DISTRICT OF SQUAMISH

2022 ASSET MANAGEMENT PLAN

PREPARED FOR:

DISTRICT OF SQUAMISH
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ATTENTION:

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TERMS AND DEFINITIONS

ASSET	A District-owned entity that forms a part of the District's infrastructure system and provides a valuable service to the community.
ASSET MANAGEMENT	A formalized, integrated, collaborative, and continuous process of bringing together the skills and expertise of people with information about assets and finances, to make informed decisions about public assets so that they support sustainable service delivery. The key best practice in AM is to consider risk, lifecycle cost, level of service, and the trade-offs between them when making decisions about assets and services they provide.
ASSET CONDITION	A measure of the level of service provided by an asset and a factor in the remaining life of the asset. When physical condition is not known, it is assumed to be a function of asset age.
AVERAGE ANNUAL LIFECYCLE INVESTMENT (AALCI)	The replacement value of an asset divided by its service life (for example, an asset valued at $100 with an expected service life of 10 years would be considered to have an AALCI of $10). It is a long-term, high-level indicator of the reserve levels needed to ensure that like-for-like replacement of existing assets can occur, to support long-term sustainable service delivery.
INFRASTRUCTURE BACKLOG	The value of assets that have reached their theoretical service life before 2021 and have not yet been replaced.
LEVEL OF SERVICE	A measure of the quality, quantity, and reliability of a service. Also, the standard to which service is provided and against which performance can be measured. It should reflect technical and regulatory requirements, as well as customer/community expectations.
LIFECYCLE COST	The total cost of an asset over its service life, including planning, design, construction, acquisition, operation, maintenance, rehabilitation, and disposal costs.
REMAINING LIFE	The number of years remaining until an asset reaches its theoretical service life, measured from the year of installation or previous renewal.
REPLACEMENT VALUE	The estimated cost to replace the asset, in 2021 dollars. Note: the replacement values used in this report are suitable for high-level, long-term financial planning; they are not intended for capital planning.
REPLACEMENT FORECAST	A high-level indication of when an asset will need to be replaced or rehabilitated.
REVENUE	The income received by the District from taxes, user fees, government transfers, and other sources. Own-source revenue refers to income received from taxation, user fees, and any interest income.

RISK(S)

Events or occurrences that may have an undesired impact on level of service. Risk = Likelihood x Consequence of occurrence.

SUSTAINABLE SERVICE DELIVERY

An approach to delivering services that ensures that services are provided to the community today in a way that:

- is fiscally, environmentally, and socially responsible
- is adaptive to changing circumstances and future conditions
- does not compromise the ability of future generations to meet their own needs.

THEORETICAL SERVICE LIFE

The number of serviceable years an asset is expected to provide.

USEFUL LIFE

The estimated time that an asset should remain in service to avoid asset failure or excessive maintenance costs.

EXECUTIVE SUMMARY

PURPOSE OF THIS ASSET MANAGEMENT PLAN

The District of Squamish's Asset Management Plan (AMP) is:

- a tool for Council and staff to inform long-term financial planning, decisions on funding levels, communications with the community on service levels and funding needs, and improvements to asset data and asset management processes and practices.
- an update to the District's 2011 AMP. It reflects updates to the District's asset inventory since 2011, and includes recommendations on funding levels and improvements to data based on the asset inventory as of 2021

The AMP answers key questions about the District's assets, services, funding levels, and risks, as summarized below.

WHAT ASSETS DO WE OWN?

Overall, the District is responsible for managing a significant asset portfolio. This portfolio includes approximately 630 km in linear assets, which include water, wastewater, and drainage assets and roads; and approximately 1,400 non-linear assets, which include various facilities, equipment, and other infrastructure. The District is relatively spread out, requiring longer roads, water mains and sewer mains to service the population.

HOW MUCH ARE OUR ASSETS WORTH?

The District has a total engineered asset value of approximately $883 M, the equivalent of over $42,000 per capita. This amount is likely higher than similar sized communities as the District is responsible for its own water supply and sewage treatment facilities, as opposed to communities that receive these services from the regional district. Natural assets provide municipal services estimated to be worth over $1.6B, in addition to the ecosystem services they provide.

WHEN MIGHT OUR ASSETS NEED TO BE REPLACED?

The replacement forecast indicates that many assets will reach the end of their service life in approximately 20 years, suggesting that more significant contributions to reserves may be needed over time than are currently being contributed, to ensure that sufficient funding is available for asset replacement and to mitigate risks to service delivery. It is important to note that this is a conservative, high-level estimation for asset replacement timing to support long-term financial planning and decision-making and is not a capital plan.

HOW MUCH DO WE NEED TO INVEST IN OUR ASSETS?

The District's current funding levels (as measured by contributions to reserves) were compared to the Average Annual Lifecycle Investment (AALCI) for assets in each fund. Practically, the AALCI is the sum of the total replacement cost of each asset divided by its

theoretical service life and is expressed in dollars per year. Conceptually, it is a long-term, high-level indicator of the reserve levels needed to ensure that asset replacement can occur to enable long-term, sustainable service delivery. It is not an indication of actual annual costs or of actual annual spending. It does not include funding needed for addressing impacts of climate change, acquiring new assets or upgrades to assets to accommodate growth or increases in level of service. A key assumption embedded in the AALCI is that assets are replaced like-for like – in this way, it can be viewed as "what we need to take care of what we already have". This is particularly important to note for assets like Facilities, where estimated costs to replace and upgrade assets to a higher level of service may be orders of magnitude higher than the cost to replace them like-for-like (for example, when replacing portables with a more complex facility). The full costs to replace *and* upgrade or acquire new assets to meet level of service and growth demands are considered in the District's Long-Term Financial Plan (LTFP).

The AALCI is sensitive to the assumed service life of the assets, so three different service life scenarios were considered:

- Scenario 1 - Theoretical service life – based on industry standard values
- Scenario 2 - 25% greater service life – this could potentially be achieved in practice through enhanced maintenance programs OR by accepting a higher risk of failure as assets exceed their theoretical service life
- Scenario 3 - 50% greater service life – this could potentially be achieved through even more enhanced maintenance OR by accepting an even higher risk of failure as assets exceed their theoretical service life

Estimating the AALCI for these three scenarios and comparing the results to current funding levels provides an indication of the extent to which the District's current funding levels may be sufficient or present risks to sustainable service delivery over the long term. A summary of the difference between current funding levels and the AALCI under the three scenarios is shown in Table 1a. All costs are in millions (M) in 2021 dollars. Positive values indicate that current funding levels are greater than the AALCI and likely sufficient; negative values indicate that current funding levels are lower than the AALCI and present risks to sustainable service delivery.

Table 1a: Current Funding Levels Compared to the AALCI

Fund	Current Funding Level	Difference Between Current Funding Level and AALCI		
		Scenario 1: Theoretical Service Life	Scenario 2: +25% Service Life	Scenario 3: +50% Service Life
GENERAL	$3,300,000	($5,900,000)	($4,060,000)	($2,830,000)
WASTEWATER	$2,000,000	($2,140,000)	($1,310,000)	($760,000)
WATER	$2,000,000	($910,000)	($330,000)	$60,000
SOLID WASTE	$379,000	$179,000	$221,000	$242,000

The results indicate that:

- Current funding levels for the General Fund are significantly lower than the AALCI across all scenarios, indicating risks to sustainable service delivery if funding levels remain the same. This is a common observation across many municipalities, as there are many high-value services like facilities and flood protection assets that compete for funding in the General Fund.
- Current funding levels for the Water and Wastewater Utility Funds are more closely aligned to the AALCI than the General Fund. This is also a common observation across many municipalities, as water and wastewater utilities provide a dedicated funding stream.
- Current funding levels for the Solid Waste Utility Fund are closely aligned to and even slightly greater than the AALCI under Scenarios 2 and 3, indicating that they are likely sufficient.

WHAT SHOULD THE DISTRICT DO NEXT?

Recommendations based on the information gathered as part of this AMP relate to:

Recommendations on Funding levels

Ultimately decisions on funding levels should be based on consideration for the trade-offs between level of service, risk, and cost. From a best practice perspective, it is recommended that the District:

- Work towards at least the AALCI Scenario 3 funding levels for the General Fund and Wastewater Utility Fund. This funding level represents acceptance of a high theoretical risk of asset failure and impact to service but is the more affordable strategy in terms of taxation levels. With this strategy, the District will likely be considerably reliant on debt and grants to cover replacement costs.
- Work towards the AALCI Scenario 2 funding levels for the Water Utility Fund, or at least maintain funding for water assets at current levels.
- Maintain current funding levels for the Solid Waste Utility Fund.

Implementation of the above would require significantly increasing contributions to reserves for the General Fund, increasing contributions for the Wastewater and Water Utility Funds, and maintaining them for the Solid Waste Fund. Decisions on how to do this, and the role of debt and grants in financing projects, should be contemplated through the development of a long-term financial plan (LTFP), which was underway at the time of finalizing this AMP. Implementing enhanced asset maintenance programs and natural asset management practices (including implementing the District's Natural Asset Management Strategy) can help to manage risks of asset failure and interruption to levels of service.

Recommendations for Improvements to Asset data

Asset management is a continuous improvement process. This AMP update built upon the 2011 AMP, and there remain opportunities to continue to refine the data on which the AMP is based over time. The AMP includes recommendations such as improving information on dikes, undertaking condition assessments and incorporating the information into the asset inventory, and incorporating data from improvements to assets, such as repaving.

Ongoing updates to the AMP

The AMP should be updated every five years to capture new assets acquired through growth, improved data collection (e.g., condition inspections), and changes to financial management strategies.

1.0 INTRODUCTION

1.1 CONTEXT

In 2021, the District of Squamish (the District) initiated an update to its Asset Management Plan (AMP), previously completed in 2011. Drivers for the update include the following:

- A significant amount of community development, infrastructure renewal, and asset management work has taken place since the 2011 AMP. The District has worked on implementing many of the recommendations provided in the 2011 AMP; it has improved its asset inventory; it has participated in annual benchmarking on service performance; and it has completed master plans that identify new and upgraded infrastructure needs in addition to the replacement needs outlined in the AMP.
- It is a best practice in asset management to regularly assess the current state of assets and funding levels to inform decisions on how best to manage them.

The 2021 AMP reflects the District's dedication to continuously improving its understanding of its assets, risks, and costs, and to improve its asset management processes and practices to support informed decision-making and sustainable service delivery.

1.2 PURPOSE AND SCOPE OF THIS PLAN

This AMP summarizes key information about the current state of District-owned infrastructure assets, risks, and funding levels. The AMP answers the following key questions:

- What assets do we own?
- How much are our assets worth?
- When might our assets need to be replaced?
- How much do we need to invest in our assets?
- What should the District do next?

