IN THE MATTER of the Resource Management Act 1991 (**RMA**)

AND

IN THE MATTER of the Freshwater Planning Instrument Parts of the Proposed Otago Regional Policy Statement 2021

STATEMENT OF EVIDENCE OF
Michael Kevin Joy for Wise Response Inc

26 June 2023

SUMMARY OF EVIDENCE

a. My name is **Michael Kevin Joy** and I am a freshwater ecologist. I summarise my evidence, according to the key headings in this statement, as follows:

b. My evidence highlights the drivers and cause of the degradation of freshwater in the Otago Region and the multiple harms this causes to people, animals and the environment. I have broken my evidence into the following headings:

Agricultural intensification

c. Increased irrigation

d. Increased fertiliser/nutrient losses

e. Increasing stocking density

Impacts of intensification nutrients.

f. Intensification leads to Increased nutrients in freshwaters, leading to eutrophication which is excess algal growth driving altered diurnal dissolved oxygen levels lethal to stream life.

g. Intensification requires irrigation, meaning more dams and more wetland drainage/removal

h. Impacts on mahinga kai

i. Intensification has negative impacts on freshwaters leading to human health harms:

j. Nitrate contamination of drinking water and E.coli, biotoxin contamination, anthropogenic contamination – metals and PCBs

Te Mana o te wai (TMOTW)

k. The hierarchy of TMOTW

l. TMOTW defined only by mana whenua

m. Ki uta ki tai (from the mountains to the sea)

Cumulative effects

n. All the impacts above accumulate down catchments, so the higher the proportion of intensive farming the more degraded the freshwaters, rivers, lakes estuaries and groundwaters.

Cheaper not to harm than to clean up after

o. There is ample evidence that it is much cheaper and safer to avoid doing harm rather than blindly going ahead and having to try to clean-up after.

A timely warning - failings of current processes and mitigations

p. A recent report from the NZ Ministry for the environment revealed that the mitigations currently accepted by councils Farm Environment Plans and Best Management Practice are ineffective. They were an industry response to avoid regulation and unsurprisingly flawed as the don’t take into account the scale of change required.

INTRODUCTION

1. My name is **Michael Kevin Joy**.
2. I am a Senior Research Fellow at the Institute for Governance and Policy Studies at Victoria University of Wellington. My field of research is in freshwater ecology.
3. I hold the qualifications of Bachelor of Science in Ecology (1997) and Master of Science with Honours in Ecology and PhD in Ecology from Massey University (2003).
4. Both my Masters and PhD research focussed on freshwater issues in New Zealand:
5. My Master thesis was called "Freshwater fish community structure in Taranaki: dams, diadromy or habitat quality?".
6. My PhD thesis was called "The development of predictive models to enhance biological assessment of riverine systems in New Zealand".
7. Previously, I was a Lecturer, then Senior Lecturer, at Massey University in ecology and environmental science from 2003-2018.
8. I have published various journal articles on topics relating to freshwater ecology, including:
9. Chambers T and others "Quantifying the nitrate levels in bottled water in New Zealand" (2022) 46(3) Australian and New Zealand Journal of Public Health 322-324.
10. Richards, J and others "Nitrate contamination in drinking water and colorectal cancer: Exposure assessment and estimated health burden in New Zealand" (2022) Environmental Research 204.
11. Joy, MK and others "The grey water footprint of milk due to nitrate leaching from dairy farms in Canterbury, New Zealand" (2022) 29(2) Australasian Journal of Environmental Management 177-199.
12. Canning, A. D., Joy, M. K. & Death, R. G.. (2021) "Nutrient criteria to achieve New Zealand's riverine macroinvertebrate targets" Peer J, 9 e11556-e11556.
13. Joy, Mike (2018) Ed. Mountains to Sea Solving New Zealand's Freshwater Crisis Wellington: Bridget Williams Books
14. Joy, M. K. & Canning, A. D. (2020) "Shifting baselines and political expediency in New Zealand. Marine and Freshwater Research".
15. Joy, M. K., & Death, R. G. (2013). Freshwater Biodiversity. In J. R. Dymond (Ed.), Ecosystem Services in New Zealand (pp. 448-459). Lincoln New Zealand: Manaaki Whenua Press.

16. Joy, M. K. (2017). Our deadly nitrogen addiction. In C. Massey (Ed.), The New Zealand Land & Food Annual (Vol. 2, pp. 119-130). Palmerston North, New Zealand: Massey University Press.
17. Joy, M. K. (2015). Polluted Inheritance New Zealand's Freshwater Crisis. Wellington: Bridget Williams Books Limited. doi:10.7810/9780908321612
18. Joy, M., Foote, K.J., McNie, P., Piria, M. (2019) "Decline in New Zealand's freshwater fish fauna: Effect of land use" 70(1) Marine and Freshwater Research 114-124.
19. Joy, M. (2019). "The environmental and human health impacts of dairy intensification; a Canterbury case study" VetScript.
20. Joy, M. K. (2014). Freshwaters in New Zealand. In A. Stow, N. Maclean, & G. Holwell (Eds.), Austral Ark: The State of Wildlife in Australia and New Zealand (pp. 227-239). Singapore: Cambridge University Press.
21. I have been an Associate Editor of Marine and Freshwater Research Journal (CSIRO, Australia) since 2015; an associate editor for the Springer Journal — Biodiversity and Conservation since 2019; and an Editorial Panel Member for Transylvanian Review of Systematical and Ecological Research since 2010.
22. I have developed bio-assessment tools used by many regional councils and consultants and have published scientific papers in many fields from artificial intelligence and data mining to the freshwater ecology of sub-Antarctic islands.
23. I have received several awards for my work, including:
    i. an Ecology in Action award from the New Zealand Ecological Society (2009);
    ii. an Old Blue from Forest and Bird (2011);
    iii. a Tertiary Education Union Award of Excellence for Academic Freedom and Contribution to Public Education (2013);
    iv. the Royal Society of New Zealand Charles Fleming Award for protection of the New Zealand environment (2013);
    v. the Morgan Foundation inaugural River Voice Award (2015);
    vi. the inaugural New Zealand Universities Critic and conscience Award (2016)
24. For the last two decades, I have been working at the interface of science and policy in New Zealand with a goal of strengthening connections between science, policy and real outcomes to address the multiple environmental issues facing New Zealand.
25. I have been retained by the Wise Response to prepare a statement of evidence on freshwater components of the plan change

26. In preparing this evidence I have read the following documents in relation to freshwater:

    i. https://www.orc.govt.nz/plans-policies-reports/regional-plans-and-policies/otago-regional-policy-statements/proposed-otago-regional-policy-statement-2021-non-freshwater-parts/proposed-rps-21-non-freshwater-parts-hearing/section-42a-hearing-report,

    ii. https://www.orc.govt.nz/media/12985/09-lf-s42a-report-oct-22.pdf

    iii. Specific parts of https://www.orc.govt.nz/media/14371/reply-report-09-lf.pdf related to Wise Response

CODE OF CONDUCT

27. I have read the Environment Court Code of Conduct for expert witnesses and agree to comply with it.

28. I confirm that the topics and opinions addressed in this statement are within my area of expertise except where I state that I have relied on the evidence of other persons. I have not omitted to consider materials or facts known to me that might alter or detract from the opinions I have expressed.

