

A cost effectiveness analysis of community water fluoridation in New Zealand

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ABSTRACT

AIM: The aim of the study was to use recent data to determine whether Community Water Fluoridation (CWF) remains a cost effective public health intervention in New Zealand, given a reduction in dental caries in all communities over time.

METHOD: Local authorities that fluoridated their water supplies were asked to complete a questionnaire regarding fixed and variable costs incurred from CWF. Cost savings were calculated using data from the 2009 New Zealand Oral Health Survey. The cost effectiveness of CWF in conjunction with treatment per dmft/DMFT averted was compared to an alternative of treatment alone. Calculations were made for communities with populations of less than 5,000, 5,000 to 10,000, 10,001 to 50,000 and greater than 50,000.

RESULTS: CWF was cost effective in all communities at base case. CWF remained cost effective for communities over 5,000 under all scenarios when sensitivity analysis was conducted. For communities under 5,000 there was a positive net cost for CWF under certain scenarios.

CONCLUSION: In this study, CWF was a cost effective public health intervention in New Zealand. For smaller communities cost effectiveness would be more dependent upon the population risk profile of the community.

The World Health Organization (WHO) recommends a water fluoride concentration of 1–1.5mg per litre, depending on local climatic conditions.¹ This level has been set in order to maximise the caries preventative benefit of Community Water Fluoridation (CWF) while minimising the degree and prevalence of dental fluorosis (which causes stained, mottled teeth). New Zealand was one of the first countries to adopt CWF as a public health intervention to lower rates of dental cavities. Results from early trials found that children born and brought up in fluoridated areas had, on average, 50% fewer cavities compared to children from non-fluoridated areas.²

Approximately 56% of New Zealander's have access to fluoridated water.³ The Ministry of Health recommends a water fluoride concentration of 0.7–1.0mg/l to improve oral health; however, responsibility for implementing CWF has remained with local authorities since the 1950s.⁴

The last economic analysis of CWF in New Zealand, by Wright et al (2001), found it

was a cost effective intervention in communities of over 1,000 people.⁵ It has been noted that prevalence of dental caries has decreased over time, both in fluoridated and non-fluoridated communities.² The aim of the current study was to use more recent data to determine whether community water fluoridation remained a cost effective public health intervention in New Zealand.

Method

A cost effectiveness analysis (CEA) was conducted from a societal perspective. CWF at a level of 0.7–1.0mg/l with treatment was evaluated against a treatment only option for the prevention of dental caries. The CEA measured the cost of preventing one newly decayed tooth, rather than a tooth surface, as the effectiveness data for teeth had greater statistical significance than that for tooth surfaces.⁵

In line with Wright et al,⁵ the CEA examined the relationship between cost effectiveness and community size. Four

communities sizes (minor, medium, large 1 and large 2) were identified based on three *Register of Drinking Water Suppliers for New Zealand*⁶ derived groupings. The large group was split into two, due to a wide variation in the size of communities included.

CEA was conducted separately for children and total population. Fluoride was considered to be effective for all adults that were dentate. Recent evidence suggests the effectiveness of fluoride is both systemic and topical, resulting in a protective effect continuing after teeth have erupted.⁷

Data collection

Fluoridation status of water supplies was identified using data from the National Fluoridation Information Service (NFIS), Environmental Scan for 2011–2012.⁸ Local authorities supplying fluoridated water were contacted to identify the correct person and organisation to direct questions regarding CWF. A questionnaire was emailed to the organisations identified. If replies were not received within two weeks, a follow-up phone call was made and a second email sent. This process was repeated if there was no response after six weeks. After this point, a non-response outcome was assumed and no further contact made.

