

2016

City of Markham Asset Management Plan



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1. EXECUTIVE SUMMARY

In April 2014, as part of the Municipal Funding Agreement renewal for the Federal Gas Tax Funds, it was identified that municipalities must develop Asset Management Plans (AMP) by December 31, 2016 in accordance with the guidelines set out in the Ministry of Infrastructure's "Building Together: Guide for Municipal Asset Management Plans" (2012) in order to be eligible for federal Gas Tax Funds.

The City of Markham Asset Management Plan aligns with the City's Strategy Plan, *Building Markham Future Together* (BMFT), and other key strategic documents, including *Greenprint*, Markham's Community Sustainability Plan, and *Official Plan*. The City of Markham's Asset Management Plan will:

- serve as a strategic, tactical, and financial document ensuring that the City's investments are timely, while optimizing available resources and establishing desired levels of service;
- provide an effective approach to managing the City's existing and future infrastructure assets through sound asset management practices and principles via a comprehensive review of the core infrastructure assets particularly; renewing, operating, maintaining, building, replacing and disposing of infrastructure.

There are two phases to develop the City's Asset Management Strategy:

- Phase I – Preparation of Asset Management Plan: Document City's existing Asset Management practices in accordance to Province's 2011 "Building Together, Guide for Municipal Asset Management Plans", and identify challenges of current and future infrastructure needs.
- Phase II – Further refinement of the City's Asset Management Strategy to ensure consistent asset management practices in data collection, decision making, and risk assessment.

The following assets are included in the AMP: Right of Way Infrastructure (Roads, Stormwater infrastructure, Bridges, Streetlight, Water, Wastewater), Parks, Facilities, IT infrastructure and Fleet.

The AMP is a detailed documentation exercise based on the City's current practices that include the following key sections:

- State of Infrastructure: documents asset type, inventory, valuation, age, condition
- Levels of Service: documents service levels, performance measures, targets and timeframes to achieve targets
- Asset Management Strategy: develops City of Markham Asset Management Framework (linking municipal goals to AMP) and Asset Management Strategy (summary of maintenance, rehabilitation/renewal, and replacement activities)
- Financial Strategy: documents expenditures, revenue, forecasts, funding shortfall and sustainable financing strategies

Highlights of the City of Markham AMP:

- The City of Markham owns a total of approximately \$7.9B in infrastructure assets, of which 90% are linear assets.
- Condition of the City's infrastructure was assessed both based on age and condition and has an overall "Good" condition rating.
- The City manages all of its assets regardless of age distribution, however, currently the City is investing in only a small fraction of aging assets at present; in the near future there will be higher volumes of aging assets nearing their end of service life and which will require significant attention and investment.
- The City of Markham Asset Management Framework links the City's goals with infrastructure asset management practices with outcomes that align with Excellence Markham principles.
- City of Markham has a sound financial strategy that aligns with infrastructure management practices.
- Financial impacts will be greater in future years in order to manage the higher volumes of aging assets requiring attention than the City is currently addressing.

The City's Asset Management Strategy is to ensure that the City's investments are strategic and timely, to provide the desired levels of service in a sustainable way, while managing risks, at the lowest total life cycle cost. The next step is to enhance the current Asset Management Strategy by:

- Developing a plan and addressing the necessary data gaps as identified in Phase I (AMP) for major assets;
- Fully documenting Corporate Asset Management Strategy including:
 - Approved levels of service (LOS) and performance measures/monitoring matrices
 - A risk management framework
 - Strategic integrated planning (e.g. coordinating water & road activity)
 - Other service delivery methods (e.g. partnerships with other municipalities)

The execution of an Enhanced Asset Management Strategy will further enhance how the City's assets are managed, which will provide the following benefits to the City:

- Detailed risk analyses of critical infrastructure across the City;
- Prioritized infrastructure investments that maximize benefits, reduce risk and provide desired levels of service;
- Support informed decision making over the life of assets (including operation, maintenance, renewal, replacement and decommissioning); and
- More efficient and effective delivery of services.

The process of managing assets is continuous, and the AMP is a living document which will be updated on a regular basis.

Overall, the City of Markham has been taking a proactive approach to manage both infrastructure needs and the requirement for sound financial planning. The City has a good foundation of information/practices/protocols in place to manage the assets. However, there is room for continuous improvement in the City's current management of its infrastructure, to maximize benefits, manage risk, and provide satisfactory levels of service to the public, in a sustainable manner.

2. Introduction

2. INTRODUCTION

2.1 PROVINCIAL GUIDELINES ON ASSET MANAGEMENT PLANS

In 2012, the Ontario Ministry of Infrastructure (MOI) declared that any municipal requests for infrastructure funding must be supported by an Asset Management (AM) Plan that includes the following elements:

- State of the Infrastructure - Summarizes the municipality's assets types, replacement value, age distribution and condition.
- Desired Level of Service - Compares the desired level of service (LOS) with the current actual level of service, proposes approaches to achieving the desired LOS within a specified timeframe, and discusses external trends or issues that may affect future desired LOS or the municipalities ability to meet them.
- Asset Management Strategy - Presents the set of planned actions to enable assets to provide the desired LOS in a sustainable way, while managing risk, at the lowest total life cycle cost. Planned actions may include non-infrastructure solutions, maintenance activities, renewal/rehabilitation activities, replacement activities, disposal activities and expansion activities.
- Financing Strategy - Presents the strategy for financing the activities proposed in the AM Strategy section.

In April 2014, as part of the Municipal Funding Agreement renewal for the federal Gas Tax Funds, it was identified that municipalities must develop Asset Management Plans (AMP) by December 31, 2016 in accordance with the guidelines set out in the MOI's "Building Together: Guide for Municipal Asset Management Plans" (2012). In order to be eligible for federal Gas Tax Funds.

The Asset Management Plan and Strategy will ensure that the City's investments are strategic and timely, in an effort to minimize future repair and rehabilitation costs to support core services. The proposed project will provide an effective approach to managing the City's existing and future infrastructure assets through a comprehensive review of the core infrastructure assets particularly; renewing, operating, maintaining, building, replacing and disposing of infrastructure.

2.2 CITY OF MARKHAM GOALS / STRATEGIC PLAN

Historically, the City has been diligent with the management of its assets and already had a solid foundation to meet the requirements of the AMP. Beginning in 1998, Council had recognized the need to set aside funds for the rehabilitation and eventual replacement of aging assets, and approved an 8% property tax increase for this purpose. Markham formally established the Life-Cycle Replacement and Capital Reserve in 2004 to address the on-going capital replacements and preventative maintenance of capital assets. The adequacy of the Life-Cycle Reserve is also reviewed annually using a 25-year rolling planning horizon (AMP minimum requirement is 10 years), based on projected inflows and outflows to sustain future rehabilitation and replacement requirements for the City's existing assets, over the next 25 years.

The City of Markham's Strategic Plan, *Building Markham Future Together* (BMFT), and other key strategic documents, including *Greenprint*, Markham's Community Sustainability Plan, and the *Official Plan*, help ensure our work is aligned with the City's four goals:

- Exceptional Services by Exceptional People;
- Engaged, Diverse and Thriving City;
- Safe and Sustainable Community, and
- Stewardship of Money and Resources.

Further, the City use Excellence Canada's Excellence Framework for municipalities to guide how we manage the whole organization, focusing on areas of Customer Satisfaction; Operational Excellence; Staff Engagement, and Financial Performance.

For the City to meet its strategic goals and deliver services in a responsible and sustainable manner, the Asset Management Plan will ensure the City's infrastructure are planned, built, and maintained through sound asset management principles and practices.

2.3 CITY OF MARKHAM ASSET MANAGEMENT PLAN (AMP)

The City of Markham's Asset Management Plan will:

- serve as a strategic, tactical, and financial document ensuring that the City's investments are timely, while optimizing available resources and establishing desired levels of service;
- provide an effective approach to managing the City's existing and future infrastructure assets through sound asset management practices and principles via a comprehensive review of the core infrastructure assets particularly; renewing, operating, maintaining, building, replacing and disposing of infrastructure.

There are two phases to develop the City's Asset Management Strategy:

- Phase I – Preparation of Asset Management Plan: Document City's existing Asset Management practices in accordance to Province's 2011 "Building Together, Guide for Municipal Asset Management Plans", and identify challenges of current and future infrastructure needs.
- Phase II – Further refinement of the City's Asset Management Strategy to ensure consistent asset management practices in data collection, decision making, and risk assessment.

The Asset Management Plan is intended to promote the continual asset management practices within the City, as the Plan is a living document that will require ongoing refinement to reflect the evolution of asset management maturity within the City of Markham over time. The Plan will be updated every 4 years.

The Asset Management Plan will become a key component of the City's planning process linking with multiple other corporate plans and documents and supports the City's Strategic Plan BMFT in the following ways:

- Exceptional Service by Exceptional People: The Plan will describe an asset management strategy including processes and practices that empower and inspire City employees to be champions of excellence service delivery by managing the City's infrastructure effectively.
- Safe and Sustainable Community: The Plan is integral to provide excellence in sustainable community planning and infrastructure management to accommodate growth.
- Stewardship of Money and Resources: The Plan will ensure the infrastructures are delivered with sound, transparent, and responsible financial and resource management to mitigate risks while ensuring efficient and effective service delivery. Integration between financial planning and infrastructure management is crucial and will be clearly outlined by the Asset Management Plan.

The Asset Management Plan aligns with Excellence Canada's Excellence Framework on how the City manages the organization. The Plan will set out how the infrastructure are managed and identify service levels (Operational Excellence), outline consistent corporate asset management processes and practices (Staff Engagement), and assist with financial investment decisions that optimize the asset's life cycle (Financial Performance).

2.4 WHICH INFRASTRUCTURE IS INCLUDED IN AMP?

The following assets are included in this Plan:

- Right of Way Infrastructure (Roads, Stormwater infrastructure, Bridges, Streetlight, Water, Wastewater)
- Parks
- Facilities
- IT infrastructure
- Fleet

2.5 DEVELOPMENT AND EVALUATION OF THE AMP

The plan was developed by staff led by the Asset Management Department, with key staff team from Finance, ITS, Operations, and Environmental Services Departments. The project was further supported by stakeholders from Engineering, Urban Design, Recreation, and Culture departments as required. The staff team reported into Senior Management to ensure the Plan meets the City's Strategic Plan and aligns with the Excellence Markham Framework.

The Plan covers 25 year period consistent with the City's Life Cycle Reserve Study that is updated every year, and used the following resources to document the current infrastructure management practices:

- Corporate Strategic Plan (2015-2019)
- Excellence Markham Framework
- City of Markham Annual Report (2014)
- Yearly capital and operating budget planning documents
- 25 year Life Cycle Reserve Study (2016-2041) of various assets and programs
- Tangible Capital Asset documents
- Department's Business Plans and service level documentation

From the completion of Phase I AMP, the existing state of the infrastructure and asset management practices, the gaps in current asset inventory/processes and action plan to further enhance the existing program will be identified. Phase II will enhance the current Asset Management Strategy by:

- Developing a plan and addressing the necessary data gaps as identified in Phase I (AMP) for major assets;
- Fully documenting Corporate Asset Management Strategy including:
 - Approved levels of service (LOS) and performance measures/monitoring matrices
 - A risk management framework
 - Strategic integrated planning (e.g., co-ordinating water & road activity)
 - Other service delivery methods (e.g., partnerships with other municipalities)

The execution of an Enhanced Asset Management Strategy is to further enhance how the City's assets are managed, which will provide the following benefits to the City:

- Detailed risk analyses of critical infrastructure across the City;
- Prioritized infrastructure investments that maximize benefits, reduce risk and provide desired levels of service;
- Support informed decision making over the life of assets (including operation, maintenance, renewal, replacement and decommissioning); and
- More efficient and effective delivery of services.

The Enhanced Asset Management Strategy will become part of the regular business practices, however, it will take several years to be developed and implemented fully. The high level stages are broken down as follows:

- Stage A: Complete all major missing asset data collection – including inventory, condition auditing, and inclusion into City's life cycle reserves.
- Stage B: Develop outcome based levels of service (LOS) and a performance management framework at a corporate level that aligns with the City's strategic objective.
- Stage C: Develop a risk management framework that build on the LOS metrics established in Stage B that can be used to inform maintenance, renewal and capital programming decision making.
- Stage D: Develop maintenance and renewal strategies (e.g. high risk assets, right investment at the right time) that build on the risk management framework established in Stage C.

3. State of the Infrastructure

3. STATE OF LOCAL INFRASTRUCTURE

This chapter identifies the state of the City's infrastructure today including:

- Asset types and quantity
- Financial accounting valuation and replacement cost valuation
- Asset age distribution and asset age as a proportion of expected useful life
- Asset condition

The data gathering is based on:

- PSAB 3150 tangible capital asset data: 2009
- City's 25 year Life Cycle Reserve Studies: 2015
- Department's current asset inventory information (e.g. GIS mapping)
- Various department's current asset management strategy/program/practice

The asset classes were reviewed at a very high level based on available data. Subsequent detailed reviews are recommended on an annual basis as more information becomes available over time.

3.1 DEFINITIONS

- **Book Value:** defined as the data/inventory collected in 2015 for the City's Tangible Capital Asset (TCA), Public Sector Accounting Board (PSAB).
- **Replacement Cost:** defined as the cost in 2015 dollars to rebuild the entire asset regardless of maintenance/rehabilitation strategies. It is assumed as a complete new build of the asset. The unit replacement costs were estimated using current standard budgeting values that are based on data such as historical tender pricing and current market replacement value.
- **Average Asset age:** defined as the age of the asset since the original construction date. As each asset class has various components, the average asset age is used.
- **Average Asset Life Cycle:** defined as the period of time that the asset is expected to be of use and fully functional to the City. As each asset class has various components, the average asset life cycle is used.
- **Asset Useful Life Age:** defined as the estimated remaining useful life of the asset based on the age only.
- **Useful Life Ratio:** defined as the Average Asset Useful Life Age divided by the Average Asset Life Cycle.

3.1.1 Asset Condition

To estimate the state of infrastructure of an asset, the remaining life of an asset based on age is employed in lieu of other condition data and supporting data. This, however, is not the best approach to assessing the useful life of an asset and its condition, as assets have the potential of outperforming their engineered useful life expectancy. To rely solely on age in certain assessments may lead to misrepresentation of an asset's performance. There exist a number of factors that will determine the asset useful life expectancy, some of these factors could include the condition by which the asset was installed and maintained. On the other end of the spectrum, poorly installed and neglected assets may fail many years before their useful life expectancy. Therefore it is important for asset owners to exercise diligence in establishing robust monitoring and maintenance programs based on condition data attained from a well developed condition assessment program.

When assets are installed they will naturally pass through a life cycle of maintenance processes which include: repair, rehabilitation, refurbishment and perhaps disposal in order to maintain their defined service levels/intended purpose. Based on the asset, the best combination of information is the inclusion of age as well as condition assessments and any other relevant information such as: records of historical repair, rehabilitation, refurbishments and expert analysis. Therefore, although the "Useful Life Age" indicates the average remaining life of an asset class, it does not reflect the life cycle activity that should be applied to the asset class.

For the purpose of this report, a qualitative scoring system was employed as illustrated in the figure below. This rating system and related definitions are consistent with Canadian infrastructure reports, Provincial government recommendations and approaches by other selected municipalities. A two pronged approach provided an estimated rating of the current condition of the City's assets:

- By Age: an asset age and average asset useful life was considered in order to provide each asset an age-based useful life ratio with an associated scale representing the condition of the asset. The majority of the data was rated based solely on the age of the asset, excluding Roads and Information Technology where there was inclusion of condition data to arrive at a condition rating.
- By Asset Owner Assessment: To obtain the best assessment of an asset in addition to age data, asset owners should assess an asset against various data sources including: asset condition assessments; industry ratings; and evaluations based on cyclic inspection/audit programs and expert judgement to ultimately assess the assets condition and how it is performing against its intended use.

Each asset is assessed based on the table below with asset conditions of Good, Fair or Aging.

Table 1 City of Markham Asset Condition Rating

Overall Asset Condition	Description
Good Stage 1 Useful Life 50-100%	The asset is performing as designed Achieving service levels with minimal maintenance needs Generally in good condition Limited deterioration if any but requires monitoring Minor maintenance early in useful life but increasing towards half life
Fair Stage 2 Useful Life 25-49%	The asset is performing as designed Achieving service levels with increasing monitoring & maintenance needs In fair condition General deterioration gradually increasing Increased maintenance necessary Attention required with monitoring e.g. Condition assessments
Aging Stage 3 Useful Life < 25%	The asset is performing as designed Requires ongoing monitoring to ensure service levels are achieved Increasing risks of failure Preparing for replacement

This approach has been applied to each asset class for the City. Although components of the asset classes may rate higher or lower than the overall rating for the Asset type, this is an average rating for the entire Asset class. Consideration must be taken to understand the components that make up the Asset class and the current state of those components as there is generally a spectrum of conditions that make up the average rating.

Understanding the rating condition for each of the assets will be the first step in asset planning for replacement and major rehabilitation activities. By employing detailed asset management planning the intelligence gained from monitoring the assets that are nearing or have exceeded their useful life, the asset owners can make informed decisions and in some cases re-direct focus to those assets with the increasing probability of failure and subsequently deteriorating levels of service.

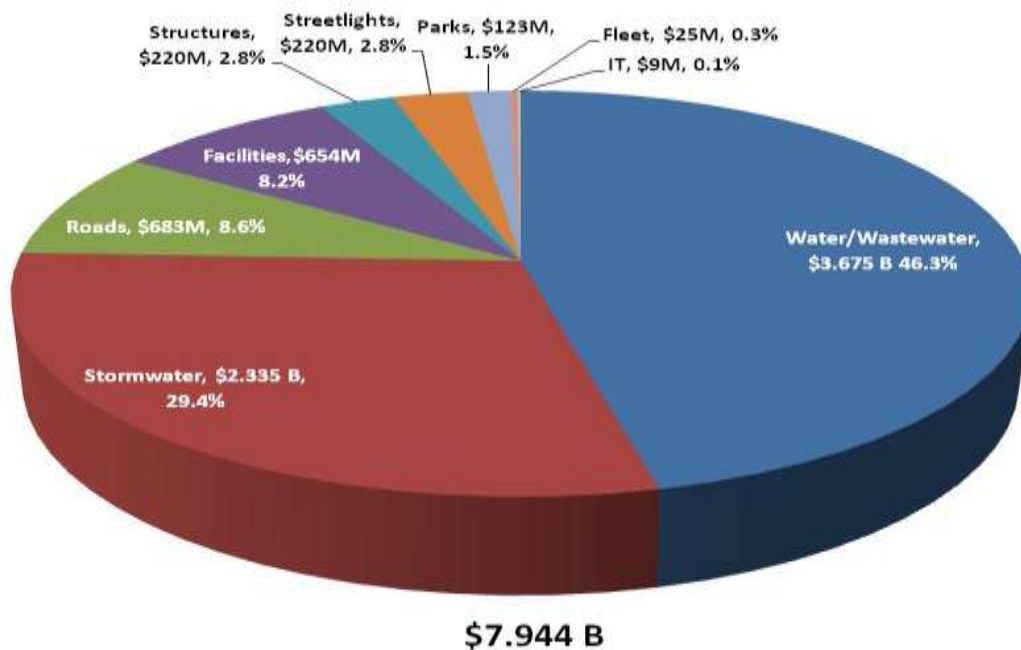
3.2 CITY INFRASTRUCTURE

The City owns the following major assets:

- Right of Way Infrastructure (Roads, Stormwater infrastructure, Bridges, Streetlight, Water, Wastewater)
- Parks
- Facilities
- IT infrastructure
- Fleet

The City of Markham owns a total of approximately \$7.9B in infrastructure assets, with primarily 90% of these assets representing linear assets.

Figure 3-1 Asset Distribution (%) by Replacement Value (\$M) – Citywide



Note 1: Asset such as watercourses (erosion sites) and stormwater ponds were not assigned replacement value due to the nature of the asset.

Note 2: Assets not inventoried were not assigned replacement value due to lack of information.

Figure 3-2 Asset Condition Rating – Citywide

Asset Classes	Average Rating %	Condition	Management Assessment
Water/Wastewater	66%	Good	Good
Stormwater	63%	Good	Good
Roads	68%*	Good	Good
Facilities	48%	Fair	Good
Structures	53%	Good	Good
Streetlights	62%	Good	Good
Parks	54%	Good	Good
Fleet	31%	Fair	Good
IT	85%*	Good	Good

The overall condition rating for City infrastructure is “Good”.

3.3 WATER AND WASTEWATER INFRASTRUCTURE

The City of Markham's Water and Wastewater assets represent the largest proportion of asset value within the City, at approximately 46% of the City's total infrastructure portfolio. The replacement value of this asset is estimated at approximately \$3.7 Billion dollars.

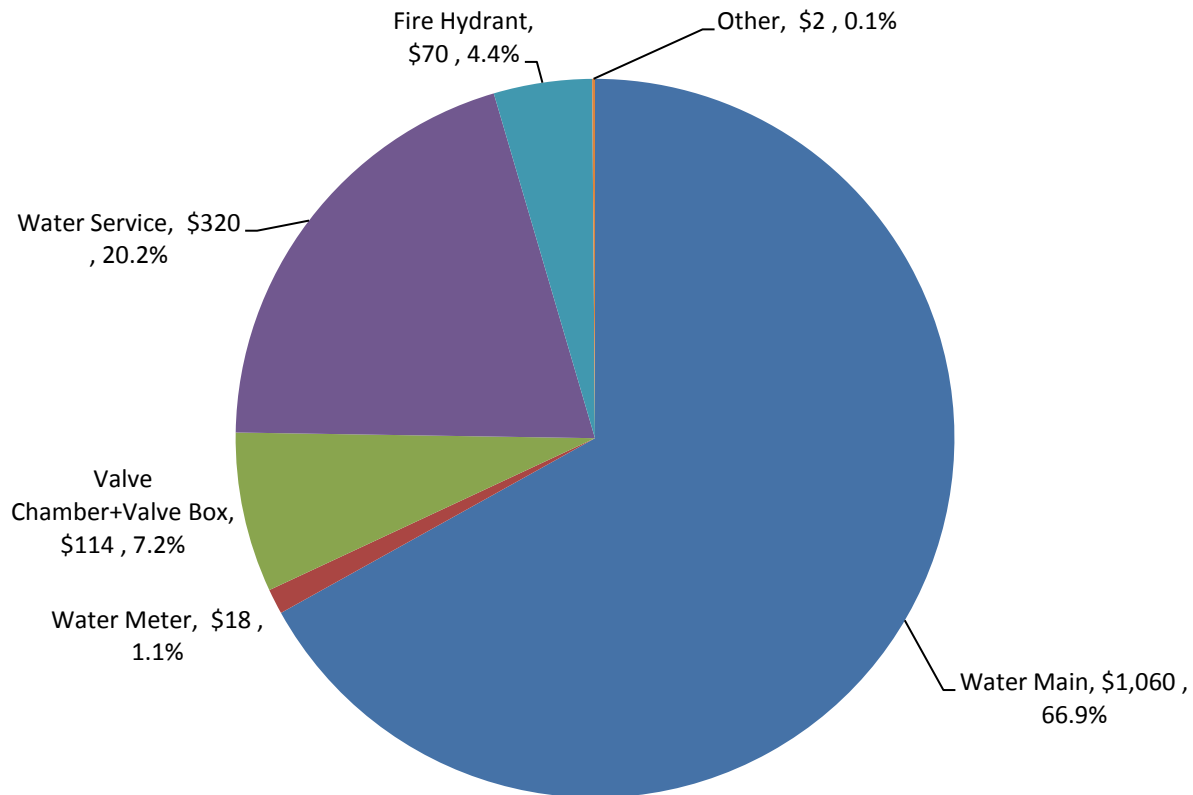
The City of Markham operates and maintains its own water mains, valves, hydrants and water meters. In addition, in order to ensure the quality of the water, the City has a continuous chlorine analyzer, dead-end flushing stations and sampling stations throughout its distribution system.

