City of Barrie
Water Asset Management Plan
Current and Proposed Levels of Service

September 29 2021
Rev. 3

Prepared by SLBC Inc.

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Executive Summary

Purpose of the Water Asset Management Plan

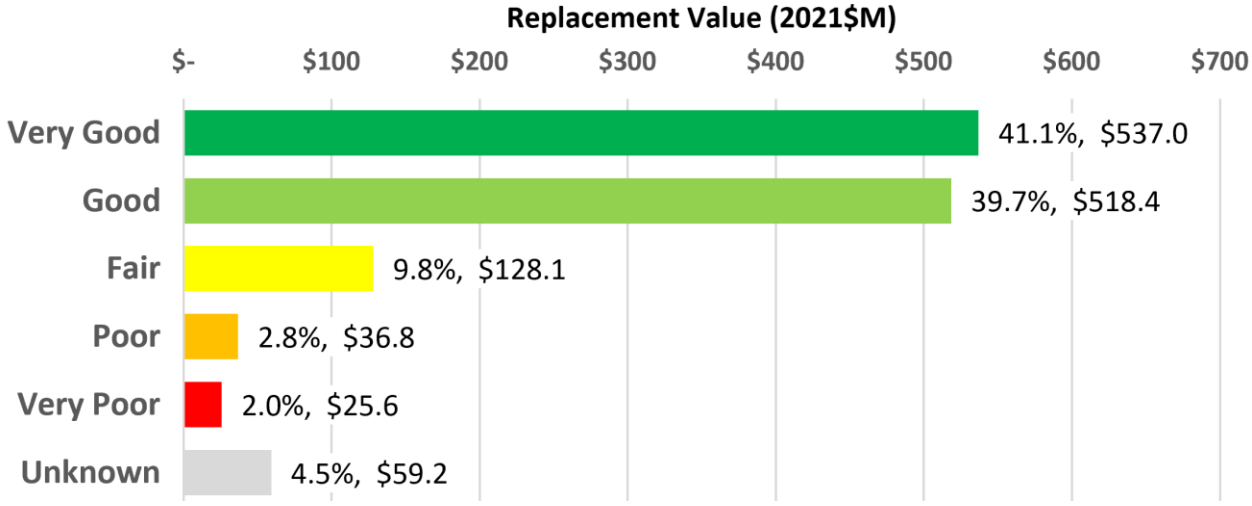
Asset management planning for water services is a comprehensive process to ensure municipalities can deliver safe drinking water in a way that minimizes risk and is financially sustainable. This Water Asset Management Plan presents information about the City of Barrie's water service assets including actions required to provide an agreed level of service in the most cost effective manner while outlining associated risks as required by Ontario Regulation 588/17, Asset Management Planning for Municipal Infrastructure. This Water Asset Management Plan defines the levels of services to be provided (referred to as proposed or target levels of service) and how the services will be provided. It forecasts what funds will be required to provide the services over the next 10-year planning period and identifies any shortfalls, associated risks and mitigation plans.

State of Local Infrastructure

The City of Barrie owns and manages physical assets that support the supply, storage, transmission and distribution of safe drinking water. Water service assets include the surface water treatment plant, wells, storage towers and reservoirs, pumping stations, water mains, valves, hydrants and meters, which together total over **$1.305 billion** in replacement value (2021 $).

As shown in Figure E-1, **90.6% of the City's water assets are currently in fair or better condition** which is referred to as a "state of good repair", and 4.8% are in Poor or Very Poor condition. The condition of the remaining 4.5% of assets is unknown, most of which are water mains, valves and valve chambers.

Figure E-1 Current Condition of Water Service Assets (2021$M)



Assets in Very Poor condition are due or overdue for replacement, and are often called the “renewal backlog”. The renewal backlog for water assets is currently 2.0% of the total replacement value, or **$25.6 million**, consisting of the following asset types:

- Water mains ($7.7 million)
- PRV Chambers ($6.1 million)
- Water meters ($6.9 million)
- Components of booster pump stations ($4.2 million), towers & reservoirs ($0.6 million) and wells ($0.1 million).

The water network is anticipated to grow by $250.8 million through developer contributions and City contracted construction to **$1.556 billion** (2021$) by the end of the 10-year planning period ending in 2031.

Over the next 10 years, the growth of the water network will add assets in very good condition. Over the same time period, existing assets will deteriorate, with some moving down from one condition state to another, and renewal investments, made possible with available funding, will improve the condition of some assets – generally those that pose the highest risk. By 2031, with available renewal funding of **$71.9 million**, the renewal backlog is forecast to be 1.8% of the 2031 replacement value, or **$28.6 million**.

Levels of Service

The City exists to provide services. Services are defined and performance is assessed according to the following attributes:

- **Capacity and Use:** Services have enough capacity and are accessible to customers
- **Function:** Services meet customer needs while limiting health, safety, security, natural and heritage impacts
- **Reliability:** Services are reliable and responsive to customers
- **Affordability:** Services are affordable and provided at the lowest cost for both current and future customers.

Performance is measured and assessed against community and indicators as required by Ontario Regulation 588/17, as well as measures defined by the City to align service delivery with its Drinking Water Quality Management System Policy and Strategic Asset Management Policy.

Table E-1 below shows the water services that the City proposes to provide described through a series of community objectives and service measures. These community objectives and service measures are supported by asset objectives and technical measures which are provided in the body of this Asset Management Plan. Table E-1 provides the current (2021) performance and forecast future performance in 10 years (2031). The target is a community performance grade of Good.

On average, the City’s water service has adequate capacity, meets customer needs and is reliable – now and forecast for 2031. However, the adequacy of funding over the next 10-year period is currently rated as Fair. Water service performance is projected to be sustainable over the 10-year planning period from 2022 to 2031 despite the short term funding shortfalls. This is in large part due to the small proportion of the City’s water assets

currently in Very Poor physical condition. **As the City's assets continue to age, the needs for investment to support reliability objectives will increase, requiring additional funding.**

Table E-1 Proposed Water Service Objectives and Measures

COMMUNITY Objectives	Community Service Measures	2021 Community Performance Grade	Expected 2031 Performance Grade*
Capacity & Use Services have enough capacity and are accessible to everyone	Properties have adequate availability of water service	Good	Good
	Properties have adequate availability of fire flow	Good	Good
Functionality Services meet customer needs while limiting impacts to health, safety, security, nature and heritage	Drinking water is safe	Very Good	Very Good
	Energy consumption and associated costs are minimized	Very Good	Very Good
	Water losses are minimized	Very Good	Very Good
Reliability Services are reliable and responsive to customers	Water assets are kept in a state of good repair	Very Good	Very Good
	Water mains remain intact	Very Good	Very Good
	Hydrants are reliable	Very Good	Very Good
Affordability Services are affordable, provided at lowest cost for both current and future customers	Service capacity is adequately funded in the short term	Fair	**
	Service reliability is adequately funded in the short term	Fair	**

* based on Available Funding (2021 Budget Plan) ** Funding for 2032 to 2041 not available

Risk Management Strategy

The City's key asset management principle is to meet service levels and manage risk while minimizing lifecycle costs. Asset criticality is determined based on the degree to which a failure of the asset would impact the community levels of service attributes of capacity and use, function, and reliability.

Pipe capacity risk was assessed in part based on fire flow velocity. Approximately 8.5 km of pipes with an estimated replacement value of $5.0 million have flow velocity >4.5m/s under fire flow conditions. Of those, 2.3 km with an estimated replacement value of $1.3 million have a condition score of Poor or Very Poor. As such, these latter segments should be prioritized for expansion / replacement in the capital plan.

The risk of not meeting the stated reliability levels of service was assessed based on asset criticality and life consumed based on condition inspections or age.

- **Current Risk:** It was found that **$9.49 million** (0.76%) of water assets are currently in the extreme risk category, consisting of a 1.5 km ($5.0 million) segment of transmission main along Ferndale Road from Tiffin Street to Ardagh Road that is currently shut down, $0.4 million of building electrical and mechanical systems at the

Leacock Booster Pumping Station, and various site works and building assets at the other booster pumping stations.

- **10-Year Forecast Risk, no Funding:** The deterioration of the water network due to age and use over the next 10 years is forecast to increase the water assets in the extreme risk category to **$54.98 million** (3.85% of the expanded / upgraded asset portfolio), if no funding is available.
- **10-Year Forecast Risk, with Available Funding:** If the extreme risk category assets are prioritized for replacement based on available funding of $71.89 million in the 2021 10-year capital plan, the forecast water assets in extreme risk category will be reduced to **$0.40 million**.

Lifecycle Management Strategy

The City uses its understanding of risks of not meeting proposed or target levels of service to inform the timing and amount of investments needed in infrastructure assets. The City aims to provide sufficient service capacity to meet demand and manages the added expansion, upgrade, operations, maintenance, and renewal of assets to meet defined service levels, including legislated and other corporate requirements.

To satisfy the City's capacity commitments, the total expansion need is estimated at **$247.6 million** for the period 2022-2031 for an average of $24.8 million per year, including assets to be constructed in the Salem and Hewitt Secondary Plan Area (developer-constructed and City-constructed), as well as assets being expanded within the former City boundary, including water mains and the Anne Street Booster Pumping Station. The City also pursues non-asset alternatives to system expansion including water conservation programs to reduce water consumption.

Upgrade needs total **$3.25 million**, or $0.325 million per year averaged over 2022-2031. These projects include installation of solar panels on the SWTP and well upgrades.

A renewal backlog of $25.6 million of assets in Very Poor condition currently exists as described under the State of Local Infrastructure heading above, including $7.7 million worth of water mains. As those water mains are replaced, it is estimated that $2.7 million worth of connected hydrants, valves and valve chambers will also be replaced (a 35% additional "connected assets" cost for replacing the water mains). As such **$28.3 million** will be needed to clear the current backlog and connected assets. As the water network assets age and deteriorate, without increased renewal investment by the City, the current renewal backlog and replacement needs of connected assets is estimated to reach **$94.2 million** by 2031. To clear the estimated 2031 renewal backlog over the next ten years, the annual renewal need is **$9.4 million per year**.

The above paragraph describes the 10-year renewal needs based on current and forecast asset condition. It is important to also consider the renewal needs over the lifetimes of the water network assets as calculated by the total lifecycle renewal costs divided by expected asset life. The full lifecycle renewal needs for the water network asset portfolio in place over the next 10 years is estimated to be $23.3 million per year for the current asset inventory, increasing to $27.2 million by 2031, for an average of **$25.2 million per year** over the ten year period. The 10-year renewal needs are substantially less than the full

lifecycle renewal needs because the City's water network assets are currently in overall good condition.

The 2021 budget plan for operations and maintenance is $21.1 million to deliver the current level of operational activities. Additional scheduled condition assessments and repair program needs of $1.2 million have been identified to adequately deliver proposed operational services for a total current need of **$22.3 million**. The estimated annual cost for operations and maintenance is expected to grow by $0.59 million per year to cover operational costs associated with the planned expansion and upgrade of assets until 2031. Therefore, the forecast cost of operational service needs is expected be **$22.9 million** in 2022, increasing to **$28.2 million** by 2031 or an average of **$25.5 million** over the 10-year planning period.

Financing Strategy

Table E-2 summarizes the average annual cost of forecast lifecycle activity needs compared with planned funding over the 10-year period 2022 to 2031 and provides any shortfalls or funding gaps. The Asset Funding Ratio is an important financial performance indicator as it reports the percentage (%) of funding projected to be available to undertake the lifecycle activities forecast to be needed over the next ten years against a target of 90% for Good (95% or higher is considered Very Good, 80% is Fair, and 70% is Poor).

Since the forecast needs exceed the planned available funding, the City has funding "gaps" for each of the asset lifecycle activity types, ranging from Poor for Renewal to Fair for Expansion & Upgrade and Operations & Maintenance.

Table E-2 AM Plan Financial Summary

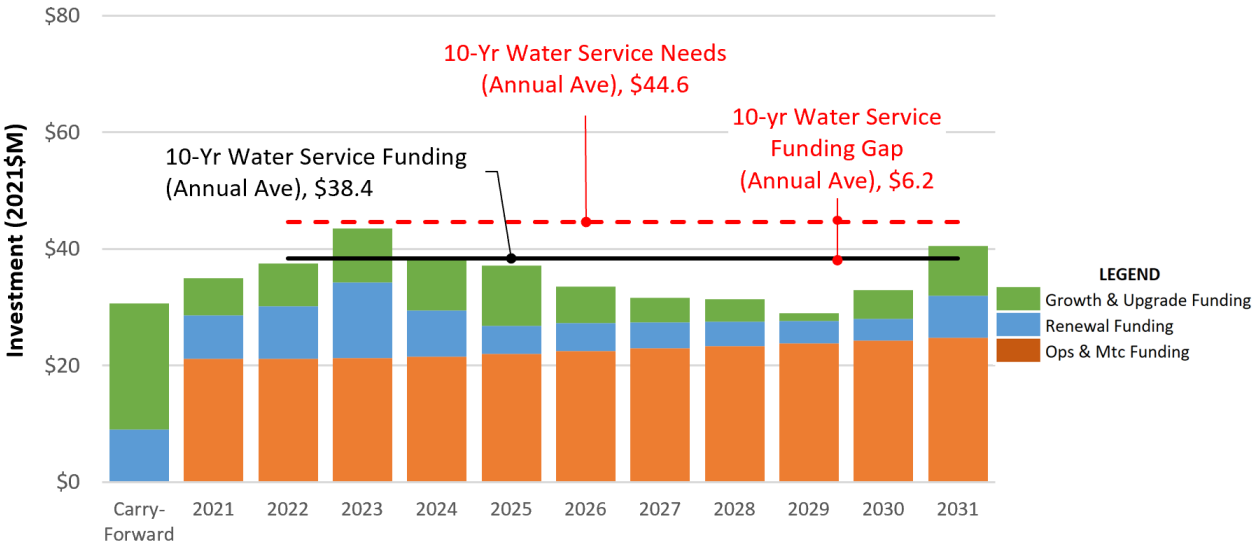
Service Attributes	Asset Lifecycle Activity	10-year (2022 – 2031) Ave Annual Amounts (2021$M/yr)				Full Asset Lifecycle Ave Annual Amounts (2021$M/yr)		
		Forecast Needs	Planned Funding*	Gap**	Funding Ratio	Forecast Needs	Gap**	Funding Ratio
Capacity & Function	Expansion*** & Upgrade	$9.7	$8.45	$1.25	87%			
Reliability	Renewal	$9.4	$7.19	$2.23	76%	$25.2	$18.0	29%
	Operations & Maintenance	$25.5	$22.81	$2.72	89%			
TOTALS	**All**	**$44.6**	**$38.45**	**$6.20**	**86%**			

** Includes Capital carry-forward, 3-yr Operating forecast and 7-yr 2% annual increase forecast*
*** Positive gap indicates that planned funding insufficient for need.*
**** Includes only assets to be constructed by the City.*

The above table also shows the cost of the forecast needed renewal activities over the full lifecycles of the water assets as **$25.2 million per year** and a full lifecycle (i.e. longer term) funding gap of **$18.0 million per year**. Although the City has a relatively small renewal funding gap in the shorter (10-year) term it will require significantly more funds over the longer term to sustain the water network in a state of good repair as the assets continue to age and deteriorate from use.

Figure E-2 summarizes the data from the preceding table. It shows the total cost of the forecast needed lifecycle activities over the next ten years as **$44.6 million per year** (dashed red line) and the budgeted annual funding as **$38.4 million per year** (solid black line), and the funding gap of **$6.2 million per year** for each of the next ten years, or $62 million over the next ten years. The graph also shows a significant amount of carry-forward capital funds, which are funds not used in 2021 and suggest a capacity issue for delivering funded capital projects.

Figure E-2 Water Asset Lifecycle Financial Sustainability



The risks associated with implementing the Water Asset Management Plan and the proposed actions in response to those risks are summarized in Table E-3.

Table E-3 Water AM Plan Risk Mitigation Summary

Service Attributes	Lifecycle Activity	Identified AM Lifecycle Risks	Risk Management Strategy
Capacity, Use and Function	Expansion and upgrade	The identified asset growth activity needs are not fully funded. The existing backlog of expansion projects suggests a need for additional effort by the City to deliver. These are considered minor risks, as development is occurring more slowly than expected at this time.	Monitor build-out of developments and continue to adjust expansion activities in Master Plans to suit. Investigate resourcing to deliver the large expansion program.
Reliability	Renewal	The identified asset renewal activity needs are not fully funded which may result in impact on asset reliability and service levels. A larger asset renewal program will require an increase in funding and effort by the City to deliver.	Completed the Water and Wastewater Financial Plan – Rate Analysis Study in April 2021 to identify and address funding gaps. Continue to use risk-based prioritization to address the most critical needs with limited funds. Investigate resourcing to deliver the large renewal program.
	Operations and maintenance	The identified operations and maintenance needs associated with a growing asset portfolio and to adequately address operational risks will increase operating funding expenditures.	Fund operations and maintenance activities to keep existing and expansion / upgrade water assets in a state of good repair.

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List of Abbreviations

AM	Asset Management
AO	Aesthetic Objective
BPS	Booster Pump Station
CDM	Conservation and Demand Management Plan 2020-2024
CoF	Consequence of Failure
CPP	Concrete Pressure Pipe
DWQMS	Drinking Water Quality Management System
ekWh	Equivalent kilo-watt hour
FF	Fire Flow
GIS	Geographic Information System
HDPE	High Density Polyethylene
ICI	Industrial Commercial Institutional
IIMM	International Infrastructure Management Manual
LOS	Level of Service
MAC	Maximum Acceptable Concentration
MDD	Maximum Daily Demand
MDWL	Municipal Drinking Water License
MECP	Ministry of the Environment, Conservation and Parks
MFOA	Municipal Finance Officers' Association
ML	Megalitre
OP	Official Plan
O.Reg.	Ontario Regulation
PCE	Perchloroethylene
PEX	Cross-linked polyethylene
PoF	Probability of Failure
PRV	Pressure Release Valve
PVC	Polyvinyl Chloride
QMS	Quality Management System
RoW	Right-of-Way
SWTP	Surface Water Treatment Plant
TCA	Tangible Capital Register
TCE	Trichloroethylene
WSD-MP	Water Storage and Distribution Master Plan Update (2019)

1 Introduction

1.1 Purpose of the Plan

1.1.1 Regulatory Requirements

This Water Asset Management Plan (AM Plan) aligns with the City's Strategic Asset Management Policy and fulfils the requirements of Ontario Regulation 588/17 Asset Management Planning for Municipal Infrastructure (O.Reg. 588/17) to report financial implications associated with current and proposed levels of service for core infrastructure.

Figure 1-1 shows the required sections of the AM Plan down the left side. The columns to the right show O.Reg. 588/17 requirements for current levels of service (centre column) and proposed levels of service (right column).

Figure 1-1 Ontario Regulation 588/17 Requirements

	Current Levels of Service AMP July 2022 (core), 2024 (non-core)	**Proposed Levels of Service AMP** July 2025 (core, non-core)
State of Infrastructure (asset register)	• Inventory of assets, by category • Replacement cost of assets • Average age of assets • Condition of assets • Approach to assessing condition	• Inventory of assets, by category • Replacement cost of assets • Average age of assets • Condition of assets • Approach to assessing condition
Levels of Service (performance)	• Current LOS (performance) provided: - To community (qualitative metrics) - By assets (quantitative metrics) • For core assets as per Tables 1 to 5 in O.Reg. 588/17 (as minimum), and as established by City for other assets	• Proposed LOS (performance) for the next 10 years - For community (qualitative metrics) - By assets (quantitative metrics) • And why appropriate based on risk and affordability assessment
Lifecycle Management Strategy	• Population and employment forecasts per 2019 Growth Plan • Lifecycle activities needed for each of the next 10 years to: - Meet demand caused by growth or upgrade of existing assets - Maintain the current LOS at least cost and acceptable level of risk	• Population and employment forecasts per 2019 Growth Plan • Lifecycle activities needed for each of the next 10 years to: - Meet demand caused by growth or upgrade of existing assets - Provide proposed LOS at least cost and acceptable level of risk
Financing Strategy	• Cost of lifecycle activities needed for each of the next 10 years to: - Meet demand caused by growth or upgrade of existing assets - Maintain the current LOS	• Cost of lifecycle activities needed for each of the next 10 years to: - Meet demand caused by growth or upgrade of existing assets - Provide proposed LOS • Funding projected to be available to undertake needed lifecycle activities • For funding shortfalls which activities will not be funded and associated risks
Implementation and Key Assumptions	• Statement on how all State of Infrastructure background information and reports will be made available to the public	• The risks and mitigation strategies associated with implementing the AM Plan • Explanation of key assumptions underlying the AM Plan that have not previously been explained

Water service assets are defined as “core municipal infrastructure assets” by O.Reg. 588/17, including assets that support supply, treatment, storage, transmission and distribution of drinking water.

Both this Water AM Plan and the Strategic Asset Management Policy are posted on the City’s website.

1.1.2 Corporate Requirements

The City of Barrie is responsible for a broad portfolio of assets that support the goals of water management. These goals, as currently modified from the City’s 2010 Official Plan, include:

- To ensure long term protection of drinking water resources. (OPA 24, Bylaw 2013-185)
- To provide safe, sanitary, environmentally sound and efficient methods of water treatment and distribution for residents, businesses, institutions and industries
- To work cooperatively with the Conservation Authorities to prepare watershed plans to guide development decisions and water servicing decisions
- To encourage measures which promote the efficient and sustainable use of water resources and the conservation of water through appropriate engineering and building requirements.

This AM Plan is a medium to long range planning document that is used to support the City’s goals by providing a rational strategy for proactively and effectively managing the City’s water assets. It provides a guide to understanding key items such as:

- The size, replacement value, and condition of City’s water asset portfolio
- The current levels of service standards and the City’s performance against them
- The assets that will be needed in the future to support water service delivery objectives and mitigate vulnerabilities
- The planned activities to sustain current and future water assets throughout their lifecycles at minimal cost, while mitigating vulnerabilities
- The funding sources for planned lifecycle activities
- The steps to improve future iterations of the AM Plan.

This AM Plan is intended to improve the City of Barrie’s ability to achieve its corporate goals and objectives in a way that best serves its customers. It provides a rational framework that enables systematic and repeatable processes to manage costs, risks and levels of service for the City’s water asset portfolio.

