THE CORPORATION OF THE CITY OF
BRANTFORD

# 2021 Asset Management Plan Environmental Services

## Public Works Core Assets
## City of Brantford, Ontario


Prepared by: Infrastructure Planning Asset Management, Public Works
Corporation of the City of Brantford, August 2021

# RECORD SHEET

| Asset Management Document Set | Asset Group | First Issuance |
|---|---|---|
| **Strategic Asset Management Policy** | All | May 2019 |
| **Asset Management Plan Overview** | Core Assets | September 2021 |
| **Asset Management Plan, Core Assets** | Transportation | September 2021 |
| **Asset Management Plan, Core Assets** | Environmental Services | (this document) |
| **Asset Management Plan Overview** | Non-Core Assets | July 1, 2024 |
| **Asset Management Plan, Non-Core Assets** | Facilities<br>Fleet & Transit<br>Parks & Recreation<br>Housing<br>Fire Services<br>Local Boards<br>Economic Development and Tourism<br>IT Services | July 1, 2024 |

# ASSET MANAGEMENT PLAN ENVIRONMENTAL SERVICES

## TABLE OF CONTENTS

**ENVIRONMENTAL SERVICES INTRODUCTION ... 8**

**1. WATER ASSETS ... 10**

1.1. INTRODUCTION ... 10
1.2. WATER ASSETS' DATA INVENTORY AND CONDITION APPROACH ... 10
1.2.1. SERVICE LIFE ... 13
1.2.2. CONDITION SCORING ... 14
1.3. SUMMARY OF WATER ASSETS ... 16
1.3.1. TOTAL SUMMARY OF ASSETS ... 16
1.3.2. WATER TREATMENT PLANT (WTP) SITE ... 18
1.3.3. WATER STORAGE & PUMP STATION FACILITIES ... 20
1.3.4. WATERMAIN ... 22
1.3.5. WATER SERVICES ... 23
1.3.6. FIRE HYDRANTS ... 24
1.3.7. CHAMBERS ... 25
1.3.8. VALVES ... 26
1.3.9. WATER METERS ... 27
1.4. LIFECYCLE OF WATER ASSETS ... 28
1.4.1. KEY LIFECYCLE STAGES OF WATER ASSETS ... 28
1.4.2. LIFECYCLE ACTIVITIES ... 31
1.4.3. RISKS OF LIFECYCLE ACTIVITIES ... 32
1.4.4. 10 YEAR LIFECYCLE COSTS OF WATER ASSETS ... 34
1.5. CURRENT LEVELS OF SERVICE ... 37
1.5.1. O.REG 588/17 CUSTOMER LEVELS OF SERVICE ... 37
1.5.2. O.REG 588/17 TECHNICAL LEVELS OF SERVICE ... 40
1.5.3. MUNICIPALLY DEFINED CUSTOMER LEVELS OF SERVICE ... 41
1.5.4. MUNICIPALLY DEFINED TECHNICAL LEVELS OF SERVICE ... 42
1.6. CURRENT ASSET PERFORMANCE ... 49

1.6.1. WATER FACILITY CURRENT ENERGY PERFORMANCE ...................... 49
1.6.2. WATER FACILITY CURRENT OPERATING PERFORMANCE ................ 50
1.7. DISCUSSION & CONCLUSIONS ................................................................ 51
**2. WASTEWATER ASSETS ..................................................................... 53**
2.1. INTRODUCTION ......................................................................................... 53
2.2. WASTEWATER ASSETS’ DATA INVENTORY AND CONDITION APPROACH 53
2.2.1. SERVICE LIFE ......................................................................................... 57
2.2.2. CONDITION SCORING ............................................................................ 58
2.3. SUMMARY OF WASTEWATER ASSETS ..................................................... 59
2.3.1. TOTAL SUMMARY OF ASSETS ................................................................ 59
2.3.2. WASTEWATER TREATMENT PLANT (WWTP) SITE .............................. 61
2.3.3. WASTEWATER PUMP STATIONS ........................................................... 62
2.3.4. FORCEMAIN ............................................................................................ 63
2.3.5. WASTEWATER GRAVITY (SEWER) MAIN .............................................. 64
2.3.6. WASTEWATER SERVICES ...................................................................... 65
2.3.7. WASTEWATER MAINTENANCE HOLES ................................................. 66
2.3.8. SIPHONS .................................................................................................. 67
2.4. LIFECYCLE OF WASTEWATER ASSETS ..................................................... 68
2.4.1. KEY LIFECYCLE STAGES OF WASTEWATER ASSETS ........................ 68
2.4.2. LIFECYCLE ACTIVITIES .......................................................................... 71
2.4.3. RISKS OF LIFECYCLE ACTIVITIES ......................................................... 72
2.4.4. 10 YEAR LIFECYCLE COSTS OF WASTEWATER ASSETS .................. 74
2.5. CURRENT LEVELS OF SERVICE ................................................................ 77
2.5.1. O.REG 588/17 CUSTOMER LEVELS OF SERVICE ................................ 77
2.5.2. O.REG 588/17 TECHNICAL LEVELS OF SERVICE ................................ 81
2.5.3. MUNICIPALLY DEFINED CUSTOMER LEVELS OF SERVICE ............... 82
2.5.4. MUNICIPALLY DEFINED TECHNICAL LEVELS OF SERVICE ................ 83
2.6. CURRENT ASSET PERFOMANCE ............................................................... 89
2.6.1. WASTEWATER FACILITY CURRENT ENERGY PERFORMANCE ......... 89

2.6.2. WASTEWATER TREATMENT CURRENT OPERATING PERFORMANCE 91
2.7. DISCUSSION & CONCLUSIONS ........ 92
**3. STORMWATER ASSETS ........ 94**
3.1. INTRODUCTION ........ 94
3.2. STORMWATER ASSETS' DATA INVENTORY AND CONDITION APPROACH 94
3.2.1. SERVICE LIFE ........ 97
3.2.2. CONDITION SCORING ........ 98
3.3. SUMMARY OF STORMWATER ASSETS ........ 100
3.3.1. TOTAL SUMMARY OF ASSETS ........ 100
3.3.2. STORMWATER STRUCTURES ........ 102
3.3.3. STORMWATER POND ........ 103
3.3.4. STORMWATER GRAVITY (SEWER) MAIN ........ 104
3.3.5. INLETS ........ 105
3.3.6. STORMWATER MAINTENANCE HOLES ........ 106
3.3.7. STORMWATER SERVICES ........ 107
3.3.8. OIL & GRIT SEPARATORS ........ 108
3.3.9. FLOOD GATES & LEVEE ........ 109
3.3.10. OUTFALLS ........ 110
3.3.11. DITCHES ........ 111
3.4. LIFECYCLE OF STORMWATER ASSETS ........ 112
3.4.1. KEY LIFECYCLE STAGES OF STORMWATER ASSETS ........ 112
3.4.2. LIFECYCLE ACTIVITIES ........ 115
3.4.3. RISKS OF LIFECYCLE ACTIVITIES ........ 117
3.4.4. 10 YEAR LIFECYCLE COSTS OF STORMWATER ASSETS ........ 118
3.5. CURRENT LEVELS OF SERVICE ........ 121
3.5.1. O.REG 588/17 CUSTOMER LEVELS OF SERVICE ........ 121
3.5.2. O.REG 588/17 TECHNICAL LEVELS OF SERVICE ........ 125
3.5.3. MUNICIPALLY DEFINED CUSTOMER LEVELS OF SERVICE ........ 125
3.5.4. MUNICIPALLY DEFINED TECHNICAL LEVELS OF SERVICE ........ 126

3.6. CURRENT ASSET PERFOMANCE ... 130
3.6.1. STORMWATER FACILITY CURRENT ENERGY PERFORMANCE ... 130
3.6.2. STORMWATER TREATMENT CURRENT OPERATING PERFORMANCE 130
3.7. DISCUSSION & CONCLUSIONS ... 132

## TABLE OF TABLES

Table 1: Asset Type Breakdown ... 9
Table 2: Water Assets’ Inventory, Replacement Cost and Condition Origin and Data Confidence Level ... 11
Table 3: Water Assets' Estimated Service Life ... 14
Table 4: Condition Score Description ... 15
Table 5: Total Summary of Water Assets ... 17
Table 6: Lifecycle Activities for Water Assets ... 31
Table 7: O.Reg 588/17 Water Technical Levels of Service ... 40
Table 8: Municipally Defined Customer Levels of Service ... 41
Table 9: Water Distribution KPIs from NWWBI ... 43
Table 10: Water Treatment KPIs from NWWBI ... 45
Table 11: Newly Defined Level of Service KPIs ... 47
Table 12: Current Energy Performance of Water Facilities ... 49
Table 13: Wastewater Assets' Inventory, Replacement Cost, and Condition Origin and Confidence Levels ... 54
Table 14: Wastewater Assets' Estimated Service Life ... 57
Table 15: Condition Score Description ... 58
Table 16: Total Summary of Wastewater Assets ... 59
Table 17: Lifecycle Activites for Wastewater Assets ... 71
Table 18: O.Reg 588/17 Wastewater Technical Levels of Service ... 81
Table 19: Municipally Defined Customer Levels of Service ... 82
Table 20: Wastewater Collection Level of Service KPIs ... 84
Table 21: Wastewater Treatment Level of Service KPIs ... 85
Table 22: Newly Defined Level of Service KPIs ... 87
Table 23: Current Energy Performance of Wastewater Facilities ... 90
Table 24: Stormwater Assets' Inventory, Replacement Cost, and Condition Origin and Confidence Levels ... 95
Table 25: Wastewater Assets' Estimated Service Life ... 98
Table 26: Condition Score Description ... 99
Table 27: Total Summary of Stormwater Assets ... 100
Table 28: Lifecycle Activities for Stormwater Assets ... 115
Table 29: O.Reg 588/17 Stormwater Technical Levels of Service ... 125

Table 30: Municipally Defined Customer Levels of Service ........ 126
Table 31: Stormwater Collection NWWBI KPIs ........ 127
Table 32: Newly Defined Level of Service KPIs ........ 129
Table 33: Current Energy Performance of Stormwater Facilities ........ 130

## TABLE OF FIGURES

Figure 1: Water Treatment Plan Site Asset Summary ........ 19
Figure 2: Water Storage and Pump Station Facilities Asset Summary ........ 21
Figure 3: Watermain Asset Summary ........ 22
Figure 4: Water Services Asset Summary ........ 23
Figure 5: Fire Hydrants Asset Summary ........ 24
Figure 6: Chambers Asset Summary ........ 25
Figure 7: Valves Asset Summary ........ 26
Figure 8: Water Meters Asset Summary ........ 27
Figure 9: Lifecycle Stages of Water Assets ........ 28
Figure 10: Water Linear Assets Business Process ........ 30
Figure 11: 10-Year Lifecycle Cost Per Water Asset Type ........ 35
Figure 12: Existing Capital Budget Forecast from 2021 – 2030 for Water Assets ........ 36
Figure 13: Map of Areas connected to municipal water system ........ 38
Figure 14: Map of existing fire flow deficiencies ........ 39
Figure 15: Wastewater Treatment Plant Asset Summary ........ 61
Figure 16: Wastewater Pump Station Asset Summary ........ 62
Figure 17: Forcemain Asset Summary ........ 63
Figure 18: Wastewater Gravity Main Asset Summary ........ 64
Figure 19: Wastewater Services Asset Summary ........ 65
Figure 20: Wastewater Maintenance Hole Asset Summary ........ 66
Figure 21: Siphon Asset Summary ........ 67
Figure 22: Lifecycle Stages of Wastewater Assets ........ 68
Figure 23: Wastewater Linear Assets Business Process ........ 70
Figure 24: 10-Year Lifecycle Cost Per Wastewater Asset Type ........ 75
Figure 25: Existing Capital Budget Forecast from 2021 – 2030 for Wastewater Assets 76
Figure 26: Areas connected to the municipal wastewater system ........ 80
Figure 27: Storm Structures Asset Summary ........ 102
Figure 28: Stormwater Pond Asset Summary ........ 103
Figure 29: Stormwater Gravity Main Asset Summary ........ 104
Figure 30: Inlet Asset Summary ........ 105
Figure 31: Stormwater Maintenance Holes Asset Summary ........ 106
Figure 32: Stormwater Services Asset Summary ........ 107
Figure 33: Oil & Grit Separators Asset Summary ........ 108
Figure 34: Flood Gates Asset Summary ........ 109

Figure 35: Outfalls Asset Summary ..... 110
Figure 36: Ditches Asset Summary ..... 111
Figure 37: Lifecycle Stages of Stormwater Assets ..... 112
Figure 38: Stormwater Linear Asset Business Process ..... 114
Figure 39: 10-Year Lifecycle Cost Per Stormwater Asset Type ..... 119
Figure 40: Existing Capital Budget Forecast from 2021 – 2030 for Stormwater Assets ..... 120
Figure 41: Flood Protection Map ..... 123
Figure 42: Existing Stormwater Network Level of Service ..... 124

# ENVIRONMENTAL SERVICES INTRODUCTION

Environmental Services is divided into four (4) Asset Classes: Water, Wastewater, Stormwater, and Solid Waste.

Per O.Reg 588/17, three (3) of these Asset Classes (Water, Wastewater, and Stormwater) are core assets and are defined as:

- Water - relates to the raw water storage, production, treatment, finished water storage, supply or distribution of water;
- Wastewater - relates to the collection, transmission, treatment or disposal of wastewater, which includes any wastewater asset that from time to time manages stormwater; and
- Stormwater - relates to the collection, transmission, treatment, retention, infiltration, control or disposal of stormwater.

**Table 1** below outlines which Asset Types are included under each Asset Class, and will be reported on in this AMP. In addition, it is important to note that the AMP only includes assets owned by the City, and does not include assets that are owned privately or by other organizations.

**Table 1: Asset Type Breakdown**

| | Asset Class | | |
|---|---|---|---|
| | **Water** | **Wastewater** | **Stormwater** |
| **Asset Type:** | Water Treatment Plant | Wastewater Treatment Plant | Stormwater Pump Station and Chamber |
| | Water Reservoirs and Pump or Booster Stations | Wastewater Pump Stations | Stormwater Ponds |
| | Watermains | Gravity Mains | Gravity Mains |
| | Water Services | Wastewater Services | Stormwater Services |
| | Water Chambers | Forcemains | Inlets (including catchbasins) |
| | Fire Hydrants | Maintenance Holes | Maintenance Holes |
| | Valves (including automatic flushing units pressure reducing, sustaining and zone dividing valves) | Siphons | Oil and Grit Separators |
| | Water Meters | | Flood Gates & Levee |
| | Elevated Storage Tanks | | Outfalls |
| | | | Ditches |

# 1. WATER ASSETS

## 1.1. INTRODUCTION

The City of Brantford owns and maintains several assets under the water asset class. The purpose of this section is to present specific information about the water asset class to answer the questions posed in **Section 2** of the **Asset Management Plan (AMP) Overview Document**, and includes the following:

- Water Assets' Data Inventory and Condition Approach;
- Summary of Water Assets;
- Lifecycle Activities and Cost of Water Assets;
- Current Water Assets' Levels of Service;
- Current Water Assets' Performance; and
- Conclusion.

## 1.2. WATER ASSETS' DATA INVENTORY AND CONDITION APPROACH

Information related to the City's data collection methodologies as well as data confidence level definitions are defined in the **Asset Management Plan Overview Document**.

The City of Brantford has three (3) different approaches to establishing the condition for water assets due to available resources, technologies, and budget restrictions:

- Condition assessments outsourced to consultants;
- Regular inspection programs conducted by City staff; and
- Estimated condition based on asset specific information.

A list of all condition assessments for all core assets can be found in **Table 6** in the **Asset Management Plan Overview Document**.

The origin of the water asset data for inventory, replacement cost, and condition, as well as data confidence in each are provided in **Table 2** below.

**Table 2: Water Assets' Inventory, Replacement Cost and Condition Origin and Data Confidence Level**

| | Inventory | | | Replacement Cost | | | Condition | | |
|---|---|---|---|---|---|---|---|---|---|
| **Asset Type** | **Inventory (incl. Quantity and Age) From** | **Data Confidence Level** | **Data Confidence Description** | **Replacement Cost From** | **Data Confidence Level** | **Data Confidence Description** | **Condition From** | **Data Confidence Level** | **Data Confidence Description** |
| **Water Treatment Plant (WTP)** | 2018 WTP Inventory and Condition Assessment - J.L. Richards and Associates Ltd | Medium | Formal condition assessment, but did not encompass all assets. | 2021 Costing Technical Memorandum – GM Blue Plan | High | Formal estimate by Consultant. | 2018 Water Treatment Plant Inventory and Condition Assessment - J.L. Richards and Associates Ltd | Medium | Formal condition assessment, but did not encompass all assets. |
| **Water Pump (Booster) Stations** | 2016 Water Distribution Station Condition Assessment – GM Blue Plan | High | Formal inventory with few unknowns. | 2021 Costing Technical Memorandum – GM Blue Plan | High | Formal estimate by Consultant. | 2016 Water Distribution Station Condition Assessments – GM Blue Plan | High | Formal condition assessment with few unknowns. |
| **Bulk Water Station** | 2016 Water Distribution Station Condition Assessments – GM Blue Plan | High | Formal inventory with few unknowns. | Environmental Services Unit Cost | Medium | Estimated based on internal pricing. | 2016 Water Distribution Station Condition Assessments – GM Blue Plan | High | Formal condition assessment with few unknowns. |
| **Reservoir & Elevated Storage Tanks** | 2016 Water Distribution Station Condition Assessments – GM Blue Plan | High | Formal inventory with few unknowns. | 2021 Costing Technical Memorandum – GM Blue Plan | High | Formal estimate by Consultant. | 2015 - 2020 inspections completed by Landmark Municipal Services | High | Formal condition assessment with few unknowns. |
| **Fire Hydrants** | GIS layer, wHydrant | Medium | GIS inventory complete with assumptions. | Asset Management 2020 Unit Costs | Medium | Estimated based on internal Class D pricing. | Fire Hydrant PM Program – Water Distribution and Wastewater Collection, Service Life | High | Preventative maintenance (PM) was completed on 92% of hydrants* in 2020. |
| **Valves** | GIS layer, wSystemValve | Medium | GIS inventory complete with assumptions. | Industry Equipment Costs | Low | Estimated based on manufacturer equipment prices. | Valve PM Program – Water Distribution and Wastewater Collection, Service Life | High | Preventative maintenance was completed on 67% of valves in 2020. |
| **Watermain** | GIS layer, wMain | Medium | GIS inventory complete with assumptions. | 2019 Master Servicing Plan Appendix B | Medium | Estimated based on internal Class D pricing. | Number of Breaks, Service Life, Minimum Size | Medium | Condition is estimated. No visual inspection is completed, which is industry standard. |
| **Water Services** | GIS Layer, wLateralLine | Medium | GIS inventory complete with assumptions. | Asset Management 2020 Unit Costs | Medium | Estimated based on internal Class D pricing. | Service Life, Minimum Size, Material | Medium | Condition is estimated. No visual inspection is completed, which is |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | industry standard. |
| **Chambers** | GIS Layer, wStructure | Medium | GIS inventory complete with assumptions. | Asset Management 2020 Unit Costs | Medium | Estimated based on internal Class D pricing. | Service Life | Low | Data is based on service life. |
| **Water Meters** | CIS Infinity Data Query | Medium | CIS Infinity Data inventory complete with assumptions. | Environmental Services Unit Cost | High | Estimated based on actual unit price. | Service Life | Low | Data is based on service life. |

*Hydrant program inspects 100% of City-owned and assumed hydrants but does not include hydrants that are currently unassumed (e.g. new developments).

Per **Table 2** above, Water assets' inventory and condition data are typically at a High or Medium confidence level with an overall average confidence level of Medium.

Inventory and condition data related to vertical infrastructure such as water treatment, pumping, and storage are typically at a High confidence level due to formal condition assessments and inventories having been completed by consultants.

Water assets' inventory and condition data related to linear infrastructure are typically at a High or Medium level. For High confidence level assets, an internal inspection program is typically completed on the assets (e.g. hydrants). For Medium confidence level assets, the inventories for these assets are mostly complete in GIS with some assumptions associated with the age or material of the asset, and the condition is estimated based on more than one criteria (e.g. watermain). The only assets at Low condition confidence levels are chambers and water meters, and that is because these assets are estimated solely on service life. Water meters are typically replaced on a 15 year cycle and only large diameter meters (>76mm) are inspected annually to ensure they are in good working order. The City is currently investigating the possibility of encompassing chamber inspections into the valve inspection program.

In addition, since watermain and water services are buried underground and are under pressure, it is not industry standard to complete CCTV inspections on these assets. While there are condition assessment technologies available to assess the condition of pressurized pipes (e.g. Smartball, PipeDiver etc.), they are costly inspections, and it is not industry standard to complete them on all watermain or water service assets. It is a future initiative to explore these technologies for assets that are considered high risk.

Improvements to the inventories and inspection programs will be ongoing as a result of the AIM project explained in **Section 7** of the **Asset Management Overview document**.

### 1.2.1. SERVICE LIFE

Where condition assessments have not been completed, the condition has been estimated based on the estimated service life of the asset shown below in **Table 3**. The average overall estimated service life for assets can be found in **Table 5**.

**Table 3: Water Assets' Estimated Service Life**

| Asset | Estimated Service Life |
| --- | --- |
| **Fire Hydrants** | 75 years |
| **Valves** | 70 years |
| **Watermain** | Ductile Iron - 65 Years; Asbestos Cement – 75 years; Copper – 50 years; Unknown – 75 years; PCCP (Prestressed concrete cylinder pipe) – 90 years; Other (including Cast Iron, PVC (Polyvinyl chloride)) – 90 years |
| **Water Services (from property line to watermain)** | Copper – 50 years; PEX (cross-linked polyethylene) – 90 years |
| **Chambers** | 100 years |
| **Water Meters** | 15 years |

### 1.2.2. CONDITION SCORING

For the purpose of this report and standardizing condition scores across all assets in the Asset Management Plan, the Condition Rating is defined by three (3) Condition Scores as defined in the table below. For assets with formal consultant condition assessments, the conditions have been modified to fit into this model.

**Table 4: Condition Score Description**

| Condition Score | Condition Rating | Description |
|---|---|---|
| **1 - 1.4** | Good | Assets in the system or network are in working order, have no or minor deficiencies. Where condition data is not available, this category applies to assets which are within the first 40% of their estimated service life. |
| **1.5 - 2.4** | Fair | Assets in the system or network show general signs of deterioration, some elements may have significant deficiencies, and asset will likely require repairs in the next 10 years. Where condition data is not available, this category applies to assets which are within 41% - 80% of their estimated service life. |
| **2.5 - 3** | Poor | Asset is below standard showing signs of significant deterioration, is in danger of imminent failure, and will require repair or replacement within the next year. Where condition data is not available, this category applies to assets which have exceeded 80% of their estimated service life. |

# 1.3. SUMMARY OF WATER ASSETS

The summary of assets for the Water Asset Class can be found below. The summary of assets includes: Quantity, Replacement Cost, Average Age, and Average Condition Score for each asset type in accordance with O.Reg 588/17.

## 1.3.1. TOTAL SUMMARY OF ASSETS

A table summarizing all water assets is included in **Table 5** below. Detailed information about each asset is included in individual sections. The total replacement cost for all water assets is approximately $697.0M and they are an average of 29 years old which is 49% of the overall average estimated service life of 58 years. The average condition scores are shown to one decimal place to illustrate how close the scores are to being on a cusp of another rating and were used to calculate the weighted overall average condition score for the asset group, but are shown rounded to the nearest whole number in subsequent sections. Although it is evident that overall water assets are in Good condition, they are approaching Fair condition with a weighted average condition score of 1.4.

**Table 5: Total Summary of Water Assets**

| Asset | Quantity | Unit | Replacement Cost | Average Age (years) | Average Estimated Service Life | % of Estimated Service Life Expended | Average Condition Score | Average Condition Description |
|---|---|---|---|---|---|---|---|---|
| **Water Assets Total** | | | $697.0M | **29** | **58** | **49%** | **1.4*** | GOOD |
| Water Treatment Plant Site | 12 | facilities | $187.0M | 22 | 35 | 63% | 1.4 | GOOD |
| Pumping and Storage Facilities | 7 | structures | $62.4M | 33 | 31 | 106% | 1 | GOOD |
| Reservoirs | | | | | | | 1.2 | GOOD |
| Watermain | 507.7 | km | $332.6M | 44 | 84 | 52% | 1.8 | FAIR |
| Water Services | 32,846 | count | $69.9M | 37 | 51 | 73% | 2.1 | FAIR |
| Fire Hydrants | 2,795 | count | $19.6M | 35 | 75 | 47% | 1.1 | GOOD |
| Chambers | 237 | count | $3.2M | 28 | 100 | 28% | 1.2 | GOOD |
| Valves | 8,673 | count | $14.8M | 20 | 70 | 29% | 1.1 | GOOD |
| Water Meters | 35,175 | count | $7.5M | 9 | 15 | 60% | 2.1 | FAIR |

*Denotes Weighted Average

### 1.3.2. WATER TREATMENT PLANT (WTP) SITE

Facilities at the Water Treatment Plant Site treat water from the Grand River and distribute it through the watermain network to serviced properties.

It can be seen in **Figure 1** that the Water Treatment Plant Site contains twelve (12) sub-facilities with a total replacement cost of $187M. Assets are typically in Good condition with a weighted average condition score of 1, however, the Original Lowlift Building and the Pretreatment Building were assessed to be in Fair Condition with a score of 2, and High Lift Pumps 5 & 6 are currently not operating and are considered to be in Poor condition with a score of 3.

The average age for the facilities is 22 years and was based on the construction year of the facility and is 69% of the average estimated service life of 35 years for all components, and the average age of all facility components is 14 years which is 40% of the average estimated service life.

It is important to note that the condition presented below was creating using a combination of information provided from the completed condition assessment and staff input. The weighted average was calculated assuming that the process equipment was weighted higher than the building envelope (where process equipment exists).

| NO OF FACILITIES | REPLACEMENT COST | AVERAGE AGE OF FACILITY (YEARS) | AVERAGE AGE OF COMPONENTS (YEARS) | AVERAGE ESTIMATED SERVICE LIFE | AVERAGE WEIGHTED CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|---|
| 12 | $187.0M | 22 | 15 | 35 | 1 | GOOD |


**Figure 1: Water Treatment Plan Site Asset Summary**

### 1.3.3. WATER STORAGE & PUMP STATION FACILITIES

Water storage facilities and pump stations maintain pressure in the watermain, and/or provide excess storage in case of a drinking water shortage.

Per **Figure 2** below, the City owns and maintains four (4) water pump stations, two (2) elevated storage tanks, and one (1) bulk water station. The Shellard Elevated Storage Tank was constructed in 2020 and has the highest replacement cost of all the elevated storage tanks. It is important to note that the King George Elevated Storage Tank will be removed in 5-10 years as it has exceeded its estimated service life of 50 years.

The pump stations with the highest replacement costs are Park Rd and Tollgate Pump Stations. The average age of the facilities is 36 years which is past the average estimated service life of 31 years, and the average age of reservoirs are 30 years. This results in an overall average age of 33 years which is past the average estimated service life of 31 years. All assets were indicated to be in Good condition with a score of 1 based on the most recent condition assessment information.

| NO. OF STRUCTURES | REPLACEMENT COST | AVERAGE FACILITY AGE (years) | AVERAGE RESERVOIR AGE (years) | AVERAGE ESTIMATED SERVICE LIFE | AVERAGE FACILITY CONDITION | AVERAGE RESERVOIR CONDITION | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|---|---|
| 7 | $62.4M | 36 | 30 | 31 | 1 | 1 | GOOD |

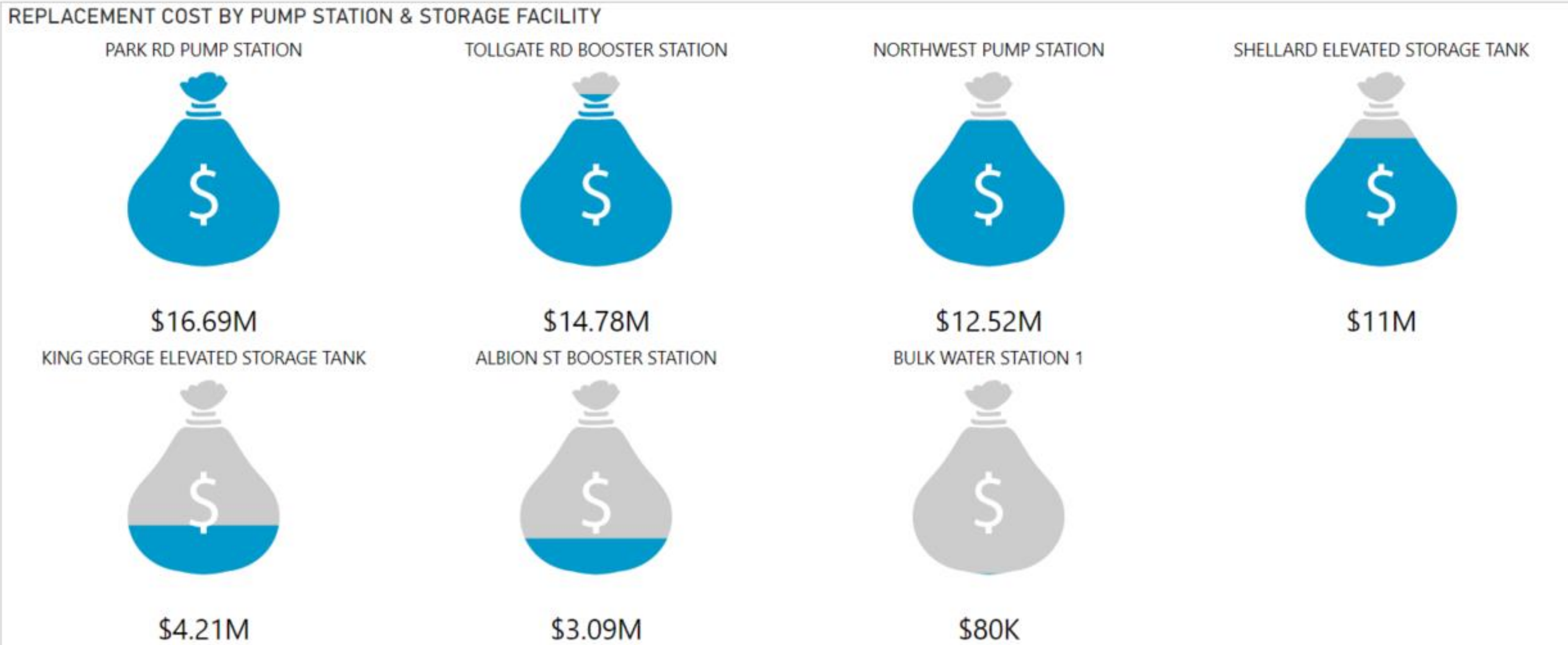



**Figure 2: Water Storage and Pump Station Facilities Asset Summary**

## 1.3.4. WATERMAIN

Watermain is an underground, pressurized pipe that distributes water from the WTP to serviced properties. The City owns and maintains approximately 508 kms of watermain with a total replacement cost of $332.6M.

It can be seen in **Figure 3** that City watermain is typically in Fair condition with an average condition score of 2. The City is currently working to replace aged watermain pipes, and PVC pipes are the most common material type used in the City. The average age of watermain in the City is 44 years old which is 52% of the average estimated service life for all pipe materials.

In addition to service life, the City also defines poor condition watermain as watermain that has exceeded 3 breaks along a section of pipe or that is undersized (<150mm).

| LENGTH (km) | REPLACEMENT COST | AVERAGE AGE (years) | AVERAGE ESTIMATED SERVICE LIFE | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|
| 507.7 | $332.6M | 44 | 84 | 2 | FAIR |

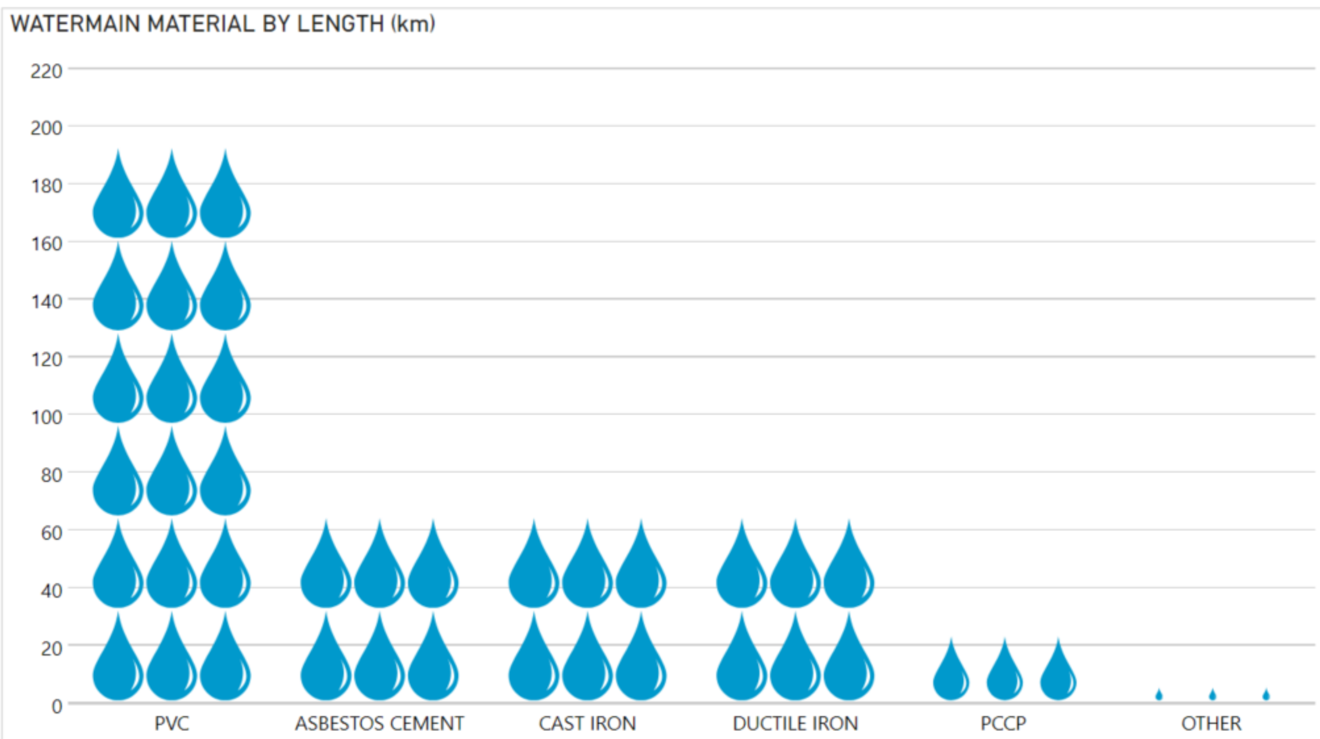



**Figure 3: Watermain Asset Summary**

Note: Other materials refers to: Unknown, Prestressed Concrete Cylinder, Fibreglass Reinforced, Steel, Copper, Polypropylene, Transite, and Polyethylene.

