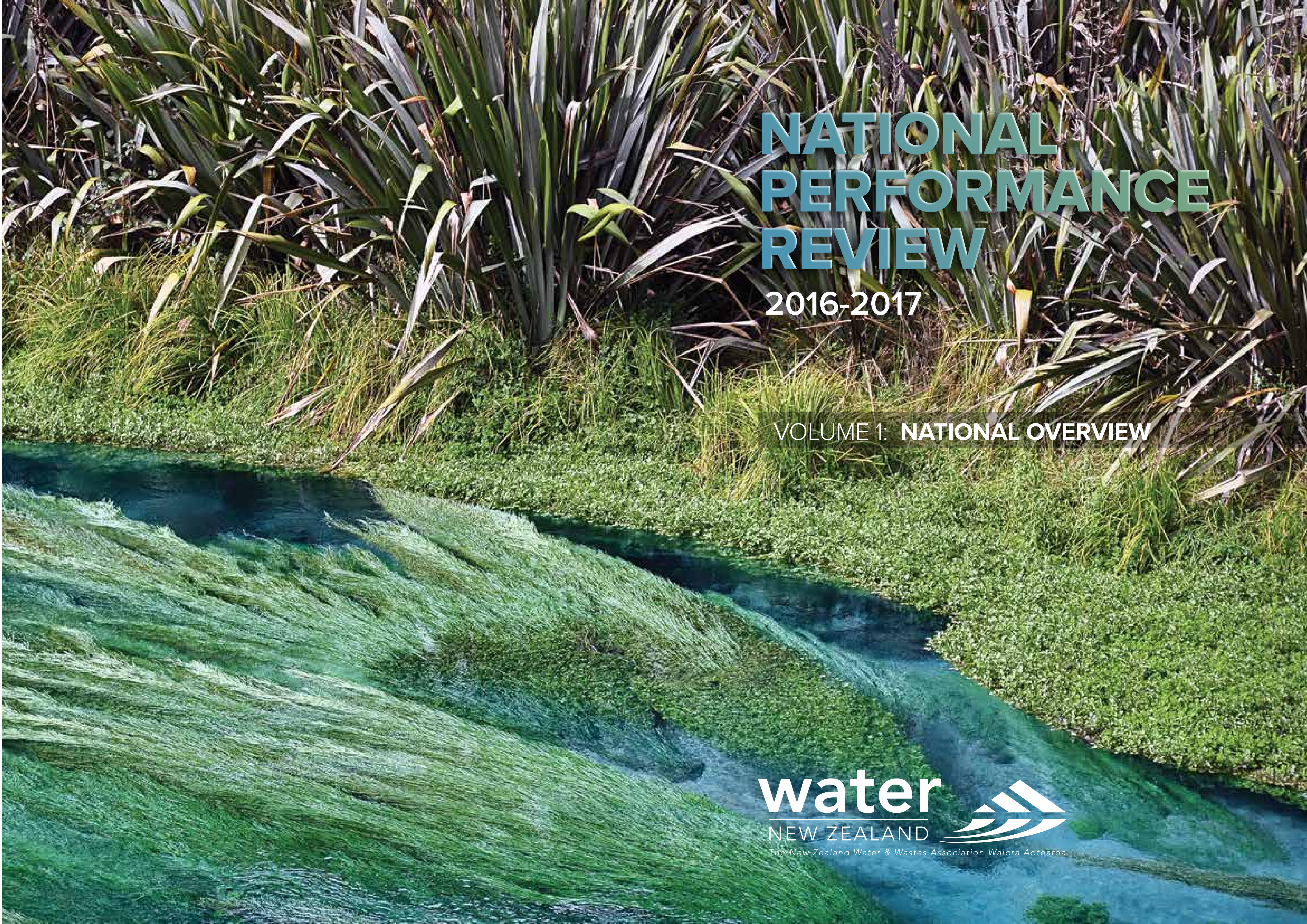

NATIONAL PERFORMANCE REVIEW

2016-2017

VOLUME 1: **NATIONAL OVERVIEW**

water
NEW ZEALAND
The New Zealand Water & Wastes Association Waiora Aotearoa

FURTHER INFORMATION ON THIS REPORT IS AVAILABLE FROM:
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MESSAGE FROM WATER NEW ZEALAND

New Zealand is at an interesting point in the delivery of 3 Waters services. The recent Havelock North Drinking Water Inquiry has exposed the shortcomings with some parts of the drinking water services provided by Councils. The Inquiry has recommended major changes to the way the sector operates. The Government has yet to respond to the report.

There is also a review being undertaken at present by the Department of Internal Affairs in various aspects of 3 Waters administration by Councils.

While it is expected that these two reviews may lead to changes in the way the sector operates going forward, the industry maintains an ongoing assessment of its performance – as reported in this annual performance review.

This Water New Zealand led review of the performance of Councils in the delivery of 3 waters services has the dual objectives of benchmarking Councils against each other, and identifying areas where there is room for improvement in service delivery. The Association frequently assists Councils to improve their levels of service by producing technical guidance material in areas where there are demonstrated shortcomings.

The survey reports Council performance against relevant international benchmarks, and against the Department of Internal Affairs Non-Financial Reporting Measures Rules.

The report does not always attempt to explain why Participants perform at different levels. It is primarily a report based on the evidence collected against the various benchmarks we assess. If Participants or the public wish us to provide further interpretation of the results they should contact Water New Zealand.

This report was compiled by Lesley Smith at Water New Zealand using data compiled by participants in the review. Auditing assistance was provided by Miles Wyatt of AECOM. Graphics in the report have been produced by Nina Vellaman of Bunkhouse design. Performance indicators contained in the review have been compiled with the our steering group, composed on the following participant representatives;

- Mike Schruer, Utilities Manager at Tasman District Council
- Steve Burton, General Manager City Waters at Tauranga City Council
- Jamie Cox, Engineering Manager at Wairoa District Council
- Ted Anderson, Group Manager Assets at South Waikato District Council
- Martyn Cole, Water & Wastewater Asset Manager at Kapiti Coast District Council
- Robert Blakemore, Chief Advisor Asset Management, Wellington Water

Our thanks to all involved for their contributions.

John Pfahlert

Chief Executive, Water New Zealand

EXECUTIVE SUMMARY

The National Performance Review (NPR) is an annual voluntary reporting initiative, benchmarking the provision of drinking water, wastewater and stormwater services.

Three water services (3 waters) in New Zealand are delivered by Territorial Authorities (TAs) and Council-Controlled Organisation (CCOs). Forty four of these, providing services in jurisdictions that cover approximately 90% of New Zealand's population, are covered by this report. The large number of entities involved in service provision creates both challenges and opportunities: avoiding the inefficiencies of reinvention, and learning from a diversity of approaches. The NPR aims to identify where such challenges and opportunities exist as a starting point for improving service delivery.

The report underscores the significance of the 3 Waters sector, both in protecting the public health and environment, and as an economic entity in its own right. Collectively, the sector was responsible for ensuring that the 550,000,000 cubic meters of drinking water delivered in 2016/17 was safe to drink and subsequently, that the environment was safeguarded from the 458,000,000 cubic meters of wastewater returned back into sewers, as well as ensuring communities were protected from flooding. The provision of these services was delivered by assets worth over $33 billion, with an annual expense bill of nearly $2 billion.

The National Performance Review is undertaken by Water New Zealand on behalf of the sector, who contribute knowledge and resources to enable its delivery. The 44 participants in this year's report have prioritised participation against a number of competing priorities, not least Long Term Plan development. The ongoing high levels of participation in the NPR is a demonstration of the sector's commitment to providing stakeholders with transparent information on sector performance, continuously improving the services they provide, and collaborating as a whole.

The report provides performance metrics related to the central purpose of drinking water, wastewater, and stormwater services, i.e. to protect public health and the environment, as well as other core considerations in delivering this goal; i.e. system reliability, resilience, customer focus, economic sustainability and resource use efficiency.

The National Performance Review has been run since 2007/08. Over this time, a number of ongoing themes have emerged, while others relate only to this year's report. Summarised here are key themes evident in 2016/17, as well as improvement opportunities and related initiatives underway in the sector.

Wet weather in 2016/17 had significant impacts for the performance of wastewater and stormwater systems.

2017 was the wettest autumn on record for parts of the North Island, and the preceding spring of 2016 was wetter than normal (NIWA). Unsurprisingly recorded sewage overflows and flooding events climbed accordingly. On average, sewage overflows related to wet-weather increased by 379% compared to the previous year. Flooding events recorded in 2016/17 increased by 62%, and the number of habitable floors affected by flooding rose by 155%.

The review contains information about design standards to protect against such events. Design capacity of sewers used to protect against wet weather overflows shows large variations (as high as a factor of 25 between different organisations), as does the modelled performance of the existing network. There are also gaps in knowledge, with only 19 of the 42 wastewater operators reporting design standards for their sewage capacity.

Stormwater design standards show similar knowledge gaps, but do employ more consistent design standards. There are, however inconsistencies and methodological issues in how the rainfall and runoff analyses that underpin stormwater system design are applied.

Water New Zealand is leading an initiative that aims to resolve these analytical issues over time. However, these issues could be resolved faster if National Rainfall and Runoff Guidelines were developed and used to support more consistent and robust infrastructure investment decisions. Central government funding would be needed for this.

The diversity of approaches to Inflow and infiltration and emergency management planning creates knowledge sharing opportunities.

Inflow and infiltration are terms used to describe the ways that stormwater and groundwater enter the wastewater system. Active programs are in place for over half of respondents to prevent inflow and infiltration, which in turn lowers costs, and prevents wastewater from overflowing into the environment. A broad range of strategies is being employed by different organisations, including targeted renewals programmes, and a variety of monitoring and inspection regimes and third party collaborations with property owners, building inspectors, and contractors.

78% of particpants have in place Emergency Management Plans. The nature and events planned for is, again, highly diverse. Events such as high water demand, pandemics and contaminated water, which may reasonably be expected to impact on all water supply operators, have only been addressed by a limited number of participants. A large majority of suppliers noted they were members of the Lifelines Forum, which may provide a vehicle for the sharing of plans.

The Water Services Managers Group, the Water Journal and annual Water Conference are all vehicles by which Water Services Managers regularly collaborate to share ideas. Addressing emergency management and inflow and infiltration through these forums provides an opportunity for participants to leap-frog their management through the learning experiences of others.

The absence of clear guidance is creating inconsistencies in the management of asset condition assessments and climate change management.

While condition assessment of pipelines and above ground assets is common place, such assessments are undertaken using a wide range of approaches, including using guidance supplied by NAMS, IPWEA and Water New Zealand, along with a range of Informal and in-house approaches.

Steps towards addressing this issue are being made. Water New Zealand has recently commissioned updates to the Pipe Inspection Manual. In addition, a decision support tool is being developed by the University of Canterbury Quake Centre to assist authorities in determining how to effectively apply the proliferation of existing, and not always consistent, advice.

Climate change considerations are included in planning documents for most organisations, but few have detailed projections for future climate conditions. Where these exist, there is a large variation in the time frames, metrics, and values being allowed for. For example Dunedin is anticipating a maximum sea level rise in the year 2090 of up to 1.6m, while in Ashburton, 50cm is being allowed for by 2100.

Most organisations sources of climate change information were generally not cited and where information sources were variable. It appears that while the Ministry for Environment have put out guidance related to climate change, there is an opportunity to raise awareness of that guidance as well as tailor the information so that it is fit for the purpose of informing 3 Waters related decision making. The Deep South Climate Challenge also presents opportunities to work with scientists on decision making guidance to address these gaps.

Actual capital expenditure trails budgeted expenditure, with participants spending a median of 76% of their budgeted capital.

This continues previous years' trends, with only 69% of budgeted capital expenditure being spent in 2015/16, and 64% in 2014/15.

Internal resources for project delivery was the number one barrier preventing participants delivering their capital works programmes. Some participants commented this related to difficulties recruiting suitably qualified staff, devoting time to on-site contract management, and having staff time to focus on project management.

While the development of a workforce capability strategy has been initiated by Water New Zealand, it is only intending to address operational staff capability. Beyond that, addressing the capacity and capability constraints that affect the delivery of capital works will also be important. This would require cross-sectoral collaboration with the engineering, trades and construction sectors.

The regulatory regime for 3 Waters services could be sharpened.

There is a high degree of variability in the way stormwater systems and wastewater treatment plants are consented. A number of wastewater treatment plant consents have expired and the low number of non-compliances reported for both systems suggests that either consent conditions are lax, or enforcement of consents is not wide spread.

In a year of wet weather, with stories of beach closures and flooded homes dominating news reports, no stormwater consent non-compliances were reported to the National Performance Review. Wastewater treatment consent breaches were also low, with only seven infringement notices and one enforcement order issued across all 42 wastewater operators.

The low number of stormwater consents is partially explained by the patchy coverage of stormwater consents. Eight participants' operating stormwater systems did not have any stormwater discharge consents. For 21 participants who did, the extent of their stormwater consents varied: some covered all discharges, while some only covered a small number of selected discharges.

Twenty of 178 wastewater treatment plants in the report were operating on expired effluent discharge consents. Most of which expired in the last three years, however one as far back as 1999.

Water New Zealand is pursuing a number of opportunities to achieve greater consistency in consenting and compliance practices, both to protect the environment and to reduce the effort and costs of administering consents. The National Policy Statement on Freshwater Management is likely to result in tougher standards for the sector through regional planning processes. It is important that issues with consenting and compliance practices are improved to enable the sector to meet these tougher standards in a timely and cost-effective way.

There is an ongoing need to improve sector data.

There has been a step change in the collection of customer focused data, best exemplified by the number of organisations supplying data for attending and resolving system faults. This has increased from 72.81% in 2014/15, to 92.86% in 2015/16, and 93.75% in 2016/17. However, large variations in data between organisations, and year on year, suggest that systems for collecting customer data are continuing to mature. For example, the average time taken to resolve non-urgent water supply issues varied by up to 25 hours compared with the previous year.

Another indication that data quality may need improvement is the lack of trends between apparently related variables. For example, there is no correlation between water supply interruption data, and either water supply pipeline age or water pipeline condition. It is unlikely that no such relationship exists between these two factors, suggesting improved data sources and further granularity in data sets are needed for meaningful analysis of pipeline performance.

National Meta Data Standards for 3 Waters assets have been drafted, and the University of Christchurch Quake Centre is attempting to refine these through a national pipe database pilot. The project aims to compile pipe data from six case study councils.

CONTENTS

TABLES

FIGURES

1 ABOUT THE NATIONAL PERFORMANCE REVIEW

The National Performance Review (NPR) is an annual benchmarking exercise of drinking water, wastewater, and stormwater (collectively referred to as the 3 Waters) provision in New Zealand. The exercise provides comparative performance information to:

a) assist water managers identify improvement opportunities;
b) provide a transparent snapshot of sector performance; and
c) reduce the number of requests for information to councils.

New Zealand's 3 Water services are provided by councils and council-controlled organisations. These organisations have voluntarily provided data and finances to produce the NPR since 2008.

The NPR is co-ordinated by Water New Zealand, an independent not-for-profit organisation representing water professionals and organisations. Development of the NPR is overseen by a project advisory group of representatives from participating entities. Water New Zealand Special Interest Groups, Water Services Managers Group, and the Water Utilities Association are used as vehicles for delivering industry-wide improvement initiatives, which are informed by the outputs of this report.

Volume 1 of the Report contains a snapshot of the status of the 3 Waters sector as a whole. Volume 2 provides comparative performance information for each of the Report participants. Soft copies of the Report, associated documents, and an online interactive data tool are available at: http://www.waternz.org.nz/NationalPerformanceReview

Figure 1: Aspects of 3 Waters service provision addressed by the NPR

The Report covers the core elements of 3 Waters service provision, as shown in Figure 1. Exceptions are drinking and freshwater quality issues, which are addressed in the Annual Report on Drinking Water Quality (Ministry of Health, 2016) and the freshwater chapter of Environment Aotearoa 2015 (Ministry for the Environment, 2015) respectively.

New Zealand data may be compared with international benchmarks using the World Banks IBNET (International Benchmarking Network) database, accessed online at: https://database.ib-net.org/Default.aspx

2 INTERPRETING INFORMATION IN THE REPORT

The Report covers data for the jurisdictions shown in Figure 2. Unless stated otherwise, services are delivered by territorial councils, and participants are referred to as the jurisdiction they service. Exceptions are:

- **Auckland:** Stormwater services are provided by Auckland Council, which is referred to as such in this report. Water and wastewater services are provided by Watercare (a council-owned CCO), which is referred to as "Auckland" in the report.
- **Wellington:** Water Management in Wellington is undertaken by Wellington Water on behalf of Upper Hutt City, Lower Hutt City, Porirua City, Wellington City, and Greater Wellington Regional Councils, whose performance is addressed separately in this report. The Greater Wellington Regional Council provides bulk water services to each of the other Councils, and is referred to as Wellington Region.
- **Kaipara District Council:** data for drinking water, wastewater and stormwater systems has been provided for Dargaville only.

Participants have been classified as small, medium, or large, based on the cumulative number of properties they service. A list of participant full names and classifications is shown in Appendix I.

Drinking water, wastewater, and stormwater system figures are colour coded as shown.

Definitions for data collection points are available online. Cross-references to the definition guidelines are provided in reported figures and tables using indicator codes delineated with square brackets. For example, the reference [WSB4] can be used to cross-check the performance indicator for water-serviced properties within the definition guidelines.

Data quality is an utmost priority in the review compilation. Water New Zealand endeavours to ensure that data is as correct as possible by following the review process shown in Appendix II. AECOM conducts independent audits to support this process, and its report is available online.

Figure 2: Jurisdictions covered by the NPR

3 SECTOR OVERVIEW

3.1 Assets under management

The report covers assets with a total value of over $33 billion. The value of assets by type is shown in Table 1.

Figure 4 shows the value of assets by participant region, illustrating that the majority of asset value is clustered in Auckland, Wellington, and Christchurch.

Table 1: Value of assets covered by the report

Asset class	Value
Water treatment facility value [WSF23a]	$2,013,043,728
Other water supply asset value [WSF23b]	$8,689,704,039
Drinking water asset value	**$10,702,747,766**
Wastewater facility value [WWF24a]	$2,867,838,717
Other wastewater asset value [WWF24b]	$10,937,881,357
Wastewater asset value	**$13,805,720,074**
Stormwater asset value [SWF20]	**$9,485,752,480**
TOTAL	***$33,994,220,320***

3.2 Workforce

Participants have 2,139 full-time equivalent staff on their internal payrolls, and employ another 822 contractors, who are exclusively involved in the delivery of 3 waters services. A further 211 full time equivalent vacancies exist at participant workplaces, which is nearly 10% of the existing workforce.

3.3 Health and Safety

In 2016/17, participants reported 1,344 near misses, and had 250 days of lost-time injuries. This was a 22% increase in near-miss reporting, and a slight decline in the average number of lost-time injuries recorded in the previous year.

Figure 3: Average number of near-misses reported and days work of lost-time injuries reported per staff member (internal and contracted)

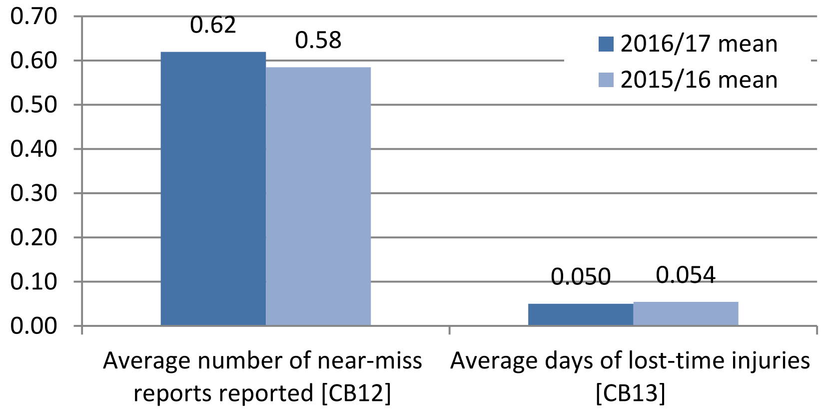
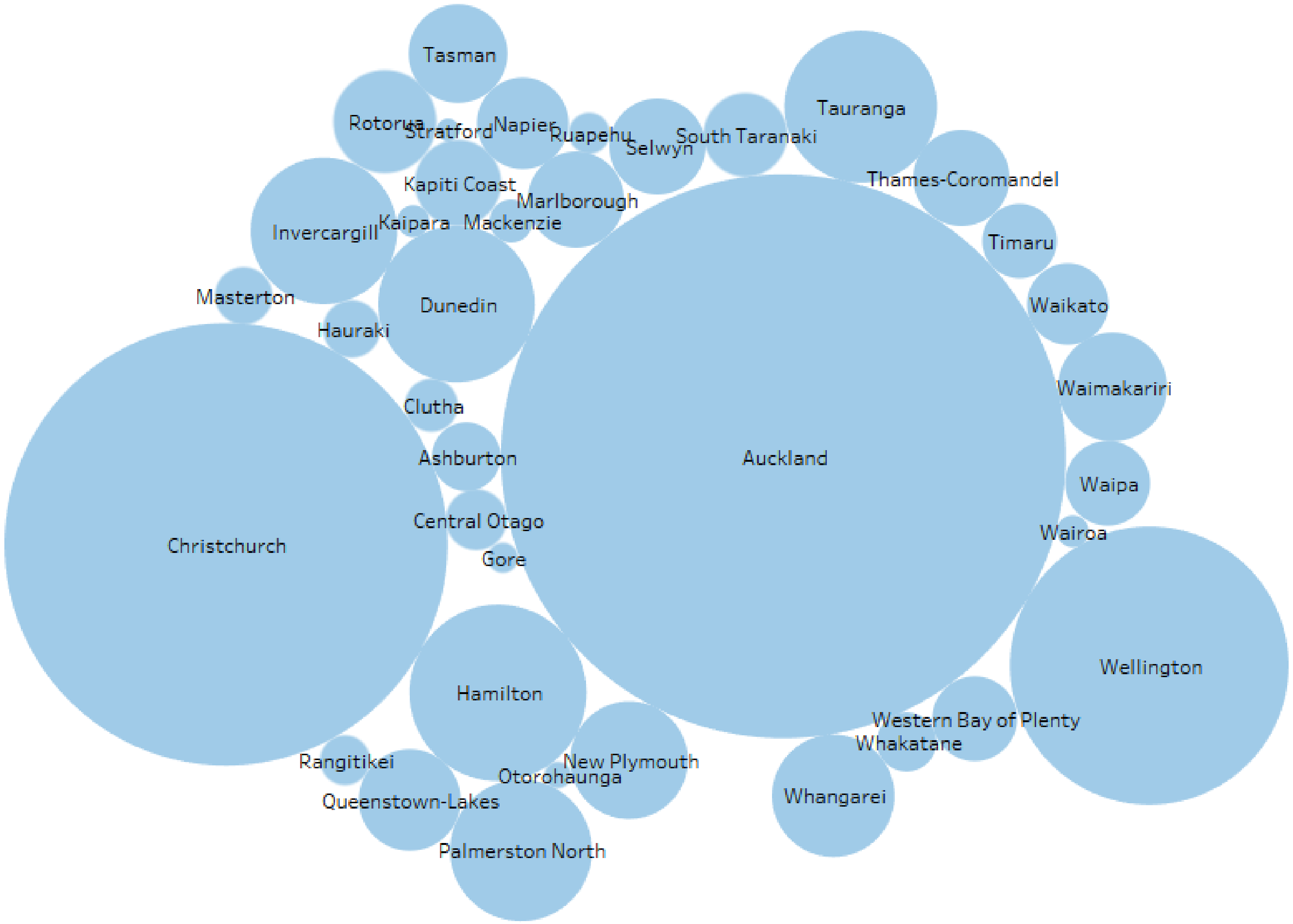


Figure 4: Total value of 3 Water assets by participant[1]

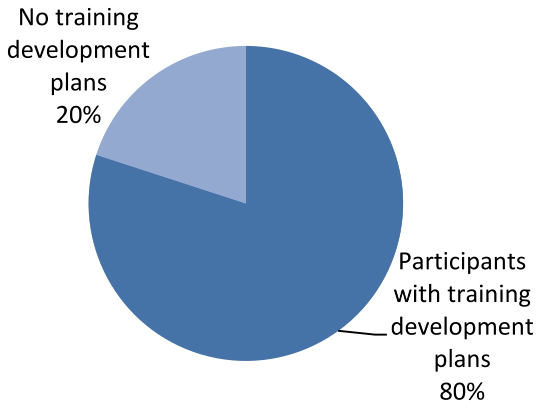


[1] Assets in Auckland have been grouped to show the combined value of Auckland Council's stormwater assets with wastewater and drinking water assets managed by Watercare. Assets in Wellington City Council, Greater Wellington Regional Council, Porirua, Lower Hutt and Upper Hutt have been grouped to show assets managed by Wellington Water.

