DRAFT 2021 – 2031 Water Supply Activity Management Plan

2021-2031 Mahere Rato Wai

Nelson City Council
te kaunihera o whakatū

Quality Assurance Statement

Version No.	Date	Description	Prepared by	Reviewed by	Approved by
1		Draft for Council Infrastructure Committee	Various	A Louverdis	SLT
2		Draft approved by Infrastructure Committee to inform LTP 2021-31	Various	Councillors	Councillors
3 Final		Approved by Council	Various	Councillors	Council

Cover Photo:

Maitai Dam

CONTENTS

LIST OF TABLES

LIST OF FIGURES

Executive summary

i The purpose of the plan

The Water Supply Activity Management Plan (Plan) outlines the current and future operational and capital requirements to meet the activity needs in a cost effective manner.

The overall objective of Activity Management planning is to:

Deliver a defined level of service to existing and future customers in a sustainable and cost effective manner.

The key elements of infrastructure activity management are:

- Taking a whole of lifecycle approach
- Developing cost-effective management strategies for the long-term
- Providing a defined level of service and monitoring performance
- Understanding and meeting the impact of growth through demand management and infrastructure investment
- Managing risks associated with asset failures and climate change
- Sustainable practices, including use of energy and physical resources
- Recognising and providing for the maintenance and enhancement of freshwater
- Continuous improvement in activity management practices

A formal approach to the management of infrastructure assets is essential in order to demonstrate how levels of service will be achieved in the most cost effective manner for the benefit of customers, investors and other stakeholders.

This plan focuses on ensuring the assets supporting the activity are operated and maintained to provide the desired level of service, and to meet the current and future community outcomes, Council priorities and focus areas in a sustainable manner.

The Goal of the Water Supply Activity is to:

Provide a water supply to Nelson City that is capable of abstracting, treating and distributing potable water in an efficient, safe, reliable and sustainable way whilst ensuring that the ecological, recreational and cultural interests of the community in the water sources are recognised and enhanced.

This Plan will provide the substantiation for budget forecasts put forward in the Long Term Plan (2021-2031) for the Water Supply Activity.

ii Asset description

The city water supply comes from river intakes on the South Branch of the Maitai River and Roding River plus a dam on the North Branch of the Maitai River. The raw water (untreated) is then piped to a modern state-of-the-art Water Treatment Plant (WTP) in the Tantragee Saddle in Brook Street where it passes through an ultra-filtration process and final chlorination before it is supplied to the city.

The extent of the Nelson City Council (NCC) water system is shown in the Figure ES-1.

The water supply assets are detailed in part vii - Lifecycle management plan of the Executive Summary of this Plan. The inventory of public water supply assets owned by NCC and managed by the Infrastructure Group – Utilities as at June 2020 is shown in Table ES-1.

Table ES-1: Summary of Water Activity Assets as at June 2020

Asset Category	km	units	Replacement Value($M)
Reticulation incl ridermains	347.3		119.14
Trunk Mains	46.7		40.15
Maitai Pipelines	17.1		22.69
Roding Pipeline	10.7		7.22
Maitai Water Supply Scheme		1	22.85
Roding Dam		1	3.122
Treatment Plant		1	26.61
Tunnels		3	12.89
Reservoirs and Tanks		39	17.96
Pump Stations		12	5.15
Pressure Reducing / Control Valves		52	0.94
Air & Non Return Valves		199	0.9
Backflow Prevention Valves		592	0.25
Gate Valves		4,302	8.03
Manholes		112	0.44
Hydrants		2,630	7.7
Residential Meters		19,617	17.68
Commercial Meters		2,010	
Network reticulation meters		40	0.24
Customer Connections (including unmetered sprinkler connections)		21,677	29.23
		Total	**343.20**

Figure ES-1: Water Network Nelson

iii Climate Change

Climate Change as an Over-arching Issue:

Climate change is a significant and urgent international, national, and local issue. At a local level, NCC has a key role to work with the community towards mitigating the driving factors of climate change and creating a resilient and low emissions future while investigating and implementing adaptive measures to manage and minimise risk. Climate change has been identified as an over-arching issue as it potentially has a bearing on all of the identified issues for water supply over the decades to come.

A focus of the first five years of this plan is to investigate in depth the impact of climate change on the water supply activity and prepare an activity emissions reduction plan.

Climate change effects on the Water Supply Activity

At a local level, Council's preliminary understanding of the impacts of climate change are as follows.

- **Sea level rise**

  Sea level rise is one of the biggest climate challenges for Nelson as a large proportion of our urban infrastructure is coastal or low lying. These areas will become more vulnerable to coastal inundation (flooding) as tides and storm surges extend further inland over time.

  Some of the key impacts this will have on the water supply activity are as follows:

  - Coastal erosion has the potential to damage roads and the water supply assets located in vulnerable coastal areas.
  - Increased risk of liquefaction to Council assets and urban areas generally due to higher water table in coastal areas.

- **Heavy rainfall and flooding events**

  Higher intensity rainfall events will result in an increase in surface water, stormwater and stream flows. The implication for the community is that without mitigation of these effects, they may experience more regular and extensive flooding from streams, rivers and stormwater overflows. The impacts this will have on the water supply activity is as follows:

  - Water intake structures, dams, pipelines, bridges and culverts that cross streams and rivers are at risk of being damaged during high flow events.
  - The increase in storm rainfall intensity will result in higher sediment volumes entering the rivers and streams which is expected to increase maintenance requirements of intake structures and increase the use of the Maitai Dam which will lead to higher treatment costs.
  - Heavy rainfall can also initiate slips that can impact pipelines on exposed benches or slopes, such as the Maitai Raw Water line and the treated supply lines to the city from the WTP. The treatment plant itself is also at risk of damage from slips from adjacent slopes.

- **Gradual Temperature rise**

  Gradually increasing temperatures lead to an increase in base demand for water and associated higher operational costs with reduced supply resilience as water takes increase from rivers. Increasing temperatures in rivers and the Maitai Dam can lead to increased risk of waterborne pest weeds and algae.

- **Droughts and extreme temperatures**

  With a warmer climate, the community will be exposed to more extreme temperatures and longer and more severe droughts. This will also have a negative impact on the environment, particularly with our streams and rivers. The impact this will have on the water supply activity is as follows:

  - Increase in water supply abstraction from the rivers and reservoir due to increased demand. This will have an impact on the flows within the rivers and increase the likelihood of moving to water restrictions

  - Droughts are expected to become more regular and potentially more severe. This may result in the water restriction requirements for residential and commercial use becoming more severe than those at present

  - Droughts will increase the likelihood of forest fires within the water supply catchment. This will have an effect on water quality, increased operational costs, and potential damage to key lifeline assets (i.e. Maitai raw pipeline)

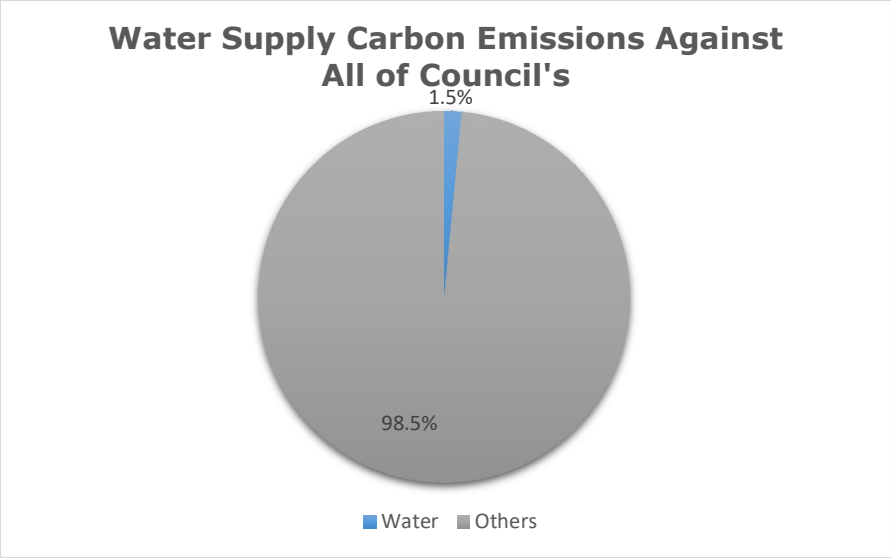
Climate Change Mitigation

The water supply activity is part of the wider community commitment to reducing Greenhouse Gases (GHG's) which are measured and monitored through the Council's Certified Emissions Measurement and Reduction Scheme (CEMARS -Toitū Envirocare) Action Plan. The activity also needs to recognise the leadership role of Council and be able to develop climate change mitigation and adaptation strategies to advise the location, design and operation of our infrastructure.

In August 2020 Council committed to adopting the 5 year emissions reduction budgets to be developed and confirmed by Central Government at a national level in 2021. This commitment is to ensure that by 2025, Council realises measureable positive change towards achieving carbon zero status. Longer term the Council has also adopted the Government targets for Council's own GHG reductions (i.e., net zero emissions of all GHGs other than biogenic methane by 2050, and a 24% to 47% reduction below 2017 biogenic methane emissions by 2050, including 10% reduction below 2017 biogenic methane emissions by 2030). These targets are intended to be achieved through the development and implementation of a Council-wide 'Emissions Reduction Action Plan'.

Figure ES-2 shows that the results of a preliminary assessment of the water supply activity's contribution to current carbon emissions. The contribution is very small and principally related to the use of electricity.

Figure ES-2: Carbon Emission For Water Supply Activity Compared With All Of Council (Preliminary)



In order to support the Council wide Emissions Reduction Action Plan some knowledge gaps have been identified that will need to be addressed:

- Exact emission reduction budgets to be confirmed by central government in 2021.
- A comprehensive analysis of the sources of production of all GHG's by the water supply activity and details of quantities.
- What options are currently available for reducing and eliminating GHG's in line with the Council resolution.
- The effectiveness and affordability of GHG reduction options.

The following projects have been identified to support the Council wide Emission Reduction Action Plan:

- Climate Change Emission Reduction Study. This is primarily anticipated to focus on energy audits.
- Climate Change Mitigation Projects. This is a placeholder for funding and projects are anticipated to be confirmed following completion of the emission reduction strategy.

Areas for further investigation to aid mitigation are:

- The potential for further electricity generation, particularly in the gravity trunk mains and use of photovoltaics.
- Consideration of materials that allow rehabilitation of existing watermains rather than replacement.
- Opportunities for co-construction of assets with other utilities to reduce use of construction plant and bitumen based road surfacing materials.
- Use of more energy efficient technology at the water treatment plant and pump stations.

- Use of nett zero carbon emission bulk electricity supplier(s).
- Reduced use of petrol and diesel powered vehicles for operations and maintenance activities.

The outcome of this work stream will feed into the Council's overall Emissions Reduction Action Plan.

Climate change adaptation – responding to the effects of climate change

Council is in the process of developing an understanding of the specific impacts of climate change on the Nelson City Area and how they will shape the community into the latter part of the century. Adaptation is the partner to mitigation in preparing the Council's response to climate change.

Areas for adaptation in the water supply activity will need to match wider community changes as follows:

- Ensuring renewals are programmed to respond to sea level rise issues and avoid un-necessary expenditure in areas that will not require services in the long term.
- Closely monitoring rainfall patterns to better prepare for fluctuating water demand.
- Monitor river temperatures and flows to track impacts on aquatic environment and resource consent compliance. Some changes to operating techniques and/or resource consent conditions may be required.
- Review flood capacity of the Maitai Dam to anticipate impacts of more extreme rainfall.
- Review demand management strategies and water loss programmes to prepare for future drought scenarios.
- Develop fire response plans for catchment forest fires.
- Upgrade testing for micro-organisms in the Maitai Dam to better predict algal blooms and diatom impacts.
- Develop network upgrades in hand with renewals to allow flexibility in establishing new residential areas across the city.

The following knowledge gaps have been identified:

- A comprehensive analysis of the water supply network's exposure to impacts of climate change.
- What options are currently available for adapting to the impacts of climate change in the short, medium and long-term.
- The effectiveness and affordability of adaptation options.

Budget has been identified for the following strategies and capital response:

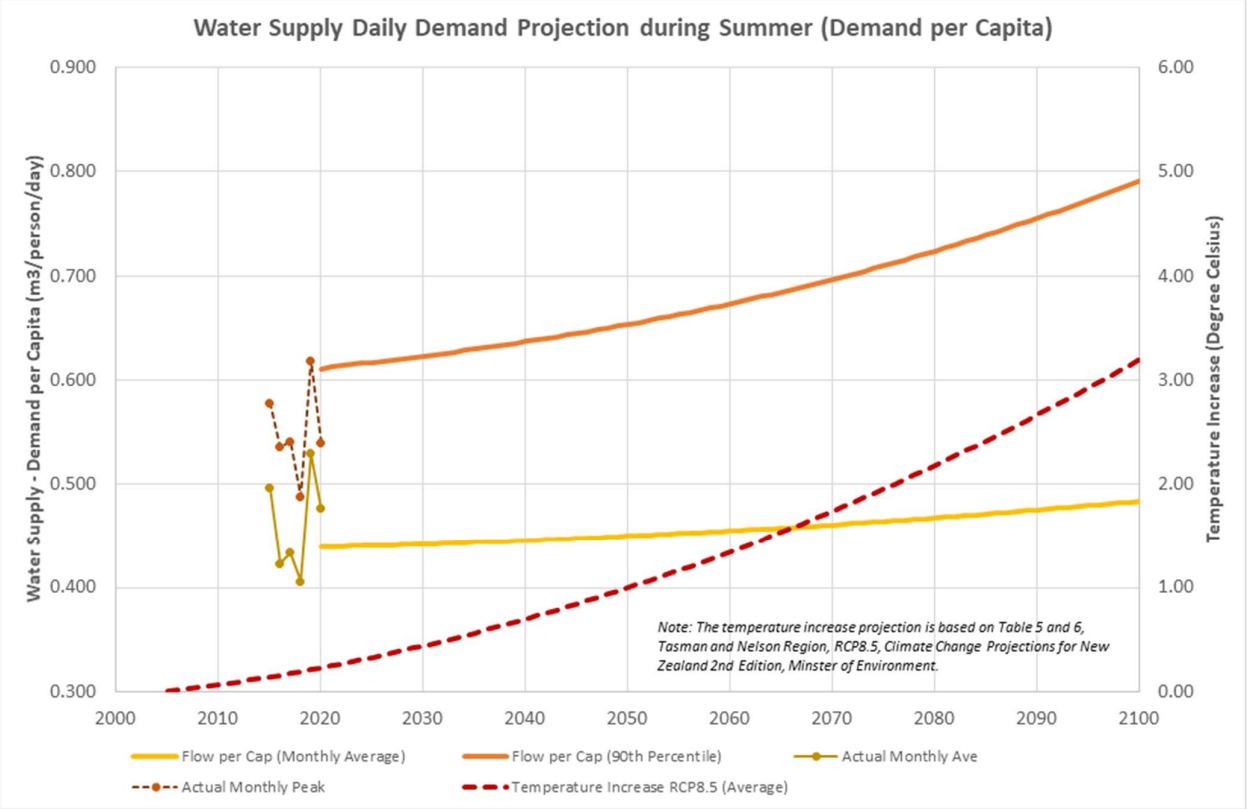
- Climate Change Vulnerability Assessment.
- Climate Change Adaptation Strategy.
- Climate Change Mitigation and Adaptation Projects. This is a placeholder for funding and projects are anticipated to be confirmed following completion of the emission reduction strategy.

Areas for further investigation to aid adaptation are:

- Detailed condition assessment of assets likely to be impacted by sea level rise to advise renewal and growth servicing strategies.
- Ongoing monitoring of weather patterns to better anticipate drought events.
- Improving demand management outcomes to reduce water use.
- Improving water loss monitoring and response.
- Identifying and securing additional raw water sources.
- Monitoring water demand as base temperatures increase.

Figure ES-3 below represents the current preliminary work looking at possible impacts of temperature rise on base water demand. To be reliable a long term project to analyse temperature and various demand scenarios is planned.

Figure ES-3: Draft Future Demand Modelling with Temperature Rise



Climate Change Planning Assumptions

In order to frame the activity response to climate change the following assumptions have been made:

- The contribution of renewable energy sources to the national grid will progressively increase over time (currently targeting 90% renewable energy by 2025). This is expected to contribute to a steady reduction in the carbon footprint of Council assets that draw on mains power.
- Where emissions cannot be reduced, a Council wide offsetting approach will be developed.
- Sea level rise by 2090 will be approximately 0.67m, and by 2130 will be approximately 1.1m-1.5m.

- Temperature warming, which contributes to increased storm rainfall intensity will follow the RCP 8.5 scenario, and sea level rise will follow RCP 8.5 M (mid-range) projections. Projected temperature increase and sea level rise at 2090 are 2.6°C and 0.67m respectively (relative to 1986-2005 baseline). Use of the RCP 8.5 scenario is based on stormwater design standards contained in the LDM 2019. This will be reviewed as climate change monitoring and assessment techniques develop over time.
- Construction materials and techniques will be available that meet net zero GHG emissions by 2050.
- The community will confirm appropriate levels of service and affordability limits that support the activity.
- Council will undertake investigations of the impacts of climate change on the Nelson City geographical area.
- Funding will be available to specifically assess the potential impact of climate change on the activity.
- Defend, Retreat or Accommodate: For the purpose of planning the 30 year programme, it is assumed at this stage that asset renewals and upgrades will continue in low-lying areas that are subject to flooding and coastal inundation. Following notification of the Whakamahere Whakatū Nelson Plan it is anticipated that new development in these areas will be designed to be resilient to flooding out to 2130. Wider community engagement is required to inform adaptation responses for existing development in these areas.

Community Engagement

Climate change is a significant issue facing the community. In order for the Council controlled water supply activity to respond to future challenges, wide community engagement is called for. This is expected to come from a number of Council activities as follows:

- Statutory consultation for the Long Term Plan and Annual Plans.
- Whakamahere Whakatū Nelson Plan consultation on natural hazards overlays (including flood maps) and provisions (Objectives, Policies, Rules and Methods)
- Notification of resource consents where required.
- Coastal Hazard Adaptation: Consultation is to be undertaken with the wider community on this significant issue.

iv Key issues

Key issues for the 2021 – 2031 Water Supply Activity are summarised in the following 7 issues:

Issue 1: *The piped water supply network is at risk of damage during earthquakes and flood events.*

Issue 2: *Water supply assets are starting to show signs of age, resulting in regular failures. Due to a greater proportion of the network reaching the end of its design life, a significant length of pipework will need to be replaced within the next 30 years – The water renewal 'bow wave'.*

Issue 3: *Planned levels of service for water supply will not be met unless assets are maintained, renewed and upgraded.*

Issue 4: *Council is unable to account for 20 – 25% of water supplied through the water supply network.*

Issue 5: *Using water from the Maitai Dam increases impacts on the Water Treatment Plant processing system*

Issue 6: *Deposits in the cast-iron pipes are discolouring the water supply received by some customers.*

Issue 7: *The need to improve the quality of water discharges from the Maitai Dam into the Maitai River to avoid impacts on the downstream environment.*

Issue 1: The piped water supply network is at risk of damage during earthquakes and flood events.

A feature of a run of river supply such as Nelson's is the dependence on the water in the rivers or dam to supply the treatment plant. The distance between intakes and the treatment plant also introduces a vulnerability that comes with very long pipelines (some of them on above ground benches and within tunnels) that cross earthquake faults, streams and rivers.

In addition the best advice to date from the Ministry for the Environment and the National Institute of Water and Atmospheric Studies (NIWA) regarding climate change is that we can anticipate more extremes in our weather including increased droughts and extreme rainfall events. Both of these will impact the access to water in the rivers and increase the supply dependency on the Maitai Dam. In summer months increased demand will likely coincide with reduced supply.

Because the Maitai Dam is a vulnerable asset, it was designed in 1984 by consulting engineers Tonkin and Taylor Ltd to withstand a 1 in 100 year seismic and flood events without damage and maximum credible earthquake (approximately 1 in 1,000) and maximum probable flood without collapse (but not without some damage, possibly requiring decommissioning and major repair work). The 1 in 100 year return period was chosen to align with the expected economic lifetime of the structure and represented 'best-practice' in the 1980's. One of the longer term impacts of climate change is the potential to change the theoretical return periods of storms which will in turn require Council to regularly review the design and operating levels of the water in the dam to maintain the safety of the structure.

The Roding Water Scheme has low and moderate risks to structures, other than a 200m length of pipe between the screenhouse and the de-commissioned chlorinator house. This pipe is suspended on piers along the riverbank.

While automatic chlorination exists at the water treatment plant, a stand-alone portable chlorinator unit, run by a small petrol generator and using sodium hypochlorite is also held there in case of emergency.

The key features of resilience in the supply side of the current network are:

- The Maitai Dam reservoir. This allows 4.1 million cubic metres of water to be stored as a buffer against droughts and extended periods of rain that discolours the rivers.
- The duplicate raw water delivery lines from the Maitai intakes. The original supply line is largely sited on an above ground bench that follows the course of the river and the recently installed duplicate line is buried in the Maitai roadway. The duplicate pipelines provide security against damage to one or other of the pipelines.

- The ultra-filtration process at the water treatment plant. The filters in the water treatment plant remove dissolved organic material and sediment and can use a variety of raw water sources. Renewal of the existing membranes was completed in 2018/19.

Other options for improving resilience are:

- Increase the stored volume in the Maitai Dam.
- Reduce demand through more efficient use of water (See Water Quantity/Efficiency of Use below).
- Develop a fourth water source in the Waimea Plains in Tasman District.
- Construct a separate high dam on the Roding River below the existing weir. Two locations 200m-250m below the caretaker's house were looked at in a pre-feasibility study in 1984. The dam would be approximately the same size as the Maitai Dam and act in a similar manner with a separate upper level river intake.

On the delivery side, the network is open to many of the same vulnerabilities, with above ground trunk mains and pipes crossing earthquake faults, streams and rivers. In coastal areas liquefaction is recognised as a potential risk to the network.
Recent work by Council has focussed on natural hazards that might impact on the city, in particular:

- Direct damage from earthquake shaking;
- Damage from liquefaction in susceptible areas;
- Damage from tsunami;
- Damage from flooding and major storm events;
- Impact of potential climate change and sea level rise.

A natural hazards investigation and remediation project has been underway since 2018/19. To date each part of the water supply network has been assigned a criticality value and plotted relative to the known hazards (See section 5-2 and Appendix I). Work is currently progressing on developing response options.

As a result of the Christchurch earthquakes Council has also undertaken a seismic review of the critical elements of the above ground network, starting with the storage reservoirs and sections of the Maitai Dam to the treatment plant trunk main. This work will continue through this proposed plan and be extended to investigate impacts of liquefaction on existing and future infrastructure, impacts of flooding and the long term planning required as a result of climate change.

Issue 2: Water supply assets are starting to show signs of age, resulting in regular failures. Due to a greater proportion of the network reaching the end of its design life, a significant length of pipework will need to be replaced within the next 30 years.

The water supply network is made up of a range of materials such as cast iron, asbestos cement, concrete, uPVC, polyethylene, concrete lined steel and ductile iron.

Significant sections of the Nelson water supply network were installed in the city from the 1950's -1970's as part of a surge of new developments. These earlier networks are now approximately 60-70 years old and some pipe materials have already reached the end of their service life. Council expects a 'bubble' of approximately 20km of pipework above normal renewals will need to be replaced in the 2030's leading to an

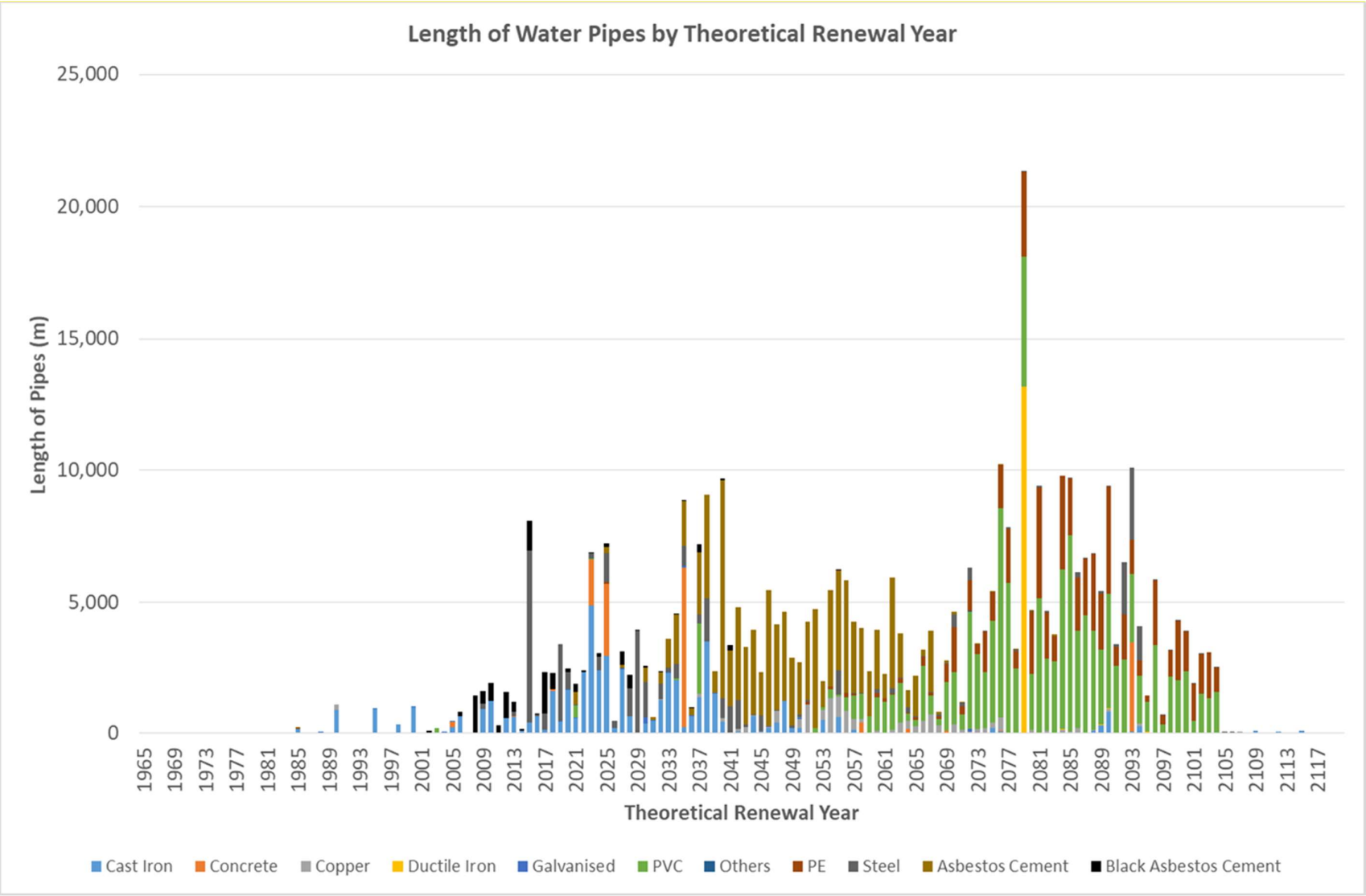
increased demand for pipe renewals or more failures in the network and disruption to supply. At today's rates the 20km could cost an additional $20M-$30M over and above the normal renewals budget in a 5-10 year timeframe. See Fig ES-4 Length of Water Pipes by Theoretical Renewal Year below.

Renewal strategies are based on the following general approaches:

- Replacement of the full pipeline for material classes identified as prone to multiple failures.
- Replacement in parts where ground conditions lead to reduced service lives in discrete sections.
- Replacement as part of upgrades required for growth.
- Replacement as part of co-construction with other utilities.
- Increasing use of detailed condition assessment and pressure reduction to maximise service life of pipelines and fittings.

Draft renewal budgets have been incrementally increased over the next ten years to address this issue.

Figure ES-4: Length of Water Pipes by Theoretical Renewal Year



Issue 3: Planned levels of service for water supply will not be met unless assets are maintained, renewed and upgraded.

Currently Council is replacing asbestos cement pipes that were installed in the 1950's and are showing higher than expected failure rates. As the current asbestos cement pipe renewal programme is expected to continue for the next 8-10 years, enhanced condition assessment of the other pipe types is expected to be part of the renewal strategy from years 5-8, in an effort to maximise the service life of the network.

Older Maitai pipeline Existing Maitai concrete pipeline

The Maitai pipeline between the Maitai Dam and the WTP transports the majority of the raw water used in the City. While it is a large capacity pipe and is very economical to run, it has numerous small shrinkage cracks and is vulnerable to slips from above and below the pipeline.

Council completed the construction of a duplicate Maitai pipeline between the dam and the WTP in 2014 but will continue to use and maintain the existing pipeline for as long as it is viable to do so. Developing a strategy to repair or renew the section between the Dam and the WTP is programmed for 2023-25 with a multi-year project to implement the strategy from 2027-28 to 2037-38.

Safety of dams

The Maitai Dam is Nelson City's largest water storage dam and is also considered to be a high impact category dam owing to the number of people in the downstream path should the dam fail catastrophically. In recognition of this Council has annual engineering safety inspections carried out by the design company and five yearly comprehensive safety reviews by an independent expert. These inspections support ongoing maintenance and upgrading works to ensure the dam is safe to operate.

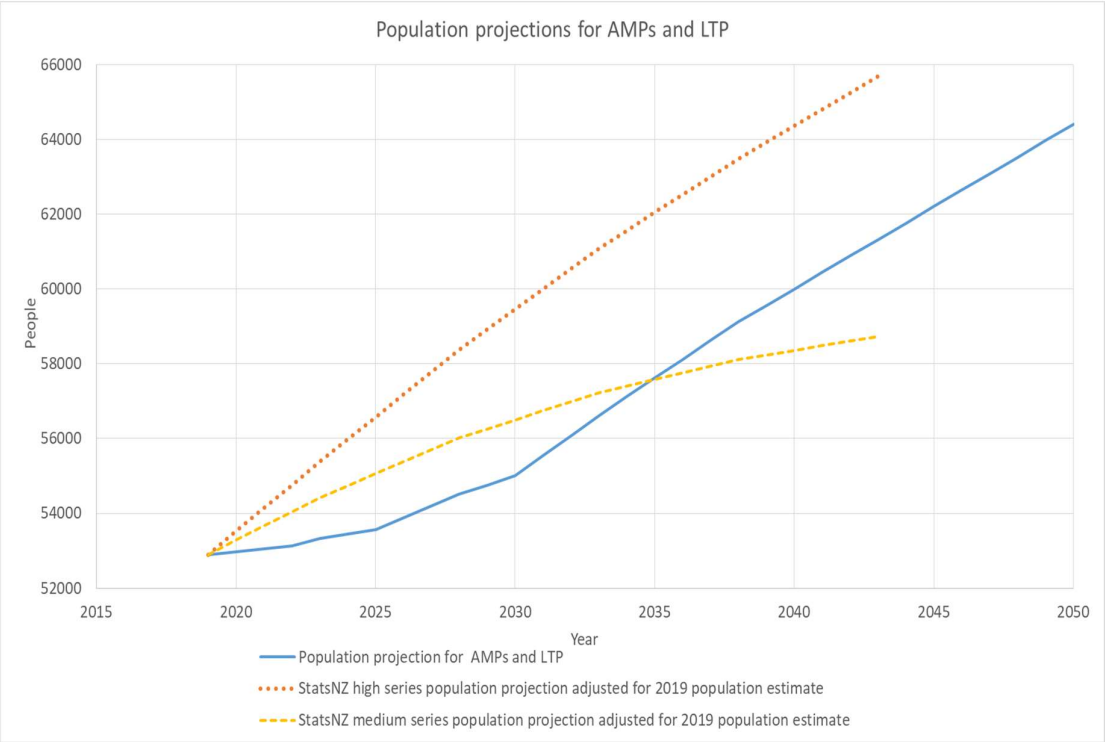
Together with emergency response agencies (Police, Fire and Emergency NZ, St John Ambulance, Nelson Marlborough District Health Board and Nelson Tasman Emergency Management) Council is proposing to meet with residents of the Maitai Valley and review the various emergency events that they will need to develop their own response plans for. It is expected that this discussion will happen as soon as possible in 2020/21-2021/22.

It is anticipated that central government policy issues around regulation of dam safety will be resolved in the first five years of this plan and some form of dam safety scheme will apply to a wider range of dams that Council owns e.g. stormwater detention dams. A budget for the first review of these dams has been included in the stormwater plan.

Growth Areas

For the period covered by this plan the population of the city is expected to increase in a relatively modest fashion due to the effects from Covid-19, as shown in Figure ES-5.

Figure ES-5: Population and household projections 2019 - 2050, Nelson



The city has adequate raw water supply sources for this increase (see section vi Future Demand) but there are some reticulation constraints in some areas. Nelson City has limited or no reticulation in the more rural areas of the city such as the Maitai Valley. Additionally we do not have the necessary trunkmain reticulation to supply fire/sprinkler flows for larger residential/commercial/industrial activities to south Nelson and parts of the inner city adjacent the Central Business District (CBD).

The Future Development Strategy (FDS) sets out where future housing is likely to be located within the next 30 years, and the likely timing of these developments. These areas are shown in Figure ES-8.

The FDS identifies space for 8,166 extra dwellings in the Nelson Urban Area (which includes Richmond), and states that about 60% of this growth can be achieved by adding new housing into existing urban areas[1]. Council has identified six intensification areas that will be focussed on in the provision of infrastructure over the next twenty years. The focus for the first 10 years is the City Centre and Victory. The six intensification areas are:

- City Centre
- Victory
- Hospital/Nelson South
- Waimea Road
- Stoke School
- The Brook

[1] More details about the specific number of additional dwellings that could be accommodated in particular areas is identified in Figure 2 in section 3 of the Intensification Action Plan.

An additional 1300 extra dwellings could be constructed in the Wood, Vanguard, Gloucester Street and Tahunanui in 20–30 years' time, but Council will not be providing for intensification in these areas unless the effects of climate change (particularly sea level rise) can be addressed in these areas.

Two areas within Nelson which have been identified as being suitable for new urban development in the short term are Maitahi and Saxton. The area for the proposed Maitahi development is situated in the lower Maitai Valley which currently does not have suitable water supply reticulation for a residential development on the scale envisaged. Budget has been included in this Plan for the Council's share of the necessary upgrading. For the proposed Saxton area there is a large diameter watermain installed between Suffolk Road and Hill Street North that is expected to vest to Council in 2020/21. This main will provide sufficient water for any residential development in the area.

Council does not have control over the location or level of uptake of intensification or urban expansion opportunities, as this is largely dependent on decisions by individual landowners and/or developers. Council can however, set enabling rules and policies, initiate the right infrastructure at the right time and support the perception of medium density living through high quality design, actions that are supported through its Intensification Action Plan.

Future residential development and intensification across the city that might require sprinkler flows will need to be investigated and where necessary trunkmains will need to be upgraded-generally as part of the normal renewal programme.

See section 3.5 for work programmes for the next ten years to address this demand.

Issue 4: Council is unable to account for 20 – 25% of water supplied through the water supply network.

The reporting of annual water losses as a percentage of annual water production is a current level of service measure. Water NZ software has been used to analyse water use records and calculate the Infrastructure Leakage Index (ILI - Annual Real Losses are expressed as a multiple of the Unavoidable Annual Real Losses) which allows year to year comparisons and also benchmarking between water supply authorities.

The infrastructure leakage index has been calculated since 2001/02. The results are shown in Figure ES-6. Identified Losses and Total Non-Revenue Water are shown in Table ES-2 below.

Figure ES-6: Infrastructure Leakage Index for Nelson

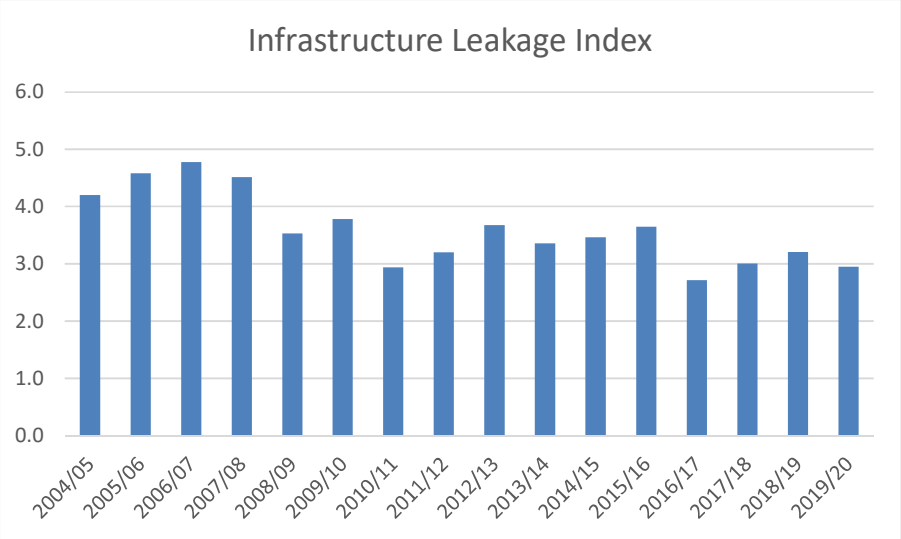


Table ES-2: Real Water Losses and Total Non-Revenue Water

Year	Real Water Loss	Total Non-Revenue Water
2016-17	23%	27.4%
2017-18	26.1%	31.6%
2018-19	25.9%	36.9%
2019-20	24.5%	29.3%

Council has an ongoing project to track real losses within the network and better quantify the other sources of un-accounted for water. As of 2020 the majority of the public network in the city had been checked for leaks. While a number of small leaks were found and repaired no substantial leaks were identified. Leak detection in the urban area is undertaken each year as part of normal operations and maintenance activities. Investigations of the large trunkmains from the water treatment plant to the urban areas are currently underway. Preliminary testing of the older supply main to the city in Brook Street suggests that this could be the source of multiple leaks totalling approximately 9l/s of water losses over the 2.1km length. Access to the pipe in this area is quite challenging and repairs are expected to be costly and time consuming. Investigation of the other sources of un-accounted for water use such as contractor use, fire-fighting services and un-metered connections continue.

Bench testing of residential water meters for accuracy confirmed a general view that some of the meters have been under reporting flows. Similar investigation of the larger flow meters at the water treatment plant in 2020 identified over recording of flows to the city. Based on these results a substantial amount of the un-accounted for water is likely to be attributed to meter performance. The current replacement of the residential meters (programmed to be completed in 2021/22) will reduce the reading discrepancy in line with manufacturers tolerances for new meters and go some way in closing the gap on un-accounted for water volumes. Additional testing of larger commercial and industrial meters is planned for 2021/22-2024/25.

Issue 5: Using water from the Maitai Dam increases impacts on the Water Treatment Plant processing system

Council has three raw water sources as described above. Of these the Maitai Dam is the only one available when river flows are low or unavailable after rain. The Maitai Dam is critically important for the resilience of the water supply in dry conditions.

A drought security study by WSP consultants in 2017 concluded that the Maitai reservoir on the North Branch of the Maitai River would provide sufficient water to allow the city to withstand a 1:100 year drought into the latter half of this century.

Use of water from the dam requires removal of organic material that builds up in the stored water. This requires the use of ferric chloride to coagulate the finer organic material and the membranes at the water treatment plant to remove it. This leads to more regular cleaning of the membranes thereby reducing their service life.

In 2016 Council undertook a trial of sourcing all raw water from the Maitai Dam reservoir to test the ability of the treatment plant to meet the needs of the city for a prolonged period. The trial delivered the following results:

- *Confirmation of the ability to supply the treatment plant with raw water to match the daily demand curve.*
- *Confirmation of the ability of the new membrane train to treat the water for a prolonged period without loss of functionality. The treatment plant has five separate 'trains' of membranes.*
- *An increase in the number of discoloured water complaints particularly from hospitality providers in parts of the city. These complaints are believed to be the result of a significant legacy issue of iron and manganese deposits plus corrosion products in the cast-iron and steel pipe that make up part of the reticulation.*

In 2019 water sampling identified the presence of an invasive freshwater diatom Lindavia intermedia (Lindavia) in the Maitai Dam. Lindavia is known to cause 'lake snow' in freshwater lakes elsewhere in New Zealand when conditions are right. Lake snow refers to suspended mucilaginous macro-aggregates that cause biofouling, especially of filters and lines. The WTP has coarse screens in place prior to the ultra-filtration elements that will go some way to reducing the risk to the water supply from lake snow. However it is anticipated that operational costs will increase in order to prevent fouling of intake screens and pipework and there remains a residual potential risk that the filters at the WTP will become clogged if lake snow develops.

Issue 6: Deposits in the cast-iron pipes are discolouring the water supply received by some customers.

Long term it is important for the city to be able to rely on the Maitai Dam as a raw water source especially in emergency. Further investigations into the causes of the dis-coloured water have been undertaken and some operational changes to the treatment plant have been implemented to help stabilise the deposits. Future work will concentrate on the following:

- *The option to pre-treat the water from the dam via a primary clarifier or more regular replacement of the membranes.*
- *Investigating changing the coagulant chemical at the treatment plant from ferric chloride to aluminium chlorohydrate to reduce the amount of iron introduced into the network. This proposal also has supply chain availability and operational cost benefits that are currently being evaluated. An additional*

benefit would also be that the chemical is less hazardous to handle and store than ferric chloride.

A means of removing the residual oxide material from inside the pipe reticulation is also being investigated.

Issue 7: The need to improve the quality of water discharges from the Maitai Dam into the Maitai River to avoid impacts on the downstream environment.

Council, iwi and the wider community are developing environmental standards for streams and rivers in Nelson based on the requirements of the National Policy Statement for Freshwater Management. These standards are expected to be the basis of rules in the proposed Whakamahere Whakatū Nelson Plan. Key features of the Nelson water supply are:

- *Council's water supply activity relies on water sourced directly from the Maitai and Roding rivers and as such has a day to day impact on the quantity of water available in the rivers.*
- *The Maitai Dam reservoir is used to supplement flows in the Maitai River by replacing the water abstracted from the south branch with water stored in the dam. No storage is available at the Roding Dam and flow augmentation is not possible.*

Compliance with the conditions of resource consents Council holds for water abstraction is mandatory. The current consents include conditions for the following:

- *Increased minimum flows in the Maitai River and Roding River particularly during summer months (230l/s for the Maitai River and 150l/s for the Roding River).*
- *Improve dissolved oxygen levels in the Maitai Dam.*
- *Fish transfer programme.*
- *Planting enhancement.*

The following are some of the current initiatives that this Plan supports in this area:

- *Stream waterway environmental enhancement. Council funds projects to enhance river bank shade through vegetation planting adjacent the Maitai Dam.*
- *Streams and rivers to be free of manufactured obstructions that impede fish passage. Fish ladders are in place on the intake weir of the south branch of the Maitai River and fish 'trap and transfer' programmes are required for the Maitai and Roding Dams to ensure natural fish populations are supported and replenished in the upper catchments.*
- *Support for development of alternative/emergency supplies such as rainwater harvesting, particularly where there is no reticulation.*
- *Ongoing initiatives to reduce the level of un-accounted for water use within the city.*
- *Influence water demand in droughts through water restrictions.*

Water Quality - Maitai Dam Aeration

The Maitai Dam reservoir is subject to seasonal variations in oxygen content over its depth. During the summer months this variation becomes pronounced with lower levels of the dam becoming very low in oxygen (anoxic). The lack of oxygen creates a number of issues for Council:

- *Leads to a challenging environment for aquatic organisms.*
- *Results in elevated levels of iron and manganese in the water as these chemicals become soluble. Using this water to supplement flows in the Maitai River has the potential to lead to adverse environmental impacts in the river.*
- *Likewise the water would need to be conditioned before it could be used as part of the potable supply.*

The most appropriate way to overcome this condition is to aerate the reservoir and mix the water to prevent the loss of oxygen in the bottom layer. The techniques used to achieve this are already used in New Zealand in some of the larger water storage lakes in the North Island.

A budget for this work has been shown in the first four years of the plan with construction in 2022/23-2024/25.

A report prepared by Manaaki Whenua Landcare Research in May 2020 compared the trophic level index of the Maitai Reservoir with lakes in Central Otago known to form lake snow. The report concludes that the Maitai Dam has higher levels of nitrogen and phosphorus than lakes that are known to develop lake snow in Central Otago. If these are critical indicators of risk for developing lake snow then the current proposal to aerate the reservoir, which is expected to reduce the phosphorus levels in the water, may increase the risk of lake snow developing.

Further investigations of the Dam are being undertaken in 2020 to better establish the history of the diatom in the reservoir as well as improve the modelling of the risk of favourable conditions for lake snow formation developing.

The results of this investigation and modelling will support discussions about the reservoir aeration project and whether it can safely proceed.

v Levels of service

Levels of service for the water supply activity are shown in Table ES-3. These reflect the requirements of the Department of Internal Affairs for reporting non-financial measures. No changes are proposed for the period 2021-31.

Table ES-3: Levels of Service for 2021-31

				Performance Target			
Community Outcomes	**Level of service**	**Performance Measures**	**Previous and current performance**	**2021/22 (Year 1)**	**2022/23 (Year 2)**	**2023/24 (Year 3)**	**2024/25 - 2030/31 (Year 4-10)**
Our communities are healthy, safe, inclusive and resilient	**Quality** ^Good quality water	The extent to which drinking water supply complies with: a) part 4 of the drinking water standards# (bacterial compliance criteria)*, and b) part 5 of the drinking water standards# (protozoal compliance criteria)* c) part 8 of the drinking water standards# (chemical compliance criteria) 1	Complied a) and b) and c) 2019/20 Complied a) and b) and c) 2018/19 Complied a) and b) and c) 2017/18 Protozoal compliance is not measured for distribution as the treatment plant removes any at source.	100% compliance with parts 4,5 and 8 of the drinking water standards			
		Total number of complaints per 1000 connections about any of the following*: - drinking water clarity - drinking water taste - drinking water odour - drinking water pressure or flow - continuity of supply - Council's response to the above issues expressed per 1,000 connections 2	18 complaints per 1000 connections in 2019/20 23 complaints per 1000 connections in 2018/19 16 complaints per 1000 connections in 2017/18 21 complaints per 1000 connections in 2016/17	No more than 50 valid complaints per 1000 connections			

				Performance Target			
Community Outcomes	**Level of service**	**Performance Measures**	**Previous and current performance**	**2021/22 (Year 1)**	**2022/23 (Year 2)**	**2023/24 (Year 3)**	**2024/25 - 2030/31 (Year 4-10)**
Our infrastructure is efficient, cost effective and meets current and future needs	**Reliability** ^A reliable supply of water	Average drinking water standard consumption per day per resident* 3	300L per person per day 2019/20 286L per person per day 2018/19 259L per person per day 2017/18	Normal demand less than 500L per person per day. This includes both domestic and commercial-industrial			
		% real water loss from the system* 4	24.5% in 2019/20 25.7% in 2018/19 28% in 2017/18	Real water loss less than 25%.			
Our infrastructure is efficient, cost effective and meets current and future needs	**Customer Service** ^Prompt response	When attending a call-out in response to a fault or unplanned interruption to the system, the following median response times will be measured*: a) attendance for urgent call-outs: from the time notification is received to the time service personnel reach the site* b) resolution of urgent call-outs: from the time notification is received to the time service personnel confirm resolution of the fault or interruption*	Median 21 minutes in 2019/20 20 minutes in 2018/19 18 minutes in 2017/18 21 minutes in 2016/17 Median 191 minutes in 2019/20 284 minutes in 2018/19 89 minutes in 2017/18 107 minutes in 2016/17	a) Contractor to attend urgent call-outs in a median time of 30 minutes or less. b) Contractor to resolve urgent call-outs in a median time of 480 minutes or less.			

				Performance Target			
Community Outcomes	**Level of service**	**Performance Measures**	**Previous and current performance**	**2021/22 (Year 1)**	**2022/23 (Year 2)**	**2023/24 (Year 3)**	**2024/25 - 2030/31 (Year 4-10)**
		c) attendance for non-urgent call-outs: from the time notification is received to the time that service personnel reach the site*	Median 76 minutes in 2019/20 78 minutes in 2018/19 52 minutes in 2017/18 54 minutes in 2016/17	c) Contractor to attend non-urgent callouts in a median time of 120 minutes or less.			
		d) resolution of non-urgent call-outs: from the time notification is received to the time service personnel confirm resolution of the fault or interruption* 2	Median 1164 minutes in 2019/20 449 minutes in 2018/19 330 minutes in 2017/18 330 minutes in 2016/17	d) Contractor to resolve non-urgent call outs in a median time of 24 hours (1440mins) or less.			

^L.O.S. included in LTP

Ministry of Health Drinking-water Standards for New Zealand 2005 (Revised 2018), Wellington, Ministry of Health

* Performance measures with an asterisk reflect the wording of the Non-Financial Performance Measures of the Department of Internal Affairs (DIA) incorporated into sec261B Local Government Act 2002. This is to allow the DIA to compare these measures across councils. Targets have been adjusted where necessary to align.

Measurement procedures:

1. South Island Drinking Water Assessment Unit - Nelson
2. Report from SR system at 1 July
3. Calculated by metered supply divided by Statistics NZ estimated population
4. Council uses a water balance methodology developed by Water NZ to track and report on un-accounted for water.

Central Government Regulation

The event of the campylobacteriosis outbreak in Havelock North in August 2016 concluded with a Government Inquiry. The focus of the Inquiry was twofold: The security of the source, particularly subsurface bores; and the regulatory framework that applies to drinking water suppliers in New Zealand. Numerous administrative and operational recommendations were made in the two final reports. The Stage 2 report also had a section with a recommendation that the Government look at aggregating supplies of water across the country.

In response to the Inquiry Central Government introduced the following legislation**:**

- *On 11 December 2019, the Taumata Arowai – Water Services Regulator Bill was introduced to Parliament. The Bill implements decisions to establish a new regulatory body – Taumata Arowai – which will be responsible for:*
    - *administering and enforcing a new drinking water regulatory system (including the management of risks to sources of drinking water); and*
    - *a small number of complementary functions relating to improving the environmental performance of wastewater and stormwater networks (developing standards and regulations then monitoring and enforcing compliance with them, and providing training).*

  The Bill passed its third reading on 22 July 2020 and now requires Royal Assent to become an Act. This is expected to be completed in 2020.
- *A separate Water Services Bill was introduced to Parliament on 28 July 2020. The Bill will establish the new drinking water regulatory system and develop provisions relating to source water protection. It also includes some obligations on wastewater and stormwater network operators. The Bill is not expected to complete the parliamentary process until sometime after the elections in October 2020.*

In July 2020, the Government announced a funding package of $761 million to provide immediate post-COVID-19 stimulus to local authorities to maintain and improve three waters infrastructure, and to support reform of local government water services delivery arrangements. Initial funding will be made available immediately to those councils that sign up to the Memorandum of Understanding (MoU) and associated Funding Agreement and Delivery Plan for the first stage of the Three Waters Services Reform Programme by 31 August 2020. NCC has confirmed acceptance of the offer and subject to final approval of the delivery plan will receive $5.6M to address infrastructure issues.

The Government has indicated that its starting intention is public multi-regional models for water service delivery to realise the benefits of scale for communities and reflect neighbouring catchments and communities of interest. There is a preference that entities will be in shared ownership of local authorities. Design of the proposed new arrangements will be informed by discussion with the local government sector.

NCC is currently well positioned to comply with any treatment requirements that may arise from future changes to legislation. Raw water is not sourced from bores and all water from the river sources is currently subject to a double barrier of ultra-filtration membranes and chlorination. Council also has a rigorous testing and monitoring regime for chlorine residual levels and bacteria.

vi Future demand

Investigations to date confirm that the delivery capacity of the water supply network below the 100m contour is good for most of the city. Much of the proposed residential growth in the city can be accommodated for the next 5-10 years without major network upgrades. Some areas of weakness exist with older asbestos cement pipes which will be addressed as the network is renewed. Likewise the reduction of water losses and un-accounted for water also improves the available capacity. The largest unknown is the potential for future 'wet' processing industries to establish in the city. Water demand drivers are outlined in Table ES-4 below.

Table ES-4: Future demand

Water Demand Drivers	Changes to Water Supply Activity
Significant population growth and residential expansion into greenfield areas	New development areas on the periphery of the city and increased density in some existing developed areas leading to increased water demand.
New 'wet' industries	Growth in the commercial sector that involves wet processing activities increases the demand for high quality potable water services.
Reduction in house occupancy	Activities such as operating washing machines and dishwashers can generate as much water demand for single person dwellings as those that house couples.
Changes in Customer Expectations	Customer expectations are increasingly tending towards higher Levels of Service for reliability and response to complaints.
Community Expectation	Community expectations are increasingly focussed on the uninterrupted supply of good quality water for residential and commercial uses. Recent complaints about dis-coloured water suggests that expectations in some parts of the community are higher than just potable water.
Climate Change	In recent years, there has been an increase in the incidence of extreme weather events around the world. The general future expected trend for Nelson is of winters being wetter and the other seasons being drier. More frequent heavy rainfall events have been predicted which will impact on the use of water from the two river sources and drier periods may increase the city's dependence on the Maitai Dam.
Legislative National Policy Statements (NPS): • Freshwater Management and • Urban Development	• Freshwater Management is a cornerstone Central Government initiative to improve the quality of freshwater bodies in New Zealand. This is expected to impact on both abstraction and discharges to waterways and require an enhanced recognition of the need for efficient use of the water to minimise the volume taken for water supply and improving the quality of the water discharged as compensation. • The NPS-Urban Development will ensure each territorial authority makes adequate provision for future population growth in their areas.

Water Demand Drivers	Changes to Water Supply Activity
	This will require Council to undertake strategic growth studies and identify the impact on the demand for water supply services.
Organisational Policies Environmental Sustainability	Development of sustainability strategies that include reduction of direct losses from the network (public and private) and un-accounted for water use from the network.

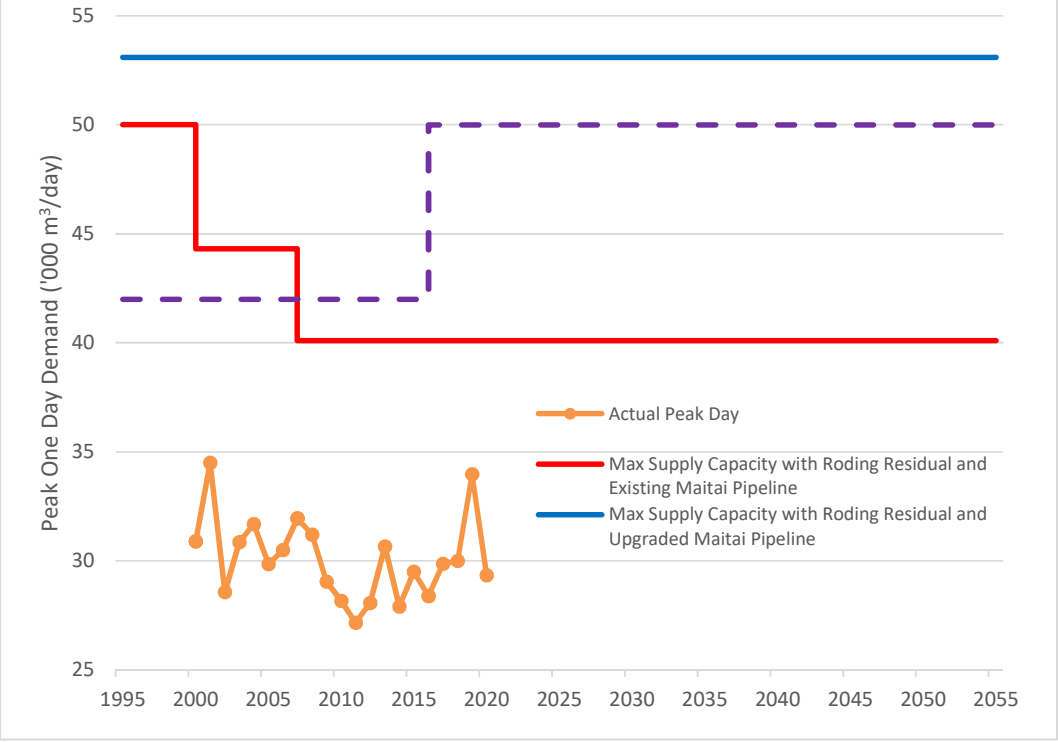
Council is concentrating on improving services to developed areas and providing services to areas that are currently being developed.

Generally sufficient water is available from the WTP to meet the demand from most growth areas although network upgrades will be required in some instances to ensure supply can be made to the development areas. Developers and property owners will also need to install storage tanks and pumps in some elevated areas to ensure adequate supply and pressure for properties which lie above the contour the city can supply.

A review of the residential demand is expected over the next three years as Council prepares the proposed Whakamahere Whakatū Nelson Plan. The likely impact on the water network will be reflected in future activity management plans.

Figure ES-7 Peak Water Demand compares the capacity of the water sources and WTP with the actual peak day water usage over the last 15 years. With the completion of the additional fifth train of treatment plant membranes in 2016/17 the city is now able to treat and supply approximately 50,000m3/day. This is expected to meet the city's growth out to 2070-2080.

Figure ES-7: Peak Water Demand



The resource consents for the city water supply require NCC to implement demand management measures through water restrictions when the level of the Maitai Dam reaches specified trigger levels. In 2019 Council adopted a revised water restriction protocol that more closely aligns NCC and TDC water restrictions. See Appendix B for details.

Bulk Water Supply South Nelson. Tasman District Council - Engineering Services Agreement

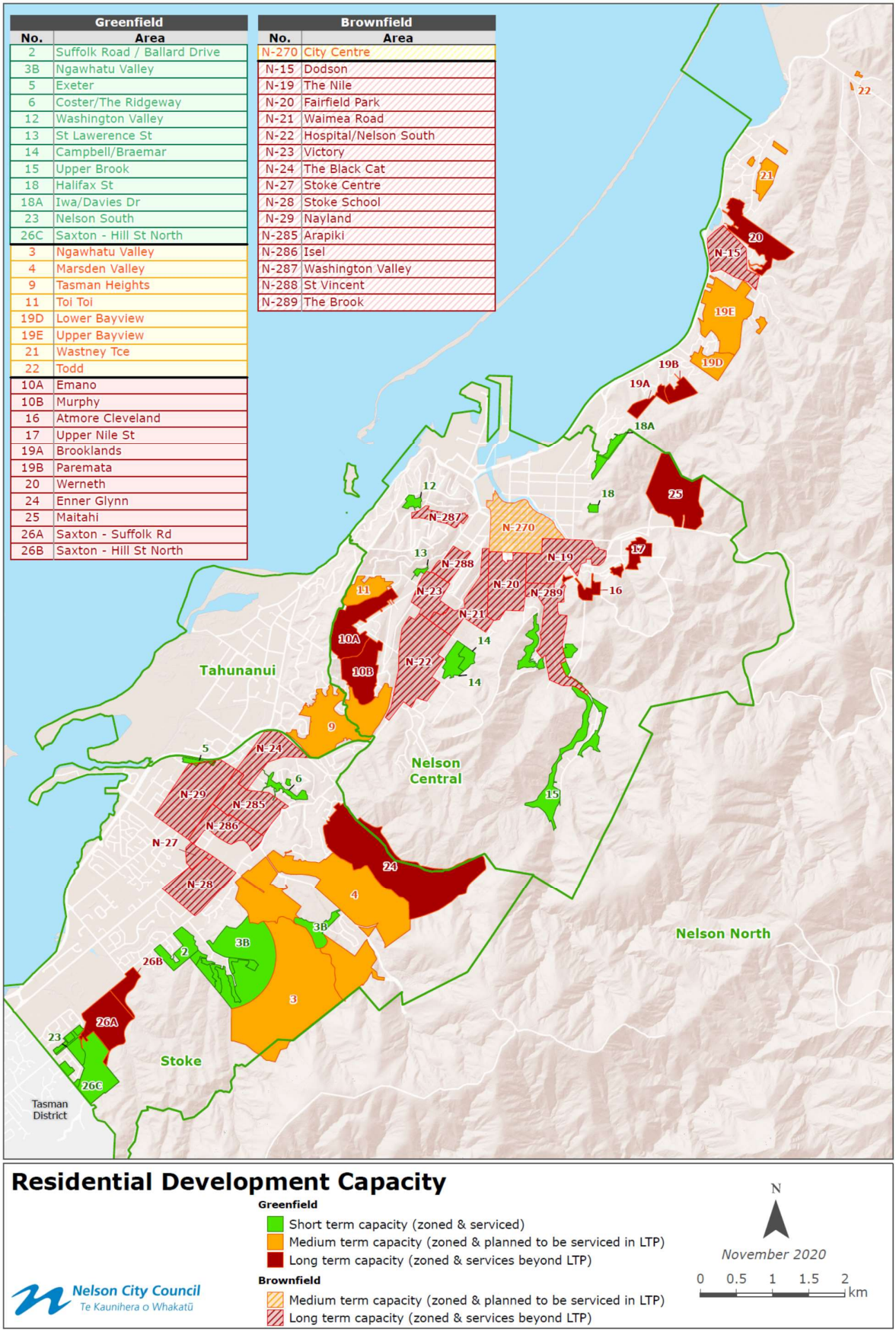
Tasman District Council (TDC) supplies water to the residential area in south Nelson adjacent to Champion Road and Hill Street North as well as the Wakatu Industrial Estate, Alliance Ltd and Turners & Growers from its Richmond supply. This water is sourced from underground bores and then treated with ultra-violet light prior to supplying the network (TDC recognise that this form of treatment does not provide residual disinfection in the drinking water and are undertaking community consultation in late 2020 about permanently chlorinating all of the separate supplies including the Richmond supply). The supply of water services across the boundary is covered in an Engineering Services Agreement (ESA). The ESA is being reviewed in 2020. Features of the cross-boundary supply are as follows:

- *Although the demand from these areas is not great (400,000 – 500,000m3/year) Council does not have the appropriately sized reticulation in place to be able to supply the required fire flows. Should the ESA not be renewed Council can anticipate that new supply mains will need to be constructed to service these areas.*
- *The ongoing supply of water to these areas is dependent upon Tasman District Council securing the long term viability of water from the Waimea Plains via the construction of the Waimea Community Dam.*
- *Nelson City Council has contributed funding to Tasman District Council investigations into the Waimea Community Dam (WCD). For Nelson City to secure a share in the dam (for water required at some future point in time) Council has also approved a $5M contribution to the construction of the WCD in 2020/21 subject to a satisfactory agreement being completed with TDC as to ongoing access to 22,000m3/d and shareholding in the WCD company.*
- *Existing options are expected to provide sufficient water for the city for the short-medium term and a new raw water source or shares in the WCD for day to day use is therefore not expected to be needed in the foreseeable future. Access to the water in the Waimea Aquifer would however provide a valuable water source for Nelson in the event of emergency.*

Infrastructure Planning for Growth Projects

Figure ES-8 shows the areas identified for future growth in the FDS. As demand for development becomes clearer they will be prioritised for services upgrades.

Figure ES-8: Nelson Growth Areas and Infrastructure Timing



vii Lifecycle management plan

Assets have a lifecycle as they move through from the initial concept to the final disposal. Depending on the type of asset, its lifecycle may vary from 10 years to over 100 years.

Section 4.1 sets out in more detail the various ages of the pipeline networks and likely renewal years.

Figure ES-9 shows the year of installation and material type for the pipe components of the network. The figure highlights the general growth timeframes in the city's history and the periods of more rapid growth or network upgrades such as the Maitai Pipelines.

Figure ES-9: Year of Installation / Material Distribution

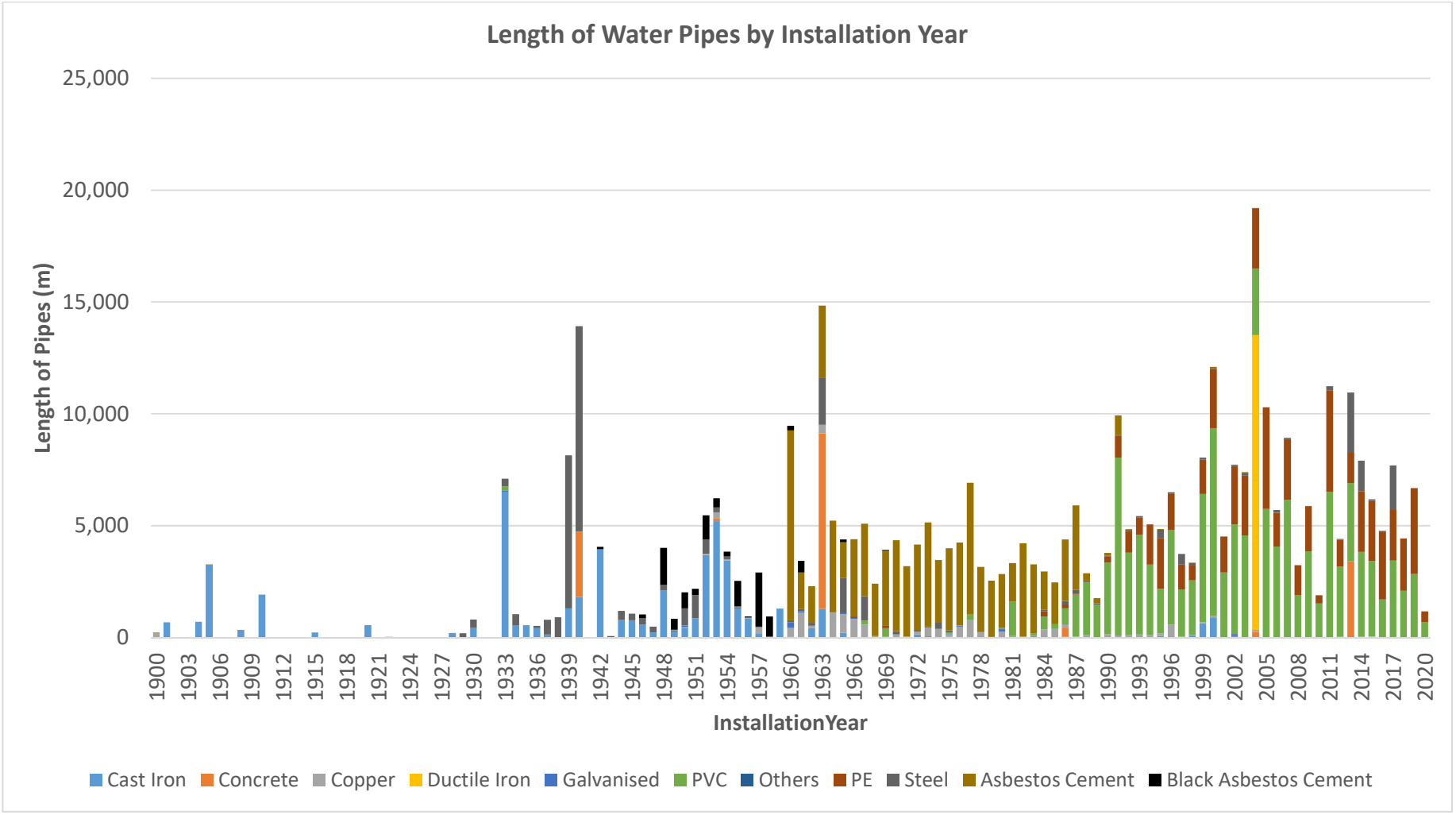


Table ES-5 sets out the lengths of network watermains by material and highlights the underlying issue of the very extensive lengths of the various pipe materials.

Table ES-5: Watermains Lengths by Material as at June 2020

Material	km
Black Asbestos Cement	10.8
White Asbestos Cement	90.2
Blue Brute Pipe	0.29
Cast Iron	0.1
Ductile Cast Iron	2
Pit Cast Iron	15.9
Spun Cast Iron	31.51
Concrete	14.9
Copper	13
Ductile Iron Concrete Lined	13.1
Galvanised	2.2
High-density polyethylene pipe	35.5
MDPE Medium Density Polyethylene	32.5
PVC	122
Steel Concrete Lined	35.5
Steel Pitch Lined	2.2
Other	0.1
Grand Total	**421.8**

viii Risk management plan

NCC is committed to using risk management principles and techniques to understand and appropriately manage all internal and external factors and influences which affect the achievement of its objectives. Doing this will:

- Provide a reliable basis for sound decision making
- Increase the likelihood of achieving objectives
- Provide an agreed basis for prudent risk management
- Enable the organisation to understand the level of risk associated with each decision as well as the Council's aggregate exposure to risk
- Improve accountability and assurance of control
- Enable the Council to avoid threats and seize opportunities
- Foster an organisational culture based on reasonable foresight and responsible hindsight.

The Council's standardised risk assessment method explicitly follows the process part of AS/NZS 31000:2009 Risk Management – Principles and Guidelines. See Section 5 of this Plan for details.

Risk analysis involves consideration of the sources of risk, their consequences and the likelihood that those consequences may occur.

The following consequences are considered:

- Health
- Safety
- Asset performance/Service Delivery
- Environmental/Historical/Cultural
- Financial
- Political/Community/Reputational
- Relationship with Iwi
- Legal compliance
- Information/Decision support

The objective of risk analysis is to separate the low impact risks from the major impact risks, and to provide data to assist in the evaluation and treatment of the risks.

Table ES-6 sets out the theoretical High Risks to the Water Supply. The dominant risks arise from natural hazards and climate change. Work programmes to address these are covered in this Plan.

Table ES-6: Summary of High Risks to the Water Supply Activity

Identification			Analysis: Residual Risk			
Event Description	**Asset Group**	**Consequence**	**Existing Controls**	**Consequence**	**Likelihood**	**Current Risk Level**
MOVEMENT FAILURE CAUSED BY EARTHQUAKE, LANDSLIDE OR SETTLEMENT	**TREATMENT PLANT**	Worse case: water not available until temporary chlorination plant in place and temporary supply from TDC - 1 day to organise	Plant has been designed to a high standard. Regular inspection for likely problems. Temporary supply from TDC	Extreme (5)	Unlikely (2)	High (10)
DAMAGE FROM LIQUEFACTION (AT RISK AREAS PORT NELSON, TAHUNANUI/STOKE)	**RETICULATION**	Asset performance reduced		Extreme (5)	Unlikely (2)	High (10)
CLIMATE CHANGE/LOWER RAINFALL INTENSITY AND RIVER FLOWS	**TREATMENT PLANT**	Reduced raw water available from rivers. Greater reliance on Maitai Dam reservoir. Increased restrictions on water supply to customers. Drought conditions.	Dam storage volume designed for current 60year drought and future demand to approx 2060-2080.	Major (4)	Likely (4)	High (16)

The specific objectives that guide the Water supply risk analysis are taken from the Water supply levels of service:

- Quality – good quality water
- Quality – Acceptable water pressure
- Reliability – a reliable supply of water
- Health and Safety – adequate flows of water

- Customer service – a prompt response to reported network issues
- A network that protects the natural environment

As noted in the priority section, uncertainty around possible future LOS changes (eg Freshwater NPS) and the risk-based decision framework feature in this area.

ix Financial summary

Expenditure for the water supply activity varies over the term of the Plan. The pipe renewal budget is trending upwards to meet the expected spike in renewals needed by approximately 2030. Likewise associated increases in capital expenditure for growth areas are evident from 2025/26 onwards.

Table ES-7: Water Operational Expenditure Years 1-10 of the 2021/31 Long Term Plan ($000)(Draft-will be updated)

Group Account	2021/22 AMP (2021/31)	2022/23 AMP (2021/31)	2023/24 AMP (2021/31)	2024/25 AMP (2021/31)	2025/26 AMP (2021/31)	2026/27 AMP (2021/31)	2027/28 AMP (2021/31)	2028/29 AMP (2021/31)	2029/30 AMP (2021/31)	2030/31 AMP (2021/31)
7005 Water	6,768,288	7,063,009	6,977,392	7,039,946	6,899,242	6,927,343	6,795,992	6,852,843	6,823,992	6,859,843
Base Expenditure	4,492,976	4,587,697	4,702,080	4,764,634	4,623,930	4,652,031	4,520,680	4,577,531	4,548,680	4,584,531
Unprogrammed Expenses	2,012,712	2,212,712	2,012,712	2,012,712	2,012,712	2,012,712	2,012,712	2,012,712	2,012,712	2,012,712
Programmed Expenses	262,600	262,600	262,600	262,600	262,600	262,600	262,600	262,600	262,600	262,600

Table ES-8: Water Capital Expenditure Years 1-10 of the 2021/31 Long Term Plan ($000)(Draft-will be updated)

Group Account	2021/22 AMP (2021/31)	2022/23 AMP (2021/31)	2023/24 AMP (2021/31)	2024/25 AMP (2021/31)	2025/26 AMP (2021/31)	2026/27 AMP (2021/31)	2027/28 AMP (2021/31)	2028/29 AMP (2021/31)	2029/30 AMP (2021/31)	2030/31 AMP (2021/31)
7005 Water	5,779,050	7,342,550	7,226,700	5,753,200	7,513,400	8,958,600	8,141,450	10,039,950	11,655,150	11,590,650
Renewals	3,588,500	4,530,050	4,105,000	2,050,000	1,982,500	2,125,500	2,772,550	2,900,550	7,036,250	7,423,550
Capital Growth	0	0	300,000	800,000	1,750,000	2,500,000	2,100,000	2,253,000	1,103,000	1,756,700
Capital Increase LOS	2,190,550	2,812,500	2,821,700	2,903,200	3,780,900	4,333,100	3,268,900	4,886,400	3,515,900	2,410,400

x Monitoring and improvement programme

The Plan is an evolving document and will be reviewed annually and updated every three years to coincide with the Long Term Plans and to incorporate improved decision making techniques, updated asset information, and Council policy changes that may impact on the levels of service.

The Plan will also be improved throughout its life cycle as further information about the water supply assets are collected in terms of condition, performance and service delivery.

Council will report variations in the adopted annual plan budgets against the original asset management plan forecasts and explain the level of service implications of budget variations.

Internal Review

Internal reviews will be undertaken every three years to assess the effectiveness of the Plan in achieving its objectives. The internal review will also assess the adequacy of the activity management processes, systems and data.

Statutory Audit

The Local Government Act requires that an independent, annual audit of the operations of the Council be carried out. This function is carried out by Audit NZ.

Benchmarking

Benchmarking (trending) of the activity through Audit NZ, Local Government NZ and WaterNZ initiatives is carried out at the request of these organisations to give increased understanding of:

- The efficiency and efficiency variations of individual activities.
- Effects of any programmes instigated by the Asset Management Plan.
- Operating costs over the range of individual activities.

