
photo credit: WikiCommons, Thomas Erskine

Sackville
NEW BRUNSWICK


photo credit: WikiCommons, Larry


photo credit: WikiCommons, Chris Campbell

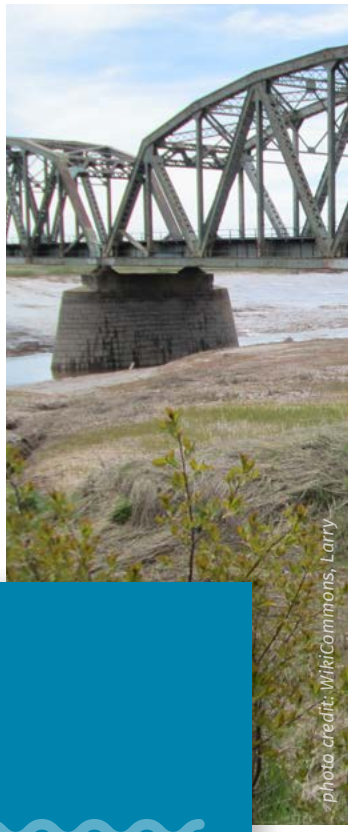
photo credit: WikiCommons, Larry


photo credit: WikiCommons, Larry

Toward natural asset management in the

Town of Sackville

New Brunswick

Summary of inventory results and recommendations
April 2022

This document features interactive elements! Clicking on a heading or sub-heading in the Table of Contents (ToC) will take you directly to that page. Also, clicking on page numbers in the footer will bring you back to the ToC.

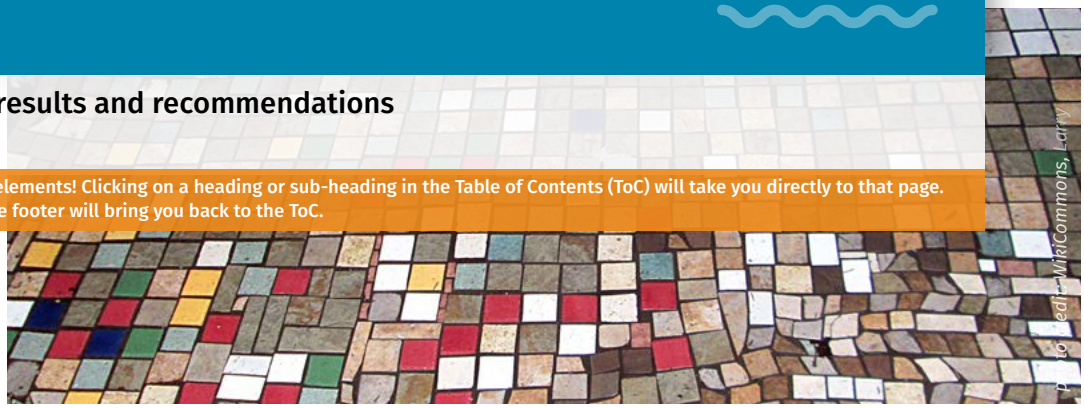
photo credit: WikiCommons, Larry

Municipal Natural Assets Initiative

MNAI.CA
Making Nature Count

Making Nature Count

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.

Please cite as:

Municipal Natural Assets Initiative (MNAI). (2021). Toward natural asset management in the Town of Sackville, New Brunswick. Summary of inventory results and recommendations. MNAI.ca

Table of Contents

1 Purpose . . . 3

2 Introduction . . . 3

What are municipal natural assets . . . 3

Why manage natural assets . . . 3

How to manage natural assets . . . 3

What is a natural asset inventory? . . . 4

Figure 1: the Asset Management process . . . 4

3 Local government context . . . 5

3.1. General . . . 5

Figure 2: The Town of Sackville. . . . 5

3.2. Asset management readiness assessment . . . 6

4 Natural asset inventory . . . 7

4.1. Inventory overview . . . 7

4.2. Inventory data . . . 8

Table 1: Summary of data sources . . . 8

Table 2: Summary of natural assets by type . . . 10

Figure 3: Spatial distribution of natural assets . . . 11

4.3. Asset registry . . . 12

Table 3: Excerpt from the registry . . . 12

4.4. Online dashboard . . . 12

Figure 4: Screenshot of main inventory summary . . . 13

4.5. Condition of natural assets . . . 13

Table 4: Condition assessment approach and indicators . . . 14

Figure 5: Screenshot of condition assessment details . . . 16

Table 5: Summary of natural asset condition ratings . . . 16

Figure 6: Summary of condition rating by natural asset type . . . 17

4.6. Maintaining the inventory . . . 17

5 Risk identification 18

5.1. Risk identification tool overview 18

5.2. Using the risk identification tool 18

5.3. Results of the risk identification process 19

Figure 7: Results of risk identification process 20

5.4. Potential priorities for the local government 20

Table 6: Risk Mitigation Strategies 21

6 Recommendations 22

6.1. Opportunities to strengthen natural asset management at an organization-wide level 22

6.2. Possible actions for the further development of the inventory 23

6.3. Steps to a full natural asset management project 23

Annex: Results of the Town of Sackville's risk identification process . . 26

Step 1: Identification of risks 26

Step 2: Complete survey 27

Table 7: Simplified risk identification survey 27

1 Purpose

This document summarizes the results of a project to develop a natural asset inventory for the Town of Sackville, New Brunswick, 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 services[1].

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 assets. Doing so can enable local governments to better 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?

Natural asset inventories provide details on the types of natural assets a local government relies upon[2], 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.

