water NEW ZEALAND

The New Zealand Water & Wastes Association Waiora Aotearoa

National Performance Review

2019 – 2020

Disclaimer

Water New Zealand endeavours to provide data that is as consistent and accurate as possible. Our quality review process is outlined in the companion document *National Performance Review: Quality Assessment Process* (Water New Zealand, 2021). Reliability is limited by the data that individual participants have made available.

Performance outcomes for water services are subject to influences outside of an organisation's control, such as customer mix, service area density, topography, quality of source water, and receiving environments. These variables should be considered when attempting to compare performance across different service providers.

Performance outcomes are also influenced by data collection and reporting systems. Service providers' systems range from pen-and-paper-based data collection to comprehensive data management technologies. This can mean participants with robust reporting methods rank comparatively poorly against those with less sophisticated methods. For example, a comprehensive customer complaints management system is likely to record more complaints than a pen-and-paper-based system, due to more accurate data capture. Metrics indicating the completeness and quality of service providers' data are listed in *Appendix I: Review participants' data quality*.

Contacting water service managers to understand data limitations or performance drivers is recommended when making decisions based on information contained in this report.

Further information on this report is available from:

Water New Zealand
PO Box 1316
Wellington
(04) 495 0899
www.waternz.org.nz/NationalPerformanceReview

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Foreword

Drinking water, wastewater and stormwater service delivery is undergoing a period of radical change. The introduction of a dedicated drinking water regulator, Taumata Arowai, the provision of COVID-19 stimulus funding, and investigations into new service delivery models will shape our sector for decades to come. It is more important than ever that our decisions are built on a strong evidence base. To this end, Water New Zealand is happy to deliver this year's National Performance Review (NPR).

The National Performance Review is an annual assessment of drinking water, wastewater, and stormwater service delivery across New Zealand. This process is co-ordinated by Water New Zealand, an independent not-for-profit organisation representing water professionals and organisations.

This fiscal year, participants have also completed an extensive request for information (RFI) for the Department of Internal Affairs. The RFI is expected to provide a detailed snapshot of New Zealand's water sector, with a strong focus on asset values and financing. The National Performance Review has continued concurrently, providing historic trending information and New Zealand-specific performance measure definitions.

Data and financing for the National Performance Review is provided by participating entities on a voluntary basis. The significant effort involved in participating in the NPR in addition to the RFI demonstrates their strong commitment to transparency and service delivery improvement. Our thanks to the many individuals who contributed.

The development of the NPR is guided by the Project Advisory Group, which represents participating entities. We wish to acknowledge the following individuals who provided advice and direction:

- Mark Baker, Queenstown Lakes District Council
- Robert Blakemore, Wellington Water
- Martyn Cole, Kāpiti Coast District Council
- Laurence Edwards, Wellington Water
- Mike Schruer, Tasman District Council
- Dave Hurdle, Watercare

Our thanks also to the many talented photographers who entered Water New Zealand's 2020 photography competition, and whose pictures have helped bring this report to life. Your pictures remind us of the beautiful water environments our people work so hard to protect.

Gillian Blythe, Chief Executive
Water New Zealand

Executive Summary

Figure 1: Aspects of 3 Waters service provision addressed by the National Performance Review

The National Performance Review (NPR) collates and compares water, wastewater, and stormwater service provision across Aotearoa New Zealand. Its principal purpose is to equip service providers and their stakeholders with accessible and comparable data to identify improvement opportunities.

This year's Review covers two Council Controlled Organisations (CCOs), and 40 of 64 territorial authorities with responsibility for water supply, wastewater, and/or stormwater services. Collectively, these entities have jurisdictions covering 4,438,525 New Zealanders (approximately 88% of the population). A list of participants is provided in *Appendix I*.

National trends in drinking water, wastewater, and stormwater delivery are summarised in this report. An accompanying data portal provides individual organisations' performance assessments and comparisons, available at: www.waternz.org.nz/NationalPerformanceReview. The NPR has been undertaken annually since 2008, with performance measures iteratively refined over this time. Previous years' reports, data definitions, and quality assurance processes are also available at the above link.

This report is broken into sections dealing with different aspects of water service delivery. The first two chapters cover the critical backbone of these services: the assets, and the people who look after them. The third section looks at performance against their primary purpose of protecting public health and the environment. Subsequent sections deal with how services are delivered, and their reliability, resilience, economic efficiency, resource efficiency, and customer focus.

Data relates to the financial year July 2019 to June 2020. This includes the period from 23 March to 13 May 2020, when New Zealand was in Level 4 and Level 3 COVID lockdown. Despite the significant societal shift that occurred in this period, the challenges facing the water sector remain largely unchanged from previous years. Core findings from each area of the Review are summarised here.

Elements of service delivery

Our people

The water sector has a **growing workforce**. The number of people employed by water service providers has **increased by 25% over four years**.

Service providers have **persistently high vacancy levels. Eight percent of roles are vacant**, continuing the trend since reporting began.

Health and safety in the sector shows a worsening trend. 1,082 days off work were reported due to injury – the highest since reporting began.

There is a gap in understanding workforce skills. Nearly **60% of service provider employees held no qualifications, or these were unknown to their employers**. Less than 10% of employees were enrolled in continuing professional development.

Assets under management

The asset base is significant. **Assets worth over $43 billion** are covered by this report.

In jurisdictions covered by the Review **82% of residential properties receive reticulated water services, and 81% wastewater services.**

Service providers manage over **88,000 kilometres of pipe, enough to run up and down the length of New Zealand 55 times.**

The uptake of technology in the sector is variable. **Some organisations had full control of the network using Supervisory Control and Data Acquisition systems. Others had none**, relying fully on manual operation.

Public health and environmental protection

Reported **wastewater overflowed from sewerage networks 3,385 times last year. The true extent of the problem is unknown**. Variable reporting, patchy monitoring, and lack of regulatory oversight mean the true number of overflows is likely to be much larger.

There is a growing trend towards stormwater quality management. The number of service providers with stormwater quality management plans has increased by 43% in the last three years. However, only 63% of service providers had in place catchment management plans, and 56% stormwater quality monitoring.

Formal responses to non-compliance with discharge consents are rare, both for stormwater and wastewater. Reportedly, **42 formal actions were taken in response to nearly 400 non-compliances with wastewater discharge consents.**

Customer focus

The average household paid $878.88 (including GST), which is significantly lower than the average household expenditure of $2,067 per year on electricity.

Water supply charges are increasing. Over the last five years the average household charge has risen by 20%, rising from $352.21 to $422.52.

There is large variation in household water and wastewater charges. **The most expensive charges take 104 hours of work on the minimum wage to pay, equivalent to 8% of annual superannuation payments.**

Economic sustainability	Reliability	Resource efficiency	Resilience
$2.3 billion was collected to fund water services, primarily through rates and volumetric charges.	At current inflow and infiltration levels, 13% of wastewater networks constructed in accordance with New Zealand design standards for new developments, would fail to contain sewage overflows resulting from a storm event with a once annual recurrence interval.	**More than half of New Zealand's residential properties have in place water meters** (skewed by full water metering in Auckland). Twenty-one service providers have no residential water metering.	Only 11% of water service providers are compliant with fire hydrant testing requirements of The New Zealand Fire Service Firefighting Water Supplies Code of Practice.
$2.6 billion was spent, $1.6 billion of which was spent on capital projects. Since last year, **capital expenditure increased by 44% for water supply, and by 30% for wastewater.**	**21% of water supplied to networks is lost on the way to its end use.** More than the combined volume of water supplied by Christchurch City and Wellington Water. Possibilities for water loss reductions exist in at least 83% of service districts.	**By volume, reported beneficial disposal routes exceeded landfill,** largely attributable to the rehabilitation of Pukete regional park using sludges produced at the country's largest wastewater treatment plant in Māngere. The most common disposal route for sludges remains either landfill or stockpiling.	On average, 1.45 days' worth of demand for treated drinking water is stored in reservoirs.
Outlay on capital expenditure was 77% of that budgeted for.	**The amount of water lost through networks is increasing.** Median current annual real water loss per property has increased by 44% in the last five years.	**251 terajoules of energy was produced by wastewater networks, and 15 terajoules of energy by water supply.** In Palmerston north, hydro-turbines in the water network generated more energy than was consumed in its operation.	Most stormwater system designs target protection from storms with a 10% annual exceedance probability for piped networks, and a 1% annual exceedance probability for overland flow paths.

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1 About the National Performance Review

1.1 Purpose

The National Performance Review is an annual assessment of drinking water, wastewater, and stormwater services, led by water service managers to provide them with information to enhance their service delivery. The Review also collates information on services into a single place to inform decision-making. The Water Services Managers Group, Water New Zealand, and National Performance Review Advisory Group all draw on information in this report to inform the sector's performance improvement initiatives.

Central government, researchers, service providers, and other stakeholders are also encouraged to use the data as an evidence base for 3 Waters-related decisions. In registering for the Review, participants acknowledge that their information will be made available in the public domain. Information requests from those seeking data to assist in advancing the sector's interests are welcomed.

1.2 Information covered by the report

The National Performance Review (NPR) is an annual assessment of drinking water, wastewater, and stormwater service delivery throughout New Zealand. This report uses colour-coded figures to show information about each of these services individually.

This report provides a high-level summary of data and trends. Individual participant data presented in comparative benchmarks is provided separately via an online data portal. The data portal and other supporting information are listed in *1.4 Supporting material*, and are available from www.waternz.org.nz/NationalPerformanceReview.

Two important aspects of water service delivery covered in detail by other annual government publications are:

- **Drinking water quality:** This is covered by the *Annual Report on Drinking Water Quality* (Ministry of Health, 2020). The most recent Drinking Water Quality report contains information on source water protection, water safety planning, and boil water notices. For this reason, these topics have been removed from NPR reporting.
- **Freshwater quality:** This is covered by *Our freshwater* as part of the Ministry for the Environment's, *Environment Aotearoa* report (Ministry for the Environment, 2020).

The NPR has been produced annually since 2008. Data in this report relates to the period 1 July 2019 to 30 June 2020, referred to as FY 2020 throughout this report. Only participants with five years' concurrent data (FY 2016 to FY 2020) are shown in trended figures.

1.3 Review participants

Review participants are listed in *Appendix I*.

Most water suppliers in New Zealand are territorial councils, which supply drinking water, wastewater, and stormwater services. Exceptions are Watercare and Wellington Water, which are both council-controlled organisations, and Auckland Council which only delivers stormwater services. Watercare provides services to the Auckland region, and is therefore referred to as "Auckland". Wellington Water services six councils within the Wellington region: Greater Wellington Regional Council, Porirua City Council, Wellington City Council, Hutt City Council, Upper Hutt City Council, and South Wairarapa District Council. Wellington Water's control of the South Wairarapa water schemes commenced during this reporting period, therefore data for this jurisdiction has been reported separately.

1.4 Supporting material

Supporting resources available at www.waternz.org.nz/NationalPerformanceReview are described below. Previous years' reports are also available via this link.

1.1.1 Data portal

The data portal shows individual participant performance, and enables performance comparisons between service providers.

1.1.2 Data quality assurance processes

Processes to review the quality and consistency of National Performance Review data are outlined in the *Quality Assessment Process* (Water New Zealand, 2021).

Independent audits are conducted as part of this process. A report summarising audit findings is produced annually, and the most recent year's report is available via Water New Zealand's website.

Metrics indicating the completeness and quality of each participant's data are summarised in *Appendix I: Review participants' data quality*.

1.1.3 Data definitions

National Performance Review 2019/20 Definition Guidelines (Water New Zealand, 2021) provides detailed definitions of data and confidence gradings, as well as a summary of changes from previous years.

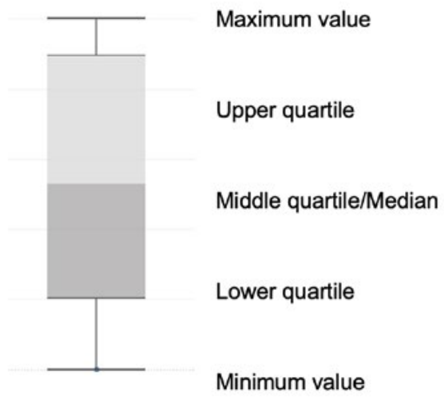
References to definition guidelines are provided in figures and tables using indicator codes delineated with brackets. Codes relate to the data definition guidelines, and adhere to the following format:

- Characters 1-2: Denotes whether the data is related to Water Supply (WS), Wastewater (WW), or Stormwater (SW).
- Character 3: Denotes whether information refers to Background (B), Asset (A), Social (S), Environmental (E), or Financial (F) characteristics.
- Characters 4-5: Numbering to delineate between the different data points.

For example, indicator SWB1 relates to stormwater background data, and is the first data point listed in the definition guidelines.

1.1.4 Interpreting box and whisker plots

Box and whisker plots are used to illustrate the distribution of data. This information can be interpreted as follows:



Our people

2. Our people

2.1 Staffing and vacancy levels

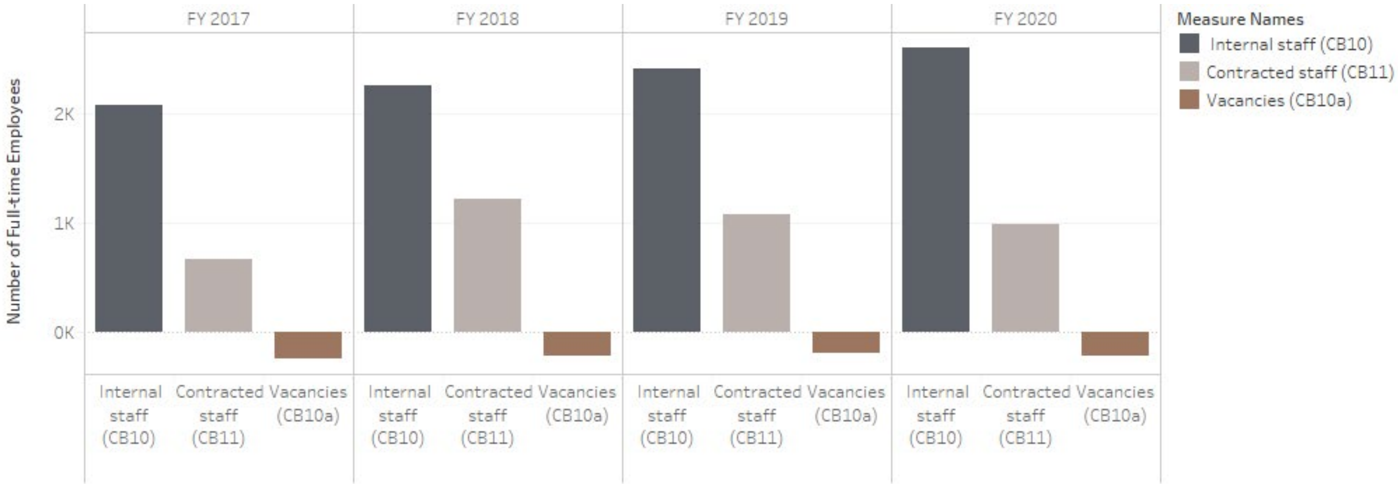
Information in this section provides an overview of:

- **Internal staff:** The number of full-time employees on participating organisations' payrolls directly or indirectly involved in the delivery of 3 Waters services.
- **Contracted staff:** The number of full-time employees not on participating organisations' payrolls, but exclusively involved in the delivery of 3 Waters services for the organisations.
- **Staff vacancies:** The number of vacant roles with participating entities at the time of reporting.

Table 1: Staffing and vacancy levels across all participants

Internal staff [CB10]	Contracted staff [CB11]	Staff vacancies [CB10a]	Median staff per 1000 serviced properties
2,745	**1,196**	**236**	**1.36**

Figure 2: Trend in staffing numbers for participants providing five years continuous data



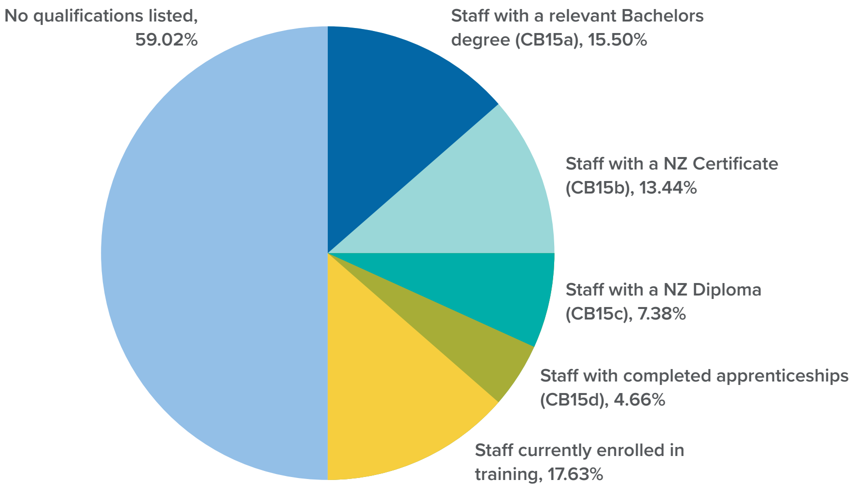
2.2 Training

2.2.1 Qualifications

The highest level of qualification of employees (i.e. not including contractors) reported in the Review is shown in Figure 3. Not all entities were able to provide information on the qualifications held by their staff. Thirty-five participants provided data on the number of staff with Bachelor's degrees or NZ Certificates, and 30 provided information on the number of staff currently completing apprenticeships. The auditor commented (AECOM, 2021):

The lack of information on staff training and qualifications is quite surprising and, possibly, quite concerning. Going forward, the thought is that the Regulator will be looking for assurances that the industry is employing the right people with suitable qualifications and training, and a commitment to staying up to date with the latest technologies. Consulting companies have been managing this type of information for some years because it is one of the key attributes when selling services, so there is no reason why local government organisations cannot do the same. Similarly, there is technical information lacking which is fundamental to the responsible management of 3 Waters.

Figure 3: Qualifications



2.2.2 Continuing professional development

The number of staff enrolled in training towards one of the qualifications shown in Figure 3 was 484.

Employees spent, on average, 29 hours in continuing professional development. The value ranged significantly from less than 5 to over 100. Thirty-five participants provided data on the number of hours per year staff members spend in training.

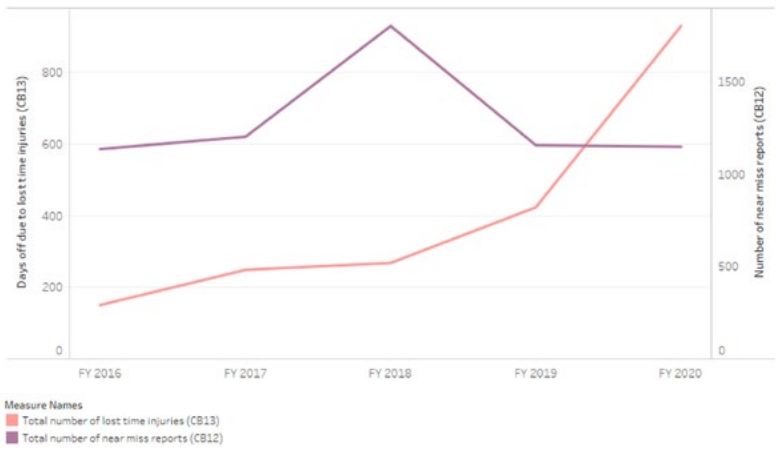
The number of staff enrolled in continuing professional development programmes was 218. Data confidence ratings provided were Less Reliable or Uncertain. Programmes listed were: Engineering New Zealand, Water Industry Operators Programme, IPWEA, and the Engineering Council of South Africa.

2.3 Health and safety

In 2020, near miss reports trended down, while lost time injuries trended up.

- 1,268 near misses were reported by the 39 entities providing data on health and safety.
- 13 entities reported having lost time injuries, totalling 1,082 days off work. The predominant injury type reported was muscular-skeletal damage. Manual handling was a common mechanism of harm.