Fixed capital costs, lifespan of plant and machinery, salvage value, and ongoing costs (purchase of chemical, labour from administration and maintenance of CWF and water testing) were requested in the questionnaire. Population which received a fluoridated water supply were cross referenced against the *Register of Drinking Water Suppliers for New Zealand*.⁶

Cost of adverse side effects (dental fluorosis) was assumed to be negligible and not attributed a value. This was in line with previous studies undertaken.^{5,9,10} In addition, the most recent New Zealand Oral Health Survey found no statistically significant difference in prevalence of dental fluorosis between 8–30-year-olds living in areas with CWF compared to those in areas without CWF.⁷

Data on mean difference in decayed, missing and filled teeth (dmft: deciduous teeth; DMFT: permanent teeth) between fluoridated and non-fluoridated communities were taken from the *New Zealand Oral Health Survey*.⁷ These data represented

a mean for the total New Zealand population and were adjusted for age, gender, ethnicity and socioeconomic deprivation. Dental costs averted were identified for total population, and children. The proportion of dentate people within the population was calculated using data from the same source.⁷

Consistent with previous studies, the following assumptions were made:

- All carious surfaces would be treated and treatment would comprise of a two surface dental restoration per dmft/DMFT.^{10–12} Wright et al based their analysis on a dental restoration.
- Cost was based on the reimbursement rate under the CDA base agreement for the treatment of children and adolescents,¹³ adjusted to the 2011/2012 financial year using the consumer price index.¹⁴ This cost may be conservative for total population as adults visiting a private dental practice may be charged at a higher rate.
- There would be a one hour loss of productivity to attend a dental appointment.⁹ Indirect costs arising from loss of productivity were based on the average hourly wage rate in 2011.¹⁵
- The population profile reflects that of the New Zealand population, described in the *New Zealand Oral Health Survey*,⁷ from which effectiveness data for CWF was based. Level of effectiveness had already been adjusted for ethnicity, age and gender.

Data Analysis

Data on costs of CWF received from local authorities supplying fluoridated water was adjusted to the 2011/2012 financial year using the New Zealand Consumer Price Index.¹⁴ Average annual equivalised costs were calculated at a base discount rate of 3.5% (as recommended by PHARMAC),¹⁶ and a base life span for capital equipment of 15 years—based on questionnaire responses and in line with other analyses conducted in Australasia.^{5,10} The salvage value of plant and machinery (FV) was set at zero in line with questionnaire responses.

The Annual Equivalised Cost of capital equipment was calculated and added to the annual costs for the chemical, mainte-

Table 1: AEC per capita of CWF at base rate (3.5% discount rate, 15 year lifespan of plant and machinery).

Size of community served	Mean annual equivalised cost (AEC) per capita of CWF
Small (< 5000) Range: 744–3,240	\$4.38 \$5.63–\$0.94
Medium (5–10,000) Range: 7,542–9,710	\$1.23 \$0.71–\$1.75
Large 1 (10–50,000) Range: 19,000–34,300	\$0.66 \$0.68–\$0.63
Large 2 (>50,000) Range: 74,953–343,900	\$0.53 \$0.88–\$0.37

nance and testing. The sum was divided by the population of the community served, to gain an Annual Equivalised Cost per person (AEC per capita).

Average AEC per capita was determined for communities with populations of: <5,000 (small); 5,000–10,000 (medium); 10,001–50,000 (large 1) and > 50,000 (large 2).⁶

Present value of cost averted resulting from CWF was calculated for the mean difference in dmft/DMFT between communities with CWF and those without. The cost of treatment was divided by the lifespan of the treatment (12.8 years),¹⁷ to determine annual cost averted at a discount rate of 3.5%. Annual cost averted was divided by the percentage of the population who were dentate to give an annual equivalised per person cost averted (AES per capita).

Cost effectiveness was calculated using net cost per DMFT averted, by subtracting AES per capita from AEC per capita, (see Appendix 1 for formulae used in the data analysis).