1.1.3 Relationship with Other City Activities and Planning Documents

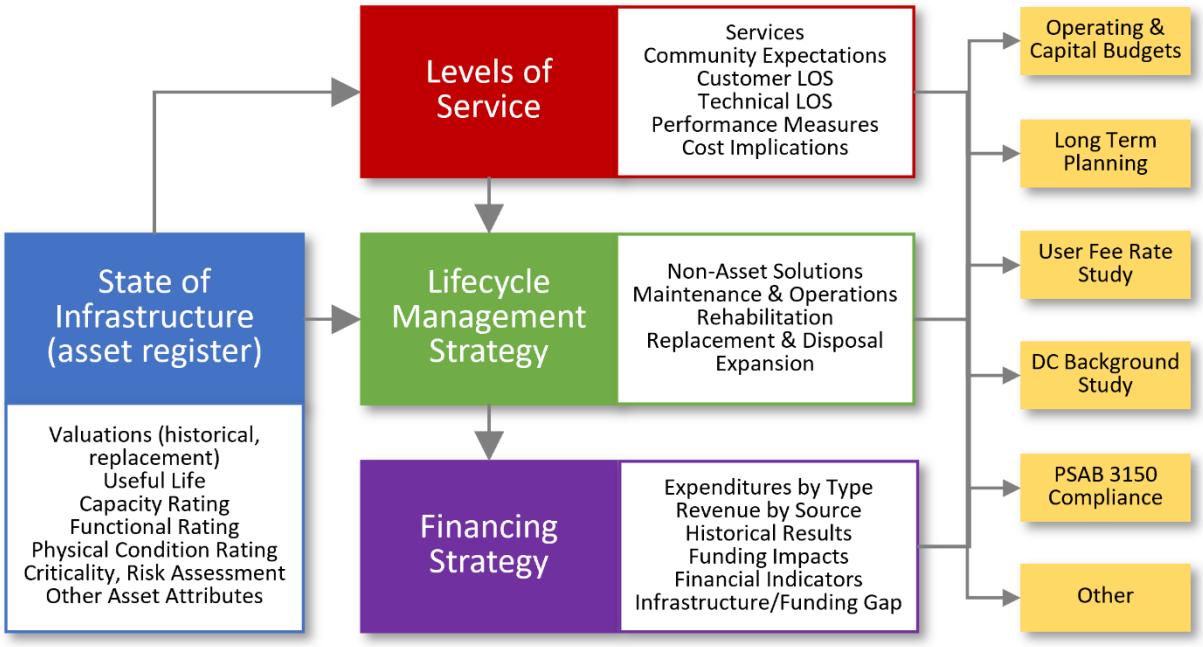
Water AM Planning is a key tactical (medium term) planning activity that relies on input from strategic planning activities and informs shorter-term decision-making. The AM Plan provides a framework to validate the City’s budgeting processes and assist in prioritizing work activities, including capital projects, based on risk. It also discusses levels of service that support goals in the 2018-2022 Barrie City Council Strategic Plan and lifecycle management strategies intended to reduce the overall cost of asset ownership.

The Asset Management Plan is intended to be read with other City planning documents. This should include the corporate Strategic Asset Management Policy and Asset Management Strategy, along with the following associated planning documents:

- Council's 2018-2022 Strategic Plan
- Official Plan
- Climate Change Adaptation Strategy
- Long-term Master Plans
- Long Range Financial Plan and Financial Policies Framework
- Operating and Capital Budgets
- Water and Wastewater Ontario Regulation 453/07 Financial Plan
- Development Charge Background Study
- PSAB 3150 Compliance Process.

The relationship of the AM Plan with other City documents is shown below, summarized from the Municipal Finance Officers' Association of Ontario (MFOA) AM Framework.

Figure 1-2 Relationship of AM Plan to Other City Documents



1.2 Scope of the Plan

1.2.1 Infrastructure Assets included

The City of Barrie owns and manages physical assets that support the supply, treatment, storage, transmission and distribution of safe drinking water. Water service assets include the surface water treatment plant, wells, storage towers and reservoirs, pumping stations, water mains, valves, hydrants, and meters, which together total over **$1.305 billion** in replacement value (2021 $).

1.2.2 Key Stakeholders

Key stakeholders of this AM Plan include:

- The City of Barrie community
- Internal Stakeholders
  - City Council
  - Senior City staff
  - Departmental staff from Infrastructure including Water Operations, Development Services, Fire and Emergency Services, Corporate Asset Management, GIS and Finance.

1.3 AM Plan Framework and Methodology

1.3.1 Framework and General Methodology

The information presented in the AM Plan is based on O.Reg. 588/17 requirements, the Guide for Municipal Asset Management Plans, originally issued by the Ontario Ministry of Infrastructure, and best in class asset management practices.

The Water AM Plan was developed by SLBC Inc. in collaboration with City staff through:

- Review of background materials available on the City's web site and provided by the City's project team including planning documents and budgets
- Workshops with internal stakeholders
- Other interim meetings with the City's project team
- Numerous data and information transfers
- Review of interim outputs by the City's project team and other stakeholders, and incorporation of comments into the AM Plan deliverable.

2 State of Local Infrastructure

This section describes the City's water asset inventory and provides a snapshot of the valuation, age, distribution, and condition of the City's water assets.

2.1 Asset Inventory Overview

The City of Barrie owns and manages physical assets that support the supply, treatment, storage, transmission and distribution of safe drinking water.

Water service assets include the Surface Water Treatment Plant, wells, storage towers and reservoirs, pumping stations, water mains, valves, hydrants, and meters, which together total over **$1.305 billion** in replacement value (2021 $). Properly managing these assets is essential to ensuring that the City can deliver services safely and reliably, while providing value for money and long-term financial sustainability.

The total estimated replacement value for existing (2021) water assets included in this AM Plan is summarized in Table 2-1. The data sources for inventory, replacement value and condition analysis are provided in Table 2-4.

Table 2-1 Current Water Asset Replacement Value

Service	Asset Group	Quantity	Replacement Value (2021 $, M)
Supply & Treatment	Surface Water Treatment Plant	1	268.5
	Well Pumping Stations	15	28.1
Storage	Underground Reservoirs	3	29.7
	Water Towers	3	18.3
Transmission & Distribution	Booster Pumping	7	41.2
	Mains	643.1 km	668.3
	Appurtenances - Hydrants	3,832 units	49.1
	Appurtenances - PRV & PRV Chambers	72 PRV 32 chambers	19.2
	Appurtenances - Valves & Valve Chambers	6,777 valves 129 chambers	170.2
	Appurtenances - Other*		0.3
	Meters	45,135 units	12.2
		TOTAL	**1,305.1**

** Backflow Devices, Bulk Water Station*

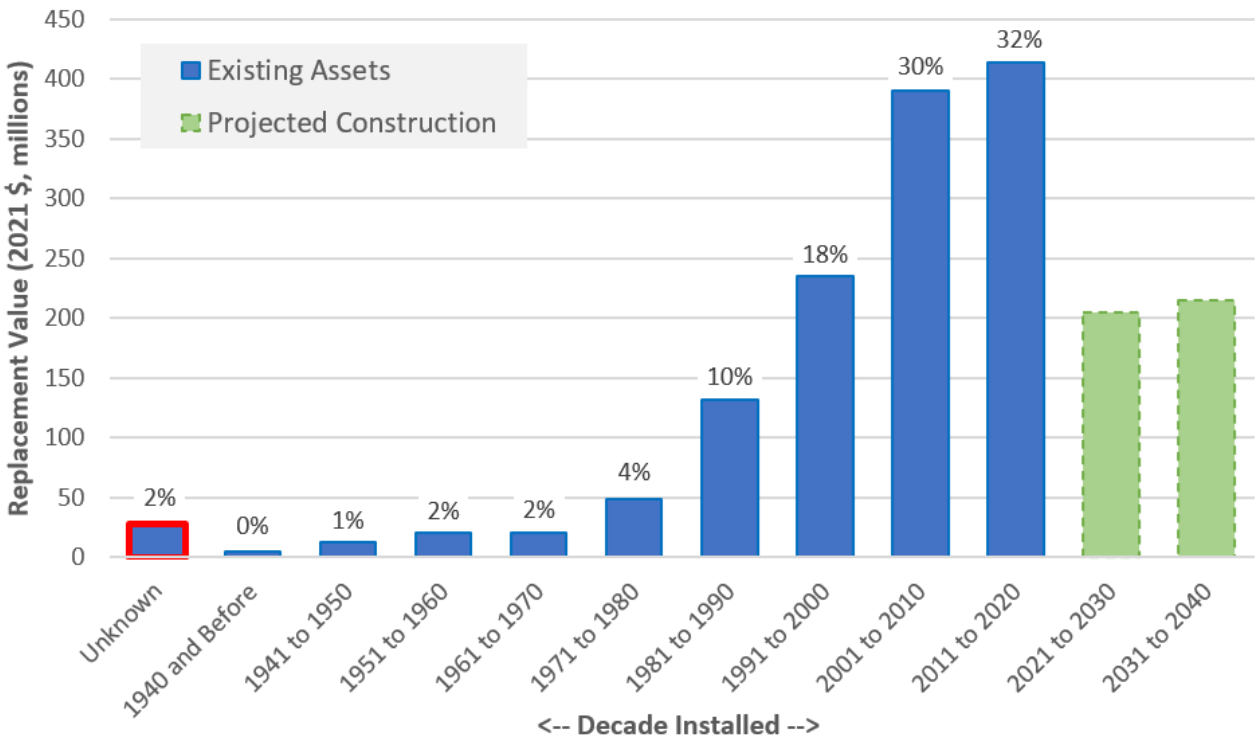
2.2 Installation Profile

Figure 2-1 shows the replacement value of the current water system's $1.3 billion of assets by decade of installation. Approximately 2% ($28.5 million) worth of assets have

an unknown installation year, represented by the red outlined blue bar. Assets with unknown installation years comprise primarily valves, valve chambers, pressure reducing valves (PRV) chambers ($22.3 million), and water meters (1,080 units).

As shown in the figure, the construction of the water system increased rapidly through the decades of the 1980s, 1990s and 2000s. Construction increased further in the first and second decade of this century; however more than half of the asset value installed in the decade 2011-2020 consisted of the Surface Water Treatment Plant (SWTP). Projected construction is shown as the green bars for the next two decades as $204 million and $215 million, respectively, as the City continues to build out the Hewitts and Salem Secondary Plan Areas and expand storage and distribution within the former City boundaries.

Figure 2-1 Installation Year Profile of Water Service Assets



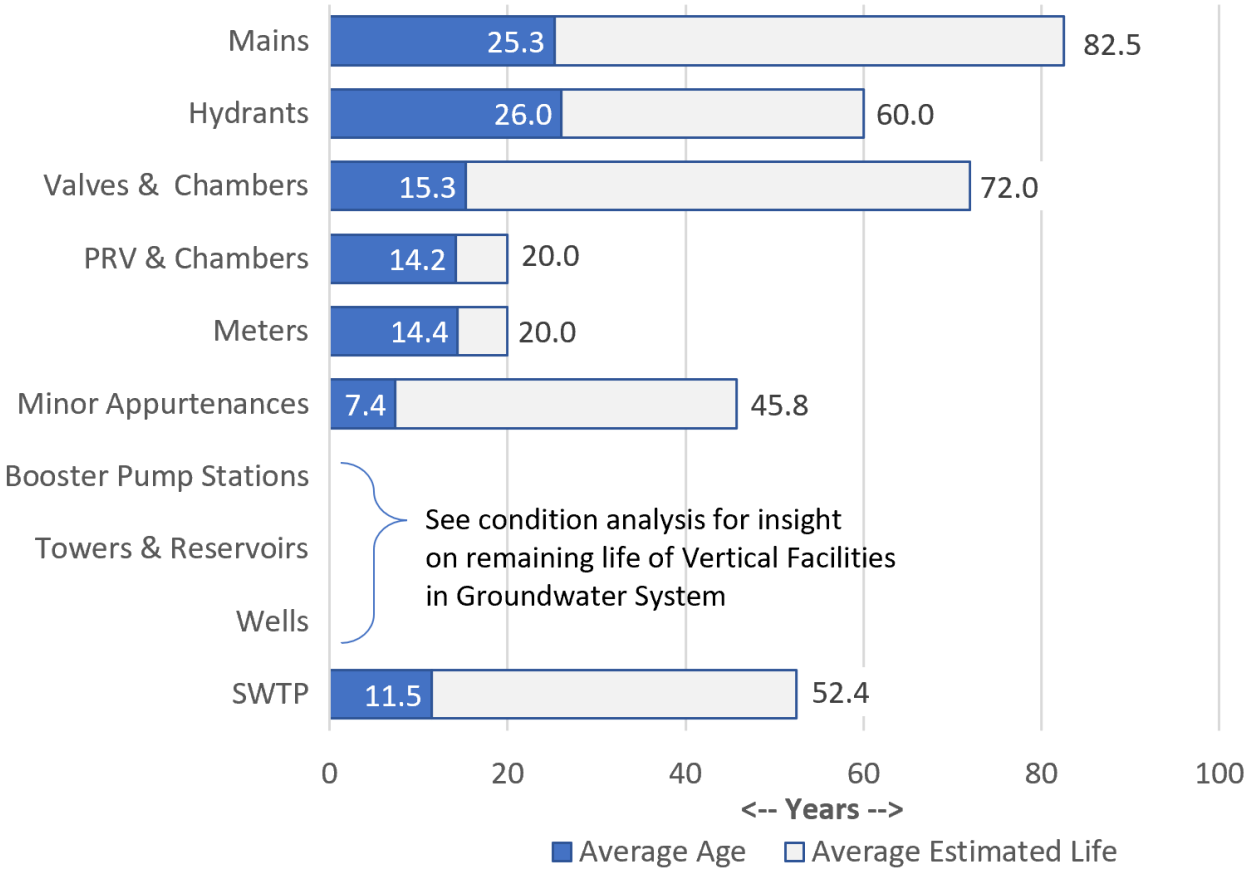
The average age and estimated life of water service assets, weighted by replacement value, is summarized in Figure 2-2. On average, assets in the linear system are in the first half of their service lives, except for PRV & chambers and meters, which have a relatively short service life of 20 years, and are on average, approximately 70% consumed.

Assets without installation year data have been excluded from the average age calculation, so the results may be slightly skewed toward younger assets, since age data is more likely to be missing for older assets. However, as was shown in Figure 2-1, only 2% of assets are missing installation year data, consisting primarily of valves, valve chambers and PRV chambers.

Average age has not been presented in Figure 2-2 for vertical assets in the groundwater system, specifically booster pump stations (BPS), towers, reservoirs and wells, due to lack of reliable age data. To determine replacement needs and remaining life for these assets,

a visual condition assessment was conducted by component, and analysed by building and process system. See Section 2.3.3 for more details.

Figure 2-2 Average Age and Estimated Life



The Surface Water Treatment Plant (SWTP) began operation in phases between 2010 and 2011, so the average age of its systems and components is 11.5 years. The average service life of those systems and components within the SWTP is 52.4 years. As such, on average, the SWTP is 22% through its lifecycle. However, the components of the SWTP with shorter estimated lives are approaching mid- to end of life such as site works, building mechanical and electrical, process electrical and process mechanical (all with 25 years estimated life), instrumentation and controls (15 years), and membranes (18 years).

2.3 Asset Condition

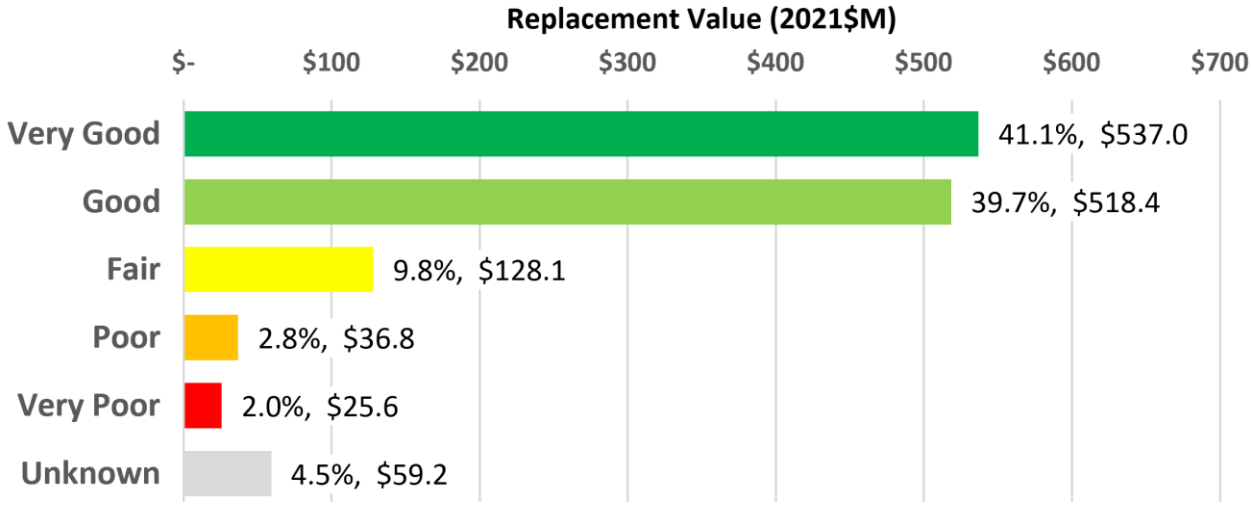
In this Water Service AM Plan, the term “condition” refers to the degree of physical deterioration of the asset determined by a combined age/material/breaks method for watermains and age divided by estimated life for other assets. Asset condition is a measured assessment of an asset’s current position or place on the asset deterioration curve. The generic rating scale (Very Good, Good, etc.) is used to present technical condition information in a way that is easy to understand. An industry standard general condition grading system that provides context of Very Good to Very Poor asset condition is summarized in Table 2-2, based on the 2015 International Infrastructure Management Manual (IIMM).

Table 2-2 General Condition Grading System (Source: IIMM, 2015)

Description	Grade	Physical Condition Criteria			Maintenance Criteria
Very Good	VG	Fit for the future	Physically sound, new / like new	80 to 100% remaining life	Maintenance work is always done as and when required
Good	G	Adequate for now	Physically sound with minimal deterioration	60 to 79% remaining life	Maintenance work is mostly done as and when required
Fair	F	Requires attention	Medium deterioration	40 to 59% remaining life	Maintenance work is mostly done mostly as and when required
Poor	P	At risk of affecting service	Significant deterioration	20 to 39% remaining life	Maintenance work is sometimes done as and when required
Very Poor	VP	Unsatisfactory for sustained service	Unsound, failing or failed	< 20% Remaining Life	Maintenance work is rarely done as and when required

Based on this scoring scale, it was found that **90.6% of the City's water assets are in fair or better condition** which is referred to as a "state of good repair", and 4.8% are in Poor or Very Poor condition. The condition of the remaining 4.5% of assets is unknown, most of which are water mains, valves and valve chambers due to unknown installation dates. The condition distribution by replacement value is shown in Figure 2-3.

Figure 2-3 Current Condition of Water Service Assets (2021$M)



Assets in Very Poor condition are due or overdue for replacement, and are often called the "renewal backlog". The renewal backlog for water assets is currently 2.0% of the total replacement value, or **$25.6 million**, consisting of the following asset types:

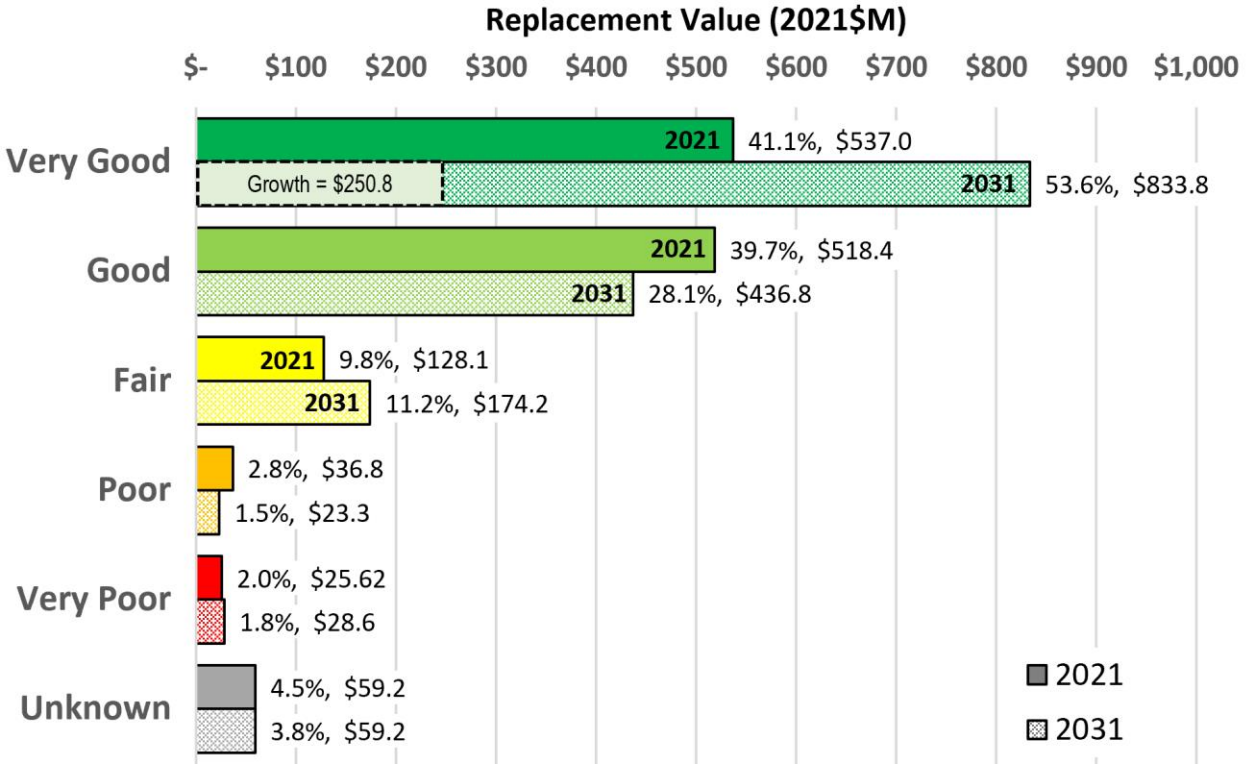
- Water mains ($7.7 million)
- PRV Chambers ($6.1 million)
- Water meters ($6.9 million)

- Components of booster pump stations ($4.2 million), towers & reservoirs ($0.6 million) and wells ($0.1 million).

The water network is anticipated to grow by $250.8 million through developer contributions and City contracted construction to **$1.556 billion** (2021$) by the end of the 10-year planning period ending in 2031. This growth includes expansion of the network and upgrade of individual components in terms of capacity/size.

