Asset Management Plan

Stormwater

City of Brampton

28 May 2022

Executive Summary

Introduction

The City of Brampton provides a range of critical services to its residents, businesses, and visitors, including stormwater management services. To deliver these services, the City relies on a network of assets including storm sewers, stormwater management ponds, and water quality units (e.g. oil grit separators).

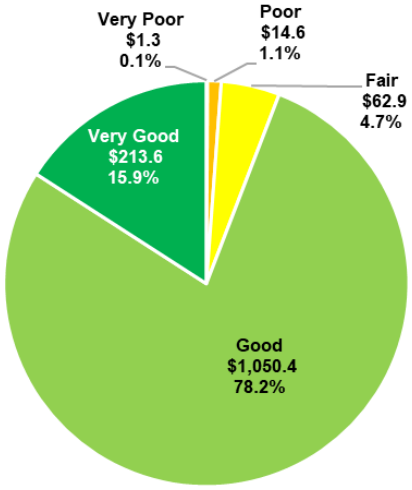
The City proactively and responsibly manages its infrastructure portfolio. As infrastructure ages and demands increase, so does the challenge of ensuring the needs of the community are effectively met with the limited resources available. This Stormwater Department Asset Management Plan (DAM Plan or Plan) addresses that concern by providing a framework for prioritizing and optimizing Asset Management (AM) efforts and providing direction for effective management of stormwater infrastructure to best achieve established goals and objectives. The resulting Plan is intended to provide the optimal allocation of resources towards meeting prescribed goals, objectives, and levels of service.

This document fulfils the Current Levels of Service AM Plan requirements defined by Ontario Regulation (O.Reg.) 588/17 Asset Management Planning for Municipal Infrastructure.

State of the Infrastructure

The Stormwater DAM Plan covers stormwater management ponds (SWMPs), water quality units (WQUs), and storm sewer systems, including foundation drain collectors, roof drain collectors, storm sewers, catchbasins, and manholes. The inventory for a few asset classes including outfalls and low impact development assets are currently being developed by the City and are not included in this Plan. The total estimated replacement value for stormwater assets in this Plan is $1.34 billion.

Figure ES-1: Condition Profile



As shown in Figure ES-1, 94% of the City's stormwater assets are estimated to be in Very Good or Good condition, reflecting that the assets are in a relatively early part of their expected useful life.

The City is currently developing appropriate data points to capture for each sewer segment based on CCTV inspection data. This data will be digitized such that a condition score can be determined for each sewer. Similarly, the City is conducting standardized inspections on ponds to better understand condition and sediment removal needs. These improvements will result in a more accurate assessment of asset condition.

Levels of Service

The City's Level of Service (LOS) is founded on a clear understanding of the ultimate outcomes to which programs and assets contribute. At the corporate level, City Council has laid out strategic objectives for the City as defined in the 2018-2022 Term of Council Priorities, which envisions an inclusive city that is safe, sustainable, and successful. The City identifies "A Well-Run City" as a strategic priority in the 2018-2022 Term of Council Priorities with specific

direction to develop asset management plan(s), and to be good stewards of assets and services. This goal demonstrates that the City is committed to delivering services effectively and supporting service delivery with informed decision-making and optimal management of stormwater infrastructure.

The Technical LOS in this DAM Plan consists of those required by O.Reg. 588/17 as well as additional LOS identified through development of this DAM Plan. The 2021 performance on key Technical LOS is summarized in the following table. Overall, the stormwater portfolio is in good condition. The City is completing further hydraulic modelling work to refine performance measures related to resiliency.

Table ES-1: Key Technical Levels of Service

Technical Level of Service Measure	Current 2021 Performance
Percentage of properties in municipality resilient to a 100-year storm (O.Reg. 588/17)	96%
Percentage of the municipal stormwater management system resilient to a 5-year storm (O.Reg. 588/17)	>80%
Average weighted condition assessment of the sewers	Good
Average weighted condition assessment of the WQUs	Good
Average weighted condition assessment of the SWMPs	Good
Average weighted condition assessment of the watercourses	Good
Annual budgeted expenditure to provide SW services - Capital & Operating ($/household)	$133.29

Risk Management Strategy

A key asset management principle for the City is to meet service levels and manage risk, while minimizing lifecycle costs. The City's risk strategy develops the framework for quantifying the risk exposure of the City's assets to enable prioritization of projects across asset classes and service areas. The relative importance of the assets to support service delivery, referred to as asset criticality, is a key driver in selection of the most appropriate asset management strategy for each asset. Criticality is evaluated on an asset's impact upon failure to service delivery, health and safety, the environment, financial position, and reputation. The City's current risk assessment for stormwater assets is a high-level assessment. It will be completed in more detail on an asset-by-asset basis as the condition data on assets, such as CCTV inspection data, is collected and applied using the risk framework.

Lifecycle Management Strategy

Lifecycle management strategies are the planned lifecycle activities that the City uses to manage its service levels and the risk of asset failure by reducing the probability of failure to acceptable levels. The City performs hundreds of inspections, maintenance actions, and repair responses to ensure that infrastructure performs reliably. Lifecycle activities also include rehabilitation and replacement activities funded through the Capital Budget. Mid-life rehabilitation activities extend asset service lives and lower overall lifecycle costs. In addition to meeting quality/reliability service levels, the City also plans for expansion and upgrade strategies to support capacity and functional service levels.

Incorporation of climate change considerations into the City's asset management planning for stormwater assets is critical to maintaining service levels and managing risk in the future. The City is currently pursuing various initiatives related to planning as well as mitigation and adaptation strategies to address climate change risks.

Financial Strategy

The Financing strategy considers how the City will fund the planned asset management actions to meet the current service levels. It is informed by the preceding sections of the Asset Management Plan: the state or condition of the assets, the current levels of service, the risks to service delivery, and the lifecycle activities needed to reduce the risks and continue to deliver services.

As recommended through the City's Stormwater Management Financing Study, the City has recently implemented a dedicated funding source for stormwater services. The projected 10-year revenue for the City is estimated to be $24.3 million on average per year. As such, stormwater rate revenue supports all operating and asset management needs associated with the City's stormwater services over the forecasting period and also allows to reserve funds to partially cover long-term sewer replacement needs.

The current financial analysis considers that long-term replacement of sewers is understood as a variable in the funding requirements. Based on the current system valuation and replacement costs, approximately 50% of full storm sewer replacement costs are included in the current financing model, and 100% of replacement costs for other stormwater assets. As physical condition data is acquired through CCTV and inspection programs and condition assessments are completed, storm sewer capital investments can be more reliably forecasted over the lifecycle, and adjustments made to the stormwater rates at appropriate intervals to ensure sustainability of the asset management programs.

Monitoring and Improvement

Development of AM Plans is an iterative process that includes improving data, processes, systems, staff skills, and organizational culture over time. The DAM Plan is compliant with Ontario Regulation 588/17 for current levels of service, and the City will continue to work on on-going initiatives for its asset management practices to best realize value from its stormwater infrastructure. Improvement of the financial forecasts can be achieved with each update of this Plan as improvements are made in the asset inventories, replacement valuation, condition estimates, lifecycle strategy costs, treatment frequencies, and utilization of risk to prioritize projects.

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Acknowledgements

The development of the 2022 Stormwater Asset Management plan was led by Environment & Development Engineering with contributions from staff across the organization. The study team acknowledges the extensive assistance provided by the Corporate Asset Management Office (CAMO) during the preparation of this document and thank everyone who provided expertise or otherwise participated in the preparation of this Plan.

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1 Introduction

The City of Brampton provides a range of critical services to its residents, businesses, and visitors, including stormwater management services. To deliver these services, the City relies on a network of assets including storm sewers, stormwater management ponds, and water quality units (e.g. oil grit separators).

The City proactively and responsibly manages its infrastructure portfolio. As infrastructure ages and demands increase, so does the challenge of ensuring the needs of the community are effectively met with the limited resources available. This Stormwater Department Asset Management Plan (DAM Plan or Plan) addresses that concern by providing a framework for prioritizing and optimizing Asset Management (AM) efforts and providing direction for effective management of stormwater infrastructure to best achieve established goals and objectives. The resulting Plan is intended to provide the optimal allocation of resources towards meeting prescribed goals, objectives, and levels of service.

1.1 Purpose of the Plan

This Stormwater DAM Plan describes the actions required to manage the stormwater portfolio of assets in a way that supports established service levels, while managing risks and costs. The Plan is an update to the City's 2018 Stormwater DAM Plan, in alignment with the City's 2021 Corporate AM Plan. It focuses on the current state of infrastructure and service levels, forecasts the next 10-year period, and provides a framework for continuously improving the City's AM practices.

1.1.1 Alignment with Regulatory Requirements

The Stormwater DAM Plan complies with the City's Corporate Asset Management Policy and Ontario Regulation 588/17 Asset Management Planning for Municipal Infrastructure made under the Infrastructure for Jobs and Prosperity Act, and proactively meets the requirements for current levels of service for core assets by July 1, 2022. This Stormwater DAM Plan covers the next ten years and will be updated at least every five years.

Background information and reports upon which this Stormwater DAM Plan is based can be made available to the public upon request. Opportunity for public feedback was provided through consultation on Levels of Service developed through the Stormwater Management Financing Study (Phase 1). For a discussion on the Communication and Engagement Plan followed in the Stormwater Management Financing Study, refer to Section 1.2.

Going forward, O.Reg. 588/17 requires that progress of implementing the AM Plan be reported to Council by July 1 each year, and that the AM Plan be updated every five years or more frequently. Background information and reports for the State of Infrastructure section may be provided by the City upon request.

1.1.2 Corporate Requirements

The City of Brampton's 2018-2022 Term of Council Priorities envision an inclusive city that is safe, sustainable, and successful. The vision sees Brampton as follows:

- A City of Opportunities: Improving liveability and prosperity by focusing on local education and employment opportunities, neighbourhood services and programs, and job investment strategies.
- A Mosaic: Celebrating Brampton's diversity by more effectively engaging and communicating with diverse groups, supporting cultural events, and developing a holistic framework to embed diversity across the city.
- A Green City: Improving liveability and prosperity by focusing on local education and employment opportunities, neighbourhood services and programs, and job investment strategies.

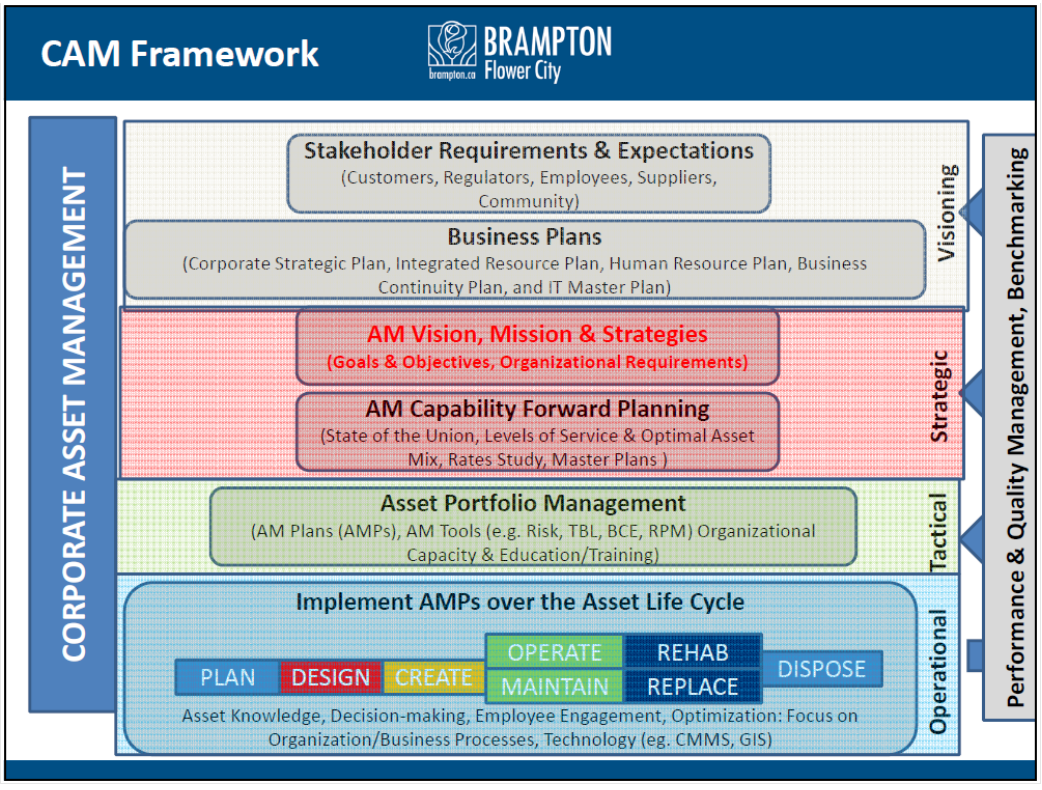
- A Healthy and Safe City: Focusing on community safety, improving mental health support, and encouraging active and healthy lifestyles.
- A Well-Run City: Continuously improving the day-to-day operations of the corporation by streamlining service delivery, effectively managing municipal assets, and leveraging partnerships for collaboration and advocacy.

In particular, "A Well-Run City" focuses on being "good stewards of assets and services". This Stormwater DAM Plan (Stormwater DAM Plan or Plan) is a medium to long range planning document that is used to support the City's goals by providing a rational strategy for proactively and effectively managing the City's stormwater assets. It provides a guide to understanding key items such as the following:

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

The lifecycle outlook discussed in the Stormwater DAM Plan aligns with the City's Corporate Asset Management (CAM) Framework which is based on the International Standard ISO 55000 Asset Management. The City's CAM Framework is shown in Figure 1-1, where asset portfolio management is viewed as an important tactical tool to successful implementation of business plans.

Figure 1-1: City Corporate Asset Management (CAM) Framework



The Stormwater DAM Plan outlines a systematic and repeatable process to determine future investment needs for existing assets, in consideration of maintaining current service levels and tolerable risk. This Plan is intended to

improve the City's ability to meet its Strategic Plan priorities in a proactive, effective, and responsible way that best services its residents and businesses.

1.2 Communication and Engagement

As recommended through the City's Stormwater Management Financing Study, the City has implemented a dedicated funding source for stormwater services. A Communication and Engagement Plan was followed in the Stormwater Management Financing Study to communicate and engage with the residents and businesses of Brampton on the stormwater services and the associated user rate. The Communication and Engagement Plan included surveys, public information sessions/meetings, and Stormwater Advisory Group meetings composed of interested persons invited from across the City, representing various stakeholders including neighbourhoods, business, and commercial interests. Four key engagement steps were completed during the following phases of the Study:

1) Planning and Relationship Building
2) Existing Stormwater Management Program
3) Recommended Future Stormwater Management Program
4) Follow-up

During the follow-up stage, the City completed an update of the City's website with relevant information, including an information video, FAQs, rate schedule, implementation timeline, Study background information, subsidies and credit program, and contact information.

Going forward, this DAM Plan will be presented to Council and published on the City website. The City will continue to share information about on-going stormwater asset management initiatives through website updates and other outreach initiatives.

1.3 Growth at the City

The impact of future growth is a key factor that municipalities need to consider in AM planning to enable meeting its goals and objectives. The City monitors trends in its population to ensure that its impacts on service levels are well understood and that strategies are developed to address additional demands due to growth and changes in demographics. The consideration of growth is discussed further in Section 5.2.3.