Figure 4: Trend in near misses and lost time injuries[1]



1 Figure only shows data for entities who have provided data to the review for five consecutive years

Assets under management

3. Asset under management

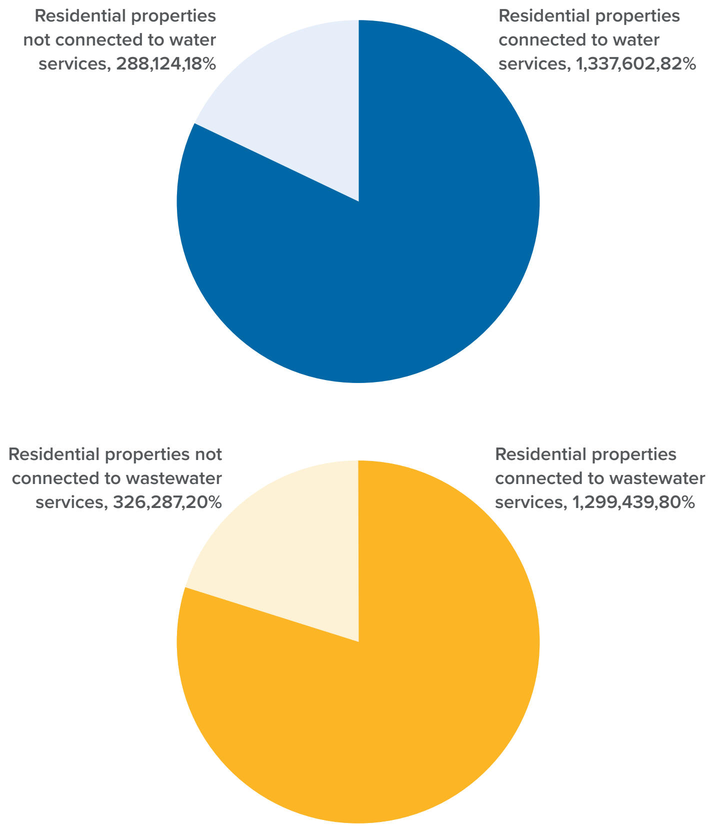
3.1 Asset overview

The 42 entities participating in the National Performance Review have jurisdictions that cover 89% of New Zealand's population. Collectively, these entities manage assets worth over $40 billion. A breakdown of assets managed by these entities, and their values, is shown in Table 2.

Table 2: Assets under management

	Water	Wastewater	Stormwater	Total
Length of network (km)	43,062	27,057	17,989	88,108
Number of pump stations	749	3,014	260	4,023
Number of treatment plants	349	222		573
Treatment plant value	$2,599,175,885	$3,335,819,563		$5,934,995,448
Other network value	$10,732,824,38	$14,360,797,968	$11,993,223,393	$37,086,845,750
Total asset value	$13,332,000,273	$17,696,617,531	$11,993,223,393	$43,021,841,198

Figure 5: Proportion of residential properties serviced by participants drinking water and wastewater networks



3.1.1 Connections to drinking water and wastewater networks

Population and properties serviced by these assets is shown in Table 3. The total proportion of the population connected to the networks in these areas is shown in Figure 5. The serviced population is derived from property connections, using average occupancy data. As such, there is an additional level of uncertainty associated with these figures.

Table 3: Population and properties serviced by participants' networks[2]

	Water Supply	Wastewater	Stormwater
Serviced population	3,978,320	3,962,340	3,829,040
Residential properties serviced	1,337,602	1,299,439	1,377,301
Non-residential properties serviced	122,798	108,338	129,049

2 Population serviced data was not available for Western Bay of Plenty and MacKenzie District Councils

3.2 Asset condition assessments

3.2.1 Pipeline condition assessment

Pipeline condition assessments are conducted for asset management and renewal planning purposes. Assets are generally assigned a grade based on a one to five scale indicating their condition. The average proportion of assets assigned a poor or very poor condition is shown in Figure 6.

The comparability and reliability of data is limited by several factors:

- Various approaches are used to assess pipeline condition. This limits the comparability of data provided in asset condition assessments. Approaches in use are listed in Table 4. Approaches promoted by Water New Zealand to achieve comparable condition grades are shown at: www.waternz.org.nz/PipeGuidance.
- Not all assets have been assigned a condition grade. The average proportion of pipelines assigned a condition grade is shown in Figure 7.
- Service providers often have low confidence in condition grades assigned to their assets. Assigned data confidence ratings for pipeline condition are available via the data portal for this metric.
- Closed circuit television (CCTV) is a commonly employed survey method for inspecting condition of wastewater and stormwater pipelines. Pipelines inspected using CCTV will generally have higher data confidence ratings. The proportion of wastewater and stormwater networks surveyed using CCTV is shown in Figure 8.

Table 4: Asset condition approaches in use

Pipeline condition assessment approach	Number of service providers employing approach		
	Water	Wastewater	Stormwater
NAMS International Infrastructure Management Manual (IIMM)	6	6	7
New Zealand Pipe Inspection Manual	2	13	11
IPWEA Condition Assessment and Asset Performance Guidelines	1	1	1
IPWEA Practice Note 7: Water Supply and Sewerage	1	1	0
New Zealand Infrastructure Asset Grading Guidelines	1	2	0
In-house	9	7	8
Informal	7	4	5

Figure 6: Proportion of networks that have been assigned a poor or very poor condition grading

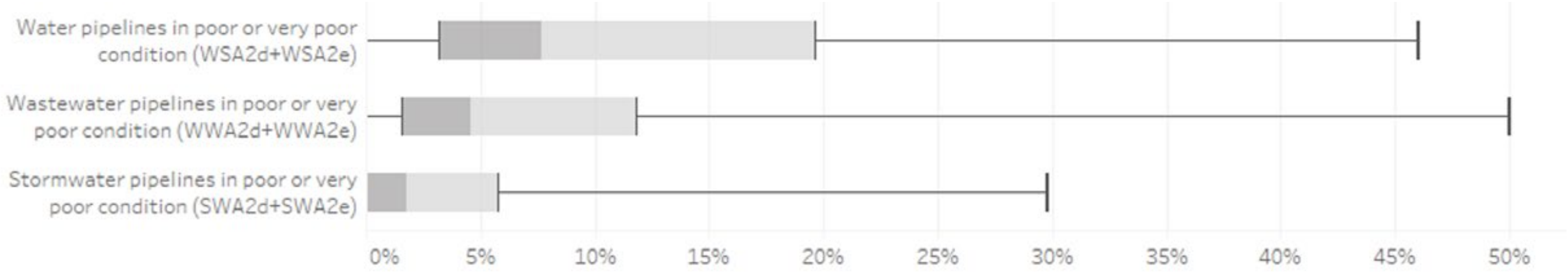


Figure 7: Proportion of networks that have not yet been assigned a condition grading

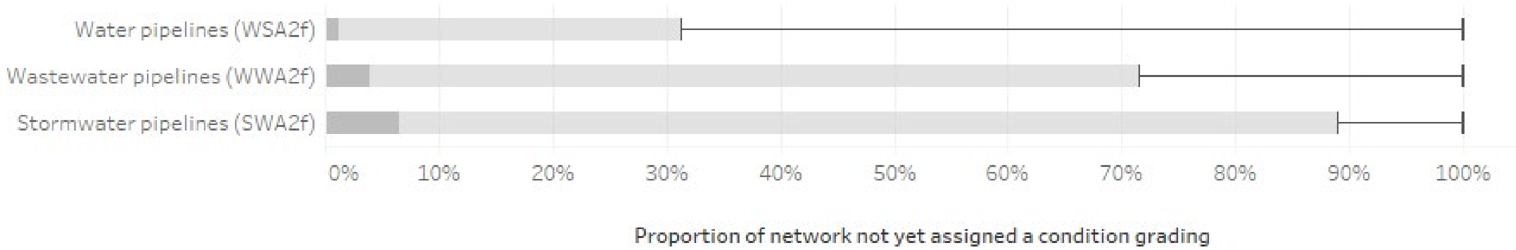
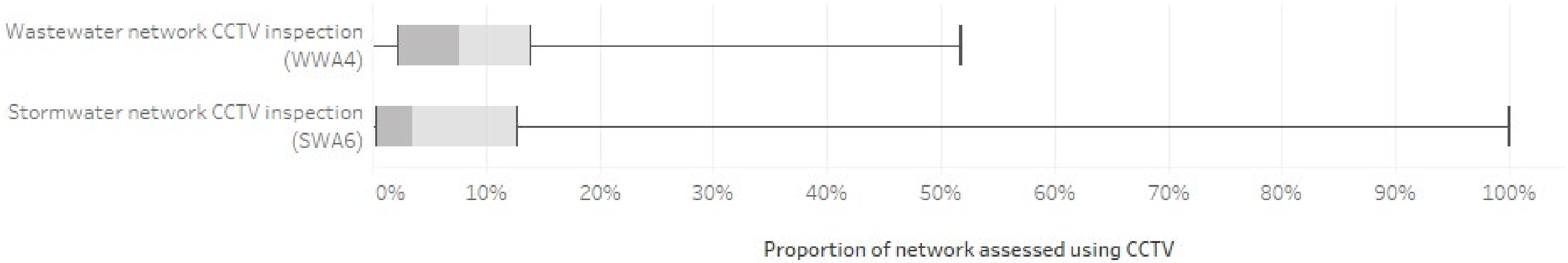


Figure 8: Proportion of wastewater and stormwater networks that have been assessed using CCTV



3.2.2 Above-ground asset inspections

In addition to underground pipelines, the water sector is responsible for the management of above-ground assets. Amongst these are water treatment plants, pump stations, telemetry units, and stormwater treatment devices. As with pipelines, there is a variety of approaches employed to assess asset condition. Approaches are shown in Table 5. The proportion of participants with a formal assessment approach for above ground assets is shown in Figure 9. The proportion of assets assessed in a three-year cycle is shown in Figure 10.

Table 5: Above-ground asset condition approaches in use

Condition assessment approach	Number of service providers employing approach		
	Water	Wastewater	Stormwater
NAMS International Infrastructure Management Manual (IIMM)	3	6	4
Visual Assessment Manual for Utility Assets	3	0	2
IPWEA Practice Note 7: Water Supply and Sewerage	0	0	0
New Zealand Infrastructure Asset Grading Guidelines	6	8	2
Inhouse	9	9	13
Informal	5	6	5
Other	1	2	8

Figure 9: Proportion of service providers with a regular condition inspection programme for above ground assets

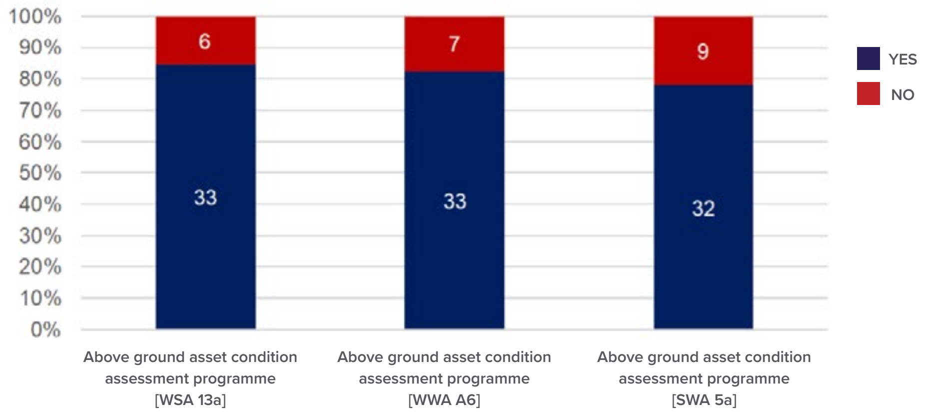
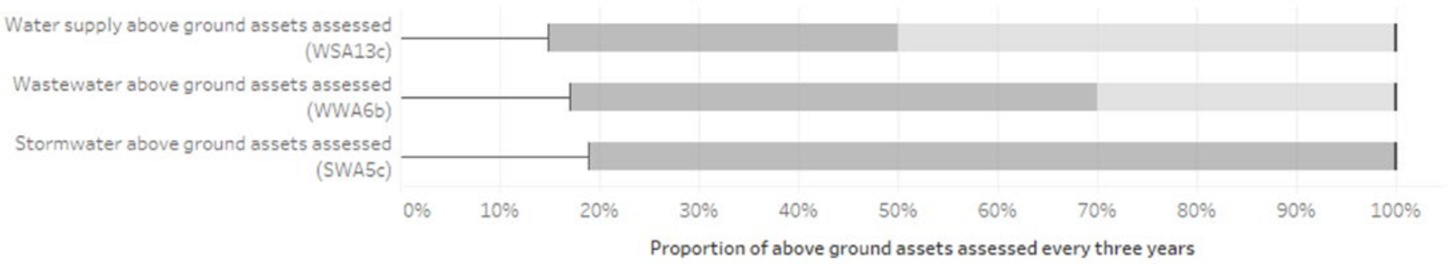


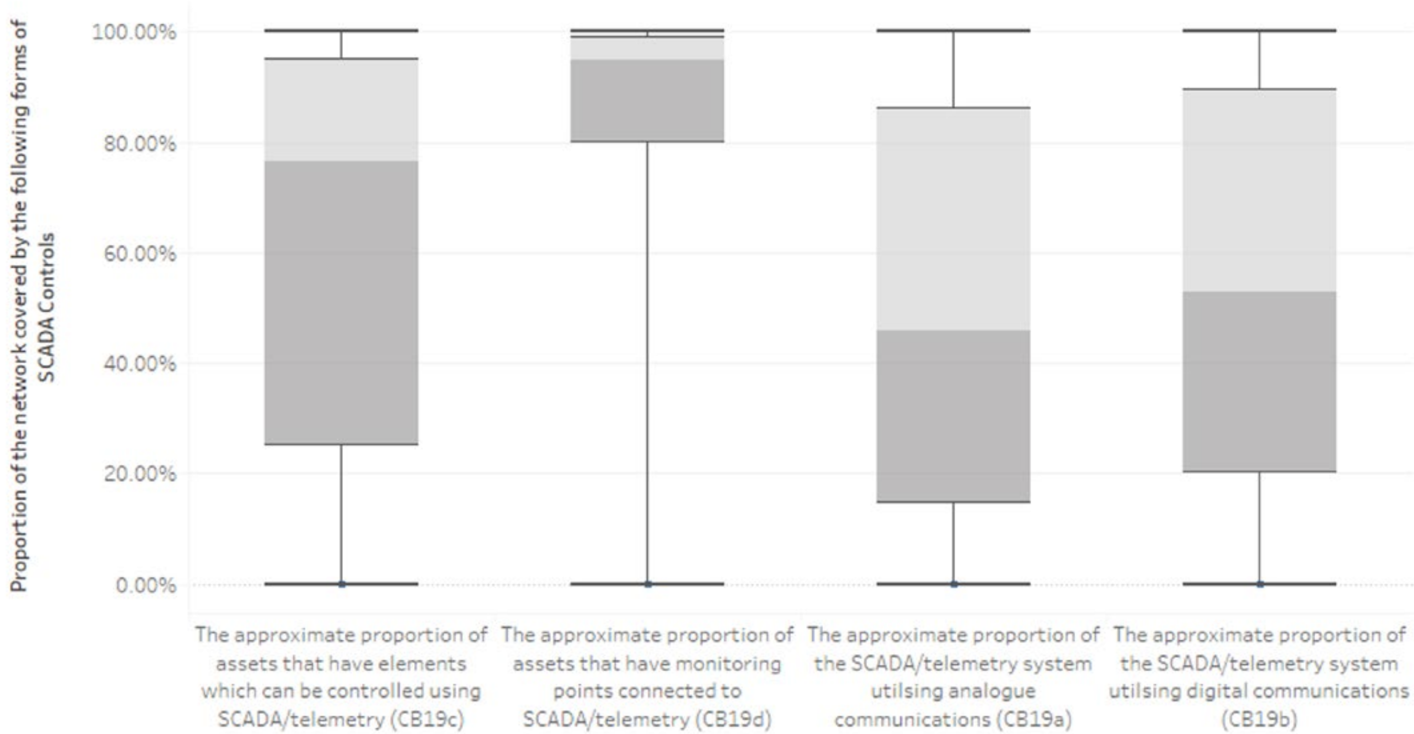
Figure 10: Proportion of above-ground assets assessed every three years



3.3 Supervisory control and data acquisition systems

Supervisory Control And Data Acquisition (SCADA) systems consist of software and hardware that can control processes locally or at remote locations. SCADA is both a component and an enabler of other smart water technologies. Data on the prevalence of SCADA for monitoring and control is provided here as an indication of the uptake of technology.

Figure 11: The proportion of the network covered by the following forms of SCADA/telemetry control



Public health and environmental protection

4 Public health and environmental protection

4.1 Wastewater overflows

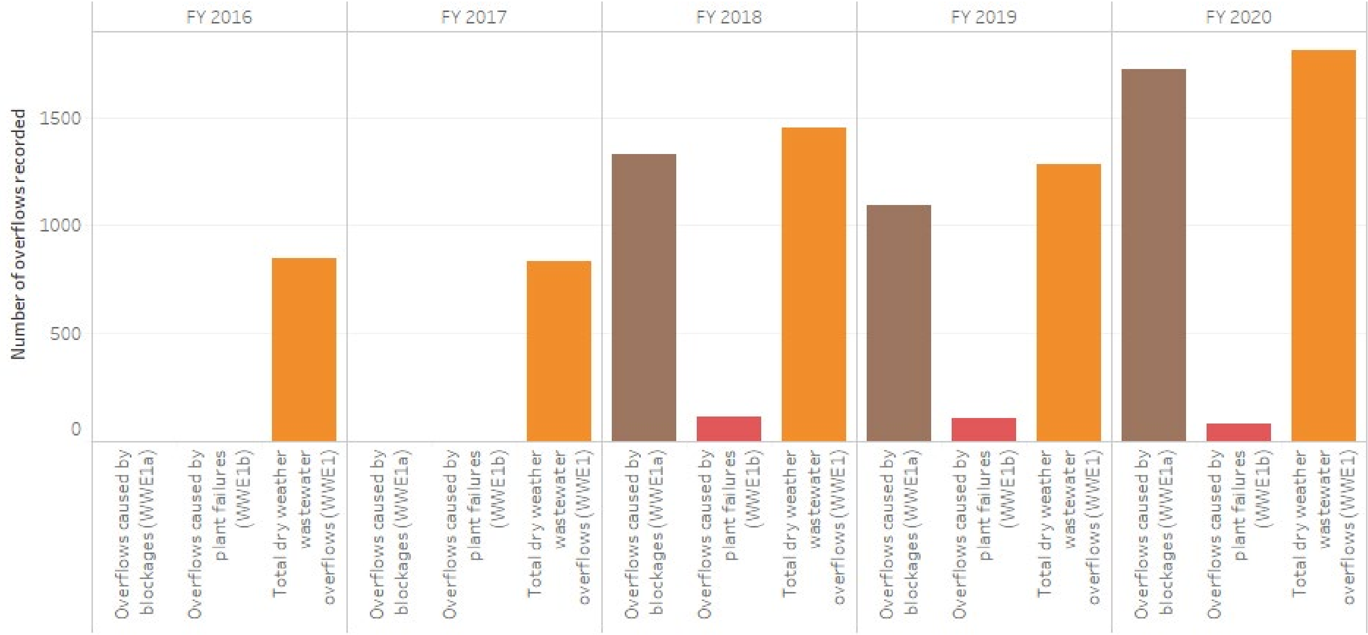
4.1.1 Dry-weather wastewater overflows

When untreated sewage spills, surcharges, discharges or otherwise escapes from the wastewater network to the external environment this is referred to as a wastewater overflow. Dry weather wastewater overflows result from system failures. In 2019/20, a total of 1,939 such overflows were reported. Where possible, this figure was split by the cause:

- **1,836 overflows caused by blockages**, which can be caused by build-up of fat, oil, and grease, foreign objects (such as wet wipes) entering the network, tree root intrusions, or sewer line collapse due to old and deteriorated pipes.
- **94 overflows caused by plant failures**, such as pump station ragging, power outages (including those from the electricity supplier's network), or failure of mechanical valves.