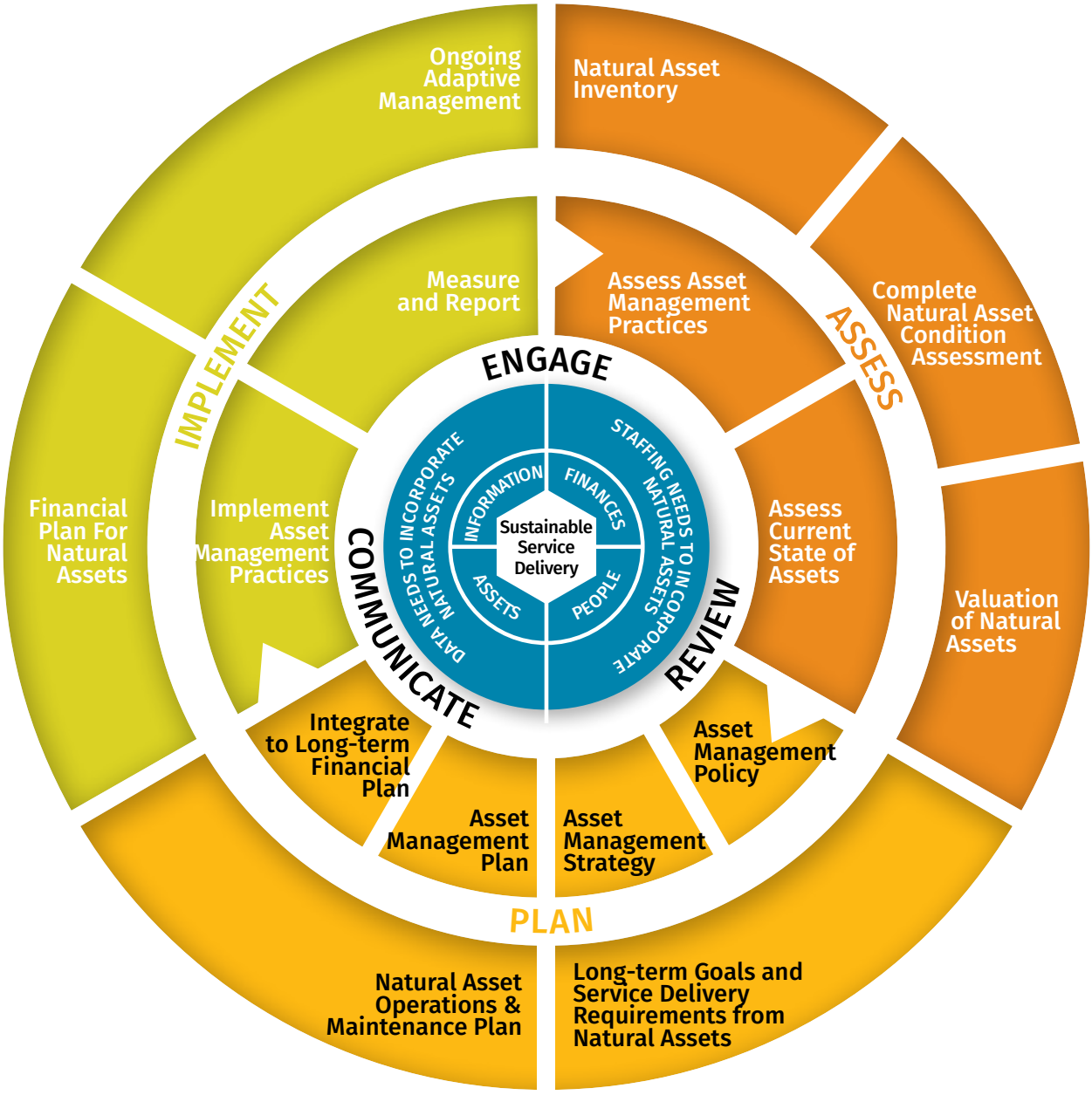

***Figure 1**: The Asset Management Process. MNAI has adapted this for use with natural assets.*

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

3 Local government context

3.1. General

We respectfully acknowledge that the Town of Sackville, and the experiences within it, take place on the unceded traditional lands of the Mi'kmaq Peoples.

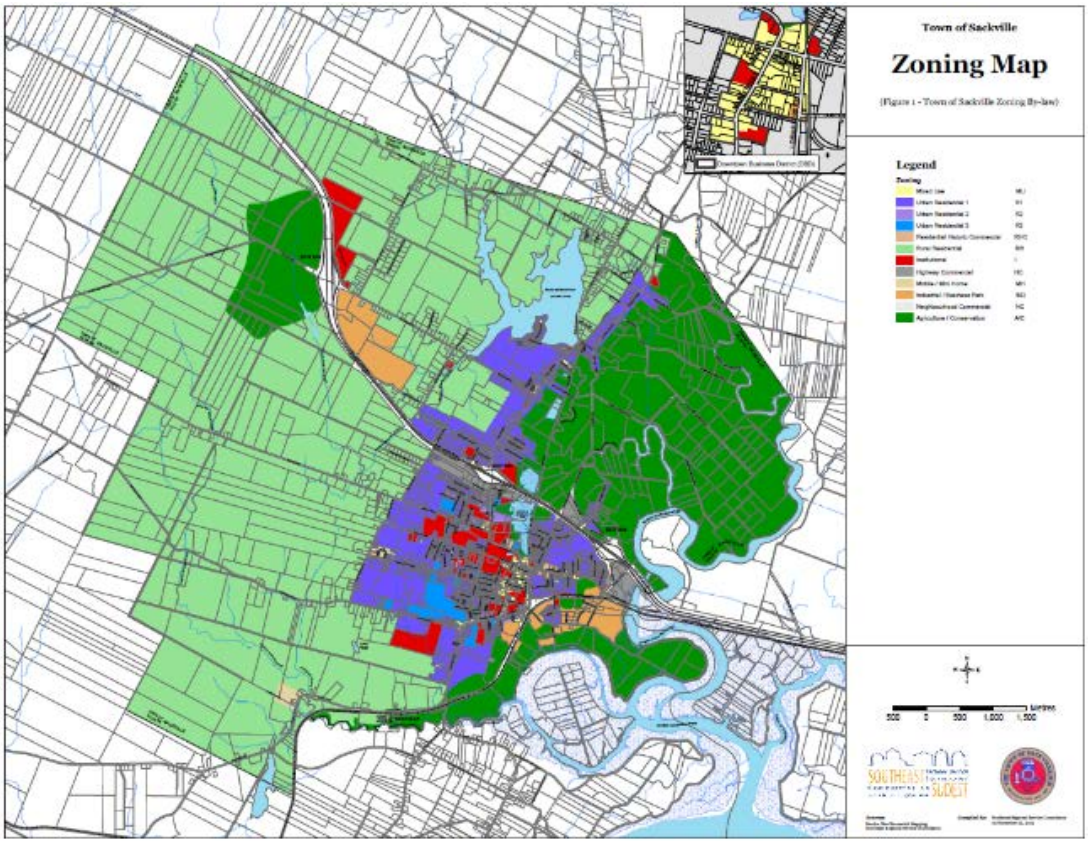

Figure 2: The Town of Sackville[3].

The Town of Sackville (population ~6,099) is in southeastern New Brunswick in the County of Westmorland, about 10 km from the Nova Scotia border and 42 km from Moncton[4].

The Town of Sackville's interest in natural asset management is to better understand the functions of the natural assets upon which they rely, and how the natural assets contribute to the town's operations. This, in turn, will improve decision-making related to budgeting and long-term planning goals, including policies aimed at protecting natural assets.

Priority natural assets are wetlands, urban tree canopy and water systems. The Town of Sackville identifies development and pollution as key risks to its natural assets. Its 100-year-old dyke system is also experiencing breaching; thus, priority natural asset services include stormwater management and flood protection.

3 *Town of Sackville. Municipal Plan-Zoning Map. (January, 2016). Retrieved August 2021 from www.sackville.com/2016/03/new-municipal-plan-zoning-law/*

4 *Statistics Canada 2021 Census*

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 tool[5] 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 readiness assessment helps local governments prioritize actions that increase their effectiveness in managing all assets, including natural ones.

Competency 1: Policy & Governance

Based on the readiness assessment, the Town of Sackville is at a relatively early stage of maturity in all competency areas, including asset management planning. It has made more progress with built/engineered assets than with natural assets.

The Town of Sackville has a draft asset management policy that council has not yet adopted. This draft policy does not explicitly exclude natural assets. Senior management has recognized the role of natural assets in service delivery as part of its commitment to a formal asset management program, and the organization has identified benefits it would like natural assets to deliver in support of organizational objectives.

The Town of Sackville has also begun to develop asset management plans, completed a strategy and road map for asset management that outlines its approach for the next 1 - 3 years, and started collecting baseline data on current asset management practices. It has also identified actions to incorporate natural assets into asset management practices, starting with the completion of this natural assets inventory.

Competency 2: People & Leadership

The Town of Sackville is at an early stage in building its people and leadership competency. It has not formalized an asset management team that meets regularly, and still needs to identify a person formally charged with incorporating natural asset management considerations into the process. It does have an overall asset management champion, its treasurer, who is planning the asset management program.