## 1.3.5. WATER SERVICES

Water lateral services are pipes that connect the serviced properties to the watermain. In **Figure 4**, it is evident that there are approximately 33,000 water services in the City with a total replacement cost of $69.9M. Due to the age of the infrastructure, water services are typically in Fair condition with a condition score of 2, and are an average of 37 years old. The average estimated service life for all materials 51 years and so while services are typically within their service lives, they are approaching end of life as 73% of their estimated service life is expended.

In addition, water services are owned by the City up until the property line when it becomes the property owner's responsibility. It can be seen that on the City side the majority of water services are copper material. As the City has replaced the City-owned portion of lead water services due to potential health and safety concerns, there are no lead services shown in **Figure 4**. However, the resident could still have a lead service on their side of the property line.

| COUNT OF SERVICES | REPLACEMENT COST | AVERAGE AGE (years) | AVERAGE EXPECTED SERVICE LIFE | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|
| 32,846 | $69.9M | 37 | 51 | 2 | FAIR |


**Figure 4: Water Services Asset Summary**

Other materials refer to: Unknown, Polyethylene, HDPE, PVC.

### 1.3.6. FIRE HYDRANTS

Fire hydrants are connected to the watermain and are used by fire trucks to access water in the event of fire. It can be seen in **Figure 5** that there are approximalty 2,800 fire hydrants in the city with a total replacement cost of $19.6M, and that fire hydrants are typically in Good condition with an average condition score of 1.

It is important to note that the condition score was based on the City's annual preventative maintenance program results which ensure the hydrant is in good working order. Where preventative maintenance was not completed (e.g. hydrants that are unassumed), the condition was based on age. Although most hydrants are in good working order, if they are beyond their service life, they should be replaced, and these replacements were encompassed in the Life Cycle Costing in **Section 1.4.4**. The data shows the oldest hydrants were installed in 1900, with a large number of hydrants installed in the 1970s and 2000s. It's important to note that these installation years contain assumptions of the installation date which explains the gaps and peaks in the data. Based on this data, the average age of a hydrant in Brantford is 35 years old which is 47% of the assumed 75 year estimated service life.

| NO OF HYDRANTS | REPLACEMENT COST | AVERAGE AGE (years) | ESTIMATED SERVICE LIFE | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|
| 2,795 | $19.6M | 35 | 75 | 1 | GOOD |

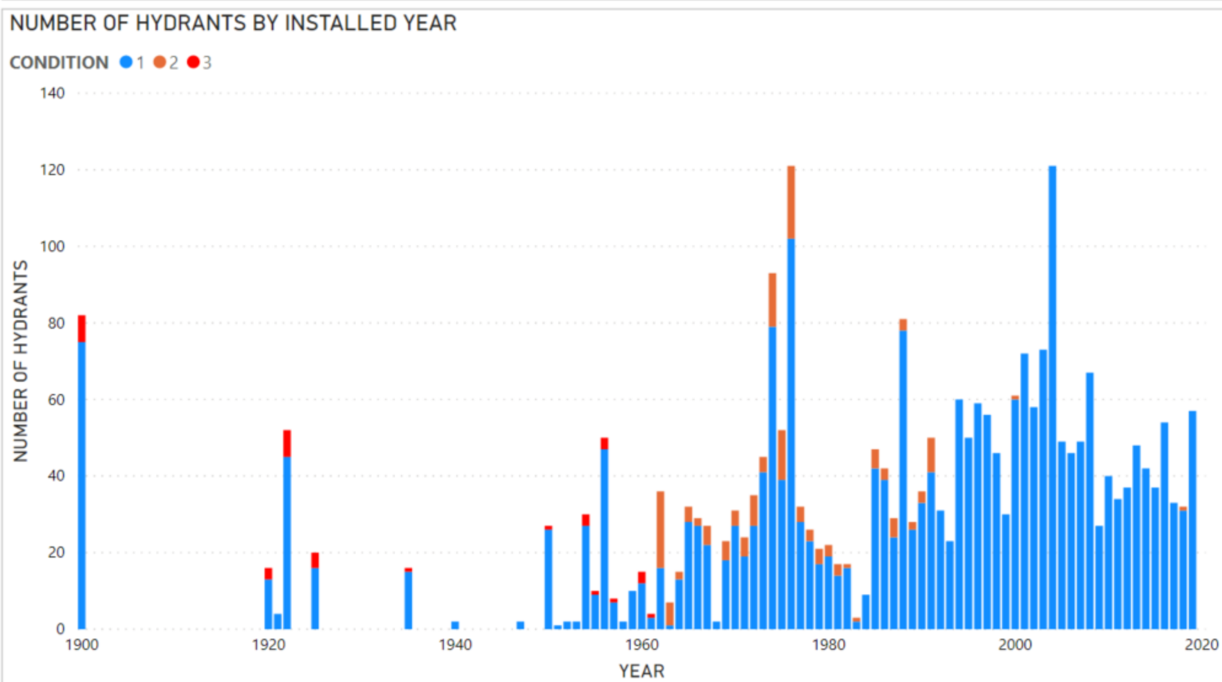



**Figure 5: Fire Hydrants Asset Summary**

### 1.3.7. CHAMBERS

Chambers are structures buried underground that contain valves which may require maintenance. Per **Figure 6** below, chambers are typically used as Air Release, Valve, and Drain chambers or a combination of the three.

There are 237 chambers in the City, and based on service life, chambers are typically in Good condition, with an average condition score of 1. The average age of chambers is 29 years which is 29% of the estimated service life of 100 years, and the total estimated replacement cost is $3.2M.

Chambers do not yet have a condition assessment or inspection program, and this may be investigated in future as part of the valve maintenance program.

| NO OF CHAMBERS | REPLACEMENT COST | AVERAGE AGE (years) | ESTIMATED SERVICE LIFE | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|
| 237 | $3.2M | 28 | 100 | 1 | GOOD |

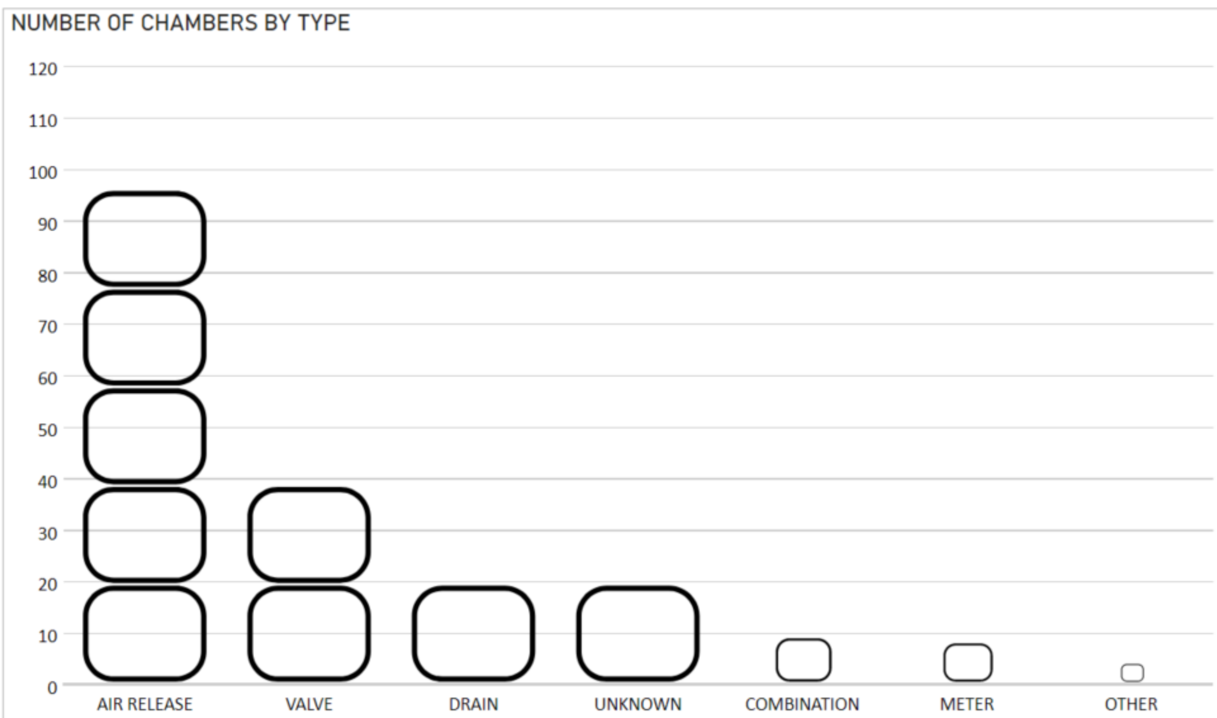



**Figure 6: Chambers Asset Summary**

Notes: Other chambers refers to Manhole or Service Chambers

## 1.3.8. VALVES

Valves are assets which can be opened and closed to allow or stop water in a pipe. It can be seen in **Figure 7** below that the most common valves found in the City are mainline and hydrant valves.

The City owns and maintains approximately 8,700 valves. Based on a combination of estimated service life and preventative maintenance inspection data, the valves are in Good condition with an average score score of 1. Valves are an average of 21 years old which is 30% of their estimated service life of 70 years, and are estimated to have a total replacement cost of $14.8M. Similar to hydrants, although preventative maintenance inspections indicate many valves are in good working order, if they are beyond their service life, they should be replaced.

Although this data is not presented, it is important to note that the majority of valves in the City are minor valves, meaning they are less than or equal to 350mm in diameter.

| NO OF VALVES | REPLACEMENT COST | AVERAGE AGE (years) | ESTIMATED SERVICE LIFE | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|
| 8,673 | $14.8M | 20 | 70 | 1 | GOOD |

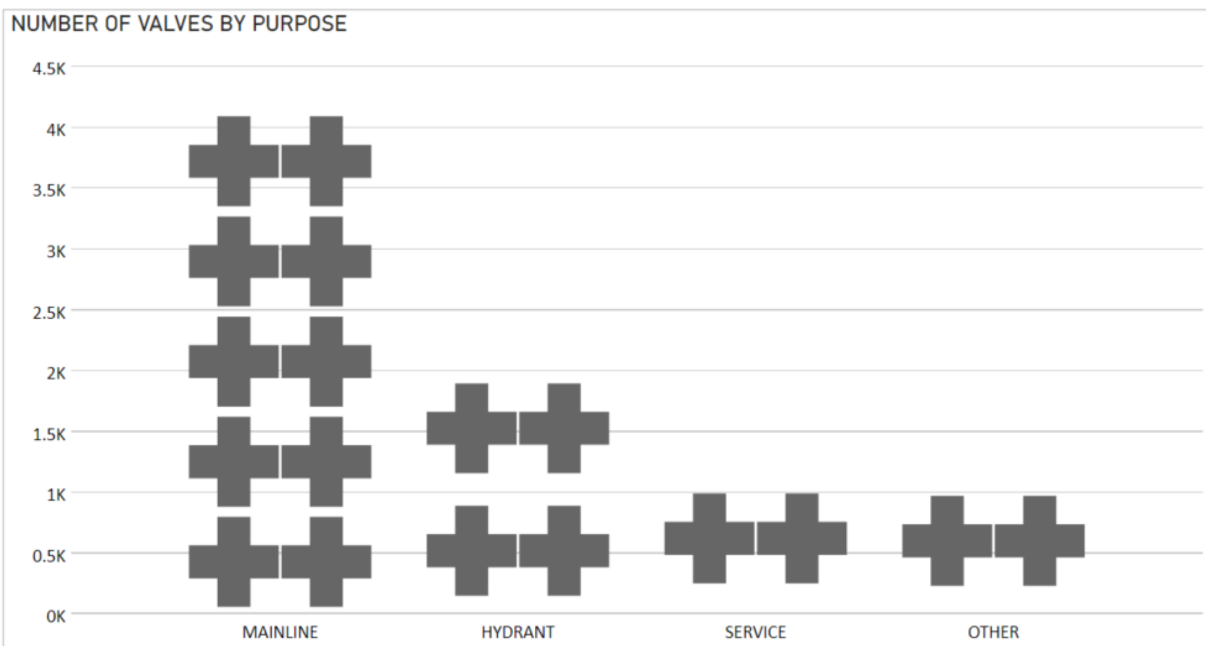



**Figure 7: Valves Asset Summary**

Note: Other valves include: Automatic Flushers, Air Release, Bypass, Blow Off, Check, Drain, Isolation, etc

## 1.3.9. WATER METERS

Water meters are installed at properties that are connected to the municipal water network and are used to measure the amount of water used by the customer for billing and performance.

Per **Figure 8** below, there are approximately 35,000 water meters in the City. The average age of a water meter is 9 years which is 60% of the 15 year estimated service life.  Based on service life, water meters are typically in Fair condition with an average score of 2. The replacment costs were based on the most recent meter purchase and installation prices from Environmental Services and total $7.5M. The majority of City water meters are residential meters, with a small percentage being commercial meters.

Currently water meters are manually read every two (2) months, but the City is investigating installing smart (wireless) meters to automatically read meters in future.

| NO OF METERS | REPLACEMENT COST | AVERAGE AGE (years) | ESTIMATED SERVICE LIFE | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|
| 35,175 | $7.5M | 9 | 15 | 2 | FAIR |

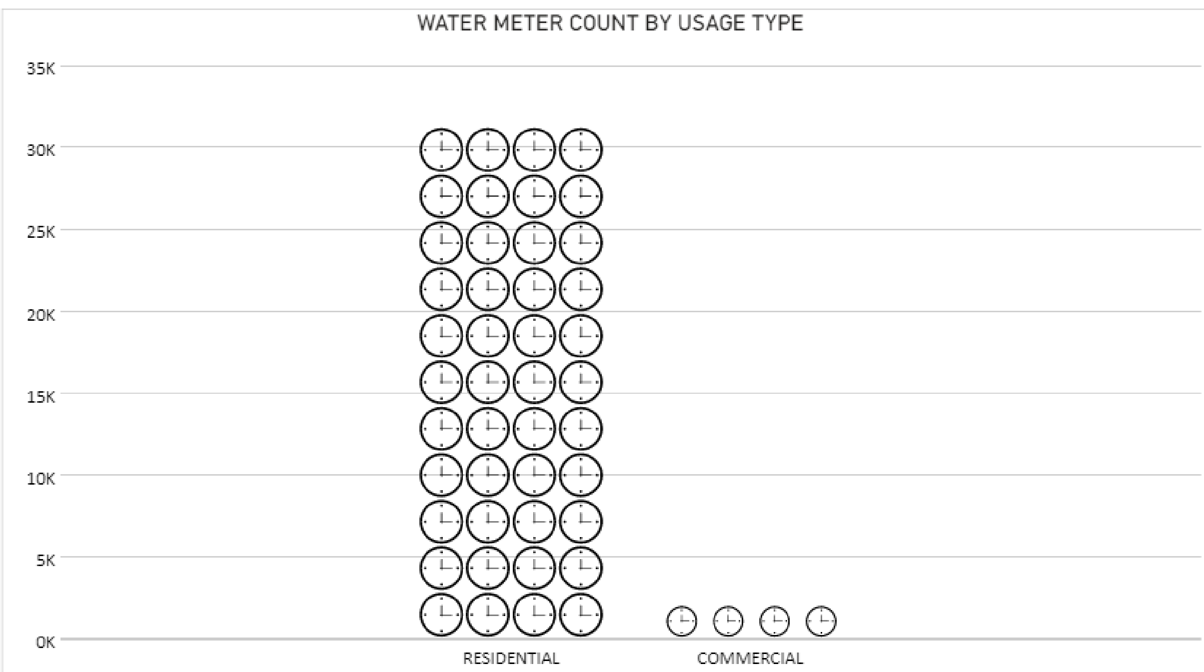



**Figure 8: Water Meters Asset Summary**

# 1.4. LIFECYCLE OF WATER ASSETS

The lifecycle of water assets is described under four (4) categories which are described in this section:

- Key Lifecycle Stages of Water Assets;
- Lifecycle Activities;
- Risks of Lifecycle Activities; and
- 10 Year Lifecycle Costs of Water Assets.

## 1.4.1. KEY LIFECYCLE STAGES OF WATER ASSETS

The lifecycle of an asset refers to the following stages: Planning, Creation/Acquisition, Operations and Maintenance, Renewal/Disposal which are defined in the Main Body of the report. For water assets specifically our general process is as follows:

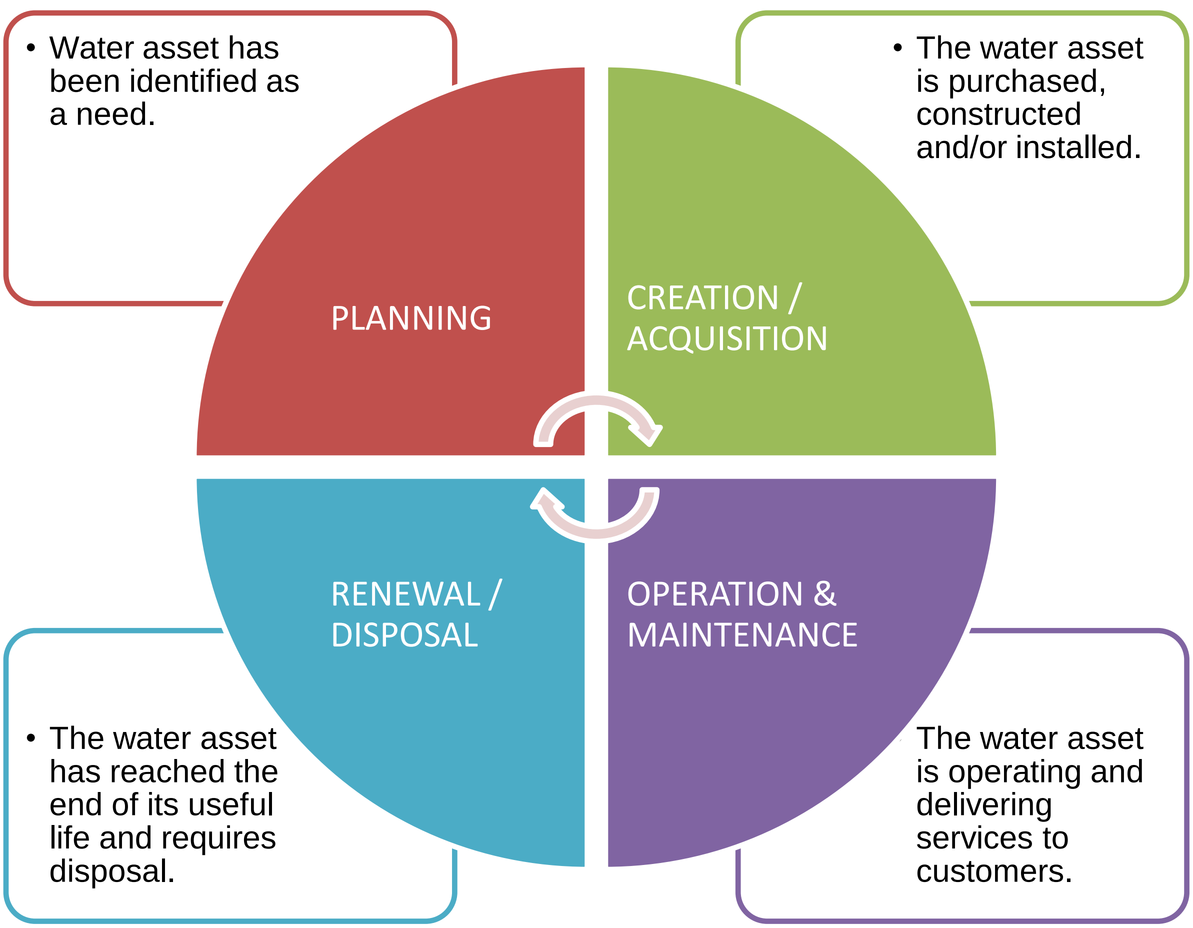



**Figure 9: Lifecycle Stages of Water Assets**

1. **Planning** –The water asset has been identified as a need through the Official Plan, Master Servicing Plan, or due to an identified poor condition of an existing asset during a watermain break, condition assessment, maintenance report, site inspection, or desktop analysis. The asset is designed using all applicable codes and standards. Typically this phase also involves planning on how to optimize the value of the assets which may include: replacing neighbouring corridor assets at the same time, improving operating and maintenance efficiencies, upsizing or rerouting for growth. The business process for state of good repair for linear water assets is shown in **Figure 10**.
2. **Creation / Acquisition / Replacement** – The cost and requirements for the new or replacement water asset are defined. The asset is purchased, constructed and/or installed. Extra care is taken at this stage to ensure the asset is constructed properly using all appropriate design standards and guidelines to avoid any premature repairs or replacements due to installation errors.
3. **Operation and Maintenance** – The water asset is operating and delivering services to customers. Maintenance (Lifecycle) Activities are completed on the asset at specific time intervals as shown in **Table 6** to prevent premature failures of the asset. Additional monitoring and potential improvements are evaluated during this process.
4. **Renewal / Disposal** – The water asset has reached the end of its useful life, is in poor condition, and/or is underperforming, and requires disposal. The disposal considers the effect on customers such as required detouring or service disruptions which are taken into account in the Planning stage thereby restarting the cycle. The City follows industry standards when disposing of these assets.

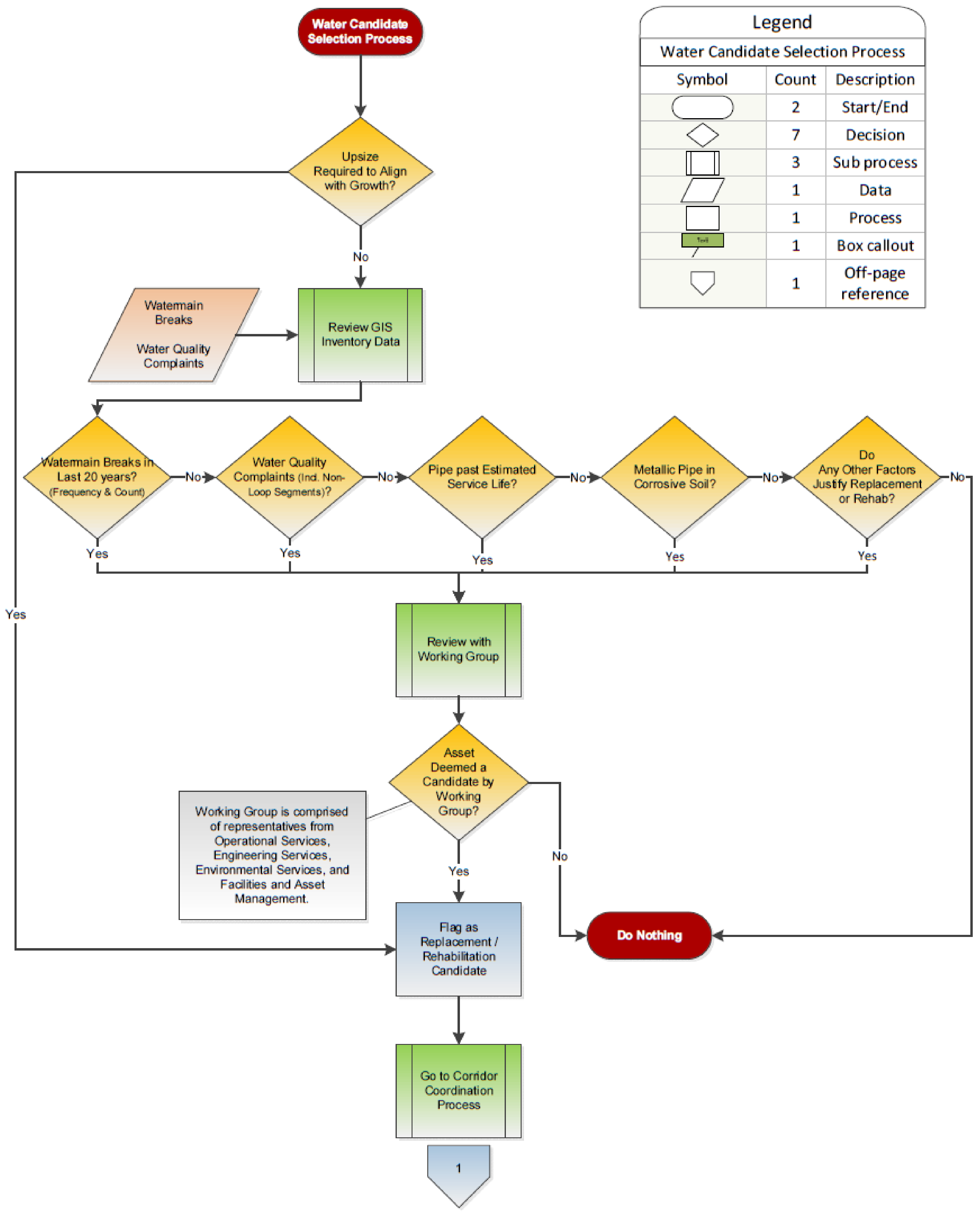



**Figure 10: Water Linear Assets Business Process**

### 1.4.2. LIFECYCLE ACTIVITIES

A list of the planned Lifecycle Activities, annual cost, and frequency for each Water Asset Class can be found in **Table 6** below. These activities are currently being undertaken to maintain water assets and therefore maintain the current levels of service.

**Table 6: Lifecycle Activities for Water Assets**

| Asset Type | Lifecycle Activity | 2021 Annual Cost* | Frequency | Completed by |
|---|---|---|---|---|
| **Watermain** | Flushing | $3,709,462.00 | Dead ends twice per year and biweekly in areas with low chlorine residual, and Ad Hoc after shutdown. | Water Distribution and Wastewater Collection |
| **Water Valves** | Exercise & Inspection | | 5 years | Water Distribution and Watewater Collection |
| **Water Service** | Exercise shut off (>38mm) | | Ad Hoc | Water Distribution and Watewater Collection |
| **Automatic Flushers (encompassed under Valves)** | Inspection | | Biweekly | Water Distribution and Watewater Collection |
| **Hydrants** | Inspection | | Annually | Water Distribution and Watewater Collection |
| | Painting | | 5 year rotation | Water Distribution and Watewater Collection |
| **Water Meters** | Inspection | | >3” annually | Water Distribution and Watewater Collection |
| | Calibration / Testing | | >3” annually | Water Distribution and Watewater Collection |
| | Seasonal Removal / Install | | Annually | Water Distribution and Watewater Collection, Parks Services |
| **Water Treatment Plant** | Condition Assessment (2015) | $96,100.00 | Periodic | Asset Management |
| | Preventative Maintenance | $6,611,855.00 | Per Operating Procedures | Water Operations |
| **Bulk Water Station** | Backflow Inspection | | Annually | Water Distribution and Watewater Collection |
| | Winter Check Inspection | | Seasonally | Water Distribution and Watewater Collection |
| **Pump Stations** | Preventative Maintenance | | Per Operating Procedures | Water Operations |
| | Condition Assessment (2016) | $45,480 | Periodic | Asset Management |

*2021 Annual Cost is typically based on estimates presented in the 2021 Preliminary Operating Budget under 2021 Budget Gross Expenditures.

Lifecycle activities occur on each of our water assets to maintain the state of good repair. Vertical infrastructure activities are currently typically tracked through Avantis, and linear activities are typically tracked through web mapping applications that connect to the ArcGIS database or paper records. Work order tracking will be moved over to AIM during implementation which is explained in **Section 7** of the **Asset Management Plan Overview Document**. Information related to Avantis, and ArcGIS Collector can be found in **Section 4.2** of the **Asset Management Plan Overview Document**.

When these activities are integrated into AIM, the frequency and cost associated with these activities will be better represented. At this time, the costs associated with the O&M activities on these assets are estimated based on the 2021 Preliminary Operating Budget and are not formally recorded, but future updates of the AMP should include actual costs, frequency, and time associated with these activities which will be recorded through AIM.

### 1.4.3. RISKS OF LIFECYCLE ACTIVITIES

The identified lifecycle activities in **Table 6** above are historical activities taken on by Water Distribution and Wastewater Collection. Some risks associated with these activities include:

- **Traffic Accidents** - when performing maintenance in the vicinity of traffic vehicles, there is a risk of a traffic accident. This is mitigated by implementing a traffic control plan and wearing high visibility clothing during maintenance activities in the right of way;
- **Falling** – Some activities require working from heights and there is a risk of falling. This risk is mitigated by having maintenance personnel trained on all equipment and having fall arrest training where required.
- **Operator Error** – When operators are operating equipment, there is a risk of an operator related accident. This risk is mitigated by ensuring all operators have the required licenses and are trained on equipment.
- **Confined Space** - There are always risks associated with confined space, technicians are trained and standard operating procedures are followed to complete the task safely.
- **Equipment Failure -** Equipment failure can occur during maintenance activities and this is mitigated by ensuring preventative maintenance is completed at regular intervals to prevent this from occurring.
- **Contamination** – When completing maintenance there is a possibility of contaminating drinking water. Contamination can occur as a result of soil containing heavy levels of petroleum or other natural contaminants. This risk is mitigated by following standard operating procedures to keep positive pressure

on the watermain. If a contamination does occur, additional standard operating procedures exist including super chlorination.

- **Utility Impact** – When digging into soil to locate a buried asset, there is a possibility of hitting a buried utility line. This is mitigated by ensuring locates are completed prior to digging.
- **Non-Accessible Easements** – There are a number of easements in the City which are considered non-accessible due to private obstructions (e.g. sheds) or natural terrain, and affect the City's ability to complete preventative maintenance. The City is currently working to secure contracts to have roadways built at each location to access these assets.

However, if these activities were not completed, the risks would include:

- **Service Disruptions** due to premature failures that could have been mitigated with preventative maintenance (e.g. valve failure from not exercising valves);
- **Water Quality Issues** due to lack of upkeep of assets (e.g. failing chlorine residuals due to no watermain flushing);
- **Fire Safety Issues** due to lack of upkeep of hydrants (e.g. hydrant or valve failing in an emergency because it hasn't been maintained, substandard size doesn't allow fire flow).
- **Increased Cost** due to reactive repairs which could have been prevented with preventative maintenance (e.g. reactive repairs are often 3x more expensive than planned repairs).

### 1.4.4. 10 YEAR LIFECYCLE COSTS OF WATER ASSETS

**Figure 11** below outlines the 10 year lifecycle costs of water assets. As noted on the graph, typically when the condition of an asset is estimated based on service life there are spikes in the first year to account for the backlog.

It can be seen that the largest water asset requiring the most expenditure to alleviate the backlog is watermain. It is important to note that it is estimated that the King George Elevated Storage Tank is currently planned for removal with a replacement tank installed at a new location, but that is encompassed in the Growth projects identified in **Section 8.3** of the **Asset Management Plan Overview Document**.

Based on the information presented in the figure below, the total annual average capital cost for the next 10 years to alleviate the backlog and maintain the state of good repair spent on water assets is $15.3M, and the average annual O&M cost to maintain the state of good repair is $32.5M. Therefore, this is the amount recommended that the City invest in water assets annually to maintain the state of good repair.

It is important to note that this figure and associated costing was developed separately from other corridor assets (i.e. watermain & services, wastewater gravity pipe, maintenance holes, & services, and roadway), in reality these assets would be considered in tandem when considering a corridor section in the City in order to obtain cost efficiencies during design and construction where possible.

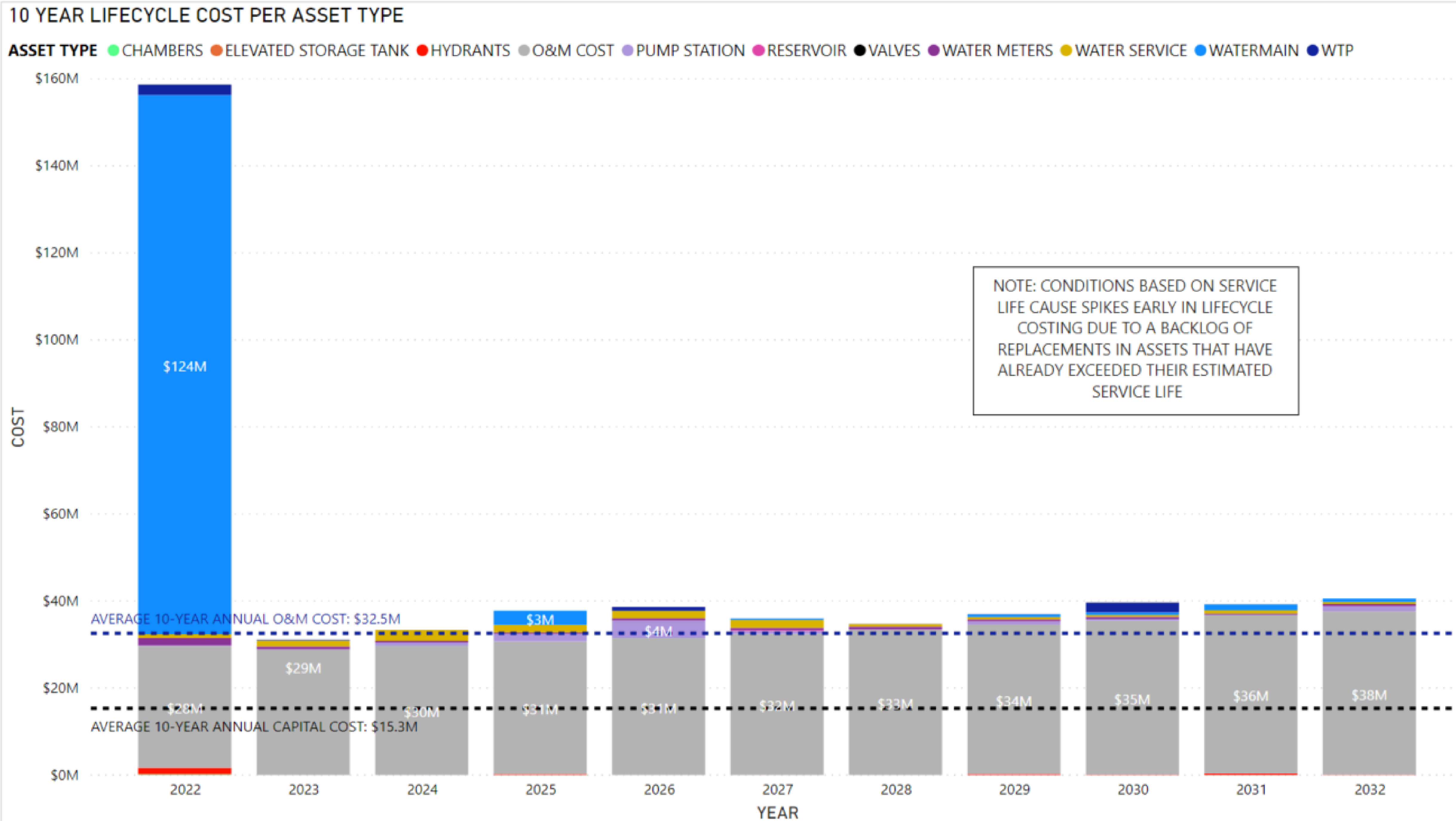



**Figure 11: 10-Year Lifecycle Cost Per Water Asset Type**

Notes:
1. O&M Costs are estimated based on the 2021 Preliminary Operating Budget and are inflated by 3% each year. These O&M Costs are associated with both Treatment and Distribution and are partially broken down in Table 6.
2. WTP Site and Pump Station replacement costs and years were taken from the respective condition assessments forecasts referred to in Table 2.
3. Watermain replacement was based on service life unless it was estimated to exceed number of breaks or be undersized, in which case it was estimated to be in 2022 to clear the backlog.
4. For all other assets where no formal forecast was available, the replacement year is based on the estimated remaining service life of each asset

Per **Figure 12** below, the existing 10-year forecast from 2021 – 2030, further explained in **Section 8.2.2** of the **Asset Management Plan Overview Document** , indicates that the City is currently planning to spend an average of $7.78M on water assets capital annually, and as noted above, the required 10-year average amount is $15.4M for water assets, which indicates there is an annual 10-year funding gap of $7.5M for water assets. It is evident in the figure below that the City never spends the required average amount in the existing 10-year forecast, but in 2023, the City is expected to spend close to the required average. As noted on the graph, the impacts resulting from these funding gaps will be monitored and reported as appropriate. However, as the forecast continues moving forward to the end of the 10-year forecast, less budget is expected to be expended on SOGR for water assets. This indicates that the City may benefit from moving some projects which are currently beyond the 10-year forecast into the end of the forecast.  Since the budget is revised annually, and the Prioritization Matrix explained in **Section 9** of the **Asset Management Plan Overview Document** is currently in its implementation phase, it is anticipated that this forecast will continue to change as City priorities shift. It is important to note that currently the City does not have access to detailed data on O&M for water assets, but with the implementation of the AIM project explained in **Section 7** of the **Asset Management Plan Overview Document,** it is anticipated this information will be provided in the next iteration of the AMP.