Examples of types of benchmarking that are to be considered include tracking progress, responsiveness to service calls, operation costs i.e. $/m/year and energy costs. As data is obtained and implications understood the benchmarking can be used for additional or revised Levels of Service and can be incorporated into a graphical display.

WaterNZ annual performance reviews include benchmarking of a range of measures across all territorial and unitary authorities that are operators of 3 Waters networks. Results for the water activity in 2018/19 can be found through the following link https://www.waternz.org.nz/Attachment?Action=Download&Attachment_id=4271

The effectiveness of the Plan will be monitored by the following procedures:

- Financial expenditure projections prior to the end of the year.
- Resource consent monitoring as required by consents.
- Operations and Maintenance reports on a monthly basis.
- The ongoing updating of the asset register of the pipe assets when repairs are carried out and the attributes are compared with the asset register attributes.
- Ongoing updates and calibration of the hydraulic model.

Table ES-9: Improvement Programme

Improvement Programme
Develop Network Contamination Response Plan.
Establish Condition Model for asbestos cement pipe and cast-iron pipe.
Implement suggestions from the Maitai Dam comprehensive Safety Review.
Routinely calibrate the accuracy of the Network Analysis model so that accurate predictions are provided.
Improve reporting on levels of service, particularly those that are based on Council service requests and work orders to contractors. Resolve issues with how the information is recorded and recovered.
Review asset lives using NAMs– NZ Infrastructure Asset Valuation and Depreciation Guidelines.
Improve accuracy of condition assessments.
Continue the water loss identification and reduction programme.
Review the lifelines risk assessment and response.
Continue investigations into dis-coloured water issues.

1. Introduction

1.1. Background

Historically, NCC has been the predominant water provider to the residents of Nelson. The supply is mostly residential with limited commercial and industrial demand. The raw water supply has seasonal limitations that make it unsuitable for large horticultural and open irrigation activities. Parks, reserves and school sports fields are the largest irrigation demands currently serviced.

The city water supply comes from run of river intakes on the South Branch of the Maitai River and Roding River plus a dam on the North Branch of the Maitai River. The raw water is then piped to a modern, state-of-the-art water treatment plant (WTP) in the Tantragee Saddle in Brook Street where it passes through an ultra-filtration process and final chlorination before it is supplied to the city.

Water Supply Area covered

The Nelson City water supply area extends to Saxton Field in the south (The Wakatu Industrial Estate, the north side of Champion Road, Hill Street North, Alliance Group and ENZA Foods, are within Nelson City, but are supplied by TDC).

In the north the area extends to Todds Valley, The Glen and Hillwood on the Wakapuaka side of the Gentle Annie Hill.

Properties in Marsden Valley, the Maitai motor camp and a small number of the adjacent houses in the Maitai Valley are also supplied.

Critical Assets

Critical Assets are defined in this Plan as assets that are essential to providing at least a limited water supply in times of emergency or that would lead to an unacceptable consequence in event of failure.

Critical assets have been identified as:

- Headworks including dams and intakes
- Raw water trunk mains
- Raw water pump stations
- Water Treatment Plant including Clearwater Reservoir
- Treated water trunk mains
- Treated water pump stations

Water Supply Drinking Water Compliance

The NCC supply is assessed by the Ministry of Health on an annual basis for compliance with national drinking water standards. The supply is currently compliant.

1.1.1. Purpose of the plan

The purpose of this Plan is to support the goal of Council for the water activity and to meet community outcomes, Council priorities and focus areas for present and future customers

The content of the Plan further supports the purpose by:

- Demonstrating responsible, sustainable management and operation of water assets which represent a significant, strategic and valuable asset belonging to Nelson City.
- Justify funding requirements.
- Demonstrating regulatory compliance under Section 94(1) of the Local Government Act 2002 which in summary requires the Council Long Term Plan to be supported by:
    - Quality information and assumptions underlying forecast information.
    - Framework for forecast information and performance measures are appropriate to assess meaningful levels of service.
- Demonstrating clear linkage to community agreed outcomes Council priorities and focus areas with stated levels of service.

The contribution of water services to the Community Outcomes and objectives will be seen through:

- Stakeholder consultation to establish service standards.
- A programme of inspections and monitoring of the network to assess asset condition and performance.
- Undertaking a risk based approach to identify operational, maintenance, renewal and capital development needs, and applying multi-criteria analysis techniques to select the most cost effective and sustainable work programme.
- Ensuring services are delivered at the right price and quality.
- Achieving the appropriate level and quality of asset management practice.
- Continuing programme of capital works.
- Futureproofing and resilience.
- Looking for opportunities to reduce Council's greenhouse gas emissions and respond to the 16 May 2019 Council Declaration of a Climate Emergency.

The overall objective of activity management planning is to:

Deliver a defined level of service to existing and future customers in a sustainable and cost effective manner.

This Plan will provide the substantiation for budget forecasts put forward in the Long Term Plan (2021-2031) for the water supply activity.

1.1.2. Relationship with other planning documents

Infrastructure Strategy

In 2014 the Local Government Act 2002 was amended to include section 101B - a requirement for local authorities to prepare an infrastructure strategy as part of the Long Term Plan. The strategy is expected to look at least thirty years into the future and detail the issues that the local authority can reasonably foresee. The office of the Auditor General has provided guidance documents for authorities to use when developing the strategy.

Much of the work required for the strategy comes from the development of this Plan and in order to avoid un-necessary duplication this plan focusses on the first ten years of the thirty year strategy timeframe.

Current Nelson Resource Management Plan

The Nelson Resource Management Plan (NRMP) is the operative plan established under the Resource Management Act 1991. Council seeks to operate the current network in compliance with this document. To that end Council holds a range of resource consents for site specific activities including the abstraction of water from the Maitai and Roding rivers plus structures in the rivers.

Proposed Whakamahere Whakatū Nelson Plan

The draft Whakamahere Whakatū Nelson Plan is currently being developed by NCC as the replacement for the NRMP. While the impact of this plan on the operation of the water network will become clearer as the proposed plan rules are developed it is expected that there will be an increased emphasis on water quality as the proposed plan responds to the National Policy Statement for Fresh Water Management. The proposed plan will also include Council's response to the requirements of the NZ Coastal Policy Statement and the National Policy Statement Urban Development Capacity. Cost implications will be identified in future activity management plans.

Environmental Activity Management Plan

Fresh water quality is a key component of the central government environmental programme for New Zealand. The National Policy Statement for Fresh Water Management is expected to halt the decline in fresh water quality and lead communities to the point of actively improving it.

Council's investigations of water quality show very good results in upper catchments where undisturbed native bush predominates and lesser quality through farm/forestry areas and urban sections of the catchment.

Where water supply activity works involving streams and rivers are undertaken by Council, environmental protection is considered in the design and resource consent process. Among the activities that enhance water quality and the wider environment are the following:

- Stream waterway environmental enhancement from the south branch intake downstream to the original North Branch fork e.g. natural gravel management in beds where practicable, protection of natural river banks, river bank shade through vegetation, protection of fish spawning areas, protection of natural 'pool and riffle' stream bed form, natural meanders where possible, free of manufactured obstructions that impede fish passage where practicable.
- Trap and Transfer programmes to ensure fish are assisted past the larger Maitai and Roding dams where obstructions cannot be remedied.
- Improved quality of water discharged to the Maitai River from the Maitai Dam reservoir through careful selection of intake points in the dam to supply the backfeed with the best available water and possible future reservoir aeration.
- Various riparian planting initiatives under this Plan and the environment activity plan.
- Freshwater and sediment contaminant monitoring.
- The establishment of re-forestation areas in the waterworks reserve under the reserves activity management plan.

Certified Emissions Measurement and Reduction Scheme (CEMARS- Toitū Envirocare) Action Plan

Council has undertaken to measure and reduce its carbon emissions. This started with all organisational emissions for 2017/18 being measured, and the development of a draft preliminary action plan for emissions reduction (refer appendix K). Council has set a target for emissions reduction in-line with the Climate Change (Zero Carbon Amendment) Act 2002 (net carbon zero by 2050, with the exception of biogenic methane, for which there are a range of targets from 24 to 47% reduction).

Iwi Management Plans:

These are accessible on: http://www.nelson.govt.nz/council/plans-strategies-policies/strategies-plans-policies-reports-and-studies-a-z/iwi-management-plans/

Ngā Taonga Tuku Iho Ki Whakatū Management Plan (2004):

This is a collective initiative involving five of the six local iwi (Ngati Rarua, Ngati Toa Rangitira, Ngati Te Atiawa, Ngati Koata and Ngati Tama) that gives a big picture approach to the management of nga taonga tuku iho (the treasured resources).

Other Iwi management Plans include:

- Pakohe Management Plan 2015: (Ngati kuia) - Kaupapa (purpose) of the Pakohe Management Plan He Taonga Pakohe tuku iho - Mai ngā tūpuna ki ngā mokopuna (Maintaining our whakapapa and historical connections to Pakohe for today and for future generations and for managing its sustainable use forever).

- Iwi Management Plan 2002: (Ngati Koata) - The primary purpose of this IMP is to provide a means by which Ngati Koata are properly and fully considered in decision-making affecting their interests in Te Tau Ihu.

- Environmental Management Plan 2018: (Ngāti Tama) – The purpose of this plan is to highlight Ngāti Tama aspirations for managing ancestral whenua, awa, wāhi tapu and wāhi taonga in the Ngāti Tama rohe (from Whangamoa in the east to Kahurangi in the west).

- Te Tau Ihu Mahi Tuna (Eel Management Plan) 2000: (All iwi)-To ensure the sustainability of the eel fishery through good management which provides for a customary, recreational and commercial harvest.

Long Term Plan 2021-31

This Plan supports Council in the development of the Long Term Plan 2021-31 by providing the substantiation for budget forecasts put forward in the Draft Long Term Plan (LTP) for water supply.

As the Plan presents the recommendations for the future operations, maintenance and capital works necessary to meet the levels of service for the water supply activity, the LTP consultation is the means for the community and Council to provide direction on priorities and affordability for the next ten years.

Annual Plan

On an annual basis Council reviews the work programme and budgets for the following year and when changes are required will prepare an Annual Plan for public submissions.

Future Development Strategy

The National Policy Statement on Urban Development (2020) impacts on the activity management plans and Infrastructure Strategy. It requires local authorities to ensure there is sufficient development capacity to meet demand in the short, medium, and long term (10 – 30 years) with projects required to be identified

In response to the previous National Policy Statement on Urban Development Capacity (2016) NCC and TDC jointly adopted the Nelson Tasman Future Development Strategy in 2019. The strategy sets out how the combined region intends to plan for its future housing capacity to accommodate projected growth in population and households, as well as the attendant business and other demands this growth will bring. The impact on water volume and quality for these future growth areas is one of the key focus areas for this activity management plan and is covered in more detail in section 3.5. In particular the following features shape the response to growth:

- Ensuring sufficient source water available to meet increasing demand
- Adequate network reticulation to meet new residential/commercial/industrial development
- Adequate storage across the city for resilience
- Robust treatment process to maintain health of residents
- Source catchment protection to ensure security of raw water supply

Nelson-Tasman Land Development Manual 2019

This is the document that sets out Council's engineering requirements for developments under the NRMP and is the basis of Council's requirements as a network utility operator under the Building Act 2004. The new manual has been developed jointly with TDC and community stakeholders.

1.1.3. Infrastructure assets included in the plan

Asset description

The assets covered are from the source water intakes in the water catchments to the point of supply at individual customers' boundaries. This includes dams, intake structures and screens, control equipment, the Water Treatment Plant, tunnels, trunk mains, secondary mains, rider mains, services, valves, hydrants, non-return valves, pressure reducing valves, pumps, reservoirs, and water meters.

The extent of the NCC water system is shown in the Figure 1-1 and is discussed in more detail in the background of Section 4. Lifecycle Management of this plan.

Figure 1-1: Water Network Nelson

1.1.4. Key partners and stakeholders in the plan

The plan recognises the following external and internal key partners and stake holders:

Table 1-1: Key Partners and Stake Holders

Key Partners and Stakeholders	Main Interests
Key Partners	
Tangata Whenua comprising of regional iwi	Environment, cultural heritage
Tasman District Council (unitary authority)	Service provider
External Partners and Stakeholders	
Residents and ratepayers	Public health and safety, service reliability, environment, cost
Industrial and commercial users	Public health and safety, service reliability, environment, cost
Nelson Marlborough District Health Board	Public health and safety, environment
Government agencies (MoH, MfE, Audit NZ)	Public health and safety, service reliability, environment, cost
Consultants, contractors and suppliers	Procurement, technical, projects/programmes
New Zealand Fire Service	Urban and rural fire fighting
Internal Stakeholders	
Councillors and Council officers	Public health and safety, service reliability, environment, cost, impact on other utilities

Integrating supply with Tasman District Council

Historically NCC and TDC have partially linked water supplies, with TDC supplying a small section of the southern part of Nelson City off Champion Road and Hill Street North as well as the Wakatu Industrial Estate- including Alliance Group Ltd plant and the fruit processing operation of Enzafoods Ltd. NCC supplies Richmond the lesser of 909m^3 of water/day or 1/15 of the Roding authorised supply rate, arising from legislation covering the construction of the Roding Dam.

Council has an Engineering Services Agreement (ESA) (2015) with TDC covering these services.

This agreement also includes a small number of cross boundary infrastructural services of sewer and stormwater reticulation that apply to parts of the above areas. In 2020 changes in the water supply environment arising out of the TDC decision to begin construction of the Waimea Community Dam plus the development of the large Summerset retirement village in the south Nelson area lead to starting the re-negotiation of the ESA.

The supply of water to ENZA and the Alliance Group plant was subject to individual contracts between TDC and the customer that expired in June 2020. The existing terms have been extended until such time as a new agreement is signed by both Councils.

The integration of the two supplies reduces the need for NCC to duplicate existing TDC trunkmain reticulation to this area of the city. This has both an economic benefit and a

GHG reduction benefit by way of less plastic pipe production and hydro-carbon emission from transport and construction activities.

Under this Plan consideration is given to investigating the most economical and efficient supply of these areas by NCC should the agreement with TDC be terminated prematurely.

1.1.5. Organisation structure

Council has an activity based structure with operations & maintenance (O&M) and asset management functions for water supply assets provided by a separate operations and asset management team with the Utilities Business Unit. The Capital Projects team supports the water supply activity through delivery of project work by project managers who sit in a separate business unit.

The day to day operations and maintenance of the network are carried out by the following contractors on Council's behalf:

- Headworks (dams, intakes, raw water delivery) and the water treatment plant- Fulton Hogan Ltd.
- Treated water network reticulation, storage reservoirs and pump stations- Nelmac Ltd.

Asset management functions are undertaken by Activity Engineers.

1.2. Climate Change

Climate change has been identified as an over-arching issue as it potentially has a bearing on all of the identified issues for water activity supply over the decades to come.

Climate change and reduction in greenhouse gas emissions.

Climate change is a significant and urgent international, national, and local issue. At a local level, NCC has a key role to work with the community towards mitigating the driving factors of climate change and creating a resilient and low emissions future and implementing adaptive measures to manage and minimise risk. The water supply activity is part of the wider community commitment to reducing GHG's through implementing Council's Certified Emissions Measurement and Reduction Scheme (CEMARS- Toitū Envirocare) Action Plan. The activity also needs to recognise the leadership role of Council and be able to develop climate change mitigation and adaptation strategies to advise the location, design and operation of our future infrastructure.

Budget has been identified for the following strategic responses:

- Climate Change Emission Reduction Strategy 2021/22 onward.
- Climate Change Vulnerability Assessment 2021/22 onward.
- Climate Change Adaptation Strategy 2022/23 onwards.

Central government introduced the Climate Change Response (Zero Carbon) Amendment Act in 2019. This legislation:

- Sets greenhouse gas emission targets at zero by 2050.
- Establishes a system of emissions budgets.
- Requires government to develop and implement policies for climate change adaption and mitigation.

- Establishes a Climate Change Commission.

To date Council has been using national generic climate change advisory reports that provide guidance on the more global impacts of climate change. A focus of the first five years of this plan is to investigate in depth the impact on Nelson City and the water supply activity.

At a local level, Council's preliminary understanding of the impacts of climate change are that it will:

- Increased air, water and ground temperatures.
- Raised sea levels.
- Higher rainfall intensity and more regular droughts.

1.2.1. Climate change effects on the Water Supply Activity

The direct impacts of climate change are likely to result in the following:

- **Sea level rise**

  Sea level rise is one of the biggest climate challenges for Nelson as a large proportion of our urban infrastructure is coastal or low lying. These areas will become more vulnerable to coastal inundation (flooding) as tides and storm surges extend further inland over time.

  Some of the key impacts this will have on the water supply activity are as follows:

  - Coastal erosion has the potential to damage roads and the water supply assets located in vulnerable coastal areas.
  - Increased risk of liquefaction to Council assets and urban areas generally due to higher water table in coastal areas.

- **Heavy rainfall and flooding events**

  Higher intensity rainfall events will result in an increase in surface water, stormwater and stream flows. The implication for the community is that without mitigation of these effects, they may experience more regular and extensive flooding from streams, rivers and stormwater overflows. The impacts this will have on the water supply activity is as follows:

  - Water intake structures, dams, pipelines, bridges and culverts that cross streams and rivers are at risk of being damaged during high flow events.
  - The increase in storm rainfall intensity will result in higher sediment volumes entering the rivers and streams which is expected to increase maintenance requirements of intake structures and increase the use of the Maitai Dam which will lead to higher treatment costs.
  - Heavy rainfall can also initiate slips that can impact pipelines on exposed benches or slopes, such as the Maitai Raw Water line and the treated supply lines to the city from the WTP. The treatment plant itself is also at risk of damage from slips from adjacent slopes.

- **Gradual Temperature rise**

  Gradually increasing temperatures lead to an increase in base demand for water and associated higher operational costs with reduced supply resilience as water takes increase from rivers. Increasing temperatures in rivers and the Maitai Dam can lead to increased risk of waterborne pest weeds and algae.

- **Droughts and extreme temperatures**

  With a warmer climate, the community will be exposed to more extreme temperatures and longer and more severe droughts. This will also have a negative impact on the environment, particularly with our streams and rivers. The impact this will have on the water supply activity is as follows:

  - Increase in water supply abstraction from the rivers and reservoir due to increased demand. This will have an impact on the flows within the rivers and increase the likelihood of moving to water restrictions

  - Droughts are expected to become more regular and potentially more severe. This may result in the water restriction requirements for residential and commercial use becoming more severe than those at present

  - Droughts will increase the likelihood of forest fires within the water supply catchment. This will have an effect on water quality, increased operational costs, and potential damage to key lifeline assets (i.e. Maitai raw pipeline)

1.2.2. Leadership

At an Extraordinary meeting of Council on 16 May 2019 Council considered the issue of climate change and the role Council and the community could play in mitigating and adapting to the challenges it presents. The meeting resolution was in five parts. Parts 1 and 3 are as follows:

1. *(Council) Publicly declares that the world is in a state of climate emergency that requires urgent action by all levels of government; that human-induced climate change represents one of the greatest threats to humanity, civilisation, other species, and the life-supporting capacity of air, water, soil, and ecosystems; and that it is possible to prevent the most harmful outcomes, if societies take sustained emergency action, including local councils.*

3. *(Council) Commits to examine how Council's plans, policies and work programmes can address the climate emergency and ensure an emergency strategy is embedded into all future Council strategic plans.*

This Plan identifies the work programmes that will be required for the water supply activity to support the resolution.

1.2.3. Climate Change Mitigation

For the timeframe covered by this Plan mitigation actions are expected to centre on reducing the discharge of GHG's into the environment.

At the Council meeting of 13 August 2020 Council approved the following resolutions regarding emission reduction targets for GHG's:

- *Commits to adopting the five-year emissions reductions budgets to be confirmed by government in 2021 as a way of ensuring Council takes early and substantive action towards achieving carbon neutral status with measurable positive changes by 2025;*
- *Agrees that Nelson City Council adopts the Government targets for Council's own greenhouse gas emissions reductions (i.e., net zero emissions of all GHGs other than biogenic methane by 2050, and a 24 to 47 per cent reduction below 2017 biogenic methane emissions by 2050, including 10 per cent reduction below 2017 biogenic methane emissions by 2030); and*
- *Agrees that work is undertaken to develop specific emission reduction projects for inclusion in the Long Term Plan 2021-31, along with development of a comprehensive Council "Emissions Reduction Action Plan" in line with timeframes to produce the upcoming Long Term Plan; and*
- *Notes that a strategic framework, to bring together and provide high level guidance to all of the key elements of climate change work underway in Council, will be considered and scheduled through the development of the Long Term Plan 2021-31;*
- *Notes that work to set targets and reduce emissions in the Nelson Tasman Regional Landfill Business Unit is critical to address Council's entire emissions profile and that substantial work is already underway in the Nelson Tasman Regional Landfill Business Unit to measure and reduce emissions; and*
- *Notes that the development of community emissions targets and actions will be undertaken as a separate piece of work, aligned with the strategic framework and the work currently being undertaken by the Nelson Tasman Climate Forum; and*
- *Advocates to central government for an appropriate legislative and regulatory framework to support the local government sector to achieve carbon zero status*

These targets are intended to be achieved through the development and implementation of a Council-wide 'Emissions Reduction Action Plan'.

A preliminary assessment of the water supply activity's contribution to current Carbon emissions suggests that the contribution is very small and principally related to the use of electricity.

Figure 1-2: Carbon Emission For Water Supply Activity Compared With All Of Council (Preliminary)

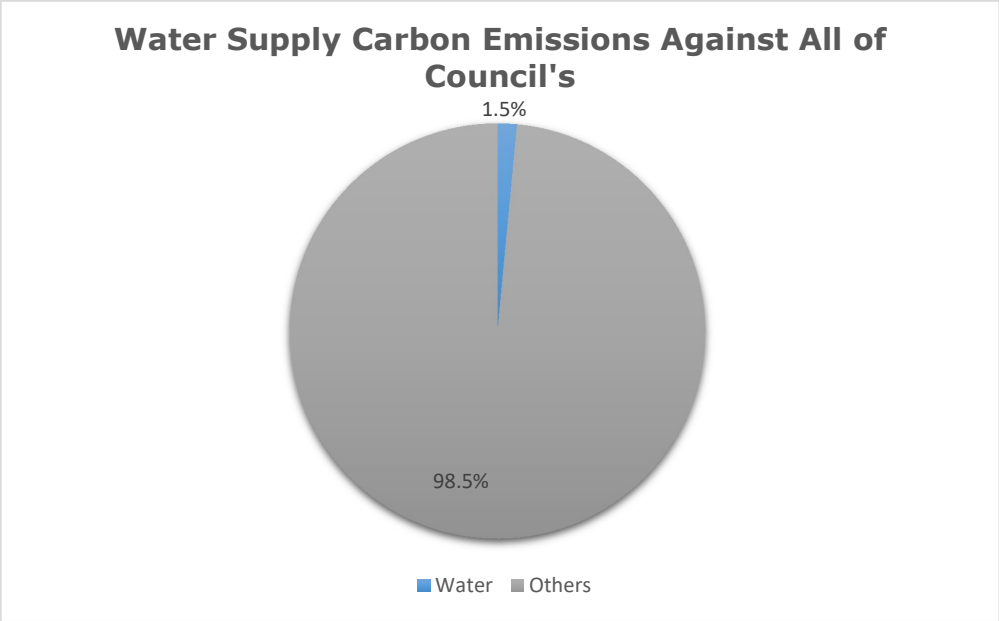
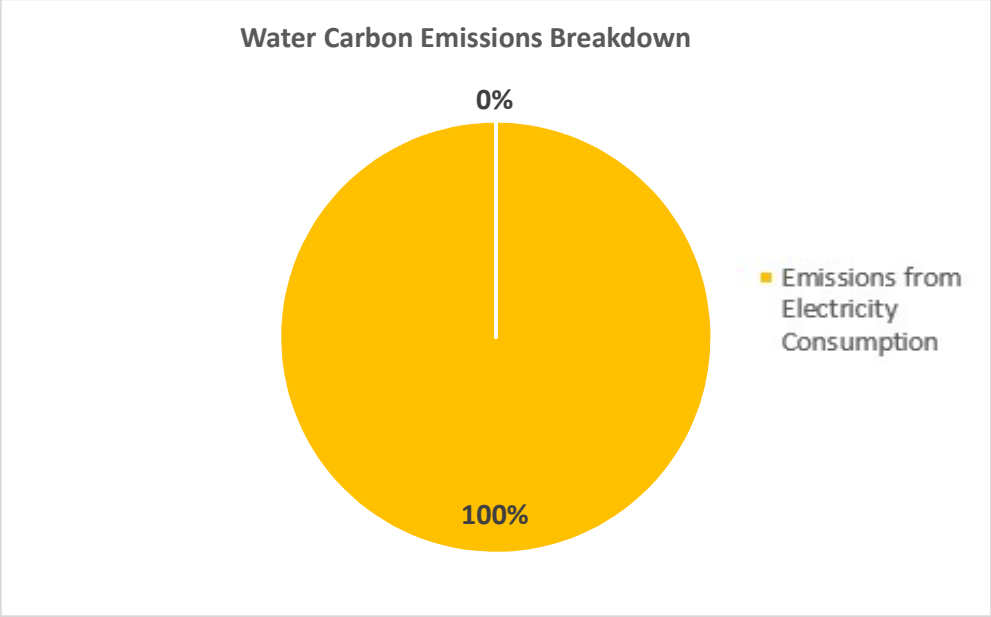


Figure 1-3: Source of Carbon Emissions for Water Supply Activity (Preliminary)



In order to support the Council resolutions the following knowledge gaps have been identified:

- Exact emission reduction budgets to be confirmed by central government in 2021.
- A comprehensive analysis of the sources of production of all GHG's by the water supply activity and details of quantities.
- What options are currently available for reducing and eliminating GHG's in line with the Council resolution.
- The effectiveness and affordability of GHG reduction options.

Budget has been identified for the following strategies and capital response:

- Climate Change Emission Reduction Study 2021/22-2022/23. $30,000.
- Climate Change Mitigation and Adaptation Projects 2025/26 onward. $4.3M (In conjunction with adaptation below).

Areas for further investigation to aid mitigation are:

- The potential for further electricity generation, particularly in the gravity trunk mains and use of photovoltaics.
- Consideration of materials that allow rehabilitation of existing watermains rather than replacement.
- Opportunities for co-construction of assets with other utilities to reduce use of construction plant and bitumen based road surfacing materials.
- Use of more energy efficient technology at the water treatment plant and pump stations.
- Use of nett zero carbon emission bulk electricity supplier(s).
- Reduced use of petrol and diesel powered vehicles for operations and maintenance activities.

The outcome of this work stream will feed into the Council's overall Emissions Reduction Action Plan.

1.2.4. Climate Change Adaptation – responding to the effects of climate change

Council is in the process of developing an understanding of the specific impacts of climate change on the Nelson City Area and how they will shape the community into the latter part of the century. Adaptation is the partner to mitigation in preparing the Council's response to climate change.

Areas for adaptation in the water supply activity will need to match wider community changes as follows:

- Ensuring renewals are programmed to respond to sea level rise issues and avoid un-necessary expenditure in areas that will not require services in the long term.
- Closely monitoring rainfall patterns to better prepare for fluctuating water demand.
- Monitor river temperatures and flows to track impacts on aquatic environment and resource consent compliance. Some changes to operating techniques and/or resource consent conditions may be required.
- Review flood capacity of the Maitai Dam to anticipate impacts of more extreme rainfall.
- Review demand management strategies and water loss programmes to prepare for future drought scenarios.
- Develop fire response plans for catchment forest fires.
- Upgrade testing for micro-organisms in the Maitai Dam to better predict algal blooms and diatom impacts.
- Develop network upgrades in hand with renewals to allow flexibility in establishing new residential areas across the city.

The following knowledge gaps have been identified:

- A comprehensive analysis of the water supply network's exposure to impacts of climate change.
- What options are currently available for adapting to the impacts of climate change in the short, medium and long term.
- The effectiveness and affordability of adaptation options.

Budget has been identified for the following strategies and capital response:

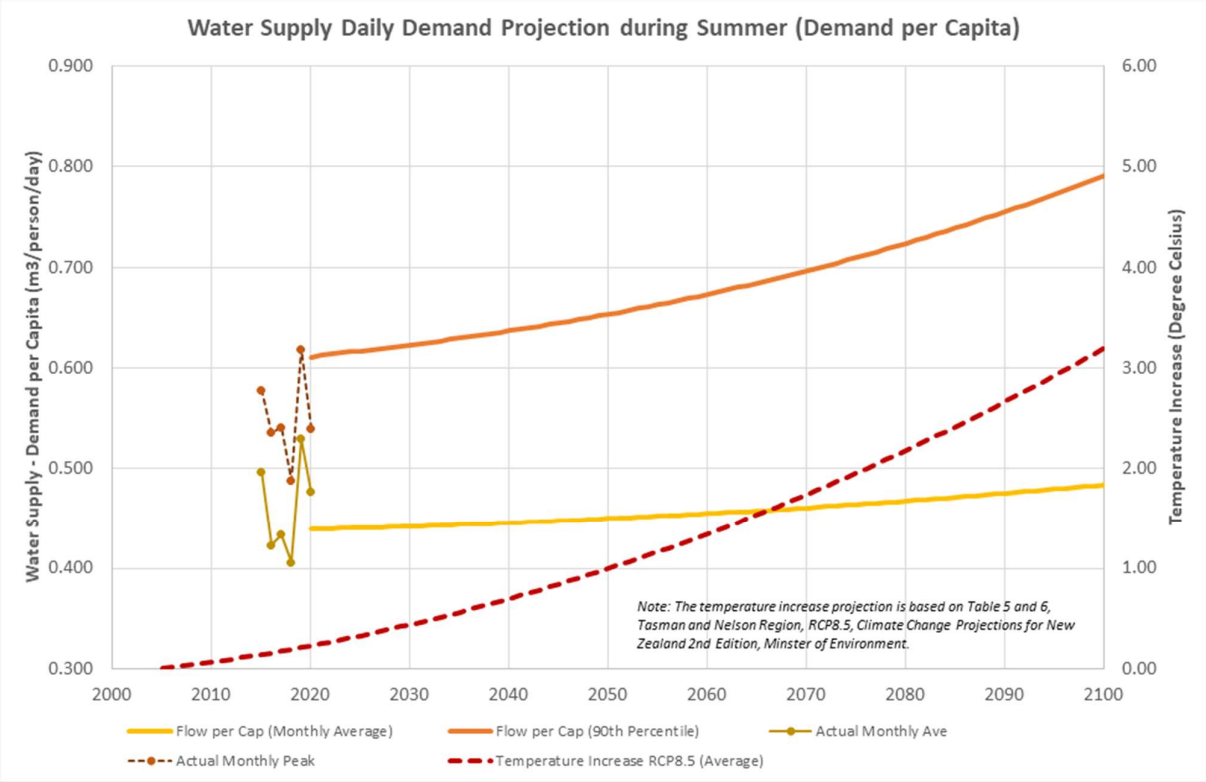
- Climate Change Vulnerability Assessment 2022/23-2024/25 ($150,000).
- Climate Change Adaptation Strategy 2025/26-2026/27 ($100,000).
- Climate Change Mitigation and Adaptation Projects 2025/26 onward ($4.3M in conjunction with mitigation above).

Areas for further investigation to aid adaptation are:

- Detailed condition assessment of assets likely to be impacted by sea level rise to advise renewal and growth servicing strategies.
- Ongoing monitoring of weather patterns to better anticipate drought events.
- Improving demand management outcomes to reduce water use.
- Improving water loss monitoring and response.
- Identifying and securing additional raw water sources.
- Monitoring water demand as base temperatures increase.

Figure 1-4 below shows preliminary in-house modelling of expected base water demand increases as temperature rises. This mimics the seasonal demand increase already experienced. Monitoring this trend is part of Council's adaptation planning.

Figure 1-4: Draft Future Demand Modelling with Temperature Rise



1.2.5. Climate Change Planning Assumptions

In order to frame the activity response to climate change the following assumptions have been made:

- The contribution of renewable energy sources to the national grid will progressively increase over time (currently targeting 90% renewable energy by 2025). This is expected to contribute to a steady reduction in the carbon footprint of Council assets that draw on mains power.
- Where emissions cannot be reduced, a Council wide offsetting approach will be developed.
- Sea level rise by 2090 will be approximately 0.67m, and by 2130 will be approximately 1.1m-1.5m.
- Temperature warming, which contributes to increased storm rainfall intensity will follow the RCP 8.5 scenario, and sea level rise will follow RCP 8.5 M (mid-range) projections. Projected temperature increase and sea level rise at 2090 are 2.6°C and 0.67m respectively (relative to 1986-2005 baseline). Use of the RCP 8.5 scenario is based on stormwater design standards contained in the LDM 2019. This will be reviewed as climate change monitoring and assessment techniques develop over time.
- Construction materials and techniques will be available that meet net zero GHG emissions by 2050.
- The community will confirm appropriate levels of service and affordability limits that support the Council resolution.
- Council will undertake investigations of the impacts of climate change on the Nelson City geographical area.

- Funding will be available to specifically assess the potential impact of climate change on the Water Supply Activity.

- Defend, Retreat or Accommodate: For the purpose of planning the 30 year programme, it is assumed at this stage that asset renewals and upgrades will continue in low-lying areas that are subject to flooding and coastal inundation. Following notification of the Whakamahere Whakatū Nelson Plan it is anticipated that new development in these areas will be designed to be resilient to flooding out to 2130. Wider community engagement is required to inform adaptation responses for existing development in these areas.

1.2.6. Community Engagement

Climate change is a significant issue facing the community. In order for the Council controlled water supply activity to respond to future challenges, wide community engagement is called for. This is expected to come from a number of Council activities as follows:

- Statutory consultation for the Long Term Plan and Annual Plans.

- Whakamahere Whakatū Nelson Plan consultation on natural hazards overlays (including flood maps) and provisions (Objectives, Policies, Rules and Methods)

- Notification of resource consents where required.

- Coastal Hazard Adaptation: Consultation is to be undertaken with the wider community on this significant issue.

1.3. Goals and objectives of asset ownership

1.3.1. Reasons and justification for asset ownership

The role of Council
Historically NCC has been the predominant water provider to the residents of Nelson.

Council is responsible for the provision of reticulation, treatment and supply along with strategic planning, including responsible climate change decision making and management functions.

Council also has a role in regulation and enforcement of the existing legislative and regulatory framework (including bylaws) to ensure members of the community act appropriately.

The decision to maintain this role is supported by the following legislative requirements:

The Local Government Act:

The Local Government Act 1974: Provides the authority for Nelson City Council to construct, operate and maintain the Wastewater, Water and Stormwater System.

The Local Government Act 2002: Defines the purpose of local authorities as enabling local decision-making by and on behalf of the community. The Nelson City Council is a local authority established under the Local Government Act 2002 (the Act) with purpose and responsibilities set out in the Act, in particular 10(1)(b), 10(2) and 14(1)(h).

The Health Act 1956:

Places an obligation on Council to improve, promote and protect public health within the District. The provision of water services helps to promote and improve public health through compliance with the Drinking Water Standards 2005 (Revised 2018).

1.3.2. Links to organisation vision, mission, goals and objectives

Vision

Nelson is a Smart Little City: *e tāone tōrire a Whakatū*

Mission statement

We leverage our resources to shape an exceptional place to live, work and play.

Community outcomes

Councils are required by the Local Government Act 2002 to have Community Outcomes – a statement of the measures of success that Council is working to achieve for the community. Council has eight current community outcomes in the LTP 2018-2028 that are summarised below.

- Our unique natural environment is healthy and protected.
- Our infrastructure is efficient, cost effective and meets current and future needs.
- Our region is supported by an innovative and sustainable economy.
- Our communities are healthy, safe, inclusive and resilient.
- Our urban and rural environments are people-friendly, well planned and sustainably managed.
- Our communities have opportunities to celebrate and explore their heritage, identity and creativity.

- Our communities have access to a range of social, educational and recreational facilities and activities.
- Our Council provides leadership and fosters partnerships, a regional perspective, and community engagement.

Of these eight the first four have direct links with the water supply activity and are discussed in more detail in Section 2 Levels of Service.

Council Priorities and Focus Areas

Council has the following four priorities and three focus areas for the development of the city for the period covered by this Plan. These form the high level strategic direction for the activity and are influenced by the need to recognise the overarching importance of climate change:

The Four Priorities

- **Infrastructure.** The water supply activity is critical to the residents and business activities in the city. Good operation and maintenance of the network plus timely renewals and upgrades to maintain capacity underpin the water supply activity. The impact of the Covid 19 virus on the local economy in 2020 is yet to be fully quantified and it is likely that some changes to budgets will need to be considered by Council through the LTP process.
- **Environment.** The city water supply is the largest abstractor of water from the Maitai and Roding Rivers. Maintaining both the supply to the city and the wider river environments is an important balance that the activity undertakes. Climate change will increase demand for water from the rivers for the water supply and also may require changes to minimum flows as water temperatures increase.
- **City Centre Development.** The CBD is the heart of the city and ensuring business and residential activities have adequate water supply to be successful and grow is very important to Council's long term strategy.
- **Lifting Council Performance.** To achieve Council's vision of Nelson is a Smart Little City, there needs to be supporting strategies and projects that enables this to happen. The projects in this activity management plan reflect the need to follow infrastructure best practice principles, while always seeking to improve how we partner with the community.

Focus Areas

- **Creating a sustainable transport culture**. To increase the proportion of journeys made using sustainable transport options (active transport - cycling and walking, electric vehicles, micro-mobility, and public transport).
- **Housing – Intensification and affordability**. In order to ensure growth in the city can be sustained into the future Council must ensure there are adequate water supplies available to match development timeframes. Areas for likely development in the next 10-15 years have been identified by Council and will be prioritised for service
- **Maitai River Precinct.** It is likely that the future Maitai River Precinct will include more open public space and recreation areas, as well as providing improved links to the City Centre, Trafalgar Centre, Rutherford Park, and down to the Haven Precinct. In order to allow for increasing construction of buildings requiring fire sprinkler systems in the central city area the network of ringmains will need to be upsized as they are renewed. The first part of this work is being carried out with the Hardy St-Vanguard St upgrade in 2020/21.

Nelson City Council Arts Strategy

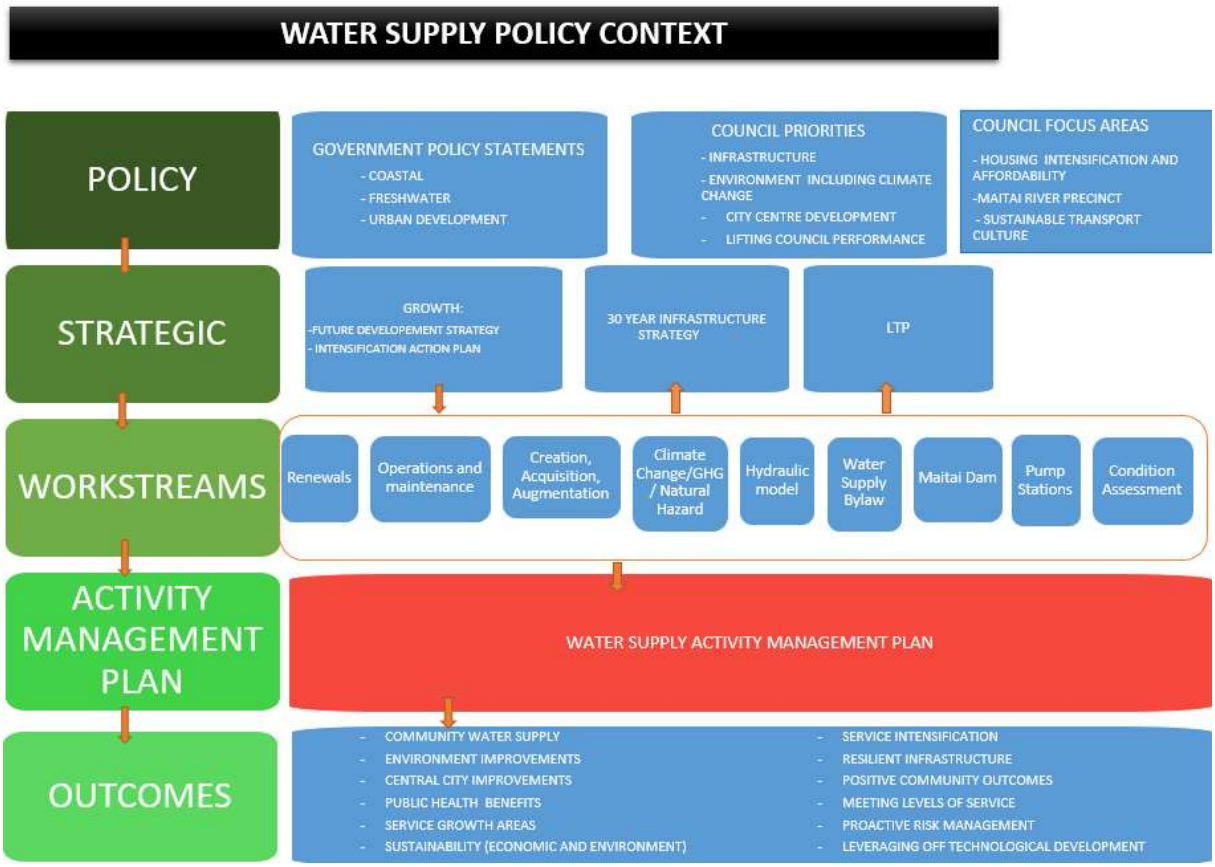
Where opportunities present themselves, consideration will be given to the incorporation of artwork in the water network.

1.3.3. Plan framework and key elements

The framework of the Plan follows the generic layout identified in section 4.2 of the International Infrastructure Management Manual 2015 (IIMM).

Figure 1-5 outlines the wastewater activity policy context and framework.

Figure 1-5: Water Supply Policy Context



The plan has the following key elements:

- Why we need a plan (Introduction)
- What we provide (Levels of service)
- Planning for the future (Future demand)
- How we provide the service (Lifecycle management)
- Dealing with uncertainty (Risk management plan)
- What it will cost and how we pay for it (Financial summary)
- What we're doing to improve (Plan improvement and monitoring)

1.4. Activity Management Maturity

Asset Management is recognised as a critical component of Infrastructure Management globally and this sector has benefited from initiatives to formalise the practice of asset

management since November 1996. The Association of Local Government Engineering New Zealand (Inc.) and the Institute of Public Works Engineering of Australia have lead the development of the International Infrastructure Management Manual (IIMM) that forms the basis of Infrastructure Asset Management Practices at Nelson City Council.

The IIMM provides an Asset Management Maturity Index. The Nelson City Council Asset Management Policy sets the level of maturity per activity. Overall the current Water Supply Activity Management Maturity is considered to be core-intermediate. Refer to the Plan Improvement and Monitoring – Status of AM Practices in Section 8 for details.

2. Levels of service

Activity Management Plans set out the level of service Council seeks to provide the community for the respective activity.

Levels of service are the standards Council aims to meet when providing a facility or service in support of community outcomes. They are the measurable effect or result of a Council service, described in terms of quality, quantity, reliability, timelines, cost or similar variables. These reflect the requirements of the Department of Internal Affairs for reporting non-financial measures.

It should be noted that levels of service are not intended as a formal customer contract, rather, Council's responsibility is initially to aim to achieve these levels and then to achieve them more cost effectively through a process of improvement where it can be met within current budgets.

The levels of service provision for the water supply activity, the current performance and the performance measures and targets by which these will be assessed are defined in this section.

This section also contains information on customer research undertaken, strategic and corporate goals and the legislative requirements adhered to in arriving at the levels of service.

Changes to the levels of service may significantly change funding requirements in some instances.

Performance measures that are included in the Long Term Plan are reported on quarterly via the Infrastructure Quarterly Report and annually, through the Annual Report.

Council uses the Significance and Engagement Policy to determine the level of engagement required for a particular issue e.g. levels of service change.

Service Level Expectations and Affordability

The levels of service set in this Plan are subject to change as legislation changes. The community can also request increases above the minimum levels as long as there is a willingness to fund the financial implications.

2.1. Customer research and expectations

While the LTP consultation process incorporates the Levels of Service associated with the water supply activity, NCC has also undertaken a range of consultation processes in the past specifically targeted at gathering information on preferred levels of service or the extent of infrastructure that Council has/will be required to install. The nature of the historical and additional proposed consultation is detailed in Table 2-1 below.

Table 2-1: Water Supply Consultation Processes

Consultation Processes	Date	Reasons for Consultation	Extent of Consultation	Applicable to Which Customer Value
Historical				
Water and Sanitary Services Assessments	2005	To meet sanitary services assessment criteria of the Local Government Act 2002	Consultation via the Long Term Council Community Plan for acceptance of the original assessment. Consultation with Medical officer of Health and local iwi and the community for any future review.	Reliability Capacity
Residents Survey	Most years since 1998	Rate satisfaction with services provided by Council	300 - 400 residents surveyed by telephone	N/A
Water abstraction and structures resource consents for the Maitai and Roding Rivers	2019/2017	Expiry of existing consents	Maitai consent was publicly advertised.	Sustainability
Water Supply Bylaw	2014/2020	Legislative requirement criteria of LGA 2002	Public, business and industry submissions requested. Advertising in local papers. Submissions heard and considered	Sustainability Capacity
Long Term Plan process	Every 3 years	Legislative requirement criteria of Local Government Act 2002	Public, business and Industry submissions requested. Advertising in local papers	Sustainability Reliability Capacity Responsiveness
Annual Plan process	Each year that changes to the Long Term Plan are proposed	Legislative requirement criteria of Local Government Act 2002.	Public, business and Industry submissions requested. Advertising in local papers.	Sustainability Reliability Capacity Responsiveness

Water and Sanitary Services Assessments

The aim of the Water and Sanitary Services Assessments is set out in section 126 of the Local Government Act 2002 as follows:

The purpose of an assessment under section 125 is to assess, from a public health perspective, the adequacy of water and other sanitary services available to communities within a territorial authority's district, in light of—

(a) the health risks to communities arising from any absence of, or deficiency in, water or other sanitary services; and

(b) the quality of services currently available to communities within the district; and

(c) the current and estimated future demands for such services; and

(d) the extent to which drinking water provided by water supply services meets applicable regulatory standards; and

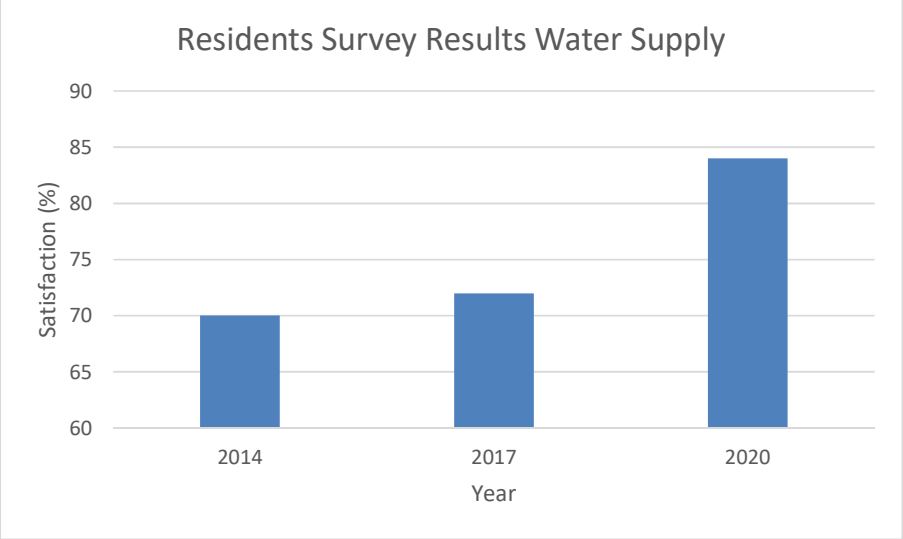
(e) the actual or potential consequences of stormwater and sewage discharges within the district.

The last comprehensive assessment was carried out in 2005 and still remains applicable for this plan. Any changes in the regulatory environment that are initiated by the new central government water services regulator will be closely monitored and a further sanitary service assessment will be carried out if required.

Residents' Survey

NCC measures a number of its satisfaction and user targets through an annual Residents' Survey. Gathering the views of the broader resident population is important in order to engage with residents who may not normally provide feedback. The method provides for representative data by randomly interviewing Nelson residents in line with population data. Longer twenty-minute surveys are undertaken prior to Long Term Plan years to inform decision making in these Plans. The water supply activity has had generally positive feedback in surveys since 2014. Issues of price, taste and chlorination are raised in comments. Results are reported to Council annually and are available on the Council's website.

Figure 2-1: Graph of Residents Survey results for water supply



The 2017 Residents Survey

Water Supply: The level of satisfaction remained high at 72% satisfied or very satisfied. The three areas of greatest dissatisfaction were dirty water/poor quality, chlorine in the water and taste of water.

2018 & 2019 Residents' Survey

The 2018 & 2019 residents' survey did not seek feedback on the Water activity.

2020 Resident's Survey

The 2020 survey was carried out in March and June. The water supply activity had a very high level of satisfaction among respondents with 84% satisfied or very satisfied with the supply. There were no particular areas for review or improvement identified in the results.

Resource Consents

Council is required to obtain consents under the Resource Management Act for the abstraction of water and the continued operation and maintenance of water supply structures. These consents set the legal minimum level of service for values such as volumes of water that can be abstracted, minimum flows in the rivers and constraints on operations that impact the quality of the water flowing in the river. Where these applications are publicly notified the opportunity is given for any person to make a submission on the proposal.

Water Supply Bylaw

Council established the bylaw under the Local Government Act to provide a basis for the supply of water to the community and set out the regulatory response for infringements.

The bylaw is advertised using a special consultative process under section 86 of the Local Government Act 2002.

The current Bylaw came into effect 4 March 2015 and is being replaced with a new Water Supply Bylaw in 2020-21.

Long Term Plan

The LTP covers the operation of the water supply activity including the reasons for undertaking the activity, levels of service, description of major projects, financial projections and any key risks that have been identified. Members of the public can make submissions directly to Council regarding any of the areas covered in the Plan.

Annual Plan

When variations to the long term plan are proposed by Council the Local Government Act requires these be set out in an annual plan for public consultation.

2.2. Strategic and corporate goals

Community Outcomes

Councils are required by the Local Government Act 2002 to have Community Outcomes - a statement of the measure of success that Council is working to achieve for the community. Council's community outcomes are set out in the LTP 2021 – 2031. The link between the community outcomes and the water supply activity is shown in Table 2-2.

Table 2-2: Link between water specific Community Outcomes and the Water Supply Activity

Community Outcome	How this Council activity contributes to the outcome
Our unique natural environment is healthy and protected	*Nelson's environment is protected by an efficiently managed water supply network that respects the natural, recreational and heritage values that are present in the rivers that supply the network and works to protect ecosystem health.* Council sources its water from run of river intakes in water supply catchments that have been designated in the Nelson Resource Management Plan. Council also holds resource consents for the operation of the water supply that have specific conditions relating to volumes of water abstracted, minimum flows in the rivers, fish transfer and environmental enhancement.
Our infrastructure is efficient, cost effective and meets current and future needs	*A good quality, sustainable and affordable water supply network meets the needs of our current and future community.* *Sufficient and appropriate water supply is provided to ensure residential and business growth projections are achieved.* The city water supply makes good use of gravity reticulation to minimise pumping costs. Supply capacity is expected to ensure sufficient water until the mid-end of this century.
Our region is supported by an innovative and sustainable economy	*Water resources have an important role in supporting a range of businesses that rely on clean and reliable water supplies.* The Nelson City water supply provides potable water to the majority of residents and business activities in the city.
Our communities are healthy, safe, inclusive and resilient	*Safe and well managed water resources deliver critical health outcomes for the community.* The city water supply is processed through ultra-filtration membranes plus residual chlorination and meets the New Zealand Drinking Water Standards.

The community outcomes have been developed to provide a link between community issues and the current goal for this activity.

Table 2-3: Goal of the Water Supply Activity

GOAL OF THE WATER SUPPLY ACTIVITY
Provide a water supply to Nelson City that is capable of abstracting, treating and distributing potable water in an efficient, safe, reliable and sustainable way whilst ensuring that the ecological, recreational and cultural interests of the community in the water sources are recognised and enhanced.

2.3. Legislative requirements

Legislative requirements form the minimum level of service that Council is required to provide.

The water supply activity is shaped by the following legislative requirements:

Health and Safety at Work Act 2015: Council must ensure the safety of the public and all workers (including contractors) when carrying out works.

The Local Government Act:

The Local Government Act 1974: Provides the authority for NCC to continue to operate and maintain the Wastewater, Water and Stormwater System.

The Local Government Act 2002: Defines the purpose of local authorities as enabling local decision-making by and on behalf of the community.

NCC is a local authority established under the Local Government Act 2002 (the Act) with purpose and responsibilities set out in the Act, in particular:

10 Purpose of local government

(1) The purpose of local government is-

(a) to enable democratic local decision-making and action by, and on behalf of, communities; and

(b) to promote the social, economic, environmental, and cultural well-being of communities in the present and for the future.

14 Principles relating to local authorities

(1) In performing its role, a local authority must act in accordance with the following principles:

(h) in taking a sustainable development approach, a local authority should take into account-

(i) the social, economic, and cultural well-being of people and communities; and

(ii) the need to maintain and enhance the quality of the environment; and

(iii) the reasonably foreseeable needs of future generations.

5 Interpretations

good-quality, in relation to local infrastructure, local public services, and performance of regulatory functions, means infrastructure, services, and performance that are—

(a) efficient; and

(b) effective; and

(c) appropriate to present and anticipated future circumstances

130 Obligation to maintain water services

(2) A local government organisation to which this section applies must continue to provide water services and maintain its capacity to meet its obligations under this subpart.

In 2010 an amendment to the Act (sec 261B) required the Secretary for Local Government to make rules specifying non-financial performance measures for local authorities to use when reporting to their communities. These have been developed for water supply and are incorporated into the levels of service.

The Act also requires that local authorities take a sustainable development approach to everything they do.

The *Local Government (Community Well-being) Amendment Act 2019* led to significant changes to sections in Part 2 - Purpose of local government, and role and powers of local authorities. A greater emphasis has been placed on democratic local decision making and the four well-beings (cultural, social, environmental and economic) whilst sections relating to core service provision have less prominence.

Resource Consents Held for Water Supply

NCC has three Resource Consents for the water supply covering the abstraction of raw water from both the Roding and Maitai rivers, the continued operation of the Maitai Dam on the North Branch and intake weir on the South Branch of the Maitai River and the Dam/ intake weir on the Roding River. The consents and expiry dates are as follows:

- RM 165122, 165192, 165193 Maitai River granted 11 March 2019 expires 11 March 2054;
- RM 165239, 165317, 165318 Roding River granted 31 May 2017 expires 31 May 2052.

The resource consents associated with the water supply activity are detailed in Table 2-4 below.

Table 2-4: Water Resource Consents

Consent Number	Consent Type	Consent Expiry Date	Consent Allowance
RM 165239	Water Permit - Take, Use and Divert water • for the consumptive water take of 254 litres per second from the Roding River for public water supply purposes; • to take up to five cubic metres water per day from the upper Long Gully Weir associated with the maintenance of the screens at the Roding Weir intake; • To dam water behind the Roding Weir; • For the diversion of water over the Roding Weir and through the weir's intake screens; • To dam water in the Roding River by means of a temporary bund for the purpose of trapping and settling sediment upstream of the Roding Weir; • To divert the flow of the Roding River through the upstream diversion tunnel; and • To divert water over the upper and lower Long Gully Weirs.	31 May 2052	The consent holder must at all times control its take so that the flow of the Roding River at the Caretaker's House (Location: 1622820 5421186 NZTM) is not less than: (a) 150 litres per second (l/s); or (b) Natural flow if the natural flow is less than 150 l/s. Abstraction must cease when instantaneous flow is less than 150 l/s at the Caretaker's House flow site. When natural flow in the Roding River is 196 l/s or less for two consecutive days at the Skid Site (Location: 1622820 5421186 NZTM) the consent holder shall cease taking water. The rate of abstraction from the Roding River shall not exceed 254 litres per second. The abstraction of water from Long Gully Stream shall not cause the loss of surface flow connectivity between the upper weir and the Roding River. The volume of abstraction from the upper Long Gully weir shall not exceed five cubic metres per day.
RM 165317	Land Use Consent – structures and disturbances • To use, reconstruct and maintain the Roding Weir structure and the upper Long Gully Weir structure and to authorise the existing lower Long Gully weir; • To disturb the bed for the purposes of flushing gravel through (via the sliding sluice gate) the Roding Weir; • To disturb the bed of the Roding River for the purpose of excavating and relocating gravel over the Roding Weir; • To disturb the bed of the Roding River for the purpose of excavating and relocating gravel through the diversion tunnel; • Operating the diversion tunnel by diverting water and gravel through the sluice gate; and • From time to time to construct, reconstruct, use, alter, extend or demolish a temporary gravel bund in the Roding River for the purpose of diverting sediment through the diversion tunnel.	31 May 2052	
RM 165318	Water Permit to discharge water containing sediment into the Roding River as a result of maintenance of the weir	31 May 2052	

Consent Number	Consent Type	Consent Expiry Date	Consent Allowance
RM 165122	Land use consent for the existing dam on the North Branch of the Maitai River; and Land use consent for the existing weir on the South Branch of the Maitai River.	11 March 2054	
RM 165192	Water permit to dam the flow of the of the North Branch of the Maitai River; Water permit to divert the flow of the North Branch of the Maitai River over the dam spillways and to the South Branch via the backfeed; Water permit to dam the flow of the South Branch of the Maitai River; Water permit to divert the flow of the South Branch of the Maitai River over the weir; Water permit to take up to the full flow of the North Branch of the Maitai River; Water permit to take up to 300 litres per second of water from the South Branch of the Maitai River;	11 March 2054	The following minimum flows shall be maintained in the Maitai River immediately below the Forks: a) From 1 May to 31 October [Winter] - The flow in the South Branch shall be measured at the existing water level recording station and: i. when the South Branch mean daily flow exceeds 140 litres per second (l/sec), the minimum flow at the Forks shall be 300 l/sec; ii. when the South Branch mean daily flow is less than or equal to 140 l/sec, the minimum flow at the Forks shall be 230 l/sec. This minimum flow shall remain effective until the South Branch flow exceeds a mean daily flow of 140 l/sec and the water level in the North Branch Reservoir exceeds the level shown in Figure 1.
RM 165193	Discharge permit to discharge up to 400 litres per second of water from the North Branch Reservoir to the South Branch via the backfeed; Discharge permit to discharge scour water, mixing box overflow, and enhancement water to the historic North Branch channel below the dam whereafter it flows into the Maitai River at the Forks; Discharge permit to discharge overflow water from the North Branch Reservoir to the Maitai River via the spillways; and Discharge permit to discharge water, sediment and gravel from pipeline service valves and surge towers to water or to land where it may enter water.	11 March 2054	Dissolved Oxygen saturation at the point of discharge to the South Branch of the Maitai River shall be maintained at or above 50 percent.

National Policy Statement on Urban Development

The most recent National Policy Statement on Urban Development 2020 (NPS-UD) replaces the NPS-Urban Development Capacity 2016 and requires local authorities to open up more development capacity, so more homes can be built in response to demand. Capacity is to be provided in accessible places, close to jobs, community services, public transport and other amenities that communities enjoy. NCC has been assessed as a Tier Two Urban Environment in conjunction with the TDC which means that it must ensure there is sufficient development capacity to meet demand in the urban environment in the short term (within 3 years), medium term (3-10 years) and long term (10-30 years). Short-term capacity must be zoned and infrastructure ready, while medium-term must either be ready or have funding for adequate infrastructure identified in the LTP.

National Policy Statement for Freshwater Management 2020

The Freshwater NPS 2020 replaces the NPS-FM 2014 (amended 2017). This National Policy Statement sets out how Councils will manage water quality and quantity. The Freshwater NPS 2020 is one of several pieces of national direction for managing New Zealand's freshwater. National Environmental Standards for Freshwater and RMA Section 360 regulations for stock exclusion are also being introduced. Guidance to support the implementation of these new rules and regulations will be released as they come into force. New requirements of the Freshwater NPS 2020 relate to:

- Manage freshwater in a way that 'gives effect' to Te Mana o te Wai: This is a concept that refers to the fundamental importance of water and recognizes that protecting the health of freshwater protects the health and well-being of the wider environment.
- Improve degraded water bodies, and maintain or improve all others using bottom lines defined in the NPS.
- An expanded national objectives framework:
- Avoid any further loss or degradation of wetlands and streams, map existing wetlands and encourage their restoration.
- Identify and work towards target outcomes for fish abundance, diversity and fish passage over time.
- Set an aquatic life objective for fish and address in-stream barriers to fish passage over time.
- Monitor and report annually on freshwater (including the data used); publish a synthesis report every five years containing a single ecosystem health score and respond to any deterioration.

With respect to water quantity the Freshwater NPS 2020 requires safeguarding of life-supporting capacity, ecosystem processes and indigenous species and ecosystems; while also avoiding further over-allocation and phasing out existing over-allocation, improving and maximising the efficient use and allocation of water, and protecting the significant values of wetlands and outstanding freshwater bodies.

Action for Healthy Waterways – Proposed Policy Reforms 2019

The *Action for Healthy Waterways* proposals released by the Ministry for the Environment in mid-2019 includes amendments to the Resource Management Act, an update of the above mentioned Freshwater NPS 2020, an updated National Environmental Standard for Sources of Human Drinking Water, and new National Environmental Standards for Freshwater and Wastewater.

Key proposals include:

- speed up the implementation of freshwater regulations through amendments to the RMA
- support the delivery of safe drinking water through amending the National Environmental Standard for Sources of Human Drinking Water
- raise the bar on freshwater ecosystem health by introducing new attributes and requirements in the NPS-FM to protect threatened species and habitats

Climate Change Response (Zero Carbon) Amendment Act 2019

The Climate Change Response (Zero Carbon) Amendment Act 2019:

- sets a new domestic greenhouse gas emissions reduction target for New Zealand to reduce net emissions of all GHG's (except biogenic methane) to zero by 2050
- establishes a system of emissions budgets to act as stepping stones towards the long-term target
- requires the Government to develop and implement policies for climate change adaptation and mitigation
- establishes a new, independent Climate Change Commission to provide expert advice and monitoring to help keep successive governments on track to meeting long-term goals.

Council has committed to a implementing a Preliminary Action Plan as part of the Certified Emissions Measurement and Reduction Scheme (CEMARS – Toitū Envirocare). This includes an Emissions Inventory Report and Action Plan to Reduce Council Greenhouse Gas Emissions. The assessment period for achieving reductions in greenhouse gas emissions is over five years from 2018 to 2023. Under this plan all Council activities will need to prepare a carbon reduction plan by June 2023.

In August 2020 Council committed to adopting the 5 year emissions reduction targets to be confirmed by Central Government in 2021. These targets are intended to be achieved through the development and implementation of a Council wide 'Emissions Reduction Action Plan'. Refer to section 1.2 for information on how this relates to the water supply activity.

Building Act 2004 - Dam Safety Regulations

The Building Act 2004 requires that dam owners assess their dam against regulatory standards as being high, medium, or low impact in the event of failure, and to provide that information to their regional authority.

In 2015 the Building and Construction Minister confirmed that these requirements were to be removed from the Building Act and new requirements would be considered for inclusion in the Resource Management Act. In 2019 the Ministry of Building, Innovation and Employment began consultation with the community on a proposed regulatory framework for dam safety. To date there is no final proposal in place.

It is anticipated that these policy issues will be resolved in the first five years of this plan and some form of dam safety scheme will be introduced. It is likely to apply to a range of dams other than water supply dams e.g. stormwater detention dams that meet specified height and volume thresholds. A budget for the first review of these dams has been included in the stormwater plan.

In the absence of a formal framework the Maitai Dam is subject to an annual safety review by the designers and every five years a comprehensive safety review is carried out by a separate specialist dam consultancy.

The National Environmental Standard for Sources of Human Drinking Water

Regulations came into force on 6 June 2008. The purpose of the regulations is to reduce the risk of contamination of drinking water sources by requiring Regional Councils to consider the effects of granting water abstraction consents or discharge consents upstream of drinking water abstraction points. As all the Maitai and Roding catchments above the intakes are owned by NCC and managed as a waterworks reserve, there is no specific level of service that comes from these regulations.

The Drinking Water Standards for New Zealand 2005/18

The Drinking Water Standards list the maximum concentrations of chemical, radiological, and microbiological contaminants acceptable for public health in drinking water. The standards also specify the sampling protocols that must be observed to demonstrate that the drinking water complies with the standards.

The Health Act 1956 & The Health (Drinking Water) Amendment Act 2007

There is a provision that requires water suppliers, when they become aware that the water is not meeting the drinking water standards to take appropriate steps to correct the problem.

Havelock North Drinking Water Government Inquiry

The event of the campylobacteriosis outbreak in Havelock North in August 2016 brought about a Government Inquiry.

Recommendations made by the Inquiry broadly fall into the following categories:

- Administrative:
    - Promulgate six principles of drinking water safety
    - Review NZ standards, Health Act and Drinking Water standards and abolish 'secure' classification for bores
    - Establish an independent drinking water regulator (Now known as *Taumata Arowai*)
    - Ministry of Health to improve compliance with existing regulations
    - Amend the Resource Management Act to improve water source protection
    - Accelerate the review of the National Environmental Standard for Sources of Human Drinking Water.
- Operational:
    - Encourage/mandate treatment (chlorination) of water supplies
    - Encourage formation of joint working groups to oversee drinking water safety throughout the country
    - Introduce licensing and qualification requirements for suppliers and operators
    - Create dedicated and aggregated drinking water suppliers,
    - Improve the testing and laboratories regime

- Prohibit high risk bore construction techniques.

The report also has a section with recommendations that the Government look at aggregating supplies of water.

Water Services Regulator

In December 2019, the Taumata Arowai – Water Services Regulator Bill was introduced to Parliament and had its first reading. The Bill establishes Taumata Arowai as a Crown Agent and provides for its objectives and general functions, including:

- administering and enforcing a new drinking water regulatory system (including the management of risks to sources of drinking water); and
- a small number of complementary functions relating to improving the environmental performance of wastewater and stormwater networks

The Bill passed its third reading on 22 July 2020 and now requires Royal Assent to become an Act. This is expected to be completed in 2020.

A separate Water Services Bill was introduced to Parliament on 28 July 2020. The Bill will establish the new drinking water regulatory system and develop provisions relating to source water protection. It also includes some obligations on wastewater and stormwater network operators. The Bill is not expected to complete the parliamentary process until sometime after the elections in October 2020.

In July 2020, the Government announced a funding package of $761 million to provide immediate post-COVID-19 stimulus to local authorities to maintain and improve three waters infrastructure, and to support reform of local government water services delivery arrangements. Initial funding will be made available immediately to those councils that sign up to the Memorandum of Understanding (MoU) and associated Funding Agreement and Delivery Plan for the first stage of the Three Waters Services Reform Programme by 31 August 2020.

The Government has indicated that its starting intention is public multi-regional models for water service delivery to realise the benefits of scale for communities and reflect neighbouring catchments and communities of interest. There is a preference that entities will be in shared ownership of local authorities. Design of the proposed new arrangements will be informed by discussion with the local government sector.

Civil Defence Emergency Management (CDEM) Act 2002

Sections 64 and 60 of the CDEM Act (Duties of local authorities and Duties of lifeline utilities accordingly) require that a local authority must plan and provide for civil defence emergency management within its district and that a local authority and lifeline utility must ensure that it is able to function to the fullest possible extent, even though this may be at a reduced level, during and after an emergency. The Risk section of this Plan provides detail of NCC's preparation and arrangements for emergency management.

2.4. Current level of service

Significant negative effects

It is a requirement of the Local Government Amendment Act 2010 (2(1)(c)) to outline any significant negative effects that any activity within a group of activities may have on the social, economic, environmental, or cultural well-being of the local community.

Table 2-5 below identifies the negative effects for the Nelson city Community that the water supply activity may have. It indicates the existing approach or proposed action to address these in future.

Table 2-5: Negative Effects – The Water supply Activity

Effect	Status of Effect		Type of Effect		Impact on Well-Being				Existing Approach or Proposed Action to Address
	Existing	Potential	Negative	Significantly Negative	Social	Economic	Environmental	Cultural	
Pump Stations									
Noise.	Static	Static	√		Minor	Nil	Minor	Nil	High degree of noise mitigation in residential areas
Environmental									
Growth is constrained by lack of water supply infrastructure	Static	Static	√		Minor	Mod	Minor	Minor	NPS-UD work for Nelson urban area guides to prioritise roll out to ensure demand is met.
High water demand decreases flow	Static	Static	√		Minor	Minor	Mod	Mod	Resource consent states that abstraction must cease when a minimum flow is met. Water restrictions decrease water use.
Water restrictions during extended dry period	Static	Static	√		Minor	Minor	Minor	Minor	Apply water restrictions in stages to avoid sudden heavy restrictions
Greenhouse gas emissions	Ongoing	Ongoing	√				Minor		Investigate options for reducing electricity use and hydrocarbon powered vehicle use. Where possible construct new pipes from sustainable materials and co-construct with other services construction.

Water Quality

Background

As a water supply authority NCC must comply with the Health Act 1956 and supply potable water. The Ministry of Health has an oversight of Council's compliance with this requirement and audits the Council water supply annually.

In 2018 Council, in consultation with the Ministry of Health moved away from voluntary Water Supply Grading under the Health Act in favour of compliance with the Drinking Water Standards New Zealand (DWSNZ).

Council monitors and reports on the non-financial reporting measures of the Department of Internal Affairs. These include complaints about drinking water clarity,

taste, odour, pressure or flow, continuity of supply and Council's response to these issues.

Reliability

Background

Council also monitors and reports on the non-financial reporting measures of the Department of Internal Affairs for average drinking water standard consumption per day per resident, % real water loss from the system and call-out in response to a fault or unplanned interruption to the system.

Results for levels of service are shown in Table 2-6.

Table 2-6: Current Levels of Service for 2018-28

				Performance Target			
Community Outcomes	**Level of service**	**Performance Measures**	**Previous and current performance**	**2018/19 (Year 1)**	**2019/20 (Year 2)**	**2020/21 (Year 3)**	**2021/22 2027/28 (Year 4-10)**
Our communities are healthy, safe, inclusive and resilient	**Quality** ^Good quality water	The extent to which drinking water supply complies with: a) part 4 of the drinking water standards# (bacterial compliance criteria)*, and b) part 5 of the drinking water standards# (protozoal compliance criteria)* c) part 8 of the drinking water standards# (chemical compliance criteria) 1	Complied a) and b) and c) 2019/20 Complied a) and b) and c) 2018/19 Complied a) and b) and c) 2017/18 Protozoal compliance is not measured for distribution as treatment plant removes any at source.	100% compliance with parts 4,5 and 8 of the drinking water standards			
		Total number of complaints per 1000 connections about any of the following*: - drinking water clarity - drinking water taste - drinking water odour - drinking water pressure or flow - continuity of supply - Council's response to the above issues 2	18 complaints per 1000 connections in 2019/20 23 complaints per 1000 connections in 2018/19 16 complaints per 1000 connections in 2017/18 21 complaints per 1000 connections in 2016/17	No more than 50 valid complaints per 1000 connections			
Our infrastructure is efficient, cost effective and meets current	**Reliability** ^A reliable supply of water	Average drinking water standard consumption per day per resident* 3	300L per person per day 2019/20 286L per person per day 2018/19 259L per person per day 2017/18	Normal demand less than 500L per person per day. This includes both domestic and commercial-industrial			

				Performance Target			
Community Outcomes	**Level of service**	**Performance Measures**	**Previous and current performance**	**2018/19 (Year 1)**	**2019/20 (Year 2)**	**2020/21 (Year 3)**	**2021/22 2027/28 (Year 4-10)**
and future needs							
		% real water loss from the system* 4	24.5% in 2019/20 25.7% in 2018/19 28% in 2017/18	Real water loss less than 25%.			
Our infrastructure is efficient, cost effective and meets current and future needs	**Customer Service** ^Prompt response	When attending a call-out in response to a fault or unplanned interruption to the system, the following median response times will be measured*: a) attendance for urgent call-outs: from the time notification is received to the time service personnel reach the site*	Median 21 minutes in 2019/20 20 minutes in 2018/19 18 minutes in 2017/18 21 minutes in 2016/17	a) Contractor to attend urgent call-outs in a median time of 30 minutes or less.			
		b) resolution of urgent call-outs: from the time notification is received to the time service personnel confirm resolution of the fault or interruption*	Median 191 minutes in 2019/20 284 minutes in 2018/19 89 minutes in 2017/18 107 minutes in 2016/17	b) Contractor to resolve urgent call-outs in a median time of 480 minutes or less.			
		c) attendance for non-urgent call-outs: from the time notification is received to the time that service personnel reach the site*	Median 76 minutes in 2019/20 78 minutes in 2018/19 52 minutes in 2017/18 54 minutes in 2016/17	c) Contractor to attend non-urgent callouts in a median time of 120 minutes or less.			

				Performance Target			
Community Outcomes	**Level of service**	**Performance Measures**	**Previous and current performance**	**2018/19 (Year 1)**	**2019/20 (Year 2)**	**2020/21 (Year 3)**	**2021/22 2027/28 (Year 4-10)**
		d) resolution of non-urgent call-outs: from the time notification is received to the time service personnel confirm resolution of the fault or interruption* 2	Median 1164 minutes in 2019/20 449 minutes in 2018/19 330 minutes in 2017/18 330 minutes in 2016/17	d) Contractor to resolve non-urgent call outs in a median time of 24 hours or less.			

^L.O.S. included in LTP

Ministry of Health Drinking-water Standards for New Zealand 2005 (Revised 2018), Wellington, Ministry of Health

* Performance measures with an asterisk reflect the wording of the Non-Financial Performance Measures of the Department of Internal Affairs (DIA) incorporated into sec261B Local Government Act 2002. This is to allow the DIA to compare these measures across councils. Targets have been adjusted where necessary to align.

