Asset Management Plan Summary

Water supply

Asset management plans

Together, our 14 asset management plans present a detailed description of all the things – roads, cycleways, footpaths, pipes, buildings, vehicles, parks and so on – that the Christchurch City Council owns, across all areas of work, and how these 'assets' are planned, managed, operated and funded.

All our assets, collectively worth $16.8 billion, belong to ratepayers and are managed and operated on their behalf. Ensuring our assets are appropriate for the city's needs enables us to deliver the services that make Christchurch and Banks Peninsula a great place to live, work and visit.

Asset management plans are technical documents. The summary documents give an overview of how we manage our assets through their lifecycles to ensure we deliver services in cost-effective ways.

For the first time, we have published these documents online as part of our commitment to transparency.

What we do

We provide potable water for drinking and other uses to around 160,000 homes, businesses and industries. We manage, maintain and operate seven urban water supply schemes and six rural water supply schemes.

Why we do it

Providing a high quality, clean, safe and sustainable drinking water supply is an essential service.

High quality drinking water ensures the community is protected from water-borne diseases and that public drinking water supplies meet safety and health risk standards.

We aim for our water supply assets and activities to contribute to safe and healthy communities, to supply high quality drinking water, to use resources in a sustainable way and for our infrastructure and facilities to be modern and robust.

Christchurch City Council

Our assets

We own, plan, manage and operate the Christchurch water supply network. Our assets have a replacement value of $2.87 billion (replacement cost at 30 June 2020).

Asset class	Replacement value
Reticulation	$2,592,416,391
Pump stations	$270,350,852
Treatment plants	$10,551,171
Total	**$2,873,318,414**

Where we've come from

Christchurch's water supply has evolved from the various community schemes that began joining up with central reticulation in the early 1900s. Standardisation of water supply provision increased from 1989 when five local bodies merged into the new Christchurch City Council. Banks Peninsula water supplies came into Council stewardship in 2006 following amalgamation.

Christchurch city has a decentralised system of multiple wells that provide high quality deep aquifer groundwater straight into the reticulation system for consumption.

The Canterbury earthquakes of 2010 and 2011 Canterbury disrupted the water supply. Repairs and temporary solutions were completed rapidly to restore water supply provision, followed by a programme of assessment and rebuilding. This event increased awareness of the need for water supply resilience.

In 2016 a water contamination event in Havelock North put a national spotlight on the risk of water supply contamination. Expert security assessments of our well heads in late 2017 found that none were secure. This cost Christchurch its secure bore status, which is needed if water is not treated. Since then much of the city and Brooklands/Kainga water supples have been temporarily dosed with chlorine while infrastructure upgrades are completed. A priority programme of work is now under way to demonstrate that Christchurch drinking water is safe without chlorine treatment.

Our issues and risks

In this asset management plan we provide a snapshot of the greatest risks recorded for water supply and summarise the main mitigations.

Our network is vulnerable to a wide range of risks, from issues such as climate change through to inherent operational risks, such as contamination of the drinking water. These are all outlined in the asset management plan, along with the mitigations we've planned.

What it costs

Our proposed budget for the activity that uses these assets in Year 1 of the LTP is $135.56 million (total activity net cost of service plus capital spend for 21/22), with the net operational expenditure projected at $70.15 million (net cost of service) and capital expenditure at $65.41 million (total capital spend). Tables for each area of spending are included in our activity plan.

**The proposed operational and capital programme is indicative only. It will be updated through the LTP 2021-31 capital prioritisation process.*

How we're funded

Our expenditure is determined under the Council's Revenue and Funding Policy, based on who benefits.

This policy is being reviewed for the Long Term Plan 2021-31.

- Operational expenditure (including maintenance) is funded by rates (targeted, general, separate and differential) and through fees and charges.
- Capital expenditure is funded by borrowing and repaying over several years.
- Private developer vesting – water supply assets are created during the subdivision process and vested with the Council.

How it's delivered

The Three Waters and Waste Unit is responsible for water supply. Several teams across this unit are involved in delivery, along with other staff and private contractors.

Staff deliver

- Network and water supply operations, water services, asset planning and management, project management, quality control and compliance.
- Reactive and planned renewals and improvements
- Major maintenance
- SCADA system
- Financial and legal advice
- Supervision and liaison with external contractors

Contractors deliver

- Maintenance and construction
- Water treatment operations

Key delivery partners

- Citycare Ltd
- External consultants

Our functions and services

Residents want reliable, safe, high quality drinking water. They want us to operate and maintain the service in a responsive manner that also demonstrates environmental stewardship. Ratepayers also want value for money.

Water sources (groundwater and surface water), water treatment (where needed), water storage and reticulation (flow, pressure and reservoir level monitoring) are also important aspects of our work in achieving these outcomes.

We apply engineering, financial and management practices to achieve the agreed levels of service, for the most cost-effective expenditure. This means optimising investment and outcomes within the constraints of finance, service levels and resources.

Managing our assets involves spending considerable amounts of public money, so it's vital that we do the right thing, at the right time and for the right price.

While managing our assets to meet agreed levels of service, financial prudence demands that we optimise asset lifecycle costs, so our management planning also aligns to the stages of an asset's lifecycle. Our renewals programme considers the condition of assets, not just their age.

Asset maturity assessment

The maturity assessment for our assets shows we are performing at an intermediate or advanced level in most areas. The average score rose from 77 percent to 82 percent in the past two years, with the target being 92 percent. More detailed information about this is included in our asset management plan.

Water Supply Asset Management Plan

February 2021

Christchurch City Council

Version Control and Approvals

Version	Date
Draft for internal review	21 May 2020
Revised draft following Council confirmation of draft budget	Under development

Version 1.0 – Draft for internal review

Role	Name	Title	Signature	Date
Author	James Thorne Michael Galambos	Asset Engineer Asset Engineer		
Reviewer	Mark Johnson	Team Leader – Asset Management		
Reviewer	Bridget O'Brien	Programme Manager – Water Supply		
Approver	Helen Beaumont	Head of 3 Waters & Waste		

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1 Summary of the activity

1.1 Activity description

1.1.1 What do we do?

This activity provides water for drinking and other potable uses to the people of Christchurch. The Council supplies water to approximately 160,000 residential and business customer connections, through seven water supply schemes in Christchurch City, Lyttelton, Governors Bay, Diamond Harbour, Akaroa, Ducauchelle Bay, Birdlings Falt, Little River, Pigeon Bay and Wainui. Christchurch City, Lyttelton, Governors Bay, Diamond Harbour, Akaroa and parts of Duvauchelle are urban on-demand water supplies also provide fire fighting water while the remainder of Duvauchelle, Birdlings Flat, Little River, Pigeon Bay and Wainui are rural restricted water supply schemes supplying a set quantity per day to fill private water tanks.

1.1.2 Why do we do it?

Access to clean and safe drinking water is an essential service to the people of Christchurch.

The water supply activity also supports the community outcomes below:

- Safe and healthy communities
- High quality drinking water
- Sustainable use of resources
- Modern and robust city infrastructure and facilities.

It also is key to achieving the Council's strategic priority of ensuring a high quality drinking water supply that is safe and sustainable.

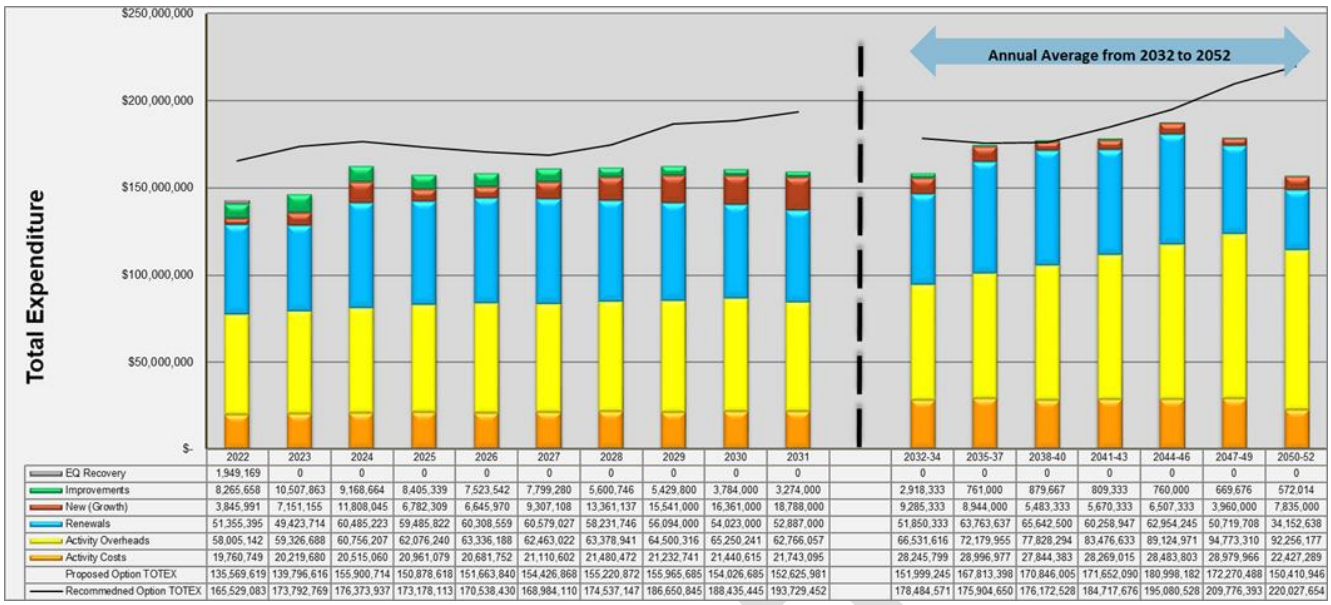
The detail of how the water supply activity contributes to Council's community outcomes and the manner that the activity responds to Council's strategic priorities provided in Section 2.

1.1.3 How much does it cost?

Projected cost of providing the necessary core services covered by this asset management plan (AMP) at the current levels of service is **$1,771 million**. Figure 1-1 shows a breakdown of these costs into operations, maintenance, renewal, upgrade and earthquake recovery over the 10 years of the Long Term Plan (LTP) from Financial Year 21/22 to Financial Year 2031/32 (FY22 – FY32). Figure 1-2 shows historic expenditure of **$604 million** for the 10 year period FY2011 to FY2020. The significant projected increase is primarily due to a large proportion of the pipe network reaching end of life creating a backlog of deferred renewals.

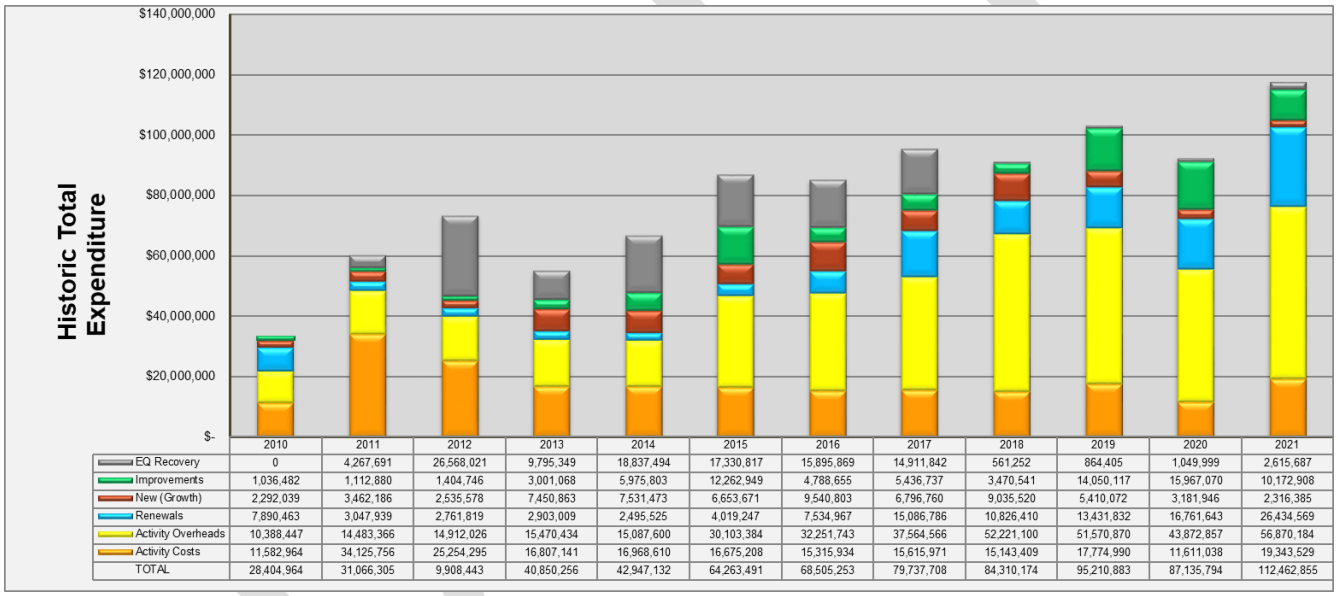
The funding allocated to providing the necessary core services covered by this AMP over the 10 years of the LTP is **$1506 million**. This is **85%** of the cost (as outlined above) to provide optimised asset management at the lowest lifecycle cost.

The allocated funding leaves an annual average shortfall of **$265 million** over the 10 years of the LTP. The projected cost and allocated funding are shown in **Error! Reference source not found.** (all values exclude inflation). Levels of service will d ecrease due to this shortfall.



	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032-34	2035-37	2038-40	2041-43	2044-46	2047-49	2050-52
EQ Recovery	1,949,169	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Improvements	8,265,658	10,507,863	9,168,664	8,405,339	7,523,542	7,799,280	5,600,746	5,429,800	3,784,000	3,274,000	2,918,333	761,000	879,667	809,333	760,000	669,676	572,014
New (Growth)	3,845,991	7,151,155	11,808,045	6,782,309	6,645,970	9,307,108	13,361,137	15,541,000	16,361,000	18,788,000	9,285,333	8,944,000	5,483,333	5,670,333	6,507,333	3,960,000	7,835,000
Renewals	51,355,395	49,423,714	60,485,223	59,485,822	60,308,559	60,579,027	58,231,746	56,094,000	54,023,000	52,887,000	51,850,333	63,763,637	65,642,500	60,258,947	62,954,245	50,719,708	34,152,638
Activity Overheads	58,005,142	59,326,688	60,756,207	62,076,240	63,336,188	62,463,022	63,378,941	64,500,316	65,250,241	62,766,057	66,531,616	72,179,955	77,828,294	83,476,633	89,124,971	94,773,310	92,256,177
Activity Costs	19,760,749	20,219,680	20,515,060	20,961,079	20,681,752	21,110,602	21,480,472	21,232,741	21,440,615	21,743,095	28,245,799	28,996,977	27,844,383	28,269,015	28,483,803	28,979,966	22,427,289
Proposed Option TOTEX	135,569,619	139,796,616	155,900,714	150,878,618	151,663,840	154,426,868	155,220,872	155,965,685	154,026,685	152,625,981	151,999,245	167,813,398	170,846,005	171,652,090	180,998,182	172,270,488	150,410,946
Recommedned Option TOTEX	165,529,083	173,792,769	176,373,937	173,178,113	170,538,430	168,984,110	174,537,147	186,650,845	188,435,445	193,729,452	178,484,571	175,904,650	176,172,528	184,717,676	195,080,528	209,776,393	220,027,654

Figure 1-1: Proposed Capital Expenditure in the Long Term Plan FY22 - FY52



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
EQ Recovery	0	4,267,691	26,568,021	9,795,349	18,837,494	17,330,817	15,895,869	14,911,842	561,252	864,405	1,049,999	2,615,687
Improvements	1,036,482	1,112,880	1,404,746	3,001,068	5,975,803	12,262,949	4,788,655	5,436,737	3,470,541	14,050,117	15,967,070	10,172,908
New (Growth)	2,292,039	3,462,186	2,535,578	7,450,863	7,531,473	6,653,671	9,540,803	6,796,760	9,035,520	5,410,072	3,181,946	2,316,385
Renewals	7,890,463	3,047,939	2,761,819	2,903,009	2,495,525	4,019,247	7,534,967	15,086,786	10,826,410	13,431,832	16,761,643	26,434,569
Activity Overheads	10,388,447	14,483,366	14,912,026	15,470,434	15,087,600	30,103,384	32,251,743	37,564,566	52,221,100	51,570,870	43,872,857	56,870,184
Activity Costs	11,582,964	34,125,756	25,254,295	16,807,141	16,968,610	16,675,208	15,315,934	15,615,971	15,143,409	17,774,990	11,611,038	19,343,529
TOTAL	28,404,964	31,066,305	9,908,443	40,850,256	42,947,132	64,263,491	68,505,253	79,737,708	84,310,174	95,210,883	87,135,794	112,462,855

Figure 1-2: Historical expenditure for water supply FY10 – FY21

Impacts of Covid-19 – short and longer term

Early forecasting advice from economic commentators (e.g. the Treasury, ChristchurchNZ, financial institutions) signals significant economic impacts locally, nationally and internationally. This advice is updated regularly and is likely to change over time (the Treasury's economic scenarios released on 14 April caution that economic impacts are 'highly uncertain').

What might this mean for the water supply activity?

- An initial focus on infrastructure that supports Covid-19 economic recovery and delivers projects critical to the capital programme or identified as part of a central government stimulus package, and completing committed projects.
- Short-term (now, and LTP years 1-3): possible delays in scheduled capital programme works, potential issues with workforce availability/contractor viability following lifting of restrictions; uncertainty about materials supplies;

changing priorities for work programming and methodologies (e.g. accommodating physical distancing). Opportunities for bringing forward 'shovel ready' work and increased financial pressure on Council budgets.

- Medium term (LTP years 4-6): Further consideration of capital works programme in light of the emerging Financial Strategy and Infrastructure Strategy response.
- Longer term (LTP years 6 – onwards): Uncertain at this stage; potentially dealing with the effect of any deferred expenditure due to the above factors.

1.1.4 How is it funded?

Council's Revenue and Financing Policy sets out how the expenditure needs for Council activities will be funded. The policy is based on who benefits.

Council reviewed its revenue and financing policy as part of the development of the LTP. In brief –

1. Operational and maintenance expenditure (OPEX) – is funded by rates generated by the collection of targeted, general, separate and differential rates and through Council's fees and charges.

2. Capital expenditure (CAPEX) – is funded by borrowing and repaying over several years, enabling Council to match best the charges placed on the community against the period of benefits from capital expenditure.

3. Private Developer Vesting – as part of the subdivision process water supply assets are created by the developer and vested with Council on completion of a subdivision.

1.1.5 How is the activity delivered?

The water activity is primarily the responsibility of Council's internal Three Waters and Waste Unit. Section 6.2 provides the structure of the three waters and waste unit.

Council's Three Waters and Waste Network Operations Team operates the Christchurch water supply network with maintenance activities carried out by Council's Three Waters and Waste Water and Wastewater Operations and Citycare Limited under contract CN4600000778. Citycare Limited is a Council Controlled Organisation (CCO). Citycare Limited also operates and maintains the Akaroa, Duvauchelle, Birdlings Flat, Little River and Wainui schemes including water the water treatment plants. Council's Water and Wastewater Operations Team provides supervision of and liaison with the external contractor. Council staff manage renewals, improvements, major maintenance, and the SCADA system.

External consultants, contractors and service delivery partners provide support in all phases of the service delivery and asset lifecycle.

1.1.6 What are the functions and services provided?

The key services that customers want delivered are:

- Water supplies are reliable
- Water supplies are operated and maintained in a responsive manner
- Water supplies are safe and wholesome to drink
- High quality water is provided
- Water supply networks and operations are sustainable.

These key services form the basis for water supply to the community through the sub-functions of:

- Water sources (groundwater and surface water)
- Water treatment (where required)
- Water storage and reticulation, including flow, pressure and reservoir level monitoring
- Water conservation program including leak detection and management.

1.1.7 Overview of assets

The water supply activity includes seven separate water supply schemes. Each scheme has headworks assets consisting of water treatment plants, pump stations, wells, stream intakes and reservoirs and reticulation assets consisting of pipes, valves, fire hydrants and other fittings. 2020 valuations give a replacement cost of $2.87 billion for water supply assets.

1.2 Where have we come from and where are we heading

1.2.1 Background

Christchurch's water supply has evolved from the various community schemes that began joining up with central reticulation in the 1890s and early 1900s. Standardisation of water supply provision increased from 1989 when five local bodies merged into the new Christchurch City Council. Stand-alone Banks Penninusla water supplies came into Council stewardship in 2006 following further amalgamation.

Christchurch City has benefitted from a decentralised system of multiple wells providing high quality deep aquifer groundwater straight into the reticulation system for customer consumption.

The 2010/2011 Canterbury earthquakes disrupted the water supply. Repairs and temporary solutions were completed rapidly after the earthquakes to restore water supply provision, followed by a programme of assessment and rebuilding. This event increased awareness of how the water supply activity can be made more resilient and the need to manage any legacy impacts of the earthquakes on the water supply infrastructure.

In 2016 a water contamination event in Havelock North put a national spotlight on the risk of contamination of water supplies and resulting in the entire water industry becomming much more risk averse. The subsequent expert security assessments of well heads in late 2017 found that none of the well heads were secure and as a result Christchurch lost its secure bore status, which is needed if treatment is not provided. Since that time much of the Christchurch City water supply has been temporarily dosed with chlorine while infrastructure upgrades are undertaken. A priority programme of work is being undertaken to demonstrate that Christchurch can safely return to unchlorinated water. New water supply regulations may prevent chlorine removal.

1.2.2 Looking forward

Long-Term Strategic Direction

The longer-term strategic direction for water supply is supported by Council's Te Wai o Tane[1] - Integrated Water Strategy. This provides Council's vision, goals, objectives and suggested implementation actions for the city's water, wastewater and stormwater services. Water supply asset management strategies are expected to align with the Integrated Water Strategy objectives.

Short-Term Tactical Direction

Network deterioration with a large proportion of pipes reaching end of life (see section 1.3.1) will hinder water supply service delivery in the short to medium term. We anticipate the increase in pipes reaching end of life to cause an increase in leakage and the number of pipe breaks meaning there will be more frequent water supply interruptions. As these interruptions will occur on the poor condition pipes, it is likely groups of the same customers will suffer multiple interruptions and satisfaction with the water supply will decrease. Pipe renewals will prioritise the pipes with highest consequences of failure so even though failure rates increase effects on the city as a whole are minimised.

Level of service changes in Table 1-1 reflect the short to medium term reduction in service quality.

[1] Te Wai o Tane Integrated Water Strategy - TRIM://19/1465878

Number	Level of Service	Performance Measure	Previous Targets	New Targets
12.0.1.2	Council operates water supplies in a reliable manner.	Number of unplanned interruptions per 1,000 properties served per year.	Year 1: ≤ 16 Year 2: ≤ 15 Year 3: ≤ 14 Year 10: ≤ 8	Year 1: ≤ 39 Year 2: ≤ 40 Year 3: ≤ 41 Year 10: ≤ 42
12.0.1.13	Council operates water supplies in a reliable manner.	Proportion of residents satisfied with reliability of water supplies.	Year 1: ≥85% Year 2: ≥85% Year 3: ≥85% Year 10: ≥85%	Year 1: ≥75% Year 2: ≥80% Year 3: ≥80% Year 10: ≥60%
12.0.6	Council water supply networks and operations are sustainable	Percentage of real water loss from Council's water supply network	Year 1: ≤ 15% Year 2: ≤ 15% Year 3: ≤ 15% Year 10: ≤ 15%	Year 1: ≤ 24% Year 2: ≤ 25% Year 3: ≤ 25% Year 10: ≤ 26%

Table 1-1: Level of Service Changes

The quantity of pipes requiring renewal is greater than the market has capacity to construct, even should budget be available. As such, reductions in service quality are unavoidable and changing budgets will only change r when or if we return to current service levels.

Vertical infrastructure in pump stations and treatment plants is also under stress with insufficient budgets to replace backlogs of obsolete, dangerous or past end-of-life assets along with additional requirements to meet new, higher drinking water standards. Deterioration and damage to reservoirs and suction tanks may prevent drinking water achieving the new requirements following the Havelock North water contamination event. Initial inspection and assessment of all reservoirs and suction tanks over the initial years of the LTP will allow preparation of a program of works to repair deterioration and damage.

A number of pump station assets are either operating well beyond their theoretical effective lives or are obsolete and cannot be repaired or replaced should they fail. Budgetary constraints mean we cannot replace these assets and we are planning to keep pushing their lives further. These tactics increase the risk of station failure potentially causing water supply failure or pressure loss.

The majority of old technology motors and unsafe electrical equipment have been or are undergoing replacement under the 2018 LTP. Two stations with these asset types remain but as the future of these stations is uncertain with proposals to replace them with new stations in a different location there are no plans to replace these assets.

Constraints and Uncertainty

The current context surrounding the water supply activity will continue to influence the current and future outlook. This includes new drinking water regulation, water industry service delivery reform, renewal of ageing infrastructure, responses to climate change, addressing risk and resilience, reducing water demand, moving to data-rich smart technology solutions, engaging with customer expectations, managing financial constraints and the uncertainty surrounding the long term impacts of Covid-19. Section 1.3 discusses strategic issues and risks in further detail.

1.3 Successes, issues, opportunities and risks

1.3.1 Success factors

Success within the water supply activity can be measured through the levels of service. Key focus areas are: compliance with the Health Act, Drinking-water Standards for New Zealand, resource consent conditions, and performance measures for customer satisfaction, network faults and response times, sustainable water demand and financial efficiency.

Where things have gone well

Water Safety Plans are in place for all Council water supplies. Revised Water Safety Plans have been created for Christchurch City and Banks Penninsula water supplies under the Ministry of Health Framework for Water Safety Plans (2018). This provides the platform for meeting public health regluatory requirements for drinking water. The Water Safety

Plans have identified where additional risk mitigation is needed to deliver safe water. However; all revised water safety plans remain to be approved.

Well head security is being addressed through the comprehensive capital upgrade programme.

Fault response times and flow and pressure complaints have consistently been tracking better than target levels.

Power costs per unit of water supplied are very low compared to national benchmarks due to the decentralised nature and ease of abstraction of the city's groundwater bore sources.

The Asset Assessment Intervention Framework (AAIF) tool for reticulation assets has been developed based on an improvement item identified in the 2018 AMP. Outputs from AAIF are now being used to inform renewal decision-making for the LTP. This marks a key milestone in the development of an effective, transparent and fast rationale for reticulation renewal planning.

Current growth projections are being planned for and can be accomodated without radical change.

Where improvements can be made

In 2016 a drinking water contamination event in Havelock North put a national spotlight on unchlorinated water being supplied directly to customers, effectively raising the standards for all drinking water supplies. In FY18, all Christchurch water supplies failed to meet the water quality standards for protozoa, due to a loss of secure bore status for the Christchurch and Brooklands/Kainga supplies. This resulted in the Council temporarily chlorinating the city's water.

Water supplies for 74% of the district's population failed to comply with the Health Act requirements for safe drinking water supplies. Failures relate to not notifying the Medical Officer of Health of water shut downs lasting more than 8 hours.

Resident satisfaction with the quality of the water supply hasranged between 84% and 92% in recent years. Following the start of temporary chlorination in 2018, satisfaction dropped to 37% in 2019.

Leakage rates have increased from 11.7% in FY16 increasing to 23% in FY19 (noting that FY19 value is artifically inflated due to leakage measurements being undertaken after irrigation had begun). Renewals are required to reduce leakage rates. This is a focus area to minimise the risk of interaction between potential contaminant sources and the water supply. Reducing leakage will also reduce power and conveyance costs and is an important issue to target ahead of other demand management measures that Council may want to implement.

The number of unplanned interruptions at 38.4 per 1000 connections is high compared to national benchmarks (median of 7.9 per 1000 connections Water NZ Benchmarking FY19). This is one indicator of a deteriorating reticulation network and the need for large scale pipe renewals.

13.4% of water main and submain pipelines are in very poor condition (Condition Grade 5 by length), a large increase from 12% in the 2018 Infrastructure Strategy. This deterioration in condition is the result of different pipe materials from different decades arriving at end of life at the same time. Reductions in expected pipe lives is an additional issue, with the lives of some materials reduced due to premature failure of material types and other material's lives reduced to reduce risks identified in the water safety plan such as with lead jointed cast iron pipes.

Peak hourly and daily demand for water is very high for a few days in the summer with high use from garden watering testing the capacity of the infrastructure to maintain adequates pressure across the City's supply zones. Effective demand management is needed to reduce this demand and mitigate the risk of a drop in pressure.

The drinking water regulatory environment in New Zealand is changing and there is a need for improvements to the water supply activity in order to keep up. This includes drinking water standards compliance, as well as targeting reservoir and suction tank condition, leakage rates and backflow prevention.

There are key areas where increased data quality will lead to better decision-making outcomes. Focus on failure data, and on the asset data held for station and treatment assets will significantly improve data confidence.

1.3.2 Strategic Issues and Risks

The key strategic issues and risks for the water supply activity are summarised in Table 1-2.

Strategic Issue	Issue Description	Responses
Drinking Water Safety	In the 2017/18 year, the Christchurch and Brooklands/Kainga water supplies lost secure groundwater status. This resulted in the Council chlorinating the city's water. New drinking water regulation requires greater demonstration of safety.	• Most of the wellheads in Christchurch City have been upgraded • New Water Safety Plans have been prepared according to the new Ministry of Health framework • A Water Safety Plan improvement programme including: backflow prevention and reservoir/suction tank condition assessment and remediation • Installing smart monitoring technology into the network • Developed high level cost estimates for permanent treatment options
Asset Renewal	Historical material choices and growth periods result in a large cohort of pipes that require renewal in the next ten-year period.	• Asset Assessment Intervention Framework (AAIF) tool implemented to use asset management data and a risk-based approach to pipe renewal planning. • Recommended renewal strategies for above and below ground infrastructure to address historic underinvestment. • Improvement programmes for asset data collection, targeting failure records and above ground asset information.
Climate Change	The many predicted impacts of climate change (changing rain patterns, sea level rise, elevated groundwater levels etc.) are going to affect the way that Council operates, maintains and plans for the activity.	• Climate change risk assessments to identify most significant issues • Introduction of carbon accounting tool • Mapping of climate change related hazard zones • Discussion of climate change and responses within the AMP • Requirement for funding of specific water supply climate change response investigation so that options and benefits can be established prior to promoting specific capital projects in the next LTP cycle
Demand Management	Customers experience a seasonal water shortage	• Installing smart monitoring technology into the network • Pressure management and smaller pressure zones have been trialled with the benefit of reducing demand • Further sustainable demand management through pressure re-zoning • Increased leak detection and remediation • Providing reduced leakage through reticulation renewal • Increasing the scope and reach of volumetric charging for water services for high users
Government Review of Service Delivery	A review under Section 17A of the Local Government Act of the delivery of 3-	Given the uncertainty with the Section 17A review, it is difficult to predict the impacts on

	Waters Services was initiated in July 2019 for two key reasons: • Impending expiry of existing maintenance contracts • To prepare for the outcomes of the Department of Internal Affairs' 3 Waters review	the water supply activity service delivery structure. The AMP is prepared on a "business as usual" assumption. Potential outcomes include: • Business as usual • Stand alone business unit • Council controlled organisation • Cross boundary or regional joining of forces
Covid-19 Uncertainty	The impact of the Covid-19 pandemic and subsequent economic downturn will have an effect on Council's assets and services, as well as rates and Council's other revenue streams.	The AMP has been prepared without a prediction of how the Covid-19 crisis will impact the activity. The future response is uncertain, but may be significant for the water supply activity.

Table 1-2: Key Water Supply Strategic Issues and Risks

2 Introduction

2.1 Background

This asset and activity management plan (AMP) is the basis for water supply activity planning. The purpose of this plan is to demonstrate responsive management of assets (and services provided from assets), compliance with regulatory requirements, and to communicate funding needed to provide the required levels of service over a 30-year planning period.

The objective of asset management is to:

"Deliver the required level of service to existing and future customers in the most cost-effective way."

In this context the specific objectives for this AMP are:

- To define the services to be provided, the target service standards that Council aims to achieve, and the measures used to monitor the performance of the water supply activity.
- To translate Council's Strategic Vision and Goals into activity strategies and action plans. The plan identifies forward works programmes based on strategic outcomes sought and financial forecasts required to meet agreed service levels and cater for growth.
- To demonstrate responsible management of the water supply activity infrastructure to stakeholders, ensuring that public funds are optimally applied to deliver cost effective services to meet customer expectations.
- To document current asset management practices used by Council based on clear evidence as part of a sustainable and optimised lifecycle management strategy for the water supply infrastructure, and identify actions planned to enhance management performance.
- To comply with the requirements of relevant legislation.

The key outputs of this AMP are inputs into the 2022-2031 Long Term Plan process, which will be the subject of a special public consultative procedure. The intention of this AMP is to set out how Council manages water supply assets and services in a way that is appropriate for a readership including elected members of the Council, executive management, interest groups and business partners associated with the management of the water supply activity along with interested members of the community. It covers the services provided from ownership and management of the associated assets.

This AMP covers a period of 30 years commencing 1 July 2021. Operational, maintenance and renewal programmes for the first three years are generally well defined with reasonable certainty of being implemented to budget as planned. Beyond this period, work programmes are generally based on projected trends and demands and there is less certainty with respect to scope and timing of the projects. All expenditure forecasts are based on unit costs as at 1 July 2020.

2.2 Relationship with other plans

Many of the assets planning activities undertaken by Council are applied to all infrastructure assets. For this reason, Council has developed asset management plans in two parts. A strategic asset management plan (SAMP) document[2] which provides an overview of asset management planning at the Council, and an AMP document for each asset group which describes the assets and how the principles contained within the SAMP are applied to the management of the assets.

[2] Strategic Asset Management Plan (Approved by ELT 5 October 2020) - *TRIM://20/1271862*

Figure 1-1 depicts the relationship between the various processes and levels of planning within the Council required to deliver on Council's vision and goals.

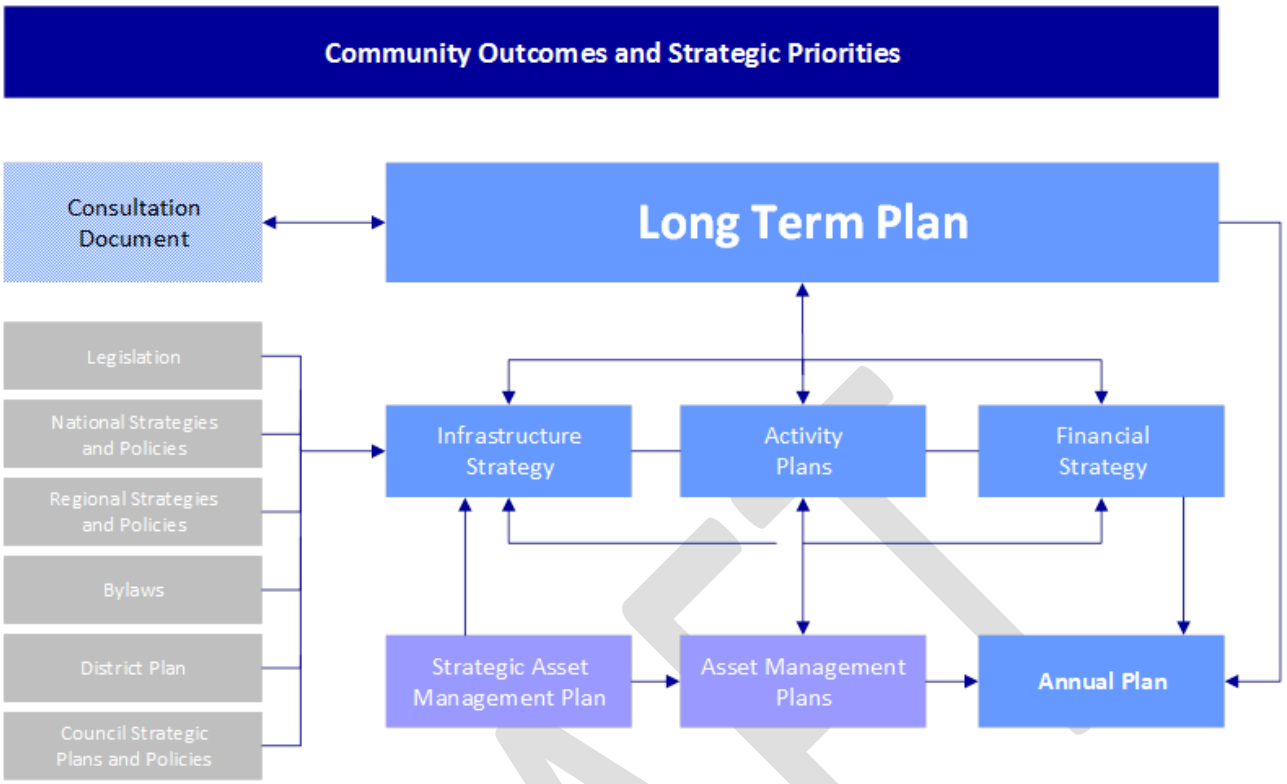


Figure 2-1: Council's Planning Framework

The SAMP provides an overview of the linkages between asset management planning and the other business processes of Council, such as strategic planning, risk management, financial management and compliance. Throughout this AMP references to the SAMP are frequently made.

The SAMP also describes the linkages between AMPs and other corporate plans and documents. In addition to these corporate documents, the following documents are specifically relevant to this AMP:

- Te Wai o Tane - Integrated Water Strategy
- Water Safety Plans.

2.3 Delivering on Council's Strategic Framework

2.3.1 Alignment of outcomes, priorities and activity objectives

Council's strategic framework and general implications for the activities are presented in Council's Strategic Asset Management Plan. Table 2-1 summarises key responses by the activity to contribute to the community outcomes and strategic priorities.

Level	Community Outcome	How the Activity Contributes to the Community Outcome
Primary Outcome 1	Safe and healthy communities	We manage the public drinking water supplies to ensure human health. In doing so we: • Protect the community from water-borne diseases • Ensure that public drinking water supplies meet safety and health risk standards
Primary Outcome 2	High quality drinking water	We ensure that drinking water has no objectionable or offensive taste, odour or appearance.

Secondary Outcome 1	Sustainable use of resources	We sustainably manage drinking water sources by: • Limiting the quantity of water abstracted so as to prevent waterway health deterioration • Promoting sustainable use drinking water through water conservation measures and education. • Limiting resource use, both for water abstraction and for water treatment
Secondary Outcome 2	Modern and robust city infrastructure and facilities network	We strive for a resilient public drinking water supply network, to support a healthy community, healthy environment and prosperous economy by: • Minimising damage from natural disasters by setting minimum requirements for new infrastructure. • Gathering an evidence base to support asset lifecycle decision making. • Performing lifecycle management to minimise whole of life costs. • Minimising disruptions to the water supply service.
Secondary Outcome 3	Great place for people, business and investment	We strive to manage costs and intergenerational debt by: • Controlling costs to minimise rates increases • Maintaining networks to prevent future generations inheriting a network in need of significant expenditure.

Table 2-1: Alignment of Outcomes, Priorities and Activity Objectives

2.3.2 Activity responses to strategic priorities

Council has confirmed the following strategic priorities requiring specific focus for the 2021 - 2031 LTP. In response to these priorities, this AMP includes a number of responses as tabulated in Table 2-2, with reference to the relevant section in the AMP where further detail on responses is provided. Responses to natural hazard risks and building resilience are dealt with in Section 5.

Revised Strategic Priority	How the Activity Contributes to the Strategic Priority
Enabling active and connected communities to own their future	Active citizenship supported and promoted via: • The Community Water Partnership (assuming that it will incorporate not only surface water and stormwater matters but also water conservation and efficiency) • Support to water management zone committee activities (e.g. the March/April 2019 'what's under your feet' field trips) • Contributing to annual residents surveys, including views on the public water supply • An improvement programme to increase customer engagement and levels of service consultation.
Meeting the challenge of climate change through every means available	Adjusting the water supply activity to account for climate change adaptation and mitigation. 1. Adaptation will be in response to impacts such as: • Increased peak demand with predicted warmer and drier weather; • Changing groundwater levels, and availability • Reduced flows in surface water sources of some Banks Peninsula water supplies (e.g. Balguerie Stream, Police Creek). • Shallow groundwater levels in parts of the city affecting underground horizontal infrastructure • Saltwater/freshwater interface in groundwater and saltwater intrusion • Managed retreat, infrastructure strengthening and installation of new infrastructure to meet plans for individual problem areas 2. Mitigation will be in response to impacts such as: • reducing carbon footprint through changes in design, material choice and construction of new assets • reducing carbon footprint through changes in water supply activity operation (pumping requirements and energy efficiency, fuel use and alternative fuels)
Ensuring a high quality drinking water supply	Safe and sustainable water supply is the raison d'être for this activity and includes:

that is safe and sustainable	• water safety plan improvements to demonstrate public health safety • smart flow monitoring and real time water quality data • detecting and change in conditions and potential contamination • water efficiency and conservation (e.g Waterwise; water demand management; leak detection and management) • infrastructure renewal and replacement programme using modern and resilient methods and materials
Accelerating the momentum the city needs	A healthy economy is supported by: • the critical provision of a safe and sustainable water supply • a modern and resilient infrastructure base
Ensuring rates are affordable and sustainable	Providing the essential service of water supply where financial decisions are prioritised using an evidence base that accounts for: • risk • public health safety • asset lifecycle cost considerations

Table 2-2: Contribution of the Activity to the Strategic Priorities

2.4 AMP Development Process

Figure 2-2 shows the process and timeline for AMP completion.

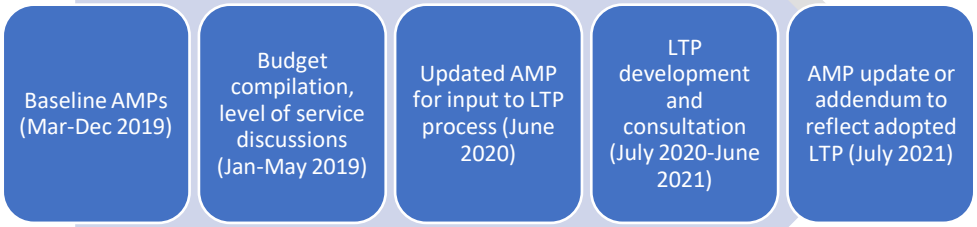


Figure 2-2: AMP Development Process and Timeline

Data from AMPs informs the Activity Plans, Infrastructure Strategy and greater LTP with outcomes from these other documents feeding back into the AMP.

2.5 Navigating the AMP

The AMP follows the general format for AMPs recommended in Section 4.2.6 of the International Infrastructure Management Manual. It comprises a series of logical steps that sequentially and collectively build the framework for sustainable asset management for the activity it serves.

Key elements of the plan are

- Levels of service – specifies the services and levels of service to be provided by the organisation,
- Future demand – how this will impact on future service delivery and how this is to be met,
- Life cycle management – how Council will manage its existing and future assets to provide defined levels of service,
- Financial summary – what funds are required to provide the defined services,
- Asset management improvement plan – the current and desired state of asset management practices and how the plan will be monitored to ensure it is meeting organisation's objectives.

3 The services we provide

This section outlines the drivers for the level of service requirements, sets out the proposed levels of service and performance measures, provides information on how Council has been performing in recent years against those requirements and identifies projects and programmes aimed at addressing any level of service gaps. (Levels of service gaps are where performance results achieved are consistently different from performance targets).

3.1 Level of Service Drivers

3.1.1 Customers and Stakeholders

Water supply assets provide water for drinking and other potable uses to the people of Christchurch. The Council supplies water through approximately 160,000 residential and business customer connections, through seven urban water supply schemes and six rural water supply schemes.

Table 3-1 identifies key stakeholders and customers to the Council public water supply.

Customers and Stakeholders	Specific Needs and Wants
• Residents • Businesses/Commercial Entities • Visitors/Tourists • Non-resident workers	• Clean, safe water • Reasonably reliable water supply • Safe, efficient and affordable water service • Polite and helpful customer service representatives • Prompt response to problems
• Contractors	• Clarity around standards of workmanship • Fair and open competition for their services
• Developers	• Capacity for new development • Fair and reasonable development contributions and connection fees
• Infrastructure providers (wastewater, storm water, roading, power companies, telecommunications companies)	• Clarity around standards of workmanship • Fair compliance monitoring
• Planners	• Clear, uniformly applied rules and procedures • Accessible and reliable information
• Elected Representatives (Councillors and Community Boards)	• Cooperation, information and compliance
• Canterbury Regional Council (Environment Canterbury (ECan) • Ministry of Health (MoH) • Community and Public Health (Canterbury District Health Board) • Fire and Emergency NZ	• Cooperation, information and compliance • Service available for all types of users • Sound long term planning • Compliance with plans, policies, standards, and consents • Protect public health • Compliance with the Drinking Water Standards for New Zealand (DWSNZ) • Adequate pressure and flow for fire fighting • Adequate frequency of hydrant locations

• Mana Whenua • Iwi	• Consultation on issues with cultural aspects or environmental impacts • Sensitivity to concerns with overflows to rivers and discharge of wastewater to water bodies • Work in accordance with the Iwi Management Plan[3]
• Central Government • Office of the Auditor General • Ministry for the Environment • Department of Conservation	• Viable local authorities in the long term • Asset planning which enables sustainable community outcomes
• Special Interest Groups • Community Groups	• Inclusion in decision making – the need to be heard • Fair and reasonable charges • Flexibility
• Environmental and recreational interest groups, e.g. Fish and Game	• Appropriate inclusion in decision making – the need to be heard • Cooperation, early warning of changes to needs and systems • Compliance with policy and standards • Conservation of the environment, consultation about environmental impacts
• Christchurch International Airport Ltd • Lyttelton Port Company • Selwyn District Council • Waimakariri District Council	• Liaison • Cooperation and information sharing • Clear and open lines of communication • Agreed stands of supply/discharge • Early warning of changes to needs and systems

Table 3-1: Key Customers and Stakeholders

Council has several ways in which it seeks to identify customer expectations and the extent to which these expectations are being met. These include:

- Detailed customer research – last completed in 2000
- Satisfaction surveys – once a year
- Direct engagement with the community
    - Direct contact with the public;
    - Community Board meetings;
    - Complaints/service requests/phone calls to the Council's Call Centre;
    - Information provided and feedback from the Council website;
    - Formal consultation as part of the LTP and annual plan processes;
    - Delegations to Council meetings;
    - Submissions and petitions; and
    - Pre-development meetings with developers.

Findings from our engagement has identified key outcomes for customers are:

- Reliability
- Responsiveness
- Safety
- Quality
- Environmental stewardship/Sustainability
- Value for money.

[3] Iwi Management Plan, 2013 https://www.mkt.co.nz/wp-content/uploads/2016/05/Mahaanui-IMP-web.pdf

3.1.2 Legislation/Regulation

Alongside customer expectations, we consider legislation, regulation and standards that impose level of service standards for water supply. These are summarised in Table 3-2.

Legislation / Regulation	Impacts on Levels of Service
Drinking Water Standards for New Zealand	*Minimum requirements for water quality, treatment and risk management process to meet public health standards.*
Resource consents	*Limits for water extraction and the management of supply zones.*
Department of Internal Affairs Non-financial Performance Measures	*Standard set of mandatory publically reported performance measures.*
New Zealand Fire Service Fire Fighting Water Supplies Code of Practice	*Clarifies the requirements for the water supply for meeting firefighting. This is standard is not mandatory*
Local Government Act	*Requirement to assess and plan for future water needs, report annual performance, provide continuous supply and assess adequacy of services provided.*

Table 3-2: Legislative and Regulatory Level of Service Drivers

3.1.3 Strategic Framework

In addition to Councils strategic priorities Section 2.3, Councils' Te Wai o Tane Integrated Water Strategy sets out a strategic direction for water supply, wastewater and stormwater. This document provides a summary of the other legislative and policy drivers for water supply. The strategy reinforces the role of the community in the provision of services and stewardship of water. Within the purpose, vision, and guiding principles of the strategy there are statements that relate to customer engagement:

From within the purpose statement:

- *guiding Council decision making including how we will involve, work with, and reflect mana whenua values and community interests in freshwater management and decision making*

From within the vision statement:

- *Provide people, communities and future generations with access to safe and sufficient water resources.*

Table 3-3 provides a full list of the objectives and the desired outcomes for each objective from Te Wai o Tane[4].

