Risk Report

Township of Hamilton

June 2023

psdcitywide

Table of Contents

LEGAL NOTICE

Introduction & Background

The Township of Hamilton engaged PSD Citywide as an asset management advisor to guide and develop lifecycle strategies, review, and evaluate risk, and establish and measure current levels of service for its infrastructure assets. This report is a culmination of PSD Citywide's engagement with Hamilton Township as it relates to risk. The report identifies and discusses relevant qualitative risks, defines quantitative risks models, and reviews their results.

Hamilton Township's staff provided key insights and information to inform this report's findings and the models developed.

PSD engaged staff, generally on a departmental basis, and reviewed common qualitative risk. To determine what qualitative risks applied to the Township and which asset categories they applied to, numerous questions were explored with Hamilton Township staff.

Identification of qualitative risks and development of quantified risk models are key elements of good asset management practices and programs. A clear understanding of qualitative risks and asset specific quantitative risks enables more proactive and strategic asset management considerations and actions, including risk mitigation.

Project Scope

This project focused on identifying and documenting relevant risks for Hamilton Township assets. This report focuses on the core and non-core asset categories as defined by Ontario Regulation 588/17 Asset Management Planning for Municipal Infrastructure. For Hamilton Township, asset categories are as follows:

Core Asset Categories	Non-Core Asset Categories
Road Network	Facilities
Bridges & Culverts	Land Improvements
Stormwater Network	Machinery & Equipment
Water Network	Fleet & Fleet Equipment

Overview of Risk

Municipalities own, manage, and maintain a broad portfolio of infrastructure assets that deliver services to the community. An important asset management objective is to manage infrastructure risks and by doing so enhance the service delivered by infrastructure assets to the community.

There are two types of risk: Qualitative and Quantitative Risk.

Qualitative Risks

Risk is defined as the effect of uncertainty on objectives. Inherent in the management of infrastructure assets is the assumption of risks. Often, asset risks are specific and measurable. Sometimes, however, risks are impractical to quantify, but are recognized for the threats they pose to assets and their ability to provide their intended service. These are qualitative risks.

Qualitative risks can indicate key trends, challenges, and risks to service delivery that the Township faces. Several qualitative risks were identified as applicable to the Township of Hamilton's assets. These qualitative risks and common markers of them are identified below. In the subsequent sections, the application of these risks to the municipality's asset categories is discussed.

Risk	Common Risk Markers
Fiscal Capacity	• Significant dependency on grants or external funding sources. Risk of not receiving the required funding, not receiving it for the work that is most critical, and/or when needed. • Taxation and/or user-fee based revenue sources are insufficient based on expected capital requirements; rate payers and council may not accept required taxation increases furthering funding gap. • Potential for deferral of capital projects and/or investment in low priority but grant eligible projects.

Risk	Common Risk Markers
Aging Infrastructure	• Significant volume of capital replacements and rehabilitations required in a short term due to many assets approaching end of life. • Insufficient capital funds (often no or limited reserve funds), and/or insufficient staff resources available to complete the work when required.
Climate Change & Extreme Weather Events	• Asset deterioration acceleration due to extreme weather (e.g., increase in freeze-thaw cycles, ice jams, and surface flooding). • May increase number of unexpected infrastructure failures with resultant potential to challenge the execution of long-term infrastructure planning. • Accelerated asset deterioration may reduce asset performance
Demographic Change	• Significant demographic change (i.e., population increase or decreases) impacting demand for infrastructure overall, or type of infrastructure and/or ability to fund it (i.e., population loss equals taxation loss) • Significant growth has potential to decrease the lifecycle of certain assets (i.e., due to increased use), and/or asset suitability for the population serviced (i.e., lacking age friendly design).
Socio-Political Expectations	• Increased (typically) public expectations surrounding the performance of assets and a low tolerance for risks held. • No corresponding increase in funding and/or staffing resources to meet the increased public expectations. • Often limited public willingness to increase funding to meet increased expectation for assets under ownership

Risk	Common Risk Markers
Organizational Cognizance/ Capacity	• Limited staff resources to support regular data collection, update, and/or review, including condition assessments. • Constrained resources to complete appropriate asset management program development and planning. • Asset inventory information may be limited in scope, poor in quality and/or comprehensiveness, and/or underutilized to effectively inform decisions and long-term planning.

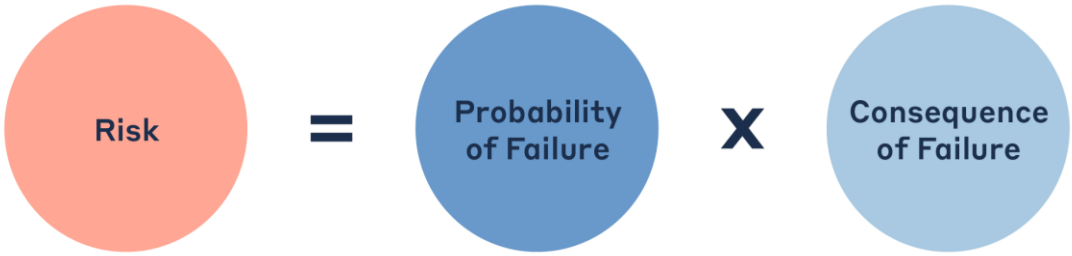
Identifying what qualitative risks are appliable to the Township of Hamilton and which asset categories may be most impacted is a critical first step in the management of risk. The qualitative risks applicable to each asset category are discussed later in the report.

Quantitative Risks

Asset risks may also be specific and measurable against an asset based on attribute features like condition, material, and the cost to replace. When risk can be quantified against an asset it is a quantitative risk.

Quantitative risk is a product of two variables: the **probability** that an asset will fail, and the resulting **consequences** of that failure event. To calculate risk, the probability and consequence of failure are each scored from 1 to 5, producing a minimum risk rating of one (1) for the lowest risk assets, and a maximum risk rating of 25 for the highest risk assets.

Formula to Assess Risk of Assets



Probability of Failure (PoF)

Various parameters may be used to estimate the probability or likelihood of an asset's failure. Typically, a model is selected for a group of similar assets (e.g., all roads, water distribution system etc.). Often parameters for estimating probability of failure include asset condition, service life remaining, and/or asset material.

For each risk model, probability of failure is determined through the following steps:

1. Identification of *available* attribute data *suitable* for determining the probability of failure for selected assets. In some instances, available asset data may be limited requiring a more simplified PoF model, at least initially.

- This process often identifies opportunities for asset data enhancements and/or data collection. Asset enhancement considerations commonly relate to data quality dimensions which are outlined in Appendix 1.

2. Where there are multiple parameters included in the PoF model, determine suitable weighting of each parameter.
    - Weighting allows the model to recognize that each factor may impact the probability of failure to a different degree. Where the weight is higher, the impact that factor has on the model increases too.

Consequence of Failure (CoF)

The consequence of failure describes the anticipated effect of an asset's failure to an organization and its stakeholders. There are different types of consequences of failure which can range from insignificant to severe. For example, failure of an infrequently used road may affect only a few residents and/or inconvenience them slightly (i.e., minimal detour distance). Conversely, failure of a more significant road could create significant issues to the transportation networks and affect many residents' ability to access critical community services (i.e., hospitals and schools).

The CoF parameters selected for each risk model aim to measure relevant consequences of an asset's failure. For each risk model, consequence of failure is determined through the following steps:

1. Identification of available attribute data suitable for determining the consequence of failure for selected assets.
    - Again, the data available to calculate consequence of failure may be limited, requiring a simplified model at least for a period.
2. Determination of the type of consequence that applies to the selected attribute.
    - Consequence types are discussed in the subsequence section.
3. Where there are multiplied parameters included in the CoF model, determine suitable weighting of each parameter.
    - Weighting allows the model to recognize that each factor may impact the consequence of failure to a different degree. Where the weight is higher, the impact that factor has on the model increases too.

Types of Consequences

The types of consequences from an asset failure are often wide ranging. Generally, types of consequences can be categorized as follows:

Table 1: Consequence Types Defined

Consequence Type	Description
Financial	Direct financial consequences of an asset's failure. These costs are typically measured as the replacement cost of the assets affected by the failure event. In some cases, actual financial consequences may be significantly greater than the replacement cost (i.e., incurred liabilities, price premiums for emergent repairs etc.)
Economic	Economic impacts of asset failure may include disruption to local economic activity and commerce, service disruptions, revenue loss, etc. Whereas financial impacts are direct, economic impacts may be broad (i.e., impacts of traffic to business corridors).
Socio-Political	Socio-political impacts are more difficult to quantify and may include inconvenience to the public and key community stakeholders, adverse media coverage, and reputational damage to the community and the municipality.
Environmental	Environmental consequences can include pollution, erosion, habitat damage or loss, etc.
Health & Safety	Health and safety impacts may include injury, fatality, or impeded access to critical services (i.e., hospitals).
Strategic	These include the effects of an asset's failure on the community's long-term strategic objectives, which may include economic development, tourism, etc.

Risk Scores

Risk Scores are derived from the total PoF multiplied by the total CoF. In this model, risk scores may range from 0-25. The table below provides some examples of respective PoF and CoF scores and the resultant risk rating.

Probability of Failure	Consequence of Failure	Risk Rating
1 – Very Low	1 – Insignificant	1 – Lowest
2 – Low	2 – Minor	4 – Low
3 – Moderate	3 – Moderate	9 – Medium
4 – High	4 – Major	16 – High
5 – Almost Certain	5 – Severe	25 – Highest

Key Definitions and Concepts

Effective asset management integrates several key components, including lifecycle management, risk management, and levels of service. This report focuses on risk. Throughout this report, the following concepts and definitions are referenced.

Asset Categories

Asset information is reported in a two-tier hierarchy: the category and segment level. Asset Categories are the first tier of categorization and are based on the general function of the asset. Asset segments are the second tier of categorization and are typically grouped by similar function and/or department. This structure provides a more detailed and tailored level of analysis. As an example, the Facilities category and segment are as follows:

Asset Category	Segment
Facilities	Fire
	General Government
	Parks
	Recreation
	Roadways

Data Effective Date

It is important to note that this report is based on ***data as of December 2021***; therefore, it represents a snapshot in time using the best available processes, data, and information at the Municipality. Strategic asset management planning is an ongoing and dynamic process that requires continuous data updates and dedicated data management resources. Future updates to asset information including replacement cost, condition, and planned capital events will be needed.

Deriving Replacement Costs

There are a range of methods to determine the replacement cost of an asset, and some are more accurate and reliable than others. This report relies on two methodologies:

- **User-Defined Cost and Cost/Unit**: Based on costs provided by municipal staff which could include average costs from recent contracts; data from engineering reports and assessments; staff estimates based on knowledge and experience.
- **Cost Inflation/CPI Tables**: Historical cost of the asset is inflated based on Consumer Price Index or Non-Residential Building Construction Price Index.

User-defined costs based on reliable sources are a reasonably accurate and reliable way to determine asset replacement costs. Cost inflation is typically used in the absence of reliable replacement cost data. It is a reliable method for recently purchased and/or constructed assets where the total cost is reflective of the actual costs that the Township incurred. As assets age, and new products and technologies become available, cost inflation becomes a less reliable method.

Since complete asset failure most often requires asset replacement as a resolution, replacement cost is a commonly used Consequence of Failure parameter. In most cases, this financial consequence of failure is based on the asset's replacement value.

Estimated Useful Life

The estimated useful life (EUL) of an asset is the period over which the Township expects the asset to be available for use and remain in service before requiring replacement or disposal. The EUL for each asset in this report was assigned according to the knowledge and expertise of municipal staff and supplemented by existing industry standards when necessary.

Remaining useful life is calculated based on the assets age (e.g., 5 years) and its EUL (e.g., 10 years). The derived value is the amount of time or the percentage of life the asset is estimated to still have.

The remaining useful life of an asset often provides good insights into the probability of an asset failing. For example, if an asset has very little remaining useful life (i.e., 10%) it is more likely to fail than if it had very significant remaining useful life (i.e., 90%). For this reason, it may be used as a PoF parameter.

Asset Condition

An incomplete or limited understanding of asset condition can mislead assessment of the risks within an asset portfolio. Accurate and reliable condition data enables more accurate estimation of an asset's probability of failure and through this can support appropriate and timely responses to the identified risk.

Asset condition can be derived using two approaches: age-based condition and assessed condition.

Age-based condition is based on the assets age relative to it's EUL. For example, if an asset is 5 years of age and has a 10-year EUL, age-based condition is 50%. This is also the remaining service life of the asset. Age-based condition is beneficial because it is easy to determine and does not require any additional data collection, however it is not always accurate. This is largely because asset degradation is generally not perfectly linear, and is often affected by other factors like location, use, and maintenance activities none of which are not accounted for when calculating age-based condition.

Assessed condition is derived from the inspection of an asset by persons knowledgeable about the asset type and sometimes aided by technology (e.g., video recording to capture footage of underground pipes). It involves the determination of condition based on a defined condition rating scale with specific criteria for rating. Assessed condition data when collected in a uniform, scale-based, and consistent manner is more accurate than age-based condition as it reflects the observed assets state based on actual defects, and where available construction information, performance, and repair history.

The table below outlines the condition rating scale most used for Hamilton Township's assets. This rating system is aligned with the Canadian Core Public Infrastructure Survey which is used to develop the Canadian Infrastructure Report Card. When assessed condition data is not available, service life remaining is used to approximate asset condition.

Condition	Description	Criteria	Service Life Remaining (%)
Very Good	Fit for the future	Well maintained, good condition, new or recently rehabilitated	80-100
Good	Adequate for now	Acceptable, generally approaching mid-stage of expected service life	60-80
Fair	Requires attention	Signs of deterioration, some elements exhibit significant deficiencies	40-60
Poor	Increasing potential of affecting service	Approaching end of service life, condition below standard, large portion of system exhibits significant deterioration	20-40
Very Poor	Unfit for sustained service	Near or beyond expected service life, widespread signs of advanced deterioration, some assets may be unusable	0-20

The analysis in this report is based on assessed condition data only as available. In the absence of assessed condition data, asset age is used as a proxy to determine asset condition.

Risk Specific Terms

Asset management recognizes that organizations will respond to and tolerate risks differently based on their context, regulatory requirements, and degree of risk held. While discussing risk the following terms are of relevance:

Risk Appetite: Amount and type of risk than an organization is willing to retain or accept.

Risk Treatment: responses to risk, often with the objective of reducing the amount of risk held. Common types of risk treatment are outlined in the report's Conclusions and Recommendations.