3.3.1 Inventory – Water Infrastructure

The City is responsible for all water distribution infrastructures total to \$1.6B. This includes:

- Water Main (1,059.8 kilometers)
- Water Meter (79,945 pieces)
- Valve Chamber+Valve Box (10,012 valves)
- Water Service/Curb Box (79,945 services)
- Fire Hydrant (8,638 hydrants),
- Other: Sampling Station (106 stations), Auto Flushing Station (12 stations)

Figure 3-3 Asset Distribution (%) by Replacement Value (\$M) – Water Infrastructure

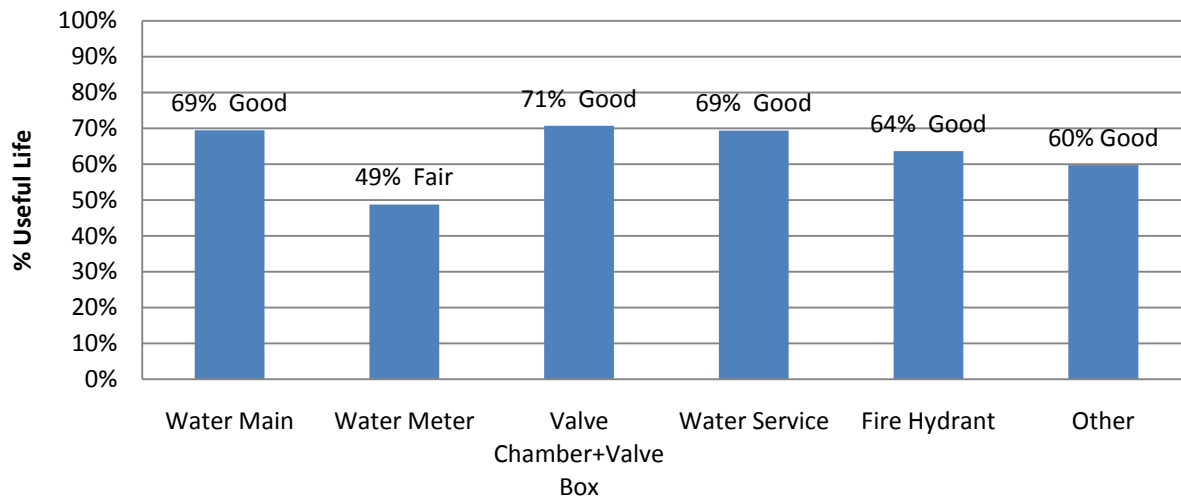


Book Value: \$385M.

3.3.2 Asset Life Cycle and Useful Life

Type of Structure	Average Asset Life Cycle (years)	Average Asset Age (year)	Asset Useful Life Age (year)
Watermain	85	25	60
Valve Chamber + Valve	85	24	61
Water Meter	20	10	10
Water Service	85	25	60
Fire Hydrant	60	22	38
Sampling Station	20	10	10
Auto Flushing Station	20	5	15

Figure 3-4 % Useful Life By Component and Condition Rating by Age – Water

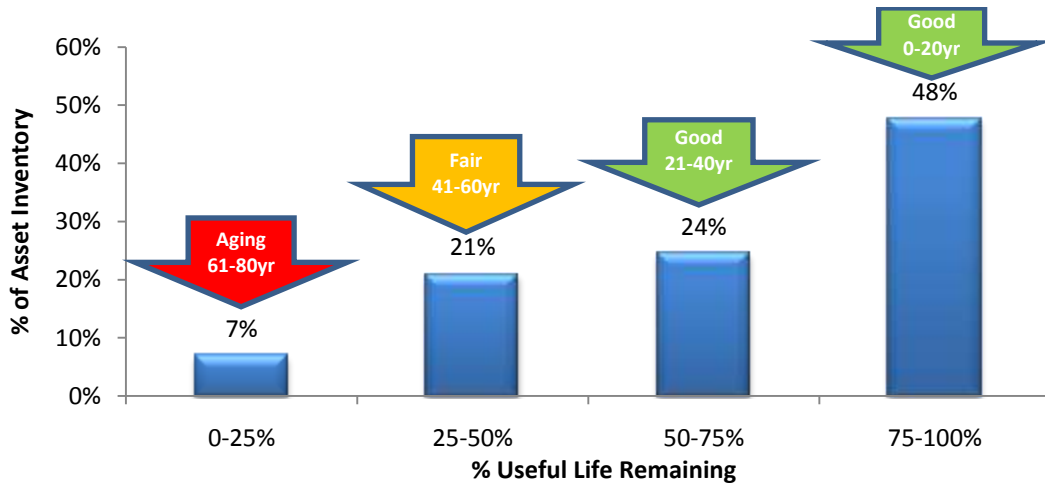


The overall condition rating of the City's water infrastructure is "Good" (average rating of 64%) both based on age and management assessment. The age distribution of the asset component provides a better picture of assets that are near its end of life. Figure below illustrates the age distribution of watermain (including watermain, valve chamber and box, water service and fire hydrant) and the associated replacement value. The replacement value of the watermain component is \$1.56B, where 7% are at or in their last 25% (~20 years) useful life of 80 years with an approximate value of \$108 Million.

The chart below shows an example of the past growth the City experienced and how it relates to the age of the infrastructure. For water infrastructure that has 80 years of service life, 7% of the watermain are in the last 25% of their useful life (i.e. 61-80 years old) which equates to approximately less than 20 years left in service life. In the next 20 years, the City will have to manage 21%, 30%, and 28% of Watermains, sanitary sewers, and storm sewers respectively, while further demands beyond 40 years are even greater than those of water infrastructure the City owns to date.

The City manages all of its assets regardless of age distribution, however, currently, the City is only investing in a small proportion of assets nearing their end of service life. Due to the City's significant growth since 1970s, the AMP data shows that City will have to manage almost three times the number of water mains for example, in the next 20 years; all infrastructure demands/needs beyond the next 20 years will be significant. There are a significant number of assets that are relatively young within their life cycle and presently do not require significant attention such as resources/investment at present.

Figure 3-5 % Useful Life Distribution – Watermains and Components

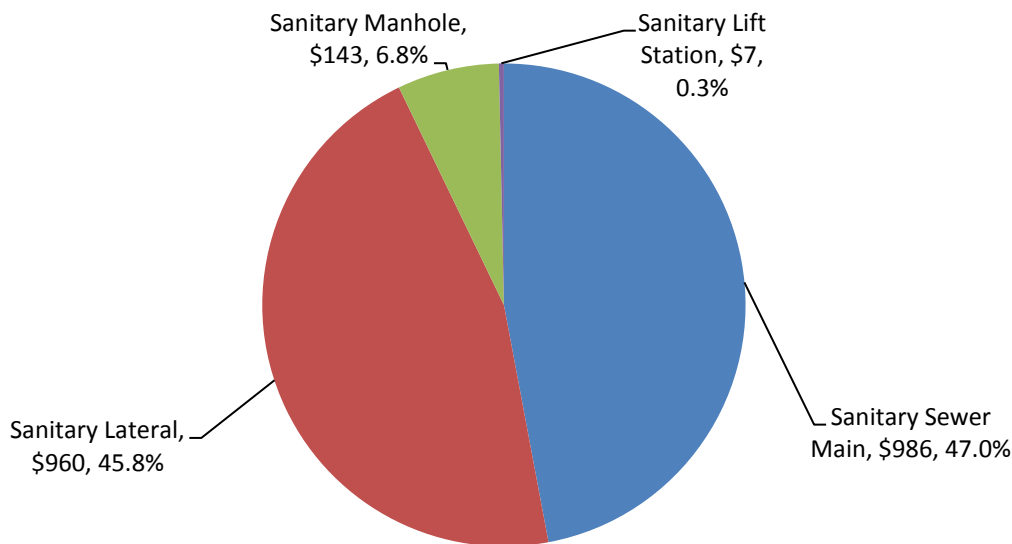


3.3.3 Inventory – Wastewater Infrastructure

Markham operates about 914 km of sanitary sewer mains at a value of approximately \$2.1B. It does not own or operate a sewage treatment plant and conveys its wastewater to Region of York’s sewer trunk and pumping stations. Markham wastewater is treated at the Duffrine’s Creek Wastewater Treatment Plant in Pickering, which is jointly owned by the Regions of York and Durham. The effluent or treated water is released back to Lake Ontario. The various asset components are:

- Sanitary Sewer Main (913.7 kilometers)
- Sanitary Trunk Sewer (75.19 kilometers)
- Sanitary Manhole (14,229 manholes)
- Sanitary Lateral (79,945 services)
- Sanitary Lift Station (5 stations)

Figure 3-6 Asset Distribution (%) by Replacement Value (\$M) – Wastewater

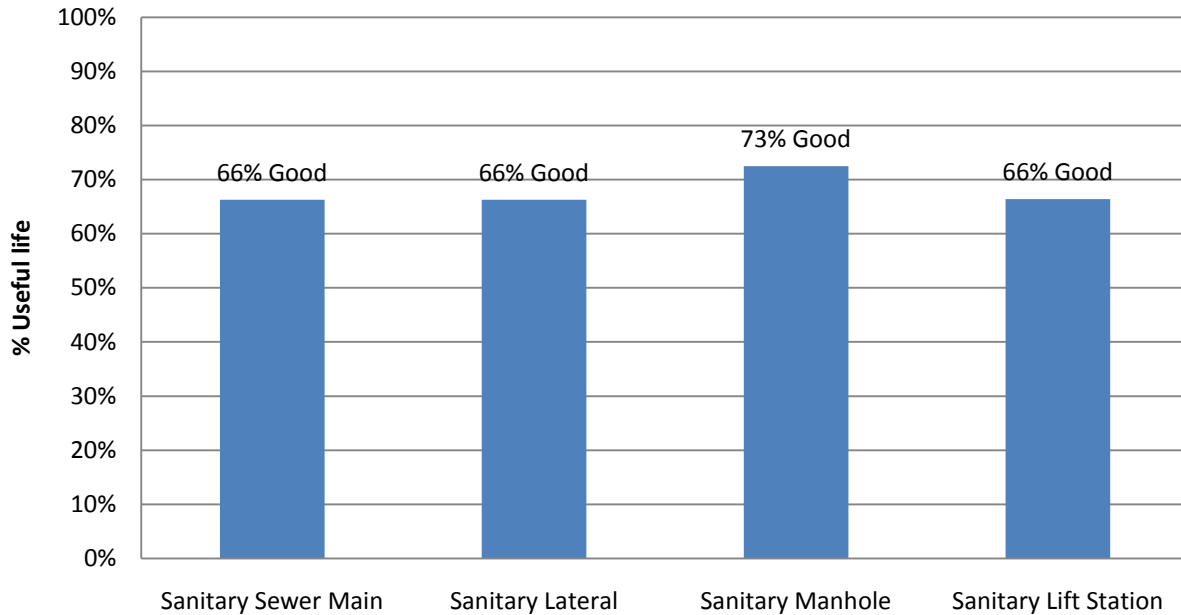


Book value: \$312M

3.3.4 Asset Life Cycle and Useful Life

Type of Structure	Average Asset Life Cycle (years)	Average Asset Age (year)	Asset Useful Life Age (year)
Sanitary Sewer / Lateral	77	27	50
Sanitary Manhole	100	27	73
Sanitary Lift Stations	Varies depending on component 48	16	33

Figure 3-7 % Useful Life By Component and Condition Rating by Age – Waste Water

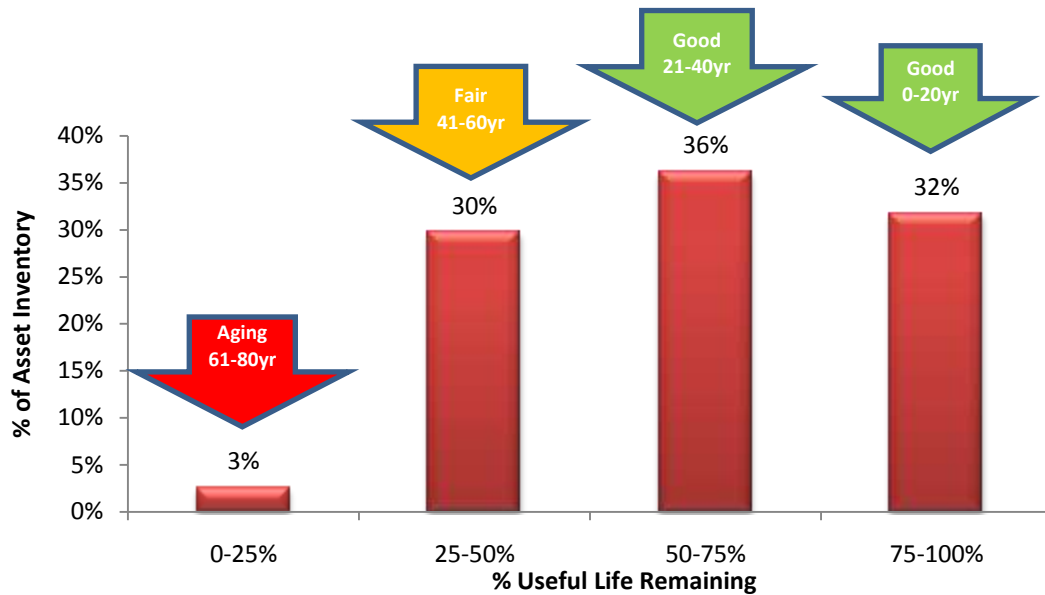


The overall condition rating of the City's wastewater infrastructure is "Good" (average rating 66%) both based on age and management assessment. The age distribution of the asset component provides a better picture of assets that are near its end of life. Figure 3-8 below illustrates the age distribution of sewer mains (including lateral and manhole) and the associated replacement value. The replacement value of the wastewater component is \$2.1B, where 3% are at or in their last 25% (~20 years) useful life of average 80 years with an approximate value of \$53 Million.

The chart below shows an example of the past growth the City has experienced and how it relates to the age of the infrastructure. For waste water infrastructure that has 80 years of service life, 3% of the assets are in the last 25% of their useful life (i.e. 61-80 years old) which equates to approximately less than 20 years left in service life. In the next 20 years, the City will have to manage 30% (ten times) of waste water infrastructure, and further demands beyond 40 years are even greater at 36% and 32% of all the water mains the City owns to date.

The City is investing in only a small fraction of aging assets at present. In the near future, there will be higher volumes of aging assets nearing their end of service life and will require significant attention and investments.

Figure 3-8 % Useful Life By Component – Wastewater (Sewer Mains)

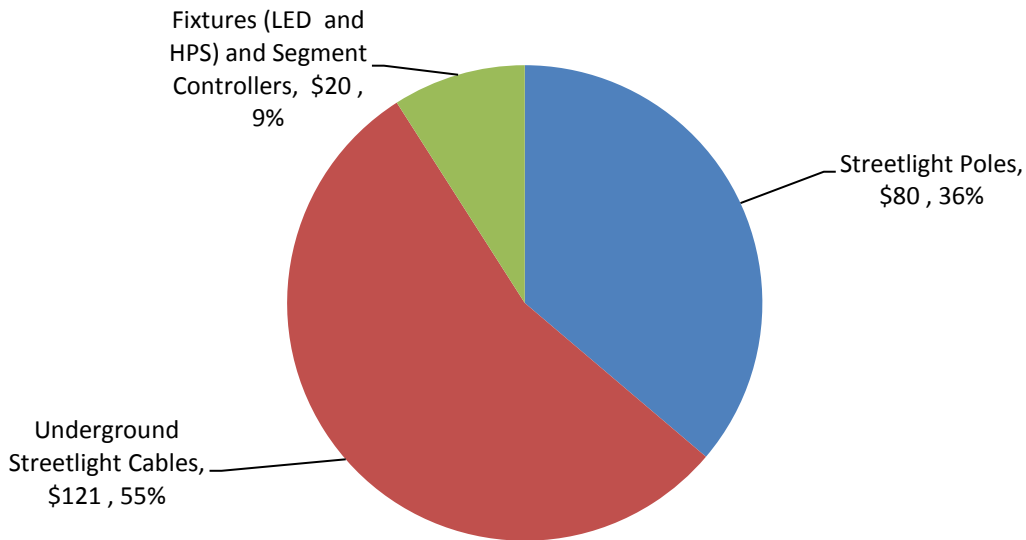


3.4 STREETLIGHTS

The City is responsible for all streetlights infrastructure excluding regional road intersections total to \$221 M which represents approximately 3% of the City's total infrastructure portfolio. This includes:

- Streetlight Poles – 24,393
- Underground Streetlight Cables – 1,005 km
- Streetlight Fixtures (LED only) – 12,503
- Streetlight Fixtures (HPS) – 15,400
- Segment Controllers – 10

Figure 3-9 Asset Distribution (%) by Replacement Value (\$M) – Streetlights

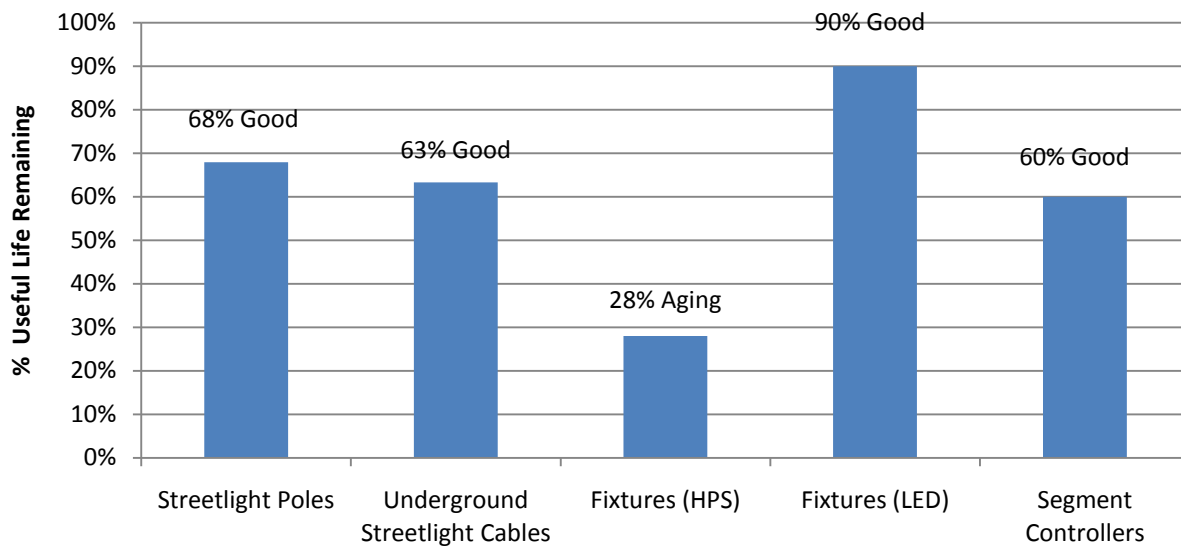


Book Value: \$68M

3.4.1 Asset Life Cycle and Useful Life

Type of Structure	Average Asset Life Cycle (years)	Average Asset Age (year)	Asset Useful Life Age (year)
Streetlight Poles installed before 1995	62	33	29
Streetlight Poles Installed after 1995	72	10	62
Underground Streetlight Cables installed before 2000	50	31	19
Underground Streetlight Cables installed after 2000	59	9	50
Streetlight Fixtures (LED)	20	2	18
Streetlight Fixtures (HPS)	20	13	7
Segment Controllers	5	2	3

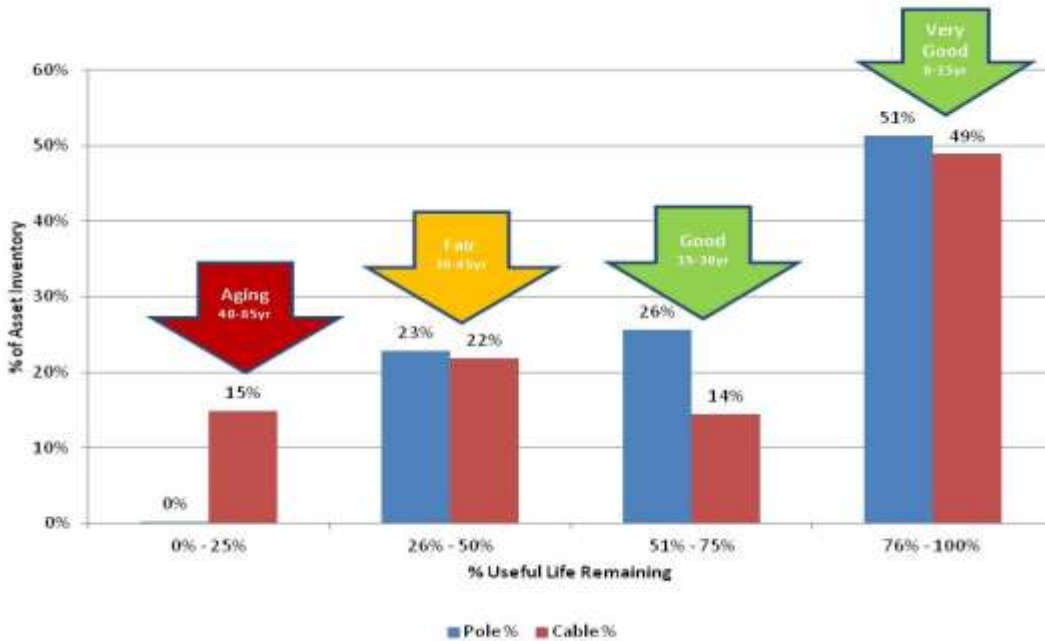
Figure 3-10 % Useful Life By Component and Condition Rating by Age – Streetlight



The overall condition rating of the City’s streetlight infrastructure is “Good” (average rating of 62%) both based on age and management assessment. The streetlight infrastructure is composed of over 91% of poles and cables at replacement value of \$201M with an average useful life of 60 years for poles and cables. An in depth review of the age distribution of the asset component provides a better picture of assets that are near end of life. Figure 3-10 below illustrates the age distribution of poles/cables and the associated replacement value. 0.2% of the poles and 15% of the cables are in their last 25% (10 years) useful life with an approximate value of \$18 Million.

The City is investing in only a small fraction of aging assets at present. In the near future, there will be higher volumes of aging assets nearing their end of service life and will require significant attention and investments.

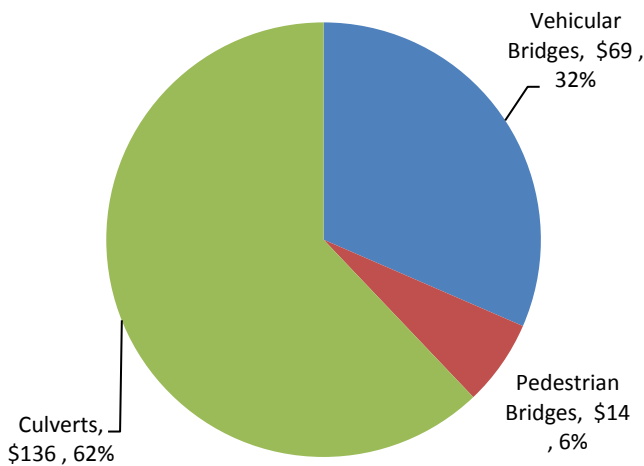
Figure 3-11 % Useful Life By Component – Streetlight Poles and Cables



3.5 STRUCTURE – VEHICULAR BRIDGES, PEDESTRIAN BRIDGES, CULVERTS

The City’s structure program includes all vehicular bridges, pedestrian bridges and culverts in the City with exception to those located on Regional roads which are owned by the Region. There are 317 structures (25 vehicular bridges, 64 pedestrian bridges and 228 culverts) within the City of Markham total to \$220M which represents approximately 3% of the City’s total infrastructure portfolio.

Figure 3-12 Asset Distribution (%) by Replacement Value (\$M) – Structures



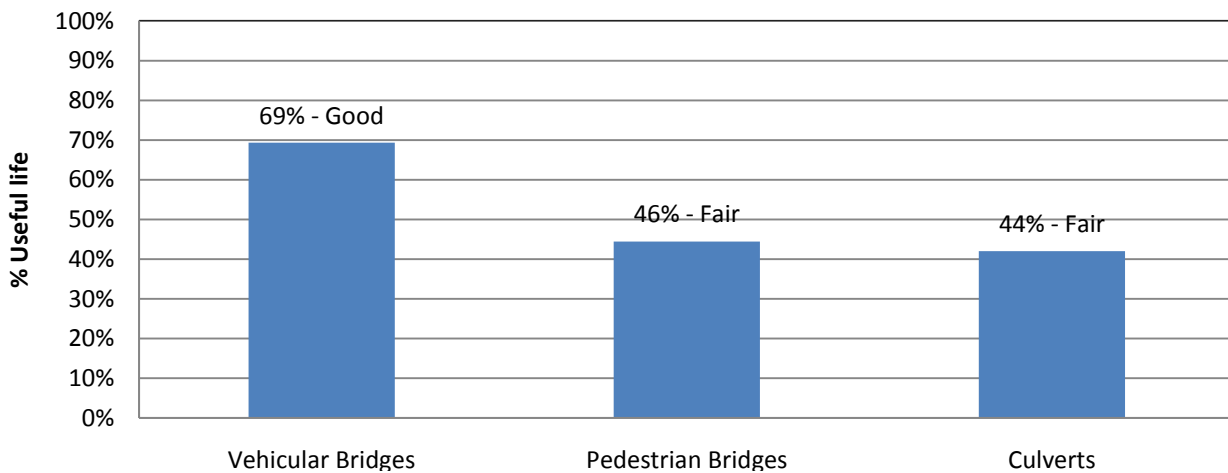
Asset Class	Inventory/Quantity (#)	Book Value (\$)
Vehicular Bridges	25	41,997,276
Pedestrian Bridges	66	2,588,846
Culverts	232	33,531,847

3.5.1 Asset Life Cycle and Useful Life

The useful life of the structures depends on the material.

