

Toward natural asset management in the City of Peterborough Ontario



Summary of inventory results and implications April 2021

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Municipal Natural Assets Initiative





Invest in Nature

The Municipal Natural Assets Initiative (MNAI) is a Canadian not-for-profit that is changing the way municipalities deliver everyday services - increasing the quality and resilience of infrastructure at lower costs and reduced risk. The MNAI team provides scientific, economic and municipal expertise to support and guide local governments in identifying, valuing and accounting for natural assets in their financial planning and asset management programs, and developing leading-edge, sustainable and climate-resilient infrastructure.

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Table of Contents

1	Purpose.3
2	Introduction3
	What are municipal natural assets	3
	Why manage natural assets	3
	How to manage natural assets	3
	What is a natural asset inventory.	4
	<i>Figure 1: the Asset Management process</i>	4
3	Local government context.5
	3.1. General	5
	<i>Figure 2: City of Peterborough</i>	5
	3.2. Asset management readiness assessment	6
4	Natural asset inventory7
	4.1. Inventory overview	7
	4.2. Inventory data	7
	<i>Table 1: Data sources summary</i>	7
	<i>Table 2: Summary of natural assets by type</i>	9
	4.3. Asset registry	9
	<i>Table 3: Excerpt from the registry</i>	9
	4.4. Online dashboard	10
	<i>Figure 3: Screenshot of main inventory summary</i>	10
	4.5. Condition of natural assets	10
	<i>Table 4: Condition assessment approach and indicators</i>	11
	<i>Figure 4: Screenshot of condition assessment results.</i>	12
	<i>Figure 5: Summary of condition rating by natural asset type</i>	13
	4.6. Maintaining the inventory	13

5	Risk identification	14
5.1.	Risk identification tool overview	14
5.2.	Using the risk identification tool	14
5.3.	Results of the risk identification process	15
	<i>Figure 6: Results of risk management process</i>	<i>16</i>
6	Implications	16
6.1.	Potential priorities for the local government	17
	<i>Table 6: Risk Mitigation Strategies.</i>	<i>19</i>
6.2.	Possible actions for the further development of the inventory	20
6.3.	Steps to a full natural asset management project	20
	Sources.	22
	Annex: Results of Peterborough’s risk identification	23
	Step 1: Identification of risks	23
	Step 2: Complete survey	24
	<i>Table 1: Simplified risk identification survey</i>	<i>24</i>

1 Purpose

This document summarizes the results of a project to develop a natural asset inventory in the City of Peterborough and documents steps the local government can take to proceed to a full natural asset management initiative.

2 Introduction

What are municipal natural assets

The term *municipal natural assets* refers to the stock of natural resources or ecosystems that a municipality, regional district, or other form of local government could rely upon or manage for the sustainable provision of one or more local government services¹.

Why manage natural assets

A growing number of local governments recognize that it is as important to understand, measure, manage and account for natural assets as it is for engineered ones. Doing so can enable local governments to provide *core* services such as stormwater management, water filtration, and protection from flooding and erosion, as well as *additional* services such as those related to recreation, health and culture. Outcomes of what is becoming known as *municipal natural asset management* can include cost-effective and reliable delivery of services, support for climate change adaptation and mitigation, and enhanced biodiversity.

How to manage natural assets

There are numerous ways for local governments to manage natural assets. The Municipal Natural Assets Initiative (MNAI) uses methodologies and tools rooted in standard asset management, and provides a range of advisory services to help local governments implement them. MNAI has developed the methods and tools with significant investments, piloting, refinement, peer review, and documentation of lessons in multiple Canadian provinces. MNAI's mission is to make natural asset management a mainstream practice across Canada, and in support of this, for local governments to accept and use the methodologies and tools in standard ways across the country.

¹ mnai.ca/media/2018/02/finaldesignedsept18mnai.pdf

What is a natural asset inventory

Inventories provide details on the type of natural assets a local government relies upon², their condition, and the risks they face. As depicted in Figure 1 and explained in detail in the Annex, a natural asset inventory is the first component of the Assessment phase. The Assessment phase, in turn, is the first of three phases of a full natural asset management project. By itself, an inventory will not give a sense of asset value, but is an essential first step in the full natural asset management project.

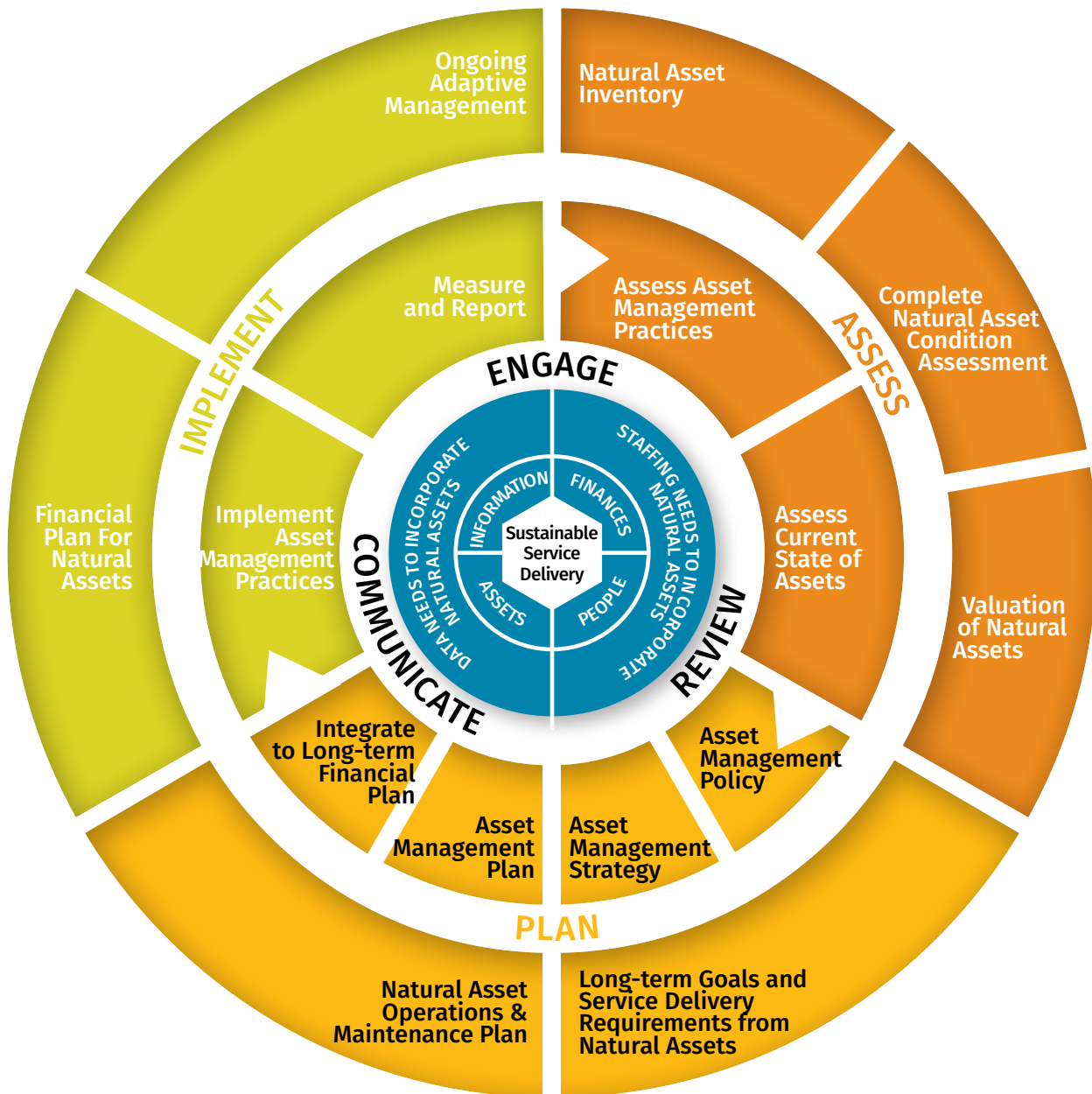


Figure 1: The Asset Management Process. MNAI has adapted this for use with natural assets.