Sensitivity Analysis

A univariant sensitivity analysis was conducted. Univariant analysis was used as (with the exception of the discount rate) inputs were prone to parameter uncertainty rather than causing uncertainty to the cost effectiveness ratio as a whole.¹⁸

Sensitivity analysis was conducted on:

- Discount rates: 0%, 5% recommended for sensitivity analysis by PHARMAC,¹⁶ and 6.4%, the nominal rate recommended by the New Zealand Treasury.¹⁹
- Number of years of life for fluoridation equipment, 8–30 years based on the shortest and longest replacement periods reported for parts in the questionnaire.

- Number of years of life for a dental restoration, 8–15 years based on protocol from previous studies.^{5,10}

Results

Fluoridation Costs Questionnaire

Twenty-eight communities (total population 2,110,778) were identified as receiving fluoridated water from 20 suppliers in 2011/2012. All 20 suppliers were contacted and asked to complete the questionnaire. Sixteen responded, of whom two suppliers refused to answer the questions for commercial reasons, two sets of costs were incomplete and one set of costs was found to be anomalous. The final inclusion rate of 55% covered 11 of the 20 suppliers of fluoridated water, 12 out of 28 fluoridated communities (43%) and a population of 420,616, (20% of those receiving fluoridated water). Responses were evenly distributed geographically and between sizes of community, with two exceptions. Water providers for four out of the five small fluoridated communities responded to the survey. The provider for Auckland, the largest community receiving fluoridated water (population 1,249,858), did not complete the questionnaire.

At base rate, the total annual equivalised per capita cost of community water fluoridation ranged from \$0.37 to \$5.63; mean: \$1.95; median: \$1.32. Full cost details used in the calculation of AEC per capita can be found in Appendix 2. A strong relationship was evident between community size and cost (Table 1).

Costs Averted from Community Water Fluoridation

The difference in mean dmft/DMFT between communities with and without CWF was 1.0 dmft/DMFT ($p < 0.05$) for

Table 2: Difference in mean dmft/DMFT between fluoridated and non-fluoridated communities
Source: *New Zealand Oral Health Survey (2009)*.⁷

	Mean dmft/ DMFT non-fluoridated area (95% CI)	Mean dmft/ DMFT fluoridated area (95% CI)	Ratio of means	Difference in mean dmft/DMFT
Children (2–17 years)	2.4 (2.0–2.6)	1.5 (1.1–1.9)	1.7	1.0
Total (> 2 years)	12.1 (11.5–12.7)	9.6 (9.1–10.1)	1.1	0.8

Table 3: Average annual per capita net cost of CWF per dmft/DMFT averted.

Population	Cost Effectiveness by Community Size (\$ per dmft/DMFT averted)			
	Small: (<5000)	Medium: (5,000–10,000)	Large 1: (10,001–50000)	Large 2: (>50,000)
Child	-\$2.23	-\$5.38	-\$5.95	-\$6.09
Total	-\$0.55	-\$4.49	-\$5.20	-\$5.38

Table 4: Sensitivity Analysis Range for CWF (net cost per dmft/DMFT averted).

Population	Value Range	Cost Effectiveness Range by Community Size (\$ per dmft/DMFT averted)			
		Small (<5,000)	Medium (5,000–10,000)	Large 1 (10,001–50,000)	Large 2 (>50,000)
Child	Low	+\$2.5	-\$1.71	-\$2.67	-\$2.8
	High	-\$9.57	-\$11.98	-\$13.71	-\$13.81
Total	Low	+\$4.24	-\$1.03	-\$2.23	-\$2.39
	High	-\$7.78	-\$10.79	-\$11.19	-\$11.31

children (<18 years) and 0.8 dmft/DMFT (p<0.05), for total population, see Table 2.⁷

Costs averted, adjusted to 2011 prices, were \$82.33 for a two surface dental restoration and \$20.64 for one hour’s loss of productivity to attend the dental appointment, based on the average wage in 2011.

The annual equalised per capita costs averted resulting from CWF was \$4.82 for total population and \$5.21 for children.