Figure 2-4 below shows the current condition from Figure 2-3, and the forecast condition of the water asset portfolio in 2031 (dotted bars), all by replacement cost in 2021$. The 2031 condition considers the growth of the portfolio, deterioration based on age, and assumes the City completes the planned asset lifecycle activities made possible with available funding of **$71.9 million** over the planning period. Over the next 10 years, the growth of the water network will add $250.8 million of assets in Very Good condition, existing assets will deteriorate with some moving down from one condition state to another, and renewal investments made possible with available funding will improve the condition of some assets. By 2031, with available funding, the renewal backlog will be 1.8% of the 2031 replacement value, or **$28.6 million**.

Figure 2-4 2021 and Forecast 2031 Water Asset Condition (2021$M)



Recommendations for addressing the renewal backlog are provided in the Lifecycle Management Strategy (Section 5), based on the criticality of these assets assessed in the Risk Management Strategy (Section 4).

The following subsections provide detail on asset condition by asset type.

2.3.1 Watermains

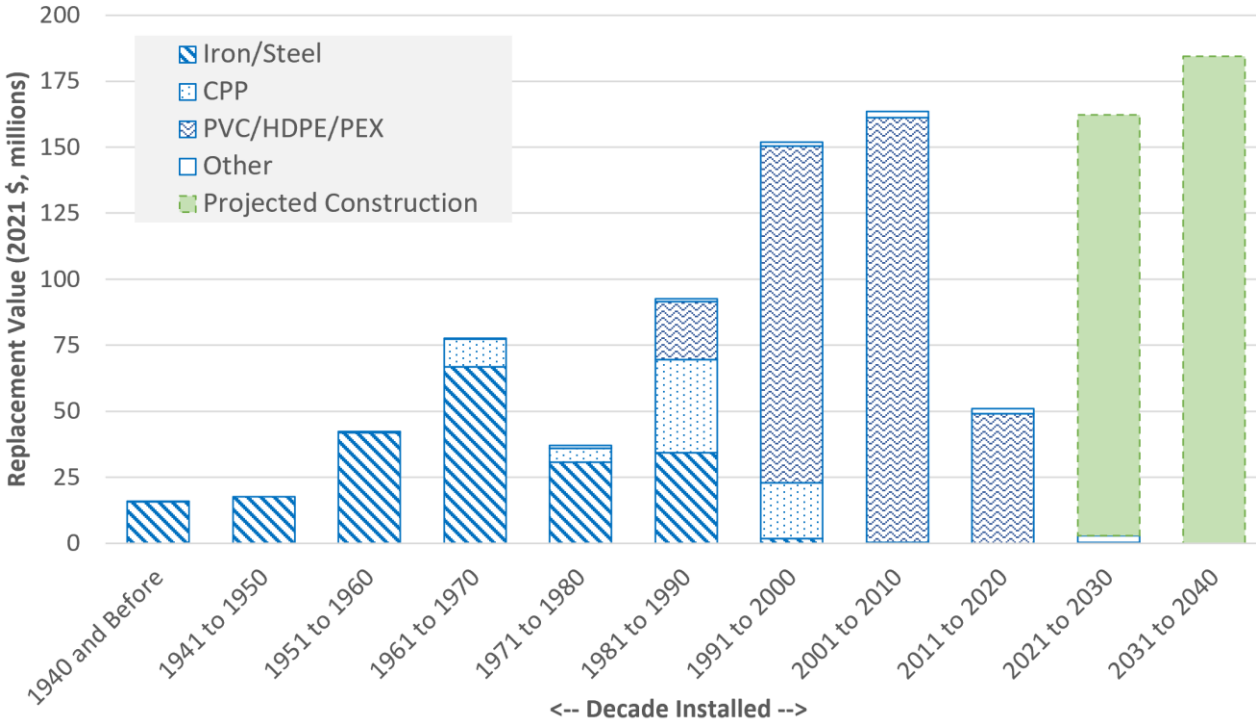
The City's watermain system is composed of different pipe materials, as shown in Table 2-3. Figure 2-5 shows the installation year profile of these assets by material type. Watermain construction rates increased through the 1970s, 80s and 90s, and peaked in the first decade of the 2000s. Expansion of the network dropped in the most recent decade (2010-19) but is expected to increase again through the 2020s and 30s as the Hewitt and Salem Secondary Plan areas are developed. These future assets will be constructed in part by developers and in part by the City; however, the City will eventually assume ownership of developer-constructed assets, and will be responsible for lifecycle costs, thereafter, including operation, maintenance, and renewal.

Table 2-3 Watermain Quantity & Replacement Value by Material

Material Category	Asset Quantity (km)	Replacement Value (2021 $, millions)
Concrete Pressure Pipe (CPP)	24.6	72.7
Iron / Steel	225.3	225.2
PVC / HDPE / PEX	375.0	359.8
Other*	18.3	10.5
Total	**643.1**	**668.3**

** Other pipe materials include Asbestos Cement, Copper and Plastic*

Figure 2-5 Installation Year Profile of Watermains

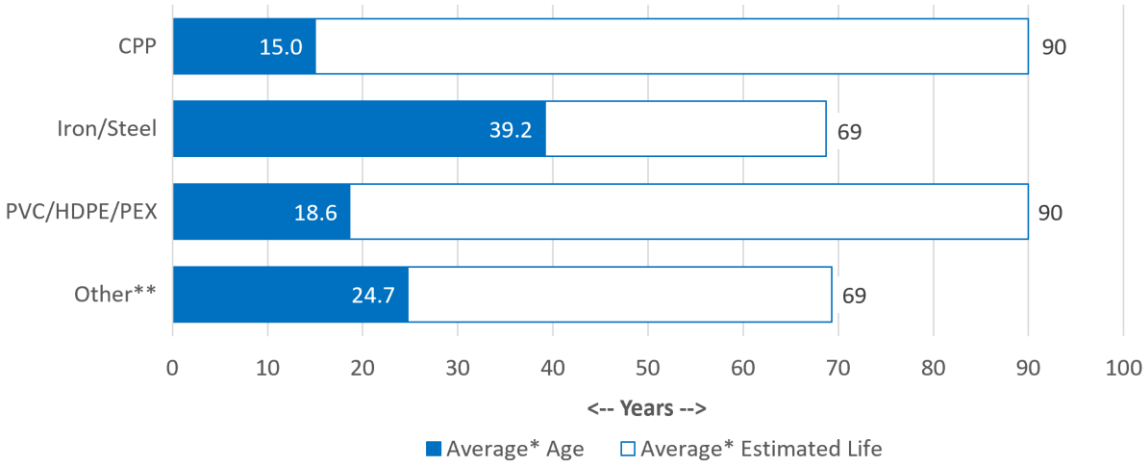


** Other pipe materials include Asbestos Cement, Copper and Plastic*

Figure 2-5 also shows that most mains through the1980s and earlier were metal; however, PVC became the predominant pipe material from the 1990s and on. Concrete Pressure Pipe (CPP) also became more commonly used at that time.

Consistent with the installation year profile in Figure 2-5, Figure 2-6 shows that, on average, Iron/Steel pipes have a higher average age than the other categories of pipes. Moreover, on average, Iron/Steel pipes have a shorter average estimated life than CPP and PVC/HDPE/PEX pipes. As a result, on average, the network's Iron/Steel pipes are 57% consumed. In contrast, the other categories of pipe material are less than 40% consumed.

Figure 2-6 Average Age and Estimated Life of Watermains

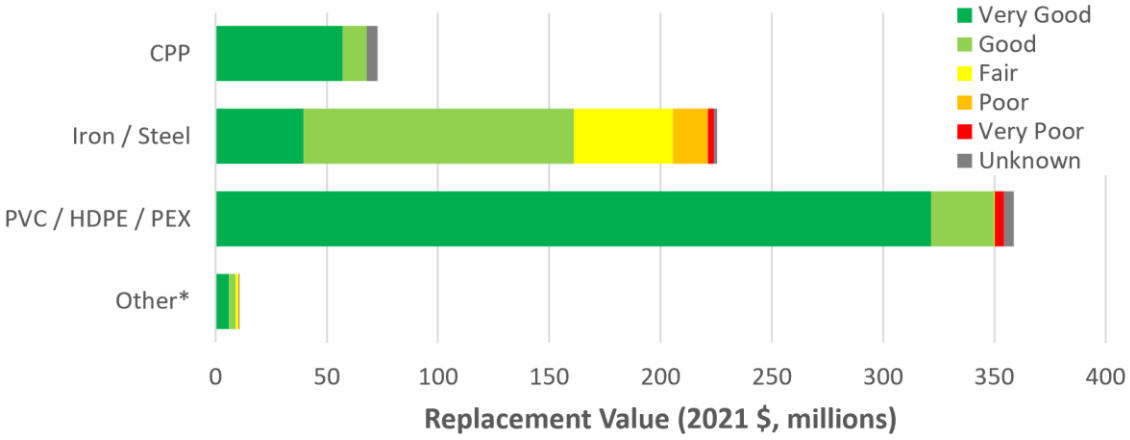


** Averaged over replacement value*
*** Other pipe materials include Asbestos Cement, Copper and Plastic.*

Figure 2-7 shows the distribution of watermain condition by material, weighted by replacement value, where condition has been assessed based on a combination of break history and remaining life by pipe material. Ninety-five percent (95%) of the mains are in Fair or better condition, while 3% are in Poor or Very Poor condition. Condition is unknown for the remaining 2%.

The pipes in Very Poor condition consist of approximately 3.5 km of iron/steel pipe, which were installed between 1934 and 1972, as well as a 1.5 km segment of HDPE transmission main along Ferndale Drive from Tiffin Street to Ardagh Road (600mm HDPE), which was installed in 2005, but was shut off in 2017 due to leaking. The City is undertaking a study to consider rehabilitation, replacement, realignment or other options to address the Ferndale Drive transmission main.

Figure 2-7 Condition of Watermains by Material

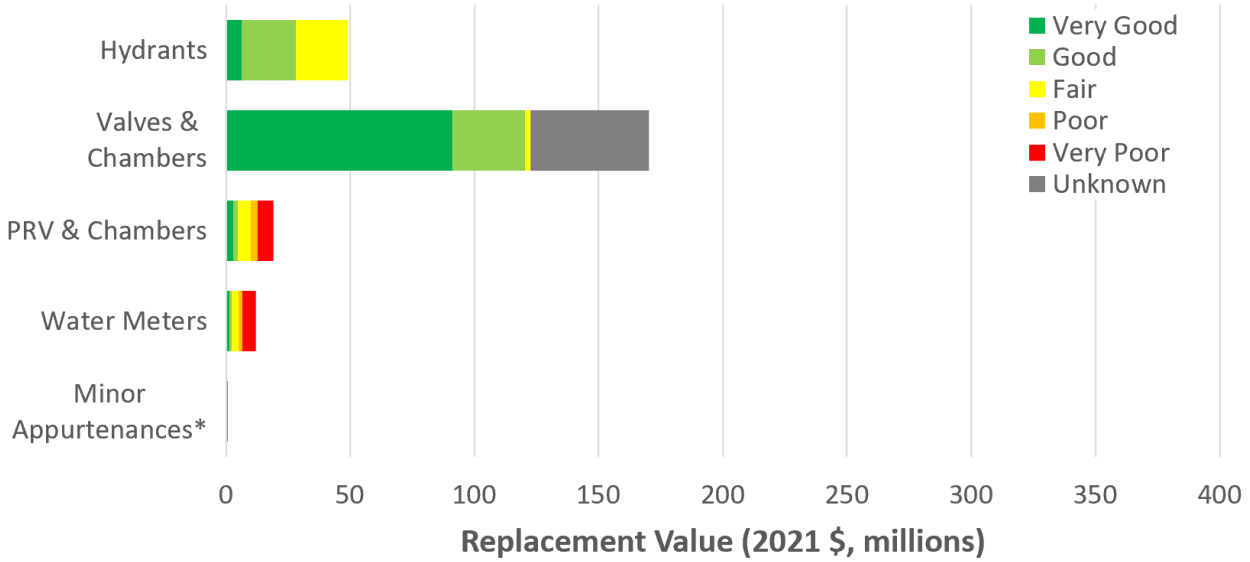


** Other pipe materials include Asbestos Cement, Copper and Plastic.*

2.3.2 Linear Network Appurtenances

Figure 2-8 shows the condition distribution of appurtenances in the linear network, weighted by replacement value. Overall, 76% of the appurtenances are in Fair condition or better, while 3% are in Poor or Very Poor condition. For the remaining 21%, the condition is unknown.

Figure 2-8 Condition of Linear Appurtenances



** Total replacement value is $0.3 million. All are in Fair condition or better condition.*

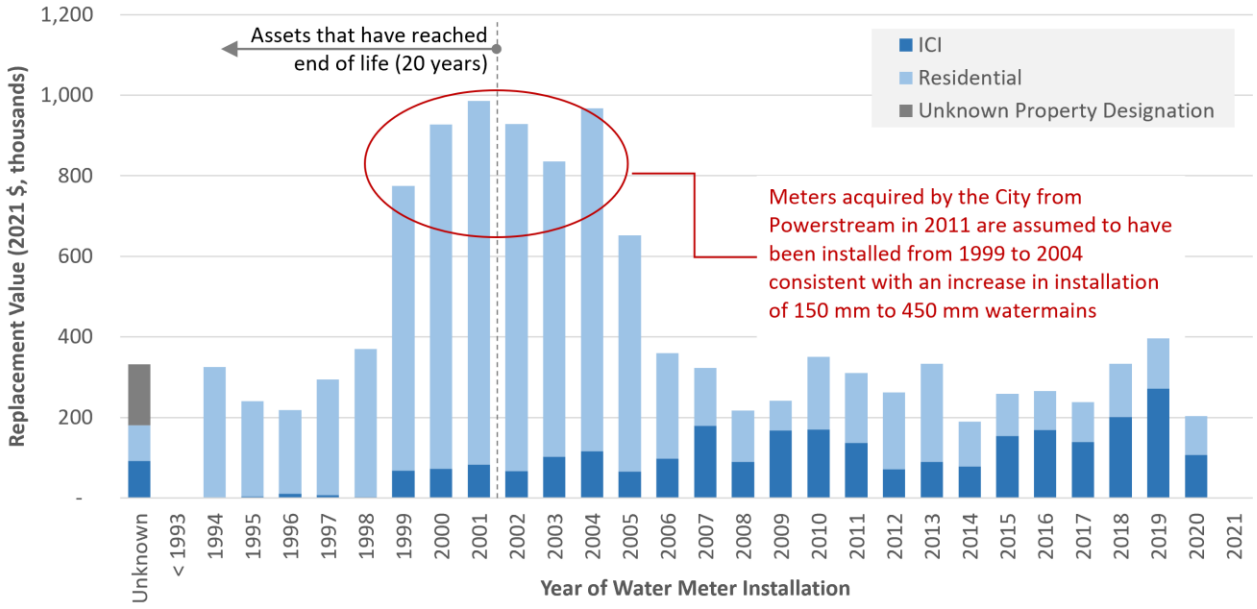
The City inspects each hydrant annually, and completes repairs and renewals as needed, ensuring that all fire hydrants are functioning. As such, all hydrants are in Fair condition or better. Similarly, valves and PRVs are tested and exercised on a regular basis (frequency varies by size), however, condition is not recorded for many valves and chambers. As such, condition is shown in Figure 2-7 as Unknown.

Figure 2-8 shows that a significant percentage of PRV chambers and water meters are in Very Poor condition, which means that they are in the last 20% of their 20-year life cycle, or beyond. Figure 2-9 shows that many residential meters that are currently in use, were in fact installed in 2001 or earlier, and these are overdue for replacement.

Figure 2-8 also shows Minor Appurtenances, which consist of backflow devices and a bulk water station. All of these assets are in Fair condition or better.

Figure 2-9 shows the installation year of water meters, by replacement cost in 2021$, millions. The water meters acquired by the City from Powerstream in 2011 are assumed to have been installed from 1999 to 2004 consistent with an increase in installation of 150 mm to 450 mm watermains through that same period.

Figure 2-9 Install Year of Water Meters by Replacement Cost (2021$M)

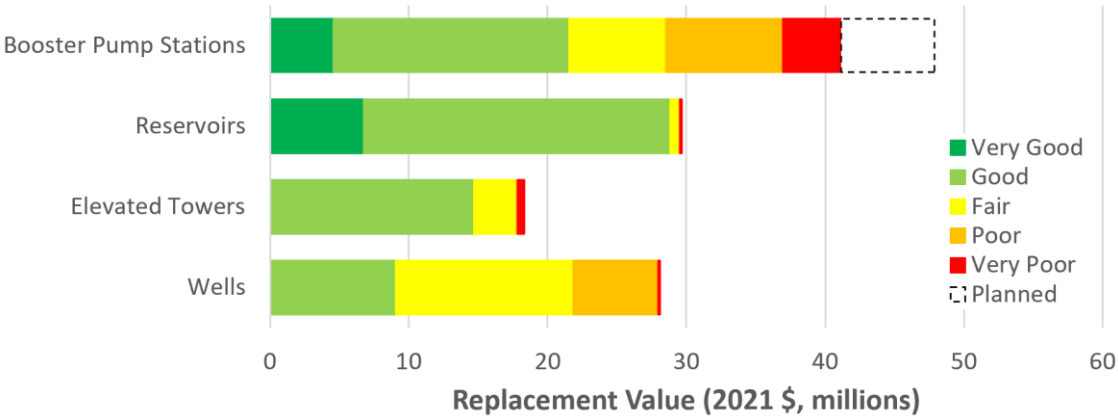


As meters age, they tend to run more slowly, which results in underbilling. As such, it is recommended that the City adhere to its replacement schedule. Water consumption trends may also be compared across meters of different age to analyse the potential impacts of meter age on billing accuracy.

2.3.3 Ground Water System Vertical Facilities

Figure 2-10 shows the condition distribution of vertical facilities in the ground water system, weighted by replacement value. Overall, 84% ($98.2 million) of the appurtenances are in Fair condition or better, while 16% ($19.1 million) are in Poor or Very Poor condition. The dotted line bar in the Booster Pump Station section shows the value that will be added with the re-construction and expansion of Anne Street Booster Pump Station (BPS). Construction is expected to take place 2023-26.

Figure 2-10 Condition of Vertical Facilities in the Ground Water System



The assets in Very Poor condition, totalling $4.4 million, consist of the following:

- Leacock BPS building systems (architectural, electrical and mechanical)

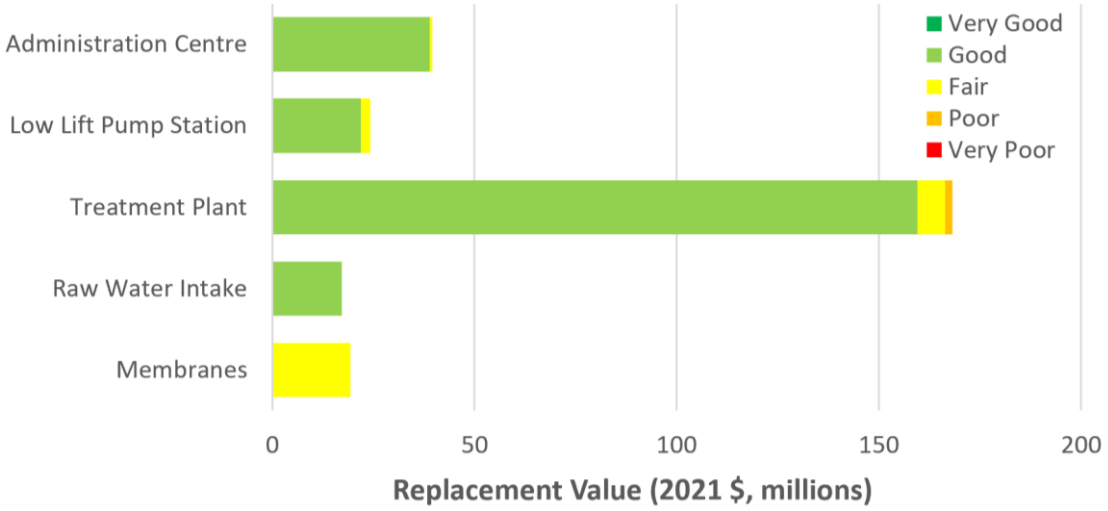
- Codrington BPS building systems (architectural, electrical and mechanical)
- Big Bay Point BPS
  - Building systems (architectural, electrical and mechanical)
  - Site works
  - Some elements of the process equipment
- Sunnidale BPS site works
- Well #12 building systems (electrical and mechanical)
- Anne Street Reservoir instrumentation and controls.

Recommendations for addressing these needs will be provided based on asset criticality in Section 4 on Life Cycle Management.

2.3.4 Surface Water Treatment Plant

The Surface Water Treatment Plant (SWTP) was constructed in 2011, and all components remain in Good or Fair condition, as shown in Figure 2-11. However, some assets have a shorter life cycle, and will soon be due for replacement, including membrane modules and instrumentation and controls equipment, which all have 15-year service lives.

Figure 2-11 Condition of Assets in the Surface Water Treatment Plant



2.4 Data Sources

The inventory was mainly developed based on the City's Corporate GIS database obtained October 21, 2020, Tangible Capital Asset (TCA) register and estimated construction costs for each asset class. A summary of data sources is provided in the following table.