3.4 Staff Training

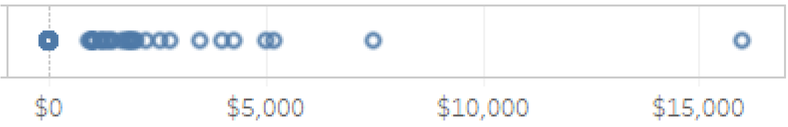
The majority of participants (78%) have formal training and development plans in place for the majority of their 3 Water staff.

Figure 5: Proportion of participants who have training development plans in place for the majority of 3 Water staff [CB18a]



Thirty three authorities provided information on their training budgets. For those who responded, the median training budget was $1,797. A box and whisker plot showing the spread of responses is shown in Figure 6. A histogram comparing the budgets at individual councils is provided in Volume 2 of the Report.

Figure 6: Annual training budget per full time 3 Waters employee [CB18b]



3.5 Participant Characteristics

Service area characteristics impact on participant performance. Some of these include connection density, tourist numbers, and service coverage. A full set of this data is published in Volume 2, and is important information to consider when comparing performance across councils. Other factors such as climate, topography and soil type can also have large performance impacts, however is not included in this report.

Figure 7: Proportion of people in participant jurisdictions connected to water and wastewater networks

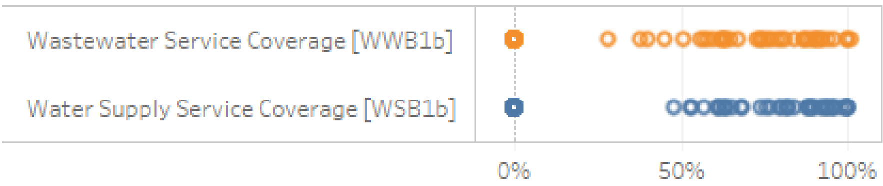
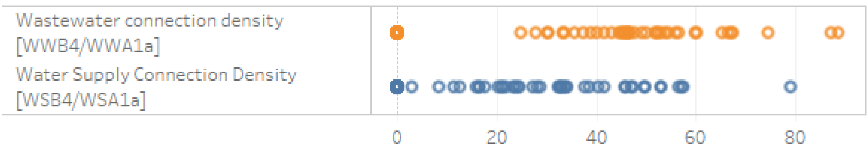
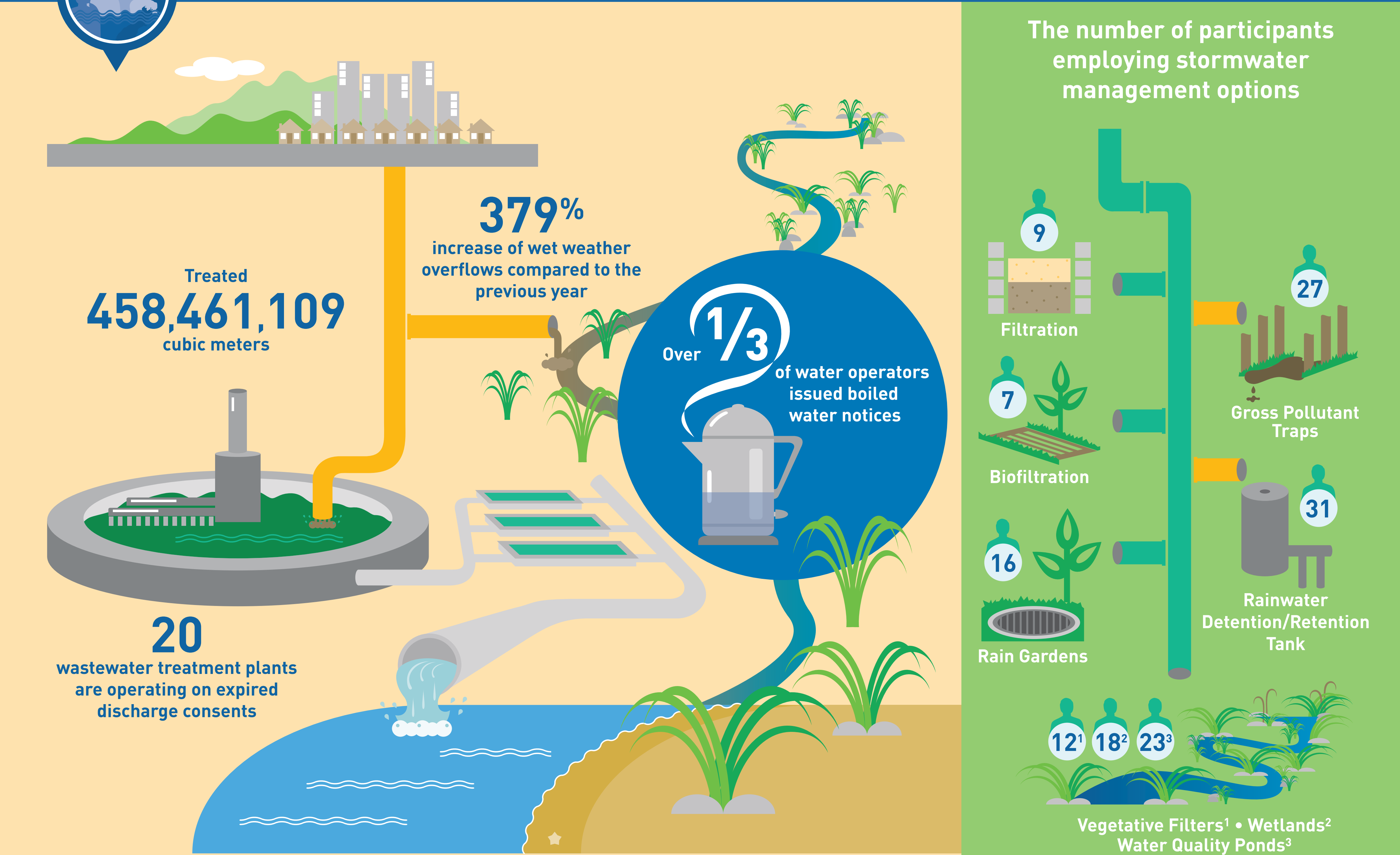


Figure 8: Number of properties connected per km of pipe



PUBLIC HEALTH AND ENVIRONMENTAL PROTECTION



Figures relate to National Performance Review participants supplying data, for the year 2016/17 financial year

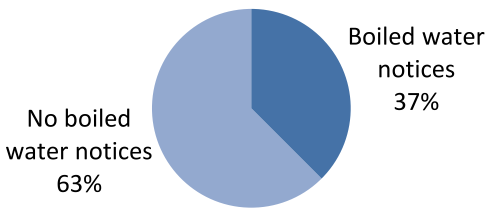
4 PUBLIC HEALTH AND ENVIRONMENTAL PROTECTION

4.1 Drinking water quality

For comprehensive information on the drinking water quality of each public water supply refer to the Annual Report on Drinking Water Quality (Ministry of Health, 2017).

Boil water notices were issued by over one third of the 31 participants who responded to this question.

Figure 9: Issuing of boiled water notices in 2016-17



4.2 Wastewater treatment

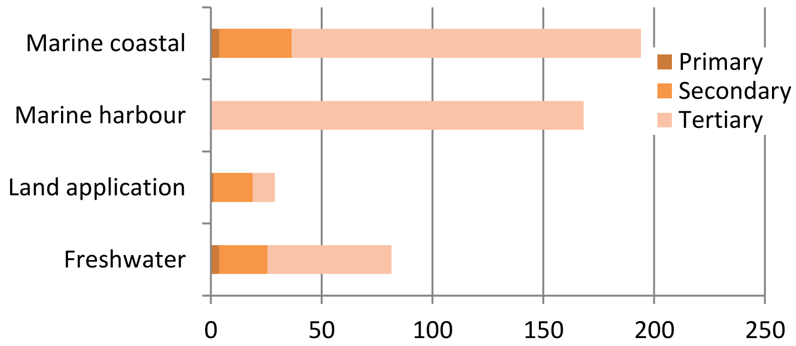
4.2.1 Wastewater treatment plants

Wastewater treatment plants are operated to minimise the impacts of sewage on receiving environments. An interactive map with details of 262 treatment plants in New Zealand is available at: https://www.waternz.org.nz/WWTPInventory

Volumes of treated sewage being discharged shown in Figure 10, have been broadly classified as;

- **Primary:** Mechanical processes to remove gross, suspended and floating solids from raw wastewater.
- **Secondary:** Biological processes to remove additional organic matter that escapes primary treatment. It typically includes additional settling to remove suspended solids created by the biological process.
- **Tertiary:** Any process that is additional to those described above. Typically used to remove phosphorous or nitrogen. Disinfection is a tertiary treatment process.

Figure 10: Receiving environment for wastewater discharges by volume (million m^3)



4.2.2 Wastewater treatment plant consents

Wastewater treatment plants require consents for discharging treated effluent. Figure 11 shows that effluent discharge consents were expired for 20 of the 178 wastewater treatment plants that provided this information in 2016-17. The majority of participants noted that, where consents were expired, applications for new consents were lodged with the regional council. One plant with an expired consent noted that this was operating under an exemption.

Figure 12 shows data for 262 wastewater treatment plants (some of which provided data in previous years). Fifty seven percent of these hold consents for air (and related odour) emissions, and 24% for sludge (the solid component of sewage).

Figure 11: Consent expiry dates for wastewater treatment plant effluent discharges

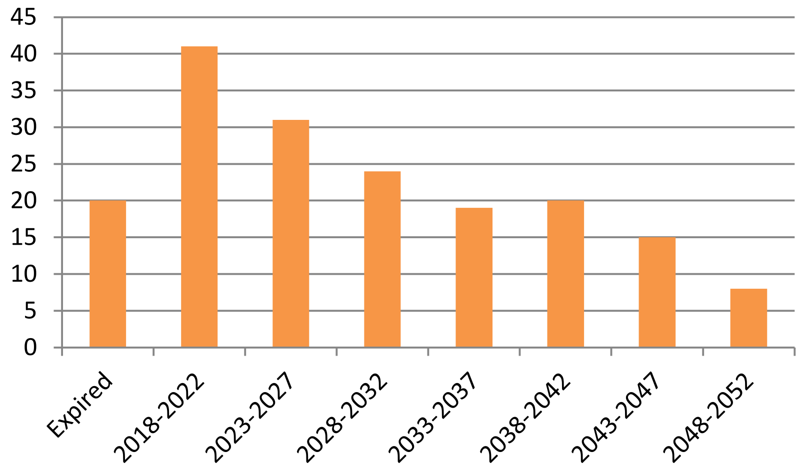
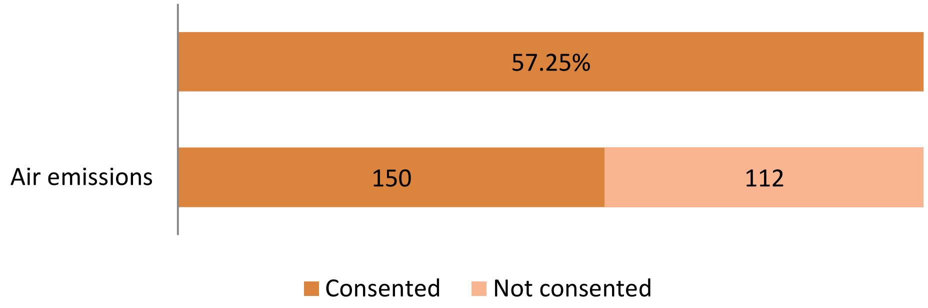
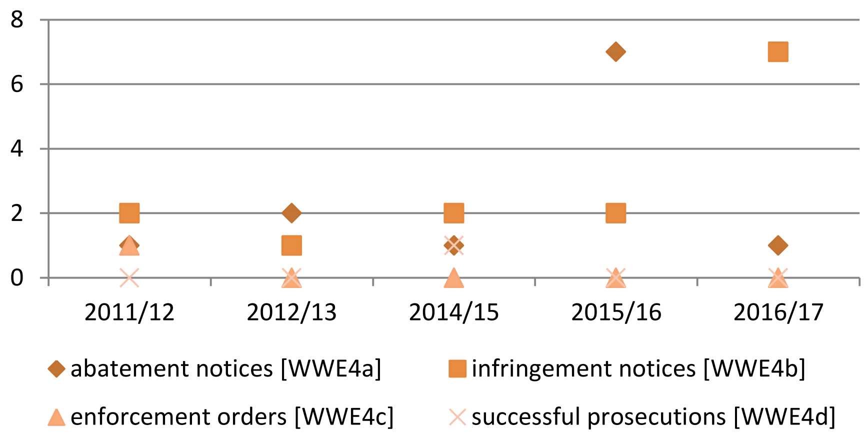


Figure 12: Discharge consent requirements for air and sludge from wastewater treatment plants



Participants recorded very few consent non-compliances. In 2016-17 only one abatement notice was received by Wairoa, and four participants received a total of seven infringement notices.

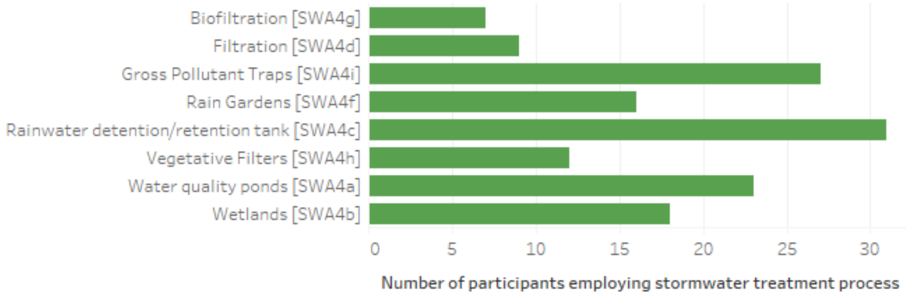
Figure 13: Wastewater consent non-compliances by type



4.3 Stormwater discharges

4.3.1 Stormwater treatment

Figure 14: Number of participants employing stormwater treatment



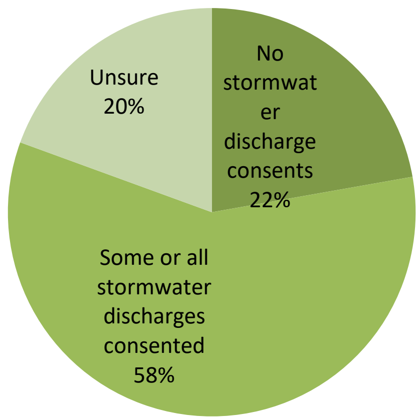
Stormwater discharge consents

Participants were asked to provide information on their stormwater discharges and whether these were consented. Eight participants, operating stormwater systems, did not have stormwater discharge consents. Seven stormwater system operators did not supply information. For those with stormwater discharge consents, further detail on these is listed in Table 2.

Confusion around the definition of "stormwater discharge consent" was reported during the review, meaning not all results were consistently reported. The following definition clarifications were provided midway through the reporting process:

- **Stormwater discharges:** refer to outfalls from stormwater systems controlled by the organisation where stormwater is discharged into receiving water bodies or to land.
- **Number of stormwater discharges with resource consents:** the number of resource consents issued by the regional council to the organisation for stormwater discharges managed by the organisation.

Figure 15: Percentage of participants with stormwater discharge consents



Despite 20 participants having discharge consents, no consent non-compliances have been reported to the National Performance Review in the last two years. The last time consent non-compliance was recorded was in 2014-15.

Table 2: Stormwater discharges and discharge consents

Participant	Stormwater discharge and consents
Auckland Council	19,919 stormwater outlets with 2,400 discharge consents.
Christchurch	5,206 discharges all covered by discharge consents.
Dunedin	734 stormwater outlet points, and 10 consents.
Hamilton	All stormwater discharges are consented via three regional stormwater consents, however there is no record of the number of individual discharge points. The majority of discharges are consented via Hamilton City Council's Citywide Comprehensive Stormwater Discharge Consent. Water and wastewater treatment plants have their own individual discharge consents.
Hauraki	Holds four separate discharge consents for their 20 discharges.
Invercargill	147 discharges to freshwater all covered by discharge consents.
Kapiti	1 discharge consent, covering 101 stormwater discharges.
Mackenzie	7 stormwater discharge consents, and 11 stormwater discharges.
Napier	5 stormwater discharge consents, and 14 stormwater discharges.
New Plymouth	Does not measure the number of stormwater discharges, however has two consents: one to Waiongana Stream, and one to the Waitaha Stream and its various unnamed tributaries.
Palmerston North	274 stormwater discharges, and 9 stormwater discharge consents.
Stratford	2 stormwater discharge consents, and 9 stormwater discharges.
Tasman	The council has 114 stormwater discharges related to 15 Urban Drainage Areas (UDA's) in Tasman District Council. None of the UDA's has a discharge consent, but application for these discharge consents is proposed within the next three years. The Council does hold 9 stormwater discharge consents, most of these are isolated discharge consents which were required in relation to stormwater upgrades or private subdivisions, and which were then made public assets to maintain.
Tauranga	2,590 stormwater discharge points, covered by 3 comprehensive resource consents.
Timaru	235 soakage pits and 177 outfalls, however only one consent related to a discharge from a private subdivision.
Waimakariri	Estimated 300 discharges to surface water bodies (does not include discharges to ground), based on known discharges in Rangiora and extrapolated to urban schemes. There are currently 62 separate stormwater discharge consents, however It is anticipated that some of these consents will get superseded by network discharge consents for the district five main urban areas.
Waipa	The number of individual stormwater discharges is known, but all are covered by five comprehensive stormwater consents. Two sites in Cambridge, and two in Te Awamutu are monitored for resource consent purposes.
Wairoa	Wairoa township has 74 discharges, all covered by discharge consents.
Wellington	243 stormwater discharges with resource consents in the primary stormwater network, all of which are discharges to the coast, and 2,200 stormwater outlets overall.
Whakatane	43 stormwater discharges all consented.

4.4 Wastewater overflows

Data is collected recording the instances where untreated sewage spills, surcharges, discharges, or otherwise overflows from the wastewater network into the external environment, against the following two categories:

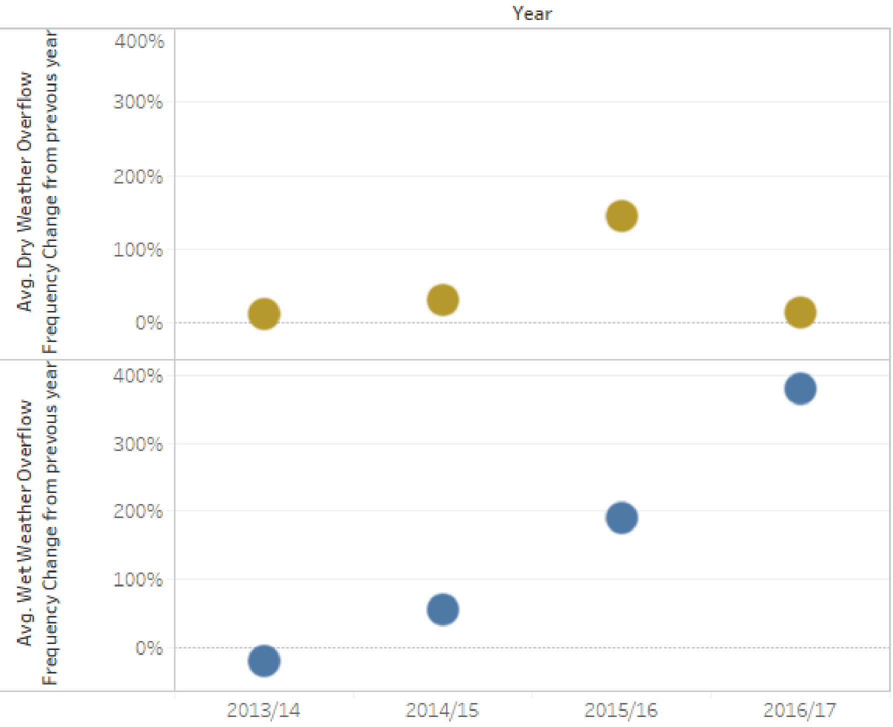
- **Dry-weather overflows** which result from events such as blockages or extended power outages, and may occur at pump stations, manholes, etc.
- **Wet-weather overflows** which typically result from excessive stormwater infiltration, and may be permitted by network discharge consents. This includes overflows (both contained and uncontained) from pump stations, pipes, manholes, and designed overflow structures as a result of wet weather events.

