

The public health case for Three Waters Reforms

New Zealand Trade & Industrial Waters Forum

Dr Tim Chambers August 19 2022 – tim.chambers@otago.ac.nz @tchambersnz

Me – Tim Chambers

Environmental Epidemiologist

- Relationship between place and space
- Impact of the built and natural environment
- Water quality focus
 - Nitrate
 - Fluoride



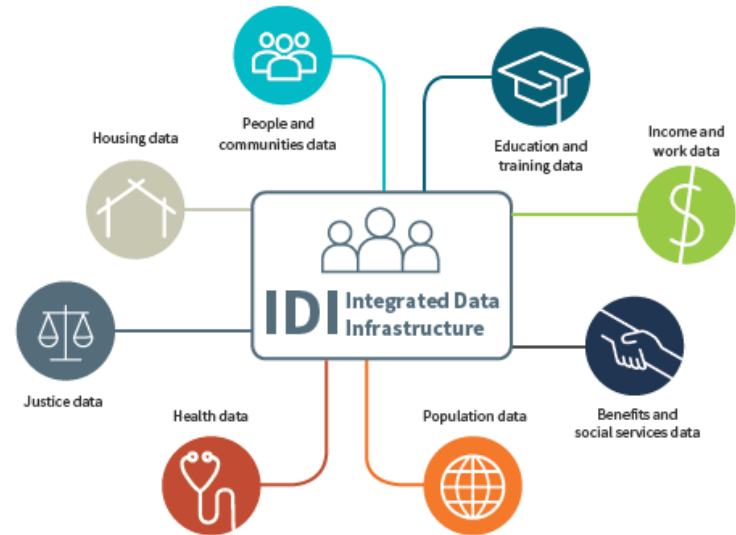
Nitrate and preterm births



Integrated Data
Infrastructure (IDI)

700,000 births from 2008-
2022

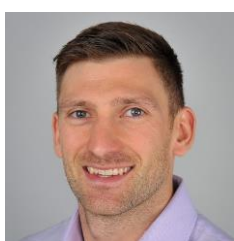
Nitrate data from LGOIMA
and environmental
Modelling



Fluoride

Water supplier ability to achieve optimal oral health

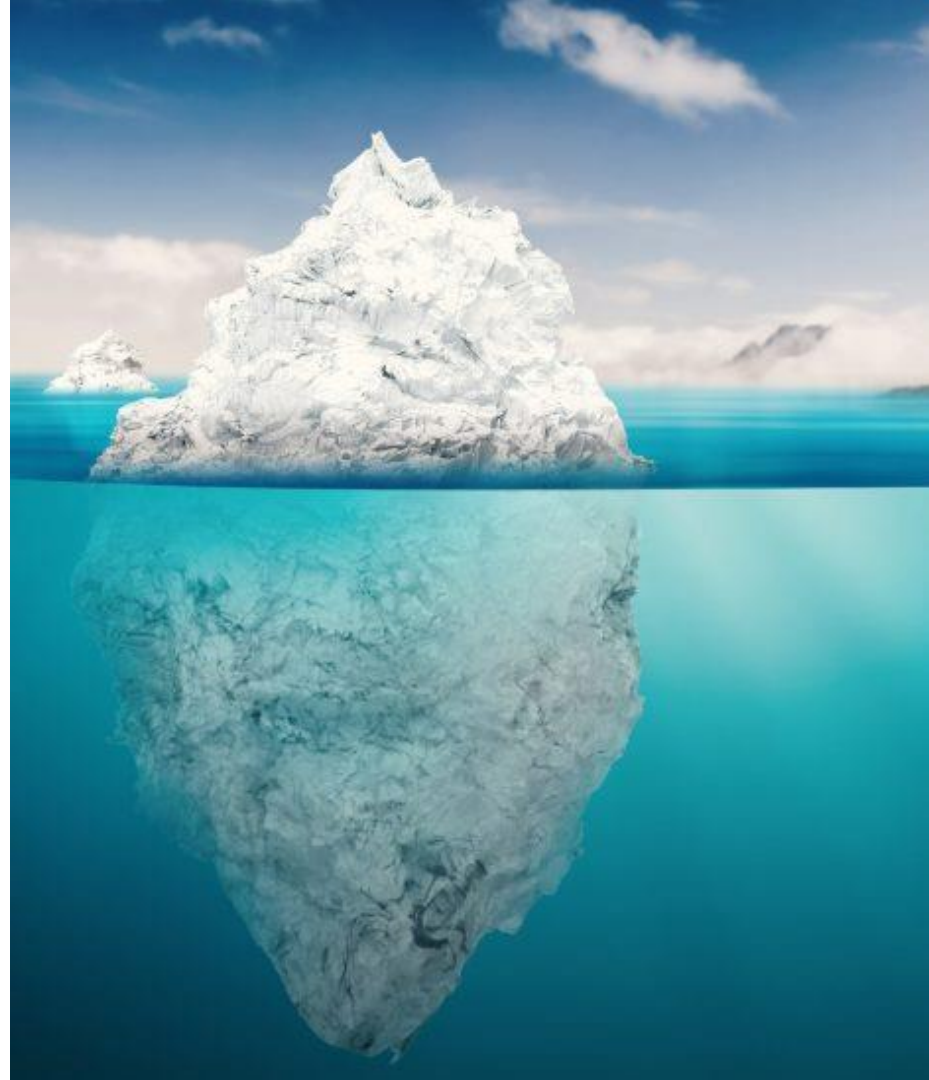
Plans to use the IDI to link fluoridation status and fluoride levels to oral health outcomes.