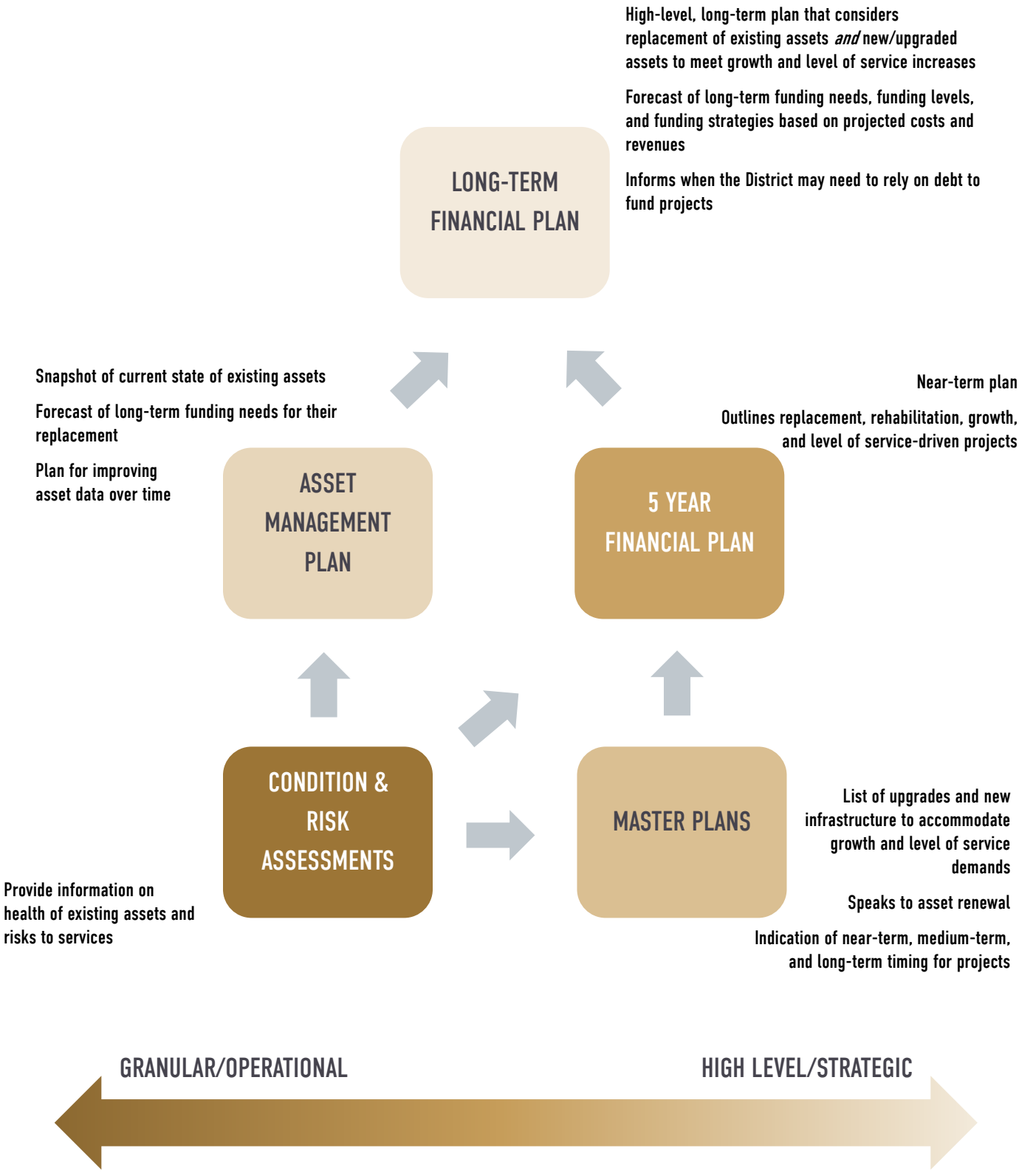
This AMP considers all of the District's existing built/engineered assets. Natural assets also provide valuable municipal services, and so the District has also developed a Natural Asset Management Strategy that includes an inventory and valuation of services provided by natural assets, to inform decisions on management of those assets.

This AMP is:

- **A tool for both Council and staff to inform long-term financial planning and decisions on funding levels, communications with the community about service levels, risks, and funding needs, and improvements to asset data and asset management processes and practices**

This AMP is not:

- **A capital plan that sets out specific projects for the community to undertake**
- **An infrastructure cost tool that can be used to predict exact replacement costs**
- **The sole component of the District's asset management program**
- **A document addressing the requirements of new or upgraded infrastructure to meet the community's growth needs or demands for increased levels of service**


LONG-TERM FINANCIAL PLAN
High-level, long-term plan that considers replacement of existing assets *and* new/upgraded assets to meet growth and level of service increases
Forecast of long-term funding needs, funding levels, and funding strategies based on projected costs and revenues
Informs when the District may need to rely on debt to fund projects
ASSET MANAGEMENT PLAN
Snapshot of current state of existing assets
Forecast of long-term funding needs for their replacement
Plan for improving asset data over time
5 YEAR FINANCIAL PLAN
Near-term plan
Outlines replacement, rehabilitation, growth, and level of service-driven projects
CONDITION & RISK ASSESSMENTS
Provide information on health of existing assets and risks to services
MASTER PLANS
List of upgrades and new infrastructure to accommodate growth and level of service demands
Speaks to asset renewal
Indication of near-term, medium-term, and long-term timing for projects
GRANULAR/OPERATIONAL
HIGH LEVEL/STRATEGIC

1.3 WHAT ASSET MANAGEMENT IS AND WHY IT IS IMPORTANT

Asset management is the formalized, integrated, collaborative, and continuous process of bringing together the skills and expertise of people with information about assets and finances, to make informed decisions about assets and the services they provide. Decisions related to assets should consider level of service, lifecycle cost, and risk (and the trade-offs between them). The goal of asset management is sustainable service delivery. When decisions are made that *don't* consider these factors, they can potentially lead to misalignment between the level of service that is being provided and funding levels required to sustain it. This can result in service interruptions due to failing infrastructure, declining level of service over time, and ultimately, erosion of public trust. Good asset management processes and practices help mitigate these problems.

The asset management process is outlined in the BC Framework for Sustainable Service Delivery. The Framework establishes a high-level, systematic approach to move toward service, asset, and financial sustainability through the AM process. This AMP is an outcome of the District undertaking the "Assess the Current State of Assets" and "Develop an Asset Management Plan" steps in the continuous process.

Asset management is:

- a continuous improvement process
- a forward-looking practice
- a means to an end
- about making informed decisions
- about taking action to make Squamish more resilient and sustainable
- about asset replacement, maintenance, acquisition, and disposal (though this AMP focuses on asset replacement)
- about how people work together to collect, use, and communicate information to make informed decisions

Asset management is not:

- a project or a plan
- a software solution
- tangible capital asset accounting
- an end itself
- just about counting assets and doing condition assessments
- about calculating infrastructure deficits that seem too big to do anything about
- about replacing assets when they fail
- one person's job

2.0 WHAT ASSETS DO WE OWN?

2.1 ASSET INVENTORY

The District has worked to improve the asset inventory since the 2011 AMP resulting in more substantial asset data which is reflected in this AMP update and better reflects existing assets within the District. The methodology and data sources used to compile this inventory are detailed in Appendix A. Table 1 below provides a summary of the District's asset inventory.

Table 1: Asset Inventory (All Funds)

Asset	Quantity
GENERAL FUND	
Facilities	
Facilities/Buildings	18
Drainage/Flood Protection	
Mains	85 km
Pump Stations	6
Dikes	21 km
Fleet & Equipment	
Vehicles and Large Equipment	105
Information Technology	multiple
Parks	
Cemetery Assets	3
Playgrounds/Playing Fields/Other	multiple
Transportation	
Bridges	9
Roads	204 km
Sidewalks	54 km
Streetlights	1200
WASTEWATER UTILITY FUND	
Facilities (Lift Stations)	25
Mains	170 km
Treatment	1
SOLID WASTE UTILITY FUND	
Landfill	1
Facilities (Other Assets)	multiple
WATER UTILITY FUND	
Facilities (Pump Stations)	4
Mains	152 km
Reservoirs	9
Wells (Domestic)	7

An important consideration in asset management planning is asset material, as it is a factor in the theoretical service life of assets. Table 2 provides a summary of material type for the District's linear assets.

Table 2: Asset Material

Material	Quantity	Percent of Infrastructure
DRAINAGE		
PVC	51 km	30%
Concrete	28 km	17%
Other or Unknown	89 km	53%
WASTEWATER		
Asbestos Cement (AC)	65 km	55%
PVC	48 km	41%
Other	5 km	4%
WATER		
AC	48 km	32%
PVC	69 km	45%
Ductile Iron	30 km	20%
Other	5 km	3%

KEY OBSERVATIONS

The District has a diverse set of assets when compared to municipalities of a similar size, specifically a greater number of flood protection and drainage assets. This is largely due to the geography and climate in Squamish, and the fact that the District is self-reliant as a community (as opposed to benefitting from asset sharing as many municipalities in the Lower Mainland do, or those municipalities who receive services from their regional district). Overall, the District is responsible for managing a significant asset portfolio.

2.2 NOTES ON ASSET DATA

- The District has a healthy asset inventory in terms of level of completeness of data; however, asset information is disaggregated across different digital and print sources, including the GIS system (linear assets), Citywide (the system the District uses for Tangible Capital Asset (TCA) reporting), Master Plans (linear and non-linear assets), RDH Building Sciences Inc. report and other reports. Each of these systems are used for different reporting purposes and track data in different ways, resulting in some differences in the data. Due to these differences, it can be difficult to determine which source should be relied on.
- When asset data was not available in the above sources, data was pulled from Citywide. However, the data in Citywide is not as granular when compared to other available sources of data, and so some gaps remained after the varying sources of data were reviewed and synthesized. It is important to note that Citywide is used for TCA reporting which does not require the level of granularity that is desired for the AMP. Where gaps existed, assumptions were made as outlined in Appendix A.
- Opportunities exist to improve the District's asset data sources – see Section 6.2.

3.0 HOW MUCH ARE OUR ASSETS WORTH?

3.1 REPLACEMENT COST

The total replacement cost of the District's existing assets is estimated at $883M (2021 dollars) and is presented by fund below. Replacement costs represent the magnitude of investment required to replace all assets as they exist today, assuming "like-for-like" replacement. Asset replacement costs do not account for additional costs that may be incurred to satisfy growth or level of service increases due to regulatory requirements or other drivers such as safety, economic development, climate change mitigation/adaptation, or other alignment with community goals. Like-for-like replacement costing represents the base cost of the asset at a minimum. It is a known and reliable cost that is suitable for the purpose of this AMP.

The assumptions and methodologies used to develop replacement cost figures are detailed in Appendix A. All values are reported in millions (M), in 2021 dollars.

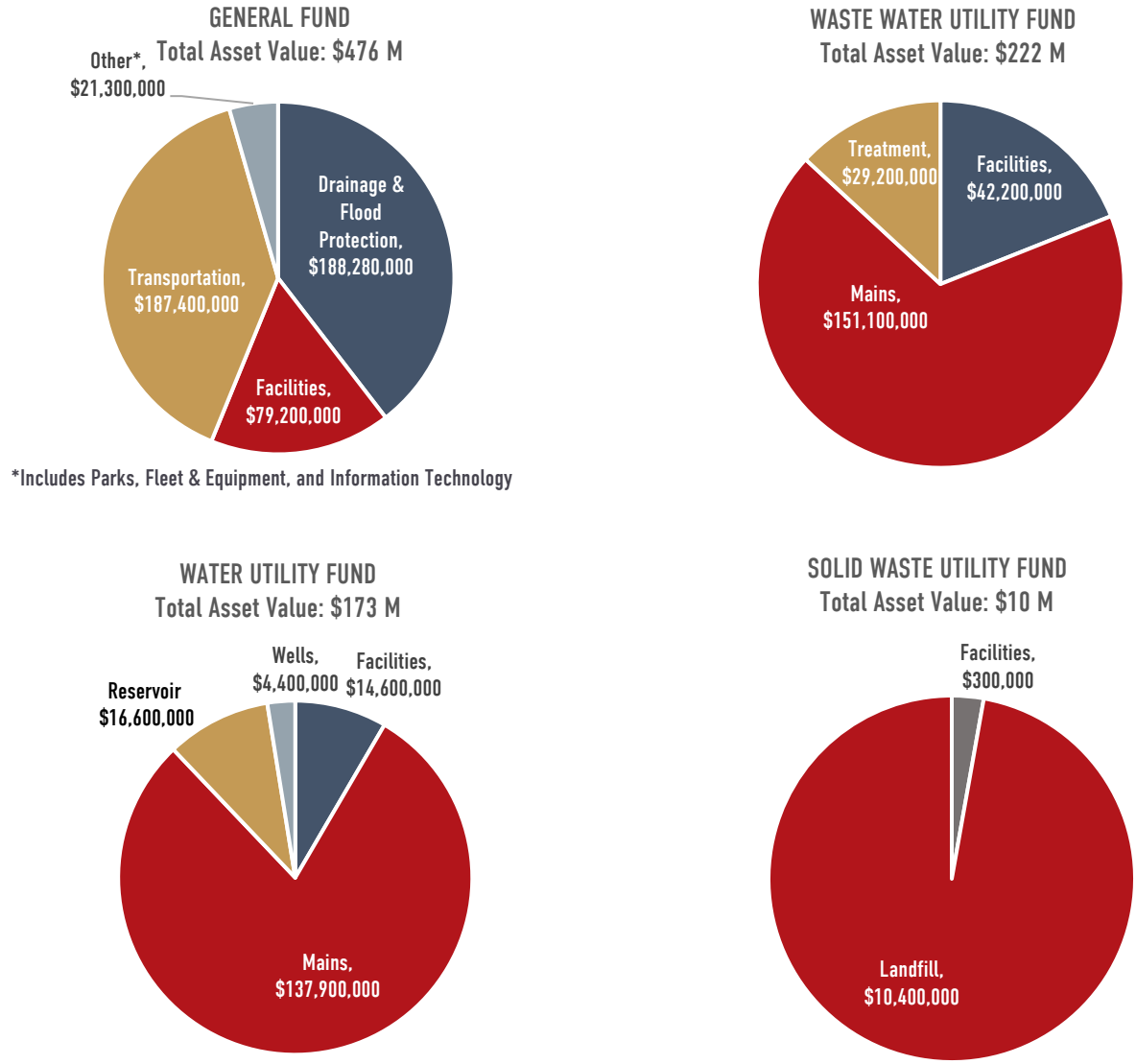


Figure 1: Total Asset Replacement Cost by Fund

KEY OBSERVATIONS

The District has a total asset value of approximately $883 M, the equivalent of over $42,000 per capita. This is a significant increase over the estimated $420 M of replacement cost (2011 dollars, or $437M in 2021 dollars) estimated in the District's 2011 Asset Management Plan. This difference can be attributed to more assets being included in the scope of the current AMP, and due to asset acquisition that has occurred over the past 10 years.

