2022
Waterworks Asset Management Plan

Hamilton

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WATERWORKS ASSET MANAGEMENT PLAN

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1.0 INTRODUCTION

WATERWORKS INTRODUCTION

The purpose of this Asset Management Plan (AM Plan) is to identify the intended asset management (AM) programs for assets delivering the City of Hamilton's Waterworks services. The City of Hamilton (City) will identify these programs based on the City's understanding of the current service level requirements, and the current ability of the network to meet those requirements. Before July 1, 2025 this plan will be updated to include the proposed service level requirements.

The infrastructure assets covered by this Asset Management Plan (AM Plan) include assets which are part of the City's Waterworks network. At this time, this AM Plan includes Water, Wastewater and Stormwater assets, which were considered Core Assets under Ontario Regulation 588/17 (O.Reg. 588/17).

For a high level summary of the assets covered in this AM Plan refer to Table 5. For detailed summaries of assets, please refer to Table 8, Table 35 and Table 60.

The infrastructure assets included in this plan have a total replacement value of $14.7 billion as shown in Table 5.

1.1 Scope

The infrastructure assets covered by this AM Plan include assets which are part of the City of Hamilton's Waterworks system. At this time, this AM Plan includes water, wastewater, and stormwater assets, which are considered core assets under Ontario Regulation 588/17 (O.Reg. 588/17).

In addition, as mentioned in Section 6.2 of the AMP Overview, these AM Plans were completed using the Federation of Canadian Municipalities (FCM) approach to asset management in partnership with the Institute of Public Works Engineering Australasia (IPWEA) and National Asset Management System (NAMS) Canada template and philosophy, and also fulfill the O.Reg. 588/17 timeline and requirements. It is important to note that this is the first iteration of the Waterworks AM Plan completed by the Corporate Asset Management (CAM) office using this framework for asset management, and as such this plan differs greatly from the 2014 Asset Management Plan. The majority of data in this plan is the data available as of January 2022.

Before July 1st, 2025, this plan will be updated to include the proposed service level requirements for these assets in accordance with the O.Reg 588/17.

1.0 INTRODUCTION

1.2 Supplementary Information

The AM Plan is to be read with other City planning documents. This should include the Strategic Asset Management Policy (SAMP) along with other key planning documents including:

- Asset Management Plan Overview;
- W/WW/SW City Wide Master Plan;
- Development Charge background study

Key stakeholders in the preparation and implementation of this AM Plan are shown in section 5 of the AMP Overview.

1.0 INTRODUCTION

1.3 Legislative Requirements

Table 1: Water Legislative Requirements

LEGISLATION	REGULATIONS	PURPOSE
Safe Drinking Water Act, 2002	O. Reg. 205/18: Municipal Residential Drinking Water Systems in Source Protection Areas	This act recognizes that the people of Ontario are entitled to expect their drinking water to be safe and controls the regulation of drinking water systems and drinking water testing.
	O. Reg. 453/07: Financial Plans	
	O. Reg. 229/07: Service of Documents	
	O. Reg. 188/07: Licensing of Municipal Drinking Water Systems	
	O. Reg. 242/05: Compliance and Enforcement	
	O. Reg. 128/04: Certification of Drinking Water System Operators and Water Quality Analysts	
	O. Reg. 248/03: Drinking Water Testing Services	
	O. Reg. 172/03: Definitions of 'Deficiency' and 'Municipal Drinking Water System'	
	O. Reg. 171/03: Definitions of Words and Expressions Used in the Act	
	O. Reg. 170/03: Drinking Water Systems	
	O. Reg. 169/03: Ontario Drinking Water Quality Standards	

1.0 INTRODUCTION

Table 1: Water Legislative Requirements		
LEGISLATION	**REGULATIONS**	**PURPOSE**
Clean Water Act 2006	**O. Reg. 288/07 Source Protection Committees**	The purpose of the Act is to protect existing and future sources of drinking water.
	O. Reg. 287/07: General	
	O. Reg. 284/07: Source Protection Areas and Regions	
	O. Reg. 231/07: Service of Documents	
	O. Reg. 288/07 Source Protection Committees	
Ontario Water Resources Act	**O.Reg 450/07 Charges for Industrial and Commercial Water Users**	
	O.Reg 387/04 Water Taking and Transfer	
	R.R.O. 1990, Reg. 903: Wells	
	O.Reg 450/07 Charges for Industrial and Commercial Water Users	
Canadian Environmental Protection Act		An Act respecting pollution prevention and the protection of the environment and human health in order to contribute to sustainable development
Canada Water Act		An Act to provide for the management of the water resources of Canada, including research and the planning and implementation of programs relating to the conservation, development and utilization of water resources

1.0 INTRODUCTION

Table 1: Water Legislative Requirements

LEGISLATION	REGULATIONS	PURPOSE
2020 Watermain disinfection procedure	**This watermain disinfection procedure is a supporting document for Ontario legislation and regulations related to Drinking Water.** **Part of O.Reg. 170/03**	For watermains, including temporary watermains, that are added to, modified, re-aligned, replaced or extended within a Drinking Water System, Operating Authorities shall ensure that the requirements of ANSI/AWWA Standard C651 are followed as modified by this procedure.
Drinking Water Quality Management Standard	**The DWQMS sets out a framework for the operating authority and the owner of a drinking water system to develop a QMS that is relevant and appropriate for the system.** **The DWQMS contains elements of both the ISO 9001 standard with respect to management systems and the hazard analysis and critical control points (HACCP) standard with respect to product safety. The DWQMS also incorporates the HACCP approach to risk assessment and reflects the multi-barrier approach for drinking water safety.**	The DWQMS approach emphasizes the importance of: ▪ A proactive and preventative approach to management strategies that identify and manage risks to public health Establishing and documenting management procedures ▪ Clearly identifying roles and responsibilities ▪ continual improvement of your management system

Table 2: Wastewater Legislative Requirements	
LEGISLATION	**PURPOSE**
Environmental Protection Act	Environmental legislation aimed at preventing pollution and protecting the environment and human health.
Clean Water Act, 2006	The purpose of this Act is to protect existing and future sources of drinking water.
Fisheries Act	The purpose of this Act is to provide a framework for the proper management and control of fisheries and the conservation and protection of fish and fish habitat, including by preventing pollution.
MECP Design Guidelines	Guidelines for the design, disinfection, and evaluation of sewage works.
Ontario Water Resources Act	To provide for the conservation, protection and management of Ontario's waters and for their efficient and sustainable use, in order to promote Ontario's long-term environmental, social and economic well-being

Table 3: Stormwater Legislative Requirements	
LEGISLATION	**PURPOSE**
Drainage Act, R.S.O. 1990, c. D.17	Provides a procedure whereby the municipality may, provide a legal outlet for surface and subsurface waters from a landowner.
Ontario Water Resources Act, R.S.O. 1990, c. O.40	To provide for the conservation, protection and management of Ontario's waters and for their efficient and sustainable use, in order to promote Ontario's long-term environmental, social and economic well-being
Canadian Environmental Protection Act, 1999	An Act respecting pollution prevention and the protection of the environment and human health in order to contribute to sustainable development
Fisheries Act	The purpose of this Act is to provide a framework for the proper management and control of fisheries and the conservation and protection of fish and fish habitat, including by preventing pollution.
Species at Risk Act (S.C. 2002, c. 29)	An act to protect wildlife species at risk, and/or provide for the recovery of wildlife species at risk.

Table 3: Stormwater Legislative Requirements	
LEGISLATION	**PURPOSE**
Environmental Protection Act, R.S.O. 1990, c. E.19	Environmental legislation aimed at preventing pollution and protecting the environment and human health.
Endangered Species Act, 2007, S.O. 2007, c. 6	An Act with identifies and protects species at risk and promotes stewardship activities for these species.

1.4 Asset Hierarchy

An asset hierarchy provides a framework for structuring data in an information system to assist in collection of data, reporting information and making decisions. As outlined in Section 6.5 of the AMP Overview, the City's functional hierarchy includes the strategic service area, asset class, and asset levels used for asset planning and financial reporting as well as service planning and delivery.

The strategic levels are defined in Section 6.5 of the AMP Overview, and the service areas included in this report are defined in Table 4 below. The service area hierarchies used in this report which outline the included assets are defined in Table 2 and Table 3 in the AMP Overview.

Currently this plan includes assets related to the following service areas: Water, Wastewater, Stormwater, and Administration because they relate to the core assets defined in O.Reg. 588/17.The asset service hierarchy is shown is Table 1.

Table 4: Asset Service Area Hierarchy

Strategic Level	Service Area	Functional Responsibilities
Waterworks	**Water**	Supply and distribution of clean, safe drinking water to all properties within Hamilton that are connected to the municipal supply. This includes all support activities that are performed in order to achieve this service. Separated into linear, vertical, and administrative assets.
	Wastewater	Collect and treat wastewater from all properties within Hamilton that are connected to municipal sewers. Include all support activities that are performed in order to achieve this service. Separated into linear, vertical, and administrative assets.
	Stormwater	Collect, monitor, and transmit storm and surface water within Hamilton either to the natural environment, or to a wastewater treatment facility. Separated into linear, vertical, and administrative assets.

1.5 Overall Summary of Assets

For the purposes of this AM Plan, the asset categories are defined using the O.Reg. 588/17 definitions as follows:

- Water assets - relate to the collection, production, treatment, storage, supply or distribution of drinking water;
- Wastewater assets - relate to the collection, transmission, treatment or disposal of wastewater, including any wastewater asset that from time to time manages stormwater; and,
- Stormwater assets relate to the collection, transmission, treatment, retention, infiltration, control or disposal of stormwater.

The overall summary of waterworks assets is shown in Table 5. Waterworks assets have a total replacement value of **$14.7B** and are in an average of **Fair** condition. In addition, the average age of these assets is **29 years** with **54%** of useful life remaining. However, the overall data confidence for the waterworks strategic level is **low to medium**, and so these numbers may change drastically in future iterations of the plan. Data confidence is explained throughout the report and is defined in Section 7.2.2 of the AMP Overview.

Table 5: Summary of Assets

ASSET CATEGORY	REPLACEMENT VALUE	AVERAGE AGE (% RSL)	AVERAGE EQUIVALENT CONDITION
Water	$4.25B	34 years (45%)	3-Fair
Data Confidence	Low	Medium	Low
Wastewater	$7.25B	30 years (34%)	3-Fair
Data Confidence	Low	Medium	Medium
Stormwater	$3.14B	22 years (73%)	2-Good
Data Confidence	Low	High	Medium
TOTAL	**$14.7B**	**29 years (54%)**	**3-Fair**
Data Confidence	**Low**	**Medium**	**Medium**

1.0 INTRODUCTION

2022

Water Asset Management Plan

Hamilton

WATER SERVICE AREA

Description

The water network distributes drinking water to its customers across the City and its objective is to deliver safe, clean drinking water on demand to all connections 24 hours a day. These assets involve assets related to the collection, production, treatment, storage, supply or distribution of drinking water.

Replacement Value $4.3 Billion

Average Asset Condition

Did You Know?

- In 2021, the Woodward WTP treated and distributed approximately **78,000 ML** for **569,000** customers which is equivalent to **39 billion, 2-litre bottles** at a rate of **$0.004 a bottle** for a house-hold that uses 1000-litres of water per month.
- The population is expected to increase to **636,000 by 2031** and so plant upgrades are being completed to improve capacity and perfor-mance.

Critical Asset Summary

Critical Assets	Quantity	Replacement Cost	Condition	Stewardship Measures
Water Treatment Plant	1	$1.0 billion	Poor	**# of instances Chlorine is below/ above target at the WTP** **8**
Pump Station	18	$125.3 million	Good	**Inspection Frequency** **Weekly**
Wells & Well Stations	8 wells 6 stations	$21.9 million	Fair Good	**# Drinking Water Advisories** **0**
Watermain	2,129 km	$1.6 billion	Fair	**Emergency breaks repaired within 2 days** **100%**

Data Confidence

VERY HIGH | MEDIUM | VERY LOW

FINANCIAL FACTS

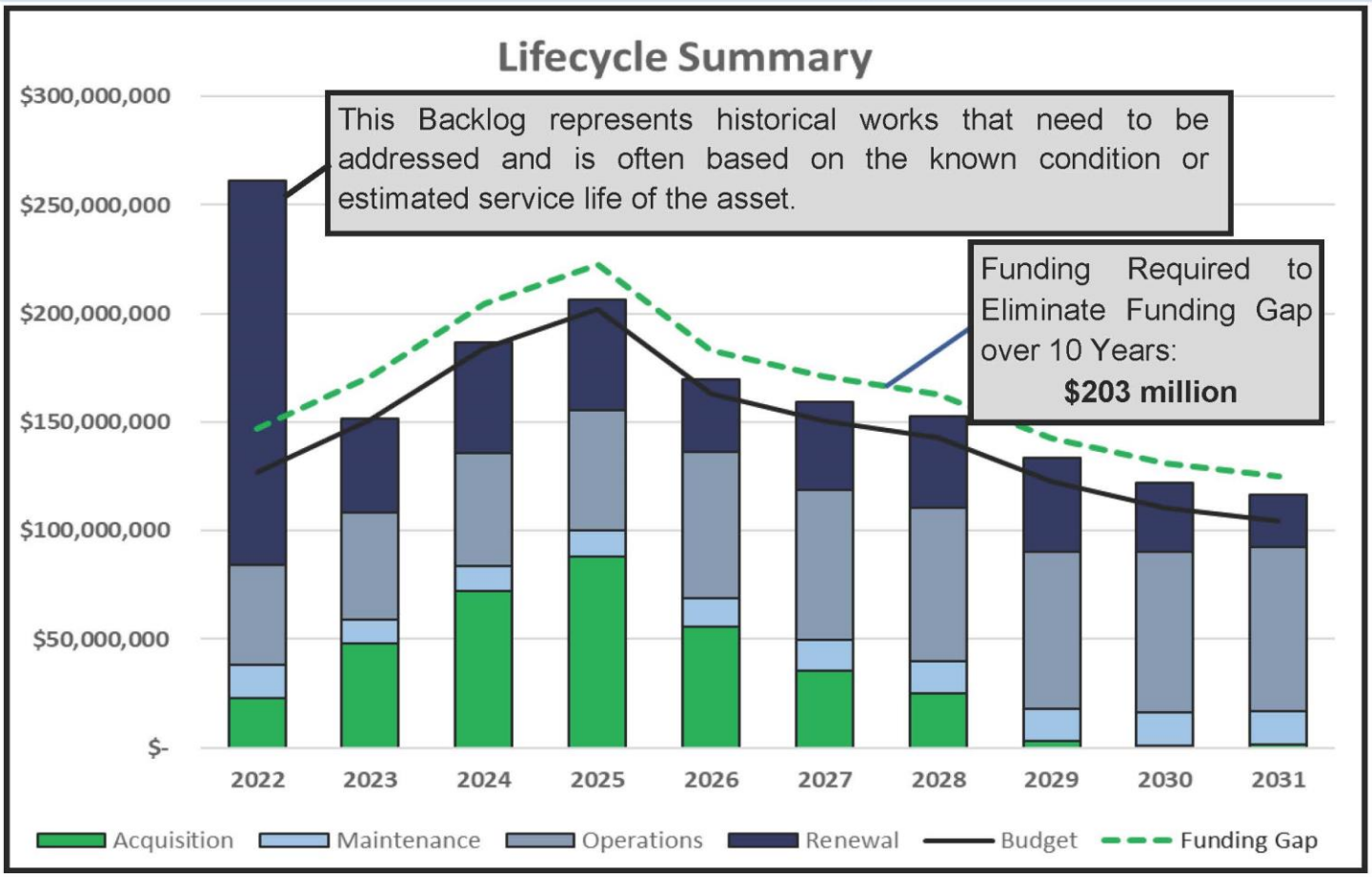
- Hamilton will receive **$512 million** dollars worth of assets over the next 10 years.
- Hamilton will invest on average **$769 million** to operate, maintain Water assets over the next ten years.

DID YOU KNOW?

- The City completes condition assessments on critical trunk watermain to reduce the chance of a critical watermain break.
- The City has a loan program to replace lead water services throughout the City.

FINANCIAL INDICATORS

Type of Indicator	Measurement	Explanation
Asset Renewal Ratio	**74.9%**	This ratio demonstrates the rate the city renews its Water Assets.
10 Year O&M Forecast	**84.5%**	The % of funding allocated compared to what needs to be spent.
Annual Infrastructure Gap	**$20 million**	The difference between what is being spent and what should be spent.



2.0 WATER ASSETS

The water network distributes water to its customers across the City and its objective is to deliver safe, clean drinking water on demand to all connections 24 hours a day, seven days a week. Clean water supports residents, businesses such as restaurants and public institutions such as schools and hospitals. The water system provides direct benefit and value to its customers whether they are residential, commercial or industrial customers as well as providing a larger Public Health benefit to the community.

Water assets relate to the collection, production, treatment, storage, supply or distribution of the drinking water service. For this iteration of the AM Plan, water assets include linear and vertical assets.

Vertical assets are assets which can only occupy one site and are typically within a building or a facility which may be comprised of multiple components. Linear assets are assets which traverse multiple sites and are often defined by length and also encompass components that are considered part of the linear network.

The asset hierarchy outlining assets included in this section is shown below in Table 6.

TABLE 6: ASSET CLASS HIERARCHY

VERTICAL ASSETS	LINEAR ASSETS	ADMINISTRATIVE
Water Treatment Plant	Trunk Watermain	Facilities (included in WTP)
Booster Stations	Local Watermain	Vehicles
Underground Reservoirs	Water Services	Lab Equipment
Elevated Water Towers	Hydrants	SCADA
Wells & Well Stations	Major (>400mm) Valves	
Water Filling Stations	Minor (<400mm) Valves	
	Water Meters	
	Sampling Stations	

2.0 WATER ASSETS

2.1 BACKGROUND

This AM Plan is intended to communicate the requirements for the sustainable delivery of services through the management of assets, compliance with regulatory requirements and required funding to provide the appropriate levels of service over the 2022 – 2031 planning period. The assets covered by this plan include the major components required to deliver effective water services to the City's customers.

The City acquired significant amounts of water network assets through amalgamation in 2001. These aging assets were included into the City's water inventory and were in varied condition when acquired. Once amalgamated, any aging assets or deficient assets became the responsibility of Hamilton Water and created several new challenges that needed to be taken into consideration and planned for.

The information in the water section of the plan is intended to give a snapshot in time of the current state of the water asset class by providing the necessary background, detailed summary and analysis of existing information.

The City currently operates and maintains five (5) drinking water systems and subsystems as listed below in Table 7. The largest system is the Hamilton System which is made up of two subsystems; Woodward and Fifty Road. The Woodward subsystem draws its water from Lake Ontario and serves the majority of the City's population, and the Fifty Road subsystem distributes water from the Town of Grimsby. In addition, there are four (4) systems which draw water from the ground using drinking water wells & well stations.

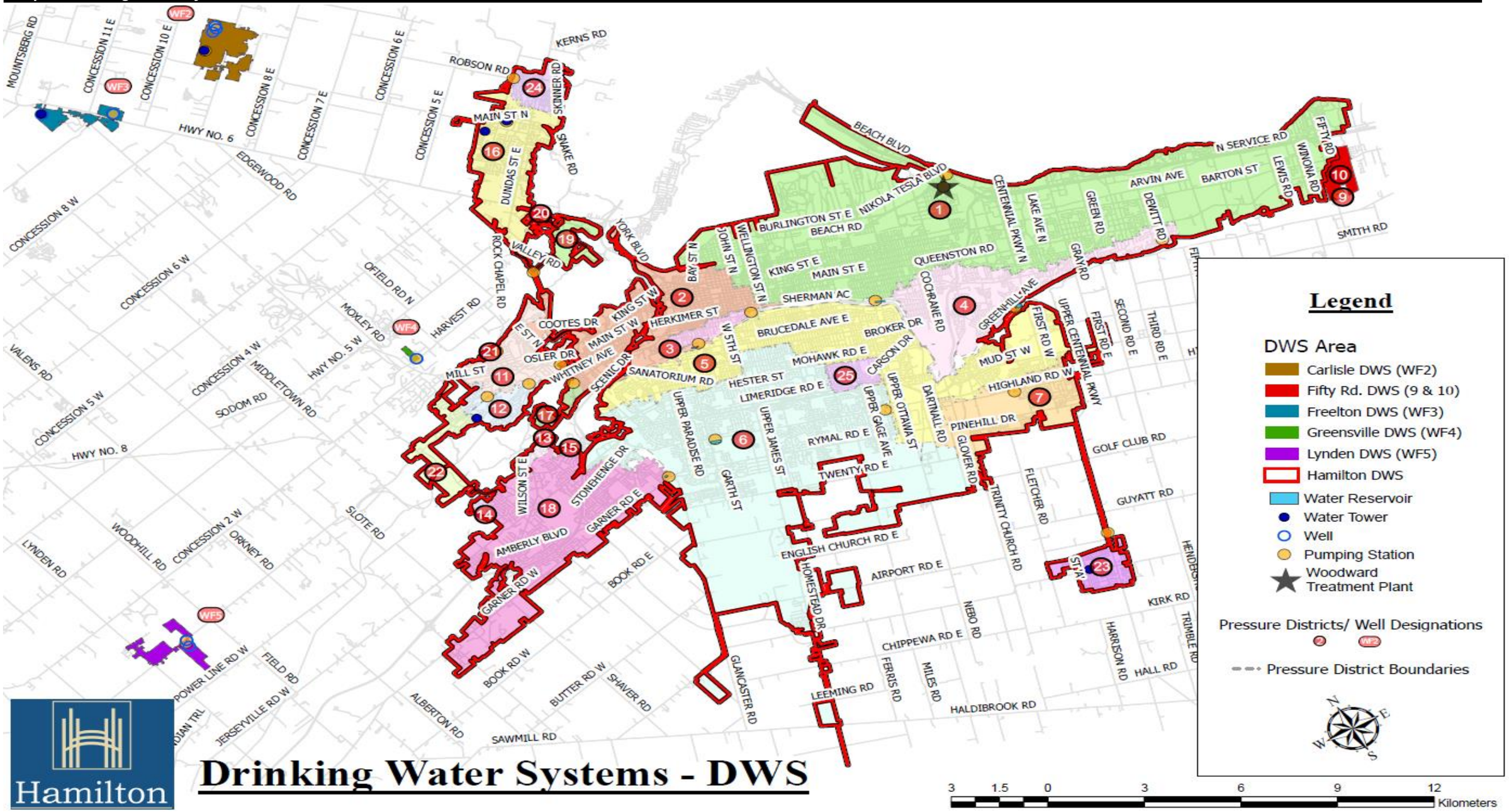
For the purposes of this report all water assets are presented together as they contribute to the overall drinking water service, but these systems and subsystems may be referenced. For a map of these systems, please refer to Map 1.

Table 7: Drinking Water Systems and Subsystems

Drinking Water System/Subsystem	Population Served	Water Source
Hamilton System / Woodward Subsystem	569,353 (2021 Census)	Lake Ontario
Hamilton System / Fifty Road Subsystem	201	Town of Grimsby
Freelton System	804	Ground water
Greensville System	108	Ground water

Table 7: Drinking Water Systems and Subsystems		
Drinking Water System/Subsystem	**Population Served**	**Water Source**
Carlisle System	1833	Ground water
Lynden System	393	Ground water

Map 1: Drinking Water Systems



2.1.1 Detailed Summary of Assets

Table 8 below displays the detailed summary of assets for the water asset class. At the time of writing, no inventory data was available for water chambers, and so they are not encompassed in this iteration of the AM Plan. In addition, it is possible that there are assets that may not be owned by Public Works which may be considered drinking water assets which may be missing from this inventory. This has been identified as a Continuous Improvement Item in Table 32.

The City owns approximately **$4.25B** in water assets which are on average in **Fair** condition. Overall, assets are an average of **34 years** in age which is **45%** of the average overall remaining service life (RSL). The data below is a combination of data from various sources as there is not yet an asset registry containing all inventory information in one data source. Examples of data sources which were used for this iteration of the Core AM Plans are stated in the AMP Overview. The lack of an asset registry is a continuous improvement item in Table 32. The City must plan to complete a detailed review of this data and create data standards in order to improve overall data quality.

For most assets, Fair condition means that the City should be planning to complete minor to moderate maintenance activities to ensure the assets reach their intended useful lives since assets begin to experience deterioration affecting asset usage at this stage as indicated in Table 8.

2.0 WATER ASSETS

Table 8: Detailed Summary of Assets
***Weighted Average**

ASSET CATEGORY	NUMBER OF ASSETS	REPLACEMENT VALUE	AVERAGE AGE (% RSL)	AVERAGE EQUIVALENT CONDITION
VERTICAL ASSETS				
Water Treatment Plant (incl Admin Facilities)	1	$1.00B	91 years (0%)	4-Poor
Data Confidence	High	Low	Medium	Very Low
Well Station	6	$17.15M	30 years (51%)	2-Good
Data Confidence	High	Medium	High	Medium
Production Wells	8	$4.783M	32 years (57%)	3-Fair
Data Confidence	High	Medium	High	Low
Underground Reservoir	12	$305.2M	53 years (30%)	2-Good
Data Confidence	High	Low	High	Medium
Booster Stations	18	$125.3M	40 years (33%)	2-Good
Data Confidence	High	Low	High	Medium
Elevated Tower	6	$28.54M	24 years (52%)	2-Good
Data Confidence	High	Low	High	Medium
Filling Station	2	$681.7K	18 years (64%)	2-Good
Data Confidence	High	Low	High	Medium
	SUBTOTAL	**$1.48B**	**41 years (33%)**	**3-Fair***
	Data Confidence	**Low**	**High**	**Medium**
LINEAR ASSETS				
Trunk Watermain (>=450mm)	185.54 km	$281.42M	60 years (36%)	3-Fair
Data Confidence	High	Medium	Medium	Low
Local Watermain (<450mm)	1,943.65 km	$1.347B	44 years (45%)	3-Fair
Data Confidence	High	Medium	Medium	Low
Water Service	146,276	$643.61M	25 years (69%)	2-Good
Data Confidence	Medium	Low	Medium	Low
Water Meter	157,596	$66.98M	13 years (48%)	3-Fair
Data Confidence	High	Low	Very High	Low
Hydrants (incl Automatic Flushing Units)	13,724	$164.69M	26 years (68%)	2-Good
Data Confidence	Very High	Medium	Medium	Low
Major Valves (>=400mm)	1,376	$103.38M	22 years (71%)	2-Good
Data Confidence	Medium	Low	Medium	Low
Minor Valves (>400mm)	21,383	$131.11M	21 years (71%)	2-Good
Data Confidence	Medium	Low	Medium	Low
Sampling Station	33	$264K	3 years (94%)	1-Very Good
Data Confidence	High	Medium	Medium	Low
Chambers	No Data	No Data	No Data	No Data
Data Confidence	Very Low	Very Low	Very Low	Very Low
	SUBTOTAL	**$2.74B**	**27 years (62%)**	**3-Fair***
	Data Confidence	**Medium**	**Medium**	**Low**
Administrative				
Vehicles	144	$12.47M	7 years (28%)	3-Fair
Data Confidence	High	Medium	High	Low
Lab Equipment (incl IT)	N/A	$3.45M	8 years (63%)	3-Fair
Data Confidence	High	Medium	Medium	Low
SCADA	N/A	$15.0M	N/A	N/A
Data Confidence	N/A	Very Low	N/A	N/A
	SUBTOTAL	**$30.9M**	**7 years (52%)**	**3-Fair***
	Data Confidence	**Medium**	**Medium**	**Low**
	TOTAL	**$4.25B**	**34 years* (45%)***	**3-Fair***
	Data Confidence	**Low**	**Medium**	**Low**

2.0 WATER ASSETS

The City has one (1) Water Treatment Plant (WTP) which services the majority of the population through the Woodward subsystem as shown in Table 7. The Woodward WTP has several complex processes that run throughout several facilities but has been simplified into one (1) asset for ease of reporting for this first iteration of the AM Plan. A Continuous Improvement item in Table 32 is to improve the reporting for the WTP for future iterations of the AM Plan to provide more details on the specific processes it undertakes. The WTP is the single largest value water asset in the City and has been estimated at **$1.0B** with a low data confidence level due to the complexity of the plant.

The data confidence for vertical assets is typically high due to the asset's locations being above ground and able to be visually confirmed easily. The confidence is not yet considered Very High due to multiple data sources which showed conflicting quantities and registry information. There has been a continuous improvement item identified to confirm data across all data sets and unify the data into a single source for future reference.

Due to the lack of current data, the complexity of vertical assets and the low frequency of asset replacements, it is difficult to achieve a high data confidence for replacement cost for this iteration of the plan. Future plans will improve on the current replacement cost values, and so the data confidence is considered low for these assets. Age, condition information and data confidence are presented in Section 2.2.4.

For linear assets, the data confidence for number of assets is considered to be high because of active data management. However, these assets are typically more challenging to confirm as they are generally buried infrastructure that cannot simply be visually verified (excluding hydrants and sampling stations). Due to these limitations there are some assets such as water services where the quantities are of a lesser confidence. The number of water meters should be almost equal to the number of services, and so it is estimated that there are approximately 11,000 water services not documented in the system. This is not an asset that historically was tracked and monitored consistently. Staff are actively working on confirming these connections and these are being added to the system as the data is collected. In addition, water meter data has a few known scenarios in ICI & multi-residential properties that would inflate the number of assets.

Linear assets are replaced much more frequently than vertical assets and as such the replacement costs generally have a higher confidence level and are often close to the approximate market rates. However, improving asset replacement costs by updating current market prices regularly instead of historical costs/estimates or internal models has been identified as a Continuous Improvement Item in Table 32.

The City has included its administrative assets (e.g. vehicles, laboratory equipment, software and administrative facilities) in a limited capacity for this iteration of the AM Plan so that the replacement costs are beginning to be recognized in the report. These assets contribute to the overall drinking water service; however, these have not yet been completed at a detailed level and will be encompassed in more detail before the 2025 iteration of the plan. It is important to

note that the administrative facilities for the Waterworks Strategic Level are encompassed in the replacement cost of the WTP.

Please refer to the AMP Overview Section 7.2.2 for a detailed description of data confidence.

2.1.2 Asset Condition Grading

Condition refers to the physical state of the water assets and are a measure of the physical integrity of these assets or components and is the preferred measurement for planning lifecycle activities to ensure assets reach their expected useful life. Since condition scores are reported using different scales and ranges depending on the asset, Table 9 below shows how each rating was converted to a standardized 5-point condition category so that the condition could be reported consistently across the AM Plan. A continuous improvement item identified in Table 32, is to review existing internal condition assessments and ensure they are revised to report on the same 5-point scale with equivalent descriptions.

TABLE 9: CONDITION GRADING EQUIVALENT

EQUIVALENT CONDITION GRADING	CONDITION DESCRIPTION	% REMAINING SERVICE LIFE	WATERMAIN (TRUNK /LOCAL)	VERTICAL ASSETS CONDITION RATING
1 Very Good	The asset is new, recently rehabilitated, or very well maintained. Preventative maintenance required only.	>79.5%	Total Breaks = 0, Default to % RSL	1-Very Good
2 Good	The asset is adequate but has slight defects and some deterioration. Deterioration has no significant impact on asset's usage. Minor maintenance may be required in addition to preventative maintenance.	69.5% – 79.4%	Total Breaks = 0, Default to % RSL	2-Good
3 Fair	The asset is sound but has minor defects. Deterioration is beginning to have an impact on asset's usage. Minor to significant maintenance is required.	39.5% - 69.4%	Breaks in 5 years = 0 AND Total Breaks > 0, OR % RSL (worse score)	3-Fair
4 Poor	Asset has significant defects and deterioration. Deterioration has an impact on asset's usage. Rehabilitation or major maintenance required in the next year.	19.5% -39.4%	Breaks in 5 years > 0 OR % RSL (worse score)	4-Poor
5 Very Poor	Asset has serious defects with significant defects and deterioration. Asset is not fit for use. Urgent rehabilitation or closure required.	<19.4%	Breaks in 5 years > 3 OR or % RSL (worse score)	5-Very Poor

The following conversion assumptions were made:

- Water Treatment Plant (WTP) condition was based on subject expert opinion based on the condition descriptions provided above;
- Watermain condition for both trunk and local were based on a combination of breaks and age;
- Vertical assets' Level 2 Condition Assessments are based on a 5-point scale which was considered equivalent to the AM Plan 5-point scale; and,
- For assets where a condition assessment was not completed or a final condition score was not assigned, but age information was known, the condition was based on the % of remaining service life.

2.1.3 Vertical

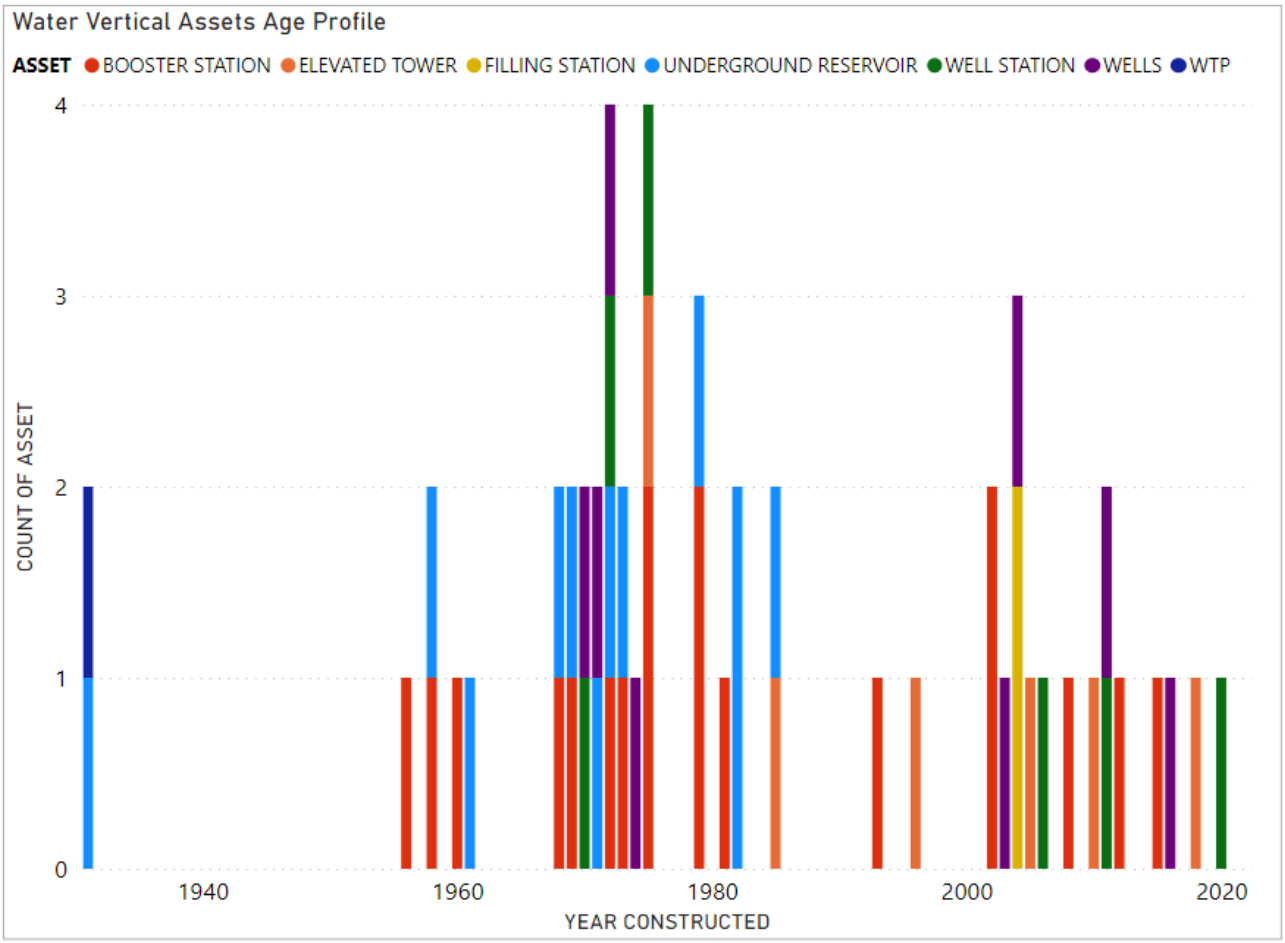
The background information for water vertical assets is included below and includes an age profile, the condition methodology used, the condition profile, and asset usage and performance.

2.1.3.1 Age Profile

The age of an asset is an important consideration in the asset management planning process especially for assets that will not receive a typical condition grading through inspections. Some lower cost or lower criticality assets can be planned for renewal based on age as a proxy for condition or until other condition methodologies are established. It should be noted that if a water assets' condition is based on age, it is typically considered to be of a lower confidence level.

The age profile of the water vertical assets is shown in Figure 1. An analysis of the age profile is provided below. For vertical assets, the data confidence for age is typically high because this information was collected using an inventory process.

Figure 1: Water Vertical Assets Age Profile



WATER TREATMENT PLANT (WTP)

The City's Water Treatment Plant (WTP) is approximately 91 years old which exceeds the design life (60 years) of the original plant. This however does not reflect the significant upgrades that have been completed over the lifecycle of the plant which have extended the life of the plant well past its design life. Future iterations of the AM Plan will ensure that the WTP is analyzed more fulsomely to ensure the City is better able to analyze the plants estimated service life. The age data confidence is considered medium because there are many assets as part of the WTP and this is only representing the initial construction date.

BOOSTER STATIONS

The majority of booster stations in the City were constructed from 1955 – 1980. The estimated service life (ESL) of a booster station is estimated to be 60 years. Three (3) booster stations are currently beyond their ESL and an additional three (3) stations will exceed their ESL in the next ten years. After an asset has reached its ESL it should be monitored with an increased

frequency to ensure the asset is performing as expected and to determine if the ESL for the asset type should be extended.

ELEVATED TOWERS

Elevated towers are a relatively new asset compared to other vertical water assets, with the oldest asset being constructed in 1975. The ESL of an elevated tower is 50 years, and so the oldest asset is approaching its ESL, but has been assessed as being in good condition from the last condition assessment.

UNDERGROUND RESERVOIR

The oldest reservoir in the City was built in 1931, had a major upgrade in 2012 and was reported to be in good condition per the last condition assessment. The second oldest reservoir which is approaching its ESL had a major upgrade in 2017 and was also reported to be in good condition per the last condition assessment. The remainder of the assets were built from 1961 – 1985. The ESL for a reservoir has been estimated at 75 years, and so while these assets will not reach their ESL in the next 10 years, condition assessments should continue so that preventative work can be completed to avoid reactive repairs on this aging piece of infrastructure.

WELL & WELL STATION

Typically, wells are drilled before or during the construction of a well station which explains why they are not always constructed at the same time in Figure 1. Historically, these assets have been reported together, but have been separated in the report because they are distinct assets with different ESLs. In addition, some well stations are serviced by two (2) wells. Wells and well stations are generally newer pieces of infrastructure with the oldest well and station being constructed in 1970. Wells' ESL are considered to be 75 years, while the well station ESL is typically considered to be 60 years. Therefore, the oldest well station is beyond its ESL, but had a major upgrade completed in 2014, and no other well station is beyond its ESL.

FILLING STATION

The City has two (2) filling stations which were constructed in 2004 and had major upgrades in 2011. It is estimated that filling stations have an ESL of 50 years, and so based on age, it is not anticipated that these will require any major work in the next 10 years.

2.1.3.2 Condition Methodology

For treatment plants, there is no formal condition assessment process, and for the purposes of this report the condition has been identified by subject matter experts at the City based on various available condition information as well as the condition descriptions presented in Table 10. Condition assessments for various components have been completed on the plant as deemed necessary. However, a formal condition assessment program should be identified by process on a pre-determined cycle. This has been identified as a continuous improvement item in Table 32.

For other vertical assets, the City typically undertakes three (3) different levels of condition assessments for vertical assets as indicated in a 2015 Technical Memorandum completed by CH2M Hill as defined below in Table 10. Historically, the City had a target of 10 years for vertical assets, but it was recommended to complete Level 1 inspections regularly to prioritize Level 2 inspections. However, the City has not fully implemented this approach, and has focused on completing Level 2 inspections.

Table 10: Condition Descriptions

INSPECTION LEVEL	DESCRIPTION	TARGET FREQUENCY	ACTUAL FREQUENCY
1	High level inspection at the facility level for stated lifecycle categories and is used to inform the Level 1 risk assessment and the lifecycle analysis.	1 to 2 years	N/A
2	More detailed condition grade assessed at the assembly level and is used to inform the Level 2 risk assessment and as a more detailed input to the lifecycle analysis. Data captured through a formalized asset inspection, typically conducted by external resources.	Dependent on Level 1 findings, or target of 10 years.	17-year cycle
3	Detailed investigation, where shown to be cost-effective.	Undertaken as required	N/A

A combination of six (6) Level 2 condition assessments for water & wastewater vertical assets are completed annually excluding the treatment plants. Typically, this is an even distribution resulting in three (3) Level 2 condition assessments being completed annually for water vertical assets, which means on average vertical assessments are completed on an approximate 17-year cycle. However, sometimes more or less water assets are included depending on priority. The priority assets have been identified by staff using information from audits completed in 2003 and 2012 as well as staff input. At this time, the process for selection is not formally documented, and so this has been identified as a continuous improvement item. Another continuous improvement item would be to achieve the Level 2 condition assessments on vertical assets on a minimum 10-year cycle if Level 1 assessments continue to not occur to ensure that the City is aware of upcoming forecast requirements, which is approximately another five (5) assessments per year.

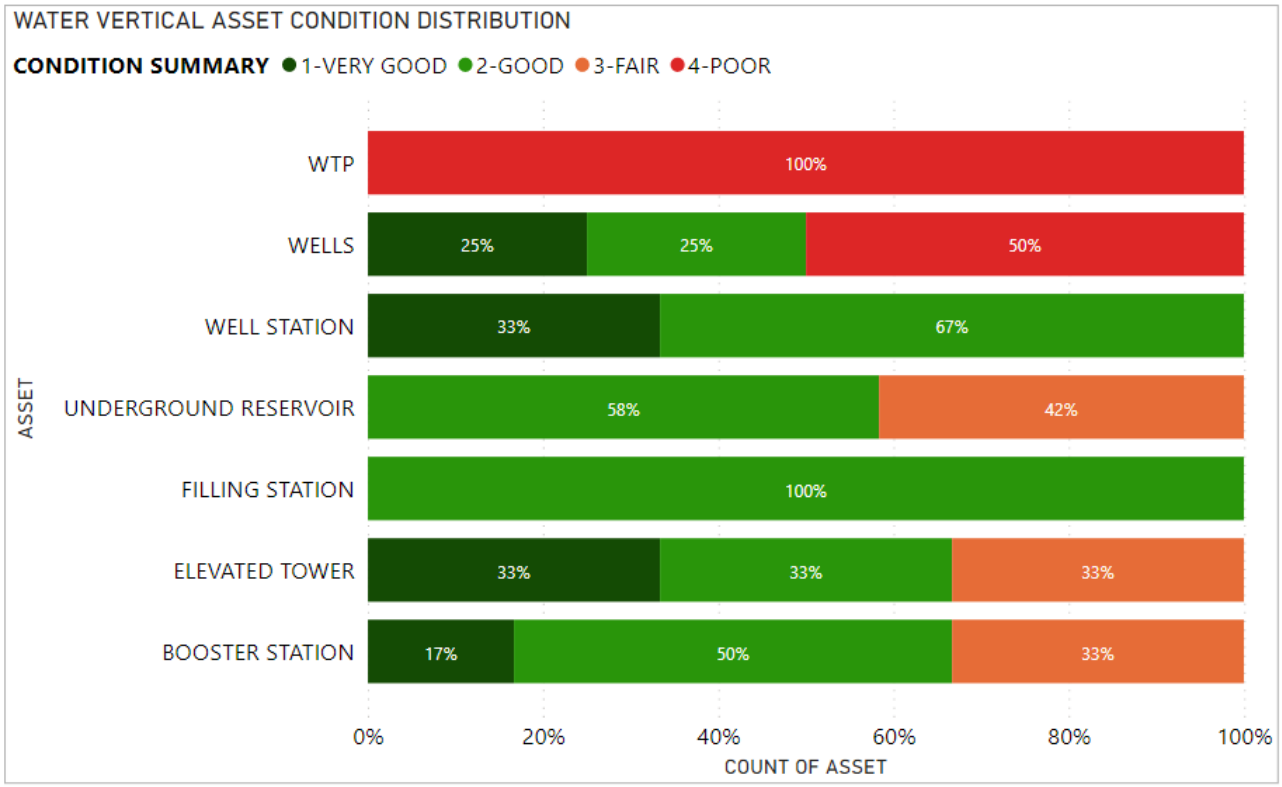
While wells do have an assessment program, the program does not output a condition score and so wells' condition have been reported based on age. This has been identified as a continuous improvement item in Table 32.

Finally, condition assessments should begin on any new facility within a determined timeline after being constructed, possibly 10-15 years into its lifecycle. These have been identified as continuous improvement items in Table 32.

2.1.3.3 Asset Condition Profile

The condition profile of the City's assets is shown in Figure 2. As mentioned in Section 1.1.2, the original condition grades were converted to a standardized condition category for report consistency.

Figure 2: Water Vertical Asset Condition Distribution



WATER TREATMENT PLANT

Based on subject area experts and the descriptions provided in Table 9, overall, the WTP is considered to be in overall Poor condition.

The Woodward Water Treatment Plant has component processes of varying ages and states of repair. Within the last 15 years a number of new or rehabilitated processes have been

constructed including new corrosion control and fluoride buildings, reconstruction of the filter building structure and significant improvements to the highlift building and associated assets. Several other processes have significant deterioration and are approaching or are at the end of their useful life. These include the chlorination building, the intake structures, components of the pre-treatment and filtration processes, high lift pump impellers and the clearwell. A capital project is currently in the proposal development phase to address many of these issues. Construction is anticipated to begin in 2025.

A condition assessment program should be implemented to proactively identify areas of concern to avoid the WTP from reaching a very poor condition level.

As stated previously, the WTP is a complex asset, and so the condition rating is currently at a low confidence level because there are a lot of components to consider. The plant is composed of five (5) major processes: Low Lift, Pre-Treatment, Filtration, Treatment, and High Lift. At this time, some components in these processes are considered to be in good to poor condition. The poor condition rating is due to some key deficiencies that are affecting the performance of the plant from the operator's perspective. Since the WTP is the most expensive water asset, there is significant expenditure required to bring this asset up to an acceptable condition.

OTHER VERTICAL ASSETS

Based on the most recent condition assessments, vertical assets are typically in good condition. As stated in Section 1.1.2, the frequency at which these inspections occur should be investigated further as they do not match the target frequencies. As a result of the frequency of inspections, the data confidence associated with the condition of these assets is medium.

Since condition assessments are completed on booster stations, these booster stations are known to be in good to fair condition, and a major upgrade was completed on one (1) of these stations in 2017. However, over the next 10 years, an additional three (3) booster stations will exceed their ESL, which shows the importance of completing condition assessments on these assets regularly and performing upgrades and preventative operations and maintenance activities so that these assets reach their ESL without major reactive repairs.

In addition, wells are inspected but the inspections do not output a final score. Therefore, the conditions of wells have been estimated based on age and so it is likely the Poor condition wells shown above are in better condition. This has been identified as a continuous improvement item in Table 32.

2.1.3.4 Asset Usage and Performance

Assets are generally provided to meet design standards where available. However, there are often insufficient resources to address all known deficiencies.

The largest performance issues with vertical water assets involve degradation of components. The service deficiencies in Table 11 below were identified using staff input.

Table 11: Known Service Performance Deficiencies			
ASSET	**LOCATION**	**SERVICE DEFICIENCY**	**DESCRIPTION OF DEFICIENCY**
Reservoir	Scenic	Leaks	Leaking expansion joints which require replacement. Project currently underway.
Booster Station	Garner	Electrical upgrades required	Electrical system is beyond service life and requires replacement.
Reservoir	Various	Upgrade required	Many reservoirs have common inlet/outlet and no mixing capability causing issues with chlorine residual.
WTP	Chlorine Building	Structural Deficiency	Structural deficiencies requiring attention.
WTP	Filter Underdrains	Deficiency	Upgrades are required.
WTP	Backwash System	Poor Performance	Upgrades may be required.
WTP	Sedimentation Tanks	Settlement Issues	Settlement issues may reduce capacity at plant, upgrades may be required.

2.1.4 Linear

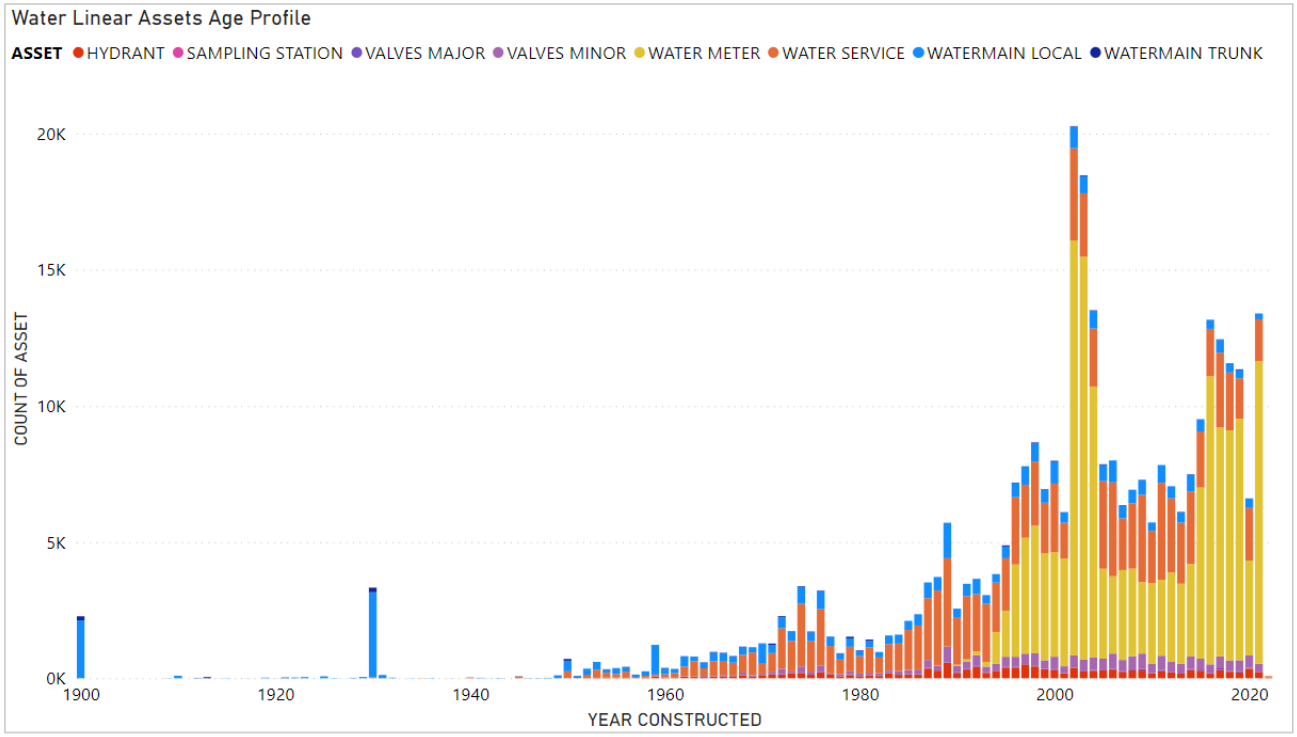
The background information for water linear assets is included below and includes an age profile, the condition methodology used, the condition profile, and asset usage and performance.

2.1.4.1 Age Profile

The age of an asset is an important consideration in the asset management process as it can be used for planning purposes as typically assets have an estimated service life where they can be planned for replacement.

The age profile of the water linear assets are shown in Figure 3. An analysis of the age profile is provided below for each asset.

Figure 3: Water Linear Assets Age Profile



There are common years where asset age is typically assumed when age is unknown. This typically includes decade and mid-decade, and so large spikes may occur in 1900, 1930, 1950, 1955 etc.

WATERMAIN

For legibility of the graph, the water linear assets have been shown since 1900. There are a small number of trunk and local watermain segments that predate 1900 with the earliest installation date being 1860, indicating that local and trunk watermains are the oldest linear water assets in the City.

The average age for trunk and local watermain in the City is 60 and 44 years respectively. With an average estimated service life (ESL) of 94 and 80 years, on average there is 36% and 45% of service life remaining respectively. The condition of watermains is partially based on age. The age data confidence for watermain is considered to be Medium as this information is typically populated, but the accuracy of the data appears to contain assumptions based on the spikes by decade.

WATER SERVICE

Based on Figure 3, water services have typically been installed gradually over time with no significant spikes. This data is considered to be medium confidence with 72% of data populated with unknown accuracy. As this data set is large, 40,000 records do not have age data, which is significant, and should be investigated. For the known data, water services are 25 years old and

with an ESL of 80 years there is approximately 69% of service life remaining. The condition of the water services has been estimated based on age.

WATER METER

Based on Figure 3, water meters are a relatively new asset, with assets typically installed after 1994, which is mostly consistent with the ESL of 25 years for these assets. The data confidence for this asset is very high with most records being populated for age, and the accuracy is also likely high because these assets are attached to billing. The average age of these assets is 13 years indicating that on average 48% of service life is remaining. However, the oldest meter in the database was installed in 1977, and approximately 6700 water meters are beyond the ESL of 25 years, and so the City should investigate replacing these old meters. The condition of the water meters has been estimated based on age.

MAJOR / MINOR VALVES

Valves are another asset without any associated spikes. These assets are on average 22 years old, and with an ESL of 75 years there is 71% of useful life remaining. This data is considered to be at a medium confidence level with 74% of data populated resulting in approximately 6000 valves without associated age data and unknown accuracy.

HYDRANT

Hydrants are another asset without any significant spikes. Hydrants were typically installed after 1951. There are three (3) hydrants installed in the 1930s and 1940s which should be investigated as they are beyond the ESL of 80 years. On average these assets are 26 years old which means there is typically 68% of service life remaining. The data confidence for hydrants are considered to be medium as this information is typically populated, although the source of this data may be estimated.

SAMPLING STATION

Since there are only 33 sampling stations, it is difficult to view these in Figure 3. However, this asset is generally new with an average age of 3 years which means the asset typically has 94% of useful life remaining. The age data confidence for sampling stations is considered to be medium as this information is likely accurate because these assets are new, but only 76% of age information is populated.

2.1.4.2 Condition Methodology

The inspection frequency and condition score output for each linear asset is found below in Table 12. An analysis for each asset is found below.

Table 12: Inspections and Condition Information		
ASSET	**INSPECTION FREQUENCY**	**CONDITION SCORE OUTPUT**
Trunk Watermain	Based on priority	None, used age and breaks
Local Watermain	None	None, used age and breaks
Hydrants	Annual	None, used age
Major Valves	1-year cycle	None, used age
Minor Valves	3-year cycle	None, used age
Water Services	Ad Hoc	None, used age
Water Meters	Ad Hoc	None, used age

Due to limitations associated with asset location and pressurized pipes, linear asset conditions are typically based on estimated service life as explained below.

