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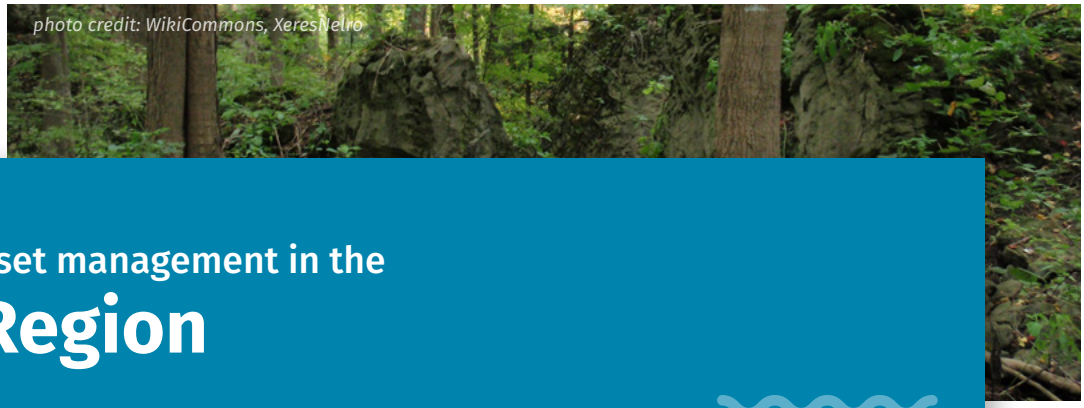
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Toward natural asset management in the

Niagara Region

Ontario

Summary of inventory results and recommendations
December 2021

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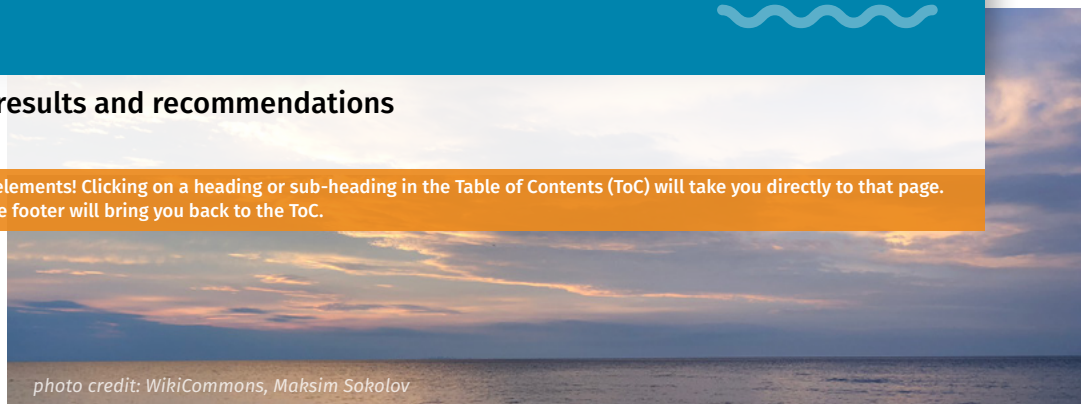
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Municipal Natural Assets Initiative

MNAI.CA
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.

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Please cite as:

Municipal Natural Assets Initiative (MNAI). (2021). Toward natural asset management in Niagara Region, Ontario. Summary of inventory results and recommendations. MNAI.ca

Table of Contents

1 Purpose

This document summarizes the results of a project to develop a natural asset inventory for Niagara Region in Ontario and documents steps the Regional 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.

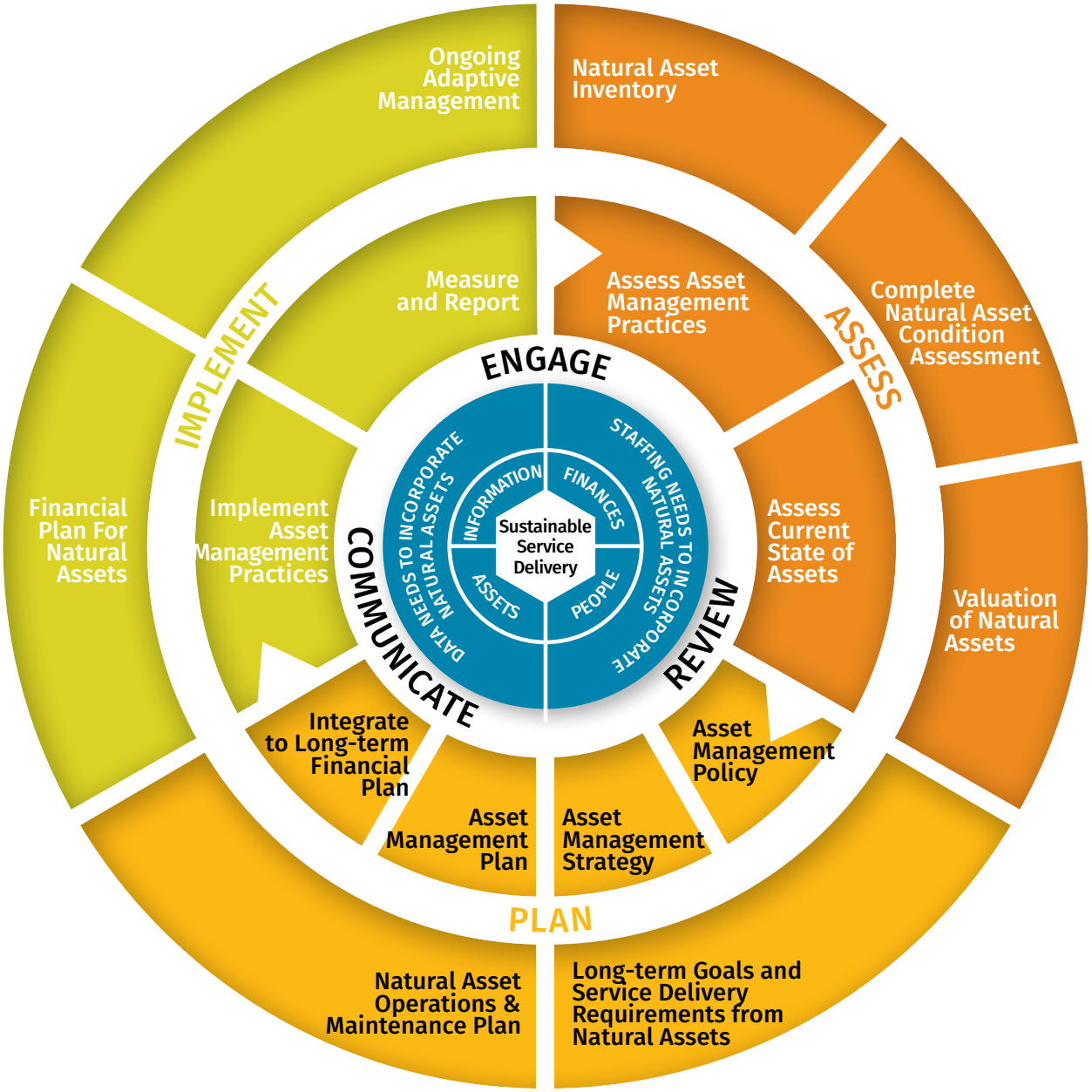


Figure 1: The Asset Management Process. MNAI has adapted this for use with natural assets.