Figure 16 shows the change in the number of wet and dry-weather overflows, averaged across participants where consecutive years data exists. Dry-weather overflows have declined, from a 2015/16 peak, however the number of wet-weather events has been gradually increasing. This may reflect that in the past some organisations have not disaggregated overflows related to wet and dry weather, instead recording all overflows as dry weather. However it is likely that wet-weather overflow increases also reflect that spring 2016 was wetter than normal, and that 2017 was the wettest autumn on record for parts of the North Island (NIWA).

Comparative performance information of wet and dry-weather overflows for all participants who provided data is shown in Volume 2.

Six participants were unable to provide data on the incidence of wet weather overflows from their systems. Only three were unable to provide data on dry-weather overflows. The higher incidence of dry-weather overflow recording is likely to be because dry-weather overflow reporting is a mandatory reporting requirement of the Non-Financial Performance Measure Rules (Department of Internal Affairs, 2013).

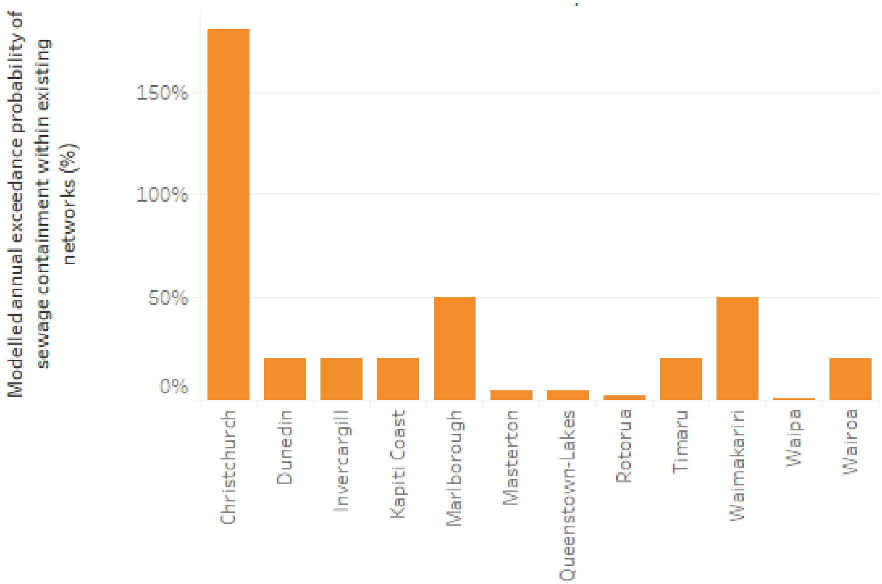
Figure 16: Average changes in overflow frequency per 1,000 properties



The ability of the wastewater network to prevent overflows can be determined using hydraulic models. The modelled annual exceedance probability (AEP) of a sewer overflow provides a system performance indicator that is independent of rainfall in any given year. Figure 17 shows supplied information for the twelve participants who provided information on design standards using the AEP metric.

Christchurch noted that the worst site from their wet-weather flow model would see an overflow occurrence of 2.4 times per year, although the actual 15 years of record suggests a frequency of 1.8 times per year is more likely.

Figure 17: Modelled annual exceedance probability of sewage containment within existing wastewater systems



Auckland's older central city combined sewer and stormwater networks were designed to have more frequent discharges in response to rain events. Watercare did not provide data for this metric however noted its network discharge consent requires that the discharge frequency of wet-weather overflows averages no more than two spills per year at engineered overflow points, equivalent to a 200% AEP. Where this containment standard cannot be reasonably achieved, the consent allows for the best practicable option. An additional requirement in the central interceptor catchment discharge consent requires an 80% reduction in predicted wet-weather overflow volumes by 2030.

The four councils under control of Wellington Water did not supply data, however noted that, based on the model and flow monitoring data, the system would contain three to six months overflows, equivalent to an AEP of between 200 and 400%. Wellington Water noted it intends to gather data to verify these figures over the next few years.

4.4.1 Sewage containment standards

Wastewater systems are designed to contain sewage. Participants were asked to provide design standards for the percentage probability that a wet-weather event will cause sewage to overflow from the wastewater system in any given year (referred to as the annual exceedance probability (AEP).

The thirteen participants who provided design standards using this metric are shown in Figure 18. A further six participants stated that their sewer design standards used a multiple of annual dry weather flows, rather than annual exceedance probability. Design standards for these councils are shown in Figure 19. Eighteen participants did not supply any information on their sewer design standards.

The four participants under control of Wellington Water did not supply a design standard, however noted regional standards are in place.

Hamilton's new sewers are designed using an allowance for infiltration of 2,250 litres per hectare per day and ingress of 16,500 litres per hectare per day.

Christchurch noted its design standard relates to an application for wet-weather overflow consent variation currently before Environment Canterbury.

Watercare noted that the design standard for Auckland shown here applies to local networks only. Different types of sewer systems, such as gravity and low pressure systems have different wet weather allowances.

Figure 18: Annual exceedance probability design standards for new sewers

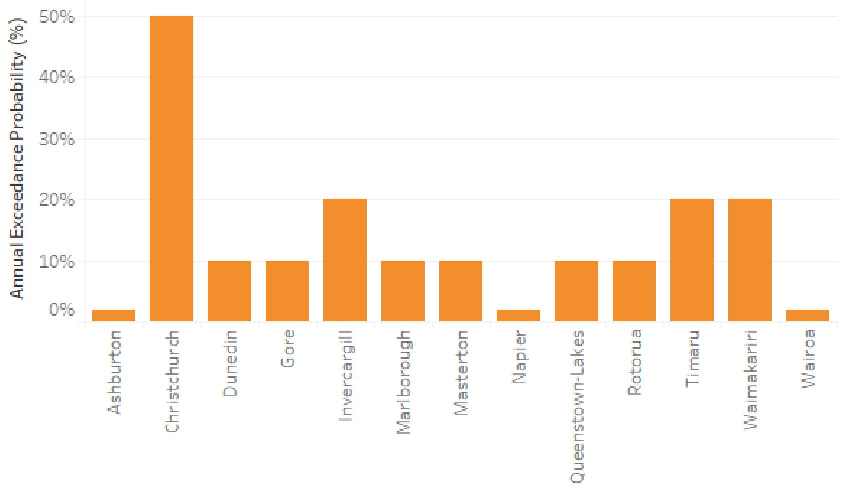
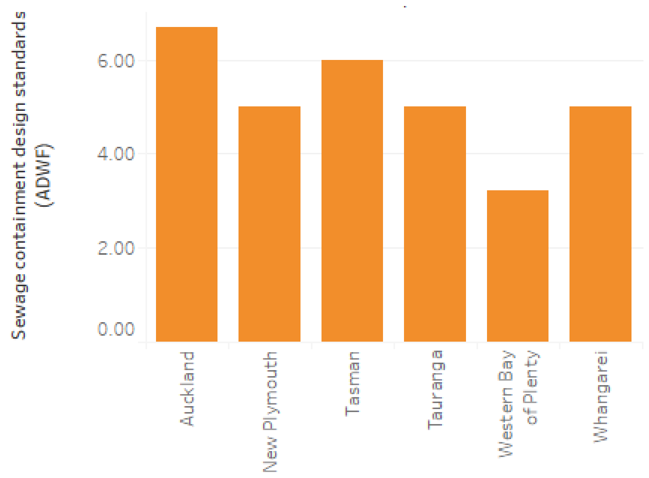


Figure 19: Average Wet to Dry Weather Flow ratio standards for new sewers



CUSTOMER FOCUS

COMPLAINTS

WATER

Continuity	Flow or pressure	Clarity	Taste	Odour
3,904	3,194	2,742	604	160

WASTEWATER

Faults	Blockages	Odour
7,378	4,698	1,100

STORMWATER

Faults	Blockages
3,368	2,845

ATTENDANCE RESOLUTION

Percentage of participants keeping a record of data

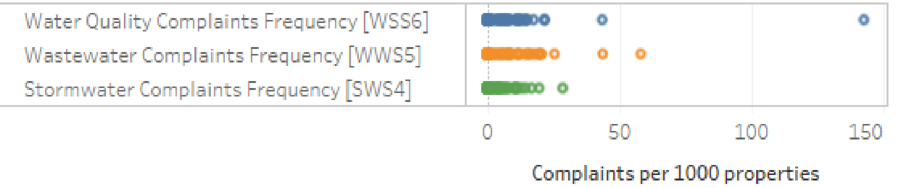
Year	Attendance	Resolution
2014 / 15	74.56%	71.05%
2015 / 16	93.45%	92.26%
2016 / 17	93.75%	93.75%

Figures relate to National Performance Review participants supplying data, for the year 2016/17 financial year

5.1 Customer complaints

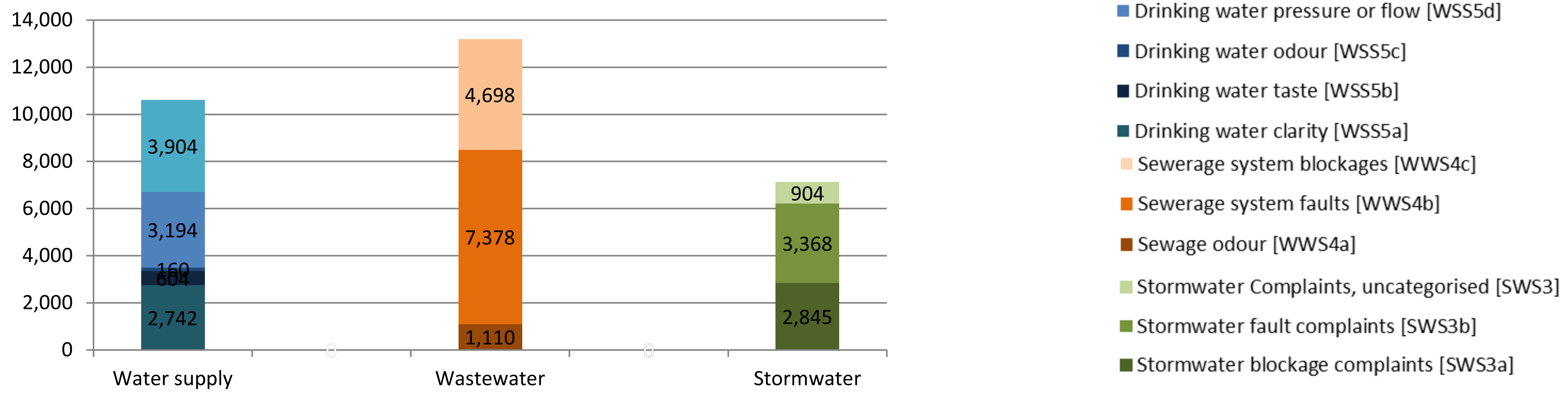
Nearly all participants supplied data for complaints recorded in relation to their 3 water's networks (with the exception of Ruapehu, which did not have complaints data for its wastewater network and Otorohanga, which did not have data for stormwater and wastewater networks). This is a marked improvement since 2013/14 when the Non-Financial Performance Measure Rules mandated complaint reporting for the first time, and data was missing for 8 percent of complaints metrics.

Figure 20: Complaints recorded per 1000 properties



The frequency of complaints per 1,000 properties is shown as a range, rather than per participant, as it is a misleading measure when used for comparative purposes. This is because high complaint volumes often reflect mature complaint recording systems, rather than high levels of customer dissatisfaction. Figure 21 shows complaints recorded by categories required by the Non-Financial Performance Measure Rules (Department of Internal Affairs, 2013).

Figure 21: Total complaints reported across drinking water, wastewater and stormwater systems by complaint type

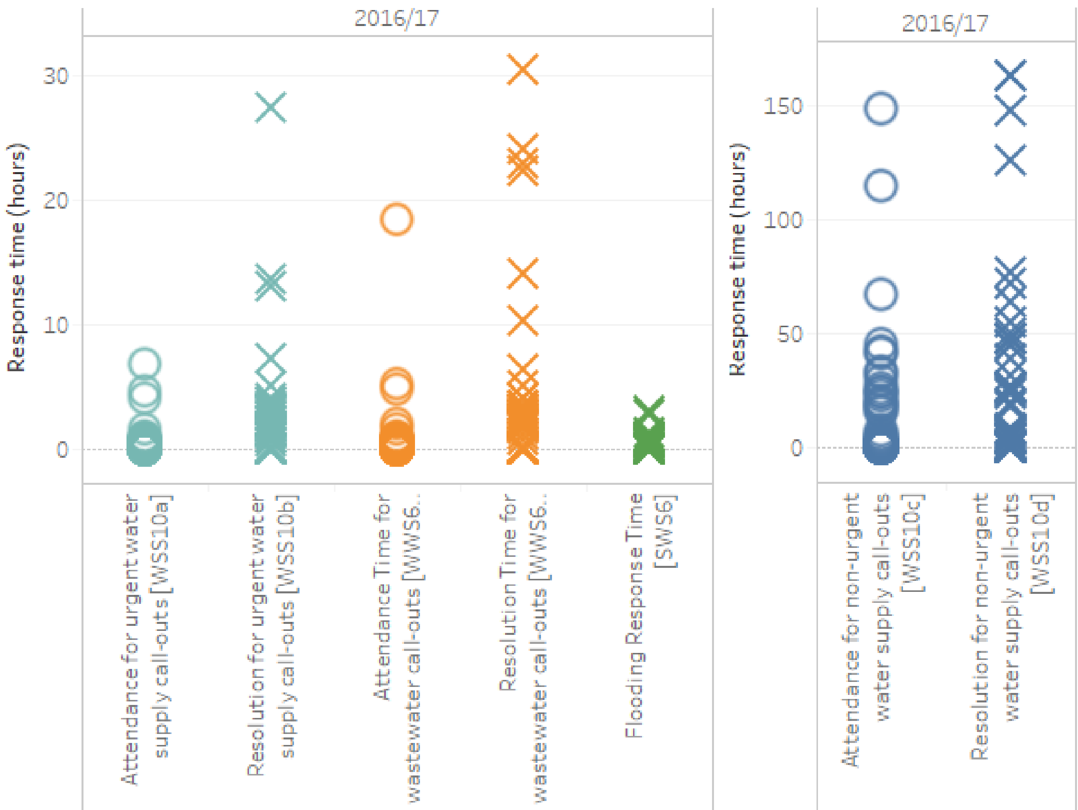


5.2 Attendance and resolution times for system faults

This section provides information on participants median time taken to attend and respond to call-outs in relation to urgent and non-urgent water supply faults, wastewater faults, and to attend flooding events. Further information showing average response and attendance times of individual participants' networks is provided in Volume 2.

Flood event attendance data was only provided by half of the participants (21 of 42 operating stormwater systems), despite being a mandatory reporting requirement for the Non-Financial Performance Measure Rules (Department of Internal Affairs, 2013). Reasons for this may be that organisations had no flooding in their districts, or that the responsibility for responding to flooding events within the participant jurisdiction lies with civil defence or the fire service.

Figure 22: Response times for attending and resolving callouts



The number of participants supplying data for attending and resolving water and wastewater supply faults in Figure 24, shows a continually improving trend since the Non-Financial Performance Measure Rules (Department of Internal Affairs, 2013) introduced mandatory reporting.

Response and attendance times reported show large variations year on year. This may reflect that attendance and response time recording systems are continuing to mature. Alternatively, response times may be sensitive to large outliers that relate to one off events.

Figure 24: Data availability for response and attendance times

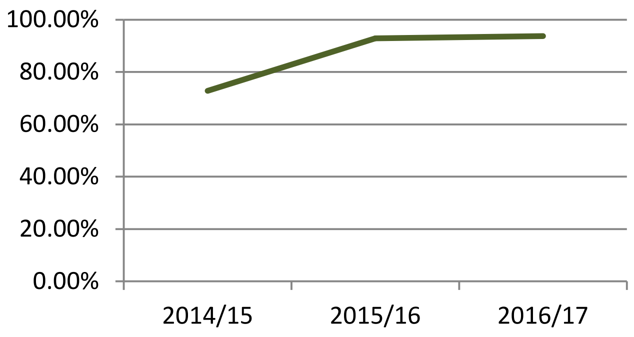
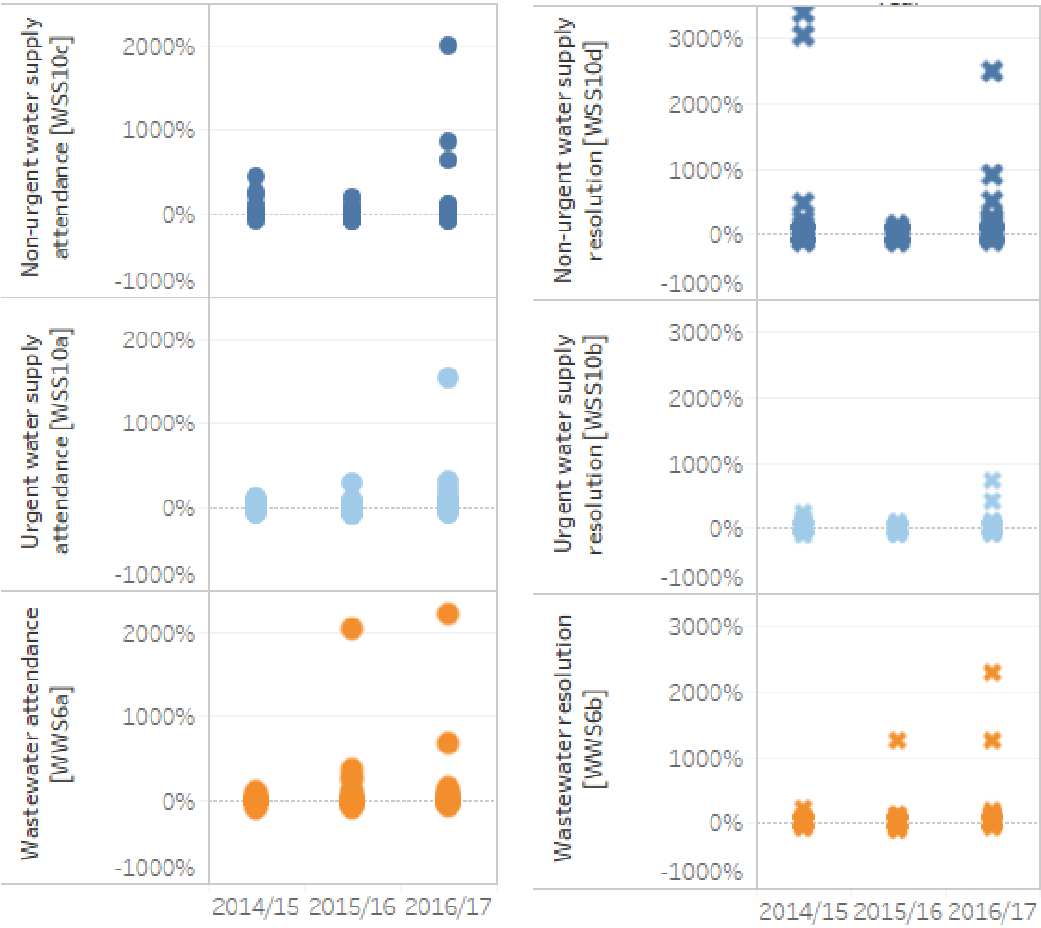


Figure 23 : Percentage change of response times from previous year



5.3 Charges

5.3.1 Residential charging approaches

A comparison of water, wastewater and stormwater charges per participant is shown in Volume 2. Further detail on residential water charging approaches, for all councils in New Zealand can be found in Water Tariffs in New Zealand (A Garnett, 2018).

Residential charges are typically levied using council rates bills, either through uniform annual general charges, general rates, or targeted rates. Charge types in use for participants that responded are shown in Figure 25. Other approaches listed for charging for water were:

- Watercare: use volumetric charges of $1.444/m^3.
- Kapiti: recovers 50% of revenue from a fixed water charge and 50% from a volumetric charge.
- Tauranga; charges a volumetric fee and an annual fee that is divided by four and included in the quarterly water bill.

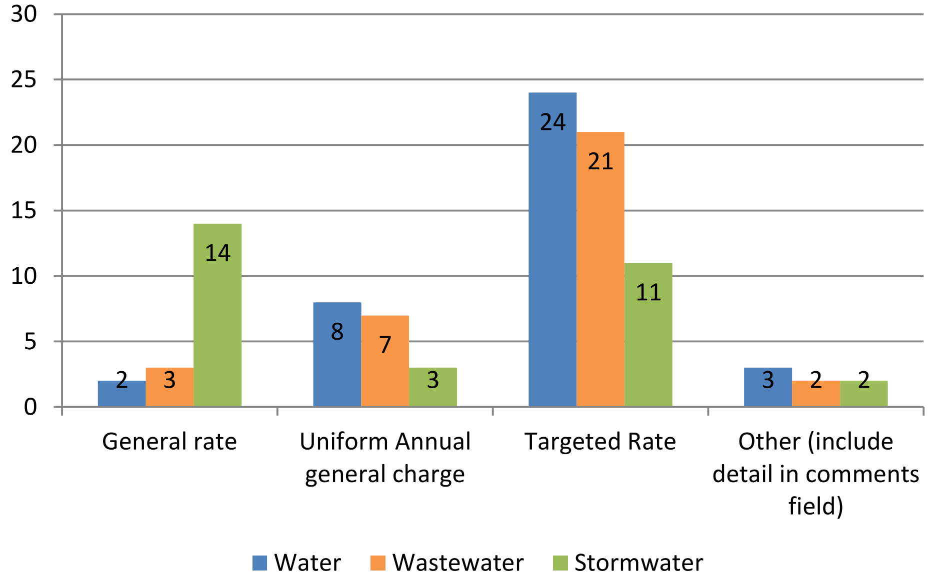
Other types of wastewater charges listed were

- Watercare: apply a fixed charge of $205 and a volumetric charge of $2.545/m3 of wastewater discharge (which is based on 78.5% of the water consumed for the majority of residences, apartments use 95%).
- Marlborough: combines a uniform charge for operation with a land value rate for capital costs.