The District's total asset replacement cost is likely higher than similar sized communities due to the fact that the District is responsible for its own water supply, and sewage treatment facilities unlike other municipalities where this responsibility is shared with a regional district. In addition, the geography of the District is relatively spread out requiring longer roads, water mains and sewer mains to service the population.

3.2 NOTES ON ASSET REPLACEMENT COSTING

Replacement costs assume like-for-like replacement – they indicate what it costs to take care of what the District currently owns, to the level of service it was designed to provide. This is an important distinction from the cost to build new assets, particularly assets like facilities, as discussed further below.

The asset valuation was informed by various sources of data:

- Linear water, transportation, and wastewater infrastructure – based on unit rates developed for this project, which are provided in Appendix A.
- Drainage assets – based on the Asset Management Investment Plan included in the Phase 1 Integrated Stormwater Management Plan (ISMP) (Urban Systems, 2019). The 2018 costs in that plan were escalated by inflation to 2021 dollars.
- Facilities/buildings – based on appraisal information for 2020 and escalated to 2021 values. As with the other assets,. The District's Real Estate and Facilities Master Plan (2019) estimates investments in the order of $146M - $176M (in 2021 dollars) may be required to replace existing assets *and* increase level of service due to various drivers such as seismic stability, increased functionality, growth, etc. At the individual asset level, this means that some of the cost estimates in the REFMP may be orders of magnitude higher than the cost to replace the asset like-for-like (for example, when replacing portables with a more complex facility). The full costs to replace *and* upgrade or acquire new assets to meet level of service and growth demands are considered in the District's Long-Term Financial Plan (LTFP).
- Fleet – based on the Fleet Replacement Plan developed by the District.
- Wastewater treatment plant – based on costs included in the Wastewater Treatment Plant Asset Management Plan (GHD, 2020).

- For any assets not included in the studies references above, the historical cost of the asset was pulled from the Citywide database and the costs were adjusted to 2021 values using the Canadian Consumer Price Index (CPI) to reflect inflation.
- All costs are in 2021 dollars. Future replacement costs are subject to change due to inflation, among other factors.

4.0 WHEN MIGHT OUR ASSETS NEED TO BE REPLACED?

4.1 REMAINING ASSET LIFE

Understanding the remaining life of assets supports long-term financial planning and decision-making. When an asset is getting toward the end of its service life, funds will have to be allocated to replacement (or upgrades if required). Understanding the remaining asset life helps the District plan for potentially investment-heavy years. This information can then be used to make decisions on funding and financing strategies, such as increases to contributions to reserves and when the District will rely on debt to finance replacement projects.

To further support financial planning and decision-making, it is helpful to examine both percent remaining life and percent of fund that the assets represent. This helps contextualize the impact of potential asset failure on the overall fund, allowing for informed decision-making on where to prioritize the allocation of resources for asset replacement within funds and on funding and financing strategies, considering all funds. For example, the Mains in the District's Wastewater Utility Fund make up more than two-thirds of the total value of assets in that fund, and have on average, about half of their remaining life left. Managing these assets serves as a significant lever for managing risks within the overall fund. Percent remaining life and percent of fund for the District's assets are shown in the following figures.

For this AMP, asset remaining life was estimated as a function of the installation year and theoretical service life, because available condition data has not yet been integrated into the District's GIS inventory. Theoretical service life estimates are generally based on rule-of-thumb values and are typically conservative; longer service lives may be achieved in practice due to various context dependant factors. Therefore, the remaining life values outlined in this AMP are a general estimation of how much serviceable life is left before the asset may require replacement and are likely conservative. They do not consider the impact of regular maintenance or upgrades, which may extend the service life of the asset, or as indicated above, actual asset condition.