AGRICULTURAL INTENSIFICATION

29. The primary driver of harm in the Otago Region is land use change towards intensive dairy farming and agriculture. This change began with human occupation using fire, large scale forest clearance that came with European colonisation, and followed by the gradual intensification of agriculture and urbanisation throughout the 20th century. However, in the late 1980s, agricultural intensification went from 'gradual' into 'overdrive', which accelerated the decline in freshwater quality and aquatic ecosystem health.

30. I focus on the following aspects of agricultural intensification, which had the worst impacts on freshwater:

    1. increased irrigation and shift to irrigation
    2. increased use of nitrogen fertiliser; and
    3. increased stock intensity of cattle.

31. The increased irrigation and move to pivot irrigation has led to an increased need for water. This has led to an increase in groundwater abstraction, which is the process of removing water from its natural underground source. Groundwater abstraction (in excess of annual recharge rates) results in the progressive lowering of groundwater levels, which has several environmental impacts that I describe below.

32. Increased irrigation led to more dams for water storage schemes for irrigation. I discuss below the direct and indirect effects of dams on rivers.

33. Agricultural intensification has led to an extreme increase in fertiliser use in New Zealand, in particular fertilisers that contain nitrogen. The OECD's 2017 environmental performance review highlights that the nitrogen balance in New Zealand has worsened more than any other country in the OECD.[1]

34. New Zealand has seen a more than 662% increase in nitrogen applied to agricultural land as urea fertiliser, from 24,586 tonnes in 1990 to 358,000 tonnes in 2019.[2]

35. The increased use of nitrogen in fertilisers on farmland resulted in an increased concentration of nitrogen in rivers, lakes and groundwater from the nitrogen leaching or running off from the land into the freshwater. Increased levels of nitrogen have significant environmental impacts, which I discuss below.

Increased stock intensity of cattle

36. Since 1990, the total number of cattle in the South Island has increased by 591%. Regions with the greatest growth were Southland (1,584%), Canterbury (973%), and Otago (706%).[3] This growing number of cattle has been made possible by the growing use of irrigation, fertiliser and cattle feed.

37. New Zealand's stocking rate is three times higher than the rate mandated by the European Union to protect freshwater, which is about one dairy cow per hectare.[4] The average for dairy stocking rate for NZ in 2017-18 was 2.8 cows per hectares and for Otago 2.9 cows per hectare [5]. To put this stocking rate in a global context, NZ's and Otago's stocking rate is three times higher than the rate mandated by the European Union (EU) to protect freshwaters of about one dairy cow per ha [6]. This boom in cattle numbers and stocking concentration has not only altered the landscape significantly but has also had devastating effects on soil and water through animal runoff.

38. Creating space for ever-growing livestock numbers has historically entailed dramatic changes to the physical landscape. This has led to the widespread

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[1] OECD, OECD Environmental Performance Reviews: New Zealand 2017 (Paris: OECD Publishing, 2017), p. 160.

[2] Ministry for the Environment, New Zealand's Greenhouse Gas Inventory 1990-2019 (Wellington: Ministry for the Environment, 2021), p. 245.

[3] "Livestock numbers," Stats NZ, accessed January 19, 2023, https://www.stats.govt.nz/indicators/livestock-numbers.

[4] EU member states are required to guarantee that the annual farm application of nitrogen (as animal manure) does not exceed 170 kg per hectare, equivalent to a stocking rate of one cow per ha. See Javier Mateo-Sagasta, Sara Marjani Zadeh, and Hugh Turral (eds.), More people, more food, worse water? A global review of water pollution from agriculture (Rome: Food and Agriculture Organization of the United Nations, 2018), p. 168, box 10.4.

[5] https://www.dairynz.co.nz/media/5794941/nz-dairy-statistics-2020-21-web.pdf

[6] EU member states are required to guarantee that the annual farm application of nitrogen, as animal manure, does not exceed 170 kg per hectare, equivalent to a stocking rate of one cow per ha https://reliefweb.int/report/world/more-people-more-food-worse-water-global-review-water-pollution-agriculture

destruction of wetlands for the creation of more farmland. The wetland area in 2008 was less than 10.1% of the pre-human area and continues to decline.[7]

Degradation of freshwater

39. Land-use changes and the introduction of exotic fish have had many drastic environmental effects. This section of my brief focusses on the worst effects on freshwater. In particular, I discuss the:

    - increase in nitrates in freshwater leading to eutrophication (excessive concentration of nutrients) of freshwater and the impact of this on dissolved oxygen levels;
    - degradation of groundwater and compounding effect of groundwater abstraction;
    - the effect of dams;
    - wetland destruction;
    - impact on mahinga kai; and impact on human health.

Nitrates in freshwater

40. One of the worst impacts of agricultural intensification for freshwater is a massive increase in the concentration of nutrients in the freshwater, largely in the form of nitrate-nitrogen (NO3-N). I refer to this as "nitrogen" or "nitrate" levels.

41. Nutrient contamination has considerably increased since European colonisation and the beginning of agriculture in New Zealand between 1861 and 2001 the total nitrogen added to freshwaters every year rose from 130,000 tonnes to 397,000 tonnes.[8] These increases are directly attributable to increased fertiliser use in agriculture.

42. Nitrate loads in freshwater has increased by 257% in Otago over the natural amount.[9] In the four major South Island farming regions, 56,555 total tonnes of nitrate per year are leached to the freshwater environment.[10]

Table 1: Water quality limits used for nitrogen summary tables and figures

Water Quality limit NO_3-N	**Explanation**

7 "Wetland extent," Stats NZ, accessed January 30, 2023, https://www.stats.govt.nz/indicators/wetland-extent.

8 R.L. Parfitt, W.T. Baisden, L.A. Schipper, and A.D. Mackay, "Nitrogen inputs and outputs for New Zealand at national and regional scales: Past, present and future scenarios," Journal of the Royal Society of New Zealand 38, no. 2 (2008): pp. 78-79.

9 Ton H. Snelder, Scott T. Larned, and Rich W. McDowell, "Anthropogenic increases of catchment nitrogen and phosphorous loads in New Zealand," New Zealand Journal of Marine and Freshwater Research 52, no. 3 (2017): p. 351, table 5.

10 "Nitrate leaching from livestock," Stats NZ, accessed January 19, 2023, https://www.stats.govt.nz/indicators/nitrate-leaching-from-livestock.