Type of Structure	Service Life (years)	Average Asset Age (year)	Asset Useful Life Age (year)
Vehicular Bridges	75 -100 years	23	52
Culverts	Average 50 years	28	22
Concrete (open & closed box)	75 years		
Corrugated Steel Pipe (CSP)	30-50 years		
High-Density Polyethylene (HDPE)	50 years		
Pedestrian Bridges	Average 46 years	25	21
Concrete & steel truss and or beam	50 Years		
Timber structures	30 years		

Figure 3-13 % Useful Life By Component and Condition Rating by Age – Structures



Note: Age for 46 culverts out of a total inventory of 232 is unknown. Hence these figures are representative of 80% of the total culvert inventory.

The overall condition rating of the City’s structures infrastructure is “Good” (average rating of 53%) both based on age and management assessment. Over 95% of structures are vehicular bridges and culverts, with a replacement value of \$206M, and average useful life of 75 years and 50 years respectively. A more in depth review of the age distribution of the asset component provides a better picture of assets that are near its end of life. Figure 3-14 and 3-15 below illustrates the age distribution of vehicle bridges and culverts, and the associated replacement value. There are no vehicle bridges with useful life less than 25%; however there are culverts that are in their last 25% (12.5 years) useful life with an approximate value of \$25 Million.

The chart below shows an example of the past growth the City had experienced and how it relates to the age of the infrastructure. For vehicle bridges at 75 years of service life, 0% of the assets are in the last 25% of its useful life (i.e. 54-75 years old) which equates to approximately less than 20 years left in service life. In the next 20 years, the City will have to manage an increase of 20% of bridge infrastructure, and further demands beyond 40 years are even greater at 36% and 44% of all the bridges the City owns to date.

The City is investing in only a small fraction of aging assets at present. In the near future, there will be higher volumes of aging assets nearing their end of service life and will require significant attention and investments.

Figure 3-14 % Useful Life Distribution – Vehicle Bridge

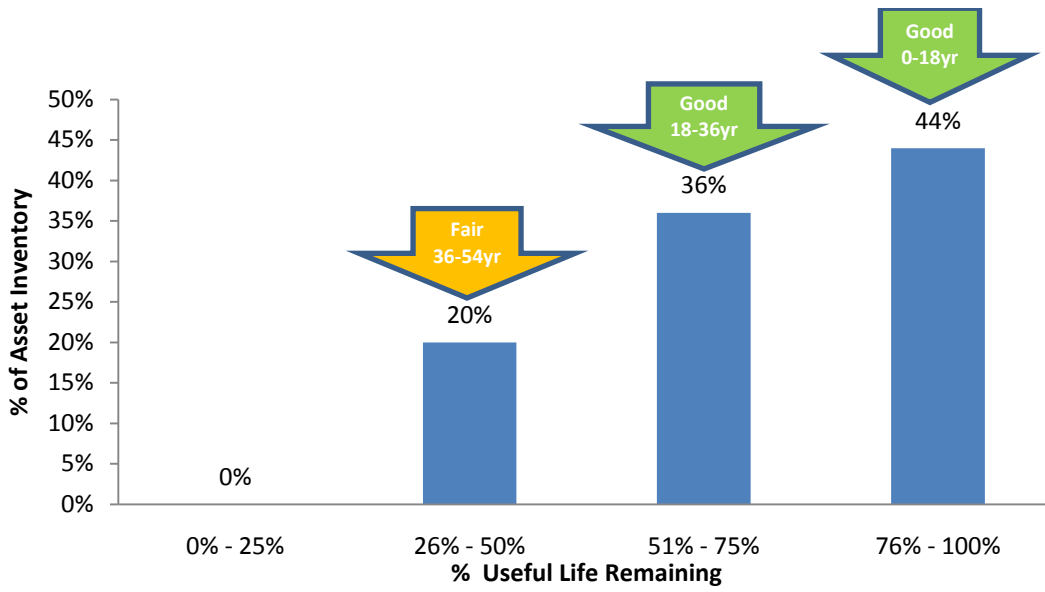
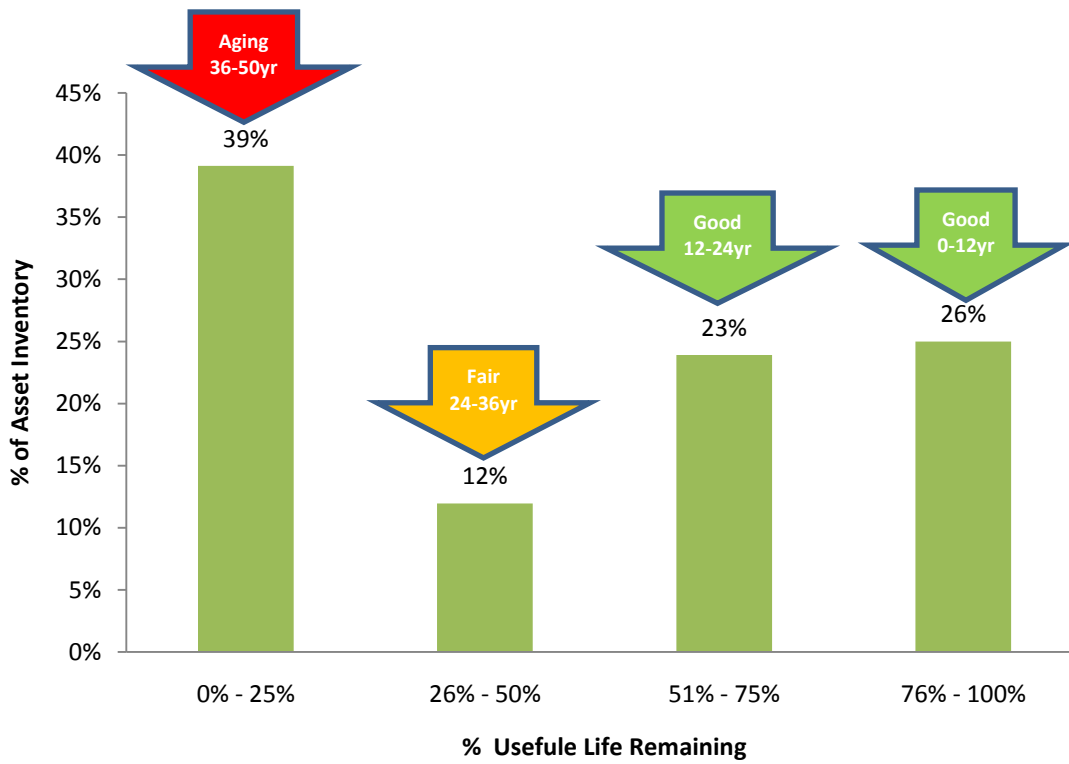


Figure 3-15 % Useful Life Distribution – Culvert

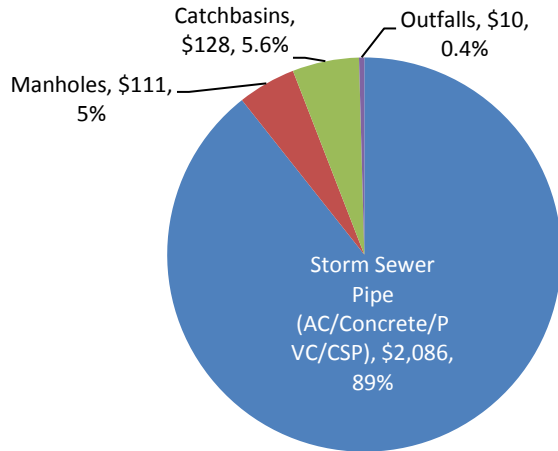


3.6 STORMWATER INFRASTRUCTURE WITHIN THE RIGHT OF WAY

The storm water network within the Right-of-Way (ROW), at a replacement value of \$2,335M, represents approximately 29% of the City’s total infrastructure portfolio, includes the following assets:

- Stormwater Pipes (AC/Concrete/PVC/CSP)– 912 km
- Manholes – 14,830
- Catch Basins – 23,202
- Outfall Structures – 262

Figure 3-16 Asset Distribution (%) by Replacement Value (\$M) – Stormwater in Right of Way

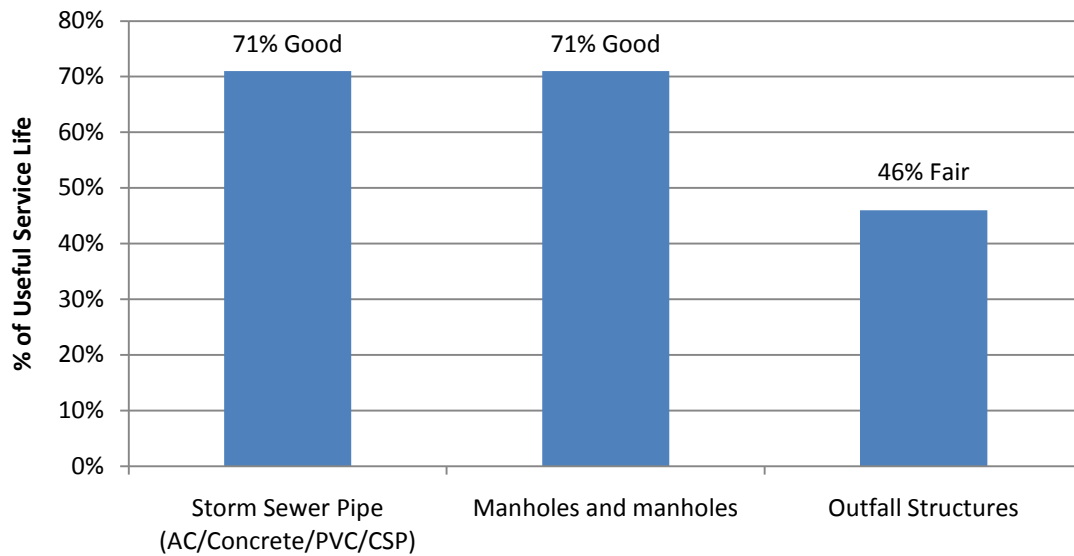


Book Value: \$250M

3.6.1 Asset Life Cycle and Useful Life

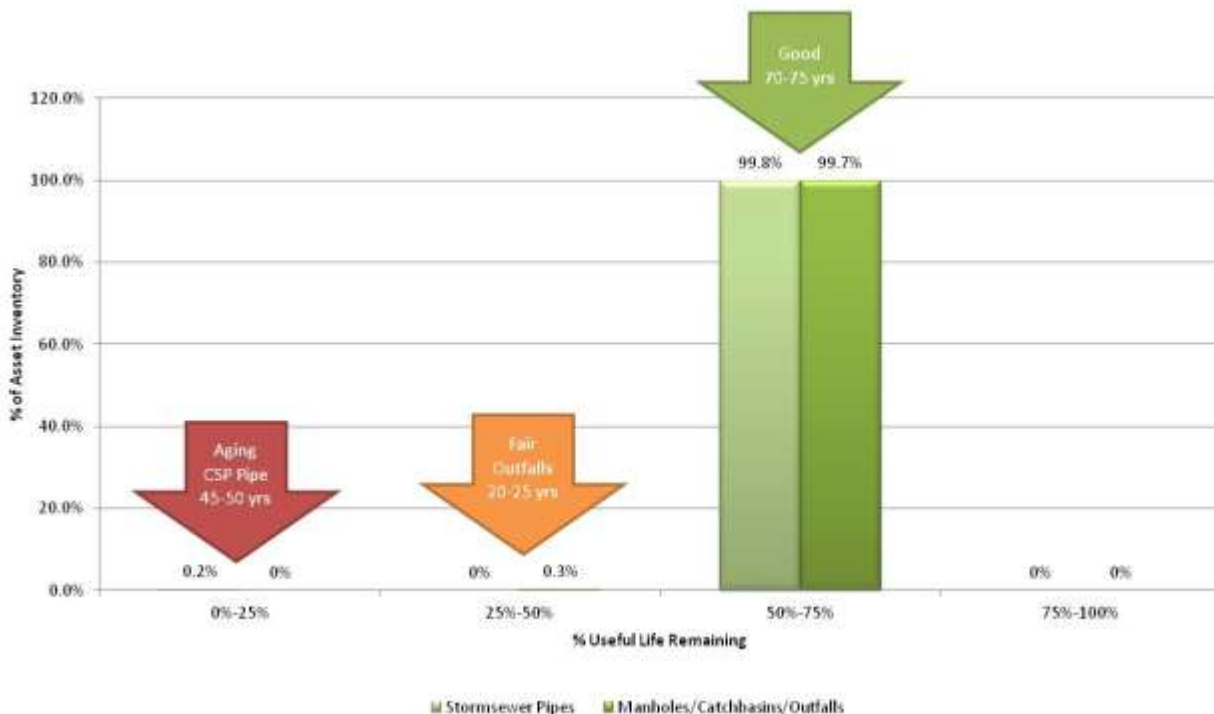
Asset Class	Inventory/Quantity (km/ #)	Service Life (year)	Average Asset Age (year)	Asset Useful Life Age (year)
Storm Pipes (AC/Concrete/PVC)	910.5 km	100	29	71
Storm Pipes (CSP)	1.5km	50	46	4
Manholes	14,830	100	30	70
Catch Basins	23,202	100	29	71
Outfall Structures	110	50	27	23
	152	50	Unknown	Unknown

Figure 3-17 % Useful Life By Component and Condition Rating by Age – Stormwater within ROW



The overall condition rating of the City's stormwater infrastructure in the ROW is "Good" (average rating of 63%) both based on age and management assessment. The age distribution of the asset component provides a better picture of assets that are near its end of life. Figure below illustrates the age distribution of storm infrastructure (storm sewer, manhole and catch basin, outfall structures) and the associated replacement value. The replacement value of the storm sewer component is \$2,335M, where 0.2% are at or in their last 25% (0-5 years) useful life of 50 years with an approximate value of \$6 Million.

Figure 3-18 % Useful Life By Component and Condition Rating by Age – Storm Sewer



3.7 STORMWATER MANAGEMENT (SWM) PONDS / NATURAL INFRASTRUCTURE

Asset Class	Inventory/ Quantity (#)	Book Value (\$)	Replacement Cost (\$)	Average Asset Age (year)	Average Asset Life Cycle (year)	Asset Useful Life Age (year)	Useful Life Ratio
Wet Ponds	29	\$14,780,339	NA	19	NA	NA	NA
	14		NA	Unknown	NA	NA	NA
Dry Ponds	33		NA	28	NA	NA	NA
	8		NA	Unknown	NA	NA	NA
Erosion Sites	458		NA	NA	NA	NA	NA
Storm Channel (Don Mills)	2		NA	NA	NA	NA	NA

Note 1: Replacement value is not applicable to stormwater ponds due to the nature of the asset. Asset will not be completely replaced but continue to function through regular maintenance and rehabilitation programs.

Note 2: Average asset life cycle is not applicable as there is no end of life for these assets.

3.7.1 Inventory

The City of Markham is responsible the management of stormwater infrastructure including: SWM ponds that are City-owned, erosion sites in river systems, and a storm channel as noted below:

- Wet Ponds – 43
- Dry Ponds – 41
- Erosion Sites – 458
- Storm Channel – 2 (Don Mills, Rodick/Miller Ditch)
- Rain Gauges – 12

3.7.2 Asset Life Cycle

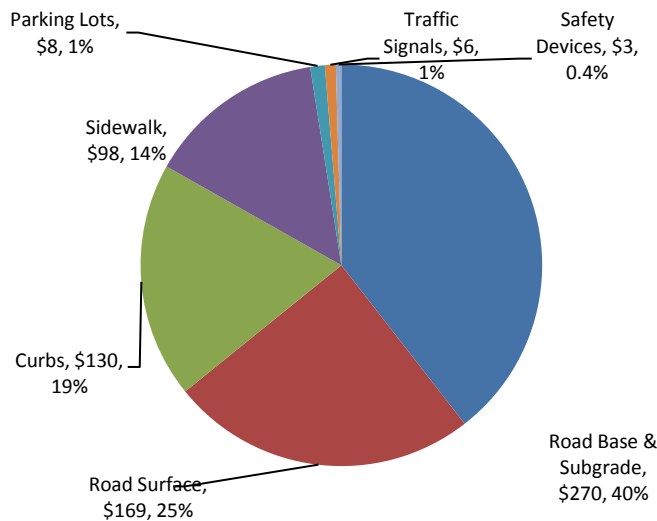
The useful life is not applicable on these assets except the rain gauges which have a useful life of 10 years.

3.8 ROADS AND SAFETY DEVICES

The City is responsible for 1100km (centreline) of road with a replacement value of \$683M represents approximately 8.6% of the City’s total infrastructure portfolio, including the following assets:

- Sidewalks – 1003 km
- Curbs – 1853 km
- Safety devices such as fences, guiderails (13,120m), retaining walls, entrance features, signs, and railway crossing (13)
- Traffic signals - 92 at the City’s intersections includes approximately 498 critical components. Additionally, the City also manages 16 speed display boards 6 warning beacons, and 1 pedestrian crossover.
- Parking lots – 96

Figure 3-19 Asset Distribution (%) by Replacement Value (\$M) – Roads



Asset Class	Inventory/Quantity (#)	Book Value (\$)
Road	2,010km	\$389,753,013
Parking Lot	96	\$4,339,581
Fencing	NA	\$677,815
Retaining Walls	NA	\$4,329,542
Sign	NA	\$1,270,602
Entrance Features	NA	\$1,137,247
Traffic Signals	92	\$7,104,498

Note1: The inventory of entrance features, and safety devices such as signs, fencing, and retaining walls is not available therefore not included in the replacement cost valuation.

3.8.1 Asset Life Cycle and Useful Life

The useful life varies depends on the component as shown in table below.

Asset Class	Average Asset Age (year)	Average Asset Life Cycle (year)	Asset Useful Life Age (year)
Roads	16	50 (Note2)	35 (Note2)
Sidewalk	NA	40	39
Curb	NA	40	38
Parking Lot	12	25	13
Guiderail	9	15	6
Fencing	NA	15	NA
Railway Crossing	4	7	3
Retaining Wall	NA	25	NA
Sign	NA	Post – 25 Sign – 15	NA
Entrance Features	NA	25	NA
Traffic signals	Varies Average 5.5 year	Varies Average 13.3 year	Varies Average 7.8 year

Note 2: Average asset life cycle of a road is 36 years, however, based on the condition survey and the City's pavement preservation program, the average asset life cycle of a road structure can reach 50 years. The asset's useful life age is also based on condition survey and the overall condition index and not strictly based on the age of the road pavement.

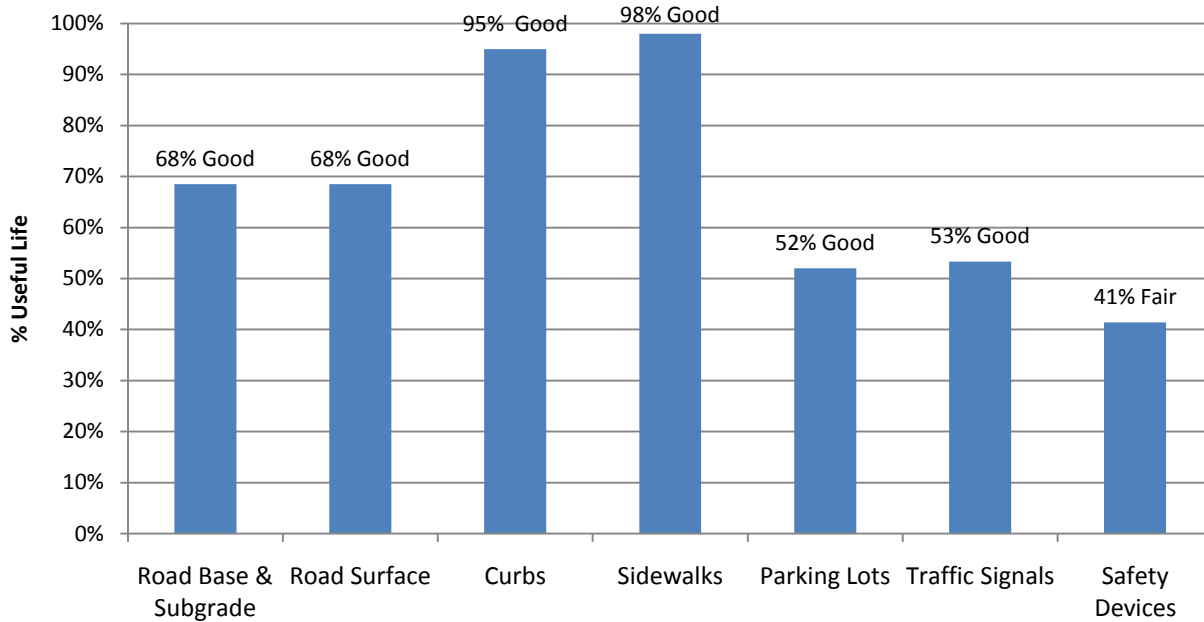
The road structure with respect to the overall condition index and its age provides an indication on the health of the road. The methodology is not completely dependent on the age of the road structure, as the class of roadway, loading condition of the road, and different levels of deterioration all contributes to the overall condition. Therefore, the following methodology is used to calculate the service life of the road structure and determine it's condition rating:

- The Remaining Service Life (RSL) of pavement is the estimated/predicted number of years remaining until a pavement section reaches its Threshold Value (Th) based on the surveyed Pavement Condition Index (PCI).
- The RSL is calculated using a straight line relationship beginning when the pavement segment was constructed or rehabilitated (the PCI at this point is 100) and the age when the condition is surveyed. The

RSL equals the number of years that the road segment will take to reach the Th assuming an extension of this straight line relationship. Currently the Th of all road segments is 50.

- The Service Life (SL) of a pavement section is the actual number of years that the pavement is expected to serve the travelling public beginning at construction until rehabilitation or between two consecutive rehabilitation activities. Hence the SL of any pavement section is equal to the sum of its current Age (number of years since construction or last major rehabilitation until present) and the RSL.

Figure 3-20 % Useful Life By Component and Condition Rating by Age – Roads



Note 3: Due to lack of inventory of safety devices, only guiderail and railway crossings were used to represent the % useful life.

The overall condition rating of the City’s road infrastructure is “Good” (average rating of 68%) based on age, condition assessment and management assessment.

The road structure component comprises 65% of the overall road infrastructure at replacement value of \$439M with a useful life of 50 years. Road functional classes (Laneways, Locals and Collectors) are included in the figures below which illustrate the age distribution of the road structure and the associated replacement value.

Figure 3-21 % Useful Life Distribution – Roadway Structure

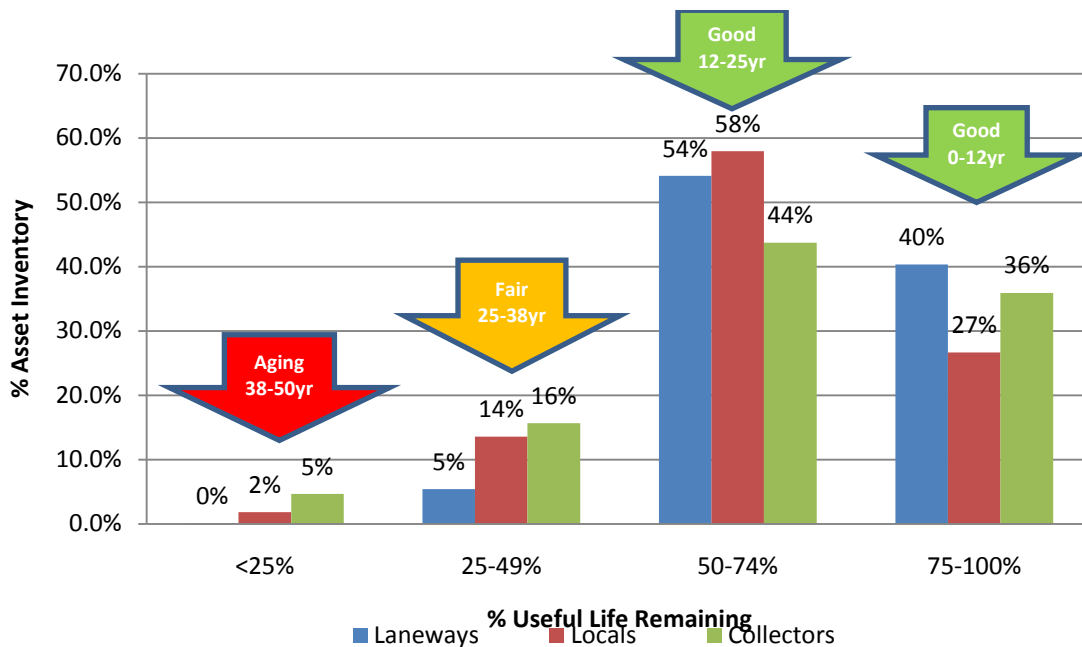


Table below illustrates the road structure at the last 50% of its service life and its associated replacement value. The road rehabilitation program is developed while taking into account the class of the road. Normally, road structures in the 0-50% of remaining useful life are included in the yearly resurfacing and asphalt-base full depth replacement program.