Objective	Desired Outcome
Objective 1 - Awareness and engagement	Increase awareness and engage with the community and mana whenua regarding the multiple uses and values of water.
Objective 2 - Efficient and resilient infrastructure	Ensure efficient use of three waters infrastructure through a completely integrated management structure and ensure the resilience of entire networks (including natural waterbodies) to future environmental, social and/or cultural changes and natural hazard risks

[4] Te Wai o Tane Integrated Water Strategy - TRIM://19/1465878

	over the long term through timely asset renewal and/or better alternative solutions.
Objective 3 - Enhancement of ecological, cultural and natural values	Enhance the ecological, cultural and natural values (including amenity, recreation, customary use, heritage and landscape) of the waterbodies within the Christchurch urban area and settlements.
Objective 4 - Water quality improvement	Improve the water quality of surface water resources to protect ecosystem health and provide for contact recreation, food gathering, mahinga kai and cultural values.
Objective 5 - Wastewater overflow management	Reduce and work towards eliminating the effects of wastewater overflows.
Objective 6 - Flood risk	Understand the likely extent and effects of flooding, and the risk posed by flooding.
Objective 7 - Flood management and adaptation	Manage and adapt to the effects of flooding using natural systems, planning tools, community adaptation and infrastructure solutions.
Objective 8 - Sustainable wastewater systems	Manage the effects of the wastewater systems to meet community needs for environmental, social, cultural and economic sustainability over the long term.
Objective 9 - Groundwater protection	Advance source protection of groundwater recharge areas and surface water supply sources for all drinking water supplies.
Objective 10 - Improvement in understanding of aquifer system	Understand the vulnerability, transit times and extent of confining layers of the Christchurch aquifers as well as the link to surface water quantity and quality.
Objective 11 - Safe and sustainable water supply	Manage the water sources for drinking water supplies to meet the forecast reasonable demands over the long term and ensure efficiency of water use, and ensure demonstrably safe drinking water without the need for residual disinfection (e.g. chlorination).

Table 3-3: Objectives and Outcomes from Te Wai o Tane

3.2 Defining and Measuring Levels of Service

3.2.1 Measuring our Levels of Service

Council's Levels of Service (LoS) measures enable us to monitor and report against our outcomes and service performance. Based on the activity objectives defined in Section 2.3.1, the following levels of service objectives have been defined:

- Council operates water supplies in a reliable manner
- Council operates water supplies in a responsive manner
- Council water supplies are safe to drink
- Council provides high quality water
- Council water supply networks and operations are sustainable
- Value for money.

There are two types of performance measures that are used to report to the relevant stakeholders as per Table 3-4.

Community performance measures (C)	Management performance measures (M)
• *Key measures for governance and community* • *Focus on what the ratepayer gets* • *Typically involve mandatory measures from central government, accessibility of the service, quality, responsiveness, resident satisfaction, compliance with (key) legislation* • *Become staff performance development plan accountabilities*	• *Management oriented* • *Typically aimed at effectiveness, efficiency, compliance with legislation, completion of (key) processes* • *Become staff performance development plan accountabilities*

• *Reported to governance and to public in Annual Report*	

Table 3-4: Community versus Management performance measures

The two types of performance measures are presented in the Water Supply Activity Management Plan section 5 and are labelled as either "C" or "M".

3.2.2 How we are / should we be performing?

What's going well

Total water abstraction has remained at around 50 million cubic metres per year since 2014, with 54.5 million cubic metres used in the year to June 2019. Per capita abstraction has dropped from 326 litres per person per day before the earthquakes to 229 litres per person in the year to June 2020.

Fault response times and flow and pressure complaints have consistently been tracking better than target levels.

Power costs per unit of water supplied are very low compared to national benchmarks due to the absence of treatment processes, decentralised nature of supply and ease of abstraction of the City's bore groundwater bore sources.

Where improvements are required

In the 2017/18 year, all Christchurch water supplies failed to meet the water quality standards for protozoa. Water supplies for 74% of the Christchurch population failed to comply with the Health Act requirements for safe drinking water supplies. This resulted in the Council temporarily chlorinating the city's water.

Resident satisfaction with the quality of the water supply has generally been between 84% and 92% in recent years. Following the start of temporary chlorination in 2018, satisfaction dropped to just 37% in 2019.

Improvements are required to reduce leakage rates. This is a key focus area to demonstrate a low risk of interaction between potential contaminant sources and the water supply due to containment issues. Reducing leakage will also reduce power and conveyance costs and is an important issue to target ahead of other demand management measures that Council may want to implement.

The number of unplanned interruptions is high compared to national benchmarks. This is one indicator of a deteriorating reticulation network and the need for targeted pipe renewal.

The drinking water regulatory environment in New Zealand is changing and there is a need for improvements to the water supply activity in order to keep up. This includes protozoal and bacterial compliance, as well as targeting leakage and backflow prevention.

Continued reduction in water demand, particularly the peak summer demand, is essential. Average day demand of 895 litres per property per day and average hour demand of approximately 30 litres per property per hour are within the capacity of the existing pipe network and pump stations but peak demands are significantly higher. High peak day demands can drain reservoirs faster than pumps can refill them. If daily demand remains high for long periods, reservoirs will run dry. Flows during high peak hour demands exceed the quantity pipes can convey increasing the pressure losses and resulting in pressure drop or lack of water at locations distant from pump stations. Reducing peak day and peak hour demands will reduce power costs and ensure the water supply operates within resource consents. Conversely, continuing demand increases will require significant infrastructure spending for pipe upgrades and new pump stations. Managing demand on water sources also has positive environmental and cultural outcomes.

3.2.3 Performance Framework, 2021-2031

In this LTP period the following performance changes are specifically targeted:

- *Unplanned interruptions*
- *Testing and compliance of backflow prevention*
- *Drinking water safety regulation measures*
- *Leakage rates*

- *Peak water use*
- I*ncreasing customer satisfaction to long term averages*

Please refer to Water Supply Activity Plan, Section 5 Specify Levels of Service

3.3 Level of Service Projects and Programmes

These are the improvement projects or programmes where the primary driver is to increase level of service.

Over the next 30 years $88.2M of new works to improve levels of service have been identified. The most significant of these capital programmes are presented in Table 3-5. Regulation change is a primary driver for many of these improvements. Within the capital programme there will be projects that have multiple benefits; improving levels of service, meeting growth demand, addressing risk and resilience, and replacing poor condition existing assets. Additionally, there will be multiple level of service benefits that come out of the renewal programmes that are not listed in this chapter, such as reduced pipe leakage as poor condition pipes are replaced.

Major Initiatives to address level of service gaps	Indicative $ over 30 years
Water Mains Renewal Program	$865.5M
Water Submains Renewal Program	$187.5M
City Water Supply Re-zoning & Demand Management	Over $20M
Fluoridation - if required	Over $20M (currently unfunded)
Water Supply Safety Improvements Programme	$14M
Modelling programme to support optimised improvements	$11M
Smart Water Network	Over $10M
Wrights Suction Tank and Pump Station Building	$4.7M
Land Purchase for Catchment Protection	$3.8M
Above ground well head conversions	$2.7M
Duvauchelle Membrane Filtration	$2.6M
Secure Groundwater / Age Dating	$2.3M
Hydrogeological Groundwater Model	$1.53M
Backflow Prevention Programme	$ 740k

Table 3-5: Projects to Address Level of Service Gaps

Table 3-5 lists fluoridation as an improvement item. The proposed LTP does not fund fluoridation infrastructure but includes the project as a placeholder should fluoridation be mandated by the Canterbury District Health Board or central government.

4 Demand for our services

This section provides an overview of growth and demand forecasts that will affect the management, provision and utilisation of services and assets. Information outlined in this section drives the need for new works.

Water supply demand includes average day demand and peak instantaneous demand.

Average day demand is the water used on a typical day, is averaged across the whole year and flattens out the peaks of the summer season and troughs of the winter season.

Peak instantaneous demand is the peak water used on (typically) the hottest day of the year. This highest level of demand corresponds to increased outdoor hose/sprinkler use, pool filling and irrigation. Infrastructure design typically considers delivering peak demands, so demand drivers that increase or decrease the peak demand will have the greatest effect on asset capacity decisions.

Water supply demand includes the **usage by customers**, the water lost in the network through **leakage**, and the provision for **firefighting** flows.

4.1 Demand Drivers

4.1.1 Population Growth

The SAMP forecasts population increase of 72,000 people in Christchurch over the next 30 years, giving a population of around 475,000 residents. Population growth will have a direct effect to increase wastewater demand.

4.1.2 Urban land use density

Christchurch urban growth over the next 30 years is planned to be concentrated in the west, northwest and southwest suburbs. New connections in these area will create higher localised water demand. Intensification will also increase localised demand but would likely see water use per individual household decrease.

Excess industrial land may convert to commercial use in areas such as Sydenham where there is a longer term commercial shortfall increasing water demand in that supply zone.

Christchurch has an ageing population. Water use is not expected to vary as a direct relationship with customer age; however, any resulting change in people per dwelling as a by-product of the aging population could affect water demand patterns.

4.1.3 Economic Growth

Growth in commercial and industrial business activities is predicted and may affect the demand for water services. An increased demand is placed on Council's water supply where industries transition from private groundwater supplies to Council water supply.

4.1.4 Temperature rainfall and climate change

Dry conditions in Canterbury result in a high demand for garden and landscape irrigation. Dry conditions also place an emphasis on providing adequate water supplies for firefighting. Conversely wet climate conditions reduce overall water demand for general use and firefighting.

The likely expected climate change scenario for Canterbury is drier climate conditions and more frequent intense rain storms (Infrastructure Strategy, 2018). Drier climate conditions will put upward pressure on water demand for irrigation and firefighting.

Surface water sources for public supply in Banks Peninsula are expected to be constrained by drier climate conditions. The aquifer water sources are not expected to be adversely affected by climate change.

4.1.5 Ageing Infrastructure

Pipes at or near the end of their theoretical useful asset lives will continue to degrade and have increased leakage and bursts. This water loss adds to the overall water demand. Under proposed budgets, leakage projections show an estimated maximum of 25.5% in 2037 before beginning to decrease.

4.1.6 Private infrastructure

Leaking pipes, fittings and faucets on private properties is a significant contributor to average daily water use. Projecting the current situation into the future, it is expected that further deterioration of these assets will increase overall water demand in the absence of a programme to address private water loss or flow-based charging.

4.1.7 Environmental attitudes

It is possible that a growing environmental conscience within the community over the next 30 years will reduce individual customer demand. Changes in environmental attitude may also drive an expectation that other water use and water loss is targeted for reduction.

4.1.8 Firefighting requirements

Peak flow demand for water supply is linked to firefighting requirements. Should any changes in firefighting requirements or legislation happen over the next 30 years there will be a direct and significant effect on the size of infrastructure required to meet firefighting demand.

4.1.9 Alternative technologies and delivery

It is expected that the uptake of modern technology and techniques over the next 30 years will be a helpful driver in meeting water supply demand. For example:

- Water efficient devices
- Water zone pressure reduction and management
- Improvements in water metering including remote metering
- Firefighting techniques
- Electronic leak survey and location equipment

4.1.10 Flow based charging

Residential water customers are charged based on property rateable value rather than on the volume of water consumed (volumetric charging). This method provides no incentive for customers to manage their water use or fix leaks. Changing the method of charging residential customers is a significant decision that will have a direct impact on water demand as evidenced from several case studies around the world. Flow based charging is a topic within the Integrated Water Strategy and the options for increasing the use of volumetric charging are being explored.

4.1.11 Demand for Service

There is a high level of uncertainty over the degree that each of the demand drivers will affect demand growth. The demand growth used within this AMP is based on the most predictable demand drivers of changes in population growth, climate change and flow based charging.

The likely changes in demand over time from the various demand drivers are presented in Table 4-1.

Demand Driver	Present Position	Projection
	Upward demand pressure	
Population growth	Medium	High

Urban land use density	Low	Medium
Economic growth	Low	Medium
Temperature, rainfall and climate change	High	High
Ageing infrastructure	Low	Medium
Private infrastructure	Medium	Medium
Firefighting requirements	Low	Low
	Downward demand pressure	
Environmental attitudes	Low	Low
Alternative technologies and delivery	Low	Low
Flow based charging	Low	High

Table 4-1: Demand Drivers and their Impacts

4.2 Demand Forecasts

4.2.1 Historic Demand Changes

The growth in average water demand in the period 2016 to 2018 aligns with the population growth in the same period (1% per annum). A reduction in the average water demand in 2016 may be attributed to SCIRT pump station and pipe renewals with subsequent reduction in leakage or improved efficiencies. The high variance in peak day demand is aligned with temperature and rainfall variance where 2017 saw dryer conditions than 2016 and 2018. The seasonal variance between average day demand and peak demand is illustrated in Figure 4-1.

Table 4-2 presents peak demand units with highlights in green showing the areas with greatest potential for demand management measures.

Demand Unit Type	Northwest WSZ	West WSZ	Riccarton WSZ	Central WSZ	Rawhiti WSZ	Parklands WSZ	Ferrymead WSZ	Total
Daily peak factor	2.0	2.1	2.8	2.6	2.4	3.4	1.5	**1.9**
Hourly peak factor	1.9	2.0	1.6	1.7	2.4	2.7	2.1	**1.9**
Average HH demand (l/day/household)	650	850	650	700	750	900	900	**750**
Peak HH demand (l/day/household)	1,300	1,700	1,000	1,260	1,950	1,800	1,980	**1,500**
Instantaneous flow demand per HH (l/s/household)	0.030	0.035	0.037	0.020	0.045	0.065	0.030	**0.030**

Table 4-2: Peak demand units per water supply zone

Consideration of historic demand trends for the 6 Banks Peninsula water supply schemes highlights that although average day demand is lower than in the Christchurch urban area (at approximately 300 to 600 l/day/household), much can still be done to reduce water loss and to improve the management of summer peak demands. The benefits of water demand management measures (through installation of smart water meters) is illustrated in Duvauchelle, where a significant reduction in peak day demand has been realized as a direct result of being able to identify and fix water leaks.

4.2.2 Forecast Future Demand

Due to the uncertainty of the individual demand drivers on demand growth, the demand growth presented within this AMP is quantified on only two demand drivers: population and economic growth. However; other demand drivers such as flow based charging that are not quantified at this stage could have significant impacts on demand. These are presented

in Table 4-1. The annual review of the demand forecast will ensure that impacts of other demand drivers will be factored into future growth projections as the most significant change in the future.

Figure 4-2 and Figure 4-3 present predicted future water demand and show impacts of alternative population growth scenarios.

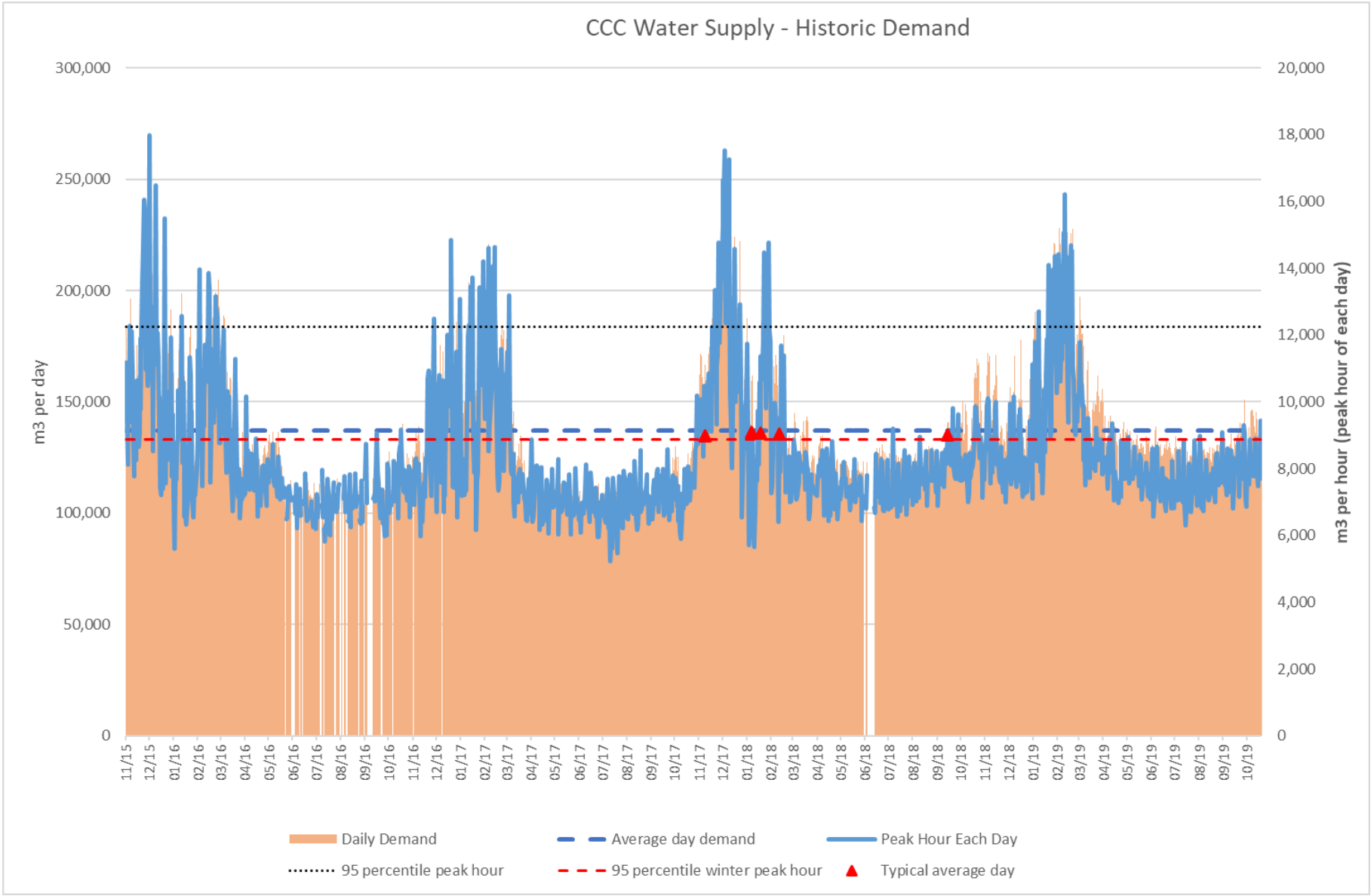


Figure 4-1: Christchurch Historic Water Demand

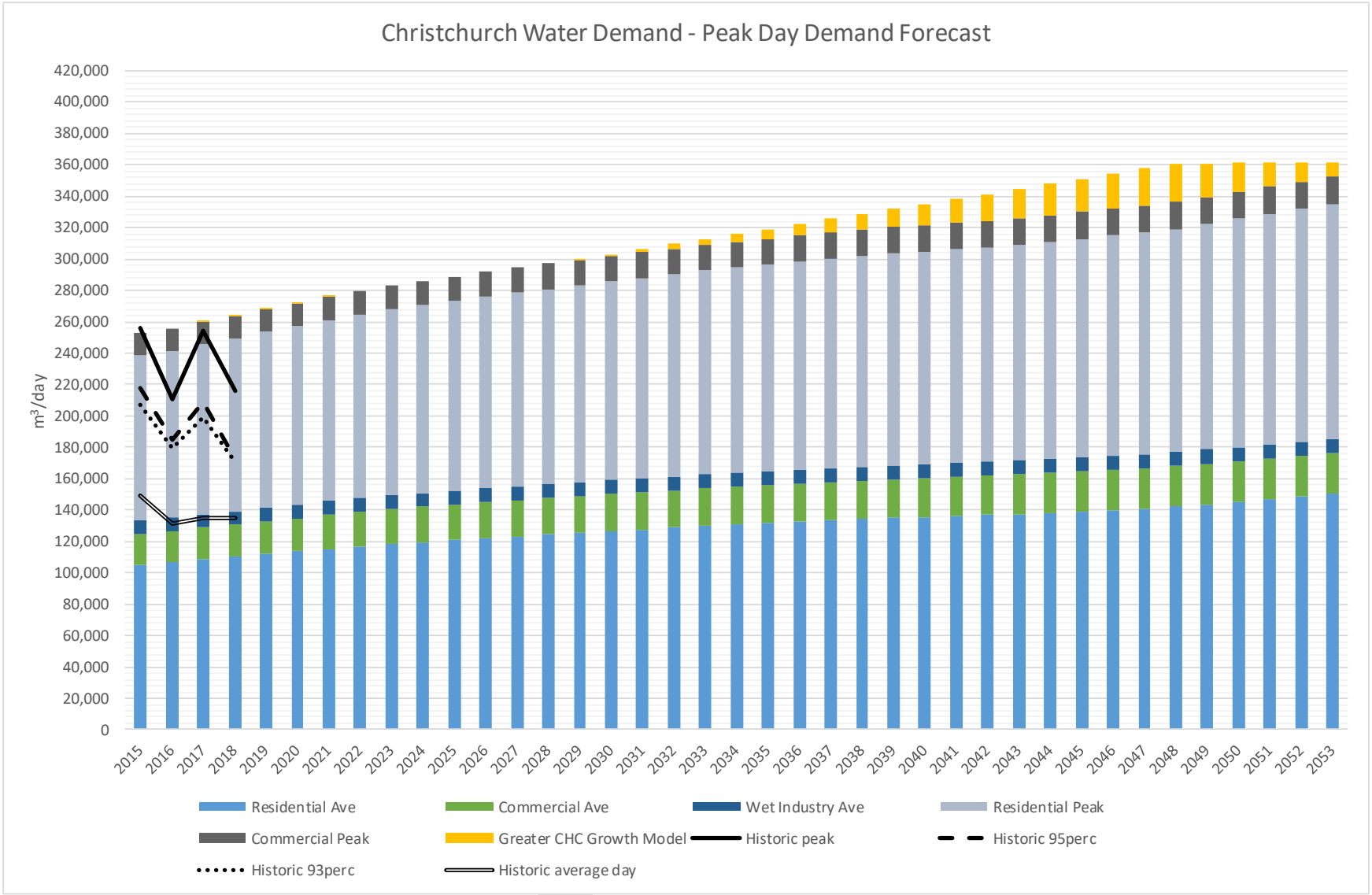


Figure 4-2: Christchurch Daily Water Demand Forecast (m3 per day)

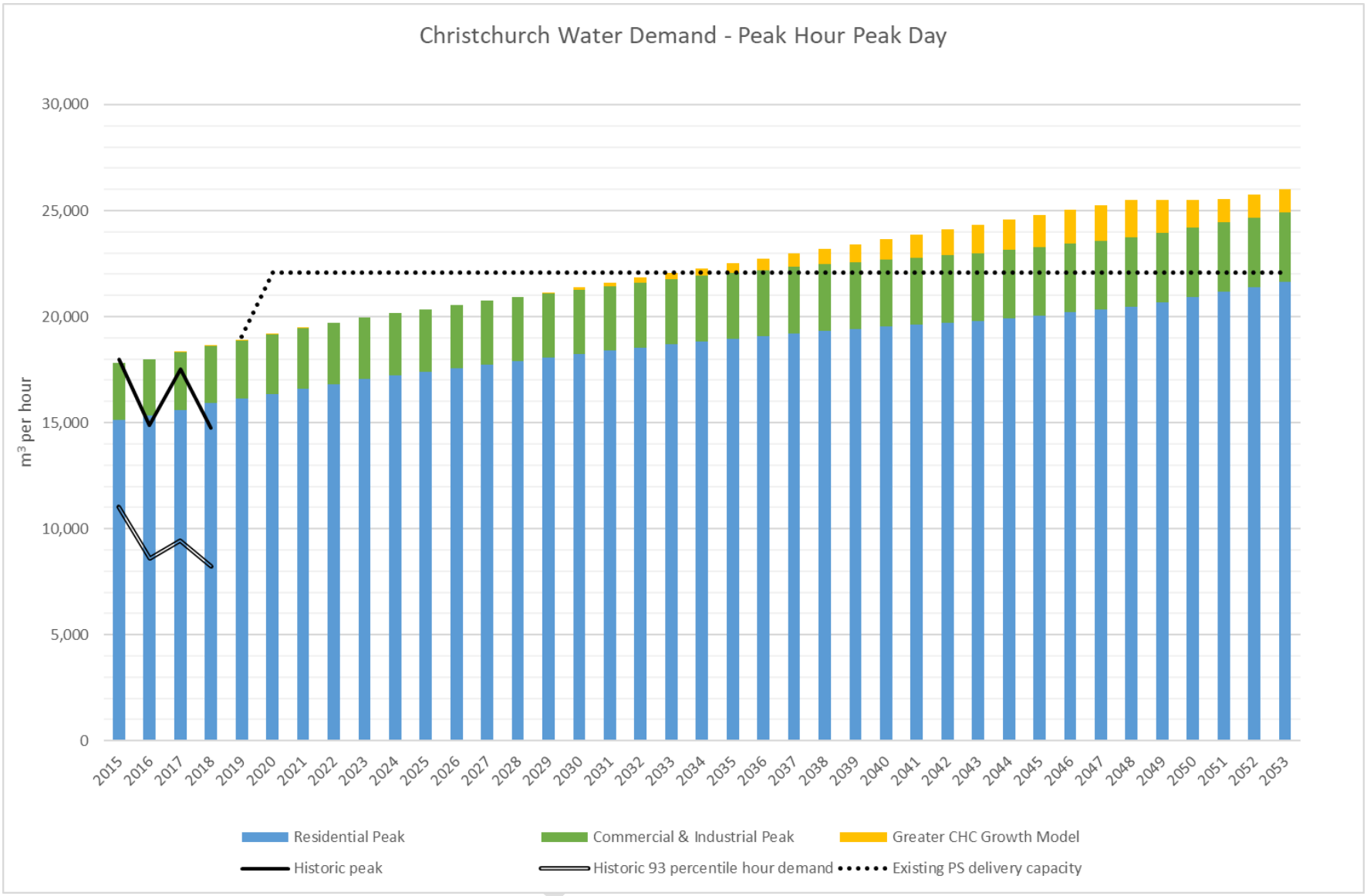


Figure 4-3: Christchurch Hourly Water Demand Forecast (m3 per hour)

The future water demand for the Christchurch water supply zones confirms that:

- Water demand is expected to increase by as much as 36% by 2053 amounting to an increase of 50,000 m^3 per day on average and representing a peak increase of as high as 90,000 m^3 per day.
- The growth in water demand is not expected to exceed the existing CCC abstraction consent. Individual well take consents may however have to be adjusted to provide adequate water where the demand is needed.
- An additional 14 production wells will be required to meet the demand forecasted for 2053. 4 of these production wells will be required within the next 10 years.
- Should population growth as projected in the Greater Christchurch Growth Model be realised, additional capacity will be required earlier than 2053.
- The cost of reducing unaccounted water is offset by the benefit of not requiring additional assets for production and transmission.
- Economic growth amounting to 28% or approximately 2,450,000 m^2 of additional commercial and industrial floor space has been factored into the demand forecast.

Figure 4-4, Figure 4-5, Figure 4-6, Figure 4-7, Figure 4-8 and Figure 4-9 display individual demand forecasts for the six Banks Peninsula water supply schemes. These figures highlight that there is adequate capacity to service the projected growth in several communities, but that any scheme expansions may require additional capacity. Demand forecasts for Duvauchelle and Birdlings Flat show a need to increase the plant operations capacity in order to meet current and future demand.

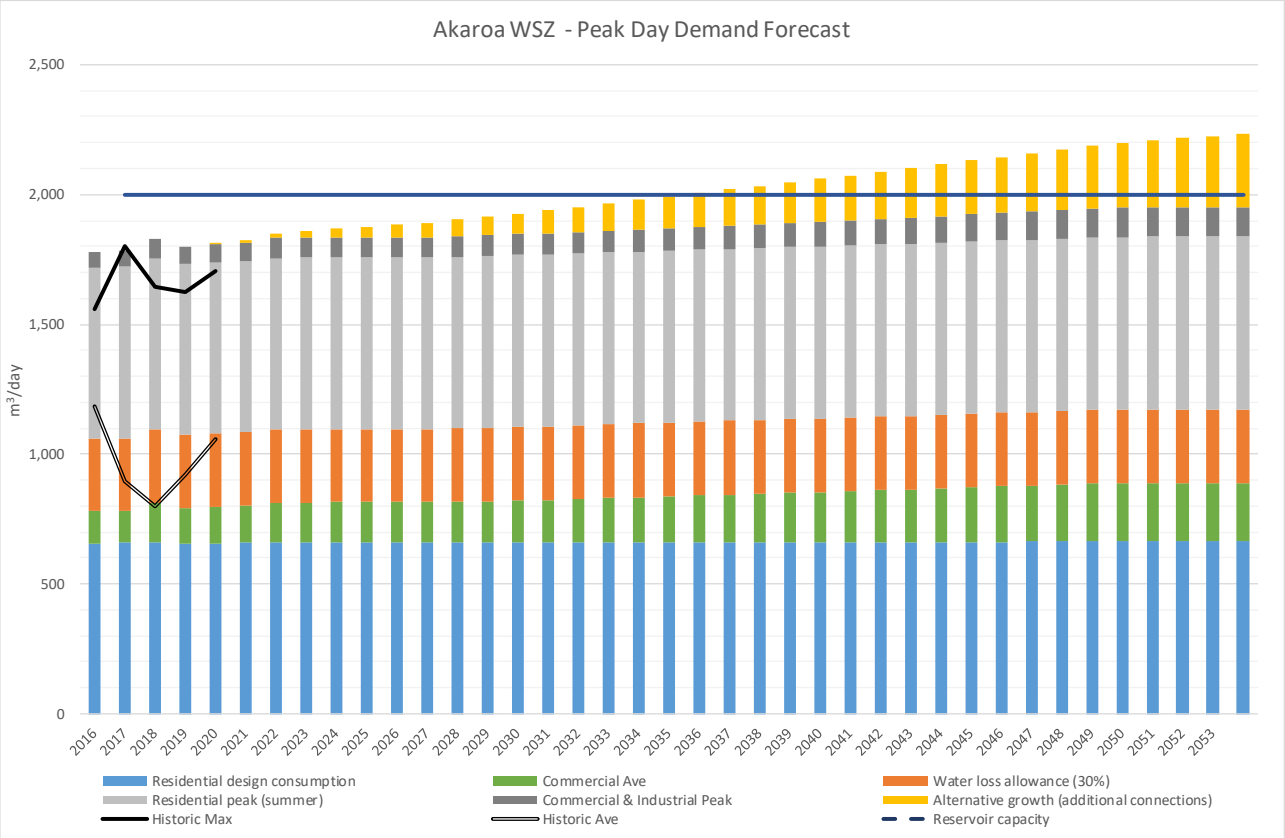


Figure 4-4: Akaroa/Takamatua water demand forecast (m3 per day)

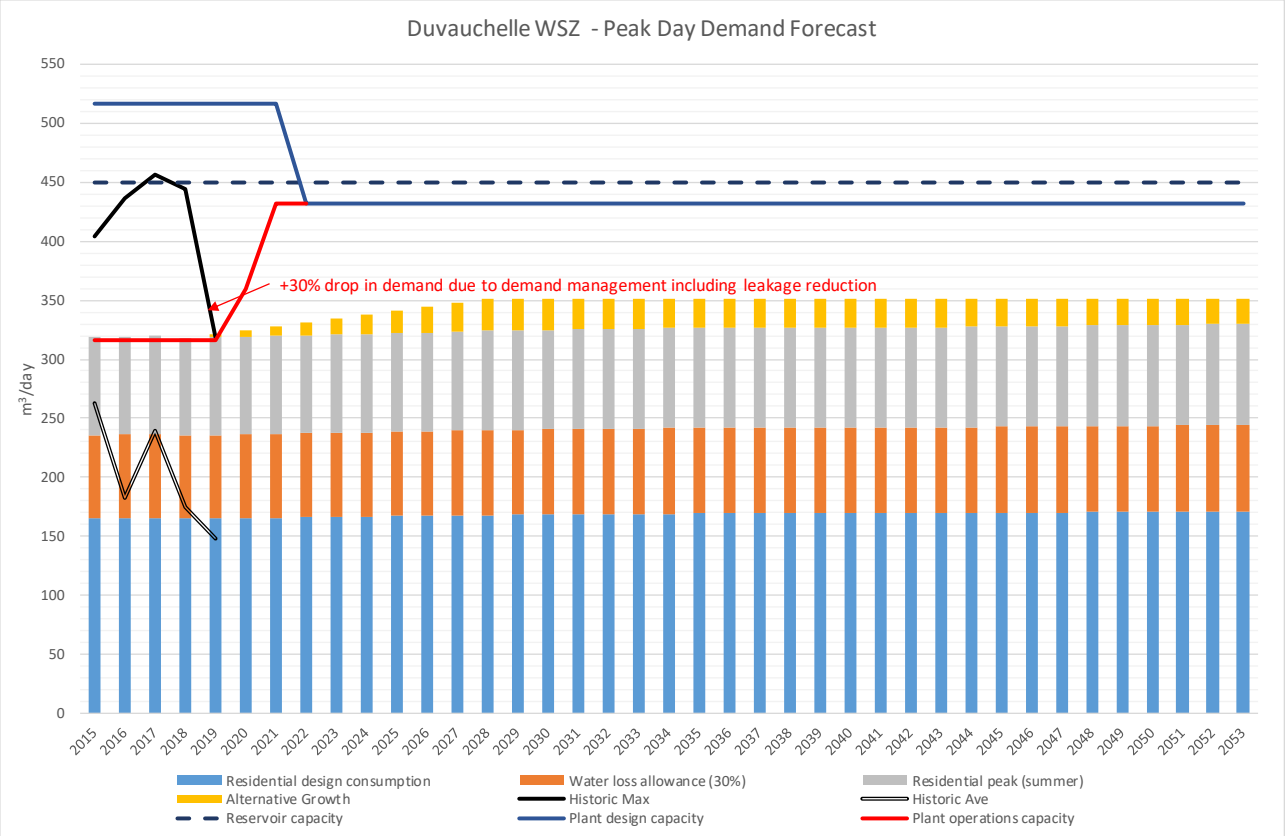


Figure 4-5: Duvauchelle water demand forecast (m3 per day)

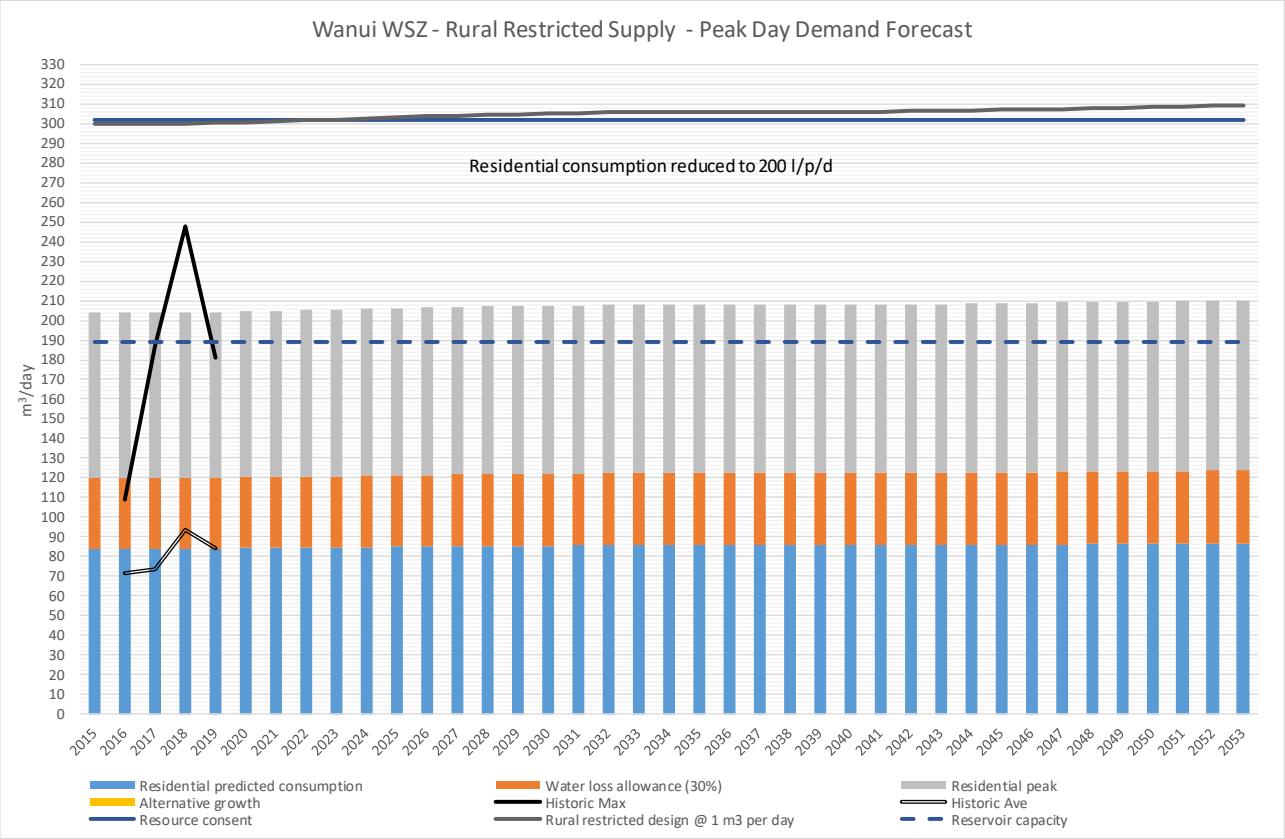


Figure 4-6: Wainui water demand forecast (m3 per day)

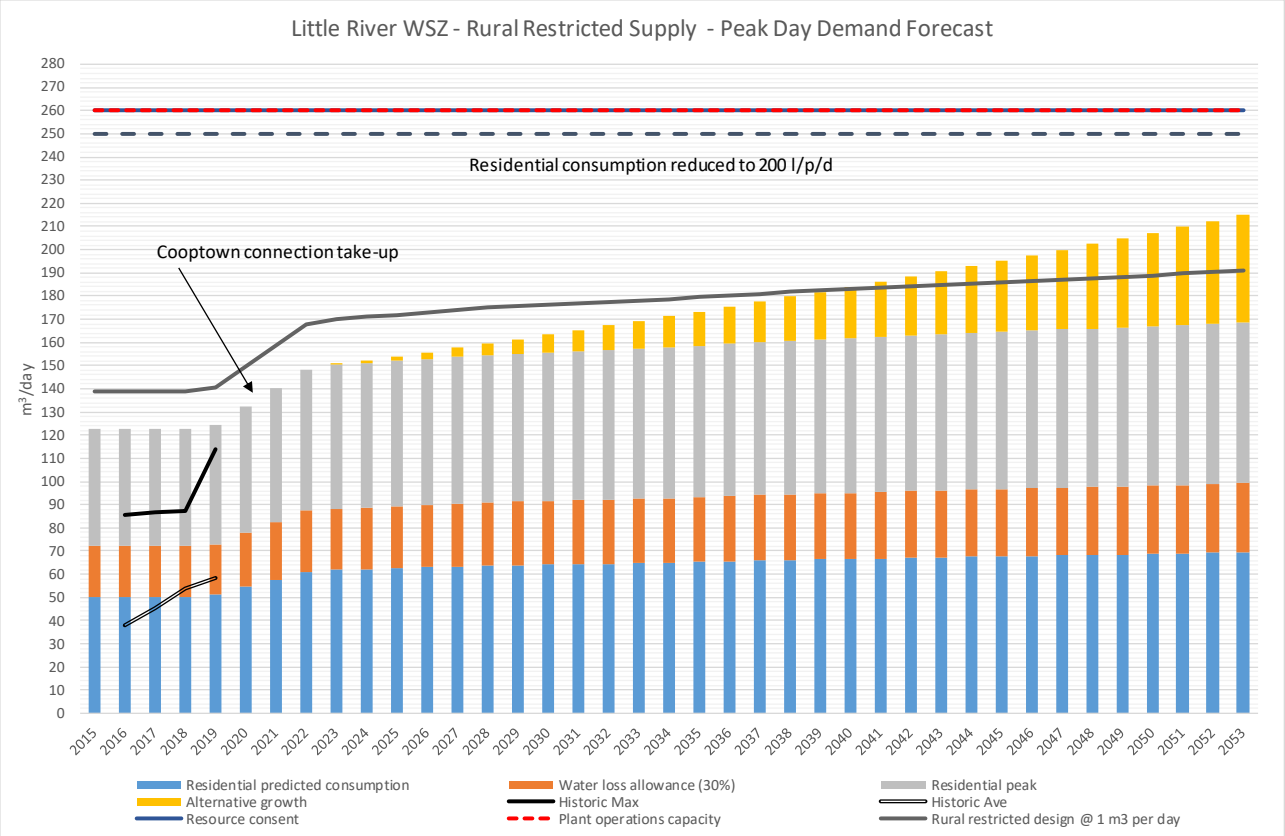


Figure 4-7: Little River water demand forecast (m3 per day)

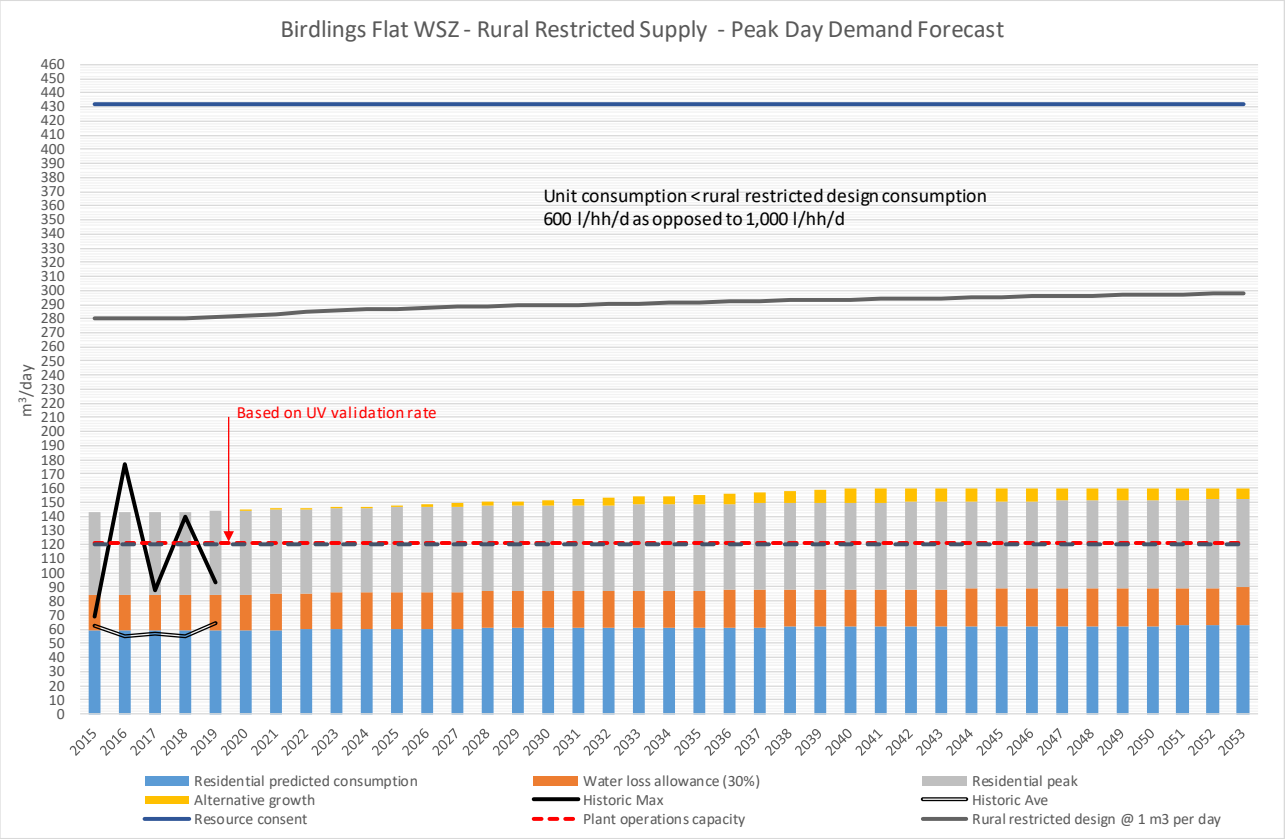


Figure 4-8: Birdlings Flat water demand forecast (m3 per day)

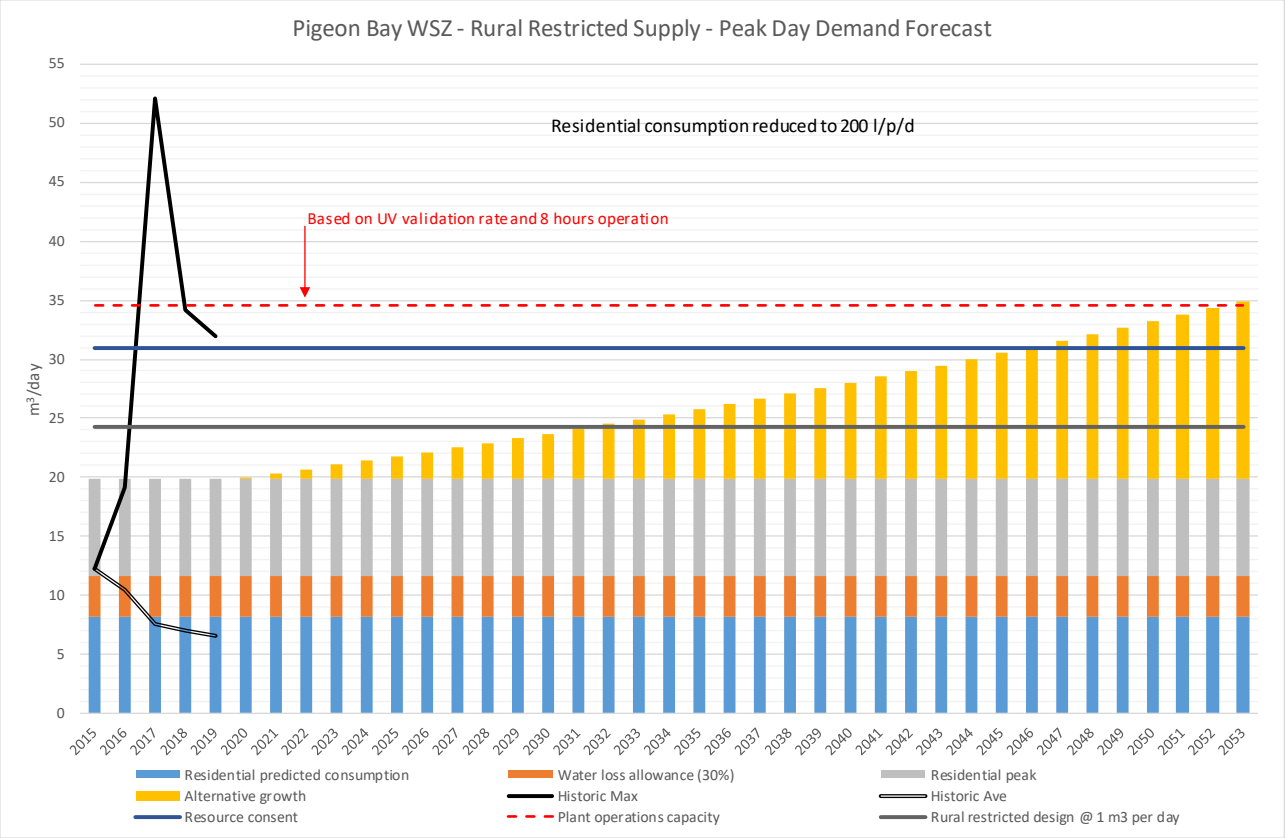


Figure 4-9: Pigeon Bay water demand forecast (m3 per day)

4.3 Impact of changing demand on existing assets

Level of service reduction

Increased demand may put existing pipes and fittings under higher pressures more frequently which could lead to a higher number of bursts and leaks.

In peak periods where demand exceeds supply there are the potential for customer water restrictions and insufficient firefighting capacity.

Reservoir storage provides for emergencies and assists in meeting peak demand. Demand increases reduce the effectiveness of and limit the ability to utilise existing storage.

Increased pumping and treatment costs

Total costs of pumping and treatment (temporary chlorine and new UV units) will increase to cater for the greater flows in the network. Power costs for pumping will go up in order to deliver the same levels of service due to higher hydraulic losses in the network.