0.44 mg/L	The trigger value for physical and chemical stressors in lowland, slightly disturbed ecosystems published in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Trigger values are used to assess risk of adverse effects due to nutrients, biodegradable organic matter, and pH in various ecosystem types.[28]
0.66 mg/L	Macroinvertebrate Community Index (MCI) is a well-accepted and robust indicator of ecosystem health, based on the presence and density of benthic macroinvertebrates (for example, insects and worms) in waterways. This limit represents the threshold where modelling revealed that there is a sudden and significant decline in MCI scores at sites where NO3-N concentration exceeds 0.66 mg/L.[29]
1 mg/L	This represents the 'A' band limit from the National Policy Statement 2020. It was the 'bottom-line' proposed by the Ministry for the Environment Science Technical Advisory Group. [30]. This is also the European Union limit for eutrophication in surface waters, [31] and the level III limit for drinking water in China. [32]
2.4 mg/L	The 'bottom line' limit value for nitrate toxicity in aquatic life stated by the National Policy Statement 2020. [33]

Table 2: Percentage of the 466 South Island LAWA monitoring sites with significant trends over 15 years for nitrogen

Region 15-year trend	Degrading	Improving
Canterbury	35%	25%
Otago	38%	29%
Southland	50%	27%
West coast	2%	12%
All sites	**30%**	**22%**

Eutrophication of freshwater

43. The increase of nutrient loads can cause freshwater to become eutrophic (contain excessive nutrients). This leads to excessive plant and algae growth, which degrades water quality and often causes algae blooms that harm to mahinga kai habitat and survival.

44. One such algae is periphyton, a green/brown alga that covers riverbeds. Unhealthy rivers and streams containing excess nutrients promotes the harmful growth of periphyton. The periphyton blooms into excessive slime cover with long tendrils known as filamentous algae. This can cover up important interstitial spaces used as habitat by aquatic life, and as a secondary effect can harm

ecosystem metabolism[11] and contribute to dangerous variability in dissolved oxygen levels. Unsurprisingly, modelling shows that lowland waterways in farming catchments with high nutrient loads have the highest levels of periphyton.[12]

45. Most lowland lakes in the South Island pasture catchments contain excess nutrients,[13] and are classified as either moderately impacted or at high risk of degradation.

Dissolved oxygen levels

46. Eutrophication also has a drastic effect on dissolved oxygen, which is key to supporting aquatic life. Dissolved oxygen concentrations vary during the day due to both respiration and photosynthesis by plants, but in healthy freshwater ecosystems this concentration is very stable. However, as water becomes more eutrophic, oxygen concentrations begin to vary wildly, from extremely low in early morning to very high in late afternoon. These fluctuations are harmful, and if left unchecked eventually make it impossible for fish and insects to live, except for a few hardy species which can gulp oxygen off the surface.

47. There has been insufficient research done on daily changes in dissolved oxygen in the Otago Region but is known to be a problem in the water of similar lowland farming catchments elsewhere in New Zealand.[14]

Degradation of groundwater and groundwater abstraction

48. Excess nutrients have also led to degradation of groundwater. Since records began, 53% of the monitored bores in Otago show significant increases in nitrogen.[15]

49. Shallow groundwater and surface waters are interconnected. This means nitrogen leaching from intensive farming accumulates in groundwater and spreads across lowland areas. There are increasingly high nitrate levels in surface and groundwater, which reflects the intensity of farming upstream.

50. Groundwater is also threatened by pesticide contamination. Invertebrates found in groundwater known as stygofauna play important ecosystem roles,

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11 Ecosystem metabolism is the numerous metabolic processes that transform energy in organisms or ecosystems.

12 Cathy Kilroy, Amy Whitehead, Simon Howard, and Michelle Greenwood, Modelling periphyton in New Zealand rivers; Part 1. An analysis of current data and development of national predictions, Prepared for Ministry for the Environment (Christchurch: NIWA, 2019), p. 10.

13 "Modelled lake water quality," Stats NZ, accessed January 20, 2023, https://www.stats.govt.nz/indicators/modelled-lake-water-quality.

14 A.D. Canning and R.G. Death, "Ecosystem Health Indicators—Freshwater Environments," in Encyclopedia of Ecology, 2nd ed., ed. B. Fath (Oxford: Elsevier, 2019), p. 8.

15 Data was collected from each regional council separately using Local Government Official Information and Meetings Act 1987 (LGOIMA).

including water purification. They are susceptible to both pesticides and nitrate toxicity,[16] and die off when pesticides are combined with high nitrogen levels. More than half of the sampled wells in the South Island contained detectable pesticide residues, and more than a third contained emerging organic contaminants (EOCs) from pharmaceuticals and agrichemicals, which are new man-made contaminants.[17]

51. As discussed above, increased irrigation has resulted in the need for more groundwater abstraction. The progressive lowering of groundwater levels leads to several environmental impacts, including the concentration of nutrients in the remaining water, depletion of streams, drying of river sections, reduction in spring flow, and near the coast an increase of risk of saltwater intrusion into groundwater.[18] These impacts also have flow-on effects, such as impaired fish migration.

52. All these impacts from groundwater abstraction are exacerbated by the loss of glaciers due to global warming, which will continue to reduce the amount of water available for irrigation as well as healthy lakes and rivers.

53. Managed Aquifer Recharge (MAR), the process of removing water from rivers to dilute groundwater, has been proposed to mitigate the effects of increased nitrate concentration in groundwater. Although it mitigates one problem (the high concentration of nitrates in groundwater), it intensifies another problem (the harms that result from removing water from rivers).[19]

Effects of dams

54. The damming of rivers for hydroelectricity and irrigation has seriously harmed freshwater diversity and the physical features of rivers (known as river geomorphology) in New Zealand.[20]

55. Dams restrict the movement of diadromous (or migrating) fish, which spend some part of their life in the ocean biome but travel back into fresh waterways at some point in their lifecycle. A unique feature of the native fish life of Aotearoa is that most are diadromous.

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16 Graham Fenwick, Michelle Greenwood, Erica Williams, Juliet Milne, and Erina Watene-Rawiri, Groundwater Ecosystems: Functions, values, impacts and management (Christchurch: NIWA, 2018), p. 53.

17 Murray E. Close, Bronwyn Humphries, and Grant Northcott, “Outcomes of the first combined national survey of pesticides and emerging organic contaminants (EOCs) in groundwater in New Zealand 2018,” Sci Total Environ 754:142005. (2021): p. 9, fig. 1.

18 P.A. White and D.M. Scott, “Canterbury groundwater – allocation policy and the underlying science,” Freshwater Update 7 (Auckland: NIWA, 2004).

19 “Band-Aid Won’t Heal Canterbury’s Water Woes,” Fish & Game New Zealand, November 24, 2021, https://fishandgame.org.nz/news/band-aid-wont-heal-canterburys-water-woes/.

