Como Lakeshore Management Plan



Capitol Region Watershed District St. Paul, Minnesota

Prepared by: Resource Environmental Solutions (RES)

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The District would like to acknowledge the Dakota peoples on whose land we work. We thank the Dakota peoples and their relatives for their care of the land, and we recognize their continuing connection to the land, waters, and community. We pay our respects to Dakota people and their culture; past, present and future. We pledge to treat this land honorably and respectfully.

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Acronyms and Abbreviations

Best Management Practices
Como Lake Management Plan
Capitol Region Watershed District
Emerald ash borer
Geographic Information System
Great River Greening
Integrated Pest Management
Minnesota Department of Natural Resources
Minnesota Pollution Control Agency
Resource Environmental Solutions, LLC
U.S. Fish & Wildlife Service

Executive Summary

Como Lake is a treasured resource, part of the City of St. Paul's Como Regional Park. Urban lakeshores experience many stressors and impacts, largely due to intensive use by people. In recent decades investments have been made by the City of St. Paul, Capitol Region Watershed District, Ramsey County, and District 10 Como Community Council to address the issues preventing Como Lake's lakeshore from reaching the condition that those who value it hope for. While progress has been made, issues remain that warrant attention but also offer opportunities to make the lakeshore more accessible, ecologically healthier, and more resilient to face its future challenges.

Building on previous planning projects, this Lakeshore Management Plan focuses on improving the ecological health, resilience, aesthetics, and functionality of the strip of land immediately surrounding Como Lake. The Plan describes the different zones around the Lake (i.e., shoreline, buffer, and active parkland), issues faced by the lakeshore, and an ecological approach to restoring and managing this natural area. The Plan presents goals, objectives, and actions for the adaptive management of Como Lake's lakeshore as a healthy, accessible, low-maintenance landscape.

Implementation of recommended actions will follow defined priorities. Several partners will assist with implementing this Plan, which uses an ecological approach to achieve project goals. Table 3 (page 41) summarizes the Plan's goals and actions: frequency of an action's occurrence; the lead agency for implementation; and the costs over twenty years. Implementing this lakeshore management plan will bequeath to future generations a cost-effective approach to improve and maintain the lakeshore and secure healthy, resilient ecosystems for the enjoyment of all and the benefit of nature.

1.0 Introduction

1.1 Overview and Purpose

Como Lake is a treasured resource within the City of St. Paul's popular Como Regional Park. As with many urban parks, historical land alterations, heavy use by people, and other environmental "stressors" have impacted the health and integrity of Como Lake and its surrounding parkland. Investments over recent decades by the City of St. Paul, Capitol Region Watershed District (CRWD), Ramsey County, and District 10 Como Community Council have addressed numerous issues around Como Lake's lakeshore, including converting vegetation to native species, managing invasive plants, and stabilizing locations experiencing erosion. Fortunately, the careful thought and diligent efforts by many groups and individuals have vastly improved the condition of the lakeshore of Como Lake. However, issues remain that warrant attention, and there are opportunities to make the lakeshore a more healthy and sustainable ecosystem.

The Como Lake Management Plan (CLMP, LimnoTech 2019) presented goals, objectives, and actions addressing the Lake and watershed issues. While that plan mentioned some lakeshore issues, those were not its focus. Therefore, an action recommended in the CLMP (Action L11) was to develop this Como Lakeshore Management Plan:

L11. Develop and implement shoreline management plan. In collaboration with the City of St. Paul, develop and implement a "Como Lake Shoreline Management Plan" that emphasizes native plant diversity, wildlife habitat, shoreline stabilization, and capture of surface runoff. Using information obtained in the shoreline assessment, the shoreline management plan should incorporate steps to implement priority actions, which include:

- Implement shoreline vegetation improvement and/or reinforcement to stabilize erosional areas and promote wildlife habitat.
- Maintain areas of shoreline vegetation that allow for visual and physical access to Como Lake from the shoreline through vegetation.
- Where needed and feasible, replace nuisance non-native vegetation with native vegetation.

This Plan builds on previous studies and work by others, but focuses on improving the ecological health, resilience, aesthetics, and functionality of the strip of land immediately surrounding Como Lake. The Plan outlines goals, objectives, and actions for the management and maintenance of Como Lake's lakeshore. As with the CLMP, this Como Lakeshore Management Plan has been developed with adaptive management in mind (see Section 3.1). This Plan will help CRWD and the City of Saint Paul prioritize routine shoreline maintenance and plan for larger-scale or site-specific shoreline improvement projects. People's access to the Lake and enjoyment of the Park are critical to the success of this Plan, as is establishment of a healthy, low-maintenance landscape around the Lake. Appendix A provides a glossary of technical terms used in this Plan.

This Plan was developed under the leadership of the CRWD, specifically Britta Belden (Water Resource Project Manager) and Bob Fossum (Monitoring & Research Division Manager). Contributions from the City of St. Paul were provided by Adam Robbins (Parks & Recreation - Natural Resources Supervisor), Maggie Barnick and Patrick Williamson (Parks & Recreation - Natural Resources Technicians), Anne Gardner (Parks & Recreation - Landscape Architect), and Pat Murphy (Public Works). Contributions from Ramsey County were provided by Justin Townsend (Environmental AIS Coordinator).

1.2 Related Planning Documents

Como Lake has been addressed in many previous plans, studies, and reports, several of which were outcomes of actions identified in the CLMP (LimnoTech 2019). Some of the most recent and applicable publications include:

- Como Lake Management Plan (CLMP, LimnoTech 2019)
- Como Lake Fishery Management Plan (Wenck Associates, Inc., now part of Stantec 2021) (CLMP, Action L8)
- Como Lake Shoreline Survey (Ramsey County Soil & Water Conservation Division (RCSWCD) 2020) (CLMP, Action L10)
- Como Lake Long-Term Aquatic Vegetation Management Plan (Wenck Associates 2020) (CLMP, Action L6)
- A Chronological Illustrated History of Como Park St. Paul, Minnesota (Gadban 2015)

These plans were reviewed and considered when developing this Lakeshore Management Plan. In particular, the CLMP (LimnoTech 2019) presents an overarching vision, issues, goals, and recommended actions for Como Lake, focusing on the Lake itself and its watershed. The plan's actions include:

- Action L10 Conduct shoreline assessment. This action was completed in 2020 as the Como Lake Shoreline Survey (Ramsey County Parks & Recreation et al 2020)
- Action L11 Develop and implement shoreline management plan. This action is being addressed through development of this Lakeshore Management Plan.

1.3 The Importance of Lakeshores

The interface between open water and adjacent uplands (e.g., a lakeshore) is an important zone in the landscape. Uplands and adjacent shallow water environments provide a "buffer," which filters runoff (protecting water quality), helps mitigate erosion from waves, and provides habitat for a diversity of plants and native wildlife (including pollinators). These important functions help provide resilience in the face of environmental change. Lakeshores are also popular places for people to enjoy.

Healthy lakeshores can take many forms, but most in the Twin Cities region are characterized by stable soils, thriving native vegetation (terrestrial and aquatic), and relatively stable (or seasonally predictable) water levels. However, lakeshores are often sensitive to environmental disturbance if not managed

properly. Human activities that disturb soil, clear or impact native vegetation, or result in altered hydrologic regimes (e.g., water levels) can compromise healthy lakeshores, resulting in erosion, reduced water quality, habitat loss, and poorer aesthetics. Therefore, careful management of lakeshores— especially heavily used and beloved lakeshores such as at Como Lake—is important to retain the function and aesthetics of these important areas.

2.0 Lakeshore Assessment

2.1 Definitions

This Lakeshore Management Plan focuses on the area between Como Lake's waterline and the perimeter trail that encircles the Lake. The following zones have been identified to facilitate discussion of the project area:

- **Shoreline.** The land-water interface, within normal water level fluctuations, that is affected by wave action and water level fluctuations.
- **Buffer.** The vegetated, non-turf area between the shoreline and active parkland.
- Lakeshore. The combined total area of the shoreline zone and the buffer zone.
- Active Parkland. Area upslope of the buffer zone (e.g., mowed turf, perimeter trail, pavement).

Figure 1. Como Lakeshore Zones



2.2 Desktop and Field Methods

In addition to the planning documents listed in Section 1.2, RES compiled and reviewed digital mapping (GIS) data provided by CRWD and from other sources (e.g., City of St. Paul, Minnesota Department of Natural Resources, MNDNR). The Como Lake Shoreline Survey (Ramsey County Parks & Recreation et al 2020) provided early guidance on erosion areas, storm sewer outfalls, and vegetation characteristics.

During our field assessment, observations were collected on paper ecological assessment forms and field maps, and we used Collector for ArcGIS (Collector), a smartphone- or tablet-based application that facilitates collection of georeferenced data points, including photographs and other features of interest (e.g., areas of erosion). These methods allowed for efficient collection of detailed field conditions, including vegetation structure (e.g., density of tree canopy and shrubs), native and invasive plant species and abundance, erosion features, park amenities, etc. Collected information was used in characterizing the varying sections of lakeshore, preparing the figures in this Plan, identifying potential actions, and estimating costs for implementation.

2.3 Past and Existing Conditions

An understanding of a site's past and existing conditions is foundational to the development of an effective management plan. Consideration of regional and local scales is also useful to place a site within its ecological and social context.

Como Lake is located within Como Regional Park in the City of St. Paul. The Park is one of the most cherished and popular recreational amenities within the City, used extensively by residents and visitors. Located in the northwest portion of the City, the Lake is surrounded by parkways and parkland dominated by turf and planted trees (Figure 2). Prior to European settlement in the mid-1800s, Como Lake was located within a region dominated by oak savanna. Savanna is characterized by individual and/or groupings of tree species such as Bur, White, Northern pin, and Red oaks as well as a variety of shrubs, prairie grasses, sedges (grass-like plants), and forbs (i.e., wildflowers). The Lake itself sits within an iceblock depression that formed when glaciers receded from the region approximately 10,000 years ago. Como Lake may have been a wetland historically; however, it has undergone significant modifications since the late 1800s, including dredging, grading, pumping, sealing, and damming (CRWD 2002). During this time, the Lake's contributing drainage area has been drastically increased in size and undergone urban development, resulting in more runoff (much from impervious surfaces) flowing into the Lake. Park improvements, such as the Lake perimeter trail, have been implemented over the decades, having a variety of effects on the lakeshore. Other documents provide a detailed account of Como Park and the Lake's rich history (e.g., Gadban 2015).

As stated previously, this Lakeshore Management Plan focuses on the area between Como Lake's waterline and the perimeter trail that encircles the Lake. Each zone of the Como Lakeshore is described in the following sections.

Figure 2. Como Lakeshore Overview Map



2.3.1 Shoreline

While some of Como Lake's shoreline was altered dramatically through dredging and filling (particularly the northwest portion of the Lake), much of the shoreline appears to consist of native soil that is vegetated primarily by native tree, shrub, and herbaceous species. Three portions of the shoreline are artificial: the sea wall along the Pavilion waterfront, riprap-armored Duck Point, and the fill and rock used to create and maintain Compass Point (Figure 2). A fishing pier extends into the southern portion of the Lake (Figure 2).

Storm Sewer Outfalls

During a 2021 survey by CRWD, 22 storm sewer outfalls were identified (Figure 3). These outfalls, mostly owned and maintained by the City of St. Paul, convey runoff from the Lake's 1,711-acre watershed directly into Como Lake. While some of these outfalls convey only a small volume of water, some are connected to extensive storm drain systems around the Lake with large collection areas. The Lake's outlet is located in the southeast portion of the lake (between Outfalls 555 and 448, Figure 3) and discharges to the Trout Brook Storm Sewer Interceptor.

Shoreline Erosion

The 2020 Como Lake Shoreline Survey (RCSWCD 2020) identified mild to severe erosion at several locations along the shoreline. The most severe erosion was associated with storm sewer outfalls due to scouring, potential structural issues, or wave action diversion. In addition to erosion near and/or associated with storm sewer outfalls, undercutting of the bank was observed in several locations, most notably along the Lake's southwestern shoreline (Figure 3).



Figure 3. Como Lakeshore Shoreline Features (based on data collected during the Como Lake Shoreline Survey (RCSWCD 2020).

2.3.2 Buffer

Since the time of European settlement and initial development around the Lake (circa the mid-1850s), much of the Lake's buffer consisted primarily of turf grasses or other planted vegetation. As recently as the early 1990s, much of the buffer was mowed turf to water's edge.

In 1999, concerned residents delivered a petition to the City of St. Paul expressing concerns about the Como Lake shoreline and polluted nature of the lake. Soon after, the community helped sponsor events to improve lake and shoreline conditions. In response, the City of Saint Paul developed the Como Lake Shoreline Management Plan in 1999 which set the foundation for future shoreline restoration projects. The goals of the plan were to help stabilize the shoreline, reduce maintenance, improve aesthetics, and enhance habitat for wildlife. The plan defined 13 shoreline zones, each distinct in slope and species composition, to begin restoring the entire perimeter of the lakeshore. The ecological restoration recommended in this plan began in the early 2000s by the City of St. Paul.

Soon after, the Como Lake Strategic Management Plan (CLSMP, CRWD 2002) included restoring lakeshore vegetation, achieving lakeshore aesthetics, and improving natural resources around the Lake. The plan also recommended installation of signage to discourage littering and foot traffic in erosion-prone areas, as well as educational signage addressing natural resource issues (e.g., water quality, ecology, geology). Designated fishing areas were recommended to discourage numerous unsanctioned footpaths. The CLSMP also called for the development of specific plans for each shoreline segment to achieve the following expectations:

- Focusing the plan on erosion control and water quality as well as aesthetics
- Restore and maintain upland forest
- Restore and maintain different prairie types
- Provide in-lake and shoreline microhabitat (rocks for turtles, woody debris, snags, etc.)
- Increase in-lake habitat (fish cribs, woody debris, emergent vegetation, etc.)
- Establish mesic wetland vegetation in exposed areas around lake
- Emergent vegetation will be part of shore plant communities in appropriate areas

Since the adoption of the Como Lake Shoreline Management Plan in 1999 and the CLSMP in 2002, the entire lakeshore of Como Lake has been planted and restored in phases. Plantings included a combination of both native terrestrial plants and aquatic plants. There have been multiple shoreline restoration projects around the Como Lake, including prescribed burnings, plantings, and shoreline stabilization. The majority of these restoration projects have been executed by the City of St. Paul and hundreds of hours by AmeriCorps members and youth volunteers. Ongoing management of the lakeshore is done primarily by the City of St. Paul's Park and Recreation department.