² Note that many local governments rely on services from natural assets they do not own.

3 Local government context

3.1. General

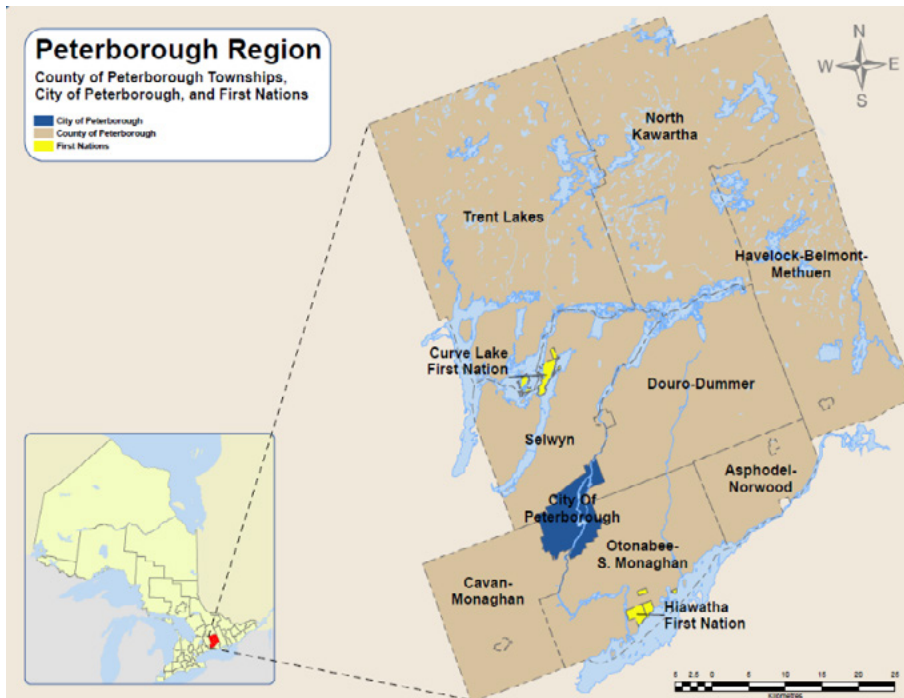


Figure 2: City of Peterborough

The City of Peterborough (population ~81,000) is located on the Otonabee River in Central Ontario, about 270 kilometres southwest of Ottawa.

Peterborough has three main interests in natural asset management. First, it wants to better understand the core municipal services that natural assets provide, or could potentially provide, and risks natural assets may be exposed to. Second, Peterborough wants to identify

opportunities for well-managed natural assets to deliver these services on their own, or as a complement to existing engineered assets. Third, Peterborough wants to enhance awareness of green infrastructure and ecosystem services across the local government to better inform planning and management activities.

Prior to the inventory, Peterborough identified as priorities for management urban forests, wetlands and parklands. Currently, these and other natural assets exist in various City service area inventories but are not consistently understood, classified or managed for the full range of services they provide. To illustrate, Peterborough notes parklands in a draft asset management plan, but only in the context of recreational services.

Peterborough has experienced several flooding incidents over the past decade which have posed significant challenges for service delivery. Thus, stormwater management (flood reduction, water quality), environmental protection, climate change mitigation and adaptation goals and targets, culture, recreation and heritage are high priority services.

Natural assets are implicitly or explicitly recognized in several core documents. For example, Peterborough's Official Plan references the protection of Natural Heritage, and the Urban Forest Strategic Plan and the Parks and Open Space Study reference the management of urban forests and parklands.

Undertaking a natural asset inventory will be part of Peterborough's asset management planning process, which, per City Council direction, will include a climate change "lens."

The inventory would also link to various plans and policies such as the Corporate Asset Management Plan, Stormwater Quality Master Plan, Climate Change Action Plan, Flood Reduction Master Plan, Urban Forest Strategic Plan, and the Watershed Plan.

3.2. Asset management readiness assessment

As part of inventory development, MNAI helps local governments determine their overall state of asset management maturity. To do this, MNAI has adapted the Federation of Canadian Municipalities (FCM)'s asset management readiness assessment tool³ to help local governments measure their progress on both asset management and natural asset management in four competency areas, with each area describing outcomes based on five levels of progress or maturity.

The completed assessment will, in turn, help the local government prioritize actions that will increase its effectiveness in managing all assets, including natural ones.

Peterborough is generally at the early-to-mid stage of adopting asset management for its engineered assets and is taking first steps in incorporating natural assets. Peterborough has an asset management policy and procedure to which it adheres. This includes all city-owned assets but does not explicitly refer to the contribution of natural assets to service delivery. Peterborough also has a council-approved, five-year asset management roadmap that is guiding implementation of asset management. It has a cross-functional asset management team to lead, communicate and support asset management workflows and organizational change.

Overall, Peterborough is progressing with capturing required data to satisfy regulatory asset management reporting requirements for engineered assets. Data confidence is low for some service areas and assets, and asset data hasn't been formally linked to financial information for critical assets.

Peterborough's current asset management plan does not include all service areas or natural assets, but it is working towards having all service areas and performance measures incorporated by 2024. The 2021 asset management plan will include some green infrastructure assets that have been identified as contributing to stormwater management and parks and recreation services.

The readiness assessment also indicates there is still progress to be made in standardizing asset investment planning so it is undertaken consistently across all service areas. Furthermore, Peterborough still assesses the annual capital budget based on current needs, which is typical of local governments at an

³ See fcm.ca/sites/default/files/documents/resources/tool/asset-management-readiness-scale-mamp.pdf for details

earlier stage of asset management. As Peterborough's asset management efforts mature, it may wish to plan infrastructure more proactively based on longer-term financial plans.

Peterborough captures its capital and operating expenditure data at a high level for core assets only, which is not yet aligned with its asset management policy and procedure service areas or the hierarchy used in the asset register. Peterborough has not yet considered financial valuation of natural assets but is in the early stages of building in capital and operating and maintenance costs for at least one critical natural asset.

4 Natural asset inventory

4.1. Inventory overview

MNAI's natural asset inventories have two main components, or ways, to express natural asset information: an asset registry (which is a tabular representation of the data) and an online dashboard. MNAI provided the registry to Peterborough in an Excel file and the dashboard as a website address. Information on the condition of the assets is a subset of the inventory and is depicted in both the registry and dashboard.

4.2. Inventory data

MNAI obtained data from Peterborough and the Ontario Ministry of Natural Resources. MNAI combined the spatial data to establish a comprehensive depiction of natural assets. Table 1 describes the data sources used to develop the inventory and condition assessment. An asset is defined as a continuous area with the same land cover type.