Class of Roadway	Useful Life Remaining		Replacement Value
	<25%	25-49%	
Laneway	0.1%	5.4%	\$1,242,622
Local	1.9%	13.6%	\$40,674,224
Collectors	4.7%	15.7%	\$31,005,420
		Total	\$72,922,265

3.9 FACILITIES

3.9.1 Inventory

The City's manages 181 facilities at approximately 2.17 million sf which includes:

- Major recreation Centres (18)
- Libraries (Standalone, excluding at recreation centres) (3)
- Fire Stations and Training Centre (10)
- Satellite Community Centres (6)
- Tennis Club houses (Tennis, Soccer) (8)
- Administration Buildings (3)
- Recycling Depots (4)
- Miscellaneous facilities (129)

Each facility includes both assets within the building as well as assets outside of the building footprint within the property line including but not limited to:

- Building envelope (windows, roof, walls)
- Architectural assets (interior finishes)

- Mechanical and electrical equipments
- Hard surface (parking lot, curbs, paver/walkways/piazzas)
- Soft surface (landscaping, tree)
- Underground services (utilities)
- Outside Lights: 404 Poles, 517 Fixtures

The facilities infrastructure has a replacement cost of \$654M, while a book value of \$253M, and represents approximately 8.2% of the City’s total infrastructure portfolio.

3.9.2 Asset Life Cycle and Useful Life

The asset life cycle of a facility is very complex as it depends on:

- The various time frame which the facilities were built
- The useful life the various components varies significantly, for example, typical HVAC system has a useful life of 15 years, while roofing system have a useful life of 20 years.
- Level of use, operational, and maintenance activities also affects the component’s useful life

All facility components has been assigned the life cycle based on industry accepted standards.

Asset Class	Inventory/ Quantity (#)	Average Asset Age (year)	Average Asset Life Cycle (year)	Asset Useful Life Age (year)	Useful Life Ratio
Facilities	31	41	75	34	45% - Fair
Parking Lot Lights	404	15	30	50	50% - Good

Note1: Assets outside of the the building such as hardscapes, underground services have not been inventoried, therefore no replacement value has been assigned.

The overall condition rating of the City’s facility infrastructure is in “Fair” condition (Average 48%) based on age, however based on the program in place to maintain the state of good repairs for the facilities, the management assessment is “Good” for City facilities.

3.10 PARKS

The City is responsible for the maintenance of approximately 250 Parks locations / 1,600 hectares of parkland and 22 km of pathways. Services include maintenance of park amenities and structures, such as play structures (200), and sports fields (216). Park infrastructure has a replacement cost of \$123M and represents approximately 1.5% of the City’s total infrastructure portfolio. The following outlines the components as well as the asset life cycle.

3.10.1 Pathways Inventory and Asset Life Cycle

- 22 km
- Pathway Resurfacing: Asphalt 20-25 years,
- Stairway Repairs: Concrete stairways 20-30 years, wood 10-15 year

3.10.2 Sports Fields Inventory and Asset Life Cycle

- Soccer (104)
- Baseball (57)
- Cricket (3)
- Rugby (1)
- Tennis Courts/Basketball Courts (75) / 7-10 years
- Artificial turf (4) / (2 in partnership with YRDSB) / 10 years
- Bleachers- Concrete (12) / 40 years
- Bleachers-Metal Frames Large (28), Metal Frame Small (16) / 35 years
- Fence-Backstop (57), Outfield (31) / 35 years

- Talc Metal Cabinet (52) / 15 years
- Goal Posts (168) / 30 years
- Cricket Cage Practice Area (1) / 20 years
- Cricket Pitch Outfield screening (1) / 10 years
- Beach Volleyball Court (1) / 10 years
- Fence tennis Court (19) / 35 years
- Tennis Court Post: 10 years

3.10.3 Electric Structures and Lighting Inventory and Asset Life Cycle

- Floodlights (45) / 30 years
- Poles (45) / 30 years
- Electrical & Cabling (Relamping) / 5 years

3.10.4 Park Structures Inventory and Asset Life Cycle

- Gazebo-Major (22), Minor (17) / 20 years
- Skateboard Park-(3) / 25 years concrete
- Clock Tower (1) / 25-50 years masonry structure, mechanism unknown
- Fountain –Decorative (5) / 20 years structure, mechanism 5-10 years
- Parks Entrance Gateway- N/A / 10-50 years depending on materials
- Ping Pong Table-(2) / 15 years
- Trellis (28) / 10-20 years depending on materials
- Pergola –N/A / 10-50 years depending on materials

3.10.5 Park Amenities Inventory and Asset Life Cycle

- City Park furniture- Moloks (327), picnic tables (400), benches (350) / Picnic tables 8 years, steel picnic tables or benches 15-20 years
- Eco Media Portable Zero Waste Bins (40) / 10 years
- Heritage Waste Receptacles (46) / 10 years Steel instead of Heritage
- Recycling Containers (580) / 10 years Steel Recycling
- Big Bellies (40) / 10 years **Solar Waste Compactors 10 years
- Concrete Planters (16) / Civic Centre: 25 years / Yonge between Thornhill Summit and John): 15 years
- Wood and Concrete Planter (30)
- Wood Planters-(11) / Baythorne & Yonge: 15 years

3.10.6 Playground Inventory and Asset Life Cycle

- Playground structure (200) / 15-20 years depending on materials
- Waterplay (22) / concrete 20 years, mechanicals 5-10 years
- Rubberized surface: 10-15 years
- Granite CSA plays and: 20 years
- Brick sand: 10-15 years
- Fibar CSA wood mulch: 5-7 years

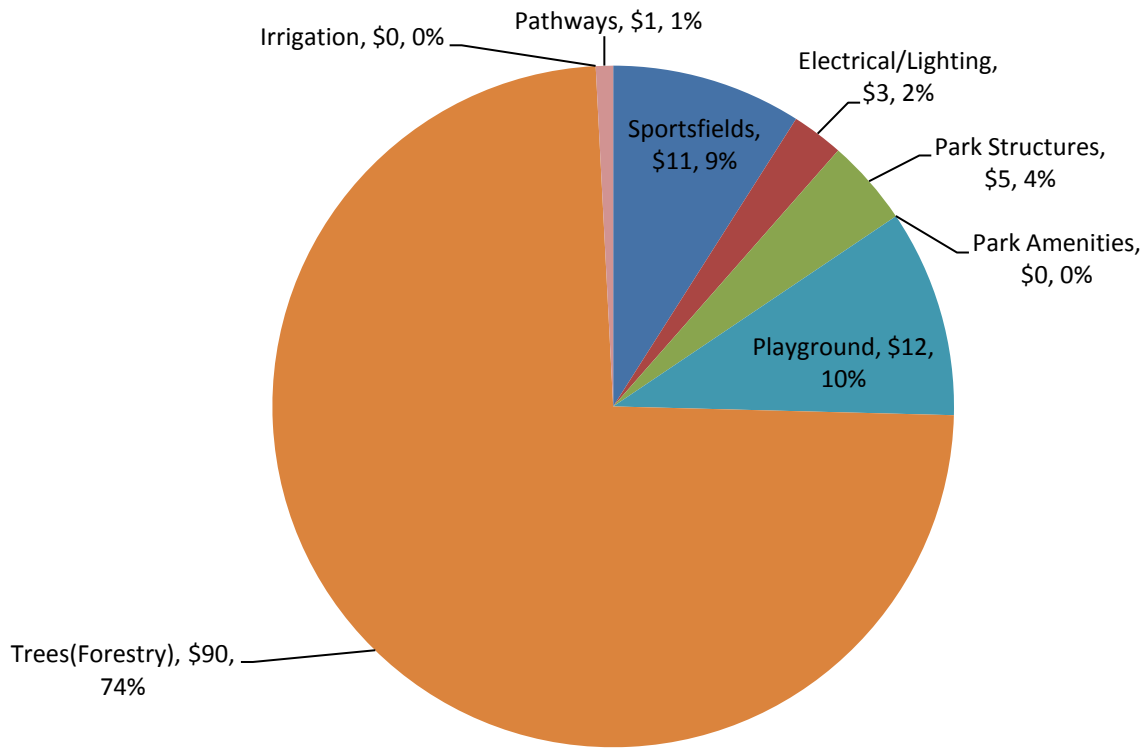
3.10.7 Trees (Forestry) Inventory and Asset Life Cycle

- 105,000 Street Trees / 40-60 years
- 45,000 Park Trees / 40-60 years

3.10.8 Irrigation

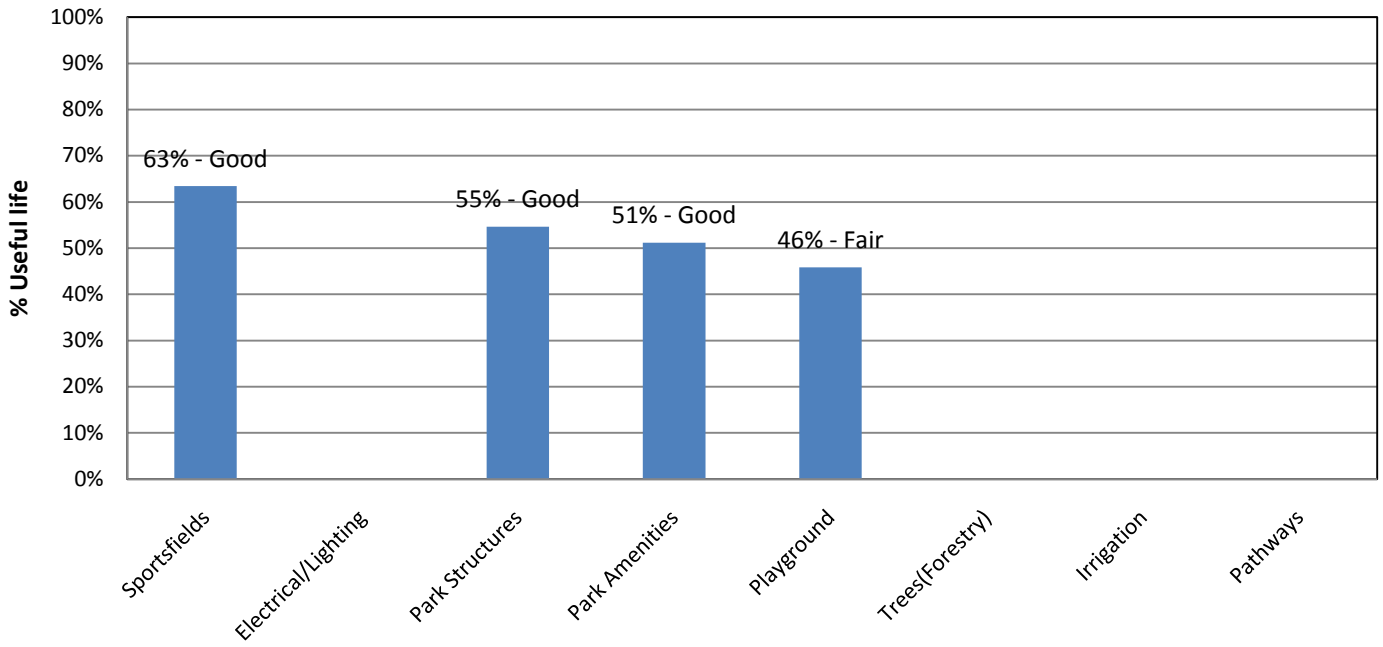
- 94 systems

Figure 3-22 Asset Distribution (%) by Replacement Value (\$M) – Parks



Asset Class	Quantity (#)	Book Value (\$)
Sportsfield	216	4,544,141
Electrical Structures/Lighting	45	2,163,889
Park Structures	110	8,235,627
Playground	200	10,977,218
Pathways	15 km	9,492,518
Trees	150,000	NA

Figure 3-23 % Useful Life By Component – Parks



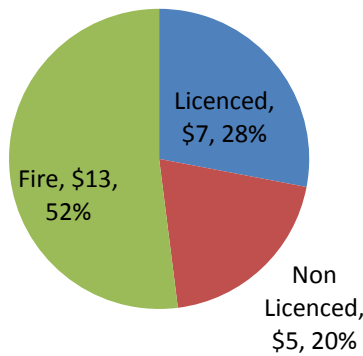
Gaps exist in the asset age of playgrounds, structures, furniture and fixtures, electrical/structures, irrigation and pathways will need to be addressed in a comprehensive inventory to address quantity, type and replacement lifecycle values.

The overall condition rating of the City’s water infrastructure is “Good” (average rating of 54%) both based on age and management assessment.

3.11 FLEET

The City manages 161 licensed fleet included a mixture of light duty and heavy duty vehicles; 179 non-licensed units which includes - tractors, loaders, roads, parks, turf and sidewalk maintenance equipment, ice resurfacers, and material handling equipment such as a stockpiling conveyor for stocking winter maintenance materials in storage domes, and 47 Fire units/apparatus. Fleet infrastructure has a replacement value of \$25M and represents approximately 0.3% of the City’s total infrastructure portfolio.

Figure 3-24 Asset Distribution (%) by Replacement Value (\$M) – Fleet



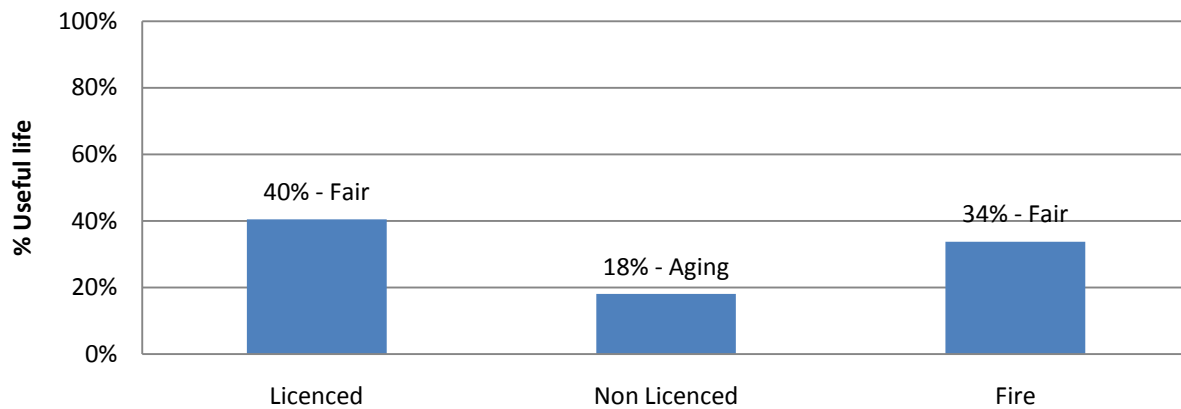
Asset Class	Quantity #)	Valuation (\$)
Licensed	161	\$3,791,286
Non- Licensed	167	\$2,136,291
Zamboni	12	
Fire	27	
Apparatus	20	4,698,014

Book Value: 10.6M

3.11.1 Asset Life Cycle and Useful Life

Asset Class	Quantity (#)	Average Asset Life Cycle (year)	Average Asset Age (year)	Asset Useful Life Age (year)	Useful Life Ratio
Licensed	161	8.4 (light duty 3-8 years, heavy duty 8-10 years)	5	3.4	40%
Non- Licensed	167	8.5 (ranges from 3-15 years)	6	2.5	29%
Zamboni	12	7.5	7	0.5	7%
Fire	27	7.4 (ranges from 8-12 years)	5	2.4	32%
Apparatus	20	9.25	6	3.25	35%

Figure 3-25 % Useful Life By Component and Condition Rating by Age – Fleet



The overall condition rating of the City's fleet infrastructure is "Fair" (average rating of 31%) based on age, however based on the program in place to maintain the state of good repairs for City fleet, the management assessment is "Good".

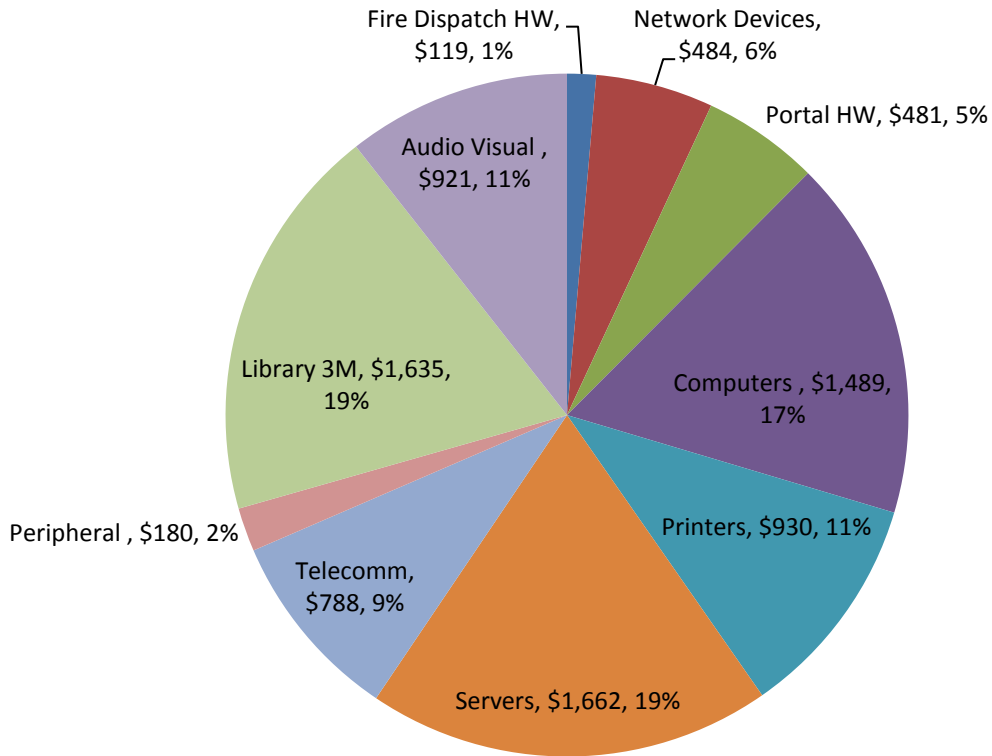
3.12 INFORMATION TECHNOLOGY INFRASTRUCTURE HARDWARE

City manages over 4000 devices which represents approximately 0.1% of the City's total infrastructure portfolio.

Various categories include:

- Fire Dispatch Hardware
- Network Devices
- Portal Hardware
- Computers
- Printers
- Servers
- Telecom
- Peripheral
- Library 3M
- Audio Visual

Figure 3-26 Asset Distribution (%) by Replacement Value (\$000s) – IT



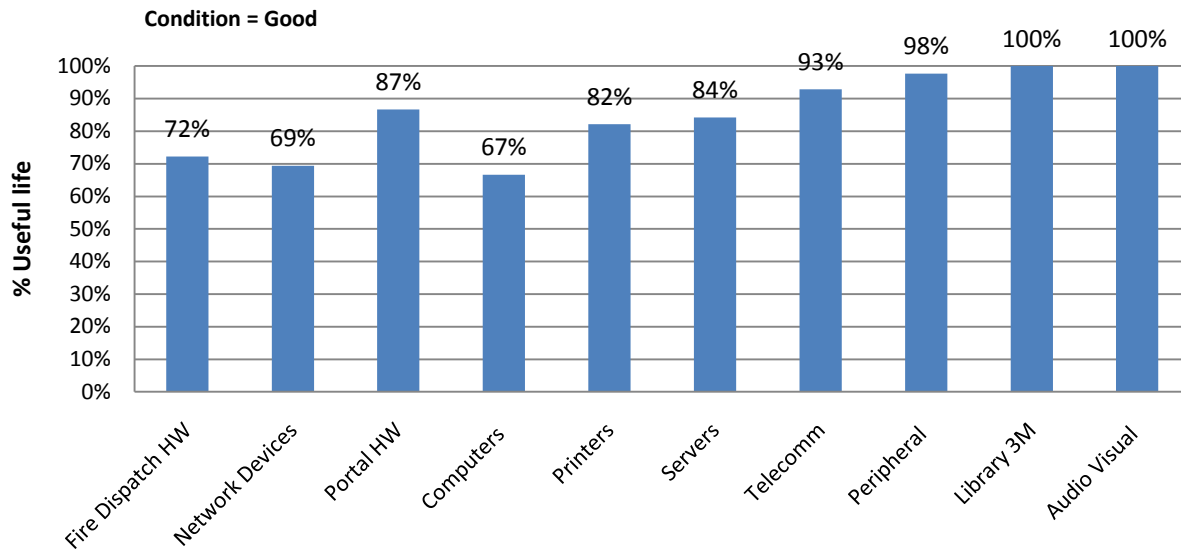
Book Value: \$5.4M

3.12.1 Asset Life Cycle

Useful life of the IT infrastructure are specific to the device. The overall range is anywhere from 3 years to 9 Years. The other areas identified fall under the following approximate duration:

- Data Centre Hardware: 6 Years
- Network and Telecom equipment: 7 Years
- Desktop Computers and Printers: 6 Years
- Library 3M hardware: 8 Years

Figure 3-27 % Useful Life By Component and Condition Rating by Age – IT



The overall condition rating of the City’s IT infrastructure is “Good” (average rating of 85%) based on age, condition assessment and management assessment.

3.13 LEVEL OF SERVICE

The ultimate goal of asset management planning is ensuring that the needs of the users are being satisfied by the infrastructure and that the asset is functioning and continues to meet the desired service levels.

The level of service is a measurable indicator that provides a municipal quality service threshold. The level of service is defined by a number of key influences:

- Legislated/ Statutory Standards and Requirements
- Prescribed Assets Intended Function
- Corporate Goals
- Performance Matrices for Assets
- Community Expectations
- Available Financing

To establish an enhanced level of service system above current practices, the City will further examine the above influences against the Corporate Goals to benchmark a desired level of service for each of its assets. Defined performance metrics will also need to be developed and inevitably provide a performance rating against the defined level of service.

As mentioned above, there are a number of existing corporate programs that the City of Markham participates in that provide performance measures related to levels of service:

- Provincial Municipal Performance Measures:
 - Municipal Performance Measurement Program (MPMP). In 2000 the Provincial government implemented a program to provide information on how municipalities conduct business and provide services. These measures were set in place to allow benchmarking between local governments to encourage increase efficiencies and effective services.
- Current Levels of Service: The following lists selective levels of service currently logged by the City of Markham. Future AMPs will be updated to provide the City opportunities to initiate progressive Asset management practices in order to set goals that are documented effectively, measurable, and stored in a defined, accessible, central database repository.

- Roads and Sidewalks
 - Minimum Maintenance Standards
 - Ontario Good Roads Association Municipal Roads Survey
 - Annual Condition Assessment
 - Design Guidelines
 - Traffic Monitoring
- Bridges, Culverts and Retaining Walls
 - OSIM inspections
 - Bridge Maintenance Strategy
- Water, Wastewater and Stormwater
 - Drinking Water Quality Management Standard (DWQMS)
 - Standard Operating Procedures
 - National Water and Wastewater Benchmarking Initiative
 - Design Guidelines
- Public Works and Admin Facilities
 - Building Condition Assessments
- Corporate Fleet
 - Preventative maintenance strategies
- Departmental Service Level examples (Specific): The City of Markham tracks a variety of levels of service for each department, below provides a brief summary of key regulatory levels of service provided by the City. Note this is not an exhaustive list as there are many lower tier service levels both legislative as well non legislative tracked by individual departments:

Division	Service Area	Service Standard	Legislated Yes/No	Service Level Target	Actual Performance
Facility Assets	Backflow Inspection	Certification of backflow devices	Yes	100%	95%
Facility Assets	Backflow Inspection	Review annually	Yes	100%	100%.
Facility Assets	Well water testing	Monthly water testing - Box Grove - Victoria Square C.C.'s	Yes	0 Level TC and AC	O level attained
ROW Assets	Bridges and Culverts	Visual inspection of all bridges (vehicular and pedestrian) and culverts over 3m span once in two years.	Yes	100%	100%
ROW Assets	Culverts	Visual inspection of all culverts less than 3m span once in four years if it is in good condition.	Yes	100%	100%
ROW Assets	Streetlighting	Streetlights are to be repaired within 7 days along Regional roads and 14 days within local roads	Yes	100%	80%
Waterworks	Fire hydrant inspection & pm	Annual (NFPA)	Yes	100%	100%
Waterworks	Sampling	# of Chlorine residual samples completed daily (MOE)	Yes	100%	100%
Waterworks	Sampling	# of Inorganic samples completed annually(MOE)	Yes	100%	100%

Division	Service Area	Service Standard	Legislated Yes/No	Service Level Target	Actual Performance
Waterworks	Sampling	# of Microbiological samples completed each week (MOE)	Yes	100%	100%
Waterworks	Sampling	# of Organic samples completed annually (MOE)	Yes	100%	100%
Waterworks	Storm Lift Station	Emergency response within 1.5 hrs	Yes	100%	100%
Waterworks	Storm Lift Station	Respond to sanitary lift station alarm within 1.5 hrs	Yes	100%	100%
Waterworks	Storm Lift Station	Weekly lift station checklist inspection	Yes	100%	95%
Waterworks	Storm Lift Station	Weekly lift station checklist inspection	Yes	100%	100%
N/A	Sidewalk Repair or Removal and replacement	When differential displacement is greater 2 cm	Yes	100%	100%

4. Asset Management Framework and Strategy

4. ASSET MANAGEMENT FRAMEWORK & STRATEGY

A two stage process is developed to ensure alignment between the corporate goals, and how the assets are managed. The first step is the development of an Asset Management Framework that ties municipal goals (e.g. OP, Strategic Plan) and planning (Departmental Business Plans and capital budget) to infrastructure management. The second steps is the development of the Asset Management Strategy, a set of planned actions that will enable the assets to provide the desired levels of service in a sustainable way, while managing risk, at the lowest life cycle cost. Both steps commits the City to provide approved levels of service in the most effective and efficient way, through the planning, design, construction, acquisition, operation and maintenance, renewal and disposal of assets.

