Wellington Water Limited

Review of Fluoridation in Drinking Water

March 2022

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Executive Summary

Fluoride exists naturally in raw water in small quantities. Additional fluoride is added to municipal drinking water supplies to optimum levels that would help reduce and prevent tooth decay. In New Zealand, fluoridation of drinking water supplies is done at the discretion of the water supplier. In the Wellington region, the Greater Wellington Regional Council is responsible for the abstraction, treatment and supply - in bulk - of treated drinking water to its customer territorial authorities. This responsibility is contracted to Wellington Water Limited by the Greater Wellington Regional Council.

Fluoridated drinking water is supplied from four water treatment plants to Wellington, Upper Hutt, Hutt and Porirua city councils except for Petone and Korokoro where the customers receive non-fluoridated water.

The purpose of fluoridation is to achieve the desired levels of residual concentrations in the water that is consumed. The Ministry of Health recommends that the residual fluoride concentration in drinking water should be within the range of 0.7 parts per million to 1.0 part per million.

Records of fluoride concentrations obtained from the online analysers at the four water treatment plants show that the recommended range of between 0.7 ppm and 1.0 ppm has consistently not been met for at least the past four years. The records also show that the fluoride dosing plants have not been operational all the time. The fluoride concentrations are not consistent and for most of the time, the fluoride concentrations have been significantly below the lower limit of 0.7 ppm.

Wellington Water Limited also monitors the fluoride concentrations in the water distribution system. These records confirm that the residual fluoride concentrations in the drinking water have been inconsistent over time and in most locations did not meet the lower limits of 0.7 ppm.

Although Wellington Water Limited did not meet the recommended dosage of fluoride in its water supply, the compliance requirements of the Drinking-Water Standards of New Zealand were met. Fluoride is a Priority 2a determinant and its concentration in the drinking water must not exceed the Maximum Allowable Value (MAV) of 1.5 ppm. By shutting down the fluoridation plants and dosing at low concentrations, the Maximum Allowable Value has not been exceeded. Therefore, the P2 chemical compliance as it relates to fluoride were met.

From the review of fluoridation of drinking water carried out by Wellington Water, we can conclude:

- The fluoride levels in the drinking water did not exceed the MAV of 1.5 ppm.
- The Drinking Water Standards of New Zealand Chemical compliance of Priority 2a for fluoride was met.
- Wellington Water met the performance objective set by Greater Wellington Regional Council in its service contract.
- Fluoride levels in the drinking water were mostly below the lower limit of 0.7 ppm
- The optimal range of fluoridation of between 0.7 ppm and 1.0 ppm, as recommended by the Ministry of Health, was inconsistently met at each WTP and over time.
- Since July 2016, on average, fluoridation within the optimal range was met about 50% of the time at Waterloo, 30% at Wainuiomata, and less than 20% at Te Marua and Gear Island WTPs.
- Since July 2021, compliance with meeting 0.7 ppm to 1.0 ppm fluoridation levels at Waterloo and Wainuiomata WTPs have significantly improved.

- The fluoridation facilities have been non-operational frequently, especially at Te Marua and Gear Island.
- Fluoridation of drinking water was ceased on 24 May 2021 at Te Marua and on 24 November 2021 at Gear Island water treatment plants.

Wellington Water has ensured that the fluoride concentrations in the drinking water delivered to consumers were kept below the harmful range and met the Priority 2a Chemical compliance of the Drinking Water Standards. In a handful of reported instances where drinking water with more than 1.5ppm of fluoride had left the treatment facilities, there were appropriate responses to ensure that over-fluoridated water did not reach consumers.

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Background

The Greater Wellington Regional Council (GWRC) is responsible for maintaining the bulk water supply systems and for delivering safe drinking water to Wellington, Hutt, Upper Hutt and Porirua city councils. These services are delivered on behalf of GWRC by Wellington Water Limited, a jointly owned water management company. There are four water treatment plants (WTP) owned by GWRC in Wellington - Te Marua, Wainuiomata, Waterloo, and Gear Island.

The Te Marua WTP supplies Upper Hutt, Porirua and the northern and western Wellington suburbs. The Waterloo, Gear Island and Wainuiomata WTPs supply Wainuiomata, Lower Hutt, and Wellington. The Gear Island WTP is operated infrequently and serves as a standby facility. The Waterloo WTP provides drinking water to Petone, which has chosen to receive non-fluoridated water. As Waterloo WTP also serves Wellington city, the treated drinking water is fluoridated using the equipment at Gear Island. Therefore, while the treatment facility at Gear Island does not treat water continuously, its fluoridation plant is required to operate continuously. The fluoridation equipment at Waterloo WTP fluoridates the water that goes to Naenae and Gracefield.

Fluoride exists naturally in raw water. The concentration varies by locality and geology. The addition of fluoride to a drinking water supply is not required under any legislation in New Zealand. Fluoridation is the addition fluoride to drinking water to bring the concentration to a level that would prevent tooth decay. Fluoridation is done at the discretion of the drinking-water supplier. In the case of GWRC, there would have been historical arrangements with its customer territorial authorities, and they would have requested fluoridation of their water supply except for suburbs such as Petone.

In December 2014, Water New Zealand released its Code of Practice, Fluoridation of Drinking-Water Supplies in New Zealand. This serves as a useful guide to water suppliers who opt to fluoridate their water.

When a water supplier decides, or is advised by its client council(s), to fluoridate drinking water, it needs to:

- Sample and monitor the naturally occurring fluoride levels in the raw water to determine the quantities of additional fluoride required to achieve the optimum fluoride concentrations in the drinking water.
- Ensure it has reliable, well-maintained, and fully functional fluoridation facilities to achieve the required fluoride concentrations in the drinking water.
- Ensure it has the requisite fluoride analysers, alarms, and monitoring equipment to prevent over fluoridation of the drinking water.
- Ensure staff have requisite training, access to procedures and personal protective equipment to manage the chemicals and treatment processes associated with fluoridation.
- Comply with the requirements of the Code of Practice – Fluoridation of Drinking-Water Supplies in New Zealand.
- Comply with the requirements of the Drinking-Water Standards of New Zealand and recommendations of the Ministry of Health.

Wellington Water ceased the operating the fluoridation plant at the Te Marua WTP on 24 May 2021. This resulted in Upper Hutt, Porirua and the northern and western Wellington to receive non-fluoridated drinking water. The fluoridation at Gear Island WTP ceased on 24 November 2021.

Performance Requirements for Fluoridation

No Past Legislative Requirement

The addition of fluoride to a drinking water supply has not been a requirement under any legislation in New Zealand. Where fluoridation has been undertaken, it has been done so at the discretion of the drinking-water suppliers. Under the recently enacted Health (Fluoridation of Drinking Water) Amendment Act 2021, the Director-General of Health can direct a local authority to fluoride its drinking water supply or not. Any direction from the Director-General of Health will need to specify the level at which fluoride must be added. A local authority that was adding fluoride to its drinking water before the enactment of the Act must continue to do so unless the Director-General of Health directs it not to.

In the Wellington region, the decision to fluoridate or not to fluoridate would have been made by the local councils (Wellington, Hutt, Upper Hutt and Porirua). The Greater Wellington Regional Council would have met this obligation through its bulk water agreements.[1] No directions have been made by the Director General of Health in relation to fluoridating drinking water for Wellington, Hutt, Lower Hutt and Porirua councils.

Drinking Water Standards of New Zealand (DWSNZ)

The Drinking Water Standards for New Zealand 2005 (and subsequent revisions) define the minimum quality standards for drinking-water in New Zealand. The Health Act 1956 requires all suppliers providing drinking-water to over 500 people to develop and implement a water safety plan to guide the safe management of their supply.

There are two themes of the DWSNZ that would apply to a water supplier:

- the maximum acceptable values (MAVs) or water quality standards, which define the quality specifications for all drinking-water, and
- the compliance criteria which specify monitoring requirements and remedial actions to be followed when a transgression of a MAV occurs.

The MAV of a chemical is the concentration of that chemical that does not result in any significant risk to the health of a 70 kg person over a lifetime of consumption of two litres of the water a day.

The DWSNZ does not require the addition of fluoride to drinking water. If a water supplier wishes to fluoridate, the Ministry of Health recommends that the concentration in drinking water should be in the range of 0.7 to 1.0 ppm for oral health reasons.

Fluoride is an inorganic determinand (classified as Priority 2a) of health significance. It can be harmful to human health if not managed. The DWSNZ has set a MAV of 1.5 ppm of fluoride in drinking water. The water supplier is required to monitor and report compliance of P2 determinants against this MAV.

[1] The reviewer was unable to obtain any documentation relating to the bulk supply obligations in the timeframe available.

Code of Practice - Fluoridation of Drinking-Water Supplies in New Zealand

The Code of practice for fluoridation of drinking-water supplies in New Zealand specifies good practice for the safe design and effective operation of a fluoridation plant. It is based on the Ministry of Health recommendations of fluoride content in drinking water being in the range of 0.7 ppm to 1.0 ppm.

It requires the water supplier to notify the Drinking Water Assessor

- if the rolling annual average fluoride concentration of drinking-water in a water supply has exceeded, or is expected to exceed, 1.0 ppm in each quarterly compliance period, or
- if the fluoride concentration in drinking-water supplied in a water sampling locality exceeds or may exceed the MAV of 1.5 ppm.

The water supplier is not required to notify the DWA If the fluoride concentration is below the lower threshold for more than 72 hours. However, the Code of Practice recommends that it does so.

Greater Wellington Regional Council Requirement

The Health Act 1956 covers the high-level obligations of a water supplier. For Wellington, the obligations relating to the treatment of drinking water falls with the Greater Wellington Regional Council. The Greater Wellington Regional Council contracts to Wellington Water Limited for the provision of management services relating to bulk water supply services. The contract, signed in September 2014, sets out the key performance indicators in Schedule 6.

Wellington Water Limited is to comply with the requirements of DWSNZ. In particular, it is required to have 100% compliance with the P2 Chemical standards. Fluoride is a Priority 2a chemical and, therefore, compliance is achieved if the concentrations do not exceed the MAV limit of 1.5 ppm.

L 1.2.1		Comply with the requirements of the DWSNZ 2005. Aesthetic and microbiological for treatment and distribution 100% of the time, and chemical requirements 100% of the time.	100% compliance with the Drinking Water Standards of New Zealand - P1 Microbiological
L 1.2.1			100% compliance with the Drinking Water Standards of New Zealand - P2 chemical
L 1.3.1			100% compliance with the Drinking Water Standards of New Zealand - Aesthetic

Table 1 Extract from Schedule 6 of the Greater Wellington Regional Council bulk water supply management services contract with Wellington Water Limited

The management services contract between GWRC and Wellington Water makes no mention of fluoridation or the need to meet the optimal levels of 0.7 ppm and 1.0 ppm. The technical information for Wainuiomata Water Treatment Plant provided by GWRC, and available on Wellington Water's website, advises that the background fluoride levels in the raw water is around 0.1 ppm and that fluoride is added to get the levels in the treated drinking water to between 0.7 ppm and 1.0 ppm as recommended by the Ministry of Health.

Customer Councils

Wellington, Lower Hutt, Upper Hutt, Porirua councils have indicated to their ratepayers via their websites directly or by directing them to the Wellington Water website whether they receive fluoridated water. Extracts from some of the council websites on fluoridation of their water supply are collated in Appendix A.

Wellington City Council advises that the water supplied meets the Drinking Water Standards of New Zealand and are tested routinely to ensure that they are safe to drink. Upper Hutt City Council refers to the recommended Ministry of Health optimum fluoride concentrations of between 0.7 ppm and 1.0 ppm. Hutt City advises which suburbs are fluoridated and that Petone and Korokoro are not fluoridated.

Wellington Water Limited

The Wellington Water website has the following information on fluoridation:

> ***Is fluoride added to my water?***
>
> *If you live in the reticulated parts of Lower Hutt, Porirua, Upper Hutt or Wellington, then you almost certainly receive fluoridated water. Petone and Korokoro - supplied from Hutt City Council's Rahui reservoir - are the only areas within the four cities that receive unfluoridated water. This is because they have historically had an unfluoridated water supply and Hutt City Council asked that GWRC continues that arrangement following a public survey in 2000.*

In its Regional Drinking Water Supply - Water Safety Plan, Wellington Water covers fluoride:

> *Fluoride is a highly toxic substance and while under dosing will have little adverse effect, overdosing above the DWSNZ MAV of 1.5mg/L has the potential to adversely affect consumers*

The standard operating procedures for the water treatment plants requires fluoride levels to be between 0.7 mg/l and 0.8 mg/l (refer Appendix B). It cautions that the limits should not be exceeded, and that fluoride can be harmful to health at levels exceeding 1.5 mg/l.[2]

Public Expectations

The public, including stakeholders such as the dental industry, would expect fluoridated drinking water to meet the definition established by the Ministry of Health. Just as importantly, they would expect that fluoride content in their water supply was below harmful levels.

[2] mg/l (milligrams per litre), grams per cubic metre, or parts per million (ppm) are equivalent units of measure

Performance of the Fluoride Dosing against Requirements

Fluoride Levels in the Water Distribution System

Drinking water samples are taken from various locations in the distribution system and analysed for compliance with the Drinking Water Standards of New Zealand. The required sampling frequency for fluoride in the drinking water supplied to customers is weekly, with maximum period between samples of 13 days. The records provided by Wellington Water have been graphed and presented in Appendix C.

The fluoridation levels in the drinking water sampled in the distribution system have never exceeded the upper limit of 1.0 ppm. The MAV of 1.5 ppm has, therefore, not been breached. Fluoridation levels in the water distribution system confirm the trends identified in the analyses of the data from analysers at the treatment plants. Fluoride levels have, at times, been within the optimal range of 0.7 ppm to 1.0 ppm but have mostly been below the lower limit.

Fluoride Levels leaving Water Treatment Plants

Online analysers measure the fluoride concentrations in the treated water in the vicinity of the treatment plant. The data is available by the minute. For the purposes of this review, data was retrieved as 30-minute averages and analysed at each of the four water treatment plants. This was plotted to identify where the fluoride levels were within the optimal range of 0.7 ppm and 1.0 ppm.

The fluoride levels between 1 January and 30 June of 2016 are plotted for the Waterloo WTP. Between 7.00 pm and 11.30 pm on the 12 of January 2016, the fluoride levels were as high as 1.03 ppm, but averaged below 1.0 for the day. Such fluctuations and variances are expected during the day.

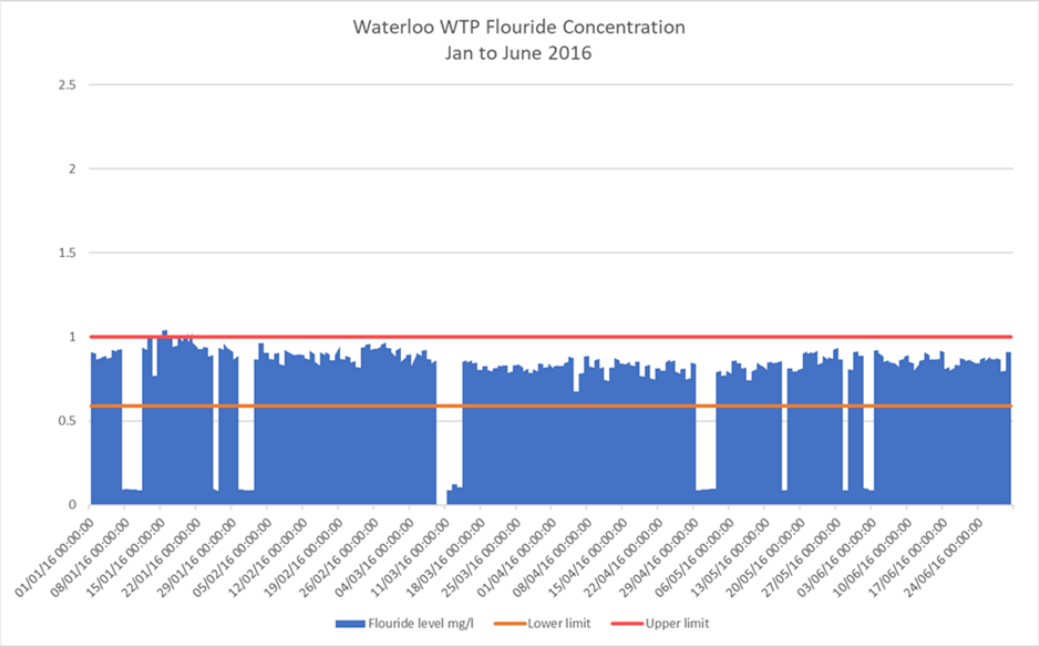


Figure 1 Fluoride concentrations at the Waterloo WTP between 1 January and 30 June 2016 plotted at 30-minute average intervals

There are four pieces of information that is required:

1. When did fluoridation exceed the MAV of 1.5 ppm and for how long?
2. When did fluoridation meet the optimal levels of 0.7 ppm to 1.0 ppm?
3. When were fluoride levels below the lower limit of 0.7 ppm?
4. When was the fluoridation plant not operating?

The 30-minute averages were used to obtain a daily average, and these were analysed and tabulated for each financial year ending 30 June.

The data was also used to obtain a weekly average value, and these were over time for the past four years. The graphical plots, while not at the granularity of 30-minute averages, provide a good overview of fluoridation at these analyser sites.

Waterloo Water Treatment Plant

There were no incidents of fluoride levels exceeding the MAV of 1.5 ppm.

Period	Fluoridation below lower limit 0.7 ppm	Fluoridation in Optimal range 0.7 to 1.0 ppm	Not Operating
1 July 2021 to 22 March 2022	21%	70%	9%
1 July 2020 to 30 June 2021	46%	33%	21%
1 July 2019 to 30 June 2020	48%	32%	20%
1 July 2018 to 30 June 2019	25%	35%	40%
1 July 2017 to 30 June 2018	12%	60%	28%
1 July 2016 to 30 June 2017	5%	89%	6%

Table 2. Percentage of time average daily fluoride concentrations were within the optimal range, below the lower limit and when fluoridation plant was not operational at the Waterloo Water Treatment Plant

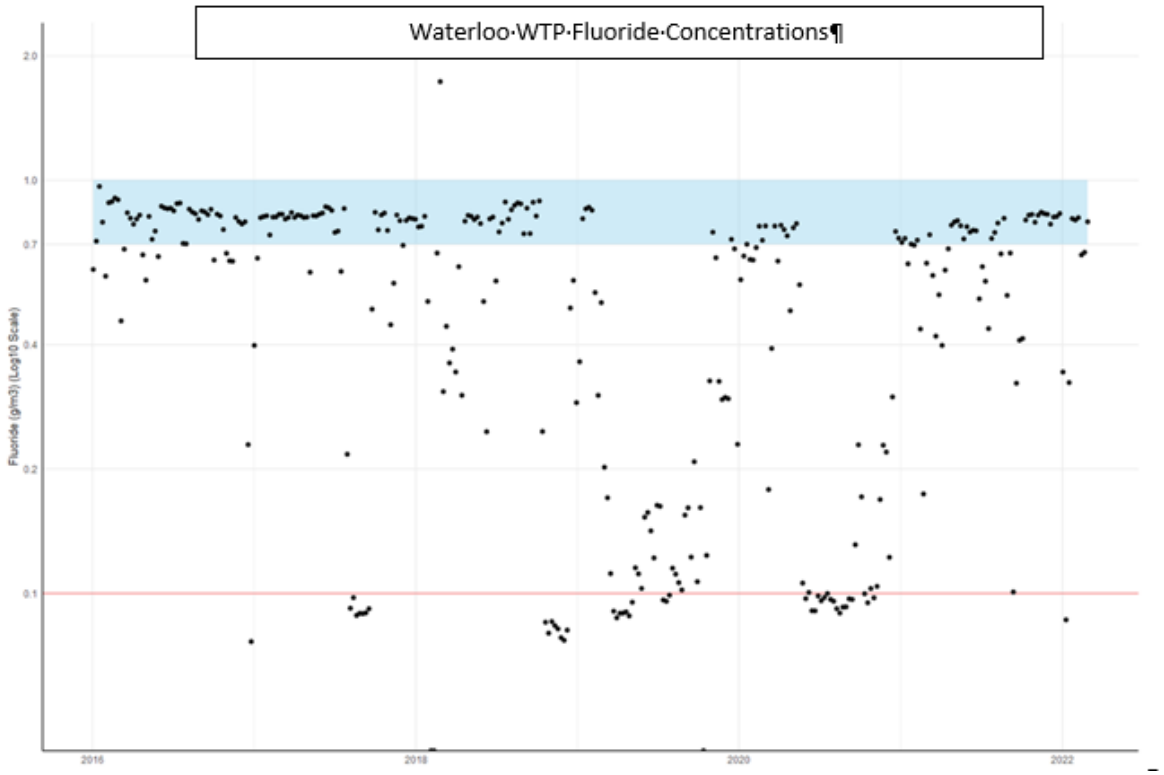


Figure 2 Fluoride concentrations expressed as weekly averages as measured at the Waterloo WTP showing the relative distribution of compliance within the optimal zone against levels below the lower limit of 0.7 ppm

Gear Island Water Treatment Plant

This set of data is from the analyser on the 1050mm diameter bulk water main. The water in this pipe includes fluoridated water from the Wainuiomata treatment plant. The Gear Island fluoridation adds additional fluoride required to meet the optimal levels.

