BEFORE THE ENVIRONMENT COURT
I MUA I TE KOOTI TAIAO O AOTEAROA

UNDER	the Resource Management Act 1991
IN THE MATTER	of appeals under Clause 14 of the First Schedule of the Act
BETWEEN	**TRANSPOWER NEW ZEALAND LIMITED** (ENV-2018-CHC-26)
	FONTERRA CO-OPERATIVE GROUP (ENV-2018-CHC-27)
	HORTICULTURE NEW ZEALAND (ENV-2018-CHC-28)

(Continued next page)

STATEMENT OF EVIDENCE IN REPLY OF ROGER HODSON ON BEHALF OF SOUTHLAND REGIONAL COUNCIL

WATER QUALITY AND ECOSYSTEM HEALTH

20 May 2022

Judicial Officer: Judge Borthwick

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ARATIATIA LIVESTOCK LIMITED
(ENV-2018-CHC-29)

WILKINS FARMING CO
(ENV-2018-CHC-30)

GORE DISTRICT COUNCIL, SOUTHLAND DISTRICT COUNCIL & INVERCARGILL CITY COUNCIL
(ENV-2018-CHC-31)

DAIRYNZ LIMITED
(ENV-2018-CHC-32)

H W RICHARDSON GROUP
(ENV-2018-CHC-33)

BEEF + LAMB NEW ZEALAND
(ENV-2018-CHC-34 & 35)

DIRECTOR-GENERAL OF CONSERVATION
(ENV-2018-CHC-36)

SOUTHLAND FISH AND GAME COUNCIL
(ENV-2018-CHC-37)

MERIDIAN ENERGY LIMITED
(ENV-2018-CHC-38)

ALLIANCE GROUP LIMITED
(ENV-2018-CHC-39)

FEDERATED FARMERS OF NEW ZEALAND
(ENV-2018-CHC-40)

HERITAGE NEW ZEALAND POUHERE TAONGA
(ENV-2018-CHC-41)

STONEY CREEK STATION LIMITED
(ENV-2018-CHC-42)

THE TERRACES LIMITED
(ENV-2018-CHC-43)

CAMPBELL'S BLOCK LIMITED
(ENV-2018-CHC-44)

ROBERT GRANT
(ENV-2018-CHC-45)

SOUTHWOOD EXPORT LIMITED, KODANSHA TREEFARM NEW ZEALAND LIMITED, SOUTHLAND PLANTATION FOREST COMPANY OF NEW ZEALAND
(ENV-2018-CHC-46)

TE RUNANGA O NGAI TAHU, HOKONUI RUNAKA, WAIHOPAI RUNAKA, TE RUNANGA O AWARUA & TE RUNANGA O ORAKA APARIMA
(ENV-2018-CHC-47)

PETER CHARTRES
(ENV-2018-CHC-48)

RAYONIER NEW ZEALAND LIMITED
(ENV-2018-CHC-49)

ROYAL FOREST AND BIRD PROTECTION SOCIETY OF NEW ZEALAND
(ENV-2018-CHC-50)

Appellants

AND **SOUTHLAND REGIONAL COUNCIL**

Respondent

Introduction, qualifications, and experience

1 My name is Roger John William Hodson. I am the Acting Team Leader, Ecosystem Response at Southland Regional Council (**Environment Southland**). My qualifications and experience are set out in full in my Statement of Evidence dated 14 December 2018.

2 I confirm that I have read the Code of Conduct for expert witnesses as contained in the Environment Court Practice Note 2014. I have complied with the Code of Conduct when preparing this statement and will do so when I give oral evidence. Other than where I state I am relying on the evidence of another person, my evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Scope of Evidence

3 In this Statement of Evidence in Reply I provide evidence in relation to:

(a) The state of deposited fine sediment (**DFS**) from long term environmental monitoring in the Southland region undertaken by Environment Southland;

(b) Comparison of the numerics proposed by Fish and Game, Prof. Death and the respective DFS national bottom lines; and

(c) The use of deposited sediment numerics to protect ecosystem health from point source discharges in the water body types in Appendix E of the pSWLP.