1.4 Scope

The Stormwater DAM Plan includes stormwater assets owned and operated by the City including sewers, catchbasins, manholes, water quality units, foundation drain collectors, roof drain collectors, and stormwater management ponds (SWMPs). The City is currently developing its inventory of outfalls, driveway culverts, ditches, watercourses and low impact development (LID) assets, which are not included in this Plan.

1.5 Relationship with Other Municipal Documents

Stormwater DAM Planning is a key tactical (medium term) planning activity that relies on input from strategic planning activities (e.g. long-term Master Plans) and informs short-term decision making. The Plan provides a framework to validate the City's Capital Budget forecasts. It also discusses levels of service that support the City's strategic goals and lifecycle management strategies intended to reduce the overall cost of asset ownership. This AM Plan has many interdependencies with other City departments and documents, as described in Section 1.6.

1.6 Interdependencies and Key Stakeholders of the Plan

As with any entity, the Stormwater (SW) Service Area does not deliver service in isolation and hence is reliant on other Service Areas, departments, and external stakeholders to support service delivery. Similarly, the Stormwater Service Area supports other internal stakeholders.

As an example, major refurbishment or replacement for storm sewers and other system components is coordinated with internal departments (e.g. Transportation) and other stakeholders, such as the Region of Peel. Although project funding is typically kept separate, project coordination is essential to maximize customer value. Communication is essential to ensure that refurbishment or replacement projects do not conflict with activities planned by other stakeholders. This coordination is typically managed through consultation with stakeholders during annual planning periods. For example, capital coordination is required between capital works (Transportation services) and stormwater services for adding stormwater retrofits to the capital works projects

A summary of the inter-dependencies is presented in the Table 1-1. Each stakeholder is defined as:

- Dependant – Stakeholders on whom the SW Service Area is dependent upon to deliver its own level of service objectives.
- Contributor – Stakeholders who are supported by the SW Service Area to deliver that stakeholder's level of service objectives.

Table 1-1: Summary of Stormwater Service Area supporting Stakeholders

Stakeholder	Inter-dependency Type	Relationship Context through LOS/Lifecycle activities lens	Governed By
Development Engineering and Development Construction (internal)	Dependant	Growth/Expansion* - Responsible for overseeing design and construction. This determines the quantity and increase of the stormwater system.	Managed through development agreements
Environmental Planning (internal)	Dependant	Growth/Expansion – Responsible for developing stormwater infrastructure master and environmental management plans that have connections to stormwater. This provides a preliminary estimate of the potential growth in the stormwater system.	Driven by Municipal Official Plan
Digital and IT Teams (internal)	Dependant	All – provides digital infrastructure (networks, software, and system support) which forms the collective understanding for assets. They also manage the procurement and implementation of digital management systems on behalf of the SW Service Area.	Issues managed 'by request', formalised procurement process for new systems, and managed through business process documents (e.g. SOPs, SLAs)
Fleet (internal)	Dependant	All – provides the right type, quality and quantity of vehicles and all lifecycle activities to enable effective year-round operation and maintenance services.	Issues managed 'by request'
Facilities (internal)	Dependant	All - Provide quality, well maintained facilities to enable the SW Service Area with working spaces and storage for fleet vehicles.	Managed through general provisioning of office spaces and services

Stakeholder	Inter-dependency Type	Relationship Context through LOS/Lifecycle activities lens	Governed By
	Dependant	Growth/Expansion* – Coordinate and provide SW services on site to meet applicable criteria.	Site plan approval
	Contributor	Quality/Renewal, O&M – Inspect and maintain lot level controls outside of the building and downstream, receiving infrastructure. The costs for this work are recovered from facilities.	Managed informally through personnel relationships and considering SLA for future use
	Dependant	Replacement or upgrade – Coordinate Stormwater replacement or upgrade projects on sites.	Managed informally through personnel relationships and considering SLA for future use
Region of Peel, Mississauga, Town of Caledon (external)	Dependant and Contributor	Growth/Expansion – Responsible for developing stormwater infrastructure master plans.	Driven by Municipal Official Plan
	Dependant and Contributor	O&M - Coordinate stormwater inspection and maintenance in regional or neighbouring authorities. Coordination occurs to ensure that connected systems are functioning.	Managed informally through personnel relationships
Emergency Management	Dependant	Capacity - Where stormwater infrastructure is not sufficient to provide sufficient flood protection, we rely on Emergency Management to provide public safety programs and procedures to ensure the community is appropriately protected.	Managed by Emergency Management Plans and governed by Emergency Management & Civil Protection Act
	Contributor	Capacity - Identify high risk areas with insufficient flood protection.	Managed informally through personnel relationships
Parks Planning and Development (internal)	Dependant	Growth/Expansion* – Provides the following services: planning, construction, preliminary and final acceptance of Stormwater assets within parks.	Development agreements or site plan applications
Parks Maintenance and Forestry (internal)	Dependant	Quality/O&M – Parks, Forestry and Horticulture support SW Service Area by providing vegetation maintenance and mowing for ditches, Stormwater ponds (including mowing along access roads), etc.	Included in annual operations
	Dependant	Function/Upgrade (safety) – Provide SWMP signage and perimeter fencing. Add access pads to SW ponds and maintaining the pads. Inspect safety stations.	
	Dependant	Quality/O&M – Parks, Forestry and Horticulture support SW Service Area by maintaining vegetation and planting beds in LIDs.	Managed informally through personnel relationships and considering SLA for future use

Stakeholder	Inter-dependency Type	Relationship Context through LOS/Lifecycle activities lens	Governed By
	Contributor	O&M - Coordinate stormwater inspection and maintenance of conveyance capacity to avoid impacts to park service areas.	Included in annual operations
Transportation (internal) Contract Services and Road Operations	Dependant	Quality/O&M – Manage contracts for catchbasin cleaning, street sweeping, Storm Sewer flushing and reaming, clean out of Water Quality Units, ditch maintenance and minor watercourses maintenance. Undertake works such as resurfacing pond access roads, repairing driveway/roadside culverts**. **Does not include crossing culverts construction and maintenance for which Transportation are accountable.	Some items are part of normal operations for transportation. Others are managed informally through personnel relationships and considering update to SLA for future use.
	Dependent	Quality/growth-Renewal, replacement and expansion: Oversee and manage repairs, replacement rehab of the stormwater system in the Road right-of-way.	Included in annual operations
	Contributor	Quality/growth-Renewal, replacement, and expansion: SW Service Area provides technical support and consulting services regarding repairs, replacement rehab to the stormwater system in the Road right-of-way.	Managed informally through personnel relationships
	Contributor	Capacity/O&M - Roads draining to SWMP and other stormwater assets are dependant on capacity of the pond, which is achieved through maintenance and dredging coordinated by SW Service Area.	Included in annual operations
	Dependant	Asset Information/All – Transportation overseeing SW assets database in right-of-way to inform work on roads. Transportation is responsible for notifications of construction/ownership of stormwater infrastructure under the roadway and in the Right-of-way	Managed informally through personnel relationships and considering updates to business process documents (e.g. SOPs, SLAs)
Animal Services	Dependant and Contributor	Quality/Replacement* - Supports flood mitigation in watercourses and SWMPs through beaver management, including installation and maintenance of bafflers	Managed informally through personnel relationships

* Asset Information: responsible for notifying SW Service Area of construction/ownership of SW assets for GIS updates

1.7 Organization of the Document

The AM Plan is organized to meet the requirements of Ontario Regulation 588/17 (Current Levels of Service) and align with the Province's "Guide for Municipal Asset Management Plans". The contents of this AM Plan follow the recommended elements of a detailed AM Plan:

- Executive Summary: Summary of AM Plan
- Chapter 1 – Introduction: Outlines scope, background information, relationship to other Municipal documents and plans, and applicable legislation
- Chapter 2 – State of the Infrastructure: Summarizes the inventory, valuation, and condition of the assets by asset type
- Chapter 3 – Levels of Service: Defines levels of service through performance indicators and targets, and outlines current performance
- Chapter 4 – Risk Management Strategy: Defines the framework for identifying critical assets and quantifying risk to enable prioritization of lifecycle activities
- Chapter 5 – Lifecycle Management Strategy: Summarizes the asset management strategies (i.e., planned actions) that will enable the assets to provide the required levels of service in a sustainable way, while managing risk, at the lowest lifecycle cost
- Chapter 6 – Financial Strategy: Summarizes the financial planning and budgeting associated with asset management planning
- Chapter 7 – AM Plan Monitoring and Improvement: Summarizes the maturity of current AM practices and the next steps including monitoring of AM Plan implementation progress and improving future iterations of the AM Plan.

2 State of the Infrastructure

2.1 Overview

This section describes the City's stormwater asset inventory, and provides a snapshot of the valuation, age, distribution, and condition of the City's stormwater assets as of 2021. Recommendations for improvements to condition monitoring, data collection and reporting are provided in Section 7.

2.2 Asset Inventory

The Stormwater DAM Plan covers stormwater management ponds, water quality units (e.g. oil grit separators), and storm sewer systems, including foundation drain collectors, roof drain collectors, storm sewers, catchbasins, and manholes. As indicated in Section 1.4, the inventory for outfalls, driveway culverts, ditches, watercourses, and low impact development assets are currently being developed by the City and not included in this Plan.

The total estimated replacement value for stormwater assets included in this Plan is $1.34 billion, as summarized in Table 2-1. The replacement value represents the expected cost to replace an asset to the same functional standard with a new version based on current market conditions and construction standards.

Table 2-1: Stormwater Asset Inventory (2021$M)

Asset Category		Quantity		Replacement Value ($M)	
Stormwater Management Ponds		184	Each	$94.7	$94.7
Storm Sewer Systems	Foundation Drain Collectors (FDC)	252,278	Meters	$70.6	$1,241.0
	Storm Sewers	1,594,134	Meters	$871.5	
	Catchbasins	37,398	Each	$120.6	
	Manholes	21,644	Each	$156.5	
	FDC Manholes	4,003	Each	$21.6	
Water Quality Units		92	Each	$7.1	$7.1
Total					$1,343

2.3 Asset Condition

In this Stormwater DAM Plan, the term "condition" refers to the degree of physical deterioration of the asset. Asset condition is a measured assessment of an asset's current position or place on the asset deterioration curve. The generic 5 grade rating scale (Very Good, Good, etc.) is aligned with Corporate asset condition framework and is used to translate condition information in a way that the public, Council, and senior management can understand. An industry standard general condition grading system that provides context of Very Good to Very Poor asset condition is summarized in the table below, based on the 2011 International Infrastructure Management Manual (IIMM).

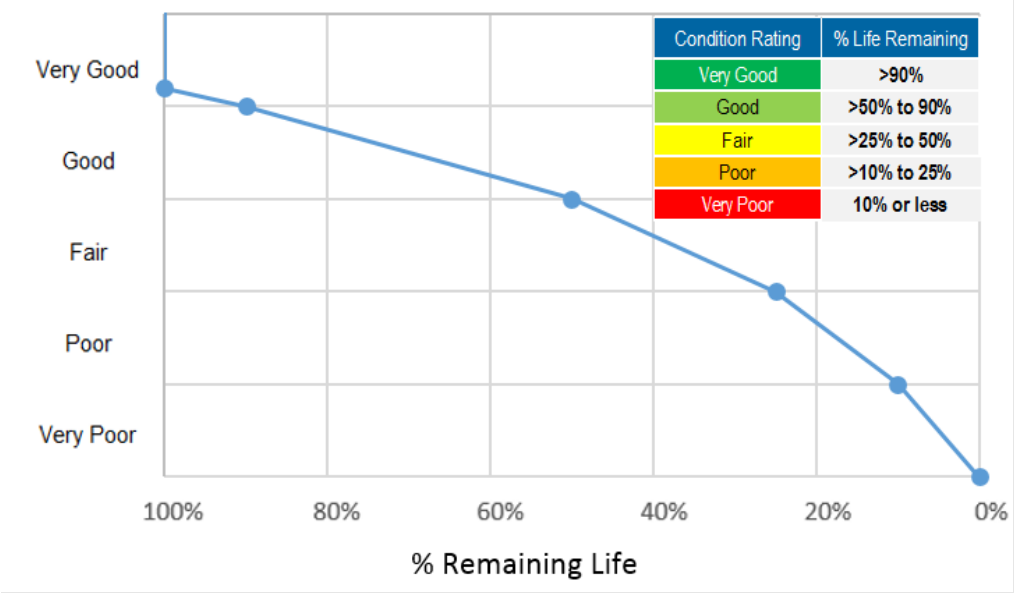
Table 2-2: Core Condition Assessment System (Source: IIMM, 2015)

Grade	Description	Condition Criteria)
VG	Very Good	Very Good Condition
G	Good	Good Condition - Minor Defects only
F	Fair	Fair or Moderate Condition – Maintenance Required to Return to Accepted Level of Service
P	Poor	Poor Condition – Consider Renewal
VP	Very Poor	Very Poor Condition – Approaching Unserviceable

The City has started CCTV inspections of the storm sewer system and has completed inspections for 200 km of sewers. The City plans to perform storm sewer system CCTV inspections on a 25-year cycle following the collection of all baseline condition data. These CCTV inspections will provide information on defects and their locations, as well as overall structural ratings and O&M (operations & maintenance) requirements for each pipe segment. For stormwater management ponds, the City has developed an inspection checklist that will be used to perform detailed inspections every five years. These inspections will include bathymetry measurements for sediment levels, as well as tracking of damages and debris for major pond engineered infrastructure components. The City will utilize appropriate data models such that information from SW asset inspections and assessments can be digitized and used for decision-making in the future.

As a complete set of CCTV and condition data has not been acquired, asset age, rather than condition assessment data, is used to develop the condition profile for storm sewer system and water quality units in this AM Plan. Figure 2-1 describes the estimate of remaining life for the storm sewer system and water quality units based on estimated Useful Life and remaining life. A non-linear deterioration curve has been assumed.

Figure 2-1: Condition Rating Scale (Storm Sewer Systems and Water Quality Units)

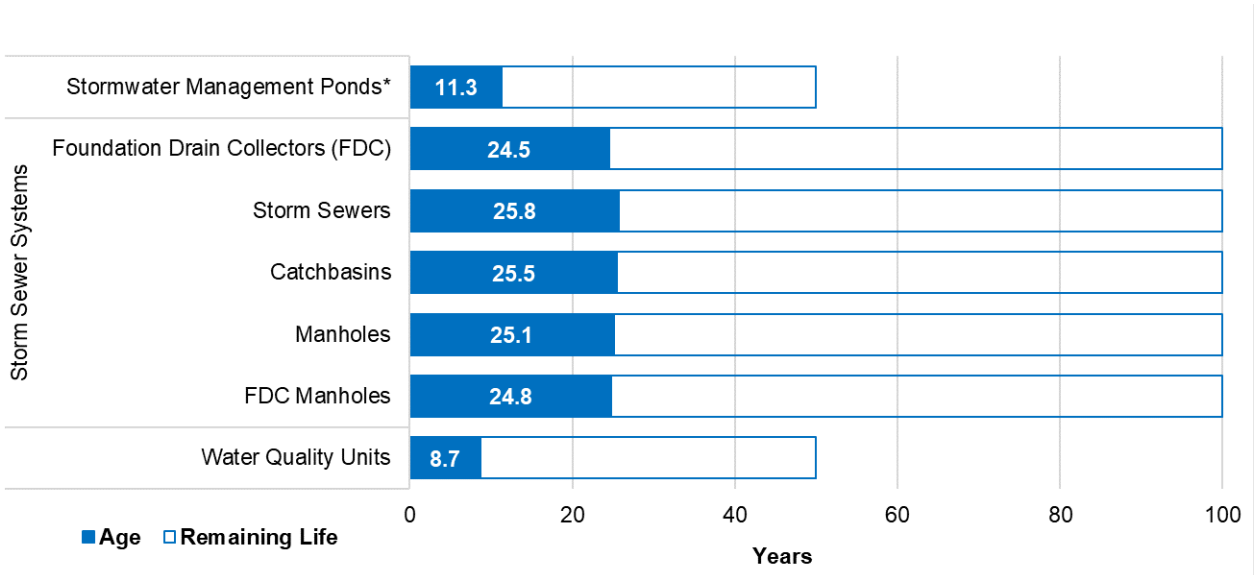


The City is currently acquiring inspection data for the engineered components of stormwater ponds as well as sediment levels within the ponds to inform a maintenance and restoration program. This DAM Plan defines pond condition based on time since assumption or last cleaning performed based on estimated average sediment cleaning frequency of 15 years as follows:

- Non assumed ponds are considered to be in Very Good condition as the developer will clean them before passing on to the City.
- For assumed ponds:
    - Very Good condition if a pond is new, was recently cleaned or does not need cleaning in the next 15 years.
    - Good condition if it requires cleaning within 15 years.
    - Fair condition if it is scheduled for cleanout.
    - Poor condition if there is no information to forecast cleaning schedule.