20 Michael K. Joy and Kyleisha Foote, “Damn the dams,” The Journal of Urgent Writing 2 (2017): 236-253.

56. The diverting of river flows from one catchment to another or toward irrigation and hydroelectric dams can have a significant effect on water quality and sediment loads, and result in the addition of contaminants to the river flows. Diadromous fish find suitable habitat by detecting the presence of adult fish of their species through odour and can be deterred by contaminated river flows. Additionally, the mixing of waters from different catchments is likely to confuse migrating fish, potentially deterring them from migration or attracting them to unsuitable habitats.

57. Dams also result in sediment suspension and dispersal. Suspended sediment leads to dirty brown water, the discolouration of which reduces feeding opportunities for fish and blocks sunlight needed by healthy ecosystem processes.[21] Suspended matter can affect aquatic life through both direct abrasion and clogging gills, which affect oxygen exchange. However, the largest impact is not on water clarity, but the loss of habitat caused when sediment falls out of suspension and settles on the river or stream bed. Most native New Zealand fish are benthic, meaning they live and feed on the bottom of the river as opposed to swimming in the upper current. These benthic fish rely on gaps between rocks and boulders called interstitial spaces. When settling sediment smothers these spaces, fish suffer a major loss of habitat.[22]

58. When comparisons were made above and below dams, and with data from undammed sites, Figure 1 shows that community composition of fish species was significantly different above and below dams. Sites above dams had lower species richness, a lower percentage of diadromous species and a higher percentage of exotic species compared to below dams. None of these differences were present at undammed sites. This shows that dams restrict the movement of diadromous fish and result in their reduction or loss from above-dam habitats and create and artificial lentic ecosystems that exotic fish species can successfully exploit.

[21] Jaeszha J. Richardson and Ian Jowett, "Effects of sediment on fish communities in East Cape streams, North Island New Zealand," New Zealand Journal of Marine and Freshwater Research 36 (2002): p. 438, table 5.

[22] A.J. McEwan and M.K. Joy, "Diel habitat use of two sympatric galaxiid fishes (Galaxias brevipinnis and G-postvectis) at two spatial scales in a small upland stream in Manawatu, New Zealand," Environmental Biology of Fishes 97 (2014): p. 905.

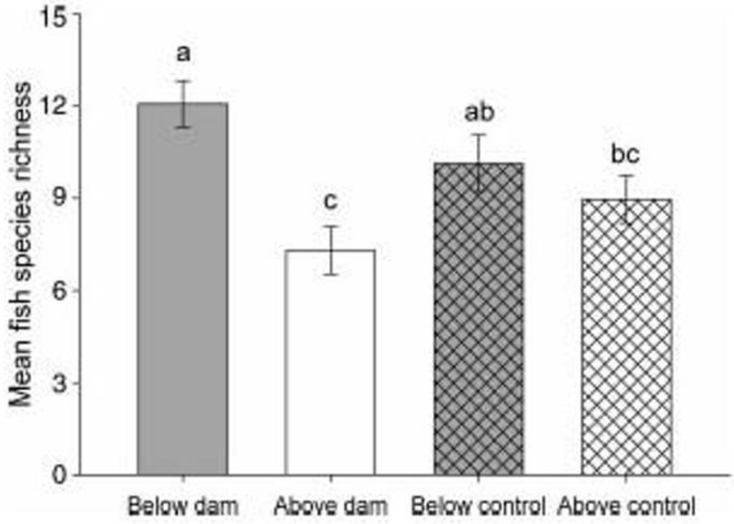

Figure 1. *Changes in mean (9 SE) fish species richness above and below 30 dams across New Zealand compared to changes in fish species richness at the 22 control waterways. (Jellyman and Harding, 2012)* [23]

59. Longfin tuna (eel) migrate extensively inland, more so than almost any other native fish. This means dams have a profoundly negative effect on the migration of longfin tuna, both upstream for elvers and downstream for mature adults. I explain [in the mahinga kai section] below the impact of dams and other environmental impacts on tuna.

60. Dams also impact the geomorphology of rivers in through altering sediment movement and flows downstream, flooding of areas upstream, the blocking of fish passage in both directions, and changes in geomorphology and channel form. These physical changes result in the reduction and degradation of habitat and affect virtually all aquatic and floodplain life. The usual outcomes are local extinctions, loss of native biodiversity, degradation of the life supporting capacity of rivers, and changes in the composition of river fish and plant communities.

61. The benefits of dams, if any, are small, and there do not appear to be any benefits to river ecosystems. Rather, the creation of more dams for water storage schemes and for irrigation exacerbates water quality problems by incentivising agricultural intensification. This creates a vicious cycle — more agriculture requires more dams, and more dams allows for more agriculture.

Wetland destruction

62. Wetlands are among the world's most productive (and thus most valuable) ecosystem. Wetlands are particularly important because they act as pathways,

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[23] Jellyman, P. G., and J. S. Harding. 2012. The role of dams in altering freshwater fish communities in New Zealand. New Zealand Journal of Marine and Freshwater Research 46:475-489.

recipients, sources, and sinks of physical and biological resources. Functionally, because wetlands are situated at the lower parts of catchments, they receive and process water, sediment, and nutrients from upslope. The combination of abundant nutrients and shallow water promotes vegetative growth that takes up nutrients and purifies water. In doing so, this makes the wetlands a habitat available to a wide range of fish, birds, and invertebrates.

63. The ecosystem services[24] of wetlands have an estimated economic value of around US $44,000 per hectare per year — among the highest of all ecosystems studied.[25] If we were to determine what these services would cost if they had to be otherwise paid for,[26] the specific value of wetland ecosystem service delivery in New Zealand in 2012 was calculated to be NZD $54,650 per hectare per year.[27]

64. There has been widespread wetland destruction to create space for farmland and ever-growing livestock numbers. It is estimated that 961,911 hectares of wetland have been destroyed in the South Island since pre-human times.[28] The wetland area in 2008 was less than 10.1% of the pre-human area and continues to decline.[29] The services value lost through their destruction could therefore be valued at $58 billion per year if converted to 2022 NZD$.

65. Lowland riparian deforestation has also impacted freshwater health, which is shown in the decline of fish diversity and abundance. Two-thirds of native fish species are nocturnal or are shy and camouflage themselves, and thus require habitat with stream shading and high amounts of woody instream cover.[30]

66. One-third of fauna require specific riparian vegetation in conjunction with autumnal bank-full flows for successful bankside or forest-litter spawning.

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24 "Ecosystem services" is the term used to describe the wide array of environmental, economic, social, and cultural benefits wetlands and other ecosystems provide. These services are the things that are valuable to humans, including maintaining or improving water quality and a stable supply of water; sequestering carbon; sustaining indigenous biology; and providing many cultural, recreational, and educational resources.