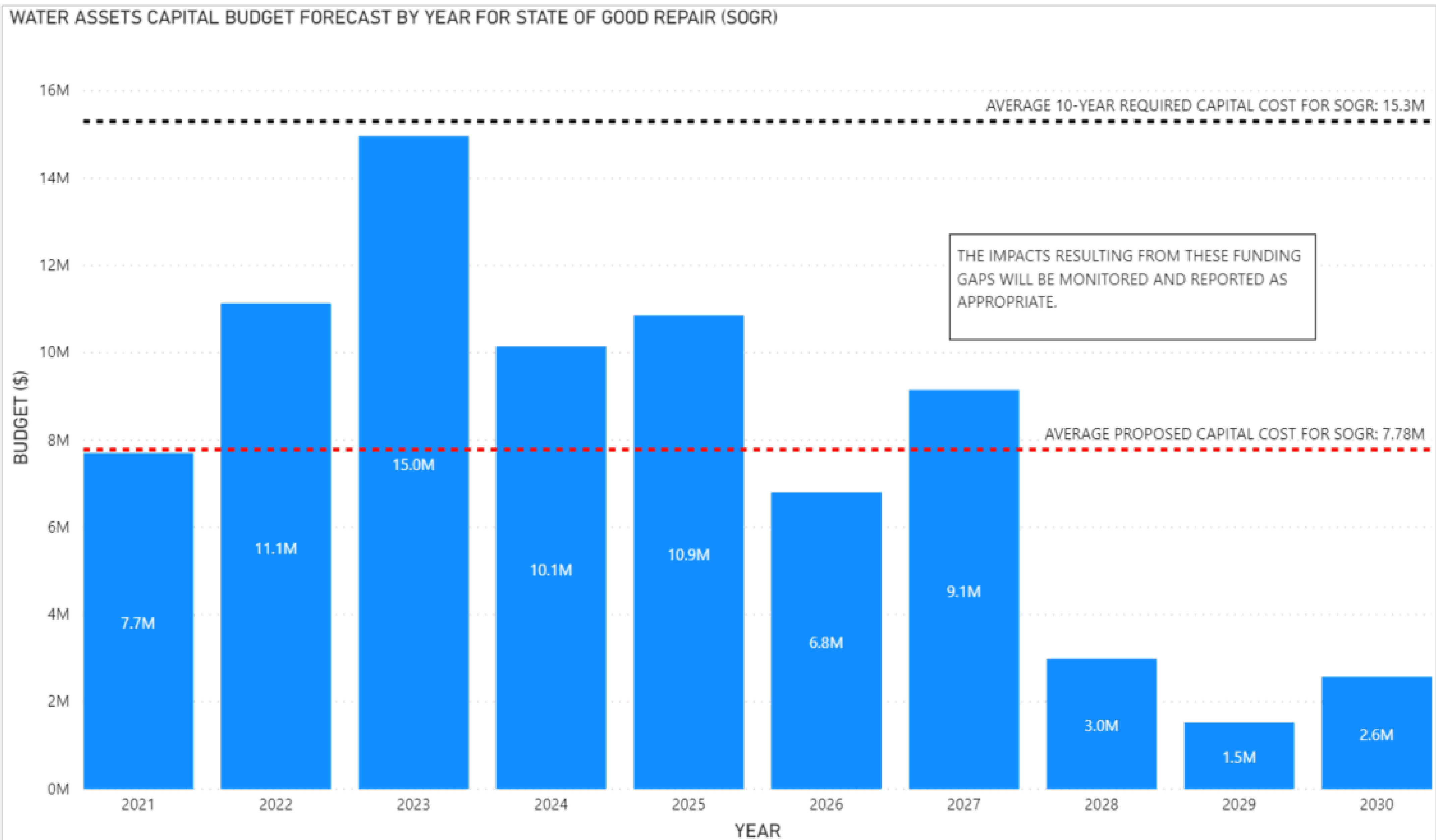



**Figure 12: Existing Capital Budget Forecast from 2021 – 2030 for Water Assets**

# 1.5. CURRENT LEVELS OF SERVICE

## 1.5.1. O.REG 588/17 CUSTOMER LEVELS OF SERVICE

Per O.Reg 588/17 there are customer levels of service the City is required to report. These levels of service are described below:

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

   Approximately 94% of properties are connected to the municipal water system. A map of the connected properties can be found in **Figure 13.** Areas not connected to the municipal water system are typically rural areas and empty lots. It should be noted that the area serviced by the municipal water system in Tutela Heights, within the recently acquired County lands, currently remain serviced by the County system rather than the City system. This area is expected to transfer to the City system before 2026.

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

   Based on the 2020 Master Servicing Plan (MSP), approximately 86% of properties have known fire flow available, however, there are some unknowns in this MSP data and so it is anticipated that a higher percentage of properties have fire flow than what is represented. Although it has been shown that where hydrants are connected, fire flow is available, during the MSP, there were junctions where fire flow deficiencies were identified and these junctions can be found in **Figure 14**.

   It is important to note that the City also has an agreement with the County of Brant for the use of tankers for areas that are not serviced by hydrants. The City is currently applying for the superior water shuttle certification through Fire Underwriters Survey (FUS), and once that rating is obtained, non-hydrant services areas will be considered to be serviced the same as hydrant serviced areas.

3. *Description of boil water advisories and service interruptions.*

   There have been no boil water advisories (BWAs) over the last two (2) years at the City of Brantford. The most recent BWA was in 2018 and was due to contamination from a construction project, and not due to infrastructure deficiencies. There were 18 watermain breaks in 2020 which resulted in service interruptions. The service disruptions took one (1) day or less to resolve.

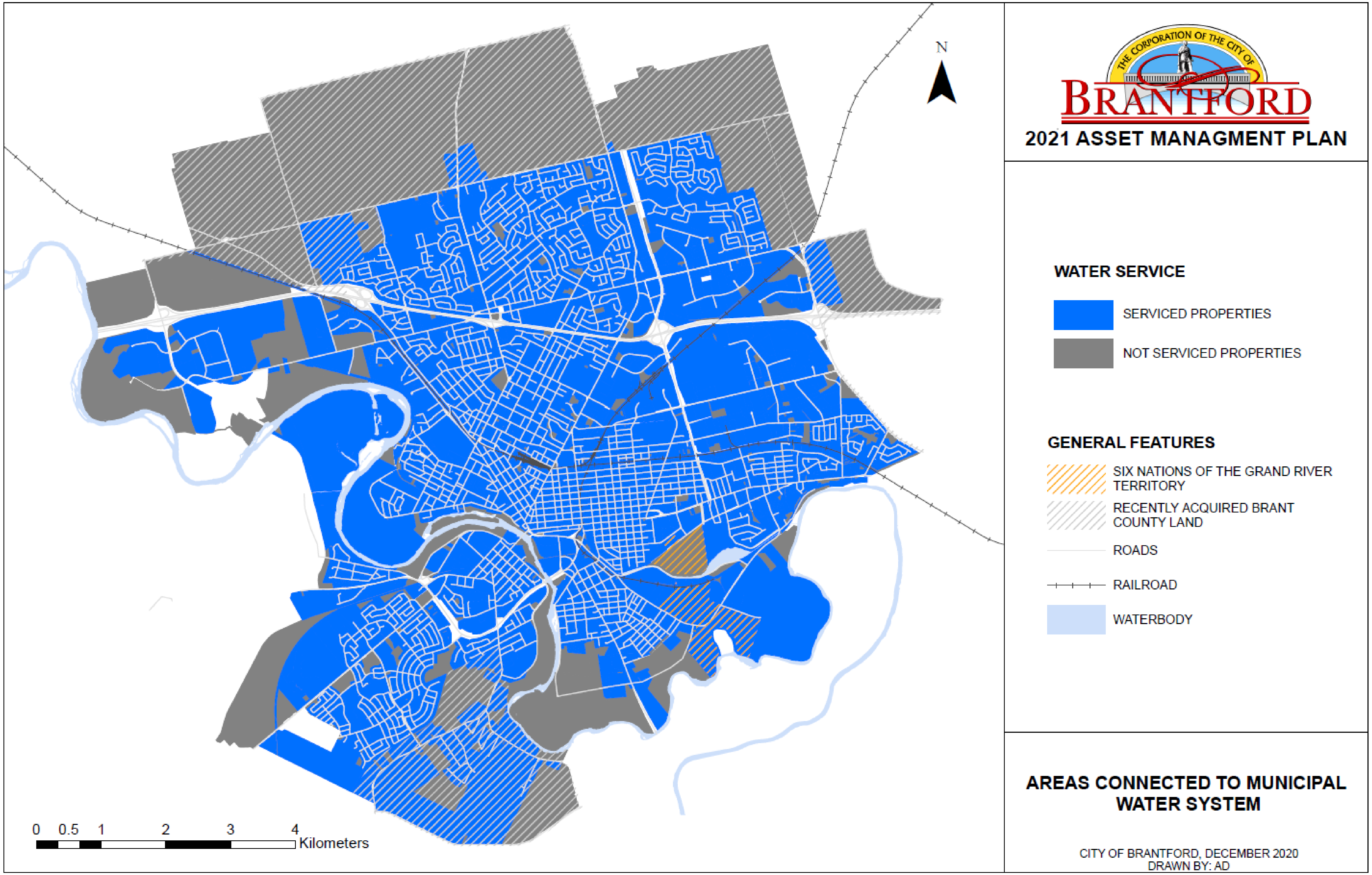



**Figure 13: Map of Areas connected to municipal water system**

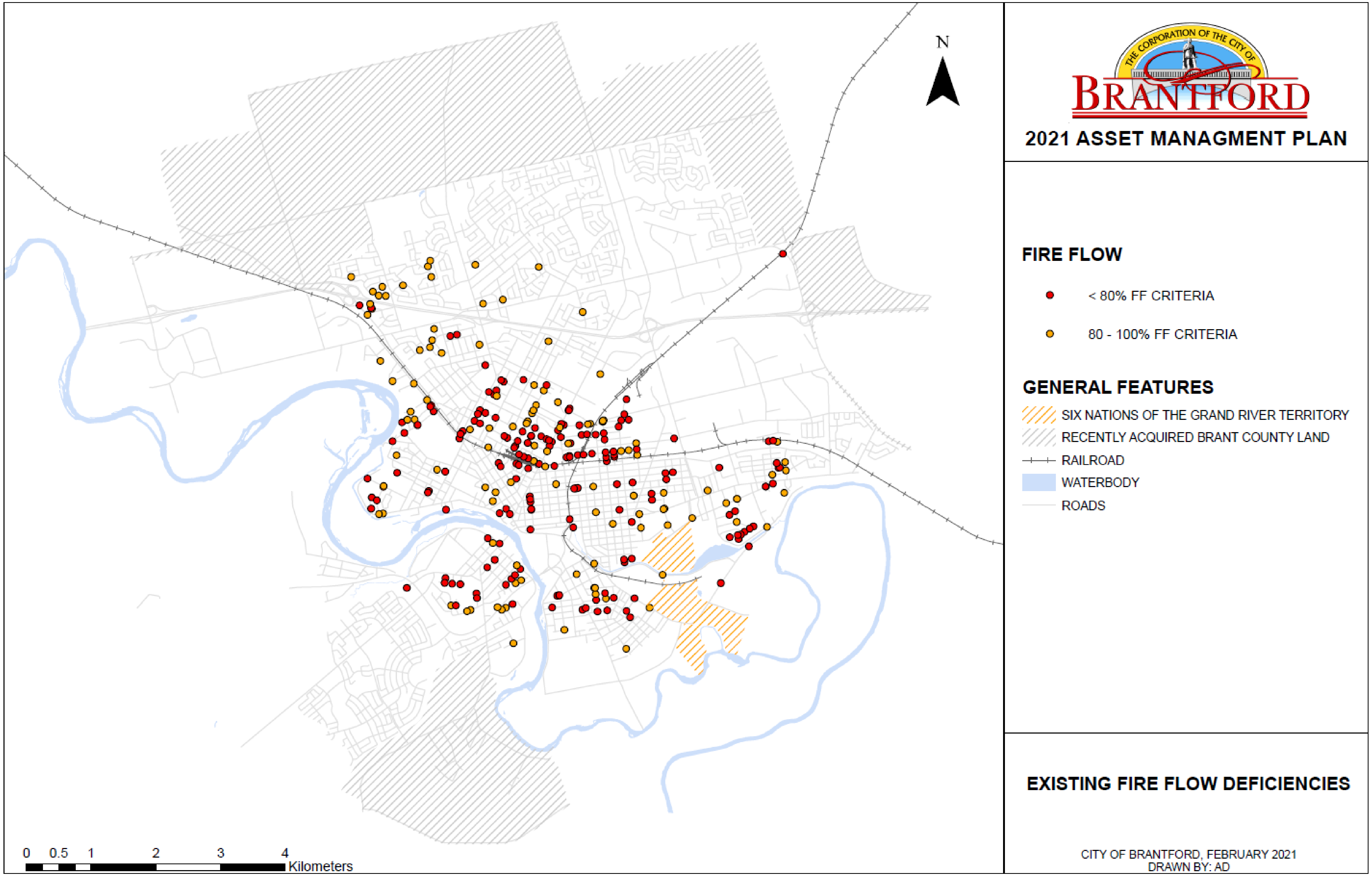



**Figure 14: Map of existing fire flow deficiencies**

## 1.5.2. O.REG 588/17 TECHNICAL LEVELS OF SERVICE

The technical levels of service that the City is required to report in this iteration of the AMP as dictated by O.Reg 588/17 can be found in **Table 7** below:

**Table 7: O.Reg 588/17 Water Technical Levels of Service**

| Service | Service attribute | Technical levels of service (technical metrics) | 2019 | 2020 |
|---|---|---|---|---|
| Water | Scope | 1. Percentage of properties connected to the municipal water system. | 94.1% of 32,363 properties | 93.7% of 32,717 properties |
| | | 2. Percentage of properties where fire flow is available. | N/A | 86.4% of 32,717 properties |
| | Reliability | 1. The number of connection-days per year where a boil water advisory notice is in place compared to the total number of properties connected to the municipal water system. | 0 connection days of 30,444 connected properties | 0 connection days of 30,661 connected properties |
| | | 2. The number of connection-days per year due to water main breaks compared to the total number of properties connected to the municipal water system. | 3,638 connection days* of 30,444 connected properties | 4,086 connection days* of 30,661 connected properties |

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

## 1.5.3. MUNICIPALLY DEFINED CUSTOMER LEVELS OF SERVICE

The customer levels of service are defined in **Section 6.2** of the **Asset Management Plan Overview**. For water assets, the asset specific interpretation of these levels of service is defined below in **Table 8**. These customer levels of service were used to create and define our technical levels of service identified in **Table 9, Table 10,** and **Table 11.**

**Table 8: Municipally Defined Customer Levels of Service**

| Customer Level of Service | Definition |
|---|---|
| **Accessibility** | Water assets should be accessible to all customers connected to the municipal water network without barriers in place. |
| **Quality** | Water assets should deliver their intended purpose at a certain quality, and assets should be sufficient capacity. |
| **Cost Efficiency** | Water assets should be operated efficiently with extra care to minimize costs. |
| **Safety** | Water assets should be both safe to use and promote community safety, and customers should feel safe using these services. |
| **Environmental Sustainability** | Water assets should be operating as environmentally as possible and also be promoting sustainable lifestyles. |
| **Reliability** | Water assets should be available to customers connected to the municipal water network when needed. |
| **Responsiveness** | Water assets should be fixed promptly when unavoidable service disruptions occur. |

In addition, the following seven (7) qualitative metrics for water distribution and treatment are used in the National Water and Wastewater Benchmarking Initiative (NWWBI) and are used in addition to the above defined Levels of Service to measure KPIs:

- Ensure Adequate Capacity
- Have Satisfied and Informed Customers
- Meet Service Requirements with Economic Efficiency
- Protect Public Health and Safety
- Protect the Environment
- Provide a Safe and Productive Workplace
- Provide Reliable Service and Infrastructure

### 1.5.4. MUNICIPALLY DEFINED TECHNICAL LEVELS OF SERVICE

For our current defined levels of service, we collect KPIs for our Water Treatment and Water Distribution which support the above defined municipally defined customer levels of service.

The Levels of Service, KPIs, and targets (where available) are presented in **Table 9** and **Table 10** below are tracked based on information required for the NWWBI. This information is mandated through that initiative, but serves as an excellent tool for a first draft of water KPIs.

**Table 9: Water Distribution KPIs from NWWBI**

| Customer Level of Service | NWWBI metric | Technical LoS | 2018 KPI | 2019 KPI | Units |
|---|---|---|---|---|---|
| **Quality** | Ensure Adequate Capacity | Hours of Water Storage Capacity at ADD | 40.70 | 40.47 | Hours |
| | Have Satisfied and Informed Customers | % Attainment of After Working Hours Non-Emergency Target | 95% | 100% | % |
| | | % Attainment of After Working Hours Emergency Target | 100% | 95% | % |
| | | % Attainment of During Working Hours Emergency Target | 100% | 100% | % |
| | | % Attainment of During Working Hours Non-Emergency Target | 95% | 95% | % |
| | | Water Pressure Complaints | 0.69 | 0.50 | #/1000 people served |
| | | Water Quality Complaints | 0.47 | N/A | #/1000 people served |
| **Cost Efficiency** | Meet Service Requirement s with Economic Efficiency | Cost of Customer Billing | $19.28 | $18.76 | $/Number of Service Connections |
| | | Average Unit Cost of Meters Replace | $58.10 | N/A | $/meter |
| | | Cost of Fire Hydrant O&M | $57.53 | $60.13 | $/hydrant |
| | | Cost of Main Break Repairs / Total O&M Cost | 5.63% | 3.73% | % |
| | | Cost of Performing Locates | $206.39 | $461.64 | $/km |
| | | Cost of Water Quality Monitoring | $2.49 | $2.30 | $/capita |
| | | Cost to provide Water - Capital | $82.33 | $165.81 | $/population served |
| | | Cost to provide Water - Debt Servicing | $23.94 | $23.51 | $/population served |
| | | Cost to provide Water - Indirect Cost | $22.40 | $22.79 | $/population served |
| | | Cost to provide Water - O&M Cost | $251.25 | $127.69 | $/population served |
| | | Cost to provide Water - Water Customer Billing | $6.48 | $6.26 | $/population served |
| | | FTEs (includes O&M, Program Support and Clerical, Supervisor/Management) | $3.22 | 2.83 | #/100km length |
| | | Indirect Costs (incl Administration Overheads, Conservation Area Charges, Property Taxes) | $22.40 | 22.79 | $/population served |
| | | Inhouse Metering Field FTEs | 0.03 | 0.03 | #/1000 meters |

| | | | | | |
|---|---|---|---|---|---|
| **Safety** | Protect Public Health and Safety | Average Trihalomethanes (THMs) | 0.04 | 0.03 | mg/L |
| | | Average value for Turbidity | 0.06 | 0.38 | NTU |
| | | Boil Water Advisory Days | 0 | 0.00 | # |
| | | Connections Affected by Boil Water Advisory (BWA) | 0 | 0.00 | # / 1000 service connections |
| | | Days with Total Coliform | 13 | 7.00 | Days |
| | Provide a Safe and Productive Workplace | Cost of Overtime Hours | $8,677.86 | $5,920.43 | $/O&M FTE |
| | | Distribution of Workforce Age 20 - 30 | 10.53% | 8.57% | % |
| | | Distribution of Workforce Age 31 - 40 | 52.63% | 51.43% | % |
| | | Distribution of Workforce Age 41 - 50 | 13.16% | 11.43% | % |
| | | Distribution of Workforce Age 51 - 60 | 18.42% | 22.86% | % |
| | | Distribution of Workforce Age 61 - 70 | 5.26% | 5.71% | % |
| | | Field Accidents with Lost Time | 0.04 | 0.00 | #/1000 O&M Labour Hours |
| | | Lost Hours due to Field Accidents | 10.13 | 0.00 | #/1000 O&M Labour Hours |
| | | Sick Days Taken | 13.9 | 10.10 | # / O&M Employee |
| | | Total Available O&M Hours / Total Paid O&M Hours | 78.93% | 76.57% | % |
| | | Total Overtime Hours / Total Paid O&M Hours | 6.32% | 4.98% | % |
| | | Unavailable O&M Hours / Total Paid O&M Hours (incl. Expended Banked Time, Long Term Leave, Other Training, Safety Training, Sick Time, Vacation) | 21.09% | 23.43% | % |
| **Environmental Sustainability** | Protect the Environment | Average Residential Daily Consumption | 167.32 | 161.49 | L/Cap/d |
| | | Cost of Water Conservation Program | 0.9 | 0.88 | $/capita |
| | | Days of water restrictions | 90 | 90 | # |
| | | Peaking Factor | 1.36 | 1.44 | MDD/ADD |
| | | Percent Metered | 100 | 100% | % |
| **Reliability** | Provide Reliable Service and Infrastructure | Capital Reinvestment / Replacement Value | 2.49% | 5.50% | % |
| | | Hydrants Inspected | 100% | 96.03% | % |
| | | Hydrants Winterized | 0 | 0.00% | % |
| | | Inoperable or Leaking Hydrants (%) | 0.29 | 0.32% | % |
| | | Inoperable or Leaking Valves (%) | 0.44 | 0.34% | % |

| | | | | | |
|---|---|---|---|---|---|
| | | Main Breaks | 4.80 | 3.36 | # / 100 km Length |
| | | Main Length Replaced or Relined (%) | 0.57% | 0.51% | % |
| **Responsiveness** | | Customer Days without Service | 0.01 | 0 | Days / Total # of Service Connections |

**Table 10: Water Treatment KPIs from NWWBI**

| Customer Level of Service | NWWBI Metric | Technical Level of Service | 2018 KPI | 2019 KPI | Units |
|---|---|---|---|---|---|
| **Quality** | Ensure Adequate Capacity | Average Day Demand / Existing Water License Capacity | 32.88% | 33.07% | % |
| **Cost Efficiency** | Meet Service Requirements with Economic Efficiency | Chemical Cost | $62.24 | $79.32 | $/ML Treated |
| | | Energy Consumed | 843.94 | 925.28 | kWh/ML Treated |
| | | FTEs relative to Volume Treated (incl Laboratory, O&M, Program Support / Clerical, Supervisor / Management, Technical / Engineering) | 1.56 | 1.74 | FTEs / 1000ML Treated |
| | | O&M Cost | $664.25 | $622.48 | $/ML Treated |
| | | Capital Reinvestment Cost | | $94.40 | $/ML Treated |
| **Safety** | Protect Public Health and Safety | Average Annual Treated Water Turbidity | 0.06 | 0.04 | Nephelometric Turbidity Units (NTU) |
| | | Days in Turbidity Ranges for Raw Water < 1 NTU | 0 | 0.00% | % |
| | | Days in Turbidity Ranges for 1 < Raw Water < 5 NTU | 21.64% | 39.45% | % |
| | | Days in Turbidity Ranges for 5 < Raw Water < 15 NTU | 50.68% | 47.40% | % |
| | | Days in Turbidity Ranges for 15 < Raw Water < 50 NTU | 23.56% | 10.68% | % |
| | | Days in Turbidity Ranges for Raw Water > 50 NTU | 4.11% | 2.47% | % |
| | | Days over Group Nitrate Target of 10 mg/L for Treated Water | 0 | 0 | # |
| | | Days over Group Turbidity Target for Treated Water | 0 | 0 | # |
| | | Raw Water Dissolved Carbon | 4 | 4.25 | mg/L |
| | | Raw Water Total Organic Carbon | 4 | 5.00 | mg/L |
| | | Total Coliform Occurrences in Treated Water | 0 | 0 | # |
| | | Treated Water Dissolved Carbon | 3 | 2.75 | mg/L |
| | | Treated Water Total Organic Carbon | 3 | 2.75 | mg/L |
| | Provide a Safe and Productive Workplace | Cost of Overtime Hours | $2,753.18 | $3,745.23 | $ / O&M FTE |
| | | Field Accidents with Lost Time | 0 | 0 | # / 1000 O&M |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | Labour Hours |
| | | Lost Hours due to Field Accidents | 0 | 0 | # / 1000 O&M Labour Hours |
| | | Sick Days Taken | 7.3 | 13.5 | # / O&M Employees |
| | | Total Overtime Hours / Total Paid O&M Hours | 2.22% | 3.11% | % |
| | | Unavailable O&M Hours / Total Paid O&M Hours (incl. Expended Banked Time, Other Training, Safety Training, Sick Time, Vacation) | 19.03% | 23.66% | % |
| **Environmental Sustainability** | Protect the Environment | GHG Emissions from Energy Consumed | 68.40 | 75.21 | kg CO2e / ML Treated |
| | | Percent Backwash Waste Treated | 100% | 88.61% | % |
| | | Water Wasted During Treatment Process | 9.65% | 12.39% | % |
| **Reliability** | Provide Reliable Service and Infrastructure | Capital Investment / Replacement Value | 0.35 | 0.60% | % |
| | | Unit Filter Run Volume | 300 | 300 | m3/m2 |
| **Responsiveness** | | Unplanned Hours where plant could not operate at Rated Capacity | 0 | 0 | # |

In addition, the City is also working to include additional levels of service to evaluate organization specific KPIs at an internal level. These KPIs have been provided in **Table 11**. The AIM project will also assist us with identifying and adding additional KPIs in future iterations because a system will be available to formally track this data.

**Table 11: Newly Defined Level of Service KPIs**

| Customer Level of Service | Technical LoS | 2019 KPI | 2020 KPI | Target | Units |
|---|---|---|---|---|---|
| **Quality** | Length of newly installed watermain | 7.88 | 2.1 | N/A | km |
| | Number of abandoned watermain segments | 22 | 25 | N/A | Count |
| **Cost Efficiency** | # of water billing inquiries | N/A | 9 | N/A | Count |
| **Safety** | Number of lead pipe grant applications received | 101 | 83 | N/A | Count |
| | Number of successful lead pipe grant application | 83 | 71 | N/A | Count |
| | # of property owner lead services | N/A | 2,490 | 0 | Count |
| **Reliability** | % of Municipally Owned Hydrants where Preventative Maintenance was Completed* | N/A | 92% | 100% | % |
| | # of hydrants with identified deficiencies during inspection | N/A | 51 | N/A | Count |
| | % of Municipally Owned Valves where Preventative Maintenance was Completed | N/A | 25% | 18% +/- 5% | % |
| | # of Valves with identified deficiencies | N/A | 79 | N/A | Count |

| | | | | | |
|---|---|---|---|---|---|
| **Responsiveness** | Average # of hours to resolve watermain service disruption | N/A | N/A | N/A | Average hours |
| | Average # of hours to resolve water service, service disruption | N/A | N/A | N/A | Average hours |

*Hydrant program inspects 100% of City-owned and assumed hydrants but does not include hydrants that are currently unassumed (e.g. new developments).

# 1.6. CURRENT ASSET PERFORMANCE

The current asset performance for water assets has been separated into two (2) categories for this section of the report:

- Energy Performance; and
- Operating Performance

## 1.6.1. WATER FACILITY CURRENT ENERGY PERFORMANCE

The City of Brantford has a Corporate Energy Management Plan (CEMP) which emphasizes energy efficiency within the City. The goals of the CEMP are to reduce energy use, energy intensity, and greenhouse gas (GHG) emissions in City Facilities. In addition, through the City's Climate Change Action Plan and Climate Lens Tool explained in **Section 10** of the **Asset Management Plan Overview Document**, the City will be working to improve our facilities' energy efficiency and reduce the associated carbon footprint. Under this plan, annual energy management data is reported, but has a reporting delay of two (2) years. The most recent report is the 2019 Corporate Energy Management Report which is where the current energy performance of each water facility in **Table 12** below was obtained.

**Table 12: Current Energy Performance of Water Facilities**

| Facility | Address | Electricity (kWh)* | Natural Gas (m3)* | GHG Emissions (kg)* | Annual Flow (Mega Litres) | Energy Intensity (ekWh/Mega Litre)* |
|---|---|---|---|---|---|---|
| **TOTAL** | - | 10,668,251 | 228,589 | 757,271 | - | - |
| **Water Treatment Plant** | 324 Grand River Ave | 8,242,647 | 200,613 | 630,462 | 12,077 | 859 |
| **Albion St Booster Station** | 180 Albion St | 59,590 | N/A | 1,816 | 75.5 | 789 |
| **Tollgate Rd Booster Station** | 106 Tollgate Rd | 747,268 | N/A | 22,772 | 2,469 | 303 |
| **Park Rd Pump** | 310 Campbell | 620,264 | 5,582 | 29,455 | 2,471 | 275 |

| Station | St | | | | | |
|---|---|---|---|---|---|---|
| **Northwest Pump Station** | 5 Kraemer's Way | 998,482 | 22,394 | 72,766 | 2,093 | 591 |

*Based on information provided in the 2019 Corporate Energy Management Report

### 1.6.2. WATER FACILITY CURRENT OPERATING PERFORMANCE

To assess the current operating performance, the City participates in the National Water and Wastewater Benchmarking Initiative (NWWBI) with other municipalities. The City reports specific data metrics for the purposes of comparing Brantford to other municipalities as well as compares reported KPIs from each year. It is important to note that a confidentiality agreement exists with other municipalities, and so although Brantford does compare our performance against other municipalities, that comparison cannot be included in this report. These KPIs are reported in the Current Levels of Service in **Section 1.5**. When comparing Brantford's 2018 to the 2019 NWWBI KPI numbers, it can be seen that many numbers remained consistent. However, there was a significantly different cost increase from 2018 to 2019 to perform locates and the cost of overtime hours decreased for distribution and increased for treatment.

In addition, the City received a perfect score in 2020 on the Ministry of Environment, Conservation and Parks (MECP)'s Brantford Drinking Water System Annual Inspection. The unannounced on-site inspection of the Water Treatment Plant, reservoirs, and elevated strorage tank occurs every three (3) years, and includes a throrough inspection of the system including records review, documents, maintenance activities, staff training, and data.

# 1.7. DISCUSSION & CONCLUSIONS

In conclusion, the City of Brantford operates and maintains several water assets. These assets are typically in Good condition, but are approaching Fair condition, with a total estimated replacement cost of approximately $697M.

The inventory and condition data confidence for vertical assets related to treatment and storage are typically at a High level due to formal condition assessments having been completed. The linear water asset inventory and condition data confidence is typically Medium. Assets that can be visually inspected are typically at a high level for both inventory and condition, where assets that are not able to be visually inspected are typically at a medium level due to inventory assumptions in the database and estimated condition based on available information, which is industry standard (e.g. watermain, water services, < 76mm water meters). These inventory assumptions are continuously being improved as new data is added into the database. In addition, new condition assessment methodologies are being investigated for critical assets. It has been noted that a chambers inspection could be added to the valve inspection program, and this will be investigated as a future initiative. As stated, some of these inspection improvements are ongoing and also will improve as a result of the AIM project explained in **Section 7** of the **Asset Management Plan (AMP) Overview** document.

Furthermore, the lifecycle stages for water assets includes: Planning, Creation, O&M, and Disposal. During the Planning stage, the City identifies the need for the asset; during the Creation stage, the asset is purchased and installed or constructed; during the O&M stage, the asset is operating and lifecycle activities (i.e. maintenance) occur on each of our water assets to maintain the state of good repair; and the Disposal stage is when the asset has reached the end of its useful life or is underperforming and requires disposal.

Lifecycle activities are currently typically tracked through Avantis CMMS for vertical assets or a mobile web application through ArcGIS for linear assets which provides limited data to ensure compliance only. For more information on key database applications and work order management, please refer to **Section 4.2** and **Section 7**, respectively, in the **AMP Overview** document. At this time, the costs associated with these activities are partially broken down as a lump sum and are estimated based on the 2021 Preliminary Operating Budget, which is created based on the total O&M expenditures from previous years. When these activities are integrated into AIM, the frequency and costs associated with specific activities will be better represented. Therefore, future updates of the AMP will include specific costs for these activities as well as the time associated with these activities in order to properly allocate budget and identify operational inefficiencies.

It is estimated based on the average annual cost in the 10 Year Life Cycle Costing that the City should be spending an average $15.3M annually for capital water assets and will be spending an average of $32.5M on O&M for water assets, however, the City is currently proposing to spend an average of $7.8M annually on capital for water assets' state of good repair.

Additionally, Current Levels of Service have been identified for water assets. These levels of service are either tracked based on reported information required for the National Water and Wastewater Benchmarking Initiative (NWWBI) or are newly identified levels of service metrics for future iterations of the AMP. The NWWBI information is mandated through this initiative, but serves as a tool for a first draft of the water asset KPIs. Brantford is also working to include these and additional metrics in AIM which will assist us with tracking these and future KPIs for future iterations.

Finally, asset performance is separated into operating and energy performance. For operating performance the City compares NWWBI data with surrounding municipalities as well as against previous years' data. In addition, the City received a perfect score in the 2020 MECP Drinking Water Annual Inspection.

For energy performance, annual energy data associated with facilities in the City's Corporate Energy Management Plan (CEMP) has been reported. The City used a total of 10,668,251 kWh for water treatment and pumping, and emitted 757,271 kg of gas emissions for these facilities. The City is continuously looking for ways to improve the energy efficiency of all facilities. Through the Climate Change Action Plan and Climate Lens Tool explained in **Section 10** of the **AMP Overview** document, the City will be setting targets to improve facilities' energy efficiency and reduce the associated carbon footprint.

# 2. WASTEWATER ASSETS

## 2.1. INTRODUCTION

The City of Brantford owns and maintains several assets under the wastewater asset class. The purpose of this section is to present specific information about the Wastewater Asset class so that we can answer the questions posed in **Section 2** of the **Asset Management Plan (AMP) Overview Document**, and includes the following:

- Wastewater Assets' Data Inventory and Condition Approach;
- Summary of Wastewater Assets;
- Lifecycle Activities and Cost of Wastewater Assets;
- Current Wastewater Assets' Levels of Service;
- Current Wastewater Asset Performance; and
- Conclusion.