In terms of resourcing and commitment for asset management, council has received a presentation by the Southeast Regional Service Commission on the importance of the natural asset inventory. Council has demonstrated buy-in and support for asset management generally and has approved funding for the asset management plan. However, neither the Town of Sackville's management nor its council have an understanding yet of what resources may be required for natural asset management.

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

Competency 3: Data & Information

The Town of Sackville has already completed a basic inventory for engineered/built assets and is now strengthening it. Through the current natural assets inventory project, the Town of Sackville is starting to create a meaningful natural assets data set to support decision-making. It is at an early stage of maturity for tracking financial data about assets. It meets PSAB-3150 financial reporting requirements but has not yet captured capital and operating expenditure data for all assets or developed a strategy to link asset management and financial information. It has not yet calculated long-term investment requirements and does not have financial data associated with natural assets, though it does have a street tree inventory.

Competency 4: Planning & Decision-making

The Town of Sackville does not yet have a structured approach to asset investment planning for all departments to use nor does it have a documented approach to managing or protecting natural assets that support municipal service delivery. It does have draft asset management plans for some asset classes, with forecasted financial needs based on estimated data, particularly for critical services. It prepares annual capital and operating budgets based on a mix of historical values and new priorities and has an internal 5-year capital plan that helps inform decision-making.

The Town of Sackville is starting plans related to natural asset management. Natural areas (e.g., wetlands, parks) are managed according to the Town of Sackville's zoning by-law and conform to relevant environmental legislation (e.g., for wetland buffers). Budgets include natural asset management activities when natural assets exist alongside grey infrastructure assets on roads and in parks (e.g., ditching, tree planting).

4 Natural asset inventory

4.1. Inventory overview

MNAI's natural asset inventories have two main components 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 the Town of Sackville 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

To establish the inventory, MNAI obtained data from the Southeast Regional Service Commission (SERSC), the Province of New Brunswick (GeoNB) and the Government of Canada. MNAI combined the spatial data layers to establish a comprehensive depiction of natural assets. Table 1 describes the data sources used to develop the inventory and complete the condition assessment.

TABLE 1: SUMMARY OF DATA SOURCES

DATASET NAME	SOURCE	PURPOSE
SK_AoI	Southeast Regional Service Commission	Used as study area boundary
geonb_municipalareas_ zonesmunicipales	GeoNB	Used to determine which assets reside within Sackville and the relevant surrounding villages
sk_lc_aoi	Southeast Regional Service Commission	Used as the main source for delineating natural assets in the area of interest. Urban low and mid-height vegetation were distinguished from rural vegetation using the zoning data provided by SERSC
NRN_NB_RDSEG	Government of Canada	Roads were buffered and inserted as polygons into the landcover derived from LiDAR dataset. Road lines were also used to perform the road density condition assessment
SK_Wetlands_2021	Southeast Regional Service Commission	Used to capture any wetlands not represented in the LiDAR landcover dataset and to add the wetland class to the asset inventory allowing for breakdown
SK_Waterbodies	Southeast Regional Service Commission	Used to add additional details to waterbodies within the inventory such as waterbody name
SK_Watercourse_ Provincial	Southeast Regional Service Commission	Used to summarize length of watercourses within assets, and assign stream name to assets where the stream runs through
SK_Stream_Network	Southeast Regional Service Commission	Used to summarize length of streams within assets
SK_Forest_Soils	GeoNB	Used to assign drainage and slope classes to assets based on the greatest area of overlap
sk_nh_1m	Southeast Regional Service Commission	Used to assign the mean height of features to assets and can be used as an estimate of mean tree stand height for forest assets
SK_Protected_ Watershed_A to C	GeoNB	Used to determine asset area within protected watersheds and to indicate assets within them

TABLE 1: SUMMARY OF DATA SOURCES

DATASET NAME	SOURCE	PURPOSE
SK_Protected_Wellfield	GeoNB	Used to determine asset area within protected wellfields and to indicate assets within them
tantamar_watershed	Southeast Regional Service Commission	Used to assign watershed indicators to assets and to summarize assets by watershed
SK_Flood_Hazard	Southeast Regional Service Commission	Used to indicate total area of assets within the floodplain zones, and within the 1:20 and 1:100 floodplain zones
SK_Trees	Southeast Regional Service Commission	Used to count number of trees within each asset and to create separate tree inventory for dashboard
SK_Land_Ownership	Southeast Regional Service Commission	Used to measure area of assets owned by Municipality of Sackville
SK_Conservation_Public_Dec_2020	Southeast Regional Service Commission	Used to measure area of assets within public conservation lands
SK_Conservation_Private_April_2021	Southeast Regional Service Commission	Used to measure area of assets within private conservation lands, and area under protection of each private entity
SK_Landuse	Southeast Regional Service Commission	Used to perform adjacent land use condition assessment
Sk_Zoning	Southeast Regional Service Commission	Used to assign the majority zoning class to assets based on greatest area of overlap
TU_Zoning	Southeast Regional Service Commission	Used to assign the majority zoning class to assets based on greatest area of overlap

The inventory project defined a total of 70,898 individual assets covering 12,299 hectares (ha), as noted in Table 2. An asset is defined as a continuous area of the same land cover type. For example, an intact forested area would be defined as one asset, but a forested area that is bisected by a road would constitute two assets. The majority of the asset area in the Town of Sackville is forest, followed by agriculture.

TABLE 2: SUMMARY OF NATURAL ASSETS BY TYPE

NATURAL ASSET TYPE	NUMBER OF ASSETS	TOTAL AREA (HA)	AVERAGE ASSET AREA (HA)
Agriculture	1,110	1,705	**1.54**
Forest	14,281	7,193	**0.50**
Rural Grassland	19,798	1,293	**0.07**
Rural Shrubland	32,128	261	**0.01**
Urban Grassland	3,135	292	**0.09**
Urban Shrubland	54	0.36	**0.01**
Water	119	225	**1.89**
Wetland	273	1,331	**4.87**
Total	**70,898**	**12,299**	**0.17**

** Built-up pervious includes manicured lawns and greenspaces (e.g., sports fields)*

Figure 3 shows the spatial distribution of the natural assets based on the original inventory.