Figure 12 shows there has been a significant increase in the number of overflows attributed to blockages reported in 2019/20. This is attributable to an increase in blockage related overflows reported in the Wellington region, resulting from a change in reporting definitions. Previously, overflows had been reported based on the number of times overflows were notified. Based on guidance from Audit NZ this has changed to include anytime wastewater overflows from the network because of a blockage. When the data from Wellington is removed, there is a slightly declining trend in blockage related-overflows.

Figure 12: Trend in dry-weather wastewater overflows for those supplying five years' continuous data



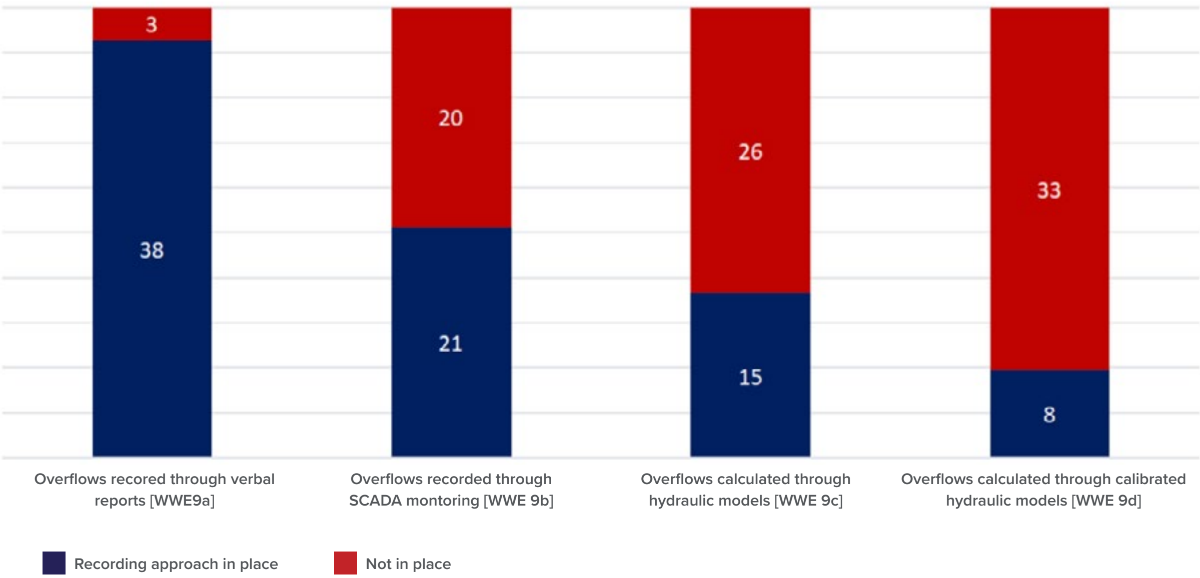
4.1.2 Wet-weather overflows

Wet weather overflows occur during storm events, when rainfall can make its way into the sewerage network and overload it. When sewerage system capacity is exceeded, wastewater escapes from either constructed overflow locations (to the stormwater network or other water courses such as streams, rivers, or the ocean) or from other points in the networks such as manholes and gully traps.

Figure 13 shows the approaches used to track wastewater overflows. Service providers using hydraulic models to track overflows generally employ SCADA monitoring and verbal reports concurrently. More than half of the service providers in this report rely upon verbal reports or SCADA monitoring to track overflows. Two entities reported having no overflow tracking in place.

Wastewater overflows tend to be under-reported when based on verbal reports or SCADA monitoring. For example, wastewater overflows occurring overnight are unlikely to be identified via verbal reports. SCADA systems will not capture uncontrolled wet weather overflow events occurring at unmonitored points in the network. *The New Zealand Wastewater Sector* report (Beca, GHD, Boffa Miskell, 2020) commissioned by the Ministry for the Environment, notes that "councils have varying degrees of knowledge of their wastewater networks including where their overflows occur (uncontrolled) and what events trigger them", and that "There are a number of councils that do not currently hold sufficient detailed knowledge of their networks to predict where overflows currently occur".

Figure 13: Number of participants employing various recording approaches for wastewater overflows



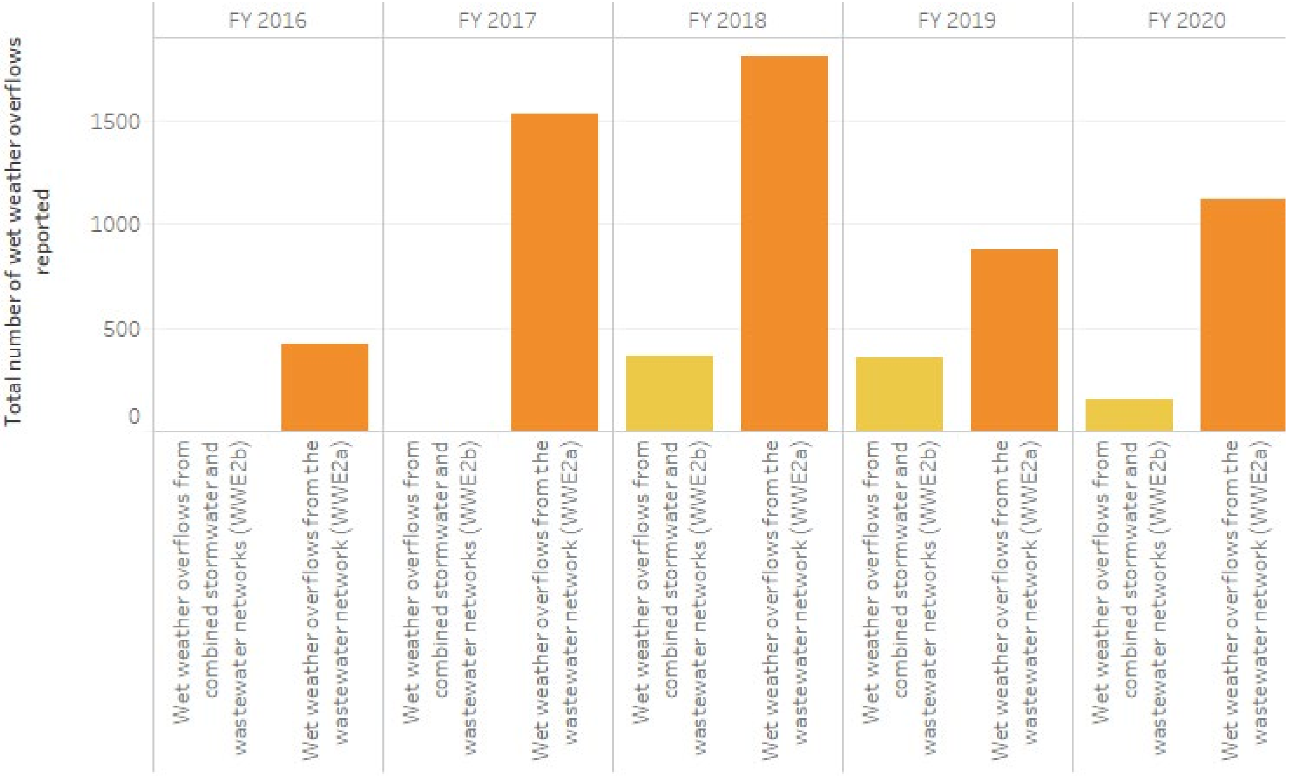
In the 2020 fiscal year, 1,123 wet weather related overflows were reported from wastewater networks, and a further 155 from combined wastewater and stormwater networks. Wet weather overflow data over the last five years show a declining trend, as illustrated in Figure 14, principally related to reduced reporting in Auckland over the past two years. This is likely due to limited reporting of overflows. Auckland's reported overflows from wastewater pipes relate to the transmission network, while sewer overflows from combined water and wastewater networks are only partially reported. The explanation provided by Watercare for this was that:

> In Auckland the very high frequency of combined sewer overflow operation in wet weather presents a significant challenge in terms of reporting and Watercare are implementing a wide range of improvements to achieve this. Against this, the complexity of the system and the sheer number of sites, many of which are very difficult to accurately monitor, makes reporting unreliable.

At a national level, there is similar uncertainty in the number of wet weather related wastewater overflows actually occurring. *The New Zealand Wastewater Sector* report (Beca, GHD, Boffa Miskell, 2020) commented:

> Current monitoring practices, knowledge of networks, and the wide range of approaches to regulation of wastewater overflows mean that, under current settings, it would not be possible to benchmark regions or engage in basic performance improvement metrics to drive better performance. Consistency in approach across all these areas would lead to considerable benefits.

Figure 14: Wet weather wastewater overflows for those supplying five years' continuous data

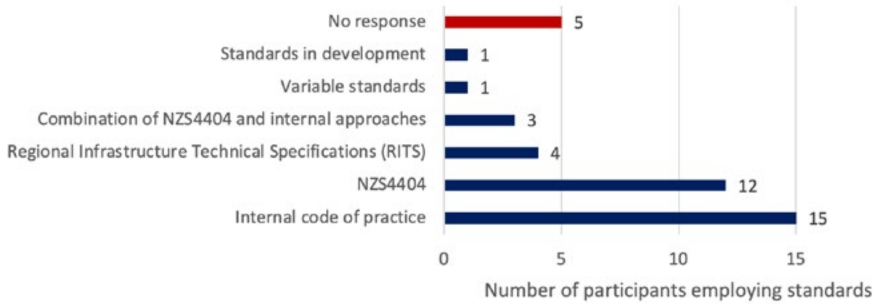


4.1.3 Sewage capacity design standards

Most service providers have in place design standards for sewers' wet weather capacity. Approaches in place are shown in Figure 15. Over 40% of participants directly employ NZS 4404 to size the capacity of their sewer networks. The specified design standards for residential flows provide the following design requirements:

- Average dry weather flow of 180 to 250 litres per day per person
- Dry weather diurnal peak flow of 2.5
- Dilution/infiltration factor of 2 for wet weather
- Number of people per dwelling of 2.5 to 3.5.

Figure 15: Sewage design standards for network capacity



The average dry weather flow of 180 to 250 litres per day per person cited in the Standard may underestimate average wastewater volumes in some networks. *Section 8.2.4 Residential water efficiency* provides data on average daily residential water use. Assuming 78.5% of water entering a property leaves as wastewater (based on the average rate applied for charging in Auckland), upper and lower daily wastewater volumes cited in the Standard correspond with average daily water use of 229.3 L/person/day and 318 L/person/day respectively. Twenty-two service providers reported more than 229.3 L/person/day average daily water use, and a further 11 reported more than 318 L/person/day average water use.

Combined-dry weather diurnal and dilution/infiltration factors in the Standard give a peaking factor of 5. *Section 7.3 Inflow and infiltration* shows that the peak wet to average weather dry weather ratio exceeds this in at least 12 wastewater treatment plants. In the networks feeding into these treatment plants current design values would mean a storm with a once-a-year probability would cause sewage overflows.

Organisations were asked to indicate whether they had a specified standard for managing wet weather related wastewater overflows. Thirteen of the 41 wastewater service providers indicated that they did have standards in place. Of those entities, however, only four provided quantitative information that could be related to a level of service for wastewater containment:

- Wellington Water: Consents currently vary across regions, however working towards 6 month Annual Recurrence Interval Standard.
- Waimakariri: For infrastructure constructed prior to 1999, a 1 in 2-year event. For infrastructure constructed post 1999, a 1 in 5-year event.
- Kāpiti District Council: A 1 in 5-year containment standard has been developed for consultation in the 2020 Long Term Plan.
- Queenstown: Wastewater networks are designed to convey a 1 in 5-year storm without surcharging manholes.

In addition, these entities provided information on design standards which influence wet weather overflows:

- Selwyn District Council: 8 hours' storage at wastewater pumping stations.
- Tasman: Standard for new assets is 6 times average dry weather flows, or 10 hours' for sensitive receiving environments.

Whanganui targeted less than 4 overflows per 1,000 connections for dry weather wastewater overflows, but did not have a specific standard for wet weather.

4.1.4 Wet weather overflow regulation approach

Despite widespread occurrence of wet weather overflows, only 11 of the 41 wastewater service providers reported having any formal regulatory processes in place to provide oversight of their management. Approaches in place are shown in Figure 16.

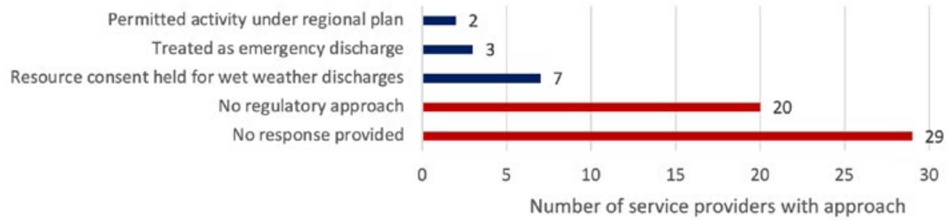
The New Zealand Wastewater Sector report elaborates on this point, noting that "there is a lack of alignment between Regional Plan rules and the reality of wastewater overflows in some regions where they are prohibited" (Beca, GHD, Boffa Miskell, 2020). The report cites a 2019 unpublished report undertaken for the Department of Internal Affairs on the regulation, controls, and extent of wastewater overflows, which concludes that:

> "... given the multiple ways in which a network can overflow, and the openness of the system, complete elimination of wastewater overflows from networks is likely an unrealistic

expectation. However, for many communities, with better knowledge of networks, and upgrades to infrastructure, the frequency of wastewater overflows could be lowered significantly while safeguarding health and the environment."

The number of overflow events, inconsistency in approach, and absence of regulation in much of New Zealand substantiates these findings. A sector-led initiative to develop a wastewater containment guideline has been funded by Water New Zealand's Water Services Managers Group. Development and publication of the guide is expected to occur in 2021.

Figure 16: Regulatory approach for wet weather-related wastewater overflows



4.2 Wastewater treatment

Participating service providers safely conveyed and treated 458,329,971 cubic meters of wastewater at 213 different wastewater treatment plants. This is equivalent to 183,331 Olympic-size swimming pools of wastewater that has been treated to protect receiving environments and public health.

Collectively, these treatment plants service 3,555,020 New Zealanders[3]. A further 860,645 people (19% of the population) live in jurisdictions covered by participating service providers, but are not serviced by municipal wastewater treatment.

Information from wastewater treatment plants in the report has been updated on the New Zealand wastewater treatment plant inventory and is available at www.waternz.org.nz/WWTPInventory. The Inventory contains information shown in Table 6 on all known 322 municipal wastewater treatment plants operated by local authorities in New Zealand.

3 Population numbers serviced by Western Bay of Plenty District Council and MacKenzie treatment plants was not available, but data on treatment plants was.

Table 6: Wastewater treatment plant information collated in the Wastewater Treatment Plant Inventory (fields updated through the National Performance Review are shown in italics)

Managing organisation	Treatment Plant name	Location: Northing	Location: Easting	Level of treatment	Volume of wastewater treated at treatment plant (m^3/year)	Receiving environment for treatment plant effluent	Proportion of Trade Waste
Treatment plant resource consent expiry date	Treatment Plant Wet Sludge Production (tonnes/year)	Treatment Plant Sludge Disposal	Treatment plant backup generator	Peak wet to dry flow ratio	Discharge Flow rate (m^3/day)	Treatment Type	Population

The Treatment Plant Inventory has been supplemented with data obtained from a database of wastewater treatment plants compiled by GHD-Boffa Miskell on behalf the Department of Internal Affairs. The content of the database and associated issues is addressed in a series of reports available on the department's website:

- National stocktake of municipal wastewater treatment plants (GHD-Boffa Miskell, 2019)
- Cost estimates for upgrading wastewater treatment plants that discharge to the ocean (GHD-Boffa Miskell, 2019)
- Cost estimates for upgrading wastewater treatment plants to meet objectives of the National Policy Statement for Freshwater Management (GHD-Boffa Miskell, 2019)

The Ministry for the Environment has also published a comprehensive overview of wastewater treatment plants in its *New Zealand Wastewater Sector* report (Beca, GHD, Boffa Miskell, 2020). Collectively, these documents provide a comprehensive and contemporary snapshot of issues facing wastewater treatment plants. Given the thoroughness of these reports, trends and issues facing wastewater treatment have not been examined further here.

4.3 Wastewater treatment plant consent compliance

The total number of compliance actions taken in relation to wastewater treatment plant non-conformances is shown in Table 7. The table shows there was an increase in regulatory action in 2020 (from 11 to 29 equivalent enforcement actions) in relation to wastewater treatment plant non-conformance. This continues to be dwarfed by the number of treatment plant non-consents that occurred (397 in 2020), indicating that formal processes to remedy non-conformance are rare.

Further analysis of the nature of non-conformances, and the gap in regulatory actions taken in response, is analysed in the *National Stocktake of Municipal Wastewater Treatment Plants* (GHD-Boffa Miskell, 2019). The report confirmed widespread non-conformance with wastewater treatment plant consents. Of the 170 wastewater treatment plants analysed in the report, just over one quarter (27%) of plants for which monitoring data was provided achieved full compliance, 26% had low risk non-compliance, 22% had moderate non-compliance, and 25% had significant non-compliance.

The report also corroborated the finding here that enforcement proceedings to address non-compliance are often not pursued (GHD-Boffa Miskell, 2019). The multi-faceted reasons for this are examined further in the report.

Table 7: Wastewater treatment resource consent non-conformance and compliance actions

	FY 2017	FY 2018	FY 2019	FY 2020
Wastewater consent abatement notices (WWE4a)	1	6	6	20
Wastewater consent infringement notices (WWE4b)	7	4	2	6
Wastewater consent enforcement orders (WWE4c)	0	0	1	0
Wastewater consent successful prosecutions (WWE4d)	0	3	2	3
Wastewater consent letter of direction (WWE4h)				9
Wastewater consent formal warning(WWE4i)				4
Wastewater treatment plant consent non-conformance (WWE4e)			627	397

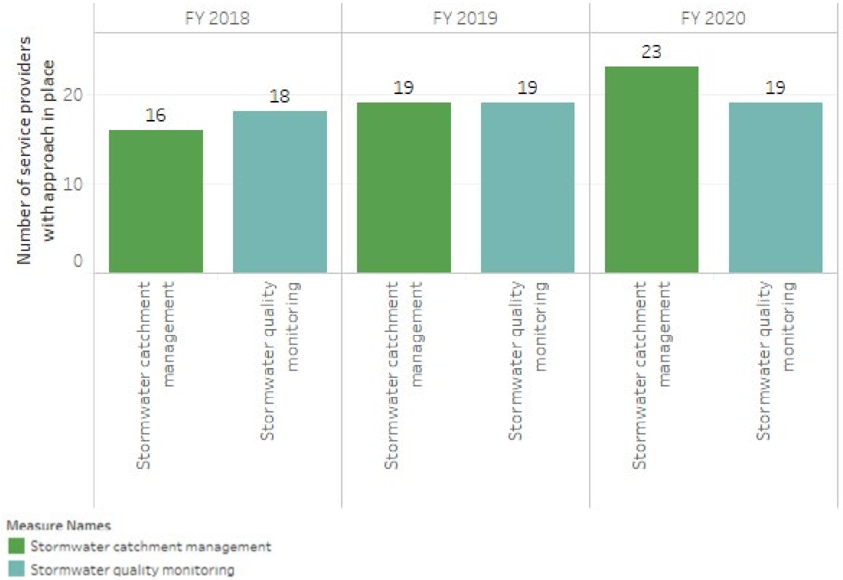
4.4 Stormwater quality management

Aquatic ecosystems are very sensitive to water quality changes due to stormwater runoff. This has been observed in the direct effects of toxic pollutants, the effects of combinations of different contaminants, and the accumulation of persistent chemicals within animal food webs. Stormwater runoff can contain elevated levels of nutrients, metals, pesticides, temperature, and organic contaminants (Auckland Council, 2021).

There is a growing trend towards the management of stormwater quality, as illustrated in Figure 17, which shows that the number of service providers with catchment management plans in place has been gradually growing over the three years in which data has been collected.

