City of Kingston

Asset Management Plan

Volume **6 of 6**: Natural Assets

2025

Table of Contents

Table of Contents

Table of Contents

Appendices (Provided in a Separate Document)

Acronyms

Acronym	Definition
AMP	Asset Management Plan
City	City of Kingston
cm	Centimetre
CSA	Canadian Standards Association
CRCA	Cataraqui Regional Conservation Authority
ELC	Ecological Land Classification
FMS	Forest Management Strategy
GHG	Greenhouse Gas
GIS	Geographic Information System
GPS	Global Positioning System
ha	Hectare
ID	Identification
ISO	International Standard for Asset Management
km	Kilometre
LOS	Levels of Service
m	Metre

Acronyms

Acronym	Definition
m^2	Square Metre
MNAI	Municipal Natural Assets Initiative
NA	Natural Assets
N/A	Not Applicable
NHS	Natural Heritage Study
ROW	Road Right-of-Way
RUF	Rural and Urban Forest

1.0   Natural Assets

The City of Kingston (City) recognizes and manages a wide array of natural assets that are integral to the community's well-being and environmental health. These assets are not traditional "built" infrastructure like roads, pipes, and buildings, but rather naturally occurring systems that provide essential services, like their engineered counterparts as shown in **Figure 1-1**. Examples of natural assets include forests, grasslands, riparian areas, and wetlands. Enhanced assets encompass features such as constructed wetlands, naturalized spaces, and street trees, while engineered assets include green roofs, rain gardens, and permeable pavement.

Natural Assets

Figure 1-1: Relationship between Natural Assets, Enhanced Assets and Engineered Assets (CSA W218:23)
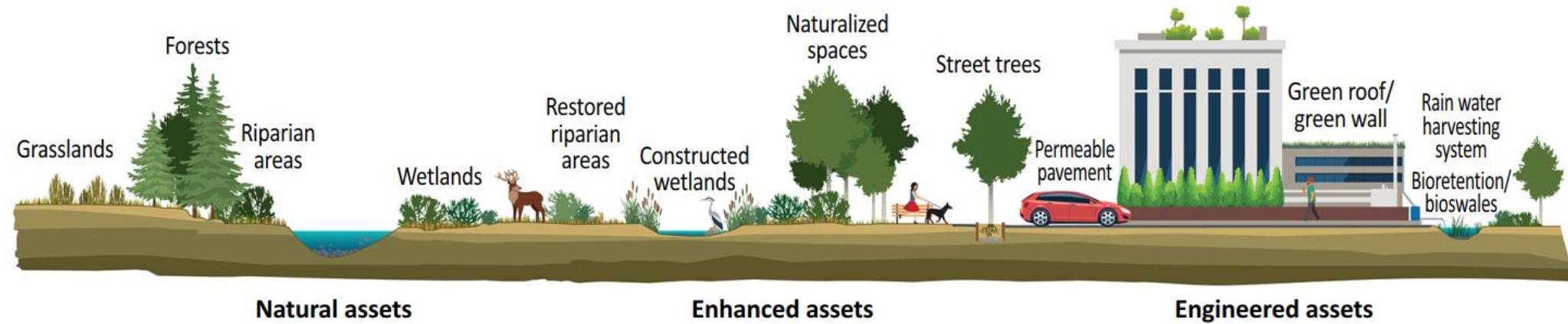
Natural Assets

Recognizing and valuing these natural systems as critical infrastructure is vital for sustainable asset management. The addition of green infrastructure aligns with the requirements of Ontario Regulation (O.Reg.) 588/17, promoting a comprehensive and holistic approach to managing all municipal assets for the long-term well-being of residents and the environment. The definition of green infrastructure from O.Reg. 588/17 is:

"Green infrastructure asset, means an infrastructure asset consisting of natural or human-made elements that provide ecological and hydrological functions and processes and includes natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces and green roofs."

The development of this chapter was guided by the following resources:

- Beacon Environmental Limited with Green Analytics and Associated Engineering, Life Cycle Costing of Restoration and Environmental Management Actions: Costing Natural Assets in Peel Region (December 2020).
- Canadian Council of Ministers of the Environment: Natural Infrastructure Framework: Key Concepts, Definitions, and Terms (2021).
- Government of Ontario, Building Together – Guide for Municipal Asset Management Plans (February 2024).
- International Standard for Asset Management: ISO 55000.
- National Standard of Canada: CSA W218:23 (Specifications for natural asset inventories).
- Natural Assets Initiative: A Guidebook for Local Governments (2024).
- Natural Assets Initiative: A Guidebook for Local Governments: Developing Levels of Service (LOS) for Natural Assets (2022).

1.1 State of the Local Infrastructure

The City owns and maintains a diverse variety of natural assets across its properties. A natural asset inventory was developed using methodologies of the *National Standard of Canada – Specification for Natural Asset Inventories; Canadian Standards Association – CSA W218:23* (CSA, 2023).

It should be noted that the asset inventory excludes those owned and managed by the Cataraqui Regional Conservation Authority (CRCA). The CRCA maintains a partnership with the City of Kingston and other municipalities, which includes representation on the Authority's board, a shared mandate for natural resource management and flood protection, and financial support through a municipal levy. The Authority works with the city to manage watersheds, conserve lands, protect water resources, and review development proposals to ensure public safety and environmental protection.

Partnership structure

As a conservation authority, its core mission is to partner with municipalities like Kingston to conserve, restore, and manage natural resources.

The CRCA is responsible for creating its own Natural Asset Management Plans for owned assets and follow O. Reg 688/21 CA Mandatory Programs and Services 5(2). This regulation indirectly supports natural asset management by focusing on the health and management of natural systems that provide critical services.

An outline of the natural asset inventory methods and results is provided in **Appendix A**. A summary of the inventory results is provided in the following subsection.

1.1.1 Asset Inventory and Valuation

The natural asset inventory was created in a Geographic Information System (GIS) workspace using property parcel files provided by the City in February 2025. This inventory covered the lands within the 1,834 City-owned parcels. The types of assets included in the inventory are described in **Table 1-1**.