Table 2-4 Data Sources for Inventory, Cost, and Condition Analysis

Asset	Inventory	Replacement Cost Valuation	Condition Estimate
Watermains	GIS Shapefile (December 10, 2019)	$/m by pipe diameter and material; estimate includes pipe, service connections and construction costs	Based on age, material, and history of breaks*
Hydrants	GIS	$8,000 / unit, including hydrant and valve, but not the service connection	Age-based, with estimated service life of 60 years. Also assumed that all hydrants are in Fair condition or better, based on annual inspection and repair practices.
Valves	GIS	$ / unit by type and size of valve	Age-based, with service life estimated by valve type • gate and other = 50 yrs • globe = 35 yrs • air relief, cone, diaphragm, flood safe valve = 25 yrs
Valve Chambers	GIS	Unit cost estimate by size: Small <8m^2 = $490k Medium 8-15m^2 = $887k Large >15m^2 = $1,086k	Age-based, with estimated service life of 85 years.
Pressure Reducing Valves (PRV)	GIS	$ / unit by size of valve	Age-based, with estimated service life of 20 years.
PRV Chambers	GIS	$ 560k / unit based on 2016 TCA re-construction cost, inflated to 2021 and escalated to include construction costs	Age-based, with estimated service life of 20 years.
Water meters	GIS	$ / unit based on 2021 contract cost, plus labour and vehicle costs for installation	Age-based, with estimated service life of 20 years.
Minor appurtenances	GIS & TCA	• Backflow devices: $ / unit based on size • Bulk Water Station: TCA construction cost inflated to 2021 and escalated to include construction costs	Age-based, with estimated service life values of: • 20 years for backflow devices • 25 years for bulk water filling station • 20 years for bulk water filling station box
Booster Pump Stations (BPS)	GIS / CityWorks	Value (y) based on firm capacity (x), using regression on peer municipality's BPS values: y = 143,301x + 2,001,668 Values then escalated to include construction costs, then portioned out to building and process systems	Based on visual inspection conducted by City staff on assets listed in GIS/CityWorks in January 2021**
Elevated Towers and Reservoirs	GIS / CityWorks TCA	Based on TCA values, inflated to 2021 and escalated to include construction costs	Based on visual inspection conducted by City staff on assets listed in GIS/CityWorks in January 2021**

Asset	Inventory	Replacement Cost Valuation	Condition Estimate
Wells	GIS / CityWorks TCA	Based on TCA values, inflated to 2021 and escalated to include construction costs	Condition of process equipment was reported based on visual inspection conducted by City staff in January 2021** Condition of Building systems was reported based on age**
Surface Water Treatment Plan (SWTP)	2011 Construction cost estimate for SWTP	Based on construction cost estimates from 2011, inflated to 2021.	Based on age**

** Watermain estimated life:*

Watermain Material Type	Asset Life (yrs)
Galvanized	30
Plastic	40
Steel	50
Ductile Iron	60
Stainless Steel	60
Asbestos Cement	70
Ductile Iron - Cathode Protection	75
Cast Iron	80
Copper	80
Concrete	90
Cross Linked Polyethylene (PEX)	90
Ductile Iron - CIPP Lined	90
High Density Polyethylene	90
Polyvinyl Chloride	90
Unknown Material/Blank	90
Cast Iron - CIPP Lined	115

*** Facility elements asset estimated life:*

Facility Element	Asset Life (yrs)
Site Works	25
Building Structural	75
Building Architectural	37
Building Mechanical & Electrical	25
Process Structural	75
Process Electrical	25
Process Mechanical	25
Process Piping	37
Instrumentation & Controls	15

3 Levels of Service

3.1 Overview

Levels of Service (LOS) are statements that describe the outputs and objectives the City intends to deliver to its citizens, businesses, and other stakeholders. Developing, monitoring and reporting on LOS are all integral parts of an overall performance management program which is aimed at improving service delivery and demonstrating accountability to the City's stakeholders.

In general, LOS are guided by a combination of customer expectations, legislative requirements, and internal guidelines, policies, and procedures. In many cases, LOS are also implied based on past service delivery, community expectations, and infrastructure system design. Effective asset management requires that LOS be formalized and supported through a framework of performance measures, targets, and timeframes to achieve targets, and that the costs to deliver the documented LOS be understood.

At the same time, water service is different from other municipal services, because it is fundamental to the well-being of the community, and an inadequate LOS has severe impacts to people's health and safety, in terms of potability and fire protection. As explained by Justice Dennis O'Connor, in the Report of the Walkerton Inquiry (2002), "Water is unique as a local service. It is … essential to human life and to the functioning of communities".

Due to the importance of safe drinking water to our communities, water service is highly regulated by the province. Key legislation includes the Safe Drinking Water Act, 2002, which provides a consistent set of provincewide standards and rules to help ensure access to safe, high quality, reliable drinking water; and the Clean Water Act, 2006, which provides a framework for protecting the raw water source for drinking water systems within source protection areas. These acts recognize that Ontario communities are entitled to expect safe drinking water from their municipalities.

In accordance with the Ministry of the Environment's Drinking Water Quality Management Standard, the City, as the owner of a municipal residential drinking water system, has adopted a Quality Management System Policy, which formalizes the City's commitment to "ensuring the reliable and sustainable supply of safe drinking water". The policy further specifies that the Corporation of the City of Barrie will maintain and continually improve the effectiveness of the Quality Management System through the following commitments:

- Provide the resources necessary to ensure the delivery of safe and reliable water treatment and distribution services in an efficient and effective manner that meets or exceeds the legislation and regulations related to water quality.
- Invest in infrastructure, technology and process improvements to safeguard the environment while continually improving water service and delivery.
- Provide high quality response services and promote consumer confidence through effective communications.

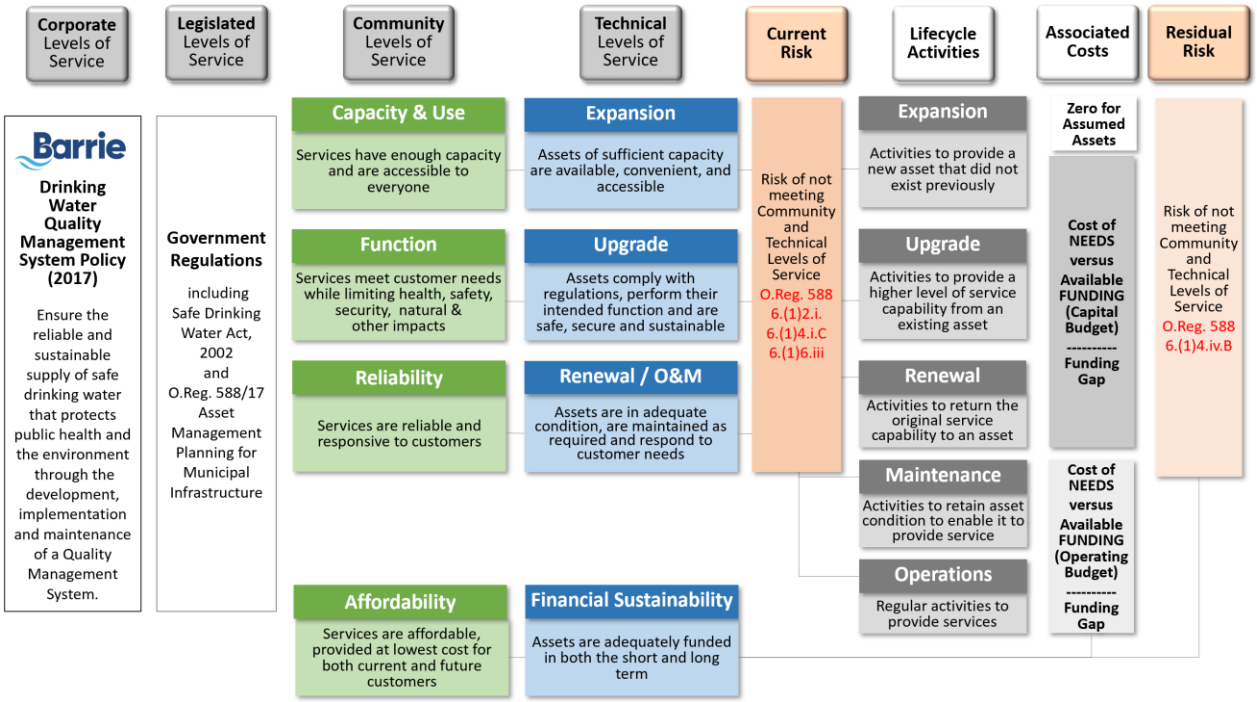
The Drinking Water QMS Policy drives the City's decision-making regarding level of service targets, resource allocations and investments. Figure 3-1 shows that Corporate LOS commitments, along with the legislated LOS referenced by them, drive the definition

of more specific Community LOS. Community LOS can be categorized as relating to one of the following service attributes:

- **Capacity and Use:** Assessing whether services have enough capacity and are accessible to the customers
- **Function:** Assessing whether services meet customer needs while limiting health, safety, security, natural and heritage impacts
- **Reliability:** Assessing whether services are reliable and responsive to customers
- **Affordability:** Assessing whether services are affordable and provided at the lowest cost for both current and future customers

Community LOS are in turn are translated into Technical LOS, where Capacity and Use LOS drive assessment of the Expansion needs; Function LOS drive assessment of Upgrade needs; Reliability LOS drive assessment of renewal, operations and maintenance needs; and Affordability LOS drive assessment of Financial Sustainability needs. The risks of failing to achieve the defined Community and Technical LOS are assessed, and life cycle activities are prioritized to address those risks. Life cycle activities may include expansion, upgrade, renewal, maintenance or operational activities, depending on the category of LOS to be addressed. The nature of the life cycle activity determines whether it should be funded as capital of operating, as well as eligible funding sources. As shown in the figure, even after the life cycle intervention, some residual risk may remain.

Figure 3-1 Levels of Service Framework



The following sub-sections present the Community and Technical LOS, which will drive the Risk and Life Cycle Management Strategies of this AM Plan.

3.2 Community & Technical LOS

The City's Community and Technical LOS are listed in Table 3-1, categorized by service attribute. The LOS have been compiled from:

- regulatory requirements
- the City's Municipal Drinking Water License (MDWL)
- the City's Water Supply Master Plan
- the City's Water Transmission and Distribution Master Plan
- the Water Operations Department's 2020 Business Plan
- the City's Conservation & Demand Management Plan 2020-24
- the City's Climate Change Adaptation Strategy
- the City's 2015 AM Plan
- the City's Water Transmission and Distribution Design Standard 2021.

Table 3-1 Community and Technical Levels of Service

Service Attributes	Service Expectations	Community Objectives	Community Levels of Service	Technical Levels of Service	Reference
Capacity and Use: Services have enough capacity and are accessible to everyone	Adequate conveyance capacity	Provide adequate availability of water service to properties	Description, which may include maps, of the user groups or areas of the municipality that are connected to the municipal water system	Percentage of properties connected to the municipal water system	O.Reg. 588/17
		Provide adequate availability of fire flow to properties	Description, which may include maps, of the user groups or areas of the municipality that have fire flow	Percentage of properties where fire flow is available	O.Reg. 588/17
			Reduce the risk that maximum daily demand pressures will not be impacted by fire flow demand	Percentage of pipes with Max Daily Demand (MDD) plus fire flow reach a flow velocity > 4.5m/s	
Function: Services meet customer needs while limiting impacts to health, safety, security, nature and heritage	Adequate water quality	Provide safe drinking water	Description of boil water advisories	The number of connection-days per year where a boil water advisory notice is in place compared to the total number of properties connected to the municipal water system	O.Reg. 588/17
	Energy efficiency	Reduce energy consumption and associated costs	Description of energy conservation initiatives implemented (e.g. submetering, training, communication)	Energy consumption per Megalitre (ekWh/ML)	Conservation & Demand Management Plan 2020-24
	System efficiency	Reduction of water loss	Reduce non-revenue water loss	Description of initiatives implemented to reduce non-revenue water loss	% of non-revenue water loss in system

Service Attributes	Service Expectations	Community Objectives	Community Levels of Service	Technical Levels of Service	Reference
Reliability: Services are reliable and responsive to customers	Reliable water service	Water assets are kept in a state of good repair	Description of overall asset condition in the system	Percentage of assets in fair or better condition	AM Plan 2015
			Description of preventive maintenance backlogs and delays	Percentage of preventive maintenance work orders completed on time	Operations
		Water mains remain intact	Description of service interruptions due to watermain breaks.	The number of connection-days per year without service due to water main breaks compared to the total number of properties connected to the municipal water system	O.Reg. 588/17
		Hydrants are reliable	Description of fire hydrant inspection program and findings	Percentage of annual planned inspections completed	AM Plan 2015
Affordability: Services are affordable, provided at lowest cost for both current and future customers	Affordable water service	Services are adequately funded in the short term	Budgets are adequate for all lifecycle activities to fund investments needed to provide services over the next 10 years	Percentage of current year funding (budget) to needs: Growth & Upgrade	2021 Water Capital Budget
				Percentage of current year budget to needs: Renewal	
				Percentage of current year budget to needs: Operations & Maintenance	2021 Water Operating Budget

3.3 Current Performance

This section presents the City's current performance based on the LOS indicators identified in the previous section. Indicators are grouped by service attribute, which identify needs for asset expansion, upgrade, renewal, maintenance and operations activities to be discussed in the Risk and Life Cycle Management analyses of this AM Plan.

3.3.1 Capacity and Use

Capacity and use service attributes assess whether services have enough capacity and are accessible to the customers. Deficiencies in these levels of service would indicate a need for expansion of the network, for example, to increase capacity or areas served.

The metrics in this section are mandated by O.Reg. 588/17. The City has not yet set targets for these metrics.

3.3.1.1 Properties Connected to the Municipal Water System

There are 45,143 properties in the City limits. Of these, 42,664 (94.5%) are connected to the water system. In other words, there are 2,479 properties that are not connected. As stated in the City's 2018 Official Plan (OP), the City's servicing goals include the following (from OP Section 5.1.1):

(a) To ensure that adequate water supply … [is] provided to the residents of the City.
(b) To ensure that development within the City is serviced by … municipal water … .

Correspondingly, the OP defines policies that ensure development occurs where municipal services can be efficiently provided, while limiting development where on-site services are required. As a result, the number of properties not connected to the municipal system is not expected to grow. Moreover, the proportion of properties not connected will drop, as the number of properties within the City limits increases with development.

3.3.1.2 Properties that have Fire Flow

For the purposes of this LOS analysis, it is assumed that all properties that have water service also have access to fire flow. In other words, of the 45,143 properties in the City limits, 42,664 (94.5%) have access to fire flow.

In the future, this metric may be further explored by considering the amount of flow capacity at different points in the water system, and comparing that with the amount of flow required by different types of land uses around those points. The City's 2019 Water Storage and Distribution Master Plan Update (WSD-MP, page 78), conducted a detailed hydraulic analysis of points in the system that had capacity deficiencies to meet the worst case flow need of Maximum Day Demand + Fire Flow (MDD+FF). For future AM plans, the MDD+FF deficiencies will be overlaid on a property map to determine the number of properties affected. Moreover, it may be necessary to update the MDD+FF needs estimate to reflect land uses and building types, as these affect the fire flow need.

A risk-based analysis of fire flow in the linear network is provided in the Chapter 4 to facilitate prioritization and coordination of pipe expansion and renewal needs.

3.3.2 Function

The service attribute related to Function assesses whether services meet customer needs while limiting health, safety, security, natural and other impacts. Deficiencies in these levels of service would indicate a need for upgrades, for example, to improve energy efficiency, or to further eliminate minerals, organics, and other chemicals.

3.3.2.1 Boil Water Advisories

The metrics in this section are mandated by O.Reg. 588/17. The City aims to have no boil water advisories, and as shown in Table 3-2, this was achieved in 2018 and 2020. However, in 2019, there was one boil water advisory, which occurred on April 5 of that year when a watermain break occurred at the Yonge St. and Big Bay Point Rd. intersection. Positive pressure was lost in the distribution system, leading to the potential for inadequate disinfection. The advisory lasted for approximately 38 hours, and affected 9021 domestic properties and 15 commercial properties.

Table 3-2 Boil Water Advisories 2018-2020

	2018 Actual	2019 Actual	2020 Actual
Incidents	0	1	0
Duration of boil water advisory (hours)	n/a	38	n/a
Number of properties affected by advisory		9021 residential 15 commercial	
Connection-days affected by boil water advisory		14,307	
Number of properties connected to the muncipal water system		42,664	
Days/year affected by boil water advisory, averaged across all connection		0.335 (approximately 8.0 hours)	

3.3.2.2 Energy Efficiency

In accordance with O.Reg. 507/18 Broader Public Sector: Energy Reporting and Conservation and Demand Management Plans, the City strives to reduce its energy consumption, and the associated costs and greenhouse gas emissions. O.Reg. 507/18 requires municipalities to report annually on their energy usage, and to update their energy conservation and demand management plan every 5 years.

The City's current Conservation and Demand Management Plan 2020-2024 (CDM) has identified water operations as a key opportunity for energy conservation. At the time of writing the CDM, water operations represented 20% of the City-wide energy consumption, with a cost of $1.92 million (2018). The CDM thus set a target of 10% reduction in energy consumed per megalitre (ML) of processed drinking water, aiming to bring the 2018 consumption of 1,212 ekWh/ML down to 1,097 ekWh/ML by 2024. This reduction was estimated to yield a potential energy savings of $143k/year.

Table 3-3 shows that consumption has been steadily decreased through 2019 and 2020. The year 2024 target was already met in 2020; however, 2020 results may have been affected by Covid restrictions, which resulted in many office staff working from home for part of the year, and thus not drawing energy from their work spaces in water facilities.

A target of 1,119 ekWh/ML has been set for 2021. Energy management initiatives focus on communication, training and engagement activities to increase energy consumption awareness among staff and encourage behaviours that conserve energy.

Table 3-3 Energy Consumption 2018-2020

	2018 Actual	2019 Actual	2020 Actual
Water energy consumption per Megalitre (ekWh/ML)	1,212	1,177	1,024

For future years, the City is exploring greenhouse gas reduction targets. These will also need to be considered in the energy conservation efforts of the City's water operation.

3.3.2.3 System Efficiency – Water Loss

Water loss is an on-going concern for all municipal water operators. As shown in Table 3-4, the City's rate of water loss for 2020 was 3.9%, which is low compared with peer municipalities, and has been steadily dropping for the past few years.

Table 3-4 Water Loss 2018-2020

	2018 Actual	2019 Actual	2020 Actual
Water Loss (%)	5.4%	4.7%	3.9%

3.3.3 Reliability

The service attribute related to Reliability assesses whether services are reliable and responsive to customers. Deficiencies in these levels of service would indicate a need for renewal, repair or changes to operations and maintenance strategies.

3.3.3.1 Work Orders Completed

The completion rate of work orders indicates how well the system is being maintained. For example, if the number of open (not completed) work orders accumulates, it indicates a backlog of preventative maintenance and/or corrective repairs. Both cases represent a risk to the operation.

As shown in Table 3-5, the City completed 95%-96% of its work orders each of the previous three years. The work orders that are not completed within the year represent the backlog, but may also include work orders that were opened late in the year. (For future reporting, it would be preferable to report the number of work orders completed by the specified due date.)

Table 3-5 Work Order Backlog 2018-2020

	2018 Actual	2019 Actual	2020 Actual
Work Orders created (excludes those that are eventually cancelled)	14,026	13,743	Not Available
Work Orders completed within the year	13,454	13,043	Not Available
% Completed in-year	96%	95%	Not Available

3.3.3.2 Water Mains Remain Intact

The metrics in this section are mandated by O.Reg. 588/17. The City aims to minimize watermain breaks and their impacts to the community. In 2020, there were a total of 22 watermain breaks, as listed in Table 3-6. All breaks occurred on Distribution mains (none on Transmission or Chlorine Contact). Of the 22 breaks, 17 were on metal pipes (cast iron, ductile iron or galvanized), and corrosion / deterioration was the most common cause. It should also be noted that two breaks (rows #1 and 2) occurred on the same segment (Asset ID #104200666 along Blake St.) one month apart, on a cast iron pipe that is 70 years old and scheduled to be replaced in 2021. Cast Iron pipe is considered to be at the end of its service life (in Very Poor condition) at 71 years old, so these breaks reinforce the assumption that cast iron should be replaced before this time to reduce risk of deterioration-related breaks.

Ductile iron is considered to be at the end of its service life (in Very Poor condition) at 47 years old. In 2020, that age was reached by pipes that were installed in 1973 or earlier, which corresponds to four of the seven ductile iron pipes that experienced deterioration-related breaks.

Galvanized and plastic pipes that experienced deterioration-related breaks (rows 16 and 18) had also reached Very Poor condition rating based on age (25 years for Galvanized and 32 years for Plastic), and should also be considered for replacement.

The City does not currently record the number of properties affected by service outages resulting from watermain breaks (as required for O.Reg. 588/17 reporting); however, none of the breaks in 2020 resulted in outages of water service of more than 9 hours.

Table 3-6 Watermain Breaks in 2020

#	Pipe Material	Cause of Break	Pipe Year of Installation	Pipe Diameter (mm)	Water Outage Duration	Comment
1	Cast Iron	Corrosion / Deterioration	1950	150	--	Sep. 8 at 329 Blake St.,
2			1950	150	--	Oct. 10 at 371 Blake St.
3		Temperature Change	1954	100	--	
4		Improper Bending	1957	150	--	
5		Differential Settlement	1960	150	--	
6			1965	150	--	
7	Ductile Iron	Corrosion / Deterioration	1965	150	--	
8			1969	200	--	
9			1973	150	2.75 hrs	
10			1973	250	--	
11			1980	250	--	
12			1980	200	< 1 day	Throttle valve issue
13			1982	300	9 hrs	Outage was overnight

#	Pipe Material	Cause of Break	Pipe Year of Installation	Pipe Diameter (mm)	Water Outage Duration	Comment
14		Differential Settlement	1972	150	--	
15		Other	1987	200	--	
16	Galvanized	Corrosion / Deterioration	1970	25	0.5 hrs	
17		Other	1964	38	--	Partial outage only
18	Plastic	Deterioration	1986	32	4 hrs	
19	PVC	Deterioration	1988	150	--	
20		Deterioration	1992	50	--	
21		Differential Settlement & Deterioration	2003	150	--	
22		Unknown	2020	300	1.5 hrs	Break occurred 2 days after installation

3.3.3.3 Fire Hydrants are Reliable

Fire hydrants are critical to the provision of fire and emergency services. As such, they are inspected at least once annually, and any defective hydrants are repaired or replaced. Table 3-7 shows that the City has inspected 100% of its fire hydrants each year since 2018, even as the quantity of hydrants has grown. In 2020, as a result of the inspections, 215 work orders for hydrant repairs were opened and resolved.

Table 3-7 Fire Hydrant Inspections Completed 2018-2020

	2018 Actual	2019 Actual	2020 Actual	2021 Plan
Number of Hydrants to Inspect	3,753	3,817	3,854	3,854+
Percent Inspected	100%	100%	100%	100% target
Number of resulting work orders	N/A	N/A	215, all resolved	N/A

It is not known whether there have been any incidents of fire hydrants not functioning in emergency situations, as this is not tracked.

3.4 Summary

Table 3-8 shows that the City is meeting most of its LOS targets. On-going renewal, enabled by adequate short- and long-term funding, will be needed to ensure a state of good repair and to reduce the occurrence of watermain breaks. Note that forecast performance in 2031 is based on funding available in the 2021 Budget Plan. Performance for each of the years 2022 to 2031 will depend on timing of investments within the 10 year period.