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

3 Local government context

3.1. General

***Figure 2**: Regional Municipality of Niagara*[3].

Niagara Region (population ~448,000) is a regional government that comprises 12 lower-tier municipalities. It is the southern end of the Golden Horseshoe[4] and occupies most of the Niagara Peninsula. Lake Ontario lies to the north and Lake Erie to the south[5,6].

Niagara Region's interest in developing a natural assets inventory is three-fold. First, the inventory will contribute to natural environment-related planning as part of the new Niagara Official Plan[7]. Specifically, through the Natural Environment Work Program[8] for the new Niagara Official Plan, Niagara Region will develop a natural heritage system and a water resource system. This systems-based approach will replace a features-based approach with the goal of identifying and protecting more natural features, which will help guide growth and development in existing urban areas[9].

3 maps.niagararegion.ca/navigator

4 en.wikipedia.org/wiki/Golden_Horseshoe

5 Wikipedia. Retrieved August 2021 en.wikipedia.org/wiki/Regional_Municipality_of_Niagara

6 Greenbelt Plan 2017. Retrieved August 2021 from files.ontario.ca/on-2019/mmah-greenbeltmaps-en-2-schedule-2-niagara-peninsula.pdf

7 New Niagara Official Plan. Retrieved August 2021 from www.niagararegion.ca/living/icp/policy-plan.aspx

8 Natural Environment Work Program - New Niagara Official Plan Update for Local Councils. (Spring 2019). Retrieved August 2021 from www.niagararegion.ca/projects/rural-and-natural-systems/pdf/natural-environment-work-plan-presentation.pdf

9 Niagara Official Plan Consolidated Policy Report. (2021, May 12). www.niagararegion.ca/official-plan/pdf/pds-17-2021-niagara-official-plan-consolidated-policy-report.pdf

Second, the inventory will help Niagara Region to better understand the vital services that natural assets provide, including in fiscal terms, to enable more evidence-based decision-making. Third, Niagara Region has ageing combined sewer systems and experiences flooding along Lake Erie and Lake Ontario. Niagara Region is in the process of preparing a region-wide stormwater management (SWM) guideline that will consider the role of natural assets management.

Niagara Region has identified urban forests, trees, wetlands and groundwater sources as priority assets. Stormwater management, flood protection, provision of drinking water, hydroelectric power, health benefits and agricultural irrigation are amongst its high priority services.

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[10] 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

Niagara Region has a Council-adopted asset management policy that is beginning to guide actions. For example, Niagara Region refers to the policy for guidance when developing asset management plans or asset management improvement projects. The policy does not explicitly refer to the role of natural assets in service delivery. It does mention climate change, but only in the context of preserving of Niagara Region's built infrastructure. Staff may wish to explore whether the policy applies only to tangible capital assets, in which case natural assets would be explicitly missing from the policy.

Niagara Region has a corporate asset management framework that depicts the asset management system in graphic form and is currently in the process of adding a detailed description of the contents to accompany it. Niagara Region also has a five-year asset management roadmap ("the roadmap") that focuses on built infrastructure. Some actions it contains are behind schedule and/or need to be adjusted because of COVID-19 pandemic-related setbacks. Therefore, it is developing a "focused action plan" to update the roadmap.

With respect to measurement and monitoring of progress on asset management, Niagara Region formed an Asset Management Office in 2019. The Asset Management Office developed a corporate model, embedded in the annual budget process, to measure risk and alignment with corporate

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

priorities[11]. It is also measuring progress on the roadmap, based on the state of maturity of Niagara Region's asset management practices.

Competency 2: People & Leadership

Niagara Region is quite advanced in developing asset management competencies in the People and Leadership category. A corporate office of asset management leads a senior corporate asset management steering team (CAMST) that guides asset management. A cross-representative group of staff from most divisions in the organization, known as the asset management working group (AMWG), provides information and consultation. Staff in this group have responsibilities for asset management identified in their job descriptions. Niagara Region is in the preliminary stage of having the AMWG guide and support asset management.

There are currently no roles and responsibilities defined related to natural asset management and no staff person responsible for its integration into asset management.

Council has demonstrated buy-in and support for asset management and has approved funding for priority improvements to the asset management system. It is not yet aware of any resourcing requirements related to natural asset management. An earlier, 2017 draft version of the asset management roadmap included recommendations for the Asset Management Office, asset management software, and annual consulting fees. It included high-level staff resourcing requirements for asset management system development. Council approved the current five-year roadmap in 2019. In the annual budget, Council approved staff resourcing for the Asset Management Office and asset management software. Staff have not made a budget request for improvement projects as, to-date, existing internal resources are conducting the work.

Competency 3: Data & Information

Niagara Region is beginning to strengthen asset information and is on track to having basic inventory data for most major assets, including information on general asset properties such as size, material, location and installation date. It is consolidating asset data in a central location. Niagara Region has some information on asset condition and performance of critical assets and is defining service levels for some asset classes. The robustness of data varies across departments and to-date there is no standard method for data collection; however, it is planning improvements in this area.

Niagara Region meets Public Sector Accounting Board 3150 financial reporting requirements and has captured capital and operating expenditures for some assets. It has not yet linked financial information with asset data for all critical assets.

11 *Known as the Corporate Asset Management Resource Allocation or CAMRA*

With respect to natural asset data, Niagara Region has detailed geographic information system (GIS) mapping of natural features, the results of this inventory, and information about the condition of natural assets through the Niagara Peninsula Conservation Authority Watershed Report Card. Detailed information on specific features is limited, however, and it has not made connections between natural asset data and critical infrastructure or asset management. Niagara Region has not yet started to identify the service levels that natural assets provide, nor has it done valuation work related to the services natural assets provide to the community.