Measurement procedures:

1. South Island Drinking Water Assessment Unit - Nelson
2. Report from SR system at 1 July
3. Calculated by metered supply divided by Statistics NZ estimated population
4. Council uses a water balance methodology developed by Water NZ to track and report on un-accounted for water.

Table 2-7 shows NCC compliance with Drinking Water Standards.

Table 2-7: Status of Water Supply under DWSNZ

Year	Status of Water Supply under DWSNZ Part 4 (Bacterial)	Status of Water Supply under DWSNZ Part 5 (Protozoal)	Status of Water Supply under DWSNZ Part 8 (Chemical)
2018-19	Compliant	Compliant	Compliant
2019-20	Compliant	Compliant	Compliant

Water Sources

Council abstracts raw water direct from surface water sources and these are open to contamination from a range of natural and people driven activities. To ensure the best quality water is supplied to the city the following controls and treatment are in place:

- The water source catchments are reserves under the Reserves Act. Council can control access and activities within the area.
- Raw water is treated at a state-of-the-art ultra-filtration and chlorination water treatment plant prior to supply to customers. The filtration can remove small organisms such as giardia and cryptosporidium from the water and chlorination is effective against smaller organisms and viruses.

As demand for access to Council reserves for recreational activities increases so too does the risk of an adverse event impacting the raw water supplies. To date Council has been adequately protected by the relative isolation of the water works reserve and the vigilance of the caretakers. Going forward it is likely that Council will need to consider a range of more formal measures to restrict activities immediately adjacent the more critical parts of the raw water sources eg hard and soft exclusion zones for earthworks and access by people.

Water reticulation

Water supply networks are historically very reliable. This high reliability has tended to make customers assume that reliability is guaranteed.

The continuity of supply can never be guaranteed, in part because many causes of supply failure are beyond the control of the water supply authority. An example is damage to a service main that could be caused by a contractor excavating in the street while working on other utilities (such as electricity, telephone, sewer, etc). Older asbestos cement pipes have also deteriorated and are the main source of spontaneous breaks.

Of note is the number of faults caused by failures of fittings such as gibault frames and bolts and tapping band bolts and washers rather than pipe body failures. Failures of fittings are of concern to Council because of the large number of them distributed across the network and the difficulty of predicting exactly what type of fitting will fail and when. Council will monitor these failures and see if any trends become apparent.

The Nelson City Council Water Supply Bylaw warns that water quality or continuity of supply is not guaranteed.

Performance Measurement and Monitoring

The following actions are currently undertaken to monitor the network reliability:

- Record daily headworks supply and treatment plant supply.
- Record the actual time the water supply is interrupted and restored, and number of properties affected.
- Record all complaints regarding "out of water".
- Record time and type of notice of shutdown given to consumers.
- Monitor peak daily demands annually and maintain graphical record to develop future demand curve.

Water Losses

Council estimates that the city network has real water losses of the order of 15-25% of the water that leaves the treatment plant. This amounts to an average 1.5 million cubic metres per year. This figure is essentially arrived at by comparing the volume of water leaving the treatment plant with the volume that is recorded by customer's meters and trying to quantify areas of un-accounted for water. Being able to quantify this figure is very important and improving the accuracy of records is currently a focus of the activity. A programme of repairing reported leaks and proactive leak detection is included in the activity budgets. See 3.4 and appendix E.

Contractors Service Response and System Operation

The Utilities Services Maintenance contract requires that the maintenance contractor responds to calls within appropriate times depending on the circumstances as follows.

Urgent Works

Urgent works are defined in the first column of the response timetable below in Table 2-8.

Response times apply 24 hours per day every day of the year.

The Contractor must respond to and satisfactorily resolve maintenance works within the maximum response times for the specified percentage of cases.

Table 2-8: Urgent Maximum Response Times

Definition of Urgent Works	Investigation and Appraisal Night and Day	Repair Completed	% of Cases
Burst pipes or major leakages likely to affect the water supply or cause damage to pavements or property.	30 minutes	8 hours	95%
No water or pump station failure.	30 minutes	8 hours	95%
Possible serious health risk (life threatening) water quality problem.	30 minutes	2 hours	100%

Non-Urgent Works

Non-Urgent works are as defined in the first column of the response timetable below in Table 2-9.

Response times defined in hours apply 24 hours per day every day of the year.

Response times defined in days are working days (Monday to Friday) excluding public holidays during normal working hours. Such works are programmed by the Contractor on a daily basis.

The Contractor must respond to and satisfactorily resolve maintenance works within the maximum response times in Table 2-8.

Table 2-9: Non Urgent Maximum Response Times

Definition of Non-Urgent Works	Investigation and Appraisal Night and Day	Repair Completed
Minor leaks including from fittings, connections, meters, etc on sensitive hill slopes as identified on drawing 34/78. Missing or damaged service lids.	1 hours	24 hours
Minor leaks including from fittings, connections, meters, etc in areas other than above.	12 hours	3 working days
Water Quality Problems: - Taste and odour - Colour and grit	2 hours	1 working day
Non-serious water quality problems including poor pressure and flow.	N/A	3 working days
Engineers discretionary work	N/A	As agreed

2.5. Desired level of service

There are no proposed changes to the Levels of Service from the previous Plan and therefore the Levels of Service Table 2-5 reflects both the current and desired Levels of Service for 2021-31.

3. FUTURE DEMAND

Existing situation

As part of the replacement resource consents for the Nelson water supply from the Maitai and Roding Rivers Council commissioned an update of the 2007 OPUS drought study report. In response WSP-OPUS prepared a number of reports looking at a range of demand scenarios for the city out to 2100. The reports conclude that under most demand scenarios the Maitai Dam will provide sufficient drought security for the city in the medium-long term out to mid-end of this century. There are a number of caveat's that come with the analysis, with uncertainties around climate change and population growth being the most significant.

3.1. Demand drivers

The Nelson water supply is largely a residential and light industrial supply with little grass irrigation outside Council reserves and school playing fields. Table 3-1 summarises basic demand drivers for the activity.

Table 3-1: Water Demand Drivers

Water Demand Drivers	Changes to Water Supply Activity
Significant population growth and residential expansion into greenfield areas	New development areas on the periphery of the city and increased density in some existing developed areas leading to increased water use.
Changes in Customer Expectations	Customer expectations are increasingly tending towards higher Levels of Service, in both the reduction of environmental impact and the quality of the water supplied.
Community Expectation	Enhancing the natural environment of streams and rivers and recognition of impacts of climate change, especially drought security.
Climatic Changes	In recent years, there has been an increase in the incidence of extreme weather events around the world. The general trend for Nelson is of winters being wetter and the other seasons being drier. More frequent heavy rainfall events have been predicted as well as the increasing trend to more extreme dry weather events. Demand for water increases in the drier warmer summer months and climate change is expected to accentuate this.
Legislative National Policy Statements: • Freshwater Management • Urban Development	• Freshwater Management is a cornerstone central government initiative to improve the quality of freshwater bodies in New Zealand. This is expected to impact on both abstraction and discharges to waterways and require an enhanced recognition of the need for efficient use of the water to minimise the volume taken for water supply and improving the quality of the water discharged as compensation. • Urban Development will ensure each territorial authority makes adequate provision for future population growth in their areas. This will require Council to undertake strategic growth studies and identify the impact on the demand for water supply services. Six areas have been identified by Council as likely areas for re-development in the next 10-15 years.

Water Demand Drivers	Changes to Water Supply Activity
Organisational Policies Environmental Sustainability	Development of sustainability strategies that include reduction of un-accounted for water volumes.
Certified Emissions Measurement and Reduction Scheme (CEMARS-Toitū Envirocare)	This includes an Emissions Inventory Report and Action Plan to Reduce Council GHG Emissions. The Water supply activity will need to prepare a carbon reduction plan by June 2023.

Industrial and Commercial Demand

Since the water demand was initially calculated in 1996 there have been significant changes in Industrial and Commercial activities (and therefore water demand) at the Port.

More processing is carried out at sea or in Asia and the Sanford (South Island) Ltd processing factory at the port has closed and is unlikely to reopen. It is also unlikely that any other similar fish processing factory will be established in Nelson in the foreseeable future.

Port Nelson has increased covered bulk storage, container and log marshalling areas with the demolition of existing buildings, including the Milk Treatment Station. Further expansion of these areas is likely, until ultimately the area bounded by the existing gated area at Graham Street, Wildman Avenue, and the Calwell Slipway becomes port storage.

Current engineering activities are likely to remain around the slipway area, and current boating activities are likely to remain around the marina area. These activities are not significant water users.

Commercial/industrial growth in the remainder of the City/Atawhai area is expected to be restricted by lack of suitable land availability and limited sewer capacity. The Nelson Resource Management Plan limits Trade Waste discharge to the sewer to 0.54 litres per second per hectare. Sites in the Central City and St Vincent/Vanguard Streets area are generally small and a major wet industry is not likely to set up in this area. The recent development of New World and Harvey Norman stores in Vanguard Street, together with their associated car parking, has further reduced commercial/industrial land available for wet uses. Also commercial users generally have a low day to day water demand. Future reticulation upgrades are likely to be based on the need to maintain fire flows, particularly for sprinklers, in larger commercial developments and multi-storey residential buildings.

Recent Commercial/industrial growth in the Stoke/Tahuna area has utilised most of the existing industrial zoned land.

The Nelson- Tasman urban development review has led to co-ordination with TDC regarding development of new land in the Richmond vicinity for larger industrial uses - taking a regional planning approach i.e. Industrial growth in Nelson will be low day to day water users on small sites.

A review of the industrial demand is expected over the next three years as Council reviews the NRMP. The likely impact on the water network will be reflected in future asset management plans.

Residential Demand

The Nelson Water Supply has approximately 18,000 residential connections and 2,000 commercial connections. In 2020 Council supplied residential users with a water volume of 3,396,500m^3/yr compared to the commercial water volume of 1,960,000m^3/yr.

Richmond is also entitled to the lesser of 909m3 of water/day or 1/15 of the Roding authorised supply rate as part of the agreement with central government at the time of the construction of the Roding Dam and supply pipelines.

A plan change to the NRMP has been completed to recognise the subdivision activity in the Saxton Creek area east of Champion Road. This area is currently supplied with water by TDC. The present supply arrangement with TDC is being reviewed by both parties in 2020 and may lead to changes in the reticulation to the area to reflect the construction of the Waimea Community Dam and the installation of a 200mm dia watermain from Suffolk Road to Hill Street North by Summerset Villages Ltd. The agreement can be revoked on 3 years notice by either Council.

Residential demand is expected to be influenced by:

- Improved plumbing and appliance technology (particularly being driven by the Australian water shortages) will mean that future household use will be reduced e.g. superlow flush 4.5/3 litre toilet flush (compared with 11 litre single flush), low use washing machines, low flow shower heads, aerator taps, reuse of grey water for toilets and irrigation etc.
- Increasing awareness of low water use gardening e.g. drought resistant planting, no mow lawns, or no lawns at all
- With intensification, smaller gardens or no gardens at all for many household units
- Reduced use due to reduced supply pressures
- Consumer education on tap use e.g. turn off while brushing teeth, shorter duration showers, showers instead of baths, rinsing dishes in a partially filled sink rather than under a running tap.
- Possible greywater and rainwater storage on site for reuse
- More stringent hosing restrictions
- Pricing incentive
- Central Government Regulation

Council is concentrating on improving services to developed areas and providing services to areas that are currently being developed (Residential, Rural Zone High Density Small Holdings, Suburban Commercial, Industrial). Servicing of other areas covered by the Services Overlay, because one or more servicing constraints have been identified as needing to be addressed prior to the complete development of that property/area, will be considered as Council develops a policy on prioritising these areas. The specific projects to facilitate future growth, identified in this Plan, therefore consist of works required to eliminate servicing constraints on the former.

A specific project has been identified to update desktop investigations, carried out in the past, looking at servicing constraints to areas currently zoned for residential development but restricted by a services overlay.

Six areas have been identified by Council as likely areas for re-development in the next 15 years. Three of these (City Centre, Victory and Maitahi/Bayview) are programmed for service upgrades in conjunction with pipeline renewals in years 3-10 of the AMP). Section 3.5 covers the details of the proposals for these areas.

Figure 3-1 in the next section compares the capacity of the water sources and water treatment plant with the actual peak day water usage over the last 15 years.

3.2. Demand forecasts

Raw Water and Treated Water Demand:

Table 3-2 shows raw water supplied to the WTP and treated water from the WTP. Figures are based on daily flows for the peak flow month for each year.

Table 3-2: Peak Raw Water and Treated Water Demand

Year	Source	Minimum (m^3/day)	Average (m^3/day)	Maximum (m^3/day)
January 2013	Maitai	10,000	15,710	23,000
	Roding	0	7,677	13,000
	WTP	19,226	23,364	30,658
February 2014	Maitai	7,000	12,893	17,000
	Roding	9,000	11,036	14,000
	WTP	18,148	23,461	27,902
January 2015	Maitai	8,717	13,063	18,236
	Roding	631	11,146	12,584
	WTP	18,902	24,969	29,500
January 2016	Maitai	10,257	17,285	23,241
	Roding	0	3,238	11,214
	WTP	17,542	21,593	28,390
January 2017	Maitai	7,819	12,373	20,595
	Roding	0	9,058	12,753
	WTP	17,643	22,579	29,862
December 2017	Maitai	15,000	20,281	25,000
	Roding	5,000	8,188	12,000
	WTP	22,000	25,194	30,000
January 2019	Maitai	9,702	19,278	26,293
	Roding	3,337	7,365	11,935
	WTP	21,890	28,044	33,971
January 2020	Maitai	9,376	13,347	17,069
	Roding	9,085	10,817	11,948
	WTP	21,233	25,218	29,341

WATER SOURCES:

CURRENTLY:

RODING PIPELINE CURRENTLY CAN AND DOES SUPPLY 16,000 M3 /DAY PLUS. CAPACITY IS OF THE ORDER OF 20-22,000 M3 /DAY.

EXISTING CONCRETE MAITAI PIPELINE CAN DELIVER 37,000 M3 /DAY.

THE DUPLICATE PIPELINE IS 600MM DIA AND CAN DELIVER THE FOLLOWING (FROM OPUS OPTIMISATION REPORT MAY 2009) AND COMPLIANCE TESTING (AUGUST 2014):

- WITHOUT PUMPING 17,000-18,000 M3 /DAY.
- WITH CURRENT TWO PUMPS RUNNING 30,240 M3 /DAY.
- WITH ADDITIONAL PUMPS INSTALLED IT IS POSSIBLE TO SUPPLY UP TO 50,000M3/DAY

THESE ARE STEADY STATE FLOWS. THE WATER RESERVOIRS ARE USED TO BUFFER PEAK HOURLY DEMAND.

Figure 3-1: Peak Water Demand

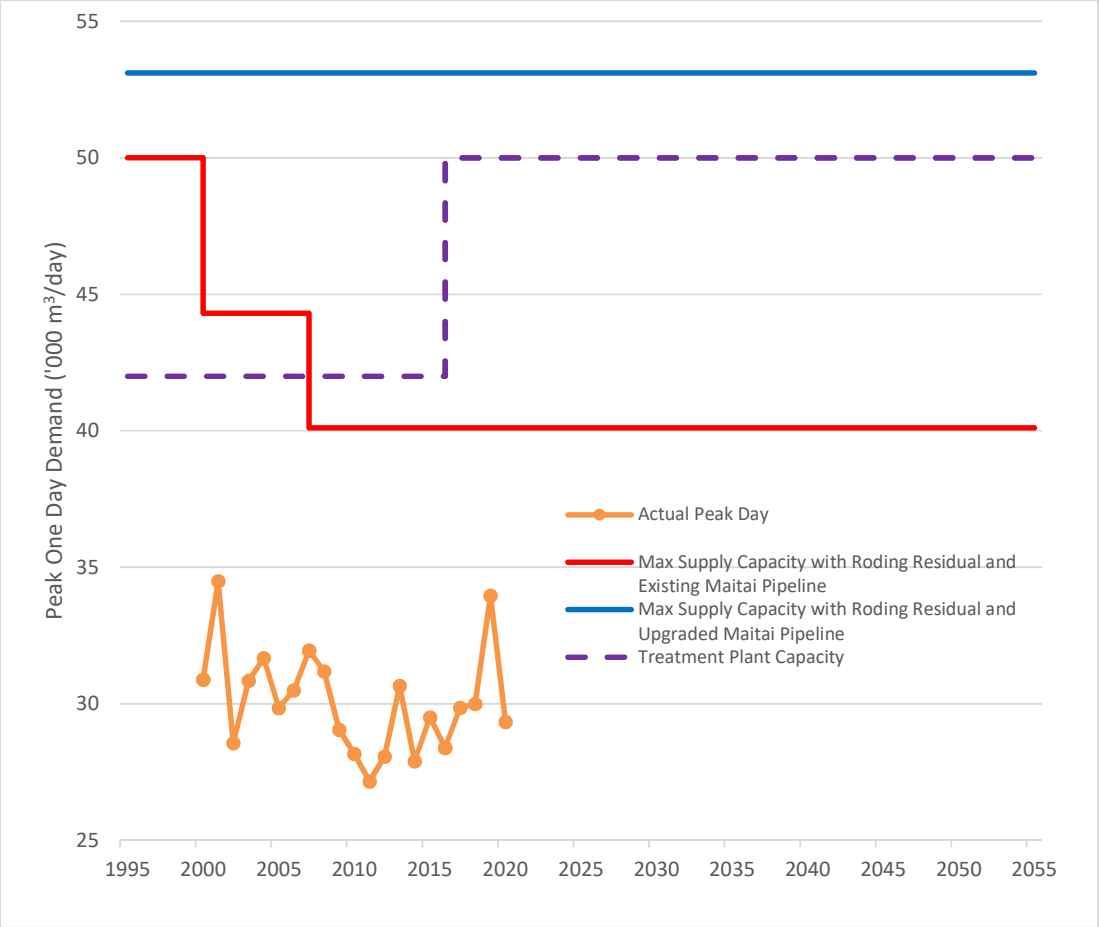


Table 3-3: Peak Daily Demand

Year	Peak Daily Supply (m3/day)	Year	Peak Daily Supply (m3/day)	Year	Peak Daily Supply (m3/day)
2000	30,900	2007	31,950	2014	27,900
2001	34,500	2008	31,200	2015	29,500
2002	28,570	2009	29,050	2016	28,390
2003	30,850	2010	28,170	2017	29,860
2004	31,680	2011	27,160	2018	30,000
2005	29,850	2012	28,070	2019	33,970
2006	30,500	2013	30,660	2020	29,340

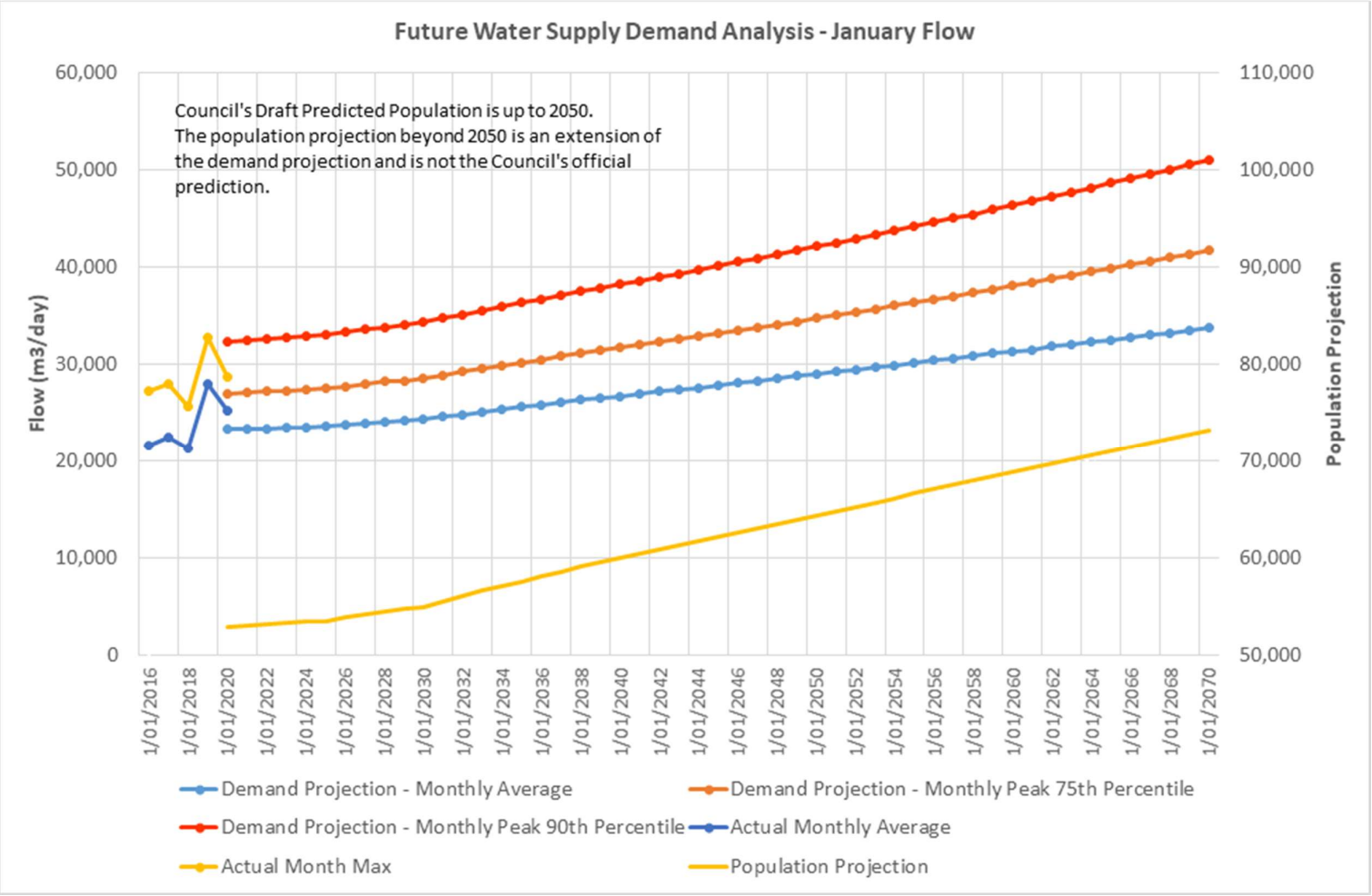
Table 3-4: Total Annual Demand

	2008 - 2009		2009 - 2010		2010 - 2011		2011 - 2012		2012 - 2013		2013 - 2014		2014 - 2015	
	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)
Sub-Total	4,696	2,908	4,995	2,977	NA	NA	4,119	3,221	4,722	2,734	4,508	2,815	4,448	2,675
Total ($000m^3$)	7,604		7,972		7,188		7,340		7,456		7,323		7,123	

	2015 - 2016		2016 - 2017		2017 –2018		2018 –2019		2019-2020	
	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)
Sub-Total	4,899	2,190	4,627	2,322	5,502	1,528	4,849	2,636	4,396	2,784
Total ($000m^3$)	7,089		6,949		7,030		7,485		7,180	

Figure 3-2 is the first approach at monitoring long term raw water demand as temperature increases. The information will support demand management initiatives and future raw water source investigations.

Figure 3-2: Future Water Supply Demand



Based on historical use figures and the supply capacity of the water sources and treatment plant, Nelson has sufficient water to supply reasonable demands within the city for the foreseeable future ie beyond 2050.

As the population increases additional storage reservoirs will be constructed and reticulation upgraded where development requires.

Nelson Population and Household Projections: 2019 - 2050

Traditionally, Statistics New Zealand would provide high, medium and low scenarios for Councils to use. In 2018, the latest census was completed but due to shortcomings in the move to online forms the return rate was lower than previously experienced. As a result, there has been significant delays in Statistics New Zealand providing updated population projections. It has been necessary to utilise alternative methods for determining future population growth in Nelson.

Further complicating projecting the future population of Nelson is the COVID-19 event. The COVID-19 event is expected to have significant immediate and future economic effects particularly as it restricts the movement of people regionally and internationally.

In this context there is a lot of uncertainty involved with projecting future population change. To account for this a custom, or hybrid, population projection for Nelson has been developed looking back at trends over previous recessionary periods to assist in developing rationale for choosing variables to develop the custom population projection.

Figure 3-3: Nelson Population and household projections 2019 - 2050

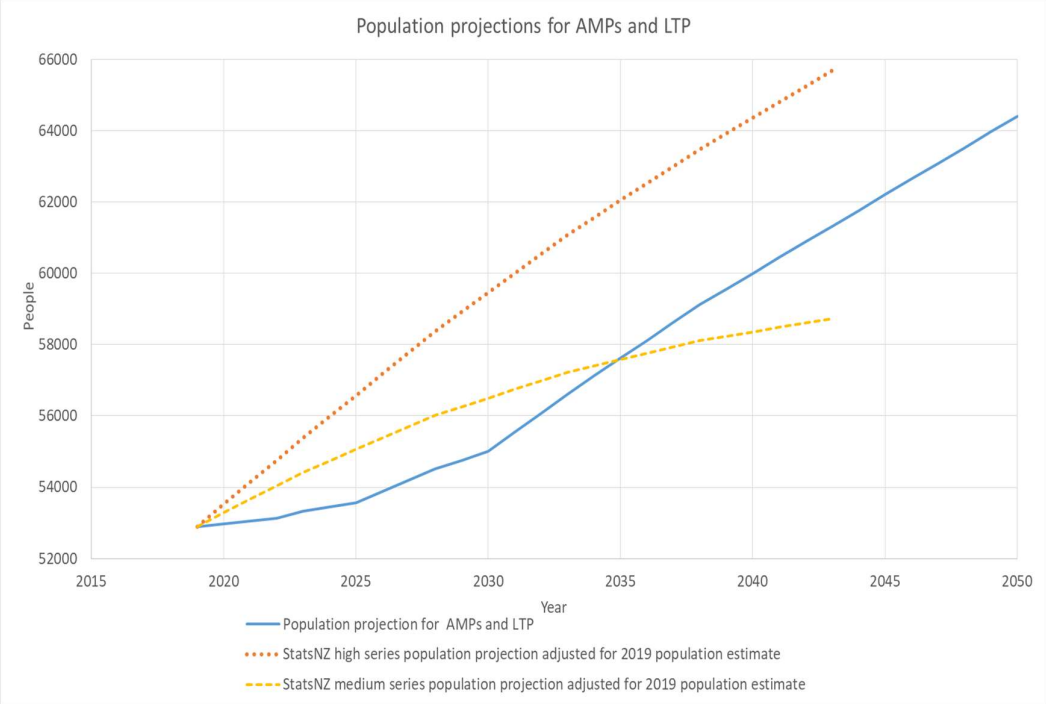
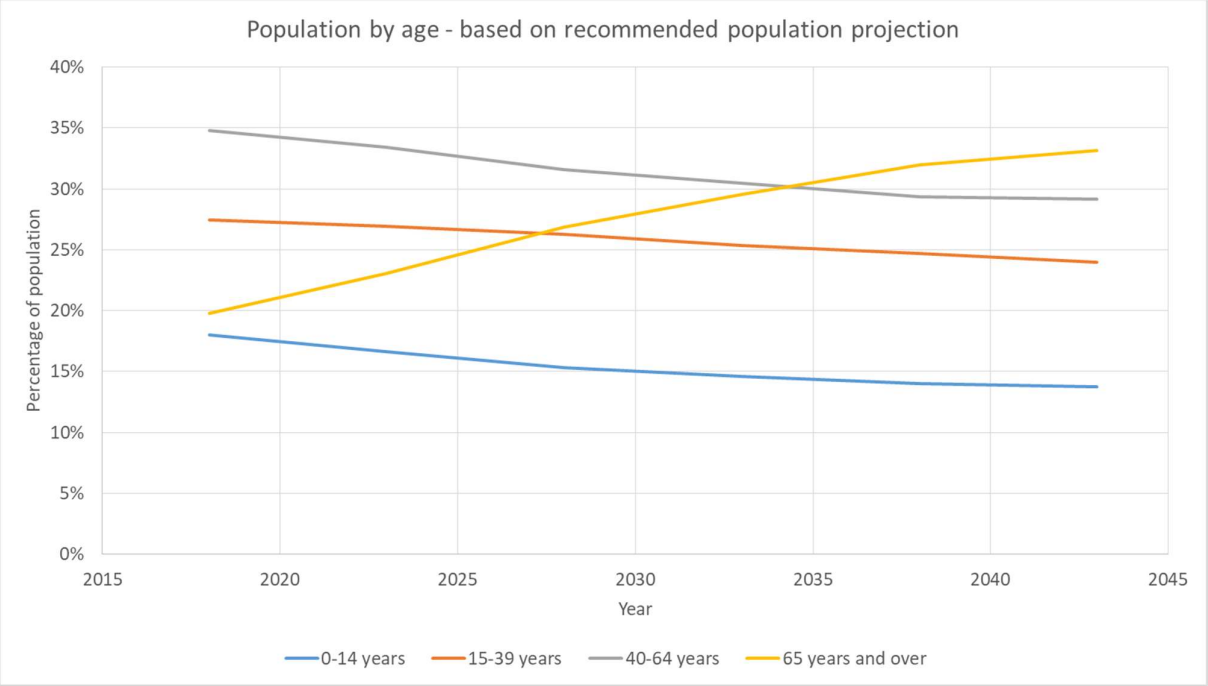


Figure 3-3 shows that, under the current lower growth scenario, population is projected to increase by 2,000 residents between 2021 and 2031.

One of the key issues facing Nelson is the aging of its population. Age has a significant impact on what sort of services Council will be required to provide and the ability of future residents to fund rate increases.

Figure 3-4 shows the projected trends for each age group from 2018 – 2043.

Figure 3-4: Population Age Trends



Projected demand under the National Policy Statement on Urban Development

The National Policy Statement for Urban Development 2020 (NPS-UD) requires local authorities to ensure there is sufficient development capacity to meet demand plus an additional margin (Nelson a medium/high growth urban area):

- In the short term (within 3 years) + minimum 20% - zoned and serviced.
- Medium term (3-10 years) + minimum 20% - zoned and planned to be serviced within LTP.
- Long term (10-30 years) + minimum 15% - zoned and planned to be service beyond LTP.

The location of actual growth will depend on where there is capacity for residential growth (residential zoning, infrastructure servicing) and where development is feasible. Residential growth areas and the sequencing of urban development capacity in the short, medium and long term have been considered in the NCC - TDC Future Development Strategy 2019. Preliminary outcomes are provided in section 3.5 Asset programmes to meet demand.

3.3. Demand impacts on assets

Peak daily demand figures suggest that Nelson has sufficient raw water source capacity to meet reasonably expected demands for the foreseeable future (out to approximately 2060-2080).

As part of the replacement resource consents for the Nelson water supply from the Maitai and Roding Rivers, Council commissioned an update of the 2007 OPUS drought study report. WSP-OPUS prepared a number of reports looking at a range of demand scenarios for the city out to 2100. The reports conclude that under most demand scenarios the Maitai Dam will provide sufficient drought security for the city in the above term.

For the Wakatu estate industrial area and Champion Rd residential subdivisions NCC currently does not have adequate network capacity to supply these areas and the supply from TDC is expected to continue in the short term.

Changes to wet industry demand can also impact on the network and these will be monitored over time.

Placeholder projects have been identified in this plan to upgrade the water supply to the growth areas as part of pipe renewals in the affected areas. As there is no detail available on exactly what form the intensification and development will take, the current basis for the proposed water upgrades is to provide a large diameter trunkmain supply to the specific area with a ringmain around the area where practical.

Three of these (City Centre, Victory, Maitahi/Bayview) are programmed for service upgrades in conjunction with pipeline renewals in years 3-10 of the Plan.

See section 3.5 and Appendix I for details.

3.4. Demand management plan

Demand management for the Nelson Water Supply has been a long term feature in the city through the imposition of summer restrictions and latterly water metering. Table 3-5 summarises the various strategies Council has in place:

Table 3-5: Demand Management Strategies

Strategy	Objective / Description
Regulation	Nelson Resource Management Plan controls water abstraction from river sources. Integrating growth planning with infrastructure provision via the Urban Development Strategy. Measuring and reporting the average daily demand for drinking water. Ensuring water is supplied predominantly through metered connections (emergencies such as fires and natural disasters are likely exceptions). Education and Enforcement of Water Supply Bylaw requirement to avoid wasting water. Track and reduce un-accounted for water volume.
Education	Continuation of non-regulatory community engagement programmes to encourage community to reduce water use especially over the drier months – Link to Environment Activity Management Plan. Re-use of grey water where appropriate for private properties. Encourage use of drought resistant gardens and lawns.
Alternative supply strategies	Private detention tanks and community rainwater harvesting and water use reduction education. Investigating the reuse of treated wastewater from Bell Island for irrigation. Support for the proposed Waimea Community Dam in Tasman District.

Universal Metering

NCC resolved to adopt universal metering in 1996 and a capital programme installed a meter for every property. Universal metering has been in operation since 1 July 1999. The maximum two day average in 1997/98 was 42,300m3/day, whereas the peak since universal metering has been in operation is less than 35,000m3/day.

Although the peak one day water usage prior to universal metering reached 42,000m3/day the typical winter usage is in the order of 21,000m3/day. Given that there is virtually no fluctuation in commercial water usage between winter and summer, the difference of 21,000m3/day has been attributed mainly to irrigating sports fields, residential garden usage and the summer holiday influx of visitors in late December and early January.

This means that to meet uncontrolled field and garden watering demand the water supply system needed up to 100% extra capacity which is only used for approximately 10% of the year.

As noted above the introduction of universal metering has acted to make people more aware of the cost of water and some 20 years later still helps to reduce the historical summer peak by approximately 30%.

The drought of 2000/01 is estimated to have had a return period of 1 in 30 years and the 2018/19 event 1 in 20 years. Other years have been average or wetter than average and this is reflected in the peak demands.

The peak one day demand since 2000 is plotted on Figure 3.1.

Other Demand Management

Use of alternative water sources for non-potable water would reduce the demand from the city water supply, particularly under summer conditions. While rainwater tanks and greywater reuse have a valuable role to play, particularly in dry summers, some thought needs to be given to the following:

- Care needed with greywater reuse to protect health and prevent contamination of the water supply.
- Financial cost to householder.
- Size of tank versus Nelson rainfall (seasonal pattern and total).
- Siting of rainwater tanks on the property.
- Rainwater tanks needs to be considered in the wider context of sustainability, e.g. environmental cost of producing, transporting and disposing of a tank.

Innovative plumbing and appliance technology is rapidly advancing and may add to better water conservation measures than tanks/greywater reuse alone e.g. Very low water usage dual flush toilets 4.5/3 litres per flush compared with 11 litre standard, and normal 11/6 dual flush, low water use clothes washers, low flow shower heads.

A full evaluation of alternative non-potable water sources suitable for Nelson, taking into consideration Nelson's current and future weather patterns was proposed in the previous Asset Management Plan. This work still needs to be carried out when resources permit.

Un-Accounted for Water/Water Losses

Council supplies approximately 7,500,000m^3 of water to the city each year. Of this approximately 5,500,000 m^3 is accounted for through customer meters. The remainder is the un-accounted for water that needs to be identified.

Sources of losses and Unaccounted for Water (UFW) are found in the following:

- Firefighting and hydrant flow testing;
- Overflows at reservoirs and losses during cleaning;
- Mains testing and flushing;
- Unknown connections;
- Use by contractors;
- Inaccurate meters;
- Pipe and fitting failures;

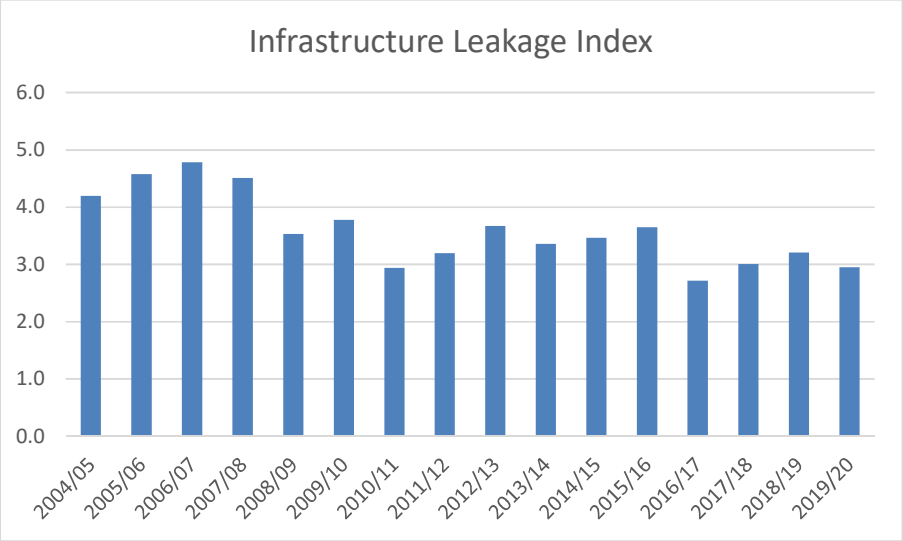
Controlling UFW can significantly reduce demand. UFW control also has an environmental benefit as it reduces the quantities of water that are required to be abstracted from the river sources and the amount of electricity required for the treatment process and pumping across the city.

WaterNZ 'Bench Loss' software has been used to calculate the Infrastructure Leakage Index (ILI) for the city which allows year to year comparisons and also benchmarking between water supply authorities. It is a non-dimensional index which assesses the overall efficiency of management of Real Losses in the system infrastructure (up to the street/property boundary, in the case of New Zealand) at the current operating pressure. The Current Annual Real Losses (CARL) are expressed as a multiple of the

Unavoidable Annual Real Losses calculated on a system-specific basis. Where water is expensive, or scarce, or both, the objective should be to achieve an ILI not greatly in excess of 1.0.

The infrastructure leakage index results since 2004 are shown in Figure 3-5.

Figure 3-5: Infrastructure Leakage Index for Nelson



The Infrastructure Leakage Index has fluctuated over the past with a decrease apparent over the last year.

This calculation was made with assumptions regarding un-metered consumption such as flushing of mains, fire-fighting, use by contractors etc. Further work is required to refine these assumptions. The viability of providing metered water tank filling points around the city and where possible metered standpipes for flushing, needs to be undertaken. This would allow more accurate measurements to be entered into the calculation.

The World Bank Banding System for interpreting the Infrastructure Leakage Index is shown in Figure 3-5.

Figure 3-6: World Bank Banding System for Infrastructure Leakage Index

	ILI	Performance in real losses management
For Developed Countries	< 2	A
	2 - 4	B
	4 - 8	C
	> 8	D

World Bank suggested strategies for each band are:

- A (0<ILI<2) Further loss reduction may be uneconomic unless there are shortages; careful analysis needed to identify cost-effective improvement.

- B (2<ILI<4) Potential for marked improvements; consider pressure management, better active leakage control practices, and better network maintenance.
- C (4<ILI<8) Poor leakage record; tolerable only if water is plentiful and cheap; even then, analyse level and nature of leakage and intensify leakage reduction efforts.
- D (ILI>8) Very inefficient use of resources; leakage reduction programmes imperative and high priority.

The water loss evaluation for Nelson is shown in Appendix E.

Table 3-6 shows water loss results from the WaterNZ spreadsheet for the past four years.

Table 3-6: Real Water Losses and Total Non-Revenue Water

Year	Real Water Loss	Total Non-Revenue Water
2016-17	23%	27.4%
2017-18	26.1%	31.6%
2018-19	25.9%	36.9%
2019-20	24.5%	29.3%

Council's maintenance contractor has leak detection equipment which is used to search for and pinpoint the location of suspected water leaks. This service is made available free of charge for locating leaks in private property.

Water leaks on hillsides and areas with clay/rock subsoil usually show quickly on the surface, but on flat and gravel subsoil areas the water from leaks may flow away without coming to the surface. Zone meters have been installed at strategic locations in Stoke and Tahunanui to measure the flow into defined areas. Night-time flows (when there is little domestic demand) can be checked for abnormalities and also the inflow into a zone can be compared with the volume of water sold through the water meters. Additional work is underway to break the city into District Metering Areas to better monitor water usage by defined zones.

The Active Leakage Control Plan is shown in Appendix F.

This level of input will be continued until the scale of UFW can be more accurately established and the need for additional effort assessed. One contributing factor to UFW in Nelson is the very high water pressures in some areas of the City leading to greater losses from leaks and normal service use. The Pressure Reduction Plan shown in Appendix H aims to reduce pressures across the city where servicing constraints such as sprinklers allow.

The current strategy for UFW has a focus on the following:

- Check the installation and accuracy of meters at the water treatment plant.
- Complete the residential meter replacement programme.
- Check the installation and accuracy of all residential and commercial meters, especially the high user meters. Council needs to better understand the accuracy of these meters at all flow ranges and at all ages. Historically a core

set of residential meters have been tested regularly to check the loss of accuracy over time. A new set will be chosen to begin the checks of the replacement meters.

- Audit Council's meter record database to check that all meters are read and flows accounted for.
- Update records of contractor hydrant takes.
- Confirm meters are installed to all properties receiving water from the network.
- Complete the DMA work so losses can be tracked by smaller zones.
- Continue to leak check a section of the city each year.

As of 2016-17 the majority of the public network in the city had been checked for leaks. While a number of small leaks were found and repaired no substantial leaks were identified. The city is continuing an annual programme of monitoring sections of the network for new leaks.

Further investigations of the large trunkmains that link separate areas of the city are also underway. These sections are typically under main roads, in private property and in the bush covered hillsides surrounding the city. They were not part of the previous urban area checks owing to the difficulty arranging access to them.

Preliminary results from the section of original trunkmain from the water treatment plant to Brook Street have identified a 9l/s discrepancy in flow meter readings between the start and the end of the main. Over a full year this could equate to approximately 280,000m^3 of water lost from the pipeline.

In 2020 water meter accuracy checks were undertaken on the primary magnetic flow meters at the water treatment plant. Two meters were found to be over-recording flows. The preliminary results from these showed an over estimation of treated water volumes of approximately 10%. This is a significant proportion of the expected real water losses in the city. Results for the 2019-20 financial year have not been adjusted in the water balance analysis pending formal confirmation of the figures.

The water supply bylaw controls access to the fire hydrant network and requires approval to be sought prior to taking water. Backflow prevention has to be in place and records must be kept of the volumes of water taken. To date the information from contractors has not been audited for completeness or accuracy.

Water Conservation Strategy

The Regional Policy Statement requires that the Council as a water user must prepare a Water Conservation Plan to limit or restrict the 'non-essential' portion of the urban water supply in times of drought.

Revised water restrictions that will support the Water Supply Conservation Strategy in this plan were adopted by the Council in June 2020 to better align the NCC approach with that of TDC. These are included in Appendix B.

3.5. Asset programmes to meet demand

Future Development Strategy

In response to the National Policy Statement on Urban Development Capacity (2016) NCC and TDC jointly adopted the Nelson Tasman Future Development Strategy in 2019. The strategy sets out how the combined region intends to plan for its future

housing capacity to accommodate projected growth in population and households, as well as the attendant business and other demands this growth will bring.

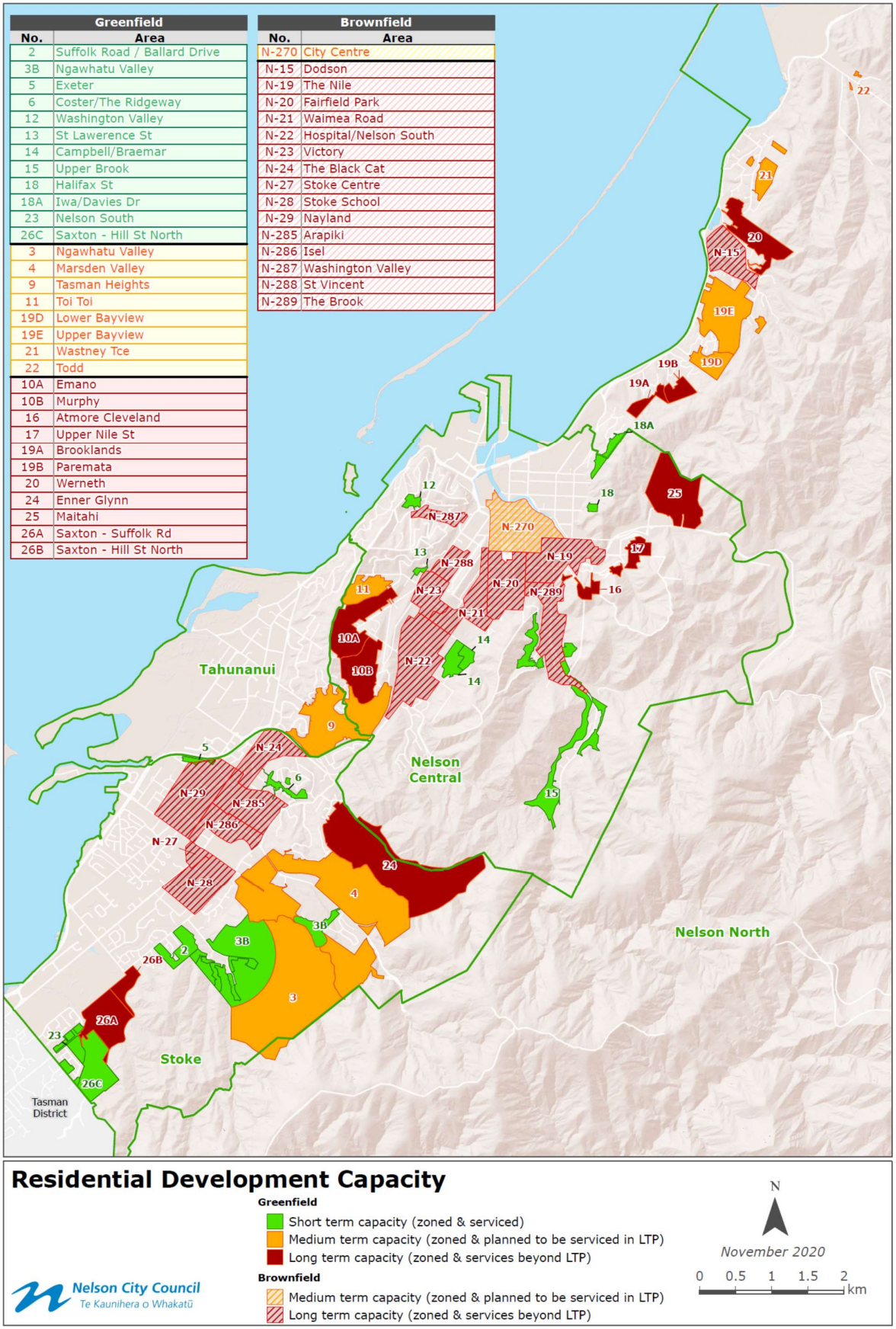
The FDS identifies space for 8,166 extra dwellings in the Nelson Urban Area (which includes Richmond), with about 60% of this growth to be achieved by adding new housing into existing urban areas including the City Centre and Stoke. An additional 1300 extra dwellings could be constructed in the Wood, Vanguard, Gloucester Street and Tahunanui in 20–30 years' time, but Council will not be providing for intensification in these areas unless the effects of climate change (particularly sea level rise) can be addressed in these areas. Two greenfield areas within Nelson which have been identified as being suitable for new urban development in the medium term are Mahitahi and Saxton.

Community feedback on the FDS supported growth through intensification of existing urban areas rather than expansion onto rural land.

A map of the areas identified for growth is shown in Figure 3-7 below.

For planning purposes 3 waters servicing for the City Centre, Victory, and Washington Valley is currently scheduled to progress in decade 1.

Figure 3-7: Nelson Growth Areas and Infrastructure Timing



Intensification Action Plan:

Implementation of intensification projects is more complex than traditional expansion, so therefore an Intensification Action Plan has been developed. The Intensification Action Plan states that Council should:

- Lead investment in urban amenity and public transport to encourage growth in specific areas.

- Lag investment in response to growth occurring (e.g. traffic lights to manage increased vehicle numbers, and wastewater services to meet demand).

Council does not have full control over the location or level of uptake of intensification or urban expansion opportunities, as this is dependent on decisions by individual landowners and/or developers.

Two of the methods in the Intensification Action Plan are to:

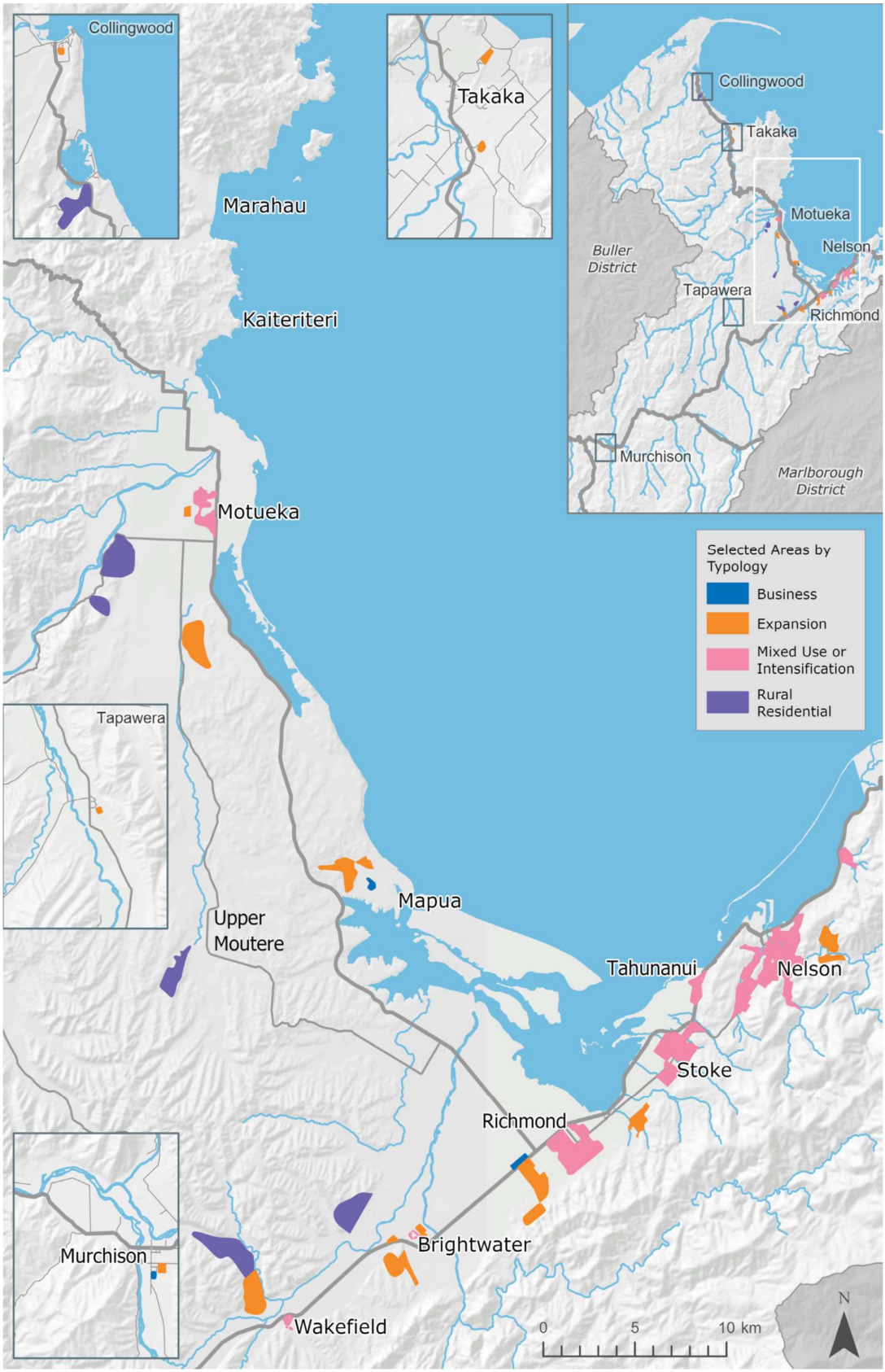
- Develop comprehensive neighbourhood upgrade plans

- Integrate urban design principles into infrastructure development and renewal processes at the scoping and design phase.

The availability of water supply reticulation, detention and treatment facilities that have capacity to service the proposed intensification will increase developers' certainty that the neighbourhoods they are investing in will be attractive to buyers.

Intensification areas for the wider Nelson-Tasman area are shown in Figure 3-8 below.

Figure 3-8: Nelson/Tasman Intensification/Expansion Map



Six areas have been identified by Council as likely areas for re-development in the next 15 years. In addition development of the Maitahi and Bayview areas have been signalled by developers as likely in the shorter 3-5 year timeframe and Washington Valley is currently being designed to take advantage of co-construction with stormwater and wastewater upgrades. While the exact nature of any services upgrades will need to be matched to the final shape of any development proposals it is possible to develop draft proposals based on ensuring there are clear trunkmain supplies to each of the areas. The preliminary servicing strategy is based on renewal and upgrading of key supply pipelines from the city main supply to the areas of interest so the city develops an identifiable ring main system around the development areas that can be used to supply individual streets. Upgrading the necessary network as part of the normal planned renewals allows the work to proceed in a more economical fashion and generally to match demand or to align with other utility upgrading.

As Council and the community finalise clearer priorities for the development and intensification areas a more detailed response can be considered.

A water growth and intensification strategy is proposed to be formulated in 2023/24-2024/25 to respond to priority sites as they are identified.

Table 3-7 and Figures 3-9 to 3-14 show the preliminary summary of upgrading works and the proposed intensification areas as general locations.

Table 3-7: Preliminary Summary of Response to Growth and Intensification Areas

Development Area	Demand Impact (No of Lots)	Proposed Network Upgrade	Year	Budget for services renewal and upgrading
City Centre N270	676	Upgrade ringmain to CBD	TBA	$6.1M
Maitahi	TBC	Install trunkmain from Tasman Street and construct reservoir	TBA	$2.55M
Bayview	TBC	Install supply main from Walters Bluff and construct reservoir	TBA	$1M
Victory N23	175	Upgrade trunkmain from CBD and install ringmain	TBA	$2.75M
Hospital/Nelson South N22	536	Upgrade trunkmain from CBD and install ringmain	TBA	$8.3M
Waimea Road N21	271	Upgrade trunkmain from CBD and install ringmain	TBA	$2.8M
Stoke School N28	254	Upgrade trunkmain from Songer Street and install ringmain	TBA	$4.25M
The Brook N289	275	Upgrade reticulation as required	TBA	$750,000
Washington Valley N287	63	Renew and Upgrade reticulation	TBA	$2.465M

Figure 3-9: City Centre Map (N-270)

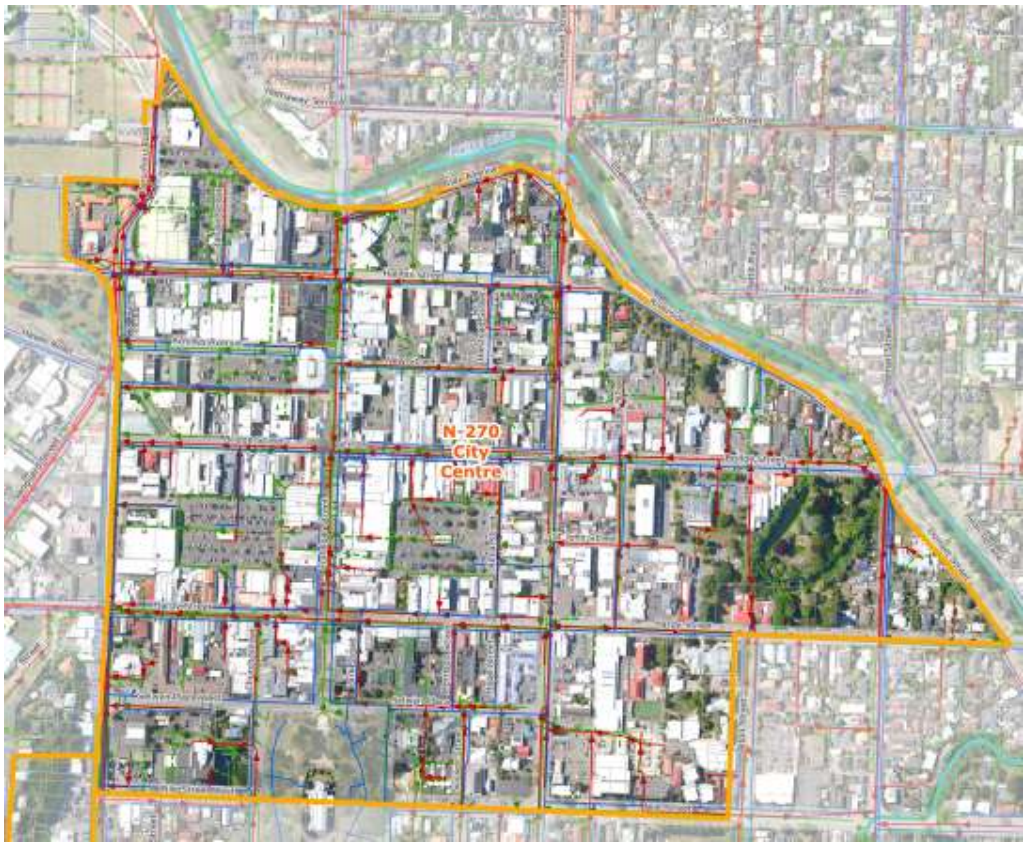


Figure 3-10: Hospital/Nelson South Map (N-22)

Figure 3-11: Stoke School Map (N-28)

Figure 3-12: The Brook Map (N-289)

Figure 3-13: Victory Map (N-23)

Figure 3-14: Waimea Road Map (N-23)

Capital projects in this asset management plan will provide options reports for parts of these areas and construction of storage reservoirs to buffer demand. Long term planning for network upgrades will be re-assessed as Council formulates a policy for these future development areas. The following work programmes are expected to continue:

- As future growth projections are available from the national census, the water supply demand for the City will be revised.
- Reports on the Atawhai No 2 reservoir site will be completed and a report on the Tasman District – Nelson City link will be commissioned if required from the outcome of the proposed Waimea Dam in Tasman District.
- Continue the water loss identification and reduction programme.
- Continue the pressure reduction programme where fire flows allow.
- Complete District Metering Areas and monitor demand by area in the city.
- Investigate viability of metered contractor filling points and metered standpipes for flushing to improve UFW results.

The need to ensure resilience in the network to maintain a reduced service in event of emergency and the projected increase in demand caused by development north of Cemetery Point means that Atawhai No. 2 reservoir (2500m3) has been programmed for construction in 2024/25-2026/27 (subject to a satisfactory site being available). Other reservoirs will be required to serve local growth.

- Malvern Hills to serve the ridge between Botanical Hill and Dodson Valley. The construction of this smaller reservoir will be 'as required by development'.

- The need for other reservoirs as the city expands has been recognised and allowed for, in general terms, in the capital expenditure tables but not necessarily scheduled by exact location as the timing and location of future development is uncertain.

Supply capacity

At the abstraction rates currently authorised in the resource consents, Nelson City has sufficient source water to meet predicted demand through a 1 in 60 year drought for the foreseeable future.

It should be noted that this may change if future resource consents are varied or demand changes from that predicted.

Possible augmentation options to make up any future deficit were considered by Council in 2007. It should be noted that these do not replace the existing sources but merely bridge the difference between existing supply and future demand. Details are in the following reports prepared by Opus International Consultants:

- Maitai Pipeline and Alternative Water Sources – Options and Costs, Opus International Consultants Ltd, 2006

- Feasibility of Raising the Water Level of Maitai Dam, Opus International Consultants Ltd, and Tonkin and Taylor Ltd, 2007

Options are:

- Roding High Dam. A high dam at the Roding could increase the Roding supply. The estimated cost for 10,000m3/day is $75-100million.
- Waimea Dam. A fourth possible source of raw or treated water to the city is via the aquifers under the Waimea Plains and/or through the TDC reticulation. The future of this option is dependent upon a separate process currently underway with the TDC.
- The present capacity of the Nelson Water Treatment Plant at the Tantragee Saddle is 40,000-50,000m3/day. It is likely that with improved future technology the flow rate of new replacement membranes will improve with an increase in capacity to 50,000m3/day using smaller or fewer membranes.
- Raising the top water level at the Maitai Dam. An adjustable weir could be installed on top of the existing spillway weir so that additional water could be impounded. Obermyer Spillway gates are bottom hinged spillway gates. They are most simply described as a row of steel gate panels supported on their downstream side by inflatable air bladders. By controlling the pressure in the bladders, the lake elevation can be maintained at user-selected points. The standard pneumatic controller provides accurate upstream pond control, and discharges water appropriately to maintain upstream lake elevation through a range of flows. This means that the existing spillway with such a spillway gate can be used to increase the water level, whilst allowing flood flows through as per normal.
- If the lake level is raised by one metre, the storage is increased by 350,000m^3. Additional work would be required to alter the auxiliary spillway and to clear an additional one metre band of vegetation around the lake perimeter.
- "Dead" Storage. The bottom 900,000m3 of water in the dam can now be accessed from the duplicate raw water supply pipeline using gravity or the booster pump in the pipeline adjacent the Maitai Motor Camp for more than 16,000m^3/d.

  The bottom layer of the Maitai dam lake has some organic material as well as elevated levels of heavy metals from the surrounding hills. The seasonal anoxic nature of this layer has led to the investigations of aeration options for the lower levels of the dam. Additional capital expenditure required to improve the quality of this water has been included in this Plan. There will also be additional operational costs in running the pump when the "dead" storage is utilised.

Extensions to the area supplied

Eastern Foothills

The Foothills Trunk Main is able to provide water to a large area including Upper Brook Valley, Upper Enner Glynn Valley, Marsden Valley, the ridge between the Ngawhatu and Marsden Valleys, and Ngawhatu Valley.

Nelson North

When the City water supply was extended to the Glen in 1990, high pressure pipework was laid along State Highway 6 from Allisdair Street to Todds Bush Road, with provision made for a pressure reducing valve at Todds Bush Road. This was to enable increased flow in the pipeline as far as Todds Bush Road.

Provision was also made in the pipework for an extension beyond the Glen turnoff. In 2003 the main was extended from the Glen turnoff to Hillwood at the foot of Gentle Annie by a private developer.

Extension over Gentle Annie would provide only a low volume rural restricted supply to existing properties in the area.

At its meeting on 24 October 2002, Council resolved that the pipeline not be extended beyond Hillwood subdivision unless a change to the Nelson Resource Management Plan allows more intensive development in the Nelson North area and the costs would be met by those being served.

Covered Storage

Additional storage reservoirs are expected to be constructed in the future to match growth and Council's ideal capacity of 24 hours demand. Table 3-8 sets out the future reservoirs identified to date.

Table 3-8: Proposed Reservoirs

Name	Location	Year Proposed	Capacity (m^3)
Atawhai No. 2	Bayview Road or Marybank. Yet to be determined.	2018-23	2,500
Ngawhatu	Ngawhatu Valley. Yet to be determined. (to service future subdivisions)	2025-26	1,000
Future Growth Areas	Nelson- North and South. Yet to be determined to match growth areas. Maitahi possible in years 1-3.	2034-38	5,000
Proposed Total			8,500

4. Lifecycle management

Lifecycle Management has a direct impact on the provision of water supply services to the residents and businesses of Nelson through the measures that need to be implemented to achieve levels of service. Lifecycle Management will allow NCC to clearly identify both the short and long term requirements of the water supply system ensuring that a cost effective service is delivered to the community.

As with many other urban areas across the country, much of the 3 waters network in Nelson was developed during a period of intense urbanisation and conversion to public servicing from the 1960s and 70s.

Asset Lifecycle

Assets have a lifecycle as they move through from the initial concept to the final disposal. Depending on the type of asset, its lifecycle may vary from 10 years to over 100 years. Key stages in the asset lifecycle are:

Table 4-1: Asset Lifecycle

	Asset planning	When the new asset is designed - decisions made at this time influence the cost of operating the asset and the lifespan of the asset. Alternative, non-asset solutions, must also be considered.
	Asset creation or acquisition	When the asset is purchased - constructed or vested in NCC. Capital cost, design and construction standards, commissioning the asset, and guarantees by suppliers influence the cost of operating the asset and the lifespan of the asset.
	Asset operations and maintenance	When the asset is operated and maintained - operation relates to a number of elements including efficiency, power costs and throughput. Maintenance relates to preventative maintenance where minor work is carried out to prevent more expensive work in the future and reactive maintenance where a failure is fixed.
	Asset condition and performance monitoring	When the asset is examined and checked to ascertain the remaining life of the asset - what corrective action is required including maintenance, rehabilitation or renewal and within what timescale.
	Asset rehabilitation and renewal	When the asset is restored or replaced to ensure that the required level of service can continue to be delivered.
	Asset disposal and rationalisation	Where a failed or redundant asset is sold off, put to another use, or abandoned.

Asset Failure Modes

Generally it is assumed that physical failure is the critical failure mode for many assets. However the asset management process recognises that other modes of failure exist. The range of failure modes includes:

Table 4-2: Asset Failure Modes

Structural	Where the physical condition of the asset is the measure of deterioration, service potential and remaining life.
Capacity	Where the level of under or over capacity of the asset is measured against the required level of service to establish the remaining life.
Level of Service Failure	Where reliability of the asset or performance targets are not achieved.
Obsolescence	Where technical change or lack of replacement parts can render assets uneconomic to operate or maintain.
Cost or Economic Impact	Where the cost to operate and maintain an asset is greater than the benefit it delivers
Operator Error	Where the available skill level to operate an asset could impact on asset performance and service delivery.

The Lifecycle Management Programmes cover the four key categories of work necessary to achieve the required outcomes for the water supply activity. These programmes are:

Table 4-3: Lifecycle Management Programmes

Management Programme: Management functions required to support the other Programmes - Developed and Implemented by NCC. **Operations and Maintenance Programme:** To ensure efficient operation and serviceability of the assets so that they achieve their service potential over their useful lives - Developed, Managed and Implemented by NCC. **Renewal Programme:** To provide for the progressive replacement of individual assets that have reached the end of their useful lives - Developed, Managed and Implemented by NCC.	Maintaining the service potential of the assets and ensuring that the assets achieve that potential
Development Programme: To improve parts of the system currently performing below target service standards and to allow development to meet future demand requirements - Developed, Managed and Implemented by NCC.	Closing service gaps. Meeting future demand

The Operations & Maintenance and Renewal Programmes are focused on maintaining the current service potential of assets, and are primarily driven by the condition of assets although asset performance is often an indicator of asset condition.

The Development Programme is focused on closing service gaps by increasing the service potential of the water system and is primarily driven by the performance of assets and the need to accommodate growth in the City.

Community infrastructure is installed and maintained on the understanding that the assets are provided in perpetuity for the benefit of future generations. Longevity of an asset is a prime consideration when design and planning is undertaken for new or replacement components in the network. Sustainability has been reflected in the decision making process when designing and constructing the water supply network.

4.1. Background data

The Council has implemented the Infor Asset Management System. It is used to generate works instructions or Service Request Instructions to the utility services maintenance contractor and to link job instructions to the particular section of the network requiring repair, thereby building up a long term maintenance history of the network.

Once a history has been established, maintenance history and age will be used to assist in a deterioration model that will be used to optimise pipe replacements.

With the purchase of Network Analysis software and monitoring equipment, further work, such as area metering, has been carried out to determine areas of excessive water loss.

4.1.1. Physical parameters

Summary of Assets

NCC is responsible for a wide variety of assets that constitute the NCC water supply network. Table 4-4 and 4-5 set out the summary of assets and pipeline lengths by material as at the 2019/20 valuation.

Table 4-4: Summary of Water Activity Assets as at June 2020

Asset Category	km	units
Reticulation incl ridermains	347.3	
Trunk Mains	46.7	
Maitai Pipelines	17.1	
Roding Pipeline	10.7	
Maitai Water Supply Scheme		1
Roding Dam		1
Treatment Plant		1
Tunnels		3
Reservoirs and Tanks		39
Pump Stations		12
Pressure Reducing / Control Valves		52
Air & Non Return Valves		199
Gate Valves		4,302
Manholes		112
Hydrants		2630
Residential Meters		19,617
Commercial Meters		2,010
Customer Connections incl Sprinklers without meters		21,677

Table 4-5: Watermains Lengths by Material as at June 2020

Material	km
Black Asbestos Cement	10.8
White Asbestos Cement	90.2
Blue Brute Pipe	0.29
Cast Iron	0.1
Ductile Cast Iron	2
Pit Cast Iron	15.9
Spun Cast Iron	31.51
Concrete	14.9
Copper	13
DICL	13.1
Galvanised	2.2
High-density polyethylene pipe	35.5
MDPE Medium Density Polyethylene	32.5
PVC	122
Steel Concrete Lined	35.5
Steel Pitch Lined	2.2
Other	0.1
Grand Total	**421.8**

Reticulation

Figure 4-1 provides details of the installation date/material distribution of the Council's water supply network.

Figure 4-2 presents the same information, but showing the expected replacement cost by theoretical renewal year.

Figure 4-3 shows the expected length of pipe by theoretical renewal year.

The three figures illustrate the future renewal challenge for Council with significant lengths of pipework expected to be renewed in the next 10-20 years.