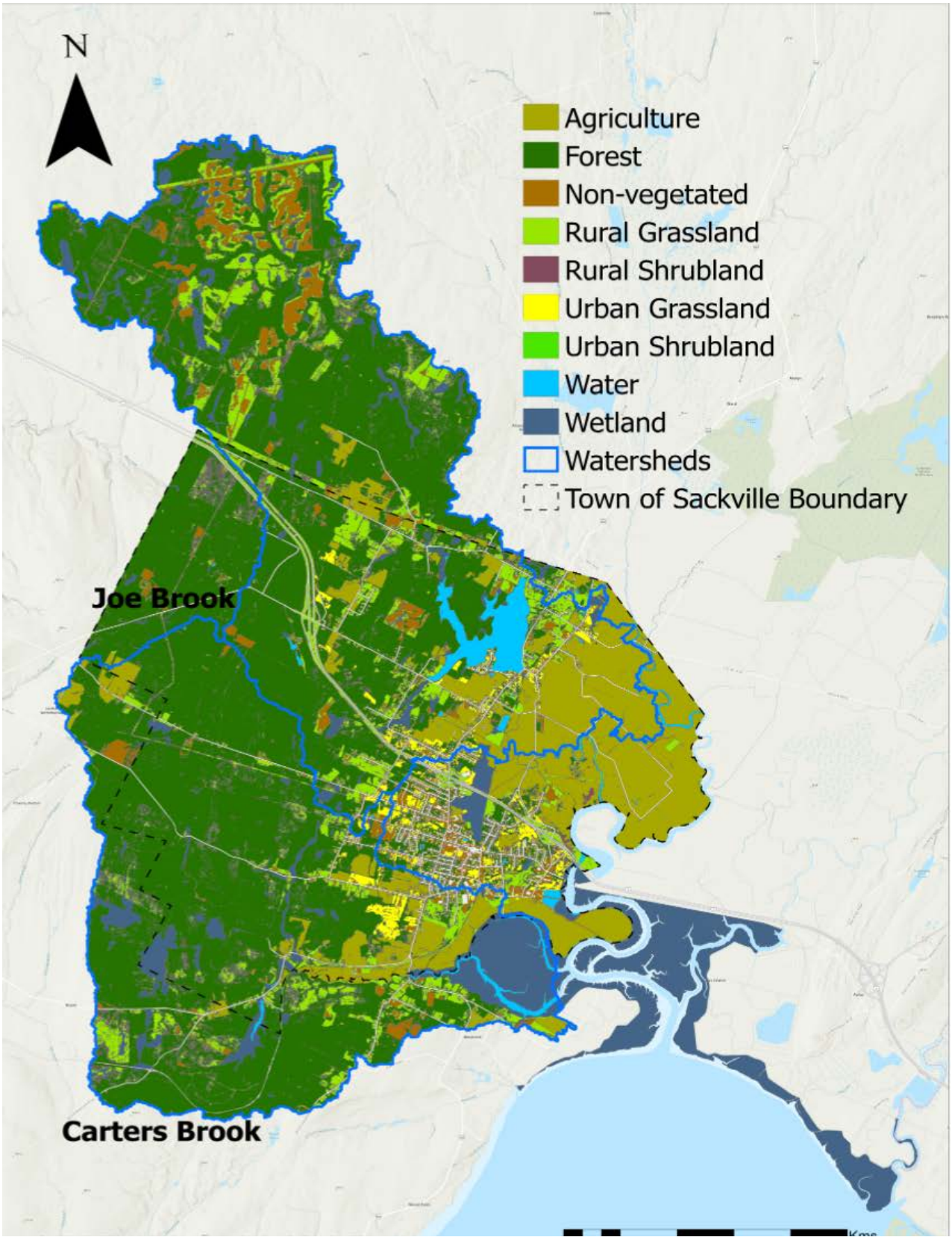

***Figure 3**: Spatial distribution of natural assets.*

4.3. Asset registry

Each asset within the inventory has a unique identification number that allows users to select and analyze individual assets, and manipulate the corresponding data as required. For example, changes in condition can be noted for individual assets. Information on each asset is housed in an asset registry. Table 3 is an excerpt from the Town of Sackville's online registry showing natural asset characteristics and details. Additional detail is provided in the online dashboard.

TABLE 3: EXCERPT FROM THE REGISTRY

Natural Asset Registry

Asset ID	Asset Type	Asset Area (ha)	Sub-Asset ID	Asset Area (ha) in Watershed	Watershed Name	Location	Trail Length (km)	Trail Name(s)	Drainage	Flood Hazard Area (ha)	Mean Height (m)	Watercourse Length (km)	Watercourse Name	Town of Sackville Owned (ha)	Crown Canada Owned (ha)	Crown NB Owned (ha)	Adjacent Land Use Score	Road Density Score	Relative Size Score	Permeability Score	Total Score
FOR37833	Forest	506.83	FOR37833-1	466.78		Sackville	3.68	Yellow Trail, Blue North Trail		19	7.65	3.95	Beau Creek	1.30		13.33	9	5	10	10	34
RUL48593	Rural Grassland	0.00	RUL48593-1	0.00		Sackville	0.00	Yellow Trail		0	0.25						10	10	1	5	26
RUL50372	Rural Grassland	0.00	RUL50372-1	0.00		Sackville	0.00	Yellow Trail		0	0.42						10	10	1	5	26
RUL50469	Rural Grassland	0.01	RUL50469-1	0.01		Sackville	0.00	Yellow Trail		0	1.44						10	10	5	5	30
RUL52597	Rural Grassland	0.01	RUL52597-1	0.01		Sackville	0.00	Yellow Trail		0	0.40						10	10	10	5	35
RUL53351	Rural Grassland	0.05	RUL53351-1	0.05		Sackville	0.00	Yellow Trail		0	0.69						10	10	10	5	35
FOR37685	Forest	2.48	FOR37685-1	2.48		Sackville	0.00	Waterfowl Park		3	7.88			0.00		0.16	5	1	10	10	26
NOV2761	Non-vegetated	0.23	NOV2761-1	0.23		Sackville	0.00	Waterfowl Park		1	0.43					0.05	4	1	1	1	7
RUL50044	Rural Grassland	0.02	RUL50044-1	0.02		Sackville	0.00	Waterfowl Park		0	0.49					0.01	5	1	10	5	21
RUL53663	Rural Grassland	5.51	RUL53663-1	5.51		Sackville	0.14	Waterfowl Park		21	0.20	0.17		3.04		1.50	5	1	10	5	21
RUL56945	Rural Grassland	0.01	RUL56945-1	0.01		Sackville	0.00	Waterfowl Park		0	0.11					0.01	5	1	10	5	21
RUL53562	Rural Grassland	1.96	RUL53562-1	1.96		Sackville	0.00	The Marshes (Sackville to Port Elgin), Sackville Waterfowl Park		2	0.12			0.72		0.01	4	1	10	5	20
FOR34343	Forest	0.00	FOR34343-1	0.00	Joe Brook	Sackville	0.00	The Marshes (Sackville to Port Elgin)	Well/bon	0	4.14			0.00		0.00	3	10	5	10	28
FOR34362	Forest	0.01	FOR34362-1	0.01	Joe Brook	Sackville	0.00	The	Well/bon	0	1.61					0.01	6	10	5	10	31
Total				**12904.46**			**16.33**			**8648**		**156.32**		**317.54**		**212.07**				**420031**	**1849**

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 4 is a screenshot from the dashboard that MNAI provided to the Town of Sackville. The full version can be accessed at *go.greenanalytics.ca/Sackville*.