Table 3-8 Proposed Water Service Objectives and Measures

COMMUNITY Objectives	2021 Community Performance Grade*	Expected 2031 Performance Grade**	Community Service Measures		Technical Asset Measures (if required by O.Reg.588/17)	Target Technical Standards	2021 Technical Performance	Forecast 2031 Technical Performance**	ASSET Objectives
Capacity & Use Services have enough capacity and are accessible to everyone	G	G	Properties have adequate availability of water service	←	% properties connected to the municipal water system (O.Reg.)	**90%**	**94.5%**	**94.5%**	**Growth & Utilization** Provide assets of sufficient capacity that are available, convenient, and accessible
	G	G	Properties have adequate availability of fire flow	←	% properties where fire flow is available (O.Reg.)	**90%**	**94.5%**	**94.5%**	
				←	% pipes with Max Daily Demand (MDD) plus fire flow reach a flow velocity > 4.5m/s	**1%**	**1.3%**	**1%**	
Functionality Services meet customer needs while limiting impacts to health, safety, security, nature and heritage	VG	VG	Drinking water is safe	←	# connection-days per year where a boil water advisory notice is in place compared to total # of properties connected to the municipal water system (O.Reg.)	0	0	0	**Upgrade** Provide assets that comply with regulations, perform their intended function and are safe, secure and sustainable
	VG	VG	Energy consumption and associated costs are minimized	←	Energy consumption per Megalitre (ekWh/ML)	1,119 (2021) 1,097 (2024)	1,024	1,000	
	VG	VG	Water losses are minimized	←	% of non-revenue water loss in system	10%	3.9%	5%	
Reliability Services are reliable and responsive to customers	VG	VG	Water assets are kept in a state of good repair (SOGR)	←	% water system assets in fair or better condition (based on assets with known condition)	90%	96%	97%	**Renewal** Retain assets in a good state of repair to enable reliable service provision
	VG	VG	Water mains remain intact	←	# connection-days per year without service due to water main breaks compared to total # of properties connected to the municipal water system (O.Reg.)	2	1.8	1.5	
				←	% preventive maintenance work orders completed on time	90%	95%	95%	**Maintenance** Retain asset condition to enable reliable service provision
	VG	VG	Hydrants are reliable	←	% annual planned inspections completed	100%	100%	100%	**Operations** Conduct regular activities to provide services
Affordability Services are affordable, provided at lowest cost for both current and future customers	F	***	Service capacity is adequately funded in the short term	←	% current year funding to needs: Growth & Upgrade	90%	87%	***	**Financial Sustainability** Assets are adequately funded in both the short and long term
	F	***	Service reliability is adequately funded in the short term	←	% 10-year funding to needs: Renewal	90%	76%	***	
				←	% 10-year funding to needs: O&M	90%	89%	***	

* VG=Very Good, G=Good, F=Fair, P=Poor, VP=Very Poor ** based on Available Funding (2021 Budget Plan) *** Funding for 2032 to 2041 not available

3.5 LOS Reporting Requirements

To meet O.Reg. 588/17 requirements for the year 2025 AM Plan, the City has established performance targets for each of the defined levels of service. The proposed targets are assessed for appropriateness by considering the following factors:

- **How the proposed LOS differ from the current LOS:** The above table shows the current and proposed (target) LOS, as required. For the most part, the current LOS are the same or very close to the proposed LOS.
- **Whether the proposed LOS are achievable:** The proposed LOS require adequate funding to enable continued adequate performance and improvement, where required. The 2021 Capital Budget provides adequate funding for growth and upgrade but not renewal. In addition to funding the renewal works, the City requires adequate internal resources (staffing) to manage the implementation of the renewal works. The 2021 Operating Budget provides adequate funding but future operations and maintenance budgets will need to accommodate the expansion of the water portfolio.
- **The municipality's ability to afford the proposed LOS:** The proposed LOS are affordable in the shorter term (next 10 years) but, as the City's assets age and deteriorate due to use over the longer term, there are risks due to current funding levels. In April 2021, the City completed a Water and Wastewater Financial Plan – Rate Analysis Study to identify and address funding gaps.
- **The risks associated with the proposed LOS to the long-term sustainability of the municipality:** The financial sustainability is further discussed in section 6 Financing Strategy.

4 Risk Management Strategy

4.1 Overview

The City's key asset management principle is to meet service levels and manage risk, while minimizing lifecycle costs. The relative importance of the assets to support service delivery, referred to as asset criticality, is a key driver in selection of the most appropriate asset management strategy for each asset. Critical assets include assets that are key contributors to performance, the most expensive assets in terms of lifecycle costs, and assets that are most prone to deterioration or need ongoing maintenance investment. More critical assets are prioritized for expansion, upgrade, inspection, cleaning, maintenance, and renewal, depending on their current and forecast future performance.

Risk events, such as an asset's failure to have sufficient capacity, function or reliability, are events that may compromise the delivery of the City's strategic objectives. Lifecycle activities are used to manage the risk of failure by reducing the chance of asset failure to acceptable levels. The importance of assets to the City meeting its strategic objectives dictate the type and timing of lifecycle activities.

Risk exposure is the multiplication of the criticality or consequence of failure (CoF), which is the direct and indirect impact on the City if an asset failure were to occur, by the probability of failure (PoF), which is the likelihood or chance that an asset failure may occur.

Risk Exposure = Consequence of Failure x Probability of Failure

Redundancy is included in the determination of consequence of failure.

4.2 Consequence of Failure Matrix

The focus in this section is on asset criticality or consequence of failure which reflects the importance of an asset to the City's delivery of services. The following impacts of a potential asset failure are considered:

- **Service Delivery** considerations ranging from a disruption of non-essential service to widespread and long-term disruption of essential service
- **Health and Safety** considerations including the ability to meet health and safety related regulatory requirements, and degree and extent of injury, ranging from negligible injuries to loss of life
- **Environmental** considerations such as length and extent of damages to the natural environment
- **Financial** impact considerations such as asset replacement cost, damages to City or private property and infrastructure, loss of revenue, and fines.

Table 4-1 shows the relative importance of each of the above listed impacts against an asset criticality rating scale from 1 to 5.

Table 4-1 Asset Criticality (Consequence of Failure) Ratings

Rating	Criticality	Service Delivery	Health and Safety	Environmental	Financial
C1	Very Low	Small number of customers experiencing disruption / impact (less than 1% of people or up to a few hours)	No obvious potential for injury or affects to health.	Very negligible impact or can be restored within 1 week	Damages, losses (including 3rd party) or fines from $1k to $10k
C2	Low	Localized service disruption / impact (1% to 2.5% of people or up to 1 day)	Potential for minor injury or affects to health of an individual. Full recovery is expected; or minor medical attention may be required.	Minor (within 1 month) very isolated damage / impact to the environment, local importance	Damages, losses (including 3rd party) or fines $10k to $100k
C3	Moderate	Significant localized disruption / impact (2.5% to 10% of people or less than 1 week)	Potential for serious injury or affects to health. May affect many individuals and / or result in short term disability; or Hospitalization may be required for a short period of time.	Significant short term impact (up to 2 months), local importance	Damages, losses (including 3rd party) or fines $100k to $1M
C4	High	Major service disruption / impact (10% to 50% of people or for more than a week)	Potential for serious injury or affects to health of one or more individuals with a possibility of loss of a life and the certainty of long term disability; or Emergency hospitalization required for one or more individuals.	Significant long term impact (up to 1 year), Provincial importance.	Damages, losses (including 3rd party) or fines $1M to $10M
C5	Very High	Wide service disruption / impact (50% to 100% of people or permanent loss of services)	Potential for death or multiple deaths with probable permanent damage; or Emergency and long term hospitalization required for several individuals.	Major long term impact (greater than 1 year), Federal importance.	Damages, losses (including 3rd party) or fines > $10M

The above criticality profiles enable risk to be incorporated into the development of asset management strategies. More critical assets are prioritized for expansion, inspection, cleaning, maintenance, and renewal, depending on their current and forecast future performance.

4.3 Risk to Levels of Service – Approach

Asset criticality is determined based on the degree to which the failure of the asset would impact the following three community levels of service attributes:

- **Capacity and Use:** Assets of sufficient capacity are available, convenient and accessible
- **Function:** Assets comply with regulations, perform their intended function and are safe, secure and sustainable
- **Reliability**: Assets are in adequate condition and are maintained as required.

4.3.1 Risk to Capacity LOS

Risk to capacity level of service was assessed based on the ability of the City to supply fire flow, focusing on the capacity of the transmission and distribution mains. The failure event is defined in this case as a fire occurring at a location where capacity is insufficient to support fire flow.

In the 2019 Water Storage and Distribution Master Plan, fire flow and pipe velocity were modelled at junctions throughout the network to identify deficiencies, and develop network-level recommendations to be implemented by horizons 2021, 2026, 2031 and 2041. The current analysis does not aim to repeat that exercise, but to determine based on current Maximum Daily Demand levels, which pipe segments pose a capacity risk. Each segment's capacity risk will be considered with its reliability (condition) risk to prioritize and coordinate expansion and replacement projects.

For this AM Plan, the probability of capacity failure for pipe segments was estimated based on flow velocity under current state Maximum Daily Demand (MDD) with additional fire flow amounts listed in Table 4-2. As shown, the fire flow amounts have been estimated based on pipe size, reflecting the assumption that large pipes exist in areas where large fire flow would be needed. This is likely true in areas of new development, but could be inaccurate in historic areas of the City, where the watermains are undersized. In future risk analyses, the City may consider refining the estimated fire flow amounts based on current land use. The approach of adding flow to a pipe to account for velocity assumes that the demand is in the same direction of the MDD. This is not always the case, and leads to a conservative (worst case) scenario.

Table 4-2 Estimated Fire Flow Amounts

Pipe Diameter (mm)	Estimated Fire Flow amounts (L/s)
≤ 75	0
100	70
150	100
200	150
250	200
300	283
≥ 350	333

As shown in the Probability of Failure ratings in Table 4-3, a pipe is considered to have reached its maximum capacity when the MDD with fire flow reach a flow velocity of 4.5 m/s or higher.

Table 4-3 Probability of Failure Ratings for Pipe Capacity (Flow Velocity)

Probability of Failure Rating	Flow Velocity (m/s) under Maximum Daily Demand + Fire Flow conditions
1	≤ 1.5
2	1.5 – 2.5
3	2.5 – 3.0
4	3.0 – 4.5
5	> 4.5

4.3.2 Risk to Function LOS

As mentioned at the beginning of this section, the Function LOS identified several metrics, for which risk is not being assessed in this section. For several of the metrics, root causes of service deficiencies relate not to asset function, but to capacity or reliability (condition). For example boil water advisories: In the period form 2015-2020, there were two boil water advisories. Both were related to watermain breaks, where one break was caused by a construction incident, and the other by asset deterioration. Risks related to these root causes are being addressed through construction practices and the reliability / condition-based risk assessment discussed in Section 4.3.3.

For energy efficiency, the City has already achieved its 2024 target of 1,119 ekWh/ML of treated water, primarily through staff education and behaviour changes (although it is also possible that those behaviour changes were related to Covid impacts on work routines). The City is also investing in solar panels this year for the SWTP, which will further improve energy efficiency. Any risks related to energy consumption are generally financial, and projects like the solar panel installation are justified by long-term energy cost savings, rather than by risk assessment. However, in the future, when climate and greenhouse gas emissions targets have been defined by upper levels of government, risks of not achieving those targets may be considered in a risk assessment.

4.3.3 Risk to Service Reliability

The Reliability Level of Service refers to the City's aim to ensure that its assets are kept in a state of good repair to reduce the incidence of unplanned service interruptions due to breakage. Unplanned breakage can have wide-ranging consequences including service disruption, damage to surrounding infrastructure and property, risks to public safety and environmental impacts. Probability of Failure is estimated based on the condition of the asset, as shown in Table 4-5.

Table 4-4 Probability of Failure Ratings for Reliability

PoF Rating	Corresponding Asset Condition
1	Very Good
2	Good
3	Fair
4	Poor
5	Very Poor

Consequence of Failure is estimated based on the expected impact of an asset failure. Table 4-5 outlines the Consequence of Failure ratings and assumptions for assets in the linear network.

For vertical facilities, each facility is assigned a CoF score that reflects the criticality of the facility to the overall Water Service. Within each facility, each building and process system is assigned a CoF score that reflects the criticality of that system to the facility. The overall CoF of the building and process systems is then calculated as:

CoF-Overall = Squareroot (CoF-Facility x CoF-Building/Process System)

Table 4-6 lists the CoF ratings of each facility, and Table 4-7 lists the CoF ratings of each building and process system.

Table 4-5 Consequence of Failure Ratings for Linear Assets

Asset Type	Assumptions	Attributes	Consequence of Failure
Watermains – Transmission & Distribution	Unplanned failure will result in damage to a pipe segment, road and Right-of-Way (RoW) assets, and may also damage private assets. Traffic and pedestrian safety may be comprised. Water service may be reduced or shut off in the area during the repair. Redundancy has not been considered in these CoF ratings. Environmental impacts are minimal for a temporary spill of treated water. Impacts are higher with greater flow, and thus pipe diameter.	< 100 mm diameter	1
		100 to < 200 mm diameter	2
		200 to < 500 mm diameter	3
		500 to < 700 mm diameter	4
		>= 700 mm diameter	5
Watermains – Chlorine Contact	Same as above; however, service impact is greater for the same pipe diameter, because of the treatment role of these pipes.	< 500 mm diameter	5
		500 to < 700 mm diameter	5
		>= 700 mm diameter	5
Fire Hydrants	If a hydrant fails, a neighbouring hydrant will be used. In other words, there is redundancy in the system. It is assumed that if a hydrant fails, only the hydrant itself is damaged, and no damage occurs to other RoW assets or private property.	ALL	2
Valves	Valves fail by getting stuck, and must be replaced, along with a new pipe segment (sleeve). If the valve is in a chamber, otherwise a dig will be required. The CoF of 2 reflects the financial consequence. Other types of consequences are minimal (safety, availability, environmental).	ALL	2
Valve Chambers	When chambers fail, it is typically the lid that fails, resulting in a need for a small excavation, replacement of asphalt, and traffic impacts during the repair.	ALL	2
PRV	Same as for valves	ALL	2
PRV Chamber	Same as for valve chambers	ALL	2
Water Meter		Residential Meters	1

Asset Type	Assumptions	Attributes	Consequence of Failure
	Meters slow down as they age, resulting in lower-than-accurate readings and reduced billings. The CoF is based on financial impact. The financial impact is more significant for heavy water users, who are typically Industrial Commercial Institutional (ICI) customers with large meters.	ICI Meters up to 100mm	1
		ICI Meters 100mm+	2
Bulk Water Station	If the bulk water station fails, water will be provided from alternate sources.	ALL	1
Backflow Devices	Backflow devices are important safety devices to prevent contaminated water from entering the distribution system during pressure-loss events.	ALL	1

Table 4-6 Consequence of Failure Ratings for Vertical Facilities

Vertical Facility Type	Vertical Facility	Comment	Consequence of Failure
Booster Pump Stations (BPS)	Leacock BPS	Anne St. BPS will be reconstructed starting from 2023-26. During this period, Leacock BPS will have no redundancy for servicing pressure zone 3N.	5
	All other BPS	Redundancy within network allows for reduced criticality of individual facilities.	3
Reservoirs and Towers	All	Redundancy exists for individual facilities.	3
Wells	All	Redundancy exists for individual facilities.	3
Surface Water Treatment Plant (SWTP)	Whole Facility	Redundancy exists for the assets within the SWTP; however, the SWTP as a whole is critical to overall water service.	5

Table 4-7 Consequence of Failure Ratings for Facility Systems

Facility System		Description / Examples of Components	Consequence of Failure
Building System	Site Works	Grading, retaining walls, service connections, walkways, pavement for parking and driveways, drainage, landscaping	3
	Building Structural	Foundation, roofing, exterior walls, support columns, beams, floors, staircases	5
	Building Architectural	Non-structural building components, including windows, doors, partition walls, fixtures, floor coverings	2
	Building Mechanical & Electrical	HVAC, plumbing, electrical distribution, lighting, communications, security, sprinklers, standpipes, elevators	5
Process Systems	Process Structural	Water storage tanks	5
	Process Electrical	Generators and electrical systems used for the water treatment/storage/pumping	5
	Process Mechanical	Pumps, motors, valves and other equipment used for the water treatment/storage/pumping	5
	Process Piping	Piping used for the water treatment/storage/pumping	5

Facility System		Description / Examples of Components	Consequence of Failure
	Instrumentation & Controls	Flow meters, chlorine regulators, pressure transmitters	5
	Raw Water Intake (SWTP only)	Pump system	5
	Membranes (SWTP only)	Membranes, modules	5

4.4 Risk Analysis Results

4.4.1 Capacity Risk

Based on the fire flow velocity analysis described in Section 4.3.1, approximately 8.5km of pipes with an estimated replacement value of $5.0 million have flow velocity >4.5m/s under modelled fire flow conditions. As shown in Figure 4-1, many of those segments are in the area surrounding Bayfield St. and Wellington St. E.

Figure 4-1 Pipes with Potential Fire Flow Capacity Risk

The City's 2019 Water Storage and Distribution Master Plan Update (WSD-MP, page 46) listed the following areas as having fire flow capacity below the required fire flow.

- Zone 1 / Zone 2N boundary along the Wellington Street and Sophia Street corridors. The deficiencies are the result of small watermains in the area with insufficient capacity to provide fire flow.
- Around the boundary between Zone 1 and Zone 2S, near Yonge Street and Little Avenue are dead ends that may deliver inadequate fire flows.

These areas also appear in Figure 4-1, indicating that these segments still pose a capacity concern. The WSD-MP also identified the following segments, which do not appear in Figure 4-1.

- The Zone 1 Tiffin Street and Innisfil Street area contains numerous dead-end pipes that do not provide adequate fire flow.
- Northwest of Highway 400 in Zone 2N and Zone 3N inadequate fire flows is the result of residential dead ends.
- In Zone 2N along Bayfield Street north of Highway 400, there are numerous commercial land use zones with 150mm pipes, which are too small to adequately handle the required fire flows. Additionally, surrounding the commercial buildings are residential zones that have numerous dead ends resulting in inadequate fire flows.
- Zone 1 / Zone 2N boundary in the St. Vincent Street / Blake Street area watermains with insufficient capacity and dead ends provide insufficient fire flows.

If these segments have not been expanded already, the City may consider further capacity analysis of these segments.

Table 4-8 lists the pipe segments, lengths and replacement values of pipes that have a very high probability of failure for Fire Flow Velocity, and that are also in Poor and Very Poor Condition. These assets should be prioritized for replacement / expansion.

Table 4-8 Pipes at Fire Flow Velocity and Condition Risk

Object ID	Physical Condition Score	Length (m)	Escalated Replacement Value
9782	Very Poor	182.8	98,511
12130	Very Poor	53.2	28,660
6940	Poor	375.8	202,486
11508	Poor	69.2	37,294
7895	Poor	161.3	86,909
7775	Poor	102.6	55,267
7121	Poor	116.3	62,647
11025	Poor	83.8	45,164
9765	Poor	117.2	63,165
8315	Poor	60.8	32,758
11125	Poor	153.7	82,819
10509	Poor	103.2	55,626
11519	Poor	96.6	97,687
7548	Poor	365.2	196,778
7650	Poor	138.8	74,776
7422	Poor	177.0	95,378
TOTAL		**2,357.0**	**1,315,925**

4.4.2 Reliability Risk

A risk map is a graphic representation of probability and consequence of one or more risks related to a similar objective. After assessing the criticality and probability of each risk, they are plotted on a matrix. Different colours on the map help to prioritize where and how to focus City resources, time, effort, and/or dollars.

- Risks that appear in the red (extreme) zone are significant to the City and therefore need to be actively managed and monitored in a more comprehensive manner than other risks (i.e., prioritized)
- Risks that appear in the orange (high) or yellow (moderate) zones will also be actively managed depending on their nature
- Risks that appear in the green (low) zone are generally acceptable without significant mitigation strategies being implemented, although monitoring may still occur in some form.

The risk of not meeting the stated reliability / renewal levels of service is influenced by both the asset criticality and asset performance, as represented by asset condition. Three sets of risk exposure maps are shown in the tables on the next page for assets **with known condition**. The top maps show the replacement value in each cell and the bottom maps show the percent of total known asset value.

- **Current Risk:** It was found that **$9.49 million** (0.76%) of water assets are currently in the extreme risk category, consisting of a 1.5km ($5.0 million) segment of transmission main along Ferndale Rd. from Tiffin St. to Ardagh Rd that is currently shut down, $0.4 million of building electrical and mechanical systems at the Leacock Booster BPS, and various site works and building assets at the other BPS.
- **10-Year Forecast Risk, no Funding:** The deterioration of the water network due to age and use over the next 10 years is forecast to increase the water assets in the extreme risk category to **$54.98 million** (3.85% of the expanded / upgraded asset portfolio), if no funding is available.
- **10-Year Forecast Risk, with Available Funding:** If the extreme risk category assets are prioritized for replacement based on available funding of $71.89 million in the 2021 10-year capital plan, the forecast water assets in extreme risk category will be reduced to **$0.40 million**.

Table 4-9 Water Asset Risk Maps

CURRENT RISK EXPOSURE

PoF	Cdn							
5	VP	$0.21	$16.02	$1.70	$7.25	$0.45	<--sum	**$9.49**
4	P	$0.08	$16.68	$7.29	$10.93	$1.80		
3	F	$0.78	$60.14	$21.02	$15.33	$30.80		
2	G	$3.62	$112.98	$116.81	$70.33	$214.69		
1	VG	$4.49	$240.63	$192.60	$54.59	$44.64		
		$9.18	**$446.45**	**$339.43**	**$158.42**	**$292.38**	<--sum	**$1,246**
		VL	L	M	H	VH		
		1	2	3	4	5		

<- Criticality (Consequence of Failure) ->

PoF	Cdn							
5	VP	0.02%	1.29%	0.14%	0.58%	0.04%	<--sum	**0.76%**
4	P	0.01%	1.34%	0.59%	0.88%	0.14%		
3	F	0.06%	4.83%	1.69%	1.23%	2.47%		
2	G	0.29%	9.07%	9.38%	5.65%	17.23%		
1	VG	0.36%	19.31%	15.46%	4.38%	3.58%		
		VL	L	M	H	VH		
		1	2	3	4	5		

<- Criticality (Consequence of Failure) ->

FORECAST 10-YR RISK EXPOSURE (no Funding)

		$0.34	$27.03	$9.42	$22.08	$32.62	<--sum	**$54.98**
		$0.38	$17.42	$3.84	$10.37	$0.29		
		$0.88	$71.64	$17.98	$20.27	$63.40		
		$3.29	$105.52	$115.58	$52.02	$151.44		
		$4.28	$281.75	$360.74	$70.14	$53.93		
		$9.18	**$503.36**	**$507.56**	**$174.87**	**$301.67**	<--sum	**$1,497**
		VL	L	M	H	VH		
		1	2	3	4	5		

<- Criticality (Consequence of Failure) ->

		0.02%	1.81%	0.63%	1.48%	2.18%	<--sum	**3.67%**
		0.03%	1.16%	0.26%	0.69%	0.02%		
		0.06%	4.79%	1.20%	1.35%	4.24%		
		0.22%	7.05%	7.72%	3.48%	10.12%		
		0.29%	18.83%	24.10%	4.69%	3.60%		
		VL	L	M	H	VH		
		1	2	3	4	5		

<- Criticality (Consequence of Failure) ->

FORECAST 10-YR RISK EXPOSURE (w/ Available Funding)

		$0.19	$23.99	$4.28	$0.11	$0.00	<--sum	**$0.40**
		$0.05	$14.96	$1.34	$6.68	$0.29		
		$0.88	$71.64	$17.98	$20.27	$63.40		
		$3.62	$107.98	$118.08	$55.70	$151.44		
		$4.44	$284.78	$365.88	$92.11	$86.54		
		$9.18	**$503.36**	**$507.56**	**$174.87**	**$301.67**	<--sum	**$1,497**
		VL	L	M	H	VH		
		1	2	3	4	5		

<- Criticality (Consequence of Failure) ->

		0.01%	1.60%	0.29%	0.01%	0.00%	<--sum	**0.03%**
		0.00%	1.00%	0.09%	0.45%	0.02%		
		0.06%	4.79%	1.20%	1.35%	4.24%		
		0.24%	7.22%	7.89%	3.72%	10.12%		
		0.30%	19.03%	24.45%	6.15%	5.78%		
		VL	L	M	H	VH		
		1	2	3	4	5		

<- Criticality (Consequence of Failure) ->

5 Asset Management Strategy

5.1 Overview

The City's ability to deliver the levels of service outlined in the Asset Management Plan is impacted in large part by:

a) forecast future population growth and the associated need for additional infrastructure to serve it

b) changing functional, legislative and sustainability requirements and the associated need for existing assets to be upgraded to continue to be fit for purpose

c) aging infrastructure and the associated need for operations, maintenance and renewal investments to sustain it

d) available funds and the associated need for assets to be provided at lowest cost for both current and future customers.