WATERMAIN

Watermains cannot easily have CCTV inspections completed like gravity mains because the pipes are under pressure, and so the pipes would have to be temporarily taken out of service to complete the inspections. In addition, there are not maintenance holes for watermains, and so finding access points to insert a CCTV camera can also be a challenge and CCTV cameras can only traverse a maximum length. There are condition assessment options for watermains where technology can be inserted into a pressurized pipe for an indeterminate length, but these methodologies are often cost prohibitive network wide and are only completed on critical assets such as trunk watermains.

In 2008, a desktop analysis was completed on the watermains in the network where a criticality score was assigned to each pipe segment. Inspections are prioritized based on these scores. Since pipes are different materials and sizes, different technologies and methodologies must be used which include electromagnetic (Pipe Diver (concrete), See Snake (metal)), ultrasonic, and acoustic (SmartBall, Sahara) inspections. Since 2011, the City has been completing inspections on trunk watermains, and to date has completed 44.5 km which is 24% of the trunk system. The City completes approximately 6km of trunk main inspections a year resulting in it taking 31 years to complete assessments on all trunk watermains. The target frequency is 10 to 15 years.

This suggests that the City should investigate increasing the amount of trunk watermain inspected by at least another 6km annually to meet this target. This has been identified as a continuous improvement item in Table 32. In addition, historically these inspections have not produced a final condition score and have been used to locate areas of concern to take the required action to prevent breaks. Another continuous improvement item is to investigate assigning a score to these lengths of watermain based on the output from these condition assessments. The City also collects data on soil and outside cast iron conditions at opportunistic times to predict the condition of surrounding infrastructure and has done so at 30 locations across the City. This could be used to assist with developing a condition score as well.

Therefore, although the City does complete assessments on critical watermains, there is not yet a process to convert these assessments into a condition score. For the purposes of estimating condition, watermain condition is based on a combination of ESL and number of breaks per Table 12.

It's important to note that age-based conditions are not necessarily representative of the actual condition of the pipe, and as previously mentioned, completing condition assessments of the network is cost prohibitive. Therefore, the City is investigating a new watermain condition model which involves multiple criteria (e.g. age, breaks, soil type, c-factor, pipe deterioration curve etc.) to improve the condition profile for the next iteration of the report.

WATER SERVICES

No condition program exists at this time, and condition was estimated on age.

VALVES

Major and minor valves are inspected and exercised on a varied cycle depending on size. If during a valve inspection, a valve has been determined to have failed, valves may be repaired on site. If a repair cannot be done, minor valves may be replaced on-site and major valves would be put onto a replacement schedule. For the purposes of estimating condition, the valve conditions are based on estimated remaining service life as shown in Table 12.

WATER METERS

Water meters are typically located within private property and cannot be inspected regularly. For the purposes of estimating condition, the water meter conditions are based on estimated remaining service life as shown in Table 12.

HYDRANTS

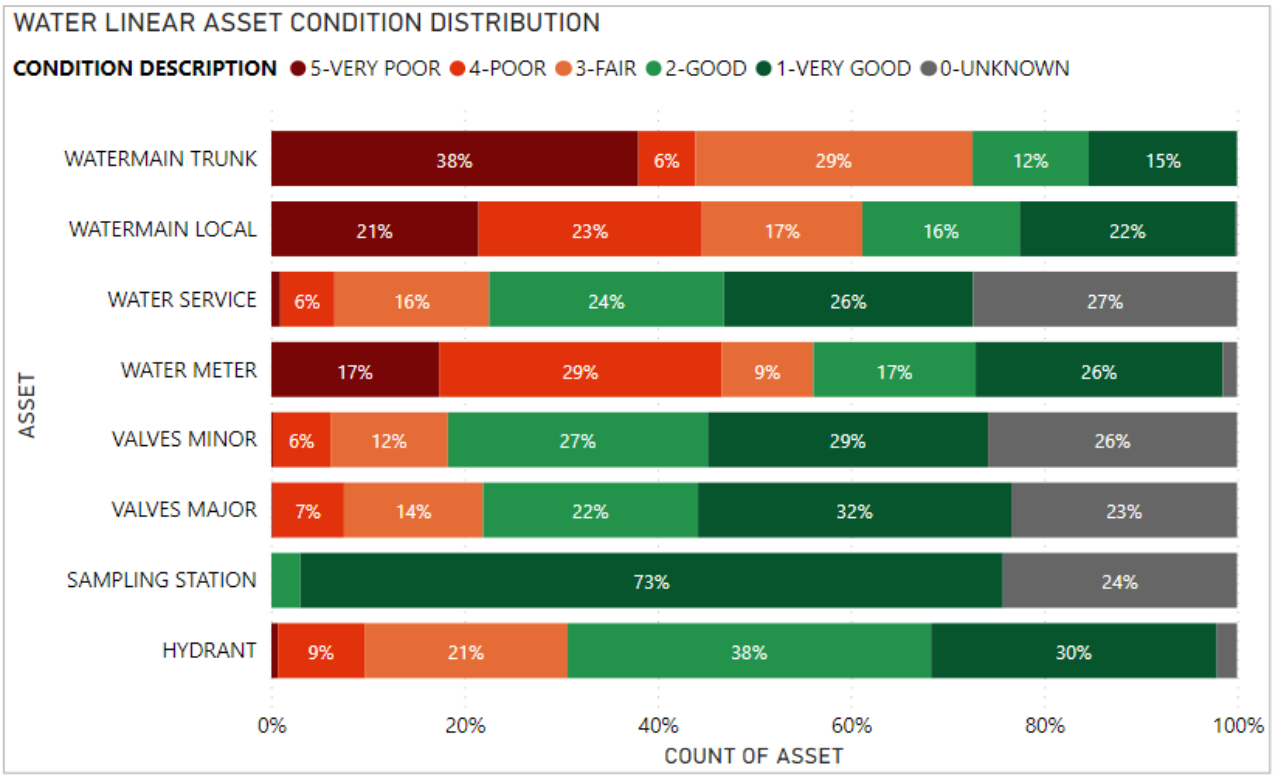
Hydrants have legislated inspections which must occur annually. However, these inspections are typically to ensure the assets are in working order but are not currently formal condition

assessments which output a condition score. A future continuous improvement item is to incorporate a condition score into these inspections which has been identified in Table 32 in the Continuous Improvement section. For the purposes of estimating condition, the hydrant conditions are based on estimated remaining service life as shown in Figure 3 although based on the inspections all hydrants are in good working order.

2.1.4.3 Asset Condition Profile

The condition profile of the City's assets is shown in Figure 4. As mentioned in Section 1.1.2, the original condition grades were converted to a standardized condition category for report consistency.

Figure 4: Asset Condition Profile



WATERMAIN

Per Figure 4 above, trunk and local watermain are in an average of Fair condition. As mentioned in Section 1.1.2, although there is a condition assessment program using electromagnetic, ultrasonic, or acoustic methodologies for 24% of trunk watermain, there is not yet a process for outputting a condition rating from this number. As a result, the information above for both trunk and local watermain is based on a combination of age and number of breaks per Table 12. The City prioritizes breaks over age for renewals, but for this analysis both were considered as

number of breaks was determined to be too conservative of an estimate of poor condition watermain. For planning purposes, it is important to consider the ESL of the pipe material.

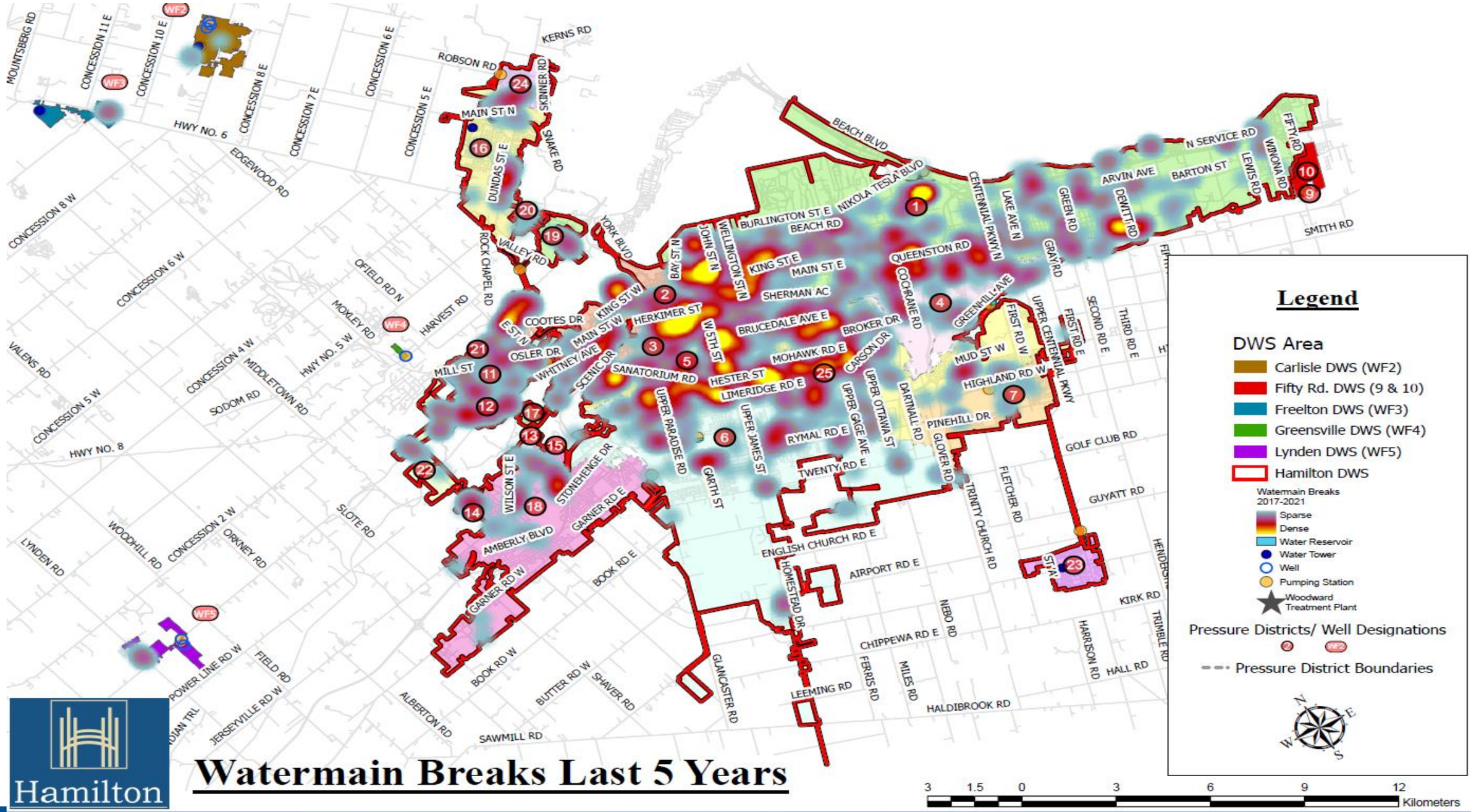
However, there are limitations to this approach. It is evident in Figure 4 above that 38% of trunk watermains are shown to be in Very Poor condition but this does not necessarily reflect reality. The results of the completed condition assessments have shown that the trunk watermains which have been assessed typically do not have extensive distresses. As a result, the condition is at a low data confidence level.

Map 2 below shows a heat map of watermain breaks over the 5 years. This figure is a snapshot in time and does not necessarily represent the condition of the entire network, but it is evident that watermain breaks have been occurring City wide. However, there is a concentration of breaks occurred in areas with older infrastructure especially in the upper city north of Limeridge Road and the lower city west of Wellington Street North, with a few pockets in Dundas and Stoney Creek. These areas should be investigated further for renewals. This figure shows that the City has been experiencing watermain breaks in areas with older infrastructure. There are limitations to this map because it does not show the type of break which can be due to a variety of factors unrelated to the condition of the pipe (e.g. temperature, breaks at the joint). However, since breaks is the main indicator of condition that the City uses to plan renewals, this map does show that there could be a relationship between age, location and the ability to predict breaks, and all of these can be indicators of condition for watermain.

OTHER LINEAR ASSETS

The remaining linear assets' conditions are estimated based on age where known. The majority of these assets are shown to be in good condition excluding water meters which are in fair condition. This shows that most assets are within their ESL and so the City should continue preventative operations and maintenance activities. The City is currently moving toward using a Smart Meter process, and so it is likely worthwhile to delay replacing some water meters until this program is fully implemented. In addition, as indicated in Section 2.1.1.6, many of these assets including valves, hydrants, and sampling stations have inspection programs which do not yet output overall condition scores, which should be investigated.

Map 2: Watermain Breaks Last 5 Years



2.1.4.4 Asset Usage and Performance

Assets are generally provided to meet design standards where available. However, there are often insufficient resources to address all known deficiencies.

The largest performance issues with water involve issues with water quality and service disruptions.

The below service deficiencies in Table 13 were identified from the most recent inspection reports as well as staff input.

Table 13: Known Service Performance Deficiencies

ASSET	LOCATION	SERVICE DEFICIENCY	DESCRIPTION OF DEFICIENCY
Watermain	Various Locations farther from Water Treatment Plant	Low chlorine residuals	Due to climate change, Lake Ontario is staying warmer into the year and customers are using less water to irrigate their properties. When low residuals are confirmed, the event is logged and the watermain is flushed.
Watermain / Storage	Various Locations especially areas with unlined cast iron watermain and pressure district boundaries	Fire Flow Deficiencies (Low Pressure)	Areas of the system have lower fire flow and/or pitot pressure readings than optimal and require additional investigation.
Fire Hydrants	Various Locations	Substandard fire hydrant	Hydrant is substandard, includes 2-port, lead port, no secondary valve, no breakaway flange.
Watermain	Pressure District Boundaries	Target Pressure Deficiencies	Pressure is too low or too high and not at City target.
Large Valves	Various Locations	Poor Condition	Some large valves are broken in an open position and require replacement.

Table 13: Known Service Performance Deficiencies			
ASSET	**LOCATION**	**SERVICE DEFICIENCY**	**DESCRIPTION OF DEFICIENCY**
Water Treatment Plant	Chlorine level	Renewal activities will allow for the reduction of chlorine and reduce costs associated with renewing carbon filters	High chlorine use increased the renewal timing for high cost carbon filters. The renewal project will ensure these high cost items last significantly longer

2.1.5 Administrative

Administrative assets are assets which contribute to the water service but are not water assets. These include vehicles, laboratory equipment, software and administrative facilities. Administrative facilities replacement costs have been incorporated as part of the WTP cost.

As previously mentioned, the City has included these assets in a limited capacity so that the replacement costs are incorporated in the report since these assets contribute to the overall drinking water service, however, these have not yet been completed at a detailed level because they are not defined as part of the O.Reg. 588/17 definition of a water asset. These will be encompassed in more detail before the 2025 iteration of the plan.

2.2 LIFECYCLE MANAGEMENT PLAN

The lifecycle management plan details how the City plans to manage and operate the assets at the agreed levels of service while managing life cycle costs.

2.2.1 Acquisition Plan

Acquisition reflects new assets that did not previously exist or works which will upgrade or improve an existing asset beyond its current capacity. They may result from growth, demand, legal obligations and social or environmental needs. Water assets are generally donated to the City through development agreements process directly related to growth.

CURRENT PROJECT DRIVERS – 10 YEAR PLANNING HORIZON

Hamilton Water currently prioritizes capital projects as per the drivers listed below. These drivers help to determine a ranking priority for projects and ensure that multiple factors are being considered to drive investment decisions. These drivers should be reviewed each iteration of the AM Plan to ensure they are appropriate and effective in informing decision making.

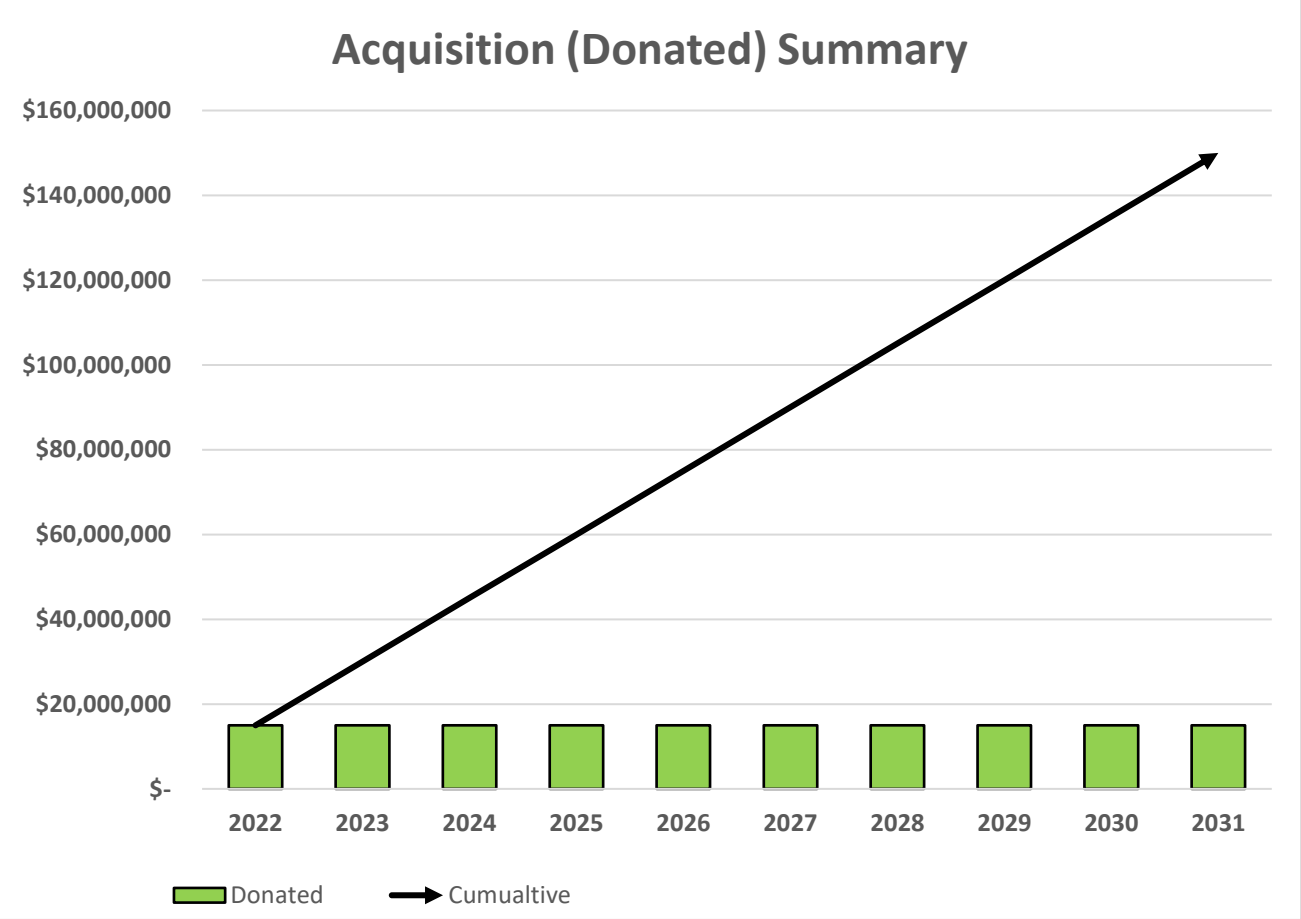
Table 14: Drivers for 10 Year Planned Projects

DRIVER	% OF PLANNED PROJECTS (10 YEAR HORIZON)
Legal Compliance	20%
Coordination, Funding, Budgeting	25%
Risk Mitigation	25%
Health and Safety	10%
Operating and Maintenance Impacts	10%
Development Growth	10%
Total	**100%**

Forecast acquisition asset costs are summarized in Figure 5 and shown relative to the proposed acquisition budget.

DONATED ASSETS

Figure 5: Acquisition (Donated) Summary
All figures are in 2021 dollars.



Annually on average, the City assumes over **$15,000,000** of donated Water assets through subdivision agreements or other development agreements. These assets annually on average include **9 km's** of watermains, **1,500** new water service connections and water meters, **63** valves and **50** fire hydrants. The City is reviewing its donated asset assumption process to ensure that it proactively understands what assets are being donated annually and can ensure they are planned for properly. This will allow multiple departments to plan for the assets properly such as:

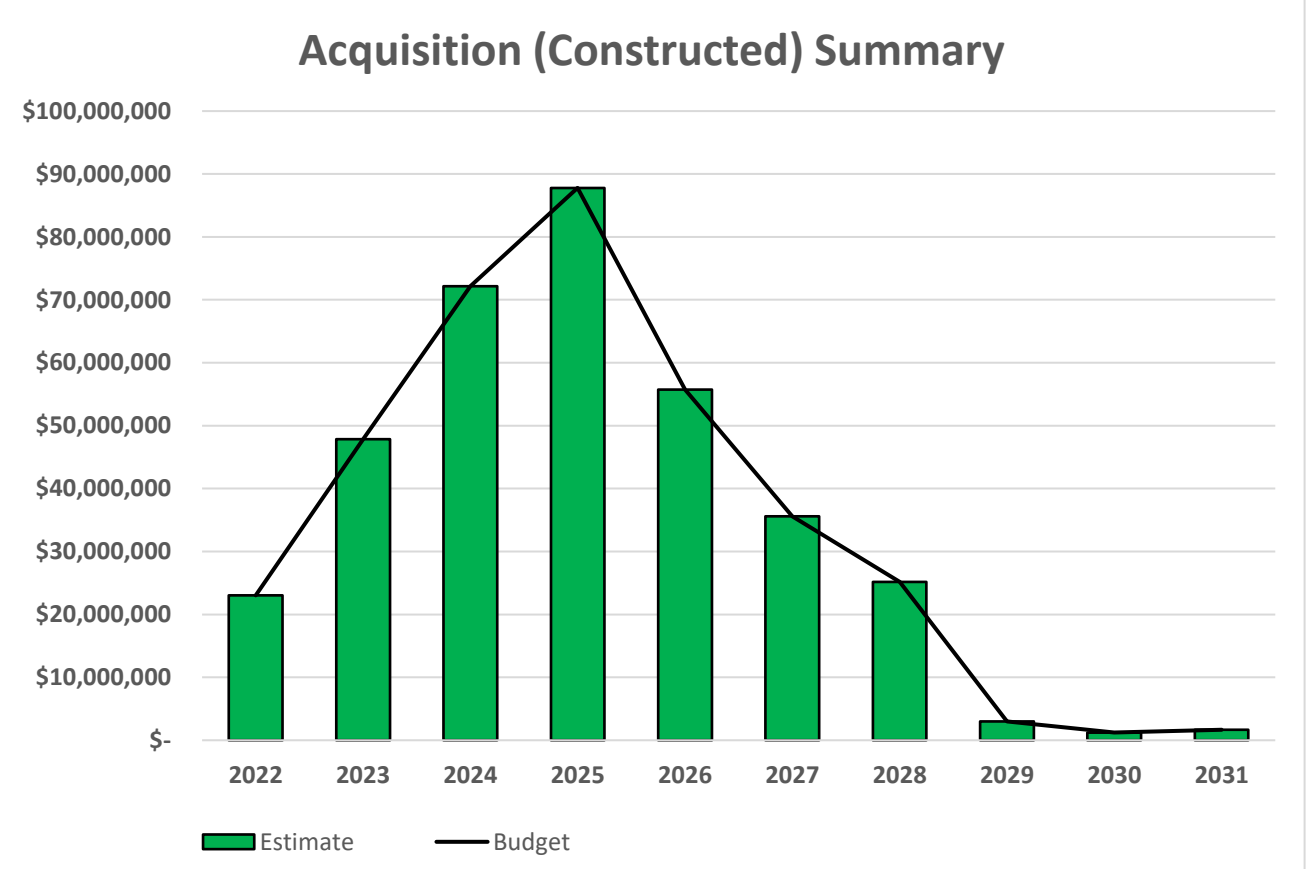
- AM to forecast the long-term needs and obligations of the assets;
- Operations and maintenance can include the assets in their planned activities (inspections, legislative compliance activities); and,
- Finance can ensure that assets are properly captured and recognized appropriately (Audited Financial Statements, TCA process, Provincial reporting such as the FIR).

Once the Water assets are assumed, Hamilton Water then becomes the stewards of these assets and is responsible for all ongoing costs for the asset's operation, continued maintenance, inevitable disposal and their likely renewal.

Construction costs are often only **10-15 %** of an asset's whole life costs. When development assets are donated to Hamilton, then the City becomes obligated to fund the remaining whole life costs. Over the next ten-year planning period the City anticipates receiving **$150,000,000** of donated assets which, would then obligate ratepayers to fund the remaining lifecycle costs over the donated assets ESL.

The City has internal design standards, inspection practices as well as assessment which are intended to ensure the assets that are being donated to the City through subdivision agreements are in excellent condition before assumption. The City should continue to review its assumption process to ensure that the City is receiving high quality and appropriately sized donated assets to defer lifecycle activities as much as possible.

Figure 6: Acquisition (Constructed) Summary
All figure values are shown in 2021 dollars.



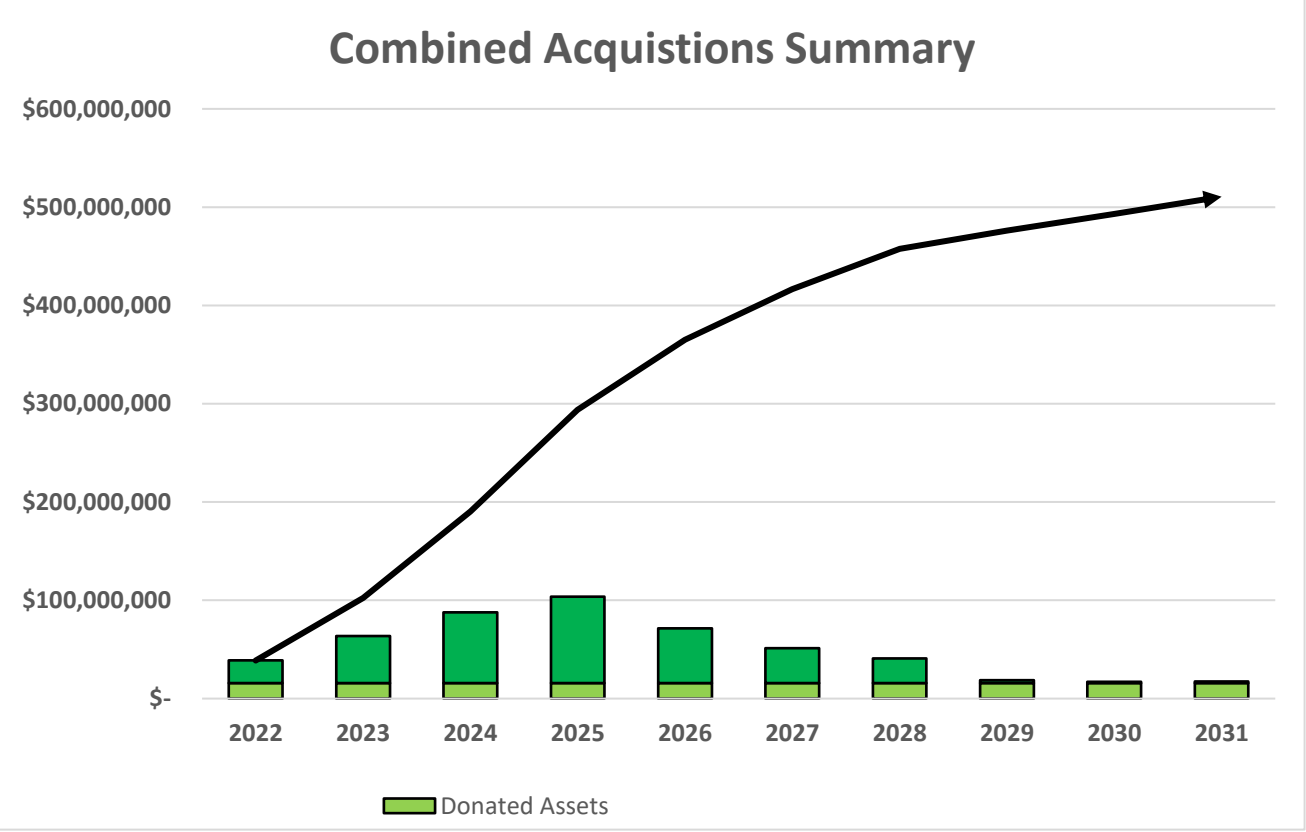
When the City commits to new assets, the municipality must be prepared to fund future operations, maintenance and renewal costs. The City must also account for future depreciation when reviewing long term sustainability. When reviewing the long-term impacts of asset

acquisition, it is useful to consider the cumulative value of the acquired assets being taken on by the Entity. The cumulative value of all acquisition work, including assets that are constructed and contributed shown in Figure 7.

Over the next 10 Year planning period the City will construct approximately **$361,174,000** of constructed assets which can either be new assets which did not exist before or expansion of assets when they are to be replaced . Major acquisition expenditures over the next ten years include:

- **$24 million** for Reservoir works, **$43** million for Water Meter Installations
- **$54 million** for Pumping Stations upgrades
- **$146** million dollar expansion to the Water Treatment Plant.

Figure 7: Combined Acquisition Summary
All figure values are shown in 2021 dollars.



SUMMARY OF ASSET FORECAST COSTS

Over the next ten (10) – years, the City expects to acquire nearly **$512 Million** dollars of water assets.

The City has sufficient budget for its planned constructed acquisitions at this time. It will become critical to understand that through the construction or assumption of new assets, the City will be

committing to funding the ongoing operations, maintenance and renewal costs which are very significant. The City will need to address how to best fund these ongoing costs as well as the costs to construct the assets while seeking the highest level of service possible.

Future AM Plans will focus on improving the understanding of Whole Life costs and funding options however at this time the plan is limited on those aspects. Expenditure on new assets and services will be accommodated in the long-term financial plan but only to the extent that there is available funding.

2.2.2 Operations and Maintenance Plan

Operations include all regular activities to provide services. Daily, weekly, seasonal, and annual activities are undertaken by staff to ensure the assets perform within acceptable parameters and to monitor the condition of the assets for safety and regulatory reasons. Examples of typical operational activities include cleaning, sample collection, quality testing, inspections, utility costs and the necessary staffing resources to perform these activities.

Maintenance should be viewed as the ongoing management of deterioration. The purpose of planned maintenance is to ensure that the correct interventions are applied to assets in a proactive manner and to ensure it reaches its intended useful life. Maintenance does not significantly extend the useful life of the asset but allows assets to reach their intended useful life by returning the assets to a desired condition.

Proactively planning maintenance significantly reduces the occurrence of reactive maintenance which is always linked to a higher risk to human safety and higher financial costs. The City needs to plan and properly fund its maintenance to ensure the engineered structures are reliable and achieve their desired level of service.

Maintenance includes all actions necessary for retaining an asset as near as practicable to an appropriate service condition including regular ongoing day-to-day work necessary to keep assets operating. Examples of typical maintenance activities include pipe repairs, service repairs, pump maintenance, equipment repairs along with appropriate staffing and material resources.

Some of the major maintenance projects Hamilton plans to undertake over the next 10 years include:

- **$56 million** allocated for Road Cut restoration program
- **$24.5 million** allocated for reactive maintenance (water valves, hydrants etc)
- **$2.5 million** allocated for Water Utility structure works

Assessment and priority of reactive maintenance is undertaken by staff using experience and judgement

2.2.3 Vertical

The major operating and maintenance lifecycle activities per vertical asset with their accompanying 2021 costs (if known) are shown below in Table 15.

Table 15: Vertical - Operations and Maintenance Summary

ASSET	LIFECYCLE STAGE	LIFECYCLE ACTIVITY	2021 ANNUAL COST
Water Treatment Plant	Operation	Inspection, Optimization, Preventative measures	$6,671,284
		Calibration & Verification	$89,794
	Maintenance	Preventative Maintenance	$16,457
		Reactive Maintenance	$396,372
Booster Stations	Operations	Inspections, Preventative measures	$8,371,077
		Calibration & Verification	$54,758
	Maintenance	Preventative Maintenance	$15,078
		Reactive Maintenance	$111,349
PRV Chambers	Operation	Preventative Operations	$15,827
Reservoirs & Towers	Operations	Inspections. Preventative measures	$387,461
		Calibration & Verification	$17,595
	Maintenance	Preventative Maintenance	$2,415
		Reactive Maintenance	$23,450
Wells	Operations	Inspections, Preventative measures	$89,301
		Calibration & Verification	$26,840
	Maintenance	Preventative Maintenance	$14,874
		Reactive Maintenance	$55,198
		Total Annual Cost	**$16,359,130**

The above table was created by categorizing work order descriptions into lifecycle activities, but the work order descriptions did not always provide a clear distinction regarding the purpose of the activities. Therefore, it is likely there are some errors in the above table for how the amounts are allocated especially regarded preventative and reactive maintenance allocations. However, the total annual cost is accurate for what was spent on vertical assets for operations and

maintenance activities in total. This is a continuous improvement item which will be addressed through the EAM project, which is described in the AMP Overview.

2.2.4 Linear

The major operating and maintenance lifecycle activities per linear asset with their accompanying 2021 costs (if known) are shown below in Table 16.

Figure 16: Linear - Operations and Maintenance Summary

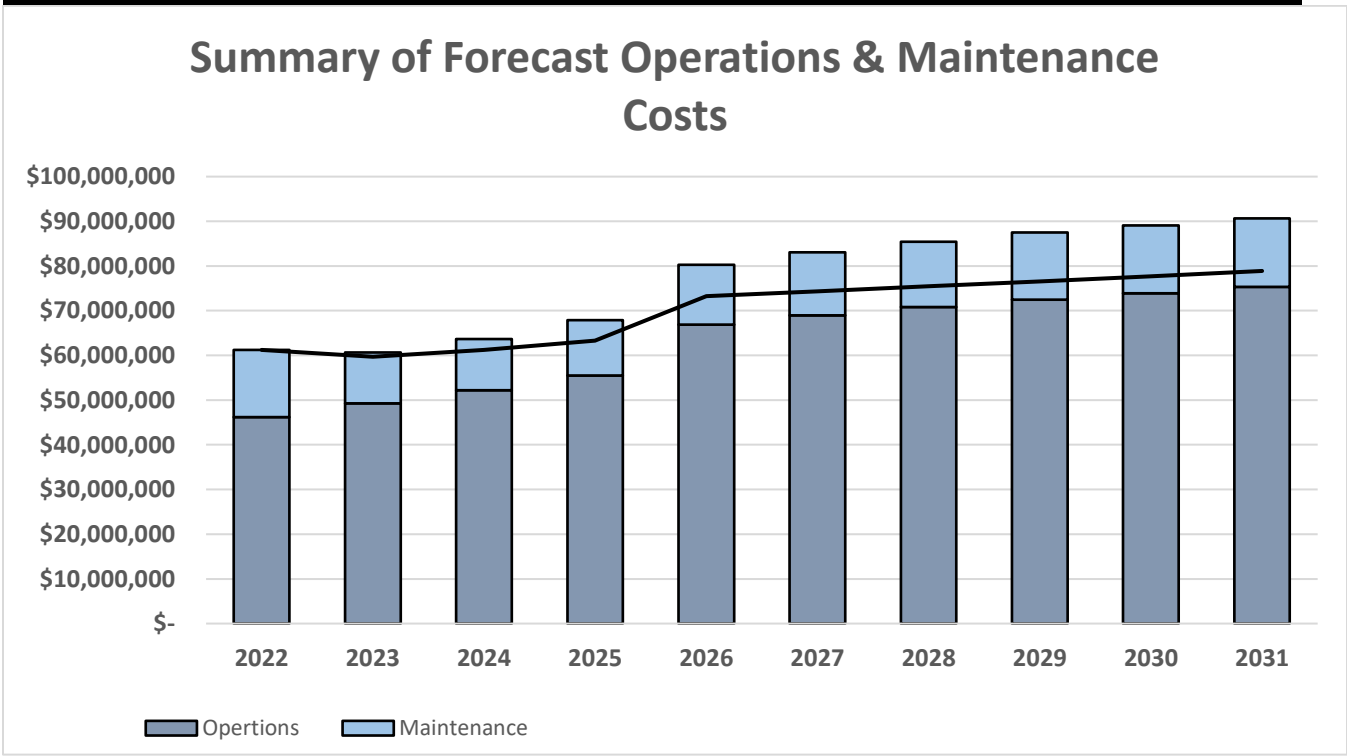
ASSET	LIFECYCLE STAGE	LIFECYCLE ACTIVITY	FREQUENCY	2021 COST	UNIT
Watermain	Operation	Flushing	Annual	$59.00	per unit
	Maintenance	Repair Program	Ad Hoc	$10,000	per unit
Water Service	Operation	Inspection	Ad Hoc	$59.00	per unit
	Maintenance	Repair Program	Ad Hoc	$800.00	per unit
		Reactive Maintenance	Ad Hoc	$2,500	per unit
Water Meters >38mm	Operation	Testing/ Calibration	5-year cycle	$250,000	per year
	Maintenance	Repair			
Hydrants	Operation	Flushing	Annual	$59.00	per unit
		Automatic Flushing Unit Inspection	Biannual	$118.00	per unit
		Hydrant Flow	3 year cycle	$195,000.00	per year
		Hydrant Code	Annually	$195,000.00	per year
		Painting	Every 5 Years	$160,000.00	per year
	Maintenance	Repair Program	Ad Hoc	$1,000.00	per unit
		Reactive Maintenance	Ad Hoc	$9,000.00	per unit
Valves	Operation	Exercising & Inspection <400mm	3 year cycle	$59.00	per unit

Figure 16: Linear - Operations and Maintenance Summary

ASSET	LIFECYCLE STAGE	LIFECYCLE ACTIVITY	FREQUENCY	2021 COST	UNIT
		Exercising & Inspection >400mm	Annually	$59.00	per unit
	Maintenance	Repair Program	Ad Hoc	$500.00	per unit
		Reactive Maintenance (<400mm)	Ad Hoc	$8,000.00	Per Unit

Forecast operations and maintenance costs vary in relation to the total value of the asset registry. When additional assets are acquired, the future operations and maintenance costs are forecast to increase. When assets are disposed of the forecast operation and maintenance costs are reduced. Figure 8 shows the forecast operations and maintenance costs relative to the proposed operations and maintenance Planned Budget.

Figure 8: Summary of Forecast Operations and Maintenance Costs



The forecast of operations and maintenance costs are increasing steadily over time and it is clear, the City has insufficient budget to achieve all of the works required to ensure that assets will be able to achieve their estimated service life at the desired level of service. It is anticipated that at the current budget levels there will be insufficient budget to address all operating and maintenance needs over the 10-year planning horizon. The graph above illustrates that without increased funding or changes to lifecycle activities there is a significant shortage of funding which will lead to:

- Higher cost reactive maintenance;
- Possible reduction to the availability of the assets;
- Impacts to private property; and,
- Increased financial and reputational risk.

The shortfall is primarily due to the significant number of assets that are donated through subdivision agreements annually and insufficient funding allocations over an extended period of time. Every year that Hamilton adds additional assets without properly funding the necessary lifecycle activities, staff's ability to sustain the assets to expected or mandatory level of service can be significantly impacted. It should be noted that there are mandatory operational and maintenance expenditures due to legislative requirements and cannot and should not simply be avoided or deferred.

The forecast costs include all costs from both the Capital and Operating budget. Asset management focuses on how taxpayer or ratepayer dollars are invested by lifecycle activities and not by budget allocation since both budgets contain various lifecycle activities, they must both be consolidated for the AM Plans.

As the City continues to develop condition profiles and necessary works are identified based on their condition, it is anticipated operation and maintenance forecasts will increase significantly. Where budget allocations will result in a lesser level of service, the service consequences and risks will be identified and are highlighted in the Risk Section 2.6.

Deferred maintenance (i.e. works that are identified for maintenance activities but unable to be completed due to available resources) will be included in the infrastructure risk management plan for the next iteration.

Future iterations of this plan will provide a much more thorough analysis of operations and maintenance costs including types of expenditures for training, mandatory certifications, insurance, staffing costs and requirements, equipment and maintenance activities.

2.2.5 Renewal Plan

Renewal is major works which does not increase the assets design capacity but restores, rehabilitates, replaces or renews an existing asset to its original service potential. Works over and above restoring an asset to original service potential is considered to be an acquisition resulting in additional future operations and maintenance costs.

Asset renewals are typically undertaken to either ensure the assets reliability or quality will meet the service requirements set out by the City. Renewal projects are often triggered by service quality failure and can often be prioritized by those that have the highest consequence of failure, have high usage, have high operational and maintenance costs and other deciding factors.

The typical useful lives of assets used to develop projected asset renewal forecasts are shown in Table 17 and are based on estimated design life for this iteration. Future iterations of the plan will focus on the Lifecycle approach to ESL which can vary greatly from design life. Asset useful lives were last reviewed in 2022 however they will be reviewed annually until their accuracy reflects the City's current practices.

TABLE 17: Useful Life of Assets

ASSET (SUB)CATEGORY	EXPECTED USEFUL LIFE
Water Mains	80
Hydrants	50
Services	80
Booster Stations	60
Water Treatment Plant	60
Sampling Stations	50
Water Towers	50
SCADA System	15
Water Meters	25
Wells	75
Well Pumping Stations	60
Valves	80
Vehicles	7 or 8

The estimates for renewals in this AM Plan were based on the register method which utilizes the detailed listing of Hamilton's asset inventory and all available lifecycle information to determine the optimal timing for renewals.

RENEWAL RANKING CRITERIA

Asset renewal is typically undertaken to either:

- Ensure the reliability of the existing infrastructure to deliver the service it was constructed to facilitate (e.g. replacing a bridge that has a load limit); or,
- To ensure the infrastructure is of sufficient quality to meet the service requirements (e.g. condition of a culvert).[1]

Future methodologies will be developed to optimize and prioritize renewals by identifying assets or asset groups that:

- Have a high consequence of failure;
- Have high use and subsequent impact on users would be significant;
- Have higher than expected operational or maintenance costs; and,
- Have potential to reduce life cycle costs by replacement with a modern equivalent asset that would provide the equivalent service.[2]

The ranking criteria used to determine priority of identified renewal proposals is detailed in Table 18.

TABLE 18: Renewal Priority Ranking Criteria

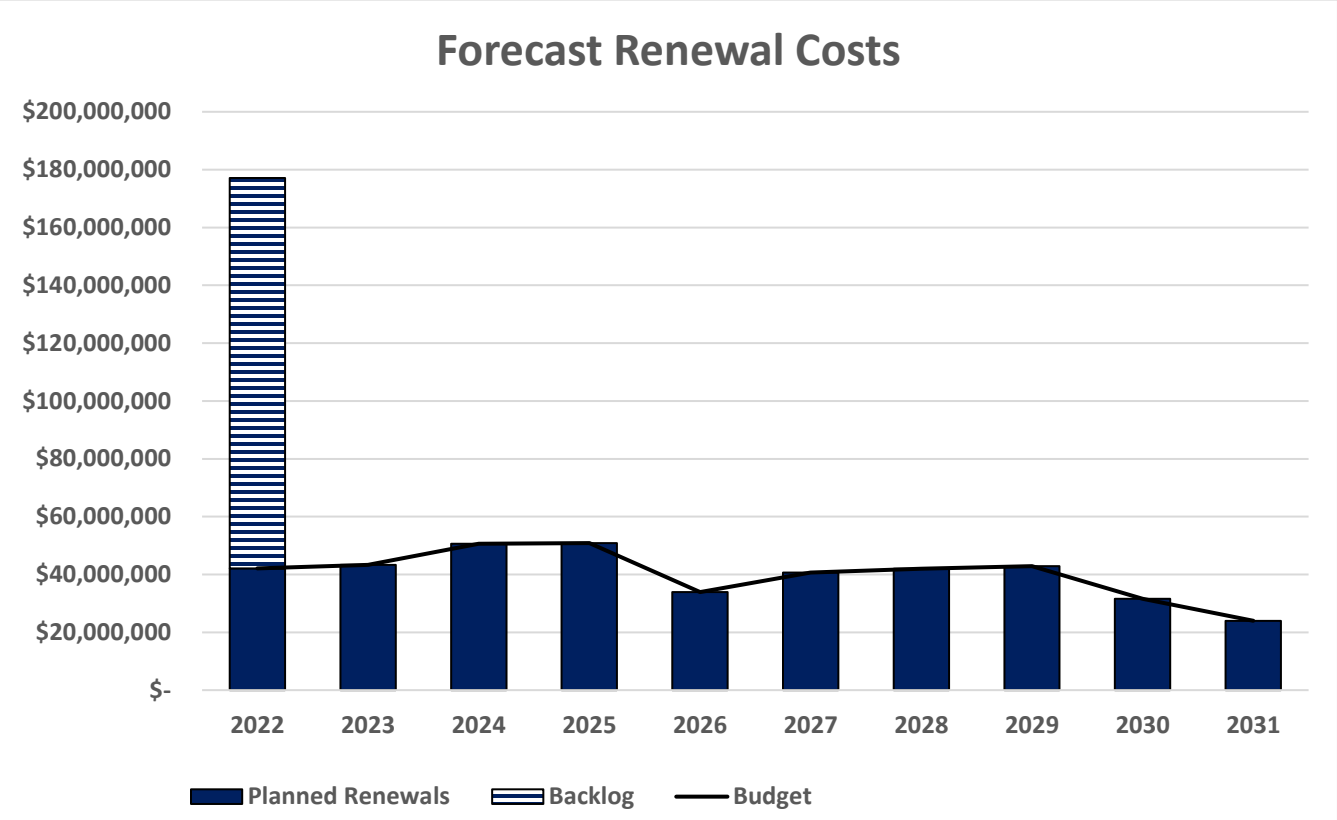
CRITERIA	WEIGHTING
Regulatory / Legal Compliance	20%
Co-ordination – Funding and Budgeting	25%
Risk Mitigation	25%
Health & Safety (Users & Staff)	10%
Lifecycle Impacts (Operations & Maintenance)	10%
Demand Driver (Growth)	10%
Total	**100%**

SUMMARY OF FUTURE RENEWAL COSTS

Forecast renewal costs are projected to increase over time if the asset stock increases. The forecast costs associated with renewals are shown relative to the proposed renewal budget in Figure 19.

[1] IPWEA, 2015, IIMM, Sec 3.4.4, p 3|91.
[2] Based on IPWEA, 2015, IIMM, Sec 3.4.5, p 3|97.

Figure 19: Forecast Renewal Costs
All figure values are shown in 2021 dollars.



The significant amount highlighted in 2022 represents the cumulative backlog of deferred work to be completed that has been either identified through its current estimated condition or age per Table 9 when condition was not available. Deferred renewal (assets identified for renewal and not scheduled) are included and identified within the risk management plan. Prioritization of these projects will need to be managed over time to ensure these can be addressed and that future renewals can occur at the optimal time.

There is only sufficient budget to support the planned projects at this time and without additional funding the backlog will remain and future projects outside of the 10-year planning horizon will continue to move forward into the 10-year scope. Continued deferrals of projects will lead to significantly higher operational and maintenance costs and will affect the availability of services in the future.

Forecasted renewals over the ten (10) – year planning horizon include select watermain replacements, water treatment plant renewals and water meter replacements. In 2022 the City will invest nearly $43.0 million to renewal assets such as **$5.3 million** for watermain structural relining, **$4.3 million** for water meter renewals and over **$7.1 million** for watermain renewals in sections of Burlington road, Concession & Mountain Brow and various other locations. In 2023 the City will invest **$43.3 million** to renew assets such as **$6.2 million** for watermain relining, **$10.0 million** renewing watermain along Barton from Sherman to Ottawa and an additional **$4.3 million** in water meter replacements. In 2024, the City will invest nearly **$15.6 million** in

watermain renewals with **$6.0 million** of that being allocated to Upper Centennial from Rymal to Mud. It will also invest **$6.4 million** to renew the Chlorine Chemical Building at the Water treatment plant.

Other major renewals over the 10 year planning horizon includes over **$200** Million of renewal initiatives at the water treatment plant as well as plant works at 2 booster stations, annual watermain lining, valve replacements, SCADA Components, lab improvements as and focused work on multiple reservoirs.

Deferring renewals create risks of higher financial costs, decreased availability, and decreased satisfaction with asset performance. Ultimately, continuously deferring renewals works ensures Hamilton will not achieve intergenerational equality. If Hamilton continues to push out necessary renewals, there is a high risk that future generations will be unable to maintain the level of service the customers currently enjoy. It will burden future generations with such significant costs that inevitably they will be unable to sustain them.

Properly funded and timely renewals will ensure the assets perform as expected and it is recommended to continue to analyze asset renewals based on criticality and availability of funds for future AM Plans.

2.2.6 Disposal Plan

Disposal includes any activity associated with the disposal of a decommissioned asset including sale, possible closure of service, decommissioning, disposal of asset materials, or relocation. Disposals will occur when an asset reaches the end of its useful life. The end of its useful life can be determined by factors such as excessive operation and maintenance costs, regulatory changes, obsolesce or demand for the structure has fallen.

Assets identified for possible decommissioning and disposal are shown in Table 20. A summary of the disposal costs and estimated reductions in annual operations and maintenance of disposing of the assets are also outlined in Table 20. Any costs or revenue gained from asset disposals is included in future iterations of the plan and the long-term financial plan.

TABLE 20: Assets Identified for Disposal

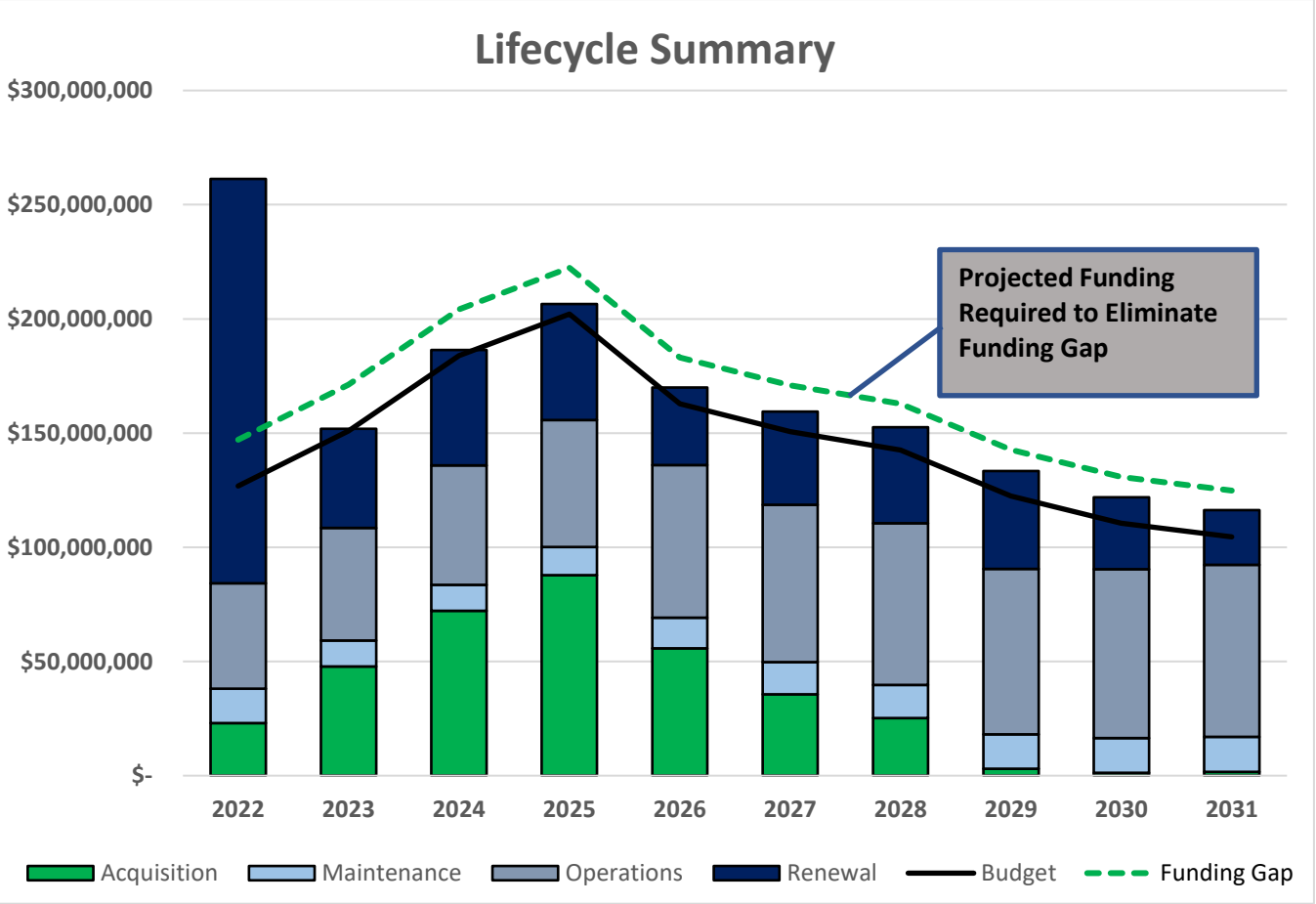
ASSET	REASON FOR DISPOSAL	TIMING	DISPOSAL COSTS	OPERATIONS & MAINTENANCE ANNUAL SAVINGS
Chlorine Building	End of Life	2028	$500,000	Undetermined
Greenhill Booster Station	End of Life	2029-2030	$800,000	Undetermined

SUMMARY OF ASSET FORECAST COSTS

The financial projections from this AM Plan are shown in Figure 9. These projections include forecast costs for acquisition, operation, maintenance, renewal, and disposal. These forecast costs are shown relative to the proposed budget.

The bars in the graphs represent the forecast costs needed to minimize the life cycle costs associated with the service provision. The proposed budget line indicates the estimate of available funding. The gap between the forecast work and the proposed budget is the basis of the discussion on achieving balance between costs, levels of service and risk to achieve the best value outcome.

Figure 9: Lifecycle Summary
All figure values are shown in 2021 dollars.



Currently there is insufficient budget to address the large backlog of renewal work projected by the plan. There is sufficient budget to address ongoing operational and maintenance needs for most of the planning period however with the assumption of assets over time and their increased costs there may be impacts to the service itself as illustrated by Figure 9. Without some adjustment to available funds or other lifecycle management decisions there will be insufficient budget to address all planned lifecycle activities.

Allocating sufficient resources is imperative to managing asset throughout their lifecycle. This can include funding for lifecycle activities, sufficient staffing, increased asset knowledge, improved planning, contracted services, additional equipment or vehicles to ensure that Hamilton is optimizing its lifecycle approach.

Without sufficient funding the City has little option but to defer these necessary lifecycle activities. Deferring important lifecycle activities is never recommended. The City will benefit from allocating sufficient resources to developing its long-term financial plan to ensure that over time the City can fully fund the necessary lifecycle activities. Funding these activities helps to ensure the assets are compliant, safe and effectively deliver the service the customers need and desire.