Competency 4: Planning & Decision-making

With the establishment of the corporate Asset Management Office, Niagara Region has developed a consistent approach to asset investment planning used across the Region. Departments may use slightly different approaches, but these are approved at a corporate level through CAMRA. The current approach does not yet build in natural asset management-related considerations. Niagara Region is currently updating forecasted financial needs that were done in 2017. The updated needs forecast will inform development of asset management plans. The forecast does not yet include risk management considerations. There are no formal natural asset management plans, and where commitments have been made to natural assets and their management, they fall outside the scope of the Regional Asset Management Framework.

With respect to financial planning, Niagara Region prepares annual capital and operational budgets that are based on a 10-year capital plan. However, these budgets are not linked to key projects or assets and there is not a strong understanding of the risks associated with funding gaps. Only a portion of budget requests are funded.

Niagara Region is starting to build in expenditures for capital, operating and maintenance costs for some natural assets. Budgeting is ad hoc and often relies on grants and other one-time funding.

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 Niagara Region 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 Niagara Region, the Ontario GeoHub, the Niagara Peninsula Conservation Authority, and Ontario Open Data. 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	DESCRIPTIVE NAME	SOURCE	PURPOSE
Boundary_Niagara	Niagara Region Boundary	Niagara Region	Used to delineate study area for Niagara Region
ELC_FINAL_2020	Niagara Region Updated ELC	Niagara Region	The series description was used as the main landcover source for identifying natural areas
Vineyards_Orchards_ ELC_Niagara_DRAFT	Draft Agricultural ELC	Niagara Region	Used to fill in landcover where main ELC not present and to detail agricultural sub-classes in the inventory dashboard
OLCC_V2	Ontario Landcover Compilation	Ontario GeoHub	Used to fill in landcover where ELC not present (agricultural land, community infrastructure, extraction sites, etc.)
Built_up_Area	Built-up Area	Ontario GeoHub	Used to fill in landcover where ELC not present (impervious and pervious areas)
10K Waterbodies 30K 300K	Waterbodies	Niagara Peninsula Conservation Authority (NPCA)	Used to capture open water not represented in the ELC or the Ontario Landcover Compilation
Municipal_Boundaries	Municipal Boundaries	Niagara Region	Used to summarize assets by municipality
Urban_Area_ Boundaries	Urban Area Boundaries	Niagara Region	Used to assign natural asset a relevant settlement area name

TABLE 1: SUMMARY OF DATA SOURCES			
DATASET NAME	**DESCRIPTIVE NAME**	**SOURCE**	**PURPOSE**
Niagara_Region_ Quaternary_ Watersheds	Watersheds	Niagara Region	Used to split natural assets by watersheds and map/summarize natural assets by watershed in inventory dashboard
Road_Segments	Road Network	Niagara Region	Used to summarize length of roads within a 100m boundary of the assets and perform road condition assessment
Agricultural_ LandBase_OMAFRA	*Agricultural Land Base*	Niagara Region	Used to assign agricultural land policy designations to natural assets by assigning the code from the agricultural land base polygon with the greatest area of overlap to the natural asset
Niagara_Trails	Niagara Trails	Niagara Region	Used to summarize length of regional trails within natural assets and to assign relevant trail names to those assets
Conservation_Areas	*Conservation Areas*	Niagara Peninsula Conservation Authority	Used to summarize natural asset area overlap with location of conservation areas and assign conservation area name by greatest overlap with the relevant natural asset
Contemporary_ Mapping_of_ Watercourses	Watercourses	Niagara Region	Used to summarize length of streams/ creeks within natural assets and total watercourse length within natural assets
Surface_Water_ Intakes_Protect	*Surface Water Intake Protection Zone SWP AR*	Niagara Peninsula Conservation Authority	Used to summarize area of natural assets overlapping with intake protection zones
Groundwater_ Protection_Quantity_ SGRA	Groundwater Protection Quantity SGRAs	Niagara Peninsula Conservation Authority	Used to summarize area of natural assets overlapping with SGRAs
NiagaraSoils	Niagara Soils	Niagara Region	Used to assign drainage, CLI, and soil name to natural assets based on greatest area of overlap with the relevant soil polygon and natural asset
Park	Niagara Parks	Niagara Region	Used to assign a count of parks within natural assets
ROP_Hamlets	Hamlets	Niagara Region	Used to assign name of relevant hamlet to natural assets
Steve_Bauer_Trail	Steve Bauer Trail	Niagara Region	Used to assign length of trail within natural assets and indicate which natural assets intersect with this trail

TABLE 1: SUMMARY OF DATA SOURCES			
DATASET NAME	**DESCRIPTIVE NAME**	**SOURCE**	**PURPOSE**
Regulated_ Floodplain_Extent	Regulated Floodplain Extent	Niagara Peninsula Conservation Authority	Used to indicate natural assets within the floodplain and summarize area of natural assets overlapping with the floodplain
Natural_Heritage_ System_Area	Natural Heritage System	Ontario Open Data	Used to indicate natural assets within the NHS boundaries and summarize area of natural assets overlapping with NHS
Niagara_Escarpment_ Plan_Designation	Niagara Escarpment Plan	Niagara Region	Used to indicate natural assets within the Niagara Escarpment boundaries, and assign relevant Niagara Escarpment designation based on designation with greatest area of overlap with the natural asset
Areas_of_Natural_ And_Scientific_ Interest_(ANSI)	ANSI	Ontario Open Data	Used to indicate natural assets that overlap with ANSI boundaries, summarize area of natural assets overlapping with ANSI area, and assign relevant ANSI name based on greatest area of overlap with the natural asset
Hydrometric_Stations	Hydrometric Stations	Niagara Peninsula Conservation Authority	Used to add hydrometric station names and IDs to natural assets
HighlyVulnerable Aquifers	Vulnerable Aquifers	Niagara Region	Used to indicate natural assets within vulnerable aquifers and summarize area of natural assets overlapping with these aquifers
Potential_Resource_ Area_Stone	Potential Resource Area - Stone	Niagara Region	Used to assign policy area designation to natural assets based on greatest area of overlap between natural assets and this dataset
Permits_to_Take_ Water	Location of Permits to Take Water	Ontario Open Data	Used to assign count of permit locations to natural assets
trees	St. Catharines Street Trees	Niagara Open Data	Used to create separate tab in dashboard that summarizes street trees in Welland, Niagara Falls, and St. Catharines
trees_inventory_ public	Niagara Falls Street Trees	Niagara Open Data	Used to create separate tab in dashboard that summarizes street trees in Welland, Niagara Falls, and St. Catharines
Welland_Trees	Welland Street Trees	Niagara Open Data	Used to create separate tab in dashboard that summarizes street trees in Welland, Niagara Falls, and St. Catharines

The inventory project defined a total of 54,873 individual assets, covering 158,406 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 Niagara Region was agriculture, followed by swamp and deciduous forest.