To achieve its program objectives, the City builds new infrastructure assets to meet capacity needs, upgrades assets to meet new functional needs and manages existing assets to meet reliability needs – all with limited funds. Asset lifecycle management strategies are planned activities that enable assets to provide the defined levels of service in a sustainable way, while managing risk, at the lowest lifecycle cost. Asset lifecycle management strategies are typically organized into the categories listed in Table 5-1, and are driven by the levels of services defined in the previous section.

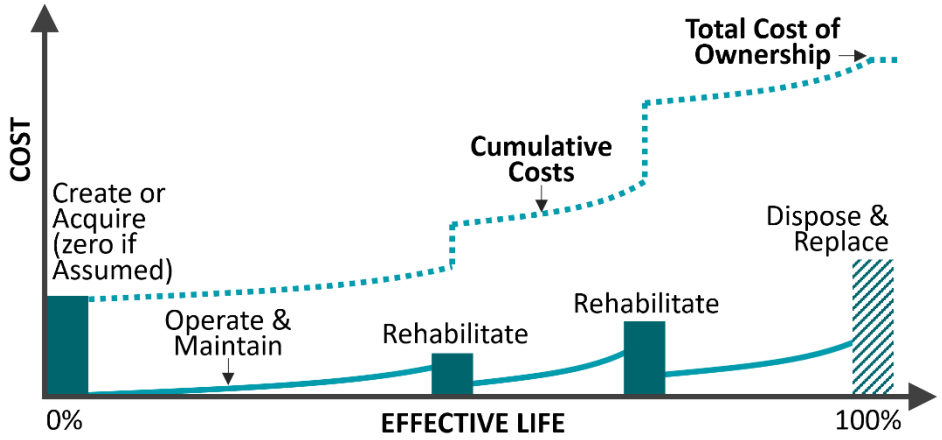
Table 5-1 Asset Lifecycle Management Categories

Life Cycle Management Category	Description	Examples of Associated Activities
Operate	Regular activities to support service delivery	Using/running a piece of equipment, cleaning, inspection, sampling
Maintain	Activities to retain asset condition to enable it to provide service for its planned life	Routine maintenance, filter changes, lubrication, minor repairs
Renew	Activities that return the original service capability of an asset	Overhaul, rehabilitation, replacement
Upgrade	Activities to provide a higher level of service capability from an existing asset to achieve better fit for purpose or meet regulatory requirements	Upgrade a boiler to one with higher energy efficiency
Expand	Activities to accommodate increased demand, for example by providing a new asset that did not exist previously, or by expanding an existing asset	Construct new watermain, expansion of a facility

Non-asset solutions are actions or policies that can lower costs, lower demands, or extend asset life (e.g. better integrated infrastructure planning and land use planning, demand management, insurance, process optimization, education of public).

The City assesses the costs of potential lifecycle activities to determine the lowest lifecycle cost strategy to manage each asset type while still meeting levels of services. The total cost of ownership is the sum of lifecycle activity costs to sustain each asset type over the asset lifecycle. (See Figure 5-1 for conceptual lifecycle cost model.) Sufficient investment of the right type and at the right time minimizes the total cost of ownership for each asset and also prevents other potential impacts (i.e., risks) such as interruption to service delivery or damage to other infrastructure. Operations, maintenance and renewal activities are timed to reduce the risk of service failure from deterioration in asset condition and are part of the total cost of ownership. Note that although the assets contributed by land developments (when the City assumes ownership) are provided at no cost to the City, the costs to sustain them over their lifecycles and to replace them must be paid by the City.

Figure 5-1 Conceptual Lifecycle Cost Model



5.2 Life Cycle Management Needs

The City uses its understanding of risks of not meeting target levels of service to inform the timing and amount of investments needed in infrastructure assets. The City aims to provide sufficient service capacity to meet demand and manages the upgrade, operations, maintenance, and renewal of assets to meet defined service levels, including legislated and other corporate requirements. This section of the AM Plan outlines the City's expansion and upgrade strategies as defined in the 2019 Water Supply Master Plan and 2019 Water Storage and Distribution Master Plan to support capacity and functional service levels, and the City's operations, maintenance, and renewal activities to support reliability service levels.

5.2.1 System Expansion Needs

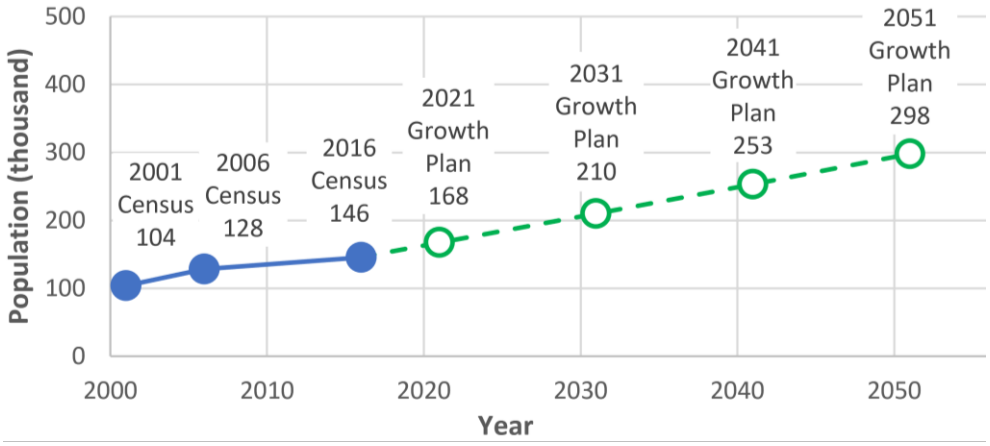
Expansion strategies enable the City to meet increasing demands, primarily due to population growth. Barrie has been one of Canada's fastest growing municipalities for the past several decades. Based on the 2020 Growth Plan, the City's population and employment numbers will continue to increase through to 2051, as summarized in Table 5-2 and

Figure 5-2. Ensuring that this level of growth is managed in a sustainable, efficient, and financially responsible manner is central to the long-term health, prosperity, and well-being of the City and its residents.

Table 5-2 City of Barrie Population and Employment Forecasts

Year	Population	Population Compounded Growth Rate	Employment
2016	145,800	-	73,800
2021	167,600	2.8%	83,400
2031	210,000	2.3%	101,000
2041	253,000	1.9%	129,000
2051	298,000	1.7%	150,000

Figure 5-2 Population History and Forecasts (thousands)



The City's efforts to achieve future water capacity objectives include Non-Asset and Asset-based actions.

Non-Asset Actions

The City has also proactively pursued non-asset alternatives to system expansion, including water conservation programs to reduce water consumption. Examples include the following:

- **Toilet Rebate Program:** The City offers a $50 rebate to residents who replace high-flow fixtures (>6L / flush) with low flow fixtures (≤6L / flush), and has been doing so since 2005.
- **Outdoor Water Use Restrictions:** The City's Outdoor Water Use Strategy allows for the implementation of outdoor water use restrictions in times of peak water demand to avoid water delivery challenges for essential purposes. At times when production cannot meet high consumer demands the Water Operations Branch / Operating Authority will initiate an outdoor water use restriction to ensure adequate quantities of potable water for consumer demand and fire fighting purposes.

Asset-based Actions

The City's efforts to achieve water capacity objectives include the system expansion actions, listed in Table 5-3 for Water Supply. In addition, Table 5-4 summarizes expansions to the Water Storage and Distribution system, specifically in the Salem & Hewitt Secondary Plan areas, as recommended in the 2019 Water Storage and Distribution Master Plan.

Table 5-3 Expansion Activities to achieve Water Supply objectives

Source: Water Supply Master Plan 2019, pages 80-81

Stage	Planned Growth & Expansion Activities	Life Cycle Management Category	Corresponding Capital Project #
Stage 1: 2019 to 2024	Keep the quarterly monitoring of sodium levels for Wells 3A, 9, 11, 12, 13, 14, and extend this frequency of monitoring for the SWTP	Operations	n/a
	Keep the monthly monitoring of PCE and TCE levels for Wells 11, 12, 14 and 15	Operations	n/a
	Initiate an assessment of the groundwater system	Expansion / Upgrade	None
	Initiate an optimization study for the SWTP optimization study to identify opportunities to increase capacity and postpone blending	Expansion	000461
	Initiate a feasibility study with mitigation plan for the blending of surface water and groundwater systems to understand the compatibility of the two water sources, chlorine decay in the network, and discolouration potential	Expansion	None
	Initiate a communication plan to inform the residential and ICI customers in Zone 2S and 3S about the potential changes in water quality due to the potentially different sources of water: surface water and groundwater systems.	Expansion	None
Stage 2: 2025 to 2031	Implement small capital works recommended by the SWTP optimization study.	Expansion	000461
	Amend the Permit to Take Water, the Drinking Water Works Permit and the Municipal Drinking Water License to reflect the SWTP small capital works, if required.	Expansion	None

Table 5-4 Expansion Water Storage & Distribution Annex Areas

Asset Description	Quantity to be added	
	2022-2031	2032-2041
Watermains 200mm diameter PVC – Developer 300mm diameter PVC – Developer 300mm diameter PVC – City 500mm diameter CPP	 109.1 km 14.8 km 17.9 km 3.7 km	 109.1 km 14.8 km 7.7 km 3.7 km
PRV Chamber with 2 PRVs	1 set	1 set
New Reservoir and Booster Pump in Salem	none	1

The new assets to be constructed in the Salem and Hewitt development areas will be constructed in part by developers and in part by the City; however, ownership of developer-constructed assets will eventually be transferred to the City, such that the City will become responsible for operation, maintenance and renewal of those assets thereafter. In addition to new assets in development areas, the City plans to expand watermains within the former City boundary.

Table 5-5 summarizes the average annual cost of asset expansion needs by asset type, including both developer-constructed and City-constructed assets. The total average expansion need is estimated at $24.8 million/year for the period 2022-2031. This is approximately 75% of the $33.0 million/year expansion cost that could be expected if the City were to expand its asset value in proportion with population growth. This suggests that increased system scale and land use density are enabling more efficient infrastructure costs for delivery of water services.

Table 5-5 10-year Expansion Needs Forecast

Asset Category	Developer-Constructed Assets (2021 $, M/year)	City-Constructed Assets (2021 $, M/year)	TOTAL Expansion Assets (2021 $, M/year)
Surface Water Treatment Plant	--	$7.90	$7.90
Well Pumping Stations	--	--	--
Reservoirs & Towers	--	--	--
Booster Pump Stations*	--	$6.70	$6.70
Pipes & Appurtenances	$150.86	$79.15	$230.01
Meters	$2.94	--	$2.94
TOTALS	**$153.80**	**$93.75**	**$247.55**

** Expansion of Anne Booster Pump Station, excluding replacement value of existing facility.*

5.2.2 System Upgrade

Energy Conservation

In 2022, the City will install solar panels on the SWTP (capital project 001015). The budgeted cost for this project is $1.4 million, with an equity payback period of 9.7 years. Over the 30-year service life of the asset, the average annual life cycle savings is $152k/year (based on 2% inflation per year), and the Net Present Value is $2.64 million. The project is easily justified by its financial benefit-cost ratio of 2.88, but also has significant environmental benefits. This project is expected to reduce consumption of fuel-based electricity by 694MWh/year, leading to a projected reduction of Green House Gas (GHG) emissions of 136.1 tonnes of CO2/year.

Considering the cost of the solar panel project (2021 $1.4 million), the average annual upgrade costs are $0.14 million/year.

Well Upgrades

The City plans to upgrade wells at an estimated cost of $1.8 million.

5.2.3 System Renewal Needs

Renewal efforts focus on the following activities to enable the City to meet its reliability objectives:

- Inspect assets to understand their performance against technical levels of service to predict the need for renewal activities to extend life and/or reduce risk of failure to provide adequate service capability
- Rehabilitate assets to extend the life and reduce the risk of failure to provide adequate service capability
- Dispose of and replace all assets at the end of life to reduce the risk of failure to provide adequate service capability.

The renewal activities included in this AM Plan are **forecast to be needed to achieve the current levels of service at acceptable levels of risk**. Over time, as the City refines the asset management strategies through tracking of actual condition and actual costs and benefits of the strategies, the City will improve its understanding of the deterioration rates and the lowest lifecycle cost for each asset type.

Table 5-6 shows the asset types that make up the current replacement backlog (assets in Very Poor condition). A renewal backlog of $25.6 million of assets in Very Poor condition currently exists as described under the State of Local Infrastructure heading above, including $7.7 million worth of water mains. As those water mains are replaced, it is estimated that $2.7 million worth of connected hydrants, valves and valve chambers will also be replaced (a 35% additional "connected assets" cost for replacing the water mains). As such **$28.3 million** will be needed to clear the current backlog and connected assets. As the water network assets age and deteriorate, without renewal investment by the City, the current renewal backlog and replacement needs of connected assets is estimated to reach **$94.2 million** by 2031. To clear the estimated 2031 renewal backlog over the next ten years, the annual renewal need is **$9.4 million per year**.

The above paragraph describes the 10-year renewal needs based on current and forecast asset condition. It is important to also consider the renewal needs over the lifetimes of the water network assets as calculated by the total lifecycle renewal costs divided by expected life. Table 5-6 also lists the average annual need for renewal based on renewal activities for both the current asset portfolio and the asset portfolio forecast to be in place in 10 years based on growth and upgrade. The full lifecycle renewal needs for the water network asset portfolio in place over the next 10 years is estimated to be $23.3 million per year for the current asset inventory, increasing to $27.2 million by 2031, for an average of **$25.2 million per year** over the ten-year period. The 10-year renewal needs are substantially less than the full lifecycle renewal needs because the City's water network assets are currently in overall good condition.

Table 5-6 Renewal Needs Forecasts

Asset Category	Renewal Need to clear the current backlog of assets in Very Poor Condition (2021 $, millions)	Renewal Need to clear backlog of assets in Very Poor Condition by 2031 (2021 $, millions)	Average Annual Renewal Amount for sustained State of Good Repair (2021 $, M/year)	
			Current	In 10 Years
Surface Water Treatment Plant	--	$30.77	$7.10	$7.68

Asset Category	Renewal Need to clear the current backlog of assets in Very Poor Condition (2021 $, millions)	Renewal Need to clear backlog of assets in Very Poor Condition by 2031 (2021 $, millions)	Average Annual Renewal Amount for sustained State of Good Repair (2021 $, M/year)	
			Current	In 10 Years
Well Pumping Stations	$0.11	$12.47	$0.97	$1.05
Reservoirs & Towers	$0.62	$2.54	$0.82	$0.82
Booster Pump Stations	$4.18	$14.17	$1.35	$1.57
Pipes & Appurtenances	$16.53	$24.63	$12.43	$15.29
Meters	$6.87	$9.59	$0.61	$0.76
TOTAL	**$28.31**	**$94.17***	**$23.28****	**$27.17****

** To clear the estimated 2031 renewal backlog over the next ten years, the annual renewal need is $9.4M per year.*

Further details on the current and forecast 2031 backlogs are provided in Appendix 8.1, Risk-Based Renewal Priorities. The table provides details, by asset type, including estimated life, criticality (CoF), current replacement value (CRV), condition in 2021 (current), forecast condition for 2031 with no funding, the application of rehabilitation and replacement treatments to reduce risk, forecast condition for 2031 with the applied treatments, and the % assets in Fair or better condition.

The 2016 Canadian Infrastructure Report Card (CIRC) provides an assessment of the health of municipal infrastructure as reported by cities and communities across Canada. CIRC provides the Average Annual Renewal Rate (AARR) as a standard metric for evaluating the rate at which assets are rehabilitated and/or replaced, with shortfalls potentially shortening asset useful life and likely increasing long-term costs. CIRC provides the following target AARR lower and upper limits for potable water:

- **Linear potable water assets:** 1.0% to 1.5%
- **Non-Linear potable water assets:** 1.7% to 2.5%

The Average Annual Renewal Amounts provided in the last two columns in the above Table, when divided by the asset replacement cost and separated into linear and non-linear assets translate to AARR of **1.4% for linear** water assets and **2.7% for non-linear** water assets. The renewal activities for linear water assets yield a renewal need that is consistent with the CIRC AARR metric target range while the renewal activities for non-linear water assets yield a slightly higher renewal need.

The City may choose to increase or decrease the needed asset management strategy investment amount for a time due to factors such as the age of the infrastructure, accumulated backlog of work, risk tolerance, and available infrastructure renewal funding. However, **eventually, asset renewal must be undertaken to avoid accumulation of large backlogs of work over time and associated risk to service delivery.**

5.2.4 Operations and Maintenance Needs

Along with timely renewal of assets, operations and maintenance (O&M) work directly enables the City to meet state of good repair service levels (percentage of assets in fair or better condition), as well as service delivery needs. The distinction between renewals

(capital programs) and operations and maintenance (operating expenses) is set by accounting policies and standard operating procedures.

Operations and maintenance activities ensure the asset continues to deliver defined levels of services, while renewal activities extend the useful life of the asset.

Renewals, operations, and maintenance are strongly linked; operations and maintenance strategies can accelerate or delay the need for renewals, and if renewals are deferred, operations and maintenance needs will often increase to ensure that assets are kept in a state of good repair.

Table 5-7 and Table 5-8 describe the current operations and maintenance activities for linear and vertical assets, respectively.

Table 5-7 O&M Activities Conducted on Linear Assets

Asset Type	Operational Activities	
	Current	Additional Potential Activities
Mains	Inspection, swabbing, flushing, CIPP lining and cathodic protection	
Hydrants	Hydrants are inspected twice per year, and repairs are made as needed to ensure that all hydrants are in Fair condition or better.	
Valves*	Large valves (>= 400mm) are exercised every year. Other valves (<400mm) are exercised every 4 years (25% of these valves/year).	
Valve Chambers	Valve chambers are repaired as needed to ensure that they are in working condition.	
Pressure reducing valves (PRV)	PRVs are checked on a semi-annual basis to ensure that they are operating as intended and fully disassembled during one of those semi-annual checks. PRVs are disassembled, cleaned and internal parts are inspected to ensure continued operation on an annual basis.	Replacement of pilot system (every 10 – 15 years). Currently they are reactively fixed when the pilot system breaks down.
PRV Chambers	Chambers are cleaned when required. Non-water tight chambers are pumped bi-annually prior to checks. Chambers are inspected on an annual basis. If there are items that can be fixed, they are completed.	Older chambers are being replaced through a PRV replacement program. The new chambers have building system components (dehumidifier, heater, electronics). Those components should be put on a replacement program to ensure continuity of operation. Staff are only in those locations on a semi-annual basis.
Meters	None	City is exploring replacing larger meters more frequently to ensure correct billing. This analysis is in progress, and may result in higher replacement expenditures, which should balance out with higher revenues.
Backflow devices (39 at water facilities)	None – assets are low criticality All backflow devices at the Ground Water Supply stations adhere to the testing requirements (annual) of the City of Barrie Backflow Prevention Bylaw. If issues are present, devices are replaced / repaired immediately	
Bulk water station	None – assets are low criticality	

** Frequency is under review*

Table 5-8 O&M Activities Conducted on Vertical Assets

Facility System	Examples of Components Included	Operational Activities	
		Current	Additional Potential Activities
Site Works	Grading, retaining walls, service connections, walkways, parking lot and driveways, drainage, landscaping	• Grass cutting • Snow clearing • Litter pick-up	None
Building Structural	Foundation, roofing, exterior walls, support columns, beams, floors, staircases	• Repairs are generally reactive	Regularly scheduled Building Condition Assessments are needed (performed by corporate facilities group)
Building Architectural	Non-structural building components, including windows, doors, partition walls, fixtures, floor coverings	• Repairs are generally reactive	Regularly scheduled Building Condition Assessments are needed Current needs at multiple facilities include: • Lighting Replacement (LED) • Window Replacement • Door Replacement • Station Interior Painting • Floor covering Replacement
Building Mechanical & Electrical	HVAC, plumbing, electrical distribution, lighting, communications, security, sprinklers, standpipes, elevators	• HVAC Inspections (bi-annual at select stations) • Otherwise, repairs are generally reactive	Current needs include: • Communication Systems renewal /Upgrade.
Process Structural	Water storage tanks	• Cleaning on 1-3 year cycle, depending on station • Lining inspections at towers during cleaning operations • Exterior painting inspections on towers during exterior washings (1-3 years depending on the station)	• Condition assessment of Clear Wells at stations • Condition assessments at reservoirs.
Process Electrical	Generators and electrical systems	• Measure station voltage annually • Load test diesel generator every 2 years • Generator maintenance every 6 months • Check batteries monthly • Reactive repairs as required. • At SWTP, bi-annual inspection and servicing is conducted by a 3rd party.	• Replacement of generator when the condition has deteriorated, and reliability is questioned.