Outline

Drinking water and public health

1. How we got here
2. Estimate burden of disease
3. Potential of Three Waters
Reforms to address existing
and future challenges





1. How we got here

Havelock North

- ~8,000 people sick
- 58 hospitalisations
- Four deaths
- \$21 million



Government Inquiry

“Problems revealed in the Stage 1 Report in relation to HDC’s supply of drinking water to the residents of Havelock North are not confined to that region”



REPORT OF THE HAVELOCK NORTH DRINKING WATER INQUIRY: STAGE 2

Three Waters Reforms



Three Waters Reforms

The image is a screenshot of a blog post. At the top, there is a dark blue header with the text "Public Health Expert" in white. Below this, a smaller line of text reads: "What could we do, and what should we not do, to improve public health? This Blog has postings from p on issues such as efficiency, equity, interventions, politics, cost effectiveness and much more." The main title of the blog post is "Public Health Expert", with "Public Health" in blue and "Expert" in yellow. The title is flanked by two rows of stylized human figures, also in blue and yellow. Below the title, there is a navigation bar with a "Home" link. The main content area features the title "Three Waters reforms are needed to protect public health and ensure changes are economically sustainable and efficient" in a large, black, serif font. To the right of the main text, there is a search bar with the word "Search" inside. Below the search bar, there is a section titled "HAVING TRC POSTING CO" and a paragraph of text that begins with "If you are ha" and ends with "seeing a gree" and "button when".

Public Health Expert

What could we do, and what should we not do, to improve public health? This Blog has postings from p on issues such as efficiency, equity, interventions, politics, cost effectiveness and much more.

Public Health Expert

» Home »

Three Waters reforms are needed to protect public health and ensure changes are economically sustainable and efficient

Search

HAVING TRC POSTING CO

If you are ha
seeing a gree
button when



2. Estimated Burden of Disease



34,000 people
sick each year



One in four
people
drink non-
compliant water

First two months of Taumata Arowai

82 breaches

27 boil notices



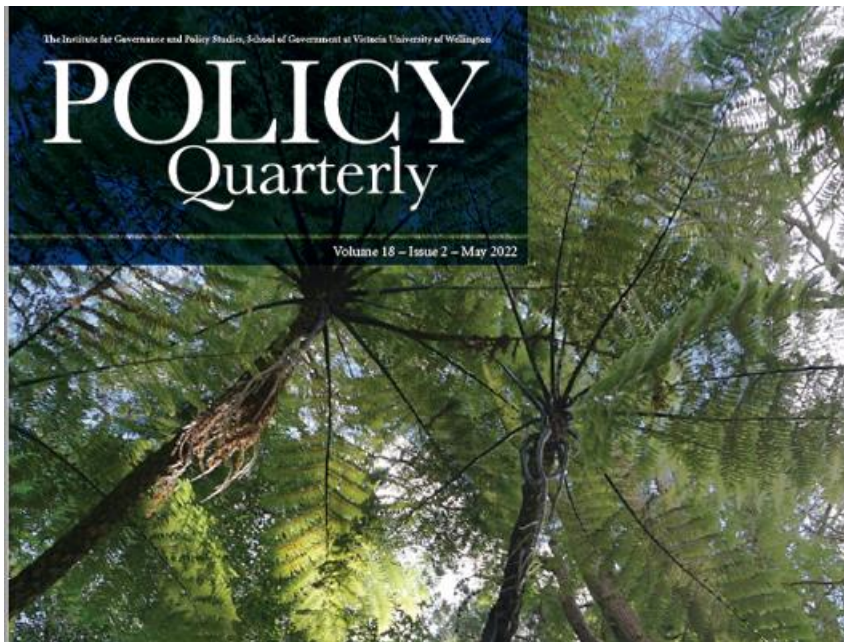
Inequities

- From 2009-2016, 96% of all bacterial exceedances came from supplies serving less than 5,000 people
- People living in deprived areas are exposed to greater public health risks than those living in lower deprived areas.
- It is estimated small/rural supplies will require almost double the increase in water charges compared to city supplies