The fluoridation at Gear Island WTP ceased on 24 November 2021 and had remained non-operational at the time of writing of this report.

There were no incidents of fluoride levels exceeding the MAV of 1.5 ppm, except:

- On 26 June 2018, elevated levels were detected and rectified by further dilution, ensuring consumers did not receive over-fluoridated drinking water.
- On 19 January 2019, there a false alarm indicating higher dosage. This was rectified and consumers did not receive over-fluoridated drinking water.
- On 2 July 2019, elevated levels due to operational changes were detected and rectified by dilution, ensuring consumers did not receive over-fluoridated water.
- On 9 June 2021, elevated levels due to a pump repair but appropriate responses were made to ensure consumers did not receive over-fluoridated water.

Period	Fluoridation below lower limit 0.7 ppm	Fluoridation in Optimal range 0.7 to 1.0 ppm	Not Operating
1 July 2021 to 22 March 2022	81%	8%	12%
1 July 2020 to 30 June 2021	59%	31%	10%
1 July 2019 to 30 June 2020	51%	31%	18%
1 July 2018 to 30 June 2019	50%	0%	50%
1 July 2017 to 30 June 2018	71%	1%	28%
1 July 2016 to 30 June 2017	32%	58%	10%

Table 3 Percentage of time average daily fluoride concentrations were within the optimal range, below the lower limit and when fluoridation plant was not operational at the Gear Island Treatment Plant (Analyser #1)

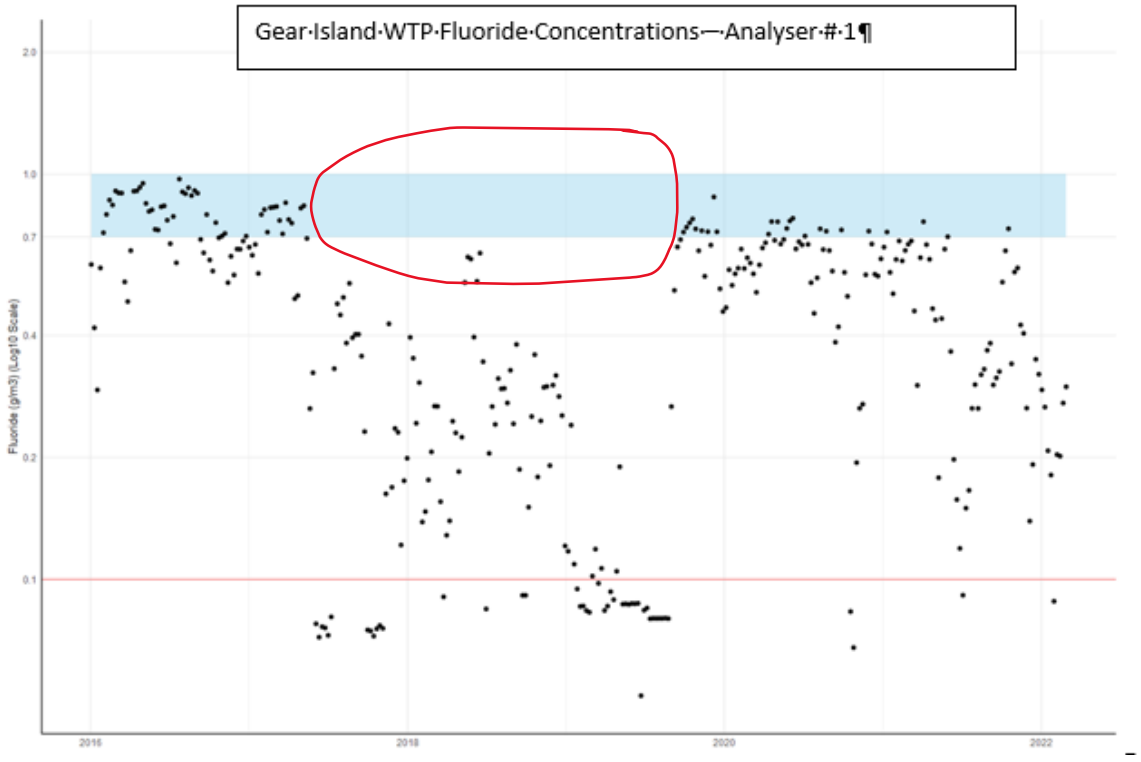


Figure 3 Fluoride concentrations expressed as weekly averages as measured at Gear Island Analyser #1 showing the relative distribution of compliance within the optimal zone against levels below the lower limit of 0.7 ppm

Period	Fluoridation below lower limit 0.7 ppm	Fluoridation in Optimal range 0.7 to 1.0 ppm	Not Operating
1 July 2021 to 22 March 2022	80%	7%	13%
1 July 2020 to 30 June 2021	65%	31%	14%
1 July 2019 to 30 June 2020	62%	29%	9%
1 July 2018 to 30 June 2019	8%	0%	92%

Table 4 Percentage of time average daily fluoride concentrations were within the optimal range, below the lower limit and when fluoridation plant was not operational at the Gear Island Treatment Plant (Analyser #2)

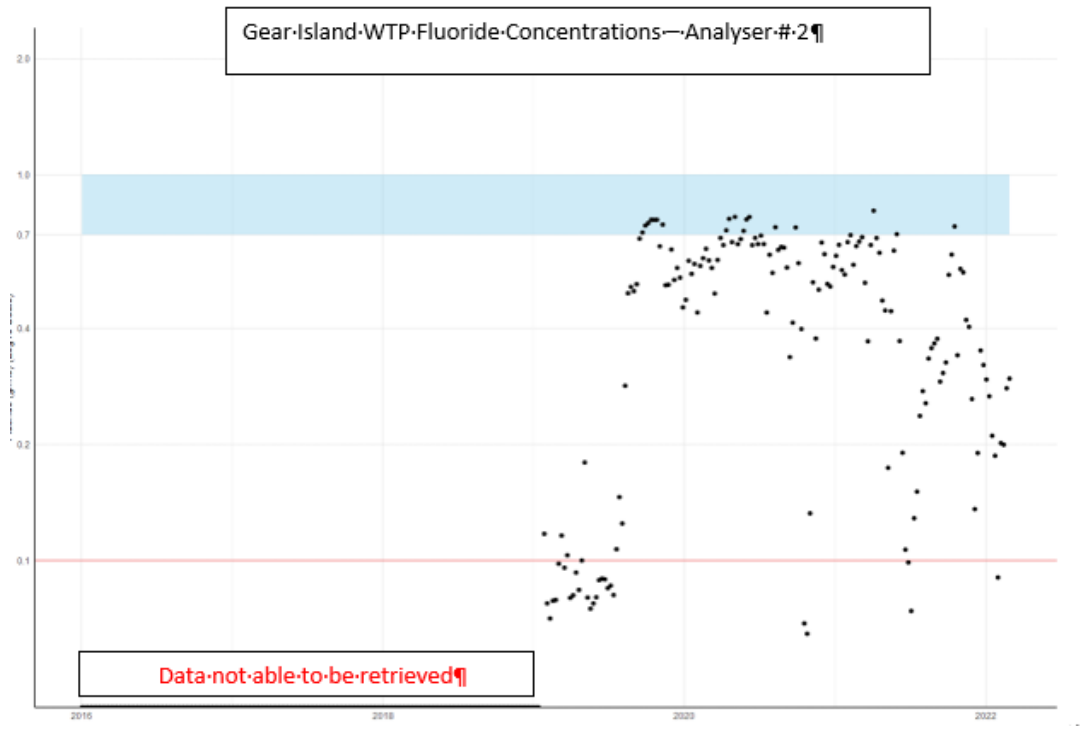


Figure 4 Fluoride concentrations expressed as weekly averages as measured at Gear Island Analyser #2 showing the relative distribution of compliance within the optimal zone against levels below the lower limit of 0.7 ppm

Te Marua Water Treatment Plant

There were no incidents of fluoride levels exceeding the MAV of 1.5 ppm.

On 20 April 2021, there was an incident of overdosing fluoride after an error was made in adjusting water flows during maintenance. Appropriate response by Wellington Water staff prevented any over-fluoridated drinking water reaching consumers.

Fluoridation of drinking water at Te Marua WTP ceased on 25 May 2021 and had remained non-operational at the time of writing of this report.

Period	Fluoridation below lower limit 0.7 ppm	Fluoridation in Optimal range 0.7 to 1.0 ppm	Not Operating
1 July 2021 to 22 March 2022	0%	0%	100%
1 July 2020 to 30 June 2021	40%	28%	32%
1 July 2019 to 30 June 2020	37%	23%	40%
1 July 2018 to 30 June 2019	46%	30%	24%
1 July 2017 to 30 June 2018	10%	4%	86%

Table 5 Percentage of time average daily fluoride concentrations were within the optimal range, below the lower limit and when fluoridation plant was not operational at the Te Marua Water Treatment Plant (Analyser #1)

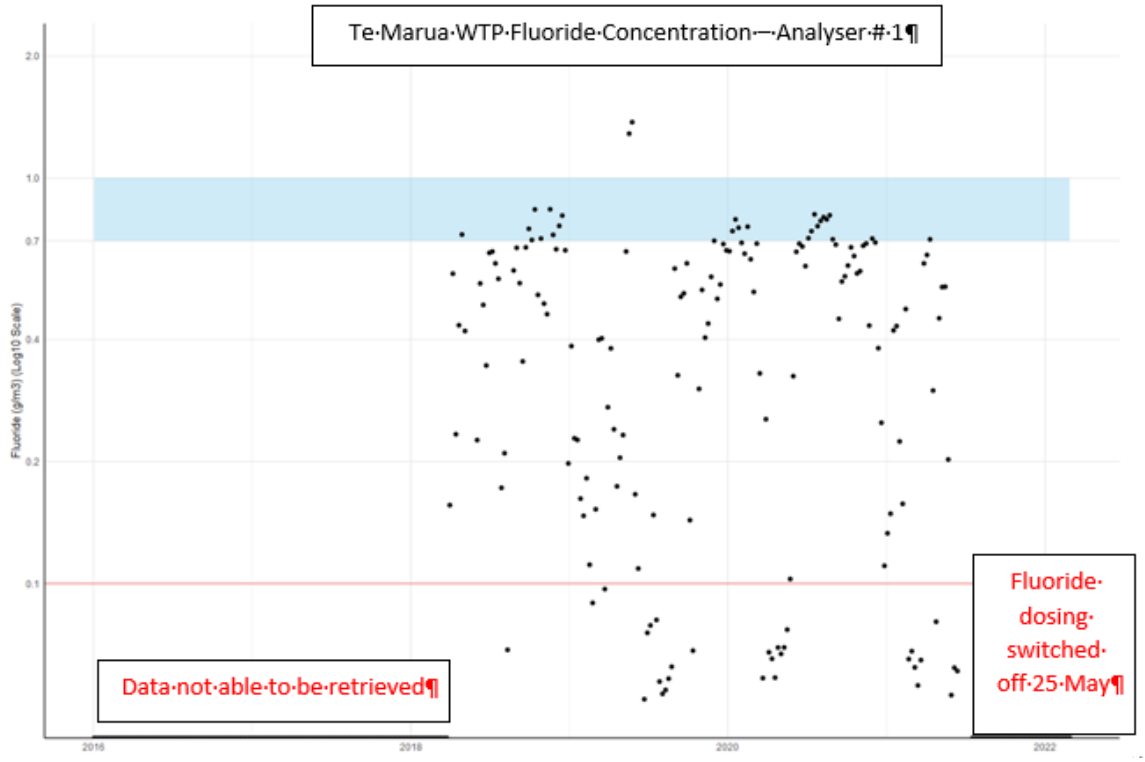


Figure 5 Fluoride concentrations expressed as weekly averages as measured at Te Marua WTP Analyser #1 showing the relative distribution of compliance within the optimal zone against levels below the lower limit of 0.7 ppm

Period	Fluoridation below lower limit 0.7 ppm	Fluoridation in Optimal range 0.7 to 1.0 ppm	Not Operating
1 July 2021 to 22 March 2022	0%	0%	100%
1 July 2020 to 30 June 2021	65%	4%	31%
1 July 2019 to 30 June 2020	57%	3%	40%
1 July 2018 to 30 June 2019	31%	27%	42%
1 July 2017 to 30 June 2018	10%	6%	84%

Table 6 Percentage of time average daily fluoride concentrations were within the optimal range, below the lower limit and when fluoridation plant was not operational at the Te Marua Water Treatment Plant (Analyser #2)

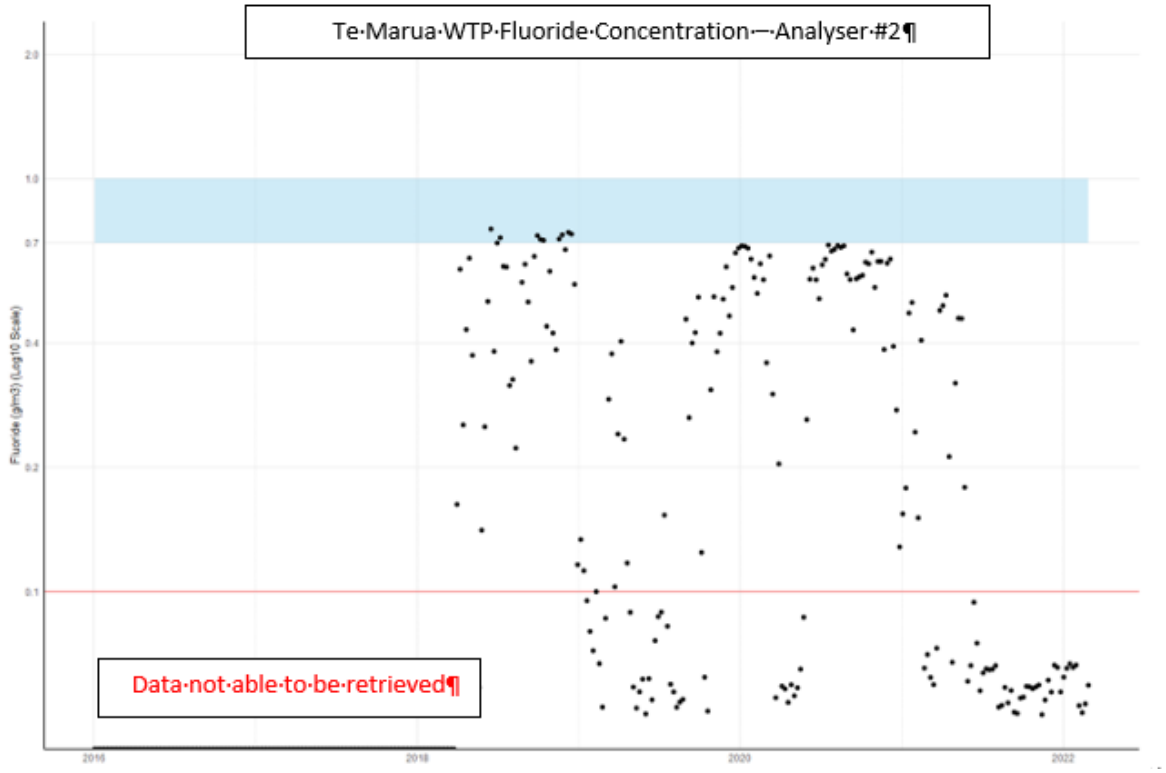


Figure 6 Fluoride concentrations expressed as weekly averages as measured at Te Marua WTP Analyser #2 showing the relative distribution of compliance within the optimal zone against levels below the lower limit of 0.7 ppm

Wainuiomata Water Treatment Plant

There were no incidents of fluoride levels exceeding the MAV of 1.5 ppm. Some of the periods during which there were no fluoridation taking place may be related to the recent seismic strengthening work in the treatment facility building.

Period	Fluoridation below lower limit 0.7 ppm	Fluoridation in Optimal range 0.7 to 1.0 ppm	Not Operating
1 July 2021 to 22 March 2022	29%	60%	11%
1 July 2020 to 30 June 2021	36%	3%	61%
1 July 2019 to 30 June 2020	6%	1%	93%
1 July 2018 to 30 June 2019	33%	33%	34%
1 July 2017 to 30 June 2018	31%	40%	29%
1 July 2016 to 30 June 2017	33%	47%	20%

Table 7 Percentage of time average daily fluoride concentrations were within the optimal range, below the lower limit and when fluoridation plant was not operational at the Wainuiomata Water Treatment Plant (Stream #1)

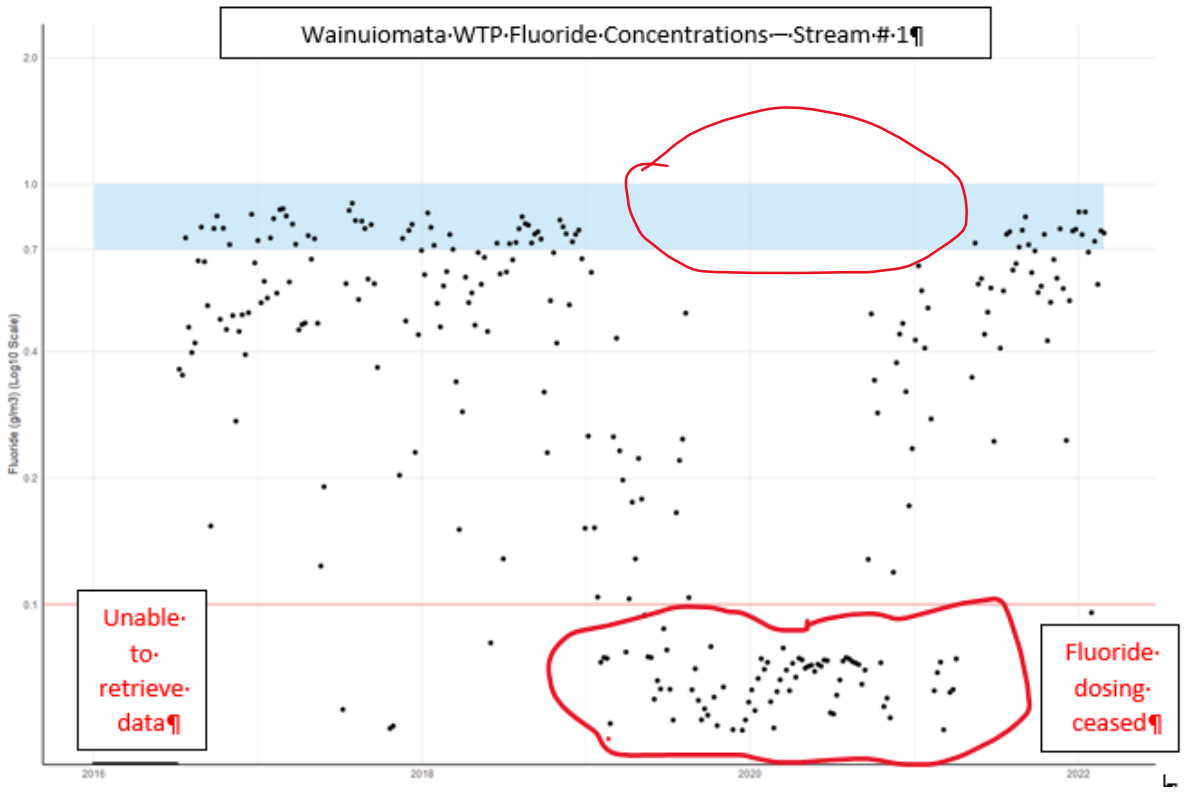


Figure 7 Fluoride concentrations expressed as weekly averages as measured at the Wainuiomata WTP #1 showing the relative distribution of compliance within the optimal zone against levels below the lower limit of 0.7 ppm

Period	Fluoridation below lower limit 0.7 ppm	Fluoridation in Optimal range 0.7 to 1.0 ppm	Not Operating
1 July 2021 to 22 March 2022	30%	63%	7%
1 July 2020 to 30 June 2021	38%	3%	59%
1 July 2019 to 30 June 2020	10%	2%	88%
1 July 2018 to 30 June 2019	30%	33%	37%
1 July 2017 to 30 June 2018	27%	44%	29%
1 July 2016 to 30 June 2017	35%	28%	37%

Table 8 Percentage of time average daily fluoride concentrations were within the optimal range, below the lower limit and when fluoridation plant was not operational at the Wainuiomata Water Treatment Plant (Stream #2)

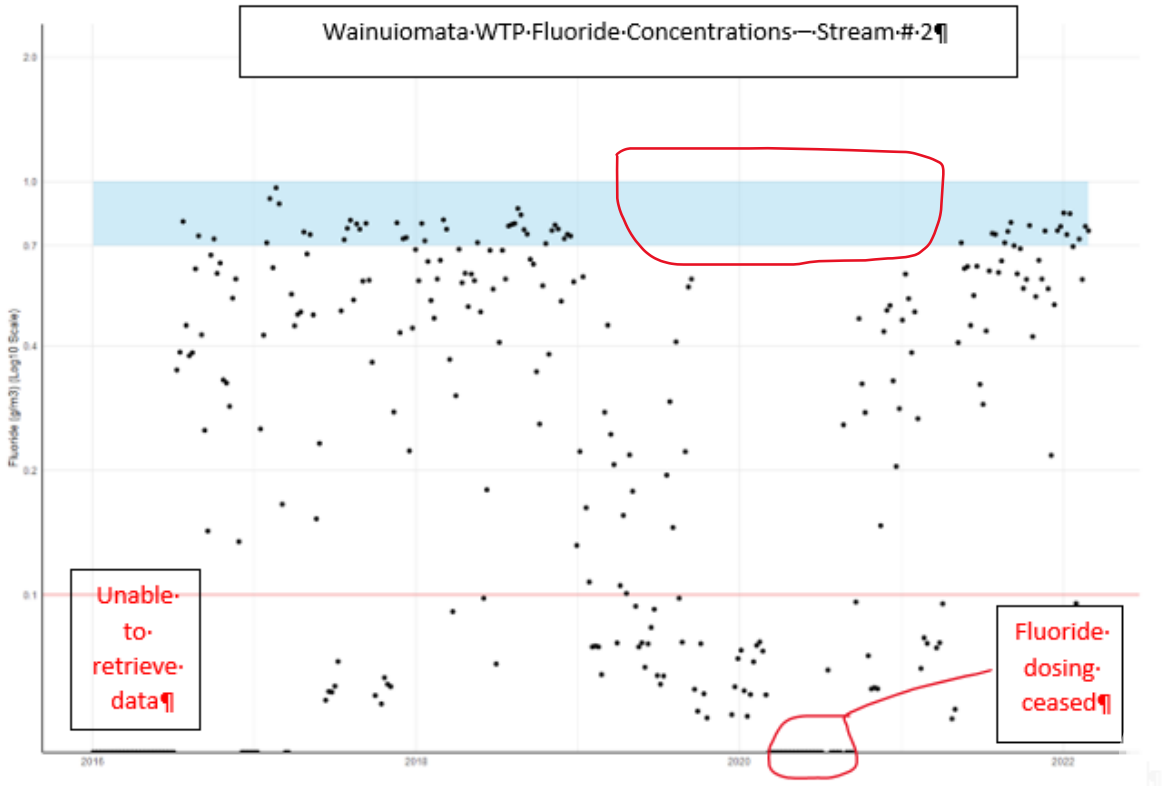


Figure 8 Fluoride concentrations expressed as weekly averages as measured at the Wainuiomata WTP #2 showing the relative distribution of compliance within the optimal zone against levels below the lower limit of 0.7 ppm

Conclusions

Fluoride, while naturally occurring in raw water, is added to drinking water to an optimum level to prevent tooth decay. The Ministry of Health recommends the optimum level to be 0.7 ppm to 1.0 ppm.