4.1 MARKHAM ASSET MANAGEMENT FRAMEWORK

The City's of Markham Asset Management Framework provides a common understanding and lexicon for describing the business processes and activities conducted by the City to manage its varied physical assets, and to illustrate the relationships between those activities. Establishment of the Corporate Framework is consistent with leading practices, as defined in the International Infrastructure Management Manual (IIMM), PAS55 and ISO 55000.

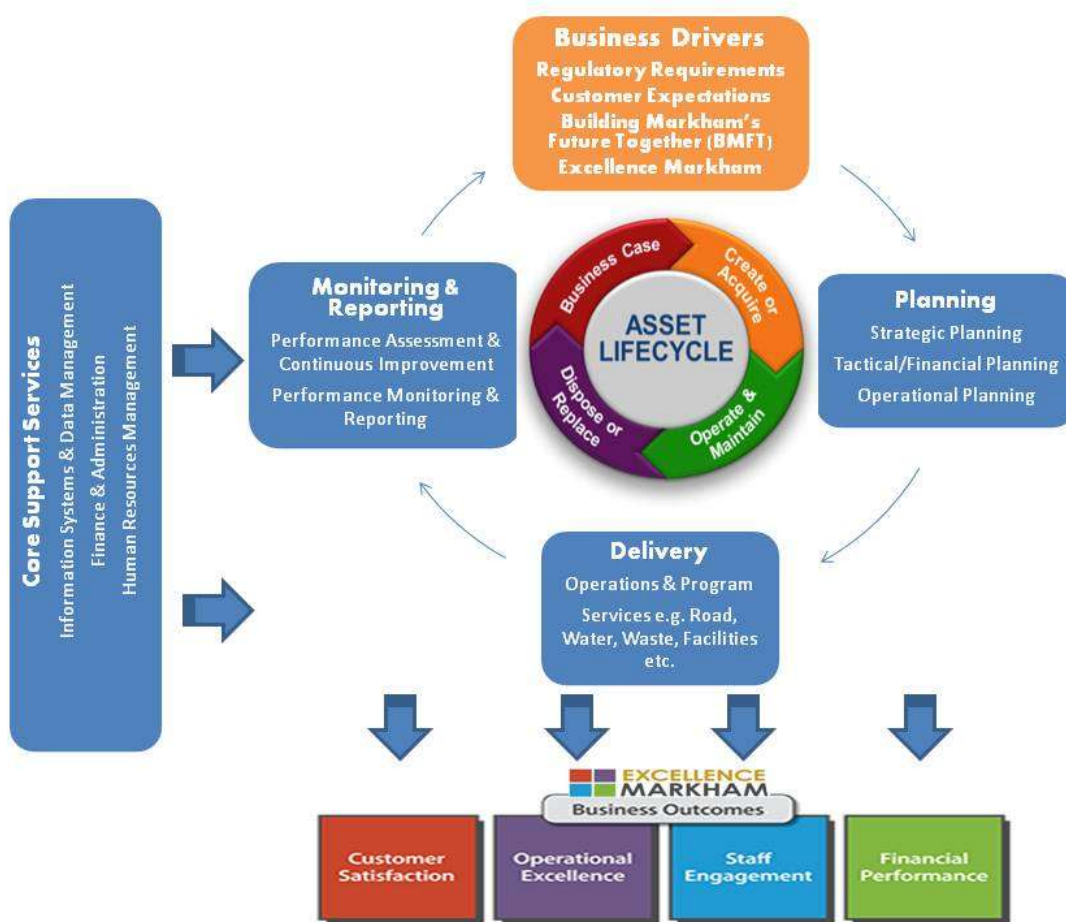
The Markham Asset Management Framework, developed in consultation with Senior staff and industry experts is illustrated in Figure 4-1 Asset Management Framework. The Framework consists of several major elements:

- Regulatory Requirements, Business Drivers (orange)
- Core Processes (blue) supported by Core Support Services
- Asset Management life cycle (center)
- Excellence Markham Business Outcomes (multi-coloured squares)

The characteristics of the Framework are:

- Framework allows for optimization of the delivery and performance of city physical assets
- Excellence Canada fulfillment ultimately Sustainable Asset Management
- Structured processes driven by City Business – Excellence Principals
- Generic enough to fit any City department
- Based on PDCA Plan Do Check Act cycle
- Industry Standard AM Frameworks
- Operations and Programs Interchangeable Core – e.g. Asset Management Life Cycle
- All outcomes aligns to the four pillars of Excellence Canada Framework

Figure 4-1 Asset Management Framework



4.1.1 Business Drivers (Orange)

Business Drivers are the external influences that govern how the infrastructures are managed and set overall expectations of how the department operates, including, but not limited to:

- Customer requirements (residents and businesses);
- Corporate goals and strategies;
- Regulatory requirements, such as the Municipal Act, the Safe Drinking Water Act, the Ontario Water Resources Act, Regional By-law requirements, municipal by-laws requirements, the Planning Act and Places to Grow requirements; and
- Environmental factors, such as the economy, technology innovations, and political and social priorities.

4.1.2 Plan-Do-Check-Act Cycle (Blue)

The underlying structure is based on the all encompassing PDCA (Plan Do Check Act) cycle which is an iterative four step universal management method and principal used by various organizations to control and continuously improve on processes and products. This control/cycle has no end, and functions as a constant repetitious process through all business programs and initiatives.

The Core Supporting Services include finance and administration, information systems and data management, and human resources management, which provides the necessary support to the Business unit to successfully manage the infrastructure.

Planning
Strategic Planning
Tactical/Financial Planning
Operational Planning

Planning - Converts the Business Drivers (Orange) into a set of operational plans that describe how the department will deliver the service. The levels of planning include:

- Long Term Planning which converts Corporate Strategic Plan/goals, regulatory and customer requirements into high level strategic deliverable (e.g. Corporate Strategic Plan Actions, Master Plans, Policies, long term funding strategy)
- Medium Term Planning which cascades Corporate requirements to Departmental level to allocate resources (natural, physical, financial, human, etc.), while meeting defined levels of service (e.g., Departmental Business Plans, Performance Management Plan, Asset Management Plan, 10-Year Capital program)
- Short Term Planning which converts medium term plans into tactical, short term executable plans (e.g. Annual Capital and Operating Budgets, Emergency Preparedness & Response Plans, Operational Standards & Specifications).

Delivery
Operations & Program
Services e.g. Road,
Water, Waste, Facilities
etc.

Delivery - Refers to the actual action of delivering the services to the customers, both internal and/or external. The services are delivered to meet the Excellence Markham business outcome: Customer Satisfaction, Operational Excellence, Staff Engagement and Financial performance.

Monitoring & Reporting
Performance Assessment &
Continuous Improvement
Performance Monitoring &
Reporting

Monitoring and Reporting - Also known as performance management checks that measures if the Department is doing what it intended/planned to do, including:

- Monitoring actual results and reporting actual against targets over time
- Conducting results based benchmarking
- Assessing gaps, and report on lessons learned
- Assess if the results meets the Business Drivers (orange) and modify plan/delivery for continuous improvement

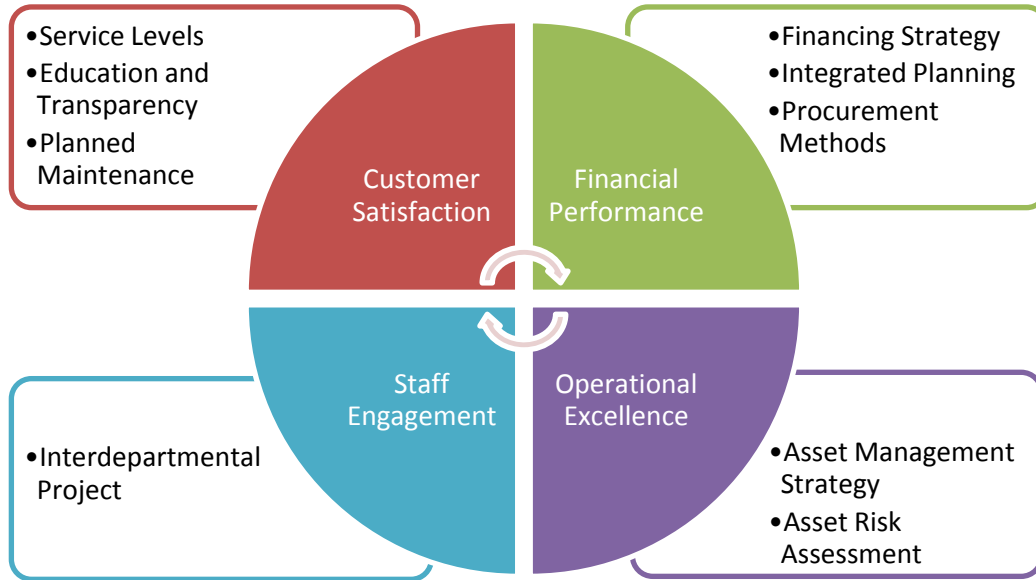
Core Support Services
Information Systems & Data Management
Finance & Administration
Human Resources Management

Core Support Services – These internal department services provides support to the various business units to achieve the planned business outcomes:

- Information systems and data management – to provide support in the design, select, implement, maintain, corporate information systems infrastructure to meet business objectives
- Financial management and administration - to provide support to record & report asset original & depreciated costs; all historical costs associated with service delivery including asset lifecycle costs; and forecasts of future asset renewal costs, to develop short term implementation budgets
- Human resources management – to provide support to recruit, manage and develop human resources to meet business objectives

4.1.3 Asset Life Cycle (Centre)

Centered amongst the Business Drivers, and overlaying the Plan-Do-Check-Act cycle, is the management of physical infrastructure. This Asset Management Cycle describes how the various assets are managed, and overall aligns to the Excellence Markham Business Outcomes as shown below:



The Asset Lifecycle includes:

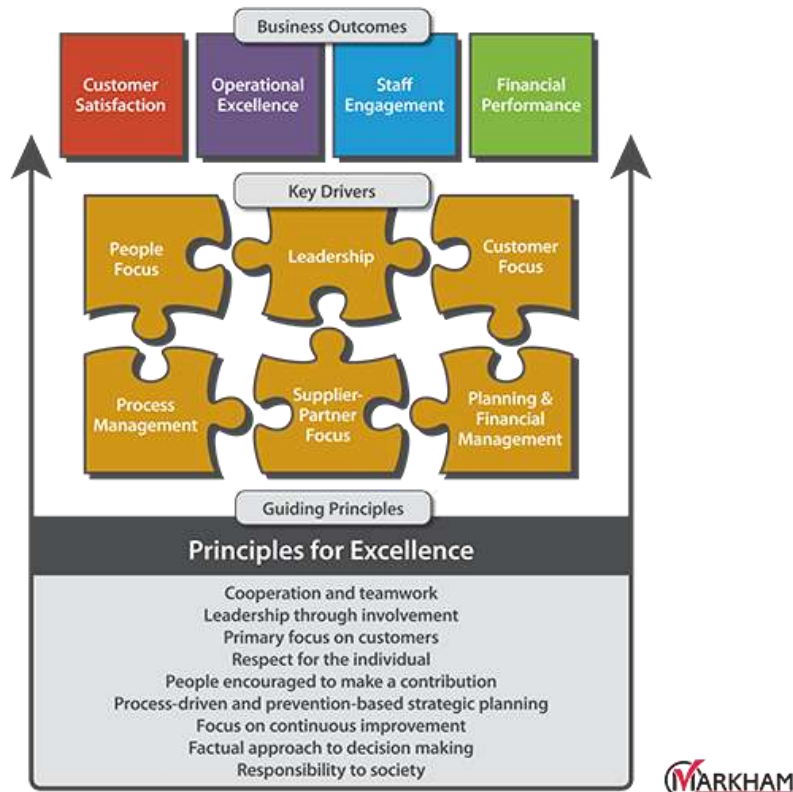
- Asset procurement, creation or acquisition - to provide assets to meet current and future needs while achieving the given levels of service and risks.
- Asset operations, maintain – to maintain an asset to meet the required functional condition and/or extend its life.
- Asset disposal, replace - To rebuild or replace an asset to restore it to a required functional condition.

4.1.4 Excellence Markham Business Outcomes

The City use Excellence Canada’s Excellence Framework for municipalities to guide how the organization is managed, focusing on areas of Customer Satisfaction; Operational Excellence; Staff Engagement, and Financial Performance, see below.

EXCELLENCE FRAMEWORK

We use Excellence Canada's Excellence Framework for Municipalities to guide how we manage the whole organization, resulting in satisfied customers, efficient systems and processes, engaged staff – all at a reasonable cost



4.2 CURRENT CITY OF MARKHAM ASSET MANAGEMENT STRATEGIES

Per the Guide for Municipal Asset Management Plans: The Asset Management Strategy is a set of planned actions that will enable the assets to provide the desired levels of service in a sustainable way, while managing risk, at the lowest lifecycle cost. While based on the internationally recognized PAS55 by the Institute of Asset Management, asset management can be defined as “the continuous improvement of systematic and coordinated activities and practices through which the City can optimally and sustainably manage its infrastructure systems, associated performance, risks and expenditures over their lifecycles for the purpose of achieving the organizational strategic plan”.

This chapter describes the current asset management strategies/practices adopted by individual department/asset classes based the following questions:

- What is the condition audit process and the evaluation criteria?
- What is the rehabilitation/replacement/maintenance program?

Overall, the City's has a strategy to manage the major assets through its life cycle which are generally consistent from condition assessment to program development to execution. However, the City does not have a documented corporate practice that considers:

- Risk analyses of critical infrastructure across the City;
- Prioritizing infrastructure investments that maximizes benefits, reduces risk and provides desired levels of service;

- Making informed decisions over the life of the assets (including operation, maintenance, renewal, replacement and decommissioning); and
- More efficient and effective way in the delivery of services.

4.3 STREETLIGHTS

4.3.1 Streetlight Poles

- Existing Asset Management Strategy / Program Description Program description: includes condition assessment; annual program to replace, rehabilitate and repair deteriorated streetlight poles and components.
- Condition Assessment:
 - Streetlight pole inspection program is scheduled every 3 years with approximately 5,000 to 8,000 poles inspected during each inspection cycle.
 - Streetlight poles that are older than 15 years are inspected once in 9 years. Poles that are in fair to poor condition are inspected every 6 years. Poles that are classified in condition fair or poor in the previous inspections are candidates for inspection.
 - As of 2015, out of a total inventory of 24,393 Poles, 17,300 (approx 71%) have been inspected.
- Rehabilitation/ Replacement:
 - Based on the condition inspection results, streetlight poles are either replaced or rehabilitated based on their condition priority.
 - The City's 25 year Life Cycle Reserve Study include:
 - Pole Condition inspection
 - Pole replacement - Due to service life of the poles, not all the poles are captured under the City's 25 year Life Cycle Reserve Study. Replacement of 2,555 poles (average age – 57 years) out of a total inventory of 24,393 Poles, has been included in 2016LC
 - Pole rehabilitation
 - Pole component repairs/replacement (handholes, foundations, brackets etc.)
- The City has an annual maintenance program which includes maintenance of the street lighting system, emergency repairs to the damaged poles and fixtures, replacement of burned out bulbs, ballasts, light sensors, fixtures (based on residents' complaints to the City's Contact Centre and outages reported by the City's night patrols), re-lamping of HPS fixtures where bulbs are replaced and fixtures are cleaned on a 5 year cycle, underground and overhead supply line repairs and locating services for underground streetlight infrastructure.
- Evaluation Criteria:
 - Level 1: No concerns; minor, non-critical deficiencies.
 - Level 2: Deficiency identified with potential to deteriorate to point of failure; monitoring recommended.
 - Level 3: Serious deficiency or safety concern; remediation, immediate repair or replacement recommended.
- Service Levels:
 - Public Safety and User Expectation – Streetlight outage
 - Legislative – Luminaires inspection (as per Ontario Regulation 239/02)

4.3.2 Underground Streetlight Cables

- Existing Asset Management Strategy / Program Description Program description: includes condition assessment; annual program to replace, rehabilitate and repair deteriorated streetlight cables; maintenance program.
- Condition Assessment:
 - Cable condition inspection program is scheduled for every 5 years based on condition index and megger testing techniques. Condition index is a visual inspection of the underground streetlight cables based on their age and condition of the fuse, handhole, cable and connector condition. For those segments where cable and connector condition were reported to be "poor" or "fair", megger test is performed. The Megger test is a non destructive method of testing by using an insulation resistance meter to verify the condition of electrical insulation. The test collects data about continuity, resistance and insulation integrity. The combined results are used to compute the overall health index to determine which cable section requires replacement.

- As of 2015, all cables older than 40 years - 254 km out of total inventory 1,005 km (approx 25%) have been inspected.
- Rehabilitation/ Replacement:
 - Based on the condition inspection results, deficient streetlight cables are replaced/repared every 2 years after each inspection cycle.
 - The City's 25 year Life Cycle Reserve Study include:
 - Condition inspection – currently accounted for only 351km (that reached 40 years, average age 49 years) of cable lengths.
 - Cable replacement/repair - currently accounted for only 40km (that reached 40 years) of cable lengths. Additional replacement lengths will be added after completion of each cable condition inspection. Due to the average service life of the cables, not all the cables are captured under the City's 25 year Life Cycle Reserve Study.
- Evaluation Criteria: Overall Health Index through visual inspection based on age, fuse, hand hole and cable/connector's condition.
- Service Levels:
 - Public Safety and User Expectation – To provide uninterrupted service to public.

4.3.3 Streetlight Fixtures

- Condition Assessment:
 - Majority of the LED fixtures are monitored through Philips Starsense software system, therefore condition assessment is not required.
 - HPS fixtures is not condition assessed, deficiencies are identified through routine patrols, resident calls, etc.
 - The City inspects all luminaires twice a year to check to see they are functioning per O. Reg 239/02.
- Rehabilitation/ Replacement:
 - Deficient fixtures are replaced via the annual streetlight infrastructure maintenance program within the Operating budget as required.
 - The City's 25 year Life Cycle Reserve Study include:
 - LED fixtures
 - HPS fixtures is not included in the City's 25 year Life Cycle Reserve Study
- Maintenance program includes washing the LED and relamping the HPS lamps every 5 years through the City's operating budget.
- Service Levels:
 - Public Safety and User Expectation – To provide better lighting to residents
 - Energy Efficiency – To save energy cost

4.3.4 Segment Controllers

- Condition Assessment: Segment controllers are not condition assessed. Need to be replaced every 10 years in line with the evolving technology.
- Rehabilitation/ Replacement: Program to replace these assets every 5 years due to technology obsolescence, included in the City's 25 year Life Cycle Reserve Study.
- There is no maintenance program associated with this asset.
- Service Levels: Public Safety and User Expectation – To reduce streetlight public complaints
- Data confidence: 100% confidence.

4.4 **STRUCTURE – VEHICULAR BRIDGES, PEDESTRIAN BRIDGES, CULVERTS**

4.4.1 Existing Asset Management Strategy / Program Description - Overview

- Condition Assessment:
 - The City has an annual detailed condition inspection program for vehicular bridges, pedestrian bridges and culverts.
 - As per this program, all bridges (vehicular and pedestrian) and culverts over 3 meters are assessed every other year (biennial basis) in accordance with the OSIM (Ontario Structure Inspection Manual). Culverts less than 3m span are assessed every 4 years if they are in good condition.

- All vehicular bridges, pedestrian bridges and culverts have been condition assessed as of August 2015.
- Rehabilitation/replacement:
 - The City has an annual Structures Rehabilitation/Replacement Program for vehicular bridges, pedestrian bridges and culverts.
 - The annual amount allocated in this program varies each year based on the quantity and condition of the asset.
 - All vehicular bridges, pedestrian bridges and culverts have been captured in the 25 year life cycle reserve program (2016).
 - The 25 year life cycle (2016) reserve program includes the following:
 - Rehabilitation Works for Vehicular Bridges
 - Rehabilitation Works for Pedestrian Bridges
 - Rehabilitation Works for Culverts
 - Minor Rehabilitation works
 - MNR Monitoring for capital projects
 - Structure Preventive Maintenance
 - Structures Annual Inspection
- The City has the following annual maintenance activities for vehicular bridges, pedestrian bridges and culverts:
 - Vehicular bridge are washed every year in spring.
 - Bridge Preventive maintenance is an annual program (for both vehicle and pedestrian bridges). The work includes asphalt, concrete, wood repairs.
 - Pedestrian bridges and culverts - There are no planned maintenance activities for pedestrian bridges and culverts.

4.4.2 Condition Audits

All vehicular bridges, pedestrian bridges and culverts over 3 meters span are inspected on a biennial basis (once every two years) in accordance with the OSIM (Ontario Structure Inspection Manual by the Ministry of Transportation).

Every year, AM staff identifies the structures to be visually inspected as per OSIM requirements. The City also performs CCTV inspections for all culverts that are less than 1.2m diameter irrespective of their material type.

4.4.3 Evaluation Criteria

All vehicular bridge, pedestrian bridge and culvert inspections are performed by or under the guidance of, a structural engineer, and include such information as structure type, dimensions and span lengths, other key attribute data, detailed photo images, and structure element by element inspection, rating and recommendations for repair, rehabilitation, and replacement. Also, each structure component is evaluated based on guidelines by Ontario Structures Inspection Manual (OSIM). An overall rolled up overall condition (good, fair, poor, critical) is provided for each structure based on MTO specifications.

4.4.4 Service Levels

The service levels for vehicular bridges, pedestrian bridges and culverts are as follows:

- Public Safety & User Expectation - To ensure safe vehicular and pedestrian passage of public
- Legislative - To comply with Public and Highway Transportation Act - Regulation 104/97.
- Operational - To maintain culverts free of obstructions that may impede proper surface water flow.

4.5 **STORMWATER INFRASTRUCTURE WITHIN THE R.O.W**

4.5.1 Storm Pipes

- Existing Asset Management Strategy / Program Description: includes CCTV inspection; rehabilitation of deficient pipe sections and flushing of clogged pipes identified through CCTV inspections.
- Condition Assessment:
 - Approximately 80-85km is inspected by closed circuit television (CCTV) inspections every year over an eight year cycle.

- The City is using Zoom Camera equipment to assess the condition of storm pipes.
- Rehabilitation / Replacement:
 - A rehabilitation program is in place where selected sections of pipes are rehabilitated every two years.
 - The City's 25 year Life Cycle Reserve Study include:
 - CCTV Inspection
 - Stormsewer Pipe Rehabilitation
 - Replacement of CSP Stormsewer pipes that are at the end of their lifecycle.
- Evaluation Criteria:
 - The City conforms to National Association of Sewer Service Companies (NASSCO) Pipe Assessment Certification Program (PACP) for all Condition Grading for:
 - Structural Pipe Segment Rating
 - Operational and Maintenance Pipe Segment Rating
- Service Level:
 - User Expectation - To ensure adequate function and operation of storm drainage facilities as intended.
 - Regulatory - To comply with NASSCO's PACP program
 - Public Safety - To eliminate the risk of flooding and minimizing disruption to the community.

4.5.2 Storm Components (Manholes and Catch Basins)

- Condition Assessment: manholes and catch basins are not condition audited.
- Rehabilitation/Replacement: minor manhole and catch basin repair/replacement are completed through annual maintenance activities by Operations Department.