Natural Assets

Table 1-1: Asset Types included in Inventory

Natural Asset	Description / Criteria
Woodlands, Forests, Plantations	• **Woodlands**: Semi-closed treed communities with tree cover between 35% and 60%. Mineral soil is greater than 15 centimetres (cm) deep. • **Forest**: Treed communities with tree cover greater than 60%; site conditions and substrate are variable. • **Plantations**: Treed areas with tree cover greater than 60% where trees are actively managed and arranged in a uniform, systematic pattern (e.g., rows, uniform age).
Constructed Green Lands	• Cemeteries, golf courses, parks, and playgrounds, plus small, passively managed tree clusters and large (1/4 hectare [ha]+) municipally managed lawns. Although they are constructed and actively managed, they are counted as natural assets due to the services they provide.
Meadows & Thickets	• **Meadows**: Open herbaceous communities with tree and shrub cover less than 25%. Mineral soil is greater than 30 cm deep. Includes areas with unique natural flora (e.g., Tallgrass Prairie) or cultural legacy. • **Thickets**: Shrub-dominated areas with shrub cover greater than 25% and tree cover less than 25%. Mineral soil is typically greater than 30 cm deep. Often associated with drier wetland verges.
Marshes	• Wetland dominated by emergent aquatic plants (macrophytes) with tree and shrub cover less than 25%. Water depth is less than 2 metre (m).
Swamps	• Wetland dominated by hydrophytic trees or shrubs with cover greater than 25%. Water depth is less than 2 m and standing water or vernal pooling is greater than 20% of ground coverage.

Natural Assets

Natural Asset	Description / Criteria
Agriculture & Fencerows	• **Agriculture**: Non-natural landscapes (e.g., annual crops, pastures, orchards) due to active management regimes, but are included for natural asset service valuation. • **Fencerows**: Linear treed areas along property boundaries or roadways, treated as an agricultural feature for management considerations.
Watercourses & Rivers	• Used to delineate and characterize watercourses (creeks, streams, etc.) which are too narrow to be delineated as Open Aquatic or Shallow Aquatic features.
Lakes & Shorelines	• Lakes (Open Aquatic): Open water communities with no vegetation, typically due to excessive depths (e.g., lakes, large rivers, ponds). • Shorelines: Narrow, linear communities adjacent to permanent or ephemeral water, subject to active shoreline processes (e.g., erosion, wave energy). Located above the high-water mark.
Constructed Storm Water Management Ponds	• Non-natural, constructed features used to manage storm water, included for natural asset service valuation despite active management.
Rock Barrens	• Areas with bedrock-controlled topography and patchy vegetation. Characterized by patchy soil development with substrate depth less than 15 cm; subject to extremes in moisture and temperature.

Natural Assets

> **Note**: While Utilities Kingston parcels were included in the initial dataset, they were excluded from the final inventory. This decision was made because Utilities Kingston manages its own land assets and completes its Asset Management Plans independently from the City.

The inventory was developed collaboratively through a detailed desktop analysis and boundary delineation process. Dillon ecologists and natural asset specialists created discrete mapping units (polygons) and classified them to identify different natural assets.

In total, 2,508 natural asset polygons were classified and delineated, representing 32 different natural asset types across approximately 3,031 hectares. An additional 1,211 polygons, totaling about 739 hectares, were also delineated but classified as "Constructed" asset types.

"Constructed" polygons (Ecological Land Classification [ELC] code CV) are communities that are highly anthropogenically managed and have limited to no natural features or characteristics. This includes municipal buildings and other built infrastructure, as well as private lawns, actively managed hydro corridors, and small lawns (smaller than approximately ¼ ha).

Note that the designation of "Constructed" for hydro corridors in this inventory specifically refers to small areas associated with utility poles found within the road right-of-way (ROW) or neighborhood utility areas. These areas are quite limited in size and ecological restoration potential due to their location within the road shoulder or ROW. Large-scale hydro corridors, such as those with significant natural asset creation potential, were not included in this inventory as they are managed by either Kingston Hydro or Utilities Kingston, and not part of this inventory.

As such, the small, City-related "Constructed" polygons were not identified as natural assets and do not have significant potential to be used or managed as a natural asset in the future; therefore, they were not assigned a Natural Asset identification (ID) number. "Constructed" polygons were delineated and classified to ensure a complete representation of all City-owned land parcels in the Natural Assets mapping.

Natural Assets

Note: The Natural Assets Inventory excludes the Tree Canopy asset class, which covers street and park trees. These specific assets were already included in Volume 1 of the 2024 AMP under the Urban Forestry chapter. This report includes the City's Woodlands and Forests assets.

Following best practices to facilitate asset management planning, the 32 natural asset types were consolidated into 10 Natural Asset Categories, which are outlined in **Table 1-2**.

Table 1-2: Summary of Natural Assets

Natural Asset Category	Total Count	Total Area (ha)
Woodlands, Forests, Plantations	672	901.9
Constructed Green Lands	565	730.3
Meadows & Thickets	435	516.6
Marshes	242	292.6
Swamps	199	261.0
Agriculture & Fencerows	138	184.2
Watercourses & Rivers	168	100.0
Lakes & Shorelines	47	22.6
Constructed Storm Water Management Ponds	28	18.0
Rock Barrens	14	4.2
Natural Asset Total	**2508**	**3031.4**

Natural Assets

To estimate the replacement costs of the City's natural assets, the costing framework developed for the Region of Peel (Beacon Environmental, December 2020) was utilized. This well-researched framework provides lifecycle cost estimates for a range of proposed natural asset sub-types. The framework shared sub-asset category and project type (e.g., creation, acquisition, softscape, hardscape) and shared the cost according to project complexity. Low estimates for simple projects, moderate cost estimates for average project and high-cost estimates involve complex projects.

The City has adopted a balanced methodology using the average of moderate-level acquisition and creation costs per hectare for each of the natural asset categories. This reflects the realistic assumption that future replacement efforts may involve both restoration and land acquisition, depending on local opportunities and development constraints. For example, the moderate cost per hectare estimate for a deciduous forest is $475,959 (creation) and $223,200 (acquisition); thus, we used the average of the two ($349,580) to develop a fair and balanced unit rate.

To calculate and convert 2020 replacement values up to current, an annual inflation rate of 2.5% over five years, compounding annually was utilized. This adjustment ensures that the Asset Management Plan (AMP) reflects current market conditions and allows for informed, forward-looking financial planning.

The resulting unit rates, applied to the mapped areas (in hectares) of each natural asset type, have been used to calculate total replacement costs.

The replacement cost for the Constructed Storm Water Management Ponds was included in the 2022 Core AMP. The total replacement value is $14,846,040 (in 2022 dollars), but it has not been included in the table below.