The lack of funding allocated for the backlog of renewals and the necessary lifecycle activities creates an additional issue which is intergenerational equity. Each year the City defers necessary lifecycle activities it pushes the ever-increasing financial burden on to future generations. It is imperative the City begin addressing the lack of consistent and necessary funding to ensure that intergenerational equity will be achieved. Over time, allocating sufficient funding on a consistent basis ensures that future generations will be able to enjoy the same standards being enjoyed today.

Over time the City will continue to improve its lifecycle data, and this will allow for informed choices as how best to mitigate those impacts and how to address the funding gap itself. This gap in funding future plans will be refined over the next 3 years and improve the confidence and accuracy of the forecasts.

2.3 MANDATORY O. REG. 588/17 LEVELS OF SERVICE

As previously mentioned, the City is developing this AM Plan to be in accordance with O.Reg 588/17 requirements. Table 1 in O.Reg. 588/17 identifies specific metrics that must be reported in the AM Plan for water assets. These metrics are required to be reported and have been separated from the municipally defined levels of service described in Section 2.4. These metrics are divided into community and technical levels of service and are detailed below.

2.3.1 Mandatory O. Reg. 588/*17* Community Levels of Service

Per Table 1 in O. Reg. 588/17, there are community levels of service that the City is required to report on in order to meet the provincial level of service requirement. These metrics are required to be reported, and so they have been separated from the customer levels of service described in Section 2.4.2. These qualitative metrics are reported below.

Scope

1. Description, which may include maps, of the user groups or areas of the municipality that are connected to the municipal water system.

Most properties within the City's urban area are connected to the municipal drinking water system. These urban properties include residential, industrial, commercial and institutional uses. Communities not within the urban area may be part of a water system with a communal well or may use their own private well.

As stated in Section 2.1, the City currently operates and maintains five (5) different drinking water systems. The largest system is the the Hamilton drinking water system which is made up of two subsystems; Woodward and Fifty Road. The Woodward subsystem draws its water from Lake Ontario and serves the majority of the the City's population, and the Fifty Road subsystem distributes water from the Town of Grimsby. In addition, there are four (4) systems which draw water from the ground using drinking water wells. A map of the subsystems can be found in MAP 1.

2. Description, which may include maps, of the user groups or areas of the municipality that have fire flow.

Most properties within the City's urban area are connected to the Hamilton drinking water system which includes fire flow. Urban properties include residential, industrial, commercial and institutional uses. It is important to note that there are areas where fire flow deficiencies may exist within the urban system which will be investigated in future iterations of this AM Plan.

Rural areas in the City which are not part of the Hamilton system typically do not have fire flow and would be serviced using rural fire fighting techniques. The Hamilton Fire Department has received "Superior Tanker Shuttle" accreditation by Fire Underwriter Survey (FUS) for the non-hydrant areas in the City, which is considered as equivalent to hydrant protection. But this will be further investigated in the future Emergency Services AM Plan.

Reliability

1. Description of boil water advisories and service interruptions.

The City did not have any boil water advisories (BWA) in 2021, however, the City did lift a longstanding drinking water advisory (DWA) in the Lynden system in 2021. The residents of Lynden had been under a precautionary drinking water advisory since September 2011 due to lead contamination from the communal well. The City drilled a new well, built a new treatment facility in Lynden which was commissioned in 2020, and completed other system improvements to the linear assets.

After the treated water from the new facility passed all required testing for a full year, City Public Health Services advised that the DWA could be lifted.

2.3.2 Mandatory O. Reg. 588/17 Technical Levels of Service

In addition, per Table 5 in O. Reg. 588/17, there are technical levels of service that the City is required to report on in order to meet the provincial level of service requirement. These quantitative metrics are reported below.

Table 21: Mandatory Technical Levels of Service

SERVICE ATTRIBUTE	TECHNICAL LEVELS OF SERVICE	MEASURE
Scope	**1**. Percentage of properties connected to the municipal water system.	90.4% of 162,308 properties
	2. Percentage of properties where fire flow is available.	89.7% of 162,308 properties
Reliability	**1**. 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.	0 connection days of 146,857 connected properties
	2. The number of connection-days* per year due to water main breaks compared to the total number of properties connected to the municipal water system.	1,305** connection days of 146,857 connected properties

*Connection-days are defined as “the number of properties connected to a municipal system that are affected by a service issue, multiplied by the number of days on which those properties are affected by the service issue”.

**261 breaks, and assumed 30 properties multiplied by 0.167 days (four (4) hours) to resolve each break

Service interruptions typically occur due to an unplanned watermain break or due to planned maintenance. Typically, these events are resolved within ten (10) hours. In addition, the City implemented a full-scale leak detection program in 2021 which proactively finds watermain leaks in the system which may not be obvious (e.g. leaks in areas with good soil drainage) and schedules these break repairs. It is estimated that this is a cost avoidance for the City of $530,000 annually in water treatment costs.

2.4 MUNICIPALLY DEFINED LEVELS OF SERVICE

Levels of service are measures for what the City provides to its customers, residents, and visitors.

Service levels are best described as the link between providing the outcomes the community desires, and the way that the City provides those services. Service levels are defined in three ways, customer values, customer levels of service and technical levels of service which are outlined in this section.

2.4.1 Customer Values

Customer values are what the customer can expect from their tax dollar in “customer speak”. These values are used to develop level of service statements.

Customer Values indicate:

- what aspects of the service is important to the customer;
- whether they see value in what is currently provided; and,
- the likely trend over time based on the current budget provision.

To develop these customer values, as stated in the AMP Overview, a Customer Engagement Survey was released in January 2022 on the Engage Hamilton platform. The survey received 184 submissions and contained 17 questions related to drinking water service delivery. The survey results can be found in Appendix “A” in the AMP Overview. While these surveys were used to establish customer values and customer performance measures, it’s important to note that the number of survey respondents only represents a small portion of the population.

The future intent is to release this survey on an annual basis to measure the trends in customer satisfaction and ensure that the City is providing the agreed level of service as well as to improve the marketing strategy to receive more responses. This has been noted in Table 32 in the Continuous Improvement section.

TABLE 22: Customer Values
SERVICE OBJECTIVE:

CUSTOMER VALUES	CUSTOMER SATISFACTION MEASURE	CURRENT FEEDBACK	EXPECTED TREND BASED ON PLANNED BUDGET
Water is safe to drink	Annual Customer Engagement Survey	Survey respondents generally feel that the water in Hamilton is somewhat safe to drink or better.	Expected to Maintain
Water looks and tastes good	Annual Customer Engagement Survey	There have been a significant portion of survey respondents who have experienced drinking water which had an unusual colour and/or odour.	Expected to Maintain
Water is available when I need it	Annual Customer Engagement Survey	The majority of survey respondents did not have an unplanned service interruption in the last year.	Expected to Maintain
Water coming out of the tap is a good pressure.	N/A	No feedback at this time via the survey, but pressure complaints were received and are documented in the technical levels of service and will be added to future surveys.	

2.4.2 Customer Levels of Service

Ultimately customer performance measures are the measures that the City will use to assess whether it is delivering the level of service the customers desire. Customer level of service measurements relate to how the customer feels about the City's water network in terms of their quality, reliability, accessibility, responsiveness, sustainability and over course, it's cost. The City will continue to measure these customer levels of service to ensure a clear understanding on how the customers feel about the services and the value for their rate dollars.

The Customer Levels of Service are considered in terms of:

Condition	How good is the service? What is the condition or quality of the service?
Function	Is it suitable for its intended purpose? Is it the right service?
Capacity/Use	Is the service over or under used? Do we need more or less of these assets?

In Table 23 under each of the service measures types (Condition, Function, Capacity/Use) there is a summary of the performance measure being used, the current performance, and the expected performance based on the current budget allocation.

Table 23: Customer Levels of Service

TYPE OF MEASURE	LEVEL OF SERVICE	SOURCE	PERFORMANCE MEASURE	CURRENT PERFORMANCE	EXPECTED TREND BASED ON PLANNED BUDGET
Condition	Provide reliable drinking water services with minimal service interruptions.	Annual Customer Engagement Survey	89.2% of survey respondents have not experienced an unplanned service interruption in the last year	Fairly Satisfied	Slight Decrease
			83.3% of survey respondents that have had an unplanned service interruption indicate the issue was resolved in a timely manner	Fairly Satisfied	Maintain Fairly Satisfied
		Confidence levels			
	Ensure water assets are kept in acceptable repair.	Condition Assessment Report	Condition of WTP	Poor	
		Confidence levels			
		Condition Assessment Report	Average condition of booster stations	Good	
		Confidence levels			
			Average condition of Wells	Fair	
		Condition Assessment Report	Average condition of Well Stations	Good	
		Confidence levels			
		Condition Assessment Report	Average Condition of Storage	Good	
		Confidence levels			
		Estimated based on age and breaks	Estimated condition of trunk watermain	Fair	
		Estimated based on age and breaks	Estimated condition of local watermain	Fair	
		Confidence levels		Medium	
		Confidence levels			
Function	Provide safe and palatable drinking water.	Annual Customer Engagement Survey	87.2% of survey respondents feel that drinking water is somewhat safe to drink or better.	Fairly Satisfied	Maintain Fairly Satisfied
			37.5% of survey respondents have a lead service or are unsure if they have a lead service.	Unsatisfied	Maintain Unsatisfied
			36.9% of survey respondents have experienced tap water that has an unusual odour and/or colour	Unsatisfied	Maintain current level
		Confidence levels			
Capacity	Ensure drinking water is accessible and the design capacity supports fire protection.	Annual Customer Engagement Survey	57.5% of survey respondents drink unfiltered tap water	Satisfied	Maintain current level
			90.8% of survey respondents are connected to Hamilton's municipal network.	High	Maintain current level
		Confidence levels			

2.4.3 Technical Levels of Service

Technical levels of service are operational or technical measures of performance, which measure how the City plans to achieve the desired customer outcomes and demonstrate effective performance, compliance and management. The metrics should demonstrate how effectively Hamilton delivers its services in alignment with its customer values; and should be viewed as possible levers to impact and influence the Customer Levels of Service. Hamilton will measure specific lifecycle activities to demonstrate how Hamilton is performing on delivering the desired level of service as well as to influence how customer perceive the services they receive from the assets.

Technical service measures are linked to the activities and annual budgets covering Acquisition, Operation, Maintenance, and Renewal.

Service and asset managers plan, implement and control technical service levels to influence the service outcomes.[3]

Table 24 shows the activities expected to be provided under the current 10 year planned budget allocation, and the forecast activity requirements being recommended in this AM Plan.

[3] IPWEA, 2015, IIMM, p 2|28.

Table 24: Technical Levels of Service

LIFECYCLE ACTIVITY	PURPOSE OF ACTIVITY	ACTIVITY MEASURE	CURRENT PERFORMANCE (2021)*	TARGET	RECOMMENDED PERFORMANCE **
Operation	Ensure water assets are kept in acceptable repair.	% Completion Flow & Code Annual Program % of plan	95%	100%	100%
		% Completion of valve inspections & exercising for annual program % of Plan	99%	100%	*100 %*
	Provide safe and palatable drinking water.	# of instances Chlorine is below/above target concentration at the WTP	8	0	0
		# of instances Fluoride is below/above target concentration at the WTP	3	0	0
		# of instances Orthophosphate is below/above target concentration at the WTP	12	0	0
		# Water Quality Complaints	558	No Data	No Data
		% of Water Quality Complaints investigated by City	100%	100%	100%
		% of Water Quality Complaints Requiring Intervention	46%	No Data	No Data
		Number Confirmed AWQIs	11	0	0
		Budget			
Maintenance	Provide reliable drinking water services with minimal service interruptions.	% of emergency above hydrant inspection / repairs completed within 15 days	100%	100%	100%
		% of scheduled above hydrant inspection / repairs completed within 45 days	98.29%	100%	100%
		% of emergency watermain repairs within 2 days	100%	100%	100%
		% of emergency valve repairs/replacement/installation/cleaning within 2 days	*100%*	100%	100%
		% of emergency water service line repairs/replacement/cleaning within 2 days	95.125%	100%	100%
		# Low pressure complaints	252	No Data	No Data
	Ensure water assets are kept in acceptable repair.	# Emergency watermain breaks	177	No Data	No Data
		# Scheduled watermain breaks	84	No Data	No Data
		Budget			
Renewal	Provide reliable drinking water services with minimal service interruptions.	% of emergency hydrant replacement within 2 days	*100*	100%	100%
		% of scheduled hydrant replacement within 70 days	79.3%	100%	100%
	Ensure water assets are kept in acceptable repair.	Length (km/yr) CIPP watermain rehabilitation	*5*	No Data	No Data
		Length (km) watermain replaced	*4*	No Data	No Data

Note: * Current activities related to Planned Budget.
***** Expected performance related to forecast lifecycle costs.***

It is important to monitor the service levels regularly as circumstances can and do change. Current performance is based on existing resource provision and work efficiencies. It is acknowledged changing circumstances such as technology and customer priorities will change over time.

At this time, many of the existing technical metrics do not have a target. These metrics should be improved to include a target to be in line with SMART objectives identified in the AMP Overview.

As the City's asset management maturity increases, and with the implementation of the EAM project mentioned in the AMP Overview in Section 7.2.3, the City will also have more capacity to measure additional metrics. In addition, the City should investigate the BIMA scorecard further to ensure data and assumptions are consistent with ministry and City reporting.

2.4.4 Level of Service Summary

At this time, the City's technical metrics for Water assets are typically based on meeting regulatory and legislative requirements include Environmental Compliance Agreements (ECAs). It is evident per Table 24 that the City is typically meeting these standards with a few exceptions. However, customer preferences and expectations do not always match minimum legislated requirements, which is discussed below. As mentioned in Section 2.4.2, while these surveys were used to establish customer values and customer performance measures, it's important to note that the number of survey respondents currently only represents a small portion of the population.

CONDITION

The majority of survey respondents had not had an unplanned service interruption, and if a service interruption did occur, they were typically satisfied with the time it took to resolve the issue. This indicates that customers are very satisfied at this time with the condition of the assets. When this is compared to the technical metrics, the City is typically meeting the targets for resolving planned and emergency interruptions within 2 days, however, typically issues are resolved with 4 hours, and so these metrics should be revised to reflect the levels of service the City is providing.

FUNCTION

The majority of survey respondents indicated that they thought the City drinking water was safe, which was considered to be very satisfied. However, some survey respondents were unsatisfied with the palatability of the water and experienced water with an unusual colour or odour. Per the technical levels of service, the City investigated 100% of the 558 water quality complaints received by residents, but only identified 11 adverse water quality incidents (ADWQIs), meaning most of these complaints were not out of compliance. The City will investigate adding additional metrics to quantify the reason for these complaints to ensure the cause for complaints is properly quantified which has been identified as a continuous improvement item in Table 32.

Some survey respondents also reported that they had lead water services, which can pose a health risk. The City has been actively contacting customers that likely have a lead service, and offers a loan program to assist customers with getting these service lines replaced, and should investigate quantifying this as a technical metric, which has been identified as a continuous improvement item in Table 32.

CAPACITY

At this time, there were not any key findings associated with the water capacity with respect to customer levels of service, but the majority of survey respondents were shown to be connected to the municipal wastewater system, which is expected.

However, the City could consider adding additional sampling stations to improve the ability to test for AWQIs throughout the water network, which has been identified as a continuous improvement item in Table 32.

2.5 FUTURE DEMAND

The ability for the City to be able to predict future demand for services enables the City to plan ahead and identify the best way of meeting the current demand while being responsive to inevitable changes in demand. Demand will inevitably change over time and will impact the needs and desires of the community in terms of the quantity of services (more communities connecting to the service) and types of service required (larger facilities to process increased volumes).

Demand is defined as the desire customers have for assets or services and that they are willing to pay for. These desires are for either new assets/services or current assets.

Since demand is not yet an extensive requirement in O.Reg 588/17 for the July 1st, 2022 deadline, this section is not as robust as some other sections of the report, but is an obligation for the report by July 1st, 2025, and will be expanded on in future iterations of the report.

2.5.1 Demand Drivers

For water, the key drivers are population change, climate change, legislative requirements and customer preferences and expectations. A future continuous improvement item is to identify additional demand drivers.

2.5.2 Demand Forecasts

The high level present position and projections for demand drivers that may impact future service delivery and use of assets have been identified and documented in Table 25. At this time, specific projections have not been calculated and will be updated in the 2025 AM Plan per the timelines stated in the AMP Overview. Growth projections have been shown in the AMP Overview.

2.5.3 Demand Impact and Demand Management Plan

The impact of demand drivers that may affect future service delivery and use of assets are shown in Table 25.

Demand for new services will be managed through a combination of managing existing assets, upgrading of existing assets and providing new assets to meet demand and demand management. Demand management practices can include non-asset solutions, insuring against risks, and managing failures.

Opportunities identified to date for demand management are shown in Table 25 while climate change adaptation is separately addressed in Table 26. Further opportunities will be developed in future revisions of this AM Plan, as identified in Table 32 in the Continuous Improvement Section.

Table 25: Demand Management Plan

DEMAND DRIVER	CURRENT POSITION	PROJECTION	IMPACT ON SERVICES	DEMAND MANAGEMENT PLAN
Population Change	573,000 (2021)	636,080 (2031)	Greater production capacity at WTP	Increase budget due to increased costs for treatment. New staff may be required for legislative compliance. Investigate possible plant upgrades where required. Adjust budgets, long-term financial plan, and AM Plan.
Population Change	573,000 (2021)	636,080 (2031)	Not enough storage to accommodate change. New storage sites may be required.	Investigate need for new water towers or reservoirs. Adjust budgets, long-term financial plan, and AM Plan
Population Change	573,000 (2021)	636,080 (2031)	More watermain required.	Investigate need for new samplings stations and storage. New staff may be required for legislative compliance. Adjust budgets, long-term financial plan, and AM Plan.
Technological Changes	Standard water meters installed.	Smart meters to be installed.	Not enough staff to accommodate change, equipment purchase is required.	New staff may be required for legislative compliance. Adjust budgets, long-term financial plan, and AM Plan.

2.5.4 Asset Programs to Meet Demand

The new assets required to meet demand may be acquired, donated or constructed. Additional assets are discussed in Section 2.2.1.

Acquiring new assets will commit the City to ongoing operations, maintenance and renewal costs for the period that the service provided from the assets is required. These future costs are identified and considered in developing forecasts of future operations, maintenance and renewal costs for inclusion in the long-term financial plan.

2.5.5 Climate Change Adaptation

The impacts of climate change may have a significant impact on the assets we manage and the services they provide. In the context of the asset management planning process, climate change can be considered as both a future demand and a risk.

Climate change impacts on assets will vary depending on the location and the type of services provided, as will the way in which those impacts are responded to and managed.[4]

As a minimum the City must consider how to manage our existing assets given potential climate change impacts for our region.

Risk and opportunities identified to date are shown in Table 4.5.1. This is a continuous process and will be updated in the 2025 AM Plan per the timelines outlined in the AMP Overview.

TABLE 26: Managing the Impact of Climate Change on Assets and Services

CLIMATE CHANGE DESCRIPTION	PROJECTED CHANGE	POTENTIAL IMPACT ON ASSETS AND SERVICES	MANAGEMENT
Global temperatures increase.	Lake Ontario's temperature will continue to increase.	More difficult for the City to maintain chlorine residuals since chlorine reacts faster at higher temperatures. Pipe corrosion increases at higher temperature.	Continue regular testing for water quality. Conduct a study to verify the optimal chlorination strategy for the Woodward subsystem.
Increased Severe Storms Causing High Lake Water Turbidity	More events or prolonged events of high turbidity raw water.	Reduced treatment capacity to ensure adequate disinfection.	Monitoring of weather forecasts and adjusting storage levels accordingly.

[4] IPWEA Practice Note 12.1 Climate Change Impacts on the Useful Life of Infrastructure

TABLE 26: Managing the Impact of Climate Change on Assets and Services			
CLIMATE CHANGE DESCRIPTION	**PROJECTED CHANGE**	**POTENTIAL IMPACT ON ASSETS AND SERVICES**	**MANAGEMENT**
			Real-time monitoring of turbidity and adjusting treatment processes accordingly. Upgrading treatment processes to more effectively treat high turbidity water.
Global Temperatures Increase	Increased internal building temperatures	Heat sensitive equipment such as VFDs at risk of damage resulting in reduced pumping capacity, increased maintenance & repair costs.	Manage HVAC to maintain acceptable temperature levels.
Global Temperatures Increase	Drought Conditions	Increase demand on water supply may impact storage levels for firefighting. Water Taking restrictions may imposed by Provincial Government.	Outdoor Water use restrictions. Expansion of treatment/supply capabilities to meet projected demands.
Increased Polar Vortex Events	Extreme Cold for Prolonged Periods of Time	Extreme cold and frost can lead to an increase of frozen water service lines and an increase in watermain breaks.	Continue to install water assets to the standard highlighted by the City of Hamilton.

Additionally, the way in which the City constructs new assets should recognize that there is opportunity to build in resilience to climate change impacts. Building resilience can have the following benefits:

- Assets will withstand the impacts of climate change;
- Services can be sustained; and
- Assets that can endure may potentially lower the lifecycle cost and reduce their carbon footprint

Table 27 summarizes some asset climate change resilience projects the City is currently pursuing.

Table 27: Building Asset Resilience to Climate Change

PROJECT	PROJECT DESCRIPTION	CLIMATE CHANGE IMPACT	BUILD RESILIENCE IN NEW WORKS
Water Distribution Leak Detection Project	Purchase of leak detection equipment. Reduction of pumping and reduction in water plan production.	Leaks in the water distribution system lead to wasted energy at the WTP which increases GHG emissions and increases draw on source water.	To increase the number of new and existing high performance state-of-the-art assets that improve energy efficiency and adapt to a changing climate.
Booster Station Upgrades	Upgrades increasing energy efficiency of equipment at various stations.	Old technology at facilities leads to wasted energy which increases GHG emissions.	To increase the number of new and existing high performance state-of-the-art buildings that improve energy efficiency and adapt to a changing climate.
New Lynden Water System	All new building, well, and reservoir including energy efficient equipment.	Old technology at facilities leads to wasted energy which increases GHG emissions.	To increase the number of new and existing high performance state-of-the-art buildings that improve energy efficiency and adapt to a changing climate.

Table 27: Building Asset Resilience to Climate Change			
PROJECT	**PROJECT DESCRIPTION**	**CLIMATE CHANGE IMPACT**	**BUILD RESILIENCE IN NEW WORKS**
Woodward Water Treatment Facility – Phase 1	Upgrades increasing energy efficiency of equipment at the WTP.	Old technology at facilities leads to wasted energy which increases GHG emissions.	To increase the number of new and existing high performance state-of-the-art buildings that improve energy efficiency and adapt to a changing climate.
AMI Implementation	Install Advanced Metering Infrastructure (AMI) technology on all water meters sized 38mm and above and all water meters located within Hamilton's well based systems.	Currently these meters are read manually which creates GHG emissions from the vehicular travel to the site. And also delays in identifying and resolving meter and billing issues.	To increase the number of new and existing high performance state-of-the-art assets that improve energy efficiency and adapt to a changing climate.
Anti-stagnation Valve Program	Implementation of anti-stagnation valves in the water distribution system to reduce flow and energy cost from the water stations. Decrease in energy consumption at water stations.	Old technology at facilities leads to wasted energy which increases GHG emissions.	To increase the number of new and existing high performance state-of-the-art assets that improve energy efficiency and adapt to a changing climate.
Service Depth Standards	New standards for service depth of frozen services from 1.6m to 1.8m this requires watermain depths to be lowered to 1.8m as well.	Climate change will increase extreme weather causing colder climates which means more watermain breaks due to colder temps.	To improve Hamilton's climate resiliency by decreasing our vulnerability to extreme weather, minimizing future damages, take advantage of opportunities, and better recover from future damages.

Table 27: Building Asset Resilience to Climate Change			
PROJECT	**PROJECT DESCRIPTION**	**CLIMATE CHANGE IMPACT**	**BUILD RESILIENCE IN NEW WORKS**
Children's Water Festival	Support and Coordination of the annual Children's Water Festival. Educate children about importance of water quality and conservation.	The City is a steward of the infrastructure built and needs to ensure future generations are educated about climate change's effects on our infrastructure.	To ensure all our work promotes equity, diversity, health and inclusion and improves collaboration and consultation with all marginalized groups, including local Indigenous Peoples.
Master Plan Update	Identify infrastructure needs related to growth. Guiding policy item related to GHG emission reduction.	The City is a steward of the infrastructure built and needs to ensure future generations are educated about climate change's effects on our infrastructure.	To improve Hamilton's climate resiliency by decreasing our vulnerability to extreme weather, minimizing future damages, take advantage of opportunities, and better recover from future damages.

The impact of climate change on assets is a new and complex discussion and further opportunities will be developed in future revisions of this AM Plan.

2.6 RISK MANAGEMENT

The purpose of infrastructure risk management is to document the findings and recommendations resulting from the periodic identification, assessment and treatment of risks associated with providing services from infrastructure, using the fundamentals of International Standard ISO 31000:2018 Risk management – Principles and guidelines.

Risk Management is defined in ISO 31000:2018 as: 'coordinated activities to direct and control with regard to risk[5].

The City is developing and implementing a formalized risk assessment process to identify risk associated with service delivery and to implement proactive strategies to mitigate risk to tolerable levels. The risk assessment process identifies credible risks associated with service delivery and will identify risks that will result in loss or reduction in service, personal injury, environmental impacts, a 'financial shock', reputational impacts, or other consequences.

The risk assessment process identifies credible risks, the likelihood of those risks occurring, and the consequences should the event occur. The City is further developing its risk assessment maturity with the inclusion of a risk rating, evaluation of the risks and development of a risk treatment plan for those risks that are deemed to be non-acceptable in the next iteration of the plan.

2.6.1 Critical Assets

Critical assets are defined as those which have a high consequence of failure causing significant loss or reduction of service. Critical assets have been identified and along with their typical failure mode, and the impact on service delivery, are summarized in Table 28. Failure modes may include physical failure, collapse or essential service interruption.

Table 28: Critical Assets

Critical Asset(s)	Failure Mode	Impact
Water Treatment Plant	Essential Service Interruption	Water not available for customers.
Wells/Reservoirs	Contamination	Water not available for customers. Boil or drinking water advisory may be issued.
Well & Booster Stations	Essential Service Interruption	Water not available for customers.
Critical Trunk Watermain	Essential Service Interruption / Surrounding asset damage	Water not available for customers, and critical route disrupted.

[5] ISO 31000:2009, p 2

Table 28: Critical Assets		
Critical Asset(s)	**Failure Mode**	**Impact**
SCADA	System failure	Water not available for customers.

By identifying critical assets and failure modes the City can ensure that investigative activities, condition inspection programs, maintenance and capital expenditure plans are targeted at critical assets.

2.6.2 Risk Assessment

The risk assessment process identifies credible risks, the likelihood of the risk event occurring, the consequences should the event occur, development of a risk rating, evaluation of the risk and development of a risk treatment plan for non-acceptable risks.

An assessment of risks associated with service delivery will identify risks that will result in loss or reduction in service, personal injury, environmental impacts, a 'financial shock', reputational impacts, or other consequences.

Critical risks are those assessed with 'Very High' (requiring immediate corrective action) and 'High' (requiring corrective action) risk ratings identified in the Infrastructure Risk Management Plan. The residual risk and treatment costs of implementing the selected treatment plan is shown in Table 6.2. It is essential that these critical risks and costs are reported to management. Additional risks will be developed in future iterations of the plan and is identified in Table 32 in the Continuous Improvement Section of the plan.

TABLE 29: Risks and Existing Controls			
SERVICE OR ASSET AT RISK	**WHAT CAN HAPPEN**	**RISK RATING**	**EXISTING CONTROLS**
Booster Station	Power failure at station causing service interruption.	Very High	Back-up generators installed at stations, or capability for a mobile generator to provide back-up power. Routine maintenance on electrical switchgear and load testing of generator.
Well Station	Equipment failure causing service interruption or contamination.	Very High	Regular station checks and verification by operators.
Critical Trunk Watermain	Breakage	High	Condition Assessment. Construction Controls. Pump control.
Reservoir	Contamination	High	Routine cleaning and internal inspections. Soil Testing. Water Quality Testing.
SCADA	Cyber attack	Very High	Weekly, monthly checks. IT Security protection.
Service Pipes	Lead contamination	High	Lead sampling program with accompanying service pipe replacements and orthophosphate treatment for corrosion control.

2.6.3 Infrastructure Resilience Approach

The resilience of our critical infrastructure is vital to the ongoing provision of services to customers. To adapt to changing conditions, the City needs to understand its capacity to 'withstand a given level of stress or demand', and to respond to possible disruptions to ensure continuity of service.

Resilience has been considered within the planning, operations, and maintenance programs for the City's water systems for more than two decades. Resilience is a consideration in the Master Planning process for the water system, within project staging and construction approvals, and within operations and maintenance programs. Staff are well trained and standard operating procedures are in place to mitigate service disruptions and significant emergencies. An example would be how Water assets operate during their peak usage. We do not currently measure our resilience in service delivery and will be included in the next iteration of the AM Plan.

Resilience covers the capacity of the City to withstand any service disruptions, act appropriately and effectively in a crisis, absorb shocks and disturbances as well as adapting to ever changing conditions. Resilience is built on aspects such as response and recovery planning, financial capacity, climate change risk assessment and crisis leadership.

2.6.4 Service and Risk Trade-Offs

The decisions made in AM Plans are based on the objective to achieve the optimum benefits from the available resources. At this time, the City does not have sufficient data to present risks and tradeoffs. This information will be presented in the 2025 AM Plan regarding Proposed Levels of Service per the timelines outlined in the AMP Overview.

2.7 FINANCIAL SUMMARY

This section contains the financial requirements resulting from the information presented in the previous sections of this AM Plan. Effective asset and financial management will enable the City to ensure its water network provides the appropriate level of service for the City to achieve its goals and objectives. Reporting to stakeholders on service and financial performance ensures the City is transparently fulfilling its stewardship accountabilities.

Due to legislative requirements, Hamilton Water has an existing long-term financial plan that has been the basis for its capital programming and outline some operational needs. AM will seek to improve on existing data and ensure it aligns to the Asset Management Plan. Long-Term financial planning (LTFP) is critical for the City to ensure the networks lifecycle activities such as renewals, operations, maintenance and acquisitions can happen at the optimal time. The City is under increasing pressure to meet the wants and needs of its customers while keeping costs at an affordable level and maintaining its financial sustainability.

Without funding asset activities properly for its water network; the City will have difficult choices to make in the future which will include options such as higher cost reactive maintenance and operational costs, reduction of service and potential reputational damage.

The City will be seeking to incorporate its water network asset planning into a corporate wide LTFP. Aligning the LTFP with the AM Plan is critical to ensure the all of the networks needs will be met while the City is finalizing a clear financial strategy with measurable financial targets. The financial projections will be improved as the discussion on desired levels of service and asset performance matures.

2.7.1 Sustainability of Service Delivery

There are two key indicators of sustainable service delivery that are considered in the AM Plan for this service area. The two (2) indicators are the:

- asset renewal funding ratio (proposed renewal budget for the next ten (10) – years / forecast renewal costs for next ten (10) – years); and,
- medium term forecast costs/proposed budget (over ten (10) – years of the planning period).

ASSET RENEWAL FUNDING RATIO

Asset Renewal Funding Ratio[6] **74.86%**

The Asset Renewal Funding Ratio is used to determine if the City is accommodating asset renewals in an **optimal** and **cost effective** manner from a timing perspective and relative

[6] AIFMM, 2015, Version 1.0, Financial Sustainability Indicator 3, Sec 2.6, p 9.

to financial constraints, the risk the City is prepared to accept and service levels it wishes to maintain. Ideally the target renewal funding ratio should be between **90% - 110%** over the entire planning period. A low indicator result generally indicates that service levels are achievable however the expenditures are below this level because the City is challenged to fund the necessary work or has historical preferences or constraints that prevent Hamilton from utilizing additional debt.

Over the next ten (10) years the City expects to have **74.86%** of the funds required for the optimal renewal of assets. By only having sufficient funding to renew **74.86%** of the required assets in the appropriate timing it will inevitably require difficult trade off choices that could include;

- a reduction of the level of service and availability of assets;
- increased complaints and reduced customer satisfaction;
- increased reactive maintenance and renewal costs; and,
- damage to the City's reputation and risk of fines or legal costs.

The lack of renewal resources has been noted in previous reports and plans and will also be addressed in future AM Plan's while aligning the plan to the LTFP. This will allow staff to develop options and long-term strategies to address the renewal rate. The City will review its renewal allocations once the entire inventory has been confirmed and amalgamated.

MEDIUM TERM – TEN (10) – YEAR FINANCIAL PLANNING PERIOD

This AM Plan identifies the forecast operations, maintenance and renewal costs required to provide an agreed level of service to the community over a 10 year period. This provides input into 10 year financial and funding plans aimed at providing the required services in a sustainable manner. As the City continues to develop condition profiles and necessary works are identified based on their condition, it is anticipated operation and maintenance forecasts will increase significantly.

This forecast work can be compared to the proposed budget over the first 10 years of the planning period to identify any funding shortfall.

The forecast operations, maintenance and renewal costs over the 10 year planning period is **$130,654,616** on average per year.

The proposed (budget) operations, maintenance and renewal funding is **$110,381,096** on average per year giving a ten (10) – year funding shortfall of **$20,273,520** per year or **$202,735,200 in total** over the ten (10) – year planning period. This indicates that **84.48%** of the forecast costs needed to provide the services documented in this AM Plan are accommodated in the proposed budget. Note, these calculations exclude acquired assets.

Funding an annual funding shortfall or funding 'gap' of **$20,273,520** per year cannot be addressed in a single year and has not been incorporated as identified within this plan into any existing plan or budget. The gap will require vetting, planning and resources to begin to incorporate gap management into the future budgets. This gap will need to be

managed over time to reduce it in a sustainable manner and limit financial shock to customers. Options for managing the gap include;

- Financing strategies – increased funding, block funding for specific lifecycle activities, long term debt utilization
- Adjustments to lifecycle activities – increase/decrease maintenance or operations, increase/decrease frequency of renewals, limit acquisitions or dispose of underutilized assets
- Influence level of service expectations or demand drivers

These options and others will allow Hamilton to ensure the gap is managed appropriately and ensure the level of service outcomes the customers desire.

Providing sustainable services from infrastructure requires the management of service levels, risks, forecast outlays and financing to achieve a financial indicator of approximately 1.0 for the first years of the AM Plan and ideally over the 10 year life of the Long-Term Financial Plan.

2.7.2 Forecast Costs (Outlays) For the Long-Term Financial Plan

Table 30 shows the forecast costs (outlays) required for consideration in the 10 year long-term financial plan.

Providing services in a financially sustainable manner requires a balance between the forecast outlays required to deliver the agreed service levels with the planned budget allocations in the operational and capital budget. The City will begin developing its long-term financial plan (LTFP) to incorporate both the operational and capital budget information and help align the LTFP to the AM Plan which is critical for effective asset management planning.

A gap between the recommended forecast outlays and the amounts allocated in the operational and capital budgets indicates further work is required on reviewing service levels in the AM Plan.

The City will manage the ‘gap’ by continuing to develop this AM Plan to provide guidance on future service levels and resources required to provide these services in consultation with the community. Options to manage the gap include reduction and closure of low use assets, increased funding allocations, reduce the expected level of service, utilize debt based funding over the long term, adjustments to lifecycle activities, improved renewals and multiple other options or combinations of options. These options will be explored in the next AM Plan and the City will provide analysis and options for Council to consider going forward.

Table 30: Forecast Costs (Outlays) for the Long-Term Financial Plan
Forecast Costs are shown in 2021 Dollar Values

YEAR	ACQUISITION	OPERATION	MAINTENANCE	RENEWAL	DISPOSAL	TOTAL
2022	$23,015,000	$46,185,012	$15,045,000	$42,105,000	$440,000	$126,790,016
2023	$47,855,000	$48,752,168	$10,950,000	$43,340,000	0	$150,897,168
2024	$72,142,496	$50,768,096	$10,450,000	$50,620,000	0	$183,980,592
2025	$87,788,000	$52,865,984	$10,450,000	$50,860,000	$150,000	$202,113,984
2026	$55,728,000	$62,828,804	$10,450,000	$33,889,540	0	$162,896,352
2027	$35,568,000	$63,907,272	$10,450,000	$40,709,632	0	$150,634,912
2028	$25,143,000	$65,007,304	$10,450,000	$42,029,792	0	$142,630,096
2029	$3,007,667	$66,129,344	$10,450,000	$42,894,000	0	$122,481,008
2030	$1,232,667	$67,273,816	$10,450,000	$31,609,000	0	$110,565,480
2031	$1,664,167	$68,441,184	$10,450,000	$23,999,990	0	$104,555,344

2.7.3 Funding Strategy

The proposed funding for assets is outlined in the City's operational budget and ten (10) – year capital budget.

These operational and capital budgets determine how funding will be provided, whereas the AM Plan typically communicates how and when this will be spent, along with the service and risk consequences. Future iterations of the AM Plan will provide service delivery options and alternatives to optimize limited financial resources.

2.7.4 Valuation Forecasts

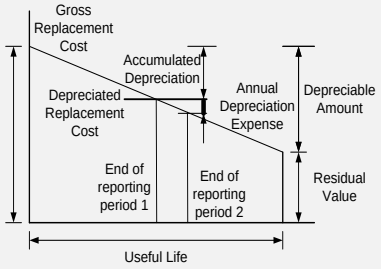
Asset values are forecast to increase as projections improve and can be validated as market pricing. The net valuations will increase significantly despite some assets being programmed for disposal that will be removed from the register over the ten (10) – year planning horizon.

Any additional assets will add to the operations and maintenance needs in the longer term and would also require additional costs due to future renewals obligations. Any additional assets will also add to future depreciation forecasts. Any disposals of assets would decrease the operations and maintenance needs in the longer term and removes the high costs renewal obligations.

2.7.5 Asset Valuations

The best available estimate of the value of assets included in this AM Plan are shown below. The assets are valued at estimated replacement costs:

Replacement Cost (Current/Gross)	4,250,000,000
Depreciable Amount	4,250,000,000
Depreciated Replacement Cost[7]	$2,133,500,000
Depreciation	$ 52,487,500



The current replacement cost is the most common valuation approach for specialized infrastructure assets such as infrastructure water assets. The methodology includes establishing a comprehensive asset registry, assessing replacement costs (based on market pricing for the modern equivalent assets) and useful lives, determining the

[7] Also reported as Written Down Value, Carrying or Net Book Value.

appropriate depreciation method, testing for impairments, and determining remaining useful life.
As the City matures its asset data, it is highly likely that these valuations will fluctuate significantly over the next three (3) years and they should increase over time based on improved market equivalent costs.

2.7.6 Key Assumptions Made in Financial Forecasts

In compiling this AM Plan, it was necessary to make some assumptions. This section details the key assumptions made in the development of this AM Plan and should provide readers with an understanding of the level of confidence in the data behind the financial forecasts.

Key assumptions made in this AM Plan are:

- Operational forecasts are based on current budget allocations and are the basis for the projections for the 10-year horizon and do not address other operational needs not yet identified;
- Maintenance forecasts are based on current budget allocations and do not identify all asset needs at this time. It is solely based on planned activities;
- 1% p.a. has been added to maintenance forecasts to accommodate for donated assets assumed over the 10-year planning horizon;
- 1.31 % p.a has been added to operational forecasts to accommodate for donated assets assumed over the 10-year planning horizon; and,
- Replacement costs were based on historical costing and engineering estimates. They were also made without determining what the asset would be replaced with in the future.

2.7.7 Forecast Reliability and Confidence

The forecast costs, proposed budgets, and valuation projections in this AM Plan are based on the best available data. For effective asset and financial management, it is critical that the information is current and accurate. Data confidence is defined in the AMP Overview.

The estimated confidence level for and reliability of data used in this AM Plan is shown in Table 31.

Table 31: Data Confidence Assessment for Data used in AM Plan

DATA	CONFIDENCE ASSESSMENT	COMMENT
Demand drivers	Medium	Further investigation is required to better understand demand drivers
Growth projections	Medium	Current growth projections will need to be vetted an improved. Continuous improvements are required and identified
Acquisition forecast	Medium	Currently based on 2019 DC study and SME opinion. Continuous improvements are required and identified
Operation forecast	Medium	Currently budget based and requires future improvement to ensure allocation is accurate
Maintenance forecast	Medium	Currently budget based and requires future improvement to ensure allocation is accurate
Renewal forecast - Asset values	Medium	Currently budget based and requires future improvements to further identify specifi needs
- Asset useful lives	Low	Based on SME opinion. Continuous improvement required to ensure data is vetted and ensure it aligns with Hamilton's actual practices
- Condition modelling	Low	Mixture of assessment methods. Requires standardization along with predictable timelines for assessments
Disposal forecast	Low	Current disposal information is rolled into renewal. Continuous improvements are required to ensure accurate data is available.

The estimated confidence level for and reliability of data used in this AM Plan is considered to be a **Medium** confidence level.

2.8 PLAN IMPROVEMENT AND MONITORING

2.8.1 Status of Asset Management Practices[8]

ACCOUNTING AND FINANCIAL DATA SOURCES

This AM Plan utilizes accounting and financial data. The sources of the data are:

- 2022 Capital & Operating Budgets;
- 2021 Tender Documents (various);
- Asset Management Data Collection Templates;
- Audited Financial Statements and Government Reporting (FIR, TCA etc);
- Financial Exports from internal financial systems; and,
- Historical cost and estimates of budget allocation based on SME experience.

ASSET MANAGEMENT DATA SOURCES

This AM Plan also utilizes asset management data. The sources of the data are:

- Data extracts from various City applications and management software
- Asset Management Data Collection Templates;
- Tender documents, subdivision agreements and projected growth forecasts as well as internal reports;
- Condition assessments;
- Subject matter expert opinion and anecdotal information; and,
- Reports from the mandatory biennial inspection, operational & maintenance activities internal reports.

2.8.2 Improvement Plan

It is important that Hamilton recognize areas of the AM Plan and planning process that require future improvements to ensure the effective management of the water network assets and inform decision making. The tasks listed below are essential to improving the plans and Hamilton's ability to make evidence based and informed decisions. These improvements span from improved lifecycle activities, improved financial planning, improve data quality and to plans to physically improve the assets. The Improvement plan in table 32 highlights proposed improvement items that will require further discussion and analysis to determine feasibility, resource requirements and alignment to current workplans. Future iterations of this AM Plan will provide updates on these improvement plans.

[8] ISO 55000 Refers to this as the Asset Management System

Table 32: Improvement Plan
***p.a – per annum**

TASK	TASK	RESPONSIBILITY	RESOURCES REQUIRED	DRAFT TIMELINE
1	Collect and confirm data from databases before it goes into EAM including spatial referencing and possible Collector Apps.	**Hamilton Water**	**$40,000 p.a. $120,000 Total** Internal Staff Time	**3 Years** (2022-2024)
2	Develop a Long-Term Financial Plan to connect the budgeting process to the AM planning process.	**CAM, Hamilton Water, Finance**	**$15,000 p.a $60,000 Total** Internal Staff Time	**4 Years** (2022-2025)
3	Standardize condition assessments for critical watermains & establish more frequent timeline to complete.	**CAM, Infrastructure Renewal**	**$10,000** Internal Staff Time	**2 Years** (2022-2023)
4	Plan condition assessments for vertical assets on a regular cycle	**CAM, Hamilton Water**	**$11,000** Internal Staff Time	**1 Year** (2022)
5	Complete condition assessments on WTP.	**CAM, Hamilton Water**	**$250,000 Total** Internal Staff, Tender Process Specialty Assessor	**3 Years** (2022-2024)
6	Integrate collection of condition data into routine inspections for hydrants, wells and valves.	**CAM, Hamilton Water**	**$20,000** Internal Staff Time	**2 Years** (2022-2023)
7	Review & improve condition assessment assumptions for local watermain.	**CAM, Hamilton Water**	**$6,000 p.a.** Internal Staff Time	**2 Years** (2022-2023)
8	Standardize condition assessment outcomes and timed deliverables.	**CAM, Hamilton Water**	**$6,000 p.a.** Internal Staff Time	**3 Years** (2022-2024)
9	Improve annual engagement survey process to optimize engagement and respondents.	**CAM, Hamilton Water, Communications**	**$35,000** Internal Staff Time	**4 Years** (2022-2025)

Table 32: Improvement Plan
***p.a – per annum**

TASK	TASK	RESPONSIBILITY	RESOURCES REQUIRED	DRAFT TIMELINE
10	Identify additional risks and identify trade-offs for what cannot be achieved.	**CAM, Hamilton Water**	**$5,000** Internal Staff Time	**Annual**
11	Improve data confidence levels for asset register.	**CAM, Hamilton Water**	**10,000 p.a. $50,000 Total** Internal Staff Time	**5 Years** (2022-2026)
12	Improve Growth projection data and modelling for next AM Plan iteration.	**CAM, Hamilton Water, Economic Development**	**$6,000 p.a.** Internal Staff Time	**2 Years** (2022-2023)
13	Develop and implement an annual demand review process to ensure sufficient knowledge is available to inform future planning.	**CAM, Hamilton Water, Economic Development**	**$35,000 Total** Internal Staff Time	**2 Years** (2022-2023)
14	Analyze operational budget to improve AM allocations for lifecycle activities.	**CAM, Hamilton Water, Finance**	**$10,000 p.a. $30,000 Total** Internal Staff Time	**3 Years** (2022-2024)
15	Analyze maintenance activities to identify future needs and recommended actions.	**CAM, Hamilton Water,**	**$10,000 p.a. $40,000 Total** Internal Staff Time	**4 Years** (2022-2025)
16	Develop Renewal forecasting prioritization to optimize resources and ensure level of services can be maintained.	**CAM, Hamilton Water,**	**$6,000 p.a. $44,000 Total** Internal Staff Time	**4 Years** (2022-2025)
17	Review Useful Life assumptions to ensure they align with actual Hamilton practices.	**CAM, Hamilton Water,**	**$8,000 p.a. $16,000 Total** Internal Staff Time	**2 Years** (2022-2023)
18	Review disposal costs and separate from renewal costs.	**CAM, Hamilton Water,**	**$10,000 p.a. $40,000 Total** Internal Staff Time	**4 Years** (2022-2025)
19	Review BIMA Scorecard reporting and ensure data and	**CAM, Hamilton Water,**	**$2,500 p.a. $5,000 Total**	**2 Years** (2022-2023)

Table 32: Improvement Plan
***p.a – per annum**

TASK	TASK	RESPONSIBILITY	RESOURCES REQUIRED	DRAFT TIMELINE
	assumptions are consistent with ministry and City reporting and investigate additional technical metrics (e.g. water quality and lead complaints)	**Continuous Improvement**	Internal Staff Time	
20	Investigate need for additional sampling stations.	**CAM, Hamilton Water**	**$2,400 p.a. $4,800 Total** Internal Staff Time	**2 Years** (2022-2023)
21	Further develop vertical asset knowledge for future iterations of AM Plans.	**CAM, Hamilton Water,**	**$50,000 p.a. $150,000 p.a.** Internal Staff Time, Tender Process	**3 Years** (2022-2024)
22	Improve asset replacement costs by vetting with current market prices instead of historical costs/estimates or internal models.	**CAM, Hamilton Water, Finance**	**$30,000 p.a. $90,000 Total** Internal Staff Time	**3 Years** (2022-2024)
23	Identify water assets in other divisions and incorporate into next AM Plan.	**CAM, Hamilton Water,**	**$10,000 p.a. $30,000 Total** Internal Staff Time	**3 Years** (2022-2024)
24	Ensure new technical metrics are considering different lifecycle stages (e.g. acquisition, disposal)	**CAM, Hamilton Water,**	**$2,000 p.a $6.000 Total** Internal Staff Time	3 Years (2022-2024)

2.8.3 Monitoring and Review Procedures

This AM Plan will be reviewed during the annual budget planning process and revised to show any material changes in service levels, risks, forecast costs and proposed budgets as a result of budget decisions.

The AM Plan will be reviewed and updated on a regular basis to ensure it represents the current service level, asset values, forecast operations, maintenance, renewals, acquisition and asset disposal costs and planned budgets. These forecast costs and proposed budget will be incorporated into the Long-Term Financial Plan once completed.

2.8.4 Performance Measures

The effectiveness of this AM Plan can be measured in the following ways:

- The degree to which the required forecast costs identified in this AM Plan are incorporated into the long-term financial plan;
- The degree to which the 1-10 year detailed works programs, budgets, business plans and corporate structures consider the 'global' works program trends provided by the AM Plan;
- The degree to which the existing and projected service levels and service consequences, risks and residual risks are incorporated into the Strategic Planning documents and associated plans;
- The Asset Renewal Funding Ratio achieving the Organisational target (this target is often 90 – 100%).

2022
Wastewater Asset Management Plan

Hamilton

WASTEWATER SERVICE AREA

Description

The wastewater network collects wastewater from its customers across the City and conveys it for treatment before it is returned to the natural watercourse. These assets relate to the collection, transmission, treatment or disposal of wastewater, including any wastewater asset that from time to time manages stormwater.

Replacement Value $7.3 Billion

Average Asset Condition

Did You Know?

- In 2021, the Woodward and Dundas WWTPs together collected and treated approximately **76,200 ML** for **510,000** customers which is equivalent to **16 billion** toilet flushes.
- The population is expected to increase to **636,000 by 2031** and so plant upgrades are being completed to improve capacity and performance.

Critical Asset Summary

Critical Assets	Quantity	Replacement Cost	Condition	Stewardship Measures
Wastewater Treatment Plant	2	$3.2 billion	Fair	**# of bypasses at Woodward WWTP in 2021** **23**
Pump Station	71	$181.2 million	Fair	**% completed monthly inspections in 2021** **92.12%**
CSO Tanks	9	$222.9 million	Fair	**# of CSO tank overflow events in 2021** **27**
Gravity Main	1,798 km	$2.4 billion	Good	**Length of sewermain lined in 2021** **22.3 km**

Data Confidence

VERY HIGH | MEDIUM | VERY LOW

FINANCIAL FACTS

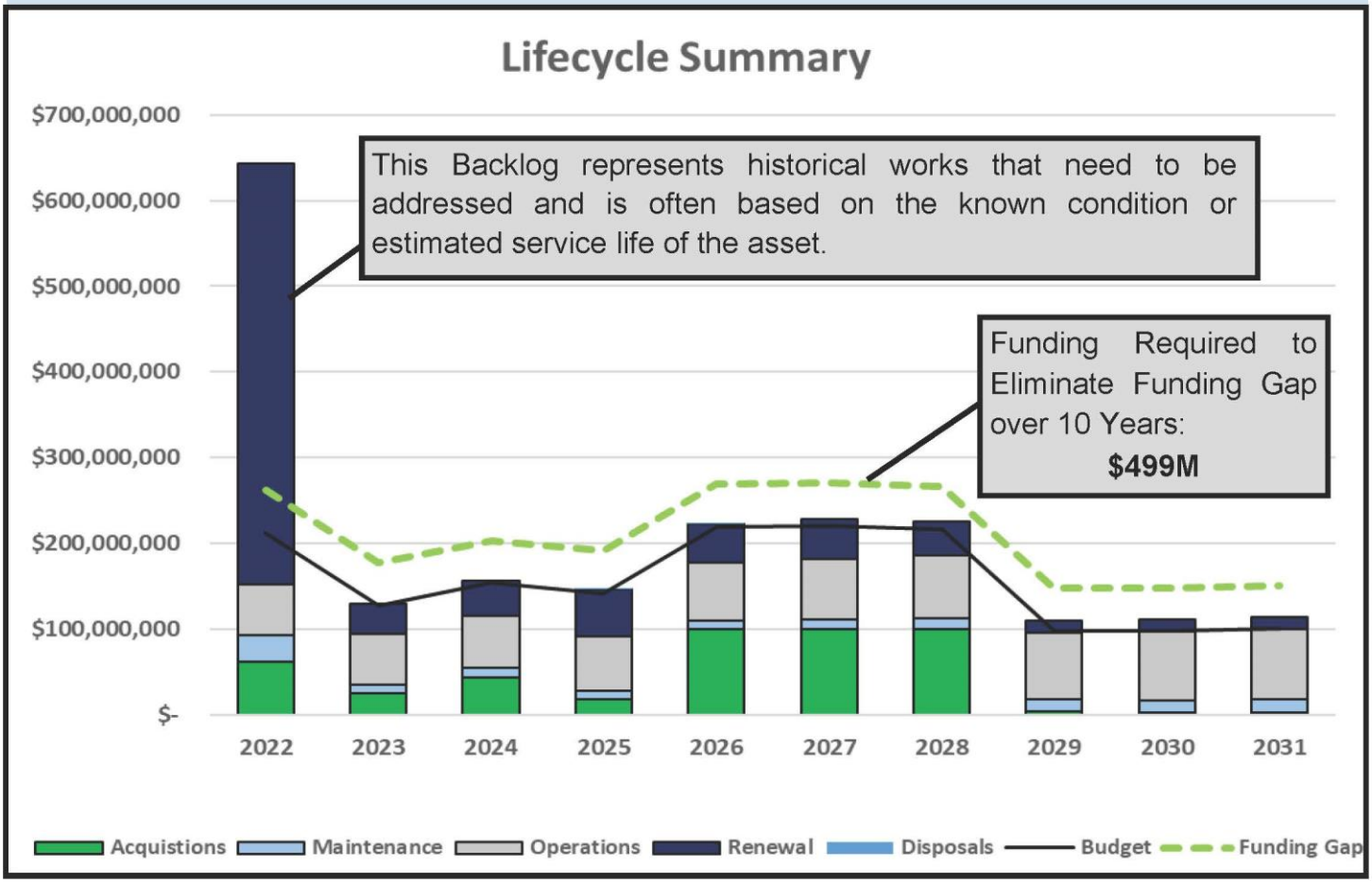
- Hamilton will receive **$440 million** dollars worth of assets over the next 10 years.
- Hamilton will invest on average **$838 million** to operate, maintain wastewater assets over the next ten years.

DID YOU KNOW?

- The City completes condition assessments on critical sewermain to reduce the chance of a critical mainline failure.
- CSO Tanks hold wastewater during heavy rain events to avoid backups and bypasses.

FINANCIAL INDICATORS

Type of Indicator	Measurement	Explanation
Asset Renewal Ratio	**45.7%**	This ratio demonstrates the rate the city renews its Wastewater Assets.
10 Year O&M Forecast	**69.4%**	The % of funding allocated compared to what needs to be spent.
Annual Infrastructure Gap	**$50 Million**	The difference between what is being spent and what should be spent.