Facility System	Examples of Components Included	Operational Activities	
		Current	Additional Potential Activities
Process Mechanical	Pumps, motors, valves	• Grease and change oil in motors annually • Remove, service and install pumps and motors every 10 years for BPS and every 5 years for wells • Check, clean and exercise valves annually • Routine PM inspections, and repair as needed.	
Process Piping	Piping used for the water treatment/storage/pumping	• Reactive work when a failure occurs.	• Replacement program for station piping that is ductile. • Replacement program for sand separators at select stations.
Instrumentation & Controls	Flow meters, chlorine regulators, pressure transmitters	• Chlorine Systems have reactive work when required. • Chlorine Systems have preventative maintenance completed on an annual basis (Regulator, booster pump, ejector, regulator, rate controller) • Routine Preventive Maintenance work orders are conducted to test and calibrate the system (weekly, monthly and annual work)	• Verification checks of the chlorine system (rate Controller & Booster Pumps) • Calibrations of chlorine system rate controller • Flow Meter replacement program
Raw Water Intake (SWTP only)	Pump system	• Annual PM inspection of well housing • Pump station has the same PM routine as plant	
Membranes (SWTP only)	Membranes Modules	• Daily performance monitoring, repairs as needed	

The City also conducts other operational activities that are necessary for the overall service, but not necessarily associated with particular assets or asset types, including:

- Sampling and testing drinking water quality
- Administration services including billing, responding to customer complaints and starting/stopping water services
- Providing underground locate services, such as marking and staking
- Purchasing fuel, electricity, chemicals and insurance needed for the water service

- Providing education and information to the community about water conservation benefits and programs.

Staff report a shortage of resources to achieve the established service levels in the groundwater service. Table 5-9 indicates that an estimated **$22.3 million** are needed to complete the operational activities listed under "Current Operational Activities" in Table 5-7 and Table 5-8, as well as to deliver the services listed above. The costs and benefits (in terms of risk reduction) should be assessed to prioritize addition of these activities to the on-going operations, such as:

- Scheduled replacement program for pilot systems in PRV
- Scheduled replacement program for building systems (electrical and mechanical) within PRV chambers
- More frequent replacement of larger water meters to ensure correct billing
- Regularly scheduled Condition Assessments for building and process systems within vertical assets
- Scheduled replacement programs for building and process components of vertical assets (windows, doors, interior paint, flooring, lighting, communication systems, piping, flow meters, sand separators, etc.)
- Regular verification checks of chlorine system and calibration of chlorine system rate controller

Table 5-9 Cost of Needed O&M Activities

	REFERENCE 2021 Budget	Additional Funding Needs to Achieve Current LOS Commitments	Operational Funding Needs (Current LOS)
SWTP	5.28	--	5.28
Wells	4.27	15%	4.91
Reservoirs & Towers	1.04	15%	1.19
Booster Pump Stations	1.51	15%	1.73
Pipes & Appurtenances	6.26	--	6.26
Meters*	2.78	5%	2.92
TOTAL	**21.13**		**22.29**

** Replacement of meters includes the capital cost for the asset and the O&M cost for installation, including the smartpoints as they approach replacement*

The expansion and upgrade assets planned to be added from 2021-2031 will result in increases in average annual operational need. As shown in Table 5-10, based on the expected expansions and upgrades in the City's water asset portfolio, the average annual operational costs are expected to grow by **$0.6 million/year** to **$22.3 million/year** (in year 2021 $) by 2031.

Table 5-10 Annual O&M Needs due to Planned Expansion and Upgrade

Expansion and Upgrade Assets planned to be added 2021-2031	Value of Assets to be installed by 2031 (2021 $, millions)	Description of impact on operational needs	Estimated impact on operational need (2021 $ /year)
Watermains and appurtenances to be added in Salem & Hewitt development area Mains Hydrants Valves & Chambers Meters 1 PRV & PRV Chamber	 121.9 9.1 31.6 2.3 0.6	Need for additional inspection, flushing, swabbing, valve exercising	+ 610,364*
Expansion of Anne Booster Pump Station	6.7**	Additional energy costs, and more equipment to be monitored and inspected	+ 80,000
Well process mechanical upgrades	1.8		
Solar Panels installed on SWTP	1.4	Reduced energy costs Need for regular inspection and maintenance	- 110,268 + 10,000
Optimization work at SWTP	7.9		
TOTAL	**183.3**		**590,096**

** An estimated $3,688 of O&M funds are needed to steward $1M of linear mains & appurtenances, based on water service's current budget of $3,344,288 to steward $906.8 M worth of mains, hydrants, valves, chambers, PRV & chambers.*

*** Value represents difference between Construction cost of expanded Anne BPS, and value of existing Anne BPS.*

5.3 Summary of Asset Life Cycle Needs

To satisfy the City's capacity commitments, the total expansion need is estimated at **$257.6 million** for the period 2022-2031 for an average of $26.8 million per year, including assets to be constructed in the Salem and Hewitt Secondary Plan Area (developer-constructed and City-constructed), as well as assets being expanded within the former City boundary, including water mains and Anne BPS. The City also pursues non-asset alternatives to system expansion including water conservation programs to reduce water consumption. Actions include seasonal restrictions for outdoor water use, and promotion of water efficiency in the home.

Upgrade needs total **$3.25 million**, or $0.325 million per year averaged over 2022-2031. These projects include installation of solar panels on the SWTP and well upgrades.

A renewal backlog of $25.6 million of assets in Very Poor condition currently exists as described under the State of Local Infrastructure heading above, including $7.7 million worth of water mains. As those water mains are replaced, it is estimated that $2.7 million worth of connected hydrants, valves and valve chambers will also be replaced (a 35% additional "connected assets" cost for replacing the water mains). As such **$28.3 million**

will be needed to clear the current backlog and connected assets. As the water network assets age and deteriorate, without renewal investment by the City, the current renewal backlog and replacement needs of connected assets is estimated to reach **$94.2 million** by 2031. To clear the estimated 2031 renewal backlog over the next ten years, the annual renewal need is **$9.4 million per year**.

The above paragraph describes the 10-year renewal needs based on current and forecast asset condition. It is important to also consider the renewal needs over the lifetimes of the water network assets as calculated by the total lifecycle renewal costs divided by expected life. The full lifecycle renewal needs for the water network asset portfolio in place over the next 10 years is estimated to be $23.3 million per year for the current asset inventory, increasing to $27.2 million by 2031, for an average of **$25.2 million per year** over the ten year period. The 10-year renewal needs are substantially less than the full lifecycle renewal needs because the City's water network assets are currently in overall good condition.

The 2021 budget plan for operations and maintenance is $21.2 million to deliver the current level of operational activities. Additional scheduled condition assessments and repair program needs of $1.2 million have been identified to adequately deliver proposed operational services for a total need of **$22.3 million**. The estimated annual cost for operations and maintenance is expected to grow by $0.59 million per year to cover operational costs associated with the planned expansion and upgrade of assets until 2031. Therefore, the forecast cost of operational service needs is estimated to be **$22.9 million** in 2022 increasing to **$28.2 million** by 2031, for a 10-year total operating need of $255.0 million or an average annual amount of **$25.5 million** over the 10-year planning period.

The lifecycle management strategy needs are summarized in the following table.

Table 5-11 Lifecycle Management Strategy Needs Summary

Service Attributes	Asset Lifecycle Activity	Water Assets Lifecycle Management Needs	
		10-year Total (2021$M)	10-year (2022–2031) Ave Annual (2021$M/yr)
Capacity	Growth – Developer	$153.1	$15.31
	Growth – City	$93.7	$9.37
Function	Upgrade	$3.2	$0.32
Reliability	Renewal	$94.2	$9.42
	Operations & Maintenance	$255.0	$25.5

6 Financing Strategy

6.1 Overview

The information presented in the preceding sections of the Asset Management Plan inform the financial requirements: the state or condition of the assets, the expected levels of service, the risks to service delivery, and the lifecycle activities needed to reduce the risks to service delivery targets to acceptable levels.

A global leader in asset management, the Local Government Association of Australia defines financial sustainability within the municipal government context as *"… a government's ability to manage its finances so it can meet its spending commitments, both now and in the future. It ensures future generations of taxpayers do not face an unmanageable bill for government services provided to the current generation".*

A municipality is in a financially sustainable position if it:

- Provides a level of service commensurate with willingness to tax and ability to pay
- Can adjust service levels in response to changes in economic conditions or transfer payments
- Can adjust its implementation plans in response to changes in the rate of growth
- Has sufficient reserves and/or debt capacity to replace infrastructure when it needs to be replaced and keeps its infrastructure in a state of good repair.

The key challenges to financial sustainability are:

- A mismatch between level of service decisions and fiscal capacity
- Growth that does not materialize as expected
- The future cost of infrastructure investments
- Unforeseen shocks to revenue or spending.

O.Reg. 588/17, proposed levels of service, requires a financial strategy that provides an estimate of the annual costs for each of the 10 years of undertaking the needed lifecycle activities, separated into capital expenditures and significant operating costs, and the annual funding projected to be available to undertake the lifecycle activities. Although the reporting period is for 10 years, the assessment of preferred lifecycle activities is to include the full lifecycle of the assets.

6.2 Financial Sustainability

6.2.1 Overview

This section compares the planned funding (budgets) against the forecast needs for the lifecycle activities identified in the previous section (growth and upgrade, renewal, and operations and maintenance).

Table 6-1 summarizes the average annual cost of forecast lifecycle activity needs compared with planned funding over the 10-year period 2022 to 2031 and provides any shortfalls or funding gaps. The Asset Funding Ratio is an important financial performance indicator as it reports the percentage (%) of funding projected to be available to undertake

the lifecycle activities forecast to be needed over the next ten years against a target of 90% for Good (95% is considered Very Good, 80% is Fair, and 70% is Poor).

Since the forecast needs exceed the planned available funding, the City has funding "gaps" for each of the asset lifecycle activity types, ranging from Poor for Renewal to Fair for Expansion & Upgrade and Operations & Maintenance.

Table 6-1 AM Plan Financial Summary

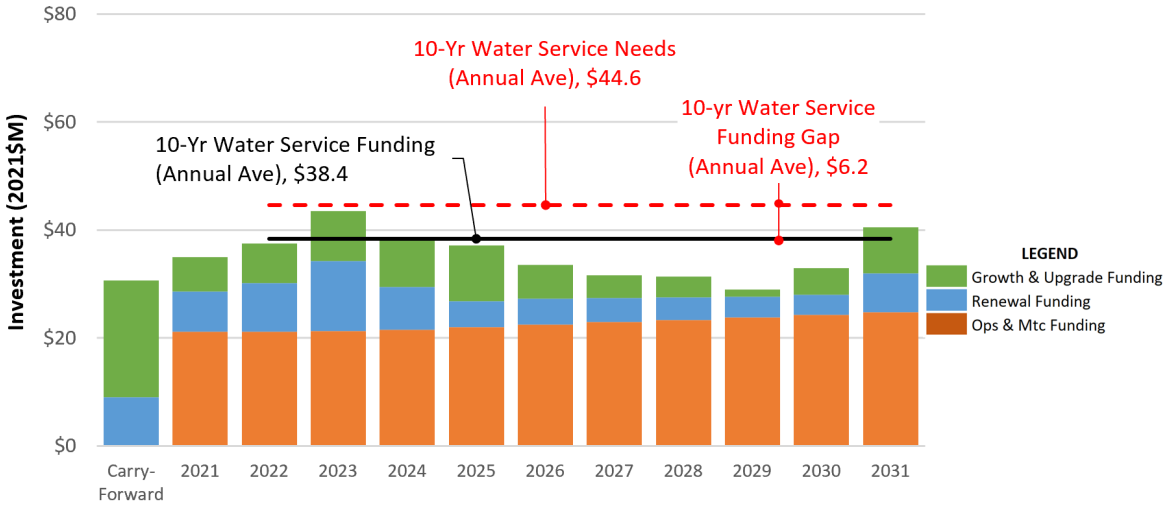
Service Attributes	Asset Lifecycle Activity	10-year (2022 – 2031) Ave Annual Amounts (2021$M/yr)				Full Asset Lifecycle Ave Annual Amounts (2021$M/yr)		
		Forecast Needs	Planned Funding*	Gap**	Funding Ratio	Forecast Needs	Gap**	Funding Ratio
Capacity & Function	Expansion*** & Upgrade	$9.7	$8.45	$1.25	87%			
Reliability	Renewal	$9.4	$7.19	$2.23	76%	$25.2	$18.0	29%
	Operations & Maintenance	$25.5	$22.81	$2.72	89%			
TOTALS	**All**	**$44.6**	**$38.45**	**$6.20**	**86%**			

** Includes Capital carry-forward, 3-yr Operating forecast and 7-yr 2% annual increase forecast*
*** Positive gap indicates that planned funding insufficient for need.*
**** Includes only assets to be constructed by the City.*

The above table also shows the cost of the forecast needed renewal activities over the full lifecycles of the water assets as **$25.2 million per year** and a full lifecycle (i.e. longer term) funding gap of **$18.0 million per year**. Although the City has a relatively small renewal funding gap in the shorter (10-year) term it will require significantly more funds over the longer term to sustain the water network in a state of good repair as the assets continue to age and deteriorate from use.

Figure 6-1 summarizes the data from the preceding table. It shows the total cost of the forecast needed lifecycle activities over the next ten years as **$44.6 million per year** (dashed red line) and the budgeted annual funding as **$38.4 million per year** (solid black line), and the funding gap of **$6.2 million per year** for each of the next ten years, or $62 million over the next ten years.

Figure 6-1 Water Asset Lifecycle Financial Sustainability



The graph also shows a significant amount of carry-forward capital funds, which are funds not used in 2021 and suggest a capacity issue for delivering funded capital projects.

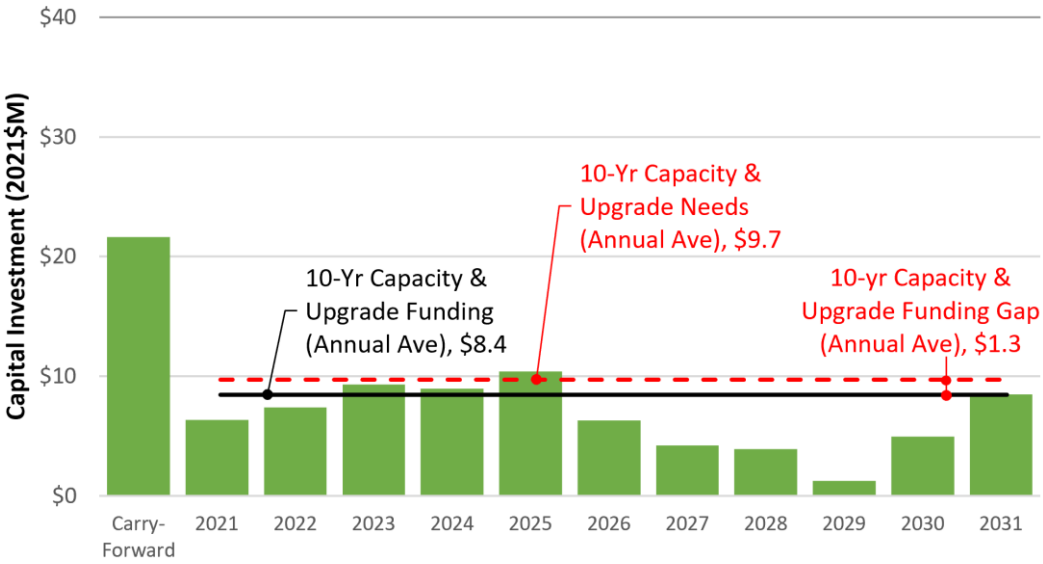
The following sections provide further details on the planned expenditures versus forecast needs, by lifecycle activity type.

6.2.2 Expansion and Upgrade Financial Sustainability

Asset expansion and upgrade activities enable the City to meet capacity, use and functionality service objectives through expansion of the assets into previously unserviced areas, increased capacity, or enhanced functionality.

Figure 6-2 summarizes the financial sustainability of asset growth and upgrade activities. It shows the cost of the forecast needed lifecycle activities over the next ten years as **$9.7 million per year** (dashed red line) and the budgeted annual funding projected to be available to undertake the forecast needed lifecycle activities over the next ten years as **$8.4 million per year** (solid black line). The Figure shows that the City has a funding "gap" of **$1.3 million per year,** on average, for each of the next ten years**,** or $13 million over the 10-year period.

Figure 6-2 Water Capacity and Upgrade Financial Sustainability



The graph also shows expansion and upgrade funding of $21.0 million carried forward from past capital budget years. This equates to more than twice the average annual funding of $8.4 million per year and suggests that additional resources may be needed to clear this backlog of capital projects.

The forecast and outlook years of the budget are subject to revenues being available as projected. If growth does not materialize as expected, there is potential that those revenues linked to Development Charges may not meet expectations.

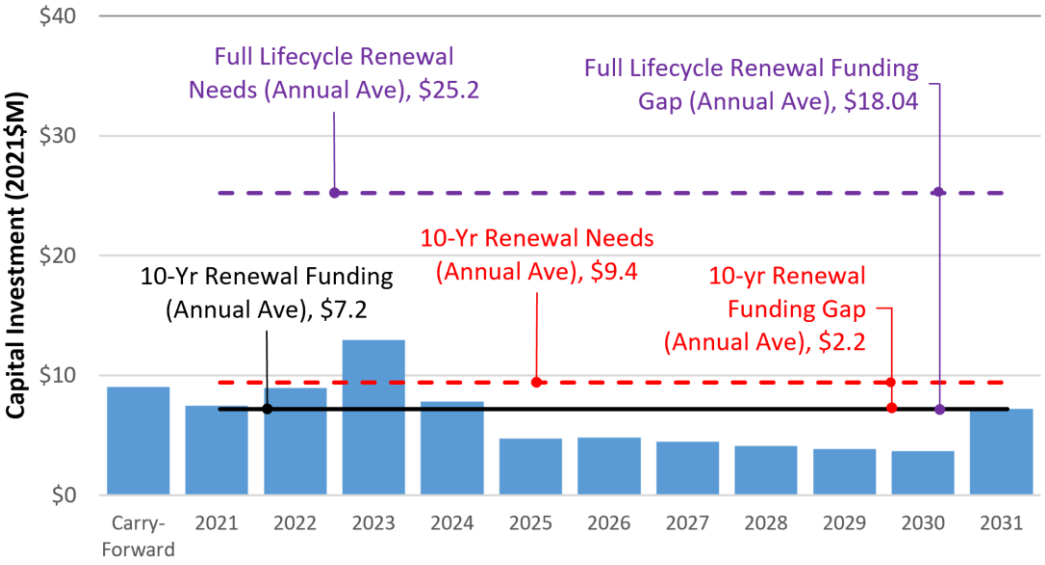
6.2.3 Renewal Financial Sustainability

Asset renewal activities enable the City to meet reliability service objectives through rehabilitation and replacement of existing assets to extend the life and maintain the assets in a state of good repair. Figure 6-3 summarizes the financial sustainability of asset

renewal activities. It shows the cost of the forecast needed renewal activities over the next ten years as **$9.4 million per year** (dashed red line) and the budgeted annual funding projected to be available to undertake the forecast needed lifecycle activities over the next ten years as **$7.2 million per year** (solid black line). The City has a funding gap of **$2.2 million per year** for each of the next ten years or $22 million over the 10 year period. The Figure also shows the cost of the forecast needed renewal activities over the full lifecycles of the water assets as **$25.3 million per year** (dashed purple line) and a full lifecycle or longer term funding gap of **$18.0 million per year**. The City will require increasing amounts of renewal funding over the longer term as the asset portfolio deteriorates due to age and use.

The graph also shows renewal projects worth $8.8 million carried forward from past capital budget years. This equates to almost a year of average annual funding and suggests that additional resources may be needed to clear this backlog of capital renewal projects.

Figure 6-3 Water Renewal Financial Sustainability



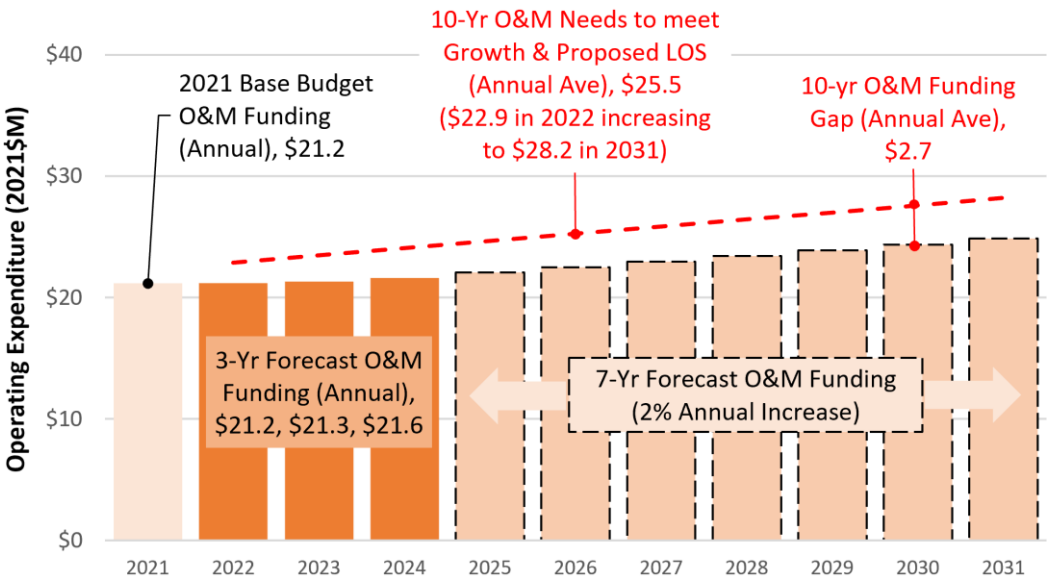
6.2.4 Operations and Maintenance Financial Sustainability

Asset maintenance and operations activities enable the City to meet reliability service objectives by maintaining the assets in a state of good repair and to appropriately use the assets to deliver services. Figure 6-4 summarizes the financial sustainability of asset maintenance and operations activities. It shows the planned expenditures in the 2021 budget as **$21.2 million** (lightest orange bar, to the left) and the forecast cost of operational service needs estimated to be **$22.9 million** in 2022 increasing to **$28.2 million** by 2031 (dashed red line).

The figure also shows the forecast annual funding projected to be available to undertake the forecast needed lifecycle activities over the next three years as $21.2 for 2022, $21.3 for 2023 and $21.6 for 2024 (dark orange bars) and over the remaining seven years as a 2% annual increase over the preceding year (medium orange bars). The City has an average annual funding gap of **$2.7 million per year** for each of the next ten years or $27 million over the 10 year period. The City will require increasing amounts of operational

funding over the longer term as the asset portfolio grows and deteriorates due to age and use.

