Minneapolis
Park & Recreation Board

NATURAL AREAS PLAN – PHASE II
ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

Consultants:

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MINNEAPOLIS PARK AND RECREATION BOARD
NATURAL AREAS PLAN - PHASE II

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NATIVE ACKNOWLEDGEMENT

We collectively acknowledge that the Minneapolis Park and Recreation Board system is located on the traditional, ancestral, and contemporary lands of Indigenous people. This land holds great historical, spiritual, and personal significance for its original stewards, the Native nations and peoples of this region.

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EXECUTIVE SUMMARY

Why This Plan?

To carry out its mission, the Minneapolis Park and Recreation Board (MPRB) protects and maintains essential habitat for diverse plant and animal communities while providing quality natural areas for park users. Natural areas in this plan are specific locations recognized for their notable natural values—native and semi-natural plant communities, native species, and restored natural communities and habitats. Natural areas are not maintained for intensive human use—rather, nature reigns.

The MPRB recognizes the importance of natural areas for people living in the Metro Region. These natural areas have tremendous value for citizens of Minneapolis and beyond, letting visitors enjoy and interact with ecologically diverse and beautiful landscapes, giving students of all ages a place to learn about the marvelous natural world, and providing a remarkable array of native plants and animals with a permanent and safe home.

What is the Plan?

This Natural Areas Plan summarizes the park system's natural resources at a high level, lays out methods and strategies to manage natural areas, and describes a strategic approach that embraces holistic, system-wide planning and administration to secure and deploy funds, staff, and equipment.

Below are the major sections of the Natural Areas Plan.

Principles & concepts for planning conservation and long-term management of park natural areas

- Lays out principles for managing natural areas.
- Introduces conservation concepts directly related to natural areas management.
- Emphasizes the importance of long-term management.

Methods for inventory and assessment of natural areas

- Describes the information sources and methods to develop the Plan.
- Presents information from a natural areas inventory and ecological assessment at the system-wide scale and also for individual parks.

Management recommendations and management briefs for natural areas

- Describes ecological restoration and management best practices for the park system.
- Presents management briefs—short vegetation management recommendations for Managed Natural Areas and other upland and wetland communities in the park system.

Costs to improve ecological conditions in park natural areas

- Gives preliminary cost estimates for ecological restoration and management of natural areas.
- Describes existing Natural Resources Program staffing, budget, partnerships, and other support for managing natural areas.
- Recommends changes to the Natural Resources Program to accelerate natural areas management across the entire park system.

Below are the main messages from each section. Details follow in the main body of the plan.

Conserving Natural Areas

Threats to natural areas come from all quarters: land conversion and habitat loss; edge effects from adjacent inhospitable landscapes; overwhelmingly invasive species; polluted runoff; and climate change, to name a few. To truly conserve natural areas, a land manager must know the science underlying these negative forces and manage to compensate for these harmful effects, and even reverse them.

In this plan there are guidelines for creating core habitat and managing edge effects in the transitions between the developed, high-impact human world and natural areas. Making physical or stepping-stone connections among natural areas prevents species extinctions by giving plants and animals a way to move around and colonize vacant territory. Taking an ecosystem approach to land management ensures that first things are done at lowest cost, and more expensive things are done later if the ecosystem does not respond with greater native biodiversity, more wildlife, and fewer invasive species.

Assessing Natural Areas

Natural areas were assessed systemwide and in fifteen major areas (mostly regional parks). Existing information was gathered, new field data collected, plant communities mapped, and their quality noted. A systemwide view of ecological change over the past 200 years was summarized. In short, major disturbances that maintained ecosystem health and resilience were lost—grazing, fire, soil burrowing, predicable water level change. Savannas and prairies became cropland or forest if not grazed. Wetlands deteriorated with ditching, filling, and seeding of invasive pasture grasses. Non-native plants, fungi, and animals devasted individual species or replaced entire layers of native ecosystems.

The diverse plant and animal life that cushioned ecosystems against drought, flooding, and other disturbances has dwindled, leaving the system without backup species to fill functional voids created when systems are stressed and lose species. Each of the fifteen major areas is described by its plant communities, its Managed Natural Areas, and its characterizing issues, opportunities, and goals.

The systemwide inventory documented 1,168 acres of upland and wetland natural areas and 1,664 acres of open water (2,832 acres of natural areas). About 1,000 acres of natural areas were addressed in this Phase II Plan, and 400 acres are Managed Natural Areas. (By contrast, the entire park system is 6,817 acres and Minneapolis itself 36,790 acres.) Managed Natural Areas harbor several high-quality examples of ecosystems native to east-central Minnesota, but overall are small, scattered, and isolated. Managed Natural Areas could be expanded outward from the high-quality cores to encompass every natural area in the system. This would create a higher value, more functional and resilient natural area network of cores, transitions, and connections.

Restoring & Managing Natural Areas

Restoring and managing targeted native plant communities to a higher quality should increase the variety and abundance of wildlife—especially insects, pollinators, small mammals, reptiles and amphibians, and some species of birds. Ecosystem services—those spin-off benefits of well-functioning natural areas, such as flood control, water and air purification, climate moderation—will expand as well.

Natural areas managers restore vegetation structure and processes using prescribed burning, biocontrol agents, mechanical removal of diseased trees and invasive plants, planting of native species, annual condition monitoring, and feedback loops in the adaptive management cycle: implement, assess, adapt, implement. Of course, after taking one or two years to restore a plant community, natural areas managers focus on getting the plant life firmly established in the next two to three years. If this short-term management lags, the Board will lose its investment in the more expensive early restoration work.

Using Management Briefs

Management briefs are a tool that field staff and the public can use to understand—in a two-page document—the condition and needed work at different natural areas. The two-pager can be posted online, taken into the field, and mapped boundaries, plant community name, acres, and quality rank all can be viewed in the cloud-based Collector for ArcGIS using a handheld device.

This plan contains management briefs for 19 natural areas in 15 parks, and extra briefs for nine major plant communities—various upland and lowland forests, woodlands, savannas, shrublands, and grasslands. These plant community management briefs can be applied anywhere in the system where that plant community occurs.

Restoration & Short-Term Management Costs

About 400 acres of the MPRB park system consist of Managed Natural Areas—natural areas that have been restored to higher quality ecosystems. The initial restoration phase was the most expensive—several hundred to thousands of dollars per acre—and protecting that investment requires that management immediately follow on the heels of that heavy restoration lift. Short-term management in the two to three years thereafter saves dollars down the road by establishing a solid matrix of native plant roots and above-ground biomass that resists weed invasion and competes vigorously against weeds that remain. Short-term management is a down payment that reduces the long-term costs of maintenance, freeing land managers from serious interventions should a restoration fail to meet expectations.

The ban on glyphosate herbicides for weed control necessarily increases initial restoration and short-term management costs as other methods are not as cost-effective in achieving short-term results. Weed removal during site preparation may require two years rather than one, for instance, and short-term management will require more mechanical work—pulling, cutting, mowing—to weaken the dominance of weeds so that native plants can establish themselves.

Long-Term Adaptive Management

The fire-dependent ecosystems that historically blanketed most of Minneapolis parklands are greatly diminished. The processes that maintained the prairies, savannas, oak woodland, and herbaceous wetlands, however, are still needed to preserve and increase biodiversity, help wildlife populations, and improve ecosystem services. On the other hand, in such small remnants, a prescribed fire every two to four years could damage wildlife populations and even some plant species if not done using a prescribed burn plan, rotational burning, and experienced crews. It will be necessary in many Managed Natural Areas each year to control weeds, overseed damaged or low diversity ground layer, plant native trees and shrubs, and monitor in an adaptive management cycle. On a per-acre basis, the cumulative cost of natural areas management long-term is less than the cost of maintaining mowed turf.

Resources for Managing Natural Areas

The Environmental Management Department's annual budget is $620,000. The Natural Resources unit that manages natural areas employs two of the 13 Department staff. These two full-time equivalent (FTE) natural resources staff leverage their time using volunteers and private contractors and are helped by staff from the Forestry and Asset Management Departments.

Recommended Program Improvements

Staffing

In the near term, increase the Natural Resources budget to fully fund the long-term management of restored lands in the Managed Natural Areas, and restore funding for Seasonal Environmental Workers at three FTE equivalents.

In three to five years, hire an additional Natural Resources Technician, a part-time Natural Resource Volunteer Coordinator, and a part-time Administrative Assistant. With the existing two FTEs, this would increase the staffing total to four FTEs.

In ten years, increase budget and staffing to expand Managed Natural Areas from 400 to 1,168 acres.

Training

Train Natural Resource workers in prescribed burning, state-licensed herbicide application, brush control, seed collection, erosion control, and ecological monitoring. Prescribed burns will be led by contractors with S-130 and S-190 certification.

Monitor ecological conditions using trained individuals in high school or college, other government entities, non-government organizations (NGOs), volunteers, and private contractors. The volunteer coordinator will organize and quality-control this work.

Work Space & Equipment

Establish a sufficiently large, centrally located workspace to store and repair equipment and tools, organize staff and volunteers for field work, and to store seed, flammable liquids, and approved herbicides, with an outdoor plant staging area. A trailer for equipment, deck mower, flail mower, forestry mower, and brush saws are essential missing pieces of equipment.

Volunteers

The part-time Natural Resource Technician-Volunteer Coordinator will leverage cost-savings by deploying and overseeing volunteers doing restoration and management tasks. Tasks are largely physical and simple (seed collection, planting, pulling invasive plants, cutting and dragging invasive brush) and could include some monitoring with training and oversight (frog census, photo points).

Private, Professional Ecological Contractors

Although contractor rates appear more expensive than staff due to the inclusion of overhead, if overhead were factored into MPRB staff time, a contractor may be cheaper for many tasks given their experience, equipment, and learned efficiencies. They can also be held to performance standards under their guarantee. Soliciting and selecting contractors is time-consuming given City of

Minneapolis and State of Minnesota Procurement and Purchasing procedures and, in three to five years, will be handled by one of the four Natural Resource FTEs discussed in Staffing above.

Partners

Partners have and will continue to leverage the Board's resources in restoring natural areas. Relationships exist with a dozen government entities, NGOs, citizen groups, and the University of Minnesota. Going forward, agreements such as Memoranda of Understanding should be put in place to ensure that partners work smoothly with MPRB staff to execute specific projects and activities.

Public Outreach & Engagement

Increase the frequency of events and upgrade existing tools to pique the public's interest in natural areas. Ideas include a bioblitz at a different natural area each year; upgrade the interactive map on the Natural Areas webpage; and install topical signage about natural history, ecosystems, ecological restoration and management practices, wildlife, and ecological stormwater management.

Grants

An increase in Natural Resource staffing to four FTEs in three to five years will allow staff to finally tap into significant grant resources from Hennepin County, the Minnesota Outdoor Heritage Fund, the National Fish and Wildlife foundation, and others. Pursuing and managing grants is time-consuming, but significantly increases the acres that can be restored and managed.

Set Priorities for Restoration & Management

Use a system like the Criteria Based System for MPRB Regional Park and Trail Capital Project Scheduling that considers both community factors and park characteristics. Prioritize management in already restored areas to secure past investments. Consider other ecological and programmatic ways to prioritize: high visibility; a quality plant community; a large natural area; sensitive wildlife present; an easily removed early infestation of invasive plant; a dense, threatening infestation; proximity to another natural area; a project improving downstream water quality. Focus on areas where little or no restoration has occurred, such as the Shingle Creek Corridor.

Phasing Projects

With priorities set, lay out a ten-year budget considering current funding and a future target level of funding by the tenth year. The first years' budget will be dedicated to top priority restoration and ongoing management projects. In subsequent years, additional short-term and long-term management will phase in, reducing the amount of new restoration projects that can be carried out. The next funding cycle out to twenty years follows in similar fashion, with a new set of restoration priorities.

Prepare Management Plans

Two-page management briefs will exist for 19 natural areas. This is good for general planning and budgeting, but to plan and carry out restoration and short-term management for large, complex sites, a Natural Resources Management Plan (NRMP) should be prepared. An NRMP entails a more detailed inventory and assessment and establishes more specific project priorities, tasks, budgets, and a schedule. Before starting park master plans, an NRMP should be prepared so the natural resource priorities and projects can be integrated into the planning process.

Next Steps

Natural Resources staff will continue as stewards of natural areas by implementing the recommendations of this plan. This Natural Areas Plan can be brought into operating procedures, funding needs can be developed through the MPRB annual budget process and capital improvement projects (CIPs), and all other capacity boosting measures advanced—with the goal of bringing 1,168 acres of natural areas into active management.

Specific outreach and engagement activities will be planned and held after the Volunteer Coordinator for Natural Resources is hired, with a goal of planning a high-visible restoration project each year, preferably with other MPRB departments and outside partners. In the short term, the online interactive map for Natural Resources will be updated with the newest inventory data.

Continue to use ArcGIS Online, MPRB's VueWorks asset management software, and department documents to track restoration and management activities. Develop a long-term, low-cost way to monitor ecological conditions and report quarterly on progress.

Bring an ecosystem perspective into all land and water management. As needed, update management briefs and at the end of each year, complete a work plan for the coming year.

Wrapping Up

A well-trained MPRB staff—helped by volunteers, partners, and private contractors—will be the keeper and main implementor of this Natural Areas Plan. The plan will be revised every ten years and adapted to changing circumstances and information. The plan is also a tool to inform residents and MPRB leadership about the future of natural areas in Minneapolis. It is more importantly a foundation for bequeathing to future generations healthy ecosystems, diverse wildlife, and greater overall ecological health of the City. The eventual outcome will healthy, resilient ecosystems, a diverse landscape, clean water, elevated ecosystem services, and better experiences for park users.

HOW TO USE THIS PLAN

This Plan can be used by the Board in a variety of ways.

- **Information for Minneapolis Park and Recreation Board Commissioners, Staff and Public**. Provides background and educational information on Minneapolis Park and Recreation Board's natural areas and approaches to their conservation.
- **Planning Documents**. Provides baseline natural resources information to support park master planning and other projects.
- **Resource Allocation and Costing**. Describes ecological restoration and management tasks and associated unit costs to help evaluate the resources necessary to implement individual projects.
- **Quantification of Need**. Provides a financial summary of system-wide natural areas needs in Minneapolis Park and Recreation Board's non-aquatic natural areas.
- **Management Briefs for Natural Areas**. Conveys management goals and strategies for natural areas (see "management briefs", described later in this Plan).
- **Pursuit of Grants**. Provides baseline information suitable to support grant applications.

DEFINITIONS AND 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.
Bioblitz	Typically a 24-hour period when professionals and volunteers document all living species within a given area, such as a public park.
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.
Climate Moderation	A local effect due to massed vegetation and shading of impervious surfaces whereby extremes in temperature and windspeed are reduced.
Conservation Biology	A branch of ecology, informed by population biology, landscape ecology, environmental economics, and anthropological sociology, which seeks holistic solutions to simultaneously conserve the natural world, support economic development, and promote the well-being of people and societies.
Conservation Planning	Using the natural sciences to identify areas and practices that protect and restore biodiversity, healthy ecosystems, and ecosystem services. A conservation plan identifies core and transition areas and describes land and water protection measures to secure those areas in perpetuity.
Cultural Land Cover/Vegetation	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	An interacting assemblage of species, interacting with the environment. An ecosystem can be any size—a tidal pool or the Amazon rainforest.

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 damaging influences of adjacent, incompatible land and water use which affects natural areas. Edge effects range from warm air blown into a forest from a parking lot to highway noise reducing bird nesting in an adjacent grassland. Edge effects can penetrate several meters to several hundred meters into a natural area.
Establishment Management	The period in a restoration process after a site's ecosystem structure and processes are restored and before long-term maintenance begins, usually lasting two to three years. It is less expensive than the initial restoration effort but more than the per-acre cost of long-term management. Failure to perform in this period usually results in failure of the restoration project.
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.
Habitat	The environment suitable for a species to carry out its entire life cycle. A turtle's habitat, for instance, includes an overwintering pond bottom, open water and aquatic vegetation for feeding, and sandy, open upland areas to lay eggs.
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)	A pest management strategy that focuses on long-term prevention or suppression of pest problems with minimum impact on human health, the environment and non-target organisms.
Invasive Species	Aggressive plant or animal species whose introduction does or is likely to cause environmental or economic harm.
Landscape	In conservation and the sciences, a landscape is an expanse of land and water, often large, that has a distinctive and relatively homogeneous character. The North Shore of Minnesota, the lakeplain of southeast Michigan, the Cumberland Plateau, and the Northern Rockies are all landscapes. The Cumberland Plateau, Northern Rockies and other vast landscape are often subdivided into smaller landscape areas.

Local Ecotype	Native seed or other plant materials that originated relatively close to the restoration site. This relates to the genetic origin of the seed/stock, not the location of a plant nursery or production field. Generally, the adage "closer is better" applies, but due to limited native seed/stock inventory from various geographies, a 200-mile radius is often specified as acceptably close.
Long-Term Management	The period in a restoration process after the initial restoration work and short-term management are completed. Costs per acre are lowest in long-term management—usually lower than the cost to manage turf.
Managed Natural Area	Term used in MPRB Asset Management software program, VueWorks, to designate the natural areas managed by Environmental Management Natural Resources staff.
Mesic	Moist, typically referring to soil conditions (as opposed to dry or wet).
Native or Natural Vegetation	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	A defined geographic area recognized for its natural values, including natural plant communities, native species, and restorable and restored native plant communities.
Natural Areas Plan	A system-wide natural resources plan, typically addressing multiple sites with a variety of habitats and native/natural vegetation types.
Natural Community	An assemblage of plant, animal, and other species characteristic of a specific environment. Mesic prairie, rich fen, and floodplain forest are examples of natural communities.
Natural Resources Management Plan (NRMP)	A plan that describes a site's existing natural resources, their ecological health, restoration and management goals, and the tasks to be implemented. Often developed for a specific site, such as a park.
Novel Ecosystem	An ecosystem that has been heavily influenced by humans but is not under human management. See also Semi-Natural Vegetation
Plant Community	An assemblage of plant species that characterize a vegetated area (e.g., a forest, savanna, or grassland).
Population Biology	The study of species population change and its causes. Major subareas include population viability, metapopulation dynamics, and extinction.
Remnant Plant Community	A plant community that still contains the same native plant material (i.e., genetics) that existed on the site prior to European settlement.
Semi-Natural Vegetation	In certain land cover/vegetation classifications, a highly disturbed and even human-origin (anthropogenic) assemblage of species that appears able to persist in its environment without human intervention. Young forests establishing in former crop fields, pastures dominated by non-native species, pine plantations—all are semi-natural vegetation types. See also Novel Ecosystem.

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	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.

1. INTRODUCTION

1.1 Project Background and Purpose

1.1.1 The MPRB and Its Mission

Created in 1883, by an act of the Minnesota State Legislature and a vote of Minneapolis residents. The Minneapolis Park and Recreation Board serves as an independently elected, semi-autonomous body responsible for governing, maintaining, and developing the Minneapolis Park System. Over the years, the Minneapolis park system has grown from a few city parks to a large, nationally recognized regional park system, earning top marks in national surveys.

Totaling more than 6,800 acres, the MPRB system (hereafter referred to as the "park system") consists of neighborhood and large regional parks. The park system's lakes, creeks, playgrounds, golf courses, recreation centers, gardens, biking and walking paths, nature sanctuaries, and its Nationally recognized parkway system, the 50-mile Grand Rounds National Scenic Byway, receive more than 20 million visits each year. The MPRB was named the number one park system in America by the Trust for Public Land every year from 2013 through 2018 and again in 2020.

The MPRB's mission is:

> The Minneapolis Park and Recreation Board shall permanently preserve, protect, maintain, improve, and enhance its natural resources, parkland, and recreational opportunities for current and future generations.
>
> The Minneapolis Park and Recreation Board exists to provide places and recreation opportunities for all people to gather, celebrate, contemplate, and engage in activities that promote health, well-being, community, and the environment.

1.1.2 Park Natural Areas

Of the 6,817 acres of lands and waters within the park system, over 2,800 acres consist of upland or aquatic natural areas. For the purposes of this study, a natural area is a defined geographic area recognized for its natural values, including natural plant communities, native species, and restorable and restored native plant communities. Aquatic ecosystems (e.g., lakes, wetlands) are not the focus of this Natural Areas Plan; however, some wetlands are noted and addressed in this Plan, such as the tamarack bog in Theodore Wirth Park. As part of park re-development projects, the MPRB planted native prairie in some park areas. These were also included in the study but are not actual native prairie remnants.

1.1.3 MPRB Natural Areas Management to Date

The MPRB Natural Resources work group was established in 2005 to manage native plant communities with higher ecological quality and naturalized prairie plantings that were installed as part of MPRB turf conversion[1] and park re-development projects. This continues to be the focus of MPRB Natural Resources, due to limited capacity in staffing, equipment and funding.

MPRB Natural Resources staff have used their Vegetation Database and VueWorks asset management software to develop work plans and document the work accomplished in the natural areas that they manage. Restoration and management investments in these "Managed Natural Areas" have resulted in some of the park system's highest quality habitats for native plants and wildlife. Management briefs developed as part of this Plan (Appendix A) build on this previous work and provide site-specific guidance for designated Managed Natural Areas as well as more general restoration and management guidance for other natural plant communities found in the park system.

MPRB Forestry Division manages City of Minneapolis woodland areas by pruning and tree removals to either control an urban forest pest or to mitigate a public hazard. Removing individual trees in woodlands can lead to the formation of gaps in the forest canopy. If a gap is created when a tree is removed, the canopy gap is assessed for existing tree regeneration to determine the direction succession will progress with no further action. If the probable course of succession is not in alignment with the desired cover type, appropriate tree species are planted to achieve stand improvement. MPRB Forestry Procedures are provided in Appendix B.

1.1.4 MPRB Natural Areas Study

The mission of the MPRB to, "…preserve, protect, maintain, improve and enhance" natural resources "for current and future generations" can be achieved only through a thoughtful process of understanding the existing ecological condition of park natural areas through inventory and assessing their condition. From there, goals can be established and steps taken to achieve the desired level of ecological function and health.

As part of ongoing system-wide planning efforts, the MPRB initiated a two-phase Natural Areas study. Towards this end, MPRB retained Applied Ecological Services, Inc. (AES, now Resource Environmental Solutions, LLC, RES) and SRF Consulting Group (SRF) to implement this project.

Phase I of the project (AES and SRF 2017) developed plant community classification and quality ranking systems that encompass and describe the wide array of MPRB's upland natural areas. A GIS-based landscape inventory of MPRB's natural areas was also developed in Phase 1.

Phase II of the project (2017-2021), addressed by this Plan, focused on a more detailed systemwide inventory, application of the quality ranking system, and the development of management recommendations and costs associated with the restoration and management of MPRB natural areas. Inventory and assessment of natural areas, GIS mapping and a written Natural Areas Plan are the deliverables for the Phase II project.

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[1] The MPRB "conversion" program was an effort to reduce mowing costs by converting turf areas into prairie plantings. The goal of this program was to increase plant diversity in the park system and reduce mowing costs. The program took place in the 1990s and established planted prairies on steep slopes and in park areas where there were many acres of turf being mowed.

1.2 MPRB Approach to Natural Areas Management

1.2.1 Considerations for Natural Areas Management

Given that the City of Minneapolis is fully urbanized and that plant communities generally require some level of maintenance in perpetuity to sustain their health and cultural benefits, MPRB recognizes the need to implement land management based in sound ecological principles as well as to perpetuate intentional stewardship – guided by science-based data and ensured by adequate funding. Understanding Minneapolis' natural areas begins with recognizing that the majority of MPRB's native plant communities have been lost, fragmented, and degraded over the past 170 years. Moreover, some plant communities are of human origin (anthropogenic), such as old fields, plantations, and gravel pits. It is not feasible, nor expected, to restore all MPRB natural areas to pre-European settlement conditions. However, implementing this Plan will enhance biodiversity, increase human enjoyment of natural areas, and put natural areas on a trajectory towards long-term ecological health and resilience.

Rejuvenating natural processes such as fire and large mammal grazing and browsing, which shaped vegetation and wildlife for thousands of years, have been largely eliminated. Invasive species further challenge the goal of maintaining healthy ecosystems and natural areas. Implementing this Natural Areas Plan will enhance biodiversity, increase human enjoyment of natural areas, and put natural areas on a trajectory towards long-term ecological health and resilience.

1.2.2 MPRB Planning Principles for Natural Areas Management

Ecologically based planning principles are guideposts, used to define how a project should unfold. Based on discussions with MPRB staff, these planning principles were established for natural areas restoration and management within the park system.

Overall

- Protect sensitive natural resources to foster resilient and biodiverse natural areas within the MPRB park system.
- 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 resilient plant communities that can be managed economically.
- Tell the ecological story of the parkland to inspire people through its restoration.
- Provide Minneapolis residents and visitors with an equitable opportunity to experience natural areas within the MPRB park system, while protecting biodiversity and ecosystem resilience.
- Use indicators and monitoring to document trends in natural resources and determine the success of restoration and management efforts.

Vegetation

- Identify sensitive natural areas for protection.
- Protect and restore MPRB's highest quality natural areas to prevent degradation.
- Maintain and enhance natural areas that are not currently managed by MPRB and its partners.
- Control invasive or aggressive native plants that reduce biodiversity and ecological resilience.

- Establish vegetative structure that is resilient and economical to maintain.

Wildlife

- Protect, improve, and restore habitat for wildlife.
- Protect habitats for sensitive wildlife.
- Identify and seek to make connections to similar habitats to benefit wildlife.

Human Use

- Detect human caused problems early by monitoring (e.g., off-trail uses).
- Recruit and foster partnerships to help maintain and monitor natural areas.

2. CONSERVATION CONCEPTS

2.1 The Importance of Park Natural Areas and Natural Resources

For millennia, the Twin Cities region consisted of a rich mosaic of natural resources. Native Americans inhabited the Twin Cities region for centuries, benefitting from its rich assemblage of game, other wildlife, edible plants, and water resources. They lived in harmony with the land, but also used fire and other land management practices to support their way of life.

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

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. In his best-known book, *A Sand County Almanac*, he wrote:

> *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.*
>
> and
>
> *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.*

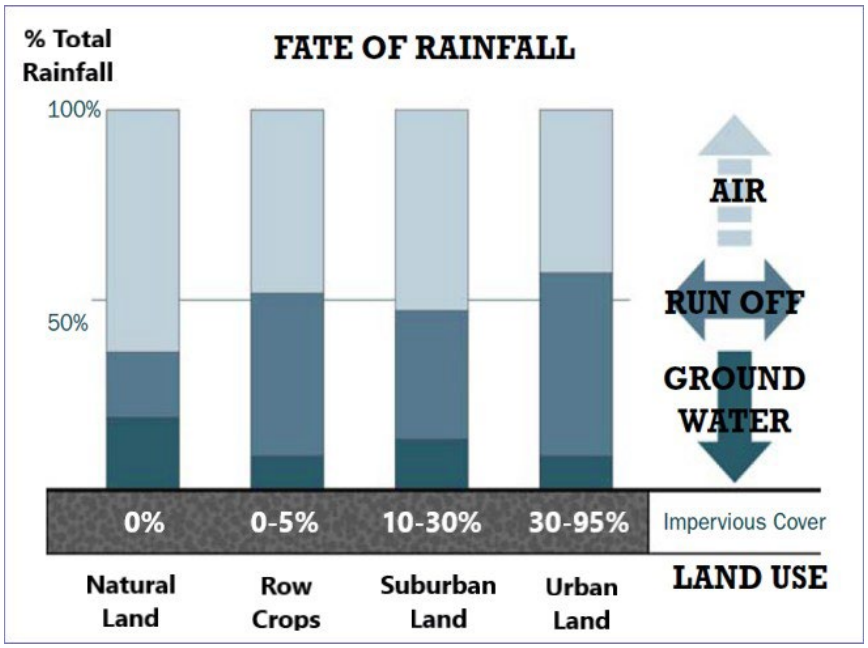
While far from a new concept, the idea that nature has intrinsic value continues to gain support as people have experiences in park natural areas or through travel, by visiting museums and zoo exhibits, or simply by watching television programs about nature.