The assets estimated to have a Poor or Very Poor condition represent those assets that are close to, or past, the end of Service Life, and therefore represent assets that are expected to require renewal immediately or in the near future. The average age and remaining life are summarized in Figure 2-2.

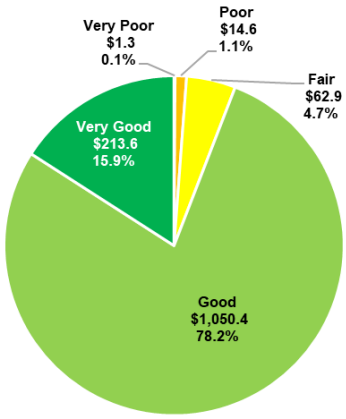
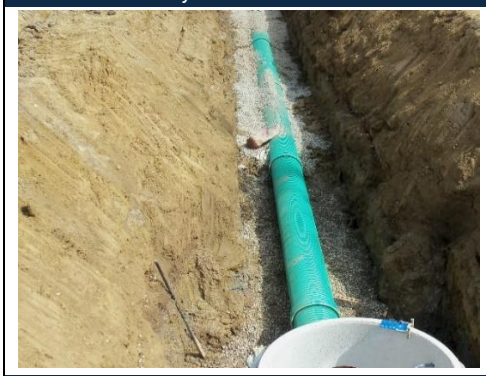
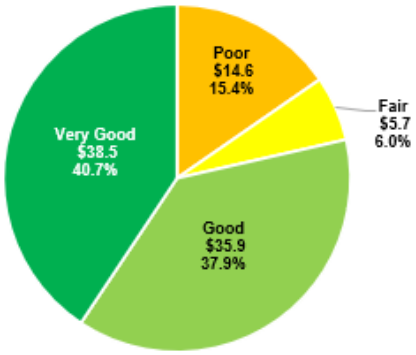
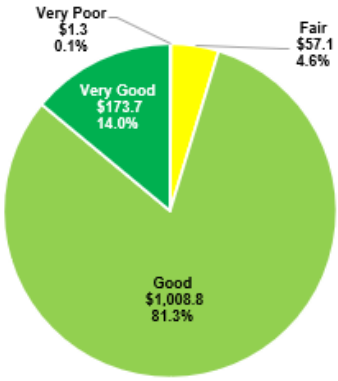
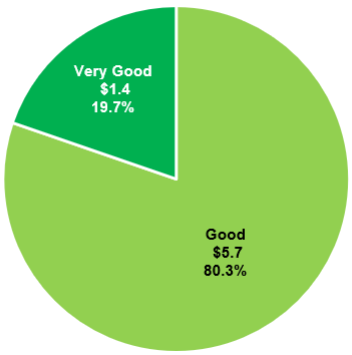
Figure 2-2: Average Age and Estimated Remaining Life



*Stormwater Management Ponds are based on 102 assumed ponds and Estimated Useful Life of 50 years

Overall asset condition and condition by asset class is summarized in the subsequent figures.

Figure 2-3: Condition Overview

Overall Stormwater Assets	Replacement Value: $1,343M (2021$)
The stormwater asset portfolio, based on age, is in GOOD condition. 94% of assets are in good or very good condition, reflecting the recent installation of the majority of infrastructure.	
Storm Sewer System Assets	Replacement Value: $1,241M (2021$)
	
Stormwater Management Ponds	Replacement Value: $94.7M (2021$)
	
Water Quality Units	Replacement Value: $7.1M (2021$)
	

2.4 Data Sources

The inventory was mainly developed based on GIS data and estimated construction costs for each asset category. A summary of data sources is provided in Table 2-3.

Table 2-3: Data Sources

Asset Category		Inventory	Replacement Cost Valuation	Condition Estimate
Stormwater Management Ponds		GIS inventory	Estimated Construction Cost for the engineered infrastructure for the average SWMP	Sediment accumulation and time till next cleaning
Storm Sewer Systems	FDC	GIS inventory	Construction Unit Cost	Age (% Remaining Life)
	Storm Sewers	GIS inventory	Construction Unit Cost	Age (% Remaining Life)
	Catchbasins	GIS inventory	Construction Unit Cost	Age (% Remaining Life)
	Manholes	GIS inventory	Construction Unit Cost	Age (% Remaining Life)
	FDC Manholes	GIS inventory	Construction Unit Cost	Age (% Remaining Life)
Water Quality Units		GIS inventory	Unit Cost by Model	Age (% Remaining Life)

3 Levels of Service

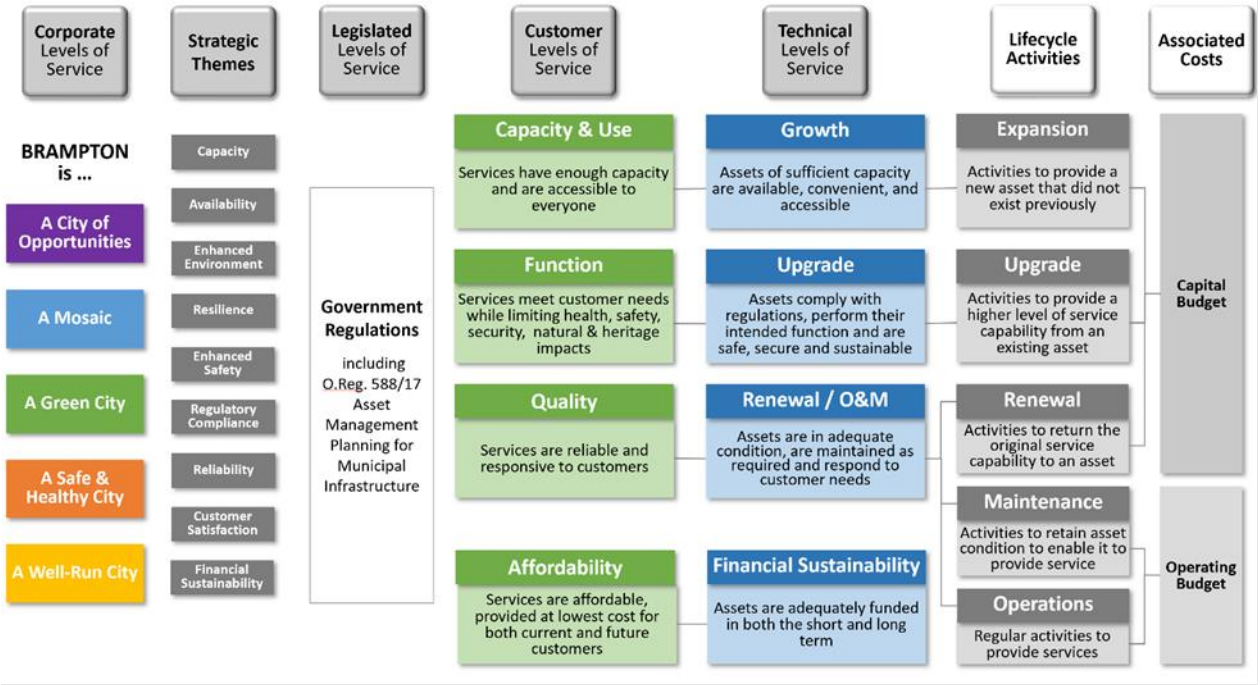
3.1 Overview

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

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

Following these leading practices, the service delivery framework for the City includes a hierarchy of corporate, legislated, customer and technical levels of service, as shown in Figure 3-1.

Figure 3-1: Levels of Service Framework



3.2 Corporate Levels of Service

Understanding the expectations of the City's residents, businesses and internal customers is imperative to provide the right services at the right levels to all customers. The City's LOS is founded on a clear understanding of the ultimate outcomes to which programs and assets contribute. At the corporate level, the Brampton 2040 Vision: Living the Mosaic is a bold new vision for the future of the City, and provides a guide for what the City will become over the next quarter century in terms of environment, jobs and urban centers, neighbourhoods, transportation, social matters, health, and arts and culture.

The 2018-2022 Term of Council Priorities are a key step to move the City toward this 2040 Vision. The City identifies "Stewardship of Assets and Services" as a strategic initiative in the 2018-2022 Term of Council Priorities as part of its

direction to be a 'well-run City'. This strategic initiative includes specific guidance to develop asset management plans.

These strategic goals and initiatives demonstrate that the City is committed to delivering services effectively, which requires responsible management of stormwater infrastructure, as supported by the City's customer and technical LOS that follow in Sections 3.4 and 3.5.

3.3 Legislated Levels of Service

Legislated requirements define the standards according to which the City is legally obligated to provide services to the community. For stormwater services, many of these standards relate to the processes involved in the removal of sediment from stormwater ponds to maintain their ability to remove pollutants from stormwater. Sediment removal and disposal operations have applicable regulations because the process can potentially affect fish and fish habitats, sediment may be classified as hazardous waste, diversion may be required for purposes of cleaning out an online pond, and easements may need to be set aside for a sediment management/drying area. Such considerations require adherence to applicable legislative requirements, including the following:

- Federal Fisheries Act
- Ontario Fish and Wildlife Conservation Act
- Ontario Conservation Authorities Act
- Ontario Municipal Act
- Ontario Nutrient Management Act
- Ontario Endangered Species Act

In terms of specific regulations related to maintenance of stormwater assets, the Ontario Ministry of the Environment, Conservation and Parks (MECP) issues approval requirements for sewage works (including stormwater) under Section 53 of the Ontario Water Resources Act (OWRA). Prior to 2011, the MECP had issued these approvals as "Certificates of Approval" (CofA) but has since changed the name to "Environmental Compliance Approval" (ECA) for all SWMFs constructed during or after 2011. These approvals sometimes, but not always, provide prescriptive requirements and ongoing monitoring and maintenance obligations. Municipal standards and other criteria for design and maintenance are usually based on subwatershed or flood management studies and are often built to accommodate the 100-year and/or Regional (Regulatory) storm. The MECP has released guidance for those designing, constructing, and managing stormwater management systems and seeking approvals under section 53 of the Ontario Water Resources Act. The MECP is implementing a new Consolidated Linear Infrastructure ECA (CLI ECA) for each municipality in 2022 which will establish a system-wide approval process for the City's stormwater infrastructure and future growth of the system. This will replace most project-by-project ECAs.

From an AM legislation perspective, O. Reg. 588/17: Asset Management Planning for Municipal Infrastructure requires the City to report on specific and Technical LOS which are discussed in more detail in Sections 3.4 and 3.5.

3.4 Customer Levels of Service

Corporate LOS commitments, along with the legislated LOS referenced by them, drive the definition of more specific Customer LOS. Customer levels of service measure how the community receives the service and whether the organisation is providing community value.

O.Reg. 588/17 defines Community LOS that are qualitative descriptions of the services being provided, and are considered Customer LOS in this DAM Plan. The City of Brampton is responsible for managing stormwater within the municipality. This includes planning, designing, constructing, operating, and maintaining stormwater assets within municipal roadways, public easements, and other City lands. The stormwater management program is crucial in

protecting public safety and health, and environment and works to reduce flood risk, control erosion, and maintain water quality in local natural waterways.

Stormwater quality and quantity are managed by the City's stormwater program. This includes operating and maintaining storm sewers, ditches, inlets, stormwater management ponds, driveway culverts, ditches, LID facilities, water quality units (e.g. oil grit separators), engineered and natural channels, and storm sewer outfalls to streams and watercourses.

Under the City of Brampton LOS framework, customer levels of service are grouped into four service attribute categories: capacity and use, function, quality, and affordability:

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

Table 3-1 shows Customer LOS and how are they related to the City's strategic themes.

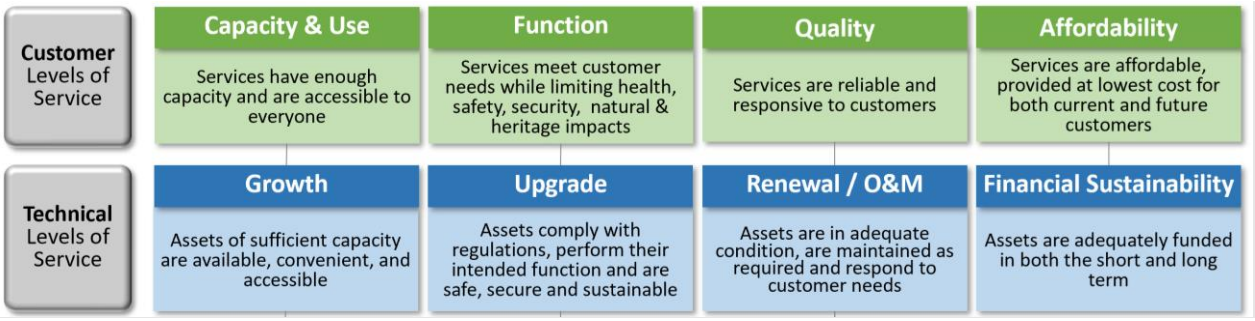
Table 3-1: Customer LOS Mapped to the City Strategic Themes

Service Attribute	Strategic Theme	Customer LOS
Capacity & Use	Capacity	Stormwater assets protect communities from flooding (Community LOS regulated by O.Reg. 588/17) The City uses flood plain maps showing properties that are within the Regulatory Storm flood plain, and therefore susceptible to flooding. These maps are prepared and maintained by the Conservation Authorities. Extent of protection provided by the municipal stormwater system is discussed in Section 3.5 Technical LOS.
	Availability	
Function	Regulatory Compliance	Stormwater assets are compliant with legislative and corporate standards and by-laws
	Enhanced Safety	Measures are in place to enhance public safety in and around stormwater assets
	Resilience	Growth and upgrades to stormwater assets adapt to climate change and contribute secondary benefits for mitigation.
	Enhanced Environment	Stormwater assets contribute to an enhanced environment and support a sustainable City
Quality	Reliability	Stormwater assets provide reliable service
	Customer Satisfaction	Stormwater Education and Outreach is coordinated, consistent, and accessible
Affordability	Financial Sustainability	Stormwater assets are cost efficient

3.5 Technical Levels of Service

Technical levels of service relate to the allocation of resources to service activities that the organisation undertakes to best achieve the desired community outcomes and demonstrate effective organisational performance. Technical levels of service are grouped into four categories: Growth, Upgrade, Renewal / O&M and Financial Sustainability, reflecting type of Lifecycle activity employed to maintain this LOS. Alignment between Customer and Technical LOS attributes is shown in Figure 3-2.