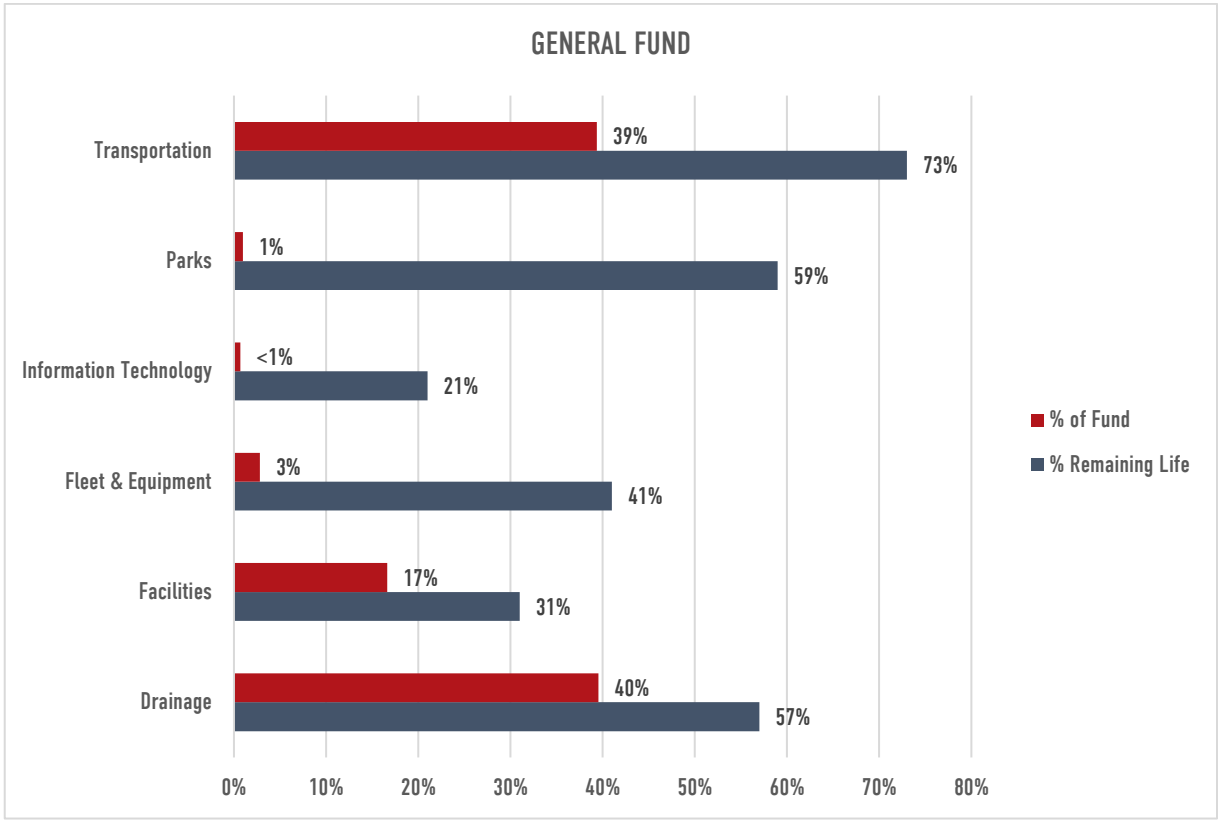


Figure 2: Asset Remaining Life - General Fund

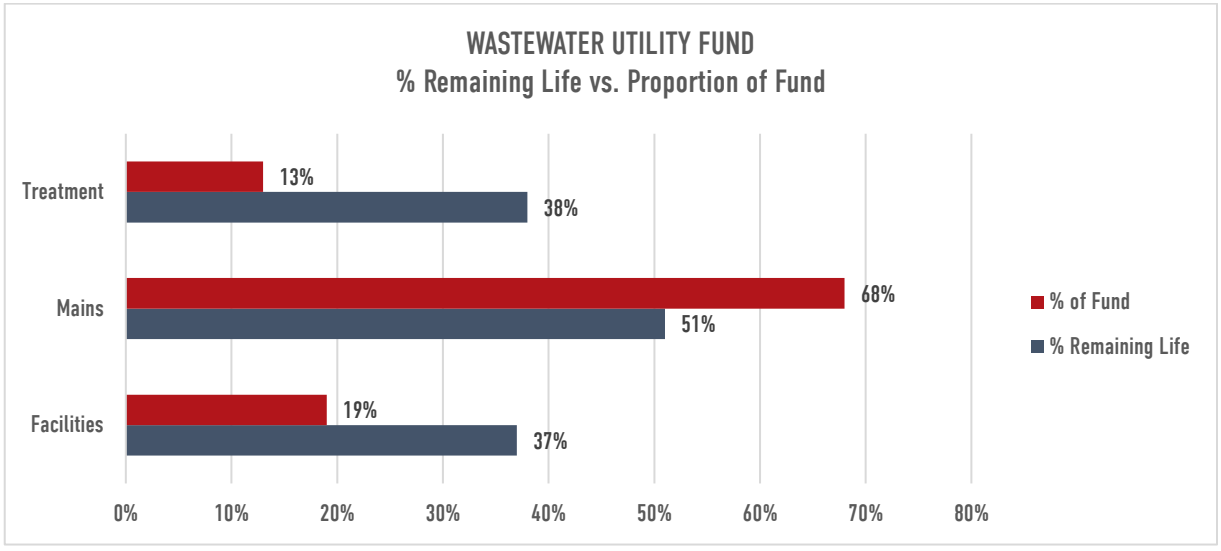


Figure 3: Asset Remaining Life - Wastewater Utility Fund

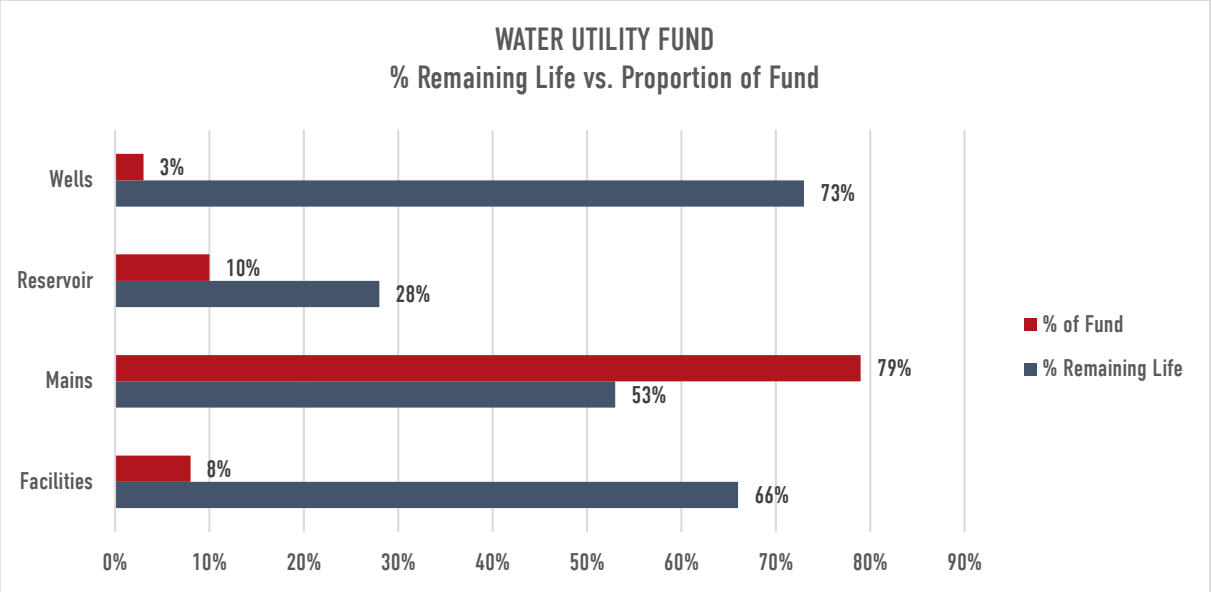


Figure 4: Asset Remaining Life - Water Utility Fund

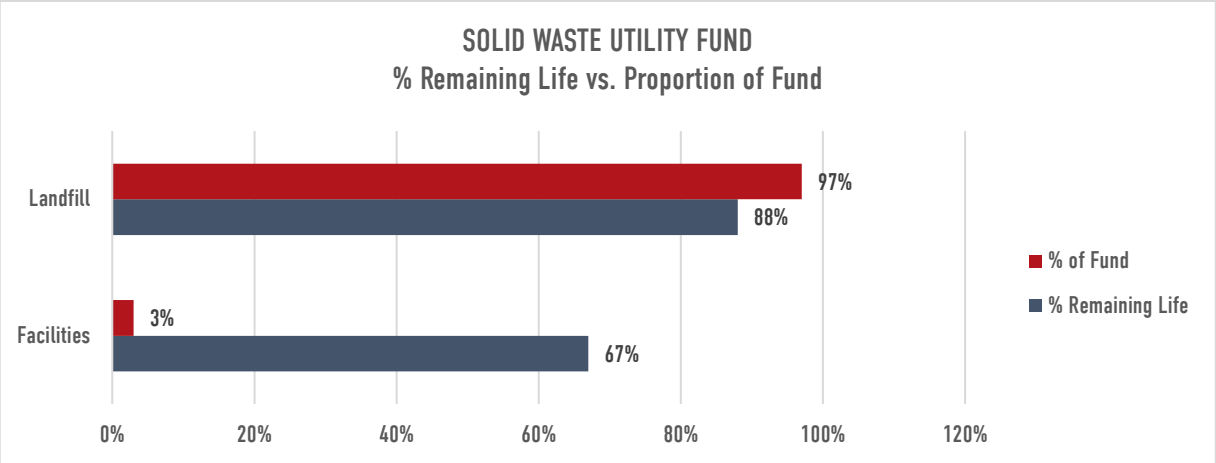


Figure 5: Asset Remaining Life: Solid Waste Utility Fund

The above information is just an indication of remaining life and an estimation of when assets might need to be replaced, for the purpose of informing long-term financial planning and decision-making such as funding and financing strategies. When an asset is actually replaced is a decision that should be based on numerous factors and the trade-offs between them, including but not necessarily limited to asset condition and risk of failure; the cost to replace the asset; other risks to service delivery such as climate change; growth and level of service increases; and needs across asset classes.

4.2 HIGH-LEVEL REPLACEMENT FORECAST

Provided in the graphs below is a high-level, 50-year forecast of approximate asset replacement timing, to illustrate how replacement needs vary over time. As shown, more significant funding needs are anticipated in some years over others, highlighting the need for strategic funding and financing to ensure that funds are available when needed and to manage risks to service delivery associated with asset failure. There is an ebb and flow of investment over the years due to estimated asset lives: some years there may not be costs associated with a specific asset type as replacement in a previous year commences the new service life.

This forecast should be used to inform long-term financial planning decisions – as the data on which the forecast is based is grounded in conservative estimates, the forecast should not be relied upon for capital planning or annual budgeting.