Part of a species' and ecosystem's intrinsic value is due to the growing realization that a healthy ecosystem supports healthy human societies and economies. For example, it is well known that most people want to live near parks and open space. 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.

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 and forests on the landscape absorb huge quantities of rainfall, which in turn shrinks the amount of runoff and eroded sediment that reaches a watershed's streams and lakes. Figure 1 illustrates how natural landscapes recharge groundwater and return the majority of precipitation to the air (through evapotranspiration), resulting in less runoff and associated erosion, water pollution, and flooding. 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. The quality of life in urban areas is better simply because natural areas give citizens and visitors places to stroll, bike, take in the scenery, or simply relax in a natural setting.

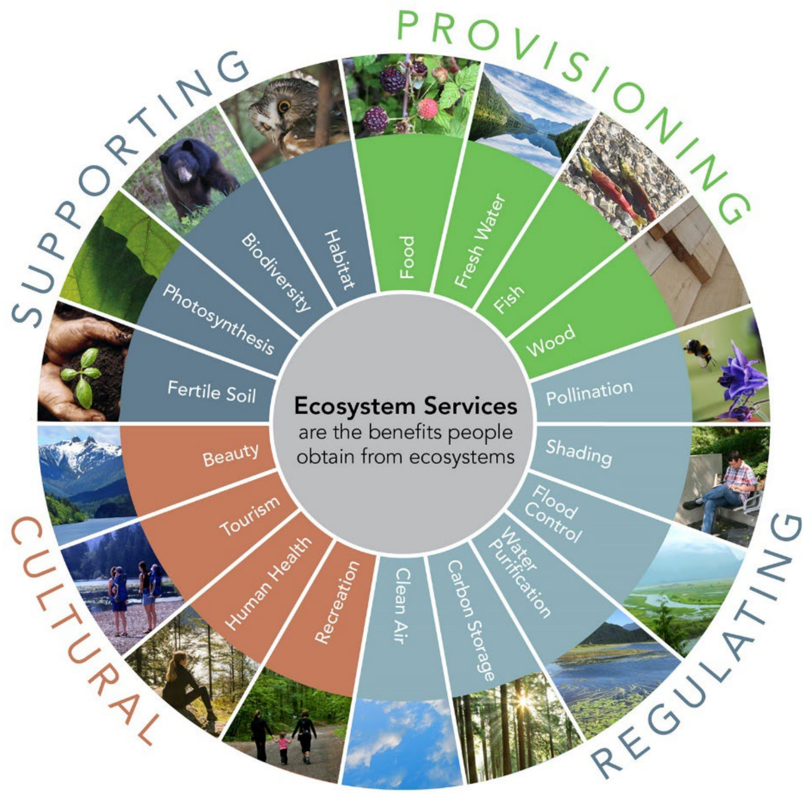
Figure 1. Runoff from Natural Versus Developed Land.



Natural land sheds two-thirds to one-half the runoff that developed land sheds and infiltrates more into groundwater. (Concept by RES, illustration by Sasaki.)

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 to people. For instance, if people were to pay to clean air and water, to build soil or regenerate forest trees and wild fish and game, the cost would be in the hundreds of millions of dollars annually for Minneapolis alone. Building flood control infrastructure, or rebuilding after floods, would be much more expensive 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 (Metro Vancouver Regional Planning 2018).



As mentioned earlier in this Plan, the award-winning and MPRB park system provides important recreation and tourism opportunities for Minneapolis residents and visitors. Research in the last 20 years has demonstrated a strong link between time spent in or near nature and 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 calm people.

Minneapolis' character also emerges from its natural resources. These resources create a sense of place that attracts people and businesses and convinces them to remain in the area. An abundance of ecosystem services not only indicates that ecosystems are healthy, but that society and the economy are being supported and enriched. By protecting and managing MPRB's natural areas, ecosystem services will persist and improve. MPRB's Ecological System Plan (2020) describes how ecosystem services benefit Minneapolis residents and visitors and presents a framework to improve ecosystem services. Appendix C provides more information on how ecological management benefits ecosystem services.

2.2 Impacts to Park Natural Areas

Natural areas within the MPRB park system are affected by a variety of actions and stressors. These can be viewed as localized impacts as well as more widespread "drivers of ecosystem change". The most obvious and influential action that affects MPRB's natural areas is direct alteration of the land (e.g., grading, removing, or planting vegetation), but there are many other impacts and drivers that influence the healthy functioning of ecosystems.

2.2.1 Land Alteration

Prior to the arrival of Europeans, Native Americans lived on the land that would later become known as Minnesota. The indigenous people's relationship with the land was very different than that of European settlers, resulting in different land management practices with different effects on biodiversity and ecosystems (see Section 4). French missionaries and English fur traders of were the first European-descended people to arrive. Settlement accelerated after military outposts were established and trade expanded. This expansion dramatically altered the environment and social landscape through trade, warfare, treaties, settlement, and city-building.

About the time Minnesota entered statehood in 1858, the parks in Minneapolis and adjacent communities were planned and construction began on an interconnected network of parks, lakes, streams, and rivers. At the time, this was seen as very progressive and still remains a national model. Progressive though it was, Minneapolis's park leaders of the 19th and 20th centuries dredged millions of cubic feet of wetland and lake bottom, altered creeks and waterways, filled wetlands, and walled the edges of lakes, and fragmented natural forests and other habitats. This created the Park landscapes of today. Pressure continues due to the densification of Minneapolis, establishment of unofficial trails through natural areas and other damaging park uses, an evolution in management practices, edge effects in remnant habitats, and climate change.

It is easy to notice when natural ecosystems are converted, for instance, from a savanna or prairie to homes and roads. In one example, 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, most apparent at lakeshores. Less apparent are the changes from nearby land use. Cultural land uses near natural areas export invasive species and some pests and diseases (discussed in the following sections). Additional adverse "edge effects" are discussed further in Section 2.3.1. Land uses also affects distant natural areas. For example, development in upper watersheds often has significant adverse impacts on rivers, lakes, and ponds downstream. Land use practices in western Hennepin County, in the headwaters of the Minnehaha Creek, affect the creek in the Minnehaha Parkway, at Minnehaha Falls, and in Minnehaha Glen. Wildlife that require large blocks of "core" habitat (discussed in Section 4.2.2) or multiple habitat types to complete their life cycles disappear from landscapes where land use damages or shrinks habitat cores and prevents movement among habitats needed to complete a species' life cycle.

Today, regular park maintenance—and even ecological restoration and management—may accidentally introduce or spread invasive species, diseases, and their vectors; therefore, MNDNR guidelines

(Appendix D) should be followed to avoid the introduction or spread of disease in the course of management.

2.2.2 Invasive Plants

Minneapolis is no different than every other city in the United States in regard to invasive plant species: their removal from natural areas is one of the primary management activities. Natural areas within The MPRB park system has been dramatically and negatively affected by several invasive plant species and threatened by relatively new pests, including the Emerald ash borer.

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 alter the composition of plant communities, often reducing native species diversity (both plants and animals). Invasive plants 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. These impacts of invasive plants lessen the resilience of ecosystems during recovery from disturbances and environmental change. MPRB has actively managed invasive plants for years, but constant pressure from wind-blown and bird-deposited seeds and adjacent private properties with invasive plants creates the need for ongoing control efforts. Invasive plant species that pose the greatest threat to MPRB's upland natural areas are:

- Norway maple (*Acer platanoides*)
- Common buckthorn (*Rhamnus cathartica*)
- Glossy buckthorn (*Frangula alnus*)
- Invasive honeysuckle shrubs (*Lonicera* spp.)
- Barberry (*Berberis* spp)
- Oriental bittersweet (*Celastrus orbiculatus*)
- Garlic mustard (*Alliaria petiolata*)

Appendix E presents MPRB's current list of upland invasive plant species known to be found within the park system as well as additional invasive plant species to control and monitor. MPRB contributes invasive plant observations to the Early Detection and Distribution Mapping System (EDD Maps 2020) in order to track populations within the park system and assist with tracking and management efforts throughout the region. Even some native plant species such as Boxelder (*Acer negundo*), Green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), Common hackberry (*Celtis occidentalis*), Eastern red cedar (*Juniperus virginiana*), Chokecherry (*Prunus virginiana*), and Western poison ivy (*Toxicodendron rydbergii*) can be invasive/aggressive in certain landscapes.

Regular park maintenance, as well as ecological restoration and management, may accidentally introduce or spread invasive species. Appendix D provides guidelines developed by the MNDNR to avoid the introduction or spread of invasive species in the course of management.

2.2.3 Pests and Diseases of Vegetation

Natural areas can also be affected by a variety of pests and diseases. Some of these may occur as natural components of an ecosystem, but others (including invasive animals) have migrated into the region by accident or by intentional human transport and may be harbored on private properties adjacent to the MPRB park system. Some invasive animals cannot be removed or cost-effectively controlled. In these cases, managing the effects of an invasive species, rather than trying to eradicate it, is the best course of action. The main pests that currently affect and may affect MPRB's upland natural areas in the future include:

- **Emerald ash borer (EAB)**. This Asian beetle (*Agrilus planipennis*) was discovered in Tower Hill Park in 2010. Its spread has devastated many mature ash trees across the region. For several years, the City of Minneapolis and MPRB Forestry Department have conducted pre-emptive removal of ash trees to reduce ash tree density and slow the borer's spread, and to accelerate tree replanting. Ash tree removals and disposal follow MPRB Emerald Ash Borer Preparedness Plan (2013) developed with USDA and MDA guidance. Ash trees are removed in woodland areas where the tree would become hazardous if no action were taken. Potentially hazardous ash trees that are symptomatic and not yet symptomatic of emerald ash borer infestation are removed. Ash trees in woodland areas that are not likely to present a risk are left to provide habitat and nutrient cycling as they decline.
- **Gypsy moth**. Present in Minneapolis, warranting special handling of cut wood and other surfaces where eggs may be found. The Minnesota Department of Agriculture (MDA) manages Gypsy moth (*Lymantria dispar dispar*) with a "Slow the Spread" strategy. MPRB is a partner to this management. In addition to treating a Lake Nokomis site in 2020, management was also carried out in Lowry Hill in 2018, and in 2017 occurred in Richfield and a small area of the adjacent Armatage neighborhood. There was a previous infestation in 2001 in the Armatage area. Most recently Gypsy moth was discovered near Loring Park. A survey was conducted in October 2020 to determine the extent. Management of Gypsy moth is developed in partnership with MDA.
- **Invasive earthworms**. Present in the MPRB park system's forests, where these invasive animals aggressively consume organic matter in the soil, altering soil structure and composition and compromising the health of the forest ground layer. Common invasive worms are night-crawlers (*Lumbricus terrestris*) and angle worms (*Aporrectodea spp., Octolasion spp.*). Jumping worms, *Amynthas spp.* Kinberg 1867, is another invasive earthworm and there are reports of them in Minneapolis. At present no control is possible, though researchers continue to seek solutions.

The main diseases that may affect trees in MPRB's natural areas include:

- **Oak wilt.** An often lethal disease of oaks caused by an invasive fungal pathogen (*Ceratocystis fagacearum*) that can travel between root grafts and is spread by sap beetles. It is especially lethal to oak species in the red oak group. Oak wilt is currently being monitored and managed at three sites within woodland areas including Eloise Butler Wildflower Garden and Bird Sanctuary, the 26th Avenue North overlook along Theodore Wirth Parkway, and within the Mississippi Gorge Regional Park east of the intersection of West River Parkway and East 36th Street. Oak wilt management consists of root graft interruption using a vibratory plow where feasible and also removal of infested oak trees. The method of wood disposal depends on the site and situation.
- **Dutch elm disease**. An often lethal disease of native elms caused by an invasive fungal pathogen (*Ophiostoma novo-ulmi)* that can travel between root grafts and is spread by elm bark beetles. This disease is present in the MPRB park system and has been managed by MPRB Forestry Department since the 1970s.
- Other potentially devastating diseases of trees and shrubs that are in Minnesota or have the potential to arrive in the next decade include Butternut canker (*Sirococcus clavigignenti-juglandacearum*), Bur oak blight (*Tubakia dryina, T. iowensis*), Asian and velvet long-horned beetles (*Anoplophora glabripennis, Trichoferus campestris*), Spotted lanternfly (*Lycorma delicatula*) and Mountain pine beetle (*Dendroctonus ponderosae*).

As mentioned, regular park maintenance, and even ecological restoration and management, may accidentally introduce or spread invasive species and diseases. For this reason, MNDNR guidelines (Appendix D) should be followed to prevent the introduction or spread of harmful pests and diseases during management work.

2.2.4 Stormwater and Erosion

The MPRB park system is best known for its urban lakes, creeks, and the Mississippi River corridor. While water resources are not the focus of this this Plan, they are an important feature of MPRB's park system and influence park natural areas.

These waters provide significant recreational value and amenities for Minneapolis residents and the metro region. The Mississippi River is an important source of drinking water for the metro region. The MPRB park systems surface waters—lakes, streams, rivers, and wetlands—provide aquatic habitat for many species of fish, amphibians, birds, and aquatic insects and clams. The MNDNR has jurisdiction over the MPRB park system's Public Waters (including lakes, rivers, streams, and certain wetlands). The National Park Service manages the 72 mile river park designated as the Mississippi National River and Recreation Area (MNRRA), which encompasses the section of the River that bisects the Twin Cities, including several MPRB parks.

Minneapolis' largely urban watersheds produce significant surface water runoff from roads, parking lots, roofs, and turf. Non-point source pollution from runoff reduces water quality, leads to erosion of streambanks and shorelines, and degrades aquatic, wetland, and lowland habitats. Non-point source pollution is best addressed at a watershed scale. Given that Minneapolis is located along the Mississippi River (the receiving water for several tributaries), it is challenging for MPRB to significantly influence these watershed-scale impacts. Urban stormwater runoff also contributes to increased flooding and alters natural patterns of water level variability, leading to challenging growing conditions for plants.

MPRB Water Resources staff work closely with the City of Minneapolis and water management organizations to implement stormwater best practices in the region to improve stormwater management to decrease non-point source pollution, flooding, and other stormwater impacts. Water Resources staff also provide lake water quality monitoring. The resulting data are published in an annual report. Creek and river monitoring is done by a variety of local water management organizations, state, and federal agencies, as well as through MPRB and City of Minneapolis.

A variety of wetland types were identified as part of MPRB plant community mapping; however, these areas may not actually be a wetland as defined and regulated by the federal Clean Water Act and Minnesota Wetland Conservation Act. No formal delineation of wetlands was completed for this Natural Areas Plan, as wetlands and park land in Minneapolis have be extensively altered due to historic development activities as the city and park system was developing.

2.2.5 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 highly 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 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, thereby creating smaller forest patches and increasing edge habitat, the ability of some plant and animal species to adapt to climate change could become progressively 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.

These climate projections warrant adjustments in the management of natural areas. Due to the many unknowns surrounding climate change (magnitude, rate, interactions, responses, etc.), adaptation strategies are generally broad. Over time, climate adaptation strategies can be refined for specific geographies and situations. The following general adaptation strategies are based on the National Fish, Wildlife and Plants Climate Adaptation Strategy (National Fish, Wildlife and Plants Climate Adaptation Partnership 2012):

1. Conserve habitat to support healthy fish, wildlife, and plant populations and ecosystem functions in a changing climate.
2. Manage species and habitats to protect ecosystem functions and provide sustainable cultural, subsistence, recreational, and commercial use in a changing climate.
3. Enhance capacity for effective management in a changing climate.
4. Support adaptive management in a changing climate through integrated observation and monitoring and use of decision support tools.
5. Increase knowledge and information on impacts and responses of fish, wildlife, and plants to a changing climate.
6. Increase awareness and motivate action to safeguard fish, wildlife, and plants in a changing climate.
7. Reduce non-climate stressors (e.g., control invasive species) to help fish, wildlife, plants, and ecosystems adapt to a changing climate.

Many of these strategies are already being practiced in the MPRB park system: invasive plants are being managed, parks are being restored to native habitats such as prairie. It may be beneficial to adapt MPRB's natural resource management practices in the following ways:

- Change timing and frequency of prescribed fire and invasive plant management to in response to changes in temperature trends;
- Increase efforts to respond to greater invasive species pressure;
- Change timing of seeding and planting in response to changes in temperature trends;
- Consider using species and genetic plant material from more southern areas, such as Iowa;
- Address implications of changing community and species ranges and composition; and
- Respond to the range of options related to persistence versus change.

2.3 Protecting Biodiversity with Conservation Planning

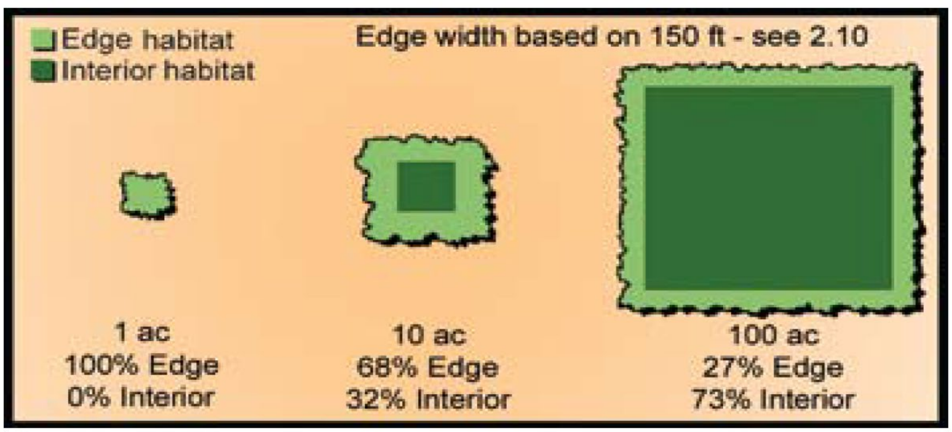
Conservation planning is an important tool for conserving biodiversity and ecosystem services in a given geographic area. Based on principles of landscape ecology, conservation biology, and population biology, existing land cover, vegetation, water features, and other environmental factors are assessed 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 can help identify regionally significant natural resources, guide prioritized implementation of ecological restoration and management projects, and achieve conservation goals through implementation of ecological restoration and management.

2.3.1 Natural Area Core Habitats, Transitions & Connections Provide for Wildlife Habitat

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 MPRB park system will improve the likelihood that uncommon and declining animal species will persist, including Species of Greatest Conservation Need (discussed in Section 4.2.2).

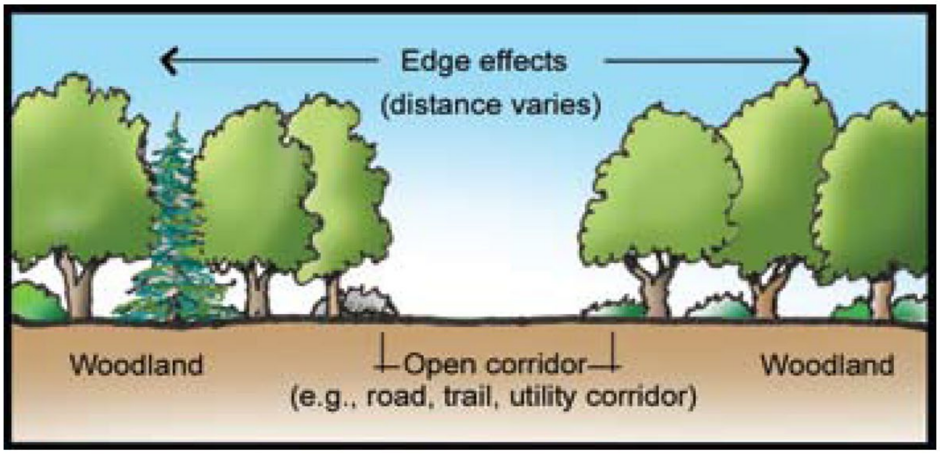
The effect of converting natural areas to developed lands (e.g., buildings, parking lots, roads), with its resulting habitat loss, has been well documented. Less obvious are long-term effects from increasing the amount of habitat *edge*. Smaller and narrower habitats have more edge than larger, rounder ones (Figure 3).

Figure 3. Natural Area Core/Interior Habitats and Edge Habitats (Bentrup 2008)



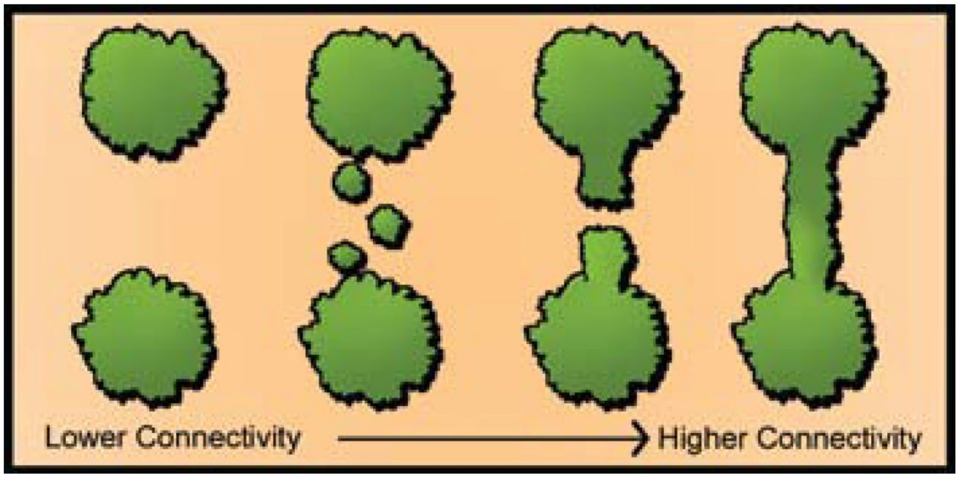
More *edge* and less *interior* habitat pose significant threats to wildlife that need core habitat. A variety of scientific papers and other sources have documented how edge effects penetrate into adjacent natural habitat. For instance, birds and other wildlife can be flushed by people walking on trails 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 4). 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 of buffers. These screens and buffers, ideally consisting of native vegetation, create *natural area transitions*, which further reduce edge effects and improve core habitats.

Figure 4. Edge Effects from Development and Disturbance (Bentrup 2008)



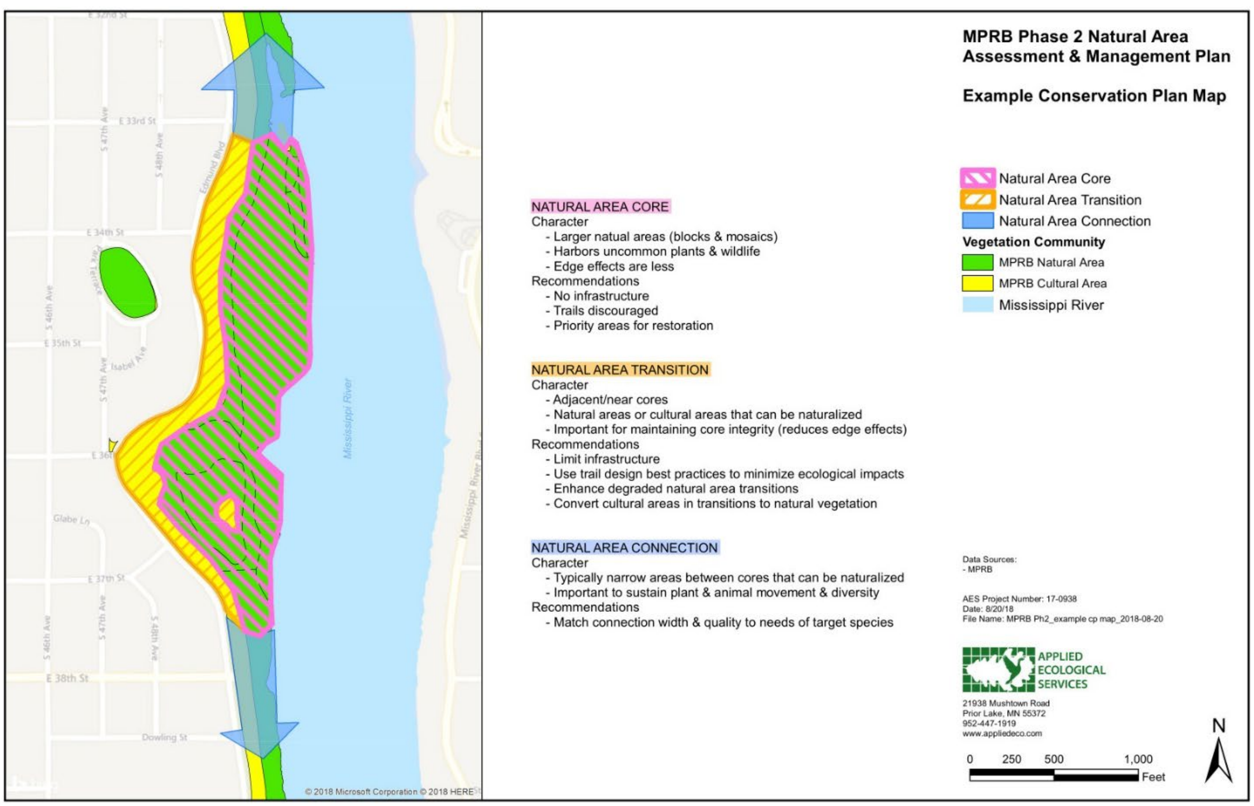
Connecting core habitats (Figure 5) allows wildlife to retreat to different, more favorable areas, without being exposed to the hazards of travel. Generally speaking, only the largest natural areas will support the City's most sensitive vertebrate species. Some of these species require corridors of several 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 all of these variables, greenways (an important method of increasing connectivity) should be designed and managed thoughtfully to maximize ecological benefits and minimize adverse effects.

Figure 5. Gradients of Ecological Connectivity (Bentrup 2008)



The concepts of core habitats, edge effects, transitions, and connectivity can be used to help conserve—and even improve—MPRB's full spectrum of biodiversity. Protecting, connecting, and restoring large areas of natural vegetation to minimize fragmentation and edge effects are critical to many Species of Greatest Conservation Need in the MPRB system. Figure 6 illustrates how natural area cores, transitions, and connections can be applied to MPRB's 36th Street Savanna, a higher ecological plant community.

Figure 6. Natural Area Cores, Transitions & Connections at 36th Street Savanna



The natural area core (Figure 6) contains the best quality plant communities insulated from adjacent incompatible land uses and buffered on the east by the Mississippi River. Unfortunately, the core is narrow, resulting in less interior habitat than if it were round. A round habitat core has more of its area outside the zone that is most influenced by edge effects. This condition is partially offset by the transition on level ground at the top of the river bluff. Although a trail and mowed turf are included in the transition, these are superior to a building or parking lot in terms of some edge effects, such as microclimate warming and populations of house sparrows and starlings—competitors with native bird species. Where the trail and turf in the transition are overtopped by tree canopy, edge effects are further minimized.

