NEW WESTMINSTER

REPORT

City of New Westminster

Sewer & Drainage
Asset Management Plan
Final Report, 2023



AUGUST 2023
ASSOCIATED ENGINEERING
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REVISIONS

Issue Date	Version	Comment
May 31, 2023	1.0	Finalized and Endorsed by Council on September 11, 2023.
August 30, 2023	1.1	Minor changes. Updated pump station costs.

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EXECUTIVE SUMMARY

1.1 Introduction

The City of New Westminster (the "City") has developed this Sewer & Drainage Asset Management Plan (Sewer & Drainage AMP) with the help of Associated Engineering (B.C.) Ltd. (Associated) to serve as a guiding document that will support the ongoing management and long-term stewardship of the City's sewer and drainage assets. This is the City's first Sewer & Drainage AMP developed following the 2019 Asset Management (AM) Strategy.

1.2 State of Infrastructure

The Sewer & Drainage AMP considers the following assets:

- Linear sewer and drainage infrastructure including:
  - pressurized mains;
  - gravity mains;
  - laterals; and,
  - catch basin leads; and,
- Vertical and point sewer and drainage assets including:
  - manholes;
  - network structures (pump stations and chambers);
  - cleanouts; and,
  - inlets.

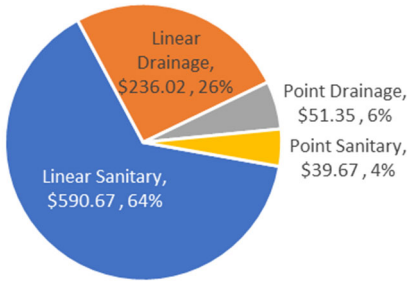


Figure ES-1 Replacement Value of Linear and Point Sewer and Drainage Records ($M)

The total replacement value of the assessed assets is $918M. The relative values of assets in the sewer and drainage portfolios are shown in **Figure ES-1**.

The condition of assets was assessed to develop an understanding of the remaining service lives and overall condition of the asset portfolio. Condition was rated on a scale of very poor to very good, based on the condition scale used in the Canadian Infrastructure Report Card as shown below:

- **Very Poor**: The asset is unfit for sustained service. It is near or beyond its expected service life and shows widespread signs of advanced deterioration. Some assets may be unusable.
- **Poor**: There is increasing potential for asset condition to affect the service it provides. The asset is approaching the end of its service life, the condition is below the standard and a large portion of the system exhibits significant deterioration.
- **Fair**: The asset requires attention. The asset shows signs of deterioration and some elements exhibit deficiencies.
- **Good**: The asset is adequate. It is acceptable and generally within the mid-stage of its expected service life.
- **Very Good**: The asset is fit for the future. It is well maintained, in good condition, new or recently rehabilitated.

The majority of condition ratings were age-based, meaning that they were derived from the assets age relative to its estimated service life. This is less reliable than an inspection-based condition rating but gives a good approximation of asset data in lieu of asset inspections. Inspection-based ratings were used for pump stations and a portion of gravity mains for which closed-circuit television (CCTV) ratings were provided.

Figure ES-2 shows the overall asset portfolio condition by replacement value. As shown, 46% of assets by replacement value are in good to very good condition, and 20% are in fair condition. The remaining 34% of assets are in poor to very poor condition.

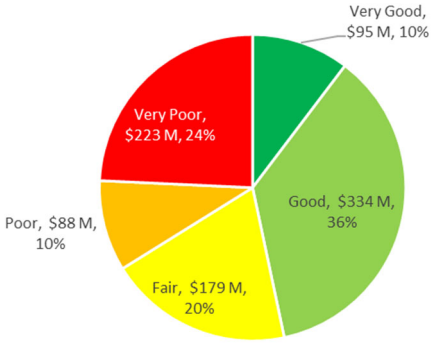


Figure ES-2 Sewer & Drainage Asset Portfolio Condition by CRV ($M)

1.3 Levels of Service

Delivering sewer and drainage services is part of the City's core mandate. Understanding the Levels of Service (LOS) that the City provides its customers and stakeholders allows the City to better deliver on the expectations of those parties. It frames service delivery around the customer rather than the organization. It enables the City, once available data is in place, to analyze and strike a balance between levels of service and the cost to deliver them.

One of the City's Asset Management Policy Principles (April 2019) states that "we shall clearly define and measure our Levels of Service for delivering on customer and stakeholder requirements."

The AMP Working Group developed a list of objectives and performance measures for sewer and drainage assets following the service-based decision-making approach described in the Strategic Asset Management Plan (SAMP). The outcome areas depicted in the graphic below were used to determine the LOS. Key performance indicators (KPIs) were developed for each measure, which the City can track to assess progress on achieving the LOS outcomes.

Table ES-1 LOS Outcome Areas

Outcome Area	Description
1. Reliability	Provide reliable service and infrastructure
2. Public Health & Safety	Protect public health and safety
3. Productivity, Efficiency, & Safety	Meet service and operation requirements with economic efficiency, safety and productivity
4. Regulatory Compliance	Meet current and anticipate future regulatory requirements
5. Affordability & Long-Term sustainability	Ensure long-term sustainment of infrastructure and services
6. Responsiveness, Service & Reputation	Have satisfied and informed customers and protect public reputation
7. Environment	Protect the environment

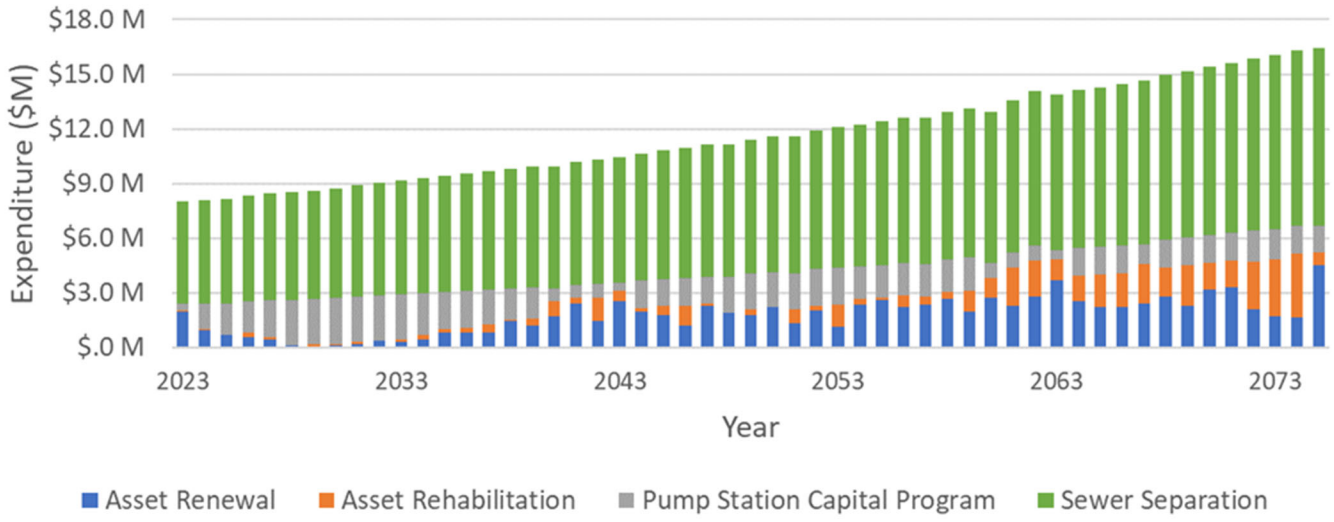
1.4 Asset Lifecycle Strategies

In the development of a modified renewal forecast for the sewer and drainage service area, two key priorities were considered:

1. Achieving full sewer separation by 2075, as regulated by Metro Vancouver; and
2. Maintaining an average asset condition of fair across the asset portfolio to balance long term asset sustainability with affordability, as outlined in the LOS outcomes.

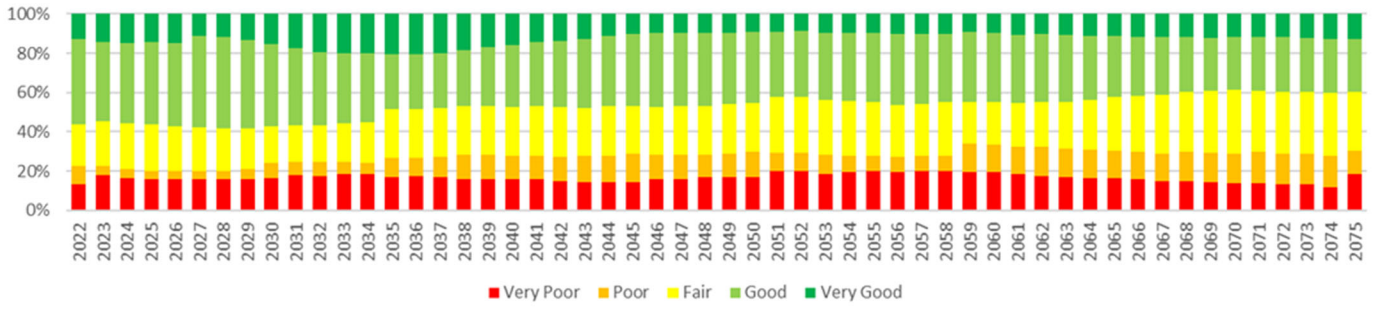
In order to achieve these goals by 2075, an annual increase of expenditure of 1.41% before inflation is required, starting at $8.0M of expenditure in 2023. This totals to a $620M investment between now and 2075 in 2022 dollars.

Figure ES-3 Annual Investment Needs



The average condition of assets through this strategy is shown below. Employing this strategy maintains an average condition score of fair (3.0) across the portfolio.

Figure ES-4 Projected Condition of Assets by % of Valuation



1.5 Data Reliability

Table ES-2 Data Reliability for Sewer and Drainage Assets

RELIABILITY			▼		
RANGE	5: UNKNOWN	4: VERY UNCERTAIN	3: UNCERTAIN	2: RELIABLE	1: HIGH RELIABILITY

Overall, data reliability is assessed as uncertain, largely based on gaps in the attribute data for certain assets including age and material. The City would benefit from a strengthening of its data capture, collection, and analysis. It is expected that the City will work to improve aspects of its data on an iterative basis through the improvement planning process.

1.6 Risks & Uncertainties

The AMP details several asset and enterprise risks to the service area, as outlined in the SAMP's risk framework. In addition, the City faces several uncertainties that may impact effective delivery of the Sewer & Drainage AMP's forecasted approach. Notable risks include:

- Providing adequate funding for increased capital investment;
- Potential additional Metro Vancouver levies or fees;
- Providing adequate resourcing for increased capital investment;
- Timing and coordination of capital projects; and,
- Developer intervention in lateral renewal

1.7 Financial Strategies

The AMP provides an overview of historic capital and operations and maintenance spending, as well as historical funding sources. Most funds for asset renewal come from Reserve Funds, obtained through sewer user fees and annual budget surplus.

Based on the anticipated 2023 capital budget of $8.0M, there is a funding deficit to the renewal forecast, where anticipated funding levels are insufficient to meet the required capital investment. The total funding required over the 10-year period is $84.8M in 2022 dollars. Assuming $8M funding is currently secured annually, the 10-year deficit totals to $4.8M in 2022 dollars.

Key questions to be considered when sourcing the funds to address this deficit include:

- Current sewer rates, projected future sewer rates, and potential limitations on the extent and speed of rate increases;
- Alternative funding source availability; and
- Overall City reserve and financial policies, including risk appetite for sewer and drainage related financial risk and risk to service delivery.

1.8 Implementation & Continuous Improvement

The Sewer & Drainage AMP must be underpinned with effective governance over the implementation of the AMP's approach. Implementation will be monitored through the City's existing AM Steering Committee and AM Team. Responsibility for implementation lays with the Engineering team and the Sewer & Drainage AMP Working Group.

This AMP, in its first iteration, has revealed several gaps and opportunities for improvement. Recommendations for improvements in business process, data and information, technology, governance, and people and capacity have been identified in **Section 7** based on the process of building this initial Sewer & Drainage AMP.

Improvement actions include the following:

- Implement process changes/enhancements to support tracking of LOS indicators.
- Improve asset data quality and accuracy and integrate available data sets to support lifecycle costing and planning.
- Develop long term funding strategies to address the funding deficit and build reserves.

ACKNOWLEDGEMENTS

The Sewer & Drainage AMP was prepared through the insights of the Sewer & Drainage AMP Working Group. The Sewer & Drainage AMP Working Group included the following members.

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LIST OF ACRONYMS & ABBREVIATIONS

This list contains frequent acronyms and abbreviations used in the Sewer & Drainage AMP, as described in the City's Strategic Asset Management Plan (SAMP).

Term	Description
AC	Asbestos Cement
AM	Asset Management
AMP	Asset Management Plan
AR	Asset Risk
Associated	Associated Engineering
CAPEX	Capital Expenditures
CCTV	Closed Circuit Television
City	City of New Westminster
CMMS	Computerized Maintenance Management System
CIP	Cast Iron Pipe
CIPP	Cured in Place Pipe
CIRC	Canadian Infrastructure Report Card
CMP	Corrugated Metal Pipe
CONC	Concrete
CRV	Current Replacement Value
CSO	Combined Sewer Overflow
CSP	Corrugated Steel Pipe
DCC	Development Cost Charge
DI	Ductile Iron
ELM	Equipment, Labour, & Materials
ER	Enterprise Risk
ESL	Estimated Service Life
FCM	Federation of Canadian Municipalities
FTE	Full time equivalent
GIS	Geographical Information System

Term	Description
HDPE	High-density Polyethylene
KPI	Key Performance Indicator
LOS	Levels of Service
NWWBI	National Water and Wastewater Benchmarking Initiative
O&M	Operations and Maintenance
OPEX	Operating Expenditures
PE	Polyethylene
PVC	Polyvinyl Chloride
RC	Reinforced Concrete
RCP	Reinforced Concrete Pipe
SAMP	Strategic Asset Management Plan
TCA	Tangible Capital Asset
VC	Vitrified Clay

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GLOSSARY

This glossary contains definitions of terms frequently used in the Sewer & Drainage Asset Management Plan, as defined in the City's Strategic Asset Management Plan (SAMP).

Term	Definition
Asset	An item, thing or entity that has potential or actual value to the City. See also: Tangible Capital Asset.
Asset Class	A group of assets with common attributes and/or objectives, such as the water asset class.
Asset Condition	The measure of the physical state of an asset but may also include functional and demand considerations.
Asset Intervention	All the measures funded from either capital expenditures or operating expenditures that are used to maintain or enhance the performance of an asset.
Asset Management (AM)	The coordinated activity of the City to realize value from its assets. This includes making decisions about the stewardship of infrastructure to deliver services in a way that considers current and future needs, manages risks and opportunities and makes the best use of resources.
Asset Management Plan[1]	Outlines actions and resources required to provide defined levels of service; Identifies AM activities (operations, maintenance, renewals, capital works, disposals, etc.); Provides financial forecasts for elements within AM plans.
Asset Management Policy[2]	Sets guiding principles to undertake AM in a structured and coordinated manner; integrates AM into the City's organizational operations.
Asset Management Strategy[3]	Develops structured set of actions aimed at optimizing the infrastructure assets to deliver effective services to the City; Reviews current status, future vision, gap analysis and timeframes.
Asset Management System	The management system for asset management whose function is to establish the asset management policy and asset management objectives.
Backlog	The estimated current replacement cost of assets that are still in-service but have exceeded their estimated useful lives.
Business Case	The framework to develop and evaluate business cases for investment decisions.

[1] City of New Westminster's Corporate Policy Document, Asset Management Policy, Version 1.
[2] City of New Westminster's Corporate Policy Document, Asset Management Policy, Version 1.
[3] City of New Westminster's Corporate Policy Document, Asset Management Policy, Version 1.

Term	Definition
Capital Assets	Include land, buildings, park improvement, and road, electrical, water, sewers and other transportation infrastructure, and vehicles and equipment. Capital assets have a useful economic life greater than one year and are used on a continuing basis.
Climate Adaptation	Action taken to reduce the negative impacts of climate change. E.g. Build up dykes.
Critical Asset	Assets for which the financial, business, or service-level consequences of failure are sufficiently severe to justify proactive inspection and rehabilitation. Critical assets have a lower threshold for action than non-critical assets.
Funding Gap	The difference between the current capital funding and the recommended capital funding.
Gap Analysis	"A method of assessing the gap between an organization's current AM practices and the future desirable AM practices" (IIMM, 2015). A gap analysis may also be referred to as a need's analysis or improvement planning.
Infrastructure	The system of core assets, facilities and/or equipment.
Inherent Risk	The risk that an asset or activity would pose if no controls or other mitigating factors were in place to alter, mitigate, or reduce either the likelihood or impact of the risk; that is, the gross risk or risk before controls.
Implementation[4]	Detailed day-to-day actions required to deliver the defined levels of service; allocation of necessary resources; establishes measurable performance indicators.
Levels of Service (LOS)	The outputs or objectives that the City intends to deliver; includes measures at the corporate, customer, and asset levels of the organization.
Objectives	A result to be achieved. Objectives can be expressed in a variety of ways and can be either strategic, tactical or operational.
Output	Specific, measurable events that contribute to the desired outcome of a service.
Outcome	The overall desired or actual result of a service. Service level outcomes define what the service is supposed to achieve, for example, a "reliable" service.
Performance Indicator/Measure	A qualitative or quantitative measure of a service or activity used to compare actual performance against a standard or target. Performance indicators commonly relate to statutory limits, safety, responsiveness, cost, comfort, asset performance, reliability, efficiency, environmental protection and customer satisfaction.
Practices	The actual application, execution or use of the processes and procedures. It includes improvisational behaviours to address changing circumstances.
Procedure	The sequence of steps taken to implement and achieve an activity within a process.

[4] City of New Westminster's Corporate Policy Document, Asset Management Policy, Version 1.

Term	Definition
Process	The structured transformation of inputs into outputs. Processes typically operate across many functions and may cross department lines. A complex process may contain many procedures.
Remaining Life	The period from the current point in time to the time that an asset requires renewal.
Replacement Cost (Replacement Value)	The estimated cost to replace a capital asset with a similar asset based on studies, appraisals, industry standards and actual experience. Future estimated replacement costs are current replacement costs inflated by an appropriate factor.
Residual Risk	The risk that remains after controls are considered; that is, the net risk or risk after controls.
Responsibilities	The obligations or expectations to perform certain specific activities or duties according to a particular role.
Risk	The effect of uncertainty on objectives. An event that impacts the achievement of objectives and deals with the uncertainty. It is measured in terms of consequence and likelihood.
Risk Management	The application of a formal process to the range of possible values relating to key factors associated with a risk to determine the resultant ranges of outcomes and their probability of occurrence.
Roles	The position(s) occupied (“the part played”) by certain internal stakeholders (and external stakeholders).
Senior Management	The group of people at the City who direct and control the organization at the highest level. Senior management has the power to delegate authority and provide resources within the organization.
Stakeholders	A person, group, or organization that can affect, be affected buy, or perceive themselves to be affected by a decision or activity.
Standard Inlet	A feature where flow goes into a pipe, channel, or ditch, but where no label or information was provided.
Tangible Capital Asset (TCA)	The physical assets addressed by the City’s policy; including infrastructure and land.
Useful Life	The estimate of the number of years over which a capital asset is expected to be used.

1 INTRODUCTION

The City of New Westminster (the "City") has developed this Sewer & Drainage Asset Management Plan (Sewer & Drainage AMP) to serve as a guiding document that will support the ongoing management and long-term stewardship of the City's sewer and drainage assets.

The City's sewer and drainage assets exist to manage wastewater produced by daily activities and stormwater from precipitation. Sewer assets make up an underground network of service connections, pipes, manholes and pump stations designed to collect and safely convey wastewater to the regional trunk sewers and wastewater treatment plants operated by Metro Vancouver. Drainage sewer systems capture and convey natural runoff through a network of ditches or pipes and then discharge it into the natural bodies of water through gravity and pump station outfalls. The City owns and operates these assets and ensures that they are maintained, repaired, and upgraded as required for reliable, safe, and sustainable provision of sewer and drainage services in New Westminster.

This iteration of the Sewer & Drainage AMP includes information on the following:

- Profile of the existing sewer and drainage assets;
- Desired levels of service (LOS) of the City's sewer and drainage services;
- Activities required for asset renewal and development of new assets required to deliver sewer and drainage services today and into the future;
- Investment required to fund the capital works outlined in the AMP through to 2075; and
- Overview of risks to be considered in asset management (AM) planning.

1.1 Background

Asset Management is identified in the Corporate Strategic Plan[5] as a priority for the City. The City is committed to "implementing a systematic asset management methodology to apply appropriate AM best practices across the organization.[6]"

The City completed its Asset Management Strategy in 2019 (EDMS # 1357644), which outlines its AM objectives and improvement roadmap. It also provides an overview of the AM system and its key documents, including an outline to guide AM planning for each service area.

The City has identified the priority for greater clarity about its sewer and drainage system investment needs. The Utility Master Plan was developed in 2015 to assess growth and capacity needs in the future.

Prior asset management work has been conducted specifically for the City's sewer and drainage assets including the development of a Risk Model in 2022. The City's Water and Sewers teams have recently implemented the Cityworks Computerized Maintenance Management System (CMMS) system and has been engaged in an update of their maintenance management manuals in conjunction to the writing of this AMP. This AMP incorporates data from this recent work. The Maintenance Management Manual can be seen in Appendix F.

[5] 2019-2022 Corporate Strategic Plan: https://www.newwestcity.ca/database/files/library/Strategic_Plan.pdf
[6] Note from the Corporate Asset Management Policy, Version 1, 2017: https://www.newwestcity.ca/database/files/library/Corporate_Asset_Management_Strategy.pdf

1.2 Purpose

The purpose of this AMP is to address key questions that will assist the City in the responsible stewardship of the assets in the sewer and drainage services, as well as the long-term sustainability of the sewer and drainage services. The questions addressed by this AMP are identified in **Table 1-1**.

Table 1-1 Questions Addressed by the AMP

Questions	Measures, Metrics & KPIs	Section of the AMP
1. What do we own?	Inventory and hierarchy	State of Infrastructure
2. What are our assets worth?	Valuation	State of Infrastructure
3. How long will our assets last?	Asset service life	State of Infrastructure
4. Which assets are beyond their theoretical service life and need to be inspected for condition?	Infrastructure renewal deficit (backlog)	State of Infrastructure Asset Lifecycle Strategies
5. What is the relative importance of our assets?	Criticality assessment completed in 2022 (used as input to AMP model)	Risk & Uncertainties
6. When do the assets need to be replaced?	Remaining life	Asset Lifecycle Strategies
7. How much will it cost to replace the assets?	Replacement value	Asset Lifecycle Strategies Financial Strategies
8. How much money will we need?	Required annual expenditure	Asset Lifecycle Strategies Financial Strategies
9. What assets do we fix first?	Prioritized backlog	Asset Lifecycle Strategies
10. How much money will we have?	Historic capital spend & funding sources	Financial Strategies
11. What are the next steps on our journey?	Recommendations	Implementation & Continuous Improvement

1.3 Scope

The Sewer & Drainage AMP includes the following assets:

- Linear sewer and drainage infrastructure including:
  - pressurized mains;
  - gravity mains;
  - laterals; and,
  - catch basin leads; and
- Vertical and point sewer and drainage assets including:
  - manholes;
  - network structures (pump stations and chambers);
  - cleanouts; and
  - inlets.

An asset hierarchy is included in **Section 2.2** of this AMP.

This AMP will inform a 53-year planning horizon to reflect the Metro Vancouver regulatory sewer separation deadline of 2075. Asset status and planning parameters should be regularly checked and updated as they are likely to change within the planning horizon.

Assets were assigned a criticality score, which fed into the risk scores developed in the 2022 AECOM Risk Model (Appendix C). These risk scores were used in the prioritization of projects for the renewal forecast.

1.3.1 Asset Types not Included

Assets within the sewer and drainage asset hierarchy which are excluded from the scope of this AMP are:

- Overflows;
- Standard outlets;
- Open drains;
- Wet ponds and detention tanks;
- Watercourses including ditches, canals, and culverts; and
- Dykes.

These assets were excluded due to data availability. As data quality improves, the assets may be incorporated into a future version of the AMP.

Other sewer and drainage assets that are the responsibility of Metro Vancouver, such as the regional trunk sewers and wastewater treatment plant, are not included. As in the Transportation and Water AMPs developed previously, natural assets such as rain gardens are not currently included within the scope of this AMP.

While not explicitly excluded, sewer system valves were not assessed independently, but rather in conjunction with pressurized mains. Valve costs were incorporated into the value of pressurized mains.

1.3.2 Climate Change and Resiliency

The impacts of climate change and the resiliency of the sewer and drainage assets were reviewed during the development of this AMP.

The City is currently addressing concerns related to projected increases in precipitation and associated flood and combined sewer overflow (CSO) risks through their Floodplain Management Strategy and Sewer Separation Program respectively. Additionally, the City's Integrated Stormwater Management Plan looks to the construction of rain gardens to reduce CSO risks, recharge groundwater aquifers, and allow for reserve capacity in the City's drainage system in order to be resilient to climate change.

At this time, there are no known additional climate adaptation actions required for the sewer system. As storm sewers near end of life, a review of their capacity and the potential need of upsizing is advised.

The vulnerability of pump stations to climate change related hazards was assessed as part of the recent Pump Station Condition Assessment completed by Associated in 2023, which provides adaptation strategies for consideration.

1.4 Stakeholders

The development and execution of this AMP relies on the collaborative effort of multiple City departments and the perspective of many external stakeholders.

Tables 1-2 and **1-3** identify the internal and external stakeholders and their interests. The stakeholder identification was conducted through a workshop with the Sewer & Drainage AMP Working Group.

Table 1-2 Internal Stakeholders and Interests

Stakeholders	Interest
AMP Working Group	This group is comprised of members from the following departments: Infrastructure Planning, Operations, IT, and Finance. This Group is tasked with developing a cohesive AMP that aligns with the City's objectives.
Asset Management Steering Committee	This group provides direction to the City's overall asset management program and will serve as a key audience of the AMP.
City Council and Executive Team	These groups act as stewards for all City assets and approve the AM policy, establish LOS delivery, and monitor progress and outcomes.
Engineering Department	This group provides sewer and drainage services, and maintains, inspects and operates the assets.
Roads and Water Renewal and Upgrade Project Managers	Roads and water renewal and upgrade projects (both capital and through developments) present opportunities for coordination of an integrated works program.
Development Services (Planning Department)	This group provides information on the Official Community Plan (OCP), Sewer Utility Master Plan and provides information such as growth and demand.
Finance & IT Departments (including Procurement)	This group provides financial and spatial data and develops/supports financial and data management strategies related to the sewer and drainage assets. Procurement services develop and execute policies and strategies to retain external services.
Parks & Recreation Department and other Civic Services	This group operates recreational and cultural programs and provides facilities that serve a wide range of public uses, using the sewer and drainage services provided.

Table 1-3 External Stakeholders and Interests

Stakeholders	Interest
Sewer and Drainage Services Customers: • Residents • Industrial • Commercial • Institutional (including Royal Columbian Hospital, schools, etc.)	These end users rely on the sewer and drainage assets for their basic daily functions.
Metro Vancouver	Metro Vancouver provides wastewater treatment for the City and outlines regional regulations around municipal sewer and drainage. This AMP must consider the objectives of Metro Vancouver and the regional sewer and drainage goals.
Neighbouring Municipalities	This group may influence local decision-making and may depend on sewer and drainage assets within their communities.
Third Party Utilities	This group may present opportunity for coordination.
Developers	This group creates demand which contributes to upgrades or new sewer and drainage assets.
Provincial and Federal Government – e.g. Ministry of Environment, Department of Fisheries and Oceans	These groups enact and enforce legislation and regulations (e.g. environmental, health and safety) to be followed.

1.5 Alignment with Corporate Direction and Documents

The Sewer & Drainage AMP was prepared in alignment with existing corporate documents which provide guidance for the City as well as the relevant provincial legislation related to water services. **Table 1-4** describes how this AMP supports and relates to the City's corporate objectives.

General City objectives, mandate, and requirements are contained within the Community Charter, the Local Government Act, and various federal and provincial legislation. The SAMP identifies several additional objectives that have and will be considered in the development and execution of this AMP.

Table 1-4 Sewer & Drainage AMP Alignment with City's Corporate Objectives

Corporate Objectives	AMP Section Reference	Alignment Description
Regional Legislation[7]	Levels of Service, Asset Lifecycle Strategies	The Metro Vancouver Integrated Liquid Waste and Resource Management Plan identifies goals for the region and its member municipalities around liquid waste management, treatment, and related environmental protection and public health measures. It identifies a deadline of 2075 for municipalities in the Fraser Sewerage Area to separate combined sewers, with an average rate of 1.5% of the system to be separated per year.
City's Asset Management Strategy[8] (SAMP)	Entire document structure	The Sewer & Drainage AMP follows the guidance of the City's Asset Management Strategy, developed in 2019. The Strategy is commonly referenced as a "Strategic Asset Management Plan", abbreviated as "SAMP". The SAMP provides guidance on the following: 1. Specifics on how City objectives are translated into Asset Management Objectives; 2. Description on how they achieve the Asset Management Objectives (Roadmap); and 3. Information on AMP development standards to maintain consistency among City departments.
Corporate Asset Management Policy[9]	Entire document structure	This document sets principles for implementing consistent processes, approaches for asset management throughout the City.
Various Related Bylaws[10,11,12,13]	Financial Strategies, Levels of Service	The Development Cost Charges Bylaw provides an overview of development cost charges required from developers. These charges help fund sewer and drainage works. The Sewer System User Charge Bylaw imposes a charge for use of the municipal sewerage system. User charges make up the majority of reserve funds for sewer and drainage. The Sewerage and Drainage Regulation Bylaw details the scope of the municipal system and expectations around City services and standards. The Engineering Fees and Rates Bylaw establishes the fees and rates for services including but not limited to sewerage system user fees and rates.
2041 Official Community Plan[14] Last updated June 2020	Levels of Service, Asset Lifecycle Strategies	The OCP defines future development to the year 2041. The projected development is used to estimate the rate of lateral separation by developers.
2019-2022 Council Strategic Plan[15]	All	The Plan identifies a priority in implementing a "systematic asset management methodology to apply appropriate AM best practices across the organization". This document reflects the continued direction of the City to continue advancing asset management efforts for all City services.
Envision 2032 New	Levels of Service	The Envision Framework provides guiding principles and a detailed plan for sustainability initiatives moving forward. Relevant goals look at understanding and minimizing the impacts

[7] Integrated Liquid Waste and Resource Management, Metro Vancouver, 2010: http://www.metrovancouver.org/services/liquid-waste/LiquidWastePublications/IntegratedLiquidWasteResourceManagementPlan.pdf.
[8] Asset Management Strategy, 2019.
[9] Corporate Asset Management Policy, Version 1. Refer to **Appendix A** for the Policy.
[10] Development Cost Charges Bylaw No. 8327, 2022: https://www.newwestcity.ca/database/files/library/Development_Cost_Charges_Bylaw_No._8327_2022.pdf.
[11] Sewerage System User Charge Bylaw No. 4252, 1971: https://www.newwestcity.ca/database/files/library/4525_Sewerage.pdf.
[12] Sewerage and Drainage Regulation Bylaw No. 7746, 2015: https://www.newwestcity.ca/database/files/library/7746__Sewerage(1).pdf.
[13] Engineering Fees and Rates Bylaw 7553,2013: https://www.newwestcity.ca/database/files/library/7553_Engineering_User_Fees_and_Rates(4).pdf.
[14] The 2041 OCP can be found here: https://www.newwestcity.ca/ocp. PDF Page 146 describes Utilities and Services Infrastructure.
[15] The City's 2019-2022 Strategic Plan and Goals: https://www.newwestcity.ca/city_hall/mayor_and_council/strategic-plan

Corporate Objectives	AMP Section Reference	Alignment Description
Westminster's Sustainability Framework[16]		of human waste of sensitive ecosystems, which relates to the reduction of CSOs, and minimizing wastewater where possible.
Environmental Strategy & Action Plan[17]	Levels of Service, Asset Lifecycle Strategies	The plan identifies strategies and actions around sewer separation, reduction in CSOs, and sewer system monitoring using flow monitoring.
Integrated Stormwater Management Plan[18]	Levels of Service, Asset Lifecycle Strategies	The plan looks to incorporate green infrastructure into the drainage system in order to protect and improve water quality in the waterbodies surrounding New Westminster. This may become more relevant in future iterations of the AMP if natural assets are brought in scope.
Seven Bold Steps for Climate Action[19]	Asset Lifecycle Strategies	City Council has set out to achieve greenhouse gas reduction targets set out by the Intergovernmental Panel on Climate Change. A 2020 Climate Action Budgeting Framework has been adopted as well as steps to achieve this goal which include prioritizing climate emergency actions in work plans and embedding carbon pricing into decision-making. The Goals also include zero-emission heating and hot water systems and investment in a smart electrical grid. These goals should be considered in evaluating operational activities into the future.
Capital 5- and 10-Year Planning	Asset Lifecycle Strategies	Strategies for use of capital will inform Asset Lifecycle Strategies. Future capital plans will be developed based on guidance from the Sewer & Drainage AMP.
Maintenance Plans	Asset Lifecycle Strategies	A maintenance plan for sewer and drainage assets, including a resourcing review, was conducted in 2017. This will inform assumptions for resource requirements of operations and maintenance activities.
National Water & Wastewater Benchmarking Initiative (NWWBI)	Levels of Service	A Nation-wide initiative to collect, report, and compare LOS data from public organizations providing similar service. Refer to their website for further details (https://nationalbenchmarking.com/). LOS and key performance indicators (KPIs) developed for this AMP were aligned with KPIs required for the NWWBI.

1.6 Methodology

Methodology for development of the Sewer & Drainage AMP involves the following steps:

- Current and projected state of infrastructure analysis;
- Direction-setting and definition of LOS;
- Forecasting of capital investment needs and projection of operational implications;
- Identification of financial needs, funding sources, and the funding gaps;
- Overview of risks to be considered in asset management planning; and
- Defining improvement initiatives to be carried out following development of the AMP.

[16] Envision 2032: https://www.newwestcity.ca/database/files/library/Envision_2032_Sustainability_Framework_FINAL_web(1).pdf
[17] Environmental Strategy & Action Plan: https://www.newwestcity.ca/database/files/library/ESAPweb.pdf
[18] Integrated Stormwater Management Plan, 2017: https://www.newwestcity.ca/planning-building-and-development/projects-on-the-go/articles/5721.php
[19] Climate Emergency Goals https://www.newwestcity.ca/environment/climate-emergency

Specific methodology for these aspects is defined in subsequent chapters of this plan. Supporting methodology underlying the analysis is outlined in the State of Infrastructure Section. Development of inputs into each section of the AMP was supported through Workshops with the Sewer & Drainage AMP Working Group. Workshop results can be seen in **Appendix D**.

1.7 Plan Inputs and Data Reliability

Table 1-5 identifies the Data Reliability Grades on a 5-point scale as recommended in the SAMP. This provides definition of the reliability levels of each data source.