Figure 4-1: Year of Installation / Material Distribution

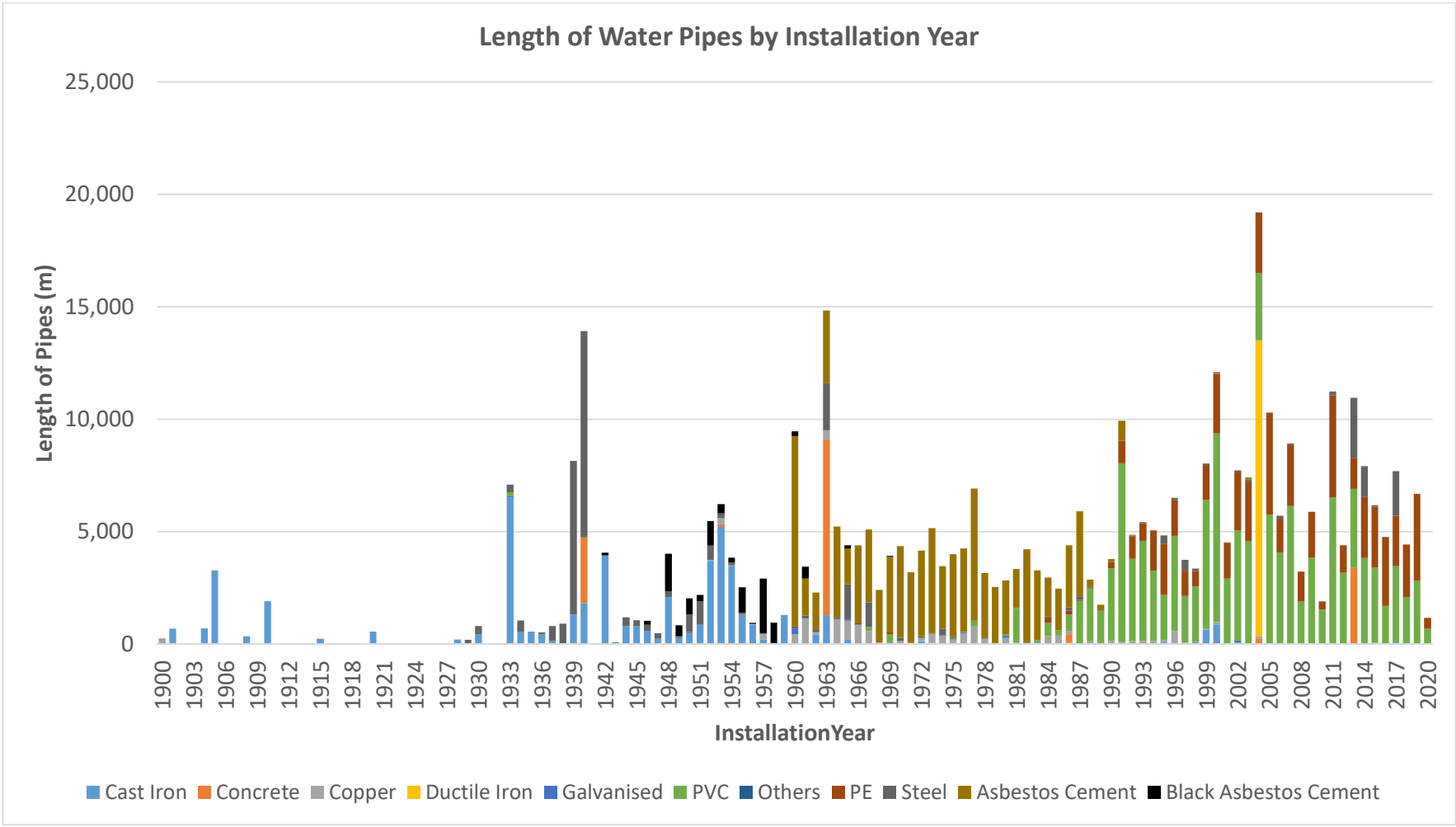


Figure 4-2: Estimated Renewal Cost Year/Material Distribution

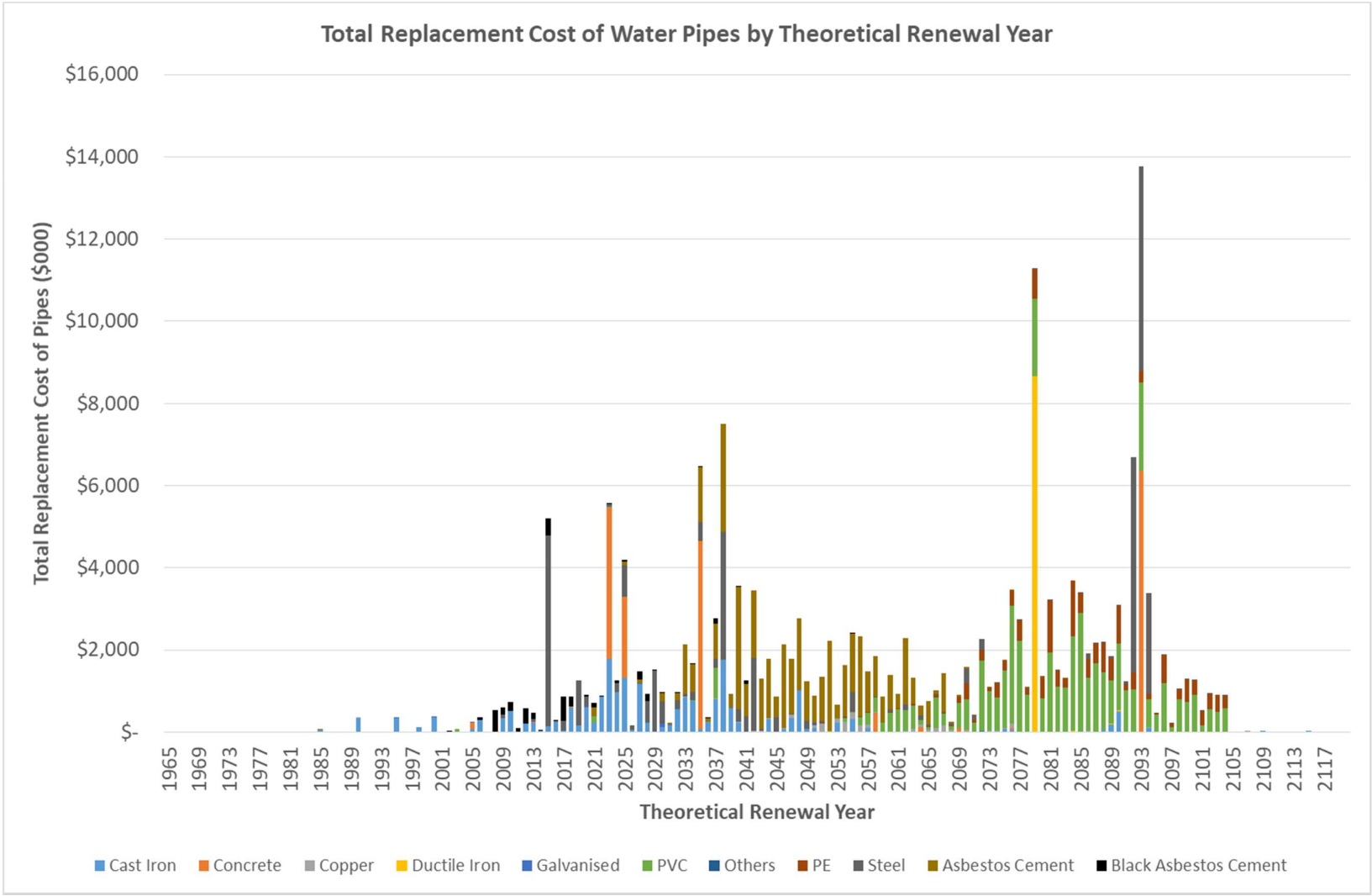


Figure 4-3: Theoretical Renewal Year / Material Distribution

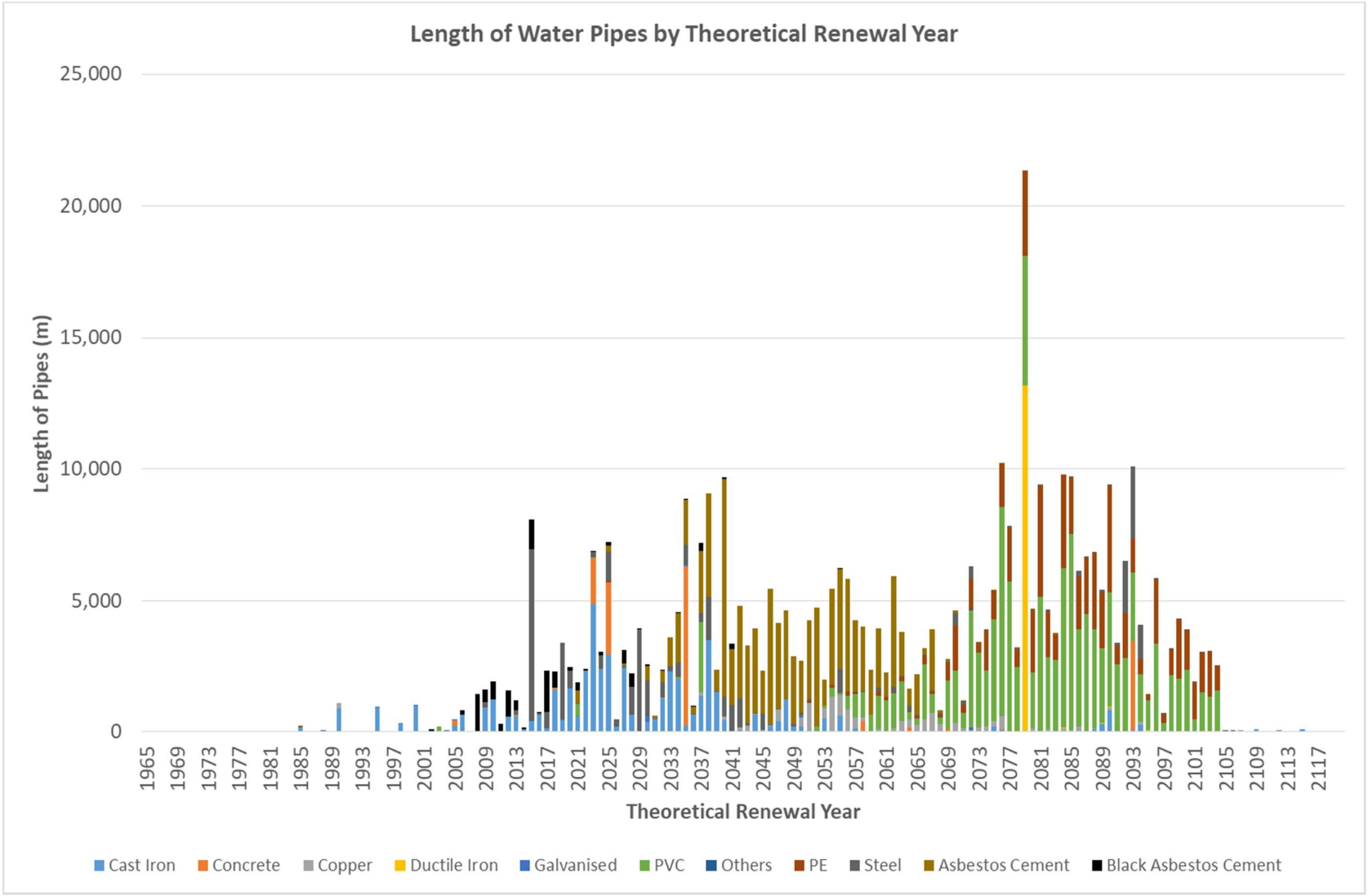


Table 4-6: Working Life of Water Reticulation Assets (Years)

Type	Low Pressure	High Pressure	Trunk Main	Maitai Pipeline	Roding Pipeline
Asbestos Cement (Black)	80	70	65		
Asbestos Cement (Fibrolite)	80	70	65	70	80
Ductile Cast Iron	110	95	90	90	
Pit Cast Iron	120	105	100		
Spun Cast Iron	100	90	85		
Concrete	70	65	60	72	85
Copper	90	80	75		
Galvanised Iron	70	55	50		
HDPE	85	70	65		
PVC	85	70	65	70	85
Concrete Lined Steel	90	80	75	72	85
Pitch Lined Steel	90	80	75	72	

The nominal working life of the reticulation pipework is based on a survival model prepared on the basis of experience of 10 European water supply systems[2]. The results of the model show good agreement with the experience to date in Nelson City.

High pressure reticulation was assigned a slightly shorter life because of the greater working stresses the pipe and fittings will experience.

Trunk mains have been assigned a shorter life again, because of the more serious implications of a pipe failure and the consequent need for a higher standard.

Fixed structures such as dams, tunnels and reservoirs have been assigned a life expectancy of 100 years.

Pump station structures have been assigned a life expectancy of 100 years, pipes/valves a life of 70 years, and pumps/control equipment 20 years.

The construction year for each individual section of pipe has been researched from field books, plans and other records. This information has been entered into the database to allow the age of the pipes to be calculated.

Reticulation

The Central City and Port Hills was one of the first areas developed in Nelson and was reticulated with cast iron and steel pipe. The 75mm diameter cast iron pipes have largely been replaced with 100mm or 150mm diameter PVC pipes over the last 10 years. Their performance however suffers from iron tubercles developing on the inside of the pipes. These restrict the flow, and slough off and can cause orange specks in the water which can stain washing and lead to dirty water complaints. However, the strength of the pipe is not affected by the tubercles.

Growths develop on the inside of cast iron pipes caused by iron bacteria. The bacteria are autotrophic and obtain energy from inorganic compounds. They use carbon

[2] Journal of Water Supply: Research and Technology – AQUA Vol. 45, No. 5, pp. 221-231, 1996

dioxide as a carbon source. They oxidise soluble ferrous iron to less soluble ferric iron. The bacteria deposit oxidised iron Ferric Hydroxide as a red-brown coloured slime. Iron bacteria thrive in unlined cast iron pipes.

Another source of dissolved iron was from lower levels of the Maitai Lake when this water is used in preference to turbid water from upper levels when the river is in flood.

There is no simple or inexpensive way of controlling iron bacteria in distribution systems.

The growths can be minimised by using high chlorine residuals, treating the water at source and lining of unlined cast iron pipes.

Cast Iron Watermains

Cast iron pipes generally have a long life before deterioration failure.

The failure of cast iron is often at the joints.

Older pipes are lead jointed. These joints sometimes work loose due to internal pressure, earthquake, or traffic vibration. The joints are repaired by re-caulking where possible or by cutting out the joint area and replacing it with a new section of pipe and two gibault couplings.

There is also a possible health hazard with the lead dissolving in the water, particularly near dead ends where there is reduced flow, and the water is in contact with the joint for longer.

There are proprietary processes to scrape and reline cast iron pipes with either cement mortar or epoxy coatings. This eliminates the effects of tubercles and lead joints as noted above.

It is therefore proposed to investigate the feasibility of refurbishment of cast iron reticulation pipes 100mm diameter and larger rather than abandoning them.

Cast iron pipes may be weakened by changes to the chemical composition of the pipe material over time, such as graphitisation.

Cast iron pipes, being brittle are liable to damage due to traffic loadings and point load over or under another service such as stormwater pipe, etc.

In assessing the reason for a cast iron pipe failure the cause of the failure will be carefully ascertained.

Asbestos Cement Watermains

The Water Supply Managers Group of the New Zealand Water and Waste Association has produced a report entitled "Condition Rating of Asbestos Cement Watermains" which includes (on hard copy and electronic) a copy of: the National Specification for Sampling and Testing, the Life Expectancy Model, the Deterioration/Life Curves, and a copy of the current database of results.

This document will be used to assess the condition of asbestos cement pipes in Nelson.

Pipes of larger diameters and pipes of higher pipe pressure classes have thicker walls to provide the necessary hoop strength.

However pipe wall degradation is nearly constant for all pipe sizes and classes, therefore smaller diameter, lower pressure class pipes will fail earlier, and large diameter higher pressure class pipes may never fail from deterioration.

Most asbestos cement pipe laid in Nelson is Class D. The exceptions are where higher pressure classes were required for specific high pressure lines.

It appears that the relationship between ground conditions and deterioration is not completely proven but may be worth investigating for critical pipelines.

By sampling and testing the remaining wall thickness on existing pipes it may be possible to predict the year of first deterioration failures in each asbestos cement pipeline.

Most AC pipelines in Nelson are 100mm and 150mm Class D pipes, laid between the 1950s and 1980s during the subdivision boom in Stoke, Atawhai and the Victory Square area.

These pipelines are of the same size, class, operating pressure, and ground conditions, and can therefore be aggregated to derive the top down deterioration model for Nelson.

Similarly there are some 50mm diameter class D rider mains which can be aggregated. As noted above these pipes are likely to be the first to fail from deterioration. They are also most likely to fail due to, for example, traffic loading, again due to the relatively thin wall thickness required for the low internal pressure hoop stresses.

A few trunk mains are 200, 300, 375, and 450 mm asbestos cement of varying pressure classes (e.g. the 375mm trunk main from Neale Park to Vickerman Street is C28. A 375mm pressure class C dimension pipe, but with a stronger asbestos cement mix in the wall). As noted above, these pipes are the least likely to fail from deterioration.

Sampling and testing for pipe wall softening will be carried out using the standard methods described in the "Condition Rating of Asbestos Cement Watermains" manual.

Asbestos pipe was imported from Britain and Italy in the early 1950s. It is coated with bitumen and is colloquially known as "Black Asbestos" cement pipe.

New Zealand made "Fibrolite" asbestos cement pipe does not appear to be softening.

A programme of replacing 50mm diameter "Fibrolite" pipe and 100mm diameter "Black Asbestos" pipe has commenced.

Trunk mains

Maitai Pipeline

The Maitai Pipeline was laid in 1963 using 900mm diameter concrete pipe on concrete cradles. 750mm diameter steel pipe was used for the syphons where the pipeline crosses from one side of the valley to the other.

The pipeline is vulnerable to damage from rock fall which can be caused by either major storms or earthquakes. The leakage that can be caused by a rock fall is far more serious than weeps from circumferential cracks.

An inspection in 1998 identified movement in a section of the pipeline near Groom Creek. This was caused by a large earth flow following a period of heavy rain. A 100m long section of affected concrete pipe was replaced by a welded steel pipe, supported on concrete columns, founded on solid ground beneath the earthflow

Stantec (MWH) Ltd have completed a geotechnical assessment of the existing Maitai Pipeline route in 2017. The level of risk is given a rating from low to very high and has been based on:

- Identification of hazards (e.g. rockfall, slumping, shallow sides, etc);
- Likelihood of the event or hazard (e.g. likely to rare);
- Consequence of event hazard (e.g. from insignificant – no leaks or obstructions to major – multiple or greater than 10m of pipe destroyed, access lost, loss of all flow for over 1 month).

A small number of items were identified as needing immediate attention- removal of trees that pose a risk to the pipeline if they fall and inspection of the steel sections at Fiddlers Elbow and adjacent the Maitai Motor Camp. These items will be addressed 2017/18-2018/19.

Since 1989 maintenance effort has been put into repairing the worst of the cracks and sandblasting and painting the steel syphons. To clear the ground from under the pipe to allow complete painting, it has been necessary to construct additional concrete supports under the pipe.

In 2007 Council decided to duplicate the section of the pipeline from the Maitai Dam to the Water Treatment Plant with a new pipe laid down the Maitai Valley Road. The pipe size has been optimised by providing pumping for peak flows. It was also decided that the existing pipeline should be kept in use for as long as possible to minimise pumping costs. As the breakeven point is about 20 years, painting of the steel syphons should be continued in future asset management plans.

On 30 July 2008 a section of the pipeline approximately half a kilometre downstream of the Treatment Plant was damaged by wind thrown trees. Duplication of this section of pipeline (WTP to Westbrook Terrace) with a pipeline laid in Tantragee Road, Brook Street, and Westbrook Terrace has been completed in 2016/17.

Roding pipeline

The Roding pipeline was constructed in the early 1940s at the same time as the Roding weir. The pipeline runs through a 2.7 km long tunnel under the Barnicoat Range, down Marsden Valley and along SH6 to Tahunanui.

The timber shoring in the tunnel was upgraded in 1992 and is considered to be in good condition. The tunnel and the concrete pipeline within it are inspected annually.

The remainder of the pipeline is constructed of steel pipe. Replacement has been programmed within 20 years on an age basis only. Condition inspection was carried out in 2014 for the tunnel plus the Marsden Valley pipeline. Further detailed investigations of the tunnel is programmed for 2020.

Foothills Trunk Mains

The Roding Transfer Pipeline was constructed in 2003/04 using 300mm and 375mm diameter ductile iron pipe. Steel pipe, of the same size, was used where the pipeline crosses two steeply incised creeks.

The pipeline is made up of two pipes buried full length in the same trench.

One pipeline carries raw Roding water from the Marsden Valley (raw water) trunk main to the Water Treatment Plant. The other pipeline carries treated water back to the Marsden Valley (treated water) trunk main.

Water is pumped to a high point (250m) at the saddle between Brook and Enner Glynn valleys. It then falls under gravity the remaining distance. Pressure reducing valves at the Marsden Valley end reduce the pressure to 170m maximum and at the Water Treatment Plant to 7m.

The raw water pipeline is also connected to a hydro electricity generator to capture some of the energy of the water in the pipeline.

Other Trunk Mains

The remainder of the trunk mains in the City have been installed since the 1960s and are in fair-good condition.

Steel Trunk Mains

Steel pipe is used for trunk mains as they are larger diameter, high pressure mains.

Steel pipe suffers from electrolytic corrosion due to "cell effects" between the steel pipe, other metals, and the soil. Where electrons leave the pipe, the metal is eaten away. Properly coated pipe is insulated from the soil and is therefore protected. The coating can however be incomplete, or have been damaged during pipe laying.

The trunk mains in Brook and Tasman Streets (between Larges Lane and Bridge Street), and under the Maitai River (at QEII Drive) are protected by an impressed current system where electrons enter the steel pipe via the coating defect and exit to the soil in a special anode bed. The Fiddler's Elbow Syphon on the Maitai Pipeline is similarly protected, but with a sacrificial zinc anode.

The systems were installed in 1995 and 1996.

In 2000 it was found that the ground anode bed in Bronte Street needed replacement. This was carried out in the 2001 financial year.

An audit of these systems is required in the next five years.

Table 4-7: Working Life of Water Assets (Years)

	Life (Years)
Manholes	
Standard < 1250 dia	84
Standard >= 1250 dia	72
Flow measuring manholes	50
Meter manhole	80
Valves	
Air/NRTN	35
Pressure Reducing	35
Gate valves <250 dia	84
Gate valves >=250 dia	72
Hydrants	
<250 dia	84
>=250 dia	72
Maitai Water Supply Scheme	
Dam and platform	200
Concrete structures (spillway etc)	100
South Supply Intake	50
Roding Dam	100+
Other	
Reservoirs	100
Tunnels	100
Stoke reservoir overflow pipe	80
Manifold and meter boxes	80
Service laterals	80
Meters	15

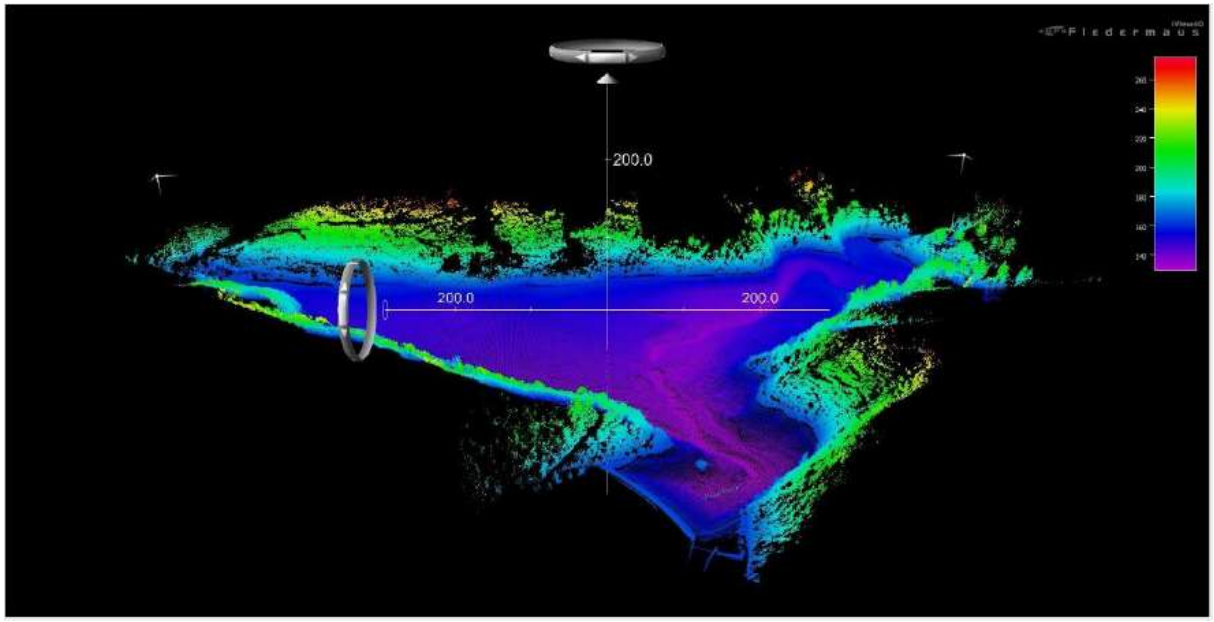
Headworks (including Dams and Intakes)

Maitai Water Supply Scheme

The Maitai Water Supply Scheme dam was commissioned in 1987. The Scheme can abstract water from the North Branch Reservoir or the run of river intake on the South Branch.

The Maitai Dam is an earthfill dam with crest height approximately 36m above the North Branch riverbed see Figure 4-4.

Figure 4-4: Maitai Dam Bathymetric Model



Usually water for Nelson's water supply is taken directly from the 'run of the river', from the Roding River and the South Branch of the Maitai River. To compensate for this loss of water (particularly during times of low flow), water is released from the Maitai Dam to the Maitai River, to increase river flows to at least the level required by Council's resource consent.

The Maitai reservoir retains higher levels of organic material than run-of-river flows, and there are some slightly elevated levels of minerals as a result of the close proximity to the Nelson Mineral Belt. However, the greatest impact on water quality comes from the tendency of the Maitai Dam to stratify[3], resulting in anoxic (oxygen-depleted) conditions at the base of the Dam. This variable water quality at different times of the year occurs in most large dams.

The lack of oxygen in the colder water (in the lower levels of the Dam) creates a challenging environment for freshwater aquatic life. In addition, elevated levels of iron and manganese occur in the water as these chemicals become soluble. Discharging this water to the river can lead to a poor quality environment until the water becomes oxygenated. In recent years Council has only discharged this water during storm events, when the impact is greatly reduced.

However, as the frequency and intensity of droughts are predicted to increase over the next 30 years as a result of climate change, it is likely Council will be more reliant on the release of Dam water to maintain flow levels, rather than only doing so during storms. This increases the need to address water quality in the Dam.

In addition, the desire for improved water quality and quantity in the Maitai River may drive increased use of the Dam water for the water supply. The new water supply resource consent gained in 2019 has increased the minimum flow from 175 litres per

[3] This means a layer of warm water settles over the heavier, cooler water below, and this restricts the movement of nutrients which then become more concentrated in the cooler water over the summer months.

second to 230 litres per second (as the Dam gets emptier during dry periods this minimum flow reduces down).

Currently, one cubic metre of water is added to the river (from the Dam) for every one cubic metre taken from the run of the river.

Under the new approach (a higher minimum flow) the drain on the Dam is quite a bit quicker due to the combined effect of augmenting the river flow, and using water from the Dam for the water supply more frequently.

Ongoing trade-offs are likely between the need to keep the Dam full at the beginning of summer to maintain resilience to droughts and the need to enhance the Maitai River's environmental values.

One way to avoid anoxic conditions in the Dam from impacting on the quality of water released into the Maitai River is to aerate the Dam, either by removing the stratification layer or introducing oxygen to the anoxic layer.

Removing the stratification layer can be achieved by installing a network of aeration pipes with larger diameter holes that provide a steady upward flow of air when charged. The flow of bubbles acts to mix the layers and prevent the stratification developing. The potential downside of this action is to homogenise the water column and remove the colder layer at the base of the dam. The advantage is that the technique is well understood and in use in lakes around the world, including New Zealand.

The alternative option is hypolimnetic aeration- this technique seeks to maintain the temperature difference across the water column and just introduce sufficient small diameter air bubbles to the lower layer to counter the anoxic tendency. The benefit of this is to allow a range of habitats within the dam and allow cooler water to be accessed for backfeed requirements in order to maintain compliance with resource consent requirements.

Council has initiated a project to evaluate the two options and confirm which is preferred. The timeframes for the project are set by the conditions of the resource consent RM165192 (11 March 2019) as follows:

Dissolved Oxygen

9. That within 5 years of the date of the commencement of this consent, the Consent Holder shall ensure the concentration of dissolved oxygen in the North Branch Reservoir is maintained at or above 50% saturation at all depths, by implementing measures identified such as mixing or hypolimnetic aeration).

Within 2 years of the commencement of this consent the Consent Holder shall provide a report to the Nelson City Council's Group Manager Environmental Management detailing the measures to be implemented to achieve the concentration of dissolved oxygen throughout the North Branch Reservoir is maintained at or above 50% saturation at all depths.

To date the following has been completed:

- Bathymetric survey of the full dam and a depth to volume curve established.
- Computer model constructed and preliminary calibration undertaken.
- Additional sampling sites established to improve distribution of oxygen monitoring results.

Roding Dam

The Roding Weir was commissioned in 1940. In 1972 the concrete structure was raised by 1.5m to its current height of 11m above the downstream riverbed.

The weir initially created approximately 40,000 cubic metres of storage. Major floods in 1985 severely damaged some of the upper catchment so there are now significant amounts of gravel and sand coming down the catchment that have filled in the storage behind the weir. This material has been removed but every time the storage area was cleaned out nature simply delivered more material to fill it in.

With the need for storage reduced by the presence of the Maitai Dam, the decision was taken to build an intake on the downstream face of the weir in 1988. As the water flows over the weir some of it falls through the intake's screens and into the pipe work which then delivers it into the water supply system. This has proved very effective and has stopped a lot of the silt and sand getting into the water supply system. The volume behind the weir has been allowed to fill in and it now appears to have reached a stable level. The storage volume behind the weir is now no more than 3,000-5,000 cubic metres. The diversion tunnel gate was renewed in 2002/03. It is now more readily opened to allow gravel to be flushed through on the falling side of a flood, to prevent gravel build up.

Covered Storage

Table 4-8 sets out the existing covered reservoir storage across the city.

Table 4-8: Reservoirs and small concrete tanks

Reservoir Name	Location	Material	Installation Date	Capacity m^3		Earthquake design importance category for tank structure^
Thompson Terrace No. 1	Ariesdale Terrace	Concrete	1963	2,300		4
Thompson Terrace No. 2	Ariesdale Terrace	Concrete	1974	5,300		<4
Stoke No. 1	Marsden Valley	Concrete	1996	2,500		4
Stoke No. 2	Marsden Valley	Concrete	2006	2,600		4
Atawhai No. 1	Walters Bluff	Concrete	2002	2,500		4
Clearwater	Tantragee WTP	Concrete	2004	3,000		4
Stoke High Level	York Valley Saddle	Steel	2011	2,500		4
Observatory Hill No. 1	Princess Drive	Concrete	1990	300		<4
Observatory Hill No. 2	Princess Drive	Concrete	2014	440		4
Panorama Drive		Concrete		185		4
The Glen		Steel	1991	110		<4
Bishopdale	Bills Drive	Steel	2020	200		4
Todd Bush	Skylark Rise	Concrete	2003	5 tanks	22 each	Unknown#
Springlea	22 Springlea Heights	Concrete	2005	1 new tank, 4 existing	22 each	Unknown#

Reservoir Name	Location	Material	Installation Date	Capacity m^3		Earthquake design importance category for tank structure^
Ledbury Road	1 Norwest Way	Concrete	1994	4 tanks	22 each	Unknown#
Strathaven Place	27 Strathaven Place	Concrete	1994	3 tanks	22 each	Unknown#
Fairleigh	Komako Way	Plastic	2019	3 tanks	22 each	Unknown#
Atmore Terrace*	41 Atmore Terrace	Concrete	1993	2 tanks	$22m^3$ each	Unknown#
TOTAL CAPACITY					**22,419**	

* Atmore Terrace tanks are not currently connected to the reticulation and are used for storage and for firefighting purposes.

^ The NZS 3106: Code of Practice for Concrete Structures for the Storage of Liquids describes category 4 as 'Must remain operational and functional post-earthquake'.

TBC with manufacturer.

Reservoirs

The two reservoirs at Thompson Terrace were constructed in 1963 and 1974. Both reservoirs were strengthened in 1991/92 to improve the seismic performance.

In 2000, an engineering inspection was carried out on the roof structure of the 2,500m3 reservoir at Thompson Terrace. It was found that the roof cladding was perforated and that some of the trusses were badly corroded. The roof was replaced in 2001/02 with fibreglass cladding supported by an external steel structure.

A further engineering inspection was carried out on the rest of the reservoir in 2002 while it was drained for roof construction. It was found that the water seals in the floor were in need of replacement. This has been completed.

The Stoke Nos.1 and 2 Reservoirs, Stoke High Level Reservoir, Walters Bluff Reservoir, Clearwater Reservoir and the Observatory Hill Reservoir are of more recent design and are category 2.

There is both mechanical and electronic equipment at the reservoirs to control and monitor refilling.

An additional reservoir at Observatory Hill was constructed in 2014 to provide water storage for the residential subdivisions in the area.

Following the 2011 Christchurch earthquake Council undertook a review of the reservoirs to identify any improvements that could be made using the knowledge gained from Christchurch. To date the smaller Thompson Terrace tank and Walters Bluff reservoir are in the process of being strengthened. A range of minor works to valves and tank draw off points at other tanks are being carried out under the operational contract.

Pump Stations

Nelson generally has a gravity fed system. (The Marsden Supply is at 170m City Datum and the Clearwater Reservoir at 155m City Datum). There is therefore low dependency on pumps.

The City has nine operational pump stations in the reticulation network and two in the raw water delivery lines. All have been constructed since 1990. The Austen Ward Heights pump station has been decommissioned and Thompson Terrace pump station is planned to be completed with an adjacent subdivision. The WTP has multiple pumps including the treated water return pump to Marsden Valley.

Table 4-9: Pump Station Locations

Location	Number of pumps	Maintenance contractor	Year Installed / Comments
On main raw water delivery line adjacent the Maitai camp ground	2	FH	2014
Marsden Valley raw water delivery from Roding supply	2	FH	2004
Water treatment Plant	Multiple	FH	2004
Princes Drive	2	Nelmac	2000
Thompson Terrace	NA	NA	Not in place yet
Wastney Terrace	3	Nelmac	2007
Bishopdale Ave (adjacent no 101)	2	Nelmac	2007
Springlea Heights	2	Nelmac	2005
Hutson Street	1	Nelmac	2017
Montebello Ave	3	Nelmac	2011
Van Diemen Street	1	Nelmac	1995
Austen Ward Heights	NA	NA	Decommissioned
Panorama Drive	2	Nelmac	1999
Farleigh Street	2	Nelmac	2019

At both ends of the Foothills Trunk Main (commissioned 2004) are large inline pump stations. These are critical for the transfer of water to and from the Water Treatment Plant.

There is a large inline underground pump on the cross town trunk watermain in Van Diemen Street. This was designed to boost the flow from the Treatment Plant to Stoke via the Thompson Terrace Reservoir at times of high demand. It is regularly used to part fill Thompson Terrace to maintain the operation of the pump and reduce the risk of sedimentation in the pipework.

The other relatively small above ground pump stations boost water to higher hillside properties.

Pressure Reducing Valves

The City has 52 pressure reducing/control valves in the reticulation system. Their locations are shown in Figure 1-1 in the Introduction.

Three pressure reducing valves are located at the Marsden Pump Station on the Clearwater Foothills Trunk Main and one is located at the Water Treatment Plant on the raw water foothills trunk main. These were installed in 2004 as part of the Water Treatment project.

At present, pressure gauges linked to the telemetry system monitor the performance of 10 of the pressure reducing valves. These gauges allow for remote monitoring of the pressure in the reticulation and generate an alarm if the pressure moves outside set tolerances. The alarm allows maintenance staff to quickly respond to excess pressures, reducing the impact of damage caused to both public and private pipework.

It is intended to progressively install new telemetry sites to monitor the performance of strategically located valves over the next five years where failure could impact large areas of the city. Target areas for remote monitoring include the CBD, Nelson South and Atawhai zones.

Service Pipes, Manifolds and Meters

Service pipes are the pipes between the watermain and the property street boundary. These pipes are part of the water asset. Pipe materials used are galvanised iron, copper and polyethylene. Galvanised pipes were installed prior to the 1950s. Copper was installed from the 1950s to the 1990s. In recent years polyethylene or polybutylene has been used.

The quantity of each type of pipe is not known with complete certainty. Whenever a street is upgraded or a new watermain is laid the water service pipes are relaid if they are galvanised. This procedure has been in force since 1990. In recent years the copper laterals are also being renewed where possible.

Supply pipes are the pipes between the property boundary and the building on the site. These pipes may be shared by several properties where there is a Right of Way or Cross Lease access. Supply pipes are privately owned.

All properties connected to the Water Supply are metered. Meters and manifolds are generally situated at the property street boundary. The exception is where one or more properties are served by a common supply pipe. In this case the meter is located in a practical location where the supply pipe branches to serve only one property. The meter and manifold is part of the water asset, although it may be sited on private property on a private supply pipe.

Manifolds were installed as replacements for all residential toby repairs, and on all new subdivisions from 1993. Manifolds were installed on all other residential properties in 1997 and 1998 as part of the Universal Metering Project. Meters were installed into these manifolds in the first six months of 1999.

In 2009 a small sample (23) of residential water meters were bench tested for accuracy by Water Meter Services Ltd as part of the water losses investigation. These tests were carried out at flows or 0.38 litres per minute, 15 litres per minute and 50 litres per minute. The results show readings ranging as follows:

- Flow 0.38 litres per minute -27.3% to +3.47%
- Flow 15 litres per minute -3.31% to +0.77%
- Flow 50 litres per minute -31.87% to -1.02%

The variability confirmed a general view that some losses must be attributed to meter performance. The testing was repeated in 2013 and 2016/17 to monitor changes and to begin developing a failure curve. The sample tested was quite small in 2016/17 (19 of) and may not be sufficient to develop a reliable curve.

Renewal of the simple double check valve assembly in the meter manifold has been identified as a priority, owing to ongoing failure of these units. This work started in 2015/16 and will be ongoing until the meter replacement programme is concluded.

The increasing use of automated meter reading technology in the power supply utility field offers real advantages to the water supply activity, principally in reducing costs of meter reading and billing and providing early warning of excess water use that may be an indication of leaks. To investigate the feasibility of adopting this technology a trial with 50 meters in a central city residential street began in 2016/17. The meters have been read using hand held wands to test the system and manually for the purposes of invoicing. The appropriate software has been installed and tested for compatibility with the NCC network.

A business case in 2017 concluded that it was not economical to renew all of the manual read meters in the city with electronic meters with the result that the current meter renewal project is replacing like for like.

Water Treatment Plant

Commissioned in August 2004, the Water Treatment Plant is made up of several hundred components.

In 2012 an S:CAN unit was installed at the treatment plant to measure the following parameters in the raw water:- total organic carbon, dissolved organic carbon and turbidity; and automatically adjust chemical coagulation dosing. Early results are promising with more efficient use of coagulation chemicals possible. As part of the new abstraction consents for the Maitai and Roding rivers an external review of the water treatment plant was commissioned. This review noted the use of ferric chloride coagulant and reticulation problems encountered during a trial using the Maitai dam as a sole raw water source and recommended a change of coagulant chemical to Aluminium Chlorohydrate. Community consultation will likely be required before any change is made.

In 2013 Council commenced a trial of dosing the raw water delivery from the Maitai with carbon dioxide as a means of adjusting the pH below 8 which will improve the efficiency of the coagulant chemicals used to remove organic loading in the raw water. While the pilot trial suggested this would be successful in reducing chemical use there is more testing required to develop a robust operations protocol that would allow this to be used in a more permanent installation.

The trial using the Maitai Dam as the sole raw water source identified further issues with the soda-ash plant used for pH correction and recommended a change to caustic soda.

The report recommendations will continue to be investigated in 2021-2031.

Land, Access Roads, Fences, Landscaping and Houses

Land, access roading, fencing and landscaping have now been included in the asset register. These facilities are regularly maintained and are in good condition. The houses at the Maitai and Roding waterworks are listed in Council's fixed asset register.

Pressure

At present, Nelson's water supply is predominantly gravity fed from covered storage reservoirs. This means the elevation of the Water Treatment Plant Clearwater reservoir and Stoke High Level Reservoir determines which areas of the City can be supplied and how much pressure is provided.

Each supply area is further broken down into high level and low level areas. The high level areas work on the full mains pressure generated by the difference in elevation between the reservoirs and the point of supply.

The low level areas have the supply pressure stepped down by pressure reducing valves. This is to protect the mains and domestic plumbing installations from continuously operating under excessively high water pressures.

The Clearwater Reservoir at the Water Treatment Plant is normally used to directly supply the area encompassed by Atawhai, the Brook Valley, Bishopdale, the Port Hills, the Port, and via the Thompson Terrace Reservoirs to Tahunanui and the Tahunanui hillside, and at times Stoke. The reservoir has an effective elevation of 155m above City Datum.

The Saddle Break Pressure Tanks and Stoke High Level Reservoir on the foothills cross-City link between the Brook and Enner Glynn Valley are at an elevation of 255m above City Datum (but the pressure is lowered in Marsden Valley by a pressure reducing valve to 170m above City Datum) and is used to supply Stoke.

The difference in elevation between the two systems means that properties on the Stoke high level areas can experience pressure fluctuations of at least 150kPa (15m head). This fluctuation in cold water pressure (and flow rate) adversely affects showers, washing machines, dishwashers, etc.

4.1.2. Asset capacity/performance

Reticulation

The flow capacity of asbestos cement pipes does not generally deteriorate with time however the failure performance of the product has not met Council's expectations. This is particularly the case with 'Black' asbestos cement. Council's current renewal strategy targets the replacement of this material as a priority.

The trial use of the Maitai Dam as the sole raw water source in 2016 resulted in a large number of dis-coloured water complaints to Council. The source of the dis-colouration is generally believed to be the deposits of iron and manganese in the network. A review of the issue has made a number of suggestions for further investigation to better identify the cause of the deposits being released into the network at that particular time.

Headworks (including Dams and Intakes)

The aim is to have the capacity to withstand a 1 in 60 year drought with only sprinkler and hosing restrictions until at least 2080. Outputs in this demand section are therefore calculated on this basis.

Water for the city is extracted directly from both the Maitai and Roding rivers, piped to the treatment plant at the Tantragee saddle and then delivered to the city.

Water from the Maitai river is extracted from a run of river intake on the South Branch of the headwaters or from the Dam reservoir on the North Branch. The dam has been constructed on the North Branch to store water for use in low flow periods and for supplementary water flows to compensate for extraction from the South Branch.

An analysis of the flows in the South Branch of the Maitai river by TDC hydrologists has indicated that low flows for the 1, 50, 90 and 100 year return periods are as follows:

1 year: 203 litres per second

50 year: 90 litres per second

90 year: 84 litres per second

100 year: 83 litres per second

The Maitai Dam was designed to meet a peak demand of 37,000m^3/day through a 75 year return period drought but has the capacity to supply water at the rate of 50,000m^3/day through a 60 year return period drought. With the completion of the Water Treatment Plant and the Maitai duplicate pipeline a further 900,000m^3 of water from the bottom of the Maitai Lake can be treated and used for city supply. However pumping will be required to transport the raw water in the duplicate pipeline if more than approx. 17,000m^3/day of this water is required for the treatment plant.

The older concrete Maitai pipeline has a maximum capacity of approximately 37,000m^3/day.

The Roding Dam has only limited storage and is a run of river intake. Provided there is an adequate flow in the river the Roding pipeline can deliver a maximum of 22,000m^3/day. The estimated flow in the Roding River in a 1 in 60 year drought is 11,200m^3/day.

However, the Resource Consent for water extraction from the Roding requires that a minimum flow of 150 litres per second, or the natural flow if less than this, be left in the river. This flow level is reached in most summers reinforcing the need to operate the Nelson Water supply with multiple raw water sources.

The current capacity of the Tantragee Water Treatment Plant is approximately 50,000m^3/day. Future technology with higher capacity membranes are expected to extend the plant capacity even further.

The foothills link from the Roding River (Marsden Valley) to the Water Treatment Plant has a maximum capacity of 22,000m^3/day. This allows the Maitai pipeline to be shut down for maintenance other than during the peak summer demand. The normal flow is 16,000m^3/day to reduce pumping costs. However, when the Maitai Dam spillway stops flowing i.e. when the lake level is below the crest, and there is still sufficient flow in the Roding, Roding water can be used to supply the City, up to the maximum allowed by the resource consent (residual) thereby minimising draw off of stored water from the Maitai Dam.

The principal trunk link between the Water Treatment Plant and Stoke is the foothills link to Marsden Valley. This has a capacity of 16,000m^3/day. Because water in the foothills link is pumped, the use of the Marsden Valley route for treated water is minimised to reduce operating costs.

The other trunk link between the Treatment Plant and Stoke is through the Thompson Terrace reservoirs. The size of the trunk mains and the elevation of the reservoirs restricts the gravity flow through this link to approximately 11,000m^3/day. However, a booster pump station in Van Dieman Street increases the peak capacity to 14,500m^3/day.

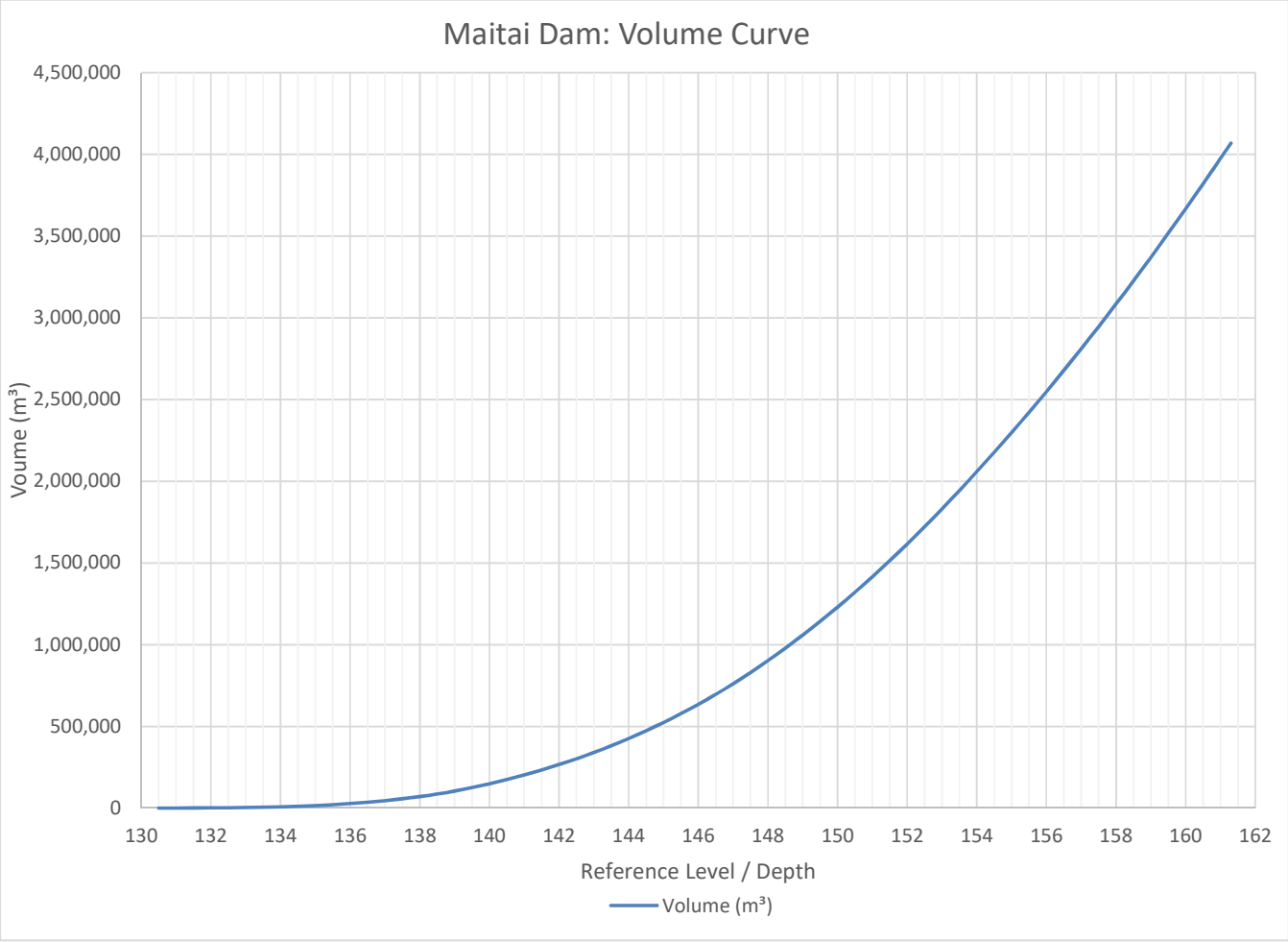
The supply capacity to Stoke and Tahunanui is:

Foothills Link	16,000m^3/day
Cross City Link	14,500m^3/day
	30,500m^3/day

Maitai Water Supply Scheme

The reservoir has a total live storage of 4.1M m^3. Figure 4-5 shows the storage volume with depth.

Figure 4-5: Maitai Dam Volume Curve



Covered Storage

Currently the Maitai and Roding together are capable of meeting the water treatment plant capacity of approximately 50,000m^3/day. However, demand is more typically spread over a 16-18 hour period. Therefore storage is required to make full use of the night time supply capacity and to meet peaks in demand during the day.

This storage is also needed to ensure continuity of supply in the event of a major problem (e.g. headworks damage, or trunk main failure) and to provide opportunities to carry out planned maintenance.

The targeted level of service is 24 hours storage (at average demand) located in the area it is to serve. This standard is met for the smaller hilltop reservoirs and tanks served by pumped systems or night time filling but not for the larger zone reservoirs.

All reservoirs above 100 m^3 have level sensors connected to the telemetry SCADA system. Alarms are monitored 24 hours a day and there is always someone on-call to respond. There are seismic valves on the outlet pipes of nine of the reservoirs over 100 m^3 (excluding The Glen and Montebello which is privately owned).

See 4.1.1. Physical parameters Table 4-8: for detail of each reservoir and tanks capacity

Pressure - Background

New Zealand Fire Service Firefighting Water Supplies Code of Practice 2008 requires 10m head residual running pressure, i.e. pressure remaining in the pipe after abstraction of the firefighting water.

NZS 4404: 2010 Land Development and Subdivision Engineering recommends water supply pressure shall be between 250 kPa and 800 kPa (25m to 80m head)

Council endeavours to maintain water pressure between 30m head and 90m head.

New Zealand Fire Service Firefighting Water Supplies Code of Practice 2008 specifies volume and pressure requirements for the water supply system within the Urban Fire District.

Pressure fluctuation

The maximum available pressure is called the static pressure. This occurs overnight during the low flow period. As demand increases in a pipe network, the friction of the moving water in the mains causes a reduction in pressure known as friction loss.

The working pressure (that experienced by the customer) is the static pressure less the friction loss. Demand varies though the day and year. With increased demand, customers experience lower pressures during the day and in summer. A difference between static pressure and working pressure of more than 35% is considered excessive.

Minimum Pressure

The minimum working pressure at the ground floor level of buildings should ideally be not less than 300kPa (30m head) with an absolute minimum of 150kPa (15 metre head) in exceptional instances. The water supply levels in the 1996 Resource Management Plan were set at 67m NCC Datum (low level zones) and 110m NCC Datum (high level zones) to ensure these standards are met for all new developments.

In some of the more recent hill top developments above the water supply level, the issues of continuity of supply and pressure fluctuations have been resolved by the installation of storage tanks and in some cases pump stations.

New dwellings connected to the NCC water supply with ground floor level less than 30m below the floor of the reservoir are required to install a domestic pressure pump and tank to ensure adequate pressures. In recent years Council has required a minimum connection diameter of 20mm across the city. This size is typically oversized from the historical minimum of 12mm diameter but has provided a better water flow for lower pressure areas. Larger oversize service connections can also be provided by developers or home owners to further minimise friction losses if required.

Maximum Working Pressure

The maximum pressure normally targeted would be in the order of 600kPa (60m head). Due to Nelson's hilly terrain and the ample pressure generated by the elevation of the headworks, Nelson City Council pressures can be substantially higher.

In the lower areas of the city, static pressures can range from 400kPa to 950kPa. (40m to 95m head). Pressures in some of these areas have been reduced over the last 20 years (in particular, the Port and the residential areas of Stoke and Tahunanui on the seaward side of State Highway 6), by installing new pressure reducing valves, adjusting down existing pressure reducing valves, or installing new mains. This can cause difficulties where plumbing and sprinkler systems have been designed for higher water pressures.

Pressures in the 60 to 95m head range are still generally acceptable for domestic supply, although not ideal, and may need reviewing in the future.

Excessive pressures can lead to early failure of mains and contribute to problems of Unaccounted for Water losses (UFW).

Of more concern are the areas on the edge of high pressure zones (in particular, the bottom of the Port Hills, the Tahunanui Hills, Toi Toi Valley, Washington Valley and the Grampians). As a cost saving measure when the City was developed, these areas were served by the high pressure mains that also carry water to the top of the hills. Static pressure in some of these areas is in the range of 1400kPa to 1800kPa (140m to 180m head).

These pressures are in excess of normal working pressures. It is likely that most of these residents have installed their own pressure limiting valves. As mains in these areas are re-laid the opportunity is taken to provide additional capacity and change them over onto the pressure reduced zone.

In addition to the above the renewal budget over the next 10 years will be used to lay new mains to better withstand the system pressures.

Performance Monitoring

The following actions are currently undertaken to monitor the network pressures:

- Record all complaints regarding "high or low pressure".
- Monitor pressure at pressure reducing valves daily.

Flow rate

Domestic Flow Rates

30 litres per minute is the standard aimed for in Nelson. Provided the minimum pressure standards are achieved then this flow rate should be available.

One of the symptoms of excessive pressure is too high a flow rate. This can cause water from the cold tap to bounce out of sinks and basins and creates water hammer in both the property's plumbing and the water reticulation system when automatic valves in dishwashers and washing machines close off.

Resolution of the excessive pressure problem will solve this problem.

Industrial/Commercial Flow Rates

The flow rates required by industrial processors are specific to each individual site. These are almost impossible to predict in advance so new reticulation systems in industrial areas are often provided with additional flow capacity when future demand can be identified.

With the exception of the Port Area, any proposal to use large volumes of water will be restricted by the capacity of the existing local mains to deliver the water and the impact on the water network, particularly during droughts.

Commercial areas as distinct from industrial areas generally have low water demand except for firefighting.

Fire Fighting Flow Rates

The public supply is designed to provide an effective firefighting network. Hydrants are installed on all service mains in urban supply areas in accordance with the New Zealand Fire Service Firefighting Water Supplies Code of Practice 2008.

This Code of Practice lead to the result that existing fire flow provisions in the city are now less than desired in many areas largely as a result of the changes to how distances from hydrants are measured.

Previous versions of this code of practice measured the distances from properties to fire hydrants as a radius centred on the property, the current version now measures the true "along the road" distance. This had the effect of increasing the number of properties that did not meet the distance requirement.

Upgrades to the fire flows have been ongoing since 2015 with the result that most of the smaller projects have been completed and generally the larger street wide pipe upgrades remain.

Approximately $850,000 is included over the ten years of this plan to continue upgrades to the water network in areas where the fire flows are not being delivered. The areas to be upgraded will be identified using the water network model.

In addition the required firefighting water supply for each building (other than single or multi-unit housing but excluding multi-storey apartment blocks) must now be calculated for the floor area of the building and the fire hazard category involved rather than being read directly from a table as previously. Any deficiencies identified for particular premises would have to be remedied by the owner by increasing the firefighting water supply, reducing the fire hazard in order to meet the requirements of the code, or installing a fire sprinkler system.

The required flow (FW2) for single or multi-unit housing (but excluding multi-storey apartment blocks) is 25 litres per second with a minimum of 12.5 litres per second from a hydrant within 135 metres of the risk and a further minimum of 12.5 litres per second from another hydrant within 270 metres of the risk. Different flows are required in Commercial/Industrial areas depending upon the fire hazard (low–medium hazards require 50l/s – 150l/s from a range of operating hydrants).

The Fire Service Code of Practice allows that where there is a reliably calibrated and accepted system for computer modelling of flows in a reticulated water system, the Fire Service may accept the outputs from such modelling in place of testing certain fire hydrants.

Generally domestic demand is not critical and the supply of water for firefighting purposes will determine the reticulation pipe sizes required.

Problems with inadequate hydrant flows are experienced in some of the older areas of the City where the original 75mm and 100mm diameter cast iron watermains are incapable of delivering the flow rates required. Renewal work in recent years has concentrated on replacing these mains. The programme of replacing all 75mm diameter cast iron mains in the City was largely completed in 2006/07. This work also helped to address the problems with fluctuating and low pressures.

A specific project to address the issue of fire flows across the city has been underway since 2015/16. To date this work has rectified flows to 149 properties. The areas to be upgraded will be regularly reviewed and identified using the water network model.

4.1.3. Asset condition

Condition Assessment

Historically asset monitoring to determine condition has been subjective, based on local knowledge and experience. Formal procedures now exist to assist assessment of asset condition in a qualitative fashion.

The development and continued use of condition assessment data is hoped to support the preparation of verifiable predictive decay curves for particular asset types and hence permit prediction of remaining life. Consideration of economic influences and other factors will also be required in the adopted life for the asset type.

By considering the current condition point on an assumed decay curve, the profile can predict the effective life (time) before failure. This failure time can be the physical end of life, minimum level of acceptable service, or limit of capacity of the asset.

Current Position on Condition Assessment

Presently a simple approach to condition assessment is being used.

Whenever the maintenance contractor is working on pipe repairs a condition report is made and entered into the Asset Management System. It is anticipated that this database will be used to plot developing problem areas on a city wide basis and allow relationships between pipe types, construction techniques, age and geology to be developed.

Pipe samples will also be recovered, where unexpected failures occur, so that sophisticated condition assessment can be implemented and the data recorded on the Asset Management System.

The Asset Management System will be used as part of an Optimised Decision Making process. The level of sophistication will increase as the condition data base is developed.

Reticulation

When considering the condition of the reticulation, the City can be considered as three reasonably distinct areas:

- The Central City and Port Hills was one of the first areas developed in Nelson. Smaller diameter reticulation has largely been replaced with 100mm or 150mm dia pipework.

  Most of the more recent (post 1975 introduction of uPVC and PE pipes) reticulation is considered to require minor maintenance only i.e. Condition generally Good.

- Stoke and Tahunanui came within the City boundaries in the 1950's. Water reticulation was provided at that time. Typically cast iron and asbestos cement pipe was used. Early asbestos cement pipes are softening and starting to fail and needs replacement.

  The reticulation is considered to be generally in satisfactory condition, i.e. Condition Fair-Good. The exception is the 'Black' asbestos cement pipes that are in poor condition.

- The Atawhai and Stoke South areas have been developed since the 1970's. Asbestos cement and more recently PVC pipe have been used.

  The reticulation is generally considered to be in very good condition, i.e. Condition Very Good.

Asbestos Cement Watermains

Table 4-10: Best Estimate of Condition of Black Asbestos Cement Watermains

	Very Good	Good	Fair	Poor	Very Poor	Total
Metres Length	321	695.5	1,166	1,348	7,169	10,700
%	3	6.5	10.9	12.6	67	100

Table 4-11: Best Estimate of Condition of White Asbestos Cement Watermains

	Very Good	Good	Fair	Poor	Very Poor	Total
Metres Length	63,784	11,995	10,377	6,188	2,856	95,200
%	67.0	12.6	10.9	6.5	3.0	100

Cast Iron Watermains

Table 4-12: Best Estimate of Condition of Cast Iron Watermains

	Very Good	Good	Fair	Poor	Very Poor	Total
Metres Length	-	-	6,237	36,481	6,782	49,500
%	-	-	12.6	73.7	13.7	100

Trunk mains

Maitai pipeline

Cycles of direct sunshine and frosts have resulted in circumferential cracking of the concrete pipes. In areas exposed to the full afternoon sun there are typically three to four cracks per pipe. The flow from the cracks is usually no more than a weep. In the more shady lengths of the line the pipes are in excellent condition. The worst area is immediately downstream of the dam as far as the first syphon.

The pipeline is inspected monthly and also following major storms and earthquakes. In November each year an engineering inspection is made.

A condition assessment of the steel pipeline section was completed in March 2011. This report has evaluated the condition of the pipeline and provided remediation specifications. The pipeline has significant sections requiring repair and recoating which we have planned to address in the Plan.

The pipeline passes through a 240m long tunnel near the Tantragee Saddle. The timber shoring in the tunnel was upgraded in 1994 and is considered to be in good condition. The tunnel is inspected annually.

Foothills Trunk Mains

The pipeline is inspected yearly, but is also continuously monitored by computer for sudden changes in pressure and flow. It is in very good condition.

Other Trunk Mains

The remainder of the trunk mains are in good condition.

Steel Trunk Mains

Above ground pipes are inspected annually to ensure that the pipe coating (epoxy or wrapping) is intact.

Because steel pipes corrode through localised action as described in Physical parameters, sampling is not a reliable means of determining pipe condition.

An assessment of the above ground steel pipe sections was carried out in 2011 by Inspection and Consultancy Services Ltd. This assessment concluded that the condition of the protective coating of the above ground pipework on the Maitai raw water pipeline was "poor". Re-coating of this main has been completed.

The overall condition of the mains varies from fair to very good condition i.e. Conditions Grade 1-3.

Headworks (including Dams and Intakes)

Maitai Water Supply Scheme

The performance of the dam is monitored monthly and following major earthquakes. Tonkin and Taylor Ltd, the designers, carry out an annual inspection of the dam and maintenance work is programmed in response to their recommendations and those of the Maitai Caretaker.

Table 4-13: Tonkin & Taylor 2020 Intermediate Dam Safety Review Summary of dam condition

Dam Element	Current Condition	Comments
Embankment	Satisfactory	
Piezometer system	Fair	Individual instrument conditions range from satisfactory to poor. Reliability of specific instruments and the entire network would benefit from targeted investigations and assessment.
Standpipe monitoring system	Fair	Maintenance and investigations of the system (particularly B23 and B27) is required in order to aid assessment of pore pressure conditions in the dam.
Drainage / seepage monitoring	Fair	Generally good - minor investigations and assessments would be beneficial.
Service Spillway	Fair	Investigate seepage in base slab.
Auxiliary Spillway	Satisfactory	Inspection of new seepage areas downstream of the fuse plug is recommended.
Intake Tower	Fair	Cathodic protection system needs to be reinstated and reliability confirmed. Ongoing maintenance and repairs (by divers) is required - of bolts and tower steel and locally paint.
Culvert	Fair	Seepage through culvert joints.
Internal Pipework and Valves	Fair	Minor repairs and maintenance required.
External Pipework	Fair	Minor repairs and maintenance required.
Control Building	Fair	Minor repairs and maintenance required.
Mixing Chamber	N/A	Not observed

While these procedures are effective at ensuring year to year reliability of the main supply dams, more work is needed on assessing the longer term requirements for items such as valves, pipework, and electronic equipment.

Comprehensive Dam Safety Reviews (CDSR) of the Maitai Water Supply Dam are commissioned by Nelson City Council every five years to independent consultants to review the original design against current practice. The latest CDSR inspection was carried out by Damwatch Engineering. The final report was received in July 2020.

The 2020 review stated: "There were no confirmed dam safety deficiencies. Most of the issues identified relate to a lack of available information that will give confidence in the operation of Maitai Dam. They do not indicate that there are significant issues."

Issues, comments, and advice provided by the review can be found in Appendix N.

In July 2020 the sealants in the construction joints of the concrete spillway were replaced after elevated levels of water seeping through the joints was detected.

Roding Dam

There is a caretaker living on site at the Roding Weir. Routine maintenance work is programmed in response to his recommendations.

The scheme is considered to be in very good condition.

Reservoirs

All reservoirs are considered to be in good-very good condition.

Pump Stations

The condition of the pumps stations is considered to be very good.

Pressure Reducing Valves

The condition of the pressure reducing valves is considered to be good. A number of watermain failures in the central city (2016/17) and Kakenga Road have been attributed to failures of PRV's in Franklyn Street and Marsden Valley respectively. A review of servicing requirements is proposed for 2021/22.

Service Pipes, Manifolds and Meters

The condition of service pipes varies from very good to unserviceable.

Service pipes are replaced when a reticulated pipe is upgraded.

Manifolds are in good condition.

Meters range from near new with a condition assessment of very good to nearly 30 years old.

Water Treatment Plant

The plant and equipment is in very good condition.

4.1.4. Asset Valuations

The replacement costs of the water assets are $342.2m at June 2020 as detailed in the table below. The majority of the replacement costs are the reticulation mains.

Valuation Method

Valuations are completed on a bi-annual cycle. Every second year a full revaluation is completed of all assets held by NCC, which is completed by reviewing all assets and valuing them based on recent costs for similar work within NCC. This work is peer reviewed by WSP International Consultants Ltd. For the intervening years an Indexed revaluation is completed based on the previous year's full revaluation and a factor of recognised price increase advised by WSP after allowing for known asset additions and disposals. In addition major assets, (dams, Pump stations etc.) are revalued by WSP on a replacement value basis. The Depreciated Replacement Value is used to calculate the straight line depreciation over the remaining useful life.

Table 4-14 sets out the asset valuation as at June 2020.

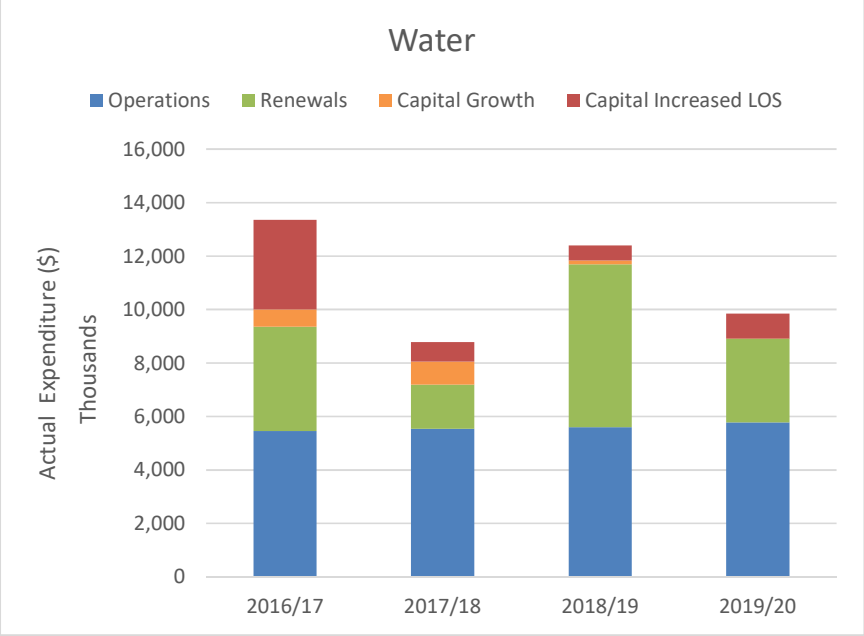
Table 4-14: Water Supply Asset Valuation - June 2020

Asset Category	June 2020				
	Quantity		RV	DRV	Depr
	km	units	($)	($)	($)
Reticulation	347.3		119,143,135	61,744,415	1,493,285
Trunk Mains	46.7		40,153,889	18,004,532	553,864
Maitai Pipelines	17.1		22,689,752	15,824,833	294,513
Roding Pipeline	10.7		7,221,307	3,556,729	91,425
Maitai Water Supply Scheme		1	22,852,700	14,916,300	242,900
Roding Dam		1	3,122,600	825,200	16,900
Treatment Plant		1	26,137,938	14,594,916	922,769
Tunnels		3	12,894,600	11,034,000	59,300
Reservoirs and Tanks		39	17,955,249	13,619,838	213,966
Pump Stations		12	5,152,292	3,031,310	189,997
Pressure Reducing / Control Valves		52	944,458	513,948	25,088
Air & Non Return Valves		199	898,286	449,551	24,491
Gate Valves		4,302	8,025,987	4,332,371	146,023
Manholes		112	438,310	270,496	5,156
Hydrants		2,630	7,700,640	3,996,051	94,732
Meters		21,303	17,682,510	3,539,746	777,405
Customer Connections		21,353	29,227,689	15,393,375	365,346
Total			**342,241,342**	**185,647,611**	**5,517,160**

The 2019 indexed replacement valuation of the water supply assets was $283,654,000.

Figure 4-6 shows recent historical expenditure on the water network.

Figure 4-6: Recent Expenditure on Water Supply Network



4.2. Operations and maintenance plan

Operations and Maintenance strategies set out how the water supply activity will be operated and maintained on a day-to-day basis to consistently achieve the optimum use of assets and meet levels of service. Operations and Maintenance activities fall into the following categories, each having distinct objectives and triggering mechanisms:

Operations - Activities designed to ensure efficient utilisation of the assets, and therefore that the assets achieve their service potential and the network is capable of meeting required levels of service. Operational strategies cover activities such as energy usage, control of mechanical and electrical plant, inspections and service management.

Maintenance - Maintenance strategies are designed to enable existing assets to operate to their service potential over their useful life. This is necessary to meet levels of service, achieve target standards and prevent premature asset failure or deterioration. There are two types of maintenance:

- Programmed - A base level of maintenance carried out to a predetermined schedule. Its objective is to maintain the service potential of the asset system. Maintenance actioned is a result of condition or performance evaluations of components of the water supply network. Its objective is to avoid primary system failure
- Reactive Maintenance - Maintenance carried out in response to reported problems or system defects. Its objective is to maintain day-to-day levels of service.

Additional planned maintenance work is carried out on the reticulation to address faults identified by the leak detection work.

4.2.1. Operations and maintenance plan

Maintenance Planning

Currently the asset maintenance is a mix of programmed and reactive. Further work moving towards advanced asset management planning techniques for critical components is considered appropriate to apply programmed maintenance programmes to the widest area of components required to ensure the safe and efficient operation of the network. This approach would allow for maximising the useful life of an asset while minimising the consequences of unforeseen failures.

Method of Delivery

The operation and maintenance of the NCC water supply activity is carried out using a combination of NCC staff and external contractors consisting of:

- Network Services internal utilities business unit for design and Supervision (NCC).
- NELMAC Limited for all reticulation operations and maintenance (CCTO).
- External contractors for specialist activities such as closed circuit television and major overhauls of mechanical equipment.

Pump stations:

The pump stations are inspected weekly, with monthly routine maintenance carried out. Full performance and condition assessment are carried out every two years.

The pump stations follow a 'rolling' pump overhaul programme.

Reservoirs:

Reservoirs are long life above ground structures. Monthly routine maintenance inspections are carried out. Full condition and performance assessment are carried out every five years.

In November 2003 engineering inspections were carried out on Thompson Terrace No. 2, Stoke No. 1, Observatory Hill and The Glen Reservoirs.

Weathering of the concrete dome roof of Thompson Terrace No. 2, corrosion of the internal steel surface of the Glen reservoir, and blistering of the water seals in the Stoke Reservoir were noted.

Remedial work of the Glen was completed in 2005/06.

Seals in the Thompson Terrace No 2 reservoir were partly replaced after seepage was noted in the underdrain collector. Anodes were fitted to the internal ladder to prevent further corrosion.

Seismic shut off valves have been retrofitted to the Stoke No.1 and Thompson Terrace Nos.1 and 2 Reservoirs. The newer Atawhai No. 1, Stoke High Level and Stoke No. 2 reservoirs were fitted with seismic valves during construction.

The pipework at the Thompson Terrace reservoirs has been modified to prevent "short circuiting" of the water flow with possible water quality problems.

Work on replacing the seals to Observatory Hill and Panorama Drive reservoirs was completed in 2010.

Water Treatment Plant:

Each component is maintained regularly on a scheduled maintenance programme in accordance with vendor data.

Operators stationed at the plant regularly inspect, check and calibrate components of the plant to ensure they are performing their design function. The cost of routine maintenance is covered by an operations contract with an external contractor.

Large portions of the plant and the components are computer monitored and alarms are raised if they go outside predetermined performance limits.

Pressure Reducing Valves

The water maintenance contract has been amended to provide for more preventative maintenance to be carried out on the pressure reducing valves so the potential for malfunction is reduced. Further work is required to prevent grit and iron/manganese deposits impacting the operation of these valves.

4.2.2. Operations and maintenance strategies

Day to day operation and maintenance of the network is carried out by contractors with specific requirements set out in the Maintenance of Utility Services contract.

Level of Service Implications:

For the water supply network to deliver the levels of service it must be intact and functioning. Reactive maintenance must be carried out promptly. Programmed maintenance must be carried out to ensure that downtime is minimised by carrying out maintenance before it becomes reactive.

Demand Implications:

With increasing demand there will be an increase in total variable costs particularly as more water is transported and pumped.

Risk Implications

Intakes, treatment plant and reticulation mains, must all be maintained, kept secure and protected from natural hazards so that they can continue to function through an emergency albeit at a reduced level of service.

Lifecycle Implications

Operations and maintenance is the longest period of the asset lifecycle and ongoing maintenance is necessary to ensure that the design life of the asset is achieved.

Table 4-15: Operations and Maintenance Strategies

Preventative Maintenance	Preventative Maintenance will be carried out in terms of defined routine maintenance items and triggers for these activities to be carried out. These are set out in the Nelmac contract for maintenance of utility services.
Reactive Maintenance	Remedial maintenance will be undertaken as quickly as practically possible to restore an asset to a satisfactory condition after a failure or other unsatisfactory condition has been detected.
Repairs	The detection and repair of faults causing failure will be undertaken as quickly as practically possible. The fault will be isolated and components repaired or replaced as appropriate and then if warranted the item will be tested to ensure that it meets the relevant operational standard.
Redesign and Modification	Redesign may be necessary if an asset or system does not meet its operational objective? Similarly, modifications may be necessary to improve the operating characteristics. Redesign and modifications will be undertaken in a methodical manner to ensure alternative options are considered and optimum decisions made.
Operations	
Operations	Operational activities for the reticulation will be undertaken via NELMAC unless specialised advice is required. The water treatment plant operation and maintenance is currently contracted to Fulton Hogan Ltd. Staff will be responsible for the determination and optimisation of planned and unplanned works, work methods and maintenance scheduling to achieve the target service standards.
Physical Works Monitoring	Audits of work will be carried out to verify compliance with standards set out in the appropriate contract.

Operation of Utilities	Utilities such as pumping stations will be operated in terms of defined parameters and standards set out in the operations and maintenance contract.
Incident management	Effectively respond to and manage incidents to ensure system availability and service continuity, and mitigate adverse effects. Maintenance staff and contractors are expected to effectively manage minor incidents. NCC staff will become involved in serious incidents.
System control and monitoring	Utilise Supervisory Control and Data Acquisition (SCADA) systems to monitor operation of the water supply facilities. The SCADA system provides surveillance of the operation of pump stations and reservoirs in the water supply system and provides alarms when equipment fails or when operating parameters are exceeded. The SCADA system also records operating data from the pump stations.

4.2.3. Summary of future costs

Refer to the section 6. Financial Summary for Financial Projections

4.3. Renewal/Replacement Plan

Renewal is major work that does not increase the asset's design capacity but restores, rehabilitates, replaces or renews an existing component to its original capacity. This includes:

- Works that do not increase the capacity of the asset but restores them to their original size, condition and capacity.
- The replacement component of augmentation works which increase the capacity of the asset, i.e. that portion of the work which restores the assets to their original size, condition and capacity;
- Reconstruction or rehabilitation works involving improvements and realignment that do not increase capacity.
- Renewal and/or renovation of existing assets, restoring the assets to a new or fresh condition consistent with the original asset.

Work over and above restoring an asset to original capacity is creation/acquisition/ augmentation expenditure. However if the additional cost is within 10% of the renewal cost then the total cost will be treated as renewal expenditure.

Renewal of the network is broken into the following broad categories that largely reflect day to day operations:

- Water treatment plant.
- Headworks – all parts of the network generally upstream of the treatment plant. (Maitai Dam, Roding Dam, South Branch intake, raw water delivery lines, Roding treated water line, High Level Reservoir and break pressure tanks and Marsden Valley Pump Station).
- Network – Pipes, reservoirs, tanks, pump stations and all associated valves, meters and fittings.
- Telemetry.

In order to maximise the service lives of network components and improve the opportunities for any co-construction of assets with other utilities it is proposed to develop the following renewal strategies:

- Water Pipeline Renewals and Upgrade Strategy - Reticulation portion of the network – pipes, valves and associated chambers and pump stations.
- Maitai Original Raw Water Pipeline Renewal Strategy.
- Water Treatment Plant Renewals and Upgrade Strategy.
- Water Headworks Renewals and Upgrade Strategy.

4.3.1. Renewal identification/strategies for Network Reticulation

Assets can fail from various modes other than the normally recognised physical, failure or breakage.

Condition assessment is a typical failure mode assessment activity.

To evaluate cost and obsolescence as failure modes it is necessary to capture the asset's operating and maintenance cost information, and to compare this with the lifecycle cost expectations.

As condition assessment and maintenance histories are built up, these will be used in determining renewal priorities.

Level of Service Implications

It is necessary to renew pipes and equipment before they impact on levels of service.

Demand Implications

Renewals will be sized to allow for future demand. Where the increase is greater than 10% then the difference will be funded from creation/acquisition/augmentation expenditure.

Risk Implications

There is a risk to water quality, financial income, and consumer parity by not undertaking renewals of pipes, meters and dual check valves.

Lifecycle Implications

Pipes and equipment must be renewed before maintenance costs become excessive. Decisions made at the time of renewal have impact on the whole lifecycle costs of the asset.

For the purpose of developing asset renewal programmes the water supply assets have been separated into "discrete" and "non-discrete" assets.

- "Discrete" assets are assets such as pumping stations, which are separately identifiable, accessible and which can readily be inspected.
- "Non-discrete" assets are assets such as buried pipelines which are part of an extensive network, are generally below ground and which cannot readily be inspected (other than by techniques such as excavation and closed circuit television).

The reticulation system has to reliably transport the required volumes of water from the trunk mains and reservoirs to the consumers, at sufficient pressure while maintaining quality. The water network is made up a range of materials such as cast

iron, asbestos cement, concrete, uPVC, polyethylene, concrete lined steel and ductile iron. Currently Council's renewal strategy is based on replacing asbestos cement pipes that were installed in the 1950's and are showing higher than expected failure rates. Further investigation of the older sections of the network are needed in order to confirm the condition of the steel and iron pipes. Figure 4-7 shows an increasing incidence of failures in materials such as concrete lined steel, PVC and HDPE that indicates further investigation will be required to identify causes. As the current asbestos cement pipe renewal programme is expected to continue for the next 8-10 years, enhanced condition assessment of the other pipe types is expected to be part of the renewal strategy from years 5-8.

Where appropriate NCC uses longer pipe sections, either coiled polyethylene or uPVC replacing shorter cast iron, concrete and asbestos cement pipes, leading to quicker installation and fewer joints.

