detailed information. Therefore, some systems maybe in reality in other adjacent categories once more specific information is available.

Low risk is NPSFM NOF A and B Bands for Chlorophyll a Lakes and ICOLLs, and low level of catchment modification.

At risk is NPSFM NOF B and C Bands for Chlorophyll a Lakes and ICOLLs, and a modified catchment.

Assimilative capacity exceeded NPSFM NOF C and D Bands for Chlorophyll a Lakes and ICOLLs, and a modified catchment. No occurrence of cyanobacteria blooms.

Assimilative capacity exceeded and potentially beyond ecological thresholds NPSFM NOF C and D Bands for Chlorophyll a Lakes and ICOLLs, and a modified catchment. With occurrence of cyanobacteria blooms.