Table 1-5 Data Reliability Scale

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

Each data source and related section of the Sewer & Drainage AMP contains a data reliability scale which is identified in **Figure 1-1**.

Figure 1-1 Data Reliability Scale

RELIABILITY					
RANGE	5: UNKNOWN	4: VERY UNCERTAIN	3: UNCERTAIN	2: RELIABLE	1: HIGH RELIABILITY

It is expected that with each iteration of the AMP, the data confidence will improve due to development and implementation of the initiatives listed in the Sewer & Drainage AMP Improvement Plan.

The information collected and used in analysis in the Sewer & Drainage AMP is based on information available at the time of preparation which includes data that was collected from the following sources:

Table 1-6 Data Source Inventory and Reliability

Data Source	Reliability Grading	AMP Section Reference	Comments
2041 Official Community Plan (OCP)	1	Levels of Service	Policies 12.1 through 12.3, as outlined in **Section 3.1.1** of this document.
Environmental Strategy and Action Plan	1	Levels of Service	Goals 5 and 10, as outlined in Section 3.1.1 of this document.
Strategic Asset Management Plan (SAMP)	1	Entire Document	The SAMP guided the development of the Sewer & Drainage AMP including items such as objectives, LOS and risk framework, decision-making approach, stakeholder engagement, etc.
Maintenance Management System Pilot, 2017	1	Levels of Service Asset Lifecycle Strategies	Defines service goals and specific maintenance activities.
National Water and Wastewater Benchmarking Initiative (NWWBI)	1	Levels of Service	NWWBI Key Performance Indicators (KPIs) for Wastewater Utility & Collection and Stormwater were used to identify Technical Levels of Service (TLOS).
2015 Utility Master Plan	2	Levels of Service	Identifies recommendations for sewer separation projects in the City.
Point Asset GIS Data	3	State of Infrastructure	Inputs into the investment models.
Linear Asset GIS Data	2	State of Infrastructure	Inputs into the investment models.
AECOM Risk Model (2022)	2	Risk & Uncertainties	Provides criticality and risk scores for subset of assets.
Associated Engineering Pump Station Assessment Report (2023)	2	State of Infrastructure Asset Lifecycle Strategies	Provides pump station condition ratings and capital investment requirements.

2 STATE OF INFRASTRUCTURE

The State of Infrastructure provides an overview of the City's current in-scope assets according to the active asset records. This section details the:

- Asset inventory & statistics;
- Asset valuation;
- Asset age; and
- Asset condition.

The reliability of data sources used is provided as applicable.

2.1 Data Sources

2.1.1 Asset Inventory

The inventory used in this AMP is collected from GIS records and the AECOM Risk Model. Sewer and drainage assets are further separated into two primary categories: linear assets and point assets. Linear assets are comprised of mains, laterals (otherwise called services or service connections), and catch basin leads. Point assets are comprised of manholes, cleanouts, pump stations, chambers, and inlets. Data quality varies significantly by asset type. The asset inventory considers assets installed from the beginning of 1909 to the end of the 2022 calendar year, as available in GIS.

The reliability of the asset inventory data is detailed by asset type in **Section 2.3**.

2.1.2 Asset Values

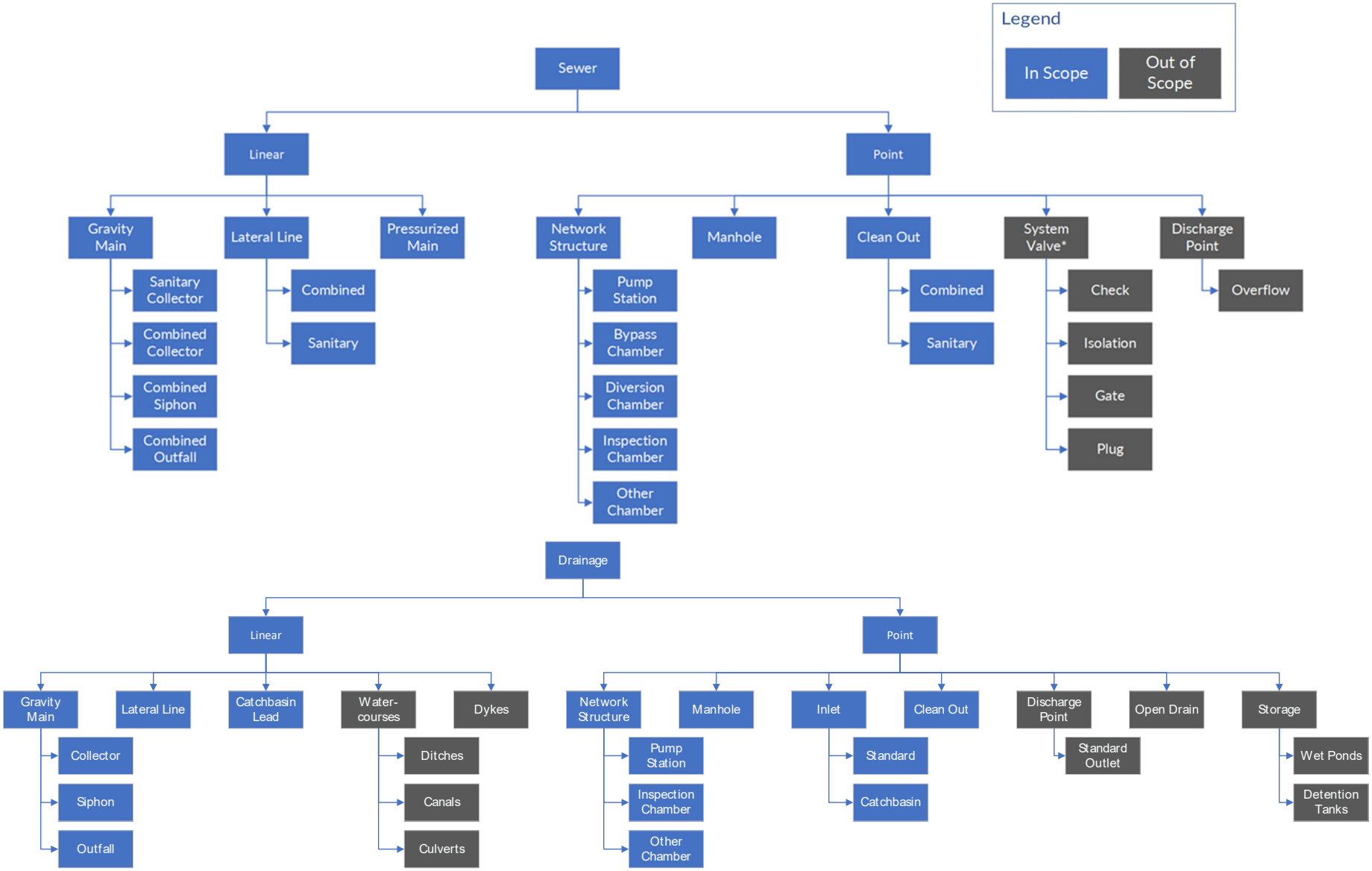
Asset values were determined using the asset inventory and asset replacement values developed by Associated and the City's Infrastructure Planning Group, as summarized in **Appendix B**. Tangible Capital Asset (TCA) records were not used in the State of Infrastructure Analysis, but as a reference point for the asset inventory. This is because, through review, it was determined that the values in the TCA records were not reflective of the total current replacement values of assets as they reflect the depreciated asset values. In the future, the City should ensure that current replacement value is used for capital renewal and replacement planning for the asset portfolio.

The reliability of asset values is detailed in **Section 2.4.**

2.2 Asset Hierarchy

The asset hierarchies for sewer and drainage assets are divided into linear and point assets and are shown in **Figure 2-1** below. The hierarchies were developed and confirmed in a workshop with the Sewer & Drainage AMP Working Group. Assets shown in grey are out of scope in this version of the AMP.

Figure 2-1 Sewer & Drainage Asset Hierarchies



**Costing for system valves was incorporated into the valuation of mains.*

2.3 Asset Inventory and Statistics

The complete asset inventory contains 25,055 active in-scope asset records, of which 14,070 are sewer assets (11,107 linear and 2,963 point) and 10,985 are drainage assets (5,024 linear and 5,961 point). **Table 2-1** provides an overview of the number of active asset records, current replacement value, and total length of the assets, data reliability and asset breakdown. Note that the current replacement values (CRVs) are detailed in **Section 2.4.**

Table 2-1 Asset Overview

Record Type	Asset Type	# of Assets	Length (km)	Asset Breakdown	Inventory Data Reliability	CRV ($ M)	CRV ($ M) Data Reliability
Linear - Sewer	Gravity Mains	3,076	191.3	44%	RELIABLE	403.6	UNCERTAIN
	Pressurized Mains	66	11.1		RELIABLE	16.5	UNCERTAIN
	Laterals	7,965	51.2		UNCERTAIN	170.5	UNCERTAIN
Point - Sewer	Manholes	2,871	-	12%	UNCERTAIN	19.6	UNCERTAIN
	Network Structures	49	-		RELIABLE	19.9	UNCERTAIN
	Clean Outs	43	-		VERY UNCERTAIN	0.2	UNCERTAIN
Linear - Drainage	Gravity Mains	1,876	91.6	20%	RELIABLE	182.5	UNCERTAIN
	Laterals	1,893	14.0		UNCERTAIN	45.9	UNCERTAIN
	Catch Basin Leads	1,255	7.6		VERY UNCERTAIN	7.6	UNCERTAIN
Point - Drainage	Manholes	1,620	-	24%	UNCERTAIN	11.1	UNCERTAIN
	Network Structures	8	-		HIGH RELIABILITY	31.1	UNCERTAIN
	Clean Outs	41	-		UNCERTAIN	0.2	UNCERTAIN
	Inlets	4,292	-		VERY UNCERTAIN	9.0	UNCERTAIN

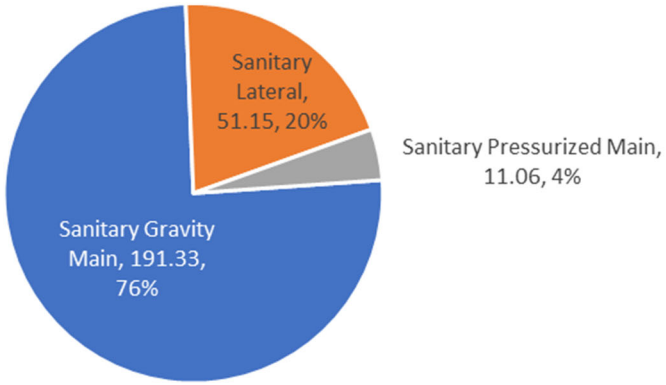
2.3.1 Sewer Assets

The in-scope sewer assets include linear assets (gravity mains, pressurized mains, laterals) and point assets (manholes, network structures (pump stations and chambers), and clean outs).

2.3.1.1 Linear Assets

Linear sewer assets include gravity mains, pressurized mains, and laterals. **Figure 2-2** shows the length of all linear sewer assets.

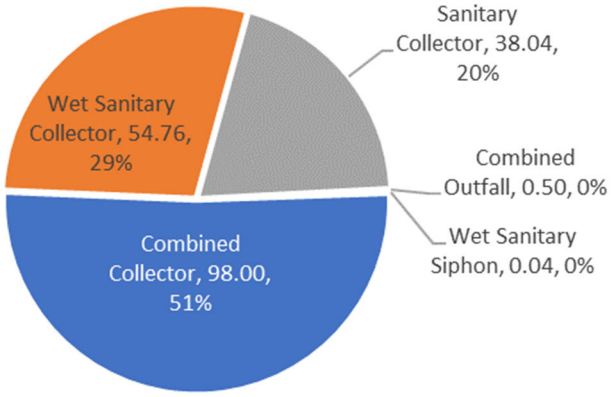
Figure 2-2 Linear Sewer Asset Lengths (km)



Gravity Mains

Gravity mains include collectors, siphons, and outfalls. These assets can be sanitary (only carry sewer waste), combined (carry both sewer and stormwater), or wet sanitary (formerly combined mains which have yet to be fully separated at all connections). Currently, the system consists of over 50% combined collectors. This is expected to decrease over time as the City continues with their Sewer Separation Program. Wet Sanitary and Sanitary Collectors make up 29% and 20% of the system respectively. There are significantly less siphons and outfalls in the system, with these assets making up less than 1% of the system each by length. **Figure 2-3** shows the lengths of gravity mains.

Figure 2-3 Sewer Gravity Main Lengths (km)



Sewer gravity main data reliability is rated reliable, as seen in **Figure 2-4**. There are minimal gaps in the asset attribute data that required estimation. Updates to data after asset rehabilitation or sewer separation are done in a way which requires some extrapolation and assumptions to assess. Details and recommendations for improvement are provided in **Section 7.4**.

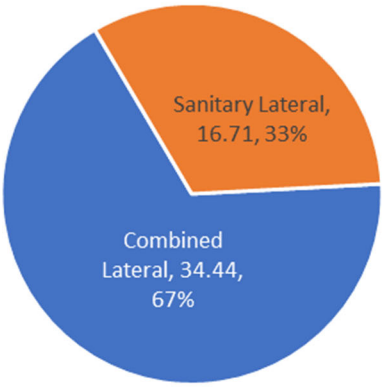
Figure 2-4 Sewer Gravity Main Data Reliability Scale

RELIABILITY				▼	
RANGE	UNKNOWN	VERY UNCERTAIN	UNCERTAIN	RELIABLE	HIGH RELIABILITY

Laterals

The sewer system contains both sanitary and combined laterals. Sanitary laterals carry only sewer waste, while combined laterals carry both sewer waste and stormwater. Currently, 67% of laterals are combined. **Figure 2-5** shows the breakdown of laterals in the sewer system.

Figure 2-5 Sewer Lateral Lengths (km)



Sewer lateral data reliability is rated uncertain, as seen in **Figure 2-6**, which is due to data gaps and uncertainty around lateral replacements completed by developers.

Figure 2-6 Sewer Lateral Materials

RELIABILITY			▼		
RANGE	UNKNOWN	VERY UNCERTAIN	UNCERTAIN	RELIABLE	HIGH RELIABILITY

Pressurized Mains

There are 11.06 km of pressurized mains in the sewer system. Sewer pressurized main data reliability is rated reliable, as seen in **Figure 2-7**, due to the minimal gaps in the data provided.

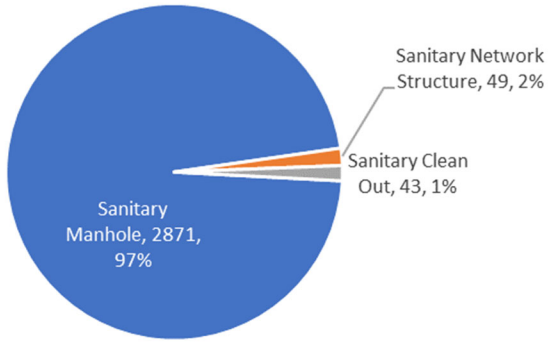
Figure 2-7 Sewer Pressurized Main Asset Data Reliability Scale

RELIABILITY				▼	
RANGE	UNKNOWN	VERY UNCERTAIN	UNCERTAIN	RELIABLE	HIGH RELIABILITY

2.3.1.2 Point Assets

Point sewer assets include manholes, network structures, and cleanouts. **Figure 2-8** shows the quantity of all point sewer assets.

Figure 2-8 Point Sewer Asset Quantities



Data on point asset characteristics is not comprehensive or complete, and point asset data is less well known than linear assets. For that reason, asset categories such as overflows, standard outlets, and open drains were excluded from the scope of this assessment. Suggestions on how to improve data on point assets are provided in **Section 7.6.2**.

Manholes

There are 2,871 sewer manholes in the system. Data on sewer manhole characteristics, like the depth or wall material, is not recorded for most entries. Data on asset installation dates is available from AECOM's Risk Model but needs to be integrated into the main GIS asset records. As a result, data reliability is rated as uncertain for sewer manholes, as seen in **Figure 2-9**.

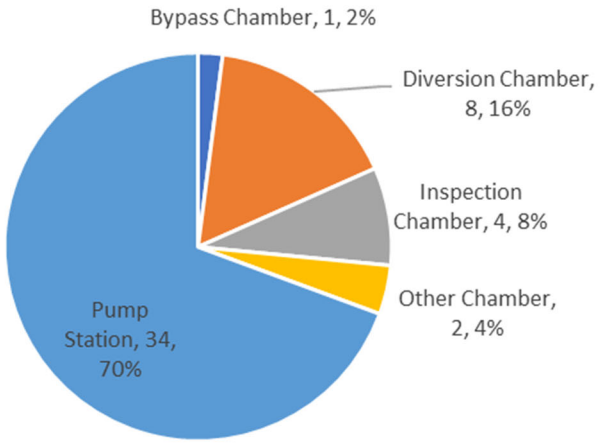
Figure 2-9 Sewer Manhole Asset Data Reliability Scale

RELIABILITY			▼		
RANGE	UNKNOWN	VERY UNCERTAIN	UNCERTAIN	RELIABLE	HIGH RELIABILITY

Network Structures

Sewer network structures consist of pump stations and bypass, diversion, inspection, and other chambers. By quantity, pump stations make up 70% of this asset category, with 34 sanitary pump stations in the City. Chambers make up the remaining 15 network structures. **Figure 2-10** shows the quantities of network structures.

Figure 2-10 Sewer Network Structure Quantities



Data on sewer network structures is reliable due to the complete datasets available for pump stations. Some gaps remain around the installation dates of certain chambers. Data reliability for sewer network structures is show in **Figure 2-11**.

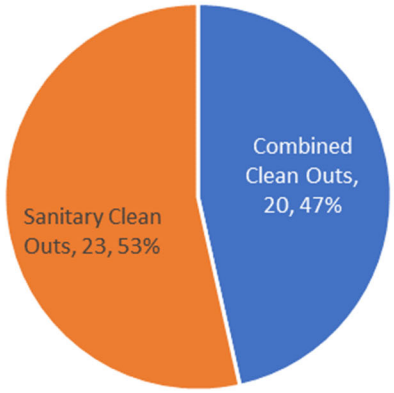
Figure 2-11 Sewer Network Structure Asset Data Reliability Scale

RELIABILITY				▼	
RANGE	UNKNOWN	VERY UNCERTAIN	UNCERTAIN	RELIABLE	HIGH RELIABILITY

Clean Outs

Clean outs are further categorized into sanitary and combined cleanouts. Sanitary clean outs provide access to sanitary laterals and combined cleanouts provide access to combined laterals. Of the 43 clean outs on record, 53% are sanitary and 47% are combined. **Figure 2-12** shows the quantities of clean outs.

Figure 2-12 Sewer Clean Out Quantities



Data on sewer clean outs is very uncertain, as very few installation dates are recorded. As a result, the average clean out age of those available was used as an estimation for the remaining ages. Data reliability for sewer clean outs is show in **Figure 2-13**.

Figure 2-13 Sewer Clean Out Asset Data Reliability Scale

RELIABILITY		▼			
RANGE	UNKNOWN	VERY UNCERTAIN	UNCERTAIN	RELIABLE	HIGH RELIABILITY

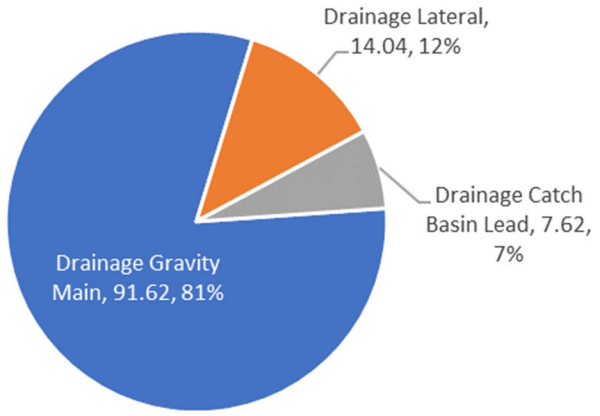
2.3.2 Drainage Assets

The in-scope drainage assets include gravity mains, laterals, catch basin leads, manholes, network structures (pump stations and chambers), clean outs, and inlets.

2.3.2.1 Linear Assets

Linear drainage assets include gravity mains, laterals, and catch basin leads. **Figure 2-14** shows the quantity of all linear drainage assets.

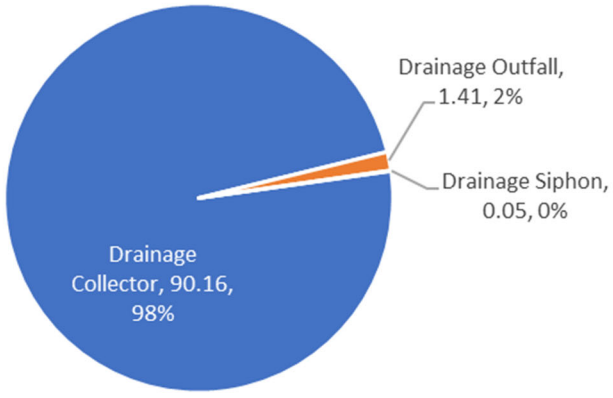
Figure 2-14 Linear Drainage Asset Lengths (km)



Gravity Mains

Gravity mains include collectors, siphons, and outfalls. Collectors make up 98% of mains by length at 90.16 km. There are 1.41 km of outfalls, making up around 2% of the system, while 0.05 km of siphons make up less than 1%.
Figure 2-15 shows the lengths of gravity mains.

Figure 2-15 Drainage Gravity Main Lengths (km)



Drainage gravity main data reliability is rated reliable due to the minimal gaps in the data provided, as seen in **Figure 2-16**.

Figure 2-16 Drainage Gravity Main Asset Data Reliability Scale

RELIABILITY				▼	
RANGE	UNKNOWN	VERY UNCERTAIN	UNCERTAIN	RELIABLE	HIGH RELIABILITY

Laterals

There are 14.04 km of laterals in the drainage system. Drainage lateral data reliability is rated uncertain, as seen in **Figure 2-17**, due to data gaps and uncertainty around lateral replacements completed by developers.

Figure 2-17 Drainage Lateral Asset Data Confidence Scale

RELIABILITY			▼		
RANGE	UNKNOWN	VERY UNCERTAIN	UNCERTAIN	RELIABLE	HIGH RELIABILITY

Catch Basin Leads

There are 7.62 km of catch basin leads in the drainage system, which connect catch basins to the drainage system. Drainage catch basin lead data reliability is rated very uncertain, as seen in **Figure 2-18**, due to the large number of unknowns in the asset data. Additionally, there are only 1,255 catch basin lead records, but 4,160 catch basin records, which indicates that the dataset is likely incomplete.

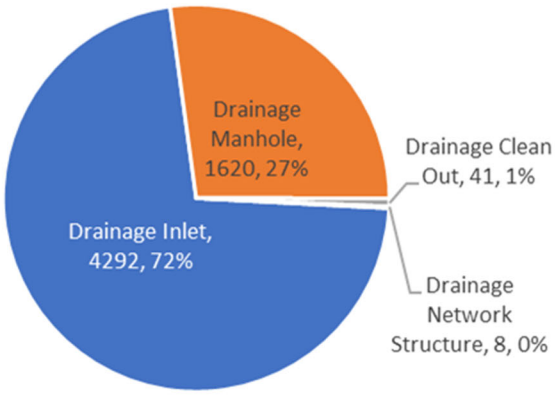
Figure 2-18 Drainage Catch Basin Asset Data Confidence Scale

RELIABILITY		▼			
RANGE	UNKNOWN	VERY UNCERTAIN	UNCERTAIN	RELIABLE	HIGH RELIABILITY

2.3.2.2 Point Assets

Point drainage assets include manholes, network structures, cleanouts, and inlets. **Figure 2-19** shows the quantities of all point drainage assets.

Figure 2-19 Point Drainage Asset Quantities



Data on point asset characteristics is not comprehensive or complete, and, point asset data is less well known than linear assets. For that reason, asset categories such as overflows, standard outlets, and open drains were excluded from the scope of this assessment.

Manholes

There are 1,620 drainage manholes in the system. Data on drainage manhole characteristics, like the depth or wall material, is not recorded for most entries. Data on asset installation dates is available from AECOM's Risk Model but needs to be integrated into the main GIS asset records. As a result, data reliability is rated as uncertain for drainage manholes, as seen in **Figure 2-20**.

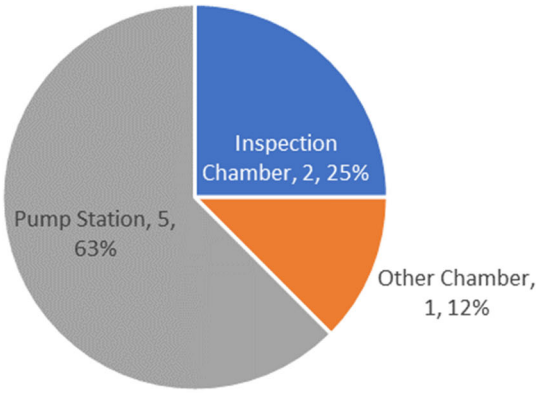
Figure 2-20 Drainage Manhole Asset Data Reliability Scale

RELIABILITY			▼		
RANGE	UNKNOWN	VERY UNCERTAIN	UNCERTAIN	RELIABLE	HIGH RELIABILITY

Network Structures

Drainage network structures consist of pump stations and inspection chambers, and other chambers. By quantity, pump stations make up 63% of this asset category, with five drainage pump stations in the City. Chambers make up the remaining three network structures. **Figure 2-21** shows the quantities of network structures.

Figure 2-21 Drainage Network Structure Quantities



Data on drainage network structures is very reliable due to the complete datasets available for pump stations and chambers. Data reliability for sewer network structures is show in **Figure 2-22**.

Figure 2-22 Drainage Network Structure Asset Data Reliability Scale

RELIABILITY					▼
RANGE	UNKNOWN	VERY UNCERTAIN	UNCERTAIN	RELIABLE	HIGH RELIABILITY

Clean Outs

There are 41 drainage clean outs in the system. Data on drainage clean outs is uncertain, as approximately half of the installation dates are unknown. The average clean out age of those available was used as an estimation for the remaining ages. Data reliability for drainage clean outs is show in **Figure 2-23**.

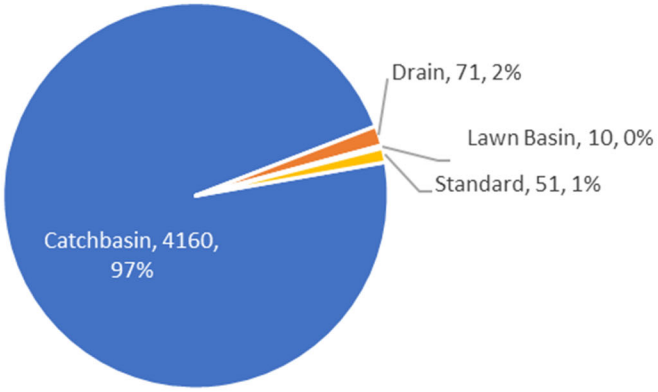
Figure 2-23 Drainage Clean Out Asset Data Reliability Scale

RELIABILITY			▼		
RANGE	UNKNOWN	VERY UNCERTAIN	UNCERTAIN	RELIABLE	HIGH RELIABILITY

Inlets

Inlets include catch basins, drains, lawn basins, and standard inlets. 97% of inlets are catch basins, 2% are drains, 1% are standard inlets, and less than 1% are lawn basins. **Figure 2-24** shows the quantities of inlets.

Figure 2-24 Drainage Inlet Quantities



Data on drainage inlets is very uncertain, as most installation dates are unknown. The average inlet age of those available was used as an estimation for the remaining ages. Data reliability for drainage inlets is show in **Figure 2-25**.

Figure 2-25 Drainage Inlet Asset Data Reliability Scale

RELIABILITY		▼			
RANGE	UNKNOWN	VERY UNCERTAIN	UNCERTAIN	RELIABLE	HIGH RELIABILITY

2.4 Asset Valuation

Asset replacement values were determined using the asset inventory and unit replacement values developed by Associated and the City's Infrastructure Planning Group, as summarized in **Appendix B**. Replacement values were developed by Associated and the City's Infrastructure Planning Group through a review of CRVs referenced in the AECOM Risk Model, past capital works completed by the City, and tender information from Associated. Where data gaps existed, such as unknown pipe diameters, the unit replacement value for the most common pipe size was used. These unit costs are used to provide a high-level strategic estimate of the replacement values for the assets in the portfolio.

The total replacement value of the portfolio is $918 million. Linear assets make up the vast majority of the asset portfolio at $827 million, in comparison to point assets at $91 million. **Figures 2-26** illustrates the value of the asset portfolio.

Figure 2-26 Replacement Value of Linear and Point Sewer and Drainage Records ($M)

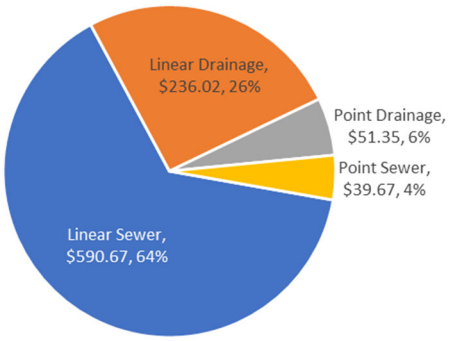


Figure 2-27 illustrates the data reliability has been assessed as "uncertain" for unit costs across all assets. Replacement values are estimated using unit costs and comparable past projects and are assumed to provide a Class 5 (strategic planning level) estimate of -25% to +50% (AACE 18R-97).

Figure 2-27 Asset Valuation Confidence Scale

RELIABILITY			▼		
RANGE	5: UNKNOWN	4: VERY UNCERTAIN	3: UNCERTAIN	2: RELIABLE	1: HIGH RELIABILITY

2.4.1 Asset Valuation Assumptions

Asset valuation is derived based on the unit rates defined in **Appendix B**. CRVs were developed by Associated and the City's Infrastructure Planning Group through a review of CRVs referenced in the AECOM Risk Model, past capital works completed by the City, and tender information from Associated.

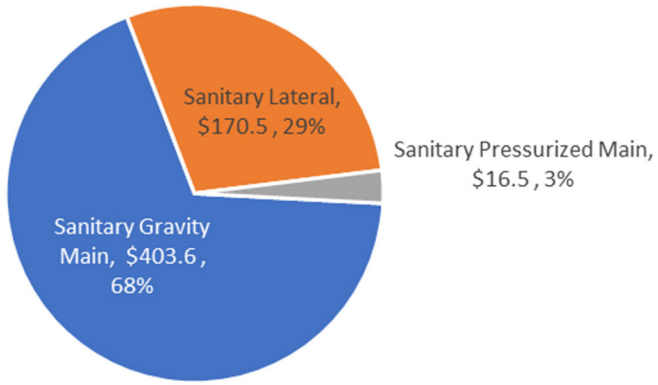
2.4.2 Sewer Assets

Sewer assets have a total value of $630.4M. The breakdown of replacement values is shown in **Table 2-1**.

2.4.2.1 Linear Assets

Linear sewer assets have a total value of $590.7M and make up 64% of the overall asset inventory by replacement value. Gravity mains make up the majority of this value at 68%, followed by laterals at 29%. Pressurized mains make up only 3% of the portfolio value. **Figure 2-28** shows the breakdown of asset values.

Figure 2-28 Linear Sewer Asset Replacement Value ($M)



Gravity Mains

The replacement value of gravity mains in the system is $403.6M. Combined collectors account for the majority of the value at 54%, followed by wet sanitary collectors at 32% and sanitary collectors at 13%. Outfalls and siphons make up the remainder of the linear sewer asset value. The City has gravity mains of different sizes and materials. There are currently 22 different diameters and 13 different materials on record, with 200 mm being the most common diameter and vitrified clay (VC) being the most common material used. There are some gaps in the inventory data, with approximately $0.22M worth of gravity mains having unknown diameters and $1.19M worth of gravity mains having unknown materials. Diameter and material information helps inform the replacement costs of linear assets with greater accuracy, where assets with unknown diameters or materials have less certainty in their replacement values. Where sizes or materials were unknown, the most common size/material within the asset type was assumed to get the unit cost. Filling these data gaps will help to improve data reliability in the future. **Figures 2-29** and **2-30** show the breakdown of main diameters and materials by CRV.

Figure 2-29 Sewer Gravity Main Diameters by CRV ($M)

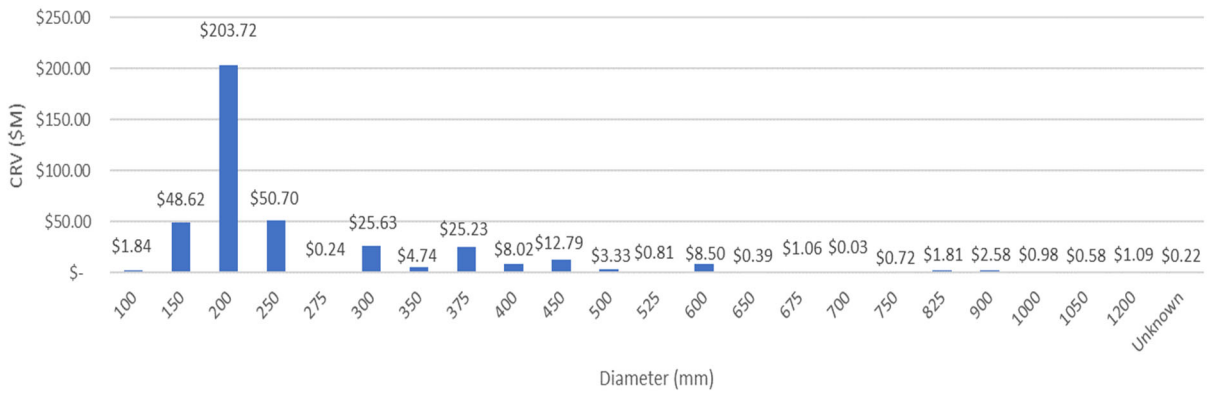


Figure 2-30 Sewer Gravity Main Materials by CRV ($M)

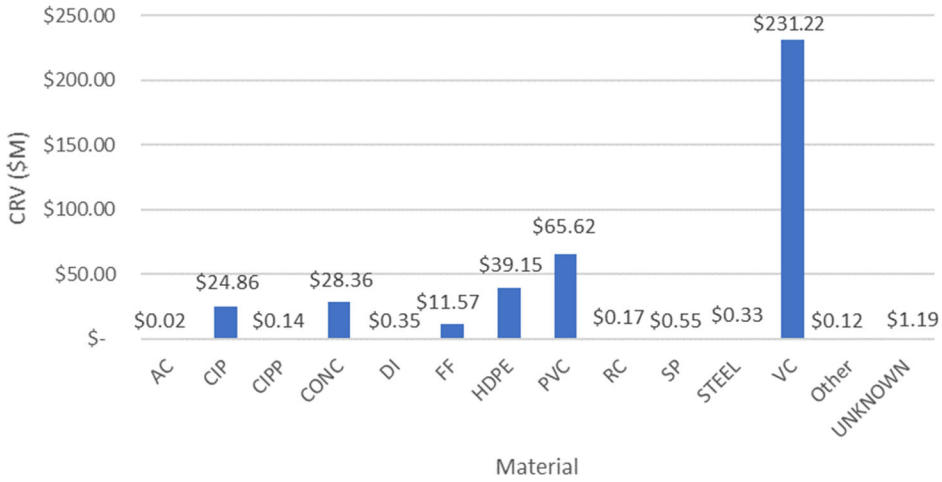
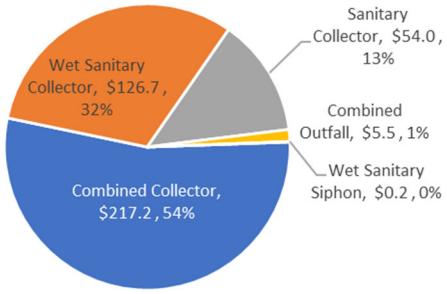


Figure 2-31 shows the replacement values.