25 Daniela Russi, Patrick ten Brink, Andrew Farmer, Tomas Badura, David Coates, Johannes Förster, Ritesh Kumar, Nick Davidson, The Economics of Ecosystems and Biodiversity for Water and Wetlands (London and Brussels: IEEP and Ramsar Secretariat, 2013), p. 10, table 2.2.

26 Beverly R. Clarkson, Anne-Gaelle E. Ausseil, and Philippe Gerbeaux, "Wetland Ecosystem Services," in Ecosystem services in New Zealand, ed. John R. Dymond (Lincoln: Manaaki Whenua Press, 2013), p. 193, table 1.

27 Murray G. Patterson and Anthony O. Cole, "'Total economic value' of New Zealand's land-based ecosystems and their services," in Ecosystems in New Zealand, ed. John R. Dymond (Lincoln: Manaaki Whenua Press, 2013), p. 508.

28 "Estimated contemporary and pre-human wetland area, by region (2008 estimate)," Ministry for the Environment, accessed January 31, 2023, https://data.mfe.govt.nz/table/52593-estimated-contemporary-and-pre-human-wetland-area-by-region-2008-estimate/data/.

29 "Wetland extent," Stats NZ, accessed January 30, 2023, https://www.stats.govt.nz/indicators/wetland-extent.

30 R.M. McDowall, New Zealand Freshwater Fishes: A Natural History and Guide (Auckland: Heinemann Reed, 1990), pp. 328-333.

Higher fish diversity and abundance is usually expected in lowland areas, but this hinges on the availability of suitable instream and riparian habitat which are now absent throughout much of the region.[31]

67. As this loss of cover acts in concert with nutrient increases and deposited sediment to harm fish populations, separating out the specific impact of any individual cause is impossible. However, it is clear that ecosystem elements connect across both land and water to affect the health of both, demonstrating that the health of water relies on the health of the wider interconnected environment.

Impacts on mahinga kai

68. It is impossible to separate the health of freshwater from the health of the life dwelling within it. Intensification and vegetation clearance not only harm the land and water, but they also severely threaten New Zealand's biodiversity.[32]

69. Native fish communities can be measured using the Fish index of biotic integrity (F-IBI), which has been declining since records began in the 1970s,[33] and is now an attribute of note in the NPS-FM. If the decline continues at the current rate, by 2050 there will be none left. In order to maintain mahinga kai and halt the decline of river fauna, it is crucial to ensure that rivers, groundwaters, lakes, and estuaries maintain natural flows, have uncontaminated water, and are not mixed across different catchments. Longfin tuna (eel) are an important native fish in both the ecosystem and Ngāi Tahu mahinga kai; their plight illustrates the challenges and harms faced by NZ native fish life.

70. New Zealand now has the highest proportion of threatened and at-risk species in the world.[34] Some of New Zealand's worst statistics for threatened and at-risk species concern the 54 native freshwater fish species: the number under threat has increased alarmingly in the past 30 years, from only about 20% in the early 1990s to 74% in 2013. Freshwater crayfish and New Zealand's only freshwater mussel are also threatened with extinction.[35] This is the highest proportion of threatened freshwater fish species among all wealthy nations and reveals much

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31 M.K. Joy, I.M. Henderson, and R.G. Death, "Diadromy and longitudinal patterns of upstream penetration of freshwater fish in Taranaki, New Zealand," New Zealand Journal of Marine and Freshwater Research 34, no. 3 (2000) p. 536.

32 Marie A. Brown, R.T. Theo Stephens, Raewyn Peart, and Bevis Fedder, Vanishing Nature: facing New Zealand's biodiversity crisis (Auckland: Environmental Defence Society Incorporated, 2015).

33 Joy, M. K., K. J. Foote, P. McNie, and M. Piria. 2019. Decline in New Zealand's freshwater fish fauna: effect of land use. Marine and Freshwater Research 70:114-124.

34 Corey J.A. Bradshaw, Xingly Giam, and Navjot S. Sodhi, "Evaluating the relative environmental impact of countries," PLoS ONE 5, no. 5 (2010): p. 2, table 1.

35 Nicholas R. Dunn, Richard M. Allibone, Gerard P. Closs, Shannan K. Crow, Bruno O. David, Jane M. Goodman, Marc Griffiths, Daniel C. Jack, Nicholas Ling, Jonathan M. Waters and Jeremy R. Rolfe, Conservation status of New Zealand freshwater fishes, 2017 (Wellington: Department of Conservation, 2018), p. 3, table 1.

about the degradation of fresh water in New Zealand.[36] Because these fish sit at the top of freshwater food webs, they are highly sensitive indicators of river health. In effect, they are the freshwater equivalent of canaries in the coal mine.

71. Modelling of riverine freshwater fish communities shows the locations of gaps in population distribution. Unsurprisingly, these gaps are found in lowland waterways in farming catchments.[37] While fish are struggling in these farming areas, the same is not true of native forest catchments. This highlights the importance of protecting and enhancing native forest to protect mahinga kai.

72. Specific data on fish decline was not available separately for the Otago Region, but as most of the species are part of national populations (juveniles spend time in the ocean and intermix), the South Island situation will be reflected in national data. Because land use changes on the East coast of the South Island have been among the most extreme in Aotearoa, declines are likely to be even worse than average.

73. Also declining are freshwater invertebrates, which are useful indicators of ecosystem health and food for mahinga kai. Nationally, the number of threatened or at-risk species of freshwater invertebrates has increased from 17 in 2005 to 82 in 2013. In total, 334 aquatic invertebrate species are threatened, at-risk, or data-deficient (52% of the known fauna).[38]

74. Predictive maps of invertebrate communities show that the lowland waterways in farming catchments are most affected.[39] River macroinvertebrate community index (MCI) data collected by Regional Councils and NIWA over the period 1998-2017 show that most South Island lowland sampling sites are likely or very likely worsening.[40]

Impacts on human health

75. Waterways are contaminated through wastewater discharge, stormwater runoff and agricultural runoff. Freshwater and mahinga kai can also be directly contaminated through faeces and associated pathogens from stock that are in and around waterways.

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36 Michael. K. Joy, “Freshwaters in New Zealand,” in Austral Ark; The State of Wildlife in Australia and New Zealand, eds. Adam Stow, Norman Maclean, and Gregory I. Holwell (Cambridge, Cambridge University Press, 2015), p. 228.

37 Adam D. Canning, “Predicting New Zealand riverine fish reference assemblages,” PeerJ 6, no. 2 (2018): fig. 2.

38 Emily S. Weeks, Russell G. Death, Kyleisha Foote, Rosalynn Anderson-Lederer, Michael K. Joy, and Paul Boyce, “Conservation Science Statement. The demise of New Zealand's freshwater flora and fauna: a forgotten treasure,” Pacific Conservation Biology 22 (2016): 110-115.

