# WATERSHED NATURAL ASSET ANALYSIS AND VALUATION



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### LAND ACKNOWLEDGEMENT

The Niagara Peninsula watershed is situated within the traditional territory of the Haudenosaunee, Attiwonderonk (Neutral), and the Anishinaabeg, including the Mississaugas of the Credit — many of whom continue to live and work here today. This territory is covered by the Upper Canada Treaties.

(No. 3, 4, and 381) and is within the land protected by the Dish with One Spoon Wampum agreement. Today, the watershed is home to many First Nations, Métis, and Inuit Peoples. Through our 2021-2031 Strategic Plan, we reconfirm our commitment to shared stewardship of natural resources and our deep appreciation of Indigenous culture and history in the watershed.

### **ABOUT US**

As a community-based natural resource management agency, the Niagara Peninsula Conservation Authority (NPCA) envisions a healthy and vibrant natural environment with shared greenspace and clean water for all.

NPCA's work supports the conservation, enhancement and sustainability of healthy watersheds with programs and services that focus on drinking water source protection, flood and hazard management, endangered species protection, ecosystem restoration, community stewardship, education, and land management.

NPCA is the caretaker of over 40 conservation areas within the Niagara Peninsula watershed held in public trust for recreation, heritage preservation, conservation and education. These natural and shared greenspaces marry nature, culture and adventure to create limitless opportunities for discovery.

NPCA Watershed Natural Asset Analysis and Valuation



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• Long Beach Conservation Area

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# INTRODUCTION

Climate change has been widely acknowledged as a major threat to global ecosystem function, with its impacts becoming increasingly evident in our daily lives. For decades, our society has relied heavily on engineered infrastructure to solve environmental challenges, but amid this crisis, natural or green infrastructure such as forests, wetlands, meadows (also known as nature-based solutions), are increasingly important to reducing the impacts of climate change and protecting ecosystems and biodiversity.

To better understand these nature-based solutions, the Niagara Peninsula Conservation Authority (NPCA) completed an assessment of the natural assets within the Niagara Peninsula watershed, which encompasses the entire Niagara Region and portions of the City of Hamilton and Haldimand County. The scope of the natural asset management assessment includes:

- Establishing a natural asset inventory
- Conducting a condition assessment
- Assigning asset replacement costs
- Evaluating carbon storage and sequestration
- Valuing some of the ecosystem services provided by the natural assets
- Completing a case study application to the Town of Fort Erie

This document summarizes the findings from the natural asset management assessment for the Niagara Peninsula watershed.



### STATE OF NATURAL ASSETS IN NIAGARA PENINSULA

The Niagara Peninsula watershed is home to a diverse range of natural assets, including forests, wetlands, and meadows. These assets provide essential services such as stormwater management, carbon uptake and storage, and numerous recreational opportunities.

To understand the assets within a location and the services they provide, a natural asset inventory is required. The asset inventory forms the foundation upon which all other asset management tasks (e.g., condition assessment, and replacement costs) are based. To create an asset inventory, the location, type and extent of natural assets are delineated and quantified.

A natural asset inventory was completed for the entire Niagara Peninsula watershed jurisdiction.

Level 1: Level 2: Level 3: The inventory includes a range of natural assets as well as agricultural lands and some enhanced assets (e.g. parks and mown fields). The enhanced and agricultural assets were included in the inventory to provide a complete picture of the land-based natural assets within the Niagara Peninsula watershed and to recognize their important contribution to community services such as stormwater management and recreation. It is for this same reason that the inventory is not limited to just those assets owned and managed by the NPCA.

Such assets are part of an integrated web of ecosystems that collectively deliver services and benefits to the people living within the Niagara Peninsula watershed. Within the inventory, assets are categorized into three levels:

Continuous area of natural landcover regardless of the land cover type. Distinguishes between natural area assets, agriculture assets, and enhanced assets.

Further categorizes these areas by specific land cover types, such as forests, wetlands or hedgewrows.