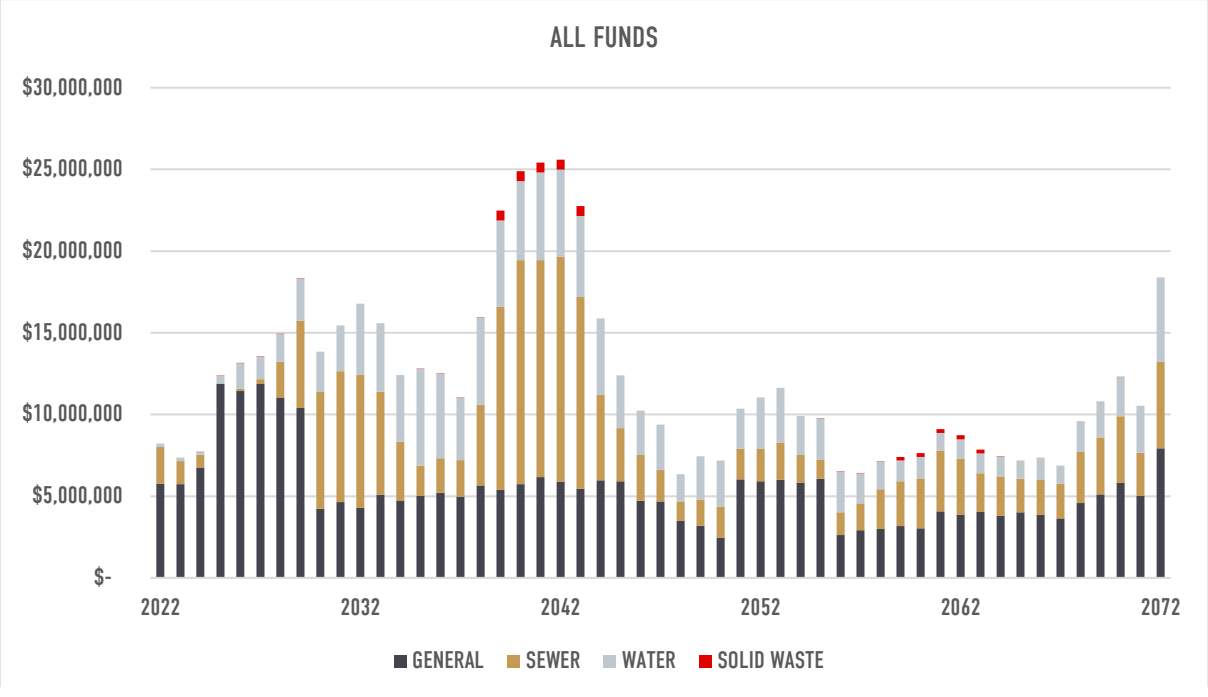


Figure 6: 50-Year Asset Replacement Forecast - All Funds

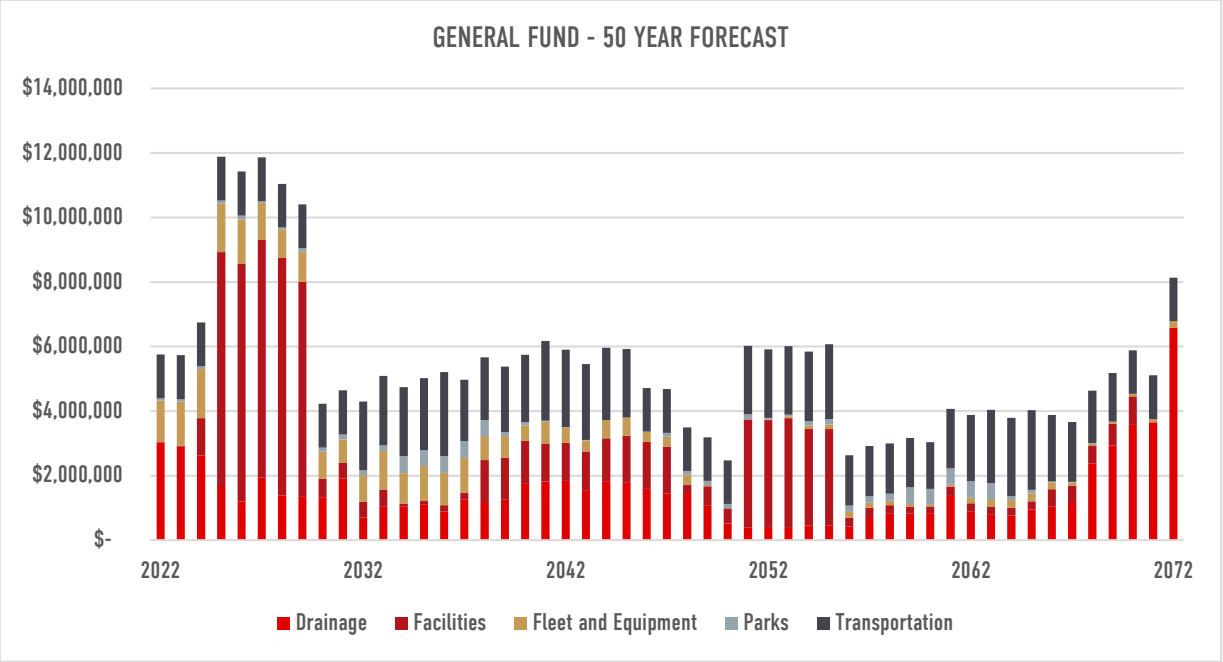


Figure 7: 50-Year Asset Replacement Forecast - General Fund

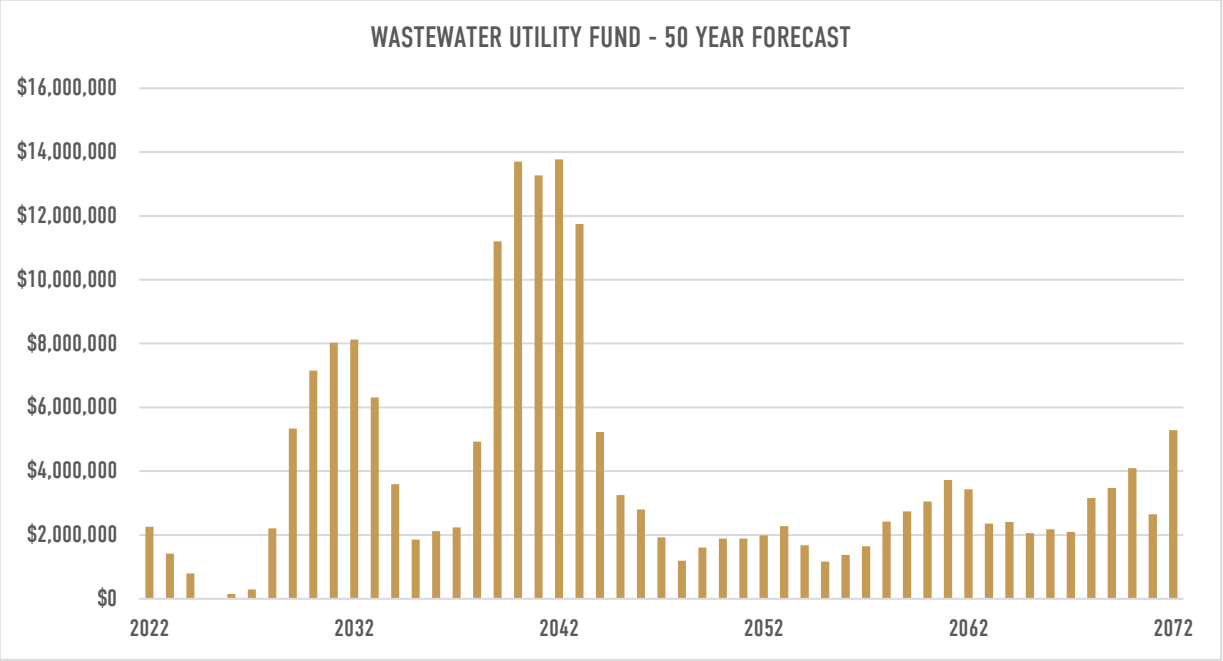


Figure 8: 50-Year Asset Replacement Forecast - Wastewater Utility Fund

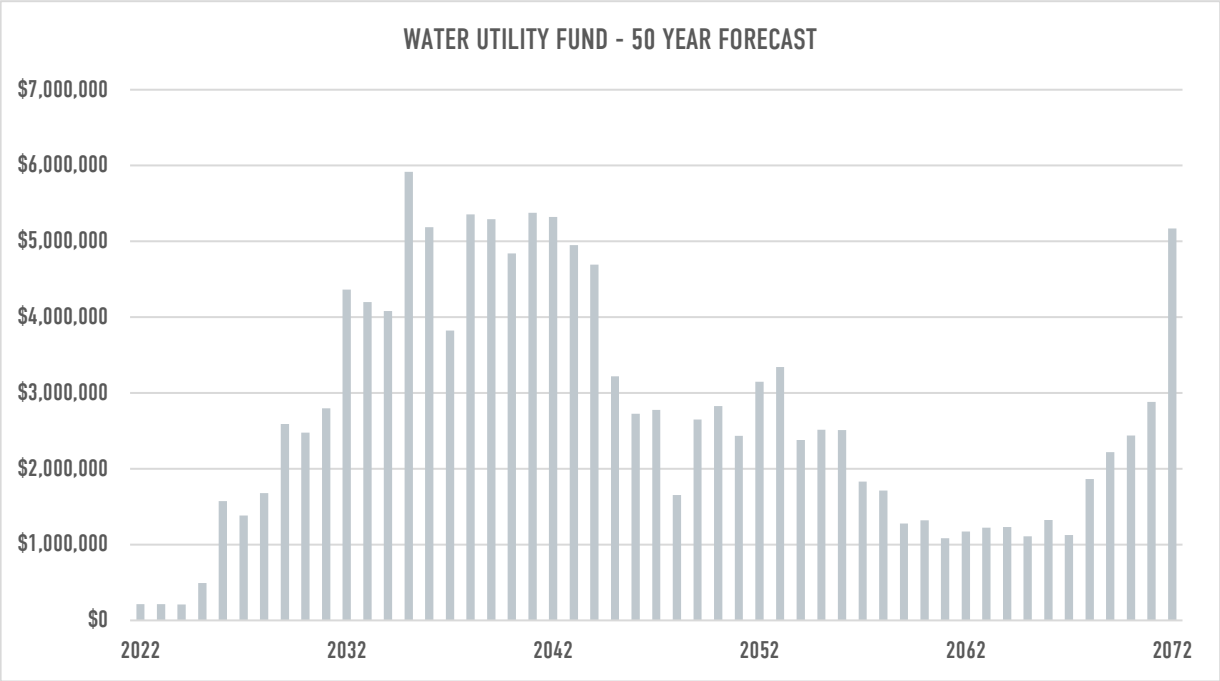


Figure 9: 50-Year Asset Replacement Forecast - Water Utility Fund

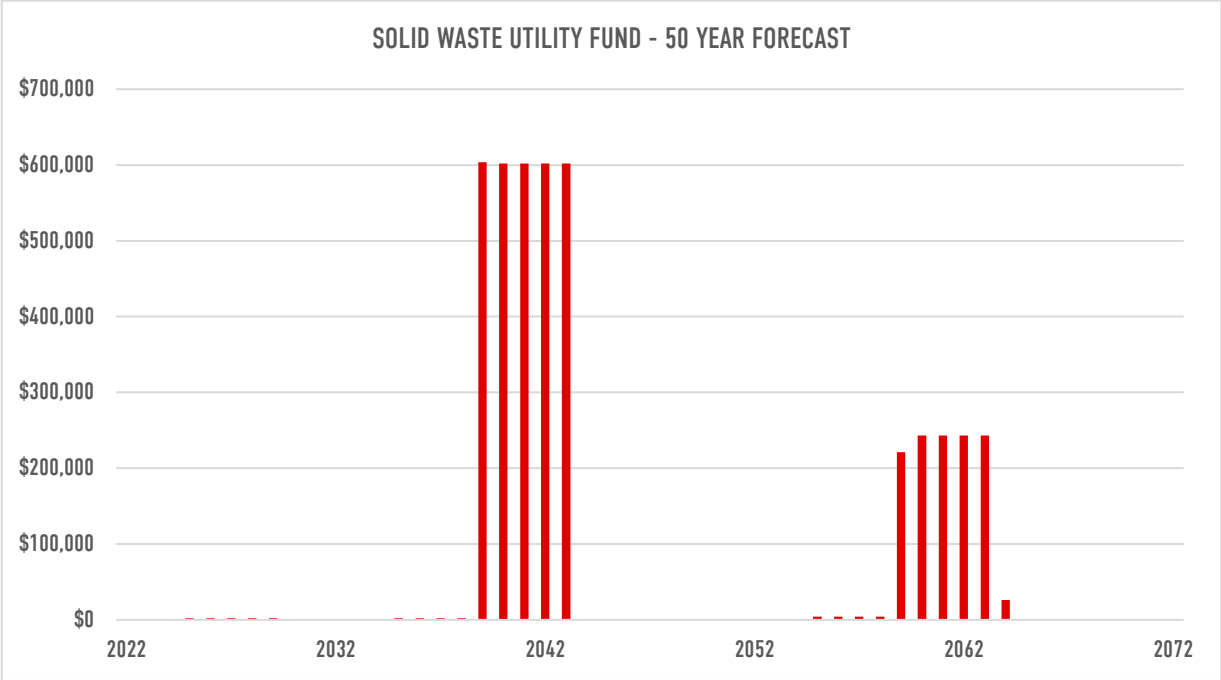


Figure 10: 50-Year Asset Replacement Forecast - Solid Waste Utility Fund

KEY OBSERVATIONS

Given the theoretical remaining life of the District's assets based on asset age, the replacement forecast suggests that more significant funding needs may be seen in approximately 20 years, due to alignment of many assets reaching the end of their service life. This is a conservative, high-level estimation. This forecast can be considerably more refined by incorporating physical condition data into the estimation of remaining life. Doing so requires integrating inspection data into the GIS where it has already been gathered, and then conducting further inspections on more assets to gain a progressively more refined understanding of the health of the District's assets. Risk-based guidance on where to focus efforts is provided below.

An area to note is Facilities within the General Fund. These assets are aging, and it is likely that investment will have to take place in the near future to address this. In addition, some drainage assets appear to be approaching the second half of their lifespan, which may indicate medium-term investment needs for replacement.

4.3 RISK OF ASSET FAILURE

Condition inspections can be expensive, particularly given the large portfolio of assets the District is responsible for. To support decisions on where to prioritize investments in condition inspections, the District should consider the results of the following high-level risk assessment.

Risk is a function of the likelihood (probability) of a negative event happening and the consequence (impact) of that negative event happening. For the purpose of this exercise, risk due to condition-related failure is the primary consideration. Due to lack of inspection-based asset condition data in the GIS, asset age and remaining life were used to estimate likelihood of condition-related failure. Consequence was assessed qualitatively as the magnitude of the financial, social, and environmental impacts if the asset were to fail. A full description of the risk assessment methodology is provided in Appendix B. A summary of risk by asset type is provided in Table 3.

Table 3: Risk Level Associated with Condition-Related Failure

Risk Level	Percent of Linear Assets		
	Drainage	Wastewater	Water
High	1 %	5 %	5 %
Medium	15 %	37 %	37 %
Low	84 %	58 %	58 %

As previously noted, asset age and remaining life were used as a proxy for the likelihood of asset failure due to the lack of condition data available in the GIS. These results should be used to prioritize investments in physical inspections so that a progressively more refined

understanding of asset condition and risk can be gained. This can then be used to inform capital planning and maintenance planning decisions.

NOTES ON REMAINING LIFE ESTIMATION

The remaining life estimates were informed by various sources of data:

- For the water, wastewater, and drainage linear assets, asset age and theoretical service life informed the remaining life value. More detailed methodologies were utilized to estimate remaining life within the Water Master Plan and Sewer Master Plan for capital planning purposes.
- For roads, the remaining value was based on the Pavement Quality Index from the Pavement Master Plan (2018). This master plan was relied upon as opposed to installation date in the GIS inventory, as the installation date in the GIS inventory currently does not reflect the dates of repaving or rehabilitation and relying on the GIS data would lead to underestimating the remaining life for roads.
- For the other assets, assumptions are provided in Appendix A.
- It is understood that the District is currently evaluating software technology for managing information. A suggested process for moving forward in that evaluation is outlined in Appendix C.

Industry standard theoretical service lives are generally conservative estimates. With proper maintenance, assets can last longer than their theoretical service life; conversely, some assets may fail prior to this point.

5.0 HOW MUCH DO WE NEED TO INVEST IN OUR ASSETS?

5.1 METHODOLOGY

There is no easy answer to what the "right" investment level in long-term asset replacement is. The decision requires thoughtful review and consideration of the trade-offs between cost, risk, and level of service. The preceding sections provided an overview of costs through the lens of replacement cost, and risk of condition-based failure based on asset age. This section provides an assessment of cost, risk, and the District's capacity for investment, through an evaluation of two key indicators:

- Average Annual Lifecycle Investment (AALCI) – The AALCI is the sum of the total replacement cost of each asset divided by its theoretical service life and is expressed in dollars per year. It is a long-term, high-level indicator of the annual funding needed to ensure that like-for-like replacement of existing assets can occur when needed, to mitigate risks and sustain services. It is not an indication of actual annual costs or of actual annual spending. It does not include funding needed for new assets or upgrades to assets to accommodate growth or increases in level of service – it can be viewed as "what we need to take care of what we already have".
- Difference between current funding levels and AALCI – both are annual costs and a high-level comparison between them provides an indication of the extent to which current funding levels may be sufficient over the long term for asset replacement or present risks to sustainable service delivery.

The AALCI is sensitive to assumptions on asset replacement cost and service life. The shorter the service life/faster the replacement cycle, the higher the AALCI. The industry standard theoretical service lives for assets are likely conservative as previously discussed, and in practice, assets could last much longer, which will reduce the resulting AALCI. As such, three scenarios are considered for the AALCI for the District's assets:

- Scenario 1 - Theoretical service life – based on industry standard values for theoretical service life as outlined in Appendix A
- Scenario 2 - 25% greater service life – this could potentially be achieved in practice through enhanced maintenance programs OR by accepting a higher risk of failure as assets exceed their theoretical service life
- Scenario 3 - 50% greater service life – this could potentially be achieved through even more enhanced maintenance OR by accepting an even higher risk of failure as assets exceed their theoretical service life

5.2 AVERAGE ANNUAL LIFECYCLE INVESTMENT

Tables 4 to 7 below summarize the AALCI for the District by fund, for each of the three scenarios. Key considerations when reviewing the results include:

- The AALCI is used for long-term financial planning. The District's Master Plans provide more detailed information for asset needs in the next 10 years and are more reliable for near-term capital and financial planning. The AALCI is used to transition from those more precise near-term Master Plan cost estimates to longer-term cost estimating and financial planning. The AALCI is a tool that can encourage saving for future rehabilitation and replacement.
- The AALCI is not an indicator of actual annual capital spending. This may be higher or lower depending on the stage of the asset's lifecycle. Newer assets require annual spending that will be less than the AALCI and older assets will require annual spending which will exceed the AALCI. In years of lower spending the portion of the AALCI (if translated to actual funds) not spent in the current year should be directed towards reserves that can be drawn on in later years to balance when spending exceeds the AALCI.
- The AALCI contemplates the reserve continuity over the long term (20 years). The District has examined the reserve continuity over the short-term (the next five years) and understand needs within that timeframe.
- The AALCI represents funding levels needed for replacement of existing assets, assuming like-for-like replacement (with some exceptions on materials as outlined in Appendix A). The District has numerous master plans that outline requirements for upgrades to existing infrastructure and for new infrastructure to meet growth and level of service demands from the community. Any upgraded or new infrastructure acquired by the District will incur a future replacement cost that would affect future calculations of the AALCI – it is an ever-evolving value.
- Values in Tables 4 to 7 are in 2021 dollars and will need to be adjusted for inflation for future costing. Since inflation is difficult to predict, it is recommended that the AMP be updated at least every five years.

GENERAL FUND

Table 4: General Fund AALCI Summary

Asset Category	AALCI			Replacement Cycle (Years)
	Scenario 1: Theoretical Life	Scenario 2: +25% Service Life	Scenario 3: +50% Service Life	
Drainage/Flood Protection	$ 2,560,000	$ 2,050,000	$ 1,710,000	74 to 110
Facilities	$ 1,880,000	$ 1,500,000	$ 1,250,000	42 to 63
Transportation	$ 3,300,000	$ 2,630,000	$ 2,190,000	35 to 52
Roads	$ 1,980,000	$ 1,580,000	$ 1,320,000	75 to 110*
Bridges	$ 480,000	$ 380,000	$ 320,000	55 to 80
Sidewalks	$ 290,000	$ 230,000	$ 190,000	75 to 110
Signage & Signals	$ 260,000	$ 210,000	$ 170,000	25 to 40
Streetlights	$ 290,000	$ 230,000	$ 190,000	40 to 60
Fleet & Equipment	$ 1,010,000	$ 820,000	$ 680,000	13 to 19 (Fleet) 22 to 33 (Equip.)
Parks	$ 180,000	$ 140,000	$ 120,000	26 to 38
Information Technology	$ 270,000	$ 220,000	$ 180,000	12 to 18
TOTAL	**$ 9,200,000**	**$ 7,360,000**	**$ 6,130,000**	

Note: The lifespan for roads is based on full surface reconstruction. In reality, the District will likely undertake more frequent and less costly treatments as directed by the pavement management plan (PMP).