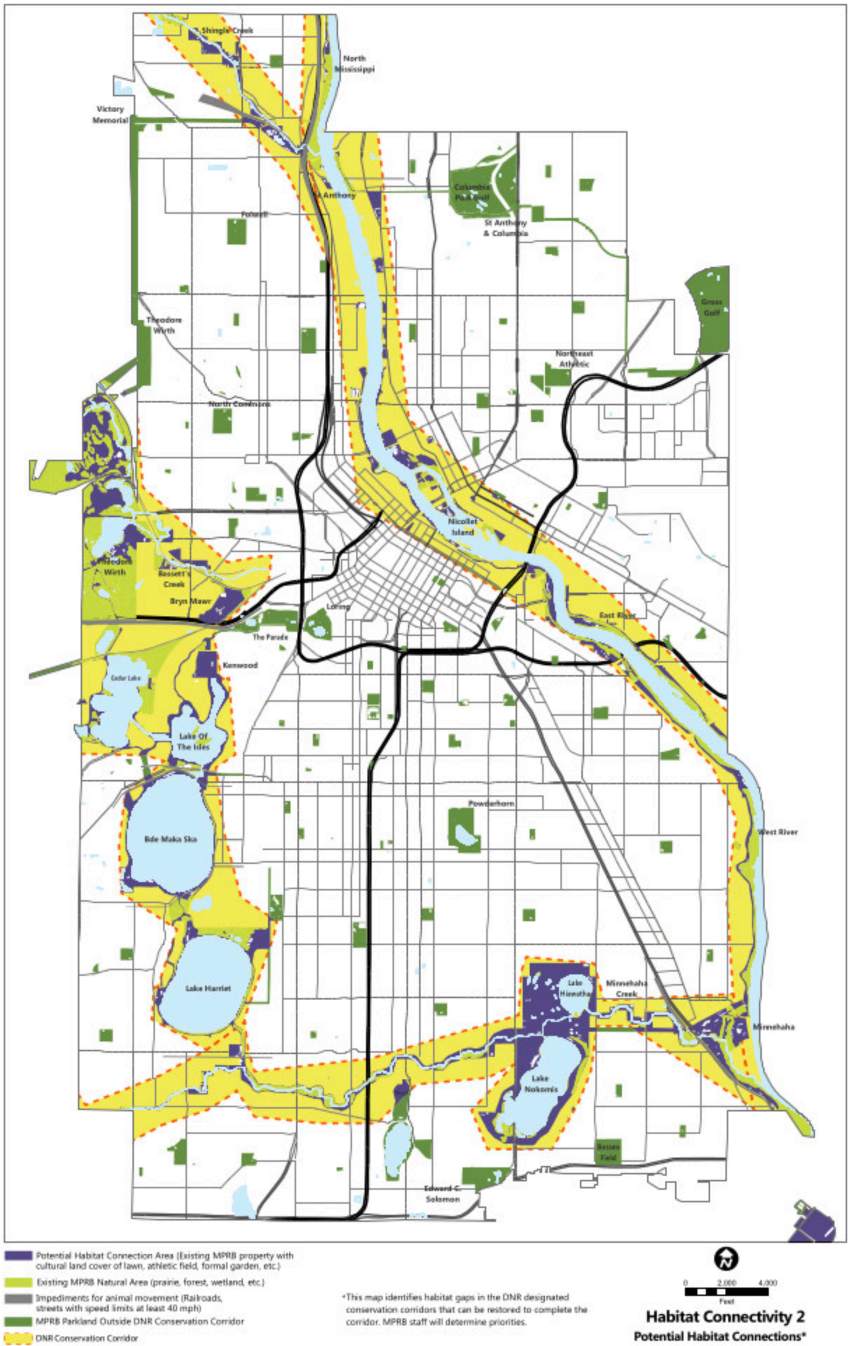
2.3.2 Potential Natural Area Connections

The MPRB park system encompasses Minneapolis' largest and highest quality natural habitats. The forests along the Mississippi River and Minnehaha Creek, the woodlands and wetlands of Theodore Wirth Park, and the natural areas surrounding the Chain of Lakes are examples of regionally important native habitats within the MPRB park system. Waterways, together with their associated, wider floodplain, represent linear aquatic and riparian habitats, and often flow between larger patches of natural upland habitats.

To increase habitat (for pollinators and other native species), to improve other ecosystem services, and to reduce long-term maintenance costs, some reduced mowed areas and trail edges could be converted to native prairie or savanna ground layer vegetation. The conversion of herbaceous vegetation from turf grass to prairie/savanna grasses, sedges, and wildflowers should consider these recommendations. Expansion, buffering, and additional connections between the MPRB's parklands 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.

Figure 7 from MPRB's Ecological Systems Plan (MPRB 2020) illustrates existing and potential connections between MPRB parks, highlighting the connectivity provided by the Grand Rounds. With cooperation from willing landowners and other partners, restoration and/or management of these areas and connections will substantially improve the health and appearance of MPRB's existing parklands and reduce long-term management effort. Conservation of rare and uncommon species would be aided by restoration and management efforts. Conservation easements and fee-title acquisition are additional strategies to achieve conservation goals. Note that ecological connections should be designed to minimize the spread of invasive species (e.g., weed seeds are often dispersed along trail corridors).

Figure 7. Habitat Connectivity (MPRB Ecological Systems Plan, 2020)



2.4 What is Ecological Restoration and Management?

Nature has an amazing ability to recover from past injury and take care of itself in the long term, but with so many impacts and stressors on natural areas (discussed in Section 2.2), people now need to intervene to maintain healthy ecological systems. 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.

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 affect positive changes in damaged ecosystems and plant communities. Planning principles for natural areas management (discussed under Section 1.2.2) help guide such interventions. After restoration to a better condition, ecosystems, plant communities, and wildlife still need to be managed, though costs of natural area management are much lower on a per acre basis than managing turf or flower beds.

Ecological restoration helps people by improving ecosystem services, described previously in this Plan. In addition, restoration 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 has identified 69 rare natural features within the area encompassing the MPRB park system (MNDNR 2018), and Minnesota's Wildlife Action Plan has identified many more Species of Greatest Conservation Need (MNDNR 2016; see "Definitions and Acronyms" in the front of this Plan for a glossary of technical terms). These species need well-managed habitats to prevent further declines. In response, over the past three decades, MPRB has completed several ecological restoration projects. This Plan will help expand MPRB's restoration efforts, preventing further loss of native plant and animal species and (it is hoped) actually increasing the population size of some specialist species.

Ecological restoration creates healthy and sustainable ecosystems, often in developed or disturbed landscapes. The composition, structure, and function of restored ecosystems aim to be like those of original ecosystems, but of course cannot in a few years (or perhaps ever) fully replicate those original ecosystems that persisted for thousands of years. Like the original ecosystems, restored ecosystems have a greater variety of native plant and animal species, higher levels of natural functions like infiltration and carbon storage, and greater resilience in the face of environmental change than turf, cropland, and other cultural ecosystems. (This Natural Areas Plan's references to "cultural" ecosystems or landscapes does not refer to historically significant features or "cultural resources.")

Restored ecosystems need to be managed to keep them in good working order, just as cultural ecosystems must be—cropland, parks, streetscapes, homes and lots, institutions and grounds all require management. The original ecosystems also were "managed" in a way by fire, grazing and burrowing animals, flooding, and other natural disturbances on the landscape. It is often most effective and efficient to restore and manage native plant communities by reintroducing these natural disturbance regimes (e.g., prescribed burning); however, this is not always feasible, especially in urban settings. Therefore, alternative management practices must be used, such as physically removing invasive vegetation.

Changes in the larger landscape and in local conditions often prevent the full re-creation of natural conditions that prevailed 170 years ago. Historical conditions give us insights into what natural conditions are possible at a given site, but no more. More importantly, the goals of a restoration project will dictate the level of effort and resulting conditions. Not all MPRB natural areas will be restored to exceptional native plant communities, but they can be restored and managed to meet MPRB's goals.

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 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. For these reasons, restoration and management plans should be viewed as a starting point in a process of restoring biodiversity and natural processes in MPRB's 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 a cycle of implementation, monitoring, evaluation, adjustment, and further implementation. 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, allowing for flexibility and adaptation as conditions change (e.g., tornados removing canopy trees in a forest). Monitoring with data collection and analysis can be supported by enlisting "citizen scientists", students and teachers. Any restoration project can become a "living lab" for research, and public education. On the other hand, some monitoring—plant and insect studies, for instance—requires a higher level of expertise, training, or oversight.

2.4.1 Ecosystem Approach

RES recommends taking an "ecosystem approach" to natural areas restoration and management. This approach considers all interacting factors in an ecosystem and designs management techniques that replicate, at lowest practical cost, the ecological structures and processes that enable ecosystems to adapt to changing conditions. Restoration and management actions are typically considered and implemented in the following sequence, although not all actions may be applicable to a given site or project. Actions that restore processes and structures are done first because these may increase species diversity without seeding and planting. If that fails to restore the desired biodiversity, seeding and planting become necessary.

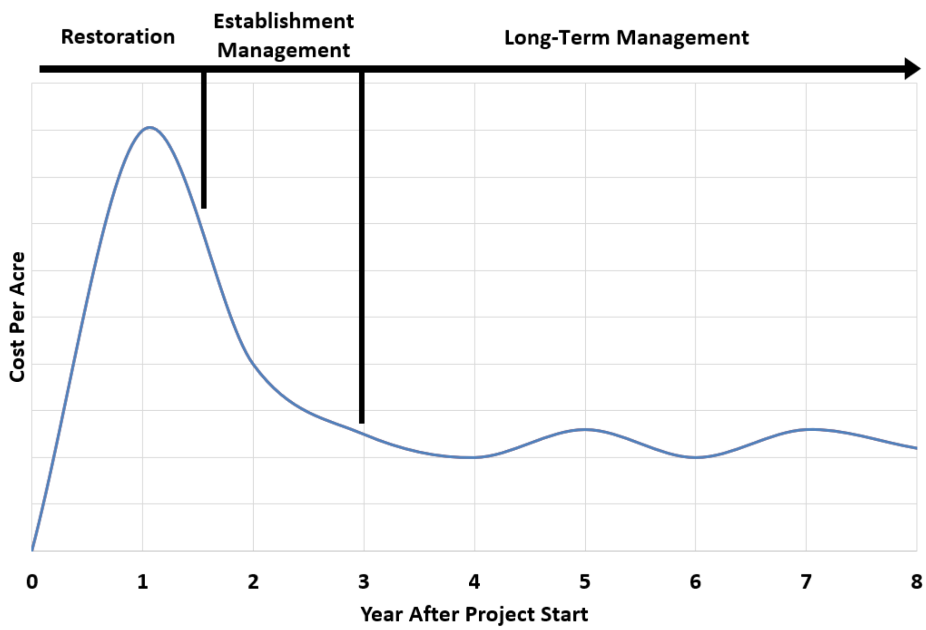
- Restore natural disturbance regimes (e.g., prescribed burning, flood regime, grazing)
- Introduce biocontrols when available and feasible
- Remove and control invasive trees/shrubs mechanically
- Install native trees and shrubs
- Remove and control invasive herbs
- Install herbaceous seeds and plants
- Use herbicides sparingly and only when other methods fall short of goals
- Provide long-term, adaptive management

These actions are accomplished during an initial restoration and short-term management phase, followed by a long-term management phase.

2.4.2 Initial Restoration and Short-Term Management Phase

Ecological restoration has short- and long-term management phases. The initial restoration and short-term (i.e., "establishment") phase is the most time-consuming and costly. Usually lasting about three years, a significant effort is needed to prepare and begin establishing the proposed native plant diversity types and ages for a given project area. Tasks often include removal of certain trees and shrubs, control of invasive species through various techniques (biological controls, herbicide, mechanical methods), seeding and planting of native species, and re-introducing fire regimes in fire-dependent systems. The length of time before moving to long-term management depends on the site's initial quality, weather conditions, how the site responds, its size, and factors unique to the site. Figure 8 shows the relatively high cost of initial restoration work, the somewhat reduced cost during short-term (or "establishment") management, and the lowest annual cost during long-term management.

Figure 8. 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 minimal-to-moderate effort and cost is required to improve the natural resource. Enhancement, for instance, means adding more native flower species to a prairie or removing an undesirable tree like Boxelder from an oak forest.

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

2.4.3 Long-Term Management Phase

After the establishment phase, the process shifts to a lower-cost, but equally important, long-term maintenance. Without a commitment to long-term management, short-term restoration investments may be wasted. Scheduling and annual budgeting long-term management protects restoration investments and ensures that the plant community and ecosystems continue on a trajectory toward greater ecological health.

Typical long-term management tasks include maintaining the disturbances (e.g., fire) that perpetuate a diverse and resilient plant community, use of biocontrol (when available and feasible), spot herbicide application of invasive plants (i.e., precise application of chemical), re-seeding/planting disturbed or poorly developing areas, and re-planting woody plants that have died. Most ecosystems need some type of disturbance that removes dead plant material, regenerates many plant species, and opens up new habitat for plants and animals to perpetuate themselves. Controlled burns (prescribed fires) are a common tool used to mimic former fire regimes in prairies, savannas, wetlands, and some woodlands. Harvesting hay from prairies, which loosely mimics grazing, can also be effective. One-hundred seventy years ago, much of MPRB's parklands were visited frequently by fires, grazers, and burrowers, and the plants and animals were adapted to those conditions.

3. MPRB NATURAL AREAS PLAN INFORMATION GATHERING AND METHODS

3.1 Review of Existing Data & Plans

Existing data and reports were used to define the geographic extent of the project and to assist with plant community classification, quality assessment, inventory, and mapping. RES/SRF compiled and reviewed numerous plans and datasets, including numerous MPRB plans (e.g., park master plans, Ecological Systems Plan), MPRB GIS data (e.g., park boundaries, managed natural areas, reduced mow areas, stormwater best management practices), and reports and data from other sources. Appendix F provides a list of information reviewed during development of this Natural Areas Plan.

3.2 Field Survey Methods

This Natural Areas Plan is based on the ecological conditions and management needs in MPRB natural areas. Phase I field methods are described in the Phase I report (AES and SRF 2017). During the 2018 and 2019 growing seasons, AES ecologists conducted field assessments of MPRB natural areas. 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. (Preliminary ecological quality ranks were assigned to natural areas in Phase I.) Digital photography (georeferenced, using Collector for ArcGIS and ArcGIS Online) was used to document representative plant communities, seeps and springs, erosion features, and other items of note throughout the park system. Desktop refinement of GIS data was conducted after field verification.

3.3 Ecological Quality Ranks

During Phase I, several ecological quality ranking systems were reviewed and considered. 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 MPRBs urban park system. The following ecological quality ranks are used for natural areas within the MPRB park system.

- **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 exotic (i.e., non-native) 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 plants, but is dominated by non-natives and/or is widely disturbed and altered.
- **NN** = Altered / non-native plant community. These semi-natural communities and novel ecosystems, by convention, do not receive a natural quality rank. These include plant

communities of human origin, such as Altered Forest/Woodland of Green ash and Box elder, Non-Native Grassland dominated by Smooth brome, and others.

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.

3.4 GIS Mapping Methods

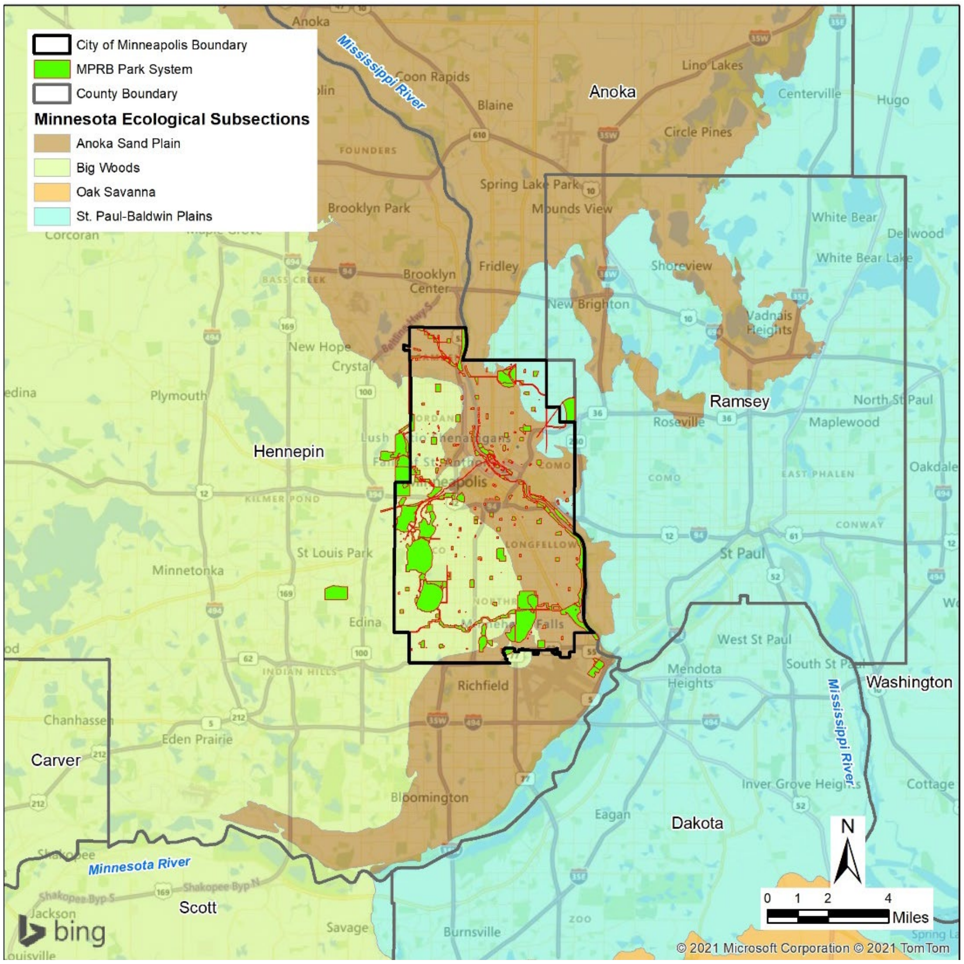
As a platform for developing and managing MPRB natural area vegetation data, AES and SRF built an ArcGIS geodatabase. (A geodatabase is a collection of geographic datasets of various types held in a common file system folder or database.) A detailed description of the methods used to develop the geodatabase are provided in the Phase I report (AES and SRF 2017).

As part of the Phase I and Phase II field efforts (2017 through 2019), ground truthing and field assessment identified areas where land cover classification, plant community boundaries, and/or quality ranks warranted revision; these edits were made to the geodatabase. Attributes (e.g., park names, Managed Natural Area names, VueWorks codes) were added to the geodatabase to provide a more robust dataset. Collector for ArcGIS and ArcGIS Online were used during data collection for field navigation, review of mapping data, and collection of georeferenced field data (e.g., photographs, seeps/springs, erosion features). The final geodatabase is an important deliverable of this project and will serve as a critical tool for the future management of MPRB's natural areas.

4. MPRB NATURAL AREAS: PAST, PRESENT AND FUTURE

Understanding the natural history of the region and current conditions of the MPRB park system provides an important foundation for planning and natural resource management. The MPRB park system is located in eastern Hennepin County, Minnesota (Figure 9).

Figure 9. Regional & Ecological Context of the MPRB Park System



4.1 Past Conditions

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 was carved out by receding meltwaters of glacial River Warren. Limestone and sandstone bedrock are exposed along sections of the Mississippi River Gorge. Soils in the region formed primarily from sandy and gravelly glacial outwash on level plains and are generally well drained. Over millennia, the bare soils became colonized by plants, which in turn helped develop soils, which enabled the establishment of woodlands and grasslands.

The MPRB park system lies within the Big Woods, Anoka Sand Plain, and St. Paul-Baldwin Plains and Moraines Subsections (Figure 9) within the Minnesota & NE Iowa Morainal Section of the Eastern Broadleaf Forest Province, according to the MNDNR Ecological Classification System (ECS), (MNDNR 2019). A description of the three subsections follows.

Big Woods. Occupies the western portion of the MPRB park system. Soils are loam to clay loam, which are productive for farming. Lakes are common and maple-basswood forest and oak woodland historically prevailed. Fire was infrequent.

Anoka Sand Plain. Occupies most of the eastern portion of the MPRB park system, including along the Mississippi River. Soils are generally sandy. Oak barrens (or savannas), maintained by intermittent fire, were once common in this subsection.

St. Paul-Baldwin Plains and Moraines. Occupies the northeast portion of the MPRB park system. 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.

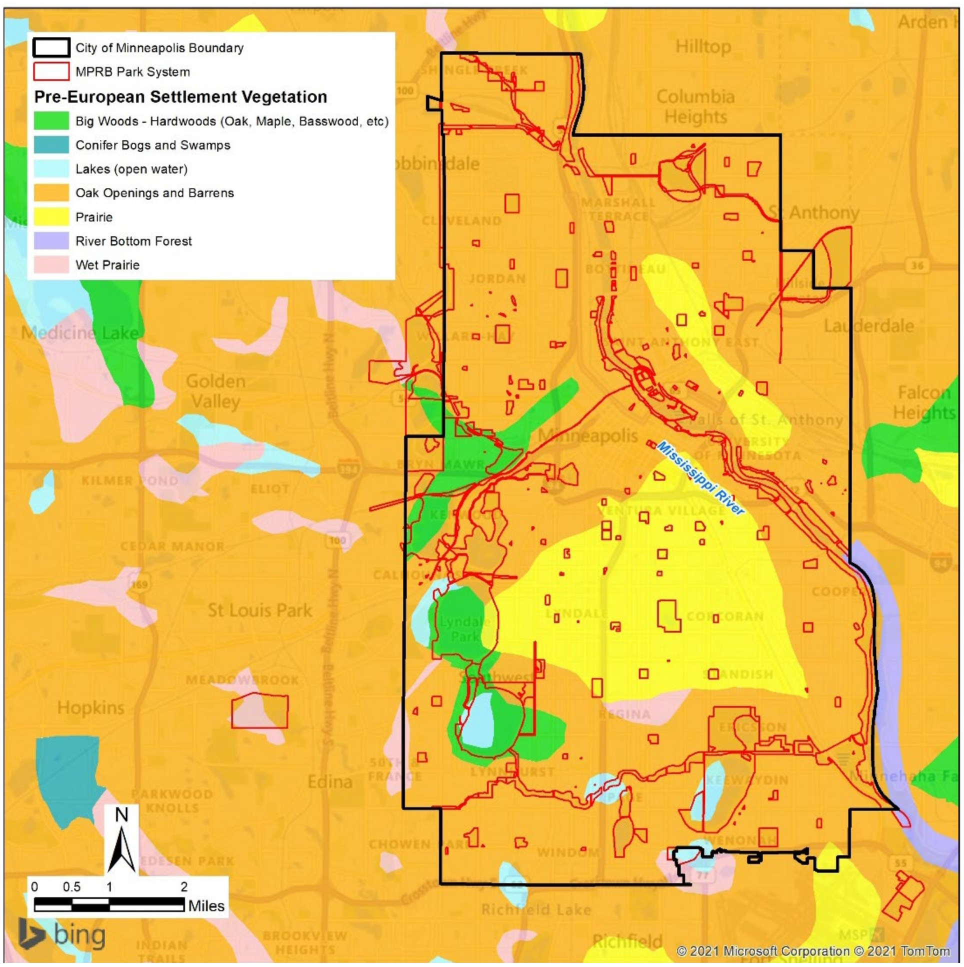
The MPRB park system historically experienced regular fires. While lightning can start natural wildfires, fires in the region were often ignited intentionally by Native Americans to clear woodlands and brush, open up land for cultivation, create habitat for game species and berry- and nut-producing plants, and clear sight-lines for self-defense and security. These fires are documented to have occurred annually to every few years in the region's larger open landscapes (Stewart 2002 and 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.

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

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.

According to vegetation mapping done by the Public Land Survey (1847-1908) and compiled by Marschner (1974), the current MPRB park system was located in a region dominated by oak openings and barrens (Figure 10). Patches of Big Woods hardwood forest and open prairies created a regional mosaic of habitats, and river bottom forests existed along the Mississippi River. habitats, and river bottom forests existed along the Mississippi River.

Figure 10. Pre-European Settlement Vegetation of the MPRB Park System



In the 1990s, the MNDNR County Biological Survey (CBS) mapped sites of biological significance and native plant communities and in Hennepin County. Sites of biological significance within the MPRB park system are limited to some of the forests in the southern portion of Theodore Wirth Regional Park, forests along Mississippi Gorge Regional Park, and portions of Minnehaha Regional Park (mostly below the falls in the “glen”). Native plant communities mapped by CBS include much of the Mississippi Gorge forests, portions of Minnehaha Regional Park, and the tamarack bog at Theodore Wirth Regional Park.

4.2 Present Conditions

4.2.1 Land Cover and Vegetation

Land cover classification systems typically include 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. In the early 2000s, the Minnesota Land Cover Classification System (MLCCS, MNDNR 2004) was used to map land cover throughout much of the Twin Cities. This provided the foundation for land cover and plant community mapping conducted as part of this Natural Areas Plan.

During development of this Natural Areas Plan, the following classification was developed to characterize MPRB’s existing plant communities (Table 1). The table presents a hierarchical classification scheme, with each level indented according to the level of organization. For instance, at the first level upland communities with drier soil are separated from lowland communities with typically wetter soil. At the second level, the dominant form of the vegetation separates types. 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, such as organic soil.

Table 1. MPRB Phase II Natural Area Vegetation Classification

PLANT COMMUNITIES	DEFINING CHARACTERISTICS	POTENTIAL MNDNR CLASSIFICATION (MNDNR 2005)[1]
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	Southern Dry-Mesic Oak (Maple) Woodland (FDs37)
Mesic Forest (2)	Often maples important	Southern Dry-Mesic Oak Forest (MHs37), Southern Mesic Oak-Basswood Forest (MHs38), Southern Mesic Maple-Basswood Forest (MHs39)
Altered Forest/Woodland (3)	**Often box elder, green ash, elms**	**Not a natural community**
Savanna/Brushland	**5-50% tree canopy**	
Savanna (4)	Tree dominated, but <50% canopy cover	Southern Dry Savanna (UPs14), Southern Mesic Savanna (UPs24)[2]
Shrub/Scrub (5)	Shrub dominated, with trees	Not a natural community
Grassland	**<5% tree canopy**	
Prairie (6)	Native plants dominate	Southern Dry Prairie (UPs13), Southern Mesic Prairie (UPs23), Southern Wet Prairie (WPs54)
Non-Native Grassland (7)	Little native plant cover	Not a natural community
Lowland Communities	**Low areas, including wetlands**	
Lowland Forest/Woodland	**50-100% tree canopy**	
Floodplain Forest (8)	Near water body; typically, on mineral soil	Southern Floodplain Forest (FFs68)
Wet Forest/Swamp (9)	Organic soil; saturated or inundated	Southern Wet Ash Swamp (WFs57)
Forested Peatland (10)	Tamarack bog	Southern Rich Conifer Swamp (FPs63)
Lowland Shrub/Scrub	**5-50% tree canopy**	
Lowland Shrub/Scrub (11)	Often willows and/or dogwoods	Northern Wet Meadow/Carr (WMn82), Southern Seepage Meadow/Carr (WMs83)
Lowland Herbaceous	**<5% tree canopy**	
Wet Meadow (12)	Grasses and sedges dominate	Northern Wet Meadow/Carr (WMn82), Southern Seepage Meadow/Carr (WMs83)
Marsh (13)	Often invasive cattails; deep water	Northern Mixed Cattail Marsh (MRn83), Northern Bulrush-Spikerush Marsh (MRn93)

[1] Potential MNDNR Classification may represent the existing plant community or what it may be restored to, depending on site-specific conditions and conservation goals. See Appendix J for MNDNR species lists.
[2] The MNDNR has not published a species list for Southern Mesic Savanna (Ups24).

Higher classification levels are not numbered or mapped because they contain multiple plant communities at more detailed classification levels. These lower and numbered plant communities were mapped. Cultural land covers (e.g., buildings, impervious surfaces, maintained landscapes turf), most lowland plant communities, and aquatic ecosystems (i.e., Open Water) are not a focus of this Natural Areas Plan; this Plan is intended primarily to guide management of *upland* natural areas.

Figure 11 shows the natural areas addressed in this Plan, with acres of the different plant communities shown in Figure 12. Following the figures is a description of each type of plant community, including a summary description, plant species that are characteristic of the community, other characteristics including soils and slopes, and the community's typical historical conditions in the Twin Cities region. The discussion of past, present, and future conditions in Section 4 refers generally to changes affecting all plant communities, while the information below is specific to each plant community type within the MPRB park system.