4 I have read, and this evidence responds to, the Statement of Evidence of Russell Death for the Southland Fish and Game Council dated 8 April 2022.

Current State of deposited fine sediment in Southland rivers

5 Despite the apparent low levels of % cover DFS for the majority of monitored sites, the accumulation of DFS is apparent within the bed substrate of many rivers and in the terminal receiving environments for rivers – the estuaries of Southland – and is negatively impacting aquatic ecosystem health.

Percentage cover

6 The Joint Witness Statement dated 14-16 October 2019 considered thresholds to identify degraded water bodies using DFS and identified a threshold of >20% for upland waterbodies and >30% for lowland waterbodies. The subsequent Joint Witness Statement dated 20-22 November 2019 assessed monitoring data against those thresholds in the context of whether a water body was degraded with respect to the mean % cover of DFS.

7 In the period of time between that analysis and the present, the National Policy Statement for Freshwater Management 2020 (**NPSFM 2020**) was promulgated which includes Table 16 setting out attribute states for DFS. Table 16 is contained within "*Appendix 2B – Attributes requiring action plans*". The four DFS classes in Table 16 each prescribe varying levels of sediment cover corresponding to A, B, C, and D bands.

8 Analysis of the Environment Southland percentage cover of DFS is provided in **Appendix 1**. None of the sites monitored for DFS are below national bottom lines prescribed for DFS classes 2, 3 and 4 of the NPSFM 2020.[1]

9 DFS in rivers assessed by % cover is transient and subject to considerable temporal variability. The episodic mobilisation, transport and deposition are strongly controlled by a combination of factors external to a river reach where a discharge may be occurring. These factors include: stream power (the energy available to mobilise and transport fine sediment); interaction with seasonal land surface management; and local aquatic habitat characteristics either favouring or increasing resilience to deposition.

10 Percentage cover of DFS can be conceptualised to represent the visible 'tip of the iceberg' with respect to the accumulation of fine sediment within and on benthic stream habitat. Fine sediment accumulates within the interstitial space of gravels in stream beds which can be assessed by measuring the re-suspendable fine sediment also described as the Quoorer (SIS mgm^{-2}). As a result the impact of fine sediment is obscured when considering % cover alone and it is necessary to consider the

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[1] Deposited fine Sediment class 1 does not occur in Southland.

levels of SIS in stream and river beds as well as the extent of sedimentation in estuaries.

11 Owing to the considerable temporal and spatial variability in DFS levels, repeated observations are needed over multiple years (minimum of 60 observations over minimum of 5 years of monthly monitoring) are required to adequately characterise DFS levels.[2] Such duration of monitoring is unlikely to be available to inform a baseline for the majority of point source discharges, and risks misrepresenting the level of and impact of fine sediment.

Stream and river bed sedimentation within interstitial spaces

12 Quoorer re-suspendable fine sediment (SIS mgm^{-2}) data are available for some Southland monitoring locations. Analysis of the available Quoorer data against the relevant guideline is provided in **Appendix 2**. The analysis illustrates that 46 of 81 (57%) of sites assessed have levels of re-suspendable fine sediment above the guideline value of 450 mgm-2 in Clapcott et al. (2011).

*Sedimentation within estuarine receiving environments*Given the dynamic nature of the hydrological processes controlling the mobilisation, transport, and deposition of sediment along the river continuum it is relevant to look to downstream receiving environment condition for the impacts of fine sediment from the river network.

14 The Evidence in Chief of Mr Ward dated 14 December 2018 identifies the New River, Jacobs River and Toetoes (Fortrose) estuaries as being stressed with respect to sedimentation.[4] Reporting of the extent of fine sediment accumulation, reported as mud content in estuaries, in 2019 identified D attribute states to be present in parts of Haldane, Jacobs

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2 "*The minimum record length for grading a site is the median of 60 samples taken over 5 years of monthly monitoring, or longer for sites where flow conditions only permit monthly monitoring seasonally*." NPSFM 2020 at Table 16 on page 55.

