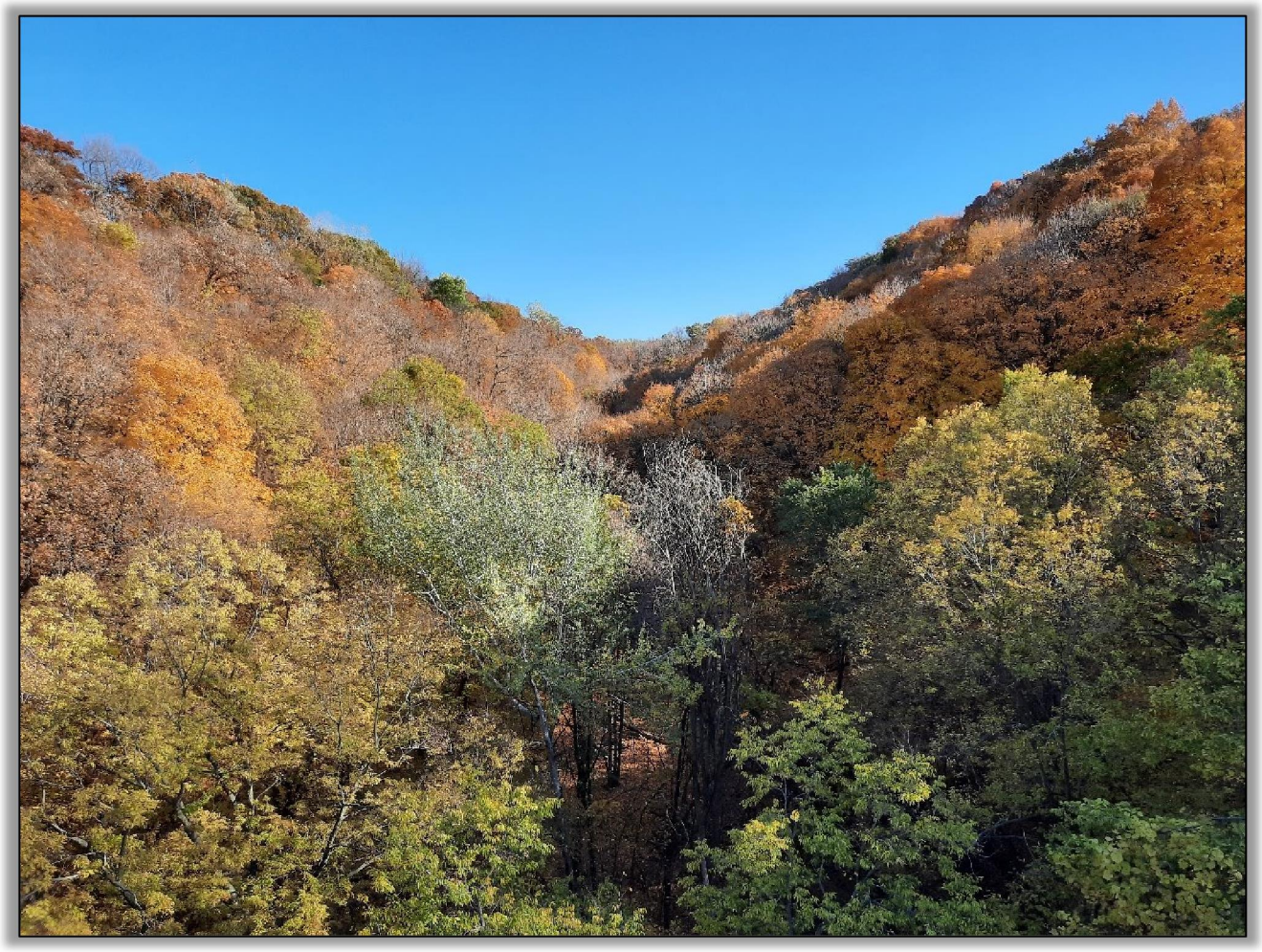
CITY OF MENDOTA HEIGHTS

NATURAL RESOURCES MANAGEMENT PLAN



FINAL PLAN – JULY 14, 2022

PREPARED FOR:
CITY OF MENDOTA HEIGHTS

SUBMITTED BY:
RESOURCE ENVIRONMENTAL SOLUTIONS

AES is excited to be part of RES

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TABLE OF CONTENTS

Tables

Figures

Appendices

ACKNOWLEDGEMENTS

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Citation: Resource Environmental Solutions. 2022. City of Mendota Heights: Natural Resources Management Plan. Report prepared for City of Mendota Heights, MN.

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EXECUTIVE SUMMARY

Natural resources are the basis of Mendota Heights' character and quality of life, beloved by residents, appreciated by visitors, and stewarded by public servants and private landowners. Natural areas—the City's most natural lands and waters—are rare gems, harboring historical and restored plant communities and wildlife populations. These easily lost natural resources deserve attention and need help to recover from past damages and to thrive well into the future, despite changes in land use, climate, and new pests and diseases.

While some natural areas are protected on public land, most are on private land, making protection and management of the City's natural areas, to some extent, a public outreach and cost-sharing initiative. The City's upland and lowland plant communities were degraded in the past by incompatible land uses and by the introduction of dominating invasive species. Its diverse wildlife was severely reduced by habitat fragmentation and edge effects. Streams, lakes, and ravines were and continue to be damaged by excessive erosion brought on by uncontrolled runoff from pavement, rooftops, and turf.

The cumulative effect of past and ongoing damage to the City's natural areas has reduced the benefits these natural resources provide to people. As a general example, the non-native shrub Common buckthorn often invades natural areas, outcompeting native shrubs, shading ground layer plants, promoting sheet erosion of soils (and sedimentation and nutrient enrichment of surface waters), and decreasing habitat quality for many native plant and animal species, including pollinators. This chain of events can be mitigated by controlling invasive buckthorn—ideally on both public and private lands—and facilitating the re-establishment of healthy, diverse, and resilient native plant communities. (Ecosystem restoration has additional spill-over benefits for surface waters, as healthy upland and lowland ecosystems in watersheds of lakes and streams reduce sediment and phosphorus inputs, sedimentation, algae blooms, and damage to aquatic ecosystems.)

This sort of intervention is needed to restore the health and function of natural areas, coupled with a commitment to perpetual stewardship, which is essential to protect those investments to restore and enhance natural areas. The effort and cost of some restoration and management projects can be substantial, such as removing dense stands of invasive plants from large areas to regenerate a diverse native ground layer. This Natural Resources Management Plan is a key step in that intervention. When natural areas are systematically inventoried and assessed, needs defined and prioritized, and projects phased over a decade or more, the City of Mendota Heights can dramatically improve its natural areas to benefit people and the environment.

The City of Mendota Heights completed a Comprehensive Plan update in 2019 and recognized that its 2002 Natural Resources Management Plan (Barr Engineering Company 2002) needed updating. In June 2020, the City retained Resource Environmental Solutions (RES, formerly Applied Ecological Services) and SRF Consulting Group, Inc. (SRF) to complete Phase 1 of the Natural Resources Management Plan, with Phase 2 following in 2021 and 2022.

Development of this Natural Resources Management Plan entailed:

- Development of a natural resources vision, principles, and goals
- Compiling and reviewing existing data
- Conducting field assessments of the City's priority natural areas
- Completing a City-wide woodland analysis (including on private lands)
- Completing a City-wide heat island analysis and analysis of ecosystem services (including on private lands)
- Identifying challenges and opportunities for the City's natural resources
- Defining target native plant communities to restore
- Describing typical restoration and management tasks
- Prioritizing short-term projects
- Identifying and pursuing a grant to fund the top priority project
- Management Briefs for select natural areas
    - Priority projects in natural areas
    - Priority project costs
    - Overall project costs and phasing in a five-year implementation plan
    - A "ten-year and beyond" implementation vision for natural resources management
- Plans for other natural resources projects and actions beyond the natural areas
- Implementation
    - SMART goals (Specific, Measurable, Achievable, Relevant, Time-bound). Management briefs, the five-year implementation plan, the monitoring program, and performance standards are SMART goals. In addition, the adaptive management approach used in this Natural Resources Management Plan is cyclical and forces goals to change. For this reason, SMART goals are presented at a programmatic level.
    - Long-term management, monitoring and reporting
    - Implementation resources, including grants, volunteers and partners
    - Public education and private lands outreach

This Natural Resources Management Plan revealed significant needs for the City's natural areas. Most natural areas are moderately to severely degraded, the City's tree canopy and planting practices would benefit from an ecosystem approach, the effects of climate change and heat islands need attention, and the City's natural resources program capacity—even with partners and volunteers—cannot achieve the conservation goals as stated in the Comprehensive Plan and this Natural Resources Management Plan. Despite these challenges, proven strategies supported by conservation science are at hand. The City can use them to cost-effectively restore a healthier environment and control future maintenance costs. With good planning and sufficient funds, the City can both take on landscape projects—core natural area protection and greenway connections—and also promote native landscaping, rain and pollinator gardens on private lands, street tree plantings, and partnership projects that demonstrate the benefits of natural resource management.

This Natural Resources Management Plan makes it clear that historical factors have resulted in a gap between the restoration and management needs of the City's natural resources and the staffing, funding and overall support for the City's natural resources management program. Section 4.3.6 of this plan quantifies program-wide needs, and Section 4.3.8 lays out a strategic, five-year schedule and the annual budgets necessary for plan execution. The proposed implementation plan calls for ***additional investments*** of approximately $68,000-$94,000 annually in each of the next five years, totaling approximately $400,000 by the end of 2027. In addition to cost and labor to restore and enhance natural areas over this period, the natural areas must be managed in perpetuity, necessitating baseline annual funding for long-term maintenance. Implementation of this Natural Resources Management Plan will enable the City to realize the benefits of a more comprehensive and holistic program for managing its valuable and irreplaceable natural resources. The City's improved natural areas will provide greater enjoyment to the community better quality habitat for plants and wildlife, and a higher functioning, healthier, more resilient environment.

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1. INTRODUCTION

1.1 Project Background & Purpose

The City of Mendota Heights, having completed a Comprehensive Plan update in 2019, recognized the need to update its 2002 Natural Resources Management Plan (Barr Engineering Company 2002), or NRMP. The Comprehensive Plan identifies the City's important natural resources, especially the functioning natural areas that support "ecosystem services" (see Glossary in Appendix A and discussion below in Section 1.2.1) and the health of the human community. Water purification and regulation, groundwater recharge, urban heat island mitigation, fish and wildlife habitat, pollinator and crop support—these are just a few of the ecosystem services that natural areas provide to the City's 11,000 residents and 13,000 daily workers. The Comprehensive Plan recommends budgetary, programmatic, collaborative, and policy initiatives to support the conservation, restoration and management of not only the City's natural areas, but all elements of the natural environment which benefit its residents.

Because City parks and open space comprise only 16 percent of the City's 6,437 acres, natural resources on private lands are essential providers of ecosystem services. City-owned parkland can only do so much to support the ecological health and resilience of the City. To make the City more resilient in the face of continued urban growth and predicted increases in temperature and precipitation, the Comprehensive Plan invites collaboration and sharing of responsibility among the City's institutions, businesses, and private landowners. Federal, state, county, and watershed management organizations are obvious places to firm up existing partnerships, but more could be done with the City's non-government players.

Conservation Strategy

The few natural areas in the City make *protection* of paramount importance. Some of the City's natural areas are protected from development due to their designation as parks, and many of these areas are undergoing ecological restoration and management to further protect their ecological health and integrity.

The 2002 NRMP and 2040 Comprehensive Plan map describe dozens of City natural areas across ownerships. These documents used existing inventory data and, in the 2002 NRMP, field investigations. What neither plan did, however, was lay out a year-by-year roadmap to plan and budget for the conservation, restoration and management of the City's natural resources. Phases 1 and 2 of this updated NRMP will present a systematic schedule and estimated costs for specific tasks that will allow City staff to decide what to do next in terms of priority, impact, and cost-effectiveness.

In early 2020, the City of Mendota Heights decided to update its 2002 NRMP. In June 2020, the City retained Resource Environmental Solutions (RES, formerly Applied Ecological Services, Inc., AES) and SRF Consulting Group, Inc. (SRF) to complete the Phase 1 Plan, and in April 2021 Phase 2 was authorized. This Phase 1 & 2 NRMP includes:

- Development of a natural resources vision, principles, and goals
- Compiling and reviewing existing data
- Conducting field assessments of the City's priority natural areas
- Completing a City-wide woodland analysis (including on private lands)
- Completing a City-wide heat island analysis (including on private lands)

- Identifying challenges and opportunities for the City's natural resources
- Defining target native plant communities to restore
- Describing typical restoration and management tasks
- Prioritizing short-term projects
- Identifying and pursuing a grant to fund a top priority project
- Management Briefs for select natural areas
    - Identification of priority projects in natural areas
    - Priority project costs
    - Project costs and phasing (five-year implementation plan)
    - "Ten-year and beyond" implementation vision for natural resources management in the City
- Planning for other natural resources projects and actions outside natural areas
- Implementation
    - SMART goals (Specific, Measurable, Achievable, Relevant, Time-bound). Management Briefs, the five-year implementation plan, the monitoring program, and performance standards provide SMART goals at a detailed level. In addition, the adaptive management approach is cyclical and can change goals. For this reason, SMART goals in Phase 2 will be defined at a programmatic level.
    - Long-term management, monitoring & reporting
    - Implementation resources, including volunteers and partners
    - Public education and private lands outreach

Natural Resources Management Plan

In 2020 the City began a process of updating its 2002 NRMP in order to better manage the City's natural resources for the benefit of its residents and the natural world.

Significant deliverables under this NRMP are geographic information system (GIS) mapping and assessment of natural areas, and field photographs of representative areas. A glossary of technical terms and acronyms is provided in Appendix A.

1.2 Ecological Restoration & Management

1.2.1 The Importance of Natural Resources

For millennia, the Twin Cities region consisted of a rich mosaic of natural landscapes. Sunlight, air, water, bedrock and minerals, soils, vegetation, and animals—that is, ecosystems—interacted in complex ways, producing an abundance of some plants and animals favored by the overall condition of the landscape, while others were more specialized and rare. Prairie grasses, bison, prairie chicken, and other huntable wildlife were abundant, while certain species of plants, insects and fish were uncommon, restricted by their habitat requirements.

An emergent wetland of lotus, bulrush and sedges creates habitat and brings beauty to the Rogers Lake shoreline.

Native Americans inhabited the Twin Cities region for several thousand years, taking advantage of game animals and other wildlife, edible plants, and an abundant water supply. Despite periodic droughts and severe winters, they did not exhaust natural resources and, in fact, managed them using fire and other practices, such as cropping of domesticated plants and seeding of wild plant species for specialized uses.

European settlers who came to the region in the mid-1800s found an open landscape dominated by prairies, savannas, and wet meadows, with forests in areas protected from fire (e.g., often around lakes and on steep slopes). Over time, settlement, conversion of prairies and forests to crop fields, and industry changed the landscape. Natural resources are limited and can be lost if over-used or managed poorly, as clearly demonstrated by the local extinction of bison, elk, and prairie chicken.

Most of the region has now been transformed by development—homes, roads, parking lots, commercial buildings, and recreational fields. The City of Mendota Heights' park system comprises approximately 298 acres (including open water), and approximately 182 acres (61 percent) of that parkland consists of natural/semi-natural areas. Of these 182 acres (2.8 percent of the City's area), only a portion represents the original landscape of the 1850s - and even these areas have been degraded by fragmentation, invasive species, and nearby development.

Healthy Natural Resources Benefit People

Natural resources in a healthy condition support a community's economy and well-being by cleaning the water and air, reducing air temperature, building soil and preventing erosion, providing green spaces for rejuvenation and recreation, and enlivening the surroundings with a variety of animal and plant life. Since the 1850s these "ecosystem services" have been damaged by incompatible styles of development and use. This NRMP is a tool to restore these lost benefits of a healthy environment.

Modern societies tend to place value on natural resources based on how useful they are. Timber for lumber, limestone for gravel, cropland soils, groundwater, and surface water have an extrinsic or monetary value. On the other hand, some argue that all species have a basic right to exist—they have intrinsic value. The conservationist Aldo Leopold, the first professor of wildlife biology in the country, talked about a land ethic in which people saw themselves as part of the ecology and felt a responsibility to treat it well. Two of his most used quotes from his best-known book, *A Sand County Almanac*, are:

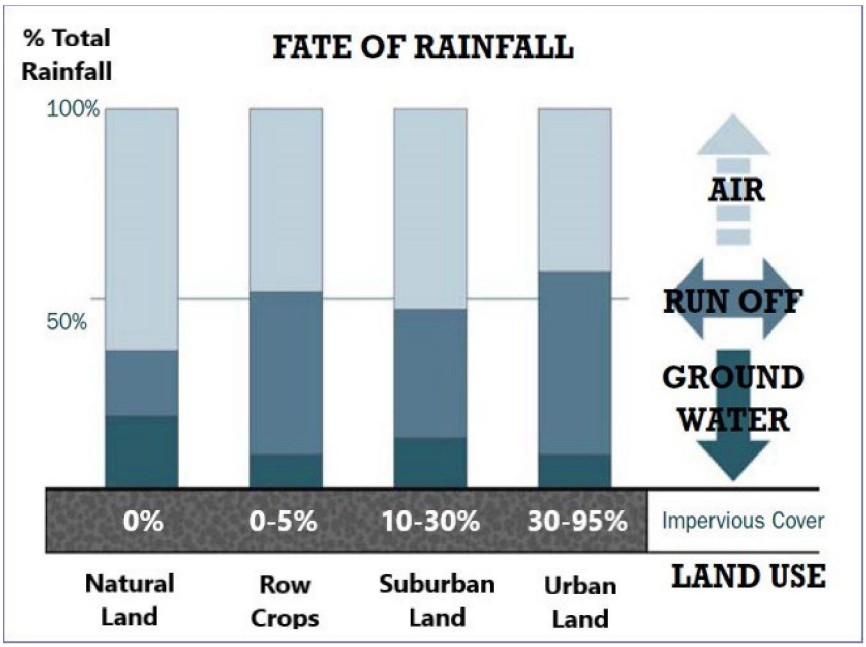
> *A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.*
>
> *We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect.*

While far from a new concept, the idea that nature has intrinsic value continues to gain support as people have experiences in park natural areas or through travel, by visiting museums and zoo exhibits, or simply by watching television programs about nature.

Part of a species' and ecosystem's intrinsic value is also due to the growing realization that healthy ecosystems support healthy human societies and economies. It has become clear through research, for instance, that preserving a certain amount of natural vegetation and soil reduces downstream flooding. Figure 1 supports this concept, as natural land is shown to absorb into the ground and release into the air the majority of rainwater, while urban land sheds most rain water, increasing potential floodwaters and

their management. In another example, homeowners and businesses consistently rate proximity to a park as highly desirable (Crompton 2001), which typically generates higher demand for buildings near open space—and higher property values.

Figure 1. Natural vs. Developed Land Runoff



Natural land sheds two-thirds to one-half the runoff that developed land sheds, and sends more into groundwater.

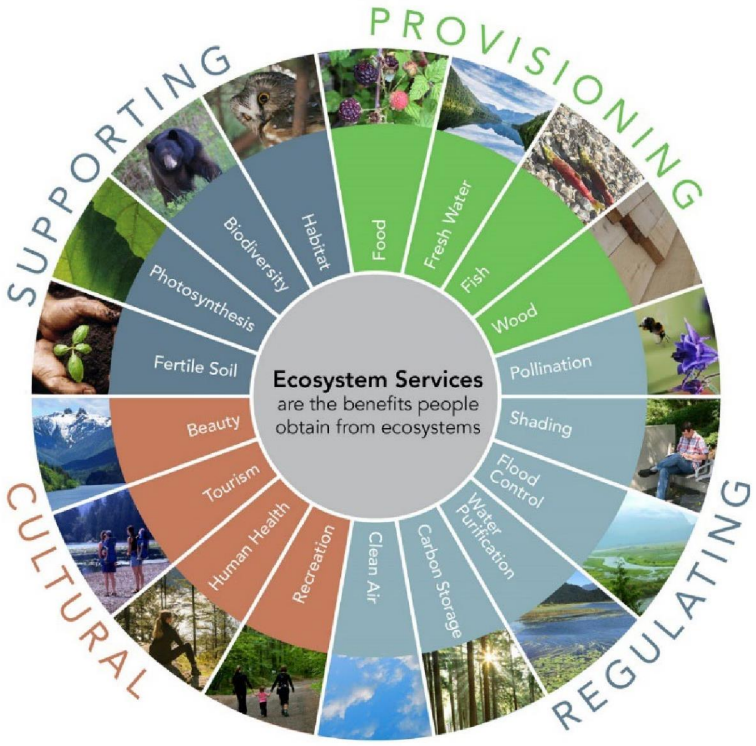
Ecosystem Services

Natural areas are vital to city residents and park visitors for several reasons besides the economic value they provide. Wetlands and forested areas along rivers and streams help reduce downstream flooding, and prairies, savannas, and forests on the landscape absorb huge quantities of rainfall, which in turn reduces the amount of runoff and eroded sediment that reaches a watershed's streams and lakes. Natural areas also absorb and store carbon from the air, helping to reduce greenhouse gasses. Schools, organizations and families use natural areas to learn about the natural world; this is especially important for young children who otherwise spend more time making virtual connections indoors. Natural areas simply make urban life better because citizens and visitors can stroll, bike, take in the scenery, or simply relax in a natural setting.

Scientists call the benefits that natural resources provide "ecosystem services". Ecosystem services save people money over the long term. A milestone scientific study completed in 2005, called the Millennium Ecosystem Assessment, summarized the state of ecosystem services worldwide (Hassan et al. 2005). Since then, dozens of scientific papers have been published demonstrating the financial savings of healthy ecosystems. For instance, if people were to pay to purify air and water, build soil, or to regenerate forest trees and wild fish and game, the cost would be in the hundreds of millions of dollars annually for a City like Mendota Heights. Building flood control infrastructure or rebuilding after flood would be much more

costly without floodplains and the natural capacity of watersheds to absorb and regulate the water moving through them. The main ecosystem services are summarized in Figure 2.

Figure 2. Ecosystem Services



Source: Metro Vancouver Regional Planning (2018)

Besides supporting and regulating the human environment, the City of Mendota Heights' park system serves recreation and tourism as well as contributes to resident well-being. Research in the last 20 years has demonstrated a strong link between time spent in or near nature with better physical and mental health. Viewing nature out a window can improve test scores in school children or elevate moods in adults. Of course, people love to fish, hike, bike, ski, picnic, camp, and celebrate with family in natural areas. Sometimes just sitting still in nature, or within sight of nature, can nourish the spirit and reduce stress.

Mendota Heights' character also emerges from its natural resources. The City's 2040 Comprehensive Plan acknowledges green space, open space and natural areas as a major feature of the community. The City has always been known for its natural look and abundant trees –its previous motto was "spacious and gracious". Natural resources create a sense of place that attracts people and businesses and convinces them to remain in the area. Healthy ecosystems not only signal that ecosystem services are operating, but that society and the economy are being supported and enriched. By protecting and managing the City's natural resources, ecosystem services will persist and improve.

1.2.2 What is a Natural Resources Management Plan?

Understanding the City of Mendota Heights' natural areas begins with recognizing that most of the City's natural resources have been lost, fragmented and degraded over the past 170 years. The City's rejuvenating natural processes—fire and large mammal grazing and browsing—shaped vegetation and wildlife for thousands of years, but have been largely eliminated. The arrival of invasive species further challenge the goal of maintaining healthy ecosystems and natural resources.

Nature has an amazing ability to recover from past injury and take care of itself in the long term, but with so much change, people now need to intervene. Some landowners manage their lands to prevent deterioration or improve the quality of natural resources. But natural resource management is complicated and people doing it must understand ecological and hydrological systems and cycles, the ways that climate is shifting, and the habits of plants and animals.

This NRMP is focused on system-wide ecologically-based planning but can be used for individual parks and specific natural areas. It provides a framework for protecting the City's valued natural areas, as well as opportunities for enhancing, expanding, and connecting these important natural resources. It is the foundation for accurate cost estimates to implement restoration and management plans citywide. Lastly, the plan will enhance biodiversity, increase human enjoyment of natural areas, and put natural areas on a trajectory towards long-term ecological health and resilience.

1.2.3 Ecological Restoration & Management

Definition. Ecological restoration is the art and science of improving the health and resilience of natural environments by stabilizing and enhancing species diversity and natural processes. Restoration ecologists use scientific knowledge of how ecologically healthy plant communities and ecosystems are composed and operate in order to describe current ecological conditions and lay out programs to create positive changes in damaged ecosystems and plant communities. After restoration to a better condition, ecosystems, plant communities, and wildlife still need to be watched and managed, though at a lower per-acre cost than managing turf or traditional landscaping.

Restoring and Managing Natural Resources is a Good Idea

The art and science of improving ecosystem health and resilience is being used by the City to support pollinators and wildlife, reduce management costs and environmental damage from incompatible past land use, and lay the groundwork for adaptation to ongoing and future climate change. It is not an attempt to restore conditions of 1850, but rather to work with existing conditions and set ecosystems on a trajectory towards a higher level of ecosystem health and resilience despite future environmental change.

Importance of Native Vegetation. Re-establishing and enhancing native vegetation—adapted to the local environment and growing in the region–is fundamental for ecological restoration and the conservation of biodiversity. Benefits of native vegetation include:

- Providing high-quality habitat for native wildlife, including many pollinators
    - Nutritious food (berries, pollen, nectar)
    - Nesting and overwintering habitat (full life-cycle needs)
- Requiring no irrigation once established

- Requiring no fertilizers or pesticides
- More resilient than many non-native or cultivated varieties due to drought- and pest-resistance and suitability for the local climate and soils

While restoring native plant communities has the greatest effect on large tracts of native forests and prairie plantings, native plantings for small restorations, rain gardens, and butterfly gardens also create habitat and deliver ecosystem services. This small restoration approach offers myriad opportunities for public and private lands. For example, small native plantings are suitable for residential lots, in boulevards, and on small areas of public property. Strategically placed, they can be buffers for adjacent natural areas.

Benefits of Ecological Restoration. Ecological restoration helps people directly by improving ecosystem services, including flood and erosion control, soil building, and pollinator resources. It also benefits plant and animal species that are uncommon or declining, species that need high quality or large habitats, and species that respond poorly to intensive human use. The Minnesota Department of Natural Resources (MNDNR) Natural Heritage Program identified 75 rare natural features within a one-mile buffer around the City of Mendota Heights (MNDNR 2020), and Minnesota's Wildlife Action Plan identified many other Species of Greatest Conservation Need (MNDNR 2016; see Appendix A for a glossary of technical terms). These species need well-managed and sometimes large habitats to stop their decline.

The City has completed several ecological restoration projects, including invasive vegetation removal and shoreline restoration projects. (Appendix B provides a summary of the City's Natural Resources Program and volunteer activities, and section 2.b.ii. of Appendix B lists restoration projects that have been undertaken). This NRMP will help expand the City's restoration and management efforts, prevent further species declines, and may increase the population size of some native species.

Limits of Ecological Restoration. Ecological restoration creates healthy and resilient ecosystems, often in developed and disturbed landscapes. The composition, structure, and function of restored ecosystems aim to be like those of original ecosystems, but of course cannot in the short-term (or perhaps ever) fully replicate those original ecosystems that persisted for thousands of years. However, restored ecosystems have more native plant and animal species, higher levels of infiltration and carbon storage, and greater ability to change as the environment changes, compared to turf, cropland, and cultural ecosystems.

Restored ecosystems need to be managed to keep them in good working order, just as cultural land must be. The ecosystems of 170 years ago also were "managed" by fire, grazing and burrowing animals, flooding, and other natural disturbances. Landscape-scale and local changes often prevent the full re-creation of original natural conditions. Historical ecological conditions give us insights into what is possible at a given site, but no more. In the end, however, the goals of a restoration project dictates the level of effort and the conditions that result.

Importance of Adaptive Management. Restoration and management plans need to be flexible. Restoration programs are often not implemented exactly according to plan because the timing of funding may not align with field operations, the response of ecosystems to restoration may dictate adjustments in techniques, and the basic management needs of an ecosystem may change in response to new threats and conditions. New scientific findings and insights also may change restoration plans and management

practices. For these reasons, restoration and management plans should be viewed as a starting point in a process of restoring biodiversity and natural processes in natural areas, subject to amendment as conditions and information change.

The most successful restoration programs use regular monitoring and reporting as feedback on the program's effectiveness. Monitoring also generates information to justify changes in the restoration and management program. 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 3). 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.

Adaptive Management

The City will use adaptive management—a cycle of planning, implementation, evaluation, and adjustment—to make decisions despite uncertainty, with the aim of reducing uncertainty with each implementation cycle.

Figure 3. Adaptive Management Framework

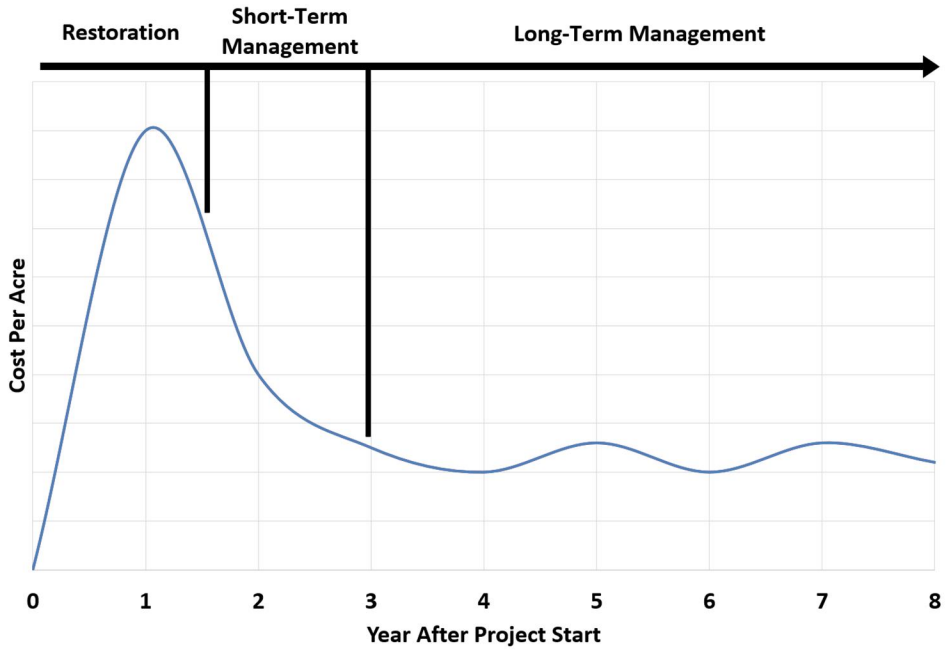
Source: Conservation Measures Partnership (2022)

Initial Restoration and Short-Term Management Phase

Ecological restoration has short- and long-term management phases. The initial restoration and short-term management phase is typically labor-intensive and costly compared to long-term management. The initial effort usually lasts about 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); re-establishing natural hydrological cycles in aquatic systems; 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 4 shows the relatively high cost of initial restoration work, the somewhat reduced cost during establishment management, and the lowest annual cost in long-term management.

Figure 4. Generalized Cost of Restoration and Management Over Time



It is usual to refer to planting a new prairie or wetland as "restoration," whereas "enhancement" is used to describe activities where natural conditions already exist and less effort is needed to improve the natural resources. Enhancement, for instance, might entail removing invasive shrubs and overseeding native woodland plants in an existing native woodland or forest.

Restoration sequence in a woodland: left: degraded, center: restoration, right: short-term management

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. Scheduling a monitoring visit and management activities every year protects the restoration investment and ensures that the plant community and ecosystems continue on a trajectory towards greater ecological health.

Long-term management tasks often are to:

- 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.

Most North American ecosystems need some type of disturbance that removes dead plant material, stimulates blooming of plant species, and opens up microhabitats for plants and animals to perpetuate themselves. Controlled or prescribed burns are a common tool used that mimics natural fire regimes in prairies, savannas, wetlands, and some forests and woodlands. Harvesting hay from prairies, which mimics fire and, to a lesser extent, grazing, can also be effective.

The Importance of Stewardship

While initial restoration and short-term management typically require more effort and higher cost per acre, long term stewardship will protect this investment in perpetuity with less effort and at lower cost per acre.

1.2.4 What Happens When Natural Resources Are Not Managed?

Some people believe that nature has been around a very long time and can take care of itself. Others think that more important issues and problems face us and that managing natural resources does not merit the expense. While these are valid views, they are not the whole story.

Studies over the last half century clearly demonstrate that, without management—i.e., "ecological stewardship"—natural resources change in ways that are not always beneficial to people or supportive of ecosystem services (Alstad et al. 2016, Le Maitreet al. 1996, Leach and Givnish 1996). A common problem in many unmanaged forests and woodlands in the region is invasion by non-native Common buckthorn (*Rhamnus cathartica*) and Asian honeysuckles (*Lonicera* spp.). When these shrubs invade natural areas, a cascade of negative effects follows. Oak regeneration is suppressed, native shrubs decline, soil chemistry and composition change, and ground vegetation is shaded—leading to the loss of soil-anchoring plants and excessive erosion. Flower resources for pollinators are eliminated, reducing the amount and variety of food for other wildlife, and further depressing wildlife populations.

Large, ecologically complex natural areas may resist these trends, but without proper management quality declines over time. This is especially true in small and scattered natural areas, which is the situation in most Mendota Heights' parks. With some level of consistent management, the situation can be stabilized and even improved. For example, removing invasive buckthorn and honeysuckle from woodland slopes preserves the soil and seedbank, and prevents sediment from reaching water bodies. This NRMP identifies and prioritizes the management actions that the City can take to improve the health and resilience of its natural areas and the resulting ecosystem services and recreational benefits.

1.3 Vision, Principles & Goals

The City of Mendota Heights recognizes the important role that natural resources play in their city. Natural areas are valued deeply by the community—they provide an enjoyable and interactive experience for residents and visitors, for example, an outdoor classroom for students of all ages and a home for a surprising variety of plants and wildlife.

Effective planning is often facilitated by development of an aspirational vision statement, establishing principles, and outlining goals.

1.3.1 Vision

The City of Mendota Heights vision for its natural areas is:

> *To secure the benefits of a healthy environment for people and the natural world, the citizens, employees, and leaders of the City of Mendota Heights will protect, improve, and maintain healthy ecosystems and all natural resources in the City.*

1.3.2 Principles

Ecologically-based planning principles are guideposts, used to define how a project should unfold. Based on discussions with City staff and the project Steering Committee, these planning principles were established for natural areas restoration and management within Mendota Heights.

Overall

- Protect and better connect sensitive natural resources in order to foster resilient and biodiverse natural areas within the City limits.
- Understand the historical and current conditions of natural areas to describe a future ecological path for natural resources.
- Design within the limits of existing soils, hydrology, and vegetation conditions.
- Create attractive and resilient plant communities that can be managed economically.
- Tell the ecological story of the City's natural areas to inspire people through its restoration.
- Bring people into the City's natural areas while protecting biodiversity and ecosystem resilience.
- Provide all City residents and visitors with an equitable opportunity to experience natural areas within the City's park system.
- Use indicators and monitoring to document trends in natural resources and determine the success of restoration and management efforts.

Vegetation

- Protect and restore the City's ecologically important natural areas and plant communities to prevent their disappearance or degradation.
- Maintain and enhance common natural areas.
- Promote a natural variety of native flowering plants across the growing season.
- Control invasive or aggressive native plants that reduce biodiversity and ecological resilience.
- Establish vegetative structure that requires the least effort to maintain.

Wildlife

- Protect, improve, and restore habitat for all wildlife—especially rare and uncommon species.
- Create the largest, roundest habitats for area-sensitive wildlife species (round habitats tend to be higher quality because they resist negative edge effects from adjacent land uses; see Section 3.3.1 for further details.)
- Design to reduce wildlife-damaging edge effects from adjacent properties.
- Install special habitat features (nest boxes, basking logs, etc.).
- Identify and seek to make connections to similar habitats on nearby conservation lands.
- Manage nuisance wildlife species using appropriate methods.

Soil & Hydrology

- Use vegetative stabilization and a natural ecosystems approach before resorting to more hard-armored and engineered solutions, or consider integrating both into a bioengineered solutions.
- Preserve and restore healthy, stable soils and natural hydrology by using a watershed management approach and identifying and stabilizing unstable slopes.
- Protect downstream and neighboring properties from floods and water damage.
- Use a series of natural features (e.g., rain gardens, prairies, wetlands), arranged in stormwater treatment trains, to manage runoff from impervious cover, and by reducing runoff at its source.
- Design and implement soil and hydrology solutions in the most cost-effective way possible.

Human Use

- Identify a conservation concept for natural areas—cores, transitions, and high impact areas.
- Improve management of natural areas by defining management units and access points.
- Detect problems early by regular monitoring.
- Recruit organizations, experts and volunteers to help maintain and monitor natural areas.
- Protect cultural resources (e.g., artifacts and historical structures).

1.3.3 Goals

The City of Mendota Heights' 2040 Comprehensive Plan identified numerous goals for the City. Of the City's goals focused on natural resources, the first sought to develop this Natural Resources Management Plan (NRMP):

- *GOAL 7.1: Develop a professional, comprehensive, strategic Natural Resources Management Plan for City-wide natural areas and natural resources.*

The second natural resources goal addressed by this NRMP is:

- *GOAL 7.2: Protect, connect, restore, buffer, and manage natural areas, wildlife habitat, and other natural resources, for high ecological quality and diversity of plant and animal species.*

To address this second goal, this NRMP:

- Summarizes the City's historical and existing natural resources
- Maps plant communities, including their ecological quality

- Characterizes the City's tree canopy and provides urban forest management recommendations
- Identifies the City's urban heat islands and provides mitigation recommendations
- Characterizes the City's other natural resources (e.g., wildlife, water resources)
- Assesses invasive species, diseases of native vegetation, and rare natural features
- Recommends changes to the City's natural resources ordinances and policies
- Summarizes the City's existing Natural Resources Program (including use of volunteers)
- Describes challenges and opportunities for achieving conservation goals
- Conveys conservation concepts and strategies, including ecological connectivity and climate resilience
- Describes an "ecosystem approach" to applying restoration and management tasks and recommends implementation methods
- Addresses conservation opportunities on private land and through public outreach
- Identifies City-wide conservation priorities, Natural Area Parks, and Priority Projects
- Provides opinions of probable cost and a five-year implementation plan
- Provides recommendations regarding funding sources and plan updates

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2 HISTORICAL & EXISTING NATURAL RESOURCES

2.1 Information Gathering

2.1.1 Existing Data & Plans

Existing data and reports were used to assist with plant community mapping, classification, and quality assessment. AES compiled and reviewed numerous plans and datasets, including:

Existing Related Plans

- City of Mendota Heights 2040 Comprehensive Plan (City of Mendota Heights 2019)
- Natural Resource Management Plan for the River to River Greenway (Dakota County 2020)
- Natural Resources Management Plan, City of Mendota Heights (Barr Engineering Company 2002)
- Oȟéyawahe/Pilot Knob – Draft Historical Landscape Plan (SRF Consulting Group 2018)

Geographic Information System (GIS) Data

- City park boundaries
- City ash tree inventory
- Dakota County parcel data
- MNDNR Natural Heritage Information System (NHIS)/Biotics data – rare natural features (MNDNR 2020)
- National Land Cover Database (NLCD, Multi-Resolution Land Characteristics (MRLC) Consortium 2016)
- MNDNR National Wetlands Inventory (NWI) Central Minnesota Update (2013)
- MNDNR Regionally Significant Ecological Areas (MNDNR 2008)
- Minnesota Land Cover Classification System (MLCCS) data (MNDNR 2004)
- MNDNR County Biological Survey data (Sites of Biological Significance and Native Plant Communities, 1997)
- Original Vegetation of Minnesota (Marschner 1974)
- Elevation data from LiDAR (MnTOPO)
- Aerial photography (historical and recent, from Metropolitan Council/MnGeo and Dakota County)
- Early Detection and Distribution Mapping System (EDDMapS)

Other Reports/Data

- Field Guide to the Native Plant Communities of Minnesota: The Eastern Broadleaf Forest Province (MNDNR 2005)
- MNDNR Natural Community Element Occurrence Ranking Guidelines (MNDNR 2001)

Several of the above plans (most notably the recent City Comprehensive Plan update) were developed using an inclusive public engagement process, providing valuable information about stakeholders, how they use City parks and natural areas, and their preferences regarding potential changes. This Natural

Resources Management Plan (NRMP) is a more technical, internal guidance document specific to the City's management of their natural areas. As such, public outreach was limited to an informational flyer posted on the City's website, as well as an opportunity for the public to review and comment on two drafts of the NRMP.

2.1.2 Methods

This NRMP is based on the ecological conditions and management needs in the City of Mendota Heights' natural areas. AES ecologists conducted field inventories and assessments of the City's priority natural areas over the four seasons of 2020. Desktop mapping was used to create maps for use in the field. The field maps were then used to verify and/or refine plant community classification, plant community boundaries, and ecological quality ranks. Collector for ArcGIS™ and ArcGIS™ Online were used during data collection for field navigation, review of mapping data, and collection of georeferenced data (e.g., digital photography of representative plant communities, unique natural features, and other items of note throughout the City). Desktop refinement of GIS data was conducted after field verification.

2.2 Natural Resources Findings

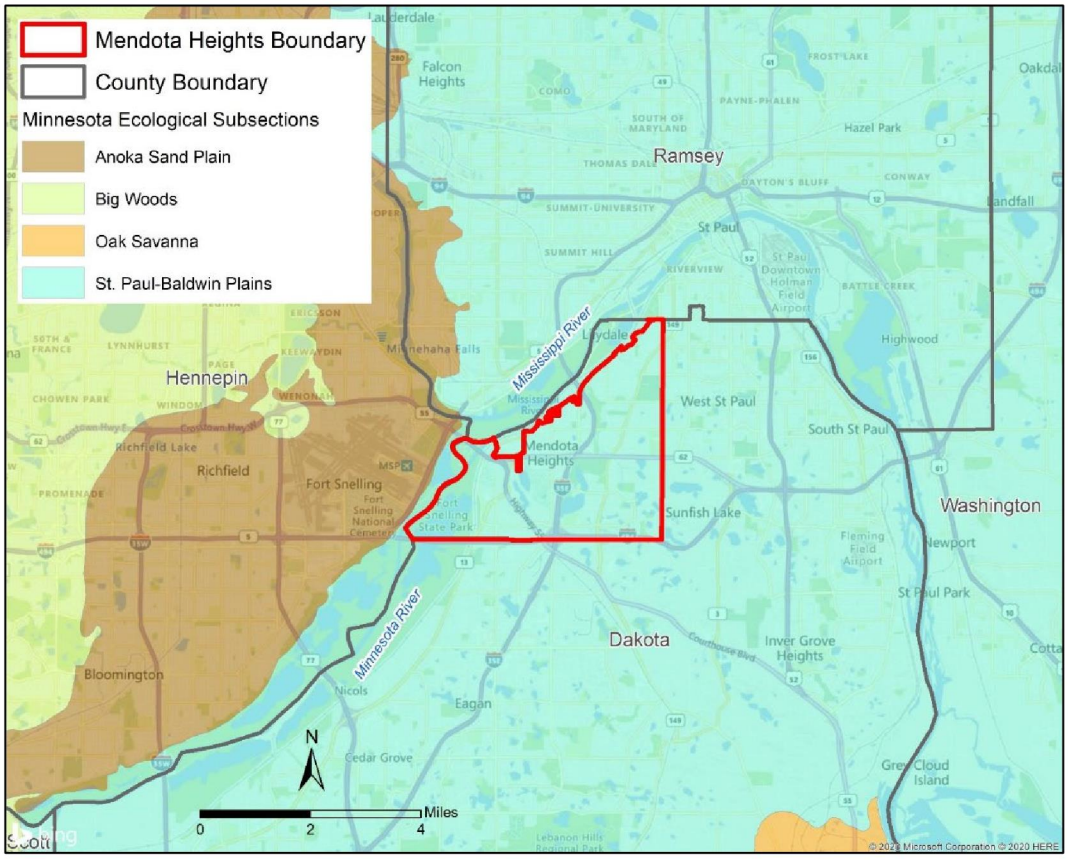
Mendota Heights is located in northern Dakota County, Minnesota (Figure 5). Understanding the natural history of the region and current conditions of Mendota Heights' natural areas provides an important foundation for planning and natural resource management.

A high-quality Mesic Forest near the top of slope of Ivy Falls Ravine.

2.2.1 Ecological Context & Overview

Ancient seas once occupied the Twin Cities region, as evidenced by limestone bedrock—a remnant of former coral reefs. The Wisconsin glaciation, which ended about 10,000 years ago, created the region's major landforms. The glaciers left a rolling and hilly landscape with lakes and wetlands in depressions, and the Mississippi River and Minnesota River valleys were carved out by receding meltwaters of glacial River Warren. Limestone and sandstone bedrock are exposed along sections of these rivers and some of their tributaries. Soils in the region formed primarily from sandy and gravelly glacial outwash on level plains and are generally well drained.

Figure 5. Regional & Ecological Context of Mendota Heights



According to the MNDNR Ecological Classification System (ECS), the City of Mendota Heights lies completely within the St. Paul-Baldwin Plains Subsection within the Minnesota & NE Iowa Morainal Section within the Eastern Broadleaf Forest Province (MNDNR 2019, Figure 5). A brief description of the subsection follows.

> **St. Paul-Baldwin Plains and Moraines.** Soils vary, and include clay loams, loams, sandy loams, and loamy sands. Oak and aspen savanna were the primary communities, but areas of tallgrass prairie and maple-basswood forest were common. Prairies burned frequently, as did many savannas.

For thousands of years prior to the arrival of Europeans, Native Americans were living on the land that would later become known as Minnesota. Oȟéyawahe, renamed by European settlers as Pilot Knob, is within the City of Mendota Heights and is a place of high cultural importance to the Dakota community. Besides serving as an important gathering place and burial ground, Oȟéyawahe was the site of signing of the Treaty of 1851, which transferred 35 million acres of Dakota land to the United States (Pilot Knob Preservation 2020).

Native Americans altered the natural landscape through repeated use of fire, clearing brush from forest understories and creating prairie and oak savanna. They established villages, trails, and plots for crops in

choice locations. During the mid-to-late 1600s, Euro-Americans arrived first as French missionaries and fur traders. Later in the 1700s and 1800s, British and American traders and explorers arrived, dramatically altering the environment and social landscape through settlement, fur trade, warfare, and treaties. Mendota Heights' landscapes were influenced by these past land uses and practices, and they continue to evolve due to changes in use, management, wildlife, and climate.

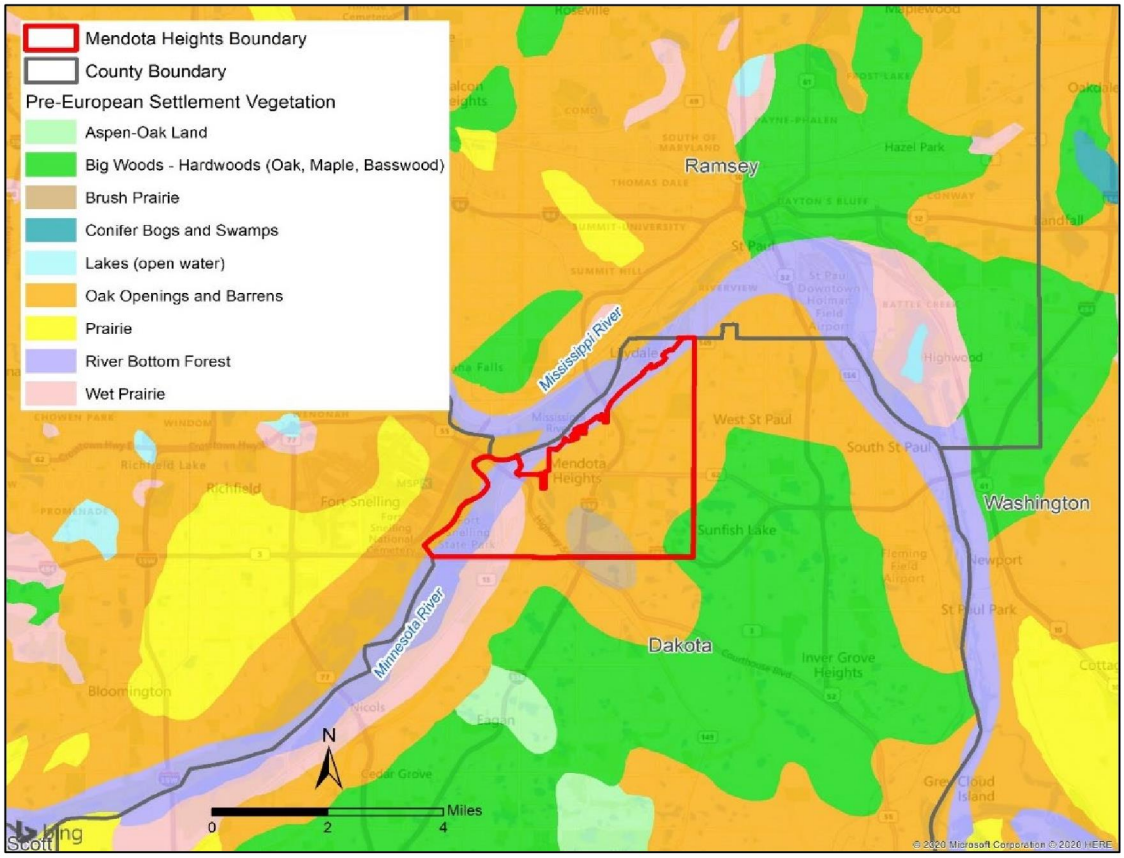
2.2.2 Land Cover & Plant Communities

Land cover includes relatively natural, usually vegetated, areas or habitats (e.g., forests, prairies, old fields, wetlands, water bodies) and more altered cultural areas (e.g., turf, impervious surfaces). Land cover mapping is usually employed to assess and manage natural resources.

Pre-European Settlement Vegetation

According to vegetation mapping by Marschner (1974), prior to European settlement (early 1800s), the City of Mendota Heights was dominated by Oak Openings and Barrens (Figure 6). This landscape mingled sun-loving prairie and shade-tolerant woodland species beneath a scattered or clumped canopy of mostly oak trees. Other plant communities in the City were: the forested Big Woods - Hardwoods (southeast corner), Brush Prairie (south-central), Wet Prairie (southwest corner), and River Bottom Forest of elm, ash, silver maple, and cottonwood along the Minnesota and Mississippi Rivers. Brush Prairie had a similar plant life to Oak Openings and Barrens but lacked an obvious tree canopy.

Figure 6. Pre-European Settlement Vegetation of Mendota Heights



Current Land Use

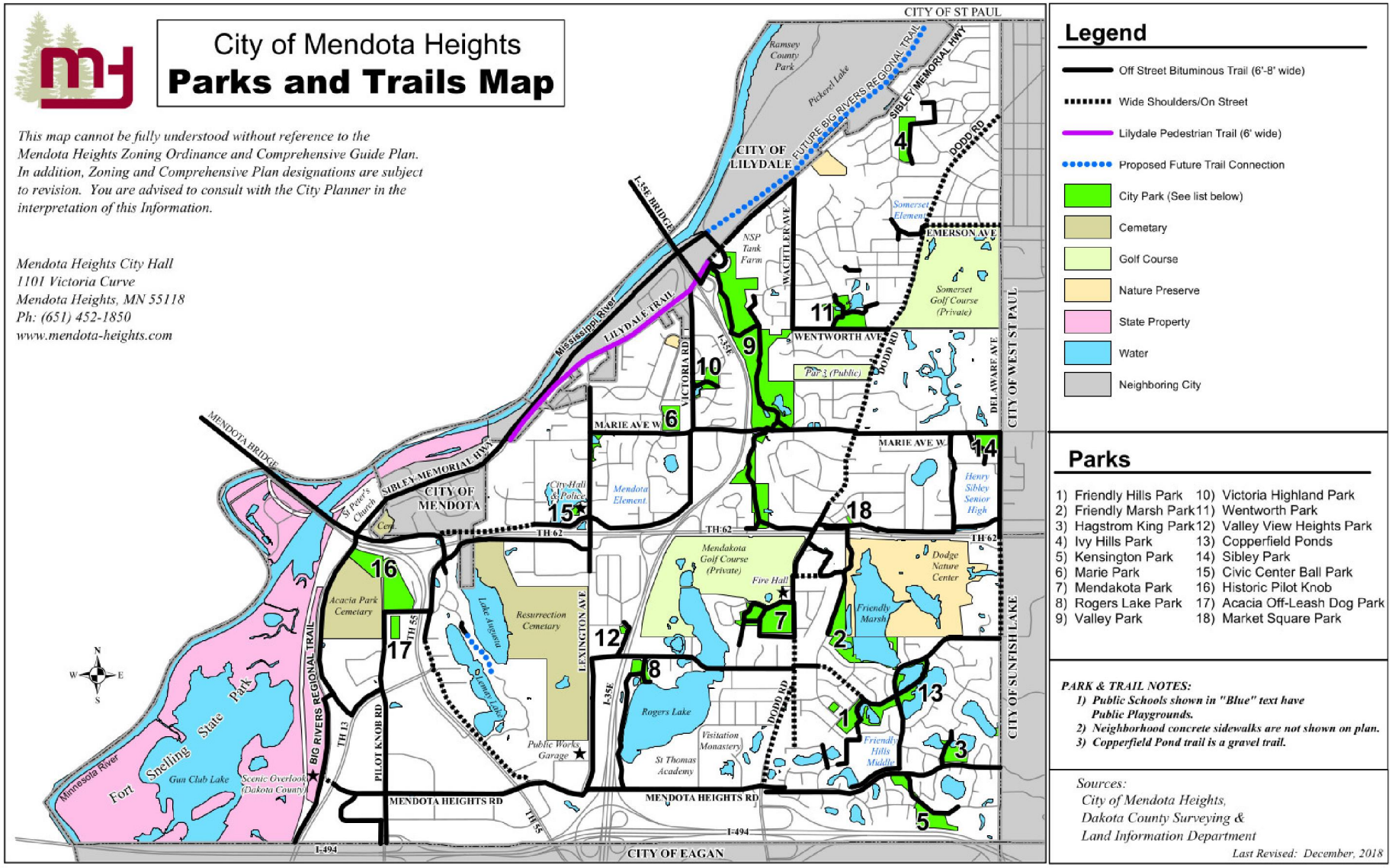
Since European settlement, over 84 percent of the City has been developed to various degrees (Table 1). Low density and rural residential areas comprise over 30 percent of the City, harboring a significant portion of the City's semi-natural vegetation.

Table 1. Land Use in the City of Mendota Heights (adapted from City data)

Land Type	Acres	Percent of City	Percent of City
Industrial, Commercial, Right-of-Way			
Industrial	399.5	6.2	29.0
Commercial/Business	44.7	0.7	
Limited Business	106.8	1.7	
Limited Business PUD	50.9	0.8	
Mixed Use PUD	22.3	0.3	
Right-of-Way (land occupied by public roads & boulevards)	1,218.7	18.9	
Rail Line – not used	20.7	0.3	
Residential			
High Density Residential	72.0	1.1	33.6
High Density Residential PUD	45.5	0.7	
Medium Density Residential	10.6	0.2	
Medium Density Residential PUD	66.4	1.0	
Low Density Residential	1,771.4	27.5	
Rural Residential	194.3	3.0	
Institutional			
State Property (mostly Ft. Snelling State Park)	497.5	7.7	21.1
City Hall/Public Works/Fire Hall	16.3	0.3	
School	122.9	1.9	
Private School	98.1	1.5	
Churches & Synagogues	15.7	0.2	
Cemetery	320.1	5.0	
Golf Course	287.8	4.5	
Open Space & Water			
Nature Preserve	114.6	1.8	16.4
Park (non-water)	214.9	3.3	
Water	724.9	11.3	
Total	***6,436.6***	***100***	***100***

Much of the City-owned property is parkland (non-water). Together with golf courses, cemeteries, and the Dodge Nature Preserve, this land represents 14.6 percent of the City's area and constitutes much of its open space (Figure 7). Residential land uses constitute the largest portion of the City (over 33 percent), underscoring the abundant opportunities for private residents to improve the ecological health of the City

Figure 7. City of Mendota Heights Parks and Trails



through native landscaping and other stewardship practices on private properties. Street boulevards ("Right-of-Way" in Table 1) also present a significant opportunity for increased native plantings, ecological connectivity, and associated benefits. These opportunities are discussed further under Section 2.4.

Vegetation & Natural Areas Mapping

In 1997, the MNDNR County Biological Survey (CBS) mapped sites of biological significance and native plant communities in Dakota County (MNDNR 1997). Sites of biological significance within the City are limited to its southwest corner in Fort Snelling State Park. Here CBS staff mapped two Bulrush Marshes (Northern) and one Calcareous Fen (Southeastern). In the early 2000s, Dakota County staff used the Minnesota Land Cover Classification System (MLCCS; MNDNR 2004) to map land cover in the City. This was the foundation for land cover and plant community mapping in this NRMP.

In 2003, the MNDNR conducted a landscape-scale assessment of the seven-county metro area to identify ecologically significant terrestrial and wetland areas (MNDNR 2008). Using MLCCS data, this assessment was updated in 2008 and identified four important natural resource areas:

- Fort Snelling State Park
- Dodge Nature Preserve
- Rogers Lake
- The area around the St. Thomas Ice Arena (between Mendota Heights Road and Interstate 494, south of Lake Drive). Most of this area has been developed, including the ice arena, parking lot, athletic fields, and community garden plots.

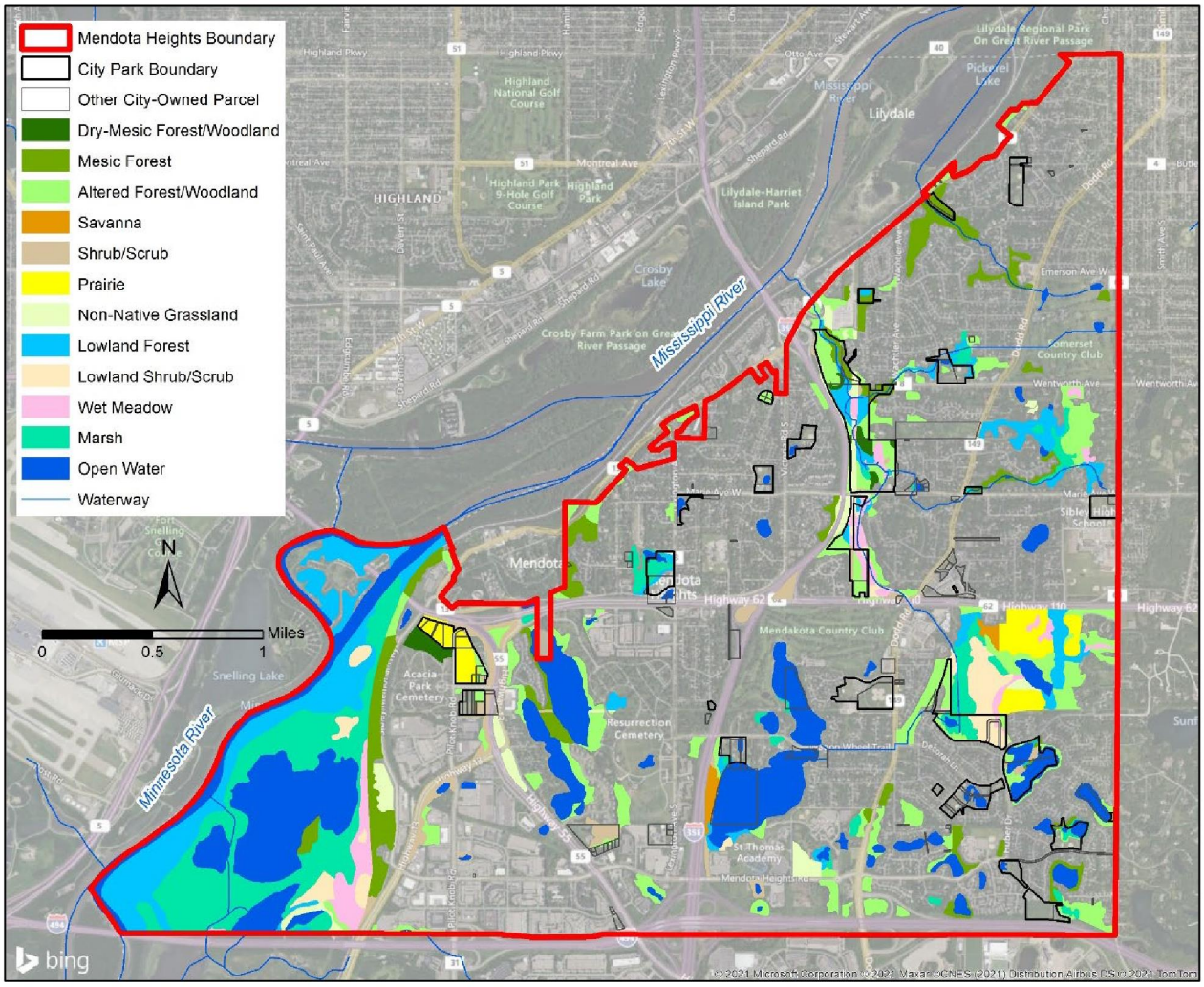
MLCCS is a detailed classification system with many uses, but a more general system is more effective to communicate with natural resource managers and the public. For this NRMP, a classification based on MLCCS was developed to characterize natural and semi-natural plant communities in the City (Table 2). ("Natural/semi-natural" plant communities include native plant communities and altered natural areas that are not routinely managed, such as second-growth forests and old fields). The classification is arranged in a hierarchy, and lower organizational levels that provide more detail are indented. For instance, the first level separates dry from wet soils (upland versus lowland communities). The second level separates communities by the dominant form of the vegetation. At the third and fourth levels, additional information is brought into the classification, such as the dominant plant species or a unique feature of the habitat.

Table 2. Natural/Semi-Natural Vegetation Classification for Mendota Heights

PLANT COMMUNITIES	DEFINING CHARACTERISTICS
Upland Communities	**High, dry ground**
Forest/Woodland	**50-100% tree canopy**
Mature Forest/Woodland	**Large trees**
Dry-Mesic Forest/Woodland (1)	Often oaks; fire-dependent
Mesic Forest (2)	Often maples important
Altered Forest/Woodland (3)	**Often box elder, green ash, elms**
Savanna/Brushland	**5-50% tree canopy**
Savanna (4)	Tree dominated, but <50% canopy cover
Shrub/Scrub (5)	Shrub dominated, with trees
Grassland	**<5% tree canopy**
Prairie (6)	Native plants dominate
Non-Native Grassland (7)	Little native plant cover
Lowland Communities	**Low areas, including wetlands**
Lowland Forest/Woodland	**50-100% tree canopy**
Lowland Forest (8)	Forests in floodplains or near water
Lowland Shrub/Scrub	**5-50% tree canopy**
Lowland Shrub/Scrub (9)	Often willows and/or dogwoods
Lowland Herbaceous	**<5% tree canopy**
Wet Meadow (10)	Grasses and sedges dominate
Marsh (11)	Often invasive cattails, deep water
Open Water (12)	**May have submerged or floating vegetation**

Using MLCCS data, current aerial imagery, AES's tree canopy analysis (discussed under Section 2.2.4), field mapping and assessment, and other data sources, AES updated mapping of the City's natural/semi-natural vegetation, focusing on its parks and natural areas. Developed land and cultural land covers (e.g., buildings, impervious surfaces, regularly maintained turf) were mapped based on Dakota County aerial imagery and other data (Figure 8).