TABLE 2: SUMMARY OF NATURAL ASSETS BY TYPE

NATURAL ASSET TYPE	NUMBER OF ASSETS	TOTAL AREA (HA)	AVERAGE ASSET AREA (HA)
Agriculture and Undifferentiated Rural Land Use	24,519	99,989	**4.08**
Built-up Pervious*	1,929	4,925	**2.55**
Cliff/Bluff/Talus	104	100	**0.96**
Coniferous Forest	749	532	**0.71**
Deciduous Forest	7,205	10,743	**1.49**
Forest (other)	808	691	**0.85**
Meadow/ Successional	6,903	7,792	**1.13**
Mixed Forest	819	1,176	**1.44**
Open Aquatic	1,412	3,005	**2.04**
Open Shoreline	166	153	**0.92**
Rock Barren	17	16	**0.96**
Sand Barren and Dune	14	3	**0.23**
Shrub/Scrub	23	14	**0.63**
Swamp	6,604	25,574	**3.87**
Wetland	3,601	3,693	**1.03**
Total	**54,873**	**158,406**	**2.88**

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

Figure 3 shows the spatial distribution of the natural assets.

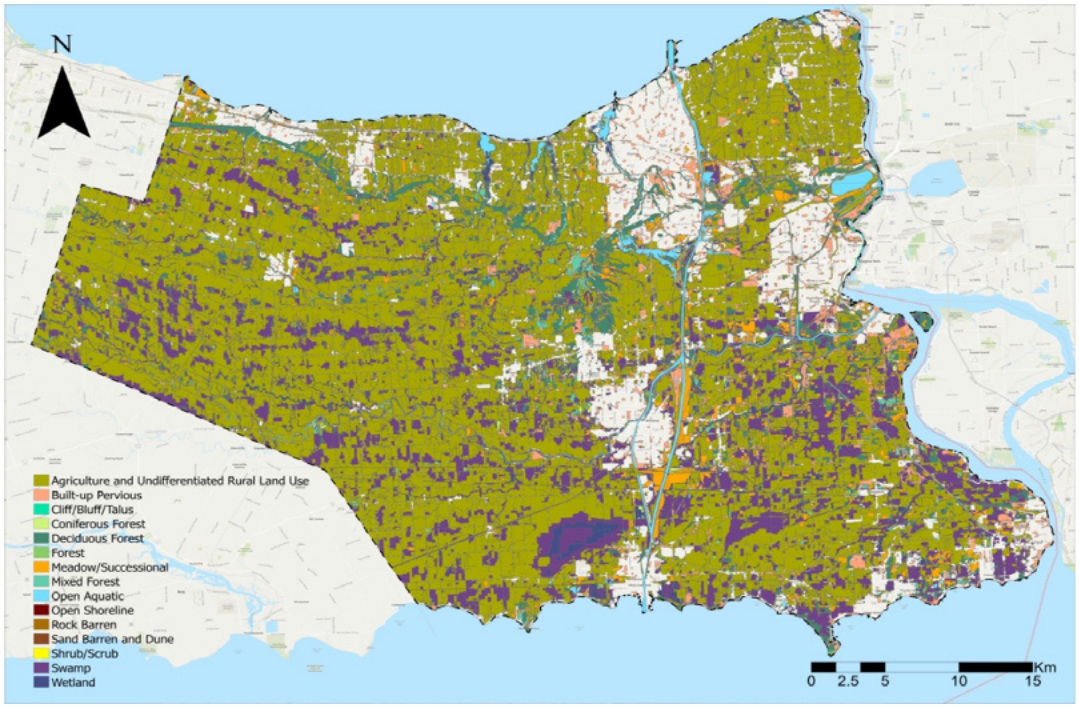


***Figure 3**: Spatial distribution of natural assets.*

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 Niagara Region'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	Sub-Asset ID	Asset Area (ha)	Asset Area (ha) in Watershed	Watershed	Municipality	ANSI Name	Interior Forest Area (ha)	Stream /Creek (km)	Conservation Authorty Trails (km)	Regional Trail Length (km)	Adjacent Land Use Score	Permeability Score	Relative Size Score	Road Density Score	Total Score
AGR1000	Agriculture and Undifferentiated Rural Land Use	AGR1000-1	0.02	0.02	Niagara River South	Fort Erie		0		0.00	0.00	6	5	1	1	13
AGR10000	Agriculture and Undifferentiated Rural Land Use	AGR10000-1	0.01	0.01	Welland Canal North	Thorold		0		0.00	0.00	9	5	1	1	16
AGR10001	Agriculture and Undifferentiated Rural Land Use	AGR10001-1	0.36	0.36	Welland Canal North	Niagara Falls		0		0.00	0.00	6	5	1	1	13
AGR10002	Agriculture and Undifferentiated Rural Land Use	AGR10002-1	0.11	0.11	Twelve Mile Creek	St. Catharines		0		0.00	0.00	6	5	1	1	13
AGR10003	Agriculture and Undifferentiated Rural Land Use	AGR10003-1	0.01	0.01	Welland Canal North	Thorold		0		0.00	0.00	9	5	1	10	25
AGR10004	Agriculture and Undifferentiated Rural Land Use	AGR10004-1	0.07	0.07	Fifteen and Sixteen Mile Creeks	Lincoln		0		0.00	0.00	6	5	1	1	13
AGR10005	Agriculture and Undifferentiated Rural Land Use	AGR10005-1	31.99	0.00	Jordan Harbour - Twenty Mile Creek	Lincoln		0		0.00	0.00	6	5	1	1	13
AGR10005	Agriculture and Undifferentiated Rural Land Use	AGR10005-2	31.99	31.99	Jordan Harbour - Twenty Mile Creek	Lincoln		0		0.00	0.00	7	5	5	1	18
AGR10006	Agriculture and Undifferentiated Rural Land Use	AGR10006-1	43.42	43.42	Fifteen and Sixteen Mile Creeks	Lincoln		0	0.51	0.00	0.00	6	5	5	1	17

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 Niagara Region. The full version can be accessed at *go.greenanalytics.ca/Niagara*.