Cost effectiveness of CWF

CWF represented a negative net cost (cost saving) at base rate per dmft/DMFT averted for total population and children in all four communities. This indicated that CWF with treatment was a more cost effective oral health intervention than treatment alone for those groups (Table 3).

Sensitivity Analysis

A negative net cost (cost saving) per dmft/DMFT averted remained for CWF for total population and children in all communities with populations of over 5,000 when the variables were adjusted for sensitivity analysis, (Table 4).

Positive values for communities under 5,000 at the ‘low’ end of the value range indicate that CWF with treatment was less

cost effective than treatment alone under certain scenarios: when the discount rate was increased above 3.5%, the lifespan of plant was reduced from 15 to 8 years; when the lifespan of a dental restoration was increased from 12.8 to 15 years; and when only direct costs (cost of treatment but not loss of productivity) were included.

CWF with treatment was less cost effective than treatment alone, for total population in small communities (<5,000) at all discount rates when lifespan of plant and machinery was ≤8 years and only direct costs were included. When the base discount rate (3.5%) was used, CWF with treatment was less cost effective than treatment alone when only direct costs were included. When the discount rate was increased to 5% and above, CWF had a positive cost effectiveness ratio when all other variables were at base case.

In small communities (<5,000), CWF with treatment was less cost effective than treatment alone, for children at the base discount rate when a dental restoration was assumed to last ≥15 years. At a discount rate of 6.4% CWF with treatment was less cost effective than treatment alone for children when all other variables were at base case.

Discussion

The baseline results, which show a negative net cost per dmft/DMFT averted for CWF with treatment when compared to treatment alone, were consistent with Wright et al, and a number of other economic analyses undertaken since.^{5,9-12,20-25} Cost effectiveness remained, despite an overall reduction in dental caries in the population. In other studies, levels of effectiveness for CWF have varied between 50–60%,¹¹ 30%,²⁶ 25%²² and 15%.²³ Even where gains in effectiveness were modest, savings in dental treatment mean that CWF could still provide a net saving to society both in monetary and oral health terms.

Community size and cost effectiveness of CWF

Due to higher per capita costs for implementation and maintenance, CWF with treatment was less cost effective than treatment alone when lifespan of a filling was reduced to eight years (in line with Wright et al) in small communities. CWF with treatment was also less cost effective than treatment alone for these communities where the lifespan of plant and machinery were reduced and the discount rate increased. These findings were similar to those of previous studies.^{5,22} Wright et al identified a 'break-even' community size for CWF of 700–900 people.⁵ The four communities making up the 'small' classification in this study ranged from 744 to 3,240 people.

Effectiveness of CWF

The levels of effectiveness used in this study were based on adjusted mean differences in dmft/DMFT between fluoridated and non-fluoridated communities, reported by the 2009 *New Zealand Oral Health Survey*.⁷ The unadjusted differences represented a 20.7% reduction in dmft/DMFT for the total population and a 47.5% reduction in dmft/DMFT for children. The figure for total population demonstrates a lower level of effectiveness for CWF than found in most previous studies.^{11,22,26} Despite lower levels of effectiveness, CWF remained cost effective. This finding was supported by Tchouaket et al, who found that cost savings could be achieved even at an effectiveness level of 1%.²⁶

In addition to differences in effectiveness between age groups and over time, some populations are more at risk of caries than others.^{25,5} The analysis undertaken in this study was based on the New Zealand population as a whole. Communities that have a higher risk of dental caries would show greater cost-effectiveness. This might make small rural communities, where the population has a greater proportion of Māori and/or low-income families, more appropriate candidates for CWF than communities with larger but more affluent populations. Wright et al identified that cost effectiveness increased in areas where the proportion of the population that were Māori was above the national rate.⁵ Lopez²⁵ identified higher levels of cost savings from CWF amongst (low income) medicaid recipients in Texas. Differences of this sort were also demonstrated by Birch using a hypothetical model of the UK.²⁷

Limitations

This cost effective analysis has a number of limitations. Costs which were not included, for example adverse effects and 'selling' CWF to the community, may have led to an over-estimation of the cost effectiveness of CWF. Likewise, cost savings which were not included, such as pain and suffering averted and dental treatments beyond a two surface dental restoration, may have led to an under-estimation of the cost-effectiveness of CWF.