3 Clapcott et al. 2011 *Sediment Assessment Methods: Protocols and guidelines for assessing the effects of deposited fine sediment on in-stream values. Cawthron Institute, New Zealand.* www.envirolink.govt.nz/assets/R4-1-Sediment-Assessment-Methods-Protocol-and-guidelines.pdf

4 Statement of Evidence of Nicholas Ward dated 14 December 2018 at paragraph 16(a).

River, New River, and Waikawa estuaries.[5]**Fish and Game proposed DFS standards**

National Policy Statement for Freshwater Management 2020

15 The spatial distribution of pSWLP Appendix E water body types differ from the NPSFM 2020 DFS classification's spatial distribution. The result of comparing the national bottom line for DFS class 2, 3, & 4 (defined at 27% or 29% DFS) with the Fish and Game proposed standards for pSWLP Appendix E classes is that for the lowland soft bed water body class (30%) the proposed DFS numerics are worse than national bottom lines by 1% or 3% for 10,372 km of pSWLP Lowland Soft Bed water body class river length. The segments of river where this occurs are illustrated in Red in **Appendix 3**.

Soft bed streams

16 The definition of stream bed characteristics in soft bed streams is defined by the presence of greater than 50% DFS cover.[6] Given this, it may not be appropriate to have a numeric of 30% cover for lowland soft bed streams as proposed by Prof Death.

17 Recent analysis of the stream substrate characteristics of monitored sites within the lowland soft bed class illustrates that the majority are dominated by gravel and cobble substrates and therefore have had hard bed monitoring techniques applied historically.[7] This illustrates the potential limitations of reliance on modelled river classifications and, in my opinion, indicates that it may be more appropriate to undertake case

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5 Norton et al. 2019 *Current Environmental State and the "Gap" to Draft Freshwater Objectives for Southland* – Technical Report (Environment Southland, Invercargill) at pages 126 – 127 and table 79 at page 131. https://contentapi.datacomsphere.com.au/v1/h%3Aes/repository/libraries/id:26gi9ayo517q9stt81sd/hierarchy/document-library/reports/Values%20and%20Objectives%20reports%20-%20People%2C%20Water%20and%20Land/Current%20environmental%20state%20and%20the%20"gap"%20to%20draft%20freshwater%20objectives%20for%20Southland%20%28December%202019%29.pdf

6 Clapcott et al. 2011 *Sediment Assessment Methods: Protocols and guidelines for assessing the effects of deposited fine sediment on in-stream values. Cawthron Institute, New Zealand.* www.envirolink.govt.nz/assets/R4-1-Sediment-Assessment-Methods-Protocol-and-guidelines.pdf at page 30.

7 De Silva and Hodson *Freshwater macroinvertebrates in the Southland Region: updating state and trend; predicting reference condition; and investigating drivers of macroinvertebrate community health.* Technical Report (Environment Southland, Invercargill, June 2021). At Table 3 in Appendix 19 https://contentapi.datacomsphere.com.au/v1/h%3Aes/repository/libraries/id:26gi9ayo517q9stt81sd/hierarchy/document-library/reports/science-reports/Freshwater%20macroinvertebrates%20in%20the%20Southland%20Region.pdf

by case assessments of the habitat characteristics of waterbodies to determine the appropriate standards to apply to a consented activity. Such an approach is consistent with the NPSFM 2020's approach where the percentage cover DFS attribute does not apply where clause 3.25 requires habitat assessment for soft bottomed sites (>50% DFS). I understand that this issue has been identified as one to be addressed in Plan Change Tuatahi.

The use of DFS numerics to protect ecosystem health from point source discharges in the water body types in Appendix E of the pSWLP.

18 I agree with Prof. Death's evidence with regard to the actual and potential effects of deposited fine sediment on fresh water ecosystem health and the impacts of elevated levels of DFS on invertebrates and fish.