3. WASTEWATER

3.0 WASTEWATER ASSETS

The wastewater network collects wastewater from its customers across the City and conveys it for treatment before it is returned to the natural watercourse. The service objective is to provide reliable wastewater services to its customers 24 hours a day and 7 days a week. A reliable wastewater network service provides both direct and indirect benefits ensuring good public health to the broader community.

Wastewater assets relate to the collection, transmission, treatment or disposal of wastewater, including any wastewater asset that from time to time manages stormwater. For this iteration of the AM Plan the wastewater asset hierarchy is grouped into linear and vertical assets. Vertical assets are assets that can only occupy one site and are typically within a building or a facility which may be comprised of other multiple components. Linear assets are assets which traverse horizontally and are often defined by length but also encompass components that are considered part of the linear network.

The asset class asset hierarchy outlining assets included in this section is shown below in Table 33.

Table 33: Asset Hierarchy

VERTICAL ASSETS	LINEAR ASSETS	ADMINISTRATIVE
Wastewater Treatment Plants	Combined Sewer Main	Vehicles
Combined Sewer Overflow (CSO) Tanks	Separated Gravity Sewer Main	SCADA
Lift Stations	Interceptor	
	Forcemain	
	Maintenance Hole	
	Odour Control Unit	
	Control Gates	
	Valves	
	Sewer Laterals	

1. 3.0 WASTEWATER

3.1 BACKGROUND

This AM Plan is intended to communicate the requirements for the sustainable delivery of services through the management of assets, compliance with regulatory requirements and required funding to provide the appropriate levels of service over the 2022 – 2031 planning period.

The information in the wastewater section of the plan is intended to give a snapshot in time of the current state of the wastewater service area by providing a detailed summary and analysis of existing information, and will provide the necessary background for the remainder of the report.

Due to the age of the City, significant portions (32%) of the wastewater system consist of combined sewer mains (the lower City and also on the escarpment north of Mohawk Road) as shown in Map 3. Combined sewer main refers to pipes where wastewater (sanitary) and stormwater are carried in the same pipe. The City's wastewater system is therefore more complex than many municipalities because during significant wet weather events, the City's wastewater system can reach capacity causing diluted wastewater to enter the natural watercourses through combined sewer overflows or WWTP bypasses. These wet weather events are anticipated to become more significant and frequent due to climate change as indicated in Section 3.5.5. The City has been working to reduce combined sewer overflows and WWTP bypasses for more than 30 years with total investments exceeding $550 million.

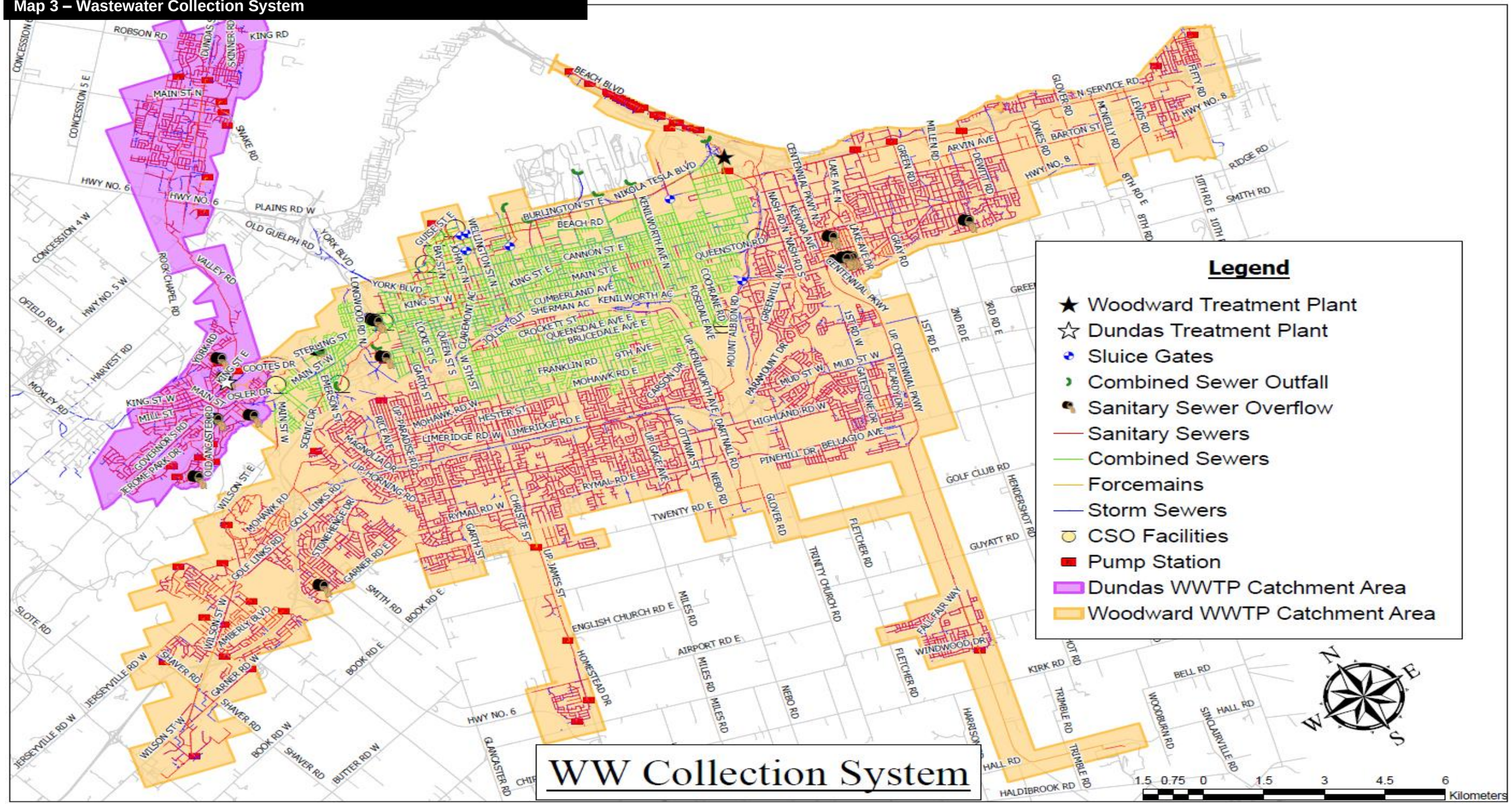
The City acquired significant amounts of wastewater network assets through amalgamation in 2001. These aging assets were included into the City's wastewater inventory and were in varied condition and held various collection capacity when acquired. Once amalgamated, any aging assets or deficient assets became the responsibility of Hamilton Water and created several new challenges that will need to be taken into consideration and planned.

The City also operates and maintains two (2) Wastewater Treatment Plants (WWTPs), Woodward and Dundas, which service different areas of the City, and are referred to as catchment areas below in Table 34 and Map 3. Map 3 also shows the locations of the major vertical assets and mains. The Woodward WWTP catchment area services the majority of the population, and the Dundas WWTP catchment services areas in Dundas and Waterdown. Residents not found on this map are typically treating wastewater on their own properties using private septic systems.

Table 34: Catchment Areas

Wastewater Catchment Area	Population Served
Woodward	465,000
Dundas	45,000

Map 3 – Wastewater Collection System



3.1.1 Detailed Summary of Assets

Table 35 below displays the detailed summary of assets for the wastewater service area. In addition, it is possible that there are assets that may not be owned by Public Works which may be considered wastewater assets which may be missing from this inventory. This has been identified as a Continuous Improvement Item in Table 58.

The City owns approximately **$7.25B** in wastewater assets which are in an average of **Fair** condition. Overall, assets are an average of **30 years** in age which indicated there is on average **34%** of remaining service life (RSL). The data below is a combination of data from various sources as there is not yet an asset registry containing all inventory information in one data source. Examples of data sources which were used for this iteration of the Core AM Plans are stated in the AMP Overview. The lack of an asset registry is a continuous improvement item in Table 58. The City must plan to complete a detailed review of this data and create data standards in order to improve overall data quality.

For most assets, Fair condition means that the City should be planning to complete minor to moderate maintenance activities to ensure the assets reach their intended useful lives since assets begin to experience deterioration affecting asset usage at this stage as indicated in Table 35.

Table 35: Detailed Summary of Assets
***Weighted Average**

Asset Category	Number of Assets	Replacement Value	Average Age (% RSL)	Average Equivalent Condition
Vertical Assets				
Wastewater Treatment Plant	2	$3.20B	66 years (0%)	3-Fair*
Data Confidence	High	Low	Medium	Low
Lift Stations	71	$181.24M	34 years (44%)	3-Fair
Data Confidence	High	Low	High	Medium
Combined System Overflow Tanks	9	$222.86M	22 years (44%)	3-Fair
Data Confidence	High	Low	High	Medium
	SUBTOTAL	**$3.604B**	**41 years (24%)**	**3-Fair***
	Data Confidence	**Low**	**High**	**Medium**
Linear Assets				
Separated Trunk Wastewater Main	217.14 km	$739.41M	39 years (60%)	2-Good
Data Confidence	High	Medium	Medium	Medium
Separated Local Wastewater Main	977.39 km	$410.21M	40 years (55%)	2-Good
Data Confidence	High	Medium	Medium	Medium
Combined Main	568.37 km	$710.86M	84 years (4%)	2-Good
Data Confidence	High	Medium	Medium	Medium
Interceptor	34.63 km	$519.38M	63 years (37%)	2-Good
Data Confidence	High	Medium	Medium	Medium
Forcemain	46.49 km	$45.24M	31 years (62%)	2-Good
Data Confidence	High	Medium	High	Low
Valves	130	$355.2K	16 years (80%)	2-Good
Data Confidence	Low	Low	High	Low
Maintenance Hole	25,897	$535.61M	54 years (33%)	3-Fair
Data Confidence	High	Low	Medium	Low
Sewer Lateral	134,202	$671.01M	13 years (78%)	2-Good
Data Confidence	Low	Low	Very Low	Very Low
Odour Control Unit	7	$525K	1 year (98%)	1-Very Good
Data Confidence	High	High	Low	Low
Control Gates	7	$350K	27 years (46%)	3-Fair
Data Confidence	High	Low	Very High	Low
	SUBTOTAL	**$3.632B**	**44 years (42%)**	**2-Good***
	Data Confidence	**Medium**	**Medium**	**Medium**
Administrative				
Vehicles	47	$2.331M	7 years (29%)	3-Fair
Data Confidence	High	High	High	Low
SCADA	N/A	$15.0M	N/A	N/A
Data Confidence	N/A	Low	N/A	N/A
	SUBTOTAL	**$17.331M**	**7 years (29%)**	**3-Fair**
	Data Confidence	**Medium**	**High**	**Low**
	TOTAL	**$7.254B**	**30 years (34%)**	**3-Fair***
	Data Confidence	**Low**	**Medium**	**Medium**

4. WASTEWATER

The City has two (2) Wastewater Treatment Plants (WWTP). The Woodward plant services the majority of the population as shown in Table 34. Both WWTPs have several complex processes that run throughout several facilities but have been simplified into two (2) assets for ease of reporting for this first iteration of the AM Plan. A Continuous Improvement item in Table 58 is to improve the reporting for the WWTP for future iterations of the AM Plan to provide more details on the specific processes it undertakes. The WWTPs are the single largest value wastewater assets in the City and has been estimated at **$3.2B** with a low data confidence level due to the complexity of the plant.

The data confidence for number of vertical assets is typically high due to the asset's locations being above ground and able to be visually confirmed easily. The confidence is not yet considered Very High due to multiple data sources which showed conflicting quantities and registry information. There has been a continuous improvement item identified to confirm data across all data sets and unify the data into a single source to reference from in the future.
Due to the lack of current data, the complexity of vertical assets and the low frequency of asset replacements, it is difficult to achieve a high data confidence for replacement cost for this iteration of the plan. Future plans will improve on the current replacement cost values, and so the data confidence is considered low for these assets. Age and condition information and data confidence is presented in Table 35.

For linear assets, the data confidence for number of assets is considered to be high because of active data management. These assets are typically more challenging to confirm as they are generally buried infrastructure that cannot simply be visually verified. Due to these limitations there are some assets such as sewer laterals where the quantities are of a lesser confidence.

Linear assets are replaced much more frequently than vertical assets and as such the replacement costs generally have a higher confidence level and are often close to the approximate market rates. However, improving asset replacement costs by updating current market prices regularly instead of historical costs/estimates or internal models has been identified as a Continuous Improvement Item in Table 58.

The City has included its administrative assets (e.g. vehicles, software, etc.) in a limited capacity for this iteration of the AM Plan so that the replacement costs are beginning to be recognized in the report. These assets contribute to the overall wastewater service however, these have not yet been completed at a detailed level and will be encompassed in more detail before the 2025 iteration of the plan. Administrative facilities are included as part of the WTP replacement cost and support the entire Waterworks Strategive Level.

Please refer to the AMP Overview for a detailed description of data confidence.

3.1.2 Asset Condition Grading

Condition refers to the physical state of the wastewater assets and are a measure of the physical integrity of these assets or components, and is the preferred measurement for planning lifecycle activities to ensure assets reach their expected useful life. Since condition scores are reported

using different scales and ranges depending on the asset, Table 36 below shows how each rating was converted to a standardized 5-point condition category so that the condition could be reported consistently across the AM Plan. A continuous improvement item identified in Table 58, is to review existing internal condition assessments and ensure they are revised to report on the same 5-point scale with equivalent descriptions.

Table 36: Condition Grading System

Equivalent Condition Grading	Condition Description	% Remaining Service Life	Combined, Wastewater & Interceptor Main	Vertical Assets Condition Rating
1-Very Good	The asset is new, recently rehabilitated, or very well maintained. Preventative maintenance required only.	>79.5%	PACP Score = 1; If PACP unknown, WRC Structural Score =1; If both unknown: RSL	1-Very Good
2-Good	The asset is adequate and has slight defects and shows signs of some deterioration that has no significant impact on asset's usage. Minor/preventative maintenance may be required.	69.5% – 79.4%	PACP Score = 2; If PACP unknown, WRC Structural Score =2 or Lined Pipe; If all unknown: RSL	2-Good
3-Fair	The asset is sound but has minor defects. Deterioration has some impact on asset's usage. Minor to significant maintenance is required.	39.5% - 69.4%	PACP Score = 3; If PACP unknown, WRC Structural Score =3; If all unknown: RSL	3-Fair
4-Poor	Asset has significant defects and deterioration. Deterioration has an impact on asset's usage. Rehabilitation or major maintenance required in the next year.	19.5% -39.4%	PACP Score = 4; If PACP unknown, WRC Structural Score =4; If all unknown: RSL	4-Poor
5-Very Poor	Asset has serious defects and deterioration. Asset is not fit for use. Urgent rehabilitation or closure required.	<19.4%	PACP Score = 5; If PACP unknown, WRC Structural Score =5; If all unknown: RSL	5-Very Poor

The following conversion assumptions were made:

- Wastewater Treatment Plant (WWTP) condition was based on subject expert opinion based on the condition descriptions provided above;
- Vertical assets' Level 2 Condition Assessments are based on a 5-point scale which was considered equivalent to the AMP 5-point scale; and
- Pipes were based on a combination of PACP and WRC scores where known, where the PACP score was prioritized over the WRC Score.
- If pipe was indicated to have been lined CIPPS, then the condition was assumed to be 2-Good.
- If PACP was unknown, and WRC score was 6, indicating an incomplete inspection, the condition was based on % of remaining service life.
- For assets where a condition assessment was not completed, but age information was known, the condition was based on the % of remaining service life.

3.1.3 Vertical

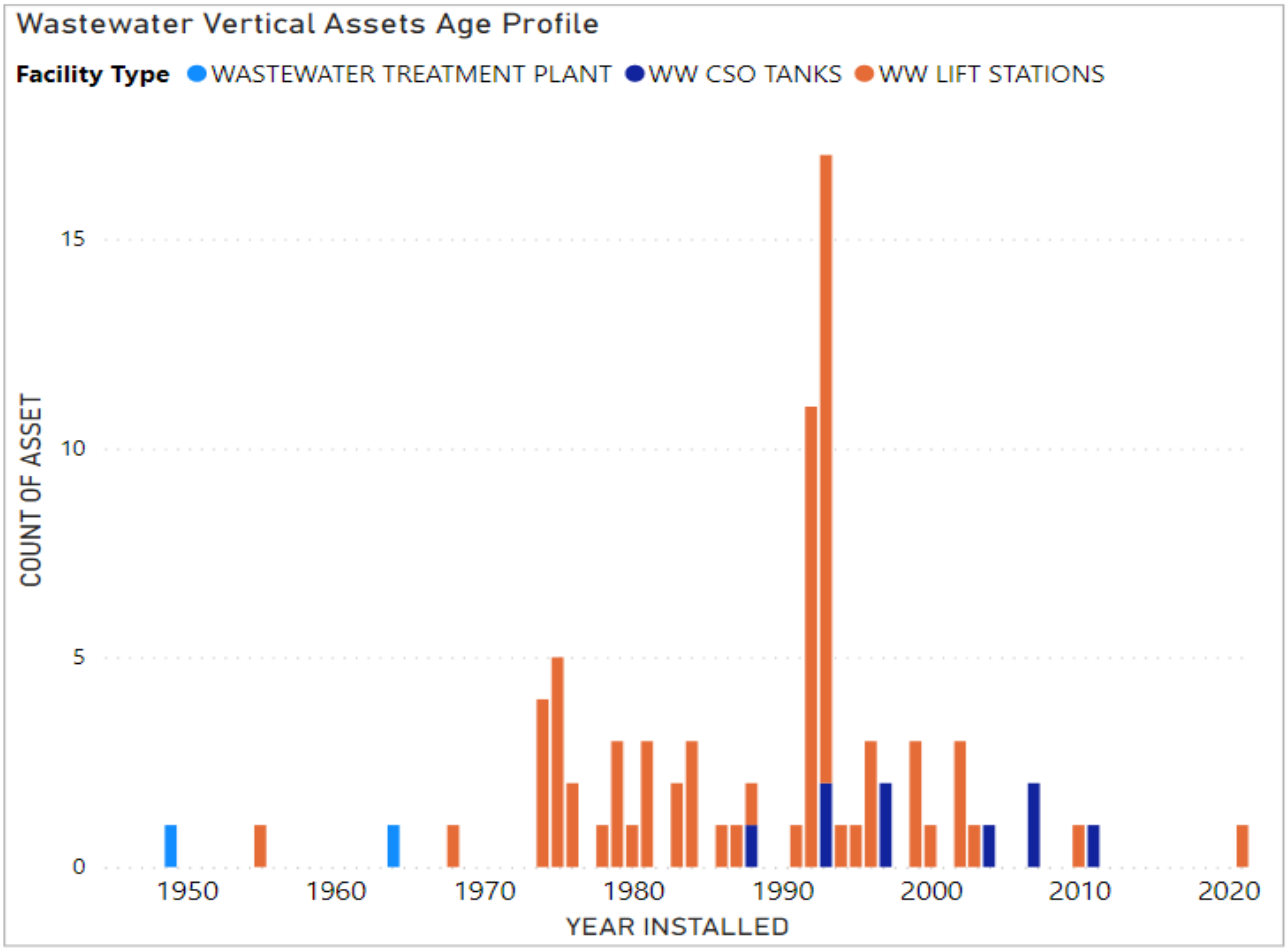
The background information for wastewater vertical assets is below and includes an age profile, the condition methodology used, the condition profile, and asset usage and performance.

3.1.3.1 Age Profile

The age of an asset is an important consideration in the asset management planning process especially for assets that will not receive a typical condition grading through inspections. Some lower cost or lower criticality assets can be planned for renewal based on age as a proxy for condition or until other condition methodologies are established. It should be noted that if a wastewater assets' condition is based on age, it is typically considered to be of a lower confidence level.

The age profile of the wastewater vertical assets are shown in Figure 10. An analysis of the age profile is provided below. For vertical assets, the age information confidence is typically high because this information was collected using an inventory process.

Figure 10: Wastewater Vertical Assets Age Profile



WASTEWATER TREATMENT PLANT (WWTP)

The Woodward WWTP is approximately 58 years old which is approaching the design life of the original plant which is estimated to be 60 years. The Dundas WWTP is approximately 73 years old which has exceeded the design life of 60 years. However, these age estimates do not reflect the significant upgrades that have been completed over the lifecycle of the plant which have extended the life of the plant well past its design life. Future iterations of the plan will ensure that the WWTPs are analyzed more fulsomely to ensure the City is better able to analyze the plants' estimated service life. The age data confidence is medium because there are many assets as part of the WWTP and this is only representing the initial construction date.

LIFT STATIONS

The majority of lift stations in the City were constructed from 1974 – 2000, with a spike in acquisitions in 1992/1993. The estimated service life (ESL) of a booster station is estimated to be 60 years old, and one (1) booster station is currently beyond its estimated service life and one (1) additional station will exceed its ESL in the next ten years. After an asset has reached its ESL it should be monitored with an increased frequency to ensure the asset is performing as

expected and to determine if the ESL for the asset type should be extended. The age data confidence is high because assets are populated and the data is likely accurate.

COMBINED SEWER OVERFLOW (CSO) TANKS

Approximately two (2) CSO tanks have been constructed per decade since 1988, and as the ESL for a CSO tank is estimated to be 40 years, none of the CSO tanks have yet reached their useful life. The age data confidence is high because assets are populated and the data is likely accurate.

3.1.3.2 Condition Methodology

For treatment plants, there is no formal condition assessment process for the entire plant, and for the purposes of this report the condition has been identified by subject matter experts at the City based on various available condition information as well as the condition descriptions presented in Table 37. Condition assessments for various components have been completed on the plant as deemed necessary. However, a formal condition assessment program should be identified by process on a pre-determined cycle, which should be investigated further. This has been identified as a continuous improvement item in Table 58.

For other vertical assets, the City typically undertakes three (3) different levels of condition assessments as defined below in Table 37. Historically, the City had a target of 10 years for vertical assets, but it was recommended to complete Level 1 inspections regularly to prioritize Level 2 inspections. However, the City has not fully implemented this approach and has focused on completing Level 2 inspections instead.

At this time, the City has not been completing Level 1 inspections. The City should investigate completing Level 1 internal assessments as part of existing operations to ensure works are up to date and to prioritize Level 2 condition assessments in case performance deficiencies are flagged by staff.

TABLE 37: Condition Descriptions

INSPECTION LEVEL	DESCRIPTION	TARGET FREQUENCY	ACTUAL FREQUENCY
1	High level inspection at the facility level for stated lifecycle categories and is used to inform the Level 1 risk assessment and the lifecycle analysis.	1 to 2 years	N/A
2	More detailed condition grade assessed at the assembly level and is used to inform the Level 2 risk assessment and as a more detailed input to the lifecycle analysis. Data captured through a formalized asset inspection, typically conducted by external resources.	Dependent on Level 1 findings, or target of 10 years.	27-year cycle

TABLE 37: Condition Descriptions			
INSPECTION LEVEL	**DESCRIPTION**	**TARGET FREQUENCY**	**ACTUAL FREQUENCY**
3	Detailed investigation, where shown to be cost-effective.	Undertaken as required	N/A

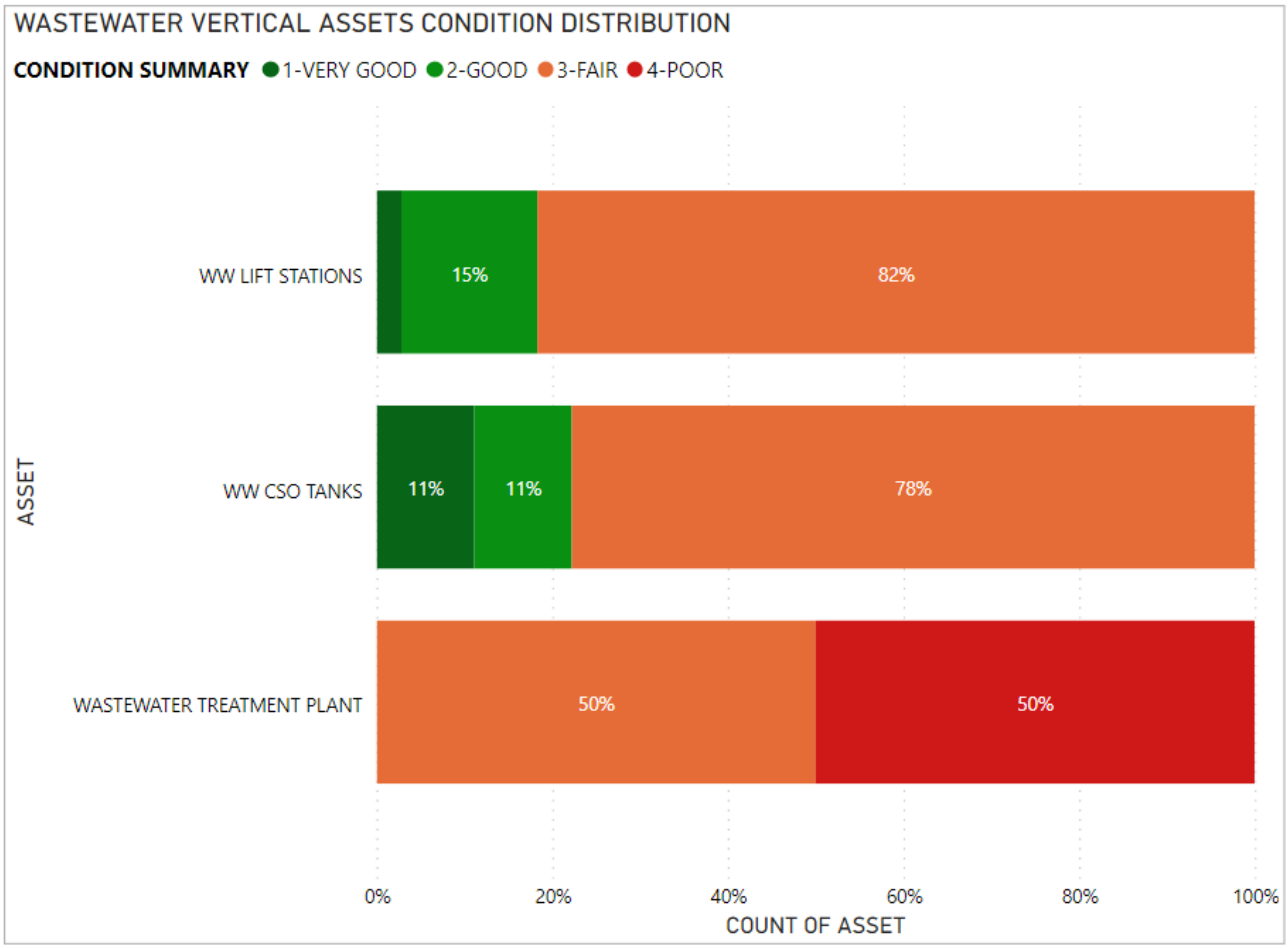
A combination of six (6) Level 2 condition assessments for water & wastewater vertical assets are completed annually excluding the treatment plants. Typically, this is an even distribution with three (3) Level 2 condition assessments completed annually for wastewater vertical assets. However, sometimes more or less water assets are included depending on priority. This means on average vertical assessments are completed on an approximate 27-year cycle. The priority assets have been identified by staff using information from audits completed in 2003 and 2012 as well as staff input. At this time, the process for selection is not formally documented, as such this has been identified as a continuous improvement item. Another continuous improvement item would be to achieve the Level 2 condition assessments on vertical assets on a minimum 10-year cycle if Level 1 assessments continue to not occur to ensure that the City is aware of upcoming forecast requirements, which is approximately another five (5) assessments per year.

Finally, condition assessments should begin on any new facility within a determined timeline after being constructed, possibly 10-15 years into its lifecycle. This has been identified as a continuous improvement item in Table 58.

3.1.3.3 Asset Condition Profile

The condition profile of the City's assets is shown in Figure 11. As mentioned in Section 3.1.2. The original condition grades were converted to a standardized condition category for reporting consistency.

Figure 11: Asset Condition Profile



WWTP

Based on subject area experts and the definitions provided in Table 37, Woodward WWTP infrastructure is considered to be in Fair condition as it is generally sound with some minor defects. This is considered for be of low data confidence because it was estimated based on staff opinion. The plant has recently had several process upgrades and facility replacements including a new Main Pumping Station, Electrical Power and Distribution system replacement, fully rehabilitated South Secondary treatment plant and addition of a new Tertiary treatment process. However, there are a number of process areas that have had condition assessments completed and do require significant rehabilitation and maintenance over the next few years, specifically the north secondary treatment process, north and south digester complexes and the middle primary clarifier tanks/galleries. Condition assessments have been completed for the Digesters, Primary Clarifiers 1-8, and North Secondary Treatment Plant, but the City has identified additional areas that would benefit from a condition assessment including the Headworks, North and South Aeration, and some other smaller systems (e.g. Boilers).

However, the Dundas WWTP infrastructure is considered to be in Poor condition due to significant deterioration as well as major parts of the plant processes and structures reaching

the end of their normal service life. An assessment and Facility Plan were completed on the Dundas WWTP in February 2015. It was determined from the findings of the assessment that due to the age and condition of Plant A, the treatment train needs to be replaced within the next 3 to 5 year period, which has already passed. Furthermore, Plant B and other auxiliary process tankage, including sludge storage, tertiary process and phosphorous chemical systems were also approaching the end of their life cycle. The Dundas WWTP provides a high level of treatment for both phosphorus and ammonia. The existing secondary process can achieve almost complete ammonia removal but is not designed to remove total nitrogen. In order for the Dundas WWTP to achieve that draft HHRAP removal targets for phosphorous and total nitrogen, the entire secondary treatment process would require replacement with a membrane bioreactor or equivalent technology. This would involve integration of the existing Plant B aeration tanks retrofitted to an Modified Ludzack-Ettinger (MLE) Activated Sludge Processconfiguration for enhanced nitrogen removal coupled with membranes designed to provide Best Available Techniques (BAT) tertiary phosphorus removal (a process to achieve low phosphorus concentrations and/or total nitrogen removal). The upgrade project for replacement fo the Dundas WWTP with a new facility with higher levels of treatment is currently unfunded.

LIFT STATIONS

Since condition assessments are completed on lift stations, these stations are known to be in overall Fair condition. However, some of these condition assessments are older and so the data confidence for condition is medium. Major upgrades have been completed on many of these stations since construction. However, some lift stations are beginning to approach their ESL, which shows the importance of completing condition assessments on these assets regularly and performing upgrades and preventative operations and maintenance activities so that these assets reach their ESL without major reactive repairs.

CSO TANKS

Based on condition assessment information, CSO tanks are in overall Fair condition. However, some of these condition assessments are older and so the data confidence for condition is medium. If the condition had been based on age, some assets that have been identified to be in Fair condition would have been assumed to be in Good condition. This shows the importance of completing condition assessments on these assets regularly and performing upgrades and preventative operations and maintenance activities so that these assets reach their ESL without major reactive repairs.

3.1.3.4 Asset Usage and Performance

Assets are generally provided to meet design standards where available. However, there are often insufficient resources to address all known deficiencies.

The largest performance issues with vertical wastewater assets involve combined sewer overflows, odours, and degradation of components. The service deficiencies in Table 38 below were identified using staff input.

Table 38: Known Service Performance Deficiencies			
Asset	**Location**	**Service Deficiency**	**Description of Deficiency**
WWTP	Woodward	Bypass incidents during major storm events	When the WWTP has reached capacity during a stormwater event, a bypass is often required so that regulated treatment capacity is not exceeded, and to ensure the plant does not become damaged.
WWTP	Woodward	Odour Complaints	Odours from the plant are often due to the biosolids handling process that is operated by a third party contractor, and improvement actions are ongoing.
CSO Tank	Main/King Cootes Paradise	Leakage of wastewater into surrounding environment	Inaccuracies in facility operational guidance documents and SCADA system programming (related to the CSO tank bypass gate) resulted in an undetected discharge to Cootes Paradise. The facility issues have since been fixed.
CSO Tanks	Various Locations	Overflows during major storm events	When CSO tank has reached capacity during a stormwater event, the combined sewer outflow overflows into the natural watercourse.
Lift Station	Various Locations	Accelerated degradation of components	Harsh operating conditions can cause components to degrade faster than expected.
CSO Tanks	Various Locations	Accelerated degradation of components	Harsh operating conditions can cause components to degrade faster than expected.

3.1.4 Linear

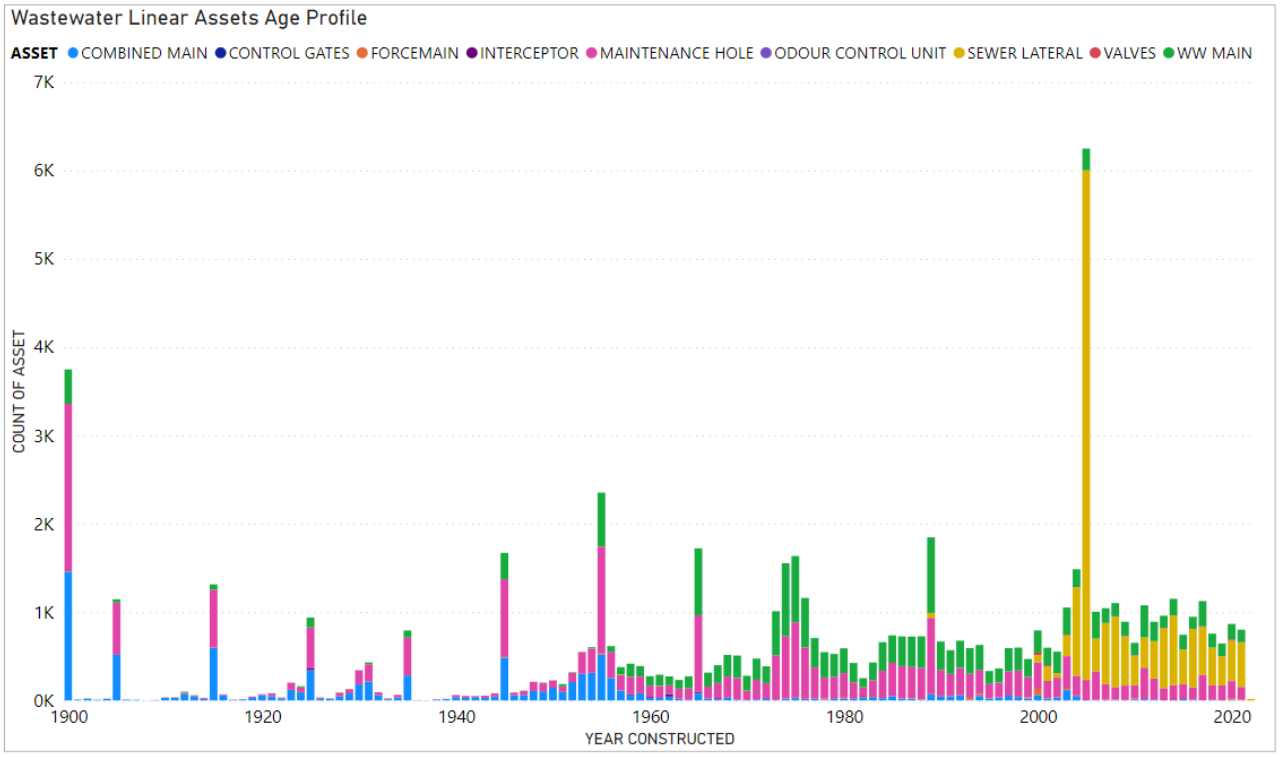
The background information for wastewater linear assets is included below and includes an age profile, the condition methodology used, the condition profile, and asset usage and performance.

3.1.4.1 Age Profile

The age of an asset is an important consideration in the asset management process as it can be used for planning purposes as typically assets have an ESL where they can be planned for replacement.

The age profile of the wastewater linear assets are shown in Figure 12. An analysis of the age profile is provided below for each asset.

Figure 12: Wastewater Linear Assets Age Profile



When age is unknown, there are common years where asset age is typically assumed. This typically includes decade and mid-decade, and so large spikes are seen in many assets in 1900, 1915, 1925, 1935, 1945, 1955, 1965, 1990 etc.

COMBINED MAIN

For legibility of the graph, the wastewater linear assets have been shown since 1900. There are a small number of combined sewer segments that predate 1900 with the earliest installation date being 1855, indicating that combined sewers are aging assets as they are the oldest linear wastewater assets in the City. Combined sewer construction was eliminated (except for replacement/rehabilitation of existing sewers) around 1955 when separated WW main construction became the standard.

The average age for combined main in the City is 84 years, and with an average estimated service life (ESL) of 87 years. This means on average there is 4% of service life remaining. The

condition of combined sewer is typically based on a condition assessment program, but if assessments had not been completed were based on age. The age data confidence for combined main is considered to be Medium as this information is typically populated, but the accuracy of the data appears to contain assumptions based on the spikes by decade.

SEPARATED WASTEWATER MAIN (WW MAIN)

Separated wastewater main is typically a newer linear asset than combined sewers as shown above and were typically installed after 1955. This is in line with historic practices as explained above as typically older municipalities began with a combined sewer network before best practice shifted to a separated sewer system. There are a few segments that pre-date 1955, but these pipe dates are likely estimated as they occur regularly every 10 years or were previously considered combined main but were later repurposed as separated WW main.

The average age for separated trunk and local wastewater main is 39 and 40 years respectively which with an average ESL of 97 and 89 years means there is 60% and 55% of the useful life remaining. The condition of separated wastewater sewer is typically based on a condition assessment program, but if assessments had not been completed were based on age. The age data confidence for wastewater main is considered to be Medium as this information is typically populated, but the accuracy of the data appears to contain assumptions based on the spikes by decade.

INTERCEPTOR

Interceptor's are difficult to view on the graph above because there are less of these assets in the City compared to some of the other linear assets. However, there is a steady distribution of interceptor acquisitions with a peak in 1962. Interceptors have an average ESL of 100 years and approximately 3 km of pipe have exceeded this value which is approximately 9% of interceptors. The condition of interceptors is typically based on inspection programs where available but is estimated based on age where condition information is unavailable.

The average age for interceptors is 63 years which indicates there is 37% of service life remaining. The age data confidence for interceptors is considered to be Medium as this information is typically populated, but the accuracy of the data appears to contain assumptions.

FORCEMAIN

Forcemains are difficult to view on the graph above because there are less of these assets in the City compared to some of the other linear assets. However, there is a steady distribution of forcemain acquisitions with a peak in 2000.

The average age for forcemain is 31 years and with an ESL of 81 years, this means there is 62% of service life remaining. The age data confidence for forcemain is considered to be High as this information is typically populated, although the source of this data may be estimated. Since condition is based on age for this asset, this also affects the condition profile shown in Figure 13.

MAINTENANCE HOLES

Maintenance holes have typically been acquired at a steady distribution over the last 100 years with a peak in 1900. This peak is due to estimated values for year of construction/acquisition.

The average age of maintenance holes is 54 years, and with an ESL of 80 years, this indicates there is typically 33% of useful life remaining. The age data confidence for maintenance holes is considered to be Medium as this information is typically populated, but the accuracy of the data appears to contain assumptions based on the spikes by decade.

SEWER LATERALS

Sewer laterals are shown above to be newer assets with installations typically occurring after 2000 with a spike in 2005. However, this data is not accurate as sewer laterals have historically not been formally inventoried as they are not considered to be a City-owned asset. However, since the City typically completes work on these assets, the City has begun collecting inventory information. Only 12% of age data for known laterals was populated a the time of writing.

Since the AM Plan can only present the data that is available, sewer laterals are shown to be an average of 13 years old with 78% useful life remaining with Very Low confidence. Since condition is based on age for this asset, this also affects the condition profile shown in Figure 13.

VALVES

These assets are also difficult to view on the graph above because the quantities of valves are small compared to other linear assets. The average age of valves is 16 years, and with an ESL of 80 years, this indicates there is typically 80% of useful life remaining. The age data confidence for valves is considered to be High as this information is typically populated, and is likely accurate. Since condition is based on age for this asset, this also affects the condition profile shown in Figure 13.

ODOUR CONTROL UNITS

These assets are also difficult to view on the graph above because the quantities of odour control units is small compared to other linear assets. These assets are very new having been constructed in the last year and typically has 98% of service life remaining, but are considered a low confidence level because many dates haven’t been populated in the database.

CONTROL GATES

These assets are also difficult to view on the graph above because the quantities of control gates are small compared to other linear assets. All seven (7) control gates have age data associated with them, and is known to be accurate showing that there is Very High data confidence associated with these assets. Since the condition is based on age for these assets, this also affects the profile below.

Since the AM Plan can only present the data that is available, control gates are shown to be an average of 27 years which is within the ESL of 50 years. However, three (3) control gates are beyond their service lives which is shown in the condition profile in Figure 13.

3.1.4.2 Condition Methodology

The inspection frequency and condition score output for each linear asset is found below in Table 39. An analysis for each asset is found below.

Table 39: Inspection Frequency

ASSET	INSPECTION FREQUENCY	CONDITION SCORE OUTPUT
Sewer Main	Based on priority	Combination of inspection & age data
Forcemain	None	None, used age
Maintenance Holes	Ad Hoc	None, used age
Valves	None	None, used age
Sewer Laterals	Ad Hoc	None, used age
Control Gates	Annual	None, used age
Ocour Control Unit	None	None, used age

GRAVITY MAIN (INCLUDING COMBINED MAIN, SEPARATED WASTEWATER MAIN, AND INTERCEPTORS)

Since gravity mains are not under pressure and there are maintenance hole access points along the pipe segments, it is easier and more cost effective to inspect these assets than it is to inspect pressurized pipes such as forcemains and watermains. The City completes CCTV (Closed Circuit Television) inspections on these assets which involves sending a robot with a camera to inspect the inside of the pipe to determine any defects or rehabilitation needs. The results of the CCTV inspections assign a structural score to the pipe segment which the City uses to prioritize sewer lining and/or renewal. The City assesses pipes based on the defined criticality of the pipe but does not yet have a cycle to assess all pipes at a specified frequency, and not all pipes have been assessed. This has been identified as a continuous improvement item in Table 58.

FORCEMAIN

Due to limitations associated with asset location and pressurized pipes, forcemains do not yet have an inspection program and conditions are typically based on estimated service life. The City does complete inspections using various technologies on critical watermain pipes and the

City should investigate completing similar assessments on forcemains since they can have rapid deterioration from corrosive gases and are suject to pressure transients and other forces that cause leaks and breaks. This has been identified as a continuous improvement item in Table 58.

MAINTENANCE HOLES

Historically, the City completed visual camera inspections of many maintenance holes, but these inspections did not output a condition score. These assessments are no longer being completed but the collected data should be reviewed, and a condition score should be approximated. This has been identified as a continuous improvement item in Table 58. For this AM Plan, the condition has been based on age.

VALVES

Wastewater valves are typically valves as part of a forcemain. Since the risk of exercising these valves is high due to the harsh environment causing premature failures and no redundancy in the forcemain, there is no valve exercising program, and valves are typically left open. For the purposes of estimating condition, the valve conditions are based on estimated remaining service life as shown in Table 39.

SEWER LATERALS

As previously explained, sewer laterals are not considered a City-owned asset. However, often the City is called when a resident has an issue with the sewer lateral and the City will reactively inspect the pipe as a result of these calls. If the City inspects the pipe and determines any issues are the fault of the City (e.g. City tree roots blocked the lateral), the City will provide the resident with a grant as part of the Sewer Lateral Management Program, or if the issue is on City property and may damage public infrastructure, the City will pay for the replacement of the pipe. Since this happens often, the City should investigate responsibilities for this asset and improve the inventory data. This has been identified as a continuous improvement item in Table 58.

CONTROL GATES

At this time, there is no condition assessment program for these assets, however, there is an inspection program which does not yet output a condition score. This has been identified as a continuous improvement item in Table 58.

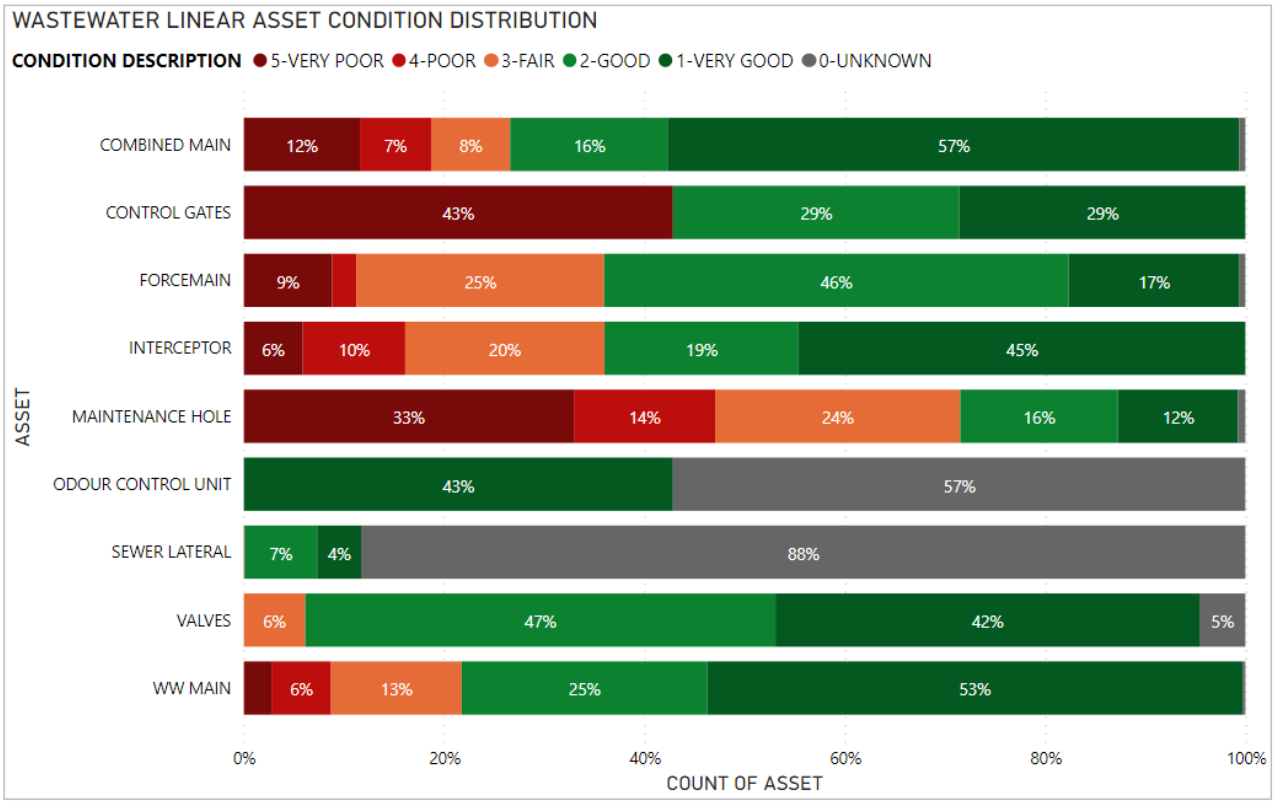
ODOUR CONTROL UNITS

For odour control units, this should eventually begin but because the assets are new, it is not yet a priority.

3.1.4.3 Asset Condition Profile

The condition profile of the City's assets is shown in Figure 13. As mentioned in Section 3.1.2, the original condition grades were converted to a standardized condition category for report consistency.

Figure 13: Asset Condition Profile



GRAVITY MAIN (INCLUDING COMBINED MAIN, SEPARATED WASTEWATER MAIN, AND INTERCEPTORS)

Based on a combination of condition and age data, these assets are shown to be on average, in Good condition. As stated above, there is a condition assessment program for gravity main. However, at this time not all assets have been encompassed into the assessment program. Therefore, the data confidence is shown to be Medium as it is a combination of very high data confidence and low to medium confidence methodologies.

This profile shows the importance of completing condition assessments on these assets. If these assets had been estimated based on age, they would typically show an average of Fair to Very Poor condition based on the remaining service life of the asset and would have been prematurely scheduled for renewals. In addition, some of these pipes may have been lined, but still show an older age profile even though the City considers these to be the equivalent of a new pipe. This should be accounted for in the data for future iterations of the AM Plan.

OTHER LINEAR ASSETS

The remaining linear assets' conditions are estimated based on age where known. As previously stated, age is not the best indicator of condition but is used when condition information is unavailable or difficult to obtain. A detailed analysis for the age profile of these assets can be found in Section 3.1.4.1. In addition, most assets are shown to be in Good condition, excluding maintenance holes which are an asset with a fairly even distribution of Good to Poor assets. There is Low confidence in sewer laterals because there are many unknown ages within this data. As previously stated, a continuous improvement item is to complete condition assessments on the wastewater control gates as age-based information is showing many of these assets to be in very poor condition.

3.1.4.4 Asset Usage and Performance

Assets are generally provided to meet design standards where available. However, there are often insufficient resources to address all known deficiencies.

The largest performance issues with linear wastewater assets involve combined sewer overflows, odours, and degradation of components.

The service deficiencies in Table 40 below were identified from the most recent inspection reports as well as staff input.

Table 40: Known Service Performance Deficiencies

Asset	Location	Service Deficiency	Description of Deficiency
Sewer	Various Locations	Odour Issues	Odours from sewer releasing into private property's basements or through maintenance holes into City streets.
Combined Sewer	Various Locations	Overflows	Overflows from outfalls during storm events
Forcemain	Various Locations	Corrosion	Hydrogen sulfide formation in air pockets in pipes causing premature corrosion in pipe wall.
Control Gates	Various Locations	Accelerated degradation of components	Harsh operating conditions can cause components to degrade faster than expected.

3.1.5 Administrative

Administrative assets are assets which contribute to the wastewater service but are not wastewater assets. These include vehicles, testing equipment, software and administrative facilities. Administrative facilities replacement costs have been incorporated as part of the WTP cost.

As previously mentioned, the City has included these assets in a limited capacity so that the replacement costs are incorporated in the report since these assets contribute to the overall wastewater service. However, these have not yet been completed at a detailed level because they are not defined as part of the O.Reg. 588/17 definition of a wastewater asset. These will be encompassed in more detail before the 2025 iteration of the AM Plan.

3.2 LIFECYCLE MANAGEMENT PLAN

The lifecycle management plan details how the City plans to manage and operate the assets at the agreed levels of service while managing life cycle costs.

3.2.1 Acquisition Plan

Acquisition reflects new assets that did not previously exist or works which will upgrade or improve an existing asset beyond its current capacity. They may result from growth, demand, legal obligations or social or environmental needs. Wastewater assets are generally donated to the City through the development agreements process directly related to growth.

CURRENT PROJECT DRIVERS – 10 YEAR PLANNING HORIZON

Hamilton Water currently prioritizes capital projects as per the drivers listed below. These drivers help to determine a ranking priority for projects and ensures that multiple factors are being considered to drive investment decisions. These drivers should be reviewed during each iteration of the AM Plan to ensure they are appropriate and effective in informing decision making.

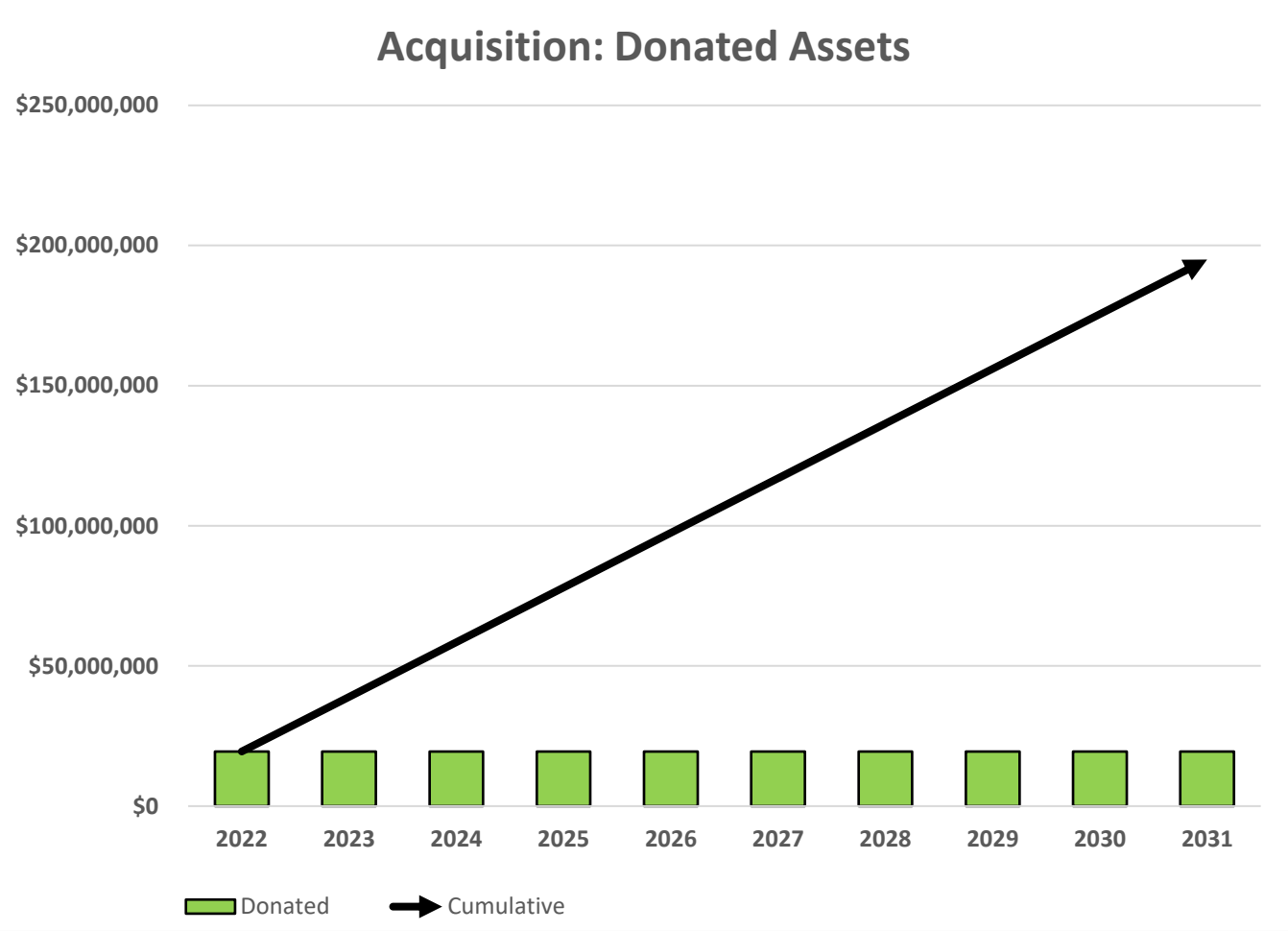
Table 41: Acquired Assets Priority Ranking Criteria

Driver	% of Planned Projects (10 Year Horizon)
Legal Compliance	20%
Coordination, Funding, Budgeting	25%
Risk Mitigation	25%
Health and Safety	10%
Operating and Maintenance Impacts	10%
Development Growth	10%
Total	**100%**

SUMMARY OF FUTURE ASSET ACQUISITION COSTS

Forecast acquisition asset costs are summarized in Figure 16 and shown relative to the proposed acquisition budget.