The replacement cost summary is provided in **Table 1-3** below. The table values are sorted by highest to lowest in total area and rounded up to the nearest $1,000.

Natural Assets

Table 1-3: Total Estimated Replacement Cost of Natural Assets

Asset Category	Total Area (ha)	Unit Rate ($/ha)	Total Estimated Cost
Woodlands, Forests, Plantations	902.0	$396,000	$357,176,000
Constructed Green Lands	730.3	$1,106,000	$807,679,000
Meadows & Thickets	516.6	$294,000	$151,869,000
Marshes	292.6	$568,000	$166,220,000
Swamps	261.0	$421,000	$109,881,000
Agriculture & Fencerows	184.2	$294,000	$54,146,000
Watercourses & Rivers	100.0	$1,139,000	$113,889,000
Lakes & Shorelines	22.6	$570,000	$12,899,000
Rock Barrens	4.2	$198,000	$832,000
Total	**3013.5**	**Not Applicable (N/A)**	**$1,774,581,000**

Table 1-3 presents the total area, unit rate, and total estimated replacement cost for each natural asset category within the lands of City-owned property parcels. The values reflect 2025-dollar estimates, calculated as described above.

Constructed Green Lands form the largest portion of the total value, contributing approximately 45% of the total value ($807.7M) whereas Woodlands, Forests & Plantations follow, comprising about 20% ($357.2M) of the total value as the second largest in the category.

The total estimated replacement cost for Municipality's natural assets amounts to $1.774 billion.

Figure 1-2 shows the distribution of total replacement cost in asset categories.

Natural Assets

Figure 1-2: Distribution of Total Replacement Cost per Natural Asset Category

- Woodlands, Forests, Plantations
- Meadows & Thickets
- Swamps
- Marshes
- Watercourses & Rivers
- Lakes & Shorelines
- Agriculture & Fencerows
- Constructed Green Lands
- Rock Barrens
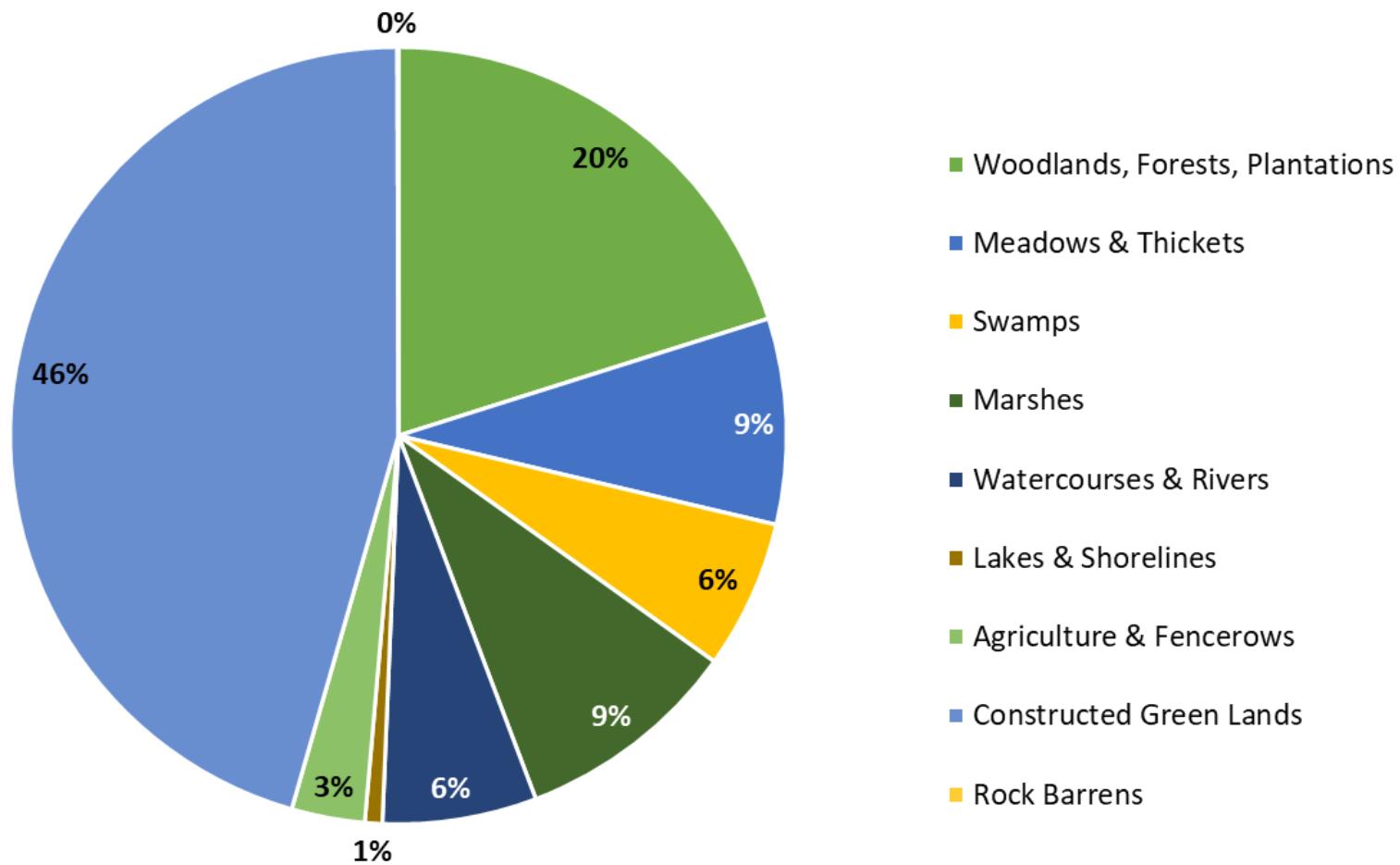
Natural Assets

1.1.2   Asset Condition

> **Note**: The condition assessment for natural assets was not completed for this version of the AMP. The following section outlines the approach to evaluating the condition of natural assets and should be incorporated into the next update of the AMP.

Documenting and identifying the condition of natural assets is a key aspect of understanding their overall state. Unlike built assets, natural assets do not have expected useful life values that can be used to forecast replacement years. Therefore, alternative approaches must be generated and developed to ensure consistent condition assessments are completed in future iterations of this AMP. A process and methodology should be outlined for conducting these assessments through either desktop analysis or field identification. As outlined in the CSA, a recommended condition assessment process includes selecting the natural asset, describing asset criteria, selecting indicators to measure ecosystem function, and applying condition rating score. See **Figure 1-3**.