Figure 2-31 Sewer Gravity Main Replacement Values ($M)



Laterals

Sewer laterals have a total replacement value of $170.5M. Of this, 67% comes from combined laterals and 33% comes from sanitary laterals. The City has laterals of different sizes and materials. Based on the data in GIS, there are currently six different diameters and four different materials on record, with 100 mm being the most common diameter and polyvinyl chloride (PVC) being the most common material used. There are some gaps in the inventory data, with approximately $3.77M worth of laterals having unknown diameters and $30.22M worth of laterals having unknown materials. Diameter and material information helps inform the replacement costs of linear assets with greater accuracy, where assets with unknown diameters or materials have less certainty in their replacement values. Where sizes or materials were unknown, the most common size/material within the asset type was assumed to get the unit cost. Filling these data gaps will help to improve data reliability in the future. **Figures 2-32** and **2-33** show the breakdown of lateral diameters and materials by CRV.

Figure 2-32 Sewer Lateral Diameters by CRV ($M)

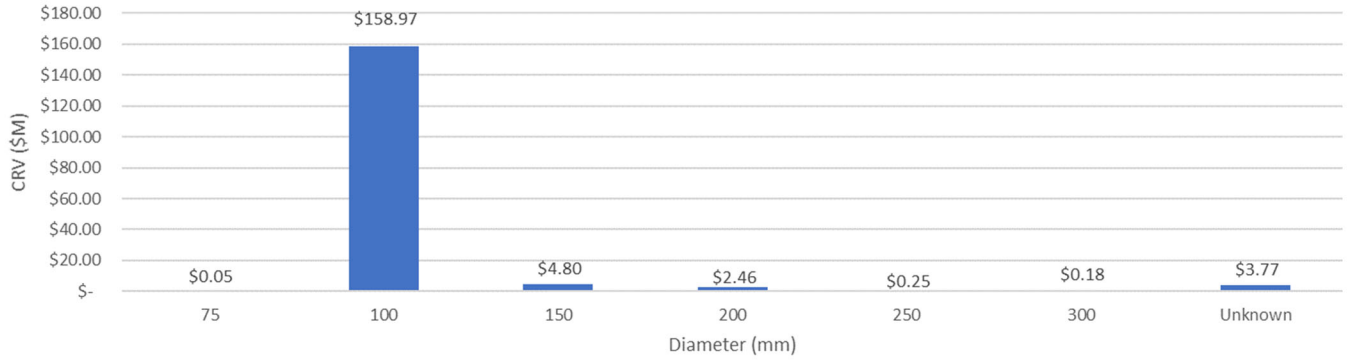


Figure 2-33 Sewer Lateral Materials by CRV ($M)

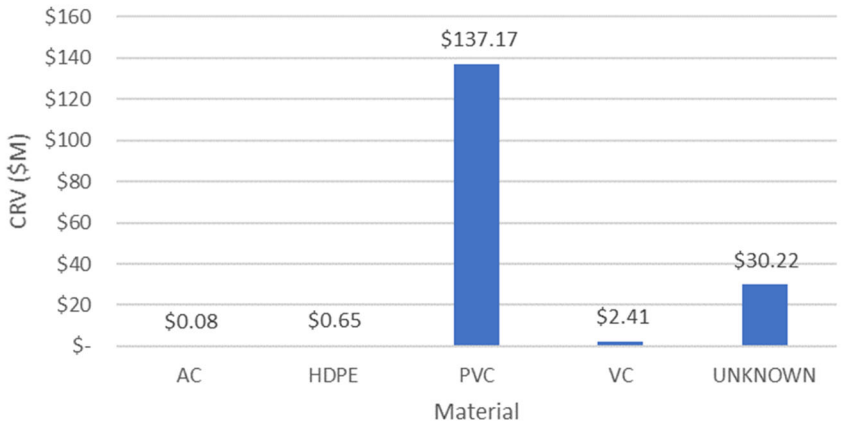
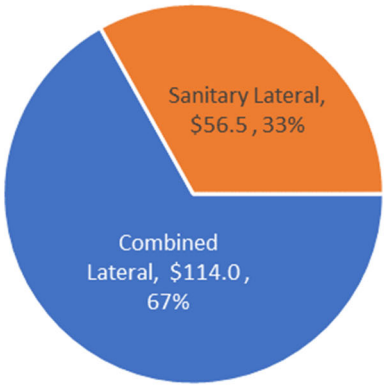


Figure 2-34 shows the breakdown of lateral replacement values

Figure 2-34 Sewer Lateral Replacement Values ($M)



Pressurized Mains

Pressurized mains have a total replacement value of $16.5M. The City has pressurized mains of various sizes and materials. There are currently four different diameters and four different materials on record, with 200 mm being the most common diameter and high-density polyethylene (HDPE) being the most common material used. There are some gaps in the inventory data, with approximately $0.28M worth of pressurized mains having unknown diameters and $0.70M worth of pressurized mains having unknown materials. Diameter and material information helps inform the replacement costs of linear assets with greater accuracy, where assets with unknown diameters or materials have less certainty in their replacement values. Where sizes or materials were unknown, the most common size/material within the asset type was assumed to get the unit cost. Filling these data gaps will help to improve data reliability in the future. **Figures 2-35** and **2-36** show the breakdown of main diameters and materials by CRV.

Figure 2-35 Sewer Pressurized Main Diameters by CRV ($M)

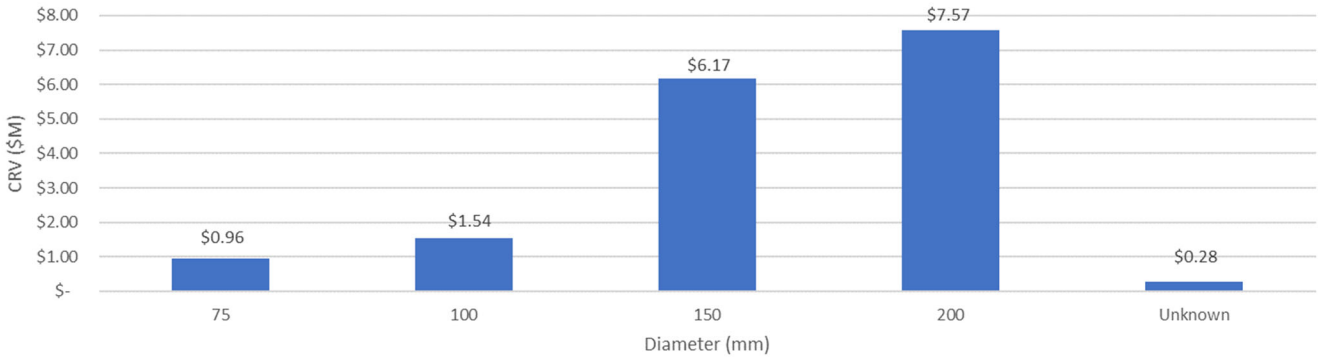
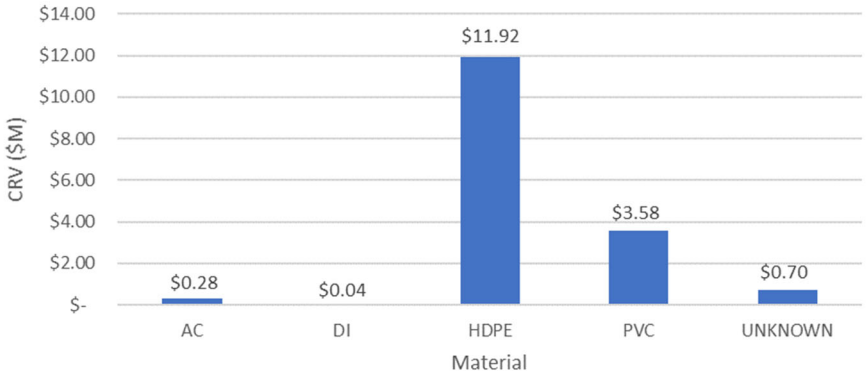


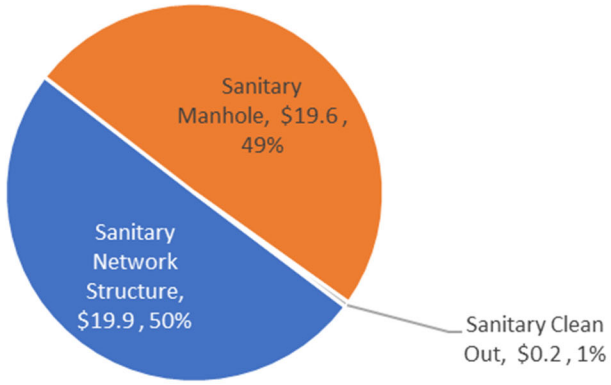
Figure 2-36 Sewer Pressurized Main Materials by CRV ($M)



2.4.2.2 Point Assets

Point sewer assets have a total replacement value of $39.7M and make up 4% of the overall asset inventory by replacement value. The replacement value of point assets is closely distributed between manholes and network structures, at about 50% each. Clean outs make up less than 1% of the overall value. **Figure 2-37** shows the breakdown of asset replacement values.

Figure 2-37 Point Sewer Asset Replacement Values ($M)



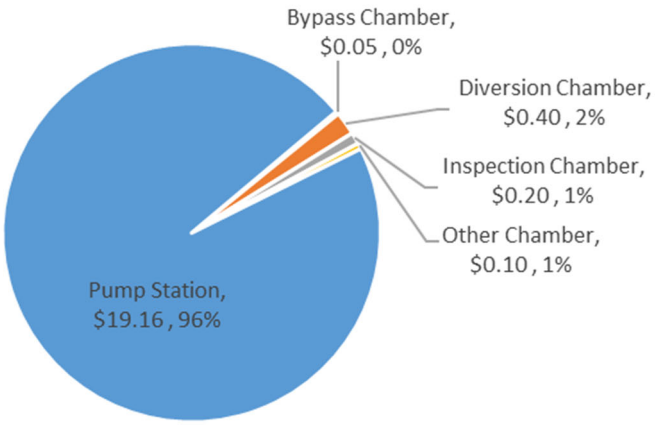
Manholes

Sewer manholes have a total replacement value of $19.6M. Due to data gaps around material type and size, a single unit price was applied to each manhole.

Network Structures

Sewer network structures have a total replacement value of $19.8M. Pump stations account for 96% of this value, or $19.2M. Bypass, diversion, inspection, and other chambers make up the remaining 3%. **Figure 2-38** shows the breakdown of sewer network structure replacement values.

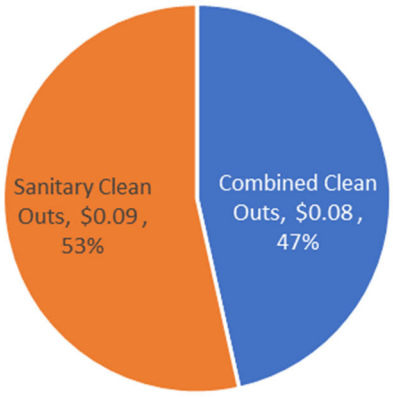
Figure 2-38 Sewer Network Structure Replacement Values ($M)



Clean Outs

Clean outs have a total replacement value of $0.2M. Sanitary clean outs account for 53% of the value and combined clean outs account for the remaining 47%. **Figure 2-39** shows the breakdown of clean out replacement values.

Figure 2-39 Sewer Clean Out Replacement Values ($M)



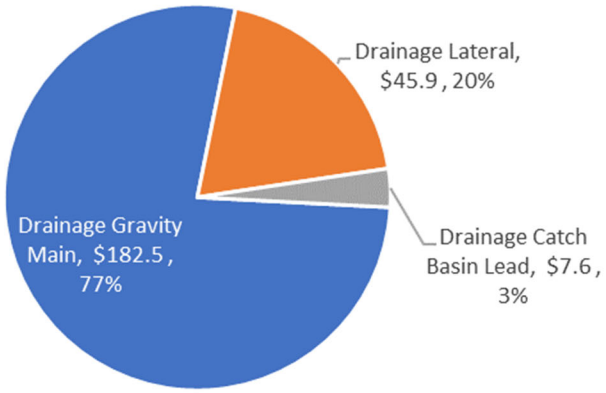
2.4.3 Drainage Assets

Drainage assets have a total replacement value of $287.4M. The breakdown of replacement values is shown in **Table 2-1**.

2.4.3.1 Linear Assets

Linear drainage assets have a total value of $236.3M and make up 26% of the overall asset inventory by replacement value. Gravity mains make up the majority of this value at 77%, followed by laterals at 20%. Catch basin leads make up only 3% of the portfolio value. **Figure 2-40** shows the breakdown of asset values.

Figure 2-40 Linear Drainage Asset Replacement Values ($M)



Gravity Mains

Drainage gravity mains have a total replacement value of $182.5M. Drainage collectors make up the majority of this value at 94%, while outfalls make up 6%. Siphons account for less than 1% of the replacement value. The City has gravity mains of different sizes and materials. There are currently 26 different diameters and 11 different materials on record, with 250 mm being the most common diameter and PVC being the most common material used. There are some gaps in the inventory data, with approximately $2.35M worth of gravity mains having unknown diameters and $5.67M worth of gravity mains having unknown materials. Diameter and material information helps inform the replacement costs of linear assets with greater accuracy, where assets with unknown diameters or materials have less certainty in their replacement values. Where sizes or materials were unknown, the most common size/material within the asset type was assumed to get the unit cost. Filling these data gaps will help to improve data reliability in the future. **Figures 2-41** and **2-42** show the breakdown of main diameters and materials by CRV.

Figure 2-41 Drainage Gravity Main Diameters by CRV ($M)

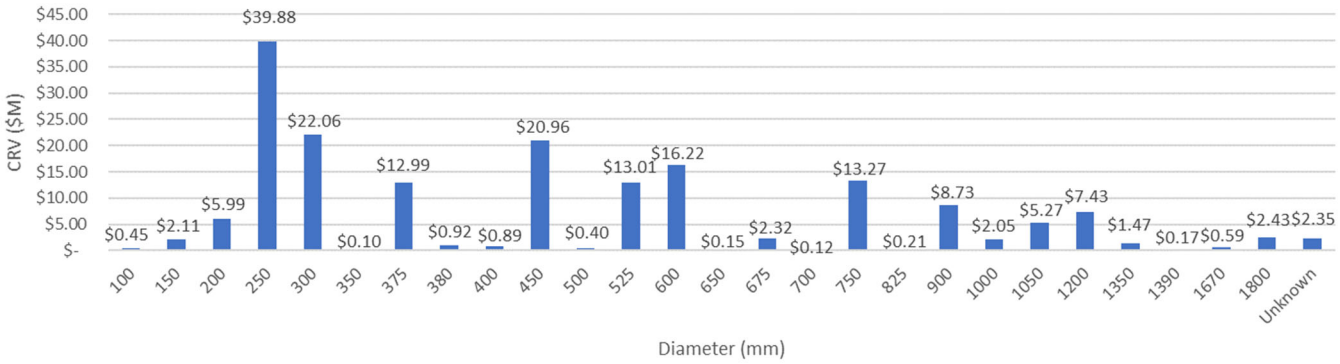


Figure 2-42 Drainage Gravity Main Materials by CRV ($M)

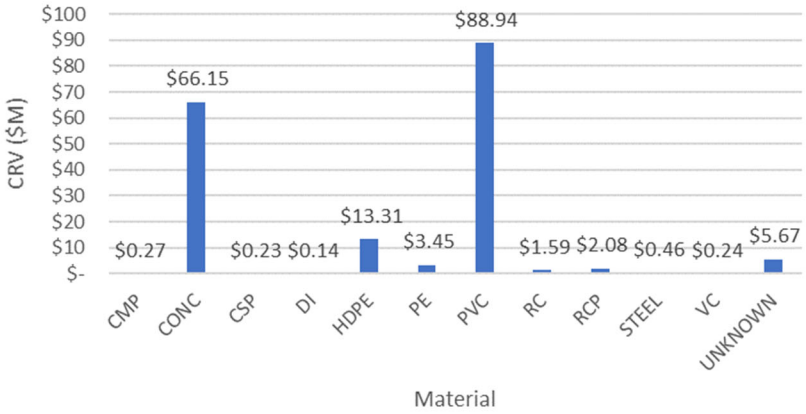
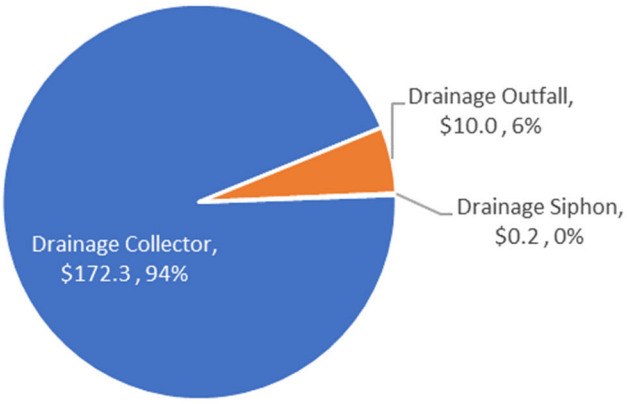


Figure 2-43 shows a breakdown of the gravity main replacement values.

Figure 2-43 Drainage Gravity Main Replacement Values ($M)



Laterals

Drainage laterals have a total replacement value of $45.9M. The City's laterals come in different sizes and materials. There are currently nine different diameters and four different materials on record, with 100 mm being the most common diameter and PVC being the most common material used. There are some gaps in the inventory data, with approximately $0.52M worth of laterals having unknown diameters and $12.38M worth of laterals having unknown materials. Diameter and material information helps inform the replacement costs of linear assets. Where sizes or materials were unknown, the most common size/material within the asset type was assumed to get the unit cost. Filling these data gaps will help to improve data reliability in the future. **Figures 2-44** and **2-45** show the breakdown of lateral diameters and materials by CRV.

Figure 2-44 Drainage Lateral Materials by CRV ($M)

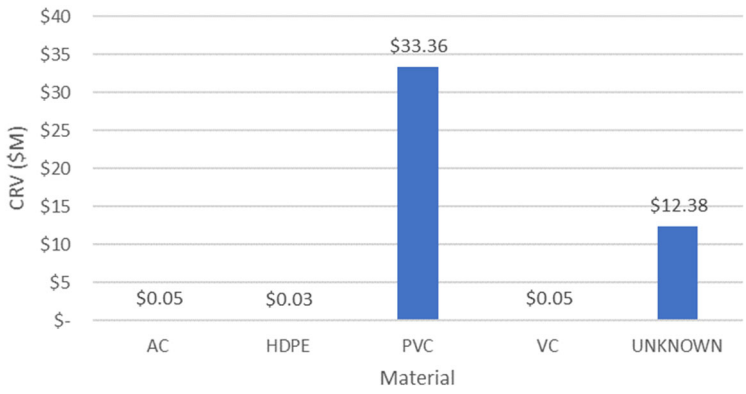
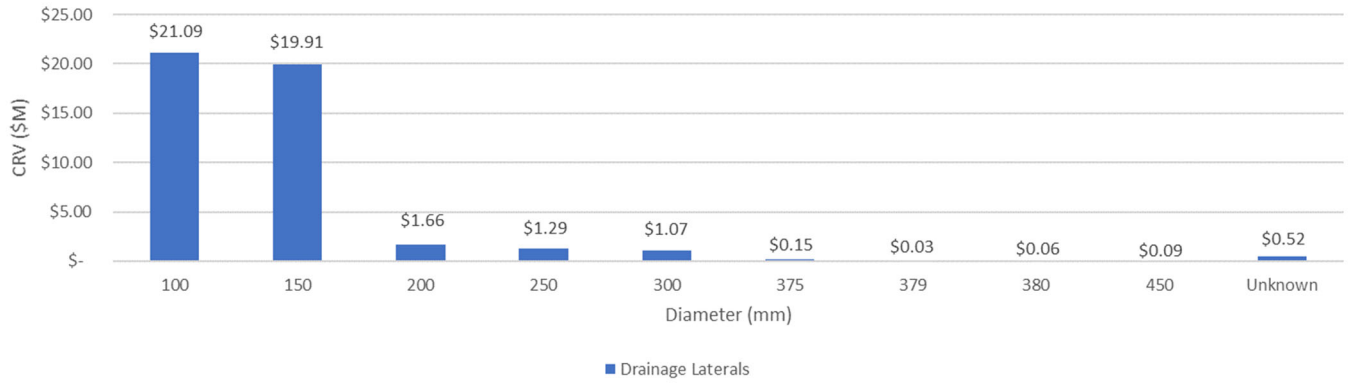


Figure 2-45 Drainage Lateral Diameters by CRV ($M)



Catch Basin Leads

Catch basin leads have a total replacement value of $7.6M. The City's catch basin leads come in different sizes and materials. There are currently four different diameters and one material on record, with 150 mm being the most common diameter and PVC being the most common material used. There are some gaps in the inventory data, with approximately $3.26M worth of leads having unknown diameters and $7.53M worth of leads having unknown materials. Diameter and material information helps inform the replacement costs of linear assets with greater accuracy, where assets with unknown diameters or materials have less certainty in their replacement values. Where sizes or materials were unknown, the most common size/material within the asset type was assumed to get the unit cost. Filling these data gaps will help to improve data reliability in the future. **Figures 2-46** and **2-47** show the breakdown of lead diameters and materials by CRV.

Figure 2-46 Drainage Catch Basin Lead Diameters by CRV ($M)

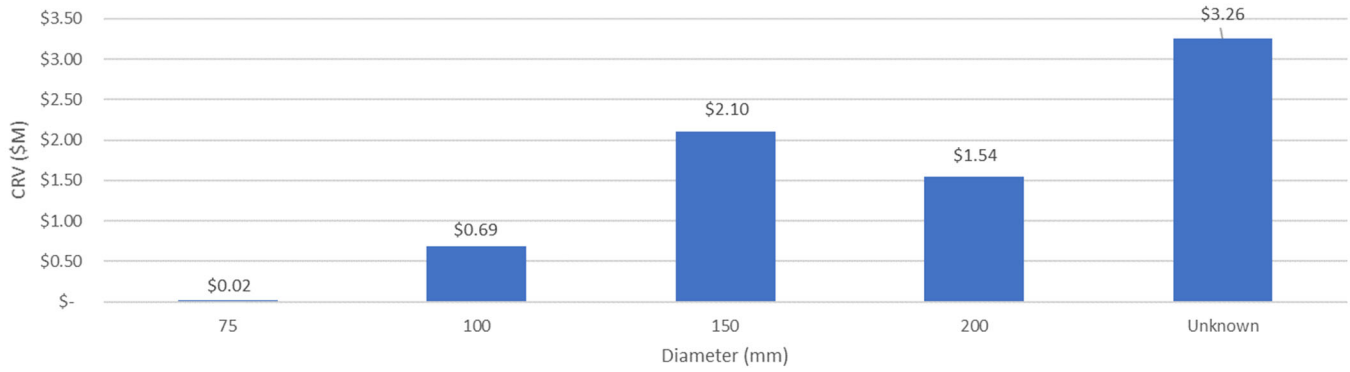
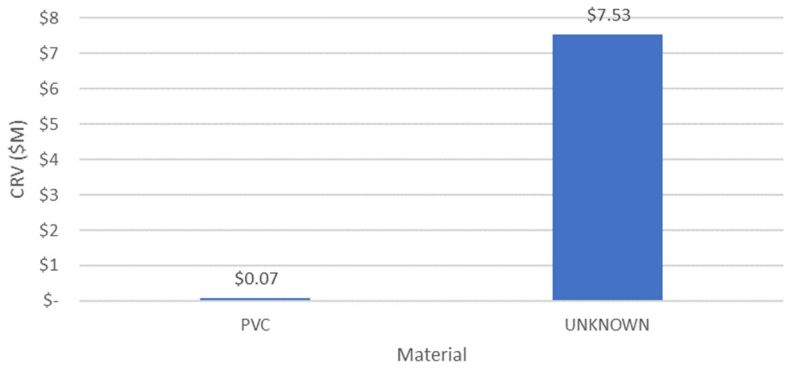


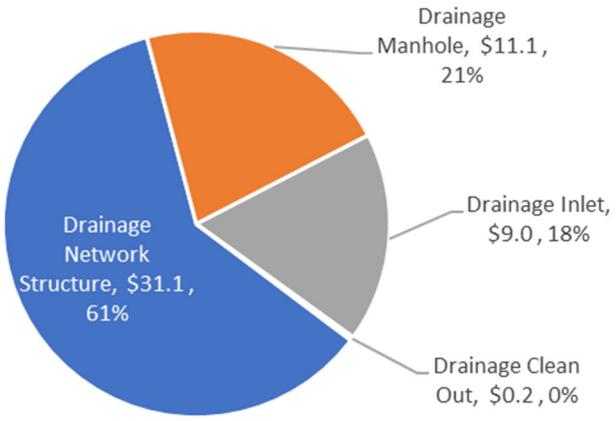
Figure 2-47 Drainage Catch Basin Lead Materials by CRV ($M)



2.4.3.2 Point Assets

Point drainage assets have a total value of $51.4M and make up 6% of the overall asset inventory by replacement value. Network structures make up the majority of this value at 61%, followed by manholes and inlets at 21% and 19% respectively. Clean outs make up less than 1% of the overall replacement value. **Figure 2-48** shows the breakdown of point drainage asset replacement values.

Figure 2-48 Point Drainage Asset Replacement Values ($M)



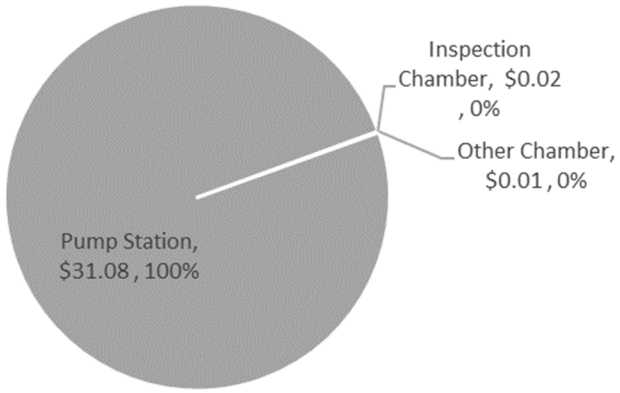
Manholes

Drainage manholes have a total replacement value of $11.1M. Due to gaps in data around sizing and material types, a singular unit value was applied to each manhole.

Network Structures

Drainage network structures have a total replacement value of $31.1M. Nearly 100% of this value is attributed to pump stations, while chambers make up less than 1%. **Figure 2-49** breaks down the total replacement value of drainage network structures.

Figure 2-49 Drainage Network Structure Replacement Values ($M)



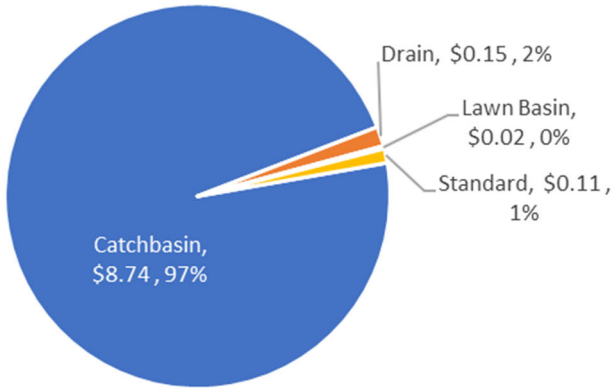
Clean Outs

Drainage clean outs have a total replacement value of $0.2M.

Inlets

Drainage inlets have a total replacement value of $9.0M. Catch basins make up the majority of this value, at 97%. Drains, standard inlets, and lawn basins make up the remaining 3%. **Figure 2-50** breaks down the total replacement value of drainage inlets.

Figure 2-50 Drainage Inlet Replacement Values ($M)



2.5 Asset Age

Asset age was determine based on installation dates in the data sets. Installation date data was considered in the asset data reliability scores provided in **Section 2.3**.

2.5.1 Asset Age Assumptions

Where available, the asset age used in the AECOM Risk Model was used. If unavailable, the installation date in the City's GIS database was referenced. For mains, if there was no asset age outlined in the risk model or GIS database, the age of the nearest manhole was used. Finally, for any outstanding age data requirements, the average age of the asset type based on available data was used. Details on ESL by asset type and material are provided in **Appendix B**.

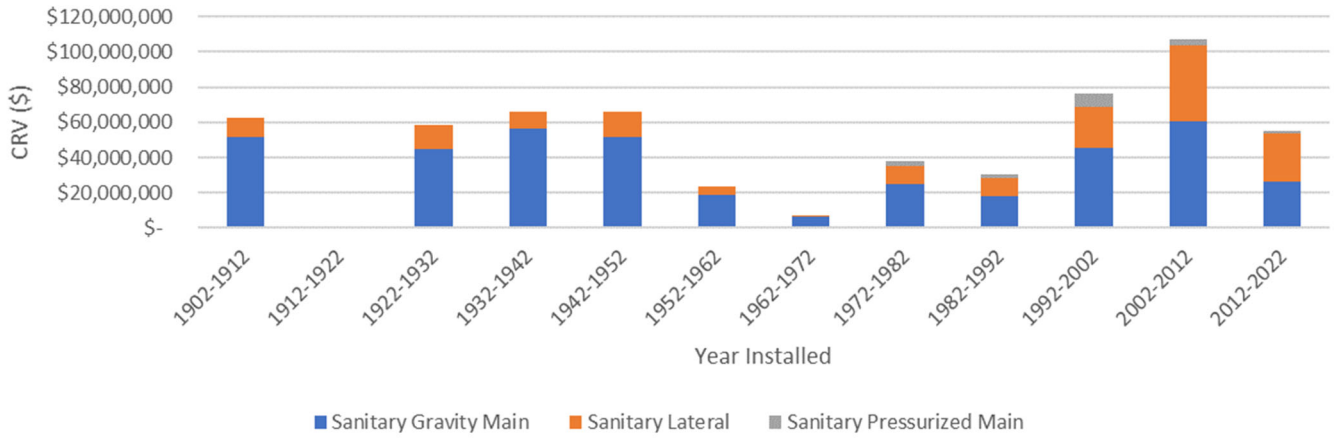
2.5.2 Sewer Assets

The installation dates of linear and point sewer assets were reviewed. Profiles are shown below.

2.5.2.1 Linear Assets

Linear sewer assets were installed beginning in the early 1900s, with periods of minimal to no recorded construction between 1912-1922 and 1962-1972. An installation profile is shown in **Figure 2-51**.

Figure 2-51 Linear Sewer Infrastructure Installation Dates by CRV ($)



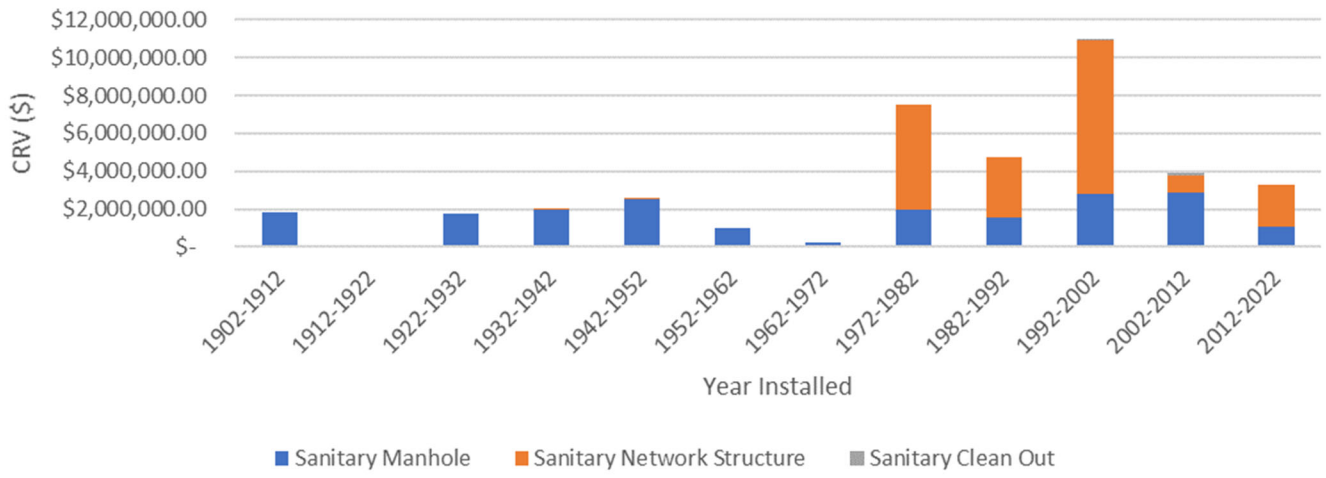
As evident in the profile, several linear assets were installed prior to 1962. With the typical estimated service life (ESL) of linear assets being around 80 years, this indicates that a number of assets are either past their ESL (backlog) or will be up for renewal within the next 20 years. The relatively steady rate of installation indicates that renewals will come up at a steady rate once the backlog is addressed.

Note that installation date can help estimate service life of an asset, but inspection (i.e. through CCTV) will give a better indication of condition and remaining service life.

2.5.2.2 Point Assets

Point sewer assets were installed beginning in the early 1900s, with periods of minimal to no recorded construction between 1912-1922 and 1962-1972. An installation profile is shown in **Figure 2-52**.

Figure 2-52 Point Sewer Infrastructure Installation Dates by CRV ($)



As evident in the profile, most of the asset value in this portfolio (network structures) was installed between 1972-2022. As pump stations have an ESL of 60 years, this indicates that there is no immediate need to replace pump station assets. However, there are several manholes which are past their ESL which contribute to the backlog.