## 2.2. WASTEWATER ASSETS' DATA INVENTORY AND CONDITION APPROACH

The City of Brantford has different approaches to establishing the condition for each wastewater asset due to available resources, technologies, and budget restrictions.

There are three (3) approaches we use to assess the condition of our wastewater assets:

- Outsourced condition assessments to consultants;
- Regular inspection programs conducted by City employees; and
- Estimated condition based on asset specific information.

A list of all condition assessments for all core assets can be found in **Table 6** in the **Asset Management Plan Overview Document**.

The origin of the wastewater asset data for inventory, replacement cost, condition as well as data confidence are provided in **Table 13** below.

**Table 13: Wastewater Assets' Inventory, Replacement Cost, and Condition Origin and Confidence Levels**

| | Inventory | | | Replacement Cost | | | Condition | | |
|---|---|---|---|---|---|---|---|---|---|
| **Asset Type** | **Inventory (incl. Quantity and Age) From** | **Data Confidence Level** | **Data Confidence Description** | **Replacement Cost From** | **Data Confidence Level** | **Data Confidence Description** | **Condition From** | **Data Confidence Level** | **Data Confidence Description** |
| **Wastewater Treatment Plant** | 2017 Condition Assessment and Strategic Plan completed by CIMA | Medium | GIS inventory complete with some field assumptions. | 2021 Costing Technical Memorandum by GM Blue Plan | High | Formal estimate by Consultant. | 2017 Condition Assessment and Strategic Plan completed by CIMA | Medium | Formal Condition Assessment, but did not include all components. |
| **Wastewater Pump Stations** | 2015 Pump Station Condition Assessment completed by GM Blue Plan | High | Formal inventory with few unknowns. | 2021 Costing Technical Memorandum by GM Blue Plan | High | Formal estimate by Consultant. | 2015 Pump Station Condition Assessment completed by GM Blue Plan | Medium | Formal condition assessment with few unknowns, but possibly outdated. |
| **Forcemains** | GIS layer - ssPressurizedMain | High | Complete GIS layer. | 2019 Master Servicing Plan Appendix B | Medium | Estimated based on internal Class D pricing. | Service Life | Low | Inventory is complete, but while service life can be a predictor of condition, it does not always indicate the true condition. |
| **Gravity Main** | GIS layer - ssGravityMain | High | Formal inventory with few unknowns. | 2019 Master Servicing Plan Appendix B | Medium | Estimated based on internal Class D pricing. | CCTV Inspection program, Material Service Life | Medium | Formal inspection program, but not yet encompassing all assets. |
| **Wastewater Services** | GIS layer - ssLateralLine | Low | GIS inventory not complete with all assets. | Asset Management 2020 Unit Costs | Medium | Estimated based on internal Class D pricing. | Service Life | Low | Inventory is not complete, and while service life can be a predictor of condition, it does not always indicate the true condition. |
| **Maintenance Holes** | GIS layer - ssManhole | Medium | GIS inventory complete with some field assumptions. | 2019 Master Servicing Plan Appendix B | Medium | Estimated based on internal Class D pricing. | Maintenance Hole Condition Assessment program, Service Life | Medium | Formal condition assessment, but annual program not yet encompassing all assets (approx. 10% assessed). |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Siphons** | GIS layer - ssGravityMain | Medium | GIS inventory complete with some field assumptions. | 2019 Master Servicing Plan Appendix B | Medium | Estimated based on internal Class D pricing. | 2019 Gilkison Siphon Condition Assessment, Material Service Life | Medium | Condition Assessment completed on three barrels, but not on all siphons. Inventory is complete, but while service life can be a predictor of condition, it does not always indicate the true condition. |

Per **Table 13** above, excluding wastewater services, wastewater assets' inventory and condition data are typically at a High or Medium confidence level with an overall average confidence level of Medium.

Inventory and condition data related to vertical infrastructure such as wastewater treatment and pumping, are typically at a High confidence level due to formal condition assessments and inventories having been completed by consultants.

Wastewater assets' inventory and condition data related to linear infrastructure are typically at a Medium level. The inventories for these assets are mostly complete in GIS with some assumptions associated with the age or material of the asset, and the condition is estimated based on more than one (1) criteria (e.g. siphons).

The only asset at a Low inventory and condition confidence level is wastewater services, and that is because the inventory for these assets is incomplete and the condition is based solely on the service life which contains unknowns due to the incomplete inventory. The City is working to add in the missing wastewater services data using As-Built drawings.

Improvements to the inventories and inspection programs will be ongoing as a result of the AIM project explained in **Section 7** of the **Asset Management Plan Overview document**.

### 2.2.1. SERVICE LIFE

Where condition assessments have not been completed, the condition has been estimated based on the estimated service life of the asset presented in **Table 14** below. The average overall estimated service life for assets can be found in **Table 16**.

**Table 14: Wastewater Assets' Estimated Service Life**

| Asset | Estimated Service Life |
|---|---|
| **Gravity Main, Siphons** | ABS (Acrylonitrile Butadiene Styrene) – 90 years, Concrete – 100 years, Clay – 70 years, Cast Iron – 90 years, PVC (Polyvinyl chloride) – 90 years, Asbestos Cement – 70 years, FRP (Fibreglass Reinforced Pipe) – 90 years, Ductile Iron – 65 years, HDPE (High Density Poly Ethylene) 90 years, Unknown – 50 years, Steel – 90 years, Polyethylene – 90 years |
| **Maintenance Holes** | 100 years |
| **Forcemains** | PVC – 90 years, Asbestos Cement – 70 years, Polyethylene – 90 years |
| **Wastewater Services** | ABS – 90 years, Concrete – 100 years, Clay – 70 years, Cast Iron – 90 years, PVC – 90 years, Asbestos Cement – 70 years, Fibreglass Reinforced Pipe – 90 years, Ductile Iron – 65 years, HDPE 90 years, Unknown – 50 years |

### 2.2.2. CONDITION SCORING

For the purpose of this report and standardizing condition scores across all assets in the Asset Management Plan, the Condition Rating is defined by three (3) Condition Scores as defined in **Table 15** below. For assets with formal consultant condition assessments, the conditions have been modified to fit into this model.

**Table 15: Condition Score Description**

| Condition Score | Condition Rating | Description |
|---|---|---|
| **1 – 1.4** | Good | Assets in the system or network are in working order, have no or minor deficiencies. Where condition data is not available, this category applies to assets which are within the first 40% of their estimated service life. |
| **1.5 – 2.4** | Fair | Asset in the system or network show general signs of deterioration, some elements may have significant deficiencies, and asset will likely require repairs in the next 10 years. Where condition data is not available, this category applies to assets which are within 41% - 80% of their estimated service life. |
| **2.5 - 3** | Poor | Asset is below standard showing signs of significant deterioration, are in danger of imminent failure, and will require repair or replacement within the next year. Where condition data is not available, this category applies to assets which have exceeded 80% of their estimated service life. |

## 2.3. SUMMARY OF WASTEWATER ASSETS

The summary of assets for the Wastewater Asset Class can be found below. The summary of assets includes: Quantity, Replacement Cost, Average Age, and Average Condition Score for each asset type in accordance with O.Reg 588/17.

### 2.3.1. TOTAL SUMMARY OF ASSETS

A table summarizing all wastewater assets is included in **Table 16** below. Detailed information about each asset is included in individual sections. The total replacement cost for wastewater assets is approximately $643M with an average age of 36 years which is 51% of the total average overall estimated service life for the asset class. The average condition scores are shown to one decimal place to illustrate how close the scores are to being on a cusp of another rating and were used to calculate the weighted overall average condition score for the asset group, but are shown rounded to the nearest whole number in subsequent sections. Although it is evident that overall wastewater assets are in Good condition, they are approaching Fair condition with a weighted average condition score of 1.4.

**Table 16: Total Summary of Wastewater Assets**

| Asset | Quantity | Unit | Replacement Cost | Average Age (years) | Average Estimated Service Life | Percentage of Estimated Service Life | Average Condition Score | Average Condition Description |
|---|---|---|---|---|---|---|---|---|
| **Wastewater Total** | | | **$643.1M** | **36** | **70** | **51%** | **1.4*** | **51%** |
| **Wastewater Treatment Plant Site** | 20 | structures | $277.0M | 39 | 31 | 135% | 1.6 | FAIR |
| **Pump Stations** | 9 | buildings | $37.0M | 29 | 39 | 79% | 1.4 | GOOD |
| **Forcemains** | 4 | km | $2.4M | 18 | 87 | 21% | 1.1 | GOOD |
| **Gravity** | 432 | km | $279.8M | 42 | 84 | 50% | 1.1 | GOOD |

| Mains | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Wastewater Services** | 10,187 | count | $16.3M | 36 | 68 | 53% | 1.7 | FAIR |
| **Maintenance Holes** | 6,146 | count | $27.7M | 43 | 100 | 43% | 1.2 | GOOD |
| **Siphons** | 2.8 | km | $2.9M | 37 | 82 | 45% | 1.3 | GOOD |

*Denotes Weighted Average

### 2.3.2. WASTEWATER TREATMENT PLANT (WWTP) SITE

The Waste Water Treatment Plant (WWTP) Site is a number of facilities which contribute to the treatment of sewage collected from properties connected to the municipal wastewater network. The Brantford WWTP is a conventional activated sludge plant (primary and secondary treatment).

Per **Figure 15** below, the WWTP is made up of 20 facilities with a total replacement cost for the entire site being $277M.The average facility age is 41 years, and the average process equipment age is 37 years, which is an overall site average of 39 years, and is past the estimated service life of 31 years. The condition data below is based on available condition assessment information and a weighted average condition score of 2 or Fair was calculated with a higher weight towards process equipment. The distribution of overall weighted condition data for each facility is below.


**Figure 15: Wastewater Treatment Plant Asset Summary**

## 2.3.3. WASTEWATER PUMP STATIONS

Wastewater Pump Stations are responsible for collecting wastewater at a low point from a catchment area and pumping it to a higher point in the gravity system to be outlet at the Wastewater Treatment Plant Site for treatment.

Per **Figure 16** below, there are nine (9) Wastewater Pump Stations which are typically in Good condition with an average condition score of 1. The average age of a pump station facility is 31 years, and the average age of the internal equipment is 33 years which equals an overall facility average of 29 years which is 74% of the estimated service life of 39 years. The total replacement cost for all pump stations is $37.0M. The cost and conditions for each pump station are broken down below.

At the time of writing this report, there are upgrades being completed on the Fifth Ave P.S. and so it is assumed to now be in Good condition.

| NO OF PUMP STATIONS | REPLACEMENT COST | AVERAGE FACILITY AGE (years) | AVERAGE EQUIPMENT AGE (years) | AVERAGE ESTIMATED SERVICE LIFE | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|---|
| 9 | $37.0M | 31 | 27 | 39 | 1 | GOOD |


**Figure 16: Wastewater Pump Station Asset Summary**

## 2.3.4. FORCEMAIN

A forcemain is a pressurized main containing wastewater which is pressurized by a pump typically from a pump station.

It can be seen in **Figure 17** below that City of Brantford has a total of 3.7km of forcemain in the City which are in overall Good condition with an average condition score of 1, and an average age of 18 years which is 20% of the average estimated service life of 87 years. The only forcemain considered to be in Fair condition based on service life is the Woodlawn Ave forcemain. The total replacement cost for all seven (7) forcemain locations is $2.4M.

It is important to note that two (2) of the pump stations (Empey P.S. and Somerset P.S.) do not have forcemain and pump directly into gravity main, and the Fifth Ave P.S. forcemain was recently replaced with two (2) twinned 300mm diameter forcemains. Additionally, there is currently not a City swabbing program because most pump stations do not have a swab launch, and this will be reviewed in future.

| LENGTH (km) | REPLACEMENT COST | AVERAGE AGE (years) | AVERAGE ESTIMATED SERVICE LIFE | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|
| 3.72 | $2.4M | 18 | 87 | 1 | GOOD |

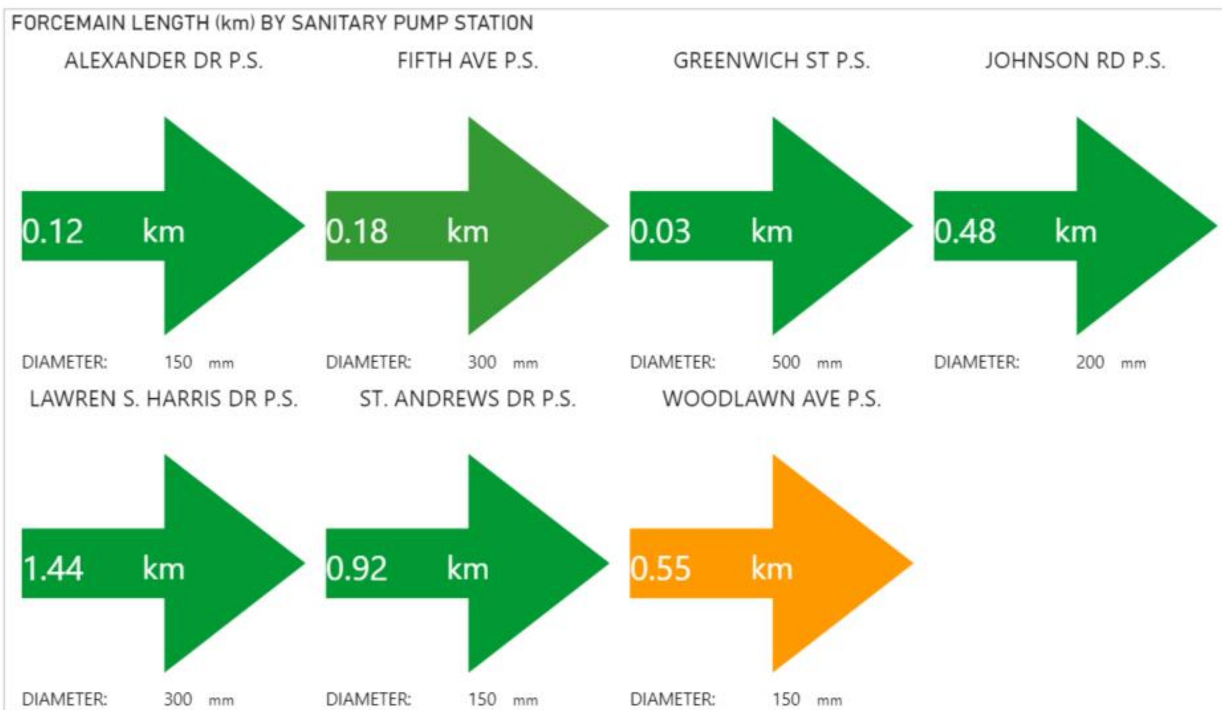



**Figure 17: Forcemain Asset Summary**

## 2.3.5. WASTEWATER GRAVITY (SEWER) MAIN

Wastewater gravity main is buried underground and carries wastewater from wastewater services to pump stations and the Wastewater Treatment Plant. The City completes CCTV (Closed Circuit Television) inspections on this asset which involves sending a robot with a camera to inspect the inside of the pipe to determine any defects or rehabilitation needs.

Per **Figure 18** below, the City has a total of 432.1km of wastewater gravity main which are in overall Good condition with an average condition score of 1. The total replacement cost for gravity main in the City is $279.8M and the average age of pipe is 42 years which is 50% of the average estimated service life of 84 years. The most common wastewater gravity main is PVC followed by Asbestos Cement (PVC).

| LENGTH (km) | REPLACEMENT COST | AVERAGE AGE (years) | AVERAGE ESTIMATED SERVICE LIFE | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|
| 432.1 | $279.8M | 42 | 84 | 1 | GOOD |

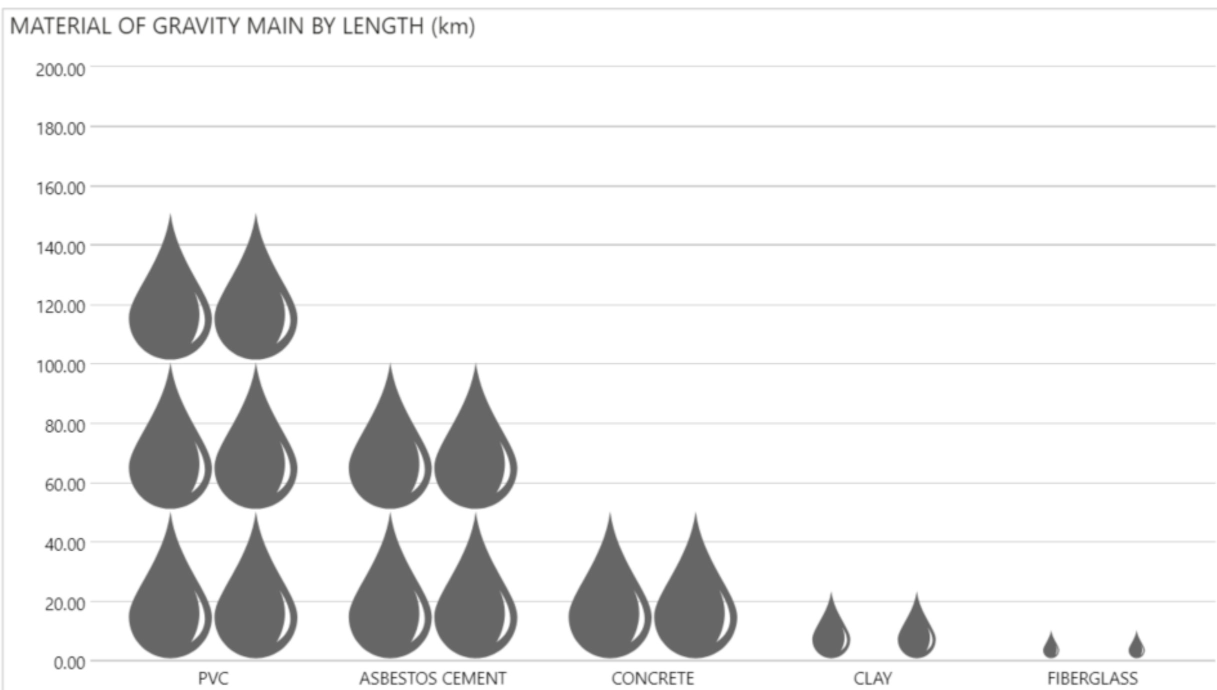



**Figure 18: Wastewater Gravity Main Asset Summary**

## 2.3.6. WASTEWATER SERVICES

A wastewater lateral service is a pipe that connects serviced properties to the wastewater gravity main. Per **Figure 19** below, it can be seen that there are approximately 10,200 known services in the City which have a total replacement cost of $16.3M. The average age of known services is 36 years which is 53% of the overall average estimated service life of 68 years. Based on estimated service life, the average condition is Fair with an average condition score of 2. Per the figure below, it is evident that most material types are unknown, and so, as a result, the condition assumptions are also at a low confidence level. It is important to note that services are owned by the City up until the property line when it becomes the property owner's responsibility, and the information below exclusively includes information related to the City owned service. In addition, it is important to note that the wastewater services layer inventory is incomplete and should be closer to the 30,000 services estimated for water services. Although there is some confidence in the known data in GIS, the City is in the process of adding missing services using As-Built information. Therefore it is expected that the data quantities will change as the data confidence increases.

| COUNT OF SERVICES | REPLACEMENT COST | AVERAGE AGE (years) | AVERAGE ESTIMATED SERVICE LIFE | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|
| 10,233 | $16.3M | 36 | 68 | 2 | FAIR |


**Figure 19: Wastewater Services Asset Summary**

## 2.3.7. WASTEWATER MAINTENANCE HOLES

A wastewater maintenance hole (sometimes referred to as a manhole) is an underground structure which is an access point for the wastewater main so that it can be maintained or flushed. The City owns approximately 6,150 maintenance holes with a total replacement cost of $27.7M. Maintenance holes are an average age of 43 years which is 43% of the 100-year estimated service life. There is an annual condition assessment program where a portion of maintenance holes are inspected every year, but the City has not yet completed an inspection of all maintenance holes. In addition, some maintenance holes have been visually assessed internally for maintenance purposes. Therefore, based on a combination of data obtained from the condition assessment program, internal inspections, and service life, maintenance holes have an average condition rating of Good with an average condition score of 1.

It can be seen in **Figure 20** below that the majority of maintenace holes have been installed in the last 80 years with installation dates occurring earlier than 1900. Although maintenance holes that are past the service life may be identified as good, if they are well past their service life, they should be planned for replacement.

| NO OF MAINTENANCE HOLES | REPLACEMENT COST | AVERAGE AGE (years) | AVERAGE ESTIMATED SERVICE LIFE | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|
| 6,148 | $27.7M | 43 | 100 | 1 | GOOD |

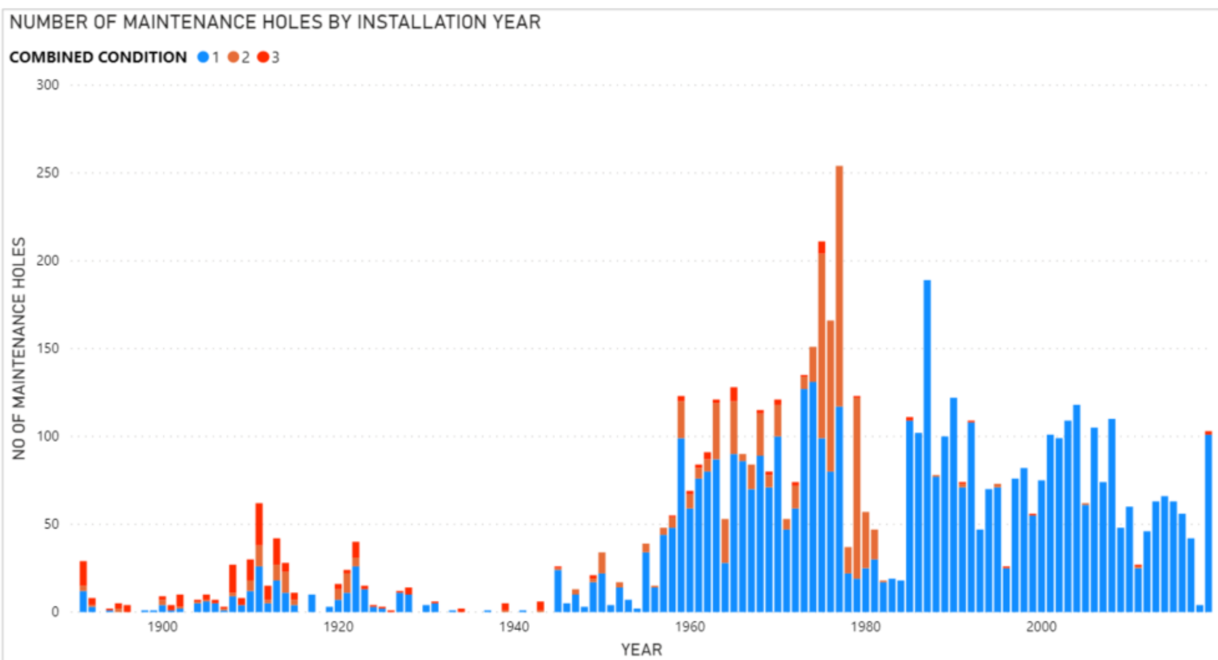



**Figure 20: Wastewater Maintenance Hole Asset Summary**

## 2.3.8. SIPHONS

A siphon is a pipe connected to the rest of the wastewater gravity system that carries wastewater flows under rivers or canals. The City has five (5) crossing points under the Grand River which are considered siphons.

Per **Figure 21** below, there is a total length of 2.8km of siphon pipe length, with a total replacement cost of $2.9M. The average age of a City siphon is 37 years, which is 45% of the average estimated service life of 82 years. The average condition based on a combination of available condition data and service life is Good with an average condition score of 1. The most common material used by length of pipe is polyethylene, however there are also cast iron, ductile iron, and concrete siphons as seen below.

| LENGTH (km) | REPLACEMENT COST | AVERAGE AGE (years) | AVERAGE ESTIMATED SERVICE LIFE | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|
| 2.8 | $2.9M | 37 | 82 | 1 | GOOD |

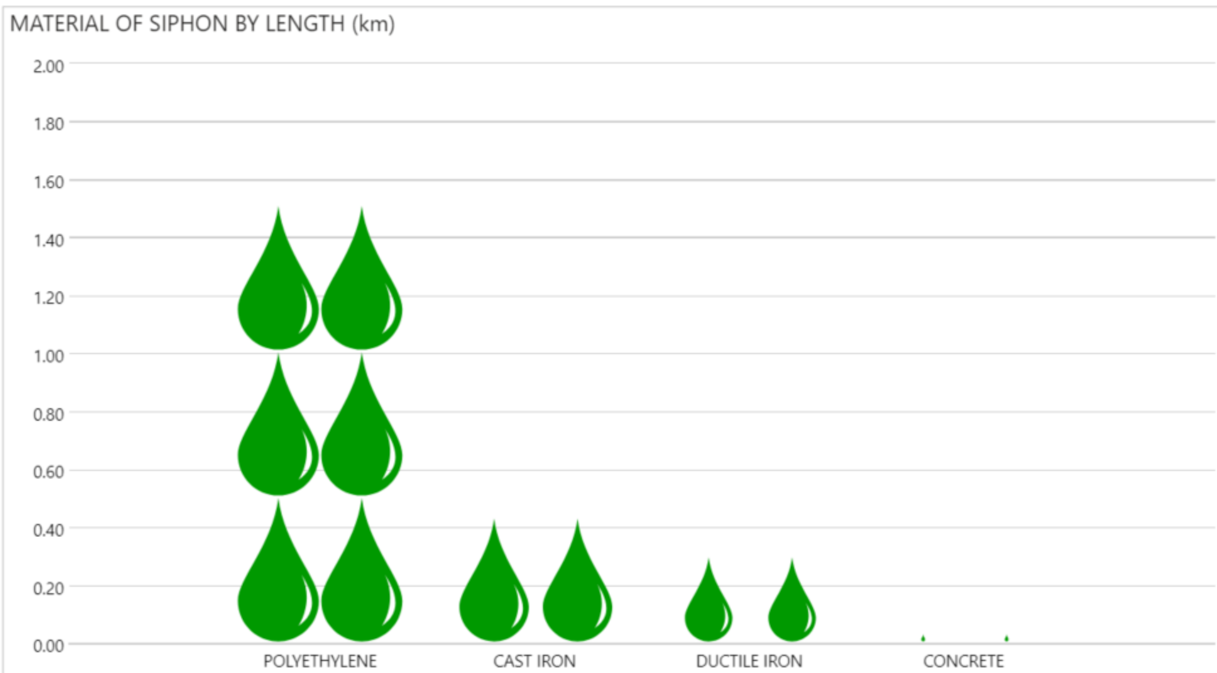



**Figure 21: Siphon Asset Summary**

# 2.4. LIFECYCLE OF WASTEWATER ASSETS

The lifecycle of Wastewater assets consists of four (4) categories which are described in this section:

- Key Lifecycle Stages of Wastewater Assets;
- Lifecycle Activities;
- Risks of Lifecycle Activities; and
- 10 Year Lifecycle Costs of Wastewater Assets.

## 2.4.1. KEY LIFECYCLE STAGES OF WASTEWATER ASSETS

The lifecycle of an asset refers to the following stages: Planning, Creation/Acquisition, Operations and Maintenance, Renewal/Disposal which are further defined in the Asset Management Plan Overview Document. For Wastewater assets specifically our general process is as follows:

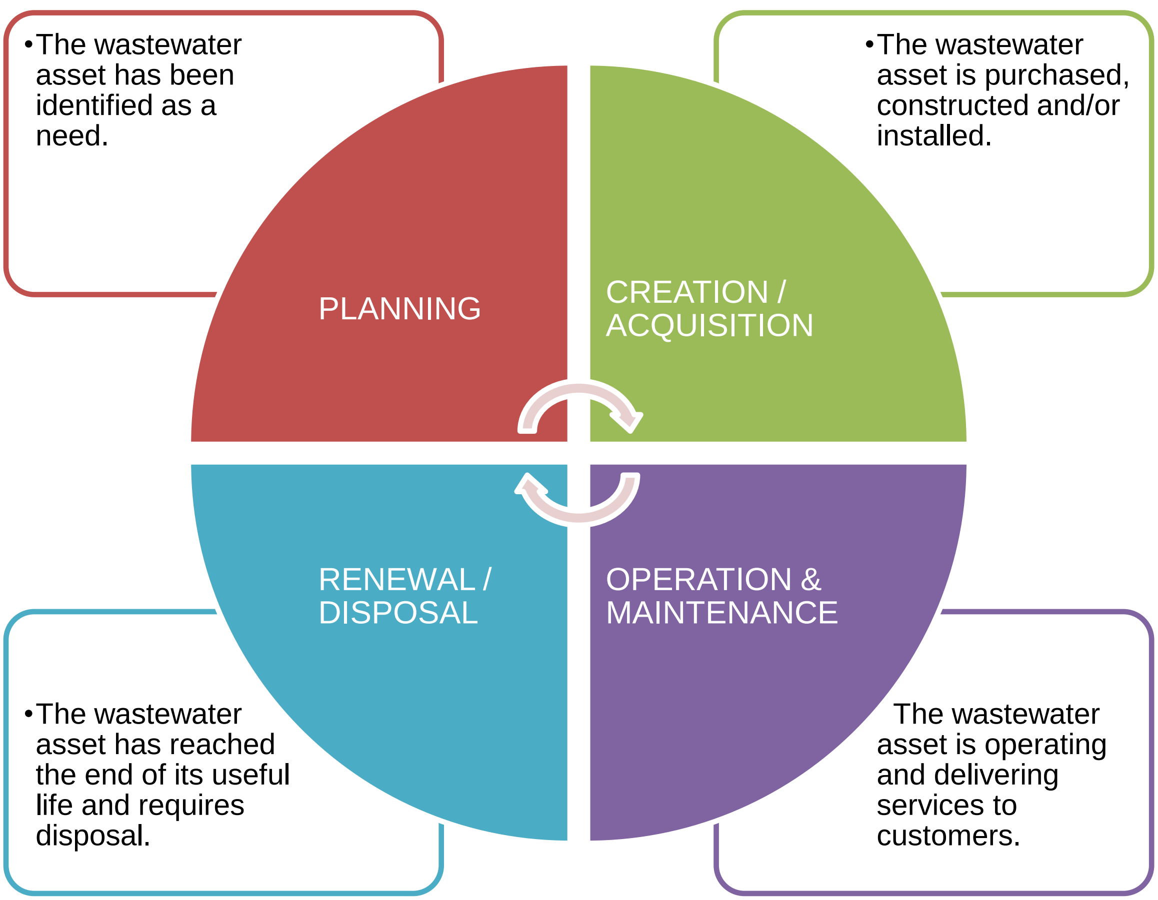
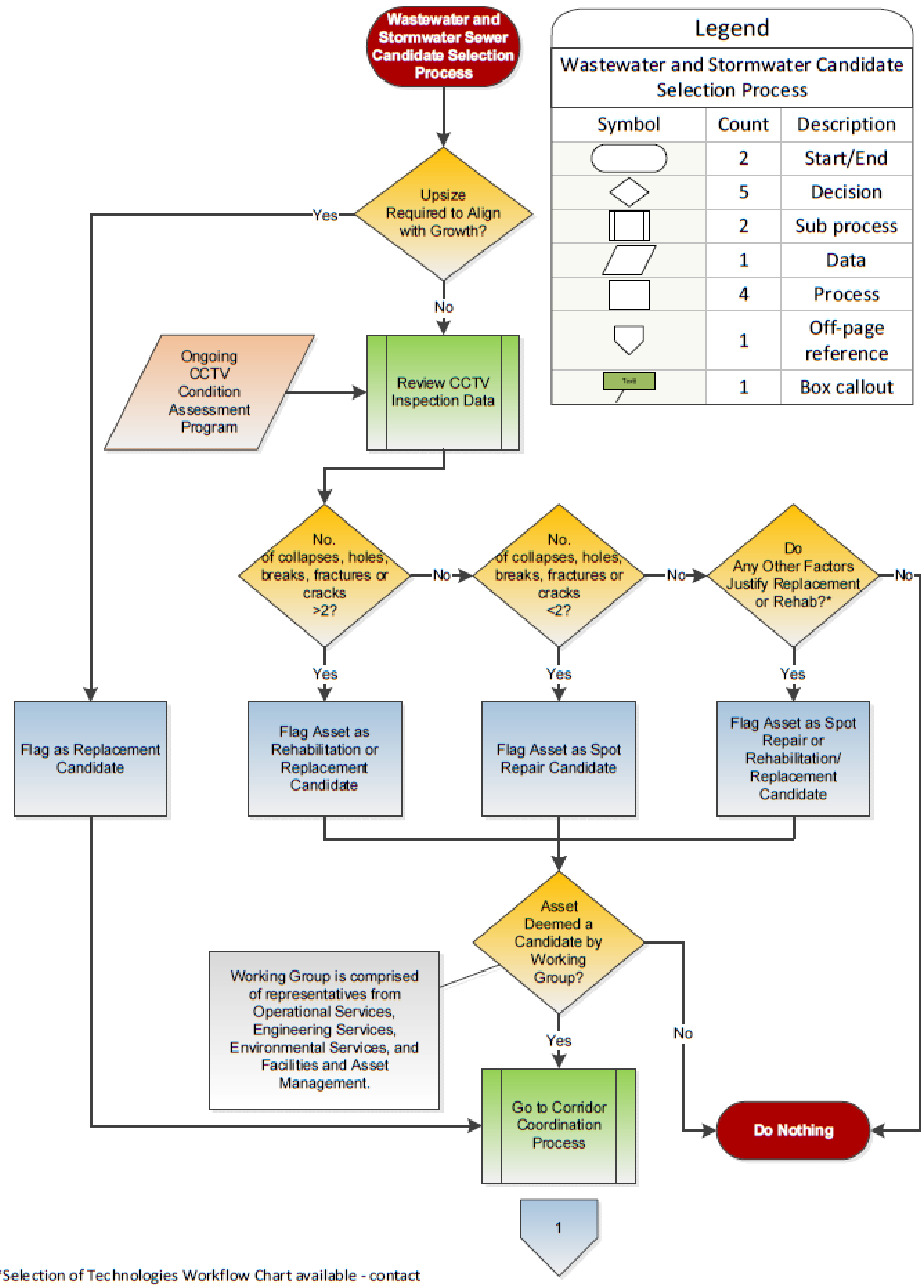



**Figure 22: Lifecycle Stages of Wastewater Assets**

1. **Planning** – The wastewater asset has been identified as a need through the Official Plan, Master Servicing Plan, or due to an identified poor condition of an existing asset during a CCTV inspection, maintenance report, site inspection, customer complaint, or desktop analysis. The asset is designed using all applicable codes and standards. Typically this phase also involves planning on how to optimize the value of the assets which may include: replacing neighbouring corridor assets at the same time, improving operating and maintenance efficiencies, upsizing or rerouting for growth. The business process for state of good repair for linear wastewater assets is shown in **Figure 23**.
2. **Creation / Acquisition / Replacement** – The cost and requirements for the new or replacement wastewater asset are defined. The asset is purchased, constructed and/or installed. Extra care is taken at this stage to ensure the asset is constructed properly using all appropriate design standards and guidelines to avoid any premature repairs or replacements due to installation errors.
3. **Operation and Maintenance** – The wastewater asset is operating and delivering services to customers. Maintenance (Lifecycle) Activities are completed on the asset at specific time intervals as indicated in **Section 2.4.2** below to prevent premature failures of the asset. Additional monitoring and potential improvements are evaluated during this process.
4. **Renewal / Disposal** – The wastewater asset has reached the end of its useful life, is in poor condition, and/or is underperforming, and requires disposal. The disposal considers the effect on customers such as required detouring or service disruptions which are taken into account in the Planning stage thereby restarting the cycle. The City follows industry standard when disposing of these assets.