Figure 3-2: Customer and Technical Levels of Service Line of Sight



Lifecycle activities may include expansion, upgrade, renewal, maintenance, or operational activities, depending on the category of LOS to be addressed. The nature of the lifecycle activity determines whether it should be funded as capital or operating, as well as eligible funding sources. The risks of failing to achieve the defined Customer and Technical LOS are assessed, and lifecycle activities are prioritized to address those risks.

Table 3-2 summarizes the City's Customer and Technical LOS and the City's current performance on these measures, which informs the City on how well it is meeting its service levels related to capacity and use, function, and quality. An understanding of the areas requiring performance improvement informs the Lifecycle Management Strategies described in Section 5.

Flooding is a major risk as it can impact public safety, damage property and infrastructure, cause increased erosion, and decrease water quality in local natural waterways. The City has had a history of flooding events and is continuing to work on developing data and models to improve its understanding of parts of the system that are not meeting resiliency requirements.

Some measures in Table 3-2 will be further developed and reported after better data is available. In addition to these measures, the City has developed a list of possible future measures that will further assist the City in balancing service levels with cost and risk. These future measures include tracking the extent of watercourses that are naturalized, completion of CCTV inspections, and financial measures regarding stormwater user rates.

Table 3-2: Customer and Technical LOS

Strategic Theme	Customer Level of Service Measure	Technical LOS Category	Technical Level of Service Measure	Current Performance	Comments
	Capacity & Use				
Capacity and Availability	Stormwater assets protect communities from flooding (O.Reg. 588/17 regulated LOS),	Growth	Percentage of properties in municipality resilient to a 100-year storm (O.Reg. 588/17)	96%	Based on Conservation Authority maps: 3.94% are wholly or partially in the Regulatory Flood plain; TRCA jurisdiction – 5666 properties, CVC jurisdiction - 550 properties).
Capacity and Availability		Growth	Percentage of the municipal stormwater management system resilient to a 5-year storm (O.Reg. 588/17)	>80%	Estimated at greater than 80%. Further modelling work is currently underway to confirm current performance with a higher degree of confidence. The City's current and known past Design Standard for the minor system is a 5-year storm.
	Quality				
Reliability	Stormwater assets provide reliable service	Renewal	Average Weighted condition assessment of the storm sewers	Good	Currently condition evaluation is based on age and useful life. On-going CCTV program will allow gradually change sewer condition reporting to actual condition within a few years.
Reliability		Renewal	Average Weighted condition assessment of the WQUs	Good	Currently condition evaluation is based on age and useful life. City condition assessment protocols are in place to identify the need for early replacement.
Reliability		Renewal	Average Weighted condition assessment of the SWMPs	Good	SWMP condition is currently based on sediment and dredging data where available. City will be developing condition assessment protocols and is currently undertaking a project to evaluate condition and lifecycle for the SWMP engineered infrastructure. These components will be added to SWMP condition protocols and reporting.
Reliability		Renewal	Average Weighted condition assessment of the Watercourses	Good	95% of the watercourses are in Good condition
Reliability		Maintenance	Frequency of Catchbasin Maintenance (cleaning)	Annual	

Strategic Theme	Customer Level of Service Measure	Technical LOS Category	Technical Level of Service Measure	Current Performance	Comments
Reliability	Stormwater assets provide reliable service	Maintenance / Non-infrastructure	Frequency of WQU Inspections	Annual	Frequency of WQU cleaning is based on regular inspections.
Reliability		Maintenance / Non-infrastructure	Asset class inspections expressed as % of target inspections	Targets not yet defined	Inspection frequency to be established in City's Operation and Maintenance Manual
Reliability		Maintenance	Regular Pond Cleaning (dredging and disposal of accumulated sediments) expressed as % of planned pond cleaning	To be reported starting from 2022	Frequency of SWMP cleaning will be determined through bathymetry inspections. Preliminary estimate is to dredge 5 to 7 ponds a year.
	Function				
Enhanced Environment	Stormwater assets contribute to an enhanced environment and support a sustainable City	Upgrade	Stormwater Pond Retrofits expenditure/planned Stormwater retrofits budgeted annually (to support water quality and erosion control)	To be reported starting from 2022	Retrofit projects include erosion control, water quality protection and temperature retrofits in uncontrolled areas or areas not meeting current regulatory targets.
Regulatory Compliance	Stormwater assets comply with regulations and provide reliable service	Maintenance/ Non-infrastructure	City has established inspection frequencies as per regulation	Consolidated ECA hasn't come into effect yet	ECA requirements to be confirmed.
Customer Satisfaction	Stormwater Education and Outreach is coordinated, consistent, and accessible	Non-infrastructure	Delivered Education and Outreach program expressed as % of planned program	To be reported starting from 2022	
	Affordability				
Financial Sustainability	Stormwater assets are cost efficient	Financial Sustainability	Annual Budgeted expenditure to provide SW services - Capital & Operating ($/household)	$133.29	Based on estimated stormwater charge revenue of $24.3 million per year over the next 10 years

The City is working on developing asset inventories and performance indicators for additional asset classes that are not included in this iteration of the SW DAMP.

4 Risk Management Strategy

4.1 Overview

A key asset management principle for the City is to meet service levels and manage risk, while minimizing lifecycle costs. Risk identification and evaluation sits within the City's business verticals aligned to departments and teams. The duplication of risk processes within departments represents an inefficiency in resource allocation and potential duplication of effort. The siloed risk process is also bounded to the departmental boundaries and could result in a blinkered view of risk. Although many departments are practicing risk management activities on a frequent and consistent basis, these risk processes are not consistently documented. The City is working to migrate to a more strategic risk management system, as described in Section 4.2.

4.2 Enterprise Risk Management (ERM) Framework

The City is currently implementing an Enterprise Level Risk Management (ERM) framework based on the ISO 31000 Standard. The ERM will enable consistent identification and evaluation of risks leading to a standardized understanding, management, and monitoring of key risks across the City.

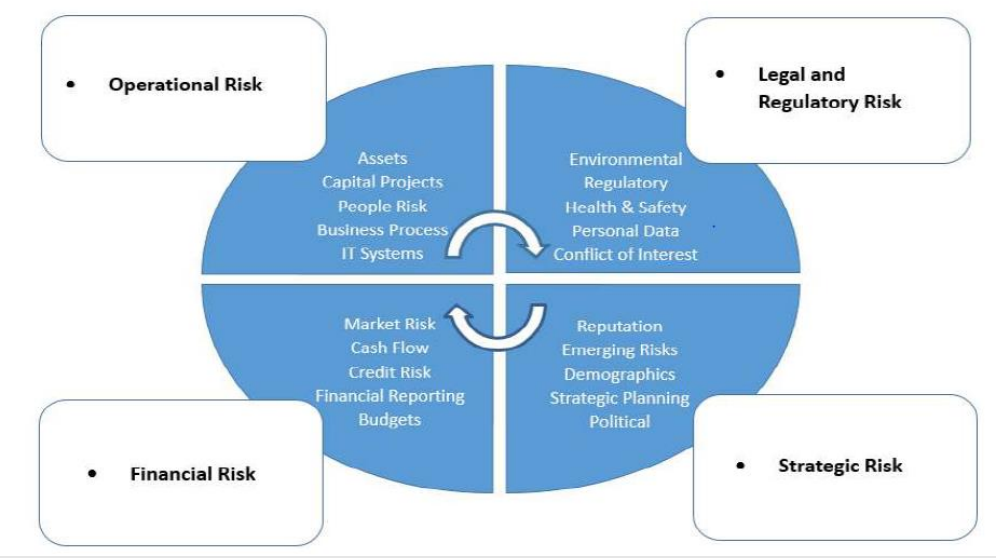
The ERM system indicates that all risks at the City must be evaluated in terms of the potential impact on the City, including both positive and negative aspects of risks, at all levels of the organisation. It also states that all risks should be measured in terms of probability and consequence. A draft 3x3 risk matrix is shown in Table 4-1.

Table 4-1: ERM Risk Matrix

		Consequence		
		Minor	Moderate	Significant
Probability	High	Manage and Monitor Risks	Manage Effort Required	Extensive Management Effort Essential
	Medium	Accept but Monitor Risks	Management Effort Worthwhile	Must Management Effort Required
	Low	Accept Risks	May Accept Risks with Monitoring	Consideration by Management Required

The ERM framework sets out and categorizes the risks into four broad categories, which is intended to help support the identification and classification of the types of risks and their impact on the organization, as shown in Figure 4-1. The figure highlights that there are interdependencies between the categories.

Figure 4-1: Risk Categories



The framework for the Enterprise Risk Management includes definitions which have been adopted for the Stormwater Portfolio and are summarized below:

- Risk - The effect of uncertainty on objectives, positive and/or negative. (Risk is often expressed in terms of a combination of the severity and associated consequences of an event and the associated likelihood or frequency of an occurrence taking place.)
- Risk Tolerance - The willingness of the corporation to accept or reject a given level of residual risk (exposure). Clarity on risk tolerance at all levels is necessary to support risk-informed decision-making and will foster risk-informed approaches. Risk Tolerance is different from Risk Appetite as tolerance is specific to a business unit, a particular risk category or a specific initiative whereas Risk Appetite is applicable to the corporation as an entity.
- Consequence (see Section 4.3.1)
- Likelihood (see Section 4.3.2)
- Risk Maps (see Section 4.4.1)

Principles of risk assessment developed in ERM have been adopted for the Corporate Asset Management risk framework and followed in evaluation of the Stormwater Asset risk in this DAMP.

4.3 Stormwater Risk Management Framework

The relative importance of the assets to support service delivery, referred to as asset criticality, is a key driver in selection of the most appropriate asset management strategy for each asset. Critical assets include assets that are key contributors to performance and have the highest consequences of failure to provide required LOS.

The City's Corporate Asset Management Plan developed an asset risk framework for quantifying the risk exposure of its assets to enable prioritization of projects across asset classes and service areas. Stormwater Services follow the guidance from the asset risk framework provided in Corporate Asset Management Plan.

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

$$\text{Risk} = \text{Consequence of Failure} \times \text{Probability of Failure}$$

An asset's failure to provide established LOS (asset failure) in one or more of the LOS service attributes - capacity, function, or quality/reliability, may compromise the delivery of the City's strategic objectives. Risk is therefore determined for each of these possible failure categories:

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

Lifecycle activities are used to manage the risk of asset failure by reducing the chance of asset failure to acceptable levels. The general approach to risk mitigation is that assets with highest risk require extensive risk management efforts while lower risk associated with other assets can be accepted and just be monitored. The highest risk score across the three possible failure modes typically informs the type and timing of lifecycle activities, though understanding the risk across all possible asset failures informs other activities that can be performed at the same time. For example, a sewer that has its highest risk due to quality (condition) failure may also be due for upsizing to accommodate capacity failure in the near future. It would likely be cost efficient and also minimize service disruption to upsize the pipe at the same time it is due for replacement.

4.3.1 Consequence of Failure

The focus in this section is on asset criticality or consequence of failure which reflects the importance of an asset to the City's delivery of services. The following impacts of a potential asset failure have been considered in accordance with the Corporate Asset Risk Framework:

Health and Safety impact considerations such as ability to meet health and safety related regulatory requirements and degree and extent of injury, from negligible injuries to multiple loss of life.

Social/Reputational impact is the change in public perception that ranges from no community concern to international media coverage.

Service Delivery considerations such as the lack of sufficient service capacity to meet demand or loss of existing service, expressed as degree and duration of impact from minimal localized short-term disruption of nonessential service to widespread and long-term disruption of essential service.

Economic/Financial impact considerations such as damages to the City or private property and infrastructure, loss of revenue, and fines.

Environmental impact considerations such as the extent of damage to the environment and the time within which the impact would be reversible.

Table 4-2 summarizes the above listed impacts against an asset criticality rating scale from 1 to 5, with a higher score indicating a higher consequence of failure.

Table 4-2: Consequence of Failure Ratings

Consequence	Health & Safety	Social	Service	Economic	Environmental
1	Negligible injuries	Event only of interest to individuals. No community concern.	Service not affected or minimal impact.	Damages, losses, or fines <$10,000.	Negligible impact fully reversible within 1 week.
2	Minor injuries, medical attention required	Minor community interest. Local media report.	Localized disruption of nonessential service.	Damages, losses, or fines $10,000 to $200,000.	Material damage of local importance. Prosecution possible. Impact fully reversible within 3 months.
3	Serious injuries, multiple minor injuries	Public Community Discussion. Broad adverse media coverage.	Localized disruption of essential service.	Damages, losses, or fines $200,000 to $2,000,000.	Serious damage of local importance. Prosecution probably. Impact fully reversible within 1 year.
4	Multiple serious injuries, Loss of life	Loss of confidence in Council. National publicity. Public agitation for action.	Widespread short-term disruption or localized long-term disruption of essential service.	Damages, losses, or fines $2,000,000 to $10,000,000.	Serious damage of national importance. Prosecution expected. Impact fully reversible within 5 years.
5	Multiple loss of life or City-wide epidemic	Public investigation. International coverage. Management changes demanded.	Widespread and long-term disruption of essential service.	Damages, losses, or fines >$10,000,000.	Serious damage of national importance. Prosecution. Long term study. Impact not fully reversible.

This AMP assumes the overall consequence of failure for each asset class within the Stormwater Service Area is determined by assigning the maximum consequence score across any of the five impacts (health & safety, reputational, service, environment, and economic). The criticality profiles enable risk to be incorporated into the development of asset management strategies. More critical assets are prioritized for inspection, monitoring, maintenance, restoration, rehabilitation, replacement, or capacity expansion depending on their current and forecasted performance.

4.3.2 Likelihood of Failure

The likelihood of asset failure is the probability of its occurrence. It may be determined objectively or subjectively and measured qualitatively or quantitatively. It can also be expressed as the probability or a frequency over a given period. The scoring of the Likelihood of Failure (LoF) is described in Table 4-3.

Table 4-3: Likelihood of Failure

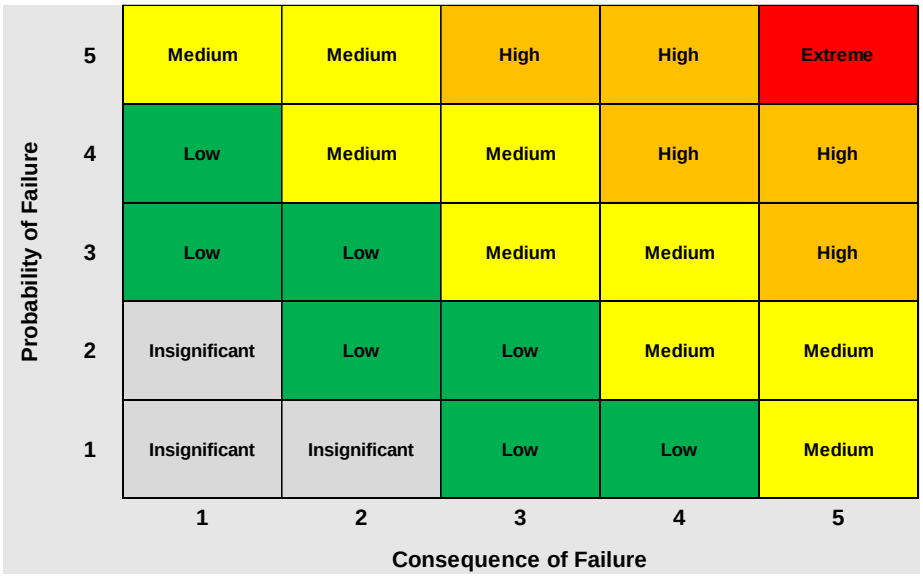
Probability	Description	Probability	Description
1	Rare	< 0.05	Asset failure could occur very infrequently or only in exceptional circumstances, but is not expected
2	Unlikely	>= 0.05 & < 0.3	Asset failure could occur infrequently
3	Moderate	>= 0.3 & < 0.7	Asset failure should occur at some time
4	Probable	>= 0.7 & < 0.9	Asset failure will probably occur regularly or in most circumstances
5	Almost Certain	>= 0.9	Asset failure is expected to occur very frequently or in most circumstances

4.3.3 Risk Map

After assessing the criticality and probability of failure, the results are plotted on a risk map, a graphic representation of probability and consequence of failure. Colours on the map denote different levels of risk and help to prioritize the City's resources, time, and effort.