Figure 11. MPRB Park System Natural Areas Addressed in this Phase II Plan

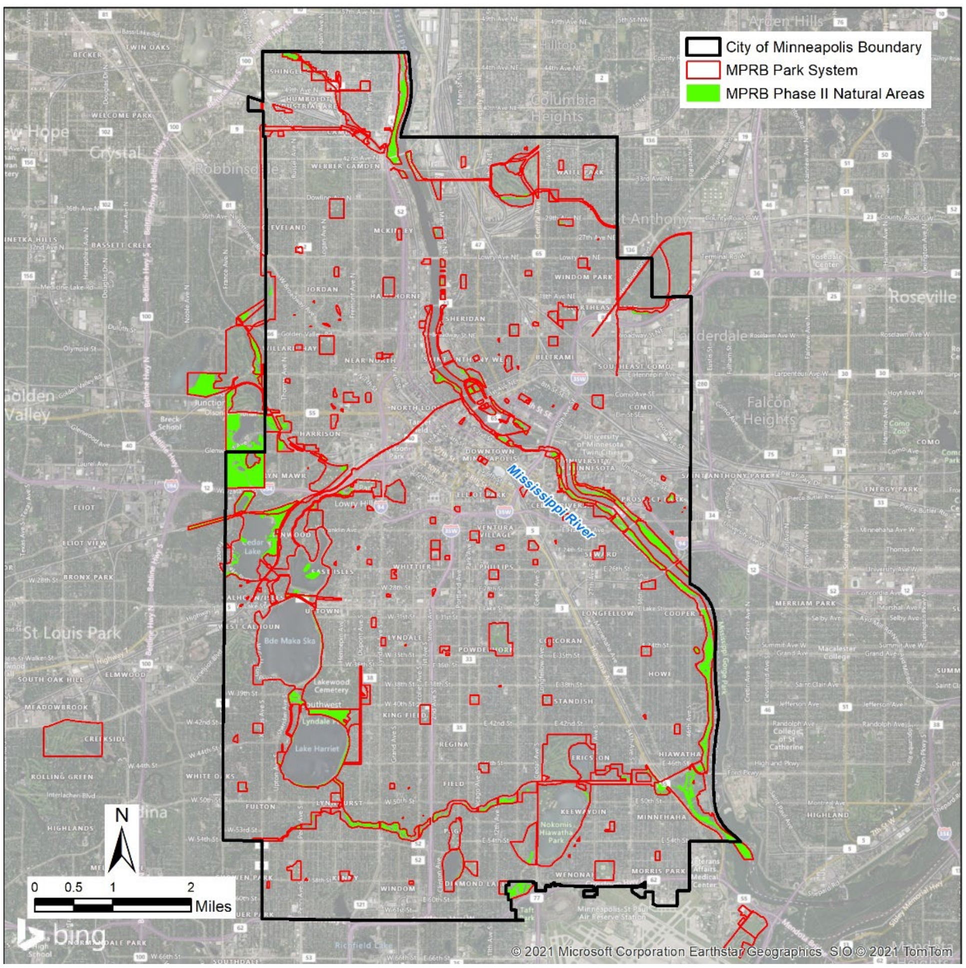
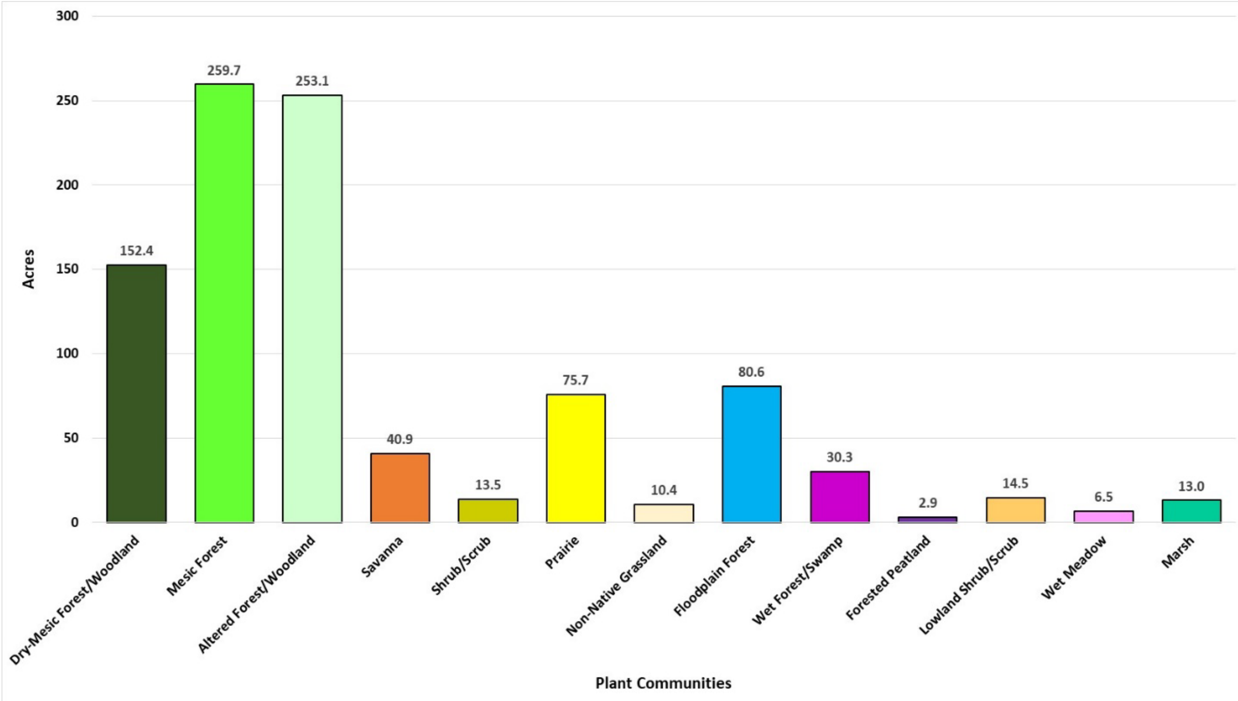


Figure 12. MPRB Park System Phase II Natural Area Plant Communities



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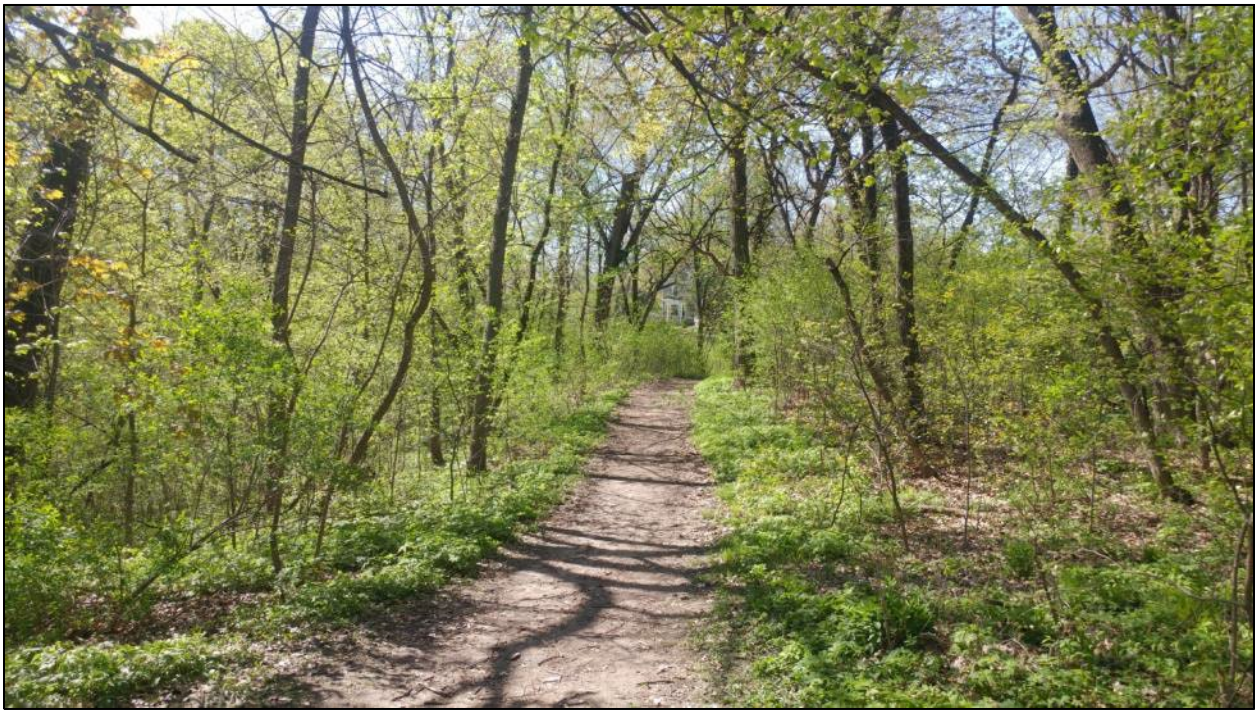
1. Dry-Mesic Forest/Woodland



Dry-Mesic Forest/Woodland, south of Lake Calhoun/Bde Maka Ska (William Berry Park).

Summary

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

Characteristic Plant Species

- 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*)

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-requiring species disappear, reducing the variety of plants and insects in the community.

2. Mesic Forest


Mesic Forest, on the east-facing bluffs of Mississippi Gorge Regional Park (along West River Parkway).

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

- Sugar maple (*Acer saccharum*)
- Black maple (*A. nigrum*)
- Red, White and Bur oaks (*Quercus rubra, Q. alba, Q. macrocarpa*)
- Basswood (*Tilia americana*)
- Hackberry (*Celtis occidentalis*)
- American and Slippery elm (*Ulmus americana, U. rubra*)
- Ironwood (*Ostrya virginiana*)

Other Plant Community Characteristics

- Tree canopy closure often is nearly 100 percent, which limits or excludes shrub and groundstory vegetation that requires direct sunlight.
- Invasive Common buckthorn (*Rhamnus cathartica*) is often present, but typically less abundant than in Dry-Mesic Forest/Woodland due to the greater shade beneath the tree canopy.
- Invasive garlic mustard (*Alliaria petiolata*) is a problem in many 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 canopy gap.
- Researchers have shown that non-native, invasive earthworms 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 MPRB’s Mesic Forest stands contain these invasive animals.

3. Altered Forest/Woodland

Altered Forest/Woodland, in the northeast portion of Cedar Lake Park.

Summary

A forested plant community on disturbed land (e.g., fill areas, former building/industrial sites, dump sites or unmanaged parkland), dominated by light-seeded trees and shrubs, most of which originated in lowland settings.

Characteristic Plant Species

- Box elder (*Acer negundo*)
- Green ash (*Fraxinus pennsylvanica*)
- American and Slippery elm (*Ulmus americana, U. rubra*)
- White pine (*Pinus strobus*) planted in parks (but also present in some original forests)
- 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, Motherwort (*Leonurus cardiaca*), 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 originally restricted to lowland settings these have light, highly mobile seeds that promote dispersal (see Characteristic Plant Species above); these trees range in age from young to mature.
- As light-seeded elms are often part of this canopy, Dutch elm disease continually removes trees from the canopy.
- On some sites, such as filled wetlands with a high water table, tree rooting is not deep and windthrow of canopy trees is common.

4. Savanna

Savanna, restoration site along West River Parkway near East 36th St.

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.

Characteristic Plant Species

- Bur oak (*Quercus macrocarpa*)
- Northern pin oak (*Q. ellipsoidalis*)
- Eastern red cedar (*Juniperus virginiana*)
- American plum (*Prunus americana*)
- Chokecherry (*P. virginiana*)

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.
- The term “Savanna” does not necessarily mean a high quality native community, such as an intact oak savanna with native groundcover; rather, Savanna in the MPRB classification means a community has the physical structure of a savanna, with 10-50 percent canopy cover, mostly of trees, and a shrubby or herbaceous ground layer. Ecological quality ranks discussed later in this

Plan can be used to easily differentiate savannas having oaks and native ground layer plants from those savannas comprised of species not characteristic of historical, species-rich savannas.

- Many of the grand, arching oaks seen throughout Minneapolis 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 soils 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, grasses, and sedges) 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 resprouted from rootstocks. Fire-tolerant trees such as the thick-barked bur oak and also trees that grew rapidly from root masses (called "grubs"), like 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.

5. Shrub/Scrub

Shrub/Scrub, in the northeast portion of Cedar Lake Park.

Summary

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

Characteristic Plant Species

- Smooth and Staghorn sumac (*Rhus glabra, R. typhina*)
- Asian honeysuckles (primarily *Lonicera tatarica, L. x bella*) – invasive non-native
- Eastern red cedar (*Juniperus virginiana*)
- Siberian elm (*Ulmus pumila*) –invasive non-native
- Smooth brome (*Bromus inermis*) – invasive non-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 in the MPRB system, but 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

- If previously farmed or heavily grazed, ground layer often consists of non-native plants, similar to those of Non-Native Grasslands.
- In Minneapolis most are former turf or other grassland areas that became overgrown with shrubs and scattered trees (including areas where MPRB has practiced reduced mowing).

6. Prairie

JD Rivers Prairie, north of Glenwood Avenue.

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

- Big bluestem (*Andropogon gerardii*)
- Indian grass (*Sorghastrum nutans*)
- Switch grass (*Panicum virgatum*)
- Little bluestem (*Schizachyrium scoparium*)
- Black-eyed Susan (*Rudbeckia hirta*)
- 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 Spotted knapweed (*Centaurea maculata*) in dry prairies, and Reed canary grass (*Phalaris arundinacea*) in wet prairies.
- 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, 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.
- Other major but lost or impractical disturbances were periodic intensive grazing with long rest periods between grazing episodes, and burrowing animals—pocket gopher, ground squirrels, badger, harvester ants. Grazer, browsers, and burrowers added specific types of disturbance to the regular fires that affected prairie biodiversity and ecological processes.

7. Non-Native Grassland

Non-Native Grassland northeast of Wirth Lake (with early invasion by woody species).

Summary

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

Characteristic Plant Species

- 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*)
- Common ragweed (*Ambrosia artimisiifolia*)
- Reed canary grass (*Phalaris arundinacea*) – invasive non-native
- Giant ragweed (*Ambrosia trifida*)
- Stinging nettle (*Urtica dioica*)

Other Plant Community Characteristics

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

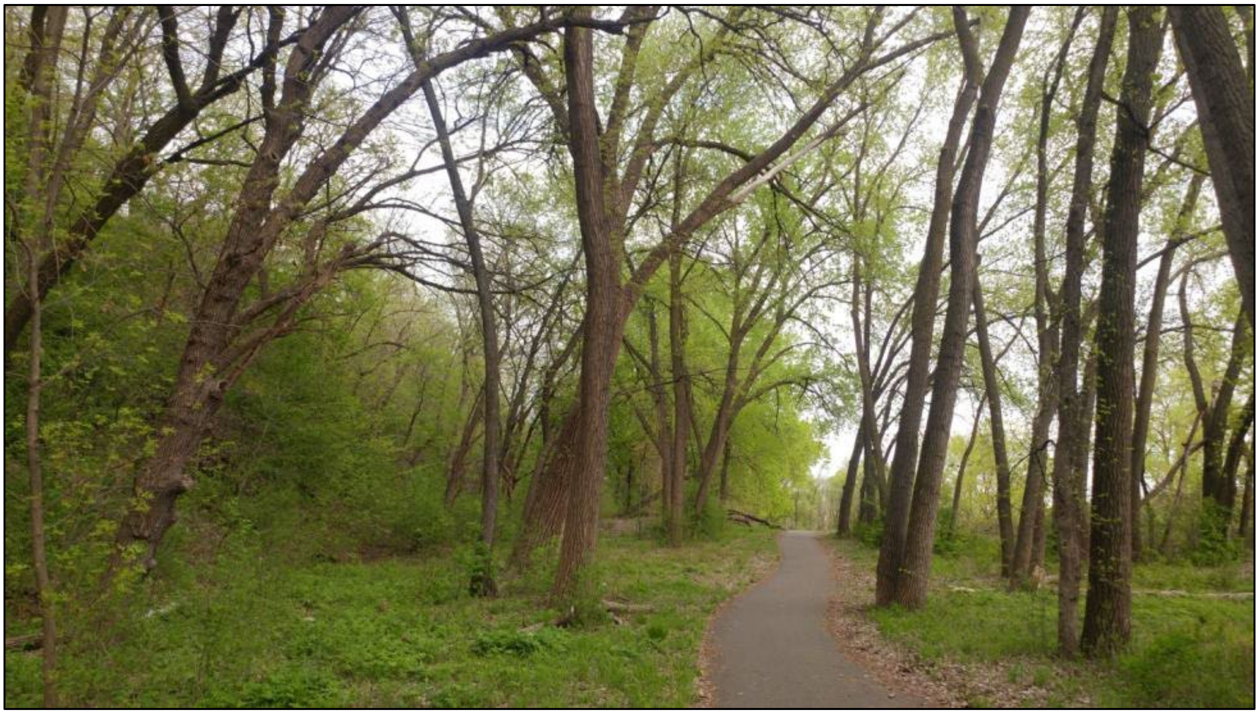
Soil and Slopes

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

Historical Conditions

- Often previously farmed or grazed long ago. In Minneapolis parks these areas frequently occur where reduced or no mowing has been practiced.

8. Floodplain Forest



Floodplain Forest, near East River Parkway, south of Franklin Avenue Bridge.

Summary

A forest in a low-lying area that intermittently experiences flooding. Typically on mineral soils adjacent to a river or other water body.

Characteristic Plant Species

- Silver maple (*Acer saccharinum*)
- Eastern cottonwood (*Populus deltoides*)
- American and Slippery elm (*Ulmus americana, U. rubra*)
- Green ash (*Fraxinus pennsylvanica*)
- Common hackberry (*Celtis occidentalis*)
- Stinging nettle (*Urtica dioica*)
- Wood nettle (*Laportea canadensis*)
- Spotted touch-me-not (*Impatiens capensis*)

Other Plant Community Characteristics

- Low-lying woodlands that experience flooding or shallow water tables for a period of time; these floods often occur annually or at least once every few years.
- In contrast to Wet Forest/Swamp, Floodplain Forests usually have mineral soil (as opposed to organic, mucky soils typical of swamps).
- Falls within the “Floodplain Forest System” of the Minnesota Native Plant Community Classification (MNDNR 2005).

Soil and Slopes

- Occurs in low-lying areas, often consisting of sands or silts (i.e., mineral soils).

Historical Conditions

- Some Floodplain Forests still experience unaltered floodplain dynamics and resemble historical forests, but others have changed due to hydrological alterations (e.g., dam, levees).

9. Wet Forest/Swamp

Wet Forest/Swamp, in Minnehaha Park below Minnehaha Falls.

Summary

A forest in a low-lying area that is frequently flooded or on slopes that experience a consistently shallow water table. Often associated with seepages, springs, and usually organic soils.

Characteristic Plant Species

- Black ash (*Fraxinus nigra*)
- Black willow (*Salix nigra*) and its hybrid with crack willow (*S. fragilis*)
- Eastern cottonwood (*Populus deltoides*)
- Silver maple (*Acer saccharinum*)
- Common elderberry (*Sambucus nigra*)
- Spotted touch-me-not (*Impatiens capensis*) or yellow touch-me-not (*I. pallida*), often near groundwater seeps and springs
- Clearweed (*Pilea pumila*)

Other Plant Community Characteristics

- Typically grow in saturated or inundated, high-organic soils. Sometimes the soils are saturated with groundwater emerging from the bases of glacial hills or bedrock bluffs, especially limestone and dolomite.
- Not typically found in floodplains, but rather in isolated basins, on seepage slopes, and in low points of the landscape. By contrast, Floodplain Forests usually have ordinary mineral soils

made up of silt and sand. Many of the same species of Floodplain Forests occur in Wet Forest/Swamp.

- Wet Forest/Swamp of the seepage type are often dominated by Black ash and may support Skunk cabbage (*Symplocarpus foetidus*) and Marsh marigold (*Caltha palustris*).
- Falls within the “Wet Forest System” of the Minnesota Native Plant Community Classification (MNDNR 2005).

Soil and Slopes

- Occurs in low-lying areas containing saturated or inundated soils, often very high in organic content.

Historical Conditions

- Some Wet Forest/Swamp areas represent historical conditions, while others have experienced partial drainage due to ditching and other hydrological modifications. Black ash seepage swamps are experiencing tree loss due to Emerald ash borer, which is expected to have significant impacts on these native plant communities.

10. Forested Peatland

Forested Peatland, the "Quaking Bog" in Theodore Wirth Park.

Summary

A forest in a low-lying area on organic soils that are consistently saturated.

Characteristic Plant Species

- Tamarack (*Larix laricina*)
- Willow shrubs (*Salix* spp.)
- Sedges (*Carex* spp.)
- Sphagnum moss (*Sphagnum* spp.)

Other Plant Community Characteristics

- Characterized by mature trees growing in organic soils of peat or muck, which were formed by plants that died but did not fully decompose. Centuries of plant death and compression produced the layer of organic soil in which these communities formed. Peat, muck, and other familiar gardening soils are mined from these organic soil plant communities.
- Notable among all plant communities for supporting the largest number of orchid species.
- Like other saturated wetlands, can be invaded by species such as Glossy buckthorn (*Frangula alnus*), Reed canary grass (*Phalaris arundinacea*), and Giant reed (*Phragmites australis*).
- Falls within the "Forested Rich Peatland System" of the Minnesota Native Plant Community Classification (MNDNR 2005).

Soil and Slopes

- Occurs in low-lying areas, where often thick organic soils have developed.

Historical Conditions

- Uncommon today in the Twin Cities region due to development, hydrologic changes, and central Minnesota's climate, which is not favorable to the development of organic soils; however, Forested Peatland remains abundant in northern Minnesota.

11. Lowland Shrub/Scrub

Lowland Shrub/Scrub, south of Wirth Lake.

Summary

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

Characteristic Plant Species

- Willow shrubs (*Salix* spp.)
- Red-osier dogwood (*Cornus stolonifera*)
- Sedges (*Carex* spp.)
- Marsh marigold (*Caltha palustris*)
- Reed canary grass (*Phalaris arundinacea*) – invasive non-native

Other Plant Community Characteristics

- Shrub-dominated wetland community.
- Often contains highly invasive Reed canary grass (*Phalaris arundinacea*), 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.

12. Wet Meadow


Wet Meadow along Minnehaha Creek near Longfellow Gardens.

Summary

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

Characteristic Plant Species

- Sedges (*Carex* spp.)
- Canada bluejoint grass (*Calamagrostis canadensis*)
- Manna grasses (*Glyceria* spp.)
- Reed canary grass (*Phalaris arundinacea*) – invasive non-native
- Swamp milkweed (*Asclepias incarnata*)
- Spotted Joe-pye weed (*Eutrochium maculatum*)
- Blue flag iris (*Iris versicolor*)
- Beggar ticks (*Bidens* spp.)
- Sensitive fern (*Onoclea sensibilis*)
- Marsh fern (*Thelypteris palustris*)

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 Meadow falls 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.

13. Marsh


Marsh containing native sedges and other wetland plants in an isolated depression in the forest at Theodore Wirth Park.

Summary

A plant community in standing water dominated by herbaceous vegetation.

Characteristic Plant Species

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

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 the 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 non-native Narrow-leaved and Blue cattails grow well with this overly-dynamic flooding regime; these species also use the higher phosphorus concentrations in most marshes receiving stormwater runoff to develop dense, tall stands.

4.2.2 Wildlife and Habitat

The desire to improve wildlife habitat through better management of park natural areas is a goal of MPRB staff and the community. Wildlife surveys were not conducted for this Natural Areas Plan, but incidental wildlife observations during field inventory and a variety of data sources were used to better understand wildlife in the MPRB park system.

Typical Species by Habitat

A representative list of wildlife species known or likely to be present in MPRB natural areas includes species and species groups that use multiple habitats (Table 2). More detailed bird reports are at eBird (https://ebird.org/region/US-MN-053/hotspots?yr=all&m=).

Table 2. Typical Wildlife Species in MPRB's Natural Areas

NATURAL LAND COVERS	MAMMALS	BIRDS	REPTILES & AMPHIBIANS	OTHER
Upland Communities – Forests/Woodlands/Savanna				
Forest/Woodland	White-tailed deer Raccoon Opossum Red fox Woodchuck Gray squirrel Eastern chipmunk	Warblers Vireos Black-capped chickadee Woodpeckers Owls Wild turkey Blue jay Northern cardinal	Garter snake Tree frog	
Savanna/Brushland	Coyote White-footed mouse Short-tailed shrew	Thrushes Thrashers 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 Buntings Hawks	Toads Garter snake	Monarch butterfly
Non-Native Grassland	Gray squirrel	Canada goose		Grasshoppers
Lowland Communities				
Lowland Deciduous Forest	Raccoon Weasel	Bald eagle Osprey	Tree frogs Turtles	
Lowland Herbaceous	Muskrats	Killdeer Red-winged blackbird Yellow warbler Common yellowthroat	Leopard frog Western chorus frog	Dragonflies Damselflies
Open Water	Beaver	Belted kingfisher Great blue heron Swallows Pied-billed grebe Mallard duck Wood duck Blue-winged teal Hooded merganser Spotted sandpiper Canada goose	Snapping turtle Softshell turtle Painted turtle Green frog	Bluegill Largemouth bass

There appears to be a moderate variety and abundance of wildlife using the MPRB park system. However, many of these species are considered "generalists." While not problems in themselves, an abundance of animals that are generalists indicates that natural areas are lower in quality, smaller, and more isolated than natural areas where generalists are not as common. 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.

By contrast, "specialists" are wildlife species that have specific environmental needs, such as a particular habitat feature, food items, or breeding conditions for raising offspring. (We include species that need large areas in this category.) Specialists are less common than generalists, more often found in larger and higher quality habitats, and are more sensitive to environmental change. Often, specialist wildlife species are classified as Species of Greatest Conservation Need, discussed 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.

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. (Core habitats on MPBR lands may extend to adjacent lands—in which case, MPRB lands and adjacent lands together function as habitat cores.) 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 MPRB park system supports habitat used by many SGCN. Through implementation of this Natural Areas Plan, 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.

Existing Wildlife Initiatives

Through the years, MPRB has engaged with several organizations to recognize the important role the MPRB park system plays in Minneapolis' urban wildlife communities and to protect these habitats.

National Audubon Society's Important Bird Area Designation. The Mississippi Flyway, encompassing several MPRB parks (North Mississippi, Central Riverfront, Mississippi Gorge, Minnehaha) is an Important Bird Area (IBA) as designated by the National Audubon Society. The Important Bird Area program, conceived by Birdlife International in 1981, is international in scope. In 1995, the National Audubon Society became the officially designated US partner of Birdlife International for the purpose of implementing the IBA program. Audubon Minnesota implements the IBA program in Minnesota. Realizing the important role Minneapolis' parkland corridor provides for bird life, representatives from

Minneapolis' Audubon Society and Audubon Chapter of Minneapolis (ACM), with approval and support of the MPRB, applied for and obtained National Audubon Society's Important Bird Area (IBA) designation for Minneapolis' Chain of Lakes Regional Park in 2009.

As a global initiative, the IBA program seeks to:

> "identify and conserve areas that are vital to birds and other biodiversity. … by working with Audubon chapters, landowners, public agencies, community groups, and other non-profits, Audubon endeavors to interest and activate a broad network of supporters to ensure that all Important Bird Areas are properly managed and conserved."

U.S. Fish and Wildlife Service's Urban Migratory Bird Treaty Program. Much of the MPRB park system lies along the Mississippi Flyway—an internationally-recognized migration corridor used by hundreds of species of birds each year. Migrating waterfowl, waders, warblers, and other birds travel north along the Mississippi River each spring from their wintering grounds along the Gulf of Mexico and in Central and South America to their breeding grounds in Canada and the northern United States. In July 2011, the U.S. Fish and Wildlife Service (USFWS) declared that the City of Minneapolis, the MPRB, the City of Saint Paul, and Audubon Minnesota were successful in their application to be part of the Urban Migratory Bird Treaty (UMBT) program. A major goal of the program is to raise awareness and improve the conditions for birds as they are migrating through urban areas. The focus area for Minneapolis and Saint Paul's UMBT is the Mississippi River corridor, and goals include:

- Enhancing bird habitat by removing invasive species and planting native species; and
- Providing educational information on bird conservation in urban areas.