Figure 14: Acquisition Donated Assets
All figures are in 2021 dollars.



Annually, on average, the City assumes over **$19,500,000** of donated assets through subdivision agreements or other development agreements. These assets include approximately 9 km's of sanitary mains, **1,500** new wastewater service connections, **140** maintenance holes and nearly **$500,000** in valves. The City is reviewing its donated asset assumption process to ensure that it proactively understands what assets are being donated annually to ensure they are planned for properly. This will allow multiple departments across the City to plan for the assets properly such as:

- AM to forecast the long-term needs and obligations of the assets;
- Operations and maintenance can include the assets in their planned activities (inspections, legislative compliance activities); and,
- Finance can ensure that assets are properly captured and recognized appropriately (Audited Financial Statements, TCA process, Provincial reporting such as the FIR)

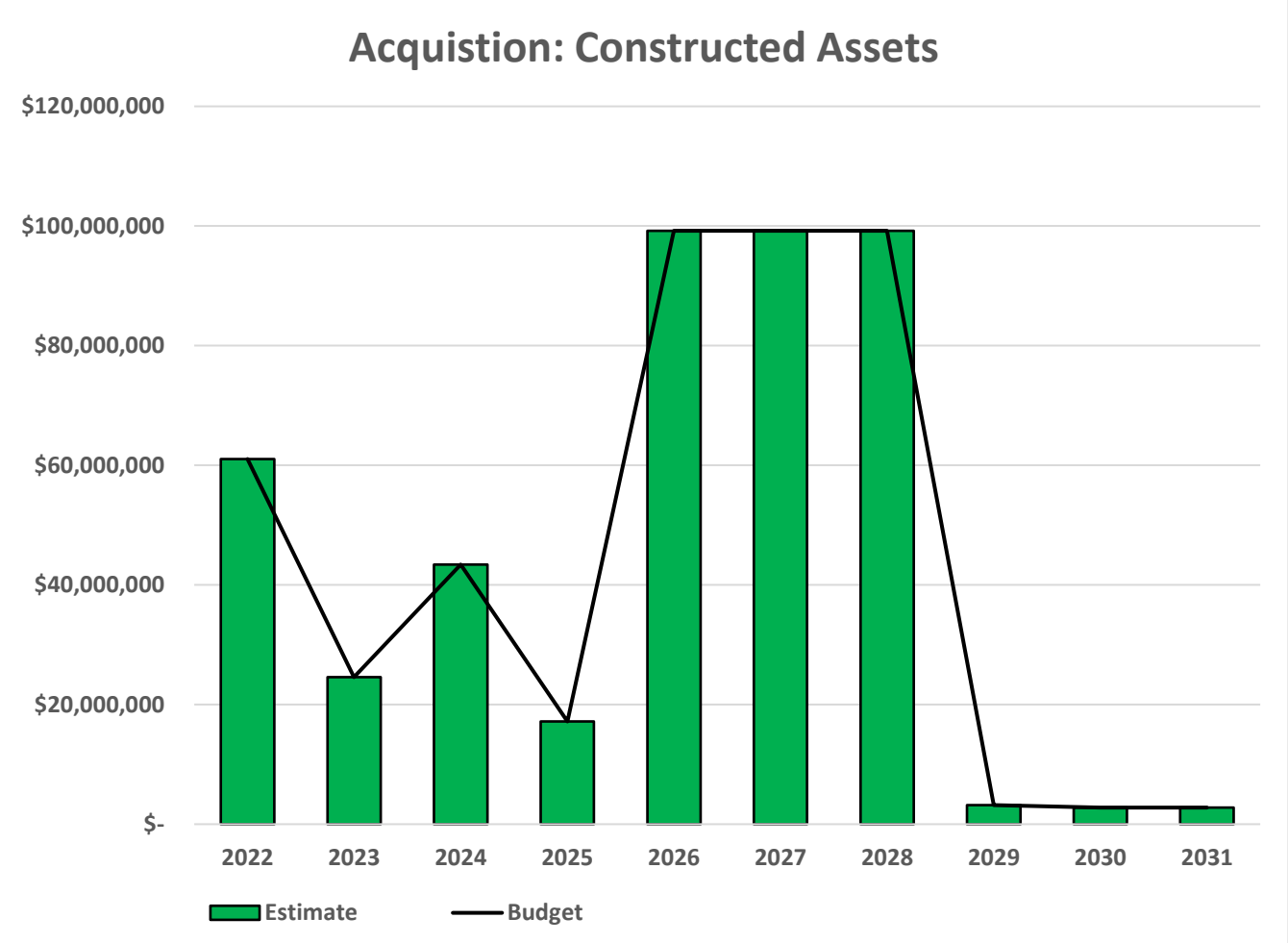
The City will need to ensure the required data is updated frequently and to a single source to ensure that all the departments have access to the data they require in a timely manner. Once Wastewater assets are assumed, the City then becomes the stewards of these assets and is

responsible for all ongoing costs for the assets operation, continued maintenance, inevitable disposal and their likely renewal.

Construction costs are often only **10-15 %** of an asset's whole life costs. When development assets are donated to the City, the City then becomes obligated to fund the remaining whole life costs. Over the next ten-year planning period the City anticipates ***receiving*** **$195,000,000** of donated assets which, would then obligate the City to fund the remaining lifecycle costs over the donated assets ESL.

Hamilton has internal design standards, inspection practices as well as assessment which are intended to ensure the assets that are being donated to the City through subdivision agreements are in excellent condition before assumption. The City should continue to review its assumption process to ensure that the City is receiving high quality and appropriately sized donated assets to defer lifecycle activities as much as possible.

Figure 15: Acquisition (Constructed) Summary
All figure values are shown in 2021 dollars.



3.0 WASTEWATER ASSETS

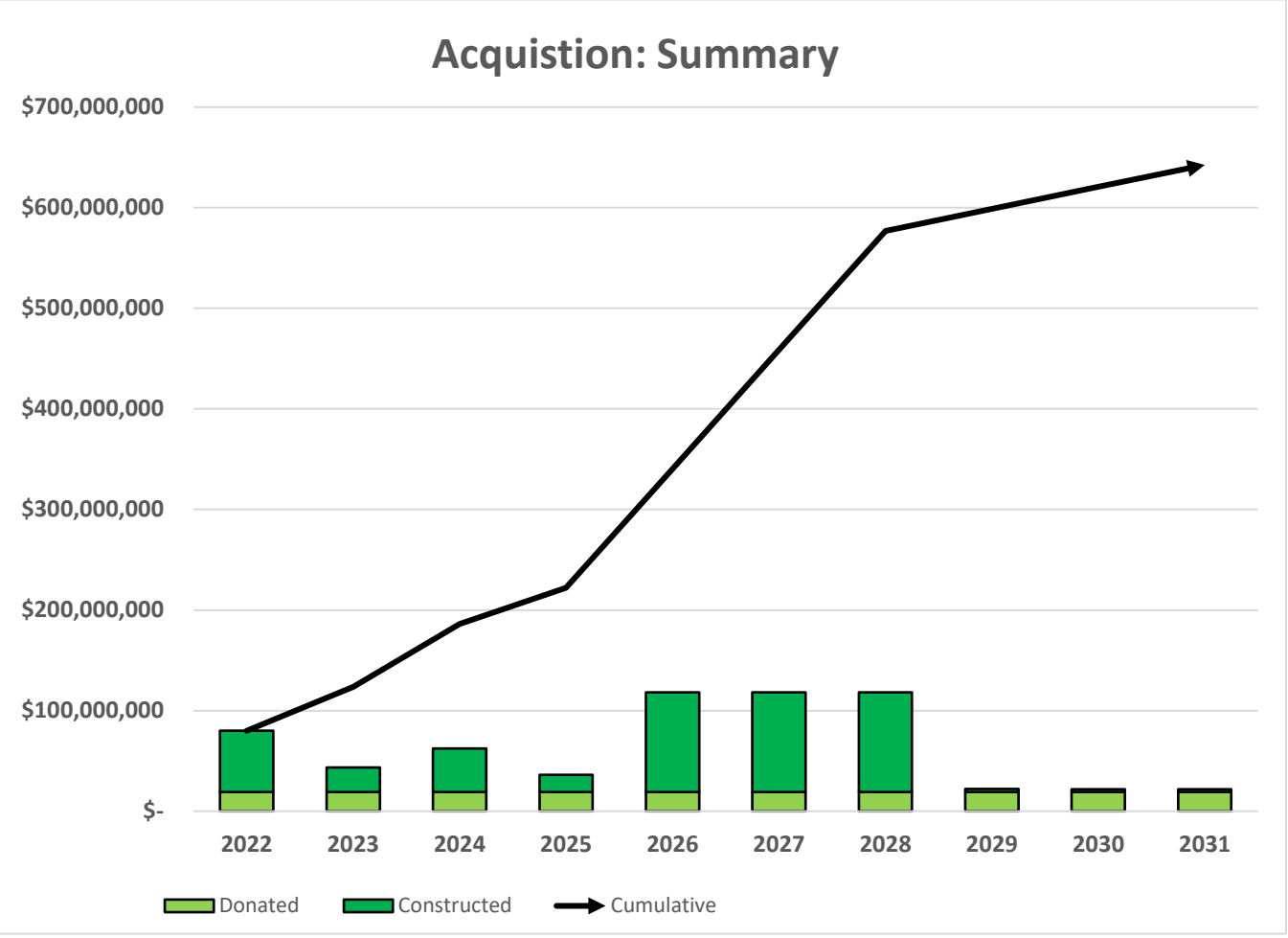
When the City commits to new assets, the municipality must be prepared to fund future operations, maintenance and renewal costs. The City must also account for future depreciation when reviewing long term sustainability. When reviewing the long-term impacts of asset acquisition, it is useful to consider the cumulative value of the acquired assets being taken on by Hamilton. The cumulative value of all acquisition work, including assets that are constructed and contributed are shown in Figure 16.

Over the next 10 Year planning period, the City will acquire approximately **$439,597,000** of constructed assets which can either be new assets which did not exist previously, or expansion of assets when they are to be replaced. Major acquisition expenditures over the next ten years include;

- **$10.6 million** for a new haulage receiving station to be completed by **2025**
- **$313** million for Woodward Treatment Plant Expansion by the end of **2028**
- **$7.5 million** for a Centralized operations centre
- **$77.6 million** for Trunk Sewers along Dickenson Rd.

The bulk of these constructed asset costs peak between 2026 – 2028 and after that it appears that there will only be minimal construction of assets. The lack of acquired constructed assets between 2029 – 2031 is due to lack of data and limited forecasting ability currently. As AM knowledge, practices and abilities mature within the City then in all likelihood there will be significant projects with significant costs that will appear within later years of the 10-year horizon.

Figure 16: Acquisition Summary
All figure values are shown in 2021 dollars.



SUMMARY OF ASSET FORECAST COSTS

Over the next ten years the City expects to acquire nearly $**642.8 million** dollars of Wastewater assets.

The City has sufficient budget for its planned constructed acquisitions at this time. It will become critical to understand that through the construction or assumption of new assets, the City will be committing to funding the ongoing operations, maintenance and renewal costs which are very significant. The City will need to address how to best fund these ongoing costs as well as the costs to construct the assets while seeking the highest level of service possible.

Future AM Plans will focus on improving the understanding of Whole Life Costs and funding options. However, at this time the plan is limited on those aspects. Expenditure on new assets and services will be accommodated in the long-term financial plan but only to the extent that there is available funding.

3.2.2 Operations and Maintenance Plan

Operations include all regular activities to provide services. Daily, weekly, seasonal, and annual activities are undertaken by staff to ensure the assets perform within acceptable parameters and to monitor the condition of the assets for safety and regulatory reasons. Examples of typical operational activities include cleaning, sample collection, quality testing, inspections, utility costs and the necessary staffing resources to perform these activities.

Maintenance should be viewed as the ongoing management of deterioration. The purpose of planned maintenance is to ensure that the correct interventions are applied to assets in a proactive manner and to ensure it reaches its intended useful life. Maintenance does not significantly extend the useful life of the asset but allows assets to reach their intended useful life by returning the assets to a desired condition.

Proactively planning maintenance significantly reduces the occurrence of reactive maintenance which is always linked to a higher risk to human safety and higher financial costs. The City needs to plan and properly fund its maintenance to ensure the engineered structures are reliable and achieve their desired level of service.

Maintenance includes all actions necessary for retaining an asset as near as practicable to an appropriate service condition including regular ongoing day-to-day work necessary to keep assets operating. Examples of typical maintenance activities include pipe repairs, service repairs, pump maintenance, equipment repairs along with appropriate staffing and material resources.

Some of the major mainteanance projects Hamilton plans to undertake over the next 10 years include:

- **$35.5 Million** for sewer lateral management program
- **$3 Million** allocated for reactive repairs for cross connections
- **13.25 Million** acllocated for Pier 25 Dredging – Windermere Basin

Assessment and priority of reactive maintenance is undertaken by staff using experience and judgement

3.2.3 Vertical Lifecycle Activities

The major operating and maintenance lifecycle activities per vertical asset with their accompanying 2021 costs (if known) are shown below in Table 42.

Table 42: Vertical Lifecycle Activities

Asset	Lifecycle Stage	Lifecycle Activity	2021 Annual Cost
Combined Sewer Overflow Tank	Operations	Calibration & Verification	$5,380
		Inspection & Operations	$102,900
	Maintenance	Preventative Maintenance	$14,390
		Reactive Maintenance	$293,780
Dundas WWTP	Operations	Calibration & Verification	$4,200
		Inspection & Operations	$306,760
		Maintenance	$110,900
Woodward WWTP	Operations	Calibration & Verification	$24,610
		Operations & Inspection	$12,417,830
		Cleaning & Flushing	$6,530
		Lubrication	$7,330
	Maintenance	Preventative Maintenance	$9,360
		Reactive Maintenance	$1,420,600
Lift Stations	Operations	Calibration & Verification	$3,210
		Inspection & Operations	$1,056,700
	Maintenance	Preventative Maintenance	$18,460
		Reactive Maintenance	$163,940
Misc Wastewater	Operations	Preventative Operations	$3,800
	Maintenance	Preventative Maintenance	$1,300
		Reactive Maintenance	$38,810
		Total Annual Cost	**$16,000,930**

3.2.4 Linear Lifecycle Activities

The major operating and maintenance lifecycle activities per linear asset with their accompanying 2021 costs (if known) are shown below in Table 43.

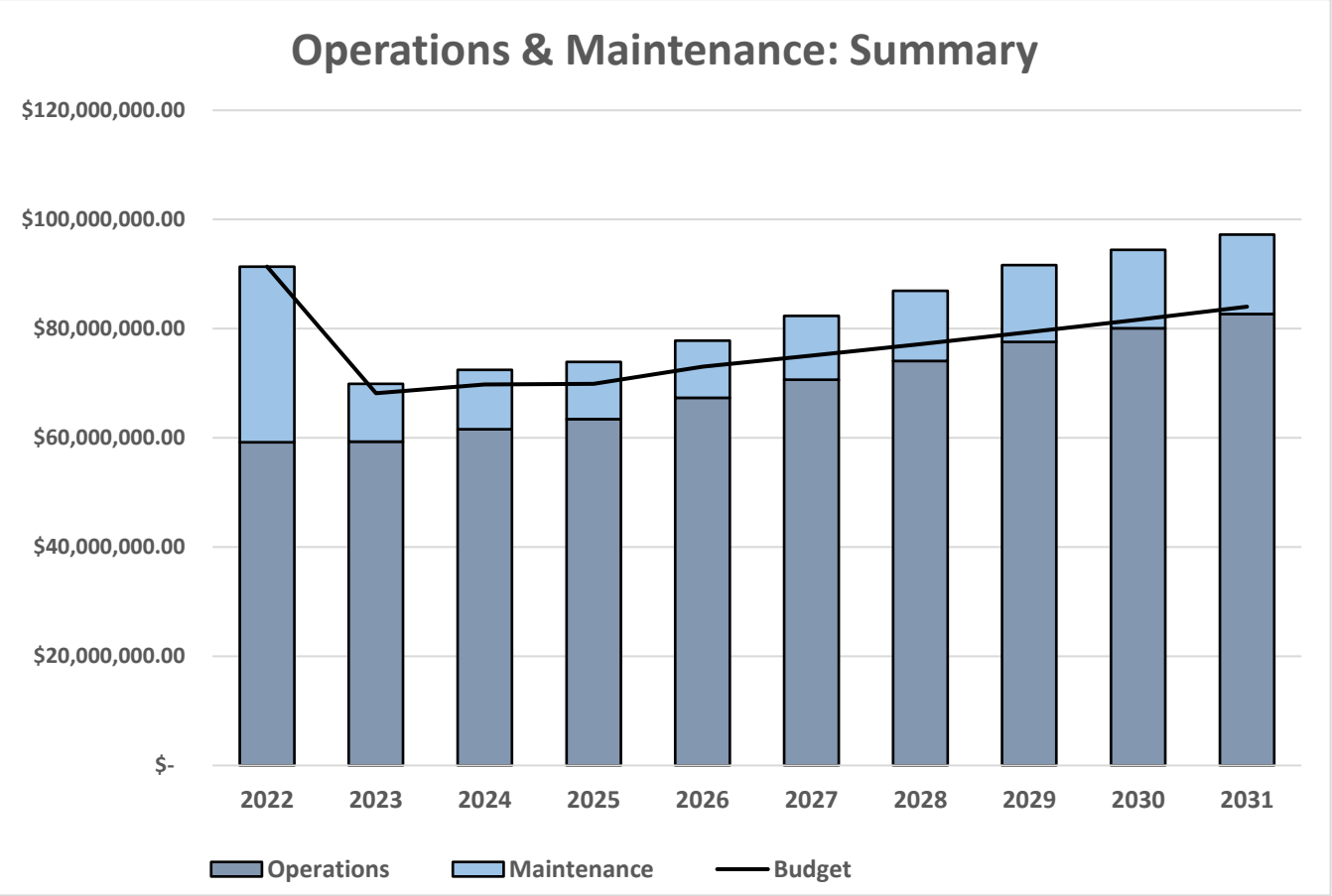
Table 43: Linear Lifecycle Activities

Asset	Lifecycle Stage	Lifecycle Activity	Frequency	2021 Cost	Unit
Sewer Main	Operation	Condition Assessment	Planned	$15-30	per metre
		Cleaning	Ad Hoc	$10,000	per instance
	Maintenance	Spot Repair	Ad Hoc	$40,000	per instance
Forcemain	Operation	Swabbing	Ad Hoc	$10,000	per instance
	Maintenance	Repair	Ad Hoc	$40,000	per instance
Odour Control Unit	Operation	Inspection	6 months	$ 61	per instance
	Maintenance	Change Media Filter	Ad Hoc	$ 1061	per instance
Maintenance Holes	Operation	Inspection	Ad Hoc	$ 50 – $ 71	per unit
	Operation	Condition Assessment - Zoom Camera	Ad Hoc	$ 50	per unit
	Maintenance	Frame & Cover Resets	Ad Hoc	$ 250,000	per year
	Maintenance	Grout Sealing	Ad Hoc	$ 3,000	per unit
	Maintenance	Ladder Rung Repair	Ad Hoc	$ 300	per unit
	Maintenance	Benching	Ad Hoc	$ 1500	per unit
Sewer Laterals	Operation	Cleaning	Ad Hoc	$ 500	ls
	Renewal	Lining	Ad Hoc	$ 456	per m
	Renewal	Replacement	Ad Hoc	$ 8000	per lateral
	Operation	Reactive Inspection	Ad Hoc	$ 500	ls
	Operation	Planned Inspection	Ad Hoc	$159	per lateral

When the City completes necessary operational and maintenance activities, high cost reactive repairs can be prevented, and this will ensure the assets reach their ESL. Currently, assessment and priority of reactive maintenance is undertaken by staff using subject matter expert experience and judgement.

Forecast operations and maintenance costs vary in relation to the total value of the asset registry. When additional assets are acquired, the future operations and maintenance costs are forecast to increase. When assets are disposed of the forecast operation and maintenance costs are reduced. Figure 17 shows the forecast operations and maintenance costs relative to the proposed operations and maintenance Planned Budget.

Figure 17: Operations and Maintenance Summary
All figure values are shown in 2021 dollars.



The forecast costs include all costs from both the Capital and Operating budget. AM focuses on how taxpayer or ratepayer dollars are invested by lifecycle activities and not by budget allocation since both budgets contain various lifecycle activities they must both be consolidated for the AM plans.

The forecast of operations and maintenance costs are increasing steadily over time and it is clear, the City has insufficient budget to achieve all of the works required to ensure that assets will be able to achieve their estimated service life at the desired level of service**.** It is anticipated that at the current budget levels there will be insufficient budget to address all operating and maintenance needs over the 10-year planning horizon. The peak in 2022 is due to the investment of **$13.2 million** for the Pier 25 dredging and other major planned maintenance activities.

The graph above illustrates that without increased funding or changes to lifecycle activities there is a significant shortage of funding which will lead to:

- Higher cost reactive maintenance;
- Possible reduction to the availability of the assets;
- Impacts to private property; and,
- Increased financial and reputational risk.

The shortfall is primarily due to the significant number of assets that are donated through subdivision agreements annually and insufficient funding allocations over an extended period of time. Every year that Hamilton adds additional assets without properly funding the necessary lifecycle activities, staff's ability to sustain the assets to expected or mandatory level of service can be significantly impacted. It should be noted that there are mandatory operational and maintenance expenditures due to legislative requirements and cannot and should not simply be avoided or deferred.

As the City continues to develop condition profiles and necessary works are identified based on their condition, it is anticipated operation and maintenance forecasts will increase significantly. Where budget allocations will result in a lesser level of service, the service consequences and risks will be identified and are highlighted in the Risk Section 3.7. Deferred maintenance (i.e. works that are identified for maintenance activities but unable to be completed due to available resources) will be included in the infrastructure risk management plan for the next iteration.

Future iterations of this plan will provide a much more thorough analysis of operations and maintenance costs including types of expenditures for training, mandatory certifications, insurance, staffing costs and requirements, equipment and maintenance activities.

3.2.5 Renewal Plan

Renewal is major works which does not increase the assets design capacity but restores, rehabilitates, replaces or renews an existing asset to its original service potential. Works over and above restoring an asset to original service potential is considered to be an acquisition resulting in additional future operations and maintenance costs.

Asset renewals are typically undertaken to either ensure the assets reliability or quality will meet the service requirements set out by the City. Renewal projects are often triggered by service quality failure and can often be prioritized by those that have the highest consequence of failure, have high usage, have high operational and maintenance costs and other deciding factors.

The typical useful lives of assets used to develop projected asset renewal forecasts are shown in Table 44 and are based on estimated design life for this iteration. Future iterations of the plan will focus on the Lifecycle approach to ESL which can vary greatly from design life. Asset useful lives were last reviewed in 2022 however they will be reviewed annually until their accuracy reflects the City's current practices.

Table 44: Useful Lives of Assets	
Asset (Sub)Category	**Useful life**
Wastewater Treatment Plant	60
Lift Stations	60
Combined System Overflow Tanks	40
Trunk Mains	97
Local Mains	89
Combined Mains	87
Interceptors	100
Vehicles	7 or 8
Forcemains	81
Valves	80
Maintenance Holes	100
Control Gates	50
Sewer Laterals	60

The estimates for renewals in this AM Plan were based on the register method which utilizes the data from the City's asset registry to analyse all available lifecycle information and then determine the optimal timing for renewals.

RENEWAL RANKING CRITERIA

Asset renewal is typically undertaken to either:

- Ensure the reliability of the existing infrastructure to deliver the service it was constructed to facilitate (e.g. replacing a bridge that has a load limit); or
- To ensure the infrastructure is of sufficient quality to meet the service requirements (e.g. condition of a culvert).[9]
- It is possible to prioritise renewals by identifying assets or asset groups that:
- Have a high consequence of failure;
- Have high use and subsequent impact on users would be significant;
- Have higher than expected operational or maintenance costs; and,
- Have potential to reduce life cycle costs by replacement with a modern equivalent asset that would provide the equivalent service.[10]

[9] IPWEA, 2015, IIMM, Sec 3.4.4, p 3|91.

[10] Based on IPWEA, 2015, IIMM, Sec 3.4.5, p 3|97.

The ranking criteria used to determine priority of identified renewal proposals is detailed in Table 45.

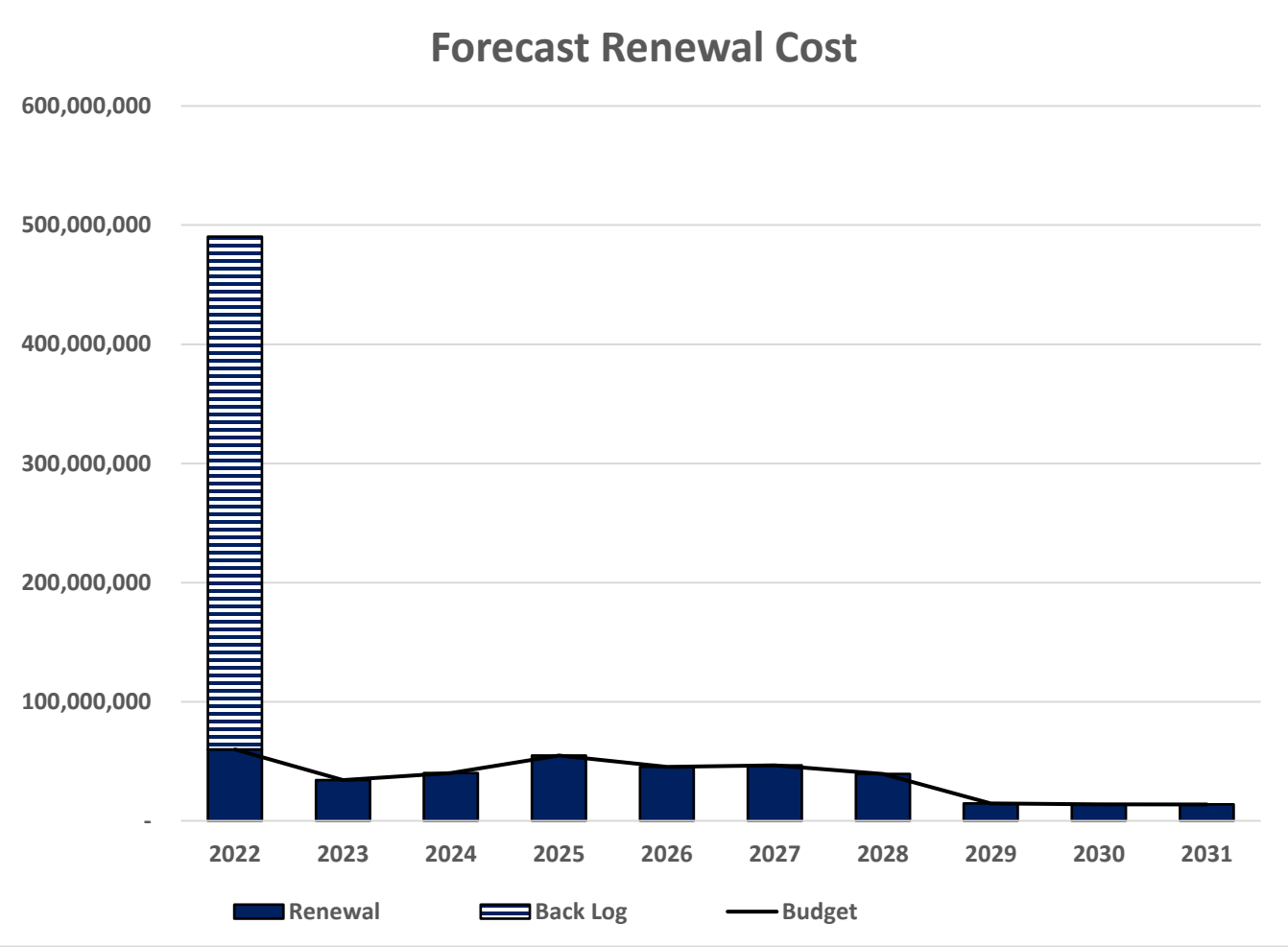
Table 45: Renewal Priority Ranking Criteria

Criteria	Weighting
Regulatory / Legal Compliance	20%
Co-ordination – Funding and Budgeting	25%
Risk Mitigation	25%
Health & Safety (Users & Staff)	10%
Lifecycle Impacts (Operations & Maintenance)	10%
Demand Driver (Growth)	10%
Total	**100%**

SUMMARY OF FUTURE RENEWAL COSTS

Forecast renewal costs are projected to increase over time if the asset stock increases. The forecast costs associated with renewals are shown relative to the proposed renewal budget in Figure 18.

Figure 18: Wastewater Asset Forecast Renewal Costs
All figure values are shown in 2021 dollars.



The significant amount highlighted in 2022 represents the cumulative backlog of deferred work needed to be completed that has been either identified through its current estimated condition or age per Table 39 when condition was not available. Deferred renewal (assets identified for renewal and not scheduled in capital works programs) are included and identified within the risk management plan. Prioritization of these projects will need to be funded and managed over time to ensure renewal occurs at the optimal time.

There is only sufficient budget to support the planned projects only and without additional funding the backlog will remain and continue to grow as future projects outside of the 10-year planning horizon continue to move forward into the 10-year scope. Continued deferrals of projects will lead to significantly higher operational and maintenance costs and will affect the availability of services in the future.

Forecasted renewals over the 10-year planning horizon include select sewer lateral replacements along Strathearne Avenue as well as main replacements along sections of Melvin Avenue, Marion Street and Fairfield Avenue in 2022. In 2023 the City will renew **$3.1 Million** of

Sewer laterals as well as **$4 Million** for network lining, **$3.35 Million** for Rockcliffe pumping station and **$4.7 Million** to complete the **$13.6 Million dollar** renewal of digesters 3 & 5 at the Woodward treatment plant. In 2024 the City will invest **$6 Million** for a secondary digestor at the Woodward plant**, $5.9 Million** to continue th e renew the North digester complex ($15.25 million total) as well as continued upgrades to the Environmental Lab. Other major renewals over the 10-year planning horizon include **$28.2 million** of renewals to the Dundas WWTP, **$44.5 million** for system relining's, **$36.6 million** for Sewer lateral replacements, **$8 million** for interceptor renewals, **$27 million** for primary clarifiers as well as continued renewals for SCADA components.

Deferring renewals create risks of higher financial costs, decreased availability, and decreased satisfaction with asset performance. Ultimately, continuously deferring renewals works ensures Hamilton will not achieve intergenerational equality. If Hamilton continues to push out necessary renewals, there is a high risk that future generations will be unable to maintain the level of service the customers currently enjoy. It will burden future generations with such significant costs that inevitably they will be unable to sustain them.

Properly funded and timely renewals will ensure the assets perform as expected and it is recommended to continue to analyze asset renewals based on criticality and availability of funds for future AM Plans.

3.2.6 Disposal Plan

Disposal includes any activity associated with the disposal of a decommissioned asset including sale, possible closure of service, decommissioning, disposal of asset materials, or relocation. Disposals will occur when an asset reaches the end of its useful life. The end of its useful life can be determined by factors such as excessive operation and maintenance costs, regulatory changes, obsolescence or demand for the structure has fallen.

Assets identified for possible decommissioning and disposal are shown in Table 46. A summary of the disposal costs and estimated reductions in annual operations and maintenance of disposing of the assets are also outlined. Any costs or revenue gained from asset disposals is included in future iterations of the AM Plan and the long-term financial plan.

Table 46: Assets Identified for Disposal

Asset	Reason for Disposal	Timing	Disposal Costs	Operations & Maintenance Annual Savings
Aberdeen Sewage Pumping Station	End of Life	2026	$1,310,000	$15,000

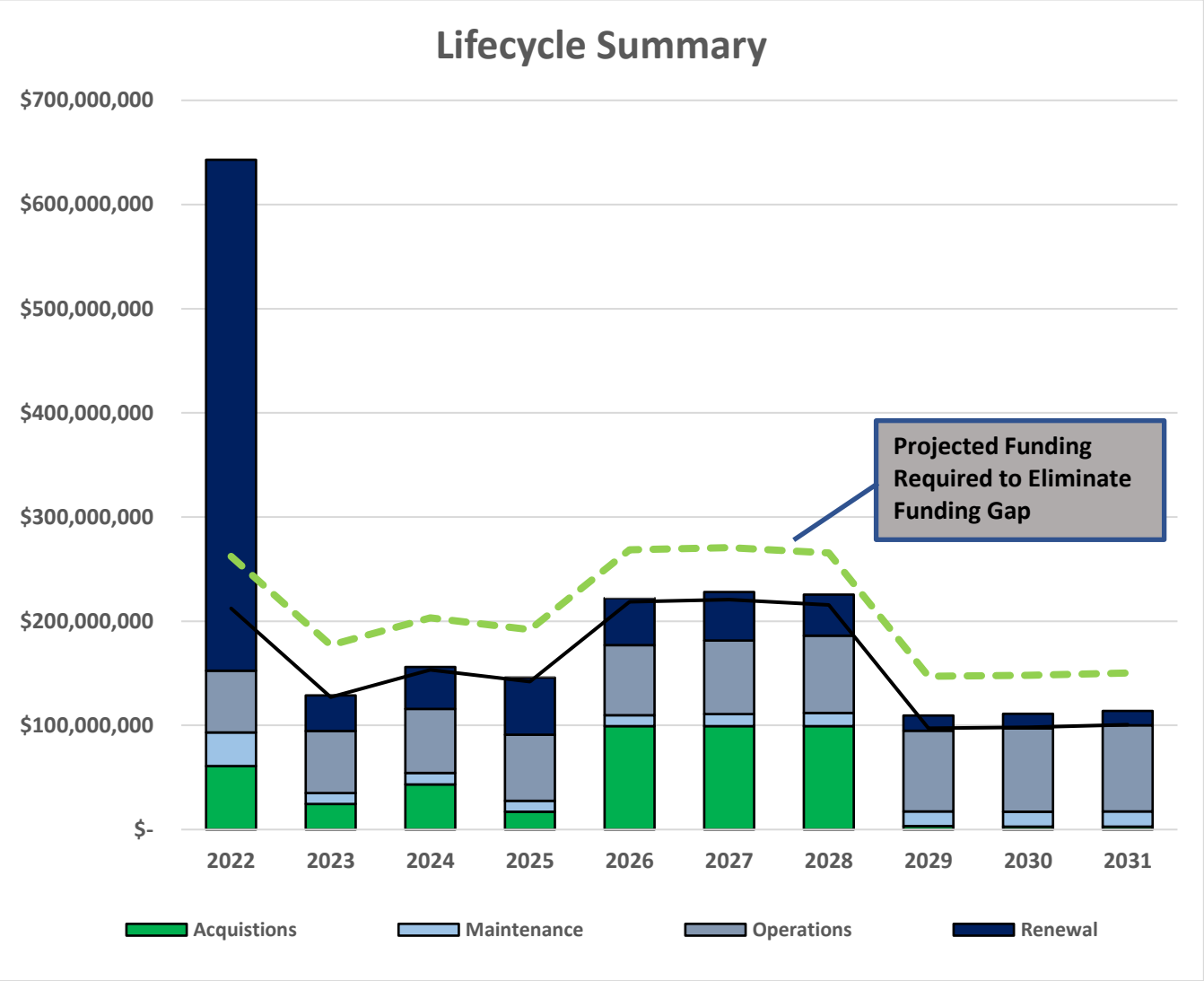
Table 46: Assets Identified for Disposal				
Asset	**Reason for Disposal**	**Timing**	**Disposal Costs**	**Operations & Maintenance Annual Savings**
Woodward WWTP Standby Bldg.	End of Life. New Power Centre installed	2022	$150,000	$3,000

SUMMARY OF ASSET FORECAST COSTS

The financial projections from this AM Plan are shown in Figure 19. These projections include forecast costs for acquisition, operation, maintenance, renewal, and disposal. These forecast costs are shown relative to the proposed budget.

The bars in the graphs represent the forecast costs needed to minimize the life cycle costs associated with the service provision. The proposed budget line indicates the estimate of available funding. The gap between the forecast work and the proposed budget is the basis of the discussion on achieving balance between costs, levels of service and risk to achieve the best value outcome.

Figure 19: Lifecycle Summary
All figure values are shown in 2021 dollars.



Currently there is insufficient budget to address the large backlog of renewal work projected by the plan. There is sufficient budget to address ongoing operational and maintenance needs for most of the planning period however with the assumption of assets over time and their increased costs there may be impacts to the service itself as illustrated by Figure 19. Without some adjustment to available funds or other lifecycle management decisions there will be insufficient budget to address all planned lifecycle activities.

Allocating sufficient resources is imperative to managing asset throughout their lifecycle. This can include funding for lifecycle activities, sufficient staffing, increased asset knowledge, improved planning, contracted services, additional equipment or vehicles to ensure that Hamilton is optimizing its lifecycle approach.

Without sufficient funding the City has little option but to defer these necessary lifecycle activities. Deferring important lifecycle activities is never recommended. The City will benefit from allocating sufficient resources to developing its long-term financial plan to ensure that over time the City can fully fund the necessary lifecycle activities. Funding these activities helps to ensure the assets are compliant, safe and effectively deliver the service the customers need and desire.

The lack of funding allocated for the backlog of renewals and the necessary lifecycle activities creates an additional issue which is intergenerational equity. Each year the City defers necessary lifecycle activities it pushes the ever-increasing financial burden on to future generations. It is imperative the City begin addressing the lack of consistent and necessary funding to ensure that intergenerational equity will be achieved. Over time, allocating sufficient funding on a consistent basis ensures that future generations will be able to enjoy the same standards being enjoyed today.

Over time the City will continue to improve its lifecycle data, and this will allow for informed choices as how best to mitigate those impacts and how to address the funding gap itself. This gap in funding future plans will be refined over the next three (3) years and improve the confidence and accuracy of the forecasts.

3.3 MANDATORY O.REG. 588/17 LEVELS OF SERVICE

Per Table 2 in O. Reg. 588/17, there are community levels of service that the City is required to report on in order to meet the provincial level of service requirement. These metrics are required to be reported, and so they have been separated from the customer levels of service described in Section 3.4.2. These qualitative metrics are reported below.

3.3.1 Mandatory O.Reg. 588/17 Community Levels of Service

Per Table 2 in O.Reg. 588/17, there are community levels of service that the City is required to report on in order to meet the provincial level of service requirement. These metrics are required to be reported, and so they have been separated from the customer levels of service described in Section 3.4.2. These qualitative metrics are reported below.

Scope:

1. Description, which may include maps, of the user groups or areas of the municipality that are connected to the municipal wastewater system

Most properties within the City's urban area are connected to the municipal wastewater system. Similar, to the water system, these urban properties include residential, industrial, commercial and institutional uses. Communities not within the urban area are likely treating wastewater using private septic systems.

4. WASTEWATER

There are two (2) wastewater treatment plants at the City which service different communities. A map of the wastewater catchment areas and the population serviced can be found in Section 3.1.

As previously mentioned, 32% of the City's wastewater linear network is combined sewer, which is a legacy system, and refers to pipes where wastewater and stormwater are collected in the same pipe. Modern areas of the City have separated sewers meaning that wastewater and stormwater are collected in separate pipes, and the City is working toward separating combined sewers where possible. Areas serviced by a combined sewer are also shown in Section 3.1. It has been identified as a Continuous Improvement item in Table 58 to continue to identify separating combined sewers as part of the renewal process.

Reliability

1. Description of how combined sewers in the municipal wastewater system are designed with overflow structures in place which allow overflow during storm events to prevent backups into homes.

During periods of heavy rainfall, snowmelt, or elevated lake levels the combined sewers are inundated with large volumes of stormwater that can exceed the capacity of the pipes. To avoid basement flooding and backups into homes, existing combined sewers have combined sewer overflows (CSOs), which relieve overloaded combined sewers into an adjacent storm sewer or receiving water bodies. Sewer overflows exist on both combined sewers and on separated sewers. Many overflows have been retroactively installed after basement flooding experiences. The design varies greatly among the overflow locations. The Hamilton Harbour Remedial Action Plan and the Pollution Prevention and Control Plan (PPCP) detail overflow locations along with characterizing each overflow site and setting priorities/strategies for remediation.

The City also has nine (9) combined sewer overflow tanks (CSOs). The purpose of these CSO tanks is to protect the system against surcharges and overflows during wet weather events by holding the untreated wastewater until the WWTPs have capacity to treat it. The CSO tanks are also necessary to protect the treatment plant against hydraulic overloading that could upset the sewage treatment processes. These tanks also contain overflow pipes which overflow into the natural watercourses during significant wet weather events. Water samples are regularly taken at these overflow locations. Additionally, overflow pump stations also exist in limited areas, and function when the wastewater system is at capacity and there is flooding risk to homes. These pump stations send wastewater to the storm sewer to be released into the environment.

Despite, these overflows, these events can still overwhelm the WWTPs resulting in a temporary bypass of certain treatment processes, and these bypasses are seasonally disinfected. WWTP operators monitor incoming flows and make operational adjustments to the treatment processes as required. To protect the plant from infrastructure damage, prevent flooding, and maintain compliance with the WWTP Environmental Compliance Approval (ECA) the WWTP operator will initiate a bypass event.

Flows from the Dundas WWTP are carefully controlled and flows exceeding the plant's capacity are directed to the Woodward WWTP rather than initiating a bypass at Dundas.

In 2021, all bypass events at the Woodward WWTP were the result of wet weather that generated flows in excess of the WWTP's treatment capacity. All bypasses are promptly reported to the Ministry of Environment, Conservation, and Parks (MECP) Spills Action Centre and to Public Health Services as required by the regulations. In 2021, there were 23 bypasses at the Woodward WWTP.

1. Description of the frequency and volume of overflows in combined sewers in the municipal wastewater system that occur in habitable areas or beaches

Overflows are triggered by wet weather (rainfall) events or snow melt. Frequency and volumes vary from site to site, based on intensity and duration of the wet weather event. Bypasses and overflows are reported online by type, volume and duration of each event.

In 2021 there were 149 known total events as shown in Table 47. The vast majority of these events are through uncontrolled and unmonitored sewer regulator structures. Many CSO assets do not have flow/volume monitoring, and the annual CSO events and volumes are estimated using a computer model. Projects are underway to install flow/volume monitoring at additional locations, but it is impractical to try to monitor every location where combined or sanitary sewage can overlow to the storm sewer system and make its way to the natural environment. Computer models will remain an important tool for CSO reporting in the future.

In addition, water at swimmable beaches is tested at a minimum of once a week during the swimming season for E. coli bacteria and residents are advised not to swim in these areas after a heavy rainfall. CSO outfalls are clearly labelled with signage.

2. Description of how stormwater can get into sanitary sewers in the municipal wastewater system, causing sewage to overflow into streets or backup into homes.

In addition to a storm event causing the combined sewers to exceed design capacity causing sewage overflows, there are other possible ways where inflow and infiltration (I&I) can make its way into the wastewater system.

Examples of situations where infiltration can occur include: defective joints, holes, and cracks in gravity main pipes can allow groundwater infiltration. This is particularly a concern at low elevation points in the system (e.g. pump stations, private infrastructure).

Examples of situations where inflow can occur include illegal sump pump, downspout, directed surface water flows, and drain connections where unanticipated stormwater is added to the system.

3.	Description of how sanitary sewers in the municipal wastewater system are designed to be resilient to avoid events described above in item 3.

Inflow & infiltration (I&I) studies have been conducted to quantify the expected amount of I&I, and rain gauges exist at various locations throughout the City to monitor rainfall. The City has used this information to establish design standards to convey flows under ultimate conditions, and design sheets for capacity. In addition, supervisors have the ability to monitor the system during wet weather events to optimize storage within the system and minimize overflows.

As indicated in item 1 above, overflow structures have also been designed to avoid events described in item 3 above.

4.	Description of the effluent that is discharged from sewage treatment plants in the municipal wastewater system.

The Ministry of Environment, Conservation and Parks (MECP) issues Environmental Compliance Approvals (ECAs) to wastewater treatment facilities in the province, which outlines the effluent limits that the City must be in compliance with. The effluent from the active treatment facilities in the City has documented compliance limits, objectives, and actual performance. The effluent criteria include but are not limited to effluent flow rates, and various quality parameters such as suspended solids and E. coli.

In 2021, the Woodward and Dundas WWTPs did not have any instances where effluent was not compliant with regulatory standards.

3.3.2 Mandatory O.Reg. 588/17 Technical Levels of Service

In addition, per Table 5 in O.Reg. 588/17, there are technical levels of service that the City is required to report on in order to meet the provincial level of service requirement. These quantitative metrics are reported below.

Table 47: Mandatory Technical Levels of Service

Service Attribute	Technical levels of service	Measure
Scope	**1.** Percentage of properties connected to the municipal wastewater system.	83% of 162,308 properties

Table 47: Mandatory Technical Levels of Service		
Service Attribute	**Technical levels of service**	**Measure**
Reliability	**1.** The number of events per year where combined sewer flow in the municipal wastewater system exceeds system capacity compared to the total number of properties connected to the municipal wastewater system.	149 events of 134,202 connected properties
	2. The number of connection-days* per year due to wastewater backups compared to the total number of properties connected to the municipal wastewater system.	446** connection days of 134,202 connected properties
	3. The number of effluent violations per year due to wastewater discharge compared to the total number of properties connected to the municipal wastewater system.	0

*Connection-days are defined as “the number of properties connected to a municipal system that are affected by a service issue, multiplied by the number of days on which those properties are affected by the service issue”.

**782 backups for single lateral connections, and 22 main line back-ups assuming five (5) properties each, multiplied by 0.5 days (12 hours) to resolve

3.4 MUNICIPALLY DEFINED LEVELS OF SERVICE

Levels of service are measures for what the City provides to its customers, residents, and visitors. Service levels are best described as the link between providing the outcomes the community desires, and the way that the City provides those services. Service levels are defined in three ways, customer values, customer levels of service and technical levels of service which are outlined in this section.

3.4.1 Customer Values

Customer values are what the customer can expect from their tax dollar in “customer speak”. These values are used to develop level of service statements.

Customer Values indicate:

- what aspects of the service is important to the customer;
- whether they see value in what is currently provided; and,
- the likely trend over time based on the current budget provision.

To develop these customer values, as stated in the AMP Overview, a Customer Engagement Survey was released in January 2022 on the Engage Hamilton platform. The survey received 184 submissions and contained 14 questions related to wastewater service delivery. The survey results can be found in Appendix “A” of the AMP Overview. While these surveys were used to establish customer values and customer performance measures, it’s important to note that the number of survey respondents only represents a small portion of the population.

The future intent is to release this survey on an annual basis to measure the trends in customer satisfaction and ensure that the City is providing the agreed level of service as well as to improve the marketing strategy to receive more responses. This has been noted in Table 58 in the Continuous Improvement section.

Table 48: Customer Values Service Objective			
Customer Values	**Customer Satisfaction Measure**	**Current Feedback**	**Expected Trend Based on Planned Budget**
Sewer backup does not occur in my home	Annual Customer Engagement Survey	The vast majority of survey respondents did not experience a sewer back-up in the past year. Though many respondents were concerned with the possibility of it happening due to aging infrastructure and climate change.	Maintain
No sewage odour in the air or in my home	Annual Customer Engagement Survey	A number of survey respondents have noticed odour issues related to wastewater in the City two or more times per year.	Maintain
No sewage discharge into environmental areas	Annual Customer Engagement Survey	A number of survey respondents do not think that the City behaves responsibly when returning wastewater back into the environment.	Maintain

3.4.2 Customer Levels of Service

Ultimately customer performance measures are the measures that the City will use to assess whether it is delivering the level of service the customers desire. Customer level of service measurements relate to how the customer feels about the City's water network in terms of their quality, reliability, accessibility, responsiveness, sustainability and over course, it's cost. The City will continue to measure these customer levels of service to ensure a clear understanding on how the customers feel about the services and the value for their rate dollars.

The Customer Levels of Service are considered in terms of:

Condition	How good is the service? What is the condition or quality of the service?
Function	Is it suitable for its intended purpose? Is it the right service?
Capacity/Use	Is the service over or under used? Do we need more or less of these assets?

4. WASTEWATER

In Table 49 under each of the service measures types (Condition, Function, Capacity/Use) there is a summary of the performance measure being used, the current performance, and the expected performance based on the current budget allocation.

Table 49: Customer Levels of Service

Type of Measure	Level of Service	Source	Performance Measure	Current Performance	Expected Trend Based on Planned Budget
Condition	Provide reliable wastewater services with minimal sewer back-ups.	Annual Customer Engagement Survey	96.3% of survey respondents had not had a sewer back-up in the last 12 months	Very Satisfied	Maintain
			45.7% of survey respondents were concerned with a sewer back-up occurring on their property	Unsatisfied	Maintain
			Confidence levels	**Medium**	
		Unknown	Average condition of WWTPs	Unknown	
			Confidence levels	**Very Low**	
		Condition Assessment	Average condition of lift station	Fair	Maintain
			Confidence levels	**Medium**	
		Combination of Inspection & Age Based	Average estimated condition of combined main	Good	Maintain
		Combination of Inspection & Age Based	Average estimated condition of wastewater main	Good	Maintain
			Confidence levels	**Medium**	
Function	Ensure wastewater is being collected and treated responsibly with minimal odour issues.	Annual Customer Engagement Survey	87.2% of survey respondents are satisfied with the wastewater services they receive.	Fairly satisfied	Maintain
			45.9% of survey respondents have noticed odour issues in the City related to wastewater	Unsatisfied	Maintain
			42.9% of survey respondents do not think Hamilton behaves responsibly when returning wastewater back to the environment	Unsatisfied	Slight Decrease
			Confidence levels	**Medium**	
		Customer BIMA Metric	15 odour complaints received from Woodward WWTP	Unsatisfied	Maintain
		Hansen	136 sewer odour complaints	Unsatisfied	Maintain
			Confidence levels	**Medium**	
Capacity	Ensure wastewater assets are used and within design capacity.	Annual Customer Engagement Survey	89.1% of survey respondents are connected to Hamilton's wastewater network.	High	Maintain
			Confidence levels	**Medium**	

3.4.3 Technical Levels of Service

Technical levels of service are operational or technical measures of performance, which measure how the City plans to achieve the desired customer outcomes and demonstrate effective performance, compliance and management. The metrics should demonstrate how effectively Hamilton delivers its services in alignment with its customer values; and should be viewed as possible levers to impact and influence the Customer Levels of Service. Hamilton will measure specific lifecycle activities to demonstrate how Hamilton is performing on delivering the desired level of service as well as to influence how customer perceive the services they receive from the assets.

Technical service measures are linked to the activities and annual budgets covering Acquisition, Operation, Maintenance, and Renewal.

Service and asset managers plan, implement and control technical service levels to influence the service outcomes.

Table 50 shows the activities expected to be provided under the current 10 year Planned Budget allocation, and the Forecast activity requirements being recommended in this AM Plan.

Table 50: Technical Levels of Service

LIFECYCLE ACTIVITY	PURPOSE OF ACTIVITY	ACTIVITY MEASURE	CURRENT PERFORMANCE*	TARGET	RECOMMENDED PERFORMANCE **
Acquisition	Ensure wastewater assets are used and within design capacity.	% Main Wastewater Pump Station Construction Progress to Date at Woodward WWTP	90	No Data	100%
		% Tertiary Treatment Construction Progress to Date at Woodward WWTP	75.75	No Data	100%
		# WW / Storm Substantially Complete Projects	19	No Data	No Data
		Budget	**$42,742,500**		**$42,742,500**
Operation	Ensure wastewater is being collected and treated responsibly with minimal odour issues.	# of Main Line Sewer Back-ups	22	No Data	No Data
		# Lateral Back-up Investigations	782	No Data	No Data
		# of Sewer Odour Investigations	136	No Data	No Data
		% of sewer odour investigations started within 12 hrs - 80%	94.5%	80%	80%
		% completion monthly outstation inspections	92.12%	80%	80%
		% Conducted required sampling as per the Woodward ECA (EME sampling only)	100%	100%	100%
		# of Raw WWTP Wastewater Samples Collected (4232)	24	24	24
		# of STP FE WWTP Samples Collected (4233)	887	No Data	No Data
		Active Sewer Discharge Permits (2646)	287	No Data	No Data
		Mainline sewers inspected per year (4253)	107 km	100	100
		Woodward WWTP Volume treated wastewater (ML) (2853)	73,332.08	No Data	No Data
		Dundas WWTP Volume treated wastewater (ML) (2854)	2,868.01	No Data	No Data
		METRIC - Total Weight Biosolids Produced (Tonnes) (2874)	21,133.95	No Data	No Data
		Number of CSO tank overflow events	27	No Data	No Data
		Number of CSO outfall overflow events	85	No Data	No Data
		Number of overflow lift station overflow events	14	No Data	No Data
		% of CSO overflows with monitors	15%	No Data	No Data

Table 50: Technical Levels of Service

LIFECYCLE ACTIVITY	PURPOSE OF ACTIVITY	ACTIVITY MEASURE	CURRENT PERFORMANCE*	TARGET	RECOMMENDED PERFORMANCE **
		Total ML of wastewater overflowed into natural watercourse in 2021	4,059.84	No Data	No Data
		Number of laterals inspected per year (4254)	2664	2200	2200
		Budget	**$49,442,892**		**$49,442,892**
Maintenance	Provide reliable wastewater services with minimal sewer back-ups.	# of Sewer Lateral Repair / Replacement Emergency & Scheduled	422	No Data	No Data
		% of emergency sewer repairs/replacement within 2 days - 100%	100%	100%	100%
		% of scheduled sewer lateral repairs/replacement within 45 days - 80%	98.92	80%	80%
		% of scheduled sewer repairs/replacement within 45 days - 80%	97.58	80%	80%
Renewal	Provide reliable wastewater services with minimal sewer back-ups.	Sewer laterals CIPP rehabilitation count/yr	500	No Data	No Data
		Sewermain CIPP rehabilitation km/yr	23.3 km	No Data	No Data
		Budget	**$34,284,500**		**$79,284,496**

Note: * Current activities related to Planned Budget.
**** Expected performance related to forecast lifecycle costs.**
***** B**

It is important to monitor the service levels regularly as circumstances can and do change. Current performance is based on existing resource provision and work efficiencies. It is acknowledged changing circumstances such as technology and customer priorities will change over time.

At this time, many of the existing technical metrics do not have a target. These metrics should be improved to include a target to be in line with SMART objectives identified in the AMP Overview.

As the City's asset management maturity increases, and with the implementation of the EAM project mentioned in Section 7.2.3 of the AMP Overview, the City will also have more capacity to measure additional metrics. In addition, the City should investigate the BIMA scorecard further to ensure data and assumptions are consistent with ministry and City reporting. In addition, often times wastewater and stormwater metrics have been reported together, and these should be separated for ease of reporting which has been identified as a continuous improvement item.