Natural Assets

Figure 1-3: Recommended Condition Assessment Process (CSA)
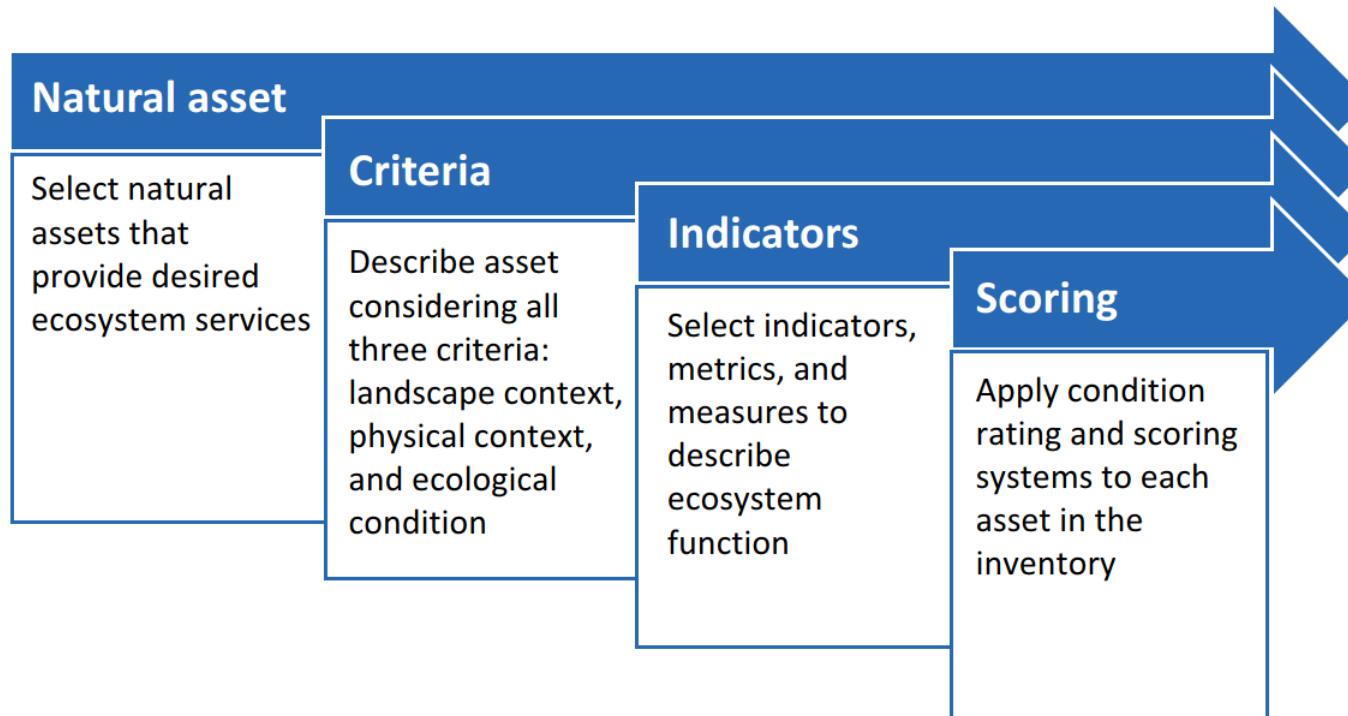
Based on this initial process, a methodology that includes indicators, measures, and metrics can be developed for each natural asset type. As the City further develops its asset inventory, a comprehensive condition assessment framework can then be generated.

Natural Assets

Figure 1-4: Example of Condition Assessment Scoring
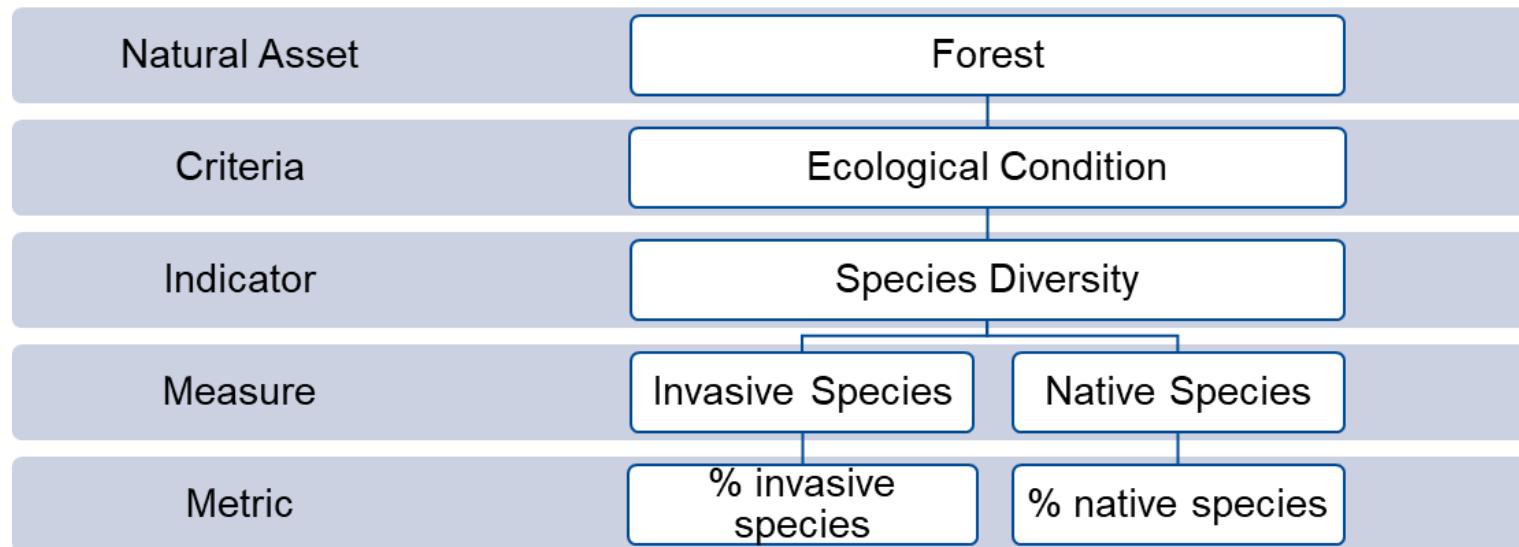
It is recommended to use a five-point rating scale (Very Good, Good, Fair, Poor, and Very Poor) to ensure a consistent approach with the other assets that are included in previous AMPs.