Catchment and monitoring plans are not yet widespread, however. Of the 41 stormwater service providers, contributing to the report 26 (63%) had in place stormwater catchment management plans, and 23 (56%) had in place stormwater quality monitoring.

Figure 17: Number of service providers with stormwater catchment and monitoring in place.[4]



4 Data only includes service providers that have contributed data to the National Performance Review in previous years.

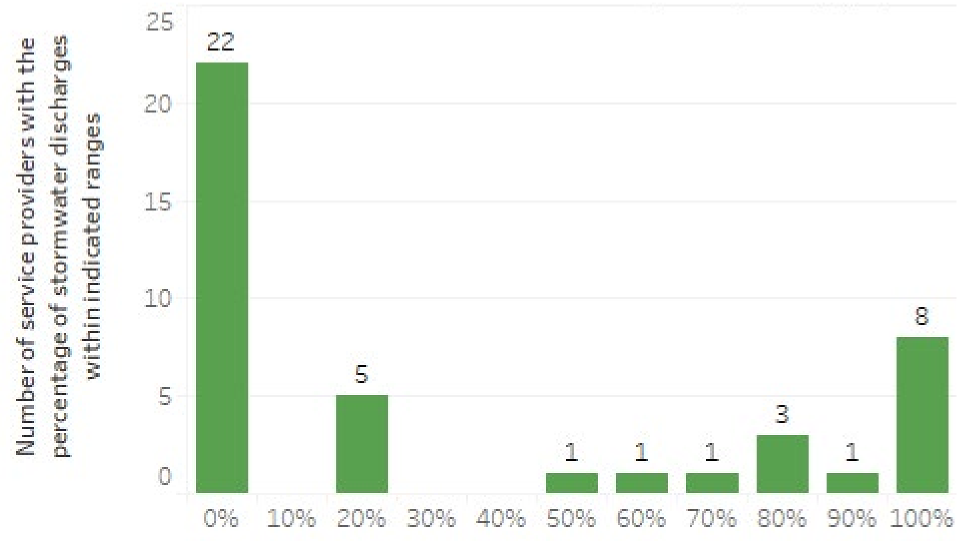
4.5 Stormwater discharge consents

Compliance actions taken in relation to breaches of stormwater consents are shown in Table 8. As with treatment plants, formal actions in response to stormwater consent breaches are rare, but gradually increasing over time. One important difference from wastewater treatment discharges is that stormwater discharges are not always consented. The differing levels of stormwater discharge consent coverage are shown in Figure 18.

Table 8: Stormwater consent compliance actions.

	FY 2017	FY 2018	FY 2019	FY 2020
Stormwater consent abatement notices (SWE2a)	0	5	3	9
Stormwater consent infringement notices (SWE2b)	0	4	0	3
Stormwater consent enforcement orders (SWE2c)	0	0	1	0
Stormwater successful prosecutions (SWE2d)	0	0	1	0
Stormwater consent letters of direction (SWE2f)				2
Stormwater consent formal warning (SWE2f)				5

Figure 18: Proportion of the network with stormwater discharge consents per service provider



Customer focus

5 Customer focus

5.1 Complaints

Customer complaints are recorded using categories shown in the *Non-Financial Performance Measures Rules 2013* (Department of Internal Affairs*, 2013*). The total number of complaints received across all service providers is shown in Figure 19.

The trend indicates a gradual increase in the number of water and wastewater complaints, as shown in Figure 20. There is insufficient context available in the data to assess whether this is cause for concern. Service providers have complaint management systems at various levels of maturity, ranging from pen-and-paper-based systems to comprehensive Customer Relationship Management software. Increases in complaints may be attributable to maturing complaint management processes and/or customer engagement.

Customer data ratings, when graded on a 1 to 5 scale from highly reliable to highly uncertain, improved slightly in certainty. In the 2019 fiscal year, complaint data rated an average confidence of 1.94, improving slightly to 1.83 in the 2020 fiscal year.

Figure 19: Number of complaints by complaint type

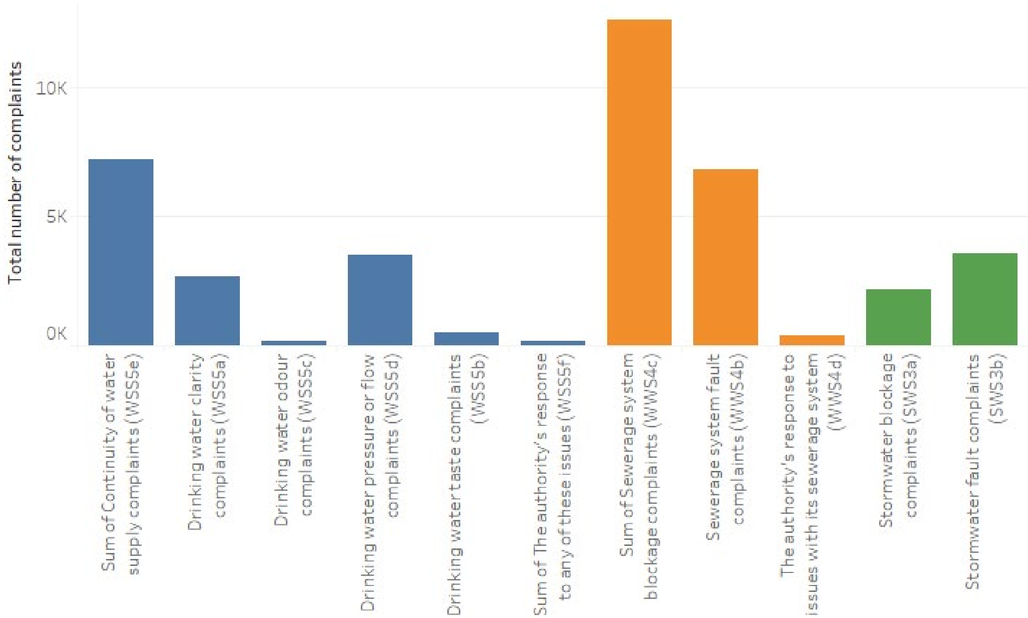
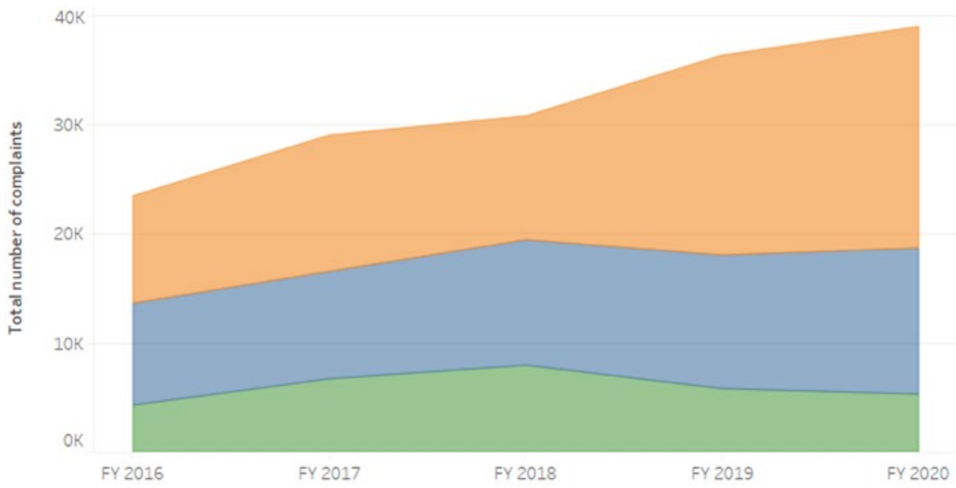


Figure 20: Trend in complaints recorded across participants supplying five years' data



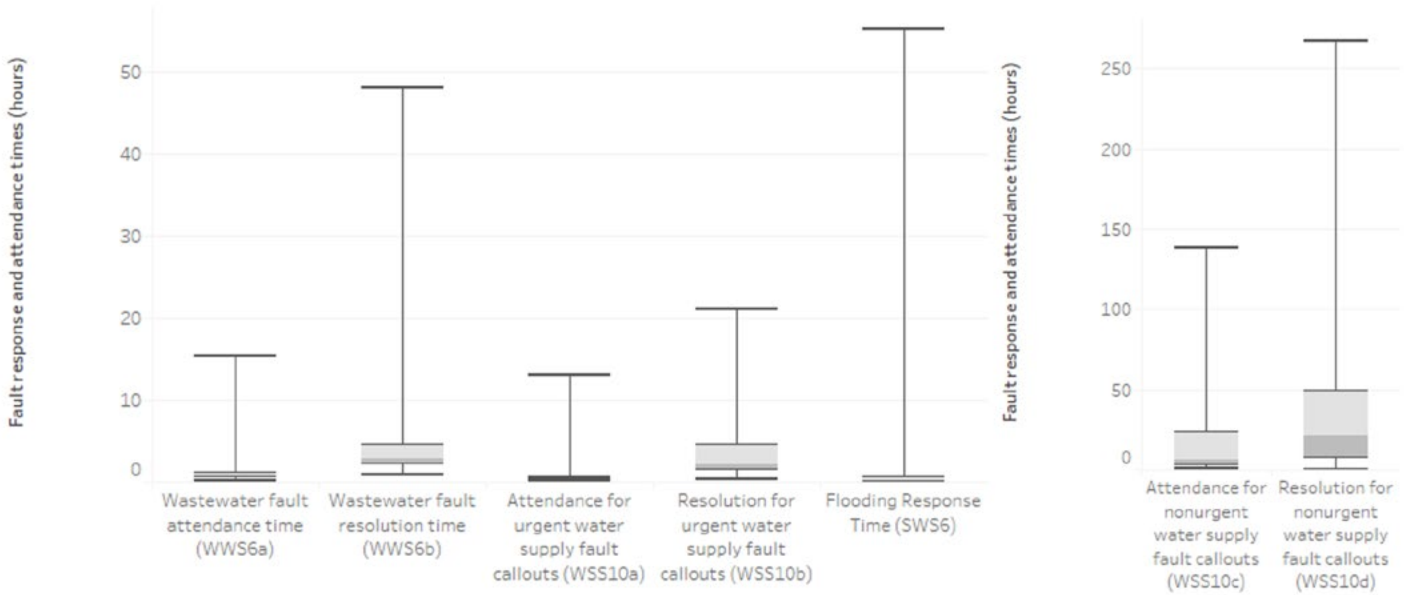
5.2 Fault response attendance and resolution times

Fault attendance and resolution times are shown in Figure 21, and median fault response times provided in Table 9.

Table 9: Median fault attendance and resolution times in hours

	Non-urgent water supply faults	Urgent water supply faults	Wastewater faults	Flooding response time[5]
Attendance time (hours)	**6.35**	**0.51**	**0.60**	**2.44**
Resolution time (hours)	**21.07**	**2.133**	**2.71**	

Figure 21: Fault response and resolution times



5 Value provided is the average flooding response time. The median for this metric is 0, as not all stormwater service providers are tasked with flood response and so often entered zero values.

5.3 Charges

5.3.1 Residential charges

The average charge for water and wastewater services in 2020 was $878.88 (including GST), which was significantly lower than the average household expenditure of $2,067 on electricity (Minsitry of Business Innovation and Employment, 2021). The average national charge would take a worker on the New Zealand minimum wage 52 hours to earn. Over the last five years, water supply charges have gradually been increasing, impacting on the average combined charge, as Figure 22.

Service providers use a combination of fixed charges and/or volumetric charges. Volumetric charging is enabled by the installation of residential water metering, an overview of which is provided in *Section 8.2.2*. Information for individual service providers is included in the data portal associated with this report. Where residential water meters are installed, a combination of fixed and volumetric charging is generally employed. Christchurch is an exception, where residential properties are metered, but water is charged using a fixed rate. Auckland is also unique in that all charges are associated with a volumetric rate.

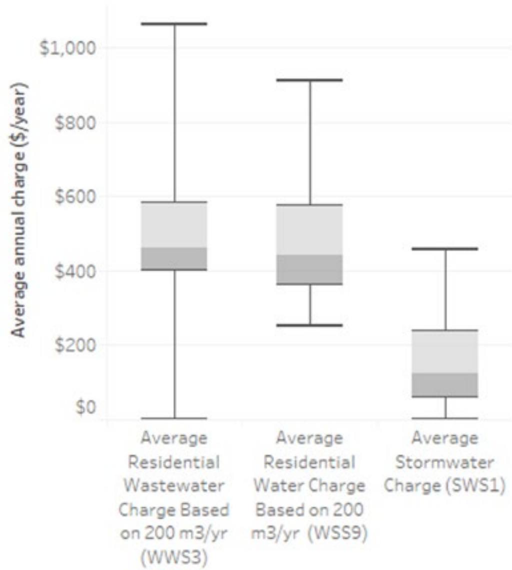
Wastewater charges are generally levied using a fixed charge. Auckland is the only exception, where charges are based on a volumetric rate charged as a proportion of water consumed.

Figure 22: Median water and wastewater charges and their affordability

Variation in charges is significant, as illustrated in Figure 23. At the upper end, New Zealand's most expensive average combined water and wastewater charge is $1,772/year. This would take a worker on the minimum wage 104 hours of work to pay, and be equivalent to 8% of the total annual superannuation payment, or 9% of the annual sole parent support payment.

Some service providers have a single charge covering the entire district. Others have separate charges for different water supply schemes and/or property types. For example, some properties that can be, but are not connected to water supply and wastewater schemes may be charged at a lower rate. Taupō District Council, with 18, has the highest number of different charging regimes, with each associated with a different water supply network.

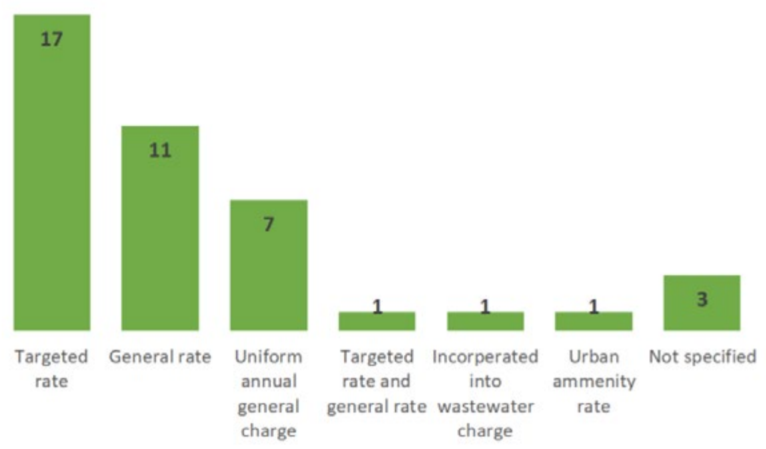
Figure 23: Variation in average charges for water supply, wastewater, and stormwater services



5.3.2 Stormwater charges

Councils charge for stormwater services through rates, however the rating approach used varies. The different approaches, and number of service providers employing them, is shown in Figure 24.

Figure 24: Rating approach used for charging for stormwater services



5.3.3 Non-residential water and wastewater charges

Non-residential customers' water use and wastewater production characteristics can vary significantly from those of residential customers. Accordingly, most service providers employ different charging approaches to recover costs from non-residential properties. Figure 25 shows the number of service providers with charging regimes which distinguish non-residential customers. The use of volumetric charging for non-residential water customers is widespread, and often used for wastewater as well, as illustrated in Figure 26.

Figure 25: Service providers' approach to non-residential charging for water and wastewater services

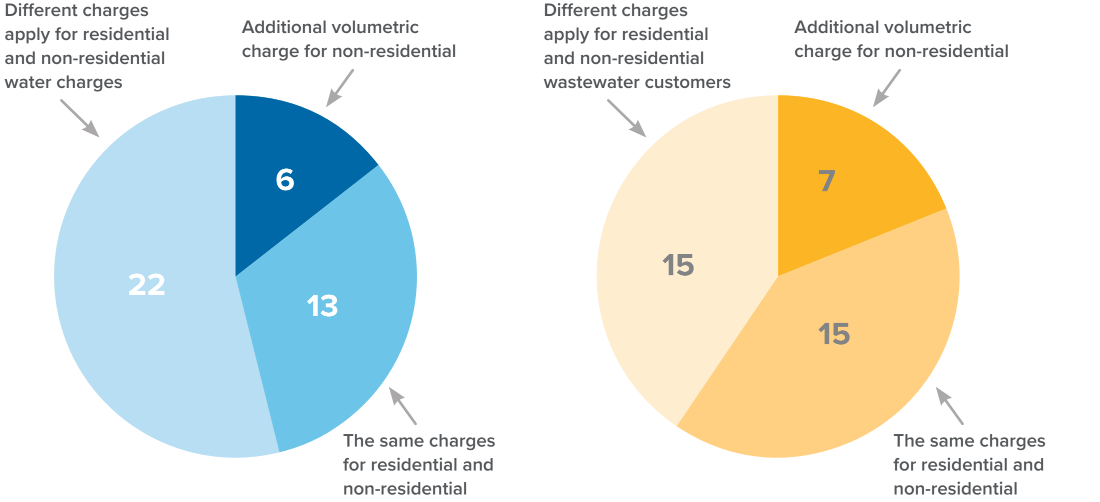
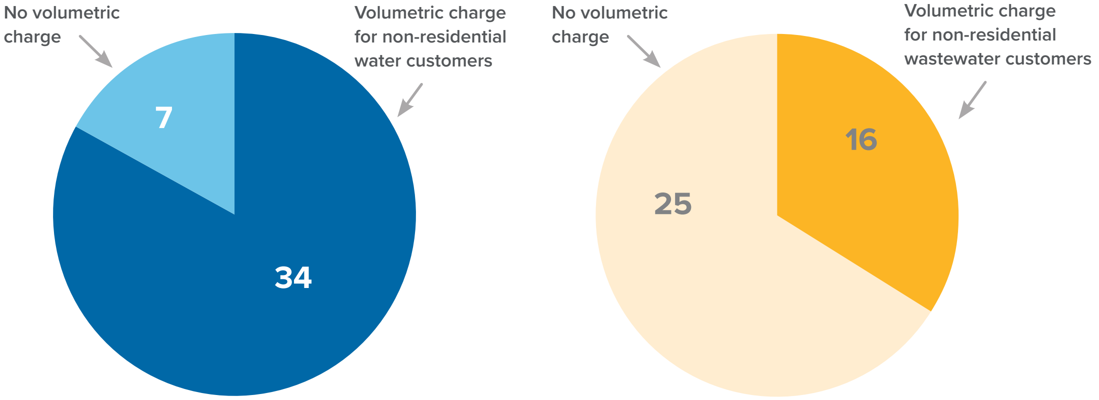


Figure 26: Service providers with volumetric charges in place for non-residential water and wastewater services



In addition to volumetric charges, contaminant-based charging is used to recover costs of treating industrial wastewater (known as trade waste). The proportion of service providers applying contaminant-based charges to trade wastes is shown in Figure 27.

Trade waste discharges can impact on wastewater network operation and, accordingly, require unique management and control protocols. The mechanisms service providers employ to manage trade waste are illustrated in Figure 28.

An in-depth look at trade waste management practices (the discharge of industrial water to municipal treatment systems) is covered in the New Zealand Wastewater Sector report (Beca, GHD, Boffa Miskell, 2020).

