

Natural and Enhanced Asset Lifecycle and Replacement Costing



Prepared by: Dougan Ecology, Grounded Solutions, and Green Analytics

Prepared for: Credit Valley Conservation

December 2025



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- Tatiana Koveshnikova, Program Manager, Natural Assets and Ecosystem Services (CVC)
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Disclaimer

The 50-year lifecycle replacement cost estimates developed for four (4) enhanced and 22 natural asset sub-types developed for southern Ontario are not intended to replace project-specific and/or site-specific cost estimates for actual projects. These replacement cost estimates are based on representative assets in hypothetical scenarios with the assumptions explicitly laid out in this report. While the estimates have been based on

actual 2025 material and labour costs from actual projects in southern Ontario and other nearby urban areas, they are not meant to replace project-specific cost estimates that are tailored to the site context, conditions, and requirements.

Any changes made to the costs in this report or accompanying spreadsheets should be done at the user's discretion. The spreadsheets with full lifecycle costing information can be requested by emailing naes@cvc.ca.

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Acronyms

CUM	Cultural meadow	MAM	Meadow marsh
CUP	Cultural plantation	MAS	Shallow marsh
CUS	Cultural savannah	MOS	Manicured open space
CUT	Cultural thicket	OWES	Ontario Wetland Evaluation
CUW	Cultural woodland	System	
CVC	Credit Valley Conservation	ROW	Right-of-way
DBH	Diameter at Breast Height	SWC	Coniferous swamp
ELC	Ecological land classification	SWD	Deciduous swamp
FOC	Coniferous forest	SWT	Thicket swamp
FOD	Deciduous forest	TR	Individual Tree
FOM	Mixed forest	TRCA	Toronto and Region Conservation Authority



Cultural plantation clearing and protection (Credit: City of Guelph)

Introduction

Credit Valley Conservation (CVC) has been at the forefront of natural asset research in Ontario for over 15 years. As such, CVC regularly collaborates with municipalities and others in its jurisdiction, and beyond, to facilitate the integration of natural (and enhanced) assets into established asset management systems.

Natural assets (as described in [Section 1.1](#)) in southern Ontario may be owned and managed by many different public and private sector parties, many of whom may have an interest in using asset management as a tool to help them plan for, implement and track their various natural areas management activities. While this project was undertaken with primarily municipalities and conservation authorities as the intended readers, it also includes information that may be of use to others responsible for managing natural areas and looking to advance their natural asset management (e.g., Parks Ontario, the Bruce Trail Conservancy, Ontario Nature, Land Trusts, Ducks Unlimited, etc.).

As part of their work in this area, CVC identified the lack of defensible replacement cost estimates that account for all lifecycle phases as a key gap. Having reasonable and defensible replacement costs for both enhanced and natural assets that occur in a jurisdiction can help:

1. Estimate the costs of maintaining existing assets and of creating and/or maintaining acquired assets into the future;
2. Inform short and long-term financial planning as part of broader asset management planning (e.g., considering costs associated with investing in enhanced and natural assets in relation to, or as compared to, other asset types to meet current or target levels of service; and
3. Inform replacement and compensation negotiations when enhanced or natural assets are being considered for removal and replacement.

To fill this gap, CVC retained a multi-disciplinary team to develop lifecycle replacement costs for a suite of representative enhanced and natural assets. These costs were hypothetical but based on realistic assumptions and lifecycle activities, as well as current and actual costs from local municipalities, agencies and industry practitioners in southern Ontario over 2019 and 2020. This resulted in the completion of a Lifecycle Costing of Restoration and Environmental Management Actions report (Beacon *et al.*, 2020) and a comprehensive 50-year lifecycle costing database for four (4) enhanced and 11 natural asset sub-types in an MS Excel™ workbook.

Since this work was first completed in 2020, these products have been used by local municipalities, agencies and others in and around CVC's jurisdiction to reasonably estimate the replacement value/costs of many of their enhanced and natural assets. Based on this use, CVC and its partners identified several gaps in the asset types costed in 2020. CVC also recognized there had likely been increases in costs for some materials and labour related to enhanced and natural asset projects since 2020.

This report accompanies updated and improved costing workbooks (in MS Excel™) for 26 terrestrial enhanced and natural asset sub-types provided under separate cover. The report (a) outlines why and how the 2025 replacement costs were developed and (b) indicates how this work built on and improved the 2020 approach and deliverables.

This report specifically includes:

1. An overview of the four (4) enhanced and 22 natural asset representative sub-types considered in this project ([Section 2](#))
2. An overview of the lifecycle framework, phases and activities ([Section 3](#))
3. A summary of the approach, overarching assumptions and costing caveats informing the development of hypothetical replacement costs ([Section 4](#))
4. Descriptions of each asset type and representative asset sub-type ([Section 5](#))
5. The 2025 replacement costs estimated for each representative asset sub-type ([Section 6](#)), and
6. Concluding remarks and next steps ([Section 7](#)).

1.1 What are enhanced and natural assets?

An “asset” is an item, thing or entity that has potential or actual value to the given municipality, including but not limited to tangible assets (e.g., a community centre), natural assets, heritage or culturally significant assets, and information assets. Green infrastructure assets include a range of assets that can be natural or human-made but must provide ecological and hydrological functions. [Figure 1](#) illustrates the three sub-types of green infrastructure assets (i.e., “natural assets”, “enhanced assets”, and “engineered assets”) with examples of each in contrast to grey infrastructure assets often owned and managed by municipal governments.

Green Infrastructure (GI)			
Nature-based [climate] Solutions (Nb[C]S)			
Natural Infrastructure (NI)	Natural Infrastructure (NI)		
Natural (GI) Assets: • Wetlands • Forests • Meadows • Watercourses • Lakes and Ponds • Soils	Enhanced (GI) Assets: • Rain gardens • Green roofs and walls • Bioswales • Street and park trees • Naturalized stormwater ponds • Manicured lawns	Engineered (GI) Assets: • Permeable pavement • Rain barrels • Cisterns • Perforated pipes • Infiltration trenches	Grey Infrastructure: • Bridges • Roads • Parking lots • Culverts • Pipes

Credit: Green Analytics

FIGURE 1. GRAPHIC ILLUSTRATION OF TYPES OF GREEN INFRASTRUCTURE ASSETS AS COMPARED TO GREY INFRASTRUCTURE ASSETS.

Grey infrastructure refers to engineered assets made exclusively of materials such as concrete and steel including bridges, dams, water treatment plants, culverts, ditches, and storm drains. "Grey infrastructure elements are generally designed for singular purposes, and although considerable expertise has accrued over time on best practices for their design and management, they are not highly adaptable to changing conditions such as extreme precipitation events and have a limited lifespan" (CCME 2021).

Green infrastructure has three sub-types of assets which can be defined as follows (as cited from CCME 2021) listed from "most" to "least" engineered:

- **Engineered assets** are built or manufactured structures intended to mimic natural functions, particularly hydrologic functions, at the site-specific scale. They generally do not have a "green" or vegetated component. Examples include rain barrels, permeable pavement, and infiltration trenches.
- **Enhanced assets** incorporate "land, water and vegetation features alongside human-made elements to sustain ecosystem functions and services... the enhancement of conventional grey infrastructure (e.g., piped, ditch and culvert, dam and reservoir systems) with nature-based elements, [often] in order to achieve the active and everyday management of the full rainfall-runoff spectrum". Examples include bioswales, green roofs, trees in built-up areas with engineered rooting environments, and native topsoil added to developed areas (with grass and/or other groundcovers) for its water infiltration and retention capacity.
- **Natural assets (also called natural infrastructure)** "refer to the use of preserved, restored, or enhanced elements or combinations of vegetation and associated biology, land, water, and naturally occurring ecological processes to meet targeted infrastructure outcomes".

Both enhanced and natural assets "can be used in place of or in tandem with grey infrastructure to create a hybrid approach, to enhance resilience of the infrastructure asset, and to provide many other co-benefits" (NAI 2024).

1.2 Why is this work important?

Ontario Regulation 588/17 (*Asset Management Planning for Municipal Infrastructure*) under the *Infrastructure for Jobs and Prosperity Act (2015)* came into effect January 1, 2018. This regulation is intended to help "municipalities better understand what important services need to be supported over the long term, while identifying infrastructure challenges and opportunities, and finding innovative solutions" (Government of Ontario 2025).

O. Reg. 588/17 requires all municipalities in Ontario to have a comprehensive asset management plan in place. As outlined in more detail on the Government of Ontario's [municipal asset management planning web page](#), this includes:

1. An asset inventory
2. Levels of service, and

3. A lifecycle management and financial strategy.

As part of the lifecycle management and financial strategy, the Act also requires that municipalities consider options to reduce full lifecycle costs of assets, including the potential use of green infrastructure solutions. As part of this work, municipalities (with populations of at least 25,000) must identify current and proposed levels of service for all municipal infrastructure assets (including green infrastructure assets), identify the costs of maintaining those levels of service, and develop a financial strategy to address the current and anticipated finding needs.

Asset Management Planning for Municipal Infrastructure (O.Reg. 588/17)

“Green infrastructure assets: ... natural or human-made elements that provide ecological and hydrological functions and processes and includes natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces and green roofs”.

This project provides realistic lifecycle and replacement costs based on management actions and costs drawn from actual projects by practitioners in southern Ontario. This approach is aligned with the current standards and guidance for natural asset inventories (CSA Group 2023, NAI 2024) and can also help inform decision-making related to how best to invest and allocate available resources to different asset types to meet established service levels.

O. Reg 588/17 also requires municipalities to consider levels of service in the context of climate change. Natural assets tend to be intrinsically more resilient to climate change over the long term than other asset types (NAI 2024). As seen in the summary of replacement costs generated for this work (see [Section 6](#)), although the initial investment in creating / establishing natural assets can be substantial, once they are established, the longer-term costs of maintaining them in good condition tend to be limited and, barring catastrophic events, these assets never need to be replaced and will continue to provide services indefinitely with limited reinvestment required.



Cultural meadow and meadow marsh, City of Guelph (Credit: Grounded Solutions)

Enhanced and Natural Asset Types and Sub-Types Costed

The main goal of this project was to update and develop replacement costs for a comprehensive suite of terrestrial¹ enhanced and natural assets (i.e., lawn, trees, meadows, wetlands, forests/woodlands and plantations) (see **Table 1**) based on an established 50-year lifecycle framework (see **Table 2**). This suite of asset types and sub-types is intended to capture the most common and widespread terrestrial enhanced community types owned and managed in southern Ontario. Replacement costs for rare and uncommon natural asset types (such as bogs, fens, tallgrass prairies / savannahs / woodlands and alvars) which typically have very limited or specialized active management have not been developed.

The objectives were to (a) update replacement costs for the enhanced assets (i.e., manicured lawn and street/park trees) and terrestrial natural assets first costed in 2020, and (b) develop replacement costs for a suite of additional terrestrial assets (mainly “cultural” communities, see text box below) to fill gaps in replacement costs identified by CVC and their partners.