Today, the buffer of Como Lake represents a mix of environmental conditions, including a variety of vegetation structure (i.e., trees, shrubs, and herbaceous vegetation), vegetation density, width, slope, aspect, and other factors. These variables influence the types of vegetation that can thrive in a given area and the management regimes that are effective. To facilitate a better understanding of this zone and help prescribe restoration and management practices, the Como Lake buffer was divided into 12 Management Areas (identified as A through L, Figure 4) for this plan and the former shoreline section designations that were defined in the 1999 Como Lake Shoreline Management Plan (identified as Sections 1-13) have been abandoned.



Figure 4. Como Lakeshore Management Areas

Management Areas

- Forest/Woodland (approximately 1.3 acres). This mosaic of plant communities is representative of the fire-protected wooded areas common in the region prior to European settlement. This Management Area is characterized by a closed or nearly-closed canopy of trees and shrubs, resulting in full shade or filtered sunlight conditions. Some inclusions of Savanna/Prairie exist in areas mapped as Forest/Woodland.
- Savanna/Prairie (approximately 3.5 acres). This mosaic of plant communities is representative of the landscape that dominated the region prior to European settlement. This Management Area is characterized by no or scattered trees, resulting in full sun or partial shade conditions. Some inclusions of Forest/Woodland exist in areas mapped as Savanna/Prairie.
- Rain Garden (approximately 0.1 acre). Two rain gardens have been installed near Como Lake, one near Duck Point (within the buffer) and the other near the southeast portion of the Lake (outside the buffer) near the convergence of East Como Lake Drive and Como Boulevard East (Figure 4). These vegetated basins receive stormwater runoff and provide treatment prior to discharging into the Lake.
- **Turf** (approximately 1.3 acres). Portions of the buffer consist of maintained turf. Most of these areas are near Duck Point and Compass Point, but several other patches of turf exist between the perimeter trail and the Lake.
- Intensive Use (approximately 0.2 acre). Four areas (the Pavilion waterfront, Duck Point, Compass Point, and the south fishing pier) consist of artificial, hard edge, or otherwise filled land along the shoreline. These areas experience intensive use by people and provide easy access to the water's edge.

The majority of the Como Lake buffer consists of stable soils; however, some minor sheet erosion occurs, especially in areas of bare soil or where concentrated runoff flows toward the Lake.

Access Paths

As with most urban lakes, footpaths have formed where people frequently access the shoreline for fishing, birdwatching, or other activities. Most of these paths are used relatively infrequently and are characterized by a narrow band of matted down vegetation with small patches of bare soil. However, some paths are used more regularly and have greater potential for sheet erosion due to a wider swath of bare soil. During this project, field reconnaissance in 2021 identified 55 access paths around Como Lake, of which 38 were classified as Low-Use and the remaining 17 were classified as High-Use (Figure 5).

2.3.3 Active Parkland Zone

This zone lies just outside the focus area of this Lakeshore Management Plan. Much of the active parkland immediately around Como Lake has remained largely unchanged from initial park establishment in the late 1800s. Today, most of this zone is characterized as the perimeter trail, the mowed turf edge along most of this trail, benches, and turf, planted trees, and other park amenities in the adjacent parkland (away from the Lake, shoreline, and buffer). Figure 6 shows some of the amenities located in the Active Parkland Zone (park benches; trash bins). Note that some benches exist within the Buffer Zone.



Figure 5. Como Lakeshore Access Paths (locations identified in a 2021 field survey).



Figure 6. Como Lakeshore Active Parkland Features (locations identified in a 2021 field survey).

2.4 Issues

A broad range of issues present challenges to restoring and maintaining a healthy lakeshore around Como Lake. Some of these issues are regional in nature, affecting all natural and semi-natural landscapes throughout the metro area (and often beyond). Some of these issues are more specific to this particular lakeshore.

2.4.1 Habitat Loss, Fragmentation and Edge Effects

Land conversion for development (e.g., buildings, parking lots, roads) throughout much of the metro areas has resulted in extensive loss and degradation of habitat for native plants and wildlife. The City of St. Paul is fully built out, such that the remaining natural areas (including Como Regional Park) are essential for maintaining the already-reduced ecosystem functioning in the City. The Como Lakeshore is a narrow band of uplands that rings the Lake, providing a sliver of natural habitat. This area has been degraded due to invasive species colonization, habitat fragmentation, and significant edge effects (see Appendix A for glossary).

2.4.2 Disrupted Natural Disturbance Regimes

The mid-1800s plant communities of St. Paul were sustained by natural disturbances such as fires, natural flooding, wind events, and large mammal grazing (e.g., bison).

Changes in natural disturbance regimes since the mid-1800s has markedly changed the plant communities and wildlife population of St. Paul. Given that the Como Regional Park uplands were dominated by firedependent oak savanna and prairie, the elimination of fire on most of the City's landscape was significant. It led to colonization and dense growth of trees and shrubs in grasslands, savannas and woodlands; this is evident around Como Lake, where when left unchecked, woody growth fills in the subcanopy and shrub layer of vegetation. The effect of fire suppression is well documented and generally results (within a few decades) in the loss of hundreds of native prairie and savanna plant and animal species. In addition, many non-native and invasive plant species more easily establish and spread, as they did not evolve with frequent fire and are protected by fire suppression.

The hydrology of the region also was dramatically altered through dredging, filling, and drainage of wetlands, expansion of impervious surfaces, and larger amounts and re-routing of stormwater runoff. Adding to the problem of more stormwater runoff, the amount of rainfall in the metro area has increased each year on average since about 1980. These alterations changed natural flooding regimes that formerly supported the area's lowland and aquatic ecosystems. Como Lake is subject to rapid inputs of urban runoff. The Lake's outlet has experienced clogging in the recent past, which led to extended periods of high water, stressing and killing shoreline vegetation.

2.4.3 Erosion

As discussed in Section 2.3, erosion is occurring along the lakeshore of Como Lake, particularly in discrete shoreline locations (Figure 3, Table 1). While most of the Lake's shoreline erosion is relatively minor and localized, it results in loss of upland soil, reduced vegetation cover (which leads to more erosion), sedimentation in the Lake, and the transfer of nutrients that contribute to lake eutrophication and algae growth.

Some of the most severe erosion around Como Lake is associated with stormwater outfalls, where concentrated runoff has caused deep rills and sedimentation along the Lake's shallows. Deflection of wave energy to shoreline areas adjacent to some outfalls has also resulted in soil erosion. Muskrats that live in Como Lake burrow into the shoreline, also contributing to unstable soils and erosion. A few sections of shoreline (primarily along the Lake's southwest edge) were observed to have undercut banks, which expose tree roots and contribute to tree loss and further erosion.

Erosion in the buffer is mostly limited to localized access paths, where foot traffic has trampled the vegetation, often leaving a path of compacted earth. These bare soil paths leading down to the shoreline provide an opportunity for sheet and rill erosion (especially when on steeper slopes); however, active erosion in these areas appeared quite minor overall.

2.4.4 Nutrient Enrichment

High levels of the nutrients, in particular phosphorus, are well documented in Como Lake. Increased impervious surfaces and connection of these areas with curb, gutter, and storm sewers leads to more runoff, sediment, and pollutants reaching surface waters. Elevated nutrients contribute to algae growth in water bodies. Nutrient-rich, or "eutrophic", waters tend to have low clarity and poorer quality habitat, with fewer native aquatic species. Several invasive plants, like Narrow-leaved cattail (*Typha angustifolia*), hybrid cattail (*Typha x glauca*), and Reed canary grass (*Phalaris arundinacea*) often thrive in nutrient-rich waters, outcompeting native plants and reducing plant and animal diversity. These invasive plants are found along the Como Lakeshore.

2.4.5 Invasive Species

Invasive Plants

Human disturbance and alteration of landscapes often lead to conditions (e.g., bare soil, nutrient enrichment) that favor invasive species. These aggressive species then establish and often thrive in these disturbed habitats, crowding out native plants and animals. Invasive species typically have the following characteristics:

- Tolerant of a variety of environmental conditions.
- Grow and reproduce rapidly, with good seed dispersion.
- Compete aggressively for resources, such as nutrients, food, water, and (for plants) sunlight.
- Lack natural enemies or effective competitors.
- Some are allelopathic (i.e., they release chemicals that inhibit growth of other species).

Invasive plants suppress native plant growth and abundance, degrade wildlife habitat, and lessen the resilience of ecosystems during recovery from disturbances and environmental change. Invasive plant species that pose the greatest threat to the Como Lakeshore are listed in Table 1.

Table 1. Invasive and Non-Native Plant Species of Como Lakeshore (identified in a 2021 field survey and the Como Lake Shoreline Survey (RCSWCD 2020)).

Common Name	Colontific Nomo	Level of Infestation in	Ecological Effect		
	Scientific Name	Como Lakeshore ¹	if Uncontrolled ²		
Woody Species					
Siberian elm	Ulmus pumila	Moderate	Moderate		
White mulberry	Morus alba	Moderate	Moderate		
Riverbank grape	Vitis riparia	Moderate	Moderate		
Non-native honeysuckles*	Lonicera tatarica, L. x bella, etc.	Low	Major		
Common buckthorn*	Rhamnus cathartica	Low	Major		
Black locust*	Robinia pseudoacacia	Low	Moderate		
Amur maple	Acer ginnala	Low	Moderate		
White poplar	Populus alba	Minor	Moderate		
Glossy buckthorn*	Frangula alnus	Minor	Major		
Norway maple	Acer platanoides	Minor	Moderate		
Herbaceous Species					
Smooth brome	Bromus inermis	Moderate	Moderate		
White sweet clover	Melilotus alba	Moderate	Moderate		
Creeping Charlie	Glechoma hederacea	Moderate	Moderate		
Reed canary grass	Phalaris arundinacea	Low	Major		
Invasive cattails	Typha angustifolia, T. x glauca	Low	Major		
Siberian cranesbill	Geranium sibiricum	Low	Moderate		
Birds-foot trefoil	Lotus corniculatus	Low	Moderate		
Common burdock	Arctium minus	Low	Moderate		
Timothy grass	Phleum pratense	Low	Low		
Common plantain	Plantago major	Low	Low		
Kentucky bluegrass	Poa pratensis	Low	Low		
Canada thistle*	Cirsium arvense	Minor	Major		
Leafy spurge*	Euphorbia virgata	Minor	Moderate		
Garlic mustard*	Alliaria petiolata	Minor	Moderate		
Purple loosestrife*	Lythrum salicaria	Minor	Moderate		
Spotted knapweed*	Centaurea stoebe	Minor	Moderate		
Crown vetch*	Securigera varia	Minor	Moderate		
Common dandelion	Taraxacum officinale	Minor	Moderate		
Yellow sweet clover	Melilotus officinalis	Minor	Moderate		
Yellow nutsedge	Cyperus esculentus	Minor	Moderate		
Curly dock	Rumex crispus	Minor	Low		
Prickly lettuce	Lactuca serriola	Minor	Low		
Bittersweet nightshade	Solanum dulcamara	Minor	Low		
Field bindweed	Convolvulus arvensis	Minor	Low		
Motherwort	Leonurus cardiaca	Minor	Low		

¹ Infestation: Major - common to abundant in most of its preferred habitats; Moderate - present in most of its preferred habitats, but with low cover; Low - occasionally encountered, or large but few populations exist; Minor - rarely encountered, usually in small populations.

² Effect: Major - significantly alters vegetation structure and plant diversity, prevents regeneration of native plants; Moderate - noticeably affects vegetation structure and plant diversity, but some native plant regeneration occurs; Low - a noticeable member of the vegetation structure and diversity, but normal ecological processes are operating; Minor - vegetation structure, native plant diversity, and normal ecological processes are largely unaffected

* Minnesota Noxious Weed

Even some native plant species such as Box elder (*Acer negundo*), Green ash (*Fraxinus pennsylvanica*), Eastern red cedar (*Juniperus virginiana*), Western poison ivy (*Toxicodendron rydbergii*), and Riverbank grape (*Vitis riparia*) can be invasive and aggressive in certain settings.

The City of St. Paul and community partners (e.g. District 10 Como Community Council) have done an admirable job of controlling invasive vegetation around Como Lake; however, some patches or strips of invasive vegetation remain, as well as many scattered individuals (generally at low density). Ongoing control of invasive vegetation is needed to counter new invasions by wind-blown and bird-dispersed seeds, persistent seed banks (i.e., weed seeds in the soil that germinate over several to many years), and nearby private properties harboring invasive plants.

Normal park maintenance, such as turf mowing, together with ecological restoration and management, may accidentally introduce or spread invasive species. Appendix B provides guidelines developed by the MNDNR to avoid the introduction or spread of invasive species during maintenance and management activities.

Invasive Animals

Invasive animals can also have adverse effects on natural areas. Some invasive animals (e.g., invasive earthworms) cannot be removed or controlled cost-effectively. In these cases, managing the effects of an invasive species, rather than trying to eradicate it, is the best course of action. The main invasive animals that are affecting or may affect the Como Lakeshore include:

- Emerald ash borer (EAB). Since this invasive animal is most destructive to trees, it is discussed under Section 2.4.6 below.
- **Gypsy moth.** Since this invasive animal is most destructive to trees, it is discussed under Section 2.4.6 below.
- Invasive earthworms. Present in City forests (and assumed to be present around Como Lake), these non-native, invasive animals, were introduced in part as discarded fishing bait. Recently, "jumping worms" (yet another invasive earthworm) have been identified in the Twin Cities. These earthworms aggressively consume organic matter on the surface of and in the soil, altering soil structure and composition, changing the amount and variety of plants living on the forest floor, and producing unknown effects on the regeneration of the future forest tree canopy.

2.4.6 Tree Pests & Diseases

Trees are an important amenity and component of ecosystems around Como Lake. As with invasive species, tree pests and diseases can also have adverse effects on native vegetation, and in turn, natural areas. The main pests and diseases that may affect trees in the Como Lakeshore include:

• Emerald ash borer (EAB). Present in the City of St. Paul and already having a devastating effect on the many mature ash trees growing throughout the region. The City has initiated removal of infected ash trees and began replanting others, with the goal of creating a more diverse tree canopy that will be more resilient despite the arrival of future diseases and pests. Ash trees that are removed must be carefully handled to prevent the spread of the borer.