3.4.4 Level of Service Analysis

At this time, the City's technical metrics for Wastewater assets are based on meeting regulatory and legislative requirements including Environmental Compliance Approvals (ECAs). It is evident per Table 50 that the City is typically meeting these standards with a few exceptions. However, customer preferences and expectations do not always match minimum legislated requirements, which is discussed below. As mentioned in Section 3.4.2, while these surveys were used to establish customer values and customer performance measures, it's important to note that the number of survey respondents currently only represents a small portion of the population.

CONDITION

The majority of survey respondents had not had a sewer back-up in 12 months and were considered to be very satisfied with the service. However, many survey respondents appeared to be concerned with possible sewer back-ups, and cited condition and climate change as reasons they were concerned with the possibility of a back-up.

As shown throughout the report, the condition of the main lines (e.g. combined, separated and interceptor) are typically in Good condition. Per the technical level of service table, the most frequent cause of sewer back-ups is with an individual home's lateral connection (782 instances), and not with main line infrastructure (22 instances). These issues can be at the fault of a deficient sewer lateral (e.g. tree roots, condition, settlement). The City investigates these issues typically within 12 hours, although technical metrics show the target as 2 days. The City will also investigate allocating more specific metrics for this issue which has been identified as a continuous improvement item in Table 58.

FUNCTION

The majority of survey respondents indicated they were satisfied with the wastewater services they received. However, many survey respondents indicated they had noticed sewage odours throughout the City on a few occasions and were considered to be unsatisfied with this level of service. Per the technical levels of service table, although odour complaints did occur, the City did respond to all of these complaints, and responded to 95% of these complaints within 24 hours which exceeds the City target of 80%. The City will continue to investigate odour complaints and investigate opportunities to prevent these complaints from occurring. The City will also investigate allocating more specific metrics for this issue which has been identified as a continuous improvement item in Table 58.

In addition, many survey respondents felt that the City was not responsible when returning wastewater back into the natural watercourse. As explained throughout the report, the City is working toward improving the legacy combined sewer system to reduce the frequency of combined sewer overflows. The technical levels of service show the number of overflow events and where these events have occurred. This data is publicly available on the website. However, it's important to note that these overflows do protect the system as well as properties in the City

connected to combined sewers from back-ups and it is a complex problem. As previously mentioned, the City has spent more than 30 years working to improve the system with total investments exceeding $550 million and will be continuing to improve the system over time.

CAPACITY

At this time, there were not any key findings associated with the wastewater capacity with respect to customer levels of service but the majority of survey respondents were shown to be connected to the municipal wastewater system, which is expected.

Although, there are some areas where the City could investigate capacity from a technical aspect to align with customer values. To quantify the volume of water exiting the outfalls, the City is in the process of acquiring monitoring at additional overflow locations. In the interim, Hamilton generates an annual report that uses the wastewater system model to compute event based overflow volumes for every CSO outfall (where there is no volumetric monitroring). The City has completed a Flooding & Drainage Improvement study to develop a long-term strategy to reduce and eliminate combined sewer overflows. This conceptual study will be presented to PWC in July. Finally, the City could also investigate adding additional odour control units in areas deemed to be hot spots for odour complaints.

3.5 FUTURE DEMAND

The ability for the City to be able to predict future demand for services enables the City to plan ahead and identify the best way of meeting the current demand while being responsive to inevitable changes in demand. Demand will inevitably change over time and will impact the needs and desires of the community in terms of the quantity of services (more communities connecting to the service) and types of service required (larger facilities to process increased volumes).

Demand is defined as the desire customers have for assets or services and that they are willing to pay for. These desires are for either new assets/services or current assets.

3.5.1 Demand Drivers

For wastewater, the key drivers are population change, climate change, technological changes, legislative requirements and customer preferences and expectations. A future continuous improvement item is to identify additional demand drivers.

3.5.2 Demand Forecasts

The high level present position and projections for demand drivers that may impact future service delivery and use of assets have been identified and documented in Table 51. At this time, specific projections have not been calculated and will be updated in the 2025 AM Plan per the timelines stated in the AMP Overview. Growth projections have been shown in the AMP Overview.

3.5.3 Demand Impact and Demand Management Plan

The impact of demand drivers that may affect future service delivery and use of assets are shown in Table 51.

Demand for new services will be managed through a combination of managing existing assets, upgrading of existing assets and providing new assets to meet demand and demand management. Demand management practices can include non-asset solutions, insuring against risks, and managing failures.

Opportunities identified to date for demand management are shown in Table 51. Climate change adaptation is included in Table 52. Further opportunities will be developed in future revisions of this AM Plan, as identified in Table 58 in the Continuous Improvement Section.

Table 51: Demand Management Plan

DEMAND DRIVER	CURRENT POSITION	PROJECTION	IMPACT ON SERVICES	DEMAND MANAGEMENT PLAN
Population Change	573,000 (2021)	636,080 (2031)	Greater treatment capacity at WWTP.	Increase budget due to increased costs for treatment. New staff may be required for legislative compliance. Adjust budgets, long-term financial plan, and AM Plan. Construction on Woodward WWTP is currently scheduled to commence in 2026 and be completed in 2030.
Population Change	573,000 (2021)	636,080 (2031)	More WW main required.	Investigate need for new lift stations. New staff may be required for legislative compliance. Adjust budgets, long-term financial plan, and AM Plan. These needs are being investigated by the Water, Wastewater and Stormwater Masterplan which will be completed in early 2023.
Customer Preferences and Expectations	Existing private properties not on a Hamilton wastewater catchment may desire to join system.	More properties connected to Hamilton wastewater catchment.	Additional connections require operations, maintenance and renewals.	Future extensions would be required, and pipe capacities would need to be assessed. New staff may be required for legislative requirements. Adjust budgets, long-term financial plan, and AM plan.

3.5.4 Asset Programs to meet Demand

The new assets required to meet demand may be acquired, donated or constructed. Additional assets are discussed in Section 3.2.1.

Acquiring new assets will commit the City to ongoing operations, maintenance and renewal costs for the period that the service provided from the assets is required. These future costs are identified and considered in developing forecasts of future operations, maintenance and renewal costs for inclusion in the long-term financial plan.

3.5.5 Climate Change Adaptation

The impacts of climate change may have a significant impact on the assets we manage and the services they provide. In the context of the asset management planning process, climate change can be considered as both a future demand and a risk.

Climate change impacts on assets will vary depending on the location and the type of services provided, as will the way in which those impacts are responded to and managed.[11]

As a minimum the City must consider how to manage our existing assets given potential climate change impacts for our region.

Risk and opportunities identified to date are shown in Table 52. This is a continuous process and will be updated in the 2025 AM Plan per the timelines outlined in the AMP Overview.

Table 52: Managing the Impact of Climate Change on Assets and Services

CLIMATE CHANGE DESCRIPTION	PROJECTED CHANGE	POTENTIAL IMPACT ON ASSETS AND SERVICES	MANAGEMENT
Increased wet weather events	Increased demand on combined sewer system.	Wastewater system at capacity causing more combined sewer overflows into natural watercourse.	Monitor overflows and bypasses. Develop plans to mitigate the increased demand (e.g. increased wet weather treatment capacity, additional wet weather storage capacity, or removal of wet weather flow from the combined sewer system).

[11] IPWEA Practice Note 12.1 Climate Change Impacts on the Useful Life of Infrastructure

Additionally, the way in which the City constructs new assets should recognize that there is opportunity to build in resilience to climate change impacts. Building resilience can have the following benefits:

- Assets will withstand the impacts of climate change;
- Services can be sustained; and,
- Assets that can endure may potentially lower the lifecycle cost and reduce their carbon footprint.

Table 53 summarizes some asset climate change resilience projects the City is currently pursuing.

Table 53: Building Asset Resilience to Climate Change

PROJECT	PROJECT DESCRIPTION	CLIMATE CHANGE IMPACT	BUILD RESILIENCE IN NEW WORKS
West Mountain Inflow & Infiltration (I/I) Study	Quantify I/I generated in West Mountain service areas.	I/I will increase as wet weather events increase due to climate change and may increase likelihood of basement flooding.	To improve Hamilton's climate resiliency by decreasing our vulnerability to extreme weather, minimizing future damages, take advantage of opportunities, and better recover from future damages.
Lift Station Upgrades	Upgrades increasing energy efficiency of equipment at various stations as well as increased capacity.	Old technology at facilities leads to wasted energy which increases GHG emissions, in addition increased capacity provides additional resilience.	To increase the number of new and existing high performance state-of-the-art buildings that improve energy efficiency and adapt to a changing climate.
Combined Sewer Upgrades	Ongoing work to upgrade the capacity and separate combined sewer infrastructure.	Significant wet weather events which may increase due to climate change may cause combined sewers to overflow more often into natural watercourses.	To improve Hamilton's climate resiliency by decreasing our vulnerability to extreme weather, minimizing future damages, take advantage of opportunities, and better recover from future damages.
WWTP Expansions	Expand treatment capacity at WWTPs for additional wet weather flow capacity.	Significant wet weather events which may increase due to climate change may cause WWTP to reach capacity and bypass wastewater into natural watercourse more often.	To improve Hamilton's climate resiliency by decreasing our vulnerability to extreme weather, minimizing future damages, take advantage of opportunities, and better recover from future damages.
Sewer Pipe Flow Monitoring	Monitors reveal whether wastewater sewers are receiving substantial amounts of rainwater inflow and groundwater infiltration (I/I) which can result in flooding.	Significant wet weather events which may increase due to climate change may cause the combined sewer system to reach capacity.	To improve Hamilton's climate resiliency by decreasing our vulnerability to extreme weather, minimizing future damages, take advantage of opportunities, and better recover from future damages.
Back Water Valves for Outfalls	Installation of back water valves at all CSO outfall locations. Mitigation/diversion of wet weather flows from the environment.	Significant wet weather events which may increase due to climate change may cause the combined sewer system to reach capacity.	To improve Hamilton's climate resiliency by decreasing our vulnerability to extreme weather, minimizing future damages, take advantage of opportunities, and better recover from future damages.
CCTV Inspections	Lateral CCTV Inspections, CCTV & Zoom Camera Inspections - proactive with inspections to help determine structural condition of pipes, presence of blockages,	Significant wet weather events which may increase due to climate change may cause the combined sewer system to reach capacity.	To improve Hamilton's climate resiliency by decreasing our vulnerability to extreme weather, minimizing future damages, take advantage of opportunities, and better recover from future damages.
Cured in Place Pipe Rehabilitation Program	Cured in Place Pipe (CIPP) Rehabilitation Program - when initiated, helps prevent infiltration and exfiltration's of water from the sewer system.	I/I will increase if wet weather events increase due to climate change and will increase likelihood of basement flooding.	To improve Hamilton's climate resiliency by decreasing our vulnerability to extreme weather, minimizing future damages, take advantage of opportunities, and better recover from future damages.
Children's Water Festival	Support and Coordination of the annual Children's Water Festival. Educate children about importance of water quality and conservation.	The City is a steward of the infrastructure built and needs to ensure future generations are educated about climate change's effects on our infrastructure.	To ensure all our work promotes equity, diversity, health and inclusion and improves collaboration and consultation with all marginalized groups, including local Indigenous Peoples.
Master Plan Update	Identify infrastructure needs related to growth. Guiding policy item related to GHG emission reduction.	Population increases and increased wet weather events will change the design capacity of the system, and so the City needs to plan accordingly.	To improve Hamilton's climate resiliency by decreasing our vulnerability to extreme weather, minimizing future damages, take advantage of opportunities, and better recover from future damages.
Flooding and Drainage Improvement Framework	Master study to identify existing performance of the City's combined sewer network and to identify system enhancements to reduce the risk of basement flooding.	Develop a long range plan to improve the performance of the combined sewer network and to reduce basement flooding during wet weather.	To improve Hamilton's climate resiliency by decreasing our vulnerability to extreme weather, minimizing future damages, take advantage of opportunities, and better recover from future damages.

The impact of climate change on assets is a new and complex discussion and further opportunities will be developed in future revisions of this AM Plan.

3.6 RISK MANAGEMENT

The purpose of infrastructure risk management is to document the findings and recommendations resulting from the periodic identification, assessment and treatment of risks associated with providing services from infrastructure, using the fundamentals of International Standard ISO 31000:2018 Risk management – Principles and guidelines.

Risk Management is defined in ISO 31000:2018 as: 'coordinated activities to direct and control with regard to risk[12].

The City is developing and implementing a formalized risk assessment process to identify risk associated with service delivery and to implement proactive strategies to mitigate risk to tolerable levels. The risk assessment process identifies credible risks associated with service delivery and will identify risks that will result in loss or reduction in service, personal injury, environmental impacts, a 'financial shock', reputational impacts, or other consequences.

The risk assessment process identifies credible risks, the likelihood of those risks occurring, and the consequences should the event occur. The City is further developing its risk assessment maturity with the inclusion of a risk rating, evaluation of the risks and development of a risk treatment plan for those risks that are deemed to be non-acceptable in the next iteration of the AM Plan.

3.6.1 Critical Assets

Critical assets are defined as those which have a high consequence of failure causing significant loss or reduction of service. Critical assets have been identified and along with their typical failure mode, and the impact on service delivery, are summarized in Table 54. Failure modes may include physical failure, collapse or essential service interruption.

Table 54: Critical Assets

CRITICAL ASSET(S)	FAILURE MODE	IMPACT
Wastewater Treatment Plants	Essential Service Interruption Contamination	Untreated wastewater returns to the environment and degrades Hamilton Harbour and the integrated natural ecosystems.
Lift Station	Essential service interruption Contamination	Wet well overflows resulting in wastewater spills and property damage caused by back-ups.
Critical Combined / Wastewater Main	Physical Failure	Sewer backups resulting in wastewater spills and property damage caused by back-ups.

[12] ISO 31000:2009, p 2

Table 54: Critical Assets		
CRITICAL ASSET(S)	**FAILURE MODE**	**IMPACT**
CSO	Physical failure	CSO tank leaks and degrades Hamilton Harbour and the integrated natural ecosystems.
SCADA	System Failure	Essential service interruption to WWTP and lift stations causing above failures.

By identifying critical assets and failure modes an organization can ensure that investigative activities, condition inspection programs, maintenance and capital expenditure plans are targeted at critical assets.

3.6.2 Risk Assessment

The risk assessment process identifies credible risks, the likelihood of the risk event occurring, the consequences should the event occur, development of a risk rating, evaluation of the risk and development of a risk treatment plan for non-acceptable risks.

An assessment of risks associated with service delivery will identify risks that will result in loss or reduction in service, personal injury, environmental impacts, a ‘financial shock’, reputational impacts, or other consequences.

Critical risks are those assessed with ‘Very High’ (requiring immediate corrective action) and ‘High’ (requiring corrective action) risk ratings identified in the Infrastructure Risk Management Plan. The residual risk and treatment costs of implementing the selected treatment plan is shown in Table 55. It is essential that these critical risks and costs are reported to management. Additional risks will be developed in future iterations of the plan and is identified in Table 58 in the Continuous Improvement Section the plan.

Table 55: Risks and Existing Controls
Note * The residual risk is the risk remaining after the selected risk treatment plan is implemented.

SERVICE OR ASSET AT RISK	WHAT CAN HAPPEN	RISK RATING	EXISTING CONTROLS
WWTP	Plant reaches capacity due to significant wet weather event.	High	Bypasses exist at each treatment level to bypass plant when necessary.
Lift Station	Pump failure or station reaches capacity.	High	Monthly station checks and verifications by operators. Overflows at station. Contingency planning. Emergency SOPs.
Critical WW, Interceptor, or Combined Main	Blockage due to structural failure, oils or debris	High	Inspections occur based on priority.
Forcemain	Break due to pressure transient, aging pipe, sewer gas build up.	High	Emergency sewer repair contract. Some forcemains have a redundancy (e.g. twinned).

3.6.3 Infrastructure Resilience Approach

The resilience of our critical infrastructure is vital to the ongoing provision of services to customers. To adapt to changing conditions the City needs to understand its capacity to 'withstand a given level of stress or demand', and to respond to possible disruptions to ensure continuity of service. An example would be how wastewater assets operate during their peak usage. We do not currently measure our resilience in service delivery and will be included in the next iteration of the AM Plan.

Resilience covers the capacity of the City to withstand any service disruptions, act appropriately and effectively in a crisis, absorb shocks and disturbances as well as adapting to ever changing conditions. Resilience is built on aspects such as response and recovery planning, financial capacity, climate change, risk assessment and crisis leadership.

3.6.4 Service and Risk Trade-Offs

The decisions made in AM Plans are based on the objective to achieve the optimum benefits from the available resources. At this time, the City does not have sufficient data to present risks and tradeoffs. This information will be presented in the **2025** AM Plan regarding Proposed Levels of Service per the timelines outlined in the AMP Overview.

3.7 FINANCIAL SUMMARY

This section contains the financial requirements resulting from the information presented in the previous sections of this AM Plan. Effective asset and financial management will enable the City to ensure its wastewater network provides the appropriate level of service for the City to achieve its goals and objectives. Reporting to stakeholders on service and financial performance ensures the City is transparently fulfilling its stewardship accountabilities.

Long-Term financial planning (LTFP) is critical for the City to ensure the networks lifecycle activities such as renewals, operations, maintenance and acquisitions can happen at the optimal time. The City is under increasing pressure to meet the wants and needs of its customer while keeping costs at an affordable level and maintaining its financial sustainability.

Without funding asset activities properly for its wastewater network; the City will have difficult choices to make in the future which will include options such as higher cost reactive maintenance and operational costs, reduction of service and potential reputational damage.

The City will be seeking to fully incorporate its wastewater network into the LTFP. Aligning the LTFP with the AM Plan is critical to ensure the all the networks needs will be met while the City is finalizing a clear financial strategy with measurable financial targets. The financial projections will be improved as the discussion on desired levels of service and asset performance matures.

3.7.1 Sustainability of service delivery

There are two key indicators of sustainable service delivery that are considered in the AM Plan for this service area. The two indicators are the:

- asset renewal funding ratio (proposed renewal budget for the next 10 years / forecast renewal costs for next 10 years); and,
- medium term forecast costs/proposed budget (over 10 years of the planning period).

ASSET RENEWAL FUNDING RATIO

Asset Renewal Funding Ratio[13] **45.7**%

The Asset Renewal Funding Ratio is used to determine if the City is accommodating asset renewals in an **optimal** and **cost effective** manner from a timing perspective and relative to financial constrains, the risk the City is prepared to accept and service levels it wishes to maintain. Ideally the target renewal funding ratio should be ideally between **90% - 110%** over the entire planning period. A low indicator result generally indicates that service levels are achievable however the expenditures are below this level because the City is challenged to fund the necessary work or has historical preferences or constraints that prevent Hamilton from utilizing additional debt.

[13] AIFMM, 2015, Version 1.0, Financial Sustainability Indicator 3, Sec 2.6, p 9.

Over the next 10 years the City expects to have **45.7%** of the funds required for the optimal renewal of assets. By only having sufficient funding to renew **45.7%** of the required assets in the appropriate timing it will inevitably require difficult trade off choices that could include:

- a reduction of the level of service and availability of assets;
- increased complaints and reduced customer satisfaction;
- increased reactive maintenance and renewal costs; and,
- damage to the City's reputation and risk of fines or legal costs.

The lack of renewal resources will be addressed in future AM Plan's while aligning the plan to the LTFP. This will allow staff to develop options and long-term strategies to address the renewal rate. The City will review its renewal allocations once the entire inventory has been confirmed and amalgamated.

MEDIUM TERM – TEN (10) - YEAR FINANCIAL PLANNING PERIOD

This AM Plan identifies the forecast operations, maintenance and renewal costs required to provide an agreed level of service to the community over a ten (10) - year period. This provides input into ten (10) - year financial and funding plans aimed at providing the required services in a sustainable manner. As the City continues to develop condition profiles and necessary works are identified based on their condition, it is anticipated operation and maintenance forecasts will increase significantly.

This forecast work can be compared to the proposed budget over the first ten (10) - years of the planning period to identify any funding shortfall.

The forecast operations, maintenance and renewal costs over the ten (10) - year planning period is **$163,083,936** on average per year.

The proposed (budget) operations, maintenance and renewal funding is **$113,198,976** on average per year giving a ten (10) - year funding **shortfall** of **$49,884,956** per year or **$498,849,560** in total over the ten year planning period . This indicates that **69.41%** of the forecast costs needed to provide the services documented in this AM Plan are accommodated in the proposed budget. Note, these calculations exclude acquired assets.

Funding an annual funding shortfall or funding 'gap' of **$49,884,956** per year cannot be addressed in a single year and has not been incorporated as identified within this plan into any existing plan. The Gap will require vetting, planning and resources to begin to incorporate gap management into the future budgets. This gap will need to be managed over time to reduce it in a sustainable manner and limit financial shock to customers. Options for managing the gap include;

- Financing strategies – increased funding, block funding for specific lifecycle activities, long term debt utilization
- Adjustments to lifecyle activites – increase/deacrease maintenance or operations, increase/decrease frequency of renewals, limit acquisitions or dispose of underutilized assets

- Influence level of service expectations or demand drivers

These options and others will allow Hamilton to ensure the gap is managed appropriately and ensure the level of service ouctomes the customers desire.

Providing sustainable services from infrastructure requires the management of service levels, risks, forecast outlays and financing to achieve a financial indicator of approximately 1.0 for the first years of the AM Plan and ideally over the ten (10) - year life of the Long-Term Financial Plan.

3.7.2 Forecast Costs (Outlays) For the Long-Term Financial Plan

Table 56 shows the forecast costs (outlays) required for consideration in the ten (10) - year long-term financial plan.

Providing services in a financially sustainable manner requires a balance between the forecast outlays required to deliver the agreed service levels with the planned budget allocations in the operational and capital budget. The City will begin developing its long-term financial plan (LTFP) to incorporate both the operational and capital budget information and help align the LTFP to the AM Plan which is critical for effective asset management planning.

A gap between the recommended forecast outlays and the amounts allocated in the operational and capital budgets indicates further work is required on reviewing service levels in the AM Plan.

The City will manage the ‘gap’ by continuing to develop this AM Plan to provide guidance on future service levels and resources required to provide these services in consultation with the community. Options to manage the gap include reduction and closure of low use assets, increased funding allocations, reduce the expected level of service, utilize debt based funding over the long term, adjustments to lifecycle activities, improved renewals and multiple other options or combinations of options. These options will be explored in the next AM Plan and the City will provide analysis and options for Council to consider going forward.

Table 56: Forecast Costs (Outlays) for the Long-Term Financial Plan
Forecast costs are shown in 2021 dollar values.

YEAR	ACQUISITION	OPERATION	MAINTENANCE	RENEWAL	DISPOSAL	TOTAL
2022	$61,038,000	$59,194,776	$32,185,000	$59,908,000	0	$212,325,776
2023	$24,590,000	$58,426,964	$9,750,000	$34,275,000	0	$127,041,968
2024	$43,395,000	$60,198,444	$9,600,000	$40,210,000	0	$153,403,440
2025	$17,170,000	$61,421,980	$8,500,000	$54,785,000	$110,000	$141,986,976
2026	$99,194,664	$64,897,460	$8,158,000	$45,158,332	$1,190,000	$218,598,464
2027	$99,194,664	$66,923,880	$8,158,000	$46,448,332	0	$220,724,880
2028	$99,194,664	$69,031,352	$8,158,000	$39,328,332	0	$215,712,352
2029	$31,900,00	$71,223,128	$8,158,000	$14,670,000	0	$97,241,128
2030	$2,770,000	$73,502,576	$8,158,000	$13,805,000	0	$98,235,576
2031	$2,770,000	$75,873,200	$8,158,000	$13,725,000	0	$100,526,200

3.7.3 Funding Strategy

The proposed funding for assets is outlined in the City's operational budget and ten (10) - year capital budget.

These operational and capital budgets determine how funding will be provided, whereas the AM Plan typically communicates how and when this will be spent, along with the service and risk consequences. Future iterations of the AM Plan will provide service delivery options and alternatives to optimize limited financial resources.

3.7.4 Valuation Forecasts

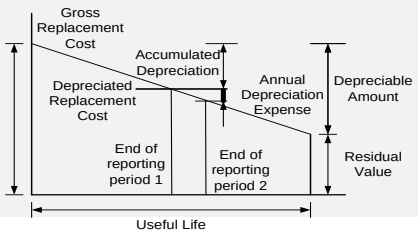
Asset values are forecast to increase as projections improve and can be validated as market pricing. The net valuations will increase significantly despite some assets being programmed for disposal that will be removed from the register over the ten (10) – year planning horizon.

Any additional assets will add to the operations and maintenance needs in the longer term and would also require additional costs due to future renewals obligations. Any additional assets will also add to future depreciation forecasts. Any disposals of assets would decrease the operations and maintenance needs in the longer term and removes the high costs renewal obligations.

3.7.5 Asset Valuations

The best available estimate of the value of assets included in this AM Plan are shown below. The assets are valued at estimated replacement costs:

Replacement Cost (Current/Gross)	$7,254,000,000
Depreciable Amount	$7,254,000,000
Depreciated Replacement Cost[14]	$4,134,922,240
Depreciation	$ 118,148,849



The current replacement cost is the most common valuation approach for specialized infrastructure assets such as infrastructure waste water assets. The methodology includes establishing a comprehensive asset registry, assessing replacement costs (based on market pricing for the modern equivalent assets), determining the appropriate depreciation method, testing for impairments, and determining remaining useful life.

3.7.6 Key Assumptions Made in Financial Forecasts

In compiling this AM Plan, it was necessary to make some assumptions. This section details the key assumptions made in the development of this AM Plan and should provide readers with an understanding of the level of confidence in the data behind the financial forecasts.

Key assumptions made in this AM Plan are:

- Operational forecasts are based on current budget allocations and are the basis for the projections for the 10-year horizon and do not address other operational needs not yet identified;
- Maintenance forecasts are based on current budget allocations and do not identify all asset needs at this time. It is solely based on planned activities;
- 1% p.a. has been added to maintenance forecasts to accommodate for donated assets assumed over the 10-year planning horizon;

[14] Also reported as Written Down Value, Carrying or Net Book Value.

- 1.03 % p.a has been added to operational forecasts to accommodate for donated assets assumed over the 10-year planning horizon; and,
- Replacement costs were based on historical costing and engineering estimates. They were also made without determining what the asset would be replaced with in the future.

3.7.7 Forecast Reliability and Confidence

The forecast costs, proposed budgets, and valuation projections in this AM Plan are based on the best available data. For effective asset and financial management, it is critical that the information is current and accurate. Data confidence is defined in the AMP Overview.

The estimated confidence level for and reliability of data used in this AM Plan is shown in Table 57.

Table 57: Data Confidence Assessment for Data used in AM Plan

DATA	CONFIDENCE ASSESSMENT	COMMENT
Demand drivers	Medium	Further investigation is required to better understand demand drivers
Growth projections	Medium	Current growth projections will need to be vetted an improved. Continuous improvements are required and identified
Acquisition forecast	Medium	Currently based on 2019 DC study and SME opinion. Continuous improvements are required and identified
Operation forecast	Medium	Currently budget based and requires future improvement to ensure allocation is accurate
Maintenance forecast	Medium	Currently budget based and requires future improvement to ensure allocation is accurate
Renewal forecast - Asset values	Medium	Currently budget based and requires future improvements to further identify specific needs
- Asset useful lives	Low	Based on SME opinion. Continuous improvement required to ensure data is vetted and ensure it aligns with Hamilton's actual practices
- Condition modelling	Low	Mixture of assessment methods. Requires standardization along with predictable timelines for assessments
Disposal forecast	Low	Current disposal information is rolled into renewal. Continuous improvements are required to ensure accurate data is available.

The estimated confidence level for and reliability of data used in this AM Plan is considered to be a **Medium** confidence level.

3.8 PLAN IMPROVEMENT AND MONITORING

3.8.1 Status of Asset Management Practices[15]

ACCOUNTING AND FINANCIAL DATA SOURCES

This AM Plan utilizes accounting and financial data. The sources of the data:

- 2022 Capital & Operating Budgets;
- 2021 Tender Documents (various);
- Asset Management Data Collection Templates;
- Audited Financial Statements and Government Reporting (FIR, TCA etc);
- Financial Exports from internal financial systems; and,
- Historical cost and estimates of budget allocation based on SME experience.

ASSET MANAGEMENT DATA SOURCES

This AM Plan also utilizes asset management data. The sources of the data are:

- Data extracts from various city applications and management software;
- Asset Management Data Collection Templates;
- Tender documents, subdivision agreements and projected growth forecasts as well as internal reports;
- Condition assessments;
- Subject matter expert opinion and anecdotal information; and,
- Reports from the mandatory biennial inspection, operational & maintenance activities internal reports

3.8.2 Improvement Plan

It is important that the City recognize areas of the AM Plan and planning process that require future improvements to ensure the effective management of the wastewater network assets and to inform decision making. The tasks listed below are essential to improving the AM Plan and the City's ability to make evidence based and informed decisions. These improvements span from improved lifecycle activities, improved financial planning, improved data quality as well as plans to physically improve the assets. The Continuous Improvement plan table below highlights proposed continuous improvement items that will require further discussion and analysis to determine feasibility, resource requirements and alignment to current workplans. Future iterations of this AM Plan will provide updates on these continuous improvement plans. The improvement plan generated from this AM Plan is shown in Table 58.

[15] ISO 55000 Refers to this as the Asset Management System

Table 58: Improvement Plan
*** p.a – per annum**

TASK	TASK	RESPONSIBILITY	RESOURCES REQUIRED	DRAFT TIMELINE
1	Collect and confirm data from databases before it goes into EAM including spatial referencing and possible Collector Apps.	**Hamilton Water**	**$40,000 p.a. $120,000 Total** Internal Staff Time	**3 Years** (2022-2024)
2	Develop a Long Term Financial Plan to connect the budgeting process to AM planning.	**CAM, Hamilton Water, Finance**	**$15,000 p.a $60,000 Total** Internal Staff Time	**4 Years** (2022-2025)
3	Complete condition assessments on WWTPs.	**CAM, Hamilton Water,**	**$250,000 Total** Internal Staff, Tender Process Specialty Assessor	**3 Years** (2022-2024)
4	Investigate modifying control gates inspection to incorporate condition score.	**CAM, Hamilton Water,**	**$10,000 Total**	**2 Years** (2022-2023)
5	Standardize condition assessments for critical wastewater main, combined main, interceptor and forcemain and establish timeline to complete system wide assessment.	**CAM, Hamilton Water, Infrastructure Renewal**	**$10,000 p.a. $20,000 Total** Internal Staff Time	**2 Years** (2022-2023)
6	Plan condition assessments for vertical assets on a regular cycle (e.g. 10 years).	**CAM, Hamilton Water,**	**$11,000** Internal Staff Time	**1 Year** (2022)
9	Standardize condition assessment outcomes and timed deliverables.	**CAM, Hamilton Water,**	**$6,000 p.a. $18,000 Total** Internal Staff Time	**3 Years** (2022-2024)
10	Improve data confidence levels for asset register.	**CAM, Hamilton Water,**	**10,000 p.a. $50,000 Total** Internal Staff Time	**5 Years** (2022-2026)

Table 58: Improvement Plan
*** p.a – per annum**

TASK	TASK	RESPONSIBILITY	RESOURCES REQUIRED	DRAFT TIMELINE
11	Improve Growth projection data and modelling for next AM Plan iteration.	**CAM, Hamilton Water, Ec. Dev**	**$6,000 p.a. $12,000 Total** Internal Staff Time	**2 Years** (2022-2023)
12	Develop and implement an annual demand review process to ensure sufficient knowledge is available to inform future planning.	**CAM, Hamilton Water, Ec. Dev**	**$17,500 $35,000 Total** Internal Staff Time	**2 Years** (2022-2023)
13	Analyze operational budget to improve AM allocations for lifecycle activities.	**CAM, Hamilton Water, Finance**	**$10,000 p.a. $30,000 Total** Internal Staff Time	**3 Years** (2022-2024)
14	Analyze maintenance activities to identify future needs and recommended actions.	**CAM, Hamilton Water**	**$10,000 p.a. $40,000 Total** Internal Staff Time	**4 Years** (2022-2025)
15	Develop Renewal forecasting prioritization to optimize resources and ensure level of services can be maintained.	**CAM, Hamilton Water**	**$6,000 p.a. $24,000 Total** Internal Staff Time	**4 Years** (2022-2025)
16	Improve annual engagement survey process to optimize engagement and respondents.	**CAM, Hamilton Water, Communications**	**$35,000 p.a. $140,000 Total** Internal Staff Time	**4 Years** (2022-2025)
17	Review BIMA Scorecard reporting and ensure data and assumptions are consistent with ministry and City reporting and develop additional technical metrics.	**CAM, Hamilton Water, Continuous Improvement**	**$2,500 p.a. $5,000 Total** Internal Staff Time	**2 Years** (2022-2023)
18	Standardize and develop risk management knowledge along with supporting documentation.	**CAM, Engineering Services, Continuous Improvement**	**$12,500 p.a. $25,000 Total** Internal Staff Time	**2 Years** (2022-2023)

Table 58: Improvement Plan
*** p.a – per annum**

TASK	TASK	RESPONSIBILITY	RESOURCES REQUIRED	DRAFT TIMELINE
19	Identify wastewater assets in other divisions and incorporate into next AM Plan.	**CAM, Hamilton Water**	**$10,000 p.a. $30,000 Total** Internal Staff Time	**3 Years** (2022-2024)
20	Investigate sewer laterals repair/replacement procedure for private residence as City does not own asset but acts as asset owner.	**CAM, Hamilton Water**	**$4,000 p.a. $8,000 Total** Internal Staff Time	**2 Years** (2022-2023)
21	Further develop vertical asset knowledge for future iterations of AM Plans.	**CAM, Hamilton Water**	**$50,000 p.a. $150,000 p.a.** Internal Staff Time, Tender Process	**3 Years** (2022-2024)
22	Identify opportunities to separate combined sewer system through renewal activities.	**CAM, Hamilton Water**	**$3,000 p.a. $9,000 p.a.** Internal Staff Time	**3 Years** (2022-2024)
23	Improve asset replacement costs by vetting with current market prices instead of historical costs/estimates or internal models.	**CAM, Hamilton Water, Finance**	**$30,000 p.a. $90,000 Total** Internal Staff Time	**3 Years** (2022-2024)
24	Refine acquisition model to ensure projections are accurate and updated.	**CAM, Hamilton Water, Ec.Dev., Finance**	**$7,000 p.a.** Internal Staff Resources	**Annual**
25	Investigate adding additional odour control units in hot spots.	**CAM, Hamilton Water**	**$5,000** Internal Staff Time	**3 Years** (2022-2024)
26	Incorporate forcemain into watermain inspection program	**CAM, Hamilton Water**	**$200,000 p.a.**	**2 years (2022-2023)**
27	Review maintenance hole inspections to output condition score	**CAM, Engineering Services**	**$6,000 p.a. $24,000 Total** Internal Staff Time	**4 Years** (2022-2025)

Table 58: Improvement Plan
*** p.a – per annum**

TASK	TASK	RESPONSIBILITY	RESOURCES REQUIRED	DRAFT TIMELINE
28	Separate & validate wastewater technical metrics reported in the BIMA tool	**CAM, Hamilton Water**	$5,000 p.a Internal Staff Time	Annual
29	Ensure new technical metrics are considering different lifecycle stages (e.g. acquisition, disposal)	**CAM, Hamilton Water**	$2,000 p.a $6.000 Total Internal Staff Time	3 Years (2022-2024)

3.8.3 Monitoring and Review Procedures

This AM Plan will be reviewed during the annual budget planning process and revised to show any material changes in service levels, risks, forecast costs and proposed budgets as a result of budget decisions.

The AM Plan will be reviewed and updated on a regular basis to ensure it represents the current service level, asset values, forecast operations, maintenance, renewals, acquisition and asset disposal costs and planned budgets. These forecast costs and proposed budget will be incorporated into the Long-Term Financial Plan once completed.

3.8.4 Performance Measures

The effectiveness of this AM Plan can be measured in the following ways:

- The degree to which the required forecast costs identified in this AM Plan are incorporated into the long-term financial plan;
- The degree to which the 1-10 year detailed works programs, budgets, business plans and corporate structures consider the 'global' works program trends provided by the AM Plan;
- The degree to which the existing and projected service levels and service consequences, risks and residual risks are incorporated into the Strategic Planning documents and associated plans; and,
- The Asset Renewal Funding Ratio achieving the Organizational target (this target is often 90 – 100%)

2022 Stormwater Asset Management Plan

Hamilton

STORMWATER SERVICE AREA

Description

The stormwater network collects stormwater from rooftops, roads, ditches, and other impervious surfaces across the City and conveys it to the natural watercourse. These assets relate to the collection, transmission, treatment, retention, infiltration, control or disposal of stormwater.

Replacement Value $3.1 Billion

Average Asset Condition

Did You Know?

- Replacing grass or gardens on your property with asphalt or concrete can increase the demand on the stormwater network.
- Low Impact Developments (LIDs) are systems that allow for infiltration or storage of stormwater. Solutions can include rain barrels and gardens.

Critical Asset Summary

Critical Assets	Quantity	Replacement Cost	Condition	Stewardship Measures
Stormwater Management ponds	119	$179 million	Good	% of Ponds inspected in 2021 **100%**
Pump Station	2	$9.52 million	Very Good	Inspection Frequency **Monthly**
Gravity Main	1,263 km	$1.8 billion	Good	km's of Main Inspected in 2021 **78 km**

Data Confidence

VERY HIGH | MEDIUM | VERY LOW

FINANCIAL FACTS

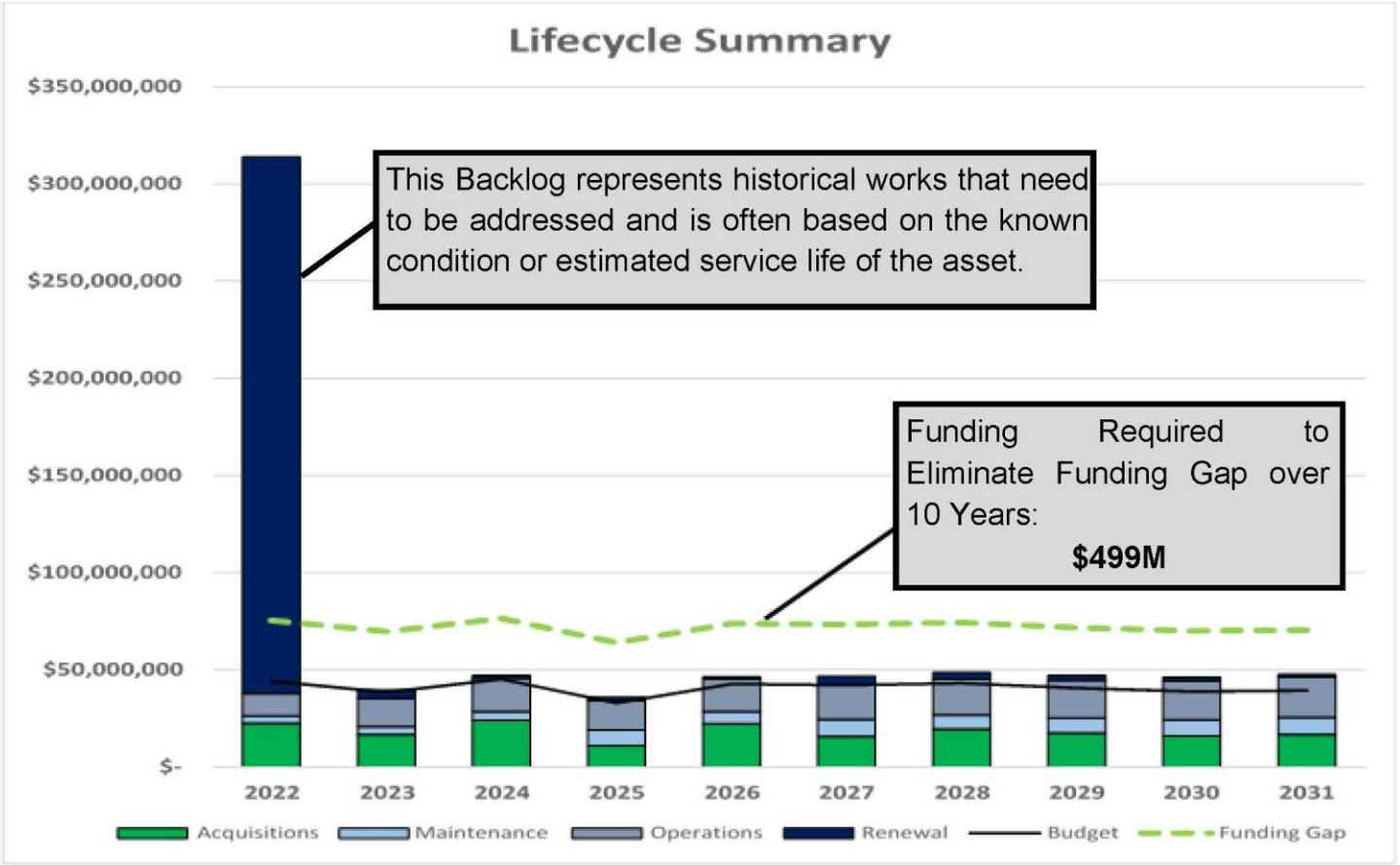
- Hamilton will receive **$451 million** dollars worth of assets over the next 10 years.
- Hamilton will invest on average **$239 million** to operate, maintain Stormwater assets over the next ten year.

DID YOU KNOW?

- Stormwater Management Ponds reduce the risk of flooding throughout the community by storing water.
- The City is completing stormwater modelling to mitigate flooding risks.

FINANCIAL INDICATORS

Type of Indicator	Measurement	Explanation
Asset Renewal Ratio	**9.49%**	This ratio demonstrates the rate the city renews its Stormwater Assets
10 Year O&M Forecast	**43%**	The % of funding allocated compared to what needs to be spent
Annual Infrastructure Gap	**$31 million**	The difference between what is being spent and what should be spent



4.0 STORMWATER ASSETS

The stormwater network collects stormwater from rooftops, roads, ditches, and other surfaces across the City and conveys it to the natural watercourse. The service objective is to provide reliable stormwater services by preventing flooding. A reliable stormwater network service provides both direct and indirect benefits ensuring good public health to the broader community. For this iteration of the AM Plan, stormwater assets include linear and vertical assets.

Stormwater assets relate to the collection, transmission, treatment, retention, infiltration, control or disposal of stormwater. For this iteration of the AM Plan the stormwater asset class hierarchy is grouped into linear and vertical assets. Vertical assets are assets that can only occupy one site and are typically within a building or a facility which may be comprised of other multiple components. Linear assets are assets which traverse horizontally and are often defined by length but also encompass components that are considered part of the linear network. It is important to note that watercourses and shorelines can also be considered Stormwater assets, but these will be included in the Natural Assets AM Plan which will be included in the 2024 iteration of the AM Plan.

The asset class asset hierarchy outlining assets included in this section is shown below in Table 59.

Table 59: Asset Class Hierarchy

VERTICAL ASSETS	LINEAR ASSETS
Pump Station	Trunk Main
Flood Control Structure	Local Main
Flood Control Gate	Minor Culverts
Stormwater Management (SW) Ponds	Catchbasins (CB)
	Catchbasin Maintenance Holes (CBMH)
	Maintenance Holes (MH)
	Oil and Grit Separators
	Inlets
	Outfalls
	Ditches
	Swales (No Data)
	Low Impact Development (LID) (No Data)

4.0 STORMWATER

4.1 BACKGROUND

This AM Plan is intended to communicate the requirements for the sustainable delivery of services through the management of assets, compliance with regulatory requirements and required funding to provide the appropriate levels of service over the 2022 – 2031 planning period. The infrastructure assets covered by this plan include the major components required to deliver effective stormwater services to the City's customers.

The information in the stormwater section of the plan is intended to give a snapshot in time of the current state of the stormwater service area by providing the necessary background, detailed summary, and analysis of existing information.

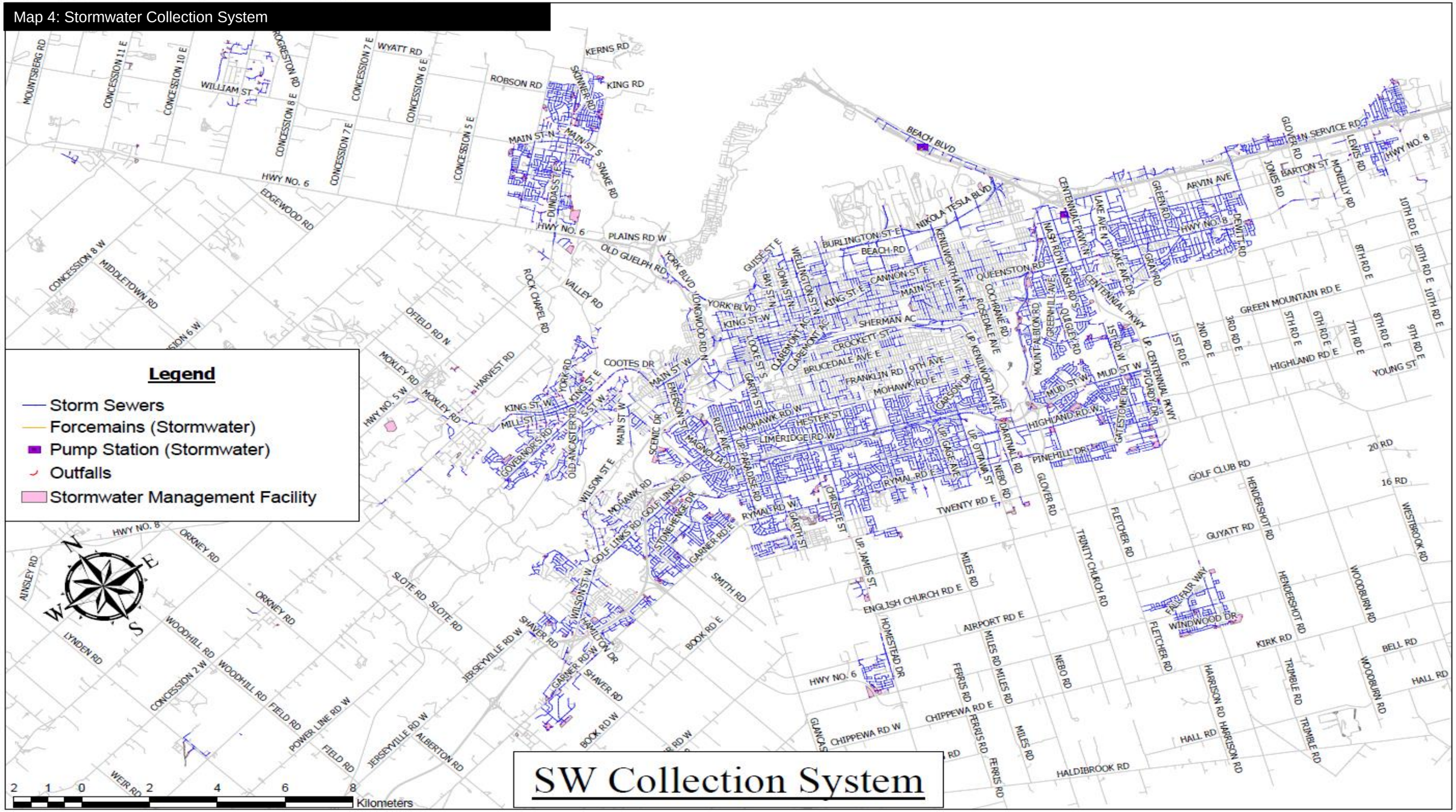
As mentioned in the wastewater section, there are combined sewer mains in the lower and upper City which carry a combination of wastewater and stormwater. The combined sewer infrastructure was considered part of the wastewater section, and so this section includes assets that exclusively manage stormwater (i.e. separated stormwater system). A map of the separated stormwater network and infrastructure is shown below in Map 4.

The City acquired significant amounts of stormwater network assets through amalgamation in 2001. These assets were included into the City's stormwater inventory and were in varied condition and held various collection capacity when acquired. Once amalgamated, any aging assets or deficient assets became the City's responsibility and created several new challenges that will need to be taken into consideration when planning.

The separated stormwater system is common in newer areas of the City such as Stoney Creek east of the Red Hill Valley Parkway, upper Hamilton south of Mohawk Road, and areas in Dundas and Ancaster. However, it is evident in the figure below that there are older areas of the City where combined sewers have been converted to a partially separated storm sewer (in these areas combined sewers have been separated, but often the separated storm sewer discharges into a combined sewer because there is no available outlet to a natural watercourse). In most rural communities, including Glanbrook and Flamborough, stormwater is typically carried to the natural watercourse via ditches and municipal drains, which are not shown on the map below.

Typically, stormwater (excluding stormwater from combined sewers) is released into the natural watercourse without any treatment because stormwater is composed of surface runoff from rain events, and as such does not require specific treatment in the same way as for drinking water and wastewater. However, to reduce any oil and grit from the road network and facilities infiltrating into the natural watercourse, there are assets such as oil and grit separators and stormwater ponds which are designed to settle out grit and collect oil before it is released into surrounding watercourses.

Map 4: Stormwater Collection System



4.1.1 Detailed Summary of Assets

Table 60 below displays the detailed summary of assets for the stormwater service area. In addition, it is possible that there are assets that may not be owned by Public Works which may be considered stormwater assets which may be missing from this inventory. In addition, LiDAR technology could be used to obtain more accurate information on ditches and swales and assist with modelling. This has been identified as a Continuous Improvement Item in Table 82.

The City of Hamilton owns approximately **$3.1B** in stormwater assets which are on average in **Good** condition. For most assets, Good condition means that the City should be completing preventative maintenance activities per the inspection reports as well as operating activities (e.g. inspection, cleaning) to ensure the assets reach their intended useful lives.

Assets are an average of **22 years** in age which means there is an average of **73%** of remaining service life (RSL). Since the separated stormwater asset class is relatively new in comparison to other core asset classes, many assets have not had the same level of inventory control and condition assessment programming. This will be investigated in future iterations of the AM Plan.

The data below is a combination of data from various sources as there is not yet an asset registry containing all inventory information in one data source. Examples of data sources which were used for this iteration of the Core AM Plans are stated in the AMP Overview.

The lack of an asset registry is a continuous improvement item in Table 82. The City must plan to complete a detailed review of this data and create data standards in order to improve overall data quality. Currently, there is no data for swales or low impact developments (LIDs) and so these have not been included as part of this plan. Ditches have been included at a limited capacity since a map was created based on aerial imagery without any attributes.

Table 60: Detailed Summary of Assets
***Weighted Average**

ASSET CATEGORY	NUMBER OF ASSETS	REPLACEMENT VALUE	AVERAGE AGE (% RSL)	AVERAGE EQUIVALENT CONDITION
VERTICAL ASSETS				
Pump Stations	2	$9.52M	8 years (87%)	1-Very Good
Data Confidence	Very High	Medium	Very High	Low
Flood Control Structure	1	$5.0M	No Data	No Data
Data Confidence	Very High	Low	Very Low	Very Low
Flood Control Gate	1	$2.5M	No Data	No Data
Data Confidence	Very High	Low	Very Low	Very Low
SWM Pond (excl wetlands)	119	$178.5M	24 years (76%)	2-Good
Data Confidence	Medium	Low	Medium	Low
	SUBTOTAL	**$195.52M**	**16 years (80%)**	**2-Good***
	Data Confidence	**Low**	**Medium**	**Low**
LINEAR ASSETS				
Trunk Stormwater Main (>600mm diameter)	607.79 km	$1.084B	39 years (60%)	2-Good
Data Confidence	High	Medium	Medium	Medium
Local Stormwater Main (<600mm diameter)	655.70 km	$702.07M	39 years (58%)	2-Good
Data Confidence	High	Medium	Medium	Medium
Catchbasin	49,882	$460.18M	No Data	2-Good
Data Confidence	Medium	Low	Very Low	Low
Maintenance Hole	20,307	$203.07M	40 years (60%)	2-Good
Data Confidence	Medium	Low	Medium	Low
Catchbasin Maintenance Hole	1,101	$11.01M	51 years (49%)	3-Fair
Data Confidence	Medium	Low	Medium	Low
Oil and Grit Separator (OGS)	84	$3.36M	15 years (41%)	3-Fair
Data Confidence	High	Low	High	Low
Storm Sewer Lateral	No data	No data	No data	No data
Data Confidence	Very Low	Very Low	Very Low	Very Low
Minor Culvert	3,448	$172.40M	4 years (92%)	3-Fair
Data Confidence	Medium	Low	Low	High
Inlet	515	$25.75M	26 years (67%)	2-Good
Data Confidence	Medium	Low	Medium	Low
Outfall	917	$45.85M	34 years (57%)	3-Fair
Data Confidence	Medium	Low	Medium	Low
Ditches	1,603.04 km	$240.46M	No Data	No Data
Data Confidence	Low	Low	Very Low	Very Low
Low Impact Development (LID)	No Data	No Data	No Data	No Data
Data Confidence	Very Low	Very Low	Very Low	Very Low
Swales	No Data	No Data	No Data	No Data
Data Confidence	Very Low	Very Low	Very Low	Very Low
	SUBTOTAL	**$2.949B**	**28 years (81%)**	**2-Good***
	Data Confidence	**Medium**	**Medium**	**Low**
	TOTAL	**$3.144B**	**22 years (73%)**	**2-Good***
	Data Confidence	**Medium**	**Medium**	**Low**

The data confidence for number of vertical assets is typically very high due to the asset's locations being above ground and able to be visually confirmed easily. The confidence for stormwater ponds is Medium as there are likely stormwater ponds in new developments that have not yet been incorporated into the existing inventory. There has been a continuous improvement item identified to confirm data across all data sets and unify the data into a single source to reference from in the future. In addition, another identified Continuous Improvement item in Table 82 is to improve the reporting for vertical assets for future iterations of the AM Plan to provide more details on the specific processes they undertake.

Due to the lack of current data, the complexity of vertical assets and the low frequency of asset replacements, it is difficult to achieve a high data confidence for replacement cost for this iteration of the plan. However, improving asset replacement costs by updating current market prices regularly instead of historical costs/estimates or internal models has been identified as a Continuous Improvement Item in Table 82. Age and condition information and data confidence is presented in Table 60.
For linear assets, the data confidence for number of assets is typically Low to Medium. Since many of these assets are newer and are not as stringently regulated as other core assets, there are not formal inventories for all stormwater linear assets. A future improvement in data would be to complete inventories of assets where no or limited data is available (e.g. sewer laterals, ditches, swales, and low impact developments (LIDs)).

These improvements have been noted in Table 82 in the Continuous Improvement section of the report. Please refer to the AMP Overview for a detailed description of data confidence.

4.1.2 Asset Condition Grading

Condition refers to the physical state of the wastewater assets and are a measure of the physical integrity of these assets or components, and is the preferred measurement for planning lifecycle activities to ensure assets reach their expected useful life. Since condition scores are reported using different scales and ranges depending on the asset, Table 61 below shows how each rating was converted to a standardized 5-point condition category so that the condition could be reported consistently across the AM Plan. A continuous improvement item identified in Table 82, is to review existing internal condition assessments and ensure they are revised to report on the same 5-point scale with equivalent descriptions.