1.1.3   Data Sources and Confidence

The natural asset inventory was created in a GIS workspace using property parcel files provided by the City in February 2025. Data confidence can be estimated based on the confidence level of various qualifiers and can be presented on a scale from 0% (low) to 100% (high), as shown in **Table 1-4**. The qualifiers chosen for evaluation are specifically targeted for estimating overall confidence of the natural asset inventory data.

Natural Assets

Table 1-4: Data Confidence Scale

Qualifier	Low	Low/ Moderate	Moderate	Moderate/ High	High
Age of Satellite Imagery	10+ Years	5 to 10 Years	3 to 5 Years	1 to 2 Years	< 1 Year
Resolution of Satellite Imagery	> 30 metres per pixel	10 to 30 metres per pixel	5 to 10 metres per pixel	1 to 5 metres per pixel	< 1 metre per pixel
Ground-Truthing (Random Sampling)	None	< 3% of total inventory	3 to 5% of total inventory	5 to 10% of total inventory	> 10% of total inventory

As summarized in **Table 1-4**, the age of the satellite imagery used to delineate the natural asset inventory was 1 to 2 years old (moderate/high confidence), the resolution of the satellite imagery was < 1 metre per pixel (high confidence), and there has currently been no ground-truthing of the natural asset inventory results (low confidence). The satellite imagery referenced while delineating the natural asset inventory was from 2024 and according to ESRI's World Imagery, Hybrid basemap achieves < 1 metre per pixel resolution in the geographical area of the City. The overall data confidence, in consideration of all three qualifiers, is estimated to be **Moderate**.

Natural Assets

The absence of ground-truthing suggests the inventory should be considered a preliminary estimate. The inventory, while a useful starting point, is unverified and relies solely on the interpretation of satellite imagery, which may introduce errors in classification and boundary delineation for natural assets. To improve data confidence, it is recommended that a phased ground-truthing approach be adopted by the City. Using a phased approach, ground-truthing should prioritize assets identified as high risk (outlined in Section 1.3), beginning with a limited systematic sampling procedure to verify a small, random subset of natural assets (e.g., 1 to 3% of total inventory). This will provide a quantifiable measure of accuracy and identify the most common classification errors. Based on these findings, a more robust statistically significant ground-truthing effort can be planned for future updates to this AMP.

1.1.4   Related Plans and Studies

This Natural Assets AMP is grounded within the context of the City's broader environmental initiatives. Specifically, the Natural Heritage Study and Forest Management Strategy are two key initiatives that provide established frameworks related to the management of local natural assets. **Figure 1-5** illustrates how these key initiatives related to the AMP and a summary of these initiatives is as follows:

- **Forest Management Strategy (FMS):** The FMS establishes a 24-year plan to Sustain, Grow, Communicate, Involve and Recognize Kingston's Rural and Urban Forest (RUF) as the critical community resource it is. The FMS has been created in the City recognizing the value the RUF provides. The FMS provides a review of the current state of Kingston's RUF and RUF management program and then sets clear direction for how the urban forest will be managed moving forward Rooted in community values, the FMS positions the RUF as essential community infrastructure—supporting climate resilience, biodiversity, and our current well-being, while shaping a greener, healthier Kingston for future generations.

Natural Assets

- **Natural Heritage Study (NHS):** The City is currently preparing the NHS to support the new Official Plan. The NHS will identify and map the key natural heritage features, such as wetlands, woodlands and watercourses, found across Kingston, as well as corridors linking these features together. The project will provide a series of policy recommendations relating to the identification and protection of these features for implementation within the Official Plan.

Natural Assets

Figure 1-5: Natural Assets AMP - Related Plans and Studies

NATURAL ASSET MANAGEMENT PLAN	NATURAL HERITAGE STUDY	FOREST MANAGEMENT STRATEGY
• Treats natural systems as assets • Measures service value (flooding, cooling, biodiversity, carbon) • Sets Levels of Service + lifecycle Integrates with funding + risk • O.Reg. 588/17 compliance	• Identifies and maps natural heritage features + corridors • Sets protection policies • Informs Official Plan	• Expand and protect canopy cover • Maintain and renew trees & woodlands • Strengthen community stewardship • Enforce tree conservation in development • Implement a 24-year action program

1.2   Levels of Service

The levels of service (LOS) are a combination of parameters that reflect the social, political, environmental, and economic outcomes an organization delivers. The LOS for natural assets encompass everything from stormwater management and water filtration to recreational opportunities and biodiversity support. This involves outlining both the community's desired qualitative outcomes and the measurable technical indicators that gauge the natural assets' performance, ultimately guiding proactive management, minimizing risk and investment strategies. **Figure 1-6** is the recommended LOS framework from the Municipal Natural Assets Initiative (MNAI).

Figure 1-6: LOS Hierarchy (MNAI)
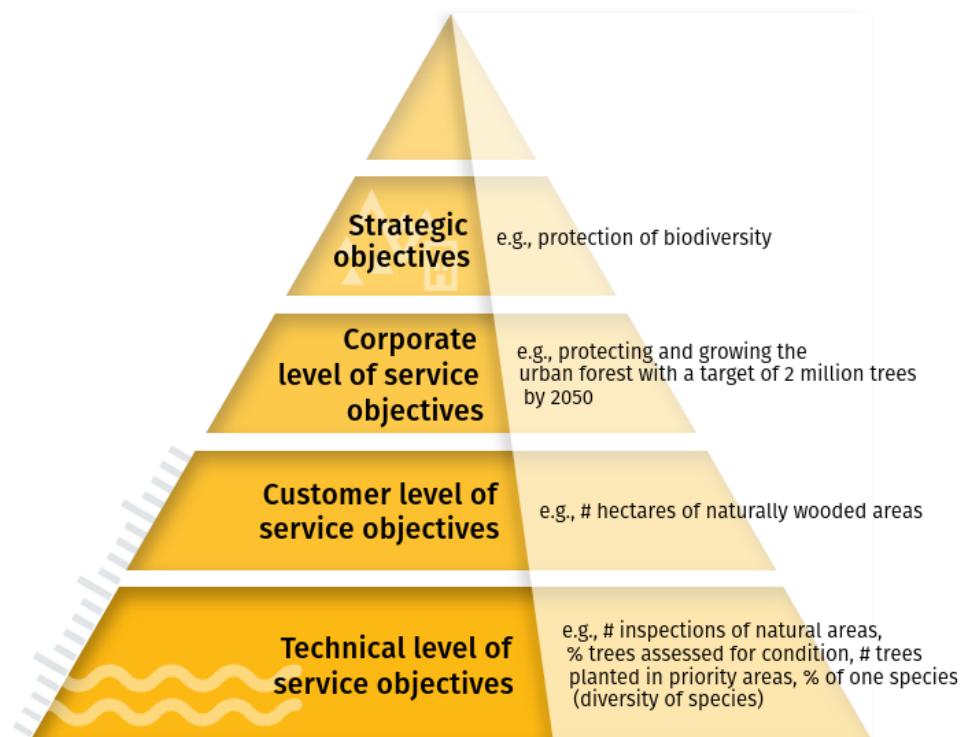
Natural Assets