TABLE 1: DATA SOURCES SUMMARY

DATA	SOURCE	PURPOSE
1310-peterborough-landcover-26917-v2.shp	City of Peterborough MNAI Data Transfer	Used as base layer for natural asset inventory
Wetland	City of Peterborough	Used to improve accuracy of natural asset inventory
Subwatershed Boundaries_ABL	City of Peterborough MNAI Data Transfer	Used to summarize natural assets by subwatershed
Roads	City of Peterborough Open Data	Used to assess linear road density of assets
PtboElevation_dtm	City of Peterborough MNAI Data Transfer	Used to estimate the mean elevation within an asset
LU_ABL_2020_03_05	City of Peterborough MNAI Data Transfer	Existing natural assets further classified into aggregated land use designations

TABLE 1: DATA SOURCES SUMMARY

DATA	SOURCE	PURPOSE
NHS_Pathways	City of Peterborough MNAI Data Transfer	Used to summarize the type and length of NHS pathways within natural assets
TreeCanopy	City of Peterborough MNAI Data Transfer	Used to summarize the area of tree canopy within a natural asset
ANSI	Ontario Ministry of Natural Resources and Forestry	Used to summarize ANSI and woodland area within a natural asset
WOODED_AREA	Ontario Ministry of Natural Resources and Forestry	Used to summarize ANSI and woodland area within a natural asset
Hydrography Polygon	City of Peterborough Open Data	Used to indicate assets that overlap with surface water polygons
Ptbo_Limits	City of Peterborough MNAI Data Transfer	Used to determine study area
Floodplain_20170215_ SelectArea	City of Peterborough MNAI Data Transfer	Used to determine area of assets residing in floodplain
MeanderBelt_20150707_ SelectArea	City of Peterborough MNAI Data Transfer	Used to determine area of assets residing in meanderbelt area
StromwaterQuality Controlled_DrainageArea	City of Peterborough MNAI Data Transfer	Used to determine area of assets residing within the storm water-controlled areas
Watercourse	City of Peterborough MNAI Data Transfer	Used to flag assets with watercourses running through them and summarize length within asset
Surficial_Geology_ABL	City of Peterborough MNAI Data Transfer	Used to assign majority deposit type and ABL primary type to assets
Ontario_Dam_Inventory	City of Peterborough MNAI Data Transfer	Assets with dams flagged, and name and ownership added

An asset is defined as a continuous area with the same land cover type. The inventory project defined a total of 35,338 individual assets covering 4,416 hectares (ha) of the municipal area, including built-up pervious assets, as noted in Table 2. Excluding built-up pervious, the main assets areas are forests and wetlands.

TABLE 2: SUMMARY OF NATURAL ASSETS BY TYPE

NATURAL ASSET TYPE	NUMBER OF ASSETS	TOTAL AREA (HA)	AVERAGE ASSET AREA (HA)
Forests	928	791	0.85
Wetland	498	424	0.85
Water	496	310	0.63
Built-up pervious	33,416	2,890	0.09
Total	35,338	4,416	0.12

4.3. Asset registry

MNAI gathered the data, then sorted and analyzed it for relevance, and then delineated the type, location and extent of natural assets within the project area. Each asset has a unique identification number that allows individual assets to be selected, analyzed, and the corresponding data manipulated as required. For example, changes in condition can be noted for individual assets. The information pertaining to each asset was then placed into an asset registry. An excerpt from Peterborough's registry showing natural asset characteristics and details is in Table 3.

TABLE 3: EXCERPT FROM THE REGISTRY

Peterborough Natural Asset Inventory									Summary		Asset Registry		Condition		Decomposition	
Natural Asset Registry																
Asset ID	Asset Type	Asset Area (ha)	Subwatershed	Mean Elevation (m)	Tree Canopy Area (ha)	Interior Forest (%)	Corridor Pathway Length (km)	Linkage Pathway Length (km)	NHS Total Pathway Length (km)	Area Intersecting ANSI or Wooded Areas (ha)	Permeability Score	Road Density Score	Adjacent Landuse Score	Relative Size Score	Total Score	
FOR-100595	Forest	30.25	North Thompson	205.12	29.25	1	0.45	0.00	0.45	11.02	10	10	8	10	38	
FOR-100596	Forest	0.12	North Thompson	205.05	0.00	0	0.00	0.00	0.00	0.00	10	10	10	1	31	
FOR-100722	Forest	0.15	Urban Catchments	194.88	0.13	0	0.00	0.00	0.00	0.00	10	1	5	1	17	
FOR-100723	Forest	0.22	Urban Catchments	194.20	0.18	0	0.00	0.00	0.00	0.00	10	1	5	1	17	
FOR-100755	Forest	0.17	Urban Catchments	193.32	0.13	0	0.00	0.00	0.00	0.00	10	1	4	1	16	
FOR-101076	Forest	0.08	Urban Catchments	208.91	0.06	0	0.00	0.00	0.00	0.00	10	1	6	1	18	
FOR-101125	Forest	0.08	Urban Catchments	210.73	0.07	0	0.00	0.00	0.00	0.00	10	1	10	1	22	
FOR-101334	Forest	2.87	Urban Catchments	204.14	2.32	0	0.00	0.00	0.00	0.00	10	1	9	5	25	
FOR-101369	Forest	1.03	Urban Catchments	205.51	1.00	0	0.00	0.00	0.00	0.84	10	1	9	1	21	
FOR-101370	Forest	0.01	Curtis	206.02	0.01	0	0.00	0.00	0.00	0.01	10	1	9	1	21	
FOR-101371	Forest	1.75	Urban Catchments	201.83	1.24	0	0.00	0.00	0.00	0.00	10	1	9	1	21	
FOR-101372	Forest	1.90	Urban Catchments	201.90	1.68	0	0.00	0.00	0.00	0.00	10	1	10	1	22	
FOR-101373	Forest	0.75	Urban Catchments	202.59	0.57	0	0.00	0.00	0.00	0.31	10	1	6	1	18	
FOR-101453	Forest	24.71	North Thompson	238.49	24.37	6	0.75	0.00	0.75	11.46	10	5	9	10	34	
FOR-101454	Forest	0.00	Urban Catchments	238.52	0.53	0	0.00	0.00	0.00	0.51	10	5	10	1	26	
FOR-101455	Forest	0.78	Urban Catchments	239.05	0.76	0	0.00	0.00	0.00	0.20	10	5	10	1	26	
FOR-101456	Forest	0.02	Urban Catchments	239.32	0.00	0	0.00	0.00	0.00	0.00	10	5	10	1	26	
FOR-101460	Forest	1.31	Urban Catchments	240.37	1.21	0	0.00	0.00	0.00	0.89	10	5	10	1	26	
FOR-101461	Forest	7.52	Urban Catchments	240.16	7.14	0	0.00	0.00	0.00	6.12	10	5	10	5	30	
FOR-101462	Forest	5.89	South Thompson	240.90	5.81	0	0.00	0.00	0.00	3.92	10	5	10	5	30	
FOR-101463	Forest	2.15	Trent	240.77	2.07	0	0.00	0.00	0.00	1.83	10	1	10	1	22	
FOR-101493	Forest	1.25	Urban Catchments	233.73	1.17	0	0.00	0.00	0.00	0.00	10	1	10	1	22	
FOR-101494	Forest	0.04	Urban Catchments	232.81	0.03	0	0.00	0.00	0.00	0.00	10	1	6	1	18	
FOR-101496	Forest	0.01	Urban Catchments	230.97	0.01	0	0.00	0.00	0.00	0.00	10	1	6	1	18	
FOR-101500	Forest	0.06	Urban Catchments	228.50	0.06	0	0.00	0.00	0.00	0.00	10	1	6	1	18	
FOR-101506	Forest	0.18	Urban Catchments	221.10	0.17	0	0.00	0.00	0.00	0.00	10	1	10	1	22	
FOR-101507	Forest	0.51	Urban Catchments	223.29	0.48	0	0.00	0.00	0.00	0.00	10	1	10	1	22	
FOR-101508	Forest	0.06	Urban Catchments	222.77	0.06	0	0.00	0.00	0.00	0.00	10	1	10	1	22	
FOR-101518	Forest	0.07	Urban Catchments	220.99	0.06	0	0.00	0.00	0.00	0.00	10	1	7	1	19	
FOR-101519	Forest	0.57	Urban Catchments	221.12	0.52	0	0.00	0.00	0.00	0.00	10	1	10	1	22	

4.4. Online dashboard

Inventories may provide more insights when characterized visually in a dashboard, which enables users to explore different aspects of the data. For instance, natural asset information can be quickly summarized by watershed area, or, if users want to dive into the specifics of forest assets, they can quickly filter the data to focus on that particular asset. Figure 3 is a screen shot from the dashboard that MNAI provided to Peterborough. The full version can be accessed at go.greenanalytics.ca/peterborough.