Residual Risk: Risk remaining after risk treatment.

Risk Tolerance: organizations readiness to bear the residual risk after completion of risk treatment.

Ontario Regulation 588/17 Requirements

As part of the *Infrastructure for Jobs and Prosperity Act, 2015*, the Ontario government introduced Regulation 588/17 - Asset Management Planning for Municipal Infrastructure (O. Reg 588/17). Along with creating better performing organizations, more liveable and sustainable communities, the regulation is a key, mandated driver of asset management planning and reporting. It places substantial emphasis on current and proposed levels of service and the lifecycle costs incurred in delivering them.

The regulation has four reporting requirements for Ontario Municipalities which include the 2024 requirement to report for all asset categories, the following:

2019

Strategic Asset Management Policy

2022

Asset Management Plan for Core Assets with the following components:

1. Current levels of service
2. Inventory analysis
3. Lifecycle activities to sustain LOS.
4. Cost of lifecycle activities
5. Population and employment forecasts
6. Discussion of growth impacts

2024

Asset Management Plan for Core and Non-Core Assets

2025

Asset Management Policy Update and an Asset Management Plan for All Assets with the following additional components:

1. Proposed levels of service for next 10 years
2. Updated inventory analysis.
3. Lifecycle management strategy
4. Financial strategy and addressing shortfalls.
5. Discussion of how growth assumptions impacted lifecycle and financial.

This report focuses on the identification and measurement of risk by asset category. The accompanying lifecycle and level of service (LOS) reports focus on the other components required under O. Reg. 588/17.

O. Reg. 588/17 defines municipal infrastructure asset as directly owned by a municipality or included on the consolidated financial statements of a municipality. Assets must meet the capitalization threshold as defined in the Tangible Capital Asset (TCA) Policy to be recognized on the financial statements. Therefore, some inventory within the Township may not be included in the asset management inventory because they are not a Tangible Capital Asset. Typically, these are assets funded from operational budgets.

O. Reg. 588/17 Compliance

The following table identifies the requirements outlined in Ontario Regulation 588/17 for municipalities to meet by July 1, 2024. Next to each requirement, a page or section reference is included to indicate status and applicable report.

Requirement	O. Reg. Section	Report Reference	Status
Summary of assets in each category	S.5(2), 3(i)	All Reports	Complete
Replacement cost of assets in each category	S.5(2), 3(ii)	All Reports	Complete
Average age of assets in each category	S.5(2), 3(iii)	Lifecycle Report	Complete
Condition of core assets in each category	S.5(2), 3(iv)	Lifecycle Report	Complete
Description of Township's approach to assessing the condition of assets in each category	S.5(2), 3(v)	Lifecycle Report	Complete
Current levels of service in each category	S.5(2), 1(i-ii)	Levels of Service Report	Complete
Current performance measures in each category	S.5(2), 2	Levels of Service Report	Complete
Lifecycle activities needed to maintain current levels of service for 10 years	S.5(2), 4	Lifecycle Report	Complete
Costs of providing lifecycle activities for 10 years	S.5(2), 4	Lifecycle Report	Complete
Risks associated with lifecycle activities to maintain current levels of service	S.5(2), 4(iii)	Risk Report	Complete
Growth assumptions	S.5(2), 5(i-ii) S.5(2), 6(i-vi)	N/A	Not Included
AMP is publicly available	S.10	N/A	Pending
AMP is approved by Council	S.8 (b)	N/A	Pending
AMP is endorsed by executive lead at the Township	S.8 (a)	N/A	Pending

Report Development & Reference Material

Township Plans & Documents Review

Several Township documents and plans were reviewed and considered in this report's development. Referenced documents and plans include:

- 2021 Northumberland Fire Services Review
- 2022 Township of Hamilton Master Fire Plan
- Township of Hamilton Parks and Recreation Master Plan 2022
- Township of Hamilton Strategic Plan (2018-2023)
- Service Delivery Review of the Water Department, 2022
- 2019 Township of Hamilton Roads Needs Study Report
- 2020 and 2021 Ontario Structural Inspection Manual (OSIM) Bridge Reports
- Historic Review of Capital Budgets

These documents and reports provided insights into existing qualitative risks, including their scope and severity.

Asset Management Policy

An asset management policy represents a statement of the principles guiding the Township's approach to asset management activities. It aligns with the organizational strategic plan and provides clear direction to municipal staff on their roles and responsibilities as part of the asset management program.

In March 2019 the Township adopted a Strategic Asset Management Policy in accordance with Ontario Regulation 588/17. The policy provides leadership and commitment to the development and implementation of the Township's asset management program to facilitate logical and evidence-based decision-making. It identifies the importance of linking service outcomes to infrastructure investment decisions to enable service focused rather than budget-driven asset management approaches. It also advances 13 principles for asset management decisions. Relevant principles to risk include:

- Infrastructure *priorities should be clearly identified* to better inform investment decisions respecting infrastructure (3).
- Infrastructure planning and investment should be *evidence based* and transparent (8).

Policy statements are also included. Those of relevance to risk are:

- The Township will implement continuous improvement protocols and adopt best practices regarding asset management planning, including risk and criticality models (item iii)

Alignment with the Strategic Plan

The Township adopted a Strategic Plan on July 16th, 2019. The plan is effective until 2023 and guides the decisions and actions of Council and municipal administration. The Strategic Plan has a major influence on the Township's course of action over a four-to-six-year period.

The Strategic Plan cites the following Vision and Mission Statements:

Vision: "Hamilton Township – making life better by supporting and enhancing a *safe*, healthy and active community."

Mission: "To provide professional, effective and efficient services within a collaborative governance model to promote the social and economic development of our community while creating an active and *safe* environment."

Council and staff identified four major pillars that are central to delivery of the Township's Vision and Mission Statements. These pillars are:

1. Effective Governance
2. Environment
3. Physical Assets
4. Recreation, Culture, and Social Well-being

The Strategic Plan's vision and mission have an emphasis on safety (a common risk) and notes the importance of risk considerations. For example:

- Under Pillar 3 and the goal to optimize use of municipal infrastructure fiscal capacity risks are addressed through the action item to "advocate for increased funding from senior levels of government" (3.2, b.)
- Under Pillar 4 and the associated goal of Developing safe communities it notes" Maintain an appropriate standard of care that *balances risk* and fiscal responsibility while fulfilling statutory requirements" (4.4, c.).
- Also, under pillar 4 and its associated goal it notes the importance of providing infrastructure services that are safe: "Maintain quality water

supply systems, septic systems, roads, bridges and multi-purpose lanes so as to provide for community safety" (4.4, e.).

Through the identification of qualitative risks and asset specific quantitative risks the Township's strategic goals, values, and missions are being advanced as risk identification is a critical first step to its mitigation.

Core Assets

Road Network

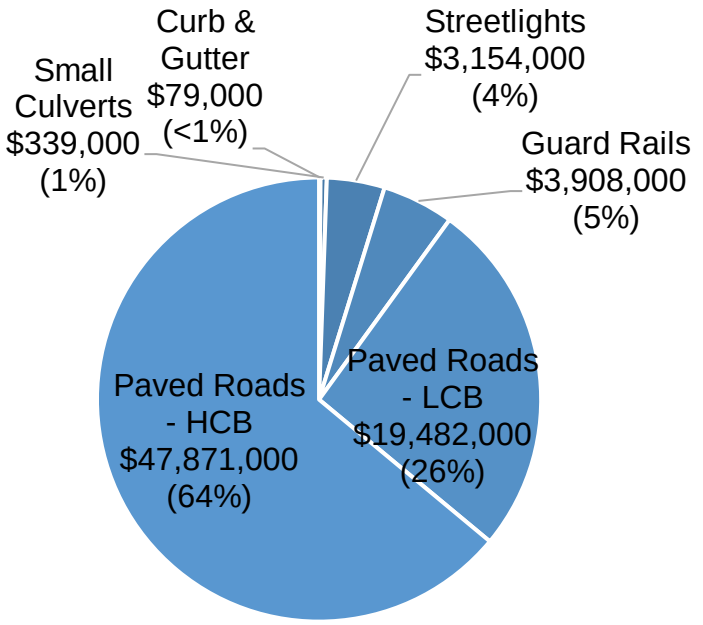
Asset Overview

The Road Network is a critical component of the provision of safe and efficient transportation services and represents the highest value asset category in the Township's asset portfolio. It includes all municipally owned and maintained roadways in addition to supporting roadside infrastructure including curb & gutters, guard rails, and streetlights. The Township's roads are maintained by the Public Works department.

The Township's road network assets are recorded in an asset management software system. The following table provides summary information about facility assets based on a December 2021 effective date:

Asset Segment	Quantity	Average Age (Years)	Replacement Cost
Curb & Gutter	0.9 KM	2	$79,000
Guard Rails	9 KM	11	$3,908,000
Paved Roads – HCB	115 KM	22	$47,871,000
Paved Roads – LCB	146 KM	20	$19,482,000
Small Culverts	10 Assets	4	$339,000
Streetlights	407 Assets	12	$3,154,000
Unpaved Roads	32 KM	19	Not Planned for Replacement[1]
Total			**$74,834,000**

[1] Unpaved road (i.e., gravel) undergo perpetual operating and maintenance activities. If maintained properly, they can theoretically have a limitless service life. Since this asset is not funded by capital dollars it is not included.



Total Current Replacement Cost: $74,834,000

As part of the project engagement, PSD Citywide worked with Hamilton Township staff to review and as needed, update asset information, including data and recommendations from the 2019 Road Needs Study which are projected to 2021.

Qualitative Risk

Qualitative risks were identified through an interview-based discussion with Township staff. Interview questions are provided for reference in Appendix 2. Through this exercise, the following risks were identified as relevant to the road network.

Fiscal Capacity

The present level of financial reinvestment does not adequately address maintenance and capital rehabilitation requirements to ensure municipal assets remain in an adequate state of repair and achieve their intended service life. Bridging the capital deficit is a constant challenge due to the small tax base of the Township and public pressures to not increase taxes. This challenging position may negatively impact service delivery and quality.

Based on a projection of the latest road condition assessment conducted by an external contractor, the Township's road assets are typically in fair or better condition. Staff expressed concern that the current level of financial reinvestment is insufficient. This sentiment is supported by the discrepancy between the average annual capital requirement of $2.1 million and historical (2019, 2020) and budgeted (2021) capital spending of $1.5 million. The funding deficit means that the infrastructure backlog will increase over time and the level of financial reinvestment will become increasingly insufficient. To maintain levels of service and ensure adequate condition of the road network, the capital deficit must be addressed.

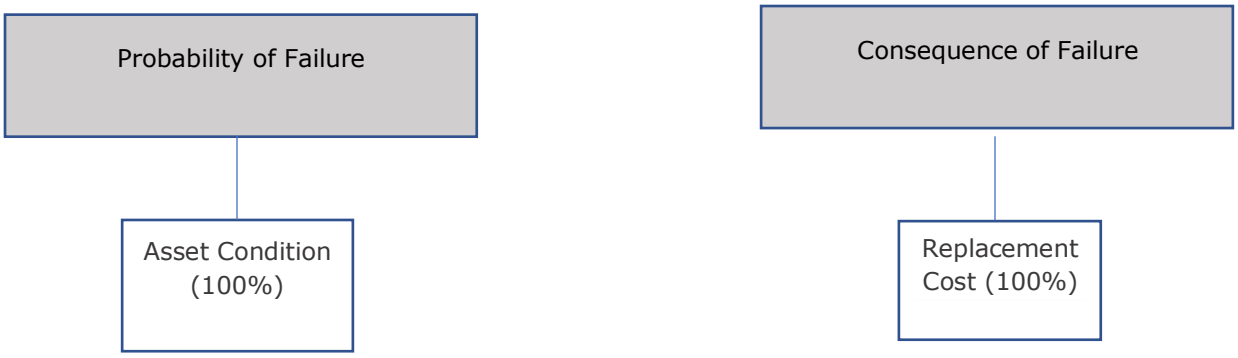
Climate Change

An increase in the frequency and intensity of precipitation events can result in flooding of sections of the road network. As well, the drainage capacity on some of the roads is not sufficient to withstand heavy water flow, particularly on gravel roads. These flooding events often result in accelerated deterioration. To improve asset resiliency, staff should identify problem areas and, where possible through design (i.e., upsizing road culverts), reduce flooding intensity and improve drainage.

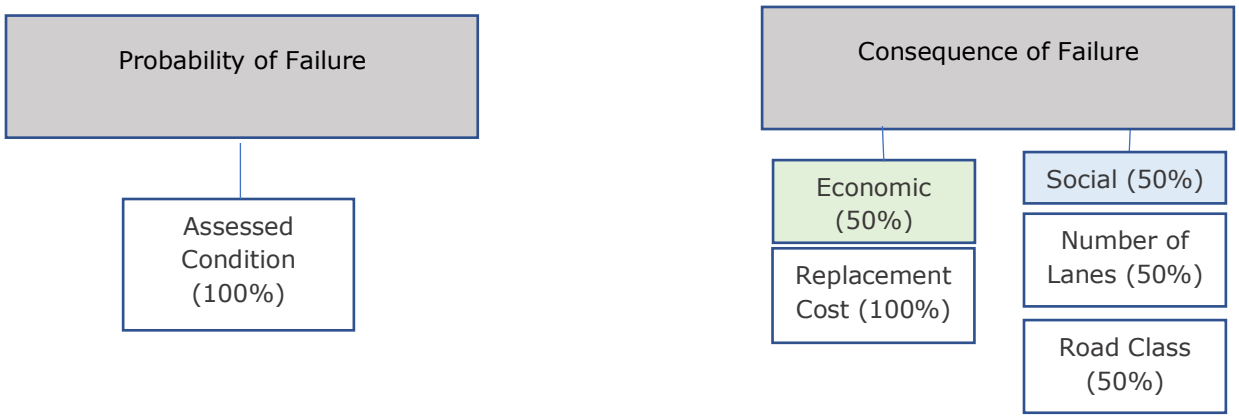
Quantitative Risk

Risk Model

Risks for **road network assets excluding paved roads** are calculated based on the following model:



Risks for **paved road assets** is based on a similar model, with additional metrics used for consequence of failure. The paved road risk model is as follows:



Scores are applied to both the probability of failure and the consequence of failure based on the below noted scales.

Probability of Failure

For all road network assets, probability of failure is based on asset condition. The Table below outlines the relationship between the probability of failure metric and the range used for the above factor.