1st issue

Drinking water monitoring



Tim Chambers, Simon Hales,
Nick Wilson and Michael Baker

Improvements to Drinking Water Monitoring, Reporting and Record-keeping Needed to Protect Health

Abstract

Taumata Arowai, the new independent water services regulator, recently consulted publicly on the drinking water rules for water suppliers. We use

In 2016, Havelock North's water-related campylobacteriosis outbreak made much of an entire town sick (around 8,000 people), with 58 hospitalisations and four deaths (Gilpin et al., 2020; Wilson et al., 2021). The outbreak was an outcome of systemic flaws in Aotearoa New Zealand's regulatory

P2 Determinands Programme

- National testing programme conducted between 1996-2004
- Below Half the MAV = no further testing required
- For example 18,000 people on water routinely tested for lead in 2020

Example Lead

Waikouaiti

- Detected through operational not regulatory monitoring.
- Only two tests for lead in the entire DCC drinking water network.



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NEW ZEALAND / HEALTH

Lead contamination in east Otago: A timeline of the events and what you need to know

5:25 pm on 5 February 2021

Share this



Example Lead

Christchurch

~47 km of pipes installed before
1940 are thought to contain lead
joints

11 exceedances since 2019

Council fast-tracks work to rid Christchurch of lead-jointed pipes

Tina Law • 16:26, Mar 07 2021



2nd Issue

Lack of data consistency

There is no national database for drinking water quality

Each water supplier keeps bespoke records which cannot be easily integrated into a national database

No data, no problem?

“Evidence of no effect”
is different than
“No evidence of an effect”

3rd Issue

Health impacts still uncertain

Waikato's worrying nitrate levels

2:17 pm on 8 July 2021

Share this



Andy Campbell, Local Democracy Reporter
✉ andyc@kingcountrynews.co.nz

Nitrate levels in Waikato's groundwater are causing concerns among scientists asked to look at the levels in the region.



Home News Radio Podcasts & Series

New Zealand World Politics Pacific Te

Concern as nitrate levels rise in half of wells tested in Canterbury



Home News Radio Podcasts & Series Topics Pacific

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NEW ZEALAND / HEALTH

Calls for 'precautionary approach' after study links nitrate levels to preterm births

NEW ZEALAND / HEALTH

Up to 800,000 New Zealanders may have increased bowel cancer risk due to nitrates in water

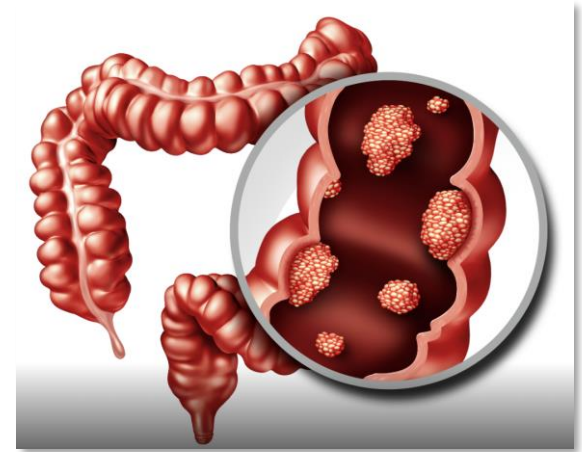
Nitrate and bowel cancer

Each year approximately 1,200 people in NZ die of colorectal cancer – high by international standards

International Agency for Research on Cancer (IARC, 2010)

“Probably carcinogenic to humans (group 2A)”

Form N-Nitroso Compounds – “NOC” (90% tested are known carcinogens)



WORLD HEALTH ORGANIZATION
INTERNATIONAL AGENCY FOR RESEARCH ON CANCER



*IARC Monographs on the Evaluation of
Carcinogenic Risks to Humans*

VOLUME 94

**Ingested Nitrate and Nitrite, and
Cyanobacterial Peptide Toxins**

Nitrate and bowel cancer

**French Agency for Food, Environmental and Occupational Health & Safety
(2022)**

“There is an association between the risk of bowel cancer and exposure to nitrites and/or nitrates, whether they are ingested via the consumption of processed meat or drinking water.