USFWS Rusty Patched Bumble Bee Initiative

Rusty patched bumble bee (*Bombus affinis*), a federally-endangered species, has been documented in the MPRB park system. Appendix G provides a map showing "High Potential Zones" for this species (discussed further under Section 4.2.3). In 2020 MPRB Environmental Management staff received funds from the USFWS for habitat enhancement plantings that benefit Rusty patched bumblebees. Volunteers and youth workers seeded and planted park areas with native prairie and woodland plants along the Mississippi River and Chain of Lakes Regional Parks. These planting efforts followed USFWS guidance specifically focused on helping this species (Appendix H). More information and guidance for land managers about this species can be found at: https://www.fws.gov/midwest/Endangered/insects/rpbb/.

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 to surface water via their droppings deposited on park lands and public beaches. The MPRB prepared a goose management plan in 2017. 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 currently rare in the MPRB park system.

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. Population controls for wild game animals (Canada geese, beaver) must be conducted in compliance with wildlife management regulations under the U.S. Fish & Wildlife Service and/or the MNDNR.

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, bugbane, columbine, coreopsis, evening primrose, native thistles, penstemons, purple coneflower, wild ginger, and foxgloves are generally avoided by deer. Native plants are generally less desirable and less of an attractant than ornamental plants. For details, see Meyer et al. (2007).

4.2.3 Rare Natural Features

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. The search area defined for this MPRB Phase II rare natural features assessment is a single polygon (area) that encompasses the park system's natural plant communities. A query of IPaC (USFWS 2020) indicated that five federally-listed species may potentially be affected by activities within the MPRB park system (Table 3).

Table 3. Federally-Listed Species Potentially Affected by Activities in MPRB Park System

Common & Scientific Name	Federal Status & Recovery Plan Status	Habitat	Presence in MPRB Park System	Potential for Positive Effect by MPRB's Actions
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 MPRB's larger forests; a survey has not been done; hibernacula not known to occur in City.	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.
Snuffbox mussel (*Epioblasma triquetra*)	Endangered (Plan not started)	Typically found in small- to medium-sized creeks.	May exist in Minnehaha, Shingle, or Bassett Creeks, but unlikely.	Very unlikely, given large watershed that affects species.
Winged mapleleaf mussel (*Quadrula fragosa*)	Endangered (Plan not started)	Medium and large rivers in sand and gravel and strong current. Historically occupied Mississippi, Minnesota, and lower St. Croix rivers. Now extant only in a small reach of the lower St. Croix River where it is rare (per MNDNR website).	Very unlikely given MNDNR website description.	Very unlikely, given large watershed that affects species.

Of the five federally-listed species, only the Rusty patched bumble bee has been confirmed to be present in the MPRB park system, and Northern long-eared bat may also use these parks. Management recommendations for these two federally-listed species are provided in Appendix H. As the planning team did not conduct special surveys, other rare plants or wildlife could not be confirmed as present or absent in MPRB-owned natural areas. The three endangered mussel species may be present in creeks and rivers that flow through or along the MPRB park system; however, MPRB has little influence over these species due to the large watersheds that affect these aquatic habitats. A brief discussion of the Rusty patched bumble bee and Northern long-eared bat follows.

Rusty patched bumble bee. Rusty patched bumble bees' 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 in the MPRB park system and likely uses restored prairies and other grasslands within the park system. Appendix G provides a map showing "High Potential Zones" for this species. 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

Protection strategies for Rusty patched bumble bee are provided in Appendix H.

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. 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 MPRB park system.

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 at MPRB parks, 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 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 has spread rapidly across the U.S. since its discovery in New York state in 2006. It is a major concern for bat conservation because it kills all or nearly all bats using overwintering caves, mines, and other "hibernacula." White-nose syndrome was confirmed in Hennepin County the winter of 2016-17 (White-nose Syndrome spread map 2020).
- 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)

Protection strategies for Northern long-eared bat are provided in Appendix H.

Other Rare Species and Habitats

In addition to federally-tracked listed species, the USFWS tracks critical habitats and migratory bird species of particular concern. The IPaC report identified 21 migratory bird species of particular concern that potentially occur in the area of the MPRB park system (i.e., within the area that encompasses the park system's natural plant communities, Table 4). No USFWS critical habitats, or fish hatcheries were identified in the MPRB park system; however, the Minnesota Valley National Wildlife Refuge is located about 1.5 miles south of the MPRB park system.

Table 4. Migratory Bird Species of Concern in MPRB Park System (USFWS 2020)

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
Eastern whip-poor-will	*Antrostomus vociferus*	BCC Rangewide (CON)	May 1 to Aug 20
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

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, as amended. Bald eagles have been known to nest within the MPRB park system. Recommended conservation and management measures for Bald eagle are provided in Appendix H.

The Dwarf trout lily (*Erythronium propullans*) is a federally-endangered plant species, native to Dodge, Goodhue, Rice, and Steele Counties. While this species grows in MPRB's Eloise Butler Wildflower Garden, it was planted there and is not reported in the USFWS's IPaC report (USFWS 2019a).

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 special concern. A review of NHIS data identified 69 rare natural feature records in the MPRB park system; these include six native plant communities, three animal assemblages, 29 rare vertebrates, 16 rare invertebrates, and 13 rare plants, one rare fungus, and one rare ecological feature (Table 5). Many of the rare plant and animal records are quite old, suggesting they may no longer exist in the MPRB park system. In addition, some listed species have been planted in MPRB gardens and boulevards.

Table 5. State-Tracked Natural Features in the MPRB Park System Area (MNDNR 2020)[1]

Rare Natural Feature Type	Common Name	Scientific Name	State Listing Status[2]	State Conservation Status Rank[3]	Global Conservation Status Rank[4]	Last Observed (year)	No. of Occurrences in MPRB Park System Area[1]
Terrestrial Community - Other	Black Ash - (Red Maple) Seepage Swamp	N/A	N/A	S1S2	GNR	1994	2
	Mesic Oak Savanna (Southern)	N/A	N/A	S1	GNR	1994	1
	Mesic Prairie (Southern)	N/A	N/A	S2	GNR	1990	1
	Native Plant Community, Undetermined Class	N/A	N/A	SNR	GNR	1994	1
	Tamarack Swamp (Southern)	N/A	N/A	S2S3	GNR	1998	1
Animal Assemblage	Bat Colony	Bat Concentration	N/A	SNR	GNR	2000	2
	Colonial Waterbird Nesting Area	N/A	N/A	SNR	GNR	1998	1
Vertebrate Animal	Lake sturgeon	*Acipenser fulvescens*	SPC	S3	G3	1998	1
	American eel	*Anguilla rostrata*	SPC	S3	G4	2013	1
	Blue sucker	*Cycleptus elongatus*	SPC	S3	G3	2014	1
	Acadian flycatcher	*Empidonax virescens*	SPC	S3B	G5	1983	1
	Blanding's turtle	*Emydoidea blandingii*	THR	S2	G4	2009	1
	Least darter	*Etheostoma microperca*	SPC	S3	G5	2006	6

Rare Natural Feature Type	Common Name	Scientific Name	State Listing Status[2]	State Conservation Status Rank[3]	Global Conservation Status Rank[4]	Last Observed (year)	No. of Occurrences in MPRB Park System Area[1]
	Peregrine falcon	*Falco peregrinus*	SPC	S3B	G4	2011	2
	Milksnake	*Lampropeltis triangulum*	Watchlist	S4	G5	2015	2
	Bullfrog	*Lithobates catesbeianus*	Watchlist	S4	G5	2006	1
	Prairie vole	*Microtus ochrogaster*	SPC	S3	G5	1917	1
	Mudpuppy	*Necturus maculosus*	SPC	S3	G5	2016	2
	Pugnose shiner	*Notropis anogenus*	THR	S2	G3	1948	2
	Western foxsnake	*Pantherophis ramspotti*	Watchlist	S4	G5	1993	2
	Louisiana waterthrush	*Parkesia motacilla*	SPC	S3B	G5	1999	1
	Tricolored bat	*Perimyotis subflavus*	SPC	S3	G2	2000	2
	Hooded warbler	*Setophaga citrina*	SPC	S3B	G5	1979	1
	Forster's tern	*Sterna forsteri*	SPC	S3B	G5	1995	1
	Bell's vireo	*Vireo bellii*	SPC	S3B	G5	2007	1
Invertebrate Animal	Mucket	*Actinonaias ligamentina*	THR	S2	G5	1977	1
	Rusty-patched bumble bee	*Bombus affinis*	Watchlist	SNR	G2	2018	5
	Spike	*Elliptio dilatata*	THR	S2	G5	PRE-2000	1
	A jumping spider	*Habronattus viridipes*	SPC	S3	GNR	1987	1
	Higgins eye mussel	*Lampsilis higginsii*	END	S1	G1	2002	1
	Black sandshell mussel	*Ligumia recta*	SPC	S3	G4	2007	3
	Wartyback mussel	*Quadrula nodulata*	THR	S2	G4	2007	2
	Leadplant flower moth	*Schinia lucens*	SPC	S3	G4	1940	1
	Fawnsfoot	*Truncilla donaciformis*	THR	S2	G5	2007	1
Vascular Plant	Handsome sedge	*Carex formosa*	END	S1	G4	1924	1
	Plantain-leaved Sedge	*Carex plantaginea*	END	S1	G5	1903	1
	Late hawthorn	*Crataegus calpodendron*	SPC	S3	G5	1912	2

Rare Natural Feature Type	Common Name	Scientific Name	State Listing Status[2]	State Conservation Status Rank[3]	Global Conservation Status Rank[4]	Last Observed (year)	No. of Occurrences in MPRB Park System Area[1]
	Water-willow	*Decodon verticillatus var. laevigatus*	SPC	S3	TNR	1946	1
	Dwarf trout lily*	*Erythronium propullans*	END	S1	G1	2005	1
	Biennial Gaura	*Gaura biennis*	Watchlist	SNR	G5	1971	1
	Kentucky coffee tree**	*Gymnocladus dioica*	SPC	S3	G5	1909	1
	Rock fir moss	*Huperzia porophila*	THR	S2	G4	1902	1
	Butternut	*Juglans cinerea*	END	S1	G4	1962***	1
	Swamp white oak	*Quercus bicolor*	SPC	S3	G5	1953	2
	Edible valerian	*Valeriana edulis var. ciliata*	THR	S2	T3	1891	1
Fungus	A species of fungus	*Psathyrella rhodospora*	END	S1	G1	2001	1
Other (Ecological)	Stream erosion (Holocene)	N/A		SNR	GNR	1972	1
Total							**69**

[1] MPRB Park System Area defined as polygon encompassing all land owned or managed by MPRB
[2] State Status: THR=Threatened; SPC=Special Concern; END=Endangered; Watchlist=on state watch list
[3] 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
[4] Global Conservation Status Rank (NatureServe 2019): 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
N/A= Not applicable
* Dwarf trout lily was planted by Eloise Butler; therefore it does not represent a natural population
** Kentucky coffee tree planted by MPRB as boulevard tree
*** Butternut reported in recent Theodore Wirth Regional Park Master Plan (2015)

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 2.3.1. Core habitat on MPBR lands may extent onto adjacent lands; in which case, core habitat is held jointly by MPBR and the adjacent landowners.

4.2.4 Summary of MPRB's Existing Natural Resources

Natural Areas

- MPRB is fortunate to have a diversity of natural areas within its parklands.
- MPRB's regional park corridors (including much of the Grand Rounds) provide a degree of ecological connectivity between natural areas; however, these corridors are relatively narrow and fragmented by roads and urban development.
- Historical land uses (e.g., grading/filling/dumping and invasive species have compromised all of MPRB's natural areas, necessitating strategic intervention and long-term management if these natural resources (and their ecosystem services) are to be sustained.
- MPRB's higher quality natural areas have been identified and designated as Managed Natural Areas by MPRB staff and are documented in their Asset Management software program VueWorks. These areas have been managed by MPRB staff, partner organizations, and volunteers for many years.

Plant Communities

- The native forests, savannas, and prairies that once dominated the region are now rare. Remnant natural plant communities are generally limited to few, narrow or small, scattered patches of vegetation. MPRB's largest natural areas include the forests and woodlands of Theodore Wirth Park (almost 300 acres) and narrow bluff and floodplain forests along the Mississippi Gorge (over 150 acres).
- Given the MPRB park system's historical vegetation and sustainability goals, natural areas should be maintained to sustain a diversity of native landscapes, including forests, savannas, prairies, and wetlands.
- Invasive plants are one of the greatest threats to MPRB'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.
- Wetlands exist in many MPRB parks, but generally do not occupy a significant portion of parkland and are not the focus of this Natural Areas Plan.
- While limited in a dense urban area, opportunities exist to increase the size and improve the quality of plant communities through restoration and management, such as removal of invasive plant species and establishment of diverse native vegetation. In addition, there are opportunities to develop ecological buffering and improve connectivity among natural areas.
- State-listed plant species have been recorded in the MPRB park system. The federally-endangered Dwarf Trout Lily exists at Eloise Butler Wildflower Garden as a planted population; however, it was not reported in the USFWS's IPaC report (USFWS 2020).

Wildlife and Rare Species

- 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 MPRB park system appear to be generalists, based on field assessment and consultation with MPRB staff.
- The MPRB park system supports or has the potential through restoration—sometimes in collaboration with adjacent landowners—to support core habitat for a range of forest, woodland, savanna, prairie, and wetland wildlife. In the largest natural areas there is a potential to attract and support Species of Greatest Conservation Need.
- Federally-listed and state-listed wildlife have been recorded on the MPRB park system. Bald Eagle (protected, but not listed) is also known to use the MPRB park system. Recommended conservation and management measures for select federally-protected wildlife species are provided in Appendix H.
- Species reintroductions, to restore plants and animals that are rare or have disappeared from Minneapolis, can target species that are rare and uncommon in the system.

4.3 Future Conditions

As City and park development occurred over many decades, the majority of the Twin Cities' historical land cover and plant communities have been altered or completely replaced through grading, construction, and management activities. These significant changes are important as we look to restoration efforts – what goals are realistic given current environmental conditions and resources? In many instances it may not be feasible or even desirable to restore the native plant communities that existed 170 years ago.

In addition to past and present conditions, MPRB's natural areas are influenced by a variety of ongoing stressors, many of which will change over time. These factors, such as invasive plants, diseases of native vegetation, and climate change, must be considered if healthy and sustainable plant communities are to be restored. Stressors of natural areas are discussed in Section 2.2.

The variety of plant communities in MPRB's park system represent a small portion of the region's biodiversity. Management practices should be implemented in a manner that ensures the preservation and celebration of that diversity.

The future of MPRB's natural areas will be largely decided by the management strategies that are adopted and implemented in the park system. Strategic and adequate management will be required to protect, restore, and maintain or enhance the ecological health and associated ecosystem services of MPRB's natural areas. Potential futures considering management or lack of management are discussed further in Sections 6.1 and 6.2.

5. PARK NATURAL AREAS ASSESSMENTS

The MPRB park system consists regional parks and neighborhood parks. Regional parks, like Minneapolis Chain of Lakes, Minnehaha and Theodore Wirth, serve many people from outside Minneapolis. An estimated five million annual visitors enjoy the Minneapolis Chain of Lakes Regional Park, the most heavily-used regional park in the seven-county metropolitan area. Regional park and maintenance programs are funded by City taxpayers and state and other public agencies serving broad constituencies. Per the 2040 Regional Parks Policy Plan (Metropolitan Council 2018),

> *Regional parks most notably contain a diversity of nature-based resources, either naturally occurring or human-built, and are typically 200-500 acres in size. Regional parks accommodate a variety of outdoor recreation activities.*

Due to this characterization, most of MPRB's natural areas occur within regional parks. Neighborhood parks are smaller, primarily funded by local tax dollars, and focus on serving the local residents. Some natural areas also occur in MPRB neighborhood parks.

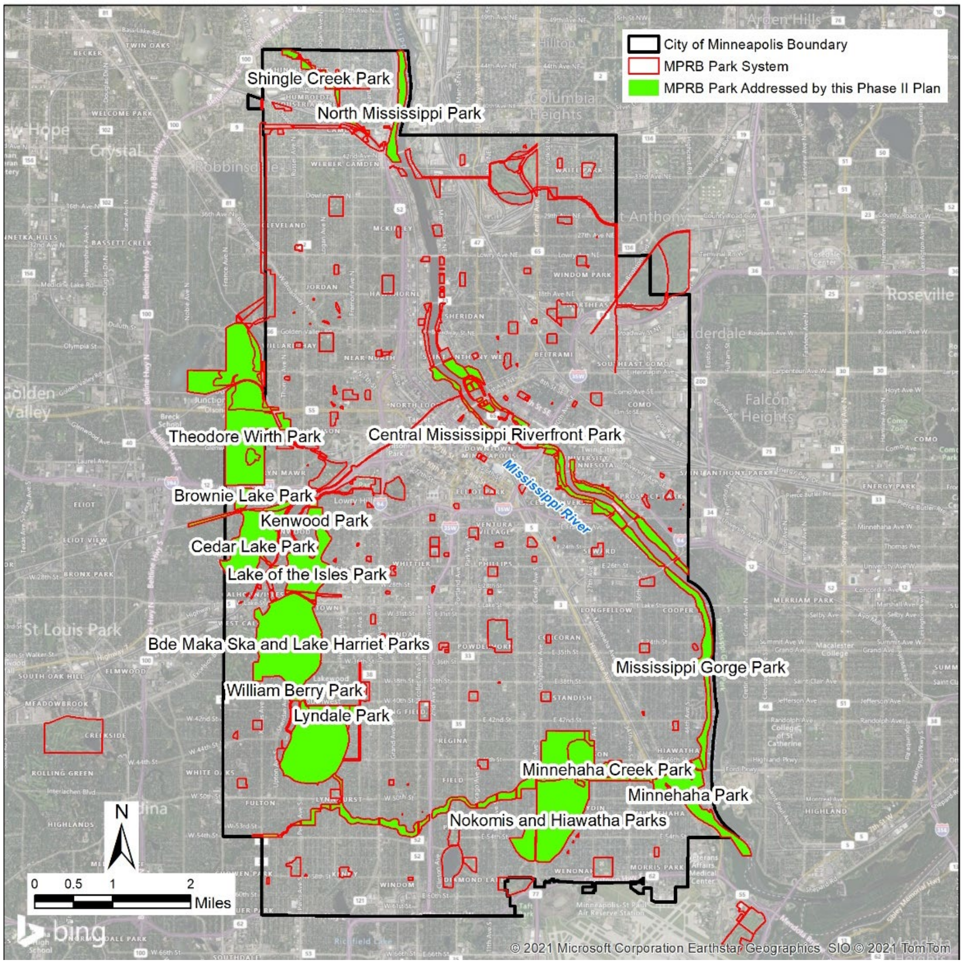
Most parks have at least one Managed Natural Area (Table 6 and Figure 13). Managed Natural Areas are managed by MPRB Environmental Management Natural Resources work group, partnerships, volunteers, and/or contractors. These areas have all been mapped, and management activities are tracked using VueWorks, MPRB's asset management software. Management briefs (Appendix A) were developed for these Managed Natural Areas. Management briefs were also developed for improving the ecological health of MPRB plant communities found in the MPRB system but not currently under management.

Table 6. MPRB Parks and Managed Natural Areas Addressed by this Plan

INDIVIDUAL REGIONAL PARKS
1. North Mississippi Park
North Mississippi Prairie
2. Central Mississippi Riverfront Park
3. Mississippi Gorge Park
36th Street Savanna
44th Street Forest
Edmund Boulevard Savanna
4. Minnehaha Park
Black Ash Seepage Swamp
Morley's Prairie
Longfellow Gardens Prairie
5. Minnehaha Creek Park
17^{th} Avenue Prairie
6. Nokomis and Hiawatha Parks
Nokomis Prairie
7. Theodore Wirth Park
Tamarack Bog
JD Rivers Prairie
8. Shingle Creek Park
Shingle Creek Prairie

CHAIN OF LAKES REGIONAL PARK
9. Brownie Lake Park
Brownie Lake Prairie
10. Cedar Lake Park
Cedar Lake Regional Trail Prairie
11. Lake of the Isles Park
Mike's Island
Raspberry Island
12. Bde Maka Ska and Lake Harriet Parks
13. William Berry Park
William Berry Forest
14. Lyndale Park
Roberts Bird Sanctuary
NEIGHBORHOOD PARKS
15. Kenwood Park
Kenwood Prairie

Figure 13. MPRB Parks Addressed in this Phase II Plan



Appendix I provides a table that summarizes plant communities within the MPRB park system covered by this Phase II Natural Areas Plan. Also presented in the appendix are the acres of each plant community type in each of the 15 parks and the range of quality ranks for each plant community type.

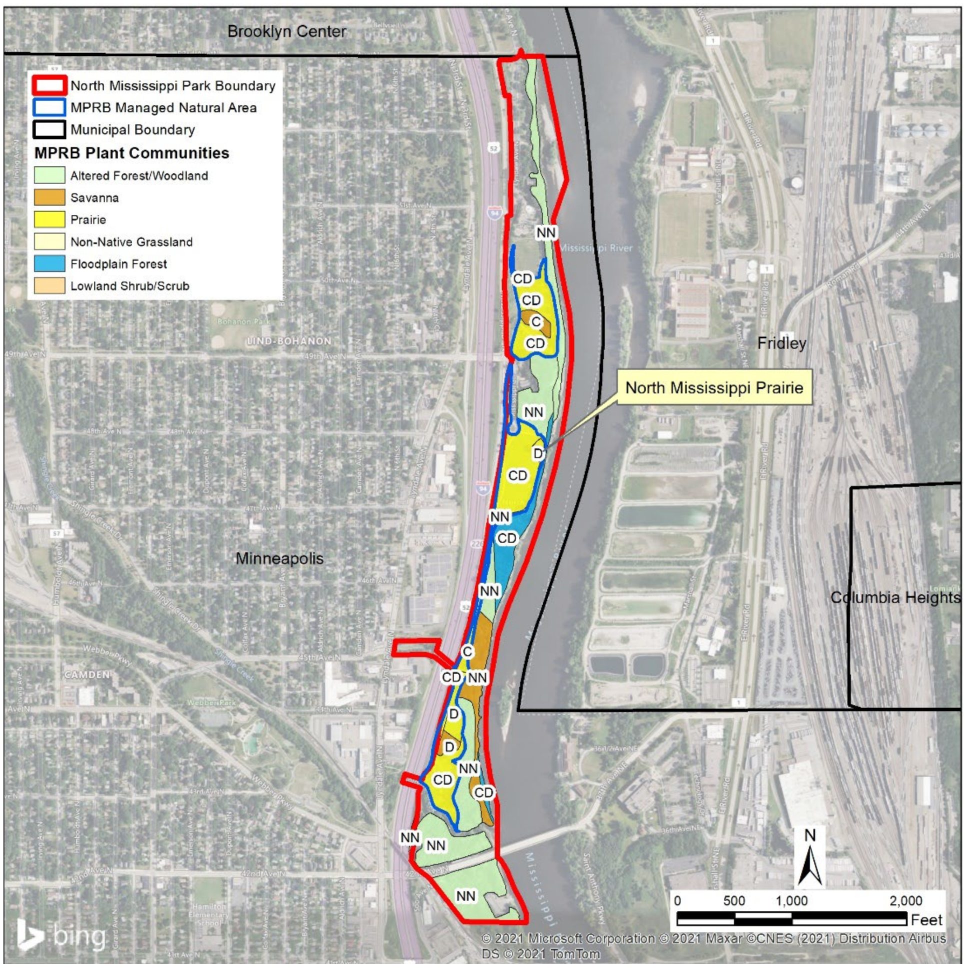
A discussion of each park follows, including a brief overview, a description of its plant communities and Managed Natural Areas, issues and opportunities, and natural resource goals.

5.1 North Mississippi Park

5.1.1 Overview of North Mississippi Park

North Mississippi Park consists of approximately 84.6 acres of land area on the east bank of the Mississippi River, from just south of 53rd Avenue North W Bridge to the 42nd Avenue Bridge (Figure 14). The Park's setting is characterized by the geology created when the glacial River Warren swelled with meltwater. This deposited deep sand terraces, as well as remnants of former channels and floodplains. Most of the park is relatively flat, with the eastern portion sloping down to the Mississippi River. Historical dredging and placement of fill to stabilize the riverbank have altered portions of the park. As suggested by its regional park designation, North Mississippi Regional Park attracts users from a large geographic area and is an urban nature destination offering opportunities for recreation, river access, picnicking, trail use, cultural events, and nature-based education, including the Carl W. Kroening Interpretive Center.

Figure 14. North Mississippi Park Location and Phase II Plant Communities



Parkland was initially acquired in 1908 and has expanded incrementally over time. In 1960, lands which were once housing developments, were added to the park and the park boundaries were adjusted to accommodate Interstate-94. Major improvements were made to the park in the late 1990s when the park was re-developed. At this time, the Kroening interpretive Center, picnic, playground and pool areas were added to the park. Prairie was planted around the interpretive center and to the south of the park, as part of this park redesign. Planted prairie areas have been continuously managed by MPRB staff and contractors since they were planted. Grant funding provided for forest restoration along the riverbanks, which included buckthorn and invasive species removal and re-planting with native shrubs. A tornado in 2011 caused losses and damage to large canopy trees along the river.

In 2014 The Mississippi Park Connection developed an experimental plot in North Mississippi Park, to study regenerating cottonwoods in the Mississippi River corridor. The study researched various reintroduction strategies: seeds vs. live stake cuttings vs. transplanted seedlings propagates in floodplain forest clearings. Mississippi Park Connection and their volunteers continue to monitor and weed the planting area.

5.1.2 Plant Communities of North Mississippi Park

Most of North Mississippi Park consists of natural to semi-natural vegetation. The Park's maintained turf areas, ornamental plantings, and developed parkland are primarily associated with the Carl W. Kroening Interpretive Center. Figure 14 (above) illustrates the Park's plant communities addressed in this Phase II plan and Table 7 presents the acres of each plant community type (including their quality ranks).

Table 7. North Mississippi Park Phase II Plant Communities

PLANT COMMUNITIES[1]	ACRES	PERCENT OF STUDY AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**45.4**	**90.9**	**C-NN**
Forest/Woodland	**22.6**	**45.2**	**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)	**22.6**	**45.2**	**NN**
Savanna/Brushland	**5.5**	**11.0**	**C-D**
Savanna (4)	5.5	11.0	C-D
Shrub/Scrub (5)	0.0	0.0	N/A
Grassland	**17.3**	**34.7**	**C-NN**
Prairie (6)	16.4	32.9	C-D
Non-Native Grassland (7)	0.9	1.7	NN
Lowland Communities	**4.6**	**9.1**	**CD**
Lowland Forest/Woodland	**4.1**	**8.2**	**CD**
Floodplain Forest (8)	4.1	8.2	CD
Wet Forest/Swamp (9)	0.0	0.0	N/A
Forested Peatland (10)	0.0	0.0	N/A
Lowland Shrub/Scrub	**0.4**	**0.9**	**CD**
Lowland Shrub/Scrub (11)	0.4	0.9	CD
Lowland Herbaceous	**0.0**	**0.0**	**N/A**
Wet Meadow (12)	0.0	0.0	N/A
Marsh (13)	0.0	0.0	N/A
TOTALS (Uplands + Lowlands)[3]	**49.9**	**100**	

[1] See Table 1 for descriptions
[2] See Section 3.3 for Ecological Quality Rank definitions; NN = Not a natural community; N/A = not applicable
[3] Rounding of values may make totals appear inaccurate

North Mississippi Park's highest quality natural areas were assigned an ecological quality rank of C (moderate) and consisted of a small Savanna area within a planted prairie, a sliver of Prairie, and a remotely assessed island of Floodplain Forest (Figure 14). The Park's planted prairies, which have been actively managed by MPRB staff, contractors, and volunteers, were assigned a quality rank of CD (moderate/poor) for most of their area; inclusions within these Prairies consist of patches of Lowland Shrub/Scrub (CD) and areas of D-quality Prairie. The majority of the Park's remaining natural areas are ranked as CD, D, or NN (altered/non-native) due to relatively poor native cover, invasive vegetation, and/or their species composition as a result of past human disturbances and other land use practices.