Probability Attribute	Factor: Paved Roads	Factor: Other Road Assets	Probability of Failure
Asset Condition (100%)	8 and above	80 and above	1—Rare
	6 and above	60 and above	2—Unlikely
	4 and above	40 and above	3—Possible
	2 and above	20 and above	4—Likely
	0 and above	0 and above	5—Almost Certain

Consequence of Failure

The replacement cost is used to estimate the consequence of failure for road assets. The Tables below outlines the ranges used for paved roads and other road network assets respectively and the associated scoring framework.

Consequence Attribute	Paved Roads	Other Road Assets	Consequence of Failure
Replacement Cost (100%)	$30,000 and below	$100,000 and below	1—Insignificant
	$60,000 and below	$250,000 and below	2—Minor
	$120,000 and below	$500,000 and below	3—Moderate
	$240,000 and below	$1,000,000 and below	4—Major
	$1,650,00 and below	$1,000,001 and below	5—Severe

For road network assets excluding paved roads, consequence of failure is 100% based on the asset replacement value.

For paved road assets, social consequences of failure are also included in the risk model. Both financial and social consequence of failure each have 50% weight. Social consequences include the number of lanes and the road class which represent traffic volume and road speeds and the number of lanes in one direction.

Consequence of failure factors and weightings are as follows:

Consequence Attribute	Factor	Consequence of Failure
Road Class[2]	100	1—Insignificant
	200	2—Minor
	300	3—Moderate
	400	4—Major
	500, 600	5—Severe
Number of Lanes (1 direction)	2	2—Minor
	1	4—Major

Risk Summary Results

Using the risk models developed, risk reports can be generated. Such outputs are often key resources and components of a municipality's Asset Management Program and provide valuable guidance on long-term financial planning, levels of service, and lifecycle management decisions.

The following table summarizes probability and consequence of failure scores and overall risk score by asset segment. All reported figures are weighted by replacement value:

Asset Segment	PoF	CoF	Risk Rating[3]
Curb & Gutter	1 / 5	1 / 5	1 / 25
Guard Rails	3.01 / 5	1.14 / 5	3.4 / 25
Paved Roads - HCB	2.04 / 5	3.73 / 5	7.49 / 25
Paved Roads - LCB	1.8 / 5	3.4 / 5	5.98 / 25
Small Culverts	1 / 5	1 / 5	1 / 25
Streetlights	3 / 5	5 / 5	15 / 25
Total	**2.06 / 5**	**3.55 / 5**	**7.17 / 25**

[2] Road class is set by O.Reg 239/02 and based on the roads annual traffic volume and speed limits.

[3] Weighting is based on asset replacement value.

Using the risk model discussed above, the overall risk score for all road network assets is 7.17. However, it is important to note that these are weighted by replacement cost and some assets within each segment may carry significantly more or less risk than the average.

To gain a more detailed overview of risk distribution, we can also review a risk matrix which plots each asset's probability and consequence of failure and overall risk. This can better illustrate risk distribution and associated replacement costs.

In the matrix below risk scores for paved roads is illustrated. On the vertical axis is the consequence of failure and on the horizontal axis is the probability of failure. Each asset's respective probability and consequence of failure score determines where it is plotted. For example, if its probability and consequence of failure are both 1, then its risk score is also 1 and it is located on the most bottom left box.

Taking a broader look at the table we can see that most paved road assets carry low risk (green boxes) with a small proportion carrying moderate risk (blue and yellow) and the remaining carry moderate to high risks (orange and red).

Paved Roads: Risk Matrix

Consequence	1	2	3	4	5
5	6 Assets 11.37 km, unit(s) $2,376,174	8 Assets 11.17 km $2,478,434	0 Assets - $0	0 Assets - $0	0 Assets - $0
4	9 Assets 10.41 km $3,001,011	25 Assets 40.88 km $14,506,177	3 Assets 3.35 km $1,521,630	0 Assets - $0	0 Assets - $0
3	39 Assets 45.43 km $9,540,143	64 Assets 70.96 km $15,938,132	33 Assets 25.78 km $9,303,284	0 Assets - $0	0 Assets - $0
2	25 Assets 9.22 km $2,126,929	28 Assets 12.23 km $2,309,092	41 Assets 12.16 km $3,318,623	2 Assets 1.38 km $124,200	1 Asset 0.10 km $37,100
1	1 Asset 0.05 km $17,500	12 Assets 2.08 km $264,690	23 Assets 3.95 km $463,478	1 Asset 0.29 km $26,100	0 Assets - $0

Probability

The matrix below reports on risk for all other road network assets. Similarly, we can see that most asset carry a low risk (green boxes) since they have a low probability and/or consequence of failure. Some assets carry low or moderate risks (blue and yellow boxes), and one asset carries high risk (red box).

Road Network Excluding Paved Roads: Risk Matrix

As noted in Key Definitions, all data is reported as of 2021-year end. Risk is a dynamic measure that is affected by changes to asset attribute information, like replacement cost and condition. In most cases, a decline in asset condition will result in an increase in risk. Therefore, it is important to regularly review the data used to calculate risk. In some cases, data inaccuracies may be identified, and their correction could impact risk scores.

A review of asset risks is an important first step to appropriate risk treatment. Based on the Township's risk appetite, various risk treatments may be deemed most suitable for road network assets.

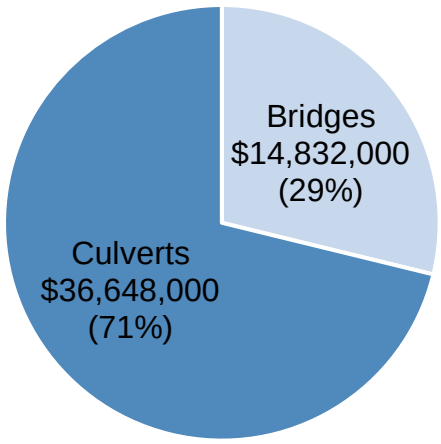
Bridges & Culverts

Asset Overview

Bridges & Culverts represent a critical portion of the transportation services provided to the community. The Township is responsible for the operations and capital upkeep of bridge and culverts. There is a total of 94 of structures in inventory as of December 2021. The Department of Public Works is responsible for the maintenance of all bridges and culverts located across municipal roads with the goal of keeping structures in an adequate state of repair and minimizing service disruptions.

Bridges and structural culverts are recorded in an asset management software system. The following table provides summary information based on a December 2021 effective date:

Asset Segment	Quantity	Replacement Cost
Bridges	20	$14,832,000
Culverts	74	$36,648,000
Total	**94**	**$51,480,000**



Total Current Replacement Cost: $51,480,000

As part of the project engagement, PSD Citywide worked with Hamilton Township staff to review and as needed update asset information, including information from the Townships latest reports as required under Regulation 104/97.

As per Regulation 104/97 Standards for Bridges, every municipal bridge and structural culvert requires inspection for structural integrity, safety, and condition at least bi-annually. Each year, half of the Township's bridge and structural culvert assets are inspected. This report utilizes inspection information from the 2020 and 2021 reports, both of which were completed by Jewell Engineering.

Qualitative Risk

Qualitative risks were identified through an interview-based discussion with Township staff. Interview questions reviewed are provided for reference in Appendix B. Through this exercise, the following risks were identified as relevant to bridge and structural culvert assets.

Fiscal Capacity

The present level of financial reinvestment does not adequately address capital investment requirements. The average annual capital requirement for bridges and structural culverts is $1.3 million. Based on a review of actuals (2019, 2020) and budgeted (2021) amounts bridges are severely underfunded. Bridging the capital deficit is a constant challenge due to the small tax base of the Township and public pressures to not increase taxes. This challenging position may negatively impact service delivery and quality.

The Township's inventory requires regular maintenance, assessment, and rehabilitation/replacement. Currently, grant funding is often relied on for major capital rehabilitation projects; where grant funding is not available projects may be deferred.

Aging Infrastructure

Like many Canadian Municipalities[4], Hamilton Township's bridge and culvert assets were constructed many years ago. Currently the average age of this category is 53 years, and the average EUL is 40 years. With aging infrastructure, their rehabilitation and/or replacement investment requirements are significant. This concentration of older assets may increase the need for increased capital investments in the coming years amid current, and likely also future, budgetary and staff resource constraints.

[4] According to the 2019 Canadian Infrastructure Report Card only 20% of all municipally owned road and bridge assets in Canada were constructed in the last 20 years (page, 18). This indicates that across most Municipalities a large proportion of assets have reached, or are reaching, the end of their estimated useful life.

Organizational Change and Capacity

Staff identified organizational change as a relevant risk, as this is a constant in any organization. It was noted that retirements over the next ten years are anticipated. Turnover will continue to be a risk given the size of the municipality, the lack of internal opportunities for advancement and salary and benefit competitiveness given the proximity to neighboring larger municipalities. The Township mitigates this risk through regular compensation reviews to remain competitive.

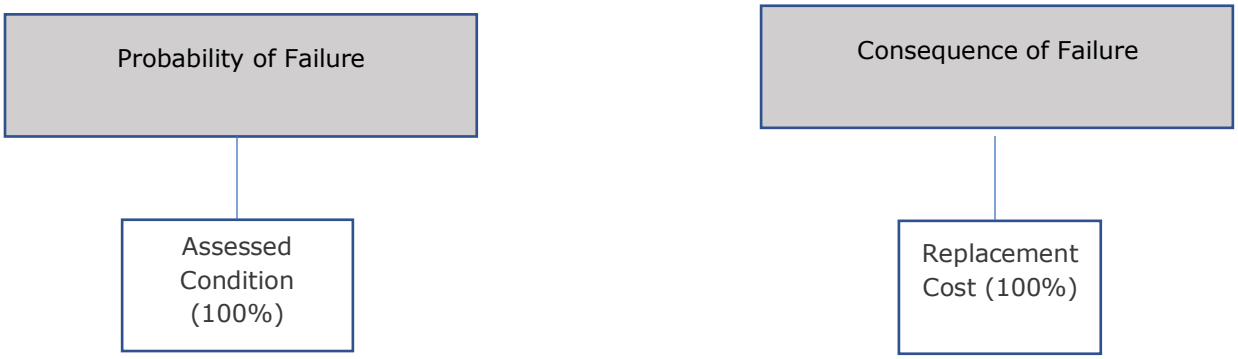
As with any organization, staff departures are a reality. Hamilton Township's existing use of asset management software to track asset attributes (i.e., road material, width, roadbed depth) and performance information reduces this risk. The Township also reduces this risk by ensuring each position has a trained backup.

The Township has a large inventory of bridges and culverts which require regular maintenance, assessment, and rehabilitation/replacement. Staff capacity and expertise are sometimes insufficient to deploy optimal maintenance and assessment strategies. The Township uses the OSIM reports that are completed bi-annually to minimize risk.

Quantitative Risk

Risk Model

Currently, the Township calculates risks for their bridges and structural culverts based on the following probability and consequence of failure factors and associated weights (listed in brackets):



Scores are applied to both the probability of failure and the consequence of failure based on the below noted scales.

Probability of Failure

In this model, estimating the probability that a bridge or culvert asset will fail relies on asset condition. The Table below outlines the relationship between the probability of failure metric and the range used for the above factor.

Probability Attribute	Factor	Probability of Failure
Assessed Condition (100%)	75 and above	1—Rare
	70 and above	2—Unlikely
	60 and above	3—Possible
	50 and above	4—Likely
	0 and above	5—Almost Certain

Consequence of Failure

The economic consequences as described in the following table are used to estimate the consequence of failure for bridge and structural culvert assets. In this model, financial consequences are 100% of the weight.

The Table below outlines the metrics used and the associated scoring framework.

Consequence	Factor	Consequence of
Replacement Cost (100%)	$225,000 and below	1—Insignificant
	$300,000 and below	2—Minor
	$400,000 and below	3—Moderate
	$800,000 and below	4—Major
	$1,400,000 and below	5—Severe

Risk Summary Results

Using the risk models developed, risk reports can be generated. Such outputs are often key resources and components of a municipality's Asset Management Program and provide valuable guidance on long-term financial planning, levels of service, and lifecycle management decisions.

Using the risk model discussed above, the overall risk scores for all bridge and culvert assets are summarized in the table below.

Asset Segment	PoF	CoF	Risk Rating[5]
Bridges	2.97 / 5	4.55 / 5	13.53 / 25
Structural culverts	2.34 / 5	3.83 / 5	8.87 / 25
Total	**2.52 / 5**	**4.04 / 5**	**10.21 / 25**

However, it is important to note that these are weighted by replacement cost and some assets within each segment may carry significantly more or less risk than the average.

To gain a more detailed overview of risk distribution we can also review a risk matrix which plots each asset's probability and consequence of failure and

[5] Weighting is based on asset replacement value.

overall risk. This can better illustrate risk distribution and associated replacement costs.

Risk scores vary across bridge and structural culvert assets. Many assets hold low risk (green and blue), but some assets are identified as having moderate risk (blue and yellow) or high risk (orange and red). For most high-risk assets there is a high consequence of failure due to the significant replacement cost, but in one instance there is both a high probability of failure due to asset condition and a high replacement cost. Various risk treatments could be explored and would be of value particularly for higher risk assets. In select instances, risk treatments could include asset disposal where there is identified alternative route(s) (e.g., Asset 164).

As noted previously, risk is a time specific measure and over time, as asset condition declines, the risks held can be expected to increase. Therefore, it is important to regularly review data used to calculate risk and the resultant outputs, and then to apply appropriate risk treatments. Risk treatments are discussed in the conclusion and recommendations section of the report.

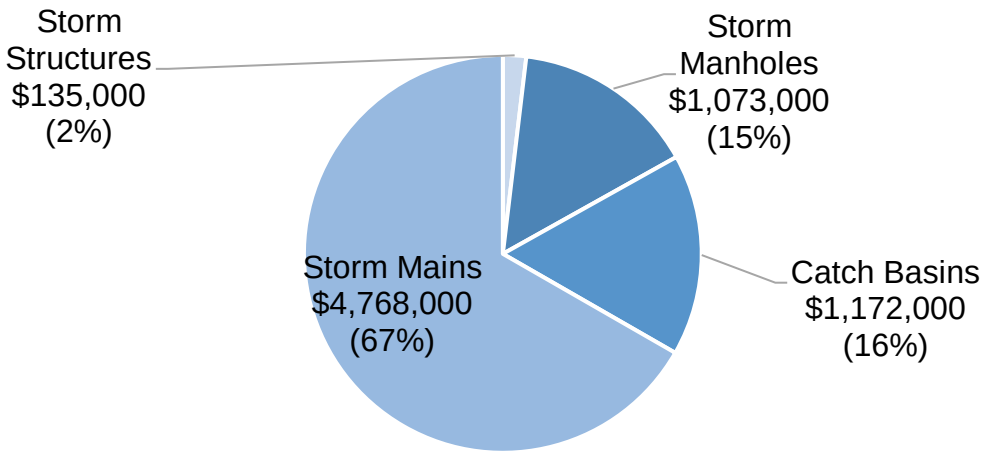
Stormwater Network

Asset Overview

The Township is responsible for the operations and capital upkeep of the stormwater network. The network consists of stormwater mains, manholes, catch basins, and storm structures (stormwater management ponds, oil grit separators, and storm drains). Storm structure mostly consist of storm ceptors which are used to capture trash, debris, oils, and suspended solids from stormwater runoff. Staff are working towards improving the accuracy and reliability of their stormwater setwork to improve long-term asset management planning.