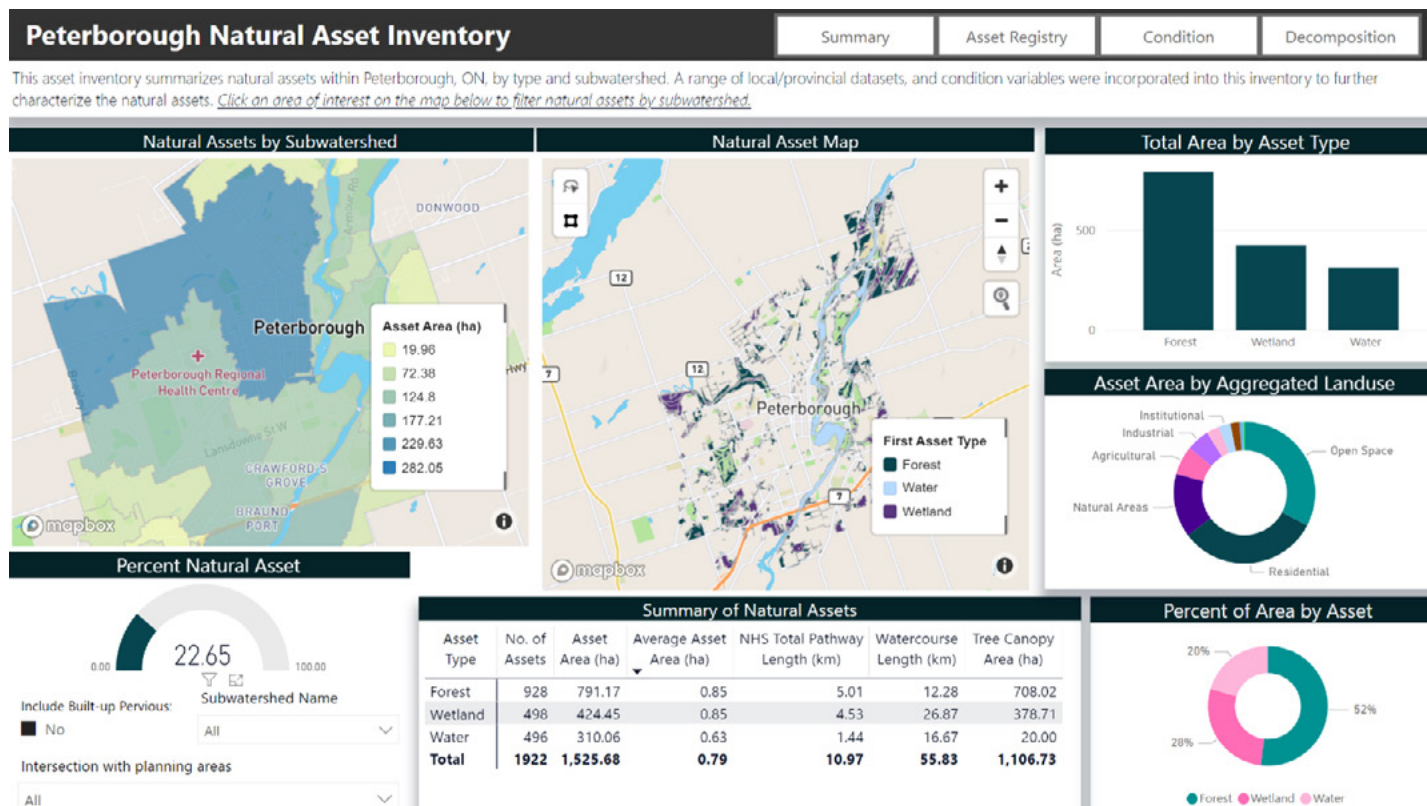


Figure 3: Screenshot of main inventory summary

4.5. Condition of natural assets

Documenting the condition of natural assets is a key aspect of natural asset inventories. A natural asset condition assessment provides an understanding of both the ecological health of natural assets, and the ability of natural assets to provide services. This information, in turn, can support the effective management of natural assets, be reflected in the registry and the dashboard, and updated over time.

MNAI completed a desktop condition assessment and built it into the inventory to provide an initial understanding of the status of the natural assets for Peterborough. Table 4 summarizes the condition assessment steps and indicators.

TABLE 4: CONDITION ASSESSMENT APPROACH AND INDICATORS

Indicator	Description & Methods for Quantification	Data used to Quantify Indicator
Relative asset size	For each natural and semi-natural asset type, total area is calculated and a rank is assigned to the assets within each class based on its percentile score. Natural assets within the top third of the ranking (e.g., the largest assets within a class) received a 3, those within the middle third of the ranking received a 2, and those within the bottom third of the ranking received a 1.	Natural asset inventory
Road density	Measures the density of the roads in and around the assets according to high density (assets with more than 2km of roads per square km), medium density (assets with between 1km and 2km of roads per square km) and low density (assets with less than 1km of roads per square km).	Natural asset inventory plus spatial representations of roads
Surface permeability	The permeability of surfaces is ranked on a scale of nil to high depending on the type of landcover present. Urban areas, roads and industrial areas are ranked as nil. Assets within impervious surfaces are assigned as low permeability. Agriculture and shrublands are ranked as medium. Wetlands, waterbodies and forests are ranked as high.	Natural asset inventory, spatial representations of land uses and roads, as well as the Global Man-made impervious surfaces dataset from NASA data.nasa.gov/dataset/Global-Man-made-Impervious-Surface-GMIS-Dataset-Fr/dkf4-4bi3
Adjacent land use (nearest neighbours)	Considers the distance to, and the nature of, the area surrounding natural assets. Intense land uses (e.g., airports) in close proximity to natural assets result in a poor rating, while distant land uses that are less intense (e.g., agriculture) result in a good rating.	Natural asset inventory plus spatial representation of land use as well as intensity rankings of land uses

Once conditions were allocated to each asset, an overall score was derived for the project area. The maximum possible score for an asset was 40, based on a possible 10 points for each of 4 categories:

- Road density as low (10), medium (5) or high (1).
- Surface permeability rated as high (10), medium (5), low (1), or nil (0).
- Adjacent intensive land use (0 for intense land uses, otherwise 10).
- Relative asset size where the largest 3rd areas receive 10, 5 for middle 3rd, and 1 point for the lowest 3rd.

The total condition score was then converted into a rating scale:

- **Good** - assets with a score of 30 or higher
- **Fair** - assets with a score between 20 to 29
- **Poor** - assets with a score between 10 to 19
- **Very Poor** - assets with a score lower than 10

Figure 4 demonstrates the results of the condition assessment as presented in the inventory dashboard.