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

Figure 4-2: Risk Map



4.4 Risk Assessment

The risk assessment for stormwater assets is presented at the asset category level as a preliminary high-level assessment. At the more detailed level, there will still be high or possibly extreme risks when individual assets or projects are evaluated on an asset-by-asset basis that take into account that asset's specific condition or criticality.

4.4.1 Risk Associated with Capacity LOS

Overall, the SW system is of adequate capacity and the likelihood of failure to provide Capacity LOS is low. The City is currently working on quantifying the likelihood of the SW system failing to provide Capacity LOS at a more detailed level. The City is updating existing computer models and developing additional models of the stormwater system with updated storm inputs to better understand any potential capacity bottlenecks that may occur presently and in the future.

Consequence of failure of the SW system to provide adequate capacity is potentially significant and may lead to more frequent urban overland flooding. In general, capacity constraints in assets located furthest downstream would have higher consequences to the overall LOS, e.g. arterial sewer capacity is more critical than local sewers due to larger number of people potentially affected by capacity constraints.

The preliminary risk assessment for stormwater infrastructure at the asset category level for Capacity failure is shown in Table 4-4.

Table 4-4: Current Risk Associated with Capacity LOS (High-Level Assessment)

Asset Category		Capacity and Use		
		PoF	CoF	Risk Value
Stormwater Management Ponds		1	3	Low
Storm Sewer System	Foundation Drain Collector	2	2	Low
	Sewers	2	3	Low
	Manholes	1	1	Insignificant
	FDC Manholes	1	1	Insignificant
	Catchbasins	1	2	Insignificant
	Outfalls	2	2	Low
Water Quality Units		1	2	Insignificant
Environment & Green Infrastructure	Low Impact Development	1	1	Insignificant
	Watercourses	3	4	Medium

4.4.2 Risk Associated with Function LOS

Failure to provide Function LOS was evaluated qualitatively based on the City's extensive efforts to comply with evolving regulatory requirements. The preliminary risk assessment for stormwater infrastructure at the asset category level for functionality failure is summarized in Table 4-4.

Table 4-5: Current Risk Associated with Function LOS (High-Level Assessment)

Asset Category		Function		
		PoF	CoF	Risk Value
Stormwater Management Ponds		2	3	Low
Storm Sewer System	Foundation Drain Collector	2	2	Low
	Sewers	2	3	Low
	Manholes	1	1	Insignificant
	FDC Manholes	1	1	Insignificant
	Catchbasins	1	2	Insignificant
	Outfalls	2	2	Low
Water Quality Units		1	2	Insignificant
Environment & Green Infrastructure	Low Impact Development	3	1	Low
	Watercourses	3	4	Medium

4.4.3 Risk Associated with Quality/Reliability LOS

The Quality/Reliability Levels of Service refers to the City's aim to ensure that its assets are kept in a state of good repair to reduce the incidence of unplanned service interruptions due to poor asset condition. Depending on the asset, unplanned failures can have wide-ranging consequences including service disruption, damage to surrounding infrastructure and property, risks to public safety, and environmental impacts. Probability of Failure is estimated based on the condition of the asset, as shown in Table 4-6.

Table 4-6: Probability of Failure Ratings for Quality

Probability	Description	Corresponding Asset Condition
1	Rare	Very Good
2	Unlikely	Good
3	Moderate	Fair
4	Probable	Poor
5	Almost Certain	Very Poor

The preliminary risk assessment for stormwater infrastructure at the asset category level for Quality failure is summarized in Table 4-7.

Table 4-7: Current Risk Associated with Quality LOS (High-Level Assessment)

Asset Category		Quality		
		PoF	CoF	Risk Value
Stormwater Management Ponds		2	3	Low
Storm Sewer System	Foundation Drain Collector (FDC)	2	2	Low
	Sewers	2	3	Low
	Manholes	2	2	Low
	FDC Manholes	2	2	Low
	Catchbasins	1	2	Insignificant
	Outfalls	2	2	Low
Water Quality Units		2	2	Low
Environment & Green Infrastructure	Low Impact Development	2	1	Insignificant
	Watercourses	3	4	Medium

As most of the urban growth in the City has occurred relatively recently, many SW assets are in the earlier stages of their lifecycle with an average quality rating of Good, resulting in a PoF rating of 2 for most asset classes. The City is planning to employ a detailed approach in future iterations of the DAMP in which risks of quality failure can be applied at the asset level to determine appropriate lowest cost mitigation strategies. On-going condition inspection programs (CCTV, bathymetry, SWMP engineered infrastructure inspections etc.) are designed to inform each asset's PoF and prioritize maintenance and renewal work. The City has already started to implement the CCTV program to determine the condition of the storm sewer network.

4.5 Climate Change Risk Considerations

Climate change risks such as more intense and frequent rainfalls, rain on snow events, heat waves, and ice-storms have significant implications on City infrastructure. An increase in extreme weather events will likely lead to exceeding capacity of infrastructure and eventual urban pluvial and riverine flooding, thus requiring increased investment in maintenance and system improvements. Understanding the severity and frequency of these climate change events and incorporation of climate change considerations into the City's asset management planning approach is critical to maintaining service levels and managing risk.

The City has several initiatives aiming to adapt to climate change hazards. These initiatives include a Climate Change Adaptation Plan, low impact development standards, and updates to design criteria related to extreme weather events for the sizing of municipal stormwater infrastructure. These activities are described in further detail in Section 5.4.

4.6 Risk Mitigation

As discussed in Section 4.3, higher risks associated with assets require mitigation strategies while lower risks can typically be accepted and monitored. The City has developed a Risk Mitigation Framework as part of the CAMP to develop mitigation options and residual risk for high-risk assets. This framework, summarized in Figure 4-3, enables the City to identify appropriate mitigation actions depending on the extent and type of risk and make efficient use of available resources.

Figure 4-3: Risk Treatment Framework

This framework formalizes the risk approach already practiced by SW Services, which plans and implements various mitigation actions according to the risks.

Table 4-8 summarizes the main risks for each major asset class along with the mitigation strategy. This preliminary assessment demonstrates that on average, watercourses are higher risk assets, and therefore, projects related to watercourse restoration and erosion control should generally be prioritized over the lifecycle strategies for other stormwater infrastructure assets.

Asset failure associated to Capacity LOS is a main driving factor based on the risk assessment. Most of the new growth in the City is accompanied by infrastructure to service that growth as part of the process of approving new developments. However, the storm drainage system is still required to be reviewed and managed as a whole to ensure capacity service levels are maintained appropriately. This may require investments in capacity upgrades in certain locations and projects to retrofit ponds to upgrade infrastructure to meet changing legislative and community needs. Section 5 provides a more detailed discussion on lifecycle strategies, including new infrastructure and other projects as part of the City's plans to mitigate the risks associated with growth, upgrade, and renewal needs.

Table 4-8: Risk Mitigation Development

Asset Category	Risk Description	Category/ LOS attribute	LoF	CoF	Risk Score	Mitigation Action	Mitigation Cost	Residual Risk
Watercourses	Watercourses do not have enough capacity to accommodate runoff and prevent riverine flooding.	Capacity	3	4	12	Deepening and widening of the natural watercourses, increasing engineered water channels. Not environmentally and economically feasible in most cases.	Very high	Accepted Residual risk: Properties located in flood plain remain in the flood plain. Mitigation of residual risk: 1. Flood forecasting and warning and emergency response. 2. Legislation is put though preventing new properties in the flood plain. 3. Reduction of flood risk through acquisition of high-risk flood-vulnerable properties
SWM Ponds	SWMPs do not have enough capacity to accommodate runoff and sedimentation which results in localised flooding and failure to meet regulation for water quality control, respectively.	Capacity/ Availability (volume available), Quality (stability)	2	3	6	Restoration, Rehabilitation, Retrofits	Will be estimated at the asset level in the future	Minimal
Mainline and Local Sewers	Sewers do not provide enough conveyance capacity, which results in localised flooding.	Capacity/ Availability and Quality	2	3	6	Repairs, Replacements, Upgrades, Non-asset solutions such as a source controls	Will be estimated at the asset level in the future	Minimal, capacity issues will increase due to Climate Change and may require special adaptation measures
Manholes	Manholes condition deteriorates and conveyance of the sewers is restricted, which can cause localised flooding. Increased safety concerns for the maintenance workers.	Capacity/Quality	2	2	4	Repairs, replacements	Will be estimated at the asset level in the future	Minimal

5 Lifecycle Management Strategy

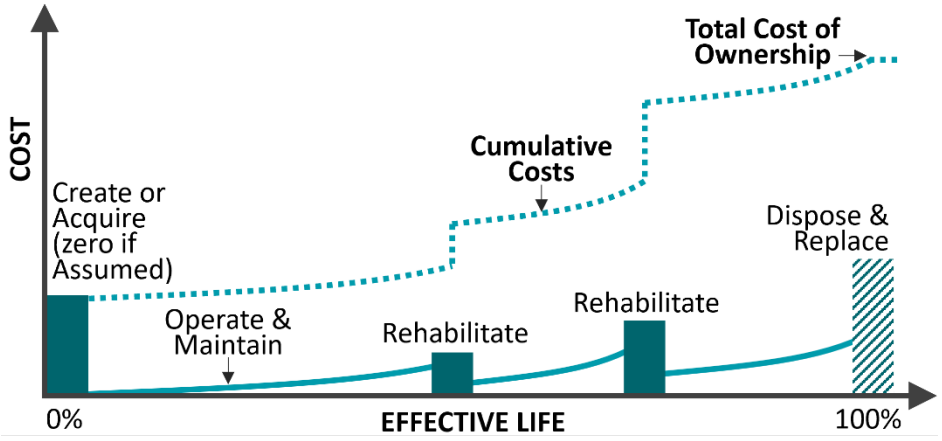
5.1 Overview

To achieve its program objectives, the City builds new infrastructure assets to meet growth needs and manages existing assets to meet reliability needs – all with limited funds. Asset lifecycle management strategies are planned actions that enable assets to provide the defined levels of service in a sustainable way, while managing risk, at the lowest lifecycle cost. Asset lifecycle management strategies are typically organized into the following categories:

- Operations & Maintenance activities – including regularly scheduled inspection and maintenance, or more significant repair and activities associated with unexpected events.
- Renewal activities – significant rehabilitation designed to extend the life of the asset and replacement activities that are expected to occur once an asset has reached the end of its useful life and rehabilitation is no longer an option.
- Expansion activities – planned activities required to extend services to previously unserved areas or expand services to meet growth demands. Also includes redevelopment activities.
- Disposal activities – the activities associated with disposing of an asset once it has reached the end of its useful life or is otherwise no longer needed by the municipality.
- Non-asset solutions – actions or policies that can lower costs, lower demands, or extend asset life (e.g. better integrated infrastructure planning and land use planning, demand management, insurance, process optimization, education of public).

The City assesses the costs of potential lifecycle activities to determine the lowest lifecycle cost strategy to manage each asset type. The sum of all asset lifecycle management costs is referred to as an asset lifecycle cost. Failing to take care of assets can impact the total cost of ownership for that asset and can also have other impacts such as causing damage to other infrastructure or causing interruption to service delivery. Maintenance and renewal activities are timed to reduce the risk of service failure from deterioration in asset condition, and to minimize the total cost of ownership. The conceptual model in Figure 5-1 shows the lifecycle expenditures associated with creating and sustaining the asset over time.

Figure 5-1: Conceptual Lifecycle Cost Model



5.2 Lifecycle Management Strategies

The City uses its understanding of current service delivery gaps and potential future gaps to inform the timing and amount of needed investments in infrastructure assets. The City aims to provide sufficient service capacity to meet

demand and manages the upgrade, operation, maintenance, and renewal of assets to sustain defined service levels, including meeting legislated and other corporate requirements. This section of the AM Plan outlines the City's expansion and upgrade strategies to support capacity and functionality service levels, and the operations, maintenance, and renewal activities to support reliability service levels.

5.2.1 Operations and Maintenance Activities

Along with timely renewal of assets, operations, and maintenance (O&M) work directly enables the City to meet state of good repair objectives to support reliable service delivery.

Renewals, operations, and maintenance are strongly linked. Maintenance will not necessarily extend the life of an asset; however, not performing regular maintenance may reduce an asset's useful life. If renewals are deferred, operations and maintenance needs will often increase to ensure that assets continue to deliver reliable service.

Best in class asset management practices seek to maximize asset reliability and extend asset life though the appropriate mix of maintenance management techniques based on asset criticality (i.e., consequence of failure). These maintenance management techniques include the following:

- Reactive maintenance: run to failure for non-critical items.
- Proactive maintenance: doing work in advance of the asset failing for critical items:
    - Predictive: proactively determine and track asset health parameters on a regular basis to help asset managers follow asset deterioration over time.
    - Preventative: proactively conduct maintenance work based on time of asset in service (or using other level of service performance statistics such as fuel consumption, gallons pumped, etc.).
- Corrective: proactively conduct maintenance work on assets that are identified with potential failure or close to marginal performance from predictive maintenance activities (bullet above).

Optimal maintenance performance is shown in the following figure, with the goal being to implement the right mix of techniques, typically 75 to 80% proactive work, as shown in Figure 5-2.