The higher the exposure to these compounds, the greater the risk of bowel cancer in the population”



anses

Nitrate and bowel cancer

A recent meta-analysis estimated a **4% increase in bowel cancer risk for every 1 mg/L increase in nitrate in drinking water** (Temkin et al., 2019)

Danish study (Schullehner et al., 2018)

Found increased risk of bowel cancer for drinking water with nitrate > 0.87 mg/L

Spanish and Italian study (Espejo-Herrera, 2016)

Found increased risk of bowel cancer for drinking water with nitrate > 1.61 mg/L

Overall limitations: small evidence base of robust studies; challenges with exposure assessment; potential confounding

doi: 10.1111/1753-6405.13222

Nitrate in drinking water and cancer risk: the biological mechanism, epidemiological evidence and future research

Tim Chambers,¹ Jeroen Douwes,² Andrea 't Mannetje,² Alistair Woodward,³ Michael Baker,¹ Nick Wilson,¹ Simon Hales¹

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3..School of Public Health, Auckland University, Auckland

Nitrate and preterm births

Preterm birth: any birth that occurs before 37 weeks

Leading cause of infant mortality (23% of deaths) and deaths of children under 5 (22% of deaths)

Surviving infants have higher rates of chronic health conditions, mental health and respiratory problems



Nitrate and preterm births

Large study of 4.6 million births conducted in California by Stanford University researchers

47% increase in risk of preterm birth (<32 weeks) where nitrate in drinking water > **5 mg/L NO₃-N**



Case study Christchurch

Council supply example

	Population	Current nitrate (mg/L)	Predicted nitrate (mg/L)		
Water supplies			5 th percentile	50 th percentile	95 th percentile
Christchurch	342,000	0.7	3.0	5.2	7.6

Modelling by GNS for Environment Canterbury's
Land and Water Regional Plan Change 7

Costs of treatment

Target Future Nitrate-Nitrogen Concentration			
Cost Estimate	5.65 mg/L	3.8 mg/L	1 mg/L
Capital Cost	\$347M	\$461M	\$610M
Annual Operating Cost	\$13M	\$18M	\$24M
Net Present Value	\$829M	\$1,117M	\$1,507M

1 mg/L scenario equates to 19 years of planned capex
and a 75% increase in opex for Christchurch water supply

Case study Waimate

Council supply example

Emergency drinking water delivered as nitrate levels exceed acceptable levels in rural Waimate supply