Provides more detailed differentiation within these categories, identifying specific types like coniferous forests, decidious forests, and mixed forests.

### NATURAL ASSET INVENTORY MAPPED AT LEVEL 1



Asset Type:

Agriculture
Natural
Enhanced
NPCA Boundary
NPCA Urban Areas

*Figure 2.* Niagara Peninsula Watershed Natural Asset Inventory Mapped at Level 1.





### **NATURAL ASSET INVENTORY MAPPED AT LEVEL 2**



Asset Type:

Agriculture
Agriculture Crop Defined
Agriculture and Undifferent tiated Rural Land Use
Aquatic
Built-up Pervious
Forest
Golf
Hedgerow
Meadow
Natural Bare
Shoreline
SWM Pond
Water Construct
Wetland
NPCA Boundary
NPCA Urban Areas

Figure 3. Niagara Peninsula Watershed





• Ball's Falls Conservation Area - Upper Falls

### CONDITION ASSESSMENT AND REPLACEMENT COST ANALYSIS

The objective of a natural asset condition assessment is to determine an asset's general ability to provide ecological services, which are valued by people (e.g., air pollution filtration, storm water reduction, carbon sequestration and storage, nature-based recreation). The underlying assumption for natural asset condition assessments is that an asset that is assessed as being in a "good" condition from an ecological perspective, is anticipated to be able to provide a "good" level of ecological services.

Nine indicators for condition were used as proxies for ecological health in a desktop condition assessment of the natural assets within the Niagara Peninsula watershed:

- **PHYSICAL CONTEXT**
- Interior Habitat
- 2 Natural Area Patch Shape
- 3 Road Density
- 4 Natural Asset Proximity to Watercourses
- 5 Forest Proximity to other Natural Assets
- 6 Wetland Proximity to other Natural Assets
- LANDSCAPE CONTEXT
- 7 Extent of Adjacent Permeable Land Uses
- 8 Percent of Forest Cover Within Watersheds
- 9 Percent of Wetland Cover with Watersheds

Figure 4. Nine Indicators used in the Condition Assessment.

The process used for the condition assessment in this project aligns with the process outlined in the Canada-wide standards and specifications for natural asset inventories. Scoring thresholds were established for each indicator so that condition scores ranging from very poor to very good could be assigned to the natural assets. An overall condition score was also assigned to the assets by combining the results of all indicators assuming equal weight.

The condition assessment revealed that 98% of the natural assets within the Niagara Peninsula watershed are in fair or good condition (Figure 5). Considering the condition result by asset types, wetlands generally rated "good," while other natural assets mostly rated "fair" (Figure 6).

# NATURAL ASSET INVENTORY MAPPED BY OVERALL CONDITION RATING



#### **Overall Rating:**



Figure 5. Niagara Peninsula Watershed Natural Asset Inventory Mapping by Overall Condition Rating.

#### Condition Breakdown by Asset Types:



Figure 6. Niagara Peninsula Watershed Natural Asset Inventory Overall Condition Rating by Asset Type.





88.90%			
87.98	8%		
	71.11%		
		37.41%	
85.30%			
		25.59%	
		38.01%	

• St. Johns Conservation Area

NPCA Watershed Natural Asset Analysis and Valuation

## NATURAL ASSET TOTAL REPLACEMENT COSTS





Replacement cost values for natural assets in the Niagara Peninsula watershed were assigned using ecosystem restoration costs from Beacon Environmental (2020).<sup>1</sup> The Beacon study compiled restoration costs for various asset types, categorized across five life-cycle phases: (1) planning, (2) creation, (3) inspection and maintenance, (4) monitoring and management, and (5) removal. For the current report, costs from phases 1 and 2 were combined to reflect the per unit replacement costs for specific asset types. Applying the per unit replacement cost values to the natural assets within the Niagara Peninsula watershed resulted in a <u>total estimated replacement</u> cost for all natural assets of over \$10 billion. • Morgan's Point Conservation Area