Figure 27: Service providers using contaminant-based charges

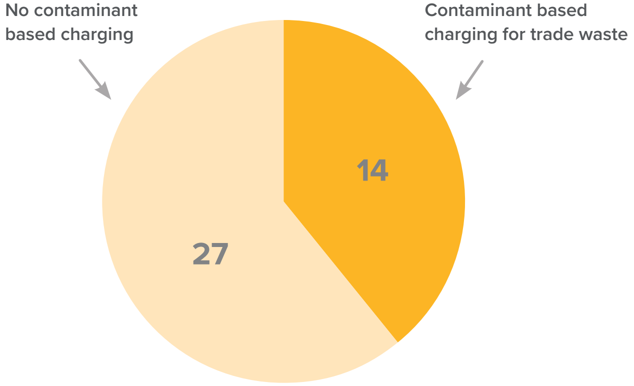
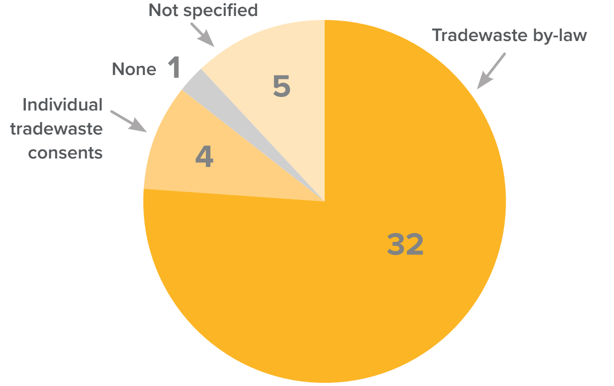


Figure 28: Service providers approach to management of trade wastes



Economic sustainability

6 Economic sustainability

6.1 Revenue

Participants collected around $2.3 billion in revenue for the provision of water, wastewater, and stormwater services in the 2020 fiscal year. Most revenue collected was obtained from fixed or volumetric service charges. Other sources of operational revenue include special levies, lease of land or space reserved for assets, revenue from asset sales, and interest.

The revenue collected per property varies significantly across service providers, as illustrated in Figure 29. Median revenue collected per property has been gradually growing over time. Since the 2016 fiscal year, water supply revenue per property has grown from $440 to $511 per property per year, wastewater revenue from $530 to $639 per property per year, and stormwater from $110 to $137 per property per year.

In addition to cash developers also provide assets, which are vested in service providers for ongoing operation. Asset contributions also show a gradual increasing trend over time, but with slight decreases in water supply and stormwater revenue in 2020. Developer asset contributions for stormwater exceeds that of water supply or wastewater, as illustrated in Figure 30.

Some service providers collect revenue from neighbouring authorities for the supply of drinking water or wastewater services. For drinking water services, these were Watercare (Auckland), Clutha District Council, Masterton District Council, Hastings District Council, Tasman District Council, and Hamilton City Council. Those supplying wastewater services to their neighbours were Watercare (Auckland), Christchurch City Council, Tauranga City Council, Masterton District Council, and Tasman District Council.

Table 10: Total revenue collected across all service providers

	Water supply	Wastewater	Stormwater	Total
Revenue from Supply of Water to Other Local Authorities (WSF1)	**$7,468,175**	**$14,782,718**		**$22,250,892**
Operating Revenue (WSF2, WWF2, SWF1)	**$693,510,370**	**$1,009,592,445**	**$339,642,172**	**$2,042,744,987**
Development Contribution Revenue: Water Supply (WSF3, WWF3, SWF2)	**$96,353,181**	**$117,789,112**	**$32,357,114**	**$246,499,407**
Total Revenue: Water Supply (WSF4, WWF4, SWF3)	**$797,331,725**	**$1,142,164,274**	**$371,999,286**	**$2,311,495,285**

Figure 29: Range in revenue per property collected by service providers over time[6]

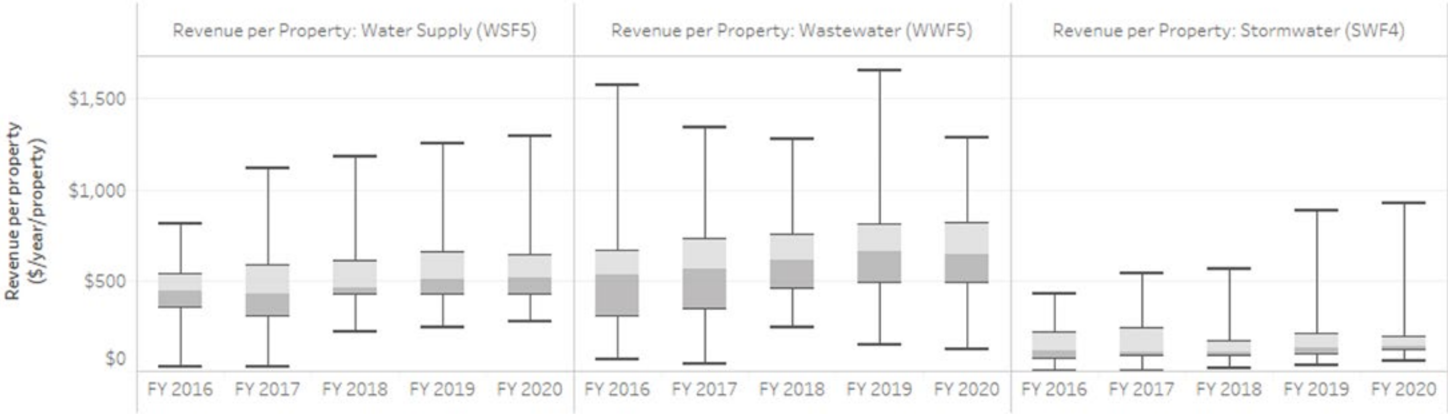
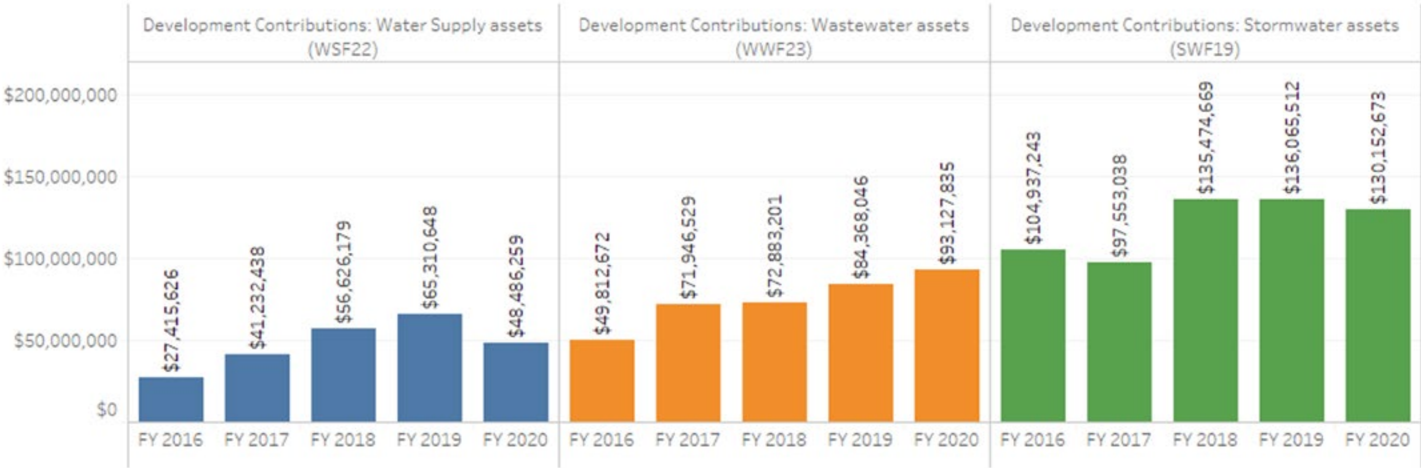


Figure 30: Developer contribution revenue[6]



6 Data only includes service providers that have provided five years of continuous data

6.2 Expenditure

Expenditure across all service providers was over $2.6 billion. A breakdown is provided in Table 11.

Table 11: Total expenditure across all service providers

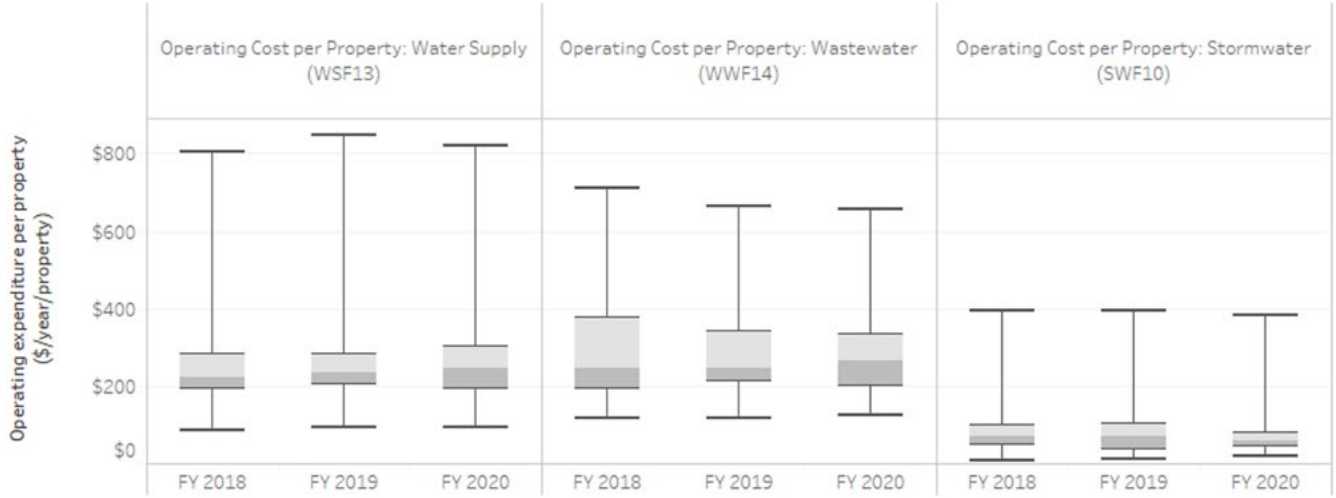
	Water supply	Wastewater	Stormwater	Total
Capital Expenditure (WSF20, WWF21, SWF17)	$577,428,075	$742,122,672	$271,062,618	$1,590,613,365
Operating Expenditure (WSF12, WWF13, SWF9)	$362,472,823	$436,060,403	$109,302,861	$907,836,087
Interest (SWF12a, WWF16a, SWF15a)	$48,455,205	$102,637,983	$37,291,611	$188,384,799
TOTAL	$988,356,103	$1,280,821,058	$417,657,090	$2,686,834,251

6.2.1 Operational expenditure

Total operational expenditure for the 2020 fiscal year was $858 million, composed of $338 million on water supply, $404 million on wastewater, and $114 million on stormwater systems. Different components of operational expenditure aggregated across all participants are shown in Figure 31.

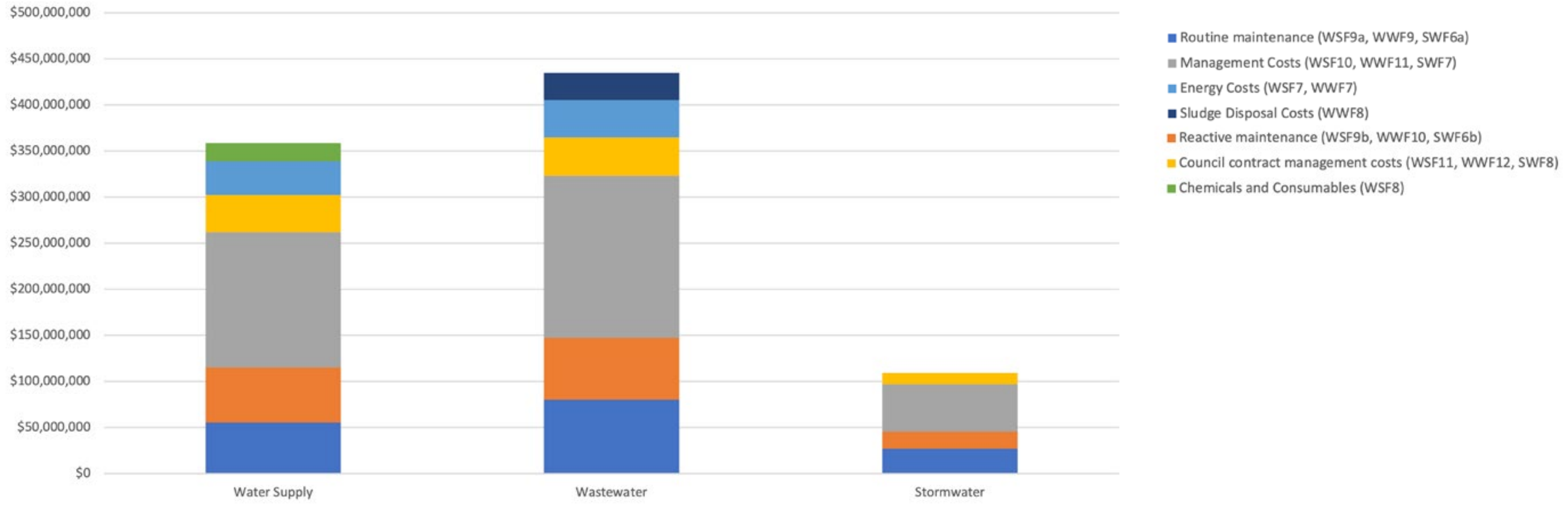
Operational expenditure per property for water supply and wastewater systems over the last three years shows a gradual increase, illustrated in Figure 31. Median per property expenditure on water supply has increased from $221 in the 2018 fiscal year to $302 in the 2020 fiscal year. Median wastewater expenditure has increased from $248 to $266 per property over the same period. Meanwhile, operational expenditure on stormwater systems has declined slightly from $71 per property to $59 per property.

Figure 31: Range in operating expenditure per property[7]



7 Data only includes service providers that have provided five years of continuous data

Figure 32: Components of operational expenditure



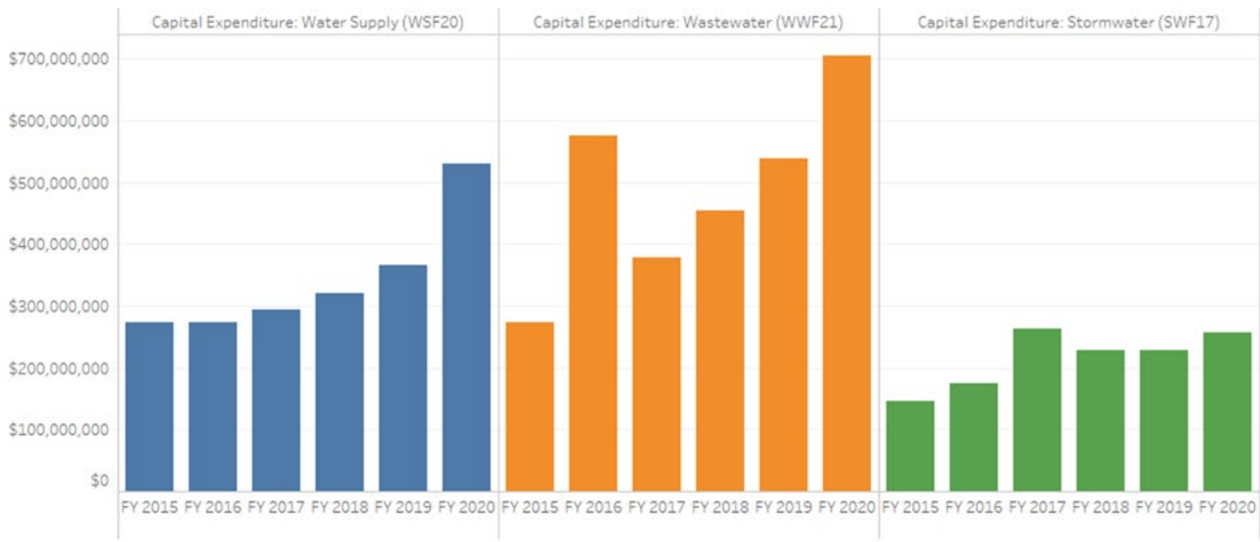
6.2.2 Capital expenditure

Capital expenditure totalled $1.59 billion in the 2020 fiscal year. The purpose of expenditure is shown in Figure 34.

Trends in capital expenditure are shown in Figure 33. Spikes in capital expenditure on wastewater systems and stormwater systems in 2016 and 2017 are largely attributable to earthquake recovery works in Christchurch.

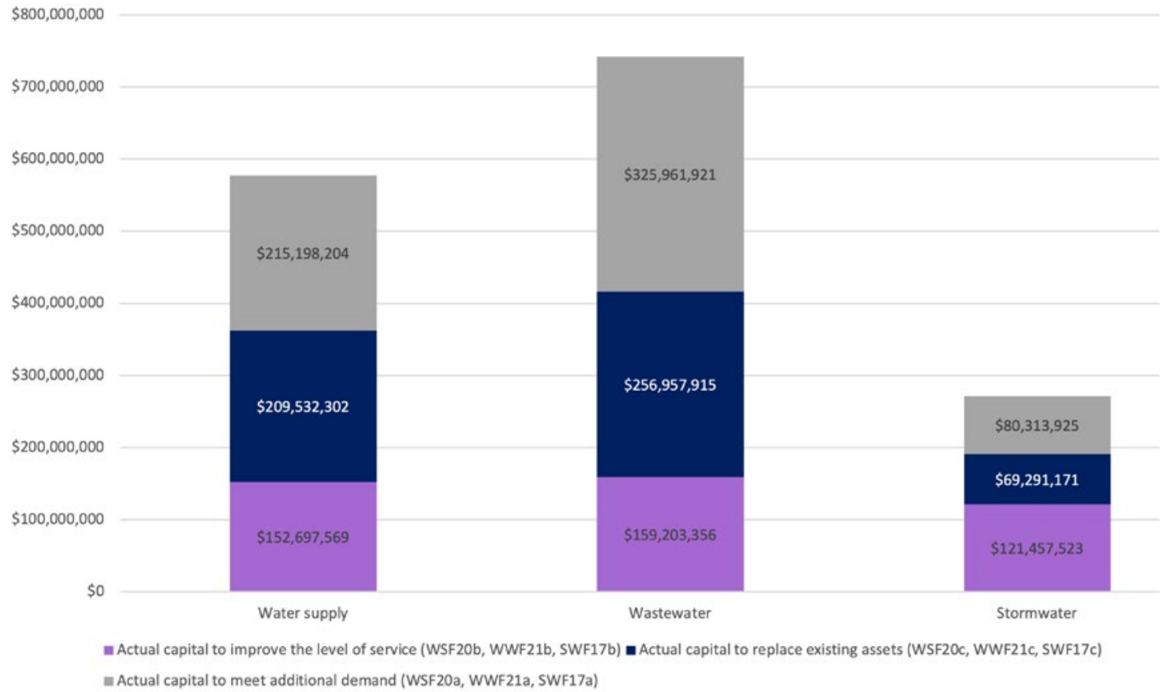
Capital expenditure on water and wastewater services increased significantly in the 2020 fiscal year. A large contributor was increased spending in Auckland, where capital expenditure increased from $148 million in the 2019 fiscal year to $192 million on water supply, and from $279 million to $391 million on wastewater.

Figure 33: Trend in total capital expenditure[8]



8 Trend only shows service providers that have provided five years continuous data

Figure 34: Capital expenditure by purpose



6.3 Depreciation

The monetary value of an asset decreases over time due to use, wear and tear, or obsolescence. This decrease is measured as depreciation. In theory, for assets to maintain their original intended levels of service, spending on assets should match depreciation.

Local government categorises capital expenditure on water assets as either expenditure on asset replacement, level of service improvements, or new growth. Figure 35 shows expenditure on asset replacement in comparison to depreciation over the previous four years. The data suggest asset renewal expenditure is falling short of depreciation across all asset classes. When capital expenditure on levels of service improvements (which could be expected to incorporate asset renewal in some circumstances) is included, however, the shortfall is significantly less, and expenditure even exceeds depreciation for stormwater systems as shown in Figure 36.

This data does not, however, necessarily provide a reliable guide as to whether renewal spending is falling short of what is needed to maintain service levels. Capital expenditure, by its nature, occurs in chunks, requiring that trends be considered over long time periods. The four-year period shown here may not be indicative of overall trends. In addition, asset depreciation for underground infrastructure is notoriously difficult to calculate, and may not accurately represent the rate of asset decline. Finally, the expenditure included in these figures represents only 31 service providers that have repeatedly been involved in the National Performance Review over the previous five years, and so may not be representative of New Zealand overall.