Stormwater assets are recorded in an asset management software system. The following table summarizes the stormwater inventory based on a December 2021 effective date:

Asset Segment	Quantity	Replacement Cost
Catch Basins	316	$1,172,000
Storm Mains	15,661 Meters	$4,768,000
Storm Manholes	173	$1,073,000
Storm Structures	4	$135,000
Total		**$7,148,000**



Total Current Replacement Cost: $7,148,000

At this time, most stormwater assets (95%) use age-based condition, which is calculated based on the assets age relative to its expected service life. In the next few years, the Township hopes to procure CCTV assessments of their stormwater mains, so they have more accurate condition information.

Qualitative Risk

Qualitative risks were identified through an interview-based discussion with Township staff. Interview questions reviewed are provided for reference in Appendix B. Through this exercise, the following risks were identified as relevant to the storm water network.

Climate Change

More extreme rainfall events may also increase the risk of surface flooding if the system is not maintained and retrofitted adequately. Staff need a better sense of the impacts of climate change on the stormwater network to inform retrofitting and replacement planning. Further data will help address concerns with system capacity and the ability of the stormwater network to handle any potential increases in the intensity, frequency, and duration of rainfall events.

Asset Information (Condition)

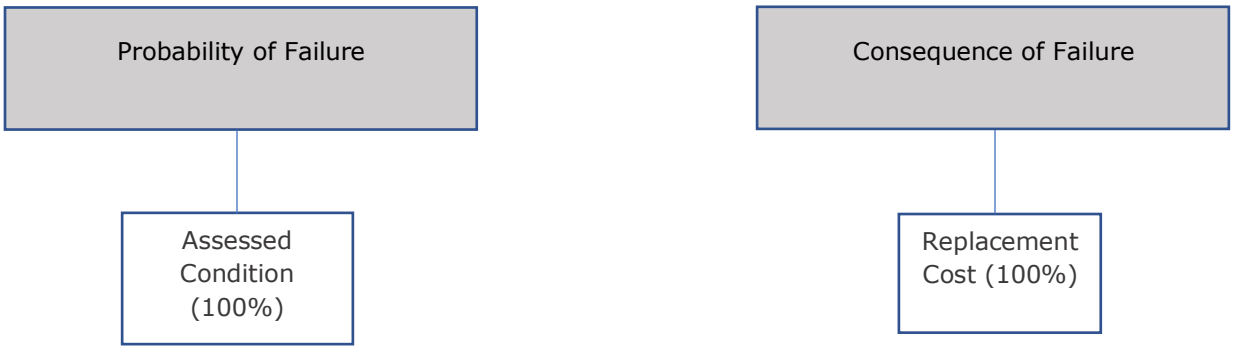
Asset information is crucially important to understanding the state of infrastructure, evaluating asset risks, and determining asset investments. This is particularly the case for underground assets which are not easily accessible

and often have concealed deficiencies. While the Township's database is comprehensive, it has very limited condition assessment information for its stormwater network. This is a hinderance to the ability of staff to accurately understand the state of their infrastructure and effectively identify priorities for capital investment. This limited asset information poses a risk to the long-term effectiveness of the asset management program as it relates to stormwater network assets.

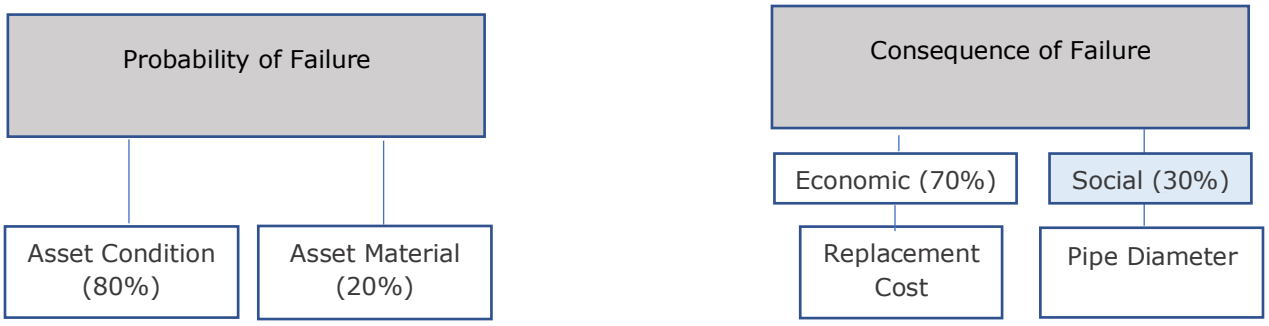
Quantitative Risk

Risk Model

Currently, the Township calculates risks for their stormwater assets (excluding stormwater mains) based on the following probability and consequence of failure factors and associated weights (listed in brackets):



The following risk model is used for the **stormwater mains**. This model utilizes additional attribute data that are good predicators for the probability and consequence of failure.



Scores are applied to both the probability of failure and the consequence of failure based on the below noted scales.

Probability of Failure

For all stormwater assets, estimating the probability that an asset will fail relies on asset condition. The Table below outlines the relationship between the probability of failure metric and the range used for the above factor.

Probability Attribute	Factor	Probability of Failure
Asset Condition	80 and above	1—Rare
	60 and above	2—Unlikely
	40 and above	3—Possible
	20 and above	4—Likely
	0 and above	5—Almost Certain

Asset condition is determined using the age-based approach for stormwater network assets.

Material is an additional probability of failure parameter for **stormwater mains** only. Asset material is used to estimate probability of failure based on a 20% weighting using the following factors and associated scoring.

Probability Attribute	Factor	Probability of Failure
Asset Material	Plastics: HDPE, PVC, PE, CPP, CP	2—Unlikely
	CSP, Steel	4—Likely

Consequence of Failure

The economic consequences as described below are used to estimate the consequence of failure for stormwater assets. In this model, financial consequences are 100% of the weight.

The Table below outlines the metrics used and the associated scoring framework.

Consequence Attribute	Mains	Other Storm Network Assets	Consequence of Failure
Replacement Cost	$10,000 and below	$100,000 and below	1—Insignificant
	$20,000 and below	$250,000 and below	2—Minor
	$50,000 and below	$500,000 and below	3—Moderate
	$100,000 and below	$1 M and below	4—Major
	$375,000 and below	$1 M and greater	5—Severe

For stormwater mains, consequence of failure also considers pipe diameter. Generally, the larger a stormwater main, the greater the impact of its failure on the community. Recognizing this, scoring is as follows:

Consequence Attribute	Factor	Consequence of Failure
Pipe Diameter (mm)	200 and below	1—Insignificant
	400 and below	2—Minor
	800 and below	3—Moderate
	1200 and below	4—Major
	2400 and below	5—Severe

Risk Summary Results

Using the risk models developed, risk reports can be generated. Such outputs are often key resources and components of a municipality's Asset Management Program and provide valuable guidance on long-term financial planning, levels of service, and lifecycle management decisions.

Asset Segment	PoF	CoF	Risk Rating[6]
Catch Basins	1.89 / 5	1.09 / 5	1.98 / 25
Storm Mains	1.83 / 5	3.61 / 5	6.37 / 25
Storm Manholes	2.01 / 5	1 / 5	2.01 / 25
Storm Structures	1.47 / 5	1 / 5	1.47 / 25
Total	**1.86 / 5**	**2.75 / 5**	**4.91 / 25**

However, it is important to note that these are weighted by replacement cost and some assets within each segment may carry significantly more or less risk than the average.

To gain a more detailed overview of risk distribution, a risk matrix which plots each asset's probability and consequence of failure and overall risk is provided. This can better illustrate risk distribution and associated replacement costs.

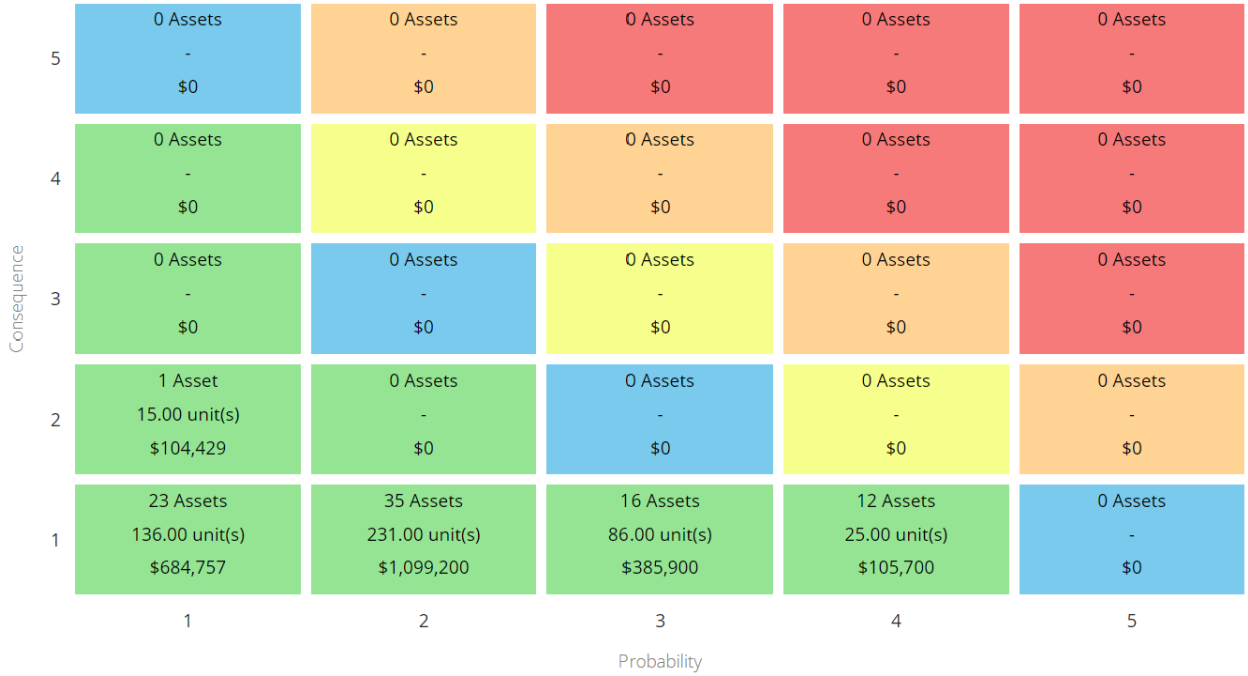
Stormwater Mains: Risk Matrix:

As indicated below, most stormwater main assets carry a low probability and a low consequence of failure and therefore are considered low risk and identified in green. Some stormwater mains carry slightly higher consequence of failure and/or probability of failure and are considered to have moderate risk. These assets are identified in blue and yellow. Two assets carry moderate to high risk (orange), in both cases these assets are in poor condition and are made of a material prone to failure which contributes to a high probability of failure. Their cost to replace and diameter as a measure of consequence of failure are moderate. Overall, their risk is moderate to high. The Township's

[6] Weighting is based on asset replacement value.

risk treatment could include further investigation into asset condition to evaluate criticality of asset replacement or instead they could without further investigation identify these assets as a priority for replacement.

Stormwater Assets (excluding mains):



The matrix above illustrates risk score for all stormwater network assets excluding stormwater mains. As indicated, risk is low (green boxes) for these assets. This is largely due to the low replacement cost of these stormwater assets. Some assets, however, do have a higher probability of failure (3 and 4). These assets should be further investigated and considered when making replacement investment decisions since they are likely to fail. A more detailed investigation may also indicate that select assets have unique conditions like location and function which are not reflected in the risk model due to data limitations but are still crucial to consider when evaluating asset risk.

As with all risk models and results, these are reported as of a specific point in time (in this case, 2021 year-end). As a best practice, regular review of risk models and their outputs will help the Township more accurately understand the risks they hold and based on their risk appetite determine suitable risk treatments.

Water Network

Asset Overview

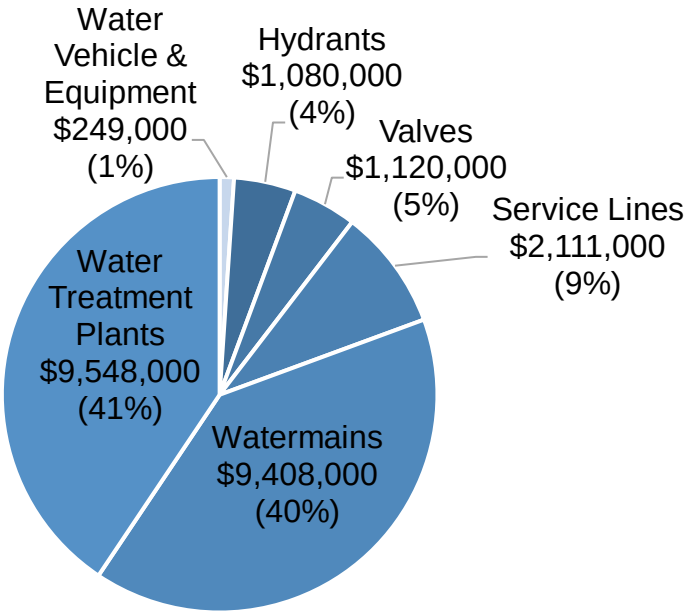
The Township is responsible for maintaining a water network that is comprised of watermains, water treatment plants, and other supportive water infrastructure like valves, service lines, water vehicles and equipment, and hydrants. The water network is managed and operated by the Waterworks department staff at the Township. The Waterworks department is responsible for the Camborne and Creighton Heights (Baltimore) Water Treatment Plant and distribution system along with supporting infrastructure. Lakefront Utility Services Inc (LUSI), an external operating authority, is responsible for the Buttersfield Distribution System.

As the operating authority for the Township of Hamilton's drinking water systems, the Waterworks department is committed to providing safe drinking water to consumers, in compliance with the Drinking Water Act.