## CARBON STORAGE AND SEQUESTRATION ASSESSMENT

Natural assets within the Niagara Peninsula watershed play a significant role in carbon storage and sequestration, helping to mitigate the effects of climate change. Two approaches were used to assess carbon storage and sequestration from the



The CBM-CFS3<sup>2</sup> model, designed to estimate carbon sources and sinks in Canadian forests, was used to calculate carbon stocks and sequestration rates for forest assets within the Niagara Peninsula watershed. For non-forested assets, asset-specific carbon sequestration rates (in tonnes of carbon sequestered per unit area) from a review of over 30 peer-reviewed studies were assigned to Figure 8: Approaches used to Assess Carbon Storage and Sequestration.

the area of the assets by asset type.

The assessment showed that forested assets store over 13 million tonnes of carbon. In terms of sequestration, the <u>forest assets were estimated</u> to sequester an average of 6.30 tonnes of carbon per hectare per year (Figure 9) while the nonforest assets were estimated to sequester an average of 1.69 tonnes of carbon per hectare per year (Figure 10).

# CARBON SEQUESTRATION RATES IN FORESTED ASSETS



Tonnes of Carbon per Hectare per Year (Forested Assets)

0,25 - 0,50
0,50 - 1,00
1,00 - 1,50
1,50 - 2,00
2,00 - 2,50
2.50+
NPCA Boundary

*Figure 9.* Carbon Sequestration Rates in Forested Assets





# CARBON SEQUESTRATION RATES IN NON-FORESTED ASSETS



Tonnes of Carbon per Hectare per Year (Non-Forested Assets)

0,25 - 0,50
0,50 - 1,00
1,00 - 1,50
1,50 - 2,00
2,00 - 2,50
2.50+
NPCA Boundary

*Figure 10.* Carbon Sequestration Rates in non-forested Assets.





• Ball's Falls Conservation Area

NPCA Watershed Natural Asset Analysis and Valuation



# **ECOSYSTEM SERVICE VALUATION**

Ecosystem services are defined as the benefits that nature provides to humans.

Ecosystem services contribute to our overall well-being as well as environmental and economic health by providing clean air and water, a source of food, regulating the climate, and moderating exteme events like flooding or extreme heat. For example, flood control is an ecosystem service humans rely on resulting in a benefit of reduced flood risk. It is this benefit that a dollar value can be placed on (e.g. the value of avoided flood damages) to understand and quanitfy the value of services humans receive from nature.

The natural assets within the Niagara Peninsula

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watershed provide a wide range of services to the people living within the watershed. A select number of relevant ecosystem services were identified for valuation in the Niagara Peninsula natural assets project. The approaches used to value the services varied by service type but, overall, focused on the value of the final services provided to those who benefit from the services. Willingness to pay (WTP) is the common convention used to establish values for ecosystem services.

To establish WTP, economists employ stated preference, revealed preference, or benefits transfer approaches. For this analysis, a benefits transfer approach was applied. The ecosystem services and associated benefits that were valued as part of this project are as follows:

	PROVISION OF RECREATION OPPORTUNITIES	►	Enjoyment of recreation activities.
	CARBON SEQUESTRATION	►	Value of carbon dioxide removed from the atmosphere.
	AIR QUALITY REGULATION	►	Avoided costs associated with health issues derived from air pollution.
	STORMWATER REGULATION	►	Avoided stormwater management infrastructure costs.
()	HABITAT PRESERVATION VALUE	►	Value people place on knowling habitat (and associated biodiversity) is preserved.
Ð	CONTRIBUTION TO CROP PRODUCTIVITY	►	Improved crop productivity generated from wild pollinators.

Figure 11: Ecosystem services that are measured in this study.