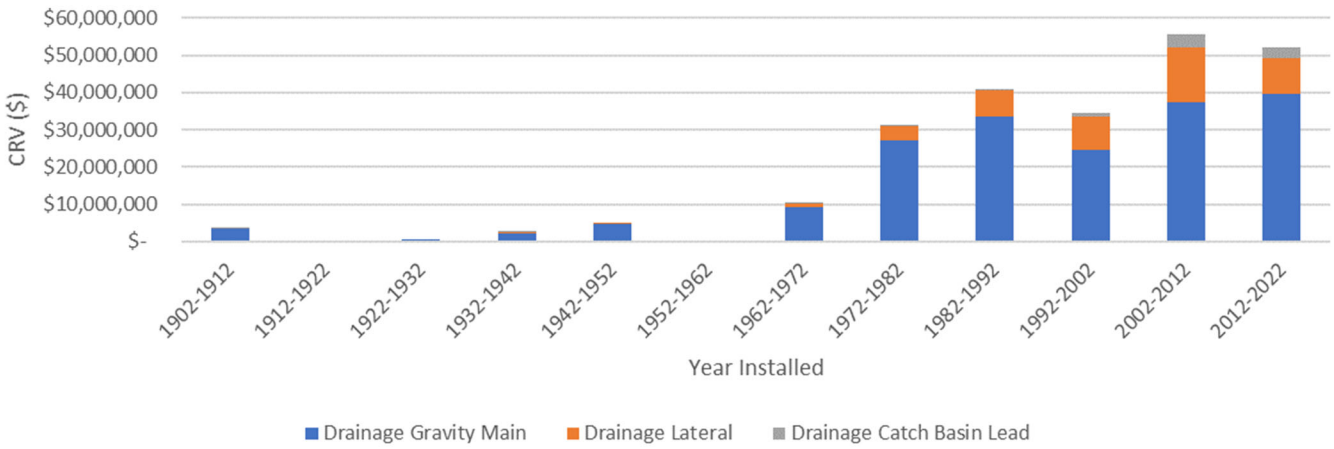
2.5.3 Drainage Assets

The installation dates of linear and point drainage assets were reviewed. Profiles are shown below.

2.5.3.1 Linear Assets

Linear drainage assets were installed beginning in the early 1900s, with the majority of construction occurring after 1962. An installation profile is shown in **Figure 2-53**.

Figure 2-53 Linear Drainage Infrastructure Installation Dates by CRV ($)

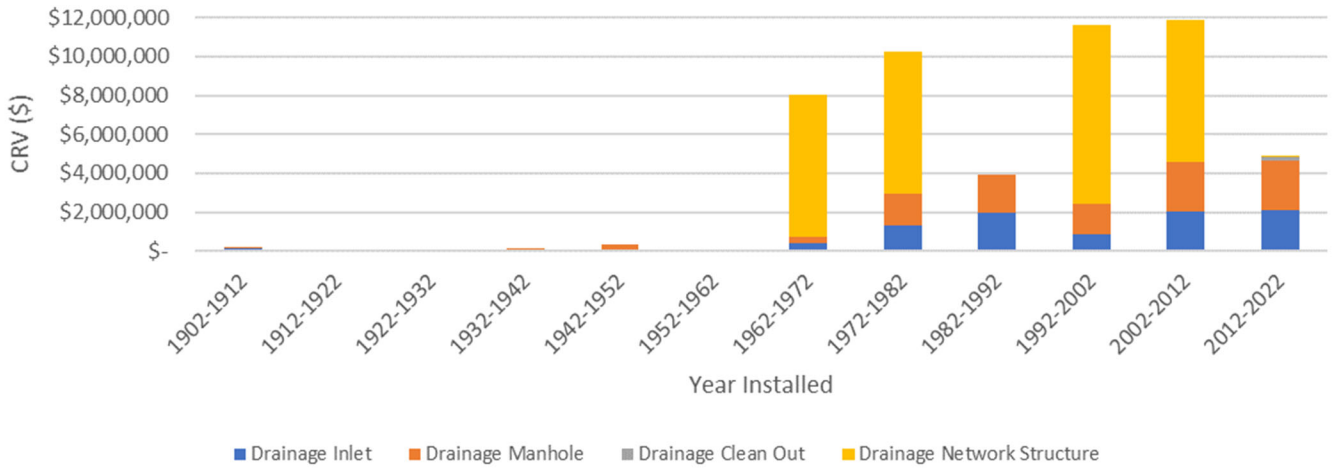


The installation profile indicates that linear drainage infrastructure is relatively new to the City in comparison to equivalent sewer assets. Some gravity mains were constructed over 80 years ago and will contribute to the renewal backlog according to their ESL and age-based condition. However, most gravity mains, along with laterals and catch basin leads, are newer assets and will not reach their ESL for a number of years.

2.5.3.2 Point Assets

Point drainage assets were installed beginning in the early 1900s, with the majority of construction occurring after 1962. An installation profile is shown in **Figure 2-54**.

Figure 2-54 Point Drainage Infrastructure Installation Dates by CRV ($)



The installation profile indicates that point drainage infrastructure is relatively new to the City in comparison to equivalent sewer assets. As seen in sewer point assets, network structures (majority pump stations) have been more recently installed.

2.6 Asset Condition

Condition ratings can be either inspection-based or age-based. In this iteration of the AMP, inspection-based asset condition ratings have been used for pump stations, as provided in Associated's Pump Station Assessment Report (2023). Where available, inspection-based asset condition ratings were also used for sewer and drainage gravity mains, based on CCTV inspections which occurred between 2010 and 2019. CCTV inspection ratings were adjusted to 2022 values according to asset age since the inspection year. For all other asset types, asset condition was age-based according to the ESL and asset age. Details are provided in **Appendix B**.

Availability of data to generate a condition score was considered in the asset data reliability scores provided in **Section 2.3**.

2.6.1 Canadian Infrastructure Report Card (CIRC)

The condition of assets was assessed to develop an understanding of the remaining service lives and overall condition of the asset portfolio. Condition was rated on a scale of very poor (5) to very good (1), based on the condition scale used in the Canadian Infrastructure Report Card (CIRC) as shown in **Table 2-2**.

Table 2-2 Canadian Infrastructure Report Card Condition Scale

Rating	Scale	Description
1	Very Good	The asset is fit for the future. It is well maintained, in good condition, new or recently rehabilitated.
2	Good	The asset is adequate. It is acceptable and generally within the mid-stage of its expected service life.
3	Fair	The asset requires attention. The asset shows signs of deterioration and some elements exhibit deficiencies.
4	Poor	There is an increasing potential for asset condition to affect the service it provides. The asset is approaching the end of its service life, the condition is below the standard and a large portion of the system exhibits significant deterioration
5	Very Poor	The asset is unfit for sustained service. It is near of beyond its expected service life and shows widespread signs of advanced deterioration. Some assets may be unusable.

Figure 2-55 shows the overall asset portfolio condition by replacement value. As shown, 46% of assets by replacement value are in good to very good condition, and 20% are in fair condition. The remaining 34% of assets are in poor to very poor condition. The current overall average condition score is 2.7, or fair.

Figure 2-55 Sewer & Drainage Asset Condition by CRV ($M)

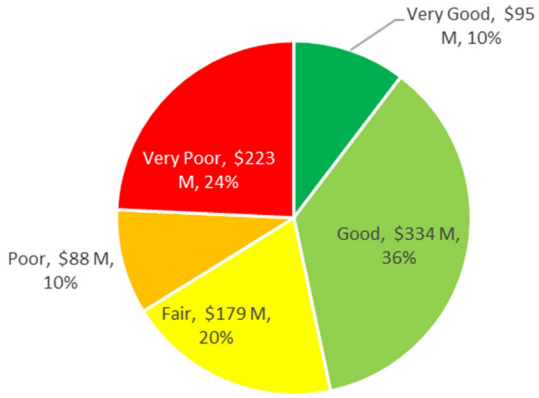


Table 2-3 shows how the City's assets compare to the national average presented in the CIRC, by % of CRV. As indicated in the footnotes of the table, this is an imperfect comparison due to the asset types included in the CIRC averages, which vary from those in the City inventory. As well, the City is older, and the asset base reflects that.

Table 2-3 Comparison of City Asset Condition to CIRC Averages

Infrastructure Type	Condition	2019 CIRC (%)	City of New Westminster[7] (%)	City's Standing
Wastewater infrastructure / Sewer Assets[1]	Very Good	25%	7%	Worse than National Average
	Good	30-40%	33%	Within National Average
	Fair	-	14%	NA
	Poor-Very Poor	-	46%	NA
Wastewater / Sewer Linear Assets	Good-Very Good	56%	41%	Worse than National Average[6]
	Fair	17%	12%	Worse than National Average[6]
	Poor-Very Poor	11%	47%	Worse than National Average[6]
	Unknown	15%	NA	NA
Wastewater / Sewer Point Assets [2]	Good-Very Good	65%	23%	Worse than National Average
	Fair	21%	43%	Worse than National Average
	Poor-Very Poor	10%	34%	Worse than National Average
	Unknown	5%	NA	NA
Stormwater infrastructure / Drainage Assets [3]	Good-Very Good	40-60%	61%	Within National Average

Infrastructure Type	Condition	2019 CIRC (%)	City of New Westminster[7] (%)	City's Standing
Stormwater / Drainage Linear Assets [4]	Good-Very Good	43%	66%	Better than National Average
	Fair	19%	29%	Worse than National Average
	Poor-Very Poor	11%	11.5%	Within National Average
	Unknown	25%	NA	NA
Stormwater / Drainage Point Assets [5]	Good-Very Good	54%	39%	Worse than National Average
	Fair	12%	45%	Worse than National Average
	Poor-Very Poor	4%	16%	Worse than National Average
	Unknown	29%	NA	NA

Notes:

(1) It should be noted that the CIRC wastewater infrastructure assessment includes wastewater treatment plans, lagoon systems, and other assets which on average are more recently constructed and have higher CRVs, which may skew the results towards higher ratings.

(2) The 2019 CIRC looks at non-linear assets including wastewater treatment plants, lagoon systems, pump stations, and lift stations.

(3) The stormwater infrastructure included in the 2019 CIRC includes linear infrastructure such as pipes, open ditches, and culverts, and non-linear assets such as pump stations, stormwater ponds, wetlands, and end-of-pipe facilities. While these asset types do not fully align with those in this AMP, the condition profile within the CIRC can be used as a tool for general comparison. There are several unknows due to data gaps, but according to this measure, the City is in-line with or ahead of the national average.

(4) The asset types assessed don't fully align with those in this AMP. While the asset types assessed don't fully align with those in this AMP, this shows that the City's drainage asset condition is on par with those across Canada.

(5) Comparatively, the City's point assets are in slightly worse condition but with the number of unknowns in the CIRC data and the differences in asset types, this comparison doesn't give much information on the City's assets compared to other municipalities.

(6) City's standing could easily be attributed to the City's age and corresponding age of the assets relative to that seen in other municipalities.

(7) Condition by CRV.

2.6.2 Sewer Assets

By replacement value, 40% of sewer assets are in good to very good condition, 14% are in fair condition, and 46% are in poor to very poor condition. The condition of sewer assets by replacement value is shown in **Figure 2-56** and summarized according to % of CRV for both linear and point sewer assets in **Table 2-4**.

Figure 2-56 Sewer Asset Condition by CRV ($M)

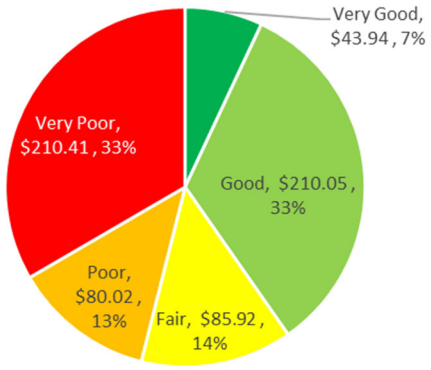


Table 2-4 Sewer Asset Condition by % of CRV

Sewer - Linear Assets	Condition by CRV	Sewer - Point Assets	Condition by CRV
Gravity Mains, Laterals, Pressurized Mains	7%	Manholes, Network Structures, Clean outs	2%
	34%		21%
	12%		43%
	13%		14%
	34%		20%

The following sections provide a further breakdown of sewer asset condition.

2.6.2.1 Linear Assets

Linear Assets are divided into gravity mains, laterals and pressurized mains. Sewer gravity main condition is based on a combination of age-based and CCTV inspection-based condition ratings. **Figure 2-57** shows the breakdown of assets assessed with CCTV or not. Assets not assessed using CCTV were given age-based condition ratings.

Figure 2-58 shows the breakdown of sewer gravity main condition. Existing mains without available CCTV condition data were assigned an age-based condition. 33% of sewer gravity mains are in good to very good condition, 12% are in fair condition, and 55% are in poor to very poor condition. As age-based condition ratings provide only an estimate of asset condition, CCTV inspections should be completed on any assets prior to major rehabilitation or renewal to understand the true asset condition. The City should review their CCTV data capture methodology to ensure CCTV inspection data can be fully translated to the asset inventory, and there are no perceived gaps in assessment due to how data is recorded. Increasing the number of assets assessed through CCTV will increase the City's understanding of the asset portfolio and renewal requirements.

The majority of sewer laterals by CRV are in good to very good condition. **Figure 2-59** breaks down the condition of sewer laterals by replacement value. There are no pressurized mains in poor or very poor condition. **Figure 2-60** shows the condition of sewer pressurized mains by replacement value.

Figure 2-57 Sewer Mains with CCTV Ratings by CRV ($M)

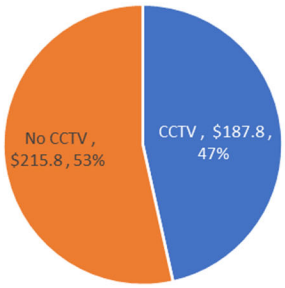


Figure 2-58 Sewer Gravity Main Condition by CRV ($M)

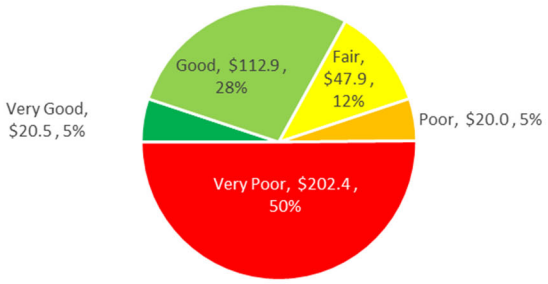


Figure 2-59 Sewer Lateral Condition by CRV ($M)

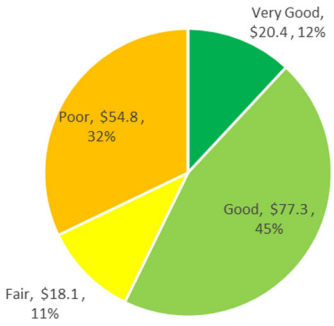
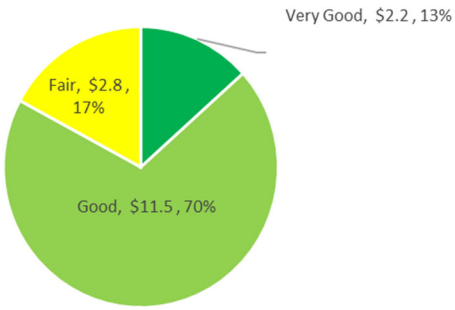


Figure 2-60 Sewer Pressurized Main Condition by CRV ($M)



2.6.2.2 Point Assets

Point assets are divided into manholes, network structures and clean outs. Sewer manholes were assessed according to age-based condition. Asset inspections can be completed to verify asset condition prior to rehabilitation or renewal and improve forecasting ability. **Figure 2-61** shows sewer manhole condition by replacement value. Sewer network structures include pump stations and chambers. Inspection-based condition ratings were used for pump stations, while age-based condition data was used for chambers. **Figure 2-62** shows the sewer network structure condition by replacement value. Sewer clean outs were assessed using age-based condition. 100% of sewer clean outs are in good condition.

Figure 2-61 Sewer Manhole Condition by CRV ($M)

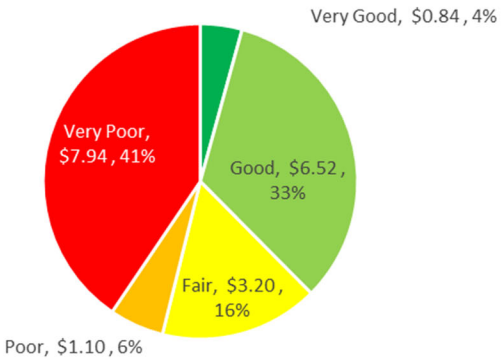
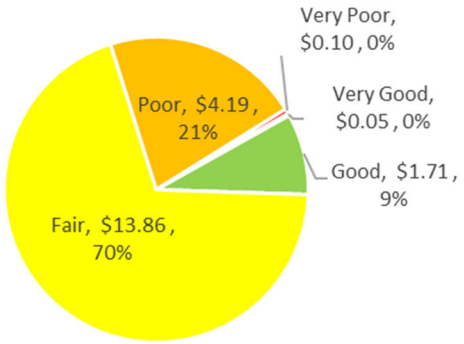


Figure 2-62 Sewer Network Structure Condition by CRV ($M)



2.6.3 Drainage Assets

By replacement value, 61% of drainage assets are in good to very good condition, 32% are in fair condition, and 7% are in poor to very poor condition. The condition of drainage assets by replacement value is shown in **Figure 2-63** and summarized according to % of CRV for both linear and point drainage assets in **Table 2-4**.

Figure 2-63 Drainage Asset Condition by CRV ($M)

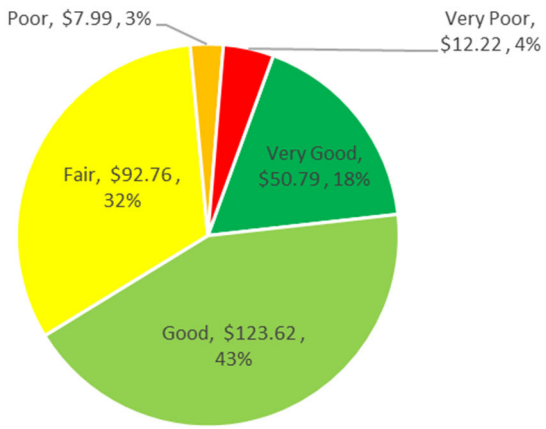


Table 2-5 Drainage Asset Condition by % CRV

Drainage - Linear Assets	Condition by CRV	Drainage - Point Assets	Condition by CRV
Gravity Mains, Laterals, Catch Basin Leads	20%	Manholes, Network Structures, Clean outs, Inlets	8%
	46%		31%
	29%		45%
	<1%		14%
	5%		2%

The following sections provide a further breakdown of asset condition for linear and point drainage assets.

2.6.3.1 Linear Assets

Linear Assets are divided into gravity mains, laterals and catch basin leads. Drainage gravity main condition is based on a combination of age-based and CCTV inspection-based condition ratings. **Figure 2-64** shows the breakdown of assets assessed with CCTV or not. Assets not assessed using CCTV were given age-based condition ratings.

Figure 2-65 shows the breakdown of drainage gravity main condition. 61% of drainage gravity mains are in good to very good condition, 33% are in fair condition, and 6% are in poor to very poor condition. As age-based condition ratings provide only an estimate of asset condition, CCTV inspections should be completed on any assets prior to major rehabilitation or renewal to understand the true asset condition. The City should review their CCTV data capture methodology to ensure CCTV inspection data can be fully translated to the asset inventory, and there are no perceived gaps in assessment due to how data is recorded.

Increasing the number of assets assessed through CCTV will increase the City's understanding of the asset portfolio and renewal requirements.

80% of drainage laterals by CRV are in good to very good condition. **Figure 2-66** breaks down the condition of drainage laterals by replacement value. There are no catch basin leads in poor condition. **Figure 2-67** shows the condition of catch basin leads by replacement value.

Figure 2-64 Drainage Mains with CCTV Ratings by CRV ($M)

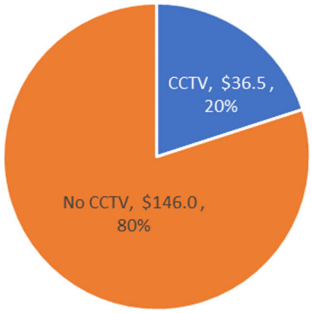


Figure 2-65 Drainage Gravity Main Condition by CRV ($M)

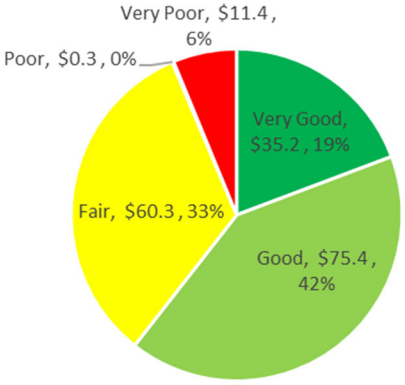


Figure 2-66 Drainage Lateral Condition by CRV ($M)

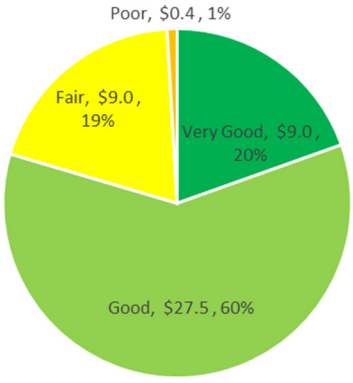
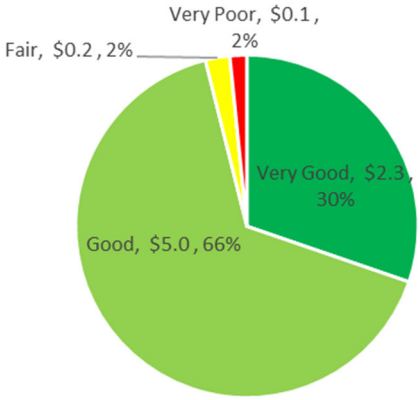


Figure 2-67 Drainage Catch Basin Lead Condition by CRV ($M)



2.6.3.2 Point Assets

Point assets are divided into manholes, network structures, clean outs and inlets. Drainage manholes were assessed according to age-based condition. **Figure 2-68** shows drainage manhole condition by replacement value. Drainage network structures include pump stations and chambers. Inspection-based condition ratings were used for pump stations, while age-based condition data was used for chambers. There are no drainage network structures in very poor condition. **Figure 2-69** shows drainage network structure condition by replacement value. Drainage clean outs were assessed according to age-based condition. 100% of drainage clean outs are in good to very good condition. **Figure 2-70** shows drainage clean out condition by replacement value. There are no drainage inlets in poor condition. **Figure 2-71** shows drainage inlet condition by replacement value.

Figure 2-68 Drainage Manhole Condition by CRV ($M)

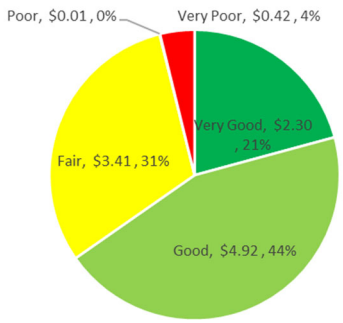


Figure 2-69 Drainage Network Structure Condition by CRV ($M)

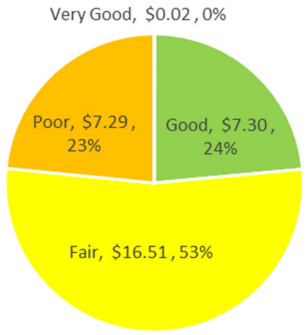


Figure 2-70 Drainage Clean Out Condition by CRV ($M)

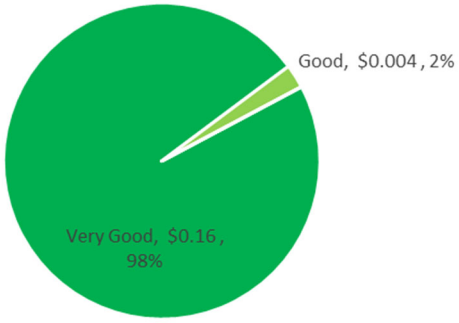
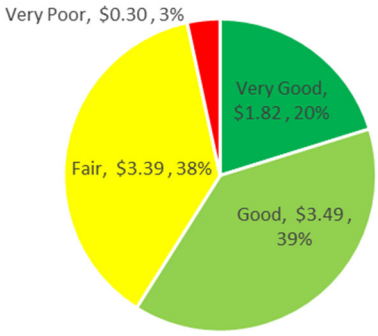


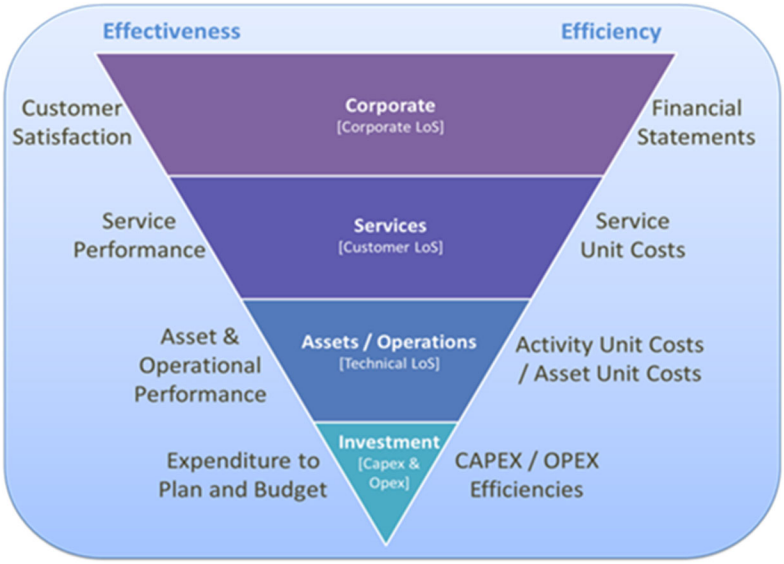
Figure 2-71 Drainage Inlet Condition by CRV ($M)



3 LEVELS OF SERVICE

Delivering sewer and drainage services is part of the City's core mandate. Understanding the LOS that the City provides its customers and stakeholders will allow the City to better deliver on the expectations of those parties. It frames service delivery around the customer rather than the organization. It enables the City, once available data is in place, to analyze and strike a balance between LOS and the cost to deliver them.

Figure 3-1 Levels of Service



One of the City's Asset Management Policy Principles (April 2019) states that "we shall clearly define and measure our Levels of Service for delivering on customer and stakeholder requirements."

The LOS indicators for the Sewer & Drainage AMP were determined through answering questions aligned to a service-based decision-making approach as described in the SAMP. They were defined by answering the following types of questions:

1. Who is the customer?
2. What services are being provided to them?
3. What can be measured to understand the customer experience?
4. What activities will support the customer experience?
5. What operational/technical performance measures contribute to the customer experience?

The LOS approach for the Sewer & Drainage AMP follows the process identified in the SAMP. **Table 3-1** summarises the SAMP's LOS Process.

Table 3-1 LOS Process

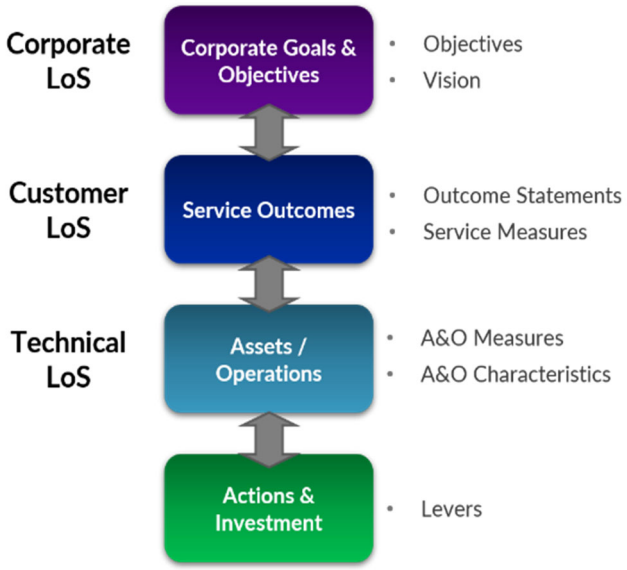
Steps	Tasks	Details
1	Identify universal customer values	The LOS measures are arranged in the following categories: availability, cost-effectiveness, reliability, responsiveness, safety, suitability, and sustainability.
2	Establish business objectives	Business objectives are defined for each customer.
3	Develop CLOS measures	Develop Customer Levels of Service (CLOS) measures that are aligned to the universal customer values as identified in the SAMP.
4	Develop TLOS measures	Develop Technical Levels of Service (TLOS) measures that align with CLOS and are arranged in the following categories: operations, maintenance, renewals and upgrades.
5	Monitor performance – collect data	Once measures are defined, then data can be collected to provide a performance baseline.
6	Set targets	Set performance targets and develop strategies to gradually improve toward set targets.
7	Benchmark results	Compare the City's performance scores against other similar organizations within different regions.
8	Publishing of performance results and consulting with customers	Communicating on targets and affordability of strategies should be done as soon as there is confidence in the numbers.

3.1 Levels of Service Framework

The typical focus for municipalities is on maintaining assets without necessarily having a complete understanding of whether those assets support the corporate, customer and technical LOS requirements. Establishing LOS for the Sewer & Drainage AMP enables the City to measure and improve its service performance.

The LOS developed in the Sewer & Drainage AMP connects and creates a line of sight between the City's objectives, the customer expectations and the daily operational activities that support sewer and drainage assets. Understanding the LOS of sewer and drainage assets will better inform decision making, management practices as well as the financial expenditures required to manage the assets.

Figure 3-2 LOS Line of Sight



3.1.1 Alignment with the City's Organizational Objectives

The LOS indicators were reviewed to determine if they support the City's vision, corporate goals, objectives and expectations of customers and stakeholders. **Table 1-4** lists corporate documentation that provides guidance in the development of the Sewer & Drainage AMP. The City's organizational objectives translated into asset management objectives were identified in the SAMP. This section further elaborates on the alignment of the City's objectives with the development of the sewer and drainage asset management objectives.

3.1.1.1 Regulatory Requirements

Metro Vancouver's Integrated Liquid Waste and Resource Management Plan identifies a strategy of reducing wet weather overflows. A key relevant municipal action from this plan is to prevent CSOs and separate the sewer system by 2075. The sewer separation deadline guides the planning within this AMP.

3.1.1.2 The City's Vision

The delivery of quality sewer and drainage services directly supports the City's Vision as set out in the City's OCP:

"New Westminster is a healthy, inclusive and thriving community where people feel connected with each other. This sustainable City showcases a spectacular natural environment, public spaces and unique neighbourhoods that are well-integrated and accessible. Superior urban design integrates its distinctive character, heritage assets, and cultural identity. Growth and development provide a variety of services and employment opportunities that contribute to a high quality of life for all."

3.1.1.3 The City's Community Goals

The City's OCP identifies 12 goals to achieve the City's vision. Goal 12 relates to the City's utilities and service infrastructure, outlining reliable and innovative servicing.

Figure 3-3 Goal 12 of the OCP

Goal 12: New Westminster has reliable and innovative servicing that efficiently and effectively meets the needs of the community and reduces impacts on the environment.

Policy 12.1: Plan, construct and operate City services in a manner that best serves the community while protecting public health and the environment.

Policy 12.2: Integrate stormwater management into the planning and design of buildings, infrastructure and open spaces.

Policy 12.3: Decrease the amount of waste generated and divert the maximum amount of material possible from the waste stream.

Policy 12.4 Provide the infrastructure that enables a digital economy.

This Plan...acknowledges the importance of utilities in supporting the health and well-being of the community and the natural environment. It also demonstrates the City's commitment to developing and implementing strategies to prepare for the effects of climate change.

This Plan also aligns with the Regional Liquid Waste Management Plan's directions towards managing stormwater by recognizing the targets established by New Westminster's Citywide Integrated Stormwater Management Plan, adopted in 2017. The Development Permit Areas included in this Plan make specific reference to the Integrated Stormwater Management Plan, which includes a Best Management Toolkit, since new development in will play a critical role in achieving the City's stormwater management targets.

Within the OCP, the following policies can be tied directly to the sewer and drainage service area:

- **Policy 12.1** identifies the need to plan, construct, and operate services in a manner which balances community needs with protection of public health and the environment. This ties to the levels of service which balance customer needs with health and environmental safety.
- **Policy 12.2** looks at the integration of stormwater management into future planning and construction. This directly relates to drainage assets as well as natural assets like rain gardens.
- **Policy 12.3** is relevant to the sewer and drainage service area as sewer separation will reduce CSOs and the corresponding sewer waste from watercourses.

3.1.1.4 The City's Sustainability Charter

The City developed ten guiding principles within the City's Sustainability Framework, "Envision 2032" to help the City evaluate future decisions and initiatives with a lens on social, economic and environmental perspectives. The Envision 2032 framework is shown in **Figure 3-4** which identifies the environmental and economic factors and further expands on social factors to include: Arts and Culture as well as Community, Liveability and Social Equality.

Figure 3-4 Envision Framework



The Envision 2032 Guiding Sustainability Principles that were identified as being relevant to the sewer and drainage assets are included below:

- "Apply long-term thinking to all decision making;
- Minimize our ecological footprint, which is the total impact of our production and consumption activities on the earth, whether this takes place within or outside of the City;
- Support people with the resources they need to live more sustainable lifestyles and foster active participation in achieving the community's future vision together;
- Engage and enable community partners, including organizations, business, institutions and other levels of government, to work towards a common, sustainable future;
- Strive towards continuous measurable improvement in meeting sustainable objectives; and
- Institutionalize accountability and transparency in governance practices."

3.1.1.5 The City's Environmental Strategy & Action Plan

To support the environmental sphere of Envision 2032, the City developed the Environmental Strategy and Action Plan to guide the City's environmental protection and preservation. It was designed to provide current and future strategies for the City to achieve their path toward making "New Westminster one of the most sustainable urban cities in British Columbia", as described in the Plan.

The Energy Emissions & Climate Change section of the plan identifies **Goal #5** to **"Prepare for and reduce impacts and risks related to climate change"** which is relates to sewer and drainage assets as they are directly impacted by changes to precipitation and flood risks seen through climate change. **Goal #5** identifies three strategies and five actions. The three strategies are listed with inclusion of the specific references to how these strategies relate to the sewer and drainage assets.

- **Strategy 5.1:** Identify climate change impacts and risks in New Westminster – the City must consider projected changes to precipitation and annual temperature and their impacts on drainage capacity and flood risk when planning for capital works.

- **Strategy 5.2:** Reduce the flood risk and manage the impact of flood events – while out of scope in this iteration of the AMP, floodplain management is a key part of the sewer and drainage service. Drainage assets are key to managing stormwater, while specific assets like dykes are built as flood prevention measures.
- **Strategy 5.3:** Improve the ability of the built environment to adapt to climate change – as assets are renewed over time, the City should consider projected climate trends and what changes can be made to existing assets, or implemented through new assets, to increase resilience.

The actions relevant to the strategies above are listed as follows:

- **5.1a.** Develop a Climate Adaptation Strategy.
- **5.2a.** Support the development of a Regional Flood Management Strategy and continue to regulate the Flood Construction Level.
- **5.2b.** Update and implement New Westminster's Floodplain Management Strategy.
- **5.3a.** Update Development Permit Area guidelines to address risks in hazard prone areas.
- **5.3b.** Incorporate climate risks into neighbourhood specific guidelines.

The Water, Waste & Materials section of the plan identifies **Goal #10** to **"Minimize the impact of waste and stormwater on the receiving environment"** which is directly related to the sewer and drainage assets. This goal was designed to support the aim "to minimize our impact on the earth's natural resources and work towards a net-zero society." **Goal #10** identifies three strategies and five actions. The three strategies are listed with inclusion of the specific references to how these strategies relate to the sewer and drainage assets.