Figure 8. Natural/Semi-Natural Vegetation of Mendota Heights



Except for Fort Snelling, Dodge Nature Preserve, Valley Park, and the two lake districts, the City's natural/semi-natural plant communities are small and scattered across the landscape. Some 1,975 acres of natural and semi-natural plant communities—including approximately 554 acres of open water and another 350 acres in Ft. Snelling State Park—are found in the City (Table 3). This is about 30 percent of the City's 6,437-acre extent. Some 29 percent of the natural and semi-natural plant communities are owned by the City— in City parks, City Hall, and other City lands—with the remainder by the private sector and other entities (Table 3). Upland and lowland plant communities on City-owned land are about equally divided, but open water makes up the majority of lowland communities.

Table 3. Natural/Semi-Natural Vegetation of Mendota Heights

PLANT COMMUNITIES[1]	ACRES IN CITY	ACRES IN CITY PARKS & PARCELS	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**700.3**	**123.8**	**BC - NN**
Forest/Woodland	**507.4**	**79.9**	**BC - NN**
Mature Forest/Woodland	**194.9**	**26.2**	**BC - D**
Dry-Mesic Forest/Woodland (1)	18.1	7.7	CD – D
Mesic Forest (2)	176.8	18.5	BC - D
Altered Forest/Woodland (3)	**312.5**	**53.7**	**NN**
Savanna/Brushland	**69.8**	**16.2**	**CD - NN**
Savanna (4)	12.1	0.4	CD - NN
Shrub/Scrub (5)	57.7	15.9	D - NN
Grassland	**123.1**	**27.7**	**BCD - NN**
Prairie (6)	68.6	21.4	BCD - CD
Non-Native Grassland (7)	54.4	6.3	NN
Lowland Communities	**1,274.8**	**143.6**	**CD - NN**
Lowland Forest/Woodland	**273.0**	**22.9**	**CD - D**
Lowland Forest (8)	273.0	22.9	CD - D
Lowland Shrub/Scrub	**71.1**	**14.0**	**CD NN**
Lowland Shrub/Scrub (9)	71.1	14.0	CD - NN
Lowland Herbaceous	**376.4**	**28.3**	**CD - NN**
Wet Meadow (10)	68.4	12.0	D - NN
Marsh (11)	308.0	16.2	CD - NN
Open Water (12)	**554.3**	**78.5**	**NA**
Totals	***1,975.0***	***267.4***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.2.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate condition; D = Poor condition; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

The most abundant upland and wetland plant communities in the City of Mendota Heights are Altered Forest/Woodland, Lowland Forest, and Marsh (Figures 8 and 9). The dominance of Altered Forest/Woodland on City-owned properties is evident. Much of the City's wooded areas are closed canopy forests, derived from overgrown savannas and second-growth forests now dominated by Boxelder, cottonwood, elms and other non-oak species. These forests provide fewer ecosystem services than native forests. The once prevalent and characteristic natural savannas and brushlands of the City now occupy only one percent of its area (Figures 9 and 10). Although the typical savanna structure of scattered and grouped canopy trees, with few saplings and shrubs beneath, can be seen at picnic areas of any park and in front yards of many homes, these cultural land covers do not provide the ecosystem services of native oak savannas.

Figure 9. Natural/Semi-Natural Vegetation Acreages of Mendota Heights

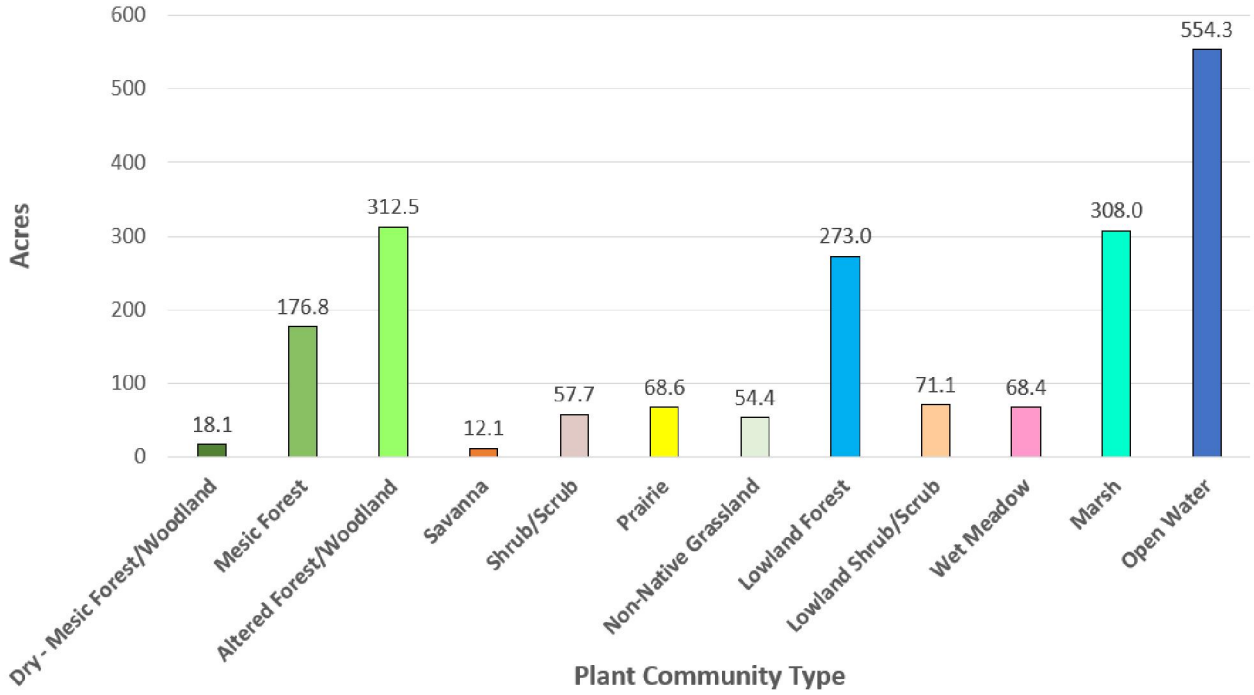
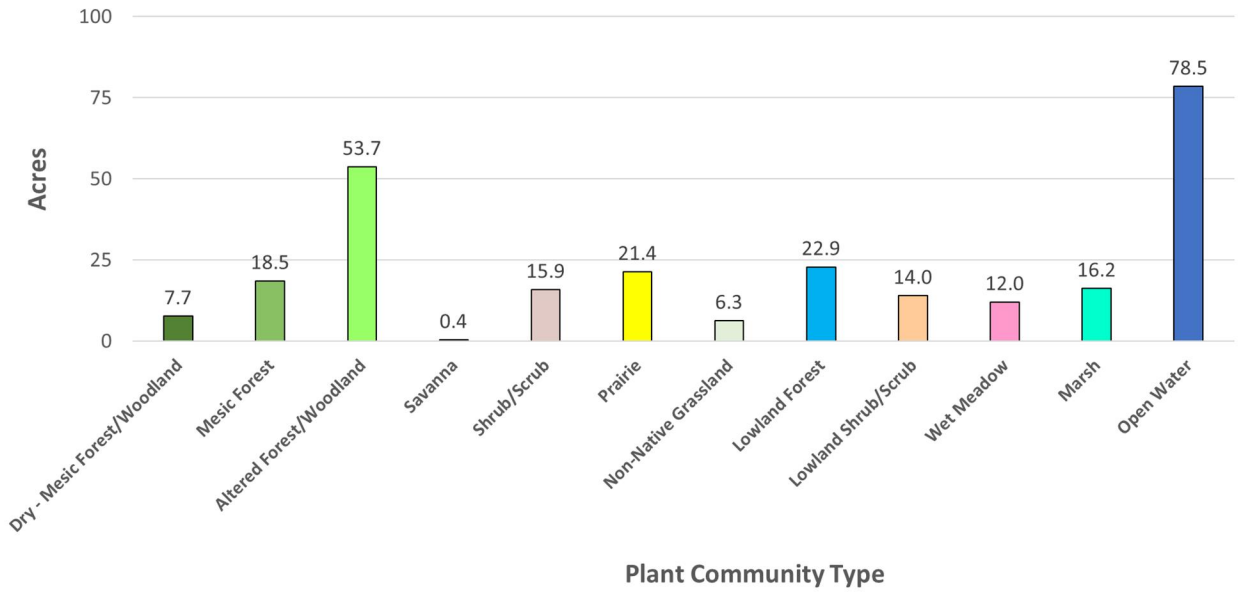


Figure 10. Natural/Semi-Natural Vegetation Acreages of City Parks & Parcels



In these descriptions of each natural and semi-natural vegetation type found in Mendota Heights, the characteristic plant species and other information is based on current conditions in the City as observed during our 2020-2021 field work. Acreages provided after each plant community name represent acres throughout the City (Figure 9), not only within City parks and parcels.

1. Dry-Mesic Forest/Woodland (18.1 acres)

Summary

A well-drained, forested plant community of oaks and other tree species on higher ground and slopes.

Characteristic Plant Species in Mendota Heights

- Bur oak (*Quercus macrocarpa*)
- Northern pin oak (*Q. ellipsoidalis*)
- White oak (*Q. alba*)
- Red oak (*Q. rubra*)
- Black cherry (*Prunus serotina*)
- Big-toothed and Quaking aspen (*Populus grandidentata, P. tremuloides*)
- Woodbine (*Parthenocissus inserta*)

Other Plant Community Characteristics

- Tree canopy typically has scattered openings, where direct sunlight dapples the forest floor.
- Compared to Mesic Forest, Dry-Mesic Forest/Woodland tends to be more susceptible to invasion by Common buckthorn (*Rhamnus cathartica*) and invasive honeysuckles (*Lonicera tatarica, L. x bella*, etc.).
- Generally falls within the "Fire-Dependent Forest/Woodland System" of the Minnesota Native Plant Community Classification (MNDNR 2005).

Soil and Slopes

- Often occurs in well- to moderately well-drained soils.
- Often found on south- or west-facing slopes but can also occur on relatively flat landscape settings.

Historical Conditions

- Historically burned relatively frequently (approximately once every 10 years).
- Low-intensity surface fires were important for maintaining plant community structure and species composition. Without fire, sun-dependent species disappear, reducing the variety of plants and insects in the community.

Dry-Mesic Forest/Woodland, restoration site (in progress) in the northern portion of Valley Park.

2. Mesic Forest (176.8 acres)

Summary

A moist, forested plant community of basswood, oaks, sugar maple, and other tree species typically on level ground, northerly-facing slopes, and lower slopes.

Characteristic Plant Species in Mendota Heights

- Basswood (*Tilia americana*)
- Red and Bur oaks (*Quercus rubra, Q. macrocarpa*)
- Bitternut hickory (*Carya cordiformis*)
- Hackberry (*Celtis occidentalis*)
- American and Slippery elm (*Ulmus americana, U. rubra*)
- Sugar maple (*Acer saccharum*)
- Ironwood (*Ostrya virginiana*)
- Woodbine (*Parthenocissus inserta*)
- Wild ginger (*Asarum canadense*)

Other Plant Community Characteristics

- Tree canopy closure often is nearly 100 percent, which limits or excludes shrub and ground layer vegetation that requires direct sunlight.
- Invasive Common buckthorn (*Rhamnus cathartica*) is often present, but typically less abundant than in Dry-Mesic Forest/Woodland.
- Invasive Garlic mustard (*Alliaria petiolata*) is a problem in many of Mendota Heights' Mesic Forests, especially those in low-lying or moist areas.
- Generally falls within the "Mesic Hardwood Forest System" of the Minnesota Native Plant Community Classification (MNDNR 2005), and includes mesic oak forests as well as maple-basswood forests.

Soil and Slopes

- Often occurs in moderately well-drained soils.
- Often found on north- or east-facing slopes, but can also occur on relatively flat landscape settings.

Historical Conditions

- Historically, burned rarely (approximately once every 20-50 years).
- Tends to become dense stands of maple in the natural process of forest succession. Individual tree death or blowdowns of several trees maintained tree canopy diversity if species other than maple were growing beneath the gap created in the forest canopy.
- Researchers have shown that non-native, invasive earthworms (including "jumping worms") harm Minnesota forests, particularly Mesic Forest. Earthworms reduce forest duff, increase erosion, and change soil structure in a way that prevents the regeneration of many native herbaceous plants and trees. It is likely that most, if not all, of Mendota Heights' Mesic Forest stands contain some invasive earthworms.

Mesic Forest, in the northern portion of Valley Park.

3. Altered Forest/Woodland (312.5 acres)

Summary

A forested plant community on formerly cropped, pastured, or disturbed land, dominated by light-seeded trees and shrubs, most of which originate in lowland settings.

Characteristic Plant Species in Mendota Heights

- Box elder (*Acer negundo*)
- Green ash (*Fraxinus pennsylvanica*)
- American and Slippery elm (*Ulmus americana, U. rubra*)
- Siberian elm (*Ulmus pumila*) – invasive non-native
- Eastern cottonwood (*Populus deltoides*)
- Quaking aspen (*Populus tremuloides*)
- White pine (*Pinus strobus*) in pine plantations (e.g., Valley Park) but historically was also present in some original forests
- Amur maple (*Acer ginnala*) – invasive non-native
- Gray dogwood (*Cornus racemosa*)
- Common buckthorn (*Rhamnus cathartica*) – invasive non-native
- Non-native honeysuckles (*Lonicera tatarica, L. x bella*, etc.) - invasive non-native

Other Plant Community Characteristics

- Some areas contain planted trees of native and non-native deciduous and coniferous species.
- Invasive plants are common, including Common buckthorn, non-native honeysuckles, Garlic mustard (*Alliaria petiolata*), Motherwort (*Leonurus cardiaca*), Japanese hedge parsley (*Torilis japonica*), and Common burdock (*Arctium minus*).
- Often mapped in MLCCS as “Boxelder – Green ash forest”.
- Not considered a natural community.

Soil and Slopes

- Occurs in a broad range of soils and slope positions.

Historical Conditions

- Often formerly disturbed areas that were colonized by pioneering species of bottomlands, which have light, highly mobile seeds (see Characteristic Plant Species above); these trees may range in age from young to mature.

Altered Forest/Woodland, northwest of Rogers Lake.

4. Savanna (12.1 acres)

Summary

A relatively open plant community where oaks, other trees, and shrubs cover less than half the ground, which is blanketed by sun-requiring and shade-tolerant plants. The term "Savanna" as used in this classification does not necessarily mean a high quality native community, such as an intact oak savanna with native groundcover. Rather, Savanna here means a community has the physical structure of a savanna, with 10-50 percent canopy cover, consisting mostly of trees, and a shrubby or herbaceous ground layer. Ecological quality ranks discussed later in this plan can be used to differentiate savannas with oaks and a native ground layer versus savannas comprised of species not characteristic of historical, species-rich savannas.

Characteristic Plant Species in Mendota Heights

- Bur oak (*Quercus macrocarpa*)
- Northern pin oak (*Q. ellipsoidalis*)
- Black cherry (*Prunus serotina*)
- American plum (*Prunus americana*)
- Chokecherry (*P. virginiana*)
- Pennsylvania sedge (*Carex pennsylvanica*)

Other Plant Community Characteristics

- Savanna is used to describe landscapes with less canopy cover than forests and woodlands (typically <50 percent canopy cover), and where the woody (i.e., tree and shrub) vegetation is dominated by trees as opposed to shrubs.
- The broken tree canopy allows sunlight to reach the ground layer, often supporting substantial herbaceous vegetation where shrubs and colonizing trees are not dominant.
- Many of the grand, arching oaks seen throughout Mendota Heights originated in savannas, and often still present the look of a natural savanna even though the ground layer is mowed or composed of non-native plants.
- Common buckthorn is an invasive shrub that dominates the understory of many Savannas.

Soil and Slopes

- Occurs in a broad range of soil types and slope positions.

Historical Conditions

- Historically, Savannas experienced frequent fires (approximately once every 2-4 years). However, where canopy cover approached 50 percent, these fires (carried by oak leaves) were not severe, with flame lengths only a few feet in height. Where trees covered only 10 percent of the ground, fires were like those in prairies, with much longer flame lengths due to the abundance of dry ground layer vegetation as fuel. While shrubs and seedlings were often killed by these fires, they re-sprouted from rootstocks. Fire-tolerant trees such as the thick-barked bur oak and trees that grew rapidly from root masses (called "grubs"), such as northern pin oak, were usually able to reach a size that survived the surface fires. Fire helped maintain an open

and patchy vegetation structure in the community, with some areas in full sun and others in partial shade.

- Variety of tree canopy cover and different amounts of light promoted a diversity of flowering shrubs, grasses, and wildflowers, combining forest and prairie flora, and made these habitats productive and able to support a wide range of wildlife.
- Attractive to people because of their park-like quality.

Savanna, restoration site on the west edge of Rogers Lake.

5. Shrub/Scrub (57.7 acres)

Summary

An upland plant community where shrubs and scrubby trees cover up to half the ground.

Characteristic Plant Species in Mendota Heights

- Smooth and Staghorn sumac (*Rhus glabra, R. typhina*)
- Common buckthorn (*Rhamnus cathartica*) – invasive non-native
- Asian honeysuckles (primarily *Lonicera tatarica, L. x bella*) – invasive non-native
- Eastern red cedar (*Juniperus virginiana*) – potentially aggressive native
- Siberian elm (*Ulmus pumila*) – invasive non-native
- Amur maple (*Acer ginnala*) – invasive non-native
- Gray dogwood (*Cornus racemosa*)
- Smooth brome (*Bromus inermis*) – invasive non-native
- Canada goldenrod (*Solidago canadensis*) – potentially aggressive native

Other Plant Community Characteristics

- Like Savanna, Shrub/Scrub describes landscapes with less canopy cover than forests and woodlands (<50 percent cover); however, the woody vegetation is primarily shrubs and not trees.
- Generally not considered a natural community; however, prior to 1850, Shrub/Scrub communities on high ground were common and supported a wide array of native plants and animals.

Soil and Slopes

- Occurs in a broad range of soils and slope positions.

Historical Conditions

- Most are former grassland areas that became overgrown with shrubs and scattered trees.
- If previously farmed or heavily grazed, ground layer often consists of non-native plants, similar to those of Non-Native Grasslands.

Shrub/Scrub, south of Lemay Lake. (Source: Google Earth Street View)

6. Prairie (68.6 acres)

Summary

A plant community of native grasses with a large variety of sunlight-dependent wildflowers that grow in different combinations based on soil moisture.

Characteristic Plant Species in Mendota Heights

- Big bluestem (*Andropogon gerardii*)
- Indian grass (*Sorghastrum nutans*)
- Switch grass (*Panicum virgatum*)
- Little bluestem (*Schizachyrium scoparium*)
- Gray-headed coneflower (*Ratibida pinnata*)
- Black-eyed Susan (*Rudbeckia hirta*)
- Stiff goldenrod (*Oligoneuron rigidum*)
- Common oxeye (*Heliopsis helianthoides*)
- Purple prairie clover (*Dalea purpurea*)
- Bergamot (*Monarda fistulosa*)

Other Plant Community Characteristics

- Herbaceous plant community, often dominated by grasses.
- Invasive species include Smooth brome (*Bromus inermis*) and Canada thistle (*Cirsium arvense*) in uplands, and reed canary grass (*Phalaris arundinacea*) in lowland areas.
- Falls within the "Upland Prairie System" or "Wetland Prairie System" of the Minnesota Native Plant Community Classification (MNDNR 2005).

Soil and Slopes

- Occurs in a broad range of soils and slope positions: dry prairie is often on sandy soils and/or south- or west-facing slopes, often the hottest, driest locations in the region; moist or mesic prairie is found in a variety of settings, but never excessively dry or wet; wet prairie grows in low, flat areas with shallow groundwater or seepage.

Historical Conditions

- Historically burned frequently (return intervals less than 5 years). A return interval of less than 4 years is recommended to prevent leaf litter accumulation, which changes soil conditions in favor of many invasive plants which were not present in Minnesota 170 years ago.

Planted prairie, in northern portion of Dodge Nature Preserve – Lily Property.

7. Non-Native Grassland (54.4 acres)

Summary

A plant community dominated by invasive non-native grasses, often supporting few wildflower species.

Characteristic Plant Species in Mendota Heights

- Smooth brome (*Bromus inermis*) – invasive non-native
- Kentucky bluegrass (*Poa pratensis*) – invasive non-native
- Dandelion (*Taraxacum officinale*) – invasive non-native
- Yellow and White sweet clover (*Melilotus officinalis, M. alba*) – invasive non-native
- Ground clovers (primarily *Trifolium repens, T. pratense*) – invasive non-native
- Canada goldenrod (*Solidago canadensis*) – potentially aggressive native
- Reed canary grass (*Phalaris arundinacea*) – invasive non-native

Other Plant Community Characteristics

- Dominated by non-native herbaceous vegetation that is not typically mowed or maintained.
- Not considered a natural community.

Soil and Slopes

- Occurs in a broad range of soils and slope positions.

Historical Conditions

- Often previously farmed or grazed.

Non-Native Grassland, in northern portion of Dodge Nature Preserve - Lily Property.

8. Lowland Forest (273.0 acres)

Summary

A wet, sometimes flooded, forested plant community of elm, ash, maple, cottonwood, and other trees and shrubs in low-lying areas.

Characteristic Plant Species in Mendota Heights

- Eastern cottonwood (*Populus deltoides*)
- Silver maple (*Acer saccharinum*)
- Black willow (*Salix nigra*) and hybrids
- Box elder (*Acer negundo*)
- American and Slippery elm (*Ulmus americana, U. rubra*)
- Green ash (*Fraxinus pennsylvanica*)
- Common hackberry (*Celtis occidentalis*)
- Black walnut (*Juglans nigra*)
- Stinging nettle (*Urtica dioica*)
- Wood nettle (*Laportea canadensis*)
- Enchanter's nightshade (*Circaea lutetiana*)
- Garlic mustard (*Alliaria petiolata*) – invasive non-native
- Spotted touch-me-not (*Impatiens capensis*)

Other Plant Community Characteristics

- Low-lying woodlands that experience flooding, shallow water tables, or very moist conditions due to solar aspect (e.g., in ravines or on north- or east-facing slopes).
- Remnant or restored native Lowland Forest often falls within the "Floodplain Forest System" or "Wet Forest System" of the Minnesota Native Plant Community Classification (MNDNR 2005).

Soil and Slopes

- Occurs in low-lying areas including basins, floodplains, drainageways, and on lower slopes.
- Floodplains usually have mineral soil; swamps typically have organic, mucky soils.

Historical Conditions

- Some Lowland Forests still experience unaltered hydrology and resemble historical forests, but others have changed due to hydrological alterations (e.g., dams, levees).

Lowland Forest, northern portion of Copperfield Ponds Park.

9. Lowland Shrub/Scrub (71.1 acres)

Summary

A plant community on moist, occasionally flooded soils, where shrubs and scrubby trees cover up to half the ground.

Characteristic Plant Species in Mendota Heights

- Black willow (*Salix nigra*) and hybrids
- Willow shrubs (*Salix* spp.)
- Red-osier dogwood (*Cornus stolonifera*)
- Glossy buckthorn (*Frangula alnus*) – invasive non-native
- Wild black currant (*Ribes americanum*)
- Narrow-leaved and Blue cattail hybrid (*Typha angustifolia, T. x glauca*) – invasive non-native
- Reed canary grass (*Phalaris arundinacea*) – invasive non-native
- Sedges (*Carex* spp.)
- Spotted touch-me-not (*Impatiens capensis*)

Other Plant Community Characteristics

- Shrub-dominated wetland community.
- Often contains highly invasive Reed canary grass, which can completely dominate the ground layer.
- Remnant or restored native Lowland Shrub/Scrub falls within the "Wet Meadow/Carr System" of the Minnesota Native Plant Community Classification (MNDNR 2005).

Soil and Slopes

- Occurs in saturated or groundwater-fed soils, usually in shallow, inundated depressions.

Historical Conditions

- Some Lowland Shrub/Scrub areas represent historical conditions, while others developed after woody plants invaded Wet Meadows following drainage and the cessation of haying or grazing or due to fire suppression.

Lowland Shrub/Scrub, in northern portion of Valley Park (along Xcel Energy ROW).

10. Wet Meadow (68.4 acres)

Summary

A plant community on moist, occasionally flooded soils. Vegetation dominated by grasses and sedges with scattered wildflowers.

Characteristic Plant Species in Mendota Heights

- Reed canary grass (*Phalaris arundinacea*) – invasive non-native
- Sedges (*Carex* spp.)
- Canada bluejoint grass (*Calamagrostis canadensis*)
- Manna grasses (*Glyceria* spp.)
- Swamp milkweed (*Asclepias incarnata*)
- Spotted Joe-pye weed (*Eutrochium maculatum*)
- Purple loosestrife (*Lythrum salicaria*) – invasive non-native
- Blue flag iris (*Iris versicolor*)
- Beggar ticks (*Bidens* spp.)

Other Plant Community Characteristics

- Herbaceous wetlands.
- Most in the Twin Cities region are dominated by the invasive, non-native Reed canary grass, and therefore are not considered a natural community.
- Remnant or restored native Wet Meadows fall within the "Wet Meadow/Carr System" of the Minnesota Native Plant Community Classification (MNDNR 2005).

Soil and Slopes

- Occurs in depressions and at edges of marshes, lakes, ponds, and some streams and rivers.
- Found in saturated soils and sometimes in shallow water.

Historical Conditions

- Wet Meadows depend on a predictable, though not static, hydrologic regime, sometimes including damming by beavers. The seasonal water level changes in response to spring runoff, May-June rains, and late summer dry periods sustained the large variety of plants in historical Wet Meadows. Currently most Wet Meadows across the Midwest have been converted to a simple plant community of Reed canary grass with a few scattered other species. This was due to the introduction of aggressive strains of Reed canary grass for pasture, as well as draining to facilitate haying and cropping. Sediment and nutrient inputs greatly favor Reed canary grass, as do steady water levels resulting from dams and berms. In dry periods, Wet Meadows were historically subject to fire, but the plants, including the shrubs, survived such fires and re-sprouted.

Wet Meadow (dominated by invasive Reed canary grass), in southern portion of Valley Park.

11. Marsh (308.0 acres)

Summary

A plant community in standing water dominated by herbaceous vegetation.

Characteristic Plant Species in Mendota Heights

- Narrow-leaved and Blue cattail hybrid (*Typha angustifolia, T. x glauca*) – invasive non-native
- Broad-leaved cattail (*Typha latifolia*)
- Purple loosestrife (*Lythrum salicaria*) – invasive non-native
- Giant reed (*Phragmites australis*) – invasive non-native
- Lake sedge (*Carex lacustris*)
- Bulrushes (*Scripus* spp., *Schoenoplectus* spp., *Bolboschoenus* spp.)
- Giant bur-reed (*Sparganium eurycarpum*)
- Broad-leaved arrowhead (*Sagittaria latifolia*)
- Lesser duckweed (*Lemna minor*)

Other Plant Community Characteristics

- Wetlands that are typically dominated by emergent wetland plants growing in shallow to deep water.
- In the Twin Cities region, marshes are most often dominated by invasive cattails. Purple loosestrife and Giant reed are two additional invasive plants commonly found in Marsh. These species often spread throughout a wetland, reducing vegetation diversity and habitat value.
- Remnant or restored native Marsh falls within the "Marsh System" of the Minnesota Native Plant Community Classification (MNDNR 2005).

Soil and Slopes

- Occurs in depressions and at edges of lakes, ponds, streams, and rivers.
- Found in shallow to deep water over mineral or organic soil.

Historical Conditions

- Invasion by cattails and other aggressive species have resulted in the dramatic degradation of this type of wetland throughout the Upper Midwest. Hydrological regimes were dynamic but predictable historically. With the current shunting of excessive runoff from roads, pavement, and rooftops, Marshes experience water level fluctuations out of the normal range that the historical vegetation can tolerate. Both Narrow-leaved cattail (*Typha angustifolia*, an invasive, non-native species) and Blue cattail (*T. x glauca*, the invasive hybrid between Narrow-leaved cattail and native Broad-leaved cattail, *T. latifolia*) grow well with this overly-dynamic flooding regime. These two aggressive cattail species also use the higher phosphorus concentrations in most Marshes that receive runoff and develop into dense, tall stands.

Friendly Marsh (in the distance).

12. Open Water (554.3 acres)

Summary

Areas of deep water that may contain floating-leaved or submergent vegetation.

Characteristic Plant Species in Mendota Heights

- Yellow water lily (*Nuphar variegata*)
- White water lily (*Nymphaea odorata*)
- American lotus (*Nelumbo lutea*)
- Eurasian watermilfoil (*Myriophyllum spicatum*) – invasive non-native
- Curly-leaf pondweed (*Potamogeton crispus*) – invasive non-native
- Coontail (*Ceratophyllum demersum*)
- Pondweeds (*Potamogeton* spp.)
- Lesser duckweed (*Lemna minor*)

Other Plant Community Characteristics

While not a focus of this study, Open Water areas often contain a variety of floating and/or submerged aquatic plants. Aquatic habitats in Mendota Heights are affected by urban stormwater runoff and aquatic invasive species (AIS), including plants such as Eurasian watermilfoil and Curly-leaf pondweed, and non-native animals, such as Common carp (*Cyprinus carpio*).

Soil and Slopes

- Lakes and ponds with mineral or organic sediment.

Historical Conditions

- Many Open Water areas represent historical conditions (e.g., natural lakes, rivers, and open water wetlands), while some represent constructed stormwater ponds.

Open Water with White water lilies, at Rogers Lake.

2.2.3 Ecological Quality

An integral component of this NRMP is the assignment of an ecological quality rank to many of the City's natural areas. This rank estimates the relative health of a specific plant community. The criteria for assigning a rank are:

- Diversity of native species
- Level of disturbance
- Presence of invasive species
- Structural and spatial diversity (i.e., vegetation layers and plant variety across the natural area)
- Connectivity with other plant communities versus adjacency to turf or active use areas
- Degree of erosion due to processes such as excessive runoff or foot traffic
- Other negative management or use impacts

Departments of Natural Resources across the country have adopted a standardized ecological ranking system used by State Natural Heritage Programs when conducting inventories of natural areas. In Minnesota, this system was refined by the MNDNR as the Natural Community Element Occurrence Ranking Guidelines (MNDNR 2001). This robust (91-page) methodology provides definitions and criteria for assigning an ecological quality rank to any given native plant community in Minnesota. For more general application of ecological quality ranks, MLCCS (version 5.4) adopted a simplified version of the MNDNR's system, whereby more general guidelines are provided to help the user assign an appropriate quality rank. Based on the ecological criteria described above, it was decided that the MLCCS ecological quality ranking system would be modified slightly for use in the City of Mendota Heights (see box below).

Often, a mapped plant community may be somewhat heterogeneous and contain characteristics of multiple quality ranks. For instance, a moderate quality forest (C rank) may have large, dense patches of invasive buckthorn (justifying a D rank). In this case, it would be acceptable to assign multiple ranks to this single plant community (i.e., CD). It is best to limit the number of ranks to two "adjacent" ranks, and if this does not accurately characterize the plant community's quality, the plant community (polygon) should be split and each portion assigned its appropriate quality rank.

Ecological Quality Ranks

A = Highest quality natural community, no disturbances and natural processes intact.

B = Good quality natural community. Has its natural processes intact, but shows signs of past human impacts. Low levels of non-native or invasive plants.

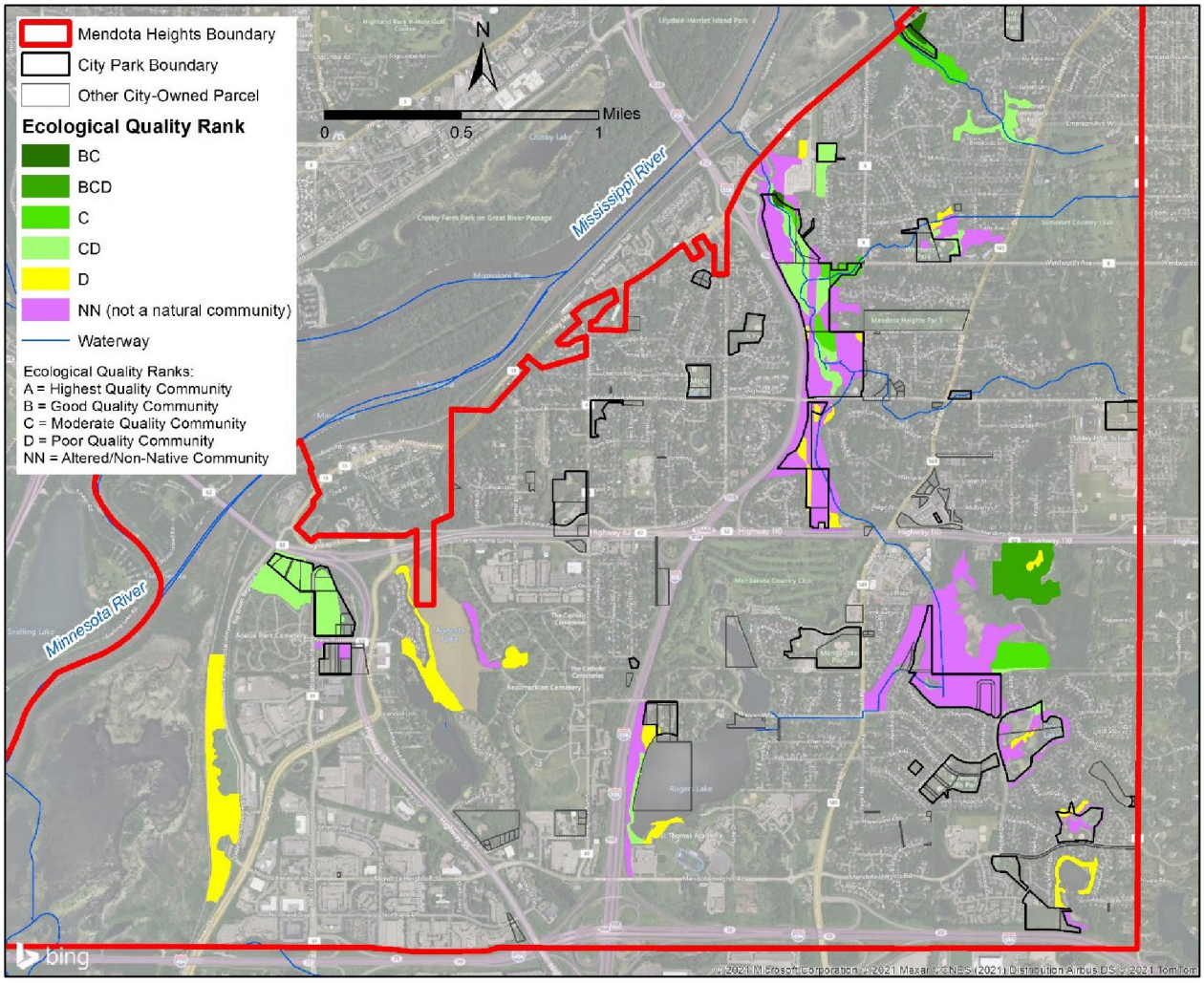
C = Moderate condition natural community with obvious past disturbance but still clearly recognizable as a native community. Typically not dominated by weedy species in any layer.

D = Poor condition of a natural community. Includes some native plant species but is dominated by non-natives and/or is widely disturbed and altered.

NN = Altered / non-native plant community. These semi-natural communities (e.g., Altered Forest/Woodland, which includes green ash/box elder forests) do not receive a natural quality rank.

Plant communities visited during AES's field assessment were assigned a quality rank. Figure 11 illustrates quality ranked plant communities within the City.

Figure 11. Quality Ranks of Assessed Natural Communities in Mendota Heights



2.2.4 Tree Canopy Analysis

The City of Mendota Heights values its urban forest. Trees play a large role in the character of the City, but much of its tree canopy is on private lands. Knowing where different tree species are growing in Mendota Heights on public and private land allows the City to identify locations where invasive tree species should be removed. It allows the City to identify locations where the tree canopy is missing species characteristic of a particular location, given the soil and moisture conditions there. A tree canopy inventory enables the City to pick areas in former savannas and woodlands to carry out prescribed burns using oak leaves as fuel. The City will be able to envision many other applications of the data once it begins using it.

Canopy Mapping and Results

To describe the entire canopy, including private lands, remote sensing and mapping techniques were used. High-resolution, four-band (red, green, blue, and near-infrared) aerial imagery was analyzed using

eCognition, an object-oriented imagery processing and classification software (https://geospatial.trimble.com/products-and-solutions/ecognition). Reference trees were selected in the field and used to calibrate the imagery and map species and species groups across the City on private and public land. The canopy extent of reference trees was field-mapped on air photos at twenty locations in the City and brought into GIS to train the software in species recognition. The software generated maps of all trees in the City. Many clusters of trees were small, isolated and unmanageable as woodlands, and therefore only tree clusters of five-acres or larger were brought into the final tree canopy classification and mapping.

Data availability and quality affected the analysis. No recent LiDAR data were available. LiDAR (Light Detection and Ranging) data can be brought into GIS to show the height of objects. LiDAR helps distinguish trees from shrubs and grass. Another challenge was that the most recent available aerial imagery (2019) exhibited "banding", or irregularities in color that were associated with different aircraft flight passes. Despite these limitations, the woodland mapping of dominant tree species is estimated to be 80-90 percent accurate, depending on species. Uncommon trees have a lower accuracy rate.

Several methods were used to assess accuracy. The field-mapped canopy was compared with the computer-mapped canopy at all locations that were mapped and spot-checked elsewhere. The computer-mapped distribution of oaks, sugar maple, and basswood was compared to the land cover mapping that AES field biologists did in dry-mesic and mesic forests. The location of lowland forest trees was inspected in wetland mosaics where reed canary grass, cattail, and open water intermingled with forest patches. Lastly, a computer-mapped large area of Siberian elm was compared with the field-mapped polygon for that species. In all these comparisons, the center of the computer-mapped tree canopy for species was largely in agreement with the field data.

Computer-mapping identified 33 species of trees, but distinguishing some species was difficult given the data (Table 4). For this reason, 14 species were combined into six species groups. As the species groups consisted of species that generally co-existed (except for the "Other" group), the accuracy of the mapping of these species will be minimally compromised. "Other" included species with few field-mapped reference trees, which would result in poor mapping accuracy if they were treated separately.

Eastern cottonwood and Box elder are the most common species in the City's tree canopy, accounting for 30 percent of the canopy area. The City's open landscape, history of cropping and grazing, and proximity to two big rivers created ideal conditions for these species to colonize the uplands, well beyond their pre-1850 locations. Both species have light seeds that carry on the wind and grow quickly.

Table 4. Canopy Area of Tree Species in Mendota Heights Forests and Woodlands

Species Name	Common Name	Tree Canopy Area (Ac.)	% of Tree Canopy Area
Acer negundo	Box elder	128.8	10.0
Acer platanoides[1]	Norway maple	18.5	1.4
Acer saccharinum	Silver maple	83.1	6.4
Acer saccharum	Sugar maple	5.4	0.4
Betula nigra	River birch	5.4	0.4
Celtis occidentalis	Hackberry	10.9	0.8
Fraxinus nigra	Black ash	0.9	0.1
Fraxinus pennsylvanica	Green ash		
Gleditsia triacanthos	Honey locust	6.7	0.5
Juglans nigra	Black walnut	53.7	4.2
Ostrya virginiana	Ironwood	0.6	0.0
Picea abies[2]	Norway spruce	2.9	0.2
Picea glauca	White spruce		
Picea pungens[2]	Colorado blue spruce	2.9	0.2
Pinus resinosa	Red pine	10.8	0.8
Pinus sylvestris[2]	Scots pine		
Pinus strobus	Eastern white pine	53.7	4.2
Populus deltoides	Eastern cottonwood	266.4	20.6
Prunus serotina	Black cherry	16.5	1.3
Quercus ellipsoidalis	Northern pin oak	10.3	0.8
Quercus rubra	Northern red oak		
Quercus bicolor	Swamp white oak	9.5	0.7
Quercus macrocarpa	Bur oak	105.6	8.2
Rhamnus cathartica[1]	Common buckthorn	12.2	0.9
Robinia pseudoacacia[1]	Black locust	18.9	1.5
Salix nigra	Black willow	8.9	0.7
Tilia americana	American basswood	30.9	2.4
Ulmus americana	American elm	3.8	0.3
Ulmus rubra	Slippery elm		
Ulmus pumila[1]	Siberian elm	103.3	8.0
Other - *Populus grandidentata*	Big-toothed aspen	320.5	24.8
Other - *Populus tremuloides*	Quaking aspen		
Other - *Carya cordifolius*	Yellowbud hickory		
Other - *Carya glabra*	Pignut hickory		
Other - *Populus alba*[2]	Silver poplar		
Other - *Acer ginnala*[1]	Japanese maple		
Other - *Malus* spp.	Apple		
Total		**1291.1**	**100**

[1] *Invasive, non-native species (orange rows)*

[2] *Non-native species*

An echo of the City's savanna past is seen in the presence and distribution of several native tree species. Bur oak, the third most abundant tree with over 8 percent of the canopy area, historically was the dominant tree, along with northern pin oak, across most of the City. Silver maple is the fifth most common species and historically and currently dominates many floodplains and low areas that often flood. It is also planted extensively as a shade tree. Black walnut, American basswood, Big-toothed and Quaking aspen are also common in the City's tree canopy. These species are not dominant but are consistently present in the upland forests of Mendota Heights. Elsewhere in Dakota County, Big-toothed aspen historically co-dominated forests with oak species at locations where fire was present but not as frequent as in the more open oak savannas. In the species grouped as Other, Big-toothed aspen probably comprises much of the cover. The native Eastern white pine historically grew sparsely along the bluffs of big rivers in the region, but has been widely planted in the City and elsewhere.

Tree Canopy Integrity & Durability

Over 43% of the City's tree canopy consists of non-native, invasive, aggressive, fast-growing, and/or short-lived species, some of which are native lowland forest species growing in uplands. The City's tree planting strategies address this issue by installing native, long-lived, climate-resilient species adapted to local site conditions.

Of trees that were not indigenous to the region (and are also invasive), Siberian elm is the most abundant, followed by Black locust and Norway maple. Together they occupy nearly 11 percent of the City's tree canopy. Siberian elm was a favorite tree in farmstead and conservation plantings from the 1930s to the 1970s because it tolerates poor, dry soil. It has the disadvantage of being a prolific seeder that germinates readily in grasslands and savannas. Siberian elm is being removed from City properties when the opportunity arises, and it is not currently planted as a landscape tree by the City. Common buckthorn is a famous problem that nearly every public landowner in the Midwest has dealt with for decades, with no biological control yet found despite rigorous research and field work in Europe. The widely-planted street tree, Norway maple, is now recognized as an invasive forest tree, casting deep shade and diminishing species diversity in the ground layer. It has a milky sap, unlike the clear sap of Sugar and Silver maples, and cannot be boiled down to maple syrup. Although a native tree, Green ash has been attacked by an invasive insect, the Emerald ash borer, which has killed tens of millions of ash trees from New England to the Midwest. In addition to simply dying out, for several years the City has removed this tree from public property, while individual landowners have done the same to a lesser extent. This may explain the low canopy percent of Green ash, despite its reputation as an aggressive seeder into upland edge habitat.

Below we explore potential applications of the data to give the reader a sense of how species-specific forest canopy mapping can be used.

Taking an Ecosystem Approach to Manage the Urban Forest

There is nothing more aspirational for Mendota Heights than to move towards an ecosystem management approach for its forests and woodlands. Identifying concentrations of once-dominant native tree species is essential because these are vestiges of viable plant communities that existed for hundreds of years. Concentrations of once-dominant native trees stand the best chance of persisting into the future and adapting to environmental and land use change because their suitability to the soils and climate of the region has been proven by their persistence for millennia.

Concentrations of tree species should be managed before other areas in the City because their canopy is more intact and supports more of the kinds of trees found in healthy ecosystems. They are also "reference sites" or best examples of which tree species to plant in altered forests, along streets, and on public lands. Species concentrations can also be used it pinpoint problems—lack of an ecologically viable tree canopy, or concentrations of invasive trees, for instance.

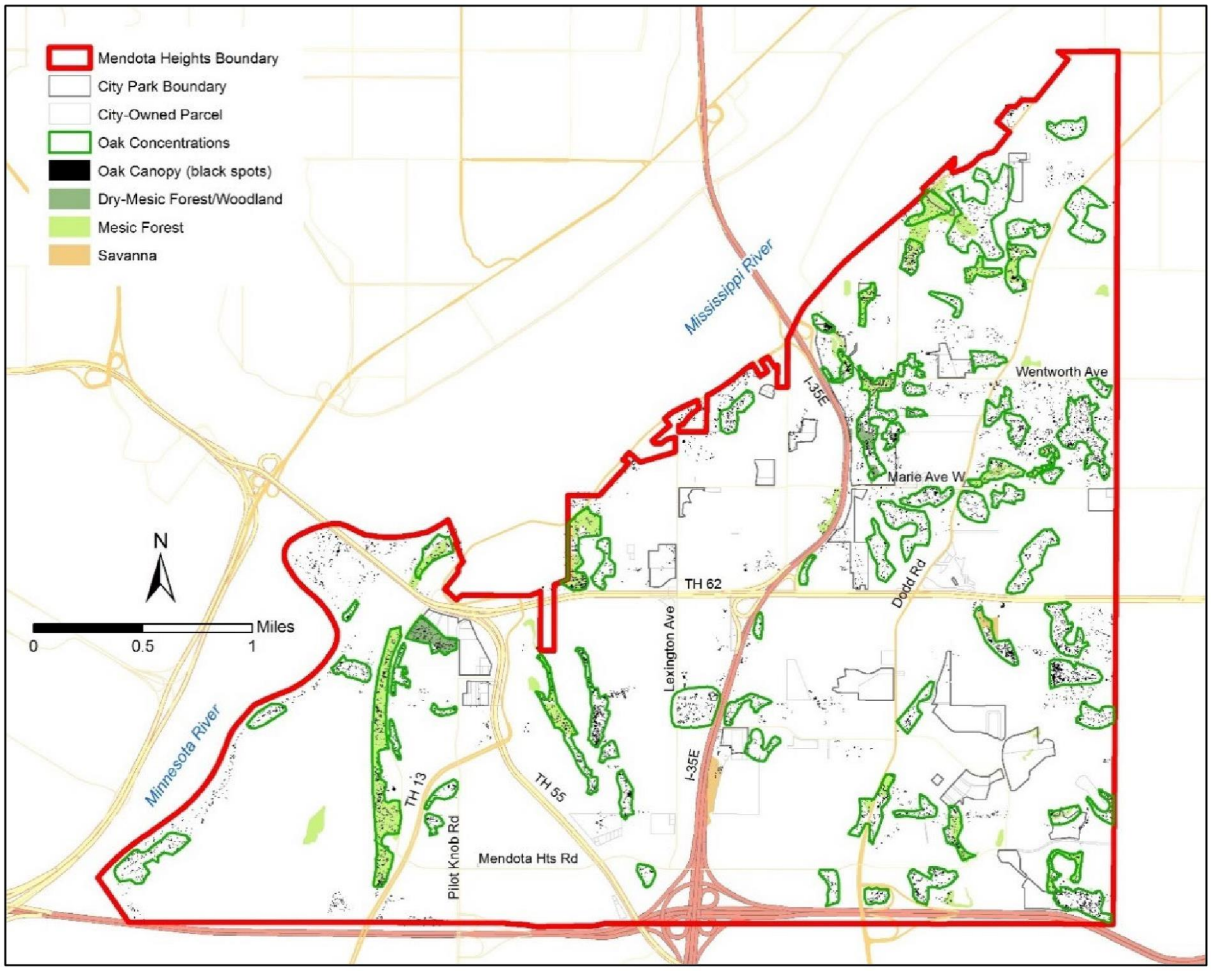
An ecosystem approach can be applied to different plant communities with different concentrations of dominant species. An ecosystem approach puts plant communities on a trajectory that is consistent with the pre-1850s trajectory and more able as a result to adapt to future change—be resilient, in other words. Five examples for how to use the tree canopy data are given below.

Increase Integrity and Resilience of Forests with Oaks

In the 1850s oaks dominated the landscape of Mendota Heights. They provided abundant acorn mast for dozens of wildlife species; their dry leaves carried fires through woodlands and kept understories open; they were long-lived; they created shaded habitat but the oak crown architecture allowed enough light to reach the ground for a diverse sun-loving ground layer; and they were natural dominants on south to west slopes, coarse-textured soils, dry sites, and the fire-managed landscape which was most of the City before 1850. (Oaks have high to moderate fire tolerance.)

Large concentrations of oak trees (Figure 12) occur on the bluffs of the Minnesota River Valley, in Acacia Park Cemetery, around Augusta and Lemay Lakes, at the City border with Mendota, in Valley Park, around Ivy Falls Ravine, in the neighborhood west of Dodge Nature Preserve and Delaware Avenue, and in Friendly Marsh Park. Many smaller concentrations are scattered throughout the City, primarily in its east half.

Figure 12. Areas of Dense Oak Tree Growth in the Tree Canopy of the City of Mendota Heights



Oak concentrations on public and semi-public institutional lands are amenable to ecosystem management. Where oak concentrations overlap with Dry-Mesic Forest/Woodland, Mesic Forest and Savanna, a higher priority should be given. Rather than start by cutting buckthorn and honeysuckle, an

ecosystem approach would establish fire breaks and begin prescribed fire management across large areas using dry oak leaves. A fire prescription would be written to kill young buckthorn and honeysuckle, remove ground layer thatch, allow native ground layer plant seeds to germinate and suppressed native plants to grow, and increase native ground layer cover to compete against buckthorn and honeysuckle seedlings from the seedbank. After two or three years of continuous burning, the effects would be evaluated and the prescription adjusted. It may be necessary to girdle and spot-apply herbicide to large invasive shrubs unaffected by fire and broadcast spread a low-cost woodland grass-sedge seed mix if the seedbank and native plants do not respond. (The grass-sedge seed mix would provide light fuel to carry fire and would compete against invasive shrubs germinating from seed or sprouting from surviving roots.) Because prescribed burning is one of the cheapest ways to effectively and ecologically manage large areas, the ecosystem approach can often be applied across larger areas for the same cost of cutting and stump-treating invasive shrubs.

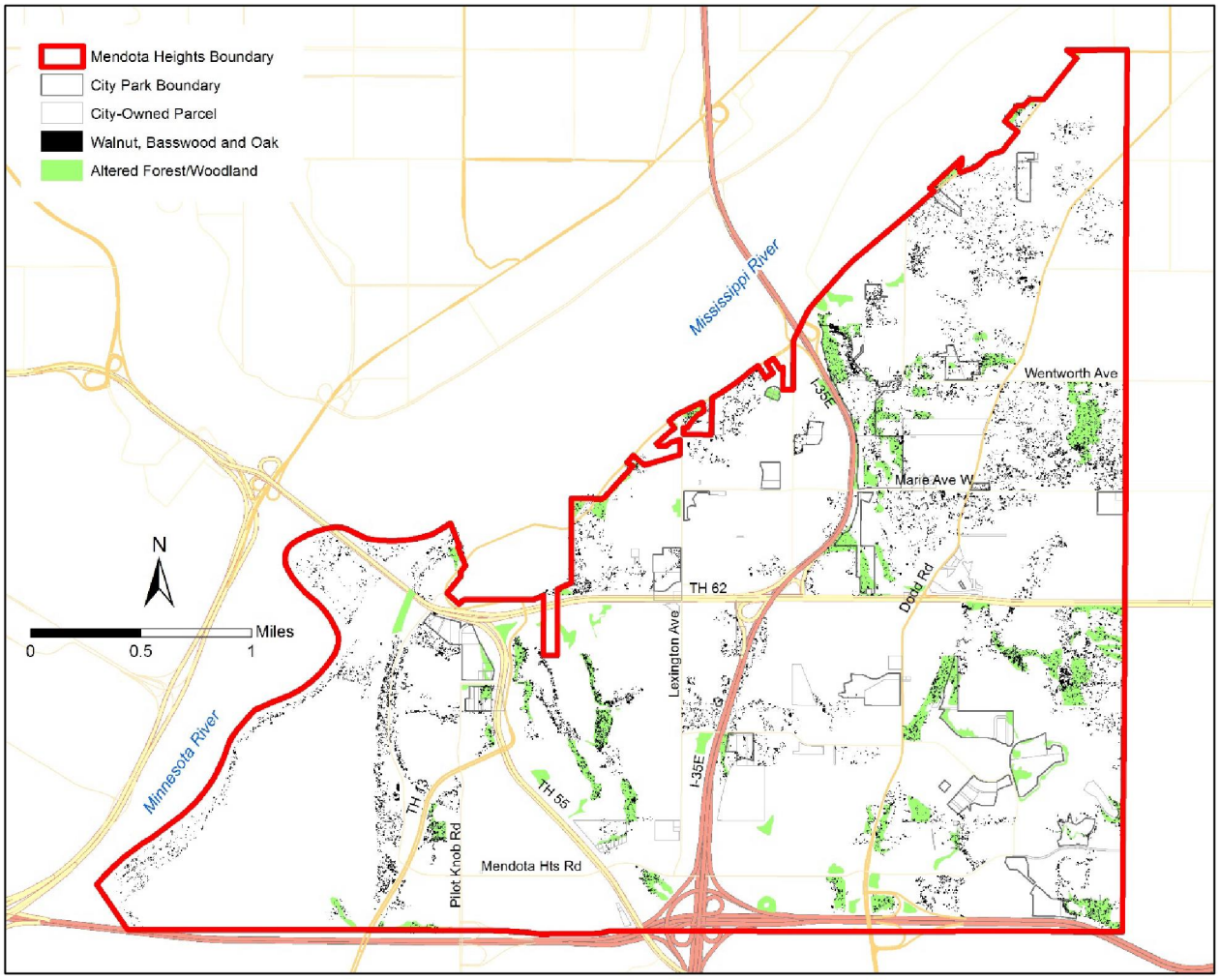
Increase Integrity and Resilience of Altered Forests/Woodlands

Altered Forest/Woodland is the commonest forest type in the City. It is also the most likely to have developed from abandoned pastures, fields and disturbed ground, or invaded grasslands and savannas. It is usually dominated by light-seeded, bottomland forest trees that have short lifespans and little food value for wildlife—Box-elder, Green ash, elm, cottonwood. Altered Forest/Woodland often harbors large populations of invasive trees and shrubs—Siberian elm, Amur maple, buckthorn, honeysuckle—and function as a seed source to spread invasive plants across the nearby landscape.

Clearing these forests is out of the question—they provide shade, screen buildings, and the general public likes forests, even of poor quality and filled with invasive plants. At the same time, improving the integrity and resilience of the City's forests requires that some action be taken. An ecosystem approach would be to replace over time the existing canopy with a canopy like that of healthy Dry-Mesic Forest/Woodland and Mesic Forest. Steps to accomplish this are as follows.

1. Identify concentrations of Black walnut, American basswood, and oaks that occur in patches of Altered Forest/Woodland (Figure 13).
2. Prioritize large, Altered Forest/Woodland patches on public land having concentrations of native trees to learn how to carry out this work.
3. Assess conditions in the priority forest patches—light levels in the understory, openings in the canopy, density of invasive shrubs in the understory, etc.
4. Write a management brief for restoring Altered Forest/Woodland for conditions in the City.
5. Fundraise, schedule, and implement. Implementation generally involves underplanting saplings and seedings of species adapted to the light levels, planting saplings and seedlings in canopy gaps and at edges, protecting seedlings and saplings from deer browsing, and controlling competing trees and shrubs around the seedlings and saplings.
6. Monitor results and adjust restoration techniques (i.e., practice adaptive management).

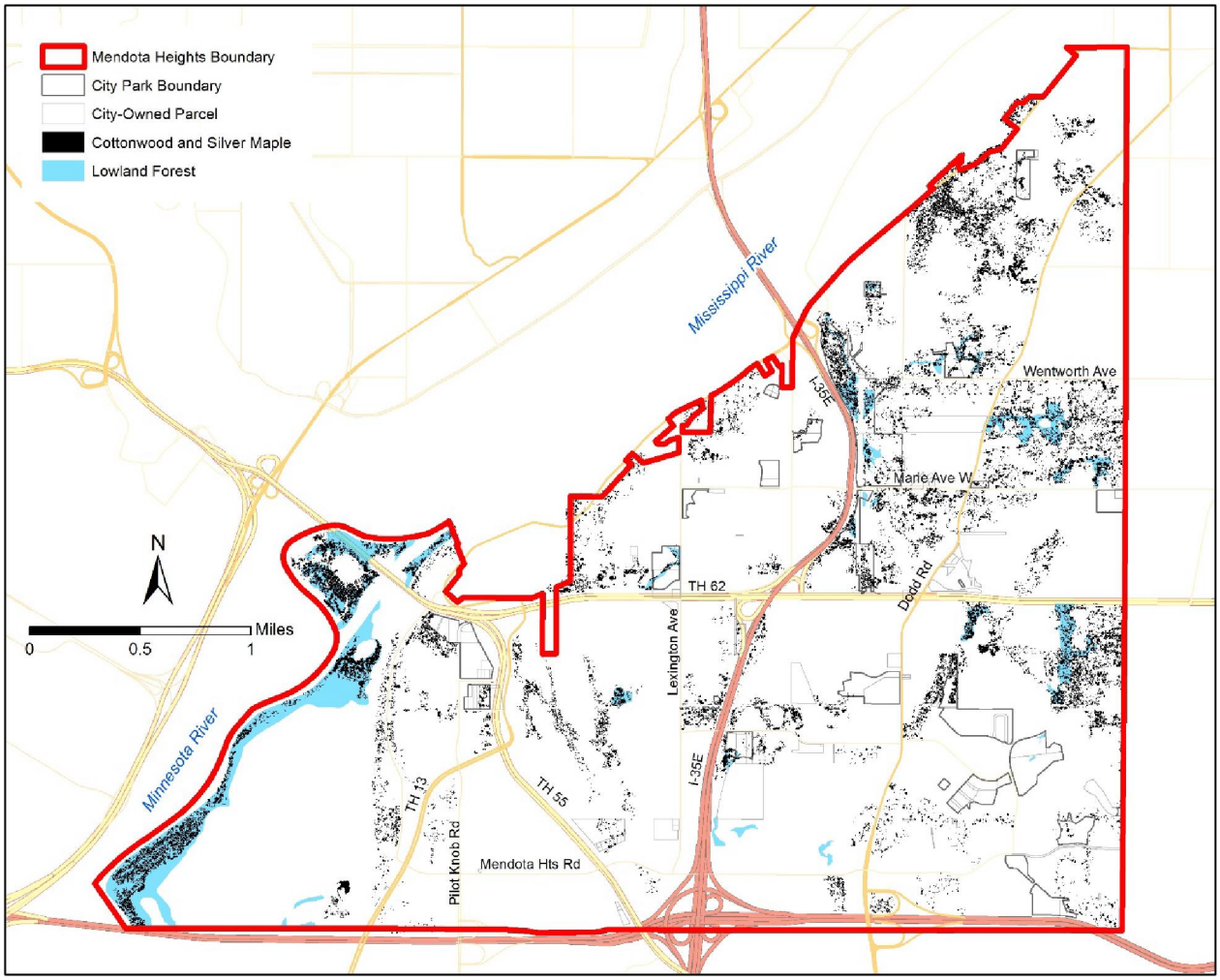
Figure 13. Concentrations of Native Trees in Patches of Altered Forest/Woodland in the City of Mendota Heights



Increase Integrity and Resilience of Lowland Forests

Eastern cottonwood, Silver maple, and Box-elder are among the most abundant trees in the City because their life history traits allowed them to move from floodplain and swamp settings into the uplands. Concentrations of Eastern cottonwood and Silver maple in lowland settings, however, suggest that the canopy of a Lowland Forest at that location is intact (Figure 14). (Box-elder is not included in this analysis because, although a native species, it is often associated with disturbed landscapes.) Steps similar to that for Altered Forest/Woodland could be taken to increase the integrity and resilience of Lowland Forests in the City. To increase tree canopy diversity, the planting palette could include Swamp white oak (*Quercus bicolor*), Bur oak, and other uncommon Lowland Forest trees and shrubs.

Figure 14. Concentrations of Native Trees in Patches of Lowland Forest in the City of Mendota Heights



Prioritize Removal of Invasive Trees and Shrubs

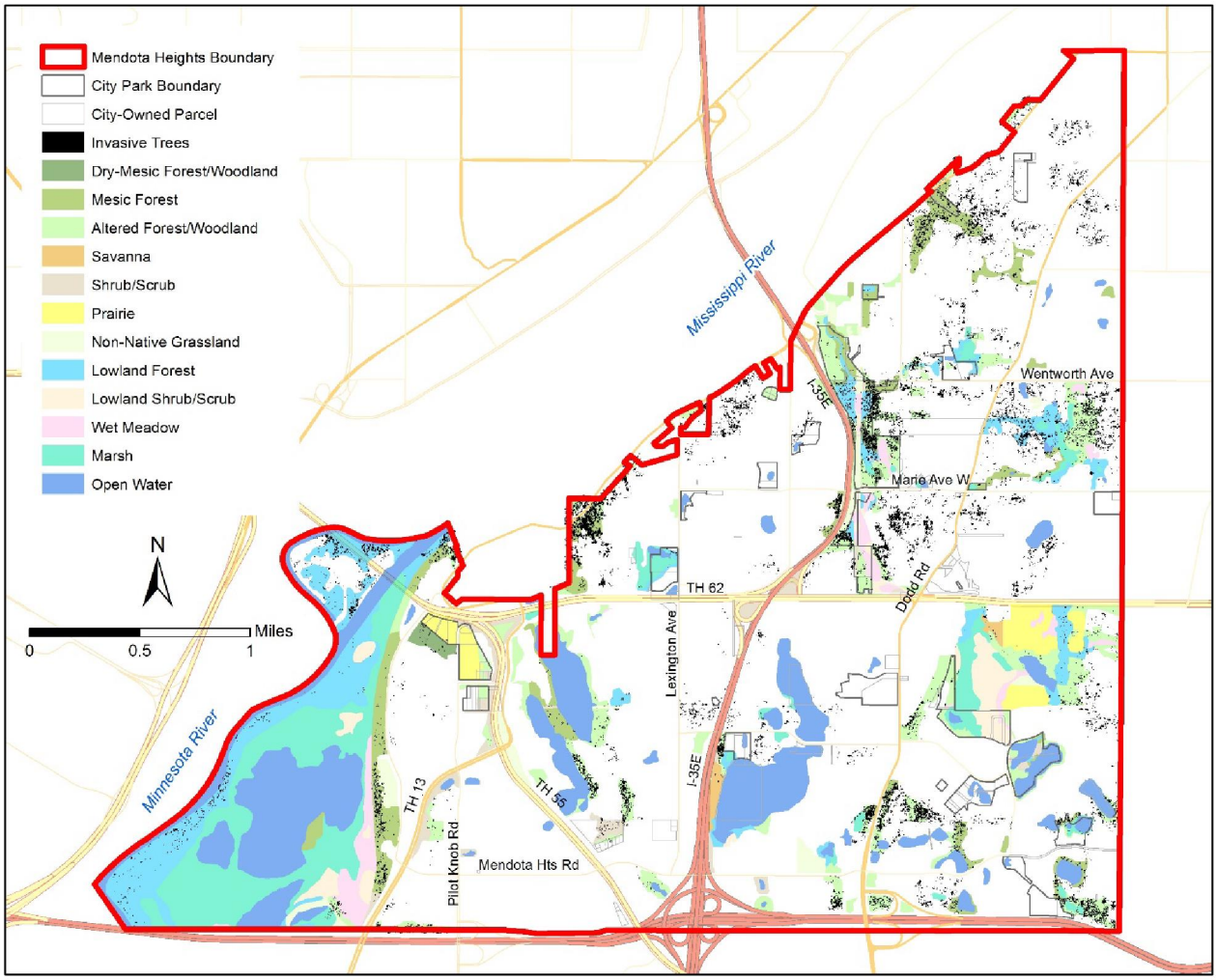
Siberian elm, Black locust, and Norway maple are invasive trees that together make up 11 percent of the City's tree canopy. White mulberry (*Morus alba*) is a recent invasive tree to the City (not detected in the tree canopy analysis). While these species and many others have been purposefully planted for a reason that was justified at the time, we now understand that the unintended consequence of planting these species has been the reduction in the integrity and resilience of natural areas and the overall landscape. Species diversity is greatly reduced wherever these species grow densely.