- **Oak wilt.** This often-lethal disease of oaks is caused by an invasive fungus (*Ceratocystis fagacearum*) that can travel between trees through root connections (or grafts) and is spread by sap beetles. Present in the City, this disease warrants special management of oak trees, especially species in the highly susceptible red oak group. To control oak wilt, root grafts must be severed and pruning times should be limited to when the spore-dispersing sap beetles are not present. Given the paucity of oaks in the Como Lakeshore (especially mature trees), it is recommended that aggressive measures be taken to prevent infection and loss of oaks.
- **Dutch elm disease.** This usually lethal disease of native elms is caused by an invasive fungus (*Ophiostoma novo-ulmi*) that can travel between trees through root grafts and is spread by elm bark beetles. This disease is present in the City, warranting special management of native elm trees or the planting of disease-resistant varieties. Elm seedlings and saplings are abundant, despite the fungus, but generally become infected and die at 15-20 years of age.
- **Gypsy moth.** While rare in the state, this federally- and state-regulated pest has been detected in nearby Twin Cities communities. Its potential presence warrants special handling of cut wood and other surfaces where eggs may be found.

2.4.7 Climate Change

According to Minnesota's Wildlife Action Plan 2015-2025 (MNDNR 2016), we are already experiencing the early effects of climate change in Minnesota—including higher temperatures, especially in winter and at night, and more severe precipitation events. These changes are likely to influence species and ecosystems by altering fundamental interactions with other species and the physical environment, potentially creating a cascade of impacts (Staudinger, et al. 2012).

The Wildlife Action Plan states with high confidence that climate change in Minnesota will result in a shorter frost season, longer growing season, earlier lake ice-outs, fewer days with snow cover, the persistence of new invasive and pathogenic species, and more intense, widespread, and damaging flash-flooding (MNDNR 2016). The Wildlife Action Plan (citing Galatowitsch et al. 2009) reports the following predicted changes for upland plant communities:

Forests (in the Prairie-Forest Border, including the Twin Cities region)

Insect damage, larger blowdown areas, droughts, and fire are expected to interact, resulting in many forests, particularly on marginal soils, becoming savannas. Invasive species, including earthworms, may limit the establishment and growth of native tree seedlings and other understory plants.

Deciduous forests within the prairie-forest border are severely fragmented by agriculture and urban/suburban land use. Should fragmentation increase and further shrink forest patches and increase edge effects, the ability of some plant and animal species to adapt to climate change may become limited. Reasons for this include greater predation on wildlife, the spread of invasive species, and competition from other native species that prefer forest edges.

Prairies & Grasslands

The small size and isolation of prairies increase their vulnerability to climate change. Already subject to inbreeding and species extirpations due to small populations, scarce pollinators, and random events, mesic and wet prairie communities are most vulnerable. Wet prairies and

meadows will become small due to tree and shrub expansion, and uncommon wet-prairie species will likely be lost. In some cases, prescribed burns, conservation grazing focused on resilience, and adding seed of plants that withstand a new climate may be needed to maintain or restore the City's prairies.

Considering those regional predictions, it is likely that the lakeshore of Como Lake will trend towards drier species and habitats—namely savanna and prairie. More intense precipitation events and periods of drought may result in greater water level variation, stressing and/or killing shoreline vegetation and increasing erosion. Responsible, effective natural resources management should heed these climate change predictions to ensure that natural areas will be functional and resilient in the face of environmental change in the coming decades. Section 3.4 provides recommendations for natural resources management in light of climate change.

2.4.8 Human Enjoyment & Wellbeing

Being one of the City's premier destinations, Como Regional Park is used heavily by residents and visitors. Park users want to see the Lake, appreciate the beauty of the lakeshore, enjoy the trails, have locations to pause and rest (e.g., benches), be able to access the shoreline (especially for fishing), and all the while feel safe while doing these activities. Clearly understandable wayfinding and signage (including use of images for multi-cultural understanding), clear sightlines, and appropriate lighting can be improved to make the Como Lakeshore feel more welcoming and safer for all.

People enjoy learning about nature and contributing to park stewardship. Especially in urban environments such as St. Paul, there is a deepened appreciation for opportunities to escape into nature. It is human nature to care more about things that we understand and can relate to, so creating opportunities to learn about the ecology of the Como Lakeshore (e.g., enhanced signage, programming, and volunteering) will increase people's appreciation of, and dedication to, these important natural areas. Volunteers can play an important part in stewardship of natural areas. Recruiting, training, and overseeing a team of dedicated volunteers increases community engagement and commitment to park natural areas.

2.4.9 Implementation and Partner Coordination

As part of a regional park, Como Lake is an important and heavily used amenity. Planning, operations, and maintenance of the lakeshore area requires coordination between a variety of partners, including the landowner (City of St. Paul), CRWD, Ramsey County, community groups, and friends/volunteers that have engaged in lakeshore projects and maintenance. These partnerships have worked reasonably well over the years, but the goals outlined in the Como Lake Management Plan (LimnoTech 2019) and this Como Lakeshore Plan will be achieved only through increased commitment by, and cooperation between, partner organizations and residents. Formalizing partners roles, enhanced communication of planning and implementation projects, demonstration projects, and celebrations of success will help foster this increased commitment and cooperation.

3.0 Restoration, Management and Conservation

3.1 Ecosystem Approach

An "ecosystem approach" is recommended to manage natural areas, control erosion, and provide a safe and enjoyable recreational experience for park users. This approach considers all interacting factors in an ecosystem and designs management techniques that replicate, at lowest practical cost, the ecological structures and processes that enable ecosystems to adapt to changing conditions. Actions that restore processes and structures are done first because these may increase species diversity without seeding and planting. If that fails to restore the desired biodiversity, seeding and planting become necessary. Restoration and management actions are typically considered and implemented in the following sequence, although not all actions may be applicable to a given site or project.

- 1. Restore natural disturbance regimes (e.g., fire, flooding, grazing).
- 2. Introduce biocontrols (i.e., natural enemies or predators used to control pests) when available and feasible.
- 3. Remove and control invasive trees and shrubs mechanically.
- 4. Install native trees and shrubs.
- 5. Remove and control invasive herbs.
- 6. Install herbaceous seeds and plants.
- 7. Use herbicides sparingly and only when other methods fall short of goals.
- 8. Conduct long-term, adaptive management.

These actions are implemented during an initial restoration and short-term management phase, followed by a long-term management phase. "Adaptive management" is an approach to structured decision making in the face of uncertainty, with an aim to reducing uncertainty over time by using a cycle of planning, implementation, monitoring, evaluation, adjustment, and further implementation (Figure 7). Adaptive management is an important way to approach conservation projects due to the uncertainties presented by varying environmental conditions and responses over time. Adaptive management is used in the best restoration programs, begins with the initial restoration work, and continues indefinitely as natural areas are managed over time.





3.2 Initial Restoration and Short-Term Management Phase

Ecological restoration has short- and long-term management phases. The initial restoration and shortterm management phase is typically labor-intensive and more costly compared to long-term management. The initial effort usually lasts approximately three years and requires a significant investment to prepare for and begin establishing the proposed native plant communities. Tasks often include: re-introducing natural disturbances (e.g., fire); using biocontrol, physical methods, and chemicals (e.g., herbicides) to control invasive plant species; and seeding and planting native vegetation. The length of time before transitioning to long-term management depends on the site's initial quality, weather conditions, how the site responds to restoration activities, the size of the site, and factors unique to the site. Figure 8 shows the relatively high cost of initial restoration work, the somewhat reduced cost during short-term management, and the lowest annual cost in long-term management.



Figure 8. Generalized Cost of Restoration and Management Over Time

The initial restoration and short-term management phase has been completed for many portions of the Como Lakeshore (e.g., areas where turf has been converted to prairie). However, significant restoration work is still warranted in some areas, including tree removals and additional opportunities for turf-to-native conversions.

3.3 Long-Term Management Phase

After the restoration and short-term management phase, the process shifts to a lower cost, but equally important, long-term management phase. Long-term management tasks often include:

- Regular monitoring and inspections.
- Maintain disturbances (e.g., fire) that perpetuate a diverse, resilient plant community.
- Selectively remove or treat invasive plants (e.g., precise spot-application of herbicide).
- Re-seed disturbed or poorly developing areas.
- Re-plant woody plants that have died.

Much of the Como Lakeshore is already under a long-term management regime, and as new restoration areas complete their short-term management, they will transition into the long-term management phase.

3.4 Climate Change Resilience

Projected changes in climate (Section 2.4.7) are forcing natural resource managers to adjust restoration and management prescriptions. Relatively broad patterns of climate change can be predicted—more rainfall in larger storms, warmer nighttime temperatures, reduced snow cover, etc. —therefore coping

strategies must also be broad. Changing the list of trees to plant in response to shifting plant hardiness zones is obvious (Appendix C). Less obvious and more challenging are managing aquatic and wetland ecosystems for changes in rainfall, anticipating future diseases, pests, and invasive species arriving with warmer temperatures, and even the timing of prescribed burns and herbicide applications.

As the specifics of climate change come into focus, CRWD and its partners can adapt their ecosystem approach. Based on current data and predictions, the following specific recommendations are provided for managing the Como Lakeshore's natural resources in a changing climate.

- In the next two to three decades, before the significant climate changes predicted by midcentury take hold, reduce the abundance of the most damaging invasive species—buckthorn, honeysuckle, Smooth brome, Reed canary grass, invasive cattails, and others. Good work has already been done in this regard by the City of St. Paul around Como Lake, but continued attention is warranted.
- For seed and live plants, **use genetic material from farther south** to pre-adapt the Como Lakeshore's ecosystems to a new climate. Countering this is research that suggests local genetic material has the potential to accommodate predicted climate change. This strategy requires more research.
- With snowless winters and often dry conditions, consider dormant season **burns in winter months** rather than in fall and early spring. This could expand the burning window, which has shrunk due to frequent red flag warnings (no burning) issued by the MNDNR or periods of wet, cold weather in historically preferred burn windows.
- Identify and watch keystone and other important species to detect and reverse their displacement by invasive plant species, loss due to disease, and lack of the correct disturbance. Keystone species vary by ecosystem; for instance, oak trees are a keystone species in many Minnesota savannas.
- **Predict the trajectory of the Como Lakeshore ecosystems** based on evidence from past and current ecosystem structure, process, and known pathways of plant succession and revise restoration and management prescriptions accordingly (discussed further under Sections 6.3 and 6.4).
- **Capture stormwater where it falls and infiltrate it** into the ground for vegetation growth and groundwater recharge—delivering baseflow to the Lake (which supports more stable water levels), reducing runoff volume, and improving water quality.

CRWD, City of St. Paul, and other partners have already initiated several of these strategies along the Como Lakeshore by controlling invasive species, restoring natural areas, and planning for a warmer/drier future climate by promoting more oak woodland/savanna habitat. Adaptive management will continue to be practiced over the coming decade, based on ecological monitoring conducted by the CRWD and its partners, and responding to new data and the evolving science of climate change.

4.0 Goals and Objectives

Goal-setting is an effective method for helping ensure that the outcomes of a plan are clearly defined. For the purposes of this Plan, the "goals" define the overarching vision. An "objective" is a general approach to achieve a goal, and "actions" (addressed in Section 5) are specific tasks that will be executed to ultimately achieve the Plan objectives.

To develop the goals for this Plan, CRWD and partners began by collaboratively identifying major and minor issues associated with Como Lake's lakeshore. From those issues that were identified, each was grouped underneath major themes such as shoreline erosion, buffer erosion, wildlife habitat improvement, user experience, and communication. Each theme addressed all three zones of the lakeshore (i.e., shoreline, buffer, and active parkland). Considering these themes, four overarching goals emerged that address 1) erosion and structural stability, 2) vegetation and wildlife habitat, 3) visitor experience, and 4) Plan administration and implementation. Underneath each overarching goal, a series of objectives were then developed which would each work toward achieving the goal. In this Plan, a goal is fully achieved when each of its objectives are met. The following are the four Plan goals, their descriptions, and their associated objectives that were defined by CRWD and partners.

4.1 Goal 1: Buffer and Bank Stability (BB)

Goal 1: Maintain a structurally stable and erosion-resistant shoreline and buffer zone around Como Lake.

- *Objective BB.A: Mitigate Shoreline Erosion.* Manage shoreline to control and prevent erosion.
- *Objective BB.B: Mitigate Buffer Zone Erosion.* Manage buffer vegetation and lake access paths to ensure soil stability.
- *Objective BB.C: Mitigate Storm Sewer Erosion.* Inspect and repair erosion associated with storm sewer outfalls.

4.2 Goal 2: Vegetation and Habitat (VH)

Goal 2: Enhance and maintain a healthy and resilient ecosystem in the buffer zone, with diverse native vegetation and quality wildlife habitat.

- Objective VH.A: Ensure Diverse Buffer Vegetation. Enhance and maintain buffer zone
 vegetation that is diverse, low maintenance, free of invasives, and appropriate to the particular
 lakeshore management area. This entails taking an ecosystem approach: re-establish natural
 vegetation structure and processes; first use biocontrols and mechanical means of invasive plant
 control; use herbicides as last resort; add native seed and live plant plugs to increase
 biodiversity if ecosystem does not respond as desired.
- *Objective VH.B: Expand Buffer Zone.* Expand buffer zone widths at appropriate locations, where opportunity allows, and maintain continuous native vegetation cover.
- *Objective VH.C: Enhance Wildlife Habitat.* Enhance wildlife habitat for pollinators, other insects, birds, reptiles, amphibians, and small mammals.

4.3 Goal 3: Visitor Experience (VE)

Goal 3: Provide a lakeshore that enhances the visitor experience at Como Lake.

- *Objective VE.A: Ensure Safe Physical Access.* Ensure visitors have safe physical access to Como Lake.
- *Objective VE.B: Ensure Clear Views.* Ensure visitors have clear views of Como Lake.
- Objective VE.C: Ensure Feeling of Safety. Ensure visitors feel safe when using Como Lake.
- *Objective VE.D: Engage Community.* Engage the community in managing the lakeshore.

4.4 Goal 4: Plan Implementation (PI)

Goal 4: Ensure stable, long-term support and partnerships for managing the Como Lakeshore over the 20-year life of the Plan.

- *Objective PI.A: Communicate Benefits of a Healthy Lakeshore.* Clearly communicate to partners and the public the benefits of a healthy, resilient lakeshore.
- *Objective PI.B: Ensure Regular Partner Coordination.* Regularly confirm commitments from partner organizations regarding respective roles, responsibilities, funding, and management priorities.

5.0 Recommended Management Actions & Implementation

Building upon the goals and objectives shown in Section 4, management actions were developed underneath each objective. Actions are specific, implementable tasks, projects, programs, or events that can be assigned to appropriate personnel and for which costs and schedule can be estimated. Completing the list of actions underneath an objective will result in the objective being accomplished.

Actions for each objective were collaboratively developed by CRWD and partners. For each action, its frequency, the lead agency, and estimations of probable cost are provided in Section 6 (Tables 2 and 3). Descriptions of each action are listed below underneath their associated goal and objective.