Other types of stormwater charges listed were:

- Clutha: includes stormwater in water and wastewater charges.
- Ashburton: stormwater charges included in urban amenity rate.

Figure 25: Number of participants using various charging approaches for residential water schemes



Nearly half (19 of 39) of the participants who provided information on water charging approaches use some form of volumetric charging, however this is employed in a variety of forms, including:

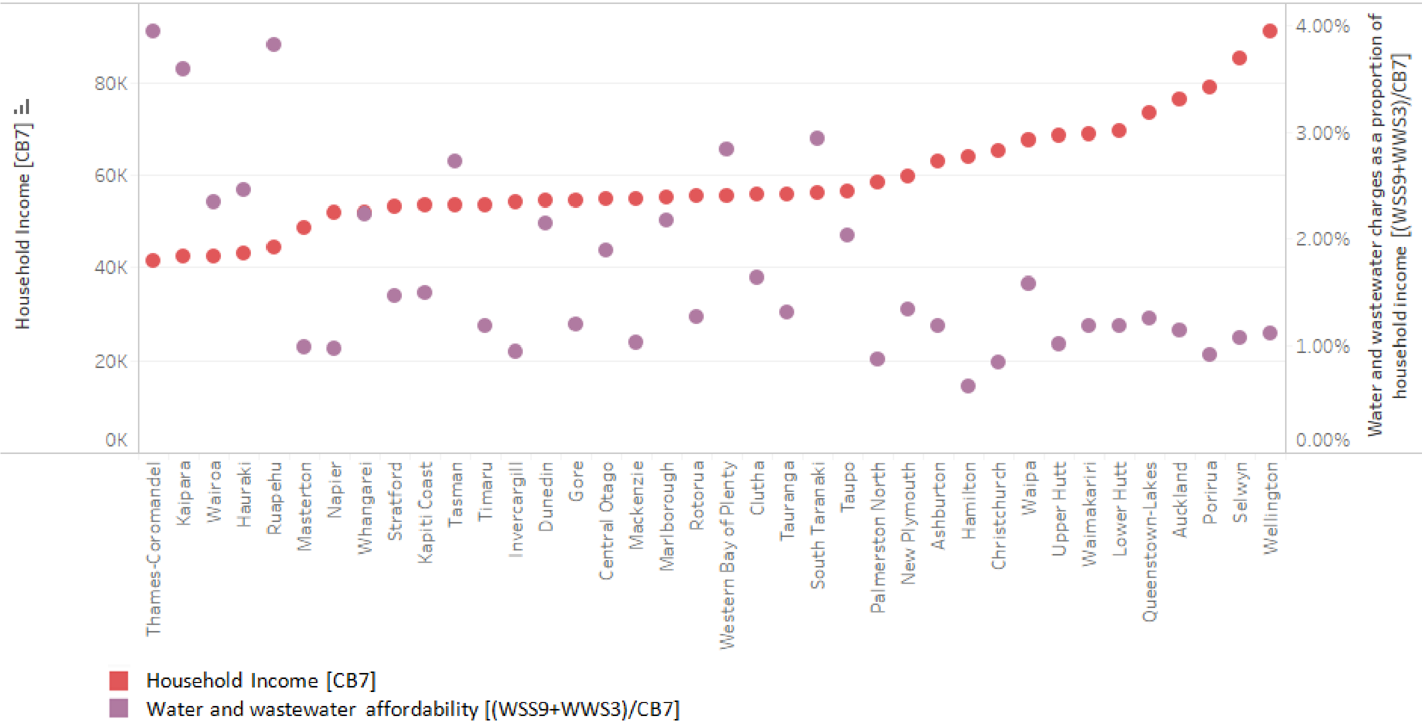
- Volumetric charges for specific schemes
- Various volumetric charges for specific meter types
- Volumetric charges for users who have elected to have meters over rates
- Free water allowance’s
- Stepped tariffs

5.3.2 Affordability

One of the greatest concerns when setting an appropriate tariff for water services is the affordability for lower income households. The affordability of charges is based on participants' supplied information of water and wastewater charges for a residential consumer using 200m3/year of water and Statistics New Zealand 2013 census data of the median household income by Territorial Authority.

Figure 26 shows that the three regions with the highest proportion of household income spent on water and wastewater are amongst the five regions with the lowest household incomes.

Figure 26: Proportion of water and wastewater charges of household income shown alongside household income



5.3.3 Non-residential water charges

65% (25 of the 39 who supplied information) of water suppliers had separate water supply charges for non-residential customers.

30 of those had a volumetric charge associated with non-residential water use, which ranged from $0.44/m^3 to $2.570/m^3. The average volumetric charge per cubic meter supplied is shown in Figure 27. Volumetric charges are not always linearly applied. The different forms of volumetric charging, described for residential charging regimes, such as free water allowances, and stepped tariffs, apply equally for non-residential water.

Figure 27: Dollars per cubic meter charges for non-residential water users

5.3.4 Non-residential wastewater charges

Twenty six authorities have a wastewater charging approach that in some way applies different charges for non-residential water users. Types of non-residential charges applied include; volumetric charges flow based charges, contaminant based charges, charges based on meter size, or charges based on the number of toilets.

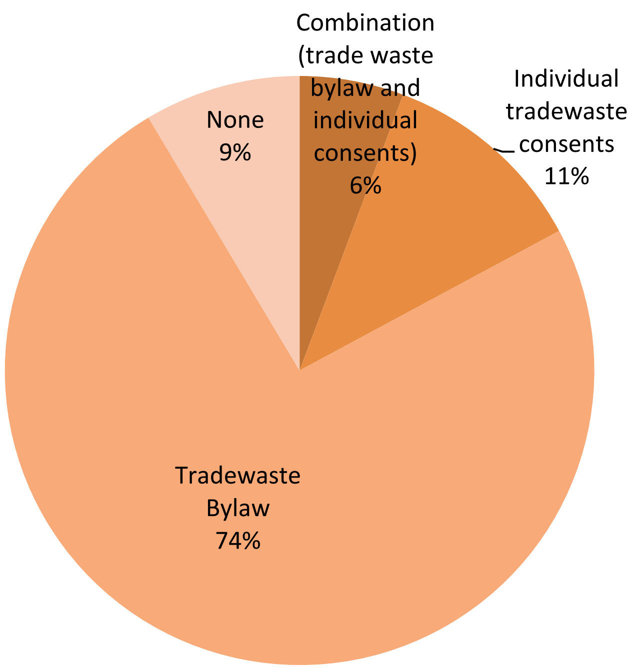
Twelve use per cubic meter volumetric rates, ranging from 40 cents to $4.80 as shown in Figure 28. Christchurch applies two volumetric rates, one for peak, and one for off peak. Tauranga City Council, Marlborough and Waimakariri District Councils have non-residential charges that factor in users flow rates.

Figure 28: Dollars per cubic meter charges for non-residential wastewater

5.3.5 Trade waste management

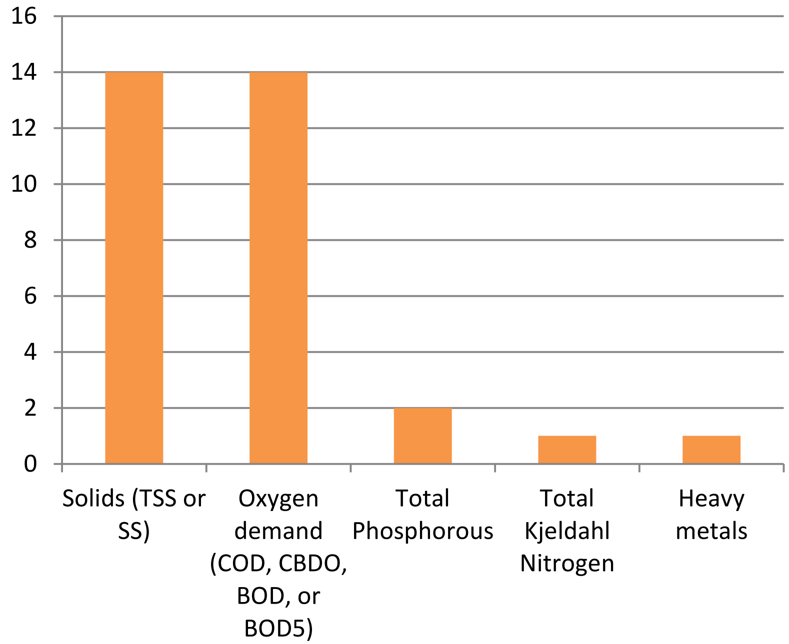
Trade waste is managed using bylaws, individual trade waste consents or a combination of approaches by most participants. Approaches used are shown in Figure 29. Otorohanga, Kaipara and Whangarei didn't provide information on their trade waste charging approach.

Figure 29: Trade waste management approach



Twenty two organisations use contaminant based charging for trade waste customers. Parameters charged for, and rates, where provided are listed in full in Volume 2. A summary of the number of participants applying charges for different parameters is shown in Figure 30.

Figure 30: Number of participants charging for various trade waste parameters



ECONOMIC SUSTAINABILITY

•RATES
•CHARGES

$1.8 billion Revenue

$2 billion Expenses

CAPITAL

$978m

Split by region

AUCKLAND	CHRISTCHURCH	OTHER
43%	15%	42%

OPERATING

$810m

2015 / 16 – 2016 / 17
Median increase across networks

WATER	WASTEWATER	STORMWATER
3.73%	1.08%	6.42%

INTEREST

$195m

10%

DOLLAR

Figures relate to National Performance Review participants supplying data, for the year 2016/17 financial year

6 ECONOMIC SUSTAINABILITY

6.1 Revenue

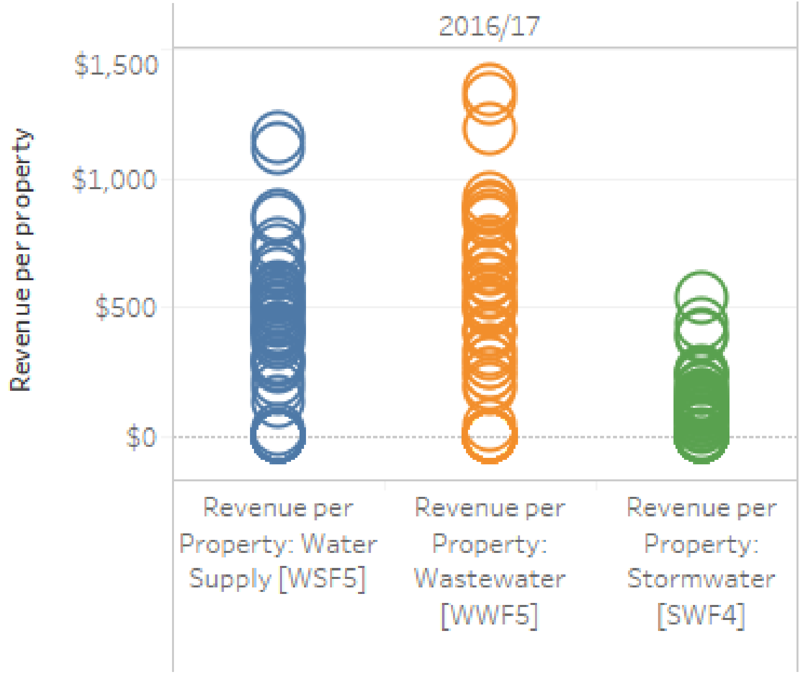
In 2016/17 participants collected over $1.8 billion to operate their 3 waters networks. The majority of revenue was collected as operational revenue, either through rates or direct charges for services.

Revenue collected for each of the three networks per property connected to the system is summarised in Figure 31. Further detail on the revenue received for individual participants is shown in Volume 2.

Table 3: 3 waters revenue

	Water	Wastewater	Stormwater
Operating revenue [WSF2, WWF2,SWF1]	$601,121,868	$831,481,524	$211,206,715
Revenue from supply of services to other authorities [WSF1,WWF1]	$33,453,857	$16,597,490	
Developer contribution revenue [WSF3, WWF3, SWF2]	$29,934,829	$60,348,107	$54,357,055
TOTAL	$664,510,555	$908,427,122	$265,563,769

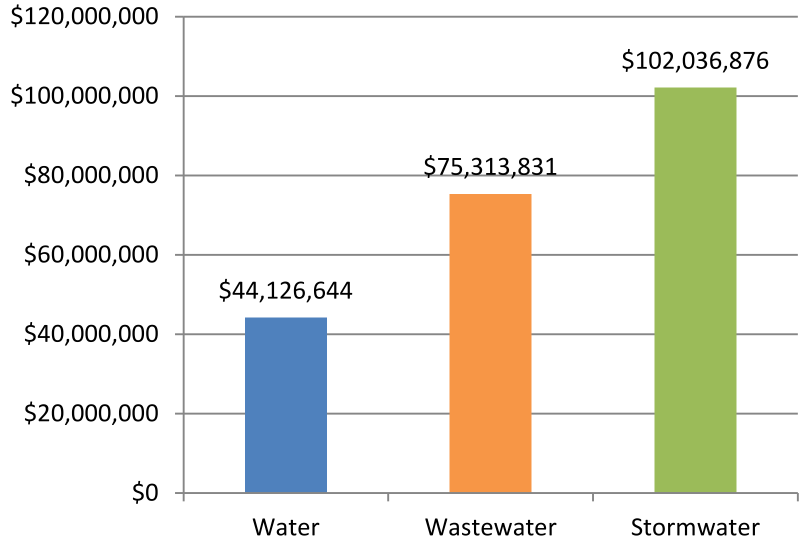
Figure 31: Revenue per property



6.2 Developer Contributions

In addition to cash contributions made by developers (quantified in section 6.1), developers also vested 3 Waters assets with a total value of $221 million across all participants.

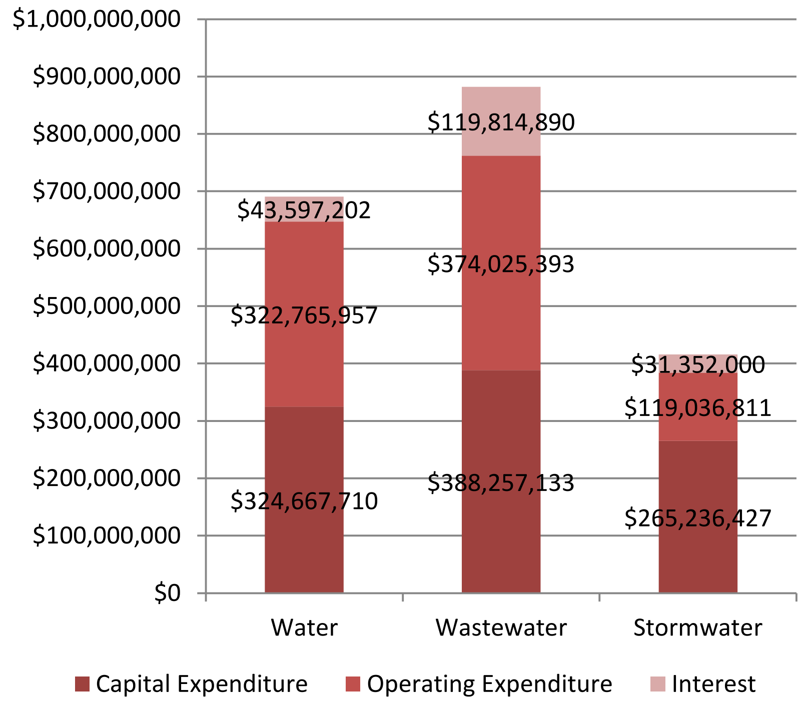
Figure 32: Vested asset value in 2016/17



6.3 Expenditure

Expenditure across all participants in 2016/17 totalled nearly $2 billion. Of this, nearly 10% ($194 million) related to interest payments.

Figure 33: Total expenditure across all participants in 2016/17



6.3.1 Operational Expenditure

Participants spent $810 million in operational expenses across all three of their networks. A summary of operational expenditure per property is shown in Figure 34. A breakdown of operational expenditure per network for each participant is provided in Volume 2.

Operating expenses continue to increase year on year, as shown in Figure 35.

Figure 35 shows the median change in operational expenses from the previous year. In 2016/17 the median increase in operational costs from 2015/16 was 3.73%, 1.08% and 6.42% across water, wastewater and stormwater networks respectively.

Figure 34: Operational expenditure per property

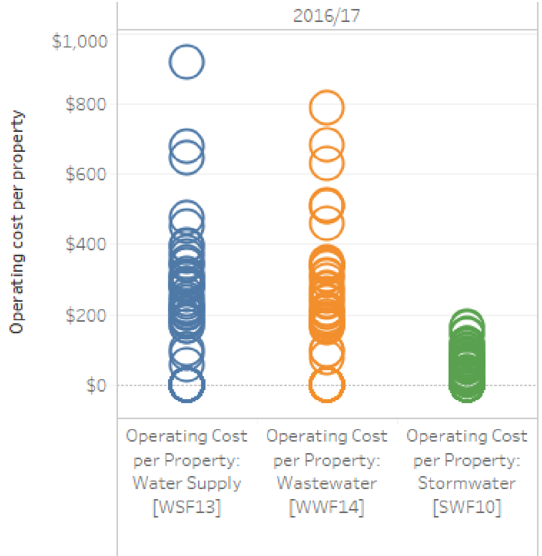
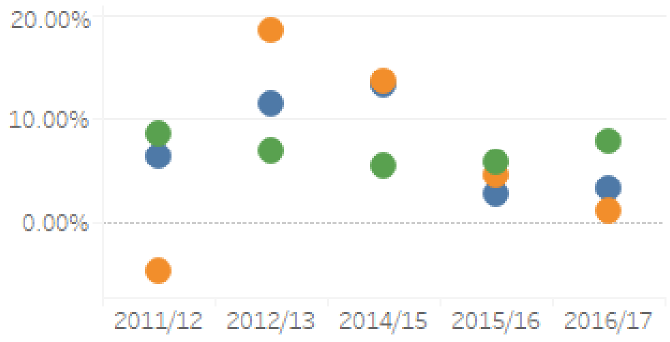


Table 4: Operational expenses by type

	Water	Wastewater	Stormwater
Council Overview Costs [WSF11,WWF12,SWF8]	$14,087,964	$5,946,335	$4,125,442
Management Costs [WSF10,WWF11,SWF7]	$106,688,737	$144,864,769	$30,685,309
Other External Opex [WSF9,SWF6]	$157,023,231		$85,939,729
Reticulation External Opex [WWF10]		$85,949,490	
WWTP External Opex [WWF9]		$86,086,369	
Sludge Disposal Costs [WWF8]		$13,522,397	
Chemicals and consumables [WSF8]	$16,098,852		
Energy Costs [WSF7, WWF7]	$26,479,698	$32,998,836	
TOTAL	$320,378,481	$369,368,195	$120,750,480

Figure 35: Median change in operational expenditure from previous year for water supply wastewater and stormwater systems



6.3.2 Capital Expenditure

Participants spent $978 million on capital works in 2016/17. A breakdown of capital expenditure by purpose is shown in Figure 37. Capital expenditure per property of individual participants is provided in Volume 2.

Figure 37: Capital expenditure by purpose

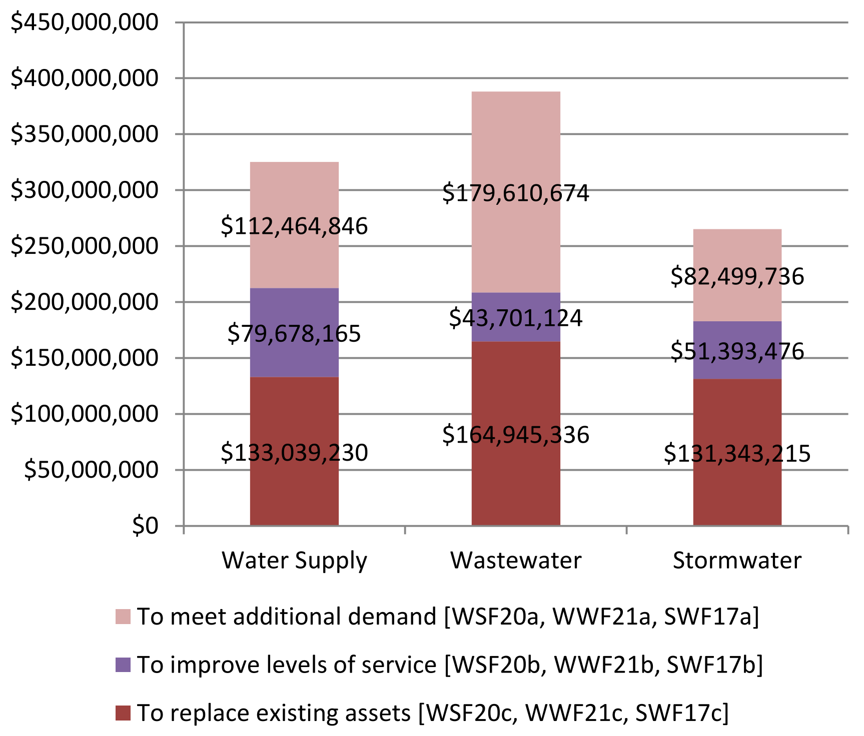
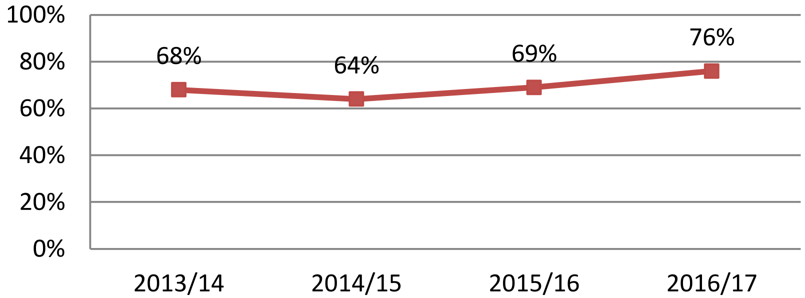


Figure 36: Capital expenditure by region

6.3.3 Capital works delivery constraints

Actual expenditure continues to trail budgeted expenditure, with participants spending a median of 76% of their budgeted capital in 2016/17. This is a slight improvement from previous years, as shown in Figure 39. A breakdown showing actual versus budgeted expenditure for individual participants is shown in Volume 2.