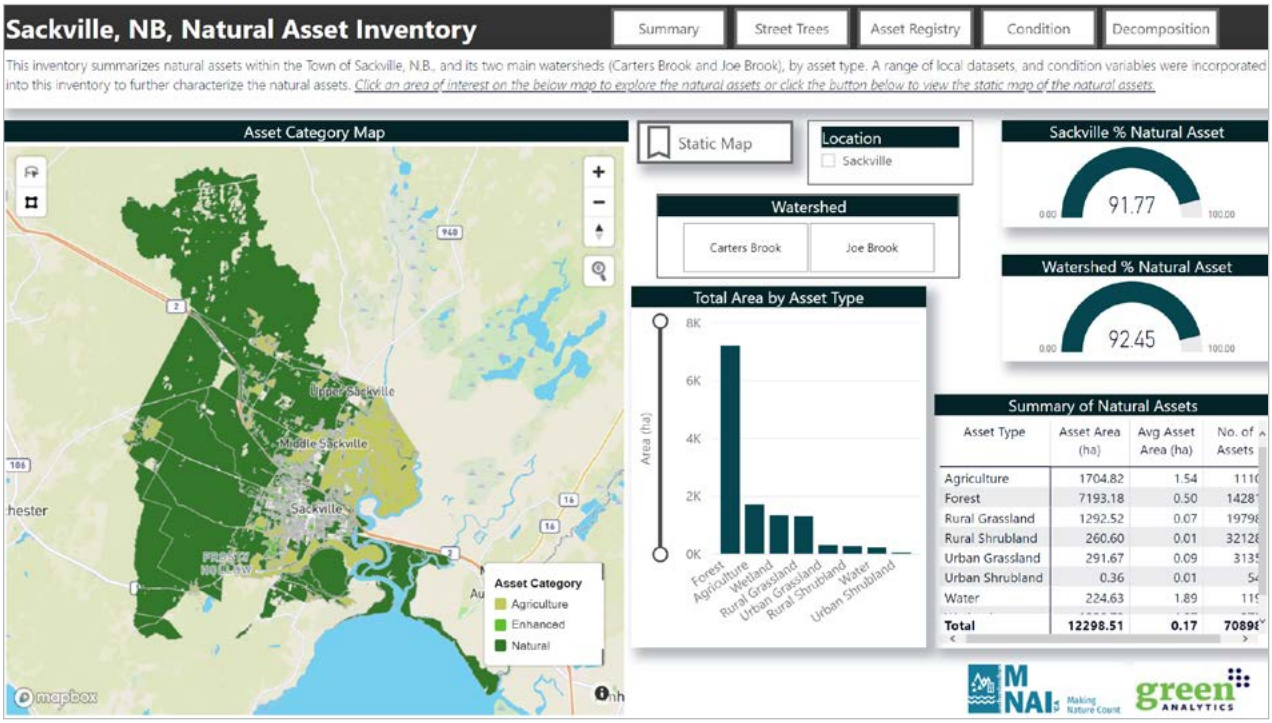

Figure 4: Screenshot of main inventory summary

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-based condition assessment and built it into the inventory to provide an initial understanding of the status of the natural assets for the Town of Sackville. As part of a full natural asset management project, MNAI would expand the assessment to include additional metrics related to condition (e.g., relative biodiversity, riparian and wetland health, soil condition, connectivity, and others). MNAI could also employ site visits to confirm and verify the condition ratings. The desktop exercise completed as part of this inventory is a reasonable first step in assessing condition and can be used as a foundation for future work in this area.

Table 5 summarizes the condition assessment steps and indicators. MNAI chose these indicators for their relative ease of measurement (given time and budget constraints) and for their relevance to measuring the ecological health and service delivery capabilities of natural assets. They are proxy metrics for these broader condition considerations. For example, larger asset size implies more connectivity of natural areas, higher road density implies more fragmentation and higher hydrologic impairment of water flows, and more permeability implies greater ability to store water which means more effective stormwater

management. The adjacent land use metric measures and distinguishes natural assets that are next to other natural assets from natural assets that are next to built infrastructure. How and the extent to which a given natural asset is influenced by the drainage in the adjacent landscape varies depending on factors such as the local topography and soils, orientation (e.g., upland versus lowland, position in the watershed) and the size and nature of the feature itself. However, it is well-established that the condition of a natural asset in an urban context tends to be negatively impacted when more of the surrounding land uses are impervious (i.e., paved, concrete or buildings) because this tends to alter pre-existing drainage and infiltration pathways, which can cause a natural area to receive much more or much less drainage than prior to being in an urban context. Urban run-off also typically carries a host of sediments and contaminants, and when such run-off is directed to natural areas and not properly treated, it can negatively impact the feature and its functions for plants and wildlife.

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 km squared), medium density (assets with between 1km and 2km of roads per km squared) and low density (assets with less than 1km of road per km squared).	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*

TABLE 4: CONDITION ASSESSMENT APPROACH AND INDICATORS		
Indicator	**Description & Methods for Quantification**	**Data used to Quantify Indicator***
Adjacent land use	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. If there are no human land uses within 100 m of the assets, the assets are scored 10. If there are intensive land uses within 100 m of the assets, the score is 0.	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 5 summarizes the natural asset condition assessment results per the online dashboard.

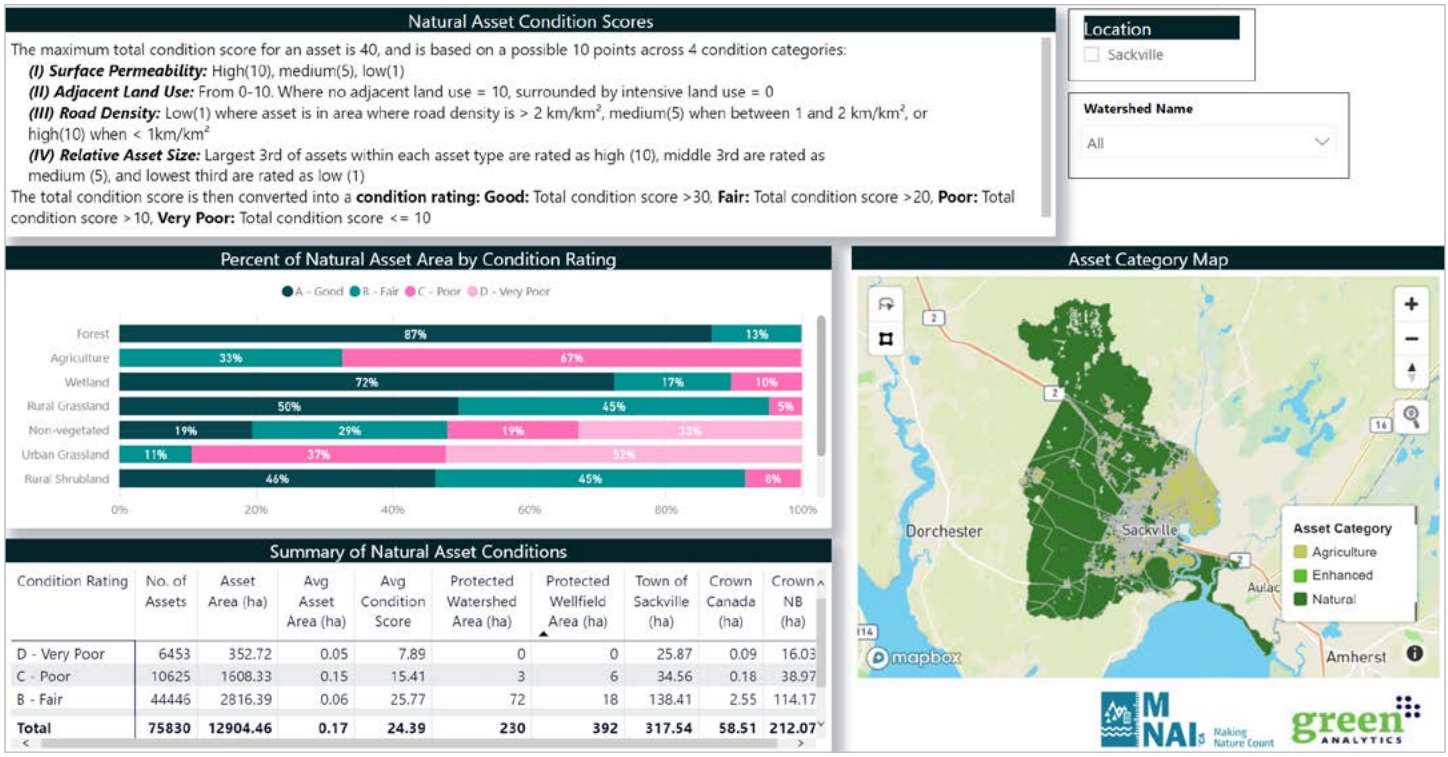

Figure 5: Screenshot of condition assessment details.