19 While I agree in principle with the approach set out in paragraph 3.1 of Prof. Death's evidence dated 8 April 2022, I do not consider that it is the role of scientists to determine the values for respective water body types. Rather, I consider that it is appropriate that values are confirmed through a process informed by community consultation. It is my understanding that the confirmation of values and the process of identifying attributes and developing limits to protect or achieve values is the subject of ongoing work toward a subsequent plan change – Plan Change Tuatahi. Furthermore, it is my understanding that Appendix E is intended to provide standards to manage the effects of discharges beyond a zone of mixing, not to apply as limits at a regional scale.[8]

20 It is my opinion that storm water discharges including those from subsurface and overland flow pathways that, as a result of anthropogenic land surface management, have the potential to contribute nutrient rich fine sediment to aquatic ecosystems, need to be managed to protect aquatic ecosystem health. There are practical limitations with respect to assessing these types of discharges, owing to:

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[8] The first sentence of Appendix E states: "These standards apply to the effects of discharges following reasonable mixing with the receiving waters, unless otherwise stated."

(a) Their intermittent occurrence during periods of excess soil moisture or precipitation in excess of infiltration capacity activating bypass (including sub surface) and/or overland flow pathways.

(b) Sub surface discharge locations being inaccessible as they are below ground or stream/river water level during high flow.

(c) Widespread and unquantified number of subsurface discharge locations. Pearson (2015) found that artificial subsurface drainage systems are present across approximately three quarters of the agricultural land in Southland.[9]

21 Efforts to control the accumulation of nutrient rich fine sediment in aquatic ecosystems need to be cognisant of all processes which can influence sedimentation. Relevant processes include increased erosion risk from land surface management practices including cultivation and crop harvest management, and surface management in critical source areas, ephemeral flow paths and sub-surface drainage. It is my opinion that, in some cases, particularly small low gradient streams, intensive management such as physical mitigation of in-stream habitat or channel morphology modification may be needed to address historical controls (e.g. low velocity, high sedimentation, nuisance plant biomass establishment), which otherwise may continue to limit ecosystem recovery.

22 Previously it was proposed that the relative change in DFS from an upstream baseline compared to downstream of the reasonable mixing zone be used to assess the effect of a discharge and as a standard to apply to point source discharges. It was intended to be a pragmatic approach to introduce controls on the potential effects of DFS from point source discharges while acknowledging the inherent spatial and temporal variability in absolute percentage cover DFS. Recent studies have highlighted the influence of catchment scale processes, finding that these can outweigh reach scale contribution to percentage cover DFS, including from upstream point and non-point source sediment sources

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9 Pearson 2015, *Artificial subsurface drainage in Southland.* Environment Southland Technical Report, Invercargill, New Zealand. www.es.govt.nz/repository/libraries/id:26gi9ayo517q9stt81sd/hierarchy/environment/water/southland-science-programme/land-use-inputs/documents/Report%20-%20Artificial%20subsurface%20drainage%20in%20Southland.pdf

as well as the impact of stream power, river continuum position and mesohabitat characteristics on reach scale DFS. For example, the DFS observed at the reach scale may not be owing to a reach scale point source discharge, in which case a % cover DFS standard may not be met owing to factors other than of the discharge itself,[10][11] or the fine sediment from a discharge may be transported downstream well beyond the zone of mixing to the location where deposition occurs.

23 After further consideration, I am now of the opinion that the control of sediment in point source discharges is more appropriately assessed in the discharge itself rather than standards relating to changes beyond a zone of reasonable mixing. The ANZECC 2000[12] guidelines provide clear advice on this matter (see **Appendix 4**). I had not adequately considered this in mediation discussions or my recent affidavit to support the (previously) agreed position of a <10 percent change in percentage DFS cover.

24 The pSWLP Appendix E standards are designed to be applied to discharges beyond a defined mixing zone. Mixing zones are generally designed to manage soluble non-bioaccumulatory substances where impacts on local biota are primarily related to toxicity at elevated concentration. The use of mixing zones is not appropriate for managing the discharge of particulate substances, including DFS. Rather, it is my opinion that the discharge of particulate substances is more appropriately managed via controls on the discharge quality itself or on

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10 Mathers et al 2022, *Temporal effects of fine sediment deposition on benthic macroinvertebrate community structure, function and biodiversity likely reflects landscape setting.* https://www.sciencedirect.com/science/article/pii/S0048969722017053

11 Davis et al, 2021 *Long-term variability in deposited fine sediment and macroinvertebrate communities across different land-use intensities in a regional set of New Zealand rivers*. https://www.tandfonline.com/doi/epub/10.1080/00288330.2021.1884097?needAccess=true

12 https://www.waterquality.gov.au/sites/default/files/documents/anzecc-armcanz-2000-guidelines-vol2.pdf. at appendix 1.

land management practices which increase the risk of sediment mobilisation.