Figure 39: Median actual versus budgeted capital expenditure reported in the NPR

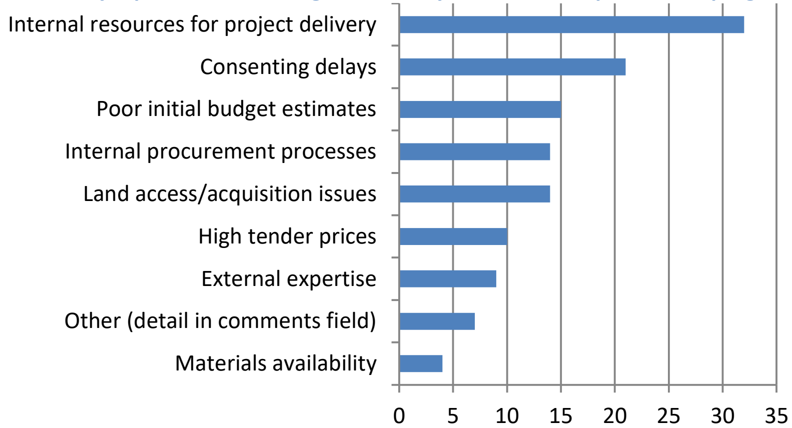


To identify reasons for this gap, participants were asked to rank the top three pressures affecting the delivery of their capital works programme.

Internal resources for project delivery were listed as the number one pressure. Consenting delays were listed as the second major pressure. A resource consent consistency project is being led by Water New Zealand to identify industry-wide opportunities that may speed up consenting processes.

Other delivery constraints listed included the pressure of insufficient preliminary planning and scoping, as noted by Gore. Ashburton noted that uncertainty around the legislative environment, especially in the drinking water space, was affecting the delivery of its capital works programme,-first around agricultural scheme compliance, and now with potential changes post-Havelock North.

Figure 38: Major pressures affecting the delivery of 3 Waters capital works programmes



Rangitikei, Ruapehu and Western Bay of Plenty District Councils listed contractor availability. This may also be an issue for others captured under the external expertise response.

Whakatane found social, cultural, and third party issues major factors in delivery of CAPEX programmes. With a diverse community and strong opinions, some projects are extremely difficult to deliver. Marlborough has similar issues, listing public consultation and acceptance of affordability as principal pressures. Invercargill listed the ability to accurately identify asset lives, and Central Otago similarly cited the availability of data on asset condition as a pressure.

6.4 Depreciation

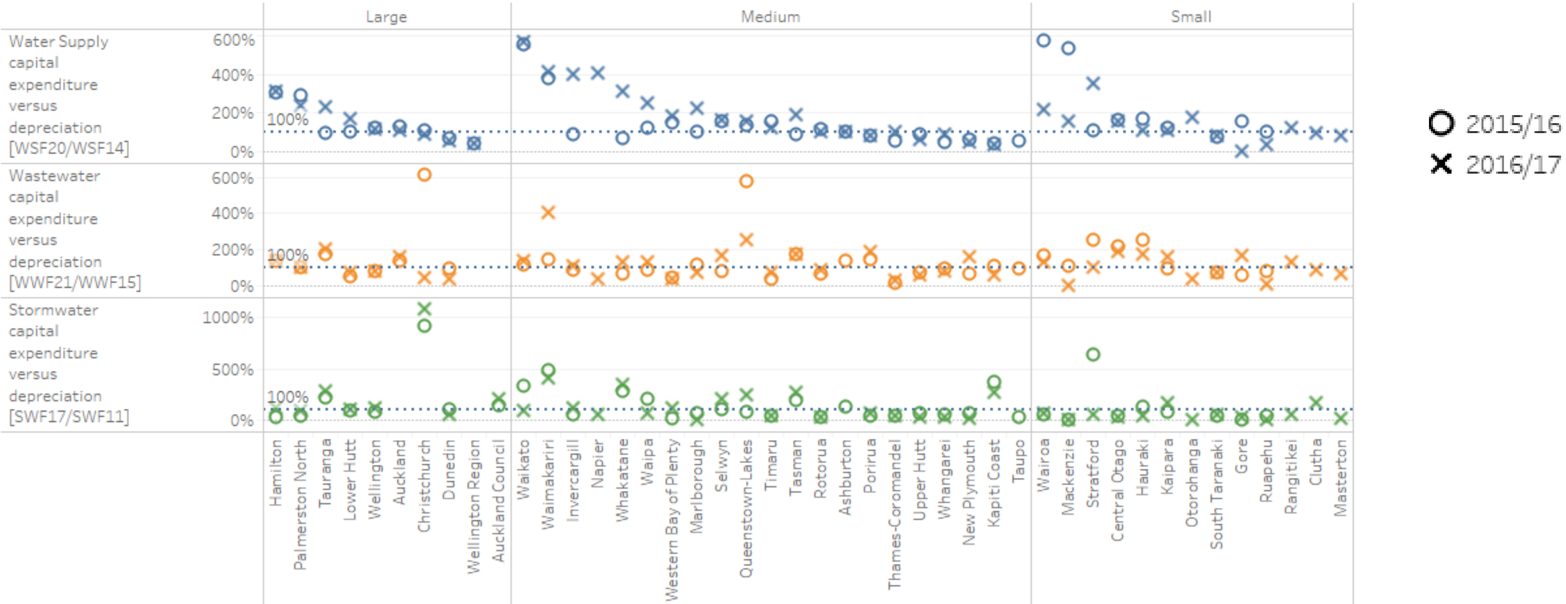
Annual depreciation recognises the decline in service potential of water, wastewater, and stormwater assets at rates that will write off the cost or valuation of the asset to its expected residual value over its expected useful economic life. The definition for depreciation reported in the National Performance Review is based on the latest replacement cost valuation. The annual depreciation applied across all participants' assets is shown in Figure 40.

Table 5: 2016/17 depreciation on 3 waters assets

	Depreciation
Water Supply [WSF14]	$255,812,238
Wastewater [WWF15]	$347,427,129
Stormwater [SWF11]	$122,085,766

Local Government meets the Essential Services Benchmark in the Local Government (Financial Reporting and Prudence Regulations 2014) if its capital expenditure on network services is greater than depreciation on network services (i.e. greater than or equal to 100%). Given the fluctuating nature of capital expenditure, the extent to which participants meet the benchmark varies significantly year on year. This is illustrated in Figure 40 which shows capital expenditure versus depreciation in 2016/17 and 2015/16 for participants who provided data in both years. The benchmark may prove less misleadinng if averaged over a greater time period.

Figure 40: Capital expenditure versus depreciation in 2016/17 and 2015/16



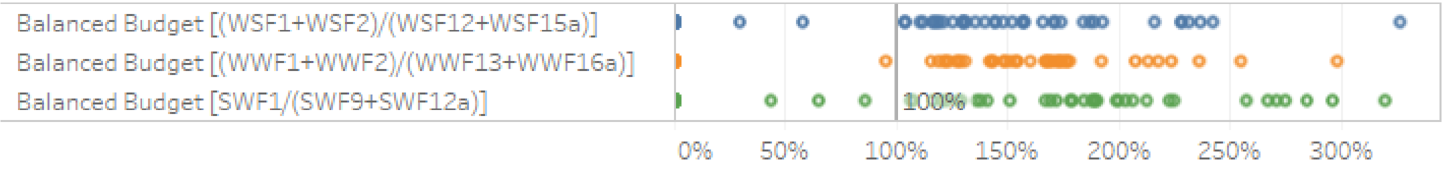
6.5 Cost coverage

6.5.1 Operational cost coverage

Operational costs and interest as a proportion of revenue for each of the 3 Waters networks are shown in Figure 40. This metric aligns with the Balanced Budget Benchmark in the Local Government (Financial Reporting and Prudence) Regulations 2014 (New Zealand Government, 2014).

The benchmark is easily achieved by the majority of participants, however neither depreciation nor capital costs, required to maintain networks, are included in the benchmark. Cost coverage per participant per network is shown in Volume 2.

Figure 41: Revenue as a proportion of operational costs and interest

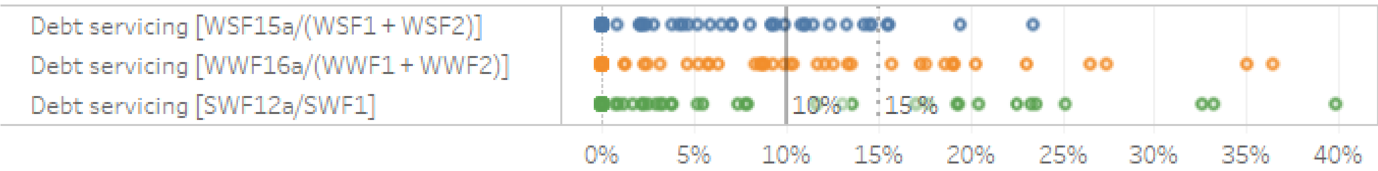


6.5.2 Debt servicing

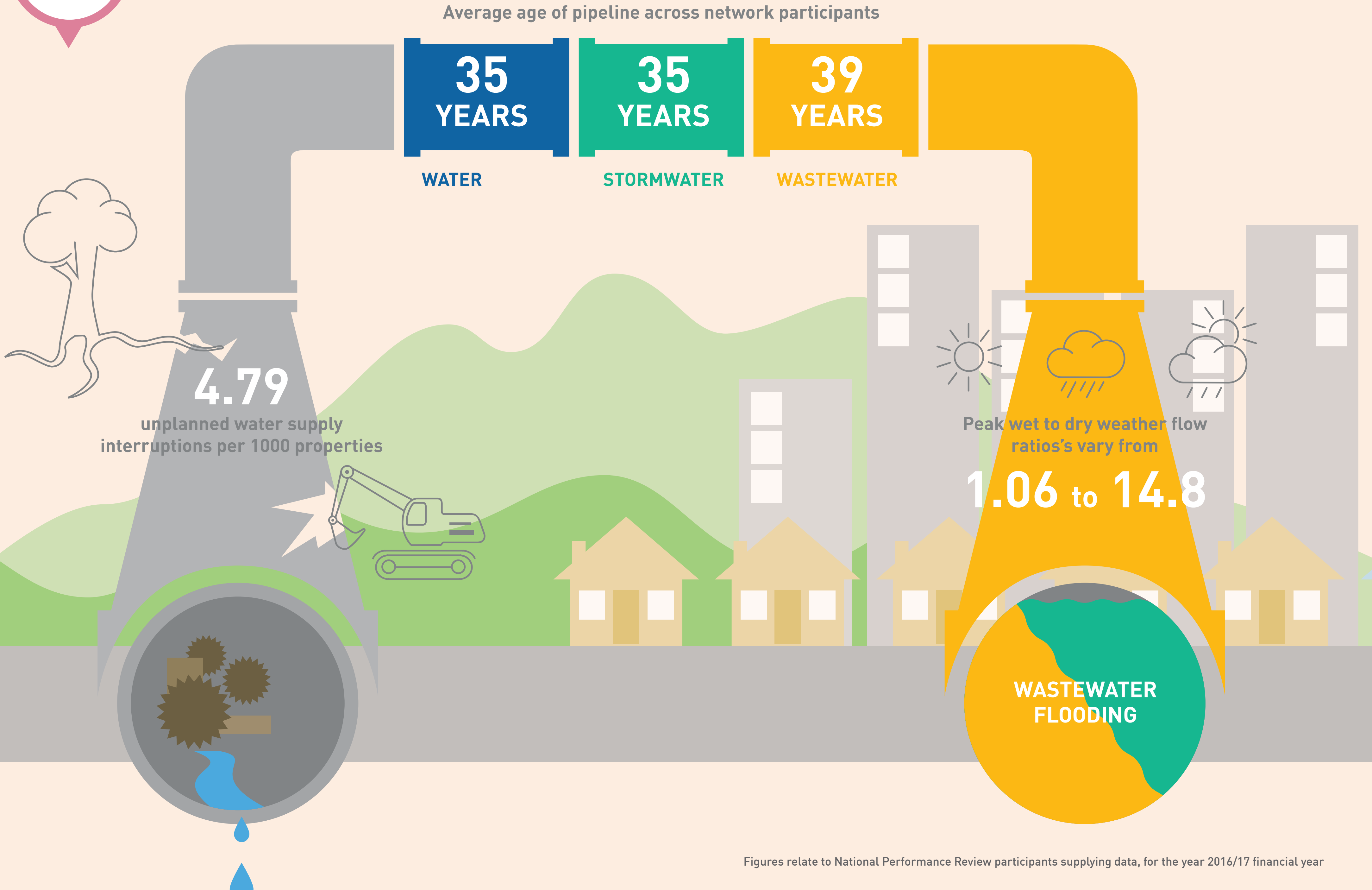
The proportion of revenue (excluding developer contributions) spent on interest payments for each of the 3 Waters networks is summarised in Figure 42. Information per participant is provided in Volume 2.

Debt servicing benchmarks under the Local Government (Financial Reporting and Prudence) Regulations 2014 (New Zealand Government, 2014) are met if borrowing costs are less than 10% of a local authorities' revenue per year, or 15% for a high-growth council. This is a whole of council requirement and not required to be met by water, wastewater or stormwater services individually. When considered on an individual basis Figure 42 shows that borrowing costs exceed these benchmarks for a large proportion of water, wastewater, and storm water networks.

Figure 42: Interest as a proportion of revenue



RELIABILITY



Figures relate to National Performance Review participants supplying data, for the year 2016/17 financial year

7 RELIABILITY

7.1 Water supply interruptions

The total number of planned, unplanned, and third party interruptions to the water supply reported by each participant is summarized in Figure 43.

Volume 2 shows a comparison of the frequency of unplanned interruptions per participant. In 2016/17 there was a median of 4.79 unplanned interruptions per 1,000 properties serviced.

Two participants reported notable increases in the number of planned interruptions to their water supply network in 2016/17: Waimakariri's water supply interruptions jumped from one in 2015/16 to 19, and Rotorua's from 35 in 2015/16 to 1,447 in 2016/17.

The group as a whole saw little change in the frequency of unplanned interruptions from the previous year, with a median decline of only 2%, while the median number of third party incidents declined across the group by 20%.

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Figure 43: Total number of planned interruptions, third party incidents and unplanned interruptions reported per participant in 2016/17

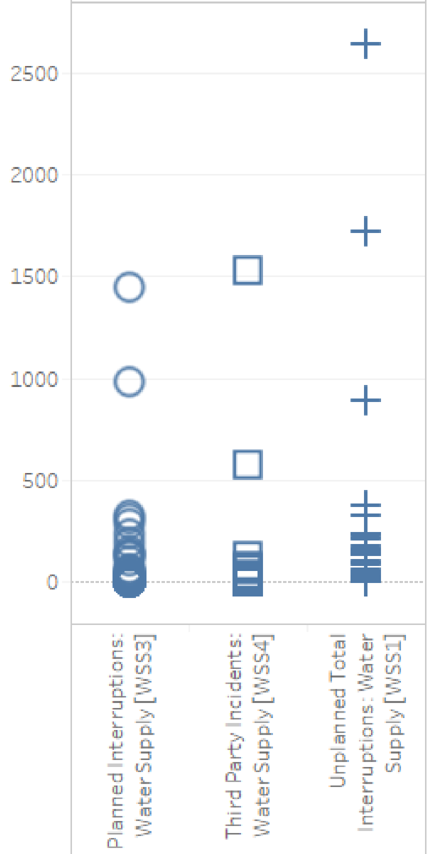
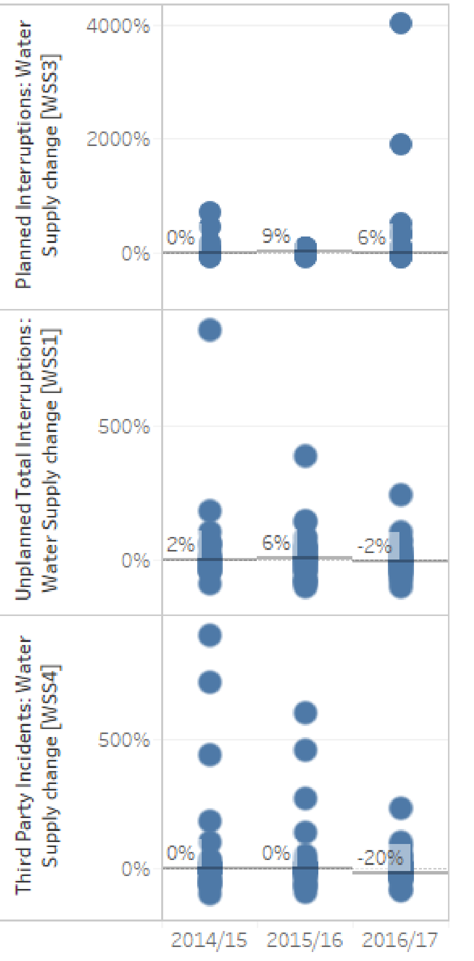


Figure 44: Percentage change in interruptions from the previous year

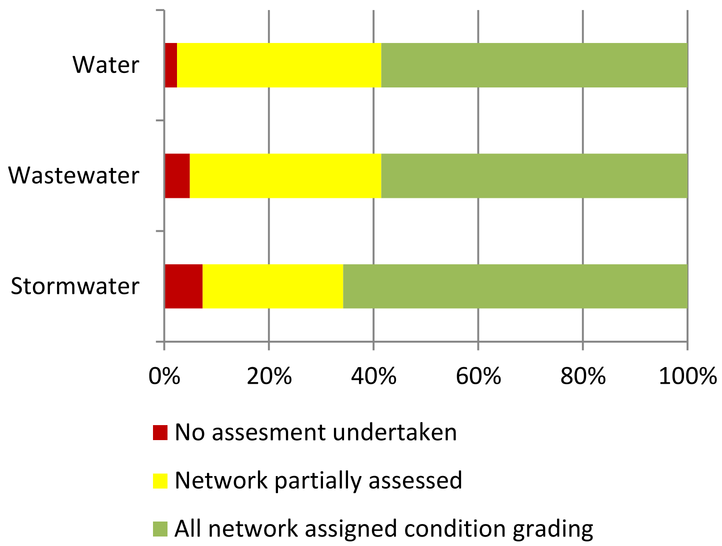


7.2 Condition Assessments

7.2.1 Pipeline condition assessment

The majority of participants have undertaken condition assessment for some, if not all, of their pipelines. Only a small fraction of participants had yet to undertake any condition grading (one, two and three for water, wastewater, and stormwater networks respectively). Volume 2 shows the percentage of participants' networks that have been condition graded, as well as the proportion of assets assessed as being in a poor or very poor condition.

Figure 45: Number of participants undertaking pipeline condition assessments



Condition assessment approaches vary, limiting the ability to make comparisons of pipe condition around New Zealand. While most participants apply condition grades from one to five (one being very good, five being very poor) a variety of different assessment approaches, shown in Table 6, are in use.

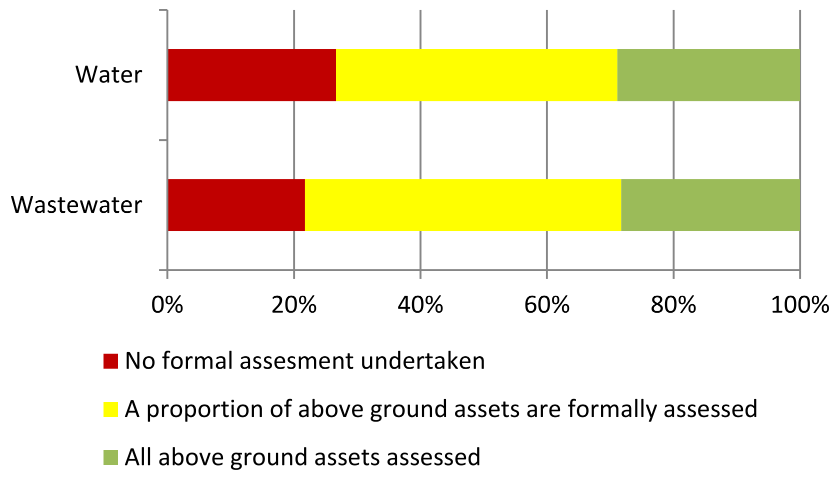
Table 6: Pipeline condition assessment approaches in use

Pipeline condition assessment approaches	Number of participants using assessment approach		
	Water	Wastewater	Stormwater
NAMS International Infrastructure Management Manual	12	8	9
New Zealand Pipe Inspection Manual	4	11	11
New Zealand Infrastructure Asset Grading Guidelines	6	7	7
IPWEA Condition Assessment and Asset Performance Guidelines	2	1	1
IPWEA Practice Note 7: Water Supply and Sewerage	0	1	1
Inhouse	5	4	2
Informal	1	2	1
Other	1	3	4

7.2.2 Above-ground asset assessment

Over 80% of participants have in place processes for assessing the condition of their above-ground water and wastewater assets, however only a third assess all of their assets as part of each three-year asset management cycle.

Figure 46: Proportion of above ground assets assessed each three year asset management cycle



A range of assessment approaches exist, however many participants have adopted in-house or informal approaches to above ground asset condition assessments.

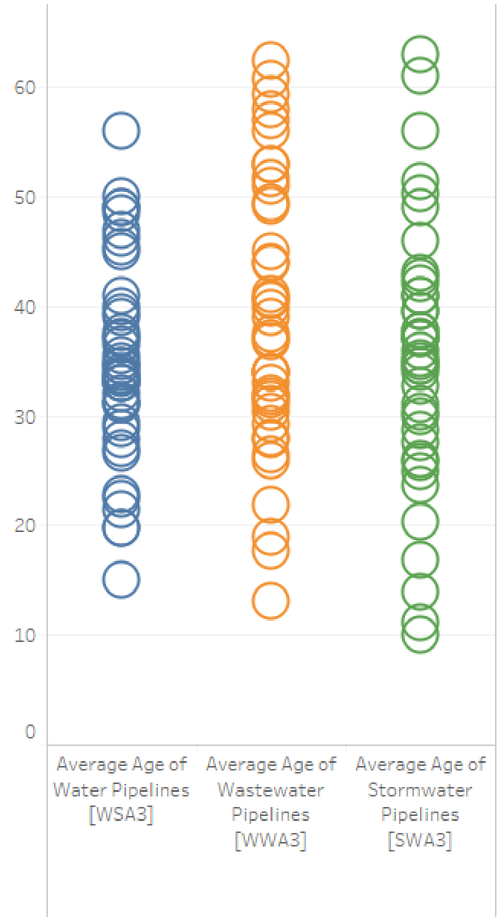
Table 7: Above ground condition assessment approaches in use

Above ground assessment approaches	Number of participants using assessment approach	
	Water	Wastewater
NAMS International Infrastructure Management Manual	15	11
New Zealand Infrastructure Asset Grading Guidelines	5	4
IPWEA Condition Assessment and Asset Performance Guidelines	4	4
Visual Assessment Manual for Utility Assets	0	2
In-house	7	7
Informal	3	5
Other	2	5

7.3 Pipeline Age

The median average water, wastewater and stormwater pipeline age is 35, 39, and 35 years respectively. The spread of average pipeline ages is summarized in Figure 47and average pipeline ages per participant are provided in Volume 2.