Table 61: Condition Grading System

EQUIVALENT CONDITION GRADING	CONDITION DESCRIPTION	% REMAINING SERVICE LIFE	STORM MAIN	MINOR CULVERTS CONDITION	CATCHBASIN
1-Very Good	The asset is new, recently rehabilitated, or very well maintained. Preventative maintenance required only.	>79.5%	PACP Score = 1; If PACP unknown, WRC Structural Score =1; If both unknown: RSL	Maximum Condition Score = 0 during inspection	N/A
2-Good	The asset is adequate and has slight defects and shows signs of some deterioration that has no significant impact on asset's usage. Minor/preventative maintenance may be required.	59.5% – 79.4%	PACP Score = 2; If PACP unknown, WRC Structural Score =2 or Lined Pipe; If all unknown: RSL	Maximum Condition Score =1 during inspection	Good
3-Fair	The asset is sound but has minor defects. Deterioration has some impact on asset's usage. Minor to significant maintenance is required.	39.5% - 59.4%	PACP Score = 3; If PACP unknown, WRC Structural Score =3; If all unknown: RSL	Maximum Condition Score = 2 during inspection	Fair
4-Poor	Asset has significant defects and deterioration. Deterioration has an impact on asset's usage. Rehabilitation or major maintenance required in the next year.	19.5% -39.4%	PACP Score = 4; If PACP unknown, WRC Structural Score =4; If all unknown: RSL	Maximum Condition Score = 3 or culvert was identified as maybe needing a replacement during inspection.	Poor
5-Very Poor	Asset has serious defects and deterioration. Asset is not fit for use. Urgent rehabilitation or closure required.	<19.4%	PACP Score = 5; If PACP unknown, WRC Structural Score =5; If all unknown: RSL	Maximum Condition = 4 or culvert was identified as needing replacement in inspection.	N/A

The following conversion assumptions were made:

- Pipes were based on a combination of PACP and WRC scores where known, where the PACP score was prioritized over the WRC Score.
- If pipe was indicated to have been lined CIPPS, then the condition was assumed to be 2-Good.
- If PACP was unknown, and WRC score was 6, indicating an incomplete inspection, the condition was based on % of remaining service life.
- Minor culverts' condition was based on the worst score for a culvert component.
- Catchbasins' condition was on the existing condition scoring in the database.
- For assets where a condition assessment was not completed, but age information was known, the condition was based on the % of remaining service life.

4.1.3 Vertical

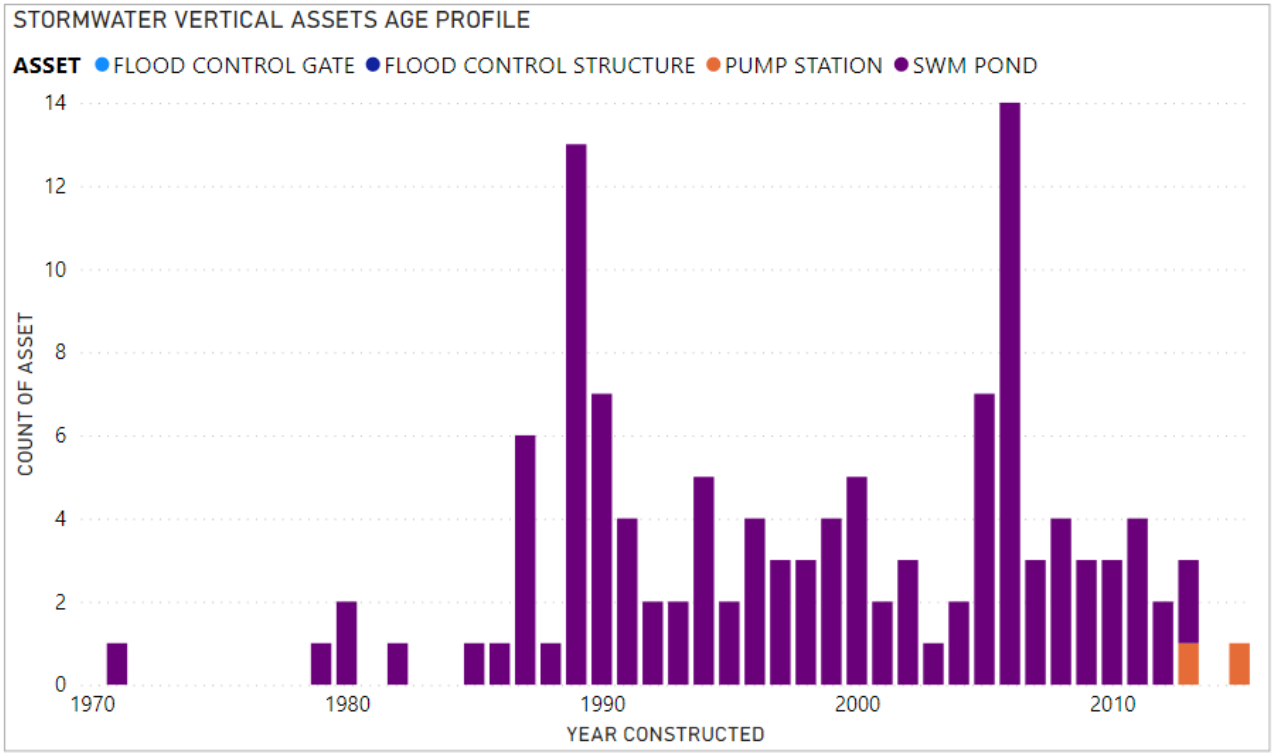
The background information for stormwater vertical assets is below and includes an age profile, the condition methodology used, the condition profile, and asset usage and performance.

4.1.3.1 Age Profile

The age of an asset is an important consideration in the asset management planning process especially for assets that will not receive a typical condition grading through inspections. Some lower cost or lower criticality assets can be planned for renewal based on age as a proxy for condition or until other condition methodologies are established. It should be noted that if a stormwater assets' condition is based on age, it is typically considered to be of a lower confidence level.

The age profile of stormwater vertical assets are shown in Figure 20. An analysis of the age profile is provided below.

Figure 20: Stormwater Vertical Assets Age Profile



STORMWATER PONDS

It is evident that there are spikes in the installation of stormwater (SW) ponds in 1989 and 2006, meaning that there may be a spike in major maintenance requirements in 2031 since full dredging activities are completed on a 25-year cycle per Table 67. In addition, the SW ponds included in the AM Plan are assumed ponds only. There are additional unassumed SW ponds that exist in the City which are not yet the City's responsibility. These will be assumed in future and therefore, may have additional maintenance requirements for which the City is not yet aware. As a result, the age information is considered Medium confidence, even though the dataset is mostly complete.

On average stormwater ponds are 24 years old and have an estimated service life of 100 years and 76% of service life remaining. At this time, there are no SW ponds which have exceeded their service life.

PUMP STATIONS

At this time there are two (2) pump stations which are new assets, with 87% of service life remaining.

FLOOD CONTROL ASSETS

At this time, there is no age data available for the age of flood control assets.

4.1.3.2 Condition Methodology

The inspection frequency, and condition score output for vertical assets is found below in Table 62. An analysis for each asset is found below.

Table 62: Inspection and Condition Information

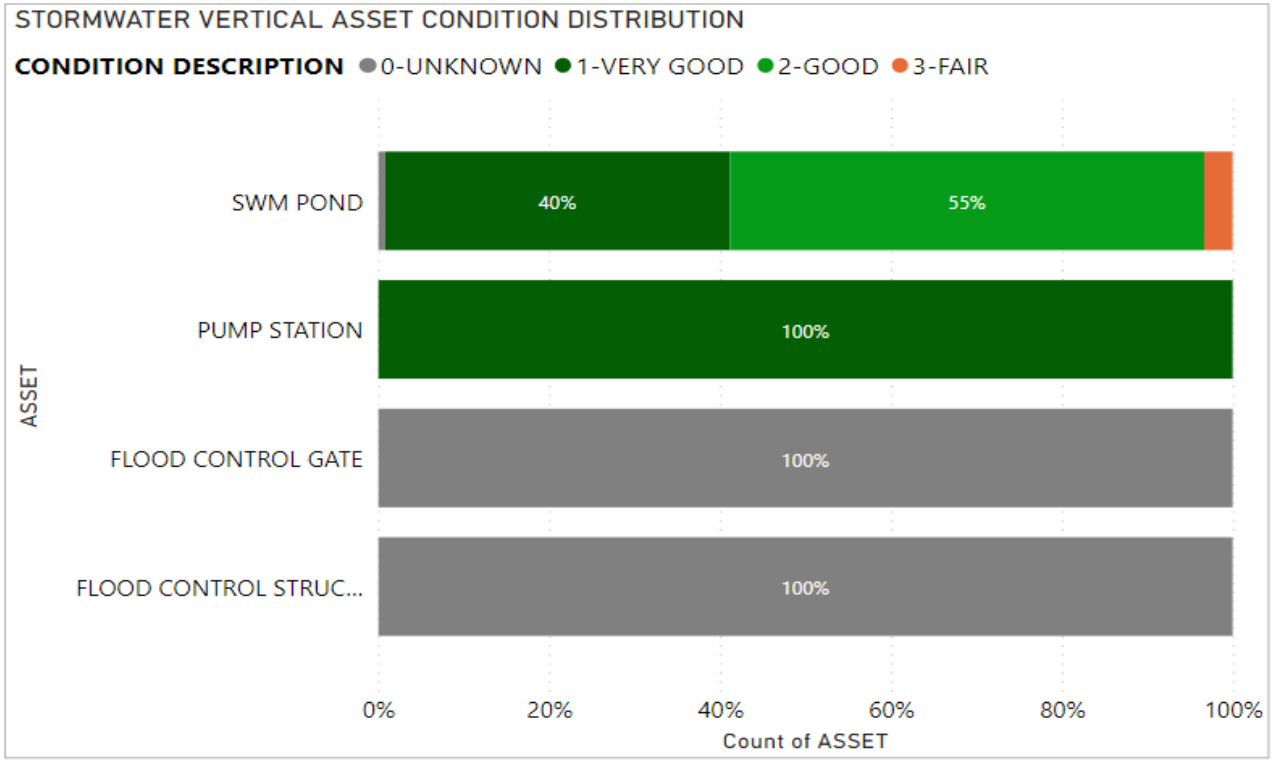
Asset	Inspection Frequency	Condition Score Output
Pump Station	N/A	None – used age
Stormwater Pond	Annually, Ad Hoc	None – used age
Flood Control Structure / Gate	N/A	N/A

Condition assessments for vertical assets are not completed on a regular cycle at this time. A continuous improvement item would be to complete asset condition assessments for pump stations using a similar methodology and frequency as booster and lift stations for water and wastewater assets. Since these assets are new, there has not yet been a need to complete an assessment, but condition assessments should begin on any new facility within a determined timeline after being constructed, possibly 10-15 years into its lifecycle. In addition, stormwater ponds are inspected on an annual basis, but do not output an overall condition score which should be investigated in future. Finally, at this time, flood control assets have not had condition assessments completed and this should be investigated. These items have been identified in Table 82 of the Continuous Improvement section.

4.1.3.3 Asset Condition Profile

The condition profile of the City's assets is shown in Figure 21. As mentioned in Section 4.1.2, the original condition grades were converted to a standardized condition category for report consistency.

Figure 21: Stormwater Vertical Asset Condition Distribution



Based on age data, vertical stormwater assets are typically in Good condition. This is because they are typically early in their useful life. At this time, there is no age or condition data available for flood control assets and therefore they are shown to be of unknown condition.

As previously stated, continuous improvement items have been identified to complete condition assessments for pump stations and flood control assets and to encompass condition scores into existing inspections for stormwater ponds to estimate condition.

4.1.3.4 Asset Usage and Performance

Assets are generally provided to meet design standards where available. However, there are often insufficient resources to address all known deficiencies.

The largest performance issues with vertical stormwater assets involve assets not functioning optimally. The service deficiencies in Table 63 below were identified using staff input.

Table 63: Known Service Performance Deficiencies			
ASSET	**LOCATION**	**SERVICE DEFICIENCY**	**DESCRIPTION OF DEFICIENCY**
Stormwater Pond	Various Locations	Reduced capacity	Backlog of ponds needing cleanout
Flood Gate	Davis Creek	Not functional	Electrical wiring stolen from station and requiring replacement.
Pump Stations	Grafton, Centennial	No emergency power	In the case of power outage, station will not function.

4.1.4 Linear

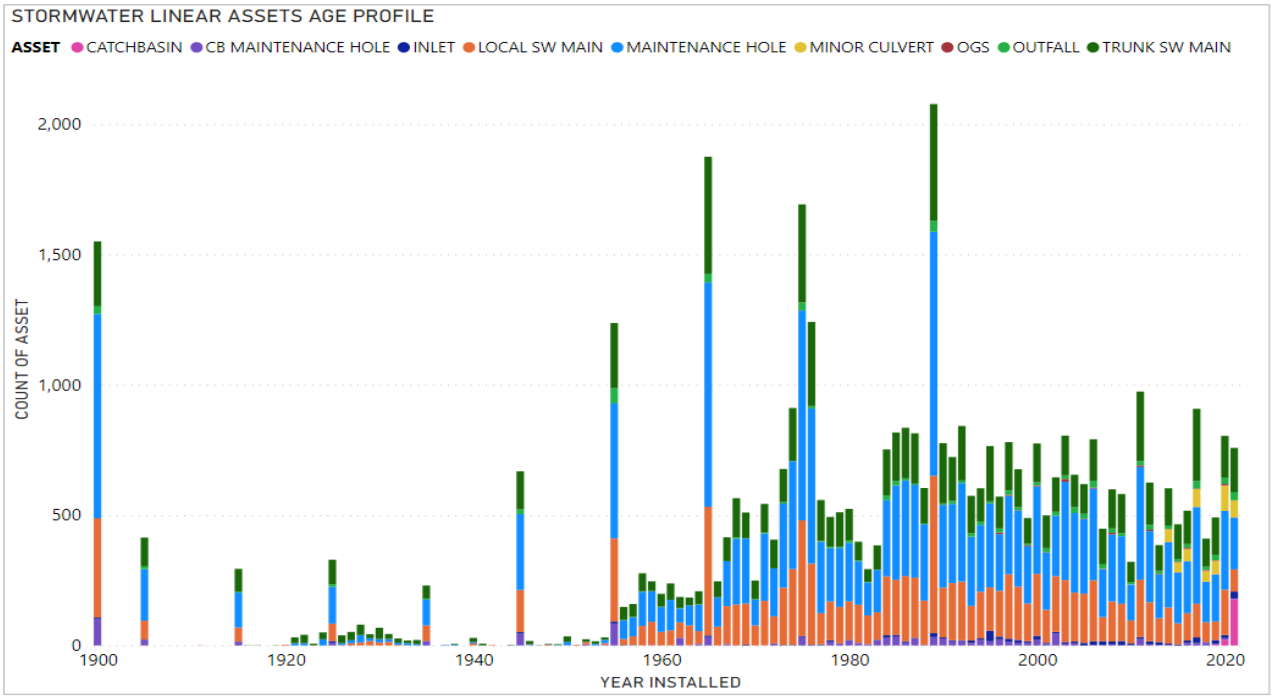
The background information for stormwater linear assets is included below and includes an age profile, the condition methodology used, the condition profile, and asset usage and performance.

4.1.4.1 Age Profile

The age of an asset is an important consideration in the asset management process as it can be used for planning purposes as typically assets have an ESL where they can be planned for replacement.

The age profile of the stormwater linear assets are shown in Figure 22. An analysis of the age profile is provided below for each asset.

Figure 22: Stormwater Linear Assets Age Profile



STORMWATER GRAVITY MAIN (INCLUDING TRUNK AND LOCAL)

Separated stormwater gravity mains began to be installed just before 1960, as best practices changed, and the City began to prioritize separating wastewater and stormwater sewers around this timeframe. The mains installed before this date, have likely been assumed by decade which is why spikes are shown in 1900, 1905, 1915, 1925, 1935, 1945, 1955 and 1965.

The average age for separated trunk and local wastewater main is 39 years with an average ESL of 97 and 93 years resulting in 60% and 58% of the useful life remaining respectively. The condition of storm sewers is typically based on a condition assessment program but if assessments have not been completed, condition was based on age. The age data confidence for stormwater main is considered to be Medium as this information is typically populated, although the source of this data may be estimated.

MAINTENANCE HOLES

Maintenance holes have typically been acquired at a steady distribution over the last 100 years with a peak in 1900. This peak is typically due to estimated values for construction.

The average age of maintenance holes is 40 years, and with an ESL of 100 years, this indicates there is typically 60% of useful life remaining. The age data confidence for maintenance holes is considered to be Medium as this information is typically populated, although the source of this data may be estimated.

CATCHBASIN

Catchbasins are at a very low confidence level since age data was mostly not populated. The current dataset for catchbasins has shown these to be a new asset (installed from 2019 – 2022) which is known to not be accurate. The City will continue to collect or estimate age data on catchbasins.

CATCHBASIN MAINTENANCE HOLE

Catchbasin maintenance holes have typically been acquired at a steady distribution over the last 100 plus years with a peak in 1900. This peak is likely due to estimated values for construction.

The average age of catchbasin maintenance holes is 51 years, and with an ESL of 100 years, this indicates there is typically 49% of useful life remaining. The age data confidence for catch basin maintenance holes is considered to be Medium as this information is typically populated, although some of the source data may be estimated.

INLET

Inlets have typically been acquired at a steady distribution over the last 100 years with a peak in 1995.

The average age of inlets is 26 years, and with an ESL of 80 years, this indicates there is typically 67% of useful life remaining. The age data confidence for inlets is considered to be Medium as this information is typically populated, although the source of this data may be estimated.

OUTFALL

Outfalls have typically been acquired at a steady distribution over the last 100 years with a peak in 1955.

The average age of outfalls is 34 years, and with an ESL of 80 years, this indicates there is typically 57% of useful life remaining. The age data confidence for outfalls is considered to be Medium as this information is typically populated, although the source of this data may be estimated.

MINOR CULVERT

Minor culverts are at a low confidence level since age data was mostly not populated. The current dataset for minor culverts has shown these to be a new asset (installed from 2007 – 2022) which is known to not be accurate.

Since the AM Plan can only present the data that is available, minor culverts are shown to be an average of 4 years old with 92% of service life remaining, which is not accurate.

OIL & GRIT SEPARATOR (OGS)

Oil & grit separators (OGS) are shown to be a relatively new asset, with the first asset being installed in 1975, but the majority being installed after 1990 with a peak in 2003. With an ESL of 25 years, it is possible there may be a spike in renewals for these assets in 2028.

The average age of OGS is 15 years, and with an ESL of 25 years, there is typically 41% of service life remaining. The age data confidence for OGS is considered to be High as this information is typically populated, and the accuracy is thought to be high..

DITCHES

As previously mentioned, there is no age data available for ditches, and so they have not been analyzed based on age.

4.1.4.2 Condition Methodology

The inspection frequency and condition score output for each linear asset is found below in Table 64. An analysis for each asset is found below.

Table 64: Inspection and Condition Information

ASSET	INSPECTION FREQUENCY	CONDITION SCORE OUTPUT
Sewer Main	Based on priority	Combination of inspection & age data
Minor Culverts	5-year cycle	Outputs scores from 0 (Very Good) – 4 (Very Poor) for each component and side of the culvert.
OGS	Monthly	None, used age
Inlet/Outfall	Annually & Ad Hoc	None, used age
Catchbasin	3-year cycle	Structural Cleaning score outputs Good, Fair, Poor.
Maintenance Hole, Catchbasin Maintenance Hole	Ad Hoc	None, used age

SEWER MAIN

Since gravity sewer mains are not under pressure and there are maintenance hole access points along the pipe segments, it is easier and more cost effective to inspect these assets than it is to inspect pressurized pipes such as forcemains and watermains. The City completes CCTV (Closed Circuit Television) inspections on these assets which involves sending a robot with a camera to inspect the inside of the pipe to determine any defects or rehabilitation needs. The results of the CCTV inspections assign a structural score to the pipe segment which the City uses to prioritize sewer lining and/or replacement. The City assesses pipes based on the defined criticality of the pipe but does not yet have a cycle to assess all pipes at a specified frequency, and not all pipes have been assessed. This has been identified as a continuous improvement item in Table 82.

MINOR CULVERTS

Minor culverts are assessed on a five (5) year cycle, where multiple components of the culverts are assessed separately and the condition of the culvert is differentiated by the side of the culvert. A continuous improvement item identified in Table 82 is to improve the inspection program to output an overall condition score.

CATCHBASINS

Catchbasins are inspected in on a three (3) year cycle. These inspections output a structural cleaning score of Good, Fair or Poor which was used to approximate condition for this report. A continuous improvement item identified in Table 82 is to improve the inspection program to be on a 5-point condition scale to be consistent with the majority of the City's condition assessment programs.

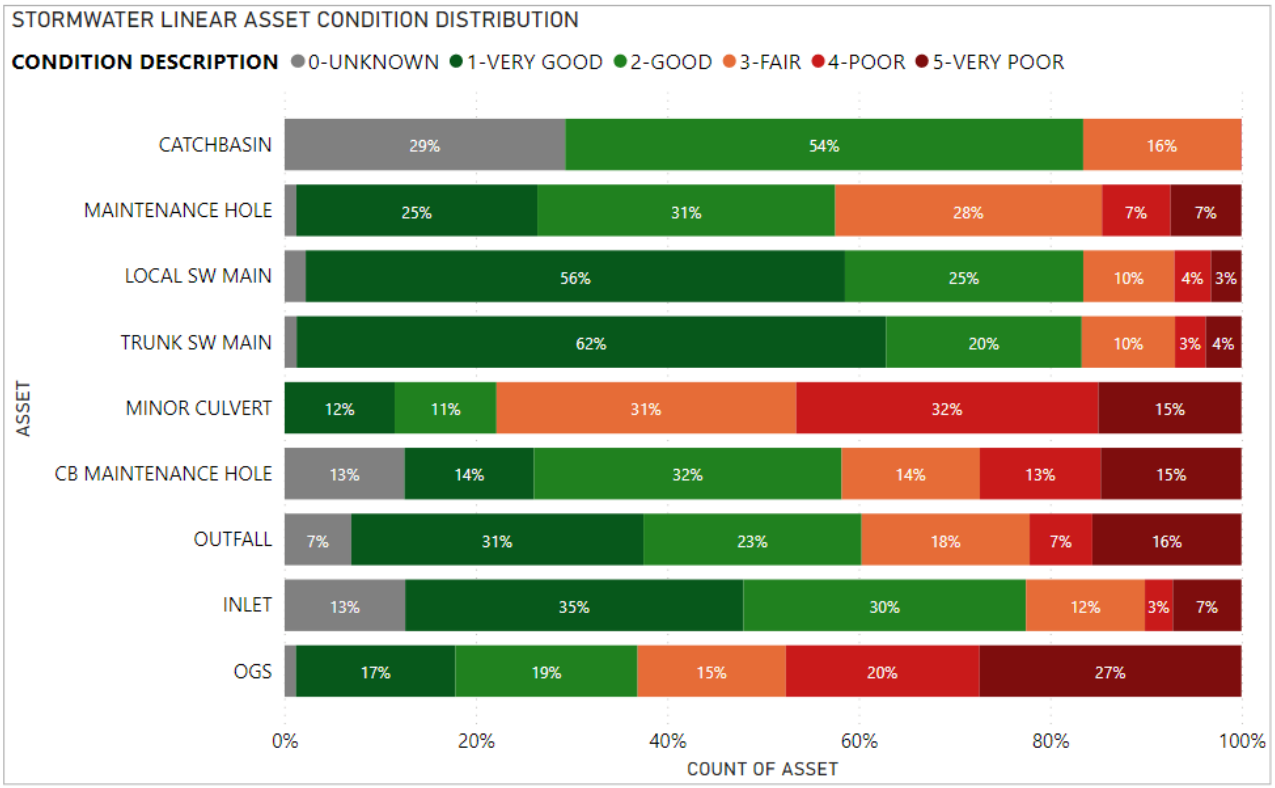
OTHER ASSETS

Other linear assets' conditions were based on age. Some of these assets are inspected regularly as shown, but these inspections do not output a condition score. A continuous improvement item identified in Table 82 is to improve the inspection program to output an overall condition score.

4.1.4.3 Asset Condition Profile

The condition profile of the City's assets is shown in Figure 23. As mentioned in Section 4.1.2, the original condition grades were converted to a standardized condition category for report consistency.

Figure 23: Stormwater Linear Asset Condition Distribution



GRAVITY MAIN (INCLUDING TRUNK AND LOCAL)

Based on a combination of condition and age data, these assets are shown to be on average, in Good condition. As stated above, there is a condition assessment program for gravity mains. However, at this time not all assets have been encompassed into the assessment program. Therefore, the data confidence is shown to be Medium as it is a combination of very high data confidence and low confidence methodologies.

MINOR CULVERT

Based on an assumed methodology to calculate overall condition from the assessment data, minor culverts are in overall Fair condition. The data confidence is considered to be High because the majority of culverts had condition data available.

CATCHBASIN

Based on available condition data populated in the data set, catchbasins are shown to generally be in Good condition, although not all assets have been included. The data confidence is considered to be Medium because 70% of catchbasins had condition data available. Where condition data was unavailable, age was used. However, as previously mentioned, the age data is of Very Low confidence. Therefore 29% of catchbasins are shown as unknown for condition.

OTHER LINEAR ASSETS

The remaining linear assets' conditions are estimated based on age where known and are shown to generally be in Good condition. As previously stated, age is not the best indicator of condition but is used when condition information is unavailable or difficult to obtain. A detailed analysis for the age profile of these assets can be found in Section 4.1.9. Many of these assets are inspected on a regular basis as shown in Table 64, but these inspections do not output condition scores which has been identified as a continuous improvement item in Table 82.

4.1.4.4 Asset Usage and Performance

Assets are generally provided to meet design standards where available. However, there are often insufficient resources to address all known deficiencies.

The largest performance issues with linear stormwater assets involve assets not functioning optimally. The below service deficiencies in Table 65 were identified using staff input.

Table 65: Known Service Performance Deficiencies			
ASSET	**LOCATION**	**SERVICE DEFICIENCY**	**DESCRIPTION OF DEFICIENCY**
Collection System	All outlets, Beach Blvd	Periodic lake levels higher than outfall location	Catchbasin surcharges during high lake levels and causes road flooding.
Minor Culvert	Alma Street	Culvert damaged, plate on road, routine maintenance required	Culvert replaced in 2022, routine disruptions in the area.
Outfall	Various Locations	Poor condition	Corrugated pipe outfall, outside of right of way, and difficult to access
Gravity main	Various Locations	Very Poor condition	Pipes are shown to be in very poor condition and may require replacement.

4.1.5 Administrative

Administrative assets are assets which contribute to the stormwater service but are not stormwater assets. These include vehicles, software and administrative facilities. These assets are shared with water and wastewater and have been included under administrative assets for these asset classes for this iteration of the AM Plan.

4.2 LIFECYCLE MANAGEMENT PLAN

The lifecycle management plan details how the City of Hamilton plans to manage and operate the assets at the agreed levels of service while managing life cycle costs.

4.2.1 Acquisition Plan

Acquisition reflects new assets that did not previously exist or works which will upgrade or improve an existing asset beyond its existing capacity. They may result from growth, demand, legal obligations or social or environmental needs. Stormwater assets are generally donated to the City of Hamilton through the development agreements process directly related to growth.

CURRENT PROJECT DRIVERS – 10 YEAR PLANNING HORIZON

Hamilton Water currently prioritizes capital projects as per the drivers listed below. These drivers help to determine a ranking priority for projects and ensures that multiple factors are being considered to drive investment decisions. These drivers should be reviewed during each iteration of the AM Plan to ensure they are appropriate and effective in informing decision making.

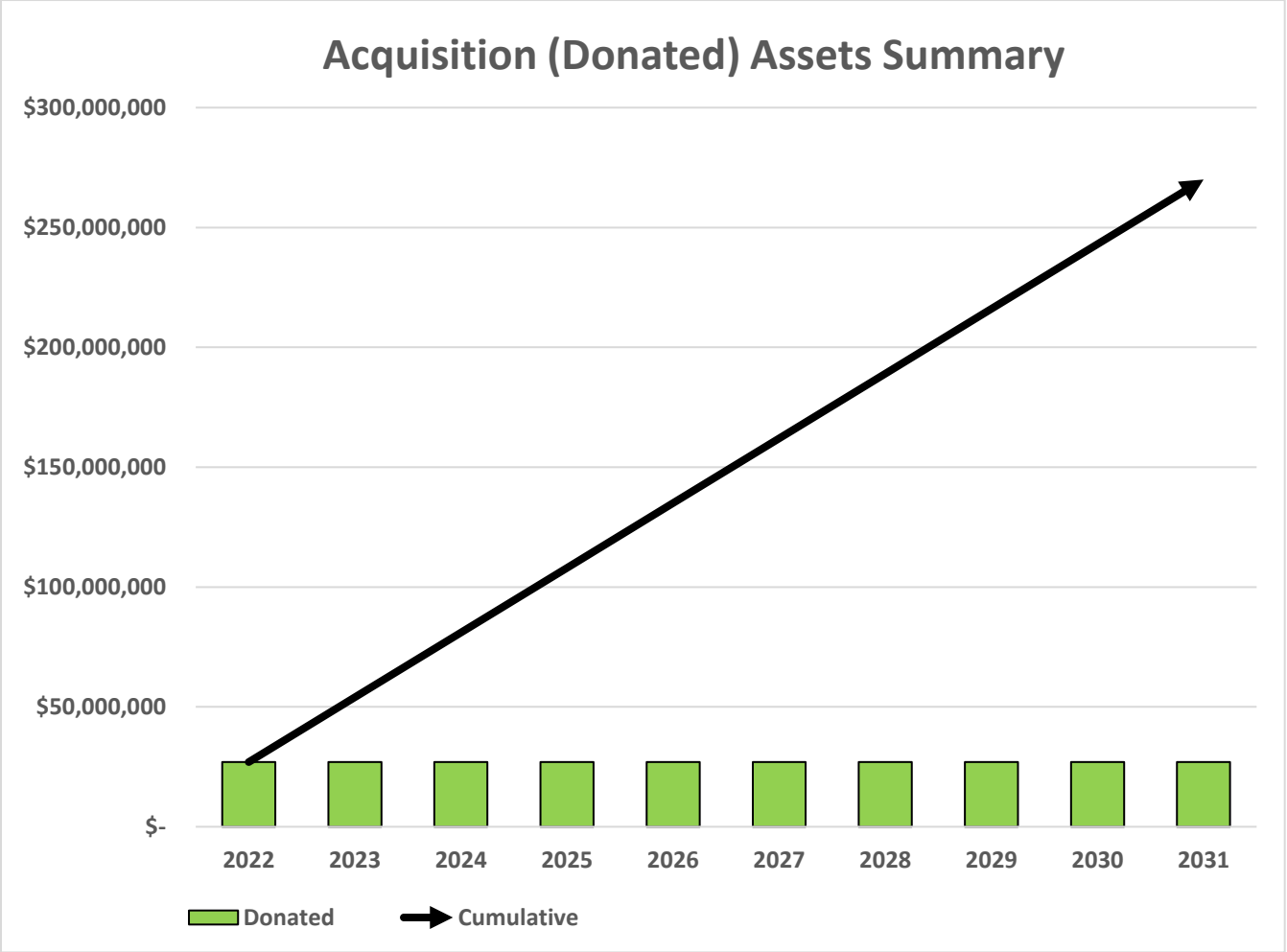
Table 66: Acquired Assets Priority Ranking Criteria

Criteria	Weighting
Legal Compliance	20%
Coordination, Funding, Budgeting	25%
Risk Mitigation	25%
Health and Safety	10%
Operating and Maintenance Impacts	10%
Development Growth	10%
Total	**100%**

SUMMARY OF FUTURE ASSET ACQUISITION COSTS

Forecast acquisition asset costs are summarized in Figure 26 and show the cumulative effect of asset assumptions over the next 10-year planning period.

Figure 24: Acquisition (Donated) Assets Summary
All figures are in 2021 dollars.



Annually, on average, the City of Hamilton will assume over **$27,000,000** of donated assets through subdivision agreements or other development agreements. These assets include approximately **9** km's of storm sewer mains, **1,500** new stormwater laterals, **144** maintenance holes, **6** ponds/facilities and **117** catch basins every year. Hamilton is reviewing its donated asset assumption process to ensure that it proactively understands what assets are being donated annually to ensure they are planned for effectively. This will allow multiple departments across the City to plan for the assets properly such as:

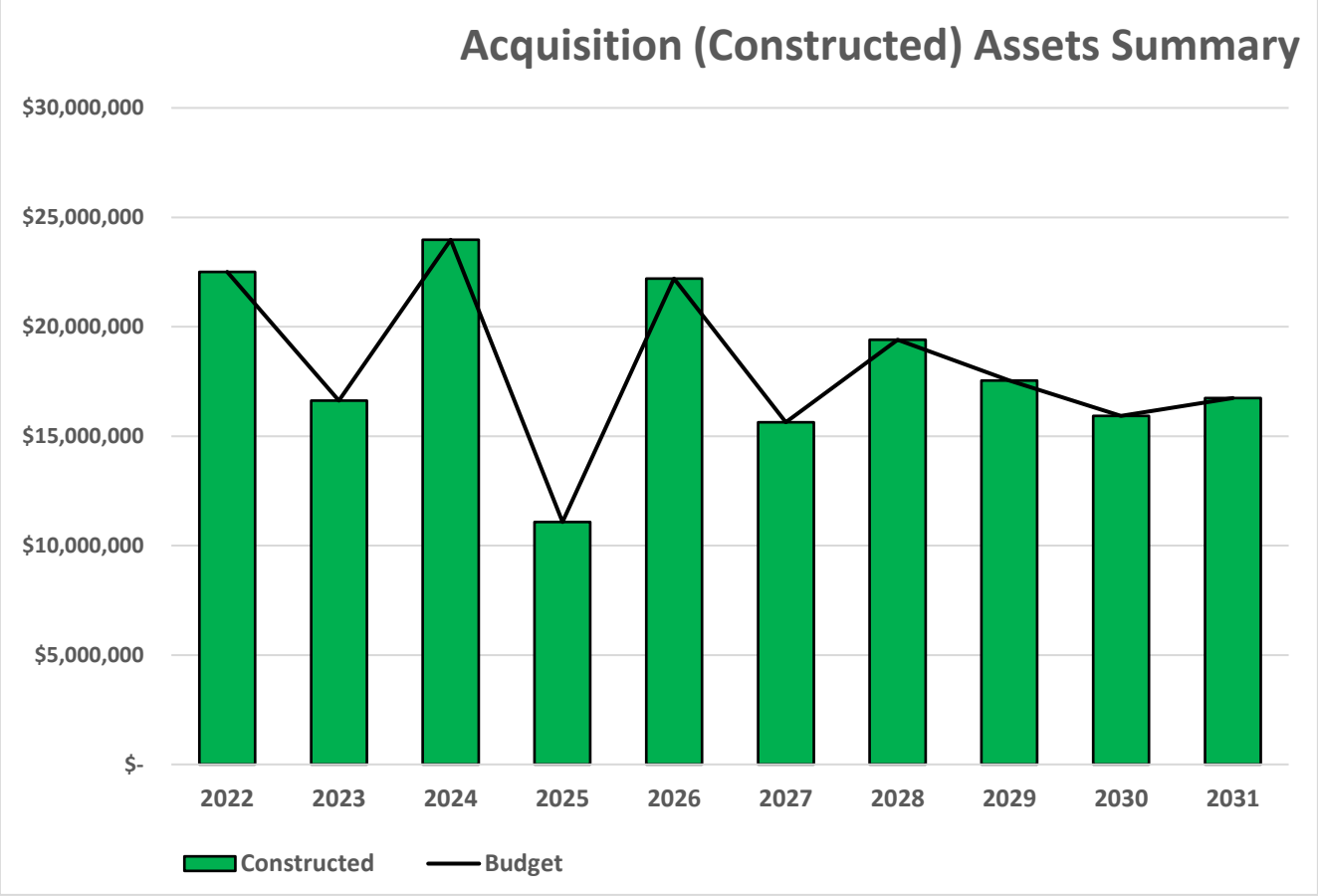
- Forecast the long-term needs and obligations of the assets;
- Operations and maintenance can include the assets in their planned activities (inspections, legislative compliance activities); and,
- Finance can ensure that assets are properly captured and recognized appropriately (Audited Financial Statements, TCA process, Provincial reporting such as the FIR).

The City will need to ensure the required data is updated frequently and to a single source to ensure that all the departments have access to the data they require in a timely manner. Once stormwater assets are assumed, Hamilton then becomes the stewards of these assets and is responsible for all ongoing costs for the asset's operation, continued maintenance, inevitable disposal and their likely renewal.

Construction costs are often only **10-15 %** of an asset's whole life costs. When development assets are donated to Hamilton, the City then becomes obligated to fund the remaining whole life costs. Over the next ten-year planning period Hamilton anticipates ***receiving*** **$270,000,000** of donated assets which, would then obligate Hamilton to fund the remaining costs over the donated assets ESL.

The City has internal design standards, inspection practices as well as assessment which are intended to ensure the assets that are being donated to the City through subdivision agreements are in excellent condition before assumption. The City should continue to review its assumption process to ensure that the City is receiving high quality and appropriately sized donated assets to defer lifecycle activities as much as possible.

Figure 25: Acquisition (Constructed) Assets Summary
All figures are in 2021 dollars.



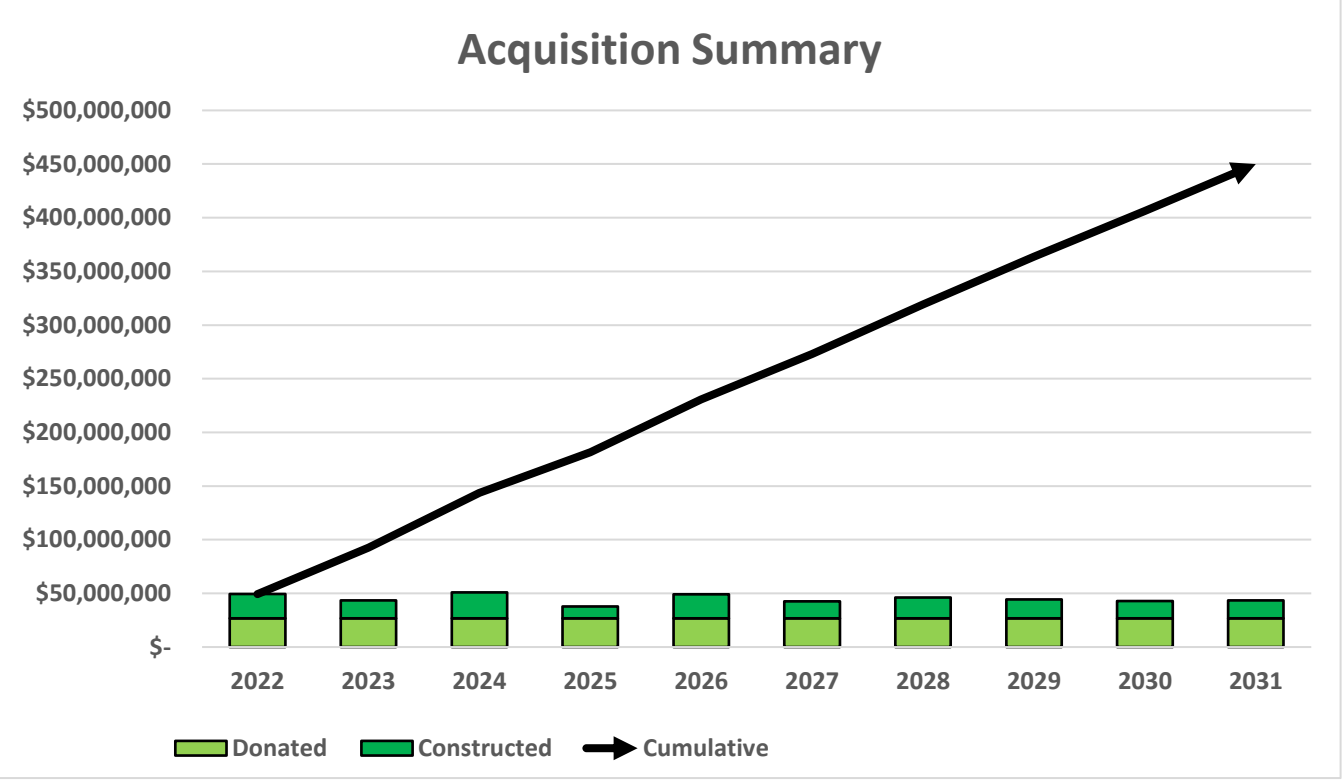
When Hamilton commits to new assets, the municipality must be prepared to fund future operations, maintenance and renewal costs. Hamilton must also account for future depreciation when reviewing long term sustainability. When reviewing the long-term impacts of asset acquisition, it is useful to consider the cumulative value of the acquired assets being taken on by the City. The cumulative value of all acquisition work, including assets that are constructed and contributed shown in Figure 26.

Over the next 10-year planning period Hamilton will acquire approximately **$181,645,000** of constructed assets which can either be new assets which did not exist before or expansion of assets when they are to be replaced. Major acquisition expenditures over the next ten years include;

- **$16 million** for new Beach Strip pumping stations
- **$12.6** million for the Parkside and Kipling stormwater facility
- **$67.5 million** to address flooding and drainage plans, and
- **$19.6** million dollars for connecting development areas

Hamilton has sufficient budget planned for its planned constructed acquisitions at this time however this does not address future asset needs that may need to be constructed to ensure service levels are maintained over the long term. With competing needs for resources across the entire city there will be a need to investigate tradeoffs and design options to further optimize asset decisions and ensure intergenerational equity can be achieved.

Figure 25: Acquisition (Constructed) Assets Summary
All figures are in 2021 dollars.



It is anticipated that Hamilton will acquire **$451,645,000** of new stormwater assets over the next ten years. This is a significant amount of assets that will require funding and resources far into the future and should be planned for over the long term.

It will become critical to understand that either the construction or assumption of new assets will commit the City to the funding of ongoing operations, maintenance and renewal costs which are significant. Hamilton will need to address how it is best to fund these ongoing costs as well as the costs to construct the assets while seeking the highest level of service possible.

Future AM Plans will focus on improving the understanding of Whole Life Costs and funding options. However, at this time the plan is limited on those aspects. Expenditure on new assets and services will be accommodated in the long-term financial plan but only to the extent that there is available funding.

4.2.2 Operations and Maintenance Plan

Operations include all regular activities to provide services. Daily, weekly, seasonal and annual activities are undertaken by staff to ensure the assets perform within acceptable parameters and to monitor the condition of the assets for safety and regulatory reasons. Examples of typical operational activities include catch basin cleaning, water sample collection, quality testing, inspections, utility costs and the necessary staffing resources to perform these activities.
Some of the major operational investments over the next 10 years include:

- **$17 million** allocated for support from Engineering Services Division;
- **$3 million** allocated for storm sewer network planning; and,
- **$2.6 million** allocated for Hamilton's Shoreline Protection Program.

Maintenance should be viewed as the ongoing management of deterioration. The purpose of planned maintenance is to ensure that the correct interventions are applied to assets in a proactive manner and to ensure it reaches its intended useful life. Maintenance does not significantly extend the useful life of the asset but allows assets to reach their intended useful life by returning the assets to a desired condition.

Proactively planning maintenance significantly reduces the occurrence of reactive maintenance which is always linked to a higher risk to human safety and higher financial costs. The City needs to plan and properly fund its maintenance to ensure the stormwater network is reliable and can achieve their desired level of service.

Maintenance includes all actions necessary for retaining an asset as near as practicable to an appropriate service condition including regular ongoing day-to-day work necessary to keep assets operating. Examples of typical maintenance activities include pipe repairs, pond dredging, catch basin repairs, equipment repairs along with appropriate staffing and material resources.

Major maintenance projects Hamilton plans to undertake over the next 10 years include:

- **$16 million** allocated for the right of way drainage program;
- **$10.3 million** allocated for Hamilton's Watercourse Erosion Rehabilitation program; and,
- **$14.1 million** allocated for Storm Water Facility maintenance.

4.2.3 Vertical Lifecycle Activities

The major operating and maintenance lifecycle activities per vertical asset with their accompanying 2021 costs (if known) are shown below in Table 67.

Table 67: Vertical Lifecycle Activities

ASSET	LIFECYCLE STAGE	LIFECYCLE ACTIVITY	FREQUENCY	2021 COST	UNIT
Pump Station	Operation	Inspection	Monthly	$639.54	annually
		Calibration	Ad Hoc	$73.34	annually
	Maintenance	Preventative Maintenance	Seasonal/ Annual	$195.03	annually
		Reactive Maintenance	Ad Hoc	$2,095.07	annually
Wet SWM Ponds	Operation	Sediment Depth Surveys	5-year cycle	$100,000.00	annually
		Water Level Monitoring	5 year cycle	$75,000.00	annually
	Maintenance	Full Dredging	25-year cycle	$1,650,000.00	annually
		Forebay Dredging	10-year cycle		
All SWM Ponds	Operation	Grass Cutting	6x per year	$110,000.00	annually
		Litter Collection	2x per year		
		Compliance Inspections	annually	$236.00	per unit
		Rainfall Inspections	ad hoc	$118.00	per unit
		Control Device Inspections	annually	$118.00	per unit
		Water Quality Sampling	6x per year	$60,000.00	annually
	Maintenance	Invasive Species Management	ad hoc	$450,000.00	annually
		Minor Repairs	ad hoc	$5,000.00	annually
		Sign Replacement	ad hoc	$10,000.00	annually
		Fencing Replacement	ad hoc	$50,000.00	annually
		Entry Treatment Replacement	ad hoc	$100,000.00	annually
		Administrative Tasks	annually	$675,000.00	annually
Flood Control Structure / Gate	Maintenance	Minor Repairs	ad hoc	$20,000	annually
	Operation	Rainfall Inspections	ad hoc	$118.00	per occurrence

When the City completes necessary operational and maintenance activities, high cost reactive repairs can be prevented, and this will ensure the assets reach their ESL.

4.2.4 Linear Lifecycle Activities

The major operating and maintenance lifecycle activities per linear asset with their accompanying 2021 costs (if known) are shown below in Table 68.

Table 68: Linear Lifecycle Activities

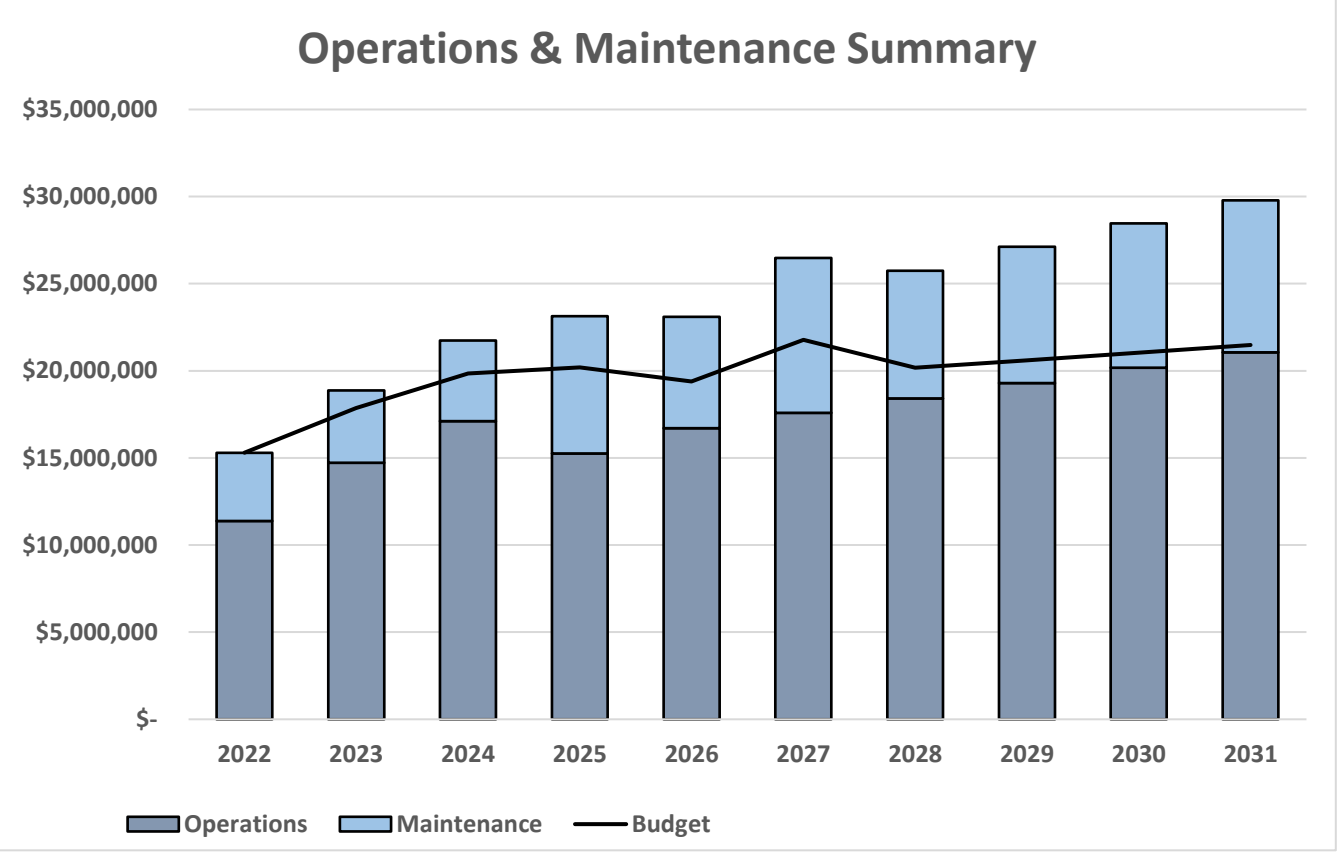
ASSET	LIFECYCLE STAGE	LIFECYCLE ACTIVITY	FREQUENCY	2021 COST	UNIT
Minor Culvert	Operation	Inspection	5 year cycle	$15,000.00	per year
		Cleaning	Ad Hoc	$1,000.00	Per instance
	Maintenance	Ditching	Ad Hoc	$500.00	Per instance
		Repair	Ad Hoc	No data	
Swales	Maintenance	Minor Maintenance	Ad Hoc	No data	
Catchbasins	Operation	Inspection	Ad Hoc	$61.00	Per instance
		Cleaning	Ad Hoc	$250.00	Per instance
OGS	Operation	Inspection Program	Monthly	$30.00	Per instance
		Cleaning	Ad Hoc	$450.00	Per instance
Inlet/Outfalls	Operation	Inspection	Annually	$30.00	Per instance
		Cleaning	Ad Hoc	$450.00	Per instance
	Maintenance	Minor Repairs	Ad Hoc	$2,000.00	Per instance

Assessment and priority of reactive maintenance is undertaken by staff using experience and judgement.

SUMMARY OF FORECAST OPERATIONS AND MAINTENANCE COSTS

Due to ongoing acquisitions the current operational and maintenance budget levels are considered to be inadequate to meet estimated service levels. Ongoing acquisitions from donated assets will require Hamilton to review its funding availability in the short term to ensure long term impacts can be mitigated.

Figure 27: Operations and Maintenance Summary
All figure values are shown in 2021 dollars.



The forecast of operations and maintenance costs are increasing steadily over time and it is clear, the City has insufficient budget to achieve all of the works required to ensure that assets will be able to achieve their estimated service life at the desired level of service. It is anticipated that at the current budget levels there will be insufficient budget to address all operating and maintenance needs over the 10-year planning horizon. The graph above illustrates that without increased funding or changes to lifecycle activities there is a significant shortage of funding which will lead to:

- Higher cost reactive maintenance;
- Possible reduction to the availability of the assets;
- Impacts to private property; and,
- Increased financial and reputational risk.

The shortfall is primarily due to the significant number of assets that are donated through subdivision agreements annually and insufficient funding allocations over an extended period of time. Every year that Hamilton adds additional assets without properly funding the necessary lifecycle activities, staff's ability to sustain the assets to expected or mandatory level of service can be significantly impacted. It should be noted that there are mandatory operational and

maintenance expenditures due to legislative requirements and cannot and should not simply be avoided or deferred.

The forecast costs include all costs from both the Capital and Operating budget. Asset management focuses on how taxpayer or ratepayer dollars are invested by lifecycle activities and not by budget allocation since both budgets contain various lifecycle activities they must both be consolidated for the AM Plans.

As the City continues to develop condition profiles and necessary works are identified based on their condition, it is anticipated operation and maintenance forecasts will increase significantly. Where budget allocations will result in a lesser level of service, the service consequences and risks will be identified and are highlighted in the Risk Section 4.5.

Deferred maintenance (i.e. works that are identified for maintenance activities but unable to be completed due to available resources) will be included in the infrastructure risk management plan for the next iteration.

Future iterations of this plan will provide a much more thorough analysis of operations and maintenance costs including types of expenditures for training, mandatory certifications, insurance, staffing costs and requirements, equipment and maintenance activities.

4.2.5 Renewal Plan

Renewal is major works which does not increase the assets design capacity but restores, rehabilitates, replaces or renews an existing asset to its original service potential. Works over and above restoring an asset to original service potential is considered to be an acquisition resulting in additional future operations and maintenance costs.

Stormwater asset renewals are typically undertaken to either ensure the assets reliability or quality will meet the service requirements set out by the City. Renewal projects are often triggered by service quality failure and can often be prioritized by those that have the highest consequence of failure, have high usage, have high operational and maintenance costs and other deciding factors.

The typical useful lives of assets used to develop projected asset renewal forecasts are shown in Table 69 and are based on estimated design life for this iteration. Future iterations of the plan will focus on the Lifecycle approach to ESL which can vary greatly from design life. Asset useful lives were last reviewed in 2022 however they will be reviewed annually until their accuracy reflects the City’s current practices.

Table 69: Useful Lives of Assets	
ASSET (SUB)CATEGORY	**AVERAGE USEFUL LIFE**
Pump Station	60 years
SWM Pond	100 years
Flood Control Gate/Structure	80 years
Local SW Main	94 years
Trunk SW Main	98 years
Inlet, Outfall	80 years
Catchbasin, Maintenance Hole,	100 years
Oil & Grit Separator (OGS)	25 years
Minor Culvert	50 years

The estimates for renewals in this AM Plan were based on the register method which utilizes the detailed listing of Hamilton's asset inventory and all available lifecycle information to determine the optimal timing for renewals

RENEWAL RANKING CRITERIA

Asset renewal is typically undertaken to either:

- Ensure the reliability of the existing infrastructure to deliver the service it was constructed to facilitate (e.g. replacing a bridge that has a load limit), or
- To ensure the infrastructure is of sufficient quality to meet the service requirements (e.g. condition of a culvert).[16]

It is possible to prioritise renewals by identifying assets or asset groups that:

- Have a high consequence of failure,
- Have high use and subsequent impact on users would be significant,
- Have higher than expected operational or maintenance costs, and
- Have potential to reduce life cycle costs by replacement with a modern equivalent asset that would provide the equivalent service.[17]

The ranking criteria used to determine priority of identified renewal proposals is detailed in Table 70.