Figure 4-7: Watermain Failures Recorded Since 2005

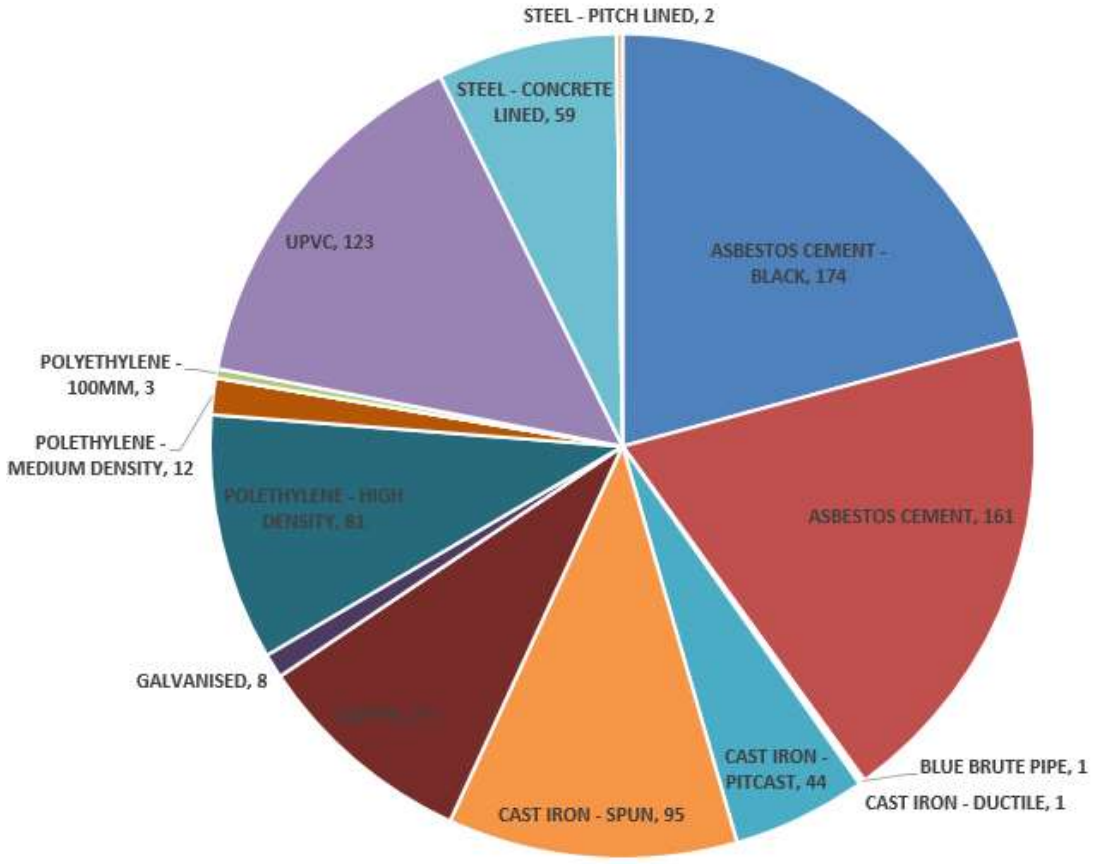


Figure 4-8 shows the watermain failures by material and pipe install date. The chart highlights the issue of the asbestos cement mains coming to the end of their expected service lives and raises the potential issue with PVC pipes. PVC pipes would be expected to provide a 70-90 year service life and the multiple failures currently identified in pipes that have been in service for approximately 40 years is un-

expected. Failures will continue to be closely monitored to see if a trend develops for PVC pipes.

Figure 4-8: Watermain Failures by Material & Decade of Pipe Install Date Recorded Since 2005

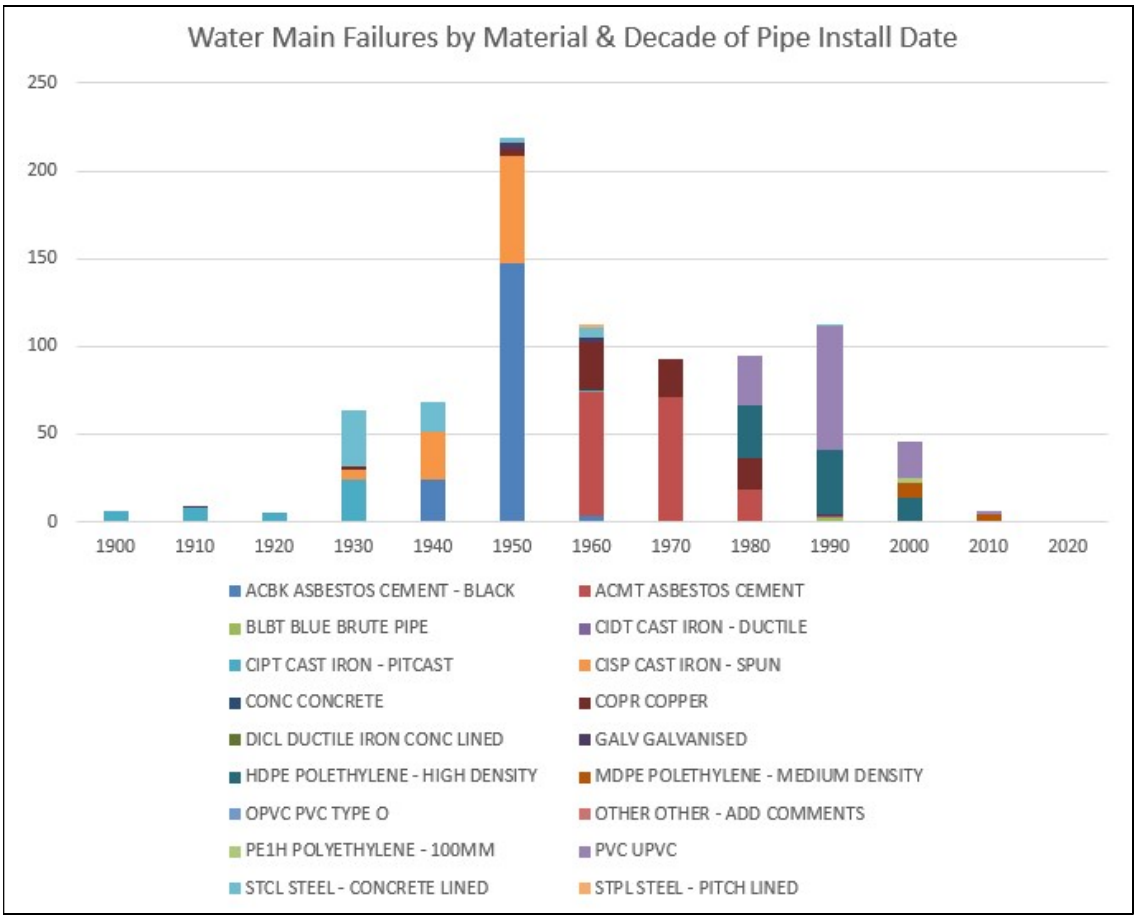


Table 4-16 sets out the current renewal strategy for the piped reticulation.
This Plan has made provision for the development of a Water Pipeline Renewals and Upgrade Strategy in 2023/24 ($20,000) to guide the future direction of renewals across the pipe reticulation network in order to take advantage of co-construction opportunities, new technology and any recent innovations in the industry.

Table 4-16: Renewal Strategies

Strategy	Objective/ Description
Identification of Renewal Needs	To avoid a concentration of asset renewals in a short window of time, when they all reach the end of their life, renewals are set by: • Potential development in the city • Other Council projects and the need to consider reduction of greenhouse gas emissions through co-construction projects. e.g. the condition of water supply pipelines will be inspected prior to major road works to identify the risk of the road being damaged by pipeline failure or the need for pipeline replacement in the short/medium term. Pipelines in poor condition will be programmed for replacement prior to or in conjunction with the road works. Issues identified with asset by location and or materials through condition reports, maintenance records (asset failure and expenditure history), request for service (RFS) records, and observations of public, staff and contractors. 1) Critical assets just before they fail. 2) Others after four or more unexpected failures over the previous five years (sum of all asset of same material and age for the street) and two breaks occurred on the same asset (individual pipe section) or breaks on the same material on a street being equivalent to one break per 100m or less. 3) Assets that do not meet required fire flow demand and have two or more failures over the past five years. 4) Alignment with other utility renewals or upgrades. Minimise projects where excavation to renew the water supply asset alone would lead to increased discharge of greenhouse gases or significant disruption to the community.
Project options	Decision Criteria are weighed. Then Business Cases which consider benefits (aligned with the Decision Criteria), dis-benefits, cost, timescale and risks are compared to determine whether to proceed with a renewal or which renewal option to take.
Prioritisation of Renewal Projects	Decisions on renewal works consider the short and long-term effects on the operating and structural integrity of the system and the opportunity for greenhouse gas emission reduction.
Design	Construct renewal works each year. These are generally designed in advance to maintain level of service. Renewal works are designed and undertaken in accordance with Nelson Tasman Land Development Manual that stress the use of long life materials. Investment is made in innovative new technologies to rehabilitate existing reticulation where appropriate, rather than excavate and replace.
Sustainability	Develop resilient infrastructure and reduce the impact on the environment from the renewal activity.
Climate change	Use of materials that reflect reduced GHG emissions will be prioritised. This includes consideration of country of origin of materials and whether equivalent materials can be sourced locally or close to NZ.

Strategy	Objective/ Description
	Renewal projects will consider the impacts of climate change and sea level rise to develop the most sustainable solution.
Deferred Renewals	The quantity and impact of deferred renewals (if any) is tracked The Council recognises that although the deferral of some items on renewal programmes will not impede the operation of many assets in the short term, repeated deferral will create a future Council liability. As Council currently funds asset renewals from depreciation deferred renewals are not expected.

Renewal Plan

- Relining of selected 100mm diameter and larger cast iron pipes will be considered in the future.
- Asbestos Cement Pipe - 50mm diameter Fibrolite pipes and 100mm diameter "Black Asbestos" pipes which are identified as being near the end of their economic life are scheduled for renewal from 2021/22 to 2030/31.
- Steel Pipe - Steel pipes tend to corrode randomly. Individual sections of steel pipe which fail will be replaced as maintenance expenditure.
- Water Meters - Residential water meters were installed in 1999, and have a life of 12-15 years. It is cheaper to replace these sizes rather than test and refurbish them. The renewal programme for these is expected to be completed in 2021/22. A detailed business case concluded that the renewal of residential meters should be on a like for like basis with manual read meters.
- Residential Backflow Prevention – The dual check valves in the water meter manifold are spring operated and lose effectiveness with time. An increasing number of the valves are also disintegrating in the manifolds and a programme to replace these has commenced in 2015/16. As the dual check valve is fitted immediately underneath the meter it was initially considered to be appropriate for them to be replaced at the same time as the meter. The number of failures and risk of pieces of the valves impacting the water meters and household water fittings has led to the need to begin the replacement in advance of the meters.

Water Meters

Trends in each property's water usage are tracked and if a meter appears to be "slowing down", then it is removed for testing or replacement. Worn meters tend to under-read and are therefore in that customer's favour, but true costs are not being recovered from the customer who is therefore subsidised by other consumers.

Commercial and Industrial water meters were installed from 1980 to 1999.

Meters on commercial and industrial properties vary in age and size. Most meters have been installed since 1980 in business groups i.e. all schools, all hotels, all hairdressers etc. Meters were installed on parks in 1998, on small users such as offices and small shops as part of the Universal Water Metering project in 1999, and in new subdivisions and developments as they occur. Larger sizes can be refurbished but spare parts for early models are not now available.

Renewal of commercial and industrial water meters started in 2014/15 and is approximately 25% complete. The work is scheduled to be completed in 2028/29.

Water Treatment Plant

As part of the operations and maintenance contract for the WTP the contractors (Fulton Hogan Ltd) have developed a ten year renewal plan and supporting asset management plan – see Appendix K.

The WTP filters are a critical component of the treatment process. The installation of the fifth train was completed in 2016/17 in order to provide greater flexibility with the filter renewal programme and possibly extend the life of future filters. Completion of the renewal of the original filters was achieved in 2018/19. Future renewals of the filters will be guided by performance of the filters and advice from the manufacturer. It is anticipated that the new filters will have a life in excess of ten years if the raw water sources are predominantly run of river rather than the Maitai Dam.

It is proposed to build on the Fulton Hogan Ltd document and support the development of a comprehensive WTP asset management plan through the preparation of a Water Treatment Plant Renewals and Upgrade Strategy in 2023/24-24/25.

Water Headworks

The Headworks - Maitai Dam, Roding Dam, South Branch intake, raw water delivery lines, Roding treated water line, High Level Reservoir and break pressure tanks and Marsden Valley Pump Station are managed on a day to day basis by contractors Fulton Hogan Ltd. The renewal strategy to date has been based on condition assessment reports and contractor recommendations.

Existing Maitai concrete pipeline

The original Maitai pipeline between the Maitai Dam and the Water Treatment Plant transports the majority of the water used in the City. It has numerous small shrinkage cracks and is vulnerable to slips from above and below the pipeline.

Council completed the construction of a duplicate Maitai pipeline between the dam and the WTP in 2014 but will continue to use and maintain the existing pipeline, to reduce pumping costs, for as long as it is viable to do so.

In order to undertake repairs and ultimately the renewal of the pipeline a construction strategy is required that recognises the complexity of the pipeline location and the need to keep it in service for as long as possible. Development of the Maitai Original Raw Water Pipeline Renewal Strategy is programmed for 2023/24-24/25.

Investigations and design of repairs and renewal for the section between the Dam and the WTP are shown in this Plan to commence in 2027/28 with construction in 2031/32-32/33.

In line with the WTP it is proposed to develop a specific Water Headworks Renewals and Upgrade Strategy also in 2023/24-24/25. The strategy will be underpinned by the comprehensive dam safety reports for the Maitai Dam and the recommendations of the following consultant's reports:

- Roding River Water Supply Pipeline Inspection Report. May 2014.
- Roding Pipeline Condition Assessment – Stage 2. January 2016.
- Geotechnical Condition and Risk Assessment Roding Water Supply Tunnel January 2016.
- Life Expectancy and Durability Assessment (Maitai Sth Branch intake and Roding Dam). December 2014.

4.3.2. Summary of future costs

Refer to the section 6. Financial Summary for Financial Projections.

Deferred Renewals

This plan indicates no deferred renewals. It is possible that some renewals will be deferred in the future where the community considers managed retreat to be the best option to adapt to the impacts of climate change and sea level rise.

Infrastructure strategy

The thirty year infrastructure strategy sets out the longer term renewal forecast for the water supply activity. The overarching strategy is based on renewing the network just in time to avoid disruption to the service and as demands of growth or other asset renewals offer opportunities to reduce cost and community disruption.

4.4. Creation/Acquisition/Augmentation plan

Creation/Acquisition/Augmentation works create a new asset that previously did not exist, or upgrade or improve an existing asset. They may result from growth, social or environmental needs and levels of service. This includes:

- Expenditure which purchases or creates a new asset (not a replacement) or in any way improves an asset beyond its original design capacity.
- Upgrading works which increase the capacity of the asset e.g. for future growth demand.
- Construction works designed to produce an improvement in the standard and operation of the asset beyond its present capacity.

Asset development and asset renewal can occur simultaneously. The purpose of asset renewal is to prevent a decline in the service potential of the assets whereas asset development is concerned with the service improvements, measured by asset performance.

4.4.1. Project selection criteria

Level of Service Implication

The capital works for system improvements and ridermains are to address problems with pressure, flow, and continuity of supply to the levels of service required.

Demand Implications

The capital works proposed will address the need for more storage and trunk mains to meet growth requirements. Failure to meet growth requirements will then impact on Levels of Service.

Risk Implications

The capital works proposed address the need for decreasing the risk on the Maitai Pipeline and preventing backflow from commercial and industrial premises.

Lifecycle Implications

Decisions made to construct a capital project will have implications for the life of the asset, as will subsequent design decisions. Optimised decision making will therefore be used to identify and prioritise all potential solutions for water supply projects over $0.5million value.

Climate change and Greenhouse gas emission reduction Implications

Consideration of opportunities to reduce the production of GHG's and respond to the wider impacts of climate change will be part of the decision making process.

Selection Strategy

Table 4-17: Selection Strategy

Criteria	Objective / Description
Identification of Upgrade Needs	Asset upgrade needs are identified from analysis of: • Demand forecasts • System performance monitoring • Network modelling • Climate change and emissions reduction potential • Risk assessments (Risk Management Plan), and • Customer service requests. • A provisional forward capital works programme is maintained and updated at least annually. • Changes in regulation.
Upgrade Project Categorisation	Upgrade Projects will be separated into projects to close service gaps or respond to climate change and projects required to accommodate growth. Upgrade projects to close service gaps are generally funded entirely by NCC. Upgrade projects to accommodate growth may be partly or wholly funded through Development Contributions.
Prioritisation of Upgrade Projects	Upgrade projects are justified and prioritised using a risk based process. Decisions on upgrade works consider the short and long-term effects on the operating and structural integrity of the water supply network. In determining the requirement for capital or asset upgrade works the short and long-term effects on the operating and structural integrity of the system are considered, together with any forecast increase in loading upon the system. Decisions on priorities for new works and renewal of assets for the water supply network are based on the following: • Known problem areas with multiple failures • New growth areas • Primary flow conduits – Trunkmains • Security of supply eg reservoirs, Maitai Dam • Criticality of proposed works • Multiple network project (e.g. incorporating road work, sewer, water assets) • Environmental impacts especially water abstraction, use and Maitai Dam • Opportunities to respond to climate change impacts and GHG emission reduction initiatives such as: o adopting new technology that reduces electricity use o reducing the use of hydrocarbon based products where possible o minimising the use of products that require discharge of GHG's for their manufacture or supply to NZ

Criteria	Objective / Description
Project Approval	A long-term upgrade programme is prepared from projects meeting the assessment criteria, and all projects are approved through the Annual Plan/LTP process. The actual timing of asset upgrade works will reflect the community's ability to meet the cost, as determined through the Annual Plan/LTP process. Scheduled projects meeting assessment criteria not funded are listed on the forward works programme for the following year.

4.4.2. Capital investment strategies

The table below sets out the strategies used for developing capital works programmes for the water supply network. These strategies are intended to progressively close gaps between target service standards (taking account of demographic and economic growth projections) and the current service capability of the asset system.

Table 4-18: Creation/Acquisition/Augmentation Strategies

Strategy	Objective / Description
Project Design	All asset upgrade works will be designed and constructed in accordance with Nelson Tasman Land Development Manual that stress the use of long life materials, and system design loading. In determining capital or asset upgrade work requirements the short and long term effects on the operating and structural integrity of the system are considered, together with the demands of any forecast increase in loading upon the system. The system will be designed to minimise supply disruptions as far as practically possible by building in an appropriate level of redundancy. The standardisation of designs and specifications will be considered in the interest of facilitating replacement and operational simplicity. All feasible options, including non-asset demand management options and the use of second-hand plant, are considered. Various components of the water supply goal are considered when developing the final detailed design: • Economics of various options • Efficiency of meeting the network need • Cultural values relating to water abstraction • Ecological values
Sustainability	New assets must meet a sustainability function that ensures the asset will meet the required levels of service and can be seen to offer the best value in terms of use of finite or non-renewable resources.
Climate Change	Capital projects support Councils leadership role in wider climate change mitigation and adaptation strategies.
Future Development	Identifies sufficient, feasible development capacity in short, medium and long term and the location, timing and sequencing if infrastructure to support it.

Strategy	Objective / Description
Gifted Assets	The risk, cost and benefits of accepting any new privately funded assets constructed in association with property development will be considered on a case by case basis in approval decisions. Such assets will be accepted into public ownership when satisfactorily completed in accordance with approvals given. Council will not contribute to the cost of such work unless there are exceptional service standard or equity issues.

Capital Plan

Reservoirs and Tanks

Within the next 30 years it is anticipated that development will require additional reservoirs for supply of potable water in emergencies at the Northern and Southern ends of the city.

In order to reduce the production of greenhouse gases through electricity generation, greater weighting for new reservoir sites will be given to those that can be filled by gravity. The choice of new reservoir materials will be made by also considering the production of GHG's in the material manufacture and reservoir construction.

Atawhai Hills Reservoir and Pump Station

Currently the larger tanks are positioned close to the central city area and Stoke. To provide a better level of security for the north of the city a further larger reservoir is proposed for the Marybank/Todd Valley area within the term of this plan.

To improve supply capacity and facilitate green field development to the upper levels of the Atawhai foothills, one option considered was a pump station alongside the Walters Bluff reservoir, pumping up to a small storage reservoir (300-500m^3) on the ridgeline above. A project to identify preferred location(s) for the Atawhai No 2 reservoir and upper level reticulation options is currently underway.

Ridermains

The renewal budgets allow for the replacement of 50mm and 100mm asbestos cement watermains. However, the Land Development Manual requires a watermain on one side of the street and a ridermain on the other. To accommodate this a separate budget is identified for new ridermain installations.

System Improvements/ Miscellaneous Pipe and Fittings

There is an ongoing need for small improvements to the water network to address localised issues that arise with flow, pressure, taste and turbidity. A budget for these is included in the CAPEX tables. Larger issues are addressed as specific CAPEX projects.

Waimea Community Dam (Lee River Brightwater)

NCC has contributed funding to investigations led by TDC into augmentation of water sources on the Waimea Plains. NCC has committed in principle to contribute $5M to the construction of the Waimea Dam subject to a satisfactory agreement being reached with TDC. This payment would potentially secure a share in the dam for water required at some future point.

Other options are expected to provide sufficient water for the city in the short – medium term and a share in the Waimea Dam is not required for the water supply activity at this stage. Funding has been allocated in 2020/21 for a grant to the Waimea Dam project subject to agreement on the conditions for access to 22,000m^3/d in an enduring fashion and that the grant be transferred into a shareholding in the Dam Company at an agreed point in the future.

Backflow Prevention.

The water supply does not currently meet Ministry of Health best practice requirements as not all premises have backflow prevention. Backflow is identified as a risk to the water supply.

Reduced pressure backflow preventers have been installed on all connections to sewage treatment plants and pump stations and new connections to Reserve facilities.

The meter manifolds installed on domestic and some commercial connections incorporate a spring loaded dual check valve. While not providing an absolute guarantee, these valves significantly reduce the possibility of accidental contamination of the water supply from a residential property, which is also considered to be a low level risk of contamination source.

Installation of backflow preventers has been recognised as an important means of protecting the network from contamination. A survey of all commercial and industrial premises determined the exact backflow prevention needs, and a programme for installation of backflow preventers was established in 2014. Table 4-19 shows the progress to date.

The sum of $1.7 million over 10 years ($170,000 per year) has been shown in the Capital Works Projections from 2021/22 for the fitting of backflow preventers to Commercial and Industrial premises in conjunction with meter renewals.

Table 4-19: Backflow Prevention Programme

Priority Rating		Backflow Prevention Devices required as at 2012	Backflow Prevention Devices installed (as at May 2020)	Remaining Backflow Prevention Devices to be Installed (as at May 2020)
High	e.g. hospitals, mortuaries, chemical plants, laboratories, cooling towers, public swimming pools, food processing and other manufacturing plants	501	62	439
Medium	e.g. irrigation systems, hairdressing salons, drink dispensers with carbonators, commercial laundries and rainwater tanks connected to internal plumbing	548	70	478

Low	e.g. properties that could cause a nuisance by colour, odour, or taste but do not endanger health.	717	460	257
	TOTAL:	**1766**	**592**	**1174**

Maitai Dam aeration

A specific project has been identified to construct the preferred aeration option once investigation has been completed (see section 4.1.1). The proposed budget is $2.6M from 2021/22 - 2024/25.

4.4.3. Summary of future costs

Refer to the section 6. Financial Summary for Financial Projections

4.5. Disposal plan

The disposal plan recognises that there can be activities and costs associated with the decommissioning and disposal of assets which are no longer required as part of the water supply network. In some situations there can be revenue resulting from asset disposal.

Mechanical equipment that has been replaced will be reused for parts or sold as scrap metal unless it is considered to have genuine resale value. In this case, the piece of surplus equipment will be sold with income directed to the NCC account.

Table 4-20: Disposal Strategies

Strategy	Objective/ Description
Asset Disposal	Assess each proposal to dispose of surplus or redundant assets on an individual basis, subject to the requirements of the relevant legislation. Asset disposal will comply with the requirements of the Local Government Act 2002 and in particular the requirement for councils to retain a capability to provide water supply services. Redundant pipes are backfilled or removed where their alignment clashes with replacement pipelines or where their existence is considered dangerous. This is to ensure collapse does not occur. Possible use of abandoned pipes for telecommunication ducts is reviewed on a case by case basis. Currently Chorus and Network Tasman lease access to abandoned gas mains and abandoned water and wastewater pipes.
Disposal for Re-use	Mechanical equipment that has been replaced will be reused for parts or sold as scrap metal unless it is considered to have genuine resale value. In this case, the piece of surplus equipment will be sold with income directed to the NCC account.
Disposal Value	The residual value (if any) of assets, which are planned to be disposed of, will be identified and provided for in financial projections. Abandoned water pipelines have possible future value for other purposes (such as ducting for cabling). As the extent of this value (if any) is uncertain it is not recognised in the asset valuation.

Strategy	Objective/ Description
Record of Abandonment	When a water supply asset is abandoned or replaced the Geographic Information System and fixed asset register are updated. A system of job number creation and asset identification is used to document this process.

Watermains are generally relaid off line. If pipes are left in the ground they are usually sealed at the connections and retained as a possible duct for cables (subject to health and safety concerns about accessing asbestos cement pipes).

5. Risk management plan

This section describes the risk management procedures used in the water supply activity.

Applying risk management procedures enables decisions to be made about the best use of limited resources to achieve as much as possible of the Council's objectives from the maintenance and development of the water supply assets.

Threats and opportunities are assessed against water supply objectives and levels of service.

As set out above risk management is not simply about uncertain events with a downside (such as financial loss or legal proceedings). The process can also be used to identify and decide on the merits of uncertain opportunities for the Council to do things more innovatively, sustainably and effectively.

5.1. Critical assets

5.1.1. How critical assets are identified and managed

For practical purposes it is helpful to separately identify critical assets to the delivery of the water supply activity.

The Activity Engineers applies professional judgement based on experience, considering risk of failure and lifelines evaluation to identify critical assets. Generally critical assets are considered to be those assets for which the consequence of failure is unacceptable given the difficulty of repair and/or the strategic role they play, and would result in a major disruption or failure in meeting one or more levels of service.

A more robust framework for identification of critical assets is noted in the improvement programme.

Assets that are considered critical within the NCC water supply system are:

- Headworks including dams and intakes
- Raw water trunk mains
- Raw water pump stations
- Water Treatment Plant including Clearwater Reservoir
- Treated water trunk mains
- Treated water pump stations
- Reservoirs

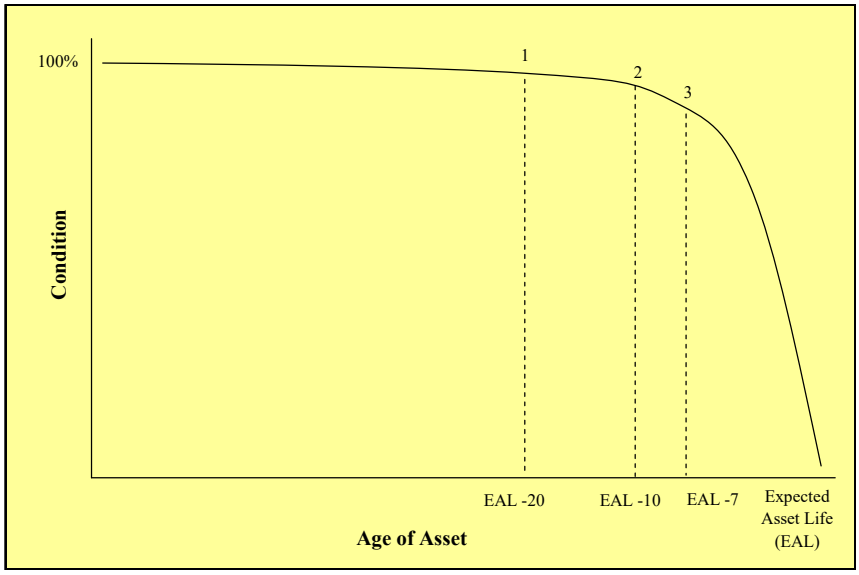
With these assets operating, treated water will be available in each suburb for distribution by water tanker or personal collection and by watermain as damaged reticulation is repaired and brought back into service.

By contrast non-critical assets are relatively quickly and easily repaired or replaced and their failure will not disrupt a significant number of customers.

Monitoring and intervention strategies are therefore quite different for both categories of asset. Critical assets attract a greater level of monitoring and ongoing condition assessment, with physical investigations taking place at a much earlier stage. Conversely non-critical assets can be expected to undergo a higher level of repair before complete replacement is considered.

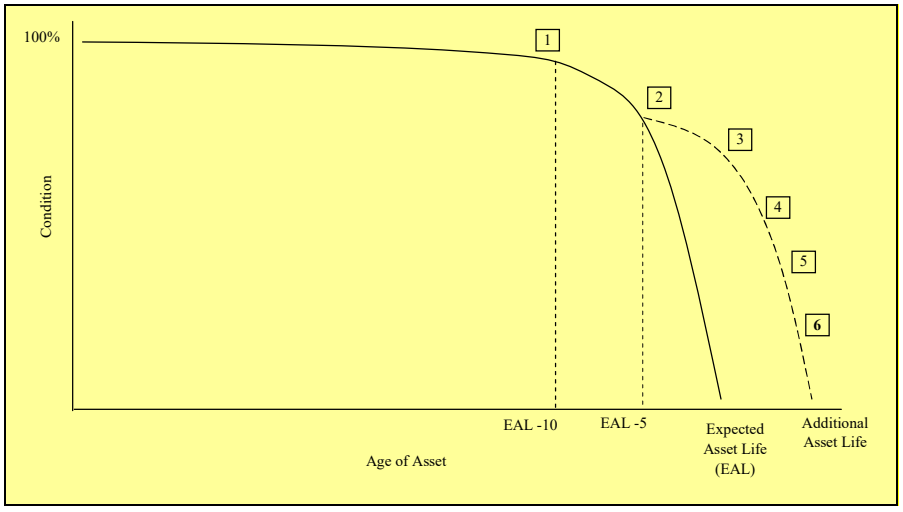
The following shows the nature and timing of interventions for both critical and non-critical assets.

Figure 5-1: Interventions for Critical Assets



Intervention: 1 Desktop review of asset and performance supported by Engineers inspection, 2 Physical inspection and testing of asset and performance review by specialist Structural or Pavement Engineer. 3 Replacement initiated.

Figure 5-2: Interventions for Non-Critical Assets



Intervention: 1 Desktop review of asset and performance, 2 Physical inspection of asset and decision made on extending expected asset life, 3 Repair, 4 Repair, 5 Repair. 6 Replace asset.

The effect of criticality on an asset is highlighted in the following areas:

- Operation and maintenance planning
- Proactive or scheduled maintenance
- Priorities for collecting and determining the required level of reliability of data for Asset Management systems
- Priorities for undertaking condition assessments
- Adjusting economic lives with respect to renewal profiles
- Prioritising/Deferring renewals
- Prioritising expenditure
- Prioritising levels of service reviews

A methodology for determining asset criticality to a component level, along with options, will be determined to integrate criticality into the ongoing operation, maintenance, renewals and capital programme for the water supply activity.

Risk Implications

Intakes, raw water trunk mains, the Water Treatment Plant, treated water trunk mains and reservoirs must all be maintained, kept secure and protected from natural hazards so that they can continue to function through an emergency albeit at a reduced level of service.

Apart from the need to provide very high levels of continuity to meet customer expectations, there are good public health reasons for maintaining pressurised mains at all times.

If watermains are allowed to lose pressure, it is possible that the weight of water in lower sections of mains will reduce the pressure in higher sections of the mains below atmospheric pressure. This will cause a vacuum in pipes which can suck back groundwater into the mains through leaks, or contaminated water from tanks or other containers not properly isolated from the public supply.

Council has established well defined procedures for shutting down watermains by Council staff, the Utilities Maintenance Contractor's staff, and Water Connection Contractor's staff.

The objective of the procedures is to minimise the amount of disruption and inconvenience to customers by using good communication skills and by timing the work to avoid times of peak demand.

Risk summary

Risks posed to the trunk mains range from low to high. The high risk is from earthquake and storm events where sections of key mains could be damaged. Presently stocks of repair materials are held to allow single repairs to each main.

Mutual aid would be required from other water supply authorities to reinstate trunk mains in the event of multiple major breaks.

As a result of the Christchurch earthquakes Council is currently undertaking a seismic review of the critical elements of the above ground network, starting with the storage reservoirs and sections of the Maitai Dam to the treatment plant trunk main looking at the direct impact of earthquake shaking. Future work will focus on near fault proximity of the network, possible impacts of liquefaction on existing and future infrastructure, impacts of flooding and the long term planning required as a result of climate change.

Maitai Water Supply Scheme

Because the Maitai Water Supply Scheme is a vulnerable asset, it was designed to withstand 1 in 100 year seismic and flood events without damage.

Key structures are designed to withstand maximum credible earthquake and probable maximum flood without collapse (but not without some damage, possibly requiring decommissioning and major repair work).

Details of the design parameters of the Maitai Water Supply Scheme are contained in "Nelson City Council Maitai Water Supply Project Design Report", Tonkin & Taylor Limited, 1984.

The Maitai pipeline between the Dam and Brook Street has been identified as an extreme risk from damage due to earthquake displacement or slip.

The pipeline supplies two thirds of Nelson's water, is above ground, on a sidling bench along the hillside. Repair/replacement of, for example, a 5m length of damaged pipe would take 24-48 hours depending on location (and has proved to be the case in 2008 when high winds brought down trees onto the pipeline). When full, city reservoirs can hold sufficient water for approximately 24 hours average consumption. The more usual capacity, allowing for filling time and continuing use, is 8-10 hours of daytime demand.

Construction of a new buried pipeline between the dam and the Water Treatment Plant was completed in 2013/14.

Design of a new pipeline between the Water Treatment Plant and Westbrook Terrace began in 2014/15 with construction completed in 2016/17.

Sections of the Maitai pipeline remain close to, or within, the river with some ongoing risk of flood damage. Identification of these sections and regular inspection and maintenance are seen to be the best response.

Roding Water Supply Scheme

The Roding Water Scheme poses low and moderate risks to structures other than a 200m length of pipe between the screenhouse and the chlorinator house. This pipe is suspended on piers along the riverbank. A 30m section was washed out in the large flood of January 1986. Subsequently the pipes were more securely fixed and rock armouring was constructed in front of the piers. There is a possibility that a similar large flood could damage the pipe again. Reinstatement would take 2-3 days, during which time the Maitai river/dam and TDC would be the only sources supplying the City. This risk is acceptable given the large storage volume of the Maitai dam.

A condition assessment of the raw water trunk main was started in 2013/14 and completed in 2015/16 to allow renewal decisions to be made. A risk assessment of any new pipeline route will be undertaken as part of any renewal design.

Water Treatment Plant

A portable chlorinator using sodium hypochlorite is held at the Water Treatment Plant. It is a complete stand-alone unit, run by a small petrol generator. This has the capacity of dosing 30l/h of sodium hypochlorite, which is sufficient to treat the full Maitai flow of 37,000m3/day.

A separate Emergency Management Plan has been developed covering Risks and Actions specific to the Water Treatment Plant.

A portable chlorinator alternatively powered by either a petrol motor or an electric motor is held at Princes Drive for emergency chlorination using High Test Hypochlorite (HTH) powder. This has a capacity of dosing 24kg of chlorine per hour. This is sufficient to treat 12,000 cubic metres of water per hour at 2 grams per cubic metre (= 2ppm or 2mg per litre).

A small slip occurred to an excavated bank adjacent the plant during the December 2011 rain event. The plant will remain at risk of small surface slips given the excavations undertaken during construction.

Trunk Mains

Risks posed to the trunk mains range from low to high. The high risk is from earthquake damage where sections of key mains would be damaged. Presently stocks of pipes and fittings are held to allow single repairs to each main.

New trunk mains are typically constructed from more ductile steel /PE materials that improve the overall network resilience.

Reservoirs

All large reservoirs have been fitted or retrofitted with automatic seismic shut off valves. When excess flow from the reservoir is detected (such as from a broken outlet trunk main) the outlet valve is automatically shut and an alarm sent to the Duty Officer via the SCADA system.

In 2013/14 a project to review the seismic response and protection features of the reservoirs, intake structures and pipework at the Maitai Dam and the steel siphons on the Maitai Dam to treatment plant pipeline was initiated. This project has been developed as a result of the damage to the Christchurch water network from the February 2011 earthquake in that region.

The project has a number of stages which can be modified as results of each stage are available:

- Stage 1- Review the seismicity of the sites and compare with the factors from AS/NZS 1170 Structural Design Actions. This provides a quick view of how design standards might have changed since the reservoirs were constructed.
- Stage 2- Review the on-site construction details of the pipework and valving arrangements to ensure seismic valves are correctly positioned and pipework details minimise the risk of water loss in earthquakes. This stage will provide an early benefit by ensuring the reservoirs can contain stored water under less than ultimate design level events.
- Stage 3- Review the structural adequacy of the reservoir, dams and pipelines. This stage will look at the structural design and detailing of the major components of the network and may be undertaken in a number of stages.

Liquefaction

Ongoing hazard investigation in 2013 identified the risk of liquefaction to the network in parts of Nelson. The initial study was restricted to the Tahunanui area but similar materials are expected to be part of the Port Nelson reclamation.

The risk to the water network in Tahunanui arises from flotation of chambers and damage to the mains from extension, shortening and translation arising from ground movement.

During the operative period of this plan further work will be carried out to better identify at risk components and current industry response.

Water Quality

Risks posed to water quality range from low to extreme. Completion of the Water Treatment Plant in August 2004 has reduced the risk of source water contaminating the customer supply to low.

The greater risk relates to possible backflow from premises into the water reticulation, thereby putting other consumers in danger.

Backflow Prevention

While the quality of the raw water entering the system is known, chemical or microbiological contamination can occur in some circumstances from water re-entering the system from consumer's premises should fittings be wrongly connected or a temporary vacuum develop in the line. The risk from activities such as undertakers, doctors and dentist surgeries are readily understood, however similar issues can also arise in commercial kitchens where food is prepared and cleaning chemicals are used.

Dual check valves have been fitted to all residential connections as part of the water meter manifold. These sit below the meter and can only be inspected when the meter is removed. Obviously damaged valves are being replaced when the meters are replaced or if they are identified as impacting on the accuracy of customer meters through the regular meter reads. Backflow preventors have been installed at all NCC drainage pump stations and Council owned buildings and facilities. However, there are fewer protection devices on commercial and industrial premises and a targeted programme of installing new devices is underway and will continue for the next ten years.

Water Safety Plan (Public Health Risk Management Plan)

The Nelson Public Health Risk Management Plan 2012 (now referred to as a Water Safety Plan- post the 2013 amendment to the Health Act 1956) outlines a range of issues that are required to be addressed within the network. The plan is currently being reviewed against new central government guidelines. This should be completed in 2021-22.

Budget has been identified for developing the response to these issues. Any further works that arise from the response will be developed in future annual or long term plans.

5.2. Risk assessment

5.2.1. Approach for assessing risk

The Council's risk management policy provides for assessing risk by:

- Clearly identifying the objectives for which achievement may be uncertain
- Identifying events which could make the achievement of one or more objectives uncertain
- For each event, using best available information (including considering the quality of that information and the controls already in place to manage the risk) to estimate the scale of consequence for an objective if the event happened and estimating a corresponding likelihood. Consequences and likelihoods are estimated using the Council's agreed risk criteria. See Appendix K.

- Selecting the likelihood consequence combination from the council's criteria giving the largest risk for the event.

As this Plan is developed it will progressively apply the criteria required by the Council's updated risk management policy (formally adopted in August 2017) to managing risks. These criteria follow principle (g) of the international standard codifying good risk management practice (ISO 31000:2009) and tailor this generic process to the Council's specific circumstances. It is the organisation's intention to progressively align the risk management practices used in asset management with Council's Policy and Criteria and to apply generally accepted good practice.

5.2.2. Top risks and how these will be managed

The level of risk established from the assessment process (formally called residual risk) is compared with the Council's residual risk tolerance as set out in Council's risk criteria.

The table sets out priorities for action and at what level of Council decisions should be taken to either accept (tolerate) the risk or take further actions to manage the risk to achieve a more acceptable risk level.

In many cases risks have already been acted on by Council in the course of the normal work of managing the water supply activity and no further action is required.

In other cases specific decisions may be required to either accept the current level of risk or place actions in this plan to reduce the level of risk.

The following table provides an indication of areas of high residual risk and some information about how these could be further treated (i.e. further controls implemented or choices made to reduce risk levels). The complete Risk Register can be found in Appendix I.

Natural Hazards Risk Investigation

In 2018 Council began a comprehensive risk assessment of the water supply network. The work is a multi-year project that is being undertaken by consultants Tonkin and Taylor Ltd on behalf of Council.

The first stage was developing a risk framework based on the NCC framework and creating a GIS portal to show identified hazards relative to the network. Stage 2 and 3 established the criticality of the various parts of the network. Figure 5.3 shows a plan of the city pipelines with identified criticality.

This information will be used to prioritise mitigation or adaptation works to support the ongoing supply of water in the event of a serious event.

Figure 5-3 Plan of the Water Supply Network Criticality

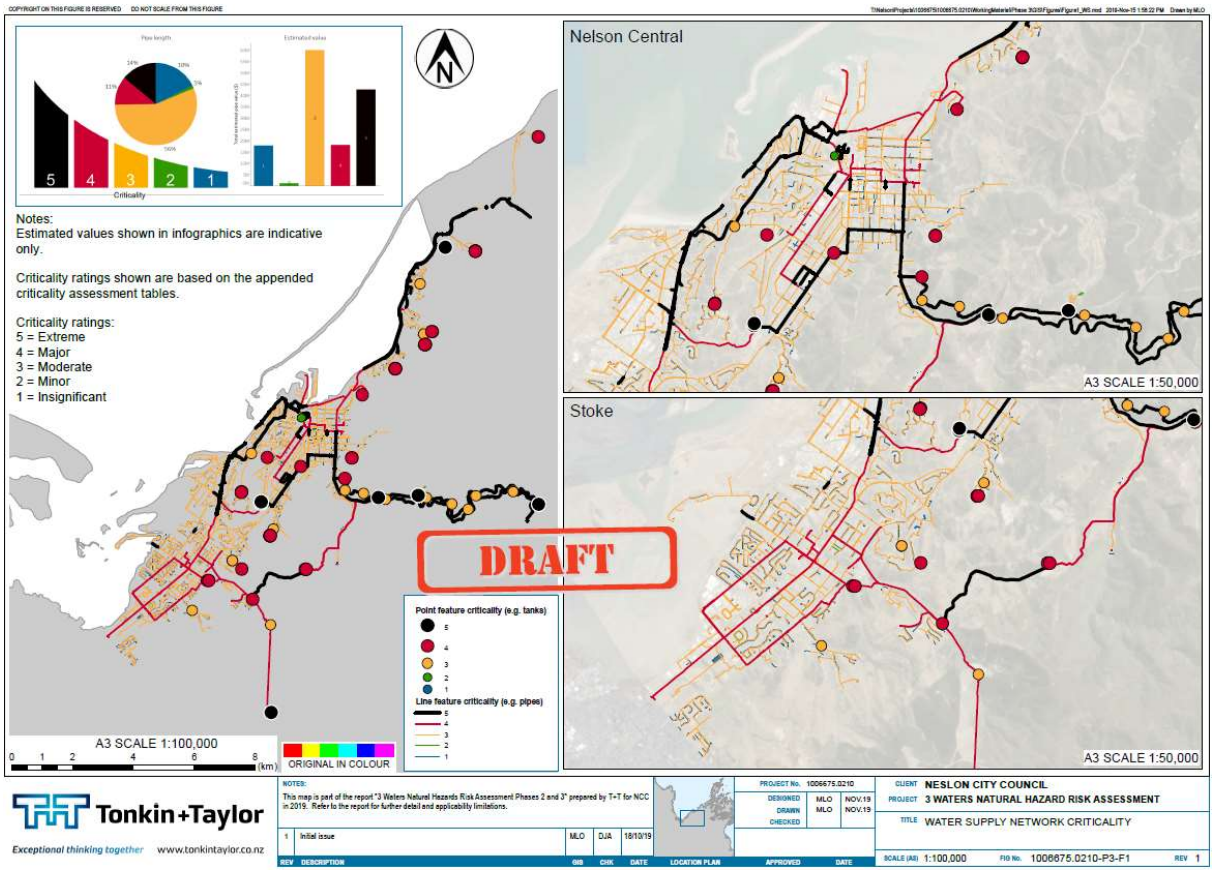


Table 5-1: Water Supply Risk Register

Identification			Analysis: Residual Risk				Response	Treatments
Event Description	Asset Group	Consequence	Existing Controls	Consequence	Likelihood	Current Risk Level		
MOVEMENT FAILURE CAUSED BY EARTHQUAKE, LANDSLIDE OR SETTLEMENT	**TREATMENT PLANT**	Worse case: water not available until temporary chlorination plant in place and temporary supply from TDC - 1 day to organise	Plant has been designed to a high standard. Regular inspection for likely problems. Temporary supply from TDC	Extreme (5)	Unlikely (2)	High (10)	Reduce	Purchase oddition portable chlorine dosing equipment. Improve supply options from TDC.
DAMAGE FROM LIQUEFACTION (AT RISK AREAS PORT NELSON, TAHUNANUI/STOKE)	**RETICULATION**	Asset performance reduced		Extreme (5)	Unlikely (2)	High (10)	Reduce	Anchor chambers. New installations designed for seismic movement and liquifaction.
CLIMATE CHANGE/LOWER RAINFALL INTENSITY AND RIVER FLOWS	**TREATMENT PLANT**	Reduced raw water available from rivers. Greater reliance on Maitai Dam reservoir. Increased restrictions on water supply to customers. Drought conditions.	Dam storage volume designed for current 60year drought and future demand to approx 2060-2080.	Major (4)	Likely (4)	High (16)	Reduce	Ongoing review of demand and storage for climate change. Investigate alternative supply sources.

Emergency response

Headworks

The Maitai and Roding headworks are manned by resident caretakers employed by the Water Treatment Plant contractor. During the caretaker's absence, resident relief caretakers are employed.

Water Treatment Plant

The Tantragee Water Treatment Plant is manned during normal working hours. After hours and on weekends, operators are able to monitor the plant remotely via a computer dial in system.

The operators also carry cell phones that are linked to the plant control system. Outside working hours, alarms are immediately sent to cell phones, so that the operators can respond immediately.

Supervision

The NCC Utilities operations and maintenance duty staff carry cell phones on a weekly roster so that at all times a Council Operations and Maintenance staff member is available to respond to major network faults or faults that have been escalated by the Treatment Contractor or Network Maintenance Contractor.

Review

The Risk Analysis will be reviewed every three years. In light of the significant seismic activity in Canterbury in 2010/2011 a review of the water reservoirs and sections of the trunk main for damage prevention and post-event response has been undertaken in 2013/14. A separate budget item has been included in the capital works programme for 2021-2031 for any remedial works to the water reservoirs and raw water trunk main sections that are vulnerable to damage. The latter are initially expected to be the steel arch siphons from the Maitai Dam to the water treatment plant.
A more extensive review of the network is required to address the risks identified. This will be undertaken over the duration of this plan and will support the next review of the Nelson- Tasman Lifelines initiative.

Potential Risks

Risks can be seen to arise from many areas of NCC, both in the physical aspect for assets and business risks.

Climate Change

Climate change is an evolving area of research with medium-long term timeframes before the exact level of impact can be established. Current advice from NIWA is that it is expected to bring with it more extreme weather in the form of higher intensity and duration rain events (with associated flood damage) and drought periods. The issue will be monitored and future asset management plans will be adjusted to address impacts as they become better understood.

See section 1.2 for details.

5.3. Infrastructure resilience approach

5.3.1. Development of resilient infrastructure to address climate change predictions and other natural hazards.

Ensuring resilience in the water supply network is an important function of the water supply activity. The following sets out the high level approach for each part of the network:

Table 5-2: High Level Approach for Each Part of the Network

Part of the network	Issue	Response
Raw Water Sources	Run of river subject to expected weather impacts and climate change	Three intakes-Maitai South Branch/Maitai Dam/Roding Dam. Possible future fourth source in Waimea Aquifer.
Raw Water delivery to WTP	Long pipelines. Original Maitai p/line mostly above ground.	Duplicate Maitai p/line installed within Maitai Valley roadway. Possible future 22,000m3/d from Waimea Aquifer. Maximise gravity delivery for as long as possible to reduce electricity consumption.
WTP	Located close to EQ fault. High use of electricity for filtration process.	Modern design of building/ multiple filtration trains/one portable chlorination pump available. Approx one days storage of treated water in distributed reservoirs. Electricity generation from inline generator on Roding raw water line.
Reticulation	Aging pipework/brittle AC mains/impacted by natural hazards.	Reticulation interlinked across the city and with TDC. Minimal pumped reticulation.

In addition to the above general approach there is an ongoing asset renewal and maintenance programme:

- The Maintenance Contractors carry out monthly inspections of assets, which include identifying any Health and Safety issues.
- Internal Audits of Health and Safety practices for construction works on the water supply assets are carried out periodically.

5.3.2. Climate Change

The Nelson City Council response is based on both mitigation and adaptation.

Mitigation is based on reducing NCC's GHG emissions.

Adaptation is based on securing water sources, demand management, regular replacement of treatment plant membranes, controlling access to the water supply catchment, monitoring sea level rise and the associated demand for a water supply in areas likely to be impacted.

5.3.3. Natural Hazard Security of the network in light of the recent Canterbury and Kaikoura Earthquakes and various storm events, including wider network hazards- Earthquake fault line and liquefaction.

Recent work by Council has focussed on natural hazards that might impact on the city, in particular:

- *Direct damage from Earthquake shaking;*
- *Damage from liquefaction in susceptible areas;*
- *Damage from Tsunami,*
- *Damage from flooding and major storm events;*
- *Impact of potential climate change and sea level rise.*

Because the Maitai Dam is a vulnerable asset, it was designed to withstand 1 in 100 year seismic and flood events without damage. Key structures are designed to withstand maximum credible earthquake and probable maximum flood without collapse (but not without some damage, possibly requiring decommissioning and major repair work).

When full, city reservoirs can hold sufficient water for approximately 24 hours average consumption. The more usual capacity, allowing for filling time and continuing use, is 8-10 hours of daytime demand.

Construction of a new buried pipeline between the dam and the Water Treatment Plant was completed in 2013/14 and between the Water Treatment Plant and Westbrook Terrace in 2016/17.

The Roding Water Scheme has low and moderate risks to structures, other than a 200m length of pipe between the screenhouse and the chlorinator house. This pipe is suspended on piers along the riverbank.

While automatic chlorination exists at the water treatment plant, a stand-alone portable chlorinator unit, run by a small petrol generator and using sodium hypochlorite is also held there in case of emergency.

As a result of the Christchurch earthquakes Council has undertaken a seismic review of the critical elements of the above ground network, starting with the storage reservoirs and sections of the Maitai Dam to the treatment plant trunk main. This work will continue through this proposed plan and be extended to investigate impacts of liquefaction on existing and future infrastructure, impacts of flooding and the long term planning required as a result of climate change.

5.3.4. Insurance

NCC has insurance cover for the Wastewater, Water & Stormwater services, staff and property as detailed in Table 5-3 below. The insurance cover is updated on a regular basis following valuations to ensure the insurance cover is appropriate for its purpose.

Table 5-3: Water Supply Insurance Provisions

Components / Items	Marsh TOS collective				Aon Si collective
	Public Liability	Professional Indemnity	Buildings and Contents	General Insurance	
Reticulation					✓
Pump Stations					
- Electrical				✓	
- Mechanical				✓	
- Structural				✓	
Staff	✓	✓			
Council Vehicles				✓	
Private property damage related to stormwater damage	✓				
✓ Indicates coverage by that particular insurance type					

Aon South Island (SI) collective

NCC is a member of an Aon South Island collective of councils.

In the event of a natural disaster, the insurance cover will generally cover 40% of the reinstatement cost of infrastructure assets that have been damaged and declared for cover by the Aon SI collective.

The Aon SI collective is a shared program limit, Council has a sub-limit of $180 million plus AICOW – Additional Increased Cost of Working – this allows for additional costs to be paid over and above normal operating costs during a loss. The $180m was deemed to be the mean 1 in 750 ARI (annual return interval) loss estimate.

5.3.5. Emergency Management

Local Authority Responsibility

Section 64 of the Civil Defence Emergency Management Act 2002 requires Local Authorities to:

64 Duties of local authorities

(1) A local authority must plan and provide for civil defence emergency management within its district.

(2) A local authority must ensure that it is able to function to the fullest possible extent, even though this may be at a reduced level, during and after an emergency"

Exercises are carried out approximately every six months to ensure staff are familiar with the procedures documented in the Nelson City Council Emergency Management Procedures Manual.

When a serious emergency event occurs an Incident Management Team (IMT) is activated to lead Council's response, to ensure a clear decision making structure. The lead role of incident manager is filled by a member of Nelson City Council's Senior Leadership Team, and the other IMT members generally include the applicable manager(s) according to the type of event. More staff are added depending on the scale and complexity of the event.

Local Emergency Management Arrangements

Nelson Tasman Emergency Management Group is a joint committee of both NCC and TDC.

The Nelson Tasman Emergency Management Group Plan provides for an 'all hazards' approach to emergency management planning and activity within Nelson and the Tasman District. The Nelson Tasman Emergency Management Group Plan states the Emergency Management structure and systems necessary to manage those hazards, including the arrangements for declaring a state of emergency in the Group's area. The Group Plan is the primary instrument whereby the community identifies and assesses its hazards and risks, and decides on the acceptable level of risk to be managed and how it is to be managed.

Lifelines Responsibility

Section 60 of the Civil Defence Emergency Management Act 2002 requires Local Authorities to support lifeline utilities as follows:

60 Duties of lifeline utilities

Every lifeline utility must—

ensure that it is able to function to the fullest possible extent, even though this may be at a reduced level, during and after an emergency

Nelson City Council participated in the 2015/16 Nelson Tasman Engineering Lifelines Group project as a life line utility. And Nelson City Council is a member of the Nelson Tasman Emergency Management Group Lifelines committee.

Nelson Tasman Emergency Management and Nelson City Council Emergency Response Plans

The following documents are available for guidance:

- Nelson Tasman Emergency Management Group Plan
- Nelson City Council Emergency Procedures Manual

Table 5-4: Risk Reduction, Readiness, Response and Recovery Status

Activities Required	Description	Water Status
Risk Reduction	Identifying hazards, describing risks, and taking actions to reduce the probability or consequences of potential events.	Asset Management Risk Register Water Strategies
Readiness	Planning and preparation required to equip agencies and communities to respond and recover.	Emergency procedures manual and exercises.
Response	Addressing immediate problems after an emergency.	Emergency procedures manual and exercises. Operations and maintenance response by contractors (Nelmac and Fulton Hogan)
Recovery	Addressing the long-term rehabilitation of the community.	Nelson-Tasman Emergency Management Group.

5.3.6. Interconnectivity Effects

Interconnectivity or interdependence between different utilities during and after a disaster is of utmost importance. In the event of failure, access is necessary to visit a site and provide power for recovery or removal of debris. To enable effective and efficient recovery of lifelines from an event which disrupts their service, dependencies on other lifelines must be understood and where necessary, mitigated against.

Figures 5-4 and 5-5 summarise interdependencies between lifelines sectors during business-as-usual and major disaster events where disruption is expected to roads and electricity networks. The ratings presented in this section are illustrative only – obviously the extent of dependence in a response and recovery situation will depend on the specific scenario. The total dependency scores clearly illustrate the importance of electricity, roads, fuel and telecommunications to the other sectors, with air transport, VHF and broadcasting becoming more important in a major disaster event.

Figure 5-4: Interdependency Matrix – Business As Usual

The degree to which the utilities listed to the right are dependent on the utilities listed below	Roads	Rail	Sea Transport	Air Transport	Water Supply	Wastewater	Stormwater	Electricity	Gas	Fuel Supply	Broadcasting	VHF Radio	Telecomms	Total Dependency
Electricity	1	2	3	3	3	3	2		2	2	3	3	3	30
Roads		3	3	3	2	2	2	2	2	3	2	2	2	28
Fuel	2	3	3	3	2	2	2	2	2		2	2	2	27
Tele-comms	2	2	2	2	2	2	2	2	2	2	2	3		25
Water Supply	1	1	1	2		3	1	1	1	1	1	1	2	16
VHF Radio	2	2	2	2	1	1	1	1	1	1	1		1	16
Stormwater	2	1	1	2	1	1		1	1	1	1	1	1	14
Wastewater	1	1	1	2	1		1	1	1	1	1	1	1	13
Rail	1		1	1	1	1	1	1	1	1	1	1	1	12
Sea Transport	1	1		1	1	1	1	1	1	1	1	1	1	12
Air Transport	1	1	1		1	1	1	1	1	1	1	1	1	12
Gas	1	1	1	1	1	1	1	1		1	1	1	1	12
Broadcasting	1	1	1	1	1	1	1	1	1	1		1	1	12

Figure 5-5: Interdependency Matrix – During / Post Disaster Event

The degree to which the utilities listed to the right are dependent on the utilities listed below	Roads	Rail	Sea Transport	Air Transport	Water Supply	Wastewater	Stormwater	Electricity	Gas	Fuel Supply	Broadcasting	VHF Radio	Telecomms	Total Dependency
Fuel	3	3	3	3	3	3	3	3	3		3	3	3	36
Roads		3	3	3	3	3	3	3	3	3	2	2	3	34
Tele-comms	3	2	2	2	3	3	3	3	3	2	2	3		31
Electricity	1	2	3	3	3	3	2		2	2	3	3	3	30
VHF Radio	2	2	3	3	2	2	2	2	2	2	2		2	26
Broadcasting	2	2	2	2	2	2	2	2	2	2		2	2	24
Air Transport	2	1	1		2	2	2	2	2	2	2	2	2	22
Water Supply	1	1	1	2		3	1	1	1	1	1	1	2	16
Stormwater	2	1	1	2	1	1		1	1	1	1	1	1	14
Wastewater	1	1	1	2	1		1	1	1	1	1	1	1	13
Rail	1		1	1	1	1	1	1	1	1	1	1	1	12
Sea Transport	1	1		1	1	1	1	1	1	1	1	1	1	12
Gas	1	1	1	1	1	1	1	1		1	1	1	1	12

3: Required for Service to Function, 2: Important but can partially function and/or has full backup, 1: Minimal requirement for service to function.

Water NZ

Nelson City Councils membership of WaterNZ give it access to a wide pool of expertise both during times of emergency and in general.

Electricity Supply

The electricity lines suppliers are Network Tasman Ltd and Nelson Electricity Ltd.

Energy supply is currently via a contract with Genesis.

Succession Planning

Succession planning within any business is considered necessary to reduce the risk associated with staff leaving the organisation. Succession planning allows institutional knowledge to be passed on, and assists in ensuring continuity of organisational culture.

Currently succession planning is largely by way of multiple staff members involved in administering the activity and detailing strategies for the future in asset management plans. In order to ensure greater effectiveness there is a need to improve planning and recording of strategies over the next three years.

6. Financial summary

This Section sets out financial statements, funding strategy, depreciation forecast and charges for the Water Supply services in Nelson City.

The Local Government Act 2002 (Part 6 Subpart 3) requires local authorities to manage their finances "prudently and in a manner that promotes the current and future interests of the community. This implies compliance with applicable Financial Reporting Standards, which include Public Benefit Entity International Public Sector accounting Standards (PBE IPSAS).

This Asset Management Plan provides the basis for meeting these requirements.

6.1. Financial statements and projections

Definition of Expenditure Categories

All expenditure on infrastructure assets falls into one of three categories:

- Operations and Maintenance Expenditure
- Capital Expenditure – Renewal/Replacement
- Capital Expenditure – Creation/Acquisition/Augmentation for both level of service compliance and growth

Table 6-1: Water Operational Expenditure Years 1-10 of the 2021/31 Long Term Plan (Draft-will be updated)

Account	2021/22 AMP (2021/31)	2022/23 AMP (2021/31)	2023/24 AMP (2021/31)	2024/25 AMP (2021/31)	2025/26 AMP (2021/31)	2026/27 AMP (2021/31)	2027/28 AMP (2021/31)	2028/29 AMP (2021/31)	2029/30 AMP (2021/31)	2030/31 AMP (2021/31)
7005 Water Expenses	**6,768,288**	**7,063,009**	**6,977,392**	**7,039,946**	**6,899,242**	**6,927,343**	**6,795,992**	**6,852,843**	**6,823,992**	**6,859,843**
Base Expenditure	**4,492,976**	**4,587,697**	**4,702,080**	**4,764,634**	**4,623,930**	**4,652,031**	**4,520,680**	**4,577,531**	**4,548,680**	**4,584,531**
70052017. After Hours Duty Officer	26,032	26,032	26,032	26,032	26,032	26,032	26,032	26,032	26,032	26,032
70052018. Mtce: Water Treatment	1,598,506	1,598,506	1,598,506	1,598,506	1,598,506	1,598,506	1,598,506	1,598,506	1,598,506	1,598,506
70052019. Mtce: Headworks	465,403	465,403	465,403	465,403	465,403	465,403	465,403	465,403	465,403	465,403
70052310. Water Metering	112,875	112,875	112,875	112,875	112,875	112,875	112,875	112,875	112,875	112,875
70052607. Telephones	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
70052617. Electricity	480,541	480,541	480,688	480,541	480,688	480,688	480,688	480,688	480,688	480,688
70052621. Rates	34,769	34,769	34,769	34,769	34,769	34,769	34,769	34,769	34,769	34,769
70052625. Water Purchased TDC	1,100,000	1,100,000	1,100,000	1,100,000	1,100,000	1,100,000	1,100,000	1,100,000	1,100,000	1,100,000
70052637. Insurance	415,990	415,990	415,990	415,990	415,990	415,990	415,990	415,990	415,990	415,990
700526412926. Civil Contractor Sponsorship	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
70052645. Advertising	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
70052699. Plant / Vehicle Operating Expense	898	898	903	903	903	903	903	903	903	903
70052710. Legal Fees	1,123	1,123	1,129	1,129	1,129	1,129	1,129	1,129	1,129	1,129
70052720. Valuation Fees	1,694	13,545	1,694	13,545	1,694	13,545	1,694	13,545	1,694	13,545
700527301496. Water Headworks Renewals and Upgrade Strategy	0	0	20,000	20,000	0	0	0	0	0	0
700527302809. Water Treatment Plant Renewals and Upgrade Strategy	0	0	20,000	20,000	0	0	0	0	0	0
700527303364. Climate Change Emission Reduction Study	15,000	15,000	0	0	0	0	0	0	0	0
700527303366. Climate Change Vulnerability Assessment	0	50,000	50,000	50,000	0	0	0	0	0	0
700527303367. Climate Change Adaptation Strategy	0	0	0	0	50,000	50,000	0	0	0	0
700527303381. Maitai Original Raw Water Pipeline Renewal Strategy	0	0	30,000	20,000	0	0	0	0	0	0
700527303382. Water Pipeline Renewals and Upgrade Strategy	0	0	20,000	0	0	0	0	0	0	0
700527303383. Water Growth and Intensification Strategy	0	0	30,000	30,000	0	0	0	0	0	0
700527303384. Reticulation Water Quality Improvement and pressure management	0	0	50,000	20,000	0	0	0	0	0	0

Account	2021/22 AMP (2021/31)	2022/23 AMP (2021/31)	2023/24 AMP (2021/31)	2024/25 AMP (2021/31)	2025/26 AMP (2021/31)	2026/27 AMP (2021/31)	2027/28 AMP (2021/31)	2028/29 AMP (2021/31)	2029/30 AMP (2021/31)	2030/31 AMP (2021/31)
70052760. Other Professional Advice	0	31,500	0	0	31,500	0	0	31,500	0	31,500
700537402692. Water Supply Bylaw	0	0	0	5,000	5,000	0	0	0	0	0
700540100689. Mtce: Pressure/Flowrate Monitoring	41,311	41,930	41,930	41,930	41,930	41,930	41,930	41,930	41,930	41,930
700540100690. Mtce: Backflow Prevention	42,823	42,823	45,400	47,250	50,750	53,500	55,000	58,000	62,000	65,000
700540100817. WTP Lagoon desludge	0	0	0	125,000	0	0	0	0	0	0
700540100820. Fish passage up Maitai dam spillway	16,012	16,012	16,012	16,012	16,012	16,012	16,012	16,012	16,012	16,012
700540101615. Network model updates and calibration	0	0	0	0	50,000	100,000	0	0	0	0
700540312138. Seismic Protection Review Water Assets	0	0	0	0	0	0	50,000	50,000	50,000	50,000
700540312803. Water loss reduction programme	50,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
70054372. Prelim Capex - investigation, options, testing	43,000	43,000	43,000	43,000	43,000	43,000	43,000	43,000	43,000	43,000
700547302808. Network Capacity Confirmation for Growth Areas	26,500	26,250	26,250	26,250	26,250	26,250	26,250	26,250	26,250	26,250
700547401457. Water Safety Plan (old PHRMP)	10,500	10,500	10,500	10,500	21,000	10,500	10,500	10,500	10,500	21,000
700547601652. water supply asset mgmt support	0	21,000	21,000	0	10,500	21,000	0	10,500	21,000	0
Unprogrammed Expenses	**2,012,712**	**2,212,712**	**2,012,712**	**2,012,712**	**2,012,712**	**2,012,712**	**2,012,712**	**2,012,712**	**2,012,712**	**2,012,712**
70053010. Water Reticulation Reactive Maintenance	2,012,712	2,212,712	2,012,712	2,012,712	2,012,712	2,012,712	2,012,712	2,012,712	2,012,712	2,012,712
Programmed Expenses	**262,600**	**262,600**	**262,600**	**262,600**	**262,600**	**262,600**	**262,600**	**262,600**	**262,600**	**262,600**
70052010. Water Reticulation Programmed Maintenance	262,600	262,600	262,600	262,600	262,600	262,600	262,600	262,600	262,600	262,600

Table 6-2: Water Capital Expenditure Years 1-10 of the 2021/31 Long Term Plan (Draft-will be updated)

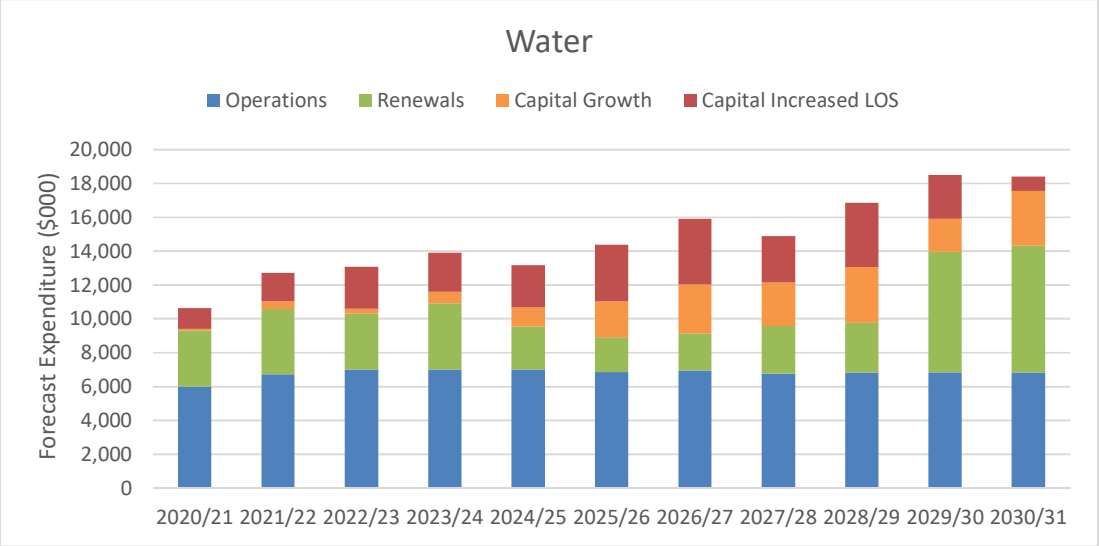
Account	2021/22 AMP (2021/31)	2022/23 AMP (2021/31)	2023/24 AMP (2021/31)	2024/25 AMP (2021/31)	2025/26 AMP (2021/31)	2026/27 AMP (2021/31)	2027/28 AMP (2021/31)	2028/29 AMP (2021/31)	2029/30 AMP (2021/31)	2030/31 AMP (2021/31)
7005 Water Capital	**5,799,050**	**7,342,550**	**7,226,700**	**5,753,200**	**7,513,400**	**8,958,600**	**8,141,450**	**10,039,950**	**11,655,150**	**11,590,650**
Renewals	**3,588,500**	**4,530,050**	**4,105,000**	**2,050,000**	**1,982,500**	**2,125,500**	**2,772,550**	**2,900,550**	**7,036,250**	**7,423,550**
700571402951. Water Treatment Plant Renewals	20,000	154,000	156,000	120,000	105,000	170,000	180,000	270,000	332,000	90,000
700571402999. Scada Renewal	31,500	24,500	0	11,500	0	24,500	149,000	30,000	0	31,000
700573051496. Renewals: Headworks	71,000	116,000	75,000	7,500	16,500	20,000	71,000	13,000	16,700	20,000
700573102850. Rutherford St (Little Go Stream) Renewal	0	450,000	100,000	0	0	0	0	0	0	0
700573103381. Maitai Raw water pipeline renewal	0	0	0	0	0	0	100,000	100,000	100,000	100,000
700573151461. Renewals: Water Pipes	2,400,500	1,800,050	1,600,500	1,650,500	1,600,500	1,650,500	2,000,500	2,000,500	2,500,500	3,000,500
700573152129. Roding Pipeline	0	0	0	0	0	0	0	115,000	115,000	115,000
700573153060. Konini Street water renewal	30,000	0	650,000	0	0	0	0	0	0	0
700573153307. Washington (Rentone to Watson) water renewal	102,000	1,212,000	1,270,000	0	0	0	0	0	0	0
700573153385. Washington Road (Hastings to St Vincent) Renewal	250,000	520,000	0	0	0	0	0	0	0	0
700573161498. Renewals: Misc Pipes & Fittings	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
700573202811. Pump Stations - Renewals	53,500	53,500	53,500	60,500	60,500	60,500	67,000	67,000	67,000	67,000
700573251491. Renewals: Commercial Meters	160,000	160,000	160,000	160,000	160,000	160,000	160,050	160,050	160,050	160,050
700573252128. Residential Meters renewals	430,000	0	0	0	0	0	0	0	0	0
700573258201. Water Meter Replacement	20,000	20,000	20,000	20,000	20,000	20,000	25,000	25,000	25,000	20,000
700573302555. Renewal: Membranes WTP	0	0	0	0	0	0	0	100,000	3,700,000	3,800,000
Capital Growth	**0**	**0**	**300,000**	**800,000**	**1,750,000**	**2,500,000**	**2,100,000**	**2,253,000**	**1,103,000**	**1,756,700**
700576153322. City Centre N270 Maitai Precinct Intensification Growth project	0	0	100,000	100,000	100,000	1,000,000	2,000,000	2,000,000	800,000	0
700576153326. Victory N23 Intensification Growth project	0	0	0	0	0	0	100,000	100,000	50,000	1,500,000
700576153328. Maitahi Development Growth project	0	0	100,000	100,000	1,600,000	750,000	0	0	0	0
700576153329. Bayview Development Growth project	0	0	100,000	100,000	50,000	750,000	0	0	0	0
700576153387. Future growth and Intensification Projects	0	0	0	0	0	0	0	0	100,000	100,000
700576502805. Future Growth Additional Storage	0	0	0	500,000	0	0	0	0	0	0

Account	2021/22 AMP (2021/31)	2022/23 AMP (2021/31)	2023/24 AMP (2021/31)	2024/25 AMP (2021/31)	2025/26 AMP (2021/31)	2026/27 AMP (2021/31)	2027/28 AMP (2021/31)	2028/29 AMP (2021/31)	2029/30 AMP (2021/31)	2030/31 AMP (2021/31)
700576503231. Ngawhatu Valley high level reservoir	0	0	0	0	0	0	0	153,000	153,000	156,700
Capital LOS	**2,190,550**	**2,812,500**	**2,821,700**	**2,903,200**	**3,780,900**	**4,333,100**	**3,268,900**	**4,886,400**	**3,515,900**	**2,410,400**
700573502812. Reservoir Refurbishment Programme	57,000	57,000	57,000	80,000	80,000	57,000	57,000	57,000	90,000	90,000
700576152801. NCC - TDC Link	0	0	0	0	0	0	0	106,700	106,700	106,700
700576203165. water pump stations - upgrades	0	0	106,700	106,700	50,000	106,700	170,000	170,000	170,000	570,000
700576302809. Water Treatment Plant Upgrades	282,000	269,000	274,500	226,000	225,000	200,000	200,000	265,000	50,000	300,000
700576502313. Capital: Atawhai Res & pump Ma	173,000	0	0	0	0	0	0	0	0	0
700576903367. Climate Change Adaptation Projects	0	0	0	0	100,000	100,000	100,000	500,000	500,000	500,000
700579051496. Headworks Upgrades	315,000	342,000	380,000	200,000	305,000	120,000	120,000	270,000	140,000	240,000
700579103010. Toi Toi St water ridermain	200,000	0	0	0	0	0	0	0	0	0
700579151058. Capital: Pressure Reduction	0	57,500	0	57,500	0	58,500	0	58,500	0	58,500
700579151064. Capital: Ridermains	63,500	63,500	63,500	63,500	63,500	63,500	63,500	63,500	63,500	63,500
700579151081. System Improvements	57,500	57,500	57,500	57,500	58,500	58,500	58,500	58,500	58,500	58,500
700579151168. Capital: Backflow Prevention	173,000	173,000	173,000	173,000	173,000	173,000	173,000	173,000	173,000	173,000
700579152140. Capital: Atawhai Trunkmain	109,500	92,000	92,000	192,000	192,000	192,000	1,920,000	1,920,000	1,920,000	0
700579152800. Pressure Enhancement	106,700	0	0	100,000	100,000	100,000	0	0	0	0
700579162131. Fire Flow Upgrades	0	50,000	100,000	100,000	100,000	500,000	0	0	0	0
700579162803. Water Loss Reduction Programme	130,500	130,500	130,500	130,500	106,700	106,700	106,700	106,700	106,700	106,700
700579162807. Natural Hazards Risk Remediation	153,350	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
700579203388. Maitai Pump Station upgrade	0	0	0	0	100,000	100,000	50,000	1,000,000	0	0
700579501180. Other Sundry: Maitai Planting	11,500	11,500	11,500	11,500	11,500	11,500	11,500	11,500	11,500	11,500
700579502314. Capital: Atawhai No.2 Reservoi	153,500	115,500	115,500	1,153,000	1,883,000	2,153,000	0	0	0	0
700579502810. Dam Upgrades	165,000	1,150,000	1,134,000	120,000	0	0	0	0	0	0
700579503142. Maitai Pipeline Hazard mitigation	0	0	0	0	106,700	106,700	106,700	0	0	0
700579902132. Telemetry/Control Upgrade	18,500	122,500	5,000	11,000	5,000	5,000	11,000	5,000	5,000	11,000
700579903259. Water supply H&S risk mitigation programme	21,000	21,000	21,000	21,000	21,000	21,000	21,000	21,000	21,000	21,000

6.1.1. Water Budgets – Ten Years

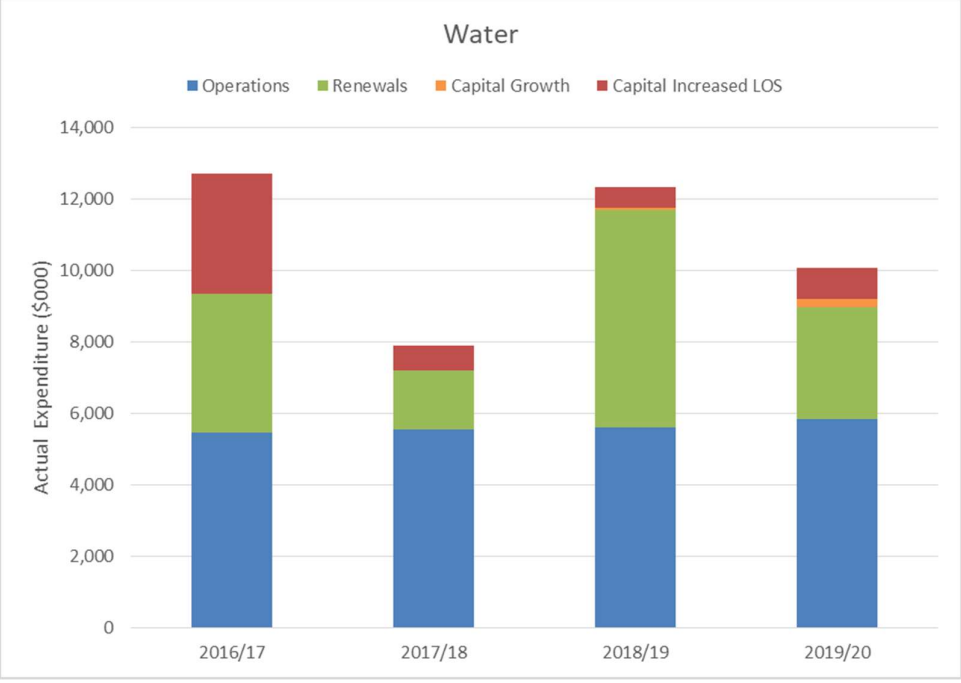
Expenditure for the water supply activity varies over the term of the plan. Renewals expenditure is high in 2021/22-2023/24 with the renewal of three central city streets. From 2029/30 renewal expenditure increases significantly to address the anticipated future renewal requirements as large sections of the piped network reach the end of their service lives. The overall trend is to increase expenditure in the water activity over the next ten years.