Figure 47: Average age of pipelines (years)



7.4 Impacts of pipeline age and condition on interruptions

Surprisingly, no trend is evident between the number of water supply interruptions, and either water supply pipeline age or water pipeline condition (shown in Figure 48). It is unlikely, however, that no relationship exists between these two factors, highlighting that improved data sources are needed for meaningful analysis of pipeline performance. It may be that trends are evident at a more granular level, or that high numbers of interruptions in relatively young pipes points to poor installation practices.

Figure 48: Unplanned interruption frequency plotted against water pipeline average age and proportion of assets in poor or very poor condition

2

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[2] Christchurch and MacKenzie have been excluded from the analysis, as their unplanned interruption frequency was a significant outlier from the group. Zero values have also been excluded.

7.5 Inflow and Infiltration

Inflow and infiltration is the process of liquids other than wastewater (predominantly stormwater and groundwater) entering the wastewater system. Participants were asked to provide information on any inflow and infiltration programmes in place, and related performance indicators. Over half (22 of 42) had in place active inflow and infiltration programs, which included:

- Modelling of reticulation, pump stations, and constructed overflows
- Inspection of private properties (including gully traps and downpipes)
- Pipeline renewals targeting areas of high infiltration
- Improvements to stormwater management
- Working with building inspectors to improve water-tightness of new plumbing
- Smoke testing to target leaky pipes
- CCTV inspections
- Flow monitoring programs

A table of participant responses is included in Volume 2.

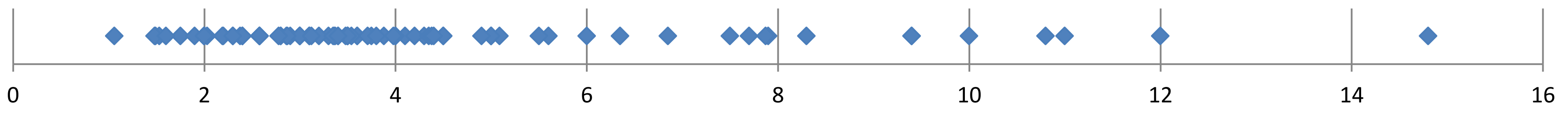
A range of key performance indicators are used to characterise the various sources of inflow and infiltration. Indicators used in the Water New Zealand Inflow and Infiltration Control Manual (Carne & Le, 2015) are:

- Groundwater Infiltration (GWI) or base flow
- Rainfall Dependent Inflow and Infiltration (RDII); and
- Wet Weather Peak Flow factor, defined by stormwater inflow (SWI)

Both RDII and SWI vary depending on the intensity of the rainfall event they relate to. Given the difficulty in providing comparable benchmarks across such a broad range of measures, participants were asked to provide the ratio of peak wet to dry weather flows at each of their wastewater treatment plants. Ratio's were supplied for 93 wastewater treatment plants and are summarised in Figure 49.

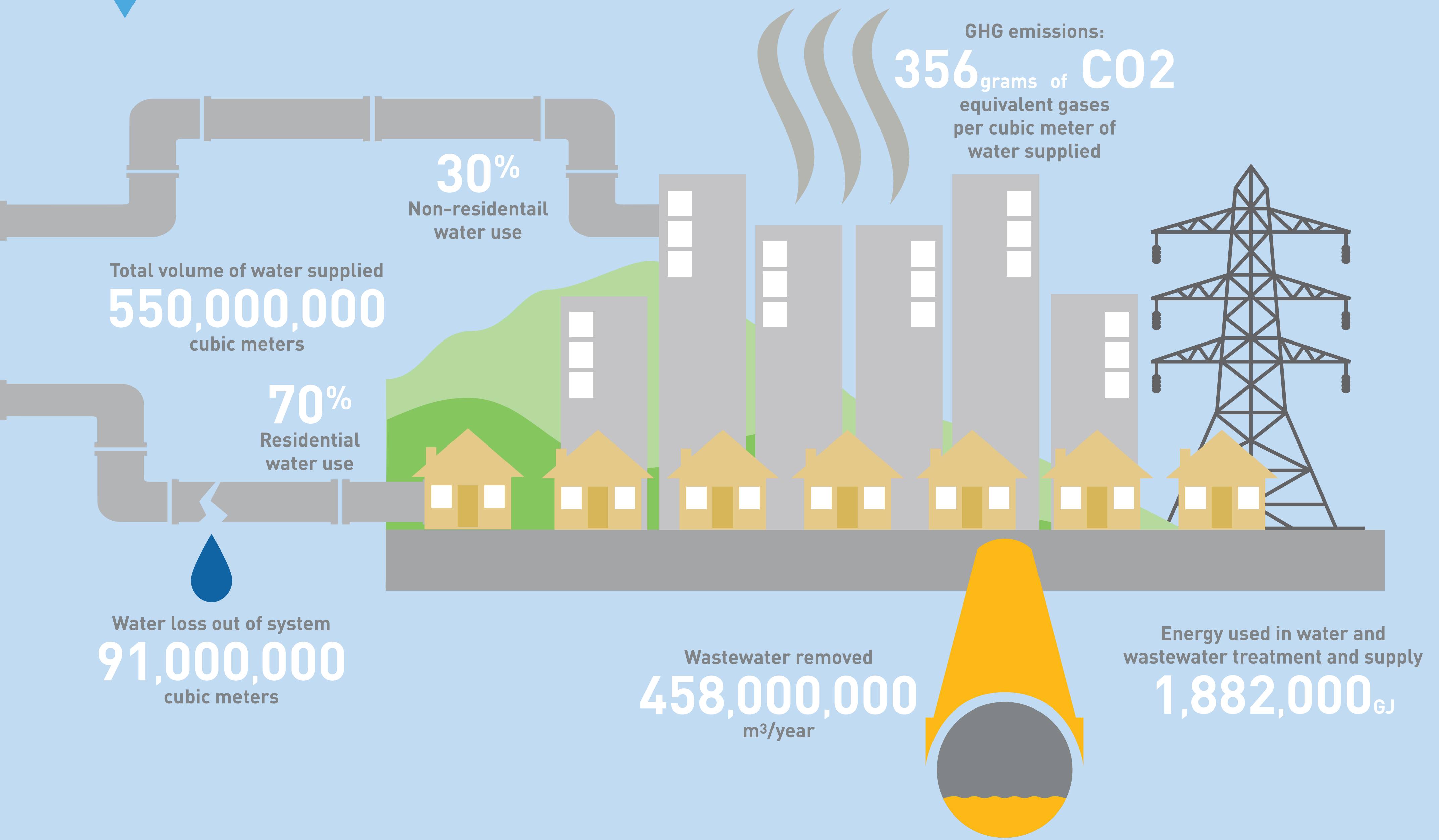
The peak wet to dry weather flow associated with each treatment plant is included in the New Zealand wastewater treatment plant inventory, available online at: https://www.waternz.org.nz/WWTPInventory.

Figure 49: Peak wet to dry weather flow ratios at wastewater treatment plants[3]



[3] each diamond represents a different wastewater treatment plants flow ratio

RESOURCE EFFICIENCY



Figures relate to National Performance Review participants supplying data, for the year 2016/17 financial year

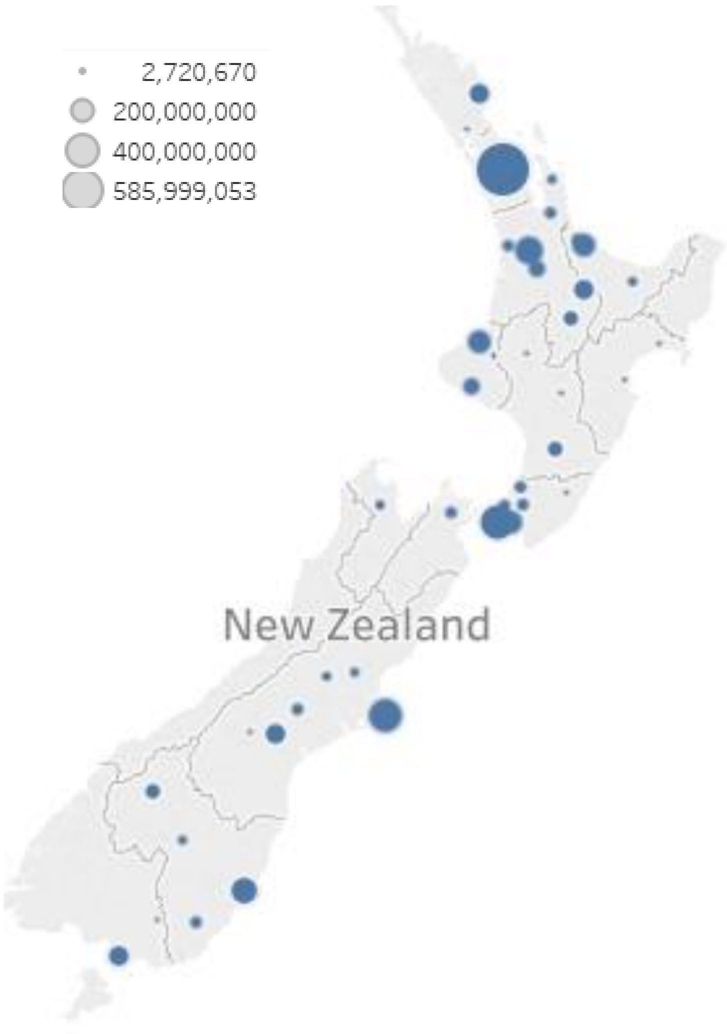
8 RESOURCE EFFICIENCY

8.1 Water abstractions

In 2016/17, participants supplied 550 million cubic meters of water, equivalent to over 220,000 Olympic-size swimming pools. Per participant volumes are illustrated in Figure 50. Of the proportion that was not lost through leakage, roughly a third (137,304,938 m^3) was identified as being for non-residential use.

Volume 2 includes a breakdown of residential and non-residential use per participant, as well as changes in abstraction to individual participant systems.

Figure 50: Volume of water supplied to participant systems (m3/year)

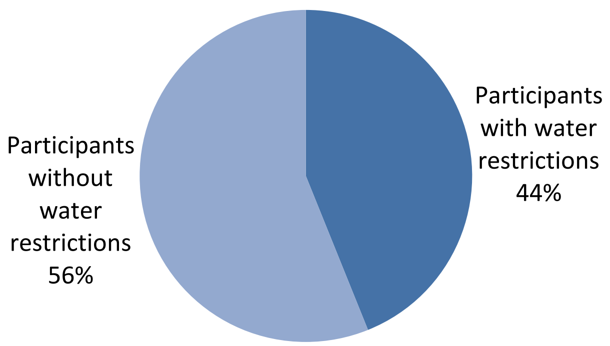


8.2 Water demand management

8.2.1 Water restrictions

Nearly half (44%) of participants applied water restrictions in some or all of their district at some period in 2016/17.

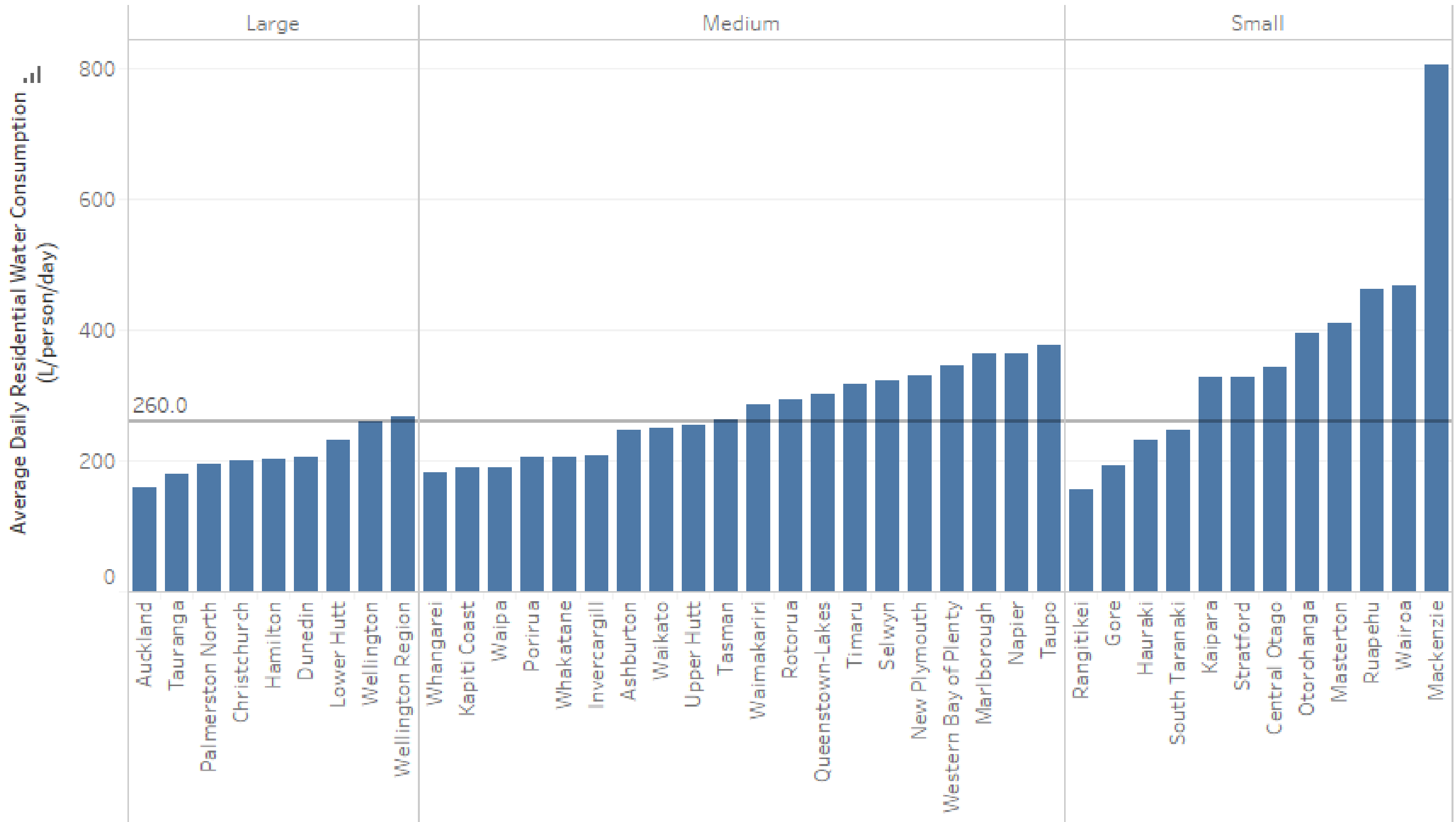
Figure 51: Proportion of participants who had water restrictions in place in 2016/17



8.2.2 Residential water efficiency

The median average daily residential water use across participant networks was 260 litres per person, per day.

Figure 52: Average daily residential water use (litres/person/day)



8.2.3 Water metering and water restrictors

The number of participants with water meters on residential properties continues to climb. In 2016/17, over 12,000 residential water meters were added to participant systems. The total number of meters installed in all participant systems over the last three years is shown in Figure 53, and the percentage of participants' residential connections with meters is shown in Figure 55.

In addition to water meters there are also 25,770 water restrictors installed across the systems of 20 participants. Volume 2 shows the total number of restrictors installed on each of these systems.

Non-residential water metering is significantly more wide spread than residential metering. Only three of the 41 participants that provided data indicated that they had no non-residential metering in place, and 30 of the 41 have meters installed in at least half of the non-residential properties connected to their water supplies. The percentage of non-residential metering coverage per participant is shown in Volume 2.

Figure 53: Total number of residential water meters installed on participant systems

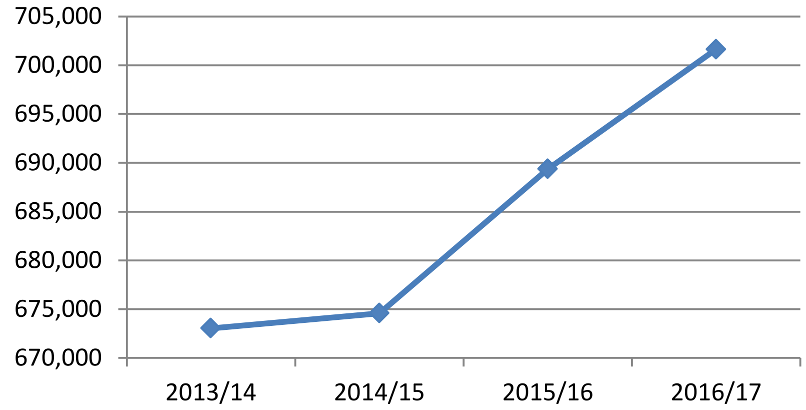


Figure 54: Number of participants with various proportions of non-residential metering

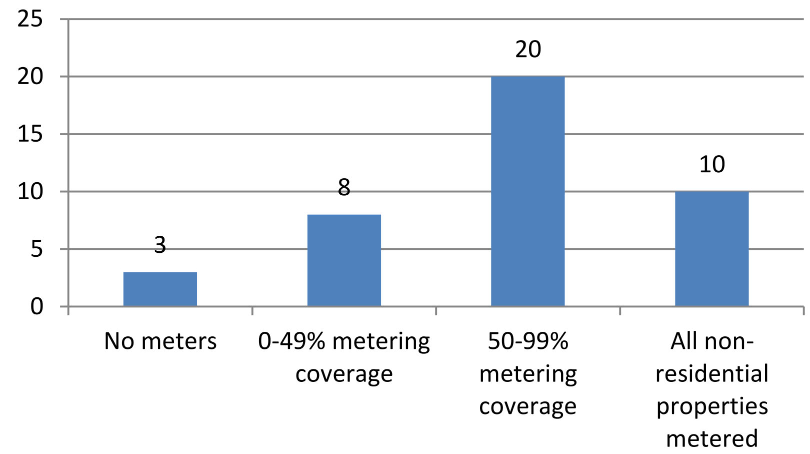
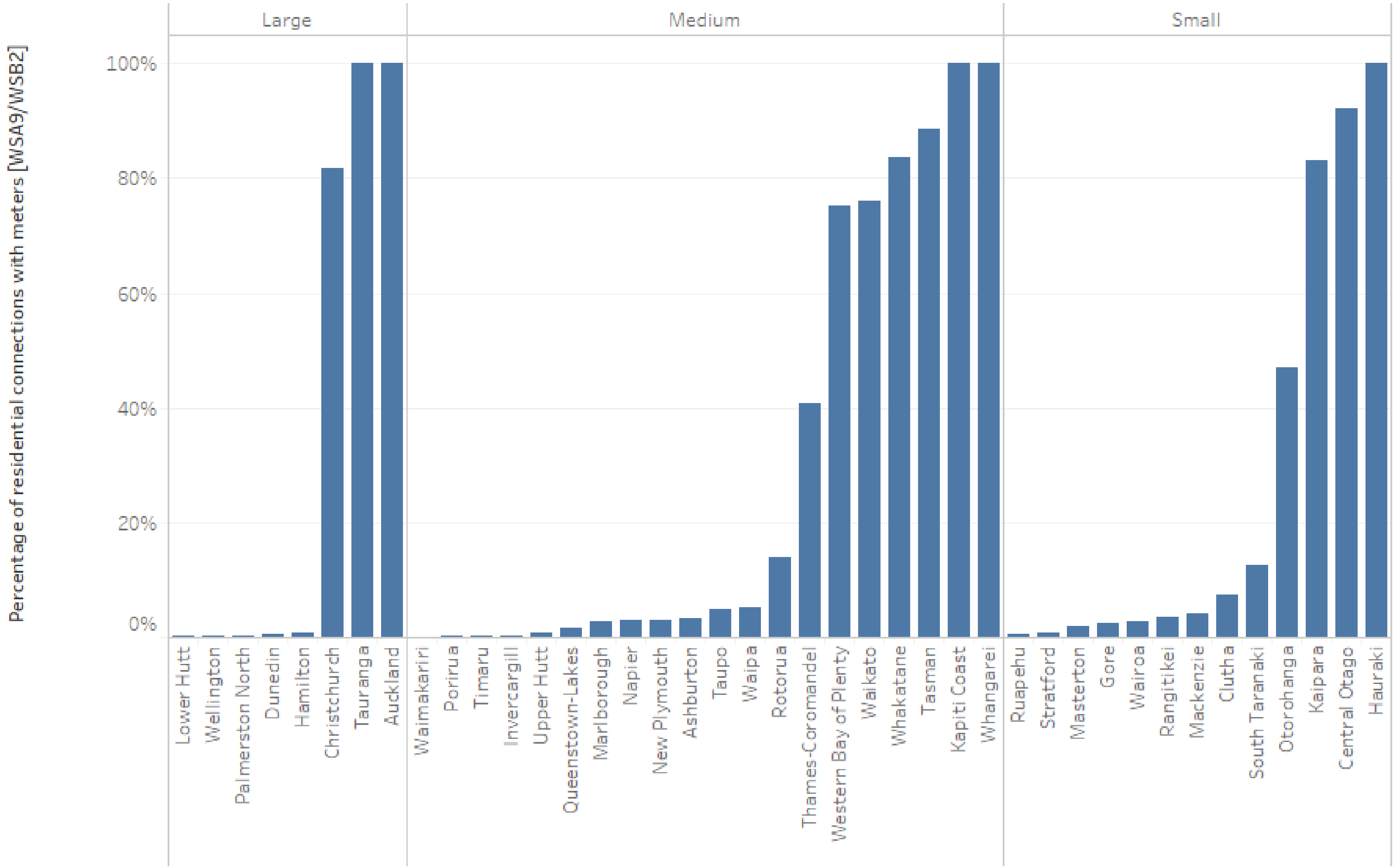