Common buckthorn was captured by the tree canopy analysis through field-mapping dense buckthorn stands and training the eCognition software. Buckthorn also grows densely under the canopy of forests but was invisible to the camera. Buckthorn under a tree canopy can only be mapped after leaves have dropped and while the buckthorn holds its leaves, usually in early November. About 12 acres of nearly pure buckthorn may exist in the City's forests, with no tree canopy overhead. These locations are the source of thousands of seeds spread each year by birds feasting on the dense buckthorn fruit. For that reason alone, buckthorn canopy areas should be targeted early in an overall buckthorn removal scheme.

The buckthorn-dominated canopy also presents a unique situation for devising an ecosystem management strategy. Should buckthorn in these areas be girdled to open the canopy, followed by a ground layer grass-sedge seeding to create a fuel source for subsequent prescribed burning? Should these areas be forestry mowed with large equipment and the buckthorn chipped on site?

Similar thinking can be applied to the dense Siberian elm and Black locust plantings (Figure 15). These can be targeted for thinning and underplanting with oaks, hickories, Big-toothed aspen, White pine, and other dominants of the Dry-Mesic Forest/Woodland where these two invasive tree species usually grow.

Figure 15. Concentrations of Invasive Trees and Shrubs in the City of Mendota Heights



Removing these invasive tree species from natural areas and parks is a top priority of the City. Removing these species from private lands and rights-of-way is another priority, especially when infestations are near natural areas and parks. Steps to accomplish this are as follows.

1. Identify concentrations of invasive trees and shrubs that occur on public land.
2. Assess concentrations for density and estimated acres of each invasive species.

3. Prioritize concentrations based on location in or near natural areas, the threat each species poses, and the size of the infestation.
4. Write prescriptions for removal of invasive trees and shrubs in priority areas, specific to those areas.
5. Fundraise, apply for grants, schedule, and implement.
6. Monitor results and adjust control techniques (i.e., practice adaptive management).

Planting Trees on Public Land

The chestnut blight, elm blight and the Emerald ash borer invasion—just a few of the many catastrophic tree loss episodes in North America over the last century—have taught foresters and urban planners that planting one or a few species across large areas is a recipe for civic disappointment on a vast scale. Around 1990, Dr. Frank Santamour, Research Geneticist at the National Arboretum, suggested the 10-20-30 rule—a municipality's urban tree canopy should consist of no more than ten percent of one species, twenty percent of one genus, and thirty percent of one family. Judged by this project's tree canopy mapping, Mendota Heights meets this rule of thumb, except for cottonwood which makes up a fifth of the City's tree canopy.

Tree canopy diversity is the best defense against devastating urban canopy loss but it just a rule of thumb and lacks nuance. For instance, at what scale should the rule be applied? Street tree and public space plantings? Private lands? All forests everywhere? The natural and semi-natural forest canopy of today is the product of several thousand years, recent land use, and invasive species introductions—ecosystems are complex, and a one-size-fits all rule is inadequate to manage natural and semi-natural forests and woodlands.

The 10-20-30 rule could be applied to plantings of street trees, around public buildings, and in the developed areas of parks. An ecosystem approach can be even more effective by mapping different sites along streets and on public lands that match the original ecosystems of Mendota Heights and planting by taking cues from species that comprise those ecosystems. Steps in this approach would do the following.

1. Identify the site conditions along City streets and on public lands.
2. In a simple scheme that has ecological validity and relevance to tree survival, one would describe site conditions using soil moisture and texture and slope-aspect position. This can be derived from existing LiDAR and soils data.
3. Assign native plant community types to match site conditions: Dry-mesic forest, Mesic forest, Lowland forest.
4. Develop a planting palette for each plant community type.
5. Implement plantings along streets and on public lands according to mapped site conditions.

Moreover, in an ecosystem approach to urban tree planting, one would mimic the structures that exist in those ecosystems—those structures also emerged from ecological-evolutionary context over centuries. These structures were tested and found adaptive over time despite catastrophes, past changes in climatic regimes, and the introduction of new species by Native Americans.

Most urban foresters tend to plant trees based on the final product—widely spaced trunks of one species whose crowns just overlap. This creates the uniform cathedral effect arching over front lawns, sidewalks,

and streets and so admired in American cities until the elm blight brought the cathedral crashing down in less than two decades. If ecologists had designed urban tree plantings, beginning in the late 1800s when landscape architects and foresters started paying close attention to this matter, tree plantings would have mimicked the forest structure in which forest trees (and most street trees are forest trees) evolved over centuries.

Taking cues from existing forest ecosystems, an ecologist-designed urban tree planting would have planted:

- trees closer together so that root systems become quickly entwined,
- the dominant tree species that matched local soil and moisture conditions,
- overstory and understory tree species together, and
- ground layer herbs and low shrubs, augmenting the soil fungal community that interacts with the tree root fungal community. In this way, urban tree plantings would place forest trees in a forest setting that bolsters the resilience and longevity of individual trees.

The usual way of planting urban trees makes every tree an island, isolated from the buffering influences of the rest of its ecosystem. Ideas of a much more interconnected forest ecosystem have emerged over the last three decades in research by Canadian forest ecologist Suzanne Simard and others and been popularized in books such as *The Hidden Life of Trees* by German forester Peter Wohlleben (2016).

The widespread practice in urban tree plantings creates a savanna structure (see top of Figure 16). With time, tree canopies and root systems may eventually touch, but the tree canopy and the soil fungal-bacterial community lacks diversity, and the warmer microclimate around each tree depletes soil moisture more quickly than if more vegetation were massed under the canopy in the form of understory trees and ground layer herbs and shrubs. Forest systems are several degrees cooler on hot days than savanna ecosystems and cooler yet than grassland ecosystems. For all these reasons, planting a single row of forest trees at the edge of a parking lot guarantees shorter lifespans, for which urban trees are well known.

For the City of Cambridge, Massachusetts' urban tree plan, RES proposed a hybrid approach to urban tree planting along streets and around public buildings (Figure 16). For aesthetic and safety reasons, true forest conditions cannot be replicated in urban settings. Landscape architects, responding to most people's preferences, devise plantings that are simple and uniform. Moreover, clear lines of sight give urban dwellers a sense of security, being able to see at a distance all around.

Figure 16. Vegetation Structure in Savanna, Forest and Hybrid Tree Planting Approaches

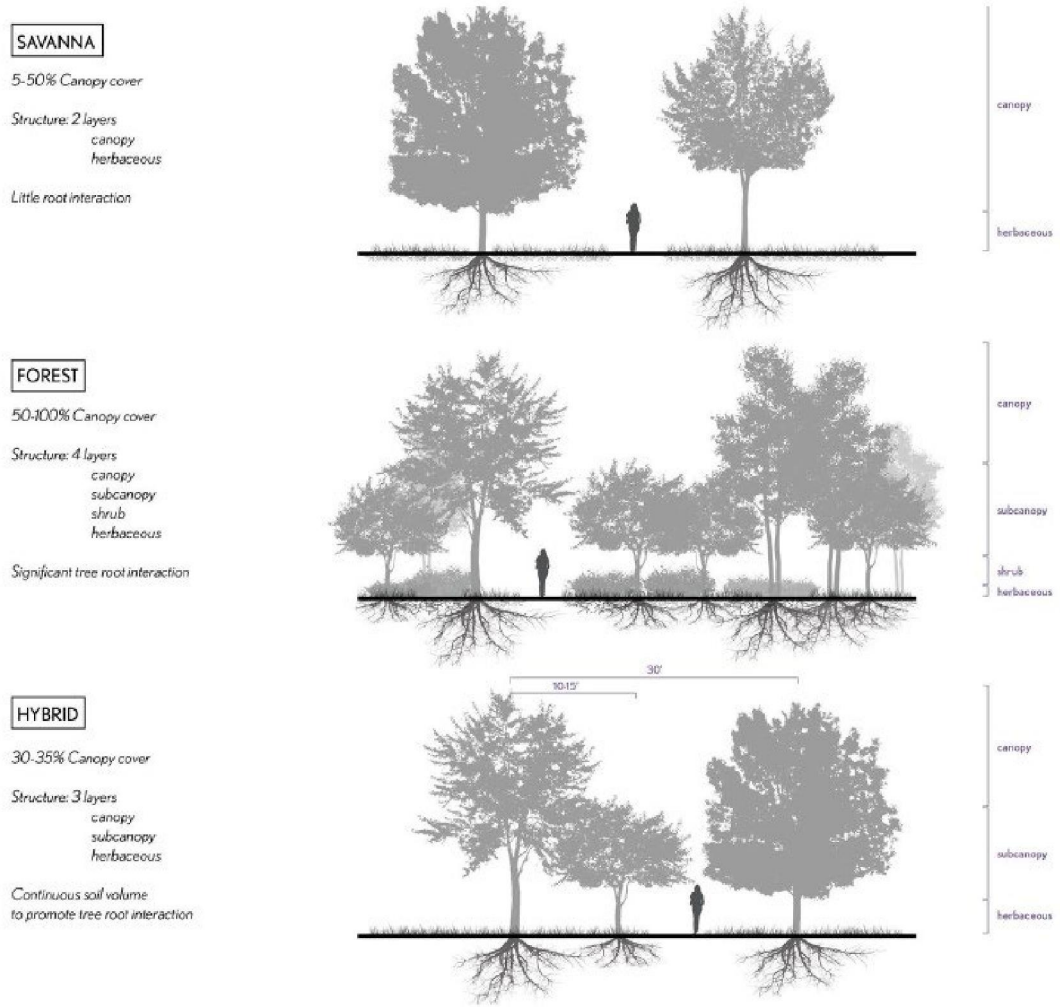


Figure concepts by RES; illustration by Reed Hilderbrand.

A hybrid planting approach

- plants a diverse array of dominant canopy trees that match local soil texture and moisture conditions,
- plants understory trees that will never reach the canopy but be tall enough to see beneath them,
- plants overstory and understory trees close enough for root interactions to quickly develop, and
- plants low herbaceous and (where appropriate) shrub species around trees to rapidly increase fungal root interactions among naturally co-occurring tree, shrub and herb species.

An ecosystem approach to urban tree planting does a better job of buffering trees against the inherently adverse urban setting compared to how trees usually are planted. But some trees at the south edge of their ranges will become weaker as their ecological tolerance for temperatures and drought fall outside

the boundaries of a new climate. Spruce, fir, birch, some pines, perhaps White cedar, and eventually Quaking aspen will be challenged to maintain growth rates and vigor with hotter summers and warmer winter nights, for instance. Lack of a snowpack and deeper frost layers in the soil will worsen this situation. To prepare for this inevitable change, foresters can stop planting these tree species and begin planting those already pushing northward—certain oaks and hickories and Ohio buckeye, to name a few (see Appendix C for a list of species to plant in a changing climate).

Planting Trees on Private & Semi-Public Land

As the majority of forests are not on City land, the City needs to think strategically about implementing ecosystem management on non-City lands. Low-hanging fruit should be picked first, starting by setting a good example on City land. Public Works, Parks, Planning, and Engineering together should agree on a unified, holistic, ecosystem approach to tree planting, tree removal, and tree management.

The City has another lever: promote good practice guidelines from its leader's bully pulpit and revise ordinances to promote the City's urban tree management guidelines. An urban forest management ordinance, a landscaping ordinance, or other requirements could be developed to help protect and enhance Mendota Heights' urban canopy on private and semi-public properties. Ordinances can only be used for activities the City has jurisdiction over—namely, new development approvals and existing agreements, such as with home-owner associations. It must be accepted that the political realities of revising ordinances will shift an ecological approach to something that is widely acceptable, implementable, and defensible. Section 2.2.14 of this Plan addresses RES' review of City ordinances and related recommendations related to urban tree management.

The next thing is to work with willing partners who own large acreages in the City. These include semi-public institutions like the school district, golf courses, cemeteries, and some businesses and institutions. With the City's unified urban forest management approach and clear guidance for implementing practices, the City will be in a good position to team up with willing partners and implement its urban tree management approach on non-City land.

Lastly, and most challenging, are to bring these ideas to the hundreds of small private landowners that control a significant percentage of tree canopy acres in the City. There is little in the way of ordinances or requirements that affect private landowners. The best motivation for most private landowners is to be given a low- or no-cost solution to a problem they want to fix. It is certainly possible to educate people about the need to control invasive shrubs on their lands, but most private landowners do not see a problem with a dense shrub layer that screens their property from a road or the neighbors—unless buckthorn is invading their lawn or the ground under their fruit trees. Likewise, having Black locust as the one tree shading their lot is fine—except for all the pods and leaf stems. In other words, success in bringing private landowners into the ecosystem management fold will come by identifying problems that the City can solve through technical advice and especially by paying for at least half of the implementation practice. In short, figure out what will work on private land beyond volunteerism and regulations—that means technical advice and cost-sharing.

2.2.5 Urban Heat Island

While not a dense, urban community like downtown St. Paul, the City of Mendota Heights nonetheless experiences "heat island effects" whereby buildings, roadways, and other artificial surfaces absorb and export heat, which increases local air temperature, lengthens the growing season, and even affects local weather patterns.

Different land cover surfaces absorb sunlight differently, and therefore emit or export different amounts of heat during the day and especially at night when air temperature falls below that in the daytime. Drawing from studies of heat export amounts from different land cover types (Herb et al. 2007), relative heat export ranks can be assigned to each land cover type in the City.

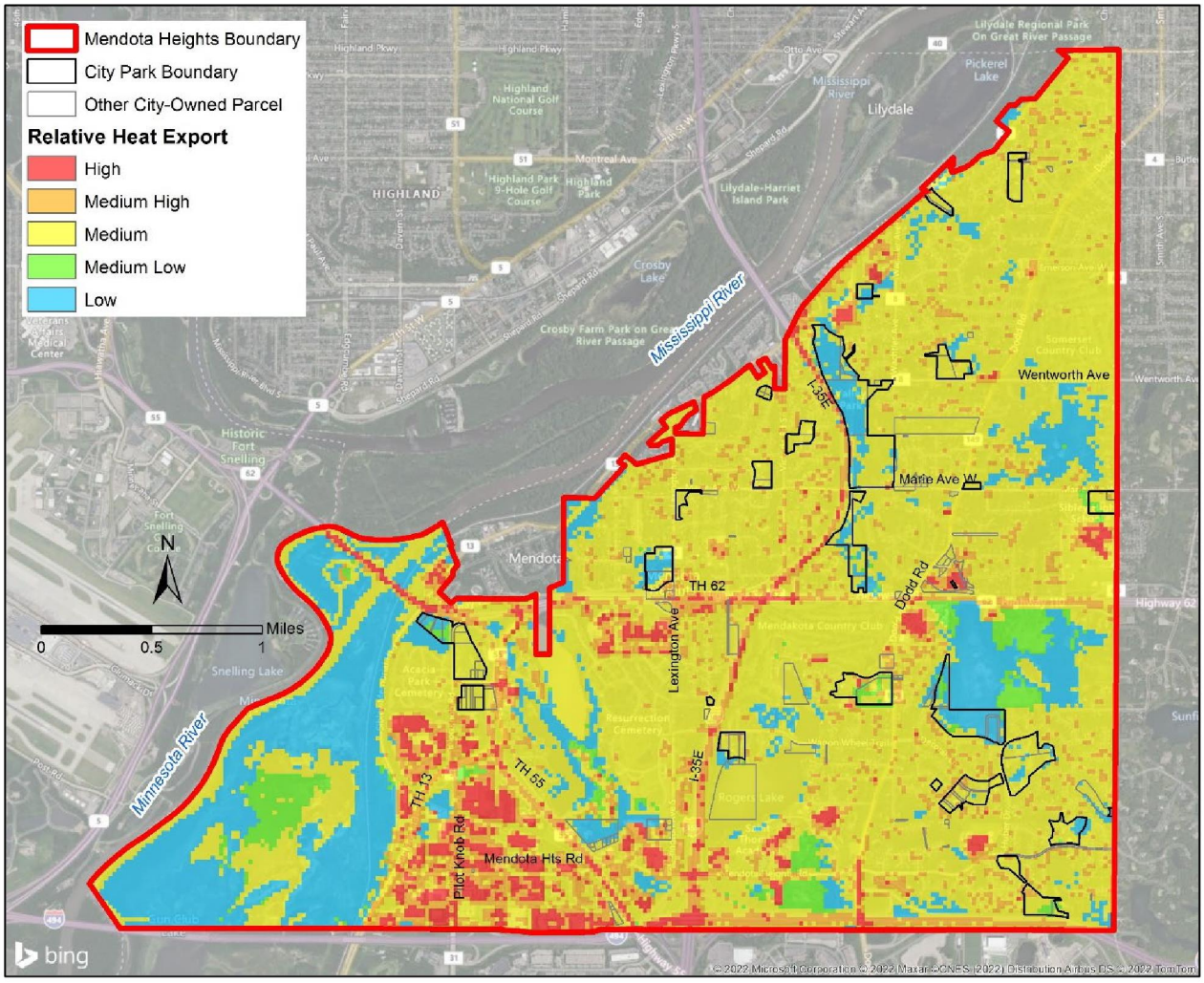
The National Land Cover Database (NLCD, Multi-Resolution Land Characteristics (MRLC) Consortium 2016) was used to map land cover types (Table 5). NLCD is a standardized land cover classification system for the United States.

Table 5. Relative Heat Export Rank of Different Land Cover Types

NLCD Land Cover Type	Heat Export Rank
Developed High Intensity	High
Developed Medium Intensity	Medium High
Barren Land	Medium High
Developed Low Intensity	Medium
Developed Open Space	Medium
Cultivated Crops	Medium
Open water	Medium
Hay/ Pasture	Medium Low
Herbaceous	Medium Low
Shrub/ Scrub	Medium Low
Deciduous Forest	Low
Evergreen Forest	Low
Woody Wetlands	Low
Emergent Herbaceous Wetlands	Low

The assignment of heat export ranks to NLCD land cover data can be visualized across the City (Figure 17). Areas most likely to experience the greatest heat island effect—buildings and pavement—are shown in red and orange. Not surprisingly, the City's industrial park between Highway 13 and Highway 55 is the City's most significant heat island. These areas would benefit the most from shading, more layering of perennial vegetation, and other strategies to reflect sunlight and reduce air temperature by shading. Strategies are discussed in Section 2.4. Ambient air temperatures are generally not elevated in forests, wetlands, and open water (green and blue). Much of the City is colored yellow—land cover types that export a moderate amount of heat. Adding tree canopy and vegetation layers in these areas would help mitigate the heat island effect, especially when positioned to shade roads, pavement, and flat-topped commercial, industrial, and institutional buildings.

Figure 17. Heat Island Hot Spots in Mendota Heights



2.2.6 Other Ecosystem Services

The urban heat island effect discussed above is directly related to ecosystem services. Red and orange areas in Figure 17 represent portions of the City that perform poorly with regard to the ecosystem service of "air temperature cooling." Blue and green areas perform this ecosystem service quite well. Yellow areas—most of the City—are intermediate in providing this ecosystem service due to the residential intermingling of streets, rooftops and lawns with shade trees. The land cover data used in the heat island analysis can also be used to estimate the level of other ecosystem services in the City. Appendix D provides figures and narratives regarding the service level provided by these additional ecosystem services:

- Air pollution removal
- Runoff pollution removal (focused on phosphorus)
- Runoff volume reduction
- Carbon sequestration

2.2.7 Water Resources

While not the focus of this NRMP, the City of Mendota Heights enjoys lakes, ponds, wetlands, and streams – as well as the Minnesota and Mississippi Rivers. Significant lakes include Rogers, Augusta, and Lemay. Significant creeks include Big Foot/Interstate Valley Creek (which flows through Valley Park) and Ivy Creek (which flows through Ivy Falls Ravine). These surface waters provide significant recreational value and amenities for City residents and the metro region, as well as aquatic habitat for many species of fish, amphibians, birds, and aquatic insects and clams.

The green-tinted waters of Augusta Lake speak to the need for watershed planning and BMP implementation.

The largely urban watersheds of the City generate excessive surface water runoff from roads, parking lots, roofs, and turf. This larger than natural volume of water and its associated "non-point source" pollution alters the normal pattern of water level variation, degrades water quality, erodes streambanks and shores, and causes flooding—all of which degrade aquatic, wetland, and lowland habitats.

Most of these water resources issues are best addressed at a watershed scale. While it is difficult for the City to influence watershed-scale impacts associated with the Minnesota and Mississippi Rivers, meaningful actions can be taken to address local sources of runoff and pollution, helping to protect the City's lakes, wetlands, and streams. Stormwater improvement projects are beyond the scope of this Plan, but there are many opportunities for partnering with water management organizations, institutions (e.g., schools, churches), homeowner associations, and private landowners to implement stormwater best management practices (BMPs) and better protect the City's wetlands and aquatic resources, if not improve them. Stormwater BMPs include natural buffers around water bodies, rain gardens, infiltration basins, and stormwater wetlands and ponds. The City's stormwater management ordinance (Title 14) and 2018 Land Disturbance Document (pages 10-12) provide BMPs that can be incorporated into road and other public improvement projects to meet specified performance standards. In addition, City ordinances could be augmented to require more stringent stormwater management practices.

The City is currently working with watershed management agencies, businesses, and residents to address stormwater management, including a future partnership with the Lower Mississippi River Watershed Management Organization (WMO) to stabilize and restore Big Foot/Interstate Valley Creek in Valley Park. The City could expand its coordination with existing lake associations (and facilitate the development of new associations) in order to increase the adoption of lakeshore buffers and the use of stormwater BMPs near lakes and other surface waters. Some of the public outreach opportunities listed in Section 4.1.6 address water resources, and there are additional opportunities for education and engagement in protecting these important aquatic habitats and amenities.

2.2.8 Invasive Plants

The City of Mendota Heights is no different than every other city in the United States regarding invasive plant species: their removal from natural areas is one of its primary management activities. Natural areas within the City have been dramatically and negatively affected by several invasive plant species.

Dense growth of invasive Garlic mustard carpeting the forest floor at Valley Park.

Invasive species often establish and thrive in disturbed habitats, usually crowding out native plants and animals. They 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 Mendota Heights' natural areas are:

- Siberian elm (*Ulmus pumila*)
- Black locust (*Robinia pseudoacacia*)
- Common buckthorn (*Rhamnus cathartica*)
- Non-native honeysuckles (*Lonicera tatarica, L. x bella*, etc.)
- Japanese knotweed (*Fallopia japonica* var. *japonica*)
- Narrow-leaved bittercress (*Cardamine impatiens*)
- Spotted knapweed (*Centaurea stoebe*)
- Leafy spurge (*Euphorbia virgata*)
- Japanese hedge parsley (*Torilis japonica*)
- Garlic mustard (*Alliaria petiolata*)
- Purple loosestrife (*Lythrum salicaria*)
- Invasive cattails (*Typha angustifolia*, *T. x glauca*)
- Reed canary grass (*Phalaris arundinacea*)

Even some native plant species such as Box elder (*Acer negundo*), Green ash (*Fraxinus pennsylvanica*), Eastern red cedar (*Juniperus virginiana*), and Western poison ivy (*Toxicodendron rydbergii*) can be invasive and aggressive in certain settings. The MNDNR has identified "early detection species," defined as those non-native, invasive species with limited distribution in Minnesota that are assessed as high risk. These species are:

- Tree of heaven (*Ailanthus altissima*)
- Brown, diffuse, and meadow knapweeds (*Centaurea jacea*, *C. diffusa*, and *C. x moncktonii*)
- Common and Cut-leaved teasel (*Dipsacus fullonum* and *D. laciniatus*)
- Dalmatian toadflax (*Linaria dalmatica*)
- Giant hogweed (*Heracleum mantegazzianum*)
- Grecian foxglove (*Digitalis lanata*)
- Narrowleaf bittercress (*Cardamine impatiens*)
- Yellow starthistle (*Centaurea solstitialis*)
- Black swallow-wort (*Cynanchum louiseae*)
- Japanese hops (*Humulus japonicus*)
- Oriental Bittersweet (*Celastrus orbiculatus*)

The City of Mendota Heights and its partners have actively managed invasive plants for years, but constant pressure from wind-blown and bird-dispersed seeds, persistent seed banks (i.e., weed seeds that germinate in the soil over long periods of time), and adjacent private properties harboring invasive plants creates the need for ongoing control efforts. Anecdotal observations suggest that little control of invasive plants occurs on private properties. The City uses the Early Detection and Distribution Mapping System (EDDMapS 2020) to track invasive plant populations within City parklands; however, this mapping is not systematically or consistently supported by the City. The City is a partner with adjacent communities in the Cooperative Weed Management Area (CWMA), which was established in 2021 and is led by the Dakota County Soil and Water Conservation District. The Xcel Energy powerline right-of-way corridor that traverses the City (including much of Valley Park) is a refuge and conduit for invasive plants moving into and throughout the landscape. Minnesota Department of Transportation and Dakota County rights-of-way also contain and facilitate the spread of invasive vegetation. Invasive plant control along this corridor is especially important where it abuts native plant communities.

Regular park and public right-of-way maintenance activities (e.g., mowing turf areas and roadsides) as well as ecological restoration and management activities may accidentally introduce or spread invasive species. Appendix E provides guidelines developed by the MNDNR to avoid the introduction or spread of invasive species during maintenance/management activities.

2.2.9 Invasive Animals

Invasive animals can also have adverse effects on natural areas. These species migrated into the region by accident or by intentional human transport and may exist on private properties adjacent to City natural areas. Some invasive animals 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 may affect the City's natural areas include:

- Emerald ash borer (EAB). Present in the City of Mendota Heights and anticipated to have 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 with the goal of creating a more

diverse tree canopy that will increase resiliency to disease and pests in the future. Removed ash trees warrant special handling to prevent spread of the borer.

- Gypsy moth. Not known to be present in Mendota Heights, but it 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.
- Invasive earthworms. Present in the City's forests, these invasive animals aggressively consume organic matter in the soil, altering soil structure and composition and compromising the health of the forest ground layer.

As mentioned above, regular park maintenance, as well as ecological restoration and management, may accidentally introduce or spread invasive species. Therefore, MNDNR guidelines (Appendix E) should be followed to avoid the introduction or spread of invasive species in the course of management throughout the City.

2.2.10 Diseases of Native Vegetation

Diseases can also have adverse effects on native vegetation, and in turn, natural areas. Sometimes these occur as natural components of an ecosystem, but as with invasive animals, others have migrated into the region by accident and may be harbored on private properties adjacent to City parkland. The main diseases that may affect Mendota Heights' natural areas include:

- Oak wilt. This often-lethal disease of oaks is caused by an invasive fungal pathogen (*Ceratocystis fagacearum*) that can travel between trees through root grafts and is spread by sap beetles. Present in the City (including at Hagstrom King Park), warranting special management of oak trees, especially species of the red oak group.
- Dutch elm disease. This often-lethal disease of native elms caused by an invasive fungal pathogen (*Ophiostoma novo-ulmi)* that can travel between trees through root grafts and is spread by elm bark beetles. This disease is also present in the City, warranting special management of native elm trees or the planting of disease-resistant varieties.

As mentioned above, regular park maintenance, as well as ecological restoration and management, may accidentally introduce or spread diseases and their vectors. Therefore, MNDNR guidelines (Appendix E) should be followed.

2.2.11 Wildlife

Wildlife surveys were not conducted for this NRMP. Based on available data (e.g., eBird), City staff, and the consultant team's familiarity with the park system, there appears to be a moderate variety and abundance of wildlife using the City's natural areas. However, many of these species are considered "generalists." Generalists persist and even thrive in cities, suburbs, farmland, and degraded natural areas. Generalists do not have narrow habitat and dietary needs that can only be satisfied by high quality or large natural areas; this allows them to build up large populations using resources inadvertently supplied by people. While not problems in themselves, an abundance of generalists indicates that natural areas are lower in quality, smaller, and more isolated than natural areas where generalists are not as common.

By contrast, "specialists" are species with specific needs, such as a particular habitat feature, preferred food, or conditions for raising offspring. (Species that need large areas are included here.) Specialists are less common than generalists, more often found in larger, higher quality habitats. They are more sensitive to environmental change and are often classified as Species of Greatest Conservation Need (see below). As natural areas are improved, connected, and shielded from the damaging effects of adjacent land uses, specialist species will appear and increase in abundance. Specialists are therefore a good indicator of the success of restoration and conservation efforts.

Typical Species by Habitat

Several dozen common wildlife species probably occur in the City's natural areas (Table 6). Many use several habitats, and many other bird species migrate through the City in spring and fall.

Table 6. Typical Wildlife in Mendota Heights' Natural Areas

Land Cover Type	Mammals	Birds	Reptiles & Amphibians	Other
Upland Communities - Forests/Woodland/Savanna				
Forest/Woodland	White-tailed deer, Raccoon, Opossum Red fox, Woodchuck, Gray squirrel, E. chipmunk	Warblers, Vireos, Black-capped chickadee, Woodpeckers, Owls, Cooper's hawk, Sharp-shinned hawk, Wild turkey, Blue jay, Northern cardinal	Garter snake, Tree frog	
Savanna/Brushland	Coyote, White-footed mouse, Short-tailed shrew	American robin, Brown thrasher, Field sparrow, Song sparrow, American crow, European starling, Gray catbird, Common grackle	Garter snake	
Upland Communities - Grassland				
Prairie	Woodchuck, Ground squirrel, Meadow vole, Red fox, Striped skunk, Eastern cottontail	American goldfinch, Dark-eyed junco, Flycatchers, Eastern bluebird, Indigo bunting, Red-tailed hawk	American toad, Garter snake	Monarch butterfly
Non-Native Grassland	Gray squirrel	Canada goose		Grasshoppers
Lowland Communities				
Lowland Forest & Shrub/Scrub	Raccoon	Bald eagle, Osprey	Tree frogs	
Wet Meadow & Marsh	Muskrat, Mink, Short-tailed weasel	Killdeer, Red-winged blackbird, Yellow warbler, Common yellowthroat	Leopard frog, W. chorus frog	Dragonflies, Damselflies
Open Water	Beaver, Otter	Belted kingfisher, Great blue heron, Swallows, Pied-billed grebe, Mallard, Wood duck, Blue-winged teal, Hooded merganser, Spotted sandpiper, Canada goose	Snapping turtle, Softshell turtle, W. painted turtle, Green frog	Sunfishes, Bass, Northern pike, Carp

More detailed observations of birds in Ramsey County (including numerous sites in Mendota Heights) can be found at eBird (https://ebird.org/hotspots?env.minX=-93.227189&env.minY=44.892371&env.maxX=-92.983802&env.maxY=45.125782&yr=all&m=).

Species of Greatest Conservation Need

Species of Greatest Conservation Need (SGCN) is a wildlife classification for regional conservation purposes; many of these species are classified as specialists, which are commonly found in higher quality or large core habitats. SGCN include state-listed species and non-listed species that are regionally rare or in decline, often as a result of habitat loss. While most are not yet endangered, they may become so in the future unless people become aware of and manage for them.

Minnesota's Wildlife Action Plan (MNDNR 2016) presents a statewide analysis of SGCN and wildlife conservation issues. The plan identifies 346 SGCN, many of which were formerly common species driven to rarity by land use changes during the past 150 years.

The City of Mendota Heights contains habitat used by many SGCN. Through implementation of this NRMP, these habitats could be restored, expanded, and better connected to benefit these species. Increases in SGCN over time will indicate that restoration and management efforts are succeeding.

Nuisance Wildlife

A variety of wildlife species in good numbers usually indicate that habitats are diverse and in good condition. However, large numbers of some animals can be considered a nuisance. For example, Canada geese, often abundant in turf grass areas near water bodies, add nutrients and bacteria in their droppings to surface waters. Rodents can present a health hazard for humans, especially where food is stored or prepared. Beaver dams can cause upstream flooding, and they may cut down trees that people value, including those in restoration plantings. On the other hand, rodents are the base of many food chains and beaver dams historically created wet meadow and marsh habitat, which is relatively uncommon in Mendota Heights.

Managing nuisance wildlife populations is the most common method to address these concerns. After determining that an animal species or an individual animal is a problem, then population control is likely the best path forward. This is most commonly accomplished by hunting or trapping, which must be conducted in compliance with wildlife management regulations under the U.S. Fish & Wildlife Service (for federally-protected wildlife species) and/or the MNDNR (state-listed animals and some additional species). Other management strategies focus on altering the habitat that attracts nuisance wildlife. For instance, fencing can reduce grazing and browsing by deer, or planting tall vegetation around water will discourage use by geese. Unpalatable plantings can also deter grazing. Plants such as Butterfly milkweed (*Asclepias tuberosa*), Columbine (*Aquilegia canadensis*), Prairie coreopsis (*Coreopsis palmata*), evening primrose (*Oenothera biennis*), native thistles (e.g., *Cirsium discolor*), beardtongues (e.g., *Penstemon digitalis*), purple coneflowers (e.g., *Echinacea angustifolia*), and Wild ginger (*Asarum canadense*) are generally avoided by deer. Native plants are generally less desirable and less of an attractant than ornamental plants. Lastly, creating suitable habitat for nuisance wildlife away from areas where they pose health, safety, and ecological challenges can reduce grazing impacts on native vegetation. Alfalfa fields,

for example, planted near forest and woodland can provide sustenance for deer and reduce their grazing on forest herbs in late winter and early spring, when highly nutritious vegetation is sparse.

2.2.12 Rare Natural Features

The rarest species in a region, state or nation speak to the vulnerability of some animal groups to extinction, such as freshwater mussels, and to the potential loss of unique members of the web of life. They are, moreover, bellwethers of humanity's effect on the natural world—diminishing as the scale of the human enterprise expands. For some animal and plant groups in the Midwest, up to half of that group's biodiversity is extinct or threatened with extinction. Rare species constitute a significant part of a region's biodiversity, without question.

It is valuable, therefore, to identify the rare species and habitats that exist or existed as this information can shape conservation priorities, projects, and strategies. Understanding the rare plants and animals in the City's natural areas can guide the siting and design of restoration projects to best protect and meet each species' particular needs. Several federal- and state-tracked rare and uncommon natural features exist, used to exist, or may exist in Mendota Heights. Some are protected by regulation; however, many are not formally protected, underscoring the importance of proactive and voluntary efforts to conserve biodiversity.

Federally-Tracked Natural Features

The U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) website is used to identify federally-tracked species in a project area. A query of IPaC (USFWS 2020a) indicated that four federally-listed species may potentially be affected by activities within the City of Mendota Heights (Table 7).

The Rusty patched bumble bee (federally-endangered) has been observed at multiple locations in the City of Mendota Heights. (photo source: USFWS)

Table 7. Federally-Listed Species Potentially Affected by Activities in City of Mendota Heights

Common & Scientific Name	Federal Status & Recovery Plan Status	Habitat	Presence in City of Mendota Heights	Potential for Positive Effect With City Action
Rusty patched bumble bee (*Bombus affinis*)	Endangered (Plan begun 2018)	Historically occupied grasslands and tallgrass prairies.	Confirmed.	Very high potential to improve habitat by expanding and improving prairies.
Northern long-eared bat (*Myotis septentrionalis*)	Threatened (Plan not started)	Roosts and forages in upland forests and woods; hibernates in caves and mines; autumn swarming occurs in surrounding wooded areas.	Possibly roosting and foraging in City's larger forests; a survey has not been done; hibernacula not known to occur in County.	After a survey to confirm presence, roosting and foraging habitat could be improved in quality and expanded.
Higgins eye mussel (*Lampsilis higginsii*)	Endangered (Plan approved)	Typically found in large rivers.	May exist in Mississippi River.	Very unlikely, given large watershed that affects species.
Prairie bush-clover (*Lespedeza leptostachya*)	Threatened (Plan began 1988)	Found only in the tallgrass prairie region.	May exist in prairie areas, but generally a southern MN species.	Potential to improve habitat by expanding and improving prairies.

Of the four federally-listed species, the Rusty patched bumble bee (endangered) is confirmed present in the City of Mendota Heights (including in City parkland), and Northern long-eared bat (threatened) may also use City parks and other natural areas. The endangered mussel species may occur in creeks and rivers that flow through Mendota Heights; however, the City has little influence over these species due to the large watersheds that affect these aquatic habitats. Prairie bush-clover generally grows farther south; no MNDNR records exist in or near the City, suggesting its presence is unlikely here. As RES did not conduct special surveys, other rare plants or wildlife could not be confirmed as present or absent in the City. Two of these species are most likely to be influenced by the City of Mendota Heights: Rusty patched bumble bee and Northern long-eared bat.

Rusty patched bumble bee. This federally-endangered insect's habitat requirements include food (nectar and pollen from flowers), nesting sites (underground and abandoned rodent cavities or clumps of grasses above ground), and overwintering sites for queens (undisturbed soil). This species has been identified at multiple locations in the City, and it may use additional restored prairies and other grasslands within the City. Impacts and threats to Rusty patched bumble bee are:

- Habitat loss and degradation, e.g. loss of native prairie
- Intensive farming and associated loss of crop diversity, hedgerows, and pastures
- Disease and pesticides
- Global climate change, which can lead to increased disease and loss of habitat elements at the critical time

Rusty patched bumble bee can be protected by:

- Removing/controlling invasive vegetation
- Installing diverse native flowering plants
- Preserving native landscape areas, where lack of mowing and soil disturbance will provide potential habitat
- Avoiding use of pesticides and chemical fertilizers

Northern long-eared bat. This federally-threatened mammal is a medium-sized bat with long ears that uses forested areas for summer roosting. Its range includes the entire Upper Midwest, including Minnesota. This bat species overwinters in caves and mines with constant temperatures, high humidity, and no air currents. This species may travel over 100 miles between summer and winter habitat, but journeys of 50 miles are more common. The Northern long-eared bat has shown a preference for upland forests but also may use lowland forests with mid-sized streams. These ecosystems are present in the City of Mendota Heights.

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, discussed below. 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. Impacts and threats to the Northern long-eared bat (and other bat species) are:

- White-nose syndrome, a severe and immediate threat to this and other cave-hibernating bat species. White-nose syndrome is a fungus that kills hibernating bats in North America. It is a major concern for bat conservation because it kills all or nearly all bats using overwintering caves, mines, and other “hibernacula.” It has spread rapidly across the U.S. since its discovery in New York state in 2006, and it has been confirmed in Dakota County (USFWS 2020b).
- Impacts to hibernacula where they spend the winter, such as access changes, microclimate changes, and human disturbances
- Loss or degradation of summer forest habitat and/or roost trees
- Wind farm operations (turbines can kill bats)

The Northern long-eared bat can be protected by:

- Not removing potential roost trees
- Not removing trees within 150 feet of a known roost tree when young bats are with mothers at the roost; this “non-volant pup” phase is June 1 through July 31

Other Rare Species and Habitats

In addition to federally-tracked listed species, the USFWS tracks critical habitats, migratory bird species of particular concern, wildlife refuges, and fish hatcheries. The IPaC report identified 20 migratory bird species of particular concern that potentially occur in the City of Mendota Heights (Table 8). No critical habitats, wildlife refuges, or fish hatcheries were identified in the City; however, the Minnesota Valley National Wildlife Refuge is located just southwest of Mendota Heights.

Table 8. Potential Migratory Bird Species of Concern in Mendota Heights (USFWS 2020a)

Common Name	Scientific Name	Level of Concern	Breeding Season
American bittern	*Botaurus lentiginosus*	BCC-BCR	Apr 1 to Aug 31
American golden-plover	*Pluvialis dominica*	BCC Rangewide (CON)	Breeds Elsewhere
Bald eagle	*Haliaeetus leucocephalus*	Non-BCC Vulnerable	Dec 1 to Aug 31
Black tern	*Chlidonias niger*	BCC-BCR	May 15 to Aug 20
Black-billed cuckoo	*Coccyzus erythropthalmus*	BCC Rangewide (CON)	May 15 to Oct 10
Bobolink	*Dolichonyx oryzivorus*	BCC Rangewide (CON)	May 20 to Jul 31
Cerulean warbler	*Dendroica cerulea*	BCC Rangewide (CON)	Apr 22 to Jul 20
Dunlin	*Calidris alpina arcticola*	BCC-BCR	Breeds Elsewhere
Golden eagle	*Aquila chrysaetos*	Non-BCC Vulnerable	Breeds Elsewhere
Golden-winged warbler	*Vermivora chrysoptera*	BCC Rangewide (CON)	May 1 to Jul 20
Least bittern	*Ixobrychus exilis*	BCC - BCR	Aug 16 to Oct 31
Lesser yellowlegs	*Tringa flavipes*	BCC Rangewide (CON)	Breeds Elsewhere
Long-eared owl	*Asio otus*	BCC Rangewide (CON)	Mar 1 to Jul 15
Red-head woodpecker	*Melanerpes erythrocephalus*	BCC Rangewide (CON)	May 10 to Sep 10
Ruddy turnstone	*Arenaria interpres morinella*	BCC-BCR	Breeds Elsewhere
Rusty blackbird	*Euphagus carolinus*	BCC Rangewide (CON)	Breeds Elsewhere
Semipalmated sandpiper	*Calidris pusilla*	BCC Rangewide (CON)	Breeds Elsewhere
Short-billed dowitcher	*Limnodromus griseus*	BCC Rangewide (CON)	Breeds Elsewhere
Willow flycatcher	*Empidonax traillii*	BCC-BCR	May 20 to Aug 31
Wood thrush	*Hylocichla mustelina*	BCC Rangewide (CON)	May 10 to Aug 31

BCC-BCR = Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

BCC Rangewide (CON) = Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska

The Bald Eagle was removed from the federal list of threatened and endangered species in 2007, but it is still protected under the Bald and Golden Eagle Protection Act of 1940. Bald eagles have been known to nest within the Mendota Heights' park system.

The Mississippi Flyway (located along the northwest edge of the City) is a globally-recognized migratory corridor used by over 325 bird species. The National Audubon Society has designated this area as an

Important Bird Area (IBA), highlighting the importance of conservation actions and the opportunity for impactful restoration projects along this important wildlife corridor along the City's northwest boundary.

State-Tracked Natural Features

The MNDNR's Natural Heritage Program uses the Natural Heritage Information System (NHIS) to track records of high quality and rare natural communities as well as rare plant and animal species, including those that are endangered, threatened, or of special concern. A review of NHIS data (MNDNR 2020) for the City of Mendota Heights and of a one-mile buffer around the City identified 75 rare natural feature records. These include four animal assemblages, 19 rare vertebrate records, 45 rare invertebrate records (mostly mussels), 5 rare plant records, and two rare ecological features (Table 9). Most of these records were documented outside of the City limits, and many of the rare species records are outdated, suggesting they may no longer exist in the City.

Table 9. State-Tracked Natural Features in and Near City of Mendota Heights (MNDNR 2020)

Natural Feature Type	Common Name	Scientific Name	State Status[1]	State Conservation Rank[2]	Global Conservation Rank[3]	Last Observed (year)	No. Of Occurrences in City[4]
Animal Assemblage	Bat Colony	Bat Concentration	N/A	SNR	GNR	2011	2
	Freshwater Mussel Concentration Area	N/A	N/A	SNR	G3	1989	2
Vertebrate Animal	American eel	*Anguilla rostrata*	SPC	S3	G4	2013	1
	Blue sucker	*Cycleptus elongatus*	SPC	S3	G3	2014	2
	Blanding's turtle	*Emydoidea blandingii*	THR	S2	G4	2000	4
	Peregrine falcon	*Falco peregrinus*	SPC	S3B	G4	2011	2
	Pallid shiner	*Hybopsis amnis*	END	S1	G4	1926	1
	Loggerhead shrike	*Lanius ludovicianus*	END	S1B	G4	1994	1
	Northern long-eared bat	*Myotis septentrionalis*	SPC	S3	G1	1985	1
	Mudpuppy	*Necturus maculosus*	SPC	S3	G5	2016	1
	Pugnose shiner	*Notropis anogenus*	THR	S2	G3	1890	1
	Louisiana waterthrush	*Parkesia motacilla*	SPC	S3B	G5	1999	1
	Paddlefish	*Polyodon spathula*	THR	S2	G4	2012	1
	Bell's vireo	*Vireo bellii*	SPC	S3B	G5	2011	3
Invertebrate Animal	Mucket	*Actinonaias ligamentina*	THR	S2	G5	2007	3
	Elktoe	*Alasmidonta marginata*	THR	S2	G4	2001	1
	Rock pocketbook	*Arcidens confragosus*	END	S1	G4	2006	2
	Rusty-patched bumble bee	*Bombus affinis*	Watchlist	SNR	G2	2018[5]	11
	Purple wartyback	*Cyclonaias tuberculata*	END	S1	G5	2001	2
	Butterfly mussel	*Ellipsaria lineolata*	THR	S2	G4	2005	1
	Elephant-ear	Elliptio crassidens	END	S1	G5	2007	1
	Spike	*Eurynia dilatata*	THR	S2	G5	2002	4
	A jumping spider	*Habronattus viridipes*	SPC	S3	GNR	1987	1
	Higgins eye mussel	*Lampsilis higginsii*	END	S1	G1	2002	1
	Yellow sandshell mussel	*Lampsilis teres*	END	S1	G5	1989	1
	Scaleshell	*Leptodea leptodon*	Watchlist	SX	G1	1820 - Pre	1

Natural Feature Type	Common Name	Scientific Name	State Status[1]	State Conservation Rank[2]	Global Conservation Rank[3]	Last Observed (year)	No. Of Occurrences in City[4]
	Black sandshell	*Ligumia recta*	SPC	S3	G4	2007	5
	Sheepnose	*Plethobasus cyphyus*	END	S1	G3	2001	1
	Round pigtoe	*Pleurobema sintoxia*	SPC	S3	G4	2001	1
	Winged mapleleaf	*Quadrula fragosa*	END	S1	G1	2001	1
	Wartyback	*Quadrula nodulata*	THR	S2	G4	2007	1
	Ebonyshell	*Reginaia ebenus*	END	S1	G4	2001	1
	Leadplant flower moth	*Schinia lucens*	SPC	S3	G4	1940	1
	Monkeyface	*Theliderma metanevra*	THR	S2	G4	2001	3
	Pistolgrip	*Tritogonia verrucosa*	END	S1	G4	2003	1
	Fawnsfoot	*Truncilla donaciformis*	THR	S2	G5	2010	1
Vascular Plant	Sterile sedge	*Carex sterilis*	THR	S2	G4	1982	1
	Small white lady's slipper	*Cypripedium candidum*	SPC	S3	G4	1993	2
	Kentucky coffee tree	*Gymnocladus dioica*	SPC	S3	G5	2006	1
	Edible valerian	*Valeriana edulis var. ciliata*	THR	S2	T3	1982	1
Other (Ecological)	Fossil invertebrate (Ordovician)	N/A		SNR	GNR	1978	1
	Proglacial river composite (quaternary)	N/A		SNR	GNR	1972	1
Total Rare Natural Features in City and 1-Mile Perimeter Search Area							***75***

N/A = Not Applicable

[1] State Status: THR=Threatened; SPC=Special Concern; END=Endangered; Watchlist=on state watch list

[2] State Rank: State Conservation Status Ranks (MNDNR 2009): S1 = critically imperiled; S2 = imperiled; S3 = vulnerable to extirpation; S4 = apparently secure, uncommon but not rare; and S5 = secure, common, widespread, and abundant; SNR = Not Ranked; B = breeding conservation status

[3] Global Conservation Status Rank (NatureServe 2020): G1 = Critically Imperiled; G2 = Imperiled; G3 = Vulnerable; G4 = Apparently Secure; G5 = Secure; T = Infraspecific Taxon followed by number representative of "G#" rank; GNR = Not Ranked; TNR - Infraspecific Taxon Not Ranked

[4] Search area included the City of Mendota Heights plus a 1-mile buffer around the City.

[5] Observed in 2019 and 2020 by citizen scientists through Bumble Bee Watch (https://www.bumblebeewatch.org/).

As indicated in Table 9, many of the listed species have not been recorded in the City for many years, and others are likely in jeopardy of being lost. When rare animal species are involved, the greatest conservation gains often are achieved by protecting and managing large natural areas. These are referred to as *core habitats* and are important to many sensitive wildlife species, depending on the animal group. Insects, small mammals, reptiles and amphibians are more likely to find habitat for breeding in the smaller core habitats, while larger mammals and many species of sensitive birds require larger ones. Enlarging, buffering, and connecting core habitats are strategies in rare species conservation, discussed in Section 3.3.1.

2.2.13 City of Mendota Heights Natural Resources & Volunteer Program

In order to better understand the City of Mendota Heights' existing Natural Resources Program, AES interviewed Krista Spreiter (Natural Resources Coordinator) and members of the Steering Committee (Cindy Johnson, Susan Light, Will Stein, and Les Pilgrim). In brief, the City's Natural Resources Program requires additional staffing and funds to meet the natural resource management need. Currently there is no organized volunteer program, however the City is in the process of creating a volunteer program to aid all departments including Natural Resources. Other attributes of the program follow, and more detailed notes from the interviews are provided in Appendix B.

- The Natural Resources Coordinator is sole natural resources staff with assistance from parks and utilities department staff
- Forestry and stormwater management are the main focus
- 14 past, ongoing, and planned restoration projects; however, many are small
- Additional designated program space is needed for storage and gathering
- Significant unmet equipment needs for in-house and volunteer work
- Volunteers are leveraged to implement a natural resources management program. The addition of a Volunteer Coordinator would better utilize volunteer resources
- Recruiting and retaining quality volunteers is a challenge

In summary, to achieve the City's conservation goals, its Natural Resources Program and volunteer program will require additional resources. This Plan will help identify the Program's most needed resources. These may include additional City staff, increased City budget allocation, more external funds from sources such as grants, and increased partner collaborations.

2.2.14 City of Mendota Heights Ordinance Review

City ordinances apply to natural resources management activities. Ordinances may require, allow, or prohibit certain conservation actions. The City of Mendota Heights recognizes the importance of natural resources-related ordinances and aligning them with the City's conservation goals.

Through discussions with City staff, tree protection was identified as a significant priority that warranted development of a new City ordinance. RES reviewed tree protection ordinances from several other cities and prepared the following draft documents for Mendota Heights:

- Urban Forest Management Ordinance
- Tree Standards (referenced by the Urban Forest Management Ordinance)

- Forest Alteration Permit Application (referenced by the Urban Forest Management Ordinance)

In addition to drafting an Urban Forest Management Ordinance (and supporting documents), RES conducted a review of select existing City of Mendota Heights' ordinances that relate to natural resources. Reviewed City ordinances were:

- Weeds; Noxious Vegetation (proposed title "Non-Forest Vegetation Management")
- Subdivision Regulations
- Wetland Systems (proposed title "Surface Water Management")

Under separate cover, the City was provided with a RES' ordinance development and review approach, a draft Urban Forest Management Ordinance (with the two supporting documents listed above), and red-line edits recommended for the three existing City of Mendota Heights' ordinances listed above.

2.3 Summary of Findings

This section summarizes the results of our inventory, assessment, and analysis of the City of Mendota Heights' natural resources and its existing Natural Resources and volunteer program.

2.3.1 General Conditions

- The City of Mendota Heights has a diversity of natural areas.
- Fort Snelling State Park and Dodge Nature Preserve represent the largest and highest quality natural areas in the City. These areas are not managed by the City of Mendota Heights.
- Mendota Heights' tributaries and location along the Minnesota and Mississippi Rivers provide ecological connectivity between natural areas both in and outside the City. However, most of the corridors in the City are narrow and fragmented by roads and development.
- Historical land uses (e.g., grading/filling/dumping, cropping, grazing) and invasive species have compromised all of the City's natural areas, necessitating strategic intervention and long-term management if these natural resources and their ecosystem services are to be restored and sustained.

2.3.2 Vegetation

- The native forests, savannas, and prairies that once dominated the region are now rare. Mendota Heights' largest natural areas include the Minnesota River backwaters (over 750 acres), Dodge Nature Preserve (approximately 180 aces), and Valley Park (approximately 132 acres). The City's remaining natural areas are few, narrow or small, and scattered patches.
- Given the City's historical vegetation and sustainability goals, natural areas should be managed as diverse native landscapes that include forests, savannas, prairies, and wetlands.
- Invasive plants are one of the greatest threats to the City's plant communities and wildlife because they displace native plants, especially in the ground layer, which leads to less pollinator nectar and pollen, lower fruit and seed production, reduction in native tree regeneration in forests, and soil erosion on slopes.

- Lack of regular natural disturbances, in particular fire, for many decades has significantly reduced the area of former prairie and savanna where those habitats had escaped destruction.
- While limited in a dense urban area, opportunities exist to increase the size and improve the quality of plant communities through restoration and management. There are also opportunities for ecological buffers and improved connectivity among natural areas.
- Four state-listed plant species have been recorded in the City; however, most of these records are over 25 years old and the most recent observation of naturally-occurring Kentucky coffee tree was in 2006.

2.3.3 Wildlife

- Turf, roads, parking lots, and buildings have reduced the size of contiguous natural areas, shrinking and fragmenting wildlife habitat.
- The most abundant wildlife species in the City appear to be generalists (i.e., adapted to human-altered landscapes), based on field assessment and consultation with City staff.
- The City of Mendota Heights supports or has the potential, with restoration, to support core habitat for a range of forest, woodland, savanna, prairie, and wetland wildlife, potentially including Species of Greatest Conservation Need in the largest habitats.
- Federally-listed and state-listed animals (including multiple records of the federally-endangered Rusty patched bumble bee) have been recorded in the City.

2.3.4 City of Mendota Heights Natural Resources and Volunteer Program

- One City employee is dedicated to the management of Mendota Heights' natural resources.
- Limited support and equipment is provided by other City departments.
- Use of volunteers is limited due to insufficient resources for recruitment, organizing, and oversight.

2.4 Challenges & Opportunities

This section identifies some of the challenges and opportunities presented by the City's natural resources, as well as potential approaches to meet those challenges. Potential approaches are offered here to give a flavor of what will be selected and refined in the implementation program in Phase 2 of this project.

Challenge: Invasive vegetation

- Invasive plants are one of the greatest threats to the ecological integrity of the City's natural areas. Removal and control of invasive vegetation often takes a concerted effort followed by long-term monitoring and management.

Opportunity: Control invasive vegetation

- This NRMP provides a foundation for strategic prioritization of ecological restoration and management, including the control of invasive vegetation. Through increased funding, partnerships, and volunteer engagement, the City can address this critical need, significantly improving the ecological quality of its natural areas.

Potential Approaches

- Increase public awareness of invasive plants through education and outreach (e.g., City website and publications).
- City and partners remove and control invasive species on public land.
- If currently practiced by the City, cease planting invasive species on public land.
- Develop or revise City ordinances to prohibit planting of invasive species (e.g., Amur maple, barberry) on private land.
- Collaborate with landowners adjacent to City natural areas to make invasive vegetation removal more efficient and reduce long-term management costs.
- Provide cost-share or other incentives for private land owners to replace invasive vegetation with native species.
- Provide City-sponsored hauling of cut buckthorn to increase participation.
- Sponsor volunteer invasive plant removal events such as a "buckthorn bust".

Challenge: Climate change

- Climate change presents its own suite of challenges. Predictions for the Twin Cities region suggest warmer temperatures (especially during winter), which is contributing to changes in species distribution and new invasions by invasive plants and pests from the south. The prediction of more severe storms suggests greater potential for flooding and erosion, especially along already unstable streams such as Big Foot/Interstate Valley Creek.

Opportunity: Increase climate resilience

- While the City has little control over the climate, it can plan and manage its natural resources for greater resilience despite predicted changes in temperature and precipitation.
- Tree canopy protection and augmentation can help mitigate localized heat islands, discussed above.
- There are many additional climate resilience and adaptation strategies beyond the scope of this project (see the City's 2040 Comprehensive Plan).

Potential Approaches

- Adopt an urban forest management ordinance to help conserve the City's valued tree canopy.
- Develop and implement a plan so that Mendota Heights qualifies as a "Tree City USA" (https://www.arborday.org/programs/treecityusa/).
- Develop a strategic City tree planting plan to identify appropriate species (including climate-resilient tree species, Appendix C), diversity goals, location and timing of plantings, etc. Tree plantings for heat mitigation should be prioritized within identified heat islands (Figure 17) and anywhere that canopies will shade artificial, heat-exporting surfaces such as roadways, parking lots, and buildings.
- Provide cost-share or other incentives for private land owners to plant (preferably native) shade trees. Tree plantings can be done on private land or public land if proper approvals are received, and maintenance commitments may be instituted by the City.
- Additional climate resilience and adaptation strategies focused on natural areas management are discussed in Section 3.3.2.

Challenge: Private lands

- The majority of Mendota Heights is private land. Multiple ownerships make landscape-scale conservation challenging, including the systematic and contiguous control of invasive vegetation, which readily crosses property lines.

Opportunity: Partner with private landowners

- The City is well positioned to work with its partners and private landowners within the City to more effectively and efficiently achieve its natural resources goals. Some private land opportunities are discussed above under the invasive vegetation and climate change challenges.

Potential Approaches

- Identify opportunities to convert large expanses of turf that are not regularly used for recreation (e.g., sports) to prairie or other low maintenance native habitat, increasing ecosystem services on the private land and for the greater community.
- Identify and work with large private landowners (e.g., golf courses, cemeteries, and other private open space) to advance larger-scale conservation initiatives (e.g., greenways, wildlife corridors).
- Develop and apply City cost share programs, residential buckthorn pick-ups, conservation development and native landscaping ordinances and/or incentives, conservation easements (such as exist adjacent to Lemay and Augusta Lakes), and other tools to achieve conservation goals through public-private partnerships.
- GreenStep Cities (https://greenstep.pca.state.mn.us/page/ordinances) has a variety of model ordinances and performance standards that can be adopted or customized for increasing the conservation value of private lands in the City of Mendota Heights.

Challenge: Rights-of-way (ROW)

- These linear strips of land (including public ROW along roadsides and private ROW, such as Xcel Energy's ROW through Valley Park) often harbor invasive vegetation and provide a conduit for dispersal of their seeds over large areas.

Opportunity: Restore/manage Rights-of-way (ROW) as natural resources

- Most ROW have restrictions on allowable vegetation and management techniques. However, most ROW can be restored to native plant communities and/or managed to reduce adverse impacts on adjacent natural areas. Such conversions to native vegetation increases wildlife habitat acreage and quality as well as improves ecological connectivity along these linear corridors and between natural areas. A portion of the Xcel Energy ROW through Valley Park is currently being restored to native, pollinator habitat, through a partnership with Xcel Energy, Great River Greening, and the Clean Water Land and Legacy Amendment.

Potential Approaches

- Collaborate with Mn/DOT and Dakota County Highway Department to bring conservation benefits to road ROW in the City.

Challenge: Urban stormwater runoff

- The City's development density (including rooftops, roadways, parking lots, etc.) results in significant stormwater runoff from impervious surfaces. For example, one inch of rainfall on a 1,000 square foot roof will yield approximately 600 gallons of runoff (Minnesota Pollution Control Agency 2017). This results in polluted, high-energy, erosive flows that cause flooding and degrade streams, wetlands, and other downstream waterbodies.

Opportunity: Better manage stormwater

- While not a focus of this NRMP, there are many stormwater best management practices (BMPs) that can help reduce the adverse impacts of runoff. Many of these will require or benefit from partnering with private landowners.

Potential Approaches

- Complete watershed plans for the City's watersheds. Watershed plans will identify, describe, and estimate costs for construction of stormwater best management practices (BMPs) at specific locations that will reduce damage to downstream water bodies from excessive and polluted runoff.
- Work with public works to identify upcoming road projects at locations where stormwater detention will reduce downstream runoff volume. Incorporate these stormwater management projects in road project planning and capital budgeting.
- Secure easements on private lands to implement stormwater BMPs identified in watershed plans
- Implement stormwater BMPs (e.g., rain gardens) on public lands (such as at parks) as demonstration projects.
- Provide cost-share or other incentives to encourage stormwater BMPs on private lands, including industrial, commercial, and residential lots.

Challenge: Incompatible park uses

- Parks provide a variety of functions for the residents of Mendota Heights, but some park uses (e.g., mountain bike trails) are not compatible with other park goals (e.g., nature preservation).

Opportunity: Define park uses

- Per the City's Comprehensive Plan (2019), each City park has been classified as either Neighborhood Park, Community Park, or Natural Resource Area. While general uses are associated with each classification, there is the potential (and a history of) inappropriate uses by the public (e.g., construction of mountain biking trails in City natural areas).

Potential Approaches

- Define goals, acceptable uses, and management practices appropriate for each park classification. Provide signage and/or educational information to inform residents of appropriate activities in park natural areas, and provide annual or regular monitoring to ensure inappropriate uses are identified and addressed promptly.

Challenge: Limited resources

- The City currently has limited resources (e.g., financial, staff, volunteers) dedicated to its natural resources.

Opportunity: Increase resources

- Through increased budgets, staffing, volunteer support, and partnerships, the City will be much better equipped to meet its natural resource goals.

Potential Approaches

- Increase annual budget for City's natural resources program. This should entail additional funds for implementing new restoration projects as well as funds for long-term management of areas previously restored or enhanced.
- Expand City staffing and volunteer support of the natural resources program, including securing a single, large space to store equipment and deploy crews and volunteers.
- Continue to collaborate with Dakota County, Great River Greening, and other partners and identify new partners to advance the natural resources program.
- Continue pursuing grants to fund restoration and management projects (addressed in Section 4.3.9).
- Create an "Adopt-A-Park" program whereby nearby residents are recruited to use the Management Brief and other park-specific information and implement environmental stewardship projects.
- Assign Parks and Recreation Commissioners one or multiple parks to work with neighborhood volunteers to develop and implement volunteer action plans based on guidance in Management Briefs and other information.

3. MANAGEMENT & CONSERVATION

3.1 Ecosystem Change: Past, Present & Future

3.1.1 What Use is an Ecosystem Change Model?

Ecosystem models are useful planning tools, which consider past conditions, influences over time, projected future conditions, and implications for ecological restoration and management. Elements of an ecosystem model include plant species composition and structure, associated wildlife, natural disturbance regimes, plant successional pathways, responses to human use, and predicted future conditions given different restoration and management activities as well as environmental changes (e.g., increasing temperature and rainfall). Most of these conditions are represented by, or reflective of, an area's plant communities.

Without regular disturbances, plant communities lose species and become less resilient (i.e., less able to change as environmental conditions change). Conserving biodiversity depends on retaining plant species and thus making plant communities more resilient. By restoring native ecosystems and establishing a sustainable management regime (including disturbances such as prescribed fire), program goals can be achieved.