To estimate the value of recreational opportunities within the Niagara Peninsula watershed, a value transfer approach was employed drawing on values published by the Spatial Informatics Group, LLC available on the Ontario government website (Voigt et al. 2013)<sup>3</sup>. Voigt et al (2013) derived dollar per hectare estimates by land cover type for recreation benefits. Per hectare values were updated to 2023 dollars (from 2011) and applied to the number of hectares of each land cover type within the Niagara Peninsula watershed. The total value of recreational opportunities was estimated at \$114 million per year in 2023 dollars. Carbon sequestration was calculated based on the rates of carbon sequestration as estimated in the carbon storage and sequestration assessment.

The value of carbon sequestration was determined by applying a carbon price per unit of carbon sequestered. Figure 12 illustrates the spatial distribution of the value of carbon sequestration by the natural asset within the Niagara Peninsula watershed. The total value of carbon sequestration in the Niagara Peninsula watershed was between \$38 million and \$171 million in 2023 dollars as per the minimum cost and social cost of carbon, respectively. • Ball's Falls Conservation Area - Upper Falls







### **SEQUESTRATION VALUE OF NATURAL ASSETS**



Sequestration Value (\$ per Year)

0
0 - 10,000
10,000 - 20,000
20,000 - 40,000
40,000 - 80,000
80,000 - 180,000
180,000 - 650,566
NPCA Boundary

*Figure 13.* Sequestration Value of Natural Assets.





• Ball's Falls Conservatioin Area

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The value of air quality regulation provided by the natural assets within the Niagara Peninsula watershed is based on an estimate of the avoided health care costs associated with exposure to air pollutants. To establish an estimate of the value of air quality provided by the natural assets within the Niagara Peninsula watershed, regression equations developed by Nowak et al. (2014)<sup>4</sup> were used. These equations account for the population densities of the municipalities within the Niagara Peninsula watershed to estimate the avoided health care costs according to the number of people exposed to surrounding air quality.

The geographic distribution of the assets providing air quality value is displayed in Figure 13. The total yearly value of air quality regulation by the 51,684 hectares of forested assets in the Niagara Peninsula watershed in 2023 dollars is \$8.5 million.

### **AIR QUALITY REGULATION VALUE OF NATURAL ASSETS**



Air Quality Regulation Value (\$)

0 - 300
300 - 1,000
1,000 - 2,500
2,500 - 5,000
5,000 - 10,000
10,000 - 20,000
20,000 - 31,595
NPCA Boundary

*Figure 14.* Air Quality Regulation Value of Natural Assets.











The value of stormwater regulation was based on the ability of natural assets to control and absorb water during low frequency, heavy rain events. Following work done by Saini et al. (2018)<sup>5</sup> from the Peel Pilot Study, forests, meadows and wetlands in the Niagara Peninsula watershed were assigned a value per hectare based on their ability to abate stormwater. This analysis assumed that site characteristics in the Peel pilot site were suitably scalable to Niagara Peninsula watershed natural assets, and that stormwater services monetized in the Peel/Credit Valley subwatersheds were similar to services provided in Niagara Peninsula subwatersheds.

The value of stormwater regulation was estimated at nearly \$103 million per year in 2023 dollars.

Figure 14 demonstrates the spatial distribution of the stormwater regulation service value for the natural assets within the Niagara Peninsula watershed.

### **STORMWATER REGULATION VALUE OF NATURAL ASSETS**



Stormwater Regulation Value (\$)

0
1 - 66,000
66,000 - 132,000
132,000 - 198,000
198,000 - 264,000
264,000 - 330,000
330,000 - 390,060
NPCA Boundary
NPCA Urban Areas

*Figure 15.* Stormwater Regulation Value of Natural Assets.





The value of habitat preservation in the Niagara Peninsula watershed relied on the work done by Brander and Koetse (2011)<sup>6</sup> which determined the preservation value of urban and near-urban greenspaces. To apply the regression equation to the natural assets within the Niagara Peninsula's watershed, data for area of natural assets, gross domestic product per capita and population density were populated with NPCA-specific data. The result was an estimate of the value of natural assets measured in dollars per hectare, which was applied to the hectares of natural assets within the Niagara Peninsula watershed. <u>The total</u> value of habitat preservation within the Niagara Peninsula watershed was estimated at \$27 million per year in 2023 dollars.