Roger Hodson
20 May 2022

Appendix 1 – percentage cover of DFS for Environment Southland sites

The below analysis uses the median % cover value for fine sediment and grades each site according to its respective NPSFM 2020 DFS class.

Table 16 of the NPSFM 2020 stipulates a minimum record length of 60 samples over five years of monthly monitoring. For transparency and comparability with previous assessments, I have included all sites along with the number of observations available. Where less than 60 observations are available there is greater uncertainty with regard to the assessment. These sites have been marked with an asterisk.

State of deposited fine sediment (% cover DFS (SAM2)) for Environment Southland sites with % observations between January 2015 and April 2022 inclusive.

Site	median % cover fine sediment <2mm	Number of observations	NPSFM class	NPSFM grade
Aparima River at Thornbury*	0.1	52	3	A
Cromel Stream at Selbie Road	0	67	4	A
Dipton Stream at South Hillend-Dipton Road	0	65	2	A
Hamilton Burn at Affleck Road	0	77	3	A
Hedgehope Stream 20m u/s Makarewa Confl*	4.25	53	3	A
Irthing Stream at Ellis Road	1.875	68	2	A
Lill Burn at Lill Burn-Monowai Road*	2.5	45	2	A
Longridge Stream at Sandstone*	0	54	3	A
Makarewa River at Counsell Road*	4.375	42	3	A
Mararoa River at Weir Road*	3.25	26	4	A
Mataura River at Gore*	1.5	40	2	A
Mataura River at Mataura Island Bridge*	4.75	40	2	A
Mimihau Stream at Wyndham*	2.25	46	2	A
Orauea River at Orawia Pukemaori Road*	1.75	43	3	A
Oreti River at Branxholme*	0	34	3	A
Oreti River at Three Kings	0	66	4	A
Otamita Stream at Mandeville	5.5	68	2	A
Otautau Stream at Otautau-Tuatapere Road*	5	43	3	A
Upper Waiau River at Queens Reach*	3	9	2	A
Upukerora River at Te Anau Milford Road*	1	58	4	A
Waiau River at Sunnyside*	2.5	34	2	A
Waiau River at Tuatapere*	0.25	53	2	A
Waikaia River at Waikaia*	4.5	29	2	A
Waikaia River at Waipounamu Bridge Road*	5.95	8	4	A

Waikaia River u/s Piano Flat	3.75	61	4	A
Waikaka Stream at Gore*	1.5	53	3	A
Waimea Stream at Mandeville	1.875	62	3	A
Wairaki River ds Blackmount Road*	1.25	52	4	A
Waituna Creek at Marshall Road*	0	44	3	A
Whitestone River d/s Manapouri-Hillside*	0	55	4	A
Dunsdale Stream at Dunsdale Reserve	13.75	65	2	B
Waiau River 100m u/s Clifden Bridge*	11.5	35	2	B
Waikawa River at Progress Valley*	14.75	45	2	B
Waiau River us Excelsior Creek*	25.375	34	2	C