Wildlife species also respond to plant community biodiversity, persisting or disappearing as plant communities change. Numbers of pollinators, for example, rise and fall with the amount of flowering plants present and timing of flowering. Where few plants flower from April through October, few pollinators find sufficient nectar and pollen to sustain populations. Even with disturbances that sustain them, healthy ecosystems can adapt when overwhelming change happens, such as the loss of species due to a northward shift in species ranges (e.g., see Chen et al. 2011). On the other hand, when new plants migrate into a plant community that is losing species, resilience may be improved. Mendota Heights contains a variety of plant communities, which may allow plant species to move within and between parks and other natural areas. However, the suburban context and fragmented nature of the City's natural areas inhibits such migrations.

Understanding the Past Helps Plan a Better Future for Ecosystems

Before 1850 the ecosystems of Mendota Heights experienced major disturbances—fire, tornado, herds of grazing animals, floods—without losing biodiversity or eroding ecosystem services. Soils continued to build, trees and other plants easily regenerated themselves, game and fish were plentiful, streams and lakes were crystal clear, and the prairies, savannas and woods were full of wildflowers, with over ten species of insects for each species of plant. All that has changed due to three factors:

- Land use that altered the structure, composition, and processes of ecosystems
- Invasive species, pests & diseases that combined with incompatible land use to change composition and biodiversity
- Climate that shaped ecosystems, but which for 200 years has been changing, with more dramatic changes predicted by 2050 and beyond.

One cannot successfully plan land management without knowing this story.

The ecosystem model developed for the City of Mendota Heights considers the distant past, conditions in the recent past and current time, and predicted future scenarios considering disturbance regimes and other factors that influence the plants and animals in the City. This determines the general restoration approach and the long-term management needed to replace natural disturbances that formerly maintained the region's biodiversity, stabilized soils and slopes, and allowed for plants and animals to gradually change as the environment changed—ensuring resilience despite future changes.

3.1.2 Drivers of Change

Land Use

The most influential driver of ecosystem change is land use. It is apparent when natural ecosystems are affected directly by conversion from natural to cultural (e.g., developed) landscapes, such as converting a savanna or prairie to homes and roads. However, less apparent are the ecosystem changes that arise from land use changes nearby, or even some distance, from natural areas. Cultural land uses near natural areas contribute to increased pressure by invasive species as well as some pests and diseases (discussed in Section 2.2.8 through 2.2.10). Additional adverse "edge effects" are discussed further in Section 3.3.1. Land uses can also affect distant natural areas. For example, development in the upper portion of a watershed can have significant adverse impacts on downstream natural systems – sometimes many miles away. Land use practices in western, central, and north-central Minnesota affect the Minnesota and Mississippi Rivers. Wildlife species that require large blocks of "core habitat" (discussed in Section 3.3.1) or multiple habitat types to complete their life cycles will disappear from landscapes where land use changes compromise these requirements.

Invasive Species, Pests & Diseases

Invasive species (introduced in Sections 2.2.8 and 2.2.9) are also important drivers of change. They alter the *composition* of plant communities, often reducing native species diversity of both plants and animals. Invasive plants and animals can affect the physical *structure* of plant communities; for instance, aggressive shrubs invade forests, crowding the shrub layer, greatly increasing shade in the ground story, and resulting in the loss of herbaceous vegetation. Ecosystem *functions* are also affected by invasive species, most notably by decreased wildlife habitat quality due to decreased native plant diversity. Another example of functional loss is when deep-rooted, soil-anchoring native vegetation is replaced by turf grass. The turf's shallow root system leaves the ground more susceptible to erosion, often apparent along lakeshores and stream banks.

Natural areas can also be affected by a variety of pests and diseases. Some of these occur as natural components of an ecosystem, but others have migrated into the region by accident (including spread by invasive animals), or by intentional human transport. The main invasive animals, pests, and diseases that currently affect and may affect the City's natural areas in the future (discussed in Section 2.2.9 and 2.2.10) include:

- Emerald ash borer
- Gypsy moth
- Invasive earthworms (including jumping worms)
- Oak wilt
- Dutch elm disease

Climate

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 during the winter and overnight) 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 throughout ecosystems (Staudinger, et al. 2012).

The Wildlife Action Plan states with high confidence that climate change in Minnesota will result in reduced frost season, longer growing season, earlier 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 ones 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 sprawl. 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 increased predation on wildlife, the spread of invasive species, and competition from other native species that prefer forest edge.
>
> ***Prairies & Grasslands.*** The relatively small size of prairies and their isolation increase their vulnerability to climate change. Isolated, low-diversity mesic and wet prairie communities are the most vulnerable. Wet prairies and meadows will be reduced in extent, and some rare wet-prairie species will likely be lost. In some cases, intensive management, such as prescribed burns, conservation grazing with a focus on system resilience, and seeding mixtures that reflect a changing climate may be necessary to maintain existing prairies or restore prairies.

3.1.3 Model of Ecosystem Change

Ecosystems change over time as a result of natural processes and human interactions. Creating a model of such change can be instructive for understanding environmental conditions of the past, present, and the future, and in recognizing the impact that management can have on such ecosystems.

Past (before mid-1800s)

Frederic Remington's painting, "The Grass Fire" (1908).

The City of Mendota Heights historically experienced regular fires. While lightning can start natural wildfires, fires in the region were often ignited intentionally by Native Americans to clear woodlands and brush, open up land for cultivation, create habitat for game species as well as berry and nut-producing plants, and clear sight-lines for self-defense and security. These fires are documented to have occurred every one to three years in the region's larger open landscapes (Stewart 2002, Pyne 1982). Plant species requiring moderate to full sunlight (e.g., prairies and savannas) inhabited the ecosystems that burned frequently. Areas that were moister, such as lowlands, were less prone to burning. Steep topography and surface water features also protected areas from fire. These moist and protected areas were characterized by woodlands and forests of nearly continuous tree canopies.

The early settlers of European descent, arriving in good numbers in the Twin Cities region in the mid-1800s, came into a landscape inhabited and modified by indigenous peoples for thousands of years. Those original inhabitants, integrated into the workings of ecosystems, continually modified their environment by deliberately using fire, building dwellings, tending cropland, and transporting plants from distant locations for food, medicine, and ceremonies. In short, indigenous people were an active force in shaping what we today term original, native, historical, or pre-settlement vegetation. There was no pristine wilderness; it was all managed by the people living there.

A landscape's vegetation pattern at any moment is dictated by its geomorphology, the greater landscape context, and disturbance, both human (farming, tree-cutting, grazing, construction) and natural (wildfire, windthrow, wildlife grazing). The type and depth of bedrock, the aridity or moisture of soils, and a site's topography also come into play. Vegetation is profoundly influenced by topography, the steepness and aspect of slopes (aspect is the direction a slope faces).

The Twin Cities region was last glaciated by the Des Moines lobe, which receded about 10,000 years ago. Over millennia, the bare soils became colonized by plants, which in turn helped develop soils, which enabled the establishment of woodlands and grasslands. Before 1800, the region was dominated by sparsely treed, grassy, and brushy "Oak Openings and Barrens," also known as savanna. Where these plant communities burned frequently, bur and other oaks would continuously sprout from roots, known to the white settlers as "oak grubs." If fire did not return for a decade or more, rapid colonizers such as red cedar, pin cherry, and choke cherry would establish with the sapling oaks that emerged from their underground grubs. The region's savannas were interspersed with patches of "Big Woods" hardwood forest and upland prairie; scattered wet prairies and lakes were also present.

Recent Past & Present (mid-1800s to present)

Since the early 1800s, European settlement and fire suppression eliminated the critical disturbance of regular burning in the region's savannas and prairies. By the late 1800s, forests in many natural areas had increased with an equal decrease in savanna and prairie. Tillable prairies were converted to crops, and others on steeper slopes became pastures. Prairie and savanna that was not cropped or grazed was colonized by early successional trees and shrubs, such as Eastern red cedar, Hackberry, elms, cherries, sumacs, and dogwoods. Prairies with oak grubs and shrubs grew, over 20-30 years, to oak woodland and forest, which lacked a prairie groundcover because of the dense shade. If livestock were allowed to graze, many prairie plants persisted among the trees and shrubs. Overall, however, most of the landscape was transformed to a forest-dominated ecosystem with sun-requiring prairie and savanna plants retreating to the driest or regularly—though not severely—disturbed places.

Other changes in the City of Mendota Heights' natural areas include the establishment and spread of invasive shrubs and trees, especially Common buckthorn, exotic honeysuckles, and Siberian elm. Buckthorn and honeysuckle were brought in by horticulturalists and gardeners as hedgerow and decorative shrubs; these fire-intolerant species have invaded the City's forests and woodlands, competed with native shrubs and saplings, inhibited oak regeneration, and extirpated many ground layer species by casting dense shade. Invasive forbs and grasses, such as garlic mustard, smooth brome, Japanese hedge parsley, and reed canary grass, have also degraded the City's natural areas. Together, non-native trees, shrubs, grasses, and forbs have been changing species composition, structure, and ecological functions for nearly two centuries.

Future (2050 and Beyond)

In developing this NRMP, the City of Mendota Heights made a commitment to better understand and more proactively restore and maintain its natural areas. Exploring likely outcomes using two possible scenarios—with and without intervention—the City will be able to better understand the importance of strategic investments in natural resources.

Without Management

Without ecological restoration and management in the City's natural areas, and assuming current climate trends continue, the following changes would be expected over the coming decades.

- Invasive and shade-tolerant woody plants will increase in dominance in all plant communities in both the tree canopy and understory, reducing overall plant species diversity through shading and root competition.
- Sensitive and specialist wildlife species will decrease.
- Forests may be less suitable for migratory passerine (perching) birds.
- In some forests, conditions may improve if a canopy of native tree species can remain intact and the ground layer is not disturbed—invasive shrubs will decrease in abundance with the shade and lack of disturbance.
- Grasslands will decrease in native species diversity and abundance, resulting in poorer wildlife habitat for pollinators and other grassland fauna.

- Erosion will worsen, given the predicted increase in severe precipitation events and the sparse groundcover in many of the City's forests. This will result in poorer water quality as well as greater damage to natural areas and infrastructure.
- Higher temperatures (and likely more droughts) will encourage drought-resistant plants, especially on dry, southerly to westerly exposures. These would be both native and invasive species of prairies and savannas.

Mendota Heights has already observed the results of lack of management in some parklands. Natural areas that have not been managed often have been overcome by invasive vegetation such as Common buckthorn and Garlic mustard.

With Management

Active management of the City's natural areas, as described and recommended in this NRMP, would be expected to result in the following outcomes over the coming decades.

- Species diversity will be higher than today in all plant communities.
- Nectar and pollen resources will be more abundant than today due to the provision of continuous blooming from April to October, providing nectar and pollen during the entire growing season.
- Sensitive and specialist wildlife species will find more acres of habitat.
- Migratory habitat for passerine birds will be of high quality.
- Grassland fauna would benefit from improved native habitat.
- Erosion and associated infrastructure damages will be reduced, and therefore become more affordable (saving taxpayer dollars), despite precipitation trends.
- Plant communities will be more open in canopy and understory, especially if predicted drought patterns occur.
- Aesthetics of parkland and natural areas will improve with the increase of native, flowering plant species and fewer invasive species.

Restoration Potential

Fortunately, some of the City's natural areas are of higher ecological quality and contain plant communities that already possess a significant proportion of native vegetation. Figure 11 identifies these B and BC quality natural areas in the northern portion of Valley Park (along the creek), Ivy Falls Ravine (west of Ivy Hills Park, where the drainageway flows under Highway 13 toward the Mississippi River), and some of Dodge Nature Preserve prairies. This considerably reduces the effort required to restore and manage these habitats. This lighter management touch is called "enhancement". Existing plant communities are typically enhanced by removing invasive vegetation, then seeding and planting the area to increase biodiversity, stabilize soils, and make future management easier due to reduced weed presence. Unmown turf areas reverting to woodland, and forests with dense invasive plant areas require more intensive restoration efforts to convert them to native plant communities.

3.2 Improving Ecosystem Services

As discussed in this Plan's Introduction, ecosystem services explain how people are supported by and provided with nature's services, and have their environment stabilized by natural landscapes. While land use changes and modernization of society have given us many benefits, they also have decreased the levels of ecosystem services. This is readily seen in smaller populations of wildlife, in water and air pollution, and in higher rates of erosion and flooding than existed in the landscape of 150 years ago. Once ubiquitous natural habitats have been eliminated, degraded, and fragmented through development. To take one specific example, conversion of perennial vegetation to pavement and rooftops—without leaving sufficient land to absorb rainfall—has accelerated streambank erosion and decreased water quality. That free ecosystem service, water regulation, now must be subsidized by the construction of stormwater management systems and regional detention basins, and by repairs to bridge piers, storm sewer outfalls, and destruction of property due to flooding and erosion. Restoration and management, especially over large areas, like parks, can greatly improve ecosystem services overall. Restoration and management activities in parks will help increase the level of ecosystem services throughout the City's natural areas.

The scientific literature presents numerous examples of how management improves ecosystem services. Appendix F summarizes this research in tabular form and provides technical references. In brief, scientists report that ecological restoration and management affect ecosystem services positively, especially as management continues over time. The scientific literature has focused predominantly on understanding forest and woodland ecosystem services. For instance, removal of invasive species from herbaceous-dominated communities has not been thoroughly studied. Instead, scientists have focused on water- and species-related issues for herbaceous plant communities. Tourism and recreation studies in forested areas were also common in the literature. Restoring prairie-soil systems appears to be a significant way to remove carbon from the atmosphere, but forest systems also store large quantities of atmospheric carbon. Planting native species and restoring the natural processes of fire, hydrology, and normal erosion rates appeared to have good support in the scientific literature as ways to increase ecosystem services.

3.3 Conservation Concepts

Conservation planning is an important tool for conserving biodiversity and ecosystem services in a given geographic area. Based on principles of landscape ecology, conservation biology, and population biology, existing land cover, vegetation, water features, and other environmental factors are assessed with the intent of identifying, protecting, and connecting natural habitats for the benefit of healthy, diverse, and sustainable communities of native plants and animals. Conservation planning concepts and their application to the City of Mendota Heights are discussed in the following sections.

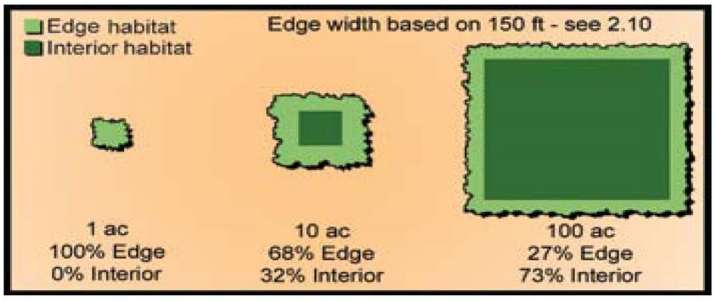
3.3.1 Natural Area Core Habitats, Transitions & Connections

As mentioned in Section 2.2.11, generalist wildlife species (crows, starlings, raccoons, etc.) are animals that are common and can tolerate and even thrive in altered and developed lands and waters where habitat fragmentation and degradation have occurred. These species are typically not a focus of conservation since their populations are usually stable or increasing. In contrast, specialist wildlife species are often rare or have declining populations due to special habitat needs. Many specialist wildlife species require large, diverse and high-quality habitat blocks to sustain their numbers. These areas are called

natural area core habitats. Protecting and managing core habitats in the City will improve the likelihood that uncommon and declining animal species will persist, including Species of Greatest Conservation Need (discussed in Section 2.2.11).

The effects of natural areas being converted to developed lands (e.g., buildings, parking lots, roads), with resulting habitat loss, are well documented. Less obvious are the effects of increasing the amount of habitat *edge*. Smaller, narrower habitats have more edge than larger, rounder ones (Figure 18).

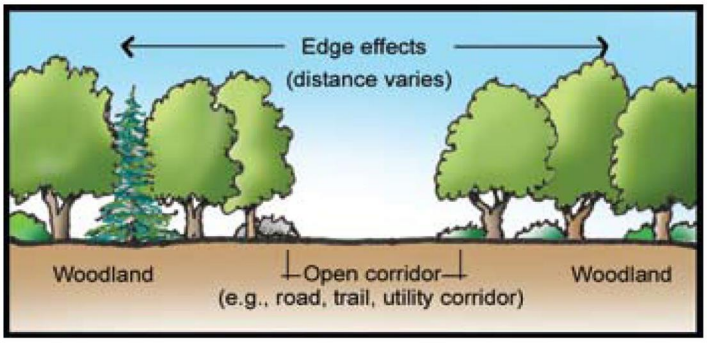
Figure 18. Natural Area Core/Interior Habitats and Edge Habitats



Source: Bentrup (2008)

More *edge* and less *interior* habitat pose significant threats to wildlife that need core habitat. A variety of scientific papers and other sources have documented how edge effects penetrate into adjacent natural habitat. For instance, birds and other wildlife can be flushed by people walking on trails up to a distance of 150 feet away. Mid-sized predators (raccoon and feral house cats) will travel several hundred feet into forests and grasslands to prey on birds, small mammals and other wildlife. Invasive plants move from edges where they grow into interior areas. Traffic noise, warm and dry air, dust from gravel roads, pesticide drift, and many other damaging influences enter wildlife habitat from these edges (Figure 19). Enlarging existing habitats and eliminating encroachments helps reduce edge effects, as does planting designs and management. Even cultural landscapes along the edges of core habitats can be designed and maintained as natural vegetative screens or buffers. These screens and buffers, ideally consisting of native vegetation, create *natural area transitions*, which further reduce edge effects and improve core habitats.

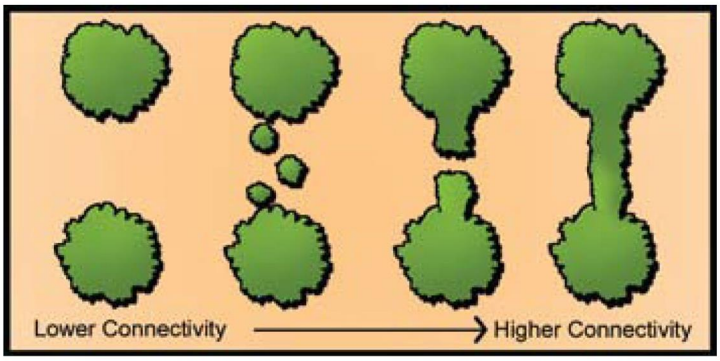
Figure 19. Edge Effects from Development and Disturbance



Source: Bentrup (2008)

Connecting core habitats (Figure 20) allows wildlife to retreat to different, more favorable areas, without being exposed to the hazards of travel. Generally speaking, only the largest natural areas will support the City's most sensitive vertebrate species. Some of these species require corridors of several hundred to thousands of feet in width to move among large habitat cores. It is more practical in developed and farmed landscapes to consider core habitats of 200 to 2,000 acres, with 200-foot to 2,000-foot wide corridors connecting large cores. Larger habitat areas and connections also benefit many types of smaller animals. On the other hand, small habitat areas can sustain many invertebrate species which have small home ranges. Native vegetation can also benefit from connectivity as seed dispersal can be facilitated; however, this becomes a problem when invasive plants take advantage of these connections. Due to these variables, greenways (an important method of increasing connectivity) should be designed and managed thoughtfully to maximize ecological benefits and minimize adverse effects.

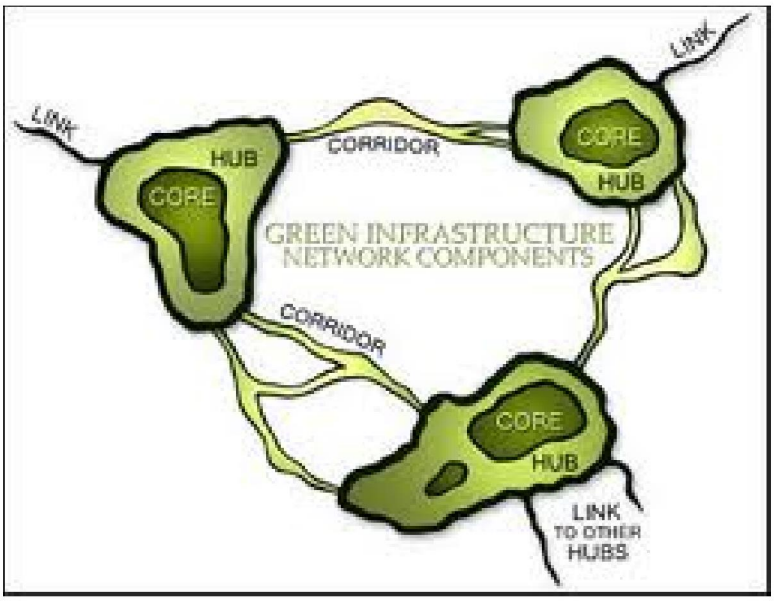
Figure 20. Gradients of Ecological Connectivity



Source: Bentrup (2008)

The concepts of core habitats, edge effects, transitions, and connectivity can be used to help conserve—and even improve—the City's full spectrum of biodiversity. Protecting, connecting and restoring large areas of natural vegetation to minimize fragmentation and edge effects (i.e., creating "green infrastructure", Figure 21) will address the habitat needs of many native plant and animal species, including sensitive and uncommon species. These concepts are applied to Mendota Heights in greater detail in Section 4.3.

Figure 21. Core Habitats, Transitional Buffers & Corridors on the Landscape



Source: Chicago Wilderness Green Infrastructure Vision (2012)

3.3.2 Climate Change Resilience

Projected changes in climate (see Section 3.1.2) are forcing natural resource managers to adjust restoration and management prescriptions. Although the broad patterns of climate change can be predicted—more rainfall in larger storms, warmer nighttime temperatures, reduced snow cover—coping strategies must be broad. As discussed, changing the list of trees to plant in response to shifting plant hardiness zones is obvious. 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, the City can adapt its ecosystem approach. The National Fish, Wildlife and Plants Climate Adaptation Strategy (National Fish, Wildlife and Plants Climate Adaptation Partnership 2012) offers general guidance on how to insulate a region, municipality, or natural area against negative effects of climate change.

- Conserve habitats for healthy fish, wildlife, and plant populations and ecosystem functions.
- Manage species and habitats to protect ecosystem processes and functions and put in place sustainable cultural, subsistence, recreational, and commercial uses.
- Increase capacity in staffing and budgets for effective management and adaptation to change.
- Support adaptive management by integrating monitoring observations and decision support tools across departments and organizations.
- Increase and share knowledge about impacts and responses of fish, wildlife, and plants.
- Increase awareness of and motivate actions to safeguard fish, wildlife, and plants.
- Reduce non-climate stressors, such as invasive species, to help fish, wildlife, plants and ecosystems adapt.

The City already has implemented some of these strategies by controlling invasive species and restoring natural areas on City property. The following recommendations should be considered as the City continues to execute its Natural Resources Program:

- With snowless winters and often dry conditions, it may be possible to conduct 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 Minnesota DNR during historically preferred burn windows.
- In the next two to three decades, before the significant climate changes predicted by mid-century take hold, remove the threat posed by the most damaging invasive species—buckthorn, honeysuckle, Smooth brome grass, Reed canary grass, invasive cattails, Giant reed, and others.
- For seed and live plants, use genetic material from farther south to pre-adapt the City's ecosystems to a new climate (see Appendix C). Countering this is research that suggests local genetic material has the potential to accommodate predicted climate change. This strategy requires more research.
- Predict the trajectory of the City's ecosystems based on evidence from past and current ecosystem structure, process and known pathways of plant succession. Use this knowledge to revise restoration and management traditional prescriptions.

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4 IMPLEMENTATION

4.1 Approaches to Restoration & Management

4.1.1 Natural Resource Management Planning

This NRMP summarizes the City's existing natural resources at a high level, lays out a vision for natural resource management, and facilitates strategic, system-wide planning and program administration. The City has been restoring and managing select natural areas over recent decades; however, this work has sometimes been conducted without consideration of systemwide prioritization, landscape setting, and the resources necessary for long-term management. To fully advance the work laid out in this NRMP, more detailed, site-specific plans should be developed. These plans would provide refinement of natural resources data and more detailed, site-specific recommendations and prioritization of specific restoration projects within the site. Each year, the City should consider and budget for natural resource planning – especially in its parks in advance of scheduled master planning efforts. NRMPs can vary in terms of content and detail, but Appendix G presents a general outline of such a plan.

4.1.2 Ecosystem Approach to Restoration & Management

Successful ecological restoration and management requires the correct execution of a series of tasks, each of which should be customized to the site's unique environmental conditions to meet project goals. This NRMP provides general management recommendations for different types of native plant communities; however site-specific restoration and management prescriptions require an understanding of site-specific goals, resources, budget, and other factors.

An Ecosystem Approach Uses Nature's Own Processes to Restore Ecosystem Health

In an ecosystem approach, managers use their understanding of past and current ecosystem processes, structure and composition to design and implement restoration and management tasks that are lower cost and more consistent with the ecosystem's own internal processes of repair and rejuvenation. When combined with adaptive management and monitoring, an ecosystem approach can be more effective in the long term than conventional approaches to ecological restoration and management.

For restoration and management planning, AES recommends an "ecosystem approach". In brief, this approach entails first using less expensive, more natural methods to restore natural processes and appropriate vegetation structure and composition to an ecosystem. This often consists of replacing dominant invasive vegetation with native species that are dominant in the target plant community. Prescribed fire and physical removal of undesirable vegetation typically follow. This is then followed by other tasks, such as targeted use of herbicides and other interventions to set the plant community on a trajectory toward greater ecological health and resilience.

The variability of plant communities, including species composition, structure, land use history, and soils, and the variety of restoration and management goals, present a complex challenge for natural resource managers. The following framework can help managers develop efficient, effective, and appropriate restoration and management prescriptions for natural areas.

1. **Understand the starting ecosystem.** Rarely intact, an inherited ecosystem is more commonly a degraded natural community, a cultural landscape of cropland, pasture, or turf, or a novel ecosystem—that is, an apparently stable plant community, such as an old field or a forest dominated by non-native trees, that originated from cultural practices.
    a. Gather baseline data and complete a natural resources inventory and assessment in the field, including an early restoration concept based on observed conditions in an ecosystem management framework.
2. **Define conservation and restoration goals** for the land or plant community, including specifying target plant communities. Goals should lead to self-perpetuation, limited human management of ecosystems, and long-term resilience despite environmental change and unexpected stressors.
    b. Consider the type and level of **ecosystem services** being restored in light of expected land use, species and habitats targeted for protection, and other desired outcomes.
    c. Consider the **achievable ecological quality.** Is it realistic to expect an A-quality plant community, or is BC-quality acceptable?
    d. Consider **short-term and long-term costs.** For instance, though generally cheaper than most management techniques, is it cost-effective (and appropriate) to manage a particular site with fire considering its natural disturbance regime and constraints?
    e. Consider **schedule and milestones.** Define the time over which the goals will be realized and define steps along the way that represent significant interim accomplishments.
3. **Develop and implement restoration and management prescriptions, including the appropriate tasks and sequence,** to set the ecosystems and target plant communities on a trajectory towards ecological health, integrity, and resilience.
    a. **Ensure adequate resources** to implement the restoration work and perpetual management thereafter.
    b. **Restore processes** that can be used cheaply and extensively to restore vegetation structures, such as prescribed fire, flood regimes, canopy closure, other processes (grazing, burrowing), the addition of legacy materials, etc.
    c. **Restore structure** by using or mimicking natural processes, physical removals (e.g., brushing) and/or native plantings, biocontrol agents, etc. Use management mowing, spot herbicide application sparingly, and broadcast herbiciding as a last resort, with the goal of restoring dominance by native plants suited to local climate, soil, and setting.
    d. **Introduce species diversity** as necessary to support restoration of native dominance in vegetation layers, enhance ecological functions such as pollinator community support, and resilience against climate change that favors southern species and disfavors northern ones. Native seeding and live-planting are typically required if native seed banks and root reserves are exhausted.
    e. **Continue short-term management** (e.g., management mow, spot spray)
4. **Practice adaptive management** (i.e., implement, monitor, report, learn, and adjust as warranted).
5. **Accept long time frames,** requiring patience and persistence to achieve long-term goals.

4.1.3 Target Native Plant Communities

Proposed native plant communities are those largely self-sustaining ecological combinations of species that are expected to develop at a site following the implementation of ecological restoration and management activities. Given the current degraded condition of most of the City's natural areas, we recommend that all native or semi-natural plant communities be enhanced to establish more ecologically healthy conditions. In addition, underutilized turf areas in parklands should undergo conversion to lower maintenance native plant communities, such as prairie.

For example, existing Mesic Forest will remain as such, but would be enhanced by removal of invasive species, selective thinning of aggressive native trees and shrubs, and limited plantings. This would diversify the canopy, understory, and ground layer vegetation and improve wildlife habitat, including habitat for pollinators. Complete replacement of vegetation could occur where natural resource conservation calls for turf grass to be replaced by native prairie or savanna grasses and wildflowers under trees.

Converting Turf to Prairie Makes Sense for Good Reason

Converting little-used turf areas to native prairie is one technique to elevate ecosystem services. Compared with regular mowing of lawns, maintenance of prairie represents a significant reduction in time, effort, and cost. At the same time, prairie generates huge increases in the land's capacity to absorb greenhouse gases, infiltrate groundwater, and support wildlife and pollinators compared to turf grass.

Native plant species lists appropriate for restoring or enhancing the City's specific plant community types can be derived from MNDNR's *Native Plant Communities of Minnesota – The Eastern Broadleaf Forest Province* (MNDNR 2005) and native seed mixes are available from the Minnesota Board of Water and Soil Resources (BWSR). Management briefs for the City's natural areas (Appendix H) reference appropriate target plant communities to restore/enhance, and appropriate species for seeding and planting (Appendix I).

Whenever possible, native plant materials (seed and live plants) used in ecological restorations should have a genetic source-origin from within 200 miles of the project area, preferably not far to the north (due to ongoing and projected climate change patterns). In addition, only native, wild-type species should be used, not cultivars and horticultural varieties. While local ecotype seeds and plants are highly recommended, some species are not always available in today's market. Substitutions for specified seed and plant materials may be necessary if materials are not available or prices for some species too high. Every effort should be made to substitute unavailable species with those that match the ecological purpose of unavailable species. Section 4.2 of this plan addresses the restoration and management tasks needed to establish healthier native plant communities in the City's natural areas.

4.1.4 Management Units

At an individual site scale, ecological restoration and management is often conducted in a given area or "management unit." Small sites may be treated as a single management unit, but larger sites are often subdivided to facilitate implementation of restoration/management tasks in areas with similar management needs and proposed uses. Management units are also used to phase projects over time, often necessitated by annual budgets, or to provide refuges for invertebrates during and after prescribed fires. Management units often consist of a single plant community type (like forest), but they may contain

a variety of plant communities. Management unit boundaries are typically delineated along existing roads/trails, plant community edges, watercourses, or topographic breaks. Management units have not been delineated in this NRMP, but many of the City's smaller natural areas could be managed easily as a single unit. Defining management units in larger parks should be done after more detailed site-specific plans are completed.

Restoration and short-term management tasks generally include site preparation, brushing and thinning (in wooded communities), weed control, native seeding and planting, and ecological monitoring and reporting. Table 10 illustrates a schedule for a typical restoration project that requires significant site preparation followed by initial management. Laying out restoration tasks for an individual management unit requires a detailed scope, often with a different schedule. The schedule below does not address long-term management.

Table 10. Generalized Restoration & Short-Term Mgmt. Schedule for a Management Unit

Task	Description/Subtask	Year 1				Year 2				Year 3			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Site Preparation	Re-establish historical hydrology and/or disturbance regimes (e.g., fire); broadcast herbicide, till, spot herbicide and/or mow	■	■	■									
Invasive Tree & Shrub Removal/Thinning	Cut & stump treat invasive woody plants				■								
	Remove or selectively thin aggressive native woody plants				■								
Invasive Herbaceous Vegetation/Weed Control	Prescribed dormant-season burn; site preparation burn can be late Summer, Fall or Spring		■	■		■							
	Spot herbicide and/or spot mow					■	■			■	■		
	Foliar herbicide the invasive woody re-growth							■				■	
Seeding & Planting After Weed Control	Install native seed								■	■			
	Install live woody plants (dormant)							■		■			
	Install live herbaceous plants									■			
Ecological Monitoring & Reporting	Assess/document site; prepare year-end summary report	■	■	■	■	■	■	■	■	■	■	■	■

4.1.5 Management of Private Land, Easements & Lowland/Aquatic Communities

Private Land

As discussed earlier in this NRMP, many of the City of Mendota Heights' natural areas are located on private land. Some of these private natural areas are protected by a conservation easement (which dictates the conservation goals and allowable activities within the area) or are wetland/aquatic

ecosystems protected by the Minnesota Wetland Conservation Act and other regulations. However, many of the City's private natural areas are not protected, and even protected areas are often not managed. To achieve the City's conservation goals, special strategies are required to address management of private natural areas, easements, and lowland/aquatic communities.

Ideally, natural areas on private lands are managed by the landowner or other partners. This is already occurring in some portions of the City (e.g., Dodge Nature Center managing its private lands), but can be facilitated and expanded through outreach and cost-share programs. Tools such as the City's website, brochures, and information offered at community events can help private landowners better understand and appreciate the need for control of invasive vegetation and other forms of natural areas management (see Section 4.1.6 for more information on public outreach). Cost-share programs and partnerships, such as the City has done with picking up buckthorn cut by volunteers, make some types of natural areas management much more feasible for landowners. The Conservation Concept developed for Mendota Heights (Figure 22 under Section 4.3) illustrates how vegetation and parcel mapping can be used to identify private lands adjacent to City natural areas and other private lands most in need of ecological restoration and management and/or locations where investment would result in the greatest ecological benefit. Targeting those specific landowners as partners will enable the City to advance your conservation goals most efficiently.

Easements

Several conservation easements exist within the City of Mendota Heights (although comprehensive mapping does not exist). While some of these easements specify management requirements, some do not, and others do not follow through on the required management regime. The City should inventory and map (using GIS) all conservation easements within the City. Based on this inventory, review of easement requirements, and field assessment, the City will be able to ascertain which ones are in compliance, which would benefit from increased management, and which are located in areas advantageous for ecological connections.

Lowland/Aquatic Communities

The Minnesota Wetland Conservation Act and other water/wetland regulations provide legal protection of most of the state's wetlands and other aquatic systems (lakes, streams, etc.). However, many of these lowland/aquatic features extend across property lines. This fact, coupled with the impact of water levels on properties and the dispersal mechanisms of aquatic invasive species, make management of lowland/aquatic areas particularly challenging to implement and sustain; hence, these areas are often not managed. Given these challenges, it is often necessary for municipalities to make strategic decisions where and how to manage lowland/aquatic areas, considering the feasibility, initial cost, and the cost to sustain the management necessary to achieve realistic goals. Detailed restoration and management planning for wetlands and other aquatic systems are out of the scope of this NRMP.

4.1.6 Public Outreach

Public outreach is a critical component of any NRMP, especially in a City such as Mendota Heights where so much of the City's natural areas exist on private land. Some of the key messages that should be conveyed to City residents (many already discussed in this NRMP) include:

- Much of the City's natural areas exist on private land, making public-private partnerships critical to achievement of the City's natural resource and conservation goals.
- Residents can take advantage of the following programs and incentives:
    - **Landscaping for Clean Water** – through partnership with the Lower Mississippi River WMO/Dakota County SWCD
    - **Metro Blooms Educational Classes** – began partnership last year; offered two classes; classes offered will vary each year
    - **Lawns to Legumes** – residents can apply through the Blue Thumb program
    - **Tree Trust Tree Sale** – trees offered at a discounted price to residents through our partnership with Tree Trust
    - **County Tree Sale** – the Dakota SWCD is providing opportunity for residents to purchase high quality, native, bare root seedlings at a low cost for urban and rural conservation purposes, such as windbreaks, reforestation, erosion control, and food and cover for wildlife
    - **Organics Program** – recently added an organics drop site at Mendakota Park
    - **Annual Recycling Events** - including the Shred Event, Mattress Collection, etc.
    - **Annual Parks Celebration** – booths offering educational resources on recycling, natural resources, and water resources
    - **Annual Earth/Arbor Day Celebration** – free community event offered annually with give-aways, educational displays, and activities, on natural resources and water resources topics; has historically involved a community service event such as a parks clean up
    - **Annual Fishing Derby** – booth and activities offering educational resources for kids focused on Water Resources
    - **Site Visits by Staff** – offered free of charge for technical advice on a variety of water/natural resource issues including: tree inspection, invasive species, native restoration projects, shoreline restoration projects, erosion prevention, etc.

Currently, the City of Mendota Heights does not have any incentive programs designated to other private landowners (e.g., cemeteries, churches, schools, businesses). However, the City has partnered with two homeowner associations on a recent street reconstruction project, providing sustainable landscaping on their property and outlots that bordered Marie Ave. W, including natives plants, a no-mow lawn, and trees and shrubs.

Volunteer opportunities are another way to engage the public in the City's natural resources program. Volunteering provides an opportunity to capitalize on knowledgeable and passionate residents who know and care about natural resources, as well as an opportunity to educate less knowledgeable citizens and employees that work in the City. Through such volunteering, people develop a deeper understanding and appreciation of natural areas, increasing the value of the City's natural resources and reinforcing their protection, restoration, and management. More information and recommendations regarding the City's volunteer program is provided in Section 4.3.5.

4.2 Restoration & Management Tasks

As mentioned above, ecological restoration and management requires execution of a series of tasks, each of which should be customized to the site's unique environmental conditions to meet project goals. Restoration and short-term management tasks for natural areas are discussed below. Long-term management is discussed in Section 1.2.3, and includes some of the tasks below.

A Note About Herbicides

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

The public is increasingly concerned about herbicides and other pesticides used on public land. City staff may be contacted for information in response to restoration and management involving herbicides. A consistent message should be conveyed to the public by City staff who receive inquiries about herbicides:

- The City minimizes herbicide use by taking an ecosystem approach and following Integrated Pest Management (IPM) practices[1]. When deemed necessary, the City allows use of herbicides with the lowest toxicity to achieve restoration goals.
- Herbicide application on City-managed lands is applied at the lowest effective concentration by licensed applicators following manufacturer's instructions.
- Recommended safety precautions are followed by herbicide applicators, and signage is installed as appropriate to inform the public of herbicide use and appropriate exclusion intervals following application.
- The City of Mendota Heights became a Pollinator-Friendly Community under adopted resolution 2016-01, urging those in the community, and committing to, limit the use of pesticides and chemicals and adopt more pollinator-friendly practices.

The amount of herbicide applied for ecological restoration and management is at levels far below that used in agricultural fields. Moreover, the herbicide is often 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 drift and spillage. Restoration professionals prefer to use broadcast herbicide application as a tool of last resort, in order to remove a dominant invasive plant in a vegetation layer that is resistant to other approaches.

4.2.1 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

[1] *Integrated Pest Management is an ecosystem-based approach that uses a combination of practices that minimize risk to beneficial insects and organisms, wildlife, humans, and the environment. Pesticides and herbicides are used only after monitoring indicates they are necessary and applied with the goal of removing only the target pest or species.*

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 slowing than surface water levels.)

Altered Hydrology and Vegetation Effects. Native plants and animals were well-adapted to the formerly gradual changes in water and groundwater level. Ditching, tiling, and other drainage systems, as well as land clearing and impervious surfaces, have deranged the natural hydrological regime in the majority of wetlands, streams, ponds, and lakes of the region. Damming and road-building also alter hydrology by impounding water uphill and drying the downhill landscape. 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 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.

A watershed approach identifies the most cost-effective opportunities to infiltrate and slow runoff before it reaches the creek valley. In developed areas this usually requires integrating infiltration and detention projects into redevelopment projects, especially along roads where storm sewers are often installed. Smaller, dispersed infiltration and detention projects, if widely installed on public lands and commercial or institutional properties, would significantly reduce the amount of runoff entering creeks. Lastly, private landowners can do many things on their own property—redirect a roof downspout to a lawn rather than a driveway or install a raingarden. Fortunately, the majority of the city has well drained to excessively drained soils, making infiltration a very effective technique to manage stormwater runoff.

4.2.2 Prescribed Burning

Prescribed burning is an important and cost-effective ecological restoration and management tool – and one that is appropriate for fire-dependent communities such as: pine, pine-oak, and oak forests; oak and oak-pine savanna; prairie; wet meadow; and marsh. The City of Mendota Heights' contains fire-dependent forests, woodlands and other native plant communities that benefit from infrequent fire. These plant communities are often most cost-effectively managed with well-planned and well-executed prescribed burns. The many benefits of fire in these communities has been well documented.

Burning Grasslands and Meadows. The City's prairie habitats should be burned approximately every three years, but this depends on the rate of woody plant invasion and the accumulation rate of fine fuel. More frequent burning may be needed to control woody plant growth, or less frequent if the litter layer accumulates slowly. Creating two or three burn units, each capturing the landscape's heterogeneity, preserves refugia for wildlife negatively affected by fire. For instance, invertebrates (including pollinators

such as the Rusty patched bumble bee) are protected by not burning an entire plant community at once, usually recolonizing the burned patch from refugia (i.e., nearby habitat areas spared from burning) in the next year or two. The USDA/NRCS recommends that most prescribed burning be done in the early spring before grassland birds nest. However, late-summer and fall burns also avoid the prime nesting season (USDA/NRCS 1999). Due to these potential adverse wildlife impacts, burning small native restorations with little or no nearby refugia (which would be the case in portions of Mendota Heights) might be at odds with the City's restoration objectives.

Burning Forests and Woodlands. Fire-dependent forests and woodlands 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 these areas can be challenging if fine fuel is sparse. Legacy materials (downed woody debris and snags) must be addressed before or after a burn. 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 Mendota Heights 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.

Prescribed burning is a safe and cost-effective restoration and management tool when conducted by trained professionals.

4.2.3 Biocontrol

Biocontrol uses natural enemies to reduce invasive species populations. Several approved biocontrol agents are available to control invasive species in the City (Table 11), but the most problematic ones—buckthorn, reed canary grass, invasive cattail—have none.

Table 11. Potential Biocontrol Options for City of Mendota Heights

Community	Plant Species	Biocontrol Agent	Mechanism	Application	References
Forests & Woodlands	Garlic mustard (*Alliaria petiolata*)	A root-crown mining weevil (*Ceutorhychus 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 tested.	Becker et al. 2020
Upland Grasslands	Leafy spurge (*Euphorbia esula*)	Leafy spurge beetle (*Aphthona lacertosa*)	*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; recommend experimental release first.	Chandler et al. 2012
		Black dot Leafy spurge flea Beetle (*Aphthona nigriscutis*)			
	Spotted knapweed (*Centaurea stoebe*)	Seedhead weevils (*Larinus minutus* and *L. obtusus*)	*Adult stage*: Herbivory of foliage. *Larval stage*: Consume developing spotted knapweed seed.	Exists in City; recommend experimental release first.	Chandler 2020
		A root-boring weevil (*Cyphocleonus achates*)	*Larval Stage*: Develop in roots, consuming starch reservoir and physically damaging roots.		
Wetlands	Purple loosestrife (*Lythrum salicaria, L. virgatum*)	Black-margined loosestrife beetle (*Galerucella calmariensis*)	*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; recommend experimental release first.	MNDNR 2020
		Purple loosestrife leaf beetle (*Galerucella pusilla*)			
		Loosestrife root weevil *(Hylobius transversovittatus)*	*Adult Stage*: Herbivory of foliage. *Larval Stage*: Feed in roots.		

4.2.4 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 Mendota Heights since they can dominate forest understories, and 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 Chokecherry (*Prunus virginiana*)—behave as invasive species in 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. 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 source of wildlife food are usually missing or scarce in damaged forest ecosystems.

If resource are limited, invasive vegetation management should focus on removing invasives from the highest quality areas or areas with the rarest natural features. These are experiencing early invasions that are easier to control than dense infestations.

Removing invasive woody vegetation typically includes the following tasks.

- **Native Plant Protection.** Protect desirable native woody and herbaceous vegetation by various means. 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" 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 disposing of material 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 (i.e., severing the bark, cambium, and sometimes the sapwood in a ring extending entirely around the trunk of the tree).
- **Goat Browsing.** Goats have been used at some restoration sites to browse and reduce invasive woody vegetation. Goats defoliate and stress small shrubs and trees, woody plant seedlings, and the low-hanging branches of taller plants, but cannot control mature shrubs. Moreover, browsing may not kill the browsed plant, allowing it to regrow. Because mature invasive shrubs

are found in many of the City's forests, goats are often not a suitable tool by themselves. Other disadvantages are that goats browse native woody species and require the installation and management of electric fencing and other infrastructure. For these reasons, goats should be used only at appropriate sites, under close supervision, and with other brush control methods.

- **Forestry Mowing.** Mechanized forestry mowing is often used for large areas of invasive woody plants, but may have the disadvantages of removing and damaging desirable native vegetation, causing soil erosion, and compacting soil. Forestry mowing also leaves uneven/shredded stump-cuts, making herbicide application challenging. For this reason, resprouts are common, 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-seral 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 (e.g., red oak), 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 (in 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 movement of pests, such as Emerald ash borer and Gypsy moth. If many large trees are being cut, these should be moved out of the way to maintain travel routes for material disposal. Where there are fewer large trees being removed, the boles 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 stream bioengineering material, understory thinning can be done with lower material removal costs.

- **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.

4.2.5 Invasive Herbaceous Vegetation Control

- **Competition by Native Plants.** As invasive plants create a seedbank which produces seedlings for years, 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 desirable native vegetation by avoiding native plants with 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.
- **Multi-Pronged Approach.** Employ an Integrated Pest Management (IPM) approach by combining manual pulling where erosion is not a concern, spot-application of herbicide, spot-mowing, and prescribed burning—the combination 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.

4.2.6 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 initiated.
- **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, such as in high visibility areas.

4.2.7 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 not install woody vegetation in 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.

4.2.8 Conifer Plantation Thinning and Restoration

City of Mendota Heights parkland contains conifer plantings and plantations (e.g., Valley Park). While often consisting of native species (e.g., White pine, *Pinus strobus*), these plantings and plantations represent altered, low-diversity plant communities. Converting conifer plantations to healthier, more diverse and resilient native plant communities is often best accomplished by selective thinning of conifers over several years, accompanied by interplanting appropriate native trees and seeding and/or live plantings other native species. Local conditions (e.g., soils, moisture regime) will help determine an appropriate target plant community and which species are most appropriate for the particular location. Tree plantings typically require browse protection from White-tailed deer, rabbits, and rodents.

4.2.9 Turf to Native Vegetation Conversion

Many of Mendota Heights' parks and other public parcels contain turf lawn; most of these are actively used, justifying this vegetation cover. To increase habitat for pollinators and other native species, to improve other ecosystem services, and to reduce long-term maintenance costs, underutilized turf areas could be converted to native prairie or savanna ground layer vegetation. Native prairie is typically maintained by prescribed burning once every few years. Compared with regular mowing of turf lawns, maintenance of prairie represents a significant reduction in time, effort, and cost when compared with conventional lawns. Even considering prairie installation costs by seeding, these native plant communities have lower cumulative costs than lawns within a couple years.

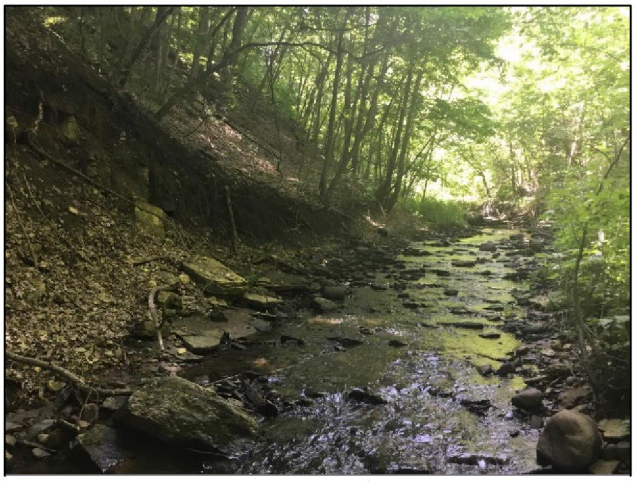
The conversion of herbaceous vegetation from turf grass to prairie/savanna grasses, sedges, and wildflowers involves the following.

- **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, the plastic must be installed as to not cause runoff and erosion problems, it may require several months to eliminate turf, and soil-dwelling biota will also be killed. Sod-cutting is another turf removal method; however, this procedure also removes topsoil from the site, which requires transport and disposal and may leave site soils less conducive to revegetation.
- **Turf Removal with Herbicide.** Use approved broadcast herbicide to kill existing lawn and other undesired vegetation. A minimum of two herbicide treatments is often required to control turf species and achieve performance standards. Mowing or burning vegetation prior to or in between treatments may improve turf removal.
- **Native Seeding.** Once turf species are removed satisfactorily, seed with local ecotype native seed. Seeding is less expensive than installing live plant plugs, however seeding requires more time for establishment, and some prairie and savanna species are slow to develop.
- **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.

4.2.10 Slope & Seep Stabilization

Mendota Heights' park system includes some steep slopes, especially along Big Foot/Interstate Valley Creek and Ivy Creek. Many of these steep slopes experience erosion due to a combination of factors:



Steep, eroding slopes along Big Foot/Interstate Valley Creek in Valley Park.

- Dense shade (by overstocked canopies or invasive shrubs) inhibits the growth of soil-anchoring ground layer vegetation.
- Runoff flowing down steep slopes causes sheet erosion that displaces topsoil, inhibiting the growth of soil-anchoring vegetation.
- Concentrated runoff (e.g., from impervious surfaces at the top of slopes) flows down steep slopes with highly erosive energy that causes rill and ravine erosion.
- Steep slopes are subject to seeps and springs, which saturate soil. Such soils lack integrity, which can lead to mass-wasting.
- Digging and other disturbance by people.

4.2.11 Diseased Tree Removals

Tree disease management is conducted by the City of Mendota Heights to control Oak wilt, Dutch elm disease, and Emerald ash borer. As trees are removed from forests, appropriate native species (see MNDNR 2005) may be planted in canopy gaps by City staff, partners, or volunteers.

4.2.12 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. Sharing monitoring results with the public can provide greater transparency, encourage the community's appreciation of natural areas, and increase the commitment to long-term stewardship.

Building on the ecological assessment work conducted for this NRMP, we recommend the following monitoring protocols for Mendota Heights' natural areas.

1. **Priority Natural Areas** (larger intact natural areas and other natural communities with a quality rank of C or better (see Section 2.2.3)).
    a. A qualified ecologist should conduct a baseline field assessment of each plant community in the area, documenting vegetation species present and percent cover of each species. Notes should include invasive species, other stressors, erosion features, rare species observations, etc.
    b. A walkabout survey (i.e., qualitative assessment documenting conditions, presence of invasives, other environmental concerns, etc.) should be conducted annually by a qualified ecologist. Any concerns should be conveyed to the Natural Resources Coordinator, and interventions should be scheduled promptly.
2. **Active Restoration Areas**
    a. Prior to initiating restoration activities, a qualified ecologist should inspect the entire project area confirming existing conditions and validating restoration goals are appropriate. Notes should include invasive species, other stressors, erosion features, rare species observations, etc.
    b. Prior to installing native seed/plants, a qualified ecologist should inspect the entire project area confirming site preparation was done properly before installation of plant materials.
    c. During restoration activities, a qualified ecologist should oversee contractors, volunteers, and other personnel at a frequency pursuant to their skill levels. Any concerns should be conveyed to the Natural Resources Coordinator.
3. **Other Natural Areas**
    a. Conduct walkabout surveys as time and resources allow and report issues to the Natural Resources Coordinator.

4.3 Advancing Conservation in Mendota Heights

4.3.1 City-wide Conservation Priorities

Based on RES's review of existing ecological data, field review of the City's priority natural areas during 2020 and 2021, and consideration of conservation planning and landscape ecology principles, we identified the following conservation opportunities, focused on the City's largest and/or highest quality core habitats. For each of the ten core habitats identified (Figure 22), there are opportunities to enhance natural areas (e.g., remove invasive vegetation), widen narrow areas, and expand core habitat by purchasing or securing conservation easements on adjacent land. In addition to improving, enlarging, and buffering core habitats, improving ecological connectivity (discussed further under Section 4.3.2) is yet another strategy to increase the ecological health and resilience of these important natural areas.

The ten identified core habitats (Figure 22) are presented in ecological priority order, considering the conservation gains that could be achieved (related to ecological quality, size, connectivity, diversity of habitats, etc.). Some areas are managed by entities other than the City of Mendota Heights and/or are already undergoing restoration or management projects (e.g., Dodge Nature Preserve, Oȟéyawahe/Pilot Knob Preserve). They are included in the list because the City should be aware of these opportunities and consider supporting and advancing them through its own work. Fort Snelling State Park (in the southwest portion of the City) is the largest natural habitat core in the City; however, it is not addressed in this section, as it is state-owned and managed.

Figure 22. Conservation Concept for Natural Areas and Connections in Mendota Heights

1. Dodge Nature Preserve – Lily Property (managed by Dodge Nature Center)**, Friendly Marsh Park and Adjacent Natural Areas**

Approx. Size: 223 acres

Landscape Context: Highway 62 on north, residences on south, institutional to northwest, estate lots to east, and City's Friendly Marsh envelopes southwest corner. Dakota County's Mendota-Lebanon Hills Greenway runs along west edge of core, and this core is just south of Dakota County's River-To-River Greenway.

Types and Quality of Ecosystems, Plant Communities, Habitats: Representative variety of ecosystems and plant communities, with some locations having BC and C quality.

Past, Ongoing and Planned Restorations: Dodge Nature Preserve - Lily Property has been conducting prairie restoration and invasive plant control for many years.

Core Habitat and Edge Effects: Squarish shape maximizes interior core habitat. Friendly Marsh Park, Dakota County land, estate lots and institutional parcel provide better buffer against damaging edge effects, and there are opportunities to reduce edge effects through partnerships. Highway 62 noise reduces quality of bird nesting habitat on north and contributes to fatalities of animals using the nature preserve.

Conservation Strategy: The northwest corner of this core is connectable to the Valley Park South Core along the trail underpass beneath Highway 62 and the south-central portion of this core is connectable to the Copperfield Ponds Core (across Huber Drive). Core expansion opportunities exist by protecting adjacent land (including where private lots abut the core). Provides a central location and facilities for conservation education and mobilization for restoration and management projects. See Appendix J for more discussion of conservation strategies.

2. Valley Park North (City park) **and Adjacent Natural Areas**

Approx. Size: 91 acres

Landscape Context: I-35E to west, residences along eastern edge, industrial site at northeast corner, Marie Avenue forms south boundary. Dakota County's River-To-River Greenway runs through this core. Adjacent to Lilydale Regional Park in north and to Valley Park South Core just south of Marie Avenue.

Core Habitat and Edge Effects: Long, narrow shape constrains interior core habitat, but I-35E serves as a barrier to the many damaging edge effects associated with residential development. Industrial site to northeast offers opportunity to increase buffering against edge effects through partnerships. I-35E noise reduces quality of bird nesting habitat along entire length of core and contributes to fatalities of animals using the park.

Types and Quality of Ecosystems, Plant Communities, Habitats: Representative variety of ecosystems and plant communities; dominated by forested ecosystems with stream valley ecosystem along center. About three acres are BC and C quality.

Past, Ongoing and Planned Restorations: Focus of much City restoration and management activities. Ongoing pollinator habitat restoration project. Future streambank stabilization project.

Conservation Strategy: This core is somewhat connected to Lilydale Regional Park in north (across Highway 13) and Valley Park South (across Marie Avenue). Core expansion opportunities exist by protecting adjacent land (including where private lots and industrial land abut the core, especially along east edge). See Appendix J for more discussion of conservation strategies.

3. Valley Park South (City park) **and Adjacent Natural Areas**

Approx. Size: 46 acres

Landscape Context: I-35E to west, residences along eastern edge, Highway 62 along south edge, Marie Avenue forms north boundary. Dakota County's River-To-River Greenway runs through this core. Adjacent to Valley Park North Core across Marie Avenue.

Core Habitat and Edge Effects: Long, narrow shape constrains interior core habitat, but I-35E serves as a barrier to the many damaging edge effects associated with residential development. Estate in southern portion of core invites a partnership to reduce edge effects. I-35E noise reduces quality of bird nesting habitat along entire length of core and contributes to fatalities of animals using the park.

Types and Quality of Ecosystems, Plant Communities, Habitats: Focus on herbaceous and shrubby wetlands and lowland forest. No high-quality remnants (most of this area is NN quality, with some D quality), but opportunity to restore a large wetland system that could simultaneously manage excess stormwater runoff that is causing stream valley degradation in Valley Park North.

Past, Ongoing and Planned Restorations: Possible future streambank stabilization project in partnership with Lower Mississippi River WMO and private landowner.

Conservation Strategy: This core is somewhat connectable to Dodge Nature Preserve Core in southeast corner (via trail underpass beneath Highway 62) and to Valley Park North Core (across Marie Avenue). Core expansion opportunities exist by protecting adjacent land (including where private lots abut the core, especially along the east edge). See Appendix J for more discussion of conservation strategies.

4. Lemay-Augusta Lakes Ridge and Shoreline (privately owned)

Approx. Size: 117 acres (mostly open water)

Landscape Context: Residences along west side of Augusta Lake and the north, west and south sides of Lemay Lake. Resurrection Cemetery (a 174-acre structural savanna) abuts the east side.

Core Habitat and Edge Effects: Although the moderately long, narrow shape constrains interior core habitat and a trail bisects the area, the adjacent savanna-like cemetery is a good buffer against the many damaging edge effects associated with residential development and could be improved through a partnership. Conservation easement agreements exist between the City and two Homeowners'

Associations (HOAs) adjacent to Augusta and Lemay Lakes. This offers an opportunity for a partnership to improve habitat and reduce edge effects.

Types and Quality of Ecosystems, Plant Communities, Habitats: Primarily oak forest and degraded forest (D and NN quality), but with potential for savanna and woodland restoration, as indicated by the presence of lily-leaved twayblade orchid (*Liparis liliifolia*) and spring ephemeral wildflowers.

Past, Ongoing and Planned Restorations: Removal of invasive vegetation, shoreline armoring, and native seeding was conducted in Fall 2020 at The Heights Apartments, just northwest of Lemay Lake. A stormwater outfall that discharges to the lake was restored and stabilized using bioengineering.

Conservation Strategy: Core expansion opportunities exist by protecting adjacent land. Partnerships with HOA, and cemetery board, and other adjacent landowners to improve habitat around the two lakes, create a large core habitat area centered on the lakes and including the west edge of cemetery (where it meshes with the cemetery's purpose, goals, and aesthetics). Although the uplands are narrow, restoring high-quality habitat around much of the lakes' perimeters will reduce sediment and nutrient loading to lake from soil erosion off slopes. See Appendix J for more discussion of conservation strategies.

5. Hidden Creek Trail Neighborhood (privately owned)

Approx. Size: 64 acres

Landscape Context: Back acreage of about 20 large private lots. Bounded by Wentworth, Delaware, Marie and Dodd. Dakota County's River-To-River Greenway is just south of this core.

Core Habitat and Edge Effects: The somewhat roundish shape results in more interior core habitat. Opportunity to reduce the edge effects of large lot residences through partnerships. Although may not be high quality, the size and shape of the area elevate the site among the City's natural areas.

Types and Quality of Ecosystems, Plant Communities, Habitats: Assumed to be low-quality lowland forest, marsh, upland forest, and old field; however, not assessed due to private ownership.

Past, Ongoing and Planned Restorations: New landowners along Hidden Creek present an opportunity for education and establishment of native buffer plantings.

Conservation Strategy: Partnership that unifies neighborhood around the creation of high-quality core habitat and the reduction of edge effects, facilitated by protecting adjacent land (including where private lots abut). Opportunity for trail system for neighborhood use and enjoyment. See Appendix J for more discussion of conservation strategies.

6. Ivy Falls Ravine (City nature preserve) **and Adjacent Natural Areas**

Approx. Size: 27 acres

Landscape Context: Adjacent to Lilydale Regional Park but separated from it by Highway 13. Residences on all other sides. An area of private forest to the northeast buffers the City nature preserve. This core is characterized by steep ravines that drain northwest under Highway 13 to Pickerel Lake.

Core Habitat and Edge Effects: The long narrow shape produces edge effects and little interior habitat.

Types and Quality of Ecosystems, Plant Communities, Habitats: The northern portion of this park (and adjacent private land) is one of few high-quality upland forests identified in City—BC ranked (fair to good); the remainder of the parkland is assumed to be comparable quality.

Past, Ongoing and Planned Restorations: None known.

Conservation Strategy: Opportunity to secure a larger area and avoid future encroachment working with private landowners to the northeast and others abutting this core. Some connectivity exists to Lilydale Regional Park and potentially other natural areas. See Appendix J for more discussion of conservation strategies.

7. Rogers Lake (City park and Mn/DOT property) **and Adjacent Natural Areas**

Approx. Size: 97 acres (mostly open water)

Landscape Context: I-35E to west, residences to north and east, St. Thomas Academy to southeast, and Patterson Companies, Inc. to south.

Core Habitat and Edge Effects: Narrow strips of upland around the lake constrain interior core habitat, but I-35E serves as a barrier to the many damaging edge effects associated with residential development.

Types and Quality of Ecosystems, Plant Communities, Habitats: Good variety of ecosystems and plant communities: upland forest, savanna, lowland forest, marsh. Quality ranges from CD to NN.

Past, Ongoing and Planned Restorations: Buckthorn removal project and shoreline restoration on 10 acres along west side of lake.

Conservation Strategy: Although the uplands are narrow, restoring high-quality habitat around much of the lake perimeter will reduce sediment and nutrient loading to lake from soil erosion off slopes. Core expansion opportunities exist by protecting adjacent land (including where private lots, St. Thomas Academy, and Patterson Companies, Inc. abut the core). See Appendix J for more discussion of conservation strategies.

8. Oȟéyawahe/Pilot Knob Preserve (City-owned) **and Adjacent Natural Areas**

Approx. Size: 39 acres

Landscape Context: Highway 55/62 along north and east edges, natural lands of Fort Snelling State Park to west, and Acacia Park Cemetery to southwest. Dakota County's Big Rivers Regional Trail runs along the northwest edge of this core.

Core Habitat and Edge Effects: Roundish shape reduces edge effects, and Hwy 55/62 serves as a barrier to the many damaging edge effects associated with residential development. A 10-acre patch of natural forest exists between the cemetery proper and the Preserve, providing a good buffer, but residences to the east increase edge effects overall.

Types and Quality of Ecosystems, Plant Communities, Habitats: A prairie planting a decade ago and ongoing management has restored most of this area's natural character to a quality rank of CD. The remaining portions of this core are generally degraded forest and old field.

Past, Ongoing and Planned Restorations: Site has been threatened by development through the years, but protection efforts by the City and others were successful. In 2017, the site was listed on the National Register of Historic Places. The Pilot Knob Preservation Association was established in 2003 as a nonprofit with the mission of protecting the site and led its nomination to the National Register of Historic Places. The nonprofit is a current partner of the City of Mendota Heights and Dakota County. Great River Greening has managed restoration efforts here for several years at the direction of the City, including prairie management and limited tree and shrub plantings. In December of 2019, the City Council authorized the establishment of the Oȟéyawahe /Pilot Knob Task Force, with the direction to pursue short- and long-term goals for the preservation of, and improvements to, the site. Dakota County is a partner and member of the current Task Force.