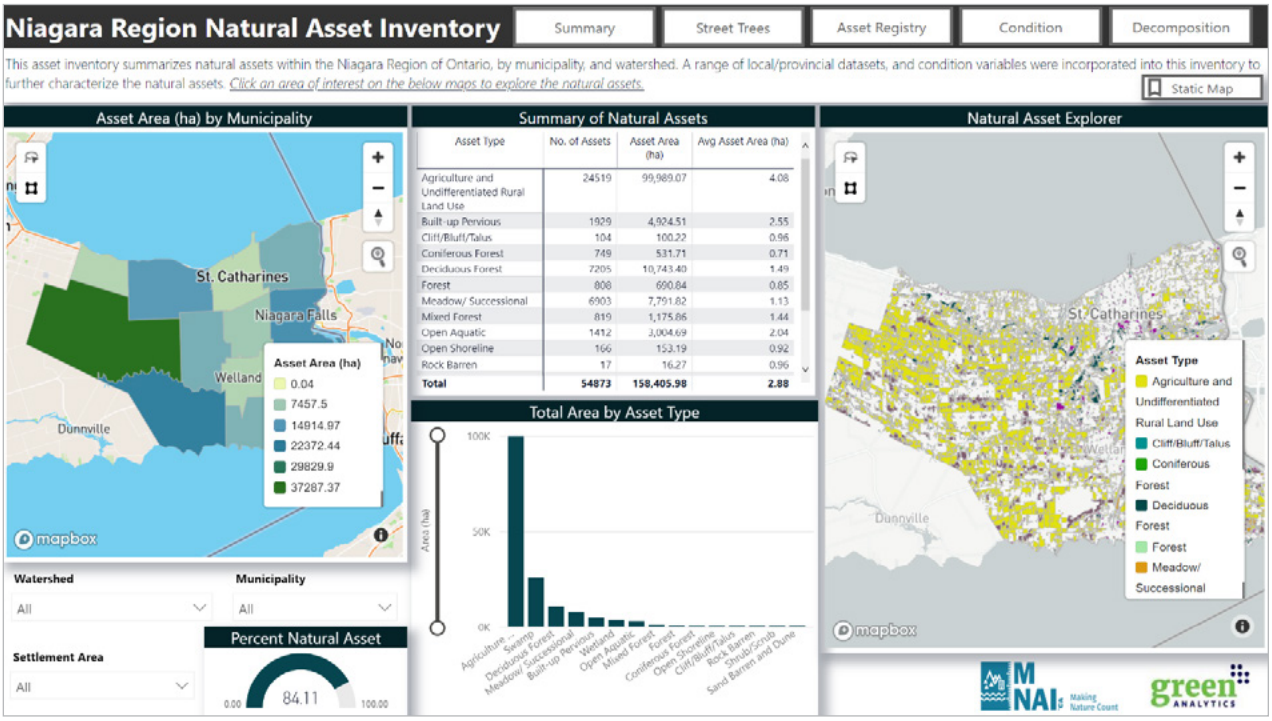


Figure 4: Screenshot of main inventory summary.

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 Niagara Region. As part of a full natural asset management project, MNAI would expand this assessment to include additional metrics related to condition (e.g., relative biodiversity, riparian and wetland health, soil condition, connectivity, and others) and possibly 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 runoff also typically carries a host of sediments and contaminants, and when such runoff 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

TABLE 4: CONDITION ASSESSMENT APPROACH AND INDICATORS		
Indicator	**Description & Methods for Quantification**	**Data used to Quantify Indicator***
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	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

** Data sources provided in Table 1 unless noted here.*

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.

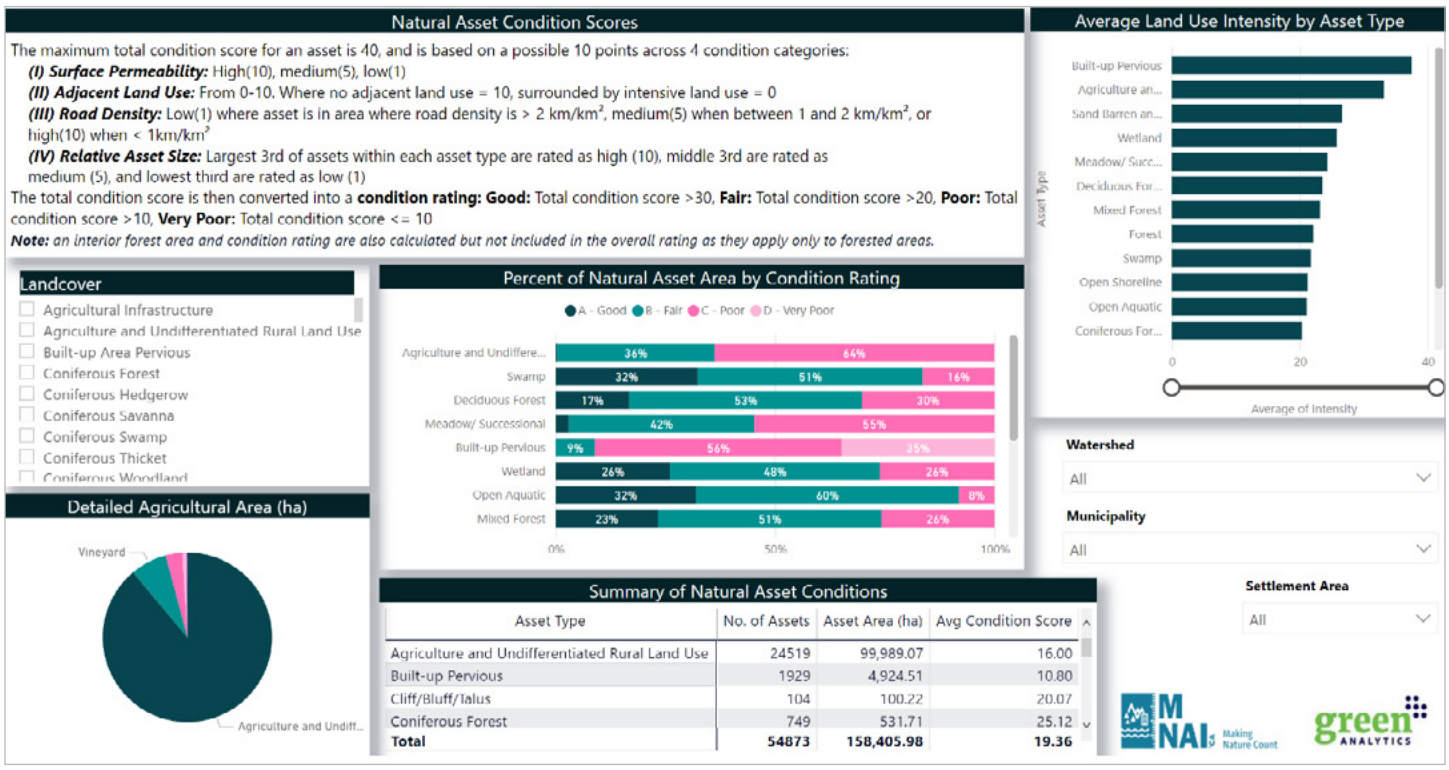


Figure 5: Screenshot of condition assessment details.