39 M.J. Unwin and S.T. Larned, Statistical models, indicators, and trend analyses for reporting national-scale river water quality (Christchurch: NIWA, 2013), p 69.

40 “River water quality: macroinvertebrate community index,” Stats NZ, accessed February 2, 2023, https://www.stats.govt.nz/indicators/river-water-quality-macroinvertebrate-community-index.

76. While there is little evidence of disease in wild fish populations, there are disease risks for humans in both eating freshwater fish and being exposed to contaminated water through the collection of mahinga kai. New Zealanders suffer very high rates of waterborne disease, with estimates from the Ministry of Health revealing that between 18,000 and 34,000 people are affected every year.[41]

77. The relevant contaminants of water and food can be categorised into four groups: metals, organics, biotoxins and micro-organisms.[42] Metals, metalloids, and organics are persistent and have a range of negative health effects. Micro-organisms include bacteria, viruses, and other microbes that can cause disease in humans.

78. Thorough cooking of kai can destroy many micro-organisms, but it does not reduce the toxicity of metals or biotoxins. Furthermore, these contaminants are not mutually exclusive, and mahinga kai species can be at risk of contamination by several types simultaneously.

E. coli contamination

79. E. coli has been found in watercress collected from agricultural land, while watercress from urban sites is often contaminated with campylobacter.[43] Certain forms of the E. coli bacterium can be very dangerous. But it is also generally used as an indicator of both faecal contamination and the broader risk of exposure to a variety of disease-causing microorganisms.

80. A recent Canterbury study revealed there are higher levels of E. coli and the antimicrobial-resistant Shiga toxin-producing Escherichia coli (STEC) and associated genes at sites below intensive dairy farming catchments.[44] Antibiotic-resistant bacteria and their genes have been found in dairy wastewater, soil from dairy farms, and dairy manure.

81. Antibiotic-resistant bacteria may infect humans and animals, and the difficulty of treatment leads to higher medical costs, prolonged hospital stays, and

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41 Andrew Ball, Estimation of the Burden of Water-borne Disease in New Zealand: Preliminary Report, Prepared as part of a Ministry of Health contract for scientific services by ESR (Wellington: Ministry of Health, 2006), p. 16.

42 Kevin J. Collier, Susan J. Clearwater, Garth Harmsworth, Yvonne Taura, and Kiri Reihana, Physical and chemical attributes affecting survival and collection of freshwater mahinga kai species, Environmental Research Institute report no. 106 (Hamilton: The University of Waikato, 2017), p. 30.

43 Andrea M. Donnison, Colleen M. Ross and Lorraine Dixon, “Faecal microbial contamination of watercress (Nasturtium officinale) gathered by a Maori protocol in New Zealand streams,” New Zealand Journal of Marine and Freshwater Research 43, no.4 (2009): p. 905.

44 Meredith Davis, Anne C. Midwinter, Richard Cosgrove, and Russell G. Death, “Detecting genes associated with antimicrobial resistance and pathogen virulence in three New Zealand rivers,” PeerJ 9, vol. 5 (2021), table 3.

increased mortality.[45] STEC are a group of E. coli bacteria that produce powerful toxins that can cause severe illness and cattle are considered their primary reservoir globally. A 2019 Ministry of Health Annual Report noted a significant increase in the reporting of STEC infections.[46] Additionally, modelling of national data collected by environment agencies throughout New Zealand has shown that median E. coli concentrations between 2013 and 2017 were 15 times higher in catchments dominated by pasture than those in native vegetation.[47]

Biotoxins contamination

82. Nutrient overloads, unshaded light, deposited sediment and high temperatures can cause algae to bloom in fresh waterways. Some algae species can produce cyanotoxins, which can be deadly to aquatic life, birds, and mammals (notably dogs) when present at high levels. Cyanotoxins can remain contained within the cell or be released later when the bacteria become anoxic and dies. This can lead to large concentrations of cyanotoxins on lake shores.

83. In humans, cyanotoxins can affect the liver and kidneys and are sometimes neurotoxic. They can also directly affect the skin through causing rashes, and if inhaled through swimming or moist air, they can damage lung tissue and cause nonspecific symptoms such as nausea or diarrhoea. A particularly dangerous cyanotoxin is the hepatotoxin (liver-damaging toxin) called nodularin. Nodularin has been detected in the liver and muscle of tuna, one sample of which exceeded the recommended levels for safe human consumption.[48]

84. Cyanotoxins are also directly relevant to mahinga kai because they can accumulate in koura, kakahi, tuna, and trout through dietary and environmental exposure. Toxin exposure can also affect the behaviour, growth, and survival of koura and juvenile kakahi.[49]

Anthropogenic contamination

85. These increasing concentrations of anthropogenic contaminants, in particular metals, in mahinga kai pose a clear risk to human health. Many contaminants

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45 "Antibiotic resistance," World Health Organization, July 31, 2020, https://www.who.int/news-room/fact-sheets/detail/antibiotic-resistance.

46 Institute of Environmental Science and Research Limited., Notifiable Diseases in New Zealand: Annual Report 2019 (Porirua: Institute of Environmental Science and Research Limited, 2021), p. 37.

47 Ministry for the Environment and StatsNZ, Environment Aotearoa 2019, New Zealand's Environmental Reporting Series (Wellington: Ministry for the Environment and StatsNZ, 2019), p. 50.

48 B. Dolamore, J. Puddick, and S. A. Wood, "Accumulation of nodularin in New Zealand shortfin eel (Anguilla australis): potential consequences for human consumption," New Zealand Journal of Marine and Freshwater Research, 51, vol. 3 (2017): p. 325.

49 Kevin J. Collier, Susan J. Clearwater, Garth Harmsworth, Yvonne Taura, and Kiri Reihana, Physical and chemical attributes affecting survival and collection of freshwater mahinga kai species, Environmental Research Institute report no. 106 (Hamilton: The University of Waikato, 2017), p. 30.

are known to bioaccumulate through the food chain, such as organochlorine pesticides, polychlorinated biphenyls (PCBs), and certain heavy metals.

86. In a comprehensive study these contaminants were analysed in the important mahinga kai species eel (Anguilla sp.), brown trout (Salmo trutta), black flounder (Rhombosolea retiaria) and watercress (Nasturtium officinale), all from important harvesting sites in South Canterbury.[50] The study of South Canterbury mahinga kai sites revealed local tuna contained relatively high concentrations of PCBs, dieldrin, organochlorines, and the insecticides DDE and DDT. The harmful metals arsenic and mercury were also found in trout and flounder.

87. A cumulative lifetime cancer risk assessment in South Canterbury revealed potential health risk for people consuming some species.[51] Thus, even at low consumption rates there is evidence for establishing recommended dietary consumption limits for harvest sites within the study region. Calculations of lifetime excess cancer risk for dieldrin, PCBs, and DDE in tuna and arsenic in trout and flounder would need to be calculated over the whole Takiwā to know if there are more places that require dietary limits.