*Selection of Technologies Workflow Chart available - contact Capital Planning

**Figure 23: Wastewater Linear Assets Business Process**

### 2.4.2. LIFECYCLE ACTIVITIES

A list of the planned Lifecycle Activities, annual cost, and frequency for each Wastewater Asset Class can be found in **Table 17** below. These activities are currently being undertaken to maintain our Wastewater assets and therefore maintain the current levels of service.

**Table 17: Lifecycle Activites for Wastewater Assets**

| Asset Type | Lifecycle Activity | 2021 Annual Cost* | Frequency | Completed by |
|---|---|---|---|---|
| **Pump Station** | Preventative Maintenance Activities | $5,159,799 | Based on SOP intervals | Wastewater Operations |
| **WWTP** | | | | Wastewater Operations |
| **Forcemain** | Repair | | As needed | Contracted Service - Water Distribution and Watewater Collection |
| | Condition Assessment | $50,000 | As Needed | Contracted Service - Asset Management |
| **Gravity Main** | Spot Repairs | $1,097,947 | As needed | Contracted Service - Water Distribution and Watewater Collection |
| | Lining | | As needed | Contracted Service – Design & Construction |
| | Cleaning | | 1 every 5 years | Water Distribution and Watewater Collection |
| | Grouting | | As needed | Water Distribution and Watewater Collection |
| | CCTV Inspection | | 1 every 10 years | Contracted Service - Asset Management |
| | Reaming | | As needed | Water Distribution and Watewater Collection |
| | Root Cutting | | As needed | Water Distribution and Watewater Collection |
| **Wastewater Services** | Lining | | As needed | Contracted Service - Water Distribution and Watewater Collection |
| | Top Hat Installation | | As needed | Contracted Service - Water Distribution and Watewater Collection |
| | CCTV Inspection | | As needed | Contracted Service - Asset Management |
| **Maintenance Holes** | Inspection | | Visual inspection as entered | Water Distribution and Watewater Collection |
| | Seal | | As needed | Contracted Service - Water Distribution and Watewater Collection |
| | Condition Assessment (2020) | $43,897 | As needed | Contracted Service - Asset Management |
| | Flow Monitoring | $18,000 per location | As needed | Contracted Service - Asset Management |
| **Siphons** | CCTV Inspection and Cleaning | $3.91 per meter | As needed | Contracted Service - Asset Management |
| | Critical Siphons Inspection and Cleaning | Included in $1,097,947 cost above | Every 2 Weeks | Water Distribution and Watewater Collection |

*2021 Annual Cost is typically based on estimates presented in the 2021 Preliminary Operating Budget under 2021 Budget Gross Expenditures.

Lifecycle activities occur on each of our wastewater assets to maintain the state of good repair (SOGR). Activities related to vertical assets (i.e. facilities) are currently tracked through Avantis. The information tracked includes: preventative maintenance, process failures, process upgrades, building failures, and building upgrades. Linear activities are typically tracked through web mapping applications that connect to the ArcGIS database or paper records. Work order tracking will be moved over to AIM during implementation which is explained in **Section 7** of the **Asset Management Plan Overview Document**. Information related to Avantis, and ArcGIS Collector can be found in **Section 4.2** of the **Asset Management Plan Overview Document**.

When these activities are integrated into AIM, the frequency and cost associated with these activities will be better represented. At this time, the costs associated with the O&M activities on these assets are estimated based on 2021 Preliminary Operating Budget and are not formally recorded, but future updates of the AMP should include actual costs, frequency, and time associated with these activities which will be recorded through AIM.

### 2.4.3. RISKS OF LIFECYCLE ACTIVITIES

The identified lifecycle activities in **Table 17** above are historical activities taken on by Water Distribution and Wastewater Collection. However, some risks with these activities include:

- **Traffic Accidents** - when performing maintenance in the vicinity of traffic vehicles, there is a risk of a traffic accident. This is mitigated by implementing a traffic control plan and wearing high visibility clothing during maintenance activities in the right of way;
- **Falling** – Some activities require working from heights and there is a risk of falling. This risk is mitigated by having maintenance personnel trained on all equipment and having fall arrest training where required.
- **Operator Error** – When operators are operating equipment, there is a risk of an operator related accident. This risk is mitigated by ensuring all operators have the required licenses and are trained on equipment.
- **Confined Space** - There are always risks associated with confined space, technicians are trained and standard operating procedures are followed to complete the task safely.
- **Equipment Failure -** Equipment failure can occur during maintenance activities and this is mitigated by ensuring preventative maintenance is completed at regular intervals to prevent this from occurring.
- **Contamination** – When completing maintenance there is a possibility of contaminating nearby water sources. This risk is mitigated by following standard operating procedures.

- **Utility Impact** – When digging into soil to locate a buried asset, there is a possibility of hitting a buried utility line. This is mitigated by ensuring locates are completed prior to digging.
- **Non-Accessible Easements** – There are a number of easements in the City which are considered non-accessible due to private obstructions (e.g. sheds) or natural terrain, and affect the City's ability to complete preventative maintenance. The City is currently working to secure contracts to have roadways built at each location to access these assets.

However, if these activities were not completed, the risks would include:

- **Service Disruptions** due to premature failures that could have been mitigated with preventative maintenance (e.g. valve failure from not exercising valves);
- **Environmental Risk:** due to sewer inflow and infiltration, surcharge and overflow, combined sewers or maintenance holes bypassing untreated wastewater to environment; and
- **Increased Cost** due to reactive repairs which could have been prevented with preventative maintenance (e.g. reactive repairs are often 3x more expensive than planned repairs).

### 2.4.4. 10 YEAR LIFECYCLE COSTS OF WASTEWATER ASSETS

**Figure 24** below outlines the 10 year lifecycle costs of wastewater assets. Typically when the condition of an asset is estimated based on service life there are spikes in the first year to account for the backlog of assets that have exceeded their service lives.

It can be seen that the largest assets requiring the most budget expenditure to alleviate the backlog are the WWTP and the gravity main. There is also a significant backlog associated with pump stations.

Based on the information presented in the figure below, the average cost for the next 10 years to be spent on wastewater asset's capital to maintain the state of good repair is $11.7M, and it is estimated that $32.5M should be spent annually on O&M. Therefore, this is the amount recommended that the City invest in wastewater assets annually to maintain the state of good repair.

It is important to note that this figure and associated costing was developed separately from other corridor assets (i.e. watermain & services, wastewater gravity pipe, maintenance holes, services, and roadway), in reality these assets would be considered in tandem when considering a corridor section in the City in order to obtain cost efficiencies during design and construction where possible.

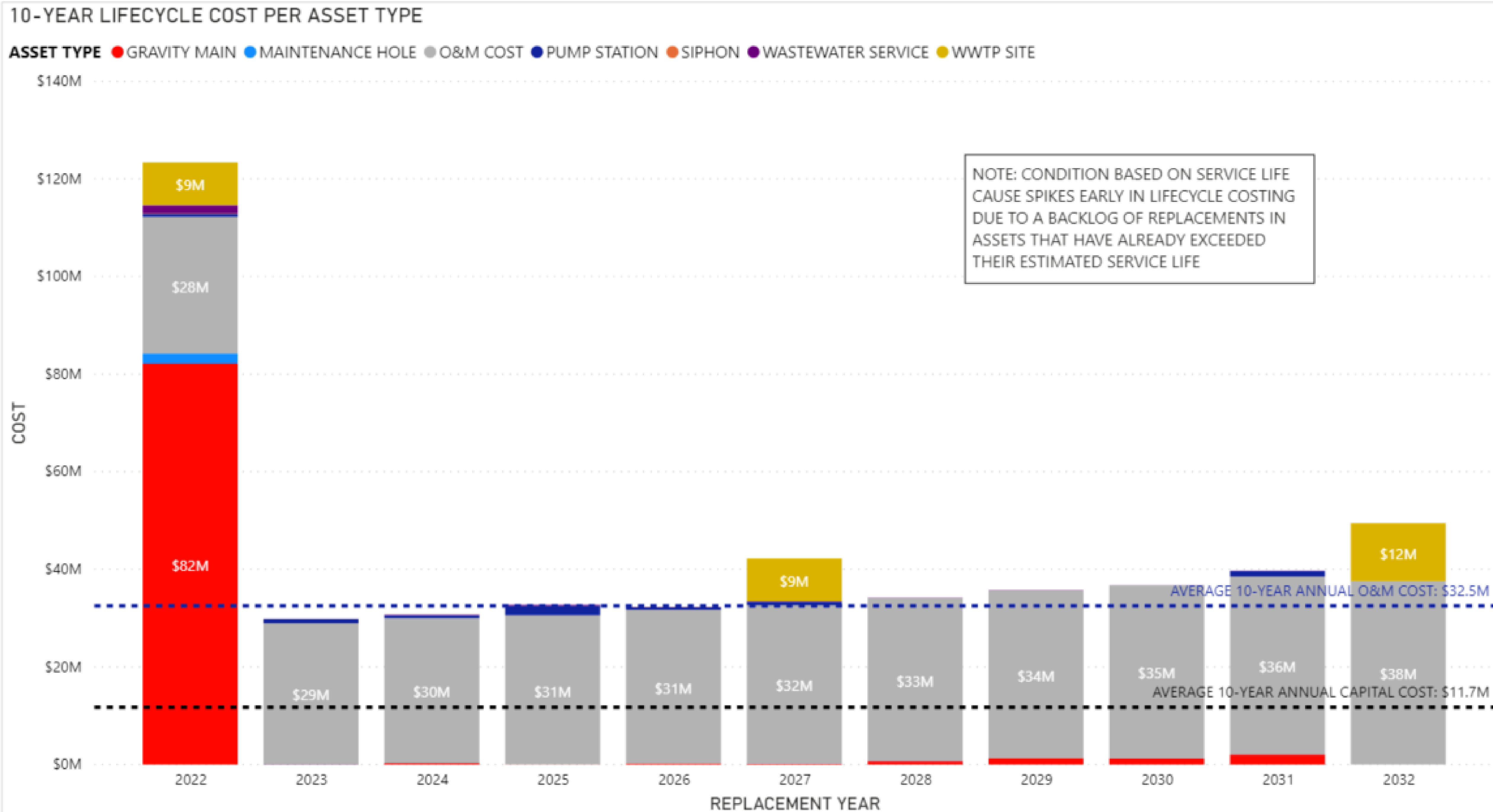



**Figure 24: 10-Year Lifecycle Cost Per Wastewater Asset Type**

Notes:

1. O&M Costs are estimated based on the 2021 Preliminary Operating Budget and are inflated by 3% each year. These O&M Costs are associated with both Treatment and Distribution and are partially broken down in **Table 17.**
2. WWTP Site and Pump Station replacement costs and years were taken from the respective condition assessments, which were updated by staff, and referred to in **Table 13.**
3. Gravity Sewer, Siphon, and Maintenance Hole replacement was based on service life unless it was estimated to be in poor condition based on the condition assessment, in which case it was estimated to be in 2022 to clear the backlog.
4. For all other assets where no formal forecast was available, the replacement year is based on the estimated remaining service life of each asset

Per **Figure 25** below, the existing 10-year forecast from 2021 – 2030, further explained in **Section 8.2.2** of the **Asset Management Plan Overview Document** , indicates that the City is currently planning to spend an average of $10.1M on wastewater assets capital annually, and as noted above, the required 10-year average amount is $11.7M for wastewater assets, therefore there is currently an average annual 10-year funding gap of $1.6M for wastewater assets. As noted on the graph, the impacts resulting from these funding gaps will be monitored and reported as appropriate. It is evident that the City is intending to expend over the required 10-year average amount from 2021 - 2023 in the existing 10-year forecast, however, as the forecast continues moving forward to 2029, gradually less budget is expected to be expended on SOGR for wastewater assets, until 2030 when the City is approaching the required amount. This indicates that the current forecast may be disproportionately allocated to the beginning and end of the forecast, and that the City may benefit from moving some projects into the middle of the forecast. Since the budget is revised annually, and the Prioritization Matrix explained in **Section 9** of the **Asset Management Plan Overview Document** is currently in its implementation phase, it is anticipated that this forecast will continue to change as City priorities shift. It is important to note that currently the City does not have access to detailed data on O&M for wastewater assets, but with the implementation of the AIM project explained in **Section 7** of the **Asset Management Plan Overview Document,** it is anticipated this information will be provided in the next iteration of the AMP.

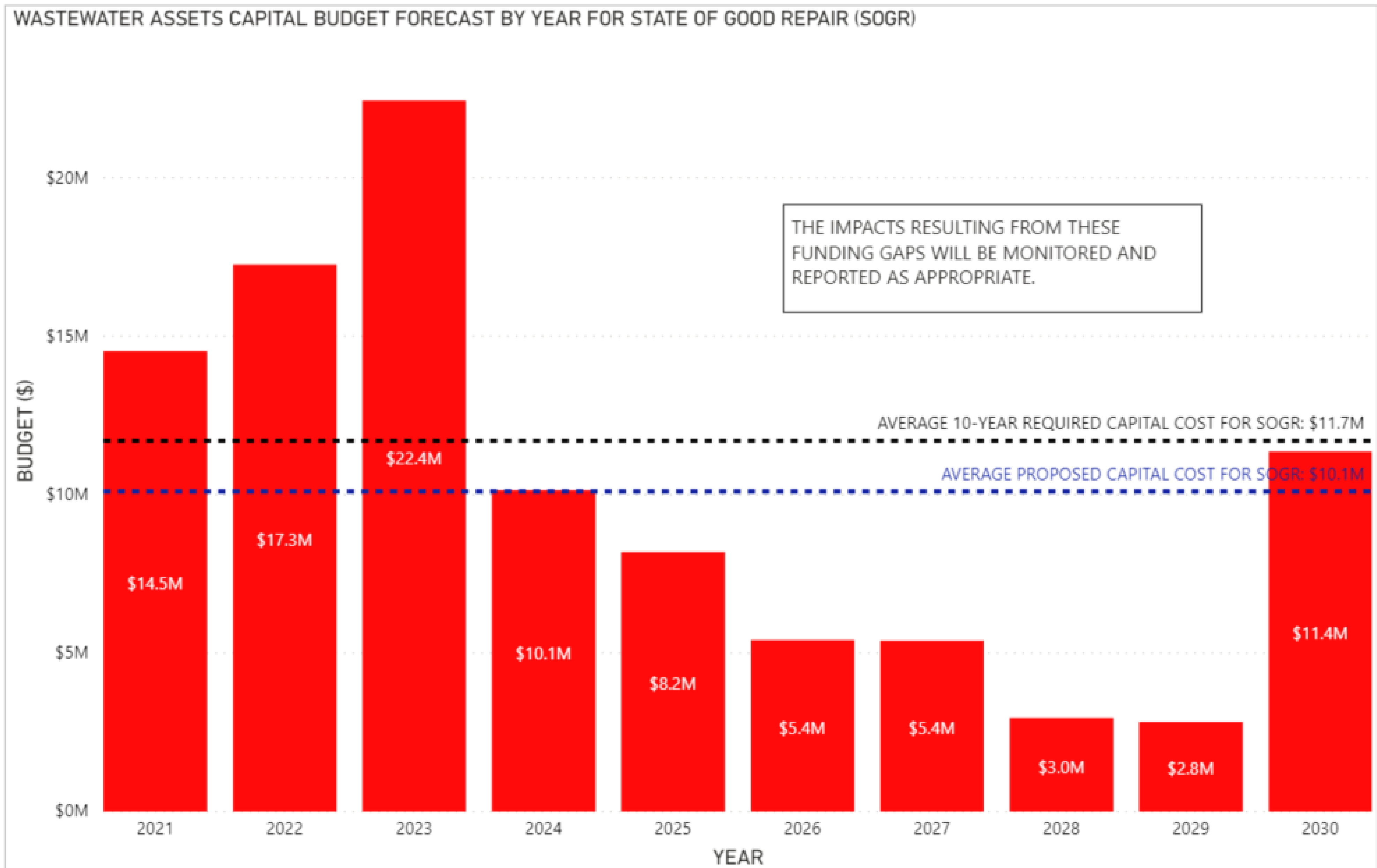



**Figure 25: Existing Capital Budget Forecast from 2021 – 2030 for Wastewater Assets**

# 2.5. CURRENT LEVELS OF SERVICE

## 2.5.1. O.REG 588/17 CUSTOMER LEVELS OF SERVICE

O.Reg 588/17 has customer levels of service that must be reported in this plan, and are explained below.

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

   Approximately 93% of properties are connected to the municipal wastewater system. A map of the connected properties can be found in **Figure 26**. Areas not connected to the municipal wastewater system are typically rural areas recently acquired during the boundary expansion which are connected to a septic system, or are empty lots. It can also be seen in **Figure 26** that there are areas which are likely serviced but are currently unknown in GIS, and this is due to the wastewater services having a low inventory confidence level as noted in **Section 1.3.5**. The likely serviced properties were properties that were connected to the water system and were known not to be septic properties.

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

   The City of Brantford does not contain any combined sewers and so overflow structures necessary for combined sewers during storm events are not required.

   Although there are no combined sewers in the City, there are areas where potential overflows from stormwater into wastewater may occur, which the City is actively locating and repairing/replacing where found.

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

   The City of Brantford does not contain any combined sewers and so the frequency and volume of overflows necessary for combined sewers during storm events are not required.

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

   Inflow and infiltration from stormwater into wastewater pipes is an issue in most wastewater networks. When stormwater enters a wastewater pipe, it can cause the wastewater system to exceed its design capacity because the network and treatment plant were not designed to handle the additional, large flows often caused by storm events. Although wastewater systems in Brantford are not directly connected to the storm system (i.e. no combined sewers), stormwater can infiltrate into the wastewater system in the following ways:

Infiltration

- Holes, cracks & defective joints in the gravity main pipes especially at low points in the system (e.g. at pump stations) can allow groundwater infiltration;
- Leaky maintenance hole covers can allow rainwater into wastewater maintenance holes.

Inflow

- Illegal sump pump, downspout, and drain connections directly pumped into wastewater main instead of storm.

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

If enough stormwater gets into the wastewater network, the design capacity of the network (including pipe size, pump station capacity, plant capacity) can be overloaded, and/or silt from stormwater runoff can clog piping, both of these can cause backups through the wastewater gravity main into the wastewater service or causing overflows into streets through the connected maintenance holes.

The City avoids the above scenario by:

- Ensuring Inflow & Infiltration (I&I) is considered during the design stage for any new wastewater infrastructure;
- Installing level monitors at strategic locations in the City to warn of surcharges in the network and responding appropriately if the monitors show dangerously high levels;
- Implementing an annual flow monitoring program in wastewater catchment areas to see if the City needs to increase design capacity in certain areas;
- Monitoring I&I by installing rain gauges throughout the City to compare our wastewater flows during wet weather conditions;
- A future implementation is to incorporate new maintenance hole covers to prevent infiltration from leaky maintenance hole lids.

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

Municipal wastewater treatment facilities in Ontario are required to be in compliance with effluent (outflow of treated water to natural water body) limits issued by the Ministry of Environment, Conservation and Parks (MECP). The MECP issues Environmental Compliance Approvals (ECAs) to wastewater treatment facilities in the province. The ECA outlines a number of items but most notably are the effluent limits. In the case of the Brantford WWTP, the City has limits for carbonaceous Biochemical Oxygen Demand (cBOD5), Total Suspended Solids (TSS) and Total Phosphorus (TP). These limits have been maintained at the same level by the Ministry for many years and are achieved with modern technologies and operator skillsets. As a result, the Brantford WWTP has been in compliance for many years, and is also well below the current effluent limits. This data is summarized in the Annual Wastewater Report that is submitted to MECP. Based on some upcoming projects in the 10 year capital forecast, an amendment to the ECA may be required which could lower the effluent limits.

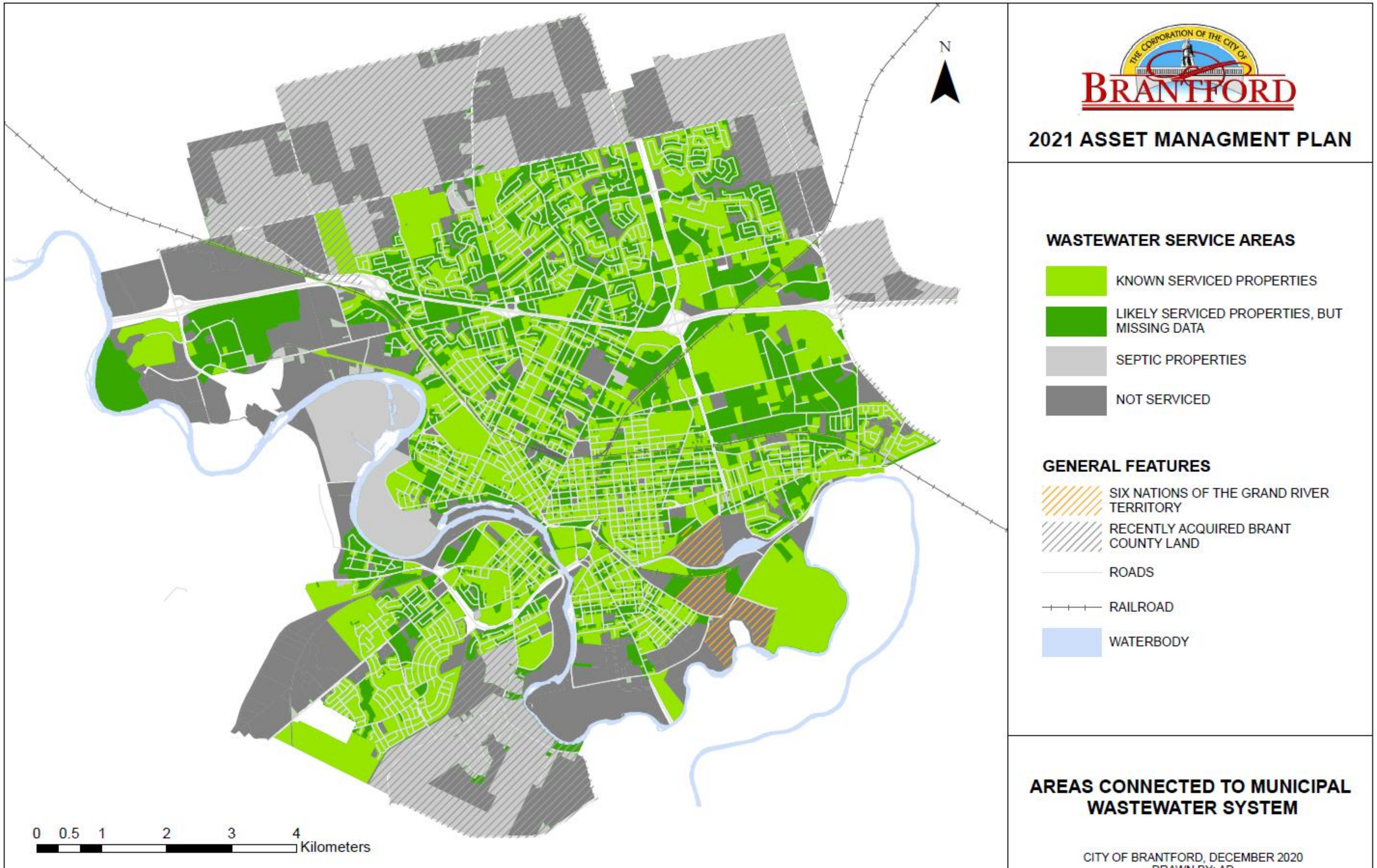



**Figure 26: Areas connected to the municipal wastewater system**

## 2.5.2. O.REG 588/17 TECHNICAL LEVELS OF SERVICE

The technical levels of service as dictated by O.Reg 588/17 can be found in **Table 18** below.

**Table 18: O.Reg 588/17 Wastewater Technical Levels of Service**

| Service | Service attribute | Technical levels of service (technical metrics) | 2019 | 2020 |
|---|---|---|---|---|
| **Wastewater** | **Scope** | Percentage of properties connected to the municipal wastewater system. | 93.4% of 32,363 properties | 93.0% of 32,717 properties |
| | **Reliability** | 1. The number of events per year where combined sewer flow in the municipal wastewater system exceeds system capacity compared to the total number of properties connected to the municipal wastewater system. | N/A | N/A |
| | | 2. The number of connection-days per year due to wastewater backups compared to the total number of properties connected to the municipal wastewater system. | 0 | 0 |
| | | 3. The number of effluent violations per year due to wastewater discharge compared to the total number of properties connected to the municipal wastewater system. | 0 | 0 |

### 2.5.3. MUNICIPALLY DEFINED CUSTOMER LEVELS OF SERVICE

The customer levels of service are defined in **Section 6.2** of the **Asset Management Plan Overview**. For wastewater assets, the asset specific interpretation of these levels of service is defined below in **Table 19**. These customer levels of service were used to create and define our technical levels of service identified in **Table 20, Table 21,** and **Table 22**.

**Table 19: Municipally Defined Customer Levels of Service**

| Customer Level of Service | Definition |
|---|---|
| **Accessibility** | Wastewater assets should be accessible to all customers connected to the municipal water network without barriers in place. |
| **Quality** | Wastewater assets should deliver their intended purpose at a certain quality, and assets should have sufficient capacity. |
| **Cost Efficiency** | Wastewater assets should be operated efficiently with extra care to minimize costs. |
| **Safety** | Wastewater assets should be both safe to use and promote community safety, and customers should feel safe using these services. |
| **Environmental Sustainability** | Wastewater assets should be operating as environmentally as possible, effluents should be in compliance, and also be promoting sustainable lifestyles. |
| **Reliability** | Wastewater assets should be available when customers need them, and care should be put in to avoid wastewater backups. |
| **Responsiveness** | Wastewater assets should be fixed quickly when service disruptions occur. |

In addition, the following seven (7) qualitative metrics for wastewater distribution and treatment are used in the National Water and Wastewater Benchmarking Initiative (NWWBI) and are used in addition to the above defined Levels of Service to measure KPIs:

- Ensure Adequate Capacity
- Have Satisfied and Informed Customers
- Meet Service Requirements with Economic Efficiency
- Protect Public Health and Safety
- Protect the Environment
- Provide a Safe and Productive Workplace
- Provide Reliable Service and Infrastructure

### 2.5.4. MUNICIPALLY DEFINED TECHNICAL LEVELS OF SERVICE

For our current defined levels of service, we collect separate KPIs for our wastewater collection and treatment which support the above defined municipally defined customer levels of service in **Table 19.**

Many of the Levels of Service, KPIs, and targets (where available) in **Table 20** and **Table 21** below are tracked based on information required for the NWWBI. This information is mandated through that initiative, but serves as an excellent tool for a first draft of wastewater KPIs.

**Table 20: Wastewater Collection Level of Service KPIs**

| Customer Level of Service | NWWBI Metric | Technical Level of Service | 2018 KPI | 2019 KPI | Units |
|---|---|---|---|---|---|
| **Quality** | Ensure Adequate Capacity | # of connections with sanitary flooding caused by service connection blockage | 4.55 | 25.00 | #/1000 connections |
| | | # of connections with sanitary flooding by mainline issue | 0.03 | N/A | #/1000 connections |
| | Have Satisfied and Informed Customers | # of wastewater related customer complaints | 5.61 | 3.44 | #/1000 people served |
| **Cost Efficiency** | Meet Service Requirements with Economic Efficiency | Annual O&M cost as a percentage of replacement value | 0.69 | 0.92 | % |
| | | Cost of cleaning hydraulically | $2,451.70 | $3,042.60 | $/km length |
| | | FTEs | 2.75 | 2.15 | #/100 km length |
| | | O&M Cost + Capital Reinvestment | $16.76 | $29.70 | ‘000 $/km length |
| | | Pipe and Pump O&M Cost | $6.00 | $6.35 | ‘000 $/km length |
| | | Pump Station Energy Consumption | 967.85 | 939.55 | kWh/pump station hp |
| | | Pump Station O&M Cost | $124.78 | $119.35 | $/pump station hp |
| | | Sewer charge for typical residential connection | $410 | $480 | $ 210 $m^3$ of water/year |
| | | Total cost to provide wastewater services | $166.57 | $205.80 | $/population served |
| **Environmental Sustainability** | Protect the Environment | Total # of reported overflows | 0 | 0.00 | #/100km |
| **Safety** | Provide a Safe and Productive Workplace | % of Workforce age 61 – 70 years | 2.94% | 3.13% | % |
| | | % of Workforce age 51 – 60 years | 11.76% | 18.75% | % |
| | | % of Workforce age 41 – 50 years | 11.76% | 12.50% | % |
| | | % of Workforce age 31 – 40 years | 64.71% | 59.38% | % |
| | | % of Workforce age 20 – 30 years | 8.82% | 6.25% | % |
| | | Field accidents with lost time | 0 | 0 | #/1000 O&M Hours |
| | | Lost hours due to field accidents | 0 | 0 | #/1000 O&M Hours |
| | | Sick days taken | 15.2 | 11.2 | #/O&M employee |
| | | Total Overtime Hours / Total Paid O&M Hours | 6.04% | 3.83% | % |
| | | Unavailable O&M Hours / Total Paid O&M Hours | 21.26 | 24.09 | % |
| **Reliability** | Provide Reliable Service and Infrastructure | Capital Reinvestment/ Replacement Value | 1.23 | 3.38 | % |
| | | Forcemain sewer repairs | 0 | 0 | #/100km |

| | | | | | |
|---|---|---|---|---|---|
| | | Gravity sewer repairs | 8.66 | 16.62 | #/100km |
| | | Number of mainline sewer blockages by debris | 0 | 0 | #/100km |
| | | Number of mainline sewer blockages by grease | 0 | 0.23 | #/100km |
| | | Number of mainline sewer blockages by roots | 0 | 0.23 | #/100km |
| | | Number of mainline sewer blockages by structure | 0.23 | 0.46 | #/100km |
| | | Number of mainline sewer blockages by unknown cause | 0 | 0.23 | #/100km |
| | | Percent of length CCTV inspected | 9.27 | 14.35 | % |
| | | Percent of manholes inspected | 74.07 | 52.85 | % |
| | | Percent of manholes repaired and replaced for I&I | 0.51 | 0.8 | % |
| | | Pump station failures | 0 | 0 | #/pump station |

**Table 21: Wastewater Treatment Level of Service KPIs**

| Customer Level of Service | NWWBI Metric | Technical Level of Service | 2018 KPI | 2019 KPI | Units |
|---|---|---|---|---|---|
| **Quality** | Ensure Adequate Capacity | Peak wet weather flow / Average dry weather flow | 3.08 | 0.85 | % |
| | | % of design AAF capacity utilized | 42.52 | 41.68 | % |
| | Have Satisfied and Informed Customers | Odour complaints | 0 | 0 | #/1000 people served |
| **Cost Efficiency** | Meet Service Requirements with Economic Efficiency | Chemical Costs | $37.63 | $42.02 | $/ML Treated |
| | | Energy consumed relative to volume treated | 1,246.65 | 1,163.23 | kWh/ML Treated |
| | | Energy costs relative to volume treated | $70.61 | $67.12 | $/ML Treated |
| | | FTEs relative to volume treated | 0.98 | 1.01 | FTEs/1000 ML treated |
| | | O&M Cost + Capital Reinvestment | $561.16 | $901.67 | $/ML Treated |
| | | O&M Cost relative to Volume treated | $411.11 | $440.95 | $/ML Treated |
| **Environmental Sustainability** | Protect the Environment | Bypasses | 0 | 0 | # |
| | | GHG emissions related to energy consumed in operation of treatment plant | 201.12 | 201.66 | Kg CO2 eq / ML Treated |
| | | Non-compliances | 0 | 0 | # |
| | | Percent of days in compliance | 100 | 100 | % |
| | | Solids disposal or reuse | 100 | 100 | % |
| | | Surcharges reported to regulator | 0 | 0 | # |
| **Safety** | Provide a Safe and | Cost of overtime hours | $5,917.08 | $4,778.80 | $/O&M FTE |

| | | | | | |
|---|---|---|---|---|---|
| | Productive Workplace | Field accidents with lost time | 0 | 0 | #/1000 O&M Hours |
| | | Lost hours due to field accidents | 0 | 0 | #/1000 O&M Hours |
| | | Sick days taken | 12.10 | 7.4 | #/O&M employee |
| | | Total overtime hours/ Total paid O&M hours | 6.22 | 3.75 | % |
| | | Unavailable O&M hours / Total paid O&M hours | 17.16 | 17.10 | % |
| **Reliability** | Provide Reliable Service and Infrastructure | Capital Reinvestment/ Replacement Value | 1.42 | 2.19 | % |
| **Responsiveness** | | Reactive maintenance hours (unscheduled/total maintenance hours) | 0 | 0 | |
| | | Total maintenance hours | 0.46 | 0.71 | Hours /ML |

In addition, the City is also working to include additional levels of service to evaluate organization specific KPIs at an internal level. These KPIs have been provided in **Table 22,** and a portion of these were presented to Council during the 2020 Annual Summary. Where available, 2019 KPI data or targets have been added. The AIM project described in **Section 7** of the **Asset Management Plan Overview Document** will also assist the City with identifying and adding additional KPIs in future iterations because a system will be available to formally track this data.