5.1 Goal 1: Buffer and Bank Stability (BB)

5.1.1 Objective BB.A – Mitigate Shoreline Erosion

- Action BB.A.1: Stabilize Undercut Banks. Stabilize undercut banks along the southwest shoreline by increasing light levels at the ground and installing erosion control materials and vegetation. Remove understory woody plants and thin crowded canopy trees; install coir logs; install native plants at the normal water level; use coarse, rhizomatous species (Three-square bulrush, Lake sedge, River bulrush, Prairie cordgrass, Giant bur-reed, etc.).
- Action BB.A.2: Inspect and Manage Shoreline Erosion. Inspect shoreline annually (early spring, before leaf-out) for undercutting and manage erosion if detected.
- Action BB.A.3: Inspect Native Plantings. Inspect native plantings (emergent, shoreline, and buffer plants) each spring and fall to assess successful establishment; evaluate reasons for failure and modify planting approach as needed (i.e., practice adaptive management).
- Action BB.A.4: Monitor and Manage Muskrats. Monitor muskrat population each spring and fall, and manage population to reduce bank erosion from muskrat burrowing. Management may entail live-capture and relocation.
- Action BB.A.5: Inspect and Maintain Lake Outlet. Inspect lake outlet structure each spring, summer, and fall for proper functioning. Evaluate the need for redesign if clogging and shoreline flooding persists.

5.1.2 Objective BB.B – Mitigate Buffer Zone Erosion

- Action BB.B.1: Selectively Thin Woody Vegetation. Selectively thin crowded trees in canopy and remove understory saplings and shrubs in the buffer to increase light at ground level, promote more vigorous ground layer vegetation, improve visibility of the Lake from the perimeter trail, and increase the feeling of safety. Some native flowering shrub patches can remain, but crowded canopy and subcanopy trees overhead should be thinned to encourage shrubs to grow in dense patches and resist buckthorn and weed invasion. Also see Objectives VE.B and VE.C.
- Action BB.B.2: Inspect and Maintain Buffer Vegetation. Inspect buffer each spring and fall to ensure dense, diverse, deep-rooted, perennial, herbaceous, native vegetation exists throughout the zone to keep soil intact and prevent surface runoff, rills, and head cut formation. Ensure

proper management and remedial seeding and/or planting are completed (under Action VH.A.1&2).

• Action BB.B.3: Inspect and Address Access Path Erosion. Inspect access paths to the Lake annually and address associated erosion. Also see Action VE.A.1. See Figure 5 for locations of high-use and low-use access paths.

5.1.3 Objective BB.C – Mitigate Storm Sewer Erosion

- Action BB.C.1: Inspect Storm Sewer Outfalls. Inspect all storm sewer outfalls annually for structural failures, leaks, erosion, and sediment/debris accumulation.
- Action BB.C.2: Repair Storm Sewer Erosion. Mitigate erosion from storm sewer outfalls by identifying the issue causing erosion and making necessary repairs. See Figure 3 for outfall locations.

5.2 Goal 2: Vegetation and Habitat (VH)

5.2.1 Objective VH.A – Ensure Diverse Buffer Vegetation

- Action VH.A.1: Manage Savanna/Prairie Areas. To ensure diverse, healthy, and sustainable Savanna/Prairie areas (Figure 4), manage as follows:
 - 1. Maintain <50% canopy cover and <5% woody understory in most areas.
 - 2. Establish or maintain continuous herbaceous ground layer of sun-loving and semi-shade tolerant plants.
- Action VH.A.2: Manage Forest/Woodland Areas. To ensure diverse, healthy, and sustainable Forest/Woodland areas (Figure 4), manage as follows:
 - 1. Maintain >50% canopy cover and <10% woody understory in most areas.
 - 2. Establish or maintain continuous herbaceous ground layer of semi-shade and shade-tolerant plants.
- Action VH.A.3: Remove and Control Invasive/Aggressive Vegetation. Remove and control herbaceous and woody invasive vegetation and aggressive native species (River grape, Boxelder, etc.).
- Action VH.A.4: Enhance Low-Diversity or Sparse Vegetation. Overseed areas of low native cover with invasive-competitive native plant species using low-cost management techniques (e.g., prescribed burning, mechanical brush removal).
- Action VH.A.5: Establish and Maintain Lake Views. Remove vegetation at specific locations to achieve desired level of visual access. View of lake from benches will be obscured <50%, and view of lake from 80% of perimeter trail will be obscured <75%. See Figure 6 for bench locations.
- Action VH.A.6: Maintain Perimeter Trail Edge. Mow 2-ft wide edge along paved trails to a height of 4-6 inches twice a year to prevent lodging of vegetation on trail. Mowing should occur June and August or early July & early September, depending on plant species present and growth rate.
- Action VH.A.7: Remove Landscape Debris. Remove leaf piles and other concentrated landscaping debris deposited in buffer zone as needed. Anticipated each spring and fall.

5.2.2 Objective VH.B – Expand Buffer Zone

- Action VH.B.1: Widen Buffer. Widen buffer to create larger and higher quality habitat. See Figure 9 for locations. Some of resulting larger natural areas could be classified as "Preserves" where additional native plantings and habitat enhancements would provide more significant patches of high-quality habitat (Figure 9). Figure 9 also shows previous restored Savanna/Prairie habitat just north of the Lake.
- Action VH.B.2: Assess Perimeter Trail Relocation. Assess feasibility to relocate perimeter trail
 onto the existing road at the east and north sides of the lake. Greater buffer width would allow
 steep banks to be re-graded to a more stable slope, improve lake access, provide space to install
 stormwater BMPs, and create new upland and wetland wildlife habitat.

5.2.3 Objective VH.C – Enhance Wildlife Habitat (VH.C)

- Action VH.C.1: Ensure Pollinator-Beneficial Buffer. Inspect buffer each spring, summer, and fall to ensure season-long provision of nectar and pollen for pollinators. Add seed or live plants as needed to ensure floral resources are available in each 1,000-ft segment of lakeshore during each month of the growing season (May through October).
- Action VH.C.2: Install and Maintain Wildlife Habitat Structures. Install and maintain wildlife habitat structures such as nest boxes for wood ducks, bluebirds, house wrens; bee and bat boxes; and sunning logs for turtles.


Figure 9. Potential Buffer Expansion and Preserve Opportunities

5.3 Goal 3: Visitor Experience (VE)

5.3.1 Objective VE.A – Ensure Safe Physical Access

- Action VE.A.1: Enhance and Stabilize High-Use Access Paths. Enhance and stabilize high-use access paths for greater durability for visitors accessing the water's edge (e.g., anglers, bird watchers). All lake access paths will be inspected and maintained under Action BB.B.3. See Figure 5 for locations of high-use and low-use access paths.
- Action VE.A.2: Consider ADA Access. Consider demand and feasibility of ADA access to the Lake in key locations.
- Action VE.A.3: Improve Duck Point. Improve Duck Point so it is a stable, low-maintenance, safe, aesthetically pleasing access point to the lake, incorporating native vegetation and naturalization of the shoreline.

5.3.2 Objective VE.B – Ensure Clear Views

• Action VE.B.1: Maintain Views From Benches. Regularly maintain buffer vegetation heights and density to improve views from benches. See Action VH.A.5. See Figure 6 for bench locations.

5.3.3 Objective VE.C – Ensure Feeling of Safety

• Action VE.C.1: Consider Safety Improvements. Address safety concerns expressed by the community (e.g., sight lines, lighting, etc.) to the extent feasible under this Lakeshore Management Plan. Seek to understand safety concerns of all user groups of Como Lake to ensure all people utilizing the lakeshore are welcomed and included.

5.3.4 Objective VE.D – Engage Community

- Action VE.D.1: Establish and Implement Como Lake Volunteer Team. Coordinate with partners to create and train a large, highly motivated volunteer team to carry out routine maintenance of the buffer and shoreline. Volunteer-appropriate activities are hand-weeding, picking up trash, inspections, seed collecting, and live planting.
- Action VE.D.2: Sponsor Lakeshore Volunteer Events. Hold regular (2x/year) volunteer lakeshore maintenance events to support maintenance efforts.
- Action VE.D.3: Facilitate Data Collection by the Public. Establish simple, low-cost data collection methods to engage the public in gathering meaningful data related to lakeshore health (e.g., repeat photography).

5.4 Goal 4: Plan Implementation (PI)

5.4.1 Objective PI.A – Communicate Benefits of a Healthy Lakeshore

• Action PI.A.1: Improve Lakeshore Signage and Displays of Public Art. Follow the Como Lake Management Plan's recommendations (CLMP (2019) Actions C9 and C10) and provide improved

interpretive signage, using symbols when feasible and text in multiple languages. Incorporate art and/or artful design where opportunities arise as an alternative communication method of Como Lake and its lakeshore (per CLMP (2019) Action C12).

• Action PI.A.2: Build Community Support for Lakeshore. Build community support of the lakeshore through events and media outreach. Sponsor community events at Como Lake, regularly update CRWD webpage, and use other forms of media to improve understanding and appreciation of the lakeshore. Target lakeshore users, the public, and City policymakers.

5.4.2 Objective PI.B – Ensure Regular Partner Coordination

- Action PI.B.1: Integrate Related Plans. Integrate this Lakeshore Management Plan with the Como Lake Management Plan, Fishery Management Plan, and Aquatic Plant Management Plan. Identify overlapping actions for meeting the goals of the Como Lake Management Plan.
- Action PI.B.2: Identify Field Survey Tool. Identify a field survey tool and develop a protocol for conducting efficient inspections.
- Action PI.B.3: Conduct Seasonal Inspections. Each year, conduct seasonal (spring, summer, and fall) lakeshore inspections to assess field conditions, identify issues, and guide management. Inspections should document and map: a) bare soil, b) invasive vegetation abundance, and c) native plant diversity and cover.
- Action PI.B.4: Identify and Use Common Data Management Platform. Document all annual management activities using an agreed-upon, shared data platform.
- Action PI.B.5: Secure Funding. Secure annual management funding in perpetuity to implement the actions and achieve the goals of the Plan.

6.0 Implementing Ecosystem Management

6.1 Prioritization and Implementation of Actions

Due to limited budgets, staffing, and related resources, implementation of recommended actions for the Como Lakeshore will likely occur over many years. Therefore, priorities need to be established to schedule actions in a strategic and efficient manner that is consistent with the priorities of District. Prioritization is often facilitated by developing a matrix that helps consider and weigh various criteria. For example, actions that score high for the following criteria could be prioritized for early implementation:

- Improves public safety and/or enjoyment.
- Has high public visibility.
- Enhances a previous restoration project (i.e., protects previous investments).
- Contributes to enlarging, buffering, or better connecting natural habitats.
- Results in water quality improvement.
- Results in improved wildlife (including pollinator) habitat.
- Engages the public (e.g., volunteers)

The City of St. Paul and CRWD should collaboratively work to prioritize actions on an annual basis over the winter months so implementation can be planned for the upcoming non-winter months. Following prioritization of actions, an inventory of currently available and projected resources will help develop a realistic picture of the financial, personnel, and equipment available for implementation. Actions can then be sequenced so the first year's available resources are dedicated to top priority actions. When scheduling implementation, it is important to ensure that adequate resources exist for completing one-time projects, short-term management, and long-term management (i.e., you should not begin actions if you lack the resources to see it through and continue with long-term management).

6.2 Partners

Partnerships provide opportunities to foster relationships with partner organizations and the community. However, developing and sustaining partnerships requires deliberate actions by all partners. The City of St. Paul and Ramsey County were active participants in the development of this Como Lakeshore Management Plan. The following organizations have contributed to natural resource-related projects or initiatives around Como Lake:

- City of St. Paul
- Minnesota Department of Natural Resources (MNDNR)
- University of Minnesota
- Ramsey County
- Capitol Region Watershed District
- Great River Greening (GRG)

- Conservation Corps of Minnesota and lowa
- Como Parks Stewards
- District 10 Como Community Council
- Como Active Citizen Network
- Master Gardeners, Master Tree Stewards, and Master Naturalists
- Local schools

In order to establish commitments and coordinate between partners (as addressed under Objective PI.B, *Ensure Regular Partner Coordination*), it is helpful to establish agreements or contracts between partner organizations to help clarify roles and responsibilities, as well as to implement management actions, especially long-term management.

6.3 Ecological Restoration & Management Tasks

Ecological restoration and management entails execution of a series of tasks, each one customized to a site's unique environmental conditions and designed to meet project goals. Restoration and short-term management tasks typically implemented during the first few years of a restoration project are discussed in Appendix D. Long-term management tasks are discussed in Section 3.3 and may include some of the tasks discussed in Appendix D.

A Note About Herbicides

Restoring native species dominance in the vegetation layers of a plant community often requires herbicides. If native dominance can be restored without herbicides, spot-treatment may still be appropriate to eliminate colonies of the most problematic species. Some species can be managed with mowing or hand-pulling, but in most cases targeted herbicide treatment is the most effective means of control.

There is increasingly concerned about herbicides and other pesticides on public land. The approach to herbicide use is as follows:

- The Como Lakeshore Plan strives to minimize herbicide use by taking an ecosystem approach and following Integrated Pest Management (IPM) practices. When deemed necessary, the use of herbicides with the lowest toxicity to achieve restoration goals will be utilized.
- Herbicide application would be applied at the lowest effective concentration by licensed applicators following manufacturer's instructions.
- Recommended safety precautions are followed by licensed individuals applying the herbicide, and signage is installed as appropriate to inform the public of herbicide use and exclusion intervals after application.

The amount of herbicide applied for ecological restoration and management is at levels far below that used in agricultural fields. Moreover, the herbicide is precisely applied to small areas, such as a cut stump or individual thistle clump. Preference is given to sponge- or wick-application or low-pressure nozzle to minimize overspray and drift. Restoration professionals use broadcast herbicide application as a tool of last resort, when an invasive plant dominating a vegetation layer is unmanageable using other methods.

6.4 Ecological Approach to Vegetation Management of the Como Lakeshore

As described previously, the natural areas around the Lake were classified as either Forest/Woodland or Savanna/Prairie (Figure 4). Establishing generalized ecological health indicators helps to guide restoration and management actions appropriate for a given location at a given time, and generalized ecological

resilience indicators help characterize achievement of success (i.e., maintaining a healthy, relatively lowmaintenance native plant community). An ecological approach to restoring and maintaining these two Management Area types follows. In the text below, an "indicator" is a measure of success, a target condition to achieve.