The Drinking Water Standards of New Zealand classifies fluoride as a Priority 2a determinant. This means that its introduction into the drinking water as a treatment chemical at certain levels could pose a public health issue. Therefore, compliance must be demonstrated by appropriate monitoring to ensure that fluoride levels do not exceed the Maximum Allowable Value of 1.5 ppm.

Greater Wellington Regional Council is the bulk supplier of drinking water to Wellington, Hutt, Upper Hutt and Porirua councils. The provision of bulk water services is contracted to Wellington Water Limited. Greater Wellington Regional Council, the customer councils and Wellington Water acknowledge that drinking water supplied to Wellington, Hutt, Upper Hutt and Porirua – except for Petone and Korokoro -is fluoridated.

Wellington Water operates the four water treatment plants – Waterloo, Gear Island, Wainuiomata and Te Marua - where drinking water is fluoridated. Fluoridation, accompanied by brushing of teeth, avoiding sugary sweets and dental care help reduce tooth cavities, especially in children. Fluoride levels below the optimum concentrations may reduce its effectiveness.

Fluoride is a chemical and there is potential public health significance of chemical transgressions in drinking water. Attempts to meet the optimal fluoride levels should not compromise public health. It is presumed that the operators of the water treatment plant have fluoridated the water using the facilities available with a strong focus on not exceeding the MAV.

The requirement not to exceed MAV is a critical control for fluoridation and this is recognised by Wellington Water in its Water Safety Plan. Fluoridation within the optimal range of 0.7 ppm and 1.0 ppm is not identified as a critical water safety requirement. This would result in a cautious approach to fluoridation to avoid exceeding 1.0 ppm.

The Ministry of Health has confirmed that water supplied to Wellington, Hutt, Lower Hutt and Porirua councils met the Drinking Water Standards for New Zealand for the years 2017-18 to 2019-20.[3]

The data provided for the fluoridation facilities demonstrate that they have all experienced operational issues which have resulted in reduced availability and reliability of fluoridation. This has adversely impacted on the consistency of fluoride concentrations in the drinking water. Due to their age, the fluoridation facilities were not designed and built to comply with the Code of Practice – Fluoridation of Drinking Water Supplies. There have been documented issues relating to inferior quality of fluoride powder supplied, inadequate dosing systems, lack of storage and mixing capacities and equipment that had reached their end of their asset lives.

Analyses of data from the fluoride analysers for the past five years at the four water treatment plants has been summarised in Table 9 as follows:

- Compliance with meeting the optimal concentration of 0.7 ppm to 1.0 ppm from 1 July 2021.

[3] Annual Report on Drinking Water Quality, Ministry of Health, 2017-2018, 2018-2019, 2019-2020

- Compliance over the four years 1 July 2016 to 30 June 2021 of meeting the 0.7 ppm to 1.0 ppm optimal range.
- Proportion of time that fluoridation was below the lower limit of 0.7 ppm over the four-year period July 2016 to June 2021
- Proportion of time that the fluoridation facilities were not operational over the four-year period July 2016 to June 2021.

Performance of fluoride dosing at water treatment plants				
Water Treatment Plant	July 2021 to March 2022 0.7 – 1.0 ppm	Past four years July 2017 to June 2021		
		0.7 ppm to 1.0 ppm	Less than 0.7 ppm	Not operating
Waterloo	70%	40%	33%	27%
Gear Island	8%	15%	55%	30%
Te Marua	0%	16%	37%	47%
Wainuiomata	62%	20%	26%	54%

Table 9 Performance of fluoride dosing at the four water treatment plants between July 2017 and June 2021 and since July 2021

As is evident from the table, the performance of fluoridating drinking water to the optimal range has improved since July 2021 at Waterloo and Wainuiomata WTPs. The Gear Island and Te Marua fluoridation units were not performing, and their operations were ceased until they are replaced or refurbished.

The analyses of the data taken from analysers at the four fluoridation facilities and of samples of drinking water from locations in the distribution system have shown that:

- The fluoride levels in the drinking water did not exceed the MAV of 1.5 ppm
- The Drinking Water Standards of New Zealand Chemical compliance of Priority 2a for fluoride was met
- Wellington Water met the performance objective set by Greater Wellington Regional Council in its service contract
- Fluoride levels in the drinking water were mostly below the lower limit of 0.7 ppm
- The optimal range of fluoridation of between 0.7 ppm and 1.0 ppm, as recommended by the Ministry of Health, was inconsistently met at each WTP and over time.
- Since July 2016, on average, the optimal range fluoridation was met about 50% of the time at Waterloo, 30% at Wainuiomata, and less than 20% at Te Marua and Gear Island WTPs.
- Since July 2021, compliance with meeting 0.7 ppm to 1.0 ppm fluoridation levels at Waterloo and Wainuiomata WTPs have significantly improved.
- The fluoridation facilities have been non-operational frequently, especially at Te Marua and Gear Island.

- Fluoridation of drinking water was ceased on 24 May 2021 at Te Marua and on 24 November 2021 at Gear Island water treatment plants.

Appendix A – Customer Council website commentaries on fluoridation of water supplied

Water testing

The Council is serious about providing clean, safe drinking water. We maintain a rigorous water quality programme that tests over 100 samples each month.

Our programme complies with the Ministry of Health's Drinking Water Standards for New Zealand 2005 (Revised 2008).

- Drinking Water Standards for NZ 2005 (Revised 2008) - Ministry of Health
- Backflow Prevention Containment Policy

Process

The Wellington water supply is sampled and analysed by Environmental Laboratory Services, an independent IANZ accredited laboratory.

Water samples are tested for:

- **E.coli** (Escherichia coli) - an important indicator of potential contamination and disease - total coliforms and heterotrophic plate count. E.coli testing is required for compliance.
- **Chemical levels** - chloride, fluoride and water 'hardness' (the amount of naturally occurring minerals in water), colour, conductivity, free available chlorine, temperature and turbidity.

The city is divided into 11 water supply zones. Within each zone, samples are taken from several different sites on a weekly schedule. Each water supply zone is sampled at different points with the largest zones sampled every 3 days and the smallest every 6 days.

The Council has 18 bulk water supply points where water arrives in the city from the treatment plant. Ten supply points are tested weekly for E.coli and chemicals. Two main bulk water supply pump stations are tested daily for chemicals and E.coli, averaging over 100 tests per month.

Wellington City Council website: https://wellington.govt.nz/climate-change-sustainability-environment/water/wellingtons-water-supply/water-quality

Is chlorine or fluoride added to my water supply?

If your property is connected to the Upper Hutt water supply network, then your water will contain both chlorine and fluoride.

Chlorine is a disinfectant that kills water-borne bacteria and viruses that could cause diseases.

The natural level of fluoride in Wellington's water is around 0.1 milligrams per litre or parts per million (ppm). The Ministry of Health recommends that water suppliers should adjust the amount of fluoride in drinking water to between 0.7 and 1.0 ppm, as this is considered the optimal level for good dental health.

Upper Hutt City Council website: https://www.upperhuttcity.com/Services/Water/Drinking-water

Area of Supply	Source of Water	Is Chlorine permanently added?	Is Fluoride added?
Stokes Valley, Manor Park, Haywards	Kaitoke (Headwaters of Hutt River)	Yes	Yes
Wainuiomata	Wainuiomata (Headwaters of Wainuiomata and Orongorongo Rivers)	Yes	Yes
Hutt Valley (excluding Stokes Valley, Manor Park) and Eastbourne	Hutt Valley Artesian System Lower Hutt	Yes, at Waterloo treatment plant	Yes
Petone, Korokoro	Hutt Valley Artesian System Lower Hutt	Yes, at Waterloo treatment plant	No

Hutt City Council website: https://www.huttcity.govt.nz/environment-and-sustainability/water/water-supply

Appendix B – Standard Operating Procedures

3.12 Fluoride Dosing

Fluoride is added to the water to provide dental health benefits to the consumer. The natural level of fluoride in the water around Wellington is 0.1 mg/L, this is increased to 0.7-1.0 mg/L as recommended by the Ministry of Health.

Sodium silicofluoride (Na_2SiF_6) is made up into a slurry and added to the treated water at the fluoride house (on exit road from plant) The fluoride is flow paced. The dose is set manually.

Table 20: Fluoride Dosing Rates

Parameter	Units	Value
Minimum Fluoride Dose	mg/L as F	0.70
Average Fluoride Dose	mg/L as F	0.75
Maximum Fluoride Dose	mg/L as F	0.80

It is extremely important that these doses are not exceeded. Fluoride can be harmful to health at levels greater than 1.5mg/L.

3.12 Fluoride Dosing

Fluoride is added to the water to provide dental health benefits to the consumer. The natural level of fluoride in the water around Wellington is 0.1 mg/L, this is increased to 0.7-1.0 mg/L as recommended by the Ministry of Health.

Sodium silicofluoride (Na_2SiF_6) is made up into a solution and added to the treated water in the outlet mixing chamber. The fluoride is flow paced. The dose is set manually.

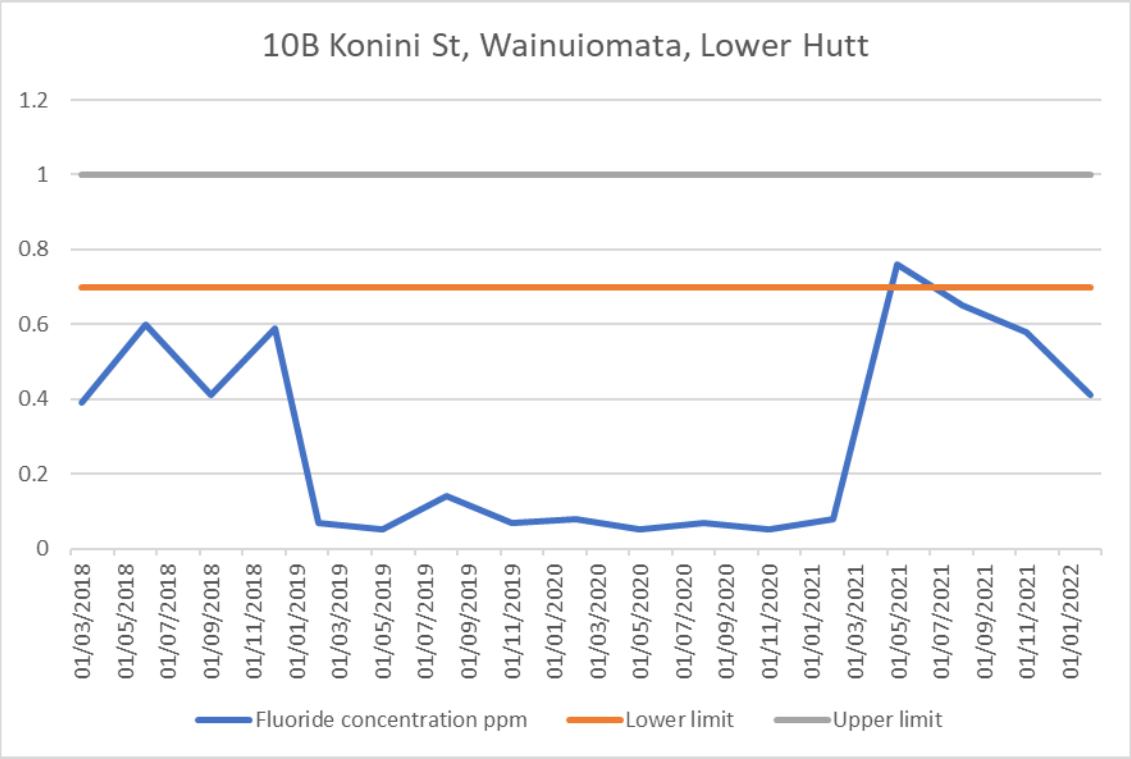
Table 18: Fluoride Dosing Rates

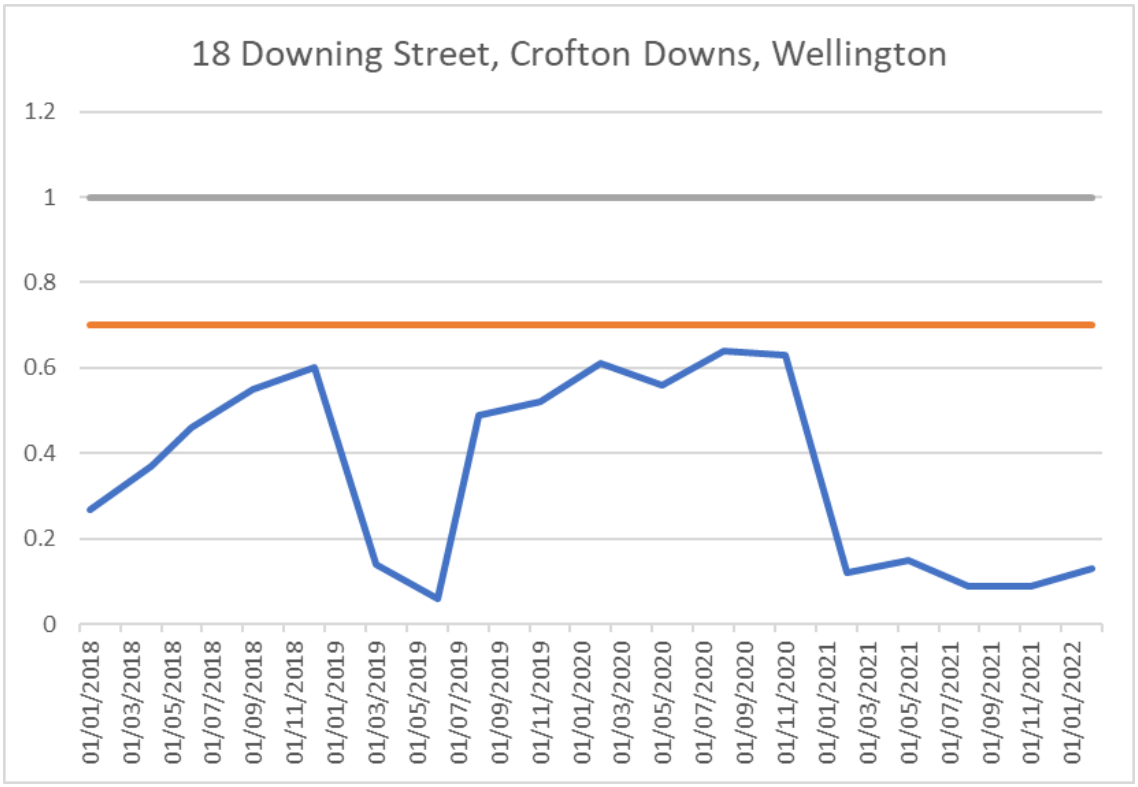
Parameter	Units	Value
Minimum Fluoride Dose	mg/L as F	0.70
Average Fluoride Dose	mg/L as F	0.75
Maximum Fluoride Dose	mg/L as F	0.80

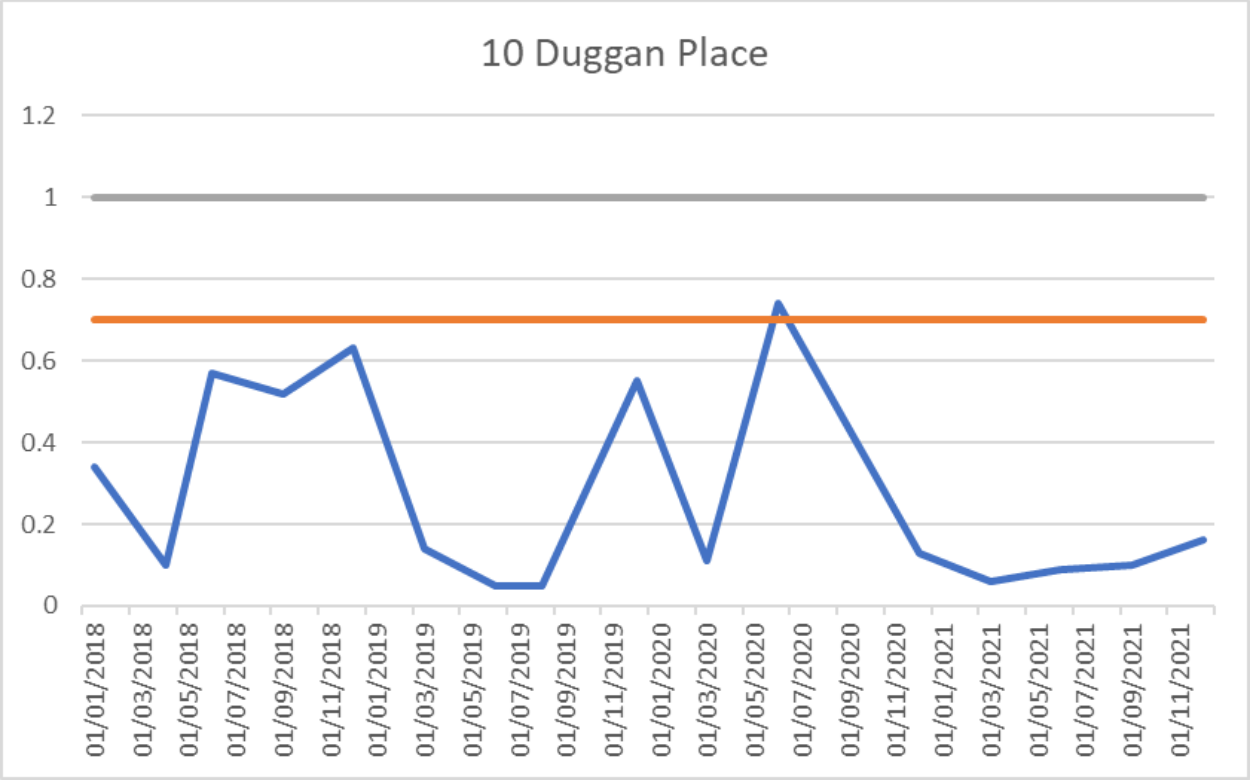
It is extremely important that these doses are not exceeded. Fluoride can be harmful to health at levels greater than 1.5mg/L.

Appendix C - Residual Fluoride Concentrations in the Water Distribution System

The analyses of samples taken from the water distribution system, and presented graphically below, showed there were no incidents of fluoride levels exceeding the MAV of 1.5 ppm.