WASTEWATER UTILITY FUND

Table 5: Wastewater Utility Fund AALCI Summary

Asset Category	AALCI			Replacement Cycle (Years)
	Scenario 1: Theoretical Life	Scenario 2: +25% Service Life	Scenario 3: +50% Service Life	
Mains	$ 2,060,000	$ 1,650,000	$ 1,370,000	73 to 100
Facilities	$ 1,390,000	$ 1,110,000	$ 930,000	36 to 51
Treatment	$ 690,000	$ 550,000	$ 460,000	
TOTAL	**$ 4,140,000**	**$ 3,310,000**	**$ 2,760,000**	

WATER UTILITY FUND

Table 6: Water Utility Fund AALCI Summary

Asset Category	AALCI			Replacement Cycle (Years)
	Scenario 1: Theoretical Life	Scenario 2: +25% Service Life	Scenario 3: +50% Service Life	
Mains	$ 1,950,000	$ 1,560,000	$ 1,300,000	70 to 106
Facilities	$ 470,000	$ 380,000	$ 310,000	38 to 57
Reservoirs	$ 380,000	$ 300,000	$ 250,000	
Wells	$ 110,000	$ 90,000	$ 70,000	
TOTAL	**$ 2,910,000**	**$ 2,330,000**	**$ 1,940,000**	

SOLID WASTE UTILITY FUND

Table 7: Solid Waste Utility Fund AALCI Summary

Asset Category	AALCI			Replacement Cycle (Years)
	Scenario 1: Theoretical Life	Scenario 2: +25% Service Life	Scenario 3: +50% Service Life	
Landfill	$ 190,000	$ 150,000	$ 130,000	43 to 66
Facilities	$ 10,000	$ 8,000	$ 7,000	
TOTAL	**$ 200,000**	**$ 158,000**	**$ 137,000**	

5.3 COMPARISON TO CURRENT FUNDING LEVELS

For this AMP, current funding levels are contributions to reserves provided by the District for long-term financial planning purposes. A comparison between these values and the AALCI under the three AALCI scenarios is provided in Table 8. All costs are in millions (M) in 2021 dollars. Positive values indicate that current funding levels are greater than the AALCI and likely sufficient; negative values indicate that current funding levels are lower than the AALCI and present risks to sustainable service delivery.

Table 8: Annual Contributions to Reserves Versus AALCI

Fund	Current Funding Level	Difference Between Current Funding Level and AALCI		
		Scenario 1: Theoretical Service Life	Scenario 2: +25% Service Life	Scenario 3: +50% Service Life
General	$3,300,000	($5,900,000)	($4,060,000)	($2,830,000)
Wastewater	$2,000,000	($2,140,000)	($1,310,000)	($760,000)
Water	$2,000,000	($910,000)	($330,000)	$60,000
Solid Waste	$379,000	$179,000	$221,000	$242,000

When interpreting the results, it is important to note that:

- The three scenarios for which the AALCI was calculated and then compared to current funding levels are ultimately arbitrary. They simply aim to illustrate the trade-off between cost and risk – how the AALCI decreases as assumed service life increases and greater potential risk of asset failure is accepted by a longer assumed service life.
- Comparing current funding levels to the AALCI for these different service life scenarios aims to help the District understand the risk it is implicitly taking on with its current funding levels, and make informed decisions about whether and how to increase funding for asset replacement or accept the risk. For example, if the District were to set the Scenario 3 AALCI for the General Fund as a funding level target, it would implicitly be assuming that the assets in its General Fund will last 50% longer than the industry standard theoretical value and accepts the risk associated with this. This risk can be mitigated through practices like enhanced maintenance.
- Other funding mechanisms can also be relied on for asset replacement and upgrades – contributions to reserves are just one of those options.

KEY OBSERVATIONS

General Fund

- Current funding levels are significantly lower than the AALCI across all service life scenarios. This situation is similar to many other municipalities. The General Fund is used to fund a wide range of services, provided by assets with significant replacement value such as facilities and flood protection assets, and these services compete for funding. Municipalities should maintain a healthy reserve balance in consideration of these varied assets.
- At current funding levels, the District assumes that assets within this fund will last substantially longer than industry standard theoretical service life. There is implicit risk to sustainable service delivery in these funding levels. More detailed information on actual asset condition will help the District better understand the risk.
- The AALCI presented does not take into consideration upgrades to assets or new assets to meet growth or level of service increases for any driver. The AALCI scenarios are provided as a high-level gauge of what it costs to take care of what the District currently owns. As outlined in the District's REFMP, actual costs to replace Facilities assets will in many cases be orders of magnitude higher as existing assets will be replaced with assets designed to provide a much higher level of service. These higher-cost assets will significantly add to the AALCI over time. How these new assets will be funded will be considered as part of the District's LTFP.
- The District should begin working toward at least the Scenario 3 AALCI as a target funding level. This is fiscally conservative but assumes that assets last 50% longer

than theoretical values and at this level, a high level of risk of asset failure is still implicitly tolerated, as assets approach and exceed their theoretical life (though this risk would still likely be lower than current risk at current funding levels). Enhanced maintenance with commensurate funding can help extend the service life of assets in the General Fund. How this is done will be considered as part of the LTFP.

- A funding gap in the General Fund was also identified in the 2011 AMP, with recommendations made to increase average annual revenues either through an immediate increase of 12% or a gradual increase of 3% to 14% from 2011 to 2040. To date, these recommendations have not been implemented and the result is a widening funding gap in the General Fund. Without implementation of a mechanism to increase annual revenues, this gap is expected to widen over time.

Wastewater Utility Fund

- Contributions to reserves in the Wastewater Utility Fund are showing a gap under all scenarios. At current funding levels, the District assumes that assets within this fund will last substantially longer than industry standard theoretical service life. The District could incrementally progress towards more sustainable funding levels by setting the 50% AALCI as a funding target.
- Based on the District's Reserve Continuity Schedules, it is apparent that the District is addressing its current wastewater deficit. Once this deficit is addressed, the District can then begin to cushion the reserve funds for future capital spending.

Water Utility Fund

- Contributions to reserves in the Water Utility Fund are showing a gap under Scenarios 1 and 2, and a slight surplus ($60K) under Scenario 3. This indicates that current funding levels generally align with an assumption of service life lasting 50% longer than industry standard theoretical values. The District could incrementally progress towards more sustainable funding levels by setting the 25% AALCI as a funding target.
- Overall the funding gaps for Water and Wastewater are narrower than for the General Fund. This highlights the impact of increases to revenues the District has implemented since the 2011 AMP was developed, which recommended immediate increases of 68% or incremental increases of 15% to 75% from 2011 to 2015 for the Water Utility, and 58% and 13% to 64% for the Wastewater Utility, respectively. Such action makes a significant difference in the overall financial health of the District and sustainability of services.

Solid Waste Utility Fund

- Contributions to the reserves for the Solid Waste Utility Fund show that the contributions are net positive even for the Scenario 1 AALCI, indicating that replacement could theoretically occur on a faster cycle than expected by industry standards. It is important to note that at this time, the District is not planning to contribute over the next few years, which could create a funding backlog. Over the long term, the District should look to maintain its current funding levels or it will accept greater risk of asset failure and a potential decrease in service from current levels.

6.0 WHAT SHOULD THE DISTRICT DO NEXT?

6.1 CONCLUSIONS FROM THE CURRENT STATE ASSESSMENT

The District is responsible for the management of a significant asset inventory for a community of its size, at a value of approximately $883M. The District also has significant growth pressures, bold community goals, and a changing demographic that is driving level of service demands. There are a lot of competing priorities to be considered and resources are finite. As the District takes on new assets, its financial obligations for asset replacement (and ongoing operation and maintenance) will grow, highlighting the importance of strategic financial planning to deliver services sustainably over the long term.

When compared to the 2011 AMP, the District has made efforts towards closing the funding gap for its Water Utility Fund and Wastewater Utility Fund has shown in the updated funding comparison. The General Fund remains underfunded and the gap has widened. This is an area that the District can aim to make improvements in.

The estimated remaining life of the District's assets is good overall, indicating that significant near-term expenditures are likely not required, in general. However, analysis indicates that the District should pay attention to Facilities and Drainage (both within the General Fund) as some significant replacement costs are likely in the nearer term. Based on the high-level 50-year forecasting, the District can anticipate infrastructure rehabilitation or replacement needs for multiple asset types in approximately 20-years. The District is starting to plan for these financial needs through the development of a Long-Term Financial Plan.

The District's contributions to reserves in the General Fund indicate that the District implicitly assumes that its assets will deliver services over a substantially greater lifespan than theoretical values. Current funding levels are lower than the 50% AALCI, which is fiscally conservative but potentially high risk (in terms of accepting risk of condition-related asset failure). Most other funds are matching the 25% AALCI or would need a slight increase to match the 25% AALCI.

The District is currently following funding guidance provided in many of its Master Plans. These plans provide a more precise indication of near-term funding levels. Progression towards at least the 50% AALCI for the General Fund over the longer term will support longer-term sustainable service delivery, and help reduce the current risk of financial impact when asset replacement is required.

6.2 RECOMMENDATIONS

As previously stated, this AMP is a tool for both Council and staff to inform long-term financial planning, decisions on funding levels, communications with the community on service levels and funding needs, and improvements to asset data and asset management processes and practices. This AMP will inform the development of a Long-term Financial Plan and assist the District with making sustainable funding decisions for the long-term benefit of the community.

RECOMMENDATIONS ON INVESTMENT LEVELS

1. The District should prepare Master Plans for all critical asset classes and follow the guidance provided in Master Plans to inform near-term funding levels.
2. Work towards at least the AALCI Scenario 3 funding levels for the General Fund and Wastewater Utility Fund, which means assuming that assets last 50% longer than theoretical lifespan. This funding level represents acceptance of a high theoretical risk of asset failure and impact to service but is the more affordable strategy in terms of increases to taxation and user fees. With this strategy, the District will likely still be considerably reliant on debt and grants to cover replacement costs as they occur.
3. Work towards the AALCI Scenario 2 funding levels for the Water Utility Fund, or at least maintain funding for water assets at current levels.
4. Maintain current funding levels for the Solid Waste Utility Fund.
5. Develop a long-term financial plan (LTFP) based on the proposed funding increases in order to provide adequate capital and operating budgets to enable timely asset replacement.

Implementation of the above would require significantly increasing contributions to reserves for the General Fund, increasing contributions for the Wastewater and Water Utility Funds, and maintaining them for the Solid Waste Fund. Decisions on how to do this, and the role of debt and grants in financing projects, should be contemplated through the development of the LTFP, which was underway at the time of finalizing this AMP.

Implementing enhanced asset maintenance programs and natural asset management practices (including implementing the District's Natural Asset Management Strategy) can help to manage risks of asset failure and interruption to levels of service.

RECOMMENDATIONS FOR IMPROVEMENTS TO ASSET DATA

6. Update the installation dates of road assets in the GIS to reflect replacement and rehabilitation conducted on those road assets.
7. Incorporate condition data gathered on assets into the City's GIS (e.g., CCTV data gathered on linear assets and PQI ratings from the Pavement Management Plan for roads).
8. Move towards a single source of truth for non-linear assets, as much of the information is spread across multiple formats and documents. These documents occasionally contradict each other. It would be best for accessibility and clarity that one source of data be compiled and relied upon to support asset management planning.
9. Conduct inspections on assets identified as (theoretically) high-risk, with a focus on assets made of AC and corrugated metal. Assets that made of AC and with a diameter of less than 200mm should be a particular focus.
10. As inspections are conducted, require that contractors provide condition data in a GIS format – all condition data should be tied to an asset digitally.
11. Water main break history should be tied to assets in the GIS.
12. A focus on dikes is expected moving forward, given the rainfall events in 2021 and greater dike information should be included within the available data set.