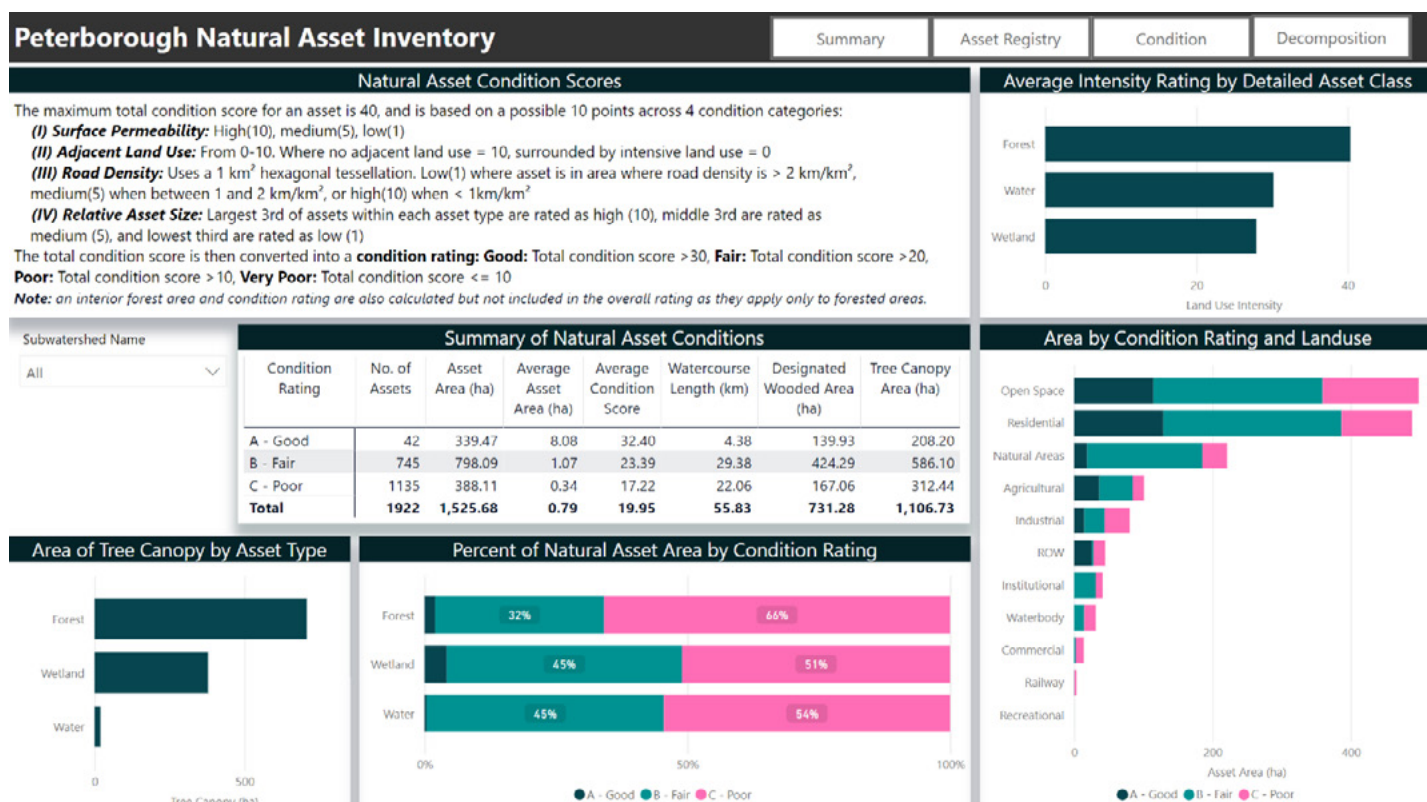


Figure 4: Screenshot of condition assessment results

Overall, about 339 ha (or 22 per cent) of natural assets were assessed as being in good condition and 798 ha (or 52 per cent) in fair condition.

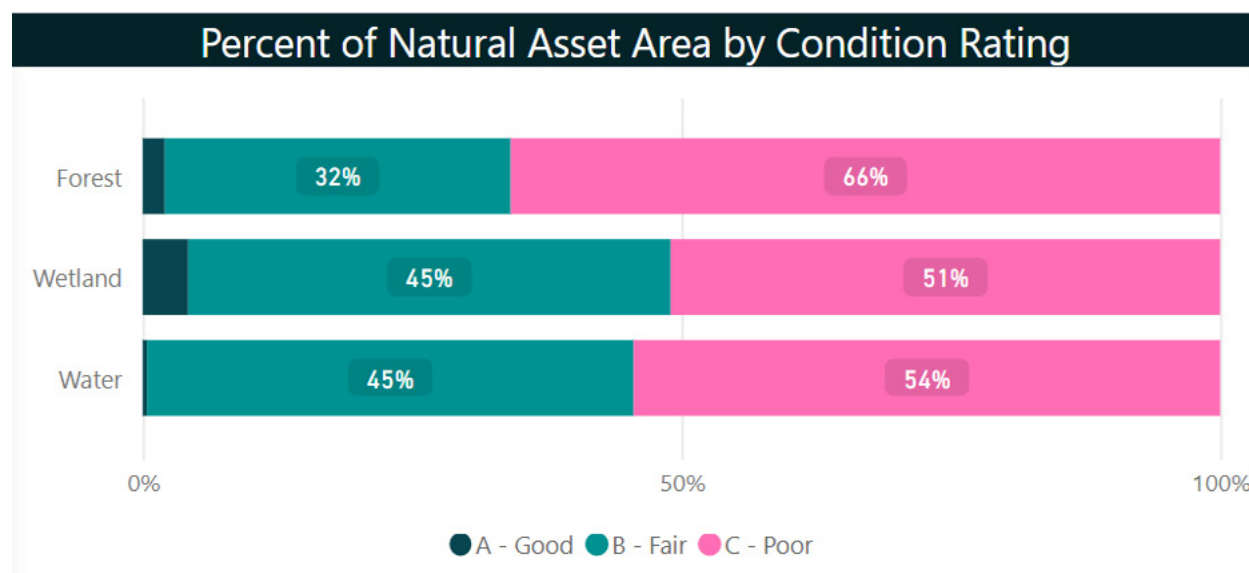
Forest, wetland and water assets were largely rated a combination of fair and poor. The poor ratings for these assets were mainly due to a combination of the assets being relatively smaller in size and in the vicinity of dense roads. Such a result is not unexpected in an urban setting where roads are located and assets tend to be smaller. The rating does not necessarily mean the assets are in poor ecological condition, just that they rated poorly due to these particular metrics. Different condition metrics suited to assessing assets located in urban environments might generate different results.

Table 5 summarizes condition ratings and Figure 6 summarizes condition by natural asset type.

TABLE 5: SUMMARY OF NATURAL ASSET CONDITION RATINGS

MNAI desktop approach

Condition Rating	Number of Assets	Total Area (ha)	Average Total Score	Average Condition Score
Good	3,707	1,663	0.45	21.06
Moderate	71,026	5,955	0.08	12.52
Poor	8,643	270	0.03	7.00
Total	8,643	7,888	0.09	12.33

*Figure 5: Summary of condition rating by natural asset type (MNAI desktop approach)*

4.6. Maintaining the inventory

Inventories are not static. Both the registry and the dashboard can be expanded as new information becomes available. For example, asset condition might improve as a result of restoration efforts, or new studies may add insights on the condition of the assets. New data can be reflected in the asset registry and subsequently in the online dashboard as it becomes available. Furthermore, the level of desired detail may evolve as asset management readiness increases, or as areas of natural asset management focus emerge. However, inventories should grow in detail and sophistication only insofar as they remain aligned with the capacity of the communities to maintain them, and the uses to which they will be put. Their evolution and development should be a function of the monitoring, reporting and lessons of the asset management cycle and be driven by the imperative of ensuring sustainable, cost-effective delivery of services to the community, which is the core of asset management.