**Table 22: Newly Defined Level of Service KPIs**

| Customer Level of Service | Technical Level of Service | 2019 KPI | 2020 KPI | Target | Units |
|---|---|---|---|---|---|
| **Quality** | Length of newly installed wastewater gravity sewer | 5.8 | 1.1 | N/A | km |
| | Number of abandoned wastewater gravity sewer segments | 6 | 11 | N/A | Count |
| | Number of sewer lateral pipe replacement grant program applications | 51 | 66 | N/A | Count |
| | Number of successful sewer lateral pipe replacement applications | 50 | 37 | N/A | Count |
| | Length of wastewater gravity sewer lining | 0.25 | 2.72 | N/A | km |
| **Cost Efficiency** | Biosolids Disposal Costs per ML Treated | $34.81 | $45.93 | N/A | $/ML treated |
| | Maintenance Costs per Maintenance Related Hours | $78.33 | $71.34 | N/A | $/hour |
| | Breakdown Maintenance as % of Total Maintenance Hours | 9.8% | 6.5% | N/A | % |
| **Environmental Sustainability** | Hydro Consumption (kWh) per ML Treated | 639.43 | 622.96 | N/A | kWh/ML Treated |
| | Number of Spill Response Incidents | 27 | 31 | N/A | Count |
| **Safety** | % of Time Raw Sewage Quality Has Exceeded By-law Limits | 2.7% | 8.1% | N/A | % |
| **Reliability** | Number of odour Complaints Received | 10 | 5 | N/A | Count |
| | Number of inspections for wastewater service issue | 184 | 152 | N/A | Count |
| | Number of service calls due to roots in City wastewater service | 9 | 15 | N/A | Count |
| | Number of service calls due to grease in City wastewater service | 4 | 2 | N/A | Count |
| | Number of service calls due to storm flooding in City wastewater service | 0 | 1 | N/A | Count |
| | Number of service calls due to structural issues in City wastewater service | 9 | 12 | N/A | Count |
| | Number of service calls due to calcite in City wastewater service | 2 | 2 | N/A | Count |
| **Responsiveness** | Average hours to respond to wastewater service | N/A | N/A | 0.5 | Hours |

| | | | | | |
|---|---|---|---|---|---|
| | disruption | | | | |
| | Average hours to resolve wastewater service disruption | N/A | N/A | 2 | Hours |

# 2.6. CURRENT ASSET PERFOMANCE

The current asset performance for Wastewater assets has been separated into two (2) categories for this section of the report:

- Energy Performance; and
- Operating Performance

## 2.6.1. WASTEWATER FACILITY CURRENT ENERGY PERFORMANCE

The City of Brantford has a Corporate Energy Management Plan (CEMP) which emphasizes energy efficiency within the City. The goals of the CEMP are to reduce energy use, energy intensity, and greenhouse gas (GHG) emissions in our Facilities. In addition, through the City's Climate Change Action Plan and Climate Lens Tool explained in **Section 10** of the **Asset Management Plan Overview Document**, the City has been working to improve our facilities' energy efficiency and reduce the associated carbon footprint. Over the last several years, there has been a steady decline in hydro usage at the WWTP. Due to falling under the usage threshold (1 MWh), the hydro billing structure was changed (from Class A to Class B) which resulted in an overall increase in hydro costs.

Under this plan, annual energy management data is reported, but has a reporting delay of two (2) years. The most recent report is the 2019 Corporate Energy Management Report which is where the current energy performance of each water facility in **Table 23** below was obtained.

**Table 23: Current Energy Performance of Wastewater Facilities**

| Facility | Address | Electricity (kWh)* | Natural Gas (m3)* | GHG Emissions (kg)* | Annual Flow (Mega Litres) | Energy Intensity (ekWh/Mega Litre)* |
|---|---|---|---|---|---|---|
| **Total** | - | 7,622,291 | 225,645 | 658,886 | - | - |
| **Wastewater Treatment Plant** | 385 Mohawk Rd | 6,769,106 | 225,645 | 632,886 | 12,446 | 737 |
| **Empey P.S.** | 50 Empey St | 282,405 | N/A | 8,606 | 6,537 | 43.2 |
| **Woodlawn P.S.** | 85 Woodlawn Rd | 49,935 | N/A | 1,522 | 303 | 165 |
| **Somerset P.S.** | 87 Somerset Rd | 107,096 | N/A | 3,264 | 420 | 255.0 |
| **Greenwich P.S.** | 220 Greenwich St | 212,783 | N/A | 6,484 | 1,919 | 111 |
| **Fifth Ave P.S.** | 25 Fifth Ave | 72,492 | N/A | 2,209 | 1,591 | 45.6 |
| **St Andrews P.S.** | 119 St Andrews Dr | 29,165 | N/A | 889 | 91.5 | 318.7 |
| **Northridge P.S.** | 8-14 Lawren S Harris | 45,126 | N/A | 1,375 | 81.6 | 553.2 |
| **Johnson P.S.** | 4 Hansford Dr | 33,405 | N/A | 1,018 | 107.2 | 311.6 |
| **Alexander P.S.** | 24 Alexander Dr | 20,778 | N/A | 633 | 118 | 176.1 |

*Based on information provided in the 2019 Corporate Energy Management Report

### 2.6.2. WASTEWATER TREATMENT CURRENT OPERATING PERFORMANCE

To assess the current operating performance, the City participates in the National Water and Wastewater Benchmarking Initiative (NWWBI) with other municipalities. The City reports specific data metrics for the purposes of comparing Brantford to other municipalities as well as compares reported KPIs from each year. It is important to note that a confidentiality agreement exists with other municipalities, and so although Brantford does compare our performance against other municipalities, that comparison cannot be reported in this report. These KPIs are reported in the Current Levels of Service in **Section 2.5**. It can be seen that many KPIs have not changed substantially between 2018 and 2019, however, there were significantly more service connection blockages, significantly more CCTV was completed, and significantly less maintenance holes were inspected from 2018 to 2019.

In addition, the City also measures wastewater performance based on the eflluent discharged from the Wastewater Treatment Plant (WWTP). In 2014, the Grand River Water Management Plan was finalized with a number of activities that municipalities along the river pledged to achieve. A major activity for the City related to wastewater treatment was the formation of the Grand River Watershed-wide Wastewater Optimization Program (GRWWOP). A key item of the GRWWOP was the development of voluntary effluent targets for Total Phosphorous (TP) and Total Ammonia Nitrogen (TAN). The voluntary targets are considerably lower than current ECA (Environmental Compliance Approval) limits, but are achievable by optimizing the WWTP. If all WWTPs part of the GWWOP achieved the voluntary targets, the quality of water in the Grand River would be drastically improved. Since mid-2016, the City began meeting the voluntary targets the majority of the time while also continuing to successfully achieve the ECA effluent limits.

In 2020, operations staff from the Brantford WWTP achieved the voluntary targets in all 12 months. Data from all WWTPs discharging into the Grand River is summarized in the WWOP Annual Report completed by the GRCA annually in October. The City will continue to strive to achieve the voluntary targets and maintain compliance in the future. In November 2020, the City was recognized by the WWOP for their efforts in 2019.

# 2.7. DISCUSSION & CONCLUSIONS

In conclusion, the City of Brantford operates and maintains several wastewater assets. These assets are typically in Good condition, but are approaching Fair condition, with a total estimated replacement cost of approximately $643M.

The inventory and condition data confidence for vertical assets related to treatment and pumping are typically at a High level due to formal condition assessments having been completed. The linear wastewater asset inventory and condition data confidence is typically Medium. Assets that can be visually inspected are typically at a High data confidence level for both inventory and condition, but many assessment programs have not encompassed all assets at this time (e.g. gravity main, maintenance holes). Assets that have not been visually inspected are typically at a medium level due to inventory assumptions in the database and estimated condition based on available information. These inventory assumptions are continuously being improved as new data is added into the database (e.g. wastewater services). In addition, new condition assessment methodologies are being investigated for critical assets. As stated, some of these inspection improvements are ongoing and also will improve as a result of the AIM project explained in **Section 7** of the **Asset Management Plan (AMP) Overview** document.

Furthermore, the lifecycle stages for wastewater assets are Planning, Creation, O&M, and Disposal. During the Planning stage, the City identifies the need for the asset; during the Creation stage, the asset is purchased and installed or constructed; during the O&M stage, the asset is operating and lifecycle activities (i.e. maintenance) occur on each of our wastewater assets to maintain the state of good repair; and the Disposal stage is when the asset has reached the end of its useful life or is underperforming and requires disposal.

Lifecycle activities are currently typically tracked through Avantis CMMS for vertical assets or a mobile web application through ArcGIS for linear assets which provides limited data to ensure compliance only. For more information on key database applications and work order management, please refer to **Section 4.2** and **Section 7**, respectively, in the **AMP Overview** document.  At this time, the costs associated with these activities are partially broken down as a lump sum and are estimated based on the 2021 Preliminary Operating Budget, which is created based on the total O&M expenditures from previous years. When these activities are integrated into AIM, the frequency and costs associated with specific activities will be better represented. Therefore, future updates of the AMP will include specific costs for these activities as well as the time associated with these activities in order to properly allocate budget and identify operational inefficiencies. It is estimated based on the average annual cost in the 10 Year Life Cycle Costing that the City should be spending an average $6.7M annually for capital wastewater assets and will be spending an average of $32.5M on O&M for wastewater assets, however, the City is currently proposing to spend an average of $10.1M annually on capital for wastewater assets' state of good repair.

Additionally, Current Levels of Service have been identified for wastewater assets. These levels of service are either tracked based on reported information required for the National Water and Wastewater Benchmarking Initiative (NWWBI) or are newly identified levels of service metrics for future iterations of the AMP. The NWWBI information is mandated through this initiative, but serves as a tool for a first draft of the wastewater asset KPIs. Brantford is also working to include these and additional metrics in AIM which will assist us with tracking these KPIs for future iterations.

Finally, asset performance is separated into operating and energy performance. For operating performance the City compares NWWBI data with surrounding municipalities as well as against previous years' data. In addition, in 2020, the City achieved the voluntary effluent targets in all 12 months at the Wastewater Treatment Plant as summarized in the Grand River Watershed-wide Wastewater Optimization Program (GWWOP) Annual Report, which is a testament to the City's dedication to both wastewater treatment and environmental sustainability.

For energy performance, annual energy data associated with facilities in the City's Corporate Energy Management Plan (CEMP) has been reported. The City used a total of 7,622,291 kWh for wastewater treatment and pumping, and emitted 658,886 kg of gas emissions for these facilities. The City continuously looks for ways to improve the energy efficiency of all facilities. The electricity usage at the Wastewater Treatment Plant has been declining over the past several years due to upgrades at the plant, which has unfortunately led to increased electricity costs due to the billing structure. Through the Climate Change Action Plan and Climate Lens Tool explained in **Section 10** of the **AMP Overview** document, the City will be setting targets to improve facilities' energy efficiency and reduce the associated carbon footprint.

.

# 3. STORMWATER ASSETS

## 3.1. INTRODUCTION

The City of Brantford owns and maintains several assets under the stormwater asset class. The purpose of this section is to present specific information about the stormwater asset class so that we can answer the questions posed in **Section 2** of the **Asset Management Plan (AMP) Overview Document**, and includes the following:

- Municipality Approach to Assessing Stormwater Asset Condition;
- Stormwater Assets' Data Inventory and Collection
- Summary of Stormwater Assets;
- Lifecycle Activities and Cost of Stormwater Assets;
- Current Stormwater Assets' Levels of Service;
- Current Stormwater Asset Performance; and
- Discussion & Conclusions.

## 3.2. STORMWATER ASSETS' DATA INVENTORY AND CONDITION APPROACH

Information related to the City's data collection methodologies as well as data confidence level definitions are defined in the **Asset Management Plan Overview Document**.

The City of Brantford has three (3) different approaches to establishing the condition for stormwater assets due to available resources, technologies, and budget restrictions and includes:

- Outsourced condition assessments to consultants;
- Internal Inspection Programs, and
- Estimated condition based on asset specific information.

A list of all condition assessments for all core assets can be found in **Table 6** in the **Asset Management Plan Overview Document**.

The origin of the water asset data for inventory, replacement cost, condition as well as data confidence are provided in **Table 24** below.

**Table 24: Stormwater Assets' Inventory, Replacement Cost, and Condition Origin and Confidence Levels**

| | Inventory | | | Replacement Cost | | | Condition | | |
|---|---|---|---|---|---|---|---|---|---|
| **Asset Type** | **Inventory (incl. Quantity and Age) From** | **Data Confidence Level** | **Data Confidence Description** | **Replacement Cost From** | **Data Confidence Level** | **Data Confidence Description** | **Condition From** | **Data Confidence Level** | **Data Confidence Description** |
| **Gravity Main** | GIS layer, swGravityMain | Medium | GIS inventory complete with some assumptions. | 2019 Master Servicing Plan Appendix B, Assumed similar to Wastewater | Low | Estimated based on internal Class D pricing, but assumed similar to wastewater cost. | CCTV Inspection Structural Score, Size, Material Service Life | Medium | Formal condition assessment, but annual program not yet encompassing all assets. |
| **Maintenance Holes** | GIS layer, swManhole | Medium | GIS inventory complete with some assumptions. | Asset Management 2020 Unit Costs | Medium | Estimated based on internal Class D pricing. | Manhole Condition Assessment program, Service Life | Medium | Formal condition assessment, but annual program has only encompassed 10% of assets. |
| **Flood Gates** | GIS layer, swSluiceGate | High | GIS inventory and condition assessment complete. | 2020 Flood Gates Condition Assessment completed by AECOM | Medium | Estimate by Consultant, but draft form and some costs were extrapolated. | 2021 Flood Gates Condition Assessment completed by AECOM | High | Formal condition assessment complete. |
| **Stormwater Pump Station & Chamber** | GIS layer, swNetworkStru cture | Medium | GIS inventory complete, but no inventory of facility components (e.g. pumps). | 2019 Master Servicing Plan Appendix B, Assumed similar to Wastewater | Low | Estimated based on internal Class D pricing, but assumed similar to wastewater cost. | Service Life | Low | Service life can be a predictor of condition, but does not always indicate the true condition. |
| **Inlets** | GIS layer, swInlet | Low | GIS inventory not complete. | Asset Management 2020 Unit Costs | Low | Estimated based on internal Class D pricing. | Service Life | Low | Service life can be a predictor of condition, but does not always indicate the true condition. |
| **Stormwater Pond** | GIS layer, swDetention | Medium | GIS inventory complete with some assumptions. | Based on industry standard unit cots | Low | Estimated based on approximate volume. | Condition Assessment Completed by Amec Foster Wheeler, Internal Inspection Program, Service Life | Medium | Formal condition assessment and inspection program, but not yet encompassing all assets. |
| **Stormwater Services** | GIS layer,swLateral Line | Low | GIS inventory not complete. | Asset Management 2020 Unit Costs | Low | Estimated based on internal Class D pricing. | Material Service Life | Low | Incomplete data set. Service life can be a predictor of condition, but does not always indicate the true condition. |
| **Oil and Grit Separators** | GIS layer, swManhole | High | GIS inventory complete with some assumptions. | Environmental Services Unit Cost | Low | Estimated based on high level estimate. | Service Life, 2020 Inspection Reports | Medium | Based on service life. Preventative maintenance inspections occur on all assets to ensure they're cleaned and in working order. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Outfalls** | GIS layer, swDischargePoint | Low | GIS inventory not complete | 2019 Master Servicing Plan Appendix B, and Industry standard unit costs | Low | Estimated based on internal Class D pricing, but assumed similar to wastewater cost | 2017 Open Drains Condition Assessment completed by GM Blue Plan | Low | Formal condition assessment, but data set is incomplete with many unknowns. |
| **Ditches** | GIS layer, swOpenDrain | Low | GIS inventory not complete | Environmental Services Unit Cost | Low | Estimated based on high level estimate. | 2017 Open Drains Condition Assessment completed by GM Blue Plan | Low | Formal condition assessment, but data set is incomplete with many unknowns. |

Per **Table 24** above, stormwater assets' inventory and condition data are typically at a Medium confidence level.

Flood Gates are at a High confidence level for both condition and inventory due to condition assessments and internal inspection programs. It is important to note that at the time of writing this report, the Flood Gates condition assessment was in draft form and subject to change, and so some replacement costs were estimated. Oil and grit separators have a High inventory confidence level, but a Medium condition level, because although they are cleaned out regularly, that does not always reflect the true condition.

Many assets are at a Medium level because the condition assessment programs have not yet encompassed all assets. The assets expected to increase to a high level after the condition program is completed include: gravity main, maintenance holes, and stormwater ponds.

Currently, the stormwater pump station has not had a condition assessment completed on it, and while it is a smaller sized pump station, this should be investigated in future. In addition, the City will be considering a formal inventory and condition assessment program for inlets as currently the inventory is not complete. While a condition assessment program was completed that included outfalls and ditches, it is estimated there are still unknowns in this data set which must be addressed.

Finally, the City will continue to add stormwater services to the inventory based on As-Built drawings.

Improvements to the inventories and inspection programs will be ongoing as a result of the AIM project explained in **Section 7** of the **Asset Management Overview document**.

### 3.2.1. SERVICE LIFE

Where condition assessments have not been completed, the condition has been estimated based on the estimated service life of the asset shown below in **Table 25**. The average overall estimated service life for assets can be found in **Table 27.**

**Table 25: Wastewater Assets' Estimated Service Life**

| Asset | Estimated Service Life |
|---|---|
| **Gravity Main** | ABS (Acrylonitrile Butadiene Styrene) – 90 years, Concrete – 100 years, Clay – 70 years, Cast Iron – 90 years, PVC (Polyvinyl chloride) – 90 years, Asbestos Cement – 70 years, Fibreglass Reinforced Pipe – 90 years, Ductile Iron – 65 years, HDPE (High Density Poly Ethylene) 90 years, Unknown – 50 years, Steel – 90 years, Polyethylene – 90 years |
| **Maintenance Holes, Inlets, Chambers** | 100 years |
| **Stormwater Pump Station** | 49 years |
| **Stormwater Pond** | 55 years |
| **Stormwater Services** | ABS – 90 years, Concrete – 100 years, Clay – 70 years, Cast Iron – 90 years, PVC – 90 years, Asbestos Cement – 70 years, Fibreglass Reinforced Pipe – 90 years, Ductile Iron – 65 years, HDPE 90 years, Unknown – 50 years |
| **Oil and Grit Separator** | 20 years |

### 3.2.2. CONDITION SCORING

For the purpose of this report and standardizing condition scores across all assets in the Asset Management Plan, the Condition Rating is defined by three (3) Condition Scores as defined in **Table 26** below. For assets with formal consultant condition assessments, the conditions have been modified to fit into this model.

**Table 26: Condition Score Description**

| Condition Score | Condition Rating | Description |
|---|---|---|
| **1 – 1.4** | Good | Assets in the system or network are in working order, have no or minor deficiencies. Where condition data is not available, this category applies to assets which are within the first 40% of their estimated service life. |
| **1.5 – 2.4** | Fair | Asset in the system or network show general signs of deterioration, some elements may have significant deficiencies. Where condition data is not available, this category applies to assets which are within 41% - 80% of their estimated service life. |
| **2.5 - 3** | Poor | Asset is below standard showing signs of significant deterioration, is in danger of imminent failure, and requires significant repair or replacement. Where condition data is not available, this category applies to assets which have exceeded 80% of their estimated service life. |

# 3.3. SUMMARY OF STORMWATER ASSETS

The summary of assets for the stormwater asset class can be found below. The summary of assets includes: Quantity, Replacement Cost, Average Age, and Average Condition Score for each asset type in accordance with O.Reg 588/17.

## 3.3.1. TOTAL SUMMARY OF ASSETS

A table summarizing all stormwater assets is included in **Table 27** below. Detailed information about each asset is included in individual sections. It can be seen that the total replacement cost for stormwater assets is approximately $4801M and assets have an average age of 28 years which is 40% of their average estimated service life. The average condition scores are shown to one decimal place to illustrate how close the scores are to being on a cusp of another rating and were used to calculate the weighted overall average condition score for the asset group, but are shown rounded to the nearest whole number in subsequent sections. In addition, overall stormwater assets are in Fair condition, but that they are on the cusp of Fair and Good condition with a weighted average score of 1.5.

**Table 27: Total Summary of Stormwater Assets**

| Asset | Quantity | Unit | Replacement Cost | Average Age (years) | Average Estimated Service Life | Percentage of Estimated Service Life | Average Condition Score | Average Condition Description |
|---|---|---|---|---|---|---|---|---|
| **Stomwater Assets Total** | | | **$480.7M** | **28** | **71** | **40%** | **1.5*** | **FAIR** |
| **Storm Pump Station** | 1 | count | $2.21M | 28 | 75 | 37% | 2.0 | FAIR |
| **Storm Chambers** | 1 | count | $13.5K | | | | 1.0 | GOOD |
| **Stormwater Ponds** | 23 | count | $16.1M | 22 | 55 | 40% | 2.0 | FAIR |
| **Gravity Mains** | 413.6 | km | $361.7M | 43 | 97 | 44% | 1.0 | GOOD |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Inlets** | 12,290 | count | $30.8M | 39 | 100 | 39% | 1.4 | GOOD |
| **Maintenance Holes** | 6,222 | count | $28.0M | 40 | 100 | 40% | 1.5 | FAIR |
| **Storm Services** | 5,010 | count | $13.1M | 15 | 72 | 21% | 1.2 | GOOD |
| **Oil and Grit Separators** | 25 | count | $1.9M | 14 | 20 | 70% | 1.6 | FAIR |
| **Flood Gates** | 39 | count | $1,878,717 | 37 | 28 | 132% | 1.9 | FAIR |
| **Outfalls** | 290 | count | $556,696 | 53 | 90 | 59% | 1.1 | GOOD |
| **Ditches** | 121.3 | km | $24,300,000 | - | - | - | 1.1 | GOOD |
| **Municipal Drain** | 318 | m | $63,600 | - | - | - | - | - |

*Denotes Weighted Average

### 3.3.2. STORMWATER STRUCTURES

It can be seen in **Figure 27** below that there are two (2) stormwater structures in Brantford which are the Parking Garage Pump Station and the Trench Chamber. These structures are responsible for collecting stormwater at a lowpoint from a catchment area and pumping it to a higher point in the gravity system to be outlet at an appropriate outfall.

The total replacement cost for these structures is approximately $2.2M. The average age of the facilities is 28 years which is 37% of the average estimated service life of the structures. The structures are an average of Fair condition with an average condition score of 2 based on their service lives. The City is currently investigating completing a formal condition assessment of these structures.

| NO STORM STRUCTURES | REPLACEMENT COST | AVERAGE AGE (years) | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|
| 2 | $2.2M | 28 | 2 | FAIR |

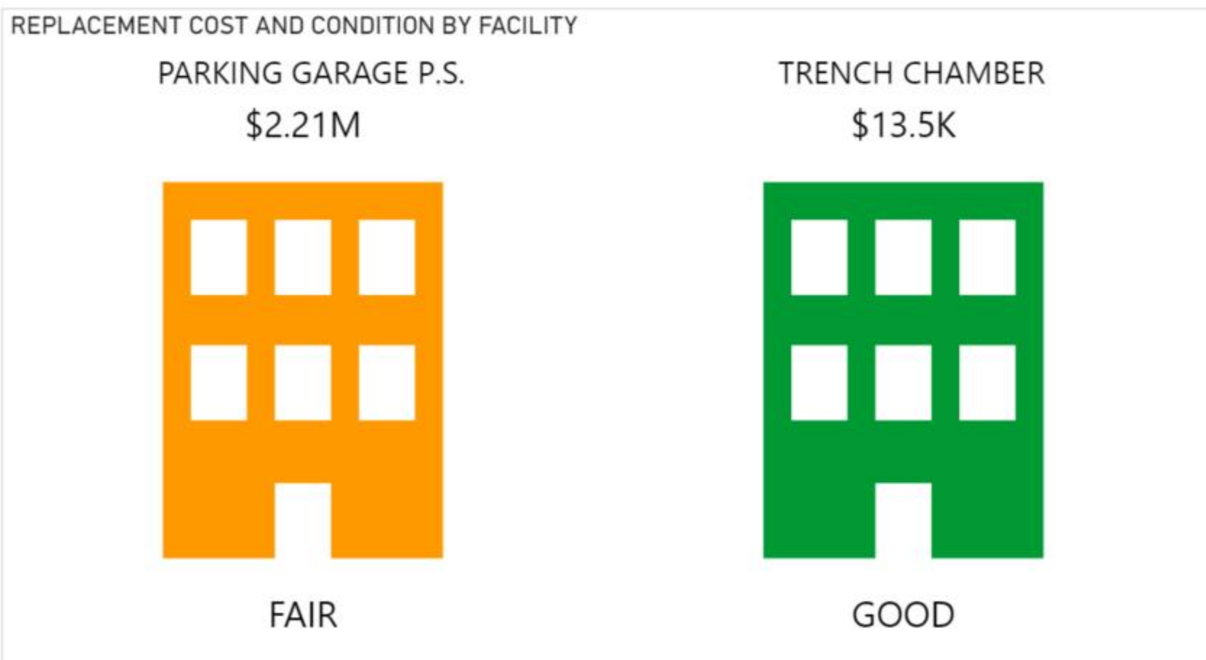



**Figure 27: Storm Structures Asset Summary**

### 3.3.3. STORMWATER POND

A stormwater pond is a man-made infrastructure pond which is built to collect rainfall and surface runoff in developed areas where natural permeation is difficult, and also allows sediments and pollutants to settle out of the stormwater before the water is released back into the watershed.

Per **Figure 28** below, there are 23 stormwater ponds in Brantford with a total replacement cost of $16.1M. The average age of a stormwater pond is 22 years which is 40% of the estimated service life based on the provincial average of 55 years (Infrastructure Canada, 2021). However, stormwater pond maintenance extends the service life of the asset as the condition of the asset is typically determined based on the sediment level of the pond. The condition of the stormwater ponds is based on a combination of the internal preventative maintenance inspection and formal condition assessment where available.

It can be seen the most common stormwater pond type in the city is a wet pond followed by a dry pond although both a hybrid and an infiltration pond also exist.

| NO OF STORM PONDS | REPLACEMENT COST | AVERAGE AGE (years) | AVERAGE ESTIMATED SERVICE LIFE | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|
| 23 | $16.1M | 22 | 55 | 2 | FAIR |

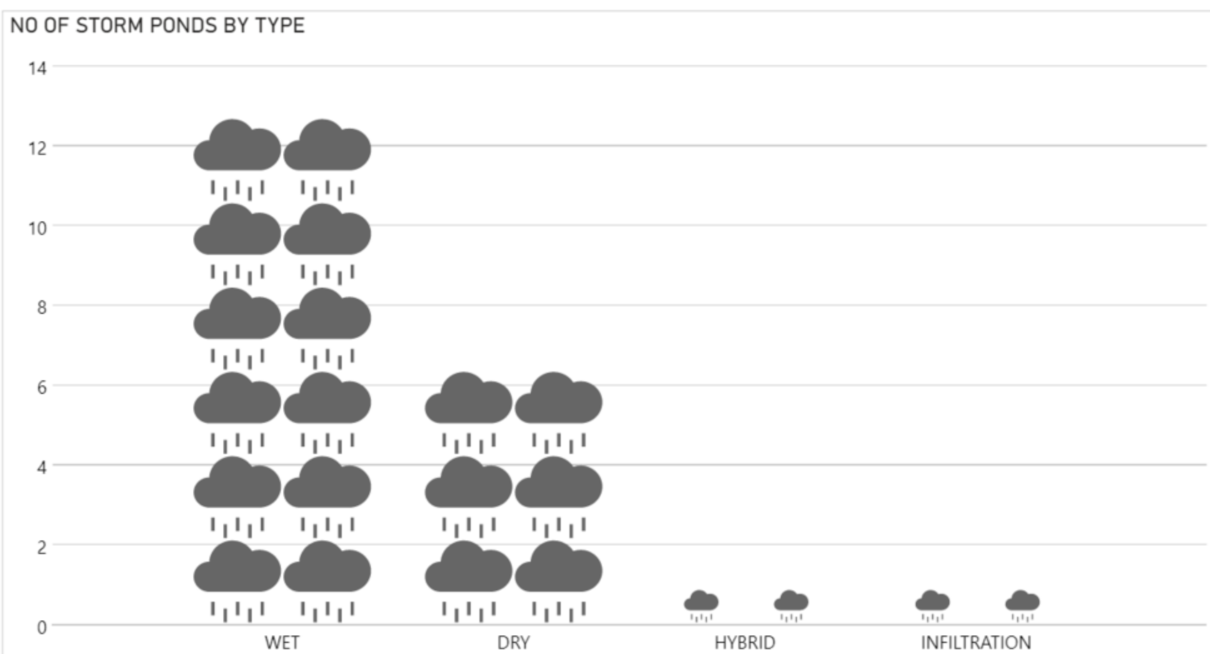



**Figure 28: Stormwater Pond Asset Summary**

## 3.3.4. STORMWATER GRAVITY (SEWER) MAIN

Stormwater gravity main is buried underground and carries stormwater from stormwater services and inlets to stormwater ponds, pump stations, or to the appropriate outfall. The City completes CCTV (Closed Circuit Television) inspections on this asset which involves sending a robot with a camera to inspect the inside of the pipe and determine any defects or rehabilitation needs. Per **Figure 29** below, there is approximately 414km of stormwater gravity main in the city with a total replacement cost of approximately $362M. The average age of a stormwater gravity main is 43 years which is 44% of the overall average estimated service life of 97 years. The condition of stormwater pipe is typically Good with an average condition score of 1.

| LENGTH (km) | REPLACEMENT COST | AVERAGE AGE (years) | AVERAGE ESTIMATED SERVICE LIFE | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|
| 413.6 | $361.7M | 43 | 97 | 1 | GOOD |

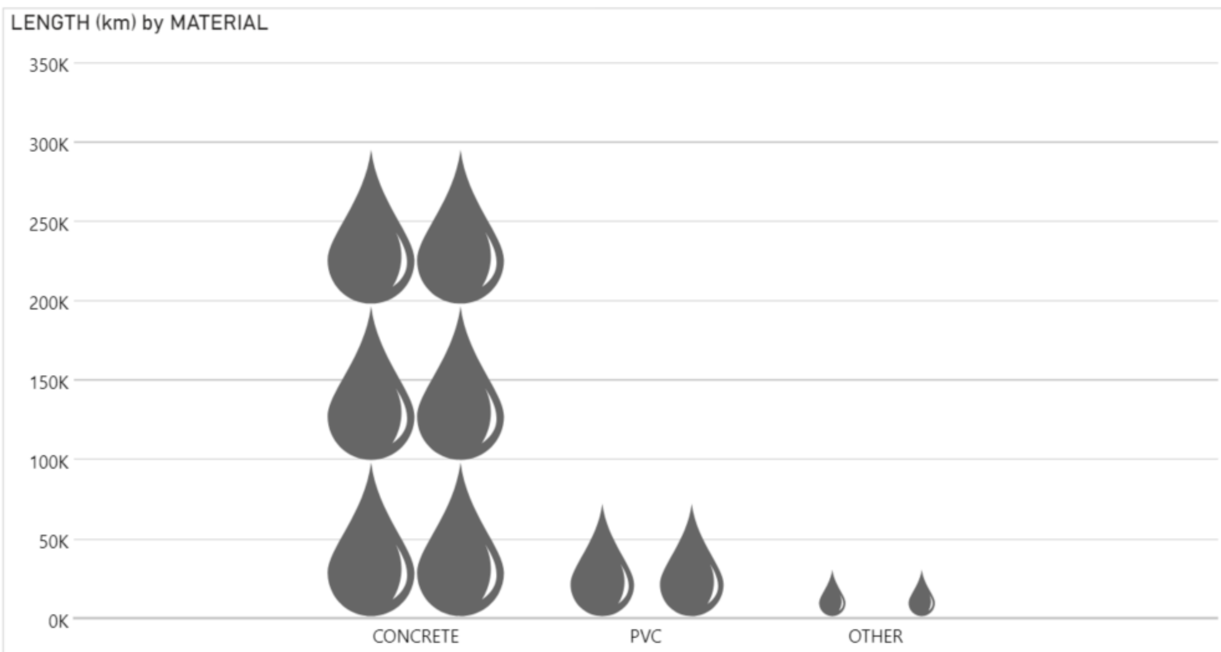



**Figure 29: Stormwater Gravity Main Asset Summary**

The other category includes materials including: Wood, Asbestos Cement, Clay, Fibreglass Reinforced, Steel, Ductile Iron, HDPE, Polyethylene, and Unknown. However, although there are many different materials used for gravity main, the most common material is Concrete (including reinforced and PCCP).

### 3.3.5. INLETS

Inlets are a receptacle to collect stormwater and settle out debris that may clog the stormwater system before entering the gravity main. Per **Figure 30** below, there are approximately 12,300 inlets in the City with a total replacement cost of $35.7M. It is important to note that the inlets inventory total below includes rear yard catchbasins which may be privately owned, however, this ownership information is not up to date in the GIS database.

The average age of inlets is 39 years which is 39% of the estimated service life of 100 years. The condition for catchbasins is typically based on the service life, and is Good with an average condition score of 1.

It is important to note that the majority of inlets in the City are catchbasins, with a small number of Standard inlets which are considered to be a segment of pipe. The City is currently investigating improving the preventative maintenance activities for these structures.

| NO OF INLETS | REPLACEMENT COST | AVERAGE AGE (years) | ESTIMATED SERVICE LIFE | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|
| 12,290 | $30.8M | 39 | 100 | 1 | GOOD |

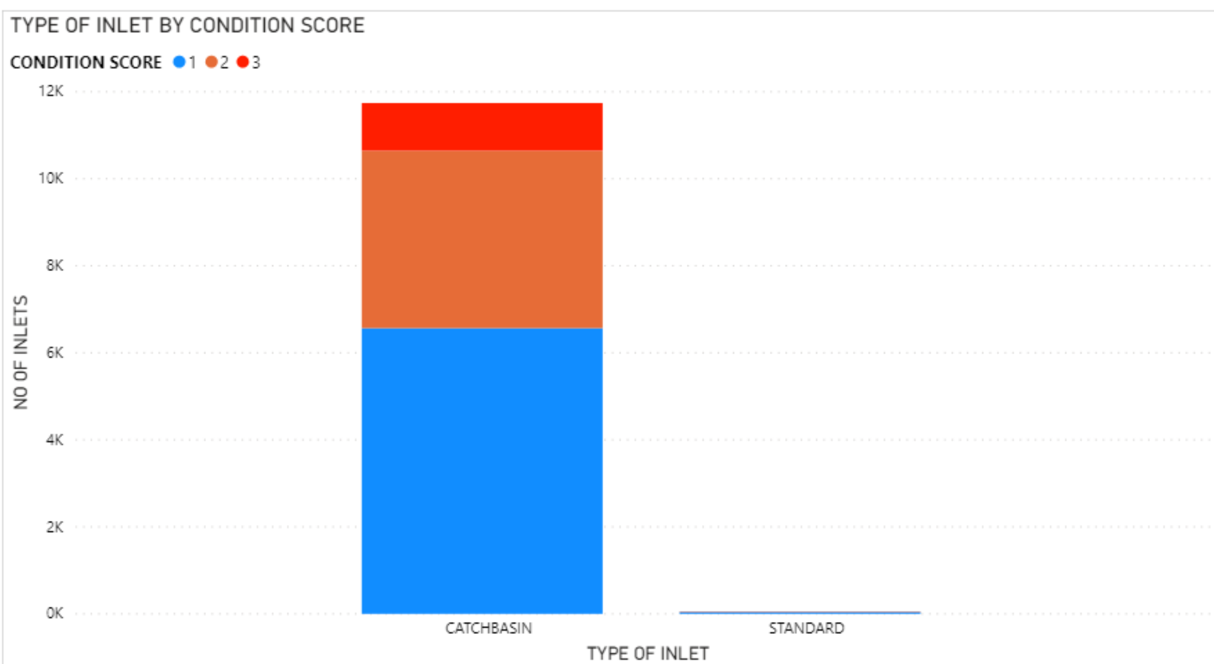



**Figure 30: Inlet Asset Summary**

### 3.3.6. STORMWATER MAINTENANCE HOLES

A stormwater maintenance hole (or manhole) is an underground structure which is an access point for the stormwater main so that it can be maintained or flushed. It can be seen in **Figure 31** below that there are approximately 6,200 stormwater maintenance holes in the City with a total replacement cost of $28M. The average age of a stormwater maintenance hole is 40 years, which is 40% of the estimated service life of 100 years.