Figure 5-2: Optimized Maintenance: Optimal Mix of Proactive and Reactive Work

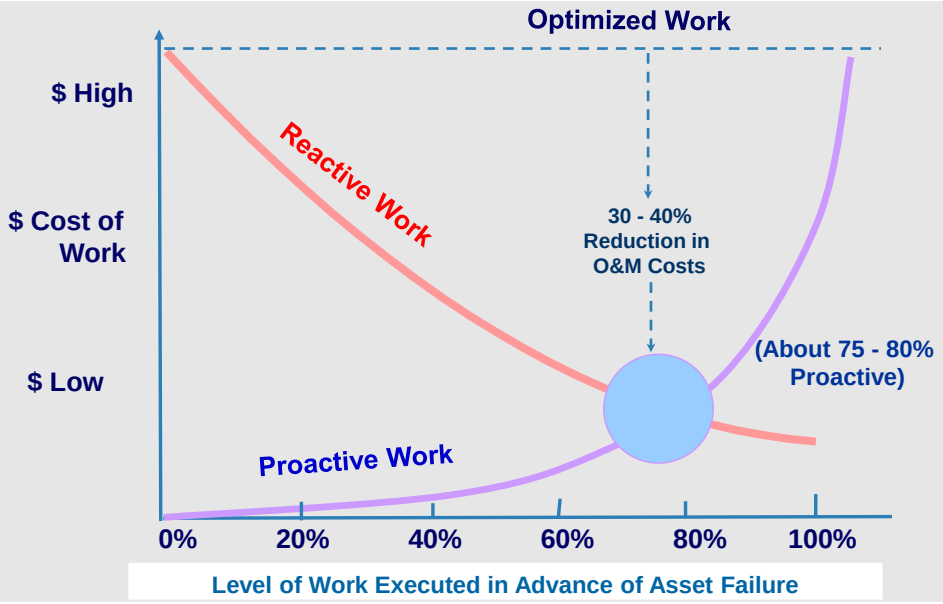


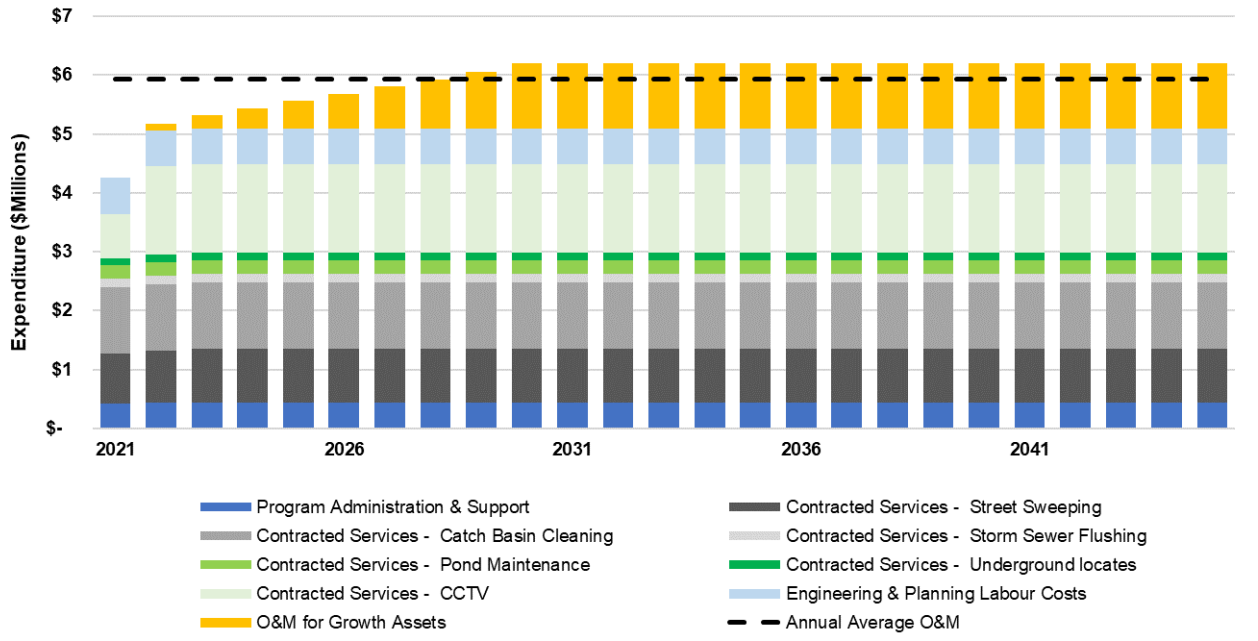
Table 5-1 summarizes the City's operations and maintenance activities for stormwater assets.

Table 5-1: Operations and Maintenance Activities

Asset Category	Operations & Maintenance
Stormwater Management Ponds	-Bathymetric surveys -Pond maintenance such as cleaning out outfalls, removing vegetation overgrowth and debris, reshaping stone overflow weir
Storm Sewer Systems, including storm sewers, FDC, catchbasins, manholes, and FDC manholes	-Ad hoc inspections -Minor repairs -CCTV inspections -Sewer flushing -Underground locates -Catchbasin frame inspections -Catchbasin cleaning -Street sweeping -Minor adjustments
Water Quality Units (WQU)	-WQU inspections -Conduct maintenance based on inspections, mainly filter replacement

Figure 5-3 summarizes the City's expected operations and maintenance expenditures for the period 2021 to 2045, at an estimated average of $5.9 million per year. These expenditures include labour costs for supporting stormwater services such as billing and engineering support, as well as operations and maintenance costs for new assets that accommodate growth.

Figure 5-3: Operations and Maintenance Needs Forecast*



*O&M for growth assets is based on an assumed 2.2% annual increase from 2022 to 2030, and no additional growth beyond 2031

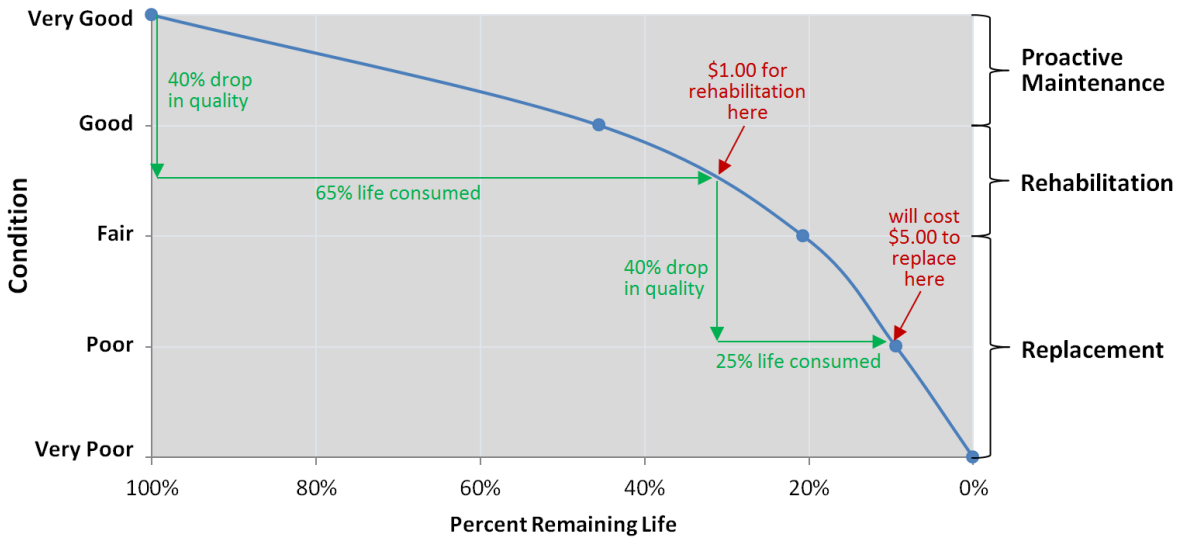
5.2.2 Renewal Needs

Renewal efforts focus on rehabilitation and replacement activities to enable the City to meet its reliability objectives. The renewal activities included in this AM Plan are forecast to be needed to maintain current levels of service. Over time, as the City refines the asset management strategies through tracking of actual condition and actual costs and

benefits of the strategies, the City will improve its understanding of the deterioration rates and the lowest lifecycle cost for each asset type. For renewal projects, the City considers coordinating multiple activities through project bundling where possible to reduce total costs.

All assets physically deteriorate at different rates to eventual failure and loss of ability to deliver the required LOS. Asset condition is a measured assessment of an asset's current position or place on the asset "decay" or deterioration curve. Many assets deteriorate slowly at first to a fair condition and, after that, there is more rapid degradation. This typical deterioration curve is illustrated in Figure 5-4, which shows the relationship between the condition and effective life (i.e. age).

Figure 5-4: Typical Asset Decay Curve



Rehabilitation activities extend the life of an asset and reduce its risk of failure. Typically these activities and associated benefits are deemed more cost effective than allowing the asset to reach its end of life. An example of a rehabilitation activity is concrete repair work on pond inlet and outlet structures.

At a certain point in an asset's lifecycle, it is no longer cost-effective or technically feasible to rehabilitate the asset, and replacement is required. Currently, the replacement strategy of most of the SW assets is based on asset age and estimated typical service live for each asset class.

The renewal strategies are applied to the asset portfolio over time to determine the program of renewal activities and the amount that must be invested in the asset portfolio to sustain service levels. The City's renewal strategies are summarized in Table 5-2. Over time, as the City refines the asset management strategies through tracking of actual condition and the actual costs and benefits (extension of asset life) of rehabilitations, the City will improve its understanding of the lowest lifecycle cost for each asset type. The affordability of the service levels and associated lifecycle activities are discussed in Section 6.

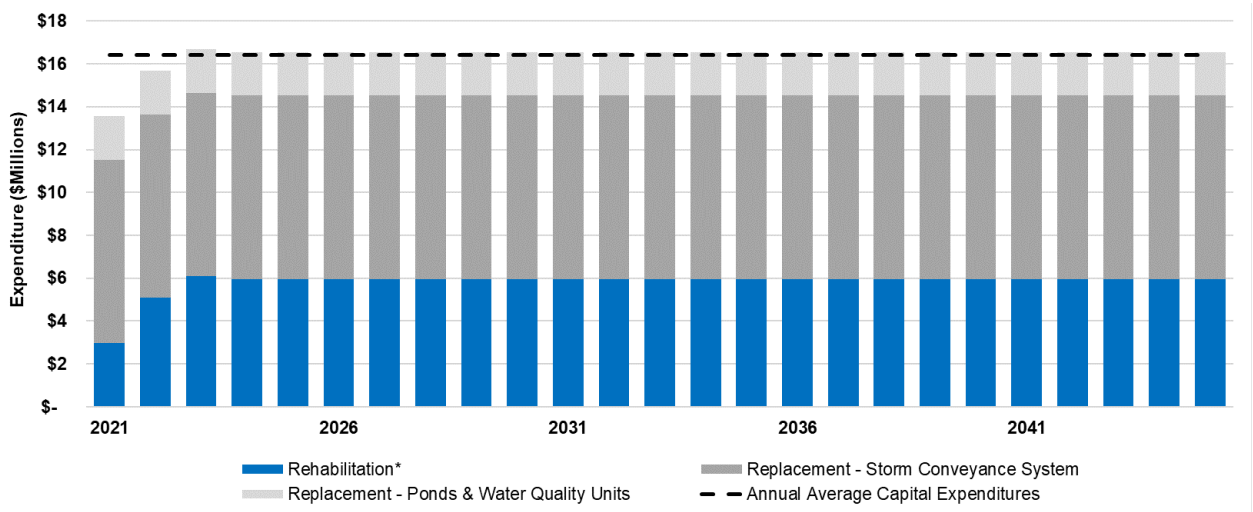
Table 5-2: Renewal Lifecycle Strategies

Asset Category		Estimated Replacement Frequency (Years)	Rehabilitation Frequency (Years)	Rehab Cost (Estimated as % of Replacement Value)	Rehabilitation Activity
SWMP	SWMP engineered infrastructure	50	15	15%	Reshape overland flow routes and rehab for SWMP engineered infrastructure fix cracks and other defects on inlet/outlet structures, site maintenance such as light replacements, etc. SWMP restoration – bank stabilisation and erosion control
	SWMP storage	N/A	Informed by Bathymetry study, estimated at 15 years on average	Average $500K per SWMP	SWMP dredging and restoration.
Storm Sewer Systems	FDC	100	33	0.6%	Repairs
	Storm Sewers	100	33	0.5%	Repairs
	Catchbasins	100			Adjustments are part of maintenance
	Manholes	100			Adjustments are part of maintenance
	FDC Manholes	100			Adjustments are part of maintenance
Water Quality Units		50			Minor repairs are part of maintenance
Watercourses		N/A			Watercourses restoration, including bank stabilization and erosion control projects

The City carries out projects to monitor and collect asset condition data to inform timing of renewal and capital activities. The City conducts bathymetric surveys which inform priority planning for dredging and disposal of accumulated sediment in ponds. The City is also completing evaluation of the SWMP engineered infrastructure condition and lifecycle requirements along with rehabilitation frequencies and replacement values for individual ponds.

Figure 5-5 shows the renewal needs over the next 25 years. The average renewal need is estimated at $16.4 million per year for the period 2021-2045.

Figure 5-5: Capital Renewal Needs Forecast*



*Rehabilitation includes repairs for sewers, FDCs, and SWMP engineered infrastructure; dredging and restorations for SWMP; and watercourse restorations. Growth is not accounted for in the Capital renewal needs forecast.

5.2.3 Growth and Upgrade Needs

The City continues to experience growth and this will place additional pressure on the capacity of existing infrastructure and create demand for new infrastructure. Based on the Region of Peel's Official Plan, the City's census population in 2016 was 614,000 and is expected to grow to a projected 890,000 by 2041. The distribution of population and employment growth for the City are summarized in Table 5-3.

Table 5-3: Population and Employment Forecasts for City of Brampton

Year	Population	Employment
2016	614,000	203,000
2031	812,000	285,000
2041	890,000	325,000

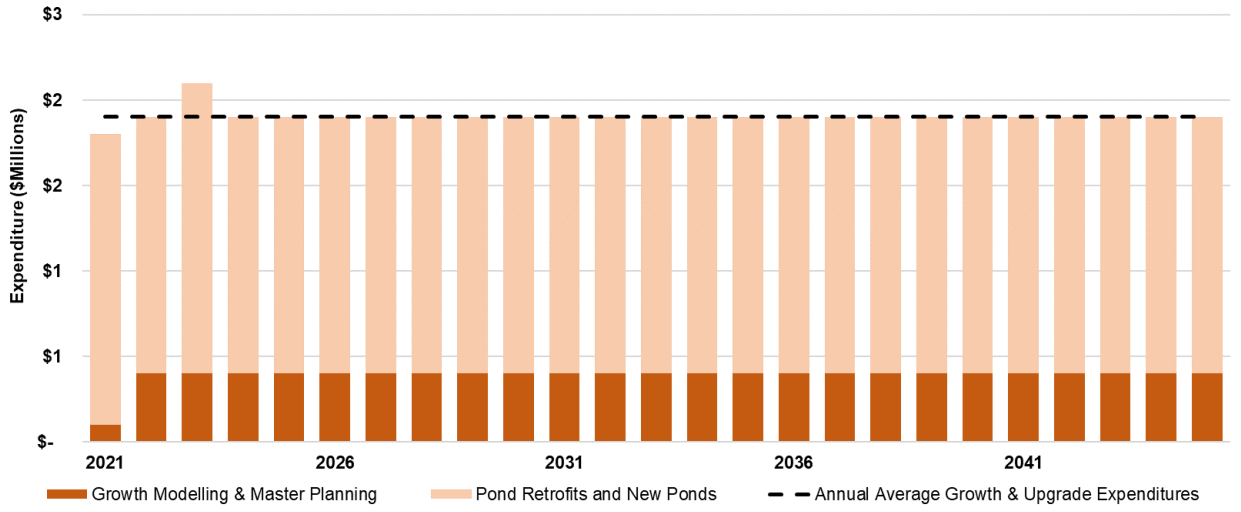
Based on the above population estimates, the compounded growth rate through to 2031 is slightly higher than the growth rate in the last ten years of the population forecast period (2032 to 2041). The City's stormwater asset portfolio is assumed to grow at an approximate 2.2% growth rate to accommodate the additional capacity demands. Much of this growth will occur from developments from which the City will assume infrastructure into their ownership such as ponds and storm sewers.

Second round capital requirements associated with City growth (future replacement of the expansion assets) is assumed to be beyond the forecast period and is not considered in this DAMP.

The City also carries out capital projects for Master Planning and hydraulic modelling to evaluate areas in need of additional or upgraded infrastructure, including new ponds or pond retrofits.

The expected costs for growth and upgrade capital projects are summarized in Figure 5-6, at an average annual cost of $1.9 million.