Figure 35: Capital expenditure to replace existing assets over the previous four years

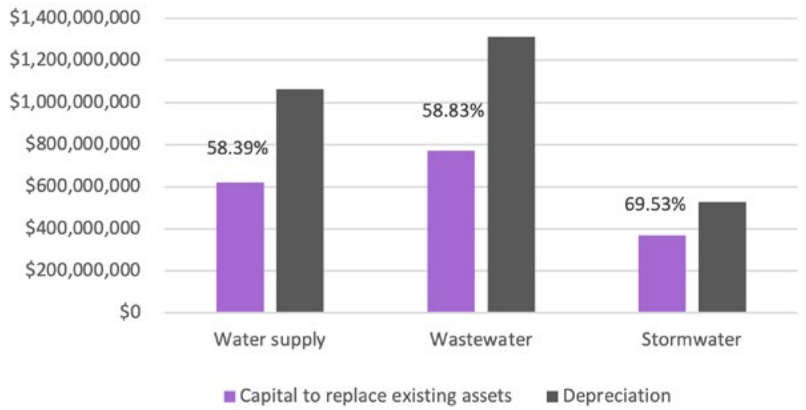
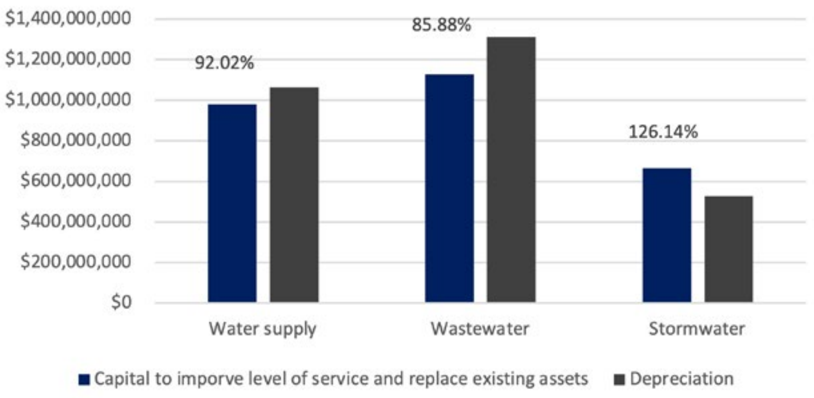


Figure 36: Capital expenditure to replace existing assets or improve levels of service, versus depreciation over the previous four years



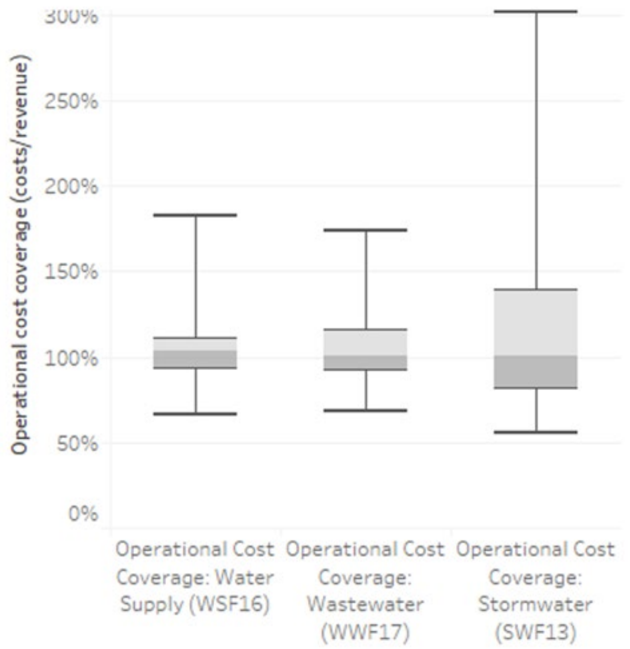
6.4 Cost coverage

6.4.1 Cost as a proportion of revenue

This metric shows revenue (excluding developer contribution) as a proportion of operational costs, asset depreciation, and interest for 3 Waters networks. To have a balanced budget, revenue should match costs. Where revenue exceeds costs, the figure will be higher than 100%, and where revenue is insufficient to cover costs, the figure will be lower than 100%. However, depreciation is not always fully funded (discussed in Section 6.3 Depreciation), which limits the accuracy of cost coverage represented by this metric.

The range of cost coverage achieved by service providers is shown in Figure 37. Median cost coverage for water supply was 103%, wastewater 100% and stormwater 101%. However, there is a large spread in cost coverage rates, particularly for stormwater. Some service providers collect revenue of nearly three times their costs, and others collect enough revenue to cover only half their costs.

Figure 37: Range of operational cost coverage (revenue/costs)



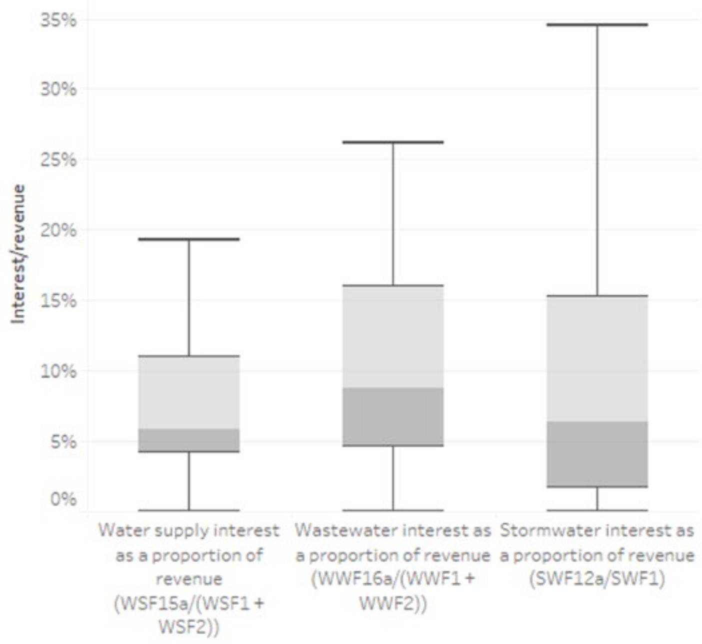
6.4.2 Debt servicing

The proportion of revenue (excluding developer contributions) spent on interest for water, wastewater, and stormwater networks is summarised in Figure 38.

This metric aligns with the Debt Servicing Benchmark in the *Local Government (Financial Reporting and Prudence) Regulations 2014* (New Zealand Government, 2015). The benchmark is met if borrowing costs are less than 10% of a local authority's revenue per year (or 15% for a high-growth council).

While met by the average service provider, the benchmarks are significantly exceeded by several. The Financial Reporting and Prudence Regulations apply to all council operations, and are therefore not required to be applied at an individual asset class level. The fact that water assets carry higher levels of debt may be attributable to their significant financial value.

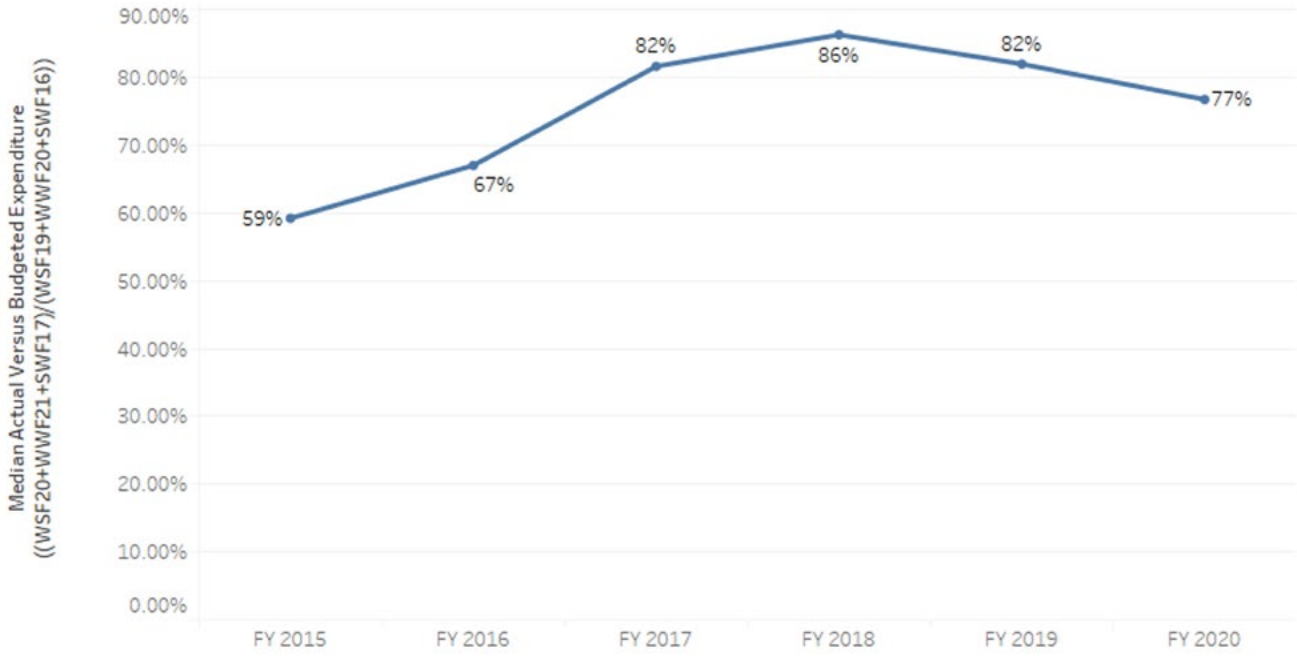
Figure 38: Interest as a proportion of revenue

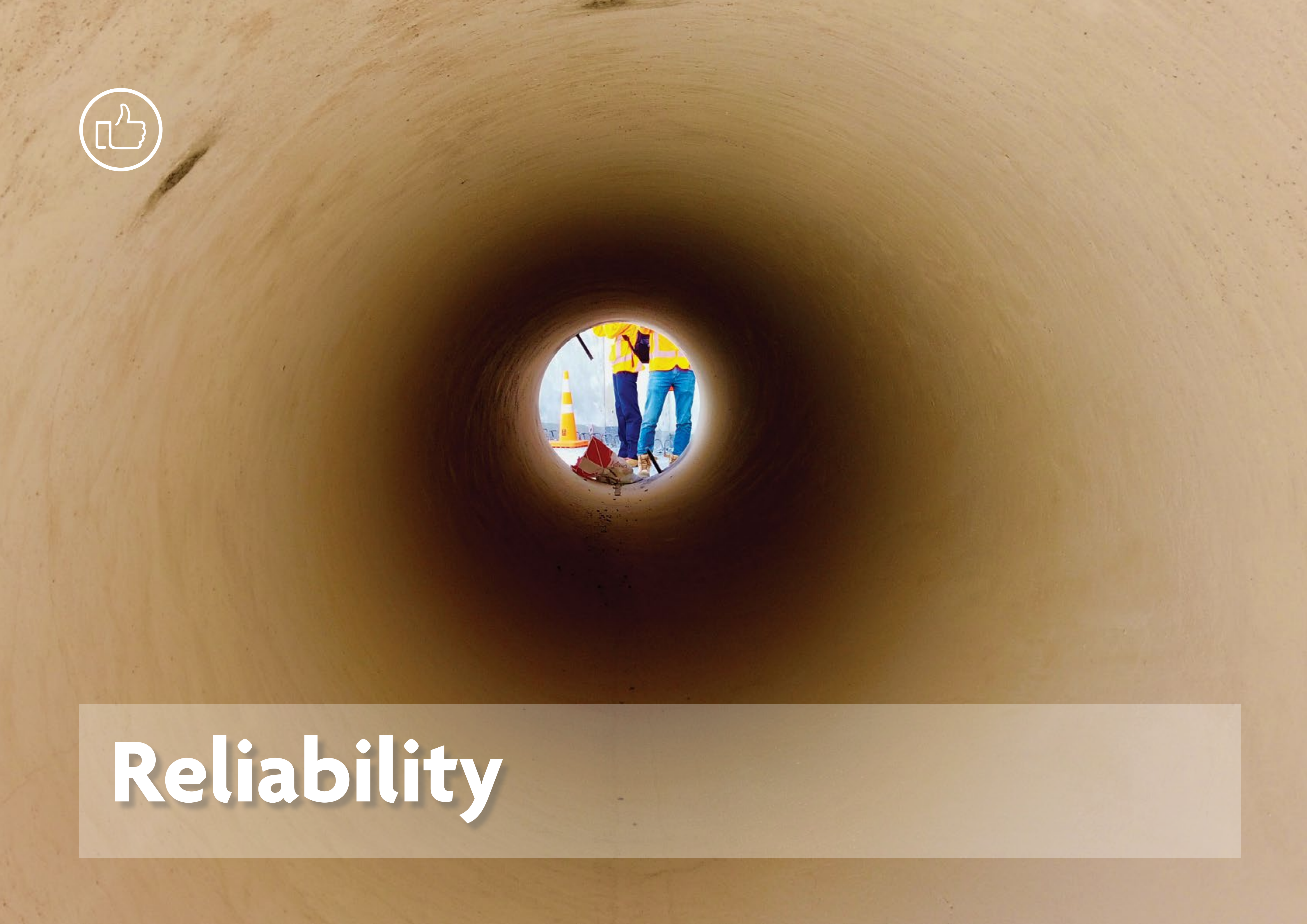


6.4.3 Balanced budget

Actual capital expenditure trails that budgeted for by an average of 77%. This continues a trend evident in previous years, as illustrated in Figure 39. Previous National Performance Review data found this shortfall attributable to a combination of pressures comprising internal resources, consenting delays, insufficient preliminary planning, lack of data, uncertainties in legislation, and difficulties obtaining community consensus on projects.

Figure 39: Actual capital expenditure as a proportion of budgeted capital expenditure





Reliability

7 Reliability

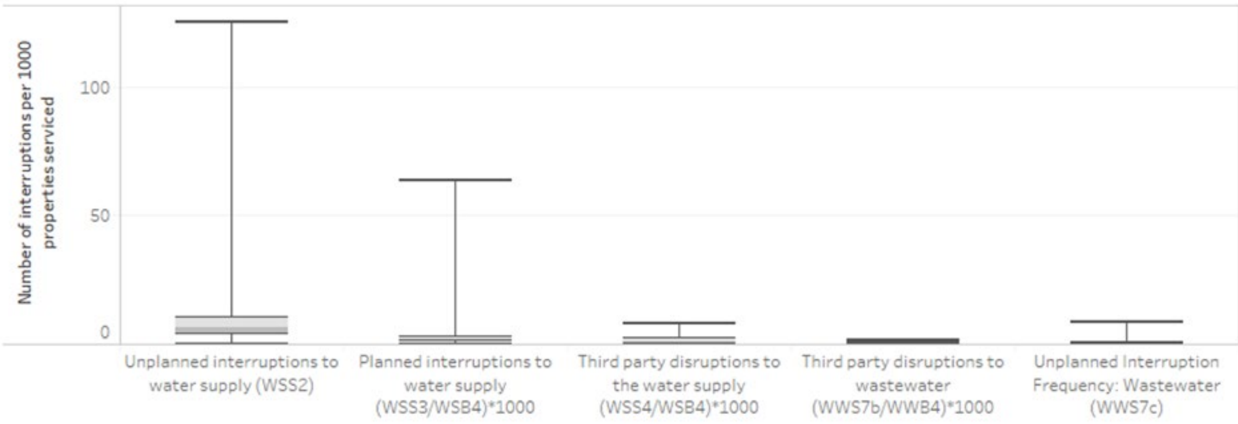
7.1 System interruptions

The total number of interruptions to water supply and wastewater services is shown in Table 12. The range of occurrence rates per property for different water service providers is shown in Figure 40.

Table 12: Total number of water and wastewater interruptions

	Water supply	Wastewater
Unplanned total interruptions	**14,794**	**726**
Third party incidents	**2,732**	**345**
Planned interruptions	**2,619**	

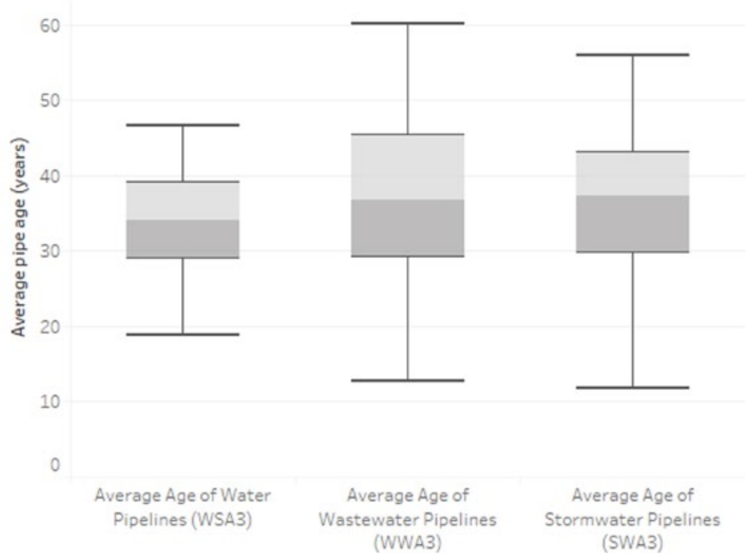
Figure 40: Range of interruptions per 1000 properties reported by service providers



7.2 Pipeline age

The range of average ages for water supply, wastewater, and stormwater pipelines is shown in Figure 41. Water supply pipelines have the lowest average age at a median of 34.1 years, followed by 36.7 years for wastewater pipelines, and 37.2 years for stormwater pipelines.

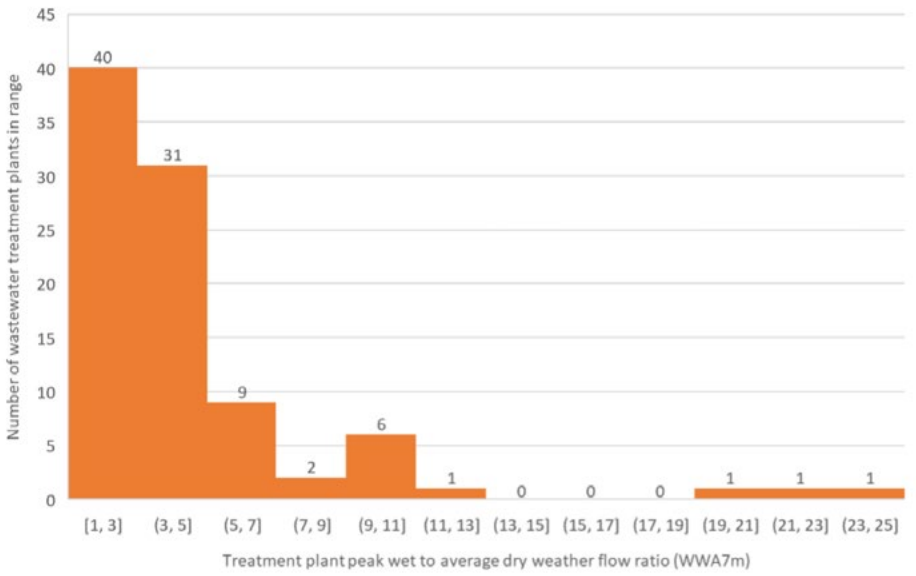
Figure 41: Range of average pipeline ages



7.3 Inflow and infiltration

Inflow and infiltration (I&I) are mechanisms by which stormwater and groundwater make their way into the wastewater network, commonly caused by cross connections or damaged pipes. High volumes of I&I put additional load on wastewater treatment plants, which can result in wastewater overflows to the environment in wet weather. Inflow and infiltration volumes also provide an indicator of the condition of pipelines. Peak wet to average dry weather flow ratios entering wastewater treatment plants serve as a proxy for inflow and infiltration into wastewater systems. The reported values entering wastewater treatment plants are shown in Figure 42.