18 Downing Street, Crofton Downs, Wellington
1.2
1
0.8
0.6
0.4
0.2
0
01/01/2018
01/03/2018
01/05/2018
01/07/2018
01/09/2018
01/11/2018
01/01/2019
01/03/2019
01/05/2019
01/07/2019
01/09/2019
01/11/2019
01/01/2020
01/03/2020
01/05/2020
01/07/2020
01/09/2020
01/11/2020
01/01/2021
01/03/2021
01/05/2021
01/07/2021
01/09/2021
01/11/2021
01/01/2022


10 Duggan Place
1.2
1
0.8
0.6
0.4
0.2
0
01/01/2018
01/03/2018
01/05/2018
01/07/2018
01/09/2018
01/11/2018
01/01/2019
01/03/2019
01/05/2019
01/07/2019
01/09/2019
01/11/2019
01/01/2020
01/03/2020
01/05/2020
01/07/2020
01/09/2020
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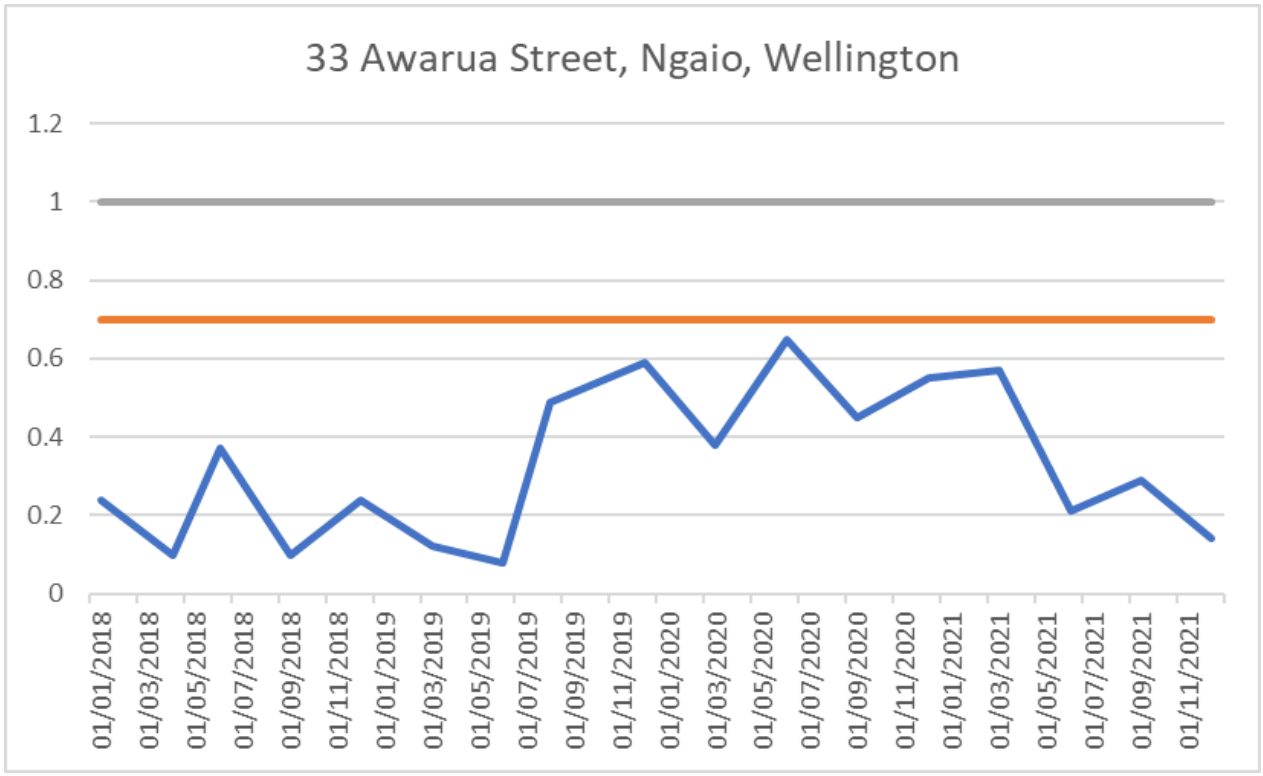
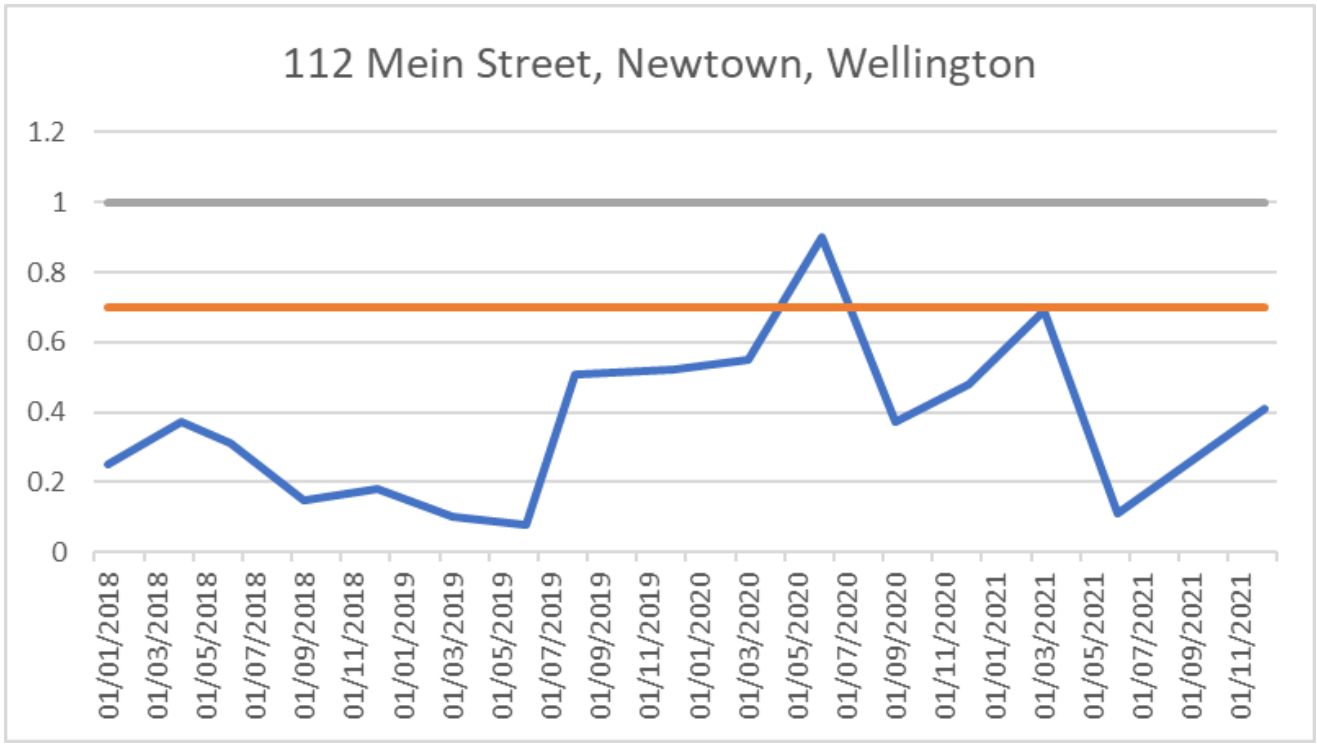
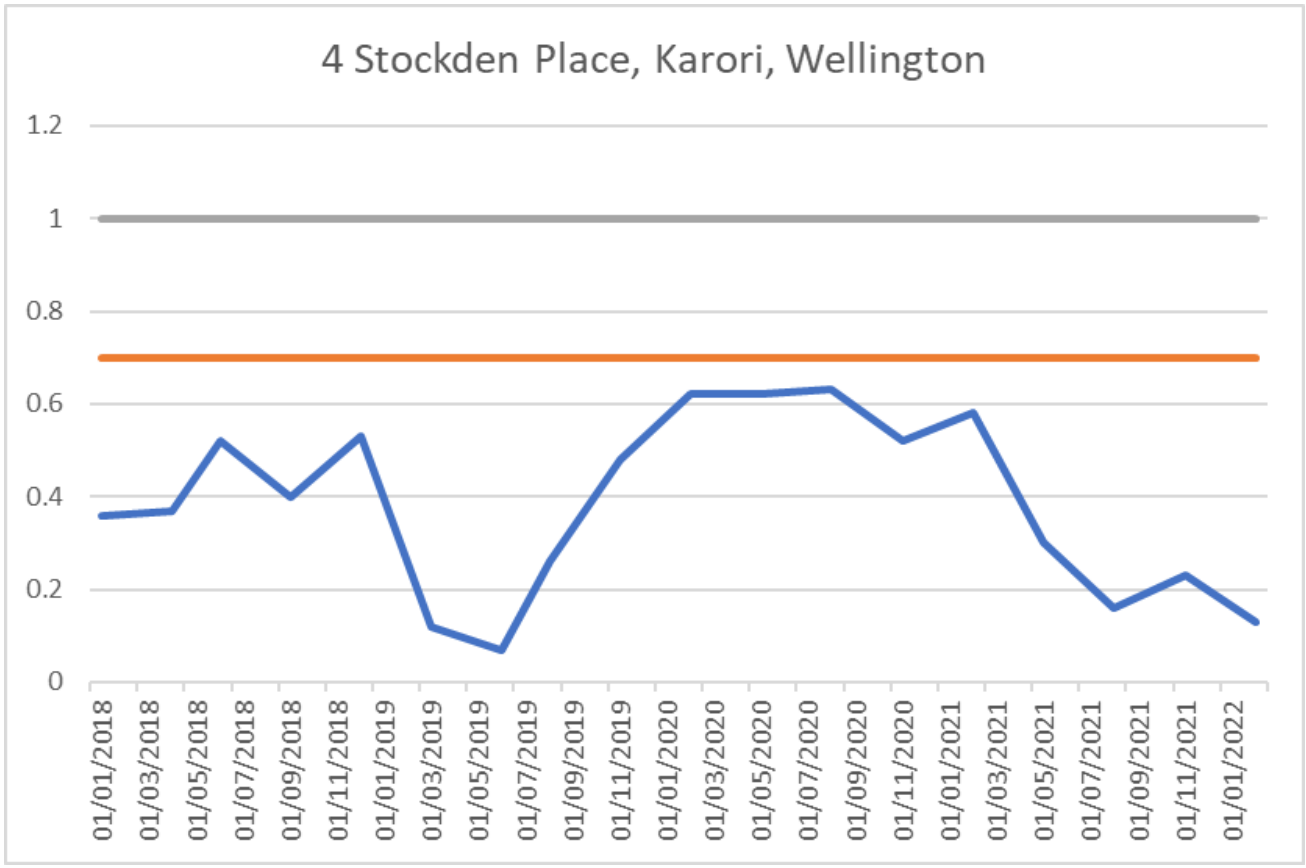
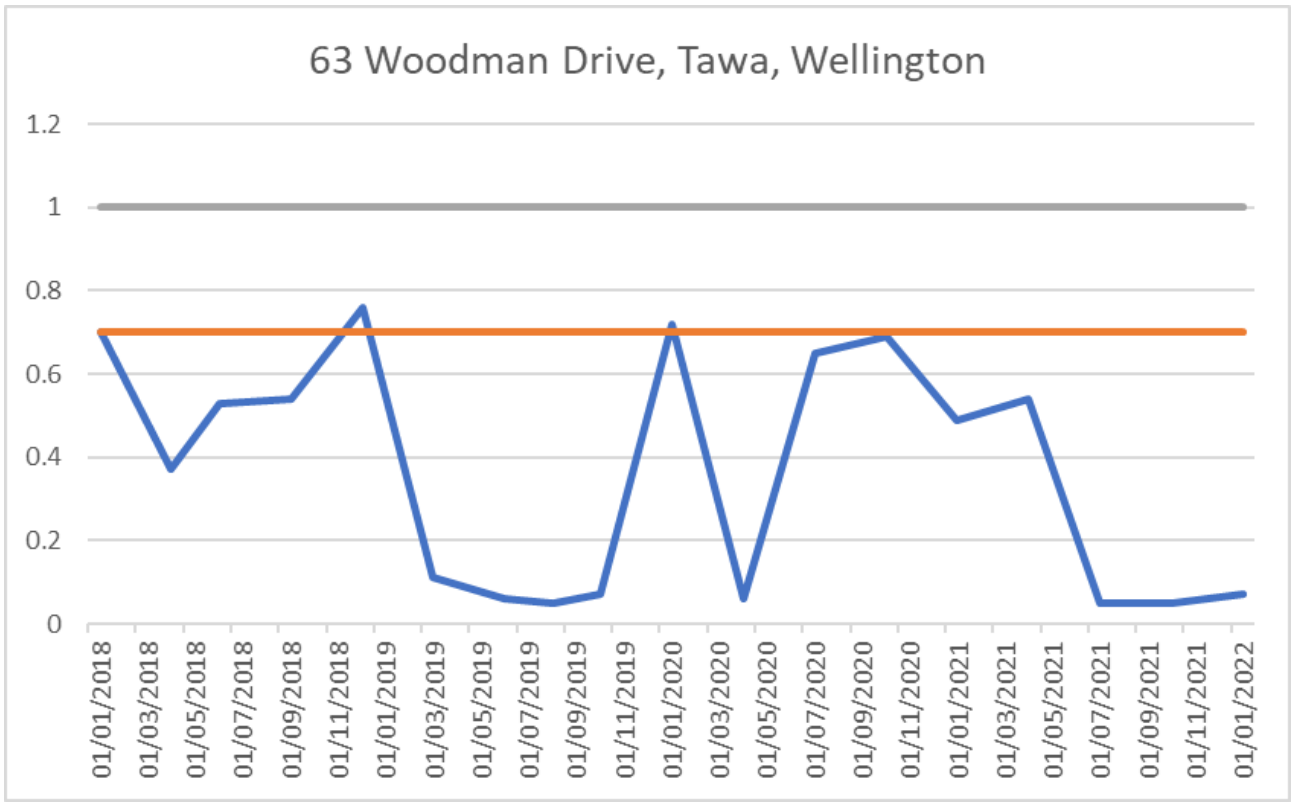
01/01/2021
01/03/2021
01/05/2021
01/07/2021
01/09/2021
01/11/2021


33 Awarua Street, Ngaio, Wellington
1.2
1
0.8
0.6
0.4
0.2
0
01/01/2018
01/03/2018
01/05/2018
01/07/2018
01/09/2018
01/11/2018
01/01/2019
01/03/2019
01/05/2019
01/07/2019
01/09/2019
01/11/2019
01/01/2020
01/03/2020
01/05/2020
01/07/2020
01/09/2020
01/11/2020
01/01/2021
01/03/2021
01/05/2021
01/07/2021
01/09/2021
01/11/2021


112 Mein Street, Newtown, Wellington
1.2
1
0.8
0.6
0.4
0.2
0
01/01/2018
01/03/2018
01/05/2018
01/07/2018
01/09/2018
01/11/2018
01/01/2019
01/03/2019
01/05/2019
01/07/2019
01/09/2019
01/11/2019
01/01/2020
01/03/2020
01/05/2020
01/07/2020
01/09/2020
01/11/2020
01/01/2021
01/03/2021
01/05/2021
01/07/2021
01/09/2021
01/11/2021


4 Stockden Place, Karori, Wellington
1.2
1
0.8
0.6
0.4
0.2
0
01/01/2018
01/03/2018
01/05/2018
01/07/2018
01/09/2018
01/11/2018
01/01/2019
01/03/2019
01/05/2019
01/07/2019
01/09/2019
01/11/2019
01/01/2020
01/03/2020
01/05/2020
01/07/2020
01/09/2020
01/11/2020
01/01/2021
01/03/2021
01/05/2021
01/07/2021
01/09/2021
01/11/2021
01/01/2022