Figure 55: Proportion of residential water supply connections with water meters



8.3 Water loss

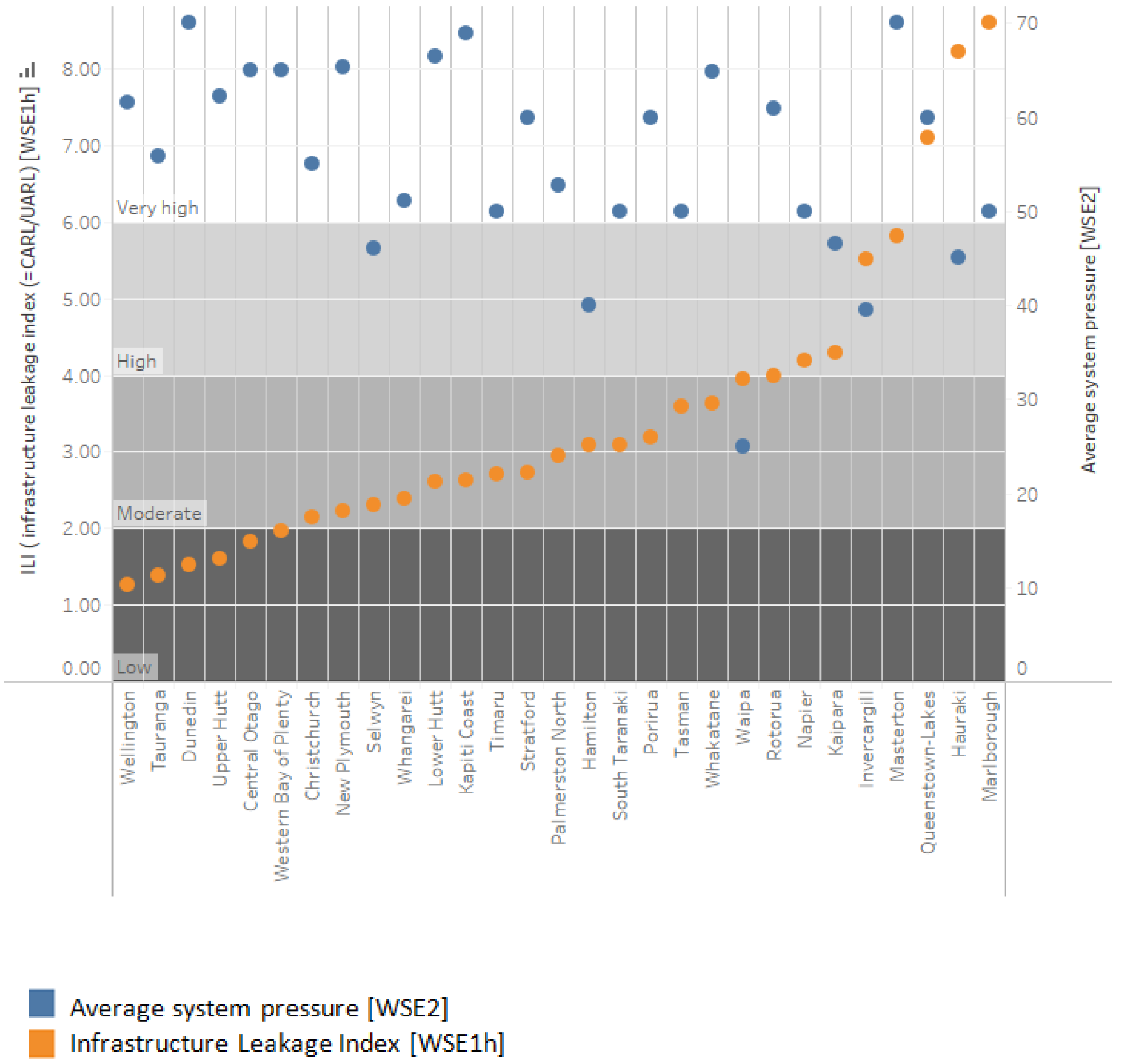
Participant systems lost an estimated 90 million cubic metres of water in 2016/17, roughly equivalent to the amount of water Tauranga residents would use over a period of nine years. To make comparisons of how efficient or inefficient individual participant losses are, the Infrastructure Leakage Index is used.

The Infrastructure Leakage Index (ILI) is a water loss performance indicator for inter-utility water-loss comparisons recommended by leading international best practice (European Benchmarking Commission, 2015) and New Zealand water loss guidance material (Dr Ronnie McKenzie, 2008). The European Benchmarking Commission (European Benchmarking Commission, 2015) classifications for water loss, as either "very high", "high", "moderate", or "low" are shown in Figure 56. A series of suggested actions are associated with each of these categories.

ILI is the ratio of current annual real losses over unavoidable annual real losses. ILI allows for current system pressure in the UARL formula, however, because pressure is a strong determinant of leak flow rates and burst frequency, the current system pressure is not necessarily optimal, and excess operating pressure and pressure transients can lead to higher water losses, pressure is shown as an additional data point.

Changes in water loss over time can be compared using the systems current annual real losses. The current annual losses, per connection, per day, for each participant are shown in Volume 2.

Figure 56: Water loss levels using the Infrastructure Leakage Index and Average System Pressure



8.4 Sludge production and disposal

8.4.1 Water treatment sludge

Twenty three participants supplied information on water treatment plant sludges, however only thirteen provided information on treatment plant sludge volumes, suggesting records of this data are not routinely kept as a matter of priority.

Participants were also asked for information on the route used to dispose of their water treatment sludge. Some participants used a combination of disposal routes. Of those who provided responses, landfill was used in ten instances, disposal to sewer was used in 15, and alternative disposal routes, typically via disposal to a water body, were used in a further nine instances. Exceptions were Rangitikei, which land-applied sludges, and New Plymouth, where these were ploughed into land which was regrassed for pasture.

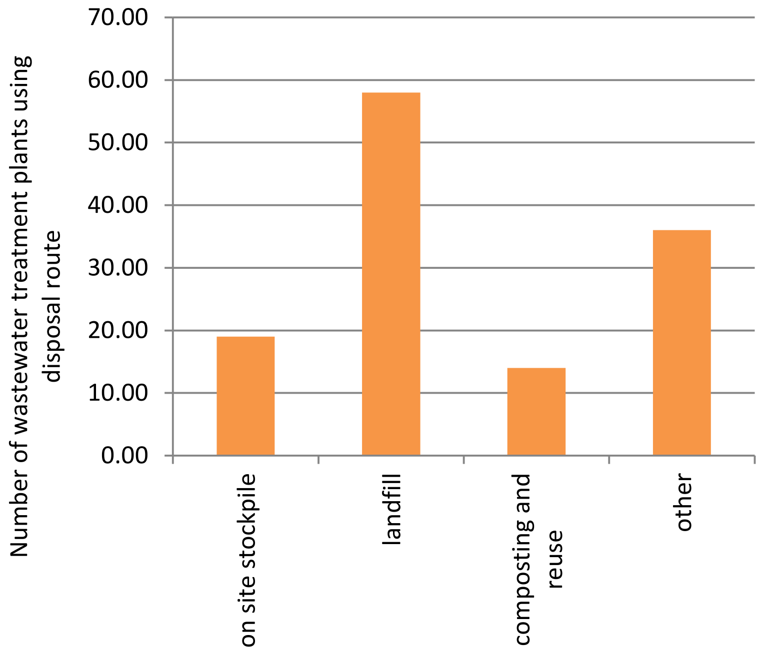
8.4.2 Wastewater treatment sludge

Of 262 treatment plants included in the wastewater treatment plant inventory, the volumes of sludge produced was supplied for 48. Not all values supplied appear credible and so figures of total sludge volume have not been reproduced here.

Information on the disposal route for sludges was supplied for 88 treatment plants, a few of which used multiple disposal routes. Figure 57 shows routes employed. Disposal routes listed in the 'other' category were largely where biosolids were sent to other wastewater treatment plants. Selwyn District Council's ESSS Pines treatment plant biosolids were used for land remediation, and Ashburton District Council's Rakaia treatment plant's biosolids were applied to pasture, however this was not harvested for reuse.

Details for sludge volumes at individual wastewater treatment plants are included in the wastewater treatment plant inventory, available online at: https://www.waternz.org.nz/WWTPInventory

Figure 57: Number of wastewater treatment plants utilising various sludge disposal routes

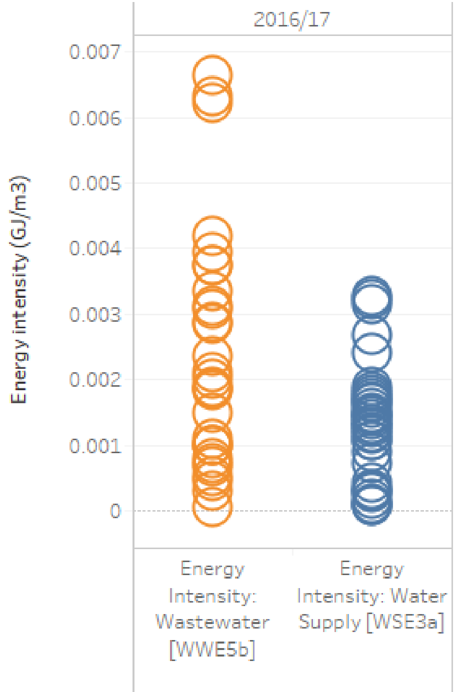


8.5 Energy use

Thirty participants provided reliable information on the energy use of their water and wastewater systems. Collectively the operation of water supply pumps and water treatment plants in these systems used 580,003 GJ of energy, and a further 1,302,007 GJ was used for wastewater pumps and wastewater treatment plants.

Of these, a median energy intensity of 1.3 MJ of energy was used per cubic metre of water supplied, and 2 MJ of energy was used per cubic metre of wastewater collected. A summary showing the range of energy intensities for each system is shown in Figure 58. A comparison of the energy use of individual participant systems is available in Volume 2.

Figure 58: GJ used per m3 of water supplied and wastewater collected



8.6 Greenhouse Gas Emissions

It is estimated that an average of 356 grams of carbon dioxide equivalent gases (CO_2-e/m^3) are emitted for every cubic meter of water supplied. This is based on calculations conducted by Water New Zealand in collaboration with BraveGen and the Bank of New Zealand.

8.6.1 Energy Related emissions

Equivalent emissions related to energy used for treating and conveying water and wastewater have been estimated based on the energy-use figures for pump stations and treatment plants, provided in Section 8.5.

The estimation does not account for the use of diesel (known to be used at some pump stations and backup generators), biogas, and gas generation (known to be used at some water and wastewater treatment plants).

Electricity related emissions per m^3 of water supplied have a weighted average of 110gCO_2-e/m^3 of water supplied, and have been determined using the following formula:

$$Emission\ Factor\ per\ Participant\ \left(\frac{kgCO_2 - e}{m^3}\right))$$
$$= Coversion\ Factor\ \left(\frac{kWh}{GJ}\right) \times Electricity\ Emissions\ Factor(kgCO_2 - e/kWh)$$
$$* \left(\frac{Water\ system\ energy\ use\ \left(\frac{GJ}{year}\right) + Wastewater\ system\ energy\ use\ \left(\frac{GJ}{year}\right)}{Water\ supplied\ \left(\frac{m^3}{year}\right)}\right)$$

Conversion Factor (kWh/GJ) = 277.778

Emissions Factor (kgCO_2-e/m^3) (Ministry for the Environment, 2016)*= 0.119*

8.6.2 Wastewater fugitive emissions

Fugitive emissions from domestic wastewater have been based on estimates included in New Zealand's Greenhouse Gas Inventory (Ministry for the Environment, 2015) for methane and nitrous oxide. Fugitive emissions of wastewater from all sources in New Zealand, including septic tanks were 238.68 ktCO_2-e. Fugitive emissions from domestic wastewater treatment plants (i.e. not including septic tanks) were 157.64 ktCO_2-e (Ministry for the

Environment, unpublished). Based on these figures, it is estimated that 246gCO_2-e of fugitive wastewater emissions are produced per cubic meter of water supplied to participant systems by using the following formula:

$$Average\ fugitive\ emissions\ (gCO_2 - e) = \frac{NZ\ fugitive\ domestic\ wastewater\ emissions \times Proportion\ of\ population\ in\ review}{m^3\ of\ water\ supplied\ by\ participants}$$

$$NZ\ fugitive\ domestic\ wastewater\ emissions\ (tCO_2 - e) = 157{,}640$$

$$Proportion\ of\ population\ in\ review = 86.08\%$$

$$Water\ supplied\ by\ participants\ (m^3) = 550{,}067{,}714$$

8.6.3 Average emissions per cubic meter of water supplied

Based on weighted energy emissions factors summed with average fugitive emissions, it has been estimated that an average of 356 grams of carbon dioxide equivalent gases (gCO_2-e/m^3) are emitted for every cubic meter of water supplied using the following formula:

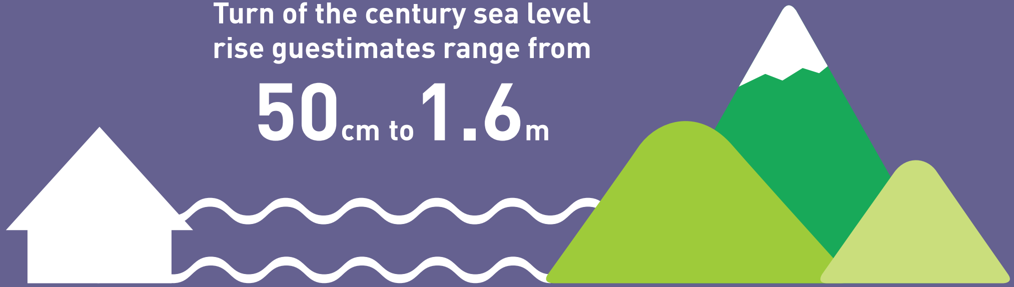
$$Water\ supply\ emission\ factor\ \left(\frac{gCO_2 - e}{m^3}\right) = \sum_{1}^{p} \frac{Emission\ factor_p \left(\frac{gCO_2 - e}{m^3}\right) \times Water\ supplied\ by\ participant_p \left(\frac{m^3}{year}\right)}{Water\ supplied\ by\ all\ participants \left(\frac{m^3}{year}\right)} + Average\ fugitive\ emissions\ \left(\frac{gCO_2 - e}{m^3}\right)$$

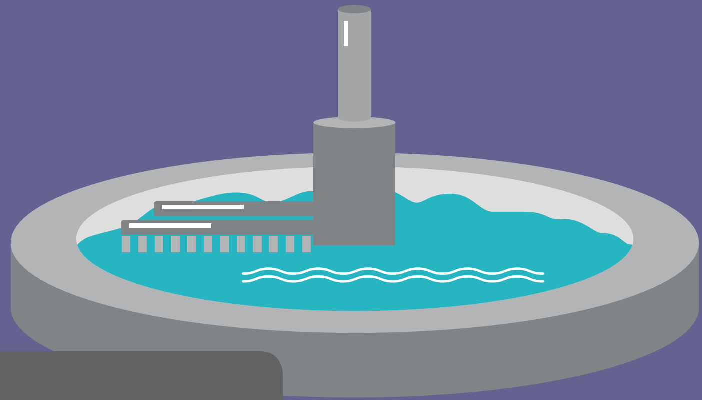
p = participant with water and wastewater data supplied

RESILIENCE

Turn of the century sea level rise guestimates range from

50cm to 1.6m

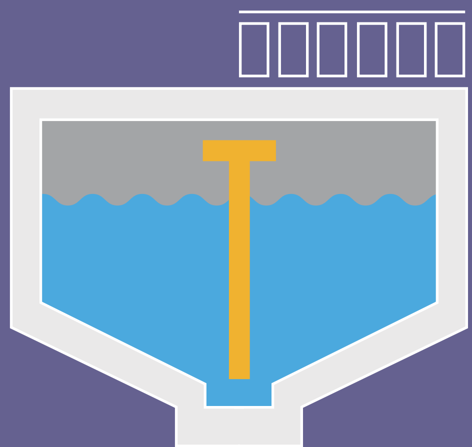




35%
of water treatment plants have backup generation

62%
increase in flooding events

155%
increase in residences inundated by flooding



1.36
days of water is stored in reservoirs on average

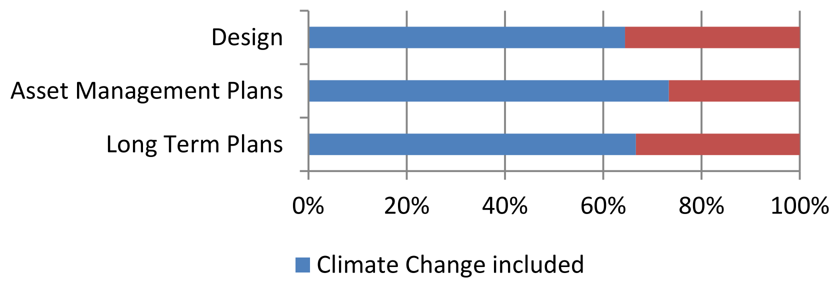
Figures relate to National Performance Review participants supplying data, for the year 2016/17 financial year

9 RESILIENCE

9.1 Climate Change

Most participants have high-level climate change considerations included in planning documents. Few have detailed projections for future climate conditions. A number of participants noted that infrastructure plans also include climate change considerations.

Figure 59: Proportion of participants with climate change considerations in the following processes



Climate change considerations within planning documents range from high level acknowledgement of climate change as a strategic issue and/or key risk, to detailed planning assumptions. In Dunedin, "forecast changes to climate have been included in activity management planning assumptions and are built into capital project scoping and design."

Some authorities that had considered climate change noted that further work needed to be done. For Christchurch City "climate change is acknowledged but there is not yet a specific policy on areas which will be defended and areas that will be retreated from." Western Bay of Plenty noted that "customer usage is observed based on climate conditions, however at this stage we are more reactive, data collecting with minor long-term planning."

Others had in progress work to address climate change issues. For example Whakatane is "working towards defining parameters for climate change", and will be "undertaking modelling projects over next few years when budget allows". Watercare has a "proposed work program to develop climate change mitigation and adaptation approaches to enhance the reliability and resilience of Watercare's existing and future assets and operations which was presented to the Watercare Board in September 2017".

In some instances climate change considerations flowed through from long term plans and asset management processes, and were embedded in design considerations. For example, at Timaru District Council, projected rainfall in 2090 is considered in asset design. Other councils had embedded climate change into design documents. For example, Tasman was working on incorporating climate change into a land development manual which sets minimum design standards. Palmerston North City Council indicated that climate change is addressed in engineering standards. Whangarei District Council imbeds climate change in design through its Environmental Engineering Standards (EES).

Stormwater System Design

- Tauranga City Council considers climate change in designing for flood hazards and coastal inundation.
- Kaipara District Council allow for Climate Change in their stormwater design and standards.
- Christchurch has Climate Change incorporated in Land Drainage designs.
- Selwyn and Auckland Council have addressed Climate Change in a Stormwater Code of Practice.
- Western Bay have climate change parameters used for stormwater network design.

Modelling Considerations

- Ashburton "Modelling accounts for future development and climate change demands." Dunedin City Council has forecast changes to climate-related variables (eg rainfall intensity) included in hydraulic modelling scenarios which are used as the basis for design calculations.
- Wellington Water's councils has the likely effects of climate change integrated into the water supply strategic planning tool (Sustainable Yield Model (SYM)). Previous assessments have included the effect of climate change on the capacity and timing of future source upgrades, and the expected impact of sea level rise on abstraction from the Waiwhetu aquifer. The SYM has recently been updated by NIWA consistent with the outcomes of the latest IPCC fifth assessment.

Project Specific Design Considerations

- Kapiti Coast District Council included Climate Change in the design of their river recharge with ground water scheme, which includes saline intrusion monitoring.
- Waipa has a number of projects which will assist in climate change adaptation; construction of a new reservoir to increase water storage, Installation of universal water metering (to reduce customer demand), Drought Management Plans updated three-yearly, and planned capacity upgrades for water and wastewater plants to cover increased demands.
- Kaipara District Council has revised Finished Floor Levels because of sea level rise.
- South Taranaki District Council had moved the location of upgraded Kapuni Water Treatment Plant away from river for flood/lahar protection and instituted an Inflow and Infiltration reduction program to account for increased rainfall. Growth and demand forecasts also account for predicted climatic changes.

9.1.1 Climate Change Projections

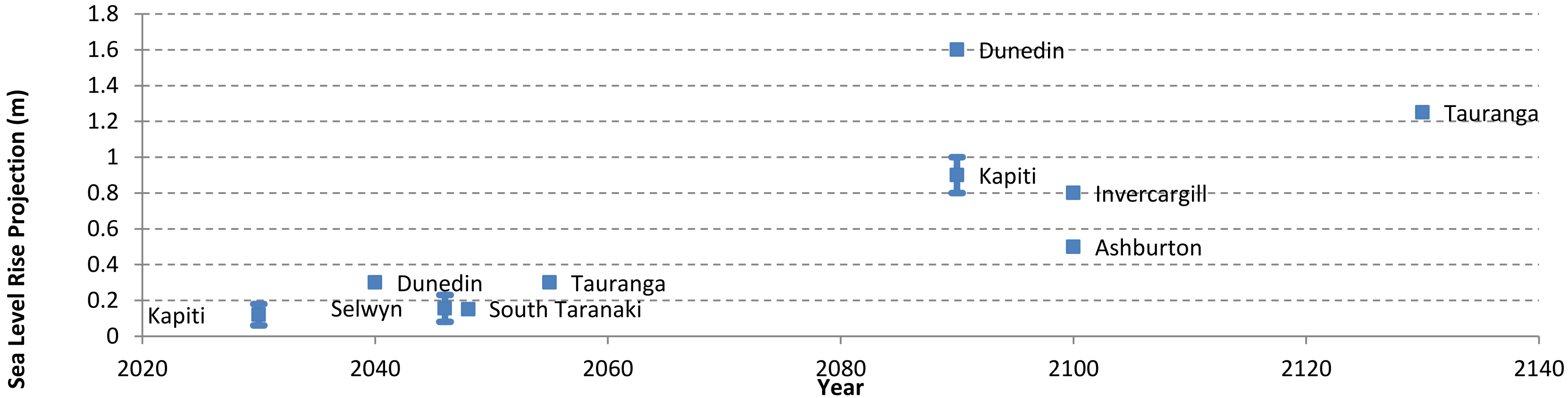
Participants were asked to provide information about the projected changes they were anticipating for sea-level rise, rainfall return period, and average annual rainfall. In each instance, a wide variety of responses was received, indicating, in general, that participants lack reliable information sources.

Data sources for most future projections were generally not cited. The sources that were listed were very variable. Tasman District Council based its predictions on a 2015 report produced by NIWA for the Council. Councils in the Wellington Region used 2008 Ministry for the Environment figures. Dunedin City Council used Ministry for the Environment figures from 2016.