Three limitations arose from the data collection.

Firstly, not all providers responded to the questionnaire.

Secondly, of those providers that did reply, data for five providers was excluded. Data suitable for use in this study equated to around 20% of people who received fluoridated water in New Zealand in 2011/2012.

Thirdly, the open nature of the questions gave a wide scope for attributing costs. While this allowed local authorities to attribute the costs of CWF as they perceived them, it did lead to a lack of consistency between local authorities.

The data for the effectiveness of CWF was taken from the 2009 *New Zealand Oral Health Survey*. Fluoridation status was determined by where the respondent lived at the time of the survey. Movement

of individuals between communities, resulting in different levels of exposure, and length of time the community had received fluoridated water was not taken into account. The lack of information on lifetime exposure particularly limits the reliability of the data for adults. In addition, confounding factors, such as oral hygiene habits, exposure to other fluoride sources and diet, were not controlled for. It was also assumed that for adults, over 45 years of age, missing teeth had been extracted solely for pathological reasons.⁹

Conclusion

The cost effectiveness analysis supports the findings of an earlier economic analysis of water fluoridation in New Zealand by Wright et al.⁵ CWF is a cost effective public health intervention in New Zealand for all populations. For smaller communities cost effectiveness is more marginal and dependent on the population profile of the community.

Competing interests: Nil

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REFERENCES:

1. Fawell J, Bailey K, Chilton J, et al. Fluoride in Drinking Water. London: World Health Organisation 2006.
2. Mullen J. History of Water Fluoridation. *British Dental Journal*. 2005;199 (7):1-4
3. Ministry of Health. Annual report on drinking water quality 2012-2013. Wellington: Ministry of Health. 2014
4. Ministry of Health. [2009]. Fluoridation -faqs. New Zealand Ministry of Health. Available: <http://www.moh.govt.nz/moh.nsf/pagesmh/3590>. [2011 September 20]
5. Wright JC, Bates MN, Cutress T, et al. The cost-effectiveness of fluoridating water supplies in New Zealand. *Australian and New Zealand Journal of Public Health*, 2001;25(2):170-178.
6. Environmental Science and Research. [2013]. Register of Drinking Water Suppliers for New Zealand. ESR. Available: <http://www.esr.cri.nz/SiteCollectionDocuments/ESR/PDF/WaterManagement/RegisterofSuppliers.pdf>. [2013, July 30]
7. Ministry of Health. Our Oral Health: Key findings of the 2009 New Zealand Oral Health Survey. Wellington : Ministry of Health, 2010.
8. National Fluoridation Information Service. [2012]. Environmental Scan: The Status of Community Water Fluoridation in New Zealand: March 2011-March 2012. NFIS. Available: <http://www.rph.org.nz/content/ed5a0549-af16-49f2-9ce0-043dcf8ff120.cmr>. [2013 May 30]
9. Campaign, AC, Marino RJ, Wright FA et. al. The impact of changing dental needs on cost savings from fluoridation. *Australian Dental Journal* 2010;55:37-44.