63 Woodman Drive, Tawa, Wellington
1.2
1
0.8
0.6
0.4
0.2
0
01/01/2018
01/03/2018
01/05/2018
01/07/2018
01/09/2018
01/11/2018
01/01/2019
01/03/2019
01/05/2019
01/07/2019
01/09/2019
01/11/2019
01/01/2020
01/03/2020
01/05/2020
01/07/2020
01/09/2020
01/11/2020
01/01/2021
01/03/2021
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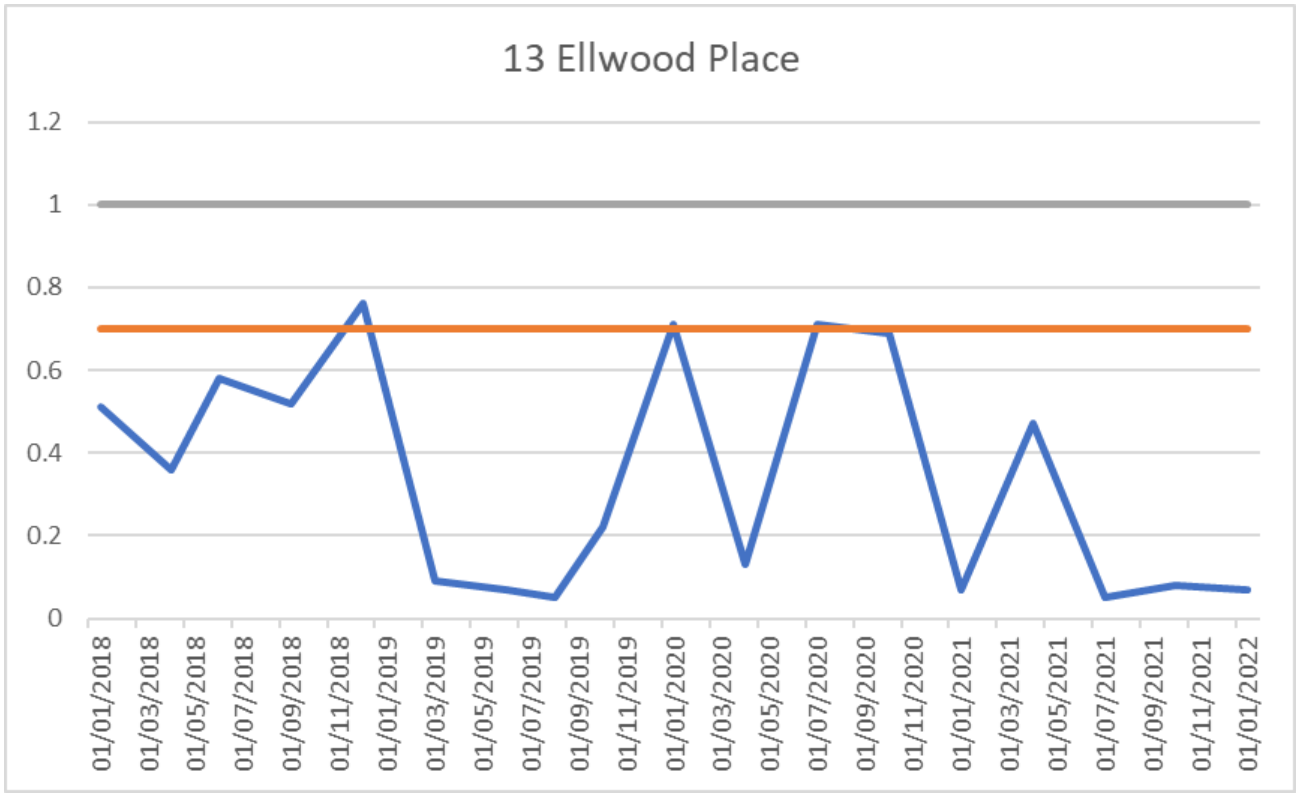
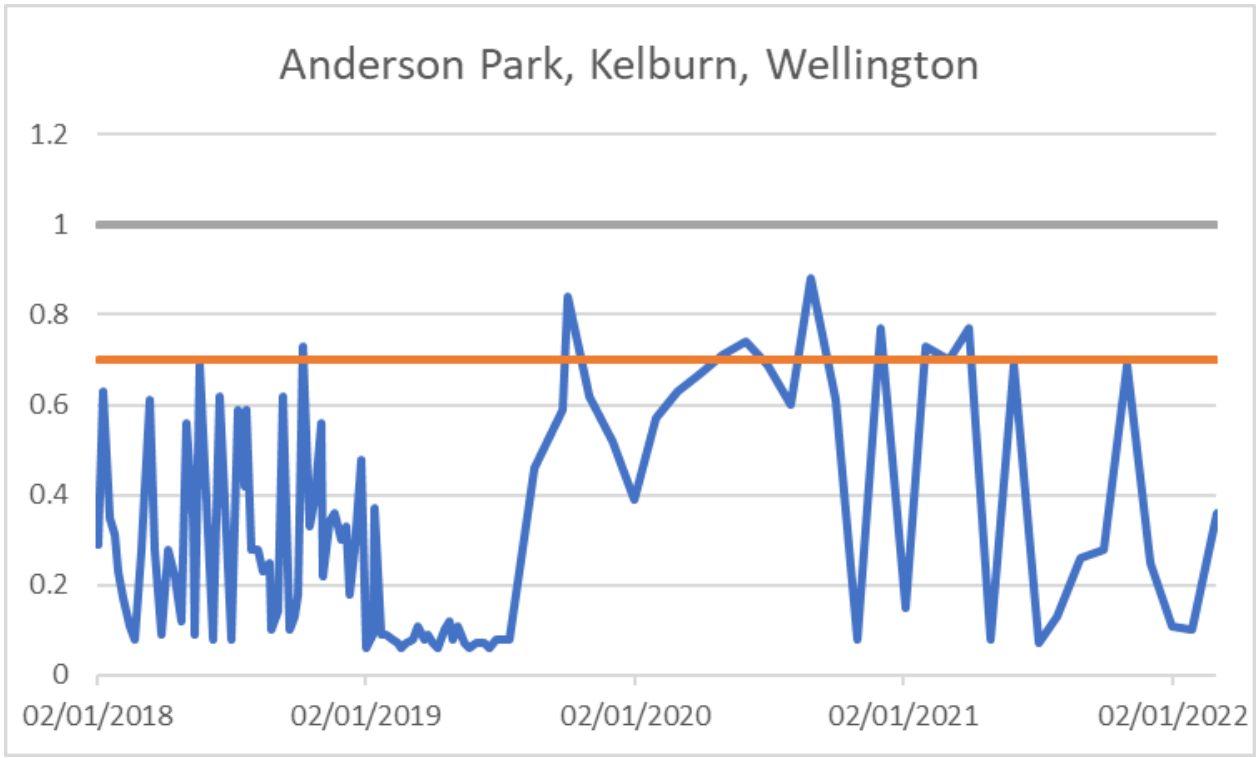
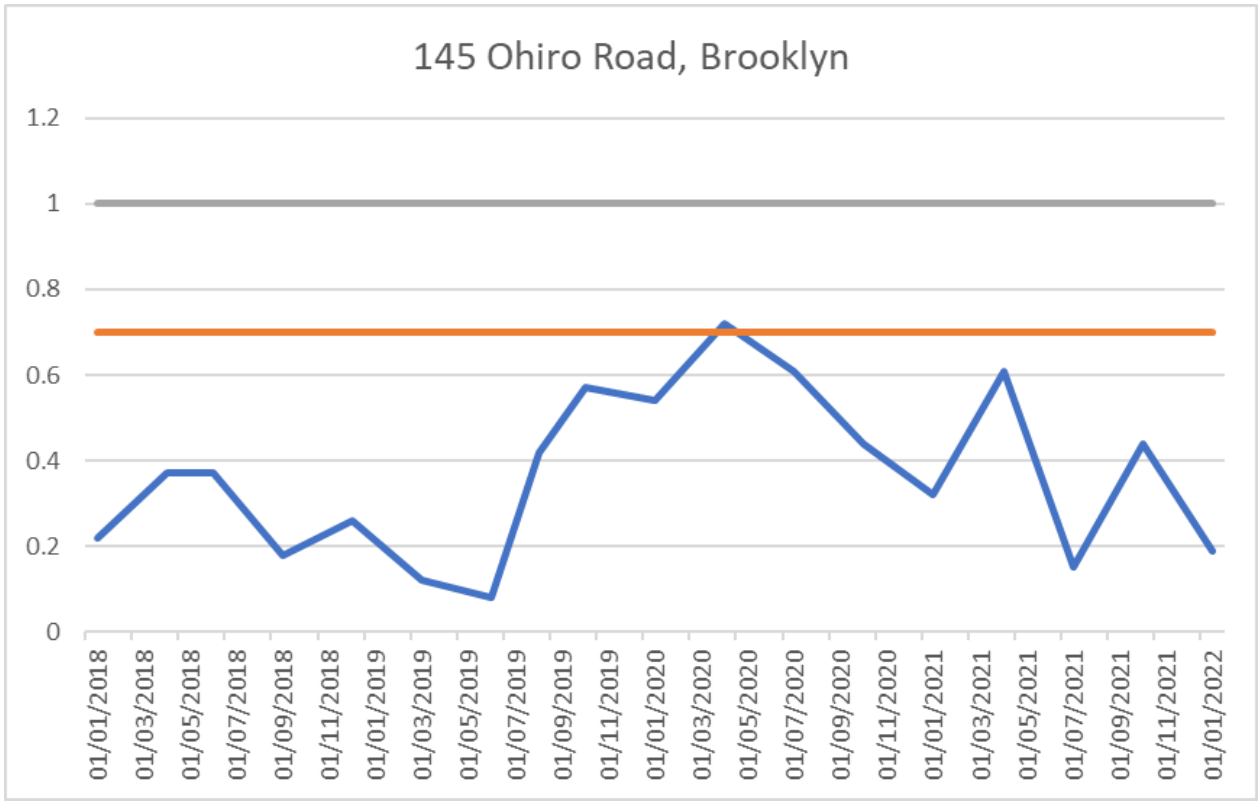
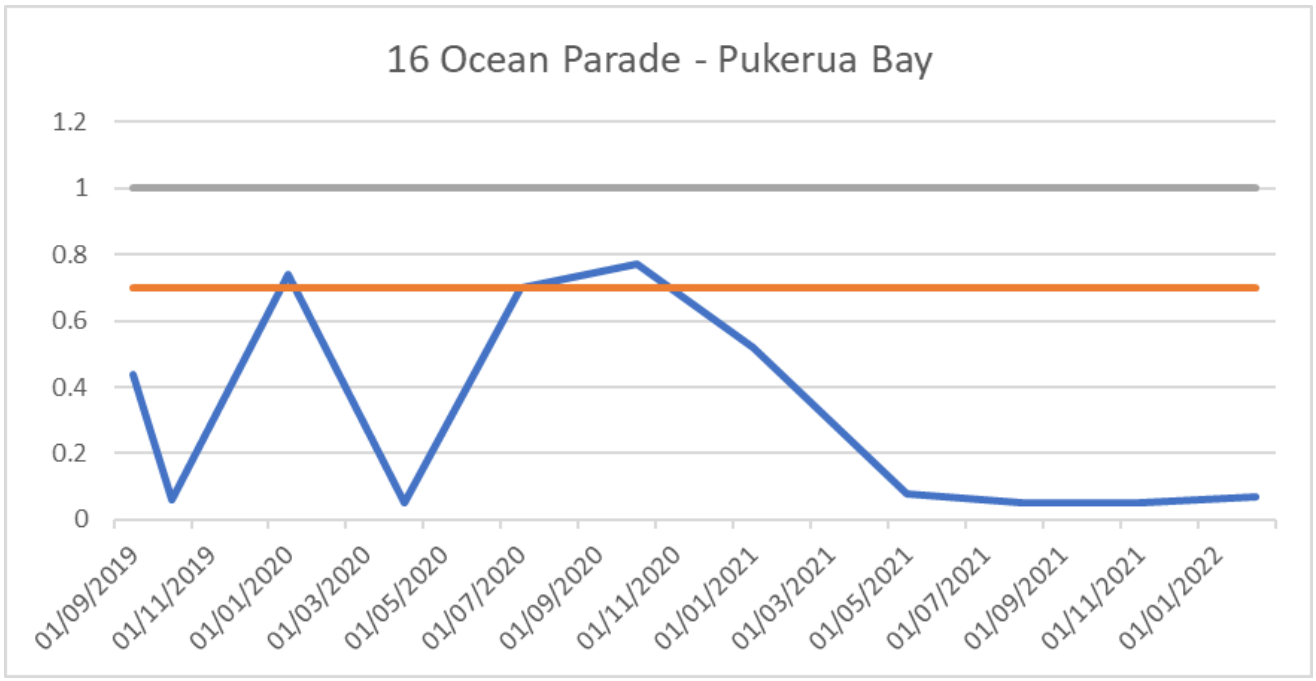
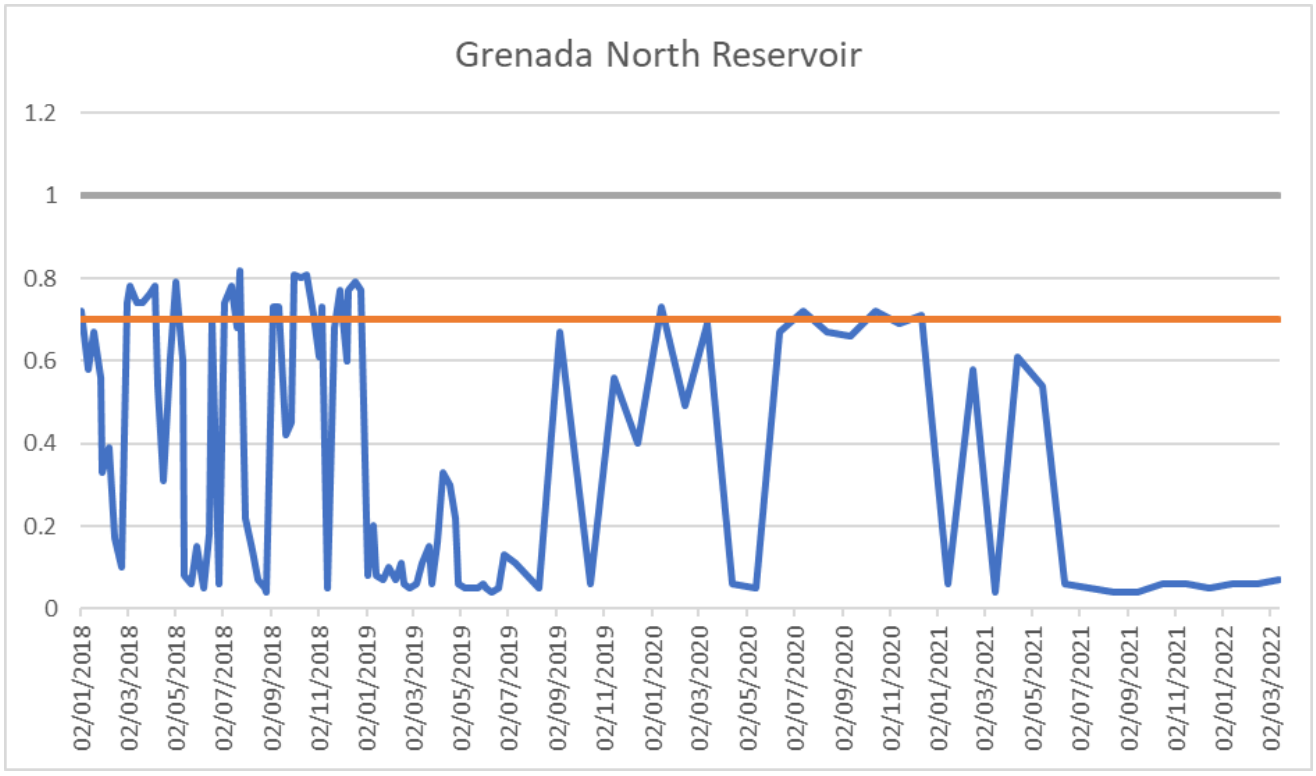
01/07/2021
01/09/2021
01/11/2021
01/01/2022


13 Ellwood Place
1.2
1
0.8
0.6
0.4
0.2
0
01/01/2018
01/03/2018
01/05/2018
01/07/2018
01/09/2018
01/11/2018
01/01/2019
01/03/2019
01/05/2019
01/07/2019
01/09/2019
01/11/2019
01/01/2020
01/03/2020
01/05/2020
01/07/2020
01/09/2020
01/11/2020
01/01/2021
01/03/2021
01/05/2021
01/07/2021
01/09/2021
01/11/2021
01/01/2022


Anderson Park, Kelburn, Wellington
1.2
1
0.8
0.6
0.4
0.2
0
02/01/2018
02/01/2019
02/01/2020
02/01/2021
02/01/2022


145 Ohiro Road, Brooklyn
1.2
1
0.8
0.6
0.4
0.2
0
01/01/2018
01/03/2018
01/05/2018
01/07/2018
01/09/2018
01/11/2018
01/01/2019
01/03/2019
01/05/2019
01/07/2019
01/09/2019
01/11/2019
01/01/2020
01/03/2020
01/05/2020
01/07/2020
01/09/2020
01/11/2020
01/01/2021
01/03/2021
01/05/2021
01/07/2021
01/09/2021
01/11/2021
01/01/2022


16 Ocean Parade - Pukerua Bay
1.2
1
0.8
0.6
0.4
0.2
0
01/09/2019
01/11/2019
01/01/2020
01/03/2020
01/05/2020
01/07/2020
01/09/2020
01/11/2020
01/01/2021
01/03/2021
01/05/2021
01/07/2021
01/09/2021
01/11/2021
01/01/2022


Grenada North Reservoir
1.2
1
0.8
0.6
0.4
0.2
0
02/01/2018
02/03/2018
02/05/2018
02/07/2018
02/09/2018
02/11/2018
02/01/2019
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02/07/2019
02/09/2019
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02/09/2020
02/11/2020
02/01/2021
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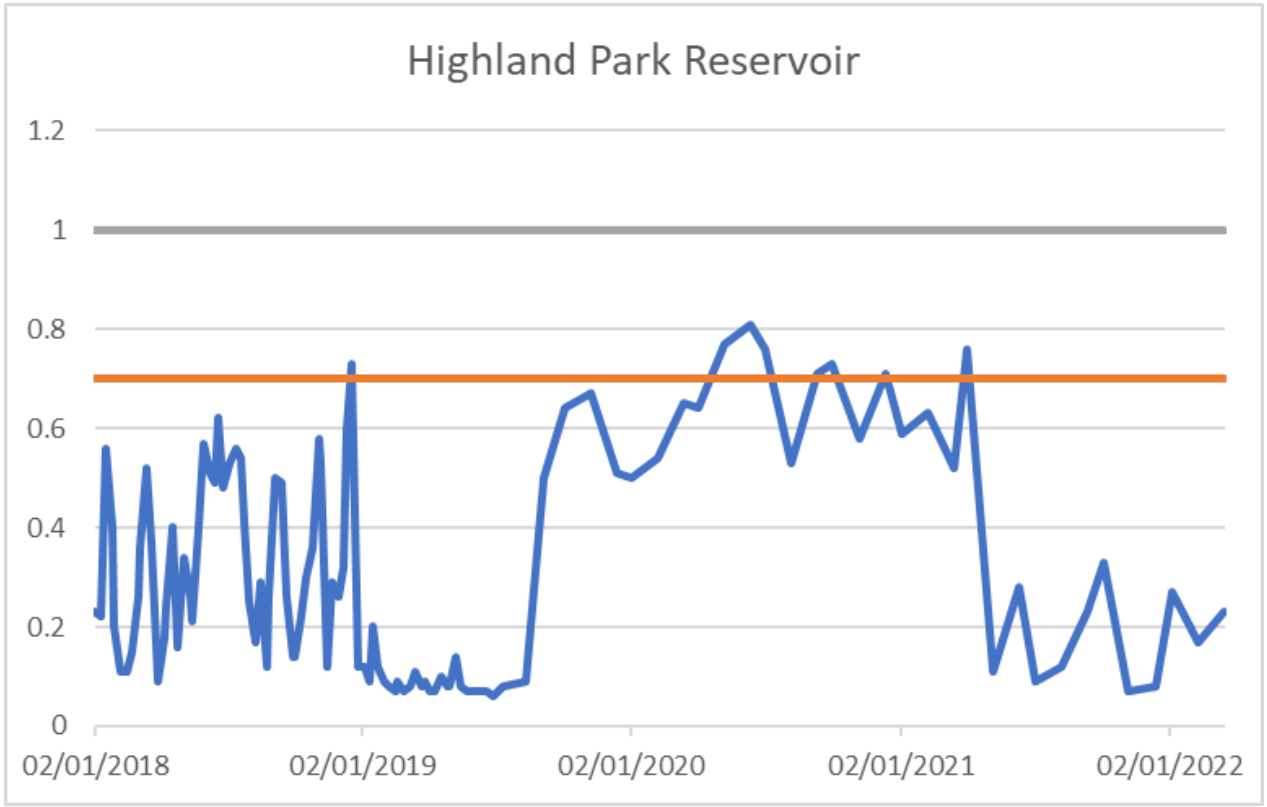
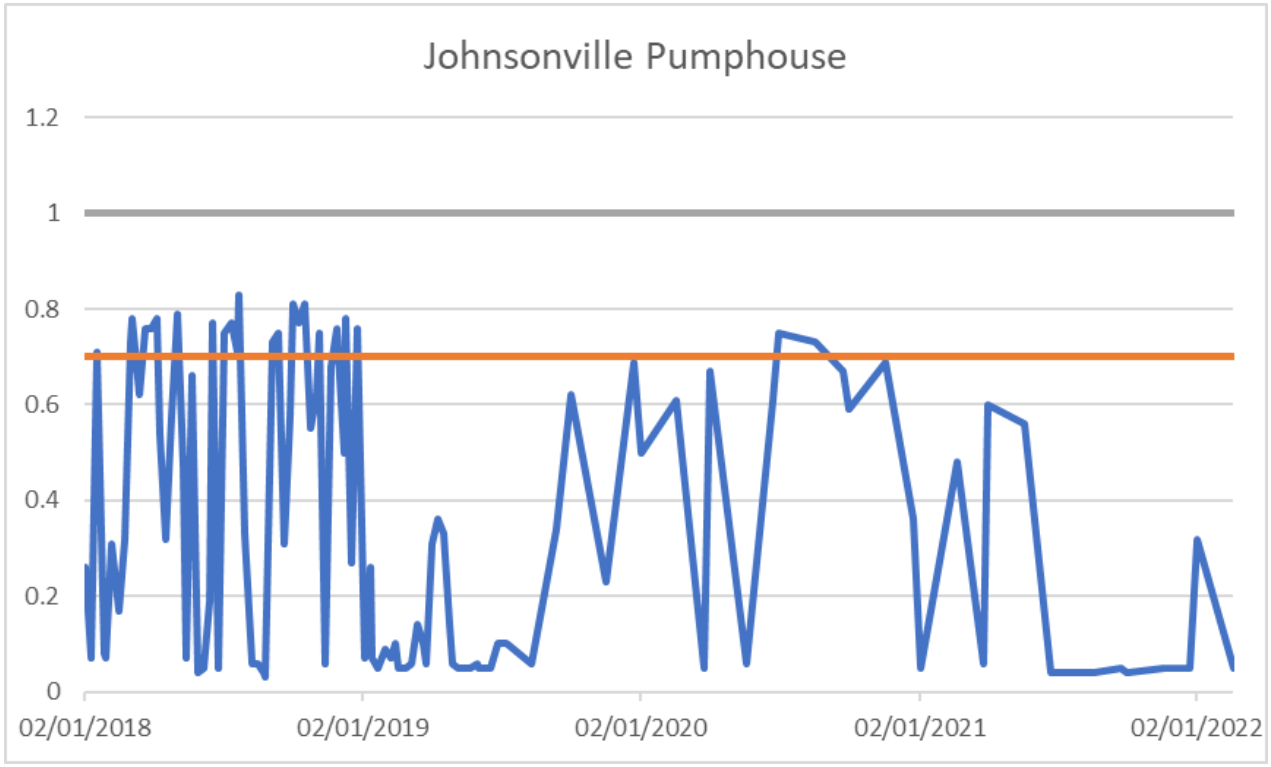
02/11/2021
02/01/2022
02/03/2022


Highland Park Reservoir
1.2
1
0.8
0.6
0.4
0.2
0
02/01/2018
02/01/2019
02/01/2020
02/01/2021
02/01/2022