5 Risk identification

5.1. Risk identification tool overview

Identifying risks facing natural assets can help local governments prioritize their management of natural assets. To this end, MNAI provides local governments with a tool entitled *Risk Identification Process in the Development of Natural Asset Inventories* and guidance in self-administering it.

Risk management is a four-stage process that includes risk identification, analysis of probability and consequence, development of risk mitigation strategies, and control and documentation. The use of the risk identification tool informs the first and second stages of risk management through the identification of top risks to natural assets and their associated services, and a high-level analysis of impacts and consequences.

Risk types relevant to natural asset management typically include:

- **Service risk:** the risk of an asset failure that directly affects service delivery.
- **Strategic risk:** the risk of an event occurring that impacts the ability to achieve organizational goals.
- **Operations and maintenance risk:** risks related to poor asset controls and oversight, which can lead to poor record-keeping and poor monitoring of asset.
- **Financial risk:** risks related to the financial capacity of the local government to maintain municipal services.
- **Political risk:** risks related to the nature of municipal politics.

5.2. Using the risk identification tool

Using the risk tool, Peterborough considered possible risks that the loss of natural asset functions could pose to built infrastructure, personal health and safety, and private property, including:

- Overuse of trails/dumping
- Flooding (current and future)
- Invasive species
- Development pressure
- Pollutant loading from urban, agricultural, or industrial sources (e.g., overuse of salt on roads)
- Drought (current and future)
- Erosion
- Ice jams

- Lack of flood hazard mapping
- Lack of land management plans
- Construction activity
- Political policy change

Each risk was then ranked low, medium or high according to the probability of an impact occurring, and the relative magnitude of its negative consequences. To assess impact and consequence, Peterborough considered four questions:

- 1/ what impact is likely to happen?
- 2/ what is the consequence of that impact happening?
- 3/ what can be done to mitigate the impact probability and/or consequence?
- 4/ what cues will signal the need for mitigation??

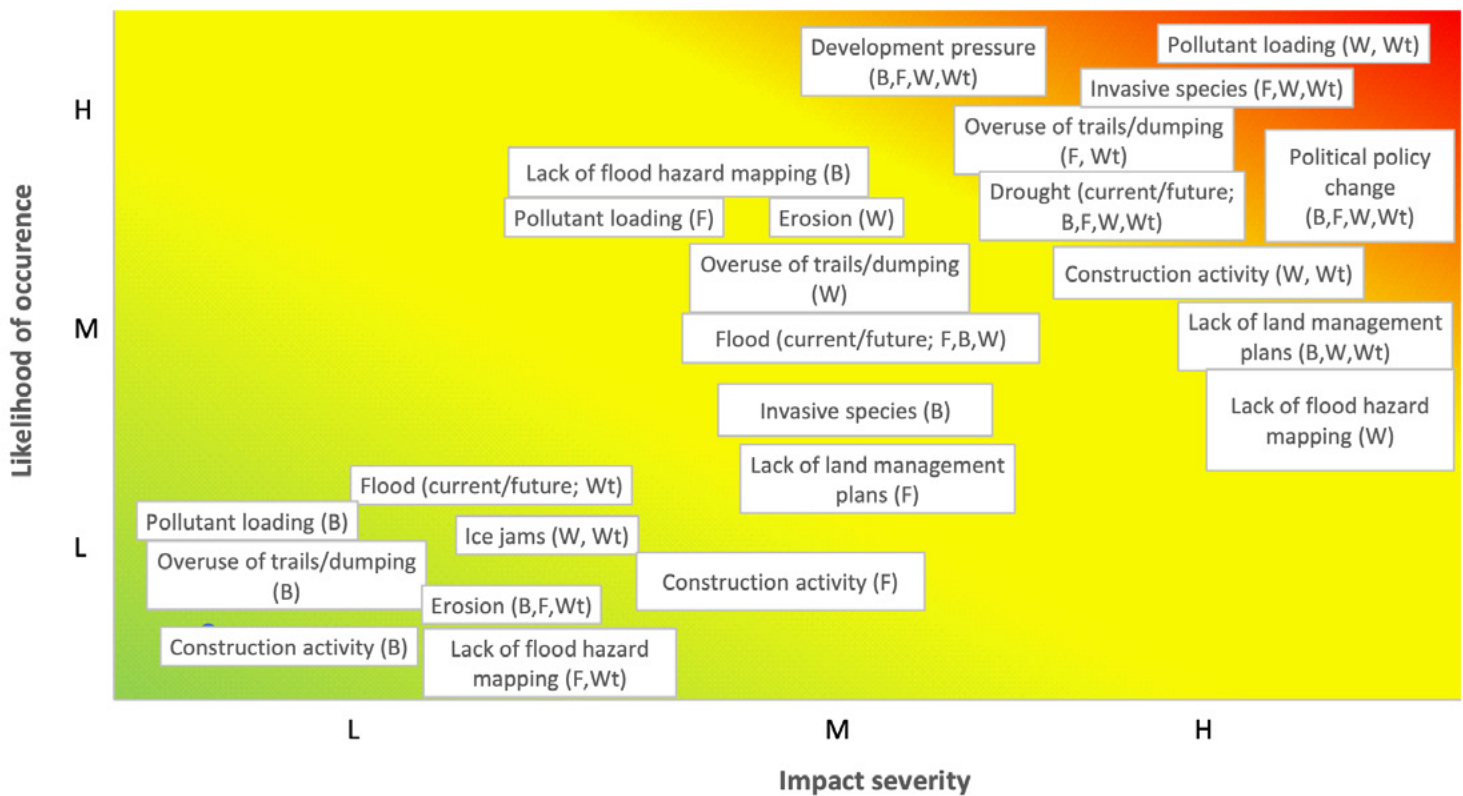
5.3. Results of the risk identification process

The risk identification process was completed separately for built-up pervious assets (B), forests (F), wetlands (Wt), and water (W). In combination, it revealed:

- Nine high-level risks [development pressure (B,F, Wt, W), drought (B,F,Wt,W), lack of land management plans (B,Wt,W), political policy change (B, F, Wt, W), overuse of trails/dumping (Wt, F), invasive species (F, Wt, W), pollutant loading (Wt, W), construction activity (Wt, W), and lack of flood hazard mapping (W)]
- Eight medium-level risks [flooding (B, F, W), invasive species (B), lack of flood hazard mapping (B), overuse of trails/dumping (W), erosion (W), pollutant loading (F), lack of land management plans (F), and construction activity (F)]
- Seven low-level risks [overuse of trails (B), pollutant loading (B), erosion (B, F, Wt), construction activity (B), flooding (Wt), ice jams (Wt, W), and lack of flood hazard mapping (F, Wt)]

The risks affect natural assets across the entire area within Peterborough's boundaries. Staff drew particular attention to wetlands; the risks associated with them were often considered intolerable and in some cases unmanageable, or manageable only with considerable cost.