10. Cobiac LJ, Vos T. Cost-effectiveness of extending the coverage of water supply fluoridation for the prevention of dental caries in Australia. *Community Dentistry and Oral Epidemiology*. 2012, 40(4);369-76
11. van Wyk PJ, Kroon J and Holtshousen WSJ. Cost evaluation for the implementation of water fluoridation in Gauteng. 2001, *Journal of the South African Dental Association*. 2001;56;71-76.
12. Ciketic S, Hayaybakhsh MR, Doran CM. Drinking water fluoridation in South East Queensland: a cost effectiveness evaluation. *Health Promotion Journal of Australia*. 2010;21(1);51-56.
13. CDA. CDA Base Agreement. Service Agreement for the Provision of Oral Health Services for Adolescents and Special Dental Services for Children and Adolescents. Wellington. unpublished. 2012.
14. Rate Inflation. [2013]. New Zealand Consumer Price Index (CPI) History - 2003 to 2013. Rate Inflation. Available: <http://www.rateinflation.com/consumer-price-index/new-zealand-historical-cpi>. [2013 October 26]
15. Statistics New Zealand. [2011]. New Zealand Income Survey. StatsNZ. Available: http://www.stats.govt.nz/browse_for_stats/income-and-work/Income/NZIncomeSurvey_HOTPJun11qtr.aspx. [2013 July 30]
16. PHARMAC. [2012]. Prescription for Pharmacoeconomic Analysis: Methods of Cost utility Analysis (v2.1). PHARMAC. [2013 November 15] http://www.pharmac.health.nz/ckeditor_assets/attachments/5/pfpafinal.pdf.
17. Van Nieuwenhausen FP, D'Hoore, Carvalho J, Qvist V. Long term evaluation of extensive restorations in permanent teeth. *Journal of Dentistry*. 2003;31(6);395-405.
18. Drummond MF, Sculpher MJ, Torrance GW. *Methods for the Economic Evaluation of Health Care Programmes* (3rd ed.). Oxford: Oxford University Press. 2005.
19. Treasury. [2008] Public Sector Discount Rates for Cost Benefit Analysis. <http://www.treasury.govt.nz/publications/guidance/planning/costbenefitanalysis/discountrates/discount-rates-jul08.pdf>. [2013 November 2]
20. Mariño R, Fajardo J and Morgan M. Cost-effectiveness models for dental caries prevention programmes among Chilean schoolchildren. *Community Dental Health*. 2012;29(4);302-308.
21. O'Connell JM, Brunson D, Anselmo T, Sullivan PW. Costs and Savings Associated with Community Water Fluoridation Programs in Colorado Preventing Chronic Disease: Public Health Research, Practice and Policy. 2005;2;1-13
22. Griffin SO, Jones K, and Tomar SL. An Economic Evaluation of Community Water Fluoridation. *Journal of Public Health Dentistry*. 2001;61(2);78-86.
23. Kroon J, Van Wyk, P J. A model to determine the economic viability of water fluoridation. *Journal of Public Health Dentistry*. 2012;72(4);327-333
24. Kroon J, van Wyk PJ. A retrospective view on the viability of water fluoridation in South Africa to prevent dental caries. *Community Dentistry and Oral Epidemiology*. 2012;40(5);441-450
25. Lopez JA. The cost of publicly financed dental care in relation to community water fluoridation in Texas. *Masters Abstracts International*. 2011;49(1)
26. Tchouaket E, Brousselle A, Fansi A et. al. The economic value of Quebec's water fluoridation program. *Journal of Public Health*. 2013;21(6);523-533
27. Birch S. The relative cost effectiveness of water fluoridation across communities: analysis of variations according to underlying caries levels. *Community Dental Health*. 1990;7(1);3-10.

Appendix 1:

Equations used in the cost effectiveness calculation:

1. Annual equivalent cost of capital for CWF:

$$PMTc = PV \times DR / (1 - (1 + DR)^{-T})$$

Where:

PMTc = Annual equivalent cost of capital equipment (fluoridation equipment)

PV = Present value (purchased cost of the asset)

FV = Future value (salvage cost (if any) of the asset when it is replaced)

DR = Discount rate

T = lifespan of the asset

2. Annual equivalised cost per capita of CWF:

$$AEC \text{ per capita} = \frac{(PMT + c + m + t)}{n}$$

Where:

PMT = Annual equivalent cost of capital equipment

C = annual cost of chemical

m = cost of maintenance, labour and administration

t = cost of independent testing of water fluoride concentration

3. Costs averted resulting from CWF:

$$PV = (dc + ic) \times dif(\mu DMFT)$$

Where:

PV = present value of dental treatment

dc = direct cost (of a two surface amalgam filling)

ic = indirect cost (productivity loss to seek treatment)

dif(μ DMFT) = the difference in mean DMFT (for the relevant population) resulting from CWF

4. Annual costs averted resulting from CWF:

$$PMTs = PV \times DR / (1 - (1 + DR)^{-T})$$

Where:

PMTs = Annual equivalent costs averted

PV = Present value (reimbursement rate for treatment)

DR = Discount rate (3.5%)

T = lifespan of the treatment (12.8 years)

5. Annual equivalised per capita costs averted:

$$AES \text{ per capita} = \frac{PMTs}{(\text{dentate population})}$$

6. Cost effectiveness per dmft/DMFT averted:

$$CE = \frac{(AEC - AES)}{dif(\mu DMFT)}$$

Where:

AEC - AES = net cost of CWF

dif(μ DMFT) = difference in mean DMFT resulting from CWF

Appendix 2: Cost components of CWF by community

Plant	Size of community served	Acquisition Costs* (\$)	Annual equivalent cost (\$)	Chemical** (\$)	Maintenance and testing*** (\$)	Population size#	Per capita capital cost (\$)	Year	Per Capita Cost of Maintenance and Testing (\$)	Per Capita Cost of Chemical (\$)	Total Annual Costs (\$)	Per Capita Annual Costs (\$)
1	large 2 (>50,000)	114,330	9,926.71	35,700	1,200	101,354	0.1	2011	0.01	0.35	46,826.71	0.46
2	small (<5,000)	22,500	1,953.56	4,624	500	2,040	0.96	2011	0.25	2.27	7,077.56	3.47
3	small (<5,000)	27,500	2,387.69	1,950	500	860	2.78	2011	0.58	2.27	4,837.69	5.63
4	small (<5,000)	22,950	1,950.00	1,687	500	744	2.68	2011	0.67	2.27	4,179.64	5.62
5	large 2 (>50,000)	240,000	2,083.80	22,000	23,432	74,953	0.28	2011	0.31	0.29	66,270.02	0.88
6	medium (5,000-10,000)	30,000	2,604.75	2,000	720	7,542	0.35	2011	0.10	0.27	5,324.75	0.71
7	large 2 (>50,000)	78,749	6,813.94	2,3412	26,500	132,471	0.05	2009	0.20	0.18	55,313.94	0.42
8	medium (50,00-10,000)	85,134	7,391.77	5,410	4,160	9,710	0.76	2009	0.43	0.56	16,951.77	1.75
9	large 1 (10,000-50,000)	27,500	2,387.69	10,000	500	19,000	0.13	2011	0.03	0.53	12,887.69	0.68
10	small (<5,000)	22,000	1,910.15	3,048	4,140	3,240	0.59	2011	1.28	0.94	9,098.15	2.81
11	large 1 (10,000-50,000)	55,000	4,775.38	12,670	4,140	34,300	0.14	2011	0.12	0.37	21,585.38	0.63
12	large 2 (>50,000)	66,294.49	5,752.12	89,052	30,674	343,900	0.02	2012	0.09	0.26	126,426.12	0.37

Based on "Register of Drinking Water Suppliers for New Zealand" (2013 edition): <http://www.esr.cri.nz/SiteCollectionDocuments/ESR/PDF/WaterManagement/RegisterOfSuppliers.pdf>

* Tank (30 years+), Dosing Pump (8 years), Pipework, Day Tank

**10/12 use hydrofluorosic acid: two use sodium silico powder no significant difference was found in the costs of these two chemicals

*** Costs vary from purely external testing (\$500 p.a.) to including maintenance and calibration, consumables (parts), safety and administration (\$22,000 p.a.)