Conservation Strategy: Continue ongoing cooperation with Dakota County, Pilot Knob Preservation Assn., and Indigenous communities. Core expansion opportunities exist by protecting adjacent land (including the 10 acres southwest of the Preserve and other adjacent cemetery land). See Appendix J for more discussion of conservation strategies.

9. Copperfield Ponds (City park) **and Adjacent Natural Areas**

Approx. Size: 30 acres (mostly open water)

Landscape Context: Surrounded by residences to the northeast, east, and south, and adjacent to Huber Drive on the west. The Dodge Nature Preserve – Friendly Marsh Core is just northwest of Copperfield Ponds, and Friendly Hills Park is just southwest (both are across Huber Drive). Dakota County's Mendota - Lebanon Hills Greenway runs along the west edge of this core (along Huber Drive).

Core Habitat and Edge Effects: Narrow strips of upland constrain interior core habitat and increase damaging edge effects associated with residential development.

Types and Quality of Ecosystems, Plant Communities, Habitats: Low-quality upland forest, lowland forest, aspen woodland and shrubland, ranging from CD to NN quality. The shallow lakes have some of the better shoreline vegetation in the City, with emergent marsh and wet meadow plants scattered along the shoreline.

Past, Ongoing and Planned Restorations: Past prairie planting. Ongoing removal of Siberian elm and other invasive woody species, and savanna restoration.

Conservation Strategy: There is an opportunity for increased connectivity to Friendly Marsh (across Huber Drive). Core expansion opportunities exist by protecting adjacent land (including where private lots abut the core). See Appendix J for more discussion of conservation strategies.

10. Wentworth Park (City park) **and Adjacent Natural Areas**

Approx. Size: 15 acres

Landscape Context: Residences to north, Dodd Road and condominiums to east, Wentworth Ave. and residences to south, and estates to the west. Core drains west through lowland forest into Valley Park North Core through the private lands.

Core Habitat and Edge Effects: Irregular shape and limited size results in damaging edge effects associated with residential development and only a small amount of core habitat.

Types and Quality of Ecosystems, Plant Communities, Habitats: Low-quality lowland and upland forests, ranging from CD to NN quality.

Past, Ongoing and Planned Restorations: None known.

Conservation Strategy: This core could be expanded within Wentworth Park proper, since much of the park consists of maintained turf. Additional core expansion opportunities exist by protecting adjacent land (including where private lots abut the core, especially to the east). Connectivity could be enhanced along the drainageway to the west. See Appendix J for more discussion of conservation strategies.

4.3.2 Potential Natural Area Connections

As discussed in the preceding section, the City of Mendota Heights park system encompasses significant natural areas (most notably Oȟéyawahe/Pilot Knob and Valley Park); however, the City's largest and highest quality natural habitats are owned by other entities (e.g., Fort Snelling State Park and Dodge Nature Preserve). Connecting these and other core habitats helps sustain native plant and wildlife communities, and therefore is important to achieving the City's conservation goals. Patches of natural lands create "stepping stones" that can be woven together for better ecological connectivity. Waterways, together with their associated, wider floodplain, represent linear aquatic and riparian habitats, and often flow between larger patches of natural upland habitats. Expansion, buffering, enhancement, and additional connections between the City's parks and other natural areas will help protect their ecological health despite inevitable environmental change while simultaneously complementing local and regional trails and greenways enjoyed by people. This long-term resilience will benefit human park users, help secure the persistence of important and uncommon native plant and animal species and reduce management effort.

A Good Conservation Concept is the Foundation for Ecosystem Health

Just managing the vegetation inside a natural area won't stop the past harm to ecosystems and biodiversity. To do that, natural areas need to be part of a larger Conservation Concept. It takes many years of discussion, policy change, and steady work to implement this tool, but incrementally it does these things:

- Builds a system of large core habitats, with transitional areas that buffer edge effects from adjacent incompatible land uses, which damage the interior conditions of natural areas.
- Creates meaningful natural connections among core habitats so that plants and animals can move between cores and survive inbreeding and catastrophic disturbances to any one core.

Figure 22 (above) identifies core habitats within the City as well as general opportunities for expanding these cores and establishing and enhancing ecological connections. The call-out boxes identify just some of the City's potential partners that can help realize this conservation concept (e.g., schools, golf courses, cemeteries, private landowners, all neighboring municipalities). Appendix J provides additional details and recommendations regarding how Mendota Heights can advance this City-wide Conservation Concept, building on the opportunities discussed in Section 4.3.1.

4.3.3 Natural Area Parks

The City of Mendota Heights contains 18 City-owned and managed parks (Figure 7). Many of these parks consist of, or are dominated by, recreational fields and other cultural land covers (e.g., turf). The data reviewed for this NRMP, the field assessments, and discussions with City staff identified these seven areas as Natural Area Parks (NAPs) representing the greatest opportunities for ecological restoration and management (including several of the City's core habitats):

Table 12. Natural Area Parks in the City of Mendota Heights

Natural Area Park	2040 Comprehensive Plan Designation
Valley Park North (north of Maria Ave. W)	Natural Resource Area
Valley Park South (south of Maria Ave. W)	Natural Resource Area
Rogers Lake Park (including land adjacent to park)	Community Park
Copperfield Ponds Park	Natural Resource Area
Wentworth Park	Neighborhood Park
Hagstrom King Park	Neighborhood Park
Friendly Marsh Park	Natural Resource Area

As with most of the metropolitan region's natural areas, reintroduction of natural disturbance regimes and removal and control of invasive vegetation are the greatest conservation needs at these NAPs. Suppression of ground fires, hydrologic alteration, and loss of large grazing animals such as bison have led to shifts in ecosystem structure, composition, and function. Dominance by invasive plants depresses biodiversity and interrupts the normal regenerative processes of native ecosystems, such as tree germination and growth in forests. A well-designed ecosystem management program, using proven restoration and management practices, can address these issues, reverse the degradation that has occurred, and bring these natural areas to a higher level of ecological function and resilience in the face of environmental change.

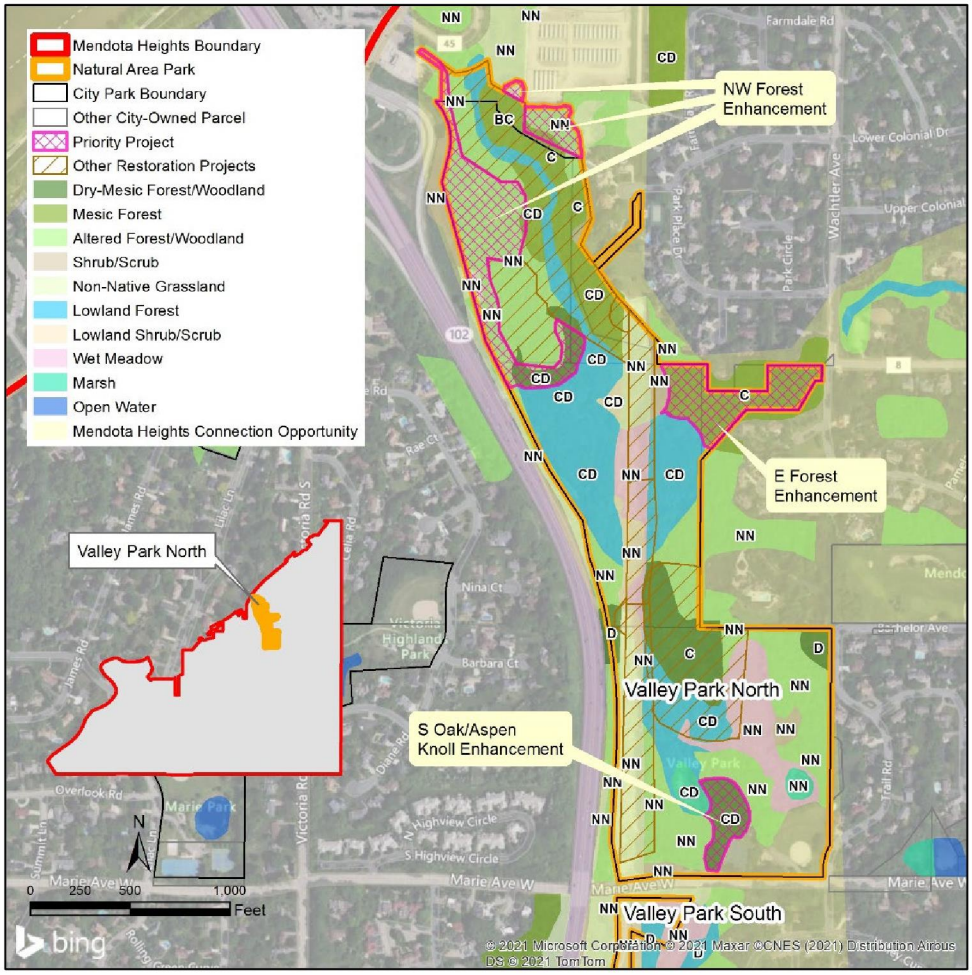
To present the full context of each park or natural area complex, adjacent important natural areas are included in some NAPs. These areas may extend outside the City park boundary, but are important to include for holistic understanding and sustainable management. Each NAP is described below.

Valley Park North

Setting. Valley Park North consists of approximately 77.6 acres of upland, lowland, and aquatic areas in the north-central portion of the City (Figure 23). This is by far the largest City-owned natural area (approximately 72.8 acres) in Mendota Heights. This NAP is bounded by:

North: the City of Lilydale, the Mississippi River Valley, and a Northern States Power tank farm;
East: single-family residential homes;
South: Marie Ave. W., Valley Park South, and single-family residential homes;
West: I-35E and single-family residential homes.

Figure 23. Valley Park North Location and Plant Communities



Characteristics. The vast majority of this NAP consists of a mosaic of natural areas with a network of walking trails (Figure 23). Recreational elements include a ballfield, tennis courts, and play structure. Big Foot/Interstate Valley Creek flows northward through the park, through the City of Lilydale, and into the Mississippi River. Over centuries, the creek and its tributaries have formed steep-sloped valleys in the northern portion of the park, and currently the creek valley and its tributaries are experiencing channel downcutting, bank erosion, and slope failure.

Soils are dominated by Chetek sandy loam in the uplands and Colo silt loam (occasionally flooded) in the lowlands. Chetek soils, found on much of the NAP's moderate slopes, are excessively drained and arose in glacial outwash. In a natural state they were associated with mixed deciduous forests with a heavy oak component. Where fire was a dominant feature of the landscape, oak savannas were the result on these Chetek soils. Colo silt loam is a poorly drained soil that historically supported wet prairies and wet meadows.

Bedrock outcrops are exposed along some of the valley side slopes. An Xcel Energy powerline corridor runs north-south through the center of this NAP, resulting in the maintenance of herbaceous and shrub-scrub conditions. Table 13 and Figure 24 summarize the NAP's City-owned natural and semi-natural plant communities. For each plant community type, the acres, percentage of the NAP's natural area, and quality ranks are provided.

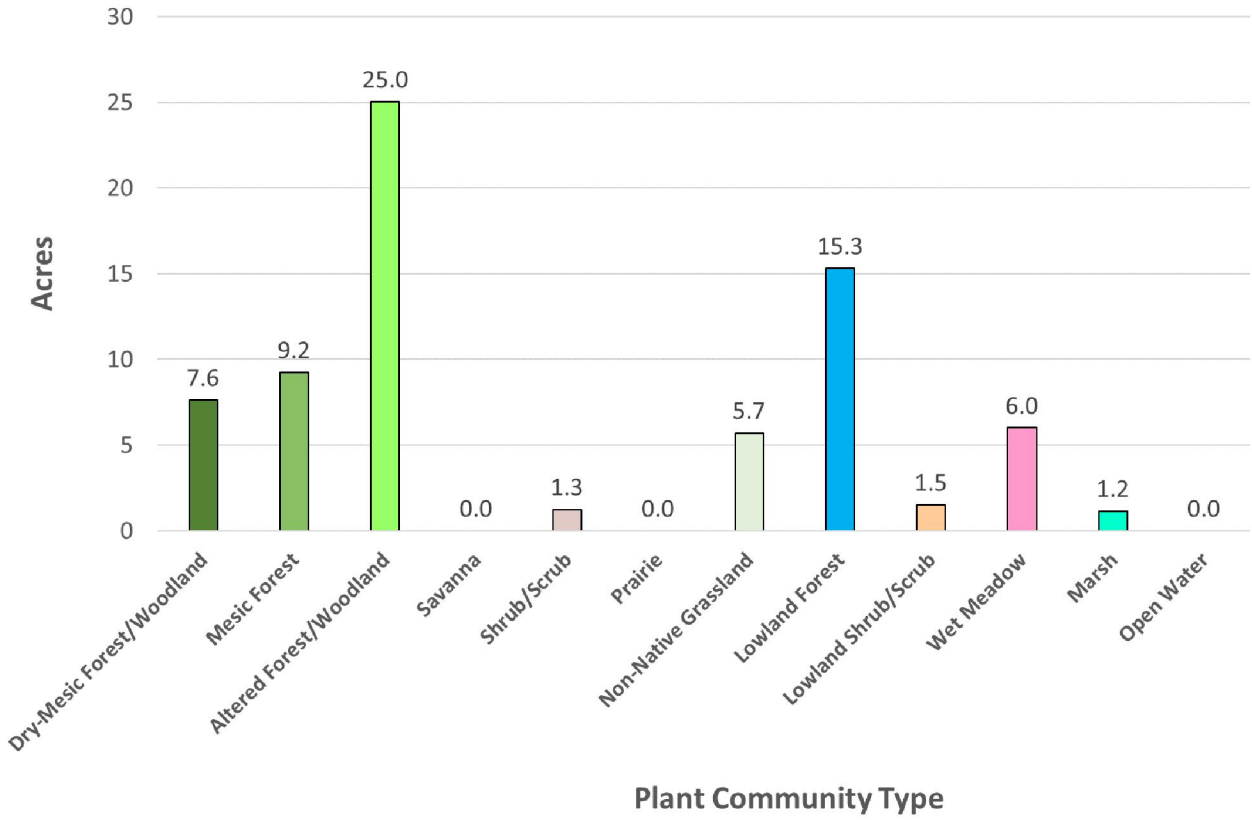
Table 13. Natural/Semi-Natural Vegetation of Valley Park North (City-owned land only)

PLANT COMMUNITIES[1]	ACRES	PERCENT OF PARK NATURAL AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**48.8**	**67.1**	**BC - NN**
Forest/Woodland	**41.9**	**57.5**	**BC - NN**
Mature Forest/Woodland	**16.9**	**23.2**	**BC - D**
Dry-Mesic Forest/Woodland (1)	7.6	10.5	C – D
Mesic Forest (2)	9.2	12.7	BC - CD
Altered Forest/Woodland (3)	25.0	34.4	**NN**
Savanna/Brushland	**1.3**	**1.7**	**NN**
Savanna (4)	0.0	0.0	N/A
Shrub/Scrub (5)	1.3	1.7	NN
Grassland	**5.7**	**7.8**	**NN**
Prairie (6)	0.0	0.0	N/A
Non-Native Grassland (7)	5.7	7.8	NN
Lowland Communities	**24.0**	**32.9**	**CD - NN**
Lowland Forest/Woodland	**15.3**	**21.0**	**CD - D**
Lowland Forest (8)	15.3	21.0	CD - D
Lowland Shrub/Scrub	**1.5**	**2.1**	**CD NN**
Lowland Shrub/Scrub (9)	1.5	2.1	CD - NN
Lowland Herbaceous	**7.2**	**9.8**	**CD - NN**
Wet Meadow (10)	6.0	8.2	DNN
Marsh (11)	1.2	1.6	CD - NN
Open Water (12)	**0.0**	**0.0**	**NA**
Totals	***72.8***	***100***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.2.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate condition; D = Poor condition; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 24. Natural/Semi-Natural Vegetation of Valley Park North (City-owned land only)



Valley Park North contains an area of good to moderate (BC) quality Mesic Forest - one of the City's highest quality native plant communities. Much of this NAP was characterized as moderate to poor quality (CD) due to relatively poor native cover, invasive vegetation, and/or species composition resulting from human disturbances and land use practices over the last 150 years. Big Foot/Interstate Valley Creek and its tributaries drain highly developed watersheds that produce flashy and erosive flows that degrade the Creek and valley slopes. Addressing this scale of damage requires a watershed approach (see Section 4.2.1).

Given that this NAP is the largest City-owned natural area and is adjacent to the important Mississippi River Valley habitat corridor, it provides a unique opportunity for achieving conservation goals – many of which depend on having large natural areas. Through restoration and enhancement of natural areas, habitat can be created and improved for a wide variety of native plant and wildlife species – possibly including Species of Greatest Conservation Need (SGCN). Dakota County's River to River Greenway, which passes through the Park, presents an opportunity to better connect several natural areas (see Section 3.3.1).

The City has worked with several partners (e.g., Great River Greening, Conservation Corps of Minnesota & Iowa, Xcel Energy) on ecological restoration and management projects within the NAP. These include

brushing of invasive buckthorn in multiple locations and establishment of a “pollinator corridor” along the Xcel Energy powerline right-of-way.

As part of Phase 1 of this NRMP, a grant application was submitted to the Outdoor Heritage Fund/Lessard-Sams Conservation Partners Legacy Grants Program. A grant of $50,000 was awarded to the City to restore and enhance much of the northern portion of Valley Park North, focused on the forests and valley slopes. This forest enhancement project began in 2021 and builds on the ongoing adjacent restoration work, and a volunteer planting event is planned for 2022. These projects will illustrate to the public the benefits of ecological restoration and management in bringing about a more biologically diverse, resilient, and attractive plant community.

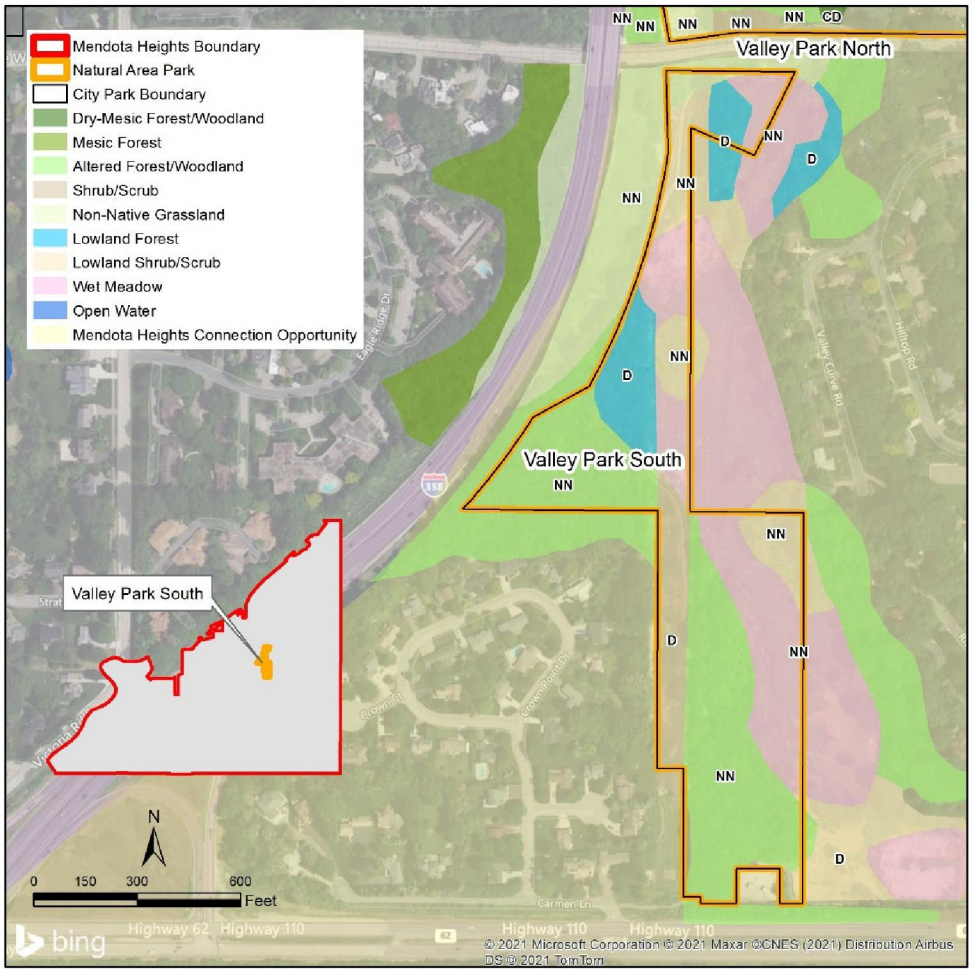
In addition to the ongoing projects above, three Priority Projects were identified in Valley Park North (see yellow call-out boxes on Figure 23). Priority Projects are addressed in Section 4.3.4 and Appendix H.

Valley Park South

Setting. Valley Park South consists of approximately 18 acres of City-owned land. This NAP consists of upland, lowland, and aquatic areas in the north-central portion of the City (Figure 25). Valley Park South is immediately south of Valley Park North, which is by far the largest City-owned natural area in Mendota Heights. Valley Park South is bounded by:

North: Marie Ave. W. and Valley Park North;
East: single-family residential homes;
South: Highway 62 and Mendakota Country Club;
West: I-35E and single-family residential homes.

Figure 25. Valley Park South Location and Plant Communities



Characteristics. This NAP consists of upland and lowland forests, shrubby and turf areas beneath the Xcel powerlines, and shrubby and herbaceous wetlands (Figure 25). Recreational elements are limited to a trail that runs north-south through the park connecting Valley Park North (to the north) down to the north side of Highway 62 and then extending east to other City trails. Big Foot/Interstate Valley Creek flows

northward through the park, through Valley Park North, through the City of Lilydale, and into the Mississippi River. The significant channel downcutting and bank erosion present in portions of Valley Park North is not apparent at Valley Park South.

Soils are dominated by Hawick loamy sand in the uplands and Spillville loam (occasionally flooded) and Seelyeville muck in the lowlands. Hawick soils, found on much of the NAP's moderate to steep slopes, are excessively drained and arose in glacial outwash. In a natural state they were associated with sandy upland prairies. Spillville loam is a somewhat poorly drained soil that historically supported floodplain forest. Seelyeville muck is a very poorly drained, organic soil that is frequently ponded due to its location in floodplains and depressions. Muck soils typically support wet prairies, wet meadows, and marshes.

An Xcel Energy powerline corridor runs north-south through the center of this NAP, resulting in the maintenance of herbaceous and shrub-scrub conditions. Table 14 summarizes the NAP's natural and semi-natural plant communities. For each plant community type, the acres, percentage of the NAP's natural area, and quality ranks are provided.

Table 14. Natural/Semi-Natural Vegetation of Valley Park South (all City-owned land)

PLANT COMMUNITIES[1]	ACRES	PERCENT OF PARK NATURAL AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**9.6**	**53.3**	**D - NN**
Forest/Woodland	**7.6**	**42.5**	**NN**
Mature Forest/Woodland	0.0	0.0	N/A
Dry-Mesic Forest/Woodland (1)	0.0	0.0	N/A
Mesic Forest (2)	0.0	0.0	N/A
Altered Forest/Woodland (3)	7.6	42.5	NN
Savanna/Brushland	**1.6**	**8.8**	**NN**
Savanna (4)	0.0	0.0	N/A
Shrub/Scrub (5)	1.6	8.8	D
Grassland	**0.4**	**2.0**	**NN**
Prairie (6)	0.0	0.0	N/A
Non-Native Grassland (7)	0.4	2.0	NN
Lowland Communities	**8.4**	**46.7**	**D - NN**
Lowland Forest/Woodland	**1.8**	**9.9**	**D**
Lowland Forest (8)	1.8	9.9	D
Lowland Shrub/Scrub	**2.1**	**11.4**	**D - NN**
Lowland Shrub/Scrub (9)	2.1	11.4	D - NN
Lowland Herbaceous	**4.6**	**25.3**	**NN**
Wet Meadow (10)	4.6	25.3	NN
Marsh (11)	0.0	0.0	N/A
Open Water (12)	**0.0**	**0.0**	**N/A**
Totals	***18.0***	***100***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.2.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate condition; D = Poor condition; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Valley Park South was characterized as a mosaic of altered/disturbed and poor quality habitat (D) due to poor native cover, invasive vegetation, and/or species composition resulting from human disturbances and land use practices over the last 150 years. As mentioned above under Valley Park North, Big Foot/Interstate Valley Creek and its tributaries drain highly developed watersheds that produce flashy and erosive flows that degrade the Creek and valley slopes. Addressing this scale of damage requires a watershed approach (see Section 4.2.1).

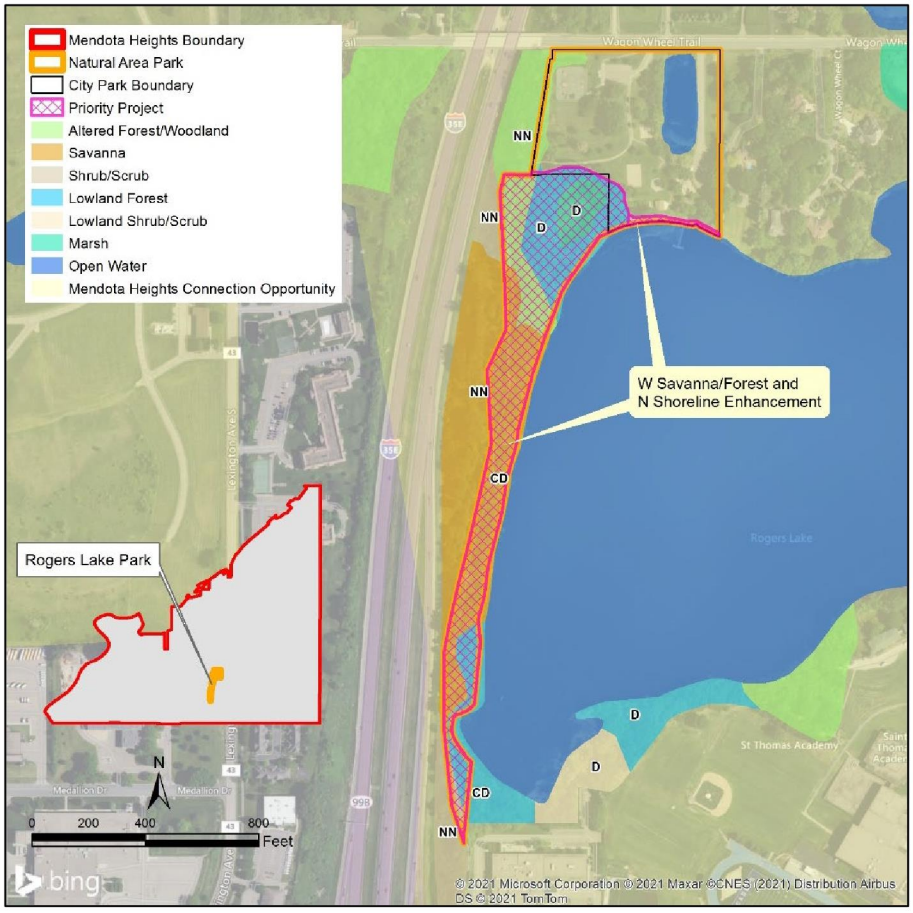
Ecological restoration and management projects are not currently occurring in this NAP. This is due to its generally degraded condition and the restoration and management challenges associated with the significant wetland portion of the NAP. Therefore, no Priority Projects were identified in Valley Park South.

Rogers Lake Park

Setting. Rogers Lake Park is located in the south-central portion of the City. The City-owned parkland consists of approximately eight acres, but the City has an agreement with Mn/DOT that permits ecological management beyond the City park boundary along the I-35E right-of-way adjacent to the west and south of the Park. Therefore, this NAP extends south of the Park limits along the west shore of Rogers Lake (Figure 26). This 15.5-acre NAP is bounded by:

North: Wagon Wheel Trail, single-family residential homes, and Mendakota Golf Course;
East: single-family residential homes and Rogers Lake;
South: Patterson Companies, Inc., Mendota Heights Road, and the I-494/I-35E interchange;
West: I-35E and apartment complexes.

Figure 26. Rogers Lake Park Location and Plant Communities



Characteristics. The majority of the northern portion of this NAP is developed, containing a skate park, playground, picnic shelter, volleyball courts, basketball court, parking lots, and a fishing pier. A stormwater pond is located near the northeast corner of the NAP. The more natural, southern portion of this NAP consists of a historical savanna and lowland/altered forests along the west shore of Rogers Lake

(Figure 26). A popular trail runs along the western edge of the NAP, connecting the park (on the north) to Mendota Heights Road (on the south) and the larger City trail system.

Soils are dominated by Kanaranzi loam in the uplands and Mayer and Quam silt loam in the lowlands. Kanaranzi soils, found along the NAP's western shore of Rogers Lake, have gentle to moderate slopes, are well drained, and arose in outwash plains. In a natural state they were associated with sandy upland prairies, as well as savanna. The majority of the developed portion of the park lies on Mayer silt loam, a poorly drained soil of outwash origin that probably historically supported wet prairies and wet meadows. The NAP's Lowland Forest and Marsh (Figure 26) contain Quam silt loam, a very poorly drained soil of glaciolacustrine sediments that historically supported depressional marsh (as some of this area currently does today).

Table 15 summarizes the NAP's City-owned natural and semi-natural plant communities; most of the NAPs natural areas lie outside of the City park boundary. For each plant community type, the acres, percentage of the NAP's natural area, and quality ranks are provided.

Table 15. Natural/Semi-Natural Vegetation of Rogers Lake Park (City-owned land only)

PLANT COMMUNITIES[1]	ACRES	PERCENT OF PARK NATURAL AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**0.4**	**24.8**	**NN**
Forest/Woodland	**0.4**	**23.7**	**NN**
Mature Forest/Woodland	0.0	0.0	N/A
Dry-Mesic Forest/Woodland (1)	0.0	0.0	N/A
Mesic Forest (2)	0.0	0.0	N/A
Altered Forest/Woodland (3)	0.4	23.7	NN
Savanna/Brushland	**0.0**	**1.1**	**NN**
Savanna (4)	0.0	1.1	NN
Shrub/Scrub (5)	0.0	0.0	N/A
Grassland	**0.0**	**0.0**	N/A
Prairie (6)	0.0	0.0	N/A
Non-Native Grassland (7)	0.0	0.0	N/A
Lowland Communities	**1.2**	**75.2**	**CD - D**
Lowland Forest/Woodland	**0.3**	**19.3**	**CD - D**
Lowland Forest (8)	0.3	19.3	CD - D
Lowland Shrub/Scrub	**0.0**	**0.0**	**N/A**
Lowland Shrub/Scrub (9)	0.0	0.0	N/A
Lowland Herbaceous	**0.0**	**0.0**	**N/A**
Wet Meadow (10)	0.0	0.0	N/A
Marsh (11)	0.0	0.0	N/A
Open Water (12)	**0.9**	**55.9**	**N/A**
Totals	***1.6***	***100***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.2.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate condition; D = Poor condition; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Much of Rogers Lake Park consists of cultural landscapes (e.g., turf and park amenities) and forests and savannas of poor quality due to relatively poor native cover, invasive vegetation, and/or species composition resulting from human disturbances and land use practices over the last 150 years. A strip of CD quality Savanna exists along the west shore of Rogers Lake, where ongoing volunteer efforts have removed invasive buckthorn, enhancing this savanna remnant. Buckthorn removal has recently extended into some of the NAPs Lowland Forests as well. Years ago, the northwest shoreline of the Lake was restored as a native buffer. Currently, this shoreline exhibits moderate cover and diversity by native plant species west of the fishing pier, but east of the pier has poor native cover and diversity.

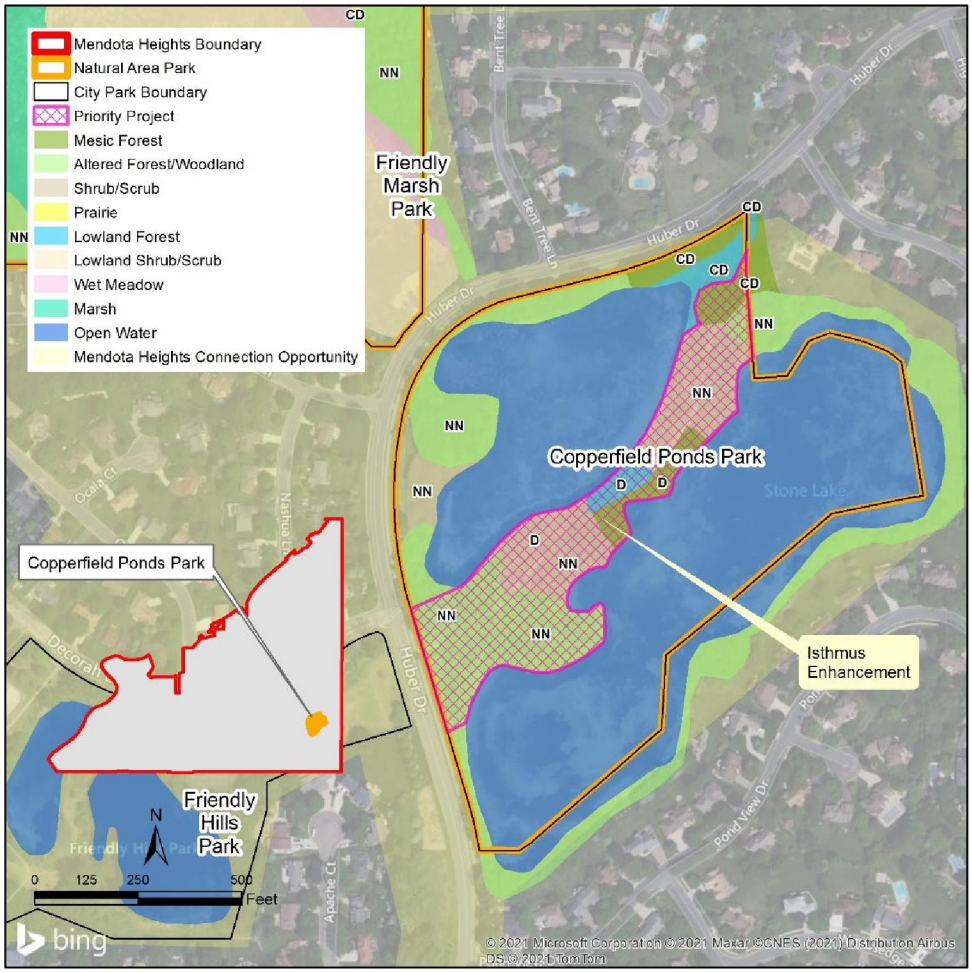
In order to build on previous volunteer efforts in this NAP (in Savanna, Lowland Forest, and shoreline buffer areas), one Priority Project was identified in Rogers Lake Park (see yellow call-out box on Figure 26). Priority Projects are addressed in Section 4.3.4 and Appendix H.

Copperfield Ponds Park

Setting. Copperfield Ponds Park is located in the southeastern portion of the City just east of Friendly Hills Park. The majority of the 24.6-acre Copperfield Ponds Park consists of two open water wetlands with upland parkland present on an isthmus between the waterbodies and along the shoreline of the northwest wetland (Figure 27). This NAP is bounded by:

North: Huber Drive, Friendly Marsh Park, single-family residential homes, and Dodge Nature Preserve;
East: single-family residential homes;
South: single-family residential homes;
West: single-family residential homes and Friendly Hills Park.

Figure 27. Copperfield Ponds Park Location and Plant Communities



Characteristics. The NAP's wetlands are shallow ponds that contain floating and submersed aquatic vegetation. The uplands consist of a mosaic of disturbed and remnant natural areas, including forests, woodlands, shrublands, and grasslands. A walking trail runs through the center of the park along the isthmus.

Soils are dominated by Chetek sandy loam and Crystal Lake silt loam in the uplands and Quam silt loam and open water in the lowlands. Chetek soils, found along the NAP's isthmus, are somewhat excessively drained and arose in glacial outwash. In a natural state they were associated with deciduous forests and savannas. Crystal Lake silt loam was mapped in the northwest portion of the NAP and consists of moderately well drained soils originating from glaciolacustrine sediments. In their natural state, these soils typically supported loamy upland forests. Quam silt loam is a very poorly drained soil that also originated from glaciolacustrine sediments and historically supported depressional marsh.

Table 16 summarizes the NAP's natural and semi-natural plant communities. For each plant community type, the acres, percentage of the NAP's natural area, and quality ranks are provided.

Table 16. Natural/Semi-Natural Vegetation of Copperfield Ponds Park (all City-owned land)

PLANT COMMUNITIES[1]	ACRES	PERCENT OF PARK NATURAL AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**7.6**	**31.0**	**CD - NN**
Forest/Woodland	**5.2**	**21.0**	**CD - NN**
Mature Forest/Woodland	1.0	4.1	CD - D
Dry-Mesic Forest/Woodland (1)	0.0	0.0	N/A
Mesic Forest (2)	1.0	4.1	CD - D
Altered Forest/Woodland (3)	4.2	16.9	NN
Savanna/Brushland	**2.5**	**10.0**	**D - NN**
Savanna (4)	0.0	0.0	N/A
Shrub/Scrub (5)	2.5	10.0	D - NN
Grassland	**0.0**	**0.0**	**N/A**
Prairie (6)	0.0	0.0	N/A
Non-Native Grassland (7)	0.0	0.0	N/A
Lowland Communities	**17.0**	**69.0**	**CD - D**
Lowland Forest/Woodland	**0.5**	**2.2**	**CD - D**
Lowland Forest (8)	0.5	2.2	CD - D
Lowland Shrub/Scrub	**0.0**	**0.0**	**N/A**
Lowland Shrub/Scrub (9)	0.0	0.0	N/A
Lowland Herbaceous	**0.0**	**0.0**	**N/A**
Wet Meadow (10)	0.0	0.0	N/A
Marsh (11)	0.0	0.0	N/A
Open Water (12)	**16.4**	**66.8**	**N/A**
Totals	***24.6***	***100***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.2.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate condition; D = Poor condition; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Copperfield Ponds Park consists of moderate to poor (CD) to altered/degraded habitats due to poor native cover, invasive vegetation, and/or species composition resulting from human disturbances and land use practices over the last 150 years. Recent volunteer efforts have removed invasive Siberian elm, Amur maple, and buckthorn in portions of this park, and years ago native prairie seeding occurred in portions of the Park.

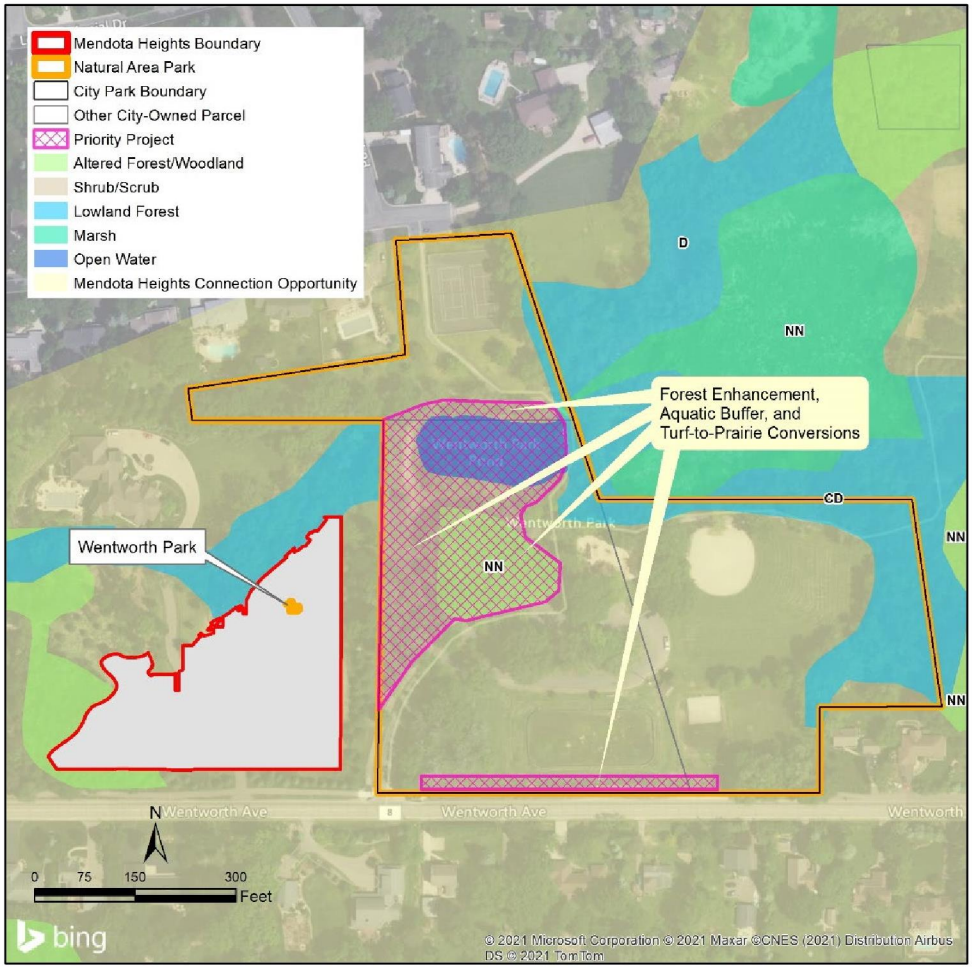
In order to build on previous volunteer efforts in this NAP (primarily along the isthmus), one Priority Project was identified in Copperfield Ponds Park (see yellow call-out box on Figure 27). Priority Projects are addressed in Section 4.3.4 and Appendix H.

Wentworth Park

Setting. Wentworth Park is located in the northeastern portion of the City. The majority of the 10.4-acre Park consists of mowed turf and park amenities (Figure 28). This NAP is bounded by:

North: single-family residential homes;
East: single-family residential homes, condominiums/townhomes, and Somerset Country Club;
South: Wentworth Avenue and single-family residential homes;
West: large estate and single-family residential homes.

Figure 28. Wentworth Park Location and Plant Communities



Characteristics. The majority of this NAP is developed parkland containing a baseball field, ice hockey rink, tennis courts, playground, picnic shelters, and a pond. A stand of degraded forest exists in the west-central portion of this NAP (Figure 28). Trails connect the NAP's parking area to the neighborhoods north and east of the Park and to Wentworth Ave. W to the south.

Soils are dominated by Cylinder loam and Kato silty clay loam in the uplands and Klossner muck in the lowlands. Cylinder soils, found in the southwestern portion of the NAP, are generally flat, somewhat poorly drained, and arose in fine-loamy glaciofluvial deposits over sandy and gravelly outwash. In a natural state they were associated with sandy upland prairies, as well as savanna. Kato soils, occupying an east-west band through the center of the Park, are poorly drained, hydric soils found on flat outwash deposits. While these soils likely supported wet prairie in the past, this area of the NAP is not currently wetland. Klossner muck, a hydric, organic soil, was mapped around the NAP's pond and in the eastern portion of the ballfield. This soil is very poorly drained and historically supported marsh.

Table 17 summarizes the NAP's natural and semi-natural plant communities. For each plant community type, the acres, percentage of the NAP's natural area, and quality ranks are provided.

Table 17. Natural/Semi-Natural Vegetation of Wentworth Park (all City-owned)

PLANT COMMUNITIES[1]	ACRES	PERCENT OF PARK NATURAL AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**0.5**	**23.9**	**NN**
Forest/Woodland	**0.5**	**23.9**	**NN**
Mature Forest/Woodland	0.0	0.0	N/A
Dry-Mesic Forest/Woodland (1)	0.0	0.0	N/A
Mesic Forest (2)	0.0	0.0	N/A
Altered Forest/Woodland (3)	0.5	23.9	NN
Savanna/Brushland	**0.0**	**0.0**	**N/A**
Savanna (4)	0.0	0.0	N/A
Shrub/Scrub (5)	0.0	0.0	N/A
Grassland	**0.0**	**0.0**	**N/A**
Prairie (6)	0.0	0.0	N/A
Non-Native Grassland (7)	0.0	0.0	N/A
Lowland Communities	**1.7**	**76.1**	**CD - NN**
Lowland Forest/Woodland	**1.2**	**55.3**	**CD - D**
Lowland Forest (8)	1.2	55.3	CD - D
Lowland Shrub/Scrub	**0.0**	**0.0**	**N/A**
Lowland Shrub/Scrub (9)	0.0	0.0	N/A
Lowland Herbaceous	**0.0**	**0.4**	**NN**
Wet Meadow (10)	0.0	0.0	N/A
Marsh (11)	0.0	0.4	NN
Open Water (12)	**0.4**	**20.5**	**N/A**
Totals	***2.2***	***100***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.2.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate condition; D = Poor condition; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

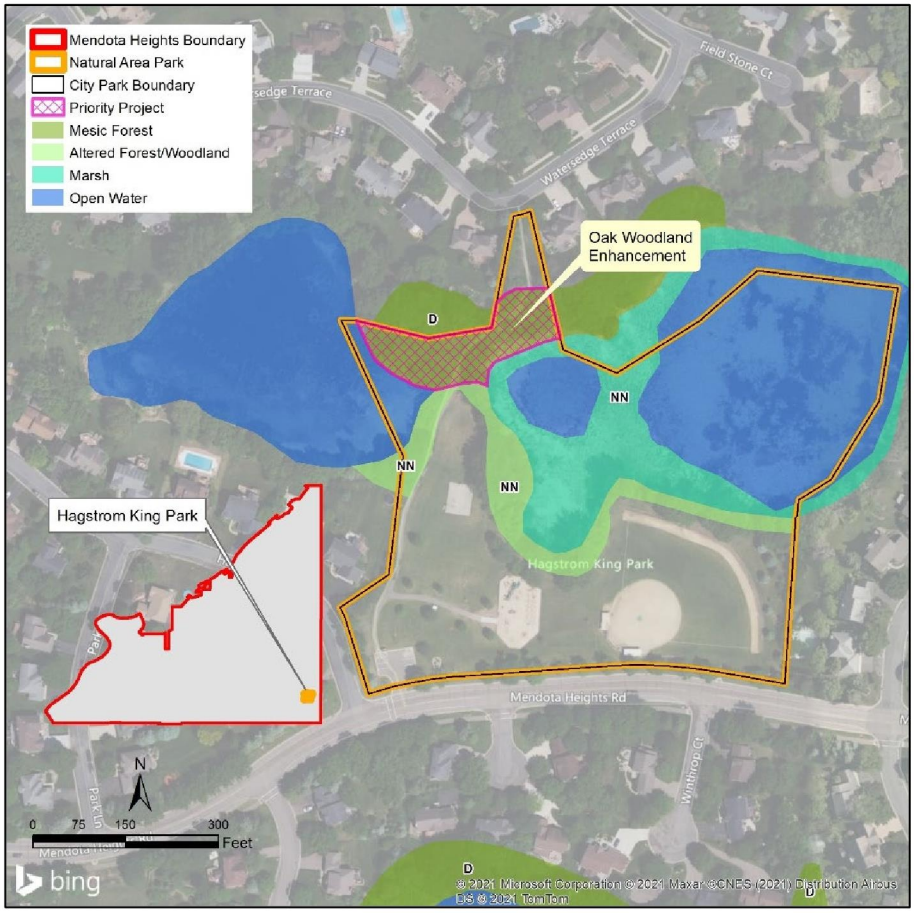
Wentworth Park's patch of forest represents an altered/degraded habitat with planted conifers, volunteer tree species (e.g., Boxelder), and poor ground layer vegetation. Lowland Forest on the east edge of the NAP is CD quality, based on poor native cover, invasive vegetation, and/or species composition resulting from human disturbances and land use practices over the last 150 years. One Priority Project (consisting of four locations, Figure 28) was identified in Wentworth Park; this is addressed further in Section 4.3.4 and Appendix H.

Hagstrom King Park

Setting. Hagstrom King Park is located in the southeastern portion of the City. About half of the 9.9-acre Park consists of mowed turf and park amenities (Figure 29). This NAP is bounded by:

North: single-family residential homes and a pond;
East: single-family residential homes;
South: Mendota Heights Road, single-family residential homes, and a pond;
West: single-family residential homes and a pond.

Figure 29. Hagstrom King Park Location and Plant Communities



Characteristics. About half of this NAP is developed parkland containing a baseball field, playground, and basketball court. A stand of degraded (D quality) Mesic Forest/oak woodland exists in the northwest portion of this NAP, and altered/non-native Lowland Forest and Altered Forest/Woodland exist around the NAPs ponds, extended off-site to the northeast and northwest (Figure 29). A trail connects Mendota Heights Road on the south to the neighborhood north of the Park.

Soils consist of Chetek and Kingsley sandy loams in the uplands and Auburndale and Quam silt loams in the lowlands. Chetek soils, found in the southwestern portion of the NAP, are rolling, somewhat excessively drained, and arose from outwash plains and moraines. In a natural state they were associated with mixed deciduous forests with a heavy oak component. Where fire was a dominant feature of the landscape, oak savannas were the result on these Chetek soils. Kingsley soils, found in the northern and eastern portions of the NAP, are well-drained soils of glacial till origin and are typically found on slopes. The northern map unit of this soil is associated with the NAP's Mesic Forest (located on a south-facing slope); however, the eastern map unit encompasses much of the (flat) ballfield and adjacent area of planted trees. Historically Kingsley soils supported loamy upland savannas. Auburndale soils, poorly drained and derived from glaciofluvial sediments, occupy the generally flat central portion of the NAP, including portions of the site's marshes and ballfield. These soils historically supported wet prairie. Quam soils are topographically lower and wetter than Auburndale soils. Quam's very poorly drained, frequently ponded soils are of glaciolacustrine origin and are mapped throughout the NAP's northeast and northwest ponds. These depressional areas historically supported marsh, as they do today.

Table 18 summarizes the NAP's natural and semi-natural plant communities. For each plant community type, the acres, percentage of the NAP's natural area, and quality ranks are provided.

Table 18. Natural/Semi-Natural Vegetation of Hagstrom King Park

PLANT COMMUNITIES[1]	ACRES	PERCENT OF PARK NATURAL AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**1.3**	**23.7**	**D - NN**
Forest/Woodland	**1.3**	**23.7**	**D - NN**
Mature Forest/Woodland	0.6	10.2	D
Dry-Mesic Forest/Woodland (1)	0.0	0.0	N/A
Mesic Forest (2)	0.6	10.2	D
Altered Forest/Woodland (3)	0.8	13.5	NN
Savanna/Brushland	**0.0**	**0.0**	**N/A**
Savanna (4)	0.0	0.0	N/A
Shrub/Scrub (5)	0.0	0.0	N/A
Grassland	**0.0**	**0.0**	**N/A**
Prairie (6)	0.0	0.0	N/A
Non-Native Grassland (7)	0.0	0.0	N/A
Lowland Communities	**4.3**	**76.3**	**NN**
Lowland Forest/Woodland	**0.0**	**0.0**	**N/A**
Lowland Forest (8)	0.0	0.0	N/A
Lowland Shrub/Scrub	**0.0**	**0.0**	**N/A**
Lowland Shrub/Scrub (9)	0.0	0.0	N/A
Lowland Herbaceous	**1.3**	**22.3**	**NN**
Wet Meadow (10)	0.0	0.0	N/A
Marsh (11)	1.3	22.3	NN
Open Water (12)	**3.1**	**54.0**	**N/A**
Totals	***5.7***	***100***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.2.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate condition; D = Poor condition; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

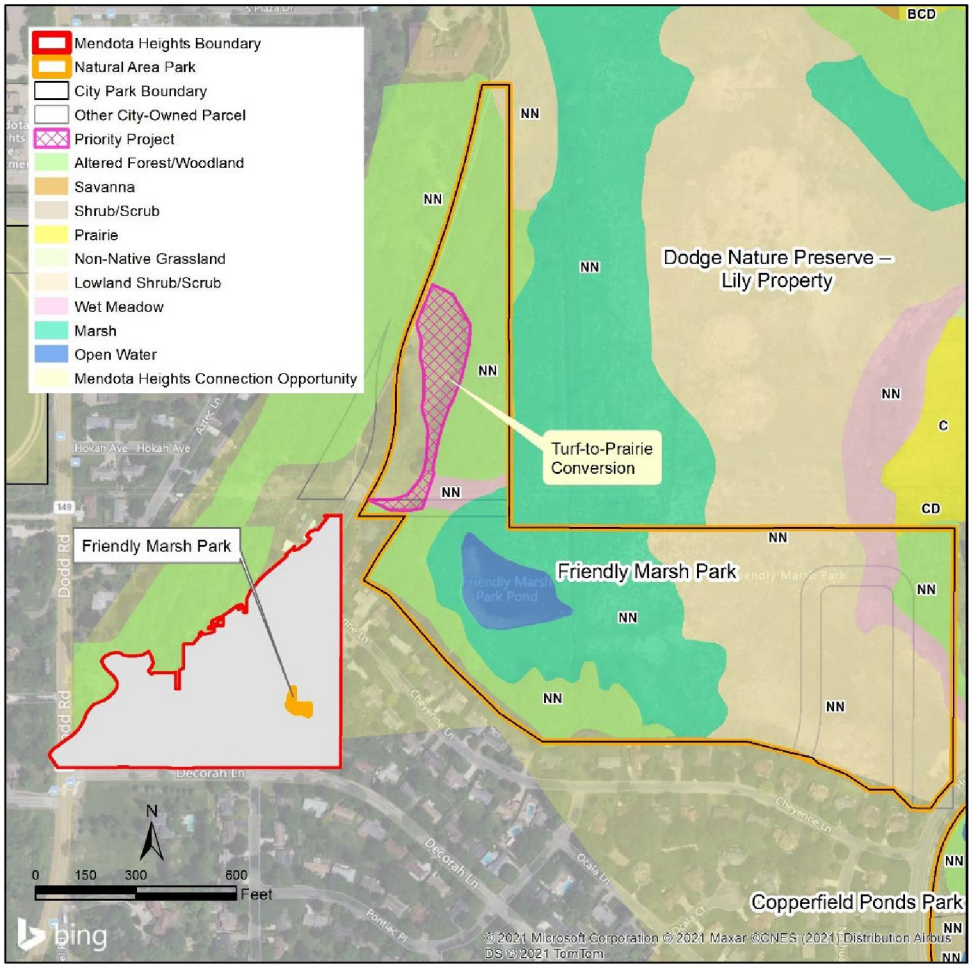
Hagstrom King Park's natural and semi-natural plant communities include a small patch of poor (D quality) Mesic Forest/oak woodland. Oak wilt has killed several of the native oaks in this stand of forest/woodland, but several mature oaks continue to persist, especially in the western portion of the woodland. Altered/non-native (quality rank NN) forests and marshes are associated with the NAP's wetlands and ponds. Quality ranks are based on poor native cover, invasive vegetation, and/or species composition resulting from human disturbances and land use practices over the last 150 years. One Priority Project was identified in Hagstrom King Park (see yellow call-out box on Figure 29); this is addressed further in Section 4.3.4 and Appendix H.

Friendly Marsh Park

Setting. Friendly Marsh Park is located in the southeastern portion of the City. The majority of the 32-acre Park consists of Friendly Marsh and adjacent forests (Figure 30). This NAP is bounded by:

North: apartments, strip mall, and Highway 62;
East: Friendly Marsh and Dodge Nature Preserve – Lily Property;
South: single-family residential homes and Copperfield Ponds Park;
West: strip of forest owned by Dakota County Community Development Agency, single-family residential homes, and Mendakota Park.

Figure 30. Friendly Marsh Park Location and Plant Communities



Characteristics. Most of this NAP consists of Friendly Marsh and forests along its perimeter. A strip of mowed turf exists on the western edge of the Park (Figure 30). A trail meanders through the turf portion of the Park, connecting the neighborhood to the west with the one to the north.

Soils are dominated by lowland/wetland soils: Klossner muck, Quam silt loam, and Udorthents, wet. Klossner is a hydric, organic soil that is very poorly drained. Quam is a very poorly drained, frequently ponded soil of glaciolacustrine origin. Both of these soil map units historically supported marsh, as they do today. Udorthents, mapped along the western edge of the NAP (generally the turf portion of the NAP), are disturbed soils often consisting of fill.

Table 19 summarizes the NAP's natural and semi-natural plant communities. For each plant community type, the acres, percentage of the NAP's natural area, and quality ranks are provided.

Table 19. Natural/Semi-Natural Vegetation of Friendly Marsh Park

PLANT COMMUNITIES[1]	ACRES	PERCENT OF PARK NATURAL AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**8.4**	**29.4**	**NN**
Forest/Woodland	**8.4**	**29.3**	**NN**
Mature Forest/Woodland	0.0	0.0	N/A
Dry-Mesic Forest/Woodland (1)	0.0	0.0	N/A
Mesic Forest (2)	0.0	0.0	N/A
Altered Forest/Woodland (3)	8.4	29.3	NN
Savanna/Brushland	**0.0**	**0.0**	**N/A**
Savanna (4)	0.0	0.0	N/A
Shrub/Scrub (5)	0.0	0.0	N/A
Grassland	**0.0**	**0.0**	**N/A**
Prairie (6)	0.0	0.0	N/A
Non-Native Grassland (7)	0.0	0.0	N/A
Lowland Communities	**20.3**	**70.6**	**NN**
Lowland Forest/Woodland	**0.0**	**0.0**	**N/A**
Lowland Forest (8)	0.0	0.0	N/A
Lowland Shrub/Scrub	**10.4**	**36.1**	**NN**
Lowland Shrub/Scrub (9)	10.4	36.1	NN
Lowland Herbaceous	**8.6**	**29.9**	**NN**
Wet Meadow (10)	1.5	5.2	NN
Marsh (11)	7.1	24.8	NN
Open Water (12)	**1.3**	**4.6**	**N/A**
Totals	***28.8***	***100***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.2.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate condition; D = Poor condition; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Friendly Marsh consists of a complex of marsh, shrub swamp, and wet meadow. These wetland plant communities are dominated by non-native, invasive species (primarily reed canary grass, narrow-leaved cattail, and hybrid cattail), resulting in a quality rank of NN (altered/non-native). However, native shrubs,

grasses, sedges, and forbs are scattered throughout much of the marsh. Altered Forest/Woodland (NN) exists along the edge of the marsh. Quality ranks are based on poor native cover, invasive vegetation, and/or species composition resulting from human disturbances and land use practices over the last 150 years. One Priority Project (see yellow call-out box on Figure 30) was identified in Friendly Marsh Park; this is addressed further in Section 4.3.4 and Appendix H.

4.3.4 Priority Projects

Section 4.3.1 identifies and prioritizes broad-scale, City-wide conservation opportunities, focusing on the City's core habitats. However, several of those natural areas are managed by other entities or are located on private lands. Section 4.3.3 identifies the City's seven NAPs, which represent the best parklands to advance the City's natural resources program. Phasing in of system-wide ecological restoration and management in the City's natural areas will take many years. Therefore, priorities need to be established to schedule actions in a strategic and efficient manner. Prioritization can be based on a variety of considerations, including location considerations (e.g., protection of high-quality plant communities and managing areas of previous investment), cultural considerations (e.g., safety issues and educational programs and opportunities), and specific actions (e.g., control of noxious invasive species).

Based on our field assessment, restoration potential, previous investments, visibility, feasibility, and discussions with City staff, the following eight Priority Projects (A through H) were identified. Priority Projects represent discrete restoration and management projects located within the City's NAPs (see Figures 23 and 25 - 30). Several of these Priority Projects represent higher quality natural areas, areas with better restoration potential, and/or areas where initial investments have been made, but additional short-term establishment management is warranted.

Valley Park North

A. NW Forest Enhancement
B. E Forest Enhancement
C. S Oak/Aspen Knoll Enhancement

Rogers Lake Park

D. W Savanna/Forest & N Shoreline Enhancement

Copperfield Ponds Park

E. Isthmus Enhancement

Wentworth Park

F. Forest Enhancement, Aquatic Buffer & Turf-to-Prairie

Hagstrom King Park

G. Oak Woodland Enhancement

Friendly Marsh Park

H. Turf-to-Prairie

Appendix H provides Management Briefs for each of the eight above Priority Projects. The Management Briefs summarize and characterize each Priority Project, including a project area overview, plant communities, existing ecological quality, issues to address, goals, recommended restoration and management tasks (strategies), restoration and management costs (over the first three years of work), a general implementation schedule, indicators of success, and a map. Species lists appropriate for restoring or enhancing Mendota Heights' native plant communities are referenced in each Management Brief and provided in Appendix I (MNDNR 2005).

4.3.5 How Work Gets Done

Implementation of the City's priority restoration and management projects will require additional planning and capacity. In addition to City funds, ecological work can be advanced by using volunteers, hiring professional ecological contractors, and engaging partners.

Volunteers

Volunteers provide opportunities for cost-savings during implementation of restoration and management programs. Volunteers learn about ecological restoration and the natural world and may develop or strengthen their personal connections to City parks. Currently, the City of Mendota Heights does not have an organized volunteer program. Staffing investments are necessary to operate a safe, effective, and sustainable volunteer program.

Many benefits can arise from engaging volunteers in a specialized natural resource management volunteer program:

- The public learns about natural resources, increasing their awareness and appreciation of natural areas and the natural world.
- Valuable data can be collected for baseline and trend monitoring.
- Cost-savings to the MPRB through volunteer labor and in-kind match for grants.
- Building community and appreciation of MPRB parks.

Natural resources volunteers typically conduct physical work (e.g., planting, seeding, removing invasive species). Additionally, volunteers can be used effectively for monitoring and research (e.g., field observations, data collection, and data analysis). Volunteer monitoring/research advances knowledge and builds public support for natural resource programs. Some volunteer activities require oversight, typically provided by City staff, trained volunteers, or partners (e.g., Great River Greening).

Volunteers can assist in a variety of tasks, and with additional training and oversight they can effectively accomplish tasks. Some volunteer tasks may be one-time events, and other tasks may be repeated over time by dedicated volunteer stewards. Table 20 presents how the City envisions conducting various restoration tasks, with a focus on how volunteers can assist.