**should be treated as uncertain – less than the stipulated 60 observations available for grading.*

Appendix 2 - re-suspendable fine sediment

Site	Median SIS (g/m2)	n	Pass/Fail (threshold 450 g/m2)[13]
Aparima River at Dunrobin	159.8	6	Pass
Aparima River at Etalvale	24.8	1	Not Assessed
Aparima River at Otautau	28.1	1	Not Assessed
Aparima River at Thornbury	263.7	7	Pass
Bog Burn d/s Hundred Line Road	643.3	7	Fail
Boundary Creek at Waiau Confluence	550.4	1	Not Assessed
Cascade Stream at Pourakino Valley Road	203.2	7	Pass
Cromel Stream at Selbie Road	39.3	7	Pass
Dipton Stream at South Hillend-Dipton Road	308.5	7	Pass
Dunsdale Stream at Dunsdale Reserve	435.0	7	Pass
Eglington River at McKay Creek Confluence	73.0	6	Pass
Hamilton Burn at Affleck Road	319.5	7	Pass
Hamilton Burn at Goodall Road	297.8	7	Pass
Hedgehope Stream 20m u/s Makarewa Confl	615.2	7	Fail
Hedgehope Stream at Block Road	830.0	5	Fail
Hillpoint Stream at Waikana Road	1344.5	6	Fail
Home Creek at Manapouri	623.8	7	Fail
Irthing Stream at Ellis Road	155.1	7	Pass
Lill Burn at Hindley Rd	423.0	7	Pass
Lill Burn at Lill Burn-Monowai Road	441.8	7	Pass
Longridge Stream at Sandstone	930.4	7	Fail
Makarewa River at Counsell Road	818.3	2	Not Assessed
Makarewa River at King Road	956.6	5	Fail
Makarewa River at Lora Gorge Road	933.2	7	Fail
Makarewa River at Wallacetown	618.1	7	Fail
Makarewa River at Winton - Hedgehope Hwy	650.7	4	Fail
Makarewa River u/s Hedgehope Confluence	719.6	6	Fail
Mararoa River at Kiwiburn	50.3	2	Not Assessed
Mararoa River at Mararoa Road Bridge	75.8	5	Pass
Mararoa River at Weir Road	160.9	7	Pass
Mataura River 200m d/s Mataura Bridge	485.9	3	Not Assessed
Mataura River at Garston	290.9	7	Pass
Mataura River at Gore	516.8	7	Fail
Mataura River at Keowns Road Bridge	451.2	5	Fail

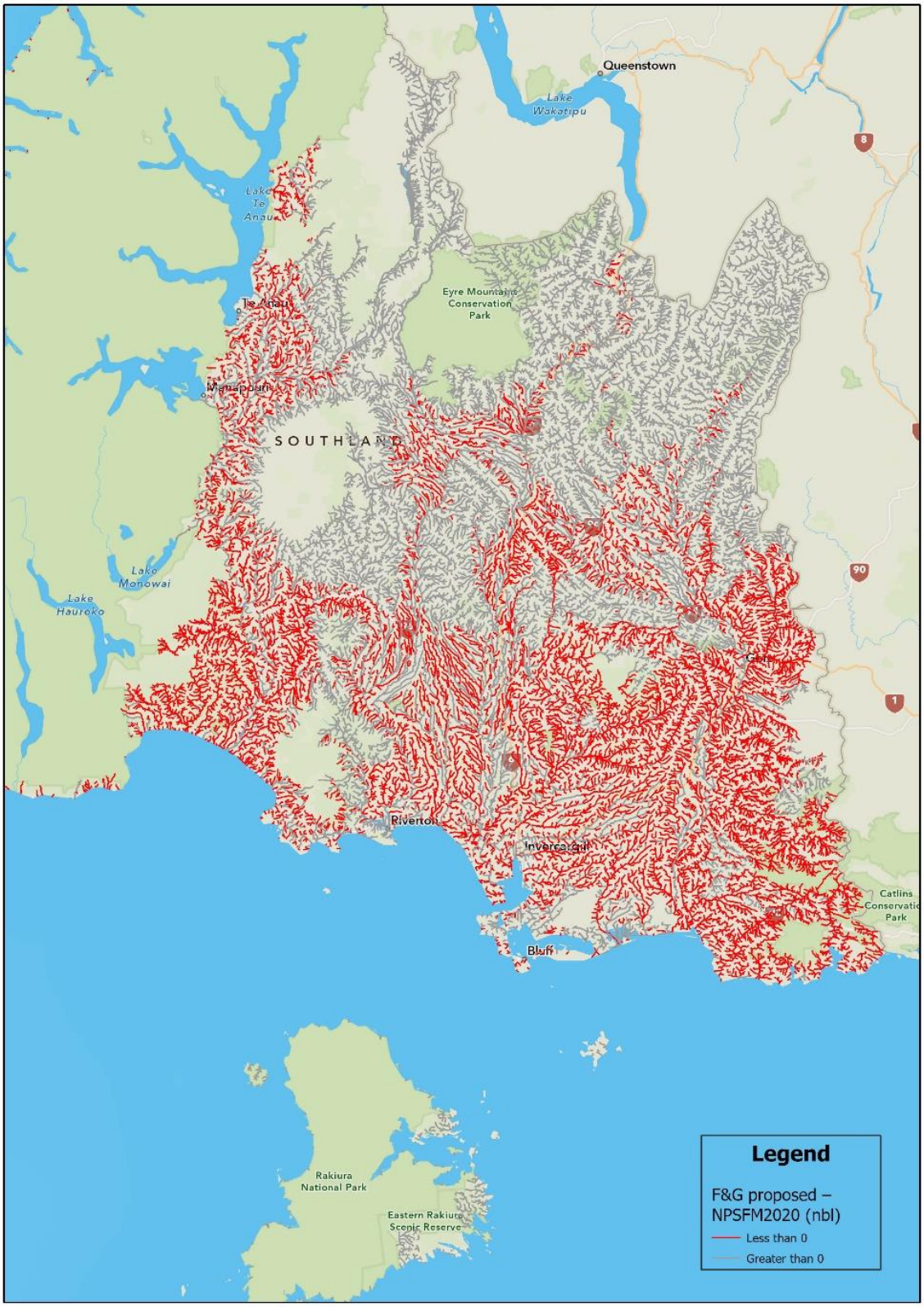
[13] Clapcott, J.E., Young, R.G., Harding, J.S., Matthaei, C.D., Quinn, J.M. and Death, R.G. (2011) Sediment Assessment Methods: Protocols and guidelines for assessing the effects of deposited fine sediment on in-stream values. Cawthron Institute, Nelson, New Zealand. At page 34.