4.5.3 Outfall Structures

- Condition Assessment:
 - Outfall inventory was first collected and documented in 2010-2011.
 - Outfall structures visual condition inspection is carried out every four years. It is anticipated that at least 50% of the outfall structures will need inspection every 4 years. Hence, full inventory of the outfall structures is visually inspected every 8 years and approx 50% of the inventory that is in poor/fair condition are inspected every 4 years.
 - Out of a total inventory of 262 outfalls, 245 (93%) outfall structures have been condition assessed as of 2015.
- Rehabilitation / Replacement:
 - A rehabilitation program is in place where selected outfall structures are rehabilitated every two years.
 - The City's 25 year Life Cycle Reserve Study include:
 - Inspection
 - Rehabilitation
 - Channel Maintenance
 - The rehabilitation cost varies based on the condition assessment and is location specific over 25 year period.
 - There are no defined maintenance activities for outfall structures; however, there is funding allocated for storm sewer outfall channel maintenance once every 5 years.
- Evaluation Criteria:
 - Outfall structures are inspected based on Ontario Structures Inspection Manual (OSIM) by the Ministry of Transportation. This inspection is not legislated.
- Service Level:
 - Operational - To ensure smooth functioning of the storm water system.
 - Public Safety and Sustainability - Effective outfall rehabilitation program prevents flooding upstream and supports City's vision for a sustainable community.

4.6 STORMWATER MANAGEMENT (SWM) PONDS / NATURAL INFRASTRUCTURE

4.6.1 Wet Ponds

- Condition Assessment:

- In 2011, the City retained a Consultant to develop SWM Ponds Database to assess the current sediment level/condition of the ponds, auxiliary assets fences/access pathways for the first time. The study assessed 35 wet ponds out of a total of 43.
- The City has a condition inspection program for wet ponds every 2 years where approximate 10-15 ponds are inspected for sediment levels through bathymetric survey and condition of inlet/outlet control structures are visually assessed. Work includes updating the SWM pond database, sediment level of ponds, and inspection of inlet/outlet structures.
- Rehabilitation/replacement:
 - The City has a program to clean the sediments that is location based on an as-required basis to ensure that the approved quality control function of the pond is maintained. Sediment removal location is selected through the condition inspection program.
 - The City's 25 year Life Cycle Reserve Study include:
 - Inspection
 - sediment removal
 - maintenance
- The City has the following annual maintenance activities:
 - The wet ponds require maintenance to function efficiently. Work includes repairing/ replacing grates, minor repairs to headwalls, railings, inlet/outlet structures, fence and debris cleanup etc.
- Evaluation Criteria: As per Ministry of the Environment and Climate Change (MOECC) Environmental Compliance Approval (ECA) requirements, a pond should be cleaned to avoid reduction of capacity of the pond, assumed to be occur when 5% of the facility treatment efficiency is lost through capacity reduction, or when the percentage of accumulated sediment is more than 15-30% of the pool volume. The owner shall ensure that sediment is removed from pond at such a frequency as to prevent the excessive build up and potential overflow of sediment into the receiving water course.
- Service Levels:
 - Environmental and Sustainability - Efficient functioning of the pond enhances and protects environment and provide a sustainable eco system that is in line with City's environmental initiative.
 - Legislative - To comply with the Ministry of the Environment and Climate Change (MOECC) requirements.
 - Public Safety - Decrease the risk of downstream flooding (ponds with quantity control function).
 - Protect Infrastructure – Decrease downstream erosion (ponds with erosion control function).

4.6.2 Dry Ponds

- Condition Assessment:
 - In 2011, the City retained a Consultant to develop SWM Ponds Database to assess the current sediment level/condition of the ponds for the first time. The study assessed:
 - 29 dry ponds out of a total of 41
 - No condition inspection program for dry ponds to date.
- Rehabilitation/replacement:
 - Dry Ponds: Accumulation is not expected for dry ponds. Hence, no sediment cleaning is required. No maintenance program has been developed to date.
 - The City's 25 year Life Cycle Reserve Study does not include any dry ponds due to nature of the asset.
- Evaluation Criteria: To be developed with a condition audit/maintenance program.
- Service Levels: Same service levels as wet ponds.

4.6.3 Erosion sites

- Condition Assessment: The City wide erosion master study identifies all erosion sites, selects priority sites, prepares conceptual designs for each site, and monitors remaining sites, which is updated every 5 years. The 2013 Erosion update study estimated 458 minor and major erosion sites.
- Rehabilitation/replacement:
 - The study has identified the 30 top priority sites, which selected sites are rehabilitated every year. The annual amount allocated in this program varies each year based on condition and location of the asset.
 - The City's 25 year Life Cycle Reserve Study include:
 - Study update

- 75 erosion sites for remediation between 2015 – 2040, approximately 3 sites are restored every year
 - No formal maintenance program for erosion site.
- Evaluation Criteria: As part of Class EA, the Environmental Study Report (ESR) needs to be updated on a 5 year basis to ensure consistency with new policies and to update priorities due to changes of erosion conditions over time.
- Service Levels:
 - Environmental - To protect the environment (watercourse, aquatic life, structures, banks, etc.) from erosion
 - Public Safety - To meet the individual and community needs to improve the public safety.
 - Protect Infrastructure – Stabilize watercourses at critical manholes, sewers, outfalls, and roadways.

4.6.4 Storm Channel (Don Mills Channel, Rodick/Miller Ditch)

- Condition Assessment: The City has an easement along the majority of the Don Mills Channel and the condition has been assessed as part of the City wide erosion master study. Culverts along the channel are assessed under the Structures program.
- Rehabilitation/replacement:
 - No formal rehabilitation program is currently in place.
 - A Municipal Class Environmental Assessment Study is underway for the Don Mills Channel to identify rehabilitation/replacement options related to the channel capacity. The study is expected to be completed in December 2017.
 - Annual maintenance activities include removal of vegetation, overgrowth and debris to ensure proper storm water conveyance, included in the City's 25 year Life Cycle Reserve Study.
- Evaluation Criteria: cleaning to maintain treatment efficiency and taking steps to ensure public health and safety
- Service Level: Public Safety and Environmental – To reduce risks of flooding to the adjoining private properties and roads while maintaining the storm water conveyance system.

4.7 WATER INFRASTRUCTURE

4.7.1 Water Infrastructure

The City of Markham's Water Distribution system is governed by the comprehensive Ministry of Ontario Environment and Climate Change's (MOECCs) Safe Drinking Water Act (SDWA) and associated Regulations. The MOECC conducts a yearly inspection of the Drinking Water Distribution System to determine compliance to the Acts and Regulations. Waterworks exercises extreme rigor in operational excellence to remain in compliance and is also diligent with conformance to the Drinking Water Quality Management Standard (DWQMS).

Program description - Water

- Infra Lifecycle Reserve Study - Replacement
- Preventive Maintenance
 - Auto-Flushing Station Maintenance and Programming Frequency & Duration
 - Flushing of Dead-end Watermain
 - Instrumentation Maintenance (Chlorine Pocket Colorimeter, Fluoride Pocket Colorimeter, Gas Detector, Turbidity Meters)
 - Sampling Station Maintenance
 - Water Sampling (THM, Nitrate / Nitrite, –Microbiological, Chlorine Residual, –Lead, Organic, Inorganic, Fluoride, Sodium)
 - Water Quality Instrumentation Operation
 - Flushing of Pressure Separation Valve
 - Instrumentation Maintenance - pH Meters
 - Unidirectional Flushing
 - Air Release Valve Inspection - Clean & Exercise
 - Fire Hydrant Flushing & Calibration
 - Hydrant Inspection (Spring and Winter)

- Inspected Suspended Watermain
- Main Line Valve Inspection
- Valve Chamber Inspection
- Valve Inspection & Exercising and Data Collection
- Pressure Reducing Valve Inspection
- Fire Hydrant Painting
- Fire Hydrant Snow Clearing / Thawing
- Valve Chamber Maintenance
- Curb Box Operation Check
- Curb Box & Rod Replacement
- Watermain Cement & Structural Lining (Cathodic Protection)
- Annual Residential Meter Change Out Program
- Annual Meter Testing
- Corrective Maintenance
 - Water Sample – Water Quality (Ad-hoc)
 - Backfilling of Watermain Repairs And/or System Modification
 - Hydrant Repair
 - Site Restoration After Corrective or Emergency Maintenance Repairs
 - Water Service – Repair or Replacement
 - Watermain Repairs and/or Modifications
- Rehabilitation
 - Fire Hydrant Replacement, Relocation, or Removal
 - Valve Chamber Construction
 - Watermain Replacement
 - Water Main Rehabilitation
 - Water Service Line Replacement
 - Sampling Station Replacement
 - Auto Flushing Station Replacement
 - Water Meter Replacement
 - Valve Chamber + Valve Box Rehabilitation

Evaluation/Condition - Water

- Water Main – completed cast iron, ductile iron, suspended watermain condition assessment in the last 2 years, also monitoring through watermain breaks
 - Acoustic
 - Watermain break
 - Ductile and Cast Iron Watermain
- Valve Chamber+Valve Box- curb box inspections and repairs done by contractor annually; by areas/year; 1900/200 per year (38 years)
- Water Meter – by customer’s call/annual meter testing; 20 years lifecycle; tests 220 meters a year replace 3000 meters annually; others maintenance and repair; frozen meters; high consumption 2500-3000 meters a year; customer satisfaction survey card.
- Water Service – repair or replacement contracted as required
- Fire Hydrant – 2 Inspections annually per hydrant; Replace obsolete
- Sampling Station – sampling station maintenance once per year
- Auto Flushing Station – auto flushing station maintenance and programming twice per year

4.7.2 Wastewater Infrastructure

Current Asset Management Strategy (Selected) - Wastewater

- SCADA – Study/Pilot program defined as Supervisory Control and Data Acquisition at \$69,500. This is relatively new tool to Waterworks which allows for advanced remote user interface and trending of performance data to help identify operations that may be outside normal conditions.
- Sanitary Trunk Sewer Manhole Inspection- Annual program condition inspections of approximately 40km of 914km Trunk Sewer mains.

- Sanitary Upgrade/ Rehab – Repair/Replacement program to sanitary sewers \$1,024,300. Increases system life expectancy and reduces service interruptions through early detection.

The above describes a selected few examples of Repair/Replacement programs related to Water infrastructure, a number of initiatives exist outside the above such as Pilot studies, Sanitary Lateral Inspections, Environmental Services Data Strategies etc.

Program description - Wastewater

- Infra Lifecycle Reserve Study - Replacement
- Preventive Maintenance
 - Sampling of Wastewater Effluent
 - Sanitary Sewer Manhole Inspection
 - Sewer Flushing Maintenance
 - Sewer Lift Station Inspection and Maintenance
 - Sewer Siphon Flushing and Cleaning
 - Sewer Video Inspection (Mainline)
 - Sewer Lateral Inspection
- Corrective Maintenance
 - Mainline Sewer Reaming
 - Manhole Maintenance and/or Repair
 - Repair or Replace a Sanitary Sewer
 - Trunk Sewer & Manhole Zoom Camera Inspection
 - Sanitary Sewer Backup & Blockage Investigation & Corrective Action (Mainline)
 - Sanitary Sewer Lateral Blockage Investigation & Corrective Action
 - Odour Investigation and Corrective Action
 - Sanitary Sewer Lateral – Repair or Replacement
 - Smoke and Dye Tests for Sanitary and Storm Sewers and Laterals
 - Vermin Investigation and Corrective Action
- Rehabilitation
 - Sanitary Sewer Main – Replacement
 - Sanitary Sewer Main - Rehabilitation
 - Sanitary Sewer Manhole Rehabilitation
 - Sanitary Sewer Lateral Replacement

Evaluation/Condition - Wastewater

- Sanitary Sewer Main – condition assessment for sanitary sewer and manholes in 5 year cycle through CCTV inspection; (PACP standard used) is running this inspection; trunk sewers five year cycle through zoom camera sewer and manhole inspection; visual condition of trunk condition of sewer main; outsourced repair w/ problem findings in following year (not longer than 300 meter) 1600 meter deep (cannot inspect)
- Sanitary Manhole – monthly inspection. There is a basic checklist in work order.
- Sanitary Lateral targeted inspection of 1200 laterals thru property line (areas with high in I/I) Sanitary Lift Station –O&M weekly inspection; assessment of PS

Service Levels-Identify by using Level of Service framework

Infrastructure levels of service are directly influenced by legislative regulatory requirements. One key legislation that governs drinking water is the Safe Drinking Water Act. What allows drinking water levels of service along with legislative requirements are guidelines and responsibilities attributed to licensing e.g. Drinking Water License and permit to operate a drinking water system in Ontario. Generally our Water and Wastewater infrastructure is in Good condition based on age.

4.8 ROADS AND SAFETY DEVICES

4.8.1 Road Surface & Base

- Existing Asset Management Strategy / Program Description Program description: includes condition assessment; complete road segment rehabilitation inclusive of identified asphalt resurfacing strategies, concrete curb and sidewalk, catch basin and manhole repair; maintenance activities.
- Condition Assessment:
 - A consultant is hired to use mechanical testing equipment to evaluate road surface condition and produce an overall condition index (OCI). This index is then used to identify the poorest sections of the road network. Testing is completed every two years and becomes the basis for further evaluation to select roads for repair. The 2,010 km of the roads are condition audited every other year.
 - In addition to the consultant, regular road patrol identifies locations for temporary repairs and permanent repair.
- Rehabilitation / Replacement:
 - Markham's pavement management program incorporate sustainable elements focusing on community, economic and environmental drivers, with the following three goals:
 - Maintain high ratio of roads rated good or better (Socially focused)
 - Reduce the overall life cycle cost (Economically focused, fiscally and financially prudent)
 - Reduce the environmental impacts of rehabilitation (Environmentally focused)

The program has the following elements:

1. **Preserve the road** by proactively treating the surface early in its life to prolong its state of good repair and reduce the need for raw material and energy required by full reconstruction strategies – primary preservation treatment applied is micro-surfacing
2. **Strengthen roads during rehabilitation** for longer life. Revise standards for new road construction to reflect a longer life cycle – using an Expanded Asphalt Stabilization (EAS) technique.
3. **Employ green technologies** such as warm asphalt mix designs to reduce emissions, save energy, and use recycled aggregate and asphalt roofing shingles in order to reduce use of virgin material , and divert shingles from landfill.
4. **Monitor, track performance**, and survey pavement condition on a regular two year cycle to ensure that network remains in good repairs.

The Pavement Preservation Strategy has been in place since 2010, where an estimated annual savings of \$1.3M to \$1.9M over the entire network once a preservation program is fully implemented in approximately 10 years.

Based on the pavement evaluation on each road section every two years, the City determines which roads are suitable candidates for rehabilitation. Once a pavement segment's Pavement Condition Index (PCI) falls below a predetermined threshold level, it becomes a candidate for rehabilitation. Subsequently, staff utilizes pre-engineering data and Annual Average Daily Traffic (AADT) volumes to assess the structural capacity of the potential candidates and confirms the feasibility of in-place asphalt recycling. The City then hires a consultant to perform a pavement evaluation and subsequent design, considering all of the potential rehabilitation strategies such as Full Depth Reclamation (FDR) with Foamed Asphalt, and mill and overlay, with and without the use of a Stress Absorbing Membrane Interlayer. In the last 15 years the Overall Condition Index has climbed from 76 to a consistent 82%, reducing maintenance costs and extending the life-cycle of the pavement.

- An annual resurfacing program of approximately 15-20km is in place where select sections of roadway are repaired based on condition rating, traffic volumes and budget availability.
- The City's 25 year Life Cycle Reserve Study include 15-20km resurfacing per year only. The total lane km of roads is not included in the 25 year Life Cycle Reserve Study because it is dependent on condition assessment and prioritized accordingly every year.
- The 25 year Life Cycle Reserve Study includes the following components:
 - Asphalt Rehabilitation (sub base, curb and sidewalk, preservation, steel, FTE) – varies every year, includes approximately 15-20km

- Asphalt-Asphalt Inspection
 - Asphalt-AC Index – is only incorporated into the life cycle reserve for 5 year cycle as it is based on the renewal of the contract that is highly dependent on posted price of crude oil.
 - Asphalt-Route and Seal
- The City has the following annual maintenance activities:
 - Localized asphalt repair - provides repairs to specific locations of the road network.
 - Pot hole repairs, minor manhole and catch basin repair/replacement
- Evaluation Criteria - Empirical OCI data is used to identify roads in most need of repairs. Further subjective evaluations are completed to confirm empirical data and to evaluate importance of roadway within the transportation network. OCI criteria is rebalanced periodically to ensure quality results
- Service Levels – Ensure all roads exceed minimum OCI rating

4.8.2 Curbs & Sidewalks

- Existing Asset Management Strategy / Program Description: In addition to the curb and sidewalk embedded in the Road Surface & Base (resurfacing) program, there is an annual localized repair program which repairs deficient concrete curb and sidewalk Citywide. The deficiencies are prioritized every year and repaired within the annual budget allowance. Segments not repaired are recorded and prioritized for next year's repair program.
- Condition Assessment:
 - Sidewalks are patrolled once per year and through road patrol identifies deficient locations in alignment with Minimum Maintenance Standards, O. Reg. 239/02.
 - Curb deficiencies are identified through road patrols, resident calls, etc.
- The City has the following annual maintenance activities:
 - Eliminate trip edges of sidewalks includes grinding, asphalt ramping and mortar repairs
- Annual program is included in the 25 year Life Cycle Reserve Study.
- Evaluation Criteria
 - Sidewalk - Trip ledges greater than 20mm, O. Reg. 239/02
 - Curb – N/A
- Service Levels
 - Sidewalk - Minimum Maintenance Standards, O. Reg. 239/02.
 - Curb – Subjective: broken, cracked, spalling and prioritized.

4.8.3 Parking Lots

- Existing Asset Management Strategy / Program Description: condition assessment, annual replacement program supported by localized repair.
- Condition Assessment: The 96 parking lots are visually condition inspected Bi- annually
- Rehabilitation/replacement:
 - Rehabilitation - The City has an annual program for the removal and replacement of concrete, interlock and asphalt infrastructure. The annual amount allocated in this program varies each year based on condition and location of the asset. All 96 parking lots are accounted for in the 25 year Life Cycle Reserve Study.
 - Localized repairs – Annual maintenance and repairs include localized repairs, maintenance holes and catch basin adjustments. The locations are prioritized annually.
- The City has the following annual maintenance activities:
 - Pot hole repair, catch basin repair/replacement
 - Snow removal, line marking and painting
- Evaluation Criteria – Subjective evaluation based field inspection of surface and support apparatus, based on defects, age and frequency of use of the lot.
- Service Levels – As deficient locations are identified, it is placed under rehabilitation program or the localized repair program based on the usage of the lot and to ensure public safety.

4.8.4 Safety Devices: Guide Rail

- Existing Asset Management Strategy / Program Description: condition assessment, annual replacement program supported by localized repair.

- Condition Assessment: Guide rail deficiencies are identified through road patrols, resident calls, etc.
- Rehabilitation/replacement:
 - Rehabilitation - The City has an annual program for replacement guide rail. The annual amount allocated in this program varies each year based on condition and location of the asset. All 13 km are accounted for in the 25 year Life Cycle Reserve Study.
 - Localized repairs – Annual maintenance and repairs are performed.
- Evaluation Criteria – Subjective evaluation based field inspection of guide rail based on if the posts are rotten, failing, and those requiring upgrading to current OPSD standards.
- Service Levels – As deficient segments are identified, they are repaired within the calendar year to provide public safety.

4.8.5 Safety Devices: Railway Crossing

- Existing Asset Management Strategy / Program Description: condition assessment, location specific rehabilitation program of level crossings to ensure vehicular and pedestrian safety. There are no operating and maintenance impacts on this program.
- Condition Assessment: 13 Locations are visually condition inspected annually.
- Rehabilitation/replacement: Based on the condition audit, each crossing is identified for either grind-and-pave operation once every 7 years, or full depth removal and replacement of rubber rail. All 13 locations are accounted for in the 25 year Life Cycle Reserve Study.
- Evaluation Criteria: Subjective field inspection evaluation based on if there are trip ledges near rails, condition of pedestrian crossing areas adjacent to roadway, condition of rubber mud rail, movement of rails affecting structural integrity of adjacent asphalt, approach areas.
- Service Levels: As deficient locations are identified, it is placed under the rehabilitation program.

4.8.6 Safety Devices: Fencing / Retaining Wall / Entrance Features

- Existing Asset Management Strategy / Program Description: Not condition assessed, annual replacement program supported by localized repair.
- Condition Assessment:
 - Inventory is unknown due to property line/ownership, therefore, not condition assessed due to lack of inventory.
 - Deficiencies are identified through patrols, resident calls, etc.
- Rehabilitation/replacement:
 - An annual replacement program of deficient assets located within the City's property and is included in the 25 year Life Cycle Reserves.
 - Localized repairs – Annual maintenance and repairs are performed.
- Evaluation Criteria: Subjective evaluation based field inspection based on:
 - Fence - deficient material, decaying, leaning, or rotten wooden
 - Retaining wall - spalling, missing coping stone, leaning, vandalized, damaged due to vehicular accidents
 - Entrance feature – no criteria developed
- Service Levels:
 - Fence - Repaired within 30 days for complaints received, and to ensure public safety.
 - Retaining wall and entrance feature - As deficient locations are identified, the location is repaired within the annual program.

4.8.7 Safety Devices: Signs

- Existing Asset Management Strategy / Program Description: Condition assessed for Regulatory and Warning Sign only, annual maintenance/replacement program.
- Condition Assessment:
 - Regulatory and Warning Signs - Minimum Maintenance Standards dictate a Reflectivity Program. Reflectivity is measured against industry standard yearly.
 - Inventory of other signs are unknown, therefore, deficiencies are identified through patrols, resident calls, etc.
- Rehabilitation/replacement: City has an annual maintenance and replacement program.

- Evaluation Criteria: Minimum Maintenance Standards set out criteria for replacement of Regulatory and Warning Signs.
- Service Levels: Regulatory and warning signs are repaired within 2 hours for stop signs and within 7 days for other regulatory signs or as indicated by reflectivity survey, other signs such as street name signs are replaced based on street patrols or public complaints and repaired within 21 days of defect identification.

4.9 FACILITIES

- Existing Asset Management Strategy / Program Description: Full building condition audits (generally every 10 years); annual review of building components due for rehabilitation/replacement for the next two years; annual replacement/repairs program on building components; preventive maintenance activities.
- Condition Assessment: annual review of building components due for rehabilitation/replacement for the next two years.
- Rehabilitation/replacement:
 - Repairs/replacement - The City has an annual life cycle program for repairs/replacement of building components. The annual amount allocated varies each year based on requirements of the annual review. All building components other than foundation/structural supports/interior mechanical/electrical system are included in the 25 year Life Cycle Reserve Study.
 - Facility related programs are also included in the life cycle reserve study: Accessibility improvement; corporate security operations and system improvements; Municipal building backflow prevention program, and corporate accommodation program.
 - Annual maintenance activities required to operate the buildings are included as part of the annual operating budget, including over 15 citywide maintenance contracts (e.g. janitorial, elevator, ESA etc.)
 - Evaluation Criteria – The condition of each component of a facility is evaluated based time of installation, typical life cycle of the component, and frequency of use. Most components such as flooring, painting, ceiling, etc. are evaluated through visual inspection. Technical components such as electrical, fire systems, etc. are evaluated by licensed contractors or specialized professionals on an as required basis. Through evaluation, condition for each component is rated as ‘Good’, ‘Fair’, or ‘Poor’, and updated accordingly in the life cycle reserve study to develop annual repair/replacement programs. Components rated as ‘Good’ are in Lifecycle plan for longer term replacement or repair. Components rated as ‘Fair’ are planned for shorter term replacement. Components rated as ‘Poor’ are planned for immediate (soonest possible) replacement or repair.
- Service Levels – The service level is unique for each facility component and assessed based on the type of use, and the need for this facility. For example, carpet in one facility may require replacement every 5 years, whereas in another facility (or, in storage room) it may require replacement every 15 years.

4.10 TRAFFIC SIGNALS

4.10.1 Condition Assessment

Condition assessments are completed twice annually (spring & fall) through visual and physical inspection by qualified electrical contractors for above ground infrastructure only. Below ground infrastructure are not condition assessed.

4.10.2 Rehabilitation/replacement:

The City has an annual program for replacement of signal equipment that has reached the end of its expected life. The annual amount allocated in this program varies each year based on the condition and location of the asset. All 92 signalized intersections and its associated components are accounted for in the 25 year Life Cycle Reserve Study. However, if conditions assessment identifies that such equipment is still in good operating condition, replacement will be deferred to a future year. Replacement scheduling is based on anticipated life cycle derived based on industry standard and benchmarking against other municipalities.

Preventative maintenance practices are completed twice annually, with minor repairs completed on an as-needed basis. Where possible, major preventative replacements are recorded and prioritized for incorporation into the following year’s capital budget, while failures/emergencies are addressed immediately.

4.10.3 Evaluation Criteria

Above-ground equipment is visually and physically inspected twice annually. There are no defined criteria to determine replacement requirements. Any minor repair or replacements are accomplished during inspection. Any repairs or replacements that may pose a pressing (although not emergency) concern and require attention is documented by the maintenance contractor and submitted to the City for approval prior to actioning repairs.