Overall, about 13,243 ha (or 8 per cent) of natural assets were assessed in good condition and 63,305 ha (or 40 per cent) were assessed in fair condition. Forest assets largely ranked good and fair while built-up pervious and open shoreline largely ranked poor.

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	1,842	13,243	31.67
Fair	19,611	63,305	25.56
Poor	32,065	80,108	15.31
Very Poor	1,355	1,751	8.43
Total	**54,873**	**158,406**	**19.63**

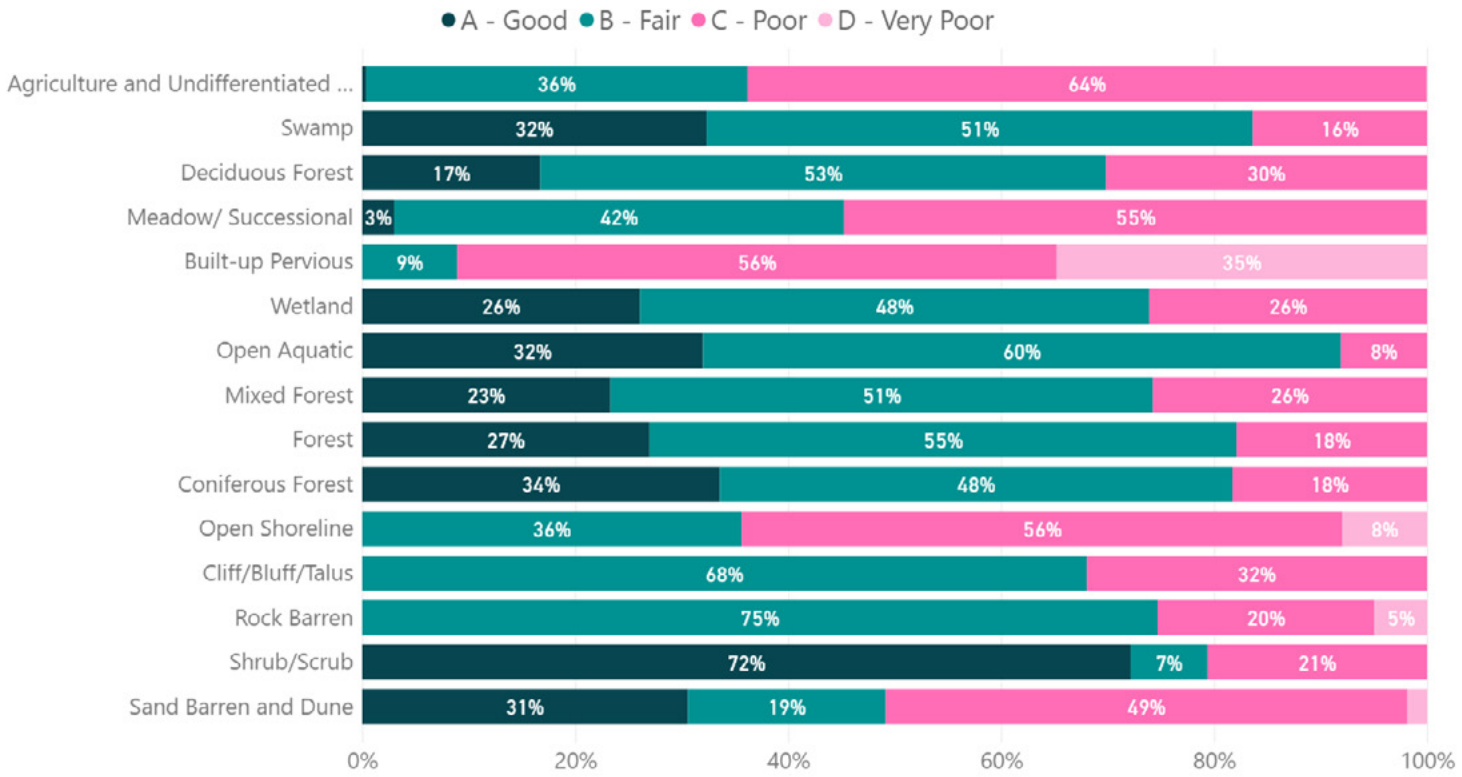


***Figure 6**: Summary of condition rating by natural asset type.*

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

- Invasive species
- Low/lack of biodiversity
- Climate change
- High use/overuse of trails, parklands, and Conservation Authority areas
- Soil degradation
- Inland flooding
- Population increase / development pressure and patterns / waste disposal
- Impacts from stormwater management
- Pollutant loading
- Erosion and sedimentation

- Storm surge, flooding, and erosion along shoreline
- Algae in Lake Erie
- Governance

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, Niagara Region 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?