Figure 6-1: Water Budgets – Ten Years



6.1.2. Trends from the previous four years 2016-17 to 2019-20

Figure 6-2: Recent Expenditure on Water Supply Network



6.2. Funding strategy

In determining how activities will be funded local authorities are required to take the following into consideration:

- The contribution to the achievement of Community Outcomes (strategic alignment)
- Beneficiaries of each activity (beneficiary/user pays principles)
- The period over which benefits from the activity will occur (intergenerational equity issues)
- The extent to which identifiable individuals contribute to the need to incur expenditure (exacerbator and user pays principles)
- The costs and benefits of funding the activity compared to other activities (cost/benefit, prioritisation principles)
- The impact of funding the activity on the wellbeing of the community (ability to pay principles)

Contributions

The Resource Management Plan has set a financial contribution so that sub-dividers, developers and new industry pay their share of the capital expenditure for reserves purposes each year as part of the costs of growth.

From 1 July 2006 Development Contributions have been collected under the Local Government Act 2002 as detailed in the Long Term Plan.

The remaining costs of collecting, treating and delivering water are funded from user charges.

Water by Meter User Charges

From 1 July 1999 universal metering has been in operation and there is no charge in the general rates for the supply of water.

The Water Pricing Structure Working Party was convened in 2003 and made its recommendation to the Infrastructure Committee which in turn recommended the pricing structure to the full Council meeting on 18 December 2003.

The objective of the pricing structure is to:

- Encourage water conservation.
- Be fair to residential and commercial water users.
- Be simple to administer and readily understood by the public.
- Recognise the opportunity value and fire-fighting value of the water supply system and the benefits this provides to empty sections and houses.
- Provide regular cash flow while avoiding excessive reading and invoicing costs.

The key points in the pricing structure are:

- A house or section without a water connection not be charged a fee.
- All properties on water by meter (including empty sections) should pay a minimum annual charge.

- The fixed costs are approximately 90% and variable costs approximately 10% of the total costs of operating the water supply. If the minimum annual charge was set to recover 90% of costs there would be little incentive to conserve water. Therefore the minimum annual charge was set to recover only 30% of the total costs. This encourages water conservation, but still means that low (or no) volume users do pay a share of the opportunity and fire-fighting value of the supply.
- There being no "entitlement to free water for low usage" associated with the minimum annual charge.
- The minimum annual charge (collected as a daily charge) be set to recover 30% of the estimated water by meter revenue requirement, and that the remaining 70% be recovered as user charges.
- The revenue required from Major Water Users with Even Demand (including financial and operating costs) be calculated based on the value of water supply assets used by those users and allocated as a percentage of peak summer demand for assets sized for peak demand (part of the treatment plant), and as a percentage of water used for assets sized for water volume.
- The charges for Bulk Water Users over 10,000m^3 per year, where there is predominantly summer irrigation, be at the average of the 0-10,000m3 and the 10,000-100,000m^3 rates. This recognises that these Users contribute to the summer peak, but do not use a large part of the reticulation.
- The charges for usage in the 10,000-100,000m^3 band and 100,000+m^3 band be set to recover the revenue calculated above and in the same ratios as used in previous years.
- A revenue issue may arise in the future, if the water reuse project involving treated water from Bells Island is developed. This project would supply irrigation water to the Tahunanui / Stoke area and impact on water sales currently made for this purpose.

Creation/Acquisition/Augmentation

Nelson City Council will review funding requirements and strategies to achieve equitable funding of upgrade works through development contributions.

6.3. Valuation forecasts

Figure 6-3: Forecasts of depreciation To be updated

6.4. Key assumptions made in financial forecasts

Council is required to identify the significant forecasting assumptions it has made in preparing its ten year Long Term Plan. Assumptions are necessary to allow Council to plan for expenditure and costs over the next ten years. They are the best reasonable assessment made on the basis of currently available information.

The Nelson Long Term Plan details possible and actual significant forecasting assumptions and uncertainties relating to Nelson City Council activities.

As well as the general assumptions that apply as the basis for forecasting budgets across Council's work, the following assumptions apply specifically to water supply:

- Renewals will be continued at a rate that is sustainable, based on consideration of both resource and financial aspects
- It is assumed that Nelson's climate will remain substantially unchanged for the next decade, with enough rain to meet our water needs. Factors such as climate change and population growth will receive increased analysis as the Activity Management Plan and Infrastructure Strategy is reviewed in future years
- It is assumed that future resource consents for the existing sources of water supply and abstraction volumes will be granted
- It is assumed that there will be reductions in water losses
- Water supply is expected to continue to be funded from water charges and, consistent with Council's financial policies, most of the capital expenditure will be funded from borrowings
- Council will provide education and promotion of the importance of water conservation; however the demand for water is expected to continue to primarily be managed through Council's water charging system
- The service delivery strategy is expected to be sustained for the term of the Long Term Plan
- Existing treatment plant membranes will continue to operate satisfactorily.

6.5. Forecast reliability and confidence

Table 6-2 below details the possible and actual significant forecasting assumptions and uncertainties relating to the Nelson City Council water supply system.

Table 6-2: Significant Forecasting Assumptions and Uncertainties

No.	Assumption	Degree of Risk or Uncertainty	Likely Impact if the Assumption is (or is Not) Realised or is Not Acceptable
1	Interest rates for new loans raised or existing debt refinanced during the years are forecasted in the range of 3%.	Low	Level of debt is moderate. Interest costs are not expected to vary significantly.
2	Growth is based on figures provided by statistics New Zealand and Nelson City Council growth projections.	Low	Any significant increase in the growth may require upgrading of reticulation to occur at an earlier stage than presently proposed.
3	The actual remaining lives of assets will not deviate significantly from those contained in the asset valuation.	Medium	Changes in estimated asset lives could lead to significant changes in asset renewal projections, depreciation and renewal budgets.
4	The replacement values are a realistic cost and have taken into consideration engineering fees, resource consents etc.	Low	Replacement values have gone through a review process.
5	Upgrade/capital estimates are as follows: Concept +/- 30% Initial & Planning +/-10 to +/- 25% Delivery/Construction +/- 5% Projects of unusual complexity or presenting landowner / regulatory issues that cannot be quantified and such that estimating with accuracy is difficult, may lie outside these figures.	Medium	Costs of upgrades are estimated only without detailed project planning.
6	Maintenance cost of service for Reticulation and Treatment will be within -5% and +10% of budget.	Low	Historically maintenance costs % variations for reticulation have been low.
7	Depreciation based on estimated useful lives not on condition of pipework.	Medium	If proposed condition assessments indicate that Councils mains have decreased useful lives, depreciation presently taken will be less than that required for replacement.
8	Electricity will be able to be sourced from a nett zero carbon source	Low	The water supply activity is unlikely to meet Council's goal of nett zero carbon emissions by 2050
9	Future sea level rise predictions will be confirmed decades in advance of the event	High	Service lives of assets in areas that the community may decide to retreat from will not be optimised leading

			to renewal of assets that are later abandoned.
10	It will be possible to co-construct assets to avoid un-necessary emission of greenhouse gases from duplicate construction	High	Very difficult to accurately identify service lives of pressure assets.

7. Asset management practices

The goal of infrastructure asset management is to:

"Deliver the required level of service to existing and future customers in a sustainable and cost effective manner."

A formal approach to the management of assets is essential in order to provide services in the most cost-effective manner, and to demonstrate this to customers and other stakeholders. The benefits of improved asset management are:

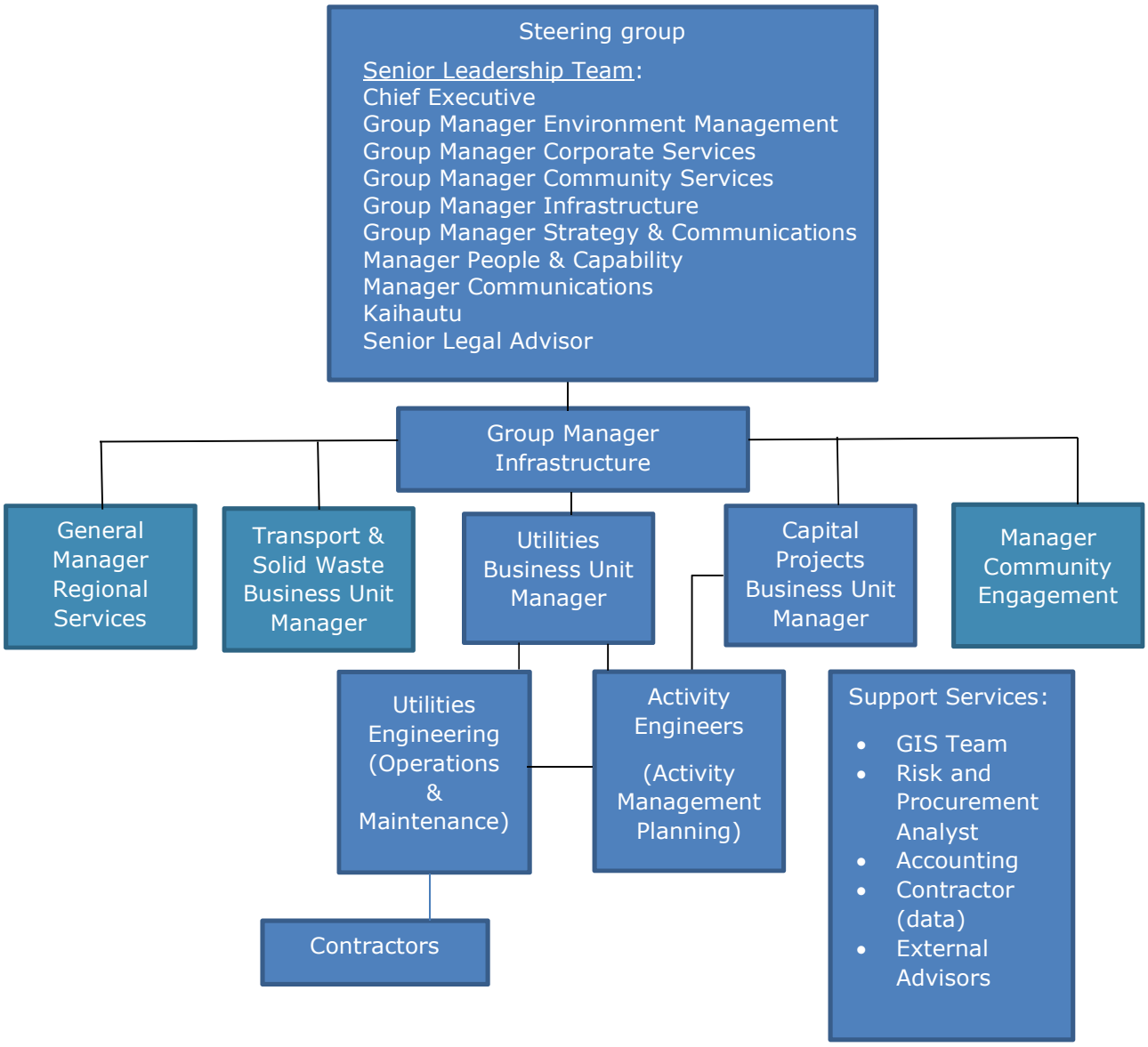
- Improved governance and accountability
- Enhanced service management and customer satisfaction
- Improved risk management
- Improved financial efficiency
- More sustainable decisions

The key elements of Asset Management are as shown below:

Figure 7-1: Activity Management Key Elements

7.1. Asset management leadership and structure

Figure 7-2: Activity Management Leadership and Structure



7.2. Management systems

A management system is defined as the set of procedures an organisation needs to follow in order to meet its objectives.

Table 7-1: Management Strategies

Strategy	Objective/ Description
Strategic Planning	
Human Resources	Develop the professional skills of the staff through adequate training and experience Personal Development Plans will be agreed with staff each year and a register maintained to record training history. Staff are encouraged to belong to appropriate professional bodies and to attend appropriate conferences, seminars and training courses.
Strategic Alignment	This Activity Management Plan will support the achievement of relevant Community Outcomes for Nelson City Council. Community Outcomes for Nelson City Council are set out in the Long Term Plan. The intended contribution of the Nelson City Council water supply services to the achievement of Community Outcomes is shown in this Activity Management Plan.
Service Levels	A clear statement of the water supply services provided and standards to be achieved that directly link to, and support the stated community outcomes, are shown within this Activity Management Plan.
Sustainable Management	Ensures all planning for the management, operation, maintenance, renewal and development of the water supply activity is compatible with sustainable management principles. Nelson City Council will pursue ways of limiting the use of natural resources including energy, valued landscapes (and other natural heritage) and adverse effects on waterways. This will involve auditing the systems and materials used, and developing ways to incorporate sustainable operation and development principles into Nelson City Council activities.
Data Management and Utilisation	
Network modelling	Continue the development of computer-based hydraulic models of the reticulation network. Computer model of the water supply reticulation enables Nelson City Council to: • Determine accurately the existing capacity of the system • Identify inadequate sections of the system • Operate the system in the most efficient and sustainable manner • Determine the impact of further development on the system • Identify system upgrading requirements • Compare options for upgrading the water supply network.

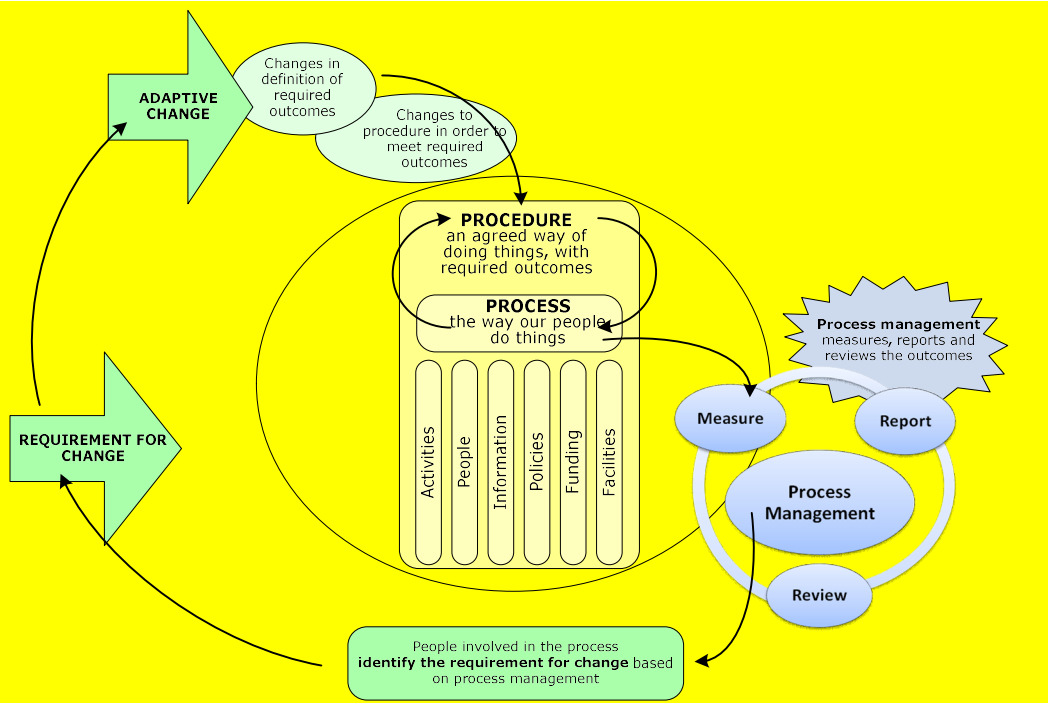
Strategy	Objective/ Description
Data Collection	Data collection programmes (condition, performance, asset registers) closely aligned with business needs will be operated in accordance with documented quality processes Data collection, maintenance and analysis are expensive and it is important that programmes and techniques are cost effective and consistent with business needs. Systematic processes will be introduced for the collection and upgrading of essential data based on asset criticality including: Asset attribute information Asset performance data Asset condition data.
Geographical Information System Data	Geographical information system data will be the subject of defined quality assurance processes. Nelson City Council has quality processes to ensure that all data entered to the Geographical information system meets defined quality standards and supports Asset Management through connectivity with the asset register and Asset Management data storage.
Business Processes	
Activity Management Plan Updates	This Activity Management Plan remains a strategic 'living' document and will be updated as required and reviewed at three yearly intervals to coincide with the Long Term Plan. The scope of the review will be influenced by changes in Community Outcomes for Nelson City Council, service standards, improved knowledge of assets and corporate strategy/ policy and process.
Risk Management	Risk Management is an essential part of Asset Management. Water supply activity risks will be managed by implementing the Risk Management Register for the Water supply activity and the implementation of risk controls to maintain risk exposure at agreed levels. Risk controls will include maintaining appropriate insurance cover, emergency response planning, condition monitoring of critical assets, preventative maintenance, use of SCADA, and operations manuals, review of standards and physical works programmes.
Infrastructure Asset valuation	Perform valuations in a manner that is consistent with national guidelines and Nelson City Council corporate policy for valuation cycles which are carried out every 1-3 years to reflect international financial activity and align with the Long Term Plan requirements. Asset valuations are the basis for several key asset management processes including asset renewal modelling and financial risk assessments. Valuations of the water supply system will be carried out based on data from the Asset Management System to ensure audit ability and alignment with other processes.
Monitoring	
Level of Service Standards	Continue with the monitoring procedures to ensure water supply activity is contributing to the community outcomes as stated and that internal controls (service requests, operational contract requirements) are also monitored and managed
Asset Performance	The performance of the water supply assets are monitored as an input to asset renewal and asset development programmes. The Monitoring includes:

Strategy	Objective/ Description
	• Customer service requests • Asset failure records • Asset Maintenance records • Compliance with Resource Consents • Critical asset audits • Supervisory Control and Data Acquisition • Legislative compliance
Financial Management	
Budgeting	Expenditure programmes for the water supply activity indicates Council funding and budgets with a 10 year projection. Use the Plan to provide sufficient detail to demonstrate the decision making process for those 10 year projections.
Financial management	Manage the water supply activity budget in accordance with statutes and corporate policy. This involves: Economic appraisal of all capital expenditure Annual review of Activity Management Plan financial programmes Recording of significant deferred maintenance and asset renewals Continuous monitoring of expenditure against budget.
Sustainable Funding	Ensure the water supply activity is managed in a financially sustainable manner over the long term. The financial requirements for the provision of the water supply activity, sustainable and to acceptable standards over the long term will be identified and provided for in the budgets. These financial requirements include: Management of the water supply activity Operation and maintenance of the water supply system Asset replacement Asset development to ensure that the ability of the water supply activity to deliver an acceptable level of service is not degraded by growth in Nelson City Council.

Quality Management

The quality management system is process management based on a quality cycle. It is aligned with ISO 9000, and benchmarked against this standard each year. The focus of the Quality Management programme is to improve the effectiveness and efficiency with which Nelson City Council deliver services to the community; ensuring processes deliver their required outcomes, which are aligned with community outcomes and organisational goals. Required outcomes are typically defined in terms of the core key performance areas - customer satisfaction, legislative compliance, and management of resources (budget and staff time), and employee engagement.

Figure 7-3: Quality Management Lifecycle



1: Define the Process: Document the Procedure

NCC's Quality Management system (QMS) is a process-based approach. A process is a set of interrelated or interacting activities which transforms inputs into outcomes. Required outcomes are achieved more efficiently when activities and related resources are managed as a process.

A procedure is an agreed way to carry out a process. A procedure includes and defines:

Required outcomes from the procedure (most important)

- Definition of the required outcome forms the "quality" standard for the process
  - Agreement of the required outcomes tells us what would success look like (our KPIs)
- We need to ensure that required outcomes are recorded so that they can be measured later - not just what needs to be achieved, but when, and how many, and what exceptions

People involved in the procedure (equally important)

- Definition of all of the people involved in all aspects of the process, including the customer, those "doing stuff", those "accountable for stuff" and any suppliers directly involved in the process
- Are the people involved the most effective, most efficient way to do this?

Activities comprising the procedure

- Defining all the activities required and undertaken to achieve the required outcomes
- Are all the activities undertaken necessary, are they in the right order, are the right people doing them, is this the most effective, most efficient way to do this?

Enablers that support the procedure

- The enablers of the process include things like information (and information systems), policies (and culture), funding and facilities. These should be documented as part of the process

Documenting the procedure (activities involved, who does what when, what funding and resources are required) provides a *written procedure* to support the process.

Processes work together to form end-to-end procedures:

Managing interrelated processes improves the organisation's effectiveness and efficiency in achieving its objectives. This means consideration of how processes interrelate to form end-to-end procedures with

1: Define the Process: Document the Procedure
overall outcomes. The outputs from one procedure often form the trigger for the next procedure. End-to-end procedures have their own required outcomes.

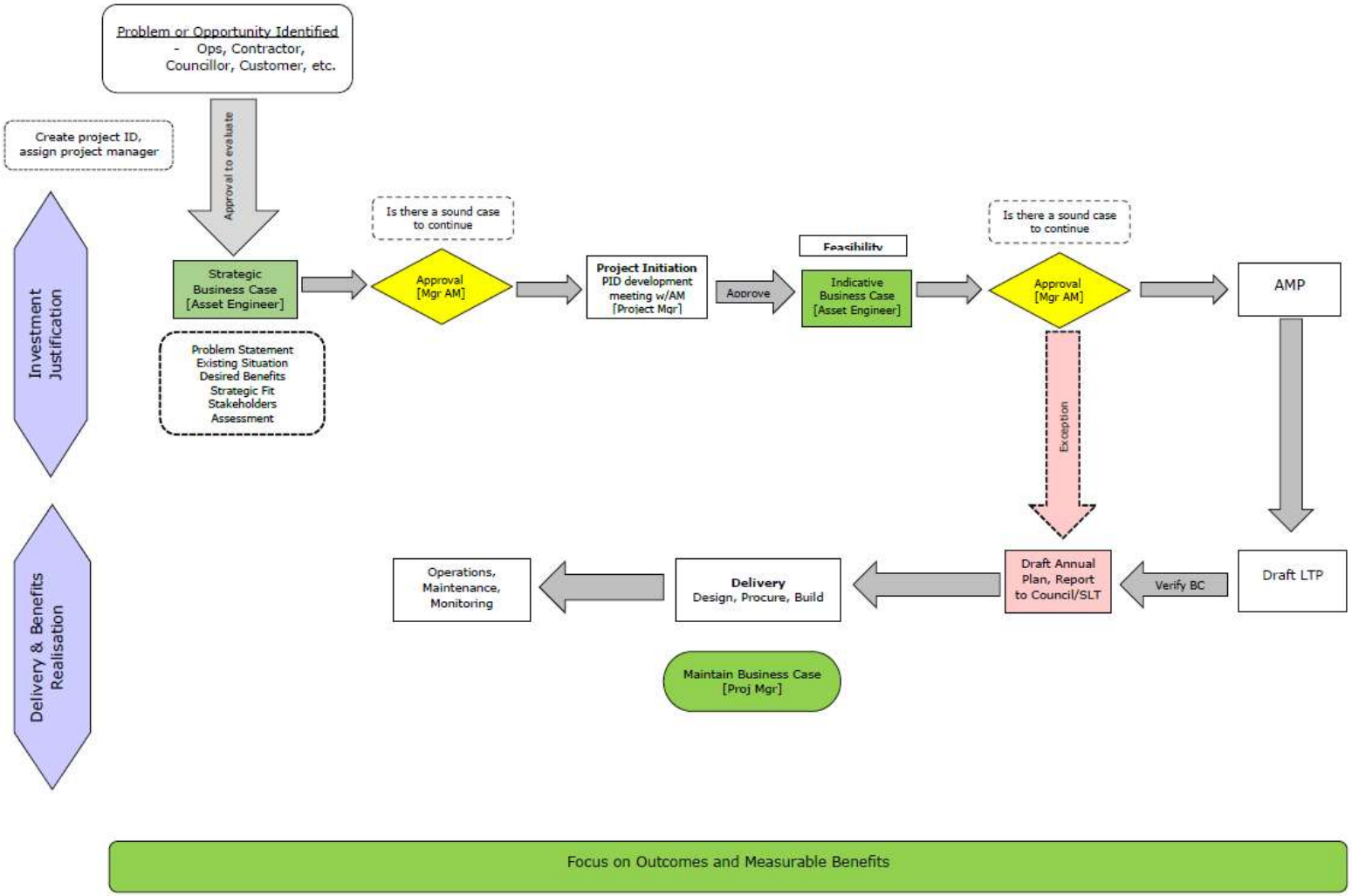
2: Manage the procedure: Measure, Report and Review
Measuring whether the procedure is being followed and whether outcomes are being met This enables us to apply a factual approach to decision making and to the need for change. • Measure how the process is going – is the procedure being followed – are interim goals being met? Measure the outputs of the process – were these met and did these meet the required outcomes? **Reporting tells us whether procedures are being followed and outcomes being met** • We need to not just know whether outcomes are being met, but to "know that we know" • Reporting gives us options for remediation or consequences of non-conformity **The procedures and the outcomes are subject to review by those responsible and accountable for the process** • Why did we really do this? What did we think we would gain? Did we get that result? • Are we doing the right things? Are we doing them the right way, and are we doing this consistently? Are we getting them done well? Are we getting the benefits? • Review provides a tool for continual improvement of the process by re-examination and change to the required outcome, or by change in the process to achieve the required outcome

3: Improve the procedure: Requirement for Change, then Adaptive Change
Procedure are subject to adaptive improvement to the process and the required outcomes. People involved with processes identify and initiate change: • Are the required outcomes still required? Is there a requirement for change? • Are the activities and people defined in this process the best way to achieve these outcomes? • Are things being done in the right order, and by the right people, in the right places? Is the process being followed? Does everyone do it the way that we've agreed? • Is there anything listed that isn't contributing? Is there something that would contribute more?

Project management

NCC processes for project management require that time, cost, and quality/scope objectives are agreed before project delivery begins. Project management is focussed on ensuring that the desired benefits, as per the agreed business case, are delivered. Project management processes are based on the principles of the PRINCE2™ method. Fiscal approvals, and change approvals are in line with Council delegations and Officer delegated authority

Figure 7-4: Business case process



7.3. Information systems

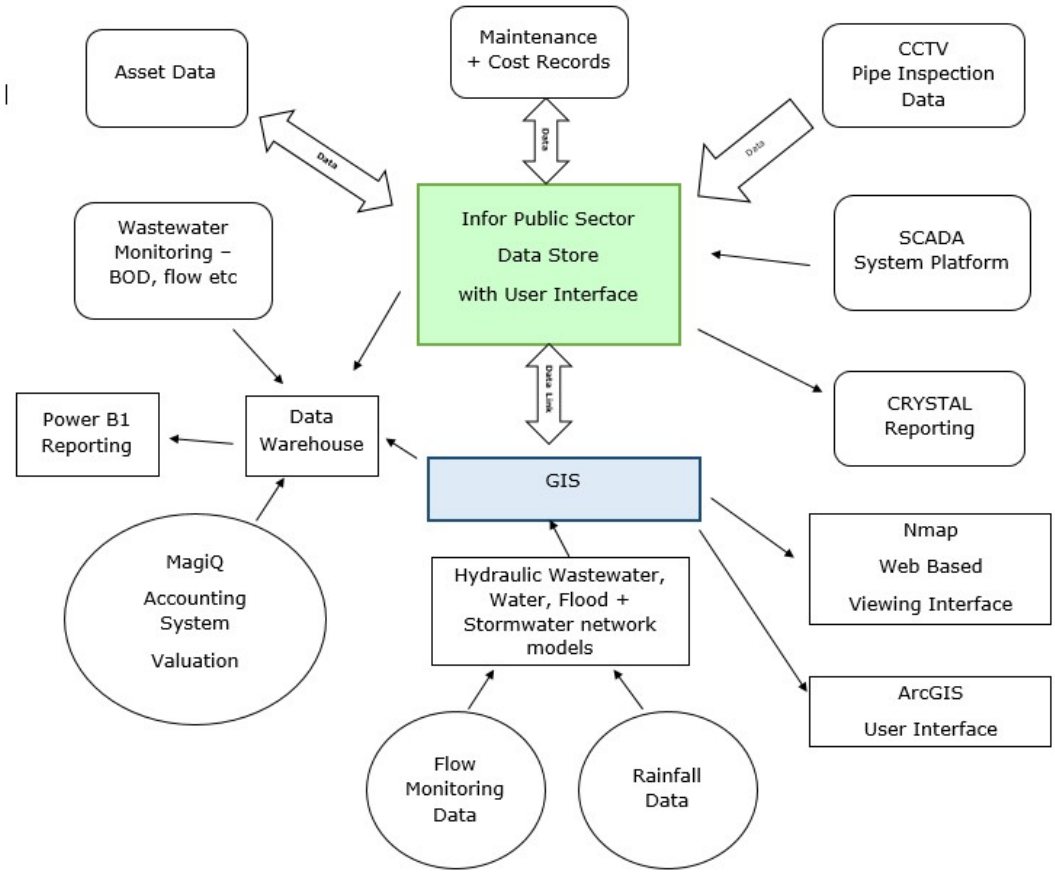
Asset Management Information Systems provide an understanding of assets to optimise lifecycle costs, identify required work, record completed work and cost of work. It benefits general management, long-term planning and data analysis.

All asset information is stored in Infor and linked with GIS.

An overview of the asset information system is depicted below. The warehousing of specific data and further development of reporting will assist in management of the assets.

The Council has a number of information systems (Infor, MagiQ, SCADA System Platform, Network Model, Azure database) that are integrated to varying degrees. The integration of these systems is considered to assist in the optimisation of operations, renewals and the ongoing development of the water supply activity.

Figure 7-5: Asset Information Systems



Asset Improvement Register (ongoing AM practice)

The Asset Improvement Register is used to capture, store, and share discussions, thoughts and concerns with regard to asset performance and improvement

Integrated Accounting, Financial, Electronic Purchase Order, and Service Request Systems

Accounting is currently carried out to Generally Accepted Accounting Principles to comply with the Local Government Act 2002 and Public Benefit Entity International Public Sector Accounting Standards (PBE IPSAS). The Nelson City Council uses integrated computer software supplied by MagiQ. The General Ledger is linked to packages that run Debtors, Creditors, Banking, Rates, Fixed Assets, Invoicing, Water Billing, Job Costing, and Payroll. Internal monthly financial reports are generated by Council significant activity and sub-activity categories although real time data is available at any time. External financial reports by significant activity are published in the annual report.

Service requests record customer questions, enquiries, and complaints.

Electronic Document and Records Management System (EDRMS)

Nelson City Council uses Objective as its electronic document and records management system.

Geographical Information System

Geographical information system was implemented in 1994 with data captured using photogrammetry (1994) and progressively delivered over the following years. Nelson City Council staff carried out accuracy checks on the geographical co-ordinate data supplied, searched all the engineering plans and field books for information on pipe alignment, material and age and entered this information into the Geographical information system.

Accuracy Limitations

The data captured by photogrammetry was required to be accurate to within a tolerance of +/- 0.3m. In inaccessible areas, it was not considered economic to search for buried fittings. Instead, the best estimated position was entered and the accuracy limitation flagged. Similarly, only limited fieldwork has been done to confirm the pipe material and sizes. The accuracy of this information is verified through time by asset data collection procedures.

New assets are recorded from the "as built" plans supplied by the subdivider (for vested assets) or Council's engineering project section (for new capital work).

Maintenance of GIS data

Procedures are in place to update new data into the Geographical information system on a monthly basis via Nelson City Council engineering staff.

Council's Engineering Standards require that any work on the Council water network must be proposed to Council by means of an engineering plan for approval and an "As-built" record submitted at the completion of works.

Data on assets associated with renewal and upgrade capital are now updated into the asset register by Nelson City Council Engineering and Finance staff. This ensures a high level of reliability.

Asset management Recording System - Infor

The use of the Infor system has enabled the following:

- Customer enquiries being logged directly and sent immediately to the contractor for action.
- Contractor directly enters resolution confirmation at completion of job.

- Tracking of expenditure on assets to allow assets that have a disproportionately high maintenance cost to be identified - upgrade or renewal can then be prioritised.

Nelson City Council principal reticulation contractor Nelmac has a live interface with Infor. Any work associated with unscheduled maintenance is entered into Infor work order by the contractor. Completed work orders forms the basis of the contractors' payment.

There are known issues with the existing implementation of Infor surrounding the work order processes including a lack of reporting to trend results and alert for operational issues. With confirming the required reporting outputs for all levels of management the work order processes and data captured by the contractor and/or Nelson City Council staff can be refined to ensure the needs of all parties are met.

The current NCC contractor responsible for the day-to-day operation and maintenance of the water treatment plant and headworks is Fulton–Hogan Ltd(FH). FH do not have a direct link to Infor and are currently developing their internal database for tracking similar inputs and outputs.

ProMapp

ProMap is Nelson City Council's procedures library

Supervisory Control and Data Acquisition System (SCADA)

The SCADA system provides surveillance of the operation of the headworks intakes, dam levels, raw water source volumes, WTP output plus pumping stations in the water system and provides alarms when equipment fails or when operating parameters are exceeded.

All of the Nelson City Council's strategic utility components are monitored remotely, at Civic House or by duty staff using laptop computers at home, utilising a telecommunication system.

This system has given Council the ability to ascertain faults and instigate repairs without affecting the service to the consumer and has significantly increased efficiency and reliability of the utility schemes. This function has become critical to the operation of the network and has been supported by Council's in house Information Management team up to now. There is a need to upgrade this package and at the same time consider how the technical requirements can be accommodated with the essentially office based computer network used by the majority of Council staff.

Council has a "Kingfisher" and "Intouch" system at the base station (rationalisation of system occurred in 2005). The system is used to monitor and control critical aspects of all Nelson City Council treatment plants and pump stations, 67 sites are presently monitored that include:

- Wastewater Treatment Plants
- Stormwater Pump Stations
- Wastewater Pump Stations
- Water Treatment Plants
- Water Pump Stations and Reservoirs

Appendix G details the over view of the Supervisory Control and Data Acquisition system. The system is used for:

- Monitoring the operation of sites

- Reporting, trending and analysing historical data
- Alarm monitoring (operators are informed of alarms via text messages to mobile phones)
- Some control functions

Monitoring of water, wastewater and stormwater systems by the Councils SCADA system has grown to the point that without the current SCADA system, maintaining the existing Levels of Service would be difficult. SCADA has given the ability for Council to ascertain faults and instigate repairs without affecting the service to the consumer and has significantly increased efficiency and reliability of the utility schemes. The SCADA system is a critical system in Council's operation.

Review and Upgrade

In 2016/17 an extensive upgrade of this package was completed.

Future Strategy for Councils SCADA

Council's strategy for the ongoing use of SCADA is:

- Maintain SCADA system at a high level to ensure system reliability and ongoing reporting ability.
- Increase availability of information to the in-house Business Units in a format that will enable increased efficiencies in operation and management.
- Develop the reporting functions of the system.
- Develop further use of the system to control plant and equipment.

7.4. Service delivery models

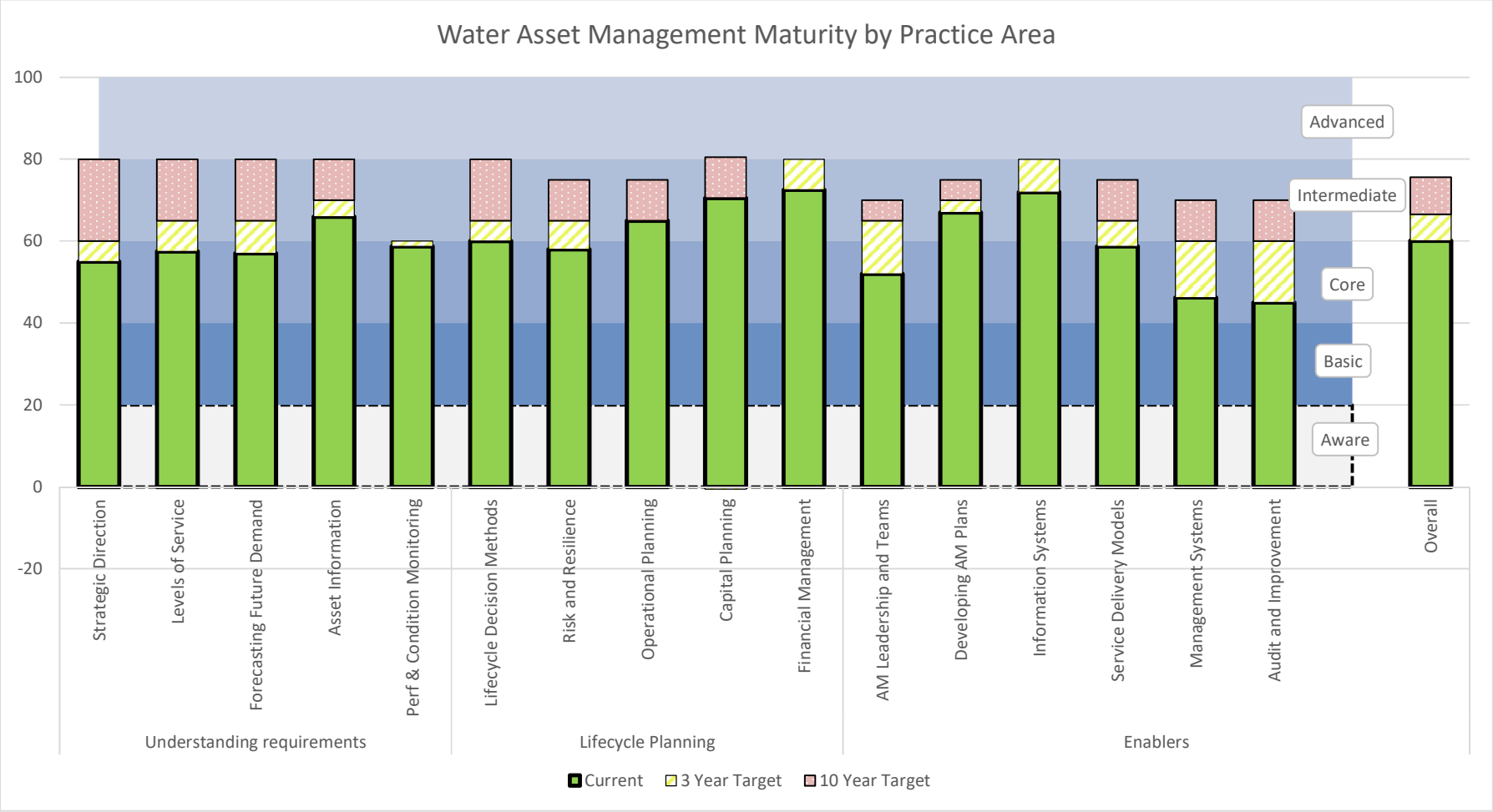
Maintenance contracts have been reviewed and grouped to provide a good balance between price and quality, and use either prequalification or price/quality supplier selection methods. The methods used to procure capital projects will differ depending on the size of the project, but will be either lowest price or price/quality.

Council maintains an in-house professional services capability balanced with external consultants as required to achieve best value for money. Additional professional services are sometimes required.

8. Plan improvement and monitoring

8.1. Status of AM practice

Figure 8-1: Current and desired state of AM processes, data and systems



8.2. Improvement programme

An important component of this activity management plan is the recognition that it is a "live" document in need of monitoring, change and improvement over time.

Improving Accuracy and Confidence in Asset Management Plan

Asset management improvements and associated objectives are noted throughout the Asset Management Plan.

These improvements will improve the accuracy of, and confidence in, the Water Asset Management Plan.

Table 8-1: Improvement Programme

AM Practice Area	Improvement Action	Priority	Responsibility	Estimated cost	Comment
Risk Management	Update Contamination Response Plan	1	Operations Team	< $5,000	Part of Bylaw and Emergency Action Plan
Renewals	Establish Condition Model for asbestos cement pipe and cast-iron pipe	2	Activity Management Team/ Operations Team	$20,000	Improve condition reporting from repairs
Risk Management	Maitai Dam comprehensive Safety Review	2	Operations Team	$20,000	Regular 5 yearly report
Levels of Service	Routinely calibrate the accuracy of the Network Analysis Model so that accurate predictions are provided	3	Operations Team	$10,000	Ongoing
Levels of Service	Improve reporting on levels of service, particularly those that are based on Council service requests and work orders to contractors. Resolve issues with how the information is recorded and recovered.	1	Operations Team	<$5,000	Underway with IT
Lifecycle Management	Review asset lives using NAMs– NZ Infrastructure Asset Valuation and Depreciation Guidelines	1	Activity Management Team/ Operations Team	<$5,000	Align with Finance for valuations
Lifecycle Management	Improve accuracy of condition assessments	1	Operations Team	$10,000	Review with contractors
Lifecycle Management	Continue the water loss identification and reduction programme	1	Operations and Capital Projects Teams	$1.2M	Ongoing 2021/22-2030/31

AM Practice Area	Improvement Action	Priority	Responsibility	Estimated cost	Comment
Risk Management	Review the lifelines risk assessment and response	1,2,3	Activity Management Team/ Operations Team	$5,000-$10,000	Maitai Dam 2021/22
Levels of Service	Continue investigations into dis-coloured water issues	2	Activity Management Team/ Operations Team	$70,000	Strategy 2023/24-2024/25

1	1 – 3 years
2	4 – 5 years
3	6 – 10 years

Data collection programmes (condition, performance, asset registers) closely aligned with business needs will be operated in accordance with documented quality processes

Data collection, maintenance and analysis are expensive and it is important that programmes and techniques are cost effective and consistent with business needs. Systematic processes will be introduced for the collection and upgrading of essential data based on asset criticality including:

- Asset attribute information
- Asset performance data
- Asset condition data.
- A more robust framework for identification of critical assets

A methodology for determining asset criticality to a component level, along with options, will be determined to integrate criticality into the ongoing operation, maintenance, renewals and capital programme for the water supply activity.

The risk register will be extended to encompass assets down to a component level

8.3. Monitoring and review procedures

The plan will be reviewed annually and updated at least every three years to coincide with the Annual and Long Term Plans and to incorporate, amongst other things, improved decision making techniques, updated asset information, and Nelson City Council policy changes that may impact on the levels of service.

The Plan will be improved throughout its life cycle as further information about the water supply assets are collected in terms of condition, performance and service delivery. Nelson City Council is committed to advanced data collection and management systems that will allow for a greater appreciation of the performance and condition of the Nelson City Council assets.

Nelson City Council will report variations in the adopted annual plan budgets against the original asset management plan forecasts and explain the level of service implications of budget variations.

Internal Review

Internal reviews will be undertaken every three years to assess the effectiveness of the plan in achieving its objectives. The internal review will also assess the adequacy of the activity management processes, systems and data.

Statutory Audit

The Local Government Act requires that an independent, annual audit of the operations of the Nelson City Council be carried out.

Previous Water Asset Management Plans were examined by Audit New Zealand in the course of audits of the Nelson City Council.

Current Level of Service Objectives

Compliance with the current level of service objectives will be monitored by internal audit.

Annual Performance Monitoring

Throughout this Water Supply Activity Management Plan annual performance and monitoring measures are noted.

8.4. Performance measures

Benchmarking

Benchmarking (trending) of the activity through Audit NZ, Local Government NZ and Water NZ benchmarking initiatives is carried out at the request of these organisations to give increased understanding of:

- The efficiency and efficiency variations of individual activities.
- Effects of any programmes instigated by the Activity Management Plan.
- Operating costs over range of individual activities.

Examples of types of benchmarking that are to be considered include tracking progress, responsiveness to service calls, operation costs i.e. $/m/year and energy costs.

How the effectiveness of the AM plan will be measured

The effectiveness of the Activity Management plan will be monitored by the following procedures:

- Financial expenditure projections prior to year end
- Resource consent monitoring as required by consents
- Operations and Maintenance reports on a monthly basis

The continued monitoring of these procedures and ongoing analysis of results will result in:

- Optimisation of expenditure through the asset lifecycle
- Service levels actively monitored and reported on
- Management of risk and control of failures

9. Appendices

APPENDIX A: GLOSSARY OF TERMS

The following terms and acronyms (in brackets) are used in this Plan.

Appendix Table A-1: Meaning of Words

Term	Definition
Advanced Asset Management	Asset management which employs predictive modelling, risk management and optimised decision-making techniques to establish asset lifecycle treatment options and related long term cash flow predictions. (See Basic Asset Management).
Annual Plan	An Annual Plan is published in years two and three, alternating with the three-yearly Long Term Plan, that sets out Council's updated financial situation, intended activities and work programme for the following three financial years.
Asset	A physical component of a facility which has value, enables services to be provided and has an economic life of greater than 12 months. Dynamic assets have some moving parts, while passive assets have none.
Asset Management	The combination of management, financial, economic, engineering and other practices applied to physical assets with the objective of providing the required level of service in the most cost-effective manner.
Asset Management System	An Asset Management system is a combination of processes, data and software applied to provide the essential outputs for effective Asset Management planning such as reduced risk and optimum infrastructure investment.
Asset Management Plan	A plan developed for the management of an infrastructure asset that combines multi-disciplinary management techniques (including technical and financial) over the lifecycle of the asset in the most cost effective manner to provide a specified level of service. A significant component of the plan is a long-term cash flow projection for the activities.
Asset Register	A record of asset information considered worthy of separate identification including inventory, historical, financial, condition, construction, technical and financial information about each.
Backflow Prevention Device	A mechanical device required by the Drinking Water Protection Regulations to prevent water from private plumbing flowing back into the water supply system and possibly contaminating the public supply. May be a column 10.7m high, a double check valve system or a reduced pressure principle device.
Benefit-Cost Ratio (B/C)	The sum of the present values of all benefits (including residual value, if any) over a specified period, or the lifecycle, of the asset or facility, divided by the sum of the present value of all costs.
Business Plan	A plan produced by an organisation (or business units within it) which translates the objectives contained in an Annual Plan into detailed work plans for a particular, or range of, business activities. Activities may include marketing, development, operations, management, personnel, technology and financial planning.

Term	Definition
Capital Expenditure	Expenditure used to create new assets or to increase the capacity of existing assets beyond their original design capacity or service potential. Capital expenditure increases the value of asset stock.
Cash Flow	The stream of costs and/or benefits over time resulting from a project investment or ownership of an asset.
City Datum	The baseline from which heights in the City are measured. It is approximately 12m below mean sea level (so that all numbers are positive).
Closed Circuit Television	A method of inspecting pipes by sending a mobile camera along the length of the pipe to visually record the interior.
Community Plan	See Long Term Council Community Plan.
Components	Specific parts of an asset having independent physical or functional identity and having specific attributes such as different life expectancy, maintenance regimes, risk or criticality.
Condition-Based Preventive Maintenance	Preventive maintenance initiated as a result of knowledge of an items condition from routine or continuous monitoring.
Condition Monitoring	Continuous or periodic inspection, assessment, measurement and interpretation of the resultant data, to indicate the condition of a specific component so as to determine the need for some preventive or remedial action.
Core Asset Management	Asset management which relies primarily on the use of an asset register, maintenance management systems, job/resource management, inventory control, condition assessment and defined levels of service, in order to establish alternative treatment options and long-term cash flow predictions. Priorities are usually established on the basis of financial return gained by carrying out the work (rather than risk analysis and optimised decision-making).
Corrective Maintenance	The remedial actions performed as a result of failure, to restore an item to a specified condition. Corrective maintenance may or may not be programmed.
Critical Assets	Assets for which the financial, business or service level consequences of failure are sufficiently severe to justify proactive inspection and rehabilitation. Critical assets have a lower threshold for action than non-critical assets.
Current Replacement Cost	The cost of replacing the service potential of an existing asset, by reference to some measure of capacity, with an appropriate modern equivalent asset.
Data Warehouse	A system that is used to centralise a group of disparate databases in an organisation to facilitate access into each of those databases.
Deferred Maintenance	The shortfall in rehabilitation work required to maintain the service potential of an asset.
Demand Management	The active intervention in the market to influence demand for services and assets with forecast consequences, usually to avoid or defer capital expenditure. Demand management is based on the notion that as needs are satisfied expectations rise automatically and almost every action taken to satisfy demand will stimulate further demand.

Term	Definition
Depreciated Replacement Cost	The replacement cost of an existing asset less an allowance for wear or consumption having regard for the remaining economic life of the existing asset.
Depreciation	The wearing out, consumption or other loss of value of an asset whether arising from use, passing of time or obsolescence through technological and market changes. It is accounted for by the allocation of the cost (or revalued amount) of the asset less its residual value over its useful life.
Deterioration Rate	The rate at which an asset approaches failure.
Economic Life	The period from the acquisition of the asset to the time when the asset, while physically able to provide a service, ceases to be the lowest cost alternative to satisfy a particular level of service. The economic life is at the maximum when equal to the physical life; however obsolescence will often ensure that the economic life is less than the physical life.
Failure Modes, Effects and Criticality Analysis	A technique for analysing and evaluating a design to ensure that the application has the desired reliability characteristics by obviating those critical failure modes through employment of redundancy, providing alternate modes of operation, derating, or any other means.
Gap Analysis	A method of assessing the gap between a business's current Asset Management practices and targeted future objectives/practices. Also called needs analysis or improvement planning.
Geographic Information System	Software which provides a means or spatially viewing, searching, manipulating, and analysing an electronic database.
Infrastructure Assets	Stationary systems forming a network and serving whole communities, where the system as a whole is intended to be maintained indefinitely at a particular level of service potential by the continuing replacement and refurbishment of its components. The network may include normally recognised ordinary assets as components.
l/sec	Litres per second. A measure of flow.
Level of Service	The defined service quality for a particular activity (i.e. water) or service area (i.e. water quality) against which service performance may be measured. Service levels usually relate to quality, quantity, reliability, responsiveness, environmental, acceptability and cost.
Life	A measure of the anticipated life of an asset or component; such as time, number of cycles, distance intervals etc.
Lifecycle	The cycle of activities that an asset (or facility) goes through while it retains an identity as a particular asset i.e. from planning and design to decommissioning or disposal.
Lifecycle Cost	The total cost of an asset throughout its life including planning, design, construction, acquisition, operation, maintenance, rehabilitation and disposal costs.
Likelihood	Used as a qualitative description of probability or frequency.
Long Term Council Community Plan	Prepared as a requirement of the Local Government Act 2002, with the purpose of describing Council's activities, describing the

Term	Definition
	'community outcomes' (goals) of the Council area, providing integrated decision-making and coordinating the resources of Council. It provides a long-term focus for the decisions and activities of the Nelson City Council, and is an important basis for the accountability of the Council to the Nelson community. It provides an opportunity for the public to participate in decisions on activities to be carried out by Council. It covers ten years planned financial expenditure in detail.
m3/day	Cubic metres per day. A measure of flow.
Main	The pipework system that conveys water from the intakes to each street. Trunk mains bring water from the intakes to the City secondary mains water to suburbs. Reticulation mains (or distribution) mains supply water into each street and are fitted with fire hydrants. Rider mains are smaller pipes supplying one side of a street.
Maintenance	All actions necessary for retaining an asset as near as practicable to its original condition, but excluding rehabilitation or renewal. Fixed interval maintenance is used to express the maximum interval between maintenance tasks. On-condition maintenance is where the maintenance action depends upon the item reaching some predetermined condition.
Maintenance Standards	The standards set for the maintenance service, usually contained in preventive maintenance schedules, operation and maintenance manuals, codes of practices, estimating criteria, statutory regulations and mandatory requirements, in accordance with maintenance of quality objectives.
Monitor	To check, supervise, observe critically, or record the progress of an activity, action or system on a regular basis in order to identify change.
Non-asset Solution	A non-asset solution is one where demand for an asset's service is dealt with in a way other than by additional investment in new resources and infrastructure. This might be by regulation (restricting time of use and type of use), economic incentives (such as pricing structures and subsidies), educational campaigns and provision of alternative ways of meeting customers' needs. Non-asset solutions are usually included in a demand management strategy.
Non-return Valve (NRV)	A mechanical device that allows water to flow in one direction only.
NZ IFRS	International Financial Reporting Standard
Optimised Decision Making (ODM)	An optimisation process for considering and prioritising all options to rectify existing or potential performance failures of assets. The process encompasses NPV analysis and risk assessment.
Optimised Depreciated Replacement Cost (ODRC)	The optimised replacement cost after deducting an allowance for wear or consumption to reflect the remaining economic or service life of an existing asset. ODRC is the surrogate for valuing assets in use where there are no competitive markets for assets, or for their services or outputs.

Term	Definition
Optimised Replacement Cost (ORC)	The minimum cost of replacing an existing asset with modern equivalent assets offering the same level of service. The optimisation process adjusts the value for technical and functional obsolescence, surplus assets or over- design.
Payback Period	The time it takes for the cumulative benefits or savings of an investment to pay back the original investment and other accrued costs.
Performance Measure (PM)	A qualitative or quantitative measure of a service or activity used to compare actual performance against a standard or other target. Performance measures commonly relate to statutory limits, safety, responsiveness, cost, comfort, asset performance, reliability, efficiency, environmental protection and customer satisfaction.
Performance Monitoring	Continuous or periodic quantitative and qualitative assessments of the actual performance compared with specific objectives, targets or standards.
Planned Maintenance	Planned maintenance activities fall into three categories: Periodic – necessary to ensure the reliability or to sustain the design life of an asset. Predictive – condition monitoring activities used to predict failure. Preventive – maintenance that can be initiated without routine or continuous checking (e.g. using information contained in maintenance manuals or manufacturers' recommendations) and is not condition- based.
Pressure Reducing Valve (PRV)	A mechanical device that modulates to maintain a constant lower pressure downstream irrespective of flow.
Rehabilitation	Works to rebuild or replace parts or components of an asset, to restore it to a required functional condition and extend its life, which may incorporate some modification. Generally involves repairing the asset to deliver its original level of service (i.e. heavy patching of roads, sliplining of sewer mains, etc) without resorting to significant upgrading or renewal, using available techniques and standards.
Renewal	Works to upgrade, refurbish or replace existing facilities with facilities of equivalent capacity or performance capability.
Remaining Economic Life	The time remaining until an asset ceases to provide the required service level or economic usefulness.
Renewal/Replacement	The complete replacement of an asset that has reached the end of its life, so as to provide a similar or agreed alternative, level of service.
Repair	Action to restore an item to its previous condition after failure or damage.
Replacement Cost	The cost of replacing an existing asset with a substantially identical new asset.
Reservoir	A large storage area for water. May be uncovered, e.g. Maitai Lake or covered, e.g. stressed concrete reservoirs at Thompson Terrace.
Residual Value	The net market or recoverable value which would be realised from disposal of an asset or facility at the end of its life.

Term	Definition
Rider Main	A small diameter watermain on the opposite side of the road from the principal watermain.
Risk Management	The application of a formal process to the range of possible values relating to key factors associated with a risk in order to determine the resultant ranges of outcomes and their probability of occurrence.
Risk Management Process	The systematic application of management policies, procedures and practices to the tasks of establishing the context, identifying, analysing, evaluating, treating, monitoring and communicating risk.
Routine Corrective Maintenance	Corrective maintenance, excluding emergency corrective and programmed corrective maintenance.
Routine Maintenance	Day to day operational activities to keep the asset operating (replacement of light bulbs, cleaning of drains, repairing of leaks, etc) and which form part of the annual operating budget, including preventive maintenance.
Sensitivity Analysis	Testing of the variations in the outcome of an evaluation by altering the values of key factors about which there might be uncertainty.
Service	A service refers to the provisioning of or the actual system of supplying a public need, A water service (pipe) is that section of the reticulation between the main in the street and the property boundary.
Stakeholders	Those people and organisations who may affect, be affected by, or perceive themselves to be affected by, a decision or activity.
Strategic Plan	A plan containing the long-term goals and strategies of the Council. Strategic plans have a strong external focus, cover major portions of the Council's operations and identify major targets, actions and resource allocations relating to the long-term survival, value and growth of the Council.
Tank	A small covered storage area for water. Usually made of concrete and of 23m3 capacity.
Universal Metering	Having water meters fitted to all properties, i.e. ordinary (residential) and extraordinary (commercial, industrial and other non-residential) users.
Unplanned Maintenance	Corrective work required in the short-term to restore an asset to working conditions so it can continue to deliver the required service or to maintain its level of security and integrity.
Useful Life	May be expressed as either: The period over which a depreciable asset is expected to be used, or The number of production or similar units (i.e. intervals, cycles) that is expected to be obtained from the asset.
Valuation	Assessed asset value which may depend on the purpose for which the valuation is required i.e. replacement value for determining maintenance levels, market value for lifecycle costing and optimised deprival value for tariff setting.

Appendix Table A-2: Acronyms

Term	Definition
AC	Asbestos cement pipe
ADWF	Average dry weather flow
ATAD	Autothermal thermophilic aerobic digestion plant
AV	Average flow
BOD	Biochemical oxygen demand
BTWWTP	Bells Island waste water treatment plant
CCTV	Close circuit television
CDEM	Civil Defence Emergency Management
FAR	Fixed asset register
FDS	Future Development Strategy
GAAP	Generally Accepted Accounting Principles
KPI	Key Performance Indicators
LA	Local Authority
LID	Low impact design
LAPP	Local Authority Protection Programme Disaster Fund
LDM	Land Development Manual 2010
LTCCP	Long Term Community Plan
MCA	Multi-Criteria Analysis
NAMS	National Asset Management Steering Group
NCS	Napier Computer System
NPV	Net present value
NRSBU	Nelson Regional Sewerage Business Unit (replaced NRSA in July 2000)
NTL	Network Tasman Ltd
P/S	Pump station
QA/QC	Quality Assurance and Quality Control
RCRRJ	Reinforced concrete rubber ring joint pipe
RMA	Resource management act
SCADA	Supervisory control and data acquisition
SS	Suspended solids
TA	Territorial Authority
uPVC	Unplasticised Polyvinyl Chloride pipe
WWTP	Wastewater treatment plant

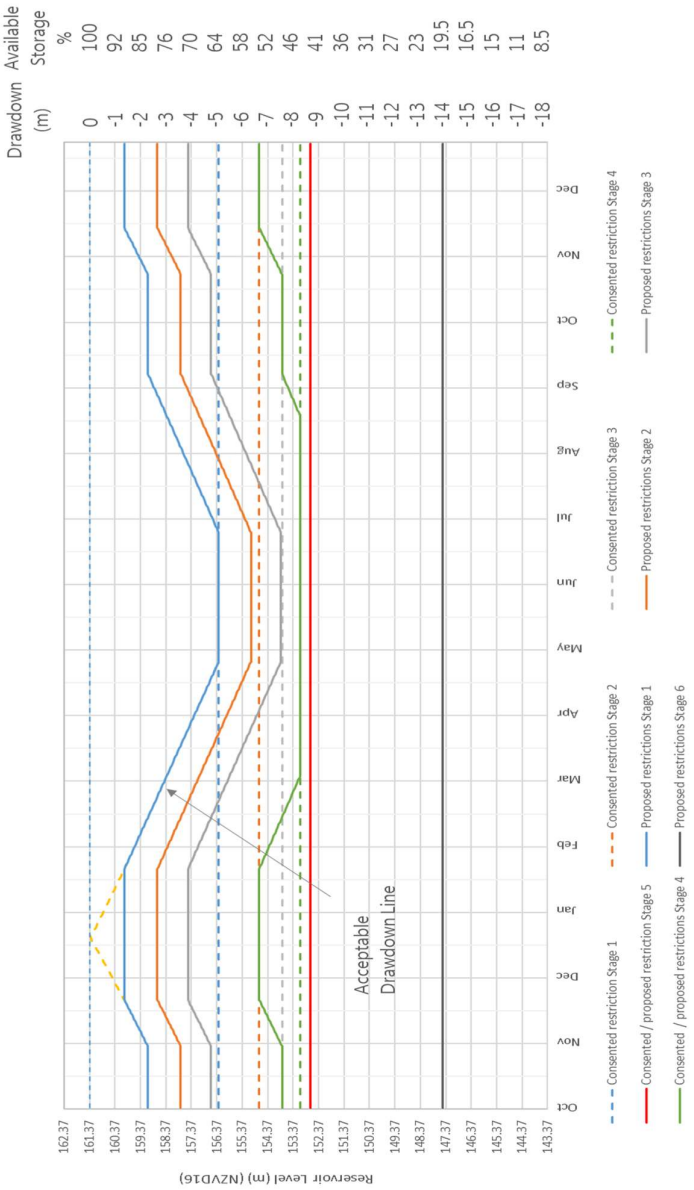
Appendix Table A-3: Geographical Information System List of Code Definitions used by Nelson City Council

Value	Description
2000	2000: Meter type
3000	3000: Meter type
ACBK	Black Asbestos Cement
ACMT	Asbestos Cement
ALUM	Aluminium
ARMC	ArmourCoil
BLBT	Blue Brute Pipe
BLKA	Black Asbestos Cement
BRCK	Brick
CIDT	Ductile Cast Iron
CIPT	PitCast Iron
CISP	Spun Cast Iron
CNIL	Concrete (InsituFORM lined)
CONC	Concrete
COPR	Copper
DRNC	Drainage Coil
EWRE	Earthenware
FGLS	Fiberglass
FLDT	Field Tiles
GALV	Galvanised
HDPE	High-density polyethylene pipe
HELA	Helcoil Aluminium
HELS	Helcoil Steel
MDPE	Medium Density Pe
NAPP	Not Applicable
OTHR	Other
PE1H	Pe 100 Material
POLE	Pole Construction
PRFC	Perforated Concrete
PVC	uPVC
STCL	Steel Concrete Lined
STNY	Nylon Coated Steel: Used in pump stations
STPL	Steel Pitch Lined
UNKW	Unknown

APPENDIX B: WATER SUPPLY CONSERVATION STRATEGY

Appendix Figure B-1: Maitai Reservoir Level

Maitai Dam Levels and Seasonal Restriction Stages



Water Restriction Stages NCC

Required by Resource Consent RM165192

Appendix Table B-1: Trigger Levels and Water Conservation Stages and Measures. Applies all year.

North Branch Reservoir Trigger level (metres above mean sea level NZVD2016)	Maitai Dam Volume (Mm^3)	Water Conservation Stage	Water Conservation Measures
161.37	4.068 (100%)	Nil. Dam Full.	Nil.
156.3	2.677 (65.8%)	1	Advertise drought condition-save water. Sprinklers only every second day (odd/even property numbers to match appropriate day)
154.7	2.224 (54.7%)	2	Sprinkler Ban. Hand held hose only
153.8	2.011 (49.4%)	3	Sprinkler and Hosing ban. Industrial and commercial property restrictions
153.1	1.852 (45.5%)	4	Reduce minimum flow at the Forks to 200 l/s, in addition to Water Conservation Stage 3 measures.
152.7	1.775 (43.6%)	5	Reduce minimum flow at the Forks to 180 l/s in addition to Water Conservation Stage 3 measures.

Appendix Table B-2: Water Restriction Trigger Levels. Applies Summer Months (Nov-Jan) – adjusted seasonally for remainder of year as per proposed seasonal restriction stages (See Figure B-1 above).

NCC Proposed Restriction Stage	Description	Maitai Dam Level NZVD (NCCVD)	Dam Volume Mm^3 (%full)	2018/19 Restrictions
0	Dam Full	161.37 (173.75)	4.068 (100%)	
0	Education about conserving water. Warning about restrictions to come if no rain.	160.87 (173.25)	3.934 (97%)	
1	Stage one restrictions	160.0 (172.38)	3.67 (90%)	159.988 (172.368) 30 Jan 2019
2	Stage two restrictions	158.7 (171.08)	3.28 (80%)	158.781 (171.161) 15 Feb 2019
3	Stage three restrictions	Proposed 157.5 (169.88)	2.95 (72.4%)	157.63 (170.01) 1 March 2019 All restrictions lifted 28 March 2019
4	Stage four restrictions Plus Supplementary flow to Maitai reduced to 200l/s at RL 153.1	Proposed 154.7 (167.08)	2.22 (54.7%)	
5	Stage five restrictions Plus Supplementary flow to Maitai reduced to 180l/s at RL 152.7 Declare a state of emergency and reduce supplementary flows into the Maitai 35l/s for each 1m reduction in level Discontinue use of old raw water supply line (new line can supply 19,000-20,000m^3/d)	Proposed 152.7 (165.08)	1.78 (43.8%)	
6	Stage six restrictions State of emergency and stop supplementary flows into the Maitai	Proposed 147.5 (159.88)	0.81 (20%)	

Appendix Figure B-2: Nelson City Council Water Restrictions Protocol

NELSON CITY RESIDENTIAL WATER RESTRICTION STAGES

The restrictions and prohibitions set out in this part apply to the use of the Public Water Supply at Residential Premises. Residential Premises means premises used principally as a place of residence and includes a dwelling, flat, hotel, motel, hostel, boarding house, camping ground, or retirement village (as defined in section 6 Retirement Villages Act 2003).

THESE ACTIVITIES ARE ALWAYS PERMITTED, EVEN WHEN RESTRICTIONS ARE IN PLACE, BUT PLEASE CONSERVE WATER WHEREVER POSSIBLE.

- Water for human public health purposes including drinking and sanitation (laundry, cleaning and showering/bathing)
- Water for fire-fighting purposes
- Water for health and safety purposes

	STAGE 1 Conserve water wherever possible for all activities. Restrictions in effect on outdoor water use.	STAGE 2 Conserve water wherever possible for all activities. Restrictions in effect on outdoor water use.	STAGE 3 Restrictions in effect on all water use. Water conservation is essential.	STAGE 4 Restrictions in effect on all water use. Water conservation is essential.	STAGE 5 Emergency: water use only permitted for human drinking water, sanitation, medical, health and safety, firefighting and livestock[1] purposes.	STAGE 6 Emergency: water use only permitted for human drinking water, sanitation, medical, health and safety and firefighting purposes.
Pools, spas, water features and water play activities	Filling a pool, spa or water feature is prohibited. Topping up a pool, spa or water feature is permitted. Using water for water play activities is permitted.	Filling and topping up a pool, spa or water feature is permitted. Using water for water play activities is permitted.	**All water use for pools, spas, water features and water play activities is prohibited.**	All water use for pools, spas, water features and water play activities is prohibited.	All water use for pools, spas, water features and water play activities is prohibited.	**All water use prohibited except for human drinking water, sanitation, medical, health and safety and firefighting purposes. Water supply only from nominated key supply points. Use of water for livestock purposes is prohibited.**
Outdoor washing (vehicle washing, outdoor surfaces and windows)	Outdoor washing permitted when using a hand held hose equipped with a trigger nozzle, high pressure cleaning unit, or bucket.	Outdoor washing permitted when using a hand held hose equipped with a trigger nozzle, high pressure cleaning unit, or bucket.	**Washing vehicles permitted when using recycled grey water only. Washing outdoor surfaces is permitted for safety reasons using a bucket only.**	Washing vehicles permitted when using recycled grey water only. Washing outdoor surfaces is permitted for safety reasons using a bucket only.	**All outdoor washing activities prohibited except where cleaning is required for health and safety reasons, or other emergency.**	
Grass area and lawns	Watering grass or lawns is permitted on alternate days.	**Watering grass or lawns is prohibited.**	Watering grass or lawns is prohibited.	Watering grass or lawns is prohibited.	Watering grass or lawns is prohibited.	
Amenity Planting (flower beds, planters, shrubs, trees)	Watering permitted when using a hand held hose equipped with a trigger nozzle, time limited watering system (automatic, spray or dripper), or a bucket/watering can. Watering protected trees listed in the District Plan is permitted using this watering method.	**Watering permitted on alternate days using a hand held hose equipped with a trigger nozzle, time limited watering system (automatic, spray or dripper) or a bucket/watering can.** Watering protected trees listed in the District Plan is permitted using this watering method.	Watering permitted on alternate days using a hand held hose equipped with a trigger nozzle, time limited watering system (automatic, spray or dripper) or a bucket/watering can. Watering protected trees listed in the District Plan is permitted using this watering method.	**Watering all amenity plants and trees is prohibited; except for protected trees listed in the District Plan.** Watering protected trees is permitted on alternate days using a hand held hose equipped with a trigger nozzle, time limited watering systems (automatic, spray or dripper) or a bucket/watering can.	**Watering prohibited.**	
Productive Gardens (fruits and vegetables for domestic use)	Watering permitted when using a hand held hose equipped with a trigger nozzle, time limited watering system (automatic, spray or dripper) or a bucket/watering can.	Watering permitted when using a hand held hose equipped with a trigger nozzle, time limited watering system (automatic, spray or dripper) or a bucket/watering can.	**Watering permitted on alternate days using a hand held hose equipped with a trigger nozzle, time limited watering system (automatic, spray or dripper) or a bucket/watering can.**	**Watering permitted on alternate days using a bucket/watering can. only.**	**Watering prohibited.**	

NELSON CITY BUSINESS WATER RESTRICTION STAGES

The restrictions and prohibitions set out in this part apply to the use of the Public Water Supply at Business Premises. Business Premises means Premises used principally for any profession, trade, manufacture or undertaking carried on for gain or reward, but excludes Public / Institutional Premises.[1]

THESE ACTIVITIES ARE ALWAYS PERMITTED, EVEN WHEN RESTRICTIONS ARE IN PLACE, BUT PLEASE CONSERVE WATER WHEREVER POSSIBLE.