Increased operational costs (reactive maintenance, pressure monitoring)

Increased reactive maintenance costs are likely as maintenance staff respond to more breaks and leaks. Mechanical and electrical equipment now operating with increased run hours will need more frequent maintenance and repair.

With higher peak demand Council faces a greater need to monitor pressure and flow conditions. This means more instruments installed within the network to measure the operational performance.

Increased risk of contamination of the supply

Significant pressure fluctuations resulting in negative pressures in poor condition pipework could allow contamination to enter the water supply. Reducing the instances of very high instantaneous, hourly and daily peak demand flows in the summer would help mitigate this risk.

Increased asset life

Pressure reductions will increase asset lives. This applies only to new or relatively young assets, where an asset has spent the majority of its life at a high pressure the increase in life will be negligible.

Assets with insufficient capacity can be replaced with assets of greater capacity. However, the replaced asset may still have several years of useful life remaining that then gets financially written off effectively increasing depreciation. Assets requiring "early" replacement due to rising demand don't provide their full whole of life benefit compared to assets that remain in use for their expected useful life.

New assets required

Demand triggered by new developments will require new pipe and pump infrastructure, and new wells to provide water supply. Reservoirs and suction tanks without sufficient capacity will need to be replaced with larger volume reservoirs or be supplemented by new assets.

Water source

An increase in water demand will impact existing groundwater and surface water sources.

4.3.1 Future Demand on Assets

Water demand forecasting for each of the existing water supply zones determines the impact of growth areas on the available capacity of the localized water supply zone. Figure 4-10 shows current water supply zones within Christchurch City and the Littleton Harbour Basin.

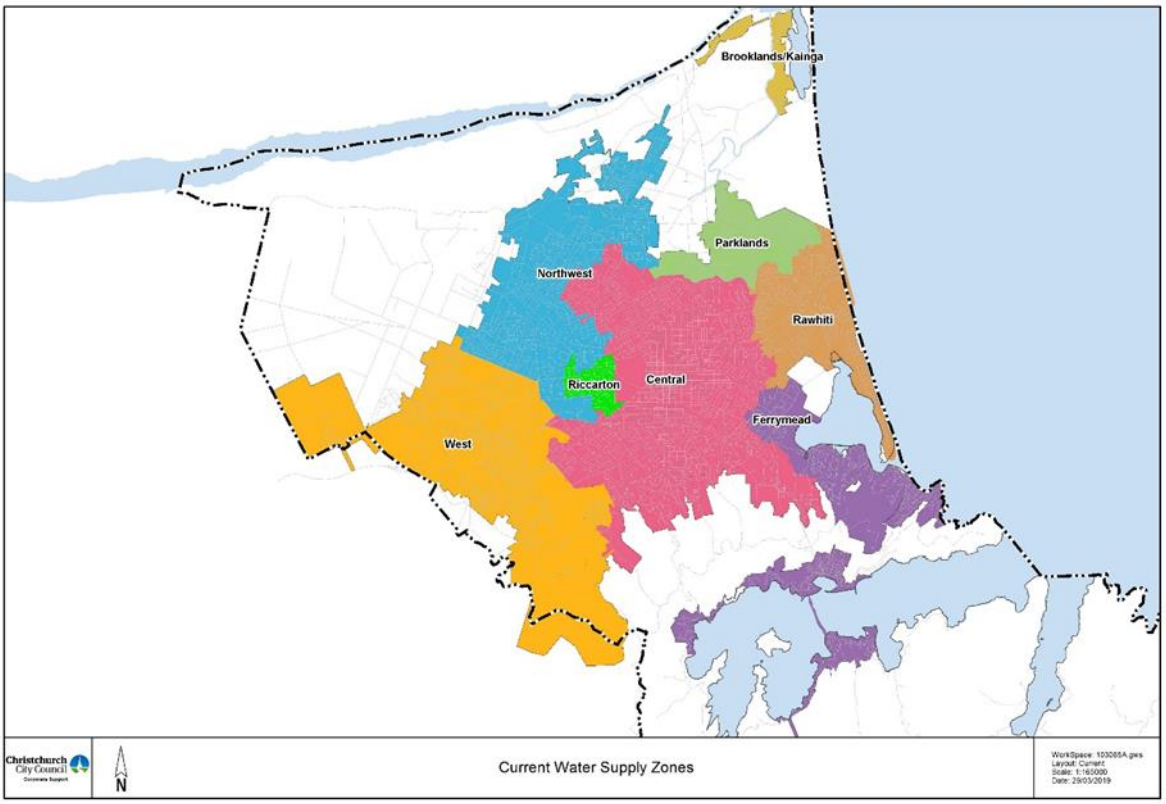


Figure 4-10: Christchurch City and Littleton Harbour Water Supply Zones

Figure 4-11 shows predicted water demand for the different water zones alongside current supply capacity.

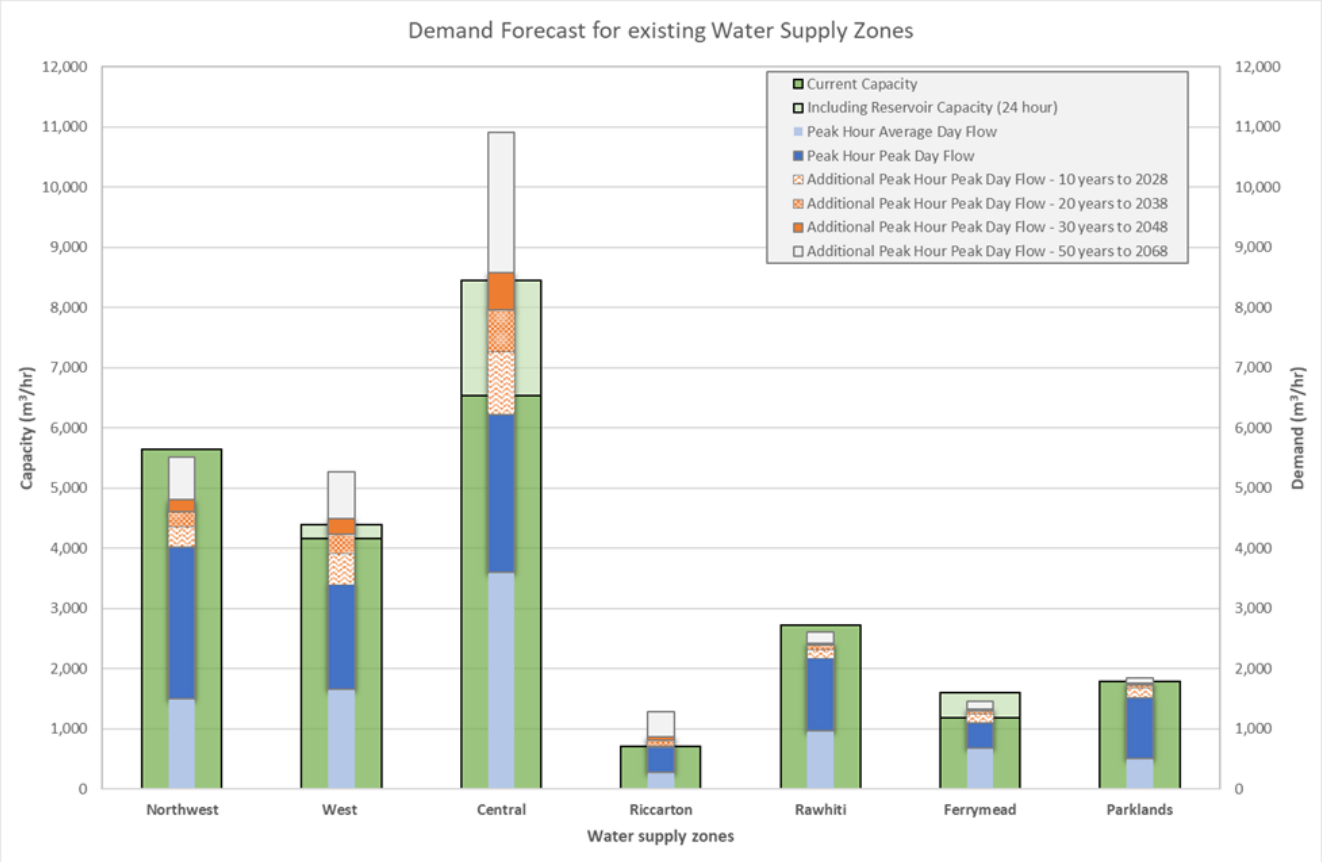


Figure 4-11: Water Demand Forecasts for Current Water Supply Zones

The water demand forecast per urban water supply zone confirms that:

- Additional capacity will be required to service the growth in demand in the Riccarton WSZ, Central WSZ and possibly the Ferrymead WSZ within the next 10 years.
- Assuming that the water supply zone boundaries will remain unchanged, it is deemed that the Northwest WSZ, Rawhiti WSZ and Parklands WSZ will have adequate capacity to service predicted demand for the next 30 years.

Demand management programs may defer or remove the need for capacity increases and their associated costs.

Asset Utilisation

Asset utilisation will change because of demand, leading to potential level of service issues and increased maintenance and renewal costs. Where the capacity of an asset is fully utilised, establishment of new assets providing additional capacity is required.

Council quantifies asset utilisation through predictive hydraulic modelling and actual measurement of pressures and flow throughout the network. This reveals where assets are over utilised and face capacity constraints. Accurately quantifying asset utilisation helps optimise the responses to increased demand and is an ongoing focus.

The Integrated Water Strategy supports the implementation of the pressure management zones. The Water Supply Strategy: 2009 identified a water rezoning strategy and identified the outcomes in Table 4-3.

Outcome	Reasoning
Improved emergency response capability	Smaller management zones will allow an improved response and recovery phase

Improved resilience and protection of vulnerable assets	Obtain an extended asset life from existing water supply infrastructure
Improved system management and monitoring	Formalize levels of service and enable improving automation in managing the system
Delivery of optimal supply pressures	Reducing burst frequency and supporting demand management
Defer or avoid the need for an additional water source for Christchurch	Improved leakage reduction and management as a result of smaller supply zones
Create a more efficient and sustainable network	Improved energy efficiency will reduce operating costs

Table 4-3: Water Rezoning Outcomes

Figure 4-12 shows the water supply rezoning concept. The Rawhiti Water Supply Zone is a trial area already in place and undergoing monitoring to provide baseline information for the pressure management phase. The proposed rezoning will see the existing seven Christchurch water supply zones re-established into fourteen water supply zones. Balancing available capacity with existing and future demand is a project requirement.

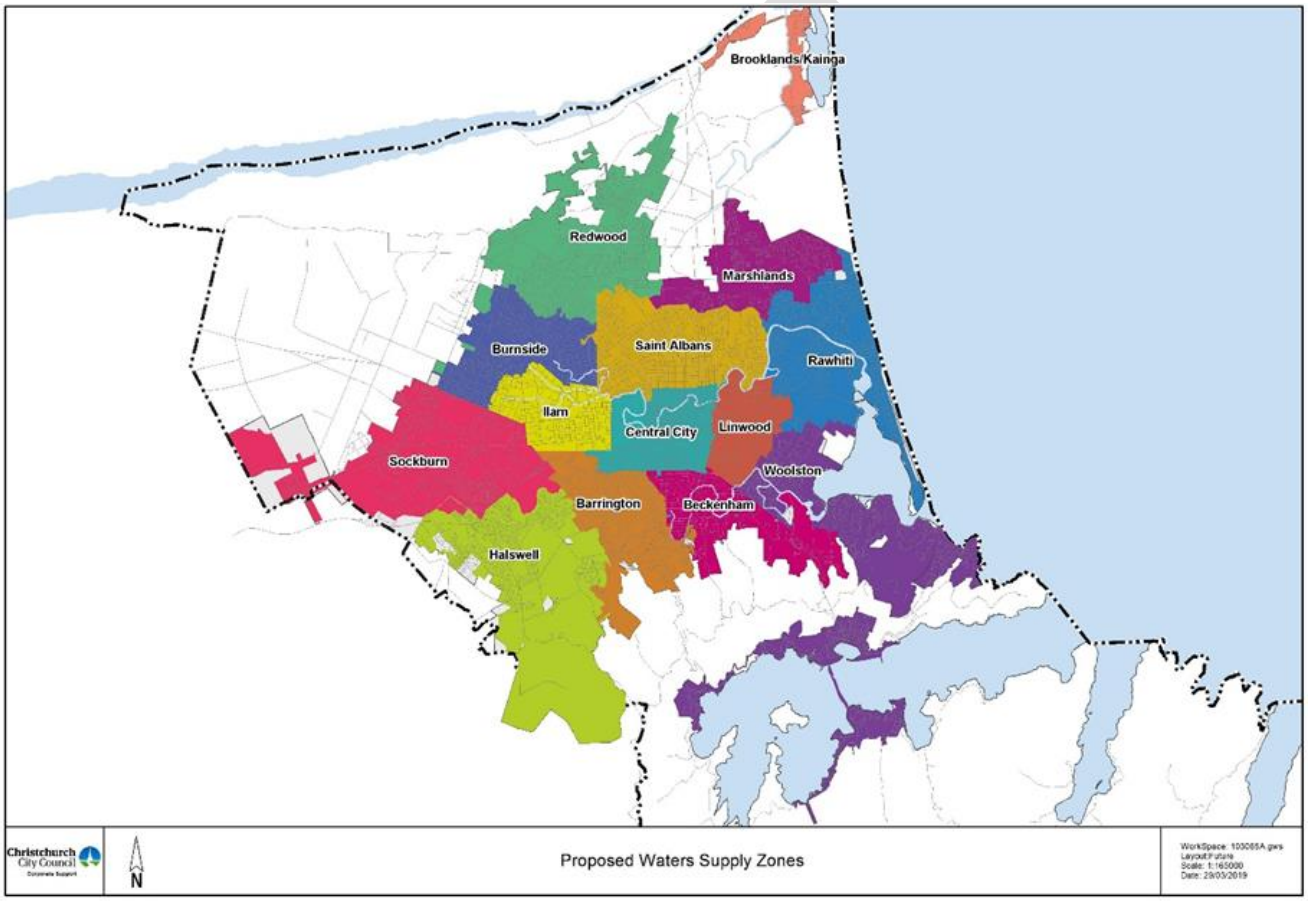


Figure 4-12: Proposed Water Supply Zones after Rezoning

Council is also working to improve integration of asset utilisation data into other asset management functions. This will improve outcomes within the long-term renewals programme, and the operation and maintenance strategy. Currently there are a number of manual checks to ensure that pipe renewals provide sufficient capacity for future demand scenarios. Council plans to automate this process so that outputs from demand scenario models directly integrate into renewal planning and maintenance optimisation.

On the other hand, there are areas in Christchurch where water infrastructure has excess capacity or where future demand may reduce. The depopulation of Red Zone areas in eastern Christchurch after the earthquakes has reduced demand for existing infrastructure in these areas. Isolation and decommissioning of redundant assets is continuing as and when additional assets become redundant. Some assets are now servicing fewer customers and therefore have a lower

priority for renewal decisions. Over time, these underutilised assets may potentially deliver lower levels of service in reflection of their lower criticality.

Coastal zones subject to flood risk, erosion, and tsunami and other areas facing an increase in natural hazard risk require consideration. Changes in future land use within these areas may reduce demand and thus reduce needs for the same level of infrastructure provision. Council is still developing their approach to address predicted changes in risk profile but increased risk, reduced level of service and reduced cost for these areas is a possibility.

Operational Costs

OPEX costs have been capped over recent years and not been adjusted for new assets coming on line. One such example is the "temporary" chlorination units, which are not depreciated and do not appear on the asset register because of their temporary nature. Adjustment of annual OPEX budget is now urgently required to cover existing shortfalls. If new assets are to achieve their design lives, we require provision of an annualised OPEX increase to maintain new assets.

For the preparation of the capital works programmes for this LTP, there has been a focus on the inclusion of OPEX costs of new projects to ensure future funding for new assets in whole of life costs and future OPEX budgets. While the process remains in development, it provides an improvement in the reporting compared to previous LTP's.

4.4 Demand Management Plan

Demand for new services will be managed through a combination of managing existing assets, upgrading existing assets and providing new assets. Demand management practices include non-asset solutions, minimising risks, maximising opportunities and managing failures.

Demand management initiatives may increase or decrease the demand for a Council service. This could have an impact on the need for assets and their management. Demand management are activities undertaken by the activity provider (Council) to alter demand. It is not related to external factors that influence demand – these are the demand drivers, discussed earlier in Section 4.1.

In many instances, demand management is understood as trying to limit the need for a service. However, demand for a service may also increase from initiatives undertaken.

Non-asset solutions focus on providing the required service without the need for the organisation to own the assets and management actions including altering demand for the service, altering the level of service (allowing some assets to deteriorate beyond current service levels) or educating customers to accept appropriate asset failures.

Table 4-4 shows demand management opportunities identified to date. A Demand Management Improvement Programme is identified and discussed further as a key focus area of improvement in Section 10.

Initiative that influences demand	Effect of initiative on demand (↑, ↓, ↔)	Can this effect be quantified – what assumptions have we made about the effect of the initiative	**Potential impact on asset planning (operation / maintenance / revenue / renewal / capex) etc**
Current initiatives			
Water demand monitoring	↔		
Network performance measurement	↔		
Leakage (water loss) control	↓	Council's water loss programme cycles through different water zones each year. Detected water loss on private infrastructure is notified to owners but without enforced action.	Reduces average daily demand through the repair of leaking pipes, joints and fittings.
Pressure management	↓	Water is supplied at high pressure (>700 kPA) in parts of the City due to historic water supply boundaries. High water supply pressure contributes to pipe breaks and leads to increased water loss through leaks.	Reduced network pressure reduces leakage water loss, pipe burst rates, general asset deterioration and energy costs. The opportunity exists to reduce water pressure whilst still providing a world class level of service to customers.
Education and outreach programmes	↓		
Council as a leader	↔		
Rainwater systems in Council facilities	↔		
Partnering and engagement	↔		
Future planned initiatives			
Putting smart meters in place for future volumetric charging	↓		

Table 4-4: Demand Management Initiatives and Impacts

Although not in the current demand management plan, demand management initiatives listed below remain for future consideration and implementation:

- Private infrastructure leak policy
- Water efficiency subsidy and rebates
- Water-efficiency in City Housing
- District plan changes
- Land use controls
- Using new water loss technology and a targeted approach
- Treated wastewater reuse demonstration projects

4.5 Growth Related Projects and Programmes

Table 4-5 summarises the major asset solutions planned to support demand growth and to manage demand impacts.

Description of asset(s)	Year Start	Value (FY22-31)
WS Highfield Water Supply Mains (to provide water connectivity to the Highfield ODP area)	Complete	$0k
WS Rawhiti Rezoning	Complete	$0k
WS Subdivisions Additional Infrastructure for Development (Programme) (to provide for increased capacity as triggered by new development)	Ongoing	$2,400k
WS Land Purchase for Pump Stations (Programme) (to provide for the purchase of land for new pump stations)	Ongoing	$6,000k
WS Highsted Road Water Supply Main (to provide improved water connectivity to the Northwest WSZ)	FY2020	$337k
WS Okains Bay New Water Supply (water treatment and reticulation for Okains Bay)	FY2020	$2,470k
WS Reticulation New Mains (Programme) (to provide for increased capacity to meet demand)	FY2022	$9,900k
WS New Pump Stations for Growth (Programme) (to provide for additional pump stations to meet the demand)	FY2022	$11,700k
WS Metro Wells, Pump Station and Water Supply Main	FY2022	$8,000k to be funded from existing programs
WS Duvauchelle Water Treatment Plant Upgrade (membrane filtration to replace existing plant in order to address operational capacity limits)	FY2023	$2,600k
WS New Wells for Growth (Programme) (to provide for additional wells to meet the demand)	FY2024	$7,800k
WS City Water Supply Re-zoning including pressure management	FY2024	$22,500k
WS Birdlings Flat Improvements	FY2025	$500k

Table 4-5: Asset Solutions Supporting Growth

Acquiring these new assets will commit the Council to fund ongoing operations, maintenance and renewal costs for the period that the service provided from the assets is required. These future costs are identified and considered in developing forecasts of future operations, maintenance and renewal costs in Sections 7 and 8.

5 Managing Risk and Investing in Resilience

This section outlines Council's approach to managing risk and investing in resilience. It includes responses by the activity to build resilience across a number of identified 'disruptors'. A risk register and schedule of proposed risk mitigation actions are also included.

5.1 Council's Approach

Investing in Resilience

The Resilience Greater Christchurch Plan (RGCP) provides a framework and multi-agency actions towards a more resilient City. All Council's activities play a role in contributing to this Plan by becoming more resilient to 'disruptors'.

To build resilience in our asset networks, we need to understand potential disruptors and their impacts on our assets and services. Disruptor outlines are in Section 5.2.1.

Key projects or activities to improve resilience, that we have identified and defined sufficiently to be included in this AMP programme, are included in Section 5.2.2.

Where further investigation is required to understand the impacts of disruptors and ways to increase resilience, opportunities are identified in Section 5.2.3.

Risk Management

Council's corporate approach to managing risk is defined in its Risk Policy and assessment framework. The framework provides a means for consistently identifying, recording and assessing risks such that risk mitigations can be prioritised across Council. The risk management framework and application to AMPs is summarised in Section 4.3.3 of the SAMP.

Whilst the resilience programme focusses on the big, strategic challenges such as natural hazards and globalisation, Council's risk register (recorded in ProMapp) is also intended to be used to manage higher frequency, lower probability events. For example, while another major earthquake would have very high consequences for many of Council assets, lower consequence risks such as third-party damage may be so frequent as to also warrant attention.

In Section 5.3.1 we provide a snapshot of the highest risks recorded for this activity and in 5.3.2 summarise the major mitigation actions that have been included in this AMP.

Resilience Definitions

Acute Shocks: Sudden, sharp events that threaten us e.g. the Canterbury earthquakes represent one of the most significant types of shock any place can endure.

Chronic stresses: Activity that weakens the fabric and functioning of a city on a day-to-day or cyclical basis.

Resilience is the capacity of individuals, communities, businesses, and systems to survive, adapt and grow, no matter what chronic stresses and acute shocks they experience. (100 Resilient Cities)

The Resilience Dividend: The practice of designing projects and policies to address multiple challenges at one time, improving services and/or saving resources i.e. the net social, economic and physical benefits achieved when designing initiatives and projects. (*100 Resilient Cities)*.

Multiple Dividends accrue from investment in disaster risk reduction and can: (1) Avoid or minimise losses when disasters strike. (2) Stimulate economic activity in a zone as a result of reduced disaster risk; and (3) develop co-benefits, or uses, of a specific investment.

Absorption is the ability to absorb shocks or stresses without triggering non-linear, abrupt environmental change (in the wider sense of 'environment' not just the natural environment). *New Zealand Treasury Resilience and Future Wellbeing 2018.*

Adaptation changing something in order to make it suitable for a new use or situation. In a climate change context, the UN Development Program calls it a process by which strategies to moderate, cope with and take advantage of the consequences of climatic events are enhanced, developed, and implemented. *(Oxford Dictionary).*

Mitigation is the action of reducing or minimising the severity and seriousness of any harmful impact *(Oxford Dictionary).*

Resilient Qualities are the characteristics of resilient projects and systems. The 100 Resilient Cities define these characteristics as reflective, resourceful, robust, redundant, flexible, inclusive, and integrated.

5.2 Investing in Resilience

5.2.1 Understanding our Resilience Challenges

Appendix 1.6 of the SAMP details the 'shocks and stresses' (disruptors) that provide resilience challenges for Christchurch. Table 5-1 summarises the most significant potential impacts of disruptors on water supply assets and services, with references stated at the end. Climate change is discussed in length as a disruptor given the Council strategic priority in this area.

Council has undertaken a natural hazard risk screening for the water supply activity to identify risks at a greater level of detail and also to rank risks according to relative severity – Refer Climate Change Risk Assessment TRIM FOLDER20/298.

Type	Disruptors	Potential Impacts on our Assets and Services
Chronic Stressors	Climate Change	Increased drought risk –less water available plus increased water demand for irrigation, supply pressure on Banks Peninsula surface water sources. Increased peak and total demand with more hot days (25°C+). Communities at end of supply/relying on reservoirs being filled in off-peak times (Port Hills and Lyttelton Harbour) are particularly vulnerable. Akaroa especially vulnerable- particularly if the drought (less water) and hot days (more demand) coincides with tourist season or when cruise ships are in the harbour. Possible biological response to low flow/higher temperature- e.g. increased bacterial action, legionella, cyanobacteria. Forest fire risk to water infrastructure and source water catchments around Banks Peninsula/Port Hills. Increased high intensity rainfall – increased flood risk (see Acute Shock: Flooding)- surface assets vulnerable to flooding. May also lead to more frequent contamination events. Increased landslides and erosion in Banks Peninsula due to de-vegetation by drought or fire, followed by more intense rainfall events and stronger winds. Risk of landslide damaging infrastructure in the hills and Banks Peninsula. Increasing sediment runoff with drought, de-vegetation and increased erosion. Turbidity compromises ability of Akaroa treatment plant to operate. Sea level rise, coastal erosion and coastal inundation - reduced viability to service some properties and possibility of stranded assets. Damage to surface assets in coastal areas, including by saline water and sediment. Groundwater rise – reduced asset life and performance of buried assets, reduced viability to service some properties. Shallow groundwater in coastal areas means that pumping will be necessary to repair pipes- increased cost/time to repair. Groundwater salinity – reduced asset life, performance of buried assets and could affect source water at some wells. Shallowing of groundwater increases liquefaction risk in coastal areas. With Increasing drought/irrigation north of the Waimakariri River, there may be increased risk of nitrates entering Christchurch's aquifers. Climate change mitigation – carbon accounting required for capital and operational projects requiring different cost, time and methodologies.
	COVID-19 and its economic impact	Early forecasting signals significant economic impacts locally, nationally and internationally. There is great uncertainty. This advice is being updated regularly and is likely to change over time. What might this mean for the water supply activity? Initial focus on critical projects, government stimulus projects and completing committed projects Short-term possible delays in scheduled capital programme works, potential issues with workforce availability/contractor viability, uncertainty about materials supplies, changing priorities, and increased financial pressure. Opportunities for

		bringing forward 'shovel ready' work. Leakage through the water network likely to increase further beyond an already high 25% Medium term consideration of capital works programme in light of the emerging Financial Strategy and Infrastructure Strategy response. Longer term horizon is very uncertain. Potentially dealing with the effect of any deferred expenditure due to the above factors e.g. intergenerational equity as a result of assets consumption outstripping renewals.
	Globalisation	Being an isolated island nation, we are exposed to the cost of materials. Any trade embargos/wars may affect the costs for replacing assets beyond budget forecasts, or preventing renewals resulting in lower levels of service.
	Population Health	Declining source water quality (e.g. nitrates in groundwater) – potential health risks or higher treatment standards required Permanent chlorination – residual chlorination of network may be required to meet public health expectations Fluoridation – potential change in fluoridation requirements and sentiment
	Housing and Social Inequity	Fairly charging users of the service – expectations that users only pay for their own use and do not subsidise high users through universal rating Intergenerational equity and debt – expectations that the cost of assets and services are equitably applied to the generations that do (and will) receive the benefits
	Regulation	Government Three Waters Review – expected changes in regulation, funding, organisational arrangements Shared service delivery – potential sharing of service delivery between multiple councils and organisations Centralisation - potential amalgamation or national delivery organisations National Environmental Standards – changing targets and controls for environment outcomes
Acute Shocks	Flooding	Flooding causing inundation in serviced areas - damage to assets and lost or impaired service Further risk profiling of areas of greatest flood hazard - reduced viability to service some properties and possibility of stranded assets.
	Seismicity	Large earthquake causing ground shaking , liquefaction, landslides and permanent ground deformation, uplift, subsidence or tilting – damage to assets and lost or impaired service Further risk profiling of areas of greatest seismic hazard - reduced viability to service some properties and possibility of stranded assets
	Tsunami	Large tsunami causing inundation, high water velocity and large quantities of entrained sediment and other debris in serviced areas - damage to assets and lost or impaired service Further risk profiling of areas of greatest tsunami hazard - reduced viability to service some properties and possibility of stranded assets.

Table 5-1: Potential Impacts of Resilience Disruptors

References:

- Vulnerable: the quantum of local government infrastructure exposed to sea level rise, LGNZ & Tonkin & Taylor Ltd, 2019
- Effects of Seal Level Rise for Christchurch City, Tonkin & Taylor, 2013
- Ministry for the Environment 2018. Climate Change Projections for New Zealand: Atmosphere Projections Based on Simulations from the IPCC Fifth Assessment, 2nd Edition. Wellington: Ministry for the Environment.
- The impacts of climate change in Canterbury: a summary of the literature, ECan, 2019
- Te Wai Ora o Tāne Integrated Water Strategy, Christchurch City Council, 2019
- List of assumptions prepared for 2021 Infrastructure Strategy
- Department of Internal Affairs: Three Waters Review
- Resource Management (National Environmental Standards for Sources of Human Drinking Water) Regulations 2007
- National Policy Statement for Freshwater Management 2014 (Updated 2017)

- Tsunami research TRIM 18/45483
- Council Wide Climate Change Risk Assessment 2020 TRIM FOLDER20/298

5.2.2 Resilient projects or activities in this plan

Table 5-2, Table 5-3 and Table 5-4 detail the projects and programmes helping build the resilience of our assets. These projects and programmes are already underway and/or are included in this AMP programme. Although not being conducted specifically for resilience, outcomes of these projects will position Christchurch to be better prepared for, and more resilient to, the disruptions identified in the Resilient Greater Christchurch Plan as most likely to impact community wellbeing.

Lyttelton Rail Tunnel Water Supply Pipeline Replacement:	
Project Description	The Lyttelton Harbour basin is serviced from Christchurch City by a pipe through the road tunnel and two pipes through the rail tunnel. The two rail tunnel pipes are in need of replacement. Council is considering options for replacing the rail tunnel pipes to ensure there is a second robust pipeline to compliment the pipe through the road tunnel. Resilience is a key part of the selection criteria for the new pipeline route. Options over the hills are being considered alongside tunnel options.
Scope and Expected Impact	Investigating route options for a second main pipeline linking Christchurch City and Lyttelton Harbour. The primary criteria for route selection is resilience, in this case allowing continuity of water supply service to Lyttelton Harbour after a natural hazard or other major event.
The Case for Change	The two rail tunnel pipes are in need of replacement. These two pipes are also an impediment for Kiwirail preventing them from performing certain maintenance activities in their tunnel. Without the rail tunnel pipelines there is only a single source of water supply for the communities of Lyttelton Harbour basin via the road tunnel. The risk of losing supply to these communities in a natural hazard or other unexpected event can be significantly reduced by providing a robust second pipeline, potentially over the hills rather than through the tunnel.
The Resilience Dividend	A duplicate pipe provides benefits further than just mitigating risk of losing supply after a hazard. There will be additional day to day capacity, providing both opportunities for growth and hydraulic performances. There will be a benefit of redundancy where service can be continued during a shutdown of either pipe for operational or maintenance purposes.
Further Opportunities	There is opportunity to use the cost / benefit analysis of this project as a precedent for looking at other opportunities in the network to increase resilience through pipeline duplication.

Table 5-2: Resilience Outcomes of the Lyttelton Rail Tunnel Water Supply Pipeline Replacement Project

Water Safety Plan Improvement Programme	
Project Description	To implement the improvements identified in the 2019/2020 Water Safety Plans. These are primarily to those changes required to address unacceptable risks.
Scope and Expected Impact	The three focus areas are: Reservoirs and suction tanks: including renewal, new works, and increased inspection and maintenance. Lead in pipes: investigate sources of lead in pipes and target renewal of lead jointed pipes were necessary Backflow prevention: Installation of backflow prevention devices, increased backflow testing, monitoring and enforcement. Additional scope includes well head security upgrades, SMART network monitoring, reducing leakage and other improvements to demonstrate safe drinking water.
The Case for Change	Central government has embarked on a regulatory drinking water supply reform programme. Following recommendations in the Havelock North Inquiry, this is

	likely to include mandatory residual disinfection unless a supplier can demonstrate that the drinking water is safe.
The Resilience Dividend	Aligned with Council's safe and sustainable water supply and improved waterways strategic priority and the community outcomes seeking high quality drinking water and a healthy environment. Co-benefits include economic sustainability, reliability of supply and resource efficiency through lower water loss.
Further Opportunities	Increase resourcing for maintain water safety plans to stay ahead of changing regulatory requirements and emerging contaminants. Reconfigure water supply zones to improve resilience and progress towards demand (and leakage) reduction targets (refer Section 4).

Table 5-3: Resilience Outcomes of the Water Safety Plan Improvement Programme

Pipe Renewal Programme	
Project Description	The pipe renewal programme is targeting very poor condition pipes and those other pipes where failure presents a high risk to Council and the community.
Scope and Expected Impact	Replacement of approx. $464M of water supply pipes in very poor condition or at high risk over the next ten years. Typically, these old poor condition pipes are made from brittle materials and pose a high risk of failure under normal conditions as well as being more vulnerable to hazards such as earthquakes. The replacement pipes are flexible and provide greater resilience to earthquake disruption. Pipe renewals will also help with leakage reduction as means to demonstrate a safe water supply network with low risk of contaminant entry.
The Case for Change	The poor condition of the reticulation network, the material composition, consequence of failure risk and the extent of deferred is discussed at length in Section 8. The estimated water loss due to leakage is 20.5% (2020). Internationally, the best practice examples for unchlorinated water supplies have leakage less than 10%.
The Resilience Dividend	Renewed pipes provide improved operational and maintenance performance while also increasing resilience to earthquake disruption and help reduce network leakage rates.
Further Opportunities	There is further opportunity to prioritise renewals and implement specific renewal strategies for areas exposed to increased natural hazard risk. For example to have a different renewal strategy for areas at greatest risk of coastal flooding inundation due to sea level rise. Also to investigate and then prioritise renewals where the resilience dividend is the greatest.

Table 5-4: Resilience Outcomes of the Pipe Renewals Programme

5.2.3 Building the case for Resilience Investment - 2021 LTP and beyond

Investigation is needed to build the case for future investment in resilience e.g. information/data, policy directions, guidelines, modelling, etc. The opportunities presented below have potential to inform the 2024 and 2027 LTP's:

Climate change

There are two sides to climate change: mitigation and adaptation

Mitigation: Council has committed to being carbon neutral by 2030, has declared a Climate Change Emergency and has helped set targets for the district. These are:

- Net zero gas emissions by 2045
- 50% reduction from 2016/17 baseline levels by 2030 (excluding methane)
- 25% minimum reduction in methane by 2030 and 50% reduction by 2045

The key steps to reach these targets and understand the implications are under development. There are opportunities to monitor and reduce carbon within operational activities and new capital projects.

Adaptation: National and regional climate change risk screening is currently underway, with district wide (Christchurch and Banks Peninsula) to be started early in 2020. More detailed screening of coastal suburbs is also in the early stages. Screening is the first step in Local Government guidance for climate change adaption shown in Figure 5-1.

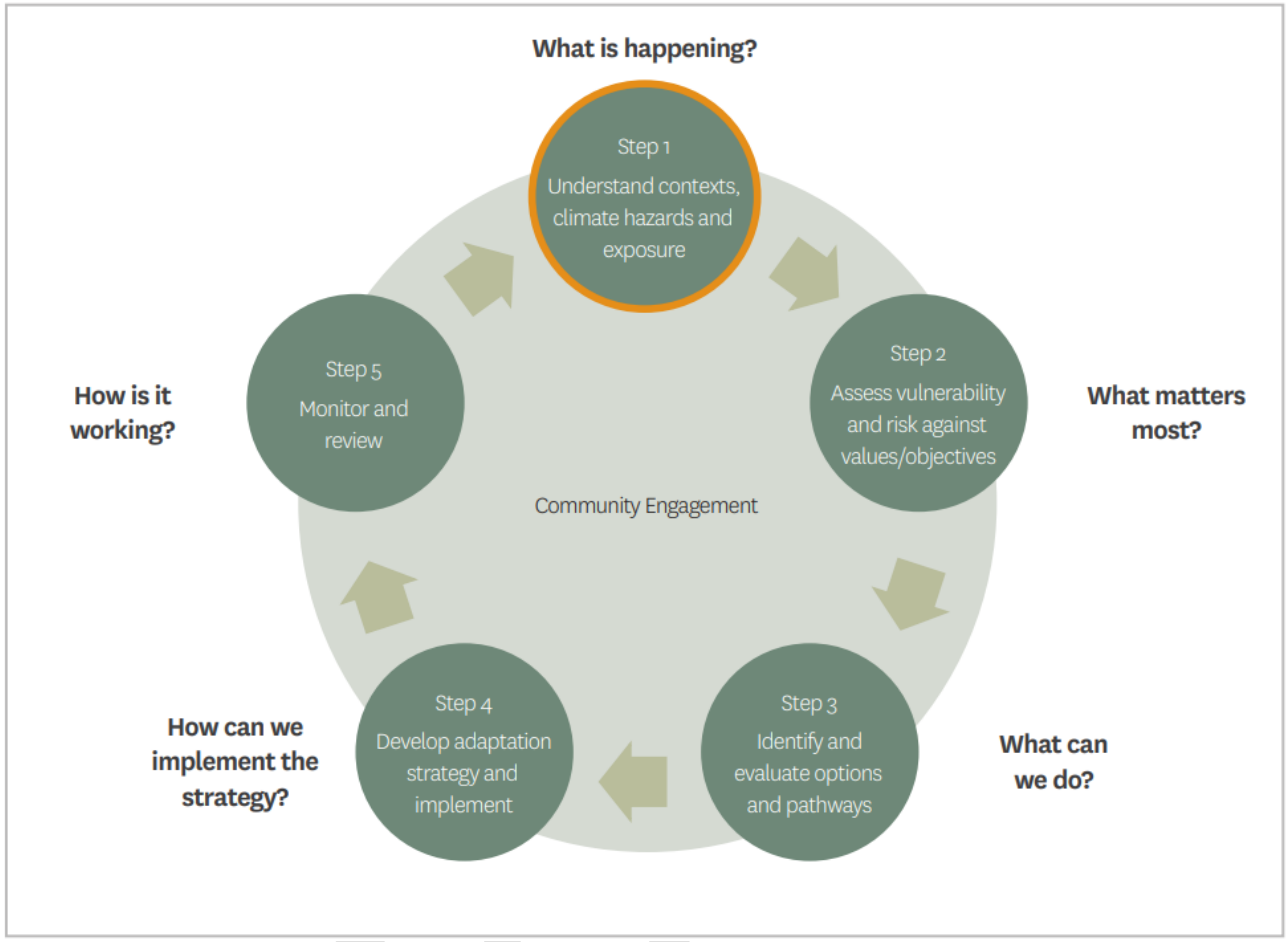


Figure 5-1: Climate change adaptation process, Exposed: Climate change and infrastructure, LGNZ, 2019

These screening projects will lead to more detailed risk assessments so that council can assess the extent of exposure to climate change impacts (Step 2) and areas that we will need to adapt (Step 3).

Climate change factors include rising temperatures, increased drought, more extreme storminess and high rainfall events, rising and increasingly saline groundwater in coastal suburbs, and rising sea levels. In-ground infrastructure in coastal areas may be exposed to a diurnal wet-dry cycle of salty water, likely to increase pipe deterioration.

Currently, no projections have been adopted for how potable water supplies will change with climate change. The aquifers in Christchurch are fed from the Waimakariri River- with an alpine watershed expected to continue receiving significant rainfall. However, it is unknown what effect increasing drought, temperatures and possibly demand for water from the river will have on flows over time, nor how this will affect aquifers. Increased temperatures and drought will affect Banks Peninsula surface water and shallow groundwater supplies; however, projections or responses are not yet complete.

Sea level and groundwater level rise will put water supply infrastructure at risk. Council has estimated at a high level that $124M of water supply infrastructure is vulnerable to a 1.0 m sea level rise. This increases to $419M for a 3.0 m sea level rise. Planning for the future of the vulnerable infrastructure cannot occur until strategies detailing which areas to strengthen and which to abandon are in place.

Climate Change Risk Mitigation Measure	Timeframe	Resources
Use ground water and sea level change modelling to evaluate asset specific risk profiles, and spatial level of service impacts	2021	$ 150,000

Develop Council strategy on infrastructure management in areas of high hazard	2022	$ 100,000
Combined Lifelines planning with transportation and consider realignment projects	2021	$ 50,000
Use quantified demand change scenarios in growth modelling and develop business case for demand management – e.g. non potable water reuse, volumetric charging	2023	$ 100,000
Use carbon accounting tool in option phase	2021	$ 100,000

Table 5-5: Climate Change Risk Mitigation Measures

Table 5-5 lists projects that will include climate change consideration in future asset planning.

Covid-19 and economic impact

The AMP has been prepared without a prediction of how the Covid-19 crisis will affect the activity. The future response is uncertain, but will undoubtedly be significant for the water supply activity. Some potential impacts and responses have been included earlier in Table 5-1.

Population health

Council's updated Water Safety Plan (2019) is the key document that describes the approach to safeguarding public health. Two future stressors identified in the Water Safety Plan are nitrates affecting water sources and emerging contaminants. The case for addressing these stressors remains under development and requires specific further investigation to understand what is happening prior to identifying response options.

Additionally, gaining a greater understanding of the existing water borne disease burden in Christchurch so that this evidence can inform the discussion around contamination risk may strengthen resilience. Strategies for communicating risk are also key to ensure that Council actions produce the desired outcomes in the community.

Table 5-6 lists projects aiming to mitigate population health risks.

Population Health Risk Mitigation Measure	Timeframe	Resources
Develop strategies for emerging contaminants	Medium priority – address over next 10 years	From internal staff as needed
Investigate cost of nitrate removal, loss of water quality and health effects	Medium priority – address over next 10 years	From internal staff as needed
Investigate water borne disease burden of customers	Medium priority – address over next 10 years	From internal staff as needed
Develop risk communication strategy for residual chlorine disinfection	Medium priority – address over next 10 years	From internal staff as needed
Develop risk communication strategy for fluoridation	Medium priority – address over next 10 years	From internal staff as needed

Table 5-6: Population Health Risk Mitigation Measures

Housing and Social Inequity

The opportunities presented in Table 5-7 below are investigations that required in order to inform decisions in future LTPs.

Housing and Social Inequity Risk Mitigation Measure	Timeframe	Resources
Investigate ability to pay and tenant/landlord cost burden of volumetric charging	2021	From internal staff as needed
Investigate ability to pay for enforce private leakage reduction	2021	From internal staff as needed
Investigate intergenerational equity of infrastructure and financial strategy	2021	From internal staff as needed

Table 5-7: Housing and Social Inequity Risk Mitigation Measures

Regulation

Water supply regulation change is occurring with the new Water Services Bill and dedicated water regulator. The full extent of changes aren't yet known however Council expects greater emphasis on demonstrating safety for supplies without chlorine treatment. This emphasis has begun already with a number of improvement programmes promoted for funding as part of the Water Safety Plan and "Beyond Wellheads" options.

The Government's Three Waters Review is proposing amendments to the National Environmental Standards for Sources of Human Drinking Water. The proposals aim to manage risks posed by activities within drinking water catchments.

Table 5-8 lists projects aiming to mitigate regulation risks.

Regulation Risk Mitigation Measure	Timeframe	Resources
Anticipate changing drinking water legislation and pursue network improvements to demonstrate water safety – e.g. Water safety plan and Smart networks	2021	$ 20 million CAPEX
Develop early cost estimates for proposed National Environmental Standards	2022	$ 50,000 OPEX

Table 5-8: Regulation Risk Mitigation Measures

Flooding, Seismicity and Tsunami

Earthquake exposure is relatively well understood following the 2010/2011 earthquakes. Increased design and construction standards have already been implemented to increase resilience. A next step is to develop policy for infrastructure investment in areas of high hazard and combine the earthquake risk with flood and tsunami.

A new liquefaction tool models the connection between liquefaction potential and groundwater levels. Further input is still needed to predict the rate that sea level rise will affect the groundwater/liquefaction profile in coastal suburbs.

NIWA has modelled the 500 year tsunami exposure for Christchurch and Banks Peninsula including various increments of sea level rise. This shows significant areas in the east are exposed to tsunami. While in-ground assets may be less affected than those at surface, the vulnerability/fragility of infrastructure to tsunami still needs further investigation, with guidance developed on how to manage the risk.

Council has estimated at a high level that 982km of pipes and 38 stations are within a 200 year flood exposure zone. For tsunami, the estimate is 292km of pipes and 26 stations exposed to this risk.

Table 5-9 lists projects aiming to mitigate Flooding, Seismicity and Tsunami risks.

Flooding, Seismicity and Tsunami Risk Mitigation Measure	Timeframe	Resources
Use earthquake, flood and tsunami modelling to evaluate asset specific risk profiles, and spatial level of service impacts	FY2021	$ 150k
Develop Council strategy on infrastructure management in areas of high hazard	FY2022	See climate change target above
Combined Lifelines planning with transportation and consider realignment projects	FY2023	See climate change target above
Compare existing network with redundancy standards for new infrastructure	Lower priority	None identified
Increase the number of earthquake shutoff valves in the water network	FY2021	$ 500k CAPEX
Integrate tsunami warning 3Waters Business Continuity Plans	Lower priority	None identified

Table 5-9: Flooding, Seismicity and Tsunami Risk Mitigation Measures

5.3 Managing Risks

Council's approach to managing risk is detailed in its Risk Management Policy (including a risk assessment framework) which is summarised in Appendix 1.6.2 of the SAMP as a background to the content in this Section.

5.3.1 Strategic Risks

Business unit leads have the responsibility for identifying, recording and monitoring business risks using 'Promapp'. The reporting within Promapp ensures that there is visibility of risks Council is managing. The Council risk framework sets out the levels for escalating, reporting and governing residual risks.

High-risk issues from Promapp fall into the following strategic themes for water supply:

Strategic risks include, the risk that:

- Drinking water supply is contaminated
- Major/critical infrastructure fails
- Customers are dissatisfied with chlorine levels
- We are unable to supply sufficient water
- The water supply operation harms staff, public or the environment
- The assets are managed poorly, resulting in high costs or poor service outcomes
- Our staff are not able to deliver our project, operational, and improvement commitments
- Covid-19 and the economic downturn affect the Council's ability to execute the recommendations within this AMP

5.3.2 Asset Risks

The Three Waters and Waste unit identifies risks and records risk responses at a more detailed level, summarised risks form part of the strategic risks in Table 5-10. Refer to Promapp for the full list of risk items and their mitigation measures.