www.envirolink.govt.nz/assets/R4-1-Sediment-Assessment-Methods-Protocol-and-guidelines.pdf

Mataura River at Mataura Island Bridge	802.8	7	Fail
Mataura River at Parawa	449.4	7	Pass
Mataura River at Pyramid Bridge	464.6	6	Fail
McKay Creek at Milford Road	893.0	5	Fail
Mimihau Stream at Wyndham	516.8	7	Fail
Mimihau Stream Tributary at Venlaw Forest	575.8	6	Fail
Moffat Creek at Moffat Road	1245.9	7	Fail
Mokoreta River at Egremont Road	1349.1	6	Fail
Mokoreta River at Wyndham River Road	673.6	7	Fail
Murray Creek at Cumming Road	377.7	5	Pass
Murray Creek at Double Road	925.7	5	Fail
North Etal Stream u/s Dunrobin Valley Rd	218.2	7	Pass
Orauea River at Orawia Pukemaori Road	518.9	7	Fail
Oreti River at Benmore	328.3	7	Pass
Oreti River at Branxholme	781.2	2	Not Assessed
Oreti River at Lumsden Bridge	170.6	7	Pass
Oreti River at McKellars Flat	610.2	5	Fail
Oreti River at Mossburn	56.4	1	Not Assessed
Oreti River at Ram Hill	2.9	1	Not Assessed
Oreti River at Three Kings	114.3	7	Pass
Oreti River at Wallacetown	541.6	7	Fail
Otamita Stream at Mandeville	679.6	6	Fail
Otapiri Stream at Anderson Road	969.4	7	Fail
Otapiri Stream at Otapiri Gorge	522.5	6	Fail
Otautau Stream at Otautau	488.7	7	Fail
Otautau Stream at Otautau-Tuatapere Road	735.2	6	Fail
Otautau Stream at Waikouro	1071.7	7	Fail
Otepuni Creek at Nith Street	3407.2	1	Not Assessed
Oteramika Stream at Seaward Downs	1385.8	6	Fail
Pig Creek at Borland Lodge	212.3	5	Pass
Pourakino River at Ermedale Road	398.8	6	Pass
Pourakino River at Jubilee Hill Road	221.7	6	Pass
Rowallan Burn East at Rowallan Road	1557.5	5	Fail
Sandstone Stream at Kingston Crossing Rd	796.8	3	Not Assessed
Silver Stream at Lora Gorge Road	1000.4	6	Fail
Taringatura Creek at Taromaunga	660.0	7	Fail
Thicket Burn at Lake Hauroko Road	775.8	6	Fail
Tokanui River at Fortrose Otara Road	2962.0	2	Not Assessed
Trenders Creek at Hall Road	762.4	1	Not Assessed
Tussock Creek at Cooper Road	1762.7	5	Fail
Upukerora River at Te Anau Milford Road	124.2	7	Pass
Waianiwa Creek 1 at Lornville Riverton Highway	1758.2	6	Fail
Waiau River 100m u/s Clifden Bridge	166.4	5	Pass
Waiau River at Duncraigen Road	118.2	1	Not Assessed
Waiau River at Sunnyside	178.5	6	Pass