Table 20. Using City Staff/CCMI[1], Volunteers & Private Contractors for Ecological Tasks

Restoration Tasks	City Staff/ CCMI	Volunteers			Professional Ecological Contractor	Equipment Source	Comments
		Generally Appropriate	*Appropriate With Training & Supervision*	*Not Appropriate*			**Use Check-In & Check-Out Equipment Procedure & List*
Collect native seed	X		X		X	City	Collecting buckets, seed bags
Hand-broadcasting native seed	X		X		X	N.A.	Small areas
Machine-broadcast/drill native seed	X				X		Truax seed drill, Vicon seed spreader, light tractor with PTO; Ford 150-style truck and trailer to haul equipment
Install live trees, shrubs, herbaceous plugs	X		X		X	City	Spades, trowels, pruning shears, watering equipment, weed wrench (City provides plants, mulch, stakes, guys, protective screening, PPE (goggles, yellow vests; cart; safety cones); younger people do not plant well and work often needs to be re-done
Hand-pull invasive plants	X		X		X	Volunteer provides gloves, City provides rest	Weed wrenches, gloves, PPE (goggles & yellow vests), bags or disposal vessels, shoe brushes to remove invasive plant seed/dirt
Drag & clear-cut brush	X	X			X	Volunteer provides gloves, City provides rest	Gloves, PPE (goggles & yellow vest), shoe brushes to remove invasive plant seed/dirt
Hand-cut brush	X		X		X	Volunteer provides gloves and cutting tools	Loppers, hand saws; adults can use all equipment; 12-18 year-olds cannot use loppers or saws unless it's personal equipment and adults are nearby; gloves, PPE
Machine-cut brush	X				X		Chain saws, brush saws, forestry mower on tracked skid steer; PPE including hard-hats, chaps, and face shields
Apply herbicide	X			X	X		Applicator wands and sponges, backpack sprayers, 50-gal ATV-mounted spray rig with hose sprayer or boom sprayer; PPE, including full-body protective suits

Restoration Tasks	City Staff/ CCMI	Volunteers			Professional Ecological Contractor	Equipment Source	Comments
		Generally Appropriate	***Appropriate With Training & Supervision***	***Not Appropriate***			**Use Check-In & Check-Out Equipment Procedure & List*
Conduct prescribed burns	X			X	X		Drip torches (2), backpack sprayers/Indian pumps (5), swatters (4), rakes (4), 50-gal water tank mounted on ATV, mowers and leaf-blowers for creating fire breaks in grass and woodlands (respectively), walkie-talkies, fuel tanks
Stabilize slopes, streambanks, lakeshores	X		X		X	Volunteer provides gloves, City provides rest	Coir logs, erosion control mats, stakes, rock, (see above for seed & live plugs), live stakes, etc.; mallets, shovels; PPE
Mow or hay by hand	X		X		X	Volunteer provides gloves and cutting/mowing equipment if necessary	Weed whips, scythes, sickles, hand mowers; adults only for weed whips, if they bring their own; PPE
Mow or hay by tractor, etc.	X				X		Tractor-pulled, 8-foot deck flail-mower to mow; tractor-pulled hay-cutter and baler for haying; truck and trailer for hauling equipment and hay bales
Construct best practices for water management	X		X		X	Volunteer provides gloves, City provides rest	Planting, weeding, drain stenciling; nothing structural; (see above for planting & weeding equipment);
Conduct simple ecological monitoring	X		Adults primarily (young people can assist)		X		Walkabout for annual workplan & bioblitz for baseline data; simple photo-point documentation; simple annual count of organisms (e.g. already doing WEP & CAMP); statistically valid randomized sampling for year-to-year change detection
Conduct ecological monitoring for permit compliance & technical standards	X		X		X		Specific to monitoring needs

[1] CCMI = Conservation Corps of Minnesota & Iowa

Ecological Contractors

Private, professional ecological contractors have staff, equipment, and experience to efficiently implement natural resource restoration and management projects. Unlike non-profits and government, however, their overhead costs must be included in their prices in order to remain viable businesses. When used, qualified ecological contractors should meet the following criteria:

- Firm has local project experience in the past five years providing the specific ecological restoration and management tasks required for the project.
- On-site field supervisor(s) overseeing project implementation communicate effectively through verbal and written communication and are present on site or available at all times during work. Field supervisor(s) should have a minimum of five years' experience conducting ecological restoration and vegetation management in the region.
- Proper training and certifications for restoration and management activities with inherent risks, such as use of heavy equipment, herbicides, chainsaws, and prescribed fire.
- Positive references from past clients.
- Sufficient bonding for the work being performed.

While professional contractors are typically more expensive than using in-house resources and volunteers, qualified contractors complete high-quality work efficiently and meet performance standards under their guarantee. Bidding documents and specifications should state required qualifications for contractors (such as those listed above), project schedules, and performance standards that ensure the City's goals are met for the project. Solicitation, assessment, and selection of bids, as well as contractor oversight and contract administration takes expertise and time and need to follow appropriate procurement and purchasing procedures.

Partnerships

As with volunteers, partnerships provide opportunities to foster relationships with partner organizations and the community. However, developing and sustaining partnerships requires dedicated staff time. The City of Mendota Heights has partnered with the following entities on natural resource-related projects or initiatives.

- Minnesota Department of Natural Resources (MNDNR)
- Minnesota Department of Transportation (Mn/DOT)
- Minnesota Historical Society
- Dakota County
- Dakota County Soil & Water Conservation District (SWCD)
- Mississippi Watershed Management Organization (MWMO)
- Great River Greening
- Friends of the Mississippi River (FMR)
- National Park Service (NPS) and Mississippi Park Connection
- Conservation Corps of Minnesota & Iowa
- Master Gardeners, Master Tree Stewards, Minnesota Water Stewards, and Master Naturalists
- University of Minnesota
- Xcel Energy

- Rogers Lake Association
- Pilot Knob Preservation Association
- Mendota Heights neighborhood groups

It is recommended that the City establish agreements or contracts with partner organizations to help implement ecological restoration and management projects, especially long-term management.

4.3.6 Cost of Natural Areas Restoration & Management

Natural areas restoration and management requires an investment. An NRMP can help focus limited resources by presenting real unit costs, such as dollar per acre to carry out a prescribed burn in a savanna. Many variables influence unit costs. The size of an area being restored, the existing site conditions, access and slope issues all affect cost. For planning purposes, it is useful to understand unit costs in general. Table 21 provides unit costs for the most common restoration and short-term management tasks, assuming a professional natural resource contracting firm does the work. Section 4.2 describes most of these tasks. Some of the costs apply to long-term management, too, as discussed in Section 1.2.3.

Table 21. Unit Costs for Ecological Restoration & Management

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

Costs can often be reduced by using City staff and equipment, partners, youth workers and volunteers; however, some tasks are best conducted by trained/licensed professionals. Use of volunteers or youth workers typically requires training. Contractors, seasonal staff, youth and volunteers all require oversight, close supervision of all steps (including contract development, material acquisition, installation, and management) is prudent to ensure work is done properly and restoration goals are achieved.

Unit costs can be multiplied by acres needing restoration and management in order to arrive at a total estimated cost for ecological restoration and management. In this exercise, opinions of probable cost are developed for each different plant community present in City parks and parcels (Table 3), anticipating the restoration and management tasks (described in Section 4.2) needed in each plant community, and assigning average unit costs for each task (similar to those found in Table 21). The following table summarizes preliminary opinions of probable cost for carrying out the necessary restoration and management tasks to improve the ecological health of all City-owned natural areas.

Table 22. Preliminary Opinions of Probable Cost for All City Parks & Parcels

PLANT COMMUNITIES[1]	ACRES[2]	AVG. UNIT COST (PER ACRE) TO RESTORE/MANAGE PLANT COMMUNITY[2]	ESTIMATED INITIAL RESTORATION & SHORT-TERM MANAGEMENT COSTS[2]
Upland Communities	**123.8**	-	**$828,493**
Forest/Woodland	**79.9**	-	**$588,628**
Mature Forest/Woodland	26.2	-	**$ 169,664**
Dry-Mesic Forest/Woodland (1)	7.7	$ 7,250	$ 55,615
Mesic Forest (2)	18.5	$ 6,150	$ 114,049
Altered Forest/Woodland (3)	53.7	$ 7,800	$ 418,964
Savanna/Brushland	**16.2**	-	**$ 126,618**
Savanna (4)	0.4	$ 12,000	$ 4,559
Shrub/Scrub (5)	15.9	$ 7,700	$ 122,060
Grassland	**27.7**	-	**$113,247**
Prairie (6)	21.4	$ 3,400	$ 72,597
Non-Native Grassland (7)	6.3	$ 6,450	$ 40, 650
Lowland Communities	**65.1**	-	**$257,163**
Lowland Forest/Woodland	**22.9**	-	**$ 139,400**
Lowland Forest (8)	22.9	$ 6,100	$ 139,400
Lowland Shrub/Scrub	**14.0**	-	**$ 87,363**
Lowland Shrub/Scrub (9)	14.0	$ 6,250	$87,363
Lowland Herbaceous	**28.3**	-	**$30,400**
Wet Meadow (10)	12.0	$ 2,525	$30,400
Marsh (11)	16.2	Assumed $0	Assumed $0
TOTALS (Uplands + Lowlands)[3]	**188.9**		**$ 1,085,656**

[1] See Table 2 for brief descriptions of plant community types

[2] Includes all natural areas within City parks and parcels that were mapped for this NRMP; assumes initial restoration and short-term management (usually first 3 years) conducted by professional ecological contractors; costs do not address long-term management

[3] Rounding of values may make totals appear inaccurate

The total system-wide anticipated cost is substantial, but it results from the acreage of City-owned natural areas, their generally degraded ecological condition, and the need for significant restoration and management efforts. This anticipated cost, however, is not out of line with other municipalities having similar land holdings. It is clear that the City's existing natural resource budget, staff, and equipment limit what can be done in a given year. To implement at the level of the anticipated costs, it is necessary to prioritize projects and phase them over many years.

In addition to the initial restoration and short-term management costs presented above, the City also needs to plan and budget for long-term management in perpetuity. This means that new restoration projects should be initiated only as aggressively as there are funds or other resources to complete the project and manage the project in perpetuity as well as continue to maintain all previously restored natural areas. Variations in the type and size of plant community, ecological quality, type and intensity of stressors, site-specific management techniques and goals, and other factors all influence the effort required to maintain restored natural areas. As a general rule of thumb, the City should assume annual long-term management costs of $200 to $400 for each acre of natural area. For comparison, actively maintained turf requires approximately $750 to $1,000 per acre per year.

4.3.7 City of Mendota Heights Natural Resources Budget

The City of Mendota Heights approved budget for 2022 includes the following allocations for its Natural Resources Program, dedicated through its Park and Recreation Department funds.

Table 23. City of Mendota Heights Natural Resources Budget (2022)

Natural Resources Task	2022 Budget	Comments
Eradicate invasive plants	$50,000	Mostly dedicated to Valley Park, Copperfield Ponds Park, and Rogers Lake Park
Oȟéyawahe/Pilot Knob Preserve restoration	$11,000	City funding, supporting work coordinated by Dakota County
Maintenance supplies/costs	$7,500	A portion of the Parks Department maintenance budget is used for maintenance of natural resources projects
Native plantings	$10,000	This is a new budget allocation as of 2022
Tree removal/replacement	$40,000	Removal and replacement of ash trees (result of EAB); replacement species selected considering climate change resilience
TOTAL	**$118,500**	

In addition to the above natural resources allocations, the City's Street Department has been allocated $50,000 for tree removals, much of which will be used for removal of ash trees in response to the Emerald ash borer.

4.3.8 Five-Year Phased Implementation Plan

Table 23 lists the City of Mendota Height's major natural resources expenditures budgeted for 2022. There are also several ecological restoration and management projects already underway in the City (primarily in Valley Park); the City will be responsible for providing long-term management of this acreage over the coming years. Lastly, there is a commitment to expand the City's restoration and stewardship efforts by advancing new, prioritized restoration projects (Section 4.3.4). Implementation of the City's natural resources restoration and management program requires careful planning to ensure limited

resources are used efficiently and that projects are phased in at a rate such that projected system-wide management costs do not exceed available resources.

Working closely with City staff, a five-year implementation scenario was developed that ensures management of ongoing restoration projects, initiates all seven new Priority Projects identified in this NRMP (Section 4.3.4), and would be phased in to manage program expenses each year (assuming a two percent annual inflation rate). This scenario calls for an annual expenditure of approximately $68,000-$94,000, over a total of five years, totaling approximately $400,000 (Table 24). These costs would be ***in addition to*** the City's annual baseline natural resources budget, such as shown in Table 23 for 2022. At the end of the five-year period (Table 24), initial restoration will have been completed for over 60 acres of natural area, and the majority will be under a short-term management regime (which is then followed by long-term management. Many assumptions are embedded in these opinions of probable cost and, therefore, these costs should be viewed as preliminary, with details worked out in annual budgets and Capital Improvement Plans. Details regarding the seven Priority Projects are provided in the management briefs (Appendix H). During the initial five-year implementation plan (Table 24) progress should be monitored, and near the end (around 2027) a subsequent five-year implementation plan should be developed for 2028-2032.

Budgeting for Success

This Plan:

- Identifies a need of over $1 million to address the first few years of ecological restoration and management if all City-owned natural areas were to be addressed.
- Presents the City's 2022 natural resources budget of $118 thousand.
- Recommends additional annual investments of <$100 thousand to advance the City's priority projects.

Table 24. Five-Year Phasing of Mendota Heights Priority Projects

Mendota Heights Natural Resources Management Plan
Prioritization, Phasing & Opinions of Probable Cost
Scenario: All in-progress ("Other") restoration projects maintained; initiate all NRMP Priority Projects in first 5 yrs; 2% annual inflation

= Initial Restoration & Short-Term Management
= Long-Term Management (avg. $300/ac/yr)
(avg. long-term management costs typically decrease after ~3 years)

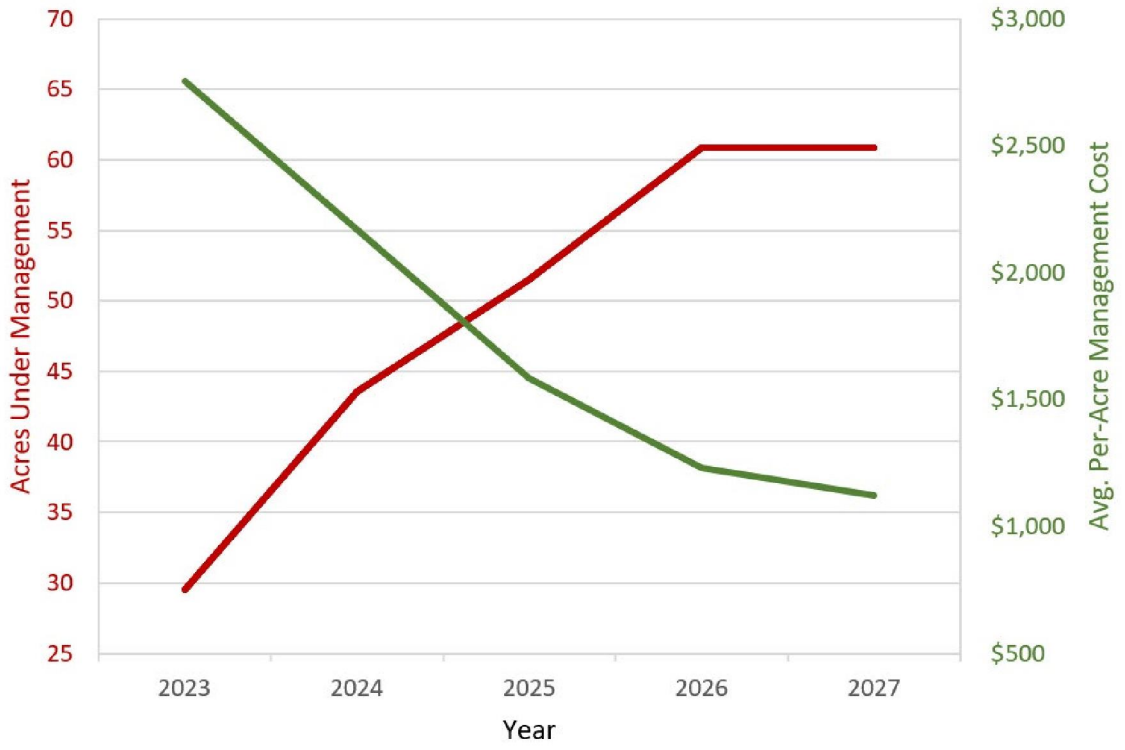
Prioritized Projects	Natural Area Investments (ac)	Initial Resto & Short-Term Mgmt Costs	Year 2023	2024	2025	2026	2027	Total Cost
Other Restoration Projects								
Valley Park Pollinator Corridor (Xcel)	8.3	$ 32,751	$ 20,044	$ 13,630	$ 2,639	$ 2,692	$ 2,746	**$ 41,750**
Valley Park Forest Enhancement - North (CPL, CCIM & Xcel)	14.3	$ 51,552		$ 32,181	$ 21,883	$ 4,650	$ 4,743	**$ 63,457**
Valley Park Forest Enhancement - South-Central (GRG)	7.8	$ 27,900		$ 17,416	$ 11,843	$ 2,517	$ 2,567	**$ 34,343**
NRMP Priority Projects								
Valley Park - NW Forest Enhancement	8.0	$ 64,053	$ 39,200	$ 19,992	$ 6,797	$ 2,599	$ 2,651	**$ 71,241**
Valley Park - E Forest Enhancement	3.7	$ 24,922	$ 15,252	$ 7,779	$ 2,645	$ 1,190	$ 1,213	**$ 28,078**
Valley Park - S Oak/Aspen Knoll Enhancement	1.5	$ 11,087	$ 6,785	$ 3,460	$ 1,177	$ 497	$ 507	**$ 12,425**
Rogers Lake - W Savanna/Forest & N Shoreline Enhancement	7.9	$ 54,211			$ 34,518	$ 17,604	$ 23,941	**$ 76,063**
Copperfield Ponds - Isthmus Enhancement	5.3	$ 39,640				$ 25,240	$ 17,506	**$ 42,746**
Wentworth Park - Forest Enh., Aquatic Buffer & Turf-to-Prairie	2.2	$ 15,458				$ 9,843	$ 6,827	**$ 16,669**
Hagstrom King Park - Oak Woodland Enhancement	0.6	$ 6,029				$ 3,839	$ 2,662	**$ 6,501**
Friendly Marsh - Turf-to-Prairie	1.3	$ 6,732				$ 4,286	$ 2,973	**$ 7,260**
Totals	**60.8**	**$ 334,335**	**$ 81,282**	**$ 94,458**	**$ 81,501**	**$ 74,955**	**$ 68,337**	**$ 400,534**

Figure 31 illustrates how, over time, the number of acres under management increases, while the per-acre cost of management decreases, allowing for the initiation of new restoration projects, which ultimately will be brought into long-term management. The City can continue this implementation model into the coming decade by identifying priority projects, estimating costs, securing funds, and implementing work in a sustainable fashion using City-allocated and other available resources. In this way, the City's natural resources program will grow and mature, resulting in a healthier, lower maintenance, and more resilient system of natural areas.

Budgeting for the Long Haul

While grants, partners, and volunteers may provide financial and labor support for *initial* restoration and short-term management of projects, these resources may not be available in the *long term*. To protect its initial restoration investment, the City would need to augment its annual budget for the natural resources program and ensure that stewardship of natural areas can continue in perpetuity.

Figure 31. Increasing Acres Under Management and Decreasing Per-Acre Costs Over Five-Year Plan



4.3.9 How Work Gets Funded

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. To augment the City's existing internal budget allocation, the following entities or programs may provide funds to help implement this plan. However, additional staffing time and expertise will be required to pursue and administer such funds, if awarded.

The Limits of Grant Funding

Many grants can be used only for initial restoration and short-term management. Perpetual management of natural areas usually depends on funding from sources other than grants.

State Programs

- **Clean Water, Land and Legacy Amendment (funded by State sales tax)**
    - **Outdoor Heritage Fund/Lessard-Sams Conservation Partners Legacy Grants**. Thirty-three percent of the sales tax revenue from the Clean Water, Land and Legacy amendment is distributed to the Outdoor Heritage Fund. Those funds, administered by the MNDNR, "may be spent only to restore, protect, and enhance wetlands, prairies, forest and habitat for fish, game, and wildlife."
      Information: https://www.legacy.mn.gov/outdoor-heritage-fund

      The Conservation Partners Legacy (CPL) Grant Program funds conservation projects under the Outdoor Heritage Fund. CPL is currently funding the forest enhancement project underway in Valley Park North.
      Information: https://www.dnr.state.mn.us/grants/habitat/cpl/index.html
    - **Clean Water Fund.** Thirty-three percent of the sales tax revenue from the Clean Water, Land and Legacy amendment is allocated to the Clean Water Fund. Those funds, administered by the Minnesota Pollution Control Agency, may only be spent to protect, enhance, and restore water quality in lakes, rivers, and streams and to protect groundwater from degradation. At least five percent of the Clean Water Fund must be spent to protect drinking water sources.
      Information: https://www.legacy.mn.gov/clean-water-fund
    - **Parks & Trails Fund.** The Parks and Trails Fund receives 14.25 percent of the sales tax revenue resulting from the Clean Water, Land and Legacy amendment. Those funds, administered by the Greater Minnesota Regional Parks and Trails Commission, may only be spent to support parks and trails of regional or statewide significance.
      Information: https://www.legacy.mn.gov/parks-trails-fund
- **Environment & Natural Resource Trust Fund**. The Environment and Natural Resources Trust Fund (ENRTF) was established following voter approval of a constitutional amendment in 1988. The money in the Trust Fund is generated by the Minnesota State Lottery, and the Legislative-Citizen Commission on Minnesota Resources (LCCMR) makes funding recommendations to the Minnesota Legislature. The Trust Fund holds assets that can be appropriated, "for the public

purpose of protection, conservation, preservation, and enhancement of the state's air, water, land, fish, wildlife, and other natural resources."
Information: https://www.legacy.mn.gov/environment-natural-resources-trust-fund

County Programs

- **Dakota County SWCD Cost Share Programs**. Dakota County Soil and Water Conservation District (SWCD) staff use these initiatives to connect citizens, developers and local government with the educational, technical and financial support needed to put innovative stormwater management and conservation practices on the land. Many types of non-agricultural conservation practices to improve and protect water quality will qualify for program assistance, including landscaping for clean water and prairie restoration.
  Information: https://dakotaswcd.org/services/incentives/

- **Dakota County-City Conservation Collaborative.** Newly formed County initiative included in the County's Land Conservation Plan that establishes partnerships with cities within the County to help restore natural areas on public property.

National Fish and Wildlife Foundation (NFWF)

- **Five Star and Urban Waters Restoration Grant.** This partnership grant focuses on water quality issues in priority watersheds, such as erosion due to unstable streambanks, pollution from stormwater runoff, and degraded shorelines caused by development. More information is available at: https://www.nfwf.org/programs/five-star-and-urban-waters-restoration-grant-program
- **Monarch Butterfly and Pollinators Conservation Fund.** A recently initiated program to protect and increase habitat for monarch butterflies on the breeding grounds and along their migration routes, and to educate people about this incredible species. More information is available at: https://www.nfwf.org/programs/monarch-butterfly-and-pollinators-conservation-fund/monarch-butterfly-and-pollinators
- **Resilient Communities Program.** Designed to prepare for future environmental challenges by enhancing community capacity to plan and implement resiliency projects and improve the protections afforded by natural ecosystems by investing in green infrastructure and other measures. Information: https://www.nfwf.org/programs/resilient-communities-program

4.3.10 NRMP Updates

This NRMP represents an important foundational step in advancing the management of Mendota Heights' natural resources. As with most planning documents, NRMPs warrant regular updating as the program is implemented, successes (and failures) are tracked, and changing circumstances warrant different strategies. This is no different from practicing adaptive management, whereby a plan is implemented, progress monitored, and changes are made based on achievement of desired outcomes. For this reason, this NRMP should be consulted regularly to assess its effectiveness at achieving the City's goals, and a comprehensive NRMP update should be conducted at least every ten years. These regular updates

represent a relatively small investment that ensures the best practices and strategies are being used for successful, cost-effective achievement of conservation goals.

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5 NEXT STEPS

The City of Mendota Heights has approximately 267 acres of natural/semi-natural areas in its parks and City-owned parcels. These areas harbor a variety of ecosystems native to east-central Minnesota. City residents use and enjoy these parks and natural areas, which also deliver ecosystem services that undergird human life and society. But over a century of land alteration, soil erosion, and colonization by invasive species has compromised the functions and value of the City's natural resources, including on private land. Implementing this Natural Resources Management Plan can reverse that situation and help achieve the City's conservation goals.

Next steps the City of Mendota Heights can take to implement this NRMP are:

- Communicate staffing and funding needs to decision makers, including City Council and staff.
- Increase the capacity of the City's Natural Resources Program, including:
  - Hire one additional full-time staff person to support the Natural Resources Coordinator.
  - Increase the Natural Resources Program annual budget to $200,000 in 2023 and increase by 5 percent annually over the next 5 years.
- Incorporate the principles, goals, and recommendations of this NRMP into the City's operating procedures, including but not limited to:
  - Implement more sustainable urban forestry management practices (Section 2.2.4).
  - Improve protection of water resources (Section 2.2.7).
  - Increase the management of invasive plants (Section 2.2.8).
  - Protect the City's rare natural features (Section 2.2.12).
  - Assimilate recommended changes to City ordinances and finalize and adopt the Urban Forest Management Ordinance and supporting documents (Section 2.2.14).
  - Advance discussions with strategic partners to strengthen ecological connectivity (Section 3.3.1).
  - Implement climate resilience practices (Section 3.3.2).
  - Use an ecosystem approach to natural resources management (Section 4.1.2).
- Secure grant funds and/or other funding/support to implement the five-year plan of Priority Projects (Table 24).
- Collaborate with and secure commitments from partner organizations and private landowners.
- Increase community engagement and effectively use volunteer labor.
- Hold a celebration of progress and initial success.

This Natural Resources Management Plan will enable the City of Mendota Heights (helped by volunteers, partners, and professional contractors) to carry out prioritized natural resource projects over the coming decades. Results will be evaluated and reported annually, staff will adapt the plan to meet changing circumstances, and residents and City leadership will be kept informed. In this way, healthy ecosystems and wildlife populations will be passed on to future generations for the enjoyment of all and the benefit of nature. One can envision that the restoration and management of natural areas in the City's parks and

parcels will improve other natural open space in the City, and over time will raise this portion of the Twin Cities to a higher level of ecological health and resilience, to the benefit of all residents and visitors.

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Appendix A. Glossary & Acronyms

Adaptive Management	Structured decision making in the face of uncertainty, with an aim to reducing uncertainty over time by a cycle of 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 or Ecosystem	Developed or significantly altered land, typically used regularly and/or intensively by people (e.g., buildings, parking lots, roads, crop fields, turf lawns).
Cultural Resource	A historically significant feature, such as Works Progress Administration (WPA) walls.
Ecological Enhancement	Improving an existing natural area, such as adding more native flower species to a prairie or removing an undesirable tree like Boxelder from an oak forest.
Ecological Restoration	As a general term, improving the natural environment by stabilizing and enhancing biodiversity, resilience, and ecosystem services. In contrast to Ecological Enhancement, Ecological Restoration typically refers to converting a non-natural area (e.g., turf grass or cropland) to a native plant community (e.g., prairie or wetland).
Ecological Stewardship	Refers to responsible use and protection of the natural environment through conservation and sustainable practices.
Ecosystem Approach	An approach to land and water management that considers all interacting 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 Species	Animal species that can live in many different types of environments and have a varied diet and broad habitat requirements.
Geographic Information System	(GIS) A computer-based mapping system designed to capture, store, manipulate, analyze, manage, and present spatial or geographic data.
Glaciofluvial	A combination of boulders, gravel, sand, silt and clay from ice sheets or glaciers.

Glaciolacustrine	Sediments deposited into glacier-formed lakes.
Habitat Fragmentation	Habitat fragmentation is the process by which habitat loss results in the division of large, continuous habitats into smaller, more isolated remnants.
Integrated Pest Management	(IPM) Integrated Pest Management is an ecosystem-based approach that uses a combination of practices that minimize risk to beneficial insects and organisms, wildlife, humans, and the environment. Pesticides and herbicides are used only after monitoring indicates they are necessary and applied with the goal of removing only the target pest or species.
Invasive Species	Aggressive species whose introduction does or is likely to cause economic or environmental harm or harm to human health.
Mesic	Moist, typically referring to soil conditions (as opposed to dry or wet).
Moraine	An accumulation of rocks and sediment deposited by a glacier, typically along the glacier's edge.
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.
Non-invasive Species	Species that are not likely to cause economic or environmental harm.
Non-point Source Pollution	Pollution (e.g., contaminants, excessive nutrients) that comes from a diffuse source; in contrast to point-source pollution, which comes from a concentrated location, such as an industrial discharge pipe.
Specialist Wildlife Species	Animal species that have specific environmental needs related to habitat, diet or another environmental factor, without which they cannot sustain their populations.
Species of Greatest Conservation Need	(SGCN) Wildlife species, including state-listed and non-listed species, that are regionally rare or in decline, often as a result of habitat loss.
Spot Herbicide Application	Using targeted application methods (e.g., backpack sprayer with wand or sponge) to apply herbicide to undesirable vegetation, such as invasive plants.
Stormwater Treatment Train	A series of various stormwater best management practices (BMPs) designed 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).
Till (Glacial)	Unsorted glacial deposits (i.e., from small particles to large rocks) that may form moraines and other glacier landforms.
Watershed Management	An approach to water and other natural resources management that considers the entire drainage area or catchment.

Appendix B. Assessment of Mendota Heights' Natural Resources Program & Volunteer Activities

1. Goal
    a. Assess municipal budget, staff and equipment and volunteer programs for the overall capacity to restore and manage natural areas.
2. Natural Resources Program
    a. Review and synthesize Municipal information: complete benchmarking questionnaire.
    b. Summarize
        i. Ongoing natural resources management programs
            1. Forestry – 50%
                a. EAB Control. Inspect all public ash trees, removal when diseased, with replanting.
                b. Mitigation of EAB grant with tree planting from MN DNR ($10k grant). Planting 100 trees by June 2022.
                c. Invasive species removal MN Dept. Agric. ($10k grant). Japanese hedge parsley (exploding in population), treatment of all noxious weeds.
                d. Annual tree sale partnering with American Tree Trust, pay half the cost and resident pays half the cost.
                e. Invasive species control and removal of woody species by volunteer groups and partnership with Great River Greening.
            2. Stormwater Management – 50%
                a. Aquatic invasive species grant program from Dakota Co. ($7k grant) to remove curly-leaf pondweed (Rogers Lake).
                b. Raingardens with every street project funded with stormwater improvement budget. Install curb cuts, install live plants (contractor installs topsoil mix). City pays for construction and materials, but property owner agrees to non-drainage-related maintenance and installation. In 2020, installed five raingardens as part of the Wesley-Marie Avenue Road Improvements project. Eleven raingardens were installed as part of the Lexington Ave. street project .
                c. CAMP Program. Citizen Assisted Monitoring Program with Met Council. Partner with local cities and agencies to sample all metro lakes and publish annual report with A-F grade given to each lake. Lower Mississippi River WMO sponsors one monitor; and City sponsors two monitors. Augusta (WMO), Rogers (City) and Lemay Lakes (City). Monitors measure indicators and Natural Resources Coordinator coordinates the volunteers and stores, cleans and restocks the sampling kits.

d. Wetland Health Evaluation Program through Dakota County. Citizen supervisor runs this program for Mendota Heights, and City stores sampling kits and selects wetlands to monitor. Reports are published annually.
e. The City is the Local Government Unit charged with administering Chapter 8420 of the Wetland Conservation Act
f. MS4 Stormwater Permit requirements.
    i. Adopt-A-Drain program with the Lower Mississippi WMO & Freshwater Society.
    ii. Erosion control inspections on construction sites.
    iii. Inspect all permanent BMPs – stormwater ponds, underground infiltration systems, raingardens, etc. with new construction and reconstruction.
    iv. MCM6 categories: Natural Resources Coordinator coordinates Education and Outreach, Public Participation and Involvement, Construction Site Stormwater Inspections, Post-Construction BMPs, Illicit Discharge Detection & Elimination (annual outfall inspections), Pollution Prevention & Good Housekeeping (Public Works Supervisor is mainly responsible for Pollution Prevention and Good Housekeeping). Natural Resources Coordinator completes annual report for City.

ii. Current and past restoration projects – request map
    1. City Hall Native Planting & Rain Garden. 2018. <1 ac. Front of City Hall, rock and shrubs replaced with native pollinator planting on upland and small raingarden receiving rooftop runoff .
    2. City Hall Solar Garden. 2018. <1 ac. Next to City Hall, native prairie mix under solar panels.
    3. Copperfield Ponds. 2020 and ongoing. 5 acs. Great River Greening installing prairie along trail between two wetland ponds. Removing invasive trees and shrubs (Siberian elm, Amur maple, buckthorn), replanting with upland grass/forb mix, plus wetland buffer and a small wetland edge planting.
    4. Hagstrom King Park Oak Wilt Management. 2020 and ongoing. 1 ac. Severe oak wilt infestation of red oak, mostly private requiring permission. Root plow to contain was used with some success. Removing oaks on City easement, private on their own land. Will be replanted with native trees and groundcover.
    5. Ivy Hills Park. In planning. 2.5 acs. Ivy Keep HOA interested in moving project forward, but no recent progress.

6. North Kensington Park. In planning. 4 acs. Open turf area north of soccer fields. Replace with bee lawn, other native plantings.
7. Oȟéyawahe Pilot Knob. 2011 and in planning. 23 acs. Upland prairie restoration. New acquisition in 2020 at end of Vallencourt. Task force formed to determine plan for site. Interpretive Plan for the site is currently in the development phase, seeking input from members of the Dakota Community and other Indigenous communities.
8. Par 3 Golf Course. 2017. 1 ac. Native plant garden in middle of golf course, raingarden in parking lot, native plant garden in front of clubhouse. City runs this site.
9. River to River Greenway. In planning. Acres not reported. Dakota County project that City will partner on. Includes all of Valley Park, which is its own restoration project.
10. Rogers Lake Buckthorn Removal. Pre-2018 and ongoing. 10 ac. MNDOT property with City trail easement on west side of Rogers Lake. Removing buckthorn but no grant is possible because City is not property owner. Paying Great River Greening to do the removal. Remove buckthorn and replant with woodland herbaceous mix.
11. Rogers Lake Shoreline Restoration. <2018 and ongoing. 0.05 ac. (120 ft long). Shoreline stabilization project near the fishing pier.
12. Valley Park Pollinator Corridor. 2019 and ongoing. 10 ac. Grant to remove invasive plants. AES did snow-seeding of southern part of corridor north of Marie Ave. in late 2019. Remove invasives and stabilize with upland plantings favoring pollinators. One small wetland area involved.
13. Victoria Road. 2016. 0.5 ac. Road upgrade project in ditch with riprap. Removed riprap, flattened ditch to create slope to road, planted upland prairie mix (MN State Mix 35-621 Dry Prairie Southeast).
14. Welcome Sign Outlot. 2019. 0.25 ac. Two parcels. First parcel is Mendota Meadows HOA property under conservation easement held by City. Required to remove invasives every five years. Buckthorn removed, but no replanting due to reluctant landowners. Second parcel is MNDOT property maintained by City. City removed buckthorn on its property and planted with native grasses, trees and shrubs. No-mow or bee lawn intended for hillside and not mow hillside in future.

iii. Staff capacity to deliver programs and projects

1. At capacity right now. Insufficient funding to hire out additional work.
2. Natural Resources Coordinator is 100% dedicated to natural resources. Tasks listed above.
3. Parks staff have a portion of their hours dedicated to natural resources. Three full-time employees & several seasonal employees dedicated to parks. Focused on tree care, watering, tree removal, tree pruning for

safety, buckthorn removal & chemical treatment. Limited weeding of native plantings by a couple full-time staff who have native species knowledge. Turf maintenance, ballfield maintenance and general park upkeep occupies most time.

4. Utilities staff make minor contribution to natural resources management. Follow up and reporting on stormwater issues raised (e.g., storm drain blockage, illicit discharge) or that they notice themselves.
5. Finding physical space for interns and seasonal employees is very limited at City Hall. Would be easier out of Public Works building. Due to COVID-19, even more challenging at City Hall. As a result, it is difficult to take advantage of programs like Community Forestry Corps (under AmeriCorps). These positions require employment of 40 hours/week for one year but keeping them busy in winter with the duties listed by the program, unless buckthorn can be removed to regenerate oak canopy.

iv. Equipment, material, training needs to deliver programs and projects

1. Lack storage for equipment and materials.
2. Current Natural Resources Coordinator certified for Type 2 Wildland Prescribed Burning
3. Needed equipment
    a. Kayak for stormwater inspections & stormwater basins depth sampling at 4-5 points for storage capacity (some inspections currently done during winter months using an ice auger).
    b. Depth finder instead of Secchi disk or rod (obtained).
    c. ATV for traversing larger areas, carrying equipment, pulling broadcast seeder.
    d. Broadcast seeder dedicated to natural resources.
    e. Field laptop for inspections.
    f. Equipment for small prescribed burns
        i. Water pump for ATV fire control (have 60 gal. tank)
        ii. Indian backpack pumps
        iii. Swatters & rakes
        iv. Drip torch
        v. Mower to cut fire breaks in grass
        vi. Leaf blowers to blow fire breaks in woods using oak leaves for fuel
    g. Bulb auger for planting plugs for raingarden projects when insufficient volunteer labor available

c. Summarize in table of findings and map of past and current projects

3. Volunteer program
    a. Assessment

i. Organization & Training
    1. Volunteer program is in the development phase, currently there is not a standing list of volunteers, database, or schedule; Krista has stepped in to help organize, but it is challenging given other duties
    2. Citizen/Resident Volunteers call for participants and Krista organizes event with their help – challenging to continue to recruit volunteers who are not already engaged in City's restoration and management efforts
    3. Need a part-time volunteer coordinator and more organized and formalized process; this person must be an inspirational, well-organized, detail-oriented, people person who enjoys and is good field work and knows local ecology, plant identification, and restoration and management practices.
    4. Need a database to schedule events and notify volunteers; can piggy-back on Parks and Recreation platform
    5. No newsletter or way to communicate to community and volunteers on regular basis; would like to see more back-and-forth between City and volunteers and the larger community to generate interest in restoration and management
    6. Increasing size of volunteer pool requires more training and supervision; training the trainer model can leverage Krista's time
    7. Young people tend to do work quality that must be re-done (e.g., tree and plug planting); corporate groups doing community service often come poorly prepared (e.g., wearing flip-flops) – chose the event that families are better able to participate in
    8. Core group of volunteers will be the backbone of the effort, building expertise and dedication to attendance and quality work
    9. Without a feedback loop from monitoring data to activity, the practical application of the data to Mendota Heights restoration and management is not there; adaptive management must be used; must be a framework to use the data; County has developed a CWMA (Cooperative Weed Management Area) using EDDMapS to have citizens report invasives and target control in those areas
ii. Work Plan for Pollinator Friendly Activities
    1. Master gardeners worked with Public Works since 2016 to educate and engage residents, partner with U of MN master gardeners for education and events
        a. Some progress made in outreach and education, including providing materials, educational workshops, and a question & answer table at Parks Celebration

b. City to promote ongoing restoration projects (Victoria Road and Plot Knob) with master gardeners and residents; events were held at Victoria Road
c. City and volunteer master gardeners collaborating on taking care of existing native plantings and expanding those plantings (with City transportation dept., for instance); workshops held
d. Events: Buckthorn Bash Education Event; native planting on City Hall grounds as showcase for public to learn from and replicate on own properties; Par 3 invasive species removal and native species planting event; rain garden planting events with City and Master Water Stewards
e. Review developer's landscape plans to guide toward pollinator-friendly plantings and green infrastructure; often too late to influence in a big way

iii. Locations and Activities for Volunteers
1. Private property. Biggest acreage in City for natural resources and place where volunteers can have immediate large impact
a. Educational focus, workshops, outreach
b. Master gardeners cannot compete with private sector for landscaping design and installation projects, but can assess and make recommendations to City if City requests it
2. Golf courses, cemeteries, institutions/campuses – how to approach?
a. One idea: master gardeners approach golf courses and cemeteries with education, but need approval and introduction from City to proceed, especially with businesses; use Audubon International Signature Program for golf courses (two private courses plus City's Par 3)
b. City staff and Council would need to approve, advocate and promote this approach.
3. City properties.
a. Raingardens easy to do
b. Model also exists for pollinator-friendly road reconstruction projects with Public Works through Work Plan (e.g., bump-outs on Marie Avenue—plan exists but planting has not been done by volunteers yet)
c. Valley View Park as part of park's natural resource management plan; use Great River Greening model of "blitzes" and "random acts of restoration" – much more challenging
d. Follow-up maintenance is weak link in system.

iv. Numbers of participants
1. Regular basis 3 steering committee members are regular volunteers (another committee member is not); 2 other community volunteers

(Rosemary & Sally) help weed already-restored projects; City Hall raingarden & Victoria Road native planting)

2. In general, challenging to secure volunteers. Number depends on events:
    a. Biggest: neighborhood curb cut neighborhood planting (multiple sites, many plants) – Leslie Pilgrim's master water steward project and master gardener (Cindy Johnson & Sue Light) event, which recruited all the volunteers – 21 people
    b. Parks clean-up & buckthorn removal event (Arbor/Earth Day) – 15 people at 3 parks
    c. Four raingardens with Wesley neighborhood during COVID; staggered volunteer attendance, fewer plants – smaller number of people

v. Frequency and type of activities undertaken
    1. One big project and a few small projects each year
    2. Planting, weeding, buckthorn and other invasive plant removal; usually plugs or 1-gal pots; can go up to 10-gal pots, but use Public Works to dig holes
    3. Tree planting canceled due to COVID; planning fall tree planting event

vi. Supervision
    1. Natural Resources Coordinator supervises all, helped by Resident Volunteers.

vii. Equipment needs versus available equipment
    1. City asks volunteers to bring all their own equipment
        a. Raingardens and simple projects – ask volunteers to bring own tools
        b. Cutting tools are biggest gap in equipment
    2. Wish list & discussion of volunteer equipment
        a. Would like to have 30 trowels and spades for planting
        b. Loppers for volunteer invasive brush removal

b. Summarize in table of findings and table of appropriate tasks for volunteers
    i. Big benefit from interest in community members; people are calling to offer help
    ii. Burnout – few events and not hard events and in good weather – can avoid burnout – won't give quantity, but master gardeners will give quality
    iii. What does growth look like?
        1. Purchase equipment
        2. Don't have volunteer coordinator – time sink is…
            a. Training volunteers before season starts – train the trainer model?
            b. Coordination of the event

3. Have a volunteer coordinator online sign-up system and sign liability release waiver online.
4. Would use volunteers to fill gap in funding for outside coordinator
5. Liability issue if master gardeners are leading; should City person always be there? Legal department to state whether always a city employee should be present.
6. Reportable/recordable standards for volunteers.
    a. Train the trainers in safety standards, report back to Krista after each event.

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. AES 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. AES's 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.

AES 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 considered suitable to plant in currently met four criteria.

1. Native to Minnesota.
2. Neither an invasive or potentially invasive exotic species, nor a native species that colonized new ground readily, grew aggressively, and 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 currently not present in Minnesota (USDA PLANTS Database) but suitable to plant met four criteria.

1. Native to nearby parts of states 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.
4. Predicted to enter the Twin Cities region in the coming decades based on the USFS climate change and tree response model.

Trees were considered unsuitable for planting if they met any of the following criteria.

1. Grew as a native species 450-500 miles from Minnesota, or did not grow as a native species in North America.
2. Currently outside or predicted to move out of its plant hardiness zone in Minnesota.
3. Abundant species that will seed in without assistance.
4. Susceptible to pests or diseases, including emerald ash borer.
5. Considered an invasive species.

This winnowing process resulted in 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 model (Prasad et al 2019).

Soil moisture and plant community context are two important field conditions that must be considered when deciding which tree species to plant at which location. 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-managed plant community like savanna. In addition, its greater shade tolerance would result in the eventual replacement of canopy oaks. Likewise, planting a white oak in a hydric soil type would likely result in the death of the white oak because it does not tolerate high moisture, low soil oxygen conditions.

Because soil moisture and plant community context are essential field conditions for proper selection of tree species, AES ecologists assessed each tree species' soil moisture tolerance and identified the appropriate plant community in which each species should be planted. Soil moisture tolerance information was obtained from the MNDNR and Iowa State University's Forestry Extension program. The plant communities to which each tree species was assigned were determined by AES ecologists based on extensive field experience throughout the Midwest and in particular work 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.

Prasad, A. M., L. R. Iverson., S. Matthews., M. Peters. 2007-Ongoing. A climate change atlas for 134 forest tree species of the eastern United States [database]. Northern Research Station, USDA Forest Service, Delaware, Ohio. https://www.nrs.fs.fed.us/atlas/tree (accessed April 2019).

MNDNR (Minnesota Department of Natural Resources). 2019. Minnesota native trees. https://www.dnr.state.mn.us/trees_shrubs/index.html (accessed April 2019).

NPS (National Park Service). No Date. Climate adapted trees Twin Cities. Excel File. National Park Service Office, Twin Cities MN.

Texas A&M AgriLife Extension. 2019. Texas plant disease handbook. Texas A&M University, College Station, TX. https://plantdiseasehandbook.tamu.edu/ (accessed April 2019).

USDA (United States Department of Agriculture). Plants database. USDA, Washington DC. https://plants.sc.egov.usda.gov/java/ (accessed April 2019).

USFS (U.S. Forest Service). 2019. Climate change tree atlas. USDA USFS, Washington DC. https://www.nrs.fs.fed.us/tools/ (accessed April 2019).

Table C.1. 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

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 illinoinensis [8]	Pecan	Juglandaceae	DMFW	Yes		Scab
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; *Botryosphaeria* 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, *Fusarium* 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
Morus rubra	Red mulberry	Moraceae	LF	Yes		Hybridizes with invasive white mulberry

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]
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, *Armillaria* 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
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, *Nectria* canker, *Armillaria* root rot, gypsy moth, two-lined chestnut borer

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 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

[1] *https://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] https://www.dnr.state.mn.us/forestry/nursery/choosing.html

[6] http://campustrees.umn.edu/tree-species

[7] https://www.extension.iastate.edu/forestry/iowa_trees/trees/

[8] *These trees currently may not be naturally present in Minnesota*

Appendix D. Other Ecosystem Services in Mendota Heights

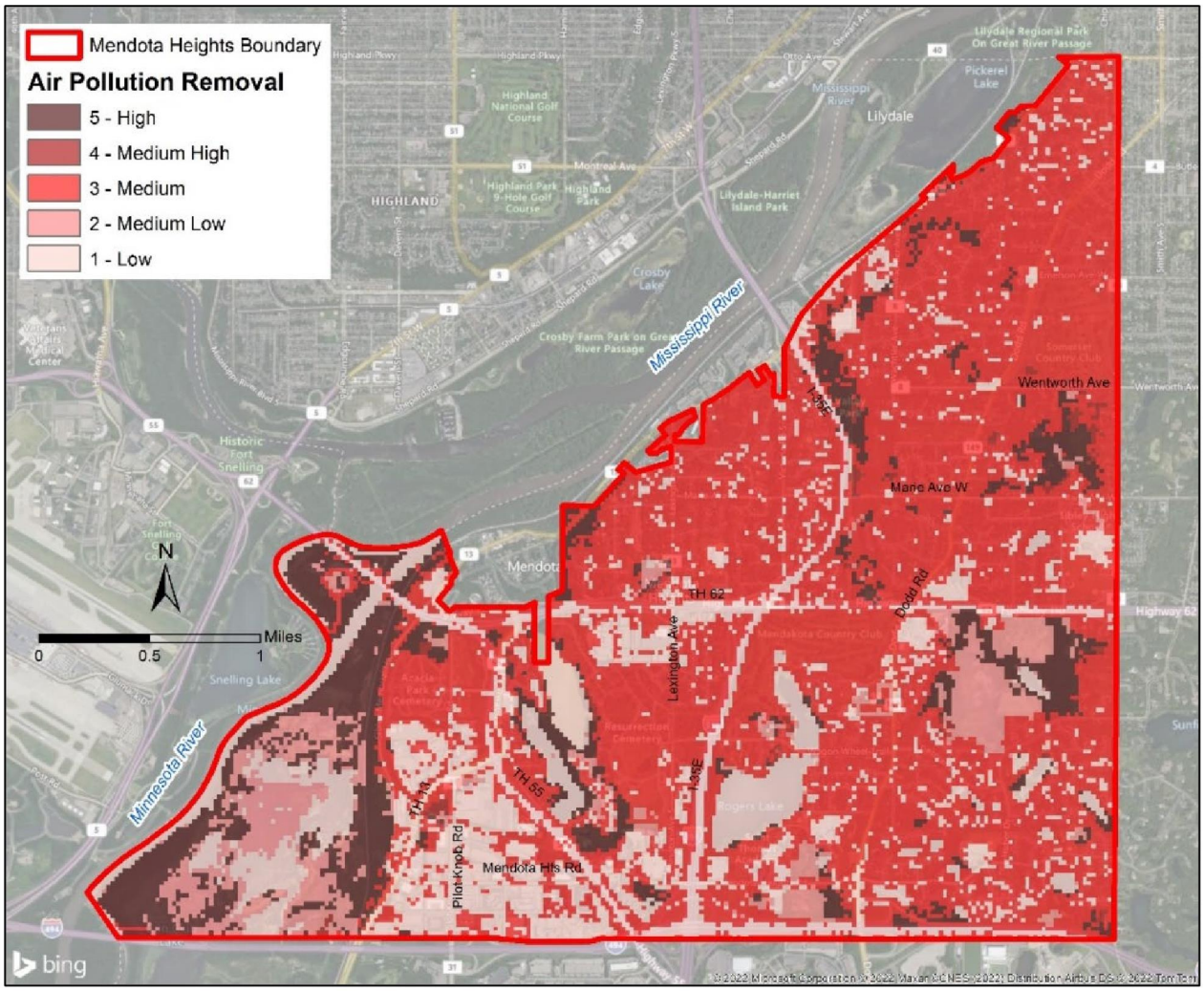
This appendix provides a land cover-based analysis of the following ecosystem services in the City of Mendota Heights:

- Air Pollution Removal
- Runoff Pollution (P) Removal
- Runoff Volume Reduction
- Carbon Sequestration

Air Pollution Removal

Air quality is a growing concern in the Twin Cities metropolitan area, and climate forecasts suggest it will become an even greater health issue. Different land cover types provide different levels of air purification. Forests are some of the most effective land covers to filter out particulates and improve air quality. This is due to the extensive surface area of their leaves and their respiration function. Impervious surfaces provide little if any air pollution removal. Figure D.1 provides a landscape-scale representation of this ecosystem service across the City of Mendota Heights. *Reference*: Maes et al., 2011.

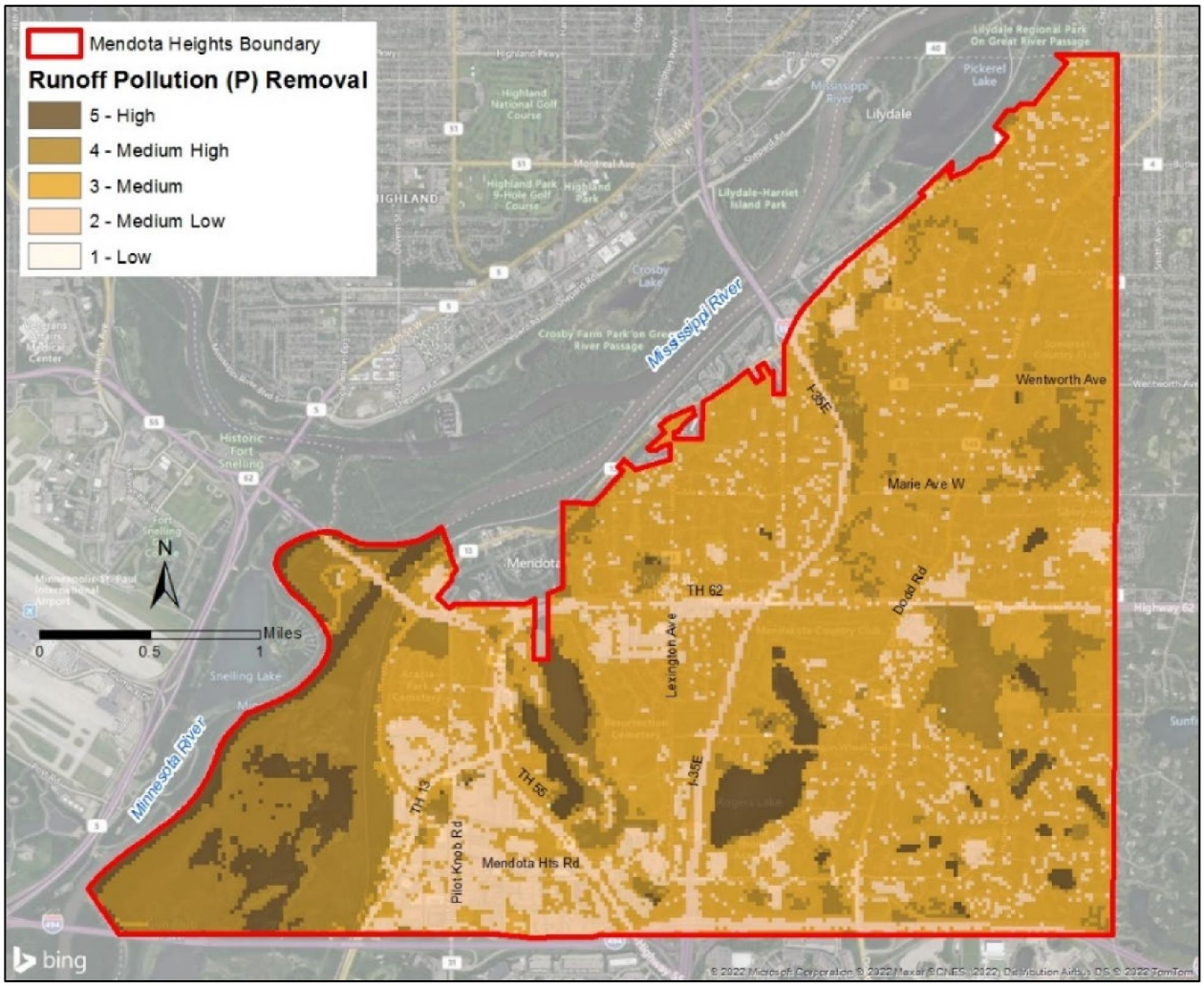
Figure D.1 Air Pollution Removal in Mendota Heights



Runoff Pollution (P) Removal

Phosphorus (P) is the primary pollutant of concern in most surface waters throughout the Upper Midwest. The growth of undesirable algae is typically limited by this nutrient; therefore, preventing P from reaching surface waters can help maintain higher water quality and reduce the frequency and severity of algal blooms (including harmful blue-green algae, which can pose a health concern for people, pets, and wildlife). Different land cover types provide different levels of runoff purification, depending on opportunities for runoff filtration (through soil and vegetation), slowing down (which enables particulates with adhered P to drop out), vegetative uptake of nutrients, etc. Water bodies often accumulate phosphorus and retain this nutrient in the form of aquatic plant growth, algae, fish, and bottom sediments. Forests and wetlands are effective at removing P from runoff. Stormwater runoff from impervious surfaces and development continue to be a major source of P and other pollutants in runoff (e.g., nitrogen species, oil and grease, heavy metals, etc.). Figure D.2 provides a landscape-scale representation of this ecosystem service across the City of Mendota Heights. *Reference*: Jeje 2006.

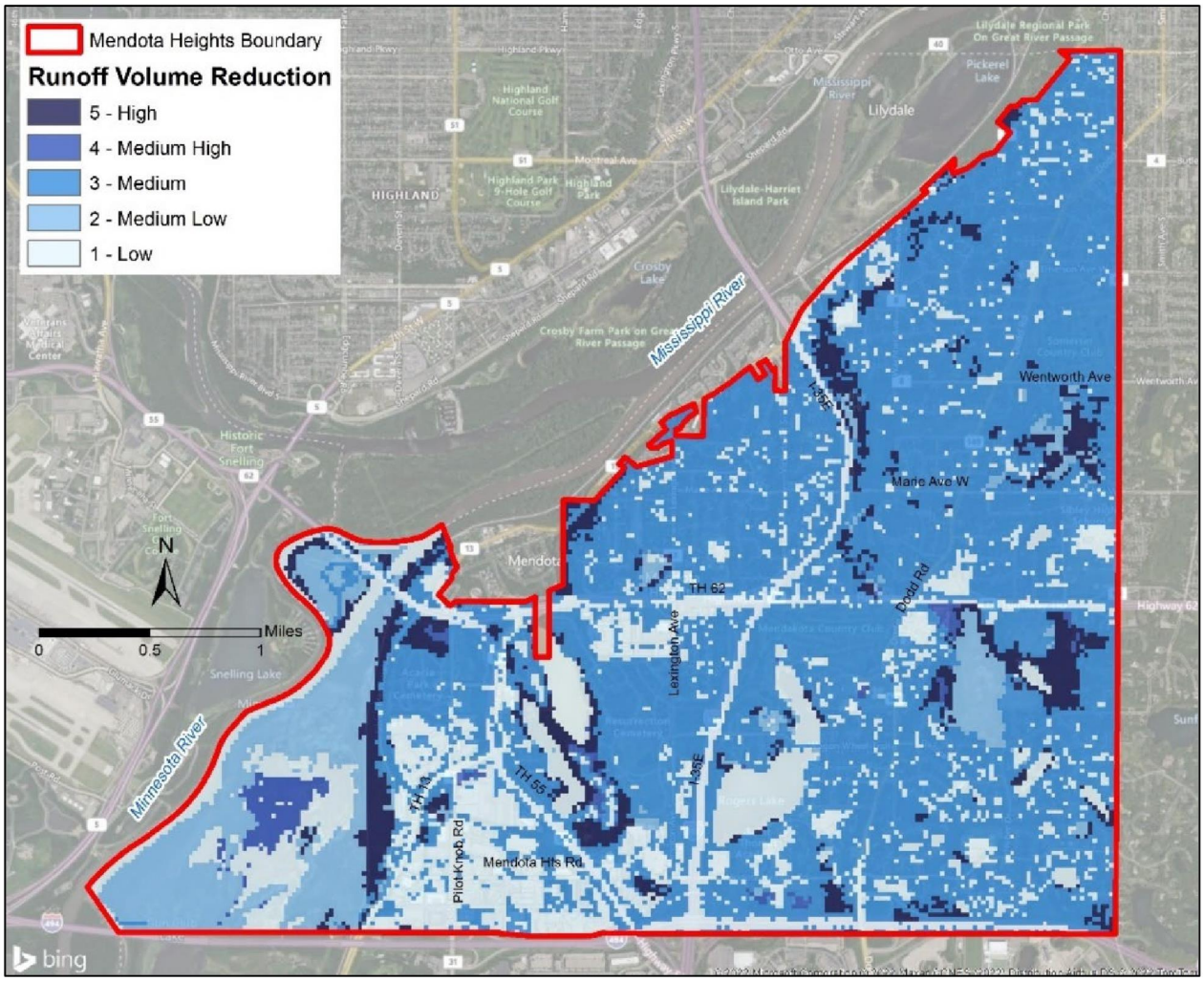
Figure D.2 Runoff Pollution (P) Removal in Mendota Heights



Runoff Volume Reduction

Urban and suburban landscapes contain impervious surfaces and stormwater infrastructure that is designed to collect and concentrates runoff into nearby surface waters. While these systems are typically effective at preventing flood damages (the primary objective of stormwater management), they also result in high flows of runoff. This urban runoff often carries heavy loads of nutrients, sediments, and other pollutants, and results in volatile water levels ("hydrologic bounce") in surface waters, which degrades habitat for native aquatic plants and wildlife. Therefore, volume reduction has become an important goal in modern stormwater design. Different land cover types provide different levels of runoff volume reduction, depending primarily on the opportunity for infiltration into the soil. Forests and prairies act like sponges in the landscape, with tree and grass leaves intercepting and absorbing precipitation, their roots sucking up moisture in shallow soils, and their soils, which typically have high infiltration rates. Impervious surfaces provide very little reduction in runoff volume. Figure D.3 provides a landscape-scale representation of this ecosystem service across the City of Mendota Heights. *Reference*: USDA NRCS 1986.

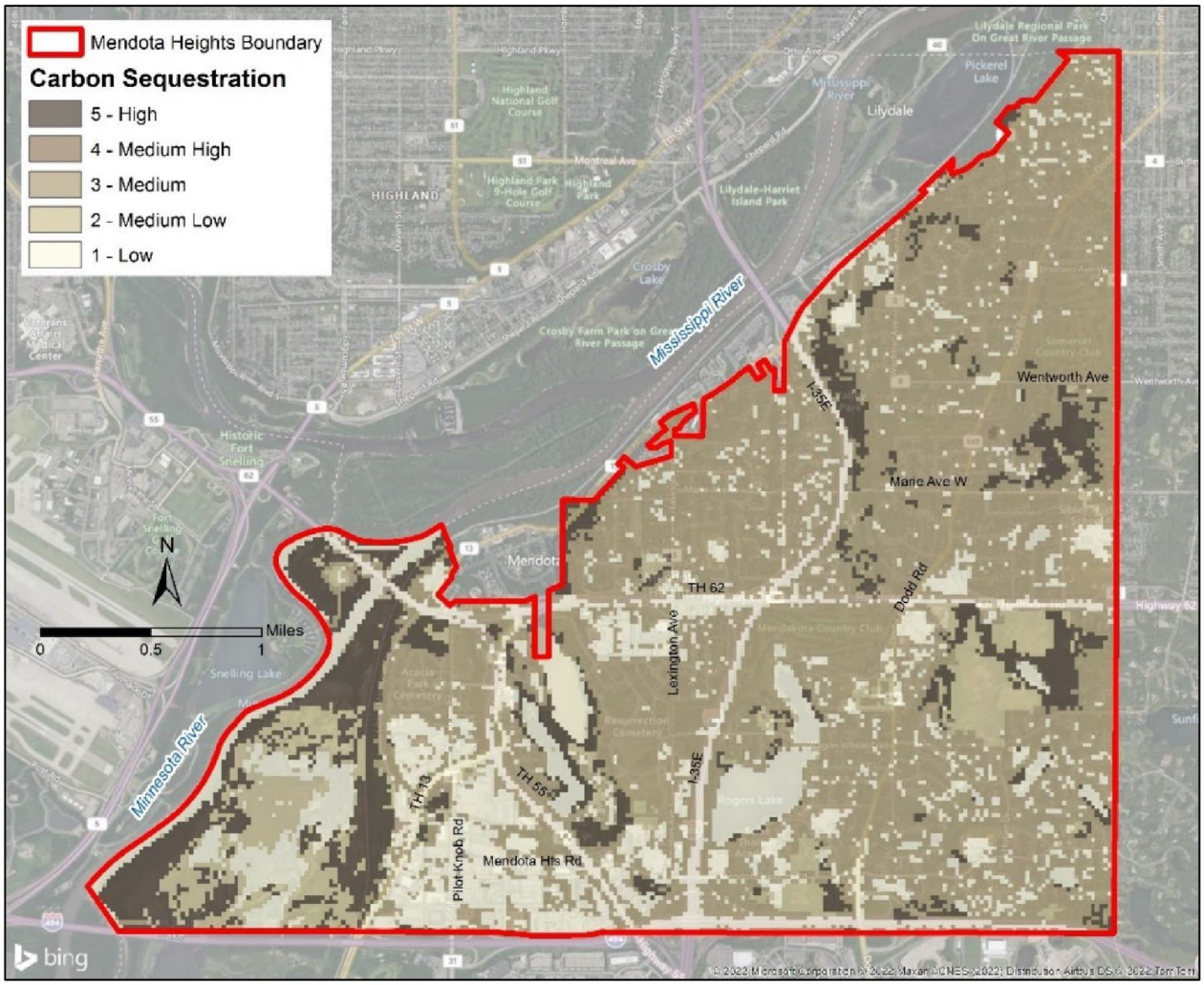
Figure D.3 Runoff Volume Reduction in Mendota Heights



Carbon Sequestration

Climate change (driven largely by high and rising carbon dioxide concentrations in the air) has underscored the importance of carbon sequestration. There are various ways to sequester carbon, but our analysis focuses on the ability of natural ecosystems to extract carbon from the air (in the form of carbon dioxide) and assimilate that carbon into growing plant matter – both above ground (tree trunks, leaves, herbaceous plants) and below ground (their root systems, which over time die, enriching the soil with carbon). Different land cover types provide different levels of carbon sequestration, depending primarily on the nature of the vegetation growing in the area. Forests typically have the highest rates of carbon sequestration due to their considerable growth rates and aboveground and below ground biomass. Impervious surfaces do not actively sequester carbon, and they displace vegetation growth, which otherwise would sequester carbon. Figure D.4 provides a landscape-scale representation of this ecosystem service across the City of Mendota Heights. *References*: USEPA 2022, Malak et al. 2021, Tangen et al. 2020, Zhu et al. 2012, Bridgham et al. 2006, West and Post 2002, Follett et al. 2001, Lal et al. 1999, Birdsey 1996.