Figure 6-4 Water O&M Financial Sustainability



6.2.5 Risks of Water AM Plan Implementation

The risks associated with implementing the Water Asset Management Plan and the proposed actions in response to those risks are summarized in Table E-3.

Table E-2 Water AM Plan Risk Mitigation Summary

Service Attributes	Lifecycle Activity	Identified AM Lifecycle Risks	Risk Management Strategy
Capacity, Use and Function	Expansion and upgrade	The identified asset growth activity needs are not fully funded. The existing backlog of expansion projects suggests a need for additional effort by the City to deliver. These are considered minor risks, as development is occurring more slowly than expected at this time.	Monitor build-out of developments and continue to adjust expansion activities in Master Plans to suit. Investigate resourcing to deliver the large expansion program.
Reliability	Renewal	The identified asset renewal activity needs are not fully funded which may result in impact on asset reliability and service levels. A larger asset renewal program will require an increase in funding and effort by the City to deliver.	Completed the Water and Wastewater Financial Plan – Rate Analysis Study in April 2021 to identify and address funding gaps. Continue to use risk-based prioritization to address the most critical needs with limited funds. Investigate resourcing to deliver the large renewal program.
	Operations and maintenance	The identified operations and maintenance needs associated with a growing asset portfolio and to adequately address operational risks will increase operating funding expenditures.	Fund operations and maintenance activities to keep existing and expansion / upgrade water assets in a state of good repair.

6.3 Funding Sources

Revenue and Funding Source Forecasts

Through the annual budget process, capital project and operating activity expenditure information is gathered from service areas, including investment needs, trends and priorities to enable preparation of the ten-year capital and annual operating plans. The ten-year capital program includes the current one-year budget, a four-year forecast, and a five-year outlook. Once the expenditure plans are finalized, a financing plan for proposed expenditures is developed. The plan includes several key sources of funding and financing as outlined in the table below.

Table 6-3 Key Sources of Funding and Financing

Funding Source	Financing Method
Development Charges (DC)	• Reserves (from current and prior years' development charges collections in accordance with the DC Act)
Front Ending Agreements / Development Contributions	• Reserves (from current and prior years' developer front ending agreements and developer contributions outside the DC Act)
Debt	• Long term borrowing, to be paid for by future taxpayers unless DC debt which is paid by DC reserves and development charges
Canada Community-Building Fund	• Funding available for eligible projects (formerly the Federal Gas Tax Fund)
Grants	• Project specific grants / subsidies (other than the Canada Community-Building Fund)
Water Capital Reserve	• Reserves (from current and prior years' water revenues)

Development Charges (DCs) are collected by the City from developers under the City's DC Bylaw. DCs are held in designated DC reserve funds and used to fund a portion of growth-related infrastructure as prescribed by the City's DC Bylaw. Projections relating to DC revenues are based on DC rates and the projected growth in developments.

Grants from the Provincial or Federal governments, including Canada Community-Building Fund grants, are also used to finance the capital program. However, many grants are a result of stimulus or other one-time funding that may be more difficult to forecast. Grants are not included in the budget forecast until confirmed.

Capital reserves are established as a source of pay-as-you-go funding for the City's capital program. Funding for these reserves is obtained annually through contributions from water revenues. The annual reserve contributions are based on forecasted financing requirements and provisions required to sustain reserve balances at appropriate levels to address infrastructure replacement costs in the future and inherent uncertainties in capital funding needs. Reserve contributions are evaluated annually to ensure adequate funds are raised to meet future capital requirements and to smooth out the impact on the annual operating budget.

Current revenue for growth related capital water projects is funded primarily by development charges and DC related debt. Revenue for capital water upgrade and renewal works is funded by water revenues (water capital reserves), with some federal

Canada Community-Building Fund, grant and debt funding. Current revenue for operations is funded by water revenues.

7 Monitoring and Improvement Plan

7.1 Overview

Development of AM Plans is an iterative process that includes improving data, processes, systems, staff skills, and organizational culture over time. This section provides an overview of the compliance of this AM Plan with Ontario Regulation 588/17 for current and proposed levels of service and recommends improvements to the City's asset management practice.

Table 7-1 O.Reg. 588/17 Compliance Status and Other Opportunities

Plan Section	O.Reg. 588/17 Compliance Practices (Current LOS)	O.Reg. 588/17 Compliance Improvements (Proposed LOS)	Other Opportunities
State of Local Infrastructure	(Yes) For each asset category, the AM Plan provides a summary of the assets, the replacement cost of the assets, the average age of the assets, the condition of the assets, and the approach to assessing condition of assets.	(Yes)	Continue to improve knowledge of asset replacement costs and current condition of the assets based on asset criticality. Target efforts on highest risk assets and assets with unknown condition, including water meters.
Levels of Service	(Yes) For each asset category, the AM Plan provides the current LOS being provided. For core assets, the 2020 AM provides the qualitative community descriptions and technical metrics as required by O.Reg. 588/17, and the current performance.	(Yes) For each asset category, provide the LOS that the City proposes to provide for the next 10 years and an explanation of why the proposed LOS are appropriate based on an assessment of: the options for the proposed LOS and the risks associated with those options to the long term sustainability of the City, how the proposed LOS differ from the current LOS, whether the proposed LOS are achievable, and the City's ability to afford the proposed LOS. (No) For each asset category, provide the proposed performance **for each year of the next 10-year period**. The proposed performance was determined for the end of the 10-year period (2031), and LOS are assumed to change in a straight line for each year of the 10-year planning period between 2022 and 2031.	Continue to develop levels of service metrics that support lifecycle asset planning activities for specific asset types. Continue to track and report on 10-year funding rates (the budgeted funds / forecast needs) specific to backlogged lifecycle activities. Acquire a comprehensive modelling system that will enable determination of proposed performance for each year of the 10-year planning period.
Asset Management Strategy	(Yes) The AM Plan provides the population and employment forecasts as set out in Schedule 3 to the 2017 Growth Plan. (Yes) For each asset category, the AM Plan provides the lifecycle activities that would need to be undertaken to maintain the current LOS for each of	(Yes) For each asset category, provide the lifecycle activities that would need to be undertaken to provide the proposed LOS for each of the next 10 years, based on risk and lowest lifecycle cost analyses.	Continue to optimize the lifecycle activities by searching out and testing various operations, maintenance and renewal activity and timing options, and then evaluating the benefits against the costs of each option over time to determine the lowest cost option for the required benefits.

Plan Section	O.Reg. 588/17 Compliance Practices (Current LOS)	O.Reg. 588/17 Compliance Improvements (Proposed LOS)	Other Opportunities
	the next 10 years, based on risk and lowest lifecycle cost analyses.		
Financing Plan	(Yes) The AM Plan provides the estimated 10-year capital expenditures and significant operating costs required to maintain the current levels of service to accommodate projected increases in demand caused by growth as set out in Schedule 3 to the 2017 Growth Plan. (Yes) For each asset category, the AM Plan provides the costs of providing the lifecycle activities that would need to be undertaken to maintain the current LOS for each of the next 10 years.	(Yes) For each asset category, provide the lifecycle management financial strategy that sets out the following for the 10-year period: • For each asset category, provide the costs of the lifecycle activities that would need to be undertaken to achieve the proposed LOS for each of the next 10 years, separated into capital expenditures and significant operating costs. • Provide the annual funding projected to be available to undertake lifecycle activities and the options examined to maximize the funding projected to be available. • For any funding shortfalls, identify which lifecycle activities will be funded and, for those not funded, the risks of not undertaking them.	Completed the Water and Wastewater Financial Plan – Rate Analysis Study in April 2021 to identify and address funding gaps including operating and capital budget requirements, further assessments of costs and complexities of administering alternative funding mechanisms, and recommendations on implementation. Track spending amounts to the LOS Framework: to lifecycle activity type, technical LOS type, and customer LOS type. Track spending amounts to asset and asset type.
Other	(Yes) The AM Plan indicates how the background information and reports upon which the state of infrastructure section within AM Plan is based will be made available to the public.	(Yes) Provide an overview of the risks associated with implementation of the AM Plan and any actions that would be proposed in response to those risks. An explanation of any other key assumptions underlying the plan that have not previously been explained.	

7.2 Monitoring and Review Procedures

This AM Plan will be reviewed during annual budget planning processes and amended to show any material changes in service levels and/or resources available to provide those services as a result of budget decisions.

The AM Plan will be updated every five years to ensure it represents the current service level, asset values, projected operations, maintenance, capital renewal and replacement, capital upgrade/new and asset disposal expenditures and projected expenditure values incorporated into the long-term financial plan.

7.3 Performance Measures

The effectiveness of the asset management plan can be measured in the following ways:

- The degree to which the required projected expenditures identified in this asset management plan are incorporated into the long-term financial plan
- The degree to which the current one-year budget and four-year forecast take into account the forecast needs provided by the AM Plan
- The degree to which the existing and projected service levels and service consequences (what we cannot do), risks and residual risks are incorporated into Council's Strategic Plan and associated plans
- The Asset Funding Ratio achieving the target of 1.0.

8 Appendices

8.1 Risk-Based Renewal Priorities

The following table provides details on asset type estimated life, criticality (CoF), current replacement value (CRV), condition in 2021 (current), forecast condition for 2031 with no funding, the application of rehabilitation and replacement treatments to reduce risk, forecast condition for 2031 with the applied treatments, and the % assets in Fair or better condition. The darker red boxes represent extreme risks with CoF of 5, the lighter red boxes represent extreme risks with CoF of 4.

Table 8-1 Risk-Based Renewal Activities

Asset Class	Asset Type	MPL	CoF	CRV 2021	Current Poor	Current Very Poor	RV 2031	Forecast 2031 P (no Funding)	Forecast 2031 VP (no Funding)	Rehab Applied to Poor	Replace Applied to Very Poor	Forecast 2031 Poor w Rehab	Forecast 2031 VP w/Replace	LOS (%F+)
		69.7	**3.2**	**$ 1,305.1**	**$ 36.8**	**$ 25.6**	**$1,555.9**	**$ 32.3**	**$ 91.5**	**$16.1**	**$69.7**	**$ 23.3**	**$ 28.6**	
SWTP	SWTP-Site Works	25	4	$ 6.8	$ -	$ -	$ 6.8	$ -	$ -	$ 7.1	$ 6.8	$ -	$ -	100%
SWTP	SWTP-Building Structural	75	5	$ 16.7	$ 1.8	$ -	$ 16.7	$ -	$ 1.8		$ 1.8	$ -	$ -	100%
SWTP	SWTP-Building Architectural	37	3	$ 23.1	$ -	$ -	$ 23.1	$ -	$ -			$ -	$ -	100%
SWTP	SWTP-Building Mechanical & Electrical	25	5	$ 19.1	$ -	$ -	$ 19.1	$ -	$ -			$ -	$ -	100%
SWTP	SWTP-Process Structural	75	5	$ 86.0	$ -	$ -	$ 86.0	$ -	$ -			$ -	$ -	100%
SWTP	SWTP-Process Electrical	25	5	$ 21.6	$ -	$ -	$ 23.0	$ -	$ -			$ -	$ -	100%
SWTP	SWTP-Process Mechanical	25	5	$ 22.5	$ -	$ -	$ 22.5	$ -	$ -			$ -	$ -	100%
SWTP	SWTP-Process Piping	75	5	$ 26.5	$ -	$ -	$ 26.5	$ -	$ -			$ -	$ -	100%
SWTP	SWTP-Instrumentation & Controls	15	5	$ 9.7	$ -	$ -	$ 17.6	$ -	$ 9.7		$ 9.7	$ -	$ -	100%
SWTP	SWTP-Raw Water Intake	75	5	$ 17.2	$ -	$ -	$ 17.2	$ -	$ -			$ -	$ -	100%
SWTP	SWTP-Membranes	18	5	$ 19.3	$ -	$ -	$ 19.3	$ -	$ 19.3		$19.3	$ -	$ -	100%
Wells	Wells-Site Works	25	3	$ 7.4	$ 2.9	$ -	$ 7.4	$ -	$ 6.6		$ 4.9	$ -	$ 1.7	77%
Wells	Wells-Building Structural	75	4	$ 4.2	$ -	$ -	$ 4.2	$ -	$ -			$ -	$ -	100%
Wells	Wells-Building Architectural	37	2	$ 2.2	$ -	$ -	$ 2.2	$ 2.2	$ -			$ 2.2	$ -	0%
Wells	Wells-Building Mechanical & Electrical	25	4	$ 1.5	$ 0.2	$ 0.1	$ 1.5	$ 0.9	$ 0.3	$ 0.9	$ 0.3	$ -	$ -	100%
Wells	Wells-Process Structural	75	4	$ 3.6	$ 0.2	$ -	$ 3.6	$ -	$ 0.2		$ 0.2	$ -	$ -	100%
Wells	Wells-Process Electrical	25	4	$ 1.4	$ -	$ -	$ 1.4	$ 0.3	$ -			$ 0.3	$ -	82%
Wells	Wells-Process Mechanical	25	4	$ 4.7	$ 2.2	$ -	$ 6.5	$ 1.8	$ 2.2		$ 2.2	$ 1.8	$ -	72%
Wells	Wells-Process Piping	37	4	$ -	$ -	$ -	$ -	$ -	$ -			$ -	$ -	-
Wells	Wells-Instrumentation & Controls	15	4	$ 3.2	$ 0.6	$ -	$ 3.2	$ -	$ 3.2		$ 3.2	$ -	$ 0.0	99%

Asset Class	Asset Type	MPL	CoF	CRV 2021	Current Poor	Current Very Poor	RV 2031	Forecast 2031 P (no Funding)	Forecast 2031 VP (no Funding)	Rehab Applied to Poor	Replace Applied to Very Poor	Forecast 2031 Poor w Rehab	Forecast 2031 VP w/Replace	LOS (%F+)
Reservoirs & Twrs	Reservoirs & Towers-Site Works	25	3	$ 0.4	$ -	$ -	$ 0.4	$ -	$ 0.4			$ -	$ 0.4	0%
Reservoirs & Twrs	Reservoirs & Towers-Building Structural	75	4	$ 6.7	$ -	$ -	$ 6.7	$ -	$ -			$ -	$ -	100%
Reservoirs & Twrs	Reservoirs & Towers-Building Architectural	37	2	$ -	$ -	$ -	$ -	$ -	$ -			$ -	$ -	-
Reservoirs & Twrs	Reservoirs & Towers-Building M&E	25	4	$ 1.9	$ 0.1	$ -	$ 1.9	$ 1.1	$ 0.1	$ 1.1	$ 0.1	$ -	$ -	100%
Reservoirs & Twrs	Reservoirs & Towers-Process Structural	75	4	$ 35.1	$ -	$ 0.5	$ 35.1	$ -	$ 0.5		$ 0.5	$ -	$ -	100%
Reservoirs & Twrs	Reservoirs & Towers-Process Electrical	25	4	$ -	$ -	$ -	$ -	$ -	$ -			$ -	$ -	-
Reservoirs & Twrs	Reservoirs & Towers-Process Mechanical	25	4	$ 0.0	$ -	$ -	$ 0.0	$ -	$ -			$ -	$ -	100%
Reservoirs & Twrs	Reservoirs & Towers-Process Piping	37	4	$ 2.3	$ -	$ -	$ 2.3	$ 1.7	$ -	$ 1.7		$ -	$ -	100%
Reservoirs & Twrs	Reservoirs & Towers-Instrn & Controls	15	4	$ 1.5	$ -	$ 0.1	$ 1.5	$ -	$ 1.5		$ 1.5	$ -	$ 0.0	99%
BPS	Leacock BPS-Site Works	25	4	$ 0.2	$ 0.2	$ -	$ 0.2	$ -	$ 0.2		$ 0.2	$ -	$ 0.0	83%
BPS	Leacock BPS-Building Structural	75	5	$ 0.3	$ -	$ -	$ 0.3	$ -	$ -			$ -	$ -	100%
BPS	Leacock BPS-Building Architectural	37	3	$ 0.3	$ -	$ 0.3	$ 0.3	$ -	$ 0.3			$ -	$ 0.3	0%
BPS	Leacock BPS-Building M&E	25	5	$ 0.4	$ -	$ 0.4	$ 0.4	$ -	$ 0.4		$ 0.4	$ -	$ -	100%
BPS	Leacock BPS-Process Structural	75	5	$ 0.7	$ -	$ -	$ 0.7	$ -	$ -			$ -	$ -	100%
BPS	Leacock BPS-Process Electrical	25	5	$ 1.3	$ -	$ -	$ 1.3	$ -	$ 1.3		$ 1.3	$ -	$ -	100%
BPS	Leacock BPS-Process Mechanical	25	5	$ 0.3	$ -	$ -	$ 0.3	$ 0.3	$ -			$ 0.3	$ -	0%
BPS	Leacock BPS-Process Piping	37	5	$ 0.4	$ -	$ -	$ 0.4	$ -	$ -			$ -	$ -	100%
BPS	Leacock BPS-Instrumentation & Controls	15	5	$ 0.1	$ -	$ -	$ 0.1	$ 0.0	$ 0.1		$ 0.1	$ 0.0	$ -	88%
BPS	Other BPSs-Site Works	25	3	$ 2.3	$ 0.5	$ 1.2	$ 2.8	$ -	$ 1.9			$ -	$ 1.9	30%
BPS	Other BPSs-Building Structural	75	4	$ 2.8	$ -	$ -	$ 3.3	$ -	$ -			$ -	$ -	100%
BPS	Other BPSs-Building Architectural	37	2	$ 2.6	$ 0.3	$ 0.8	$ 3.1	$ 0.3	$ 1.1			$ 0.3	$ 1.1	57%
BPS	Other BPSs-Building M&E	25	4	$ 4.4	$ 0.5	$ 1.2	$ 5.2	$ -	$ 2.2		$ 2.2	$ -	$ 0.0	99%
BPS	Other BPSs-Process Structural	75	4	$ 5.2	$ 1.3	$ -	$ 6.1	$ 1.3	$ -			$ 1.3	$ -	79%
BPS	Other BPSs-Process Electrical	25	4	$ 12.6	$ 4.8	$ 0.1	$ 14.9	$ 2.3	$ 4.9		$ 4.9	$ 2.3	$ 0.0	85%
BPS	Other BPSs-Process Mechanical	25	4	$ 2.7	$ 0.6	$ 0.0	$ 3.1	$ 0.7	$ 0.6		$ 0.6	$ 0.7	$ 0.0	77%
BPS	Other BPSs-Process Piping	37	4	$ 3.5	$ -	$ -	$ 4.1	$ 0.4	$ -			$ 0.4	$ -	92%
BPS	Other BPSs-Instrumentation & Controls	15	4	$ 1.1	$ 0.2	$ 0.1	$ 1.3	$ 0.0	$ 1.1	$ 0.0	$ 1.1	$ -	$ -	100%
Pipes & Appurt's	T&D Mains < 100 mm dia	77.6	1	$ 8.6	$ 0.1	$ 0.2	$ 8.6	$ 0.1	$ 0.2			$ 0.1	$ 0.2	97%
Pipes & Appurt's	T&D Mains >= 100 to < 200 mm dia	82.9	2	$ 240.9	$ 12.0	$ 2.2	$ 240.9	$ 12.0	$ 2.2		$ 2.2	$ 12.0	$ -	95%
Pipes & Appurt's	T&D Mains >= 200 to < 500 mm dia	81.9	3	$ 310.7	$ 3.8	$ 0.2	$ 478.5	$ 3.8	$ 0.2	$ 2.5	$ 0.2	$ 1.3	$ -	99%
Pipes & Appurt's	T&D Mains >= 500 to < 700 mm dia	80.9	4	$ 55.4	$ -	$ 5.0	$ 64.2	$ -	$ 5.0	$ -	$ 5.0	$ -	$ -	96%
Pipes & Appurt's	T&D Mains >= 700 mm dia	87.4	5	$ 42.0	$ -	$ -	$ 42.0	$ -	$ -	$ -	$ -	$ -	$ -	95%
Pipes & Appurt's	CC Mains < 500 mm dia	86.4	5	$ 2.7	$ -	$ -	$ 2.7	$ -	$ -	$ -	$ -	$ -	$ -	100%
Pipes & Appurt's	CC Mains >= 500 to < 700 mm dia	88.8	5	$ 6.8	$ -	$ -	$ 6.8	$ -	$ -	$ -	$ -	$ -	$ -	94%
Pipes & Appurt's	CC Mains >= 700 mm dia	60.0	5	$ 1.3	$ -	$ -	$ 1.3	$ -	$ -	$ -	$ -	$ -	$ -	100%

Asset Class	Asset Type	MPL	CoF	CRV 2021	Current Poor	Current Very Poor	RV 2031	Forecast 2031 P (no Funding)	Forecast 2031 VP (no Funding)	Rehab Applied to Poor	Replace Applied to Very Poor	Forecast 2031 Poor w Rehab	Forecast 2031 VP w/Replace	LOS (%F+)
Pipes & Appurt's	Fire Hydrants & Hydrant Valves	60.0	2	$ 49.1	$ -	$ -	$ 60.9	$ -	$ -	$ -	$ -	$ -	$ -	100%
Pipes & Appurt's	PRV	20.0	2	$ 1.2	$ -	$ -	$ 1.2	$ 0.0	$ 0.8	$ 0.0	$ 0.8	$ -	$ -	79%
Pipes & Appurt's	PRV Chambers	20.0	2	$ 18.0	$ 2.8	$ 6.2	$ 18.5	$ 1.7	$ 13.5	$ 1.2		$ 0.5	$ 13.5	25%
Pipes & Appurt's	Valves	49.8	2	$ 63.5	$ -	$ -	$ 63.5	$ 0.3	$ -	$ 0.3		$ -	$ -	43%
Pipes & Appurt's	Valve Chambers	85.0	2	$ 106.7	$ -	$ -	$ 147.7	$ -	$ -	$ -	$ -	$ -	$ -	92%
Pipes & Appurt's	Other Appurtenances	22.3	1	$ 0.3	$ -	$ -	$ 0.3	$ 0.2	$ 0.0	$ 0.2	$ 0.0	$ -	$ -	100%
Meters	Meters Res, ICI Meters < 100mm	20.0	2	$ 11.7	$ 1.5	$ 6.8	$ 14.7	$ 0.9	$ 9.4	$ 0.9	$ 0.0	$ -	$ 9.4	33%
Meters	Meters ICI Meters >= 100mm	20.0	1	$ 0.4	$ 0.0	$ 0.0	$ 0.4	$ 0.1	$ 0.1	$ 0.1	$ 0.1	$ -	$ -	100%