The reasons for establishing LOS for natural assets include:

- **Recognizing Natural Assets**: Acknowledging their role in providing essential services.
- **Accountable Management**: Establishing clear responsibilities for effective management.
- **Lifecycle Budgeting**: Incorporating monitoring, maintenance, and restoration into financial plans.
- **Adaptive Management**: Using progress to inform updates to strategic plans and land use policies.

1.2.1 Contribution of Natural Assets to Service Delivery

Natural assets are inherently "multi-taskers," providing a wide array of services and benefits to both human communities and the broader ecosystem. Unlike grey infrastructure, which typically serves a singular purpose, natural assets often contribute simultaneously to multiple service objectives. Recognizing this holistic value is critical to avoid under-estimating and under-valuing their contribution, which could lead to suboptimal land-use decisions.

Table 1-5: Potential Natural Service Areas

Service Areas	Services Related to Natural Assets
Stormwater	Natural assets offer cost-effective solutions for water storage, flood control, groundwater recharge, and erosion prevention, improving water quality and ecosystem health by reducing runoff.
Drinking Water	Protecting natural source water is crucial for cost-effective and safe drinking water provision. Natural assets like forests support aquifer recharge, and demand management helps conserve supply, especially with increasing drought risks.
Wastewater	While generally not for wastewater treatment (except for supplementary constructed wetlands), natural assets play a role in water purification. Constructed wetlands offer an efficient and environmentally friendly method for treating various wastewaters.

Natural Assets

Service Areas	Services Related to Natural Assets
Transportation	While not direct transportation, natural assets create connected green networks that enhance experiences for walking, biking, and other forms of active transportation. Their degradation can also impede transportation.
Recreation	Natural assets like parks and green infrastructure offer vital recreation opportunities, contributing to healthy and socially connected communities. Recognizing these assets in planning is important.
Health	Natural assets provide services that promote both physical and mental well-being in communities.
Biodiversity Support	Biodiversity is essential for healthy, functioning ecosystems, and changes in natural assets directly impact this diversity. Natural assets serve as critical living laboratories for ecological research and monitoring, which in turn affects ecosystem services.
Climate Resilience	Natural assets are vital for carbon storage, regulating the water cycle, and maintaining biodiversity, thus playing a key role in the climate system. They also buffer against climate change impacts like flooding and urban heat islands. Understanding their complex responses to climate change requires long-term monitoring and adaptive management, often driven by research and study conducted within these areas.
Culture & Heritage	Nature plays a significant role in community culture and heritage, with cultural landscapes holding special meaning and supporting overall well-being.
Economic Benefits	Natural assets underpin local economies through provisioning services for agriculture, forestry, fishing, and resource extraction. They also support nature-based tourism, recreation, and can enhance property values.

To understand which natural assets within the City boundary may impact service delivery, a mapping exercise was completed. This exercise is shown in **Table 1-6** below and outlines the interplay between these natural assets and the services they provide, thereby establishing a foundational understanding of how our natural environment underpins community well-being and service delivery.

Natural Assets

Table 1-6: Mapping of Natural Assets to Services

Natural Service Areas	Stormwater	Drinking Water	Wastewater	Transportation	Recreation	Physical Health	Biodiversity Support	Climate Resilience	Culture & Heritage	Economic Benefits
Woodlands, Forests, Plantations	✓	✓				✓	✓	✓	✓	✓
Constructed Green Lands				✓	✓	✓		✓	✓	✓
Meadows & Thickets	✓				✓	✓	✓	✓	✓	✓
Marshes	✓	✓	✓		✓	✓	✓	✓	✓	
Swamps	✓	✓	✓		✓	✓	✓	✓	✓	✓
Agriculture & Fencerows	✓						✓	✓	✓	✓
Watercourses & Rivers	✓			✓	✓	✓	✓	✓	✓	✓
Lakes & Shorelines	✓	✓		✓	✓	✓	✓	✓	✓	✓
Constructed Storm Water Management Ponds	✓							✓		
Rock Barrens						✓	✓			✓

Natural Assets

Table 1-7 and Table 1-8 outline the City's current levels of service for natural assets.

Table 1-7: Community LOS – Natural Assets

LOS Parameter	LOS Statement	Performance Measure	Current LOS (2024)
Scope	Understand the existing location of natural assets within the City boundary.	Availability of maps of natural asset locations.	The locations of natural assets throughout the City are stored in a separate layer within the GIS.
Quality	Build community resilience to flooding with natural assets.	# of residents affected by flooding with the past 5 years.	Data currently unknown - To be included in next AMP.
Quality	Build community resilience to flooding with natural assets.	# of Green Infrastructure features included in plans or projects	Data currently unknown - To be included in next AMP.
Sustainability	Provide opportunities to build community awareness of and engagement in nature-based solutions that build resilience to climate impacts	# of stewardship programs in place supporting nature-based solutions to Climate Change	Data currently unknown - To be included in next AMP.
Sustainability	Provide opportunities to build community awareness of and engagement in nature-based solutions that build resilience to climate impacts.	# of partnerships supporting nature-based solutions to climate change	Data currently unknown - To be included in next AMP.
Sustainability	Maintain and enhance the natural resource base for future generations.	# of trees planted in rural managed forests	Data currently unknown - To be included in next AMP.