Figure D.4 Carbon Sequestration in Mendota Heights



Appendix E. 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

4. When possible maintain separate equipment to use on uninfested sites.
5. If working on multiple sites, work in uninfested sites before infested sites and clean equipment after use.
6. When working within a site with invasive species work in uninfested areas before infested areas and clean equipment after use.
7. Avoid entering site under wet conditions to minimize rutting and other soil disturbances.
8. Minimize area of soil disturbance with equipment.
9. Minimize number of access points to site.
10. When creating roads and trails minimize area of vegetation and soil disturbance.
11. Survey site before management treatment and treat or avoid moving equipment through existing patches of invasive species.
12. Conduct post management treatment monitoring and treat any responding invasive species.
13. Inspect all gear and remove vegetation, soil, and organisms prior to arriving and leaving site.
14. 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.
15. Carry boot brush in or on all vehicles and clean boots and clothing (in a controlled area) when leaving any site.
16. Use brush to clean gear and equipment such as chainsaws to remove loose soil and plant materials.
17. Avoid parking in patches of invasive species. When unavoidable, clean vehicle of all visible evidence of soil and vegetation when leaving site.
18. Brush off (hand remove) plants, seeds, mud, soil and animals from vehicles, including wheel wells, tracks, hums, blades, grills, etc.
19. 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. Site-level 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 F. Studies of Ecosystem Services Response to Restoration and Management

Notes: green = positive effect; yellow = neutral effect

Management Activity & Land Cover Type	*Water*			*Soils & Plants*		*Species*			*Atmosphere*		*Human Focus*			
	Water Flow Regulation	Water Purification	Ground-water Recharge	Erosion Control	Carbon Storage	Wildlife Population Stabilization	Pollination	Rare Species and Habitat	Air Purfication	Micro Climate Moderation	Pest & Disease Control	Game & Fish Production	Genetic & Wild Materials	Recreation, Tourism, Spiritual, Aesthetic
A. Remove Invasive Plants (numbers refer to citations following the table)														
Dry-Mesic Forest/Woodland, Mesic Forest, Altered Forest/Woodland, Savanna, Shrub/Scrub	2	2		3	3, 14	4, 12	7, 9	9, 12	4	4	2, 10	6	6	6
Dry-Mesic Forest/Woodland, Mesic Forest, Altered Forest/Woodland, Savanna, Shrub/Scrub	2	2		3	3, 14	1, 5, 12	7, 9, 13	1, 9, 12			2, 10	6	6	6
Herbaceous Uplands (e.g., Prairie, Non-native Grassland & Ground layer of Forest/Woodland	2	2			14	13	7, 9, 13	7, 9			2, 10			
Herbaceous Lowlands (e.g., Wet Meadow, Marsh)	15	15			14	3, 11, 13, 15	3, 9, 13	3, 11						
B. Plant Native Species (numbers refer to citations following the table)														
Cultural Landscapes (e.g., turf)	4, 11	5, 12	12	4, 11	3, 4	4, 11	2, 14	2, 11	6	6	1, 5	4		5, 15
Forest, Woodland & Savanna	7, 10	7, 10		7, 10	8, 13, 15	7, 8, 9	7	7	7, 10, 13, 15	7, 10, 13, 15		7	7	7, 15
C. Restore Natural Processes (Fire, Hydrology, Erosion Rate, etc.; numbers refer to citations following the table)														
Savanna & Shrub/Scrub, Herbaceous Upland & Lowland	5, 11	5, 11	5	5, 11	4	1, 10, 11	1, 9	1, 10	2	3	1	3	3, 10	1
Prairies & Wetlands	14		14											
River, Stream, Lake, Pond	6, 13	6, 13		6, 7, 13		7, 12, 13	8	1			8	7	7	7

Appendix F. (continued) - Ecosystem Services References

A. Remove Invasive Species

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Appendix G. Example Outline of a Park Natural Resources Management Plan (NRMP)

1. EXECUTIVE SUMMARY

2. INTRODUCTION

- 2.1. Precedent Planning Efforts
- 2.2. Regional Natural Resource Conservation Context
- 2.3. Natural Resource Public Values

3. EXISTING NATURAL RESOURCES

- 3.1. Landscape Context
  - 3.1.1. Location
  - 3.1.2. Regional Natural Resources Context
  - 3.1.3. Adjacent Land Use
- 3.2. Physical Conditions
  - 3.2.1. Geology
  - 3.2.2. Topography
  - 3.2.3. Soils
- 3.3. Vegetation
  - 3.3.1. Historical Vegetation and Land Use
  - 3.3.2. Land Cover and Use Trends
  - 3.3.3. Land Cover Mapping and Assessment
- 3.4. Aquatic Resources
  - 3.4.1. Groundwater and Aquifer Sensitivity
  - 3.4.2. Surface Waters
- 3.5. Wildlife
  - 3.5.1. General Wildlife Habitat
  - 3.5.2. Wildlife in the Park Today
  - 3.5.3. At Risk Wildlife Populations
- 3.6. Rare Natural Features

4. NATURAL RESOURCES ISSUES AND OPPORTUNITIES

- 4.1. Issues
  - 4.1.1. Issue 1
- 4.2. Opportunities
  - 4.2.1. Opportunity 1

5. NATURAL RESOURCE VISION AND GOALS

- 5.1. Vision for Park Name
- 5.2. Goals for Park Name
  - 5.2.1. Goal 1

Appendix H. Management Briefs for Priority Projects

Valley Park North

1. NW Forest Enhancement
2. E Forest Enhancement
3. S Oak/Aspen Knoll Enhancement

Rogers Lake Park

4. W Savanna/Forest & N Shoreline Enhancement

Copperfield Ponds Park

5. Isthmus Enhancement

Wentworth Park

6. Forest Enhancement, Aquatic Buffer & Turf-to-Prairie

Hagstrom King Park

7. Oak Woodland Enhancement

Friendly Marsh Park

8. Turf-to-Prairie

VALLEY PARK NORTH - NW FOREST ENHANCEMENT

IDENTIFIERS & BASIC INFORMATION

Natural Area Park: Valley Park North
Natural Acres: 8.0
Primary Habitat Type(s): Forest
Primary Activity: Enhancement

ASSESSMENT OF CURRENT CONDITIONS

Site History: Remnant mesic forest and oak savanna.
Existing Vegetation Type, Area & Quality Rank: Altered Forest/Woodland (6.3 ac, NN quality); Mesic Forest (0.3 ac, BC-C quality); Dry-Mesic Forest/Woodland (1.0 ac, CD quality); Non-Native Grassland (0.4 ac, NN quality)
Current Condition (2021): The project area consists of three patches of forest and woodland, most of which are second-growth forest. The southern portion of the project area includes Dry-Mesic Forest/Woodland (a fire-dependent plant community) that has undergone initial restoration work. Adjacent forest/woodland and prairie restoration efforts are ongoing.

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues

- Invasive woody species, primarily Common buckthorn; Invasive herbaceous species, including Garlic mustard
- Historical land uses resulted in low tree species diversity and few age classes

Goals (transition to a natural forest community and increase biodiversity by implementing the following)

- Maintain/establish ≥90% canopy cover
- Control invasive species, including those listed above
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

Strategies

- Use prescribed fire where feasible for site preparation and management
- Manually remove invasive vegetation where safe and feasible
- Conduct stump and foliar spray treatments
- Spot spray invasive vegetation where manual removal infeasible
- Install native trees, shrubs, live plant plugs, and seed to diversify canopy (over time), shrub stratum, and ground layer; for Dry-Mesic Forest/Woodland see MNDNR species lists for MHs37 (Southern Dry-Mesic Oak Forest) and narrative for UPs24 (Southern Mesic Savanna) and species lists for UPs23 (Southern Mesic Prairie, understory species appropriate for mesic savanna); for remaining forests see MHs38 (Southern Mesic Oak-Basswood Forest) and MHs39 (Southern Mesic Maple-Basswood Forest)

RESTORATION & MANAGEMENT TASKS, TIMEFRAME, INDICATORS OF SUCCESS & COSTS (OPC)

Restoration/Management Task	Timeframe	Indicator of Success	OPC (first 3 yrs)
Restore processes: Conduct prescribed burn when and where feasible for site preparation and initial management	Yr 1 (prep of Non-Native Grassland and Dry-Mesic Forest/Woodland)	≥80% of target vegetation burned	$503
Restore structure: Remove invasive trees/shrubs	Yr 1, dormant season	All target woody species cut & treated	$22,466
Restore structure: Treat woody re-sprouts & seedlings	Yrs 2-3 (min.), fall	<3% cover by target woody species	$6,881
Restore structure: Broadcast herbicide	Yr 1, 2x during growing season	All Non-Native Grassland killed prior to seeding	$287
Introduce species diversity: Install native trees/shrubs	Phased in following adequate preparation and with available resources	Tree/shrub strata diversified (≥5 native tree species and ≥5 native shrub species well distributed), with ≥90% canopy cover achieved in forests in 10 yrs	$7,330
Introduce species diversity: Native seeding (and mulching where warranted)	Yr 1 (Non-Native Grassland seeded & mulched); other areas overseed following adequate preparation and with available resources	All Non-Native Grassland seeded & mulched; ≥50% of seeded species germinate, survive, and are well distributed in all seeding zones	$9,704
Introduce species diversity: Native herbaceous plantings	Optional, phased in with available resources	≥50% survivorship of live plantings	$0
Continue short-term management: Management mow	Yr 2 (2x), Yr 3 (1x)	All Non-Native Grassland mowed after seeding	$287
Continue short-term management: Spot herbicide	Yrs 1-3, semi-annually	<3% cover by target herbaceous species by end of Yr 3	$11,119
Restore processes: Prescribed burn	Yr 3 (where sufficient fuel)	≥80% of target vegetation burned	$1,226
Practice adaptive management: Ecological monitoring/oversight	Yrs 1-3, at least annually	Inspection report of findings & recommendations	$4,249
		Total Cost (first 3 yrs):	**$64,052**


VALLEY PARK NORTH -
NW FOREST ENHANCEMENT
Natural Area Park Boundary
Priority Project Area
Other Restoration Project
Parcel Boundary
Dry-Mesic Forest/Woodland
Mesic Forest
Altered Forest/Woodland
Shrub/Scrub
Non-Native Grassland
Lowland Forest
Lowland Shrub/Scrub
Wet Meadow
Elevation Contour (2-ft interval)
0.2 ac
1.1 ac
6.8 ac
Bluff Circle
Park Place Dr
E Forest Enhancement
Ecological Quality Ranks:
A = Highest Quality Community
B = Good Quality Community
C = Moderate Quality Community
D = Poor Quality Community
NN = Altered/Non-Native Community
N
0
150
300
Feet
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VALLEY PARK NORTH - E FOREST ENHANCEMENT

IDENTIFIERS & BASIC INFORMATION

Natural Area Park: Valley Park North
Natural Acres: 3.7
Primary Habitat Type(s): Forest
Primary Activity: Enhancement

ASSESSMENT OF CURRENT CONDITIONS

Site History: Remnant mesic forest.
Existing Vegetation Type, Area & Quality Rank: Mesic Forest (3.7 ac, C quality)
Current Condition (2021): The project area consists of a remnant Mesic Forest located primarily within a ravine. A variety of native trees are present, as are patches of native wildflowers. An intermittent drainageway flows west into Big Foot/Interstate Valley Creek. Most of the project area exhibits moderate to steep slopes, some of which contain patches of bare soil.

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues

- Invasive woody species, primarily Common buckthorn (but generally not dense/abundant)
- Invasive herbaceous species, including Garlic mustard
- Extensive sheet erosion on steep slopes, and some channel downcutting and bank erosion in ravine

Goals (transition to a natural forest community and increase biodiversity by implementing the following)

- Maintain/establish ≥90% canopy cover
- Control invasive species, including those listed above
- Establish ≥90% cover by soil-anchoring herbaceous vegetation in ground layer to reduce sheet erosion on slopes
- Improve biodiversity by increasing abundance and diversity of native plants throughout area
- Better manage upstream stormwater to reduce flashy flows and erosion in ravine

Strategies

- Manually remove invasive vegetation where feasible
- Conduct stump and foliar spray treatments
- Spot spray invasive vegetation where manual removal infeasible
- Install native seed to increase ground layer cover and stabilize soils
- Install native trees, shrubs, live plant plugs, and seed to diversify canopy (over time), shrub stratum, and ground layer; see MNDNR species lists for MHs38 (Southern Mesic Oak-Basswood Forest) and MHs39 (Southern Mesic Maple-Basswood Forest)
- Install stormwater BMPs (e.g., rain gardens) in contributing watershed to reduce volume and rate and improve water quality.

RESTORATION & MANAGEMENT TASKS, TIMEFRAME, INDICATORS OF SUCCESS & COSTS (OPC)

Restoration/Management Task	Timeframe	Indicator of Success	OPC (first 3 yrs)
Restore structure: Remove invasive trees/shrubs	Yr 1, dormant season	All target woody species cut & treated	$9,164
Restore structure: Treat woody re-sprouts & seedlings	Yrs 2-3 (min.), fall	<3% cover by target woody species	$3,297
Restore structure: Native overseeding of soil-stabilizing herbaceous species	Yr 1 or 2, following adequate preparation	≥50% of seeded species germinate, survive, and are well distributed in all seeding zones, resulting in ≥90% ground layer cover	$4,396
Introduce species diversity: Install native trees/shrubs	Phased in following adequate preparation and with available resources	Tree/shrub strata diversified (≥5 native tree species and ≥5 native shrub species well distributed), with ≥90% canopy cover maintained	$2,203
Introduce additional species diversity: Native overseeding	Optional, phased in following stabilization overseeding (under "Restore structure" above) and with available resources	≥50% of seeded species germinate, survive, and are well distributed in all seeding zones	$0
Introduce species diversity: Native herbaceous plantings	Optional, phased in with available resources	≥50% survivorship of live plantings	$0
Continue short-term management: Spot herbicide	Yrs 1-3, semi-annually	<3% cover by target herbaceous species by end of Yr 3	$3,304
Restore processes: Identify and implement stormwater BMPs in watershed	Optional, phased in with available resources	Ravine downcutting and bank erosion reduced (measurable indicator of success to be determined)	$0
Practice adaptive management: Ecological monitoring/oversight	Yrs 1-3, at least annually	Inspection report of findings & recommendations	$2,559
		Total Cost (first 3 yrs):	**$24,923**


VALLEY PARK NORTH -
E FOREST ENHANCEMENT
Natural Area Park Boundary
Priority Project Area
Other Restoration Project
Parcel Boundary
Mesic Forest
Altered Forest/Woodland
Shrub/Scrub
Non-Native Grassland
Lowland Forest
Wet Meadow
Elevation Contour (2-ft interval)
Park Place Dr
Boardwalk Ct
Wachtler Ave
Deer Trail Ct
NN
C
3.7 ac
CD
N
0
100
200
Feet
Ecological Quality Ranks:
A = Highest Quality Community
B = Good Quality Community
C = Moderate Quality Community
D = Poor Quality Community
NN = Altered/Non-Native Community
bing
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VALLEY PARK NORTH – S OAK/ASPEN KNOLL ENHANCEMENT

IDENTIFIERS & BASIC INFORMATION

Natural Area Park: Valley Park North
Natural Acres: 1.5
Primary Habitat Type(s): Woodland
Primary Activity: Enhancement

ASSESSMENT OF CURRENT CONDITIONS

Site History: Remnant oak woodland.
Existing Vegetation Type, Area & Quality Rank: Dry-Mesic Forest/Woodland (1.5 ac, CD quality)
Current Condition (2021): The project area is a woodland knoll dominated by Bur oaks and Quaking aspen. This is a fire-dependent plant community. The eastern portion of the project area has already been brushed and overseeded with natives; however, the western portion contains dense buckthorn and other invasive species.

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues

- Invasive woody species, primarily Common buckthorn
- Invasive herbaceous species, including Garlic mustard, Common burdock, and Japanese hedge parsley
- Fire suppression has led to aggressive woody growth

Goals (transition to a natural savanna/woodland community and increase biodiversity by implementing the following)

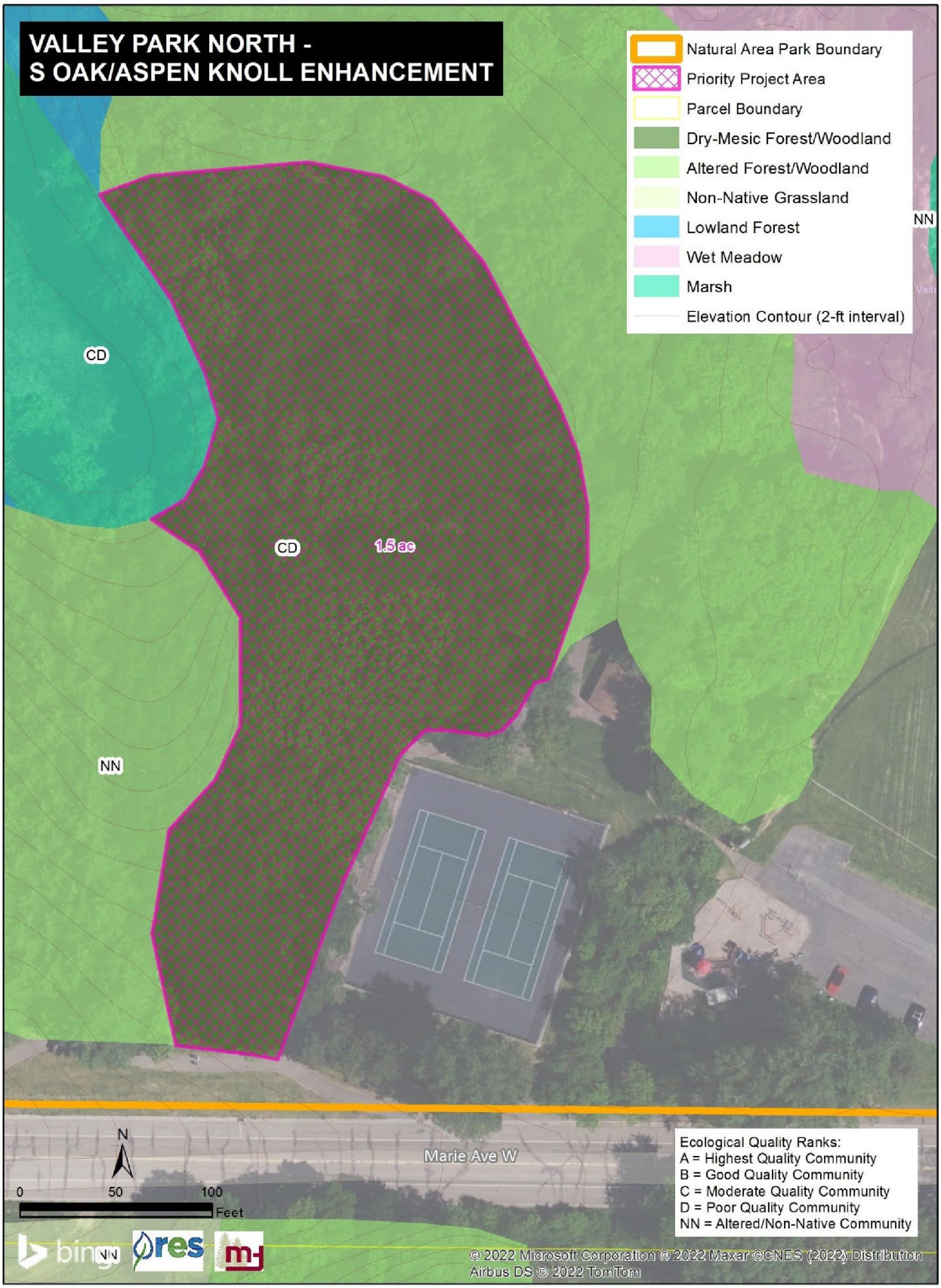
- Maintain/establish 50-70% canopy cover
- Control invasive species, including those listed above
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

Strategies

- Use prescribed fire where feasible for site preparation and management of this fire-dependent plant community
- Manually remove invasive vegetation where feasible
- Conduct stump and foliar spray treatments
- Spot spray invasive vegetation where manual removal infeasible
- Install native trees, shrubs, live plant plugs, and seed to diversify canopy (over time), shrub stratum, and ground layer; see MNDNR species lists for MHs37 (Southern Dry-Mesic Oak Forest); see narrative for UPs24 (Southern Mesic Savanna) and species lists for UPs23 (Southern Mesic Prairie, understory species appropriate for mesic savanna)

RESTORATION & MANAGEMENT TASKS, TIMEFRAME, INDICATORS OF SUCCESS & COSTS (OPC)

Restoration/Management Task	Timeframe	Indicator of Success	OPC (first 3 yrs)
Restore processes: Conduct prescribed burn when and where feasible for site preparation and initial management	Yr 1	≥80% of target vegetation burned	$1,224
Restore structure: Remove invasive trees/shrubs	Yr 1, dormant season	All target woody species cut & treated	$2,294
Restore structure: Treat woody re-sprouts & seedlings	Yrs 2-3 (min.), fall	<3% cover by target woody species	$1,147
Introduce species diversity: Install native trees/shrubs	Phased in following adequate preparation and with available resources	Tree/shrub strata diversified (≥5 native tree species and ≥5 native shrub species well distributed), with 50-70% canopy cover maintained	$1,223
Introduce species diversity: Native overseeding	Phased in following adequate preparation and with available resources	≥50% of seeded species germinate, survive, and are well distributed in all seeding zones	$1,529
Introduce species diversity: Native herbaceous plantings	Optional, phased in with available resources	≥50% survivorship of live plantings	$0
Continue short-term management: Spot herbicide and/or spot mow	Yrs 1-3, semi-annually	<3% cover by target herbaceous species by end of Yr 3	$1,376
Restore processes: Prescribed burn	Yr 3	≥80% of target vegetation burned	$1,224
Practice adaptive management: Ecological monitoring/oversight	Yrs 1-3, at least annually	Inspection report of findings & recommendations	$1,070
		Total Cost (first 3 yrs):	**$11,087**


VALLEY PARK NORTH -
S OAK/ASPEN KNOLL ENHANCEMENT
Natural Area Park Boundary
Priority Project Area
Parcel Boundary
Dry-Mesic Forest/Woodland
Altered Forest/Woodland
Non-Native Grassland
Lowland Forest
Wet Meadow
Marsh
Elevation Contour (2-ft interval)
CD
CD
1.5 ac
NN
NN
Marie Ave W
N
0
50
100
Feet
Ecological Quality Ranks:
A = Highest Quality Community
B = Good Quality Community
C = Moderate Quality Community
D = Poor Quality Community
NN = Altered/Non-Native Community
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ROGERS LAKE PARK – W SAVANNA/FOREST & N SHORELINE ENHANCEMENT

IDENTIFIERS & BASIC INFORMATION

Natural Area Park: Rogers Lake Park
Natural Acres: 7.9
Primary Habitat Type(s): Savanna, Lowland Forest & Prairie
Primary Activity: Enhancement

ASSESSMENT OF CURRENT CONDITIONS

Site History: Remnant oak savanna, lowland forest, and mesic-wet prairie.
Existing Vegetation Type, Area & Quality Rank: Savanna (3.2 ac, CD quality); Lowland Forest (2.6 ac, CD-D quality); Altered Forest/Woodland (1.1 ac, NN quality); Marsh (0.7 ac, D quality); Shrub/Scrub (0.2 ac, NN quality); Prairie (0.1 ac, C to NN quality)
Current Condition (2021): The project area is a mosaic of wooded and more open habitats. Previous restoration work created the project area's NE sliver of shoreline prairie, and significant brushing was underway in the savanna and forests.

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues

- Invasive woody species, primarily Siberian elm and Common buckthorn
- Invasive herbaceous species, including Garlic mustard, invasive cattails, and Reed canary grass (Purple loosestrife nearby)
- Fire suppression has led to aggressive woody growth in Savanna

Goals (transition to healthier natural communities and increase biodiversity by implementing the following)

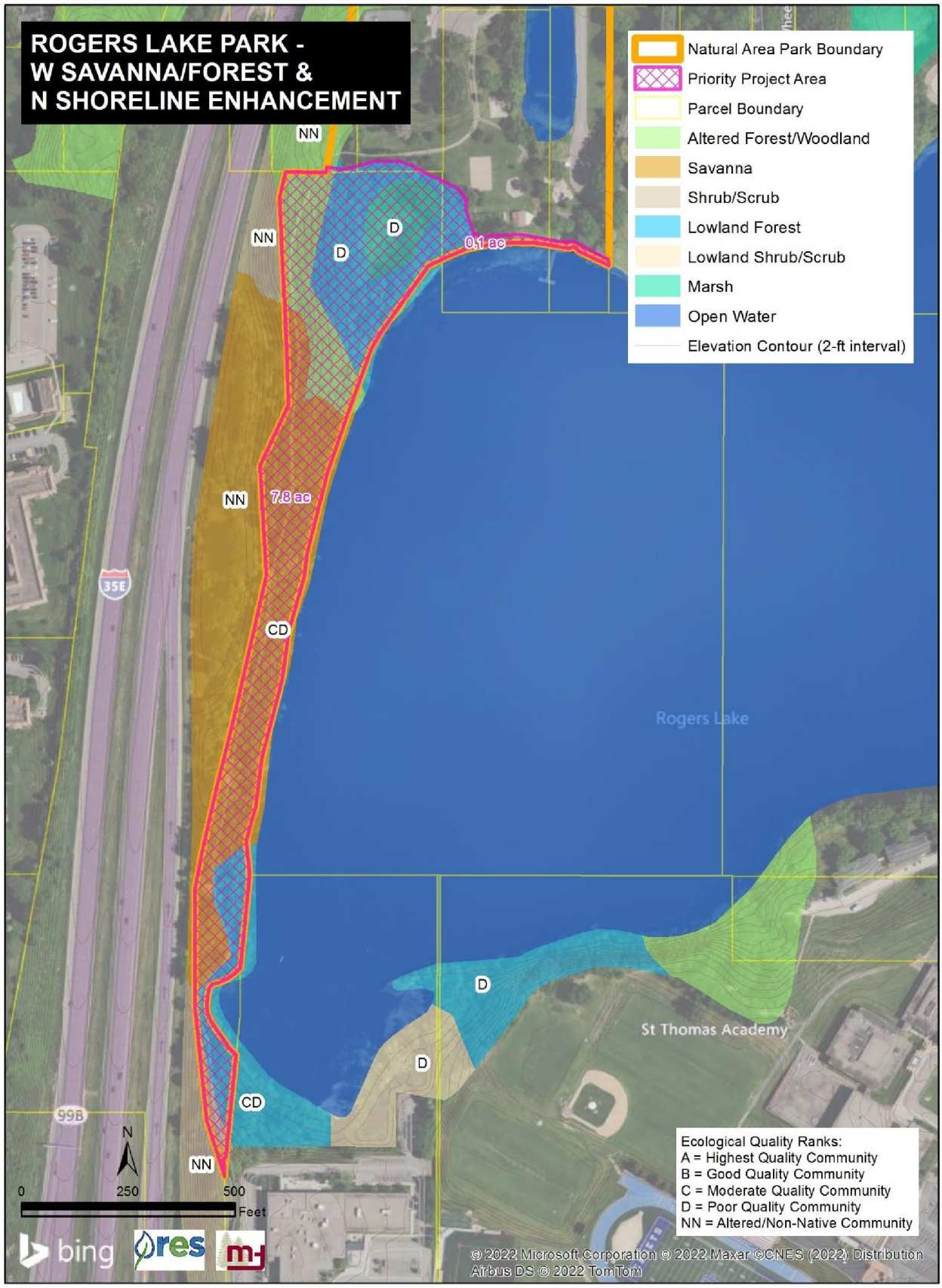
- Maintain/establish 50-70% canopy cover in Savanna and ≥90% canopy cover in remaining forests
- Restore native vegetation to Marsh
- Control invasive species, including those listed above
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

Strategies

- Use prescribed fire where feasible for site preparation and management of fire-dependent plant communities
- Manually remove invasive vegetation where feasible
- Conduct stump and foliar spray treatments
- Spot spray invasive vegetation where manual removal infeasible
- Install native trees, shrubs, live plant plugs, and seed to diversify canopy (over time), shrub stratum, and ground layer; for Savanna and Shrub/Scrub see MNDNR narrative for UPs24 (Southern Mesic Savanna) and species lists for UPs23 (Southern Mesic Prairie, understory species appropriate for mesic savannas); for other forests see MHs37 (Southern Dry-Mesic Oak Forest), MHs38 (Southern Mesic Oak-Basswood Forest), MHs39 (Southern Mesic Maple-Basswood Forest), and FFs59 (Southern Terrace Forest); for Marsh see MRn83 (Northern Mixed Cattail Marsh) and MRn93 (Northern Bulrush-Spikerush Marsh); for Prairie see UPs23 (Southern Mesic Prairie) and WPs54 (Southern Wet Prairie)

RESTORATION & MANAGEMENT TASKS, TIMEFRAME, INDICATORS OF SUCCESS & COSTS (OPC)

Restoration/Management Task	Timeframe	Indicator of Success	OPC (first 3 yrs)
Restore processes: Conduct prescribed burn when and where feasible for site preparation and initial management	Yr 1	≥80% of target vegetation burned	$3,457
Restore structure: Remove invasive trees/shrubs	Yr 1, dormant season	All target woody species cut & treated	$13,312
Restore structure: Treat woody re-sprouts & seedlings	Yrs 2-3 (min.), fall	<3% cover by target woody species	$6,562
Restore structure: Broadcast herbicide	Yr 1, 2x during growing season	All invasive Marsh vegetation killed prior to seeding	$654
Introduce species diversity: Install native trees/shrubs	Phased in following adequate preparation and with available resources	Tree/shrub strata diversified (≥5 native tree species and ≥5 native shrub species well distributed), with 50-70% canopy cover maintained	$5,341
Introduce species diversity: Native seeding	Phased in following adequate preparation and with available resources	≥50% of seeded species germinate, survive, and are well distributed in all seeding zones	$8,859
Introduce species diversity: Native herbaceous plantings	Optional, phased in with available resources	≥50% survivorship of live plantings	$0
Continue short-term management: Spot herbicide and/or spot mow	Yrs 1-3, semi-annually	<3% cover by target herbaceous species by end of Yr 3	$9,366
Restore processes: Prescribed burn	Yr 3	≥80% of target vegetation burned	$2,400
Practice adaptive management: Ecological monitoring/oversight	Yrs 1-3, at least annually	Inspection report of findings & recommendations	$4,260
		Total Cost (first 3 yrs):	**$54,211**


ROGERS LAKE PARK -
W SAVANNA/FOREST &
N SHORELINE ENHANCEMENT
Natural Area Park Boundary
Priority Project Area
Parcel Boundary
Altered Forest/Woodland
Savanna
Shrub/Scrub
Lowland Forest
Lowland Shrub/Scrub
Marsh
Open Water
Elevation Contour (2-ft interval)
NN
NN
D
D
0.1 ac
NN
7.8 ac
35E
CD
Rogers Lake
D
St Thomas Academy
D
99B
CD
N
NN
0
250
500
Feet
Ecological Quality Ranks:
A = Highest Quality Community
B = Good Quality Community
C = Moderate Quality Community
D = Poor Quality Community
NN = Altered/Non-Native Community
bing
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COPPERFIELD PONDS PARK – ISTHMUS ENHANCEMENT

IDENTIFIERS & BASIC INFORMATION

Natural Area Park: Copperfield Ponds Park
Natural Acres: 5.3
Primary Habitat Type(s): Forest, Woodland & Shrub/Scrub
Primary Activity: Enhancement

ASSESSMENT OF CURRENT CONDITIONS

Site History: Disturbed site with patches of remnant oak forest/woodland.
Existing Vegetation Type, Area & Quality Rank: Altered Forest/Woodland (2.3 ac, NN quality); Shrub/Scrub (2.1 ac, D to NN quality); Mesic Forest (0.7 ac, CD to D quality); Lowland Forest (0.2 ac, D quality)
Current Condition (2021): The project area is a mosaic of wooded and more open habitats. Previous restoration work included limited prairie planting, and removal of invasive Siberian elm and brushing was underway.

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues

- Invasive woody species, including Siberian elm, Common buckthorn, invasive honeysuckles, and significant Amur maple
- Invasive herbaceous species, including Garlic mustard, Japanese hedge parsley, and Common burdock
- Fire suppression has led to aggressive woody growth in forests/woodlands

Goals (transition to healthier natural communities and increase biodiversity by implementing the following)

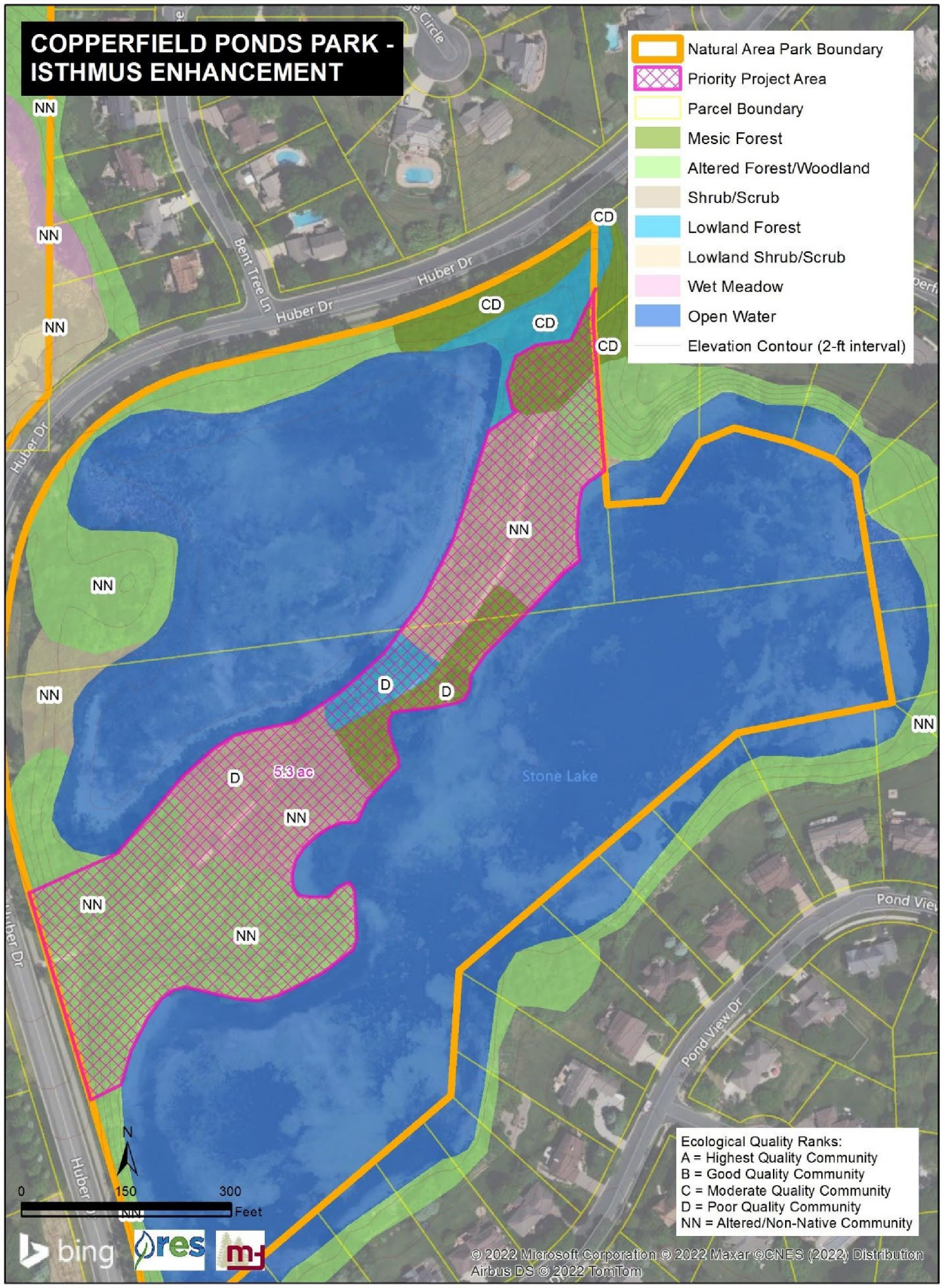
- Maintain/establish ≥90% canopy cover in areas maintained as forest and 50-70% canopy cover in areas maintained as Savanna
- Control invasive species, including those listed above
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

Strategies

- Use prescribed fire where feasible for site preparation and management of fire-dependent plant communities
- Manually remove invasive vegetation where feasible
- Conduct stump and foliar spray treatments
- Spot spray invasive vegetation where manual removal infeasible
- Install native trees, shrubs, live plant plugs, and seed to diversify canopy (over time), shrub stratum, and ground layer; for forests see MNDNR species lists for MHs37 (Southern Dry-Mesic Oak Forest), MHs38 (Southern Mesic Oak-Basswood Forest), MHs39 (Southern Mesic Maple-Basswood Forest), and FFs59 (Southern Terrace Forest); for Savanna see narrative for UPs24 (Southern Mesic Savanna) and species lists for UPs23 (Southern Mesic Prairie, understory species appropriate for mesic savannas); for more open areas (i.e., Prairie) see UPs23 (Southern Mesic Prairie)

RESTORATION & MANAGEMENT TASKS, TIMEFRAME, INDICATORS OF SUCCESS & COSTS (OPC)

Restoration/Management Task	Timeframe	Indicator of Success	OPC (first 3 yrs)
Restore processes: Conduct prescribed burn when and where feasible for site preparation and initial management	Yr 1	≥80% of target vegetation burned	$1,900
Restore structure: Remove invasive trees/shrubs	Yr 1, dormant season	All target woody species cut & treated	$11,752
Restore structure: Treat woody re-sprouts & seedlings	Yrs 2-3 (min.), fall	<3% cover by target woody species	$4,759
Introduce species diversity: Install native trees/shrubs	Phased in following adequate preparation and with available resources	Tree/shrub strata diversified (≥5 native tree species and ≥5 native shrub species well distributed), with 50-70% canopy cover maintained	$3,625
Introduce species diversity: Native overseeding	Phased in following adequate preparation and with available resources	≥50% of seeded species germinate, survive, and are well distributed in all seeding zones	$6,167
Introduce species diversity: Native herbaceous plantings	Optional, phased in with available resources	≥50% survivorship of live plantings	$0
Continue short-term management: Spot herbicide and/or spot mow	Yrs 1-3, semi-annually	<3% cover by target herbaceous species by end of Yr 3	$7,397
Restore processes: Prescribed burn	Yr 3	≥80% of target vegetation burned	$1,041
Practice adaptive management: Ecological monitoring/oversight	Yrs 1-3, at least annually	Inspection report of findings & recommendations	$2,998
		Total Cost (first 3 yrs):	**$39,639**


COPPERFIELD PONDS PARK - ISTHMUS ENHANCEMENT
Natural Area Park Boundary
Priority Project Area
Parcel Boundary
Mesic Forest
Altered Forest/Woodland
Shrub/Scrub
Lowland Forest
Lowland Shrub/Scrub
Wet Meadow
Open Water
Elevation Contour (2-ft interval)
Huber Dr
Bent Tree Ln
Stone Lake
Pond View Dr
5.3 ac
0
150
300
Feet
Ecological Quality Ranks:
A = Highest Quality Community
B = Good Quality Community
C = Moderate Quality Community
D = Poor Quality Community
NN = Altered/Non-Native Community
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WENTWORTH PARK – FOREST ENHANCEMENT, AQUATIC BUFFER & TURF-TO-PRAIRIE

IDENTIFIERS & BASIC INFORMATION

Natural Area Park: Wentworth Park
Natural Acres: 2.2
Primary Habitat Type(s): Forest & Turf
Primary Activity: Convert turf to prairie and enhancement

ASSESSMENT OF CURRENT CONDITIONS

Site History: Disturbed site with no remnant native plant communities.
Existing Vegetation Type, Area & Quality Rank: Turf (1.5 ac, NN quality); Altered Forest/Woodland (0.5 ac, NN quality); pond shoreline (0.2 ac, NN quality)
Current Condition (2021): The project area is primarily maintained turf with a patch of second-growth forest and an excavated pond.

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues

- Low-use, high-maintenance turf
- Poor quality patch of forest and pond
- Invasive woody species, including Common buckthorn, invasive honeysuckles, and White mulberry
- Invasive herbaceous species, including Garlic mustard, Dame's rocket, and Common burdock

Goals (convert to, or enhance existing, natural communities and increase biodiversity by implementing the following)

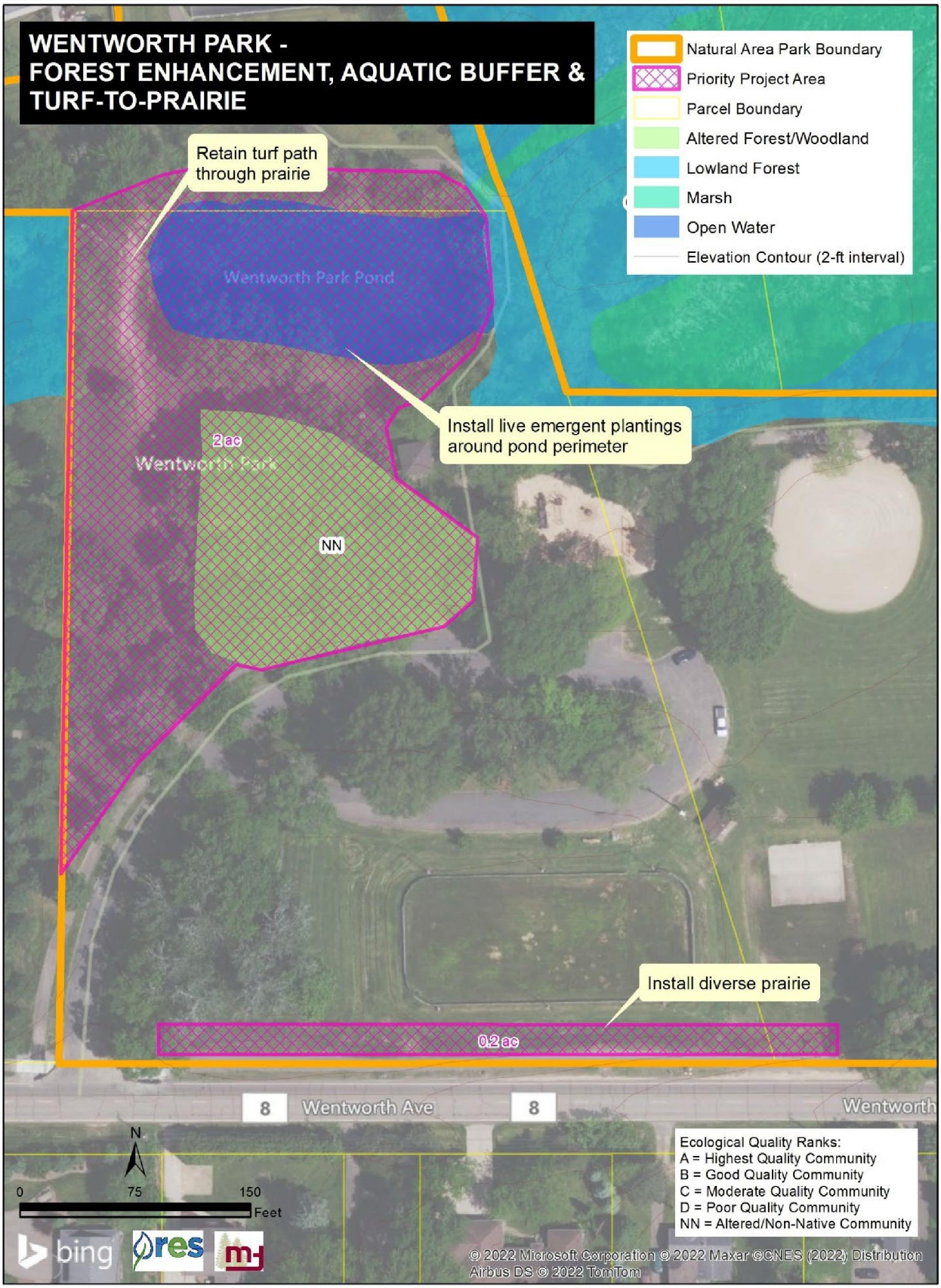
- Maintain ≥90% canopy cover in forest patch
- Control invasive species, including those listed above
- Establish diverse native Prairie areas
- Augment seeded native aquatic buffer around pond by installing live emergent plants

Strategies

- Use prescribed fire for management of Prairie and aquatic buffer
- Manually remove invasive vegetation where feasible
- Conduct stump and foliar spray treatments
- Spot spray invasive vegetation where manual removal infeasible
- Install native trees, shrubs, live plant plugs, and seed to establish or diversify forest canopy (over time), shrub stratum, and ground layer; for forest see MNDNR species lists for MHs38 (Southern Mesic Oak-Basswood Forest) and MHs39 (Southern Mesic Maple-Basswood Forest); for Prairie see UPs23 (Southern Mesic Prairie, for majority of project area) and WPs54 (Southern Wet Prairie, for buffer around pond); for aquatic edge of pond see MNDNR species lists for MRn83 (Northern Mixed Cattail Marsh) and MRn93 (Northern Bulrush-Spikerush Marsh)

RESTORATION & MANAGEMENT TASKS, TIMEFRAME, INDICATORS OF SUCCESS & COSTS (OPC)

Restoration/Management Task	Timeframe	Indicator of Success	OPC (first 3 yrs)
Restore structure: Remove invasive trees/shrubs	Yr 1, dormant season	All target woody species cut & treated	$1,568
Restore structure: Treat woody re-sprouts & seedlings	Yrs 2-3 (min.), fall	<3% cover by target woody species	$470
Restore structure: Broadcast herbicide	Yr 1, 2x during growing season	All turf killed prior to seeding	$770
Introduce species diversity: Install native trees/shrubs	Phased in following adequate preparation and with available resources	Tree/shrub strata diversified (≥5 native tree species and ≥5 native shrub species well distributed), with 50-70% canopy cover maintained	$523
Introduce species diversity: Native seeding (drill seed into killed turf areas)	Yr 1 (turf-to-prairie seeded); other areas overseed following adequate preparation and with available resources	All Prairie seeded; ≥50% of seeded species germinate, survive, and are well distributed in all seeding zones	$2,675
Introduce species diversity: Native herbaceous plantings (emergent zone)	Optional, phased in with available resources	≥50% survivorship of live plantings	$2,500
Continue short-term management: Spot herbicide and/or spot mow	Yrs 1-3, semi-annually	<3% cover by target herbaceous species by end of Yr 3	$3,856
Restore processes: Prescribed burn	Yr 3	≥80% of target vegetation burned	$1,540
Practice adaptive management: Ecological monitoring/oversight	Yrs 1-3, at least annually	Inspection report of findings & recommendations	$1,557
		Total Cost (first 3 yrs):	**$15,459**


WENTWORTH PARK -
FOREST ENHANCEMENT, AQUATIC BUFFER &
TURF-TO-PRAIRIE
Natural Area Park Boundary
Priority Project Area
Parcel Boundary
Altered Forest/Woodland
Lowland Forest
Marsh
Open Water
Elevation Contour (2-ft interval)
Retain turf path through prairie
Wentworth Park Pond
Install live emergent plantings around pond perimeter
2 ac
Wentworth Park
NN
Install diverse prairie
0.2 ac
8
Wentworth Ave
8
Wentworth
N
0
75
150
Feet
Ecological Quality Ranks:
A = Highest Quality Community
B = Good Quality Community
C = Moderate Quality Community
D = Poor Quality Community
NN = Altered/Non-Native Community
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HAGSTROM KING PARK – OAK WOODLAND ENHANCEMENT

IDENTIFIERS & BASIC INFORMATION

Natural Area Park: Hagstrom King Park
Natural Acres: 0.6
Primary Habitat Type(s): Woodland
Primary Activity: Enhancement

ASSESSMENT OF CURRENT CONDITIONS

Site History: Remnant oak woodland.
Existing Vegetation Type, Area & Quality Rank: Mesic Forest (0.6 ac, D quality); some Dry-Mesic Forest/Woodland attributes
Current Condition (2021): The project area is a woodland dominated by Bur oak, Northern pin oak, and Black cherry. While classified as Mesic Forest (due to shrub and ground layer species observed), over time this can likely be maintained with prescribed fire. Several oaks have succumbed to oak wilt, but several Bur oaks appear healthy.

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues

- Invasive woody species, primarily Common buckthorn, invasive honeysuckles, and Siberian elm
- Invasive herbaceous species, including Garlic mustard and Common burdock
- Fire suppression has led to aggressive woody growth
- Oak wilt resulting in loss of mature canopy trees

Goals (transition to a natural savanna/woodland community and increase biodiversity by implementing the following)

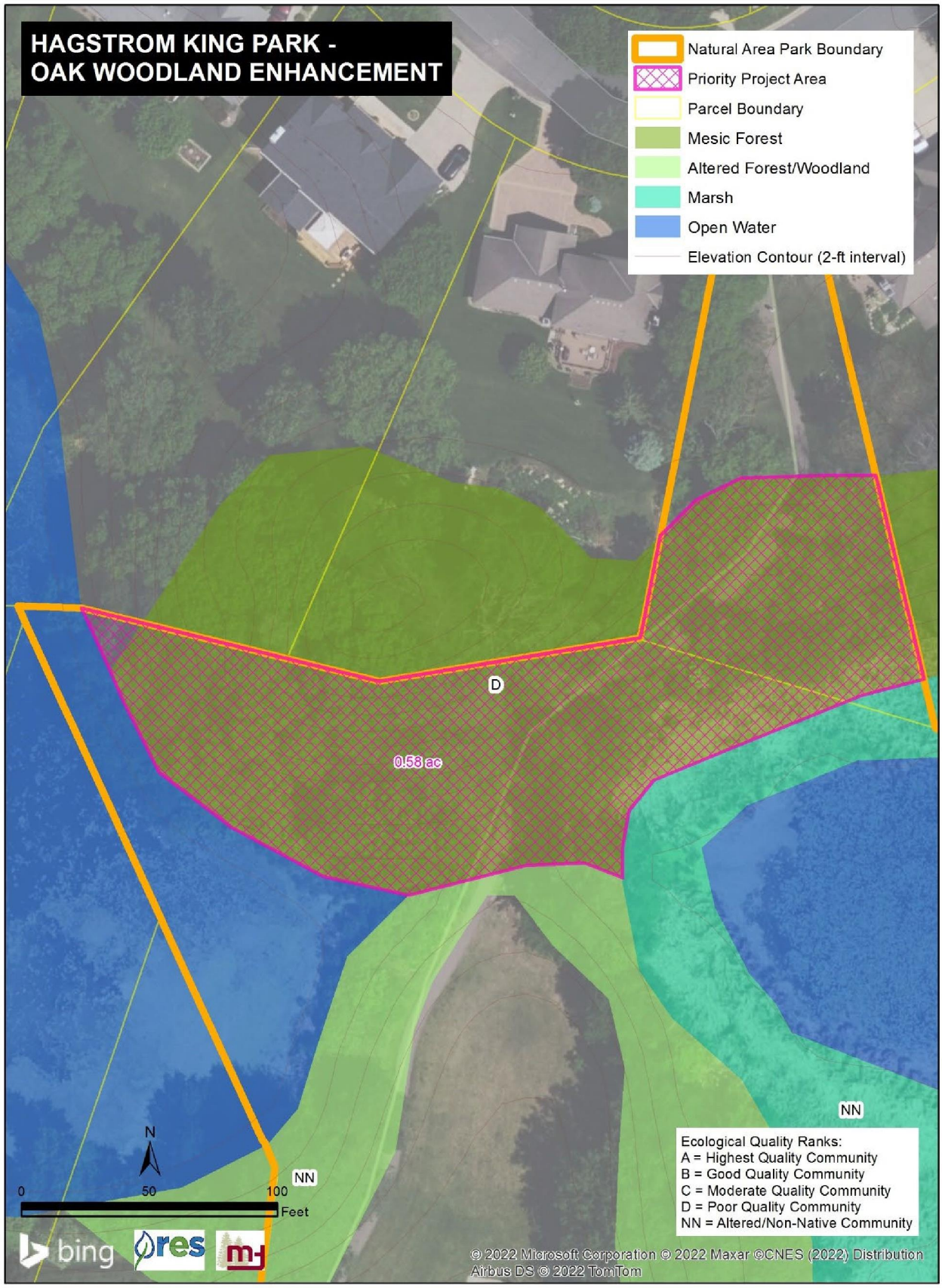
- Maintain/establish 50-70% canopy cover
- Control invasive species, including those listed above
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

Strategies

- Use prescribed fire where feasible for site preparation and management
- Manually remove invasive vegetation where feasible
- Conduct stump and foliar spray treatments
- Spot spray invasive vegetation where manual removal infeasible
- Install native trees, shrubs, live plant plugs, and seed to diversify canopy (over time), shrub stratum, and ground layer; see MNDNR species lists for MHs37 (Southern Dry-Mesic Oak Forest); see narrative for UPs24 (Southern Mesic Savanna) and species lists for UPs23 (Southern Mesic Prairie, understory species appropriate for mesic savanna)

RESTORATION & MANAGEMENT TASKS, TIMEFRAME, INDICATORS OF SUCCESS & COSTS (OPC)

Restoration/Management Task	Timeframe	Indicator of Success	OPC (first 3 yrs)
Restore processes: Conduct prescribed burn when and where feasible for site preparation and initial management	Yr 1	≥80% of target vegetation burned	$747
Restore structure: Remove invasive trees/shrubs	Yr 1, dormant season	All target woody species cut & treated	$1,435
Restore structure: Treat woody re-sprouts & seedlings	Yrs 2-3 (min.), fall	<3% cover by target woody species	$574
Introduce species diversity: Install native trees/shrubs	Phased in following adequate preparation and with available resources	Tree/shrub strata diversified (≥5 native tree species and ≥5 native shrub species well distributed), with 50-70% canopy cover maintained	$574
Introduce species diversity: Native overseeding	Phased in following adequate preparation and with available resources	≥50% of seeded species germinate, survive, and are well distributed in all seeding zones	$574
Introduce species diversity: Native herbaceous plantings	Optional, phased in with available resources	≥50% survivorship of live plantings	$0
Continue short-term management: Spot herbicide and/or spot mow	Yrs 1-3, semi-annually	<3% cover by target herbaceous species by end of Yr 3	$919
Restore processes: Prescribed burn	Yr 3	≥80% of target vegetation burned	$747
Practice adaptive management: Ecological monitoring/oversight	Yrs 1-3, at least annually	Inspection report of findings & recommendations	$459
		Total Cost (first 3 yrs):	**$6,029**


HAGSTROM KING PARK -
OAK WOODLAND ENHANCEMENT
Natural Area Park Boundary
Priority Project Area
Parcel Boundary
Mesic Forest
Altered Forest/Woodland
Marsh
Open Water
Elevation Contour (2-ft interval)
D
0.58 ac
NN
NN
N
0
50
100
Feet
Ecological Quality Ranks:
A = Highest Quality Community
B = Good Quality Community
C = Moderate Quality Community
D = Poor Quality Community
NN = Altered/Non-Native Community
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FRIENDLY MARSH PARK – TURF-TO-PRAIRIE

IDENTIFIERS & BASIC INFORMATION

Natural Area Park: Friendly Marsh Park
Natural Acres: 1.3
Primary Habitat Type(s): Turf
Primary Activity: Convert turf to prairie

ASSESSMENT OF CURRENT CONDITIONS

Site History: Disturbed site with no remnant native plant communities.
Existing Vegetation Type, Area & Quality Rank: Turf (1.3 ac, NN quality)
Current Condition (2021): The project area is maintained turf. A paved trail runs north-south to the west of the project area.

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues

- Low-use, high-maintenance turf

Goals (convert to native Prairie and increase biodiversity by implementing the following)

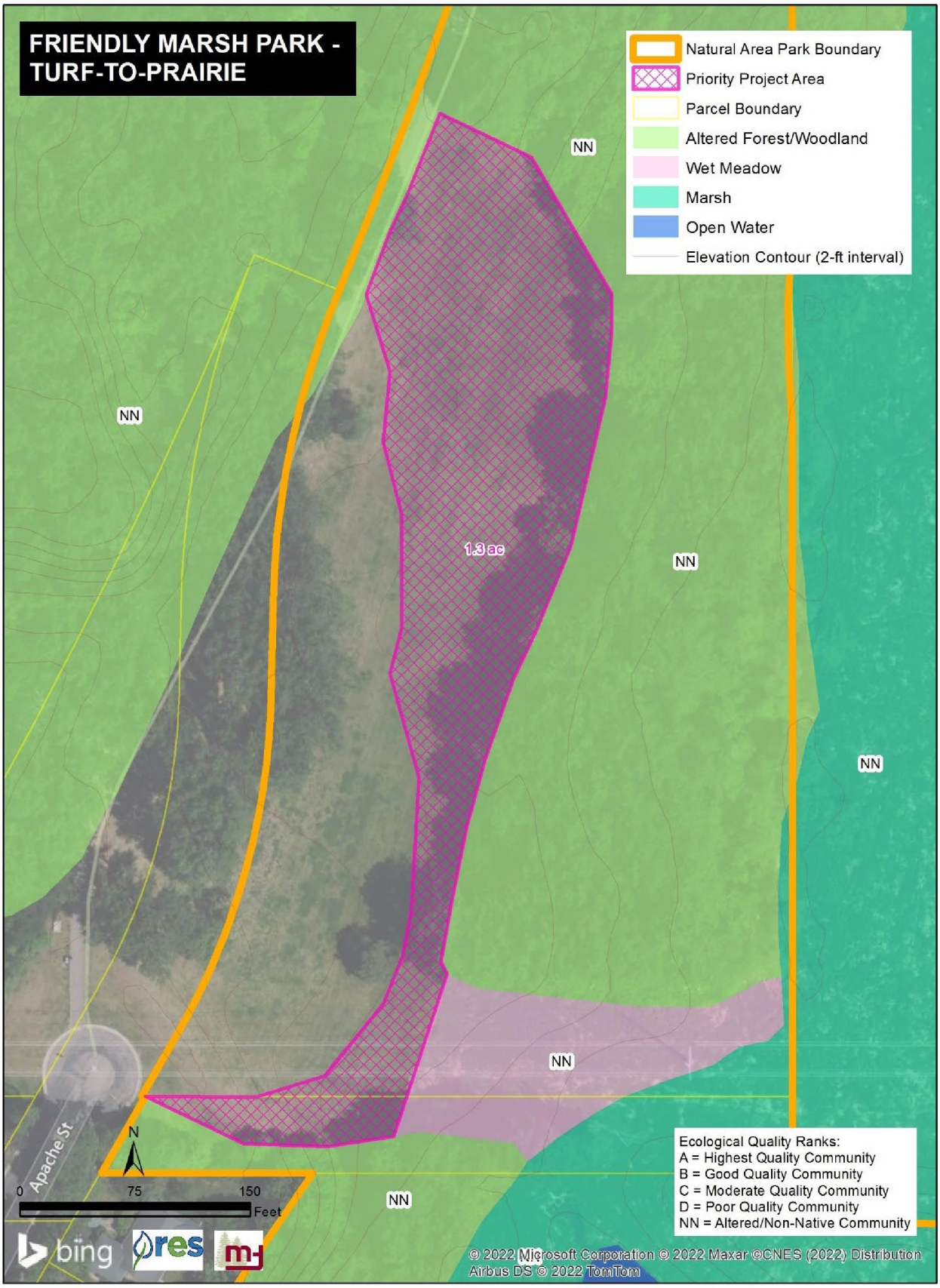
- Establish diverse native Prairie

Strategies

- Use prescribed fire for management
- Install native seed (and optionally live plant plugs); see MNDNR species lists for UPs23 (Southern Mesic Prairie, for higher/drier portions of project area) and WPs54 (Southern Wet Prairie, for lower/wetter portions of project area)

RESTORATION & MANAGEMENT TASKS, TIMEFRAME, INDICATORS OF SUCCESS & COSTS (OPC)

Restoration/Management Task	Timeframe	Indicator of Success	OPC (first 3 yrs)
Restore structure: Broadcast herbicide	Yr 1, 2x during growing season	All turf killed prior to seeding	$660
Introduce species diversity: Native seeding (drill seed into killed turf)	Yr 1, following adequate preparation	All Prairie seeded; ≥50% of seeded species germinate, survive, and are well distributed in seeding area	$1,584
Introduce species diversity: Native herbaceous plantings	Optional, phased in with available resources	≥50% survivorship of live plantings	$0
Continue short-term management: Spot herbicide and/or spot mow	Yrs 1-3, semi-annually	<3% cover by target herbaceous species by end of Yr 3	$2,376
Restore processes: Prescribed burn	Yr 3	≥80% of target vegetation burned	$1,320
Practice adaptive management: Ecological monitoring/oversight	Yrs 1-3, at least annually	Inspection report of findings & recommendations	$792
		Total Cost (first 3 yrs):	**$6,732**


FRIENDLY MARSH PARK - TURF-TO-PRAIRIE
Natural Area Park Boundary
Priority Project Area
Parcel Boundary
Altered Forest/Woodland
Wet Meadow
Marsh
Open Water
Elevation Contour (2-ft interval)
NN
1.3 ac
Apache St
N
0
75
150
Feet
Ecological Quality Ranks:
A = Highest Quality Community
B = Good Quality Community
C = Moderate Quality Community
D = Poor Quality Community
NN = Altered/Non-Native Community
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Appendix I. Species Lists for Mendota Heights Native Plant Communities (MNDNR 2005)

SPECIES LISTS FOR MENDOTA HEIGHTS NATIVE PLANT COMMUNITIES
1. Southern Dry-Mesic Oak Forest (MHs37)
2. Southern Mesic Oak-Basswood Forest (MHs38)
3. Southern Mesic Maple-Basswood Forest (MHs39)
4. Southern Terrace Forest (FFs59)
5. Southern Mesic Savanna (UPs24) – narrative, not species lists
6. Southern Mesic Prairie (UPs23)
7. Southern Wet Prairie (WPs54)
8. Northern Mixed Cattail Marsh (MRn83)
9. Northern Bulrush-Spikerush Marsh (MRn93)

Note: The following native species lists are a useful guide for restoring and enhancing Mendota Heights' various types of natural areas. However, due to past human disturbances and other ecological stressors, attention must be paid to each particular site's existing environmental conditions, and projected future conditions (e.g., in light of climate change) should be considered.