5.1.3 Managed Natural Areas of North Mississippi Park

The Park contains one Managed Natural Area (Figure 14), which is described briefly below and in greater detail in its own management brief (Appendix A).

- **North Mississippi Prairie** (19.0 acres) – This planted prairie consists of three areas within the Park. The Park's planted prairie has been routinely managed by MPRB staff and contractors since they were planted. Management has focused on controlling invasive plants through the use of prescribed burning, dormant mowing and herbicide applications. Most of this planted prairie was given an ecological quality rank of CD (moderate to poor) due to low native diversity and the presence of invasive and weedy species.

Ecological management is not routinely conducted in portions of the North Mississippi Park outside of the planted prairies. See individual plant community management briefs (Appendix A) for details on improving ecological quality for other plant community types found in the Park.

5.1.4 Issues & Opportunities at North Mississippi Park

Issues

- Invasive vegetation:
    - Invasive species that have been managed through the years in North Mississippi Prairie: Black locust, Box elder, Common buckthorn, sumacs, Riverbank grape, Common burdock, Garlic mustard, sweet clovers, Smooth brome, Reed canary grass, Birds-foot trefoil, Crown vetch, and invasive cattails.
    - Dominant or common invasive species in other portions of the park: Common buckthorn (in Altered Forest/Woodland) and Reed canary grass (in Floodplain Forest). Riverbank grape (a native species) was sub-dominant in portions of Savanna.
    - Additional invasive species: Siberian elm, White mulberry, invasive honeysuckles, Canada thistle, Leafy spurge, Purple loosestrife, Hoary alyssum, Butter and eggs, Motherwort, Creeping Charlie, Alfalfa, Yellow nutsedge, and Yellow foxtail.
- Erosion along Shingle Creek and other drainageways discharging into Mississippi River.

Opportunities

- Continue to manage and enhance to create a higher-quality, moderate-sized urban prairie.
- Expand restoration, management, and enhancement of other Park natural areas to improve quality and connectivity.
- Expand interpretive opportunities (e.g., signage).
- Engage volunteers in restoration and management of the Park's natural areas.

5.1.5 Goals of North Mississippi Park

1. Improve quality rank of North Mississippi Prairie from its current quality rank (mostly CD) to BC quality or better. This will be accomplished primarily through regular, rotational, prescribed burning and spot treatment of persistent invasive vegetation (e.g., pulling, mowing, spot herbicide). See management brief for details (Appendix A).

2. Maintain other natural areas, beginning with the next highest quality areas. This will generally entail the following considerations and tasks. Restoration and management tasks and methods are described in greater detail in Section 6.7.
    a. Restore natural disturbance regimes as appropriate (e.g., prescribed burning in prairies, savannas, and some forests and wetlands).
    b. Use biocontrols for invasive species management, when feasible. Leafy spurge and Purple loosestrife are present in North Mississippi Park, but may not be sufficient to support colonies of beetles.
    c. Remove of invasive Common buckthorn and other invasive brush.
    d. Remove invasive herbaceous vegetation.
    e. Continue to install Eastern cottonwood (*Populus deltoides*) saplings in tornado-damage area to restore lowland and floodplain forest.
    f. Install other diverse native plantings—trees, shrubs, grasses, sedges, forbs, etc.
3. Expand and connect natural areas with vegetation wherever possible to reduce the effects of habitat fragmentation (see Section 2.3.1). This could entail conversion of existing turf to native prairie/savanna, native plant gardens, or bee lawns.
4. Develop a more detailed park-specific Natural Resource Management Plan (NRMP) and implement recommendations.
5. Inventory and address existing erosion along Shingle Creek and other Park drainageways. Design stabilization strategies using appropriate native vegetation and wildlife-friendly bioengineering techniques (e.g., natural fiber erosion control blankets), using hard engineering solutions as a last resort.
6. Engage volunteers in restoration and management of the park's natural areas.

5.2 Central Mississippi Riverfront Park

5.2.1 Overview of Central Mississippi Riverfront Park

Central Mississippi Riverfront Park consists of approximately 158.7 acres of land encompassing eight distinct, named parks, many of which are connected by trails or other park features. The Park flanks both the east and west banks of the Mississippi River, from just south of the I-35W bridge to the north edge of Mississippi Gorge Park (Figure 15).

Figure 15. Central Mississippi Riverfront Park Location and Phase II Plant Communities

Central Mississippi Riverfront Park is a regional park destination, encompassing a mixture of open space, historic and cultural resources, and riparian ecosystems bordering the Mississippi River in the heart of Minneapolis. The Park provides a variety of opportunities for recreation, river access, picnicking, trail use, cultural events and the potential for urban environmental education offerings.

The Park is rich with natural and cultural history. Limestone bluffs and exposed faces of sandstone, indicative of the ancient seas that once occupied the region and millennia of deposition and erosion. Most notably these features are present in Father Hennepin Bluffs Park. Nicollet Island is the largest inhibited island in the Mississippi River's 2,350-mile course from northern Minnesota to the Gulf of

Mexico. As an island, Nicollet Island is an uncommon feature in the Mississippi River. Previously the area had six islands; In the 1890s, the federal government initiated the construction of a lock and dam system, which facilitated commerce up and down the river, and greatly altered the flow and ecology in this stretch of the Mississippi. Due to the lock and dam systems and urban development, Nicollet Island is the only island that remains (Hage and Hage 2010).

It is reported that members of Tacanku Waste's band camped near the falls to collect sap and process sugar from sugar maples on present day Nicollet Island (Terrell and Terrell 2016). Europeans first settled near the falls of St. Anthony and used the river for transportation, moving cut timber and to provide power to their lumber and grain mills. Father Hennepin Bluffs was part of the Pillsbury company's milling operations, which included canals, tunnels, and other infrastructure built into the bluffs and along the riverbanks below. These structures from the days of the milling industry still exist today

More about the Park (its natural and cultural history, existing visitor uses, and recommended improvements) can be found in the Central Mississippi Riverfront Regional Park Master Plan (MPRB 2016).

Dedicated volunteers have removed buckthorn and other invasive species from the bluffs in Father Hennepin Park. This area is also a site for the "Cover it Up"[2] buckthorn research project, which began in 2020.

The MPRB and Friends of the Mississippi River (FMR) entered into a cooperative Umbrella Agreement in January 2019 (Board Action 2019-107). Through this Agreement FMR has implemented a number of restoration projects on Nicollet Island, including riverbank erosion repair and prairie and forest restoration and a prairie demonstration garden near the trail on the east side of the island. FMRs work has been funded through grants and the support of the neighborhood, MPRB and volunteers

Prairies were planted in the 1990s at Mill Ruins and Boom Island Parks that were part of MPRB efforts to convert turf to native vegetation. These plantings over the years became overgrown with persistent invasive and weedy vegetation. At Mill Ruins Park, Mississippi Park Connection and their volunteers have worked to control extensive populations of crown vetch and replant native prairie species into the slope near the West River Parkway and Portland Avenue intersection. The Boom Island planted prairie is annually mowed, due to the extensive population of weeds that have invaded the site.

A Natural Resource Management Plan (NRMP), which would entail more detailed information on Central Mississippi Riverfront Park would be necessary for restorations in this park due to its extensive history of disturbance, slope stabilization needs and accommodation of increasing public use. A NRMP would study and make recommendations for slope stabilization and public access as well as refinement of natural resources data (inventory and assessment). Once this information is gathered more detailed,

[2] Cover it Up is a University of Minnesota, Department of Forest Resources citizen science project. The research project investigates, through a combination of field experiments, if re-establishing native plants can control buckthorn following removal efforts. The project engages volunteers throughout the state who are interested in conducting ecological research and in contributing to more sustainable buckthorn control.

park-specific recommendations and prioritization of specific restoration projects within the park natural areas can be made.

5.2.2 Plant Communities of Central Mississippi Riverfront Park

Most of Central Mississippi Park consists of maintained turf, ornamental plantings, and developed parkland. Patches of natural to semi-natural vegetation exist throughout the Park, mostly along bluffs and slopes leading down to the Mississippi River. Figure 15 (above) illustrates the Park's plant communities addressed in this Phase II plan, and Table 8 presents the acres of each plant community type (including their quality ranks).

Table 8. Central Mississippi Riverfront Park Phase II Plant Communities

PLANT COMMUNITIES[1]	ACRES	PERCENT OF STUDY AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**36.4**	**100.0**	**CD-NN**
Forest/Woodland	**30.0**	**82.3**	**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)	**30.0**	**82.3**	**NN**
Savanna/Brushland	**2.2**	**5.9**	**CD-D**
Savanna (4)	0.7	1.8	D
Shrub/Scrub (5)	1.5	4.1	CD
Grassland	**4.3**	**11.8**	**CD-NN**
Prairie (6)	4.1	11.3	CD-D
Non-Native Grassland (7)	0.2	0.5	NN
Lowland Communities	**0.0**	**0.0**	**D**
Lowland Forest/Woodland	**0.0**	**0.0**	**N/A**
Floodplain Forest (8)	0.0	0.0	N/A
Wet Forest/Swamp (9)	0.0	0.0	N/A
Forested Peatland (10)	0.0	0.0	N/A
Lowland Shrub/Scrub	**0.0**	**0.0**	**N/A**
Lowland Shrub/Scrub (11)	0.0	0.0	N/A
Lowland Herbaceous	**0.0**	**0.0**	**D**
Wet Meadow (12)	0.0	0.0	N/A
Marsh (13)	0.0	0.0	N/A
TOTALS (Uplands + Lowlands)[3]	**36.4**	**100**	

[1] See Table 1 for descriptions
[2] See Section 3.3 for Ecological Quality Rank definitions; NN = Not a natural community; N/A = not applicable
[3] Rounding of values may make totals appear inaccurate

Central Mississippi Riverfront Park's highest quality natural areas were assigned an ecological quality rank of CD (moderate/poor) and consisted of over 30 acres of natural plant communities, some of which are actively managed by volunteers. The majority of the Park's remaining natural areas are ranked as D or NN (altered/non-native), primarily due to relatively poor native cover, invasive vegetation, and/or their species composition as a result of past human disturbances and other land use practices.

5.2.3 Managed Natural Areas of Central Mississippi Riverfront Park

MPRB Natural Resources does not regularly manage natural areas in Central Mississippi Riverfront Park. As stated above, some management is conducted by FMR and volunteers. See individual plant community management briefs (Appendix A) for details on improving the ecological quality of plant community types found in this park.

5.2.4 Issues & Opportunities at Central Mississippi Riverfront Park

Issues

- Invasive vegetation:
    - Dominant or common invasive species: Siberian elm (in Shrub/Scrub), Common buckthorn and invasive honeysuckles (in Altered Forest/Woodland), and Crown vetch and Common burdock (in planted prairie)
    - Additional invasive species: White mulberry, Black locust, invasive honeysuckles, Canada thistle, Leafy spurge, Catnip, Common mullein, Purple loosestrife, Hoary alyssum, Common burdock, Butter and eggs, Lamb's quarters, Motherwort, Creeping Charlie, Birds-foot trefoil, Spotted knapweed, Alfalfa, Bladder campion, Yellow and White sweet clovers, Yellow nutsedge, Curly dock, Yellow foxtail, and Kentucky bluegrass
- Bluff and riverbank erosion, and erosion at stormwater outfalls and in bluff drainageways.

Opportunities

- Expand restoration, management, and enhancement of other Park natural areas adjacent to downtown Minneapolis.
- Expand interpretive opportunities (e.g., signage).
- Sustain volunteerism in restoration and management of the park's natural areas.

5.2.5 Goals of Central Mississippi Riverfront Park

1. Maintain natural areas, beginning with the next highest quality ranked areas. This will generally entail the following considerations and tasks. Restoration and management tasks and methods are described in greater detail in Section 6.7). See individual plant community management briefs (Appendix A) for details on improving ecological quality for Central Mississippi Riverfront Park's plant communities.
    a. Restore natural disturbance regimes as appropriate (e.g., prescribed burning in prairies, savannas, and some forests and wetlands).
    b. Use biocontrols for invasive species management. Leafy spurge and Spotted knapweed are present in Central Mississippi Riverfront Park, but may not be sufficient to support colonies of beetles.
    c. Removal of invasive Common buckthorn and other invasive brush.

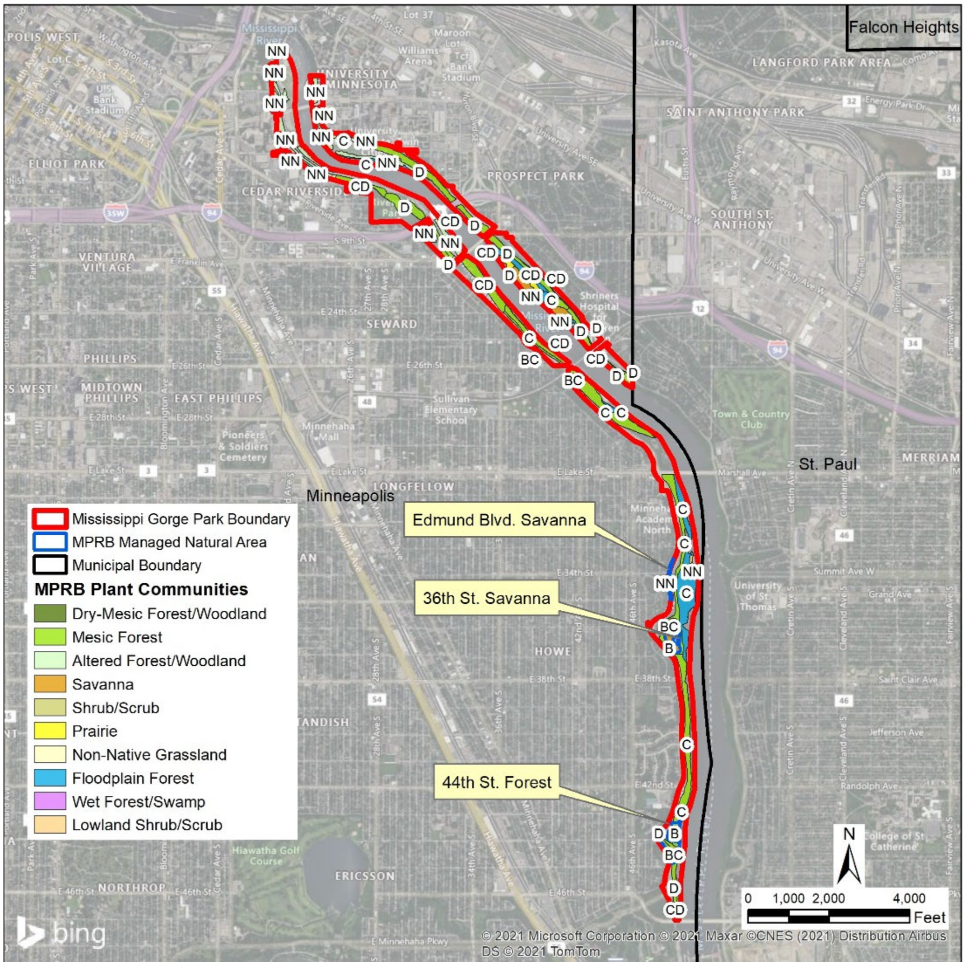
    d. Remove invasive herbaceous vegetation.
    e. Install Eastern cottonwood (*Populus deltoides*) saplings along riverbanks to stabilize slopes and provide continuous canopy along the river.
    f. Install other diverse native plantings—trees, shrubs, grasses, sedges, forbs, etc.
2. Conduct inventory and document with GPS erosion areas along Father Hennepin Bluffs and Park riverbanks. Design stabilization strategies using appropriate native vegetation and wildlife-friendly bioengineering techniques (e.g., natural fiber erosion control blankets), using hard engineering solutions as a last resort.
3. Conduct an inventory and document with GPS locations of seeps and springs along the Park. Assess the potential risk of slope failure, erosion, and/or infrastructure damage.
4. Install ecologically-appropriate herbaceous vegetation and shrubs following stormwater outfall and infrastructure rehabilitation projects. Appropriate native species can be selected from the MNDNR species list (Appendix J) that matches the plant community mapped in the outfall/infrastructure location. Trees should not be planted near infrastructure to prevent damage. If planned well, this native revegetation has the potential to buffer and connect adjacent natural areas.
5. Expand and connect natural areas with vegetation wherever possible to reduce the effects of habitat fragmentation (see Section 2.3.1). This could entail conversion of existing turf to native prairie/savanna, native plant gardens, or bee lawns.
6. Sustain the legacy of volunteerism in Central Mississippi Riverfront Park's natural areas.

5.3 Mississippi Gorge Park

5.3.1 Overview of Mississippi Gorge Park

Mississippi Gorge Park consists of approximately 381.2 acres of land flanking both the east and west banks of the Mississippi River, from just south of Bridge No. 9 to the north edge of Minnehaha Regional Park (Figure 16).

Figure 16. Mississippi Gorge Park Location and Phase II Plant Communities



About 12,000 years ago glaciers receded from the region, creating river channels and depositing a variety of landforms. Over millennia, the Mississippi River carved through limestone and sandstone bedrock to create the Gorge—a unique natural feature as the only gorge in the river's 2,350-mile course from northern Minnesota to the Gulf of Mexico.

Mississippi Gorge Park truly is a regional park destination, rich in natural resources—some of the highest quality in the MPRB system. The natural environment of maple forest, oak savanna, and lowland forest is enjoyed by people who love nature and green space. People appreciate the park as they drive the river parkways, use bluff-top trails, and sand bars at the river's edge with views across the Gorge. It is a destination for many seeking respite from urban crowding and noise and provides a different style of recreation. More about the Park (its natural and cultural history, existing visitor uses, and recommended improvements) can be found in the Mississippi Gorge Regional Park Master Plan (MPRB 2019a).

Extensive management has been done in the higher quality natural areas located on the West side of the River. MPRB staff, contractors and volunteers have managed the native prairie and savanna at W. 36th Street and West River since the early 1980s. The native woodland located at W. 42nd Street with its many native wildflowers continues to be managed by MPRB staff and volunteers.

In the early 2000s, MPRB Forestry and Environmental Management, along with non-profits and neighborhood volunteers, removed mature common buckthorn from many areas of the Gorge on both the east and west banks of the River. A large grant from the USDA along with neighborhood funding and MPRB labor and equipment, supported these extensive buckthorn removal efforts.

Since 2002, MPRB Environmental Management staff and Friends of the Mississippi River (FMR) through their Gorge Stewards volunteer program has been involved in continuing invasive species removals and enhancing the native plant communities. Volunteers and staff dedicate many hours annually removing buckthorn and re-planting with native shrubs, tree seedlings, wildflowers, and grasses. Invasive plant removals and native plantings have not been conducted on steep and unstable slopes due to safety concerns for volunteers and staff.

The MPRB and FMR entered into a cooperative Umbrella Agreement in January 2019 (Board Action 2019-107). Through this Umbrella Agreement FMR has removed woody invasive species from the sand flats (34th Street to 36th street, below the bluff) and planted native shrubs and wildflowers in the forested area of the Gorge from 38th Street to 44th Street. This work has been done through grant funding for contracted services, volunteers and MPRB staff and equipment support.

Woody invasive species removals on the Riverside Park bluff were conducted by the MPRB and Conservation Corps of Minnesota and Iowa in 2008 and 2012. FMR volunteers installed erosion bars and planted native shrubs into the area in 2012. At present there is no ongoing management of the bluff area.

The savanna planted at Edmund Boulevard and W. 35th Street was one of the MPRB's turf conversion areas that was planted in 1998 with native prairie/savanna species. Management of this area has primarily focused on removal of woody species, including the control of native tree seedlings. Prescribed burning, mowing and brush sawing is done by MPRB staff to control woody plants. Staff has allowed natural regeneration of oaks by selective removal of tree seedlings.

5.3.2 Plant Communities of Mississippi Gorge Park

Most of Mississippi Gorge Park consists of natural to semi-natural vegetation, dominated by Mesic Forest. Most of the Park's maintained turf areas, ornamental plantings, and developed parkland are associated with gathering areas along East and West River Parkways. Figure 16 (above) illustrates the Park's plant communities addressed in this Phase II plan, and Table 9 presents the acres of each plant community type (including their quality ranks).

Table 9. Mississippi Gorge Park Phase II Plant Communities

PLANT COMMUNITIES[1]	ACRES	PERCENT OF STUDY AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**142.4**	**81.8**	**B-NN**
Forest/Woodland	**125.6**	**72.1**	**B-NN**
Mature Forest/Woodland	**99.1**	**56.9**	**B-D**
Dry-Mesic Forest/Woodland (1)	1.5	0.9	CD-D
Mesic Forest (2)	97.6	56.1	B-D
Altered Forest/Woodland (3)	**26.5**	**15.2**	**NN**
Savanna/Brushland	**13.1**	**7.5**	**B-NN**
Savanna (4)	12.1	7.0	B
Shrub/Scrub (5)	1.0	0.6	NN
Grassland	**3.6**	**2.1**	**C-NN**
Prairie (6)	2.7	1.5	C-D
Non-Native Grassland (7)	0.9	0.5	NN
Lowland Communities	**31.8**	**18.2**	**C-D**
Lowland Forest/Woodland	**31.5**	**18.1**	**C-D**
Floodplain Forest (8)	31.3	18.0	C-D
Wet Forest/Swamp (9)	0.1	0.1	D
Forested Peatland (10)	0.0	0.0	N/A
Lowland Shrub/Scrub	**0.3**	**0.2**	**D**
Lowland Shrub/Scrub (11)	0.3	0.2	D
Lowland Herbaceous	**0.0**	**0.0**	**N/A**
Wet Meadow (12)	0.0	0.0	N/A
Marsh (13)	0.0	0.0	N/A
TOTALS (Uplands + Lowlands)[3]	**174.2**	**100.0**	

[1] See Table 1 for descriptions
[2] See Section 3.3 for Ecological Quality Rank definitions; NN = Not a natural community; N/A = not applicable
[3] Rounding of values may make totals appear inaccurate

The Park's highest quality natural areas are those that have been actively managed by MPRB staff, contractors, and volunteers; these managed natural areas have ecological quality ranks of BC (having characteristics of both B (good) and C (moderate) quality natural areas). However, the majority of the Gorge's natural areas are ranked as C, CD or D (i.e., fair to poor) quality, primarily due to the presence of invasive species. Many of the forests in the northern portion of the Park are classified as NN (altered/non-native) due to their species composition as a result of past human disturbances and other land use practices.

5.3.3 Managed Natural Areas of Mississippi Gorge Park

Mississippi Gorge Park has high quality remnant native plant communities consisting of good assemblages of native plants as well as planted natural areas. Some of these areas have been routinely managed over the years by MPRB staff, contractors, and volunteers, primarily by controlling invasive plants. The Park contains three Managed Natural Areas (Figure 16), which are described briefly below and in greater detail in their own management briefs (Appendix A).

- **36th Street Savanna** (3.5 acres) – Possibly the most used and appreciated natural area within the Park, this savanna/prairie area contains many remnant native prairie plants (i.e., they were not planted by humans). Park staff, neighborhood volunteers, and conservation non-profits such as Friends of the Mississippi River (FMR) have expended hundreds of hours restoring and maintaining this natural area, resulting in its relatively high quality (ecological quality rank of B, good). This quality rank reflects historical vegetation structure (i.e., mature oaks), good native plant cover and diversity, and relatively low invasive cover. Currently, the 36th Street Savanna is managed by the MPRB or its contractors using prescribed burning (generally on a 3-year rotation) or dormant season mowing and brush sawing. Control of herbaceous and woody weedy and invasive species has typically been done by spot application of herbicides.
- **44th Street Mesic Forest** (6.2 acres) – This forest contains mature native trees (e.g., oaks and sugar maples) and a variety of native shrubs and wildflowers. As with the 36th Street Savanna, this area has received concentrated management by MPRB staff and volunteers. This forested area contains higher quality vegetation (quality rank B and BC) because of these ongoing efforts and the presence of historical vegetation structure (i.e., mature forest trees), good native plant cover and diversity, and relatively low invasive cover. Lower quality areas are characterized by more sparse native cover and more abundant invasives, including Common buckthorn and Norway maple.
- **Edmund Boulevard Savanna** (1.1 acres) – As mentioned above, this area was originally a mowed turf area that was restored into a natural area. The northern portion of this area is currently maintained turf. This area was given an ecological quality rank of NN (altered/non-native) because the northern portion is maintained turf and the southern portion contains invasive/weedy vegetation.

5.3.4 Issues & Opportunities at Mississippi Gorge Park

Issues

- Invasive vegetation:
    - Dominant or common invasive species: Common buckthorn (in Altered Forest/Woodland and Mesic Forest), Black locust (in Mesic Forest), Siberian elm (in Altered Forest/Woodland), and Canada thistle (in Wet Meadow).
    - Additional invasive species: Amur maple, Norway maple, White mulberry, Glossy buckthorn, invasive honeysuckles, European highbush cranberry, Bladder campion, Showy goats beard, Bull thistle, Day lily, Garlic mustard, Lily-of-the-valley, Catnip, Common mullein, Hoary alyssum, Common burdock, Lamb's quarters, Yellow poppy, Dames and Yellow rockets, Motherwort, Creeping Charlie, Birds-foot trefoil, Black medic, Queen Anne's lace, Common dandelion, Yellow and White sweet clovers, Smooth brome, Reed canary grass, and Kentucky bluegrass.
- Presence of Oak wilt, Emerald ash borer and Dutch elm disease.
- Informal paths created by park users (e.g., many in the 36th Street Savanna).
- Sheet and gully erosion, primarily on steep bluffs and in areas with limited vegetation cover.
- Erosion at stormwater outfalls and in bluff drainageways.

- Bluffs contain numerous seeps and springs, which can create unstable slopes, especially when coupled with climate change; however, slumpage at seeps is a natural process if not exacerbated by surface runoff from above.
- Woody vegetation compromising limestone walls, staircases, and other historical Works Progress Administration (WPA) structures.

Opportunities

- Sustain or improve high quality native plant communities (e.g., 36th Street Savanna and 44th Street Mesic Forest).
- Conduct strategic restoration and management at Edmund Boulevard Savanna, Lower Riverside, and other unique natural areas.
- Expand restoration, management, and enhancement of other Park natural areas to improve quality and connectivity.
- Expand interpretive opportunities (e.g., signage).
- Sustain and expand volunteer engagement in restoration and management.

5.3.5 Goals for Mississippi Gorge Park

1. Sustain or improve quality rank of 36th Street Savanna and 44th Street Mesic Forest through continued management. The 36th Street Savanna was ranked as B quality, which should be maintained by continued management including regular, rotational, prescribed burning and spot treatment of persistent invasive vegetation (e.g., pulling, mowing, spot herbicide). The 44th Street Mesic Forest was ranked as B-D; continued management (mostly spot treatment of persistent invasive vegetation) should continue to bring all these areas up to a quality rank of at least BC. The Edmund Boulevard Savanna should be managed to increase its quality rank from NN to C. See management briefs for details (Appendix A).
2. Maintain other natural areas, beginning with the next highest quality areas. This will generally entail the following considerations and tasks. Restoration and management tasks and methods are described in greater detail in Section 6.7.
   a. Restore natural disturbance regimes as appropriate (e.g., prescribed burning in prairies, savannas, and some forests and wetlands).
   b. Use biocontrols for invasive species management, when feasible; however, Leafy spurge, Spotted knapweed, and Purple loosestrife (i.e., species for which there are effective biocontrols) are not common in Mississippi Gorge Park.
   c. Removal of invasive Common buckthorn and other invasive brush:
      i. Removal of invasive Common buckthorn and other invasive brush from accessible areas, excluding steep or unstable bluff slopes. This would be done using brush saws and approved herbicides.
      ii. Removal of invasive Common buckthorn from steep bluff slopes and other inaccessible areas. This could be done by people using harnesses and rappelling gear.