These 50-year lifecycle management costs for selected enhanced and natural assets common in southern Ontario are expected to provide a comprehensive suite of realistic replacement costs for use by municipalities, agencies and others in southern Ontario.

The Ecological Land Classification (ELC) system (as per Lee *et al.*, 1998) was developed by the Province almost 30 years ago. This system:

- Remains the most well-established standard for southern Ontario and provides a known “common language”, at least among ecologists and restoration practitioners
- Has formally established vegetation structures, compositions and cover levels that can be referenced, and
- Includes the full spectrum of community types known to occur in southern Ontario, with the caveat that cultural communities are well less defined than some of the other community types.

What do we mean by “cultural” natural asset types?

The ELC system uses the term “cultural” to label community types that have been disturbed by human activities and continue to show predominant characteristics (e.g., structural, species composition) associated with relatively recent (e.g., within the past 25 years) human anthropogenic disturbances. This typically includes natural assets with a high proportion of non-native and often invasive species, as well as natural assets that have recently or continue to be subject to management for human uses (e.g., plantations).

¹ It is anticipated that replacement costs for a suite of riparian and aquatic natural assets are to be developed in 2026

Examples include: (a) an abandoned farm field that has become naturalized with goldenrods, asters and orchard grass (i.e., a cultural meadow), (b) an abandoned gravel pit that has over time become dominated by staghorn sumac, autumn olive, eastern white cedars and Siberian elms (i.e., a cultural woodland), or (c) a wooded area dominated by the same age of densely planted red pines due to having been originally created as a plantation (i.e., a cultural plantation).

The complete list of enhanced and natural asset sub-types for which 2025 replacement costs were developed as part of this project is provided in [Table 1](#).



Naturalized cultural thicket, City of Guelph (Credit: Grounded Solutions)

Table 1. Enhanced and natural asset types and sub-types for which 2025 replacement costs were developed.

ASSET TYPE	ASSET SUB-TYPE (Size)	CODE ³
ENHANCED ASSETS		
1. Manicured Open Space	1a. Manicured Open Space (Lawn) - Creation (1 ha) ¹	MOS-cr
	1b. Manicured Open Space (Lawn) - Acquired (1 ha)	MOS-ac
2. Individual Trees	2a. Individual Trees - Softscape (3 trees) ¹	TR-sft
	2b. Individual Trees - Hardscape (3 trees) ¹	TR-hrd
NATURAL ASSETS		
3. Stream Corridors ²	<i>To be updated as part of a follow-up project ²</i>	
4. Wetlands	4a. Meadow Marsh - Creation (1 ha) ¹	MAM-cr
	4b. Meadow Marsh - Acquired (1 ha) ¹	MAM-ac
	4c. Shallow Marsh - Creation (1 ha)	MAS-cr
	4d. Shallow Marsh - Acquired (1 ha)	MAS-ac
	4c. Thicket Swamp - Created (1 ha)	SWT-cr
	4d. Thicket Swamp - Acquired (1 ha) ¹	SWT-ac
	4e. Deciduous Swamp - Acquired (1 ha)	SWD-ac
	4f. Mixed Swamp - Acquired (1 ha)	SWM-ac
	4g. Coniferous Swamp - Acquired (1 ha)	SWC-ac
5. Upland Cultural Meadows	5a. Cultural Meadow - Creation (1 ha) ¹	CUM-cr
	5b. Cultural Meadow - Acquired (1 ha) ¹	CUM-ac
6. Upland Forests	6a. Deciduous/Mixed Forest - Creation (1 ha) ¹	FOD/M-cr
	6b. Deciduous/Mixed Forest - Acquired (1 ha) ¹	FOD/M-ac
	6c. Coniferous Forest - Created (1 ha)	FOC-cr
	6d. Coniferous Forest - Acquired (1 ha)	FOC-ac
7. Upland Cultural Treed Communities	7a. Cultural Thicket - Acquired (1 ha)	CUT-ac
	7b. Cultural Savanna - Acquired (1 ha)	CUS-ac
	7c. Cultural Woodland - Acquired (1 ha)	CUW-ac
	7d. Cultural Plantation, Deciduous - Acquired (1 ha)	CUP1-ac
	7d. Cultural Plantation, Mixed - Acquired (1 ha)	CUP2-ac
	7d. Cultural Plantation, Coniferous - Acquired (1 ha)	CUP3-ac
8. Cultural Plantation to Forest	8c. Cultural Plantation to be Mixed Forest - Acquired (1 ha) ¹	FOM-ac

¹ Replacement costs for these asset sub-types were updated from 2020; replacement costs for all other asset sub-types were new in 2025.

² Replacement costs for the stream corridor asset sub-types as well as open water communities will be developed in 2026.

³ Asset sub-type codes have been developed for this project to facilitate communications, use of the spreadsheets and cross-referencing. These codes are based on the Ecological Land Classification (ELC) system for southern Ontario (1998 version) and aligned with the codes used by Credit Valley Conservation. Endings have been added to the codes to indicate if the asset has been costed based on it being "-cr" = created or "-ac" = acquired.

The 1998 ELC system acknowledges that in this first approximation “the cultural or anthropogenic communities have not been fully addressed” and as such this guide does not provide a detailed breakdown of cultural community types. However, the cultural communities it does include (see Tables 29 and 30 in the guide) are described at an adequate level of detail for informing and developing replacement costs (see [Section 5](#) for descriptions).

What does Assets “Created (-cr)” or “Acquired (-ac)” mean?

The codes in [Table 1](#) align with the CVC’s ELC and land cover classification system. Where codes did not exist (e.g., for individual trees), they were created.

The codes also indicate whether the asset sub-type has been costed hypothetically with the assumption that it has been either:

- a) secured or acquired (“-aq”) by a municipality, agency or other organization in a poor to fair condition and requires some work to bring it to a good or very good condition (as per [Table 4](#)), or
- b) needs to be created / installed (“-cr”) on existing open lands that have been secured or are owned (by a municipality, agency or other organization) and maintained in good to very good condition (as per [Table 4](#)).

No asset sub-types for deciduous, mixed or coniferous swamps that have been “created” were included because there are few to no precedents for effectively creating these types of natural communities.

In addition, for this project, the full suite of cultural communities in the ELC system (except for cultural meadow) have been costed for acquisition but not creation. This is because these communities are common in southern Ontario but are typically not deliberately created as long-term target community types. Once acquired, such communities are typically either (a) maintained / protected *in situ* as is (e.g., where no resources are available to improve their condition) or (b) managed to succeed into more “natural” and less “cultural” asset types (e.g., invasive species control, planting a diversity of native species). For this project, it is assumed that these assets have been acquired in a poor to fair condition with the intent of improving and maintaining their condition to “good” or “very good” (as per [Table 4](#)) over the 50-year lifecycle period through targeted and strategic management.

Cultural meadows have been, and continue to be, created by municipalities, agencies and others involved in natural areas management in southern Ontario. Typical reasons are to provide compensation habitat for grassland Species at Risk (e.g., Bobolink or Meadowlark) or to create what are often called “pollinator gardens”. More details on the specific assumptions related to the creation, maintenance and restoration of these representative asset types and sub-types are provided in [Section 4](#). General description of each of these asset and sub-asset types is provided in [Section 5](#) below. The specific assumptions related

to each activity within each lifecycle phase for each sub-asset are included in the spreadsheets used to generate the costs, available from CVC under separate cover.

Lifecycle Framework, Phases and Activities

Asset management seeks to account for the “full” cost of asset ownership by including the anticipated activities and capital / operating costs required to maintain established levels of service over the life of the given asset. However, as noted in the 2020 report (Beacon Environmental *et. al.*, 2020), establishing an appropriate time frame for enhanced and natural assets is challenging because the time required for these assets to establish themselves and become self-sustaining varies depending on the asset type and local conditions.

For the natural and enhanced assets being considered, a 50-year time frame was considered appropriate because:

- Use of 25 to 50-year lifecycles is not unusual in asset management
- A lifespan of up to 50 years for well-established and maintained street trees was considered reasonable (see sources cited in Beacon *et al.*, 2020), and
- Most natural assets in an urban setting can be sustained for at least 50 years, and ideally indefinitely, with the right conditions and appropriate management.

Furthermore, trees and natural assets are distinguished from other asset types in that: (a) many of the functions and values that natural assets provide can increase in magnitude over time as the asset matures, and (b) once well-established, natural assets have the intrinsic capacity to sustain most functions with little management intervention. Consequently, the investment is greatest in the initial phases to ensure the asset is well-established. Therefore, as shown in the replacement costing by phase in [Section 6](#), the potential returns on investment are more realistically assessed in a longer lifecycle window.

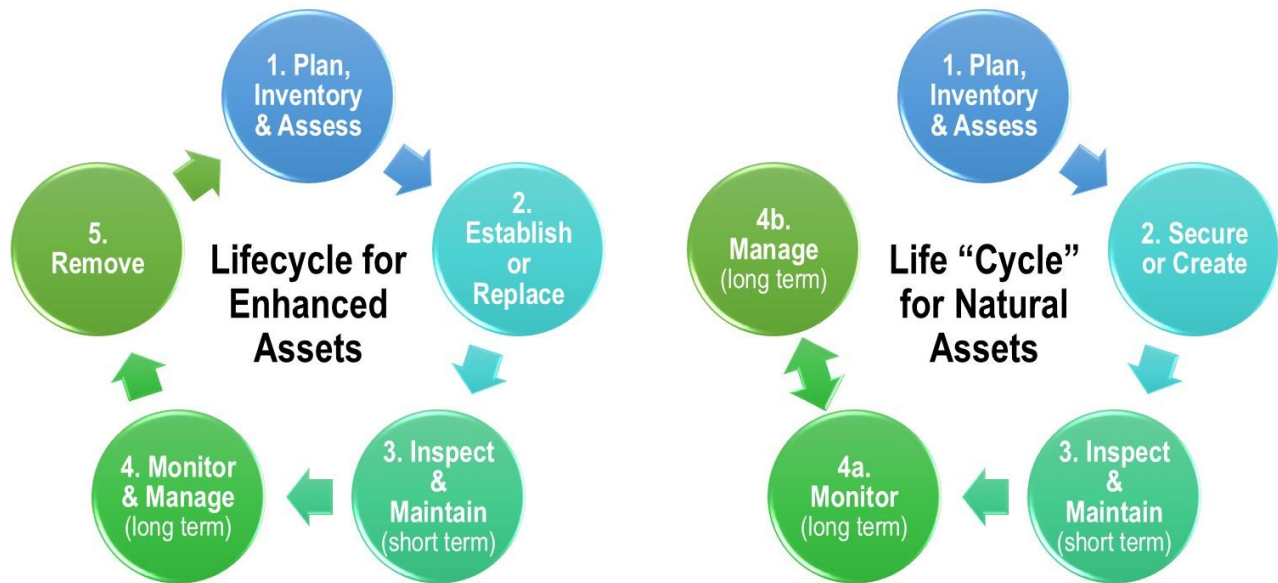
An overview of the lifecycle phases for the representative (a) enhanced assets and (b) natural assets costed for this project is shown in [Figure 2](#). Each lifecycle phase and its duration is outlined in [Table 2](#). A description of each lifecycle phase is outlined in [Table 3](#).