Risk Title There is a risk that/of:	Caused By:	Resulting In:	Controls and Mitigations
There is a risk that the groundwater that we use to supply Christchurch, Lyttelton, Wainui, Birdlings Flat, Little River and Akaroa/Takamatua receives microbial or chemical contamination.	• Wastewater seeping into the aquifer from broken or leaking pipes, septic tanks or wastewater overflows • Water abstracted from a well that is less than 1 year old. (microbial contamination may still be present) • Chemical or diesel spills seeping into the aquifer, leaching from contaminated sites • Intensive farming in the groundwater source area contaminates the groundwater with nitrate • Contamination of Wells and groundwater source, due to insufficient maintenance and renewals budget, lack of staff/contractor capability and capacity, or negligence • Abandoned or improperly decommissioned wells provide a direct route for contamination to enter the aquifer	• Illness and possibly deaths from drinking water contaminated water • Non-compliance with the Drinking-water Standards for New Zealand, which may lead to intervention by the drinking water regulator (e.g. requirement to chlorinate) • Inability to supply sufficient water to meet demand • Additional costs to treat contaminated water reputational damage	• Increased communications and engagement with community through community boards • Programmed wellhead security assessments • Programmed reservoir/suction tank assessments • Programmed CCTV inspections of high consequence of failure pipes • Regular maintenance • Appropriately resourced 3 waters business unit • Adequately funded renewals programmes • Confined aquifer system prevents microbial contaminants from entering the aquifers used for our water supply • Microbial and chemical contamination monitoring, risk assessment and reactive processes • Drinking-water source protection zones and associated rules are included in the Land and Water Regional Plan • Liaising with Environment Canterbury on groundwater protection matters • Double skinned heat exchangers to prevent loss of fluids into the aquifer • All CCC fuel tanks are above ground • Site audits of high hazard sites • Appropriate decommissioning and sealing of unused Council bores
There is a risk that the Council, as a water supplier, does not comply with the Drinking-water Standards for New Zealand or the Health Act.	• Loss of secure bore water status (Christchurch/Lyttelton and Wainui) • Not having an approved Water Safety Plan for each water supply that serves more than 500 customers (Christchurch/Lyttelton and Akaroa/Takamatua)	• Illness and possibly deaths from drinking water contaminated water • Regulator intervention, including issuing a compliance order, prosecution, fines, declaration of a drinking water emergency with a designated officer of the Ministry of Health	• Approved Water Safety Plans for water supplies that serve more than 500 customers (Christchurch/Lyttelton and Akaroa/Takamatua) • Action plans to implement improvements in the water safety plans • Qualified and experienced staff for preparing and implementing Water Safety Plans, operating and maintaining the water supplies,

	• Not implementing the preventive measures and improvements in the Water Safety Plans • Not operating, maintaining, renewing and upgrading water supply infrastructure (including treatment plants) to meet the required standards • A failure to adequately respond to transgressions and escalate breaches of the standards or Act • Insufficient trained and experienced staff (Council and Citycare) • Inadequate funding of water supply renewals and upgrades and/or operations and maintenance	taking control of the water supply • Increased capital, operational and maintenance costs • Reputational damage	and planning and delivering renewals and upgrades to water supply infrastructure • Audits of water supply operations and maintenance activities • Operational processes and procedures for the water supplies • Providing sufficient funding in the Long Term Plan for operational, maintenance and capital costs to ensure compliance
There is a risk that our water treatment plants at Duvauchelle, Little River, Akaroa, Birdlings Flat, Pigeon Bay and Main Pumps do not adequately remove contaminants from the source water.	• Contaminant load is greater than the treatment plant was designed for • Treatment plant not properly maintained and/or operated due to insufficient maintenance and renewals budget, lack of staff/contractor capability and/or capacity, or negligence • Break-down of treatment plant	• Illness and possibly deaths from drinking water which has received insufficient treatment to remove contaminants • Non-compliance with the Drinking-water Standards for New Zealand, which may lead to intervention by the drinking water regulator • Increased operational and maintenance costs • Inability to supply sufficient water to meet demand • Reputational damage	• Multi-stage treatment system (coagulation/flocculation, membrane and chlorination) • Use of alternative groundwater source if stream sediment loads are high (Akaroa and Little River) • Turbidity monitoring at the intakes and automatic bypass if stream sediment loads are high • Visual inspections of streams to check for cyanobacteria • Qualified and experienced Maintenance staff to operate and maintain the water treatment plants • Audits of treatment plant operations and maintenance activities

			• Rules in the Land and Water Regional Plan control activities in Water Supply Protection Zones • Making submissions on resource consents that pose a contamination risk, submitting on changes to the Land and Water Regional Plan and liaising with Environment Canterbury on surface water supply catchment protection matters • Implementation of the Canterbury Water Management Strategy • Treated water storage tanks so that water can still be provided during short outages • Tankering water from another nearby water supply if the treatment plant cannot treat water sufficiently • Planned upgrade to the Duvauchelle water treatment plant included in the Annual Plan • Fire bans during high risk times

Table 5-10: High Level Risk Items

5.3.3 Risk Mitigation Strategies

Risk management is inherent in all of Council's asset management processes. Table 5-10 lists specific risk treatments. Significant risk management strategies for this activity include:

Asset Design

Significant effort has been applied to updating design and construction standards for infrastructure to become more resilient to earthquakes, specifically targeting: flexible materials, jointing systems, foundation designs, structural interfaces, wellheads, earthquake shut off valves.

Design requirements are set out in Council's Infrastructure Design Standards (IDS). This includes:

- approved materials, jointing systems and design solutions to provide resilient earthquake performance
- duty/standby pumping for redundancy
- avoiding water supply pipelines fed from only one direction
- storage requirements

Where necessary, new infrastructure installed since the 2010/2011 Canterbury earthquakes is made of modern materials to the latest design standards and therefore has greater resilience to future earthquake damage and potentially other disruptions.

Insurance

The Strategic Asset Management plan states:

"Insurance is a risk transfer strategy to mitigate financial risks associated with disruptors. Council's approach is to attract and consolidate a balanced insurer panel and secure the maximum amount of insurance possible for the best possible price."

Business Continuity and Emergency Response Planning

The business continuity plans for water supply are located within the Three Waters and Waste Business Continuity Plan. An index of the individual plans is:

- CWW-WS-021: Aquifer Contamination
- CWW-WS-022: Medium to Long Term Degradation of Aquifers
- CWW-WS-023: Salination of Coastal Wells
- CWW-WS-024: Contamination of Surface Water Sources (Banks Peninsula)
- CWW-WS-025: Physical Terrorist Attack on Assets (3 Waters)
- CWW-WS-026: Cyber Attack on 3 Waters PLC, SCADA and IT Systems
- CWW-WS-027: Tsunami (3 Waters)
- CWW-WS-028: Earthquake (3 Waters)
- CWW-WS-029: Water Demand exceeds Consent Water Take
- CWW-WS-030: Water Supply Treatment Plant Process Failure
- CWW-WW-57: Death or Major Harm Incident in the Operations Area
- CWW-WW-60: Contractor is Terminated for Insolvency or Poor Performance

Other specific initiatives:

Water Safety Plans

The Health Act 1956 requires Council to have and implement a water safety plan. A water safety plan documents a public health risk-based assessment and management process that aims to ensure a safe and secure supply of drinking water for consumers, protecting public health.

Table 5-11 lists Council's seven water safety plans and their current status.

Water Supply Scheme	Water Safety Plan Status

Akaroa and Takamatua	Approved
Christchurch City and Lyttelton Harbour Basin	Under review by the Drinking Water Assessor
Birdlings Flat	Being updated to new framework and requirements
Duvauchelle	Being updated to new framework and requirements
Little River	Being updated to new framework and requirements
Pigeon Bay	Being updated to new framework and requirements
Wainui	Reviewed by Drinking Water Assessor, returned to Council for amendment

Table 5-11: Christchurch City Council Water Safety Plans

Water safety plans identify improvements that are required in order to comply with drinking water regulation. The costs, timelines and delivery mechanisms for water safety plan improvements are still being developed and will form a key part of the next LTP.

5.4 Summary of Risk and Resilience Projects

There are a number of capital programmes being implemented to primarily address level of service, demand or renewal that will provide a resilience dividend. These projects are listed in those respective sections of this AMP. For example, where possible the pipe renewal programme will replace poor condition pipes with new pipes less prone to damage from local risks. Additionally, the water safety plan improvement addresses water safety as a level of service and therefore addresses risk.

The table below summarises these initiatives and includes programmes to improve resilience for the water supply activity. Large scale capital projects have not yet been identified to address certain disruptors such as climate change and other natural hazard risks specifically. The proposed programme to address these risks and disruptors is to dedicate significant resources within the next LTP period to identify and evaluate options such as large scale capital projects, so that decisions can be made for the next AMP cycle to invest in the most beneficial options.

Major Initiatives to address resilience	Response to	Indicative $ 2022-2024
Water Supply Safety Improvements Programme and Smart network	Regulation and population health hazards	Refer Section 3
Asset renewal programmes	Seismic, regulatory, site specific and climate change hazards	Refer Section 8
Climate change issues and options, promoting capital programmes and projects prior to 2024	Climate change hazards	$500k OPEX Refer Section 10 for related AMP Improvement Programme
Natural hazard issues and options, promoting capital programmes and projects prior to 2024	Flooding, seismicity and tsunami hazards	$250k OPEX
Contaminant investigation and risk communication strategy	Regulatory hazards	$150k OPEX
Water use payment investigation and communication strategy	Social and housing inequality	$150k OPEX

Table 5-12: Major Initiatives to Address Resilience

6 How we Deliver our Services

This section explains how Council delivers the activity through its organisational structure, contracting partners and other agencies involved in service delivery.

6.1 Historical Context

Development of the seven Council water supply schemes occurred at different times under different supply authorities.

Pre-1890: Water supply provision through private and community wells without a widespread reticulation system.

1890: Reticulated public water supply development begins in Akaroa and Lyttelton.

1900-1910: Reticulated public water supply development begins in the suburbs of Sydenham, Beckenham and Cashmere between 1903 and 1910.

1910-1989: Water supply network expansion to supply the entire Christchurch City area.

1962: Reticulated public water supply development begins in Wainui.

1966: Reticulated public water supply development begins in Diamond Harbour.

1976: Reticulated public water supply development begins in Birdlings Flat.

1981: Reticulated public water supply development begins in Pigeon Bay.

1988: Treated, reticulated public water supply development begins in Duvauchelle.

1988: Treated, reticulated public water supply development begins in Governors Bay and Little River.

1989: Following the 1989 local government reforms, the five local bodies providing local government to Christchurch were merged into the new Christchurch City Council. The existing water supply activities of the local bodies and Christchurch Drainage Board were merged into the Council. As Christchurch City Council's first water supply assets were designed by six different entities there is a lack of standardisation across early well and pump station design.

1994: Treated, reticulated public water supply development begins in Takamatua.

1996: Major expansion of Wainui water supply scheme.

2001: Major expansion of Birdlings Flat water supply scheme.

2006: In 2006 the Banks Peninsula District Council was incorporated into the Council. This includes water supply schemes for Akaroa, Takamatua, Duvauchelle, Birdlings Flat, Little River, Pigeon Bay, and Wainui.

2010-2016: 2010/11 earthquakes. Earthquake impacts on water supply less than that on wastewater and roads. Repairs and temporary solutions completed rapidly after the earthquakes to restore water supply provision. The Stronger Christchurch Infrastructure Recovery Team (SCIRT) established to respond assess, rebuild and repair assets. Although SCIRT completed some renewals, the quantity was less than what Council would have completed over the same period using the pre-earthquake replacement rates.

2014: Major expansion of Little River water supply scheme.

2015-2016: Akaroa and Takamatua water supply schemes combined into a single scheme. Three existing water treatment plants replaced with a single, modern treatment plants.

6.2 Internal business structure

The water activity is primarily the responsibility of the Three Waters and Waste Unit. This unit reports directly to the Council CEO as shown in Figure 6-1. Table 6-1 lists the key teams delivering the water supply activity and their roles.

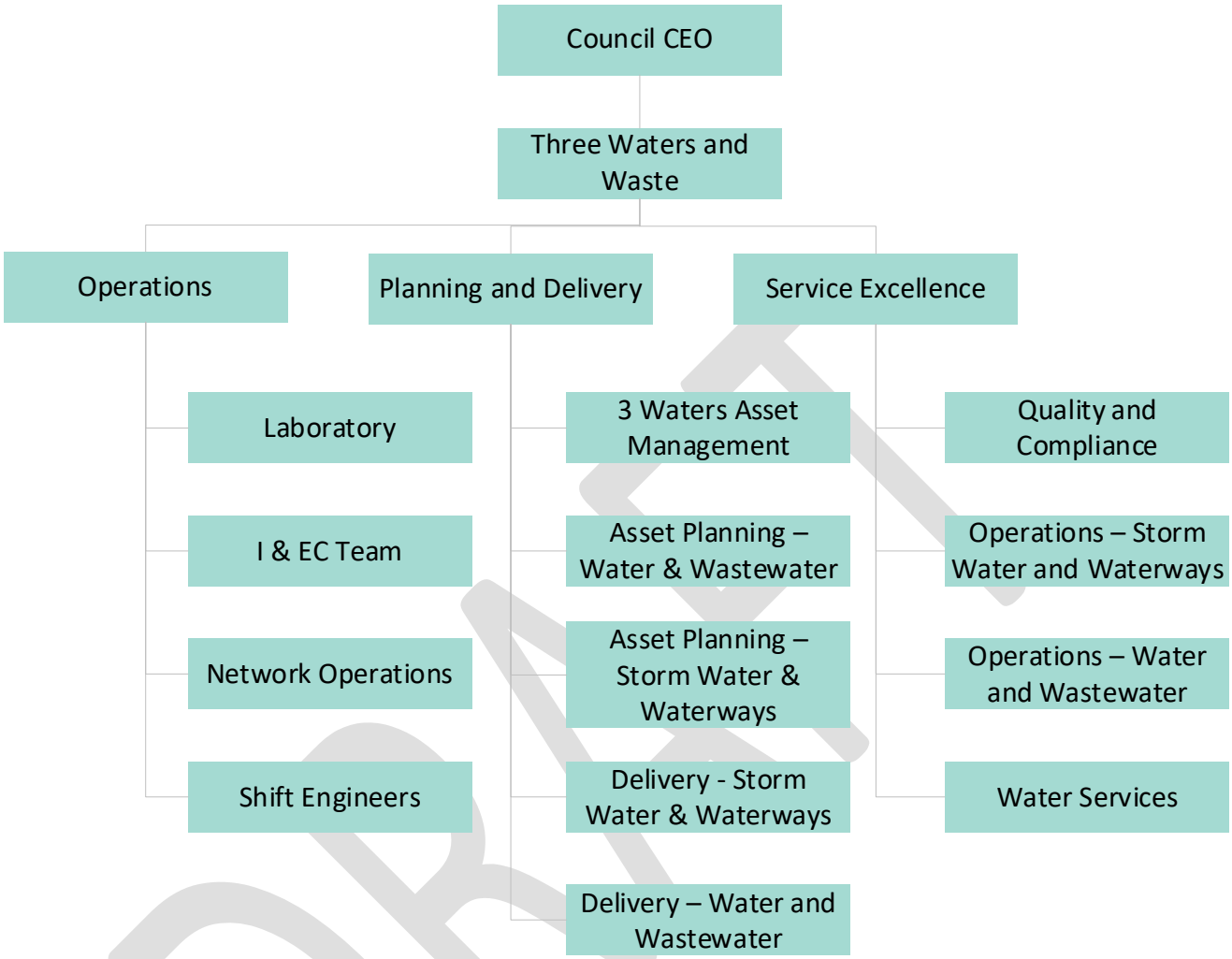


Figure 6-1: Organisational Structure

Team within Council	Role in Delivering Water Supply
Laboratory	Collecting and testing water samples and providing timely results to demonstrate compliance with the drinking water standards.
IE&C Team	Maintenance and replacement of instrumentation, electrical and control systems.
Network Operations	Operate the pump stations and treatment plant from the Christchurch WWTP control room.
Shift Engineers	Day to day maintenance of Christchurch WwTP electrical and mechanical assets.
3 Waters Asset Management	"Asset owners" responsible for lifecycle planning of assets, design reviews to ensure assets meet requirements. Renewals planning.
3 Waters Asset Planning – Water and Wastewater	Water supply and wastewater infrastructure planning for long-term supply and demand, including growth and land development.

3 Waters Asset Planning – Storm Water and Waterways	Storm water and waterway infrastructure planning for long-term supply and demand, including growth and land development.
3 Waters Project Delivery – Water and Wastewater	Manage the capital projects within the water supply and wastewater activities.
3 Waters Project Delivery – Storm Water and Waterways	Manage the capital projects within the storm water and waterway activities.
Quality and Compliance	Writing and implementing water safety plans. Ensuring drinking water security and safety. Resource consent compliance monitoring and reporting. Ecological and environmental monitoring and reporting.
Operations – Storm Water and Waterways	Oversees the network maintenance contract and provides liaison with the external contractor. Liaison with the public regarding complaints and service requests.
Operations – Water and Wastewater	Oversees the network maintenance contract and provides liaison with the external contractor. Liaison with the public regarding complaints and service requests.
Water Services	Processing applications, issues and billing for water supply metering and trade waste consents. Ensuring backflow suitability and compliance. Investigation into water pressure, flow and contamination complaints.

Table 6-1: Water Supply Service Delivery Teams

The Three Waters and Waste Unit also interfaces with departments across Council which support the asset management and service delivery functions.

6.3 External Contracts and Partners

Council uses a combination of internal and external capability to deliver the water services. The rationale for the current service delivery approach is continuing the existing procurement arrangement of using internal capabilities for functions where Council is the best party to manage risk and influence performance, and using external contractors elsewhere. A review of Council's current approach is within the scope of a wider business review described later in section 6.5.

Maintenance of the water pipe network and pump stations is carried out by an external contractor City Care Limited under contract CN4600000778. City Care Limited is a Council Controlled Organisation (CCO). The Banks Peninsula WTPs are also operated and maintained under this contract. Council's Reticulation and Maintenance Unit provide the liaison with the external contractor.

The following is excluded from the maintenance contract and is managed directly by Council:

- SCADA equipment maintenance
- Renewals, major maintenance and improvements that have been identified in the LTP

Table 6-2 summarises the main contracts involved in delivering the water supply activity.

Contract	Term and Type	Contract Management Approach
Water and wastewater network maintenance contract, City Care Limited contract # CN4600000778	External contractor term maintenance contract. Partial lump sum and partial measure and value. Currently extended until March 2022	Preventative and reactive maintenance of water and wastewater assets. Council provide the maintenance scope through the contract service information, specification and contract meetings. Also includes the operation of Bank Peninsula treatment plant assets to agreed performance standards.

Water supply network leakage reduction, Detection Services South Island Limited contract # CN460002119	Supply of services agreement, term contract with a 3 + 1 + 1 year timeframe (2016 – 2021, extended to May 2022). Procurement documents for new RFP 23920855 under development.	Night flow testing. Leakage detection via noise loggers and ground sensors. The contractor systematically cycles through the 120 isolatable water zones, completing 40 zones per year for night flow testing and 20 zones per year for leak detection.
Smart network monitoring – Council is currently developing an Expression of Interest to evaluate available services in the marketplace	To be determined	Pressure transient monitoring and leak detection technology
Water outlook - operational and compliance management tool and service provision. CN 4600001383.	Supply of services agreement contract with a 3 + 1 + 1 year timeframe (expires 2020)	Operational and compliance management tool for real time access to water supply data.
Drinking water laboratory testing. Predominantly completed by the Council lab at the Bromley WWTP with periodic support from external lab contract engagements	Internal - service level agreement External – one off contract engagements	Water quality testing for Drinkwater Water Standards New Zealand compliance and specific contaminant and characteristic testing.
Pipe sampling and condition assessment. New procurement method currently being developed to engage external technical specialist	Contract to be confirmed	Opportunistic and planned testing. Pipe sample analysis to determine pipe condition and characteristics.
Temporary hydrant connections - Humes	Service contract	Administer the connection logistics and the water charging for temporary hydrant connections to the water supply (typically for contractors).
Water meter reading – Arthur D. Riley	Service contract	Meter reading for commercial and residential customers.

Table 6-2: Major Contracts for Service Delivery

6.4 Other Service Delivery Partners

Council is the provider of community water services in the city, with a few exceptions such as Christchurch Hospital, Princess Margaret Hospital, Christchurch Airport and the Waterloo Business Park that provide their own water. In Banks Peninsula the community water schemes are supplied by Council. Council also provides water to customers across the Selwyn District Council boundary to the Lansdowne scheme and to a small number of other properties. Some rural residents within the Christchurch area are supplied by private bores or rainwater collection.

Planning and constructing new capital works involves liaison with internal and external utility providers to ensure that capital works are coordinated between the different activities. Transport, water supply, wastewater and land drainage asset engineers aim to maintain draft renewals programmes to ensure works proceed in a logical and cost effective manner and minimise disruption to residents. Draft programmes are also available to external service providers through the forward works viewer.

Table 6-3 identifies partners supporting Council's Three Waters and Waste Unit in the delivery of water services.

Service Delivery Partner	Role
Council (internal) - Technical Services Unit	Provide engineering design services for new capital works and contribute to Council's engineering standards.

Council (internal) - Transport	Coordination of renewal works capital projects between transport and water supply to optimise pavement life in locations of pipe trenching.
Council (internal) Project Management Office	Develop the process for how projects and programmes are delivered. Review and support alternative delivery models and frameworks.
City Care Limited	Contractor providing water supply network and plant maintenance, and operation of Banks Peninsula water treatment plants.
Consultants Panel	Professional service consultants providing ongoing design and construction management for water supply capital works.
Land developers	Build water supply infrastructure to service newly developed land. Infrastructure is vested in Council.
Selwyn District Council	The Christchurch City Council owned and operated scheme in Lansdowne is on the Selwyn/Christchurch boundary.
Environment Canterbury	Approve and monitor water take resource consents for Council's water supplies, protect source water.
Ministry of Health/Government Regulator	Assess water safety plans and sign off compliance to New Zealand Drinking Water Standards.

Table 6-3: Water Supply Service Delivery Partners

6.5 Business Reviews Undertaken

A Section 17A Service Delivery Review (S17A) is a legal requirement under the Local Government Act and determines whether the existing means for delivering a service remains the most efficient, effective and appropriate approach. The legislation requires that a S17A Service Delivery Review should periodically assess:

"The cost-effectiveness of current arrangements for meeting the needs of communities within its district or region for good quality local infrastructure, local public services, and performance of regulatory functions".

A review of water supply activities was initiated in July 2019 for two key reasons:

- the expiry of the existing 3 waters maintenance contracts and a desire to go out to market for these services
- to enable Council to be prepared for the outcomes of the Department of Internal Affairs' 3 Waters review

The section 17A review was completed in June 2020 and presented to Council in August 2020. The review confirmed that there were underlying challenges with the status quo. Central Government's water reform programme gained significant momentum in mid-2020 and Council agreed to sign a non-binding Memorandum of Understanding with the Crown at the same extra ordinary Council meeting in August 2020 regarding water reform. Due to the increasing pace of water reform, the status quo was the recommended way forward for the section 17A review. The reform is going to lead to significant changes to water service delivery across the country and adding in further structural change during the reform process was not seen to add value to Christchurch.

The Government has announced a new national water regulator and is reviewing how to improve the supply arrangements of drinking water, wastewater and stormwater, including financing provisions and decision-making capability. Any changes implemented at a national level will have an impact on Council's service delivery.

Given the uncertainty in terms of the outcomes and timing water reform, it is difficult to predict the impacts on the water supply activity service delivery structure. The AMP is prepared on a "business as usual" assumption. Potential outcomes include:

- Regional or larger asset owning 2 waters entity
- Regional, top of the South Island or full South Island entity that includes storm water and waterways

6.6 Significant changes planned for the activity

A central government program of water reform is underway addressing outcomes from the Havelock North water contamination event and subsequent inquiries. Outcomes and timing of water reform remain uncertain but are likely to include significant change to the delivery of water supply services.

In the shorter term, until confirmation of water reform outcomes, the main significant change is the renewal of the water supply and wastewater maintenance contract. The new maintenance contract will be very prescriptive rather than outcomes based, and involve the collection of key asset condition and performance data to support optimisation of maintenance plans/schedules performed by the maintenance contractor

The new contract is likely to have a short term to allow for changes occurring as part of water reform.

7 Portfolio Lifecycle Management Plan

The lifecycle management plans detail how the Council plans to manage the network of assets at the agreed levels of service (defined in Section 3) while optimising life cycle costs.

Section 7 provides the lifecycle management information and strategies at a portfolio level. Section 8 provides this information at an asset class level.

7.1 Asset Lifecycle Approach

Council has established a lifecycle management framework, aligned to the *International Infrastructure Management Manual* as illustrated in Figure 7-1. Section 7 and 8 are structured to align to the lifecycle stages.

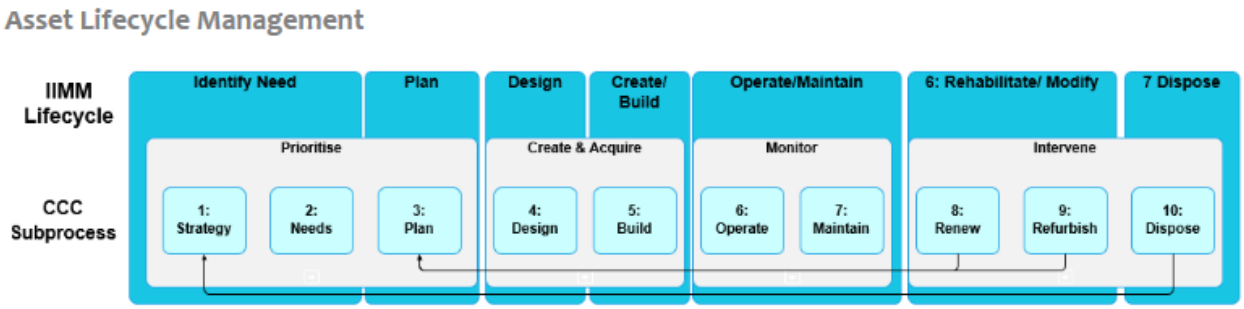


Figure 7-1: Asset Lifecycle Categories

7.2 Our Asset Portfolio

7.2.1 Number and Value

Table 7-1 lists the value of water supply assets based on the 2020 Valuation[5]. Total replacement cost of water supply assets is $2.87 billion with a book value of $1.61 billion and an annual depreciation of $38.2 million.

Asset Class	Asset Type	Quantity	Replacement Value	Book Value	Annual Depreciation
Reticulation	Submain	1,510.9 km	$609,459,609	$419,816,242	$7,047,441
	Crossover	150.4 km	$63,324,540	$42,426,389	$753,399
	Mains<=150mm	1,273.2 km	$841,993,169	$414,487,915	$10,171,141
	Mains (200/250/300mm)	498.1 km	$559,364,196	$355,725,519	$5,918,488
	Trunk Main	42.1 km	$103,412,366	$54,780,501	$1,057,177
	Lateral	219.6 km	$78,257,164	$54,791,479	$869,587
	Meters	133,367	$86,947,043	$39,315,603	$2,307,593
	Connections	133,367	$56,550,413	$13,151,120	$2,152,404
	Valves	35,361	$105,693,063	$49,998,244	$2,009,149
	Hydrants	14,412	$83,212,904	$44,338,290	$1,029,339

[5] CCC Three Waters Final Valuation Report June 2020 - TRIM://20/897727

	Reticulation Structures	387	$2,039,621	$1,618,400	$18,542
	Pipe Protection	10.9 km	$2,162,304	$1,791,455	$21,609
	Reticulation Total	**N/A**	**$2,592,416,391**	**$1,492,241,158**	**$33,355,868**
Pump Stations	Pipework	222	$15,191,370	$4,874,090	$284,827
	Valves	1,010	$5,951,512	$2,523,560	$79,954
	Pump set	689	$10,901,933	$3,357,734	$319,449
	Standby Plant	155	$8,850,373	$4,070,789	$209,938
	Plant & Equipment	17	$1,305,406	$1,178,422	$27,501
	Electrics	541	$14,413,991	$8,197,756	$351,514
	Instrumentation & Control	1,041	$6,712,657	$1,858,650	$386,522
	Buildings	154	$45,576,491	$14,607,094	$521,257
	Wells & Wellheads	170	$57,067,263	$31,259,092	$1,095,051
	Reservoirs & Tanks	155	$104,379,856	$43,302,565	$1,296,428
	Pump Station Total		**$270,350,852**	**$115,229,753**	**$4,572,441**
Water Treatment Plants	Pipework	8	$545,524	$476,466	$10,397
	Valves	116	$741,071	$589,286	$9,263
	Pump set	25	$1,205,750	$617,130	$31,984
	Standby Plant	2	$692,898	$533,949	$17,322
	Plant & Equipment	109	$1,568,535	$1,192,750	$43,999
	Electrics	24	$1,238,422	$921,029	$30,629
	Instrumentation & Control	113	$1,062,858	$622,843	$59,598
	Buildings	2	$1,394,157	$609,944	$17,427
	Wells & Wellheads	3	$2,101,955	$975,074	$35,033
	Treatment Plant Total		**$10,551,171**	**$6,538,470**	**$255,653**
Water Supply Total			**$2,873,318,415**	**$1,614,009,381**	**$38,183,962**

Table 7-1: Water Supply Asset Quantity and Value

Figure 7-2 and Figure 7-3 show an overview of where the water supply reticulation, station and treatment assets are located in Christchurch city and in Banks Peninsula.

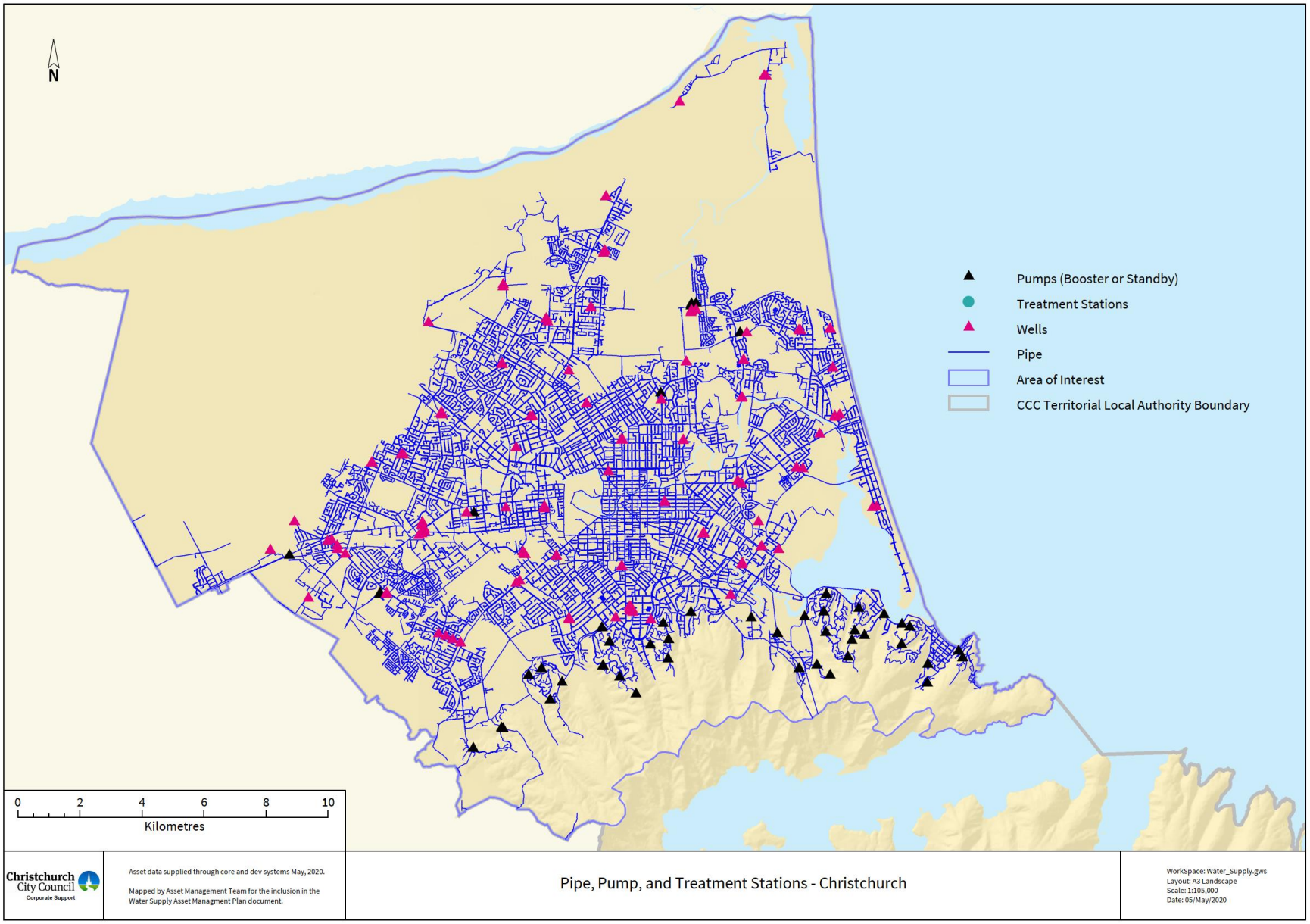


Figure 7-2: Christchurch City Water Supply Asset Locations

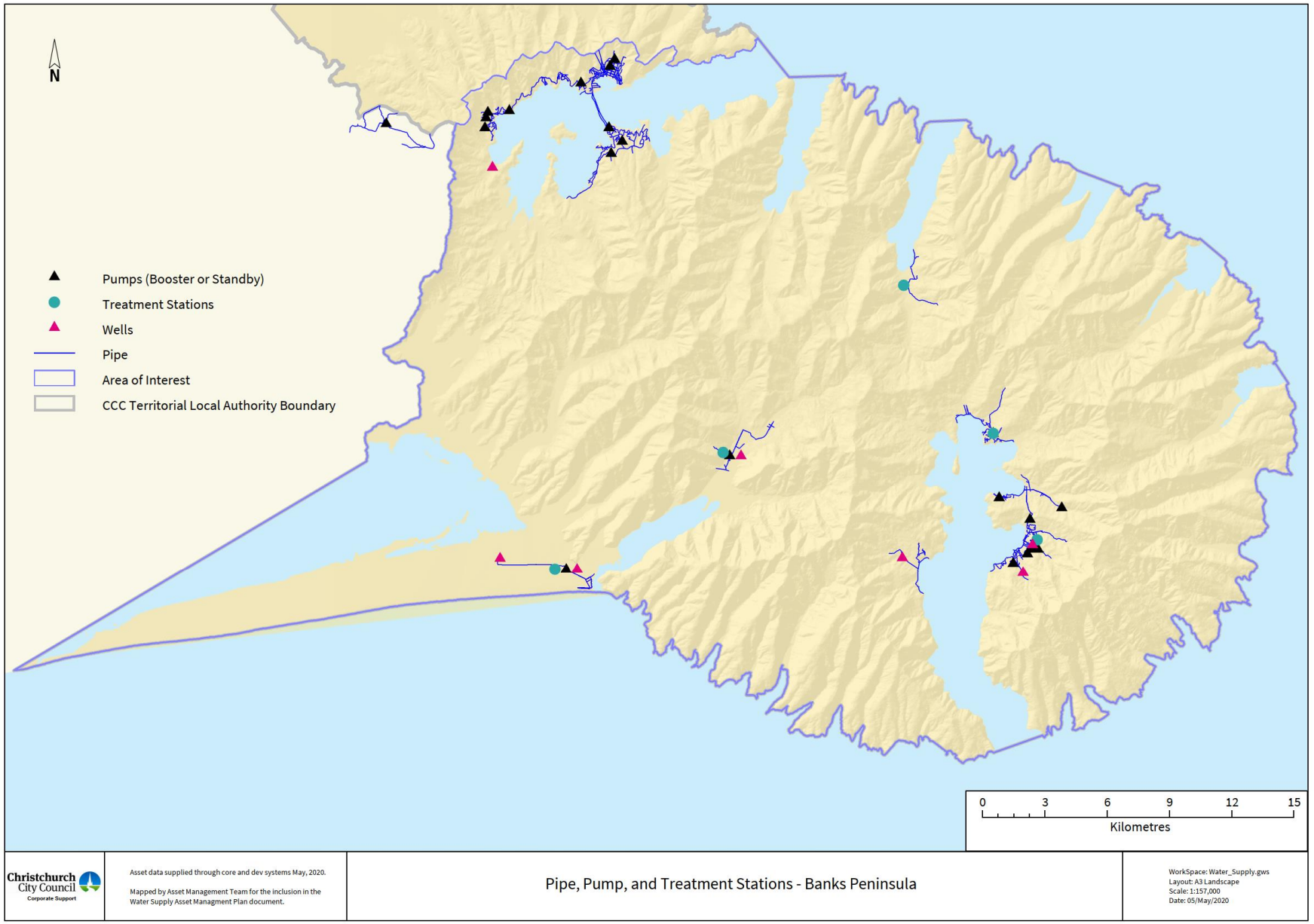


Figure 7-3: Banks Peninsula Water Supply Asset Locations

7.2.2 Condition

Condition assessment of individual assets applies a 1 to 5 scale. Table 7-2 describes the grading system.

Condition Grade	Description	Percentage Theoretical Useful Life Remaining
1	Excellent	Life remaining ≥ 50%
2	Good	25% ≤ Life remaining < 50%
3	Average	15% ≤ Life remaining < 25%
4	Poor	5% ≤ Life remaining < 15%
5	Very Poor	Life remaining < 5%

Table 7-2: Asset Condition Grades

The subterranean nature of the majority of the water supply network makes inspection and data collection difficult. Lacking actual inspection data, condition grades for reticulation assets are estimates based on age closely linking the condition, age and lifecycle stage.

Proactive condition assessments take the consequences of pipe failure into account, targeting those assets most at need of accurate condition and failure year data.

7.2.3 Assets with High Consequences of Failure

Consequences of failure, often also referred to as criticality, grades the importance of individual assets to the delivery of the service. Within three waters we do not call this criticality as national data standards limit criticality only to the consequences of failure on service delivery to customers while with consequences of failure we are looking at financial, environmental, cultural, heritage, damage to other infrastructure, health and safety and reputational outcomes as well. In general assets with high consequences of failure receive a higher level of asset management than other assets.

The criteria used for assessing consequences of failure for water supply assets are defined in the Draft Three Waters Lifecycle Management Manual (TRIM 16/212372). Consequence of failure assessments are complete for reticulation assets but criteria are still being developed for station and treatment assets. In the interim a basic concept has been applied for station assets where all assets at the station location are given the same criticality score based on the total flow provided by that station. Consequences of failure are not a criteria that is used explicitly for treatment assets, however the Water Safety Plans use risk-based assessments that considers such factors as the numbers of customers supplied by the treatment facility.

Figure 8-10 shows a map of reticulation assets and their consequences of failure.

7.2.4 Asset Performance

National data standards define performance as the ability of an asset to deliver its design function. In the reticulation network this relates to the ability of a pipe to carry the design flow while for a pump this would be the ability to pump the design flow to required pressures. Performance of assets is covered in more detail under performance subsections of respective asset classes in Section 8.

7.2.5 Asset Repairs Maintenance and Operation

Repair, Maintenance and Operations (RMO) grades are a 1 to 5 score for each asset based on the historical number and frequency of failures and maintenance interventions. RMO assessment currently only applies to reticulation assets and is detailed further in Section 8.1.

7.2.6 Network Age and Lifecycle Stage

The age and condition of reticulation assets, station assets and treatment assets are discussed in more detail under condition subsections of respective asset classes in Section 8.

7.2.7 Asset Data Confidence

Table 7-3 summarises the confidence of asset data for water supply assets while Table 7-4 describes the confidence assessment system. Asset data is held in SAP, GIS and InfoAsset systems.

Although the numbers of most assets and asset types are available, detailed data is commonly lacking.

Asset Group	Data Confidence				
	Quantity	Age	Condition	Performance	RMO
Buildings	Highly Reliable	Reliable	Uncertain	Reliable	Unknown
Electrical and electronic equipment	Highly Reliable	Very uncertain	Uncertain	Reliable	Unknown
Mechanical equipment & plant	Reliable	Uncertain	Uncertain	Uncertain	Unknown
Land	Very uncertain	N/A	Very uncertain	Unknown	Unknown
Station Pipework	Highly Reliable	Uncertain	Uncertain	Uncertain	Unknown
Structures	Very uncertain	Reliable	Uncertain	Uncertain	Unknown
Water wells	Highly Reliable	Reliable	Uncertain	Uncertain	Unknown
Reticulation	Highly Reliable	Reliable	Uncertain	Uncertain	Reliable
Water meters	Highly Reliable	Very uncertain	Very uncertain	Uncertain	Unknown
Spares	Uncertain	Very uncertain	Very uncertain	Very uncertain	Unknown

Table 7-3: Asset Data Confidence

Confidence Grade	Description
Highly reliable	Data based on sound records, procedures, investigations and analysis, documented properly and recognised as the best method of assessment. Dataset is complete and estimated to be accurate ± 2%
Reliable	Data based on sound records, procedures, investigations and analysis, documented properly but has minor shortcomings, for example some of the data is old, some documentation is missing and/or reliance is placed on unconfirmed reports or some extrapolation. Dataset is complete and estimated to be accurate ± 10%
Uncertain	Data based on sound records, procedures, investigations and analysis which is incomplete or unsupported, or extrapolated from a limited sample for which grade A or B data are available. Dataset is substantially complete but up to 50% is extrapolated data and accuracy estimated ± 25%
Very Uncertain	Data is based on unconfirmed verbal reports and/or cursory inspections and analysis. Dataset may not be fully complete and most data is estimated or extrapolated. Accuracy ± 40%
Unknown	None or very little data held.

Table 7-4: Asset Data Confidence Descriptions

7.2.8 Asset Data Improvements

The following improvements to data quality are included in the AM Improvement Plan in Section 10.

- Reticulation operation and maintenance data standards and collection
- Operation and maintenance data financial data collection
- Stations and treatment assets data hierarchy and system use refresh
- Stations and treatment assets data inventory collection
- Stations and treatment assets standard condition assessment methodology and criteria

7.3 Asset and Network Planning

7.3.1 Asset planning strategies

Te Wai Ora o Tāne Integrated Water Strategy

This is a strategy document that provides Council's vision, goals, objectives and suggested implementation actions for the city's water, wastewater and stormwater services. Asset planning strategies are expected to align with the Integrated Water Strategy.

Asset Assessment Intervention Framework (AAIF)

The AAIF is a project focussed on continuous improvement of the lifecycle management and renewal planning. AAIF uses multiple-criteria to determine which assets should be prioritised for various interventions. Assets are assigned 1-5 grades across a number of schema. Schema completed for water supply pipes to date include:

- Condition
- Repairs, Maintenance and Operation (RMO)
- Degradation
- Consequences of Failure

A number of asset data sources are used as inputs into AAIF such as condition assessment and operation and maintenance reporting. Collectively these schema provide an overall Risk profile for reticulation assets.

Water Safety Plans

Water Safety Plans describe how each of their drinking water supplies are managed and operated to ensure compliance with the Health Act and Drinking Water Standards for New Zealand. The Water Safety Plan process identifies potential asset improvements and risk prevention measures to include in asset planning strategies.

Electrical and Automation Strategy

This is a strategy document that provides the vision, goals, objectives and suggested implementation actions for SCADA and communications systems used to monitor and control the water supply network.

Implementation of this strategy provides information for future planning and renewal planning.

Smart Water Strategy

This is a strategy document that provides the vision, goals, objectives and suggested implementation actions for installation of sensors in the water supply network and systems integration to provide real time data sharing to partners, contributors and stakeholders.

Hydraulic Modelling Strategy

This is a strategy document that provides the vision, goals, objectives and suggested implementation actions to ensure hydraulic models are fit for purpose and available to inform network expansion and operation.

Hydraulic network models

Hydraulic network models representing the physical network asset cover the majority of the reticulated water supply network. Models are used by the business teams to assist decision making throughout the asset lifecycle; for growth and network planning, operations and maintenance, renewal and asset management.

Optimisation analysis

The hydraulic network models are used to evaluate and optimise network improvement alternatives in order to achieve increased efficiency and compliance. The city-wide wastewater optimisation study informs the wastewater overflow reduction programme, whilst the rezoning of water supply areas is recommended for achieving the benefits from pressure management.

Master planning

Master planning focused on catchments, water and wastewater supply areas or growth areas provides for the establishment of long-term servicing plans to meet the future demand. As such, annual growth and demand forecasts inform the need for master plans.

Feasibility studies

These are conducted to determine the net benefits of proceeding with a particular option where significant changes in infrastructure provision are anticipated. For example: Lyttleton Harbour Water supply.

Scoping capital projects

A capital project scoping phase is implemented to ensure that the budget for asset renewal is applied in the most effective manner. Council staff investigate those assets that are candidates for renewal and create discrete packages of work that can move into the design phase followed by construction.

7.3.2 Asset Planning Improvements

The following improvements to asset planning processes are included in the AM Improvement Plan in Section 10.

- Collect operation and maintenance data that can be used effectively for asset planning
- Continue to refine the importance of each schema under the AAIF, develop new schema and refine how each is used for decision-making
- Increase resourcing for condition assessment where necessary to justify decision-making
- Develop underlying masterplans so that interventions are aligned to long term goals
- Strategies required to meet Councils agreed targets of carbon neutrality by 2030 as per the Infrastructure Sustainability Council of Australia (ISCA) documentation

7.4 Asset Creation (Design and Build) and Acquisition

7.4.1 Identifying and recording capital projects

New works are those works that create a new asset that did not previously exist or works which upgrade or improve an existing asset beyond its existing capacity. Assets may be developed by Council, or by developers and then handed over on completion of the development. In this AMP, a number of projects have been identified through consideration of:

- Level of service requirements (Section 3).
- Growth and demand requirements (Section 4).
- Investment in network resilience (Section 5).
- Asset lifecycle management (Section 8).

7.4.2 Selection criteria

Projects for new assets are collated and recorded and then included in the Infrastructure Strategy selection process as supported by the Finance Strategy. The project identification process is described below for projects required under each of the heading categories:

7.4.3 Level of service requirements

Collated by:

- 3 Waters Asset Planning Team
- 3 Waters Asset Management Team

Identified and documented through the following processes:

- Requirements to support current and future resource consents

- Identifying urgent and emerging needs for the water supply service delivery

Selected for inclusion in capital works programme based on criteria:

- If the project is required for meeting Drinking Water Standards or resource consent compliance
- Case-by-case development and presentation of individual project business cases
- Professional judgement

For example, water supply pressure transient monitors, water supply lead jointed pipe investigation and response.

7.4.4 Growth and demand requirements

Collated by:

- 3 Waters Asset Planning Team

Identified, documented and selected through the following processes:

- Growth and demand forecasting
- Hydraulic modelling supported by flow calibration
- Compliance to water take consents
- Service plans for growth areas identified in the District Plan
- Service plans for current unserved areas
- Infrastructure master plans
- Other plans including; water supply sustainable zoning plan, urban development strategy

7.4.5 Investments in network resilience

Risk and resilience is generally considered in conjunction with asset renewal, growth and demand, and regulation compliance. As a tactic to improve resilience within the capital work programme, Council look to add logical and often low cost resilience measures to the renewal, improvement and growth projects.

Collated by:

- No specific team

Identified and documented by:

- Risk and resilience workshops
- Increased resilience awareness and mindset
- Asset management plans
- The unacceptable risks and potential improvements identified within the Water Safety Plans. These are categorised as “Compliance” projects

Selected for inclusion in capital works programme based on criteria:

- Water safety plan improvement items needed to comply with drinking water regulation (“Compliance” projects)

7.4.6 Asset class lifecycle management

- Discussed in detail in Section 8.

7.4.7 Asset Design

The design phase is where a lot of value can be added to the project. The aim is to report whole-of life costing (Capex + Opex) for the whole project when considering design options. We use todays’ dollars to report, for the purposes of simplicity.

During the asset design phase the following mechanisms are used that contribute to successful whole-of-life asset management outcomes:

Updating costs estimates

Project costs are prepared during the initial project brief, then updated during preliminary design and detailed design. This allows the budget expectation adjustments throughout design to ensure delivery of maximum value from the project.

Predicting operation, maintenance and monitoring requirements

These requirements are outlined during the initial project brief and then refined during the design phases. This helps convey understanding of the longer-term requirements and costs that accompany the project and allow other parts of Council's City Services Unit to plan.

Risk assessment and workshops

Risk registers created during the initial project brief are maintained, monitored and updated throughout the project lifecycle. Regular risk workshops allow different perspectives for consideration when identifying risks. During project closure, the final risk register identifies the residual risks for transfer to the relevant stakeholder.

Safety in design

Safety in design workshops occur the design phase to identify any design changes that can be made to maximise safe constructability and the long-term safe operation, maintenance and monitoring of the asset.

Hazard and operability study (HAZOP)

HAZOP workshops take place during the design phase to systematically identify issues with more complex assets such as stations and treatment plants to identify and evaluate problems that may eventuate during operation, maintenance and monitoring.

An increase in requirements for Building Information Modelling (BIM) models to support HAZOP and safety in design workshops is underway.

Sustainability workshops

Sustainability workshops can take place during the design phase to identify issues and opportunities to improve environmental and sustainability outcomes, such as measuring and reducing carbon footprint, through design changes.

Resilience checklist

A resilience checklist is used as resilience baseline in the planning or design phase of a project, and again towards the end of the project lifecycle to check if resilience to natural hazards, changing climate conditions, and other anticipated future disruptors has been improved. The checklist is also used as a gaps/needs analysis to identify areas for improvement, where further emphasis and resourcing is required to improve resilience.

Options reports

If value-add opportunities are identified the design phase can pause while options reports are prepared to consider the benefits of potential changes in project scope.

Design Standards and Guidelines

Council maintains the Infrastructure Design Standard (IDS), Construction Standard Specification (CSS) and approved materials list. These standards list the materials that permit the materials, parameters, processes and methods available for use in water supply construction. The CSS and IDS aim to ensure the final design meets Council requirements. Council have a number of other design guidelines and documents and is in the process of integrating or linking these to the IDS.