4.10.4 Service Levels

- High priority maintenance concerns are addressed within 1 hour. Temporary repairs are completed within one (1) hour of site arrival. Permanent repairs are completed within 24 hours.
- Low priority maintenance issues are responded by 16:30 the next business day. Temporary repairs are completed within one (1) hour of site arrival. Permanent repairs are completed within 10 business days.
- Maintenance practices are in accordance to the Ontario Traffic Manual Book 12 and the Municipal Act, Regulation 239/02 – Minimum Maintenance Standards for Municipal Highways.

4.11 **PARKS**

- Existing Asset Management Strategy / Program Description: condition assessment, annual replacement program supported by localized repair.

4.11.1 Sports fields:

- Asset Management Strategy / Program Description - This is an annual program that involves the annual inspections and rehabilitation of the approximately 200 sportfields every season.
- Condition Assessment: Sportsfields are inspected/reviewed 4 times a year.
- Evaluation Criteria: Based on condition assessment, use, type and location.
- Rehabilitation/replacement: The fields are assessed and work is allocated according to those that require immediate attention. The 25 Year life cycle reserve study allocates approximately 3.3M each year. As a result a maintenance program is continued throughout the season that involves top-dressing, aerating, over-seeding, sodding, and fertilizing, as well as having at least one crew in the parks weekly to inspect bleachers and cut fields.
- Service Level: Cultural practices (aerating, topdressing, over-seeding, and fertilizing) are performed on the sports fields from Spring to Fall. A cut schedule is also in place, where they are mowed twice a week.

4.11.2 Electrical Structures/Lighting:

- Asset Management Strategy / Program Description - There is an annual program for repair and replacement however budget varies from year to year depending on inspections.
- Condition Assessment: All structures/lighting inspected once a year. Annual inspection of all lighting occurs every Spring. Staff and various user groups continue to use lighting throughout the operating season and provide information to Operations of any deficiencies for repair or replacement.
- Evaluation Criteria: Based on condition assessment.
- Rehabilitation/replacement: All lighting is being replaced with efficient environmentally friendly lighting the approximate Capital project is estimated at \$416,400. Relamping program performed every 5 years (Which would include replacing bulbs, blown ballast, cables and broken lenses). Replacements are based on the life cycle analysis and actual condition after inspections. Operations retains an Electrical Consultant every 5 years to provide an independent assessment with costs.
- Annual maintenance as required (Spring assessment).

4.11.3 Park Structures:

- Waterplay (Splashpads) are inspected weekly, and crews are in parks at least once a week overseeing the condition of the structures. Structures are inspected weekly as part of maintenance operations with repairs being performed as required on a yearly basis outside of lifecycle replacements.
- Park Amenities: Parks Operations Supervisors are inspecting amenities such as benches, waste receptacles, bike racks, picnic tables, games tables and Moloks as part of their inspections weekly. Parks Operations staff attends to waste receptacles, and recycling bins at least once a week. Moloks are inspected twice a week in

the summer months and monthly throughout the winter season. Condition audits are conducted once a year. Crews are in parks all year emptying trash receptacles (at least once a week), and removing damaged bins. And reporting any damage or repairs necessary.

- Playgrounds: As per CSA guidelines, all 190 playgrounds are inspected monthly and Splash pads are inspected weekly throughout the operating season, with an annual audit performed by consultant. Average asset age is not available as there have been replacements to the older playground and data is not available. Efforts should be made to explore purchasing records at least 10 years back and identify replacement playgrounds, age, costs, and lifecycle.
- Pathways: Existing annual program for resurfacing & stairway repairs with condition assessed once a year, and inspected throughout the summer. The approximate yearly cost based on a 3 year average is \$326,900. There is currently no information on age and inventory of pathways. The maintenance of these assets include but are not limited to grading, adding material, blowing off debris, repairs due to tree roots. An improved inspection program and current inventory is needed to better address life cycle issues.
- Trees (Forestry): Trees for Tomorrow annual program which includes the supply, planting and maintenance of trees for approximately \$120K per year. Block pruning performed every 20 years. Forestry crews respond to residential concerns/inquiries about trees on a regular basis
- Irrigation: A program is in place where the irrigation systems are serviced in both the spring and fall, and repairs are completed throughout the season where needed from inspection on a yearly basis. System is tested in the Spring for leaks and other problems, and again in the Fall when blown out for the Winter. Issues addressed weekly as required.

4.12 FLEET

4.12.1 Existing Asset Management Strategy / Program Description - Overview

Corporate Fleet Maintenance / Management Policy identify the criteria established for the Fleet Replacement and Fleet Refurbishing programs. Both programs are funded through the City's Lifecycle Reserves, the replacement program has an annual amount that varies each year based on the number of units due for replacement as identified in the Fleet Lifecycle Reserve, while the refurbishing program has an annual amount of \$36K. Fleet Services monitor use of assets through specific maintenance schedules and data that highlight fleet and equipment that require replacement. This reduces down time of vehicles and equipment and increases efficiency. Maintenance of fleet and equipment is in accordance with the performance standards set out in the Highway Traffic Act regulations.

Various maintenance programs exist e.g. Fleet refurbishing is an annual program which includes refurbishing and corrosion protection at approximately \$36,000 per year. The activities involved in this process include body work and painting as well as repairs that aid in meeting replacement guidelines.

A Lifecycle replacement program exists which utilizes parameters that identify the most cost effective time period for replacement called the Optimal Replacement Program (ORI). The ORI program considers fleet unit downtime, operating and maintenance costs, reliability and serviceability as factors in performing fleet unit condition audits/assessments identified in each year's replacement program schedule.

4.12.2 Condition Audits

All units are inspected at scheduled preventative maintenance service intervals and tracked in Fleet Maintenance software program flagging exceptions that may accelerate or defer units that are outside set criteria as identified in the Fleet Policy.

4.12.3 Evaluation Criteria

Scheduled maintenance programs with condition assessments along with repair history and downtime are applied to all units.

4.12.4 Service Levels

Fleet Policy guidelines along with manufacturers recommended maintenance schedules are followed for a majority of units. In house maintenance program have been developed to better suit a majority of the severe and

heavy duty applications such as Fire Apparatus, Plow Trucks and some Non-licensed units allowing the ability of the unit to achieve the full asset life expectancy.

4.13 INFORMATION TECHNOLOGY INFRASTRUCTURE HARDWARE

4.13.1 Existing Asset Management Strategy / Program Description – Overview

The City of Markham demonstrates responsive management of Information Technology Services Assets. Unlike most of the City Asset, IT asset types do not display visible physical deterioration over time, however the functional condition decrease over time. In addition the other contributing factor is the changing technology and short useful life, it is not practical to implement a condition monitoring program. The new technology and current performance of the assets drives the current replacement strategy.

The Life Cycle replacement of the asset is based on historical data, industry standards and best practises, as well vendor support for the hardware.

ITS uses various tools for monitoring of the performance of its assets to inform decision-making for asset renewal, replacement, upgrade and disposal. Technology asset concerns are captured on a reactive basis through routine maintenance program executions or problems reported by the user to the internal IT Helpdesk.

4.13.2 Evaluation Criteria

Due to relative short life of IT Assets physical conditions are not key driver for replacement. The technology and maintaining the service level drive the performance measure of the assets. The asset are evaluated as:

- o Excellent condition: When planned maintenance required
- o Good: Significant maintenance (part replacements) are required.
- o Fair: When the Manufacturer has discontinue the Hardware model.
- o Due for Immediate Replacement: Replacement parts are hard to find.

4.13.3 Service Levels

- Current Service levels are driven by commitment to deliver Excellent Customer Satisfaction by providing reliable information and efficient ITS systems at a reasonable cost.
- Service Levels are established as part of the Service Level Agreements within various City business units by understanding the business needs and expectations, delivery of their services and allocating appropriate resources. Service levels are mainly performance-related (response time, incident resolution, information availability, equipment failure, etc). These are based on the business demands.

Service Standards:	<ul style="list-style-type: none"> • Service Requests (via ITS Ticketing System) will be resolved in accordance with the service standards applicable to the request (as specified in the ITS Service Catalogue); • In the case of Critical Network Connectivity issues (Severity 1), all available resources will be assigned to resolve the issue and restore service as soon as possible. • Incidents resolved within set targets (severity-based): at least 85% • Average Customer Satisfaction (from monthly service follow-up survey): at least 75% very satisfied • High severity (Severity 2) incidents will be resolved within 8 business hours; medium severity (Severity 3) incidents will be resolved within 2 business days. • Virus signatures updated within 24 actual hours of global release; • Overall Data Centre System Availability – 99% or better; • Individual Server Availability – 90% or better; • A complete list of services and related service standards is found in the ITS Service Catalogue.
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Availability:	<ul style="list-style-type: none"> • Network connectivity is normally available 24 hours a day, 7 days a week except during scheduled or emergency system maintenance; • Full support services are available 0800-1700, Monday to Friday (excluding Public Holidays); • Network connectivity incidents occurring after hours will be dealt with on a best effort support basis.
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4.14 NON-INFRASTRUCTURE SOLUTIONS

Non-infrastructure solutions are items such as studies, policy development, data collection, condition assessments, consultant exercises etc. that could potentially extend the life of assets or lower total asset program costs in the future.

The City, through the “Safe and Sustainable Community” strategic goal, initiated a corporate project “Sustainable and Integrated Growth”. The corporate project examines policies, processes, practices on how new infrastructure are planned, designed and built to ensure the overall life cycle cost and operational/maintenance impacts are considered. This non-infrastructure project is intended to:

- Enhance communication and approval processes between the departments that built the infrastructure and the departments that maintain and operate the assets for the rest of its life cycle.
- Ensure sustainable planning and infrastructure decision making occurs with consideration on operating and maintenance activities.
- Ensures what is built aligns with City’s growth objectives while minimize overall life cycle cost.
- Active participation from the operating and maintenance departments to influence future built form in growth and intensification areas.

From the completion of Phase I AMP, the gaps in current asset inventory/processes will be identified. A key step for the City is to continue into Phase II of the AMP, which will enhance the current Asset Management Strategy by:

- Developing a plan and addressing the necessary data gaps as identified in Phase I (AMP) for major assets. It is important to allocate resources to complete data collection, condition assessments for assets that have not been completely assessed, reviewed, and estimated.
- Fully documenting Corporate Asset Management Strategy that includes:
 - Approved levels of service (LOS) and performance measures/monitoring matrices
 - Risk management framework
 - Strategic integrated planning (e.g. co-ordinating water & road activity)
 - Other service delivery methods (e.g. partnerships with other municipalities)

The Enhanced Asset Management Strategy will become part of the regular business practices, however, it will take several years to be developed and implemented fully. The high level stages are broken down as follows:

- Stage A - Complete all major missing asset data collection – including inventory, condition auditing, and inclusion into City’s life cycle reserves.
- Stage B: Develop outcome based levels of service (LOS) and a performance management framework at a corporate level that aligns with the City’s strategic objective.
- Stage C: Develop a risk management framework that build on the LOS metrics established in Stage B that can be used to inform maintenance, renewal and capital programming decision making.
- Stage D: Develop maintenance and renewal strategies (e.g. high risk assets, right investment at the right time) that build on the risk management framework established in Stage C.

The sequence of execution, implementation and timing of Phase II will be defined in more detail pending the outcome of the gap analyses from Phase I and associated resource available.

4.14.1 Renewal / Rehabilitation / Replacement / Maintenance Activities

The City’s current renewal, rehabilitation, replacement, maintenance decisions varies significantly by type of asset. It is also dependent on availability of data, understanding of the asset condition, regulatory requirements,

and type of maintenance program associated with the asset. A consistent practice is not practical for every asset due to high variability of the asset and the different levels of service the asset is expected to provide. Some assets may have no life cycle activities (“intervention”) and are simply “run to failure” at the maximum potential life. Other assets may have several technically/economically feasible interventions prior to replacement at the end of the asset life cycle. Typically, as an asset progresses through its life cycle, the initial assumption about the asset’s effective life should be revised through condition monitoring and assessment. However, a process to determine which life cycle activity can be applied at the appropriate time in an asset’s life, to provide the greatest additional life at the lowest cost, i.e. doing the right thing to the right asset at the right time, is a standard technique that should be documented, trained, and executed consistently across entire asset networks or portfolios.

Many of the City’s assets have already implemented detail strategies to ensure the appropriate life cycle activities is applied in a timely manner to minimize the overall life cycle cost, such as roads, vehicle bridges, watermains and sanitary sewers, IT, and facilities. Phase I of the Asset Management Plan is to document these processes and best practices which is described in State of Infrastructure Section.

A review should be conducted for remaining major asset classes to determine if the appropriate strategy is in place that ensure the life cycle activity is timely, effective, and minimizes the overall cost over the life span of the asset. For example, investing in preventive maintenance and regular repair prolongs the service life of municipal infrastructure which helps to prevent premature and costly reconstruction and service disruption. This review will be conducted through Phase II of the City’s AMP for selected major asset classes.

In general, the **current process** of renewal/rehabilitation/replacement activities is planned based on knowledge of asset condition and service level expectations. The planned work is incorporated into the City’s 25 Year Life Cycle Reserve Study annually, which it is then approved through the capital budget process. Maintenance activities, including regularly scheduled inspections, preventive maintenance, and minor repairs are plan and funded from the City’s operating budget. When emergency occurs, the City has a number of ways to fund the work from various reserves and dealt with through the City’s emergency purchase procedure.

The following **guiding principles** serve as a series of parameters around which practices and decisions are formed: (*Source: Victoria Asset Policy Statement*)

- 1. Service delivery needs form the basis of all asset management practices and decisions.**
 - The City’s asset needs are reviewed and prioritized across the organization in a consistent manner to reflect the community’s needs.
 - Assets are to be operated and maintained to meet the desire levels of service.
- 2. An integrated approach to planning (informed decision making, highlight risk management framework)**
 - Asset planning and management are to be integrated into corporate and business plans, and budgetary and evaluation processes.
 - The City’s asset management activities will support the City’s Strategic Plan and documents such as the Official Plan, Greenprint, Integrated Leisure Master Plan, Transportation Master Plan etc.
- 3. Informed decision making**
 - Asset management decisions are to be based on evaluation of all alternatives (including non-infrastructure alternatives) that takes into account all costs incurred through the life cycle of the assets, from acquisition to disposal, and related benefits and risks.
 - Consider integration of assets (e.g. replace sanitary sewer at the same time of road reconstruction), network effects (e.g. saving in wastewater treatment due to water conservation initiatives), investment scheduling (e.g. delaying maintenance activities prior to a reconstruction), and environmental/climate change impacts.
- 4. Accountability and responsibility**
 - Ownership, control, accountability and reporting requirements for assets are to be established, clearly communicated and implemented.

- Evaluation of the contribution of asset management to meet departmental objective is to be part of the performance management.
- Business processes and resources are structured to provide the most efficient management of asset that aligns with Excellence Markham principles.

5. Sustainability

- Planning is to include evaluation of all potential methods, where opportunities to save resources by coordinating solution to multiple problems are to be explored.
- Assets will be optimized throughout the entire lifecycle to meet levels of service in the most cost-effective way.

4.14.2 Disposal Activities

The practice for linear assets is generally to retain the asset and maintain it's life through renewal/ rehabilitation/ replacement activities. Facilities/land is one of the only asset class that may be disposed, the process is managed through the City's Real Property Department of which a business case is prepared to make the decision regarding the disposal of the asset.

4.14.3 Expansion Activities

The City's strategy related to expansion activities is driven by long range planning documents such as the Official Plan, Secondary Plans of subdivision, Master Transportation Plans, Integrated Leisure Master Plan, Culture Strategic Plan, Public Realm Master Plan, Public Art Policy, etc. The long range plans dictates the timing of the growth activities and provide appropriate funding sources (e.g. Development Charges) for the construction of new infrastructure.

4.14.4 Procurement Methods

The City utilizes a number of procurement strategies and delivery mechanism in order to ensure the most efficient allocation of the City's resources. The key strategies include undertaking spend analysis, membership with the York Purchasing Co-operative, and utilizing Supply Chain Ontario's Vendor of Record Arrangements.

The Purchasing Department regularly reviews purchasing card transactions, small invoices less than \$5,000 and purchasing acquisitions between \$5,000 and \$25,000 in order to complete a spend analysis. By collecting, classifying and analyzing expenditure data, goods and contracts sourced from numerous suppliers may be consolidated to reduce procurement cost and increase efficiency.

Membership with the York Purchasing Co-operative allows the City to realize savings by combining individual requirements and seeking bids for larger volumes of goods and services. In addition, one agency within the Co-operative takes the lead and awards the bid on behalf of the group, reducing the workload which would normally be done by each agency.

The vendor of record arrangement provides a list of vendors resulting from a procurement process that meets the requirements of the government procurement directive. An arrangement is valid for a defined time period, with defined terms and conditions and pricing. The arrangement allows the City to leverage the greater buying power of Provincial agencies.

4.14.5 Summary of Planned Actions

The following is summary of planned actions:

#	Action	Timeline
1.	Phase II – AMP: Enhance the current Asset Management Strategy	
1a.	Stage A - Complete all major missing asset data collection (inventory, condition assessment per asset class) <i>Note: refer to State of Local Infrastructure chapter with detail breakdown</i>	2017
1b.	Stage B: Develop outcome based levels of service (LOS) and performance management framework	2017
1c.	Stage C: Develop a risk management framework	2018
1d.	Stage D: Develop integrated maintenance and renewal strategies	2019
2.	Sustainable and Integrated Growth Project	Continuous
3.	Enhancement to Life Cycle Reserve (25 years+)	Continuous
4.	IT infrastructure to assist with the inventory and analysis of city infrastructure: <ul style="list-style-type: none"> • Enterprise Asset Management Software (to store the infrastructure data, work order management system to understand maintenance history etc.) • Asset Management Planning Software (to analyze life cycle costing, integration of assets, overall cost of ownership to inform decision making) 	2017-2018 2018-2019

4.14.6 Risks Associated with the Strategy

The risks associated with the current City of Markham asset management strategy are:

- Lack of resources to proceed into Phase II
- Continual building of infrastructure without consideration of asset management principles
- Large volume of aging infrastructure requiring attention is imminent

5. Financing Strategy

5. FINANCING STRATEGY

5.1 INTRODUCTION

A financial plan is a key component for integrating asset management planning with financial planning and budgeting, and to make full use of all available infrastructure financing tools. As such, the financing strategy outlines the approach the City has taken to ensure adequate funding is available to carry out the asset management strategies outlined in the previous chapters.

The long-term financial strategy for both expenditures and revenue sources is consistent with the City's budget structure. Assets, excluding water and wastewater infrastructure, are included in the City's Life-Cycle Replacement and Capital Reserve Study, a detailed 25-year plan. The Reserve Study is updated annually to ensure adequate funding is available for the rehabilitation and replacement of the City's existing assets. The maintenance activities for these assets are identified in the multi-year operating budget forecast.

The long-term financial strategy for water and wastewater assets is included in the City's Water and Wastewater Reserve Study, a detailed 25-year plan updated annually to ensure adequate funding is available for the operation and maintenance of the system, and the rehabilitation and replacement of the City's existing assets.

Expansion activities are identified in the City's Development Charges Background Study. The Study includes a capital forecast of 10 years for soft services, such as recreation and library facilities, fire services, and parks, and a forecast to buildout (2031) for engineered services, such as roads, sidewalks, and bridges.

This chapter of the Asset Management Plan includes:

- a summary of the City's current financial strategies;
- the impact of funding shortfalls;
- alternative strategies for managing those impacts;
- historic revenue and expenditures; and
- annual forecast of revenues and expenditures.

5.2 FINANCIAL STRATEGIES

A new asset at the beginning of its life-cycle, may be eligible to be financed through Development Charges. However, rehabilitation requirements partway through an asset's life-cycle, and the replacement of the asset at the end of its life-cycle, must be funded through other means. Therefore, the City utilizes various financing tools to support its asset management plan based on the type of asset, and the stage of an asset's life-cycle, from emplacement to maintenance, and eventual replacement.

5.2.1 Development Charges

The City utilizes Development Charges to fund capital projects related to growth throughout Markham so that development pays for its capital requirements to the extent allowed by the *Development Charges Act*. This ensures that additional services required by growth are provided in a fiscally responsible manner.

The City currently levies three types of Development Charges for the recovery of development-related capital costs:

- City-Wide Soft (CWS) Service Development Charges — for the recovery of development-related costs for the provision of general government, library, fire, indoor recreation, parks development and facilities, public works (building, equipment and fleet), and parking services.
- City-Wide Hard (CWH) Service Development Charges — for the recovery of development-related costs for the provision of major roads and related services, including structures, sidewalks, streetlights and special traffic management and design features, as well as storm water management projects (erosion control projects), special projects (streetscaping), and related studies.

- Area-Specific Development Charges (ASDC) — for the recovery of development-related costs for the provision of some roads, intersection improvements, streetlighting, watermains, sanitary sewers, storm water management facilities (storm water ponds), and related studies.

In accordance with the *Development Charges Act*, CWS Development Charges have been calculated at a level no higher than the average service level provided in the City over the ten-year period immediately preceding the preparation of the background study, on a service by service basis.

The By-laws governing the Development Charges rates must be revisited at least every five years, ensuring adequate financing of expansion activities to maintain service levels are recovered.

It is projected that commencing in 2018; \$4M of Federal Gas Tax funding will be allocated to fund the non-growth and discounted portion of the growth-related projects.

5.2.2 Life-Cycle Replacement and Capital Reserve Study

The City implemented its Life-Cycle Replacement and Capital Reserve Study in 2004. The purpose of the reserve study was to address the on-going capital replacements and preventative maintenance of capital assets over their useful lives.

The reserve study uses a rolling 25-year planning horizon. The reserve study is updated annually to identify if there is adequate funding in the reserve based on projected inflows and outflows to sustain future rehabilitation and replacement requirements of the City's existing assets for the next 25 years. For example, the update for 2015 applies to a forecast period of 2016-2040, and the update for 2016 would apply to the period 2017-2041. The use of a rolling 25-year planning horizon provides a number of key benefits to the City's asset management strategy. This allows the City to adapt to changes in asset management practices or asset useful life assumptions. Also, positive reserve balances are invested to generate returns in order to offset the effects of inflation.

The inflows to the Life-Cycle Replacement and Capital Reserve include annual contributions from the operating budget, interest and dividends earned from investments, and Federal Gas Tax funding.

Although the replacement values of assets summarized in the State of the Infrastructure chapter provide a good measure of the quantum of the City's assets, it is not the basis for calculating the future asset rehabilitation and replacement funding requirement over the planning period. The timing and amount of outflows from the Life-Cycle Replacement and Capital Reserve are identified through development of a long-term rehabilitation and replacement program based on the City's asset management strategies. The outflows include the cost of periodic rehabilitation, and required replacements of the City's assets over the 25 year planning period. To estimate the future cost of rehabilitation or replacement of an asset, the current value of this activity is inflated at an assumed rate of inflation.

A cash-flow analysis of the projected inflows and outflows of the Life-Cycle Replacement and Capital Reserve is used to determine the adequacy of the reserve over the 25-year planning horizon. The analysis targets available funding at the time of rehabilitation and replacements, and a revenue neutral position for the reserve at the end of the planning period. If the analysis identifies a shortfall, then the necessary steps are taken to address it, either by increasing the transfer to the reserve or finding mitigating strategies to reduce outflows from the reserve.

5.2.3 User Fee Supported – Water and wastewater Reserve Study

The City implemented the Water & Wastewater Reserve Study in 2007 with the purpose of addressing the ongoing replacement and rehabilitation requirements for Waterworks infrastructure and other Waterworks related capital assets, such as Fleet, Facilities and ITS infrastructure, over their useful lives.

The Reserve Study is updated annually to establish the water and wastewater rate. The rate revenues ensure that there is adequate funding in the Waterworks Reserve to sustain future replacement and rehabilitation requirements of the City's water and wastewater infrastructure for the next 25 years. Rate revenues also finance

the operation and maintenance activities of the water and wastewater systems. The approach is the same as that implemented in the Life-Cycle Replacement and Capital Reserve Study.

The water and wastewater system is self-funded. As such, the sources for annual contributions to the Water and Wastewater Reserve are user rate revenues, revenues from water system related fees, and interest earned on the reserve balance. The water and wastewater rates are reviewed annually and rate adjustments are applied as necessary to ensure adequate funding is available.

5.2.4 Funding Shortfall

Assets with useful lives beyond the study period

Currently, the financing strategies only account for assets due for replacement in the coming 25-year period. Therefore, provisions for rehabilitation or replacement are only made once the scheduled rehabilitation or replacement is within the 25-year period.

Growth-related assets not in service at time of study update

It is estimated that the City's asset base will grow by approximately \$78 million per year until build-out (currently forecasted to be 2031) through capital projects and the assumption of subdivision internal works. Although some of these assets are infrastructure with life-cycle's greater than 25 years, there are assets that require funding within the 25-year period after its initial purchase or assumption, creating a funding shortfall. However, since the Reserve forecast is updated on an annual basis, mitigating strategies can be identified to close the gap.