Johnsonville Pumphouse
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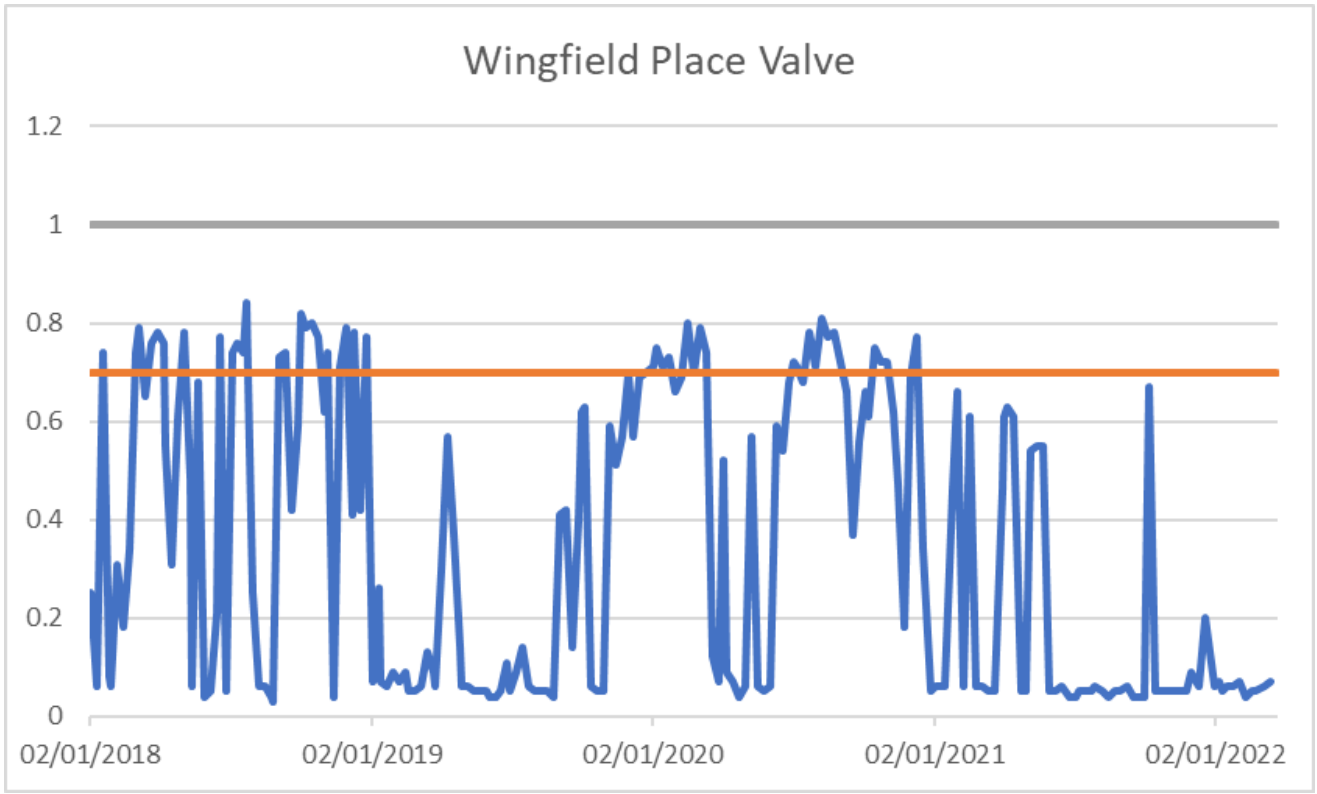
1
0.8
0.6
0.4
0.2
0
02/01/2018
02/01/2019
02/01/2020
02/01/2021
02/01/2022


Wingfield Place Valve
1.2
1
0.8
0.6
0.4
0.2
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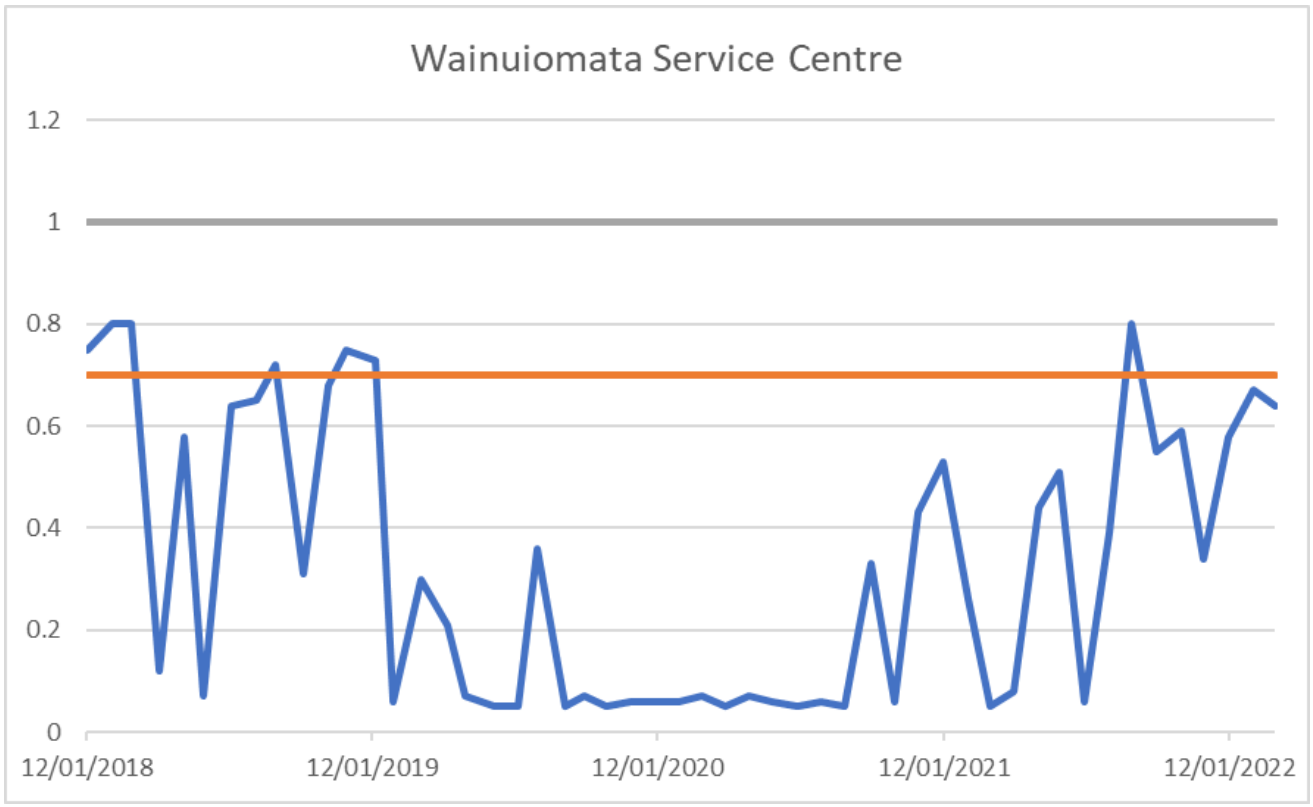
02/01/2018
02/01/2019
02/01/2020
02/01/2021
02/01/2022


Wainuiomata Service Centre
1.2
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0.8
0.6
0.4
0.2
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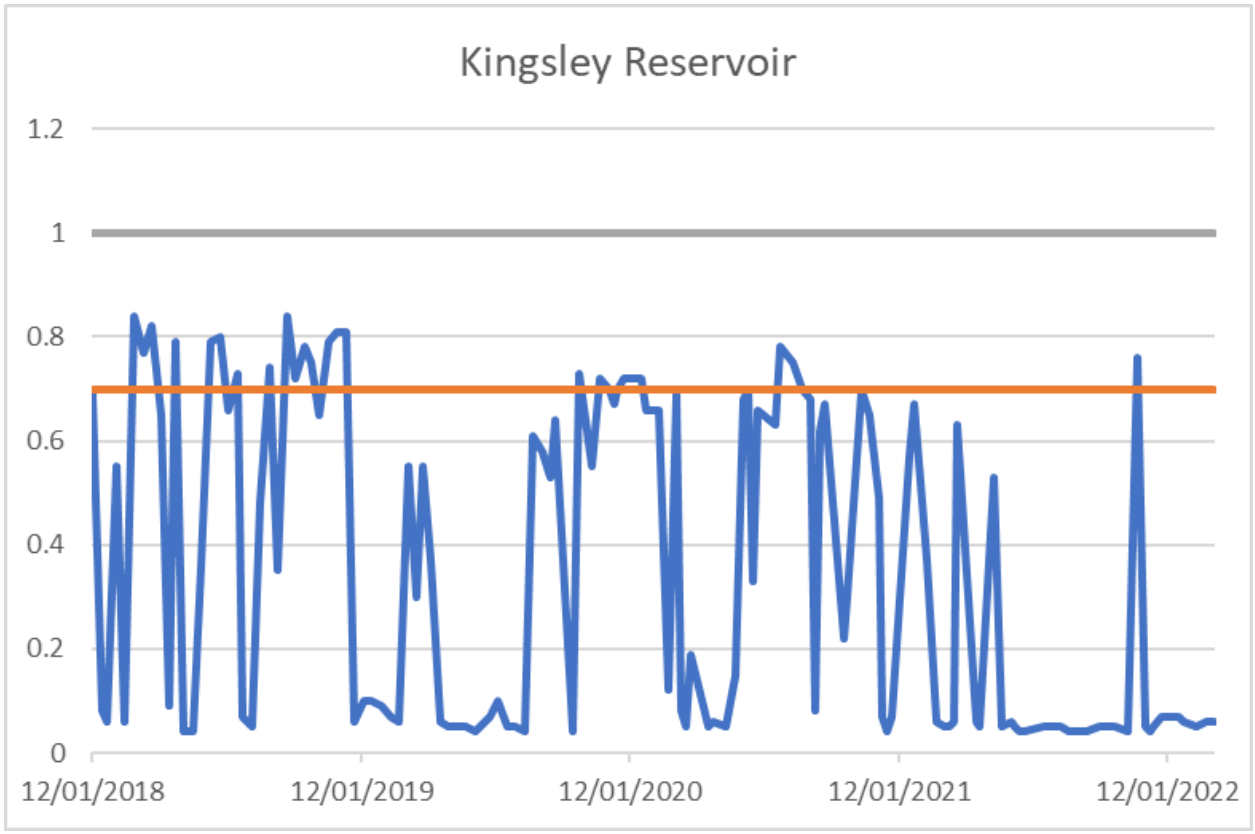
12/01/2018
12/01/2019
12/01/2020
12/01/2021
12/01/2022


Kingsley Reservoir
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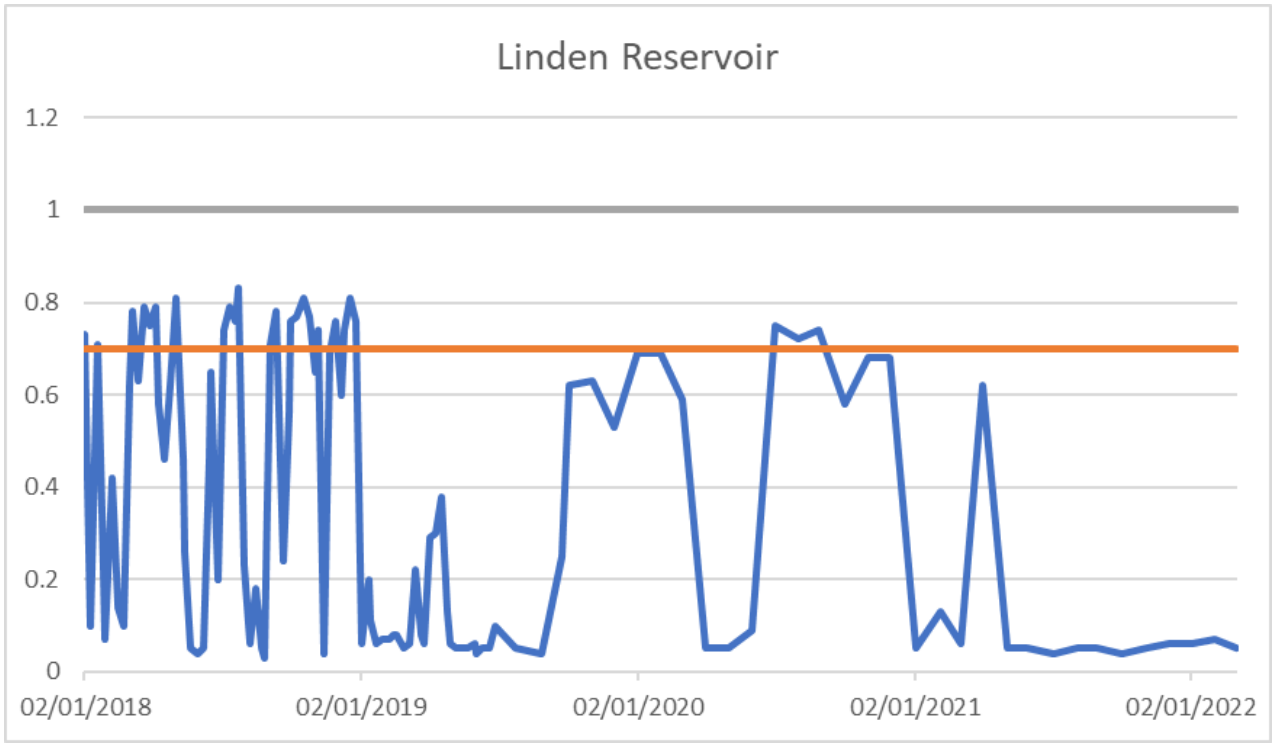
12/01/2019
12/01/2020
12/01/2021
12/01/2022


Linden Reservoir
1.2
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0.6
0.4
0.2
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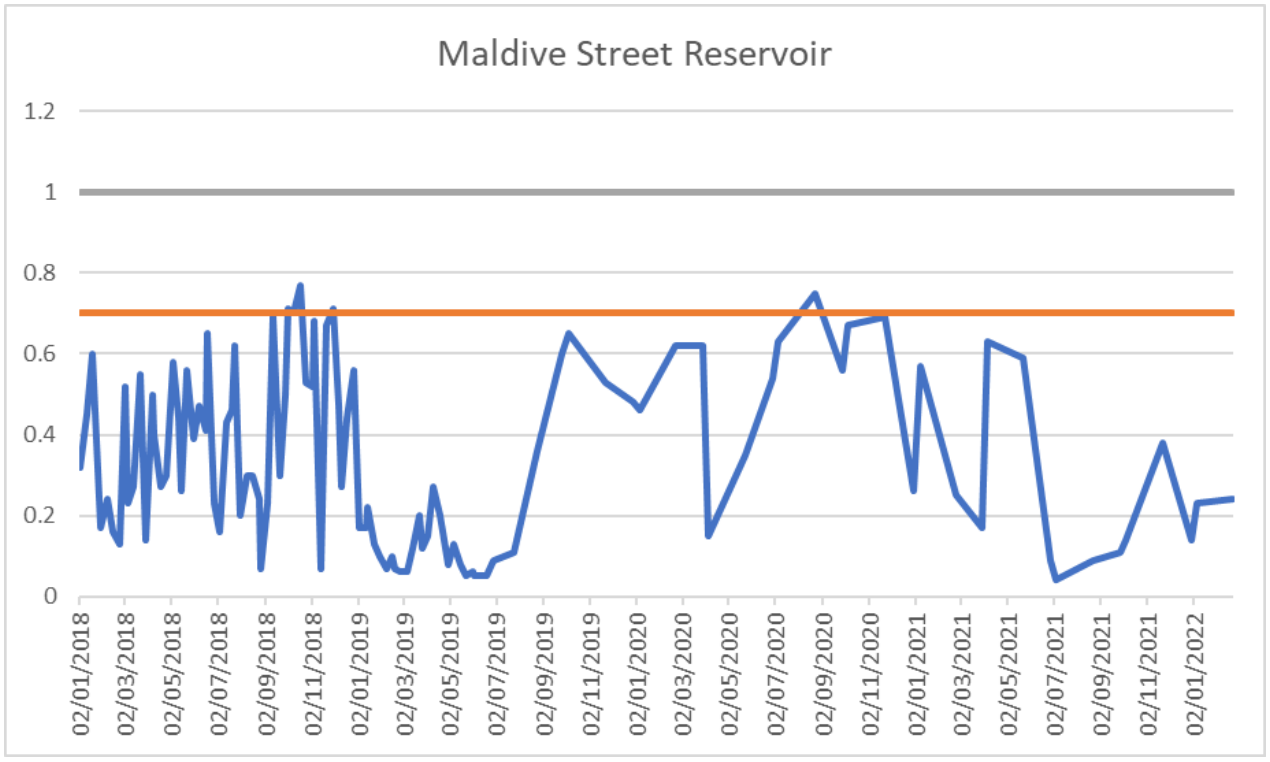
02/01/2018
02/01/2019
02/01/2020
02/01/2021
02/01/2022


Maldive Street Reservoir
1.2
1
0.8
0.6
0.4
0.2
0
02/01/2018
02/03/2018
02/05/2018
02/07/2018
02/09/2018
02/11/2018
02/01/2019
02/03/2019
02/05/2019
02/07/2019
02/09/2019
02/11/2019
02/01/2020
02/03/2020
02/05/2020
02/07/2020
02/09/2020
02/11/2020
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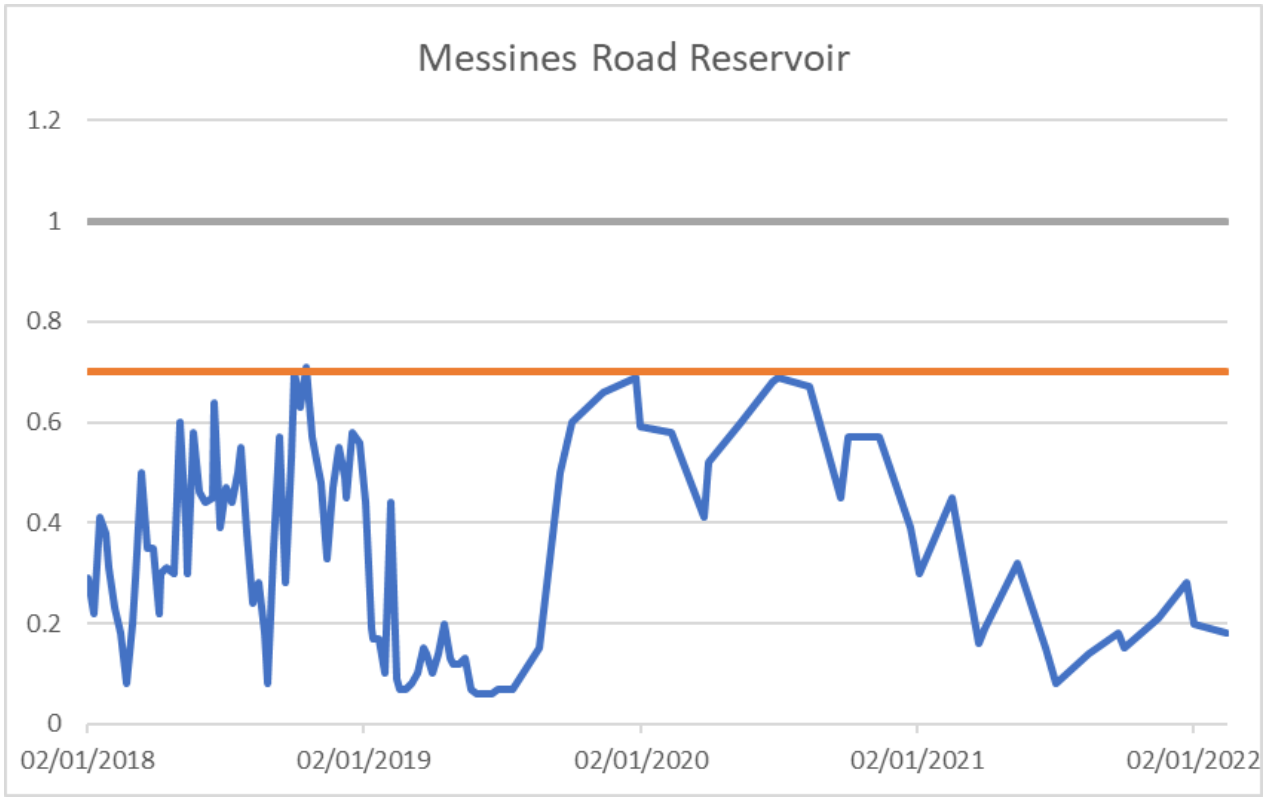
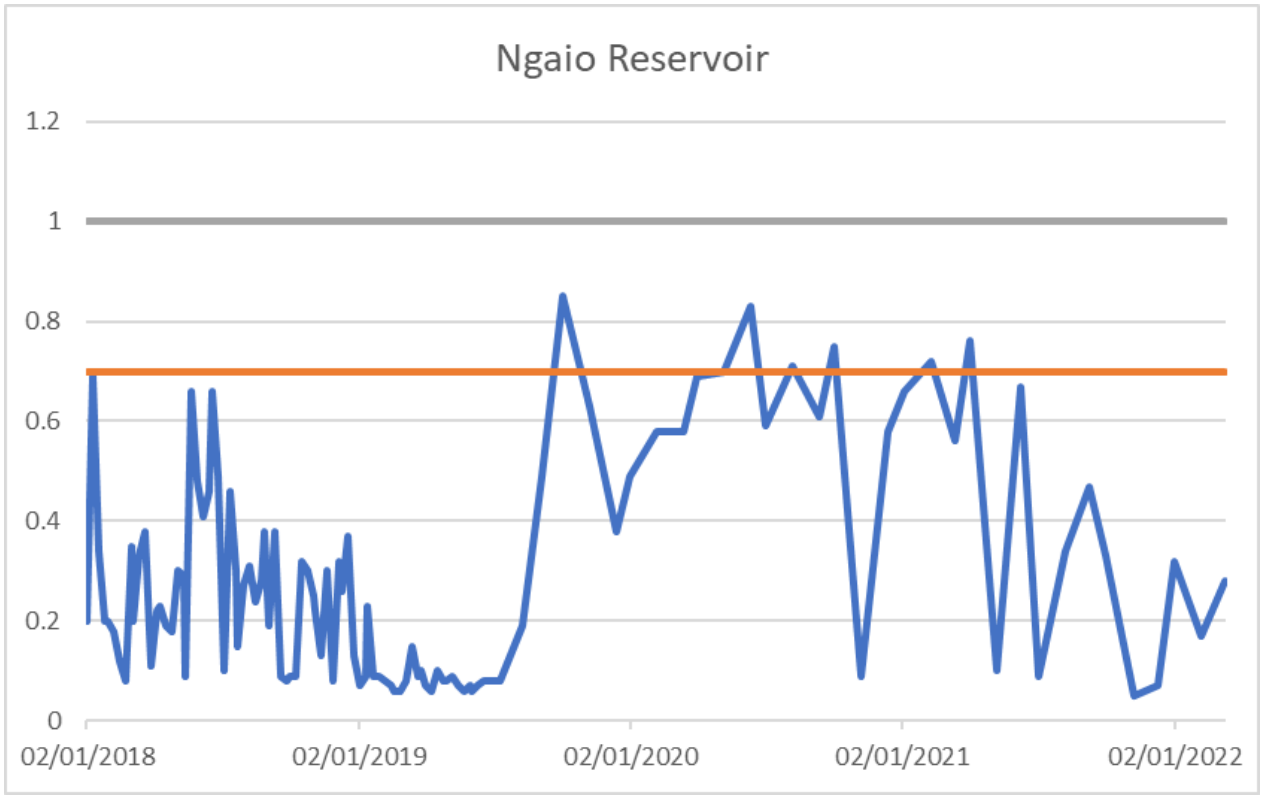
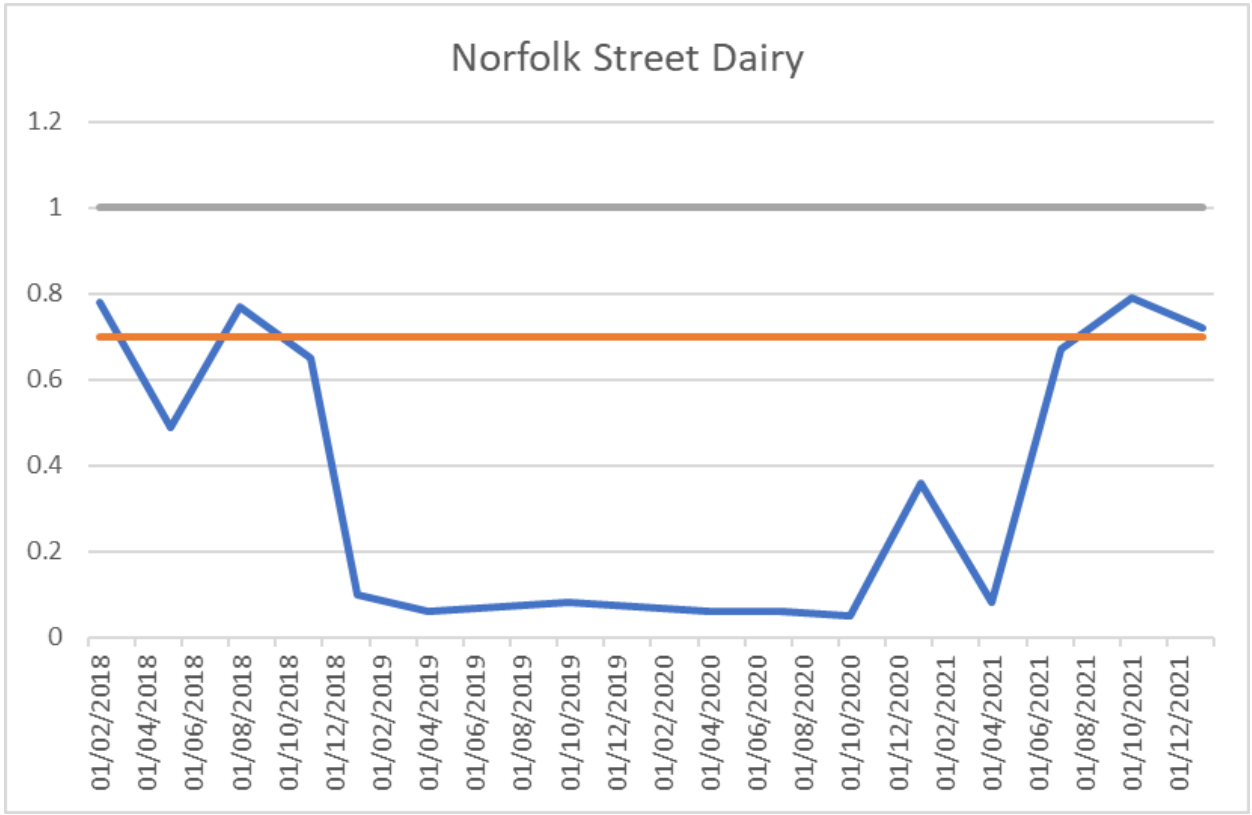
02/07/2021
02/09/2021
02/11/2021
02/01/2022