TABLE 2. DURATION FOR EACH LIFECYCLE PHASE FOR THE REPRESENTATIVE ENHANCED AND NATURAL ASSETS COSTED HYPOTHETICALLY*.

Lifecycle Phase	Phase Name	For Enhanced Assets*	For Natural Assets*
Phase 1	Plan, Inventory and Assess	Years 1 to 2 (two years)	Years 1 to 2 (two years)
Phase 2	Secure or Create (or Establish)	Years 3 to 5 (three years)	Years 3 to 5 (three years)
Phase 3	Inspect and Maintain	Years 6 to 10 (five years)	Years 6 to 10 (five years)
Phase 4	Monitor and Manage	Years 11 to 49 (38 years)	Years 11 to 50 (39 years)
Phase 5	Remove	Year 50 (1 year)**	Not applicable

* See Table 1 for a list of the representative enhanced and natural assets costed.

** Assumed to apply to both individual trees and manicured lawn.



Credit: Updated from Lifecycle Costing of Restoration and Environmental Management Actions (Beacon Environmental *et al*, 2020)

FIGURE 2. LIFECYCLE PHASES DEVELOPED FOR ENHANCED ASSETS (RIGHT) AND NATURAL ASSETS (LEFT).

TABLE 3. DESCRIPTION OF EACH LIFECYCLE PHASE FOR THE REPRESENTATIVE ENHANCED AND NATURAL ASSETS COSTED.

Lifecycle Phase (Duration)	Description for Enhanced and Natural Assets, unless otherwise noted*	Suite of Activities Considered **
Phase 1: Plan, Inventory and Assess (Years 1 to 2)	- This entails planning for acquisition of an existing asset or for creation of a new asset on lands that are already owned or are to be acquired. - For existing assets, inventory and assessment occur before being added to the asset management system to confirm site and feature condition. - For asset creation this includes costs for development of conceptual and detailed design. EXCLUDED ACTIVITIES AND COSTS: - Labour and expenses associated with any required permitting and approvals - Labour and expenses associated with consultation or engagement (e.g., with local Indigenous groups, agencies and/ or the public and/ or other stakeholders)	ACTIVITIES WITH COSTS INCLUDED: - Site-specific plans and/or designs - Assessment of existing conditions (land cover type, soils, slope, hydrology) COSTS EXCLUDED, BUT CAN BE INSERTED BY USER IN SPREADSHEET: - Planning for asset creation - Assessment of immediate context and coordination of access and permissions
Phase 2: Secure or Create (or Establish) (Years 3 to 5)	- Can be considered the "Establishment Phase". - The asset either (a) already exists in poor to fair condition and needs some targeted management to improve its condition to	ACTIVITIES WITH COSTS INCLUDED FOR SITE PREPARATION: - Mobilization and demobilization - Silt fencing; Tree preservation fencing

Lifecycle Phase (Duration)	Description for Enhanced and Natural Assets, unless otherwise noted*	Suite of Activities Considered **
	good or very good, or (b) is to be created so that it can be maintained in good to very good condition. - Creation of a natural asset will involve a range of activities from site preparation to vegetation establishment. - This phase includes some basic maintenance associated with asset creation and/ or establishment, such as watering and mulching.	- Removal of waste / debris / structure - Vegetation Clearing; Tree Removal - Invasive Species - Removal and control - Grading - Mini-piezometer (Installation) - Flail Mowing - Fertilizing and/or other soil amendments - Salvage of biological materials - Caliper tree site preparation ACTIVITIES WITH COSTS INCLUDED FOR PLANTING AND HABITAT FEATURES: - Sod application - Seeding - Planting - Trees, shrubs, live stakes - Mulching - Inspection - Bird boxes - Snake hibernacula - Woody debris - Basking logs COSTS EXCLUDED, BUT CAN BE INSERTED BY SPREADSHEET USER: - Land base acquisition or securement process (e.g., donation, purchase, dedication, conservation easement, etc.) - Trails / signage / fencing / structures
Phase 3: Inspect and Maintain (Years 5 to 10)	- Once the asset has been created or established to a good or very good condition, it must be inspected and will typically undergo some very basic management to maintain its condition. "Maintenance" includes basic activities to help the asset become more self-sustaining and build resilience. It is not undertaken in response to a specific impact or identified risk (which is addressed in lifecycle Phase 4). "Inspection" is comparable to short-term condition assessment or monitoring. For example, it includes assessment of key indicators of hydrologic function (e.g., water levels in a wetland) and / or ecological function (e.g., vegetation cover in a newly created feature). - A well-established asset that is not subject to undue impacts or a catastrophic event will not require much maintenance during this	ACTIVITIES WITH COSTS INCLUDED: - Inspection - Mowing - Aerating - Re-sodding - Watering - Supplemental plantings (trees, shrubs, other) - Supplemental plant care (e.g., watering, tree guards, mulch, young tree pruning)

Lifecycle Phase (Duration)	Description for Enhanced and Natural Assets, unless otherwise noted*	Suite of Activities Considered **
	phase, but certain types of activities are typically required in an urban setting to ensure the feature can continue to provide the service(s) for which it was acquired or created (e.g., pruning).	
Phase 4: Monitor and Manage (Years 11 to 49 for enhanced assets; Years 11 to 50 for natural assets)	THIS PHASE CAN EXTEND INDEFINITELY FOR WELL-ESTABLISHED NATURAL ASSETS - This phase of the lifecycle can be considered the "Maturity Phase" during which the asset should continue to be monitored to ensure it remains in "good" or "very good" condition. - In this phase, the asset is well-established, some aspects of regular maintenance (e.g., watering, mulching) will cease and the focus of efforts will shift to longer-term monitoring and management needs (e.g., pruning, invasive species management, human use management). - Some management activities and restoration are expected to be required in response to one or more specific impact or identified risk to the asset's functioning in a context of urbanization and climate change (e.g., invasive species management, wildfire risk mitigation). - Monitoring is to focus on the risk related to the loss of asset functions and identify the need for targeted management as required. This includes monitoring for impacts and risks related to human use that can be readily managed (e.g., removal of hazard trees, localized invasive plant species infestation, localized encroachments). - Monitoring is also to assess if the asset's vegetative structure is consistent with the target community for which the feature is being maintained. For example, if woody vegetation is becoming pervasive in a cultural meadow, management in the form of manual removals or a controlled burn may be warranted.	ACTIVITIES WITH COSTS INCLUDED: - Monitoring – vegetation, trees - Forestry Assessment - Inspection – trees, lawn - Mowing - Aerating - Targeted re-sodding - Targeted watering, mulching - Targeted re- plantings (trees, shrubs, other) - Pest Control - tree pests/ diseases - Invasive Species - removal and control - Targeted woody vegetation removal and / or intermitting mowing - Tree Risk Management (mature trees) - Repair or replacement of tree protection - Enhanced underplanting COSTS EXCLUDED, BUT CAN BE INSERTED BY SPREADSHEET USER: - Monitoring - wildlife
Phase 5: Remove (Year 50, for enhanced assets only)	APPLICABLE TO ENHANCED ASSETS ONLY - For individual trees and lawn, the asset will eventually come to the end of its life span and require removal (followed by replacement, Phase 1 of the lifecycle). - This phase involves the removal of the asset (e.g., costs associated with removal, chipping, stumping and grinding for a tree).	ACTIVITIES WITH COSTS INCLUDED: - Street/park tree removal - Including chipping of removed tree - Street/park tree stumping and grinding - Old lawn / turf removal

* See **Table 1** for a list of the representative enhanced and natural assets costed hypothetically.

** These are the range of possible activities for each sub-asset. The specific activities costed for each lifecycle phase for each sub-asset (and with what assumptions) are provided in the spreadsheets used to generate the costs, available from CVC under separate cover.

Approach and Assumptions for all Assets Costed

4.1 Approach

Each representative enhanced and natural asset sub-type considered through this work (as listed in [Table 1](#)) was costed hypothetically using the 50-year lifecycle framework (outlined in [Section 2](#)) based on the costs for specific activities that could reasonably be expected to be required to establish, maintain and manage these assets to a good or very good condition (as in [Table 4](#)) over their 50-year lifecycles. Costs for materials and labour related to each of these activities were updated or identified based on the 2025 costs gathered from a range of private sector, municipal, and agency sources and practitioners.

Where costs differed, an average cost based on the range was used to feed into the total replacement cost, however the ranges were included in the spreadsheets for reference.

The 2025 replacement costs have all been based on a scenario where a private contractor is being retained to create and/or maintain the acquired asset. An improvement to the 2025 spreadsheets² was to add a column to each spreadsheet to allow for an “in-house labour (and equipment) discount” to be applied to each activity. So for each asset-specific activity, a percent discount (ranging from 0% to 100%, as deemed appropriate) was applied to generate a reduced replacement cost for jurisdictions where in-house labour and equipment can be used. For example:

- if plans for creation of a natural asset are to be completed by in-house staff, then this cost was reduced (e.g., by 25% to 50%), and
- salvage of existing materials and inspection / monitoring completed by in-house staff was discounted (e.g., by 50% to 75%), but
- costs for plant materials (e.g., seeds, shrubs, trees, live stakes) were not discounted assuming most of the cost is related to the materials themselves.

These percentage discounts are shown explicitly in a new column and can be adjusted by the user on a case-by-case and activity-by-activity basis.

4.2 Overarching assumptions

The following overarching assumptions were made to help standardize the hypothetical cost estimating for these representative assets in a realistic way.

- REPRESENTATIVE ASSET SIZE ASSUMPTIONS:
 - The lawn, wetland, upland meadow and upland forest assets were each assumed to be rectangular or circular areas 1 hectare in size without consideration for any vegetative buffers, setbacks or adjacent land uses.
 - The individual tree asset was assumed to be a single tree in a manicured or hardscape setting (with mulch round its’ base) along a municipal road where

² This is a change from the 2020 spreadsheets which identified a “low”, “medium” and “high” replacement cost for each asset, with the assumption that work done by a contractor would fall into the “medium” to “high” cost range, whereas if the work was to be done with in-house labour and equipment it would likely be closer to the “low” cost.