Where design requirements introduce additional steps, such as sustainability workshops and climate change impact assessments, these introduce new costs to the design phase of capital projects that need to be taken into account when forecasting activity costs.

7.4.8 Capital Investment Programme

Section 9 details the water supply capital investment programme.

7.4.9 Management of Vested Assets

Property vesting is handled through the Council property consultancy, but service-providing assets must be approved as compliant to Council requirements by the business unit accepting them for operational purposes. Vesting agreements do not proceed for assets failing to meet requirements.

Capital works are carried out in adherence with standard Contract documents which list Council's design, specification and construction documents. If provision of the required quality assurance records, compliance with Contract and/or Consent documents and provision of asset data demonstrates the quality of construction, then assets are accepted for hand over.

On asset acceptance by Council, the asset information is captured within the asset management systems, and provision made for the appropriate operation and maintenance of the asset, according to the life-cycle plan for that asset.

7.4.10 Asset Creation and Upgrade Improvements

The following improvements to asset creation processes are included in the AM Improvement Plan in Section 10.

- Whole of life costs and anticipated maintenance requirements estimated and detailed at design phase
- • Complete the works highlighted by the Asset Management Unit to improve the Asset Data Handover Process including the empowerment of staff in Roles and Responsibilities

7.5 Operations and Maintenance

7.5.1 Portfolio-level O&M Strategies

Current strategy is based on executing the conditions of the maintenance contract within the contract budget. The annual contract budget is set each year and is largely based on previous years' budgets and the maintenance outcomes achieved. Throughout the year, staff attempt to manage maintenance efforts to balance the budget and the expected level of maintenance.

Further work has been identified to formalise the maintenance strategy, basic maintenance requirements, categorisation of maintenance costs and the desired split between proactive and reactive works.

Figure 7-4 shows the value of proactive and reactive work carried out under the maintenance contract over the previous four years.

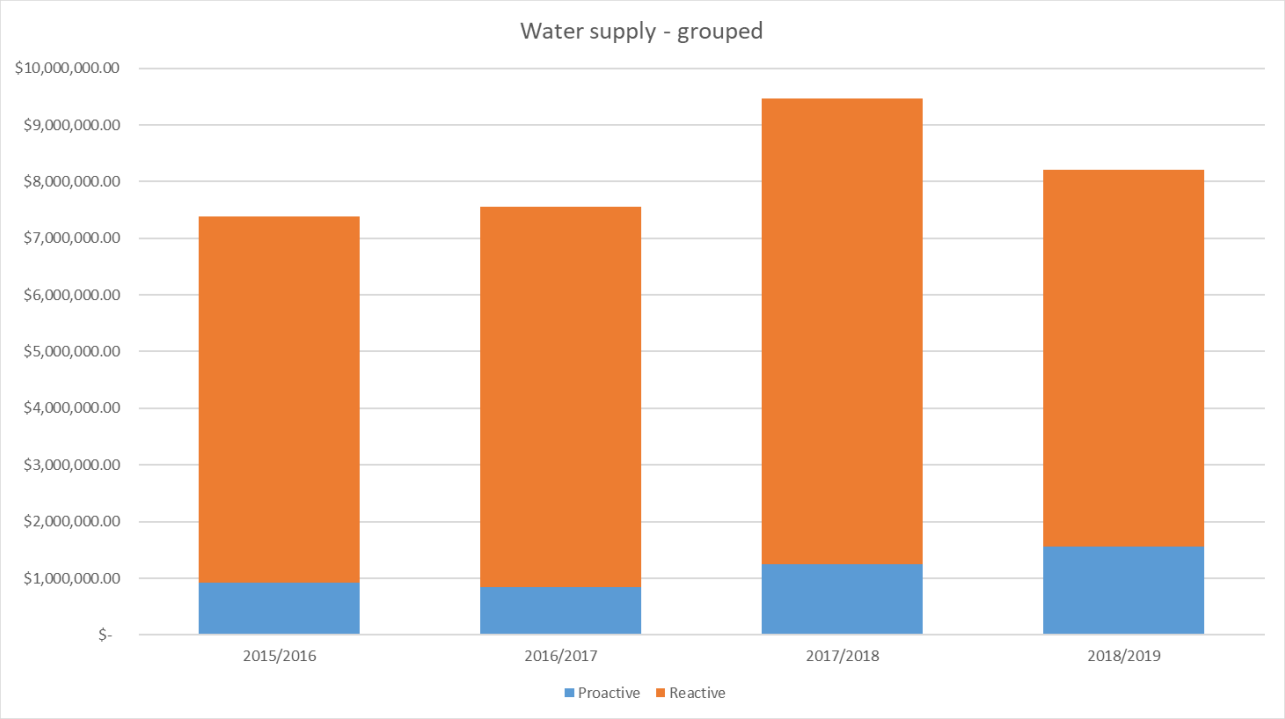


Figure 7-4: Historic Water Supply Maintenance Contract Costs

In 2018/2019 the ratio of preventative to reactive maintenance was 20% to 80% respectively. The major portion of the high reactive maintenance costs is the investigation and repair of reticulation leaks and bursts. The maintenance cost breakdown for reticulation, stations and treatment assets is provided separately in Section 8.

7.5.2 Operations and Maintenance Improvements

The following improvements to operations and maintenance processes are included in the AM Improvement Plan in Section 10.

- Formalise maintenance strategy
- Specify maintenance requirements at an asset level and considering criticality
- Measure effectiveness of preventative maintenance over time and adjust frequency of intervention
- Risk based maintenance strategy – criticality
- Collect O&M data to inform decision making
- Collect O&M financial data at sufficient detail to inform decision making. Including OPEX costs outside of maintenance contract

7.6 Renewals

7.6.1 Portfolio Renewal Strategies

Renewal expenditure is major work which does not increase the asset's design capacity but restores, rehabilitates, replaces or renews an existing asset to its original or lesser required service potential. Work over and above restoring an asset to original service potential is upgrade/expansion or new works expenditure.

Where possible, renewals planning uses a risk based approach that considers the condition and criticality. For some asset groups there is a lack of key data (such as condition and install data) to effectively inform renewals planning and in these situations it has been necessary to make assumptions based on the data that is available and anecdotal information from staff involved with the day to day management of the assets.

The general renewal strategy is to either replace or rehabilitate assets when justified by:

1. Age and condition – the age or condition of the asset will result in a condition based failure.
2. AAIF project - the project aims to provide an on-tool renewals planning process that is evidence based, transparent, documented, fast and repeatable. Under the AAIF assets are assigned 1-5 grades across a number of schema. Schema completed for land drainage pipes to date include:
   - Condition
   - Deterioration
   - Consequences of failure

   AAIF uses multiple-criteria to determine which assets should be prioritised for various interventions. Rules and weightings around these schemas allow renewal planning to be aligned with Council strategic priorities and requirements of elected representatives. The AAIF process includes the advancement or delay of renewals based on consequences of failure to develop different risk profiles.
   A number of asset data sources are used as inputs into AAIF including district plan rules, LIDAR surveys, national databases, ECan databases and internal Council models.
3. Asset Performance – when it fails to meet the required Level of Service. Non-performing assets can be identified, often following an unspecified event, by factors such as:
   - Repeated asset performance failure
   - Structural failure (condition based)
   - Excessive maintenance requirements
   - Ineffective and/or uneconomic operation
   - Exceedance flooding
4. Risk – the risk of failure of the asset and the associated financial, environmental and social impact justifies action.
5. Economics – the cost of maintenance for that asset component is deemed to be uneconomic to continue repairing the asset when the annual cost of repairs exceeds the annualised cost of renewal. Economic factors may also come into consideration in order to co-ordinate renewals with other major works. This model of economic cost does not consider effects on other Council directives such as the community well-being outcomes. As Councils asset management systems matures, then perhaps other models of economic cost can be considered.
6. Political and Community Feedback – Any feedback received from political or community sources that influence or change decision making.

Renewal detail is covered in Section 8 under the separate asset class categories of: reticulation, stations and treatment.

7.6.2 Renewal Process Improvements

Renewal process improvements are covered in detail in Section 8 under the separate asset class categories of: reticulation, stations and treatment.

7.7 Asset Disposal

Disposal includes any activity associated with disposal of a decommissioned asset including sale, demolition or relocation. Any revenue gained from asset disposals is accommodated in Council's long-term plan.

Asset disposal is covered in detail in Section 8 under the separate asset class categories of: reticulation, stations and treatment in accordance with the Disposal Policy[6].

[6] Asset, Equipment and Materials Disposal Policy TRIM://18/8676160

8 Lifecycle Management Plans

8.1 Reticulation Lifecycle Management Plan

8.1.1 Reticulation Issues and Priorities

Key Issue	Priority for this Plan
Aging assets and deferred renewals	Addressing the renewal of pipes where evidence proves they are at end of life or where required by consequence of failure. Required works exceed budget so some deferrals required.
Demonstrating safe drinking water supplied through reticulation without chlorine residual	Prioritising pipe renewal and network monitoring to reduce risk of leaks, breaks and backflow
Reducing water consumption	Implementing pressure management (water rezoning) and increased focus on leak detection
Reducing reactive maintenance	Prioritising pipe renewal based on risk and using maintenance history data effectively
Increase maturity and transparency of investment decision-making	Use the outputs of the AAIF to inform renewal criteria and integrate with growth and improvement criteria
New approach in renewal budget forecasting	Collect data to calibrate renewal forecasting tool
Lead in water from undetermined source	Investigate cause and impact of lead and increase renewal programme where needed
Further introduction of smart water meters	Replacing standard meters with smart meters when sub-mains are renewed

Table 8-1: Reticulation Issues and Priorities

Water supply reticulation includes water mains, submains, hydrants, valves, fittings and connections. Asset management effort focusses on mains and submains as these make up the majority of the value of the reticulation network. Valves, hydrants, fittings and other auxiliary assets connected to the mains and submains generally last as long as the main or submain and are renewed as part of a main or submain renewal.

The Asset Assessment Intervention Framework (AAIF) described in Section 7.3.1 is underway to improve asset management maturity by providing a transparent, repeatable, accurate and fast process for determining renewal requirements. AAIF is operational for reticulation, determining renewals requirements through a multi-criteria assessment based on the following criteria:

- Condition
- Repairs, Maintenance and Operation (RMO)
- Degradation
- Consequences of Failure

The Lifecycle Management Manual (TRIM 16/212372) lists full details on the criteria and the overall AAIF process.

8.1.2 Reticulation Age and Condition

Water supply reticulation condition grades use the 1 to 5 scale as described in Section 7.2.2. Lack of consistent results from visual and chemical tests means sample collection followed by a laboratory condition assessment is currently the sole method for condition grading. Sample collection and assessment costs limit this assessment to very high consequence of failure mains and opportunistic assessment where failures of individual materials are suspicious. At present approximately 70 mains have a measured condition grade; other mains have an estimated condition grade based on the installation year and a theoretical useful life. Determining theoretical useful lives uses international documentation and staff knowledge of how pipes in the Council networks are actually deteriorating backed by condition

assessment results. Review of the theoretical useful lives and modification to reflect recent trends in failures occurs as part of each LTP.

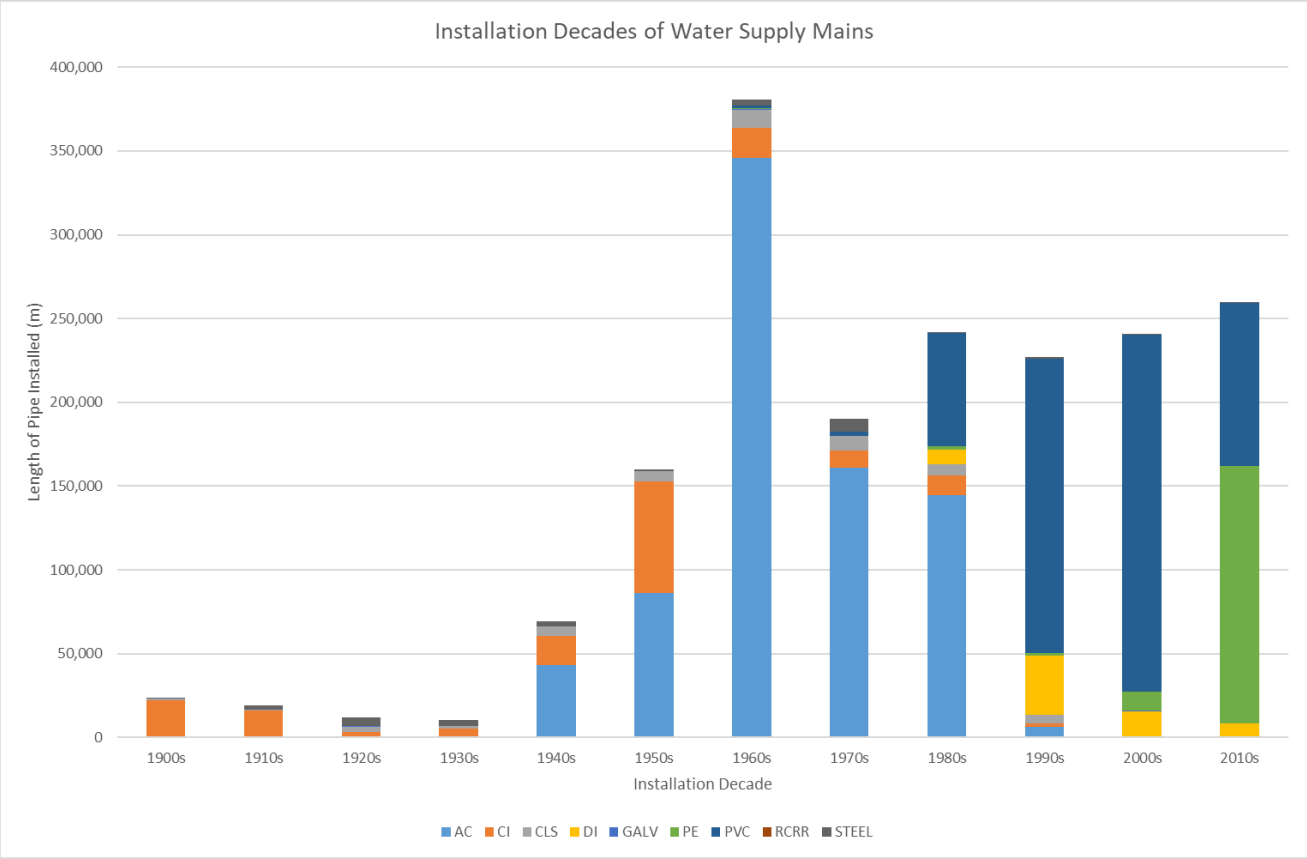


Figure 8-1: Pipe Installation Decades

Figure 8-1 shows the length of pipe of each material installed in each decade; this only shows pipes currently in service and ignores historic or abandoned pipes. Comparing Figure 8-1 to the dates in Section 6.1 suggests that, although public water supplies may date back to 1890s or 1900s, networks did not become widespread until the 1950 and 1960 building booms and have expanded relatively consistently since then.

Pipe materials have also changed over time with cast iron (CI) the predominant pipe material up until the 1940s, followed by asbestos cement (AC) from 1950 to mid-1980s and plastic from the mid-1980s to now. Theoretical useful lives of CI, AC and early generation PVC are 120, 60 and 40 years respectively, meaning that much of the initial network, network from the 1950s and network from the 1980s are all approaching end of life with estimated poor conditions. This sequence of different pipe lives influencing the network condition and renewals profile is shown in Figure 8-2.

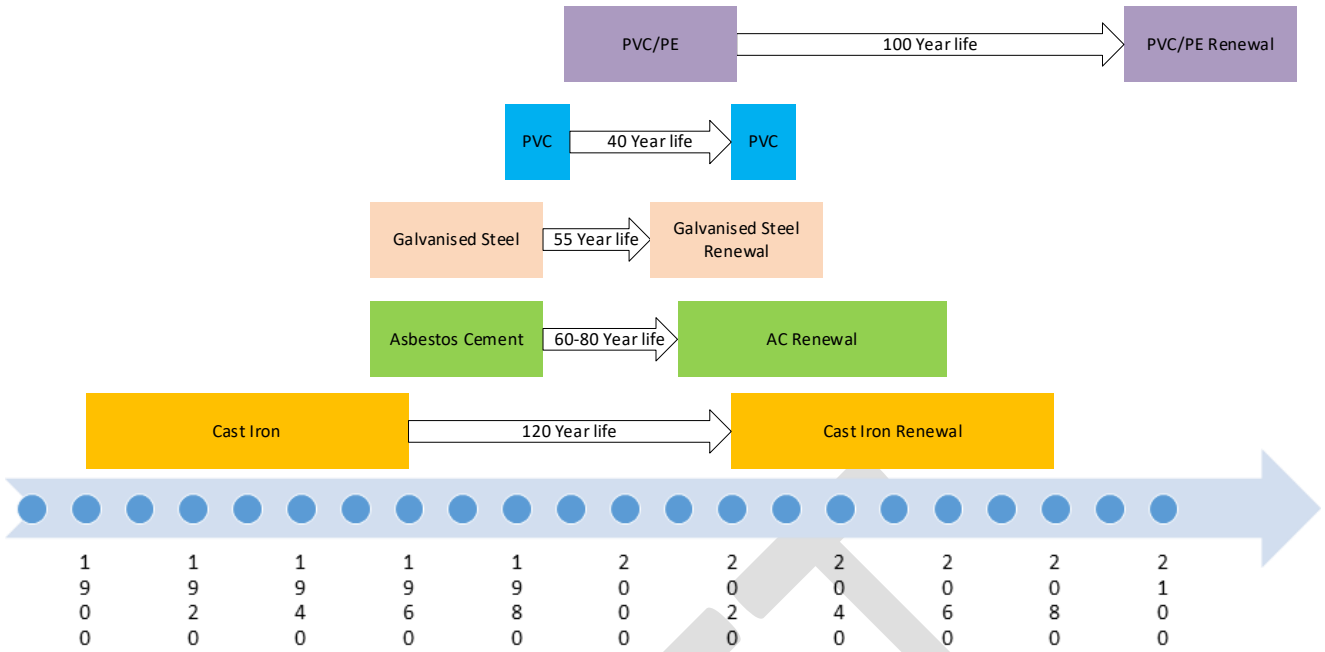


Figure 8-2: Impact of Different Asset Lives on Condition and the Renewal Profile

Figure 8-3, Figure 8-4 and Figure 8-5 show the current condition profile of reticulation assets for water supply mains, water supply submains and the overall water supply reticulation network respectively.

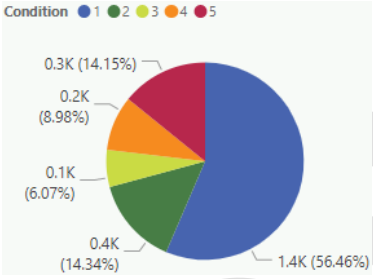


Figure 8-3: Water Supply Main Condition

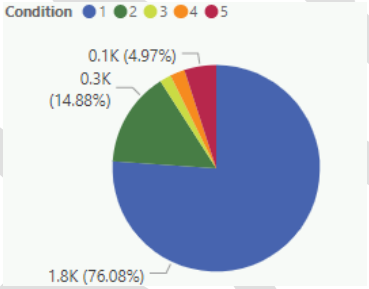


Figure 8-4: Water Supply Submain Condition

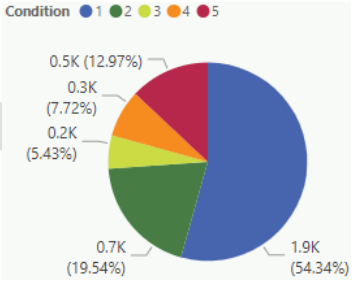


Figure 8-5: Overall Water Supply Network Condition

Joins between individual lengths of early CI pipe use lead as a sealant. These lead-jointed pipes have recently emerged as a possible lead contamination source. September 2019 routine testing results indicate elevated lead levels in Lyttelton. Further sampling following isolation of an older lead jointed main showed lead levels less than 50% of the maximum acceptable value under DWSNZ. Further testing is currently in progress to confirm the source of lead contamination and identify if there is a need to replace or prioritise replacement of lead-jointed cast iron pipes.

Maintaining an acceptable condition profile of water supply reticulation in Christchurch will be part of providing demonstrably safe water. Poor condition and advanced age are two factors that result in increased failures and leakage. Pipe failures, including leaks and breaks, increase risk of contamination. Therefore, improving the network condition through pipe renewal will reduce this risk.

Figure 8-6 shows condition grades over the Christchurch water supply network by location.

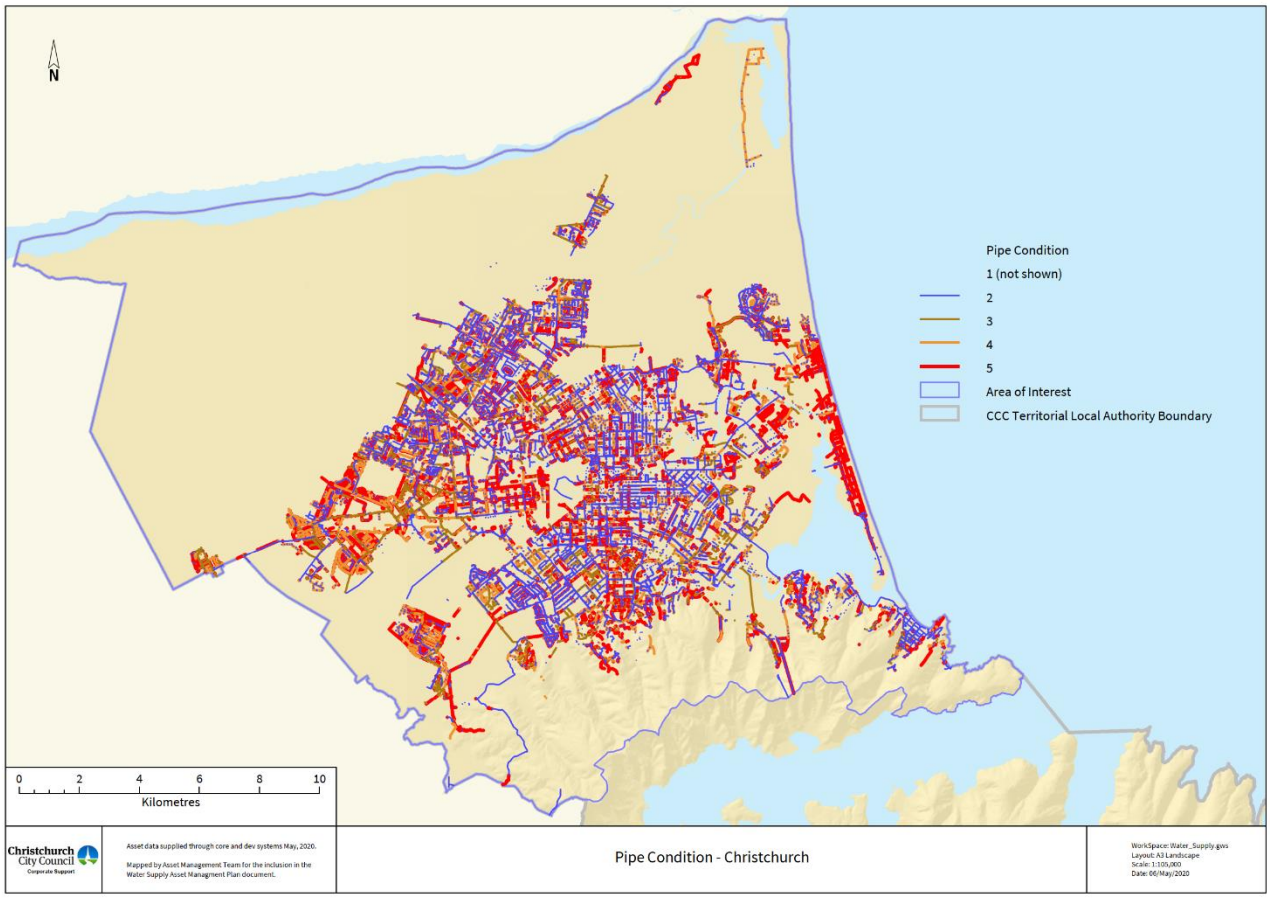


Figure 8-6: Water Supply Pipe Condition Map

8.1.3 Reticulation Consequences of Failure

Section 7.2.3 describes the relationship between criticality and consequences of failure. The overall consequence of failure is a weighted average of the score from each of the eight consequence of failure categories. Weightings for the water supply activity prioritise the consequences on service delivery to customers (how many properties and the importance of facilities) and service disruption (number of failures affecting the same customers) with a lower weighting on damage to other infrastructure.

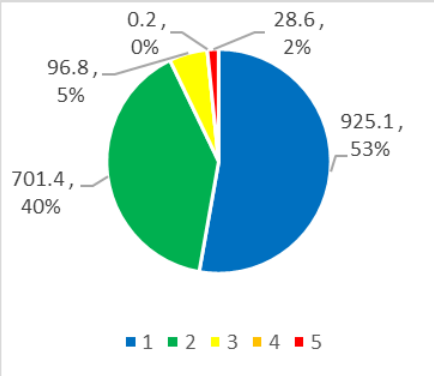


Figure 8-7: Water Supply Main Consequences of Failure

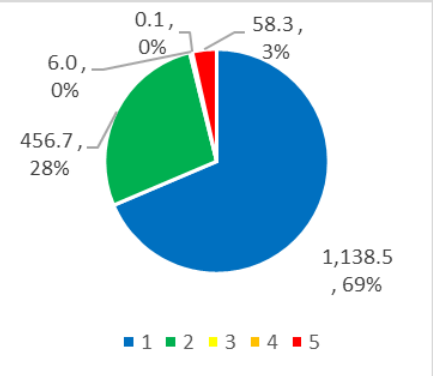


Figure 8-8: Water Supply Submain Consequences of Failure

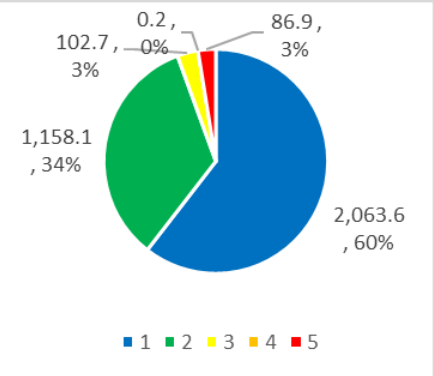


Figure 8-9: Overall Water Supply Network Consequences of Failure

The decentralised nature of the Christchurch City water supply network means that there are few pipelines with "very high" or "extreme" overall consequences of failure. Figure 8-7, Figure 8-8 and Figure 8-9 show the consequence of failure profiles for mains, submains and the overall network while Figure 8-10 shows locations.

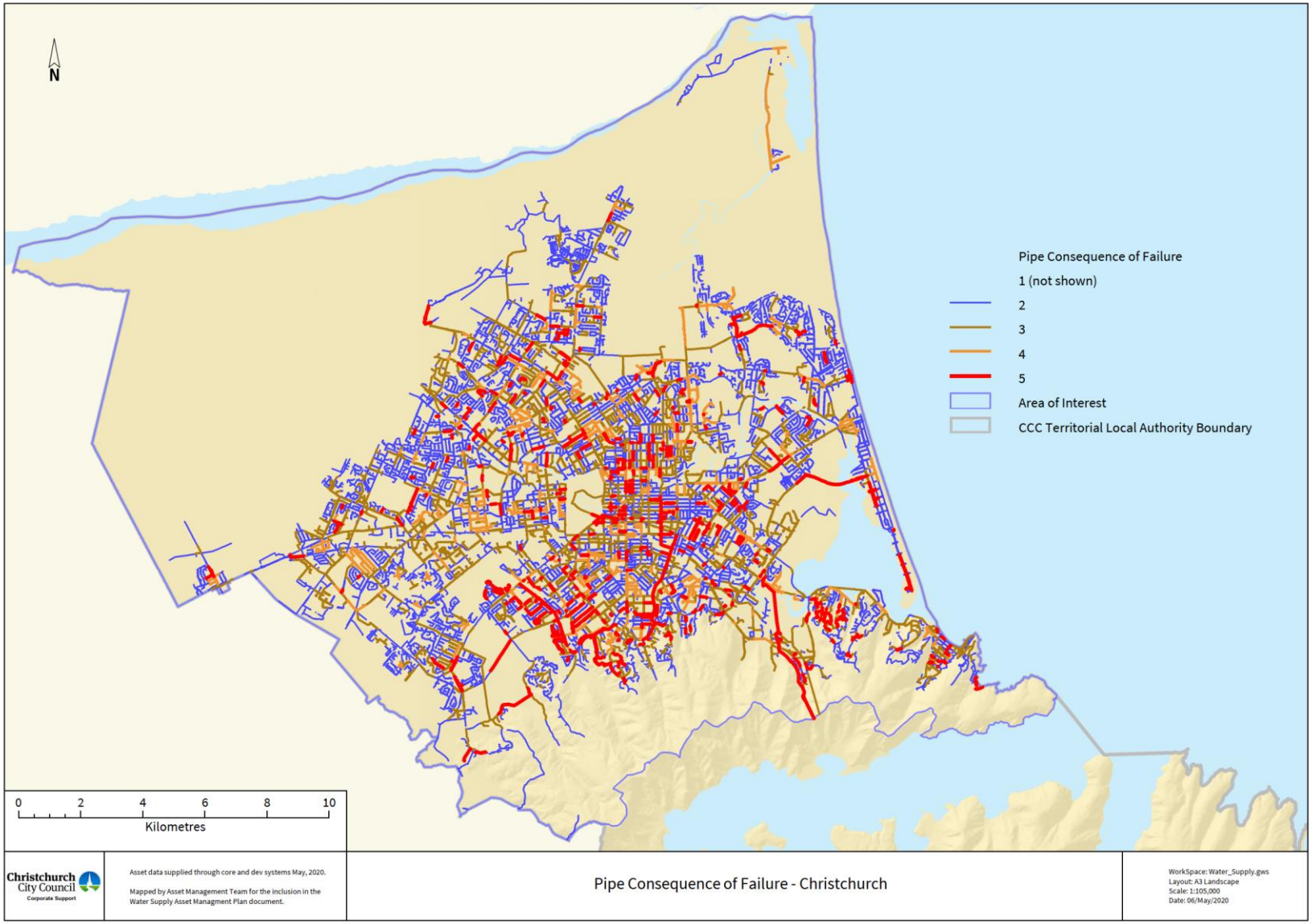


Figure 8-10: Water Supply Reticulation Consequences of Failure

8.1.4 Reticulation Repairs, Maintenance and Operation (RMO)

The repairs, maintenance and operation (RMO) assessment provides a score of 1 – 5 based on recorded pipe failures. A score of 1 means no failures while a score of 5 indicates numerous and repeat failures and that the pipe has met or exceeded the criteria for becoming a renewal candidate. This assessment only counts failures on the pipe itself and excludes failures or faults relating to fittings or third party damage.

Figure 8-11, Figure 8-12 and Figure 8-13 show RMO profiles for water supply mains, water supply submains and the overall water supply network respectively. Figure 8-14 shows RMO grades over the Christchurch water supply network by location.

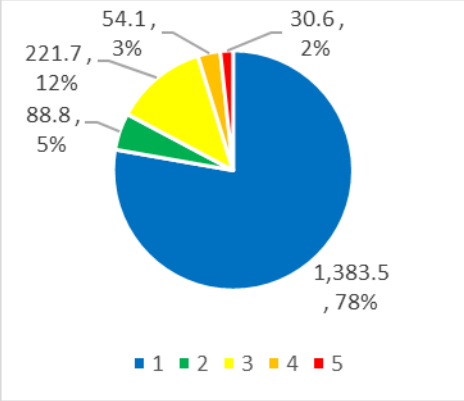


Figure 8-11: Water Supply Main RMO

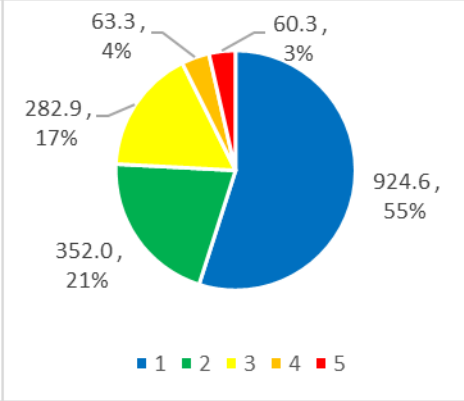


Figure 8-12: Water Supply Submain RMO

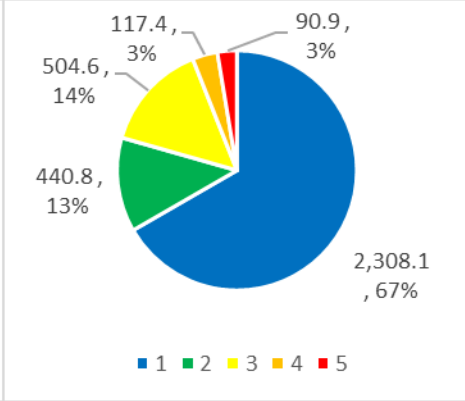


Figure 8-13: Overall Water Supply Network RMO

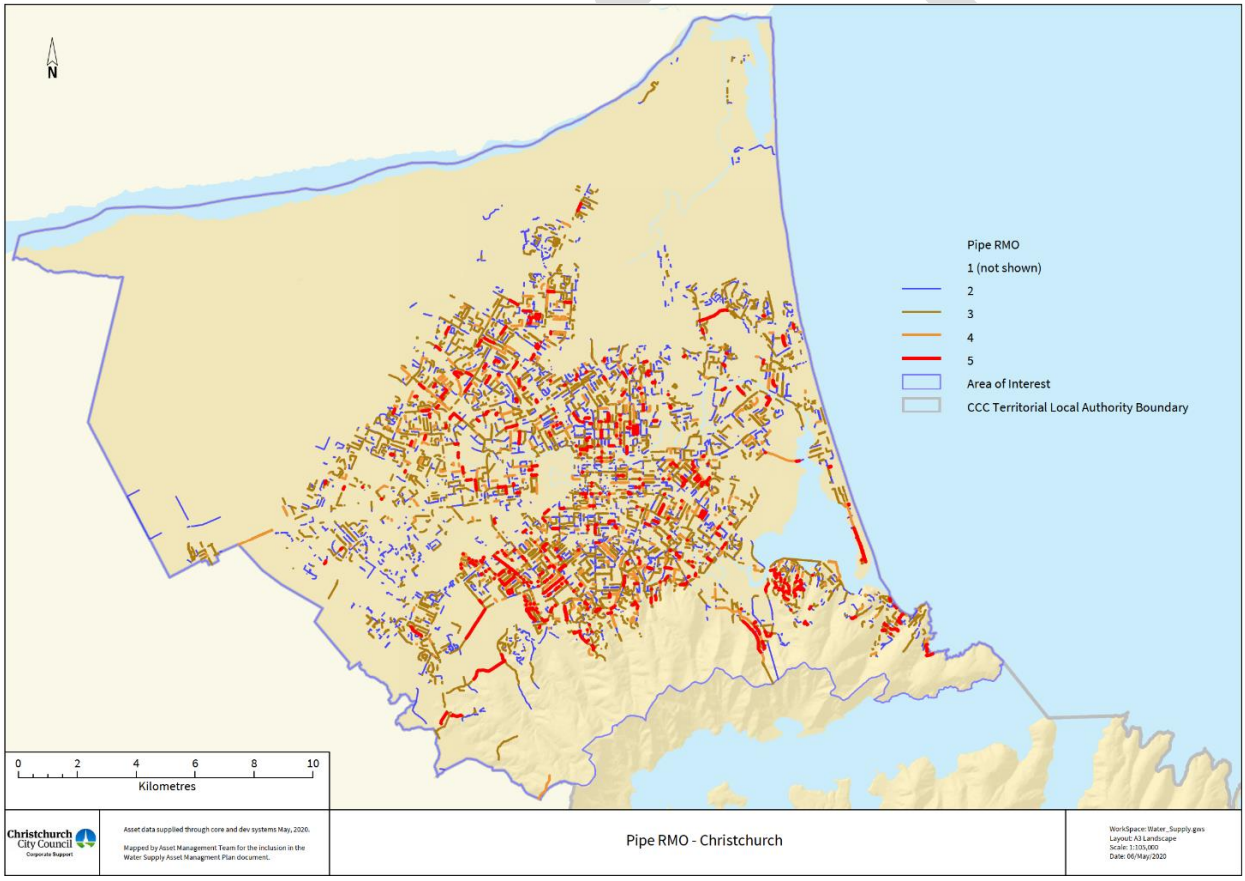


Figure 8-14: Water Supply Pipe RMO Map

The RMO assessment relies heavily on the quality of failure data. Each maintenance job must identify the correct pipe and identify the component of the pipe that failed (a fitting, a seal or the pipe itself). Manual data cleansing of historical data combined with improved data collection forms for completion during future works aim to ensure data quality is sufficient for RMO grading.

8.1.5 Degradation

Degradation grading awards a 1 to 5 score based on the environmental hazards in proximity to each pipe and the susceptibility of the pipe material to each hazard. Degradation grades identify pipes likely to deteriorate faster or slower than average and are applied as adjustments to the theoretical useful lives to account for each assets environmental exposure.

Degradation scores for water supply reticulation depend on three parameters:

1. Exposure of the pipe to pressure spikes. Pressure spikes from pump starts/stops and valve closures cause fatigue damage to pipes and contribute to early failures.
2. Exposure of the pipe to groundwater. Corrosive groundwater leaches lime from cementitious pipe materials and accelerates corrosion on ferrous pipe materials.
3. Exposure of the pipe to tree roots. Plants seek water and roots crack or break pipes to access the water inside.

A pipe made of a material highly susceptible to all three of these factors and installed in a location exposed to all three hazards would suffer a 15% reduction in theoretical life while the same pipe installed in a location with none of the hazards present would gain a 10% increase in life.

8.1.6 Reticulation Renewals Plan

Completion of this AMP included calculation of three options for renewals budgets.

Parameters Applicable to All Budgets

Council's AAIF tool provided budgets for all three options; this tool optimises renewals and reduces risk.

Optimisation compares the condition, RMO and degradation grades. This ensures that where pipes are failing but not yet at end of theoretical life, the pipes will be included in renewals profiles. Conversely the optimisation defers pipes that are at or past the end of their life but show no evidence of failure. Application of optimisation includes real evidence to theoretical renewal year estimates ensuring renewals profiles only include pipes that actually need replacement.

Consequences of failure of existing pipes are difficult to change, but risk minimisation is possible by reducing the likelihood of failure. Applying a condition assessment programme focussing on high consequence of failure pipes as per Section 7.2.2 will provide an accurate estimate of failure year. Budgets assume a median level of risk mitigation by programming renewal of very high consequence of failure pipes six years before and high consequence of failure pipes three years before the estimated failure year. Attempts at other levels by changing the three and six years showed insufficient risk mitigation with lower values and significant cost increases with higher values.

The AAIF tool calculates a priority score for each individual pipe renewal using consequence of failure grades, RMO grades, break history, degradation grades and other data. Where the recommended and proposed budgets allow less expenditure than the required budget the lowest priority pipes are deferred until later years.

Council and market resource to deliver projects is a consideration for the recommended and proposed budgets. Large budget changes will mean that budget exceeds resource so not all renewals can be completed or that resource exceeds budget potentially resulting in companies closing and loss of resource for future years where budgets increase again. Discussions with project managers suggest limiting budget change between years to 15% for all 3 waters reticulation assets and a minimum 5-year plateau at peak budget is a sustainable level of budget change.

Required Renewals Budget

Figure 8-15 shows the reticulation renewals required to maintain the current level of service and prevent operational cost increases. Each column of the figure is total expenditure over a three-year period. Colours in each column show the consequences of failure of the pipes proposed for renewal.

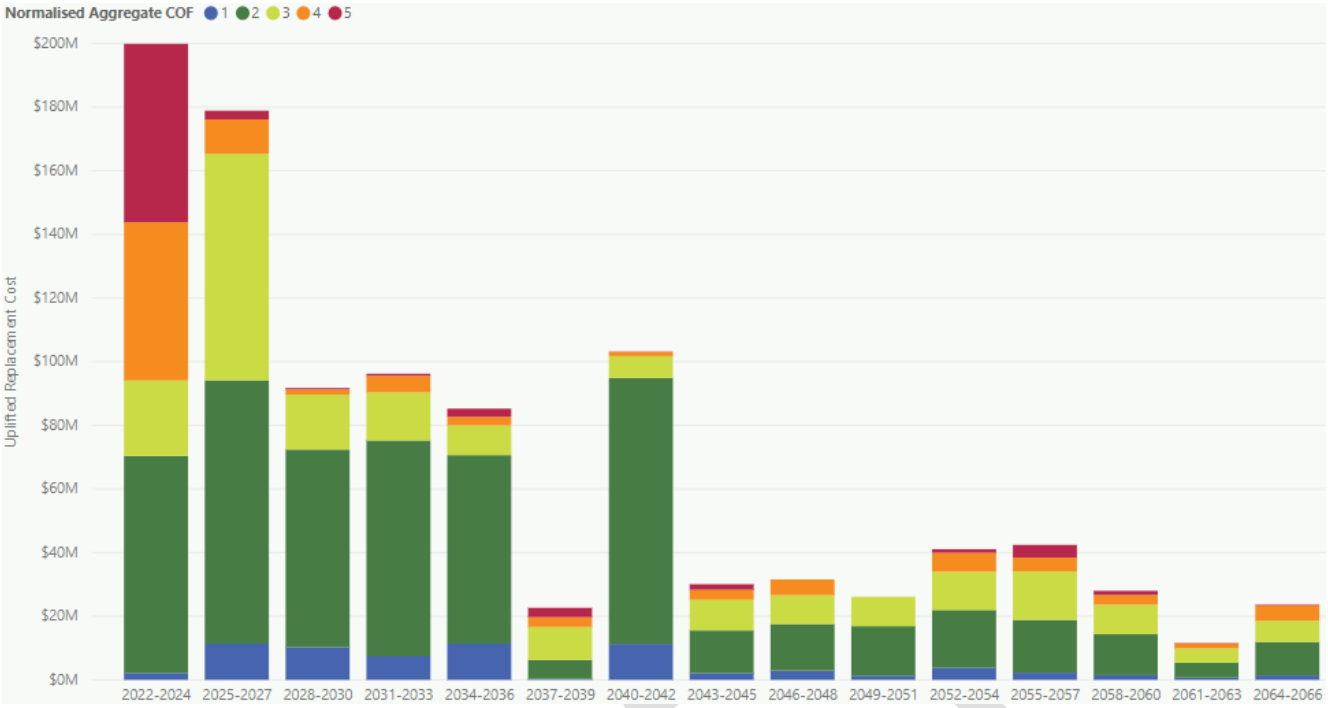


Figure 8-15: Required Water Supply Main Renewals Budget

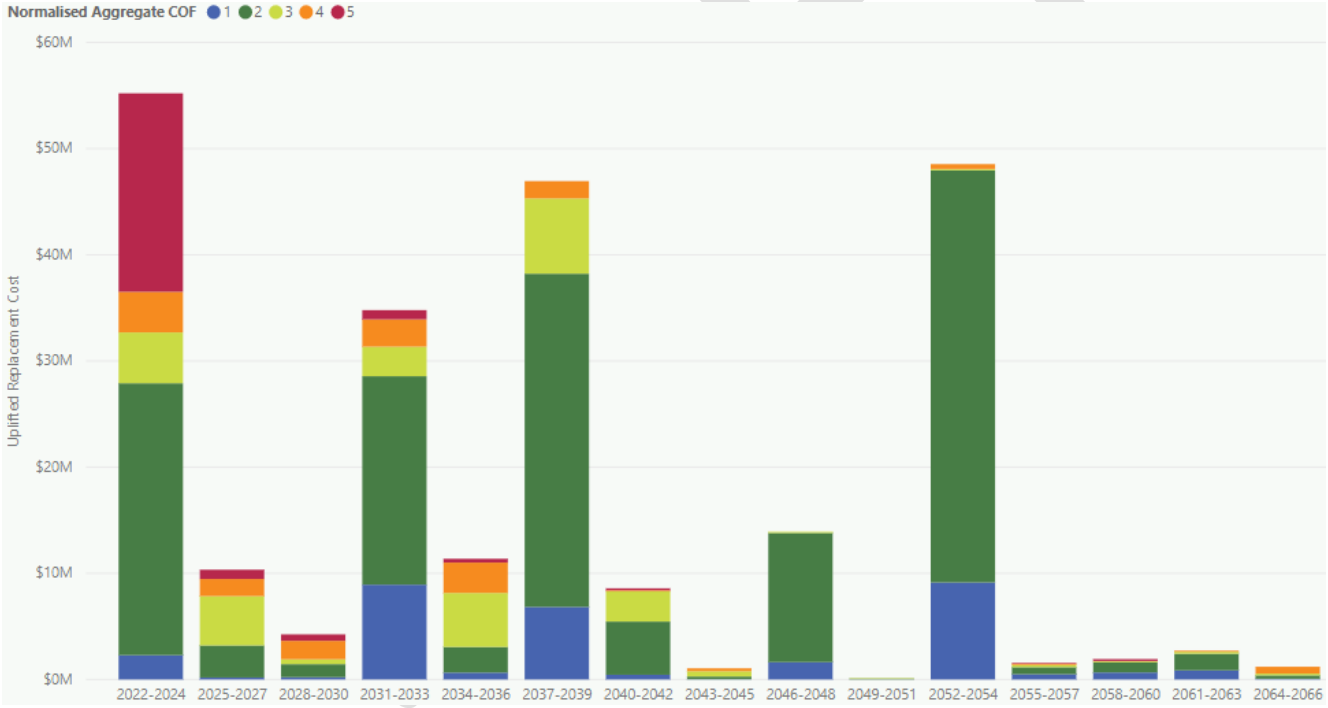


Figure 8-16: Required Water Supply Submain Renewals Budget

Although each column in Figure 8-15 covers a three-year period, even allowing for annual expenditure one third of each column the costs are neither affordable nor sustainable for the contracting market. As this level of investment is undeliverable, there is no choice except spreading renewals over a longer period and allowing a level of service decrease in the meantime.

Recommended Renewals Budget

Figure 8-17 shows the recommended budget to return to current levels of service as soon as possible with minimal additional operational costs. Each column of the figure is total expenditure over a three-year period. Colours in each column show the consequences of failure of the pipes proposed for renewal.