Figure 5-6: Growth & Upgrade Capital Expenditures Forecast, 2021 to 2045*



*Expenditures for growth and upgrade are forecasted based on planned projects for the next three years; subsequent years are forecasted assuming the average expenditure of the next three years.

5.3 Non-Infrastructure Solutions

Non-infrastructure solutions that assist in reducing demand on the City's stormwater infrastructure include public education where efforts focus on educating residents about the impact of surfaces that do not absorb water, including resident roofs, driveways, roads, and parking lots. As discussed in Section 1.2, during development of the Stormwater Management Financing Study, public information sessions were held to discuss the development of stormwater rates for the City. On the City's website, recommendations are posted to keep storm sewer inlets clear as well as cleaning and maintaining downspouts, weeping tiles, sump pumps, back water valves and sewer lines from resident properties to the municipal lines. Suggestions for residents also include rain barrels and plant vegetation to minimize flows draining from residential properties.

Non-infrastructure solutions also include outreach initiatives that educate private property owners in their obligation to maintain private stormwater management facilities, such as private water quality units, in accordance with the City's Sewage By-law 90-75. These units are typically located on industrial and commercial properties. Outreach initiatives like this reduce demand on the City's stormwater infrastructure by capturing and removing pollutants before they enter the City's system.

In addition to advising residents on the impact of impervious surfaces and businesses of their obligation to maintain private stormwater management facilities, the City is developing alternative City standards and practices through Low Impact Development (LID) strategies and Construction Erosion and Sediment Control that address stormwater management. Non-infrastructure solutions are estimated to cost an average of $69,400 per year.

5.4 Climate Change Considerations

As noted in Section 4.4, incorporation of climate change considerations into the City's asset management planning approach for stormwater assets is critical to maintaining service levels and managing risk. As described in the following subsections, the City is currently pursuing various initiatives related to planning as well as mitigation and adaptation strategies to address climate change risks.

5.4.1 Environmental Master Plan

In 2014, City Council approved the Brampton Grow Green Environmental Master Plan (EMP), the City's first blueprint for improving environmental sustainability at both the City (internal) and community (external) level. The outcome of extensive research, consultation, and collaboration, Brampton Grow Green outlines a vision, guiding principles, goals, and actions for a more sustainable future.

In 2020, the City provided a refreshed EMP action plan focused on the next ten years for charting the course for a greener Brampton. The EMP outlines two main action plan items related to stormwater:

- Establish a water quality monitoring program for stormwater management assets.
- Develop and commence implementation of an outreach and education strategy regarding stormwater management

These actions support the service levels outlined in Section 3.5 associated with enhancing water quality and increasing public education on stormwater services.

5.4.2 Climate Change Adaptation Plan

The City is also developing a Climate Change Adaptation Plan (CCAP). The Plan is intended to evaluate, guide, and integrate the diverse policies, programs, and activities of the City, conservation authority partners, and other stakeholders to ensure that their collective efforts are directed towards the long-term health and resilience of Brampton.

It will provide a clear vision for how the City should develop, enhance, manage, and promote climate change adaptation action so that opportunities are maximized and vulnerabilities are reduced. The CCAP will examine current initiatives, identify strengths, weaknesses/risks, opportunities, and constraints, and recommend actions to improve climate change resilience in the City based on science and best management practices.

5.4.3 Low Impact Development Standards

The City is developing standards and specifications for the implementation, operation and maintenance of low impact development (LID) practices that accelerate integration with other stormwater management infrastructure to create a more sustainable and resilient stormwater system. LID assets can help reduce demand on the City's stormwater drainage system and also help protect natural green infrastructure, such as watercourses and wetlands. LID practices mimic natural hydrology through a combination of retention (infiltration, reuse), filtration, and detention, which helps achieve water balance, erosion control, and water quality protection. They can also provide secondary benefits such as supporting biodiversity and forming ecological linkages between natural heritage features such as woodlands, wetlands, and valleys. Recent and on-going LID projects implemented by the City include stormwater tree trenches, vegetated swales, and rain gardens.

5.4.4 Stormwater Modelling and Intensity-Duration-Frequency (IDF) Curve Update

As indicated in Section 3.5, the City is developing a comprehensive stormwater hydraulic model to better understand the resiliency of the network to riverine and urban pluvial flooding during extreme weather events. This model will support identification of required projects to increase infrastructure resilience such as pond retrofits and sewer upgrades.

This initiative will also update the core criteria for design of municipal infrastructure which is based on the likelihood of occurrence of specific storm events (typically 5-year or 10-year storms for sewer design, and 100-year storm for stormwater retention pond design). The Intensity-Duration-Frequency (IDF) curve update will expand the dataset used for the statistical analysis to include all available data to the current period, will incorporate many of the more

extreme weather events of the last 20 years, and will consider potential projected climate change impacts to rainfall. The results of the analysis are anticipated to increase the magnitude of each of the storm events of interest, which would have implications for the sizing of municipal stormwater infrastructure during the design phase and the level of service provided by existing stormwater assets.

5.5 Summary of Planned Lifecycle Strategies

This AM Plan supports the City's ability to achieve its service levels while balancing risk and minimizing lifecycle costs. If the City does not invest in operations, maintenance and renewal of its stormwater infrastructure, there would be a significant deterioration in asset condition over time. The planned strategies support maintaining infrastructure assets in a state of good repair and at an acceptable level of risk.

Total costs and the affordability of the planned lifecycle strategies is discussed in Section 6.

6 Financial Strategy

6.1 Overview

The financial strategy is informed by the preceding sections of the Asset Management Plan: the state or condition of the assets, the expected levels of service, the risks to service delivery, and the lifecycle activities needed to reduce the risks to service delivery to acceptable levels. The financial strategy considers how the City will fund the planned asset management actions to meet service levels.

A municipality is in a financially sustainable position if it:

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

The key challenges to financial sustainability are:

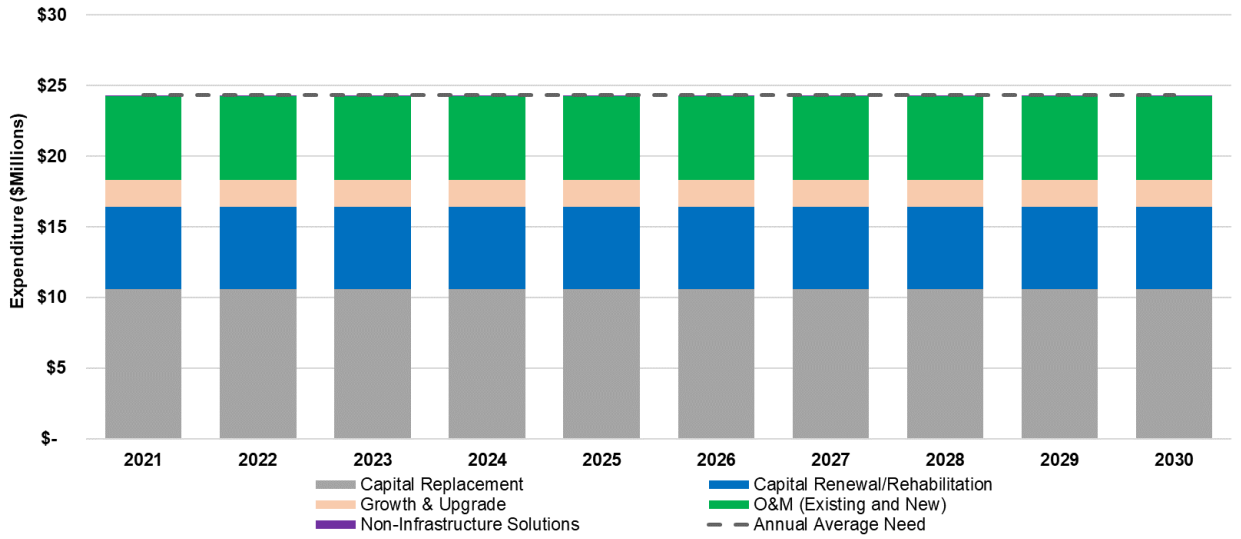
- A discrepancy between level of service decisions and fiscal capacity
- The future cost of infrastructure investments
- Unforeseen impacts to revenue
- Potential impacts due to climate change

Per O.Reg. 588/17, this section of the AM Plan identifies the annual funding projected to be available to undertake the planned lifecycle activities and assesses potential funding shortfalls. Forecast assumptions are listed in Appendix A.

6.2 Costs of Planned Lifecycle Strategies

Based on the lifecycle strategies discussed in Section 5, the City's total forecasted needs based on its planned strategy for managing its assets is estimated at $243 million for the period 2021-2030 for an average of $24.3 million per year. Figure 6-1 provides the total average annual renewal, operations and maintenance, non-infrastructure solutions, and growth and upgrade 10-year forecasted expenditures for the City's stormwater assets. This forecast is based on the 25-year average.

Figure 6-1: 10-Year Expenditure Average Annual Forecast, 2021 to 2030

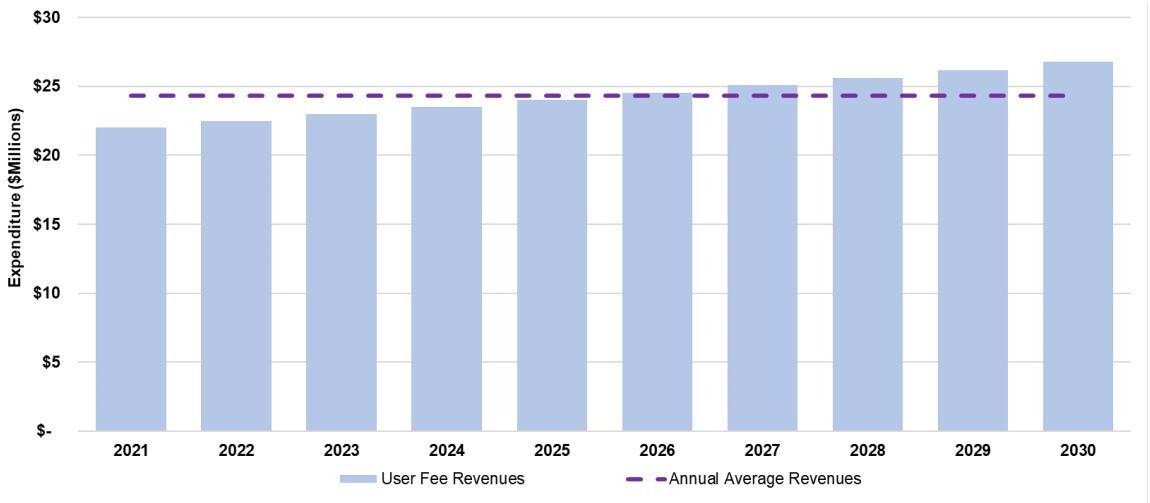


6.3 Available Funding Amounts and Sources

As recommended through the City's Stormwater Management Financing Study, the City has recently implemented a dedicated funding source for stormwater services. As such, stormwater charges are recommended and being implemented as a funding source for all operating and asset management needs associated with the City's stormwater services.

While the annual funding requirement may fluctuate, it is important for the City to implement a consistent yet increasing annual revenue base. It is assumed that the stormwater charges collected will increase at a rate of 2.2% annually, in line with the assumed growth rate in the asset portfolio. The projected 10-year revenue for the City is shown in Figure 6-2, and is estimated to be $24.3 million on average per year.

Figure 6-2: Total 10-Year Funding Forecast, 2021 to 2030



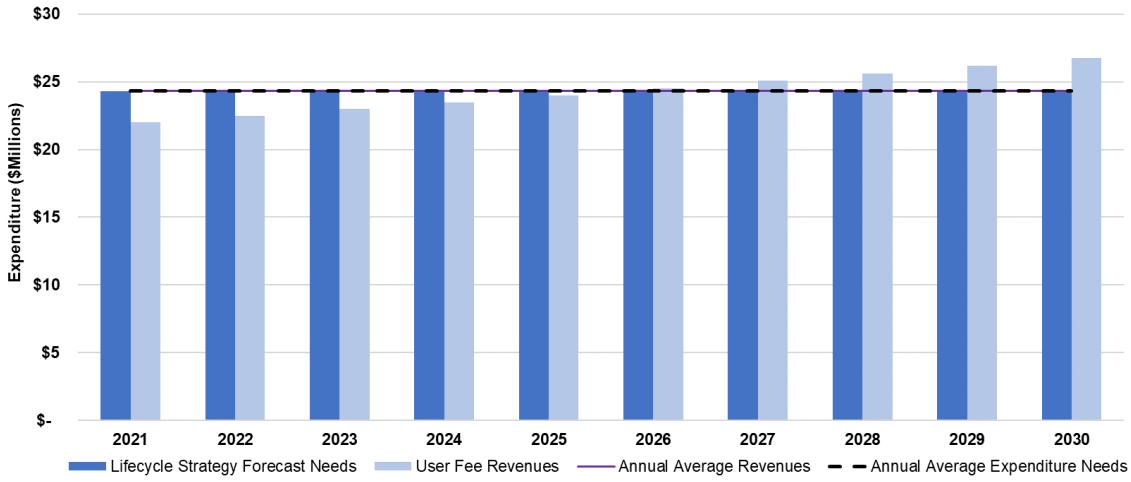
Financial Sustainability

The current funding model for stormwater infrastructure recognizes the longevity of storm sewers once properly installed and maintained. As such, the full replacement of the storm sewer system over time will consist of various components replaced according to a non-uniform distribution of service lives. The current financial analysis thus

considers that long-term replacement of sewers is understood as a variable in the funding requirements. Based on the current system valuation and replacement costs, approximately 50% of full storm sewer replacement costs are included in the current financing model, and 100% of replacement costs for other stormwater assets. As physical condition data is acquired through CCTV and inspection programs and condition assessments are completed, storm sewer capital investments can be more reliably forecasted over the lifecycle, and adjustments made to the stormwater rates at appropriate intervals to ensure sustainability of the asset management programs.

The planned funding (Section 6.3) of $24.3 million per year equals the forecast needs for the planned lifecycle activities (Section 6.2) under the current model. Figure 6-3 shows that the forecasted average annual need over the next ten years of $24.3 million per year (dashed black line) equals the average annual funding of $24.3 million per year (overlapping solid purple line).

Figure 6-3: Funding Gap



The City will continue to refine its asset management plan over the coming years to better understand the funding requirements of its stormwater assets. As discussed in 2.3, the City started CCTV inspections and bathymetric surveys programs to better understand sewer and pond condition and improve the long-term forecast for renewal of these assets. This improvement will enable more detailed year-by-year forecasts in the future and mitigate the risks of uncertainty in the long-term forecast.

An updated financial strategy will be identified in the next iteration of the City's asset management plan and will be incorporated into its funding strategy for stormwater services at that time. In future iterations of the SW AMP it may be necessary to balance the financial requirements of the SW system with SW charges collected, and to mitigate any funding gaps through periodic adjustments to the SW charge.

7 AM Plan Monitoring & Improvement

7.1 Overview

Development of AM Plans is an iterative process that includes improving data, processes, systems, staff skills, and organizational culture over time. This section provides an overview of recommended improvements to the City's asset management practices. As summarized in Table 7-1, this AM Plan is compliant with O.Reg. 588/17 Current Levels of Service requirements for July 1st, 2022.