The condition score is based on available condition data from the annual Manhole Condition Assessment program where possible, but at the time of writing only 11% of maintenance holes have inspection data from this program. Therefore the majority of the condition scoring data is based on the service life, and shows a typical Good condition with an average condition score of 1. This data is evident by the colour distribution on the graph showing the majority of poor (3) condition manholes occurring before 1940, and fair occurring between 1940 and 1980.

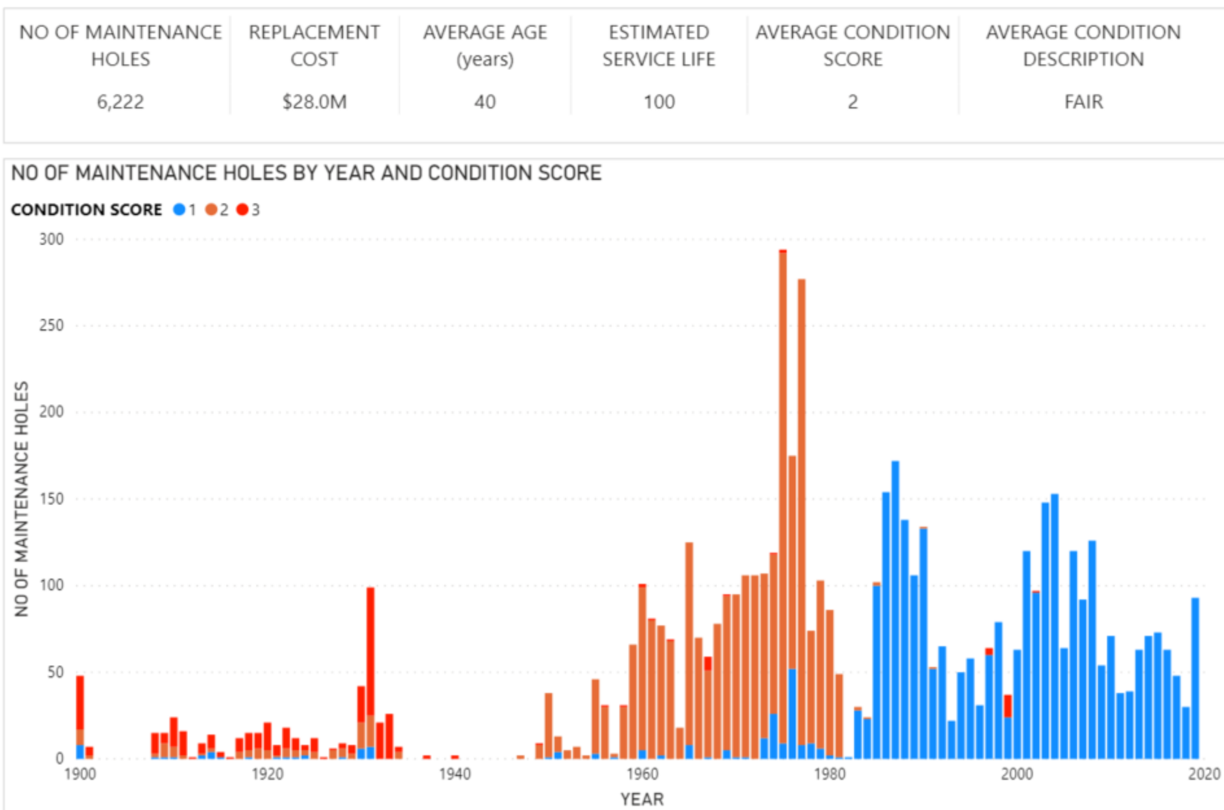



**Figure 31: Stormwater Maintenance Holes Asset Summary**

### 3.3.7. STORMWATER SERVICES

A stormwater service is a pipe that connects to the stormwater gravity main and collects the stormwater from a property. Per **Figure 32** below there are approximately 5,000 stormwater services in the city with a total replacement cost of $13.3M. The data confidence on the inventory is low and so it is anticipated this number will increase as the inventory improves. The average age of the known services is 15 years which is 21% of the 72 year average estimated service life. The condition is based on the service life of the material and so the condition is typically Good with an average condition score of 1.

In addition, based on the information below the majority of stormwater services are PVC, however, it is estimated that there are a portion of asbestos cement (AC) stormwater services which are not yet included in the inventory.

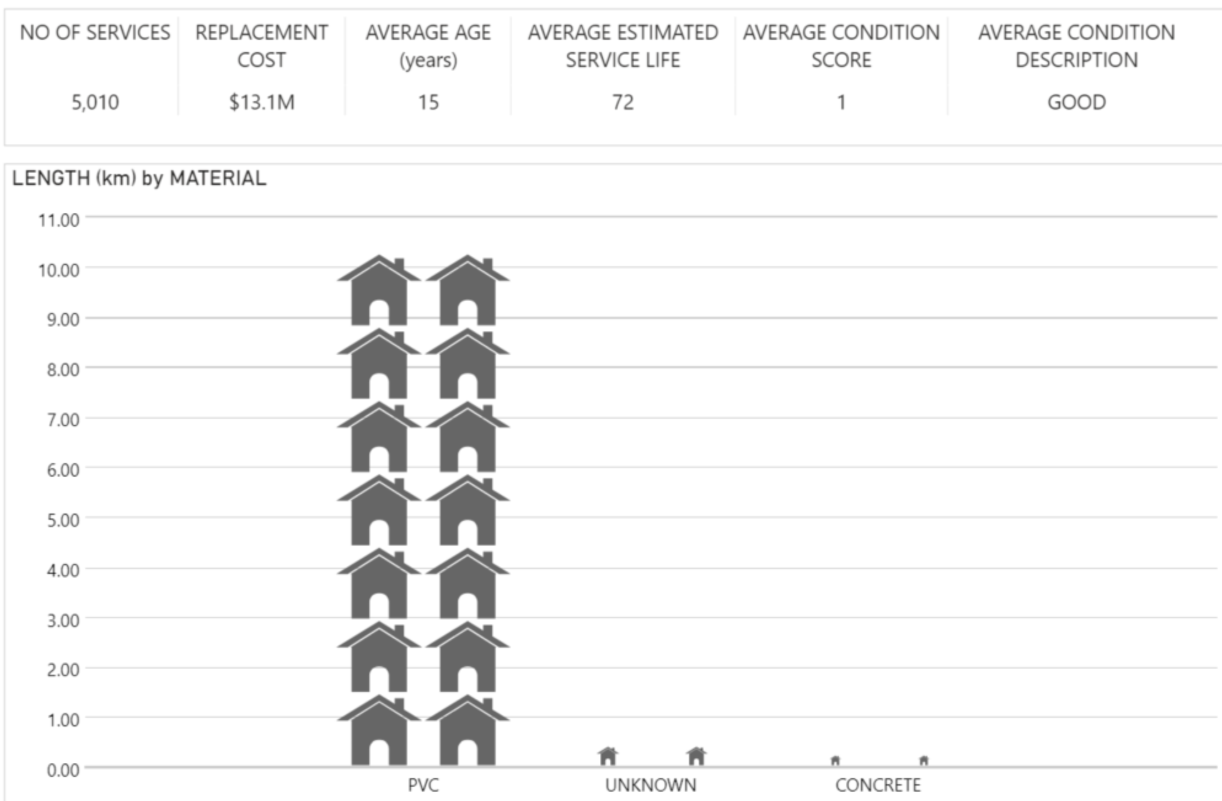



**Figure 32: Stormwater Services Asset Summary**

### 3.3.8. OIL & GRIT SEPARATORS

An oil & grit separator (sometimes referred to as a stormceptor®) is a maintenance hole fitted with a device which captures oil and sediment runoff from parking lots and roads so that these pollutants do not damage the network or the watershed.

Per **Figure 33** below the City owns and maintains 25 oil & grit separators with a total replacement cost of $1.9M. Oil & grit separators are an average age of 14 years which is 70% of the estimated service life with the first devices being installed in 2000. The condition score is based on the estimated service life and so the condition score is typically Fair with an average condition score of 2. However, oil and grit separators are inspected twice a year and cleaned out as needed to ensure they are clean and in working order, and so it is anticipated that many are in Good condition.

| NO OF OIL & GRIT SEPARATOR | REPLACEMENT COST | AVERAGE AGE (years) | ESTIMATED SERVICE LIFE | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|
| 25 | $1.9M | 14 | 20 | 2 | FAIR |

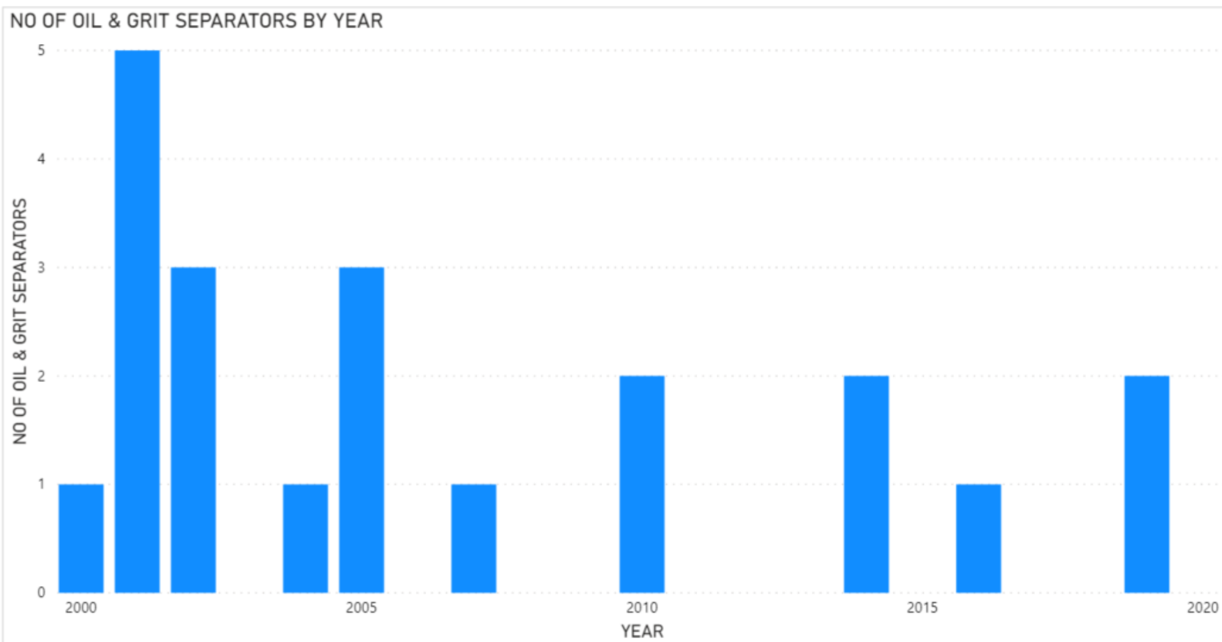



**Figure 33: Oil & Grit Separators Asset Summary**

## 3.3.9. FLOOD GATES & LEVEE

Flood gates are used to allow the stormwater network to outlet into the Grand River, but are also able to be closed so that if the Grand River rises above the flood gate level, the river will not overload the stormwater network and cause flooding. The 16.9km levee is an embankment built to prevent the overflow of the river, and the flood gates are located along the levee.

Per **Figure 34** below, there are 39 flood gates in Brantford with a total replacement cost of approximately $1.7M. The flood gates are an average age of 38 years which are past the average estimated service life of 28 years. Based on the draft condition assessment information, the condition is typically Fair with an average condition score of 2. At the time of writing this report, the flood gates condition assessment is in draft final form and so this information is subject to change, and replacement costs may change.

Per the figure below, it can be seen that the most common type of flood gate is a sluice gate. It is anticipated that as repairs occur, these gates will be fitted with WaStop® check valves which stops backflow in drains. In addition, there is one (1) additional flood gate not included below which has been decommissioned. In addition, the Wilkes Dam headgates, which are used for controlling water entry into the Holmedale Canal, can act as a flood gate, but this asset has not been included in this iteration of the AMP.

| NO OF FLOOD GATES | REPLACEMENT COST | AVERAGE AGE (years) | AVERAGE ESTIMATED SERVICE LIFE | LENGTH OF LEVEE (km) | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|---|
| 39 | $1.9M | 38 | 28 | 16.9 | 2 | FAIR |

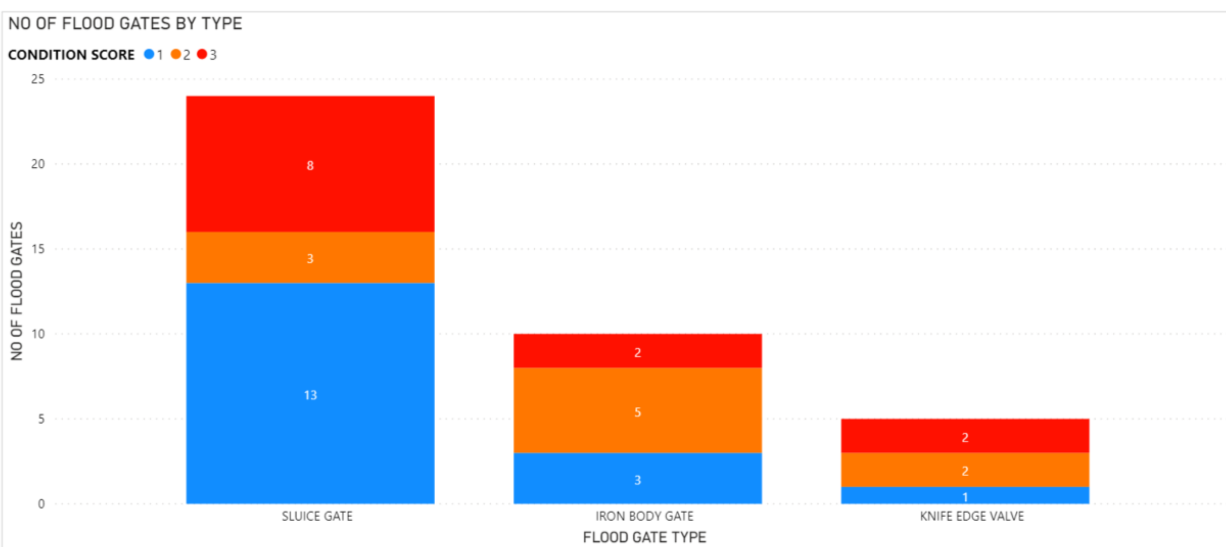



**Figure 34: Flood Gates Asset Summary**

## 3.3.10. OUTFALLS

Outfalls are points in the City where stormwater outlets to the watershed. Per **Figure 35** below, there are 290 outfalls with a total replacement cost of $557K. It is important to note that the inventory is at a Low confidence level and so it is anticipated this number will increase as the inventory improves. The average age of the known outfalls is 53 years which is 59% of the estimated service life of 90 years, and they are typically in Good condition with an average condition score of 1.

It can be seen that the most common outfall is a concrete outfall, which refers to a headwall which is a structure designed to reduce erosion. The next common type of outfall is a discharge pipe which is a section of pipe that outlets stormwater. While a condition assessment was completed which included outfalls, the City is not highly confident in the inventory of the data.

| NO OF OUTFALLS | REPLACEMENT COST | AVERAGE AGE (years) | ESTIMATED SERVICE LIFE | AVERAGE CONDITION SCORE | AVERAGE CONDITION DESCRIPTION |
|---|---|---|---|---|---|
| 290 | $556.7K | 53 | 90 | 1 | GOOD |

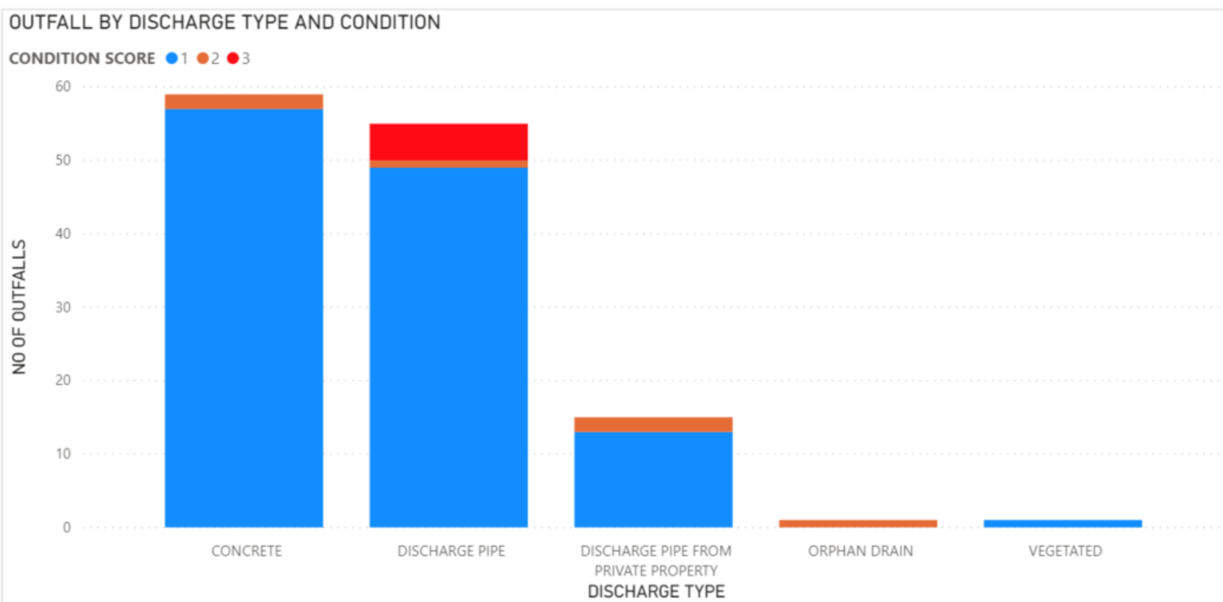



**Figure 35: Outfalls Asset Summary**

### 3.3.11. DITCHES

Ditches are sections of earth cut out to direct overland flow. Per **Figure 36** below, the total length of ditches in the City is 121.3km. The City also owns one (1) municipal drain with a total length of 318.2m. The total replacement cost for ditches is $24.3M, and for the municipal drain is $63,600. The cost estimates are a very high level cost estimate assuming $200 per metre of ditch or drain. Based on available condition data, the average condition of ditches is Good with a score of 1. The condition of the municipal drain is currently unknown. Although a condition assessment was completed on ditches, the City is not highly confident in the inventory data for this asset. Currently, the age of City ditches is unknown.

It can also be seen below that the most common type of ditch is a vee shape although circular, rectangular, and trapezoidal shaped ditches also exist in the City.

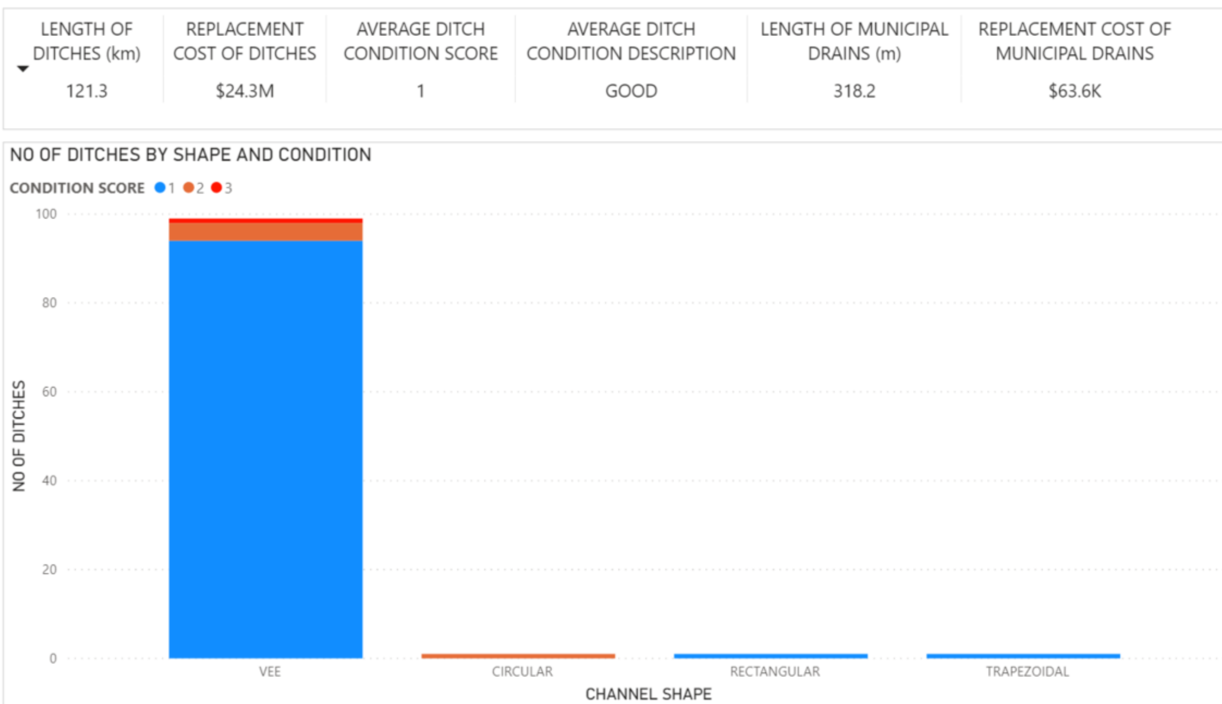



**Figure 36: Ditches Asset Summary**

# 3.4. LIFECYCLE OF STORMWATER ASSETS

The lifecycle of Stormwater assets consists of four (4) categories which are described in this section:

- Key Lifecycle Stages of Stormwater Assets;
- Lifecycle Activities;
- Risks of Lifecycle Activities; and
- 10 Year Lifecycle Costs of Stormwater Assets.

## 3.4.1. KEY LIFECYCLE STAGES OF STORMWATER ASSETS

The lifecycle of an asset refers to the following stages: Planning, Creation/Acquisition, Operations and Maintenance, Renewal/Disposal which are defined in the Asset Management Plan Overview Document. For Stormwater assets specifically our general process is as follows:

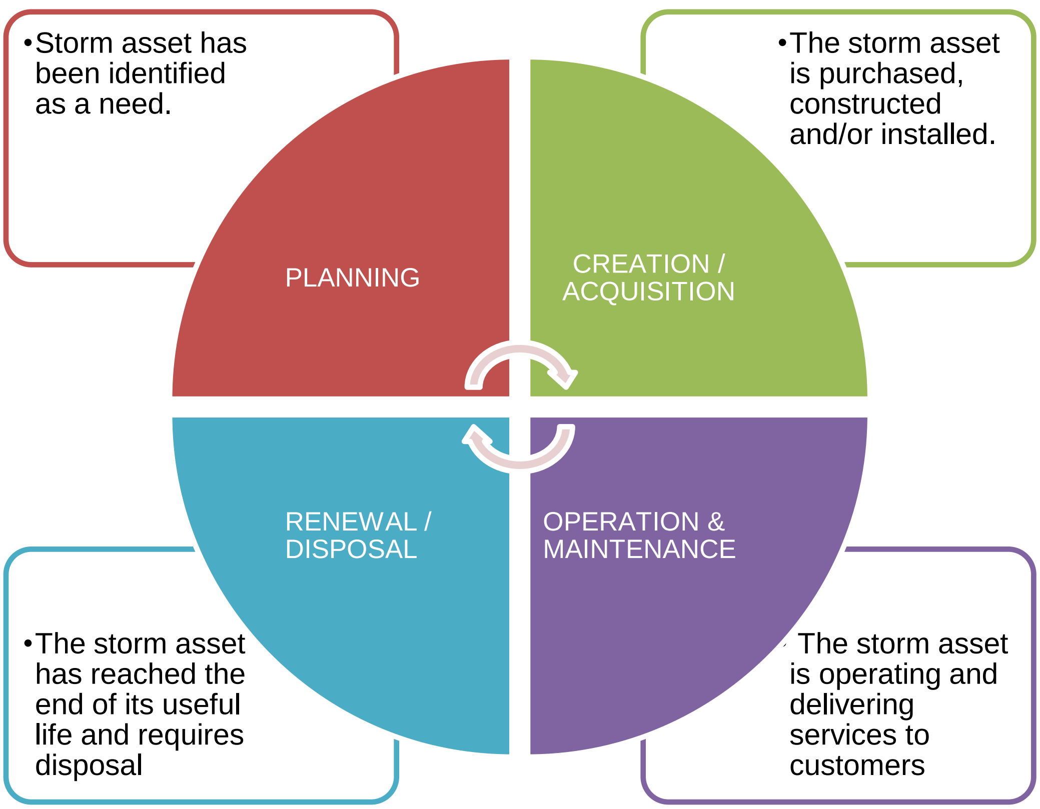
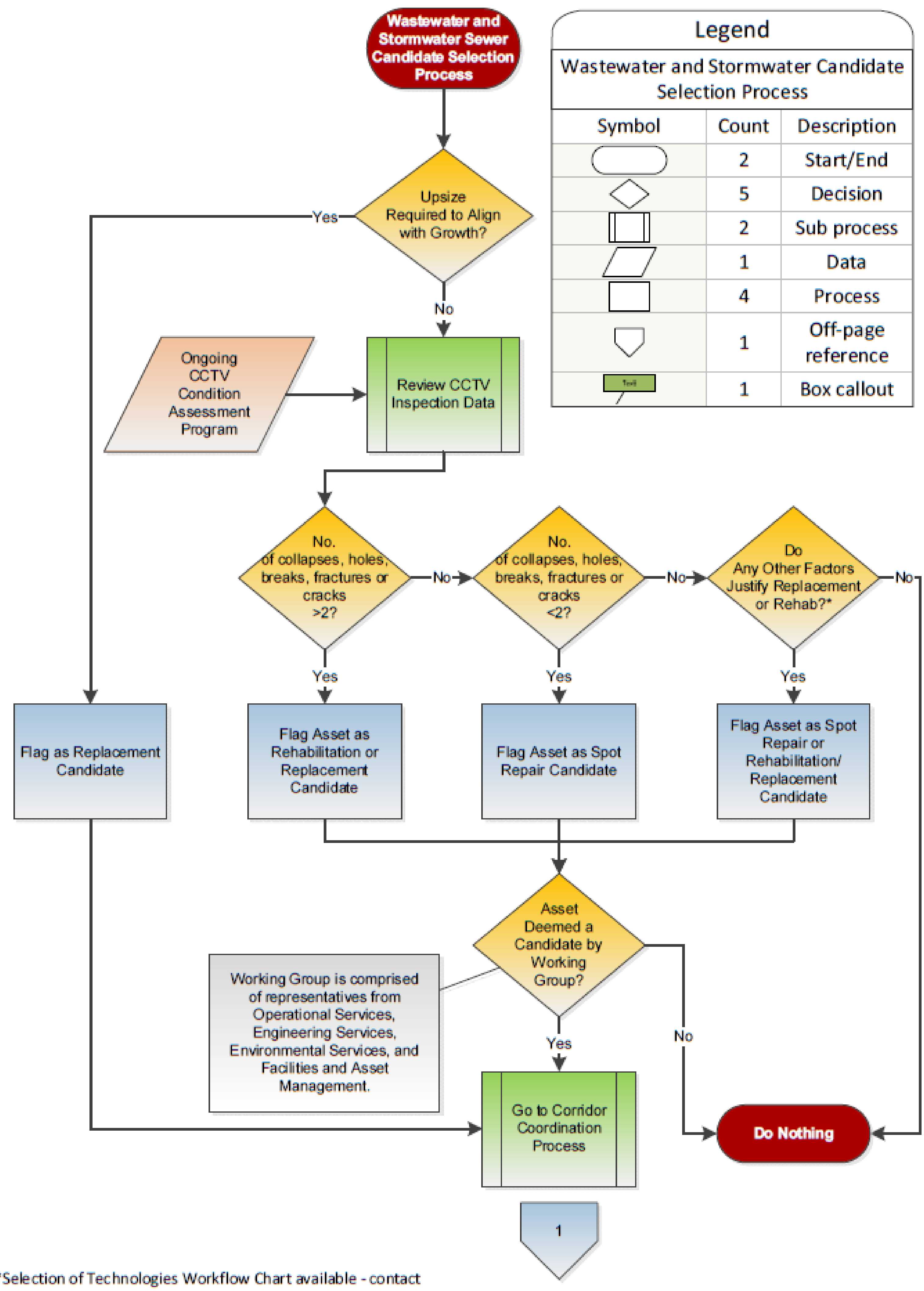



**Figure 37: Lifecycle Stages of Stormwater Assets**

1. **Planning** –The stormwater asset has been identified as a need through the Official Plan, Master Servicing Plan, or due to an identified poor condition of an existing asset during a CCTV inspection, LiDAR project, maintenance report, site inspection, customer complaint, or desktop analysis. The asset is designed using all applicable codes and standards. Typically this phase also involves planning on how to optimize the value of the assets which may include: replacing neighbouring corridor assets at the same time, improving operating and maintenance efficiencies, upsizing or rerouting for growth. The business process for state of good repair for linear wastewater assets is shown in **Figure 38**.
2. **Creation / Acquisition**– The cost and requirements for the new or replacement stormwater asset are defined. The asset is purchased, constructed and/or installed. Extra care is taken at this stage to ensure the asset is constructed properly using all appropriate design standards and guidelines to avoid any premature repairs or replacements due to installation errors.
3. **Operation and Maintenance** – The stormwater asset is operating and delivering services to customers. Maintenance (Lifecycle) Activities are completed on the asset at specific time intervals as indicated in **Table 28** to prevent premature failures of the assets. Additional monitoring and potential improvements are evaluated during this process.
4. **Renewal / Disposal** – The stormwater asset has reached the end of its useful life, is in poor condition, and/or is underperforming, and requires disposal. The disposal considers the effect on customers such as required detouring or service disruptions which are taken into account in the Planning stage thereby restarting the cycle. The City follows industry standard when disposing of these assets




*Selection of Technologies Workflow Chart available - contact Capital Planning

**Figure 38: Stormwater Linear Asset Business Process**

### 3.4.2. LIFECYCLE ACTIVITIES

A list of the planned Lifecycle Activities, annual cost, and frequency for each stormwater asset class can be found in **Table 28** below. These activities are currently being undertaken to maintain our stormwater assets and therefore maintain the current levels of service

**Table 28: Lifecycle Activities for Stormwater Assets**

| Asset Type | Lifecycle Activity | Annual Cost* | Frequency | Completed by |
|---|---|---|---|---|
| **Stormwater Sewer** | CCTV Inspection | $3.91/m | 1 every 10 years | Contractor |
| | Flow Monitoring | $18,000 per location | | Asset Management |
| | Grouting | $414,400 | As needed | WD WWC Operators, Contractor |
| | Cleaning | | 1 every 10 years | WD WWC Operators, Contractor |
| **Pump Station** | Preventative Maintenance | | Per Standard Operating Procedures | Wastewater Operations |
| **Stormwater Service** | Cleaning | | As needed | WD WWC Operators, Contractor |
| | CCTV Inspection | | As needed | WD WWC Operators, Contractor |
| **Inlet** | Catchbasin Cleaning | | 1 every 5 years | WD WWC Operators, Contractor |
| | Catchbasin Internal Inspection | | When cleaned | WD WWC Operators, Contractor |
| | Critical (Hot Spot) Catchbasins Cleaning | | Before weather event | Operational Services |
| **Manholes** | Inspection and Cleaning | | As needed | Operational Services |
| | Condition Assessment | | Annual Program | Contractor, Infrastructure Planning Technologist |
| **Oil and Grit Separator** | Inspection | | Twice per year | WD WWC Operators |
| | Cleaning | | As needed | WD WWC Operators |
| **Flood Gate** | Status Inspections | | Monthly | Operational Services |
| | Exercise Valves | | 2x per year | Operational Services |
| | Formal Condition Assessment | $98,880 | One time | Infrastructure Planning Technologist, Operational Services |
| **Stormwater Ponds** | Inspections | Included in $414,400 cost above | Visual quarterly | Asset Management |
| | Cleaning | | As needed | WD WWC Operators |
| | Grass Cutting | | 5 times per year | WD WWC Operators |
| | Debris Removal | | As needed | Operational Services |
| | Condition Assessments | $6,500 per pond | As needed | Contractor, Asset Management |
| **Ditches** | General Maintenance | $4,600.00 – 8 hour day | Ad Hoc | Operational Services |
| | Condition Assessment | $70,378 | As needed | Contractor, Asset |

| | | | | |
|---|---|---|---|---|
| | (2017) | | | Management |
| | Cleaning & Debris Removal | | As needed | Operational Services |
| **Outfalls** | Cleaning & Debris Removal | $335,379 | 2x per year | Operational Services |
| | Creek Maintenance Tree removal | | Every 3 months | Operational Services |
| | Condition Assessment (2017) | Included in ditches Condition Assessment cost | As needed | Contractor, Asset Management |

*2021 Annual Cost is typically based on estimates presented in the 2021 Preliminary Operating Budget under 2021 Budget Gross Expenditures.

Lifecycle activities occur on each of the stormwater assets to maintain the state of good repair (SOGR). Vertical infrastructure activities are currently typically tracked through Avantis, and linear activities are typically tracked through web mapping applications that connect to the ArcGIS database or paper records. Work order tracking will be moved over to AIM during implementation which is explained in **Section 7** of the **Asset Management Plan Overview Document**. Information related to Avantis, and ArcGIS Collector can be found in **Section 4.2** of the **Asset Management Plan Overview Document**.

When these activities are integrated into AIM, the frequency and cost associated with these activities will be better represented. At this time, the costs associated with the O&M activities on these assets are estimated based on the NWWBI submissions, but are not formally recorded. Future updates of the AMP should include actual costs, frequency, and time associated with these activities which will be recorded through AIM.

### 3.4.3. RISKS OF LIFECYCLE ACTIVITIES

The identified lifecycle activities in **Table 28** above are historical activities taken on by Operational Services, Water Distribution and Wastewater Collection. Some risks with these activities include:

- **Traffic Accidents** - when performing maintenance in the vicinity of traffic vehicles, there is a risk of a traffic accident. This is mitigated by implementing a traffic control plan and wearing high visibility clothing during maintenance activities in the right of way;
- **Falling** – Some activities require working from heights and there is a risk of falling. This risk is mitigated by having maintenance personnel trained on all equipment and having fall arrest training where required.
- **Operator Error** – When operators are operating equipment, there is a risk of an operator related accident. This risk is mitigated by ensuring all operators have the required licenses and are trained on equipment.
- **Confined Space** - There are always risks associated with confined space, technicians are trained on how to complete this task safely.
- **Equipment Failure -** Equipment failure can occur during maintenance activities and this is mitigated by completing regular preventative maintenance to avoid sudden failure, or setting up pumps and monitoring levels (i.e. flood gates).
- **Major Storm Events –** Ground conditions during storm events may make completing certain maintenance activities difficult on storm assets. This is mitigated by completing maintenance before the storm event occurs by monitoring weather patterns.

However, if these activities were not completed, the risks would include:

- **Service Disruptions or backups** due to premature failures that could have been mitigated with preventative maintenance (e.g. debris in stormwater sewer causing backups);
- **Increased Cost** due to reactive repairs which could have been prevented with preventative maintenance (e.g. reactive repairs are often 3x more expensive than planned repairs);
- **Environmental Risk** due to contaminants entering river (e.g. oil and grit separator failure); and
- **Property Damage** due to flooding (e.g. flood gate or stormwater pond failure).