- a below-ground rooting area of at least 30 m³ could be accommodated and above ground area could accommodate a medium to large-sized tree canopy at maturity.
- REPRESENTATIVE ASSET SITE CONTEXT ASSUMPTIONS:
 - All assets – whether being created or acquired – were assumed to be in relatively flat areas (i.e., not on a slope or on hummocky lands) and readily accessible by roads or trails able to accommodate the necessary equipment and vehicles to transport it as needed.
 - Created assets were assumed to be created in old fields or manicured lawns.
 - It was assumed that native soils are present and suitable except for trees being installed in hardscape scenarios where it was assumed soils would need to be imported.
 - It was assumed that the site can generally accommodate and provide the appropriate conditions (i.e., space, climate, drainage) for the feature being created.
 - REPRESENTATIVE ASSET CONDITION ASSUMPTIONS:
 - All enhanced assets and natural assets that are being created (note these are asset sub-types with “-cr” in their assigned code in [Table 1](#)) are being established, maintained and managed to be in a “good” or “very good” condition.
 - All assets being acquired are assumed to be in “poor” to “fair” condition and in need of some management (i.e., about 20% of the total area) to achieve “good” condition, while maintenance and management over the long term were established at levels intended to sustain the asset in “good” condition or better (as outlined in [Table 4](#)).
 - It was further assumed that in Phase 4 (Monitor and Manage) that about 20% of the given feature requires management (e.g., invasive species removal and native species replacement) periodically (e.g., about once every 5 to 10 years depending on the asset sub-type) over the 39-year phase.

TABLE 4. GENERALIZED CONDITION RATING SYSTEM FOR NATURAL AND ENHANCED ASSETS*

Grade	Condition Criteria	Enhanced Asset Criteria Description
Very Good (VG)	Fit for the future	Well maintained, good condition, no signs of deterioration in biophysical conditions.
Good (G)	Adequate for now	Biophysical conditions appear to be sufficient, some minor localized (or isolated) impacts noticeable, which may be a warning sign of possible decline.
Fair (F)	Requires attention	Clear signs of deterioration in condition and function influencing factors.
Poor (P)	Increasing potential of affecting service	Condition is below standard with large portions of the asset exhibiting significant deterioration.
Very Poor (VP)	Unfit for sustained service	Widespread signs of advanced deterioration, unlikely the asset is providing much function.

* Adapted from the *Lifecycle Costing of Restoration and Environmental Management Actions* report (Beacon et al., 2020).

Notably, it is recognized that municipalities, agencies and others involved in natural areas management may not, in fact, have the resources to maintain and manage the enhanced and natural assets under their jurisdiction to a “good” or “very good” condition level. However, it was assumed that those committed to creating, acquiring and managing natural assets for the provision of services to the community would be working towards this objective. Therefore, replacement costs based on this assumption were appropriate.

4.3 Costing assumptions and caveats

The same approach to including and excluding different possible project components was taken as for the 2020 spreadsheets to (a) help standardize the cost estimating for these representative assets in a realistic and pragmatic way, and (b) maintain a consistent approach.

- **LABOUR ASSUMPTIONS:**
 - Labour at \$100 per hour, where itemized separately, and discounted to \$0 where labour was assumed to be provided in-house
 - Vegetation assessments and monitoring assumed to be completed using CVC’s Natural Asset Rapid Condition Assessment Methodology or a comparable approach focused on collection of key condition indicators.
- **COSTS INCLUDED:**
 - Materials and labour reasonably expected to be associated with activities related to asset creation or restoration / rehabilitation, maintenance and long-term management.
 - This included the initial site assessment, site preparation, plantings and some targeted re-plantings over the lifecycle, invasive species management and targeted monitoring (focused on the condition of the vegetation), as specified in the costing database.
- **COSTS EXCLUDED:** As in the 2020 spreadsheets, certain tasks or components that might reasonably be expected to be included in the costing, but that were considered too variable to cost or that could be added to a given project on a

discretionary basis were excluded. Specifically, these elements/components are as follows.

- LAND: Costs associated with the purchase or securement of the land base for the asset, including costs (i.e., labour) that may be associated with planning for the acquisition or securement of the land on which the asset already exists or is to be created.
- ACCESS: Costs (i.e., labour and potentially materials) associated with accessing the land once secured/acquired are not included. For example, if a temporary or permanent access route is needed through adjacent lands owned by others.
- PERMITS: The costs (i.e., labour) for applying for and securing and required municipal, provincial or federal permits are not included. Examples include municipal site alteration permits and conservation authority permits for works in regulated areas.
- BUILT STRUCTURES: Built structures potentially associated with natural areas such as washrooms, trails, boardwalks, signs, fences, benches, and lookouts
- BUILT ELEMENTS: Built elements potentially associated with individual trees such as planters, tree grates, permanent tree protection barriers or fences.
- BUILT INFRASTRUCTURE: Costs related to any infrastructure or servicing that might occur within or near a natural area.
- WILDLIFE HABITAT ENHANCEMENTS AND MONITORING: These costs focus primarily on establishment and maintenance of self-sustaining enhanced and natural assets that are expected to provide habitat for wildlife. Any costs (i.e., labour and potentially materials) associated with constructing, installing and maintaining specialized wildlife structures are not included (e.g., bat boxes, snake hibernacula, turtle nesting mounds, etc.).
- WILDLIFE MONITORING: As noted above, this database focuses on establishment and maintenance of self-sustaining enhanced and natural assets that are expected to provide habitat for wildlife as a “natural by-product”. Therefore, the monitoring costed focuses on the establishment and maintenance of self-sustaining native vegetation. Wildlife-specific monitoring (e.g., for breeding birds, calling amphibians, reptiles, insects, bats or any other mammals) will depend on the site, the conditions and the monitoring requirements, and therefore has been excluded.

As noted above, costing for some activities that could reasonably be expected to be included in these types of projects were not estimated because they were considered too variable depending on the project context. However, as noted in [Table 3](#), several line items have been left in the asset sub-type costing spreadsheets related to the following activities and noted as “user defined” to allow for this information to be inserted as needed/appropriate on a case-by-case basis if desired:

- Labour involved in planning for asset acquisition or creation

- Studies required for assessment of immediate context and coordination of access and permissions
- Land base acquisition (legal, land costs, etc.)
- Installation of any trails, signage, trail-related fencing and/or structures (e.g., lookouts), and
- Monitoring for wildlife occurrences / abundances and/or habitat use.

The financial caveats associated with the lifecycle costing approach used for the 2020 database were also carried forward into the 2025 project for consistency. As such, 2025 replacement cost estimates generated for this project do not account for:

- a. Inflation or discounting over the 50-year lifecycle
- b. Opportunity costs that would represent profit or loss from alternative land uses not being implemented, (such as agriculture or land development)
- c. Any cost savings that may apply to activities if undertaken at a larger scale than the areas assumed for the representative asset sub-types (e.g., no discount applied for a 10 hectare wetland creation even though it could be anticipated that the actual cost would not be 10 times those quoted for 1 hectare), or
- d. Contingencies related to the risk of failure or catastrophic events resulting in complete or near-complete destruction/elimination of the entire representative natural asset prior to the end of the 50 -year lifecycle (e.g., the need to recreate an entire coniferous forest following complete elimination after a forest fire 25 years into its' lifecycle).

Finally, the hypothetical cost estimates generated for this project are specific to the scale and scope of the representative asset sub-types as outlined. The 50-year lifecycle replacement cost estimates developed for four (4) enhanced and 22 natural asset sub-types developed for this project are not intended to replace project-specific and/or site-specific cost estimates for actual projects. These replacement cost estimates are based on assets in hypothetical scenarios with the assumptions explicitly laid out in this report. While the estimates have been based on actual 2025 material and labour costs from actual projects in urban areas in southern Ontario, they are not meant to replace project-specific cost estimates that are tailored to the site context, conditions, and requirements.

Enhanced and Natural Asset Descriptions

High level descriptions for the enhanced and natural asset types and sub-types listed in [Table 1](#) are provided in this section. These descriptions update and expand on the descriptions developed for the 2020 work. They are based on the available and provincially supported descriptions in the ELC manual (Lee *et al.* 1998) to the greatest extent possible and include other key assumptions that informed the replacement costing.

1.3 Asset Type: Manicured Open Space

Manicured open space (i.e., lawn or grass) is considered an enhanced asset because even though it does not have much ecological function, it is still a pervious land cover that can support hydrological functions. Manicured open space (as it is called by CVC) can contribute to municipal services such as water quantity and quality management, erosion control, and provision of open space for outdoor community events and activities. Although not diverse in terms of its species composition or vegetative structure, manicured open space can represent a significant amount of land cover.

For this project, the focus was on lawn for general open space uses, not turf for sports fields (which requires more intensive management). Although there are different species of grass used to create lawn, this was not considered a significant factor influencing cost estimates for installation or long-term management. Therefore, two scenarios for generically defined manicured lawn, as outlined below, were selected for costing through this project.

- **1a. Manicured Open Space (Lawn) - Creation (MOS-cr):** One (1) hectare of lawn to be created on open soil or in an old field acquired by the municipality, agency or other organization and maintained as manicured lawn in good condition for entire 50-year lifecycle.
- **1b. Manicured Open Space (Lawn) - Acquired (MOS-ac):** One (1) hectare of existing manicured lawn has been acquired by the municipality, agency or other organization to be maintained and managed in good condition and maintained as manicured lawn for entire 50-year lifecycle.

1.4 Asset Type: Individual Trees

Individual trees outside of natural areas that are established and maintained on lands owned by a municipality, agency or other organization (often called “street trees” or “park trees”) are also considered enhanced assets and green infrastructure assets (see [Figure 1](#)) as part of the broader urban forest. These trees typically do not provide the same range and diversity of ecological functions as trees in woodlands and forests, but street and park trees can provide a wide range of valued ecosystem services (e.g., shade, air temperature moderation, air filtration, water attenuation and filtration, etc.).

Trees on land outside of natural areas are one of the green infrastructure asset types most easily incorporated into existing asset management plans because they are often already being actively inventoried and managed.

The species and / or type (i.e., deciduous versus coniferous) of trees being established does not significantly influence installation costs. However, installation of trees in “softscapes” (e.g., open soil or lawn) versus “hardscapes” (e.g., concrete boulevards and sidewalks) does significantly influence initial installation cost, particularly if some type of soil cell system is being installed, and to a lesser extent ongoing maintenance.

The two representative sub-types of trees outside natural areas selected for replacement costing are as follows.

- **2a. Individual Trees - Softscape (TR-sft):** A large caliper sapling established along a street or in a park owned by a municipality, agency or other organization where there is lawn or open soil. Assumes a 30 m x 1 m x 1 m deep pit for three (3) 60 mm caliper deciduous trees planted 8 to 10 m on center and maintained in good condition maintained for their entire 50-year lifecycle.
- **2b. Individual Trees - Hardscape (TR-hrd):** A large caliper sapling established along a street or in a park owned by a municipality, agency or other organization where the trees are being integrated into a sidewalk or some other kind of hardscape. Assumes it is a deciduous tree planted in a soil pit or trench (30 m x 1 m x 1 m deep) using soil cell structural technology and technology and imported soil, actively maintained to be in good condition for their entire 50-year lifecycle.

1.5 Asset Type: Stream Corridors

Replacement costing for these assets was outside the scope of this project but are to be developed in 2026. In the interim, please see the *Lifecycle Costing of Restoration and Environmental Management Actions* report (Beacon et al., 2020) for descriptions.