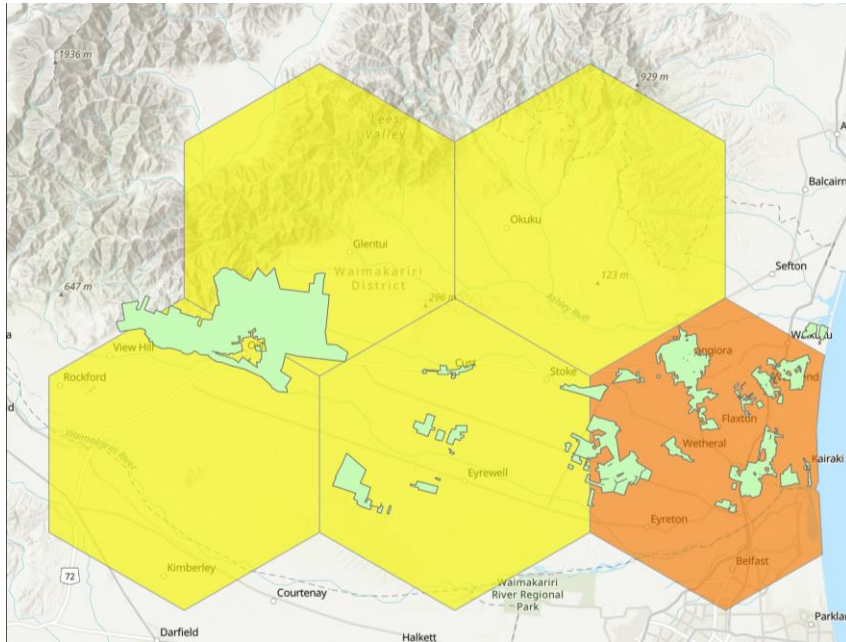
Yashas Srinivasa · 20:00, Aug 10 2022



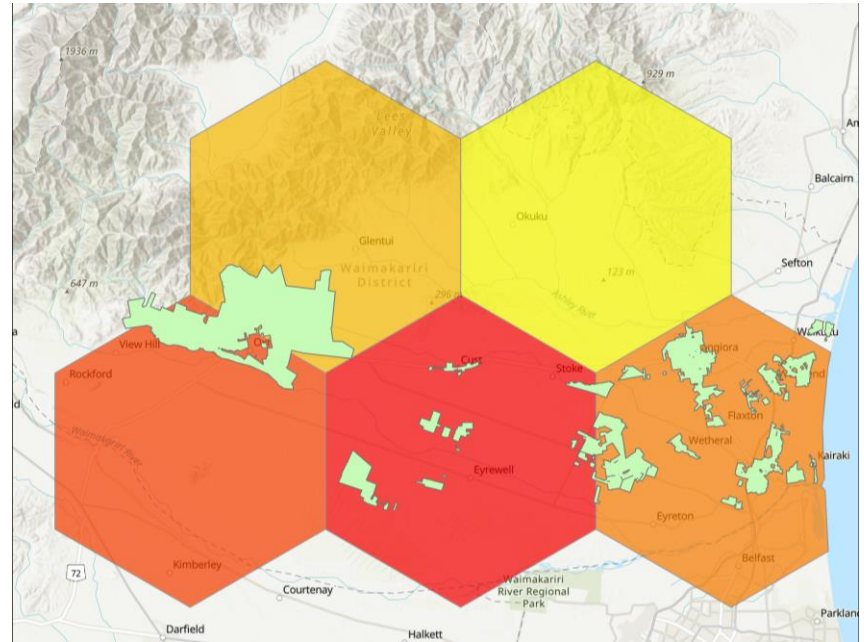
Case study Waimakariri

Private supplies

1994

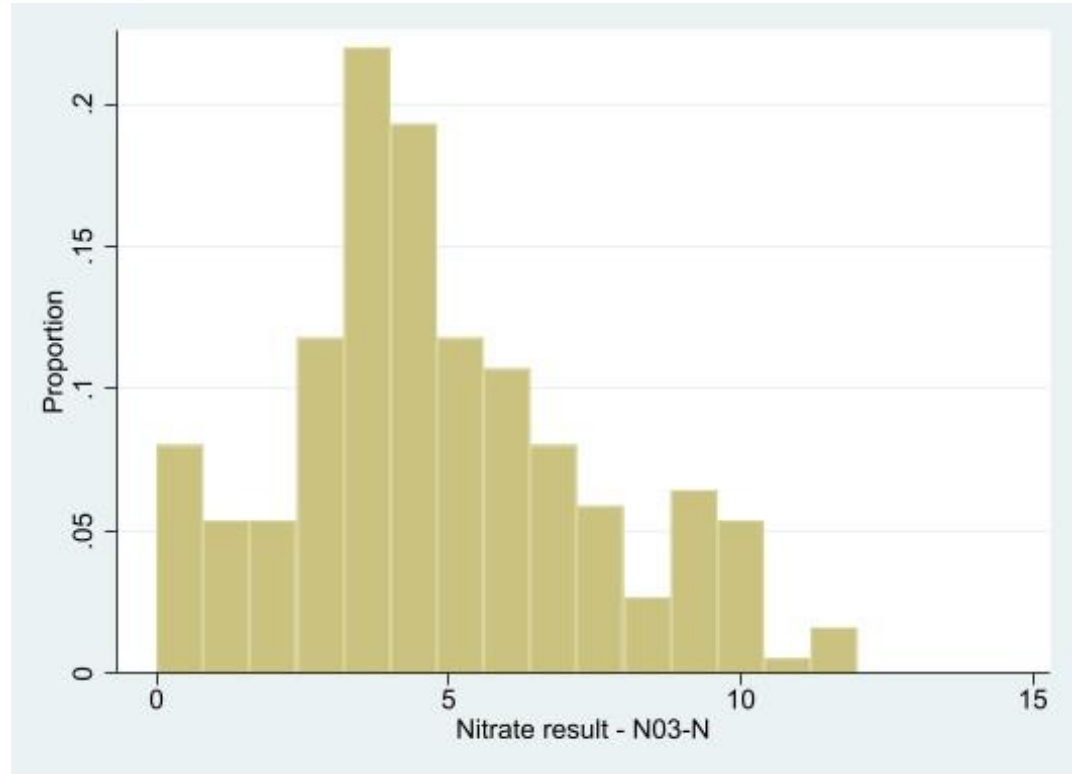


2017



Case study Waimakariri

Private supplies



Potential burden in New Zealand?