OTHER RECOMMENDATIONS

13. Squamish is a high-growth community; therefore, the AMP should be updated every 5 years to capture new additions to the asset inventory.

APPENDIX A

DATA SOURCES & ASSUMPTIONS

DATA SOURCES

The following table provides the list of asset types within the District and the information source that was reviewed to determine the asset data informing the AMP.

Asset Type	Information Source
Drainage	USL 2018 Stormwater AMIP
Facilities	RDH Buildings Asset Management System (BAMS) Real Estate and Facilities Master Plan
Equipment	Citywide and KWL 2011 Asset Management Plan
Fleet	DoS 2020 Fleet Replacement Plan
Information Technology	Citywide
Parks	Citywide
Bridges	KWL 2011 Asset Management Plan
Roads	GIS and TetraTech 2020 Pavement Management Study
Sidewalks	GIS
Signage and Signals	KWL 2011 Asset Management Plan
Streetlights	GIS
Wastewater	
Facilities	Citywide and Opus 2018 Sewer Master Plan
Mains	2018 Asset Management Investment Plan
Treatment	GHD 2020 WWTP Asset Management Plan
Solid Waste	Citywide
Water	
Facilities	OPUS 2016 Water Master Plan and KWL 2011 Asset Management Plan
Mains	GIS
Reservoirs	OPUS 2016 Water Master Plan and KWL 2011 Asset Management Plan
Wells	OPUS 2016 Water Master Plan and KWL 2011 Asset Management Plan

DATA GAPS AND ASSUMPTIONS

For the purposes of the AMP, data gaps are considered areas of missing asset information once the various sources of asset data were reviewed, and available data was synthesized. Based on the collected information, data gaps included:

- Install dates for roads in GIS do not reflect the District's pavement management/resurfacing program
- Costs from previous studies were escalated based on inflation to reflect current 2020 values
- Missing install dates for some water and sewer mains
- Missing pipe materials for some water and sewer
- Missing diameters for some water and sewer mains

Where these gaps existed, the following assumptions were made:

- Remaining life for roads was derived from the 2018 Pavement Management Plan
- Missing install dates were based on the pipe material
    - PVC pipes were assumed to be 1980
    - Non-PVC pipes were assumed to be 1975
- Missing pipe materials were based on the pipe age
    - Pipes installed after 1980 were assumed to be PVC
    - Pipes installed before 1980 were assumed to be AC
    - Missing pipe diameters were assumed to be 200mm

UNIT RATES

Replacement values from stormwater values came from 2019 Asset Management Plan and the Phase 1 Integrated Stormwater Management Plan.

DESCRIPTION		UNIT COST	CONTINGENCY 25%	ENGINEERING 15%	TOTALS
	WASTEWATER (INCLUDING MANHOLES AND SERVICE CONNECTIONS)				
200	Wastewater	$868	$217	$130	$1,215
250	Wastewater	$918	$229	$138	$1,285
300	Wastewater	$968	$242	$145	$1,355
375	Wastewater	$1,018	$254	$153	$1,425
450	Wastewater	$1,068	$267	$160	$1,495
525	Wastewater	$1,118	$279	$168	$1,565
600	Wastewater	$1,168	$292	$175	$1,635

DESCRIPTION		UNIT COST	CONTINGENCY 25%	ENGINEERING 15%	TOTALS
675	Wastewater	$1,268	$317	$190	$1,175
750	Wastewater	$1,318	$329	$198	$1,845
900	Wastewater	$1,368	$342	$205	$1,915
1050	Wastewater	$1,568	$392	$235	$2,195
1200	Wastewater	$1,668	$417	$250	$2,335
	WATER (INCLUDING VALVES, FITTINGS, AND SERVICE CONNECTIONS)				
150	Watermain	$571	$143	$86	$799
200	Watermain	$621	$155	$93	$869
250	Watermain	$671	$168	$101	$939
300	Watermain	$721	$180	$108	$1,009
350	Watermain	$771	$193	$116	$1,079
400	Watermain	$821	$205	$123	$1,149
450	Watermain	$871	$218	$131	$1,219
	ROADS (SURFACE ONLY)				
	Local (7m)	$370	$55	$95	$520
	Collector (9m)	$480	$70	$120	$670
	Arterial (11m)	$530	$80	$135	$745

DATA GAP ANALYSIS

Note that this table reflects the data pulled from the Districts GIS data and may not reflect the numbers utilized in above report due to other data sources providing more recent data not yet reflected in the GIS

				Install Years				Material Type				Diameter			
GIS Dataset	Asset System	Asset Type	Total Number of Assets	# With	% With	# Without	% Without	# With	% With	# Without	% Without	# With	% With	# Without	% Without
Road_Network	Roads	Road Network	4141	0	0.0%	4141	100.0%								
Sanitary_Liftstation	Sanitary	Sanitary Lift Stations	23	0	0.0%	23	100.0%								
Sanitary_Main	Sanitary	Sanitary Mains	1635	1632	99.8%	3	0.2%	1584	96.9%	51	3.1%	1631	99.8%	4	0.2%
Sanitary_Manholes	Sanitary	Sanitary Manholes	1640	62	3.8%	1578	96.2%								
ENTGODB_GISADMIN_Sidewalks	Sidewalks	Sidewalks	325	0	0.0%	325	100.0%								
Storm_Facility	Stormwater	Floodbox	11	0	0.0%	11	100.0%								
Storm_Facility	Stormwater	Oil Grit Separator	2	0	0.0%	2	100.0%								
Storm_Facility	Stormwater	Outlet	13	0	0.0%	13	100.0%								
Storm_Facility	Stormwater	Pump Station	4	0	0.0%	4	100.0%								
Storm_Catchbasin	Stormwater	Storm Catchbasins	498	0	0.0%	498	100.0%								
Culvert	Stormwater	Storm Culverts	1293	0	0.0%	1293	100.0%	0	0.0%	1293	100.0%	241	18.6%	1052	81.4%
Storm_Main	Stormwater	Storm Main	2332	1609	69.0%	723	31.0%	1029	44.1%	1303	55.9%	2156	92.5%	176	7.5%
Storm_Manhole	Stormwater	Storm Manholes	1369	0	0.0%	1369	100.0%								
ENTGEODB_GISADMIN_WTR_VALVE	Water	Air Valve	39	9	23.1%	30	76.9%								
ENTGEODB_GISADMIN_WTR_FACILITY	Water	Blow Off Valve	4	0	0.0%	4	100.0%								
ENTGEODB_GISADMIN_WTR_VALVE	Water	Blow Off Valve	65	5	7.7%	60	92.3%								
ENTGEODB_GISADMIN_WTR_VALVE	Water	Chamber	1	0	0.0%	1	100.0%								
ENTGEODB_GISADMIN_WTR_FACILITY	Water	Chlorination Building	3	0	0.0%	3	100.0%								
ENTGEODB_GISADMIN_WTR_FACILITY	Water	Control Building	3	0	0.0%	3	100.0%								
ENTGEODB_GISADMIN_WTR_FACILITY	Water	Control Valve	4	4	100.0%	0	0.0%								
ENTGEODB_GISADMIN_WTR_VALVE	Water	Hydrant Valve	6	5	83.3%	1	16.7%								
ENTGEODB_GISADMIN_WTR_FACILITY	Water	Monitoring Well	1	0	0.0%	1	100.0%								
ENTGEODB_GISADMIN_WTR_FACILITY	Water	PRV	20	13	65.0%	7	35.0%								
ENTGEODB_GISADMIN_WTR_FACILITY	Water	Pump Station	3	2	66.7%	1	33.3%								
ENTGEODB_GISADMIN_WTR_FACILITY	Water	Reservior	2	2	100.0%	0	0.0%								
ENTGEODB_GISADMIN_WTR_VALVE	Water	Sample Station	1	1	100.0%	0	0.0%								
ENTGEODB_GISADMIN_WTR_FACILITY	Water	Sampling Station	1	1	100.0%	0	0.0%								
ENTGEODB_GISADMIN_WTR_VALVE	Water	Stand Pipe	13	0	0.0%	1	7.7%								
ENTGEODB_GISADMIN_HYDRANT	Water	Water Hydrants	646	619	95.8%	27	4.2%								
ENTGEODB_GISADMIN_WTR_MAIN	Water	Water Main	2109	2079	98.6%	30	1.4%	2014	95.5%	95	4.5%	2093	99.2%	16	0.8%
ENTGEODB_GISADMIN_WTR_FACILITY	Water	Water Meter	7	4	57.1%	3	42.9%								
ENTGEODB_GISADMIN_WTR_FACILITY	Water	Water Supply	10	7	70.0%	3	30.0%								
ENTGEODB_GISADMIN_WTR_FACILITY	Water	Water Tank	8	5	62.5%	3	37.5%								
ENTGEODB_GISADMIN_WTR_VALVE	Water	Water Valve	2870	251	8.7%	2619	91.3%								

inventory.

APPENDIX B

RISK ASSESSMENT FRAMEWORK

1.0 INTRODUCTION

1.1 WHY A RISK FRAMEWORK IS IMPORTANT

The District of Squamish (the District) strives to continuously improve its asset management processes and practices in support of providing sustainable service delivery. It is considered a best practice in asset management to make risk-based decisions. When decisions are based on risk, scarce resources can be allocated to where they are most needed; service interruptions can be avoided; and the District can protect its residents and manage its liability.

As part of the Asset Management Plan update Urban Systems Ltd. has developed this Risk Framework (the Framework) for the District's water, sewer, stormwater, and roads assets. The Framework will help the District:

- Prioritize limited resources for inspection, rehabilitation, and replacement of assets
- Ensure that everyone is using a consistent definition of risk
- Make decisions based on risk, not risk perception
- Allow for open discussion about risk tolerance

1.2 WHAT A RISK FRAMEWORK IS

The Framework describes how the District will go about assessing risk for water, sewer, stormwater, and roads assets. Specifically, the Framework defines:

- What risk is and how it is assessed
- What types of hazards will be considered
- How likelihood and consequence will be defined
- How risk ratings will be assigned to assets

It is important to note that the Framework is meant to be simple to use and suitable for the purpose of identifying relative priorities among District assets. It is meant to help the District answer the question "What assets really require attention?" – it is not meant to be exhaustive in terms of how risk is assessed, and it is not meant to produce an absolute or exact measure of risk for each asset.

1.3 SCOPE OF THE RISK FRAMEWORK

The scope of this Risk Framework is limited to the following:

- Risk of failure due to asset condition (deterioration)
- Linear water, sewer, and stormwater assets
- Major roads assets

It does not describe how the District will go about assessing risk of failure due to the capacity of an asset, and it does not include major assets such as pump stations. The methodology for assessing risk reflects the quantity and quality of data that the District

currently has on its assets. Over time, the methodology may be updated as data improves and allows for a more granular approach to assessing risk.

Note that the Framework in and of itself does not tell the District what the risk rating of each asset is, what the District's risk tolerance is, or what to do to address risks. It describes *how* risk ratings will be assigned.

1.4 HOW THE RISK FRAMEWORK WILL BE USED

The Framework will be used to:

1. **Assign a risk rating to the District's existing water, sewer, stormwater, and roads assets, and to identify resulting priorities.** Results of this process are provided in Part 2 of this document. With this information, the District will be able to identify priorities based on its risk tolerance and then make decisions about what to do with the results.
2. **Assess and track the risk of assets over time, including new assets.** This will be part of the District's ongoing asset management practices. The Framework will be integrated into the District's GIS systems so that the risk rating of any given asset can readily be identified in GIS and used to support decision-making over time.

2.0 IMPORTANT CONCEPTS

2.1 WHAT RISK IS – AND WHAT IT ISN'T

Risk is a function of the **likelihood** (or probability) of a negative event happening and the **consequence** (or impact) of that negative event happening.

In the context of asset management, we are interested in assessing risks related to asset failure.

Risk = Likelihood x Consequence

Asset age does **not** equal risk. Asset condition does **not** equal risk.

Age may be used a proxy for assessing the condition of a pipe, which is an indicator of the likelihood of an asset failing, but it does not speak at all to what the consequence of asset failure may be.

When assessing risk, both likelihood and consequence must be considered to make the most informed decision.