1.6 Asset Type: Wetlands

The Ontario Wetland Evaluation System (OWES) (MNR, 2022) defines wetlands as: “Lands that are seasonally or permanently flooded by shallow water as well as lands where the water table is close to the surface; in either case the presence of abundant water has caused the formation of hydric soils and has favoured the dominance of either hydrophytic or water tolerant plants” and identifies the four major types of wetlands as swamps, marshes, bogs and fens. The ELC system also recognizes the same four wetland types, although the feature delineation approach using OWES and ELC are similar but not identical. For consistency with the approach used to the other natural asset types, ELC wetland community descriptions were used as references for the representative wetland assets for which replacement costs were developed for this project (as provided below).

For this project, marshes (i.e., meadow marshes and shallow marshes) and swamps (i.e., thicket, deciduous, coniferous and mixed) were selected as the natural asset sub-types for

costing. In southern Ontario, most of the existing wetlands are marshes and swamps, while bogs and fens are very rare. Furthermore, restoration practitioners in southern Ontario and elsewhere have had some success in creating, maintaining and restoring basic marsh and thicket swamp communities, and in maintaining swamps (e.g., Toronto and Region Conservation Authority (TRCA), see <https://trca.ca/conservation/restoration/wetlands/>), but success creating swamps and creating or restoring other types of wetlands in North America has been much more limited³.

Successful habitat creation and maintenance actions related to marshes or thicket swamps need to be tailored to respond to unique site, biophysical, and hydrologic conditions. As with other natural features, costs can vary widely depending on a range of factors (e.g., access to the site, amount and extent of cut and fill, extent and nature of water management required – if any, types and densities of plant materials, etc.).

Given the overview above, for this project, nine natural asset sub-types and scenarios considered representative of most wetland types in southern Ontario were identified for developing 50-year lifecycle replacement costs. All descriptions were adopted from the ELC manual (Lee *et al.*, 1998). Notably, in all cases the representative 1 hectare wetlands are assumed to be isolated or palustrine (a lowland feature outside of a shoreline or riverine floodplain).

The nine representative sub-types of wetlands selected for replacement costing are as follows.

- **Meadow Marsh (MAM):** A wetland that is characterized by no more than 25% tree and/or shrub cover (see [Figure 5](#)) and dominated by emergent hydrophytic macrophytes with seasonal flooding (i.e., soils typically flooded in the spring, moist to dry by the summer, and typically moist or flooded again in the fall) and periodic open water depth of less than 2 m. Meadow marshes are typically at the wetland-terrestrial interface, which is seasonally inundated with water and usually dominated by grasses or forbs.
 - **4a. Meadow Marsh - Creation (MAM-cr):** One (1) hectare of meadow marsh wetland created in an old field or manicured open space owned by a municipality, agency or other organization. This asset is created in good to very good condition, and maintained, monitored and managed (as needed) to remain in good condition for its 50-year lifecycle.
 - **4b. Meadow Marsh - Acquired (MAM-ac):** One (1) hectare of existing meadow marsh wetland acquired by a municipality, agency or other organization. This

³ There is a growing body of technical and peer-reviewed research assessing the challenges, opportunities, successes and failures of freshwater wetland restoration. It is outside the scope of this project to explore this in any detail, but the findings of some of this work is summarized succinctly by the U. S. Geological Survey department and can be viewed at websites such as <https://water.usgs.gov/nwsun/WSP2425/restoration.html>.

asset is established, maintained, monitored and managed (as needed) to remain in good condition for its 50-year lifecycle.

- **Shallow Marsh (MAS):** A wetland created in an open field or on unused agricultural lands that is characterized by no more than 25% tree and/or shrub cover (see [Figure 5](#)) and dominated by broad-leaved or narrow-leaved emergent species with seasonal flooding, open water depth of up to 2 m, some standing or flowing open water for much or all of the growing season, and a water table that rarely drops below the substrate surface.
 - **4c. Shallow Marsh - Creation (MAS-cr):** One (1) hectare of shallow marsh wetland created in an old field or manicured open space owned by a municipality, agency or other organization. This asset is created in good to very good condition, and maintained, monitored and managed (as needed) to remain in good condition for its 50-year lifecycle.
 - **4d. Shallow Marsh - Acquired (MAS-ac):** One (1) hectare of existing shallow marsh wetland acquired by a municipality, agency or other organization. This asset is established, maintained, monitored and managed (as needed) to remain in good to very good condition for its 50-year lifecycle.
- **Thicket Swamp (SWT):** A wetland vegetation type is characterized by less than 10% tree cover and more than 25% tall shrub cover (see [Figure 5](#)), dominated by hydrophytic tree and shrub species, with a variable flooding regime with permanent or periodic open water of up to 2 m in depth, and standing water or vernal pooling for more than 20% of the feature's ground cover.
 - **4c. Thicket Swamp - Created (SWT-cr):** One (1) hectare of thicket swamp wetland created in an old field or manicured open space owned by a municipality, agency or other organization. This asset is created in good to very good condition, and maintained, monitored and managed (as needed) to remain in good condition for its 50-year lifecycle.
 - **4d. Thicket Swamp - Acquired (SWT-ac):** One (1) hectare of existing thicket swamp wetland acquired by a municipality, agency or other organization. This asset is established, maintained, monitored and managed (as needed) to remain in good condition for its 50-year lifecycle.
- **Deciduous Swamp (SWT):** A wetland vegetation type characterized by more than 25% cover by trees of at least 5 m tall (see [Figure 5](#)) with at least 75% of those trees being deciduous, dominated by hydrophytic tree species, with a variable flooding regime with permanent or periodic open water of up to 2 m in depth, and standing water or vernal pooling for more than 20% of the feature's ground cover. Common species include Fowl Manna Grass, Spotted Touch-me-not, Bugleweed, Skunk Cabbage, Marsh Marigold, Bedstraws and Stinging Nettle. This wetland type is typically fern and sedge rich.

- **4e. Deciduous Swamp - Acquired (SWD-ac):** One (1) hectare of existing deciduous swamp wetland acquired by a municipality, agency or other organization. This asset is established, maintained, monitored and managed (as needed) to remain in good condition for its 50-year lifecycle.
- **Mixed Swamp (SWM):** A wetland vegetation type characterized by more than 25% cover by trees of at least 5 m tall (see **Figure 5**) with at least 25% of those trees being coniferous, dominated by hydrophytic tree species, with a variable flooding regime with permanent or periodic open water of up to 2 m in depth, and standing water or vernal pooling for more than 20% of the feature's ground cover. Common species include Bunchberry, Starflower, Goldthread, Bluebead Lily, Naked Mitrewort along with Bedstraws, Fowl Manna Grass, Spotted Touch-me-not, Skunk Cabbage, Marsh Marigold and Sedges. This wetland type is typically fern rich (e.g., Sensitive Fern, Cinnamon Fern, Royal Fern, Marsh Fern and Ostrich Fern).
 - **4f. Mixed Swamp - Acquired (SWM-ac):** One (1) hectare of existing mixed swamp wetland acquired by a municipality, agency or other organization. This asset is established, maintained, monitored and managed (as needed) to remain in good condition for its 50-year lifecycle.
- **Coniferous Swamp (SWC):** A wetland vegetation type characterized by more than 25% cover by trees of at least 5 m tall (see **Figure 5**) with at least 75% of those trees being coniferous, dominated by hydrophytic tree species, with a variable flooding regime with permanent or periodic open water of up to 2 m in depth, and standing water or vernal pooling for more than 20% of the feature's ground cover. Typically has a more northern compliment of species, including Bunchberry, Dwarf Raspberry, Wintergreen, Starflower, Goldthread, Canada Mayflower, Naked Mitrewort, Dewdrop, Bluebead Lily and Horsetails.
 - **4g. Coniferous Swamp - Acquired (SWC-ac):** One (1) hectare of existing coniferous swamp wetland acquired by a municipality, agency or other organization. This asset is established, maintained, monitored and managed (as needed) to remain in good condition for its 50-year lifecycle.



Source: Lee *et al.*, 1998

FIGURE 5. ILLUSTRATION OF ABSOLUTE COVER VALUES USED TO DEFINE AND DISTINGUISH DIFFERENT COMMUNITIES IN THE ECOLOGICAL LAND CLASSIFICATION SYSTEM FOR SOUTHERN ONTARIO.

1.7 Asset Type: Upland Cultural Meadows

The ELC system distinguishes two types of naturally occurring upland vegetation communities dominated by grasses and forbs: tallgrass prairie and tallgrass savannah. However, both of these community types are exceedingly rare across southern Ontario. In addition, tallgrass prairies and savannahs are also challenging to create and maintain as, among other things, they require prescribed burning or grazing to be maintained in an open grassland condition. However, upland cultural meadows are much more common throughout southern Ontario.

Cultural meadows are not a naturally occurring habitat *per se* but can result once mowing, grazing or cropping practices are abandoned. A “cultural community” is defined in the ELC manual as a “vegetation community originating from, or maintained by, anthropogenic influences and culturally based disturbances, often containing a large proportion of non-native species,” while meadows are defined as “open terrestrial communities characterized by grasses or forbs, usually originating or maintained by cultural disturbances such as mowing, burning or grazing” (Lee *et al.*, 1998).

Cultural meadows have become relatively widespread across eastern North America as a result of more than two centuries of active management of the lands for agricultural purposes followed by intermittent and localized abandonment of such practices. Cultural meadows support a range of wildlife (some of which are now considered rare, endangered or threatened) and important pollinator habitat. With sustained maintenance (i.e., so that they do not succeed into thicket, woodland or forest), upland cultural meadows can support local biodiversity including habitat for some Species at Risk.

For these reasons, cultural meadows (as defined in Lee *et al.* 1998) were selected as a natural asset type for replacement costing through this project. For this project, the two asset sub-types representing scenarios considered realistic for meadows in southern Ontario selected for replacement costing are as follows:

- **Cultural Meadow (CUM):** An upland vegetation community 25% or less tree and/or shrubs cover with variable site conditions and substrate types, often with a large proportion of non-native plants. and a community resulting from (or maintained by) cultural or anthropogenic-based disturbances.
 - **5a. Cultural Meadow - Creation (CUM-cr):** One (1) hectare of cultural meadow created in an old field or manicured open space owned by a municipality, agency or other organization. This asset is created in good to very good condition, and maintained, monitored and managed (as needed) to remain in good condition for its 50-year lifecycle.
 - **5b. Cultural Meadow - Acquired (CUM-ac):** One (1) hectare of existing cultural meadow acquired by a municipality, agency or other organization. This asset is established, maintained, monitored and managed (as needed) to remain in good to very good condition for its 50-year lifecycle.

In the context of eastern North America, upland meadows (not unlike grasslands), if left unmanaged, will succeed into shrublands, and eventually woodlands and forests. Therefore, ensuring these features remain open spaces dominated by grasses and other herbaceous plants requires a commitment to ongoing maintenance designed to pre-empt the gradual establishment and dominance of woody vegetation.