- **Strategy 10.1** Return stormwater to natural pathways – drainage assets and green infrastructure both support this strategy.
- **Strategy 10.2** Reduce the release of hazardous and other contaminated materials in wastewater, stormwater and watercourses – solid products can clog pipes and sewers, and medications and chemical pollutants can enter the waterway through CSOs; the City will develop new regulations and a process to better monitor and enforce environmental protection bylaws and reduce pollutions that enters the receiving environment.
- **Strategy 10.3** Reduce Combined Sewer Overflows – the City is currently separating the sewer system into sanitary sewers and storm sewers at a rate of 1.5% of the total sewer length annually, to be completed by 2075.

The actions relevant to the strategies above are listed as follows:

- **10.1a.** Implement the Integrated Stormwater Management Plan (ISMP).
- **10.2a.** Develop a process to better monitor and enforce the City's environmental protection bylaws to reduce pollution.
- **10.3a.** Assess the long-term performance of sewer system using flow monitoring.
- **10.3b.** Continue to separate 1.5% of the total length of combined sewers annually, as required by the regional Integrated Liquid Waste and Resource Management Plan.

3.1.2 Stakeholder Analysis

The stakeholder groups and their requirements are identified in **Section 1.4**. The stakeholders align with those identified in the SAMP and were further refined in the LOS Workshop held with the Working Group. The SAMP identifies that "a Stakeholder is any person or organization who can affect or be affected by a decision or activity carried out by the City." The internal and external stakeholders identified in **Section 1.4** either affect or are affected by the sewer and drainage assets.

The SAMP describes that stakeholder analysis is the process of understanding the needs, requirements and expectations relative to each of the stakeholders' requirements. **Figure 3-5** identifies the levels of stakeholder engagement and the corresponding communication goals as shown in **Table 3-2** of the SAMP.

Table 3-2 Levels of Stakeholder Engagement

Level of Engagement	City Goal	City Promise	Level of Effort
Inform	To obtain balanced and objective information in a timely manner	"We will keep you informed"	Low
Consult	To obtain feedback on analysis, issues, alternatives and decisions	"We will listen to and acknowledge our concerns"	Low
Involve	To work with public to make sure that concerns and aspirations are considered and understood	"We will work with you to ensure your concerns and aspirations are directly reflected in the decisions we make"	Med
Collaborate	To partner with the public in each aspect to decision making	"We will look to you for advice and innovation and incorporate this in decisions as much as possible"	High
Empower	To place the final decision making in the hands of the public	"We will implement what you decide"	High

Stakeholder groups should be eventually "involved" in validating the levels of service defined within this AMP.

3.1.3 Identified Levels of Service

Table 3-3 identifies the outcomes that have been defined for this AMP.

Table 3-3 SAMP Outcomes

SAMP Outcomes	
Reliability	Provide reliable service and infrastructure.
Public Health & Safety	Protect public health and safety.
Productivity, Efficiency, & Employee Safety	Meet Service and operation requirements with economic efficiency, safety, and productivity.
Regulatory Compliance	Meet current and anticipate future regulatory requirements.
Affordability & Long-Term Sustainability	Ensure long-term sustainment of infrastructure and services.
Responsiveness, Service & Reputation	Have satisfied and informed customers and protect public reputation
Environment	Protect the environment

These outcomes were arrived by the Working Group through a comprehensive facilitated customer values exercise and mapped to existing objectives and performance frameworks.

Customer Values were defined by the Sewer & Drainage AMP Working Group as part of the development of the Sewer & Drainage AMP. The values align with the universal customer values identified in the SAMP Service Goals for the sewer and drainage assets, which were identified in the development of the Maintenance Management Manual in 2017. These Service Goals were further defined through the development of the Sewer & Drainage AMP. The Service Goals and related customer values are included in **Table 3-4**.

Table 3-4 Service Goals, Customer Values, and Outcome Statement

Service Goals	Defined Sewer & Drainage Service Customer Values	SAMP-Defined Customer Values	Customer Outcome Statement
Provide Reliable Service and Infrastructure	Reliability	Reliability	Sewer and drainage service is reliable and meets the current and future needs.
Meet Service Requirements with Economic Efficiency	Affordability & Long-Term Sustainability	Reliability	Sewer and drainage service provision is cost-effective.
Provide a Safe and Productive Workplace	Safety Productivity	Safety	Sewer and drainage services are provided using safe work practice.
Have Satisfied and Informed Customers	Responsiveness, Customer Service & Reputation	Quality Accessibility	Sewer and drainage services are voided with exemplary customer service.
Protect Public Health and Safety	Regulatory Compliance	Quality Safety	Customers are satisfied with the quality of sewer and drainage services.

3.1.4 Investment Drivers and Levers

There are a number of internal and external key drivers that could impact the City's Sewer & Drainage service delivery. These drivers and LOS impacts are identified below in **Table 3-5**.

Table 3-5 Drivers and Impacted LOS

Drivers	Description	LOS Impacted
Climate Change	Changes to the intensity and volume of rainfall events, as well as annual temperatures, are anticipated through climate change. These changes could result in an increase of CSOs or potential increases in flood risk.	Overflows Flood Resilience Flood Incidents
Legislative Changes	Legislation evolves which can impact sewer and drainage standards in the City, or timelines surrounding sewer separation. The City will need to monitor and evaluate the impacts of the changing legislation as they are enacted. This involves federal, provincial, and regional legislation.	To be defined as legislative changes evolve
Development	Although the City's OCP identifies the grown areas for redevelopment within the City, effective prediction of the growth rate and timeline within a service area is challenging. The growth rates and timelines are driven by market demand. Scheduled capital projects may need to be advanced to align with development projects.	System flow and pressure On-time delivery of projects and maintenance
Aging Infrastructure	The City's aging infrastructure has inherent risk as service levels may decline due to failure.	Systems Disruption / Interruption Breaks Leakages Emergency Repairs
Staff Retirement	Certified skilled labour is aging out of the workforce. In addition to the qualifications, tactic knowledge is also leaving with the retiring workforce. Both losses could create inefficiencies, additional investment in training and temporary gaps in available certified operators.	On-time delivery of projects and maintenance Available Resources
Global Pandemic	During the COVID-19 global pandemic, the delivery of services had to be adjusted to protect the health and safety of the City workforce and public. The change in work processes have had impacts to the efficiency of delivery of the projects and could have impacts on available resources if staff got sick.	On-time delivery of projects and maintenance Available Resources

3.2 Levels of Service Measurement

3.2.1 Performance Measures for the LOS Framework

This section identifies the Customer Levels of Service (CLOS) and Technical Levels of Service (TLOS). TLOS measures which are based on the asset and operational measures required for the assets to support the CLOS. The TLOS originated from the KPIs that the City identified through the NWWBI program.

3.2.2 Performance Legend

The following legend in **Table 3-6** identifies the meaning behind LOS performance trend indicators.

Table 3-6 LOS Performance Trend Indicators

Symbol	Trend	Description
↗	Positive Upward Trend	Improvement in LOS is anticipated over the AMP's planning horizon, likely to result in a positive outcome for the City.
↘	Positive Downward Trend	
↗	Negative Upward Trend	Decline in LOS is anticipated over the AMP's planning horizon, likely to result in a negative outcome for the City.
↘	Negative Downward Trend	
↔	Consistent/Stable Trend (Positive)	LOS is trending consistently at the target level, and no changes are anticipated over the AMP's planning horizon.
↔	Consistent/Stable Trend (Negative)	LOS is trending consistently at an unacceptable level, and no changes are anticipated over the AMP's planning horizon.

3.2.3 Performance Metrics Dashboard (Framework Only – Data to be collected)

The framework in **Table 3-7** provides an overview of the levels of service measures and metrics that the Sewer & Drainage AMP Working Group established in the planning process. The City is committed to measuring the outlined metrics and establishing targets based on current and desired performance. Further internal discussion will take place in 2023 to establish a process for measurement.

Table 3-7 Service Performance Metrics Dashboard

Service Outcome	Measure	Type	Supporting Asset	Metric	Target	Current	Trend
Reliability	On-time delivery of projects and maintenance	Technical	System	% of projects and work orders delivered on time			
	Unplanned Maintenance	Technical	System	Unscheduled maintenance hours/total maintenance hours			
	Corrective Maintenance	Customer	System	% corrective maintenance hours/total maintenance hours			
	Emergency Repairs	Technical	System	# of emergency repairs & replacements / 100 km of length (linear) or #			
	Overflows due to Capacity	Customer	System	# reported overflows due to Capacity/100 km			
	Main Cleaning	Technical	Mains	% of cumulative main length cleaned			
	CCTV Inspection	Technical	Mains	% of CCTV inspected			
	Sewer blockages	Customer	Mains	# of blocked sewers/100 km length			
	Sewer blockages	Customer	Mains	% of blocked sewers that were repeat occurrences			
	Blocked Service Connections	Technical	Laterals	Number of blocked service connections/1000 service connections			
	Backups	Customer	Laterals	# of backups /1000 service connections			
	Service Connection Repairs	Technical	Laterals	# of service connection repairs			
	Visual inspections of pump stations	Customer	Pump Stations	% inspections completed			
	Pump Station Failure	Technical	Pump Stations	# of pump station failures/# pump stations			
	Emergency Pump Station Repairs	Technical	Pump Stations	# of emergency pump station repairs			

Service Outcome	Measure	Type	Supporting Asset	Metric	Target	Current	Trend
	Manhole Repairs	Technical	Manholes	% of manholes repaired and replaced for inflow and infiltration			
	Catch Basin Cleaning	Customer	Catch Basins	% catch basins cleaned			
	Ditch Cleaning	Technical	Ditches	# of actual and target length of ditch cleaned			
Affordability & Long-Term Sustainability	Aligned with Sustainability Targets	Customer	System	# of areas in the City where investment/timing is not aligning with sustainability planning			
	Aligned with Growth Plan	Customer	System	# of areas in the City where investment/timing is not aligning with planned and/or anticipated growth			
	Capital Costs	Technical	System	Capital costs '000/km length			
	O&M Costs	Technical	System	O&M costs ('000)/km length			
	Reinvestment Rate	Customer	System	Capital and operating dollars invested back into infrastructure			
	Reserve Adequacy	Customer	System	Capital renewal reserves as a percentage of CRV			
Public Health & Safety	Time-Loss Injuries	Customer	System	# of time-loss injuries or # of hours lost due to Injuries	0		
Regulatory Compliance	Sewer Separation	Technical	Sewer Mains	% combined sewer mains/total sewer mains	0% by 2075		
	Lateral Separation	Technical	Laterals	% combined laterals/total laterals	0% by 2075		
Responsiveness, Service & Reputation	Customer Complaints	Customer	System	# of wastewater/stormwater complaints/ 1000 people served			
	Incident Response	Customer	System	Average length of time to respond to incident			
	Claims	Customer	System	# of wastewater/stormwater claims made against the City			

Service Outcome	Measure	Type	Supporting Asset	Metric	Target	Current	Trend
Productivity, Efficiency & Employee Safety	Available Hours	Customer	System	Total available O&M hours/total paid O&M hours			
	Overtime Hours	Customer	System	Overtime hours/total paid field hours			
	Overtime Hours – O&M	Customer	System	Total overtime O&M hours/total paid O&M hours			
Environment	Spills	Customer	System	# of spills			
	Overflows	Customer	System	# of reported overflows by cause/100km			
	Flood Resilience	Customer	System	Progress on implementation of Flood Management Plan			
	Flood Incidents	Customer	System	# of flood incidents			

3.2.4 LOS Monitoring and Reporting

The LOS defined above have been identified by the Sewer & Drainage AMP working group as the most relevant and meaningful measures by which to understand, monitor and manage the state of the sewer and drainage service. The majority of the KPIs above also align with NWWBI and Maintenance Management Manual.

These KPIs will be measured on at least an annual basis to monitor trends in service and understand how successful implementation of the AMP is. Performance against these measures will be reported to the Manager, Infrastructure Planning, the City's Asset Management Steering Committee, the City's senior management and Council.

4 ASSET LIFECYCLE STRATEGIES

The following section outlines strategies and approaches for various aspects of the sewer and drainage infrastructure asset cycle, including:

- Demand management;
- Asset acquisition;
- Asset operations and maintenance;
- Asset renewal; and
- Asset decommissioning and disposal.

This initial iteration of the AMP focuses on capital forecasting, including:

- Asset acquisition, seen through the creation of new assets within the sewer separation program and through development; and
- Asset renewal, seen through renewal forecasting which identifies strategies for the rehabilitation and replacement of existing assets.

Current strategies for demand management were reviewed and can be built upon in future iterations of the AMP if conditions change. Asset operations and maintenance and asset decommissioning and disposal strategies are less developed in the AMP at this time and have been identified as areas for improvement in future AMP iterations, see **Section 7.6**.

4.1 Demand Management

Population growth and potential increases in future demand as outlined in the OCP were discussed with the Sewer and Drainage AMP Working Group while preparing the forecast for the AMP. At this time, it is felt that the current system capacity is adequate to meet future growth, particularly as sewer separation continues. Sewer separation allows for additional capacity in existing combined mains which become sanitary mains as separate storm sewers are developed. This strategy is used for most of the City, except in certain portions such as Glenbrook (north and south) neighbourhoods. Future demand should be monitored and considered in future iterations of the AMP if conditions change.

4.2 Asset Acquisition

In order to meet sewer separation regulations, as seen in the renewal forecast developed for Section 4.4, the City is constructing new storm mains to separate the existing combined mains. These new assets will have to be incorporated into operations and maintenance budgets and planning. Currently, the City constructs their own sewer and storm mains through the separation program or new development. Construction of new laterals which connect developments to the sewer and storm mains is the responsibility of developers. Strategy for asset acquisition should be considered in future iterations of the AMP.

4.3 Asset Operations and Maintenance

A maintenance review conducted in 2019 outlined set of key maintenance and operational activities that are regularly undertaken, published as the Maintenance Management System Phase 2 implementation for sewers and drainage. This review resulted in an estimation of required FTEs for the previous and upcoming years of the review, which should be continuously validated and assessed on an annual basis. A copy of this document is attached as **Appendix F**.
Maintenance efforts were analyzed based on the following categories of asset classes and functions:

- Capital works;
- Combined sewers;
- Connections;
- Customer service;
- Development;
- Drainage;
- Drainage pump stations;
- Overhead;
- Pressurized mains;
- Sanitary pump stations;
- Sanitary sewers;
- Storm sewers; and
- Third party damage.

This work was an hours-based analysis based on available work management data. In the future, this could be analyzed iteratively based on documented work and hours in the Cityworks system through documentation of Equipment, Labour, and Materials (ELM).

Based on the analysis of 2019 maintenance activities by asset type, sanitary pump stations require the highest level of effort, accounting for 27%. 21% of the time was spent on development, and drainage maintenance, lateral maintenance, and overhead accounted for around 10% of the total time each. The remaining hours were distributed among other asset types.

By activity classification, 25% of time was spent on preventative maintenance, 23% on corrective maintenance, 24% on development, 11% in operational maintenance, 11% on overhead, and the remaining 6% on capital works or customer service.

Analysis of historical spend on operations and maintenance activities is provided in **Section 6**. This information was generated through the City's core financial system, JD Edwards, so the categorization of hours may not be identical. However, it has been segmented into similar categories.

4.4 Asset Renewal Forecast

4.4.1 Asset Renewal Methodology

The following methodology outlines how renewal projections were determined through to 2075. Key renewal assumptions and projections are identified throughout this section and in **Table 4-1**.

4.4.1.1 Estimated Asset Condition

As discussed in **Section 2.6**, most assets by replacement value are in fair to good condition (66%). With most condition ratings in this iteration of the AMP being age-based, it's possible that the true condition of assets varies from what is seen here. Asset inspections should be completed prior to any rehabilitation or renewal to get a true understanding of asset condition.

4.4.1.2 Key Renewal Assumptions

Key renewal assumptions made in the asset renewal forecasts are summarized in **Table 4-1**.

Table 4-1 Assumptions in Renewal Forecast

Scenario	Baseline Asset Renewal Forecast	Modified Asset Renewal Forecast
General overview of scenario	Asset renewal occurs at the end of an assets expected service life. There are no budget limitations in this scenario, and all assets beyond their ESL are renewed in 2023.	The total budget is capped at $8M in 2023. The annual budget is optimized to see the smallest annual increase that will enable complete sewer network separation by 2075 and an overall average asset condition score of fair (3) being maintained through renewals. In the first year, 70% of the annual budget annual goes towards sewer separation, and the remaining 30% going towards asset renewals. In subsequent years, a higher percentage goes towards renewals to maintain the average asset condition. Asset renewal was prioritized in the following order, established through discussion with the City: 1. Pump station capital maintenance and renewal program costs. 2. Renewal of assets past their ESL, in order of % beyond ESL and risk. 3. Renewal of gravity mains at the end of their ESL, in order of risk. 4. Renewal of other assets at end of ESL, in order of risk. 5. Renewal of laterals at the end of ESL, in order of risk.
Gravity main renewal details	80% of annual gravity main renewals are completed by rehabilitating the existing assets through either relining or bursting. This was modelled as costing 25% of the CRV and having a shortened service life of 50 years. 20% of annual gravity main renewals are completed by replacing the assets at their CRV.	
Lateral renewal details	The City replaces up to 30 laterals annually. The majority of lateral renewals are completed and paid for by developers through redevelopment projects. 600 laterals are renewed (and separated, if combined) by developers annually through to 2036. This reflects the rate of development outlined in the City's OCP.	
Treatment of pump stations	Pump station capital maintenance and renewals are completed following the capital program outlined in the City's 2023 Pump Station Condition Assessment Report.	
Sewer Separation	Construction of the remaining storm mains required for sewer separation is evenly distributed between 2023 and 2075.	Construction of the remaining storm mains required for sewer separation is completed using 70% of total expenditure in the first year. This is adjusted annually to meet separation and condition targets.

4.4.2 Asset Renewal Forecast

4.4.2.1 Baseline Asset Renewal Forecast

Figure 4-1 shows the baseline asset renewal forecast, which assumes an "uncapped scenario" where assets are replaced at the end of their ESL and outstanding sewer separation requirements are evenly distributed annually. The spike in expenditure of $40.9M seen in 2023 represents the backlog of assets already past their expected service lives (deferred renewal), which the Baseline Forecast addresses in the first year without any distribution or prioritization. Comparatively, **Section 4.1.2.2** provides a modified renewal forecast which distributes the backlog and prioritizes annual investments for greater practicality.

Figure 4-1 Baseline Asset Renewal Forecast

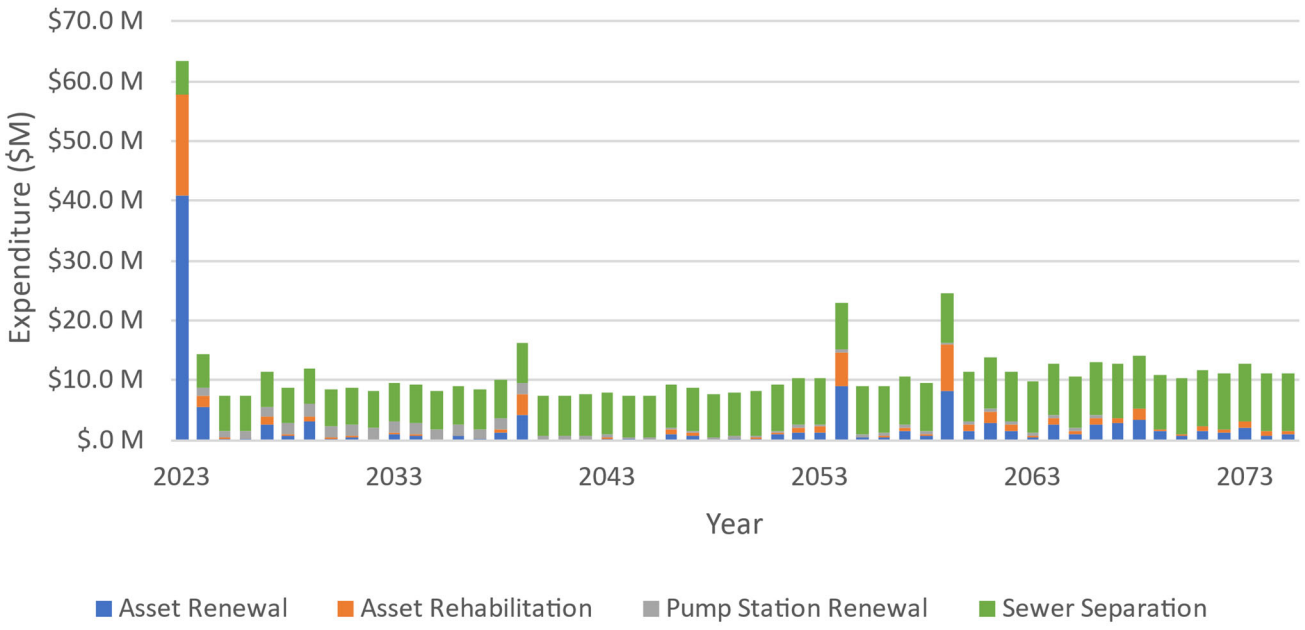


Figure 4-2 shows the cumulative investment needs in the baseline renewal forecast. In this scenario, the City requires a cumulative total of $216.2M to complete the required asset renewal and rehabilitation between 2023 and 2075. An additional $396.5M is required to achieve sewer separation targets, resulting in a total cumulative expenditure of $622.5M in 2022 dollars.

Figure 4-2 Baseline Cumulative Renewal Forecast

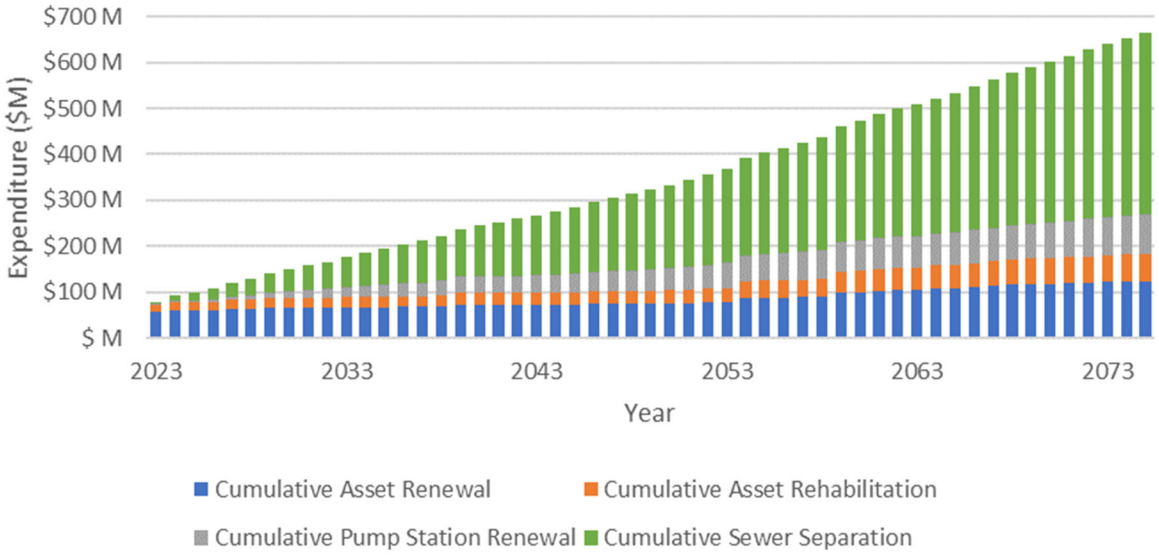
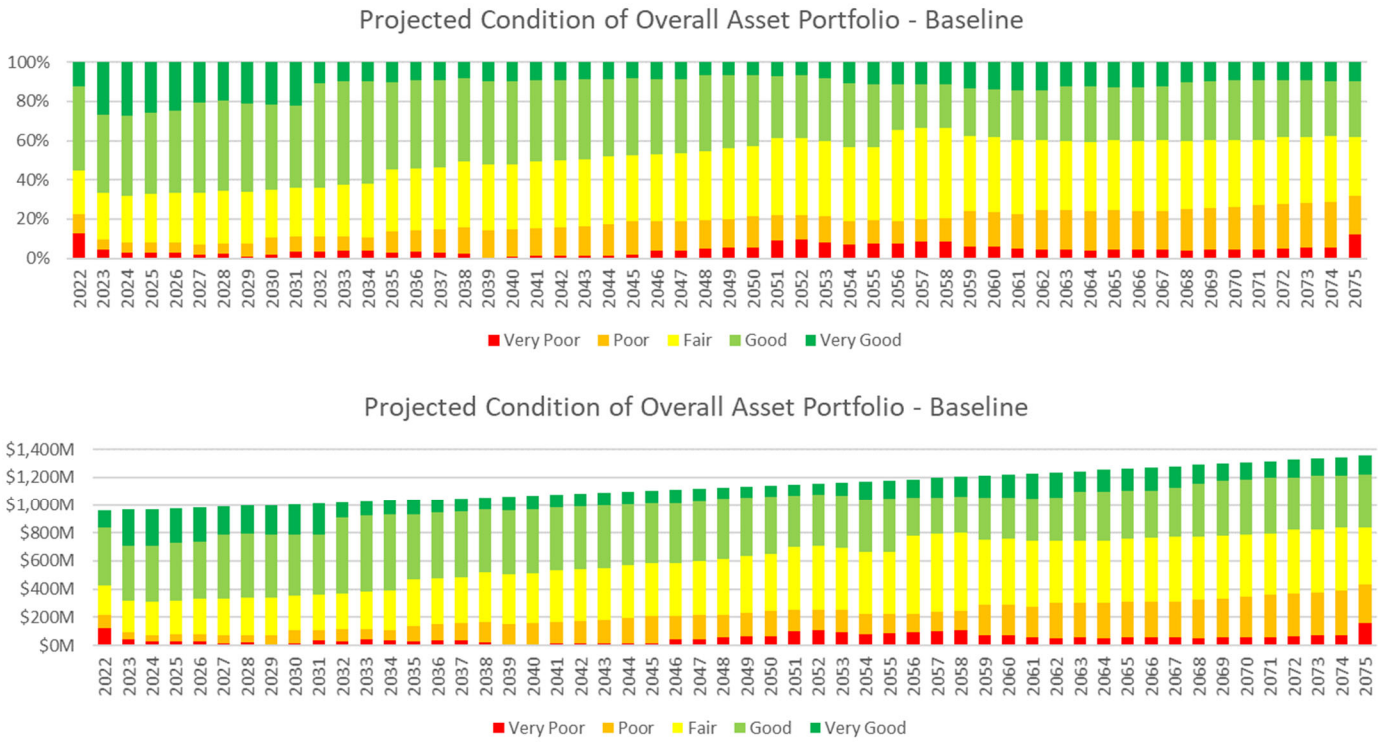


Figure 4-3 shows the projected condition of the asset portfolio over time in both percentage and dollar value. Here, the average condition improves significantly in 2023 following the renewal of the asset backlog, but average asset condition sits around a level of fair in 2075. Assets being renewed at the end of their ESL results in clusters of assets aging at the same rates, resulting in required spikes in expenditure over the forecast period.

Figure 4-3 Project Asset Condition – Baseline Forecast



4.4.2.2 Modified Asset Renewal Forecast

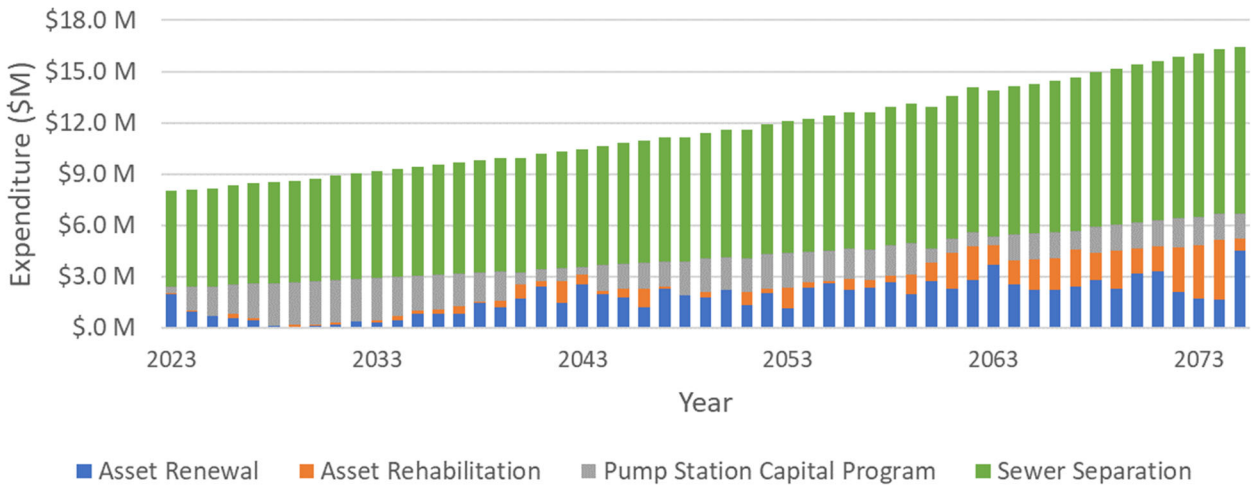
A modified asset renewal forecast (**Figure 4-4**) was developed to provide a more realistic renewal strategy. The forecast was optimized to determine the minimum annual budget increase required in order to maintain an asset condition of fair while achieving sewer separation targets. Meeting these conditions will help mitigate both asset and enterprise risk faced by the City, as outlined in **Section 5**.

Asset renewal was prioritized as seen in **Table 4-2**, established through discussion with the City.

Table 4-2 Renewal Prioritization

Priority #	Description	Rationale
Priority #1	Pump station capital program costs.	Through the work completed by Associated Engineering in the Pump Station Condition Assessment Report, a 50-year capital works program was developed. The City indicated that the capital maintenance and renewal works identified in this program were a priority for them, so these costs were built into the annual renewal budget as laid out in the Pump Station Condition Assessment Report.
Priority #2	Renewal of assets past their expected service life as of 2023, according to % beyond ESL and risk.	If any renewal budget remained after Priority 1, the asset backlog was addressed in order of % beyond ESL. Where % beyond ESL was identical, risk scores were used to determine order of renewal (risk scores were taken, for assets where provided, from the AECOM Risk Model, and take into account both asset criticality and probability of failure which is derived from both condition and demand).
Priority #3	Renewal of gravity mains at the end of their service life going forward, in order of risk.	If any renewal budget remained after Priorities 1 and 2, the renewal of gravity mains that had reached their ESL was addressed. Where multiple gravity mains had met their ESL, risk scores were used to determine order of renewal.
Priority #4	Renewal of other asset types at end of expected service life going forward, in order of risk.	If any renewal budget remained after Priorities 1-3, remaining assets from other asset categories in very poor condition were addressed in order of risk score.
Priority #5	Renewal of laterals at the end of expected service life going forward, in order of risk.	Any outstanding renewal budget after Priorities 1-4 were addressed went to the renewal of laterals at the end of their service lives. Where multiple laterals had met their ESL, risk scores were used to determine order of renewal. The City indicated that they aim to renew ~25-30 laterals annually based on customer reported condition. However, several laterals in the model are renewed annually through redevelopment at developer cost so most laterals in poor to very poor condition were addressed in that way.

Figure 4-4 Modified Annual Renewal Forecast



Here, annual renewals are prioritized annually, beginning with the pump station renewal program as well as deferred renewals, to fit the annual budget. 2023 expenditures are capped at $8.0M to reflect current budgets. From there, an overall increase of 1.41% expenditure annually (excluding inflation) is required to maintain the average condition of existing assets while achieving sewer separation goals. **Figure 4-5** shows the cumulative renewal requirements.
Table 4-3 shows the annual budget requirements for the modified forecast split into sewer separation and renewals and rehabilitation (including asset renewal, asset rehabilitation, and the pump station capital requirements).