2.2 HOW RISK IS ASSESSED

Risk in this context is assessed by:

1) Identifying potential causes of asset failure (hazards)
2) Assessing the likelihood of that hazard occurring
3) Assessing the consequence of that hazard occurring
4) Multiplying likelihood by consequence to determine risk

To simplify the process, each asset is assigned a **rating** for the likelihood and consequence of asset failure on a scale of 1 to 5. These numbers are then multiplied to determine the risk rating, which is expressed on a scale of 1 to 25 and shown graphically as follows.

5	10	15	20	25
4	8	12	16	20
3	6	9	12	15
2	4	6	8	10
1	2	3	4	5

2.3 HOW RISK ASSESSMENT FITS WITHIN A BROADER RISK MANAGEMENT PROCESS

Assessing risk happens as part of a broader risk management process:

- Once the District has assessed risk, it will identify the risks it chooses to address. The choices that are made about which risks to address will be based on the District's risk tolerance: what the District considers to be acceptable versus unacceptable risk.
- Once unacceptable risks have been identified, the District will identify the root cause of the risk. This is typically done through a process of asking "why" until the source is identified.
- The District will then identify actions to reduce risk to an acceptable level. Actions will focus on reducing the likelihood and/or consequence of asset failure, and may be capital and/or operational.
- Actions are then prioritized through the capital and operational plans and then implemented.
- Risk is iteratively assessed to determine if the risk has been reduced to an acceptable level and if there are any new risks, and the cycle continues.

3.0 RISK FRAMEWORK

3.1 HAZARDS

Asset failure may occur by one of three modes:

1) Condition failure – due to asset deterioration
2) Capacity failure – due to surcharging
3) Physical failure – due to physical impact, such as seismic

The purpose of this Risk Framework is to identify relative priorities among assets so that inspection, rehabilitation, and renewal can be directed to where it is most needed. Therefore, **the hazard that is considered in this Framework and Assessment is condition-based failure due to asset deterioration.**

Hazards that may cause capacity-related or physical failure of an asset, such as earthquakes, landslides, population growth, flooding, etc. – many of which are worsened with climate change – are important but are not part of the scope of this Framework.

3.2 LIKELIHOOD OF FAILURE

General Approach

Likelihood of failure (LOF) scores are a function of asset condition (if available) or asset age. In general, likelihood of failure was assessed and scored as described in Table 1.

Table A: Approach to Assigning Likelihood of Failure Scores

LIKELIHOOD OF FAILURE	DESCRIPTION	AS INDICATED BY CONDITION RATING (IF AVAILABLE)	AS INDICATED BY AGE (IF CONDITION DATA UNAVAILABLE)	ASSIGNED LOF SCORE
Very Low	Unlikely in foreseeable future	Excellent	Asset age is <=50% of useful life	1
Low	20+ years	Good	Asset age is >50% to <=75% of useful life	2
Medium	10-20 years	Fair	Asset age exceeds useful life by >75% to <=100%	3
High	5-10 years	Poor	Asset age exceeds useful life by >100% to <=125%	4
Very High	<5 years	Immediate Attention	Asset age exceeds useful life by >125%	5

3.4 CONSEQUENCE OF FAILURE

Table B outlines the potential financial, environmental, and social consequences of asset failure, and the factors that influence the magnitude of impact.

Table B: Potential Consequences of Failure

TYPE OF CONSEQUENCE	POTENTIAL IMPACTS	FACTORS INFLUENCING THE MAGNITUDE OF IMPACT
Financial	• Cost to restore service • Third party liability	• Road classification • Pipe size
Social	• Service interruptions to downstream customers • Impacts to public health and safety (sewer assets in particular)	• Road classification • Pipe size • Proximity to structures and type of structure
Environmental	• Environmental contamination (sewer assets in particular)	• Proximity to environmentally sensitive area

Preliminary Score

As shown in Table B, the most common factor influencing the magnitude of impact for all types of assets is road classification. Therefore, a preliminary consequence of failure score was assigned to assets as described in Table C.

Table 9 Approach for Assigning Preliminary Consequence of Failure Scores

CONSEQUENCE OF FAILURE	DESCRIPTION	AS INDICATED BY ROAD CLASSIFICATION	ASSIGNED COF SCORE
Insignificant	• <$5000 to restore service and 3rd party liability • Impact to few downstream customers	Outside of Road	1
Minor	• $5000-$50,000 to restore service and 3rd party liability • Impact to some downstream customers	Lane	2
Moderate	• $50,000-$150,000 to restore service and 3rd party liability • Impact to many downstream customers	Local	3
Major	• $150,000-$500,000 to restore service and 3rd party liability • Impact to significant downstream customers	Collector	4
Severe	• >$500,000 to restore service and 3rd party liability	Arterial	5

Modified Score

Certain factors may lead to the consequence of failure of a given asset being particularly impactful; for example, if the asset is close to an environmentally sensitive area, or if the pipe diameter is particularly large or a force main. Therefore, the score was increased by 1 if the asset meets any of the conditions described in the tables on the following page.

Note that for this analysis: Modified consequence of failure scores were only applied to pipe assets (where applicable) and not to road assets.

Table D: Criteria for Modifying Consequence of Failure Scores for Drainage

ORIGINAL SCORE		1	2	3	4	5
MODIFIED SCORE	Pipe >=300mm and <750mm	2	3	4	5	5
	Pipe >=750mm	3	4	5	5	5

Table E: Criteria for Modifying Consequence of Failure Scores for Water

ORIGINAL SCORE		1	2	3	4	5
MODIFIED SCORE	Pipe >=250mm and <350mm	2	3	4	5	5
	Pipe >=350mm	3	4	5	5	5

Table F: Criteria for Modifying Consequence of Failure Scores for Wastewater

ORIGINAL SCORE		1	2	3	4	5
MODIFIED SCORE	Pipe >=250mm and <350mm	2	3	4	5	5
	Pipe >=350mm	3	4	5	5	5

RESULTS

The breakdown of assets by % of value is provided in the table below.

Table G: Risk Results

Risk Level	Percent of Linear Assets
Drainage	
High	1%
Medium	15%
Low	84%
Wastewater	
High	5%
Medium	36%
Low	58%
Water	
High	5%
Medium	37%
Low	58%

APPENDIX C

ASSET MANAGEMENT SOFTWARE REVIEW

MEMORANDUM

URBAN SYSTEMS

DATE	October 2, 2021	FROM	John Weninger
TO	David Roulston	FILE	1928.0039.01
CC	Reann Sousa	SUBJECT	Software Review

The District of Squamish is currently in the process of reviewing and upgrading its software systems to better support Asset Management and Maintenance Management. The District currently has a variety of systems in use for specific purposes. These systems are summarized in the following table.

CURRENT ASSET RELATED SYSTEMS

NAME	DEVELOPER	CURRENT USE
Citywide	Public Sector Digest	TCA Reporting
BMS	RDH Building Sciences	Buildings Inventory and Funding Analysis
RTA Fleet Management	RTA	Fleet Management
ARCGIS	ESRI	Spatial inventory of most linear assets
Unit4 Business World	Unit4 Software	Financial Management (GL, AP, AR), Payroll/HR

An initial meeting with DoS Finance, Engineering and Public Works staff were held on June 7th and a follow-up meeting was held on August 16th. During these meetings some of the challenges and deficiencies related to the existing systems were discussed. They are summarized as follows.

CURRENT CHALLENGES

- No work order functionality is currently implemented (Citywide or UBW)
- Citywide asset information is at too “high level” to allow effective lifecycle, risk management and capital planning
- The existing Citywide asset inventory is incomplete and does not match other information sources such as the GIS and the recent Asset Management Plans
- No dynamic linkage between Citywide and the ESRI GIS
- Labour and material costs are not tracked or recorded at the asset level in UBW or Citywide
- No single point of truth for asset information

In addition to identifying the current challenges, some of the most important functional requirements were also identified by DoS staff.

DESIRED FUNCTIONALITY

- Work order generation and maintenance management
- High information granularity (component level) is needed for maintenance planning
- Integration between a w/o system and Finance (UBW) is desired to allow tracking of labour and other costs at the asset level
- Integration between GIS, the asset management system and UBW
- Ability to conduct more accurate lifecycle, risk management and capital planning
- Ability to effectively manage information for all asset types
- Mobile capture of field data (including spatial)

NB It should be noted that a much more detailed review of functional requirements was completed by the District in 2015 and that the list above is presented at a much higher level.

OTHER CONSIDERATIONS

- Implementation and annual licensing costs
- Human resources to develop and maintain the system
- Business processes to support the maintenance of the information
- Reputation of the Vendor and surety in the long-term support of the product

BACKGROUND

The District has made significant investment into the ESRI ArcGIS system. This system is acknowledged to house the most accurate information related to the District's linear infrastructure (water, sewer, stormwater and roads).

The importance of such a spatial inventory cannot be overstated as it is invaluable to supporting capital planning, master planning, modeling, land use planning, and asset management planning in addition to many other uses.

ESRI ArcGIS is also by the far the largest and most implemented GIS system in the world and the on-going support of their products is almost guaranteed. As such the option to supersede the ESRI GIS as the primary information source for linear assets with another system was not considered to be practical or advisable.

The District has also placed significant investment into the implementation of Unit4 Business World (UBW). UBW supports all financial and the majority of other business processes within the District. Unit4 origins go back to 1980 and it has global operations with annual revenues near $1B. Future support for Unit4's products is also very secure. As such no option to supersede Unit 4 with another system was considered.

During the discussions with DoS staff the ERSI Cityworks product was discussed. Cityworks provides maintenance management and asset management functionality and is completely integrated with their ArcGIS platform. The ability to integrate the District's ESRI systems easily with UBW is not currently known, however there are communities in the Lower Mainland (notably Surrey and Chilliwack) that have integrated UBW and ESRI via Cityworks.

Based on the information above (3) possible options were considered and evaluated at a very high level. The options provided were considered the worthiest of additional investigation, but there are certainly many other options that could be considered.

OPTIONS FOR DOS

1. Maintain the ESRI ArcGIS as the source of truth for "linear assets" and implement the CMMS functionality of Citywide as well as the additional asset management functionality, with service automation to ensure data consistency between the two systems.
2. Implement ESRI Cityworks for maintenance, asset management and TCA reporting with possible UBW integration.
3. Implement the CMMS functionality for UBW and maintain ESRI GIS as the source of truth for linear assets.

Each of these options was evaluated against the desired functionality that was expressed by DoS staff.

The evaluation is summarized in the following table.

EVALUATION OF OPTIONS

REQUIREMENTS	OPTION 1	OPTION 2	OPTION 3
Work order generation and maintenance management	x	x	x
High information granularity	x	x	x
Integration between a w/o system and Finance (UBW)	?	x	x
Integration between GIS, the w/o system and UBW	?	x	x

REQUIREMENTS	OPTION 1	OPTION 2	OPTION 3
Lifecycle, risk management and capital planning	x	x	x
Effectively manages information for all asset types	?	x	?
Mobile capture of field data	?	x	x

DISCUSSION

The above table, although very high level, indicates that both options 2 and 3 could be viable solutions that would merit additional investigation. Based on the discussions and review of the available information further investment in Citywide probably doesn't make sense given the existing information base within it is very limited and its use is currently limited to TCA. Options 2 and 3 would also be preferred due to the scale of the Vendors which would provide the DoS with considerable confidence that these two products will continue to be supported and improved on many years into the future.

NEXT STEPS

1. Select a multi-disciplined working group to guide the selection process.
2. Prepare a terms of reference for the working group clarifying the project objectives, team member roles, stakeholders, timelines, and how engagement will occur within the group and with other stakeholders such as senior leadership and Council.
3. Develop a set of criteria and weightings to assist with software and vendor selection.
4. Update the 2015 list of functional requirements for asset management software.
5. Invite ESRI and UBW to demonstrate their abilities in meeting these updated functional requirements.
6. Interview other communities that may have implemented either the UBW maintenance management functionality or have successfully integrated Cityworks with UBW.
7. Have the working group members individually evaluate the options and determine the preferred approach.
8. Approach to include completing a proof-of-concept project involving one department and a limited set of asset classes to validate requirements and inform on scope, schedule and budget for organizational-wide asset and work order system deployment

The eight steps above, although very basic, are intended to provide some initial guidance on how to proceed from this point forward. The selection of a sophisticated software and its integration with other IT systems is anything but simple so a clear and transparent process is critical.

Sincerely,

URBAN SYSTEMS LTD.

John Weninger, P.Eng., MBA
Senior Consultant

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