1.8 Asset Type: Upland Forests

The terms “forest” and “woodland” are defined and used somewhat differently depending on the context (e.g., planning, regulatory, technical) in southern Ontario. For the purposes of this project, the term “forest” is used to describe treed areas that meet either the *Forestry Act* definition or the ELC definition, both cited below.

Ontario’s *Provincial Planning Statement* (PPS) (MMAH 2024) broadly defines “woodlands” as: “treed areas that provide environmental and economic benefits to both the private landowner and the general public, such as erosion prevention, hydrological and nutrient cycling, provision of clean air and the long-term storage of carbon, provision of wildlife habitat, outdoor recreational opportunities, and the sustainable harvest of a wide range of woodland products. Woodlands include treed areas, woodlots or forested areas and vary in their level of significance at the local, regional and provincial levels. Woodlands may be delineated according to the *Forestry Act* definition or the Province’s Ecological Land Classification system definition for “forest”.”

Ontario’s *Forestry Act* (1998) defines forest using a stem density-based approach as: “lands with at least: (a) 1,000 trees, of any size, per hectare, (b) 750 trees, measuring over five centimetres in diameter, per hectare, (c) 500 trees, measuring over 12 centimetres in diameter, per hectare, or (d) 250 trees, measuring over 20 centimetres in

diameter, per hectare, but does not include a cultivated fruit or nut orchard or a plantation established for the purpose of producing Christmas trees. For the purpose of the definition of “woodlands”, all measurements of the trees are to be taken at 1.37 metres from the ground”.

The ELC system distinguishes forest from woodlands based exclusively on percent tree cover with forests having at least 60% tree cover (usually including plantations) and woodlands (including cultural woodlands) having between 35% and 60% cover, with the understanding that these are to be applied to reasonably well-established or mature features, whereas the *Forestry Act* definition also captures wooded areas that are in the process of being created or restored based on stem diameters and densities.

Therefore, for this project, both the *Forestry Act* and ELC-based definitions of “forests” and “woodlands” are considered appropriate for helping to define the replacement costs for the following representative forest assets. Notably, the activities and associated cost for creating and managing or acquiring and managing a Deciduous Forest (FOD) and a Mixed Forest (FOM) were determined to be so similar that it was considered appropriate to make their replacement cost the same (i.e., interchangeable).

For this project, the four asset sub-types representing scenarios considered common and realistic for forests in southern Ontario selected for replacement costing are as follows:

- **DECIDUOUS FOREST (FOD):** An upland area with at least 35% tree canopy cover but typically at least 60% canopy cover, with at least 75% of that cover being deciduous tree species, on variable site conditions and substrate types.
- **MIXED FOREST (FOM):** An upland area with at least 35% tree canopy cover but typically at least 60% canopy cover, with at least 25% of that cover being coniferous tree species and at least 25% of that cover being deciduous tree species, on variable site conditions and substrate types.
 - **6a. Deciduous/Mixed Forest - Creation (FOD/M-cr):** One (1) hectare of deciduous or mixed forest created in an old field or manicured open space. This asset is created in good to very good condition, and maintained, monitored and managed (as needed) to remain in good condition for its 50-year lifecycle.
 - **6b. Deciduous/Mixed Forest - Acquired (FOD/M-ac):** One (1) hectare of existing deciduous or mixed forest acquired by a municipality, agency or other organization. This asset is established, maintained, monitored and managed (as needed) to remain in good condition for its 50-year lifecycle.
- **CONIFEROUS FOREST (FOC):** An upland area with at least 35% tree canopy cover but typically at least 60% canopy cover, with at least 75% of that cover being coniferous tree species, on variable site conditions and substrate types.
 - **6c. Coniferous Forest - Created (FOC-cr):** One (1) hectare of coniferous forest created in an old field or manicured open space owned by a municipality, agency or other organization. This asset is created in good to very good

condition, and maintained, monitored and managed (as needed) to remain in good condition for its 50-year lifecycle.

- **6d. Coniferous Forest - Acquired (FOC-ac):** One (1) hectare of existing coniferous forest acquired by a municipality, agency or other organization. This asset is established, maintained, monitored and managed (as needed) to remain in good condition for its 50-year lifecycle.

Notably, different jurisdictions in southern Ontario may have their own locally tailored definition of “forest” and/or “woodland” but these would need to at least align with what is in the PPS, so the above approach should be generally workable.

1.9 Asset Type: Upland Cultural Treed Communities

In the original 2020 project, replacement costing was not developed for any cultural communities apart from cultural meadows because these tend not to be ideal or target communities when habitat creation and/or restoration is being considered. However, in terms of replacement costing, these communities are quite common and widespread in southern Ontario. Therefore, CVC and its municipal partners expressed interest in current replacement costs for the full range of cultural communities in their natural asset inventories, even if these were not the optimal community types from an ecological function or biodiversity perspective. Therefore, replacement costs for acquisition and maintenance of the full suite of cultural community types identified in the ELC system were developed as part of this project.

As noted above, a “cultural community” is defined in the ELC manual as a “vegetation community originating from, or maintained by, anthropogenic influences and culturally based disturbances, often containing a large proportion of non-native species,” (Lee *et al.*, 1998).

For this project, the six asset sub-types representing scenarios considered common and realistic for cultural treed communities in southern Ontario selected for replacement costing are as follows:

- **7a. Cultural Thicket - Acquired (CUT-ac):** One (1) hectare of existing cultural thicket acquired by a municipality by a municipality, agency or other organization. This is an upland vegetation community with no more than 25% tree cover and no more than 25% shrub cover in which the community has resulted from, or been maintained by, cultural or anthropogenic-based disturbances, often having a large proportion of non-native plant species. This asset is established, maintained, monitored and managed (as needed) to remain in good condition for its 50-year lifecycle.
- **7b. Cultural Savanna - Acquired (CUS-ac):** One (1) hectare of existing cultural savanna acquired by a municipality, agency or other organization. This is an upland vegetation community with between 25% and 35% tree cover in which the community has resulted from, or been maintained by, cultural or anthropogenic-

based disturbances, often having a large proportion of non-native plant species. This asset is established, maintained, monitored and managed (as needed) to remain in good condition for its 50-year lifecycle.

- **7c. Cultural Woodland - Acquired (CUW-ac):** One (1) hectare of existing cultural woodland acquired by a municipality, agency or other organization. This is an upland vegetation community with between 35% and 60% tree cover in which the community has resulted from, or been maintained by, cultural or anthropogenic-based disturbances, often having a large proportion of non-native plant species. This asset is established, maintained, monitored and managed (as needed) to remain in good condition for its 50-year lifecycle.
- **7d. Cultural Plantation, Deciduous - Acquired (CUP1-ac):** One (1) hectare of existing coniferous plantation acquired by a municipality, agency or other organization. This is an upland vegetation community that is treed with at least 60% tree cover in which most trees have been planted, where the planted trees are at least 75% deciduous.
- **7e. Cultural Plantation, Mixed - Acquired (CUP2-ac):** One (1) hectare of existing coniferous plantation acquired by a municipality, agency or other organization. This is an upland vegetation community that is treed with at least 60% tree cover in which most trees have been planted, where the planted trees are a mix of deciduous and coniferous species (at least 25% each).
- **7f. Cultural Plantation, Coniferous - Acquired (CUP3-ac):** One (1) hectare of existing coniferous plantation acquired by a municipality, agency or other organization. This is an upland vegetation community that is treed with at least 60% tree cover in which most trees have been planted, where the planted trees are at least 75% coniferous.

Notably, for these communities a “good” condition rating can be achieved with a lower proportion of native species in the ground layer, sub-canopy (i.e., shrubs and saplings) and canopy layers than the wetland and forest communities described above because they are all defined as having a “large” proportion of non-native species. In general, “good” proportion of non-native species could be considered less than 50% for cultural communities whereas for other natural assets it could be less than 25%, noting that these percentage should be lower where certain very aggressive or otherwise impactful invasive species are present.

1.10 Asset Type: Cultural Plantation to Forest

In some cases, municipalities, agencies or other organizations involved in natural areas securement and management may acquire a “cultural” natural asset type (as described above) and decide to enhance its ecological functions (and service provision) by gradually converting it into an asset type that is more dominated by a greater diversity of native species.

Although there are many different possibilities for what we call “community conversions”, one of the more common conversions implemented in southern Ontario is from an established cultural plantation to a mixed forest (FOM). Therefore, this is the natural asset conversion for which replacement costing was developed (first in 2020 and updated in 2025).

- **8a. Cultural Plantation (CUP3) to be Mixed Forest, Created (FOM-cr):** One (1) hectare of existing coniferous plantation (i.e., a treed with at least 60% tree cover in which the majority of trees have been planted, where the planted trees are at least 75% coniferous) acquired by a municipality, agency or other organization that is gradually managed to become a treed area with at least 25% of that cover being coniferous tree species and at least 25% of that cover being deciduous tree species.

Replacement Cost Estimates (2025)

This section provides summaries of the replacement cost estimates for each asset sub-type by phase and in total based on realistic labour and materials cost from 2025 for contractor-based work for each of the enhanced (Table 5a) and natural assets (Table 5b) costed hypothetically.

This section also provides summaries of these same 2025 replacement cost estimates for each of the enhanced (Table 6a) and natural assets (Table 6b) costed hypothetically but discounted based on assumptions for agencies or organizations where in-house labour and equipment are available and do not represent an additional cost.

The actual costing workbooks are available from CVC on request. Please email naes@cvc.ca to request the costing workbooks. Notably, the unit costs as well as the percentage discounts can be manually adjusted by users if desired on the master costing spreadsheet in each workbook if desired. Similarly, there are several fields to add user defined values if desired.

Municipal partners, agencies and other organizations interested in using the replacement costs (or at least the approach and format) developed for this project should understand that:

- The cost estimates generated for this project are specific to the scale and scope of the representative natural asset sub-types as defined for this project and are not intended for use in detailed design cost estimating, and
- Detailed design cost estimating should be done on a project-specific basis and should be tailored to the local site context and conditions.

The cost estimates generated for this project are, however, intended to provide reasonable cost estimates to inform and facilitate comparisons of different options from an asset planning and management perspective.

TABLE 5A. SUMMARY OF REPLACEMENT 2025 COST ESTIMATES FOR REPRESENTATIVE ENHANCED ASSET SUB-TYPES BY PHASE AND TOTALS BASED ON 2025 CONTRACTOR COSTS.