Figure 42: Peak wet to average dry weather flow rations entering wastewater treatment plants

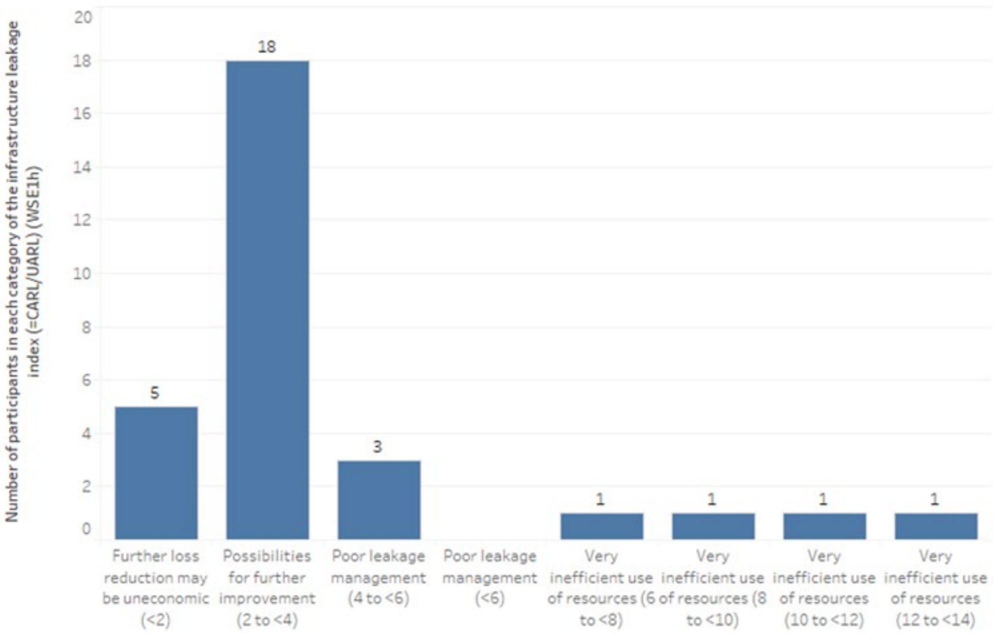


7.4 Water loss

In the 2020 fiscal year, participants lost 116 million cubic meters of water through their water supply systems, equivalent to over 47,000 Olympic-sized swimming pools. This constituted 21% of the 549 million cubic meters[9] of water supplied to systems with known water loss.

International experts recommend the Infrastructure Leakage Index (ILI) is used to compare water losses across different systems. ILI is determined by dividing current annual real water loss levels (CARL) by unavoidable annual real losses (UARL). The number of participants achieving each of the ILI performance bands contained in Water New Zealand's *Water Loss Guidelines* (Lambert & Taylor, 2010) is shown in Figure 43.

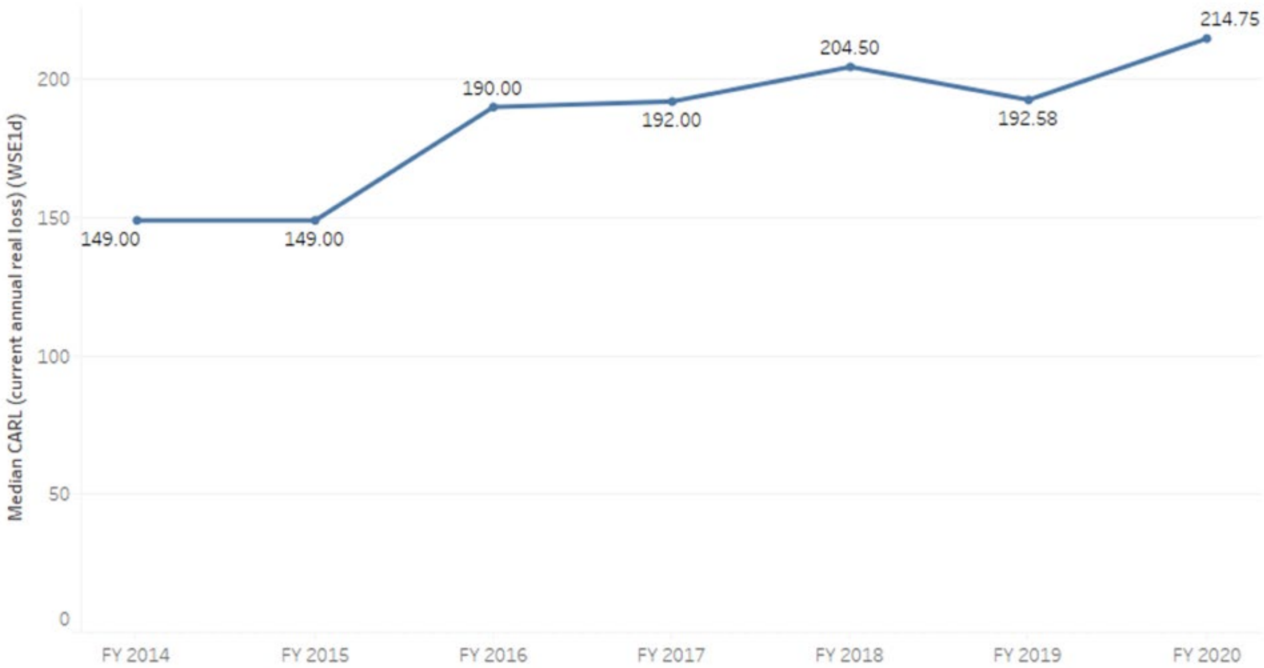
Figure 43: Water loss performance summary using the Infrastructure Leakage Index



9 This differs from the total volume of water supplied previously as service providers who were not able to provide water loss data have been excluded.

Changes in water loss over time can be compared by looking at changes in current annual real loss levels (CARL). Median CARL levels for participants continuously supplying data to the NPR is shown in Figure 44 show that on average, water loss volumes are increasing.

Figure 44: Changes in median, and number of entities reporting, current annual real loss of water in litres/property/day



Resource efficiency

8 Resource efficiency

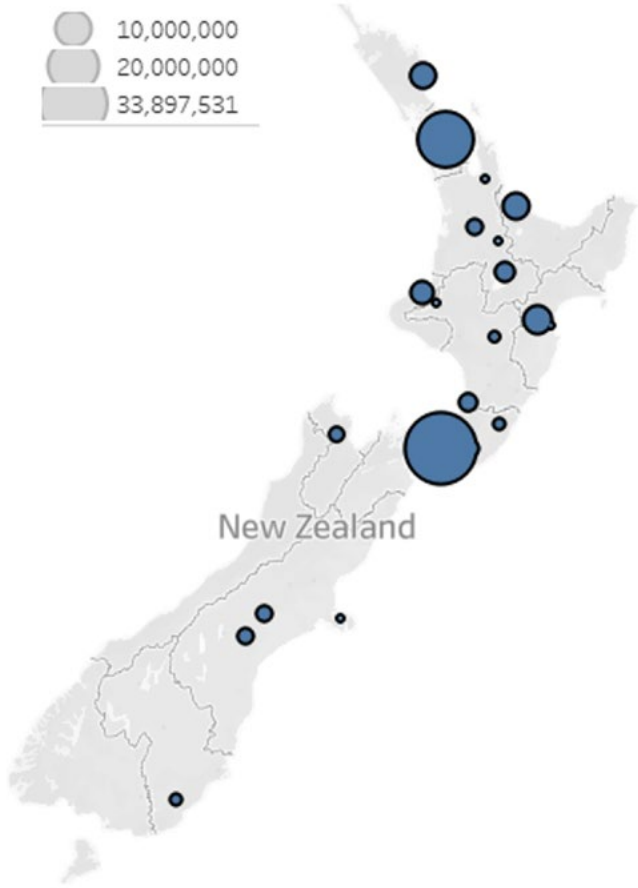
8.1 Water abstractions

A total of 560,462,868 cubic meters of water was supplied to participant systems, equivalent to 614 Olympic size swimming pools of water every day of the year. The amount of water supplied has been gradually increasing over the previous five years, as shown in Figure 45.

Figure 45: Total water supplied to the systems of service providers who had contributed five years' continuous data

8.2 Water demand management

Figure 46: Resident affected water restriction days



8.2.1 Water restrictions

Twenty-one participants, just over half the water service providers contributing to the report, put in place water restrictions in the 2020 fiscal year. In total, these restrictions affected 75,925,560 resident days. A scaled map showing where they occurred is shown in Figure 46.

8.2.2 Water metering

More residential consumers than not receive water through metered connections: 55% of residential connections, and 80% of non-residential connections. shows the total number of metered and unmetered properties. This data is skewed by widespread water metering in Auckland. Slightly over half of water service providers have no residential water metering in their districts, as illustrated in Figure 47. Use of water meters for non-residential properties is more widespread. Only two service providers have no meters installed on non-residential properties.

Figure 47: Metering coverage in different service districts

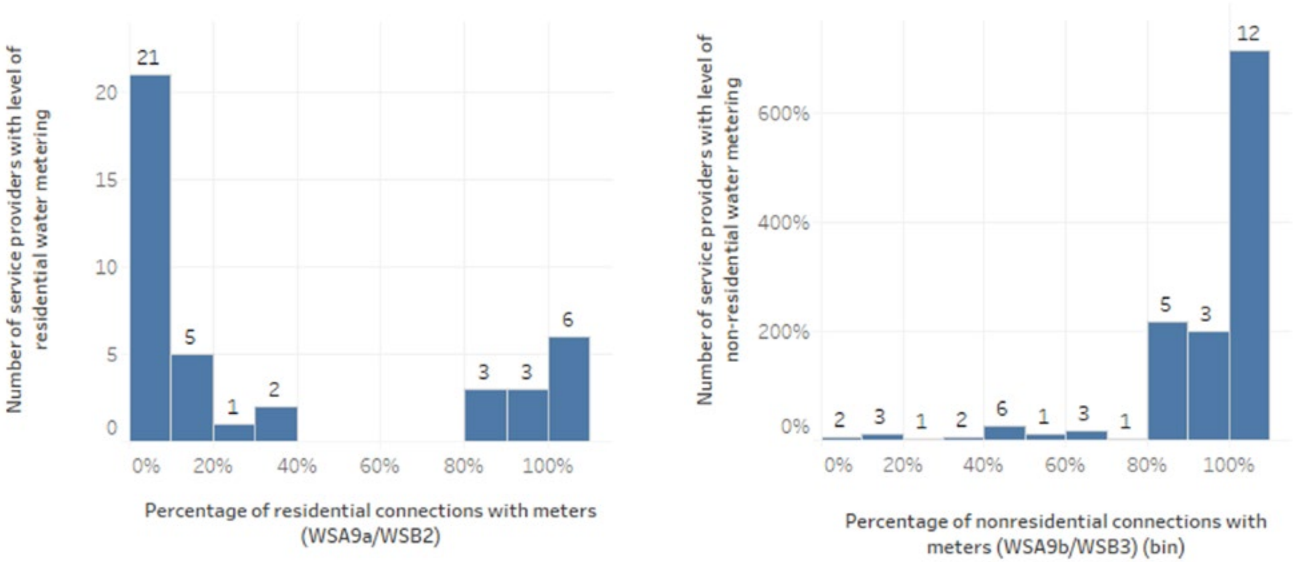
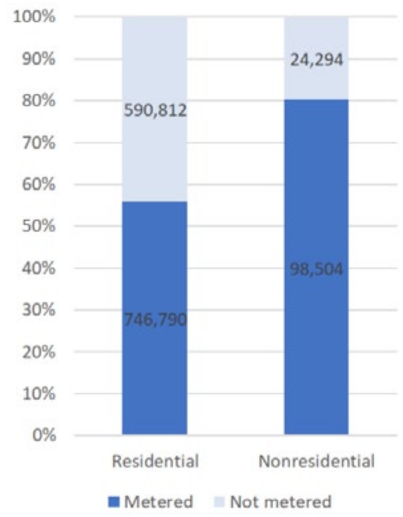


Figure 48: Number of properties with water meters



8.2.3 Water restrictors

Water restrictors are another widely used method of managing property water demand. Over 28 water service providers had water restrictors on their properties, however not in large numbers. In total 18,655 properties were on restricted supplies.

8.2.4 Residential water efficiency

Figure 49 shows the range of average daily residential water use of networked supplies in different service providers' districts. This is determined by dividing total volumes of water supplied (less network losses and non-residential use) by the serviced population. Five service providers did not provide information on water loss, and an additional three did not provide data on the amount of water supplied to non-residential customers. The Figure separates data from these districts. Amongst those who had all data available median residential water consumption was 229 litres per person per day.

The extent to which residential water metering correlates with lower water use is indicated in Figure 50. The numbers show the percentage of residential connections metered, and the colour scale shows residential water consumption, with darker colours illustrating higher consumption.

Figure 49: Average daily residential water use

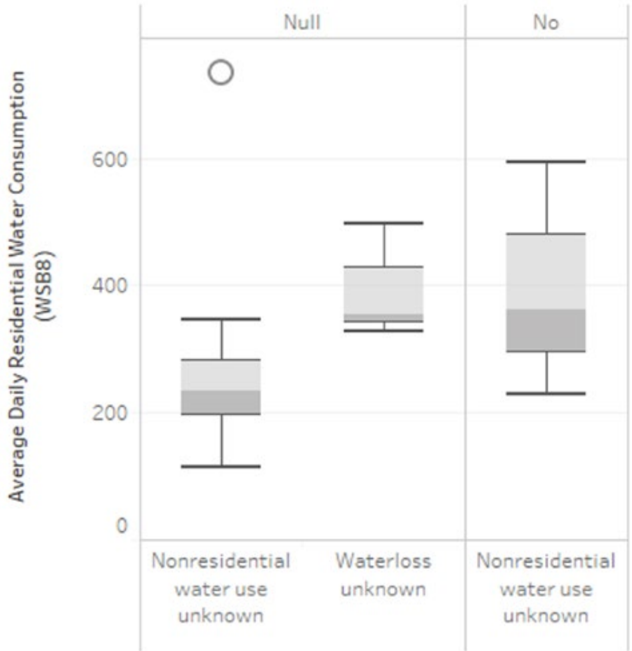
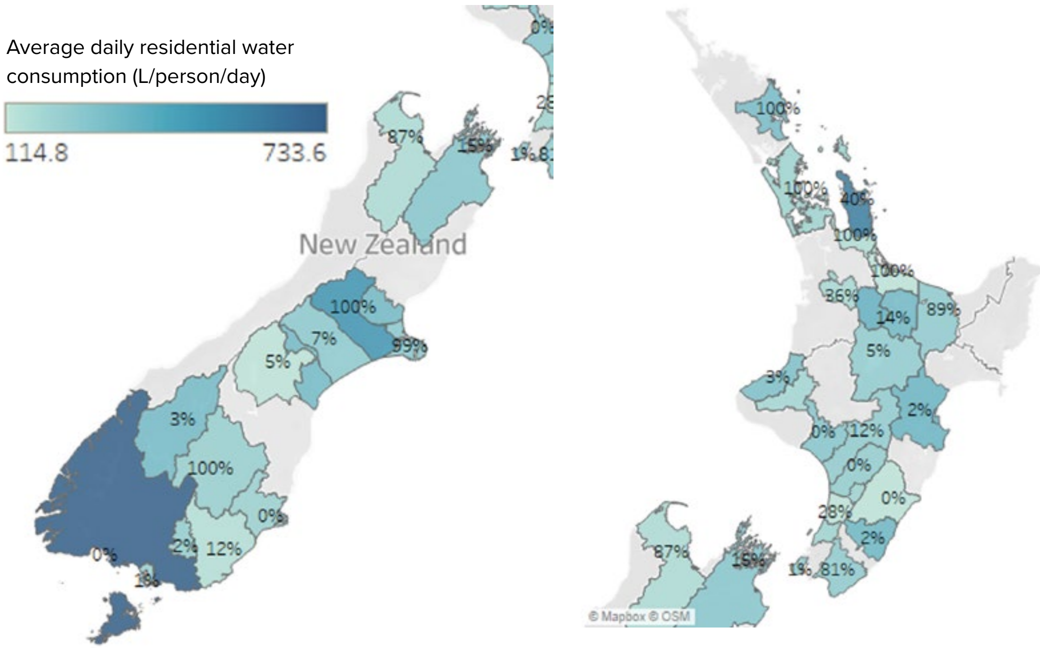


Figure 50: Average daily residential water use and metering coverage



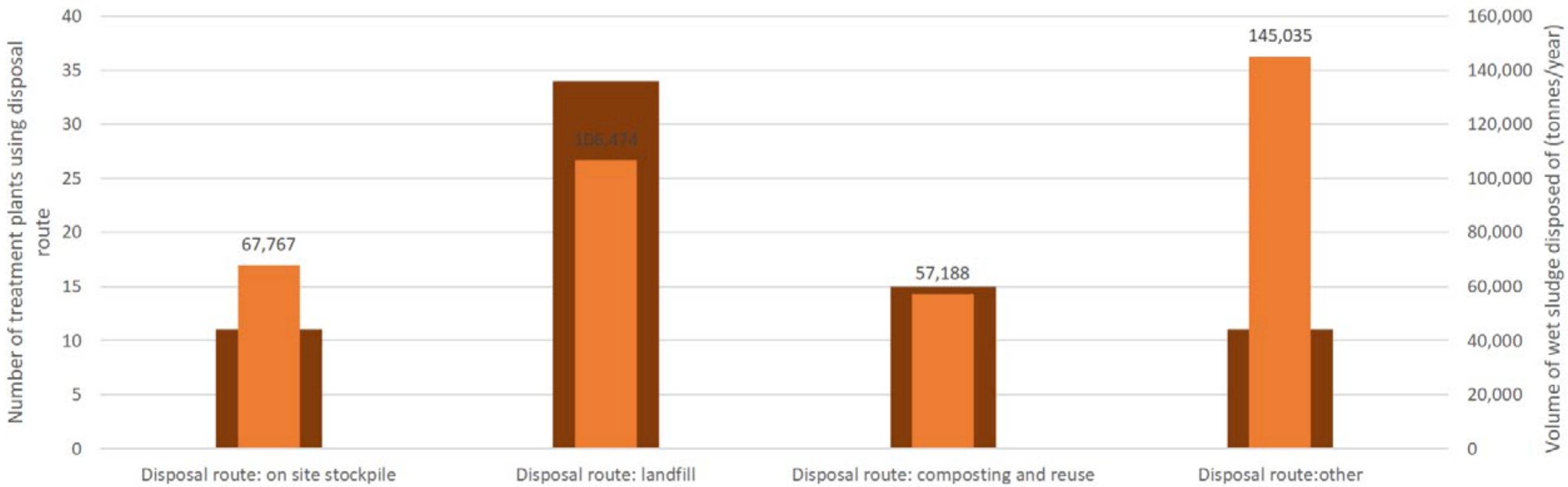
8.3 Sewerage sludge

Of 222 wastewater treatment plants supplying data to the Review, only 46 provided information on sludge production volumes. In total, 375,228 tonnes of wet sludge was reportedly produced in 2019/2020. A further 97 wastewater treatment plants were either pond, septic tank, or wetland-based systems, which would not be expected to be desludged annually. Of the remaining treatment plants, a flow-weighted estimate of the sludge produced by these plants is 47,286 tonnes per year (based on sludge per volume of wastewater treated). Using this methodology, it is estimated 442,513 tonnes of wet sludge a year is produced by the 222 treatment plants covered by the National Performance Review. The Māngere treatment plant produces 118,000 tonnes of wet sludge a year, comprising a significant proportion of this volume.

With adequate trade waste management and treatment processes in place, wastewater sludges can be a rich source of carbon and nutrients. Wastewater treatment plants Nonetheless, the most employed disposal route is for sludges to go to landfill. Commonly employed disposal routes for sludges are shown in Figure 51. Sludges from Māngere, New Zealands largest wastewater treatment plant are being used to rehabilitate land at Puketutu Island. Further disposal routes listed in the “other disposal routes” category were New Plymouth, where biosolids are used to produce a fertiliser product; and Rakaia, where sludge is applied to pasture which is not harvested for reuse.

A more detailed analysis of wastewater sludges and their disposal is available in *The Value of Biosolids in New Zealand* (Tinholt, 2019).