Natural Assets

Table 1-8: Technical LOS – Natural Assets

LOS Parameter	LOS Statement	Performance Measure	Current LOS (2024)
Scope	Availability of natural assets to the community, contributing to general well-being and ecological resilience.	Area of natural assets per Population.	**Table 1-9** identifies the area of natural assets per population.
Quality	Proactively manage tree health and hazards to minimize risk across natural assets.	# of tree hazard assessments completed annually.	Data currently unknown - To be included in next AMP.
Quality	Implement a comprehensive program to minimize ecological impacts during projects and operations on City-owned property.	# of City staff receiving specialized ecological training each year.	Data currently unknown - To be included in next AMP.

Natural Assets

Table 1-9: Technical Level of Service – Natural Assets per Resident

Table 1-9 Notes:

[1] Uses Kingston population of 154,100 residents, as per the 2024 AMP.

Asset Category	Area (ha)	Asset Area (square metre [m^2]) per Resident[1]
Woodlands, Forests, Plantations	902.0	58.6
Constructed Green Lands	730.3	47.4
Meadows & Thickets	516.6	33.5
Marshes	292.6	19.0
Swamps	261.0	16.9
Agriculture & Fencerows	184.2	12.0
Watercourses & Rivers	100.0	6.5
Lakes & Shorelines	22.6	1.5
Constructed Storm Water Management Ponds	18.0	1.2
Rock Barrens	4.2	0.3
Total	**3031.5**	**196.9**

1.3 Risk Assessment

This section examines the vital aspects of risk and criticality assessment for natural assets, which are paramount for prioritizing investments and ensuring sustainable service delivery.

Risk is the likelihood and magnitude of a negative scenario (hazard) occurring that limit the ability of the asset to deliver the service. Risk is the consideration of asset failure (or under performance) and the consequence of the failure.

RISK = LIKELIHOOD x CONSEQUENCE

Natural Assets

Consequence considers the severity of the impact, vulnerability of the asset and exposure to the negative scenario.

Applying the methodology of a score of 1 to 5 for the likelihood and the consequence, the maximum risk rating is 25 (high). Based on the available information for natural assets, a threat-based approach was taken to estimate the risk of the assets.

1.3.1 Threat-Based Approach

This approach assesses the range of threats to which natural assets are exposed. It recognizes that natural assets are also vulnerable to cumulative effects and can reach critical points under sustained pressure.

Step 1: Identify Threats

The assessment begins by identifying threats that could negatively impact natural assets and, consequently, their ability to deliver services. There were two types of threats identified: cumulative which are impacts that build up over time due to repeated exposures, and event-driven threats which have a more immediate impact and are tied to a specific event. The list of threats identified for this version of the AMP are included in **Table 1-10**.

Table 1-10: Identified Threats

Cumulative Threats	Event-Driven Threats
• Invasive Species • Pests & Disease • Encroachments/ Disturbances • Overuse/ Inappropriate Use • Contamination • Drought	• Construction Impacts • Flooding • Erosion & Sedimentation • Extreme Wind • Ice Storms • Extreme Heat • Fire

Natural Assets

Step 2: Identify Likelihood of Failure

Based on the identified threats, an iteration matrix was developed to generate a likelihood of failure rating allocated to each threat, also typically on a 1 to 5 scale, from Improbable to Certain. The likelihood of failure ratings was determined in discussion with City staff at a workshop held in May of 2025. This rating corresponds to the annual probability of occurrence or a return period.

Table 1-11: Likelihood of Failure

Rating	Qualitative	Description
1	Improbable	1 every 50 to 100 years
2	Unlikely	1 every 10 to 50 years
3	Possible	1 every 5 to 10 years
4	Likely	1 every 2 to 5 years
5	Certain	More than 1 in every 2 years

Step 3: Review Consequence of Failure

A relative consequence of failure rating was assigned to each asset category, which was a low (1), moderate (3), or high (5). This rating represented the consequence of losing the service of those natural assets. The consequence of failure ratings was determined in discussion with City staff at a workshop in May of 2025.

Step 4: Calculate Risk Score

The overall risk score for each threat is derived by multiplying its assigned impact rating by its likelihood rating. A risk score between 1 to 9 was rated a Low risk, a score of 10 to 15 was a Moderate risk and a score of 16 to 25 was a High risk.

Natural Assets

1.3.2   Results

Based on the approach outlined above, **Table 1-12** outlines the risk scores and ratings for each of the different asset categories. The inputs for the steps can be found in **Appendix B.**

Table 1-12: Risk Ratings

Asset Category	Likelihood of Failure	Consequence of Failure	Risk Score	Risk Rating
Lakes & Shorelines	5	5	25	High
Constructed Green Lands	4	5	20	High
Marshes	4	5	20	High
Swamps	4	5	20	High
Watercourses & Rivers	4	5	20	High
Constructed Storm Water Management Ponds	4	5	20	High
Agriculture & Fencerows	5	3	15	Moderate
Woodlands, Forests, Plantations	5	3	15	Moderate
Rock Barrens	2	5	10	Moderate
Meadows & Thickets	3	1	3	Low

1.4   Asset Management Strategy

1.4.1   Lifecycle Activities

Based on the "Building Together – Guide for Municipal Asset Management Plans" (Ministry of Infrastructure), the lifecycle activities for built assets are categorized in the following categories: non-infrastructure solutions, maintenance activities, renewal/rehabilitation activities, replacement, disposal and expansion activities. For natural assets, these activities are adjusted to focus on prolonging the asset's useful life. The recommended adapted lifecycle activities are:

- **Construct and Secure:** This typically refers to new assets or acquiring assets that already exist.
- **Monitor and Manage**: This includes maintenance activities to help assets be more resilient and monitoring if the assets are performing as intended. Focusing on preserving the assets.
- **Rehabilitate and Restore:** This involves significant repairs to extend the life and enhance the performance of existing assets.

The City maintains its natural assets through a variety of programs and initiatives, including:

Urban Forestry and Tree Management

- Urban Forestry Management Plan: A guiding document that directs the care and maintenance of city-owned trees.
- Tree Bylaw and Permits: Regulations are in place to protect trees by requiring permits for removal or injury on municipal property or in environmentally sensitive areas.
- Planting Programs: The city has programs like the Neighbourhood Tree Planting Program and the Community Trees in Trust Program to increase urban canopy cover.
- Horticultural Care: Dedicated teams manage public gardens and urban forests with a focus on using native species and low-maintenance plants.