Forest/Woodland (approximately 1.3 acres)

Ecological Health Indicators for Como Lakeshore

- Vegetation structure is typical of high-quality forest/woodland
 - Canopy/subcanopy cover ≥75% (to help resist invasive shrubs)
 - Native shrub cover <25% (to not overshade ground layer vegetation)
- Native plant species diversity is "high" (≥4 species in canopy/subcanopy; ≥6 species in shrub/sapling layer; ≥8 forb species and ≥4 graminoid species; all these species should be well-distributed throughout each Forest/Woodland Management Area)
- Canopy/subcanopy includes ≥3 native species of long-lived hardwoods (e.g., oak, basswood, walnut)
- Native herbaceous species (forbs and graminoids) cover ≥75% of the ground
- Invasive plant cover is "low" (<3% areal cover)

Ecological Resilience Indicators for Como Lakeshore

- Vegetation structure maintained by canopy/subcanopy and shrub layer shading
- Native plant species diversity is "high" (as defined above)
- Native wildlife species diversity (including mammals, birds, reptiles, amphibians, insects, etc.) is "high" (≥10 species using each Forest/Woodland Management Area)

Savanna/Prairie (approximately 3.5 acres)

Ecological Health Indicators for Como Lakeshore

- Vegetation structure is typical of high-quality savanna/prairie
 - Savanna patches (generally ≥1 acre): canopy/subcanopy cover <50% (trees include native, long-lived hardwoods, such as oak, basswood, walnut, etc.); shrub/sapling layer cover <10%
 - Prairie patches (generally <1 acre): canopy/subcanopy cover 0%; shrub/sapling layer cover <10%
- Native plant species diversity is "high" (≥2 species in canopy/subcanopy; ≥3 species in shrub/sapling layer; ≥12 forb species and ≥6 graminoid species; all these species should be well-distributed throughout each Savanna/Prairie Management Area)
- Native herbaceous species (forbs and graminoids) cover ≥95% of the ground
- Invasive plant cover is "low" (<3% areal cover)

Ecological Resilience Indicators for Como Lakeshore

- Vegetation structure maintained by prescribed fire every 2-3 years for savanna and every 3-4 years for prairie
- Oak seedling germination and oak sapling recruitment to canopy is occurring
- Plant species diversity is "high" (as defined above)

• Native wildlife species diversity (including mammals, birds, reptiles, amphibians, insects, etc.) is "high" (≥10 species using each Savanna/Prairie Management Area)

The general ecological restoration and management tasks required to manage these natural areas are discussed in Appendix D.

6.5 Como Lakeshore Management Area-Specific Tasks (A-L)

Considering the goals for this Lakeshore Management Plan (Section 4), and the ecological approach described in Section 6.3, we provide more specific restoration and management prescriptions for each discrete natural Management Area (A through L, Figure 4) around Como Lake.

Area A (0.48 acres of Savanna/Prairie)

- Retain all:
 - large canopy trees (except ash and invasive species)
 - o oak, dogwood, sumac, juniper, false indigo, crabapple, Symphoricarpos, Viburnum
- Remove all:
 - o ash trees (*Fraxinus* spp.)
 - trees <6" dbh (diameter at breast height), if not listed above in "retain" list
 - invasive vegetation, including: White poplar, Amur maple, buckthorn, Clematis, grapevines, Creeping Charlie, Crown vetch, Smooth brome, Canada thistle, Reed canary grass
- Thin (remove) crowded canopy trees, and limb-up (remove) lower branches
- Seed areas of bare soil, low native cover, and/or low diversity with savanna/prairie species

Area B (0.46 acres of Forest/Woodland)

- Retain all:
 - oak, dogwood, cherry, juniper, walnut, crabapple
- Remove all:
 - o ash trees (*Fraxinus* spp)
 - subcanopy trees and shrubs within 15' of oaks
 - solitary canopy/subcanopy trees <4" dbh, if not listed above in "retain" list
 - groupings of canopy/subcanopy trees <6" dbh, if not listed above in "retain" list
 - invasive vegetation, including: Siberian elm, Black locust, White mulberry, buckthorn, invasive honeysuckles, Smooth brome, Kentucky bluegrass, Creeping bellwort
- Seed areas of bare soil, low native cover, and/or low diversity with forest/woodland species

Area C (0.05 acres of Savanna/Prairie) - same prescription as Area A

Area D – Duck Point

- **Remove** all:
 - o invasive vegetation

Area E (0.19 acres of Savanna/Prairie) – same prescription as Area A, plus:

• Install native plants along shoreline, including species such as American three-square, Giant bur-reed, Lake sedge, Green bulrush, River bulrush, Blue flag iris, Sweet flag, and in sunny locations, Prairie cordgrass

Area F (0.38 acres of Forest/Woodland)

- Retain all:
 - large canopy trees (except ash and invasive species)
- **Remove** all:
 - o ash trees (Fraxinus spp)
 - elm (Ulmus spp) in the subcanopy or smaller
 - \circ $\;$ subcanopy trees and shrubs within 15' of oaks
 - o invasive vegetation, including: White mulberry, buckthorn, invasive cattails
- Install native plants in two depressions on east side of path, including species such as American three-square, Giant bur-reed, Lake sedge, Green bulrush, River bulrush, Blue flag iris, and Sweet flag

Area G (1.34 acres of Savanna/Prairie) – includes Compass Point; same prescription as Area A, except in Compass Point area:

- Also remove invasive Reed canary grass and Yellow nutsedge
- Seed areas of bare soil, low native cover, and/or low diversity with wet-mesic prairie/savanna species
- Install native plants in areas where invasive cattails removed, including species such as American three-square, Giant bur-reed, Lake sedge, Green bulrush, River bulrush, Blue flag iris, Sweet flag, and in sunny locations, Prairie cordgrass

Area H (0.38 acres of Forest/Woodland) – same prescription as Area B, except:

- Manage Weeping willow as follows:
 - Limb-up (remove) lower branches
 - Remove stump-sprouting and other poorly-formed specimens

Area I (0.57 acres of Savanna/Prairie) – same prescription as Area A, plus

• Install coir log and native plants along undercut portion of shoreline, including species such as American three-square, Giant bur-reed, Lake sedge, Green bulrush, River bulrush, Blue flag iris, Sweet flag, and in sunny locations, Prairie cordgrass

Area J (0.11 acres of Forest/Woodland) - same prescription as Area B

Area K (0.86 acres of Savanna/Prairie) – same prescription as Area A

Area L – Pavilion waterfront; no management proposed

6.6 Implementation Costs

To successfully execute any management plan, costs must be understood. Meaningful planning can only be accomplished by specifying program needs, applying realistic cost estimates, and projecting costs over

time while considering potential available resources. The following sections address short-term and longterm ecological restoration and management costs. Section 6.5 provides opinions of probable cost for each of this Plan's recommended actions, including ecological restoration and management actions as well as other programmatic actions.

6.6.1 Unit Costs

This Plan can help focus limited resources by presenting realistic unit costs, such as dollar per acre to manage invasive vegetation in a savanna. Many variables influence unit costs. The size of an area being restored, the existing site conditions, access, and slope all affect cost. For planning purposes, it is useful to understand unit costs in general. Table 2 provides unit costs for the most common ecological restoration and short-term management tasks, assuming a professional natural resource contracting firm does the work. Appendix D describes most of these tasks. Some of the tasks apply to long-term management, too, as discussed in Section 3.3.

Task	Unit	Unit Cost Range
Invasive/Aggressive Tree & Shrub Removal Tasks		
Tree removal (size, access, and disposal method influence cost)	each	\$180-\$600
Brushing (non-steep slopes; cut and stump treat)	acre	\$1,500-\$3,500
Brushing (steep slopes; cut and stump treat)	acre	\$3,000-\$6,000
Brushing (forestry mower)	acre	\$800-\$2,000
Brushing (goat browsing)	acre	\$3,000-\$4,000
Foliar spray young woody brush	acre	\$200-400
Invasive/Aggressive Herbaceous Species Removal Tasks		
Broadcast herbicide	acre/trip	\$175-300
Spot herbicide	acre/trip	\$200-400
Mowing	acre/trip	\$150-350
Conservation haying	acre/trip	\$350-\$1,000
Prescribed burn (minimum 3 acres)	acre	\$300-700
Tilling	acre	\$150-350
Native Seeding & Planting Tasks		
Native seed (material only)	acre	\$200-\$1,100
Native seeding (no-till drill, labor only)	acre	\$200-500
Native seeding (hand-broadcast, labor only)	acre	\$300-600
Straw mulch (spread and crimp)	acre	\$600-900
Installed live herbaceous plant plug	each	\$3-7
Installed shrub (2-gallon pot)	each	\$25-40
Installed shrub (5-gallon pot)	each	\$50-75
Installed tree (10-gallon pot)	each	\$150-250
Installed tree (2" ball & burlap)	each	\$300-600

Table 2. Unit Costs for Ecological Restoration & Management

6.6.2 Long-Term Management Costs

Long-term management costs vary widely across different plant communities depending on land use history, pressure by invasive species, human-induced disturbances (e.g., hydrological alterations, soil disturbance), site access, size of the management area, etc. Following initial restoration and short-term management investments, it should be assumed that managed natural areas require an average of \$150 to \$450 per acre per year to provide the long-term management necessary to sustain high quality natural areas. Intermittent management activities, such as prescribed burning in fire-dependent plant communities, may occur only every few years; however, annual budgeting can allow for "saving up" to fund these intermittent activities.

6.7 Implementation Resources

Securing financial resources—both for initial restoration efforts and long-term management—is critical to the long-term success of any management plan. Funding typically comes from internal budgets and external sources such as grants.

6.7.1 Agency Funding

CRWD, City of St. Paul and Ramsey County have historically funded work in the Lakeshore Zone of Como Lake. It is anticipated that that will continue and support implementation over the life of this plan.

6.7.2 Grants

CRWD and the City of St. Paul have been successful at pursuing and securing grants to help fund their natural resources program. These funds are critical to extending the capacity of internal watershed district and City budgets and funding. Additional staffing time and/or expertise may be required to pursue and administer such funds.

It is fortunate that the CRWD and City have access to a number of state, county, and federal grant programs. Below are some of the programs most applicable to natural resources restoration and management. This list is not all-inclusive list for the life of this Plan.

State Programs

- Clean Water, Land and Legacy Amendment (funded by State sales tax)
 - Outdoor Heritage Fund/Lessard-Sams Conservation Partners Legacy Grants
 - o Clean Water Fund
 - Parks & Trails Fund
- Environment & Natural Resource Trust Fund

National Fish and Wildlife Foundation (NFWF)

- Five Star and Urban Waters Restoration Grant
- Monarch Butterfly and Pollinators Conservation Fund
- Resilient Communities Program

Other Federal Grant Programs

• EPA/MPCA 319 Small Watersheds Grant (awarded to CRWD for Como Lake shoreline projects for years 2022-2025).

6.8 Recommended Actions Summary

6.8.1 Implementation Schedule, Costs & Responsibilities

Implementation actions identified in this Plan are presented in Table 3. For each action, the table presents the recommended frequency of occurrence, lead agency, one-time or annual cost, and the total plan cost over the course of 20 years. Ecological restoration and management costs assume the use of professional ecological contractors but do not assume use of prevailing wage. Cost savings may be accomplished, depending on how actions are timed, staffed and executed. Costs do not account for inflation.

Table 3. Implementation Schedule, Costs & Responsibilities

Goal / Objective	Action	Frequency	Lead Agency	One-Time (O) or	Total Plan Cost
Goal 1. Buffer and Bank Stability (BB)				Annual (A) Cost	
	BB.A.1 Stabilize Undercut Banks	One-time	City	\$15,400 (O)	\$15,400
	BB.A.2 Inspect and Manage Shoreline Erosion	Annually	CRWD	\$640 (A)	\$12,800
Mitigate Shoreline Erosion (BB.A)	BB.A.3 Inspect Native Plantings	Seasonally (2x/yr)	CRWD	\$1,600 (A)	\$32,000
	BB.A.4 Monitor and Manage Muskrats	Seasonally (2x/yr)	City	\$1,440 (A)	\$28,800
	BB.A.5 Inspect and Maintain Lake Outlet	Seasonally (3x/yr)	City	\$800 (A)	\$16,000
	BB.B.1 Selectively Thin Woody Vegetation	One-time	City	\$26,400 (O)	\$26,400
Mitigate Buffer Zone Erosion (BB.B)	BB.B.2 Inspect and Maintain Buffer Vegetation	Seasonally (2x/yr)	CRWD	\$2,560 (A)	\$51,200
	BB.B.3 Inspect and Address Access Path Erosion	Annually	CRWD	\$1,600 (A)	\$32,000
	BB.C.1 Inspect Storm Sewer Outfalls	Annually	CRWD	\$800 (A)	\$16,000
Willigate Storm Sewer Erosion (BB.C)	BB.C.2 Repair Storm Sewer Erosion	Annually	City	\$1,080 (A)	\$21,600
Goal 2. Vegetation and Habitat (VH)					
	VH.A.1 Manage Savanna/Prairie Areas	Annually	City	\$2,275 (A)	\$45,500
	VH.A.2 Manage Forest/Woodland Areas	Annually	City	\$845 (A)	\$16,900
	VH.A.3 Remove and Control Invasive/Aggressive Vegetation	Seasonally (2x/yr)	City	\$5,280 (A)	\$105,600
Ensure Diverse Buffer Vegetation (VH.A)	VH.A.4 Enhance Low-Diversity or Sparse Vegetation	Annually	CRWD	\$1,200 (A)	\$24,000
	VH.A.5 Establish and Maintain Lake Views	Annually	City	\$1,680 (A)	\$33,600
	VH.A.6 Maintain Perimeter Trail Edge	Seasonally (2x/yr)	City	\$800 (A)	\$16,000
	VH.A.7 Remove Landscape Debris	Seasonally (2x/yr)	City	\$800 (A)	\$16,000
Expand Puffor Zono (1/H P)	VH.B.1 Widen Buffer (turf to prairie conversion costs only)	One-time	City	\$28,000 (O)	\$28,000
Expana Bujjer zone (VH.B)	VH.B.2 Assess Perimeter Trail Relocation	One-time	City	\$3,200 (O)	\$3,200
	VH.C.1 Ensure Pollinator-Beneficial Buffer	Seasonally (3x/yr)	CRWD	\$1,920 (A)	\$38,400
Ennance whanje Habitat (VH.C)	VH.C.2 Install and Maintain Wildlife Habitat Structures	Annually	City	\$13,600 (O)	\$13,600
Goal 3. Visitor Experience (VE)					
	VE.A.1 Enhance and Stabilize High-Use Access Paths	One-time	City	\$34,000 (O)	\$34,000
Ensure Safe Physical Access (VE.A)	VE.A.2 Consider ADA Access (no implementation costs)	One-time	City	\$2,000 (O)	\$2,000
	VE.A.3 Improve Duck Point	One-time	City	\$25,000 (O)	\$25,000
Ensure Clear Views (VE.B)	VE.B.1 Maintain Views From Benches	Seasonally (2x/yr)	City	\$1,440 (A)	\$28,800
Ensure Feeling of Safety (VE.C)	VE.C.1 Consider Safety Improvements (no implementation costs)	One-time	City	\$2,000 (O)	\$2,000
	VE.D.1 Establish and Oversee Como Lake Volunteer Team	Annually	City	\$2,400 (A)	\$48,000
Engage Community (VE.D)	VE.D.2 Sponsor Lakeshore Volunteer Events	Seasonally (2x/yr)	CRWD	\$3,200 (A)	\$64,000
	VE.D.3 Facilitate Data Collection by the Public (initial setup only)	Annually	CRWD	\$6,600 (O)	\$6,600
Goal 4. Plan Implementation (PI)					
Communicate Reposits of a Healthy Lakesborg (DLA)	PI.A.1 Improve Lakeshore Signage and Displays of Public Art	One-time	City	\$6,600 (O)	\$6,600
Communicate Benefits of a Healthy Eakeshore (FI.A)	PI.A.2 Build Community Support for Lakeshore	Annually	City	\$6,900 (A)	\$138,000
	PI.B.1 Integrate Related Plans	One-time	City	\$1,600 (O)	\$1,600
	PI.B.2 Identify Field Survey Tool	One-time	CRWD	\$1,600 (O)	\$1,600
Ensure Regular Partner Coordination (PI.B)	PI.B.3 Conduct Seasonal Inspections	Seasonally (3x/yr)	CRWD	\$1,200 (A)	\$24,000
	PI.B.4 Identify and Use Common Data Management Platform	Annually	City & CRWD	\$3,200 (A)	\$64,000
	PI.B.5 Secure Funding	Annually	City & CRWD	\$TBD (A)	\$TBD
				Total Plan Cost:	\$1.030.800