Water network assets are recorded in an asset management software system. The following table provides summary information based on a December 2021 effective date:

Asset Segment	Quantity (# assets)	Replacement Cost
Hydrants	90	$1,080,000
Service Lines	451	$2,111,000
Valves	114	$1,120,000
Water Treatment Plants	2 (3,320)[7]	$9,548,000
Water Vehicle & Equipment	74	$249,000
Watermains	21,664 linear Meters	$9,408,000
Total		**$23,516,000**

[7] There are two water treatments plants (Creighton Heights & Camborne) which each contain various building components. The figure in brackets represents the total number of various building components (i.e., roofing, doors, pumps, control values, filtration system etc.) contained within or connected to (i.e., associated parking lot) the treatment plants.



Total Current Replacement Cost: $23,516,000

As part of the project engagement PSD Citywide worked with Township of Hamilton staff to review and as needed update asset information.

Qualitative Risk

Qualitative risks were identified through an interview-based discussion with Township staff. Interview questions reviewed are provided for reference in Appendix B. Through this exercise, the following risks were identified as relevant to the water network.

Fiscal Capacity

Currently the Township owns and operates three water systems which together service approximately 12% of properties within the Township. Throughout the Township, development is low density, so the amount of water infrastructure is high relative to the number service connections. This makes it very challenging to obtain the affordability benefits of economies of scale that are otherwise common of a municipal water system. Based on a review of historical actual and budgeted capital investments to the water network, about 14% of the average annual capital requirement is funded. If the cost of municipal water rises, property owners may choose to switch to private service which would further the Township's challenge of providing an affordable water service. The historic level of underfunding in conjunction with the rural nature of the Township and the low percentage of properties connected is a severe risk to having the fiscal capacity (currently and in the future) to properly maintain water assets.

Asset Capacity & Design

The current water systems contain some capacity issues (primarily within Creighton Heights) that can impact Staff's ability to meet desired levels of service. The Township will be completing a Water Master Plan Study that will explore capacity issues for Creighton Heights.

Organizational Change and Capacity

Staff identified organizational change as an immediately relevant risk to the water network. As of 2022, several key operators for the Township's water systems were eligible to retire within three (3) years. Succession planning has begun for the first eligible retiree and throughout the last several years historical knowledge of the system has been collected by the Water Operations Manager. Given the critical service operators provide in the provision of water and the approaching retirements, organization change is a risk. Through

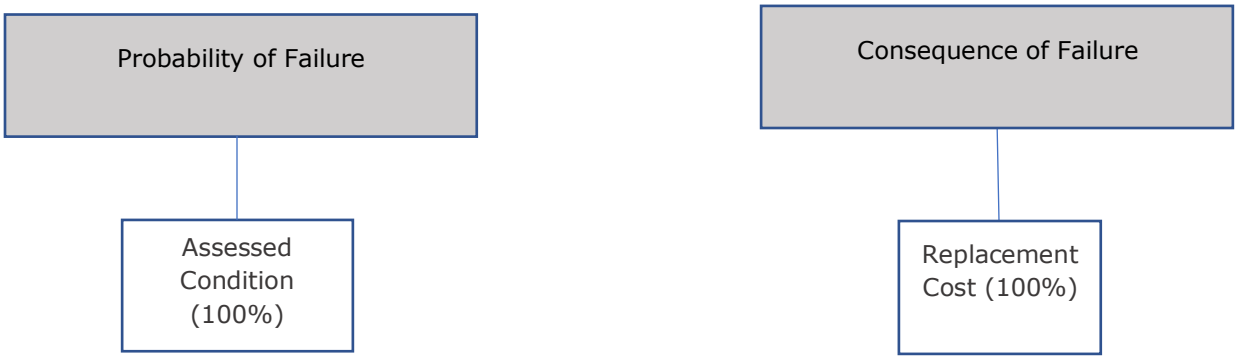
mitigative actions such as succession planning, this risk can be substantially reduced.

Quantitative Risk

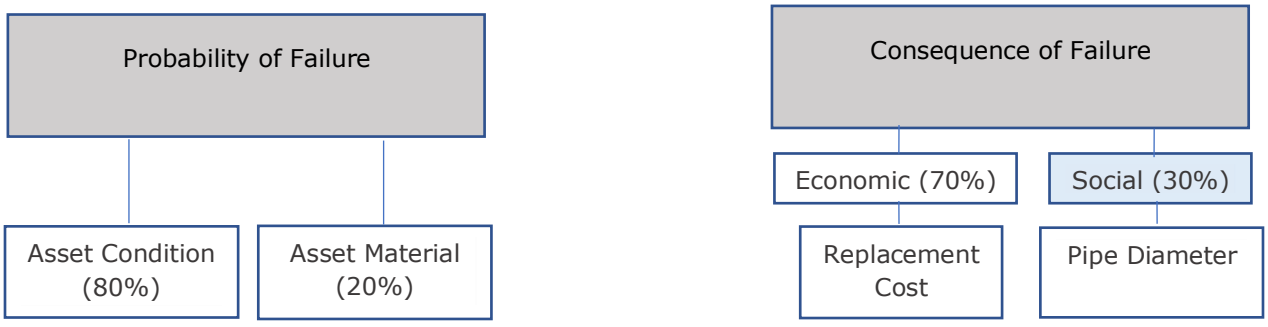
Risk Model

Currently, the Township calculates risks for their water network assets based on the following probability and consequence of failure factors and associated weights (listed in brackets):

Water Network (Excluding water mains):



Water Mains however utilized a different risk model. The water main model is as follows:



Scores are applied to both the probability of failure and the consequence of failure based on the below noted scales.

Probability of Failure

In this model, estimating the probability that a water network asset will fail relies on asset condition. The Table below outlines the relationship between the probability of failure metric and the range used for the above factor.

Probability Attribute	Factor	Probability of Failure
Asset Condition	1 and below	1—Rare
	2 and below	2—Unlikely
	3 and below	3—Possible
	4 and below	4—Likely
	5 and below	5—Almost Certain

Material is an additional probability of failure parameter for **water mains** only. Asset material is used to estimate probability of failure based on a 20% weighting using the following factors and associated scoring.

Probability Attribute	Factor	Probability of Failure
Asset Material	Plastics: HDPE, PVC, PE, CPP, CP	2—Unlikely
	CSP, Steel, Cast Iron	4—Likely

Consequence of Failure

The Table below outlines the metrics used to calculate consequence of failure for water network assets and the associated scoring framework. As noted in the table below, ranges are specific to the asset segments.

Consequence Attribute	Asset Segments		Consequence of Failure
	Water Mains	All Others	
Replacement Cost	$10,000 and below	$100,000 and below	1—Insignificant
	$20,000 and below	$250,000 and below	2—Minor
	$50,000 and below	$500,000 and below	3—Moderate
	$100,000 and below	$1,000,000 and below	4—Major
	$375,000 and below	$1,000,001 and below	5—Severe

The **water main** risk model also accounts for pipe diameter when calculating the consequence of failure. The larger the pipe diameter the greater than number of properties affected by asset failure. The following table outlines the parameter ranges and associated consequence ratings.

Consequence Attribute	Factor	Probability of Failure
Main Diameter	50 and below	2—Minor
	150 and below	3—Moderate
	200 and below	4—Major
	300 and below	5—Severe

Risk Summary Results

Using the risk models developed, risk reports can be generated. Such outputs are often key resources and components of a municipality's Asset Management Program and provide valuable guidance on long-term financial planning, levels of service, and lifecycle management decisions.

Asset Segment	PoF	CoF	Risk Rating[8]
Hydrants	1.8	1.33	2.32 / 25
Service Lines	2.29	1.49	3.34 / 25
Valves	1.75	1.14	1.9 / 25
Water Treatment Plants	3.13	1.95	5.59 / 25
Water Vehicles & Equipment	3.93	1.69	7.21 / 25
Water Mains	2.92	2.96	8.62 / 25
Total	**2.85**	**2.24**	**6.29 / 25**

However, it is important to note that these are weighted by replacement cost and some assets within each segment may carry significantly more or less risk than the average.

To gain a more detailed overview of risk distribution we can also review a risk matrix which plots each asset's probability and consequence of failure and overall risk. This can better illustrate risk distribution and associated replacement costs.

Using the risk model discussed above the overall risk scores for water main asset and all other water network assets is summarized in the matrixes below.

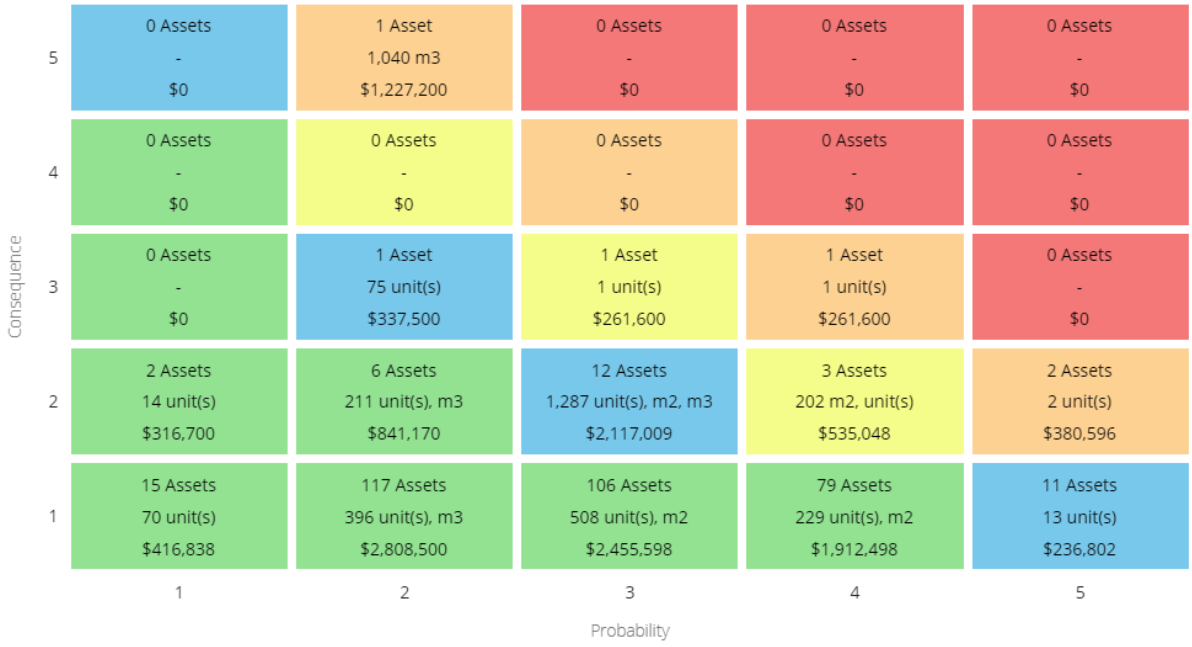
[8] When reporting at the segment level scores are weighted by asset replacement value.

Water Mains: Risk Matrix

As indicated in the table above, most water main assets carry a low-to-moderate probability and consequence of failure; these assets are in green and blue boxes. Some assets carry a slightly higher consequence of failure and/or probability of failure and are considered to carry higher risks than average. These assets are identified in yellow and orange. As of 2021, there are no high-risk water main assets.

All Other Water Assets: Risk Matrix

Based on an average reporting, water network assets carry low probability and consequence of failure. However, risks do vary by asset and some carry slightly higher or lower consequence and/or probability of failure than the average. The matrix below summarizes assets risks for water network assets (excluding water mains discussed previously). As identified in orange there are some assets that are moderately high risk. In these instances, the assets carry a low probability of failure but a very high consequence of failure or a low or moderate consequence of failure but a very high probability. Most assets carry low risk and are identified in green and blue boxes. Four assets carry moderate risk as identified in yellow.



As of 2021-year end data, high risk assets are all related to the water treatment plant. Since risk is a time specific measure, risk scores can be expected to change over time. This may be both due to changes in the data used to calculate risk and/or changes to the risk model (i.e., how risk is evaluated). In either case, it is important to regularly review asset data alongside risk models and their outputs, and then to treat risk appropriately. Risk treatments are discussed in the conclusion and recommendations section of the report.

Non-Core Assets

Facilities

Asset Overview

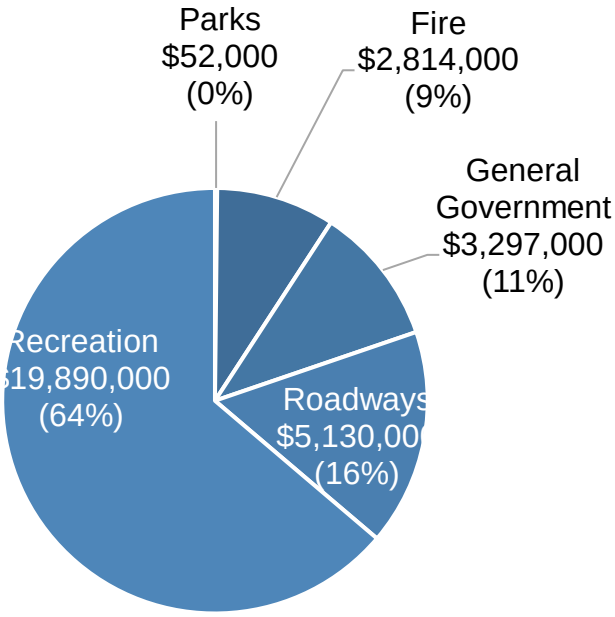
The Township is responsible for the operations and capital upkeep of several facilities used both for municipal operations and public services. Facilities include:

- Township Municipal Office
- Fire Halls
- Recreation and Community Centres
- Public Work Garages

The Township's facility assets are recorded in an asset management software system. The following table provides summary information about facility assets based on a December 2021 effective date:

Asset Segment	Quantity (# Facilities)	Replacement Cost
Fire	4	$2,814,000
General Government	2	$3,297,000
Parks	1	$52,000
Recreation	4 (33[9])	$19,890,000
Roadways	6	$5,130,000
Total	**46**	**$31,182,000**

[9] In most instances, facility assets are recorded as a single asset for each building. For recreation assets, however the Baltimore Recreation Centre is represented by multiple assets that each represent a various building component (i.e., lighting, floors etc.).



Total Current Replacement Cost: $31,182,000

As part of the project engagement PSD Citywide worked with Hamilton Township staff to review and as needed update asset date including assessed condition. Typically, assessed condition better reflects the actual condition of assets and is determined based on a combination of visual inspection and a review of asset performance.