ASSET TYPE	ASSET SUB-TYPE	CODE*	COSTS BY PHASE					TOTALS
			Phase 1: Plan, Inventory and Assess (Years 1 - 2)	Phase 2: Secure or Create (Years 3 - 5)	Phase 3: Inspect and Maintain (Years 6 - 10)	Phase 4: Monitor and Manage (Years 11 - 49)	Phase 5: Remove (Year 50)	
			TOTAL	TOTAL	TOTAL	TOTAL	TOTAL	
1. Lawn	1a. Manicured Open Space - Creation (1 ha)	MOS-cr	\$1,700.00	\$279,238.50	\$111,975.00	\$341,502.00	\$12,500.00	\$746,915.50
	1b. Manicured Open Space - Acquired (1 ha)	MOS-aq	\$750.00	\$88,680.00	\$55,852.50	\$301,002.00	\$12,500.00	\$458,784.50
2. Individual Trees	2a. Individual Tree - Softscape	TR-sft	\$625.00	\$2,783.13	\$2,470.00	\$15,780.00	\$2,504.50	\$24,162.63
	2b. Individual Tree - Hardscape	TR-hrd	\$675.00	\$8,564.43	\$2,620.00	\$15,780.00	\$2,504.50	\$30,143.93

* The suffixes "-cr" = created and "-ac" = acquired. The primary part of the codes is based on the Ecological Land Classification (ELC) system for southern Ontario (1998 version) with some refinements and additions for communities not defined in the ELC system.

TABLE 5B. SUMMARY OF REPLACEMENT 2025 COST ESTIMATES FOR REPRESENTATIVE NATURAL ASSET SUB-TYPES BY PHASE AND TOTALS BASED ON 2025 CONTRACTOR COSTS.

ASSET TYPE	ASSET SUB-TYPE	CODE*	COSTS BY PHASE				TOTALS
			Phase 1: Plan, Inventory and Assess (Years 1 - 2)	Phase 2: Secure or Create (Years 3 - 5)	Phase 3: Inspect and Maintain (Years 6 - 10)	Phase 4: Monitor and Manage (Years 11 - 50)	
			TOTAL	TOTAL	TOTAL	TOTAL	
4. Wetlands	4a. Meadow Marsh - Creation (1 ha)	MAM-cr	\$200.00	\$217,945.00	\$10,500.00	\$226,765.00	\$455,410.00
	4b. Meadow Marsh - Acquired (1 ha)	MAM-ac	\$200.00	\$53,718.13	\$10,500.00	\$206,496.25	\$270,914.38

ASSET TYPE	ASSET SUB-TYPE	CODE*	COSTS BY PHASE				TOTALS
			Phase 1: Plan, Inventory and Assess (Years 1 - 2)	Phase 2: Secure or Create (Years 3 - 5)	Phase 3: Inspect and Maintain (Years 6 - 10)	Phase 4: Monitor and Manage (Years 11 - 50)	
			TOTAL	TOTAL	TOTAL	TOTAL	
	4c. Shallow Marsh - Created (1 ha)	MAS-cr	\$200.00	\$217,945.00	\$10,500.00	\$161,705.00	\$390,350.00
	4d. Shallow Marsh - Acquired (1 ha)	MAS-ac	\$200.00	\$53,718.13	\$10,500.00	\$206,496.25	\$270,914.38
	4e. Thicket Swamp - Created (1 ha)	SWT-cr	\$200.00	\$207,990.00	\$10,500.00	\$185,745.00	\$404,435.00
	4f. Mixed Swamp - Acquired (1 ha)	SWT-ac	\$200.00	\$53,718.13	\$10,500.00	\$206,496.25	\$270,914.38
	4g. Deciduous Swamp - Acquired (1 ha)	SWD-ac	\$200.00	\$67,706.25	\$10,500.00	\$206,496.25	\$284,902.50
	4h. Mixed Swamp - Acquired (1 ha)	SWM-ac	\$200.00	\$53,718.13	\$10,500.00	\$206,496.25	\$270,914.38
	4i. Coniferous Swamp - Acquired (1 ha)	SWC-ac	\$200.00	\$53,718.13	\$10,500.00	\$206,496.25	\$270,914.38
5. Upland Meadows	5a. Cultural Meadow - Creation (1 ha)	CUM-cr	\$15,000.00	\$253,013.13	\$7,655.00	\$102,396.25	\$378,064.38
	5b. Cultural Meadow - Acquired (1 ha)	CUM-ac	\$15,000.00	\$32,795.63	\$7,655.00	\$102,396.25	\$157,846.88
6. Upland Forests	6a. Deciduous/Mixed Forest - Creation (1 ha)	FOD/M-cr	\$18,500.00	\$364,842.75	\$96,576.50	\$179,900.00	\$659,819.25
	6b. Deciduous/Mixed Forest - Acquired (1 ha)	FOD/M-ac	\$19,500.00	\$107,240.00	\$39,374.00	\$65,601.25	\$231,715.25

ASSET TYPE	ASSET SUB-TYPE	CODE*	COSTS BY PHASE				TOTALS
			Phase 1: Plan, Inventory and Assess (Years 1 - 2)	Phase 2: Secure or Create (Years 3 - 5)	Phase 3: Inspect and Maintain (Years 6 - 10)	Phase 4: Monitor and Manage (Years 11 - 50)	
			TOTAL	TOTAL	TOTAL	TOTAL	
	6c. Coniferous Forest - Created (1 ha)	FOC-cr	\$18,500.00	\$364,842.75	\$96,576.50	\$179,900.00	\$659,819.25
	6d. Coniferous Forest - Acquired (1 ha)	FOC-ac	\$19,500.00	\$107,240.00	\$35,874.00	\$65,601.25	\$228,215.25
7. Upland Cultural Treed Communities	7a. Cultural Thicket - Acquired (1 ha)	CUT-ac	\$200.00	\$60,838.25	\$5,483.20	\$65,601.25	\$132,122.70
	7b. Cultural Savanna - Acquired (1 ha)	CUS-ac	\$200.00	\$65,529.00	\$4,112.40	\$66,846.25	\$136,687.65
	7c. Cultural Woodland - Acquired (1 ha)	CUW-ac	\$200.00	\$78,681.75	\$4,112.40	\$66,846.25	\$149,840.40
	7d. Cultural Plantation, Deciduous - Acquired (1 ha)	CUP1-ac	\$200.00	\$83,454.50	\$5,483.20	\$64,978.75	\$154,116.45
	7e. Cultural Plantation, Mixed - Acquired (1 ha)	CUP2-ac	\$200.00	\$83,454.50	\$5,483.20	\$64,978.75	\$154,116.45
	7f. Cultural Plantation, Coniferous - Acquired (1 ha)	CUP3-ac	\$200.00	\$83,454.50	\$5,483.20	\$64,978.75	\$154,116.45
8. Cultural Plantation to Forest	8. Cultural Plantation to be Mixed Forest - Acquired (1 ha)	FOM-ac	\$200.00	\$166,397.76	\$5,483.20	\$133,016.25	\$305,097.21

* The suffixes "-cr" = created and "-ac" = acquired. The primary part of the codes is based on the Ecological Land Classification (ELC) system for southern Ontario (1998 version) with some refinements and additions for communities not defined in the ELC system.

TABLE 6A. SUMMARY OF 2025 REPLACEMENT COST ESTIMATES FOR REPRESENTATIVE ENHANCED ASSET SUB-TYPES BY PHASE AND TOTALS BASED ON 2025 DISCOUNTED CONTRACTOR COSTS.**

ASSET TYPE	ASSET SUB-TYPE	CODE*	DISCOUNTED** COSTS BY PHASE					TOTALS
			Phase 1: Plan, Inventory and Assess (Years 1 - 2)	Phase 2: Secure or Create (Years 3 - 5)	Phase 3: Inspect and Maintain (Years 6 - 10)	Phase 4: Monitor and Manage (Years 11 - 49)	Phase 5: Remove (Year 50)	
			TOTAL	TOTAL	TOTAL	TOTAL	TOTAL	GRAND TOTAL
1. Lawn	1a. Manicured Open Space - Creation (1 ha)	MOS-cr	\$1,700.00	\$76,859.25	\$8,950.00	\$89,200.00	\$3,125.00	\$179,834.25
	1b. Manicured Open Space - Acquired (1 ha)	MOS-aq	\$750.00	\$6,000.00	\$20,150.00	\$104,550.00	\$6,250.00	\$137,700.00
2. Individual Trees	2a. Individual Tree - Softscape	TR-sft	\$625.00	\$252.18	\$389.60	\$1,516.80	\$626.13	\$3,409.71
	2b. Individual Tree - Hardscape	TR-hrd	\$675.00	\$3,246.84	\$389.60	\$1,516.80	\$626.13	\$6,454.36

* The suffixes "-cr" = created and "-ac" = acquired. The primary part of the codes is based on the Ecological Land Classification (ELC) system for southern Ontario (1998 version) with some refinements and additions for communities not defined in the ELC system.

** For each asset-specific activity a percent discount (ranging from 0% to 100%, as deemed appropriate) was applied to generate a reduced replacement cost for jurisdictions where in-house labour and equipment can be used. Note these can be adjusted by the user.

TABLE 6B. SUMMARY OF 2025 REPLACEMENT COST ESTIMATES FOR REPRESENTATIVE ENHANCED ASSET SUB-TYPES BY PHASE AND TOTALS BASED ON 2025 DISCOUNTED CONTRACTOR COSTS.**

ASSET TYPE	ASSET SUB-TYPE	CODE*	DISCOUNTED** COSTS BY PHASE				TOTALS
			Phase 1: Plan, Inventory and Assess (Years 1 - 2)	Phase 2: Secure or Create (Years 3 - 5)	Phase 3: Inspect and Maintain (Years 6 - 10)	Phase 4: Monitor and Manage (Years 11 - 50)	
			TOTAL	TOTAL	TOTAL	TOTAL	GRAND TOTAL
4. Wetlands	4a. Meadow Marsh - Creation (1 ha)	MAM-cr	\$200.00	\$69,526.35	\$0.00	\$81,112.85	\$150,839.20

ASSET TYPE	ASSET SUB-TYPE	CODE*	DISCOUNTED** COSTS BY PHASE				TOTALS
			Phase 1: Plan, Inventory and Assess (Years 1 - 2)	Phase 2: Secure or Create (Years 3 - 5)	Phase 3: Inspect and Maintain (Years 6 - 10)	Phase 4: Monitor and Manage (Years 11 - 50)	
			TOTAL	TOTAL	TOTAL	TOTAL	
	4b. Meadow Marsh - Acquired (1 ha)	MAM-ac	\$200.00	\$15,251.98	\$0.00	\$74,424.16	\$89,876.14
	4c. Shallow Marsh - Created (1 ha)	MAS-cr	\$200.00	\$69,526.35	\$0.00	\$48,582.85	\$118,309.20
	4d. Shallow Marsh - Acquired (1 ha)	MAS-ac	\$200.00	\$15,251.98	\$0.00	\$74,424.16	\$89,876.14
	4e. Thicket Swamp - Created (1 ha)	SWT-cr	\$200.00	\$66,241.20	\$0.00	\$48,582.85	\$115,024.05
	4f. Mixed Swamp - Acquired (1 ha)	SWT-ac	\$200.00	\$15,251.98	\$0.00	\$74,424.16	\$89,876.14
	4g. Deciduous Swamp - Acquired (1 ha)	SWD-ac	\$200.00	\$19,868.06	\$0.00	\$74,424.16	\$94,492.23
	4h. Mixed Swamp - Acquired (1 ha)	SWM-ac	\$200.00	\$15,251.98	\$0.00	\$74,424.16	\$89,876.14
	4i. Coniferous Swamp - Acquired (1 ha)	SWC-ac	\$200.00	\$15,251.98	\$0.00	\$74,424.16	\$89,876.14
5. Upland Meadows	5a. Cultural Meadow - Creation (1 ha)	CUM-cr	\$15,000.00	\$48,931.83	\$2,077.50	\$22,504.16	\$88,513.49
	5b. Cultural Meadow - Acquired (1 ha)	CUM-ac	\$15,000.00	\$10,292.08	\$0.00	\$22,504.16	\$47,796.24
6. Upland Forests	6a. Deciduous/Mixed Forest - Creation (1 ha)	FOD/M-cr	\$18,500.00	\$107,149.96	\$36,813.83	\$69,808.33	\$232,272.11