Overall, about 8,009 ha (or 65 per cent) of natural assets were assessed in good condition and 2,643 ha (or 21 per cent) were assessed in fair condition. Forests, wetlands, rural grasslands and shrublands, and water largely ranked good and fair, while agriculture, urban grasslands and shrublands largely ranked poor and very poor. This is not a surprising result given that these assets are likely closer to more intensive land uses and road networks.

Table 5 summarizes condition ratings and Figure 6 summarizes condition by natural asset type. Additional insights on the condition results can be obtained through the "Decomposition" tab of the online dashboard.

TABLE 5: SUMMARY OF NATURAL ASSET CONDITION RATINGS

Condition Rating	Number of Assets	Total Area (ha)	Average Condition Score
Good	14,302	8,009	34.23
Fair	44,105	2,643	25.80
Poor	9,546	1,492	15.37
Very Poor	2,945	154	7.79
Total	**70,898**	**12,298**	**25.35**

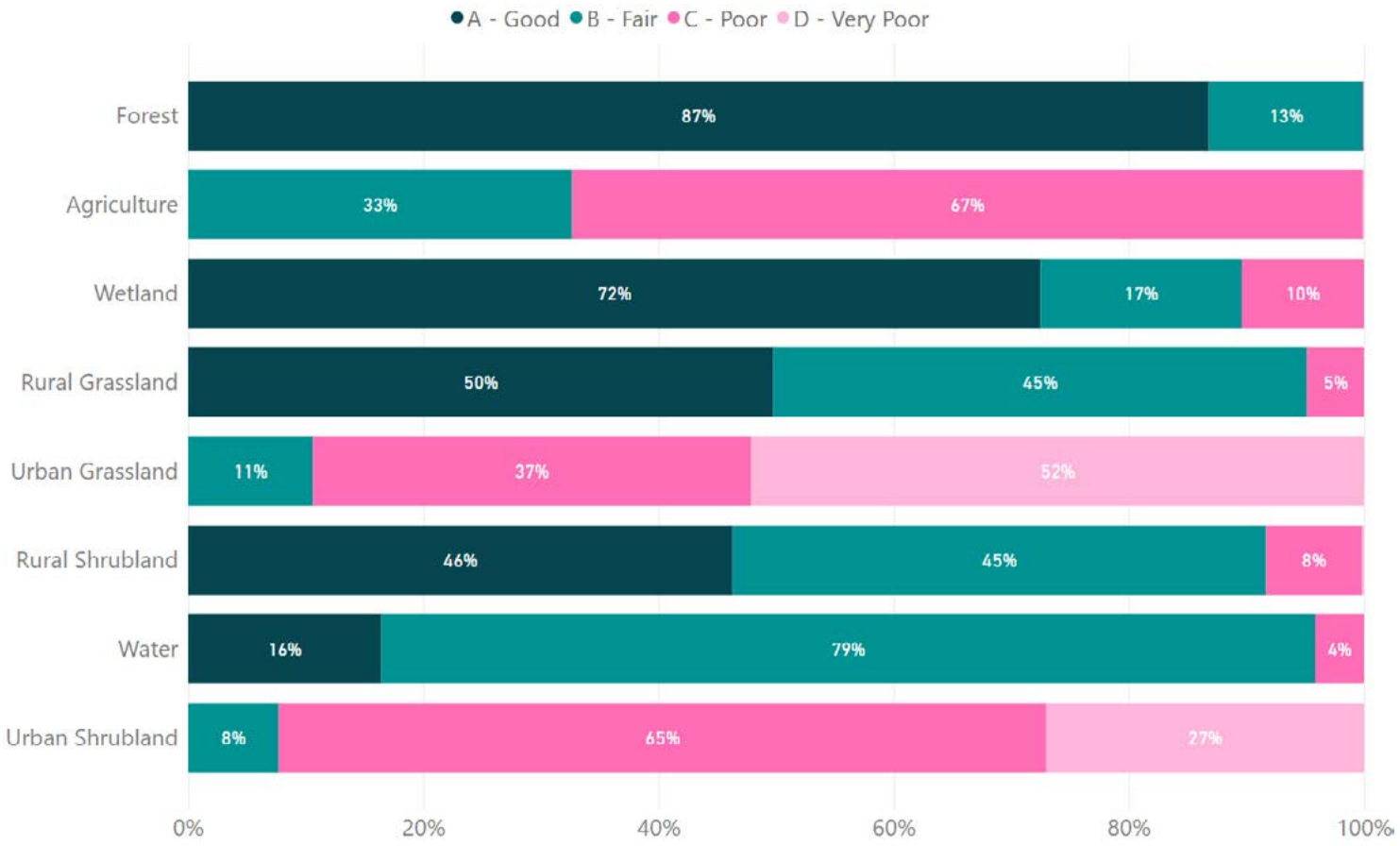

***Figure 6**: Summary of condition rating by natural asset type.*

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. That said, 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 by identifying the top risks to natural assets and their associated services, plus 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 Town of Sackville 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, the Town of Sackville 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
- Overland flooding
- Forest fire
- Invasive species
- Development pressure
- Pollutant loading (agricultural, industrial, etc.)
- Drought
- Erosion
- Storm surge/coastal flooding/sea-level rise
- Lack of monitoring reports
- Dams
- Political policy change
- Local governance reform

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, the Town of Sackville considered four questions:

i/ what impact is likely to happen?

ii/ what is the consequence of that impact happening?

iii/ what can be done to mitigate the probability of impact and/or consequence?

iv/ what cues will signal the need for mitigation?

5.3. Results of the risk identification process

The risk identification process revealed:

- 3 high-level risks (overuse of trails/dumping, overland flooding, and erosion)
- 1 medium-high level risk (development pressure)
- 4 medium-level risks (invasive species, pollutant loading, drought, and storm surge/coastal flooding/sea level rise)
- 5 low-level risks (forest fire, lack of monitoring reports, dams, political policy change, and local governance reform)

In terms of scope, the identified risks affect natural assets across the Town of Sackville with numerous risks potentially affecting forest, water, and wetland assets. The identified risks also have the potential to negatively impact engineered assets (both city-owned and non-city-owned), property, and personal health and safety.