Current Asset Structure

Currently most major components of a facility (i.e., HVAC, roof) are recorded as a single asset in Asset Manager, however not all building components (i.e., windows, doors) are recorded as an asset. In most cases, replacement costs are the building's insured replacement value and information on specific asset interventions (i.e., repairs, replacements) is limited. The Township would benefit from a more comprehensive and consistent componentization of their asset so that all components are appropriately accounted for, and replacement schedules are tailored to each assets estimated useful life and relevant details (i.e., poor condition may prompt earlier replacement). More details on recommendation componentization approach and considerations are provided in the lifecycle strategies report.

Qualitative Risk

Qualitative risks were identified through an interview-based discussion with Township staff. Interview questions reviewed are provided for reference in Appendix B. Through this exercise, the following risks were identified as relevant to facility assets.

Fiscal Capacity

The Township's current level of financial reinvestment does not sufficiently address maintenance and capital rehabilitation requirements for facilities. A tax change was recommended in 2016 to reach full funding requirements and the 2022 capital budget for parks and recreations (which contains many facilities) is $35,000. Based on surveys conducted for the 2022 Parks & Recreation Master Plan, the public at large is not in favor of increased taxation to fund recreational assets. Despite public preference to minimize taxes, assets will always require investment. Facility assets include essential services like the Fire Halls, one of which was identified as not having sufficient capacity for the force.

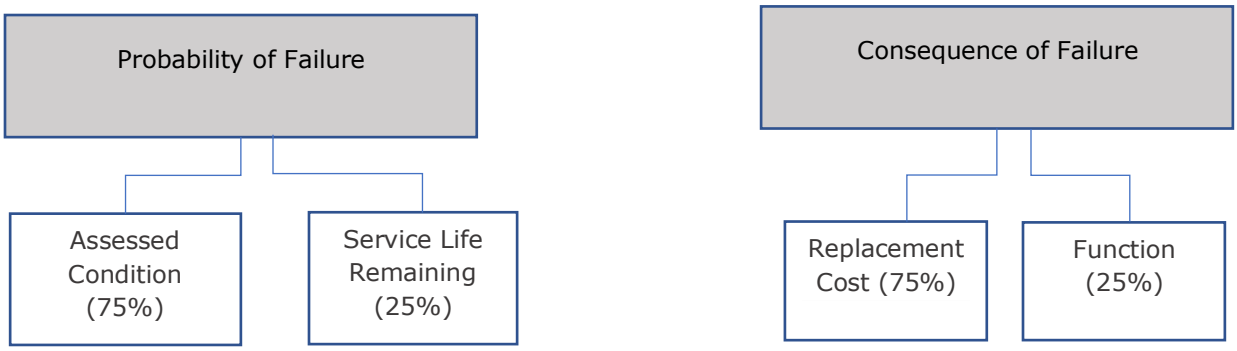
Aging Infrastructure

Some facilities, especially the fire halls, have original and aged components. Budgeting is often prioritized to public safety needs, and otherwise building components are often run until failure. This creates risks associated with unplanned asset failure alongside a ballooning investment requirement for the facility assets as they age and deteriorate with time.

Quantitative Risk

Risk Model

Currently, the Township calculates risks for their facility's based on the following probability and consequence of failure factors and associated weights (listed in brackets):



Scores are applied to both the probability of failure and the consequence of failure based on the below noted scales.

Probability of Failure

In this model, estimating the probability that a facilities asset will fail relies on asset condition and service life remaining. The Table below outlines the relationship between the probability of failure metric and the range used for the above factor.

Probability Attribute	Factor	Probability of Failure
Assessed Condition (75%)	80 and above	1—Rare
	60 and above	2—Unlikely
	40 and above	3—Possible
	20 and above	4—Likely
	0 and above	5—Almost Certain
Service Life Remaining (25%)	80 and above	1—Rare
	50 and above	2—Unlikely
	30 and above	3—Possible
	15 and above	4—Likely

Probability Attribute	Factor	Probability of Failure
	0 and above	5—Almost Certain

Consequence of Failure

The economic consequences used to estimate the consequence of failure for facilities assets considers the replacement costs mostly (75%) with some consideration for the asset segment. The Table below outlines the metrics used and the associated scoring framework.

Consequence Attribute	Factor	Consequence of Failure
Replacement Cost (75%)	$400,000 and below	1—Insignificant
	$900,000 and below	2—Minor
	$1,300,000 and below	3—Moderate
	$5,000,000 and below	4—Major
	$5,200,000 and below	5—Severe
Function (25%)	No Function	1—Insignificant
	General Government	2—Minor
	Recreation & Cultural Services	
	Environmental Services	3—Moderate
	Transportation services	
	Health Services	5—Severe
	Protection Services	

Risk Summary Results

Using the risk models developed, risk reports can be generated. Such outputs are often key resources and components of a municipality's Asset Management Program and provide valuable guidance on long-term financial planning, levels of service, and lifecycle management decisions.

Using the risk model discussed above the overall risk scores for all facility assets is summarized by asset segment in the table below:

Asset Segment	PoF	CoF	Weighted[10] Average Risk Rating
Fire	2.02	3.23	6.59 / 25
General Government	2.07	3.25	6.99 / 25
Parks	2.7	1.25	3.38 / 25
Recreation	2.16	3.12	6.38 / 25
Roadways	2.15	2.92	6.54 / 25
Total	**2.13**	**3.11**	**6.49 / 25**

However, it is important to note that these are weighted by replacement cost and some assets within each segment may carry significantly more or less risk than the average.

To gain a more detailed overview of risk distribution we can also review a risk matrix which plots each asset's probability and consequence of failure and overall risk. This can better illustrate risk distribution and associated replacement costs. As indicated, most assets carry a low probability and a low consequence of failure and therefore are low risk and identified in green. Some assets carry a slightly higher consequence of failure and/or probability of failure and are considered to have moderate risk. These assets are identified in blue and yellow.

As of 2021-year end data there are no facility assets identified as high risk, however risk is a time specific measure and over time as asset condition declines, and assuming there is insufficient investment, risks held by facility assets can be expected to increase. As well, asset risks could change following increased evaluation (i.e., Building Condition Assessments discussed in lifecycle strategies report). Therefore, it is important to regularly review data used to calculate risk and the resultant outputs, and then to treat identified risks appropriately.

[10] Weighting is based on asset replacement value.

Land Improvements

Asset Overview

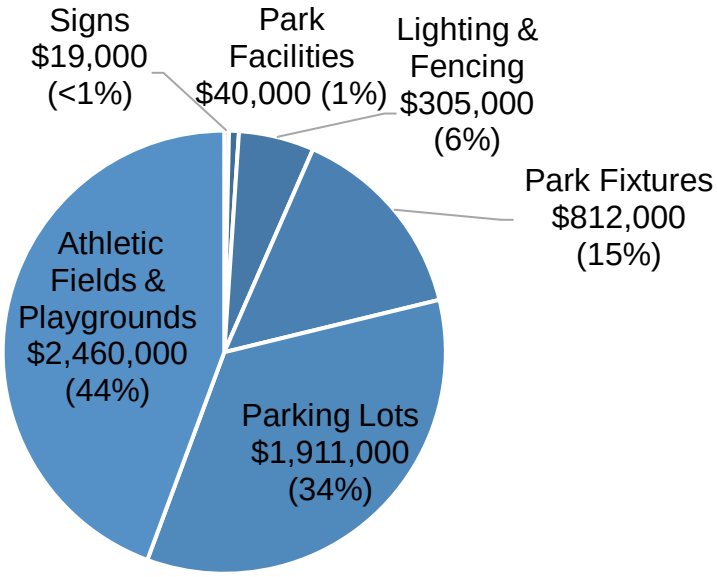
The Township is responsible for the operations and capital upkeep of a diverse array of land improvement assets. For reporting purposes these assets have been segmented based on similar function. These segments, and examples of common assets included in them, is detailed below:

- Athletic Fields & Playgrounds: outdoor playgrounds and play equipment, outdoor playing courts and fields.
- Lighting & Fencing: outdoor lighting
- Park Facilities: non-enclosed structures like gazebos
- Park Fixtures: benches, picnic tables, waste receptables, boardwalk and retaining walls.
- Parking Lots: parking lots associated with buildings and parks
- Signs: various outdoor signs[11]

The Township's land improvement assets are recorded in an asset management software system. The following table provides summary information based on a December 2021 effective date:

Asset Segment	Quantity	Replacement Cost
Athletic Fields & Playgrounds	12	$2,460,000
Lighting & Fencing	6	$305,000
Park Facilities	1	$40,000
Park Fixtures	13	$812,000
Parking Lots	11	$1,911,000
Signs	9	$19,000
Total	**52**	**$5,546,000**

[11] Please note that while the Township may own other land improvements like walking trails, they may not all be represented in this table. This will, in most cases be due to not meeting the Township's TCA threshold.



Total Current Replacement Cost: $5,546,000

As part of the project engagement, PSD Citywide worked with Hamilton Township staff to review and as needed update the asset data including assessed condition.

Qualitative Risk

Qualitative risks were identified through an interview-based discussion with Township staff. Interview questions reviewed are provided for reference in Appendix B. Through this exercise, the following risks were identified as relevant to land improvement assets.

Fiscal Capacity

The present level of financial reinvestment is not sufficient to ensure municipal assets remain in an adequate state of repair and achieve their intended service life. Bridging the capital deficit is a constant challenge due to the small tax base of the Township and public pressures to not increase taxes. This challenging position may negatively impact service delivery and quality.

Required land improvement funding is far below the existing annual investment. There are persistent pressures from the public for investments to land improvement assets, like a splash pad, but with an existing capital funding deficit and public discontentment with taxation increases, the Township is in a very challenging position. Historically, significant land improvement investments have depended on the availability of grant funding, the securement of which is not guaranteed.

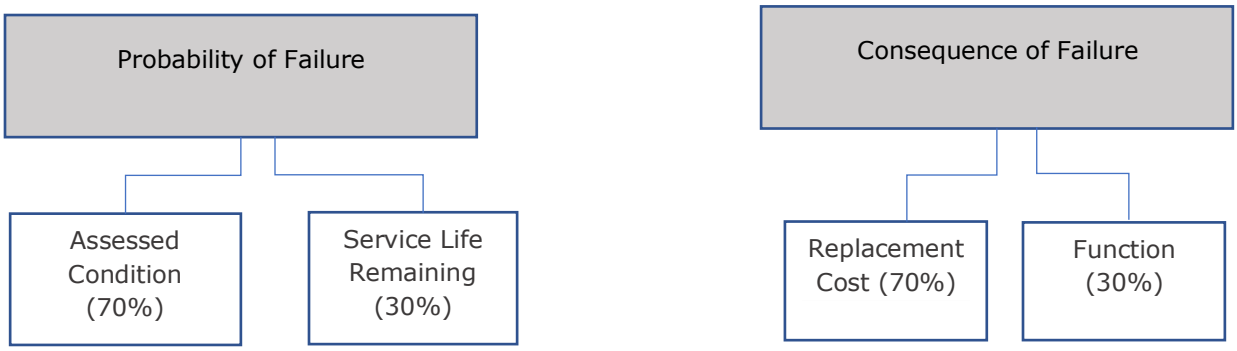
Demographic Change & Community Expectations

The Hamilton Parks and Recreation Master Plan notes the public's increased recognition of the importance of outdoor activity during the pandemic as well as dramatic increases in the use of parks, paths, and trails. This has stimulated support for renewal, expansion, and accessibility enhancements of land improvement assets. These sentiments are supported by a report by the Canadian Parks and Recreation Association which notes that in 2020, 70% of Canadians expressed an increased appreciation for parks and green spaces; 66% reported increased levels of walking/jogging outdoors, and there was a 25% increase in cycling. The increased valuation of land improvement assets combined with the challenging fiscal capacity severely hinders the Township's ability to fund their assets as required. This is a significant risk to the long-term asset performance and risk.

Quantitative Risk

Risk Model

Currently, the Township calculates risks for their land improvement based on the following probability and consequence of failure factors and associated weights (listed in brackets):



Scores are applied to both the probability of failure and the consequence of failure based on the below noted scales.

Probability of Failure

In this model, estimating the probability that a land improvements asset will fail relies mostly on asset condition (70%) with some consideration also for service life remaining (30%). The Table below outlines the relationship between the probability of failure metrics factor score and the resultant probability of failure score.

Attribute	Factor	Probability of Failure
Assessed Condition (70%)	80 and above	1—Rare
	60 and above	2—Unlikely
	40 and above	3—Possible
	20 and above	4—Likely
	0 and above	5—Almost Certain
Service Life Remaining (30%)	80 and above	1—Rare
	50 and above	2—Unlikely
	30 and above	3—Possible
	15 and above	4—Likely
	0 and above	5—Almost Certain

Consequence of Failure

The attributes as described in below are used to estimate the consequence of failure for land improvement assets. In this model, replacement costs (a financial consequence) have the highest weighting (70%) with asset function contributing the remaining 30%. The Table below outlines the metrics used and the associated scoring framework.

Consequence Attribute	Factor	Consequence of Failure
Replacement Cost (70%)	$45,000 and below	1—Insignificant
	$80,000 and below	2—Minor
	$200,000 and below	3—Moderate
	$500,000 and below	4—Major
	$600,000 and below	5—Severe
Function (30%)	Fencing, landscaping, waste receptacles	2—Minor
	Furnishings, Gazebo, Parking Lots, Retaining Walls	3—Moderate
	Athletic Fields & Playgrounds, Boardwalks, Picnic Tables, Playgrounds, Tennis Courts	4—Major

Consequence Attribute	Factor	Consequence of Failure
	Docks	5—Severe

Risk Summary Results

Using the risk models developed, risk reports can be generated. Such outputs are invaluable to an asset management program as they provide meaningful summary about risks by category and often guide financial planning, levels of service, and lifecycle management decisions.

The following table summarizes weighted average probability and consequence of failure, and risk rating for each land improvement segment.

Asset Segment	PoF	CoF	Weighted[12] Average Risk Rating
Athletic Fields & Playgrounds	3.24	4.01	13.36 / 25
Lighting & Fencing	2.56	2.38	6.28 / 25
Park Facilities	2.9	1.6	4.64 / 25
Park Fixtures	1.39	3.14	4.14 / 25
Parking Lots	2.37	3.7	7.98 / 25
Signs	1.16	1	1.16 / 25
Total	**2.62**	**3.66**	**9.66 / 25**

Overall, athletic fields and playgrounds carry the highest average risk rating. This is in part due to the consequence of failure reflecting their function as major (4).