7.0 Conclusion

Despite its relatively small acreage and narrow width, the Como Lakeshore represents an important natural area within the City of St. Paul and the CRWD. City residents use and enjoy the adjacent Como Park and natural areas within the buffer, which also delivers important ecosystem services that undergird human life and society. Over a century of land alteration, intensive human use, and pressure by invasive species has compromised the functions and value of this important natural area. Building on CRWD's and the City's work to date, implementing this Como Lakeshore Management Plan will continue to reverse past alteration and disturbance and help achieve conservation and community goals.

The CRWD, City of St. Paul, other partners, volunteers, and professional contractors will carry out recommended actions over the coming decades. Results will be evaluated and reported annually, staff will adapt the plan to meet changing circumstances, and residents and partners will be engaged and kept informed. In this way, the Como Lakeshore will be improved and maintained to provide healthy and resilient ecosystems and wildlife habitat, which will be passed on to future generations for the enjoyment of all and the benefit of nature.

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Appendices

Appendix A. Glossary

Adaptive	Structured decision making in the face of uncertainty, with an aim to
Management	reducing uncertainty over time by a cycle of planning, implementation,
	monitoring, evaluation, and adjustment.
Biocontrol	The use of natural enemies to reduce invasive species populations.
Biodiversity	The variety of life in a particular habitat or ecosystem, including plants and
	animals.
Bioengineering	Use of natural materials (e.g., dead wood, live stakes/fascines, plants, seeds,
	etc.), sometimes in combination with more "hard" techniques (e.g., riprap)
	to stabilize eroding soil along streambanks, shorelines, ravines, etc.
Cultural Land Cover	Developed or significantly altered land, typically used regularly and/or
or Ecosystem	intensively by people (e.g., buildings, parking lots, roads, crop fields, turf
	lawns).
Ecological	Improving an existing natural area, such as adding more native flower
Enhancement	species to a prairie or removing an undesirable tree like Boxelder from an
	oak forest.
Ecological	As a general term, improving the natural environment by stabilizing and
Restoration	enhancing biodiversity, resilience, and ecosystem services. In contrast to
	a non-natural area (a.g., turf grace or cropland) to a native plant community
	(e.g. prairie or wetland)
Fcological	Refers to responsible use and protection of the natural environment through
Stewardship	conservation and sustainable practices
Footuntom Annuach	
Ecosystem Approach	factors in an ecosystem and designs management techniques that replicate
	at the lowest practical cost, the ecological structures and processes that
	enable ecosystems to adapt to changing conditions.
Ecosystem Services	The natural outputs of healthy ecosystems that benefit people—air and
	water purification, flood control, groundwater recharge, fish and wildlife
	production, soil building, recreation, food and fiber production, and spiritual
	renewal and recreational pleasure. Ecosystem services are worth trillions of
	dollars annually worldwide.
Edge Effects	The (usually negative) impacts that altered or developed land have on
	adjacent natural habitats (e.g., increased noise, microclimate changes,
	increased predation). Smaller, narrower habitats are more impacted by
	edge effects than larger, rounder ones.
Generalist Wildlife	Animal species that can live in many different types of environments and
Species	have a varied diet and broad habitat requirements.
Geographic	(GIS) A computer-based mapping system designed to capture, store,
Information System	manipulate, analyze, manage, and present spatial or geographic data.
Habitat	Habitat fragmentation is the process by which habitat loss results in the
Fragmentation	division of large, continuous habitats into smaller, more isolated remnants.

Integrated Pest	(IPM) A pest management strategy that focuses on long-term prevention or
Management	suppression of pest problems with minimum impact on human health, the
Invasivo Spocios	Aggressive species whose introduction does or is likely to cause economic or
invasive species	environmental harm or harm to human health
Keystone Species	A species that has greater effects on ecological processes than would be
	predicted from their abundance or biomass alone.
Mesic	Moist, typically referring to soil conditions (as opposed to dry or wet).
Native Plants	Plants indigenous to a given area in geologic time. This includes plants that
	have developed, occur naturally, or existed for many years in an area.
Natural Area	Areas consisting of natural and/or semi-natural vegetation and not
	intensively managed for human use.
Specialist Wildlife	Animal species that have specific environmental needs related to habitat,
Species	diet or another environmental factor, without which they cannot sustain
	their populations.
Species of Greatest	(SGCN) Wildlife species, including state-listed and non-listed species, that are
Conservation Need	regionally rare or in decline, often as a result of habitat loss.
Spot Herbicide	Using targeted application methods (e.g., backpack sprayer with wand or
Application	sponge) to apply herbicide to undesirable vegetation, such as invasive plants.
Stormwater	A series of various stormwater best management practices (BMPs) designed
Treatment Train	to manage stormwater runoff. These BMPs may include structural or
	engineered features (e.g., sediment-removal devices, rain barrels, cisterns)
	as well as naturalized BMPs (e.g., rain gardens, vegetated swales,
	stormwater wetlands).
Watershed	An approach to water and other natural resources management that
Management	considers the entire drainage area or catchment.

Appendix B. Practices to Avoid Introducing & Moving Invasive Species (MNDNR)

It is the MNDNR's policy to limit the introduction of invasive species onto MNDNR managed lands and waters, limit their rate of geographical spread, and reduce their impact on high value resources.

The movement of equipment, organisms, and organic and inorganic material are potential pathways for the introduction or spread of invasive species. Each of these pathways should be considered and addressed to reduce risk associated with invasive species movement.

General Procedures for Intentional Movement of Equipment

- 1. Before arriving at a work site, inspect for and remove all visible plants, seeds, mud, soil, and animals from equipment.
- 2. Before leaving a work site, inspect for and remove all visible plants, seeds, mud, soil and animals from equipment.
- 3. After working on infested waters or waters known to harbor pathogens of concern, clean and dry equipment prior to using in locations not known to be infested with species or pathogens present at the last location visited.

Specific Procedures: Vehicles and Heavy Equipment

- 1. When possible maintain separate equipment to use on uninfested sites.
- 2. If working on multiple sites, work in uninfested sites before infested sites and clean equipment after use.
- 3. When working within a site with invasive species work in uninfested areas before infested areas and clean equipment after use.
- 4. Avoid entering site under wet conditions to minimize rutting and other soil disturbances.
- 5. Minimize area of soil disturbance with equipment.
- 6. Minimize number of access points to site.
- 7. When creating roads and trails minimize area of vegetation and soil disturbance.
- 8. Survey site before management treatment and treat or avoid moving equipment through existing patches of invasive species.
- 9. Conduct post management treatment monitoring and treat any responding invasive species.
- 10. Inspect all gear and remove vegetation, soil, and organisms prior to arriving and leaving site.
- 11. On sites that are known to be infested with species such as garlic mustard, spotted knapweed, leafy spurge, etc. (species with small seed that can collect on cloth material) wash clothing after work is complete.
- 12. Carry boot brush in or on all vehicles and clean boots and clothing (in a controlled area) when leaving any site.
- 13. Use brush to clean gear and equipment such as chainsaws to remove loose soil and plant materials.
- 14. Avoid parking in patches of invasive species. When unavoidable, clean vehicle of all visible evidence of soil and vegetation when leaving site.

- 15. Brush off (hand remove) plants, seeds, mud, soil and animals from vehicles, including wheel wells, tracks, hums, blades, grills, etc.
- 16. Power spray equipment after hand removal if necessary to remove aquatic plant remnants (particularly curly-leaf pondweed, Eurasian watermilfoil, flowering rush, and purple loosestrife) and earthworms.

General Procedures for Intentional Movement of Organisms, Organic and Inorganic Material (including water, fish, plants, mulch, soil, gravel, rock)

- 1. Do not plant or introduce prohibited or regulated invasive species or other listed invasive species.
- 2. Do not transport water from infested waters, except by permit. When you must use water from an infested waters, do not drain this water or water that has come in contact with organisms from the infested waters, where it can run into another basin, river, or drain system that does not go to a treatment facility.
- 3. Use only mulch, soil, gravel, etc. that is invasive species-free or has a very low likelihood of having invasive species.
- 4. Do not transplant organisms or plant material from any waters with known populations of invasive aquatic invertebrates
- 5. Do not move soil, dredge material, or raw wood projects that may harbor invasive species from infested sites.

Specific Procedures: Re-vegetation (Aquatic and Terrestrial Plants)

- 1. Do not plant or introduce prohibited or regulated invasive species or other listed invasive species.
- 2. Inspect transplanted vegetation for signs of invasive species that may be attached to the vegetation and remove (i.e., other plant material and animals, etc.)
- 3. Re-vegetate with native species.
- 4. Preserve existing native vegetation. Peel topsoil that contains natives away from the work zone, stockpile and then replace it at the end of construction. This can help re-establish native species quickly.
- 5. If stockpiled invasive free topsoil isn't adequate for post-construction landscaping, and black dirt, sand or gravel must be purchased, purchase invasive species (i.e., worm) free material.
- 6. Purchase certified weed-free mulch.
- 7. Inspect outside of storage containers and materials for visible presence of invasive species.
- 8. If possible, use seeding material, plants, fill, straw, gravel, and mulch that are certified as uninfested.
- 9. Monitor areas where materials are added for evidence of invasive species germination.
- 10. When possible minimize the use of outside materials.

Procedures to Minimize the Risk of Increasing the Dominance of Invasive Species on Site

1. Survey site before burning and treat or avoid moving through patches of invasive species before burn is conducted.

- 2. Avoid entering site under wet conditions to minimize rutting and other soil disturbances.
- 3. Conduct post-treatment monitoring and treat any invasive species (such as resprouts and germination).

Site Planning and Management

Construction activities that disturb the soil surface can expose dormant invasive species seed banks and create a growth medium that favors invasive plants. Landscaping can also introduce invasive plant species, as can maintenance activities such as mowing, grading, and stormwater pond maintenance.

Exercise site-level management to minimize the introduction, spread, and impact of invasive species. Sitelevel management shall include planning, implementation and evaluation procedures that reduce the risk of introduction, spread, and impact of invasive species. Procedures include identification of invasive species, monitoring for invasive species, developing strategies and actions to minimize spread and impact, implementing management actions, and evaluating success.

References

Minnesota Department of Natural Resources Operational Order #113, Invasive Species, May 31, 2007.

Minnesota Department of Natural Resources Invasive Species Operational Handbook, May 31, 2007.

Minnesota Department of Natural Resources Standard Protocols for Invasive Species Prevention on Terrestrial Sites (Draft).

Appendix C. Climate-Adapted Trees to Plant in the Twin Cities Region

The following climate-adapted tree species have been identified for planting in the Twin Cities region. RES ecologists used their field experience and scientific information to identify tree species having the greatest chance of persisting in the Twin Cities region over the coming decades, despite predicted changes in local climate. RES used the following approach.

The National Park Service's (NPS) local Twin Cities office prepared a list of 42 tree species suitable for planting in the changing local climate (NPS No Date). These included 21 tree species native to Minnesota, 15 species with ranges outside Minnesota, four species to plant in limited numbers due to their susceptibility to pests, and two species soon to be extirpated.

RES reviewed the NPS list and adjusted the species with information from three reputable sources:

- 1. A native tree species list maintained by the Minnesota Department of Natural Resources (MNDNR 2019);
- 2. US Department of Agriculture (USDA 2019) PLANTS Database to identify tree species in adjacent states likely to migrate into Minnesota in the next few decades;
- 3. US Forest Service's (Prasad et al. 2019) climate change and tree response model to identify trees predicted to move into or out of the Twin Cities region in the next few decades.

This analysis identified 94 climate-adapted tree species potentially suitable for planting in the Twin Cities region. Each tree species was evaluated as to its suitability for planting in the Twin Cities region by dividing them into three categories: 1) trees suitable to plant currently; 2) trees suitable to plant in 2040; and 3) trees not suitable for planting.

Trees To Plant Now in the Twin Cities

- 1. Native to Minnesota.
- 2. Neither an invasive or potentially invasive exotic species, nor a native species that readily colonizes new ground, grows aggressively, or would be the target of control efforts in natural areas (e.g., box-elder, *Acer negundo*).
- 3. Not susceptible to pests or diseases.
- 4. Predicted to remain in the Twin Cities region's plant hardiness zone at least until 2100, based on the USFS climate change and tree response model.

Trees to Plant but Not Present Now in Minnesota

- 1. Native to areas adjacent to Minnesota: northern Iowa, western Wisconsin, northwest Illinois and eastern South Dakota and North Dakota.
- 2. Not considered invasive or potentially invasive.
- 3. Not susceptible to pests or diseases, or resistant varieties are available.
- 4. Predicted to enter the region in coming decades based on USFS climate change and tree response models.