Risk Matrix



Legend
Minor
Moderate
Major
Severe

Figure 6: Results of risk management process

6 Implications

This section provides insights from considering both the inventory, including the condition and risk assessments, and the asset management readiness assessment. It is divided into (a) potential priorities for the local government (b) possible actions for the further development of the inventory, and (c) issues Peterborough can consider to advance to a full natural asset management initiative.

6.1. Potential priorities for the local government

Combining the results of the condition assessment with the outcomes of the risk identification highlights potential priorities for Peterborough to focus their natural asset management efforts. These are:

- **Development pressure:** Development pressure was identified as an imminent, but largely manageable, high-level risk for natural assets across Peterborough, including parks and open spaces, woodlands, street trees, wetlands (both provincially significant and unevaluated wetlands), creeks, and waterbodies. Peterborough has an extensive Natural Heritage System, implemented through the Official Plan, which includes strong protection to provincially significant features and/or ensures ecological functions are maintained or compensated⁴. The Official Plan's Growth Management goals and objectives considers natural assets outside of the Natural Heritage System through measures to encourage the efficient use of land (e.g., re-use of greyfields).
- **Drought:** Future drought is an imminent risk to Peterborough's trees in parks and open spaces, woodlands, street trees, and all wetlands. Risk to wetlands is of particular concern, being characterized as unmanageable and intolerable. For small wetlands close to intensive land use, the expansion of buffer zones will be essential. Promising actions are found in the Urban Forest Strategic Plan (2011) and the Greater Peterborough Area Climate Change Action Plan (2016), both of which include recommendations to develop response plans for severe weather events such as drought. The role of natural assets should be considered in the development of response plans.
- **Lack of land management plans:** The lack of land management plans was identified as an imminent, yet manageable, high-level risk across built-up pervious areas, wetland, and water natural assets in Peterborough. Attention was drawn to increased concern for unevaluated wetlands, and risks to creeks and waterbodies that were considered intolerable. Peterborough is preparing an updated Official Plan⁵; this will be an important opportunity for setting natural asset objectives and policy direction.
- **Political policy change:** Political policy changes can have unintended consequences on natural assets across Peterborough. Peterborough has identified this risk across every natural asset class. This risk was deemed imminent yet manageable for built-up pervious areas and forests; imminent, manageable and intolerable for wetlands; and a future manageable and tolerable risk to water class assets (i.e., creeks and waterbodies). Natural asset management can provide an opportunity to amend bylaws and regulations to protect critical natural assets such as wetlands.

⁴ City of Peterborough, 2018

⁵ Province of Ontario, 2020

- **Overuse of trails/dumping:** Overuse of trails and dumping was ranked as a high-level risk to forests and wetlands. This risk is considered imminent, yet manageable, for forests; and imminent, manageable, yet intolerable for wetlands. Wetlands backing onto private property or next to built-up areas can be degraded, negatively impact wildlife, and diminish trail experience and solitude.
- **Invasive species:** Invasive species are an imminent risk to forests, wetlands and waterways within Peterborough. Risks to wetlands and waterways are deemed intolerable, particularly for creeks with sensitive species. Peterborough has a 12-year, \$4-million Emerald ash borer management plan⁶, and several documents call for additional measures to address other invasive species. For instance, the Urban Forest Strategic Plan calls for the development of an information system for invasive species, and the Greater Peterborough Area Sustainability Plan⁷ calls for Invasive Species policies.
- **Pollutant loading:** Pollutant loading is an imminent, intolerable, yet manageable risk for wetlands and water-based natural assets in Peterborough. The proximity of intensive land use and roads in the Bears, Byersville, and Riverview subwatersheds contributes to low condition ratings and could signal areas of heightened concern for pollutant loading. Water quality monitoring in the areas could assist Peterborough to better understand where mitigative measures are warranted.
- **Construction activity:** Construction activity is identified as an imminent, intolerable, yet manageable risk for wetlands and water-based natural assets in Peterborough. The increase in impermeable areas and degradation of natural assets can exacerbate existing risks, such as pollutant loading and drought.
- **Lack of flood hazard mapping:** The lack of current flood hazard mapping for creeks and waterbodies was identified as an imminent, intolerable, yet manageable risk. Peterborough completed a Flood Reduction Master Plan in 2005⁸, which identified three catchments in need of attention: Jackson, Riverview, and Curtis. It is recommended that flood hazard mapping be updated to ensure that flood plain boundaries are current and up-to-date.

⁶ City of Peterborough. 2013

⁷ Sustainable Peterborough, 2012

⁸ City of Peterborough, 2005

TABLE 6: RISK MITIGATION STRATEGIES

Accept	Risk may be acceptable if probability and consequences are small
Minimize	Risk under local government's control that warrants exposure reduction
Share	Partners in a project permit the sharing of larger risks to reduce it for each
Transfer	Insurance, fixed price contracts, and other risk transfer tools.

Table 6 lists and provides brief descriptions of risk mitigation strategies.

Opportunities to strengthen natural asset management at an organization-wide level

In its readiness assessment, Peterborough identified actions to strengthen asset management and better incorporate natural asset considerations. For example, asset management roles and responsibilities could be better defined and added to job descriptions, and a terms of reference for the asset management team could be formalized. If Peterborough proceeds on that basis, it could identify role(s) and responsibilities related to natural asset management and develop formal terms of reference. Peterborough could also enhance corporate awareness of its asset management policy and ensure that all staff understand how they fit into asset management processes.

The asset management roadmap could be updated to better reflect how current resources, timelines and processes will be managed. For example, the current roadmap does not refer to how Peterborough's new enterprise maintenance management system will be used. An updated roadmap could also ensure that Peterborough's asset management strategy includes objectives for both engineered and natural assets. Another next step will be to link asset and financial data.

Peterborough will still need to incorporate all service areas (and the contribution of natural assets) into its new asset management plan and develop corresponding levels of service and performance measures. Peterborough also noted the need to develop an integrated risk management policy and procedures and explore processes to align investment decisions with established levels of service, risk assessments, and asset conditions. Council is aware that natural asset management needs to be resourced, but funding details still have to be determined.

To develop staff capacity in natural asset management, a next step could be completing a staff competency review to identify required skillsets for natural asset management and to fill gaps.

6.2. Possible actions for the further development of the inventory

Based on the inventory, Peterborough could consider the following, regardless of whether or not it pursues a full natural asset management process. These are mostly incremental measures.

- Expand the risk identification to include field verification of results.
- Determine acceptable levels of risk to inform Peterborough's risk mitigation strategies (see Table 6).
- Further develop the condition assessment and risk assessment using local climate projections, land use modelling, and other data already at their disposal.
- Identify linkages between services and assets, and assess the condition of, and risks to, the assets from the perspective of their ability to deliver services. From a flooding and stormwater management perspective, the wetlands and forested areas in the watersheds will be key.
- Share the inventory with adjacent local governments to stimulate collaboration.
- Initiate or enhance monitoring - for example, using gauges, water level sensors, and loggers to improve understanding of trends, feed into condition ratings of assets, and gather information for modelling.
- Update flood hazard mapping to ensure that flood plain boundaries are current.
- Develop response plans for severe weather events such as drought and flooding. The role of natural assets should be considered in the development of these plans.
- Schedule regular updates (e.g., every 3-5 years) of the inventory, condition assessment, and risk identification to understand trends.
- Maintain interest and momentum in natural asset management to move towards a full natural asset management project.

6.3. Steps to a full natural asset management project

If Peterborough wishes to proceed with a full natural asset management project, including implementation, they could consider the following:

- 1/ Confirm scope, roles and responsibilities.** Undertake a meeting or workshop to confirm (a) assumptions [for example, that stormwater management is a primary service of concern] (b) roles, responsibilities and capacities (c) local government capacity to undertake a larger project.