Messines Road Reservoir
1.2
1
0.8
0.6
0.4
0.2
0
02/01/2018
02/01/2019
02/01/2020
02/01/2021
02/01/2022


Ngaio Reservoir
1.2
1
0.8
0.6
0.4
0.2
0
02/01/2018
02/01/2019
02/01/2020
02/01/2021
02/01/2022


Norfolk Street Dairy
1.2
1
0.8
0.6
0.4
0.2
0
01/02/2018
01/04/2018
01/06/2018
01/08/2018
01/10/2018
01/12/2018
01/02/2019
01/04/2019
01/06/2019
01/08/2019
01/10/2019
01/12/2019
01/02/2020
01/04/2020
01/06/2020
01/08/2020
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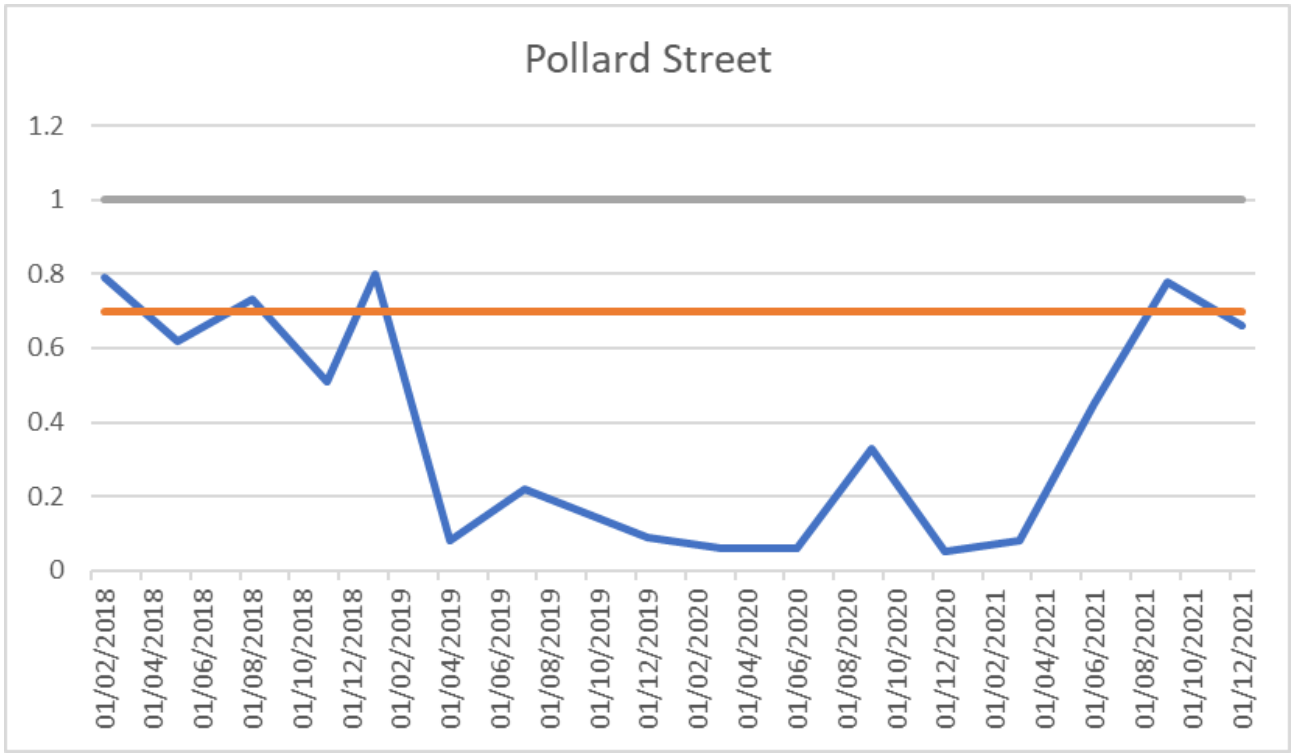
01/08/2021
01/10/2021
01/12/2021


Pollard Street
1.2
1
0.8
0.6
0.4
0.2
0
01/02/2018
01/04/2018
01/06/2018
01/08/2018
01/10/2018
01/12/2018
01/02/2019
01/04/2019
01/06/2019
01/08/2019
01/10/2019
01/12/2019
01/02/2020
01/04/2020
01/06/2020
01/08/2020
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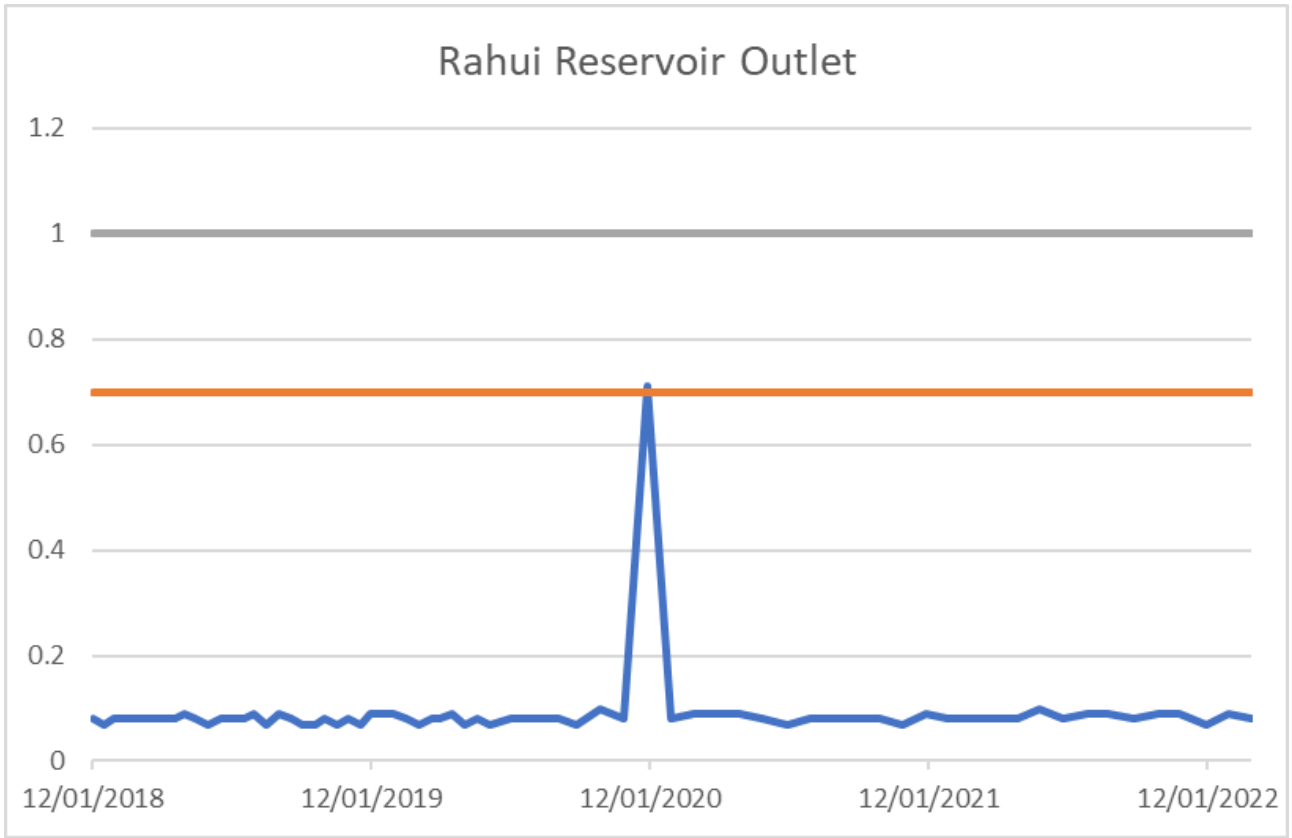
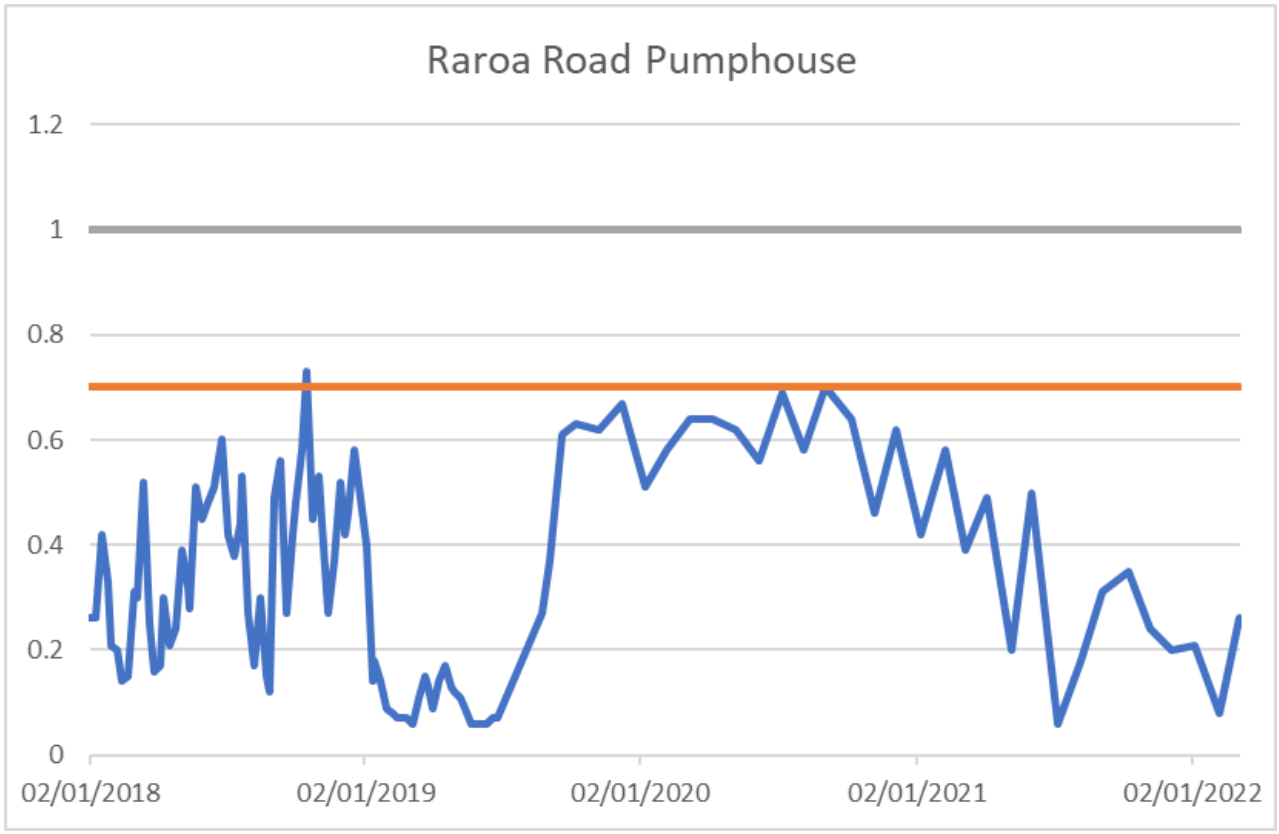
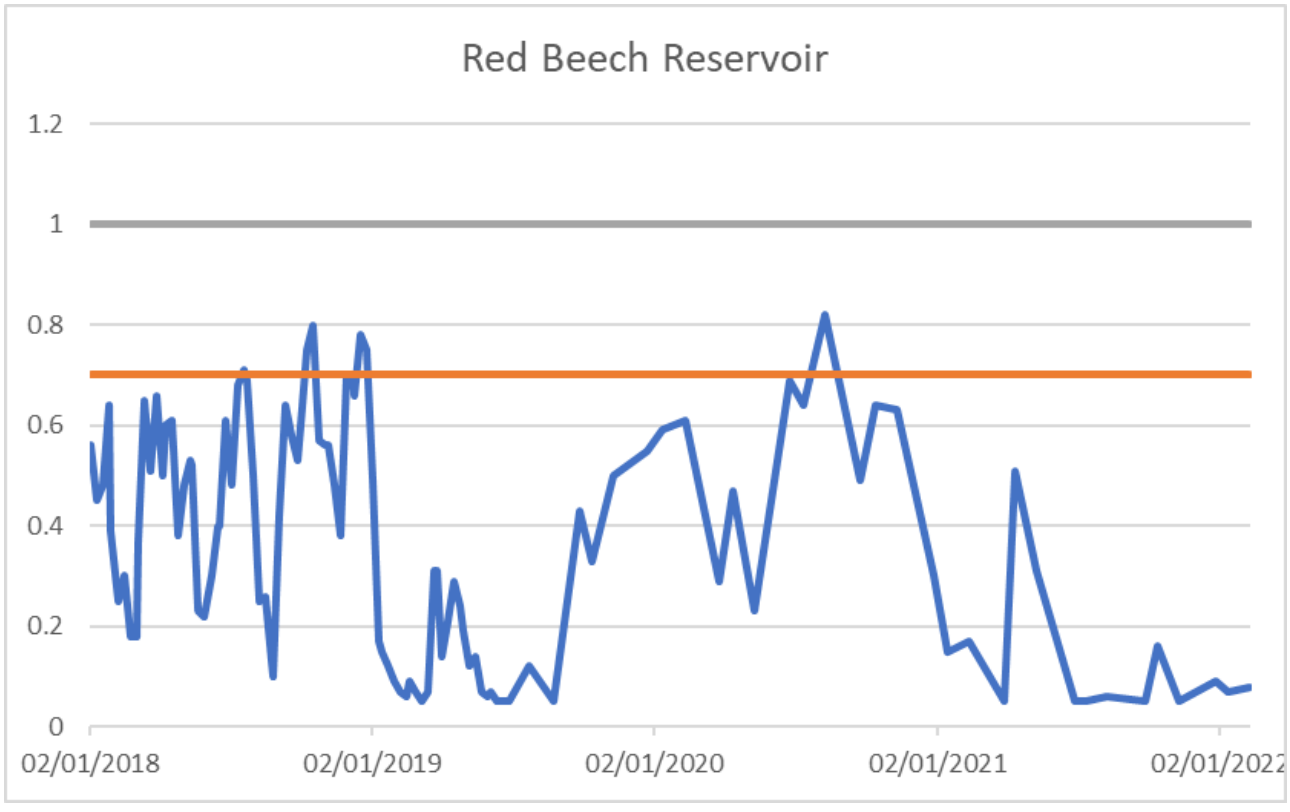
01/10/2021
01/12/2021


Rahui Reservoir Outlet
1.2
1
0.8
0.6
0.4
0.2
0
12/01/2018
12/01/2019
12/01/2020
12/01/2021
12/01/2022


Raroa Road Pumphouse
1.2
1
0.8
0.6
0.4
0.2
0
02/01/2018
02/01/2019
02/01/2020
02/01/2021
02/01/2022