Figure 4-5 Modified Cumulative Renewal Forecast

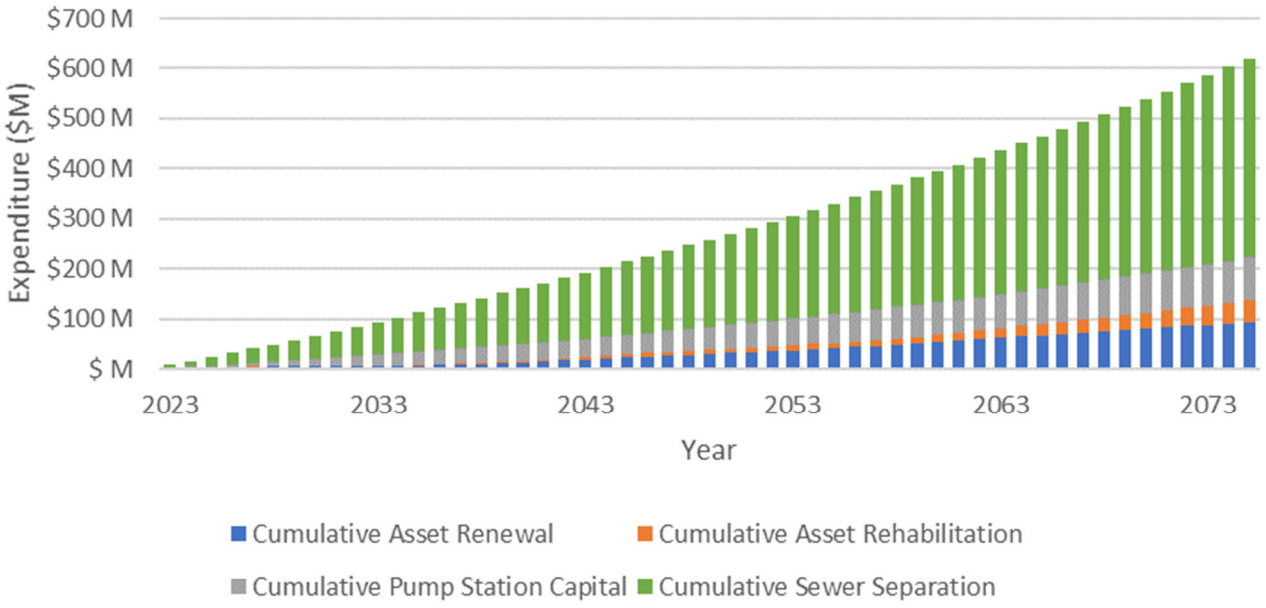


Table 4-3 Modified Renewal Forecast Annual Expenditures ($2022)

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Sewer Separation	$5.60M	$5.66M	$5.72M	$5.78M	$5.84M	$5.91M	$5.97M	$6.03M	$6.10M	$6.16M	$6.23M	$6.29M	$6.36M	$6.43M
Renewals & Rehabilitation	$2.40M	$2.43M	$2.44M	$2.55M	$2.60M	$2.60M	$2.65M	$2.70M	$2.81M	$2.86M	$2.92M	$2.99M	$3.05M	$3.11M
Total	$8.00M	$8.09M	$8.16M	$8.33M	$8.44M	$8.51M	$8.62M	$8.74M	$8.91M	$9.02M	$9.15M	$9.28M	$9.41M	$9.54M
Total % Annual Increase	-	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%

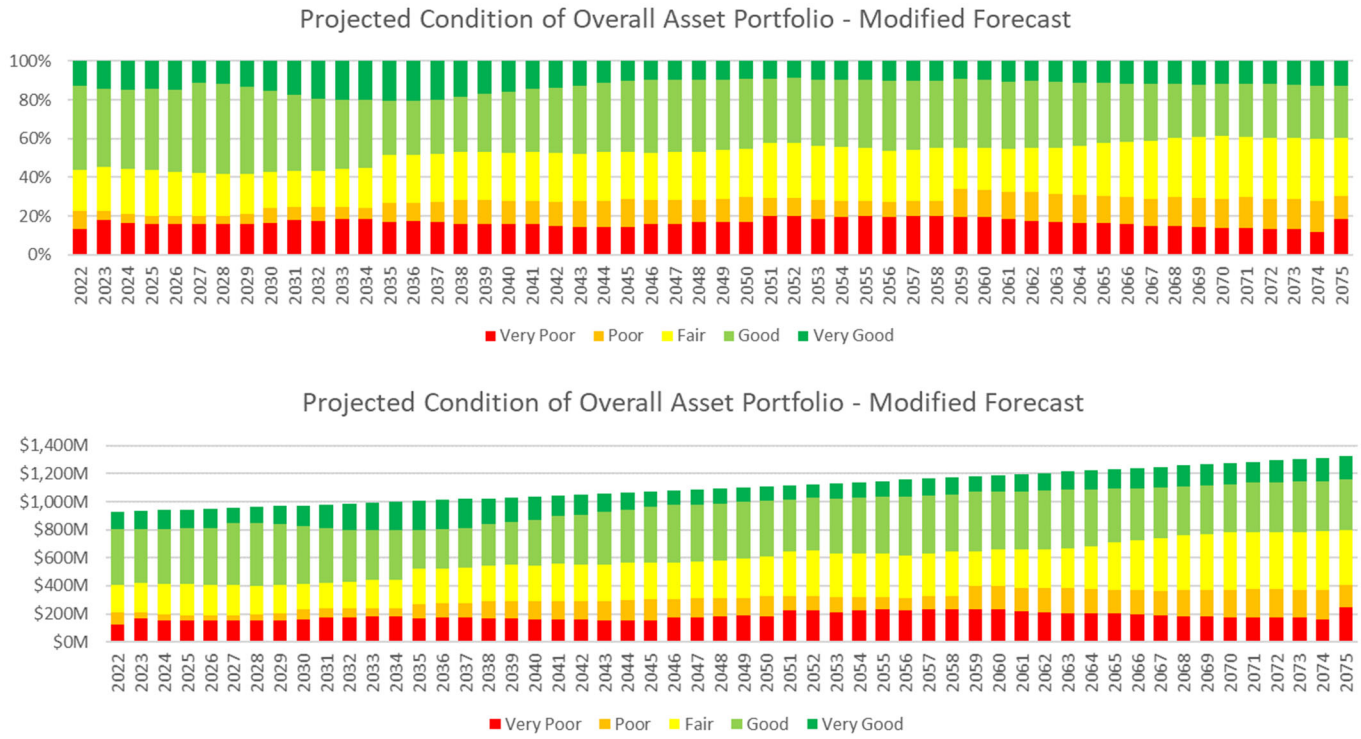
Year	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Sewer Separation	$6.50M	$6.57M	$6.64M	$6.71M	$6.78M	$6.85M	$6.93M	$7.00M	$7.08M	$7.15M	$7.23M	$7.31M	$7.38M	$7.46M
Renewals & Rehabilitation	$3.18M	$3.24M	$3.30M	$3.24M	$3.44M	$3.48M	$3.53M	$3.66M	$3.73M	$3.79M	$3.88M	$3.85M	$4.04M	$4.13M
Total	$9.67M	$9.81M	$9.94M	$9.95M	$10.22M	$10.34M	$10.46M	$10.66M	$10.81M	$10.94M	$11.11M	$11.16M	$11.42M	$11.59M
Total % Annual Increase	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%

Year	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064
Sewer Separation	$7.54M	$7.62M	$7.70M	$7.79M	$7.87M	$7.95M	$8.04M	$8.13M	$8.21M	$8.30M	$8.39M	$8.48M	$8.57M	$8.66M
Renewals & Rehabilitation	$4.04M	$4.30M	$4.38M	$4.46M	$4.54M	$4.65M	$4.59M	$4.83M	$4.94M	$4.61M	$5.19M	$5.58M	$5.34M	$5.47M
Total	$11.59M	$11.92M	$12.08M	$12.25M	$12.41M	$12.60M	$12.63M	$12.95M	$13.15M	$12.91M	$13.58M	$14.06M	$13.91M	$14.13M
Total % Annual Increase	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%

Year	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075
Sewer Separation	$8.75M	$8.85M	$8.94M	$9.04M	$9.13M	$9.23M	$9.33M	$9.43M	$9.53M	$9.63M	$9.74M
Renewals & Rehabilitation	$5.55M	$5.59M	$5.69M	$5.90M	$6.05M	$6.16M	$6.28M	$6.41M	$6.52M	$6.67M	$6.71M
Total	$14.30M	$14.44M	$14.63M	$14.94M	$15.18M	$15.40M	$15.61M	$15.84M	$16.05M	$16.30M	$16.44M
Total % Annual Increase	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%	1.41%

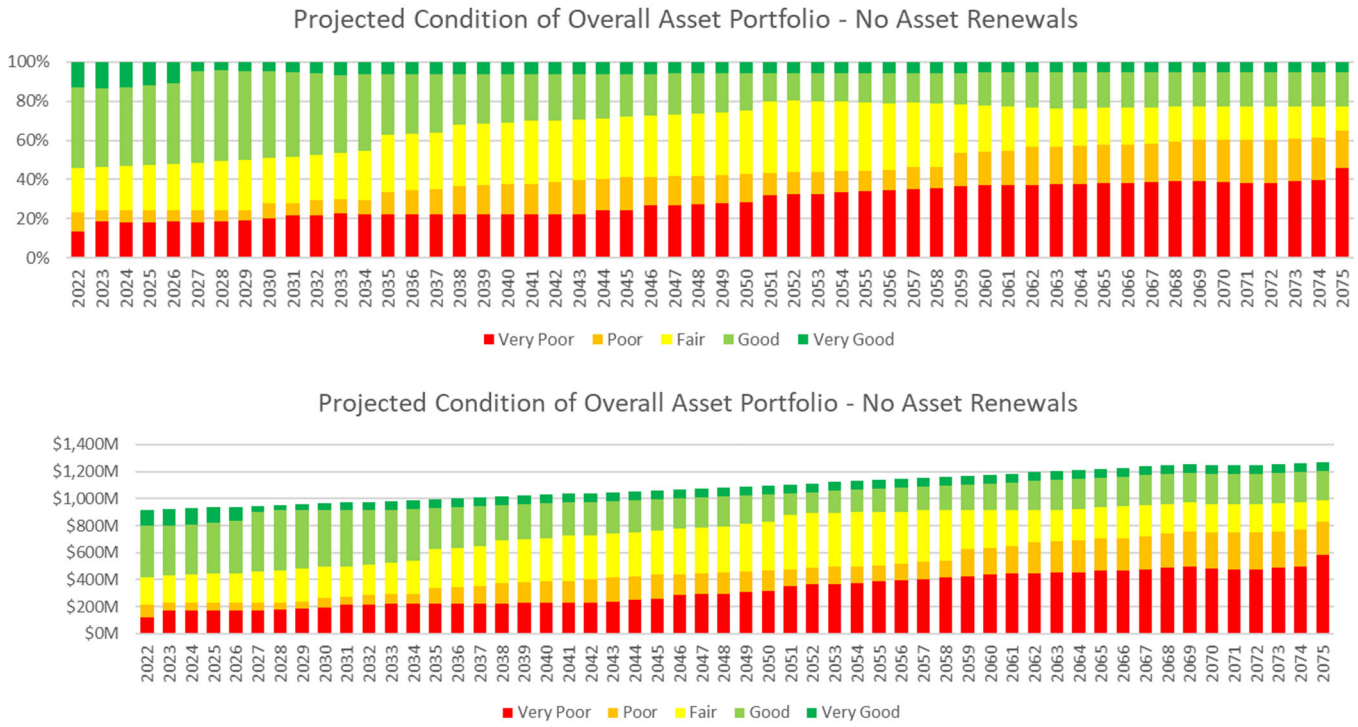
The cumulative spend in the modified forecast is $619.6M. This is $2.9M less than the cumulative total in the baseline scenario, as some renewal can be deferred while maintaining an overall average asset condition of fair. **Figure 4-6** shows the projected condition of the asset portfolio over time in both percentage and dollar value. Here, the average score of fair is maintained but through the prioritization of sewer separation (seen in the increasing portfolio value), the backlog of assets in very poor condition is not all immediately addressed, which is seen through the relatively consistent value of assets in poor and very poor condition which slightly increases towards the end of the forecast. While not all backlogged assets are addressed immediately, the approach to renewal of these assets is prioritized in order of importance based on criteria set by the City. The addition of new assets through sewer separation increases the condition of the asset portfolio. In comparison to the Baseline Forecast, there is very minimal decrease in condition seen at the end of the forecasted period, with a much more balanced annual expenditure.

Figure 4-6 Projected Asset Condition – Modified Forecast



Comparatively, **Figure 4-7** shows the projected condition if the City were to not renew any existing assets, and only complete sewer separation. This illustrates the deterioration of asset condition that will occur without any investment into the existing asset base. Here, you can see that while new assets (in very good condition) are being added to the asset portfolio, the value of assets in very poor condition is increasing annually, until close to half of the total asset value is in very poor condition.

Figure 4-7 Projected Asset Condition - No Asset Renewals



4.5 Asset Decommissioning and Disposal

Strategies for asset decommissioning and disposal were not a focus of this iteration of the AMP. Strategy for asset decommissioning and disposal, including considerations of any associated fees or potential liabilities, should be considered in future iterations of the AMP.

4.6 Non-Asset Solutions

The following non-asset solutions should be highlighted for consideration during future iterations of the AMP:

- Continuous review of emerging climate change and asset resiliency practise and strategies by the industry: climate change considerations should be incorporated into renewal strategy, either through replacement or retrofit of existing assets to increase resilience to climate change.
- Improved data collection and maintenance including CCTV data and beginning outfall data collection: improving data collection methodology will ensure the most accurate asset condition is considered in renewal forecasting.
- Reserve fund management: increased reserves will be required to meet sewer separation and asset renewal targets, as well as O&M and the renewal of out of scope assets.
- Wet weather flow forecasting: analysing future flows will help ensure new and existing drainage assets are adequately sized.
- Management of potential future Metro Vancouver levies: future levies should be considered as these will impact the overall budget requirements for sewers and drainage.

These are considerations which could affect City strategies across the asset lifecycle. These items are included as implementation or improvement items under Section 7.

5 RISK & UNCERTAINTIES

Understanding the risk and uncertainties that infrastructure assets may experience throughout their lifecycle is essential to successfully managing assets. This section lays out risk theory that should be used as a guideline for a revised risk model for the water assets, as well as the identification and evaluation of general asset and enterprise-level risks.

5.1 Introduction to Risk Management

The level of risk is identified through defining the likelihood and consequence of an impact from a potential uncertainty. In very broad terms risk can be simplified as:

Risk = Likelihood x Consequence

Asset risk is derived from understanding **remaining life** and **asset criticality** and should be the primary decision-making criteria for determining asset interventions.

The **remaining life** of existing assets may be used as an indicator of **likelihood** of asset failure which can be based on asset age or condition. The older an asset, the more likely it is to stop working or fail to provide acceptable service.

Asset criticality is an indicator of the importance of an asset in relation to the levels of service objectives. The **criticality** of the asset can be used as an indicator of **consequence**. A more critical asset is one which is more important and if it were to fail, it would significantly impact service to the community.

This section follows the six-step risk management process as outlined in the SAMP:

1. Risk Context
2. Risk Identification
3. Risk Analysis
4. Risk Evaluation
5. Risk Treatment & Control
6. Risk Monitoring & Review

5.2 Risk Context

Understanding the risk landscape in context of what the City is trying to achieve is the first component to realizing an effective risk management methodology. **Table 5-1** shows Change Model #4 from the SAMP, which describes the City's existing Risk Context. The SAMP resulted in development of a preliminary risk framework for the City, which was to be tested in accordance with the change model.

Table 5-1 Change Model for the City's Existing Risk Framework

Case Study	Change Model	Description
The "Problem"	Current State	• Individual departments do not currently document asset specific risks • Asset risks are addressed intuitively/subjectively by each department • There is no formal risk treatment plan • Residual risk has not been quantified
The "Solution"	Transition State	• Pilot testing of the risk framework within one of the service areas
	Future State	• A fully developed and operationalized risk framework consistent across service areas that is used to make risk-based decisions • Criticality scores are assigned to all assets and consistently recorded in GIS
The "Outcome"	Benefits	• To mitigate risk • To improve operational efficiencies • To treat/control and monitor risk

This change model will be used to drive improvement actions in **Section 7**.

As described in the SAMP, Risks may be categorized into the following two types of risk:

1. **Asset Risk** which includes items such as equipment failures, warranty failures, deferred maintenance backlogs, vandalism, injuries, inclement weather, service interruptions, etc.
2. **Enterprise Risk** which includes items such as seismic events, pandemics, strikes, acts of war, dissatisfied stakeholders, reputational damage, etc.

5.3 Risk Identification

The Sewer & Drainage AMP Working Group may wish to host an annual "Risk Review" to capture risks into the Risk Register and jointly discuss the implications and likelihood of risks in context of the City. Risks should be assessed every five years to identify changes in risk.

Tables 5-2 and **5-3** provide preliminary lists of sample Asset Risks and Enterprise Risks.

5.3.1 Asset Risk in Current Iteration of the AMP

Evaluation of risk specific to individual assets was completed in the 2022 AECOM Risk Model, which can be seen in **Appendix C**. The Risk Model provides an understanding of distribution of risk in each asset category, along with the cost distribution of risk according to asset CRV. The developed risk scores, which are a product of probability of failure and asset criticality, were used to inform the prioritization of renewals in **Section 4** of the report.

The AMP looks at broader risks across the asset lifecycle and identifies risks related to the following sewer and drainage assets:

Linear sewer and drainage infrastructure	Vertical and point sewer and drainage assets
Pressurized Mains	Manholes
Gravity Mains	Network Structures (Pump Stations And Chambers)
Laterals	Cleanouts
Catch Basin Leads	Inlets

Examples of asset risks and related risk events are provided in **Table 5-2**. These risks were generated through a risk identification exercise and validated by the Sewer & Drainage AMP Working Group. Through identification of these risks, improvement plan options were developed, which are identified in **Section 5.5** Risk Treatment & Control and **Section 7** Implementation & Continuous Improvement.

Table 5-2 Preliminary Asset Risks

Asset Class	ID	Type of Risk Events	Cause (due to…)
Sewer & Drainage	AR.1	Equipment failure.	Inadequate preventative maintenance.
	AR.2	Service interruption.	Unplanned maintenance work (emergency repairs); pump station power outages.
	AR.3	Major failure such as a main break	Age and condition of infrastructure.
	AR.4	Pump failure	Inadequate preventative maintenance.
	AR.5	Blockage	Wipes, grease, debris, etc. entering system.
	AR.6	Combined Sewer Overflows	Inadequate capacity; heavy rainfall/storm events.
	AR.7	Sanitary Sewer Overflows	Inadequate capacity; stormwater infiltration (cracks in sewer lines or illegal cross connections)
	AR.8	SCADA Failure	Programming deficiencies; signal interference/outages; inadequate preventative maintenance.
	AR.9	Damages to or leaks in rigid connection points of assets in Queensborough	Ground conditions or groundwater levels leading to asset buoyancy or ground settlement.

5.3.2 Enterprise Risks

The enterprise risks are related to the sewer and drainage system overall. These risks were generated through a risk identification exercise and validated by the Sewer & Drainage AMP Working Group. Through identification of these risks, improvement plan options were developed, which are identified in **Section 5.5** Risk Treatment & Control and **Section 7** Implementation & Continuous Improvement.

Table 5-3 Preliminary Enterprise Risks

Service	ID	Type of Risk Events	Cause (due to…)
Sewer & Drainage	ER.1	Do not achieve sewer separation targets	Inability to meet sewer separation targets due to budget or resource constraints or overestimation of developer contribution to lateral separation.
	ER.2	Increase in operating costs	Increase in MV charges or levies and market inflation.
	ER.3	Increase to capital expenditure	Market conditions.
	ER.4	Inadequate staff resources lead to inefficiencies and accelerated asset failures	Operations staff turnover rate, vacancies, and lack of succession planning.
	ER.5	Inaccurate replacement costs	Increase in construction costs have made it difficult to estimate replacement costs. Lack of construction pricing data.
	ER.6	Major failure such as a main break	Due to seismic activity. Due to third party accidental hits.
	ER.7	Lack of knowledge on existing asset inventory leading to inaccurate estimation of future needs	Inadequate data and knowledge management practices in terms of data capture, storage, maintenance and retirement in Cityworks, GIS or the Financial system. e.g. install dates of mains being replaced with date of relining/bursting instead of rehab data being inputted in a separate field. e.g. outdated GIS due to time lapse between completed constructed work and updating the GIS dataset. In many cases, attribute data is missing, which has potential to lead to inaccurate analysis on future needs.
	ER.8	Inadequate budget preventing timely rehabilitation or replacement of assets	Backlog of assets past expected life exceeding annual budget; potential shift in council priorities or grant funding cancellation could exacerbate issue.
	ER.9	Inadequate stormwater capacity leading to overflows and localized flooding	Greater than anticipated increase in intensity of rainfall and storm events through climate change not considered in renewal of stormwater infrastructure.
	ER.10	Inadequate sewer capacity leading to backups and overflows	Rate of projected development and population growth exceeds the growth curve established in the OCP resulting in undersized infrastructure.
	ER.11	Oversized sanitary mains resulting in septicity and/or blockages	Reduced flows in separated sanitary sewers (which used to take both sewer and stormwater) resulting in pipes being oversized or unable to reach flushing velocities in sanitary mains.

5.4 Risk Analysis

Risk analysis requires consideration of the causes of risk: likelihood of occurrence and consequences. The consideration of existing controls will also support the determination of likelihood. Determining the level of risk will enable the City to develop treatment and control to mitigate those risks.

Section 7 identifies data improvements to support the future assessment of Asset Risk.

5.4.1 Determining Likelihood

The potential likelihood of an impact is traditionally determined by a frequency-based determination (i.e. "how likely will the asset be affected?"). The frequency of occurrence is graded on a scale of 1 to 5 as defined in **Table 5-4**, as guided by the SAMP. The Likelihood Scale identifies how likely an event is expected to occur.

Table 5-4 Likelihood Scale

Likelihood	Probability	Score	Description
Almost Certain	≥90%	5	Very high probability that risk will occur in the next 36 months
Likely	≥70% to <90%	4	High probability that risk will occur in the next 36 months
Possible	≥25% to <70%	3	Moderate probability that risk will occur in the next 36 months
Unlikely	>1% to <25%	2	Low probability that risk will occur in the next 36 months
Rare	≤1%	1	Very low probability that risk will occur in the next 36 months

5.4.2 Determining Consequence

Consequences or impacts of risks can be determined also on a 1 to 5 scale as defined in **Table 5-5**. Assets with a significant consequence in the event of failure are considered critical assets.
The City has identified six[20] types of consequences:

1. Financial
2. Health & Safety
3. Availability/Reliability
4. Legislation
5. Environment
6. Corporate Image

[20] Items 1-5 reflect the SAMP and Item 6 incorporates "Corporate Image", as identified in the Asset Management Program Phase III Summary conducted by Urban Systems.

Table 5-5 Consequence/Impact Matrix

Consequence Categories	1 Insignificant	2 Minor	3 Moderate	4 Severe	5 Catastrophic
Financial	Damages, losses (including 3rd party) or fines less than $10,000	Damages, losses (including 3rd party) or fines $10k to $100k	Damages, losses (including 3rd party) or fines $100k to $500k	Damages, losses (including 3rd party) or fines $500k to $1M	Damages, losses (including 3rd party) or fines greater than $1M
Health & Safety	No impact to health and safety	Minor injury or illness without lost time	Illness/injury resulting in lost time	Illness/injury resulting in permanent or long-term disability	Illness/injury resulting in fatality
Availability/ Reliability	Small number of customers experiencing disruption/ impact (less than 100 people or up to 2 hours)	Localized service disruption/ impact (100 to 500 people or up to 1 day)	Significant localized disruption/ impact (500 to 1,000 people or up to 1 week)	Major service disruption/ impact (1,000 to 5,000 people or up to 2 weeks)	Organizational wide service disruption/ impact (greater than 10,000 people or loss of services for longer than 2 weeks)
Legislation	No expected violations of regulations, Acts or bylaws	Potential verbal or written warnings/notices	Compliance orders or notice of violations	Potential for charges to individuals or the Corporation	Numerous charges to individuals or the Corporation or labelling as a repeat offender
Environment	Very negligible impact or can be restored within 1 week	Material damage/ improvements of local importance. Minor, short term (within 1 month) very isolated damage/ improvements to the environment	Significant short term (up to 2 months) local damage/ improvements to the environment	Significant long term (up to 1 year) widespread damage/ improvements to the environment. Some Provincial importance.	Major long term (greater than 1 year) or permanent widespread damage/ improvements to the environment. Federal importance.
Corporate Image	Event only of interest to individual. Nil effect or community concern	Minor community interest. Local media report	Public community discussion. Broad adverse media coverage	Loss of confidence in Council. National publicity. Public agitation for action.	Public investigation. International coverage. Management changes demanded

5.4.3 Risk Equation

The risk equation can vary based on the degree of sophistication applied to the City's assets. The SAMP recommends that the risk equation will be kept to a "Level 2 complexity" which sums up the value of the consequences, as follows:

Risk = Likelihood x Σ Consequences

In cases where consequence cannot be scored across all consequence categories, a "Level 1" complexity can be employed, as follows:

Risk = Likelihood x Highest Consequence

A risk register was provided to the City to begin tracking and scoring risks, which follows the Level 1 complexity. This best reflects the risk exposure matrix and subsequent tolerance zones for risk as outlined in the SAMP. Should the City want to employ a Level 2 complexity for risk calculation in the future, new thresholds for risk tolerance will need to be developed.

5.4.4 Criticality

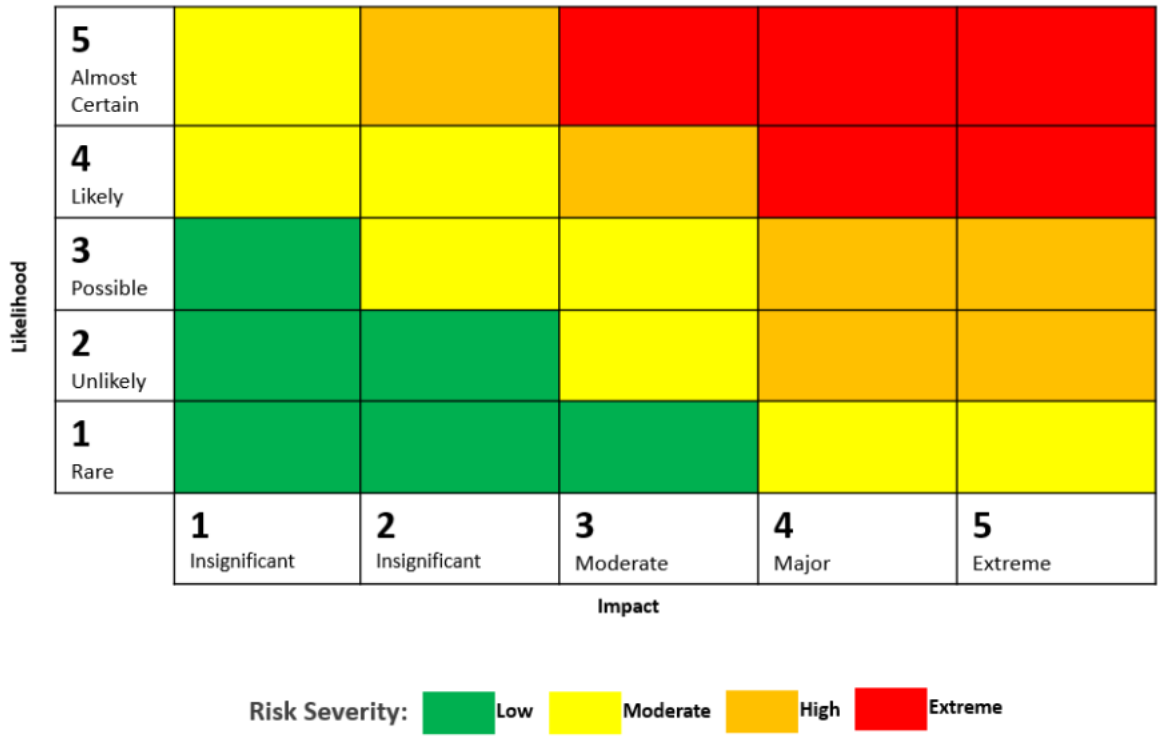
AECOM completed a Risk Model for water, sewer, and drainage assets in 2022, which can be seen in **Appendix C**. Here, a criticality analysis was completed using a triple bottom-line assessment approach looking at the economic, operational, social, and environmental impacts of an asset's failure. Each criticality index consists of individual parameters that when combined, represent the overall criticality, or consequence of failure, of an asset. Through this analysis, assets were given a criticality score ranging from very low to very high.

Criticality scores fed into the risk scores within the model, with risk being the product of the probability of failure (based on condition, age, and demand) and criticality. This methodology of scoring risk follows a modified Level 2 complexity, with multiple consequence categories feeding into the criticality score, but these categories varied from those outlined in the SAMP.

5.4.5 Risk Matrix

The level of risk is determined through plotting the Likelihood against the Impact/Consequence. The level of risk determines the risk tolerance strategy. **Figure 5-1** as copied from the SAMP identifies the Risk Exposure Matrix.

Figure 5-1 Risk Exposure Matrix



The level of tolerance to a risk helps in the development of the risk management response measures and the balancing of the risks to the asset against the risks to the service. **Table 5-6** identifies the tolerability of the risk scale.

Table 5-6 Risk Tolerance Zones

Level of Tolerance	Description
Extreme Risk	The risk is intolerable and must be reduced. The potential for failure must be addressed as a high priority.
Major/High Risk	The risk is manageable, but consequences are experienced upon failure. Monitoring and maintenance actions are required.
Moderate	The risk can be tolerated if it is as low as reasonably practicable. If a cost-effective action can be identified to reduce the risk, then it should be implemented.
Low	The risk is acceptable provided there are replacements and contingencies in place to ensure smooth operations. Run to fail strategies may be provided for non-critical assets.

5.5 Risk Evaluation

Risk evaluation is the review of the identified risk tolerances as presented in the previous section. Actions to manage risks should consider the overall management of the services, not just the minimisation of risk to an asset. If possible, proposed actions should align with other initiatives to:

- Reduce capital investment costs;
- Reduce operating and maintenance costs;
- Reduce business risk exposure;
- Increase effective asset life/value; and,
- Sustain or enhance levels of service.

The risk information in the Risk Register can be used to prioritize investment needs within Sewer and Drainage. High risk assets with very low or negative remaining life should be prioritized for asset replacement. This iteration of the Sewer & Drainage AMP identifies mitigation or treatment actions for both asset and enterprise risks.

5.6 Risk Treatment and Control

Risk Management should be explored further during the development of an updated risk model. The general steps to assess risk are:

- Identify risks to be treated and map defined treatments against them, including elimination of cause, reducing likelihood or consequence by managing risk drivers, sharing, transferring, insuring, outsourcing, etc.
- Identify risk controls to be put in place on an ongoing basis.
- Discuss business continuity / recovery procedures and any gaps / improvements.
- The consideration of risk treatment options will depend on the root cause of the risk. Risk treatment options will include the elimination of the causes of risk, reducing the likelihood or consequences of risk, sharing or transferring the risk to other parties through outsourcing or insuring against the risk or simply accepting the risk.
- The nature of the risk together with an understanding of likelihood and probability will help determine the appropriate strategy to apply to modify the risks. Examples are listed as follows:

High Consequence but Very Low Likelihood Risks – These are typically disaster scenarios, such as earthquake, wildfire in populated areas, outbreak of illness, or extreme flood event. For these risks, contingency plans or emergency plans should be established that will reduce the consequences of the risk.

High Consequence and High Likelihood Risks – These are the highest category of risk and should be eliminated or reduced to a tolerable level. These risks will often require capital interventions, such as upgrading of an infrastructure, fencing, or fire breaks/fire smart activities.

Low Consequences but High Likelihood Risks – These are often about working practices and may require changes to working processes and procedures including potentially outsourcing work to a third party who is better able to manage the risk.

Low Consequence and Low Likelihood Risks – These risks may be recognized and accepted with no further action other than monitoring the risk through regular review.
The success in implementing the strategies developed will be dependent on the City's capacity to be resilient.
Table 5-7 identifies generic risk treatment options, as presented in the SAMP.

Table 5-7 Preliminary Risk Reduction/Treatment Options

Risk Reduction/Treatment Options		Reduce Likelihood	Reduce Consequence
1	Asset renewal	●	
2	Asset rehabilitation	●	
3	New redundant asset		●
4	Enact Policy	●	
5	Develop Standard Operating Procedures	●	●
6	Rigorous maintenance program	●	
7	Enhanced monitoring regime	●	
8	Contingency planning	●	●
9	Staff training	●	●
10	Signage	●	
11	Critical spares inventory		●

Corresponding Risk Treatment Options were developed for the Asset and Enterprise Risks, validated by the Sewer & Drainage AMP Working Group. **Tables 5-8** and **5-9** identify specific treatment options for each Risk.

Table 5-8 Asset Risk Treatment Options

Asset Class	ID	Type of Risk Events	Risk Treatment
Sewer & Drainage	AR.1	Equipment failure.	Perform maintenance as per manufacturer recommendation. Source critical spares.
	AR.2	Service interruption.	Consider adding redundancy into the system. Consider installation of backup generators at critical pump stations.
	AR.3	Major failure such as a main break	Review CCTV data for asset condition and plan for renewals and replacements accordingly.
	AR.4	Pump failure	Perform maintenance as per manufacturer recommendation. Source critical spares.
	AR.5	Blockage	Monitor and maintain assets. Communicate and distribute materials from Metro Vancouver's Unflushables campaign to the public.
	AR.6	Combined Sewer Overflows	Continue following sewer separation program.
	AR.7	Sanitary Sewer Overflows	When planning for asset renewal, assess capacity of mains to determine if upsizing mains or adding to system is required. Monitor flows and investigate/remediate any suspected cross-connections or cracks.
	AR.8	SCADA Failure	Hire SCADA Technician or outsource maintenance. Develop standard operating procedures for SCADA system maintenance.
	AR.9	Damages to or leaks in rigid connection points of assets in Queensborough	Monitor asset elevations to assess any movement and correlate to groundwater levels.

Table 5-9 Enterprise Risk Treatment Options

Asset Class	ID	Type of Risk Events	Risk Treatment
Sewer & Drainage	ER.1	Do not achieve sewer separation targets	Monitor progress annually to ensure rate of separation aligns with 1.5% annual target for mains. Track rate of developer lateral separation and develop contingency plan for case where City intervention is required.
	ER.2	Increase in operating costs	Negotiate fixed long-term fees and adjust sewer rates to accommodate increase, when possible. Communication with Metro Vancouver regarding proposed levies or rate increases. Propose gradual rate increase as early as possible.
	ER.3	Increase to capital expenditure	Prepare financial plan for future asset replacements based on recent capital costs that includes materials and labour and regularly update to account for inflation and market changes.
	ER.4	Inadequate staff resources lead to inefficiencies and accelerated asset failures	Develop a human resource plan identifying required FTE for O&M activities. Plan funding required for hiring and training on an on-going basis.
	ER.5	Inaccurate replacement costs	Maintain a summary of recent constructed works to better estimate future replacement costs. Obtain more data from other municipalities.
	ER.6	Major failure such as a main break	Consider adding redundancy into the system.
	ER.7	Lack of knowledge on existing asset inventory leading to inaccurate estimation of future needs	Set up business flow model whereby new assets are updated in related information systems within a specified timeframe.
	ER.8	Inadequate budget preventing timely rehabilitation or replacement of assets	Prepare financial plan for future asset replacements based on recent capital costs that includes materials and labour and regularly update to account for inflation and market changes.
	ER.9	Inadequate stormwater capacity leading to overflows and localized flooding	When planning for asset renewal, assess capacity of mains relative to projected rainfall in asset lifespan to determine if upsizing mains or adding to system is required.
	ER.10	Inadequate sewer capacity leading to backups and overflows	When planning for asset renewal, assess capacity of mains relative to projected development in asset lifespan to determine if upsizing mains or adding to system is required.
	ER.11	Oversized sanitary mains resulting in septicity and/or blockages	Monitor flow rates of separated mains to ensure sizing is appropriate. Review maintenance requirements of oversized mains to prevent septicity and blockages.

5.7 Risk Monitoring and Review

Monitoring and reviewing risk levels, emerging risks and risk trends is important to manage uncertainty in the delivery of water services. In addition, actions and controls to address risks should be monitored and reviewed for effectiveness. The review process will also require consideration of lessons learned when risks materialize.

The Sewer & Drainage AMP Working Group may wish to host an annual “Risk Review” to capture risks into the Risk Register and jointly discuss the implications and likelihood of risks in context of the City. Risks should be assessed every 5-years to identify changes in risk.

In addition to identifying the risks, the use of a Risk Register identifies the implications of likelihood of risk. It provides actions and indicators to drive and monitor progress. The following items are should be included in the Risk Register, and are identified in the SAMP:

- **Inherent Risk:** The likelihood and impact of the risk without controls in place.
- **Current Risk:** The likelihood and impact of the risk with controls in place.
- **Mitigating Controls:** Identify controls currently in place to mitigate the risk. These controls should be working practices or procedures, checks, alarms, or alternative arrangements.
- **Action Plan:** Determine what can be done to further mitigate the risk.
- **Monitoring:** Identify if and how the risk needs to be monitored and identify if it needs to be reported.
- **Status of the Action:** Identify if the controls are proposed or in progress.

5.8 Risk Applied within the Renewal Forecast

The renewal forecast incorporated risk ratings from the AECOM risk model as a criterion for prioritization, where assets with higher likelihoods and consequences of failure were prioritized for renewal each year.

6 FINANCIAL STRATEGIES

6.1 Financial Policies and Rules

The setting of the annual budget, 5-year rates, and funding forecast are guided by the following financial sustainability principles:

- **Sustainable:** Maintain assets in a state of good repair through reasonable tax/rate hikes without disruptions to services; living within our means;
- **Adaptable:** The ability to change debt levels or leverage reserves; ability to ramp up or down on spending;
- **Stable:** Predictability of the City's sustainable revenue sources, and less reliance on external funding and third-party funding; and
- **Accountable:** Fiscally prudent and responsible; the ability to ensure that the City's financial decisions are in the best interest of all.