ASSET TYPE	ASSET SUB-TYPE	CODE*	DISCOUNTED** COSTS BY PHASE				TOTALS
			Phase 1: Plan, Inventory and Assess (Years 1 - 2)	Phase 2: Secure or Create (Years 3 - 5)	Phase 3: Inspect and Maintain (Years 6 - 10)	Phase 4: Monitor and Manage (Years 11 - 50)	
			TOTAL	TOTAL	TOTAL	TOTAL	
	6b. Deciduous/Mixed Forest - Acquired (1 ha)	FOD/M-ac	\$19,500.00	\$19,350.54	\$17,937.00	\$15,947.96	\$72,735.50
	6c. Coniferous Forest - Created (1 ha)	FOC-cr	\$18,500.00	\$107,149.96	\$36,813.83	\$69,808.33	\$232,272.11
	6d. Coniferous Forest - Acquired (1 ha)	FOC-ac	\$19,500.00	\$19,350.54	\$17,937.00	\$15,947.96	\$72,735.50
7. Upland Cultural Treed Communities	7a. Cultural Thicket - Acquired (1 ha)	CUT-ac	\$200.00	\$9,405.08	\$2,391.60	\$15,947.96	\$27,944.65
	7b. Cultural Savanna - Acquired (1 ha)	CUS-ac	\$200.00	\$11,295.24	\$1,793.70	\$15,947.96	\$29,236.90
	7c. Cultural Woodland - Acquired (1 ha)	CUW-ac	\$200.00	\$15,635.65	\$1,793.70	\$15,947.96	\$33,577.31
	7d. Cultural Plantation, Deciduous - Acquired (1 ha)	CUP1-ac	\$200.00	\$17,210.66	\$2,391.60	\$15,947.96	\$35,750.22
	7e. Cultural Plantation, Mixed - Acquired (1 ha)	CUP2-ac	\$200.00	\$17,210.66	\$2,391.60	\$15,947.96	\$35,750.22
	7f. Cultural Plantation, Coniferous - Acquired (1 ha)	CUP3-ac	\$200.00	\$17,210.66	\$2,391.60	\$15,947.96	\$35,750.22
8. Cultural Plantation to Forest	8. Cultural Plantation to be Mixed Forest - Acquired (1 ha)	FOM-ac	\$200.00	\$40,703.80	\$2,391.60	\$58,504.16	\$101,799.56

* The suffixes "-cr" = created and "-ac" = acquired. The primary part of the codes is based on the Ecological Land Classification (ELC) system for southern Ontario (1998 version) with some refinements and additions for communities not defined in the ELC system.

** For each asset-specific activity a percent discount (ranging from 0% to 100%, as deemed appropriate) was applied to generate a reduced replacement cost for jurisdictions where in-house labour and equipment can be used. Note these can be adjusted by the user.

Concluding Remarks and Next Steps

To the best of our knowledge, this project remains unique in that it provides comprehensive 50-year lifecycle cost-estimates for a suite of representative enhanced and natural assets based on current materials and labour costs, as well as a suite of activities expected to establish and maintain these assets in a good to very good condition.

As noted above, these costs have been gathered from a range of practitioners who oversee and undertake this type of specialized work in southern Ontario, and so the costs are considered realistic for scenarios in southern Ontario. However, they may also be reasonable for urban and urbanizing jurisdictions elsewhere in Ontario or Canada.

As part of this work:

- replacement costs for the previously identified priority terrestrial enhanced and natural assets were updated based on 2025 costs (i.e., all asset types except for stream corridors)
- 2025 replacement costs were developed for additional terrestrial natural assets known to be common in southern Ontario (i.e., mainly cultural communities and wetlands)
- the spreadsheets with the detailed lifecycle replacement cost estimates were improved by:
 - breaking them out into four separate workbooks (in MS Excel™) to reduce the number of tabs in each and simplify use
 - including a master costing spreadsheet in each workbook with unit costs linked as appropriate to each asset sub-type costing sheet to facilitate changing or updating cost in the future, and
 - reformatting the asset sub-type sheets to make the asset-specific and task/activity-specific assumptions more explicit.

These changes are expected to facilitate user-based updates to unit costs and/or to asset sub-type specific assumptions, if desired and to facilitate overall costing updates in the future

The focus of this project was on updating lifecycle costs for a comprehensive suite of terrestrial enhanced and natural assets (i.e., lawn, trees, meadows, wetlands, forests/woodlands, and plantations). A follow-up project to update and expand costs for a suite of riparian and aquatic natural assets is planned for 2026. Together, these costs are expected to provide a complete suite of 50-year replacement costs for the most common enhanced and natural assets that occur or can be created in southern Ontario.

“At a more advanced level, average replacement costs can be based on credible sources such as historical restoration costs from comparable local projects, or estimated based on the specific work anticipated to restore the natural asset as determined by restoration and naturalization specialists”. (NAI 2024)

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Glossary of Technical Terms

TERM	DEFINITION*	SOURCE
Asset Management Planning	An ongoing and long-term process that allows municipalities and others to make the best possible investment decisions for their infrastructure assets.	Government of Ontario 2025
Basal Area	The area occupied by a plant near the ground surface; measured across the stem of a tree 1.3 to 1.5 m above the ground surface, or across a clump of graminoids [a.k.a. grasses] usually 2 to 3 cm above the ground surface.	ELC Manual (Lee <i>et al.</i> , 1998)
Cultural Community	A vegetation community originating from, or maintained by, anthropogenic influences and culturally based disturbances, often containing a large proportion of non-native species.	ELC Manual (Lee <i>et al.</i> , 1998)
(Cultural) Meadow	Open terrestrial communities characterized by grasses or forbs; usually originating or maintained by cultural disturbances such as mowing, burning or grazing. May also include “old field”, defined as an early successional community that has regenerated from abandoned agricultural land.	ELC Manual (Lee <i>et al.</i> , 1998)
Green Infrastructure Asset	An infrastructure asset consisting of natural or human-made elements that provide ecological and hydrological functions and processes and includes natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces and green roofs.	O. Reg. 588/17
Infrastructure Asset Inventory	According to the applicable regulation in Ontario (i.e., O. Reg. 588/17), municipalities are required to provide summary-level information on each asset category, if applicable, including: • asset types (for example, urban arterial road, rural arterial road, watermain) and quantity/extent (for example, length in kilometers for linear assets); • replacement cost valuation (replacement cost valuation is forward-looking and accounts for expected inflation, changes in technology and other factors); • average age of the assets in the category • asset condition, including a description of the municipality’s approach to assessing the condition of assets in the category (for example, this could include categorizing the proportion of assets in “good,” “fair” and “poor” condition) The municipality must indicate how the background information and reports used to inform the summary-	Government of Ontario 2025

TERM	DEFINITION*	SOURCE
	level information for each asset category will be made available to the public.	
Isolated wetlands	Wetlands that have no surface outflow. The sources of nutrients to isolated wetlands can include precipitation, diffuse overland flow and occasionally groundwater.	OWES (MNR 2022)
Lakes	Areas of open water that are greater than 8 hectares in size and at some locations are greater than 2 m in depth from the normal low water mark.	OWES (MNR 2022)
Lifecycle Activities	Activities undertaken with respect to a municipal infrastructure asset over its service life, including constructing, maintaining, renewing, operating and decommissioning, and all engineering and design work associated with those activities. By July 1, 2024, the regulation requires municipalities to determine the lifecycle activities that would need to be undertaken for each asset category over a 10-year period to provide the proposed levels of service.	O. Reg. 588/17 and Government of Ontario (2020a)
Marsh Wetland (includes Open Water Marshes)	Wet areas periodically inundated with standing or slowly moving water, and / or permanently inundated areas characterized by robust emergent, and to a lesser extent, anchored floating plants and submergents. Surface water levels may fluctuate seasonally, with declining levels exposing drawdown zones of matted vegetation or mud flats.	OWES (MNR 2022)
Meadows	Open terrestrial communities characterized by grasses or forbs, usually originating or maintained by cultural disturbances such as mowing, burning or grazing.	ELC Manual (Lee <i>et al.</i> , 1998)
Municipal Natural Asset	The stocks of natural resources or ecosystems that contribute to the provision of one or more services required for the health, well-being, and long-term sustainability of a community and its residents.	NAI 2024
Natural Asset	The stock of natural resources and ecosystems that yield a flow of benefits to people... including wetlands, forests, parks, lakes / rivers / creeks, fields and soil.	NAI 2024
Palustrine Wetlands	These wetlands generally occur in lands positioned physiographically upslope from lacustrine and riverine wetlands and are defined either by absent or intermittent inflow and either intermittent or permanent outflow. They are often found in headwater areas and may drain in opposite directions into different streams or river basins.	OWES (MNR 2022)
Riverine Wetlands	Wetlands within a channel of continuously moving water to the 2 m depth, as well as adjacent wetlands and normal flood plains or rivers and permanent streams.	OWES (MNR 2022)
Service Life	The total period during which a municipal infrastructure asset is in use or is available to be used.	O. Reg. 588/17

[Type here]

TERM	DEFINITION*	SOURCE
Thicket Swamp Wetlands	A wetland vegetation type that is characterized by <10% tree cover and >25% shrub cover (Lee <i>et al.</i> , 1998). Thicket swamps are characterized by thick grows of tall shrubs such as willow species, red-osier dogwood, buttonbush and speckled alder (MNR 2022).	ELC Manual (Lee <i>et al.</i> , 1998) and OWES (MNR 2022)
Vegetation Structure	The vertical stratification associated with a plant community.	ELC Manual (Lee <i>et al.</i> , 1998)
Wetlands	Lands that are seasonally or permanently covered by shallow water, as well as lands where the water table is close to or at the surface. In either case, the presence of abundant water has caused the formation of hydric soils and has favoured the dominance of either hydrophytic or water tolerant plants.	OWES (MNR 2022)

* Definitions have been cited verbatim from the sources cited.