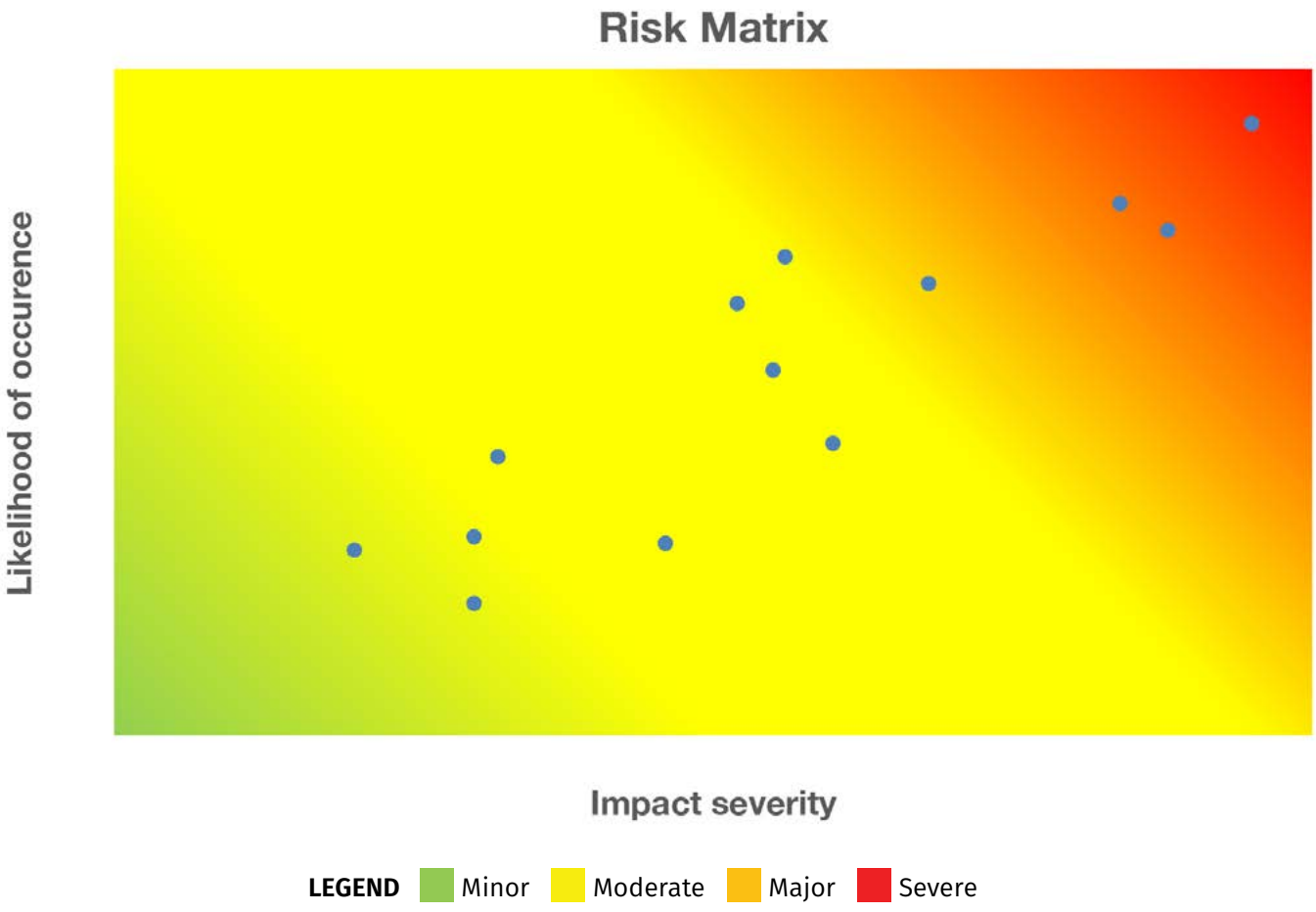

Figure 7: Results of risk identification process.

5.4. Potential priorities for the local government

The outcomes of the risk identification process highlight potential priorities on which the Town of Sackville could focus their natural asset management efforts. Where possible, the condition assessment also informs these risks, which are:

- **Overuse of trails/dumping:** The overuse of trails and dumping is identified as a high-level risk to water, forest, and wetland assets in the Town of Sackville, particularly in Ogden Mill and Joe Brook. Off-trail use can harm understory growth, which can reduce wildlife. Dumping garbage and/or animal feces can contaminate drinking water and require additional treatment, and in extreme cases, create water supply issues. In addition to regular trail maintenance, public education through, for example, the promotion of Leave No Trace principles[6], is vital to preserving natural assets in the vicinity of trails.
- **Overland flooding:** Overland flooding is a high-level risk to urban vegetation, forests, and wetlands, which is exacerbated with projected increases in severe storms. Locations of concern include downtown

6 www.lnt.org/why/#why

Sackville, King and Main Street, Bulmer Pond, and West Sackville. Many streets are already experiencing flooding when retention ponds and stormwater drains are at capacity. The condition assessment reinforces that smaller assets in the vicinity of roads have less-than-optimal performance, suggesting the need to maintain larger upland natural assets while exploring hybrid (e.g., grey-green) options in built-up areas.

- **Erosion:** Erosion is a high-level risk to wetlands and water assets, particularly where the Tantramar River meets the Bay of Fundy at the outlet of the sewage lagoon, and at various locations of dykes. In areas where there are dykes with no salt marsh buffers, erosion is occurring, which can lead to coastal flooding and the sedimentation of surrounding water bodies. It is recommended the Town of Sackville appeal to the Province to realign at-risk sections of existing dykes and restore the natural hydrology and habitat of tidal wetlands, which has proven promising in other Atlantic locations[7].
- **Development pressure:** Development pressure is a medium-high-level risk to forest, water, and wetland assets. Locations of concern include Lorne St., Carters Brook, Joe Brook, and Mountain View, where impacts such as increased sedimentation of water bodies and uncontrolled run-off and flooding from increased impervious surfaces can result. Currently, developers bear limited responsibility for downstream impacts resulting from development. Densification strategies should be paired with the protection of large, connected and intact natural spaces to maximize ecological services and minimize the need for built infrastructure.

Table 6 provides brief descriptions of risk mitigation strategies. These can be addressed in future stages of the MNAI process.

TABLE 6: RISK MITIGATION STRATEGIES

Condition Rating	Number of Assets
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

7 *See for example: www.transcoastaladaptations.com/making-room-for-wetlands#:~:text=Making Room for Wetlands is,they historically would have been.*

6 Recommendations

This section provides insights that can be gained from considering both the inventory - including the condition and risk assessments - and the asset management readiness assessment. It is divided into (6.1) opportunities to strengthen natural asset management at an organization-wide level, (6.2) possible actions for the further development of the inventory, and (6.3) steps the Town of Sackville can consider to advance to a full natural asset management initiative.

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

Because the Town of Sackville is at an early stage of adopting asset management, there are opportunities to make progress on natural asset management as they advance on asset management practices overall.

For example, if the Town of Sackville moves forward with a formal asset management team with formal terms of reference, it can ensure that someone is designated with responsibility for assessing asset management needs related to natural assets.

For strengthening data and information to support asset management planning, the Town of Sackville is including information about condition and performance of assets to its basic inventory data for most major assets. It could consider housing asset data in a central location for the formal asset management team to use and defining levels of service for all its asset classes.

Through this project, the Town of Sackville will gain basic inventory data for its key natural assets, including information about condition and risk. To strengthen decision-making, it may wish to do a full condition and risk assessment for assets where it has identified high priority risks, and analysis of the functional performance of natural assets where appropriate (e.g., stormwater modelling, water quality monitoring).