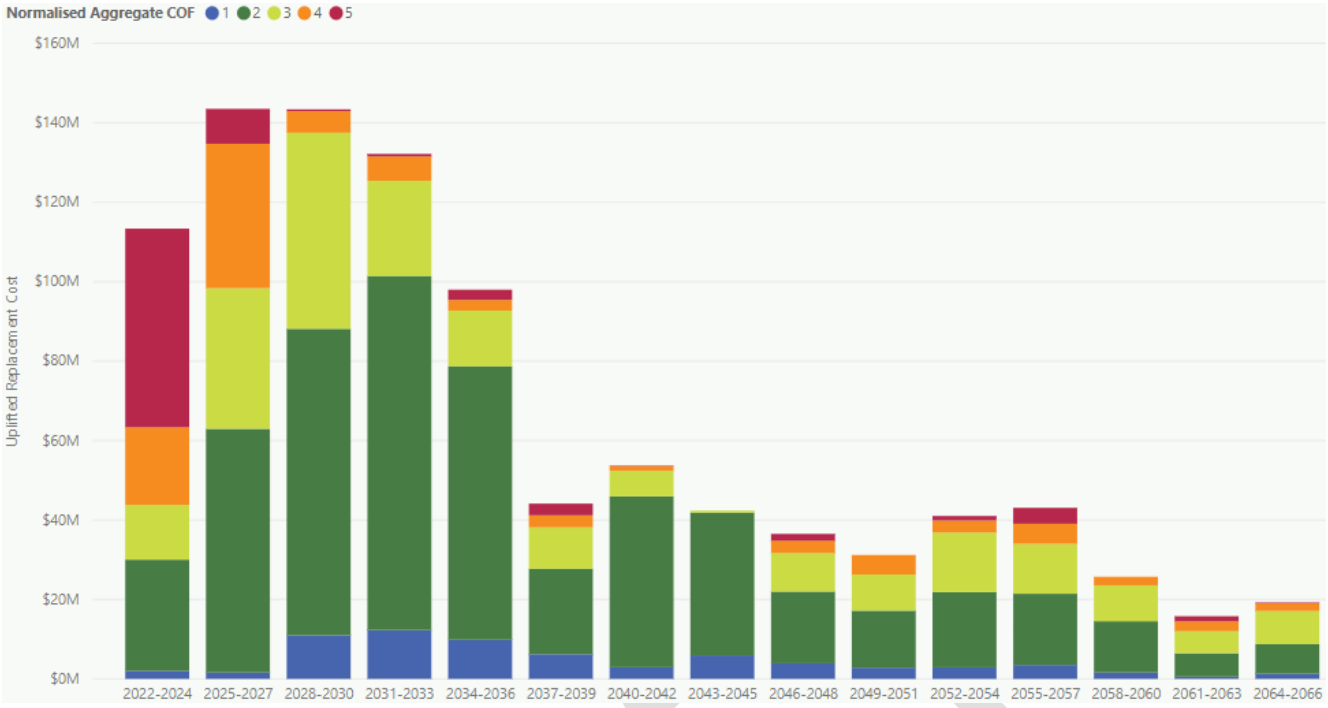


Figure 8-17: Recommended Water Supply Main Renewals Budget

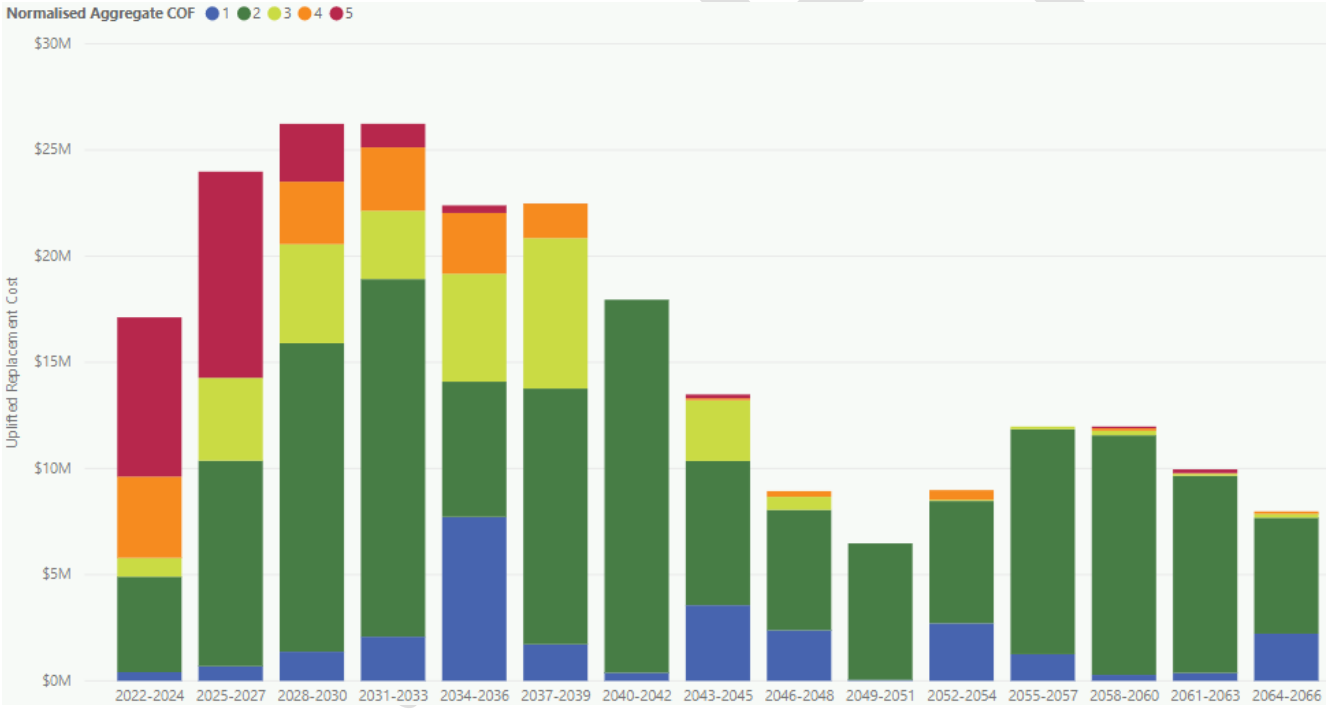


Figure 8-18: Recommended Water Supply Submain Renewals Budget

The recommended budget provides a sustainable market for delivery of the projects and allows for return to current levels as soon as possible with minimum additional operational costs. This budget has high costs out to 2045 that may require rates increases or reduction of Council expenditure on other activities to achieve.

Fitting the required renewals to a budget requires deferral of any projects where the required renewals exceed the recommended renewals. Of the $105 million of very high and high consequence of failure water mains and $22 million of very high and high consequence of failure water submains identified for renewal in the 2022-24 period under the required renewals option, the recommended option only has $69 million and $11 million respectively over the same period. This means deferral of $36 million of very high and high consequence of failure water mains and $11 million of

very high and high consequence of failure submains is occurring. These deferrals reduce the effects of risk mitigation and increase the risk of important facilities such as hospitals and lifeline facilities losing water supply.

Proposed Renewals Budget

Figure 8-19 shows the proposed budget minimise rates increases and maintain funding to other Council activities. Each column of the figure is total expenditure over a three-year period. Colours in each column show the consequences of failure of the pipes proposed for renewal.

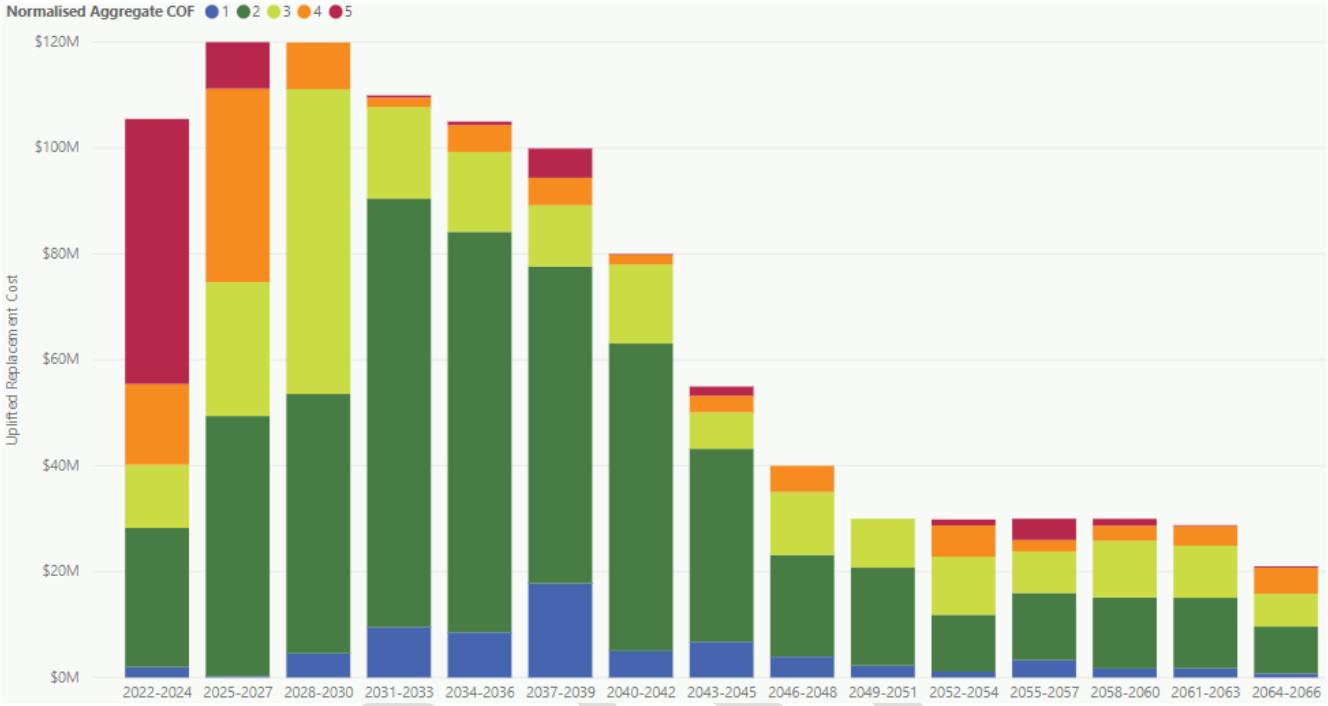


Figure 8-19: Proposed Water Supply Mains Renewals Budget

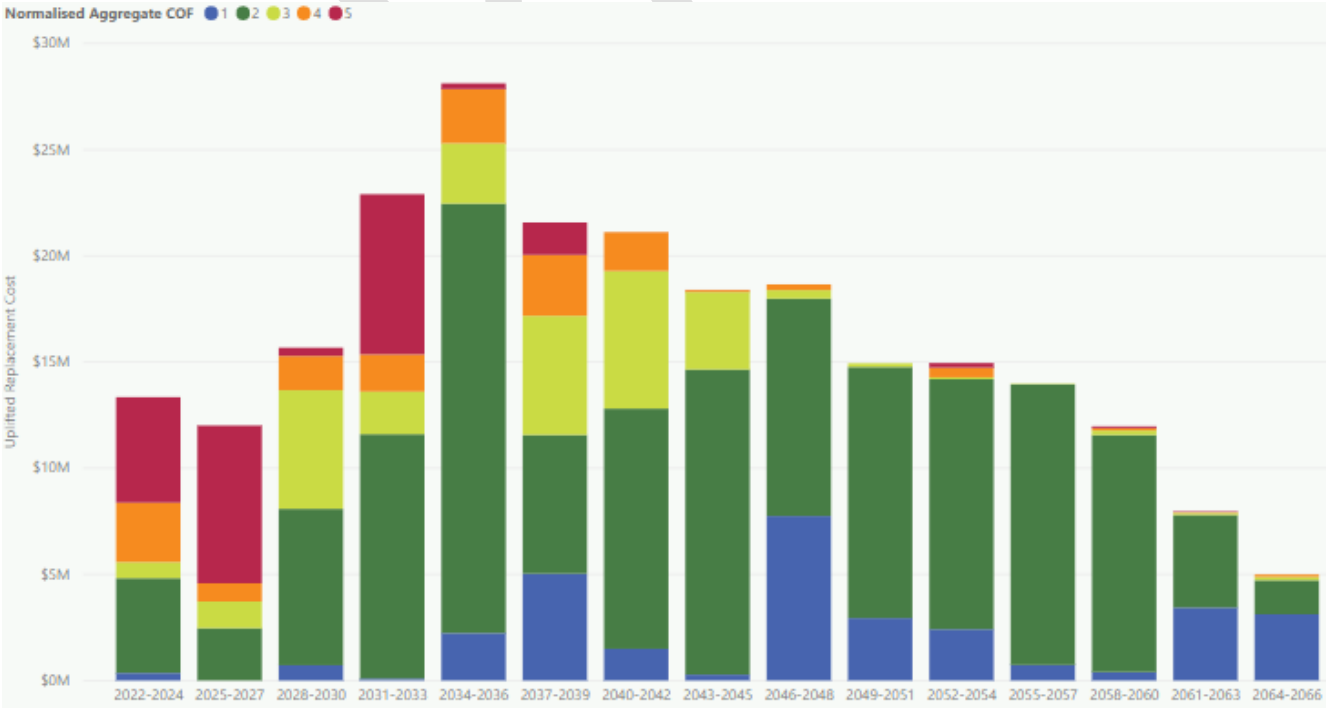


Figure 8-20: Proposed Water Supply Submains Renewals Budget

The proposed budget fits within Council's financial strategy for no or minimal rates rises and no funding cuts to other Council activities and is sustainable for the market to deliver.

The proposed budget requires more deferrals than the recommended budget with only $64 million of very high and high consequence of failure water mains and $8 million of very high and high consequence of failure submains remaining in 2022-24 compared to $105 million and $22 million respectively under the required budget. This means deferral of $41 million of very high and high consequence of failure water mains and $14 million of very high and high consequence of failure submains is occurring. These deferrals further reduce the effects of risk mitigation and increase the risk of important facilities such as hospitals and lifeline facilities losing water supply. Very high consequence of failure pipes are highest priority so deferral of any very high consequence of failure pipes means there is also significant deferral of low consequence of failure pipes. While deferral of low consequence of failure pipes does not have the same risks in term of essential facilities, it does increase the risk of customer satisfaction dropping.

Implications of Budget Choices

Table 8-2 summarises the three budget options.

Financial Year	Required Budget			Recommended Budget			Proposed Budget		
	Mains	Submain	Overall	Mains	Submain	Overall	Mains	Submain	Overall
2022	$66.3	$19.2	$85.6	$33.0	$5.0	$38.0	$30.5	$5.0	$35.5
2023	$66.3	$19.2	$85.6	$38.0	$5.8	$43.7	$35.0	$2.8	$37.8
2024	$66.3	$19.2	$85.6	$42.9	$6.5	$49.4	$40.0	$5.5	$45.5
2025	$58.4	$3.2	$61.6	$47.9	$7.3	$55.1	$40.0	$3.5	$43.5
2026	$58.4	$3.2	$61.6	$47.9	$8.0	$55.9	$40.0	$3.6	$43.6
2027	$58.4	$3.2	$61.6	$47.9	$8.8	$56.6	$40.0	$5.0	$45.0
2028	$8.1	$1.4	$9.5	$47.9	$8.8	$56.6	$40.0	$5.4	$45.4
2029	$8.1	$1.4	$9.5	$47.9	$8.8	$56.6	$40.0	$5.4	$45.4
2030	$8.1	$1.4	$9.5	$47.9	$8.8	$56.6	$40.0	$4.9	$44.9
2031	$70.5	$11.5	$82.0	$47.9	$8.8	$56.6	$40.0	$4.8	$44.8
10 Year Total	**$469.0**	**$83.0**	**$552.0**	**$448.8**	**$76.3**	**$525.1**	**$385.5**	**$45.9**	**$431.3**
30 Year Total	**$1,047.5**	**$258.0**	**$1,305.5**	**$859.7**	**$187.3**	**$1,046.9**	**$865.5**	**$187.5**	**$1,053.0**

Table 8-2: Reticulation Renewals Budgets (millions of dollars, uninflated).

The inability to afford or deliver the required renewals budget means that there will be a reduction in level of service and increase in failures and the operational cost to repair them irrespective of the actual final budget. A balance is required to ensure the final budget is affordable yet remains sufficient to maintain an acceptable level of service, does not cause an unacceptable operational cost increase and does not permit the network to fall to a poor condition that cannot be recovered from. Figure 8-21 shows the thirty-year projections for additional operational cost (columns) and number of failures per thousand connected properties for the recommended and proposed budgets. The required budget has zero additional OPEX cost and would be a horizontal line at 38.43 interruptions per thousand connected properties.

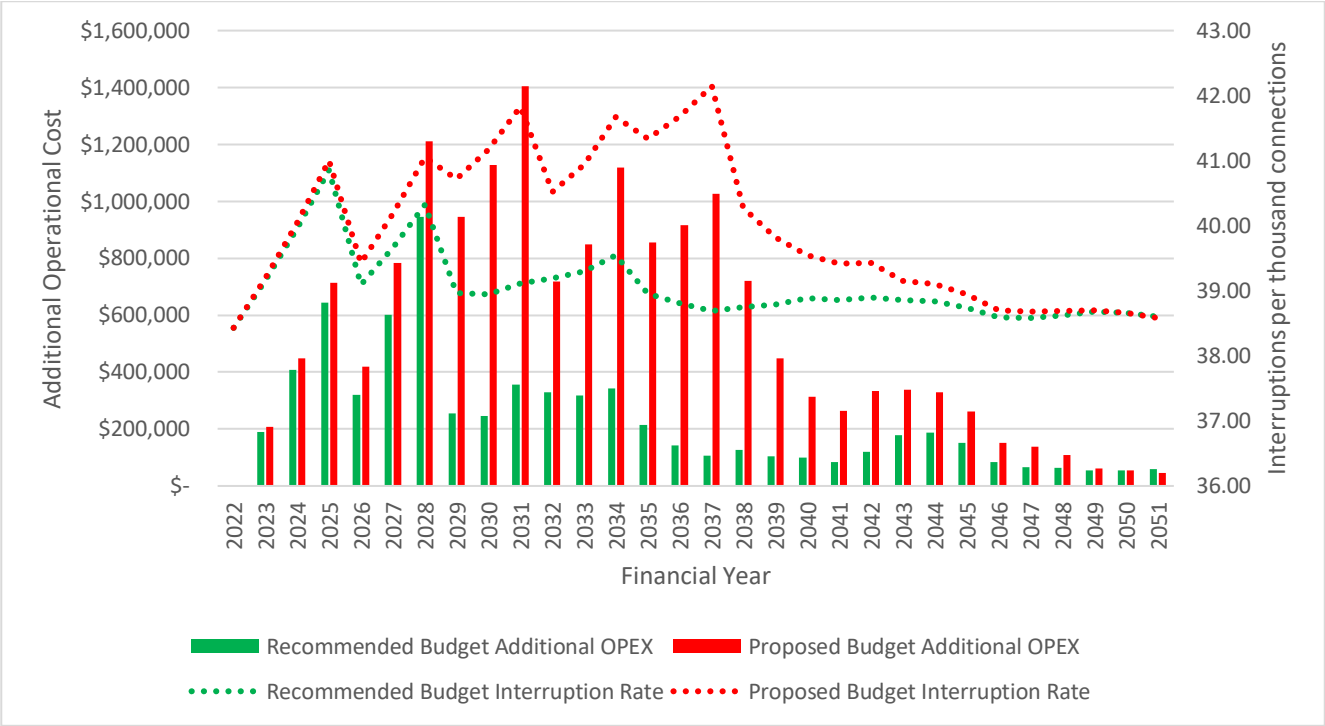


Figure 8-21: Effects of Budgets on OPEX and Interruption Rates.

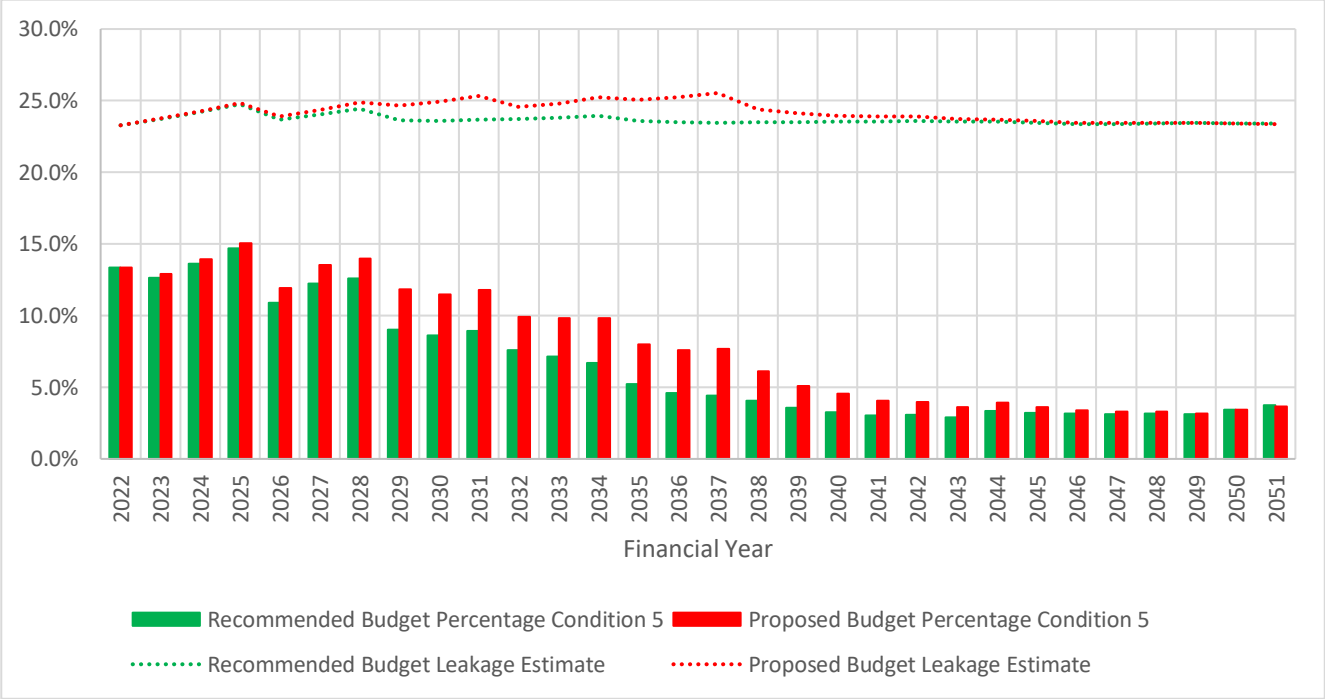


Figure 8-22: Effects of Budgets on Leakage and Network Condition

Examining Table 8-2, both the recommended and proposed budgets have similar thirty-year totals for CAPEX and return back to the current level of interruptions per thousand properties within thirty years. The ten-year totals show the proposed budget is lower in the first ten years than the recommended budget indicating the proposed budget defers expenditure into the later twenty years. Deferring renewal of failing pipes will result in additional failures (Figure 8-21, lines), additional costs to repair them (Figure 8-21, columns), an increase in leakage (Figure 8-22, lines) and a decrease in network condition (Figure 8-22, columns). Table 8-4 shows that selecting the proposed option will add an additional $15.2 million operational cost over the next thirty years compared to $6.2 million for the recommended budget.

Limitations in modelling mean the leakage and interruptions per thousand connected properties only show a return to current levels. In actuality, the leakage and interruption rate will decrease with completion of renewals.

Renewal scheduling by year for first three years

Individual pipe renewal projects are finalised three years prior to their expected construction date. This scheduling assigns the LTP budgets into funding for the individual projects.

Renewals scheduling introduces further considerations:

- Packaging of renewals into projects by location and type to achieve economies of scale.
- Deconfliction to ensure wastewater renewals occur first, then water supply, then storm water followed lastly by road reconstruction or resealing.
- Further prioritisation of renewal to account for any new condition related failures.

This is a time-intensive process for the asset engineers, and is therefore performed after LTP budgets are finalised.

Other Reticulation renewals Budgets

Financial Year	Reactive Renewals Budget	Water Meter Renewal Budget
2022	$7.0 million	$2.3 million
2023	$5.0 million	$2.2 million
2024	$5.0 million	$2.5 million
2025	$5.0 million	$2.8 million
2026	$5.0 million	$3.1 million
2027	$5.0 million	$3.4 million
2028	$5.0 million	$3.6 million
2029	$5.0 million	$3.6 million
2030	$5.0 million	$3.6 million
2031	$5.0 million	$3.6 million

Table 8-3: Reactive Renewal and Water Meter Renewal Budgets

In addition to the budgets for water supply main and water supply submain renewals there are additional budgets for reactive pipe renewals and water meter renewals. Table 8-3 lists these budgets.

Renewals models exclude those pipes with a low or medium consequence of failure that are not currently experiencing failures. The reactive renewal budget is an emergency fund to cover pipes that are not in the renewals plan but begin to fail repeatedly and cause significant and frequent problems for customers.

Water meter renewals budgets historically were $250-500k per year prioritising old, inaccurate or failing commercial meters. In line with the smart water strategy pipe, renewals will now include the renewal of meters with an increase in the meter renewal budget to cover this additional renewals scope.

8.1.7 Renewal Process Improvements

- Improved process for collecting and handling failure data so that decisions based on RMO are more informed
- Further condition assessment and condition management of AC and CI pipes that are not in the first three years of the renewal plan
- Formalise maintenance strategy, including the interaction with the renewal strategy

8.1.8 Reticulation Operations and Maintenance Plan

O&M Historic Trends

Operations and maintenance performed under contract CN4600000778: Christchurch City Council Maintenance of City Water and Wastewater Network includes the following functions for reticulation assets:

- Investigating faults
- Resolving problems
- Water pipe repairs
- Valve and hydrant repairs
- Meter repairs and replacements
- Service valve repairs and replacements
- Resolving dirty water problems
- Inspection and repair of water restrictors
- Preventing contamination of the water supply
- Reporting and providing information to Council
- Implementing quality assurance measures to ensure quality levels are achieved.

Figure 8-23 displays historic maintenance contract costs for reticulation assets. Maintenance or reactive renewal requirements are identified following inspections carried out as part of the maintenance contract or following customer service requests or complaints.

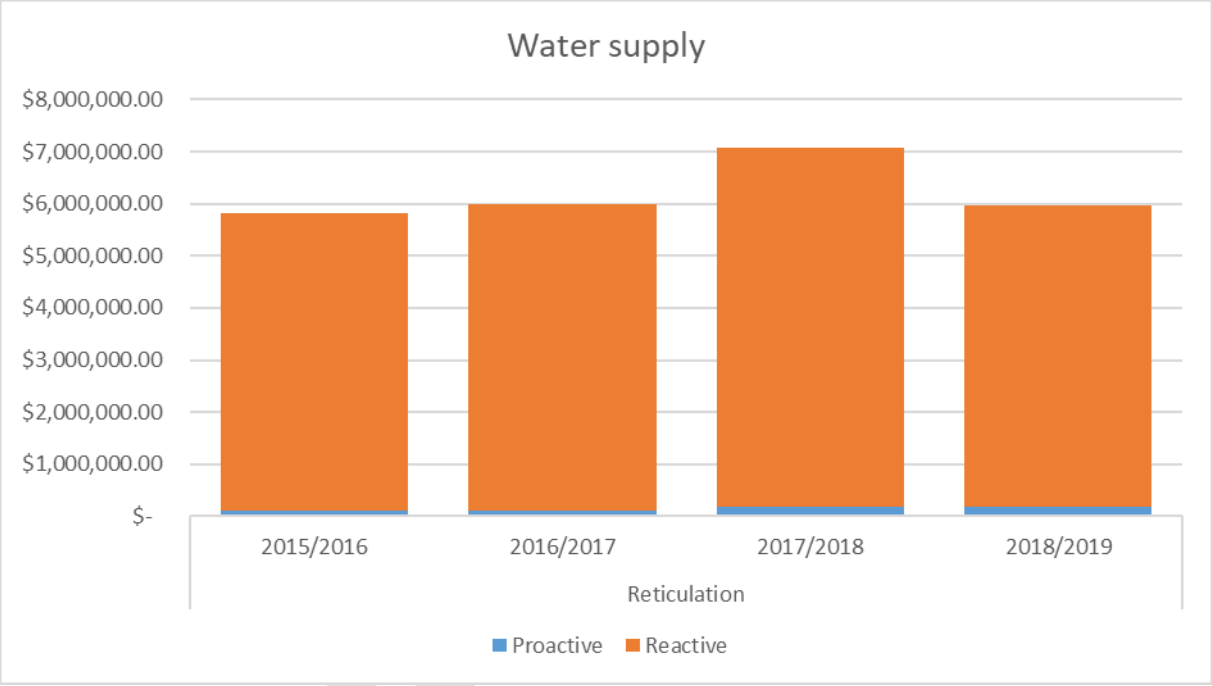


Figure 8-23: Reticulation Planned Maintenance Activities

Reactive Maintenance

Maintenance on the reticulation network is predominantly reactive and includes both repairs and the reactive renewal of low criticality assets. There is limited opportunity for preventative maintenance on the underground pipes under constant pressure. The approach taken for high criticality assets is to renew these prior to failure based on their condition score.

Water supply reticulation assets reactively renewed under the maintenance contract include:

- Valves;
- Fire hydrants;
- Laterals;
- Connections;
- Meters; and

- Restrictors.

Where identified these reactive renewals are now categorised as capital works and are funded from the capital renewal programme budget.

Formalising the maintenance strategy and desired split between proactive and reactive works requires further work.

Summary of future operations and maintenance expenditure

Some condition 5 pipes will be deferred rather than proactively replaced in the renewal programme. This is expected to increase reactive maintenance and operational costs into the future. Also, current maintenance requirements are being reviewed and the existing maintenance contract is up for renewal. Changes in maintenance spend is dependent on the outcome of the current Section 17A review and the subsequent structure of the new contract.

Additional OPEX is expected where pipe renewal is deferred due to pipes operating at or beyond their expected useful life. Figure 8-21 and Table 8-4 provide a modelled estimation of increased OPEX due to condition related failure rates across the network.

Financial Year	Recommended Option		Proposed Option	
	Water Mains	Water Submains	Water Mains	Water Submains
2022	$ -	$-	$ -	$ -
2023	$ 167,000	$ 31,000	$ 180,000	$ 34,000
2024	$ 359,000	$ 65,000	$ 388,000	$ 71,000
2025	$ 570,000	$102,000	$ 620,000	$ 112,000
2026	$ 285,000	$60,000	$ 361,000	$ 117,000
2027	$ 523,000	$80,000	$ 670,000	$ 154,000
2028	$ 805,000	$102,000	$ 1,027,000	$ 195,000
2029	$ 145,000	$14,000	$ 652,000	$ 170,000
2030	$ 51,000	$9,000	$ 691,000	$ 200,000
2031	$ -	$2,000	$ 814,000	$ 228,000
10 Year Total	**$ 2,905,000**	**$466,000**	**$ 5,401,000**	**$ 1,281,000**
30 Year Total	**$ 5,568,000**	**$ 629,000**	**$ 12,208,000**	**$ 2,998,000**

Table 8-4: Additional OPEX Costs

There is also additional OPEX required relating to areas that sit outside of the maintenance contract failure costs and include:

- Data standards and collection
- Leak detection
- Pressure monitoring and management
- Condition assessment and condition management
- Asset failure and disposed asset post-mortem.

Estimates for these costs are discussed alongside the future OPEX projections within Section 9 Financial.

8.1.9 Reticulation Disposal Plan

The preferred method of water pipe disposal is to abandon the pipes in place. Pipes being renewed have little residual value and also incur extra removal and disposal costs in the case of AC pipes, so there is no financial incentive to remove and dispose old assets.

Valves, hydrants and other metallic fittings removed as part of a maintenance task or renewal project become the responsibility of the contractor.

Meter replacement only occurs as part of maintenance tasks. Under the current maintenance contract meters and other assets removed as part of maintenance tasks become the property of the maintenance contractor.

8.2 Stations Lifecycle Management Plan

8.2.1 Stations Issues and Priorities

Key Issue	Priority for this Plan
Aging assets and deferred renewals. Station assets have been "sweated" over extended periods rather than renewed which has increased reactive works and operational risk	Addressing renewal of assets operating well beyond theoretical useful lives
Several reservoirs and suction tanks are in very poor condition and pose water safety concerns. Replacement costs are significant and uncertain	Performing inventory and condition assessment of all reservoir and suction tanks to gauge the full extent of the issue. Refurbishment and replacement of these assets where required. Several priority repairs are already identified as well as full replacement of the Quarry and Hackthorne reservoir sites
Demonstrating safe drinking water supplied through source security	Comprehensive upgrades have already been carried out on wellheads to address this issue. A number of asset upgrade, decommissioning and monitoring projects remain as priorities for this plan
Unsafe switchboards	Unsafe switchboards were identified during the last AMP and LTP period and most of these have been replaced. The remaining unsafe switchboards will be prioritised for replacement
Select network control equipment is obsolete and not possible to repair or directly replace. Older assets are currently running on spares gifted from other councils	Increased funding for control equipment replacement to keep up with the growing number of stations and the short useful lives of this asset type
Failures of older technology motors	Prioritise replacement of the very old slip ring motors and motor types with most frequent failures and disruptions to service
Communication infrastructure (SCADA) needs upgrading. Full replacement is needed at older sites	Selection and pilot testing of replacement design and hardware, followed by a full scale roll out
Asset data for stations is poor. Current O&M data is not easily useful for long term decision-making	Resourcing to: a) collect and update inventory data that supports asset management planning, b) refine and update valuation process and how costs are applied, c) collect O&M data that can be analysed network-wide to determine strategy for proactive/reactive split

Table 8-5: Water Supply Station Key Issues and Priorities

Water supply stations include assets under the categories:

- civil and structures (including wells)
- mechanical
- electrical
- instrumentation, automation and control (IAC)

Civil and structural assets are fewer in number, high in value and in asset life, compared to mechanical, electrical and IAC assets that are greater in number, lower in value and shorter in asset life.

Different asset management approaches are used across the categories; for example, there is high benefit in condition assessing civil and structure assets prior to renewal. Whereas the majority of electrical and IAC assets can be effectively managed using network-wide rather than individual assessment.

8.2.2 Stations Age and Condition

Asset Condition

To address specific issues, targeted condition assessments are periodically carried out. A recent reservoir and suction tank survey included a condition grading exercise and identified a priority list of assets that require refurbishment, repair or replacement.

At a portfolio level, the condition data held in the database for station assets is poor compared to reticulation assets. The high-level condition assessments rely on asset age as a proxy for condition and a large number of start-up dates are missing for assets.

Asset condition is measured on a 1-5 scale based on remaining useful life as presented in Section 7.

Figure 8-24 shows the condition grading profile of the station assets by replacement value.

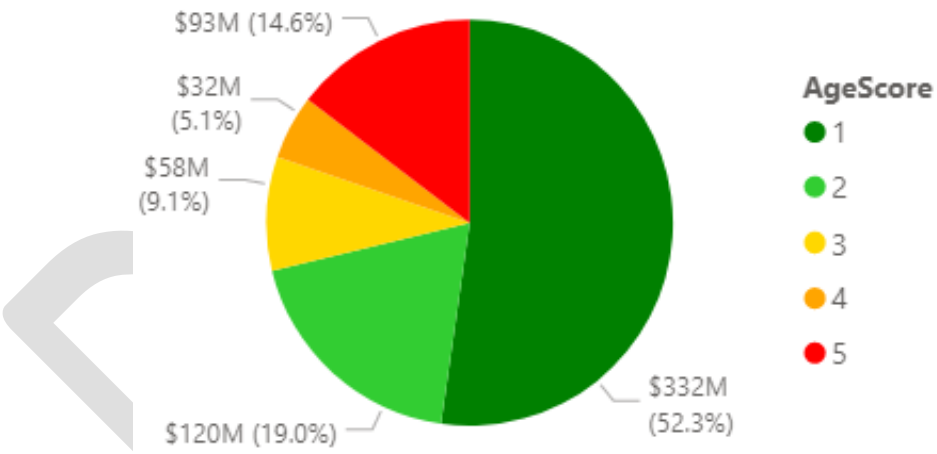


Figure 8-24: Station asset condition by value

There is a high proportion of assets in very poor condition; 29% of the total station asset value have a condition grade of 5. Figure 8-25 show which types of assets are in poor or very poor condition (grade 4 and 5).

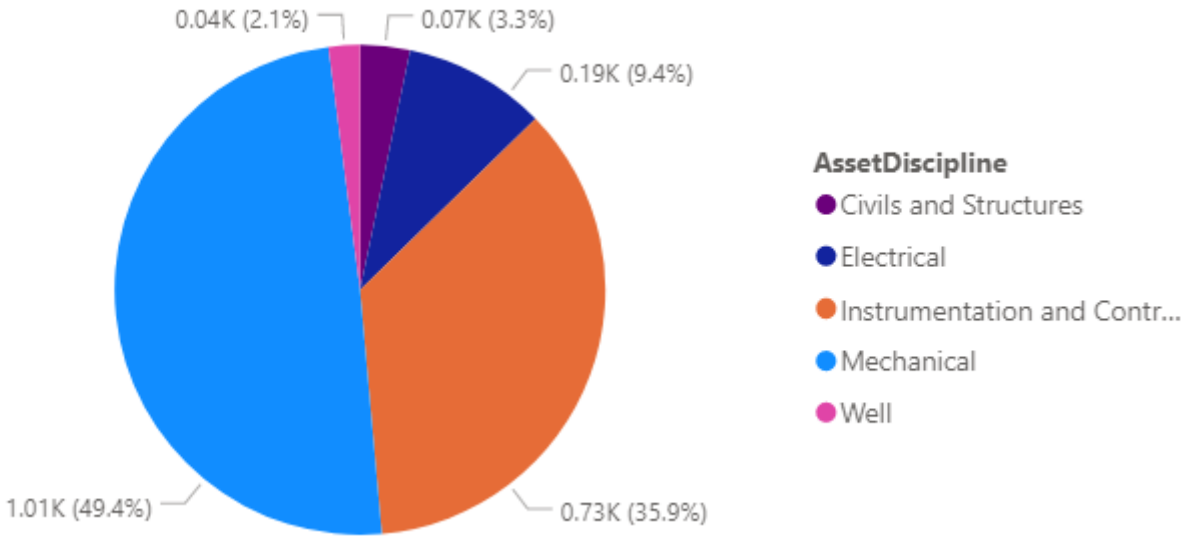


Figure 8-25: Types of assets in poor or very poor condition (by number)

There are a small number of civil and structures assets that are relatively expensive to replace. 3% of the poor condition assets represent 38% of the value.

There are a large number of poor condition IAC assets that are relatively cheap to replace. 56% of these poor condition assets represent 6% of the value.

To increase confidence in this age-based condition profiling, future condition assessment effort is focussed on civil and structures assets, then mechanical, electrical and IAC in that order.

Despite current data limitations, the condition profiles shown above agree with operation and maintenance observations:

- The SCADA system has a backlog of assets that are obsolete and beginning to fail. Some of these assets are running on spares gifted from other councils. This SCADA system underpins the water supply network. There is opportunity to combine the timing of this necessary upgrade with an investment in emerging smart technology to collect and analyse new data that will support future operations and lifecycle planning.
- Mechanical and civil assets from the oldest station sites are requiring reactive repair and renewal. These are high value assets where renewal includes a long lead-in time for design and construction. Funding provision and condition assessment is needed in the short term as several sites are likely to require significant renewal in the next 10 years.
- Initial assessments of reservoir and suction tank assets found the several immediate repairs are needed as well as the full replacement of both the Quarry and Hackthorne reservoir sites.
- Most of the unsafe station switchboards have now been replaced, however there are still a small number that need replacement.
- Slip ring and other old technology motors are failing and need motor replacement.

8.2.3 Stations Repairs and Maintenance Performance

Field teams have communicated to asset owners that station assets have required a higher level of reactive repair and emergency works. This has put increased demand on reactive capital budgets. Failures include several motor, switchboard, instrument and control assets in the 2019/2020 year and now a focus on reactive work at reservoirs with boil water events in 2020/2021.

This AMP promotes greater proactive renewal funding to reduce the impact of reactive replacement on customers and to avoid the increased costs of completing works under emergency response. Customer impacts have included drinking water quality transgressions within reservoirs and suction tanks resulting in interruption to supply, boil water notices and temporary treatment with higher levels of chlorine.

Improved failure data recording, processing and handling behaviour is also part of the plan to track repair and maintenance performance more effectively across the stations asset class.

As well as keeping up with failure rates, increased reactive budgets are needed due to a change in funding definition. Prior to this change any reactive work that increased asset life wasn't specifically identified and was just covered under operational expenses. This is now required to be funded as a capital expense from a reactive renewal budget.

8.2.4 Stations Criticality

Criticality criteria is still being developed for stations assets. Current criticality criteria is based on the sum of electric motor power for direct pumping stations or the total reservoir capacity as shown in Table 8-6 below.

Criticality Score	Station Size	Reservoir Storage (m^3)
1	Up to 5kW	Up to 25
2	5kW to 22kW	20 to 100
3	22kW to 100kW	100 to 250
4	100kW to 200kW	250 to 500
5	Over 200kW	Over 500

Table 8-6: Station criticality criteria

Additionally, stations with generators are criticality 5 as these are needed to meet minimum flows or public health protection barriers during outages.

By their nature as points of supply, water supply station assets typically have a high criticality. This profile is shown in Figure 8-26, the consequence of failure profile by number of station assets.

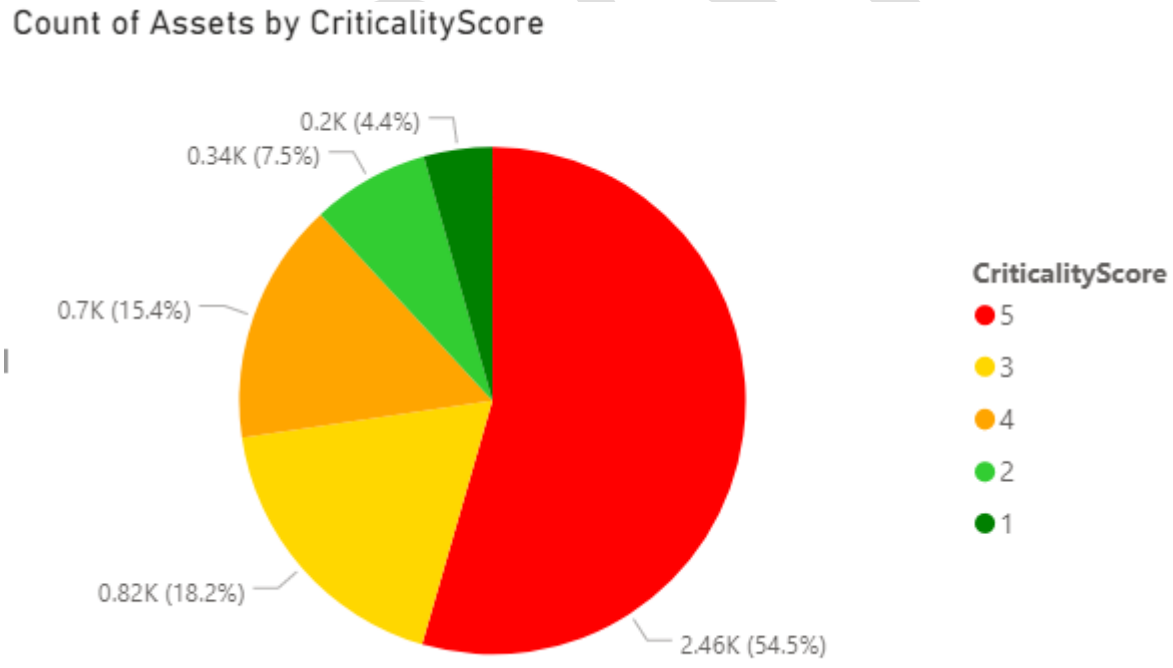


Figure 8-26: Station asset criticality (by number)

40% of all water supply station sites are criticality 4 or 5.

Looking at both condition and criticality at the same time shows that a large number of the poor condition assets have high criticality. Figure 8-27 shows the criticality profile of assets with a condition score of 4 or 5.

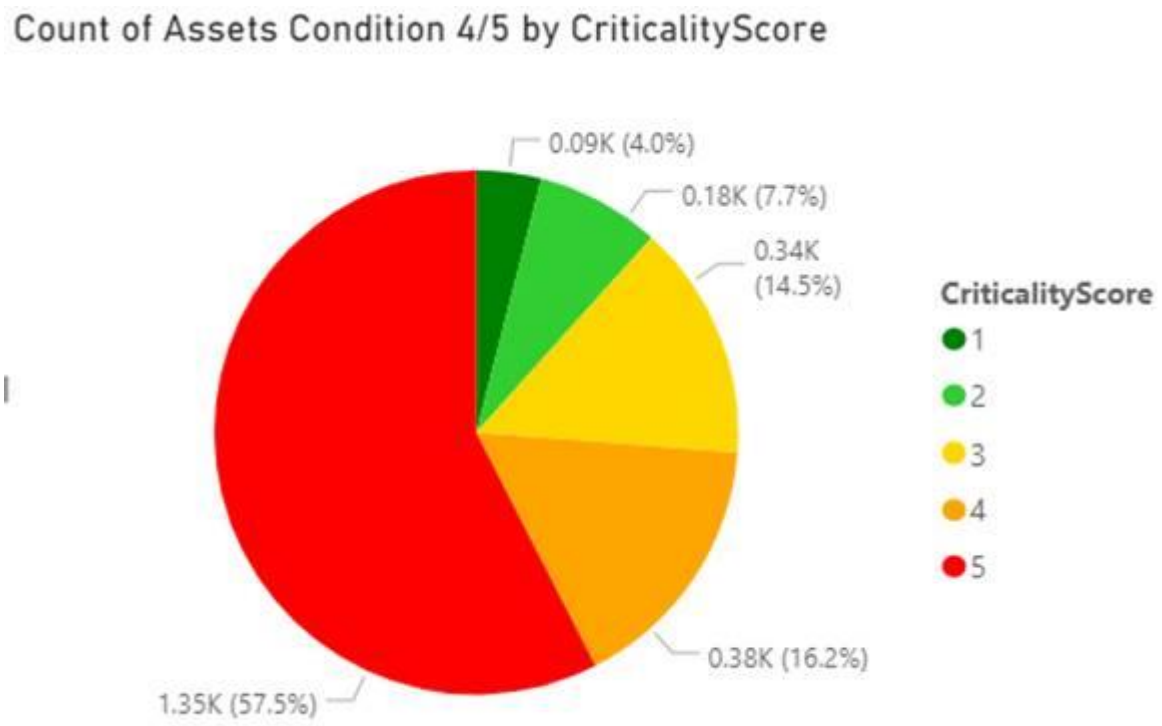


Figure 8-27: The criticality of poor and very poor condition station assets

The high criticality of the poor condition assets supports the strategy to increase the condition assessment and renewal of water supply station assets.

8.2.5 Stations Renewals Plan

Renewal forecasting begins with the age-based condition and remaining life. This is adjusted for the near term (years 1 – 3) where candidates are selected for inclusion as renewal projects based on the empirical criteria in Table 8-7.

Activity	Approach Used	Criteria
Renewals for the long term forecast (4-30 years)	Age-based condition estimation.	Industry guideline theoretical asset age and dates of installation
Renewals for the short term forecast (1-3 years)	Selection based on operations and maintenance feedback, obsolete assets and owner knowledge to identify short list of renewal sites. Site inspection of shortlist sites to better understand the scope of replacement required.	• Equipment and service failures • High operational cost • Obsolete or failing models • Safety hazards
Replacement cost estimates	Standard rates applied based on valuation data and staff knowledge base.	

Table 8-7: Renewal Planning Criteria

Summary of future renewal and replacement expenditure

The raw data forecast of asset renewals is presented in Figure 8-28.

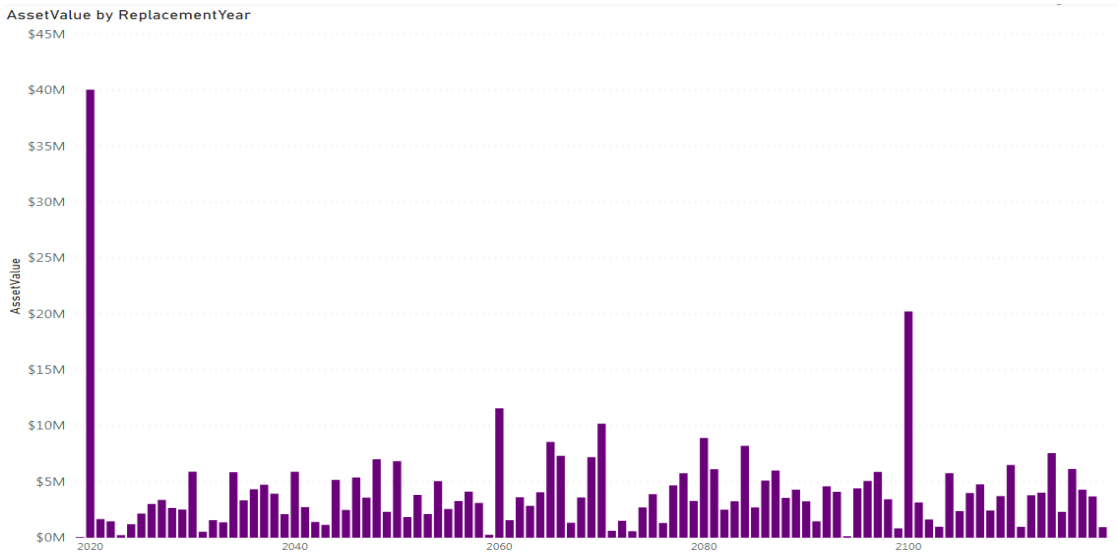


Figure 8-28: Required Station Renewal Budget

This renewal profile shows several features:

- The large spike in 2021 reflects assets within the database that have exceeded their theoretical useful life. These are addressed through increased condition assessment and increased renewal over a ten year period (refer renewal strategy in Table 8-8.
- There is an additional $50M of assets without installation dates that are not included in the forecast graph above. This is addressed through the data collection improvement programme.
- The large spike in 2021 creates smaller peaks in future years based on these assets being renewed in 2021 and then requiring future renewal in 20, 40, 60, 80 years depending on the type of asset (see large spike in 2101 after 80 years).