Potentially 100
cases of bowel
cancer attributable to
nitrate

BUT

Major assumptions

Environmental Research 204 (2022) 112322



Contents lists available at [ScienceDirect](#)

Environmental Research

journal homepage: www.elsevier.com/locate/envres



Nitrate contamination in drinking water and colorectal cancer: Exposure assessment and estimated health burden in New Zealand

Jayne Richards^a, Tim Chambers^{b,*}, Simon Hales^b, Mike Joy^c, Tanja Radu^a,
Alistair Woodward^d, Alistair Humphrey^e, Edward Randal^b, Michael G. Baker^b

2022 Interim Updated PFOA and PFOS Health Advisories

	2016		2022
PFOA	70ppt	—————→	0.004ppt
PFOS	70ppt	—————→	0.02ppt



3. Potential of Three Waters

1. Standardisation

Drinking water monitoring and reporting

Four water entities easier than 67

Expertise in data management centralised

Taumata Arowai not committed to a central database of water quality results

Better data, better public health surveillance and research

2. Centralisation of technical expertise

Limited expertise in the water sector - ~6000-9000 skilled workers needed over next 30 years

Not have sufficient expertise to run 67 water entities

- think hydrologists, engineers, public health, GIS specialists

Example GIS

Spatial data on water supply boundaries

Spatial data available	Number of councils		Population covered	
Complete GIS file	42	(63%)	3,600,000	(88%)
Incomplete GIS file	12	(18%)	266,000	(6%)
No files provided to researchers	9	(13%)	187,000	(5%)
Aerial images	4	(6%)	61,000	(1%)
Total	67	(100%)	4,114,000	(100%)

Example Fluoride

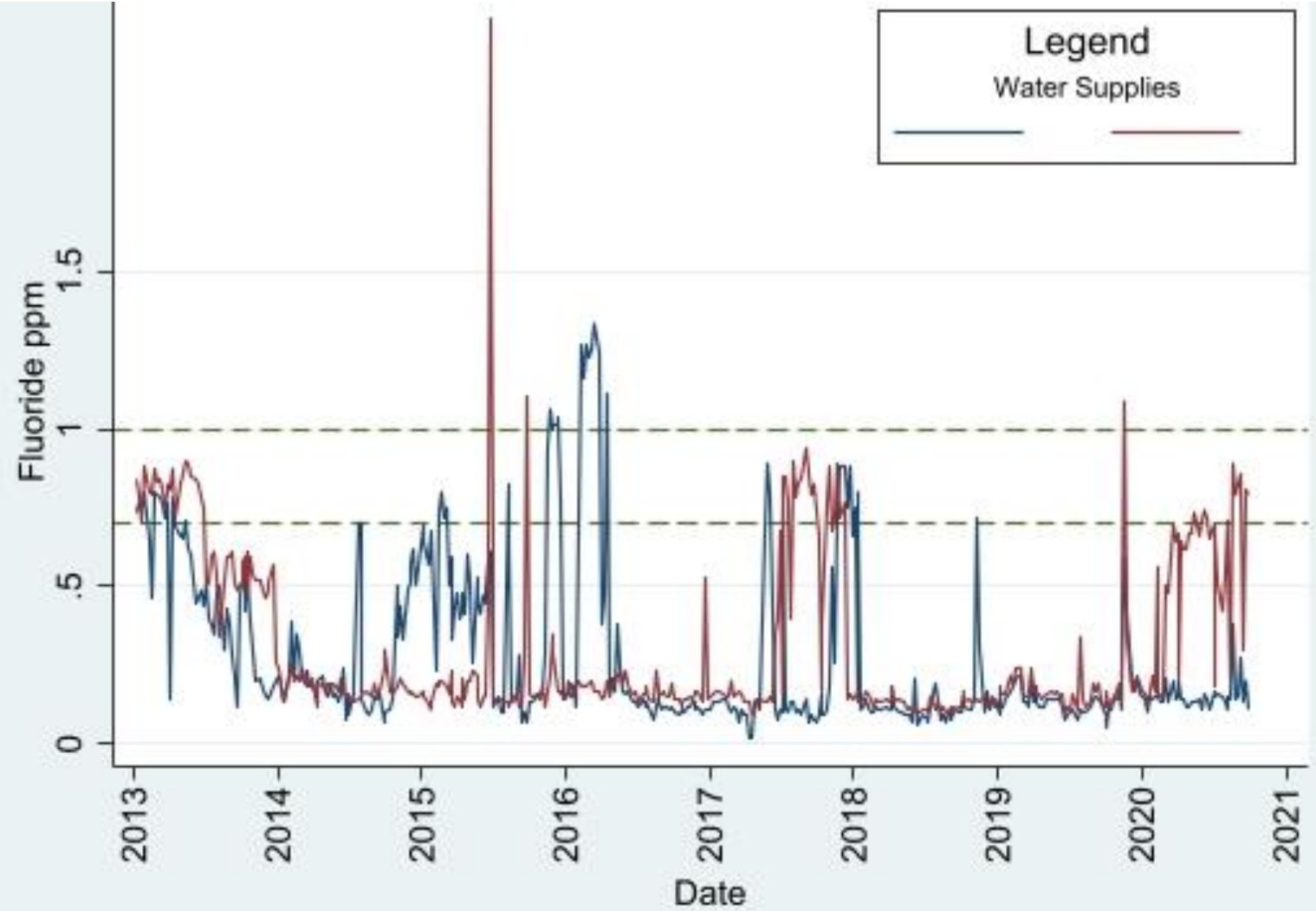
Wellington's water has been inadequately fluoridated for six years, review finds