Infrastructure Funding Gap

It is forecasted that every year the Reserve forecast is updated, there will be a funding shortfall due to new assets being constructed and assumed, as well as accounting for inflation and replacement of assets that were previously outside of the 25 year planning horizon.

Markham will continue to seek out sustainable ways to mitigate the forecasted infrastructure funding gaps to reduce the impact on Markham taxpayers. Potential methods of closing the funding gap are to reduce replacement/rehabilitation costs, extend the lifecycles of assets, and to identify new revenue opportunities. This may involve trying to get increased levels of Federal Gas Tax and/or improved legislative powers from the Province, such as the ability to levy a Land Transfer Tax.

Staff will continue to work with Council to develop a phased approach to reduce the future infrastructure funding gaps.

Assets not yet fully addressed

The City has identified assets that may require additional funding in the future. Some asset categories are managed through annual programs. Annual programs forecast a funding requirement for the group of assets rather than the individual assets within the asset category. The annual programs have identified sufficient funding is available for the next 25 years. The sufficiency of annual programs beyond 25 years is currently being assessed.

Projects related to watercourse management implementation for 13 watercourses are estimated to require \$13.5 million to undertake. However, the need to conduct the remediation work is fully dependant on future development.

Investment in district energy infrastructure

The City of Markham invests in district energy infrastructure and community energy projects through Markham District Energy Inc. (MDEI), a district energy utility owned by the City. Planned investments currently allocate \$4 million of the annual Federal Gas Tax funding towards these projects. The final contribution at this rate is scheduled up to and including 2017. This portion of the annual Federal Gas Tax funding will be re-allocated towards non-growth related projects in 2018 onwards.

Flood control program

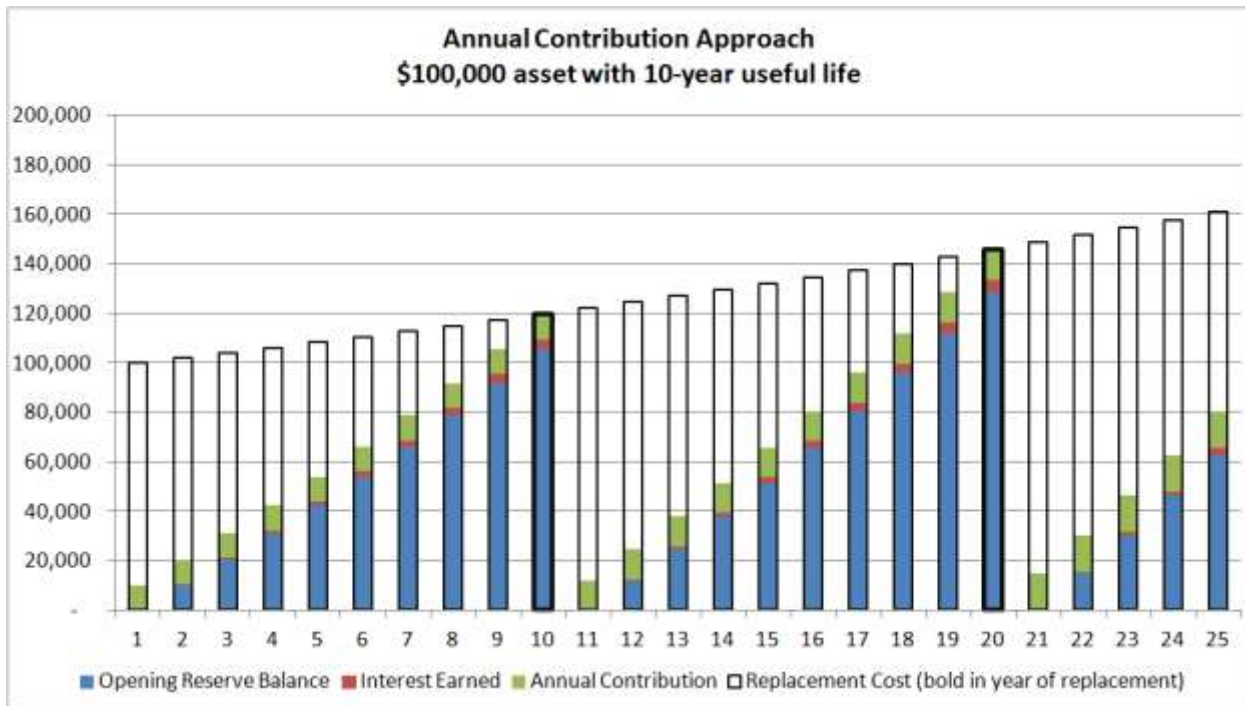
Markham’s Flood Control Program, initiated in 2015, is a long term, City-wide initiative to improve storm drainage capacity and limit surface and basement flooding risks in urban areas. These flood control improvements will be primarily funded through a Stormwater Fee, and charged to all property owners, residential and non-residential. This fee, combined with funds from the Federal Gas Tax, will provide dedicated funds for both approved and future storm infrastructure improvement projects City-wide. The current allocation of Federal Gas Tax funds totals \$2 million per year, up to and including 2018. The program’s financial sustainability is to be reviewed and updated every five years.

5.2.5 Alternative Scenarios

Alternative Funding Strategies

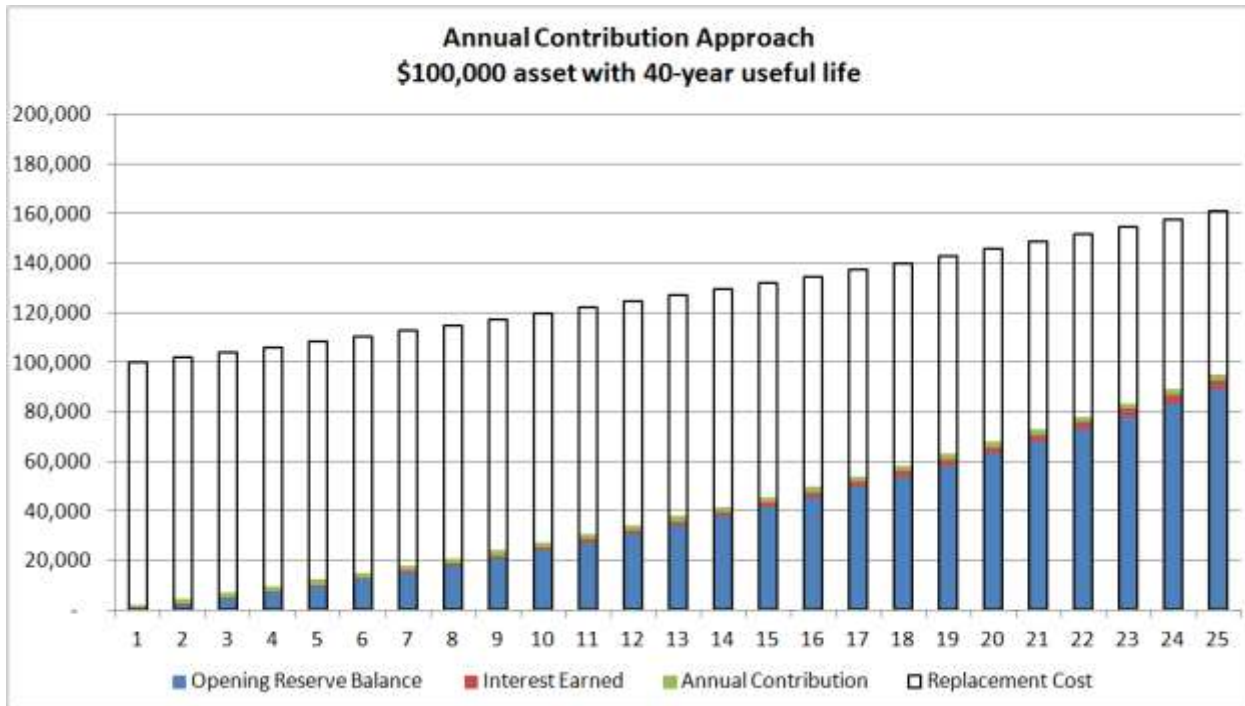
The City is currently in the process of identifying the future replacement requirements and the funding implications for assets with useful lives greater than 25 years that are currently outside the 25-year period. The City is also currently reviewing alternative approaches for determining and ensuring reserve fund adequacy. One such approach is to calculate the required provisions for the funding of future rehabilitation and replacements using an annual contribution methodology. To estimate the future cost of rehabilitation and/or replacement of an asset, the current value of this activity is inflated at an assumed rate of inflation. To ensure adequate funds are available at the time of rehabilitation or replacement of an asset, a calculation is then performed to determine an even annual contribution which, when invested in a reserve fund will increase to match the future cost of rehabilitation or replacement.

The following graph illustrates the alternative approach considered for the Life-Cycle Replacement and Capital Reserve Study, and Water and Wastewater Reserve Study. This example is for a single asset with a 10-year life-cycle and a current replacement value of \$100,000. In this example, an annual rate of 2 per cent for inflation and 4 per cent for investment earnings is assumed.



The example illustrates over the next 25 years, the asset will need to be replaced twice. Although the cost to initially replace the asset is \$100,000 the replacement cost inflates to approximately \$120,000 by the end of the first asset life-cycle, and to over \$145,000 by the time the asset is due for its second replacement. Despite the

increase in replacement cost, planning for these replacements allows for even annual contributions to the reserve (as represented by the green bar segments), and ensures adequate funds are available as the asset comes due for replacement. The future cost of rehabilitation and replacements are accrued over the asset’s useful life. In the example, annual contributions are made for one half of the asset’s third life-cycle replacement, even though the third replacement does not occur in the 25 year planning period. Similarly, annual contributions are accrued for assets with useful lives greater than the 25 year planning period as outlined in the following graph. This example is for a single asset with a 40-year life-cycle and a current replacement value of \$100,000. The future replacement cost of this asset is estimated to be about \$216,000 based on an annual rate of 2 per cent for inflation. Again, a 4 per cent investment earnings rate is assumed.



Fluctuations in capital expenditures are unavoidable due to the differences in useful lives and costs of asset rehabilitation and replacement. Using the annual contribution approach assists in identifying the requirement of a stable funding source, while reducing spikes in revenue requirements due to fluctuations in capital expenditures.

Markham is not currently pursuing this approach as the existing 25-year Lifecycle strategy provides a better balance between placing the funding burden on current and future taxpayers.

Excellence through Efficiency & Effectiveness (E3) – Capital

In 2008, the City launched an initiative – “Excellence through Efficiency & Effectiveness” (E3) – with the objective of developing and implementing a sustainable process to deliver the lowest possible tax rate increases. The E3 initiative involved a corporate-wide business transformation through the review of services to find efficiencies to either maximize revenue opportunities or reduce expenditures, without reducing levels of service. To date, the City was successful in finding efficiencies through the operating budget. Moving forward, a greater focus on the capital and asset management opportunities will be relied upon to reduce funding requirements.

5.3 FINANCIAL MANAGEMENT

5.3.1 Historical Financial Data

The following table outlines the historical maintenance/non-infrastructure costs for 2014 and 2015. All maintenance for waterworks related assets was funded through the water and wastewater user charges, and maintenance for all other assets was funded through taxation.

MAINTENANCE AND REPAIR	2014 Actual	2015 Actual
Expenses		
All Departments (excl. Waterworks)	5,313,345	5,059,719
Waterworks	336,601	317,360
Revenues		
Taxation	(5,313,345)	(5,059,719)
Water and Wastewater Rate Charges	(336,601)	(317,360)
Net Unfunded	-	-

The following table outlines the historical capital expenses for 2014 and 2015, including rehabilitation, replacement, disposal, and expansion activities. The capital funding includes Development Charges, capital reserves, and grants.

REHABILITATION, REPLACEMENT, DISPOSAL AND EXPANSION	2014 Actual	2015 Actual
Capital Expenses		
Rehabilitation, Replacement, and Disposal	(61,822,354)	(54,618,025)
Expansion	(61,205,802)	(60,452,126)
Capital Financing		
Federal Gas Tax	9,839,650	9,957,922
Development Charges	49,244,087	45,116,489
Other External	26,689,765	11,302,587
Capital Reserves (Life-Cycle)	31,540,966	37,349,640
Capital Reserves (Waterworks)	5,713,687	11,343,513
Net Unfunded	-	-

5.3.2 Forecast Revenue and Expenditures

Assumptions

- Federal Gas Tax funding has been identified as a funding source for the incremental asset life-cycle capital program as part of the financing strategy. A key assumption is that the City will continue to receive this funding at the current levels throughout the forecast period.
- The first \$500,000 of taxation assessment growth is allocated to the Life-Cycle Replacement and Capital Reserve.
- Dividends received from investments are consistent with current forecasts.
- Development charges rates are assumed to increase at 2% annually.
- Interest earned on reserve balances will be 2% annually.

- In the case where debt financing is needed, the analysis assumes debt using an annual interest rate of 2.5%. For growth related debt, debt payments are shown as funded directly from the development charge reserve funds.

Appendix A – Cashflow Projection – Capital Rehabilitation, Replacement, Maintenance and Repairs

Appendix B – Cashflow Projection – Waterworks

Appendix C – Cashflow Projection – Development Charges Reserves

Cashflow Projection – Waterworks

APPENDIX B

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	...
Opening Balance	41,473,288	40,777,569	43,587,367	42,131,628	41,124,965	38,432,515	33,041,422	31,392,169	34,151,523	36,845,809	39,802,023	40,074,472	
Interest	1,036,832	1,223,327	1,307,621	1,263,949	1,233,749	1,152,975	991,243	941,765	1,024,546	1,105,374	1,194,061	1,202,234	
Revenue	11,011,305	11,892,464	12,217,994	12,581,920	12,919,429	13,319,377	13,681,237	14,052,709	14,434,039	14,825,479	15,227,288	15,591,231	
Expenditure													
Maintenance & Repair	-399,956	-407,955	-416,114	-424,437	-432,925	-441,584	-450,415	-459,424	-468,612	-477,984	-487,544	-497,295	
Capital Rehabilitation, Replacement, and Disposal	-12,343,900	-9,898,038	-14,565,240	-14,428,095	-16,412,703	-19,421,861	-15,871,317	-11,775,696	-12,295,686	-12,496,654	-15,661,355	-16,900,265	
Subtotal Expenditure	-12,743,856	-10,305,994	-14,981,354	-14,852,531	-16,845,628	-19,863,445	-16,321,733	-12,235,120	-12,764,298	-12,974,639	-16,148,899	-17,397,560	
Closing Balance	40,777,569	43,587,367	42,131,628	41,124,965	38,432,515	33,041,422	31,392,169	34,151,523	36,845,809	39,802,023	40,074,472	39,470,378	
	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Opening Balance	39,470,378	42,699,238	43,760,196	43,074,254	48,919,203	56,683,146	59,139,838	51,927,169	46,163,419	50,451,529	58,449,093	51,433,005	36,880,915
Interest	1,184,111	1,280,977	1,312,806	1,292,228	1,467,576	1,700,494	1,774,195	1,557,815	1,384,903	1,513,546	1,753,473	1,542,990	1,106,427
Revenue	15,963,591	16,344,553	16,734,307	17,133,044	17,540,961	17,958,259	18,385,141	18,821,816	19,268,497	19,725,400	20,192,745	20,670,759	21,159,671
Expenditure													
Maintenance & Repair	-507,241	-517,386	-527,733	-538,288	-549,054	-560,035	-571,236	-582,660	-594,314	-606,200	-618,324	-630,690	-643,304
Capital Rehabilitation, Replacement, and Disposal	-13,411,601	-16,047,187	-18,205,321	-12,042,034	-10,695,541	-16,642,026	-26,800,769	-25,560,721	-15,770,976	-12,635,181	-28,343,983	-36,135,149	-58,503,710
Subtotal Expenditure	-13,918,842	-16,564,572	-18,733,055	-12,580,322	-11,244,595	-17,202,061	-27,372,005	-26,143,382	-16,365,289	-13,241,381	-28,962,306	-36,765,839	-59,147,014
Closing Balance	42,699,238	43,760,196	43,074,254	48,919,203	56,683,146	59,139,838	51,927,169	46,163,419	50,451,529	58,449,093	51,433,005	36,880,915	0

PROJECTED CASHFLOW - DEVELOPMENT CHARGES RESERVES
(excl. non-growth & discounted share)

APPENDIX C

LIBRARY	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Opening Balance	1,828,956	908,102	-2,128,902	524,498	-4,428,558	-2,052,818	1,175,771	4,143,839	7,221,077	9,184,310	11,217,151	6,088,077	4,451,566	6,431,653	7,465,328	8,536,347	9,646,659
Interest	24,160	-69,505	-58,131	-75,315	-184,211	-51,613	59,376	137,926	198,590	248,458	226,766	136,230	128,770	169,591	195,848	223,059	251,263
Revenues	433,125	1,166,917	2,711,531	1,963,279	2,559,952	3,280,202	2,908,692	2,939,312	1,764,642	1,784,383	1,806,283	1,827,258	1,851,317	864,084	875,171	887,253	899,478
Expenditures	-1,378,139	-4,134,417	0	-6,841,020	0	0	0	0	0	0	-7,162,123	-3,600,000	0	0	0	0	0
Closing Balance	908,102	-2,128,902	524,498	-4,428,558	-2,052,818	1,175,771	4,143,839	7,221,077	9,184,310	11,217,151	6,088,077	4,451,566	6,431,653	7,465,328	8,536,347	9,646,659	10,797,400
FIRE SERVICE	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Opening Balance	-991,537	-711,332	-173,842	-4,462,060	-3,485,000	-2,142,193	-345,915	-12,099,948	-10,815,632	-10,093,757	-9,322,372	-11,973,983	-11,271,242	-11,828,424	-9,027,302	-6,041,232	-2,857,042
Interest	-23,181	-42,546	-127,605	-204,665	-152,046	-76,808	-232,075	-578,243	-530,567	-493,358	-541,101	-588,721	-600,397	-542,100	-398,090	-244,581	-80,962
Revenues	303,385	580,036	1,573,844	1,181,725	1,494,853	1,873,087	1,678,042	1,862,560	1,252,441	1,264,743	1,278,391	1,291,462	1,306,455	3,343,223	3,384,160	3,428,771	3,473,906
Expenditures	0	0	-5,734,457	0	0	0	-13,200,000	0	0	0	-3,388,900	0	-1,263,240	0	0	0	0
Closing Balance	-711,332	-173,842	-4,462,060	-3,485,000	-2,142,193	-345,915	-12,099,948	-10,815,632	-10,093,757	-9,322,372	-11,973,983	-11,271,242	-11,828,424	-9,027,302	-6,041,232	-2,857,042	535,902
INDOOR RECREATION	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Opening Balance	-52,130,680	-60,605,938	-78,752,725	-69,458,960	-63,357,082	-54,045,095	-40,724,266	-28,490,198	-15,396,918	-14,588,386	-14,536,267	-6,348,101	-1,603,596	7,410,272	13,716,044	20,259,862	27,054,779
Interest	-1,337,103	-3,641,120	-3,767,239	-3,355,807	-3,019,130	-2,482,285	-1,778,214	-1,118,401	-762,350	-731,555	-567,667	-225,000	39,738	249,461	409,799	576,215	748,984
Revenues	2,086,062	4,166,987	13,061,004	9,457,685	12,331,117	15,803,114	14,012,282	14,211,681	8,553,982	8,649,674	8,755,833	8,857,506	8,974,130	6,056,310	6,134,019	6,218,702	6,304,381
Expenditures	-9,224,218	-18,672,654	0	0	0	0	0	0	-6,983,100	-7,866,000	0	-3,888,000	0	0	0	0	0
Closing Balance	-60,605,938	-78,752,725	-69,458,960	-63,357,082	-54,045,095	-40,724,266	-28,490,198	-15,396,918	-14,588,386	-14,536,267	-6,348,101	-1,603,596	7,410,272	13,716,044	20,259,862	27,054,779	34,108,144

PARK DEVELOPMENT AND FACILITIES	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Opening Balance	46,085,019	43,550,292	27,881,370	24,837,715	24,012,722	17,913,772	8,419,378	-2,542,630	-2,681,076	-2,826,575	-2,979,486	-2,998,486	-2,947,055	-2,811,098	-2,216,510	-1,504,884	-662,468
Interest	567,744	838,381	621,669	572,919	500,003	313,951	80,659	-138,446	-145,499	-152,911	-158,072	-157,694	-153,521	-138,167	-106,152	-68,016	-23,181
Revenues	1,437,682	1,849,123	9,001,322	6,517,978	8,498,546	10,891,656	9,657,333	9,793,021	5,893,603	5,959,533	6,032,676	6,102,727	6,183,080	6,626,357	6,711,381	6,804,034	6,897,778
Expenditures	-4,540,153	-18,356,426	-12,666,645	-7,915,890	-15,097,500	-20,700,000	-20,700,000	-9,793,021	-5,893,603	-5,959,533	-5,893,603	-5,893,603	-5,893,603	-5,893,603	-5,893,603	-5,893,603	-5,893,603
Closing Balance	43,550,292	27,881,370	24,837,715	24,012,722	17,913,772	8,419,378	-2,542,630	-2,681,076	-2,826,575	-2,979,486	-2,998,486	-2,947,055	-2,811,098	-2,216,510	-1,504,884	-662,468	318,525

PUBLIC WORKS	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Opening Balance	13,223,299	13,653,268	13,900,978	15,520,046	6,779,483	-2,729,267	-6,811,084	-10,416,000	-9,689,980	-9,078,171	-10,540,833	-11,235,557	-10,667,735	-10,057,483	-7,713,446	-5,214,545	-2,549,741
Interest	166,573	330,784	361,870	303,486	71,336	-226,923	-417,369	-516,022	-480,042	-502,743	-546,708	-558,063	-528,708	-465,846	-345,331	-216,863	-79,929
Revenues	263,397	411,097	1,366,072	1,025,706	1,297,550	1,625,731	1,456,499	1,621,172	1,091,851	1,102,581	1,114,484	1,125,884	1,138,961	2,809,882	2,844,233	2,881,667	2,919,540
Expenditures	0	-494,171	-108,875	-10,069,755	-10,877,636	-5,480,625	-4,644,046	-379,130	0	-2,062,500	-1,262,500	0	0	0	0	0	0
Closing Balance	13,653,268	13,900,978	15,520,046	6,779,483	-2,729,267	-6,811,084	-10,416,000	-9,689,980	-9,078,171	-10,540,833	-11,235,557	-10,667,735	-10,057,483	-7,713,446	-5,214,545	-2,549,741	289,870

PARKING	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Opening Balance	44,907	51,914	75,399	111,115	-63,801	-35,013	3,112	38,757	84,759	119,196	132,831	139,496	146,328	153,333	160,515	167,879	175,429
Interest	582	1,428	2,224	-336	-2,692	-1,087	456	1,480	2,459	3,195	3,404	3,573	3,745	3,922	4,104	4,290	4,481
Revenues	6,425	22,057	33,493	25,220	31,480	39,211	35,189	44,521	31,979	10,440	3,260	3,260	3,260	3,260	3,260	3,260	3,260
Expenditures	0	0	0	-199,800	0	0	0	0	0	0	0	0	0	0	0	0	0
Closing Balance	51,914	75,399	111,115	-63,801	-35,013	3,112	38,757	84,759	119,196	132,831	139,496	146,328	153,333	160,515	167,879	175,429	183,169

HARD SERVICES	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Opening Balance	25,922,802	26,808,765	7,324,401	15,766,070	5,618,206	-13,873,056	-16,710,579	-26,004,883	-36,738,618	-55,557,923	-44,384,597	-40,227,998	-39,963,996	-33,805,370	-21,808,484	-19,019,114	-15,831,965
Interest	353,657	463,685	275,386	315,238	-180,891	-788,330	-946,222	-1,432,394	-2,218,324	-2,607,936	-2,177,318	-2,040,729	-1,917,789	-1,500,262	-1,069,162	-921,710	-512,004
Revenues	7,395,706	24,769,942	28,011,373	21,482,855	28,024,300	33,212,340	30,596,117	31,044,191	21,309,717	21,490,140	21,690,297	21,881,997	21,788,540	22,988,386	23,218,097	23,468,423	23,124,163
Expenditures	-6,863,400	-44,717,990	-19,845,090	-31,945,957	-47,334,672	-35,261,532	-38,944,199	-40,345,532	-37,910,699	-7,708,879	-15,356,380	-19,577,265	-13,712,124	-9,491,239	-19,359,565	-19,359,565	-6,168,868
Closing Balance	26,808,765	7,324,401	15,766,070	5,618,206	-13,873,056	-16,710,579	-26,004,883	-36,738,618	-55,557,923	-44,384,597	-40,227,998	-39,963,996	-33,805,370	-21,808,484	-19,019,114	-15,831,965	611,326