Long-term financial planning, 5-Year Financial Plan Bylaw and annual budgeting for the operating and capital budgets processes:

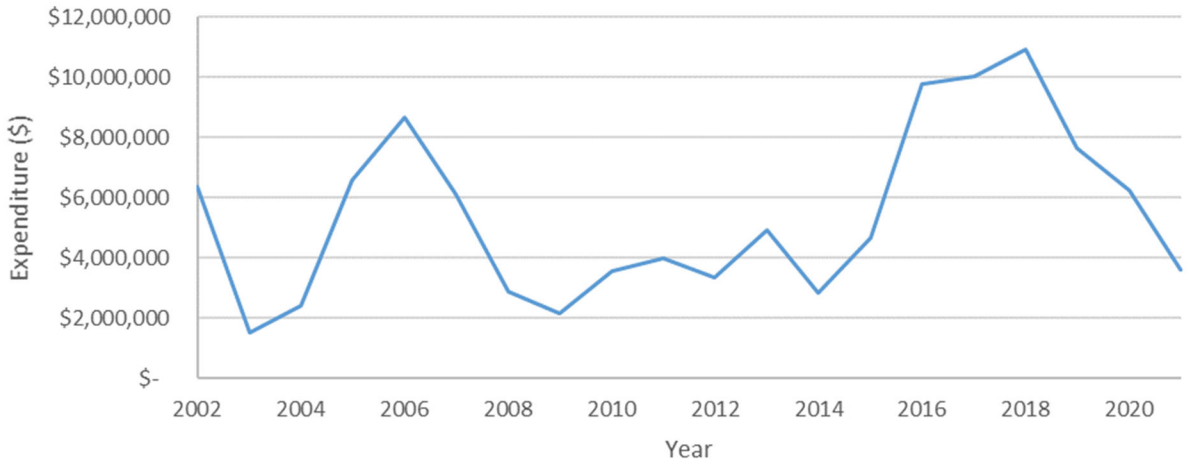
- **30-Year Vision:** guided by the City of New Westminster OCP, AMP and strategic choices about investments, a high-level financial model is created which sets the minimum/maximum levels for reserve and policy;
- **5-Year Financial Plan Bylaw:** from the 30 Year Vision forecast short-term priorities for projects/program spending; forecast rates and other funding sources; create a detailed financial model; and
- **1-Year Budget (Operating and Capital):** starting with the 5-Year Financial Plan, identify the projects with detailed information on the outcomes, estimated spends, delivery strategy and net operating budget enhancements – seek council approval for the projects and associated rate/funding strategy.

6.2 Historical Analysis – Capital Expenditure

6.2.1 Historical Capital Spend (CAPEX)

Figure 6-1 shows the actual capital yearly spend on renewal and upgrade projects from 2002 to 2021. Based on this data, the average historical capital spend from 2002-2021 is $5.42M annually, not accounting for inflation. that values shown include Development Cost Charge (DCC) projects which are partially funded through the DCC program. The implementation of DCC projects are dependent on the development.

Figure 6-1 Historical Capital Spend

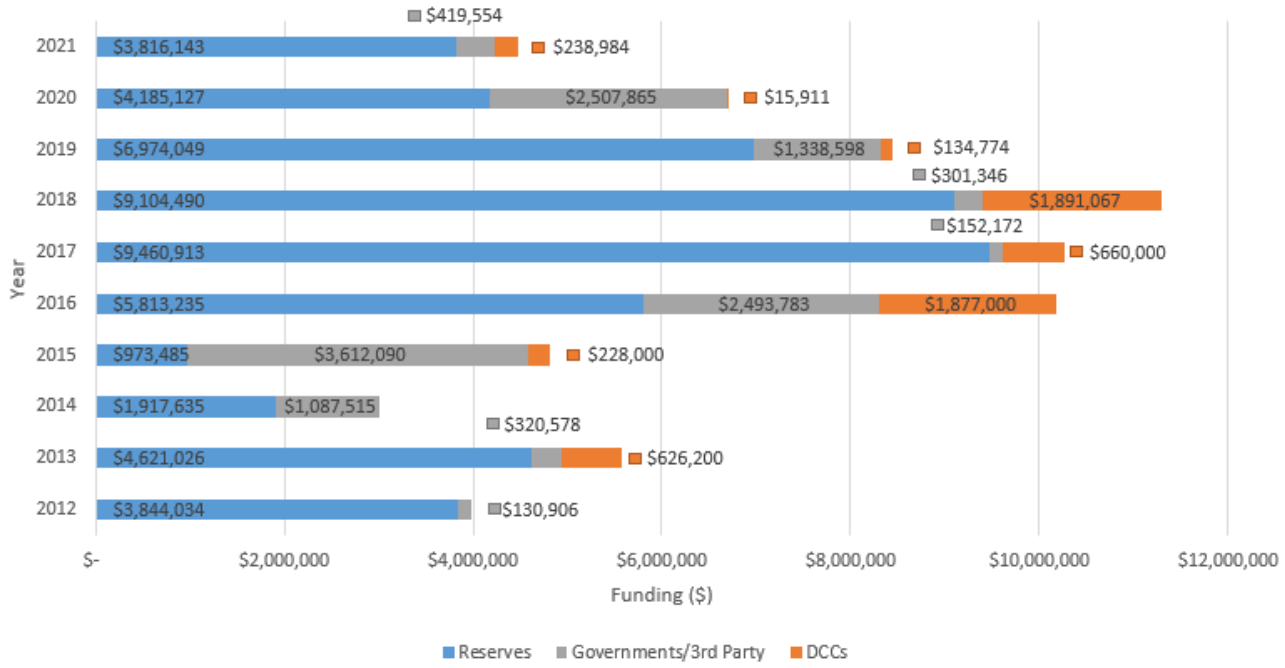


The capital budget for 2023 is set at $8.0M, which includes both asset acquisition and renewal and excludes O&M costs.

6.2.2 Historical Funding Sources

The use of funding sources varies on an annual basis. The use of DCCs is for strictly growth-driven expenses and is used only in years where development-related sewer and drainage system upgrades are completed. The City also makes use of third-party contributions. The primary funding source annually is the Sewer Reserve, which is funded by sewer user fees and sewer fund operating surplus. **Figure 6-2** shows the historical funding sources from 2012 to 2021.

Figure 6-2 Historical Funding Sources

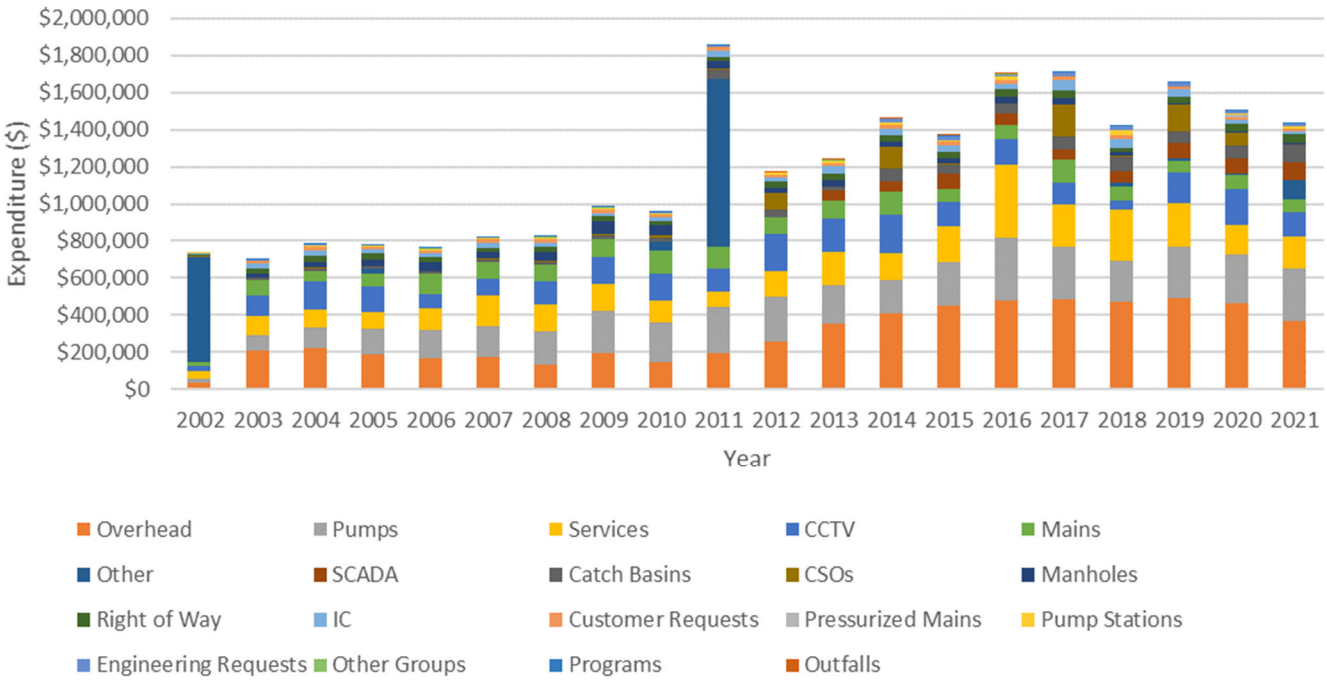


6.3 Historical Analysis – Operational Expenditure

Figure 6-3 presents a summary of the financial requirements needed to maintain the sewer and drainage system. This is based off historical data from JD Edwards provided by the City and categorized by Associated. How the current work orders were categorized for this assessment is summarized in **Appendix E**. Based on this data, the average historical spend from 2002-2021 on O&M activities is $1.17M annually. Note that this data does not account for inflation. As the focus of this AMP iteration was on asset renewal and sewer separation, O&M costs are not incorporated into forecasted expenditures at this time.

Prior to future iterations of the AMP, there is opportunity to better categorize activities in JD Edwards as the integration with Cityworks continues. This would allow for better tracking of maintenance across the organization.

Figure 6-3 Historical Operations & Maintenance Expenditures



6.4 Metro Vancouver Sewer Fees

The City pays annual fees to Metro Vancouver to support regional sewer and drainage infrastructure maintenance and development based on volumes of sewer water sent to the Annacis Island Wastewater Treatment Plant. Changes to these fees, as well as any additional charges or levies put in place by Metro Vancouver, should be proactively monitored and planned for in the capital planning process. Annual data on Metro Vancouver fees was not provided for analysis, but these rates and expenditures are considered outside the Capital Recommendations outlined in this report.

6.5 Asset Valuation

Asset valuation is provided in **Section 2.4**. The asset valuations feed into the renewal forecast.

6.6 Sources of Funding

6.6.1 Reserve Funding

The City strives to hold the following reserves specific to supporting the sewer and drainage utility:

- Provision for future sewer and drainage expenditure
  - Capital infrastructure lifecycle planning of existing assets
  - Sewer rate stabilization against fluctuations in annual spending and Metro Vancouver levies; and
  - 5-10% capital asset replacement value
- Sewer and drainage equipment replacement:
  - Vehicle and IT equipment lifecycle planning of existing assets.
- Sewer DCCs:
  - New sewer or drainage infrastructure as a result of major development; and
  - Developer specific projects and developers funded (funds collected at permit stage for future works).

The reserves aim to support the key strategic objectives and align with the financial sustainability principles in the following ways:

- Address the growing need to renew the City's critical infrastructure and amenities and maintain them in a state of good repair;
- Optimize the City's network of infrastructure and amenities to support economic development and growth; and,
- Advance Council and community priorities in a sustainable and resilient manner.

6.7 Project Funding Requirements

Growing the City's reserves has been identified as an improvement action by the City, as outlined in **Section 7**. An increase in annual expenditure is anticipated in the forecast outlined in the AMP, which will rely on an increase in reserve funding. Key questions to be considered when sourcing these funds include:

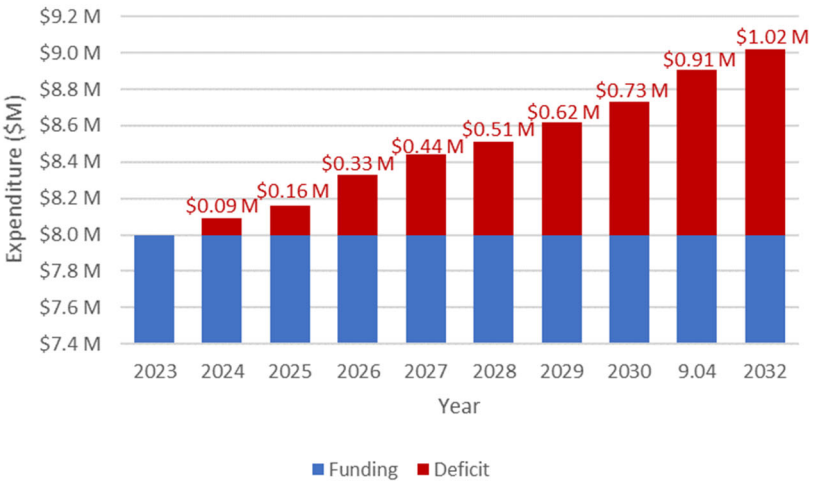
- Current sewer rates, projected future sewer rates, and potential limitations on the extent and speed of rate increases;
- Alternative funding source availability; and
- Overall City reserve and financial policies, including risk appetite for sewer and drainage related financial risk and risk to service delivery.

6.8 The Infrastructure Gap

The identified infrastructure gap shows the 10-year funding deficit, in 2022 dollars, assuming $8M funding is currently secured annually. Based on the anticipated 2023 capital budget of $8.0M, an increase in budget of 1.41% annually before inflation is required to meet sewer separation requirements and maintain existing assets, as seen in **Section 4.1.2.2**. Annual funding needs were identified based on discussions with the City around priorities for renewal, with consideration to asset age and risk. Funding sources to support this annual increase in budget have not yet been secured. Future expenditures above $8.0M per year are a projected deficit, as the secured funding levels are insufficient to meet required capital investment.
Figure 6-4 shows the funding requirement and deficit in the first 10 years of the modified forecast in 2022 dollars. The total funding required over the 10-year period is $84.8M in 2022 dollars. Assuming $8M funding is currently secured annually, the 10-year deficit totals to $4.8M in 2022 dollars.

This projection does not consider operations and maintenance costs, or costs associated with out of scope assets, as the focus on this iteration of the AMP was capital renewals and sewer separation. Additional scopes should be incorporated into forecasting in the next iteration of the AMP. Additionally, this forecasted deficit assumes that the current funding of $8.0M could be maintained with current reserve levels. Available reserves may not meet this funding level annually, making the deficit more significant.

Figure 6-4 10-Year Modified Asset Renewal Forecast



6.9 Reinvestment Scenarios

Reinvestment scenarios are provided in **Section 4**.

6.10 Strategies to Address the Infrastructure Gap

As identified in **Section 4** and **Section 6.8**, a budget increase of 1.41% annually before inflation would address the infrastructure gap for capital works of assets in scope of this AMP, with a total need of $620M (in 2022 dollars) invested by 2075. Funding sources to support this annual increase in budget have not yet been secured. Developing funding strategies has been identified as an improved item in **Section 7.6**.

7 IMPLEMENTATION & CONTINUOUS IMPROVEMENT

The City is committed to continually improving the way assets are managed and how services are delivered. This Sewer & Drainage AMP will require continual improvement of the asset management practices employed as part of the City's asset management journey. To achieve continuous improvement, suggested monitoring controls and governance are included in this section.

7.1 Governance Model

Supporting the continuous improvement for the Sewer & Drainage AMP will involve commitment from active stakeholders engaged in the advancement of asset management at the City of New Westminster. **Table 7-1** identifies roles of the active stakeholders and the governance structure to support the successful implementation of the Sewer & Drainage AMP. Key activities for implementation include:

- Continuously communicating the AMP objectives and strategies which will further advance the culture of asset management;
- Implementing the AMP recommended renewal program and investment;
- Tracking performance against LOS KPIs, including investment outcomes, to determine it outcomes are being achieved and determine where additional supports may be required;
- Implementing the Improvement Plan through multi-departmental initiatives; and
- Reviewing and updating the AMP.

Table 7-1 Sewer & Drainage AMP Governance Structure

Stakeholder	Role
AMP Working Group	This group is comprised of members from the following departments: Infrastructure Planning, Operations, IT, Finance and Design & Construction. This Group is tasked with developing a cohesive AMP that aligns with the City's objectives, and then implementing and monitoring the outcomes related to the AMP.
Asset Management Steering Committee	This group provides direction to the City's overall asset management program and will serve as a key audience of the AMP. This group will support implementation by monitoring implementation progress.
City Council and Executive Team	These groups act as stewards for all City assets and approve the AM policy, establish levels of service delivery, and monitor progress and outcomes.
Engineering Department	This group maintains, inspects and operates the assets. This group is fundamental in achieving service delivery and management of the sewer and drainage assets daily. Asset condition, criticality, risk, decision making, performance, planning, and regulatory compliance are influenced by this department. This group also collects and maintains the asset data.
Finance & IT Departments	This group provides financial and spatial data and develops/supports financial and data management strategies related to the water assets.

7.2 Delivery Risk and Uncertainties

The City faces several uncertainties that main impact effective delivery of the Sewer & Drainage AMP's forecasted approach. Notable risks include:

- **Providing adequate funding for increased capital investment:** In order to deliver the renewal and sewer separation requirements of the forecast, a 1.41% annual increase in budget is required before inflation. This level of expenditure aims to be a balance between affordability and long-term sustainability of assets, both identified levels of service outcomes. Not securing the increased funding could limit the City's ability to achieve the regulated sewer separation deadline or result in a deterioration of asset condition across the portfolio. The high investment needs also make it challenging for the City to build their reserves.
- **Potential additional Metro Vancouver levies or fees:** There is a risk that Metro Vancouver will place additional fees or levies on the City of New West, which would place additional strain on the budget.
- **Providing adequate resourcing for increased capital investment:** Both internal and external resources will need to be bolstered to provide effective system design, coordinate investment planning and construction with other teams, manage projects and contract, and provide enough operations, procurement, human resources, and financial support.
- **Timing and coordination of capital projects:** Successful delivery of the AMP will require effective integration of capital projects from across the City's service areas as each seek to deliver required investment to sustain services. This will require advance definition and scoping of projects, which will have the added benefit of being first-to-market in a high-cost construction environment.
- **Developer intervention in lateral renewal:** a large part of the City's approach to the renewal and separation of laterals is dependent on developer renewals during redevelopment. If redevelopment does not occur at the anticipated rate, or in the necessary areas, the City could be responsible for additional lateral separations to achieve the 2075 sewer separation deadline. Monitoring developer's renewal of lateral assets and revaluating the forecast accordingly will be essential to avoiding any unanticipated costs in the future.

7.3 Implementation Roadmap

The Sewer & Drainage AMP will serve as the guiding document to effectively and efficiently manage the City's sewer and drainage infrastructure. It provides guidance on levels of service, data collection, maintenance, operation, risk, capital and operational planning, and integrates the sewer and drainage assets across departments including Engineering, Finance, and GIS. This document must be useful and relevant to each department.

Table 7-2 identifies recommended activities that support the implementation of the Sewer & Drainage AMP. This table assigns scheduling and responsibility.

Table 7-2 Implementation Activities

Item	Frequency	Accountability for Completion
Endorsement of Sewer & Drainage AMP by the AM Steering Committee. Presentation to, review by and adoption by AM Steering Committee, which includes assigning support to implement the Sewer & Drainage AMP.	3 years	AM Steering Committee, Sewer & Drainage AMP Working Group
Implement Sewer & Drainage AMP Recommendations. Prioritize and plan for the implementation of the Sewer & Drainage AMP recommendations. Assign and review roles and responsibilities, set timelines and milestones	Annual (aligned with capital and operational budget process).	Engineering
Implement Sewer & Drainage AMP Improvement Plan. Prioritize and plan for the implementation of the Sewer & Drainage AMP improvement activities Assign and review roles and responsibilities, set timelines and milestones	Annual (aligned with annual business planning process).	Engineering with support from a wide range of corporate stakeholders
Update Sewer & Drainage AMP to remain current.	Every 5 years.	Sewer & Drainage AMP Working Group
Coordinate, Engage, Collaborate and Communicate the Sewer & Drainage AMP. Implement Standing Meeting Agenda: Condition of assets; Repairs, replacements and renewals of assets; Risk assessment conducted and changes in risk status of assets; and Asset management budgeting.	Quarterly	Sewer & Drainage AMP Working Group
Develop Business Cases. Develop and submit business cases for proposed asset intervention and capital projects as part of the annual budget requests to demonstrate options to address needs and the benefits to service delivery.	Annual	Engineering
Prepare Benefits Summary. Measure the success of projects based on whether CLOS and risk levels have been achieved.	Annually	Sewer & Drainage AMP Working Group
Implement Quality Assurance Audit. Assess the level of effort of the current data collection methods and quality of information.	Annually	Engineering
Review Climate Change Projections. Monitor projected climate data around precipitation and other key indicators to ensure ongoing resilience of the sewer and drainage assets. Incorporate findings into capital plans and revisions to the AMP.	Annually	Engineering; Sewer & Drainage AMP Working Group

Table 7-3 incorporates indicators of AMP success for consideration by the Sewer & Drainage AMP Working Group and the Asset Management Steering Committee.

Table 7-3 Key Indicators of Success

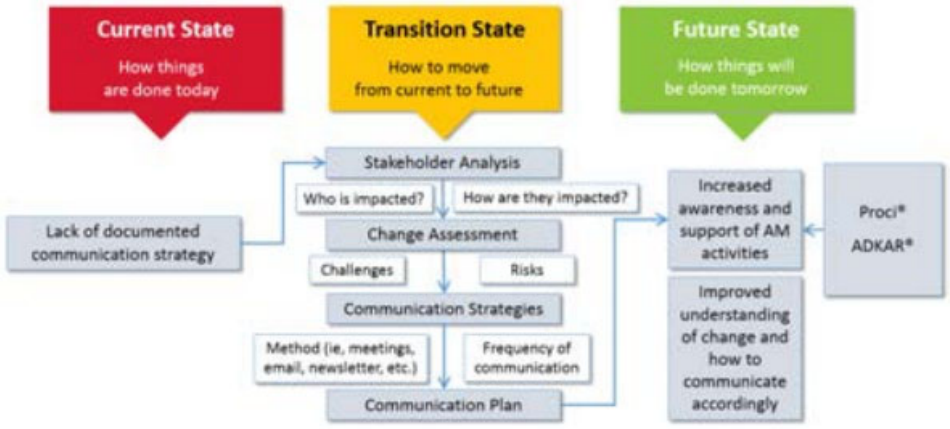
Key Indicator	Detail	Recommended Frequency	Accountability for Completion
Legislative Compliance	100% compliant with legislative requirements.	Every 1 – 2 years	Infrastructure Engineer
Quality of Service	100% compliant with Levels of service targets.	Every 1 – 2 years	Superintendent
Capital Project Delivery	Percent of projects completed on schedule and budget.	Every 1 – 2 years	Infrastructure Engineer
Operational Performance	Percent of operational and maintenance budgets achieved.	Every 1 – 2 years	Superintendent
Risk Management	Number of unplanned risk events.	Every 1 – 2 years	Infrastructure Planning Manager
Benchmarking	Quality of benchmarking to previous years' targets and current years' targets.	Every 1 – 2 years	Asset Management Engineer
Data Reliability	Quality of asset data collected including reliability, consistency across departments and accuracy.	Every 1 – 2 years	Asset Management Engineer

The broader City asset management roadmap is outlined in the SAMP and provides guidance on corporate capability improvements in asset management. Like the Sewer & Drainage AMP implementation activities, these asset management efforts need to be championed and communicated effectively by City Council and the Executive team and resources must be assigned to carry out the activities.

7.4 Change Management & Communication Plan

The SAMP identifies a change management and communication plan initiative to support the transition from the current state of asset management practices in the service area to the desired future state. This initiative should be employed to implement actions within the Sewer & Drainage AMP recommendations and the improvement plan in **Section 7.6**. **Figure 7-1** shows the conceptual model of the change management and communication plan, as outlined in the SAMP.

Figure 7-1 States of Change from SAMP



7.4.1 Change Management

As outlined in the SAMP, the initial focus of change management at the City will be to understand the City's readiness for change and establish an internal stakeholder map and internal communications plan. These help with the understanding of who is impacted by various changes, and how to best communicate these impacts to them. Stakeholders are identified in this AMP in **Section 1.4**. Change management should be an iterative process that integrates with regular project management activities. Employing change management strategies when implementing actions outlined in the AMP will facilitate meeting and/or exceeding the objectives of this AMP.

7.4.2 Communication Plan

Based on the objectives of the AMP, the following messages are key when communicating the importance of AMP implementation in Sewers and Drainage:

- AM provides the opportunity to be more aware of level of service and regulatory requirements;
- The AMP pulls together a variety of service considerations about performance, risk, and cost;
- The AMP projects the capital cost of delivery sewer and drainage services out to 2075;
- The AMP should be a key business planning document and must be integrated into the City's capital plan and operational budget;
- Implementing the AMP can help improve services and reduce risks, and will help the City move to more sustainable service delivery into the future; and
- Implementing the AMP will mean moving towards a more sustainable funding model that will manage risks to residents and businesses and ensure that sanitary and drainage sewer systems function well as the City grows and densifies.

Table 7-4 provides an overall, high-level plan for communicating about and engaging various key stakeholders on the AMP. Communications should focus on key messages but can be tailored according to the specific stakeholder's role, interest, and needs. The communication plan provides tactics to the AMP Working Group for how to best approach and deliver key messages to specific stakeholder groups. This plan can be expanded to additional stakeholders in future AMP iterations, as required.

Table 7-4 Communication Plan

Stakeholder	Role	Interests/Needs	Communication Tactics	Delivery
Asset Management Steering Committee	Support Working Group in AMP implementation; advocate for appropriate resources.	• Financial impacts • Level of service • Alignment with SAMP • Achievement of improvement recommendations • Risk management	• Keep communications concise • Focus on big picture, tradeoffs, and triple bottom line • Show connections and progress made in respect to SAMP • Provide opportunities for feedback	Presentations on AMP updates and progress every three years or more frequently as required.
City Council and Executive Team	Integrate AMP considerations into capital and operating budgets.	• Financial impacts • Level of service • Alignment with overarching City strategy and goals • Investment prioritization • Regulatory requirements • Risk management	• Keep communications concise • Focus on big picture and triple bottom line • Show connections to overarching strategy and goals	Presentations or forwarding of budgets/plans for approval as required.
Engineering Department	Execute AMP requirements in capital works and O&M programs.	• Financial impacts • Training/support • Resource requirements • Ongoing operations • O&M requirements • Capital project scoping & prioritization	• Provide overarching guidance and support on AMP roll-out • Ensure consistency in approach • Focus on program benefits to overall operations and delivery	Meetings to review implementation plan items annually or as required; include necessary individuals in quarterly Working Group meetings.
Sewer and Drainage Service Customers	Pay taxes to fund Sewer & Drainage AMP implementation.	• Financial impacts • Level of service	• Focus on big picture benefits and triple bottom line • Use graphics to display key information	Annual program reporting and service/asset reporting.

7.5 Improvement Plan

The Sewer & Drainage AMP will be in effect over the lifespan of the sewer and drainage infrastructure. This AMP, in its first iteration, has revealed a number of gaps and opportunities for improvement. **Table 7-5** identifies recommendations will help

the Sewer & Drainage AMP evolve and improve its analysis through each iteration. Recommendations for improvements in business process, data and information, technology, governance, and people and capacity are identified based on the process of building this initial Sewer & Drainage AMP.

7.5.1 Improvement Recommendations

The recommendations in **Table 7-5** identify gaps, opportunities, and recommendations for consideration by Sewer & Drainage AMP stakeholders and City leadership. Implementation of these improvement items is critical to generating better information and therefore making better decisions when managing water infrastructure assets.

Table 7-5 Improvement Recommendations

Item	Gap/Opportunity	Recommendation
Regularly monitor and report LOS KPIs.	Understanding the performance of sewer and drainage services and their assets will support long-term planning and evaluation of expenditures based on outcomes.	Implement process changes and enhancements to ensure that each KPI is measurable and effectively measured. This will include documenting service requests through Cityworks and standardizing the approach to managing and documenting work orders.
Develop long term funding strategies.	A 1.41% increase in annual expenditure is anticipated through forecasting, which creates a deficit in the long term when considering the historic budget. Additionally, reserves are currently small and could be built to better manage any emergencies as they arise without derailing the asset renewal and sewer separation plans.	Work with Finance to identify funding strategies to meet expenditure requirements and build reserves. Be proactive in planning for future needs and regularly review strategy and monitor the forecast for change.
Establish benchmarking for LOS indicators.	There is currently limited understanding of current LOS performance against several indicators, or targets that the City should strive for.	Establish what data needs to be collected to track indicators and use it to develop an understanding of the current LOS. Determine what data is currently being collected, and what gaps exist where additional data is required to generate the required reports and establish benchmarking. Once benchmarking is complete, compare findings to levels set out in the NWWBI to identify LOS targets.
Develop a risk register	The risk work completed in the AECOM Model and this iteration of the AMP can be built upon to develop a holistic understanding of asset and enterprise risk in the sewer and drainage service areas.	Develop a sewer and drainage risk register based on previous works and monitor and review the register regularly to deepen the City's understanding of asset and enterprise risks, mitigation measures, and where efforts should be prioritized.

Item	Gap/Opportunity	Recommendation
Integrate available datasets to support lifecycle costing	Work management and financial data is currently not reconcilable through the multiple systems and asset data structures used.	Enable lifecycle costing through reconciliation of financial and work order data. As JD Edwards, GIS, and Cityworks are further integrated, take the opportunity to align the datasets and build a meaningful GL structure that will allow for effective costing of both operational and capital expenditure. Track work orders in Cityworks to assets and move away from standing work orders.
Develop asset acquisition strategy	The Sewer and Drainage group does not have a formalized asset acquisition strategy, as current acquisitions are limited to laterals acquired through development. Inclusion of this in the AMP would align with the SAMP.	Develop an asset acquisition strategy for inclusion in the next iteration of the AMP. This section should identify different avenues of acquisition (i.e. development, donation, "found" assets) as relevant to the Sewer and Drainage group, as well as key processes for the incorporation of acquired assets into asset inventory, O&M planning, and renewal forecasting.
Develop O&M forecasting	O&M forecasting was not included in the scope of this iteration of the AMP, which focused on the capital requirements of separation and renewals. Similar to how renewal requirements were forecasted, the annual O&M expenditure requirements can be identified and aid in resource planning. Inclusion of this in the AMP would align with the SAMP.	Build upon the work done in the initial maintenance management manual which identifies historic time spent on O&M activities to develop an understanding of typical maintenance requirements for different asset types. Understanding the level of effort (cost/resource needs) and frequency of each activity will allow the Working Group to build a forecast of annual O&M requirements for each asset, and the asset portfolio, including new assets. This should be incorporated into the next iteration of the AMP.
Develop asset decommissioning and disposal strategy	A decommissioning and disposal strategy are not included in this iteration of the AMP. Highlighting potential costs or liabilities associated with these activities within the AMP would be beneficial and align with the SAMP.	Develop an asset decommissioning and disposal strategy for inclusion in the next iteration of the AMP. This section should identify key considerations for the decommissioning and disposal of different asset types, including but not limited to costs, environmental considerations, or potential liabilities.
Develop process model	The SAMP identifies a process model as a required component of asset management plans in the City under the Implementation and Continuous Improvement section. Requirements of the process model were unclear at the time of this AMP iteration, so this section was not included.	Confer with the AM Steering Committee and other City resources to clarify requirements of the process model and develop this section in the next iteration of the AMP.

Item	Gap/Opportunity	Recommendation
Increase availability of inspection-based condition data	The majority of condition data used in this iteration of the AMP is age-based. Inspections provide a more accurate view of asset condition, capturing repairs and maintenance performed on the asset. Inspection-based condition data will inform a more accurate renewal forecast.	Mains are inspected using CCTV. Currently, this data is showing for less than half of the sewer mains based on the data provided for this AMP. CCTV data should be reviewed to ensure it is being tagged in a way that captures all lengths of main inspected, and any other assets such as manholes or laterals that may also be captured by the CCTV data. Inspections were completed for pump stations in 2022. The City should review inspection and condition assessment programs for sewer and drainage assets and incorporate opportunistic data collection into regular operations and maintenance activities by providing guidance and structure to complete assessments. Ensure inspection and assessments are repeatable.
Increase understanding of lateral data and strategy around lateral renewals.	Currently, there is limited data on existing laterals and renewal of laterals is assumed to be handled by developers. The limited data and assumptions leave a high level of uncertainty in City understanding of lateral condition and renewal strategy.	The City should review developer requirements regarding asset data provision when building new laterals, to ensure adequate asset information is being provided to inform renewal strategies. Areas of development should be cross-referenced with areas with older or combined laterals to ensure that developers are in fact renewing the required assets. If not, the City should develop a revised strategy for lateral renewal.
Improve asset data overall	Through the process of AMP development, several data improvement opportunities were identified. Recommendations include the following areas of practice: • Data Architecture • Data Lineage • Data Quality	Undertake asset data improvements as detailed in **Section 7.4.2**.
Improve accuracy of key asset attributes	Through the process of AMP development, several data improvement opportunities were identified. Key areas that would benefit from more accurate numbers or tracking include: • CRV;	Develop a strategy to prioritize and address each field. This may include putting in place better practices for initial data capture, data quality management and review, data analysis and reporting, and ongoing maintenance and/or refresh of the data.

Item	Gap/Opportunity	Recommendation
	• Asset age/installation date; • Asset attributes (diameter, materials); • Asset rehabilitation; and, • Sewer separation.	

7.5.2 Data Improvement Plan

Ensuring that asset data is properly catalogued and maintained can reduce the amount of effort required to analyze that data, improve the accuracy of future forecasts, and allow for new kinds of decision-making. The recommendations in this section are primarily focused on the data used by GIS but would apply to any dataset or tool used. There are three main areas of focus for data improvement: data architecture, data lineage, and data quality.

7.5.2.1 Data Architecture and Asset Hierarchy

Table 7-6 summarizes the areas for improvement within data architecture and asset hierarchy.

Table 7-6 Data Improvements

Rationale	Issue Identified	Proposed Solution
Ensuring that there are common structures for data between different assets, to the extent that it is reasonably possible, reduces the amount of effort required to compare and manipulate the data. Keeping data structures (column names and positions) identical between asset types can help reduce the amount of effort required to manipulate or compare assets of different classes in a full inventory of the data.	Utility data follows a local government data model which contains several fields, not all of which are required for each asset. Fields aren't always being used consistently between different inventories for various asset types.	Consistent column use and order for all point and linear assets can be established. Some columns may not be applicable to each asset type (e.g. diameters for fountains, # of ports for hydrants) and could be left blank or hidden but should not be removed as this would cause variation between data structures and increase effort to compare inventories. A metadata catalogue for City utilities is in the work plan for 2023.
Where possible, recording data that can be represented as a quantity numerically instead of as text can reduce the amount of effort required during analysis (e.g. recording "1/2 IN" valve diameters as "0.5", or in metric as "12.7").	Nearly every point asset has many unused or uninformative columns which could be stripped away or combined into a single column.	When creating a common structure, unimportant, uninformative, or very infrequently used columns that are not likely to see more usage can be removed.
Having a single unique identifier for each asset in the inventory is extremely important and will cut down on a large amount of unnecessary re-cataloguing and errors during data analysis.	Each asset type has its own facility ID which may be identical to a facility ID of another asset type (e.g. a main and a system valve may both have a facility ID of "103").	A single unique identifier, either numeric or numeric and text, should be assigned to each asset (e.g. "M103" for a main, "V103" for valves). This could consist of an asset type identifier in addition to the facility ID. Facility ID can remain as its own identifier, so its value isn't lost.
When an asset is partially abandoned or replaced, its unique identifier should not be re-used for the asset replacing it.	Currently, active and partially abandoned or replaced assets can share identifiers, leading to unnecessary difficulties when selecting and sorting those assets.	To capture which asset an abandoned asset has been replaced by or which asset has replaced an abandoned asset, a column should be created for "Preceding/Replacement Asset" with the unique identifier of that asset. A parent/child relationship could also be used to document this.