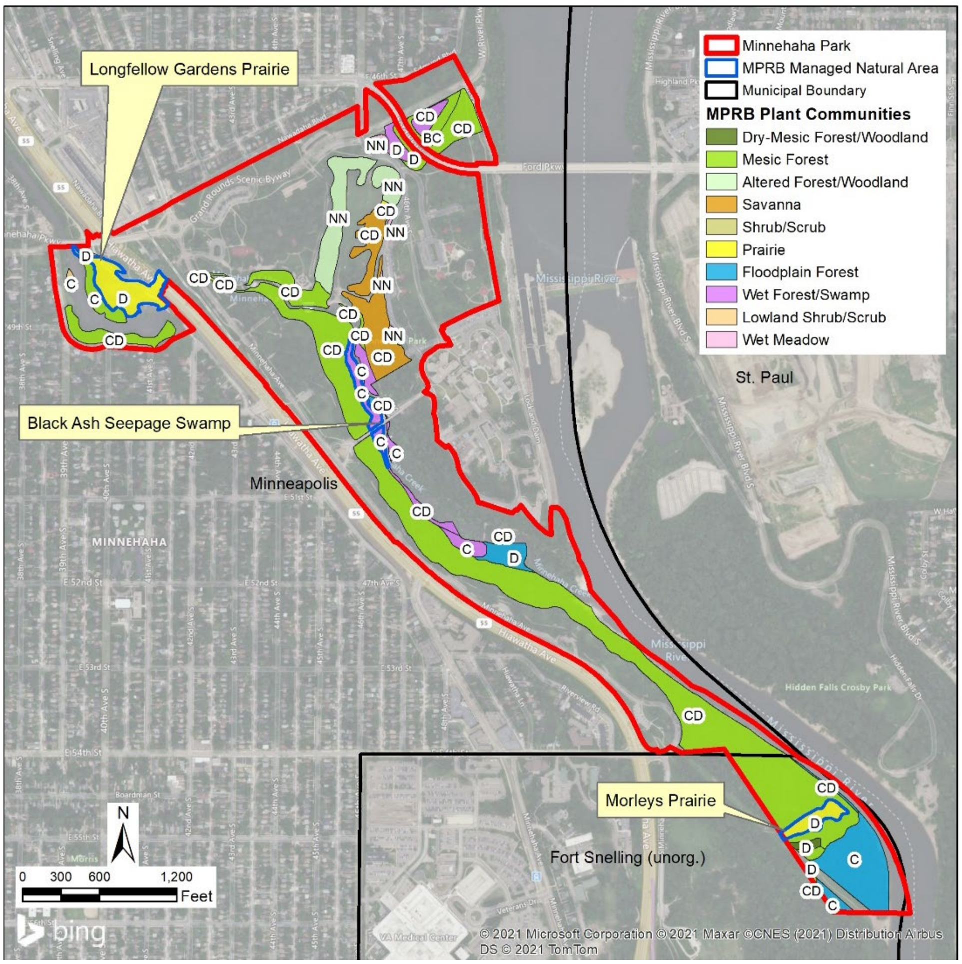
    d. Remove invasive herbaceous vegetation.
    e. Install diverse native plantings—trees, shrubs, grasses, sedges, forbs, etc.
3. Conduct inventory and document with GPS locations having sparse vegetation or conspicuous sheet or gully erosion. Design stabilization strategy using appropriate native vegetation and wildlife-friendly bioengineering techniques (e.g., natural fiber erosion control blankets), and hard engineering solutions as warranted (Barr Engineering 2007).
4. Conduct inventory and document with GPS locations of all Park trails. Determine which trails should be abandoned, block off and revegetate those trails, and install signage to explain the reason for trail closure.
5. Conduct an inventory and document with GPS locations of seeps and springs along the Park. Assess the potential risk of slope failure, erosion, and/or infrastructure damage.
6. Conduct inventory and locate using GPS the limestone walls, staircases, and other historic WPA structures. Assess if woody vegetation is compromising structures, and then manage woody vegetation to preserve these cultural resources (see Section 6.8.1).
7. Install ecologically-appropriate herbaceous vegetation and shrubs following stormwater outfall and infrastructure rehabilitation projects. Appropriate native species can be selected from the MNDNR species list (Appendix J) that matches the plant community mapped in the outfall/infrastructure location. Trees should not be planted near infrastructure to prevent damage. If planned well, this native revegetation has the potential to buffer and connect adjacent natural areas.
8. Expand and connect natural areas with vegetation wherever possible to reduce the effects of habitat fragmentation (see Section 2.3.1). This could entail conversion of existing turf to native prairie/savanna, native plant gardens, or bee lawns.
9. Develop a more detailed park-specific Natural Resource Management Plan (NRMP) and implement recommendations.
10. Sustain the legacy of volunteerism in Mississippi Gorge Park's natural areas.

5.4 Minnehaha Park

5.4.1 Overview of Minnehaha Park

Minnehaha Park consists of approximately 205.3 acres of land along the final stretch of the Minnehaha Creek near its confluence with the Mississippi River (Figure 17). The Park contains one of Minnesota's most iconic natural features: Minnehaha Falls. This feature, which currently cascades 53 feet down into the Minnehaha glen, has been slowly migrating upstream as the streambed above the falls continues to be eroded. Below the falls, the Creek meanders about three-quarters of a mile where it empties into the Mississippi River. The Park's exposed faces of limestone and sandstone are indicative of the ancient seas that once occupied the region and the millennia of deposition and erosion.

Figure 17. Minnehaha Park Location and Phase II Plant Communities



The Falls were an important place to the Dakota who considered the site a place where they could gather in peace. The Dakota word "Minnehaha" translates to "curling water" or the "waterfall" (Cairn et al. 2003). The creek and falls have drawn indigenous people, explorers, settlers, tourists, and entrepreneurs over the site's history.

Today, Minnehaha Park is a Minnesota landmark and popular regional destination. The upper portion of the Park is characterized by mowed lawns, mature oak trees, play grounds, a bandshell, a refectory/picnic shelter, and other park amenities. Below Minnehaha Falls, the Creek meanders through a 54-acre complex of forest and wetland that is maintained in its natural state. This area has the highest population of native wildflowers in the park system and also includes a Black ash swamp, an uncommon feature in the metro region.

Beginning in 2010, the MPRB (in partnership with the Minnehaha Creek Watershed District and with funding from the Minnesota DNR) embarked on an extensive restoration project below Minnehaha Falls (i.e., in the glen). Goals of the project were to restore native plant communities, stabilize slopes, and improve the banks along this stretch of the creek. This project included removal of Common buckthorn and other invasive vegetation from steep wooded slopes along the glen. Invasive vegetation was removed, and prescribed burning and reseeding with native savanna was conducted on the west-facing slope of the “deer pen” area near the center of the Park. The “deer pen” is in reference to where deer were kept when part of Minnehaha Park was a zoo (1897- 1923). The deer pen area is actually an abandoned falls and channel of the Mississippi River. The 2010 project work was documented in a report by Barr Engineering (2011).

5.4.2 Plant Communities of Minnehaha Park

Most of Minnehaha Park consists of maintained turf, ornamental plantings, and developed parkland. Linear bands of natural to semi-natural vegetation (mostly Mesic Forest) exist throughout the Park, primarily along the steep slopes leading down to the Minnehaha Glen. Figure 17 (above) illustrates the Park’s plant communities addressed in this Phase II plan, and Table 10 presents the acres of each plant community type (including their quality ranks).

Table 10. Minnehaha Park Phase II Plant Communities

PLANT COMMUNITIES[1]	ACRES	PERCENT OF STUDY AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**56.7**	**79.8**	**BC-NN**
Forest/Woodland	**45.8**	**64.4**	**BC-NN**
Mature Forest/Woodland	**40.9**	**57.6**	**BC-D**
Dry-Mesic Forest/Woodland (1)	0.3	0.5	D
Mesic Forest (2)	40.6	57.2	BC-D
Altered Forest/Woodland (3)	**4.8**	**6.8**	**NN**
Savanna/Brushland	**6.0**	**8.4**	**CD-D**
Savanna (4)	5.8	8.2	CD
Shrub/Scrub (5)	0.1	0.2	D
Grassland	**4.9**	**7.0**	**CD-D**
Prairie (6)	4.9	7.0	CD-D
Non-Native Grassland (7)	0.0	0.0	N/A
Lowland Communities	**14.4**	**20.2**	**C-D**
Lowland Forest/Woodland	13.6	19.1	C-D
Floodplain Forest (8)	8.4	11.9	C-D
Wet Forest/Swamp (9)	5.1	7.2	C-D
Forested Peatland (10)	0.0	0.0	N/A
Lowland Shrub/Scrub	**0.2**	**0.3**	**C**
Lowland Shrub/Scrub (11)	0.2	0.3	C
Lowland Herbaceous	**0.6**	**0.8**	**NN**
Wet Meadow (12)	0.6	0.8	NN
Marsh (13)	0.0	0.0	N/A
TOTALS (Uplands + Lowlands)[3]	**71.0**	**100.0**	

[1] See Table 1 for descriptions
[2] See Section 3.3 for Ecological Quality Rank definitions; NN = Not a natural community; N/A = not applicable
[3] Rounding of values may make totals appear inaccurate

Minnehaha Park's highest quality natural areas are those that have been managed by MPRB staff, contractors, and volunteers; these have ranks of B (good). However, the majority of Minnehaha Park natural areas are ranked as C, CD, or D quality due to low native diversity and the presence of invasive and weedy species.

5.4.3 Managed Natural Areas of Minnehaha Park

Minnehaha Park has remnant native plant communities consisting of good assemblages of native plants in addition to planted natural areas. These areas have been intermittently managed over the years by MPRB staff, contractors, and volunteers, primarily by controlling invasive plants. Projects have included removal of Common buckthorn and other invasive vegetation from steep slopes along the Minnehaha glen (below the falls) and from historical oak savannas located near the center of the Park (between Wabun Picnic Area and the "deer pen").

The Park contains three Managed Natural Areas (Figure 17), which are described briefly below and in greater detail in their own management briefs (Appendix A).

- **Black Ash Seepage Swamp** (1.4 acres) – This forested wetland contains native trees (e.g., Black ash, Black willow, and American elm) and a variety of native herbaceous species including Skunk cabbage and Marsh marigold. It has a quality rank of C due to moderate native diversity and the presence of invasive and weedy species. Due to the threat of Emerald ash borer, some black ash trees were removed from this native plant community by MPRB Forestry in 2019.
- **Morley's Prairie** (1.4 acres) – This is a remnant prairie located near the top of the bluff in the southern portion of Minnehaha Park. The prairie is enclosed by a chain link fence to protect it from adjacent trails and an off-leash dog park. This area contains remnant prairie plants (i.e., they were not planted by humans). The prairie had become overgrown in recent years by Gray dogwood, Sumac, and Common buckthorn, and Oriental bittersweet was present in the west side of this prairie. This woody overgrowth and invasive cover contributed to the area's quality rank of D. However, brushing conducted in late 2020 will help elevate the quality of this important remnant assuming follow-up management is conducted.
- **Longfellow Gardens Prairie** (3.4 acres) – Planted in 2005, when highway 55 and Minnehaha Creek was rerouted, the prairie contains a variety of native herbaceous species. This area was assigned a quality rank of D due to low native diversity and the presence of invasive and weedy species. Sewer repairs during early 2020 have since disturbed a significant portion of this restored natural area.

Ecological management is not routinely conducted in portions of Minnehaha Park outside of the above Managed Natural Areas. See individual plant community management briefs (Appendix A) for details on improving ecological quality for other plant community types found in the Park.

5.4.4 Issues and Opportunities at Minnehaha Park

Issues

- Invasive vegetation:
  - Dominant or common invasive species: Common buckthorn (in Mesic Forest, Altered Forest/Woodland, and Savanna).
  - Additional invasive species: White mulberry, invasive honeysuckles, Bull thistle, Canadian thistle, Day lily, Garlic mustard, Lily-of-the-valley, Catnip, Common mullein, Hoary alyssum, Common Burdock, Lamb's quarters, Motherwort, Creeping Charlie, Birds-foot trefoil, Queen Anne's lace, Common dandelion, Yellow and White sweet clovers, Curly dock, Timothy, Creeping Charlie, Smooth brome, Reed canary grass, Purple loosestrife, True forget-me-not, Narrow-leaved bittercress, Oriental bittersweet.
- Informal paths created by park users (e.g., many on steep bluffs below falls).
- Sheet and gully erosion, primarily on steep bluffs and in areas with limited vegetation cover. Erosion at stormwater outfalls
- Woody vegetation compromising limestone walls, staircases, and other Works Progress Administration (WPA) structures.

Opportunities

- Improve remnant and restored native plant communities (e.g., Black Ash Seepage Swamp, Morley's Prairie, and Longfellow Gardens Prairie).
- Conduct strategic restoration and management at restored oak savannas and other unique natural areas.
- Expand restoration, management, and enhancement of other Park natural areas to improve quality and connectivity.
- Expand interpretive opportunities (e.g., signage).
- Engage volunteers in restoration and management of the park's natural areas.

5.4.5 Goals of the Minnehaha Park

1. Sustain or improve quality rank of Black Ash Seepage Swamp, Longfellow Gardens Prairie, and Morley's Prairie through continued management. The Black Ash Seepage Swamp was ranked as C quality; continued management should include spot treatment of persistent invasive vegetation (e.g., pulling, mowing, spot herbicide). Morley's Prairie was ranked as D quality. Due to lack of fire and subsequent woody invasion, this area may require manual brushing in conjunction with prescribed burning to restore more prairie/savanna structure; continued management should then include regular, rotational, prescribed burning and spot treatment of persistent invasive vegetation (e.g., pulling, mowing, spot herbicide). The Longfellow Gardens Prairie was ranked as D; continued management of regular, rotational, prescribed burning and spot treatment of persistent invasive vegetation) should continue to bring all these areas up to a quality rank of at least C See management brief for details (Appendix A).
2. Maintain other natural areas, beginning with the next highest quality areas. This will generally entail the following considerations and tasks. Restoration and management tasks and methods are described in greater detail in Section 6.7.
    a. Restore natural disturbance regimes as appropriate (e.g., prescribed burning in prairies, savannas, and some forests and wetlands).
    b. Use biocontrols for invasive species management, when feasible. Purple loosestrife is present in Minnehaha Park, but may not be sufficient to support a colony of beetles.
    c. Removal of invasive Common buckthorn and other invasive brush:
        i. Removal of invasive Common buckthorn and other invasive brush from accessible areas, excluding steep or unstable bluff slopes. This would be done using brush saws and approved herbicides.
        ii. Removal of invasive Common buckthorn from steep bluff slopes and other inaccessible areas. This could be done by people using harnesses/rappelling gear. The use of goats on steep bluff slopes may be another strategy, but it is costly and would require a variance from the City of Minneapolis due to the ordinance prohibiting electrified fencing.
    d. Remove invasive herbaceous vegetation.
    e. Install diverse native plantings—trees, shrubs, grasses, sedges, forbs, etc.

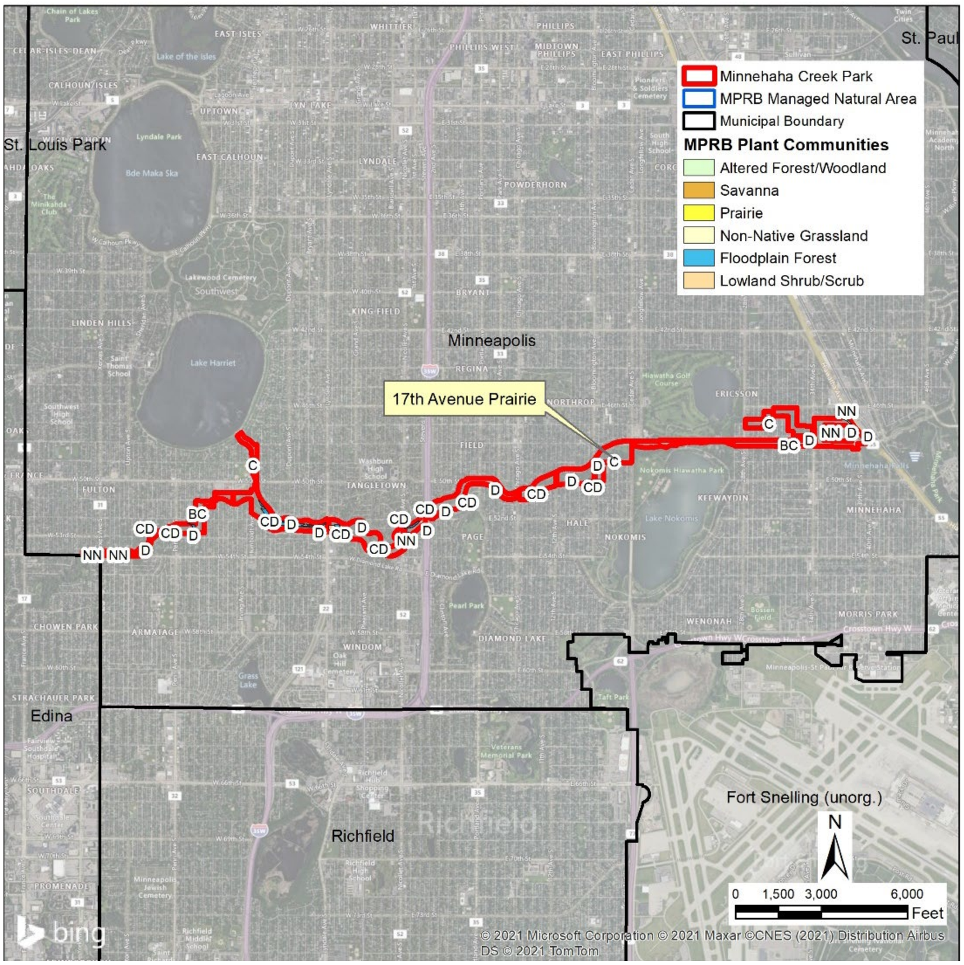
3. Conduct inventory and document with GPS locations having sparse vegetation or conspicuous sheet or gully erosion. Design stabilization strategy using appropriate native vegetation and wildlife-friendly bioengineering techniques (e.g., natural fiber erosion control blankets), using hard engineering solutions as a last resort.
4. Conduct inventory and document with GPS locations of all Park trails. Determine which trails should be abandoned, block off and revegetate those trails, and install signage to explain the reason for trail closure.
5. Conduct an inventory and document with GPS locations of seeps and springs along the Park. Assess the potential risk of slope failure, erosion, and/or infrastructure damage.
6. Conduct inventory and locate using GPS the limestone walls, staircases, and other historic WPA structures. Assess if woody vegetation is compromising structures, and then manage woody vegetation to preserve these cultural resources (see Section 6.8.1).
7. Install ecologically-appropriate herbaceous vegetation and shrubs following stormwater outfall and infrastructure rehabilitation projects. Appropriate native species can be selected from the MNDNR species list (Appendix J) that matches the plant community mapped in the outfall/infrastructure location. Trees should not be planted near infrastructure to prevent damage. If planned well, this native revegetation has the potential to buffer and connect adjacent natural areas.
8. Expand and connect natural areas with vegetation wherever possible to reduce the effects of habitat fragmentation (see Section 2.3.1). This could entail conversion of existing turf to native prairie/savanna, native plant gardens, or bee lawns.
9. Develop a more detailed park-specific Natural Resource Management Plan (NRMP) and implement recommendations.
10. Engage volunteers in restoration and management of the park's natural areas.

5.5 Minnehaha Creek Park

5.5.1 Overview of Minnehaha Creek Park

Minnehaha Creek Park consists of approximately 256 acres extending from Lake Minnetonka in the west and flows east for 22 miles through several suburbs west of Minneapolis, and continues through south Minneapolis, eventually flowing through Minnehaha Park and into the Mississippi River (Figure 18). The 181-square mile watershed drains agricultural fields, suburbs, and urban areas into the Creek.

Figure 18. Minnehaha Creek Park Location and Phase II Plant Communities



In 1928 the MPRB voted to acquire Minnehaha Creek Park by condemnation. The MPRB owned the entire banks of the Creek within the Minneapolis city limits, from eastern border at the City of Edina to the Mississippi River by 1930.

The Park is a very popular regional bike and walking trail. It meanders along with the Creek through urban forests and parkland, and the Creek is paddled using personal watercraft (e.g., canoes, kayaks). More about the Park (its natural and cultural history, existing visitor uses, and recommended improvements) can be found in the Draft Minnehaha Parkway Regional Trail Master Plan (MPRB 2019b).

The large hillside at 17th Avenue and 49th Street was planted into prairie in 1997 as part of MPRB conversion efforts to reduce mowing and re-introduce native plants into the park system. The 17th Avenue hill has long been a neighborhood destination for sledding and has been mowed to accommodate this activity.

In 2000, land cover mapping and a management plan were developed for the Park (Kestrel Design Group 2000). In the early 2000s, with USDA grants, neighborhood funds and support of MPRB Forestry and Environmental Management staff removed buckthorn in the Fulton neighborhood near the western edge of the City. The Lynnhurst neighborhood hosts annual volunteer buckthorn removals along Minnehaha Creek from Humboldt to Lyndale Avenue South. Near Pleasant Avenue and W. Minnehaha Creek Parkway, neighbors have been removing buckthorn and replanting as part of the Cover It Up research project.

5.5.2 Plant Communities of Minnehaha Creek Park

Most of Minnehaha Creek Park consists of maintained turf, ornamental plantings, and developed parkland. Linear bands of natural to semi-natural vegetation (mostly Mesic Forest) exist along the Minnehaha Creek. Figure 18 (above) illustrates the Park's plant communities addressed in this Phase II plan, and Table 11 presents the acres of each plant community type (including their quality ranks).

Table 11. Minnehaha Creek Park Phase II Plant Communities

PLANT COMMUNITIES[1]	ACRES	PERCENT OF STUDY AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**46.5**	**80.5**	**BC-NN**
Forest/Woodland	**44.8**	**77.6**	**BC-NN**
Mature Forest/Woodland	**41.7**	**72.1**	**BC-D**
Dry-Mesic Forest/Woodland (1)	0.0	0.0	N/A
Mesic Forest (2)	41.7	72.1	BC-D
Altered Forest/Woodland (3)	**3.2**	**5.5**	**NN**
Savanna/Brushland	**0.5**	**0.8**	**D**
Savanna (4)	0.0	0.0	N/A
Shrub/Scrub (5)	0.5	0.8	D
Grassland	**1.2**	**2.1**	**C-NN**
Prairie (6)	0.6	1.0	C
Non-Native Grassland (7)	0.6	1.1	NN
Lowland Communities	**11.2**	**19.5**	**C-NN**
Lowland Forest/Woodland	**9.9**	**17.1**	**C-D**
Floodplain Forest (8)	9.3	16.2	C-D
Wet Forest/Swamp (9)	0.5	0.9	CD
Forested Peatland (10)	0.0	0.0	N/A
Lowland Shrub/Scrub	**0.0**	**0.0**	**N/A**
Lowland Shrub/Scrub (11)	0.0	0.0	N/A
Lowland Herbaceous	**1.4**	**2.4**	**D-NN**
Wet Meadow (12)	0.9	1.6	NN
Marsh (13)	0.5	0.8	D
TOTALS (Uplands + Lowlands)[3]	**57.8**	**100.0**	

[1] See Table 1 for descriptions
[2] See Section 3.3 for Ecological Quality Rank definitions; NN = Not a natural community; N/A = not applicable
[3] Rounding of values may make totals appear inaccurate

The Park's highest quality natural areas are those that have been actively managed by MPRB staff, contractors, and volunteers; these have ranks of BC (having characteristics of both B (good) and C (moderate) quality natural areas). However, the majority of the Park's natural areas are ranked as CD or D (i.e., fair to poor) quality, primarily due to the presence of invasive species. Some of the forests along the Park are classified as NN (altered/non-native) due to their species composition as a result of past human disturbances and other land use practices.

5.5.3 Managed Natural Areas of Minnehaha Creek Park

The Park contains one Managed Natural Area (Figure 18), which is described briefly below and in greater detail in its own management brief (Appendix A).

- **17th Avenue Prairie** (0.6 acres) – This planted prairie was assigned a quality rank of C due to relatively low native diversity and cover, as well as the presence of invasive and weedy species.

A dense stand of native Cup plant (*Silphium perfoliatum*) exists in the lower portion of the prairie.

Ecological management is not routinely conducted outside the planted prairie. See individual plant community management briefs (Appendix A) for details on improving ecological quality for other plant community types found in the Park

5.5.4 Issues & Opportunities at Minnehaha Creek Park

Issues

- Invasive vegetation:
    - Dominant or common invasive species: Common buckthorn (in Mesic Forest and Altered Forest/Woodland).
    - Additional invasive species: Siberian elm, White mulberry, Glossy buckthorn, invasive honeysuckles, Showy goats beard, Bull thistle, Day lily, Garlic mustard, hostas, Lily-of-the-valley, Catnip, Common mullein, Canada thistle, Hoary alyssum, Common burdock, Lamb's quarters, Yellow poppy, Motherwort, Creeping Charlie, Birds-foot trefoil, Queen Anne's lace, Common dandelion, Yellow and White sweet clovers, Curly dock, Smooth brome, Reed canary grass, and Kentucky bluegrass.
- Presence of emerald ash borer and Dutch elm disease.
- Sheet and gully erosion, primarily on steep slopes and in areas with limited vegetation cover. Erosion at stormwater outfalls.

Opportunities

- Improve higher quality native plant communities (e.g., Standish-Ericsson Natural Area).
- Conduct strategic restoration and management at other unique natural areas.
- Expand restoration, management, and enhancement of other Park natural areas to improve quality and connectivity.
- Expand interpretive opportunities (e.g., signage).
- Sustain volunteerism in restoration and management of the park's natural areas.

5.5.5 Goals of Minnehaha Creek Park

1. Improve ecological quality rank of the 17th Avenue Prairie. This area was ranked as C quality, and should be improved to a rank of B if heavy sledding use and disturbance is eliminated. See management brief for details (Appendix A).
2. Maintain other natural areas (beginning with the next highest quality areas. This will generally entail the following considerations and tasks. Restoration and management tasks and methods are described in greater detail in Section 6.7.
    a. Restore natural disturbance regimes as appropriate (e.g., prescribed burning in prairies, savannas, and some forests and wetlands).

   b. Use biocontrols for invasive species management, when feasible; however, Leafy spurge, Spotted knapweed, and Purple loosestrife (i.e., species for which there are effective biocontrols) are not common in Minnehaha Creek Park.
   c. Removal of invasive Common buckthorn and other invasive brush.
   d. Remove invasive herbaceous vegetation.
   e. Install diverse native plantings—trees, shrubs, grasses, sedges, forbs, etc.
3. Conduct inventory and document with GPS locations having sparse vegetation or conspicuous sheet or gully erosion. Design stabilization strategy using appropriate native vegetation and wildlife-friendly bioengineering techniques (e.g., natural fiber erosion control blankets), using hard engineering solutions as a last resort.
4. Conduct inventory and locate using GPS the limestone walls, staircases, and other historic WPA structures. Assess if woody vegetation is compromising structures, and then manage woody vegetation to preserve these cultural resources (see Section 6.8.1).
5. Install ecologically-appropriate herbaceous vegetation and shrubs following stormwater outfall and infrastructure rehabilitation projects. Appropriate native species can be selected from the MNDNR species list (Appendix J) that matches the plant community mapped in the outfall/infrastructure location. Trees should not be planted near infrastructure to prevent damage. If planned well, this native revegetation has the potential to buffer and connect adjacent natural areas.
6. Expand and connect natural areas with vegetation wherever possible to reduce the effects of habitat fragmentation (see Section 2.3.1). This could entail conversion of existing turf to native prairie/savanna, native plant gardens, or bee lawns.
7. Develop a more detailed park-specific Natural Resource Management Plan (NRMP) and implement recommendations.
8. Sustain volunteerism in management of Minnehaha Creek Park’s natural areas.