Table 7-1: O.Reg. 588/17 Compliance for Current Levels of Service

DAM Plan Section	O.Reg. 588/17 Compliance	Comment
State of Local Infrastructure	Compliant	The AM Plan provides a summary of the assets, the replacement cost of the assets, the average age of the assets, the condition of the assets, and the approach to assessing condition of assets.
Levels of Service	Compliant	The AM Plan provides the qualitative community description and technical metrics as required by O.Reg. 588/17 and the current performance.
Asset Management Strategy	Compliant	The AM Plan provides the population and employment forecasts as set out in Schedule 3 to the 2017 Growth Plan for the Greater Golden Horseshoe. It also provides the lifecycle activities that would need to be undertaken to maintain the current LOS for each of the next 10 years, based on an assessment of lowest lifecycle cost options and risks.
Financing Plan	Compliant	The AM Plan provides the financial forecast for the next 10 years based on the costs of the lifecycle activities to maintain current levels of service.

This AM Plan also meets some of the Proposed Levels of Service O.Reg. 588/17 requirements by providing a preliminary funding and shortfall analysis in Sections 6.3.

7.2 Confidence Level Rating

In simple terms, the Confidence Level Rating is based on the following principles:

- That the AM Plan is produced following a best practice guideline and process.
- That the processes undertaken to develop the AM Plan are assessed for effectiveness according to ISO 55000.
- That the data used in the process is assessed based on the International Infrastructure Management Manual (IIMM).
- That the average of process effectiveness and data quality develops a confidence level rating.

The confidence grading systems for Data Quality and Process Effectiveness are defined in Table 7-2 and Table 7-3, respectively.

Table 7-2: Data Quality Confidence Grading System

Confidence Grade	Description
5 Highly reliable	Data based on sound records, procedure, investigations and analysis, documented properly and recognized as the best method of assessment. Dataset is complete and estimated to be accurate +/- 2%.
4 Reliable	Data based on sound records, procedures, investigations and analysis, documented properly but has minor shortcomings, for example some data is old, some documentation is missing and/or reliance is placed on unconfirmed reports or some extrapolation. Dataset is complete and estimated to be accurate +/- 10%.
3 Uncertain	Data based on sound records, procedures, investigations and analysis which is incomplete or unsupported, or extrapolated from a limited sample for which grade 5 or 4 data are available. Dataset is substantially complete but up to 50% is extrapolated data and accuracy estimated +/- 25%.
2 Very uncertain	Data based on unconfirmed verbal reports and/or cursory inspection and analysis. Dataset may not be fully complete and most data is estimated or extrapolated. Accuracy +/- 40%.
1 Unknown	None or very little data held

Table 7-3: Process Effectiveness Confidence Grading System

Confidence Grade	Description
5 Highly effective	The organization's AM activities are fully integrated and are being continuously improved to deliver optimal whole life value. AM best practice concepts are fully rolled out and being practiced by all staff.
4 Effective	The organization's AM activities are fully effective and are being integrated throughout the business. AM best practice concepts are fully rolled out and being practiced by most staff.
3 Somewhat Effective	The organization's AM activities are developed, embedded and are becoming effective. Many AM best practice concepts are rolled out and being practiced by many staff.
2 Ineffective	The organization is developing its AM activities and establishing them as Business As Usual. Some best practice concepts are rolled out and being practiced to a limited extent.
1 Unknown	The organization is aware of the importance of AM and is starting to apply this knowledge. Few best practice concepts are rolled out, and to a limited extent.

Based on the grades allocated to the AM Plan sections as outlined in Table 7-4 below, the City's confidence level rating for Data Quality is 2.7 and for Process Effectiveness is 2.6. The scores are reflective of the quality and type of data available, current processes and management strategies. Recommendations to improve the confidence level rating are provided in Section 7.3.

Table 7-4: Confidence Level Rating Assessment Summary

AM Plan Section	AM Plan Element	Data Quality	Process Effectiveness	Average
State of Infrastructure	Asset Inventory	3	3	3
	Replacement Costs	3	2	2
	Condition	2.5	2	2.25
Levels of Service	Technical LOS	3	2	2
	Customer LOS	3	3	3
AM Strategy	Rehab Strategies & Service Lives	3	2.5	2.75
	Growth	3	2.5	2.75
Financial Strategy	Operating Needs Forecast	3	3	3
	Capital Needs Forecast	2.5	3	2.75
	Funding Analysis / Affordability of Proposed LOS	2.5	3	2.75
	Risk Management	2	3	2.5
Overall		2.7	2.6	2.7

7.3 Recommendations for Future Improvement

As part of continuous improvement and compliance with year 2025 O.Reg. 588/17 requirements, it is recommended that the City focus on the recommendations summarized in the table below.

Table 7-5: AM Plan Recommendations

DAM Plan Section	Recommendations
State of Local Infrastructure	
Asset Inventory	The asset inventory for sewers, manholes, catchbasins, and water quality units is currently maintained in GIS. The inventory for stormwater ponds is managed in GIS as well as a MS Excel file, which tracks bathymetry survey results. Standard data models were recently developed for these assets. It is recommended that the City develop asset management processes that detail how an asset is created and tracked throughout the asset lifecycle by the City's software systems to ensure that data attributes are captured going forward according to the data models. The inventory should align with other associated inventories, such as PSAB (financial) data, through a common Asset ID. An inventory needs to be developed for outfalls, driveway culverts, ditches, and LID assets. The City is also taking steps to define asset governance in the inventory of some stormwater assets and components that are shared across multiple departments, such as safety lights and fences.
Replacement Costs	Linear Assets: Replacement costs for linear assets are based on unit construction costs and were based on recent contracts and latest manufacturer price data. Costs should be re-calibrated in future updates of this DAMP. Stormwater Management Ponds: The City is currently undertaking a project to evaluate the Current Replacement Cost for each pond which will define replacement costs at the pond component level. These replacement costs will improve the accuracy of the State of Infrastructure valuation as well as the capital expenditure needs forecasts.
Condition	Linear assets: Sewer condition is based on age in this AM Plan. Relevant CCTV data should be digitized for each GIS sewer segment such that condition can be more accurately determined for the overall linear asset portfolio. The original CCTV inspection reports should be linked to the GIS segment such that additional information can be accessed as required. The City has currently completed approximately 200km of storm sewer CCTV inspections and the CCTV program will continue on an annual basis to acquire baseline information for the entire storm sewer system. Stormwater Management Ponds: It is recommended that the City develop an inspection checklist from which an overall pond condition score can be determined and digitized in accordance with the data model. Pond inspection results should be linked to the GIS segment such that additional information can be accessed as required. Bathymetry surveys will be utilized for all ponds to inform timing of cleanout requirements.

DAM Plan Section	Recommendations
Levels of Service	
Customer (Community) LOS	Consider adding maps to visually show the extent of flooding protection provided by the municipal stormwater management system.
Technical LOS	Regulatory LOS: It is evaluated that 96% of properties in the City are resilient to the 100-year storm event based on the flood plain maps provided by the TRCA and CVC which is a reflection of the riverine flooding extent. It is estimated that at least 80% of the stormwater system is resilient to 5-year storm events. It is recommended that the City continue to improve its understanding of flooding events and the activities required to resolve these issues, in particular for urban pluvial flooding (separate from riverine flooding). Further modelling work is currently underway to establish the City's performance on this measure with a higher degree of confidence. Proposed service levels on resiliency can be developed once the current performance is better established. The City identified a few additional LOS for future tracking including those associated with additional asset classes currently excluded from this DAMP. The City will work on establishing performance measures for these additional LOS for inclusion in the future iterations of this DAMP.
Asset Management Strategy	
Risk Strategy	Risks in this AM Plan are assessed at the asset category level. It is recommended that the City develop an asset-by-asset risk assessment based on condition ratings such as CCTV data. Based on the Risk Framework, criticality ratings can also be developed at a more granular level to further improve maintenance and renewal planning (example: it may be appropriate to clean out critical ponds more frequently than less critical ponds). Once asset risks are quantified on the more granular level, risk tolerance should be established and risk mitigation plans should be developed to meet acceptable residual risks. The City also plans to apply this risk framework at the more detailed level across the various Levels of Service: • Quality/Reliability LOS attribute: As the City develops more accurate data such as CCTV condition, bathymetric surveys, SWMP engineered infrastructure assessment on an asset-by-asset basis, it will be able to develop a more detailed risk assessment at the asset level that are not captured in the high-level assessment. • Capacity/Use LOS attribute: The City's development of the Storm Sewer System model will enable a more robust understanding of current and future system capacity. IDF curves will take into account changed precipitation intensities when evaluating current system capacity and will be applied to the future design of SW facilities.

DAM Plan Section	Recommendations
Risk Strategy (continued)	• Functionality LOS attribute: The City strives to quickly adapt to changing legislative requirements, including the new consolidated linear infrastructure ECA for the SW system. Planned functional improvements already include improving TSS removal efficiencies through the City's retrofit program. In the future, a more detailed understanding of risk across these different LOS categories will allow the City to account for evolving factors such as the impact of climate change, changing legislature, and changing overall economic situations.
Demand Strategy (Future Growth)	The asset portfolio is assumed to grow at a constant rate of 2.2%. This assumed growth rate should be adjusted as required over time.
Lifecycle Strategies	Renewal strategies were developed collaboratively with the City for each asset category based on typical estimated life and time-based activities, with most rehabilitation costs based on historical data and expressed as a percentage of replacement cost. To validate that the maintenance and renewals are lowest lifecycle strategies, the City should develop a comprehensive understanding and documentation of treatment options and their benefits. This understanding will be achieved by tracking (1) historical activities and costs, (2) asset expected useful lives, and (3) available intervention options (e.g., renewal treatments), including costs and associated benefits (extension of asset life). Cityworks implementation for work order management is underway and will significantly improve historical activities and costs tracking. Planned condition assessments will allow for more accurate planning of lifecycle activities. For example, the structural PACP score, length of major and minor defects, and specific PACP defect code information may be used as part of a decision logic decision tree to assist in determining possible rehabilitation work. Projects should be based on a review of CCTV inspection reports on a segment-by-segment basis. Possible treatment categories based on CCTV data could include: • Emergency Replacement • Full Replacement • Full Lining • Point Repair and or Partial Lining • Re-inspection • Standard inspection

DAM Plan Section	Recommendations
Lifecycle Strategies (continued)	Additional lifecycle activities may be required based on deficiencies in the stormwater network that are being more accurately identified through on-going condition assessment as well as modelling work. As the City improves its understanding of system performance given the dynamic and interdependent nature of the storm sewer network, lifecycle activities may be identified to improve system resiliency to maintain the current LOS of aging assets. Projects each year should be prioritized using the risk assessment framework. The prioritization matrix should enable a business case evaluation outlining project benefits, costs, assumptions, risks, timeframes, and options considered, including analysis of the impacts of deferred implementation. This business case evaluation may be formalized through a Capital Planning Framework. Establish asset governance in terms of responsibilities for lifecycle activities and develop SLA's where required for interdependencies noted in Section 1.6.
Financial Plan	
Operating Needs Forecast	Develop a Standard Operating Procedure that clearly delineates work to be covered by the City's operating budget versus the City's capital budget. For example, pond maintenance, including the rehabilitation and replacement of pond components may be included as Operating; dredging and pond restoration costs may be included in the Capital budget.
Capital Needs Forecast	Future forecasts are based on the asset replacement costs (Section 2) and AM strategies (Section 5) to meet the current LOS (Section 3). Continual improvement of the financial projections in this AM Plan can be achieved with each update as the improvements indicated above for asset inventory, valuation, condition estimates, asset management strategies are refined and completed. Future forecasts should include asset classes not included in this DAMP such as driveway culverts, LID assets, and outfalls. Additional lifecycle activities and associated costs may also need to be considered to meet resiliency targets (refer to Lifecycle Activities section above).
Funding Analysis / Affordability of Proposed LOS	The City will continue to refine its asset management plan over the coming years to better inform sustainable financial planning for stormwater assets.

7.4 Asset Information Improvement Roadmap

SW Services in collaboration with Corporate Asset Management office and IT has developed an Asset Information Improvement Roadmap to show a clear path of continuous improvement in its asset management information and practices over the short, medium, and long-term. A summary is provided in Table 7-6, which captures asset information related recommendations.

Table 7-6: Asset Information Improvement Roadmap

Improvement Area	Short Term	Medium Term	Long Term
General focus area for roadmap phases	Governance and processes for basic SOI data	Tools and systems with integration	Mature solutions and strategic information (including QA processes)
Intermediate Maturity Assets (Storm Sewer Systems, Water Quality Units, SWMPs)	Refine data models and continue implementation of data models in GIS and Cityworks for Storm Sewer Systems, SWMPs, and Water Quality Units.	Incorporate condition data achieved through the asset condition programs such as CCTV program and bathymetric surveys to refine lifecycle models. Finalize storm system model and develop risk assessments at more detailed asset or project level as appropriate.	Use condition information and stormwater model to refine lifecycle forecasting, develop proposed LOS, and assess financial sustainability. Use risk assessments to prioritize projects.
Basic Maturity Assets (LIDs, watercourses, outfalls, driveway culverts, ditches)	Update asset hierarchy, develop inventories and attributes including condition data protocols.	Implement data models for LIDs and watercourses into GIS and Cityworks. Develop lifecycle models and develop risk assessments at more detailed asset or project level as appropriate.	
Governance and Processes	Establish basic governance for implementation of SW assets in GIS and Cityworks. Establish Asset Information Transfer standards as part of procurement & land development process to ensure asset data is collected from design consultants and developers upon asset assumption.	Finalize workflows for maintaining asset information	
ECA requirements	Application for Consolidated Linear Infrastructure ECA (CLI ECA)	Annual updates and ongoing notifications per CLI ECA of discovered assets and newly constructed assets. Assets will be discovered as data gaps are addressed (e.g. SWMPs on private property, characterize level of treatment within sewersheds)	5-year renewal of CLI ECA

7.5 Monitoring and Review Procedures

The AM Plan will be updated at least every five years to ensure it reports an updated snapshot of the City's asset portfolio and its associated value, age, and condition. It will ensure that the City has an updated 10-year outlook including the proposed service levels, costs of the associated lifecycle strategies and as assessment of any funding shortfalls.

Per O.Reg. 588/17, the City will conduct an annual review of its asset management progress in implementing this AM Plan and will discuss strategies to address any factors impeding its implementation.

Appendix A Financial Forecast Assumptions

Forecast Category	Main Budgeted Expenditures and Forecast Assumptions
Rehabilitation	Restoration of SWM ponds and watercourses, including dredging, bank stabilization and erosion expenditures increase from $1.4M in 2021 to $4.4M in 2023, and forecasted to remain at $4.4M over the remainder of the forecast.
	Projects for data collection to inform timing of renewal and capital activities is $525k per year, except for 2022 and 2023 where expenditures increase to $650k per year.
	Pond components are rehabilitated every 15 years at a 15% cost of the overall pond replacement value
	Minor Storm sewer rehabilitations cost $100k per year across the sewer network (repair of storm sewer laterals)
Replacement	50% of the average annual investment for sewer system is accounted for in the forecast. The investment is calculated based on the replacement value divided by the asset useful life, then multiplied by 50%.
Growth & Upgrade	Growth modelling/master planning and pond retrofits/new pond projects increase from $1.8M to $2.1M in 2023. From 2024 and onward, it is assumed that an approximate average expenditure of the first three years ($1.9M per year) is required.
Operations & Maintenance	The Operations & Maintenance (O&M) budget increases from $4.3M in 2021 to $5.1M in 2023 and forecasted to remain at $5.1M over the remainder of the forecast. O&M expenditures for growth assets are accounted for by adding 2.2% annual increases to the O&M budget. The annual average O&M expenditure over 25 years is $5.9M per year.