Financial Year	Required Renewals ($ millions)	Recommended Renewals ($ millions)	Proposed renewals ($ millions)
2022	$ 92.20	$ 14.94	$ 9.57
2023	$ 2.47	$ 18.68	$ 5.28
2024	$ 3.93	$ 21.65	$ 10.36
2025	$ 7.69	$ 13.05	$ 12.90
2026	$ 7.39	$ 6.95	$ 14.18
2027	$ 6.38	$ 5.50	$ 11.56
2028	$ 5.09	$ 4.99	$ 7.51
2029	$ 5.84	$ 4.50	$ 3.93
2030	$ 9.29	$ 5.72	$ 4.56
2031	$ 2.00	$ 4.41	$ 2.92
10 Year Total	**$ 142.29**	**$ 100.39**	**$ 82.78**
30 Year Total	**$ 387.74**	**$ 253.03**	**$ 308.45**

Table 8-8: Stations Renewals Budgets

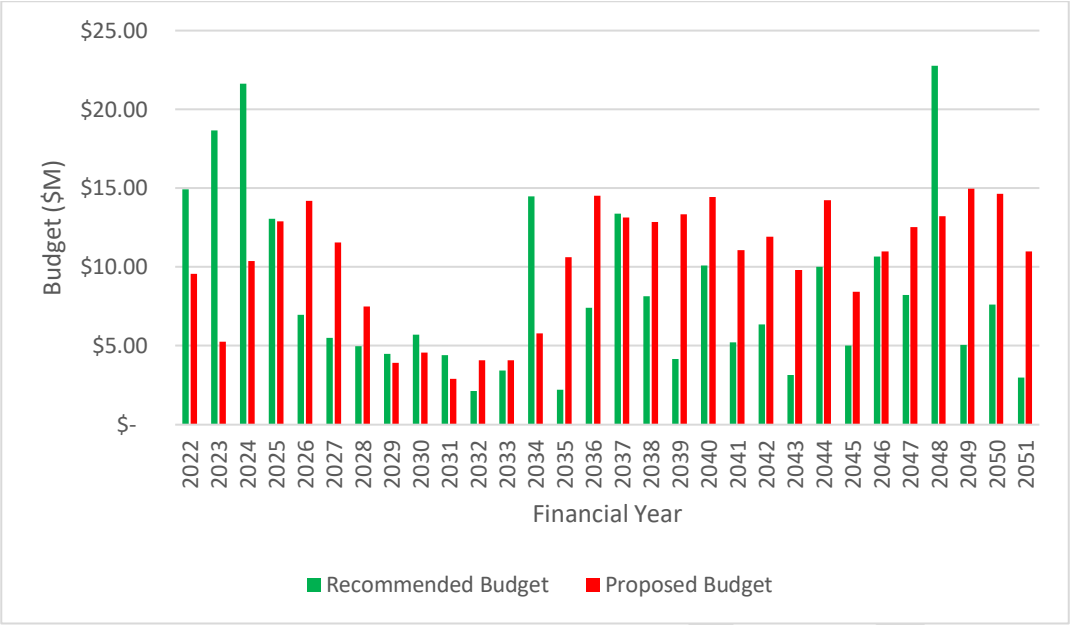


Figure 8-29: Station Renewals Budget Comparisons

Budgets set out in the recommended option looked at the historical under spending in these areas and looked to reduce the backlog as soon as possible whilst still remaining deliverable both at a council and private contracting business level as the backlog is now too large to be effectively and efficiently caught up on in a short time frame. The changes in the proposed option will continue to increase the backlog and further reduce the ability to recover from the slow degradation of assets. The current state of the asset base and the continued low investment are going to make it increasingly difficult if not impossible to maintain current level of service.

Delays in the several major project budgets will maintain existing risks around pressure transients and damage to horizontal infrastructure. This will maintain the current level of risk and will increase the risk to reactive renewals in the horizontal infrastructure area. This will also increase the likelihood of more catastrophic failure events to these assets causing boiled water notices. Also, several stations continue to increase their risk profiles due to age and being delayed for several LTP cycles already, increasing the risk around health and safety events, water restrictions and boiled water notices.

Significant reductions in health and safety budgets and asbestos removal budgets will continue to maintain the council and CEO's high-risk exposure to prosecution due to serious harm injuries with many stations having asbestos present. Several installations also currently do not meet New Zealand health and safety regulation laws, particularly around working at heights.

Reductions in programme budgets around civil, mechanical works will result in further maintaining and increasing risks with water safety around reservoir repair and replacement. This will continue to maintain and increase elevated risks around boiled water notices, New Zealand Drinking Water Standards transgressions and chlorination due to failing or damaged infrastructure.

Reductions in the Electrical, Instrumentation, Controls and Automation programmes will increase the risk of failure to meet our obligations under the NZDWS and water safety plans. This may have a serious impact on the businesses political health as well as further damage the council's ability to return to a chlorination free state. In addition to this, new risks are emerging with respect obsolete and failing electronics and starters within this activity will continue to erode our ability to reliably and safely produce and distribute safe drinking water.

Reduction in the Software programmes will continue to increase the business risk to reliable control and monitoring and will likely make it increasingly difficult to meet regulatory requirements for ECAN and NZDWS. In addition to this, the continued neglect in this area will continue to cause operational issues, maintaining or increasing the risk to operational budgets. Furthermore as the software in this area ages and the hardware in the Instrumentation, Controls and Automation areas continue to age the risk of cyber security attacks will continue to increase as the business falls further

behind in maintaining a professional system. Several of the stations will now only be able to be repaired with second hand equipment sourced from WaterCare after they decommissioned their aged assets.

In addition to the afore mentioned programmes the reactive renewals budget adjustments to cope with the much higher failure rates being encountered, remain at historically low levels. This will result in an increased risk of the business not being able to repair failures in a timely fashion, or at all. This will slowly reduce the infrastructures ability to produce safe drinking water, particularly in summer resulting in an increased risk of more frequent and longer water restrictions, an increased risk to the number frequency, and size of water outages.

8.2.6 Stations Capital development plan

The projected capital renewal programme for station assets is summarised in Table 8-9.

Financial Year	New Water Supplies	New Pump Stations	New Wells	Communal Fire Storage	Water Safety Improvements	New Trunk Mains
2022	$ 1.30	$ 0.21	$ -	$ -	$ -	$ -
2023	$ 1.17	$ 2.74	$ -	$ -	$ -	$ 0.48
2024	$ -	$ 4.84	$ -	$ -	$ -	$ 2.50
2025	$ -	$ 1.72	$ -	$ 0.05	$ -	$ 1.02
2026	$ -	$ 1.50	$ 1.10	$ 0.05	$ -	$ -
2027	$ -	$ 1.86	$ 0.73	$ 0.05	$ 2.50	$ -
2028	$ -	$ 2.61	$ 1.46	$ 0.05	$ 5.00	$ -
2029	$ 0.25	$ 1.80	$ 1.50	$ 0.05	$ 7.50	$ -
2030	$ -	$ 3.00	$ 1.50	$ -	$ 7.50	$ -
2031	$ -	$ 5.50	$ 1.50	$ -	$ 7.50	$ -

Table 8-9: New Stations Asset Budgets ($ millions)

8.2.7 Renewal Process Improvements

- Improved process for collecting and handling stations failure data and reactive renewal interventions
- Further condition assessment and condition management of high value critical assets, beginning with reservoirs and suction tanks
- Formalise maintenance strategy, including the interaction with the renewal strategy

8.2.8 Stations Operations and Maintenance Plan

O&M Historic Trends

Operations and maintenance performed under contract CN4600000778: Christchurch City Council Maintenance of City Water and Wastewater Network includes the following functions for station assets:

- Building and grounds maintenance;
- Cleaning and inspection of reservoirs and suction tanks;
- Disinfection following work in reservoirs and suction tanks;
- Emergency cleaning and disinfection of reservoirs and suction tanks;
- Minor repairs to concrete structures;
- Unblocking drains and gutters;
- Pumping out of pits containing ground water;
- Sweeping, cleaning and tidying of pump houses;
- Painting equipment following servicing or renewal;
- Pump maintenance, servicing, repairs and testing;

- Standby diesel servicing maintenance and testing;
- Installation, repair and removal of borehole pumps and assessment of borehole pump condition;
- Condition assessment by vibration analysis of pump sets;
- General (minor) structural metal work fabrication/repairs (handrails, ladders, safety equipment, etc.);
- Maintenance, repair and testing of site pipework and valves;
- Maintenance and calibration of specialist control valves (pressure reducing valves, pressure sustaining valves, etc.);
- Electric motor repairs, servicing and testing;
- Motor starter servicing and repair;
- Switchboard servicing and repair;
- Battery maintenance and testing;
- Standby generator testing, maintenance and overhaul;
- Upkeep of cathodic protection systems;
- Supply of all consumables excluding electricity and diesel fuel; and
- Other miscellaneous works of a similar nature.

SCADA equipment including radios and RTUs, level controllers, flow meters, pressure transducers, level transducers, float switches, earthquake sensors, instrumentation and data loggers are excluded from the maintenance contract and maintained directly by Council.

The contract cost for the last four years is shown in Figure 8-30.

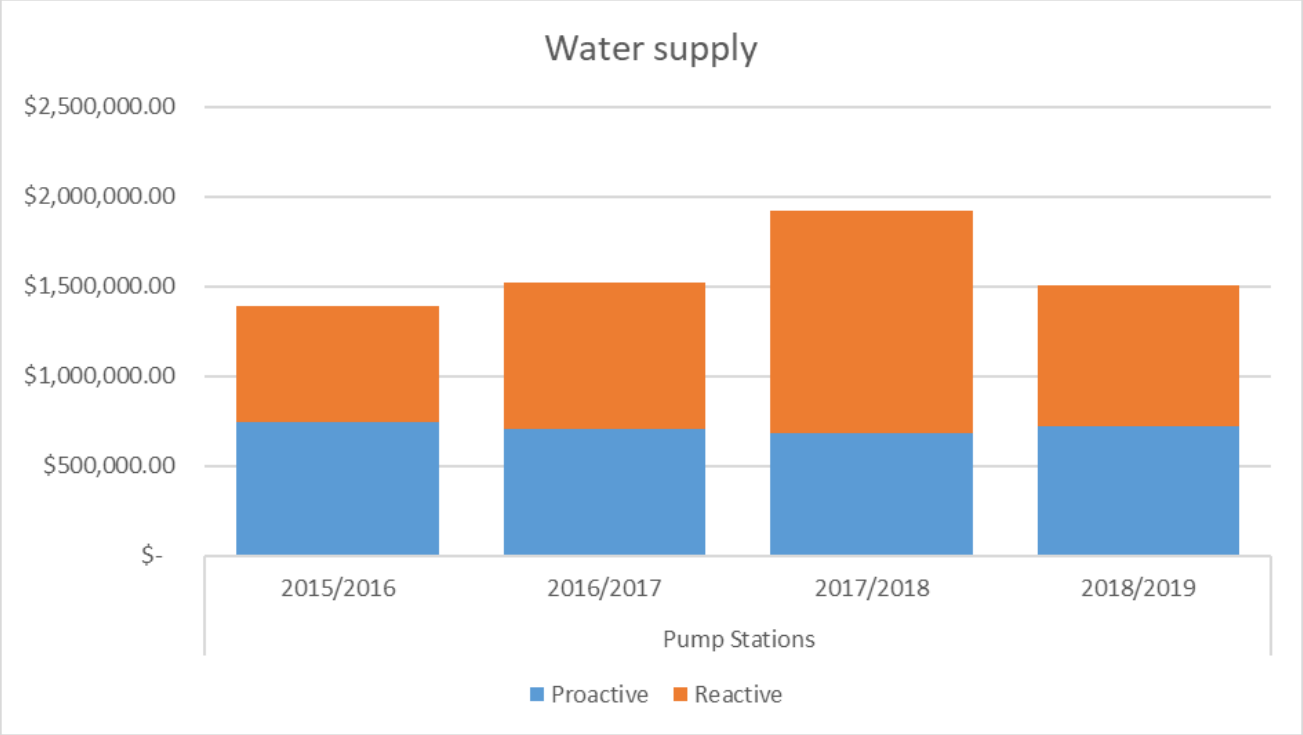


Figure 8-30: Water supply Station Operational and Maintenance Costs

Operational costs such as the cost of electricity and functions performed by internal Council staff are not included in the figure above.

Reactive Maintenance

Maintenance on the station assets is split between proactive (scheduled) and reactive (un-scheduled). Proactive work is carried out to improve reliability and to maintain asset condition and service levels.

Where identified, station asset reactive renewals are now categorised as capital works and are funded from the capital renewal programme budget.

Further work has been identified to formalise the maintenance strategy, basic maintenance requirements, categorisation of maintenance costs and the desired split between proactive and reactive works.

Summary of future operations and maintenance expenditure

The existing maintenance contract is up for renewal and changes in maintenance spend is dependent on the outcome of the review of the contract requirements.

There is also additional OPEX required relating to areas that sit outside of the maintenance contract costs and include:

- Data standards and collection
- Pressure monitoring and management
- Condition assessments. E.g. 5yearly Wells, Reservoirs and suction tank detailed condition assessments
- Asset failure and disposed asset post-mortem

8.2.9 Stations Disposal Plan

Several stations have been decommissioned and in some cases not yet disposed. These now require separate demolition and disposal funding. New programme funding is sought as part of this plan to dispose of assets in cases where the disposal wasn't part of a related capital project.

The following water supply stations need disposal:

- Mandeville Pumping Station
- Wrights Pumping Station
- Harewood Pumping Station

Estimates for these costs are discussed alongside the future OPEX projections within Section 9 Financial.

8.3 Treatment Lifecycle Management Plan

8.3.1 Treatment Issues and Priorities

Key Issue	Priority for this Plan
Communication infrastructure (SCADA) needs upgrading	Selection and pilot testing of replacement design and hardware, followed by a full scale roll out
Asset data for stations is poor. Current O&M data is not easily useful for long term decision-making	Resourcing to: a) collect and update inventory data that supports asset management planning, b) refine and update valuation process and how costs are applied, c) collect O&M data that can be analysed network-wide to determine strategy for proactive/reactive split
Instrumentation renewal needs to account for increased regulatory monitoring requirements	Replacement and upgrade of instrumentation to latest regulatory standards
Poor performance of Duvauchelle WTP	UV renewal needed. Duvauchelle WTP programme otherwise covered under "Improvement" project

Figure 8-31: Water Treatment Plant Key Issues and Priorities

8.3.2 Treatment Assets Age and Condition

Asset Condition

At a portfolio level, there is limited condition data held in the database for treatment assets. Additionally, the majority of treatment assets do not have a start-up date so are not able to have an age-based condition score applied.

Further resourcing is needed to fill data gaps, verify existing data and collect new data. The greatest need is to verify the asset inventory and add appropriate start up dates so that database analysis methods can be used.

Operation and maintenance observations on treatment asset conditions are:

- Communication assets are showing their age and in some cases are not repairable and subject to a declining stock of spares. The current system is being augmented by temporary solutions and requires capacity upgrades and digitisation when renewal takes place.

8.3.3 Treatment Repairs and Maintenance Performance

Improved failure data recording, processing and handling behaviour is part of the plan to track repair and maintenance performance more effectively across the treatment asset class. This includes tracking reactive renewals and ensuring related data is captured in the core Council data systems.

Predicting timely renewal is difficult due to data gaps for this asset class, so a balanced approach between proactive and reactive renewal is adopted.

8.3.4 Treatment Criticality

By definition all water supply treatment plants are critical. No criticality criteria has been used to differentiate assets within the Treatment asset subcategory.

8.3.5 Renewals Plan

Renewal forecasting begins with the age-based condition and remaining life and only includes those assets with startup dates. This is adjusted for the near term (years 1 – 3) where candidates are selected for inclusion as renewal projects based on the empirical criteria below.

Activity	Approach Used	Criteria
Renewals for the long term forecast (4-30 years)	Age-based condition estimation where possible	Industry guideline theoretical asset age and dates of installation
Renewals for the short term forecast (1-3 years)	Selection based on operations and maintenance feedback, obsolete assets and owner knowledge to identify short list of renewal sites. Site inspection of shortlist sites to better understand the scope of replacement required.	• Equipment and service failures • High operational cost • Obsolete or failing models • Safety hazards
Replacement Cost Estimates	Standard rates applied based on valuation data and staff knowledge base Contingency based on recent projects is added to account for data gaps and other unknowns	

Table 8-10: Water Treatment Plant Renewals Criteria

Summary of future renewal and replacement expenditure

The renewal strategy for water treatment plants has three key parts.

- Including renewal funding for software as an asset class. Software can have a significant replacement cost and short asset life and warrants inclusion in future asset renewal planning
- Reduce decision-making uncertainty – through condition assessment, data improvements, asset management processes
- Given the uncertainty, allowing for both proactive and reactive renewal programmes

Financial Year	Required Renewals ($ millions)	Recommended Renewals ($ millions)	Proposed renewals ($ millions)
2022	$ 1.27	$ 0.22	$ 0.00
2023	$ 0.00	$ 0.41	$ 0.36
2024	$ 0.21	$ 0.05	$ 0.00
2025	$ 0.00	$ 0.05	$ 0.02
2026	$ 0.00	$ 0.05	$ 0.02
2027	$ 0.00	$ 0.05	$ 0.03
2028	$ 0.01	$ 0.05	$ 0.03
2029	$ 0.43	$ 0.05	$ 0.03
2030	$ 0.00	$ 0.05	$ 0.00
2031	$ 0.00	$ 0.05	$ 0.03
10 Year Total	**$ 1.93**	**$ 0.81**	**$ 0.52**
30 Year Total	**$ 20.01**	**$ 4.77**	**$ 3.64**

Table 8-11: Water Treatment Plant Renewals Budgets

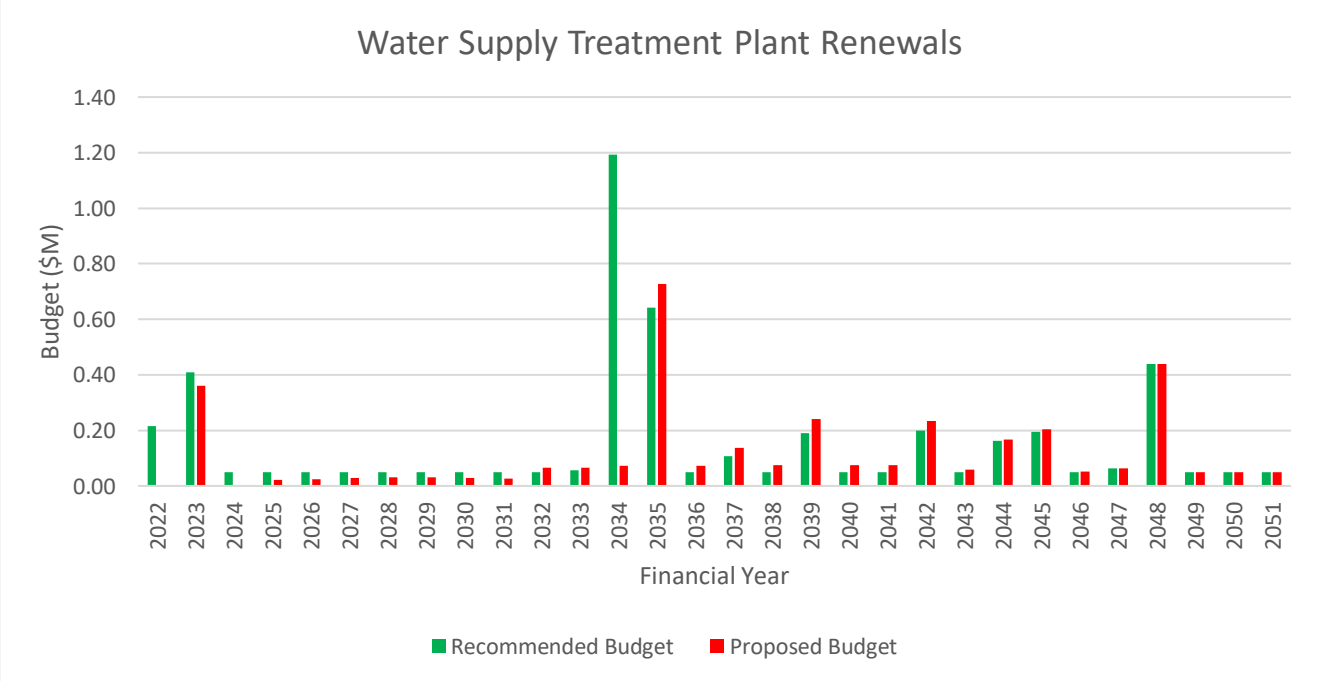


Figure 8-32: Water Treatment Plant Renewals Budget Comparisons

Current asset data on the water supply treatment plants is very poor and, as such, the required budgets being generated from the asset database are not deemed to be reflective of the actual asset state. All of the water supply treatment plants are very new and as such an approach of little funding in the planned renewals space has been taken with a larger amount of reactive renewals funding to offset any unforeseen breakdowns or works becoming evident as better data is collected.

Whilst these budgets are small, the proposed budgets fall short of recommendations and placed the council at risk of not being able to fund any major asset condition problems encountered. In addition to this work, budget set aside to resolve NZDWA problems, water safety plan obligations and other operational efficiencies and monitoring updates will have to be reprioritised with not all work able to be completed. This will increase the risk of boiled water notices and plant failures causing considerable operational expense to maintain safe water supplies to these smaller communities with water trucked in from Christchurch City supplies.

8.3.6 Treatment capital development plan

Although water supply security improvements and new water supplies in Table 8-8 may include some works at treatment plants, The LTP contains no individual water treatment plant improvement or development projects.

8.3.7 Renewal Process Improvement

- Improved process for collecting and handling treatment asset failure data and reactive renewal interventions
- Further data inventory, install date estimation and condition assessment of assets, beginning with the high value asset types.
- Formalise maintenance strategy, including the interaction with the renewal strategy

8.3.8 Treatment Operations and Maintenance Plan

O&M Historic Trends

Operation and maintenance of the water supply treatment plants in Banks Peninsula is carried out under contract CN4600000778: Christchurch City Council Maintenance of City Water and Wastewater Network. Under the maintenance contract Council retains responsibility for the maintenance and renewal of SCADA, RTU and radio assets but all other operations and maintenance required to meet the intent of the New Zealand Drinking Water Standards 2008, or its subsequent amendments, is the responsibility of the maintenance contractor. The Contractor is required to maintain the plant and assets at or above condition grade 3 as assessed using the NZ Infrastructure Guidelines.

The contract cost for the last four years is shown in Figure 8-33 below.

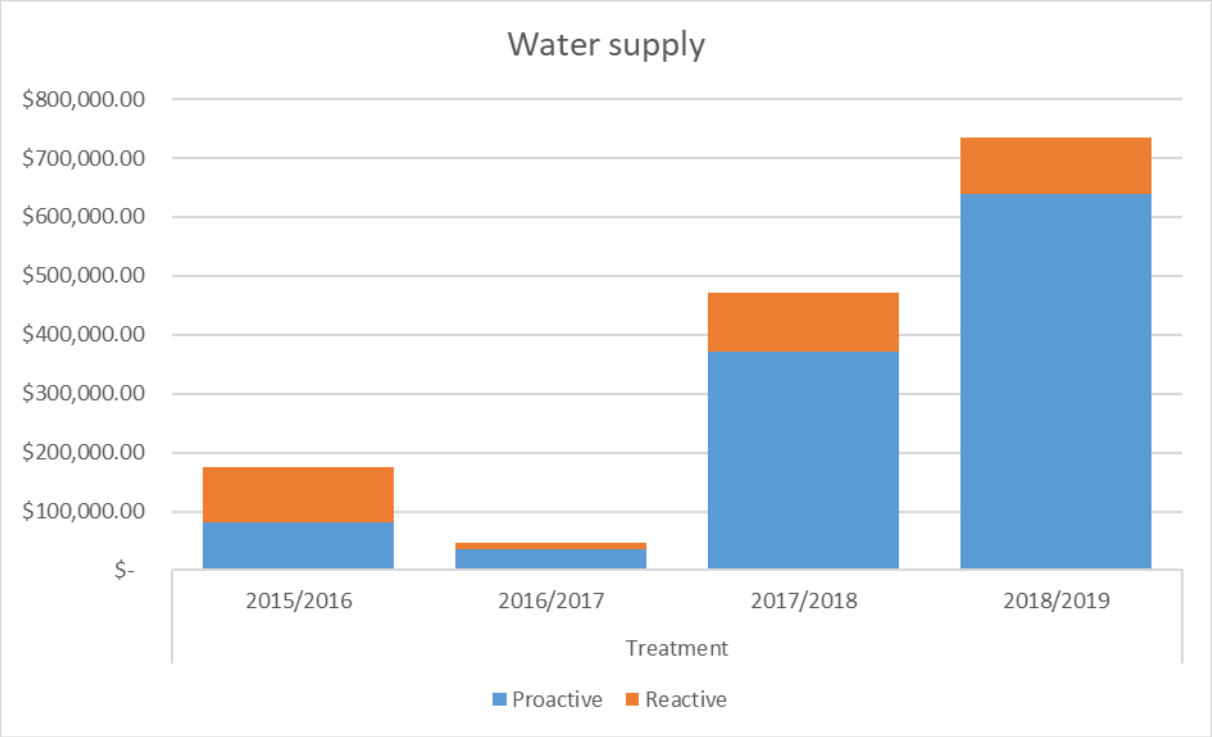


Figure 8-33: Water Supply Treatment Plant Operations and Maintenance Budgets

Operational costs for functions performed by internal Council staff are not included in the figure above.

Reactive Maintenance

Maintenance on the station assets is primarily proactive. Proactive work is needed to ensure water is continually delivered to the required standard. Where identified, treatment asset reactive renewals are now categorised as capital works and are funded from the capital renewal programme budget.

Further work has been identified to formalise the maintenance strategy, basic maintenance requirements, categorisation of maintenance costs and the desired split between proactive and reactive works.

Summary of future operations and maintenance expenditure

The existing maintenance contract is up for renewal and changes in maintenance spend is dependent on the outcome of the review of the contract requirements.

Operational expenditure for a number of improvement areas may sit inside or outside of the maintenance contract and include:

There is also additional OPEX required relating to areas that sit outside of the maintenance contract costs and include:

- Data standards and collection
- Pressure monitoring and management
- Condition assessments. E.g. 5yearly detailed condition assessments
- Asset failure and disposed asset post-mortem

Estimates for these costs are discussed alongside the future OPEX projections within Section 9 Financial.

8.3.9 Treatment assets and disposal plan

No water supply treatment assets have been identified for disposal.

9 Financial projections and trends

This section outlines the long-term financial requirements for the activity based on the long-term strategies and tactics described earlier in the Plan.

9.1 Financial Statements & Projections

The financial statements are in 2020 dollars excluding inflation.

The recommended capital costs presented at the time of writing are based on the requirements of lifecycle asset management, growth and demand drivers, and levels of service (particularly with regard to drinking water safety regulation and Council's Water Safety Plan). Large scale capital programmes in response to disruptors such as climate change are not included in the projections. The strategy to address these is to provide sufficient budget for detailed optioneering and benefit analysis so that these projects can be promoted in the next LTP. The projected costs do not include financial responses to the immediate and long term effects of Covid-19.

Impacts of Covid-19 – short and longer term

Early forecasting advice from economic commentators (e.g. the Treasury, ChristchurchNZ, financial institutions) signals significant economic impacts locally, nationally and internationally. This advice is being updated regularly and is likely to change over time (the Treasury's economic scenarios released in April 2020 caution that economic impacts are "highly uncertain").

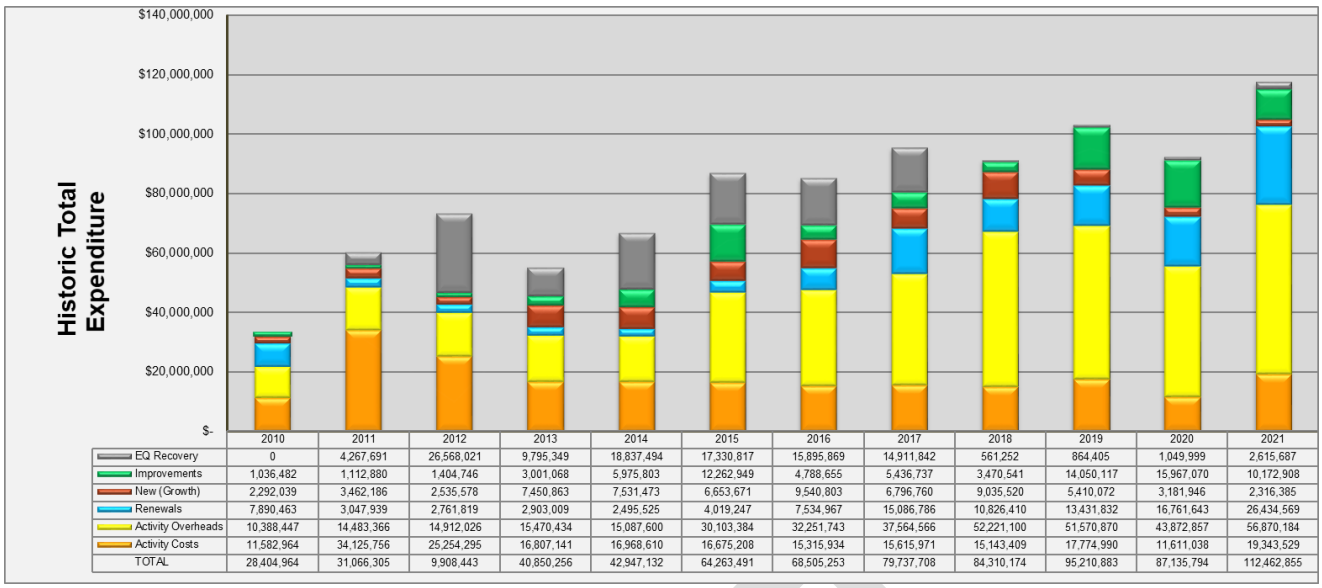
The AMP has been prepared without a prediction of how the Covid-19 crisis will impact the activity. The future response is uncertain, but will undoubtedly be significant for the water supply activity.

Some of the high level possibilities are briefly listed below:

- An initial focus on infrastructure that supports Covid-19 economic recovery and delivers projects critical to the capital programme or identified as part of a central government stimulus package, and completing committed projects.
- Short-term (now, and LTP years 1-3): possible delays in scheduled capital programme works, potential issues with workforce availability/contractor viability following lifting of restrictions; uncertainty about materials supplies; changing priorities for work programming and methodologies (e.g. accommodating the norm of physical distancing). Opportunities for bringing forward 'shovel ready' work and increased financial pressure on Council budgets.
- Medium term (LTP years 4-6): Further consideration of capital works programme in light of the emerging Financial Strategy and Infrastructure Strategy response.
- Longer term (LTP years 6 – onwards): Uncertain at this stage; potentially dealing with the effect of any deferred expenditure due to the above factors.

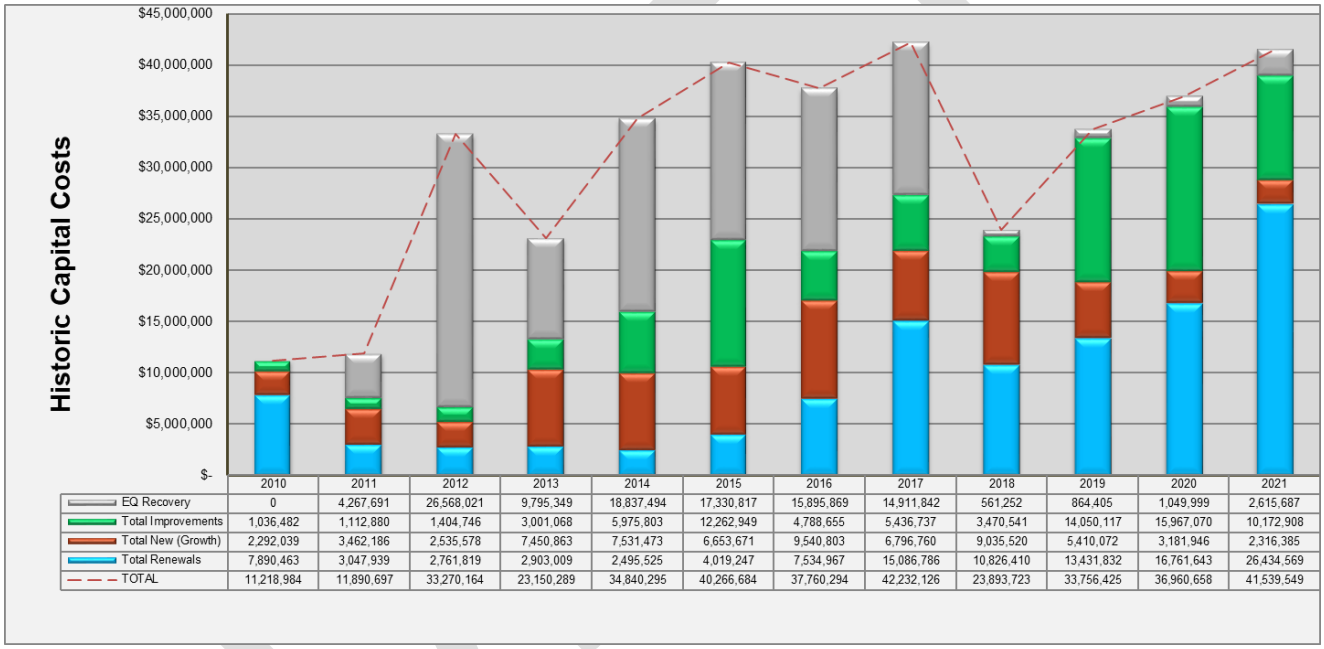
9.1.1 Historical Expenditure

The historic water supply activity expenditure are shown in Figure 9-1. Figure 9-2 and Figure 9-3 show the expenditure split by CAPEX and OPEX respectively.



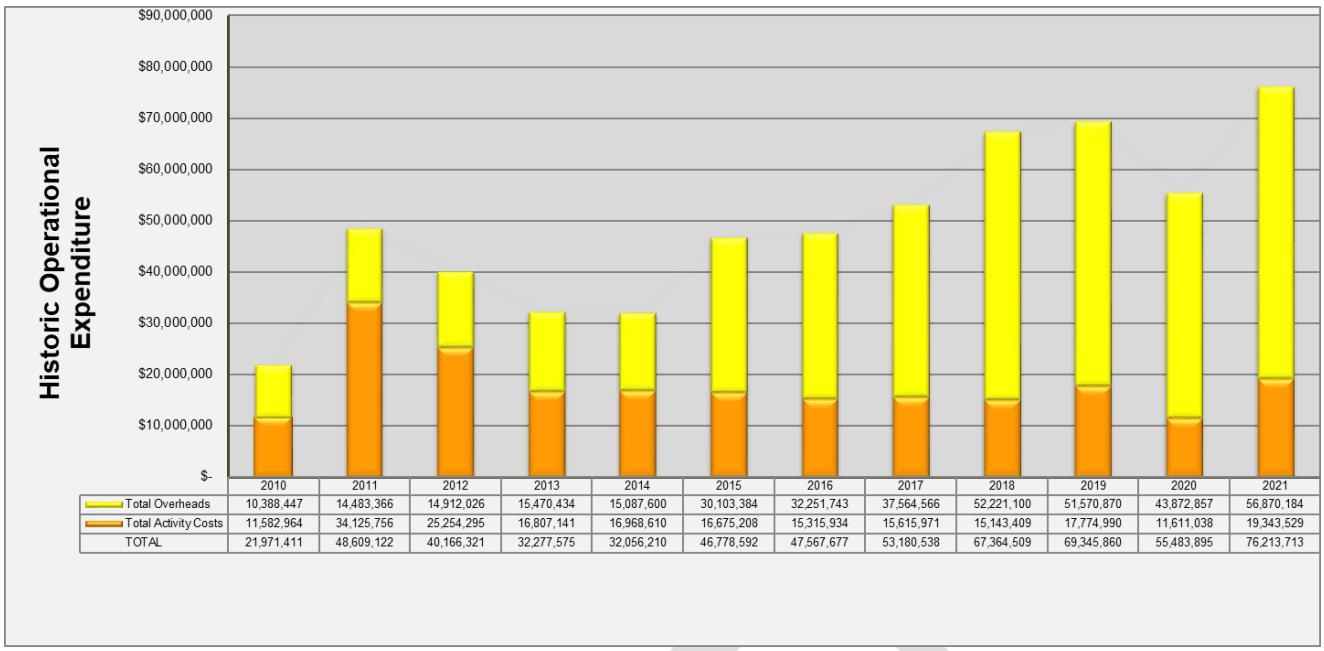
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
EQ Recovery	0	4,267,691	26,568,021	9,795,349	18,837,494	17,330,817	15,895,869	14,911,842	561,252	864,405	1,049,999	2,615,687
Improvements	1,036,482	1,112,880	1,404,746	3,001,068	5,975,803	12,262,949	4,788,655	5,436,737	3,470,541	14,050,117	15,967,070	10,172,908
New (Growth)	2,292,039	3,462,186	2,535,578	7,450,863	7,531,473	6,653,671	9,540,803	6,796,760	9,035,520	5,410,072	3,181,946	2,316,385
Renewals	7,890,463	3,047,939	2,761,819	2,903,009	2,495,525	4,019,247	7,534,967	15,086,786	10,826,410	13,431,832	16,761,643	26,434,569
Activity Overheads	10,388,447	14,483,366	14,912,026	15,470,434	15,087,600	30,103,384	32,251,743	37,564,566	52,221,100	51,570,870	43,872,857	56,870,184
Activity Costs	11,582,964	34,125,756	25,254,295	16,807,141	16,968,610	16,675,208	15,315,934	15,615,971	15,143,409	17,774,990	11,611,038	19,343,529
TOTAL	28,404,964	31,066,305	9,908,443	40,850,256	42,947,132	64,263,491	68,505,253	79,737,708	84,310,174	95,210,883	87,135,794	112,462,855

Figure 9-1: Historic Total Expenditure



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
EQ Recovery	0	4,267,691	26,568,021	9,795,349	18,837,494	17,330,817	15,895,869	14,911,842	561,252	864,405	1,049,999	2,615,687
Total Improvements	1,036,482	1,112,880	1,404,746	3,001,068	5,975,803	12,262,949	4,788,655	5,436,737	3,470,541	14,050,117	15,967,070	10,172,908
Total New (Growth)	2,292,039	3,462,186	2,535,578	7,450,863	7,531,473	6,653,671	9,540,803	6,796,760	9,035,520	5,410,072	3,181,946	2,316,385
Total Renewals	7,890,463	3,047,939	2,761,819	2,903,009	2,495,525	4,019,247	7,534,967	15,086,786	10,826,410	13,431,832	16,761,643	26,434,569
TOTAL	11,218,984	11,890,697	33,270,164	23,150,289	34,840,295	40,266,684	37,760,294	42,232,126	23,893,723	33,756,425	36,960,658	41,539,549

Figure 9-2: Historic CAPEX

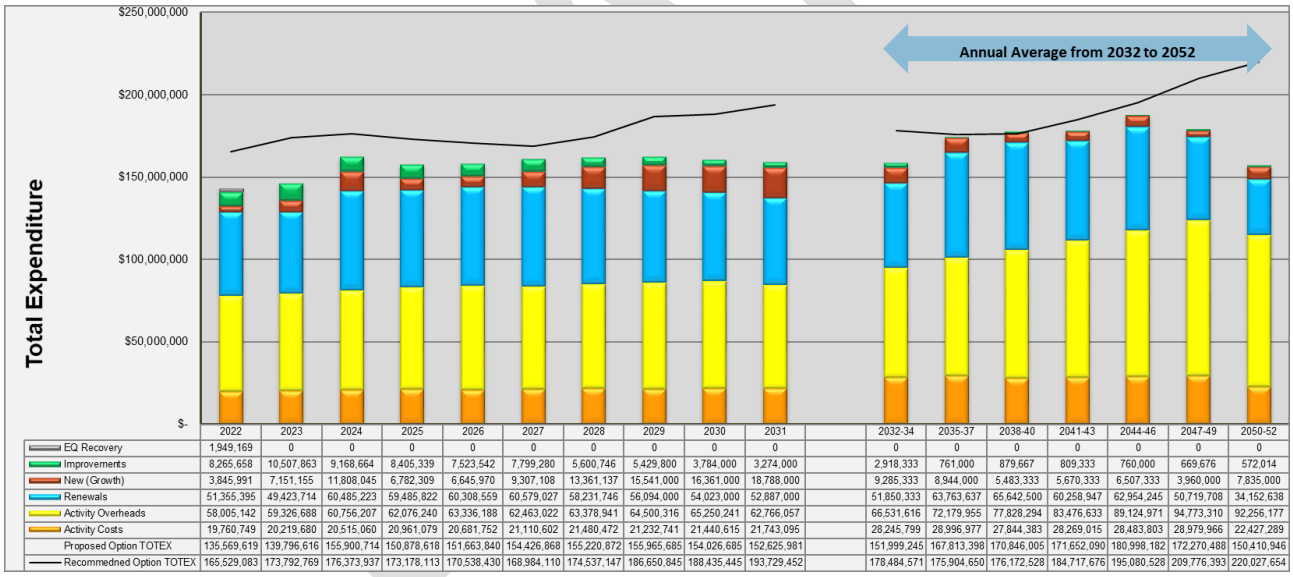


	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total Overheads	10,388,447	14,483,366	14,912,026	15,470,434	15,087,600	30,103,384	32,251,743	37,564,566	52,221,100	51,570,870	43,872,857	56,870,184
Total Activity Costs	11,582,964	34,125,756	25,254,295	16,807,141	16,968,610	16,675,208	15,315,934	15,615,971	15,143,409	17,774,990	11,611,038	19,343,529
TOTAL	21,971,411	48,609,122	40,166,321	32,277,575	32,056,210	46,778,592	47,567,677	53,180,538	67,364,509	69,345,860	55,483,895	76,213,713

Figure 9-3: Historic OPEX

9.1.2 Forecast Expenditure

Future expenditure is forecast in Figure 9-4. This provides a breakdown of expenditure based on the categories listed. The solid bars represent the proposed option and combines the programmes from the various sections of this AMP.



	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032-34	2035-37	2038-40	2041-43	2044-46	2047-49	2050-52
EQ Recovery	1,949,169	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Improvements	8,265,658	10,507,863	9,168,664	8,405,339	7,523,542	7,799,280	5,600,746	5,429,800	3,784,000	3,274,000	2,918,333	761,000	879,667	809,333	760,000	669,676	572,014
New (Growth)	3,845,991	7,151,155	11,808,045	6,782,309	6,645,970	9,307,108	13,361,137	15,541,000	16,361,000	18,788,000	9,285,333	8,944,000	5,483,333	5,670,333	6,507,333	3,960,000	7,835,000
Renewals	51,355,395	49,423,714	60,485,223	59,485,822	60,308,559	60,579,027	58,231,746	56,094,000	54,023,000	52,887,000	51,850,333	63,763,637	65,642,500	60,258,947	62,954,245	50,719,708	34,152,638
Activity Overheads	58,005,142	59,326,688	60,756,207	62,076,240	63,336,188	62,463,022	63,378,941	64,500,316	65,250,241	62,766,057	66,531,616	72,179,955	77,828,294	83,476,633	89,124,971	94,773,310	92,256,177
Activity Costs	19,760,749	20,219,680	20,515,060	20,961,079	20,681,752	21,110,602	21,480,472	21,232,741	21,440,615	21,743,095	28,245,799	28,996,977	27,844,383	28,269,015	28,483,803	28,979,966	22,427,289
Proposed Option TOTEX	135,569,619	139,796,616	155,900,714	150,878,618	151,663,840	154,426,868	155,220,872	155,965,685	154,026,685	152,625,981	151,999,245	167,813,398	170,846,005	171,652,090	180,998,182	172,270,488	150,410,946
Recommedned Option TOTEX	165,529,083	173,792,769	176,373,937	173,178,113	170,538,430	168,984,110	174,537,147	186,650,845	188,435,445	193,729,452	178,484,571	175,904,650	176,172,528	184,717,676	195,080,528	209,776,393	220,027,654

Figure 9-4: Forecast Total Expenditure

The solid line in above show the recommended option to account for deliverability. It includes a provision to accelerate the renewal of assets with a high consequence of failure.

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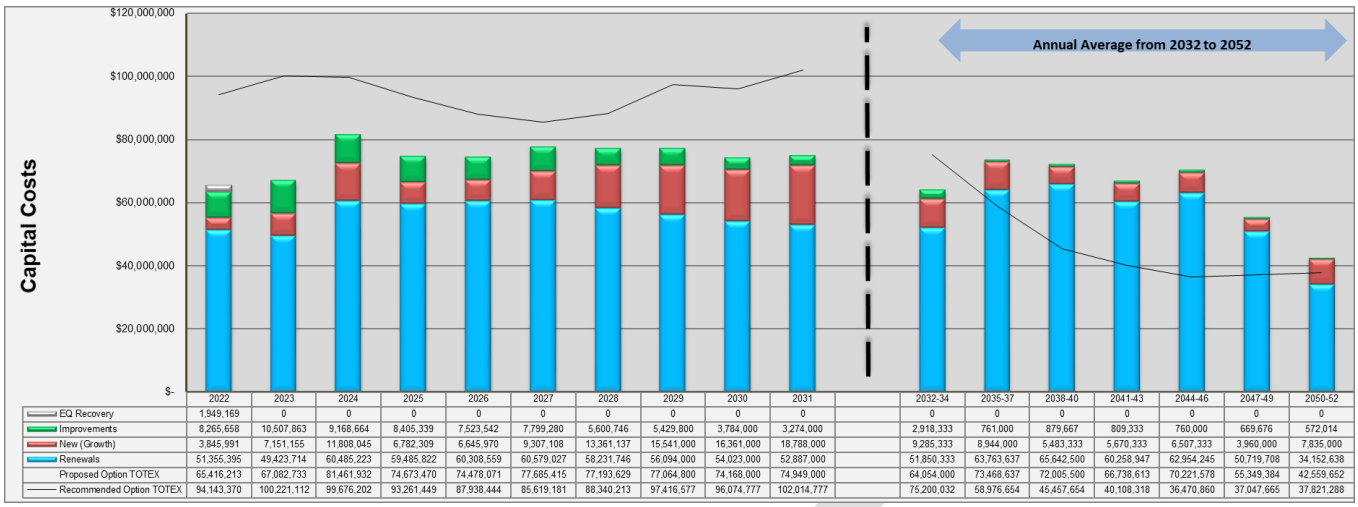
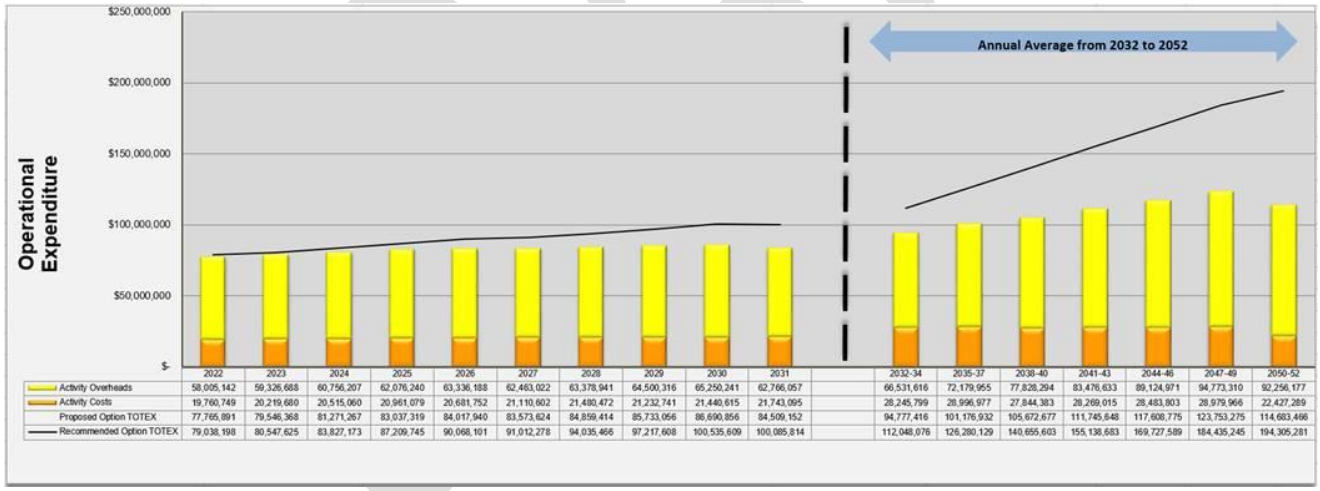


	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032-34	2035-37	2038-40	2041-43	2044-46	2047-49	2050-52
EQ Recovery	1,949,169	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Improvements	8,265,658	10,507,863	9,168,664	8,405,339	7,523,542	7,799,280	5,600,746	5,429,800	3,784,000	3,274,000	2,918,333	761,000	879,667	809,333	760,000	669,676	572,014
New (Growth)	3,845,991	7,151,155	11,808,045	6,782,309	6,645,970	9,307,108	13,361,137	15,541,000	16,361,000	18,788,000	9,285,333	8,944,000	5,483,333	5,670,333	6,507,333	3,960,000	7,835,000
Renewals	51,355,395	49,423,714	60,485,223	59,485,822	60,308,559	60,579,027	58,231,746	56,094,000	54,023,000	52,887,000	51,850,333	63,763,637	65,642,500	60,258,947	62,954,245	50,719,708	34,152,638
Proposed Option TOTEX	65,416,213	67,082,733	81,461,932	74,673,470	74,478,071	77,685,415	77,193,629	77,064,800	74,168,000	74,949,000	64,054,000	73,468,637	72,005,500	66,738,613	70,221,578	55,349,384	42,559,652
Recommended Option TOTEX	94,143,370	100,221,112	99,676,202	93,261,449	87,938,444	85,619,181	88,340,213	97,416,577	96,074,777	102,014,777	75,200,032	58,976,654	45,457,654	40,108,318	36,470,860	37,047,665	37,821,288

Figure 9-5: Forecast CAPEX

Significant renewal funding is required in the first ten year period. This is in response to the poor condition of assets and is exacerbated by the large cohort of assets that were installed at the same time, and where renewals have been historically underfunded.