Water for human public health purposes including drinking and sanitation (laundry, cleaning and showering/bathing)

Water for fire-fighting purposes

Water for health and safety purposes

	STAGE 1 Conserve water wherever possible for all activities. Restrictions in effect on outdoor water use.	STAGE 2 Conserve water wherever possible for all activities. Restrictions in effect on outdoor water use.	STAGE 3 Restrictions in effect on all water use. Water conservation is essential.	STAGE 4 Restrictions in effect on all water use. Water conservation is essential.	STAGE 5 Emergency: water use only permitted for human drinking water, sanitation, medical, health and safety, firefighting and livestock[4] purposes.	STAGE 6 Emergency: water use only permitted for human drinking water, sanitation, medical, health and safety and firefighting purposes.
All business activities (incl contractor use of hydrants)	Conserve water wherever possible.	Conserve water wherever possible.	Reduce usage by 10% – 30% of the baseline as notified by Council.[2,3]	Reduce usage by 31% – 50% of the baseline as notified by Council.[2,3] Contractor water from nominated hydrants only, volume as notified by Council.	All water use prohibited except for human drinking water, sanitation, medical, health and safety, firefighting, and livestock[4] purposes.	All water use prohibited except for human drinking water, sanitation, medical, health and safety and firefighting purposes. Water supply only from nominated key supply points. Use of water for livestock[4] purposes is prohibited.
Outdoor washing (vehicle and container washing, outdoor surfaces and windows)	Outdoor washing permitted when using a hand held hose equipped with a trigger nozzle, high pressure cleaning unit, or bucket.	Outdoor washing permitted when using a hand held hose equipped with a trigger nozzle, high pressure cleaning unit, or bucket.	Washing vehicles permitted when using recycled grey water only. Washing outdoor surfaces is permitted for safety reasons using a bucket only. Washing containers for biosecurity is permitted.	Washing vehicles permitted when using recycled grey water only. Washing outdoor surfaces and containers is permitted for safety reasons using a bucket only.	All outdoor washing activities prohibited, except where cleaning is required for health and safety reasons, or other emergency.	
Grass area and lawns **Amenity Planting** (flower beds, planters, shrubs, trees, under verandah hanging baskets)	Watering grass or lawns is permitted on alternate days. Watering permitted when using a hand held hose equipped with a trigger nozzle, time limited watering system (automatic, spray or dripper), or a bucket/watering can. Watering protected trees listed in the District Plan is permitted using this watering method.	**watering grass or lawns is prohibited.** **Watering permitted on alternate days using a hand held hose equipped with a trigger nozzle, time limited watering system (automatic, spray or dripper) or a bucket/watering can.** Watering protected trees listed in the District Plan is permitted using this watering method.	Watering grass or lawns is prohibited. Watering permitted on alternate days using a hand held hose equipped with a trigger nozzle, time limited watering system (automatic, spray or dripper) or a bucket/watering can. Watering protected trees listed in the District Plan is permitted using this watering method.	Watering grass or lawns is prohibited. **Watering all amenity plants and trees is prohibited; except for protected trees listed in the District Plan. Watering protected trees is permitted on alternate days using a hand held hose equipped with a trigger nozzle, time limited watering systems (automatic, spray or dripper) or a bucket/watering can.**	Watering grass or lawns is prohibited. **Watering prohibited.**	
Pools, spas, water features and water play activities[5]	Filling a pool, spa or water feature is prohibited. Topping up a pool, spa or water feature is permitted. Using water for water play activities is permitted.	Filling and topping up a pool, spa or water feature is permitted. Using water for water play activities is permitted.	**All water use for pools, spas, water features and water play activities is prohibited.**	All water use for pools, spas, water features and water play activities is prohibited.	All water use for pools, spas, water features and water play activities is prohibited.	

1. Business premises includes the Richmond Aquatic Centre, Riverside Pool and Nayland Pool and premises used principally for a farming, agricultural or horticultural business.
2. When water restrictions are in force under this stage, the restrictions and prohibitions on water use applicable during this stage are in addition to the obligation to reduce use of the Public Water Supply by the percentage specified for 'all business activities'. Savings that are made through compliance with the restrictions and prohibitions applicable during this stage will count towards, and may exceed, the required percentage savings. Regardless of the water savings made due to restrictions and prohibitions applicable during this stage, users may need to reduce their water use in other areas in order to achieve the required percentage savings.
3. The Council may exempt the owner or occupier of any new business from the requirement to reduce water usage at a Business Premises by the percentage specified if the owner or occupier of the new business has applied in writing for the exemption and the Council is satisfied that the new business has not previously operated from that Business Premises. Any such exemption granted by the Council shall be in writing and shall expire on the Expiry Date. Where the Council issues a water invoice to the exemption holder on a monthly basis the Expiry Date is the date of the twelfth water invoice issued by the Council in respect of the new Business Premises. For all other exemption holders the Expiry Date is the date of the second water invoice issued by the Council to the exemption holder in respect of the new Business Premises. An exemption granted under this clause shall not exempt any Person from the obligation to comply with the other restrictions or prohibitions on water use at the Business Premises, which are set out above.
4. Livestock means cattle, sheep, horses, swine, alpacas, llamas, goats, deer, poultry, bees, fish, rabbits and other animals kept on the premises for business purposes.
5. When Stage 1, 2, 3, or 4 water restrictions are in force, the Richmond Aquatic Centre, Riverside Pool and Nayland Pool are exempt from the restrictions and prohibitions on use of water for pools, spas, water features and water play activities in this table.
6. The Council may grant an exemption upon application to comply with restrictions outlined during Stage 1, 2, 3, 4 and 5 for water used for animal welfare purposes.

NELSON CITY PUBLIC / INSTITUTIONAL WATER RESTRICTION STAGES

The restrictions and prohibitions set out in this part apply to the use of the Public Water Supply at Public / Institutional Premises. Public / Institutional Premises means Premises used principally for the purposes of:

a. not-for-profit organisations, whether incorporated or unincorported;
b. local government, central government or Departments of State;
c. utility operators as defined in section 4 Utilities Access Act 2010;
d. childcare centres and kindergartens, whether public or private;
e. hospitals and hospice, whether public or private;
f. medical and dental surgeries, and medical and other primary health care centres;
g. educational institutions, including public and private primary, intermediate, and secondary schools, universities, polytechnics, and other tertiary institutions;
h. public libraries, public museums, and public art galleries;
i. police stations;
j. fire stations;
k. community halls and community recreation centres;
l. public parks, sports grounds;
m. courthouses;
n. churches and chapels;
o. probation and detention centres;
p. road as defined in section 315 Local Government Act 197 or state highway as defined in section 5 Land Transport Management Act 2003, but does not include fire hydrant

THESE ACTIVITIES ARE ALWAYS PERMITTED, EVEN WHEN RESTRICTIONS ARE IN PLACE, BUT PLEASE CONSERVE WATER WHEREVER POSSIBLE.

- Water for human public health purposes including drinking and sanitation (laundry, cleaning and showering/bathing)
- Water for fire-fighting purposes
- Water for health and safety purposes

	STAGE 1 Conserve water wherever possible for all activities. Restrictions in effect on outdoor water use.	STAGE 2 Conserve water wherever possible for all activities. Restrictions in effect on outdoor water use.	STAGE 3 Restrictions in effect on all water use. Water conservation is essential.	STAGE 4 Restrictions in effect on all water use. Water conservation is essential.	STAGE 5 Emergency: water use only permitted for human drinking water, sanitation, medical, health and safety, firefighting and livestock[1] purposes.	STAGE 6 Emergency: water use only permitted for human drinking water, sanitation, medical, health and safety and firefighting purposes.
Water play activities (water slides etc)	Using water for water play activities is permitted.	Using water for water play activities is permitted.	**Using water for water play activities is prohibited.**	Using water for water play activities is prohibited.	Using water for water play activities is prohibited.	**All water use prohibited except for human drinking water, sanitation, medical, health and safety and firefighting purposes. Water supply only from nominated key supply points.**
Council's water supply maintenance activities (flushing hydrants and pipes)	Conserve water wherever possible.	Conserve water wherever possible.	**All activities using water prohibited, except with Group Manager Infrastructure approval.**	All activities using water prohibited, except with Group Manager Infrastructure approval.	All activities using water prohibited, except with Group Manager Infrastructure approval.	
Outdoor washing (vehicle washing, outdoor surfaces and windows)	Outdoor washing permitted when using a hand held hose equipped with a trigger nozzle, high pressure cleaning unit, or a bucket.	Outdoor washing permitted when using a hand held hose equipped with a trigger nozzle, high pressure cleaning unit, or a bucket.	**Washing vehicles permitted when using recycled grey water only. Washing outdoor surfaces is permitted for safety reasons using a bucket only.**	Washing vehicles permitted when using recycled grey water only. Washing outdoor surfaces is permitted for safety reasons using a bucket only.	**All outdoor washing activities prohibited except where cleaning is required for health and safety reasons, or other emergency.**	
Grass areas and lawns, (parks/reserves/cemeteries, schools and sports fields)	Watering grass or lawns is permitted on alternate days.	**Watering grass or lawns is prohibited except for the watering of bowling greens, croquet greens, golf greens, cricket pitches, grass tennis courts and Council approved premier event fields.**	**Watering grass or lawns is prohibited except for the watering on alternate days of bowling greens, croquet greens, golf greens, cricket pitches, grass tennis courts and Council approved premier event fields.**	**Watering grass or lawns is prohibited except for the watering on alternate days of bowling greens, croquet greens, golf greens and Council approved premier event fields.**	**Watering grass or lawns is prohibited.**	
Amenity planting (flower beds, planters, shrubs, trees, under verandah hanging baskets)	Watering permitted when using a hand held hose equipped with a trigger nozzle, time limited watering system (automatic, spray or dripper), or a bucket/watering can. Watering protected trees listed in the District Plan is permitted using this watering method.	**Watering permitted on alternate days when using a hand held hose equipped with a trigger nozzle, time limited watering system (automatic, spray or dripper), or a bucket/watering can. Watering protected trees listed in the District Plan is permitted using this watering method.**	Watering permitted on alternate days when using a hand held hose equipped with a trigger nozzle, time limited watering system (automatic, spray or dripper), or a bucket/ watering can. Watering protected trees listed in the District Plan is permitted using this watering method.	**Watering all amenity plants and trees is prohibited except for protected trees listed in the District Plan and high value recently planted trees.** Watering these trees is permitted on alternate days using a hand held hose equipped with a trigger nozzle, time limited watering systems (automatic, spray or dripper) or a bucket/watering can.	**Watering prohibited.**	
Community food gardens (productive gardens growing fruits and vegetables for personal/community use)	Watering permitted when using a hand held hose equipped with a trigger nozzle, time limited watering system (automatic, spray or dripper), or a bucket/watering can.	Watering permitted when using a hand held hose equipped with a trigger nozzle, time limited watering system (automatic, spray or dripper), or a bucket/watering can.	**Watering permitted on alternate days using a hand held hose equipped with a trigger nozzle, time limited watering system (automatic, spray or dripper), or a bucket/watering can.**	**Watering permitted on alternate days using a bucket/watering can only.**	**Watering prohibited.**	
Public/school pools (water used for the operation of community pools/spas and school pools)	Conserve water wherever possible.	Conserve water wherever possible.	**Filling a pool is prohibited and topping up a pool is permitted.**	**Filling or topping up a pool is prohibited.**	Filling or topping up a pool is prohibited.	

NELSON CITY WATER RESTRICTION NOTES

Definition of baseline for the purposes of the Business Water Restriction Protocol

A For each Business Premises the baseline (measured in cubic metres) in any month is the monthly mean / average of the quantity of water supplied by the Council to the Business Premises calculated in accordance with section 1 below. Upon application the Council's Group Manager Infrastructure may agree in writing in any particular case to calculate the baseline using the statistical median rather than the mean if that better represents normal usage.

SECTION 1

Six monthly billing customers

Monthly baseline mean = (A+B+C) / 18

A, B, and C are the six monthly water supply figures for each of the billing periods that included the same month in the previous 3 years respectively.

Monthly billing customers

Monthly baseline mean = (A+B+C) / 3

A, B, and C are the monthly water supply figures for the same month in the previous 3 years respectively.

B In this definition month means a calendar month.

C The definition may be amended from time to time.

D During Stage 3 and 4, a business's monthly water allocation will be prorated when translating into weekly limits, unless otherwise agreed by the Group Manager Infrastructure.

APPENDIX C: NELSON CITY COUNCIL ADVANCED ASSET MANAGEMENT GAP ANALYSIS – WATER

Appendix Table C-1: Gap Analysis – Water

Water Asset Maturity Assessment					Maturity Levels								w				
Reference	Question	IIMM Descriptors			Aware	Basic	Core	Intermediate	Advanced								
		Process Development and Documentation			Ad hoc processes, minimal documentation.	Process and documentation in development	Main process components developed and documented	Process complete, optimisation developing	Optimised process in place, documentation complete.								
		Coverage (assets, people, frequency)			Rarely	Occasionally	Often	Usually	Always								
		Section	Questions	Why	0-20	25-40	45-60	65-80	85-100	Element %	Element Score (out of 100)	Current Score	Appropriate Target (3 yrs)	Target (10 years)	Reason for scores	Improvement Tasks to close gap	
Understanding and Defining Requirements																	
IIMM 2.1	**1**	**Establishing Strategic Direction**	To what extent has your organisation's AM Policy and AM Strategy been articulated, approved, communicated and acted on? How consistent is this policy and strategy with current government policies?	The AM Policy supports an organisation's strategic objectives. It articulates the principles, requirements and responsibilities for asset management (AM). It articulates the objectives, practices and action plans for AM improvement, audit and review processes. The AM Policy and Strategy may be incorporated into the AM Plan.	Corporate awareness of the benefits of AM.	Corporate expectation expressed in relation to development of AM Plans and AM objectives.	AM Policy and AM Objectives developed, aligned to corporate goals and strategic context.	AM System scope is defined and documented. Strategic context (internal, external, customer environment) analysed and implications for the AM System documented in the Strategic AM Plan.	AM Policy and Strategy fully integrated into the organisation's business processes and subject to defined audit, review and updating procedures.			55	60	80			
		Strategic context (internal / external) analysed and AM implications understood.								25%	50						
		AM Policy sets out AM expectations, objectives and accountabilities								25%	50						
		The organisation's AM System / Framework is defined								25%	60						
		Strategic, tactical and operational goals are aligned across the organisation								25%	60						
IIMM 2.2	**2**	**Defining and Measuring Levels of Service**	How does your organisation determine what is the appropriate level of service for its customers and then ensure that asset performance is appropriate to those service levels?	Levels of service are the cornerstone of asset management and provide the platform for all lifecycle decision making. Levels of service are the outputs a customer receives from the organisation, and are supported by performance measures. One of the first steps in developing asset management plans or processes is to find out what levels of service customers are prepared to pay for, then understand asset performance and capability to deliver those requirements.	Level of service requirements generally understood but not documented or quantified.	Asset contribution to organisation's objectives and some basic levels of service have been defined. Customer Groups defined and requirements informally understood.	Levels of service and performance measures in place covering a range of service attributes. Annual reporting against performance targets. Customer Group needs analysed.	Level of service and cost relationship understood. Customers are consulted on significant service levels and options.	Customer communications plan in place. Levels of service are integral to decision making and business planning.			57.5	65	80			
		Customer engagement to understand level of service requirements.								25%	55						
		Levels of service and performance measures defined								25%	70						
		Measurement and reporting occurs, including analysis of trends.								25%	70						
		Level of service and cost relationship analysed.								25%	35						
IIMM 2.3	**3**	**Forecasting Future Demand**	How robust is the approach your organisation uses to forecast demand for its services and the possible impact on its asset portfolios?	This AM activity involves estimating demand for the service over the life of the AM plan or the life of the asset. Demand is a measure of how much customers consume the services provided by the assets. The ability to predict demand enables an organisation to plan ahead and meet that demand, or manage risks of not meeting demand.	Future demand requirements generally understood but not documented or quantified. Demand forecasts based on mathematical analysis of past trends and primary demand factors.	Demand forecasts based on experienced staff predictions, with consideration of known past demand trends and likely future growth patterns.	Demand Forecasts based on robust projection of a primary demand factor (eg: population growth) and extrapolation of historic trends. Risk associated with demand change broadly understood and documented. Demand management considered as an alternative to major	A range of demand scenarios is developed (eg: high/medium/low). Demand management is considered in all strategy and project decisions.	Risk assessment of different demand scenarios with mitigation actions identified.			57	65	80			
		Historical demand / consumption of services recorded and trends analysed history recorded								20%	75						
		Demand factors identified and analysed								20%	60						
		Demand forecast models developed								20%	60						
		Demand management strategies identified and impacts on future demand quantified								20%	45						
		Risk associated with demand uncertainty understood, scenarios are developed and managed								20%	45						
IIMM 2.4	**4**	**Collecting Asset Information (Asset Knowledge)**	What sort of asset-related information does the organisation collect, and how does it ensure the information has the requisite quality (accuracy, consistency, reliability)?	Asset data is the foundation for enabling most AM functions. Planning for asset renewal and maintenance activities cannot proceed until organisations know exactly what assets they own or operate and where they are located	Asset information in combination of sources and formats. Awareness of need for asset register.	Basic physical information recorded in a spreadsheet or similar (e.g. location, size, type), but may be based on broad assumptions or not complete.	Sufficient information to complete asset valuation (basis attributes, replacement cost and asset age/ life) and support prioritisation of programmes (criticality). Asset hierarchy, identification and attribute systems documented. Metadata held as appropriate.	A reliable register of physical, financial and risk attributes recorded in an information system with data analysis and reporting functionality. Systematic and documented data collection process in place.	Information on work history type and cost, condition, performance, etc. recorded at asset component level. Systematic and fully optimised data collection programme with supporting metadata.			66	70	80			
		Asset hierarchy defined and data requirements for each level of the hierarchy specified.								20%	60						
		Basic physical information captured against assets (age, material, type, etc)								20%	65						
		Spatial / location information recorded or links to GIS from asset register (if separate)								20%	70						
		Asset age / life / replacement cost recorded at asset level (information for valuation / renewals)								20%	70						
		Asset criticality data recorded at asset level								20%	65						
IIMM 2.5	**5**	**Monitoring Asset Performance and Condition**	How does the organisation measure and manage the condition of its assets?	Timely and complete condition information supports risk management, lifecycle decision-making and financial / performance reporting.	Condition and performance understood but not quantified or documented.	Adequate data and information to confirm current performance against AM objectives.	Condition and performance information is suitable to be used to plan maintenance and renewals to meet over the short term.	Future condition and performance information is modelled to assess whether AM objectives can be met in the long term. Contextual information, such as demand, is used to estimate likely performance.	The type, quality and amount of data are optimised to the decisions being made. The underlying data collection programme is adapted to reflect the assets' lifecycle stage.			58.75	60	60			
		Condition and performance monitoring programmes established								25%	60						
		Condition data captured in asset register								25%	60						
		Performance data captured in asset register (eg: service outages)								25%	50						
		Works costs recorded at asset level								25%	65						

Water Asset Maturity Assessment					Maturity Levels												w	
Reference	Question	IIMM Descriptors			Aware	Basic	Core	Intermediate	Advanced									
		Process Development and Documentation			Ad hoc processes, minimal documentation.	Process and documentation in development	Main process components developed and documented	Process complete, optimisation developing	Optimised process in place, documentation complete.									
		Coverage (assets, people, frequency)			Rarely	Occasionally	Often	Usually	Always									
		Section	Questions	Why	0-20	25-40	45-60	65-80	85-100	Element %	Element Score (out of 100)	Current Score	Appropriate Target (3 yrs)	Target (10 years)	Reason for scores	Improvement Tasks to close gap
Lifecycle Decision Making																
IIMM 3.1	6	**Lifecycle Decision Methods**	How does your organisation go about making decisions on the replacement or refurbishment of existing assets or investment in new ones?	Decision techniques provide the best value for money form an organisation's expenditure programmes. These techniques reveal strategic choices, and balance the trade off between levels of service, cost and risk. ODM is a formal process to identify and prioritise all potential asset and non-asset solutions with consideration of financial viability, social and environmental responsibility and cultural outcomes.	AM decisions based largely on staff judgement.	Corporate priorities incorporated into decision making.	Formal decision making techniques (MCA / BCA), are applied to major projects and programmes, where criteria are based on the organisations' AM objectives.	Formal decision making and prioritisation techniques are applied to all operational and capital asset programmes within each main budget category. Critical assumptions and estimates are tested for sensitivity to results.	AM objectives/targets are set based on formal decision making techniques, supported by the estimated costs and benefits of achieving targets. The framework enables projects and programmes to be optimised across all activity areas. Formal risk-based sensitivity analysis is carried out.			60	65	80		
		Good information available to support AM decisions.								20%	55					
		Options developed and analysed (including 'do nothing')								20%	65					
		Agreed frameworks / techniques applied to support decision making								20%	65					
		Decision frameworks are aligned to straregic objectives / levels of service								20%	65					
		Sensitivity analysis / scenario testing used to assess robustness of result								20%	50					
IIMM 3.2	7	**Managing Risk and Resilience**	How does your organisation manage the interplay between business risks and asset-related risks?	Risk management helps identify higher risks, and identify actions to mitigate those risks. This process reduces the organisation's exposure to asset related risk, especially around critical assets, and drives renewal and rehabilitation programmes and decision making.	Risk management is identified as a future improvement. Risk framework developed.	Critical services and assets understood and considered by staff involved in maintenance / renewal decisions.	Critical assets and high risks identified. Documented risk management strategies for critical assets and high risks.	Resilience level assessed and improvements identified. Systematic risk analysis to assist key decision-making. Risk register regularly monitored and reported. Risk managed and prioritised consistently across the organisation.	Resilience strategy and programme in place including defined levels of service for resilience. Formal risk management policy in place. Risk is quantified and risk mitigation options evaluated. Risk is integrated into all aspects of decision making.			58	65	75		
		Risk policy / framework in place								20%	80					
		Risks are identified and recorded in risk register.								20%	80					
		Risk actions are identified, monitored and reported.								20%	30					
		Strategy for management of critical assets in place								20%	50					
		Assessments of network resilience to major hazards								20%	50					
IIMM 3.3	8	**Operational Planning**	How does your organisation manage the cost effective performance of its key business assets over time (e.g. in terms of utilisation, availability, fitness for purpose)?	Effective operational strategies can mitigate risk, defer the need for asset renewals and minimise service downtime following asset failures. Planning for business continuity and full utilisation of assets are key factors in good asset management processes.	Operational processes based on historical practices.	Operating Procedures are available for critical Operational Processes. Operations Organisational structure in place and roles assigned	Operating Procedures are available for all Operational Processes. Operational Support Requirements are in place.	Risk and Opportunity Planning completed. Operational objectives and intervention levels defined and implemented. Alignment with Organisational Objectives can be demonstrated.	Continual Improvement can be demonstrated for all operational processes. Comparison with ISO 55001 requirements complete.			65	65	75		
		Operational programmes and processes are developed and optimised								25%	65					
		Operational objectives and intervention criteria are defined								25%	65					
		Emergency response arrangements are in place and tested								25%	65					
		Operational performance is monitored and improvements identified								25%	65					
IIMM 3.4	9	**Capital Investment Planning**	What processes and practices does the organisation have in place to plan and prioritise capital expenditure?	Capital investment include the upgrade, creation or purchase of new assets, typically to address growth or changes in levels of service requirements, or for the periodic renewal of existing assets, to maintain service levels. Agencies need to plan for the long term asset requirements relative to future levels of service. The decision on whether to create a new asset is typically the time when there is the most opportunity to impact on the potential cost and level of service. Cabinet expects all capital-intensive agencies to disclose 10 year capital intentions and make appropriate use of the better business cases methodology for programmes and individual investment proposals.	Capital investment projects are identified during annual budget process.	There is a schedule of proposed capital projects and associated costs for the next 3-5 years, based on staff judgement of future requirements.	Projects have been collated from a wide range of sources and collated into a project register. Capital projects for the next three years are fully scoped and estimated. A prioritisation framework is in place to rank the importance of capital projects.	Formal options analysis and business case development has been completed for major projects in the 3-5 year period. Major capital projects for the next 10-20 are conceptually identified and broad cost estimates are available.	Long-term capital investment programmes are developed using advanced decision techniques such as predictive renewal modelling.			70.5	70	80		
		Capital projects are identified and recorded in a register								20%	80					
		Capital projects are scoped and costs estimated for inclusion in budget forecasts								30%	65					
		Capital projects are prioritised within and between activities and work areas								25%	65					
		Renewal forecasts are modelled based on age, condition, performance								25%	75					
IIMM 3.5	10	**Financial Management**	How does your organisation plan for the funding of its future capital expenditure and asset-related costs?	Poor financial management can lead to higher long run life cycle costs, inequitable fees and charges, and financial "shocks". Good collaboration between financial and asset managers is important, especially in relation to long term financial forecasts and asset revaluations. Asset valuation is required by International Accounting Standards, and can be used in lifecycle decision making. Robust financial budgets are a key output of any asset management planning process.	Financial planning is largely an annual budget process, but there is intention to develop longer term forecasts.	Assets re-valued in compliance with financial reporting and accounting standards. 10 year financial forecasts are based on extrapolation of past trends and broad assumptions about the future. Expenditure categories compliant with FRS.	Asset revaluations have a 'B' grade data confidence 10 year+ financial forecasts based on current comprehensive AMPs with detailed supporting assumptions / reliability factors.	Asset revaluations have a 'B' grade data confidence 10 year+ financial forecasts based on current comprehensive AMPs with detailed supporting assumptions / reliability factors.	Asset revaluations have an 'A' grade data confidence. 10 year + financial forecasts based on comprehensive, advanced AM plans with detailed underlying assumptions and high confidence in accuracy. Advanced financial modelling provides sensitivity analysis, demonstrable whole of life costing and cost analysis for level of service options.			72.5	80	80		
		Budget categorisation supports analysis of asset-specific financial requirements								25%	75					
		Long term financial forecasts are developed								25%	65					
		Assets are revalued in accordance with financial reporting standards								25%	80					
		Supporting assumptions and forecasting methodologies are documented and auditable.								25%	70					

Water Asset Maturity Assessment					Maturity Levels												w	
Reference	Question	IIMM Descriptors			Aware	Basic	Core	Intermediate	Advanced									
		Process Development and Documentation			Ad hoc processes, minimal documentation.	Process and documentation in development	Main process components developed and documented	Process complete, optimisation developing	Optimised process in place, documentation complete.									
		Coverage (assets, people, frequency)			Rarely	Occasionally	Often	Usually	Always									
		Section	Questions	Why	0-20	25-40	45-60	65-80	85-100	Element %	Element Score (out of 100)	Current Score	Appropriate Target (3 yrs)	Target (10 years)			Reason for scores	Improvement Tasks to close gap
Asset Management Enablers																		
IIMM 4.1	**11**	**Asset Management Leadership and Teams**	What is the level of organisational commitment to asset management? How is this reflected in existing organisation structure, responsibilities and resourcing of AM competencies?	Effective asset management requires a committed and co-ordinated effort across all sections of an organisation.	Leadership is supportive of AM.	AM functions are carried out by small groups. Roles reflect AM requirements.	Position descriptions incorporate AM roles. AM coordination processes established. Ownership and support of AM by leadership. Awareness of AM across most of the organisation.	Organisational structures support AM. Roles reflect AM resourcing requirements and reflected in position descriptions for key roles. Consistent approach to AM across the organisation. Internal communication plan established.	Roles reflect AM requirements and defined in all relevant position descriptions. Formal documented assessment of AM capability and capacity requirements to achieve AM objectives. Demonstrable alignment between AM objectives, AM systems and individual responsibilities			**52**	**65**	**70**				
		Leadership supports and actively advocates investment in AM.								20%	60							
		AM roles and role interfaces are defined.								20%	55							
		Resources (internal and external) to support an effective 'AM System' are in place.								20%	55							
		All staff understand AM and their role / contribution to the AM System.								20%	45							
		AM capability requirements are reviewed and provided								20%	45							
IIMM 4.2	**12**	**Developing AM Plans**	How does your organisation develop, communicate, resource and action its asset management plans?	An asset management plan is a written representation of intended capital and operational programmes for it's new and existing infrastructure, based on the organisations understanding of demand, customer requirements and it's own network of assets.	Stated intention to develop AM Plans	AM Plans contains basic information on assets, service levels, planned works and financial forecasts (5-10 years) and future improvements.	AM objectives are defined with consideration of strategic context. Approach to risk and critical assets described, top-down condition and performance assessment, future demand forecasts, description of supporting AM processes, 10 year financial forecasts, 3 year AM improvement plan.	Analysis of asset condition and performance trends (past/future), customer engagement in setting levels of service, ODM/risk techniques applied to major programmes. Strategic context analysed with risks, issues and responses described.	Evidence of programmes driven by comprehensive decision making techniques, risk management programmes and level of service/cost trade-off analysis. Improvement programmes largely complete with focus on ongoing maintenance of current practice.			**67**	**70**	**75**				
		AMP development includes relevant staff and stakeholders								20%	60							
		AMP content in line with IIMM								20%	65							
		AMP document is of good quality, readable for target audience								20%	65							
		AMPs are integration with other business processes / plans								20%	55							
		AMPs are communicated to / approved by Council / Executive/ key stakeholders								20%	90							
IIMM 4.3	**15**	**Establishing and Maintaining Management Systems**	How does your organisation ensure that it's asset management processes and practices are appropriate and effective?	When AM processes are part of a Quality Management system the organisation is able to operate consistent and reliable processes,, provide evidence that what was planned was delivered, and ensure that knowledge is shared. In short, that processes are appropriate and consistently applied and understood.	Awareness of need to formalize systems and processes.	Simple process documentation in place for service-critical AM activities.	Basic Quality Management System in place that covers all organisational activities. Critical AM processes are documented, monitored and subject to review. AM System meets the requirements of ISO 55001.	Process documentation implemented in accordance with the AM System to appropriate level of detail. Internal management systems are aligned.	ISO certification to multiple standards for large asset intensive organisations, including ISO 55001. Strong integration of all management systems within the organisation.			**46.25**	**60**	**70**				
		Management systems are in place to support AM.								25%	60							
		AM processes are documented within a management system framework								25%	45							
		Processes are subject to review, audit and continual improvement								25%	45							
		AM System is aligned / certified to ISO 55001								25%	35							

Water Asset Maturity Assessment					Maturity Levels											w	
Reference	Question	IIMM Descriptors			Aware	Basic	Core	Intermediate	Advanced								
		Process Development and Documentation			Ad hoc processes, minimal documentation.	Process and documentation in development	Main process components developed and documented	Process complete, optimisation developing	Optimised process in place, documentation complete.								
		Coverage (assets, people, frequency)			Rarely	Occasionally	Often	Usually	Always								
		Section	Questions	Why	0-20	25-40	45-60	65-80	85-100	Element %	Element Score (out of 100)	Current Score	Appropriate Target (3 yrs)	Target (10 years)	Reason for scores	Improvement Tasks to close gap	
IIMM 4.4	13	**Establishing and Maintaining Information Systems**	How does your organisation meet the information needs of those responsible for various aspects of asset management?	AM systems have become an essential tool for the management of assets in order to effectively deal with the extent of analysis required.	Intention to develop an electronic asset register / AMIS.	Asset register can record core asset attributes – size, material, etc. Asset information reports can be manually generated for AM Plan input.	Asset register enables hierarchical reporting (at component to facility level). Customer request tracking and planned maintenance functionality enabled. System enables manual reports to be generated for valuation, renewal forecasting.	Spatial relationship capability. More automated analysis reporting on a wider range of information.	Financial, asset and customer service systems are integrated and all advanced AM functions are enabled. Asset optimisation analysis can be completed			72	80	80			
		IS records asset data within a hierarchy								20%	80						
		IS enables tracking of service requests and scheduling of planned maintenance								20%	80						
		IS suports AM analysis (performance evaluation, valuation / renewal forecasting)								20%	70						
		IS reporting supports management and AMP requirements								20%	65						
		Information systems share / exchange data								20%	65						
IIMM 4.5	14	**Service Delivery Models**	How does your organisation procure asset-related services like maintenance and consumables for different classes of assets? How does the organisation exercise control over any outsourced asset management services?	The effectiveness of asset management planning is proven in the efficient and effective delivery of services at an operational level.	AM roles generally understood.	Service delivery roles clearly allocated (internal and external), generally following historic approaches.	Core functions defined. Procurement strategy/policy in place. Internal service level agreements in place with the primary internal service providers and contract for the primary external service providers.	Risks, benefits and costs of various outsourcing options considered and determined. Competitive tendering practices applied with integrity and accountability.	All potential service delivery mechanisms reviewed and formal analysis carried out to identify best delivery mechanism.			58.75	65	75			
		Service delivery roles / functions defined (O&M, capital project delivery, etc)								25%	55						
		Functions allocated to roles / teams / contracts								25%	60						
		Service delivery options are evaluated and a strategy for outsourcing is in place								25%	60						
		Contracts / SLAs are in place for outsourced / in house service delivery								25%	60						
IIMM 4.6	16	**Audit and Improvement**	How does your organisation ensure that it continues to develop its asset management capability towards an appropriate level of maturity?	Well performing agencies give careful consideration of the value that can be obtained from improving AM information, processes, systems and capability. The focus is on ensuring AM practices are "appropriate" to the business objectives and government requirements.	Recognition of AM improvements.	Improvement actions identified and allocated to appropriate staff.	Current and future AM performance assessed and gaps used to drive the improvement actions. Improvement plans identify objectives, timeframes, deliverables, resource requirements and responsibilities	Formal monitoring and reporting on the improvement programme to Executive Team. Project briefs developed for all key improvement actions.	Improvement plans specify key performance indicators (KPIs) for monitoring AM improvement and these are routinely reported. Improvement plans specify key performance indicators (KPIs) for monitoring AM			45	60	70			
		Gap analysis used to identify AM improvement tasks								25%	50						
		Improvement tasks prioritised and developed into an AM improvement plan with allocated resources / timeframes / deliverables								25%	50						
		Project scope / brief developed for major improvement tasks.								25%	40						
		Progress against the AM improvement programme is regularly monitored and reported to management								25%	40						

APPENDIX D: WATER LOSSES EVALUATION

Background

Water loss, or "un-accounted for water" is identified as the difference between the volume of water supplied to the network and the summation of the volumes supplied to customers through metered supplies. In Nelson City the supplied volume is split into two parts: the first is the raw water supplied to the treatment plant from the Roding and Maitai supplies and the second is the treated water supplied to the city. The volume of raw water losses is found from the comparison of meters on the raw water supply lines at the Maitai Dam and Roding Dam and the raw water lines at the treatment plant. The volume of treated water losses is found from comparing the recorded volume supplied from the Water Treatment Plant via the three meters that record flows to the main serving a number of Maitai valley properties, the city network via the main to Westbrook Terrace and the return main to the York Valley reservoir and the total volume supplied through the approximately 20,000 metered connections for the same period. The difference is "un-accounted for" water or "lost" water.

This section examines the components and evaluates their impact on the Nelson City water supply losses, and defines the work required to reduce each aspect of the losses.

The components of water loss are well documented in the New Zealand Water and Wastes Association "Benchloss" manual which is based on the International Water Association Water Loss Task Force "Guidance Notes", and the definitions are therefore not repeated here.

Figure D1 show the components and their numerical magnitude. Note the boxes are not to scale.

The following work is being carried out as priorities allow to determine (improve the accuracy of) the numbers:

- Collect Water Supply Data
- Test Source Meter for Accuracy
- Collect and assess metered water use data
- Test customer meters for accuracy
- Collect data to quantify unmeasured authorized uses e.g. mains flushing, fire-fighting etc
- Review water accounting and data handling procedures
- Measure water losses including field inspection of reservoirs, tanks, control valves

Appendix Figure D-1: The Water Balance Data for 2019/20 Financial Year (latest available)

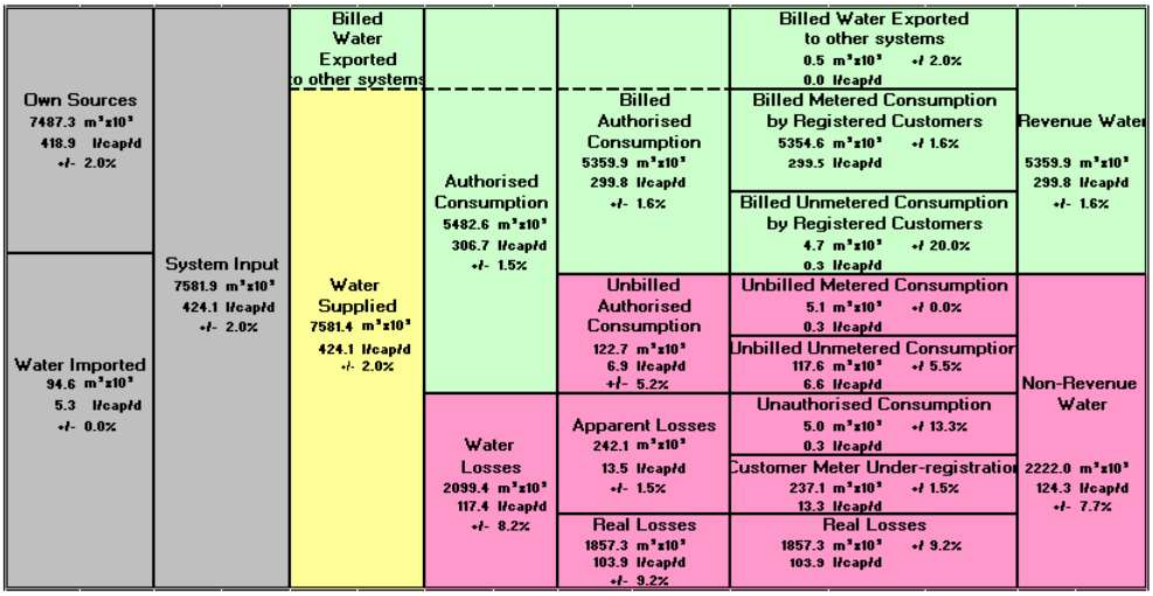
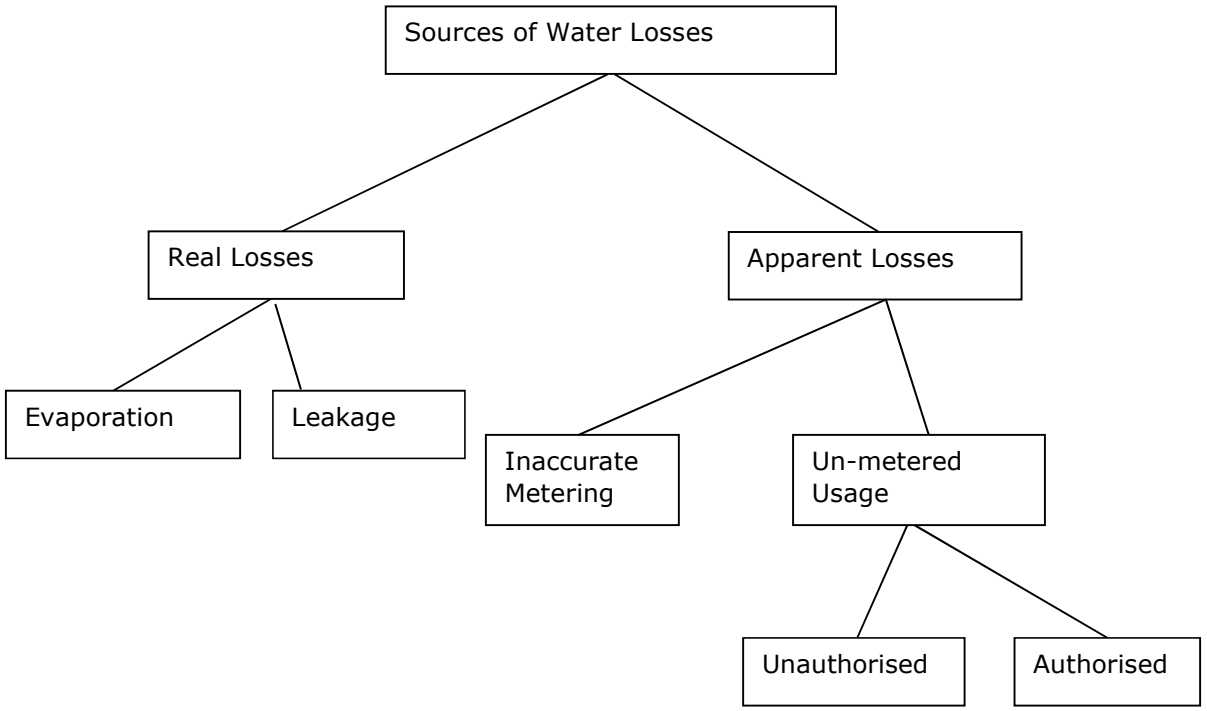


Figure E-2 shows the sources of Real and Apparent Water Losses diagrammatically

Appendix Figure D-2: Sources of Water Losses



Note re Authorised Un-metered Usage

Strictly speaking, authorised un-metered usage is not an apparent loss, if it is identified and correctly quantified

Real Losses

Refer figures D-1 and D-2.

Evaporation

All of Nelson's treated water storage is covered therefore evaporation is not considered to be a factor in the water losses.

Leakage

Leakage from trunk mains

The trunk mains are operated at high pressure. Most trunk mains are laid under roads or in otherwise visible areas. Where leaks show on the surface quickly they are repaired promptly. Some trunkmains are laid in hillside properties where leaks are not readily apparent or are very difficult to access for repairs. These need to be quantified and a plan developed to effect repairs.

Leakage from trunk mains is considered to be a factor in the water losses but difficult to quantify.

Leakage from reticulation pipes

Leakage from reticulation pipes is unquantified. While pipe bursts show at the surface, smaller leaks may go undetected for some time and infiltrate into the ground, particularly in Stoke, Tahunanui and The Wood which are on gravel and sand.

Reticulation pipe leaks are considered to be a major factor in the water losses

Leakage from service pipes

Leakage from service pipes is also unquantified. Typically leaks in service pipes occur at connections to the main or after the meter where they are mostly found by property owners after the water invoices show a higher than expected usage.

The water leaks in property service pipes that occur after the meter are accounted for, while being unquantified.

Service pipe leaks are considered to be a factor in the total volume of water lost from the network.

Leakage through Scour Valves

Scour valves are situated in low spots near creeks or storm watermains to facilitate draining of trunk and large diameter reticulation mains. Leaks from scours could go un-noticed for some time. A system has been set up for Nelmac to regularly check scour valves by inspecting the outlets and electronically listening on the valve for water escaping.

Leakage through scour valves is not considered to be a major factor in the water losses.

Leaking Hydrants

Hydrants usually only leak after use and the fire service (and others) usually report if they are unable to fully shut off the hydrant. Due to the design of fire hydrants, the shaft glands do not leak when the hydrant is turned off.

Fire Hydrants are situated in the road or other accessible places and are visible, therefore leaks quickly fill the hydrant box and show on the surface unless the ground is particularly porous.

Hydrant leaks are not considered to be a major factor in the water losses.

Leakage from Valves

Unlike hydrants, glands on valves can leak at any position of the valve gate. Valves used to be checked and "exercised" by Nelmac on a 3 yearly basis. However this procedure was ceased when it was found that the process actually initiated many valve gland leaks. Leakage normally fills the valve box and shows on the surface. Valve gland leaks are now repaired on a reactive basis.

Leaks through "shut" valves allow water into an adjacent zone – normally from a high pressure zone into a low pressure zone, but water is not lost from the system.

Leakage through reservoir filling valves is discussed in "reservoir overflows" below

Leakage from valves is not considered to be a significant factor in the water losses.

Bursts

Nelson City Council has quick response times in its level of service. Nelmac's contract requires them to respond to bursts within 30 minutes. Leakage from bursts is allowed for in the water balance, but is not significant.

Bursts are not considered to be a major factor in the water losses.

Leakage from reservoirs

All reservoirs and tanks are above ground and inspected monthly by Nelmac. No leakage from the walls has been noted.

All major reservoirs have underdrains leading to inspection manholes. Nelmac checks these monthly and any leakage is investigated and repairs made. The only seepage in recent years has been at the Thompson Terrace #2 reservoir where (in 2007) there was a slight seepage, and the internal water seals on a sector of the reservoir were renewed.

Reservoir leakage is not considered a factor in the water losses.

Reservoir overflows

All major reservoirs have level recorders, are connected to the SCADA system, and alarmed.

Minor reservoirs and tanks are inspected monthly by Nelmac.

Reservoir overflows are not considered to be a factor in the water losses.

Apparent Losses

Refer figures D-1 and D-2.

Inaccurate Metering

Misreading of meters

Customer meters are read manually and the reading is keyed into a handheld data logger on site. The data is then downloaded electronically to the computer system, where the bills are generated. Reports of exceptionally high or low usage are generated, and the meters are re-read in case there are reading or data entry errors. This process would also identify if the reading for the previous period (i.e. start reading for the current period) held in the archive is incorrect.

Misreading of meters, Data Transfer errors, and Data Analysis errors are not considered to be factors in the water losses.

Residential Meters out of calibration

A sample of 89 manifold water meters has been tested for accuracy over three flow volumes; 0.38lpm, 15lpm and 50lpm (Refer A754715). All were installed as part of the 1999 Universal metering programme and have been in operation for approximately 15 years. A significant number of meters under-recorded flows in the 0.38lpm flow range. It is possible that a component of the water losses may result from under recording flows to consumers.

The water meters will be checked again within the next three years to see if a trend can be shown.

Residential meter accuracy is considered to be a factor in the water loss equation.

Commercial/Industrial Meters out of Calibration

As at June 2008, commercial/industrial water meters have not been tested for calibration. Installation of water meters commenced prior to 1980 and was completed in 1999 at the same time as residential meeting. Therefore some meters are up to 30 years old.

Commercial/industrial meter accuracy is also considered to be a factor in the water losses.

Meters not recording low flows

Large diameter meters do not accurately record low flows. Until recently meters were sized the same as pipe size, i.e. for maximum flow. Large commercial/industrial water meters will therefore be under reading normal and low flows. New installations now have combination (low and high flow) meters installed.

Meters not recording low flows is considered to be a factor in the water losses.

Meters not in System

Occasionally meters are found that have been installed, but have not been entered into Napier Computer Systems water billing system, and are therefore not being read or charged. One recent example was where the connection was approved and completion signed off, but not entered into Napier Computer Systems. A system has been implemented (May 2008) to correlate the 3 steps - connection applications, meter data returns from approved water connection contractors (AWCCs), and water meter records in Napier Computer Systems.

Meters not in the system are not considered to be a significant factor in the water losses.

Un-metered Usage

Unauthorised Un-metered Usage

Illegal hydrant use

The use of water from fire hydrants other than for fire-fighting, testing or mains flushing is contrary to the Water Supply Bylaw. However this has not been enforced to date.

Illegal hydrant use is not considered to be a significant factor in the water losses.

Illegal connections

It is difficult to make illegal connections directly to mains, ridermains and service connections (within legal road) due to their depth and high pressures. However on cross lease or Right of Way sections it is possible to turn off the isolating valve at the

street boundary and make an illegal connection on private property before the meter. Most residents would not have the technical ability to make such a connection. Water would still have to be used through the meter to avoid suspicion. Illegal use would most likely be used for garden watering or swimming pool filling. In recent years only one such case was reported by a concerned neighbour.

Illegal connections are therefore not considered to be a significant factor in the water losses.

Authorised Un-metered Usage

Strictly speaking, authorised un-metered usage is not an apparent loss, if it is identified and correctly quantified in the water balance. Assumptions have been made on the following uses.

Firefighting

Water suppliers with a reticulated system are required to provide fire-fighting water to the NZ Fire Service and to not charge for it. The normal fire demand is 25 L/sec (90 m3/hr). Allowing two full hours use of water per week, the fire demand is less than 10,000 m3/yr. (e.g. compare with a single leak of 1 L/sec running for 1 year at 32,000 m3/yr).

Fire-fighting use is therefore not considered to be a significant factor in the water losses.

Other approved use of Fire hydrants

When the fire service receives a request for assistance in supplying water for non- fire purposes they refer their applicant to the Council's Technical Services section for approval. Similarly contractors requiring large volumes of water for subdivision or roading purposes apply for permission to take the water. In both cases the parties are asked to advise the council of the volume used.

Therefore it is only small users of water from hydrants that are not recorded.

Other approved use of fire hydrants is therefore not considered to be a factor in the water losses.

Mains flushing

Dead end mains are regularly flushed by Nelmac to prevent any debris build up where the water velocity is low. Mains are also flushed after repair to remove any debris that has settled. Nelmac have used metered standpipes for this and the volume of water flushed each year has been estimated and included in the water balance.

Mains flushing is therefore not considered to be a significant factor in the water losses.

Mains testing

The volume of water used in the testing, chlorination, and flushing of new mains both on subdivisions and council renewals and capex has been estimated and included in the water balance.

Mains testing is therefore not considered to be a significant factor in the water losses.

Draining mains

The volume of water used to drain mains for repair has been estimated and included in the water balance.

Draining mains is therefore not considered to be a significant factor in the water losses.

Draining reservoirs

The volume of water used in draining reservoirs and tanks for repair and to maintain chlorine residual has been estimated and included in the water balance.

Draining reservoirs is therefore not considered to be a significant factor in the water losses.

Central Business District amenities

Hanging baskets irrigation, Bird scaring tree sprays, Symonds Gas Lamp (in Trafalgar Street outside the Victorian Rose), and drinking fountains at Church steps and Bridge / Trafalgar corner are metered.

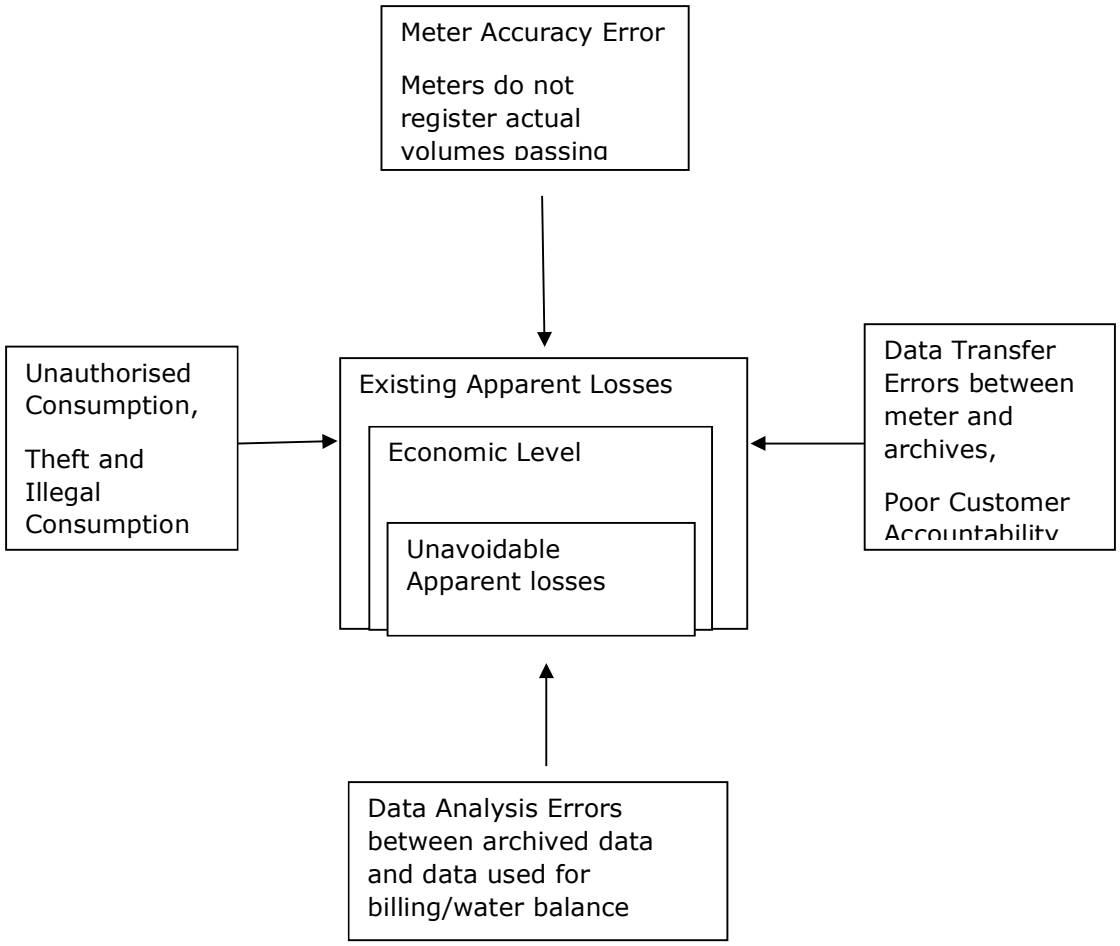
Central Business District amenities are therefore not considered to be a significant factor in the water losses.

Reducing Apparent Losses

Figure D-3 shows the components for managing apparent losses by "squeezing the box". Taking each corrective action will reduce the apparent losses.

Appendix Figure D-3: The Four Components of Managing Apparent Losses

"Squeezing the box"



Considering the four factors in Apparent Losses

- Meter Accuracy
- Data Transfer
- Unauthorised Consumption
- Data analysis

As discussed above, only Meter Accuracy is considered to be a significant factor in the losses and needing priority attention at this time.

Action Plan

Complete residential meter accuracy testing programme to allow 95% confidence.

Schedule replacement of residential meters

Test all commercial/industrial water meters 100mm dia. and over, and repair or replace as necessary.

Test all commercial water meters 50 mm dia and over but less than 100mm dia. and replace as necessary.

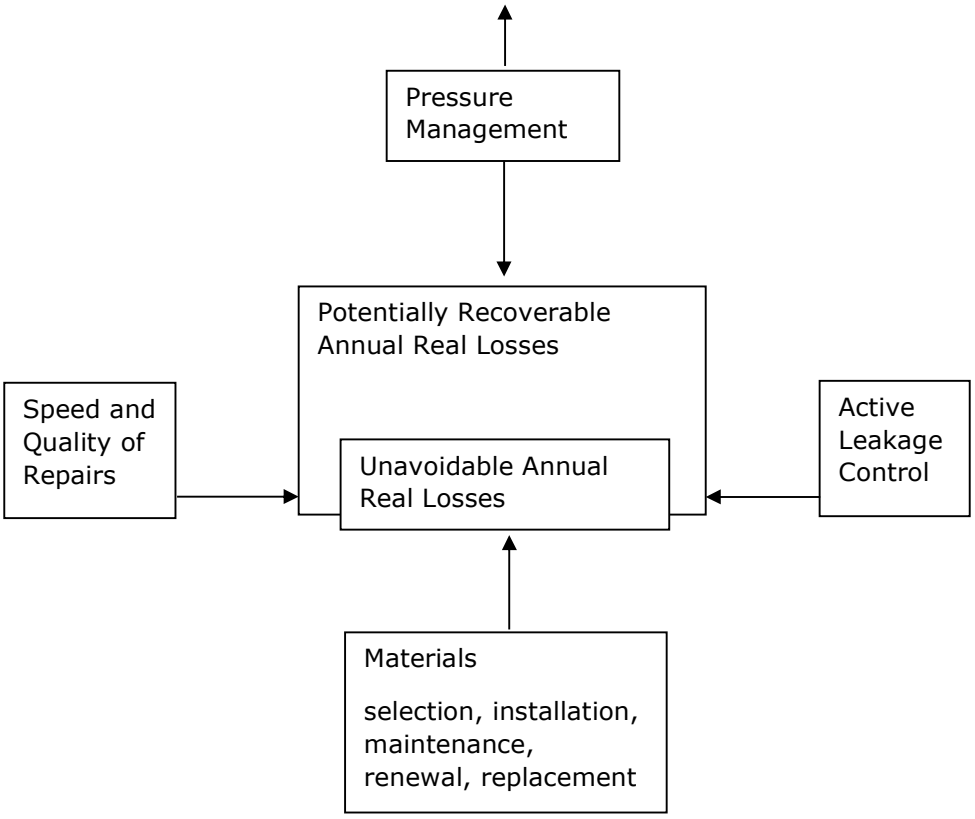
If water meters 50 mm dia. and over are to be replaced, consider whether a combination meter (low flow/high flow) should be installed.

Reducing Real Losses

Figure D-4 shows the components for managing real losses by "squeezing the box". Taking each corrective action will reduce the real losses.

Appendix Figure D-4: The Four Components of Managing Real Losses

"Squeezing the box"



Considering the four factors in Real Losses

Speed and Quality of Repairs. The Nelmac utilities maintenance contract has short response times that are recorded in Hansen and are met. Repairs are made to a high standard. Little "squeeze" is therefore available from Speed and Quality of Repairs.

Materials Selection. The Nelson City Council Engineering Standards specifies the materials to be used in repairs, maintenance, renewals, capital expenditure and assets to be vested. These are of a high and appropriate standard. Little "squeeze" is therefore available from Materials Selection.

Active Leakage Control. Leakage is identified above as a major factor in the losses. Significant "squeeze" is available from Active Leakage Control and it is a matter of priority. The active leakage control action plan is shown in Appendix E.

Pressure Management. Pressure reduction is identified as a major factor in the losses. Significant "squeeze" is available from Pressure reduction and it is a matter of priority. The pressure reduction action plan is shown in Appendix G.

APPENDIX E: ACTIVE LEAKAGE CONTROL PLAN

Proposed Methodology

Divide the water supply system into discrete reservoir/pressure reducing valve supply zones and designate them as District metering areas;

Test and repair isolation valves for District Metering Areas;

Install district flow meters and data loggers;

Night time low flow tests including reading customer meters at beginning and end to quantify demand;

Acoustic leak detection survey to identify leak locations;

Repair located leaks;

Repeat night time low flow tests to confirm repair and quantify "background" losses;

Consider more proactive maintenance program;

Reduce time between leak reports and repairs;

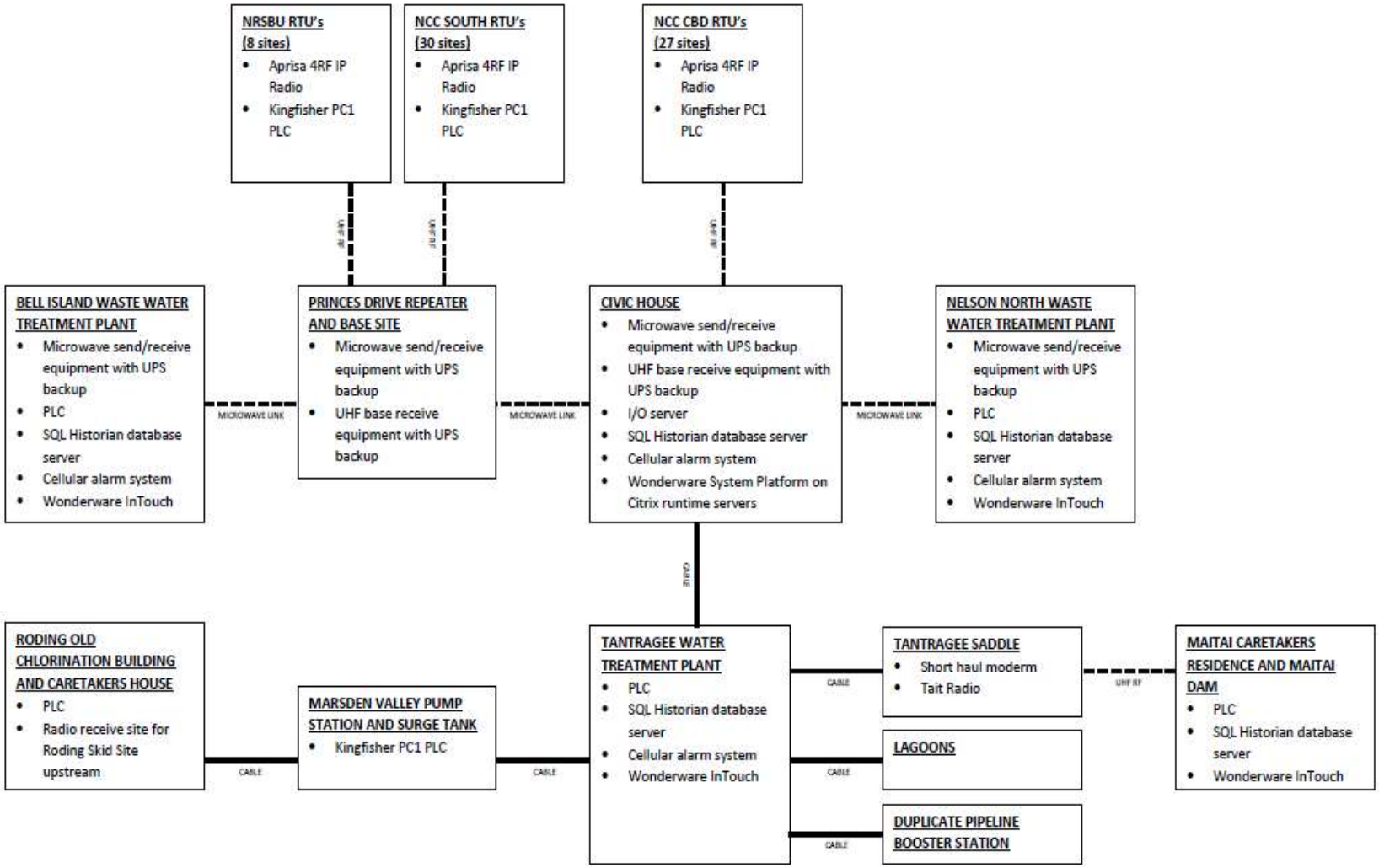
Implement pressure management (refer Appendix G);

Continue main replacement program (currently 50 and 100mm dia. asbestos cement);

Moving to "smart meters", or property owners regularly checking their water meters are good ways of providing early alerts to leaks which allows for prompt repair. Ongoing public education is required.

APPENDIX F: SCHEMATICS

Appendix Figure F-1: Supervisory Control and Data Acquisition Schematic



APPENDIX G: PRESSURE REDUCTION PLAN.

Background

Many areas of the city receive pressures in excess of the Levels of Service specified in the Water Supply Asset Management Plan.

High pressures result in

- More pipe failures (particularly Asbestos Cement pipes)
- More water losses from undetected leaks
- Higher customer usage
- Demerit points in the water supply distribution grading
- Reduction in pressure will therefore have long term benefits to the water asset.

Parts of the Stoke area (particularly) have Asbestos Cement pipes that were laid in the 1950's and are starting to fail. Lowering the pressure in these pipes will extend their useful life. However some pipes are under capacity for fire flows when the pressure is reduced so will have to be renewed with a larger diameter pipe.

The renewal and new ridermain projects seek to strategically combine Capex and Renewal funding such that pressures can be lowered in the future.

A ridermain in Tosswill Road laid in conjunction with road upgrading will allow houses on the downhill side of the road to be put on low pressure in the future. Houses on the uphill side will remain on the existing high pressure main, as will the fire hydrants. This area is not high priority for pressure reduction, but the opportunity is being taken lay the ridermain at this time. Additional works yet to be scheduled will include a low pressure pipe from the bottom of Tamaki Street down the steps to the low pressure main on the opposite side of Tahunanui Dve., and a new main in Tosswill Road from Tahunanui Dve to the Chamberlain Street intersection. A similar riderman will also be laid in Chamberlain Street from Tosswill Road to Maire Street in the future.

Recent work in the Enner Glynn/Wakatu area (Beatson Road to Torlesse St) has allowed this area to be transferred to low pressure (107m City Datum). The new pipes have been sized to meet the Fire flow Levels of Service at the reduced pressure. The pressure reducing valve currently at Cawthron Crescent will have to be relocated to the top of Beatson Road near Waimea Road.

The Maitland/Ridgeway area is currently on Marsden Valley High Pressure (170 m City Datum). The proposed works in 2008/09 and 2009/10 will allow this area to be transferred to Treatment Plant/Thompson Terrace. Reservoir High Pressure (155m City Datum). A new pressure reducing valve will be required on the Ridgeway near Marsden Road, and the Austen Ward Heights booster pump station will have to be upgraded to sustain pressures to Leach Place, and the top of Austen Ward Heights / Calamaras Street.

The additional works noted in 5 and 6 above are proposed for "System Improvements" funding.

The lower Port Hills (including Haven Road / Wakefield Quay), Washington Valley, Toi Toi Valley (including Emano / Murphy), Hospital, and Mount Street areas are also on Treatment Plant/Thompson Terrace Reservoir High Pressure (155m City Datum), but should be on low pressure (107 m City Datum). No synergies with renewals are possible in this area and additional funding for Capex is proposed in the Water Supply Asset Management Plan 2009/19.

The City/Atawhai low pressure zone has been split into three zones – Atawhai, The Wood and the Central City. This has enabled the Wood zone to be put on 83m City Datum while the other two zones remain on 107m City Datum. This split also allows for smaller District Metering Areas.

Lowering of night-time pressure in all pressure reducing valve zones will achieve the benefits listed in 1 above. Additional funding for System Improvements is proposed in the Water Supply Asset Management Plan 2009/19 for the fitting of a variable controller to one pressure reducing valve in each zone, and the resetting of other pressure reducing valves to a lower pressure.

Network Modelling Results

Network Modelling of The Wood Pressure Reduction

Background

The City/Atawhai low pressure zone has been split into three zones – Atawhai, The Wood and the Central City. This has enabled the Wood zone to be put on 83m City Datum while the other two zones remain on 107m City Datum. This split also allows for smaller District Metering Areas.

This was achieved by modelling different scenarios and carrying out the following works:

Completed works as at 2011
Modelling results
The Trafalgar Street pressure reducing valve was reduced from a setting of 107m to 83m.
A new pressure reducing valve was inserted at the corner of Nile and Tory Streets, set to 83m.
Valves were shut at Trafalgar Street bridge (just north of Ajax Avenue), Hardy Street bridge, Bridge Street bridge and in Atawhai Drive just south of Iwa Road to enclose the new lower pressure zone.
It was found that fire flows were no longer achievable in Iwa Road and Walters Bluff. A new pressure reducing valve at the bottom of Walters Bluff (set to 107m) was required to remedy this.
New pressure reducing valves that have been installed.
At the bottom of Walters Bluff set to 107m
In Tory Street at the intersection with Nile Street, set to 83m
Other Misc New Works that have been completed
New valve in Atawhai Drive just south of Iwa Road
Change setting of Trafalgar Street pressure reducing valve to 83m

Network Modelling of Port Hills / Washington / Victory / Toi Toi Pressure Reduction

Background

Currently the Port Hills / Washington Valley / Victory Square / Toi Toi Valley areas are supplied directly at Water Treatment Plant / Thompson Terrace Reservoir pressure, but much of the land is at low level and is therefore receiving excess pressure.

The objective was to model scenarios giving pressures within the Targeted Level of Service in the Water Supply Asset Management Plan (30 m to 90 m head at each property).

The initial attempt to design alterations to the reticulation to achieve lower pressures was hampered by the need to maintain high pressure in the cross city links in the reticulation (Wellington St, Gloucester St, Washington Road, Hampden Street, Alfred Street, Toi Toi Street etc.).

The second attempt put all the areas onto low pressure and then devised means of providing high pressure to those areas needing it. This was successful.

Results

A 200 pipe is required in Princes Drive (Day's Track to Richardson Street) to provide continuity of supply to the Port Hills / Port area (including Sealord) if the trunkmain from North Road to Vickerman Street is out of action. Note this pipe is not needed for normal operation.

There are a few houses at the top of the southern end of Montreal Road which are above the 67 m contour and will not receive adequate pressure.

Can't achieve a fire flow to a couple of houses at the end of Konini Street (numbers 5A and 7). Can get 12.5 litres per second out of the hydrants outside 16 Konini and 87 Mount Street but these are both over 135m away.

Fireflows were not adequate at the top of Emano Street without upgrading the main in Orsman Crescent. Once this is upgraded to a 150 then we can get 12.5 litres per second at the end of Emano and 12.5 litres per second at the corner of Emano and Orsman which is sufficient.

Cannot achieve 25 litres per second in Mount Street without the non-return valve which brings water from the low pressure system when there is a fire flow.

New pressure reducing valves

At the corner Russell Street and Stanley Crescent supplying into the new low pressure zone in Washington Valley and into the new 150 main supplying the Port/Queens Road area.

Toi Toi below Abraham

Laval Heights to replace shut valve – set to 140m – could be lower

Quebec Road to replace shut valve – reduces from Observatory Hill pressure to Maitai High Level – set to 155m

At the corner of Princes / Richardson supplying into the top of Richardson Street and into Washington Road

Outside 7 Orsman Crescent

New Links

150 to link the new low level system either side of the newly shut valves in Hampden Street at the corner of Kawai Street

150 - Corner of St Vincent and Toi Toi to link the 150 on the southern side of Toi Toi to the 200 in Toi Toi

Need to link the Fountain Place main to the 100 low pressure in Haven Road

100 link between the 100 and 150 in Haven Road south of Vickerman Street

New Mains

370m of 150 main up Russell Street from Haven to Queens

385m of 50 ridermain up Russell Street from Haven Road to Stanley Crescent

235m of 100 main from Russell Street to end of Mt Pleasant Avenue

1070m of 200 main along Princes Drive from Princes/Toi Toi to Princes/Richardson

70m of 150 from new 200 in Princes Dve down to the end of The Cliffs via the reserve.

Upgrade Orsman Cr from 100 to 150 – length 330m

Other Miscellaneous New Works

New non-return valve outside 36 Mount Street – required so that upper Mount Street can achieve fire flows

Small booster Pump (and tank?) Montreal Road / Hutson Street.

New valve outside 41 Wolfe St

New valve outside 17 Mt Pleasant Avenue

New valve outside 16 Albert Road

New valve in Haven Road just north of Russell Street in the 200

New valve by 121 Queens Road

New valve in Haven Road just south of Vickerman Street in the 150 CIPT

Completed works as at 2011
New pressure reducing valve in Laval Heights to replace shut valve – set to 140m – could be lower
New non-return valve outside 36 Mount Street – required so that upper Mount Street can achieve fire flows
New valve outside 41 Wolfe Street.

Network Modelling of Pressure Reduction Wakatu / Enner Glynn / Ridgeway

Background

The Wakatu area (Beatson Road to Torlesse Street) is currently on Treatment Plant/Thompson Terrace Reservoir High Pressure (155m City Datum). The proposed works in 2008/09 and 2009/10 will allow this area to be transferred to low pressure (107 m City Datum). The new pipes have been sized to meet the Fire Flow Levels of Service at the reduced pressure. The pressure reducing valve currently at Cawthon Crescent will have to be relocated to the top of Beatson Road near Waimea Road.

The Maitland/Ridgeway area is currently on Marsden Valley High Pressure (170 m City Datum). The proposed works in 2008/09 and 2009/10 will allow this area to be transferred to Treatment Plant/Thompson Terrace Reservoir High Pressure (155m City Datum). A new pressure reducing valve will be required on the Ridgeway near Marsden Road, and the Austen Ward Heights booster pumpstation will have to be upgraded to sustain pressures to Leach Place, and the top of Austen Ward Heights / Calamaras Street.

Results

A pressure reducing valve was inserted in the Ridgeway just north of Marsden Road. This needs to be set to 'Thompson Terrace Reservoir' pressure, but sufficiently low so that water does not flow north along the new 200 main above. A setting of 142m was sufficient to supply 30m to the top of Arapiki Road and still have the water flowing south along the new main. This setting will have to be established through experimentation and possibly varied seasonally.

A pressure reducing valve was inserted in Beatson Road just below the (eastern) intersection with Scotia Street to achieve fire flows at Beatson / Waimea.

To achieve fire flows in Anglia Street requires upgrading the 100 AC main in Beatson Road to 150 PVC, the 100 AC main in Scotia Street from Beatson to Anglia to 150 PVC and the 100 AC in Anglia to 100 PVC.

To achieve fire flows in Burrough Place requires upgrading the 100 AC in Waimea, Chings, Enner Glynn from Beatson to Burrough to 150 PVC

To obtain fire flows in Cherry Avenue requires a connection into the new 200 main at Baigent / The Ridgeway, upgrading the 100 AC in Baigent from The Ridgeway to Cherry to 150 PVC and upgrading the 100 AC in Cherry to 100 PVC.

Other fire flows which were tested and were adequate are as follows:

- Can get 12.5 litres per second in Newman Drive at Boyes Place (and 12.5 litres per second from above non-return valve)
- Last hydrant on Enner Glynn Road providing Baigent upgraded as above
- Panorama, Arapiki, View Mount, Coster

To achieve the residential pressure level of service in Leach Place, Sophies Way, and the top of Austen Ward Heights and Calamaras Street, a booster pumpstation is required. (The existing small pump and 2x25 cu m tanks do not provide a permanent solution).

If the booster pump is sited at the intersection of Torlesse and Jerningham Streets a link between Torlesse Street and the intersection of Waterhouse and Austen Ward Heights, (or a pressure reducing valve at the intersection of Waterhouse and Austen Ward Heights) is required to maintain fire flows to Coster Street and Calamaras Street.

New Pressure Reducing Valves

In The Ridgeway just north of Marsden Road

In Beatson Road

New Mains

500m of 200 main from Waimea Road/The Ridgeway to The Ridgeway/Torlesse (abandon AC 100). Connection at Baigent Road.

Upgrade 535m of 100 AC to 150 PVC main in Waimea Road, Chings Road, Enner Glynn Road (from Chings Road to Burrough Place) Note : Continue renewal in 100 PVC to Newman Dve.

Upgrade 71m of 100 AC to 150 PVC in Baigent Road from The Ridgeway to Cherry Avenue. Note : Continue renewal in 150 PVC to high point of Baigent Road (start of existing 100 PVC

Renew 220m of 100 AC to 100 PVC in Cherry.

A new 150 PVC (or PE) link between Torlesse Street and Waterhouse Street, Austen Ward Heights intersection via the walkway is needed to maintain fire flows if the pump station is built on the intersection of Torlesse and Jerningham Streets.

Other Misc New Works

New valve in Enner Glynn Road just north of Newman Drive

New valve in Waterhouse just north of Torlesse

Remove the pressure reducing valve in Cawthron Crescent

Future new ridermain at the top end of Scotia Street to Ulster to keep the top houses on high pressure and reduce the others to low pressure

The initial modelling did not include the Austen Ward Heights area above the NRV.

Subsequently a new PS on the intersection of Torlesse and Jerningham Streets was modelled.

Completed works as at 2011
200 main laid from Waimea Road/Beatson Road to The Ridgeway intersection (abandon AC 100). Connected at Ulster Street
Upgrade 338m of 100 AC to 150 PVC in Beatson Road
Upgrade 188m of 100AC to 150 PVC in Scotia Street from Beatson to Anglia
Renew 262m of 100 AC to 100 PVC in Anglia Street
New valve in Scotia Street just south of Ulster

Network Modelling of Pressure Reduction East side of Waimea Road (Motueka Street to Boundary Road)

Background

The East side of Waimea Road between Motueka Street and Market Road is currently on Treatment Plant/Thompson Terrace Reservoir High Pressure (155m City Datum). The proposed works will allow this area to be transferred to low pressure (107m City Datum). The pipe capacities have been checked to ensure that the Fire Flow Levels of Service can be maintained at the reduced pressure.