Red Beech Reservoir
1.2
1
0.8
0.6
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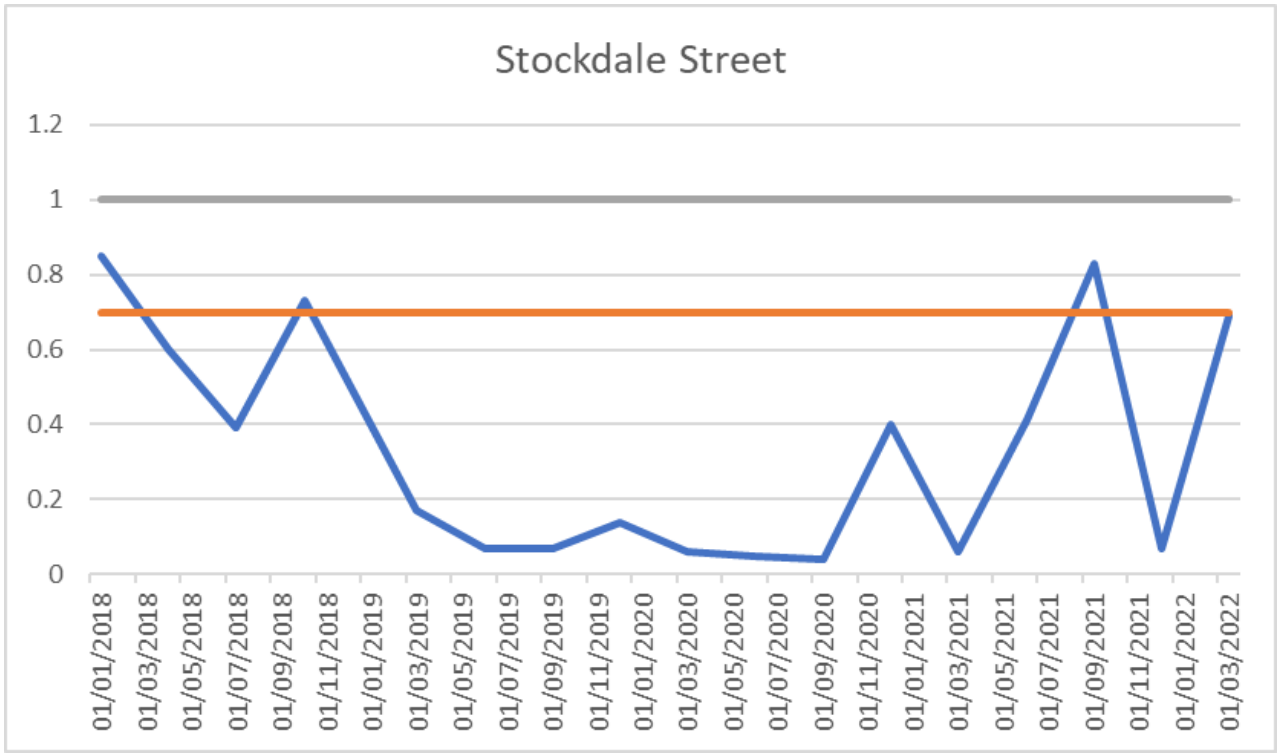
02/01/2019
02/01/2020
02/01/2021
02/01/2022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01/05/2018
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01/09/2018
01/11/2018
01/01/2019
01/03/2019
01/05/2019
01/07/2019
01/09/2019
01/11/2019
01/01/2020
01/03/2020
01/05/2020
01/07/2020
01/09/2020
01/11/2020
01/01/2021
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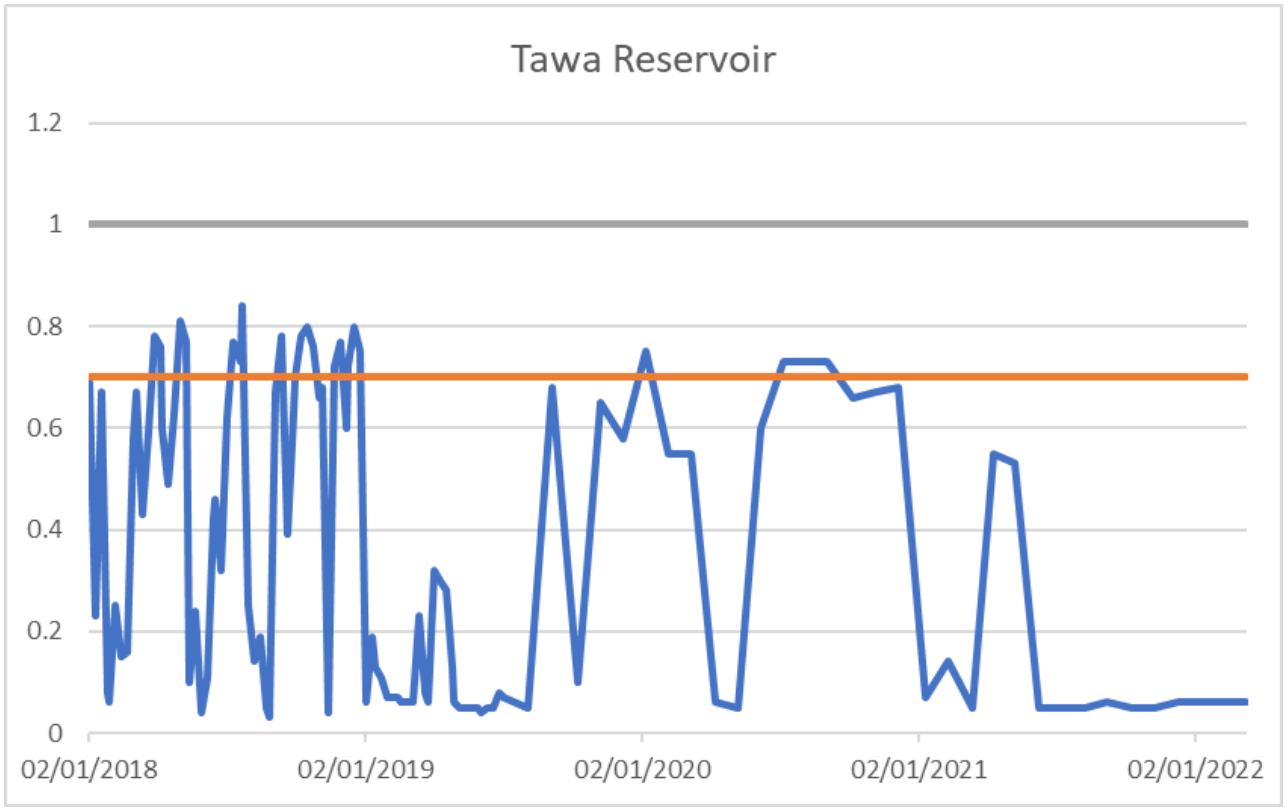
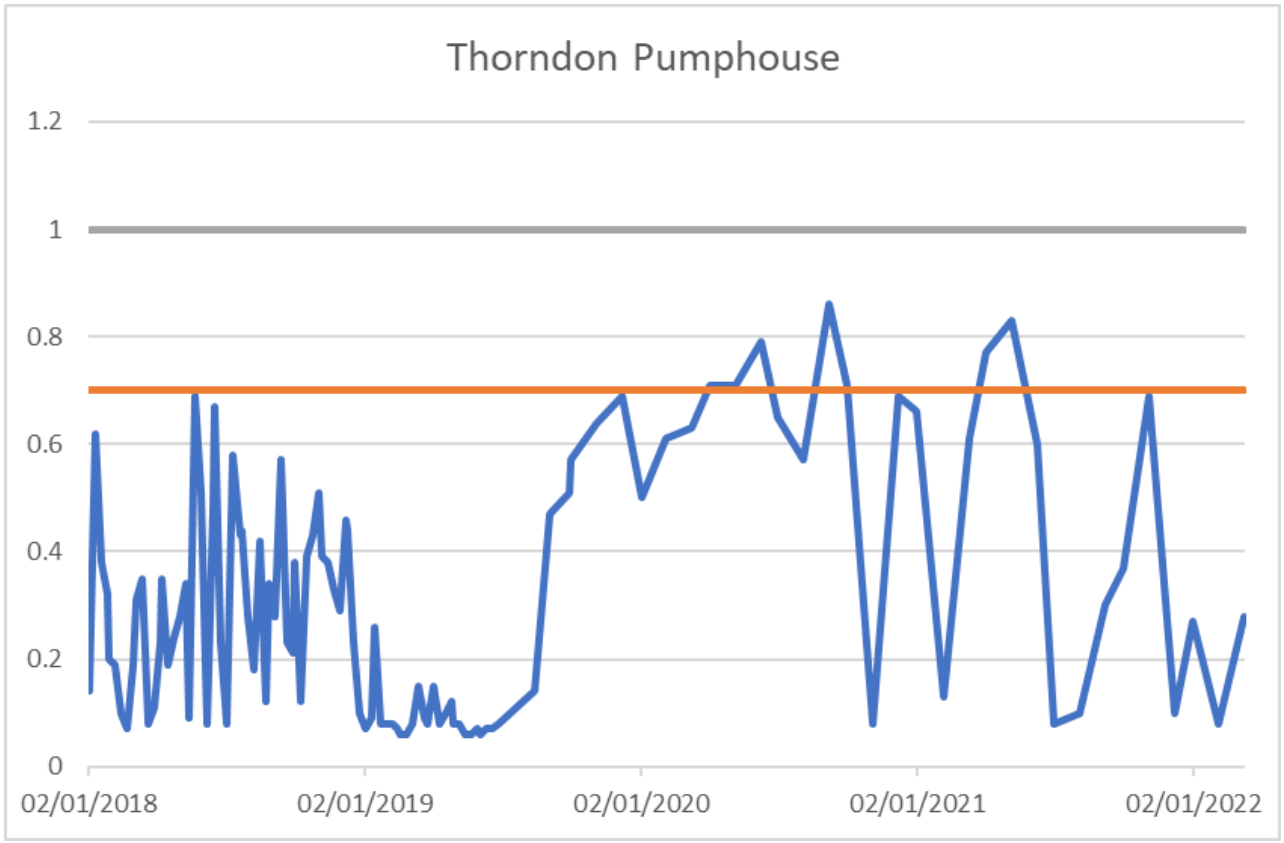
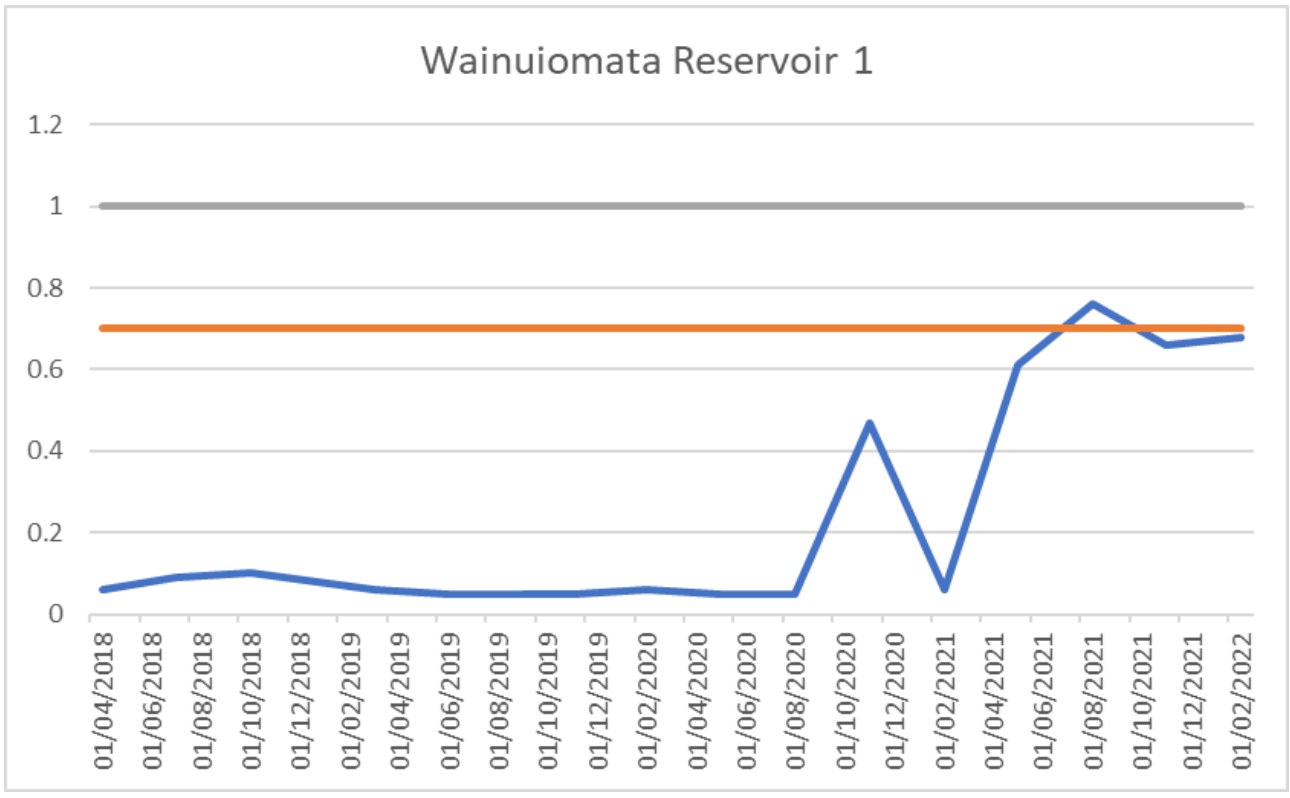
01/03/2022


Tawa Reservoir
1.2
1
0.8
0.6
0.4
0.2
0
02/01/2018
02/01/2019
02/01/2020
02/01/2021
02/01/2022


Thorndon Pumphouse
1.2
1
0.8
0.6
0.4
0.2
0
02/01/2018
02/01/2019
02/01/2020
02/01/2021
02/01/2022


Wainuiomata Reservoir 1
1.2
1
0.8
0.6
0.4
0.2
0
01/04/2018
01/06/2018
01/08/2018
01/10/2018
01/12/2018
01/02/2019
01/04/2019
01/06/2019
01/08/2019
01/10/2019
01/12/2019
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01/08/2020
01/10/2020
01/12/2020
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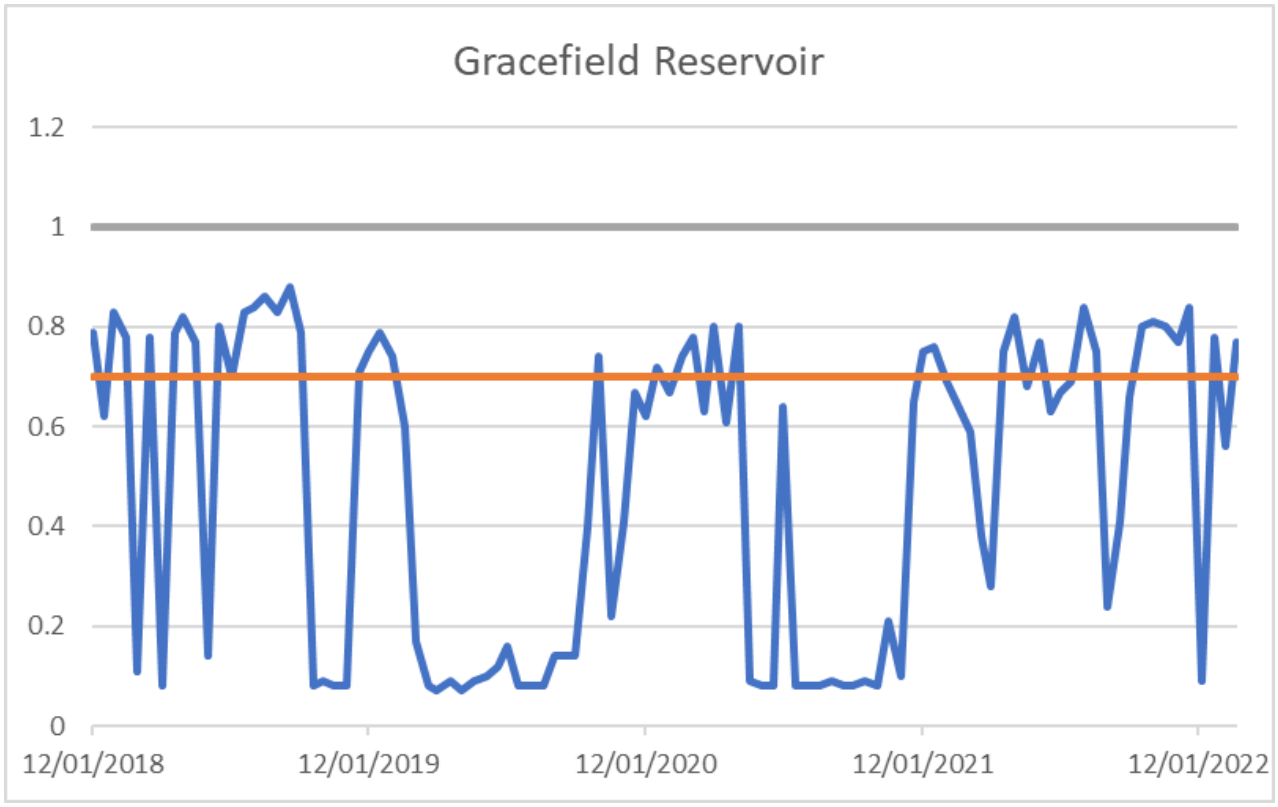
01/12/2021
01/02/2022


Gracefield Reservoir
1.2
1
0.8
0.6
0.4
0.2
0
12/01/2018
12/01/2019
12/01/2020
12/01/2021
12/01/2022

Appendix D - Annual Report on Drinking Water Quality 2019–2020

The Ministry of Health published its Annual Report on Drinking Water Quality for the 2019-2020 year in 2021. The report describes the compliance of the supplies with the drinking-water requirements of the Health Act 1956 and the Drinking-water Standards for New Zealand 2005 (revised 2018).

Abstracts for the Wellington, Hutt, Upper Hutt and Porirua councils are provided below.

These show that the chemical compliance was met for the 2019-2020 year.

Wellington and Hutt

Supplier: Hutt City Council

Lower Hutt			**Population: 103,872**
Health Act: Complied	Standards: Bacterial Met	Protozoal Met	Chemical Met

The water supply uses mixed sources, is treated with coagulation, filtration and UV and is chlorinated. The water is fluoridated.

Supplier: Porirua City Council

Judgeford			**Population: 175**
Health Act: Complied	Standards: Bacterial Met	Protozoal Met	Chemical Met

The water supply uses surface water, is treated with coagulation and filtration and is chlorinated. The water is fluoridated.

Porirua			**Population: 54,830**
Health Act: Complied	Standards: Bacterial Met	Protozoal Met	Chemical Met

The water supply uses surface water, is treated with coagulation and filtration and is chlorinated. The water is fluoridated.

Supplier: Upper Hutt City Council

Upper Hutt			**Population: 39,927**
Health Act: Complied	Standards: Bacterial Met	Protozoal Met	Chemical Met

The water supply uses surface water, is treated with coagulation and filtration and is chlorinated. The water is fluoridated.

Supplier: Wellington City Council

Wellington City			**Population: 210,637**
Health Act: Complied	Standards: Bacterial Met	Protozoal Met	Chemical Met

The water supply uses mixed sources, is treated with coagulation, filtration and UV and is chlorinated. The water is fluoridated.

Appendix E - Annual Report on Drinking Water Quality 2018–2019

The Ministry of Health published its Annual Report on Drinking Water Quality for the 2018-2019 year in 2020. The report describes the compliance of the supplies with the drinking-water requirements of the Health Act 1956 and the Drinking-water Standards for New Zealand 2005 (revised 2018).

Abstracts for the Wellington, Hutt, Upper Hutt and Porirua councils are provided below.

These show that the chemical compliance was met for the 2018-2019 year.

Wellington and Hutt

Supplier: Greater Wellington Water

Wellington Region Bulk Water — Population: 350,000

Health Act: complied Standards: Bacterial met Protozoal met Chemical met

The water supply uses mixed sources. It is chlorinated and parts of the supply are treated by UV. The water is fluoridated.

Supplier: Hutt City Council

Lower Hutt — Population: 103,862

Health Act: complied Standards: Bacterial met Protozoal met Chemical met

The water supply uses mixed sources. It is chlorinated and parts of the supply are treated by UV. The water is fluoridated.

Supplier: Porirua City Council

Judgeford — Population: 175

Health Act: complied Standards: Bacterial met Protozoal met Chemical met

The water supply uses surface water and is chlorinated. The water is fluoridated.

Porirua — Population: 54,830

Health Act: complied Standards: Bacterial met Protozoal met Chemical met

The water supply uses surface water and is chlorinated. The water is fluoridated.

Supplier: Upper Hutt City Council

Upper Hutt — Population: 39,927

Health Act: complied Standards: Bacterial met Protozoal met Chemical met

The water supply uses surface water and is chlorinated. The water is fluoridated.

Supplier: Wellington City Council

Wellington City — Population: 210,637

Health Act: complied Standards: Bacterial met Protozoal met Chemical met

The water supply uses mixed sources. It is chlorinated and parts of the supply are treated by UV. The water is fluoridated.

Appendix F - Annual Report on Drinking Water Quality 2017–2018

The Ministry of Health published its Annual Report on Drinking Water Quality for the 2017-2018 year in 2020. The report describes the compliance of the supplies with the drinking-water requirements of the Health Act 1956 and the Drinking-water Standards for New Zealand 2005 (revised 2008).

Abstracts for the Wellington, Hutt, Upper Hutt and Porirua councils are provided below.

These show that the chemical compliance was met for the 2017-2018 year.

12 Wellington and Hutt

Supplier: Greater Wellington Water

Wellington Region Bulk Water	Complied Health Act	Met Standards	Population: 350,000

The water supply uses mixed sources. It is chlorinated and fluoridated and parts of the supply are treated by UV. *E. coli* was detected in 1 of 1,827 monitoring samples (this is allowable).

Supplier: Hutt City Council

Lower Hutt	Complied Health Act	Met Standards	Population: 95,469

The water supply uses mixed sources. It is chlorinated and fluoridated and parts of the supply are treated by UV. *E. coli* was detected in 1 of 2,278 monitoring samples (this is allowable).

Supplier: Porirua City Council

Judgeford	Complied Health Act	Met Standards	Population: 200

The water supply uses surface water and is chlorinated and fluoridated.

Porirua	Complied Health Act	Met Standards	Population: 46,444

The water supply uses surface water and is chlorinated and fluoridated. A temporary boil-water notice was issued during the period. *E. coli* was detected in 2 of 585 monitoring samples (this is allowable).

Supplier: Upper Hutt City Council

Upper Hutt	Complied Health Act	Met Standards	Population: 34,650

The water supply uses surface water and is chlorinated and fluoridated.

Supplier: Wellington City Council

Wellington City	Complied Health Act	Met Standards	Population: 165,126

The water supply uses mixed sources and is chlorinated and fluoridated.