Trees Not to Plant

- 1. Native species growing 450-500 miles from Minnesota or not native to North America.
- 2. Currently outside or predicted to move out of its plant hardiness zone in Minnesota.
- 3. Abundant species that can regenerate without assistance.
- 4. Susceptible to serious damage or death from pests or diseases.
- 5. Considered an invasive species.

This winnowing process identified 45 climate-adapted tree species suitable for planting in the Twin Cities region. This list differs somewhat from the NPS list (NPS No Date) by taking advantage of the most current data from the USFS climate change and tree response models (Prasad et al 2019).

Before planting any tree, soil moisture and plant community context must be considered. For instance, a sugar maple should not be planted in an oak savanna because it has low fire tolerance and would not persist in a fire-dependent plant community. In addition, its greater shade tolerance would result in the eventual replacement of canopy oaks should fire management be interrupted. Likewise, planting a white oak in a wetland soil would likely result in the death of the white oak because it does not tolerate high soil moisture and low oxygen conditions in the rooting zone.

Because soil moisture and plant community context are essential field conditions for proper selection of tree species, RES ecologists assessed each tree species' soil moisture tolerance and identified the appropriate plant community in which to plant each species. Soil moisture tolerance information was obtained from the MNDNR and Iowa State University's Forestry Extension program. The plant community to which RES ecologists assigned each tree species was based on extensive field experience across the Midwest and in Twin Cities natural areas.

References

- Iverson, L. R., A. M. Prasad, S. N. Matthews, and M. Peters. 2008. Estimating potential habitat for 134 eastern US tree species under six climate scenarios. *Forest Ecology and Management* 254:390-406.
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Table C1. Climate-Adapted Trees to Plant in the Twin Cities Region

Species Name ^{1,2}	Common Name ^{1,2}	Family ^{1,2}	Plant Community Suitable for Planting ³	Wet Soil Tolerant 4,5	Dry Soil Tolerant 4,5	Potential Diseases, Pests & Problems ^{6,7,8}
Acer rubrum	Red maple	Aceraceae	MF, LF	Yes		Susceptible to storm damage, inviting fungi and insect pest; leaf chlorosis
Acer saccharinum	Silver maple	Aceraceae	LF	Yes	Yes	Storm damage; verticillium wilt
Acer saccharum	Sugar maple	Aceraceae	MF		Yes	Verticillium wilt
Aesculus glabra	Ohio buckeye	Sapindaceae	DMFW, LF	Yes		Buckeye lacebug, leaf blotch, Asian long-horned beetle
Amelanchier arborea	Serviceberry	Rosaceae	DMFW, S		Yes	None serious
Amelanchier laevis	Serviceberry	Rosaceae	DMFW, S		Yes	None serious
Betula nigra	River birch	Betulaceae	LF	Yes		Bronze birch borer, chlorosis, Asian long- horned beetle host
Carpinus caroliniana	Blue beech, Musclewood, Hornbeam	Betulaceae	MF, LF	Yes		Fire
Carya cordiformis	Bitternut hickory	Juglandaceae	MF	Yes	Yes	Hickory bark beetles, pecan weevils, anthracnose, and powdery mildew
Carya illinoinensis ⁸	Pecan	Juglandaceae	DMFW	Yes		Scab

Species Name ^{1,2}	Common Name ^{1,2}	Family ^{1,2}	Plant Community Suitable for Planting ³	Wet Soil Tolerant 4,5	Dry Soil Tolerant 4,5	Potential Diseases, Pests & Problems ^{6,7,8}
Carya ovata	Shagbark hickory	Juglandaceae	DMFW, S		Yes	Hickory anthracnose or leaf spot
Catalpa speciosa ⁸	Northern catalpa	Bignoniaceae	DMFW	Yes		Verticillium wilt
Celtis occidentalis	Common hackberry	Cannabaceae	MF, LF		Yes	Nipple gall and witches broom gall
Cercis canadensis ⁸	Eastern redbud	Fabaceae	MF, S	Yes		Leaf anthracnose; <i>Botryosphaeria</i> canker; verticillium wilt
Cornus alternifolia	Pagoda dogwood	Cornaceae	MF, SS	Yes		Anthracnose, crown canker
Fraxinus americana	White ash	Oleaceae	MF	Yes	Yes	Emerald ash borer, ash dieback, environmental pollutants
Gleditsia triacanthos	Honeylocust	Fabaceae	LF	Yes	Yes	Nectria canker
Gymnocladus dioicus	Kentucky coffee tree	Fabaceae	LF		Yes	Pest resistant species
Hamamelis virginiana	Witch hazel	Hamamelidaceae	DMFW, S	Yes		Japanese beetles can damage the leaves
Juglans nigra	Black walnut	Juglandaceae	DMFW, S	Yes		Thousand canker disease, <i>Fusarium</i> cankers, root rot diseases, walnut anthracnose
Juniperus virginiana	Eastern red cedar	Cupressaceae	DMFW, S, SS		Yes	Host of cedar-apple rust, susceptible to leaf blights

Species Name ^{1,2}	Common Name ^{1,2}	Family ^{1,2}	Plant Community Suitable for Planting ³	Wet Soil Tolerant ^{4,5}	Dry Soil Tolerant 4,5	Potential Diseases, Pests & Problems ^{6,7,8}
Morus rubra	Red mulberry	Moraceae	LF	Yes		Hybridizes with invasive white mulberry
Ostrya virginiana	Ironwood, Eastern hophornbeam	Betulaceae	DMFW, MF		Yes	Trunk and butt rots
Pinus strobus	Eastern white pine	Pinaceae	DMFW	Yes		White pine weevil, white pine blister rust, <i>Armillaria</i> root rot
Platanus occidentalis ⁸	American sycamore	Platanaceae	DMFW	Yes	Yes	Anthracnose
Populus deltoides	Eastern cottonwood	Salicaceae	LF	Yes		Clearwing borer, possible host of Asian long-horned beetle
Prunus americana	Wild plum	Rosaceae	S, SS	Yes	Yes	Insects and pests
Prunus pensylvanica	Pin cherry	Rosaceae	DMFW, S		Yes	Insects and pests
Prunus serotina	Black cherry	Rosaceae	DMFW	Yes	Yes	Eastern tent caterpillar, cherry scallop shell moth
Ptelea trifoliata	Hoptree	Rutaceae	S, SS	Yes	Yes	Leaf spots and rust, nothing serious
Quercus alba	White oak	Fagaceae	DMFW, MF	Yes	Yes	Oak wilt, oak scale, oakworm, gypsy moth
Quercus bicolor	Swamp white oak	Fagaceae	LF	Yes	Yes	Anthracnose, Oak wilt
Quercus ellipsoidalis	Northern pin oak	Fagaceae	DMFW, S		Yes	Oak wilt
Quercus imbricaria ⁸	Shingle oak	Fagaceae	DMFW	Yes		Oak wilt, gypsy moth

Species Name ^{1,2}	Common Name ^{1,2}	Family ^{1,2}	Plant Community Suitable for Planting ³	Wet Soil Tolerant 4,5	Dry Soil Tolerant 4,5	Potential Diseases, Pests & Problems ^{6,7,8}
Quercus macrocarpa	Bur oak	Fagaceae	DMFW, MF, S, LF	Yes	Yes	Bur oak blight, Oak wilt, gypsy moth
Quercus muehlenbergii	Chinkapin oak	Fagaceae	DMFW, S		Yes	Oak wilt, <i>Nectria</i> canker, <i>Armillaria</i> root rot, gypsy moth, two-lined chestnut borer
Quercus palustris ⁸	Pin oak	Fagaceae	DMFW	Yes		Oak wilt, gypsy moth
Quercus rubra	Northern red oak	Fagaceae	DMFW, MF		Yes	Oak wilt
Quercus velutina	Black oak	Fagaceae	DMFW, S		Yes	Oak wilt
Salix amygdaloides	Peachleaf willow	Salicaceae	LF	Yes		Willow rust, aphids, Asian long-horned beetle host
Salix nigra	Black willow	Salicaceae	LF	Yes		Willow rust, aphids, Asian long-horned beetle
Sassafras albidum ⁸	Sassafras	Lauraceae	DMFW	Yes		Laurel wilt
Tilia americana	American basswood	Tiliaceae	DMFW, MF		Yes	Borers, beetles, lacebugs, caterpillars, scale, spider mites
Ulmus americana	American elm	Ulmaceae	MF, LF	Yes	Yes	Dutch elm disease, Asian long-horned beetle host
Ulmus rubra	Slippery elm	Ulmaceae	MF, LF	Yes	Yes	Dutch elm disease, Asian long-horned beetle host

¹https://plants.sc.egov.usda.gov/java/

² https://www.dnr.state.mn.us/trees_shrubs/index.html

³ DMFW = Dry-Mesic Forest/Woodland; MF = Mesic Forest; S = Savanna; SS = Shrub-Scrub; LF = Lowland Forest

⁴ https://www.extension.iastate.edu/forestry/iowa_trees/trees/

⁵ <u>https://www.dnr.state.mn.us/forestry/nursery/choosing.html</u>

⁶ <u>http://campustrees.umn.edu/tree-species</u>

⁷ <u>https://www.extension.iastate.edu/forestry/iowa_trees/trees/</u>

⁸ These trees currently may not be naturally present in Minnesota

Appendix D. Ecological Restoration and Management Tasks

Hydrological Restoration

Natural Hydrology. In natural settings of the Midwest and Great Lakes Region, wetlands and associated streams, ponds, and lakes experienced gradual rises and falls in water level after large storms and spring snowmelt. Small storms rarely caused surface and groundwater levels to rise. Evapotranspiration from the land and vegetation gradually drew down water and groundwater levels from early summer into fall. (The groundwater table that is visible in wetlands, streams, ponds and many lakes rises and falls even more slowly than surface water levels.)

Altered Hydrology and Vegetation Effects. Native plants and animals are well-adapted to gradual changes in water and groundwater level. Ditching, tiling, and other drainage systems, combined with land clearing and impervious surfaces, have deranged the natural hydrological regime in the majority of the region's wetlands, streams, ponds, and lakes. Damming and road-building also alter hydrology by impounding water upslope and drying out the downslope wetlands. These changes in hydrology alter the plant and animal communities of hydrologically-dependent ecosystems by favoring certain species well-adapted to either a static hydrological regime (such as above dams) or an artificially dynamic hydrological regime, such as below drained agricultural and developed landscapes. Dominance by a few species often results, with the loss of plant and insect biodiversity, and shifts in the abundance of bird, amphibian, and small mammal densities.

Restoring Hydrology. In hydrologically-deranged wetland and related systems, the first restoration task is to identify where ditches, tiles, undersized road culverts, berms and dikes exist on a site in order to remove them and restore a more natural hydrological regime. A second task is to identify locations outside the site which have a disproportional effect on the hydrology of the site. The first task is a common part of restoration, while the second requires taking a watershed approach that often involves multiple parties, considerable expense, and long time frames.

Prescribed Burning

Prescribed burning is an important and cost-effective ecological restoration and management tool, very appropriate for fire-dependent communities such as pine, pine-oak, and oak forest; oak and oak-pine savanna; prairie; wet meadow; and marsh. The City of St. Paul harbors many native plant communities that benefit from periodic fire. These plant communities are often most cost-effectively managed with well-planned and well-executed prescribed burns. The many benefits of fire in have been well documented.

Burning Grasslands and Meadows. The City's prairie habitats should be burned about every three years, depending on the rate of woody plant growth and the accumulation of fine fuel. More frequent burning may be needed to control woody plant growth, or less frequent if the dead leaf litter accumulates slowly. Creating two or three burn units, each capturing the site's heterogeneity, preserves refuges for wildlife whose numbers may decline after a fire. For instance, invertebrates such as the Rusty patched bumble bee are protected by burning subunits of a prairie, rather than the entire thing. This insect and others

quickly recolonize the burned patch from nearby unburned habitat in a year or two. The USDA/NRCS recommends that most prescribed burning be done in early spring before grassland birds nest; latesummer and fall burns also avoid the nesting period (USDA/NRCS 1999). Burning small prairie restorations with little to no nearby refugia may not protect some species, even using small burn units.

Burning Forests, Woodlands & Savannas. Fire-dependent forests, woodlands, and savannas may have sufficient oak or pine leaf litter to carry a low-intensity surface fire, generally with flame lengths only up to two to three feet. These surface fires help remove excess leaf litter and organic duff, control invasive plants not adapted to fire, and stimulate the growth of a diverse assemblage of native plants. (The fire research at Minnesota's Cedar Creek Ecosystem Science Reserve demonstrates this clearly for savannas.)

For routine management, the City's fire-dependent forests and woodlands should be burned every five to ten years, depending on their species composition, available fuel, ecological quality, and restoration and management needs. More frequent burns, even annually, may be beneficial for killing invasive vegetation (e.g., buckthorn) and preparing a site for restoration. However, burning wooded areas can be challenging if fine fuel is sparse. Legacy materials (downed woody debris and snags) must be addressed before or after a burn, as they burn for a long time and require overnight watching or extra effort to extinguish. In closed-canopied forests, especially with a woody understory, dense shade often suppresses invasive plants, making prescribed burning less important as a management tool.

Challenges of Using Prescribed Fire. Prescribed burning can be challenging in a developed setting. Park users, neighboring residences and businesses, traffic on roads, and air quality all need to be considered when developing a thorough and safe burn plan. Prior to burning, the City of St. Paul or its appointed contractor should secure the necessary permissions, notify the community, and take appropriate precautions to protect infrastructure or vegetation that is not intended to be burned. Due to fixed costs associated with mowing fire breaks, notifications, mobilization, and burn coordination and execution, small burns of less than a dozen or so acres are much more expensive on a per-acre basis than larger ones.

Biocontrol

Biocontrol uses natural enemies to reduce invasive species populations. Several approved biocontrol agents are available to control invasive vegetation in the City (Table D1), but the most problematic ones—buckthorn, reed canary grass, invasive cattail—have none.