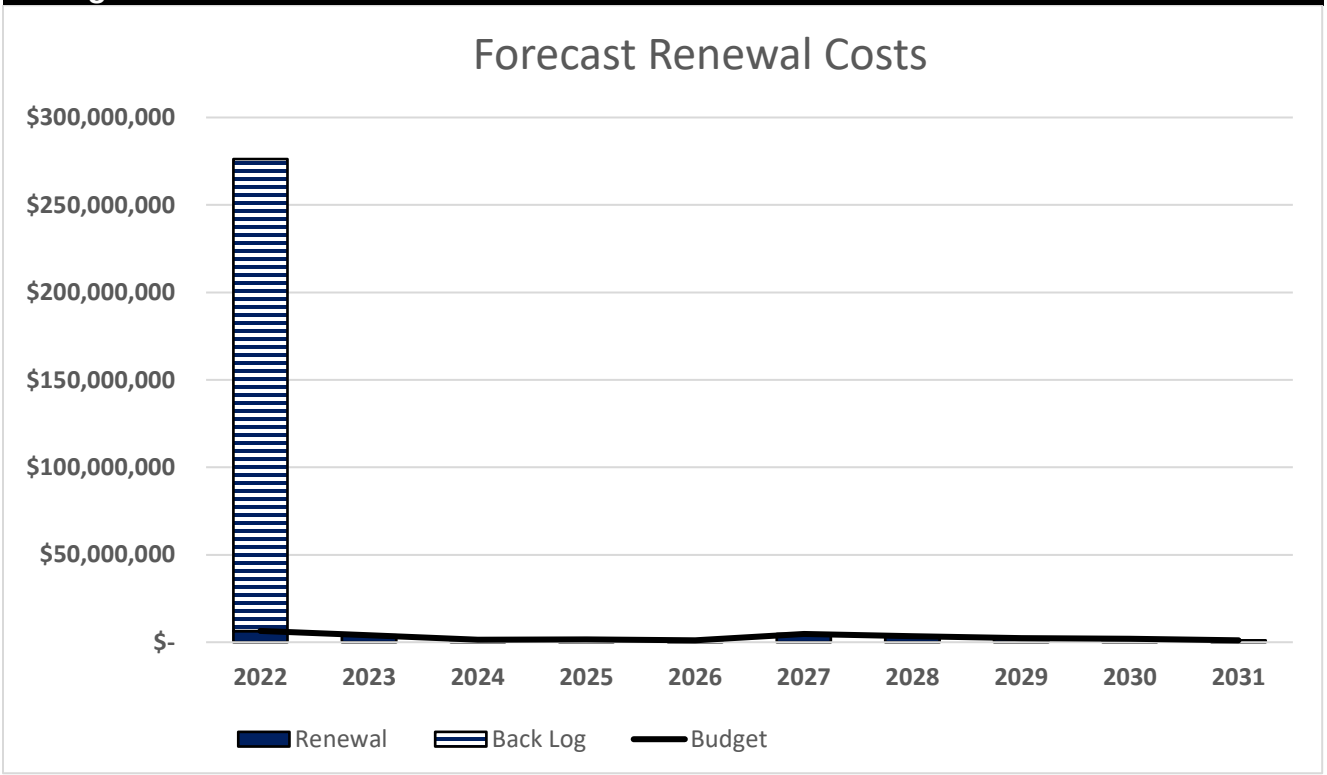
[16] IPWEA, 2015, IIMM, Sec 3.4.4, p 3|91.
[17] Based on IPWEA, 2015, IIMM, Sec 3.4.5, p 3|97.

Table 70: Renewal Priority Ranking Criteria	
CRITERIA	**WEIGHTING**
Regulatory / Legal Compliance	20%
Co-ordination – Funding and Budgeting	25%
Risk Mitigation	25%
Health & Safety (Users & Staff)	10%
Lifecycle Impacts (Operations & Maintenance)	10%
Demand Driver (Growth)	10%
Total	**100%**

SUMMARY OF FUTURE RENEWAL COSTS

Forecast renewal costs are projected to increase over time if the asset stock increases. The forecast costs associated with renewals are shown relative to the proposed renewal budget in Figure 28.

Figure 28: Forecast Renewal Costs
All figure values are shown in 2021 dollars.



The significant amount highlighted in 2022 represents the cumulative backlog of deferred work to be completed that has been either identified through its current estimated condition or age per Table 61 when condition was not available. This back log represents nearly **$272,000,000** of deferred works. Deferred renewal (assets identified for renewal and not funded) are included and identified within the risk management plan. Prioritization of these projects will need to be managed over time to ensure renewal occurs at the optimal time.

There is sufficient budget to support the **planned** projects only. Without additional funding the **backlog** will remain and continue to grow as future projects outside of the 10-year planning horizon continue to move forward into the 10 years scope. Continued deferrals of projects will lead to significantly higher operational and reactive maintenance costs and will affect the availability of services in the future. Hamilton has allocated **$28.3 million** dollars for future renewal projects which includes **$3.2** million for renewals in Westdale North neighborhood, **$6.5 million** for watercourse and drainage channel projects and **$5.5 million** for Catch Basin renewals.

Deferring renewals create risks of higher financial costs, decreased availability, and decreased satisfaction with asset performance. Ultimately, continuously deferring renewals works ensures Hamilton will not achieve intergenerational equality. If Hamilton continues to push out necessary renewals, there is a high risk that future generations will be unable to maintain the level of service the customers currently enjoy. It will burden future generations with such significant costs that inevitably they will be unable to sustain them.

Properly funded and timely renewals will ensure the assets perform as expected and it is recommended to continue to analyze asset renewals based on criticality and availability of funds for future AM Plans.

4.2.6 Disposal Plan

Disposal includes any activity associated with the disposal of a decommissioned asset including sale, possible closure of service, decommissioning, disposal of asset materials, or relocation. Disposals will occur when an asset reaches the end of its useful life. The end of its useful life can be determined by factors such as excessive operation and maintenance costs, regulatory changes, obsolesce or demand for the structure has fallen.

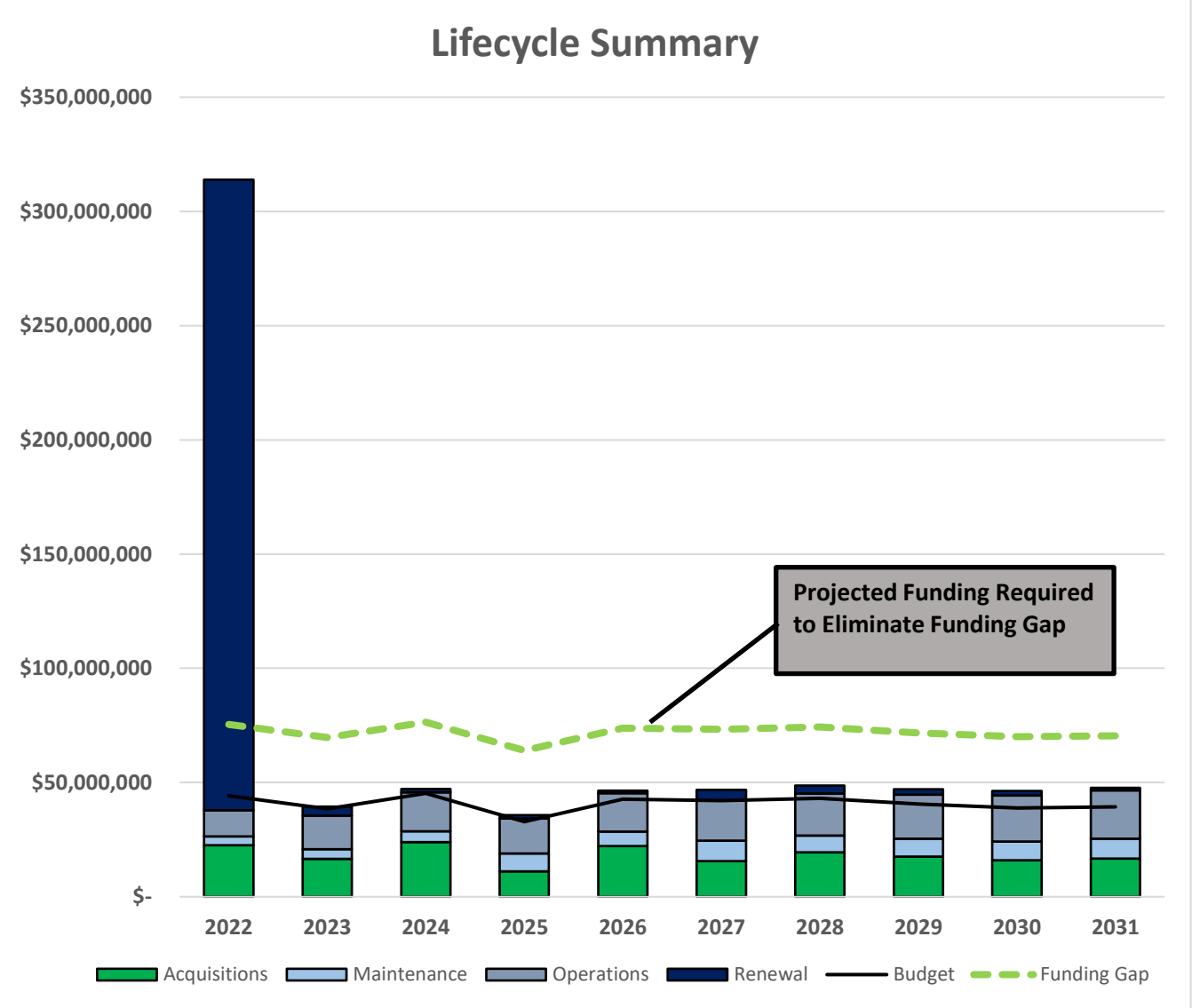
In future plans assets identified for possible decommissioning will be summarized withing this section of the plan. Hamilton will provide summary of the disposal costs and estimated reductions in annual operations and maintenance of disposing of the assets are also outlined. Any costs or revenue gained from asset disposals is included in future iterations of the AM Plan and the long-term financial plan.

SUMMARY OF ASSET FORECAST COSTS

The financial projections from this asset plan are shown in Figure 29. These projections include forecast costs for acquisition, operation, maintenance, renewal, and disposal. These forecast costs are shown relative to the proposed budget.

The bars in the graphs represent the forecast costs required to minimize the life cycle costs associated with the service provision. The proposed budget line indicates the estimate of available funding. The gap between the forecast work and the proposed budget is the basis of the discussion on achieving balance between costs, levels of service and risk to achieve the best value outcome.

Figure 29: Lifecycle Summary
All figure values are shown in 2021 dollars.



Currently there is insufficient budget to address the large backlog of renewal work projected by the plan. There is sufficient budget to address most of the ongoing operational and maintenance activities for the planning period however with the significant assumption of assets over time and their increased costs there may be impacts to the service itself as illustrated by Figure 29. Without some adjustment to available funds or other lifecycle management decisions there will be insufficient budget to address all planned lifecycle activities.

Allocating sufficient resources is imperative to managing asset throughout their lifecycle. This can include funding for lifecycle activities, sufficient staffing, increased asset knowledge, improved planning, contracted services, additional equipment or vehicles to ensure that Hamilton is optimizing its lifecycle approach.

Without sufficient funding the City has little option but to defer these necessary lifecycle activities. Deferring important lifecycle activities is never recommended. The City will benefit from allocating sufficient resources to developing its long-term financial plan to ensure that over time the City can fully fund the necessary lifecycle activities. Funding these activities helps to ensure the assets are compliant, safe and effectively deliver the service the customers need and desire.

The lack of funding allocated for the backlog of renewals and the necessary lifecycle activities creates an additional issue which is intergenerational equity. Each year the City defers necessary lifecycle activities it pushes the ever-increasing financial burden on to future generations. It is imperative the City begin addressing the lack of consistent and necessary funding to ensure that intergenerational equity will be achieved. Over time, allocating sufficient funding on a consistent basis ensures that future generations will be able to enjoy the same standards being enjoyed today.

Over time the City will continue to improve its lifecycle data, and this will allow for informed choices as how best to mitigate those impacts and how to address the funding gap itself. This gap in funding in future plans will be refined over the next 3 years and improve the confidence and accuracy of the forecasts.

4.3 MANDATORY O.REG. 588/17 LEVELS OF SERVICE

Table 1 in O.Reg. 588/17 identifies specific metrics that must be reported in the AM Plan for stormwater assets. These metrics are divided into community and technical levels of service and are provided below.

4.3.1 Mandatory O.Reg. 588/17 Community Levels of Service

Per Table 3 in O.Reg. 588/17, there are community levels of service that the City is required to report on in order to meet the provincial level of service requirement. These metrics are required to be reported, and so they have been separated from the customer levels of service described in Section 4.3.2. These qualitative metrics are reported below.

Scope

1. Description, which may include maps, of the user groups or areas of the municipality that are protected from flooding, including the extent of the protection provided by the municipal stormwater management system.

Areas of the City are protected from flooding through a variety of City infrastructure. In urban areas, underground storm infrastructure (i.e. stormwater main) provides some degree of flooding protection to private properties and flooding of the road allowance. Stormwater facilities and structures, including wet ponds, low impact development structures and storage facilities also allow the City to lower the risk and impacts of flooding. In rural areas, roadside ditches manage road flooding and may offer some property flooding protection, and municipal drains provide formal drainage and flooding considerations. Map 4 in Section 4.1 shows the areas of the City which have separated storm sewers and also shows the location of the stormwater ponds (Stormwater Management Facilities).

4.3.2 Mandatory O.Reg 588/17 Technical Levels of Service

In addition, per Table 3 in O.Reg 588/17, there are technical levels of service that the City is required to report on in order to meet the provincial level of service requirement. These quantitative metrics are reported below.

Table 71: Mandatory Technical Levels of Service

SERVICE ATTRIBUTE	TECHNICAL LEVELS OF SERVICE	MEASURE
Scope	**1.** Percentage of properties in municipality resilient to a 100-year storm.	95%
	2. Percentage of the municipal stormwater management system resilient to a 5-year storm.	89%

4.0 STORMWATER

In theory, all City properties connected to the stormwater drainage system should currently be protected from a 100-year storm. However, there are known flooding issues in the City which have not yet been quantified. Therefore, the number above is an estimate which will be updated when the stormwater modelling for the City's storm system is complete.

In addition, the current City-wide criteria is for minor system conveyance to be designed for a 5-year return period, however many legacy systems remain throughout the City especially in Ancaster, Dundas and Flamborough.

4.4 MUNICIPALLY DEFINED LEVELS OF SERVICE

Levels of service are measures for what Hamilton provides to its customers, residents, and visitors. Service levels are best described as the link between providing the outcomes the community desires, and the way that Hamilton provides those services. Service levels defined in three ways, customer values, customer levels of service and technical levels of service which are outlined in this section.

4.4.1 Customer Values

Customer values are what the customer can expect from their tax dollar in “customer speak”. These values are used to develop level of service statements.

Customer Values indicate:

- what aspects of the service is important to the customer;
- whether they see value in what is currently provided; and,
- the likely trend over time based on the current budget provision.

To develop these customer values, as stated in the AMP Overview, a Customer Engagement Survey was released in January 2022 on the Engage Hamilton platform. The survey received 184 submissions and contained 14 questions related to stormwater service delivery. The survey results can be found in Appendix “A” in the AMP Overview. While these surveys were used to establish customer values and customer performance measures, it’s important to note that the number of survey respondents only represents a small portion of the population.

The future intent is to release this survey on an annual basis to measure the trends in customer satisfaction and ensure that the City is providing the agreed level of service as well as to improve the marketing strategy to receive more responses. This has been noted in Table 82 in the Continuous Improvement section.

Table 72: Customer Values Service Objective:			
CUSTOMER VALUES	**CUSTOMER SATISFACTION MEASURE**	**CURRENT FEEDBACK**	**EXPECTED TREND BASED ON PLANNED BUDGET**
Streets and properties don't flood	Annual Customer Engagement Survey	Most survey respondents had not had flooding on their properties or had to detour due to flooding on roads, but many survey respondents were concerned with future flooding.	Maintain Trend
Stormwater is returned to the natural watercourse responsibly.	Annual Customer Engagement Survey	Many survey respondents did not think the City was responsible about returning stormwater back to the environment.	Maintain Trend

4.4.2 Customer Levels of Service

The Customer Levels of Service are considered in terms of:

Condition	How good is the service? What is the condition or quality of the service?
Function	Is it suitable for its intended purpose? Is it the right service?
Capacity/Use	Is the service over or under used? Do we need more or less of these assets?

In Table 73 under each of the service measures types (Condition, Function, Capacity/Use) there is a summary of the performance measure being used, the current performance, and the expected performance based on the current budget allocation.

Table 73: Customer Levels of Service

TYPE OF MEASURE	LEVEL OF SERVICE	SOURCE	PERFORMANCE MEASURE	CURRENT PERFORMANCE	EXPECTED TREND BASED ON PLANNED BUDGET
Condition	Provide reliable stormwater services with minimum flooding.	Annual Customer Engagement Survey	76.4% of survey respondents have not experienced flooding impacts on their property	Fairly Satisfied	Maintain Trend
			48.4% of survey respondents are concerned with flooding on their property	Unsatisfied	Trending downwards
			76.4% of survey respondents have not experienced flooding impacts on their property	Fairly Satisfied	Maintain Trend
			92.9% of survey respondents did not have to delay or cancel plans due to roads flooding	Very Satisfied	Maintain Trend
			Confidence levels	Medium	
		Age-based	Average condition of pump stations	Very Good	Trending downwards
		Age-based	Average condition of stormwater ponds	Good	Maintain Trend
			Confidence levels	Low	
		Age & Condition Based	Average condition of stormwater main	Good	Maintain Trend
			Confidence levels	Medium	
		Unknown	Average condition of flood control gate/structure	Unknown	Trending downwards
			Confidence levels	Very Low	
Function	Ensure stormwater is being collected responsibly.	Annual Customer Engagement Survey	40.1% of survey respondents do not think that Hamilton behaves responsibly when returning stormwater back to the environment	Unsatisfied	Maintain Trend
			Confidence levels	Medium	
Capacity	Ensure stormwater assets are used and within design capacity.	Annual Customer Engagement Survey	30.3% of survey respondents were connected to the storm sewer	Low	Maintain Trend
			Confidence levels	Medium	

4.4.3 Technical Levels of Service

Technical levels of service are operational or technical measures of performance, which measure how the City plans to achieve the desired customer outcomes and demonstrate effective performance, compliance and management. The metrics should demonstrate how effectively Hamilton delivers its services in alignment with its customer values; and should be viewed as possible levers to impact and influence the Customer Levels of Service. Hamilton will measure specific lifecycle activities to demonstrate how Hamilton is performing on delivering the desired level of service as well as to influence how customer perceive the services they receive from the assets.

Technical service measures are linked to the activities and annual budgets covering Acquisition, Operation, Maintenance, and Renewal.

Service and asset managers plan, implement and control technical service levels to influence the service outcomes.

Table 74 shows the activities expected to be provided under the current 10 year Planned Budget allocation, and the Forecast activity requirements being recommended in this AM Plan.

Table 74: Technical Levels of Service					
LIFECYCLE ACTIVITY	**PURPOSE OF ACTIVITY**	**ACTIVITY MEASURE**	**CURRENT PERFORMANCE***	**TARGET**	**RECOMMENDED PERFORMANCE ****
Acquisition	Ensure stormwater assets are used and within design capacity.	% of stormwater ponds inspected before assumption	100%	100%	100%
Operation	Provide reliable stormwater services with minimum flooding.	METRIC -# of Oil & Grit Interceptor Inspections	862	No Data	No Data
		Mainline sewers inspected per year	78 km	100	100
		% of stormwater pond inspections completed	100%	100	100%
		% Watercourse erosion inspection per year	No Data	33%	33%
		# inlet/outlet inspections completed	2,267	No Data	No Data
Maintenance	Provide reliable stormwater services with minimum flooding.	% of stormwater ponds cleaned out versus ponds requiring clean out	No Data	No Data	No Data
Renewal	Provide reliable stormwater services with minimum flooding.	Sewermain CIPP rehabilitation km/yr (4113)	4.5 km	No Data	No Data
Note: * Current activities related to Planned Budget. ** Expected performance related to forecast lifecycle costs.					

It is important to monitor the service levels regularly as circumstances can and do change. Current performance is based on existing resource provision and work efficiencies. It is acknowledged changing circumstances such as technology and customer priorities will change over time.

As the City's asset management maturity increases, and with the implementation of the EAM project mentioned in the AMP Overview, the City will also have more capacity to measure additional metrics. In addition, the City should investigate the balanced scorecard further to ensure data and assumptions are consistent with ministry and City reporting. This has been identified as a continuous improvement item in Table 82. In addition, often times wastewater and stormwater metrics have been reported together, and these should be separated for ease of reporting which has been identified as a continuous improvement item.

4.4.4 Levels of Service Summary

At this time, the City's technical metrics for stormwater assets are not as robust as for other core service areas. This will improve as the City continues to mature in asset management. As mentioned in Section 3.4.2, while these surveys were used to establish customer values and customer performance measures, it's important to note that the number of survey respondents currently only represents a small portion of the population.

CONDITION

Survey respondents appeared to be overall satisfied with the stormwater services they were provided. The majority of survey respondents had not had flooding on their properties and had not had to cancel travel plans due to road flooding. However, there were respondents who were concerned with the possibility of future flooding on their properties. Survey respondents who indicated flooding had occurred on their property typically referenced basement flooding associated with snow melt, faulty sump pumps, grading issues, or heavy rain events. These types of events are not typically the result of City infrastructure, although sometimes heavy rain events do cause some of these issues – however as shown in the technical metrics approximately 2200 inspections and clean outs (if required) were completed on inlets/outlets in the City to ensure they were functioning as intended. As shown throughout the report, the separated storm sewer network is typically maintained in Good condition, and the City is completing inspections and renewals for priority stormwater main. Additional technical metrics should be explored for stormwater for future iterations of the report and has been identified in Table 82 as a Continuous Improvement item.

FUNCTION

Many survey respondents did not feel that the City was responsible when returning stormwater back into the natural watercourse. As previously mentioned, best practice is not to disinfect stormwater before being returned to the environment since it is not of poor water quality, but as shown in the technical levels of service the City does complete the required inspections for stormwater ponds and oil & grit separators (OGS) which settle out grit and remove oil to prevent pollution.

CAPACITY

At this time, there were no key findings associated with stormwater capacity with respect to customer or technical levels of service. Few survey respondents were shown to be connected to the municipal stormwater system, which is expected since most residents do not have a storm lateral.

4.5 FUTURE DEMAND

The ability for Hamilton to be able to predict future demand for services enables the City to plan ahead and identify the best way of meeting the current demand while being responsive to inevitable changes in demand. Demand will inevitably change over time and will impact the needs and desires of the community in terms of the quantity of services (more communities connecting to the service) and types of service required (larger facilities to process increased volumes).

Demand is defined as the desire customers have for assets or services and that they are willing to pay for. These desires are for either new assets/services or current assets.

Since demand is not yet an extensive requirement in O.Reg 588/17 for the July 1st, 2022 deadline, this section is not as robust as some other sections of the report, but is an obligation for the report by July 1st, 2025, and will be expanded on in future iterations of the report.

4.5.1 Demand Drivers

For stormwater, the key drivers are population change, climate change and customer preferences and expectations. A future continuous improvement item is to identify and incorporate any additional demand drivers.

4.5.2 Demand Forecasts

The high level present position and projections for demand drivers that may impact future service delivery and use of assets have been identified and documented in Table 75. At this time, specific projections have not been calculated and will be updated in the 2025 AM Plan as per the timelines stated in the AMP Overview. Growth projections have been shown in the AMP Overview.

4.5.3 Demand Impact and Demand Management Plan

The impact of demand drivers that may affect future service delivery and use of assets are shown in Table 75.

Demand for new services will be managed through a combination of managing existing assets, upgrading of existing assets and providing new assets to meet demand and demand management. Demand management practices can include non-asset solutions, insuring against risks, and managing failures.

Opportunities identified to date for demand management are shown in Table 75. Climate change adaptation is included in Table 76. Further opportunities will be developed in future revisions of this AM Plan, as identified in Table 82 in the Continuous Improvement Section.

Table 75: Demand Management Plan

DEMAND DRIVER	CURRENT POSITION	PROJECTION	IMPACT ON SERVICES	DEMAND MANAGEMENT PLAN
Population Change	573,000 (2021)	660,000 (2031)	More SW main required	Investigate need for new pump stations. New staff may be required for legislative compliance. Adjust budgets, long-term financial plan, and AM Plan.
Population Change	573,000 (2021)	660,000 (2031)	More SWM Ponds required	Acquisitions through subdivision agreements. Impacts to budget, LTFP and Staffing
Customer Preferences & Expectations	Most rural roads have rural cross sections (e.g. ditches)	Rural roads converted to urban cross section (e.g. curbs and stormwater pipes)	Reduced infiltration of stormwater increasing flow to downstream facilities.	Educate customers on benefits of ditches. Complete models of stormwater network and run models before urbanizing road.
Customer Preferences & Expectations	Homeowners have areas for infiltration on property (e.g. grass)	Homeowners converting lot with more impervious surfaces (e.g. driveways)	Reduced infiltration of stormwater increasing flow to downstream facilities.	Dedicated SW Rate Program based on impervious surface. Incentive programs for LIDs.

4.5.4 Asset Programs to meet Demand

The new assets required to meet demand may be acquired, donated or constructed. Additional assets are discussed in 4.2.1.

Acquiring new assets will commit the City of Hamilton to ongoing operations, maintenance and renewal costs for the period that the service provided from the assets is required. These future costs are identified and considered in developing forecasts of future operations, maintenance and renewal costs for inclusion in the long-term financial plan.

4.5.5 Climate Change Adaptation

The impacts of climate change may have a significant impact on the assets we manage and the services they provide. In the context of the asset management planning process, climate change can be considered as both a future demand and a risk.
Climate change impacts on assets will vary depending on the location and the type of services provided, as will the way in which those impacts are responded to and managed.[18]

As a minimum the City must consider how to manage our existing assets given potential climate change impacts for our region.

Risk and opportunities identified to date are shown in Table 76. This is a continuous process and will be updated in the 2025 AM Plan per the timelines outlined in the AMP Overview.

Table 76: Managing the Impact of Climate Change on Assets and Services

CLIMATE CHANGE DESCRIPTION	PROJECTED CHANGE	POTENTIAL IMPACT ON ASSETS AND SERVICES	MANAGEMENT
Increased wet weather events.	Increased demand on storm sewer system.	Stormwater system at capacity causing more overflows into natural watercourse or flooding.	Model combined sewer network and upgrade pipe size or separate sewers.

Additionally, the way in which the City constructs new assets should recognize that there is opportunity to build in resilience to climate change impacts. Building resilience can have the following benefits:

- Assets will withstand the impacts of climate change;
- Services can be sustained; and
- Assets that can endure may potentially lower the lifecycle cost and reduce their carbon footprint

Table 77 summarizes some asset climate change resilience projects the City is currently pursuing.

[18] IPWEA Practice Note 12.1 Climate Change Impacts on the Useful Life of Infrastructure

Table 77: Building Asset Resilience to Climate Change

PROJECT	PROJECT DESCRIPTION	CLIMATE CHANGE IMPACT	BUILD RESILIENCE IN NEW WORKS
Rain Gauges Monitoring Program	Operate a rain gauge network in the City of Hamilton.	Significant wet weather events which are increasing due to climate change will cause sewers to overflow more often into natural watercourse and increase risk of basement flooding.	To improve Hamilton's climate resiliency by decreasing our vulnerability to extreme weather, minimizing future damages, take advantage of opportunities, and better recover from future damages.
Rosedale Neighborhood Flood Protection Works	EA study for the control of surface water flows to mitigate basement flooding in the Rosedale Neighborhood.		
Stormwater Management Pond Retrofits	Condition assessment and analysis on the operating performance of four existing SWM ponds which will quantify operating performance and recommend enhancements.		
Rain Barrels	Rain-barrel sale; encourage use of rain barrels through outreach program		
Downspout Disconnection Program	Downspout Disconnection Program - This pilot program was implemented as an effort to provide some immediate relief against flooding basements during major rain storms for selected volunteer homes		
Stormwater Computer Models	Development of Stormwater Computer Models - A robust and calibrated computer model can predict the location within a collection system where the capacity will be exceeded when modelling increased rain fall events		
Bioretention Swales	Integrate bio retention swales into new roadway/boulevard construction		
LID Solutions in Parks	Storm Water Management - included some LID solutions in parks.		
Beach Strip SW Pump Station	Environmental Assessment to Identify Preferred Flood Mitigating Solutions for Beach neighbourhood flooding and elevated Lake Ontario water levels.	Frequency and extent of floods is increasing due to higher Lake Ontario water levels, driven in part by climate change	
Backflow Device Installation	Installation of new backflow devices in the city's sewer system, which are designed to prevent lake and harbour water from entering sewers during extreme storms, and therefore lessen basement flooding		
Stormwater Funding Restructuring	Report presented to Council which proposed to restructure the funding mechanism to separate the stormwater rate from water rate.	Increased wet weather events and higher lake levels means that stormwater will become a larger part of City budget and must be budgeted accordingly.	

The impact of climate change on assets is a new and complex discussion and further opportunities will be developed in future revisions of this AM Plan.

4.6 RISK MANAGEMENT

The purpose of infrastructure risk management is to document the findings and recommendations resulting from the periodic identification, assessment and treatment of risks associated with providing services from infrastructure, using the fundamentals of International Standard ISO 31000:2018 Risk management – Principles and guidelines.
Risk Management is defined in ISO 31000:2018 as: 'coordinated activities to direct and control with regard to risk[19].

Hamilton is developing and implementing a formalized risk assessment process to identify risk associated with service delivery and to implement proactive strategies to mitigate risk to tolerable levels. The risk assessment process identifies credible risks associated with service delivery and will identify risks that will result in loss or reduction in service, personal injury, environmental impacts, a 'financial shock', reputational impacts, or other consequences.

The risk assessment process identifies credible risks, the likelihood of those risks occurring, and the consequences should the event occur. For its bridge and culvert assets Hamilton utilizes two risk assessment methods to determine risk along with subject matter expert opinion to inform the prioritization. The City is further developing its risk assessment maturity with the inclusion of a risk rating, evaluation of the risks and development of a risk treatment plan for those risks that are deemed to be non-acceptable in the next iteration of the plan.

Risk Assessment is not yet an extensive requirement in O.Reg. 588/17 for the July 1st, 2022 deadline. As a result, this section is not as robust as some other sections of the report, but is an obligation for the report by July 1st, 2025, and will be expanded on in future iterations of the report.

4.6.1 Critical Assets

Critical assets are defined as those which have a high consequence of failure causing significant loss or reduction of service. Critical assets have been identified and along with their typical failure mode, and the impact on service delivery, are summarized in Table 78. Failure modes may include physical failure, service interruptions or lack of availability.

Table 78: Critical Assets

CRITICAL ASSET(S)	FAILURE MODE	IMPACT
Pump Station	Essential service interruption	Overflow of wet well or gravity main causing flooding.

[19] ISO 31000:2009, p 2

Table 78: Critical Assets		
CRITICAL ASSET(S)	**FAILURE MODE**	**IMPACT**
Storm Water Management Pond	Physical Failure	Contaminants don't settle out and pollutes watercourse and/or pipes reach capacity causing flooding.
Critical Stormwater Main	Physical Failure	Storm backup might occur at catchbasins or laterals and flood streets/properties.
SCADA	Essential service interruption	System failure causing service interruption to pump station

By identifying critical assets and failure modes an organization can ensure that investigative activities, condition inspection programs, maintenance and capital expenditure plans are targeted at critical assets.

4.6.2 Risk Assessment

The risk assessment process identifies credible risks, the likelihood of the risk event occurring, the consequences should the event occur, development of a risk rating, evaluation of the risk and development of a risk treatment plan for non-acceptable risks.

An assessment of risks associated with service delivery will identify risks that will result in loss or reduction in service, personal injury, environmental impacts, a 'financial shock', reputational impacts, or other consequences.

Critical risks are those assessed with 'Very High' (requiring immediate corrective action) and 'High' (requiring corrective action) risk ratings identified in the Infrastructure Risk Management Plan. The residual risk and treatment costs of implementing the selected treatment plan is shown in Table 6.2. It is essential that these critical risks and costs are reported to management. Additional risks will be developed in future iterations of the plan and is identified in Table 82 in the Continuous Improvement Section the plan.

Table 79: Risks and Existing Controls			
SERVICE OR ASSET AT RISK	**WHAT CAN HAPPEN**	**RISK RATING**	**EXISTING CONTROLS**
Stormwater network	Lack of comprehensive stormwater model so City cannot predict where flooding may occur	Very High	Modelling is currently being completed.
Orphan Stormwater Asset	Asset fails due to no maintenance or inspection program	High	None
SWM Pond	Pipe Blockage	High	Control Structure Inspections; Compliance Inspections; Rainfall Inspections
SWM Pond	Invasive species reduce storage capacity (e.g. phragmites, goldfish)	High	Contract works; Educate public on not discarding pets
Low Impact Development	Lack of lot level controls on LIDs necessary to support intensification leads to assets not effectively managing stormwater	High	None
Critical Stormwater Main	Blockage due to structural failure or debris	High	CCTV inspection program
Pump Station	Pump failure or station reaches capacity.	High	Monthly station checks and verifications by operators

4.6.3 Infrastructure Resilience Approach

The resilience of our critical infrastructure is vital to the ongoing provision of services to customers. To adapt to changing conditions Hamilton needs to understand its capacity to 'withstand a given level of stress or demand', and to respond to possible disruptions to ensure continuity of service. An example would be how the storm water management ponds perform during the most significant storm water events during a given year. We do not currently measure our resilience in service delivery and will be included in the next iteration of the AM Plan.

Resilience covers the capacity of Hamilton to withstand any service disruptions, act appropriately and effectively in a crisis, absorb shocks and disturbances as well as adapting to ever changing conditions. Resilience is built on aspects such as response and recovery planning, financial capacity, climate change, risk assessment and crisis leadership.

4.6.4 Service and Risk Trade-Offs

The decisions made in AM Plans are based on the objective to achieve the optimum benefits from the available resources. At this time, the City does not have sufficient data to present risks and tradeoffs. This information will be presented in the **2025** AM Plan regarding Proposed Levels of Service per the timelines outlined in the AMP Overview.

4.6.5 Financial Summary

This section contains the financial requirements resulting from the information presented in the previous sections of this AM Plan. Effective asset and financial management will enable Hamilton to ensure its storm water network provides the appropriate level of service for the City to achieve its goals and objectives. Reporting to stakeholders on service and financial performance ensures Hamilton is transparently fulfilling its stewardship accountabilities.

Long-Term financial planning (LTFP) is critical for Hamilton to ensure the stormwater network's lifecycle activities such as renewals, operations, maintenance and acquisitions can happen at the optimal time. Hamilton is under increasing pressure to meet the wants and needs of its customer while keeping costs at an affordable level and maintaining its financial sustainability.

Without funding asset activities properly for its storm water network; Hamilton will have difficult choices to make in the future which will include options such as higher cost reactive maintenance and operational costs, reduction of service and potential reputational damage.

Hamilton will be seeking to fully incorporate its storm water network into the LTFP. Aligning the LTFP with the AM Plan is critical to ensure the all the networks needs will be met while the City is finalizing a clear financial strategy with measurable financial targets. The financial projections will be improved as the discussion on desired levels of service and asset performance matures.

4.6.6 Sustainability of Service Delivery

There are two key indicators of sustainable service delivery that are considered in the AM Plan for this service area. These indicators are used to monitor and assess financial performance over the planning period. The two indicators are the:

- asset renewal funding ratio (proposed renewal budget for the next 10 years / forecast renewal costs for next 10 years), and
- medium term forecast costs/proposed budget (over 10 years of the planning period).

ASSET RENEWAL FUNDING RATIO

Asset Renewal Funding Ratio[20] **9.49**%

The Asset Renewal Funding Ratio is used to determine if Hamilton is accommodating asset renewals in an **optimal** and **cost effective** manner from a timing perspective and relative to financial constrains, the risk Hamilton is prepared to accept and service levels it wishes to maintain. The target renewal funding ratio should be ideally between **90% - 110%** over the entire planning period. A low indicator result generally indicates that service levels are achievable however the expenditures are below this level because Hamilton is reluctant to fund the necessary work or prefers to maintain low levels of debt.

Over the next 10 years Hamilton expects to have **9.49%** of the funds required for the optimal renewal of assets. By only having sufficient funding to renew **9.49%** of the required assets in the appropriate timing it will inevitably require difficult trade off choices that could include:

- a reduction of the level of service and availability of assets;
- increased complaints and reduced customer satisfaction;
- increased reactive maintenance and renewal costs;
- damage to the City's reputation and risk of fines or legal costs; and,
- property damage and increased pollutants entering the watercourse

The historical lack of renewal funding resources will be addressed in future AM Plan's while aligning the plan to the LTFP. This will allow staff to develop options and long-term strategies to address the renewal rate. Hamilton will review its renewal allocations once the entire inventory has been confirmed and amalgamated.

The Asset Renewal Funding Ratio is an important indicator and illustrates that over the next 10 years we expect to have **9.49 %** of the funds required for the optimal renewal of assets.

MEDIUM TERM → 10-YEAR FINANCIAL PLANNING PERIOD

This AM Plan identifies the forecast operations, maintenance and renewal costs required to provide an agreed level of service to the community over a 10 year period. This provides input into 10 year financial and funding plans aimed at providing the required services in a sustainable manner.

This forecast work can be compared to the proposed budget over the first 10 years of the planning period to identify any funding shortfall.

The forecast operations, maintenance and renewal costs over the 10 year planning period is **$53,766,052** on average per year.

[20] AIFMM, 2015, Version 1.0, Financial Sustainability Indicator 3, Sec 2.6, p 9.

The proposed (budget) operations, maintenance and renewal funding is **$22,596,378** on average per year giving a 10 year funding **shortfall** of **$31,169,674** per year or **$311,696,740** in total over the ten year planning period. This indicates that **42.03%** of the forecast costs needed to provide the services documented in this AM Plan are accommodated in the proposed budget. Note, these calculations exclude acquired assets.

Funding an annual funding shortfall or funding 'gap' of **$31,169,6746** per year cannot be addressed in a single year and has not been incorporated as identified within this plan into any existing plan. The Gap will require vetting, planning and resources to begin to incorporate gap management into the future budgets. This gap will need to be managed over time to reduce it in a sustainable manner and limit financial shock to customers. Options for managing the gap include;

- Financing strategies – increased funding, block funding for specific lifecycle activities, long term debt utilization;
- Adjustments to lifecyle activites – increase/deacrease maintenance or operations, increase/decrease frequency of renewals, limit acquisitions or dispose of underutilized assets; and,
- Influence level of service expectations or demand drivers

These options and others will allow Hamilton to ensure the gap is managed appropriately and ensure the level of service ouctomes the customers desire.

Providing sustainable services from infrastructure requires the management of service levels, risks, forecast outlays and financing to achieve a financial indicator of approximately 1.0 for the first years of the AM Plan and ideally over the 10 year life of the Long-Term Financial Plan.

4.6.7 Forecast Costs (Outlays) For the Long-Term Financial Plan

Table 80 shows the forecast costs (outlays) required for consideration in the 10-year long-term financial plan.

Providing services in a financially sustainable manner requires a balance between the forecast outlays required to deliver the agreed service levels with the planned budget allocations in the operational and capital budget. Hamilton will begin developing its long-term financial plan (LTFP) to incorporate both the operational and capital budget information and help align the LTFP to the AM Plan which is critical for effective asset management planning.

A gap between the recommended forecast outlays and the amounts allocated in the operational and capital budgets indicates further work is required on reviewing service levels in the AM Plan.

Hamilton will manage the 'gap' by continuing to develop this AM Plan to provide guidance on future service levels and resources required to provide these services in consultation with the community. Options to manage the gap include reduction and closure of low use assets, increased funding allocations, reduce the expected level of service, utilize debt based funding

over the long term, adjustments to lifecycle activities, improved renewals and multiple other options or combinations of options.

These options will be explored in the next AM Plan and Hamilton will provide analysis and options for Council to consider going forward. Table 80: Forecast Costs (Outlays) for the Long-Term Financial Plan

Table 80: Forecast Costs (Outlays) for the Long-Term Financial Plan
Forecast costs are shown in 2021 dollar values.

YEAR	ACQUISITION	OPERATION	MAINTENANCE	RENEWAL	DISPOSAL	TOTAL
2022	$22,500,000	$11,381,345	$3,920,000	$64,55,000	0	$44,256,344
2023	$16,630,000	$14,222,998	$3,650,000	$40,10,000	0	$38,513,000
2024	$23,975,000	$16,189,918	$3,650,000	$14,50,000	0	$45,264,920
2025	$11,080,000	$13,826,635	$6,370,000	$15,80,000	0	$32,856,636
2026	$22,202,000	$14,899,700	$4,490,000	$11,00,000	0	$42,691,700
2027	$15,642,000	$15,287,688	$6,490,000	$46,90,000	0	$42,109,688
2028	$19,412,000	$15,691,196	$4,490,000	$35,10,000	0	$43,103,196
2029	$17,542,000	$16,110,844	$4,490,000	$24,30,000	0	$40,572,844
2030	$15,922,000	$16,547,287	$4,490,000	$19,50,000	0	$38,909,288
2031	$16,742,000	$17,001,168	$4,490,000	$11,00,000	0	$39,333,168

4.6.8 Funding Strategy

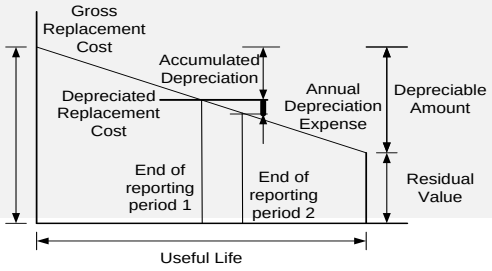
The proposed funding for assets is outlined in Hamilton's operational budget and ten (10) - year capital budget.

The financial strategy of Hamilton determines how funding will be provided, whereas the AM Plan communicates how and when this will be spent, along with the service and risk consequences of various service alternatives. Future iterations of the AM Plan will provide service delivery options and alternatives to optimize limited financial resources.

4.6.9 Asset Valuations

The best available estimate of the value of assets included in this AM Plan are shown below. The assets are valued at estimated replacement costs:

Replacement Cost (Current/Gross)	$3,100,000,000
Depreciable Amount	$3,100,000,000
Depreciated Replacement Cost[21]	$2,189,000,000
Depreciation	$ 51,054,900



The current replacement cost is the most common valuation approach for specialized infrastructure assets. The methodology includes establishing a comprehensive asset registry, assessing replacement costs (based on market pricing for the modern equivalent assets) and useful lives, determining the appropriate depreciation method, testing for impairments, and determining remaining useful life.

As the City matures its asset data, it is highly likely that these valuations will fluctuate significantly over the next 3 years and they should increase over time based on improved market equivalent costs

4.6.10 Valuation forecast

Asset values are forecast to increase as projections improve and can be validated as market pricing. The net valuations will increase significantly despite some assets being programmed for disposal that will be removed from the register over the ten (10) – year planning horizon.

Any additional assets will add to the operations and maintenance needs in the longer term and would also require additional costs due to future renewals obligations. Any additional assets will also add to future depreciation forecasts. Any disposals of assets would decrease the operations and maintenance needs in the longer term and removes the high costs renewal obligations.

[21] Also reported as Written Down Value, Carrying or Net Book Value.

4.6.11 Key Assumptions Made in Financial Forecasts

In compiling this AM Plan, it was necessary to make some assumptions. This section details the key assumptions made in the development of this AM Plan and should provide readers with an understanding of the level of confidence in the data behind the financial forecasts.

Key assumptions made in this AM Plan are:

- Operational forecasts are based on current budget allocations and are the basis for the projections for the 10-year horizon and do not address other operational needs not yet identified;
- Maintenance forecasts are based on current budget allocations and do not identify asset needs at this time. These forecasts are solely based on planned activities;
- 1.04 % p.a. has been added to maintenance forecasts to accommodate for donated assets assumed over the 10-year planning horizon; and,
- 1.00 % p.a has been added to operational forecasts to accommodate for donated assets assumed over the 10-year planning horizon.

4.6.12 Forecast Reliability and Confidence

The forecast costs, proposed budgets, and valuation projections in this AM Plan are based on the best available data. For effective asset and financial management, it is critical that the information is current and accurate. Data confidence is classified on a A - E level scale[22] in accordance with Table 5 in the AMP overview.
The estimated confidence level for and reliability of data used in this AM Plan is shown in Table 81.

Table 81: Data Confidence Assessment for Data used in AM Plan

DATA	CONFIDENCE ASSESSMENT	COMMENT
Demand drivers	Medium	Further investigation is required to better understand demand drivers.
Growth projections	Medium	Current growth projections will need to be vetted and improved. This is identified under continuous improvement initiatives.
Acquisition forecast	Medium	Currently based on 2019 DC study and SME opinion. Continuous improvements are required and identified.
Operation forecast	Medium	Currently budget based and requires future improvements to ensure allocation is accurate.
Maintenance forecast	Medium	Currently budget based and requires future improvements to ensure allocation is accurate.

[22] IPWEA, 2015, IIMM, Table 2.4.6, p 2|71.

Table 81: Data Confidence Assessment for Data used in AM Plan		
DATA	**CONFIDENCE ASSESSMENT**	**COMMENT**
Renewal forecast - Asset values	Low	Currently based on estimates and historical costs. These need to be improved to market prices.
- Asset useful lives	Low	Based on SME opinion. Continuous improvement required to ensure data is vetted and ensure it reflects Hamilton's actual practices.
- Condition modelling	Low	Mixture of assessment methods. Requires standardization along with predictable timelines for assessments.
Disposal forecast	Low	Current disposal information is rolled into renewal. Continuous improvements are required to ensure accurate data is available.

The estimated confidence level for and reliability of data used in this AM Plan is considered to be of **Low to Medium** confidence level.

4.7 PLAN IMPROVEMENT AND MONITORING

4.7.1 Status of Asset Management Practices[23]

ACCOUNTING AND FINANCIAL DATA SOURCES

This AM Plan utilizes accounting and financial data. The sources of the data:

- 2022 Capital & Operating Budgets;
- 2021 Tender Documents (various);
- Asset Management Data Collection Templates;
- Audited Financial Statements and Government Reporting (FIR, TCA etc);
- Financial Exports from internal financial systems; and,
- Historical cost and estimates of budget allocation based on SME experience.

ASSET MANAGEMENT DATA SOURCES

This AM Plan also utilizes asset management data. The sources of the data are:

- Data extracts from various city applications and management software;
- Asset Management Data Collection Templates;
- Tender documents, subdivision agreements and projected growth forecasts as well as internal reports;
- Condition Assessments;
- SOP's, Subject matter expert opinion and anecdotal information; and,
- Reports from the mandatory biennial inspection, operational & maintenance activities internal reports.

4.7.2 Improvement Plan

It is important that Hamilton recognize areas of the AM Plan and planning process that require future improvements to ensure the effective management of the stormwater network assets and to inform decision making. The tasks listed below are essential to improving the AM Plan and Hamilton's ability to make evidence based and informed decisions. These improvements span from improved lifecycle activities, improved financial planning, improved data quality as well as plans to physically improve the assets.

Each year Hamilton will revisit these planned activities and report on progress made. The Continuous Improvement plan table below highlights proposed continuous improvement items that will require further discussion and analysis to determine feasibility, resource requirements and alignment to current workplans. The Improvement plans in Table 32 highlights proposed improvement items that will require further discussion and analysis to determine feasibility,

[23] ISO 55000 Refers to this as the Asset Management System

resource requirements and alignment to current workplans. Future iterations of this AM Plan will provide updates on these improvement plans.

Table 82: Improvement Plan
*** p.a – per annum**

TASK	TASK	RESPONSIBILITY	RESOURCES REQUIRED	DRAFT TIMELINE
1.	Collect and verify data from systems (GIS, Hansen, etc.) before integrating into EAM	Hamilton Water	$40,000 p.a. $120,000 Total Internal Staff Time	3 Years (2022-2024)
2.	Develop a Long-Term Financial Plan to connect the budgeting process to AM planning	CAM, Hamilton Water, Finance	$15,000 p.a. $60,000 Total Internal Staff Time	4 Years (2022-2025)
3.	Complete condition assessments on pump stations and flood control structure/gates. Implement on a consistent cycle/methodology.	CAM, Hamilton Water	$84,000 p.a. $252,000 Total Internal Staff, Tender Process Specialty Assessor	3 Years (2022-2024)
4.	Standardize condition assessments for stormwater main and establish program and timeline to complete system wide assessment	CAM, Hamilton Water, Infrastructure Renewal l	$10,000 p.a. $20,000 Total Internal Staff Time	2 Years (2022-2023)
5.	Complete stormwater modelling to assess capacity of system and identify areas of concern.	CAM, Hamilton Water	$150,000 p.a. $450,000 Total Internal Staff time, Tender Process, External Assessment	3 Years (2022-2024)

6.	Investigate LIDAR technology to create inventory for swales and ditches	CAM, TOM	$100,000 p.a. $500,000 Total Internal Staff time, Tender Process, External Assessment	5 Years (2022-2026)
7.	Create inventory of low impact developments (LID) , ditches, swales, laterals in the City	CAM, Hamilton Water	$50,000 p.a. $150,000 Total Internal Staff time, Tender Process, External Vendors	3 Years (2022-2024)
8.	Modify existing inspection programs to output condition scores (SWM Ponds, minor culverts, OGS, Inlet/Outfalls)	CAM, Hamilton Water	$20,000 p.a. $60,000 Total Internal Staff Time	3 Years (2022-2024)
9.	Establish condition assessment programs for all maintenance holes, and catchbasins	CAM, Hamilton Water	$5,000 p.a. $10,000 Total Internal Staff Time	2 Years (2022-2023)
10.	Standardize condition assessment outcomes and timed deliverables	Engineering Services, TOM, CAM	$6,000 p.a. $18,000 Total Internal Staff Time	3 Years (2022-2024)
11.	Improve data confidence levels for asset register especially for assets with low data confidence (e.g. sewer laterals)	CAM, Hamilton Water	10,000 p.a. $50,000 Total Internal Staff Time	5 Years (2022-2026)
12.	Improve Growth projection data and modelling for next AM Plan iteration	CAM, Hamilton Water, Ec. Dev	$6,000 p.a. $12,000 Total Internal Staff Time	2 Years (2022-2023)

13.	Develop and implement an annual demand review process to ensure sufficient knowledge is available to inform future planning	CAM, Hamilton Water, EC. Dev	$17,500 $35,000 Total Internal Staff Time	2 Years (2022-2023)
14.	Analyze operational budget to improve AM allocations for lifecycle activities	CAM, Hamilton Water, Finance	$10,000 p.a. $30,000 Total Internal Staff Time	3 Years (2022-2024)
15.	Analyze maintenance activities to identify future needs and recommended actions	CAM, Hamilton Water	$10,000 p.a. $40,000 Total Internal Staff Time	4 Years (2022-2025)
16.	Develop Renewal forecasting prioritization to optimize resources and ensure level of services can be maintained	CAM, Hamilton Water	$6,000 p.a. $24,000 Total Internal Staff Time	4 Years (2022-2025)
17.	Improve annual engagement survey process to optimize engagement and respondents	CAM, Hamilton Water, Communications	$35,000 p.a. $140,000 Total Internal Staff Time	4 Years (2022-2025)
18.	Review BIMA Scorecard reporting and ensure data and assumptions are consistent with ministry and City reporting and develop additional technical metrics.	CAM, Hamilton Water, Continuous Improvement	$2,500 p.a. $5,000 Total Internal Staff Time	2 Years (2022-2023)
19.	Standardize and develop risk management knowledge along with supporting documentation	CAM, Engineering Services, Continuous Improvement & Quality	$12,500 p.a. $25,000 Total Internal Staff Time	2 Years (2022-2023)
20.	Identify stormwater assets in other divisions and incorporate into next AM Plan	CAM, Hamilton Water	$10,000 p.a. $30,000 Total Internal Staff Time	3 Years (2022-2024)

21.	Investigate sewer laterals repair/replacement procedure for private residence as City does not own asset but acts as asset owner	CAM, Hamilton Water	$4,000 p.a. $8,000 Total Internal Staff Time	2 Years (2022-2023)
22.	Further develop vertical asset knowledge for future iterations of AM Plans	CAM, Hamilton Water	$50,000 p.a. $150,000 p.a. Internal Staff Time, Tender Process	3 Years (2022-2024)
23.	Improve asset replacement costs by vetting with current market prices instead of historical costs/estimates or internal models	CAM, Hamilton Water, Finance	$30,000 p.a. $90,000 Total Internal Staff Time	3 Years (2022-2024)
24.	Refine acquisition model to ensure projections are accurate and updated	CAM, Hamilton Water, Ec.Dev., Finance	$7,000 p.a. Internal Staff Resources	Annual
25.	Implement additional technical metrics for SWM ponds and minor culverts	CAM, TOM	$5,000 p.a Internal Staff Time	Annual
26.	Separate & validate stormwater technical metrics reported in the BIMA tool	CAM, Hamilton Water	$5,000 p.a Internal Staff Time	Annual
27.	Ensure new technical metrics are considering different lifecycle stages (e.g. acquisition, disposal)	CAM, Hamilton Water	$2,000 p.a $6.000 Total Internal Staff Time	3 Years (2022-2024)

4.7.3 Monitoring and Review Procedures

This AM Plan will be reviewed during the annual budget planning process and revised to show any material changes in service levels, risks, forecast costs and proposed budgets as a result of budget decisions.

The AM Plan will be reviewed and updated on a regular basis to ensure it represents the current service level, asset values, forecast operations, maintenance, renewals, acquisition and asset disposal costs and planned budgets. These forecast costs and proposed budget will be incorporated into the Long-Term Financial Plan once completed.

4.7.4 Performance Measures

The effectiveness of this AM Plan can be measured in the following ways:

- The degree to which the required forecast costs identified in this AM Plan are incorporated into the long-term financial plan,
- The degree to which the 1-10 year detailed works programs, budgets, business plans and corporate structures consider the 'global' works program trends provided by the AM Plan,
- The degree to which the existing and projected service levels and service consequences, risks and residual risks are incorporated into the Strategic Planning documents and associated plans,
- The Asset Renewal Funding Ratio achieving the Organisational target (this target is often 90 – 100%).

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