Once the Town of Sackville has captured capital and operating expenditure data for most assets, it will be better able to identify gaps between forecasted infrastructure needs and current spending levels for both engineered and natural assets.

6.2. Possible actions for the further development of the inventory

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

- Determine acceptable levels of risk to the Town of Sackville's risk mitigation strategies (see Table 6).
- Further develop the condition assessment and risk assessment for wetlands, the urban tree canopy, and water assets (the identified priority assets) 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 stormwater management and flood mitigation perspective, watercourses, wetlands and forested areas in the watersheds will be key.
- Share and discuss the inventory with adjacent local governments to stimulate collaboration within the watershed.
- 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.
- 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

A full natural assessment management project allows local governments to move through all phases of the cycle depicted in Figure 1. This, in turn, helps them understand the capacity of the natural assets they own and/or the ones they rely upon for services, understand changes in services as a result of different interventions (e.g., restoration, acquisition), determine the current services from natural assets, their value, and how these services and values may change with interventions, and develop strategies and actions to protect and manage natural assets for the long-term.

Following is an illustrative list of steps that the Town of Sackville could undertake with MNAI, should it wish to proceed with a full natural asset management project. These steps can be phased, and/or adapted to local context. MNAI is available to discuss specifics in detail:

1/ **Confirm scope, roles and responsibilities**. Undertake a meeting or workshop to confirm (a) assumptions [for example, that water management and development pressure are the primary services of concern] (b) roles, responsibilities, and capacities (c) community 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 allows local governments to explore different scenarios such as "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, local governments can understand and quantify changes in service levels. 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**. MNAI can provide ongoing advice / guidance on policy pieces and integration of the above information for 12-18 months. After that, the local government, together with local partners and service providers, would ideally have the capacity to continue efforts on their own.

7/ **Ongoing monitoring**. It is essential to continue monitoring the project to learn whether interventions are working and to share lessons and learnings from other communities undertaking natural asset management. MNAI would typically stay involved with the community for three years through a monitoring arrangement to be established with the communities.

Sources

Federation of Canadian Municipalities. October 2018. Asset Management Readiness Scale: Municipal Asset Management Program. *fcm.ca/sites/default/files/documents/resources/tool/asset-management-readiness-scale-mamp.pdf*

MNAI. Defining and Scoping Municipal Natural Assets. June 2017. *mnai.ca/media/2019/07/SP_MNAI_Report-1-_June2019-2.pdf*

MNAI. Results from the First National Cohort. Decision-maker summary. 2018. *mnai.ca/media/2019/08/spmnaijuly31-summaryweb.pdf*

MNAI. Cohort 2 National Project Overview. February 2020. *mnai.ca/media/2020/02/MNAI-CohortSummary.pdf*

Annex: Results of the Town of Sackville's risk identification process

This annex contains the results of the Town of Sackville's use of MNAI's risk identification tool, which they self-administered with guidance from MNAI. Table 7 was the main product that personnel developed 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 7: SIMPLIFIED RISK IDENTIFICATION SURVEY

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
1. Overuse of trails/ dumping	H	■ Water ■ Forests ■ Wetlands	■ Ogden Mill ■ Joe Brook	■ Dumping of garbage and animal feces can lead to contamination of drinking water and supply issues. ■ Dumping will require more water treatment. ■ Walking off paths can harm understory growth.
2. Overland flooding	H	■ Urban vegetation ■ Forests ■ Wetlands	■ Downtown Sackville ■ King and Main St. ■ Bulmer Pond ■ West Sackville	■ Overland flooding poses a higher risk than coastal/ storm surge due to predicted increase in severe storms. ■ Many streets already experience flooding when retention pond & stormwater drains are at capacity.
3. Forest fire	L			■ More extreme heat days are trending upward increasing the risk of fires.
4. Invasive species	M	■ Waterfowl park ■ Silver lake ■ Culverts ■ Urban forests	■ Waterfowl park ■ Silver lake ■ Culverts ■ Urban forests	■ Emerald Ash borer kills 99% of ash trees within 10 years after infestation. ■ Japanese knotweed can damage infrastructure due to its extensive root system. ■ European common reed (Phragmites australis) invades wetlands & ditches creating a monoculture and decreases natural flora biodiversity.

TABLE 7: SIMPLIFIED RISK IDENTIFICATION SURVEY

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
5. Development pressure	M/H	■ Lorne St ■ Carters Brook ■ Joe Brook ■ Mt. View ■ Walker Rd	■ Lorne St ■ Carters Brook ■ Joe Brook ■ Mt. View ■ Walker Rd	■ Development may lead to increased sedimentation in water bodies. ■ Uncontrolled run off and flooding from altered ground state and no responsibilities of developers.
6. Pollutant loading from urban, agricultural or industrial sources	M	■ Water ■ Peatland ■ Wetland	■ Tantramar River ■ Silver Lake ■ Memramcook River and surrounding watershed	■ An increase in precipitation leads to more run-off, further harming water quality. ■ Monitoring in Sackville watersheds already show high levels of phosphorus, low dissolved oxygen & E.coli. ■ Increased nutrients allow for harmful algal blooms to flourish.
7. Drought	M	■ Agriculture ■ Forest ■ Vegetation	■ All of Sackville	■ Climate models do not predict longer heat waves or less rain for Sackville, but the area has seen longer periods with little rain. ■ This will impact crop production, water levels, availability and quality.

TABLE 7: SIMPLIFIED RISK IDENTIFICATION SURVEY

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
8. Erosion	H	■ Wetlands ■ Water	■ Tantramar river meets Bay of Fundy ■ Various locations of dykes ■ Outlet of sewage lagoon	■ There are no salt marsh buffers in certain areas where there are dykes, leading to erosion. ■ Erosion of dykes can lead to coastal flooding. ■ Erosion leads to sedimentation in surrounding water bodies.
9. Storm surge / flooding / sea-level rise	M	■ Wetland ■ Peatland ■ Agriculture ■ Water ■ Urban vegetation	■ Waterfowl Park near Trans Canada Highway ■ Silver Lake ■ Most of downtown	■ The overtopping of dykes is likely with a 1:50 storm event, combined with high tides and predicted sea level rise.
10. Lack of monitoring reports	L	■ Water ■ Forests ■ Wetlands ■ Peatlands		■ Water quality monitoring has only started approximately 4 years ago by EOS. ■ Mount Allison University and other local organizations conduct monitoring studies of local natural assets and related ecosystem services.
11. Dams	L	■ Water ■ Wetlands	■ Tantramar River ■ Silver Lake ■ Frosty Hollow	■ Dams impede fish passage and alter reproductive cycles and migration. ■ If dams break or overflow, it leads to erosion of banks and flooding can occur.

TABLE 7: SIMPLIFIED RISK IDENTIFICATION SURVEY

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
12. Political policy change	L	■ All assets		■ Sackville cannot afford to lose more wetlands from development, agriculture or dyking as they provide important ecosystem services such as flood mitigation. ■ Land-use policies must reflect priorities of asset management and protection. ■ Dyke management is provincially regulated and is subject to changes in leadership or priorities, posing a major risk to Sackville.
13. Local governance reform	L	■ All assets		■ Studies and data have been collected for specific geographical areas and proposed municipal boundary changes may affect the feasibility of these studies.

Municipal Natural Assets Initiative