Waiau River at Tuatapere	276.2	7	Pass
Waihopai River at Dacre	4084.3	1	Not Assessed
Waihopai River at Kennington	669.4	4	Not Assessed
Waihopai River at Waihopai Dam	794.2	2	Not Assessed
Waihopai River u/s Queens Drive	795.8	7	Fail
Waikaia River at Waikaia	518.9	7	Fail
Waikaia River at Waipounamu Bridge Road	313.1	7	Pass
Waikaia River u/s Piano Flat	256.6	6	Pass
Waikaka Stream at Gore	655.4	7	Fail
Waikaka Stream at Hamilton Park	1366.5	1	Not Assessed
Waikawa River at Progress Valley	490.5	7	Fail
Waikiwi Stream at North Road	17294.2	1	Not Assessed
Waikopikopiko Stream at Haldane CurioBay	583.7	6	Fail
Waimatuku at Waimatuku Township Road	381.7	4	Not Assessed
Waimatuku Stream at Lorneville Riverton Hwy	486.6	6	Fail
Waimatuku Stream at Rance Rd	363.3	7	Pass
Waimea Stream at Mandeville	335.1	7	Pass
Waimeamea River at Young Road	189.1	5	Pass
Wairaki River at Blackmount Road	229.6	6	Pass
Waituna Creek at Marshall Road	1006.1	7	Fail
Whitestone River d/s Manapouri-Hillside	201.4	6	Pass
Winton Stream at Benmore - Otapiri Road	3127.2	2	Not Assessed
Winton Stream at Lochiel	594.2	7	Fail
Waiau River us Excelsior Creek	338.3	2	Not Assessed

Appendix 3: 1 Spatial comparison of Fish and Game/Prof. Death proposed DFS standards with NPSFM 2020 national bottom lines. Red river segments illustrate where the national bottom line is lower (more stringent) than the standard proposed by Fish and Game/Prof. Death.



Appendix 4

Excerpt from ANZECC 2000 guidelines:
https://www.waterquality.gov.au/sites/default/files/documents/anzecc-armcanz-2000-guidelines-vol2.pdf

Appendix 1 Mixing zones adjacent to effluent outfalls

The nature of mixing zones

In a management context, mixing zones are often defined as an explicit area around an effluent discharge where the Management Goals of the ambient waters do not need to be achieved and hence the designated Environmental Values (EVs) may not be protected. In this context mixing zones are sometimes termed *exclusion zones.* The boundaries of these zones are usually determined under worst case scenarios.

Mixing zones are generally designated to manage the controlled discharge of soluble, non-bioaccumulatory toxicants whose impacts on local biota are primarily related to their concentration. The use of mixing zones is not appropriate for managing the discharge of nutrients, bio-accumulatory or particulate substances. With respect to nutrients, for example, stimulation of algae (e.g. phytoplankton) may occur considerable distances away from the outfall and is mediated by the biological characteristics of the waterbody as a whole.