MHs37 Southern Dry-Mesic Oak Forest – Species Frequency & Cover

	freq%	cover
Forbs, Ferns & Fern Allies		
Lady fern *(Athyrium filix-femina)*	91	●●
Pointed-leaved tick trefoil *(Desmodium glutinosum)*	88	●●
Clayton's sweet cicely *(Osmorhiza claytonii)*	86	●
Common enchanter's nightshade *(Circaea lutetiana)*	81	●
Wild geranium *(Geranium maculatum)*	79	●
Honewort *(Cryptotaenia canadensis)*	72	●
White avens *(Geum canadense)*	72	●
Lopseed *(Phryma leptostachya)*	72	●
Hog peanut *(Amphicarpaea bracteata)*	70	●●
White snakeroot *(Eupatorium rugosum)*	65	●
Common false Solomon's seal *(Smilacina racemosa)*	65	●
Large-flowered bellwort *(Uvularia grandiflora)*	63	●
Gregarious black snakeroot *(Sanicula gregaria)*	58	●
Maidenhair fern *(Adiantum pedatum)*	56	●
Wild sarsaparilla *(Aralia nudicaulis)*	56	●
Jack-in-the-pulpit *(Arisaema triphyllum)*	56	●
Sweet-scented bedstraw *(Galium triflorum)*	53	●
Rattlesnake fern *(Botrychium virginianum)*	51	●
Spreading Jacob's ladder *(Polemonium reptans)*	47	●
Blue cohosh *(Caulophyllum thalictroides)*	47	●
Erect, Smooth, or Illinois carrion-flower*	44	●
Wood anemone *(Anemone quinquefolia)*	42	●
Red baneberry *(Actaea rubra)*	42	●
Bracken *(Pteridium aquilinum)*	40	●
Cleavers *(Galium aparine)*	40	●
Bloodroot *(Sanguinaria canadensis)*	40	●
Early meadow-rue *(Thalictrum dioicum)*	35	●
Maryland black snakeroot *(Sanicula marilandica)*	35	●
Zigzag goldenrod *(Solidago flexicaulis)*	33	●
Clearweed *(Pilea* spp.)	28	●
Grasses & Sedges		
Starry sedge *(Carex rosea)*	37	●
Pennsylvania sedge *(Carex pensylvanica)*	35	●
Bland sedge *(Carex blanda)*	23	●

	freq%	cover
Climbing Plants		
Virginia creeper *(Parthenocissus* spp.)	86	●●
Wild grape *(Vitis riparia)*	79	●
Low Shrubs		
Red raspberry *(Rubus idaeus)*	42	●
Black raspberry *(Rubus occidentalis)*	30	●
Tall blackberries *(Rubus allegheniensis* and similar *Rubus* spp.)	28	●●
Shrubs		
Chokecherry *(Prunus virginiana)*	79	●●
American hazelnut *(Corylus americana)*	72	●●
Missouri gooseberry *(Ribes missouriense)*	63	●●
Poison ivy *(Toxicodendron rydbergii)*	63	●
Pagoda dogwood *(Cornus alternifolia)*	58	●●
Prickly gooseberry *(Ribes cynosbati)*	51	●●●
Gray dogwood *(Cornus racemosa)*	42	●
Round-leaved dogwood *(Cornus rugosa)*	30	●●
Nannyberry *(Viburnum lentago)*	26	●

Trees	Canopy		Subcanopy		Shrub Layer	
	freq%	cover	freq%	cover	freq%	cover
Northern red oak	91	●●●●	35	●	72	●
White oak	67	●●●●	30	●●	28	●
Basswood	51	●●	74	●●	60	●
American elm	40	●●●	51	●●●	40	●
Sugar maple	35	●●	49	●	28	●
Black cherry	33	●	67	●	70	●
Ironwood	30	●●	56	●●	35	●
Bur oak	30	●●●	12	●	12	●
Red elm	30	●●●	51	●●●	51	●●
Shagbark hickory	28	●	30	●●	28	●
Northern pin oak	23	●●●●	-	-	-	-
Hackberry	23	●	47	●	37	●
Paper birch	21	●●	-	-	-	-
Bitternut hickory	19	●	37	●●●	56	●
Box elder	14	●	56	●●	67	●

* Erect, Smooth, or Illinois carrion-flower *(Smilax ecirrata, S. herbacea,* or *S. illinoensis)*

MHs38 Southern Mesic Oak-Basswood Forest — Species Frequency and Cover

	freq%	cover
Forbs, Ferns & Fern Allies		
Zigzag goldenrod *(Solidago flexicaulis)*	84	●●
Clayton's sweet cicely *(Osmorhiza claytonii)*	81	●
Bloodroot *(Sanguinaria canadensis)*	77	●
Large-flowered bellwort *(Uvularia grandiflora)*	73	●●
Lopseed *(Phryma leptostachya)*	65	●
Common enchanter's nightshade *(Circaea lutetiana)*	64	●
Early meadow-rue *(Thalictrum dioicum)*	63	●
Virginia waterleaf *(Hydrophyllum virginianum)*	63	●●●
Jack-in-the-pulpit *(Arisaema triphyllum)*	56	●
Erect, Smooth, or Illinois carrion-flower*	55	●
Wild geranium *(Geranium maculatum)*	55	●
Honewort *(Cryptotaenia canadensis)*	54	●
Wild sarsaparilla *(Aralia nudicaulis)*	54	●
Blue cohosh *(Caulophyllum thalictroides)*	53	●
Rattlesnake fern *(Botrychium virginianum)*	50	●
Lady fern *(Athyrium filix-femina)*	50	●
Yellow violet *(Viola pubescens)*	50	●
Common false Solomon's seal *(Smilacina racemosa)*	48	●
Maryland black snakeroot *(Sanicula marilandica)*	48	●
Pointed-leaved tick trefoil *(Desmodium glutinosum)*	47	●
Red baneberry *(Actaea rubra)*	46	●
Maidenhair fern *(Adiantum pedatum)*	44	●
Hog peanut *(Amphicarpaea bracteata)*	44	●
Wild ginger *(Asarum canadense)*	43	●●
Wood anemone *(Anemone quinquefolia)*	41	●
Sweet-scented bedstraw *(Galium triflorum)*	41	●
Sharp-lobed hepatica *(Anemone acutiloba)*	38	●
White avens *(Geum canadense)*	37	●
Canada mayflower *(Maianthemum canadense)*	37	●
Cleavers *(Galium aparine)*	34	●
Shining bedstraw *(Galium concinnum)*	31	●
Grasses & Sedges		
Pennsylvania sedge *(Carex pensylvanica)*	57	●●●
Starry sedge *(Carex rosea)*	41	●

	freq%	cover
Bland sedge *(Carex blanda)*	31	●
Bottlebrush grass *(Elymus hystrix)*	28	●
Long-stalked sedge *(Carex pedunculata)*	27	●●
Nodding fescue *(Festuca subverticillata)*	20	●
Bearded shorthusk *(Brachyelytrum erectum)*	19	●
Woody Vines		
Virginia creeper *(Parthenocissus* spp.)	80	●
Wild grape *(Vitis riparia)*	39	●
Shrubs		
Prickly gooseberry *(Ribes cynosbati)*	71	●
Chokecherry *(Prunus virginiana)*	64	●
Prickly ash *(Zanthoxylum americanum)*	57	●●
Poison ivy *(Toxicodendron rydbergii)*	57	●
Pagoda dogwood *(Cornus alternifolia)*	53	●
Missouri gooseberry *(Ribes missouriense)*	30	●●
Nannyberry *(Viburnum lentago)*	23	●
Downy arrowwood *(Viburnum rafinesquianum)*	22	●
American hazelnut *(Corylus americana)*	21	●●

Trees	Canopy		Subcanopy		Shrub Layer	
	freq%	cover	freq%	cover	freq%	cover
Basswood	82	●●●	52	●●	73	●
Northern red oak	60	●●●●	11	●	52	●
Sugar maple	59	●●●●	60	●●●	65	●●●
Ironwood	42	●●●	84	●●●	70	●●
Green ash	36	●●●	16	●	38	●
Bur oak	33	●●●	-	-	18	●
White oak	30	●●●	-	-	9	●
American elm	27	●●	21	●●	32	●
Paper birch	20	●	-	-	-	-
Bitternut hickory	18	●●	26	●●	46	●
Red elm	16	●	19	●	34	●
White pine	12	●●●●	-	-	-	-
Black cherry	9	●	9	●	34	●
Blue beech	-	-	20	●●●	19	●

*Erect, Smooth, or Illinois carrion-flower *(Smilax ecirrata, S. herbacea,* or *S. illinoensis)*

MHs39 Southern Mesic Maple-Basswood Forest — Species Frequency and Cover

	freq%	cover
Forbs, Ferns & Fern Allies		
Virginia waterleaf *(Hydrophyllum virginianum)*	85	●●●
Bloodroot *(Sanguinaria canadensis)*	85	●
Yellow violet *(Viola pubescens)*	77	●
Large-flowered bellwort *(Uvularia grandiflora)*	75	●
Wild leek *(Allium tricoccum)*	74	●
Blue cohosh *(Caulophyllum thalictroides)*	72	●
Early meadow-rue *(Thalictrum dioicum)*	67	●
Cleavers *(Galium aparine)*	66	●
Clayton's sweet cicely *(Osmorhiza claytonii)*	66	●
Zigzag goldenrod *(Solidago flexicaulis)*	60	●
Jack-in-the-pulpit *(Arisaema triphyllum)*	60	●
Wood nettle *(Laportea canadensis)*	59	●●●
Lady fern *(Athyrium filix-femina)*	55	●
Common false Solomon's seal *(Smilacina racemosa)*	53	●
Wild ginger *(Asarum canadense)*	52	●●
Common enchanter's nightshade *(Circaea lutetiana)*	49	●
Sharp-lobed hepatica *(Anemone acutiloba)*	47	●
Maidenhair fern *(Adiantum pedatum)*	45	●
Wood anemone *(Anemone quinquefolia)*	45	●
Erect, Smooth, or Illinois carrion-flower*	44	●
Dutchman's breeches *(Dicentra cucullaria)*	44	●
Rattlesnake fern *(Botrychium virginianum)*	41	●
White avens *(Geum canadense)*	41	●
Kidney-leaved buttercup *(Ranunculus abortivus)*	40	●
Honewort *(Cryptotaenia canadensis)*	40	●
Stemless blue violets *(Viola sororia* and similar *Viola* spp.)	38	●
Blue phlox *(Phlox divaricata)*	36	●
Cut-leaved toothwort *(Cardamine concatenata)*	36	●●
Wild geranium *(Geranium maculatum)*	35	●
White trout lily *(Erythronium albidum)*	30	●●●
Red baneberry *(Actaea rubra)*	30	●
Lopseed *(Phryma leptostachya)*	29	●
Touch-me-not *(Impatiens* spp.)	28	●
Drooping trillium *(Trillium flexipes)*	27	●
Sweet-scented bedstraw *(Galium triflorum)*	26	●
Two-leaved miterwort *(Mitella diphylla)*	25	●
False rue anemone *(Enemion biternatum)*	25	●●
Nodding trillium *(Trillium cernuum)*	25	●
Gregarious black snakeroot *(Sanicula gregaria)*	22	●
Hairy Solomon's seal *(Polygonatum pubescens)*	22	●
Grasses & Sedges		
Pennsylvania sedge *(Carex pensylvanica)*	34	●
Starry sedge *(Carex rosea)*	27	●
Long-stalked sedge *(Carex pedunculata)*	27	●
Bland sedge *(Carex blanda)*	26	●
Bottlebrush grass *(Elymus hystrix)*	25	●
Woody Vines		
Virginia creeper *(Parthenocissus* spp.)	50	●
Canada moonseed *(Menispermum canadense)*	25	●
Shrubs		
Prickly gooseberry *(Ribes cynosbati)*	81	●
Chokecherry *(Prunus virginiana)*	58	●
Pagoda dogwood *(Cornus alternifolia)*	45	●
Prickly ash *(Zanthoxylum americanum)*	31	●
Missouri gooseberry *(Ribes missouriense)*	28	●●
Red-berried elder *(Sambucus racemosa)*	27	●

Trees	Canopy freq%	Canopy cover	Subcanopy freq%	Subcanopy cover	Shrub Layer freq%	Shrub Layer cover
Sugar maple	91	●●●●●	87	●●●●	88	●●●
Basswood	90	●●●	46	●	57	●
Northern red oak	55	●●●	-	-	37	●
Red elm	35	●●●	20	●●	33	●●
American elm	35	●●	18	●	22	●
Ironwood	35	●	67	●●●	39	●
Bitternut hickory	25	●●	31	●●	75	●
Black ash	25	●	12	●	18	●
Green ash	16	●●	-	-	28	●
Blue beech	-	-	15	●●●	15	●●

*Erect, Smooth, or Illinois carrion-flower *(Smilax ecirrata, S. herbacea,* or *S. illinoensis)*

FFs59 Southern Terrace Forest — Species Frequency & Cover

	freq%	cover
Forbs, Ferns & Fern Allies		
Wood nettle *(Laportea canadensis)*	98	●●●●
Touch-me-not *(Impatiens* spp.)	77	●
Virginia waterleaf *(Hydrophyllum virginianum)*	70	●●●
Tall coneflower *(Rudbeckia laciniata)*	67	●●
Stinging nettle *(Urtica dioica)*	58	●
Cleavers *(Galium aparine)*	51	●●●
Honewort *(Cryptotaenia canadensis)*	49	●●
White avens *(Geum canadense)*	40	●
Aniseroot *(Osmorhiza longistylis)*	37	●●
Blue phlox *(Phlox divaricata)*	37	●
Virginia knotweed *(Polygonum virginianum)*	35	●●
Stemless blue violets*	35	●●
Erect, Smooth, or Illinois carrion-flower**	35	●
Jack-in-the-pulpit *(Arisaema triphyllum)*	33	●
Rugulose or Yellow violet *(Viola canadensis* or *V. pubescens)*	30	●
False rue anemone *(Enemion biternatum)*	30	●●
Clearweed *(Pilea* spp.)	28	●●
Hispid buttercup *(Ranunculus hispidus)*	28	●●
Common enchanter's nightshade *(Circaea lutetiana)*	26	●
Ontario aster *(Aster ontarionis)*	26	●
Gregarious black snakeroot *(Sanicula gregaria)*	23	●
Maryland black snakeroot *(Sanicula marilandica)*	23	●
Cow parsnip *(Heracleum lanatum)*	23	●●
Sweet-scented bedstraw *(Galium triflorum)*	21	●
Clayton's sweet cicely *(Osmorhiza claytonii)*	19	●●●
Hog peanut *(Amphicarpaea bracteata)*	19	●
Woodmint *(Blephilia hirsuta)*	16	●
Early meadow-rue *(Thalictrum dioicum)*	16	●
Starry false Solomon's seal *(Smilacina stellata)*	16	●
Virginia bluebells *(Mertensia virginica)*	16	●●●
Ostrich fern *(Matteuccia struthiopteris)*	16	●●●
Wild geranium *(Geranium maculatum)*	16	●
Grasses & Sedges		
Virginia wild rye *(Elymus virginicus)*	44	●
Ambiguous sedge *(Carex amphibola)*	30	●
Bland sedge *(Carex blanda)*	30	●
Nodding fescue *(Festuca subverticillata)*	28	●
White grass *(Leersia virginica)*	23	●
Starry sedge *(Carex rosea)*	14	●
Gray's sedge *(Carex grayi)*	12	●
Woody Vines		
Virginia creeper *(Parthenocissus* spp.)	53	●
Wild grape *(Vitis riparia)*	53	●
Greenbrier *(Smilax tamnoides)*	47	●
Canada moonseed *(Menispermum canadense)*	33	●
Shrubs		
Missouri gooseberry *(Ribes missouriense)*	53	●
Prickly ash *(Zanthoxylum americanum)*	33	●●
Common elder *(Sambucus canadensis)*	33	●
Chokecherry *(Prunus virginiana)*	33	●●●
Poison ivy *(Toxicodendron rydbergii)*	23	●●
Nannyberry *(Viburnum lentago)*	16	●●
Prickly gooseberry *(Ribes cynosbati)*	16	●
Hawthorn *(Crataegus* spp.)	14	●●

Trees	Canopy freq%	Canopy cover	Subcanopy freq%	Subcanopy cover	Shrub Layer freq%	Shrub Layer cover
American elm	65	●●●	67	●●●	44	●
Box elder	56	●●●	53	●●●	26	●
Silver maple	51	●●●	21	●●	9	●
Green ash	44	●●	40	●●	30	●
Hackberry	40	●●●	58	●●	33	●
Basswood	37	●●●	26	●	12	●
Cottonwood	30	●●●●	-	-	-	-
Black ash	28	●●●	19	●●	19	●
Red elm	26	●●●	12	●●●	-	-
Swamp white oak	19	●●●●	9	●●	16	●
Bitternut hickory	14	●●●	9	●●●	14	●
Black walnut	14	●●●●	-	-	-	-

*Stemless blue violets *(Viola sororia* and similar *Viola* spp.) **Erect, Smooth, or Illinois carrion-flower *(Smilax ecirrata, S. herbacea,* or *S. illinoensis)*

UPs24

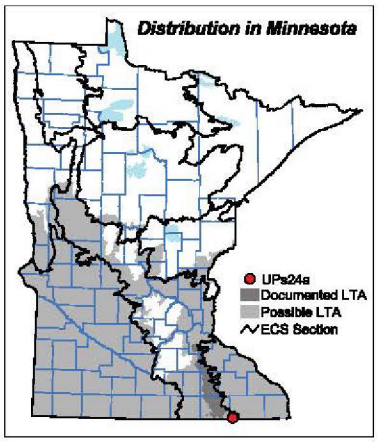
UPLAND PRAIRIE SYSTEM
Southern Floristic Region

Southern Mesic Savanna

Sparsely treed communities with tallgrass-dominated ground layers on somewhat poorly drained to well-drained loam soils mainly formed in unsorted glacial till, sometimes in a thin loess layer over till, and locally in lacustrine sediments and outwash deposits. Present primarily on level to gently rolling sites. Drought stress is irregular in occurrence and usually not severe.

Vegetation Structure & Composition

There is only one vegetation plot for this class; description is based mainly on inference from Southern Mesic Prairie (UPs23) and Southern Dry Savanna (UPs14).



- **Graminoid** cover is interrupted to continuous (50–100%). Tallgrasses dominate, but several midheight grasses are also important. Big bluestem *(Andropogon gerardii)* and Indian grass *(Sorghastrum nutans)* are the dominant tallgrasses, with prairie dropseed *(Sporobolus heterolepis)* either a codominant or subdominant component. On the drier end of the moisture gradient, little bluestem *(Schizachyrium scoparium)*, porcupine grass *(Stipa spartea)*, and side-oats grama *(Bouteloua curtipendula)* are important.
- **Forb** cover is sparse to patchy (5–50%). The most common species are heart-leaved alexanders *(Zizia aptera)*, heath aster *(Aster ericoides)*, stiff and Canada goldenrods *(Solidago rigida* and *S. canadensis)*, purple and white prairie clovers *(Dalea purpurea* and *D. candida)*, silverleaf scurfpea *(Pediomelum argophyllum)*, stiff sunflower *(Helianthus pauciflorus)*, white sage *(Artemisia ludoviciana)*, northern bedstraw *(Galium boreale)*, and smooth blue aster *(Aster laevis)*. Maximilian's sunflower *(Helianthus maximiliani)*, tall meadow-rue *(Thalictrum dasycarpum)*, prairie phlox *(Phlox pilosa)*, and gray-headed coneflower *(Ratibida pinnata)* are common in moister examples; rough blazing star *(Liatris aspera)*, Missouri and gray goldenrods *(Solidago missouriensis* and *S. nemoralis)*, and bird's foot coreopsis *(Coreopsis palmata)* are common in drier ones.
- **Woody vines** are a minor component. Virginia creeper *(Parthenocissus* spp.) is frequently present, and wild grape *(Vitis riparia)* is occasionally present.
- **Shrub layer** is patchy to interrupted (50–75% cover) and composed of low (< 20in [50cm]) semi-shrubs, taller (up to 6ft [2m]) shrubs, and oak seedlings and saplings (< 6ft). The low semi-shrubs leadplant *(Amorpha canescens)*, prairie rose *(Rosa arkansana)*, and poison ivy *(Toxicodendron rydbergii)* are generally common. Common taller shrubs are chokecherry *(Prunus virginiana)*, American hazelnut *(Corylus americana)*, smooth sumac *(Rhus glabra)*, gray dogwood *(Cornus racemosa)*, wolfberry *(Symphoricarpos occidentalis)*, low juneberry *(Amelanchier humilis)*, and wild plum *(Prunus americana)*.
- **Trees** are scattered or in scattered clumps, with total cover < 70% and typically 25–50%. Bur oak is most common, but northern pin oak is also usually present.
- **Notes**: The exotic grasses Kentucky bluegrass *(Poa pratensis)* and smooth brome *(Bromus inermis)* are often problematic in UPs24. Pennsylvania sedge *(Carex pensylvanica* var. *pensylvanica)*, a native graminoid that is naturally a minor component of UPs24, increases in abundance with prolonged heavy grazing. With fire suppression, trees other than the oaks become established, especially green ash, quaking aspen, and basswood.

Landscape Setting & Soils

Historically, UPs24 occurred most commonly in low relief prairie landscapes on ground moraines and end moraines, and less commonly on lacustrine deposits and finer-textured outwash. In the Rochester Plateau Subsection of the PPL, UPs24 occurred on loess-mantled pre-Wisconsin till. Soils are somewhat poorly drained to well drained, mostly moderately permeable to permeable, fine- and medium-textured loams and loamy sands. These are mollisols, characterized by thick, dark, organic-enriched upper horizons with high base saturation and dominantly bivalent cations.

Natural History

Savannas form where fire recurs frequently enough to prevent trees and shrubs from dominating, but where frequency and severity are low enough to allow fire-tolerant trees to become established and sometimes reach maturity. Historically, savannas occurred in physical proximity to prairies, but where features such as streams, lakes, and steep topography impeded the spread of fires, providing local amelioration of the prairie fire regime. All savannas are highly sensitive to fire suppression, quickly succeeding to woodland and eventually to forest, and the higher productivity of sites where UPs24 occurs makes it even more susceptible to succession than UPs14. UPs24 occupies sites where soil moisture availability remains high on average because of soil texture and composition, although the water table is below the rooting zone during the growing season except for brief periods. Before Euro-American settlement, grazing, browsing, and trampling by large ungulates were probably regular occurrences in UPs24. The contribution of this disturbance to the composition and structure of the vegetation is poorly understood, although confined grazing by domestic livestock can quickly destroy mesic savannas, promoting replacement of most of the native species by introduced ones. The fertile soils and gentle relief of UPs24 are ideal for row-crop agriculture, and almost all of the land that supported UPs24 has been converted to cropland; areas not converted have either been so heavily pastured that almost none of the native herbaceous flora survives, or they have become woodland or forest with fire suppression.

Similar Native Plant Community Classes

- **UPn24 Northern Mesic Savanna**

The scarcity of plot data for UPn24 and UPs24 make comparison of these classes speculative. Differences in the herbaceous flora probably mirror differences between UPs23 and UPn23. The two differ in tree composition, with northern pin oak frequent in UPs24 but rare in UPn24, and white oak occasional in UPs24 but not present in UPn24. Quaking aspen is probably more frequent in UPn24 than in UPs24. The boundary between these two classes, like that between UPs23 and UPn23, is set more or less by convention and could be repositioned or abandoned on further study.

- **UPs23 Southern Mesic Prairie**

UPs23 has similar herbaceous composition to UPs24—although forbs may be more important relative to graminoids in UPs24 than in UPs23—but generally lacks trees, while UPs24 has at least sparse (> 10%) tree cover, dominated by bur oak. Because of partial shading in UPs24, cool-season graminoids such as junegrass *(Koeleria pyramidata)*, porcupine grass, green needle grass *(Stipa viridula)*, and Pennsylvania sedge may be more important relative to warm-season grasses than in UPs23.

- **UPs14 Southern Dry Savanna**

Differences in the herbaceous flora between UPs14 and UPs24 are probably similar to the differences between UPs13 and UPs23. Shrub cover is probably greater in UPs24 than in UPs14—UPs24 might have more the appearance of a shrub thicket than that of a tree-studded prairie. Differences in substrate characteristics (predominantly sandy or gravelly outwash and lacustrine deposits versus predominantly loamy till) are sufficient in most cases to distinguish the two classes; classification uncertainty is likely only when UPs14 is on loamy slopes (UPs14c).

Native Plant Community Types in Class

- **UPs24a Mesic Oak Savanna (Southern)**

UPs24a is the only community type recognized in this class. Additional data and further analysis may warrant subdivision based on soils (sands versus loams).

photo by D.S. Wovcha, MN DNR

Fillmore County, MN

UPs23 Southern Mesic Prairie — Species Frequency & Cover

	freq%	cover
Forbs, Ferns & Fern Allies		
Heart-leaved alexanders *(Zizia aptera)*	78	●
Heath aster *(Aster ericoides)*	77	●●
Stiff goldenrod *(Solidago rigida)*	74	●
Canada goldenrod *(Solidago canadensis)*	69	●●
Purple prairie clover *(Dalea purpurea)*	68	●
Yarrow *(Achillea millefolium)*	65	●
Rough blazing star *(Liatris aspera)*	59	●
Prairie phlox *(Phlox pilosa)*	55	●
White prairie clover *(Dalea candida)*	55	●
Hoary puccoon *(Lithospermum canescens)*	53	●
Stiff sunflower *(Helianthus pauciflorus)*	50	●
Prairie wild onion *(Allium stellatum)*	49	●
Missouri goldenrod *(Solidago missouriensis)*	47	●●
Long-headed thimbleweed *(Anemone cylindrica)*	46	●
Bearded birdfoot violet *(Viola palmata)*	45	●
Flodman's thistle *(Cirsium flodmanii)*	45	●
Tall meadow-rue *(Thalictrum dasycarpum)*	44	●
Daisy fleabane *(Erigeron strigosus)*	44	●
Silverleaf scurfpea *(Pediomelum argophyllum)*	43	●
White sage *(Artemisia ludoviciana)*	43	●
Northern bedstraw *(Galium boreale)*	39	●●
Smooth blue aster *(Aster laevis)*	37	●
Gray-headed coneflower *(Ratibida pinnata)*	36	●●
Silky aster *(Aster sericeus)*	34	●
Maximilian's sunflower *(Helianthus maximiliani)*	31	●●
Gray goldenrod *(Solidago nemoralis)*	31	●●
Ox-eye *(Heliopsis helianthoides)*	31	●
Tall cinquefoil *(Potentilla arguta)*	31	●
Common milkweed *(Asclepias syriaca)*	31	●
Bird's foot coreopsis *(Coreopsis palmata)*	30	●●
Narrow-leaved purple coneflower *(Echinacea pallida)*	30	●
Prairie turnip *(Pediomelum esculentum)*	30	●
Alumroot *(Heuchera richardsonii)*	28	●
Great blazing star *(Liatris pycnostachya)*	27	●●
White camas *(Zigadenus elegans)*	27	●
Common strawberry *(Fragaria virginiana)*	26	●
Bastard toadflax *(Comandra umbellata)*	25	●
Virginia mountain mint *(Pycnanthemum virginianum)*	25	●
Pale-spiked lobelia *(Lobelia spicata)*	25	●
American vetch *(Vicia americana)*	23	●
Ground plum *(Astragalus crassicarpus)*	23	●
Canada anemone *(Anemone canadensis)*	22	●
Clasping dogbane *(Apocynum sibiricum)*	22	●
Virginia ground cherry *(Physalis virginiana)*	22	●
Toothed evening primrose *(Calylophus serrulatus)*	21	●
Wood betony *(Pedicularis canadensis)*	20	●
Northern plains blazing star *(Liatris ligulistylis)*	20	●
Wild bergamot *(Monarda fistulosa)*	19	●
Skyblue aster *(Aster oolentangiensis)*	18	●●
Canada tick trefoil *(Desmodium canadense)*	17	●
Smooth rattlesnakeroot *(Prenanthes racemosa)*	15	●
Wood lily *(Lilium philadelphicum)*	13	●
Rattlesnake master *(Eryngium yuccifolium)*	12	●
Grasses & Sedges		
Big bluestem *(Andropogon gerardii)*	94	●●●●
Indian grass *(Sorghastrum nutans)*	80	●●●●
Little bluestem *(Schizachyrium scoparium)*	67	●●●
Prairie dropseed *(Sporobolus heterolepis)*	66	●●●
Porcupine grass *(Stipa spartea)*	58	●●●
Side-oats grama *(Bouteloua curtipendula)*	46	●●●
Switchgrass *(Panicum virgatum)*	44	●●
Leiberg's panic grass *(Panicum leibergii)*	43	●●
Slender wheatgrass *(Elymus trachycaulus)*	32	●
Prairie cordgrass *(Spartina pectinata)*	30	●●
Semi-Shrubs		
Leadplant *(Amorpha canescens)*	74	●●
Prairie rose *(Rosa arkansana)*	70	●
Shrubs		
Wolfberry *(Symphoricarpos occidentalis)*	17	●●

WPs54 Southern Wet Prairie — Species Frequency & Cover

	freq%	cover
Forbs, Ferns & Fern Allies		
Canada goldenrod *(Solidago canadensis)*	78	●●●
Tall meadow-rue *(Thalictrum dasycarpum)*	69	●
Heath aster *(Aster ericoides)*	67	●
Eastern panicled aster *(Aster lanceolatus)*	61	●
Clasping dogbane *(Apocynum sibiricum)*	61	●
Virginia mountain mint *(Pycnanthemum virginianum)*	57	●●
Common strawberry *(Fragaria virginiana)*	55	●
Great blazing star *(Liatris pycnostachya)*	53	●
Giant, Sawtooth, or Nuttall's sunflower*	51	●●●
Golden alexanders *(Zizia aurea)*	49	●
Giant goldenrod *(Solidago gigantea)*	45	●●
Golden or False golden ragwort *(Senecio aureus* or *S. pseudaureus)*	43	●●
Riddell's goldenrod *(Solidago riddellii)*	41	●
Northern bog violet *(Viola nephrophylla)*	41	●
Northern plains blazing star *(Liatris ligulistylis)*	41	●
Heart-leaved alexanders *(Zizia aptera)*	39	●
Autumn sneezeweed *(Helenium autumnale)*	37	●
Spotted water hemlock *(Cicuta maculata)*	35	●
Stiff goldenrod *(Solidago rigida)*	35	●
Prairie loosestrife *(Lysimachia quadriflora)*	33	●
Prairie phlox *(Phlox pilosa)*	33	●
Swamp milkweed *(Asclepias incarnata)*	33	●
White camas *(Zigadenus elegans)*	33	●
Northern bedstraw *(Galium boreale)*	29	●
Purple prairie clover *(Dalea purpurea)*	29	●
Yarrow *(Achillea millefolium)*	29	●
Pale-spiked lobelia *(Lobelia spicata)*	29	●
Canada anemone *(Anemone canadensis)*	27	●●
Gray-headed coneflower *(Ratibida pinnata)*	27	●
Marsh vetchling *(Lathyrus palustris)*	27	●
Smooth scouring rush *(Equisetum laevigatum)*	25	●
Cut-leaved bugleweed *(Lycopus americanus)*	25	●
Maximilian's sunflower *(Helianthus maximiliani)*	24	●●
Field horsetail *(Equisetum arvense)*	24	●
Grass-leaved goldenrod *(Euthamia graminifolia)*	22	●●
New England aster *(Aster novae-angliae)*	22	●
Canada tick trefoil *(Desmodium canadense)*	22	●
Skyblue aster *(Aster oolentangiensis)*	22	●
Swamp thistle *(Cirsium muticum)*	22	●
Bottle gentian *(Gentiana andrewsii)*	20	●
Rough bugleweed *(Lycopus asper)*	18	●
Veiny pea *(Lathyrus venosus)*	18	●
Swamp lousewort *(Pedicularis lanceolata)*	16	●
Culver's root *(Veronicastrum virginicum)*	14	●●
Flat-topped aster *(Aster umbellatus)*	14	●●
Great lobelia *(Lobelia siphilitica)*	12	●
Yellow stargrass *(Hypoxis hirsuta)*	12	●
Cup plant *(Silphium perfoliatum)*	12	●
Wood lily *(Lilium philadelphicum)*	12	●
Grasses & Sedges		
Prairie cordgrass *(Spartina pectinata)*	86	●●●
Big bluestem *(Andropogon gerardii)*	80	●●●
Indian grass *(Sorghastrum nutans)*	51	●●●
Switchgrass *(Panicum virgatum)*	47	●●●
Woolly sedge *(Carex pellita)*	41	●●●
Rigid sedge *(Carex tetanica)*	39	●
Flattened spikerush *(Eleocharis compressa)*	39	●
Mat muhly grass *(Muhlenbergia richardsonis)*	33	●●●
Bluejoint *(Calamagrostis canadensis)*	25	●●
Baltic rush *(Juncus arcticus)*	25	●●
Tussock sedge *(Carex stricta)*	24	●●●
Prairie dropseed *(Sporobolus heterolepis)*	24	●●
Narrow reedgrass *(Calamagrostis stricta)*	24	●
Fowl manna grass *(Glyceria striata)*	20	●●
Semi-Shrubs		
Prairie rose *(Rosa arkansana)*	29	●●
Shrubs		
Red-osier dogwood *(Cornus sericea)*	18	●
Pussy willow *(Salix discolor)*	16	●

*Giant, Sawtooth, or Nuttall's sunflower *(Helianthus giganteus, H. grosseserratus,* or *H. nuttallii)*

MRn83 Northern Mixed Cattail Marsh — Species Frequency & Cover

	freq%	cover
Grasses & Sedges		
Lake sedge *(Carex lacustris)*	45	●●●
Bristly sedge *(Carex comosa)*	41	●●
Red-stalked spikerush *(Eleocharis palustris)*	32	●
Bluejoint *(Calamagrostis canadensis)*	27	●●●
Rice cut grass *(Leersia oryzoides)*	23	●
Tall manna grass *(Glyceria grandis)*	23	●
Soft stem bulrush *(Scirpus validus)*	18	●●
Fen wiregrass sedge *(Carex lasiocarpa)*	14	●
Wild rice *(Zizania palustris)*	14	●●
Common reed grass *(Phragmites australis)*	14	●
Tussock sedge *(Carex stricta)*	14	●
Cyperus sedge *(Carex pseudocyperus)*	14	●●
River bulrush *(Scirpus fluviatilis)*	14	●●
Beaked sedge *(Carex utriculata)*	14	●●
Ovoid spikerush *(Eleocharis ovata)*	9	●
Lesser-panicled sedge *(Carex diandra)*	9	●
Aquatic sedge *(Carex aquatilis)*	9	●●
Fragrant cyperus *(Cyperus odoratus)*	9	●
Porcupine sedge *(Carex hystericina)*	9	●●
Woolgrass *(Scirpus cyperinus)*	9	●
Floating-Leaved & Submergent Forbs		
Star-duckweed *(Lemna trisculata)*	64	●●
Lesser-duckweed *(Lemna minor)*	59	●●
Greater duckweed *(Spirodela polyrhiza)*	55	●
Common bladderwort *(Utricularia vulgaris)*	45	●●
Common coontail *(Ceratophyllum demersum)*	36	●●
Water smartweed *(Polygonum amphibium)*	32	●
Flat-stemmed pondweed *(Potamogeton zosteriformis)*	14	●
Common white water-lily *(Nymphaea odorata)*	14	●
Straight-leaved pondweed *(Potamogeton strictifolius)*	9	●
Intermediate bladderwort *(Utricularia intermedia)*	9	●
Yellow pond lily *(Nuphar variegata)*	9	●
Unbranched bur reed *(Sparganium emersum)*	9	●
Emergent Forbs		
Broad-leaved arrowhead *(Sagittaria latifolia)*	64	●
Marsh skullcap *(Scutellaria galericulata)*	64	●
Three-cleft or small bedstraw *(Galium trifidum* or *G. tinctorium)*	59	●
Bur marigold and Beggarticks *(Bidens* spp.)	50	●
Tufted loosestrife *(Lysimachia thyrsiflora)*	45	●
Bulb-bearing water hemlock *(Cicuta bulbifera)*	41	●●
Great water dock *(Rumex orbiculatus)*	41	●
Marsh bellflower *(Campanula aparinoides)*	41	●
Clearweed *(Pilea* spp.)	36	●
Northern bugleweed *(Lycopus uniflorus)*	32	●
Broad-leaved cattail *(Typha latifolia)*	32	●●●●
Touch-me-not *(Impatiens* spp.)	32	●
Giant bur reed *(Sparganium eurycarpum)*	27	●●●
Water parsnip *(Sium suave)*	27	●
Linear-leaved, Marsh, or Downy willow-herb*	23	●
Spotted water hemlock *(Cicuta maculata)*	23	●
Dotted smartweed *(Polygonum punctatum)*	18	●
Sweet flag *(Acorus calamus)*	18	●●●
Swamp milkweed *(Asclepias incarnata)*	18	●
Northern marsh fern *(Thelypteris palustris)*	18	●
Cut-leaved bugleweed *(Lycopus americanus)*	18	●
Marsh cinquefoil *(Potentilla palustris)*	14	●
Spotted Joe pye weed *(Eupatorium maculatum)*	14	●
Marsh horsetail *(Equisetum palustre)*	9	●
Common mint *(Mentha arvensis)*	9	●
Stinging nettle *(Urtica dioica)*	9	●
Nodding smartweed *(Polygonum lapathifolium)*	9	●
Lady's thumb *(Polygonum persicaria)*	9	●
Common water plantain *(Alisma triviale)*	5	●
Shrubs		
Red-osier dogwood *(Cornus sericea)*	9	●●

*Linear-leaved, Marsh, or Downy willow-herb *(Epilobium leptophyllum, E. palustre,* or *E. strictum)*

MRn93 Northern Bulrush-Spikerush Marsh — Species Frequency & Cover

	freq%	cover
Grasses & Sedges		
Rice cut grass *(Leersia oryzoides)*	65	●●●
Soft stem bulrush *(Scirpus validus)*	38	●●●
River bulrush *(Scirpus fluviatilis)*	38	●●●●
Red-stalked spikerush *(Eleocharis palustris)*	32	●●●
Tall manna grass *(Glyceria grandis)*	26	●●●
Lake sedge *(Carex lacustris)*	24	●●●
Common reed grass *(Phragmites australis)*	18	●●●
Three-way sedge *(Dulichium arundinaceum)*	18	●●●
Bristly sedge *(Carex comosa)*	18	●
Bluejoint *(Calamagrostis canadensis)*	18	●●
Northern manna grass *(Glyceria borealis)*	15	●
Fen wiregrass sedge *(Carex lasiocarpa)*	12	●
Woolgrass *(Scirpus cyperinus)*	12	●
Beaked sedge *(Carex utriculata)*	12	●●●
Floating-Leaved & Submergent Forbs		
Water smartweed *(Polygonum amphibium)*	65	●●
Lesser-duckweed *(Lemna minor)*	56	●●●
Greater duckweed *(Spirodela polyrhiza)*	18	●
Common white water-lily *(Nymphaea odorata)*	15	●●●
Common coontail *(Ceratophyllum demersum)*	12	●
Northern water milfoil *(Myriophyllum sibiricum)*	12	●
Flat-stemmed pondweed *(Potamogeton zosteriformis)*	12	●
Star-duckweed *(Lemna trisculata)*	12	●●
Flexuous naiad *(Najas flexilis)*	12	●
Floating pondweed *(Potamogeton natans)*	9	●
Common bladderwort *(Utricularia vulgaris)*	9	●
Straight-leaved pondweed *(Potamogeton strictifolius)*	9	●
Spiny coontail *(Ceratophyllum echinatum)*	9	●
Watershield *(Brasenia schreberi)*	6	●●
Unbranched bur reed *(Sparganium emersum)*	6	●●●●
Emergent Forbs		
Broad-leaved arrowhead *(Sagittaria latifolia)*	68	●●●
Bur marigold and Beggarticks *(Bidens* spp.)	59	●●
Giant bur reed *(Sparganium eurycarpum)*	47	●●●●
Bulb-bearing water hemlock *(Cicuta bulbifera)*	35	●
Water parsnip *(Sium suave)*	29	●
Clearweed *(Pilea* spp.)	26	●●
Three-cleft or small bedstraw *(Galium trifidum* or *G. tinctorium)*	26	●●
Marsh skullcap *(Scutellaria galericulata)*	26	●
Tufted loosestrife *(Lysimachia thyrsiflora)*	26	●●
Common water plantain *(Alisma triviale)*	26	●●
Nodding smartweed *(Polygonum lapathifolium)*	24	●
Northern bugleweed *(Lycopus uniflorus)*	24	●●
Sweet flag *(Acorus calamus)*	21	●●●●
Common mint *(Mentha arvensis)*	21	●
Cut-leaved bugleweed *(Lycopus americanus)*	18	●
Dotted smartweed *(Polygonum punctatum)*	18	●
Broad-leaved cattail *(Typha latifolia)*	15	●
Arrow-leaved tearthumb *(Polygonum sagittatum)*	15	●
False nettle *(Boehmeria cylindrica)*	15	●●
Great water dock *(Rumex orbiculatus)*	15	●
Golden dock *(Rumex maritimus)*	15	●
Mad dog skullcap *(Scutellaria lateriflora)*	12	●
Swamp milkweed *(Asclepias incarnata)*	12	●
Bulrush *(Scirpus acutus* or *S. heterochaetus)*	12	●●●
Icelandic yellow cress *(Rorippa palustris)*	12	●
Labrador bedstraw *(Galium labradoricum)*	12	●
Touch-me-not *(Impatiens* spp.)	12	●
Northern blue flag *(Iris versicolor)*	9	●
Marsh bellflower *(Campanula aparinoides)*	9	●
Pennsylvania smartweed *(Polygonum pensylvanicum)*	9	●●

Appendix J. Conservation Core & Connection Opportunities in Mendota Heights

The Conservation Concept developed for Mendota Heights (Figure 22) envisions how existing natural areas (including the ten identified core habitats) could be better connected to each other, expanded, and enhanced to ensure their ecological health and resilience. Some of these areas are publicly-owned, but many are private lands. Willing landowners, cooperative agreements among institutions, and much coordination are needed to advance this Conservation Concept. However, this approach offers tremendous potential to prevent further habitat loss, reverse landscape fragmentation, improve the health and resilience of natural areas, stabilize and restore wildlife populations, and prevent rare species from disappearing.

Conservation easements and fee-title acquisition of core habitats, adjacent natural areas, and connections has been essential for decades to the success of The Nature Conservancy, Minnesota Land Trust, Trust for Public Lands, Minnesota Department of Natural Resources, U.S. Fish and Wildlife Service, Ducks Unlimited, Pheasants Forever, and other conservation entities. The history and successes of land trusts can be found in Conservancy: The Land Trust Movement in America (Brewer 2003). Land Protection Options: A Handbook for Minnesota Landowners (The Nature Conservancy 1996) is an excellent resource for those wishing to understand the complex and myriad tools available to protect natural areas in perpetuity.

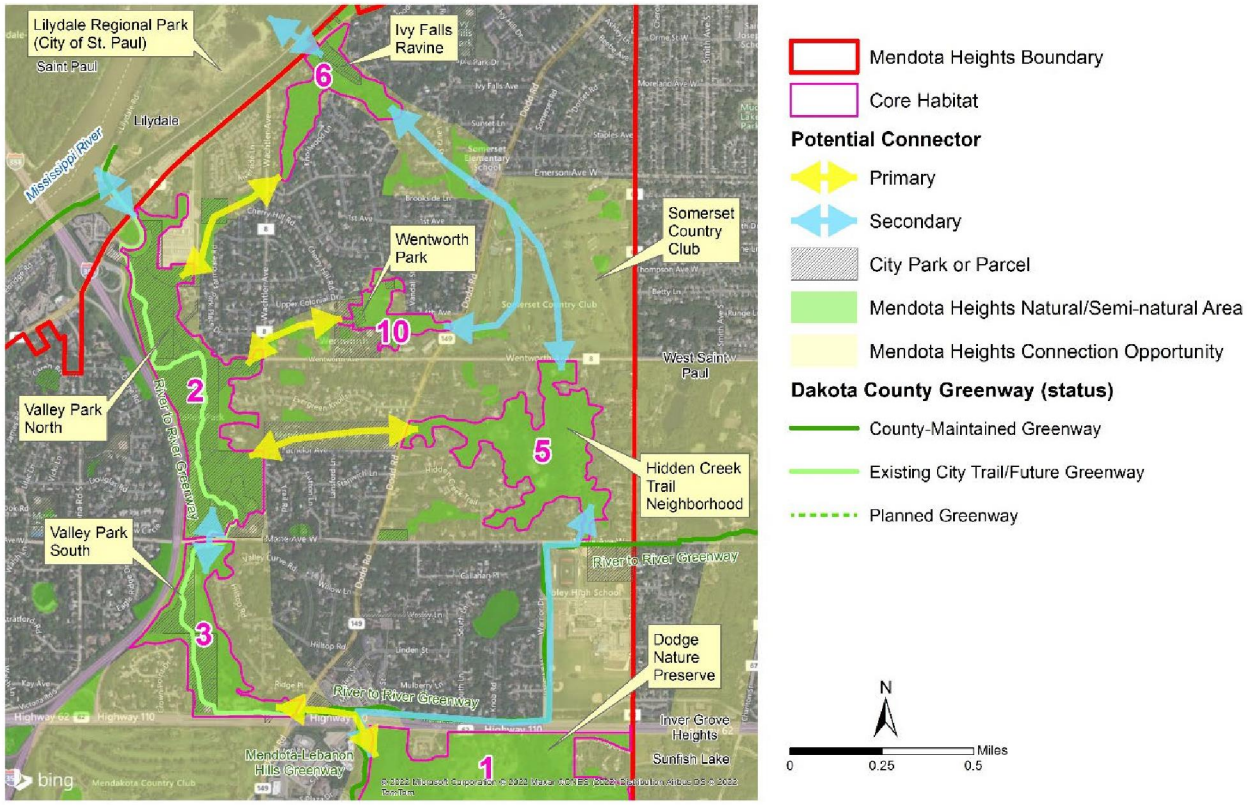
An essential early step to realizing the Conservation Concept is to solicit the support of partners, funders, political leaders, and community members to create and sustain ecologically meaningful connections that link the City's natural areas. Some of these connections exist to a degree today, others will take decades to realize, while still others may exist only as aerial connections; i.e., used by birds, flying insects, and wind-disseminated seeds. Based on analysis of land cover, plant communities, and land ownership, as well as discussions with City staff and in consideration of feedback from the Steering Committee, three "conservation improvement districts" were identified and are presented in priority order below. In each district, opportunities are summarized for: 1) better connecting core habitats through improved linkages of native vegetation and mitigating obstacles to terrestrial wildlife (e.g., road crossings), 2) expanding cores by working with private landowners and other partners to establish conservation easements or other protections, and 3) general ecological restoration and enhancement activities in improve habitat quality in cores and along connections.

1. River to River Greenway District. Connection opportunities in this district focus on the three most important core habitats in the City: Dodge Nature Preserve, Valley Park North, and Valley Park South, with connections to other lower priority but nearby cores. The existing Dakota County "River to River Greenway" runs along the western and southern portions of this district and is described as follows:

> *The River to River Greenway connects Lilydale, Mendota Heights, West St. Paul and South St. Paul. The trail is in place between Robert Street and the Mississippi River in South St. Paul. Future construction projects will link Valley Park in Mendota Heights to the area near Dodge Nature Center in West St. Paul.*

Some of the best opportunities to improve the ecological health and resilience in this district are shown in Figure J.1 and discussed below.

Figure J.1. River to River Greenway District



Core habitats (numbered) can be connected at four primary locations (yellow arrows), with secondary connections elsewhere (blue arrows).

Connect Cores

This district's primary connectors (yellow arrows in Figure J.1) are the most important and are discussed below.

Valley Park - Dodge Connection. Perhaps the most important connection in this district is the corridor between Valley Park South and Dodge Nature Preserve. Highway 62 presents a formidable challenge to connectivity between these two core habitats; however, the existing greenway trail provides an underpass beneath the highway. While this underpass was not designed to accommodate terrestrial wildlife, it does provide a relatively safe corridor from Valley Park South to Dodge Nature Preserve and may be used by some mammals, amphibians, reptiles and insects. With carefully designed native plantings and fencing to help guide wildlife, the narrow strip for the trail on the north side of Highway 62 and the underpass itself could be modified to encourage wildlife to move through the connector and underpass.

Valley Park – Hidden Creek Connection. The Mendota Heights Par 3 golf course provides a publicly-owned connection between Valley Park North and the Hidden Creek Trail Neighborhood. While conventional golf courses have limited value as ecological connections, they can provide safe passage for wildlife, and converting out of play areas to native plant communities can greatly increase their function as connectors. Dodd Road presents a hazard to wildlife crossing. This crossing (and other road hazards discussed below) could be mitigated by installing a wildlife underpass (i.e., a properly designed culvert usable by terrestrial wildlife) and/or placing signage or painting the road surface cautioning drivers to slow down and watch for wildlife crossing the road.

Valley Park - Wentworth Connection. A drainageway that flows from Wentworth Park to Valley Park North passes through private residential parcels. Cooperation with or incentives for these landowners could establish a more naturalized habitat connection between the cores. Wachtler Ave. presents a hazard to wildlife crossing, which could be mitigated as described above.

Valley Park - Ivy Falls Connection. Valley Park North could be better connected to Ivy Falls Ravine by enhancing the Xcel Energy powerline right-of-way and improving the adjacent forests. Wachtler Ave. presents a hazard to wildlife crossing, which could be mitigated as described above.

Additional (secondary) connections (blue arrows in Figure J.1) are discussed below.

Valley Park North - South Connection. While Valley Park North and Valley Park South are nearly connected, Marie Ave. W presents a hazard to wildlife crossing between these two cores. This crossing could be mitigated as described above.

Ivy Falls – Wentworth & Hidden Creek Connection. Connectivity between Ivy Falls Ravine and Wentworth Park and/or Hidden Creek Trail Neighborhood could be improved through Somerset Country Club. As discussed above under the Valley Park – Hidden Creek Connection, there are opportunities for making Somerset Country Club (predominantly a golf course) a more effective connector. Dodd Road and Wentworth Ave. present hazards to wildlife crossing, which could be mitigated as described above.

Dodge - Hidden Creek Connection. Dodge Nature Preserve somewhat connects to Hidden Creek Trail Neighborhood along the Mendota-Lebanon Hills Greenway, under Highway 62, and along the River to River Greenway (running along the west edge of Henry Sibley High School). However, the Greenways are generally quite narrow, and Marie Ave. W presents a hazard to wildlife crossing, which could be mitigated as described above.

Valley Park - Mississippi River Connection. Valley Park North connects to the Mississippi River corridor via Lilydale Road, which goes under Highway 13 and crosses the railroad tracks that parallel the river. These roads and railroad tracks present hazards to wildlife, which could be mitigated as described above.

Ivy Falls - Mississippi River Valley Connection. Ivy Falls Ravine connects to the Mississippi River Valley via the drainage ravine that flows beneath Highway 13 into Pickerel Lake. Fencing could be used to help guide wildlife to this safe under-passage; however, the steep ravine slopes may present challenges for some species.

Expand & Protect Cores

Protect private and other non-City land through voluntary acquisitions or conservation easements in the following locations:

- East of Valley Park South would help widen this core habitat and improve the connection to Dodge Nature Preserve.
- East of Valley Park North would widen this relatively narrow core.
- Land surrounding Ivy Falls Ravine would expand this higher quality natural area and improve connectivity to other core areas.
- Land within the Hidden Creek Trail Neighborhood would expand this core.

Restore & Enhance Cores

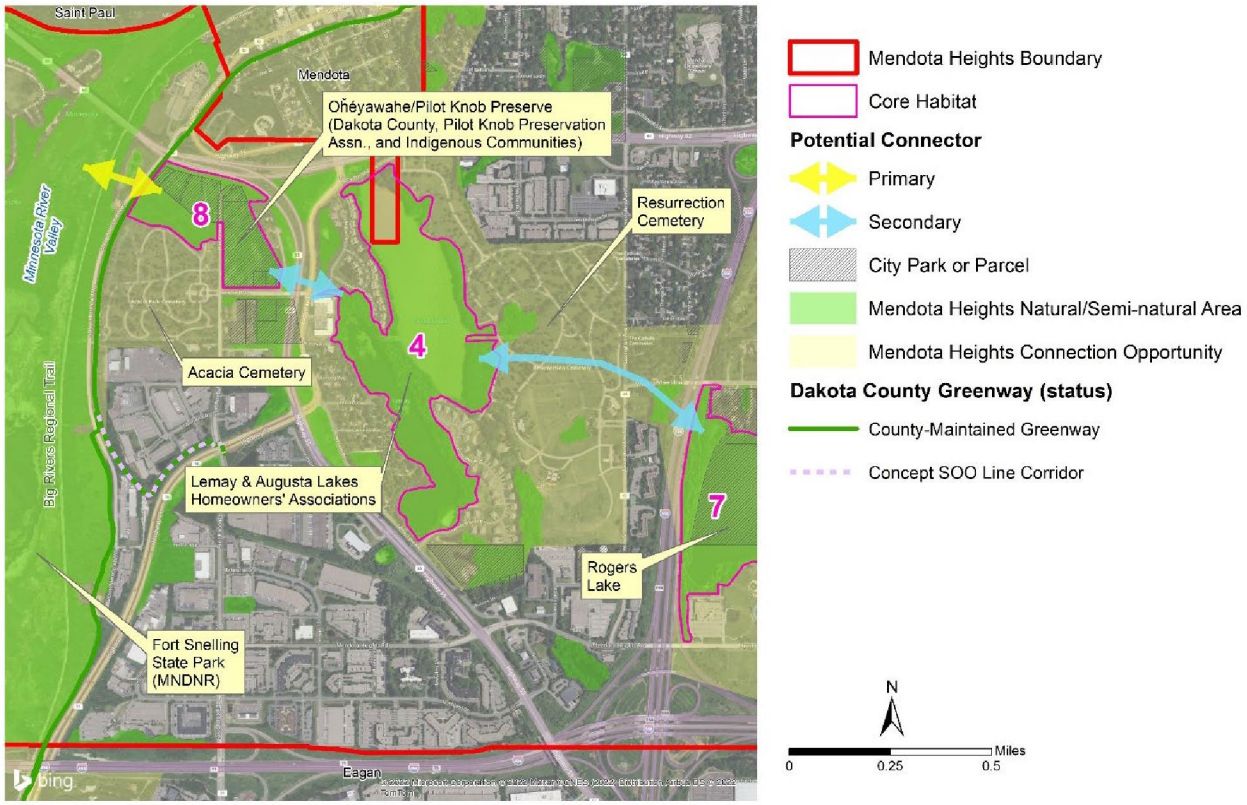
Several ecological restoration and enhancement projects are ongoing in this district; namely, forest/woodland and prairie restoration in Valley Park North. Additional restoration and enhancement project opportunities include:

- Continue and expand ecological restoration and enhancement of all natural areas in City parks.
- Provide cost-share, technical support, and/or other incentives to promote restoration and enhancement on private properties included in the Conservation Concept.

2. Minnesota River – Rogers Lake District

Connection opportunities in this district focus on providing improved connectivity between the Minnesota River Valley on the west with Rogers Lake on the east. This includes Fort Snelling, Oȟéyawahe/Pilot Knob Preserve, Lemay and Augusta Lakes, Resurrection Cemetery, and Rogers Lake. Some of the best opportunities to improve the ecological health and resilience in this district are shown in Figure J.2 and discussed below.

Figure J.2. Minnesota River – Rogers Lake District



Core habitats can be connected at one primary location (yellow arrows), with secondary connections elsewhere (blue arrows).

Connect Cores

This district's primary connector (yellow arrows in Figure J.2) is the most important and is discussed below.

Minnesota River - Oȟéyawahe/Pilot Knob Preserve. Connecting the extensive Minnesota River Valley and Fort Snelling Park with other core habitats to the east is an important conservation opportunity in this district. This connection to Oȟéyawahe/Pilot Knob Preserve is perpendicular to the bluffline, which also contains railroad tracks, Big Rivers Regional Trail, and Sibley Memorial Highway. These transportation corridors present hazards to wildlife crossing, which could be mitigated as described under the Valley Park – Hidden Creek Connection (above).

Additional (secondary) connections (blue arrows in Figure J.2) are discussed below.

Oȟéyawahe/Pilot Knob Preserve – Lemay-Augusta Lakes Connection. It would also be advantageous to connect the core habitats of Oȟéyawahe/Pilot Knob Preserve and Lemay-Augusta Lakes; however, Highway 55 and Highway 13/Sioux Trail present a formidable challenge to connectivity. Short of a wildlife-crossing (e.g., associated with the Acacia Boulevard bridge), these obstacles may be infeasible to surmount for terrestrial wildlife, limiting this to an aerial connection used primarily by birds, flying insects, and wind-disseminated seeds.

Lemay-Augusta Lakes – Rogers Lake Connection. Most of the connection between Lemay-Augusta Lakes and Rogers Lake could be achieved through Resurrection Cemetery. However, I-35E presents a formidable challenge to connectivity across to Rogers Lake, limiting this eastern end to a primarily aerial connection.

Expand & Protect Cores

Conservation easement agreements exist between the City and two Homeowners' Associations (HOAs) adjacent to Augusta and Lemay Lakes. This offers an opportunity for a partnership to improve habitat and reduce edge effects. Protect additional private and other non-City land through voluntary acquisitions or conservation easements in the following locations:

- A parcel along Vallencourt Road was recently purchased by the City; this could contribute to slightly enlarging the Oȟéyawahe/Pilot Knob Preserve Core.
- Acacia Cemetery contains an approximately 10-acre stand of forest/woodland that abuts Oȟéyawahe/Pilot Knob Preserve. Protecting this wooded area from being cleared (and protecting other adjacent, unutilized portions of the cemetery) would ensure the persistence of this area as moderate-sized core habitat.
- Land around Lemay-Augusta Lakes, especially where this core habitat could be expanded into Resurrection Cemetery on the east.

Restore & Enhance Cores

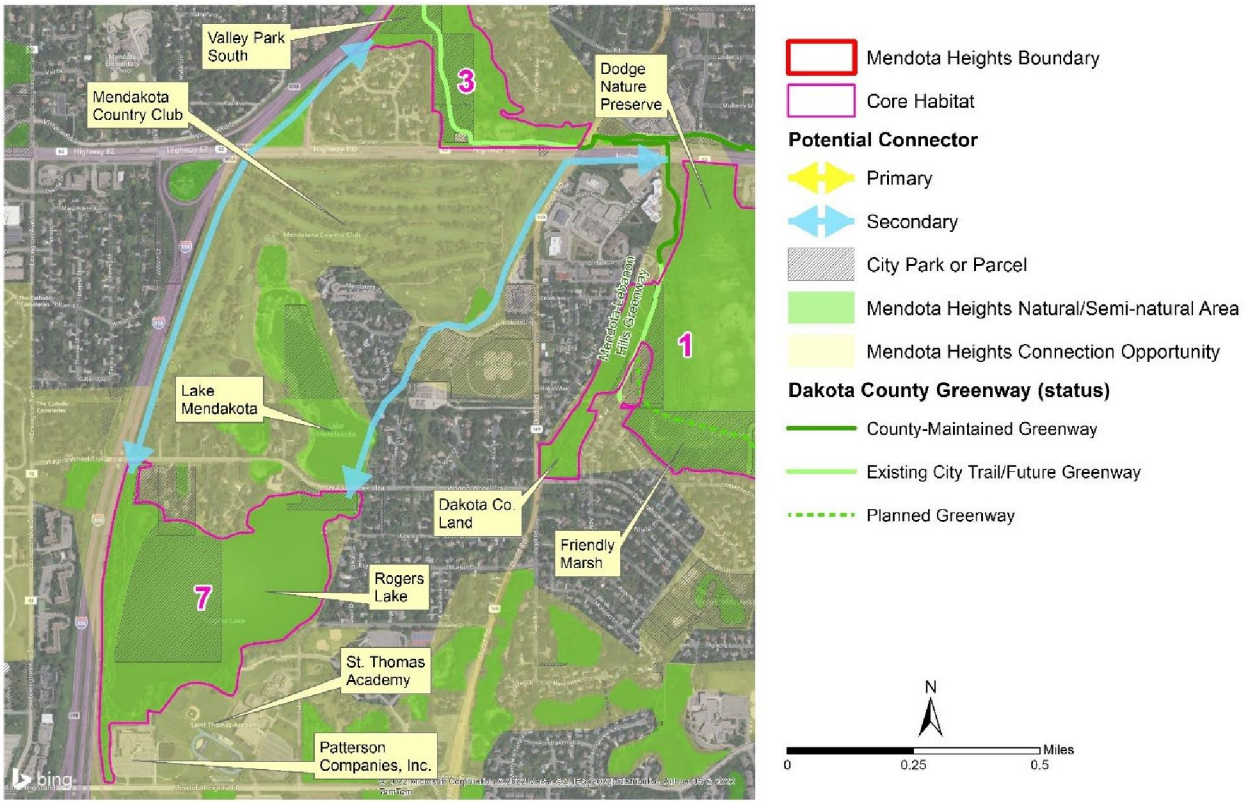
Ecological restoration and enhancement projects are ongoing in this district; namely, prairie and savanna management in Oȟéyawahe/Pilot Knob Preserve and savanna and forest restoration west of Rogers Lake. Additional restoration and enhancement project opportunities include:

- Provide cost-share, technical support, and/or other incentives to promote restoration and enhancement on private properties included in the Conservation Concept (including Acacia and Resurrection Cemeteries, and the Lemay and Augusta Lakes HOAs).

3. River to River Greenway – Rogers Lake District

The primary connection opportunity in this district focuses on providing improved connectivity from the River to River Greenway (originating in Valley Park and near the northwest corner of Dodge Nature Preserve) to Rogers Lake to the southwest. Most of this connectivity would be achieved through Mendakota Country Club. Some of the best opportunities to improve the ecological health and resilience in this district are shown in Figure J.3 and discussed below.

Figure J.3. River to River Greenway – Rogers Lake District



Core habitats (numbered) can be connected via secondary connections (blue arrows).

Connect Cores

The potential connections identified for this district present significant challenges; therefore they are shown as secondary connections (blue arrows in Figure J.3) and discussed below.

Valley Park – Rogers Lake Connection. This connection runs along semi-natural vegetation just east of I-35E and along the west edge of Mendakota Country Club. Noise from the freeway may limit the use of this connection by more sensitive wildlife species. Highway 62 presents a formidable obstacle to wildlife, limiting this to a primarily aerial connection. Wagon Wheel Trail at the south end of this connector represents another obstacle; however, this could be mitigated as described under the Valley Park – Hidden Creek Connection (above).

Dodge – Rogers Lake Connection. This connection extends from the River to River Greenway, beneath Highway 62 (via the Mendota – Lebanon Hills Greenway underpass), touches the northwest

corner of Dodge Nature Preserve, then proceeds west along the south side of Highway 62, through the Mendakota Country Club, to Rogers Lake. Dodd Road and Wagon Wheel Trail at the south end of this connector represent obstacles to terrestrial wildlife; however, these crossings could be mitigated as described under the Valley Park – Hidden Creek Connection (above).

Expand & Protect Cores

Protect private and other non-City land through voluntary acquisitions or conservation easements in the following locations:

- Strip of forest just south of Valley Park South (at the northern end of the Valley Park – Rogers Lake Connection).
- Land surrounding Lake Mendakota, especially adjacent to Rogers Lake, could expand the Rogers Lake Core.
- St. Thomas Academy and Patterson Companies, Inc. properties adjacent to Rogers Lake could expand this core.
- County-owned land west of Dodge Nature Preserve and Friendly Marsh Park could expand this core.

Restore & Enhance Cores

Dodge Nature Preserve undergoes regular land management, especially the prairie restoration areas. As mentioned above, savanna and forest restoration is ongoing just west of Rogers Lake. Additional restoration and enhancement project opportunities include:

- Provide cost-share, technical support, and/or other incentives to promote restoration and enhancement on private properties included in the Conservation Concept (including the west and east edges of Mendakota Country Club, the south frontage along Highway 62, St. Thomas Academy, Patterson Companies, Inc., and private landowners around Lake Mendakota and Rogers Lake).