However, it is important to note that these are weighted by replacement cost and some assets within each segment may carry significantly more or less risk than the average.

[12] Weighting is based on asset replacement value.

To gain a more detailed overview of risk distribution we can also review a risk matrix which plots each asset's probability and consequence of failure and overall risk. This can better illustrate risk distribution and associated replacement costs.

When viewing all land improvements, most assets carry a low probability and consequence of failure and therefore a low risk. Some assets (yellow and blue) however carry moderate risk due to a higher probability and/or consequence of failure, and a few assets (orange) are considered high risk.

Risk treatments would be valuable to explore at a minimum for assets with moderate-high risk (orange). Further investigation may help the Township identify suitable risk treatments based on their accepted risk tolerance.

Machinery & Equipment

Asset Overview

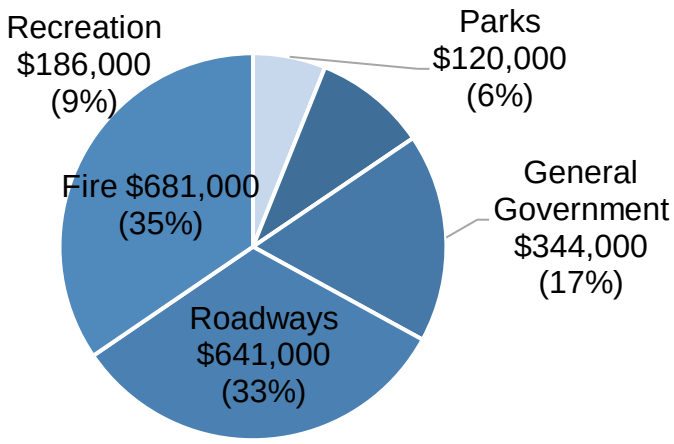
The Township owns a variety of fleet and fleet equipment assets that are central to the Townships daily operations. For reporting purposes these assets have been segmented based on similar function. These segments, and examples of common assets included in them, is detailed below:

- Roadways: predominately comprised of pick-up and dump trucks and trailers and various small utility vehicles including excavators and tractors.
- Recreation: ice resurfacing machines and trucks used specifically to support recreational programs.
- Parks: a small assortment of pick-up trucks to support the transportation and work requirements of parks and recreation staff.

Fire assets are also included in fleet and fleet equipment category; these assets are discussed in the Fire Fleet Asset section.

The Township's fleet and fleet equipment assets are recorded in an asset management software system. The following table provides summary information based on a December 2021 effective date:

Asset Segment	Quantity	Replacement Cost
Fire	50	$681,000
General Government	12	$344,000
Parks	3	$120,000
Recreation	251	$186,000
Roadways	26	$641,000
Total	**342**	**$1,973,000**



Total Current Replacement Cost: $1,973,000

As part of the project engagement, PSD Citywide worked with Hamilton Township staff to review and as needed update asset data, including assessed condition, replacement costs, and other asset details.

Qualitative Risk

Qualitative risks were identified through an interview-based discussion with Township staff. Through staff interview (questions included in Appendix B) the following risks were deemed relevant to machinery and equipment assets.

Fiscal Capacity

The present level of financial reinvestment does not adequately address maintenance and capital rehabilitation requirements to ensure municipal assets remain in an adequate state of repair and achieve their intended service life. For fire machinery and equipment assets, there is currently only a $15,000 minor capital budget item and sometimes capital replacements may be funded from operational budgets. Bridging the capital deficit is a constant challenge due to the small tax base of the Township and public pressures to not increase taxes. This challenging position may negatively impact service delivery and quality.

Organizational Change and Capacity

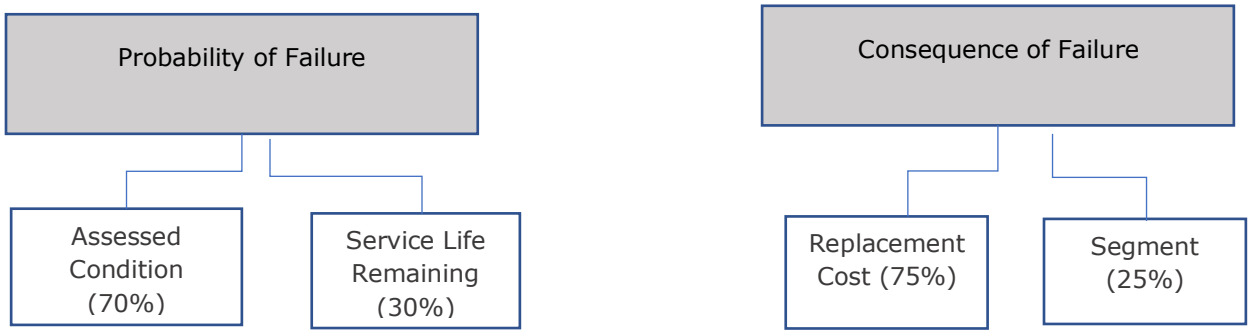
Staff identified organizational change as a relevant risk, as this is a constant in any organization. It was noted that retirements over the next ten years are anticipated. Turnover will continue to be a risk given the size of the municipality, the lack of internal opportunities for advancement and salary and benefit competitiveness given the proximity to neighboring larger municipalities. The Township mitigates this risk through regular compensation reviews to remain competitive.

As with any organization, staff departures are a reality. Hamilton Township's existing use of asset management software to track asset attributes (i.e., road material, width, roadbed depth) and performance information reduces this risk. The Township also reduces this risk by ensuring each position has a trained backup.

Quantitative Risk

Risk Model

Currently, the Township calculates risks for their machinery and equipment assets based on the following probability and consequence of failure factors and associated weights (listed in brackets):



Scores are applied to both the probability of failure and the consequence of failure based on the below noted scales.

Probability of Failure

In this model, estimating the probability that a machinery & equipment asset will fail relies on asset condition (70%) and service life remaining (30%). The table below outlines the relationship between the probability of failure metric and the range used for the above factor.

Probability Type	Factor	Probability of Failure
Condition (70%)	80 and above	1—Rare
	60 and above	2—Unlikely
	40 and above	3—Possible
	20 and above	4—Likely
	0 and above	5—Almost Certain
Service Life Remaining (30%)	80 and above	1—Rare
	50 and above	2—Unlikely
	30 and above	3—Possible
	15 and above	4—Likely
	0 and above	5—Almost Certain

Consequence of Failure

Consequence of failure considers both the economic impact of replacing an asset and the health and safety impacts of asset failure based on the assets segment. The following table outlines the consequence type, factor, and resultant consequence rating.

Consequence Type	Factor	Consequence of Failure
Economic: Replacement Cost (75%)	$20,000 and below	1—Insignificant
	$50,000 and below	2—Minor
	$150,000 and below	3—Moderate
	$175,000 and below	4—Major
	$190,000 and below	5—Severe
Health & Safety: Segment (25%)	Software	2—Minor
	Hardware, Parks Equipment, Recreation Equipment	3—Moderate
	Roads Equipment	4—Major
	Fire Equipment	5—Severe

Risk Summary Results

Using the risk models developed, risk reports can be generated. Such outputs are often key resources and components of a municipality's Asset Management Program. The following table summarizes the average probability and consequence of failure scores and the risk rating for machinery and equipment asset segments.

Asset Segment	PoF	CoF	Weighted[13] Average Risk Rating
Fire	2.16 / 5	3.57 / 5	7.92 / 25
General Government	3.15 / 5	2.32 / 5	7.39 / 25
Parks	2.96 / 5	2.25 / 5	6.67 / 25
Recreation	2.16 / 5	1.61 / 5	3.62 / 25
Roadways	2.15 / 5	3.51 / 5	7.27 / 25
Total	**2.38 / 5**	**3.07 / 5**	**7.14 / 25**

Based on the weighted replacement costs, the average probability of failure for machinery & equipment is 2.38, or unlikely and the average consequence of failure is 3.07, or moderate. The average risk rating is 7.14 (out of 25) which is considered low. When viewing all machinery & equipment, most assets carry a low risk of failure with four assets in moderate to high risk. This is illustrated in the Matrix below:

[13] Weighting is based on asset replacement value.

Like with other asset categories, risk results should be reviewed and investigated, especially where the scores are high. Following this, risk treatment which may include asset investment can be further explored and determined.

Fleet & Fleet Equipment

Asset Overview

The Township owns a variety of fleet and fleet equipment assets that are central to the Townships daily operations. Hamilton Township has 54 vehicles, including trucks, graders, excavators, tractors, backhoes, dump trucks, ice resurfacers, fire trucks, etc., with a 2021 replacement value of $12.2 million. For reporting purposes, these assets have been segmented based on similar function. These segments, and examples of common assets included in them, is detailed below:

Roadways: Predominately comprised of pick-up and dump trucks and trailers and various small utility vehicles including excavators and tractors.

Recreation: Ice resurfacing machines and trucks used specifically to support recreational programs.

Parks: A small assortment of pick-up trucks to support the transportation and work requirements of parks and recreation staff.

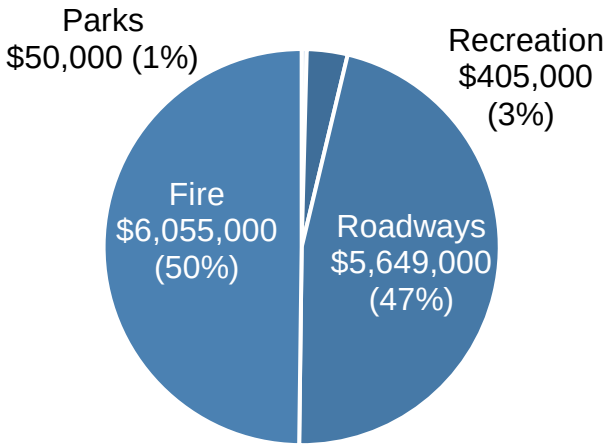
Fire: Comprised of a variety of assets including tankers, pumpers, utility trucks, and utility terrain vehicles (UTVs).

The Township's fleet and fleet equipment assets are recorded in an asset management software system. The following table provides summary information based on a December 2021 effective date:

Asset Segment	Quantity	Replacement Cost
Fire	18[14]	$6,055,000
Parks	1	$50,000
Recreation	6	$405,000
Roadways	33	$5,649,000

[14] Please note that four of the fire fleet assets are not planned for replacement. For this reason, the replacement cost noted does not account for the cost of replacing these four assets.

Total	**58**	**$12,159,000**



Total Current Replacement Cost: $12,159,000

As part of the project engagement PSD Citywide worked with Hamilton Township staff to review and as needed update asset information including replacement cost, assessed condition, and other attribute data points.

Qualitative Risk

Qualitative risks were identified through an interview-based discussion with Township staff. Interview questions reviewed are provided for reference in Appendix B. Through this exercise, the following risks were identified as relevant to fleet and fleet equipment assets.

Fiscal Capacity & Price Escalations

The present level of financial reinvestment does not adequately address maintenance and capital rehabilitation requirements to ensure municipal assets remain in an adequate state of repair and achieve their intended service life. Inadequate funding is partly the result of significant price escalations over the last several years which are well outside of the Townships control. Bridging the capital deficit is a constant challenge due to the small tax base of the Township and public pressures to not increase taxes. This challenging position may negatively impact service delivery and quality.

Demographic Change & Community Expectations

Demographic changes can result in changes to the Township's level of service for existing assets, so more investment in infrastructure and services may be required to meeting community expectations. For example, increased expectations of asset performance would require increased staff to service infrastructure and increased number of fleet assets for staff to access the community. The existing funding challenges make it very difficult to satisfy the competing demands of performance against cost.

Organizational Change and Capacity (Fire Fleet)

Staff identified organizational change as a relevant risk, as this is a constant in any organization. It was noted that retirements over the next ten years are anticipated. Turnover will continue to be a risk given the size of the municipality, the lack of internal opportunities for advancement and salary and benefit competitiveness given the proximity to neighboring larger municipalities. The Township mitigates this risk through regular compensation reviews to remain competitive.

As with any organization, staff departures are a reality. Hamilton Township's existing use of asset management software to track asset attributes (i.e.,

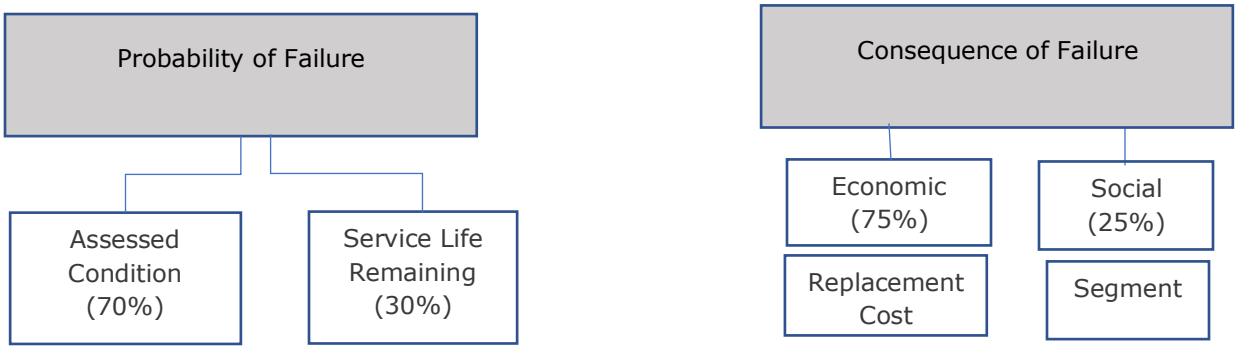
road material, width, roadbed depth) and performance information reduces this risk. The Township also reduces this risk by ensuring each position has a trained backup.

Quantitative Risk

Risk Model

Currently, the Township calculates risks for their fleet assets based on the following probability and consequence of failure factors and associated weights (listed in brackets). Fleet assets risk models vary slightly by asset function, and are as follows:

Public Work and Recreation Fleet Assets:



Fire Fleet Assets:

Probability of Failure

In this model, estimating the probability that a fleet and fleet equipment asset will fail relies on asset condition only (fire fleet and fleet equipment) or

additionally service life remaining (public works and recreation fleet and fleet equipment asset)

The table below outlines the relationship between the probability of failure metric(s) and the range used for the above factor.