8 Jul, 2022 03:00 PM

🕒 5 minutes to read



The independent inquiry was launched after fluoridation was turned off to parts of the Wellington region last year without residents being told. Photo / 123RF



Example fluoride



Between 1992 and 2022

**An assessment of compliance with optimal fluoride levels
for oral health benefit by New Zealand drinking water
suppliers**

22,000 weekly observations

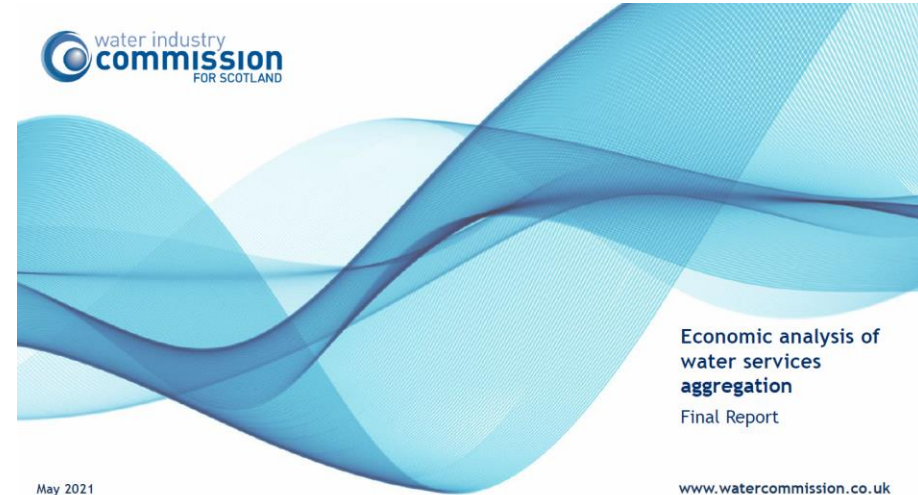
54% compliance with oral
health targets

3. Financial

Infrastructure deficit 120-185bn

Cost of Nitrate; PFAS; Lead; Fluoride;
Asbestos

Climate change



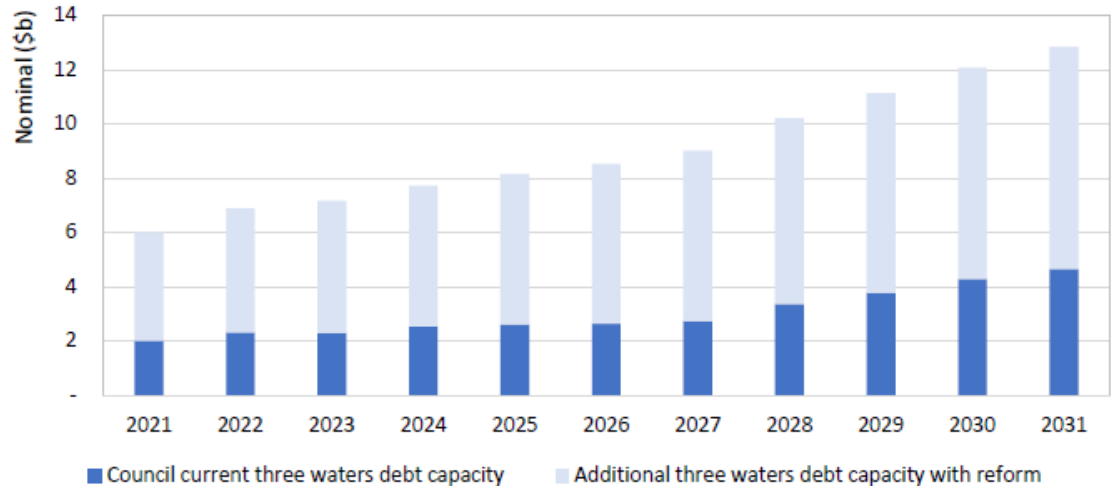
Financial

Borrowing constraints
of councils

Council balance sheets
inadequate

System efficiencies

Figure 10: Comparison of current council three waters debt capacity and additional debt capacity for new water services entities following reform