Rationale	Issue Identified	Proposed Solution
In the assessment completed in this iteration of the AMP, assumptions had to be made based on asset materials to identify which assets had been relined. Correct recording of this information will strengthen data reliability.	Currently, when a main is relined, the install date is replaced with the date of relining and the asset material is replaced with the relining material. This method of updating asset records effectively removes the asset history from the record, making it difficult to know the asset's origin.	When an asset is rehabilitated, such as when a gravity main is relined, this data should be inputted into the "Lined Year" and "Liner Type" columns.
For sewer assets, a key piece of data that is currently not being captured in the datasets is around sewer separation.	Currently, linear sewer infrastructure is flagged as "sewer" or "combined". When a combined sewer asset is separated through the construction of an adjacent drainage main, this flag is not changed, and the asset is still labelled as combined as the laterals are not all yet separated. However, this limits the ability to distinguish sewers which have not undergone any separation.	This could be addressed through the addition of a "wet sewer" label to indicate which assets have been separated (the label could again be changed to "sewer" in the future once all incoming laterals are also separated). However, this method would not effectively track the assets history. A better strategy for tracking this information in the dataset could be the addition of two columns indicating "separation status" and "separation status date" to track the progress of separation for that particular main. GIS and Engineering will need to work together to update the sewer type classification.
Having a common system for assigning locations to assets will also greatly cut down on effort required for future analysis.	Currently, there is a column named "Location" for each asset type that is used infrequently. Mains and laterals tend to use this column more often than point assets.	"Location" should be broken down in the same manner for all asset types, as follows: • Building number • Street (N-S) • Avenue (E-W) The location field would then be populated as follows: "Building Number-Street (N-S)-Avenue (E-W)". This will allow for easier analysis by allowing the user to quickly select all assets along a given street or section of street. If the City uses a common numbering for blocks, this should be included as well.
Non-main assets can be grouped together, potentially by the main they connect to. This grouping would drastically cut down the level of effort required to track or estimate the age	Main records presently identify the start and end manholes connected to them. However, other assets have no fields identifying the connected mains.	System valves, manholes, or laterals could have a column recording the unique identifier of the main they connect to, similar to how mains have

Rationale	Issue Identified	Proposed Solution
of non-main assets and allow for easier grouping of assets into similar projects.	This makes it difficult to estimate asset age where there are gaps, or identify asset groupings for projects, without seeking assistance from a GIS analyst to provide the necessary spatial data.	columns recording the start and end manholes. Alternatively, this could be left as an automated process on an as-needed basis through GIS processing.
If data is not captured when the asset is first acquired/built and added to GIS, it becomes much harder to gather the necessary information and update the asset records.	There are gaps in data within asset records such as size, installation date, or material. This information is not always provided to GIS when an asset record is created.	Ensure adequate and retrievable data (i.e. geometry with attributes that are important to all involved) is provided for all assets through projects, sketches, and emails. Engineering, GIS, and Finance should work together to establish a City standard process for asset record creation or update. More staff resources are required for updating and maintaining data.

7.5.2.2 Data Lineage

Ensuring that the source of the data is clearly recorded, as well as data entry dates and potentially the name of the inputter can help record the path of data as it moves from different sources to different end uses. This can help trace errors and omissions as data is passed from source to end use.

A flowchart of where data originates, how it is recorded, and where it is used can be a helpful tool for visualizing the path of data as it passes through the organization. A flowchart like this can help connect the end users of the data to the people who initially capture or record it to allow for better communication between the users and the people who best understand the extents and limitations of the data being recorded. A flowchart can also help identify if any data has been missed or exists elsewhere during the initial data-discovery phase of a project.

7.5.2.3 Data Quality

Ensuring that data quality is properly maintained reduces the uncertainty of analysis going forward and increases confidence in the results obtained. Improving data quality can include improving the completeness, consistency, timeliness, validity, and accuracy of the data recorded.

- Completeness: ensuring that data is input without gaps for an asset class. Where data is not available, being sure to record "Unknown" instead of leaving the column blank (e.g. The "City-Owned" column should be fully populated for every asset in the inventory).
- Consistency: ensuring that the characteristics captured are recorded in the same manner or that the same characteristics are not represented in different ways (e.g. having both "Ductile Iron" and "DI" tags for main material types, recording "0.5 IN" and "1/2 IN" for valve diameters).
- Timeliness: ensuring that all data is entered in the system in a timely manner, preferably as soon as the data is available. Data should also include a "Data Entry Date" (e.g. only data up to October 2019 was available in the GIS records).
- Validity: ensuring that data in the system reflects the conditions in-the-ground. Regularly 'sanity-checking' this data with staff knowledgeable about the assets can help identify if there are any gaps or errors in the data.
- Accuracy: ensuring that data in the system reflects an appropriate level of knowledge of the assets. This can include clearly labelling where data has been estimated and recording how that data has been estimated.

7.6 Decision-Making Processes and Tools

7.6.1 Decision-Making Criteria

To make optimized asset renewal decisions, key decision-making criteria need to be identified and understood by staff tasked with making the decision, with the CLOS and TLOS in mind. Assets that are compromising the achievement of these objectives may need to be replaced or upgraded or new assets may need to be created. Older assets or assets in poor condition are more likely to fail leading to service impacts. Age and condition can be used as indicators of likelihood to support a risk evaluation. Asset criticality can be used as an indicator of consequence. More critical assets are those that, in the event of failure, may lead to a bigger impact on service levels. This approach to decision-making is summarized in the following sections.

7.6.1.1 Remaining Life

The remaining life of existing assets may be used as an indicator of likelihood of failure. Estimates of remaining life are included in the lifecycle analysis.

- Assets with a very low or negative remaining life may need to be replaced.
- Where condition information is available, the condition assessment should be used to indicate remaining life.
- Where there is no condition information, the age and life expectancy (measured in years) of the asset can be used to evaluate remaining life. This age-based approach needs an understanding of the asset creation date.

The condition of an asset is typically measured on a defined scale, i.e. 1 (excellent) to 5 (almost certain, poor). Condition ratings can trigger or be a factor in triggering treatment solutions. There are two (2) primary methods available to determine remaining life which are both relevant in developing an asset renewal strategy:

1. Age-based approach to calculate deprecation.
2. Condition assessments from suitably trained resources to determine treatment methods or replacement requirements.

Age-Based

Age-based remaining life is determined by adding the date of original installation with the asset's original useful life and then simply taking the difference between this value and the current date. The formula for calculating age-based remaining life is as follows:

Remaining Life = (Date of Asset Installation + Useful Life of Asset) – Date of Asset Assessment

This method assumes an asset will deteriorate at an average rate based on industry standards. If the asset is functioning beyond its originally planned service life, the calculation will indicate a negative value or asset 'backlog'. The backlog indicates the number of years beyond which the asset was originally planned to provide service. This backlog is important from an accounting perspective because it will indicate the asset has fully depreciated in value. The asset may still be in good condition and provide the intended services even though it has a book value of zero.

Assumptions:

- Uses estimated life expectancies for assets and assumes complete renewal at end of service life.

Condition-Based

Conditioned-based remaining life is determined by considering the condition rating, i.e. 1 (excellent) to 5 (poor), and the original useful life of an asset. The condition rating them modifies the remaining life estimate based on the assumed percentages of remaining life.

Assumptions:

This is based on identified condition and modelling of remaining life as follows:

- With full replacement at end of life; and
- With defined investment intervention, i.e. repair, rehabilitation, or renewal based on condition.

7.6.1.2 Asset Criticality

Asset criticality is an indicator of the importance of an asset in relation to the level of service objectives. An indication of asset criticality is included in the lifecycle analysis. The City should continue to review critical assets on an ongoing basis. Critical assets may require preventative maintenance to mitigate failure. In addition, emergency and contingency plans may need to be considered for critical assets. This may include the holding of critical spares or emergency plans.

7.6.1.3 Asset Risk

Asset risk is derived from understanding **remaining life** and **asset criticality** and should be the primary decision-making criteria for determining asset interventions. High risk assets with very low or negative remaining life should be prioritized for asset replacement. High risk assets with a long remaining life should be considered for upgrade or have a contingency plan established. Risk assessment is the central basis for a renewal strategy.

APPENDIX A - CORPORATE AM POLICY

NEW WESTMINSTER

CORPORATE POLICY DOCUMENT — Asset Management Policy

Title	Asset Management		
Prepared by	Asset Management Steering Committee	Doc# 913317	Version 1

1. Purpose To set principles for implementing consistent Asset Management (AM) processes throughout the City of New Westminster (the City).

2. Scope This policy applies to all staff using or managing tangible assets that provide services for the City.

3. Framework This policy sets up a general framework for developing and implementing AM within the City. It is based upon the framework developed by Asset Management BC and consists of a number of steps from broad policy statements through to detailed day-to-day actions that implement AM Plans.

3.1 AM Policy - Sets guiding principles to undertake AM in a structured and coordinated manner; integrates AM into the City's organizational operations

3.2 AM Strategy - Develops structured set of actions aimed at optimizing the infrastructure assets to deliver effective services to the City; Reviews current status, future vision, gap analysis and timeframes

3.3 AM Plans – Outline particular actions and resources required to provide defined levels of service; Identify AM activities (operations, maintenance, renewals, capital works, disposals and etc.); Provide financial forecasts for elements within AM plans

3.4 Implementation – Detailed day-to-day actions required to deliver the defined level of service; Allocation of necessary resources; Establishes measurable performance indicators.

4. Policy

4.1 Background

4.1.1 AM has been identified in the Corporate Strategic Plan as one of the priorities for 2016 to 2018.

4.1.2 At June 20, 2016 Regular Council, City Council directed staff to prepare a Corporate AM Policy to guide and expand the asset management process for all other capital assets.

4.1.3 The City is committed to implementing a systematic asset management methodology in order to apply appropriate AM best practices across the organization. This includes ensuring that assets are planned, created, operated, maintained, renewed and disposed of in accordance with City priorities for service delivery.

4.1.4 AM principles assist in achieving Council's vision of New Westminster as a sustainable, livable and thriving community and the City's Long Term Financial Plan objectives.

4.1.5 There is strong indication from UBCM and all levels of government that access to future infrastructure grant programs will be dependent on whether municipalities have documented AM Programs in place.

4.2 Principles

The City will

4.2.1 Ensure a consistent approach for implementing systematic AM and appropriate AM best-practices throughout all departments.

4.2.2 Take into account the future life cycle costs, relevant legislative requirements together with political, social, economic and environmental considerations in AM.

4.2.3 Consider the implications of climate change while assessing assets and analyzing true costs of long-term service delivery.

4.2.4 Proactively integrate climate mitigation and adaption considerations with AM Strategy.

4.2.5 Maintain organizational accountability and responsibility for asset inventory, condition, use and performance within the planning and operational processes.

4.2.6 Develop AM plans for major asset categories. These plans will be used to update the City's long term financial plan.

4.2.7 Conduct monitoring and inspecting as part of AM to ensure agreed service levels are maintained and to identify asset renewal priorities.

4.2.8 Provide systematic and cyclic reviews to all asset classes and ensure that the assets are managed, valued and depreciated in accordance with appropriate best practice using replacement values; not historical costs.

4.2.9 Engage the community on future service levels of infrastructure planning and maintenance activities, consistent with the corporate public engagement strategies, land use planning, financial planning and reporting.

4.2.10 Ensure staff resources and operational capabilities are identified and optimized; provide training in asset and financial management for relevant staff with an emphasis on multi-disciplinary team learning to build a strong foundation, sustain corporate memory, aid in succession planning and mitigate risks associated with staff turnover.

5. Legislation

- Community Charter (SBC 2003) Chapter 26
- 254/2004 – Municipal Liabilities Regulation
- Local Government Act [RSBC 1996] CHAPTER 323
- Various Federal and Provincial legislation applicable at the asset and corporate levels. Examples: Canada Health Act, Fisheries Act, BC Building Code, BC Drinking Water Protection Regulation, BC Environment Management Act

6. Related Documents

- Asset Management for Local Governments –relating to AGLG Audit Topic 3 (EDMs#966663)
- Master Plans

7. Responsibilities Both Council and staff have roles to play in the support of this policy. Council acts as stewards for all City assets and approves the policy, establishes levels of service delivery, and monitors progress and outcomes. Staff will develop, implement, monitor and review the asset management strategy as well as advance and implement the asset management plans. The asset management program shall be reported to Council and the community on a regular basis.

Approval History

Approved by: City Council	**Date: April 2017**

APPENDIX B - AMP ASSUMPTIONS

Current Replacement Value

CRVs were developed by Associated and the City's Infrastructure Planning Group through a review of CRVs referenced in the AECOM Risk Model, past capital works completed by the City, and tender information from Associated. The CRVs for all assets except pump stations are outlined in the table below. Pump station CRVs were estimated on a station by station basis and are provided in a subsequent table. Where sizes were unknown, the most common size within the asset type was assumed to get the unit cost.

Service Line	Asset Type	Asset Subtype	Size (mm)	CRV	Unit	Comments
Drainage	CB Lead	-	-	$998	/m	Assume 200 mm diameter and shallower depth.
Sewer/ Drainage	Cleanout	-	-	$4,000	each	-
Sewer/ Drainage	Manhole	-	-	$6,825	/m	-
Drainage	Gravity Main	Storm Outfall	300	$4,000	/m	Priced as: Outlet valve (flapper style backflow, duckbill, etc.), moderate erosion protection (riprap and geotextile).
Drainage	Gravity Main	Storm Outfall	375	$5,000	/m	
Drainage	Gravity Main	Storm Outfall	450	$6,000	/m	
Drainage	Gravity Main	Storm Outfall	500	$6,500	/m	
Drainage	Gravity Main	Storm Outfall	525	$6,500	/m	
Drainage	Gravity Main	Storm Outfall	600	$7,000	/m	
Drainage	Gravity Main	Storm Outfall	750	$8,000	/m	
Drainage	Gravity Main	Storm Outfall	900	$9,000	/m	
Drainage	Gravity Main	Storm Outfall	1200	$12,000	/m	
Drainage	Gravity Main	Storm Outfall	1800	$16,000	/m	
Sewer	Gravity Main	Combined Outfall	375	$5,000	/m	
Sewer	Gravity Main	Combined Outfall	450	$6,000	/m	
Sewer	Gravity Main	Combined Outfall	600	$7,000	/m	
Sewer	Gravity Main	Combined Outfall	750	$8,000	/m	
Sewer	Gravity Main	Combined Outfall	900	$9,000	/m	
Sewer	Gravity Main	Combined Outfall	1050	$10,000	/m	
Sewer	Gravity Main	Combined Outfall	1200	$12,000	/m	
Sewer/ Drainage	Gravity Main	Collector	75	$1,171	/m	Cost derived from: AECOM pipe unit cost, plus set cost per m for typical installation costs (based on local Associated tender info).
Sewer/ Drainage	Gravity Main	Collector	100	$1,208	/m	
Sewer/ Drainage	Gravity Main	Collector	150	$1,313	/m	

Service Line	Asset Type	Asset Subtype	Size (mm)	CRV	Unit	Comments
Sewer/ Drainage	Gravity Main	Collector	200	$1,412	/m	City added 5% to this estimated cost.
Sewer/ Drainage	Gravity Main	Collector	250	$1,509	/m	
Sewer/ Drainage	Gravity Main	Collector	275	$1,558	/m	
Sewer/ Drainage	Gravity Main	Collector	300	$1,608	/m	
Sewer/ Drainage	Gravity Main	Collector	375	$1,743	/m	
Sewer/ Drainage	Gravity Main	Collector	350	$1,701	/m	
Sewer/ Drainage	Gravity Main	Collector	400	$1,853	/m	
Sewer/ Drainage	Gravity Main	Collector	450	$1,979	/m	
Sewer/ Drainage	Gravity Main	Collector	500	$2,105	/m	
Sewer/ Drainage	Gravity Main	Collector	525	$2,195	/m	
Sewer/ Drainage	Gravity Main	Collector	600	$2,303	/m	
Sewer/ Drainage	Gravity Main	Collector	650	$2,414	/m	
Sewer/ Drainage	Gravity Main	Collector	675	$2,470	/m	
Sewer/ Drainage	Gravity Main	Collector	Unknown	$1,391	/m	
Sewer/ Drainage	Gravity Main	Collector	700	$2,525	/m	
Sewer/ Drainage	Gravity Main	Collector	750	$2,637	/m	
Sewer/ Drainage	Gravity Main	Collector	825	$2,804	/m	
Sewer/ Drainage	Gravity Main	Collector	900	$2,970	/m	
Sewer/ Drainage	Gravity Main	Collector	1000	$3,193	/m	
Sewer/ Drainage	Gravity Main	Collector	1050	$3,304	/m	
Sewer/ Drainage	Gravity Main	Collector	1200	$3,639	/m	
Sewer	Gravity Main	Combined Siphon	375	$3,320	/m	Assumed double collector pipe cost, plus installation costs per m.
Sewer	Gravity Main	Combined Siphon	450	$3,770	/m	
Drainage	Gravity Main	Storm Siphon	375	$3,530	/m	
Drainage	Gravity Main	Storm Siphon	450	$4,180	/m	
Drainage	Gravity Main	Storm Siphon	750	$5,022	/m	
Drainage	Gravity Main	Storm Siphon	900	$5,658	/m	
Drainage	Inlet	Catch Basin		$2,100	each	-
Drainage	Inlet	Drain		$2,100	each	-
Drainage	Inlet	Lawn Basin		$2,100	each	-

Service Line	Asset Type	Asset Subtype	Size (mm)	CRV	Unit	Comments
Drainage	Inlet	Standard		$2,100	each	-
Sewer	Lateral Line		≤6	$17,382	each	-
Sewer	Lateral Line		>6	$28,970	each	-
Drainage	Lateral Line		≤6	$17,382	each	-
Drainage	Lateral Line		>6	$28,970	each	-
Sewer	Network Structure	Bypass Chamber		$50,000	each	Values from AECOM Risk Model
Sewer	Network Structure	Diversion Chamber		$50,000	each	
Drainage	Network Structure	Inspection Chamber		$10,000	each	
Sewer	Network Structure	Inspection Chamber		$50,000	each	
Drainage	Network Structure	Other Chamber		$10,000	each	
Sewer	Network Structure	Other Chamber		$50,000	each	
Drainage	Open Drain			$100	/m	
Sewer	Pressurized Main		≤200	$1,494	/m	Estimated CRV, plus an additional 15% to account for valves.
Sewer	System Valve	Check				CRV incorporated into that of pressurized mains as valves were not included in the forecasted inventory.
Sewer	System Valve	Gate				
Sewer	System Valve	Isolation				
Sewer	System Valve	Plug				

The following table summarizes the CRVs used for pump stations. Pump Station CRVs are detailed in Associated Engineering's 2023 Pump Station Condition Assessment Report.

Pump Station ID	CRV ($k)
DG-1	$7,289
DG-2	$6,706
DG-3	$7,289
DG-4	$7,289
DG-5	$2,511
SA-1	$401
SA-2	$401
SA-3	$401
SA-4	$401
SA-5	$401
SA-6	$401
SA-7	$401
SA-8	$401
SA-9	$401
SA-10	$401
SA-11	$699
SA-12	$423
SA-13	$1,142
SA-14	$578
SA-15	$2,273
SA-16	$1,330
SA-17	$887
SA-18	$330
SA-19	$330
SA-20	$330
SA-21	$494
SA-22	$366
SA-23	$699
SA-24	$366

Pump Station ID	CRV ($k)
SA-25	$330
SA-26	$286
SA-27	$401
SA-28	$1,142
SA-29	$584
SA-30	$1,230
Hume Park PS	$224
Pier Park PS	$224
QCC PS	$303
Quayside PS	$179

Estimated Service Lives

ESLs were developed by Associated and the City's Infrastructure Planning Group through a review of ESLs referenced in the AECOM Risk Model, and further specification of ESLs according to material type based on engineering judgement. The table below shows the ESLs referenced in the AMP.

Service Line	Asset Type	Asset Subtype	Material	ESL (Years)	Comments
Drainage	CB Lead			80	
Sewer/ Drainage	Cleanout			80	
Sewer/ Drainage	Discharge Point	Outfall		80	
Sewer	Discharge Point	Overflow		80	
Drainage	Discharge Point	Standard Outlet		80	
Sewer	Gravity Main	Collector	AC	70	
Drainage	Gravity Main	Collector	ALUM	80	Likely corrugated steel
Sewer	Gravity Main	Collector	CIP	50	Assume material indicates relined pipe.
Sewer	Gravity Main	Collector	CIPP	50	
Drainage	Gravity Main	Collector	CMP	80	
Sewer/ Drainage	Gravity Main	Collector	CONC	80	Assume non-reinforced
Drainage	Gravity Main	Collector	CSP	50	
Sewer/ Drainage	Gravity Main	Collector	DI	70	

Service Line	Asset Type	Asset Subtype	Material	ESL (Years)	Comments
Sewer	Gravity Main	Collector	FF	50	Assume material indicates relined pipe.
Sewer/ Drainage	Gravity Main	Collector	HDPE	100	
Sewer	Gravity Main	Collector	Other	80	
Drainage	Gravity Main	Collector	PE	80	
Sewer/ Drainage	Gravity Main	Collector	PVC	80	
Sewer/ Drainage	Gravity Main	Collector	RC	100	
Drainage	Gravity Main	Collector	RCP	100	
Sewer/ Drainage	Gravity Main	Collector	STEEL	70	
Drainage	Gravity Main	Collector	UL	80	Not typically a pipe material; likely PVC.
Sewer	Gravity Main	Collector	VC	80	
Sewer/ Drainage	Gravity Main	Collector	VIT	80	
Drainage	Gravity Main	Collector	WYE	80	Not typically a material type; other
Sewer/ Drainage	Gravity Main	Outfall	CONC	80	Assume non-reinforced (100 if RCP).
Drainage	Gravity Main	Outfall	PE	70	
Drainage	Gravity Main	Outfall	PVC	70	
Drainage	Gravity Main	Outfall	RC	100	
Sewer	Gravity Main	Outfall	SP	80	SP type unknown; assume 80 years.
Drainage	Gravity Main	Outfall	STEEL	50	Service life would be longer if coated.
Sewer	Gravity Main	Outfall	VIT	50	Concern about VC pipe breaking as part of an outfall.
Drainage	Gravity Main	Siphon	CONC	80	Assume non-reinforced (100 if RCP).
Drainage	Gravity Main	Siphon	PVC	80	
Sewer	Gravity Main	Siphon	VIT	80	VC
Drainage	Inlet	Catch Basin		80	

Service Line	Asset Type	Asset Subtype	Material	ESL (Years)	Comments
Drainage	Inlet	Drain		80	
Drainage	Inlet	Lawn Basin		80	
Drainage	Inlet	Standard		80	
Sewer	Lateral Line		PVC	80	
Sewer	Lateral Line		Asbestos Cement	70	AC
Sewer	Lateral Line		HDPE	100	
Drainage	Lateral Line		PVC	80	
Sewer	Lateral Line		Vitrified Clay	80	VC
Sewer/ Drainage	Lateral Line		Unknown	80	
Sewer/ Drainage	Manhole		CIP	50	
Sewer/ Drainage	Manhole		CONC	80	
Sewer/ Drainage	Manhole		Precast Concrete	80	
Sewer/ Drainage	Manhole		RC	100	
Drainage	Manhole		HDPE	100	
Drainage	Manhole		STEEL	70	
Sewer	Network Structure	Bypass Chamber		80	Variable, by inspection.
Sewer	Network Structure	Diversion Chamber		80	
Sewer, Drainage	Network Structure	Inspection Chamber		80	
Sewer, Drainage	Network Structure	Other Chamber		80	
Sewer, Drainage	Network Structure	Pump Station		60	60-year service life for structure; but bulk of components would require early replacement.
Drainage	Open Drain			80	
Sewer	Pressurized Main	AC		70	
Sewer	Pressurized Main	DI		70	
Sewer	Pressurized Main	HDPE		100	
Sewer	Pressurized Main	PVC		80	

Service Line	Asset Type	Asset Subtype	Material	ESL (Years)	Comments
Sewer	System Valve	Check		40	
Sewer	System Valve	Gate		40	
Sewer	System Valve	Isolation		40	
Sewer	System Valve	Plug		80	

Installation Date Estimates

Asset age was determined based on installation dates in the data sets. Installation dates for assets were determined in the following manner:

1. Where available, the asset age used in the AECOM Risk Model was used.
2. If unavailable, the installation date in the City's GIS database was referenced.
3. For mains, if there was no asset age outlined in the risk model or GIS database, the age of the nearest manhole was used.
4. Finally, for any outstanding age data requirements, the average age of the asset type based on available data was used.

Age-Based Condition Ratings

The table below shows how condition ratings were determined from asset installation date and ESL, according to their % of remaining service life.

Condition Grade	% of Remaining Service Life	Canadian Infrastructure Report Card
1: Very Good	>90%	The asset is fit for the future. It is well maintained, in good condition, new or recently rehabilitated.
2: Good	60%-90%	The asset is adequate. It is acceptable and generally within the mid-stage of its expected service life.
3: Fair	30%-60%	The asset requires attention. The asset shows signs of deterioration and some elements exhibit deficiencies.
4: Poor	10%-30%	There is an increasing potential for its condition to affect the service it provides. The asset is approaching the end of its service life, the condition is below the standard and a large portion of the system exhibits significant deterioration.
5: Very Poor	<10%	The asset is unfit for sustained service. It is near or beyond its expected service life and shows widespread signs of advanced deterioration. Some assets may be unusable.
Unknown		Not enough data exists to respond.

Determination of Combined vs. Wet Sewer Mains

As detailed in **Section 7.4.2**, the City's inventory currently does not distinguish which combined gravity mains have effectively been separated through the construction of drainage gravity mains. Combined laterals may still feed into these mains, so they are considered "wet sanitary" instead of sanitary mains.

In order to distinguish between wet sanitary and combined mains in the data provided, Associated reviewed the spatial data in GIS and identified any combined mains with parallel drainage mains. It was assumed that the two mains running side by side indicates that the combined main is in fact wet sanitary.

Section 7.4.2 provides recommendations on how to clarify which mains have undergone separation within the asset inventory moving forward.

Forecasting Assumptions

Annual Expenditure

The annual expenditure in the Modified Forecast was split in the first year with 70% annually dedicated to sewer separation costs, and 30% annually dedicated to asset renewal and rehabilitation. This split varied slightly over the forecast, with the amount going towards renewals and rehabilitation increasing at a higher rate to maintain an average condition of fair.

Asset Renewal

Asset renewal was prioritized in the following order, established through discussion with the City:

Priority #	Description	Rationale
Priority #1	Pump station capital maintenance and renewal program costs.	Through the work completed by Associated Engineering in the Pump Station Condition Assessment Report, a 50-year capital works program was developed. The City indicated that the capital maintenance and renewals as identified in this program were a priority for them, so these costs were built into the annual renewal budget as laid out in the Pump Station Condition Assessment Report.
Priority #2	Renewal of assets past their expected service life in 2023, according to % beyond ESL and risk.	If any renewal budget remained after Priority 1, the asset backlog was addressed in order of % beyond ESL. Where % beyond ESL was identical, risk scores were used to determine order of renewal (risk scores were taken, for assets where provided, from the AECOM Risk Model, and consider both asset criticality and probability of failure which is derived from both condition and demand).
Priority #3	Renewal of gravity mains at the end of their service life going forward, in order of risk.	If any renewal budget remained after Priorities 1 and 2, the renewal of gravity mains that had reached their ESL was addressed. Where multiple gravity mains had met their ESL, risk scores were used to determine order of renewal.
Priority #4	Renewal of other asset types at end of expected service life going forward, in order of risk.	If any renewal budget remained after Priorities 1-3, remaining assets from other asset categories in very poor condition were addressed in order of risk score.
Priority #5	Renewal of laterals at the end of expected service life going forward, in order of risk.	Any outstanding renewal budget after Priorities 1-4 were addressed went to the renewal of laterals at the end of their service lives. Where multiple laterals had met their ESL, risk scores were used to determine order of renewal. The City indicated that they aim to renew ~25-30 laterals annually based on customer reported condition. However, several laterals in the model are renewed annually through redevelopment at developer cost so most laterals in poor to very poor condition were addressed in that way.

Laterals

As mentioned above, the model assumed that 600 laterals annually are renewed through developer intervention during redevelopment. This value was arrived at through discussion with the City based on the rate of development of approximately 6,000 houses per decade between 2013 and 2031. The figure below, excerpted from the OCP, shows the anticipated City-Wide growth that was used to make this assumption. Developers are required to replace any combined laterals with both sewer and drainage laterals during redevelopment. Based on the rate of development, the City assumes that this will address the separation of laterals. The cost of connection of any new drainage laterals is assumed to be covered in the CRVs of drainage gravity mains.

Figure 11.
New Westminster's Anticipated City-Wide Growth
Source: Coriolis Consulting Corp, City of New Westminster Urban Development Forecast – 2013 to 2041.

Year	2013	2021	2031	2041
Total Population	68,280	79,061	92,098	103,871
Total Housing Units	31,611	36,602	42,638	48,088
Total Jobs	24,845	Not Available	Not Available	46,030

Note: Jobs discussed in this section reflect any employment position, not just full-time positions.

APPENDIX C - AECOM RISK MODEL

APPENDIX D - AMP WORKSHOP OUTPUTS

APPENDIX E - WORK ORDERS

The table below contains the work orders assessed in **Section 6.3** of the report, indicating how they were categorized by Associated for review. Note that the Work Orders are listed as they appear in JD Edwards and may contain typos or inconsistencies in formatting.

Category	Work Order
Catch Basins	CB Clean & Inspect - Inhouse
CCTV	2015 Sewer CCTV - Contract
	2016 Sewer CCTV - Contract
	2017 Sewer CCTV - Contract
	2018 Sewer CCTV - Contract
	2018 Sewer CCTV - Contract
	2020 Sewer CCTV - Contract
	2021 Sewer CCTV - Contract
	2022 Sewer CCTV - Contract
	C.C.T.V. - Capital Program
	CCTV Sewer Mains
	T.V. Inspect Sewer - Contract
	T.V. Inspect Sewer - Inhouse
	T.V. Inspect Sewer Services
CSOs	CSO Facility Operation
	CSO Inspections
	CSO Tank Operating Costs
Customer Requests	Customer Requests - Sewer
Engineering Requests	Engineering Requests - Sewer
IC	IC Service Box Maintenance
	IC Service Box Maintenance
	IC/Service Box Maintenance
Mains	Clear Blocked Sewer Mains
	Repair main 707 Hamilton St.
	Root Cut Sewer Mains
	Sewer Main Valve Maintenance
	Sewer Mains Clean & Inspect

Category	Work Order
Manholes	Drop Manholes Clean & Inspect
	Locate Sewer Manholes
	Sewer m hole GPS Program 2006
	Sewer m hole GPS Program 2006
	Sewer Manholes Clean & Inspect
Other	1002-1020 Auckland
	123 on Street
	139 Carroll Cap Sewer Non-reus
	1406 Nanaimo St Lower Sewer
	2102 Hamilton Sewer Repair
	715 Sixth Str. Emergency Sew
	930 Eighth Str. Lower Sewer
	Cap Sewer 446 Buchanan Avenue
	Cap Sewer Reuse 2103 Hamilton
	Diesel Spill - Braid Street
	Ewen Ave. Phase 3 C.O. 06
	Ewen Ave. Phase 3 C.O. 07
	Lower Sewer 1511 London St.
	Port Metro Site 433 Boyd ST
	Q.B. bridge fire Oct 2017
	Repair Sewer 12th Str. at 6th Ave.
	Repair Vehicle Damage SA-3
	Voltage conversion SA14-BCH re
Other Groups	Hauling Spoils For Parks
	Mowing For Parks
	Sewer Work For Parks
	Work for Fire
	Work for Parks
	Work for Police
Outfalls	Church Outfall - SSO
	Outfall License Payment FRPA
Overhead	03/04 Retro Pay - Sewer Ops
	Acting Supervisor - Sewer

Category	Work Order
	Cel Phone Costs - Sewer
	COVID-19
	Eng. Ops. Gravel Stockpile
	Enviro Education Sewer
	Fire Extinguisher Mtce.-Sew
	Genset Maintenance
	Medical Examination for M.E.
	Medium Term Sick Leave
	Month Chg Out Rate Sewer
	Other - Dr. Appt Etc.
	Predicted time sheets-sewer
	Purchase Tailboard Forms
	Railway Crossing Permits-Sewer
	Retro 2007
	Retro Pay
	Retro Pay 2016/17
	Sewer Conserv&Environ Outreach
	Sewer Generator Chargeouts
	Sewer Laptops
	Sewer Radio Licence
	Sewer Telephone costs
	Sewer Truck 931 Float
	Sewer Truck 932 Float
	Sewers Safety Meetings
	Sewers Vehicle Chargeouts
	Short Time
	Small Equip. Mtce - Sewer
	Spoils to Landfill
	Standby
	Statutory Holidays
	To Refund Flat Rate 1839Dublin
	Tools & Supplies - Sewer
	Tools & Supplies - Sewer

Category	Work Order
	Training - Sewer
	Union Recoverable
	Unit 345 50%of Costs to Sewer
	Vacation
	WCB
	Worksyard Allocation - Sewer
	Yard Allocation Costs - Sewer
Pressurized Mains	Force Main tie in at 728 Ewen
Programs	City Events - Sewer
Pump Stations	Sewer P.S. Grounds Mtce
	Sewer P.S. Building Mtce
	Stanley St. P.S. Legal Work
Pumps	Sewer Pump Clean & Inspect
	Sewer Pump Energy Costs
	Sewer Pump Repairs & Servicing
Right of Way	Sewer ROW Cutting - Contract
	Sewer ROW Debris Cleaning
	Sewer ROW Gate & Sign Mtce
	Sewer ROW Vegetation Control
SCADA	SCADA Maintenance
	Scada Repairs & Upgrades
	WPS Scada Tech Support
Services	319 Louellen New sewer service
	621 12th Str. New Sewer Service
	Clear Blocked Sewer Services
	Locate Sewer Services
	Root Cut Sewer Services
	Sewer Service Clean & Inspect
	Sewer Service Repair

APPENDIX F - MAINTENANCE MANAGEMENT MANUAL