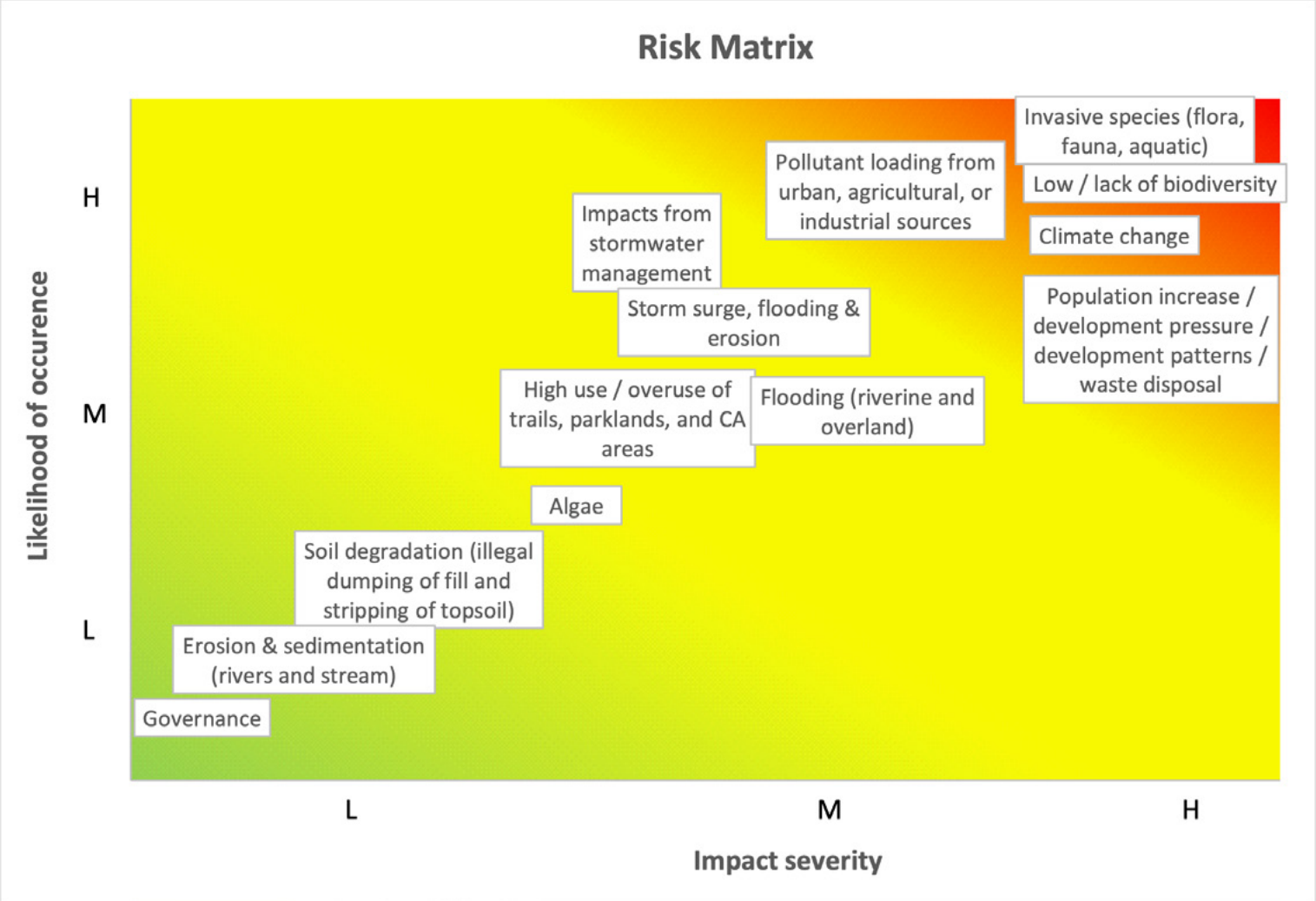
iv/ what cues will signal the need for mitigation?

5.3. Results of the risk identification process

The risk identification process revealed:

- 5 high-level risks (invasive species, low/lack of biodiversity, climate change, population increase / development pressure and patterns / waste disposal, and pollutant loading)
- 4 medium-level risks (high use/overuse of trails, parklands, and Conservation Authority areas; inland flooding; impacts from stormwater management; and storm surge, flooding and erosion along shoreline)
- 1 low-medium level risk (algae)
- 3 low-level risks (soil degradation, erosion and sedimentation, and governance)

In terms of scope, the identified risks affect natural assets across Niagara Region, with numerous risks potentially affecting watercourses, urban areas, and agricultural lands. The identified risks also have the potential to negatively impact engineered assets, property, and personal health and safety.



LEGEND Minor Moderate Major Severe

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 Niagara Region could focus their natural asset management efforts. Where possible, these are also informed by the condition assessment. These are:

- **Invasive species:** Invasive species are identified as a high-level risk affecting woodlands, wetlands, watercourses, and agricultural lands across Niagara Region. A range of invasive species are present, including emerald ash borer, phragmites, gypsy moth, and European buckthorn. Additional invasive species are considered an imminent and future risk, such as Asian carp. Invasive species can reduce resiliency, increase climate-related risks, negatively impact biodiversity, lower property values, and increase municipal costs to maintain, control and eradicate target species. Invasive species risks increase under climate change. Some species could be managed through a comprehensive management strategy that would require collaboration with a range of stakeholders.

- **Low/lack of biodiversity:** Low biodiversity is a high-level, imminent risk to natural assets across Niagara Region, contributing to low resilience of natural features and associated services. For instance, low biodiversity of pollinating species within agricultural assets can impact the service of food production and increase susceptibility to invasive species and climate change impacts. Strategies to reverse this trend should address direct drivers such as land-use change, pollution, climate change, natural resource use and exploitation, and invasive species. This will require collaboration across levels of government, business, and society.
- **Climate change:** Niagara Region has declared a Climate Emergency and ranks climate change as an imminent, high-level risk to natural and agricultural assets across the region. Niagara Region recognizes that addressing this risk will require both mitigation and adaptation activities. Maintaining, restoring and managing natural assets is a key strategy that mitigates climate change through the sequestration and long-term storage of greenhouse gases. Natural assets also play a role in adaptation by reducing the severity of impacts to society, through services such as flood attenuation and mitigating urban heat island.
- **Population increase / development pressure and patterns / waste disposal:** Niagara Region identified the related risks of population increase, development pressure and patterns, and waste disposal as a high-level risk to natural assets, including agricultural areas, across the region. Highest impacts are anticipated in urban areas and the urban fringe, which corresponds with poor rankings on the condition categories of road density and adjacent land use. Natural environment-related planning, such as the new Niagara Official Plan, should seek to balance the protection of the natural heritage and water resource systems with competing needs. This will be an on-going and adaptive process to ensure the right balance is achieved and maintained.
- **Pollutant loading:** Pollutant loading is identified as a high-level risk to watercourses, riparian areas, and receiving water bodies across Niagara Region. The Niagara Peninsula Conservation Authority has identified this issue for several years in their Watershed Report cards. Medium and major watercourses, as well as watercourses connected to stormwater management systems, are at heightened risk. In broad terms, MNAI recommends that Niagara Region seeks out priority pollution reduction opportunities, protect natural assets such as wetlands and riparian buffers that help control run-off, and begin ecological restoration and retrofit activities to clean up degraded water bodies.