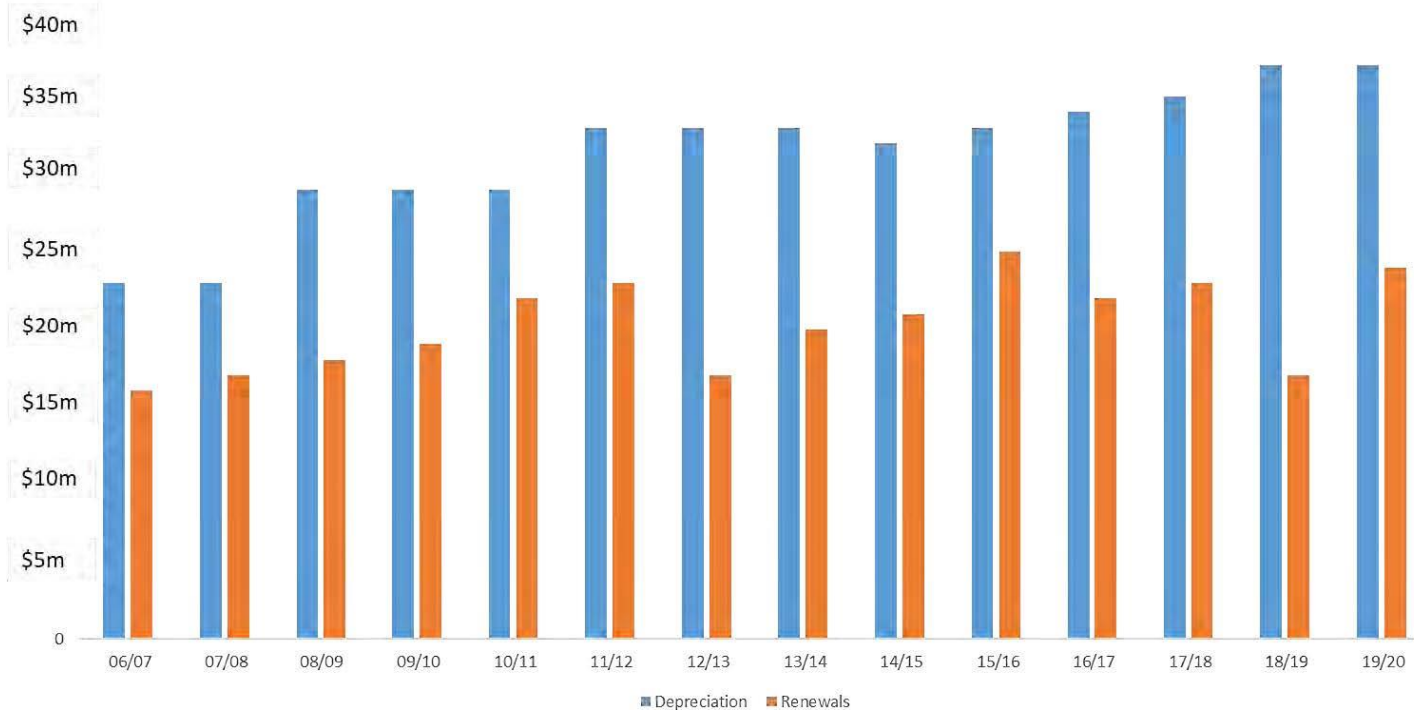
4. Decision-making

Short-term decision making

Prioritising political necessity

Decision-making

Comparing Historic Depreciation Funding
and Renewals Expenditure



Decision-making

Water Metering

Kāpiti Coast District Council

- 25% less water consumption

- 65% people paid less for water

Central Otago District Council

- Reduced operating costs by ~25%

- ~80% people paid less for water

Voted out...

A large white iceberg floats in a blue body of water under a clear sky. The iceberg's tip is visible above the water, while a much larger, submerged portion is visible below the surface, illustrating the concept of the 'tip of the iceberg'.

Conclusions

Three Waters is about public health

Current estimates may only be the tip of the iceberg

Three Waters is required to protect public health from existing and future challenges



Thank you – Questions