Figure 9-6 shows a forecast of the activity operational costs. This projection assumes that current operational expenditure remains at a similar level. Projected depreciation is included. The projection also includes an allowance for the future operational and maintenance costs of new infrastructure to be delivered in the proposed capital programme. Operational expenditure to fund the various improvement programmes identified in this AMP are not included in the forecast at this stage.



	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032-34	2035-37	2038-40	2041-43	2044-46	2047-49	2050-52
Activity Overheads	58,005,142	59,326,688	60,756,207	62,076,240	63,336,188	62,463,022	63,378,941	64,500,316	65,250,241	62,766,057	66,531,616	72,179,955	77,828,294	83,476,633	89,124,971	94,773,310	92,256,177
Activity Costs	19,760,749	20,219,680	20,515,060	20,961,079	20,681,752	21,110,602	21,480,472	21,232,741	21,440,615	21,743,095	28,245,799	28,996,977	27,844,383	28,269,015	28,483,803	28,979,966	22,427,289
Proposed Option TOTEX	77,765,891	79,546,368	81,271,267	83,037,319	84,017,940	83,573,624	84,859,414	85,733,056	86,690,856	84,509,152	94,777,416	101,176,932	105,672,677	111,745,648	117,608,775	123,753,275	114,683,466
Recommended Option TOTEX	79,038,198	80,547,625	83,827,173	87,209,745	90,068,101	91,012,278	94,035,466	97,217,608	100,535,609	100,085,814	112,048,076	126,280,129	140,655,603	155,138,683	169,727,589	184,435,245	194,305,281

Figure 9-6: Forecast OPEX

Financial indicators

Financial indicators are provided in Table 9-1. These are based on the IPWEA recommendations and are intended to provide an overview of short, medium and long term implications of funding decisions.

9.1.2.1.1 10 year average funding ratio and shortfall

The 10 year average funding ratio (Ref A) shows the percentage of the total CAPEX and OPEX costs (i.e. those associated with the recommended option) that will receive LTP funding. It is assumed that the recommended option is funded.

9.1.2.1.2 Rate of annual asset consumption and renewal

The rate of annual asset consumption (C) shows how much of the asset stock is being used up each year and is **1.33%**.

The rate of annual asset renewal (D) shows how much of the asset stock is being renewed/replaced in a year and this has been calculated based on the average annual renewal expenditure over the first three years of the LTP. The reason for this is that there is a tendency to push spend out beyond the first three years at each LTP and so by using only the first three years, the ratio is likely to be more realistic than using a longer time period. The rate of asset renewal is **1.87%**, which is **140.8%** the rate of consumption (F). Historically the water supply rate of asset renewal has been lower than the rate of consumption i.e. 'sweating the asset', which yields the current situation where renewal rates are playing catch-up. This is shown in the historic ratio of renewals to depreciation (H2) which was **33.4%** for the last ten years. i.e one third of what should have been spent.

9.1.2.1.3 Rate of annual asset upgrade

The rate of annual asset creation and improvement, or upgrade (E) shows how much is being added to the asset stock each year and is **0.59%.**

9.1.2.1.4 Asset renewal funding ratio

The asset renewal funding ratio (G1-G3) shows the percentage of renewal costs (i.e. those associated with the recommended option) that will receive LTP funding. The ratio has been calculated using the average costs and expenditure over the first three, five and ten years of the LTP period.

- Three year (G3) 69.9%
- Five year (G2) 69.9%
- Ten year (G1) 77.6%

This shows that there are short term renewals funding shortfalls as funding has been pushed out to later years, by the end of ten years the required funding should be available (as long as it is not pushed out again through subsequent LTP's).

9.1.2.1.5 Renewal to depreciation ratio

The renewal to depreciation ratio gives (H1) an indication of whether renewals investment is at an appropriate level and for the ten year period has been calculated as **190%,** which is due to the significant increase in renewals expenditure. While this may look like there is potentially greater investment in renewals than required, the additional renewal funding requirement is partially due to historic underfunding (backlog) and is required to reach a sustainable position. The renewal to depreciation ratio for the previous 10 years (H2) was **33.4%**.

It should be noted that the projected renewal budget for the largest asset group considers the actual deliverability of the renewals over the actual backlog. As discussed in Section 8.1, the backlog has been smoothed over the first 10 years to ensure that there is sufficient time for the initial investigation/design phases to be completed, and the market to "ramp up" for the delivery.

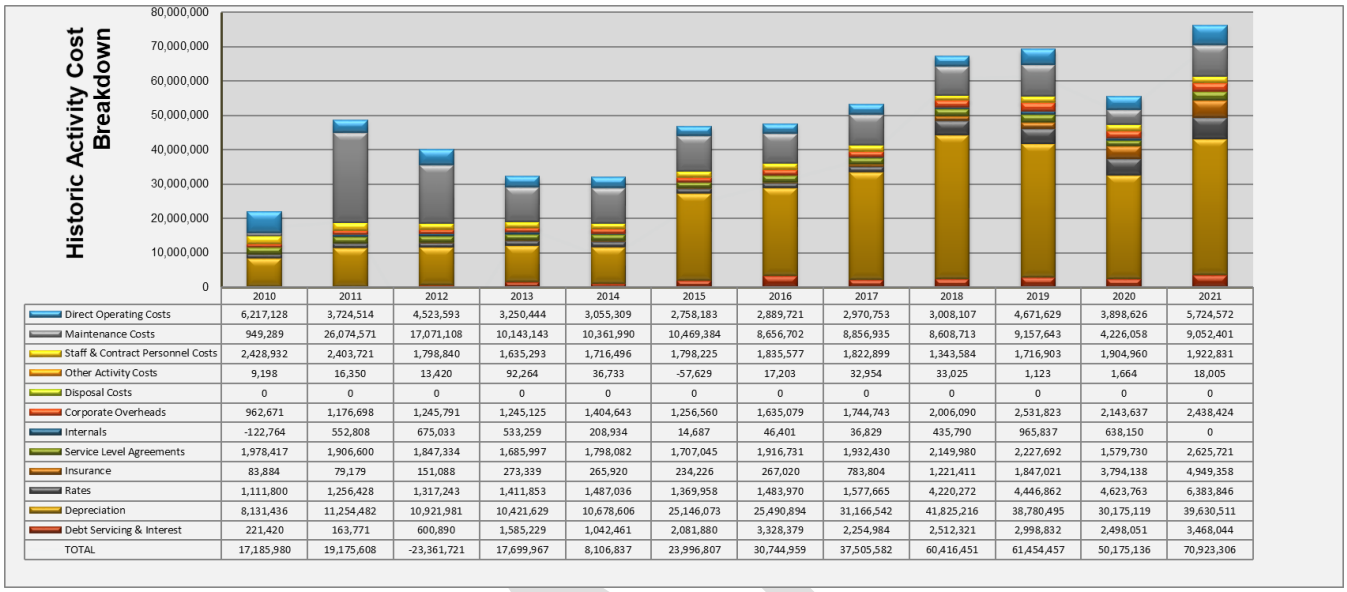
Summary				
Ref	Indicator	Calculation	Description	$ or %
	10 year total **cost**	Projected 10yr total OPEX, CAPEX renewal & CAPEX upgrade costs		$ 1,771,749,330
	10 year average **cost**			$ 177,174,933
	10 year total LTP budget **expenditure**	2021 LTP 10yr total OPEX, CAPEX renewal & CAPEX upgrade budgets		$ 1,506,075,497.7
	10 year average LTP **expenditure**			$ 150,607,549.8
A	10 year total average funding ratio	10yr total average expenditure / 10yr total average cost	Shows percentage of total recommended cost that will be funded	85.00%
B	10 year total average funding shortfall	10yr total average cost - 10yr total average expenditure	Quantifies overall underfunding	$ 265,673,833
Value				
	Current optimised replacement cost (ORC)			$ 2,873,318,000.0
	Depreciable amount	ORC - RV (residual value) - Assumed same as ORC (ie RV -= 0)		$ 2,873,318,000.0
	Optimised depreciated replacement cost (ODRC)			$ 1,614,009,000.0
	Annual depreciation expense (AD)			$ 38,184,000.0
C	Rate of annual asset consumption (AD / ODRC)	Annual depreciation / depreciated replacement cost	How much of the asset stock is being used up each year	1.33%
D	Rate of annual asset renewal (FY2022-2024)	Average FY2022-2024 renewal expenditure / annual depreciable amount	How much of the asset stock is being renewed / replaced each	1.87%
E	Rate of annual asset new+upgrade (FY2022-2024)	Average FY2022-2024 new+upgrade expenditure / annual depreciable amount	How much is being added to the asset stock each year	0.59%
F	Asset renewals as a percentage of consumption	Rate of renewal / rate of consumption	How much asset stock is being renewed vs how much is being	140.78%
Sustainability				
	Asset renewal funding ratio			
G1	10 yr asset renewal funding ratio	10yr renewal expenditure / 10yr renewal cost	What percentage of the 10yr recommended renewal cost will be	77.6%
G2	5yr asset renewal funding ratio	5yr renewal expenditure / 5yr renewal cost	What percentage of the 5yr recommended renewal cost will be	69.9%
G3	3yr asset renewal funding ratio	3yr renewal expenditure / 3yr renewal cost	What percentage of the 3yr recommended renewal cost will be	69.9%
H1	10yr forecast renewals to depreciation ratio	10 yr renewal expenditure / 10 depreciation expenditure		190.0%
Historic trends (2011 to 2020)				
Ref	Indicator	Calculation	Description	2011-2020 $ or %
	Historic 10 year total **expenditure**	Historic 10yr total OPEX, CAPEX renewal & CAPEX upgrade costs (actual)		$ 603,935,439.6
	Historic 10 year average **expenditure**			$ 60,393,544.0
	Historic 10yr average depreciation			$ 23,586,103.7
	Historic 10yr average renewals expenditure			$ 7,886,917.8
H2	Historic 10yr forecast renewals to depreciation ratio	FY2011-2020 average renewal expenditure / FY2012-2021 average		33.4%

Table 9-1: Water Supply Financial Indicators

9.1.3 Expenditure by Service Group

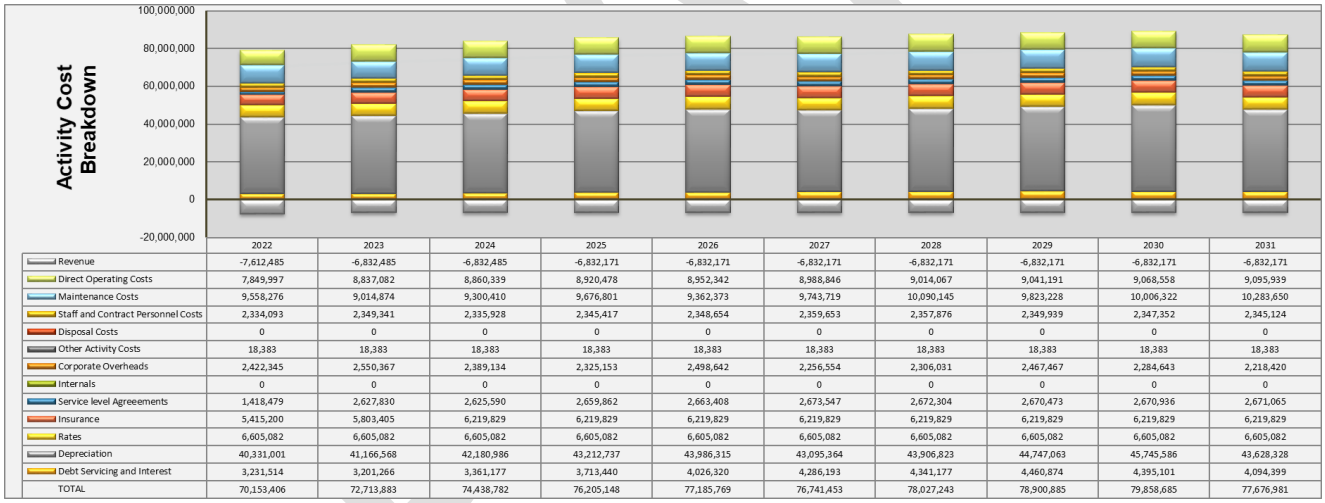
Operations & maintenance expenditure

A more detailed breakdown of the historic and forecast operational expenditure is provided in Figure 9-7 and Figure 9-8. The assumptions, inclusions and exclusions within the OPEX breakdown is as discussed at the start of Section 9.



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Direct Operating Costs	6,217,128	3,724,514	4,523,593	3,250,444	3,055,309	2,758,183	2,889,721	2,970,753	3,008,107	4,671,629	3,898,626	5,724,572
Maintenance Costs	949,289	26,074,571	17,071,108	10,143,143	10,361,990	10,469,384	8,656,702	8,856,935	8,608,713	9,157,643	4,226,058	9,052,401
Staff & Contract Personnel Costs	2,428,932	2,403,721	1,798,840	1,635,293	1,716,496	1,798,225	1,835,577	1,822,899	1,343,584	1,716,903	1,904,960	1,922,831
Other Activity Costs	9,198	16,350	13,420	92,264	36,733	-57,629	17,203	32,954	33,025	1,123	1,664	18,005
Disposal Costs	0	0	0	0	0	0	0	0	0	0	0	0
Corporate Overheads	962,671	1,176,698	1,245,791	1,245,125	1,404,643	1,256,560	1,635,079	1,744,743	2,006,090	2,531,823	2,143,637	2,438,424
Internals	-122,764	552,808	675,033	533,259	208,934	14,687	46,401	36,829	435,790	965,837	638,150	0
Service Level Agreements	1,978,417	1,906,600	1,847,334	1,685,997	1,798,082	1,707,045	1,916,731	1,932,430	2,149,980	2,227,692	1,579,730	2,625,721
Insurance	83,884	79,179	151,088	273,339	265,920	234,226	267,020	783,804	1,221,411	1,847,021	3,794,138	4,949,358
Rates	1,111,800	1,256,428	1,317,243	1,411,853	1,487,036	1,369,958	1,483,970	1,577,665	4,220,272	4,446,862	4,623,763	6,383,846
Depreciation	8,131,436	11,254,482	10,921,981	10,421,629	10,678,606	25,146,073	25,490,894	31,166,542	41,825,216	38,780,495	30,175,119	39,630,511
Debt Servicing & Interest	221,420	163,771	600,890	1,585,229	1,042,461	2,081,880	3,328,379	2,254,984	2,512,321	2,998,832	2,498,051	3,468,044
TOTAL	17,185,980	19,175,608	-23,361,721	17,699,967	8,106,837	23,996,807	30,744,959	37,505,582	60,416,451	61,454,457	50,175,136	70,923,306

Figure 9-7: Historic OPEX details



	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Revenue	-7,612,485	-6,832,485	-6,832,485	-6,832,171	-6,832,171	-6,832,171	-6,832,171	-6,832,171	-6,832,171	-6,832,171
Direct Operating Costs	7,849,997	8,837,082	8,860,339	8,920,478	8,952,342	8,988,846	9,014,067	9,041,191	9,068,558	9,095,939
Maintenance Costs	9,558,276	9,014,874	9,300,410	9,676,801	9,362,373	9,743,719	10,090,145	9,823,228	10,006,322	10,283,650
Staff and Contract Personnel Costs	2,334,093	2,349,341	2,335,928	2,345,417	2,348,654	2,359,653	2,357,876	2,349,939	2,347,352	2,345,124
Disposal Costs	0	0	0	0	0	0	0	0	0	0
Other Activity Costs	18,383	18,383	18,383	18,383	18,383	18,383	18,383	18,383	18,383	18,383
Corporate Overheads	2,422,345	2,550,367	2,389,134	2,325,153	2,498,642	2,256,554	2,306,031	2,467,467	2,284,643	2,218,420
Internals	0	0	0	0	0	0	0	0	0	0
Service level Agreeements	1,418,479	2,627,830	2,625,590	2,659,862	2,663,408	2,673,547	2,672,304	2,670,473	2,670,936	2,671,065
Insurance	5,415,200	5,803,405	6,219,829	6,219,829	6,219,829	6,219,829	6,219,829	6,219,829	6,219,829	6,219,829
Rates	6,605,082	6,605,082	6,605,082	6,605,082	6,605,082	6,605,082	6,605,082	6,605,082	6,605,082	6,605,082
Depreciation	40,331,001	41,166,568	42,180,986	43,212,737	43,986,315	43,095,364	43,906,823	44,747,063	45,745,586	43,628,328
Debt Servicing and Interest	3,231,514	3,201,266	3,361,177	3,713,440	4,026,320	4,286,193	4,341,177	4,460,874	4,395,101	4,094,399
TOTAL	70,153,406	72,713,883	74,438,782	76,205,148	77,185,769	76,741,453	78,027,243	78,900,885	79,858,685	77,676,981

Figure 9-8: Forecast OPEX details

An improvement programme item has been identified to focus on greater categorisation of operational expenditure. This is expected to provide a basis for greater analysis, tracing of significant costs, and increase confidence when forecasting trade-offs between OPEX and CAPEX under different investment scenarios.

Additional OPEX is needed to fund the various improvement programmes identified within this AMP. These are needed to support levels of service, demand, risk and resilience, lifecycle asset management, and financial tracking to ensure value is added through a proactive asset management planning process.

9.2 Funding Strategy

9.2.1 Expenditure Funding Strategy

Funding for water supply activities is primarily sourced from rates, developer contributions (for growth projects) and borrowing. A small amount of funding is through fees and charges. Details of how the activity will be funded are included in the Financial Strategy.

9.3 Assumptions, Risk and Confidence Levels

9.3.1 Key Assumptions and Risk

Assumptions relating to each asset group have been identified under the Lifecycle Management asset group sub-sections.

Valuation data quality is variable. The 2020 asset valuation has been applied wherever possible, however the forecasting of asset replacement costs has required some input from quantity survey professionals and asset engineers to ensure that forecast budgets are sufficient to deliver each identified project. These are described in Section 8 for the three primary asset classes; reticulation, station assets, and treatment assets.

The financial forecasting relies on Council's core asset management system database. The database confidence is generally strong for reticulation assets, lower confidence for station assets and very low confidence for treatment assets. Improvement programmes have been identified to increase the confidence of basic asset data held for stations and treatment assets. Failure data and analysis is also an identified improvement area where improvements will yield a greater evidence base to support future forecasts.

The financial analysis relies on accurately categories costs that can be easily accessed for asset management decision making. This data has been prepared from numerous sources for the purposes of this AMP. The risk of erroneous or incomplete data can be mitigated if data is held centrally and is accessible in real time by decision-makers. An improvement programme has been identified to enable better financial tracking, forecasting and analysis of relationships between CAPEX and OPEX.

10 Continuous Improvement

10.1 Overview of the Improvement Programme

Council has made a strong commitment to the improvement of asset management practices and seeks to further improve the approach. Council acknowledges the need to focus efforts to further asset management practices over the next 2-3 years to an appropriate level of capability.

Council's overall AM improvement process is outlined in the SAMP. This section details the water supply improvement programme.

10.2 Current Asset Management Maturity

An independent assessment of current asset management practice was undertaken in October 2020. Asset Management Maturity Assessments (AMMA) are carried out once every two years.

The baseline maturity assessment was predominantly achieved through onsite interviews, with a good cross-section of participants. Future maturity level was also set based on appropriate best practice and considering the agreed business drivers. Strength and opportunities for improvement are summarised alongside the results to acknowledge the baseline achievements.

The appropriate level of AM practice for this Activity has been defined in our AM Policy as 'Intermediate or advanced level for most functions'. Summarised scores are shown in Figure 10-1.

A summary of the assessment results and improvement activities required to achieve greater maturity in asset management systems, culture and decision making is provided within section 10.4.

Figure 10-1: Asset Management Maturity Assessment for water supply

The maturity assessment shows that:

- Small improvements have been made between 2018 and 2020
- The greatest areas of improvement have been in:
    - Management Systems
    - Asset Information Systems
- No progress has been made in:
    - Asset register data
    - Decision making
    - Operational planning and reporting
    - Financial strategies
    - Service delivery models
- Progress in the stagnant categories above can be made with additional resourcing and effective problem solving regarding data issues. A systematic approach would consider data definition, capture, handling, storage, ownership and specified end use. The end goal would be improving decision making (both current operational and future life-cycle needs), presenting useful financial reporting and forecasting, and quality assurance.

10.3 Review of Progress against Previous Plan

The last improvement plan was developed as part of the 2018 AMP update. The indicative term of the improvement programme was three years. **Error! Reference source not found.** provides an update on the status of the improvement p rogramme items as at January 2021.

In addition to the items within the improvement programme, the following improvements have been made to the activity since the last AMP:

- 3 Waters maintenance tracking dashboard
- Maintenance contract improvement programme (service information overhaul)
- The Asset Assessment Intervention Framework (AAIF) for reticulation assets; Further development of decision-making processes and data capture will leverage the work completed so far within the AAIF project.

Task ID	Action/Task	Timeline	Progress
2-1	Formalise and document the process for developing levels of service. The process needs development, sign-off and documentation into ProMapp. Following documentation dates for levels of service sessions and workshops should be added to the corporate calendar as part of the AMP and LTP processes.	TBC	Not complete
2-2	Develop systems to effectively monitor real-time performance in relation to approved service plans. This may include developing dashboards to show progress in the year to date.	TBC	Not complete
2-3	Develop and document procedures for reconciling levels of service, price projections and demand projections.	FY19 improvement plan.	Not complete
3-1	Development of a hydraulic modelling strategy that aligns Council with New Zealand best practice standards in three-waters modelling, with a view on how modelling can be better delivered now and in the future to improve efficiencies and to drive cost-saving benefits.	FY19 improvement plan.	Complete
3-2	Implement the actions from the hydraulic modelling strategy. Depending on the contents of the strategy this may include: 1. Update the Christchurch City water supply network model; 2. Create a Banks Peninsula water supply network model; and 3. Calibrate all models.	TBC	Not complete
4-1	Document the process to Improve data capture for repairs to 3-Waters networks, including how data is captured by the contractor and how it is stored and accessed in current systems. In order to enable automation of validation consider FME as middleware with the B2B. Recommendation to enable for all Business Units.	TBC	Partially complete for water supply reactive repairs.
4-2	Develop and document a process to transfer asset condition assessment information from Contractor systems into the AMIS via the B2B interface. The process will ensure all condition and performance assessment scores are stored against the correct assets and allow for transfer and storage of associated inspection documentation.	TBC	Not complete
4-3	Asset Assessment Intervention Framework – Stage 1 Develop a multi-criteria decision making framework for renewals planning including determining when an asset should be renewed and the priority of each renewal project. 1. Determine criteria for the decision making framework based on chosen schema from the NZ Metadata Standards. Schema to be chosen based on relevance to the network, availability of information, ease of implementation and cost effectiveness. 2. Develop and implement a methodology for calculating scores for each criteria. Depending on the criteria this may involve review of failure modes, causes of failure, deterioration curves, number of customers affected, importance of individual customers 3. Develop a weighting multiplier for each criteria. 4. Create locations in the AMIS for the individual criteria scores, overall score and planned renewal dates to be retained and displayed. 5. Document all steps 1 to 5.	Timeline to be calculated in re-planning sessions 29/08/2018 and 05/09/2018.	Complete and working Further refinement ongoing
4-4	Asset Assessment Intervention Framework – Stage 2 Apply AAIF criteria from Improvement Item 4-3 to transport assets. This may include re-development of schema criteria or inclusion of different schema.	TBC. Follows item 4-3.	Not complete
4-5	Asset Assessment Intervention Framework – Stage 3	TBC. Follows item 4-4.	Not complete

	Apply AAIF criteria from Improvement Item 4-3 to facilities and parks assets. This may include re-development of schema criteria or inclusion of different schema.		
4-6	Asset Assessment Intervention Framework – Stage 4 Apply AAIF criteria from Improvement Item 4-3 to three waters and waste station and headworks assets.	TBC. Follows item 4-5.	Not complete
4-7	Asset Assessment Intervention Framework – Stage 5 Expand on previous AAIF stages to include additional schema, refine existing schema, refine weightings, improve reporting and rectify any other issues identified.	TBC. Follows item 4-6.	Not complete
4-8	Integrate operational data from SCADA systems into the AMIS. Integration may occur via Water Outlook or another system. 1. Identify what data from SCADA would be useful to a wider audience (e.g. pump run hours, motor start numbers, power usage, etc.); 2. Identify which historical SCADA alarms would be useful to a wider audience; 3. Create measurement points in SAP for the operational data and alarms; and 4. Migrate data from SCADA to SAP; Requirements are/shall be documented in TRIM 15/212387 AMT - CCC SCADA Data Governance Standards - Business Needs & Data Standards - Rev 1.	TBC	Not complete
4-9	Resilience Modelling & Earthquake Event Network Analysis. Investigate which stations are fitted with flexible joints, earthquake valves or other resilience promoting assets. Model the Likely Effects of Earthquake Events on Current Network and Impact to LOS. This may include incorporating the results of external earthquake models from consultants such as the BECA snapshot. Models will need to be reviewed against actual results from the 2011 earthquake events.	TBC	Not complete
4-10	Develop a 3W Project Renewals Standard Operating Procedure (SOP) and Checklist. The business requires a quality assurance framework to ensure that all of the information and requirements utilised to generate the LTP Capital Programme are based on current data and meet Council requirements. It will ensure all aspects have been taken into account when compiling renewal programme project briefs to inform the LTP. These need to ensure the future horizon is accounted for.	TBC as part of the FY19 improvement plans.	Partially complete using AAIF and Infonet
4-11	Renewal Decision Improvements. Ongoing support and engagement across new technologies and projects which link to improved renewal decisions and insights, e.g. UC Quake Centre; AAIF; Resilience Programme; Transient Flow Meters; Pipe Sonar Technology. Continue supporting and working with UC Quake centre to deliver the evidence based investment decision making for 3 waters pipe networks. i.e. Network resilience assessment and improvement opportunities; National pipe database.	TBC	Not complete
4-12	Develop a process for identifying and recording assets that potentially are health and safety risks. This will enable planning for health and safety improvement budgets.	TBC	Not complete
4-13	CWW Treatment Plant Efficiencies. To develop and implement improved maintenance management and inventory (stores) work-flow processes supported by SAP for effective asset management within WTPs and WWTPs. There is a significant amount of upskilling required in SAP usage, process application and data management quality.	TBC	Not complete
5-1	Develop and document a process for defining risk scoring for individual water supply assets following the corporate risk policy. Risk scores for each asset to be entered and stored in appropriate Council systems.	TBC	Not complete
5-2	3W AAIF Risk Assessment of Critical Assets 1. Perform risk assessment of 3W critical assets / infrastructure in alignment with corporate risk prioritisation tools and store the risk value ascertained within the appropriate system (Promapp). 2. Develop risk mitigation strategies for all critical assets and infrastructure with elevated risks as determined in 1. 3. Ensure staff responsible for completing the risk mitigation strategies in 2 are aware of requirements. Implement KPIs and reporting for high risks	TBC	Not complete

6-1	Develop procedures for reconciling Levels of Service and Price Projections with Demand Projections. (1) Document current method of determining cost of providing each Group of Activity (GOA) (2) Produce reports and or dashboards for unit costs at activity level and also key facilities level.	TBC	Not complete

Table 10-1: Progress against 2018 Improvement Plan

10.4 Improvement Plan

The starting point for the 2021 Improvement Plan is the recent Asset Management Maturity Assessment 2020 which identified priority areas for improvement for 2021 through to 2024. Summary of the AMMA 2020 is provided in below.

Section	Current/ Target		Reason for scores 2020	Improvement actions planned or underway
AM Policy and Strategy	85	95	Corporate AM Policy and Strategic AM Plan in place, provides key principles, objectives, corporate AM improvement path, framework for AM planning. Strategic context analysis is thorough and documented in Water Strategy, IS, AMP and Activity Plan. Strategic priorities are well embedded with good alignment through to AMP and Activity Plans.	Advancing asset management programme. Continue to build strategic alignment into AMP programmes. Update AM Policy and Objectives.
Levels of Service	85	90	The levels of service and performance framework is aligned to strategic objectives and customer expectations and well measured, reported and benchmarked. There is a general understanding of customer and stakeholder needs, and there is engagement with Council over level of service and cost trade-offs. However, there is still a reliance on the community satisfaction survey and LTP /IS consultation as the means of customer engagement. It has been many years since there was wider community engagement	Re-engage with community around level of service options (beyond 'document submissions' processes). Further enhancements to network models and AAIF will support ongoing improvements in level of service and cost discussions.

Section	Current/ Target		Reason for scores 2020	Improvement actions planned or underway
			over levels of service and willingness to pay. The ability to link key levels of service and cost is strengthening as modelling (both capacity and condition) progresses. There are some improvements needed to operational performance measures, but that aspect is covered under 'operational planning'.	
Forecasting Demand	**85**	**95**	Water demand is planned at a city wide, supply zone and asset level. Demand is monitored and future demand is mapped for each water supply zone. Water supply zones are being rezoned and pressure management implemented to maximise value from supply, increase resilience and better manage demand. Various demand scenarios have been modelled (demand report 2020). Growth related projects have been identified.	Demand management initiatives. Operational demand management and control.
Asset Register Data	**80**	**95**	There is a robust core dataset for reticulation assets and wells, with data quality improvements for reticulation recently being driven by AAIF. Data quality dashboards are being established to be able to monitor data quality and easily identify remaining gaps. Work is required to establish an up-to-date dataset for stream intakes and water treatment plants. Data management processes are developed, but more work needs to be done to manage and enforce data quality coming into the organisation. Assignment of data owner/steward responsibilities has been a good step. Quality and timeliness of data for vested assets has improved.	Asset data validation - stream intakes and treatment assets. Bring wells data into the corporate system. Continue development of data quality monitoring/data improvements through data quality dashboards. Review and audit processes for incoming data sources and implement improvements.
Asset Performance/ Condition	**75**	**90**	Condition is estimated based on material type, pipe breakages and age and data is being validated with sampling following breaks. Performance data is collected via monitoring (SCADA) and modelling. Condition and performance deterioration models are part of AAIF for reticulation assets. A detailed assessment of reservoirs has recently been completed. There is a well-established history of reactive maintenance performance and cost and an improved process for transferring performance, works and cost data from contractor data Council systems. Dashboards have been developed to support performance monitoring, including contract KPIs.	Ongoing management and update of network models. Implementation of updated communication and control technology.
Decision Making	**80**	**90**	Formal decision-making processes are applied to major projects and programmes - business cases are used to justify the financial and non-financial benefits of projects. Options are evaluated using a Council framework. CAPEX projects are captured and prioritised against decision criteria (aligned to Council priorities) in the CPMS. See also CAPEX planning re: AAIF/ renewal decisions.	See capital planning.
Managing Risk	**85**	**95**	The Council risk policy and framework is well established and regularly updated. Regular risk reporting on 'management-level risks' in Promapp, reported to the Audit and Risk Committee and work has been done to align these with more	Complete assessment of 'resilience' against disasters for earthquake, tsunami, coastal, storm (risk analysis, mitigation programmes).

Section	Current/ Target		Reason for scores 2020	Improvement actions planned or underway
			detailed risk assessments done for water safety plans. Resilience section of AMP is new with stronger coverage of 'shocks/disruptors' risks and GIS hazard mapping is being used to improve understanding of hazard-related risks. The AMP Risk section summarises high risks and mitigation measures. Criticality/risk ratings have been applied to reticulation assets and used to prioritise renewals (AAIF).	Application of critical framework to assign asset criticality rating. Noted that Risk team are also progressing other recommendations from Deloitte risk review 2019.
Operational Planning	**85**	**95**	The networks are remotely monitored, intervention levels are defined, and corrective actions implemented. A significant review of operations and maintenance practices has been part of the water safety planning process with a much higher level of monitoring required. AAIF identifies risk-based inspection frequencies for pipes. There has been a focus on getting better monitoring and control of contractor operational activities and costs. Emergency management plans, and procedures for specific operations events (e.g. contamination) are in place but the emergency plan needs ongoing review and exercising.	Develop, implement 'Smart Network' strategy to support optimisation of network operations. Continue pump station maintenance review. Continue AAIF programme to inform 'optimised' inspections and maintenance programmes. Emergency management plan review/exercise programme.
Capital Works Planning	**90**	**95**	See decision making, plus. Capital projects and programmes managed in accordance with CPDF and projects tracked in CPMS. A 10-year (AMP/LTP) and 30-year (IS) CAPEX programme is in place. Renewal programmes for reticulation are based on age/condition/life/performance/cost (AAIF). Water network models are the basis for growth and level of service CAPEX programmes.	AAIF enhancements and expansion to non-retic assets.
Financial Planning	**80**	**90**	10- and 30-year financial forecasts are developed with supporting data confidence information to inform reliability of forecasts. A good financial overview is provided in the AMP, supported by detailed programmes in the lifecycle section covering how the finances were developed and the key assumptions and risks. Revaluations occur regularly - the most recent one seeing a significant increase in value (partly arising from application of actual rather than contracted rates). Funding/level of service scenarios are being presented to Council as part of LTP process. There has been more focus given to unit rates-based development of OPEX forecasts and calculation of 'consequential OPEX', however these still get 'disconnected' from CAPEX discussions for LTP budgeting. A 3-waters financial data framework project aims to better align financial and asset data structures to provide better lifecycle cost analysis and asset financial reporting.	Continue three-waters financial data framework to support asset lifecycle cost analysis and financial reporting.
AM Leadership and Teams	**85**	**90**	The organisational structure for asset management has embedded. AMU lead the consistent approach to AM across Council. There are council wide AM communications on AM through SharePoint and forums and this has been an area of improvement. AMU has developed an AM competence framework,	Continue to use opportunities to grow understanding and improve 'AM System' - i.e. how various Council teams work together to deliver good AM outcomes.

Section	Current/ Target		Reason for scores 2020	Improvement actions planned or underway
			but this has not been applied to individual roles or job descriptions. Generally, AM practice is becoming more standard Council language and culture.	Contine AM working group/s to support shared learnings and knowledge. Review staff/team capabilities against AM competence framework to identify capability development needs (training, mentoring, etc).
AM Plans	**85**	**95**	The AMP is a significant improvement on the one presented for the last review (which was incomplete). It is supported by strong data and analysis noted in other elements of this maturity framework. It contains all the required elements of an AM Plan, is well written and supported by good information. The process for AMP was collaborative with involvement from key support areas such as risk/resilience and strategic planning. There could be some streamlining between Activity and AMP content considered before the next LTP.	Review relative content, timing, scope of AMP and Activity Plan prior to next LTP. Robustness will improve as the AM improvement plan is further implemented.
Management Systems	**65**	**85**	A Quality Management Framework has been developed and a QMS role has been recruited to progress development of this. Processes are well established and documented for many corporate processes such as capital delivery and risk. Since the last review, AMU has reviewed/improved some critical AM processes including asset handover and disposals. AMU is supporting a more formal process to assist activities prioritising 'critical AM Processes' and reviewing/improving the highest priority ones, this is being progressed as part of the QMS.	Continue QMS implementation and prioritised development, documentation and monitoring of critical AM processes.
AM Information Systems	**85**	**95**	Several systems are in place to support the business needs for asset information - SAP, Infoasset, GIS, AAIF, hydraulic models. Data warehousing shares information between corporate systems. GIS Smartmap and Power BI tools (dashboards) are changing the way that staff interact with the information systems making it much easier to consume data and information. AMU has established a number of standardised asset and data quality reporting tools across the business, Waters have supplemented this with some to meet their own specific needs. Better financial analysis and reporting tools are still required.	Continue implementation of B2B and BI tools to support integrated, easy access to information. Asset Information Strategy.
Service Delivery Mechanisms	**75**	**90**	New Council procurement rules have been developed and are being implemented as contracts come up for renewal. Core operations functions have been defined and external contracts developed and procured following Council's procurement policy. A big focus has been better oversight, control and visibility of contractor activity. Hybrid delivery model for capital - (consultant panel). New AMP section provides a documented basis for service delivery/procurement approach.	Continued focus on improving oversight and control of contract operational activities. Ensure AM requirements are built into new contract/s.

Section	Current/ Target		Reason for scores 2020	Improvement actions planned or underway
Audit and Improvement	**80**	**90**	A business improvement programme was developed following the first maturity assessment in 2016 and a water industry benchmarking process. An updated improvement plan was developed in 2018 but only limited funding was provided. Three major projects (risk, Quality Management Framework, maintenance contract review) are monitored through the corporate AM improvement programme led by AMU. Reporting on this programme is via AMGB. Other improvements are a lower priority and progress as BAU as time permits.	Establish KPIs to monitor AM improvement - AMMA results are appropriate but consider more detailed targets such as data quality and completeness, % reviews of AM processes.

Table 10-2: AMMA Results 2020 for Water Supply

The improvement focus areas are:

1. Asset inventory, condition assessment and failure data improvement programme
2. Financial tracking, forecast and relationships improvement programme
3. Demand management improvement programme
4. Integrated master planning improvement programme
5. Climate change response improvement programme
6. Level of service and customer engagement improvement programme

Asset management improvements can also support the following existing improvement programmes within the water supply activity:

7. Water safety plan improvement programme
8. "Smart" technology improvement programme

Improvement programme	**Asset inventory, condition assessment and failure data improvement programme**
Scope	Targeted data capture strategy for vertical assets to improve completeness and confidence of asset inventory, with a specific focus on treatment assets. Condition assessment of critical or high value assets for stations and treatment plants to inform renewal programmes. Condition assessment of pipes where evidence will help refine AAIF criteria for applying condition scores (AC and CI). Asset failure and disposed asset post-mortem to understand failure mechanisms and verify condition grading. Improve failure data capture and handling to strengthen the connection between historical failure performance and proactive renewal/maintenance strategy.
Issues addressed	Incomplete asset register, particularly for vertical assets with many treatment assets missing from the register or without installation dates. Poor information on the condition of vertical assets, which presents a risk particularly for critical or high value assets. Condition assessment of pipes is primarily based on age and material and requires ongoing validation. Failure data is not always captured in a manner where it can be analysed across the portfolio to aid decision-making.
Benefits	Increased confidence in decision making around risk management, maintenance strategy, condition management and renewal intervention.
Resourcing	1 x FTE with skillset engineer/asset manager/analyst for system improvements

	Condition assessment experts for both vertical and horizontal assets to carry out the targeted inspection programme.
Budget	$100,000 (1xFTE) for system improvements and programme overview; $400,000 per year for reservoir and suction tank inspection, expand programme for pipe condition testing and failure post mortem, $150,000 data collection.
Timeline	Intensive 2 years, then ongoing

Improvement programme	**Financial tracking, forecast and relationships improvement programme**
Scope	Require TOTEX (combined CAPEX and OPEX) estimation at all stages of a project. Provide templates for generating these TOTEX estimates Overhaul how OPEX costs are categorised to allow greater analysis of decision making impacts Develop a live and "BAU" method for the financial reporting that carried out as one-off as part of the AMP writing process. Create tools to make financial analysis more accessible and reliable for asset managers
Issues addressed	OPEX impacts are not always taken into account when projects are promoted and then put into service. Poor visibility on where OPEX is being directed and how effective it is over the long term to achieve desired outcomes. The financial analysis and reporting that is required as part of the AMP process is pulled together for a one-off process, is inefficient and lacks clarity.
Benefits	Measuring the combination of CAPEX and OPEX together to support effective financial decisions. Give decision-makers the visibility of clear financial data as evidence to support asset management strategy. Reduce the inefficiency and risk of error when pulling together financial data for AMPs.
Resourcing	Change programme champion (internal): staff time. Staff buy in from City Services, Finance, IT and PMO. Potential: (external) advisors, analyst, project manager
Budget	$200,000 (2xFTE)
Timeline	12 months

Improvement programme	**Demand management improvement programme**
Scope	Proactive demand management, beginning with strategy and quantifying the most useful areas to target. Determine the off-set cost of infrastructure that is not needed if demand is reduced. Set milestones to reach the Level of Service targets for reduced average and peak demand. Determine options for leak detection and reduction and leverage these existing budgets. Determine options for managing demand via "Smart" networks and leverage these existing budgets. Identify new bulk metering sites required to support accurate demand calculation and management.
Issues addressed	Infrastructure is sized to deliver peak flows. Infrastructure costs can be avoided by reducing the peaks through demand management. There is no overarching demand management strategy that sets clear goals, and tactics. Effort is needed to determine where the most cost effective demand management techniques can be applied. Peak water supply demand surges in Summer as high as 552 litres per person per day[7] (l/p/d), compared to the average daily flow of 209 l/p/d. The estimated leakage rate for the water supply network is 23%.

[7] February 2020 Newsline update : https://newsline.ccc.govt.nz/news/story/christchurch-facing-water-restrictions-as-demand-surges

	Quantitative demand forecasting currently does not include allowances for different demand scenarios and is done using only population growth prediction.
Benefits	A strategy for demand management provides a starting point and clear direction. Quantifying the need for demand management sets out the costs and benefits. Reducing demand can defer new infrastructure that would otherwise be needed to meet capacity Reducing demand can reduce running costs for pumping and treatment Reducing demand can reduce pressure on source water sources Reducing leakage demonstrates public health protection through a well contained reticulation network
Resourcing	1 x FTE with skillset engineer/asset manager/analyst
Budget	$100,000 per year for 4 years ($400,000 total)
Timeline	4 years

Improvement programme	**Integrated master planning improvement programme**
Scope	To create a high level infrastructure master plan that sets out strategy for main supply, conveyance, treatment and disposal zones. To make clear which long term infrastructure solutions are preferred. To integrate master plan priorities when projects are promoted for other reasons, such as renewals.
Issues addressed	Projects can be promoted in isolation which misses out on delivering co-benefits or helping address long term issues.
Benefits	Combine growth, level of service and renewal needs into one integrated master plan
Resourcing	Freeing up time and providing support labour to Team Leader Asset Planning WWW
Budget	$100,000 (1xFTE) to support planning team who is the owner of this programme
Timeline	12 - 24 months

Improvement programme	**Climate change response improvement programme**
Scope	Develop and begin to implement a strategy to mitigate and adapt to climate change specifically for the water supply activity. Set clear goals, identify options and identify the costs and benefits. Develop a long term strategy for supplying water to land areas exposed to rising sea and groundwater level.
Issues addressed	Council has declared a climate change emergency however a clear strategy is needed to ensure that the most significant impacts to the water supply activity can be planned for. Decisions regarding climate change require financial support and have long term service impact so require a robust decision-making process. The strategy and planning needs to be done now so that the any specific responses that require CAPEX support can be promoted in the next LTP.
Benefits	Clear direction to meet Council's climate change commitments. Ensure quality decisions are made responding to climate change mitigation and adaption impacts to the water supply activity. Get the groundwork complete so that any specific responses can be promoted.
Resourcing	1 x FTE with skillset engineer/climate change impact
Budget	$100,000 (1xFTE) to support planning team and asset management team
Timeline	12 months

Improvement programme	**Level of service and customer engagement improvement programme**
Scope	To engage with customers to ensure that levels of service expectations align with community values. To determine and then carry out various methods of engagement; e.g. customer stakeholder group, survey, workshop, level of service training, representation.
Issues addressed	The last detailed customer research that was carried out for water supply levels of service was over 20 years ago. Informed perspectives of water supply customers are essential for setting levels of service targets and long term programmes.

Benefits	To ensure alignment between the views of water supply customers and the decisions made regarding water supply costs and levels of service
Resourcing	1 x FTE with skillset in community engagement/customer relations. Internal support from asset management/planning
Budget	$100,000 (1xFTE), part time staff commitment from asset management/planning
Timeline	Ongoing

Improvement programme	**Water safety plan improvement programme**
Scope	Section 3 identifies that $20M is needed to support the water safety plan improvements. Asset management team resources will be required to support these improvements.
Resourcing	Asset management team staff time
Timeline	Ongoing

Improvement programme	"Smart" technology improvement programme
Scope	Section 3 identifies that $10M is needed to support the water safety plan improvements. Asset management team resources will be required to support these improvements.
Resourcing	Asset management team staff time
Timeline	Ongoing

Summary of the above improvements are provided in Table 10-3 below.

Project / Task	AM Maturity Gaps	Priority (H, M, L)	Responsibility	Resources (teams, $)
Asset inventory, condition assessment and failure data improvement programme	Data, lifecycle asset management	H	Asset management	Up to $1M / yr
Financial tracking, forecast and relationships improvement programme	Data, lifecycle asset management, financial	H	Asset management	$200k / yr
Demand management improvement programme	Demand, data	M	Planning	$100k / yr
Integrated master planning improvement programme	Demand, lifecycle asset management	M	Planning	$100k / yr
Climate change response improvement programme	Risk and resilience	M	Planning	$100k / yr
Level of service and customer engagement improvement programme	Levels of service, financial	L	Service delivery	$100k / yr
Water safety plan improvement programme	Regulation, risk, levels of service	H	Asset management team support	Staff time
"Smart" technology improvement programme	Demand, data	M	Asset management team support	Staff time

Table 10-3: Asset Management Improvement Programme Summary

10.5 Resourcing the improvement programme

The activity requires resources and budget to deliver the improvement plan tasks. To date commitment has not been made which is demonstrated in the level of progress made to the improvement items from the 2018 AMP. For any significant improvement to be achieved in the activity to improve the data quality and confidence as recommended as

well as improve the business structure to increase the level of maturity, a greater commitment (change in existing workloads, increase in FTE's, change to corporate priorities etc.) is required to meet the indicative completion dates shown in the improvement programme.

In an effort to drive these business improvements, a project has been created within the CPMS system which is to be funded by OPEX to deliver the costs items contained in Table 10-3 above.

Given the pressures on Council to deliver a zero rates increase coupled with the economic effects of the Covid-19 emergency, it is likely that across Council, a prioritisation will be required for the delivery of all the improvement items. The prioritisation exercise will be required to ensure the highest priority items are delivered first and that future delivery costs are understood, and sufficient budgets allocated within the LTP.

The LTP process will determine budgets for delivering the improvement tasks. The process to prioritise improvement items is coordinated by the AMU.

10.6 Monitoring and review

The improvement programme will be reported to the AMU and either included within the advancing asset management improvement programme (corporate) or within the continuous improvement programme (unit based). All improvement items will be monitored by the AMU and tracked through the Council's Asset Management Governance Board and the PDP tool.