Community	Plant Species	Biocontrol Agent	Mechanism	Application	References
Forests & Woodlands	Garlic mustard (Alliaria petiolata)	A root-crown mining weevil (<i>Ceutorhychus</i> scrobicollis)	Adult Stage: Herbivory of foliage. Larval Stage: Mine petioles and root crowns in winter and early spring.	Biocontrol agent not available in the U.S. but is being texted.	Becker et al. 2020
	Leafy spurge (Euphorbia esula)	Leafy spurge beetle (Aphthona lacertosa) Black dot Leafy spurge flea Beetle (Aphthona nigriscutis)	Adult Stage: Herbivory on foliage, then lay eggs at the base of plant. Larval Stage: Eggs hatch, larvae feed on roots over winter until pupation and emergence as adults the next summer.	Exists in City; City has released at multiple sites through the years.	Chandler et al. 2012
Upland Grasslands Spotted knapwee (<i>Centauro</i> <i>stoebe</i>)	Spotted knapweed (Centaurea stoebe)	Seedhead weevils (Larinus minutus and L. obtusus) A root-boring weevil	Adult stage: Herbivory of foliage. Larval stage: Consume developing spotted knapweed seed. Larval Stage: Develop in roots, consuming starch	Exists in City; City has released root weevil at one site; seedhead weevils have been released at several, but seem to be present at all	Chandler 2022
Wetlands	Purple loosestrife (Lythrum salicaria, L.	Black-margined loosestrife beetle (<i>Galerucella calmariensis</i>) Purple loosestrife leaf beetle (<i>Galerucella pusilla</i>)	damaging roots. Adult Stage: Herbivory of foliage. Larval Stage: First instar larvae feed concealed in leaf or flower bud; later instars feed on aboveground plant parts.	Exists in City; City has released at multiple sites through the years.	MNDNR 2021
virgat	virgatum)	Loosestrife root weevil (Hylobius transversovittatus)	Adult Stage: Herbivory of foliage. Larval Stage: Feed in roots.	,	

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Invasive Tree & Shrub Removal

As part of an ecosystem approach, removing invasive woody vegetation often dramatically accelerates the ecological restoration process. Common buckthorn (*Rhamnus cathartica*) and non-native honeysuckles (e.g., *Lonicera x bella, T. tatarica*) are primary targets in St. Paul since they can dominate forest understories. Siberian elm (*Ulmus pumila*) and Black locust (*Robinia pseudoacacia*) trees, saplings, and seedlings can also be abundant. In addition, some native trees and shrubs—Boxelder (*Acer negundo*), Green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), Eastern red cedar (*Juniperus virginiana*), and Prickly ash (*Zanthoxylum americanum*)—can dominate native plant communities damaged by past poor management. In these cases, selectively or completely removing them from a forest understory may help to accelerate the restoration process; however, aggressive removal of native species should occur only after thorough assessment of the plant community and consideration of conservation goals.

It is important to note that the federally-threatened Northern long-eared bat (*Myotis septentrionalis*) may use trees within the City for summer roosting. Survey techniques to determine the presence or absence of the Northern long-eared bat should follow the USFWS survey guidelines for Indiana bat (USFWS 2019b). USFWS management guidelines (USFWS 2016) recommend that tree-cutting in suitable habitat should not occur from April 1 through September 30, with the pup-rearing season (June 1 through July 31) being critical, especially in the white-nose syndrome zone (UFFWS 2020). This federal guidance (USFWS 2016) suggests that tree clearing, even for ecological restoration, should occur from early October through March (with June 1 through July 31 being the most sensitive period due to pup rearing). Fortunately, this is the typical period for tree removal in ecological restoration projects, and this timing also avoids harming nesting migratory birds.

Once aggressive shrub and understory species are under control, soil-anchoring native ground layer vegetation and native trees and shrubs can be planted to stabilize soils and compete with the invasives. Planting nut- and berry-producing trees and shrubs should be a priority, as these important wildlife foods are usually missing or scarce in damaged forest ecosystems.

If resources are limited, invasive vegetation management should focus on removing invasives from the highest quality areas or areas with the rarest natural features. These situations represent early invasions that are easier to control than dense infestations. Likewise, it is more important to remove seed-producing specimens (such as female buckthorn shrubs) first to prevent seed drop and dispersal.

Removing invasive woody vegetation typically includes the following tasks.

- Native Plant Protection. Protect desirable native woody and herbaceous vegetation by various means. When desirable native vegetation exists at a site, avoid forestry mowing, goat grazing, heavy equipment use, and broadcast herbiciding. Where native vegetation is sparse in one or more layers of a plant community, these indiscriminate methods can be used.
- Slope Protection and Safety. Steep slopes may make mechanized woody plant removal very difficult. Hand cutting with workers in safety harnesses is a better choice. Leaving roots intact in the soil (i.e., not using a Weed Wrench) will reduce erosion potential. Goat grazing may be effective on steep slopes, but has disadvantages discussed below.

- **Soil Protection.** Woody plant removal should be done when the ground is frozen to minimize rutting and damage to plant roots.
- Hand-Pulling. Where feasible on relatively flat, stable soils, hand-pull seedlings and young invasive shrubs of up to 2-inch diameter near the base. This can be done with a Weed Wrench or similar tool. If control can be executed over several years, buckthorn may be removed from sites with sandy, mucky, or other loose soil by cutting the stem at a height of 3 feet. These stems may "sucker" or re-sprout but can then be extracted through leverage or tools after a year or two, avoiding the use of chemicals. Physical removal of invasive species disturbs soil and can promote weed seeds in the soil to germinate; therefore, this practice should be used only after considering site conditions, the likelihood of weed seed growth, and potential for erosion.
- Hand-Cutting or Killing in Place. When other methods are not feasible, invasive woody plants should be cut and stump-treated with an approved contact herbicide. This is a commonly used technique as it accommodates most situations, but material disposal can add significant costs (see below). If a less expensive method is desired, invasive woody plants can receive a basal bark application of herbicide and left standing after dying where appropriate. Herbicides should be appropriate to the task and methods should be used that minimize damage to native vegetation or soil biota. Unwanted trees can be killed and left to die standing in place by girdling. Girdling consists of cutting a ring around the trunk through the bark and cambium.
- **Goat Browsing.** Goats have been used in some restorations to reduce invasive woody vegetation. Goats browse, defoliate and stress small shrubs and trees, woody plant seedlings, and the low-hanging branches of tall shrubs and trees, but cannot control mature shrubs. Moreover, many browsed plants regrow from roots. Because large invasive shrubs infest many City forests, goats are often not a suitable tool by themselves. Other disadvantages are that goats browse native woody plants and require the installation and management of electric fencing and other infrastructure. Goats may have limited use at the right sites combined with other brush control methods.
- Forestry Mowing. Mechanized forestry mowing is often used for large areas of invasive woody plants but may remove or damage desirable native vegetation, cause soil erosion, and compact soil. Forestry mowing also leaves shredded stumps and stems, making spot herbicide application to stumps challenging. Resprouts are common with forestry mowing, requiring foliar application of herbicide (see below). For large areas dominated by invasive woody plants and lacking native woody plants, mechanical forestry may be appropriate.
- Understory Thinning. Where past poor management has allowed early-successional trees to colonize the forest understory, a deep shade develops. Selective thinning of these trees can accelerate the restoration process. A continuous forest canopy should be maintained in most forests, as this reduces the invasion and growth of buckthorn and honeysuckle. Thinning the understory and creating canopy gaps, however, allows more sunlight to reach the ground, helps the growth of mid- to late-seral species, and stimulates the spread of native ground layer plants.

- Woody Material Disposal. Cut material is typically hauled off site, chipped and thin-spread on the site, or stacked into brush piles for wildlife habitat or burning at approved locations. Care should be taken to not spread invasive plant seeds and berries during removal. Handling and transporting cut material should follow all state and federal recommendations to prevent the transport of pests, such as Emerald ash borer and Gypsy moth. If many large trees are cut, these should be placed to maintain travel routes for material disposal. Where fewer large trees are removed, branches can be bucked, chopped and thin-spread, and the trunks left on the ground as wildlife habitat. If generating a commercial product, such as biomass for energy or material for stream bioengineering, removal can be done at lower cost.
- Treating Resprouts and Seedlings. To control woody brush resprouts and seedlings (and encourage growth of ground layer vegetation, including woodland grasses that can help carry ground fires for management), "critical period cuts" can be effective. Conducted in July (when woody plants have expended much of their root resources on growth for the year), cutting brush at ground level will encourage resprouting later in the season, which uses up the plants limited resources at a time when it typically would be storing up reserves in its roots for the winter and following year. Use of prescribed fire the spring following a critical period cut can be particularly effective at killing the seedlings and resprouts. This approach eliminates the need for herbicide application, helping to protect native, non-target vegetation.

When a critical period cut is not feasible, treat invasive woody vegetation seedlings and resprouts with approved foliar herbicide in the growing season after cutting, preferably late summer or early fall, to avoid collateral damage to native ground layer vegetation. Due to the seedbank in well-established stands of buckthorn and honeysuckle, treating seedlings may take up to seven years after the mature individuals are removed.

Invasive Herbaceous Vegetation Control

- **Competition by Native Plants.** Invasive plants create a seedbank which produces seedlings for years. Consequently, expanding the cover of native vegetation is the most effective way in the long term to compete with and suppress the germination and growth of invasive plant seedlings.
- Native Plant Protection. Protect native vegetation by avoiding damage from equipment and herbicides. Select the right herbicide and apply at the proper time with the proper method to minimize drift and drip. Properly use prescribed burning. Use a broadleaf-specific herbicide when protecting native grasses, sedges, and graminoids, and a grass-specific herbicide when protecting native forbs. Avoid using wheeled equipment when soil is wet.
- Multi-Pronged Approach. Employ an Integrated Pest Management (IPM) approach by combining techniques: manual pulling where erosion is not a concern; spot-application of herbicide; spotmowing; and prescribed burning. The combination is determined by the vulnerabilities of the invasive plants being controlled.

• **Broadcast Herbicide Treatment.** Two or three herbicide treatments are usually required to control certain perennial weeds—for example, Smooth brome (*Bromus inermis*), Kentucky bluegrass (*Poa pratensis*), and Canada thistle (*Cirsium arvense*). Spot-herbicide treatment after initial removal is usually needed in these situations. Broadcast herbicide applications should be used as a last resort.

Herbaceous Vegetation Installation

- Native Seedbank Assessment. Following initial removal of invasive woody and herbaceous species, the native seedbank should be allowed to express itself. If in the first year it does not respond sufficiently in variety or coverage, native seeding should be employed.
- Native Seeding. Seeding is less expensive than installing live plants, but requires more time to establish, often up to three years. Always use native seed of the local ecotype, originating within 150-200 miles of the site. Seeding a native grassy cover crop will rapidly stabilize soils and create a competitive environment for invasive seedlings emerging from the seedbank. A native grass seeding also provides fine fuel to carry a prescribed burn, if that is a restoration and management action. Diversity can be increased by seeding forb species after the graminoids are established, usually by drilling seed after a burn or mowing. Volunteers can collect native seed and hand sow it in sparse or low diversity areas. The ground layer vegetation will help stabilize soils, prevent new invasion by invasive and weedy plants, and restore the ecological composition, structure, and function of the area being restored.
- Live Plugs. Live plant plugs ("plugging") produces an immediate effect but is relatively expensive. An intermediate approach is to add plugs to a native seeding area, either to increase diversity of species that do not establish well from seed, or to create an impressive floral display in areas that are in full view of the public.

Tree & Shrub Installation

- Planting Trees and Shrubs. Native woody plantings are used to replace or compete with invasive
 or early-seral native woody plants, setting the plant community on a trajectory to a more resilient
 condition. In restoration projects, plant material typically consists of whips, bare root stock or
 small saplings. Using smaller material is less expensive than larger material and usually results in
 better establishment over time. As guided by restoration goals and plant community targets,
 install ecologically appropriate and local ecotype native trees and shrubs. Appropriate native
 species can be selected from the MNDNR species list for each target plant community (MNDNR
 2005). Protection from deer and rodent browsing may be necessary.
- **Direct Seeding.** Direct seeding of harvested acorns, walnuts, hickory nuts, butternut, and seeds of elm and maple is a low-cost but slow method to establish woody plants; however, it may be effective in certain areas.

• **Timing of Planting.** It is often best to install woody vegetation after the first year or two of restoration and management due to the extensive invasive plant removal occurring. Native trees and shrubs can be added after invasive management is completed.

Turf to Native Vegetation Conversion

Many of St. Paul's parks and public lands have turf lawns. Most are actively used, justifying this vegetation. To increase habitat for pollinators and other native species, to improve other ecosystem services, and to reduce long-term maintenance costs, however, underused turf could be converted to native prairie or savanna ground layer vegetation. The conversion of turf to prairie/savanna grasses, sedges, and wildflowers involves the following.

- **Native Plant Protection.** Protect desirable vegetation, especially mature native trees, by marking a perimeter around them in which turf removal methods are carefully applied.
- **Turf Removal without Herbicide.** Black plastic laid on the turf in summer will kill turf. However, this process requires large amounts of plastic sheeting and plastic must be installed to not cause runoff and erosion. Several months may be needed to eliminate the turf and soil biota are usually killed in the process. Sod-cutting is another method of removing turf, but this also removes topsoil which must be disposed of.
- **Turf Removal with Herbicide.** An approved herbicide is broadcast applied to the turf. A minimum of two herbicide treatments is often required to control turf and achieve performance standards. Mowing or burning vegetation prior to or between treatments may improve turf removal.
- **Native Seeding.** Once turf species are removed satisfactorily, a local ecotype native seed is drilled into the soil.
- Live Plugs. Some species are best installed as live plants. If rapid establishment and additional species diversity is desired, enhancement plugging can be conducted in select areas, such as along roads and paths, or near buildings, signage, and other site amenities.

Slope Stabilization

The Como Lakeshore includes steep slopes. Steep slopes can suffer erosion due to one or more factors:

- Dense shade from overstocked canopies or invasive shrubs inhibits the growth of soil-anchoring ground layer plants.
- Runoff flowing on steep slopes causes sheet erosion that removes topsoil, inhibiting the growth of soil-anchoring vegetation.
- Runoff from impervious surfaces at the top of slopes easily becomes concentrated and into high energy streams that cause rill and ravine erosion.
- Steep slopes often have seeps and springs that saturate soil. While natural, this unstable condition can lead to mass wasting of entire slopes. This can be triggered by any of the above factors.
Diseased Tree Removals

The City of St. Paul carries out diseased tree management, focused on Oak wilt, Dutch elm disease, and Emerald ash borer. As trees are removed, appropriate native species (see MNDNR 2005) may be planted in canopy gaps by City staff, partners, or volunteers.

Ecological Monitoring & Reporting

Monitor natural areas' response to restoration/enhancement activities so management activities are adjusted accordingly. Monitoring the restoration and management activities at a site will help define the best management schedule and techniques. Monitoring can range from rapid and simple assessments to quantitative surveys with detailed reporting.

References:

Minnesota Department of Natural Resources. 2005. Field Guide to the Native Plant Communities of Minnesota: The Eastern Broadleaf Forest Province. Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program. St. Paul, MN.