### 3.4.4. 10 YEAR LIFECYCLE COSTS OF STORMWATER ASSETS

**Figure 39** below outlines the 10 year lifecycle costs of stormwater assets. As noted on the graph, typically when the condition of an asset is estimated based on service life there are spikes in the first year to account for the backlog. Since this spike exists, it can be concluded that there are many assets in the City that have exceeded their service lives especially stormwater gravity pipe assets. It can be seen that the asset groups with the most backlog is gravity main followed by storm ponds.

It is anticipated that after the LiDAR study identified in **Section 3.6.2** is complete, operational deficiencies within the current stormwater network will be identified, and the required capital and/or O&M to maintain the state of good repair may increase.

Based on the information presented below, the average cost for the next 10 years required to be spent on Stormwater assets' capital projects to maintain the state of good repair is $4.4M, and the estimated annual O&M cost is $0.9M. Therefore, this is the amount recommended that the City invest in stormwater assets annually to maintain the state of good repair.

It is important to note that this figure and associated costing was developed separately from other corridor assets (i.e. watermain & services, wastewater gravity pipe, maintenance holes, services, and roadway), in reality these assets would be considered in tandem when considering a corridor section in the City in order to obtain cost efficiencies during design and construction where possible.

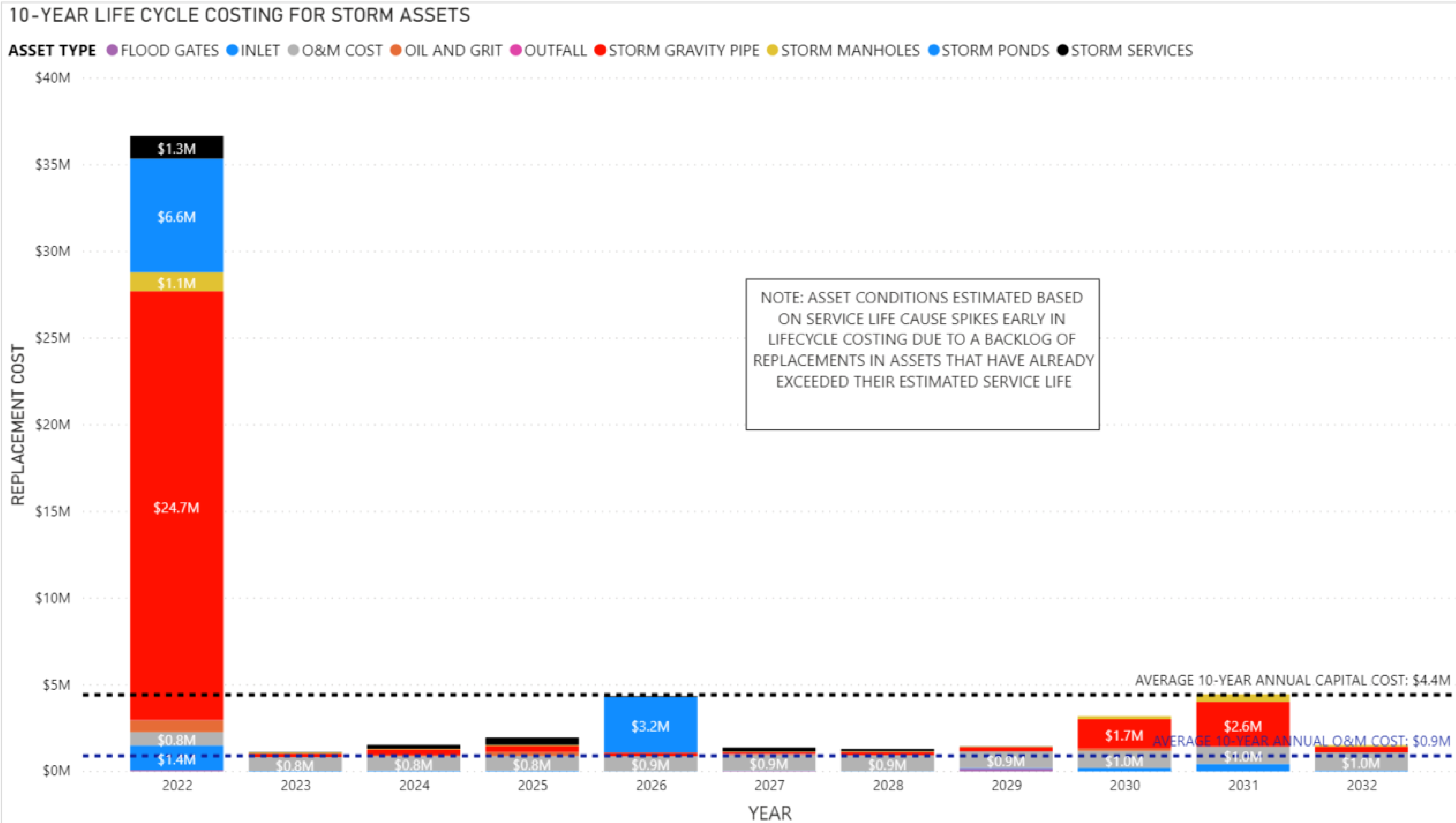



**Figure 39: 10-Year Lifecycle Cost Per Stormwater Asset Type**

Notes:

1. O&M Costs are from the numbers reported in the 2021 Preliminary Operating Budget and assumed to be projected 3% per year to account for inflation. These O&M Costs are associated with both Treatment and Distribution and are partially broken down in **Table 28.**
2. Assets with formal condition assessments which contained forecasting (i.e. flood gates) were included based on the estimated replacement/repair year, and referred to in **Table 24.**
3. Gravity main replacement was based on service life unless it was estimated to have a poor WRC structural score or be undersized, in which case it was estimated to be in 2022 to clear the backlog.
4. If a condition assessment was completed without a forecast (e.g. maintenance holes, stormwater ponds), if condition was poor, works occurred in 2022, if condition was fair, works occurred in 2026.
5. For all other assets where no formal forecast was available, the replacement year is based on the estimated remaining service life of each asset

Per **Figure 40** below, the existing 10-year forecast from 2021 – 2030, further explained in **Section 8.2.2** of the **Asset Management Plan Overview Document**, indicates that the City is currently planning to spend an average of $2.4M on stormwater assets capital annually, and as noted above, the required 10-year average amount is $4.4M for stormwater assets, therefore there is currently an average annual 10-year funding gap of $2.0M for stormwater assets. As noted on the graph, the impacts resulting from these funding gaps will be monitored and reported as appropriate. It is evident that the City is intending to expend over the required 10-year average amount in 2022 in the existing 10-year forecast, however, as the forecast continues moving forward to 2029, gradually less budget is expected to be expended on SOGR for stormwater assets, until 2030 when the City meets the required amount. This indicates that the current forecast may be disproportionately allocated to the beginning and end of the forecast, and that the City may benefit from moving some projects into the middle of the forecast. Since the budget is revised annually, and the Prioritization Matrix explained in **Section 9** of the **Asset Management Plan Overview Document** is currently in its implementation phase, it is anticipated that this forecast will continue to change as City priorities shift. It is important to note that currently the City does not have access to detailed data on O&M for stormwater assets, but with the implementation of the AIM project explained in **Section 7** of the **Asset Management Plan Overview Document,** it is anticipated this information will be provided in the next iteration of the AMP.

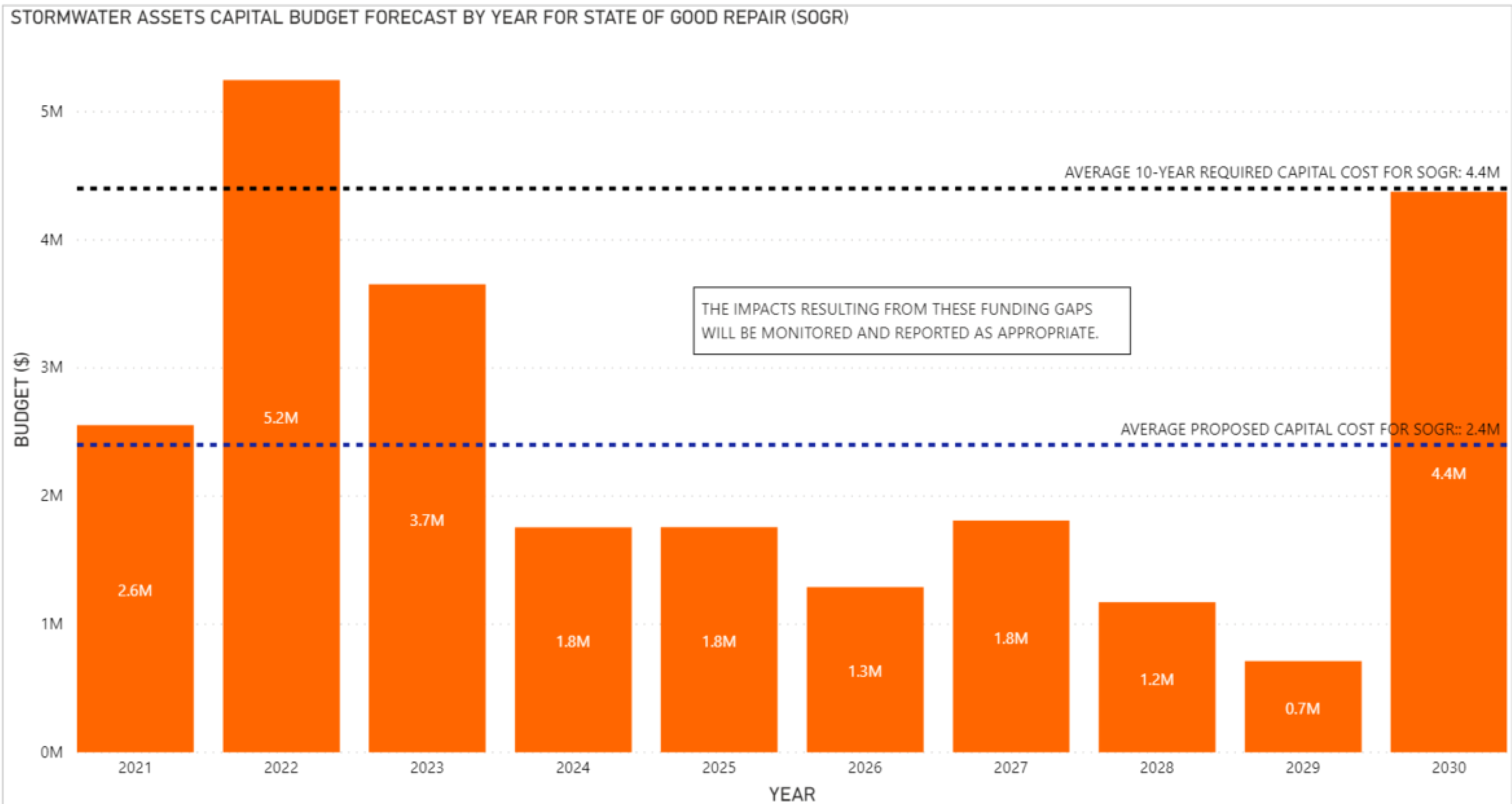



**Figure 40: Existing Capital Budget Forecast from 2021 – 2030 for Stormwater Assets**

# 3.5. CURRENT LEVELS OF SERVICE

## 3.5.1. O.REG 588/17 CUSTOMER LEVELS OF SERVICE

***1.*** *Description, which may include maps, of the user groups or areas of the municipality that are protected from flooding, including the extent of the protection provided by the municipal stormwater management system*

The City of Brantford is bisected by the Grand River, and as a result, there is a floodplain along the length of the river. The floodplain included in **Figure 41** is provided by the Grand River Conservation Authority (GRCA), and shows the approximate limits of the floodplain. A 16.9km levee exists along the river, which is owned by GRCA. The levee includes 39 flood gates along its length, which are operated and maintained by the City of Brantford. The GRCA and City of Brantford have a maintenance agreement for how maintenance activities occur on these assets. The levee and flood gates protect surrounding properties in the floodplain during a flood event. These flood gates are typically open in non-emergencies to outlet stormwater to the Grand River, but they are closed in flood emergencies where the river exceeds the height of the gates so that the flood waters do not enter and overwhelm the municipal system causing flooding.

On February 21st, 2018, City of Brantford was in a state of emergency due to an ice jam event. An ice jam is when ice accumulates in a section of a river thereby blocking the flow and causing flooding. An ice jam occurs in Brantford at the river reach in the Lower Grand River almost every winter due to the natural bends in the river, and typically does not cause emergency events. However, the magnitude of the 2018 event was caused by the release of an additional large ice jam from upstream of the Parkhill Dam in Cambridge. Due to warm temperatures and rainfall, the ice jam in Cambridge released, and a surge of water, ice, and debris made its way downstream to Brantford. Brantford’s ice jam remained intact, and so the surge resulted in an additional accumulation of ice and debris and caused flooding over top of portions of the levee system through the central portion of the City until the ice jam released on February 22nd, 2018. During this event, Operational Services closed the flood gates along the river so that water did not enter the stormwater management system. This event required the evacuation of residents, caused damage to private properties and public infrastructure, and required emergency service operations from multiple agencies. In April 2019, GRCA retained KGS Group to complete a study to investigate the ice jam and explore high level mitigation strategies for future ice jam events.

At the time of writing this report, GRCA, in partnership with the City of Brantford, retained Ecosystem Recovery Incorporated to develop an additional ice jam mitigation feasibility study to further develop concepts and costs for mitigation solutions. When this study is completed, Brantford will be able to provide additional solutions to protect properties from flooding in the case of another major ice jam event.

In addition, based on **Figure 42** it can be seen that the municipal network is rated for two (2) and five (5) year storms depending on the area of the City. It is a City initiative to upgrade the areas rated for two (2) year storms to five (5) year storms. In addition, ditches which collect overland flow throughout the City are rated for 100 year storms and further increase protection in these areas.

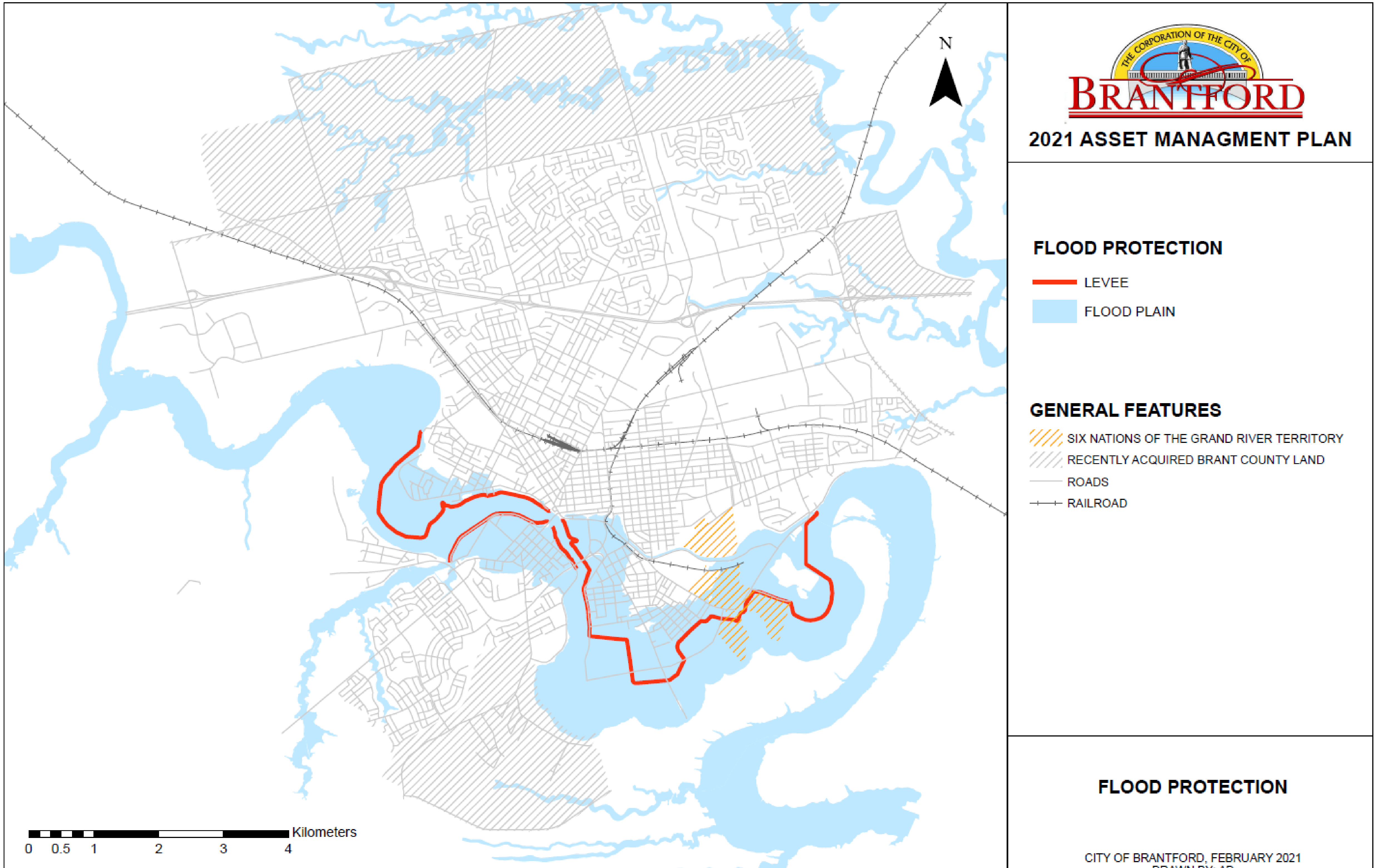



**Figure 41: Flood Protection Map**

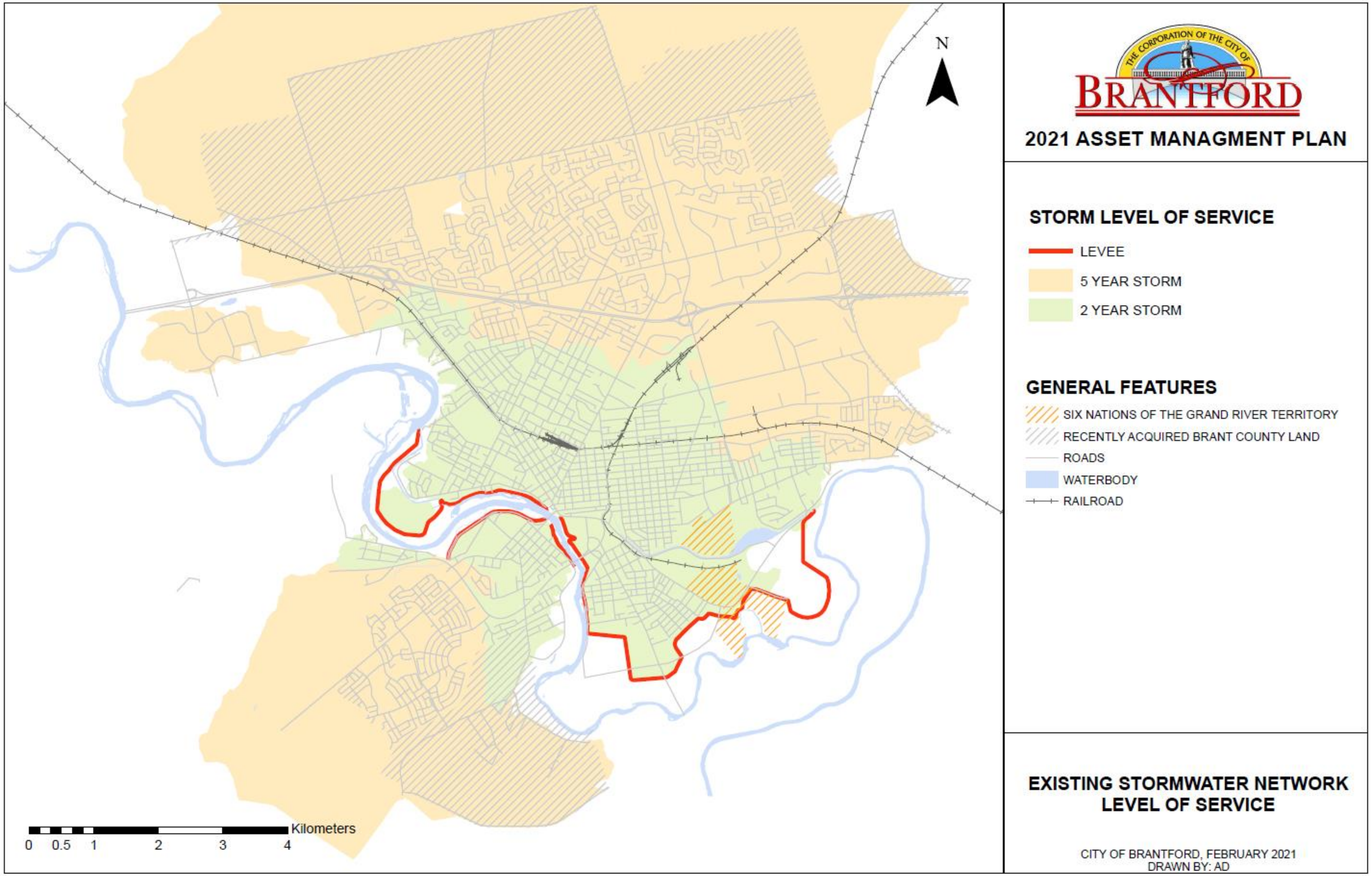



**Figure 42: Existing Stormwater Network Level of Service**

## 3.5.2. O.REG 588/17 TECHNICAL LEVELS OF SERVICE

The technical levels of service as dictated by O.Reg 588/17 can be found in **Table 29** below.

**Table 29: O.Reg 588/17 Stormwater Technical Levels of Service**

| Service | Service attribute | Technical levels of service (technical metrics) | 2019 | 2020 |
|---|---|---|---|---|
| **Stormwater** | Scope | 1. Percentage of properties in municipality resilient to a 100-year storm. | N/A | 55.4% |
| | | 2. Percentage of the municipal stormwater management system resilient to a 5-year storm. | N/A | 52.3% |

## 3.5.3. MUNICIPALLY DEFINED CUSTOMER LEVELS OF SERVICE

The customer levels of service are defined in **Section 6.2** of the **Asset Management Plan Overview**. For stormwater assets, the asset specific interpretation of these levels of service is defined below in **Table 19**. These customer levels of service were used to create and define our technical levels of service identified in **Table 31**.

**Table 30: Municipally Defined Customer Levels of Service**

| Customer Level of Service | Definition |
|---|---|
| **Accessibility** | Stormwater assets should be accessible to all customers connected to the municipal water network without barriers in place. |
| **Quality** | Stormwater assets should deliver their intended purpose, protect residents from flooding, and assets should be sufficient capacity. |
| **Cost Efficiency** | Stormwater assets should be operated efficiently with extra care to minimize costs. |
| **Safety** | Stormwater assets should protect residents from flooding and promote community safety, and customers should feel safe using these services. |
| **Environmental Sustainability** | Stormwater assets should be operating as environmentally as possible and also be promoting sustainable lifestyles. |
| **Reliability** | Stormwater assets should be available when customers need them. |
| **Responsiveness** | Stormwater assets should be fixed quickly when service disruptions occur. |

### 3.5.4. MUNICIPALLY DEFINED TECHNICAL LEVELS OF SERVICE

For our current defined levels of service, we collect KPIs for stormwater collection which supports the above defined municipally defined customer levels of service.

The Levels of Service, KPIs and targets (where available) in **Table 31** below are tracked based on information required for the NWWBI. This information is mandated through that initiative, but serves as an excellent tool for a first draft of water KPIs.

**Table 31: Stormwater Collection NWWBI KPIs**

| Customer Level of Service | NWWBI Metric | Technical Level of Service | 2018 KPI | 2019 KPI | Units |
|---|---|---|---|---|---|
| Quality | Ensure Adequate Capacity | Calls Regarding Flooding due to Public System Issues | 20 | 22 | # |
| | | Ditch Length Cleaned | 2.44% | 2.44% | % |
| | | Ditches Inspected | 100 | 100 | % |
| | | Length of Root Cutting in sewers | N/A | 0.53 | km |
| | Have Satisfied and Informed Customers | Calls Regarding Flooding due to Public System Issues relative to People Served | 0.2 | 0.21 | #/1000 people |
| | | Cost of Storm Education Program | $97.79 | $96.05 | $/1000 people |
| | | Percent Attainment of Target Emergency Response Time after Working Hours | 100% | 100% | % |
| | | Percent Attainment of Target Emergency Response Time during Working Hours | 100% | 100% | % |
| | | Percent Attainment of Target Non-Emergency Response Time after Working Hours | 95% | 95% | % |
| | | Percent Attainment of Target Non-Emergency Response Time during Working Hours | 95% | 95% | % |
| | | Stormwater Related Customer Complaints | 0.24 | 0.23 | #/1000 people |
| Cost Efficiency | Meet Service Requirements with Economic Efficiency | Cost to Remove Sediment from Ponds per Volume of Sediment Removed | $164.58 | $164.58 | $/m3 |
| | | Linear O&M Cost | $0.65 | $0.74 | ‘000 $/km of sewer and ditches |
| | | Pond Facility O&M Cost | 8.74 | $17.94 | ‘000 $/pond |
| | | Stormwater O&M Cost Relative to Catchment Area | $7.43 | $11.13 | ‘000 $/km2 of catchment area |
| | | Stormwater O&M Cost Relative to System Length | $1.27 | $1.88 | ‘000 $/km of sewer and ditches |
| | | Unit Cost of Catchbasin Cleaning | $60.56 | $64.50 | $/basin |
| | | Unit Cost of Catchbasin Inspections | $10.56 | $7.68 | $/basin |
| | | Unit Cost of Oil and Grit Separator Cleaning | N/A | $6,371.61 | $/separator |
| Safety | Protect Public Health and Safety | Mass of Sand and Salt Used | 28.16 | 27.81 | tonnes/km of roadway length |
| | | Volume of Brine Used | 0.29 | 0.79 | m3/km roadway length |
| | Provide a Safe and | Field Accidents with Lost Time | 0 | 0 | #/1000 O&M Hours |

| | | | | | |
|---|---|---|---|---|---|
| | Productive Workplace | Lost Hours due to Field Accidents | 0 | 0 | #/1000 O&M Hours |
| | | Sick Days Taken | 13.1 | 14.4 | #/employee |
| | | Total Available O&M Hours/Total Paid O&M Hours | 79.22% | 74.5% | % |
| | | Total Overtime Hours/Total Paid O&M Hours | 8.27% | 8.49% | % |
| | | Unavailable O&M Hours / Total Paid O&M Hours | 20.82 | 25.65 | % |
| **Environmental Sustainability** | Protect the Environment | Area of Permeable Pavement | 2000 | 2000 | m2 |
| | | Catchbasin Sumps Cleaned | 16.13 | 20.55 | % |
| | | Cost of Stormwater Monitoring Program | $437.01 | $306.02 | $/km2 of catchment area |
| | | Maintenance Visits per Oil and Grit Separator | 1 | 0.59 | #/separator |
| | | Maintenance Visits per Outlet to Receiving Waters | N/A | 2.23 | #/outlet |
| | | Maintenance Visits per Stormwater Pond | 0.74 | 2.69 | /pond |
| **Reliability** | Provide Reliable Service and Infrastructure | Capital Reinvestment/Replacement Value | 0.01 | 0.05 | % |
| | | Emergency Pump Station Repairs | 0 | 0 | #/pump station |
| | | Emergency Sewer Repairs | 0 | 3.14 | #/100 km of stormwater sewer length |
| | | FTEs | 2.18 | 2.37 | #/100km sewer and ditches |
| | | Maintenance visits to Dikes | 0.01 | 0.01 | #/km |
| | | Net Change in Capital Reserves / Replacement Value | 0.09 | 0.11 | % |
| | | Non-Emergency Sewer Repairs | 10.03 | 7.49 | #/100km of stormwater sewer length |
| | | O&M Budget and Regional Fees relative to Catchment Area | $9,707.70 | $9,754.65 | $/km2 |

In addition, the City is also working to include additional levels of service to evaluate organization specific KPIs at an internal level. These KPIs have been provided in **Table 32**. Where available, 2019 KPI data or Targets have been added. The AIM project will also assist with identifying and adding additional KPIs in future iterations because a system will be available to formally track this data.

**Table 32: Newly Defined Level of Service KPIs**

| Customer Level of Service | **Technical Level of Service** | **2019 KPI** | **2020 KPI** | **Units** |
|---|---|---|---|---|
| Quality | % of stormwater system resilient to 2-year storm | N/A | 47.7% | % |
| | Number of basement flooding prevention grant funding applications | N/A | 3 | Count |
| | Number of storm events | 12 | 10 | Count |
| | Largest return year storm event | 1.9 | 1.8 | Return year |
| | Number of overland flood complaints | N/A | 0 | Count |
| | Length of newly installed stormwater gravity main | 6.91 | 0.796 | km |
| | Number of abandoned stormwater gravity main segments | 19 | 16 | Count |
| | No of basement flooding complaints | N/A | 1 | Count |
| | Number of Right of Way Flooding complaints | N/A | 2 | Count |
| | Number of stormwater pond complaints | N/A | 2 | Count |
| Cost Effectiveness | Number of hours spent preparing for storm weather events | N/A | N/A | Hours |
| | Cost spent preparing for storm weather events | N/A | N/A | $ |
| Environmental Sustainability | Number of waterwise gardening participants | N/A | 320 | Count |
| | Number of rain barrels sold | N/A | 200 | Count |
| Responsiveness | Length of time to respond to flooding service request | N/A | N/A | Hours |

# 3.6. CURRENT ASSET PERFOMANCE

The current asset performance for Stormwater assets has been separated into two (2) categories for this section of the report:

- Energy Performance; and
- Operating Performance

## 3.6.1. STORMWATER FACILITY CURRENT ENERGY PERFORMANCE

The City of Brantford has a Corporate Energy Management Plan (CEMP) which emphasizes energy efficiency within the City. The goals of the CEMP are to reduce energy use, energy intensity, and greenhouse gas (GHG) emissions in our Facilities. In addition, through the City's Climate Change Action Plan and Climate Lens Tool explained in **Section 10** of the **Asset Management Plan Overview Document**, the City has been working to improve our facilities' energy efficiency and reduce the associated carbon footprint.

Under this plan, annual energy management data is reported, but has a reporting delay of two (2) years. The most recent report is the 2019 Corporate Energy Management Report which is where the current energy performance of each water facility in **Table 33** below was obtained.

**Table 33: Current Energy Performance of Stormwater Facilities**

| Facility | Address | Electricity (kWh)* | Natural Gas (m3)* | GHG Emissions (kg)* | Annual Flow (Mega Litres) | Energy Intensity (ekWh/Mega Litre)* |
|---|---|---|---|---|---|---|
| **Stormwater P.S.** | 59 Icomm Dr | 311,019 | N/A | 9,478 | 2269 | 137.1 |

*Based on information provided in the 2019 Corporate Energy Management Report

## 3.6.2. STORMWATER TREATMENT CURRENT OPERATING PERFORMANCE

To assess the current operating performance, the City participates in the National Water and Wastewater Benchmarking Initiative (NWWBI) with other municipalities. The City reports specific data metrics for the purposes of comparing Brantford to other municipalities as well as compares our reported KPIs from each year. It is important to note that a confidentiality agreement exists with other municipalities, and so although Brantford does compare our performance against other municipalities, that comparison cannot be reported in this report These KPIs are reported in the Current Levels of

Service in **Section 3.5**. When comparing our KPIs from 2018 to 2019, many of our results have not changed substantially. However, there was a significant amount more O&M expenditure for stormwater ponds because the City is working to improve the maintenance of these assets.

In addition, the City is currently completing a Light Detection and Ranging (LiDAR) data project, which is an airborne technology that uses a pulsed laser light emitted towards the Earth's surface, and then reflects back to the sensor. This project is part of City's infrastructure planning process, and will be used to analyze the City's stormwater management data and capacity as well as related areas as noted in City's infrastructure master plan. It is anticipated that after this study, deficiencies within our current stormwater network will be identified, which will evaluate the current performance.

# 3.7. DISCUSSION & CONCLUSIONS

In conclusion, the City of Brantford operates and maintains several stormwater assets. These assets are typically in Fair condition with a total estimated replacement cost of approximately $481M.

The inventory and condition data confidence for stormwater assets are typically at a Medium level due to incomplete ArcGIS inventory information. Assets that can be visually inspected are typically at a higher level for both inventory and condition, but many assessment programs have not encompassed all assets at this time (e.g. gravity main, maintenance holes). Low data confidence assets for inventory and condition will be investigated and improved as new data is added into the database (e.g. inlets, stormwater services, outfalls, ditches). In addition, new condition assessment methodologies are continuously being investigated for critical assets. As stated, some of these inventory and inspection improvements are ongoing and also will improve as a result of the AIM project explained in **Section 7** of the **Asset Management Plan (AMP) Overview** document.

Furthermore, the lifecycle stages for stormwater assets includes: Planning, Creation, O&M, and Disposal. During the Planning stage, the City identifies the need for the asset; during the Creation stage, the asset is purchased and installed or constructed; during the O&M stage, the asset is operating and lifecycle activities (i.e. maintenance) occur on each of our stormwater assets to maintain the state of good repair; and the Disposal stage is when the asset has reached the end of its useful life or is underperforming and requires disposal.

Lifecycle activities are currently typically tracked through Avantis for vertical assets or a mobile web application through ArcGIS for linear assets which provides limited data. For more information on key database applications and work order management, please refer to **Section 4.2** and **Section 7**, respectively, in the **AMP Overview** document. At this time, the costs associated with these activities are partially broken down as a lump sum and are estimated based on the 2021 Preliminary Operating Budget, which is created based on the total O&M expenditures from previous years. When these activities are integrated into AIM, the frequency and costs associated with specific activities will be better represented. Therefore, future updates of the AMP will include specific costs for these activities as well as the time associated with these activities in order to properly allocate budget and identify operational inefficiencies.

It is estimated based on the average annual cost in the 10 Year Life Cycle Costing that the City should be spending an average $4.4M annually in capital costs on stormwater assets and will be spending an average of $0.9M on O&M for stormwater assets, however, the City is currently proposing to spend an average of $2.4M annually on capital for stormwater assets' state of good repair. It is anticipated that the capital costs will increase as a result of the 2021 LiDAR inspection described in **Section 3.6.2**.

Additionally, Current Levels of Service have been identified for stormwater assets. These levels of service are either tracked based on reported information required for the National Water and Wastewater Benchmarking Initiative (NWWBI) or are newly identified levels of service metrics for future iterations of the AMP. The NWWBI information is mandated through this initiative, but serves as a tool for a first draft of the stormwater asset KPIs. Brantford is also working to include these and additional metrics in AIM which will assist us with tracking these KPIs for future iterations.

Finally, asset performance is separated into operating and energy performance. For operating performance the City compares NWWBI data with surrounding municipalities as well as against previous years' data. For energy performance, annual energy data associated with facilities in the City's Corporate Energy Management Plan (CEMP) has been reported. The City used a total of 311,019 kWh for stormwater pumping, and emitted 9,478 kg of gas emissions for this facility. The City continuously looks for ways to improve the energy efficiency of all facilities. Through the Climate Change Action Plan and Climate Lens Tool explained in **Section 10** of the **AMP Overview** document, the City will be setting targets to improve facilities' energy efficiency and reduce the associated carbon footprint.