- 2/ Fill essential knowledge gaps.** If discussions on scope and certainty and related data needs for modelling indicate the need for additional data, these could be filled.
- 3/ Modelling.** Modelling the levels of service that natural assets currently provide, and the levels of service under different potential management, local climate change projections, and rehabilitation or restoration scenarios, is central to natural asset management as it gives communities the ability to explore how different actions will affect the health and corresponding performance of natural assets.
- 4/ Economic assessment.** The economic assessment component provides a market-based indication of (a) the current value of the services from natural assets if they had to be provided by an engineered means, and (b) the costs and values of different interventions in terms of service delivery.
- 5/ Planning.** This step enables local governments to explore different scenarios such as, for example, “what happens to the services provided by the wetland if there is significant building upstream?” or “what happens to the services if the forest is restored?” Using modelling, changes in service levels can be understood and quantified. Corresponding values can also be determined through continued economic assessment. Based on the foregoing, local governments can begin to consider and prioritize actions ranging from status quo to planning, regulatory, financial operations, maintenance, acquisition, and monitoring interventions.
- 6/ Implementation.** The natural asset implementation phase is part of an adaptive management cycle, not a finite journey. It is during this time that actions identified based on the previous steps can begin to be implemented. MNAI can provide ongoing advice / guidance on policy pieces and integration of the above information for 12-18 months. After this point, the local government, together with local partners and service providers, would ideally have the capacity to continue these efforts on their own.
- 7/ Ongoing monitoring.** Project monitoring is essential to learn whether interventions are working, and to share lessons from other communities undertaking natural asset management. MNAI typically stays involved with the community for three years through a monitoring arrangement to be established with the communities.

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Annex: Results of Peterborough's risk identification

This Annex contains the results of Peterborough's use of MNAI's risk identification tool, which they self-administered with guidance from MNAI. Table 1 was the main product, developed by Peterborough personnel, that resulted from the exercise.

Step 1: Identification of risks

Common Risks to Natural Assets:

- Overuse of trails/dumping
- Flooding (current and future)
- Forest fire
- Invasive species
- Development pressure
- Pollutant loading from urban, agricultural, or industrial sources (e.g., overuse of salt on roads)
- Drought (current and future)
- Erosion
- Ice jams
- Storm surge
- Lack of flood hazard mapping
- Lack of land management plans
- Lack of monitoring reports
- Construction activity
- Political policy change

Step 2: Complete survey

Table 1: Simplified risk identification survey

1/ Asset Type: Built Up Pervious				
Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
Overuse of trails/dumping	L	Built up pervious	Parks and open spaces property line, trails	Manageable, imminent
Flooding (current and future)	M	Built up pervious	Parks and Open Spaces	Imminent, tolerable
Invasive species	M	Trees within parks and open spaces	Parks and Open Spaces	Imminent, intolerable
Development pressure	H	Built up pervious	Parks and Open Spaces	Imminent, manageable
Pollutant loading from urban, agricultural, or industrial sources	L	Built Up Pervious	Parks and Open Spaces	
Drought (current and future)	H	Built Up Pervious, trees within parks and open spaces	Parks and Open Spaces	Imminent, future risk
Erosion	L	Built Up Pervious	Areas along edges of Otonabee River	
Lack of flood hazard mapping	M	Built Up Pervious	Parks and Open Spaces	Imminent, manageable
Lack of land management plans	H	Built Up Pervious	Parks and Open Spaces	Imminent, manageable
Construction activity	L	Built Up Pervious	Parks and Open Spaces	Manageable
Political policy change	H	Built Up Pervious	Parks and Open Spaces	Imminent, manageable

2/ Asset Type: **Forest**

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
Overuse of trails/ dumping	H	Forest	Woodlands, Street trees	Imminent, manageable
Flooding (current and future)	M	Forest	Woodlands, Street trees	Future risk
Invasive species	H	Forest	Woodlands, Street trees	Imminent
Development pressure	H	Forest	Woodlands, Street trees	Imminent
Pollutant loading from urban, agricultural, or industrial sources	M	Forest – mostly street trees	Woodlands, Street trees	Imminent
Drought (current and future)	H	Forest	Woodlands, Street trees	Imminent, future risk
Erosion	L	Forest	Woodlands, Street trees	
Lack of flood hazard mapping	L	Forest	Woodlands, Street trees	Imminent, manageable
Lack of land management plans	M	Forest	Woodlands, Street trees	Imminent, manageable
Construction activity	M	Forest – backyards/ private properties	Woodlands, Street trees	Manageable
Political policy change	H	Forest	Parks and Open Spaces	Imminent, manageable

3/ Asset Type: **Wetlands**

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
Overuse of trails/ dumping	H	PSW, evaluated and unevaluated	Wetlands backing onto private property, or next to built-up areas	Manageable, imminent, intolerable
Flooding (current and future)	L	PSW, evaluated, and unevaluated	All	Imminent, tolerable – wetlands meant to flood/control flooding
Invasive species	H	PSW, evaluated, and unevaluated	All	Imminent and future risk, intolerable, likely unmanageable
Development pressure	H	PSW, evaluated, and unevaluated	Unevaluated wetlands	Imminent, intolerable, manageable
Pollutant loading from urban, agricultural, or industrial sources	H	PSW, evaluated, and unevaluated	All	Imminent, intolerable, manageable with high level of effort
Drought (current and future)	H	PSW, evaluated, and unevaluated	All	Future risk, unmanageable, intolerable
Erosion	L	PSW, evaluated, and unevaluated	Linear wetlands along creek corridors (Curtis, Meade, Thompson)	Manageable
Ice jams	L	PSW, evaluated, and unevaluated		No real risk to wetlands as a result of ice jam
Lack of flood hazard mapping	L	PSW, evaluated, and unevaluated	All	Manageable – all wetlands are in a flood hazard
Lack of land management plans	H	PSW, evaluated, and unevaluated	All – more of a concern for unevaluated	Imminent, manageable, intolerable
Construction activity	H	PSW, evaluated, and unevaluated	All	Manageable, imminent, intolerable
Political policy change	H	PSW, evaluated, and unevaluated	All – more of a concern for unevaluated	Imminent, manageable, intolerable

4/ Asset Type: Water

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
Overuse of trails/ dumping	M	Creek, waterbody	Sensitive areas, next to industrial/ commercial	Imminent, manageable, intolerable
Flooding (current and future)	M	Creek, waterbody	All	Future risk, unmanageable, MAY be tolerable
Invasive species	H	Creek, waterbody	All – more to creeks with sensitive species	Imminent/future, manageable, intolerable
Development pressure	H	Creek, waterbody	All	Imminent, manageable, intolerable
Pollutant loading from urban, agricultural, or industrial sources	H	Creek, waterbody	All – more to creeks with sensitive species	Imminent, manageable, intolerable
Drought (current and future)	H	Creek, waterbody	All	Imminent/future risk, unmanageable, intolerable
Erosion	M	Creek, waterbody	All	Imminent, manageable, intolerable
Ice jams	L	Creek, waterbody	All	Tolerable
Lack of flood hazard mapping	H	Creek, waterbody	All	Imminent, manageable, intolerable
Lack of land management plans	H	Creek, waterbody	All	Imminent, manageable, intolerable
Construction activity	H	Creek, waterbody	All	Imminent, manageable, intolerable
Political policy change	H	Creek, waterbody	All	Future risk, manageable, tolerable

Municipal Natural Assets Initiative