Some councils had commissioned their own studies to inform their climate-change considerations. For example, Waipa had a climate-change report produced by CH2M Beca Ltd in 2013 to report on the impact of climate change on 3 Waters services. Central Otago was using the report "The Past, Present and Future Climate of Central Otago" written by Bodeker Scientific.

This is leading to inconsistent assumptions being used for climate change planning around New Zealand. An example of this is shown in Figure 60, which shows sea-level rise allowances for those who listed this by year. A table showing a full list of responses provided is included in Volume 2 of the report.

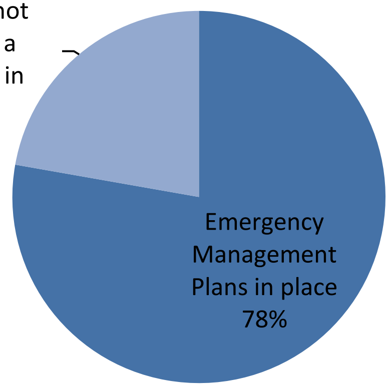
Figure 60: Sea level rise allowances



9.2 Emergency Management Plans

The majority of participants (78%) have in place Emergency Management Plans.

The nature and extent vary significantly. A selection of participant responses is shown here. A full list of responses is included in Volume 2.



Kapiti Coast District Council has completed the following emergency and risk planning studies

- Water mains Contingency Planning Report 2006.
- Treatment Plants Earthquake Risk Reduction Study
- Reservoirs structural assessment and auto shut valve installation 2004-2010
- Business Continuity Plans for water treatment and operations, updated on a bi-annual basis.
- Council Civil Defence Emergency Plan that details planning and response procedures.
- Business continuity plan
- Lifelines response plan
- Asset criticality framework

Dunedin City Council is currently building Business Continuity Plans for the 3 Waters using the Water Research Foundation, EPA and American Water Works Associations, Business Continuity Plan for Water Utilities Guidance Document. The plans will cover the first 30 days of any event that disrupts business as usual (BAU) process.

It is also developing a suite of Emergency Response Plans, to give an overview of processes for the first three to four days following an event, additional to water safety plans. So far included are processes to guide for:

- Disruption to BAU operations
- Contaminated water
- Drinking water tankers
- Flushing the water system in residential properties and smaller buildings
- Flushing the water system in a large building
- Lifting a boil water notice
- Earthquake
- Landslide

Christchurch City Council has developed plans for water supply contamination events, loss of supply in zones (emergency valves), drainage flooding, and wastewater overflow response, and clean up.

South Taranaki District Council has a Business Continuity Plan that includes water supply and wastewater. Significant hazards covered include earthquakes, volcanic hazards (ashfall and lahars), damaging winds, floods and pandemic.

Wellington group of councils scenarios considered are:

- Tsunami
- Earthquake
- Severe storm
- Prolonged power outage
- Loss of communication or control system capability
- Contamination of water supply
- Loss/lack of raw water

Marlborough District Council's Assets and Services Department has developed Emergency Response Plans. Earthquake and flood are predominant risks, while other risks are more frequent but with lesser consequences. It is also learning more about tsunami. Plans are exercised using real and fictional scenarios.

Tauranga City Council has in place an Incident Response Plan, Business Continuity Plan, and Drought Management Protocol (for high water demand).

Tasman District Council are currently formulating a Water Emergency Plan that outlines a call tree (communication model), Bacteria Transgression Procedures, Chlorine Dosing Procedures, Issuing a Boil Water Notice Procedures, Contingency Plans, and identifying critical control points. Staff are also updating Water Safety Plans for each water supply scheme which has an identified specific contingency for each scheme. Other documents outline procedures in the event of a wastewater overflow.

Auckland Council has the following plan types in addition to a civil defence programme:

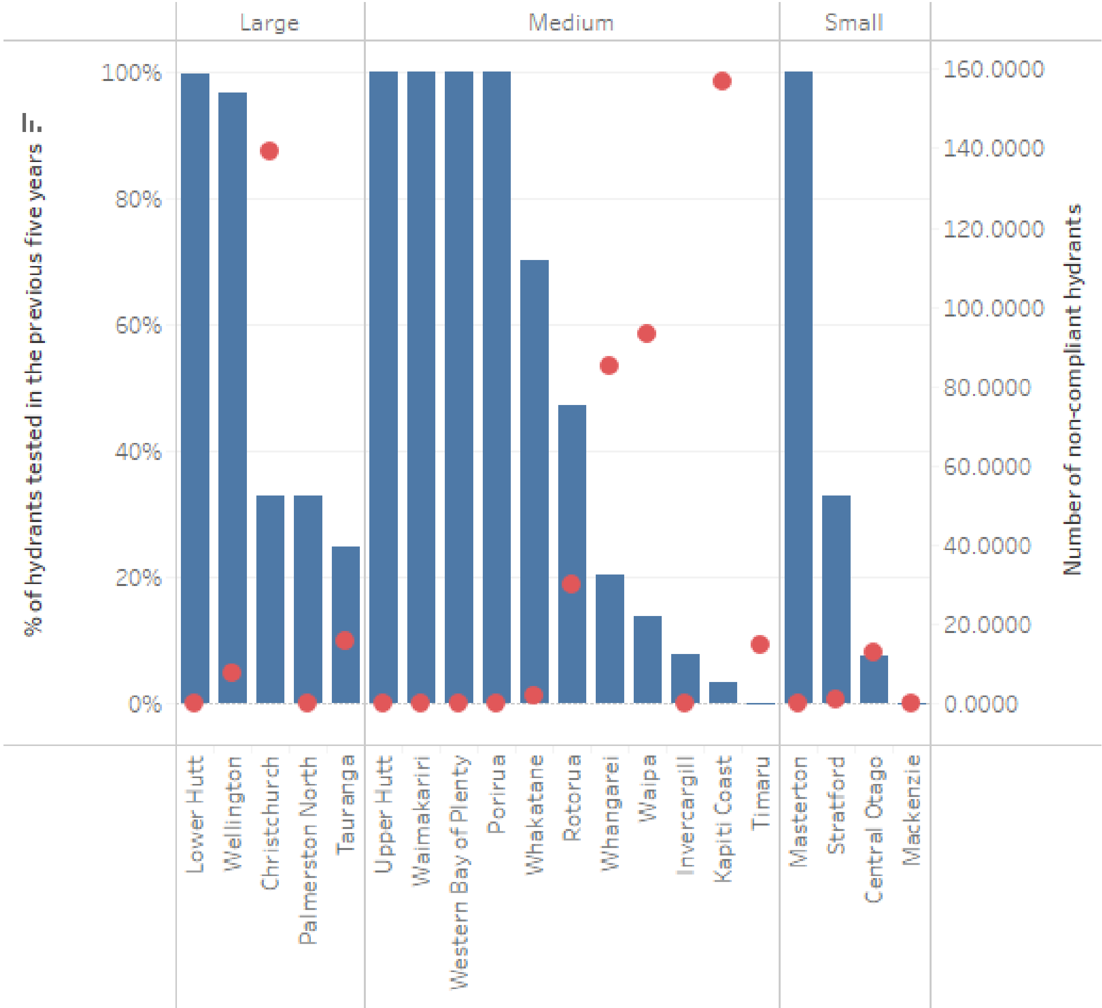
- Business Continuity Plans (BCP)
- Incident Response Plans (IRP)
- Contractors' contingency plans

9.3 Firefighting water supplies

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

Participants were asked to provide information on the percentage of fire hydrants they inspected in the previous five years and the number of key hydrants that do not meet testing requirements of the code. Results for the twenty participants that provided information are shown in Figure 61. Kapiti Coast noted that while they do not test hydrants themselves the local file brigade to. This may be the case with other participants, potentially explaining the low number of responses to this question.

Figure 61: Fire hydrant testing and compliance with the New Zealand Fire Service Firefighting Water Supplies Code of Practice



9.4 Backup-generation

Information on the number of back-up generators on water and wastewater treatment plants and pump stations is shown in Volume 2. The total number across all participants is shown in the table below.

Figure 62: Number of treatment plants with backup generation

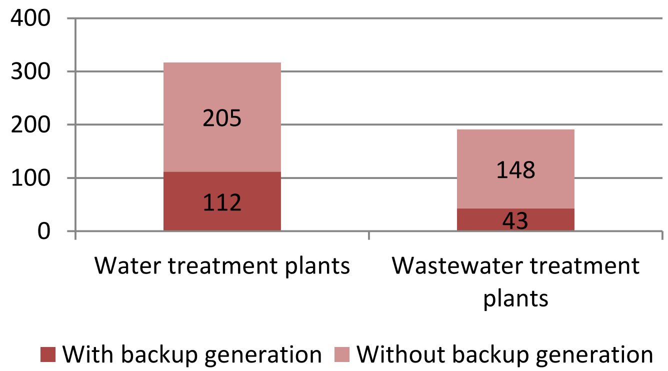
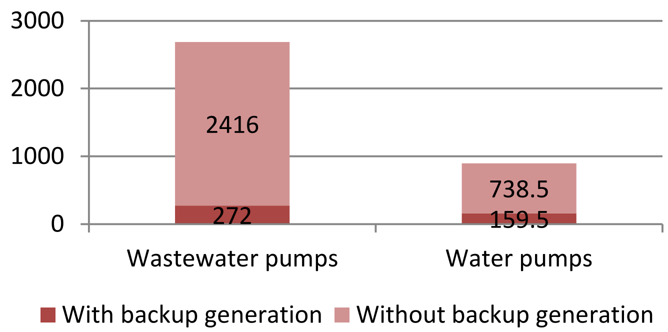


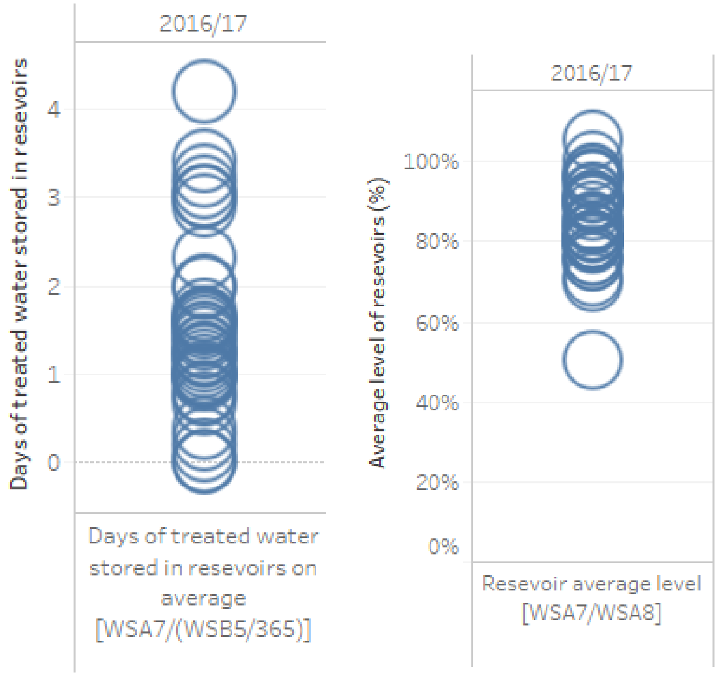
Figure 63: Number of pump stations with backup generation



9.5 Water storage

Participants have a median of 1.36 days of water stored in their systems, and a median average reservoir level of 86%. The average number of days of water storage, and reservoir levels per participant, are shown in Volume 2.

Figure 64: Average days storage in reservoirs and average reservoir level

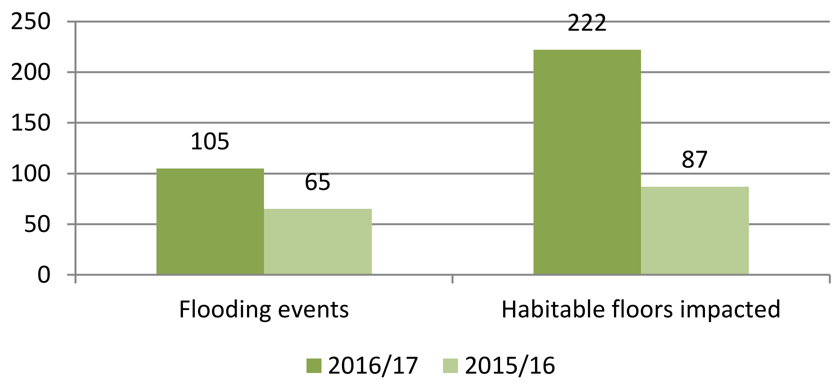


9.6 Flooding

9.6.1 Flooding events

The number of flooding events recorded in 2016/17 increased by 62% from 2015/16, and the number of habitable floors affected by flooding rose by 155%. Gross numbers are summarised in Figure 65 and per participant results are available in Volume 2.

Figure 65: Number of flooding events and habitable floors impacted



9.6.2 Flood design standards

The number of participants targeting various levels of service for the design of primary and secondary stormwater networks is summarised in Figure 66 and Figure 67.

The primary network typically consists of a network of pipes, culverts, and soak holes designed to minimise nuisance flooding by collecting and discharging stormwater from moderate rainfall events into streams and other watercourses. The secondary network refers to the stormwater flow path when the primary system is overloaded, and typically includes drains and other overland flow paths through private property and along roadways, designed to convey excess stormwater with a minimum of damage.

The figures show the annual exceedance probability (AEP) for both primary and secondary networks, i.e.the chance or probability of a flooding event occurring annually. If different levels of service exist across a participant's jurisdiction, participants have been asked to provide the value used across the largest proportion of the catchment.

Figure 66: Number of participants employing various design standards for the primary network

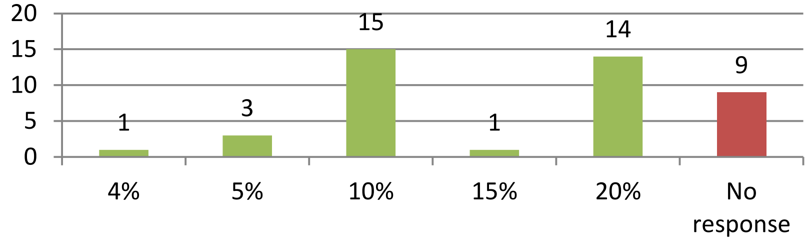
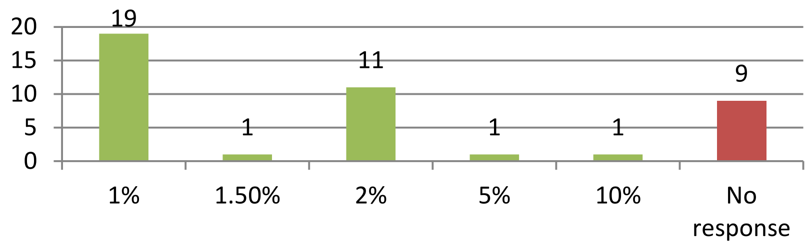


Figure 67: Number of participants employing various design standards for the secondary network



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APPENDIX 1: Participant Abbreviations

Participant name	Report abbreviation
Ashburton District Council	Ashburton
Auckland Council	Auckland Council
Central Otago District Council	Central Otago
Christchurch City Council	Christchurch
Clutha District Council	Clutha
Dunedin City Council	Dunedin
Gore District Council	Gore
Hamilton City Council	Hamilton
Hauraki District Council	Hauraki
Invercargill City Council	Invercargill
Kaipara District Council	Kaipara
Kapiti Coast District Council	Kapiti Coast
Mackenzie District Council	Mackenzie
Rangitikei District Council	Rangitikei
Marlborough District Council	Marlborough
Masterton District Council	Masterton
Napier City Council	Napier
New Plymouth District Council	New Plymouth
Otorohanga District Council	Otorohanga
Palmerston North City Council	Palmerston North
Queenstown Lakes District Council	Queenstown Lakes
Rotorua District Council	Rotorua
Ruapehu District Council	Ruapehu
Selwyn District Council	Selwyn
South Taranaki District Council	South Taranaki

Participant name	Report abbreviation
Stratford District Council	Stratford
Tasman District Council	Tasman
Taupo District Council	Taupo
Tauranga City Council	Tauranga
Thames - Coromandel District Council	Thames - Coromandel
Timaru District Council	Timaru
Waikato District Council	Waikato
Waimakariri District Council	Waimakariri
Waipa District Council	Waipa
Wairoa District Council	Wairoa
Watercare Services Ltd	Auckland
Wellington City Council	Wellington Central
Lower Hutt City Council	Lower Hutt
Porirua City Council	Porirua
Wellington Regional Council	Wellington Region
Upper Hutt City Council	Upper Hutt
Western Bay of Plenty District Council	Western Bay of Plenty
Whakatane District Council	Whakatane
Whangarei District Council	Whangarei

APPENDIX 2: Quality assurance processes

Data in the report is manually entered by participants. Participants rate the confidence level of data they provided using a 5 to 1 descending scale, with 5 being very high confidence, and 1 being very low. The definition of each data confidence level is provided in Table 8. Where data confidence is low, highly variable, or showing a noteworthy trend, data confidence has been included in the report.

Data quality checks have followed the process shown here.

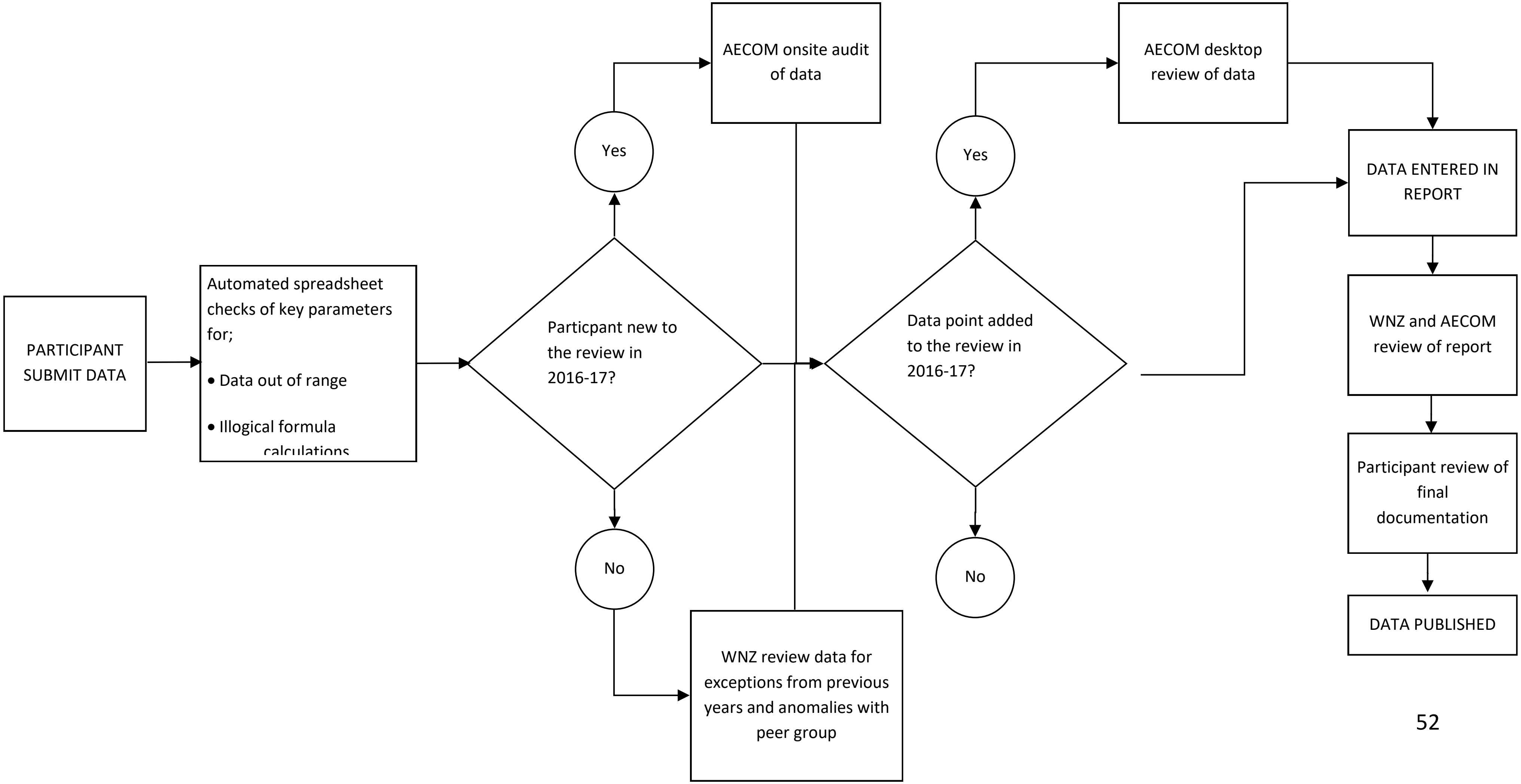

Table 8: Data quality definitions used in the NPR

RATING	DESCRIPTION	PROCESSES	ASSET DATA
5	Highly reliable/ Audited	Strictly formal process for collecting and analysing data. Process is documented and always followed by all staff. Process is recognised by industry as best method of assessment.	Very high level of data confidence. Data is believed to be 95-100% complete and + or - 5% accurate. Regular data audits verify high level of accuracy in data received.
4	Reliable/ Verified	Strong process to collect data. May not be fully documented but usually undertaken by most staff.	Good level of data confidence. Data is believed to be 80-95% complete and + or - 10% to 15% accurate. Some minor data extrapolation or assumptions has been applied. Occasional data audits verify reasonable level of confidence.
3	Less Reliable	Process to collect data established. May not be fully documented but usually undertaken by most staff.	Average level of data confidence. Data is believed to be 50-80% complete and + or - 15to20% accurate. Some data extrapolation has been applied based on supported assumptions. Occasional data audits verify reasonable level of confidence.
2	Uncertain	Semi-formal process usually followed. Poor documentation. Process to collect data followed about half the time.	Not sure of data confidence, or data confidence is good for some data, but most of dataset is based on extrapolation of incomplete data set with unsupported assumptions.
1	Very uncertain	Ad hoc procedures to collect data. Minimal or no process documentation. Process followed occasionally.	Very low data confidence. Data based on very large unsupported assumptions, cursory inspection and analysis. Data may have been developed by extrapolation from small, unverified data sets.
0	No data	No process exists to collect data.	No data available.

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NEW ZEALAND
The New Zealand Water & Wastes Association Waiora Aotearoa

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