Table 6 lists and provides brief descriptions of risk mitigation strategies. Future stages of the MNAI process can address these.

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

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 Niagara Region can consider to advance to a full natural asset management initiative.

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

Niagara Region could consider explicitly including natural assets and their role in delivering services to the community in its asset management policy. This would help ensure it treats natural assets with the same importance as other infrastructure. Related to this, Niagara Region could include natural asset management considerations in its structured approach to asset investment planning. This would ensure it incorporates the protection and management of natural assets into its budgets and financial plans.

While staff have indicated that the current roadmap is focused on built infrastructure, Niagara Region could consider including one or more priority objectives in the 'focused action plan' (noted above) based on the results of this inventory.

Niagara Region also has an opportunity to set asset management objectives for understanding the services that natural assets provide and ensure that risks to natural assets and related services are understood. This will enable it to develop levels of service for natural assets and build a corresponding case for policies, partnerships, monitoring and maintenance routines to protect and sustain those services.

While Niagara Region has formalized a cross-functional asset management team with accountability and clear roles and responsibilities, those roles and responsibilities do not yet include natural asset management. Niagara Region could include a staff member with responsibilities for environmental protection or management of natural assets on the asset management team to ensure natural asset considerations are integrated in all relevant services areas.

Finally, to increase buy-in and support for natural asset management, Niagara Region should share the results of this project with Council together with updates on progress made on natural asset management.

6.2. Possible actions for the further development of the inventory

Based on the inventory, Niagara Region 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 process to include field verification of results.
- Expand the risk identification to consider future, inter-related risks associated with climate change impacts.
- Determine acceptable levels of risk to Niagara Region's risk mitigation strategies (see Table 6).
- 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 regional stormwater management perspective, watercourses, wetlands and forested areas in the watersheds will be key.
- Share the inventory with adjacent local governments to stimulate collaboration within the watershed.
- 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 Niagara Region wishes to proceed with a full natural asset management project, including implementation, it will need to consider the following steps:

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, 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**. 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.

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Annex: Results of Niagara Region's risk identification process

This Annex contains the results of Niagara Region'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
Invasive species (flora, fauna, aquatic)	H	e.g., emerald ash borer (woodlands), phragmities wetlands, watercourses, agricultural infrastructure, Asian carp (potential – water courses), gypsy moth (woodlands), European buckthorn (woodlands), dog strangling vine (woodlands)	Region-wide	Range of invasive species, both imminent and future risk, potential for management of some through comprehensive management strategy that would require a range of stakeholders to implement. Risk of invasive species being introduced to the Region increase with the impacts of climate change.
Low / lack of biodiversity	H	All natural assets + agricultural assets and food production	Region-wide	Imminent risk that leads to low resilience of natural features. Low biodiversity makes natural features more susceptible to other risks including invasive species and climate change.
Climate change (temperature change, wind, ice storms, freezing rain, drought, change in precipitation patterns)	H	All natural assets + agricultural assets	Region-wide	Niagara Region has declared a climate change emergency. Imminent and future risk. Both mitigation and adaptation will be required.
High use / overuse of trails, parklands, and CA areas - low parkland to resident ratio	M	Woodlands, some wetlands, areas of natural and scientific interest. Parklands, conservation areas. Shoreline and other natural areas close to the great lake shorelines (i.e., swimming and beach areas)	Region-wide, especially public lands that are in or are in close proximity to urban areas. Niagara Escarpment Plan areas. Along great lakes shorelines.	Niagara has one of the lowest parkland-to-resident ratios in the Greater Golden Horseshoe. Increased impacts and risk have been seen associated with COVID-19 pandemic.

TABLE 7: SIMPLIFIED RISK IDENTIFICATION SURVEY

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
Soil degradation (illegal dumping of fill and stripping of topsoil)	L	Primarily agricultural areas and natural areas directly adjacent to agricultural areas	Region-wide – higher instances of illegal dumping above the escarpment.	The is a manageable risk that can be addressed through site alternation by-laws and other tools that are available to municipalities
Flooding (riverine and overland)	M	Watercourse, riparian lands, natural areas and agricultural areas adjacent to water courses	Region-wide.	Riverine flooding is a natural process, higher risk is associated with overland flooding which is often associated with development and other changes in land use.
Population increase / development pressure / development patterns / waste disposal	H	All natural assets + agricultural areas	Region-wide – with highest impact in urban areas and the urban fringe.	Niagara Region is expected to grow by 160,000 people by the year 2041.
Impacts from stormwater management (increase in permeability, quantity, temperature, sediment, lack of green infrastructure)	M	Watercourse, riparian and adjacent lands (erosion), ultimate receiving water bodies	Region-wide, medium and major watercourse. Higher risk associated with sensitivity of the watercourse.	Linked to development. Can be partially mitigated with higher standards for SWM, environmental design, building standards, etc. Risk that is currently being addressed as a priority in Niagara. Seen as an intolerable risk.
Pollutant loading from urban, agricultural, or industrial sources (e.g. overuse of salt on roads, nutrients, sedimentation, etc)	H	Watercourse, riparian and adjacent lands erosion, ultimate receiving water bodies	Region-wide, medium and major watercourse. Higher risk associated with sensitivity of the watercourse. Higher risk associated with watercourses that are connected to SWM systems.	Watershed Report cards completed by NPCA have identified this as an issue for several years.

TABLE 7: SIMPLIFIED RISK IDENTIFICATION SURVEY

Risk	Ranking (L/M/H)	Assets Affected	Location	Notes
Erosion & sedimentation (rivers and stream)	L	Watercourses	Region-wide	Sedimentation is often associated with non-point sources. Will take a number of actions to address.
Storm surge, flooding & erosion (Great Lakes shorelines)	M	Shoreline areas, natural areas and agricultural areas that are adjacent to shorelines	Great Lakes shoreline	Has become a more significant risk in the last few years, linked to higher lake levels and larger storm events; anticipated to become a higher risk in the years to come.
Algae (i.e. blue green algae in Lake Erie)	L-M	Lake Erie and shoreline areas	Lake Erie Shoreline	Level of risk varies by year. Has the potential to impact drinking water (all drinking water in Niagara is from Great Lakes). Recreational impacts (i.e., beach usage).
Governance	L	Potential for all	Region-wide	Potential for changes in the land use policies and protections for natural features / other natural assets at all levels of government.

Municipal Natural Assets Initiative

Making Nature Count