Nitrates in drinking water

88. The levels of contaminants in drinking water, in particular nitrates, are a major concern. Most drinking water in NZ comes from groundwater (53%) and rivers and lakes (26%), with only the minority made up of rainwater free from rising nitrate contamination.[52] Nitrate exposure during pregnancy contributes to poor birth outcomes, including pre-term births, low birth weights and congenital anomalies.[53]

89. A recent study in 2018 showed that nitrate levels of only 0.87 mg/L of nitrate-nitrogen in drinking water is linked to an increased risk of colorectal (bowel) cancer.[54] It is thought that the nitrate in the water converts into the carcinogenic compound N-nitroso after ingestion. Notably, 0.87 mg/L of nitrate-nitrogen is

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50 Michael Stewart, Ngaire R. Phillips, Greg Olson, Christopher W. Hickey, and Gail Tipa, "Organochlorines and heavy metals in wild caught food as a potential human health risk to the indigenous Māori population of South Canterbury, New Zealand," Sci Total Environ 409, no. 11 (2011): pp. 2029-2039.

51 Michael Stewart, Ngaire R. Phillips, Greg Olson, Christopher W. Hickey, and Gail Tipa, "Organochlorines and heavy metals in wild caught food as a potential human health risk to the indigenous Māori population of South Canterbury, New Zealand," Sci Total Environ 409, no. 11 (2011): pp. 2029-2039.

52 Ministry for the Environment, Review of National Environmental Standard for Sources of Human Drinking Water (Wellington: Ministry for the Environment, 2018), p. 10.

53 L. Grout, T. Chambers, S. Hales, M. Prickett, M.G. Baker, and N. Wilson, "The potential human health hazard of nitrates in drinking water: a media discourse analysis in a high-income country," Environmental Health 22, no. 1 (2023): p. 2.

54 J. Schullenher, B. Hansen, M. Thygesen, C.B. Pedersen, and T. Sigsgaard, "Nitrate in drinking water and colorectal cancer risk: A nationwide population-based cohort study," International Journal of Cancer 143, no. 1 (2018): p. 75, fig. 1.

more than 10 times lower than the current "maximum acceptable value" set by the Ministry of Health (which is 11.3 mg/L of nitrate-nitrogen).[55]

90. New Zealand has some of the highest rates of bowel cancer, with the highest incidences in South Canterbury and Southland.[56] These are also areas that contain high levels of nitrates in aquifers.[57]

Te Mana O Te Wai

91. Te Mana o te Wai (TMOTW) was developed initially through wānanga conducted by the Freshwater Iwi Chairs in 2017. It was then included in the National Policy Statement on Freshwater (NPSFW) in 2014 and 2017 through the advocacy of the Iwi Chairs and then was substantially extended in the current version in the NPSFW 2020 through Te Kahui Wai Māori (TKWM). TKWM was one of three groups set up by the Crown to give advice on NPSFW policy options (the others were the science technical advisory group and the freshwater leaders group).

i. TMOTW the hierarchy

92. The TMOTW hierarchy in the NPSFM is:

    1. the health and well-being of waterbodies and freshwater ecosystems
    2. the health needs of people (such as drinking water)
    3. the ability of people and communities to provide for their social, economic, and cultural wellbeing, now and in the future (my emphasis).

ii. The importance of TMOTW

93. The hierarchy of TMOTW is crucial as it is effectively the reverse of any hierarchy applied to date. Regional Councils have since their inception with the passing of the Resource Management Act consistently put short-term economic well-being before cultural, health and ecosystem health.

94. Putting the health and well-being of waterbodies and freshwater ecosystems first means a holistic approach and crucially applying the principle of ki uta ki tai ('from the mountains to the sea') including lakes, rivers, groundwaters, and hapua. The crucial part of level 3 is the 'in the future' this component can't be overstated long term thinking has been largely absent.

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55 https://www.health.govt.nz/your-health/healthy-living/drinking-water/nitrate-drinking-water#:~:text=Using%20drinking%2Dwater%20that%20has,the%20gut%20of%20an%20infant.

56 "HQSC Atlas of Healthcare Variation | Bowel cancer," Health Quality & Safety Commission New Zealand, accessed January 30, 2023, https://www.hqsc.govt.nz/assets/resources/Health-Quality-Evaluation/Atlas/BowelCancerSF/atlas.html.

57 "Groundwater quality," Stats NZ, accessed January 30, 2023, https://www.stats.govt.nz/indicators/groundwater-quality.

iii. TMOTW must be defined by mana whenua

95. Ki uta ki tai is crucial to TMOTW, it requires integrated management, integrating all the multitude of connected activities on the whenua. The only way real change for the better or at minimum halting the decline in freshwaters is through unconditionally changing what we do on the land. The biggest driver by far in the region currently is agricultural intensification. Thus, the only way change can occur is through reducing landuse intensity.

96. Reducing intensity can, easily be falsely framed as negative because in the short-term it will look like economic loss. This economic loss is a misconception because the current intensive landuse is not paying for the harm it causes, and so is effectively being subsidised by the public. This subsidy has resulted in a very uneven playing field favouring business as usual. In this situation landuse change that does less harm will undoubtably be less profitable on the farm balance sheet, but far better for all in the longer term.

iv. Integrated and Holistic - Ki uta ki tai

97. Adopting an integrated approach, ki uta ki tai, as required by Te Mana o te Wai, requires that local authorities must [58] :

98. recognise the interconnectedness of the whole environment, from the mountains and lakes, down the rivers to hāpua (lagoons), wahapū (estuaries) and to the sea; and

99. recognise interactions between freshwater, land, water bodies, ecosystems, and receiving environments; and

100. manage freshwater, and land use and development, in catchments in an integrated and sustainable way to avoid, remedy, or mitigate adverse effects, including cumulative effects, on the health and well-being of water bodies, freshwater ecosystems, and receiving environments; and encourage the co-ordination and sequencing of regional or urban growth.

101. ki uta ki tai is crucial to TMOTW since not one of the individual freshwater components (streams, rivers, groundwaters, lakes, and hapua can be individually healthy or protected if the whole catchment is not healthy.

102. Any management actions or activities undertaken aiming to achieve point one of TMOTW – the well-being of waterbodies and freshwater ecosystems must be concurrent and part of catchment-based plans. The current siloed approach where ad hoc restoration projects are undertaken simply does not work, it is not possible to fix individual parts of a totally connected and integrated system like a freshwater catchment.

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[58] https://environment.govt.nz/publications/guidance-on-the-national-objectives-framework-of-the-nps-fm/policy-3-and-clause-3-5/

103. Examples of this “ambulance at bottom of cliff” approach are restoration projects that ignore the source and try to treat the parts. Two relevant examples are “lake restoration projects” like those for Lake Horowhenua and Te Waihora.