New Links

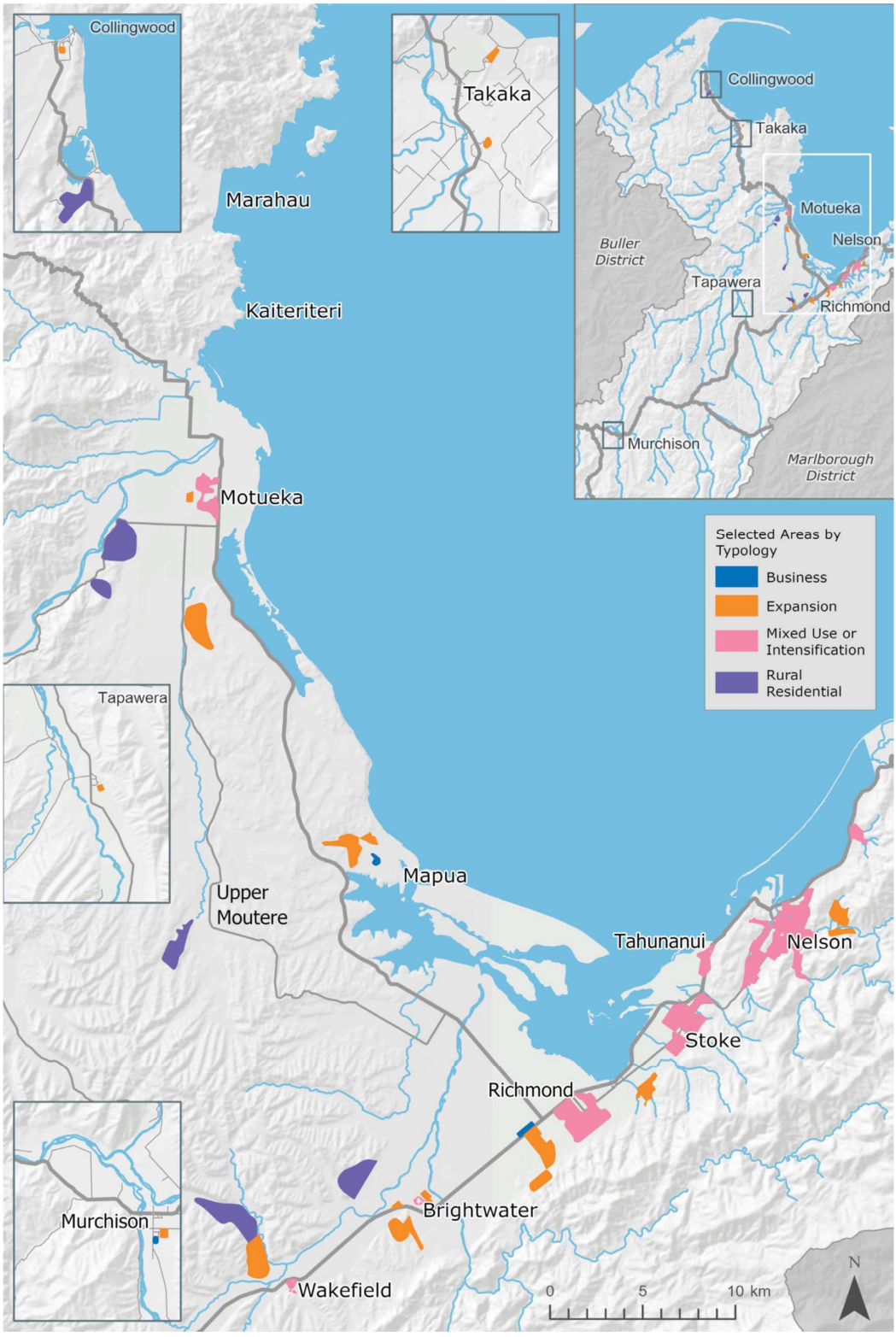
100 link from the 100 AC to the 150 CI in Waimea Road just south of the valve to be shut at Motueka Street

100 link from the 100 AC to the 150 CI in Waimea Road, south of Tukuka Street

100 link from the 100 AC to the 150 CI in Waimea Road, north of Boundary Road

APPENDIX H: INFRASTRUCTURE PLANNING PROCESS FOR GROWTH PROJECTS

Appendix Figure H-1: Growth Areas NELSON TASMAN FUTURE DEVELOPMENT STRATEGY JULY 2019



Appendix Figure H-2: Future Development Areas

Table 7. Anticipated sequencing and timing of growth

Future development area		Proposed sequencing and timing: Decade 2: 2029-2038	Decade 3: 2039-2048	Estimated capacity
FUTURE DEVELOPMENT AREAS WITHIN THE NELSON URBAN AREA				
NELSON				
Kaka Valley	N-3 Kaka Valley	●		614
	N-32 Orchard Flats		●	228
FUTURE DEVELOPMENT AREAS WITHIN THE NELSON URBAN AREA				
NELSON				
Dodson	N-15 Dodson	●		190
Central	N-270 City Centre	●		676
	N-20 Fairfield Park	●		254
	N-21 Waimea Road	●		271
	N-22 Hospital/Nelson South	●		536
	N-23 Victory	●		175
	N-289 The Brook	●		275
	N-288 St Vincent	●		102
	N-287 Washington Valley		●	63
	N-19 The Nile		●	90
Stoke	N-27 Stoke Centre	●		58
	N-28 Stoke School	●		254
	N-29 Nayland		●	373
	N-285 Arapiki		●	254
	N-286 Isel		●	169
	N-24 The Black Cat		●	184
Saxton	N-11 Saxton	●		819
TASMAN				
Richmond	T-22 Richmond Intensification	●		936
	T-23 McGlashen Redevelopment	●		16
Richmond South	T-38 Hope		●	774
	T- 39 Paton Road foothills		●	588
	T-40 Hill Street South foothills		●	266

APPENDIX I: RISK

Appendix Table I-1: Water Supply Risk Register

Identification			Analysis: Residual Risk					
Event Description	**Asset Group**	**Consequence**	**Existing Controls**	**Consequence**	**Likelihood**	**Current Risk Level**	**Response**	**Treatments**
POISON OR ORGANICS ACCIDENTAL SPILLAGE OR SABOTAGE	**INTAKES**	Worse case: significant loss of life	Caretaker on site. Regular inspection of intakes and visitors. Access to intakes controlled overnight by locking access road gate. Maintain vigilance	Extreme (5)	Rare (1)	Medium (5)	Accept	Increase vigilance. Ensure storage reservoirs are full. Control access to intakes
POISON OR ORGANICS ACCIDENTAL SPILLAGE OR SABOTAGE	**RETICULATION**	Worse case: significant loss of life	Reticulation under pressure deters casual sabotage. Access to network controlled through permit process. Maintain vigilance	Extreme (5)	Rare (1)	Medium (5)	Accept	Increase vigilance. Ensure storage reservoirs are full. Control access to intakes
MOVEMENT FAILURE CAUSED BY EARTHQUAKE, LANDSLIDE OR SETTLEMENT	**TREATMENT PLANT**	Worse case: water not available until temporary chlorination plant in place and temporary supply from TDC - 1 day to organise	Plant has been designed to a high standard. Regular inspection for likely problems. Temporary supply from TDC	Extreme (5)	Unlikely (2)	High (10)	Reduce	Purchase oddition portable chlorine dosing equipment. Improve supply options from TDC.
MOVEMENT FAILURE CAUSED BY EARTHQUAKE, LANDSLIDE OR SETTLEMENT	**MAITAI PIPELINE**							
	Dam - Water Treatment Plant	Interrupt supply from old pipeline	Regular inspection to look for potential slips and possible rocks or logs that could fall. Cover pipe during logging. Duplicate pipelines from dam to WTP and WTP to Brook Street plus Roding supply.	Major (4)	Unlikely (2)	Medium (8)	Reduce	Construct "avalanche" shutter in known rockfall areas.
	Water Treatment Plant - City	Interrupt supply from old pipeline	Regular inspection to look for potential slips and possible rocks or logs that could fall. Cover pipe during logging. Duplicate pipelines from dam to WTP and WTP to Brook Street plus Roding supply.	Major (4)	Unlikely (2)	Medium (8)	Reduce	Construct "avalanche" shutter in known rockfall areas. Construct alternative main down Brook Valley Road.
MOVEMENT FAILURE CAUSED BY EARTHQUAKE, LANDSLIDE OR SETTLEMENT	**RODING PIPELINE**	Asset performance reduced	Regular inspection to look for potential slips and possible rocks or logs that could fall. Multiple raw water sources	Moderate (3)	Unlikely (2)	Medium (6)	Accept	Construct "avalanche" shutter in known risk areas.

MOVEMENT FAILURE CAUSED BY EARTHQUAKE, LANDSLIDE OR SETTLEMENT	**TRUNK MAINS**	Assed performance reduced	Fitting of seismic valves to water reservoirs to turn off water in event of earthquake. Multiple supply options as network inter-connected	Moderate (3)	Unlikely (2)	Medium (6)	Reduce	Ensure movement joints in network
MOVEMENT FAILURE CAUSED BY EARTHQUAKE, LANDSLIDE OR SETTLEMENT	**RESERVOIRS**	Asset performance reduced	Major reservoirs are designed for 1 in 1000 or 1 in 333 year earthquakes. Ensure seismic valves properly located, ensure construction details adequate.	Moderate (3)	Unlikely (2)	Medium (6)	Reduce	Multiple storage reservoirs. Network interconnection.
FLOOD DAMAGE	**MAITAI PIPELINE**	Asset performance reduced	Maintain rockwork on riverbank. Keep pipeline full to reduce floatation.	Major (4)	Unlikely (2)	Medium (8)	Share	
FLOOD DAMAGE	**RODING PIPELINE**	Asset performance reduced	Maintain rockwork on riverbank. Keep pipeline full to reduce floatation.	Moderate (3)	Unlikely (2)	Medium (6)	Share	
BACKFLOW CONTAMINATION FROM PRIVATE PROPERTY	**RETICULATION**	Health/reputation damage	Backflow prevention devices incorporated into meter assembly	Moderate (3)	Rare (1)	Low (3)	Reduce	Replace dual check valves
BACKFLOW CONTAMINATION FROM INDUSTRY	**RETICULATION**	Worse case: loss of life	Backflow prevention devices incorporated into meter assembly. Separate backflow devices for larger industries.	Major (4)	Rare (1)	Medium (4)	Reduce	Fit backflow preventors to all commercial and industrial premises.
DAMAGE FROM LIQUEFACTION (AT RISK AREAS PORT NELSON, TAHUNANUI/STOKE)	**RETICULATION**	Asset performance reduced		Extreme (5)	Unlikely (2)	High (10)	Reduce	Anchor chambers. New installations designed for seismic movement and liquifaction.
CLIMATE CHANGE/INCREASED RAINFALL INTENSITY AND RIVER FLOWS	**MAITAI DAM/RESERVOIR**	Safety issue if dam spillway capacity inadequate. Dam out of commission if damaged.	Dam designed for maximum probable precipitation	Major (4)	Unlikely (2)	Medium (8)	Reduce	Ongoing review of design for climate change
CLIMATE CHANGE/INCREASED RAINFALL INTENSITY AND RIVER FLOWS	**TREATMENT PLANT**	Increased sediment in rivers and dam. Impact on membranes.	Use water from cleanest river source or level in the dam.	Minor (2)	Likely (4)	Medium (8)	Reduce	Ongoing review of design for climate change
CLIMATE CHANGE/LOWER RAINFALL INTENSITY AND RIVER FLOWS	**TREATMENT PLANT**	Reduced raw water available from rivers. Greater reliance on Maitai Dam reservoir. Increased restrictions on water supply to customers. Drought conditions.	Dam storage volume designed for current 60year drought and future demand to approx 2060-2080.	Major (4)	Likely (4)	High (16)	Reduce	Ongoing review of demand and storage for climate change. Investigate alternative supply sources.
CLIMATE CHANGE/LOWER RAINFALL INTENSITY AND RIVER FLOWS	**TREATMENT PLANT**	Forest fires lead to increased demand for water and impact on water supply catchments if fire occurs there.	Dam storage volume designed for current 60year drought and future demand to approx 2060-2080. Can select lower levels of dam for water. Minimise vehicle and open fire use in catchments.	Moderate (3)	Possible (3)	Medium (9)	Reduce	Ongoing review of demand and storage for climate change. Investigate alternative supply sources.
CLIMATE CHANGE/ SEA LEVEL RISE	**RETICULATION**	Rising sea levels can lead to inundation of roadways with salt water with consequential damage to reticulation fittings and changed or no access.	Fitting materials are located to avoid salt water environments or protected from its impact.	Minor (2)	Likely (4)	Medium (8)	Reduce	Ongoing review of demand for services in areas impacted by sea level rise. Investigate alternative means of supply.

Appendix Table I-2: Consequence Rating (Impact)

Rating	Safety	Health	Asset Performance/ Service Delivery	Environmental/ Historical/cultural	Financial	Political / Community/ Reputational	Relationship with Iwi	Legal compliance	Information/ decision support
Exterme (5)	Multiple fatalities of workers or public (MF)	Significant loss of life expectancy for multiple persons or incapacity for more than 1000 person days	Service not provided for more than 5000 person days	Permanent environmental damage on a nationally significant scale and/or permanent loss of nationally significant building, artwork, or other valued entity	Overspend, loss (i.e. spend without result) or income loss of > $5m OR >100% of business unit budget	Major loss of public confidence in Council (>2000 opponents via social media or other mediums) Negative international mainstream media coverage; shareholder or key stakeholder outage; or loss of a key customer	Major breakdown of relationship affecting multiple areas. Refusal to resolve without one or more major concessions from council	Litigation/ prosecution or civil action successful resulting in major (>50% of maximum available) fine/costs awarded and/or imprisonment of council officer.	Multiple errors in information and analysis and presentation misleading (intentionallly or not) or not understandable by non- specialists
Major (4)	Single fatality of workers or public (SF)	Single loss of life expectancy or incapacity for between 100 and 1000 person days	Service not provided for less than 5000 person days but more than 500 person days	Major environmental damage with long-term recovery requiring significant investment and/or loss or permanent damage to a registered historical, cultural or archaeological site or object	Overspend, loss (i.e. spend without result) or income loss of > $1m and <$5m OR between 70% and 100% of business unit budget	Significant negative public reaction likely (200-2000 opponents via social media or other mediums) Negative national mainstream media coverage; significant negative perception by shareholder or key stakeholder; or a customer disruption	Significant breakdown of relationship largely in in one area. Some concessions from council sought before substantive issue considered by iwi grouping affected	Litigation/ prosecution or civil action successful resulting in minor fine(<50% of max available)/ costs awarded.	One major error in information, analysis incomplete and presentation ambiguous
Moderate (3)	Notifiable injury of workers or public.	Incapacity for between 20 and 100 person days	Service not provided for less than 500 person days but more than 50 person days	Measurable environmental harm on a nationally significant scale. Some costs in terms of money and/or loss of public access or conservation value of the site and/or restorable damage to historical, cultural or archaeological site or object	Overspend, loss (i.e. spend without result) or income loss of > $0.5m and <$1m OR between 30% and 70% of business unit budget	Some negative public reaction likely (30-200 opponents via social media or other mediums) Repeated complaints; Regulatory notification; or negative stakeholder, local media attention	Major relationship damaged in a single area but amenable to negotiation	Documented Breach of legislation, no legal action or prosecution or civil action not successful.	Information correct but presentation/ analysis insufficient to support decision on the day
Minor (2)	Serious injury on one person requiring medical treatment (MA)	Incapacity for between 1 and 20 person days	Service not provided for less than 50 person days but more than 5 person days	Medium term environmental impact at a local level and/or development compromising the integrity of a registered historical, cultural or archaeological site	Overspend, loss (i.e. spend without result) or income loss of > $100k and <$500k OR between 10% and 30% of business unit budget	Minor public reaction likely (<30 active opponents via social media or other mediums) Workforce attention; limited external attention;	Relationship damage resolvable through normal communication/ consultation mechanisms	Formal warning of breach from legislative authority.	Information correct, analysis complete but presented in a way which could be misinterpreted
Insignificant (1)	Minor injury requiring only first aid or less (FA)	Incapacity for less than 1 person day	Service not provided for between 1 & 5 person days	Short term and temporary impact requiring no remedial action and/or restorable loss damage to historical/ cultural record	Overspend, loss (i.e. spend without result) or income loss of > $10k and <$100k OR between 5% and 10% of business unit budget	Very limited negative reaction (1 or 2 active opponents via social media or other mediums) Internal attention only from staff directly working on the matter.	Iwi/ tribe/ hapu public dissatisfaction resolvable through routine communication	Breach of minor legislation/ no legal action	Small errors in information or presentation - no effect on decision

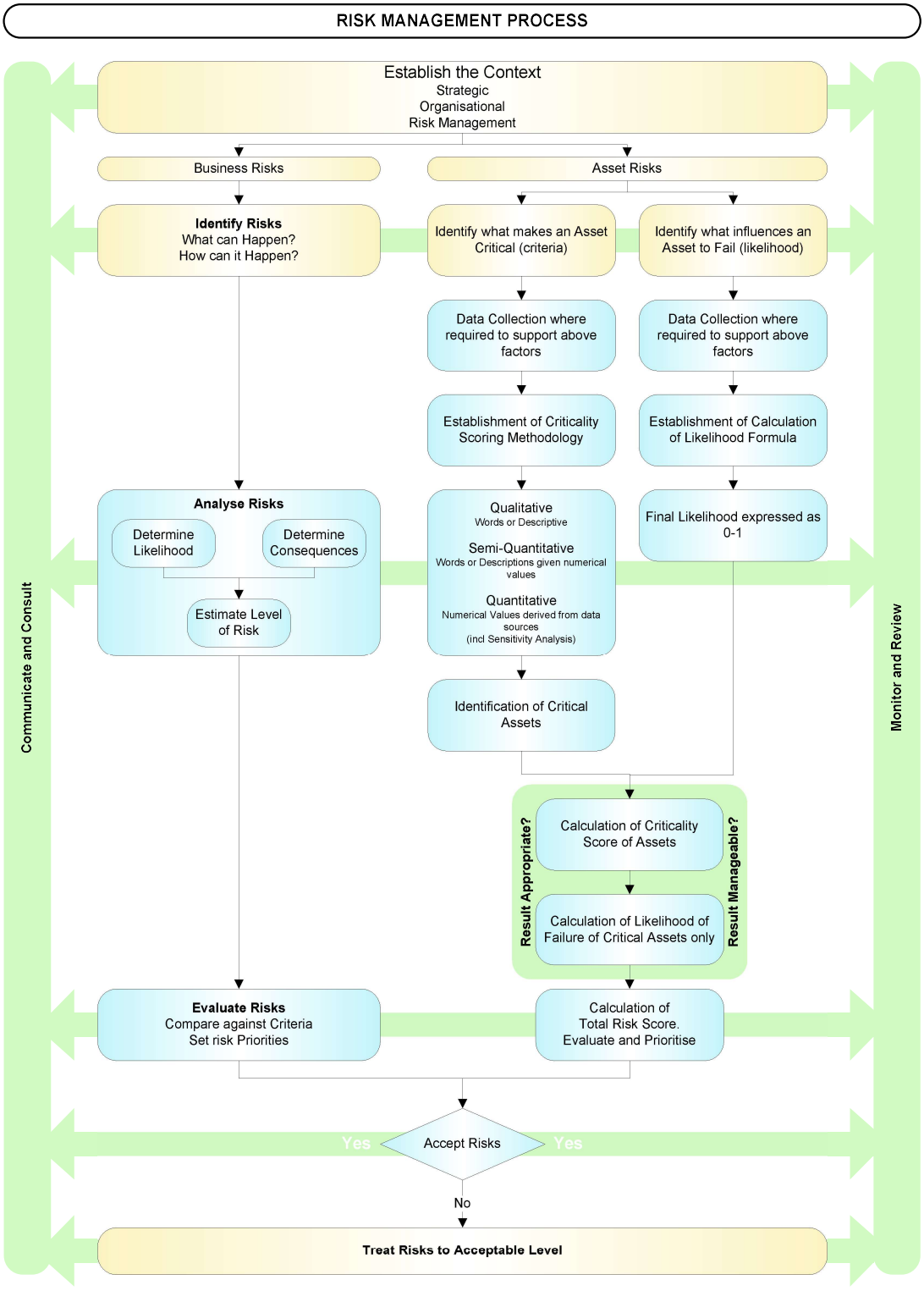
Appendix Table I-3: Risk Matrix – Consequences x Likelihood

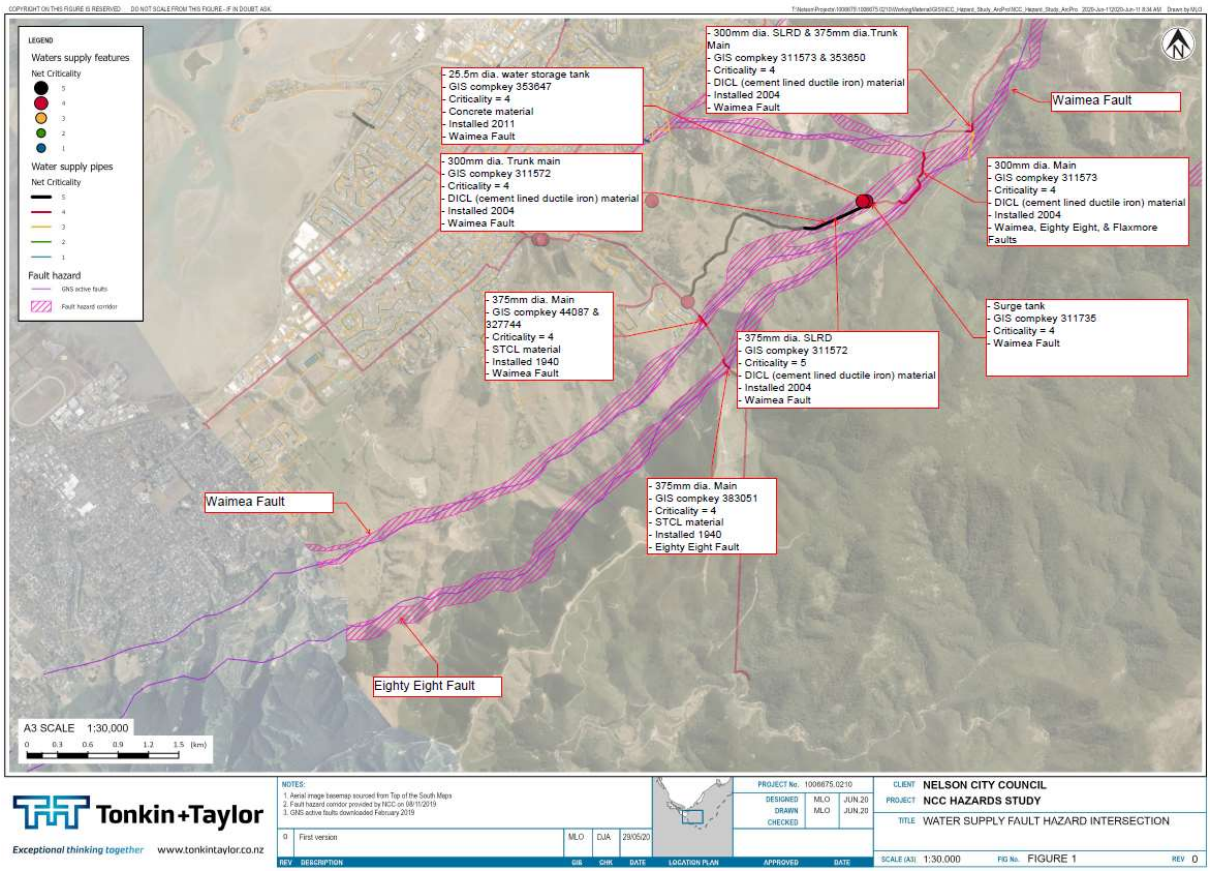
CONSEQUENCES					LIKELIHOOD of the given consequence occurring			
Insignificant(1)	Minor (2)	Moderate (3)	Major (4)	Extreme (5)	Descriptor	Qualitative guidance statement	Indicative Probability range %	Indicative frequency range (years)
Medium (5)	Medium (10)	High (15)	Very High (20)	Very High (25)	Almost certain (5)	The consequence can be expected in most circumstances OR *A very low level of confidence/information*	>90%	>1 occurrence per year
Medium (4)	Medium (8)	High (12)	High (16)	Very High (20)	Likely (4)	The consequence will quite commonly occur OR *A low level of confidence/information*	20% - 90%	Once per 1-5 years
Low (3)	Medium (6)	Medium (9)	High (12)	High (15)	Possible (3)	The consequence may occur occasionally *A moderate level of confidence/information*	10% - 20%	Once per 5-10 years
Very Low (2)	Low (4)	Medium (6)	Medium (8)	High (10)	Unlikely (2)	The consequence may occur only infrequently *A high level of confidence/information*	2% - 10%	Once per 10 - 50 years
Very Low (1)	Very Low (2)	Low (3)	Medium (4)	Medium (5)	Rare (1)	The consequence may occur only in exceptional circumstances *A very high level of confidence/information*	<2%	Less than once per 50 years

Appendix Table I-4: Residual Risk Tolerance

Risk Level	Description and Action	Authority for continued tolerance	Timing for implementing action	Obligation to promptly advise including advising treatments
Very High	Not normally tolerable, immediate intervention to reduce risk	Full Council on advice from CE	Immediate if possible but no more than one month	Full Council using best practicable means
High	Not normally tolerable, initiate action as soon as practicable to reduce risk below High	SLT or Group Manager (Council at CE discretion)	As soon as practicable but no more than 2 months	SLT or accountable Group Manager (Council at CE discretion)
Medium	Normally tolerable, frequently review to look for opportunities to further reduce risk where practicable	Business Unit Manager	At least within one quarter	Accountable Group Manager
Low	Acceptable risk, routine review for low cost actions to reduce risk further	No specific authority required	Routine review period (e.g. 3- 6 monthly)	None
Very Low	Acceptable risk, no specific actions to reduce further	No specific authority required	Only if incidental to another action	None

Appendix Figure I-1: Risk Management Process




LEGEND
Waters supply features
Net Criticality
Water supply pipes
Net Criticality
Fault hazard
GNS active faults
Fault hazard corridor
- 25.5m dia. water storage tank
- GIS compkey 353647
- Criticality = 4
- Concrete material
- Installed 2011
- Waimea Fault
- 300mm dia. SLRD & 375mm dia.Trunk Main
- GIS compkey 311573 & 353650
- Criticality = 4
- DICL (cement lined ductile iron) material
- Installed 2004
- Waimea Fault
Waimea Fault
- 300mm dia. Trunk main
- GIS compkey 311572
- Criticality = 4
- DICL (cement lined ductile iron) material
- Installed 2004
- Waimea Fault
- 300mm dia. Main
- GIS compkey 311573
- Criticality = 4
- DICL (cement lined ductile iron) material
- Installed 2004
- Waimea, Eighty Eight, & Flaxmore Faults
- 375mm dia. Main
- GIS compkey 44087 & 327744
- Criticality = 4
- STCL material
- Installed 1940
- Waimea Fault
- Surge tank
- GIS compkey 311735
- Criticality = 4
- Waimea Fault
- 375mm dia. SLRD
- GIS compkey 311572
- Criticality = 5
- DICL (cement lined ductile iron) material
- Installed 2004
- Waimea Fault
Waimea Fault
- 375mm dia. Main
- GIS compkey 383051
- Criticality = 4
- STCL material
- Installed 1940
- Eighty Eight Fault
Eighty Eight Fault
A3 SCALE 1:30,000
0 0.3 0.6 0.9 1.2 1.5 (km)
Tonkin+Taylor
Exceptional thinking together
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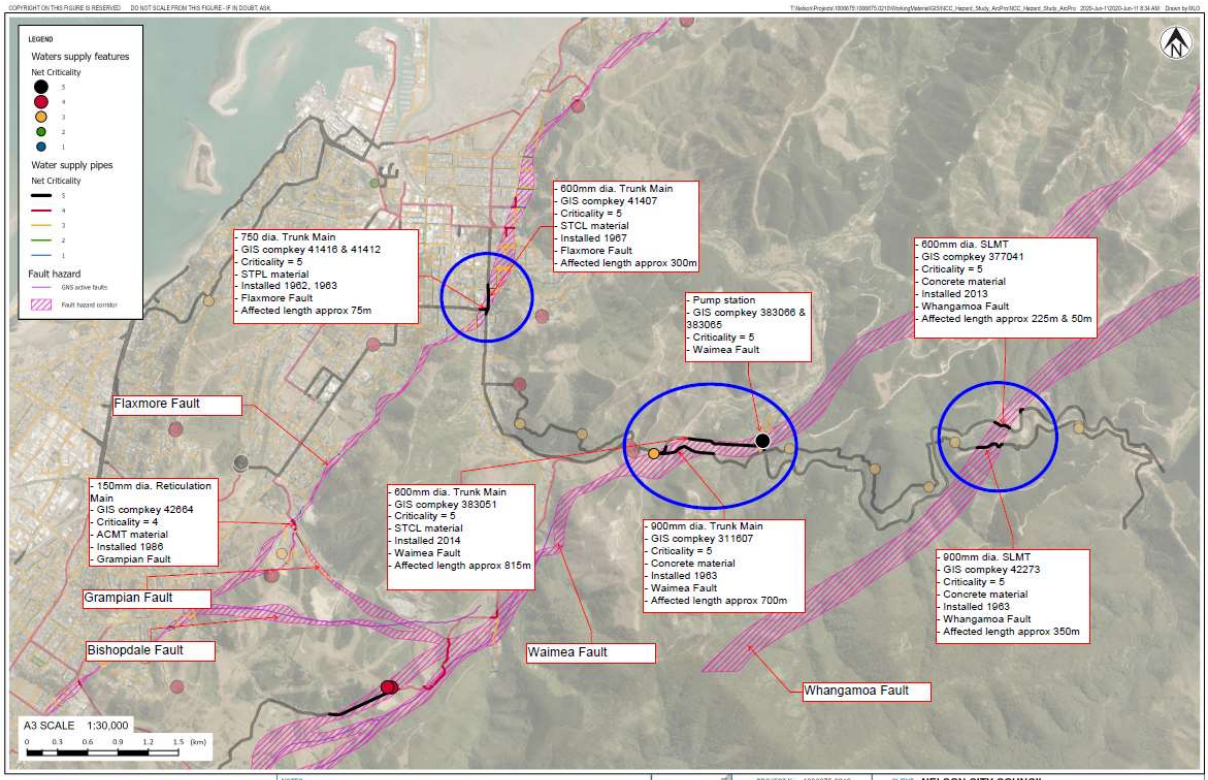
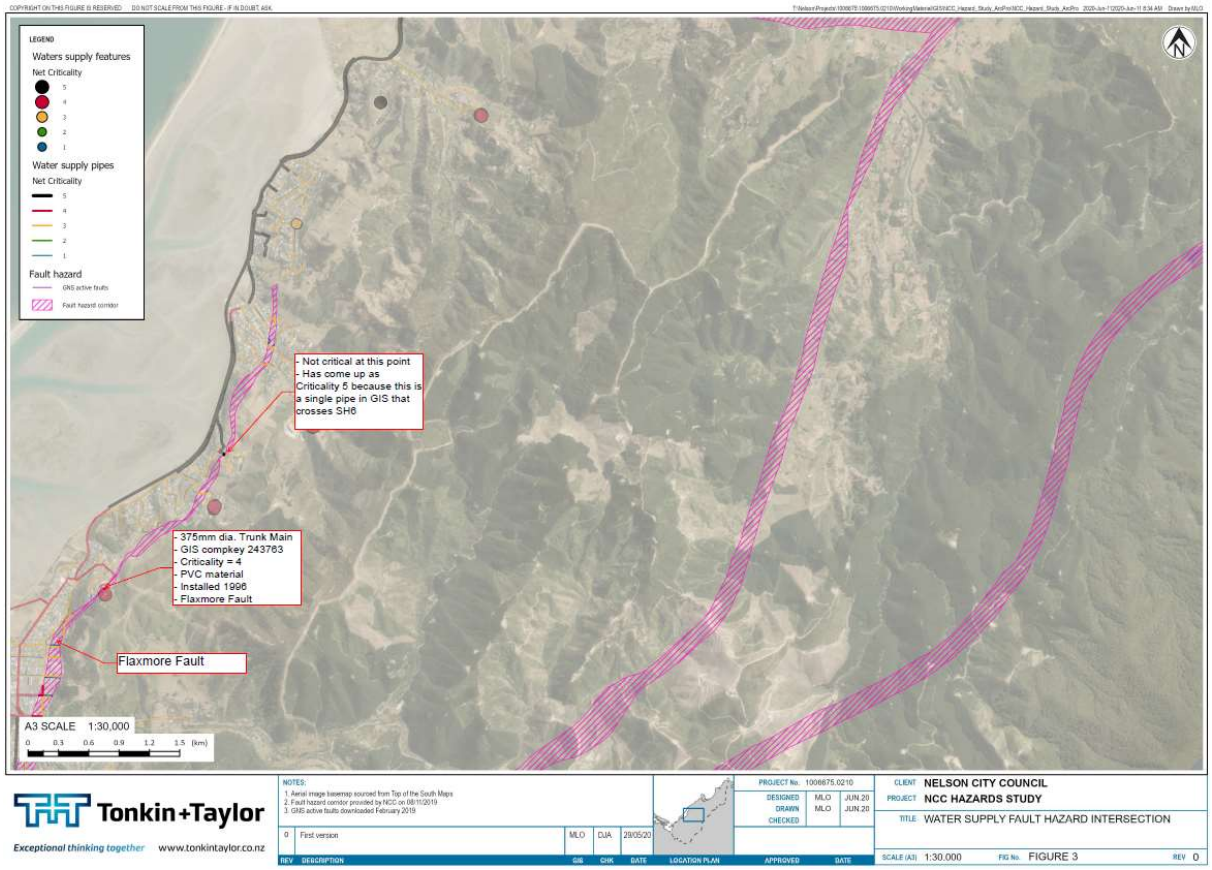
NOTES:
1. Aerial image basemap sourced from Top of the South Maps
2. Fault hazard corridor provided by NCC on 08/11/2019
3. GNS active faults downloaded February 2019
0 First version MLO DJA 29/05/20
REV DESCRIPTION ORIG CHK DATE
LOCATION PLAN
PROJECT No. 1006675.0210
DESIGNED MLO JUN 20
DRAWN MLO JUN 20
CHECKED
APPROVED DATE
CLIENT NELSON CITY COUNCIL
PROJECT NCC HAZARDS STUDY
TITLE WATER SUPPLY FAULT HAZARD INTERSECTION
SCALE (A3) 1:30,000
FIG No. FIGURE 1
REV 0


LEGEND
Waters supply features
Net Criticality
Water supply pipes
Net Criticality
Fault hazard
GNS active faults
Fault hazard corridor
- 750 dia. Trunk Main
- GIS compkey 41416 & 41412
- Criticality = 5
- STPL material
- Installed 1962, 1963
- Flaxmore Fault
- Affected length approx 75m
- 600mm dia. Trunk Main
- GIS compkey 41407
- Criticality = 5
- STCL material
- Installed 1967
- Flaxmore Fault
- Affected length approx 300m
- Pump station
- GIS compkey 383066 & 383065
- Criticality = 5
- Waimea Fault
- 600mm dia. SLMT
- GIS compkey 377041
- Criticality = 5
- Concrete material
- Installed 2013
- Whangamoa Fault
- Affected length approx 225m & 50m
Flaxmore Fault
- 150mm dia. Reticulation Main
- GIS compkey 42664
- Criticality = 4
- ACMT material
- Installed 1986
- Grampian Fault
- 600mm dia. Trunk Main
- GIS compkey 383051
- Criticality = 5
- STCL material
- Installed 2014
- Waimea Fault
- Affected length approx 815m
- 900mm dia. Trunk Main
- GIS compkey 311607
- Criticality = 5
- Concrete material
- Installed 1963
- Waimea Fault
- Affected length approx 700m
- 900mm dia. SLMT
- GIS compkey 42273
- Criticality = 5
- Concrete material
- Installed 1963
- Whangamoa Fault
- Affected length approx 350m
Grampian Fault
Bishopdale Fault
Waimea Fault
Whangamoa Fault
A3 SCALE 1:30,000
0 0.3 0.6 0.9 1.2 1.5 (km)
Tonkin+Taylor
Exceptional thinking together
www.tonkintaylor.co.nz
NOTES:
1. Aerial image basemap sourced from Top of the South Maps
2. Fault hazard corridor provided by NCC on 08/11/2019
3. GNS active faults downloaded February 2019
0 First version MLO DJA 29/05/20
REV DESCRIPTION ORIG CHK DATE
LOCATION PLAN
PROJECT No. 1006675.0210
DESIGNED MLO JUN.20
DRAWN MLO JUN.20
CHECKED
APPROVED DATE
CLIENT NELSON CITY COUNCIL
PROJECT NCC HAZARDS STUDY
TITLE WATER SUPPLY FAULT HAZARD INTERSECTION
SCALE (A3) 1:30,000
FIG No. FIGURE 2
REV 0


LEGEND
Waters supply features
Net Criticality
Water supply pipes
Net Criticality
Fault hazard
GNS active faults
Fault hazard corridor
- Not critical at this point
- Has come up as Criticality 5 because this is a single pipe in GIS that crosses SH6
- 375mm dia. Trunk Main
- GIS compkey 243763
- Criticality = 4
- PVC material
- Installed 1996
- Flaxmore Fault
Flaxmore Fault
A3 SCALE 1:30,000
0 0.3 0.6 0.9 1.2 1.5 (km)
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TITLE WATER SUPPLY FAULT HAZARD INTERSECTION
SCALE (A3) 1:30,000
FIG No. FIGURE 3
REV 0

APPENDIX J: CEMARS ACTION PLAN

Appendix Figure J-1: CEMARS Action Plan

CEMARS ACTION PLAN

1. Introduction:

The purpose of this plan is to provide a range of projects ranked in order of priority to enable Council to reduce its greenhouse gas emissions. This plan has been compiled based on activities and projects identified in Council's CEMARS (Certified Emissions Measurement and Reduction Scheme) Emissions Inventory for the baseline year 2017/18 (Appendix One). The assessment period for achieving reductions in greenhouse gas emissions is over five years from 2018 to 2023.

2. Funding:

Confirmed projects are funded through existing funding. All investigation work will be carried out within existing project budgets, or through the funding allocated for climate change through the 2019 Annual Plan. Opportunities to secure external funding, such as business energy reduction funding through EECA (Energy Efficiency and Conservation Authority), will be reviewed during the investigations where appropriate.

Subsequent actions identified will need to be funded through the Long Term Plan business case process, or other processes as appropriate.

3. Primary emissions sources for 2017/18 (baseline year):

4. Projects:

(Projects highlighted in green are priority projects for emissions reduction)

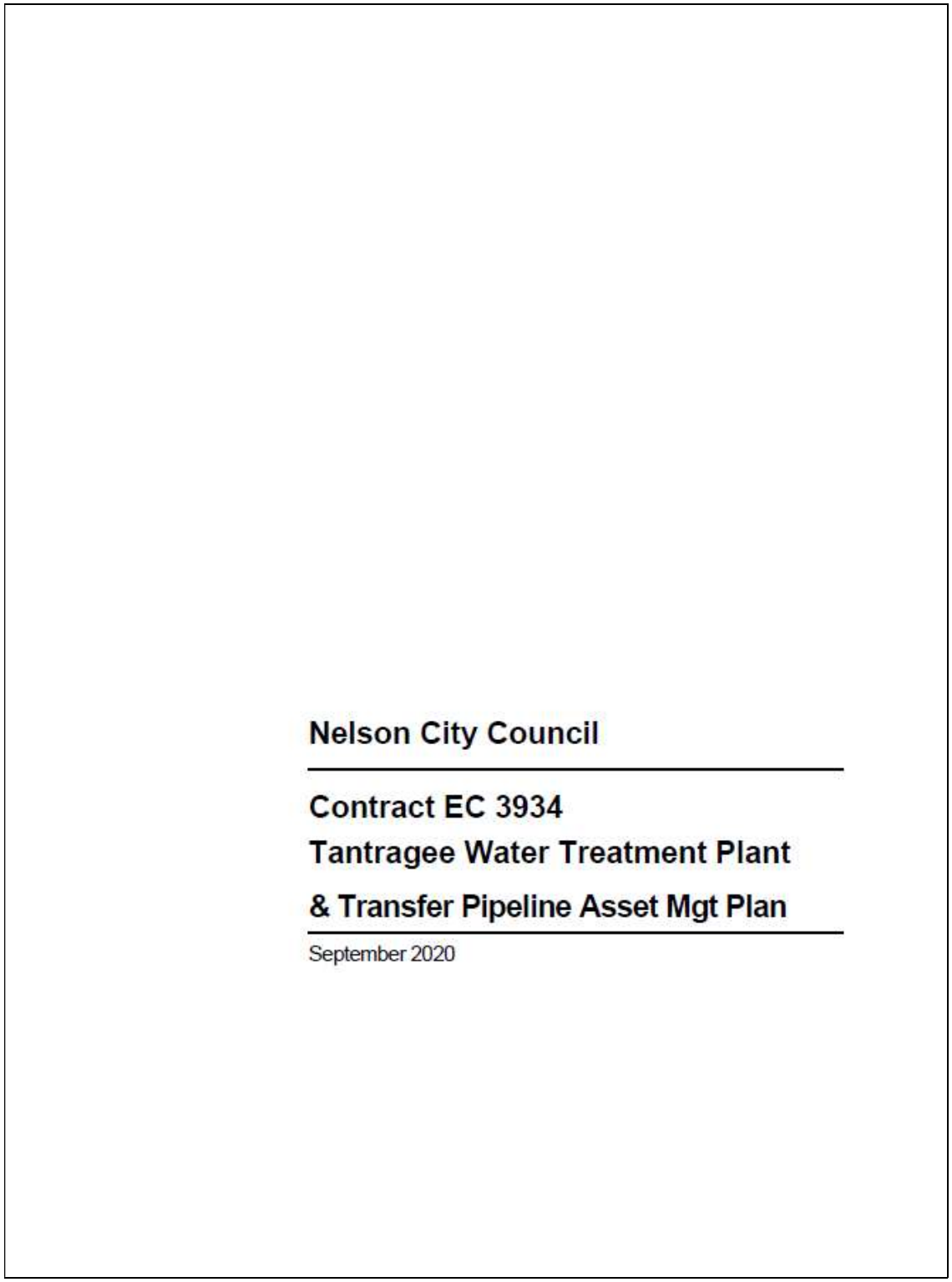
CONFIRMED PROJECTS FOR YEAR 1 (2018/19)			
Responsible	**Action**	**Completion date**	**Objective**
Infrastructure/Transport	Replace existing street lights with energy-efficient LED streetlights	June 2019	Reduce electricity usage
Corporate Services/Property	Procure two electric vans to replace one existing and one proposed new vehicle	June 2019	Reduce fossil fuel usage
CONFIRMED PROJECTS FOR YEAR 2 (2019/20)			
Responsible	**Action**	**Completion date**	**Objective**
All	Design and deliver carbon reduction plan	June 2023	Manage Council carbon reduction
Corporate Services/Property	Implement electric vehicle first policy when replacing existing or procuring new vehicles.	June 2023	Reduce fossil fuel usage
Years 1 to 5 (2019/2020) PROJECTS FOR INVESTIGATION (all projects will be subject to standard business case approval process where required) PRIORITY WILL BE GIVEN TO INVESTIGATION WITH BEST POTENTIAL TO REDUCE EMISSIONS			
Responsible	**Action**	**Completion date**	**Objective**

Infrastructure	Investigate collaboration with the NRSBU/NTRLBU to evaluate/reduce emissions from assets jointly-owned with Tasman District Council	June 2020	Reduce emissions
Infrastructure/ Utilities	Investigate emissions from Nelson North Wastewater Treatment Plant	June 2020	Reduce emissions
All/Senior Leadership/Strategy/Asset and Activity Managers	Investigate building climate change impact assessment into Council planning processes, including asset and activity management plans, policies, management plans and strategies	June 2020	Reduce emissions
Corporate Services	Establish feasibility of assessing carbon impact during the procurement process, including developing policy and criteria to guide significant purchases towards lower emission options, eg in infrastructure and building investments (new builds and refurbishments), equipment, electricity supply and service contracts	June 2020	Reduce emissions
Corporate Services	Investigate reducing and offsetting air travel	June 2023	Reduce emissions
Community Services/Facilities	Investigate energy efficiency opportunities such as energy audits on Council facilities that have emissions greater than 10tCO2e/yr	June 2023	Reduce electricity usage
Corporate Services/Finance	Investigate zero carbon energy suppliers	June 2020	Reduce emissions
Activity management/all	Investigate installing solar PV systems at Council buildings and facilities	June 2023	Reduce electricity usage
Senior Leadership Team	Investigate encouraging CCOs to measure, report and reduce carbon emissions	June 2020	Reduce emissions

Corporate Services/Property	Investigate removal of oil boilers and replacement with heat pumps	June 2020	Reduce fossil fuel usage
Corporate Services/Property	Water heating improvements at Riverside Pool	June 2020	Reduce electricity usage
Corporate Services/Parks	Investigate replacing park lighting with LEDS	June 2023	Reduce electricity usage
Infrastructure/transport & Corporate Services/Parks	Investigate installing outdoor lighting controllers on LED lights to reduce power use late at night	June 2023	Reduce electricity usage
Corporate Services/Parks	Investigate reducing nitrogen fertiliser use	June 2023	Reduce emissions
Corporate Services/Parks	Investigate replacement of grazing land with carbon forestry	June 2023	Increase carbon sequestration
Science and Environment	Investigate reducing waste at Council facilities	June 2023	Reduce emissions

APPENDIX K: NELSON WATER TREATMENT PLANT ASSET MANAGEMENT PLAN

Appendix Figure K-1: Nelson Water Treatment Plant Asset Management Plan



Fulton Hogan Water

Contract EC 3934
Tantragee Water Treatment Plant and Transfer Pipeline
Asset Management Plan

Contents

Status—AM Plan
Job Number—44552
Date—September 2020
Our Ref—amplan 2020.doc

Fulton Hogan Water

1. Summary

This document presents the Asset Management Plan for the Tantragee Water Treatment Plant, the Roding transfer pipeline system including the new High Level Reservoir, and the Maitai Duplicate pipeline.

The purpose of the plan is to ensure optimal life-cycle use and cost of plant and equipment.

The Plan contains:

- Current and projected service standards to be met by the water treatment plant and Roding pump stations and pipelines.
- Asset Register
- Details of asset condition and performance
- Estimates of useful remaining life of the components of the plant and transfer pipeline system based on condition assessment.
- A maintenance management plan based on the concepts of reliability-centred maintenance.
- A prioritised 10-year component renewals programme based on asset condition and performance.

Fulton Hogan Water

2. General

The Tantragee Water Treatment Plant and Roding Transfer Pipeline system were commissioned in 2004 and the Maitai Duplicate Raw Water Pipeline was commissioned in 2015. These are newly constructed assets of the Nelson City Council.

Details of these assets are described in the As-Built drawings, and the Operations & Maintenance Manual.

3. Asset Register

Roding Transfer Pipelines:

- Roding Break tank (downstream of tunnel)
- Roding raw water pump station
- Roding raw water pipeline
- Roding raw water saddle tank
- Roding clear water pump station
- Roding clear water pipeline
- Roding High Level Reservoir
- Roding clear water saddle tank

Tantragee Water Treatment Plant:

- Building
- CWS tank
- Exterior pipework
- Landscape and road surfaces within fenced enclosure
- Water treatment system within building
- Lagoons, pipes and pump station
- Maitai clear water return pipe

Maitai Duplicate Pipeline:

- Maitai duplicate pipeline and valves
- Pump station
- Valve chamber
- Interconnection chamber
- Cathodic Protection system

For details of each component reference should be made to the Operations and Maintenance (O&M) manual.

Fulton Hogan Water

4. Asset Condition and Performance Standard

The Water Treatment Plant and Roding Transfer pipelines were new on August 2004.
The Roding High Level Reservoir was new on June 2011
The Maitai Duplicate pipeline was new on August 2014
Performances standards are:

CONDITION	Roding to Tantragee Pump Station/Pipeline Ml/d	Minimum Plant Capacity Ml/d	Tantragee to Roding Pump Station/Pipeline
1) Normal Maximum	16 (net through plant)	52	16
2) Emergency	22 (gross)	N/A	N/A

4.1 Service Standards

4.1.1 Buildings and structures

Buildings and structures were generally provided with service for 50 years. This will be achieved following on-going inspection and periodic maintenance.

4.1.2 Pipelines and Mechanical Plant

Pipelines and pumps will generally provide service for 20 years. This will be achieved following on-going inspection and periodic maintenance.

4.1.3 Electrical Equipment

Electrical equipment will generally provide service for 15 years. This will be achieved following on-going inspection and periodic maintenance.

4.1.4 Controls

Controls will generally provide service for 10 years. This will be achieved by observation during use and prompt attendance to any issues that arise.

Fulton Hogan Water

5. Remaining Useful Life

The assets are made up of a large number of components.
For details of each component reference should be made to the Operations and Maintenance (O&M) manual.

An Excel spreadsheet of all items of equipment is held electronically at the Water Treatment Plant and in hard copy within the O&M manual.

During the operations phase of the Water Treatment Plant by Fulton Hogan, the operator will enter an estimate of the remaining life of each component onto the equipment list spreadsheet.

6. Maintenance Management Plan

The maintenance of the assets will be focused on ensuring that performance standards are reliably met. Components critical to achieving the required performance are to be maintained as a priority.

During the Operations phase of the WTP by Fulton Hogan, the operator will update and manage a maintenance plan.

The maintenance plan will form part of the O&M manual, and be drawn from vendor data on each item.

7. 10-year Renewals Programme

During the Operations phase of the WTP by the Fulton Hogan, the operator will identify a prioritised 10-year component renewals programme.

This will be entered as a column on the Equipment List.

The operator will use the above mentioned estimate of the remaining life of each component to predict required renewals.

This schedule will be adapted for incorporation into the Long Term Plan 2021/31

Appendix Figure K-2: WTP Renewals schedule from contractor September 2020

Draft Summary September 2020

NWTP 10 year renewals schedule ($x1000)

Finacial year	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
Analysers	-	-	-	-	-	101	71	53	60	100	-
Blowers	-	-	-	-	19	26	7	12	97	102	177
CIP Dosing	2	2	31	-	-	-	-	-	-	-	-
CIP System	-	-	-	29	2	10	-	8	-	21	-
Ferric Dosing	-	-	2	17	9	-	-	-	-	-	1
Plant External	-	2	-		55	-	-	-	-	-	-
Lower Level	-	-	-		16	26	-	-	-	-	-
Rej & Sup	-	-	29	5	66	6	2	15	6	-	-
CW PH	-	-	-	37	8	12	140	-	-	-	-
RW PH	-	-	3	28	150	29	33	9	-	0	-
Soda Ash	-	-	25	-	33	5	8	2	-	5	-
Cl_2	-	-	4	-	12	-	-	-	-	28	-
Switch Room	-	-	32	7	-	7	-	31	2	8	8
Tanks	-	2	5	113	-	2	3	2	-	77	-
Trains	-	-	24	122	178	19	12	7	14	48	106
										-	
Total	2	2	153	357	546	243	274	140	178	387	291
Maitai			28	28	28	28	28	28	28	28	28
Cassettes	-	-	-	-	-	168		3312	3480		
Total Renewals	2	2	153	357	546	411	274	3452	3658	387	319

Note: This does not include:

- Some electrical and electronic components in the MCC
- The Emergency Generator
- The PAT
- The HLR or associated componenets
- The Duplicate Pipeline and associated equipment
- A consideration for the buildings and structures

Maitai - A very rough estimate has been made on the equipment and the total renewal cost is spread over the period

Cost based on 2.5% inflation compounding on 2004 values (indicated in the 'Total' column of the attached sheets)or the last renewal

APPENDIX L: SOLUTIONS TO FIRE FLOW LEVEL OF SERVICE

2016 fireflow testing was undertaken to validate the hydraulic model and review prioritisation of fireflow projects.

As a result of the testing the following additional hydrant flow testing failures were identified:

Moana Ave x 2

Matuka Place 1 of 2

Quebec Rd x 2

St Lawrence x 3

Cape View x 2

Arrow St x 2

Brooklands Way x 2

Previously identified solutions to Breaches of Fire Flow Level of Service:

Champion Tce: 22 properties affected

Create a connection between the 350 main and the 100 main either at 66 or 49 Bisley Ave. This fixes the issue for 21 properties. 8 Bisley Ave is 145m from the nearest hydrant (should be 135m). This can be fixed by shifting the hydrant to the corner by 10 Bisley (but probably not worth it). Bisley Avenue solution likely to require upgrading 40mm rider main to 150dia main to support hydrant flows. Programme in for future AMPlan 2018/19. PR 15/12/2014. Design started but not yet complete.

Moncrieff Ave: 10 properties affected

Renew 262m of 100 cast iron main with 100 PVC from the start of Moncrieff Ave to 25 Moncrieff Ave. Design started but not yet complete.

Montcalm St: 8 properties affected

Renew 100m of 100 cast iron main from 47 Wolfe St north to the walkway between 31 and 37 Wolfe St. Lay 50m of 100 main up the walkway with a hydrant at the end. This fixes fire flows for 5 properties: 30, 32, 34, 37 and 39 Montcalm St.

Remaining 3 properties: 68Arrow St has no house on it (owned by same owners as 70 Arrow St). 70 Arrow St is 186m from the hydrant at the end of Arrow St. 50 Arrow St also fails. To fix these, renew 620m of 100 CI from Washington Rd, up arrow St, down walkway to Quebec Rd and to end of Arrow St. Extend another 40m to the very end of Arrow St and put on a hydrant and then it will get to within 146m of 70 Arrow St house and fix 50 Arrow St.

Strathaven Pl: 20 properties affected

Note that 27, 31, 35, 39, 40 and 43 Strahaven Pl have C0689 (Non Compliance Fire Service) condition so are not included. Replace 123m of 50 HDPE with 100 main from Strathaven tanks down to where it meets the 150 main. Also put a new hydrant on the high side of the NRV outside 17 Strathaven Pl. Now only 1 property – 34 Strathaven Pl fails.

Hazells Way: 5 properties affected

Replace the first 50m of 40 dia main in Manchester Way with 50 dia main and put a hydrant in at the corner. Design started.

Norwest Way / Seawatch Way: 4 properties affected

Note there are 2 fire hydrants on tanks in Seawatch Way to cover the top 6 houses in Seawatch Way. However 10 and 15 Seawatch Way are not adequately covered by these (not within 135m). These are not included in this evaluation as we cannot fix them with reticulation.

Would have to have a pump to fix these as the top hydrant (which still 142m from the furthest house) is not 10m below the tanks.

Chamboard Pl: 3 properties affected

A new hydrant outside the property boundary of 5 and 7 Chamboard Pl at the 89.5m contour will deliver 25l/s and is within 135m of the 3 properties. Note this is only 15m from the existing hydrant so not sure if it's worth it. Install new hydrant outside No7, halfway between existing hydrants.

Point Rd: 4 properties affected

These properties are located near the portion of Point Rd which is subject to high tide so no easy solution.

Orakei St: 4 properties affected

Replace 258m of 100 AC with 100 PVC. Design started.

20a Matipo Tce: 1 property affected

The driveway to this house is 200m on its own – would need a dedicated fire main.

Atmore Tce: 6 properties affected

Putting a new hydrant at the 129m contour and 66m of 150 main leading down to it from the tank (new and replace existing 100 dia) gets 25 l/s which fixes 4 properties. 46 Atmore is too far away so would require a pump.

City Heights: 2 properties affected

Need a new hydrant 20m on from the last hydrant (connected by 100 dia main) so that 7 City Heights is within 135m. Also need to replace 100m of 100 dia with 150 dia main from Cleveland Tce to City Heights.

Cherry Ave: 4 properties affected

The Stoke pressure reduction scenario had Baigent Rd from The Ridgeway to Cherry Ave being upgraded to 150 and Cherry Ave being renewed in 100 PVC to fix this.

Willow Ave: 2 properties affected

Upgrade 128m of 100 main to 150 in Ranui Rd from Main Rd to Willow Ave. Upgrade 80m of 100 main to 100 PVC in WilloW Ave from Ranui Rd to the first hydrant.

17B Titoki St

Nearest hydrant is 20m too far away. Need new hydrant outside 17 Titoki.

Nearest hydrant is 20m too far away. Need new hydrant outside 17 Titoki.

Properties Needing Further Investigation

10 and 15 Seawatch Way

5 and 5A Te Ata Pl

6 Ngapua Pl

12 Naumai St

9 and 13 Werneth Ridge

49, 51, 53, 55, 56, 58, 60 St Lawrence St

APPENDIX M: MATAI DAM SAFETY REVIEW

Appendix Table M-1: Damwatch Engineering Maitai Dam 2018 Comprehensive Safety Review Summary of Dam Safety Issues:

No.	DSI Type	Dam Safety Issue	Comments/Advice	Report Ref.
CDSR 2019-01	Physical Infrastructure Issue	The condition of the anchors in the base of the valve tower is unknown and therefore the stability of the tower and valve chamber under extreme seismic loads is uncertain.	The anchors are submerged in the bed of the reservoir. It is therefore not practical to investigate the condition of these anchors. However, it is not known on how much reliance is placed on the anchors during an extreme earthquake. A re-assessment of the valve chamber stability with updated seismic loads would clarify the issue.	3.9
CDSR 2019-02	Non-Conformance	The NZ Dam Safety Guidelines recommend a site specific seismic hazard study should be completed for High PIC dams. An appropriate study is not available.	A site specific seismic hazard study should be completed for Maitai dam by an appropriate specialist using both deterministic and probabilistic analyses.	4.2.3
CDSR 2019-03	Potential dam safety deficiency	The failure modes report states that the service spillway has been founded on rock as a defensive measure. However, there is no evidence or records confirming that this is the case.	It is recommended that the NCC archives are searched for any construction records that confirms the quality of rock in the service spillway foundation.	5.0 FM22
CDSR 2019-04	Potential dam safety deficiency	A potential deficiency in the spillway chute reinforcement was identified during the 2013 CDSR.	The strength of the spillway and expected damage during an extreme earthquake should be investigated to improve confidence in the ability to continue operating following an earthquake. This investigation should also consider the damage that could occur to the embankment in the event of a breach.	5.0 FM23
CDSR 2019-05	Potential dam safety deficiency	The performance of the auxiliary spillway depends on the quality of the rock and its ability to withstand high flows. No records are available to confirm the strength and condition of the rock in this area.	The NCC archives should be searched for any construction records that confirm the quality of the rock in the auxiliary spillway foundation. An assessment of the vulnerability of the foundation for backwards erosion under the weir crest should be carried out.	5.0 FM25 and 26

No.	DSI Type	Dam Safety Issue	Comments/Advice	Report Ref.
CDSR 2019-06	Potential dam safety deficiency	The estimated freeboard between maximum PMF flood level and dam crest is only 0.09 m. This could potentially lead to overtopping by waves	It is recommended that a review is carried out of the wave heights and run-up that will occur on Maitai Dam upstream face. This should then be compared with the present estimates of maximum reservoir level and dam crest plus confirmation of the adequacy and height of the wave boards.	5.0 FM27, 8.2.1
CDSR 2019-07	Potential dam safety deficiency	FM29 considered failure of the spillway and adjacent embankment due to overtopping of the side walls. However, no hydraulic assessments were carried out to confirm the credibility of this failure mode.	It is recommended that a hydraulic assessment is undertaken for the PMF to estimate the freeboard to the top of the walls and potential areas of overtopping.	5.0 FM29
CDSR 2019-08	Physical Infrastructure Issue	Minor seepage and exposure of embankment material in the joint observed along the true right of the Bay 9 culvert joint.	It is unclear if this seepage and exposure of embankment material is deteriorating. It is recommended to include the Bay 9 joint as a visual observation point in the routine monitoring.	6.1
CDSR 2019-09	Physical Infrastructure Issue	Wet spot observed along the first step, immediately downstream of the diversion culvert on the right hand side	The source of this seepage is unclear and it could be seepage from the true right side of the culvert. It is recommended to include this wet spot as a visual observation point and monitor for any changes or development	6.1
CDSR 2019-10	Physical Infrastructure Issue	The readings in P23 and P27 are considered unreliable.	At present it is unclear if the piezometers are dry or the small amount of water at the base of the piezometer correctly indicates the level of the phreatic surface. If the latter is the case then the downstream shoulder could be locally saturated and potentially unstable. An assessment should be made of the reliability of the instruments and measured data, and consideration given to supplementary monitoring in this location. The level of the location of the piezometers and the tip levels should be investigated as part of this issue. This should also include B23, B27, SB1-3 and BH7 for which there is no as built data.	7.3.2
CDSR 2019-11	Potential dam safety deficiency	The seepage monitoring records indicate small changes	Separately these changes do not appear significant and none of the changes exceeded the design alarm levels for seepage. However, they could be related to several failure modes. The	7.3.3

No.	DSI Type	Dam Safety Issue	Comments/Advice	Report Ref.
		to seepage flows in several areas	alarm levels have not been reviewed since the design stage and the capacity of the drainage system is unknown. A review of the drainage system would assist in the understanding of the cause of the recent changes and the risk of initiation of a failure mode. In particular the review could provide guidance on: • Cause of fluctuations in seepage flow and risk of initiation of internal erosion, • expected seepage flows based on the collected data (piezometer and seepage), • review of the alarm levels (this should cover all monitoring systems, • the capacity of the drainage system to cope with concentrated flows due to seismically induced cracks, • the risk of internal erosion due to incompatible materials and • the adequacy of the drainage monitoring system to collect all of the seepage flows.	
CDSR 2019-12	Physical Infrastructure Issue	The performance of the service spillway depends on an adequate drainage system. Repairs have already been carried out to the spillway chute joints. However, the condition of the spillway drainage is unknown.	It is recommended that the spillway drainage system be assessed for condition and performance, and flushed to maintain functionality, as far as is practicable. The records of the previous repairs should also be reviewed to understand the cause and confirm the extent of the damage. Spillway drains should be inspected whenever the spillway is in operation to identify any leaks in the spillway chute. This should be an ongoing dam safety observation.	7.3.4
CDSR 2019-13	Physical Infrastructure Issue	Not all of the service spillway monitoring points were able to be accessed during the most recent survey due to the construction of a fence and the auxiliary spillway crest and fuse boxes are not included in the survey. Survey results are	Several improvements are suggested to improve the monitoring and assessment of the dam deformations: • Access is improved to allow monitoring of all survey points • The dam survey mark locations and movement vectors be plotted onto the as-built valley cross sections so that deformations can be evaluated in the context of foundation geometry and time series plots provided	7.4

No.	DSI Type	Dam Safety Issue	Comments/Advice	Report Ref.
		also not presented in a clear manner for interpretation.	• Survey points are added to the auxiliary spillway crest and its fuse boxes to confirm the freeboard to the crest and monitor movement.	
CDSR 2019-14	Non-conformance	No KPIs assigned to PFMs. FMEA still in draft form.	It is recommended that the FMEA is finalised and that KPIs associated with each of the PFMs are formally identified. A review of the performance monitoring system should also be carried out to ensure that all credible PFMs are monitored	7.5
CDSR 2019-15	Physical Infrastructure Issue	The auxiliary spillway crest requires the upstream face to be complete so that it does not fuse too early. At present no specific checks are required on this area following high reservoir levels and therefore deterioration of the fuse area may not be identified.	It is recommended inspection of the upstream slope area of the auxiliary spillway be performed following unusual high reservoir levels.	8.2.2
CDSR 2019-16	Physical Infrastructure Issue	If pressures in P23 and P25 are confirmed as valid, this would indicate that the chimney drain is ineffective and that the downstream shoulder is not dry. The design assumes that the downstream shoulder remains unsaturated and therefore it could become unstable if it becomes saturated.	If the results of the investigation of P23 and P25 indicate saturation of the downstream shoulder then slope stability analysis should be performed for Maitai Dam.	8.3.1
CDSR 2019-17	Potential dam safety deficiency	Performance of the embankment under earthquake loading cannot be assessed with certainty due to outdated ground motions and assessment methods.	It is recommended that an assessment of seismic-induced deformations (settlement and cracking) be performed following development of ground motions from the site specific seismic risk study (CDSR2019-02), and confirmation of the downstream shoulder seepage conditions (CDSR2019-15). The assessment should also include the potential for internal erosion as a result of seismic induced cracking.	8.3.1

No.	DSI Type	Dam Safety Issue	Comments/Advice	Report Ref.
CDSR 2019-18	Potential dam safety deficiency	Internal erosion has not been assessed under normal conditions using modern practices. Fines have been identified in the seepage monitoring system which could indicate initiation of internal erosion	It is recommended an assessment of potential internal erosion be performed for Maitai Dam embankment materials using current practice. This should include all materials including the embankment, chimney drain and other drainage materials.	8.3.2
CDSR 2019-19	Non-Conformance	Performance of the scour offtake are not well understood.	It is recommended that the performance characteristics of the Maitai Dam scour offtake are understood for the purpose of emergency dam dewatering.	8.5
CDSR 2019-20	Physical Infrastructure Issue	Following an earthquake, there may be sufficient water ingress into the culvert (through culvert joints or pipe damage) to prevent access to the isolation valves in the valve chamber.	The robust of the remote valve access should be investigated to ensure that the valves can be either opened to lower the reservoir or closed to isolate the pipe through the culvert following a major earthquake which causes leakage into the culvert.	8.5
CDSR 2019-21	Non-Conformance	No formal documented DSMS was provided for review. In particular there appeared to be no system of tracking and resolution of dam safety deficiencies identified during previous CDSRs.	It is recommended that NCC develop a DSMS in line with the NZ Dam Safety Guidelines. This should include procedures for ongoing surveillance activities, including a process to ensure evaluation, quality assurance and follow up of routine monthly surveillance data collected. It should also include procedures for the investigation, assessment and resolution of dam safety deficiencies be formalised.	10.5
CDSR 2019-22	Non-Conformance	There does not appear to be a complete Emergency Action Plan	It is recommended that the Maitai Dam Emergency Action Plan is completed in alignment with the NZ Dam Safety Guidelines 2015, that NCC staff and emergency agencies become highly familiar with it, and that it is tested for effectiveness and areas identified for improvement addressed. The latest draft is unclear in several areas and is missing key information.	10.5

Appendix Table M-2: Tonkin & Taylor Maitai Dam Intermediate Dam Safety Review 2020 Summary of Recommendations

ID	DSI [2]	Description and comments	Priority [1]
Significant events – earthquakes (Section 2)			
IDSR 2020-1	NC	Review the OM&S manual to clarify definitions and thresholds for 'significant events' earthquakes, alarm level(s) (if appropriate), subsequent actions, responsible parties, and reporting and record keeping requirements.	Necessary
Significant evets – rainfall (Section 2.2.2)			
IDSR 2020-2	NC	Review and update the OM&S manual to confirm 'heavy rainfall' event trigger level(s) and subsequent monitoring and reporting requirements.	Necessary
Hydraulic piezometers (Section 2.3.1)			
IDSR 2020-3	PDSD	Piezometer instrument and recording system review including, instrument functionality, de-airing processes, automated reading system, responses to alarm levels, causes for high readings in downstream shoulder, etc. with any changes adopted carried through to a revised OM&S.	Necessary
Standpipes (Section 2.3.2)			
IDSR 2020-4	PII	Maintain all standpipes, and the report results. This could include a recorded micro-camera visual inspection of the standpipe, flushing / bailing-out of the water and response zone, and an appropriate permeability test (e.g. falling or rising head test).	Necessary
Seepage monitoring (Section 2.5)			
IDSR 2020-5	PII	Rationalise and standardise the seepage qualitative flow terminology (including assignment of numerical flows / flow ranges to qualitative terms) and updated any adopted changes in the OM&S manual.	Necessary
IDSR 2020-6	PDSD	The reliability of the method and procedure to monitor suspended sediment and /or turbidity in the seepage flows should be improved. This could include assessing the practicalities of incorporating automated data capture into the surveillance programme. Any adopted recommendations, including trigger levels etc., should be updated in the OM&S manual.	Necessary
Embankment and abutments (Section 4)			
IDSR 2020-7	PDSD	Top up small area of rip rap near the right abutment of the service spillway.	Necessary
IDSR 2020-8	PII	Vermin proof the outlet of the RHS auxiliary chimney drain on the dam face.	Necessary
Service spillway (Section 5.1)			
IDSR 2020-9	AMR	The system and procedure for entering the spillway floor is assessed and upgraded, if necessary, to maintain health and safety of staff	Priority
IDSR 2020-10	PDSD	The spat-rope residual flows, and associated algae growth (up to approximately 2 to 3 m wide) is preventing visual inspection of the right-side of the service spillway floor. We recommend that the OM&S manual is updated so as soon as practicable this area is temporarily cleared and visually inspected. This inspection should be repeated, on average bi-annually thereafter.	Necessary
IDSR 2020-11	PDSD	Undertake additional investigations and assessment of the new transient seepage flows from the service spillway floor joints at slab 4. The OM&S manual should be updated as appropriate.	Priority

Auxiliary spillway (Section 5.2)			
IDSR 2020-12	PDSD	Investigate and assess potentially new, and existing, seepages in the auxiliary spillway. The OM&S manual should be appropriately updated with findings and a system for ongoing monitoring of these seepage areas.	Necessary
Intake tower (Section 6)			
IDSR 2020-20	PDSD	A structural engineer should review the divers report, and supporting information (e.g. photos and videos etc.) on the potential local corrosion of weld near the ends of horizontal struts, and provide advice on strategies and timeframes for repair (if any).	Priority
Concrete culvert and valve chamber, and external valves (Section 7.1)			
IDSR 2020-13	PII	Undertake a detailed baseline visual inspection and assessment of the condition of the culvert walls and joints (e.g. logging and photographing the extent and type of deposits and flow etc.) (refer also DSR 2013-8 and CDSR 2019-8).	Necessary
IDSR 2020-14	PII	Water should be drained from a pipe bracket U-channel section upstream of the chimney drain, which was full of seepage water by drilling a drain hole in the side wall or base of the channel (Photograph 7 2). Any exposed steel should be appropriately painted and protected.	Necessary
External piping and surrounds (Section 7.3)			
IDSR 2020-15	PII	Repair local minor damage to protective tape wrapping the pipework downstream of the cone valve in accordance with the requirements of the OM&S Manual	Priority
Control building and surrounds (Section 7.4)			
IDSR 2020-16	PII	Secure the timber reveals in the old chlorination room doorway.	Priority
IDSR 2020-17	PII	Caretaker to arrange for repair of minor, but enlarging, rust area in control room pipework where it enters the floor. T+T can provide advice on repair technique upon request.	Necessary
IDSR 2020-18	PDSD	Engage a structural engineer to complete a seismic assessment of the control building (if not already undertaken).	Necessary
South Branch Intake (Section 10)			
IDSR 2020-19	AMR	Review potential that residual flows discharging onto South Branch rock armour could be a slip hazard, particularly during frosty conditions.	Priority

APPENDIX N: TOTAL MONTHLY DEMAND

Appendix Table N-1: Total Monthly Demand

Month	2008 - 2009		2009 - 2010		2010 - 2011		2011 - 2012		2012 - 2013		2013 - 2014		2014 - 2015		2015 - 2016	
	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)
July	420	204	315	280	NA	NA	268	313	309	277	336	239	330	199	328	202
Aug	319	298	381	220	NA	NA	286	315	444	140	367	212	299	237	291	228
Sept	361	238	485	69	359	208	291	316	353	200	330	226	324	201	331	197
Oct	323	299	364	256	348	252	318	258	394	196	403	172	300	288	344	237
Nov	423	182	382	322	356	344	346	278	398	288	355	286	434	260	358	275
Dec	447	179	435	306	413	252	441	194	429	300	421	273	480	170	426	252
Jan	444	322	458	281	410	278	425	278	487	238	443	241	405	346	536	100
Feb	345	330	403	307	348	330	325	331	376	271	361	309	451	171	455	201
Mar	439	246	456	313	385	267	409	214	393	281	458	225	490	130	359	296
Apr	381	247	483	208	398	178	319	268	365	195	418	173	356	201	569	11
May	465	108	421	218	467	82	328	267	389	195	298	248	278	260	528	40
June	329	255	412	197	349	209	363	189	385	153	318	211	301	212	374	151
Sub-Total	4,696	2,908	4,995	2,977	NA	NA	4,119	3,221	4,722	2,734	4,508	2,815	4,448	2,675	4,899	2,190
Total ($000m^3$)	7,604		7,972		7,188		7,340		7,456		7,323		7,123		7,089	

Month	2016 - 2017		2017 - 2018		2018 - 2019		2019 - 2020	
	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)	Maitai (000m3)	Roding (000m3)
July	292	243	479	66	369	199	360	193
Aug	309	237	496	63	368	234	303	256
Sept	297	238	477	62	328	251	306	236
Oct	391	151	513	74	348	259	320	242
Nov	346	217	557	108	359	272	338	245
Dec	385	233	579	202	438	235	389	217
Jan	384	281	534	109	597	228	414	335
Feb	341	278	387	80	651	45	466	212
Mar	416	230	531	93	490	143	413	190
Apr	492	72	349	219	309	257	346	234
May	492	74	377	157	320	243	366	222
June	482	68	223	295	272	270	375	202
Sub-Total	4,627	2,322	5,502	1,528	4,849	2,636	4,396	2,784
Total ($000m^3$)	6,949		7,030		7,485		7,180	

APPENDIX O: DECISION CRITERIA (RENEWAL)

Appendix Table O-1: Decision Criteria (Renewal)

Indicator or Attribute	Definition	Weight
Public water supply asset	Does the section meet the criteria for a water supply asset	Y/N
Life safety or injury hazard	Would failure of the asset present a life safety or injury hazard	Y/N
Damage to property or roads	Is there evidence that more than minor damage to property or roads would be directly attributable to the failure of the water supply asset	Y(1-5) /N(0)
Overall system capacity	Can the asset cope with demand and meet the levels of service	Y(1-5) /N(0)
Number of properties covered	Does the asset (location and or material) serve multiple properties (See public water supply asset)	1-4 (1) 5-9(2) 10-19(3) 20-49(4) 50+(5)
Multiple system failures: Location	Has the asset failed more than once in the past 5 years?	Y 2-3(2) 4-6(5) 7+(8) N(0)
Multiple system failures: Material	Has the asset failed more than once in the past 5 years?	Y 2-3(2) 4-6(5) 7+(8) N(0)
Other NCC works in same general location	Is there an opportunity to combine works	Y(2)/N(0)
Condition Assessment	Results of condition assessment (Scale 1-5, Best-Worst)	1-2(0) 3(2) 4(4) 5(5)
Asset Criticality	Is it a critical asset	Y (10) N (0)