Natural Assets

Biodiversity and Invasive Species Management

- Monitoring and Management: Staff survey natural areas and manage priority invasive species like wild parsnip and giant hogweed.
- Public Education: The City provides information to residents on how to identify and safely manage invasive plants on private property.
- Pest Control: They monitor for and manage pests that threaten trees, such as the spongy moth and emerald ash borer.

Water and Environmental Quality (in partnership with Utilities Kingston)

- Wastewater Management: Programs are in place to reduce sewer overflows to protect local waterways like Lake Ontario.
- Stormwater Management: The City encourages practices that reduce runoff and pollutants from entering the stormwater system and local waterways.
- Environmental Monitoring: The City responds to and evaluates environmental incidents, such as spills or algae blooms, and work with provincial agencies to monitor air and water quality.
- Shoreline Protection: The City monitors and implements capital projects to protect its waterfront from present and future erosion and flood conditions (example – An Gorta Mor Park).

1.4.2   Recommendations for Managing and Monitoring Natural Assets

Based on the City's programs and initiatives, the following recommendations are provided for managing and monitoring assets.

- **Urban Forestry and Data Management**: When staff perform ecological surveys, forest management treatments, or forest health assessments (such as looking for invasive species or disease), they could use a tablet or mobile device to input data directly into the system. This collected data could include a stand ID or plot location (using Global Positioning System [GPS]), dominant species composition, overall canopy health and biomass estimates, and a record of any interventions or management history. This approach would allow the City to move beyond simple treatment counts and support detailed long-term analysis. Staff could analyze the survival and success rates of different restoration efforts, monitor the

ecosystem health of specific forest stands, and use this robust data to effectively justify future management, conservation, and maintenance budgets.

- **Biodiversity and Invasive Species Management**: While continuous public reporting of invasive species (such as buckthorn, phragmites, and wild parsnip) remains valuable, a recommendation could be to evolve towards a coordinated removal and management. The system could be used to facilitate an action scenario by:
  - Mapping High-Priority Removal Zones: Staff would identify and map specific municipal lands (especially in highly used parks like Butternut Creek Nature Park or Greenwood Park Trail) where targeted invasive species removal would have the greatest ecological and community benefit.
  - Organizing Volunteer Stewardship: The platform could be used to municipally organize and deploy community volunteer efforts in these priority zones. This would transform invasive species management into a community-wide network, directing volunteer labor to areas where residents are most willing to contribute and where the need is greatest.
- **Water and Environmental Quality:** The City could establish a clear data link between stormwater runoff and natural assets. For key stormwater management ponds and constructed green spaces, the City could install sensors to measure water flow and quality. The data could be logged and paired with data on precipitation events. This would allow for measurement of a specific amount of runoff and pollutants that the natural asset is managing and supporting.
- **Natural Heritage Study:** The City is currently preparing a Natural Heritage Study (NHS) to support the new Official Plan. The NHS will identify and map the key natural heritage features, such as wetlands, woodlands and watercourses, found across Kingston, as well as corridors linking these features together. The project will provide a series of policy recommendations relating to the identification and protection of these features for implementation within the Official Plan. The City should consider the findings of the NHS as part of the management of their natural assets, especially in relation to: enhancement areas to grow the overall natural heritage system; the current or potential role municipal natural assets can provide within linkages and corridors; contributions towards significant wildlife habitat or habitat for species at risk; and opportunities to expand public access to natural areas for education, recreation and cultural purposes.

Natural Assets

- **Restoration and Enhancement on Municipal Lands:** The system could track natural asset restoration and enhancement strategies on municipal properties (including parks) to meet public consultation requests and expand the Natural Heritage System. This involves staff inputting data on targeted projects, such as intensive woodland replanting to transition thicket areas into mature forest and converting maintained grass areas into meadows or other naturalized habitats with greater ecological value.

1.5   Roadmap with Next Steps

This section focuses on recommendations identified through the development of the Natural Asset AMP. These recommendations are based on experience with limited or outdated data, gaps or barriers to reporting on levels of service and performance, or the desire to apply global best practices to advance asset management at the City. The recommendations have been summarized in the table below with specific recommendations for the Natural Asset Inventory data and reporting.

Table 1-13: Recommendation – Natural Assets (NA)

Item	Type	Recommendation
NA-1	Asset Data	Create a process, budget, and methodology for conducting condition assessments for natural assets through either desktop analysis or field identification.
NA-2	Asset Data	It is recommended that a phased ground-truthing approach be adopted by the City to verify the natural asset inventory. Using a phased approach, ground-truthing may begin with a limited systematic sampling procedure to verify a small, random subset of natural assets (e.g., 1 to 3% of total inventory). This will provide a quantifiable measure of accuracy and identify the most common classification errors. Based on these findings, a more robust statistically significant ground-truthing effort can be planned for future updates to this AMP.

Natural Assets

Item	Type	Recommendation
NA-3	Asset Data	Establish and develop an Asset Data Management Strategy to help standardize the collection and reporting of asset and condition information.
NA-4	Asset Data	It is recommended that City natural assets abutting or in proximity to major development applications be prioritized for ground-truthing to verify the natural asset inventory in relation to the natural heritage system. These assessments may assist the City when assessing potential environmental impacts of the development applications, identifying areas of enhancement, identifying significant wildlife habitat, understanding linkages and corridors, and evaluating potential parkland contributions.
NA-5	Performance	Expand the collection of performance data to be able to track and report how the assets are performing and to assist the City in establishing targets for proposed LOS.

1.6   References

Beacon Environmental Limited with Green Analytics and Associated Engineering, *Life Cycle Costing of Restoration and Environmental Management Actions: Costing Natural Assets in Peel Region* (December 2020) https://files.cvc.ca/cvc/uploads/2023/12/rpt_NatAssetLifeCycleCosting_f_ACCESSIBLE_20231016_a.pdf

Canadian Council of Ministers of the Environment, *Natural Infrastructure Framework: Key Concepts, Definitions, and Terms* (2021)

Government of Ontario, *Building Together – Guide for Municipal Asset Management Plans* (February 2024) https://www.ontario.ca/page/building-together-guide-municipal-asset-management-plans

International Standard for Asset Management: ISO 55000

Natural Assets Initiative, *A Guidebook for Local Governments* (2024)

Natural Assets Initiative, *A Guidebook for Local Governments: Developing Levels of Service (LOS) for Natural Assets* (2022)

National Standard of Canada, *Specification for Natural Asset Inventories; Canadian Standards Association – CSA W218:23* (2023)