104. Lake Horowhenua in the Horowhenua District for example has had millions of dollars spent on lakeside planting and walkways while horticultural intensity and freshwater impacts are increasing negating almost all the work of the restoration. The decline in the health of the lake has now been locked in for decades more when recently the Crown decided [59] to exempt the region from the NPSFM including TMOTW.

105. Another example in the Ngai tahu takiwā is Te Waihora where much effort is put into putatively restorative projects [60] but not challenging or reducing the source of the problem. A Crown analysis of the degradation of the Te Waihora waituna showed that the required reduction of nutrient flows (just to halt declines, not improve the waituna) would require wetland construction costing $380 million, or reduction in farming intensity resulting in a loss of revenue for dairy farmers of $250 - 300 million/pa [61]. This estimate was for loss of revenue but did not include other costs like the estimated costs for drinking water nitrate removal [62] and predicted costs of human health impacts like cancer [63]. These figures put into context the minimal amounts going into “restoration” projects.

106. The restoration efforts in both Lake examples are positive and valuable but the reality that they cannot have a hope of real change while the source of the problem is ignored must be acknowledged. This means accepting that despite the good work and goodwill the TMOTW hierarchy is not being met under this well-meaning but flawed approach.

Cumulative effects of intensification

107. One of the substantial flaws in freshwater management to date was a failure to take cumulative effects into account. Each consent was granted by Regional Councils under the mistaken assumption it would be the only impact and thus with granting of multiple consents with purportedly “less than minor” impacts they inevitably added up to major impacts. Thus, to achieve the goals and the hierarchy of TMOTW cumulative effects must be considered for the entire catchment or FMU.

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[59] https://www.environmentguide.org.nz/issues/freshwater/freshwater-management-framework/national-policy-statement-for-freshwater/
[60] https://tewaihora.org/regeneration/whakaora-te-waihora/
[61] https://environment.govt.nz/assets/OIA/Files/18-D-02833.pdf
[62] https://api.ecan.govt.nz/TrimPublicAPI/documents/download/3909177
[63] https://www.wsp.com/-/media/News/New-Zealand/Documents/What-if-the-allowable-nitrate-limit-is-lowered.pdf

Cheaper not to do harm

108. There was recognition from the Crown in the Essential Freshwater discussion document [64], that "It is more cost-effective to prevent degradation of waterways than to restore them after degradation has occurred, particularly in systems that have passed ecological 'tipping points' due to ongoing degradation."

109. This can be seen clearly with Crown analysis of the degradation of Te Waihora which showed that the required reduction of nutrient flows would require wetland construction costing $380 million [65] and the estimated costs for drinking water nitrate removal for Christchurch City and predicted costs of human health impacts like cancer [66].

MfE report on the failures of current mitigation practises to protect freshwater

110. A recent report from the Ministry for the Environment [67] revealed systemic failures of the key mitigation options for dairy farms, Farm Environment Plans (FEP) and Good Management Practice (GMP). This report is important because it highlights the failure of FEPs being promoted by government as a mitigation option for farm impacts on freshwater [68]

111. Despite in this example all the farms in the Ashburton Lakes catchment having FEPs that meet requirements of the Land and Water Regional Plan (LWRP) there is clear evidence of significant ongoing declines in lake water quality.

112. This failure highlighted another major issue because the FEPs meet the plan requirements the regulator Environment Canterbury (ECAN) is powerless to act even when harm to freshwater is clear. As was noted "resource consent conditions are locked in for the duration of a consent" so when evidence shows that despite the consents the environment is degrading councils have no way to react or reduce harm to environment until consent period ends.

113. The MfE report identified that targets in the Land and water regional Plan are too high to achieve required outcome. This mismatch of targets is what has happened all over New Zealand because targets are set by negotiation and compromise not science. This reveals the flawed approach where the scientific

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[64] https://environment.govt.nz/assets/publications/Files/action-for-healthy-waterways.pdf
[65] https://environment.govt.nz/assets/OIA/Files/18-D-02833.pdf
[66] https://www.wsp.com/-/media/News/New-Zealand/Documents/What-if-the-allowable-nitrate-limit-is-lowered.pdf
[67] Ministry for the Environment. 2023. Ōtūwharekai/Ashburton Lakes lessons-learnt report: A case study examining ongoing deterioration of water quality in the Ōtūwharekai lakes. Wellington: Ministry for the Environment.
[68] https://environment.govt.nz/acts-and-regulations/freshwater-implementation-guidance/freshwater-farm-plans/ ; https://www.beehive.govt.nz/release/freshwater-farm-plans-being-phased

limits are based on evidentially proven eutrophication tipping points, they are real and cannot be compromised by expediency and negotiation.

114. A further conclusion of the MfE report was that using controls based on output (the basis of freshwater management currently) don’t work, thus they must be input based or a combination of both.

115. The report also identified that critical decisions were devolved to farmers and their advisor’s and the fact they failed to protect freshwaters, reveals once again that industry attempts at self-regulation do not protect the environment. Monitoring of farms plans and GMP is reliant on third-party professionals, this has proven to be ineffectual and worse leaves the monitoring wide open to industry capture.

116. The MfE report revealed problems with using Overseer because the model averages N-loss across the entire farm, this meaning that the smaller scale crucial hot-spots, the pathways to lakes, rivers and groundwaters are averaged away.

117. The report revealed that Good Management Practice (GMP) audits are inadequate. While on-farm practices done less badly is better than nothing, crucially what is missed is the required scale of change required. Less bad is still bad for freshwaters.

118. The MfE report revealed that Farm Environment Plans are all about process and not outcome. This is a major flaw because the same requirements are set for all farms regardless of their differing potential to harm freshwater ecosystems.

119. One of the most crucial requirements for protecting freshwaters is Compliance Monitoring and Enforcement (CME) and like in many other regions ECAN was found to have failed in this crucial role. As they noted in the report “transparency and access to regulatory data was also not always adequate”.

120. The report concluded the only cost-effective mitigation identified by scientific studies were to remove livestock, this option despite being the obvious simplest solution is very rarely considered.

CONCLUSION

121. In summary, I conclude that:

a. Freshwater quality and ecosystem health in rivers lakes and groundwaters is declining in the Otago Region.

b. Halting this degradation of probably the most important resource for humankind is urgent.

c. Achieving this outcome will require a rapid and large reduction in landuse intensity particularly agriculture.

d. The hierarchy in the crucial part of the National Policy Statement for Freshwater 2020 Te mana o te wai makes this very clear – the health of water comes before all other demands.

e. It is important to note the crucial importance of a mountains to the sea Ki uta ki tai whole of catchment approach to freshwater management, and that it is much cheaper to avoid than it is to try and clean up after.

Dated this 27 day of 2023

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[Michael Kevin Joy]