To estimate the contribution of wild pollinators to crop productivity, the agricultural assets within the watershed were buffered by an assumed pollinator foraging range of 1,500 m to identify crops within the range of wild pollinators (AAFC 2014)<sup>7</sup>. The crop types were reviewed to determine those that are dependent on wild

 St. Johns Conservation Area pollination and allocated a pollination crop dependency based on research by Aizen et al. (2009<sup>8</sup>, 2019<sup>9</sup>) and Klein et al. (2007<sup>10</sup>). Agriculture statistics were used to establish average Ontario crop production values per hectare for the pollination dependent crops. Average production values (\$/ha) for each relevant crop type were established based on a 5-year average from 2019-2023. <u>The total value of wild pollinator</u> contribution to crop productivity was estimated to be approximately \$42 million per year in <u>2023 dollars.</u> The spatial distribution of the value provided by wild pollinators is shown in Figure 15.

In summary, the ecosystem services considered in this assessment provide a combined value of between \$331 million and \$463 million annually. Key services include stormwater regulation, which alone is valued at nearly \$103 million per year, and air quality regulation, contributing \$8.5 million annually. These services not only support the local economy but also enhance the quality of life for residents.

### VALUE OF NATURAL ASSETS FOR WILD POLLINATORS



Value of Wild Pollinators (\$)

_	
	0
	0 - 10,000
	10,000 - 20,000
	20,000 - 30,000
	30,000 - 60,000
	60,000 - 110,000
	110,000 - 220,000
	220,000 - 550,992
	NPCA Boundary
	NPCA Urban Areas

*Figure 16.* Value of Natural Assets Contribution to Crop Productivity.





• Morgan's Point Conservation Area

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# FORT ERIE CASE STUDY

The Fort Erie case study demonstrates the practical application of natural assetmanagement at a municipal level and showcases how the broader watershed project can be scaled for use in local decision-making.

The study highlights the importance of maintaining natural assets to ensure the continued provision of essential services. Lessons learned from Fort Erie can be applied to other municipalities within the NPCA's jurisdiction, offering a roadmap for integrating natural asset management into local planning.

# The scope of the Fort Erie case study includes:

- Natural asset inventory
- Condition assessment
- Risk assessment
- Proposed levels of service
- Asset replacement costs
- Ecosystem services values



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# CONCLUSION

Natural asset management is not just an environmental initiative; it is a critical strategy for building resilient and sustainable communities.

This report highlights the immense value of natural assets within the Niagara Peninsula watershed. From carbon sequestration to stormwater regulation, natural assets provide essential services that support the environment, local economy, and well-being of residents and visitors to the region. Investing in natural asset management is not only a smart financial decision but also a necessary step toward ensuring a sustainable future for all residents of the NPCA watershed.

The NPCA is committed to supporting these efforts by providing expertise, resources, and partnerships. By prioritizing natural asset management, we can protect these invaluable resources and create a legacy of sustainability and resilience for generations to come.

#### ACKNOWLEDGEMENT:

This summary report was created in partnership with Green Analytics, whose expertise in environmental economics and data-driven analysis helped shape our findings. Special thanks to NPCA project leads Natalie Green and Tara Gaade for their invaluable contributions and leadership throughout this initiative.

# **CONTACT US**

At the Niagara Peninsula Conservation Authority, we understand that the health of our communities and local economies is deeply tied to the wellbeing of our natural assets. As stewards of these vital resources, we are committed to helping municipalities incorporate natural asset management into their planning processes.

#### **INTERESTED IN LEARNING MORE?**

If you'd like to explore how we can support your asset management goals, contact us today to begin the conversation. Together, we can protect and enhance the natural assets that make Niagara a great place to live, work, and thrive.

**CONTACT INFORMATION:** 

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