Probability Type	Factor	Probability of Failure
Assessed Condition	80 and above	1—Rare
	60 and above	2—Unlikely
	40 and above	3—Possible
	20 and above	4—Likely
	0 and above	5—Almost Certain
Service Life Remaining (Public Works & Rec only)	80 and above	1—Rare
	60 and above	2—Unlikely
	40 and above	3—Possible
	20 and above	4—Likely
	0 and above	5—Almost Certain

Consequence of Failure

The economic consequences used to estimate the consequence of failure for fleet & fleet equipment is based on replacement cost (fire fleet) and for public works and recreation assets the asset function as well. The Table below outlines the metrics used and the associated scoring framework.

Consequence Type	Factor	Consequence of Failure
Replacement Cost	$80,000 and below	1—Insignificant
	$200,000 and below	2—Minor
	$225,000 and below	3—Moderate
	$250,000 and below	4—Major
	$300,000 and below	5—Severe
Function (Public Works & Rec only)	General Government, Recreation & cultural services	2—Minor
	Environmental Services, Transportation Services	3—Moderate
	Health Services, Protection Services	5—Severe

Risk Summary Results

Using the risk models developed, risk reports can be generated. Such outputs are often key resources and components of a municipality's Asset Management Plan and provide valuable guidance on long-term financial planning, levels of service, and lifecycle management decisions.

Asset Segment	PoF	CoF	Weighted[15] Average Risk Rating
Fire	2.98 / 5	4.71 / 5	14.07 / 25
Parks	2 / 5	1.25 / 5	2.5 / 25
Recreation	2.12 / 5	1.84 / 5	3.9 / 25
Roadways	2.66 / 5	3.9 / 5	10.09 / 25
Total	**2.8 / 5**	**4.22 / 5**	**11.83 / 25**

Based on the weighted replacement costs, the average probability of failure for fleet & fleet equipment is 2.8, or unlikely and the average consequence of failure is 4.2, or major. The average risk rating is 11.8 (out of 25), which is

[15] Weighting is based on asset replacement value.

considered high. When viewing all fleet and fleet equipment assets, most assets carry a low risk of failure with 9 assets holding high risk. This is illustrated in the Matrix below:

Conclusions and Recommendations

The information presented in this report enhances Hamilton Township's identification of both general and asset specific risks, which supports prudent decision making. For example, by understanding the qualitative risks assets hold program decisions (i.e., staffing, policy, procedure) can appropriately account, and to the extent possible mitigate, such risks. Further, through the quantification of risks at the asset level, the Township can begin to identify suitable risk treatments. Risk treatment, including asset investment can be prioritized to reduce risk, based on an established risk tolerance.

Qualitative Risk Summary

Several qualitative risks were identified and, in some cases, deemed particularly relevant to certain asset classes. The following two qualitative risks were identified as applicable across the Townships asset categories.

Fiscal Capacity

The present level of financial reinvestment does not adequately address the capital investment requirements of municipal assets. In some cases, asset investment is particularly dependent on grant funding (land improvements, bridges and structural culverts) which may not always be available. Bridging the capital deficit is a constant challenge due to the small and primarily residential tax base of the Township and public pressures to not increase taxes. This challenging position may lead to increasing capital backlogs which typically negatively impacts service delivery and quality.

Organizational Change & Capacity

Staff identified organizational change as a relevant risk, especially for the water network and the fire services department. It was noted that retirements over the next ten years are anticipated. Turnover will continue to be a risk given the size of the municipality, the lack of internal opportunities for advancement and salary and benefit competitiveness given the proximity to neighboring larger municipalities. The Township mitigates this risk through regular compensation reviews to remain competitive.

As with any organization, staff departures are a reality. Hamilton Township's existing use of asset management software to track asset attributes (i.e., road material, width, roadbed depth) and performance information reduces this risk. The Township also reduces this risk by ensuring each position has a trained backup.

Quantitative Risk Summary

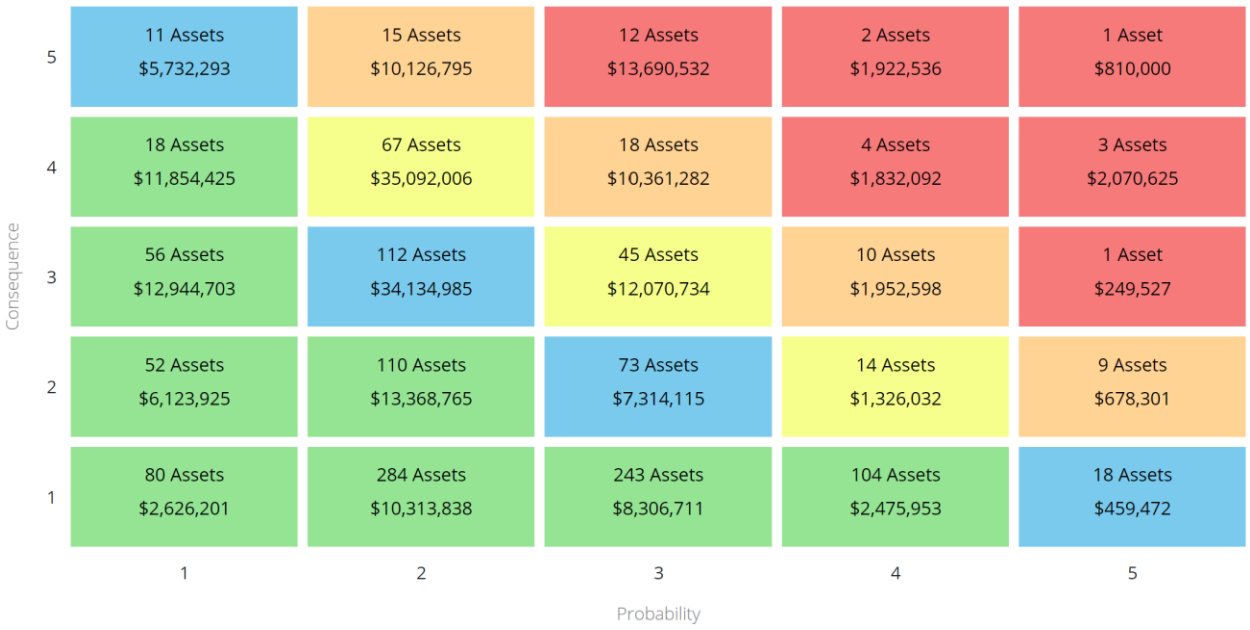
Risks were also measured against each asset based on parameters that reflect the probability and the consequence of asset failure. Overall, the Township's core assets as of 2021 have an average risk rating of Y based on the average probability and consequence rating of A and B respectively. These calculations are weighted based on asset replacement value. The risk matrix below provides a summary of risk by asset category.

Asset Category	Quantity	Replacement Cost	Weighted Average Risk Rating
Road Network	261 KM (paved road length)	$74,834,000	7.17 / 25
Bridges & Culverts	94	$51,480,000	10.21 / 25
Water Assets	22 KM (Main Length)	$23,516,000	6.29 / 25
Stormwater Network	16 KM (Main length)	$7,148,000	4.91 / 25
Facilities	46	$31,182,000	6.49 / 25
Land Improvements	51	$5,546,000	9.66 / 25
Machinery & Equipment	342	$1,972,000	7.14 / 25
Fleet & Fleet Equipment	54	$12,159,000	11.83 / 25

Overall, the Township's portfolio of assets as of 2021 have an average risk rating of 8.02/25 based on the average probability and consequence rating of 2.34 and 3.47 respectively. These calculations are weighted based on asset replacement value.

These risk scores and their associated probability and consequence of failure scores can also be viewed in matrix format. This provides a higher-level overview of risk distribution across the Township's asset portfolio.

Figure 1: Risk Results for Portfolio of Assets



To ensure a consistent response to risk across all Township departments, it would be valuable for the Township to develop a Risk Management Policy and Framework. This is further reviewed in the section below.

Risk Treatments

Understanding the risks carried by an asset is an important first step in identifying appropriate risk treatments. How asset owners choose to respond to risk may vary based on the assessed risks, the available risk treatments, and the risk appetite and tolerance. For reference, common risk treatments have been identified below.

Avoid (Completely or Significantly)

Completely: Disposing of the assets that carries the risk or discontinuing the services provided by the asset (i.e., permanently closing a road). This is response may only be viable in select circumstances (i.e., mine is closed and public access road is also permanently closed).

Significantly: Investing substantially in assets to reduce the risks they hold. For example, replacing or significantly rehabilitating an important road asset reduces the probability of failure and therefore its overall risk.

Transfer- the risk carried by an asset is transferred to a third party (i.e., public road is made private).

Mitigate- the risk is reduced through a variety of actions and initiatives. Some methods of risk reduction may be non-infrastructure based (i.e., updates to bus routes etc.).

Accept- the risk is accepted and carried. This may be more common amongst road assets deemed less critical to the Municipality's transportation network.

These risks response may be valuable for the Township of Hamilton to consider when developing their strategy for managing the risks held by their assets.

The effort to respond to and treat risks will naturally vary based on the confidence in the data used to calculate risk and the proportion of risk being treated. For example, where there is low confidence in asset data the efforts may first focus on general data review to validate risk scores and thereafter risk treatment. As well, investigation into assets treatment options for assets with very low risk may be much more limited when compared with investigation into treatment options for high-risk assets. This would support efficient resource allocation and the asset management principle of managing cost, risk, and performance.

Risk Models: Future Considerations

The developed risk models reflect data currently available and relevant to each asset class. The data available to calculate risk and/or the relevancy of the risk model parameters may change over time. Therefore, Hamilton Township's Staff should regularly review the models to ensure they remain locally relevant, are supported by accurate and up to date data, and are appropriately weighted. Key questions to consider when reviewing the risk models include:

1. Within both the probability and consequence of failure variables, do the factors used remain suitable?
2. Are the weightings and the ranges used for each factor appropriate or should they be adjusted?
3. Should other types of consequences of failure be incorporated into the models?
4. If yes, is there valid data readily available to use or feasible to collect to aid in measuring these additional factors?
5. How should these new factors be weighted and what are appropriate ranges?

In addition to understanding asset specific quantitative risks, it is also valuable to regularly review qualitative risks that the Municipality may hold. Such risks often change over time and thus regular review can be helpful to ensure relevant risks are identified so that steps may be taken to mitigate them. Key questions to consider may include:

1. Do we still carry the same types of risks that we previously did? Have internal changes (i.e., increased funding or staffing) changed the level of risk we hold?
2. Has the degree of risk and/or the assets that such risks pertain to changed?
3. Are there any new or emerging qualitative risks that are relevant (i.e., new legislation, economic changes)?

Key Recommendations

- The Township would benefit from the development of a Risk Management Policy and Framework. Such a policy works to establish the scope of risk management, identify, and incorporate relevant principle and objectives, and effectively consider and account for the municipality's specific context (i.e., budget process, election cycles, staffing scale and structure). It seeks to demonstrate the organization's commitment to an established set of principles and objectives that are applied to risks in a consistent manner.
- Ensure that the developed Risk Management Policy and Framework includes the Township's risk appetite, accepted or common risk treatments and the risk tolerance. As a best practice the framework should include the expected reduction in risk from the applied treatment, the costs of the treatment, and the residual risk after treatment. This may help determine the suitability of the risk treatments considering factors of cost, performance, and risk.
- The Risk Management Policy and Framework is to be signed off by senior leadership to ensure commitment across the organization.
- Risk results should be reviewed and considered when making investment prioritization decisions. Where there is high confidence in the asset information the risk models will generally be a more reliable tool for investment prioritization. Where there is low confidence in the accuracy of asset information (i.e., storm water assets- concealed assets without assessed condition), the results may be used with more discretion.
- Identify asset information most valuable to risk models and determine if it is currently available. If so, work to collect it and or review and update it. If the information is not available establish a plan to collect with consideration for priority (i.e., select assets of identified high risk for condition assessment first) assets. Collect asset information using the existing asset management software structure with reference to the Asset IDs.

Appendix 1: Data Quality Dimensions

The quality of data affects the reliability of its outputs, and the trust organizations have in those outputs, especially when used to inform decisions. As a best practice, the quality of data can be evaluated based on the six data quality dimensions. These quality dimensions are as follows:

1. **Accuracy**: The information collected reflects reality and can be confirmed with a verifiable source (i.e., VIN information). An example of accuracy not being met is the in-service year on record is 1950 & the Asset model indicates a service year of 1980. Accurate reporting assists in powerful and trusted reporting.

2. **Completeness**: Data is comprehensively collected so that it can deliver meaningful inferences and effectively inform decisions. E.G.: Required fields are populated for all assets

3. **Consistency:** Data on the same asset is consistent across multiple sources if applicable. For example, information in the Asset Management System matches information in the finance system.

4. **Timeliness:** Data is available when it is needed. This often requires limited lag time between the event that generates the asset data (i.e., condition assessment) and the updates to the system to reflect the event.

5. **Validity**: Consistent Data Format that is supported by any associated standards or structures. For example, the asset in service date is consistently formatted YYYY-MM-DD and not sometimes YYYY-DD-MM and month value is never greater than 12.

6. **Uniqueness:** Each asset appears only once in the system and there is no data duplication or overlaps. For example, each asset has a unique asset ID, no duplication of asset information.

Appendix 2: Qualitative Risk Interview Questions

To identify qualitative risks, Hamilton Township staff were interviewed and asked the below noted questions. In some cases, additional questions which are not noted here were prompted by the conversation that unfolded.

Fiscal Capacity

1. Has the level of service provided been impacted by fiscal capacity or budget constraints within the municipality?
2. Has your municipality seen an increase or decrease to government grants or other grant funding opportunities that support investment in infrastructure?

Data Confidence

1. Generally, do you believe that the information on your assets is reliable?
2. Are there any processes, formal or informal, to review data and make updates?
3. Do you find you have the data you need to make decisions effectively?

Aging Infrastructure

1. What impact is the age or condition of infrastructure assets having on your ability to meet expected levels of service?

Climate Change/Weather Events

1. What impact has climate change or extreme weather events had on your infrastructure?
2. Are there plans, practices, or strategies in place to assess the potential impacts of climate change to your assets?

Demographic Change

1. Have you integrated growth forecasts into your asset management strategies?
2. How do you expect growth forecasts over the next 20 years to impact your capacity to provide expected levels of service?

Trends in Service Usage

1. Are you witnessing an increase or decrease in service usage? (e.g., decline in water consumption)

Socio-political Expectations

1. Describe the service expectations of the general public? How have they changed and evolved?
2. Are there any new regulations or requirements from senior levels of government that are placing greater strain on your resources and capacity?

Organizational Change and Capacity

1. How has organizational change affected your capacity to provide adequate levels of service? Has there been any recent staff turnover that has affected service provision?
2. Are there any upcoming retirements for key staff responsible for delivering or managing either a service or asset class?