Figure 51: Disposal routes for wastewater sludges



8.4 Energy use and generation

Water and wastewater networks can be both energy consumers and energy producers. Energy is consumed primarily in the operations of treatment plants and pumps. Stormwater systems can also consume small amounts of energy, generally where stormwater networks employ pumping. Total amounts of energy consumed and generated are shown in Table 13[10].

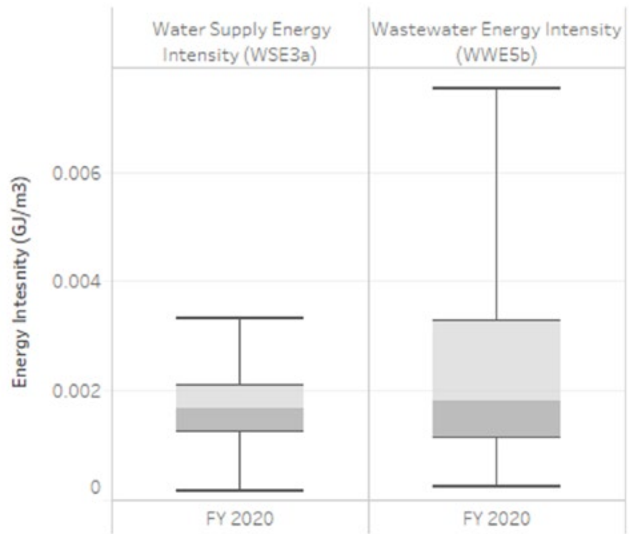
The amount of energy used to convey and treat water and wastewater depends on several variables such as terrain, quality of source and receiving waters, and the constituents of trade waste. The variation in energy intensity of different service providers is shown in Figure 52. Major outliers have been removed due to the probability of erroneous data.

Table 13: Energy consumption and generation

	Water Supply	Wastewater	Stormwater
Energy consumption (GJ/year)	706,018	1,047,639	4,420
Energy generation (GJ/year)	15,099	251,052	

Energy generation from water supply networks occurs in Auckland, Wellington, Palmerston North, and Tasman. Energy can be generated in water supply networks via microturbines placed within pipelines. In Palmerston North, mini hydro generators produce more energy than is consumed by the city's water network.

Figure 52: Variation in water and wastewater energy intensity



Energy can also be generated from biogas produced during wastewater treatment processes. For example, Hamilton's Pukete Road wastewater treatment plants operate a cogeneration unit powered by gas from the treatment plants' digesters. Energy generation from wastewater occurs in Auckland, Whangarei, Hamilton, Palmerston North, and Christchurch.

Other types of renewable energy can also be co-located with water and wastewater assets. For example, the Rosedale wastewater treatment plant in Albany is also home to a floating solar array.

8.5 Greenhouse gas emissions

Emissions related to water networks are generated through purchased electricity, onsite fuel use, vehicle use, use of ancillary goods and services, construction, wastewater treatment plant processes, from wastewater discharged into receiving bodies, and from wastewater sludge. Many of these sources of emissions occur across a range of other sectors. Emissions from wastewater processes, discharges, and sludge are not, and estimation methods for these sources are not widely available or standardised.

Ten of 41 wastewater service providers had assessed their greenhouse gases from wastewater and sludges. The majority of these (nine of the 10) had included emissions related to wastewater discharge as well. Those who had undertaken assessments sited various approaches: using *IPCC Guidelines for National Greenhouse Gas Inventories 2019*, in-house knowledge, private consultants, or the Toitū Envirocare tool.

10 Major outliers have been excluded due to a high likelihood of eroneous data

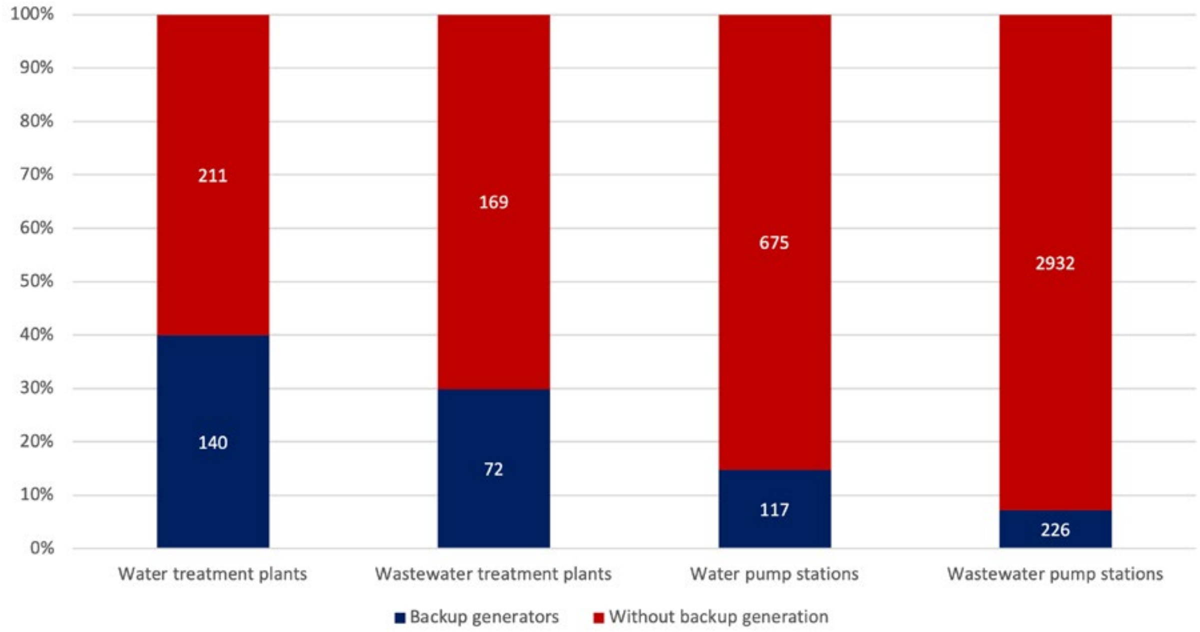
Resilience

9 Resilience

9.1 Back-up power supplies

Backup generation is installed at 40% of water treatment plants, and 30% of wastewater treatment plants. For pump stations, figures are lower, with 15% of wastewater pump stations and 7% of water pump stations having back-up generation. The total number of assets in each category is shown in Figure 53.

Figure 53: Backup generation

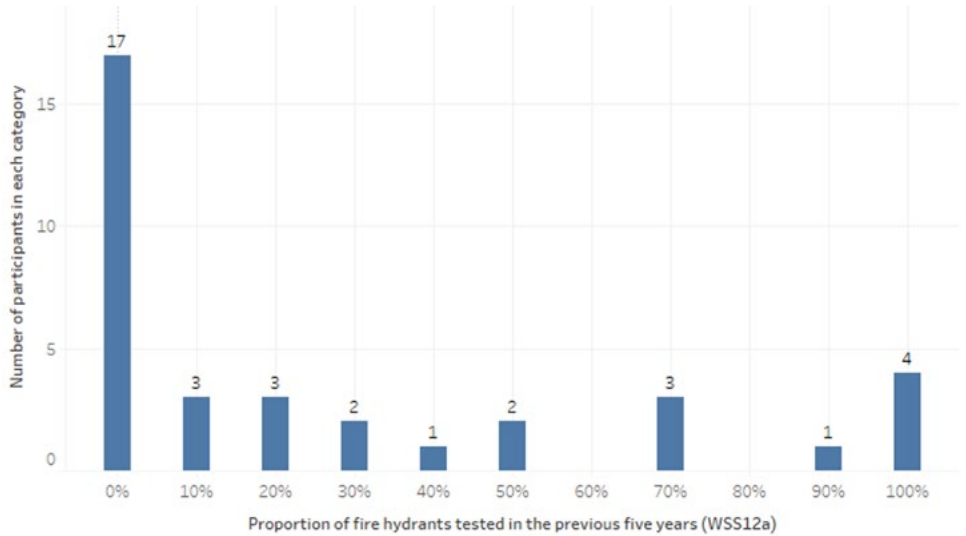


9.2 Firefighting water supplies

The *New Zealand Fire Service Firefighting Water Supplies Code of Practice* (Standards New Zealand, 2008) provides direction on what constitutes enough supply of water for firefighting in urban fire districts.

The Code specifies that all fire hydrants should be inspected and flushed every five years by an approved tester. Assessing hydrants' compliance with the code holds technical challenges for water suppliers, and assessment against the Code is not widespread. The proportion tested in different service provider districts is illustrated in Figure 54.

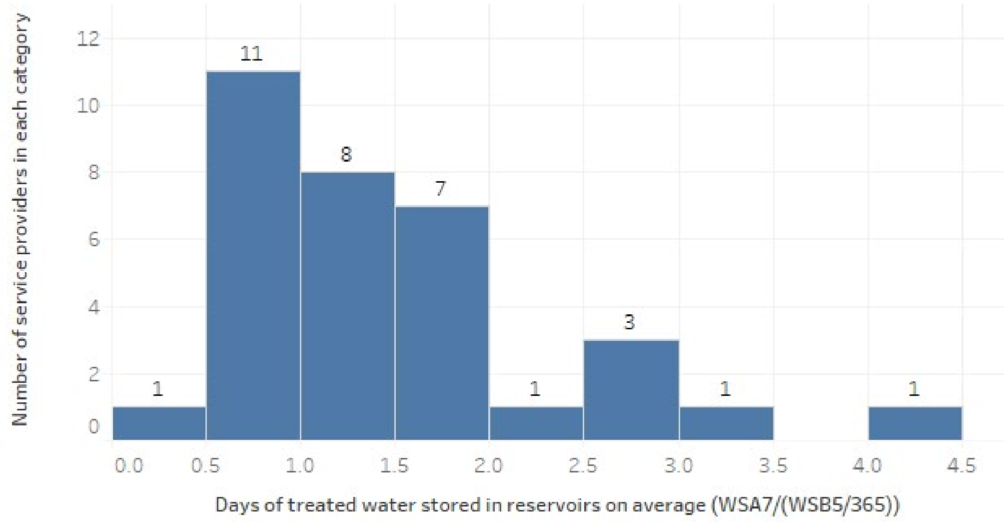
Figure 54: Proportion of fire hydrants tested in the previous five years in service districts



9.3 Water storage

On average, 1.45 days' worth of water is kept in storage reservoirs. Figure 55 illustrates the average number of days treated water is stored in reservoirs for different service districts.

Figure 55: Average number of days water is stored in reservoirs in different service districts



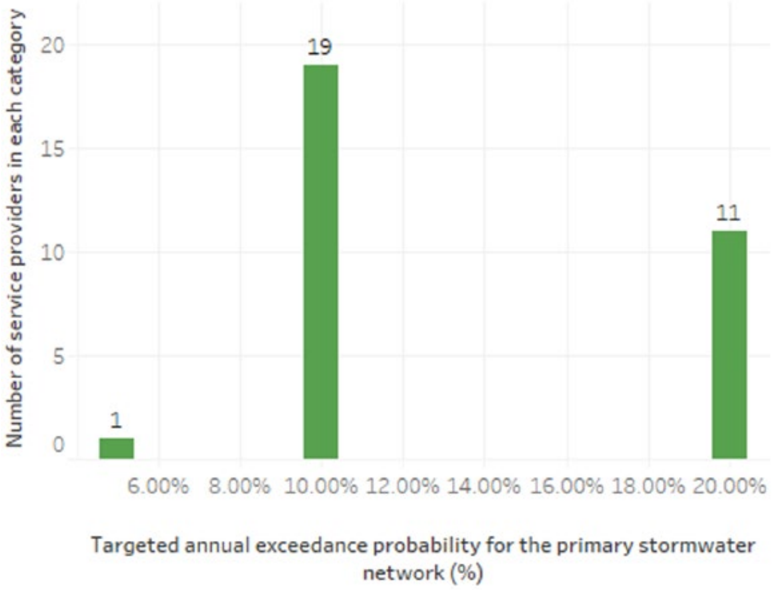
9.4 Flooding

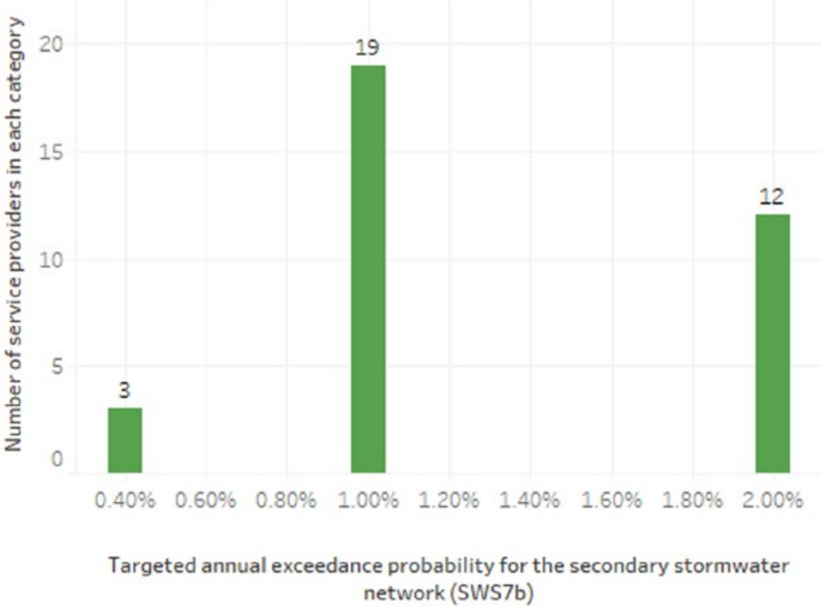
9.4.1 Flooding events

In total, 25 flooding events were recorded from rainwater exceeding the capacity of stormwater systems, affecting 35 habitable floors. Forty-five flooding events related to other causes were recorded, affecting a further 46 floors. This is a significant decrease from the previous year, when 204 flooding events were recorded. This improvement is unlikely to reflect the performance of the stormwater system, but is more likely due to fewer intense rainfall events.

A performance-based measure of stormwater systems' capacity is the level of protection they provide in flood events. The levels of service targeted when designing stormwater networks are shown in Figure 56.

Figure 56: Average annual exceedance probability targeted during stormwater network design





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Appendix I: Review participants' data quality

Service provider	Report reference	Data completeness	Average data confidence (on a scale of 1) highly reliable to 5, highly unreliable)	Audit status
Ashburton District Council	Ashburton	Mostly complete	2.12	WNZ audit complete
Watercare Services Ltd	Auckland	Mostly complete	1.88	WNZ audit complete
Auckland Council	Auckland Council	Partially complete	1.76	Audit queries not returned
Central Otago District Council	Central Otago	Mostly complete	1.72	WNZ audit complete
Christchurch City Council	Christchurch	Mostly complete	1.74	Onsite external audit
Clutha District Council	Clutha	Mostly complete	1.03	WNZ audit complete
Dunedin City Council	Dunedin	Mostly complete	1.85	WNZ audit complete
Gore District Council	Gore	Mostly complete	1.83	WNZ audit complete
Hamilton City Council	Hamilton	Mostly complete	1.56	Audit queries not returned
Hastings District Council	Hastings	Mostly complete	1.52	WNZ audit complete
Hauraki District Council	Hauraki	Mostly complete	1.80	WNZ audit complete
Horowhenua District Council	Horowhenua	Mostly complete	1.47	Audit queries not returned
Invercargill City Council	Invercargill	Mostly complete	1.53	WNZ audit complete
Kāpiti Coast District Council	Kāpiti Coast	Mostly complete	1.34	WNZ audit complete
Mackenzie District Council	Mackenzie	Mostly complete	1.31	Audit queries not returned
Manawatū District Council	Manawatū	Partially complete	1.89	Audit queries not returned
Marlborough District Council	Marlborough	Mostly complete	1.80	AECOM audit complete
Masterton District Council	Masterton	Mostly complete	1.42	WNZ audit complete
Napier City Council	Napier	Mostly complete	1.82	WNZ audit complete
New Plymouth District Council	New Plymouth	Mostly complete	1.80	AECOM audit complete
Palmerston North City Council	Palmerston North	Mostly complete	1.82	WNZ audit complete
Queenstown Lakes District Council	Queenstown-Lakes	Mostly complete	2.14	AECOM audit complete
Rangitikei District Council	Rangitikei	Mostly complete	2.27	WNZ audit complete
Rotorua District Council	Rotorua	Mostly complete	1.56	AECOM audit complete
Selwyn District Council	Selwyn	Mostly complete	2.51	Audit queries not returned

Service provider	Report reference	Data completeness	Average data confidence (on a scale of 1) highly reliable to 5, highly unreliable)	Audit status
South Waikato District Council	South Waikato	Mostly complete	1.80	AECOM partially audited
South Wairarapa District Council	South Wairarapa	Mostly complete	2.22	Audit queries not returned
Southland District Council	Southland	Mostly complete	2.51	WNZ audit complete
Stratford District Council	Stratford	Mostly complete	1.87	WNZ audit complete
Tararua District Council	Tararua	Partially complete	2.06	AECOM partially audited
Tasman District Council	Tasman	Mostly complete	1.55	WNZ audit complete
Taupō District Council	Taupō	Mostly complete	1.72	Audit queries not returned
Tauranga City Council	Tauranga	Mostly complete	1.54	AECOM audit complete
Thames - Coromandel District Council	Thames-Coromandel	Mostly complete	1.98	AECOM audit complete
Timaru District Council	Timaru	Mostly complete	1.47	WNZ audit complete
Waimakariri District Council	Waimakariri	Mostly complete	2.09	AECOM audit complete
Waipā District Council	Waipā	Mostly complete	2.01	WNZ audit complete
Wellington Water	Wellington Water	Mostly complete	2.06	Audit queries not returned
Western Bay of Plenty District Council	Western Bay of Plenty	Partially complete	2.04	Audit queries not returned
Whakatāne District Council	Whakatāne	Mostly complete	2.21	AWNZ audit complete
Whanganui District Council	Whanganui	Mostly complete	1.74	WNZ audit complete
Whangarei District Council	Whangarei	Mostly complete	1.59	WNZ audit complete

Appendix 2: Drinking water, wastewater and stormwater service providers not participating in the review

Council	Approx. Water and wastewater connections
Buller District Council	7,141
Carterton District Council	Unknown
Central Hawkes Bay District Council	Unknown
Far North District Council	21,266
Gisborne District Council	Unknown
Grey District Council	10,019
Hurunui District Council	Unknown
Kaikoura District Council	3,614
Kaipara District Council	4,600
Kawerau District Council	Unknown
Matamata-Piako District Council	Unknown
Nelson City Council	42,526
Ōpōtiki District Council	4,297
Ōtorohanga District Council	6,363
Ruapehu District Council	10,122
South Taranaki District Council	18,406
Waikato District Council	22,459
Waimate District Council	3,612
Wairoa District Council	3,977
Waitaki District Council	Unknown
Waitomo District Council	Unknown
Westland District Council	Unknown

Photograph acknowledgements

Ngā mihi nui to the photographers whose images have livened up our report.

- Richard Sutton of ESR for the photo in "Our people" of Panan and Phil from the ESR Groundwater Team, sampling for stygofauna and monitoring water chemistry at the Silverstream Reserve in Canterbury.
- Caitlin Robertson of Dunedin City Council for the photo in "Assets under management". At the Southern Water Treatment Plant a UV lamp exploded into pieces inside one UV reactor. Water Treatment Supervisor Ian Hamilton (pictured) had the clever idea to get the pieces out of the intact sleeve – by luxing it out! So here we are with a long pole, duct taped to the lux nozzle. Looks crazy but worked!
- Mel Mun of Asmuss Water Systems Ltd for the photo in "Public health and Environmental Protection" of Hamurana Springs Water
- Lesley Smith of Water New Zealand for the photo in "Customer focus" of her daughter Fern and friend Barnaby enjoying a water efficient bath.
- Ian Garside for two photos. One in "Economic sustainability" of a crane at the Pukekohe East Water Reservoir and one in "Reliability" which he calls 'Down the tube'.
- Andre Meier of Flexi Tanks NZ in "Resource efficiency" for this shot of two 500,000L water storage Flexi Tanks.