5.6 Nokomis and Hiawatha Parks

5.6.1 Overview of Nokomis and Hiawatha Parks

Nokomis and Hiawatha Parks consist of approximately 653 acres of land in southeast Minneapolis, just north of the City of Richfield. The parks are separated by East Minnehaha Parkway, with Nokomis to the south and Hiawatha to the north (Figure 19). Minnehaha Creek Regional Trail connects Nokomis and Hiawatha to the Chain of Lakes Regional Park and Mississippi Gorge Regional Park.

Figure 19. Nokomis and Hiawatha Parks Location and Phase II Plant Communities

In the early 1900s, under the direction of park Superintendent Theodore Wirth, Lake Amelia (a 300-acre wetland) was dredged and redesigned into today's Lake Nokomis (currently approximately 200 acres) (MPRB 2015a). Dredging and filling of Rice Lake (another historical wetland just to the north of Lake Nokomis) in the 1930s created Lake Hiawatha, Hiawatha Golf Course and surrounding park lands.

Today, Nokomis and Hiawatha Parks are used for a wide range of summer and winter recreation activities including, boating swimming and trail systems. The parks are surrounded by residential neighborhoods of mostly single-family homes. More about the Park (its natural and cultural history, existing visitor uses, and recommended improvements) can be found in the Nokomis-Hiawatha Regional Park Master Plan (MPRB 2015a).

The east shoreline of Lake Hiawatha has had two shoreline restoration efforts, most recently in 2007. These restoration efforts involved planting emergent vegetation into the lake shoreline and plant prairie species to stabilize the shoreline edges of the lake. Shoreline emergent plantings struggled to survive as the lake levels fluctuate rapidly and significantly due to water level manipulation of Minnehaha Creek at the Gray's Bay dam on Lake Minnetonka; few of these emergent plants remain today.

At Lake Nokomis, the prairie located to the north of the intersection of East Lake Nokomis Parkway and 50th Streets was planted as part of a park redesign in the 1990s. Turf was converted into prairie and native plant gardens were put in for interpretive areas on native plant use in the landscape.

The three large stormwater wetlands at Lake Nokomis were installed in 2000 to improve the water quality of the lake. This project, The Blue Water Partnership, was a joint effort between the MPRB, City of Minneapolis, and the Minnehaha Creek Watershed District (MCWD). MCWD maintains the native vegetation planted around the ponds and performs dredging as needed.

MPRB Environmental Management staff received Clean Water Fund grant to remove woody invasive species along the eastern shoreline and plant native species on this side of Lake Nokomis. This work was completed with Conservation Corps of Minnesota and Iowa Youth Outdoors program the summer of 2011. Friends of Lake Nokomis volunteers have continued these efforts to control of invasive species in the park since that time. In 2020, the Friends began participation in the Cover it Up project for their buckthorn removal areas.

In late 2019, shoreline restoration and establishment of native shoreline buffers was conducted along Lake Nokomis' north, east, and west shorelines. This shoreline enhancement project (funded through Outdoor Heritage grant funds and in cooperation with the Minnehaha Creek Watershed District) entailed removal of invasive vegetation and turf, selective tree thinning, stabilization of the lakeshore, and installation of native prairie and wetland vegetation, including emergent plantings protected by wave breaks.

5.6.2 Plant Communities of Nokomis and Hiawatha Parks

Most of Nokomis and Hiawatha Parks (including Hiawatha Golf Course) consists of maintained turf, ornamental plantings, and developed parkland. Small linear bands and patches of natural to semi-natural vegetation exist throughout the Park, mostly along slopes and in wetland areas. Figure 19 (above) illustrates the Parks' plant communities addressed in this Phase II plan, and Table 12 presents the acres of each plant community type (including their quality ranks).

Table 12. Nokomis and Hiawatha Park Phase II Plant Communities

PLANT COMMUNITIES[1]	ACRES	PERCENT OF STUDY AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**1.9**	**37.7**	**CD**
Forest/Woodland	**0.0**	**0.0**	**N/A**
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)	**0.0**	**0.0**	**N/A**
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	**1.9**	**37.7**	**CD**
Prairie (6)	1.9	37.7	CD
Non-Native Grassland (7)	0.0	0.0	N/A
Lowland Communities	**3.1**	**62.3**	**N/A**
Lowland Forest/Woodland	**2.9**	**59.6**	**N/A**
Floodplain Forest (8)	2.9	59.6	N/A
Wet Forest/Swamp (9)	0.0	0.0	N/A
Forested Peatland (10)	0.0	0.0	N/A
Lowland Shrub/Scrub	**0.0**	**0.0**	**N/A**
Lowland Shrub/Scrub (11)	0.0	0.0	N/A
Lowland Herbaceous	**0.1**	**2.7**	**N/A**
Wet Meadow (12)	0.0	0.0	N/A
Marsh (13)	0.1	2.7	N/A
TOTALS (Uplands + Lowlands)[3]	**4.9**	**100**	

[1] See Table 1 for descriptions

[2] See Section 3.3 for Ecological Quality Rank definitions; NN = Not a natural community; N/A = not applicable

[3] Rounding of values may make totals appear inaccurate

The Parks' highest quality natural areas include those that have been actively managed by MPRB staff, contractors, and volunteers (see following section). These natural areas have ranks of CD (having characteristics of both C and D quality natural areas), primarily due to relatively poor native cover, invasive vegetation, and/or their species composition as a result of past human disturbances and other land use practices.

5.6.3 Managed Natural Areas of Nokomis and Hiawatha Parks

These Parks contains one Managed Natural Area (Figure 19), which is described briefly below and in greater detail in its own management brief (Appendix A).

- **Nokomis Prairie** (1.9 acres) – This planted prairie contains a variety of native grass and wildflower species. Scattered mature native trees (e.g., oaks) and a grove of planted evergreens outline the borders of this prairie. This prairie was assigned a quality rank of CD due to low native diversity and the presence of invasive and weedy species.

Ecological management is not routinely conducted by MPRB outside of the planted prairie. See individual plant community management briefs (Appendix A) for details on improving ecological quality for other plant community types found in the Park.

5.6.4 Issues & Opportunities at Nokomis and Hiawatha Parks

Issues

- Invasive vegetation
    - Dominant to uncommon invasive species: Common buckthorn, White mulberry and invasive honeysuckles (Floodplain Forest), Canada thistle and cool-season grasses (Prairie), and Reed canary grass (shoreline and Marsh).
- Presence and Emerald ash borer and Dutch elm disease.
- Informal paths created by park users through the prairie introduces and spreads invasive and weedy species.

Opportunities

- Sustain or improve higher quality native plant communities (e.g., Nokomis Prairie and recently enhanced shorelines).
- Conduct strategic restoration and management at other unique natural areas to improve quality and connectivity, including additional shoreline restoration and intentional restoration of native vegetation at flooded/wet turf areas that have become wetlands.
- Expand volunteer engagement in restoration and management of the park's natural areas.

5.6.5 Goals of Nokomis and Hiawatha Parks

1. Improve quality rank of Nokomis Prairie through continued management. This planted prairie was ranked as CD quality; continued management (mostly rotational prescribed burning and spot treatment of persistent invasive vegetation) and potentially overseeding with more native forbs should continue to bring this area up to a quality rank of at least C. See management brief for details (Appendix A).
2. Maintain other natural areas, beginning with the next highest quality areas. This will generally entail the following considerations and tasks. Restoration and management tasks and methods are described in greater detail in Section 6.7.
    a. Restore natural disturbance regimes as appropriate (e.g., prescribed burning in prairies, savannas, and some forests and wetlands).
    b. Use biocontrols for invasive species management, when feasible. Purple loosestrife is present in Nokomis and Hiawatha Parks, but may not be sufficient to support a colony of beetles.
    c. Removal of invasive Common buckthorn and other invasive brush.

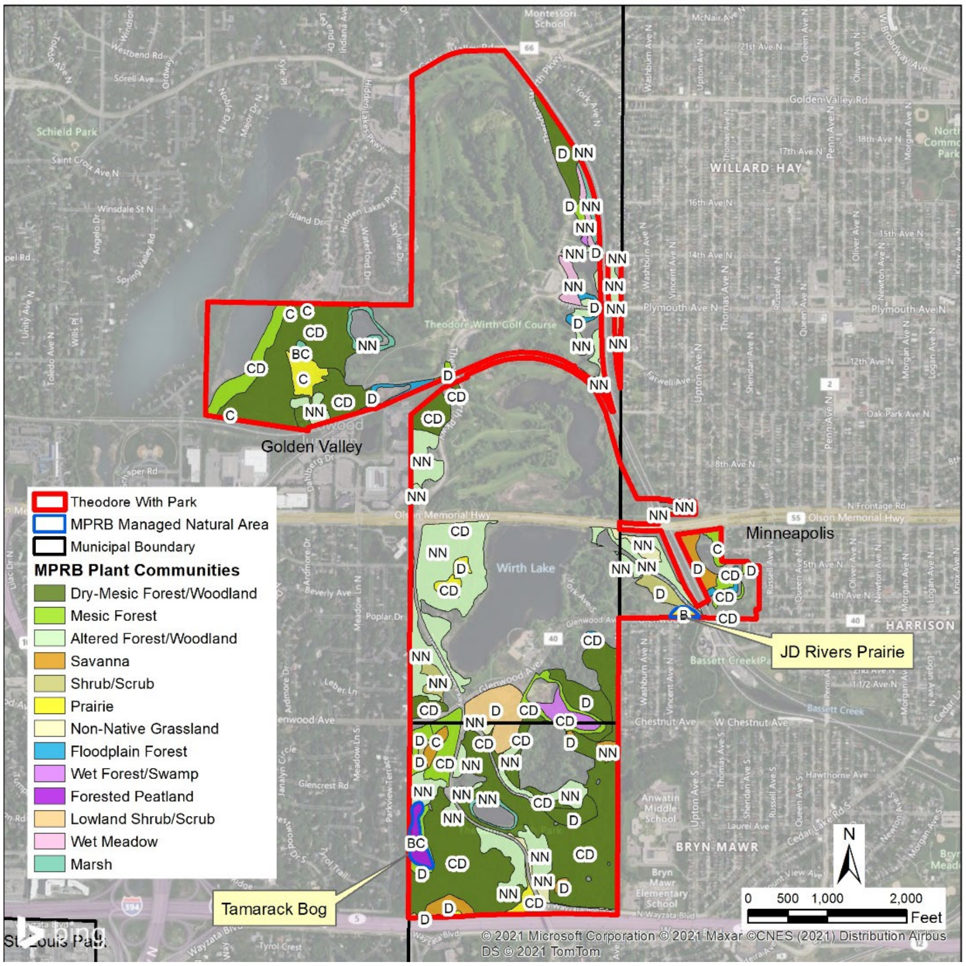
    d. Remove invasive herbaceous vegetation.
    e. Install diverse native plantings—trees, shrubs, grasses, sedges, forbs, etc.
3. Expand and connect natural areas with vegetation wherever possible to reduce the effects of habitat fragmentation (see Section 2.3.1). This could entail conversion of existing turf to native prairie/savanna or converting flooded turf areas back into wetland, planting native gardens or bee lawn.
4. Foster volunteerism in management of Nokomis and Hiawatha Parks' natural areas.

5.7 Theodore Wirth Park

5.7.1 Overview of Theodore Wirth Park

Theodore Wirth Park, the largest park in the MPRB system, consists of approximately 736 acres of land area located within the cities of Golden Valley and Minneapolis (Figure 20). The park derives its name from the former MPRB park Superintendent from 1906-1935.

Figure 20. Theodore Wirth Park Location and Phase II Plant Communities



About 12,000 years ago glaciers receded from the region, leaving behind a variety of landforms ranging from flat to rolling to hilly landscapes. In areas, glaciers deposited large mounds of soil called moraines, and melting blocks of ice left behind obvious depressions in the landscape. These glacial processes created the hilly topography seen in much of the Park today, and formed Wirth Lake, Twin Lake, the tamarack bog (forested peatland) and Bassett Creek which flows through the north and east portions of the Park.

Today, the Park is enjoyed for its extensive, year-round recreation opportunities, natural beauty, and event facilities. Nature lovers enjoy the natural environment of woodlands, prairie, and remnant Tamarack bog. Extensive walking, mountain-biking, and cross-country skiing trails provide recreational activity throughout the seasons. Additional Park amenities include: an 18-hole golf course, picnic areas, Wirth Lake beach, the JD Rivers Children's Garden and historic structures. Established in 1907, the Eloise Butler Wildflower Garden and Bird Sanctuary, the nation's oldest public wildflower garden, is located in the southern part of the park. More about the Park (its natural and cultural history, existing visitor uses, and recommended improvements can be found in the Theodore Wirth Regional Park Master Plan (MPRB 2015b).

The tamarack bog in the south west portion of the park is a rare native plant community for this area of the state. At one time the wetland area in Eloise Butler Wildflower Garden and Bird Sanctuary was a tamarack bog. A relic from glacial times, tamarack bogs change over time due to environmental changes. In the 1980s installation of a floating boardwalk and bridge allowed for better access to the bog. Native bog plants were installed at this time as well. Wetland delineations of the tamarack bog, the Eloise Butler and Glenwood Avenue wetland areas were completed in 2012, to document their boundaries and make note of plants found there.

In 2000, land cover mapping and a management plan were developed for the Park (Kestrel Design Group 2000). This management plan made note of the historic land cover of forest, savanna and prairie once found in the area. For many years, the park was more open and savanna like, maintained by mowing and even a sheep herd in the 1920s. Reduction of mowing in the park allowed common buckthorn to invade the park and become well established in the understory of the mature oaks. Forests of green ash, boxelder and hackberry filled in after turf areas of the park were left unmown, most notably in south Wirth.

As reported by the Kestrel Design Group (2000),

> *In terms of its natural health, Theodore Wirth Park (TWP) is in poor condition with very few quality native plant communities still existing. In many ways it is not very different than other weed dominated urban natural areas. Recruitment by non-native invaders has now become the rule rather than the exception. This makes the restoration effort a long term maintenance commitment rather than a short term fix. Its veneer of green masks an unhealthy, unstable example of a Minnesota native landscape, which in a few more decades without maintenance will see the elimination of its remnant natural areas. However, because of its mass, TWP is more resistant to "edge" pressures than a narrow corridor like the Minnehaha Creek Corridor.*

MPRB Natural Resources staff, volunteers and contractors have worked to control invasive species in South Wirth Park continuously since 2006. A large grant from MNDNR Outdoor Heritage Funds (2014-2019) enhanced habitat in South Wirth and in the north west corner of Wirth Park. The work done with Outdoor Heritage Funds involved forestry mowing in previously cleared areas and additional removal of mature buckthorn. These grant funds also paid for an experimental goat browsing project in two park locations after mature buckthorn removals were completed (2017-2019).

5.7.2 Plant Communities of Theodore Wirth Park

Most of Theodore Wirth Park consists of natural to semi-natural vegetation, dominated by Dry-Mesic Forest/Woodland. Figure 20 (above) illustrates the Park's plant communities addressed in this Phase II plan, and Table 13 presents the acres of each plant community type (including their quality ranks).

Table 13. Theodore Wirth Park Phase II Plant Communities

PLANT COMMUNITIES[1]	ACRES	PERCENT OF STUDY AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**255.2**	**88.8**	**B-NN**
Forest/Woodland	**225.4**	**78.4**	**C-NN**
Mature Forest/Woodland	**156.2**	**54.4**	**C-D**
Dry-Mesic Forest/Woodland (1)	133.0	46.3	CD-D
Mesic Forest (2)	23.2	8.1	C-D
Altered Forest/Woodland (3)	**69.1**	**24.1**	**NN**
Savanna/Brushland	**15.3**	**5.3**	**C-D**
Savanna (4)	9.1	3.2	C-D
Shrub/Scrub (5)	6.2	2.2	D
Grassland	**14.5**	**5.0**	**B-NN**
Prairie (6)	9.7	3.4	B-D
Non-Native Grassland (7)	4.8	1.7	NN
Lowland Communities	**32.2**	**11.2**	**BC-D**
Lowland Forest/Woodland	**12.8**	**4.4**	**BC-D**
Floodplain Forest (8)	5.8	2.0	C-D
Wet Forest/Swamp (9)	4.1	1.4	CD-D
Forested Peatland (10)	2.9	1.0	BC
Lowland Shrub/Scrub	**9.3**	**3.2**	**D**
Lowland Shrub/Scrub (11)	9.3	3.2	D
Lowland Herbaceous	**10.1**	**3.5**	**BC-CD**
Wet Meadow (12)	3.8	1.3	CD
Marsh (13)	6.3	2.2	BC-C
TOTALS (Uplands + Lowlands)[3]	**287.4**	**100.0**	

[1] See Table 1 for descriptions
[2] See Section 3.3 for Ecological Quality Rank definitions; NN = Not a natural community; N/A = not applicable
[3] Rounding of values may make totals appear inaccurate

The Park's highest quality natural areas are those that have been actively managed by MPRB staff, contractors, and volunteers; these have ranks of BC (having characteristics of both B and C quality natural areas). However, the majority of the Park's natural areas are ranked as C, CD or D quality (Figure 20), primarily due to relatively poor native cover, invasive vegetation, and/or their species composition as a result of past human disturbances and other land use practices.

5.7.3 Managed Natural Areas of Theodore Wirth Park

Theodore Wirth Park contains a variety of natural areas, including remnant native plant communities and restored habitats. These areas have been managed over the years by MPRB staff, contractors, and volunteers, primarily by controlling invasive plants.

Forested areas of Wirth park are managed by Environmental Management staff, contractors and volunteers primarily by removing invasive woody species. Prairies are typically managed using prescribed burning (generally on a 3-year rotation) or dormant season mowing and brush sawing of small trees and shrubs. Tree disease management is conducted by the MPRB Forestry Division to minimize the adverse effects of Oak wilt, Dutch elm disease, and Emerald ash borer. As trees are removed from forests, native species from Appendix J may be planted using either: 1) appropriate tree species (to fill canopy gaps where contiguous forest/woodland is desired), or 2) native grasses, sedges, and wildflowers (where prairie openings or savanna are desired).

The Park contains two Managed Natural Areas (Figure 20), which are described briefly below and in greater detail in their own management briefs (Appendix A).

- **Tamarack Bog** (2.9 acres) – This is a remnant tamarack peat bog located west of Birch Pond and near the western edge of the park. The bog is managed by MPRB, and in the 1980s native bog plants were installed along with a boardwalk. Since then, Glossy buckthorn removal efforts have helped suppress this invasive shrub; however, it continues to be a management challenge, and its presence contributed to the bog's quality rank of BC.
- **JD Rivers Prairie** (0.8 acres) – This planted prairie (established in 1997) contains a variety of native grass and wildflower species. This prairie was assigned a quality rank of B due to good native diversity and cover and limited presence of invasive vegetation.

Ecological management is not routinely conducted in portions of Theodore Wirth Park outside of the Managed Natural Areas. See individual plant community management briefs (Appendix A) for details on improving ecological quality for other plant community types found in the Park.

5.7.4 Issues & Opportunities at Theodore Wirth Park

Issues

- Invasive vegetation:
  - o Dominant or common invasive species: Common buckthorn and Garlic mustard (in Mesic Forest, Altered Forest/Woodland, Dry-Mesic Forest/Woodland, Floodplain Forest, and Savanna), Norway maple (in Mesic Forest), Glossy buckthorn (in Forested Peatland), and Reed canary grass (in Wet Meadow).
  - o Additional invasive species: Siberian elm, European highbush cranberry, invasive honeysuckles, Curly dock, Common burdock, Creeping bellflower, Birds-foot trefoil, Yellow and White sweet clover, Alfalfa, White clover, Leafy spurge, Canada thistle, Spotted knapweed, Common St. John's wort, Common mullein, Lamb's quarters, Bittersweet nightshade, Purple loosestrife, Blue (hybrid) cattail, Kentucky bluegrass, Smooth brome, and Barnyard grass.
- Presence of Oak wilt, Dutch elm disease and Emerald ash borer.

Opportunities

- Sustain or improve higher quality native plant communities (e.g., Tamarack Bog, JD Rivers Prairie, and South Theodore Wirth Park Oak Forest).
- Expand restoration, management, and enhancement of other Park natural areas to improve quality and connectivity to Wirth Park..

- Engage volunteers in restoration and management of the park's natural areas.

5.7.5 Goals of Theodore Wirth Park

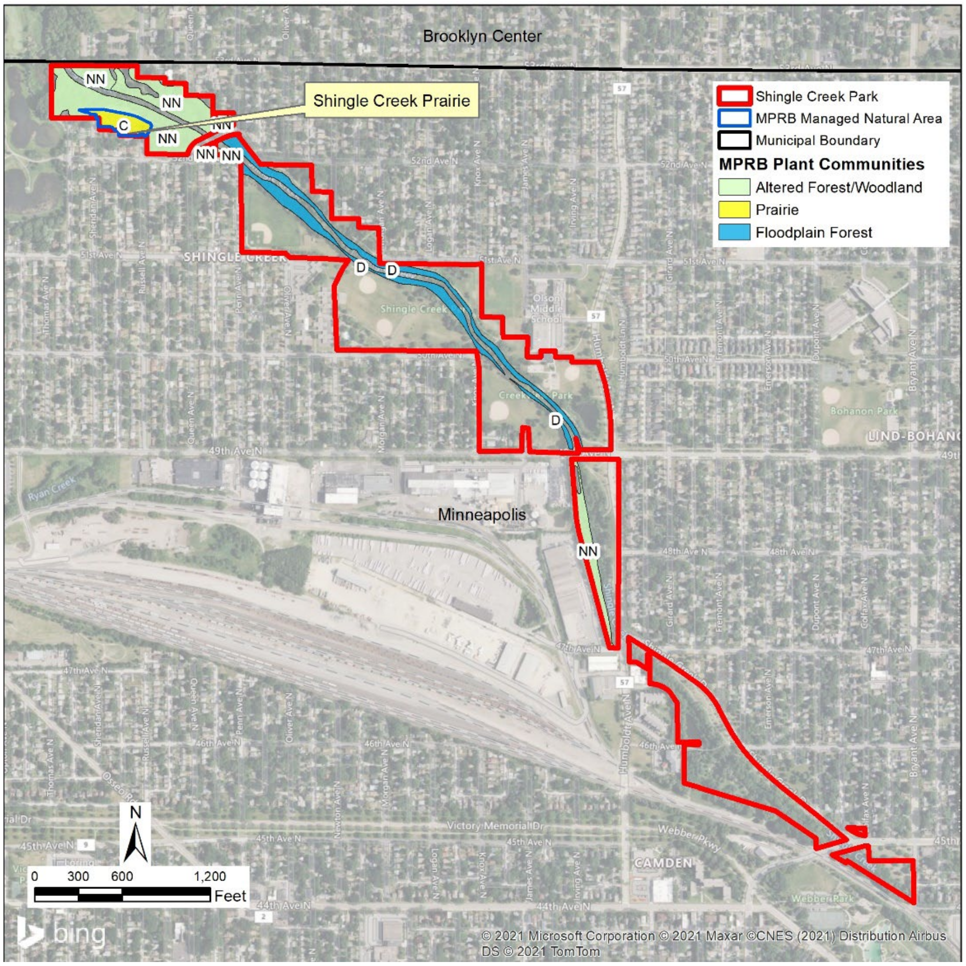
1. Sustain or improve quality rank of the Tamarack Bog and JD Rivers Prairie. The Tamarack Bog was ranked as BC quality, which should be improved to at least a B rank by removing Glossy buckthorn, other woody invasives, and spot treatment of persistent invasive vegetation (e.g., pulling, mowing, spot herbicide). The JD Rivers Prairie should be managed to maintain or increase its quality rank from B to AB by rotational, prescribed burning and spot management of invasive species. See management briefs for details (Appendix A).
2. Maintain other natural areas, beginning with the next highest quality areas (including the South Theodore Wirth Park Oak Forest). This will generally entail the following considerations and tasks. Restoration and management tasks and methods are described in greater detail in Section 6.7.
    a. Restore natural disturbance regimes as appropriate (e.g., prescribed burning in prairies, savannas, and some forests and wetlands).
    b. Use biocontrols for invasive species management, when feasible. Leafy spurge, Spotted knapweed, are present in Theodore Wirth Park, but may not be sufficient to support colonies of beetles. Purple loosestrife beetles were introduced in the 1990s and continue to be working as biocontrols.
    c. Removal of invasive Common buckthorn and other invasive brush.
    d. Remove invasive herbaceous vegetation.
    e. Install diverse native plantings—trees, shrubs, grasses, sedges, forbs, etc.
    f. Strategic management of Oak wilt per MPRB forestry procedures.
3. As trees are removed from forests and canopy gaps occur, determine if the area warrants restoration of contiguous tree canopy (by planting appropriate native trees) or rather if prairie/savanna openings are preferred in order to diversify habitat.
4. Install ecologically-appropriate herbaceous vegetation and shrubs following stormwater outfall and infrastructure rehabilitation projects. Appropriate native species can be selected from the MNDNR species list (Appendix J) that matches the plant community mapped in the outfall/infrastructure location. Trees should not be planted near infrastructure to prevent damage. If planned well, this native revegetation has the potential to buffer and connect adjacent natural areas.
5. Expand and connect natural areas with vegetation wherever possible to reduce the effects of habitat fragmentation (see Section 2.3.1). This could entail conversion of existing turf to native prairie/savanna, native plant gardens, or bee lawns.
6. Develop a more detailed park-specific Natural Resource Management Plan (NRMP) and implement recommendations. A NRMP would expand upon the extensive work done in South Wirth Park to control invasive species and diversify plant communities. A NRMP would take into consideration recreational trails and access points, historic structures, study of the hydrology of the area and a specific management plan for the Tamarack Bog and South Wirth Park.
7. Engage volunteers in Theodore Wirth Park's natural areas.

5.8 Shingle Creek Park

5.8.1 Overview of Shingle Creek Park

Shingle Creek Park consists of approximately 68 acres of land along this urban stream. Shingle Creek flows for 12 miles from its source in Brooklyn Park to its confluence with the Mississippi River in North Mississippi Park (Figure 21).

Figure 21. Shingle Creek Park Location and Phase II Plant Communities



Historically, the Creek was likely a shallow, meandering swale that may have even dried up during the summer months. As the native prairie gave way to agriculture and development, runoff to creeks increased, and many prairie streams were straightened and ditched to provide for more efficient drainage. The Creek derives its name from the shingle mills that once operated on its banks near the Mississippi River. In the 1950s, the MPRB relocated, lowered, and widened the creek bed.

Today, the Creek is typical of many urban streams – a shallow and relatively wide channel with steep, eroded banks. Shingle Creek Park, located along the Creek, features natural riparian habitats (mostly forests) as well as several recreational opportunities. The Park proper consists of 75 acres of land (when you include Creekview and Webber Parks) and provides sports fields and courts, a wading pool, and other amenities. Shingle Creek Regional Trail, an 8.4-mile paved trail runs through the Park. The prairie planted at along Shingle Creek between Penn and Russell Avenue North was planted in 1997, as part of MPRB turf conversion program. This prairie continues to be managed by MPRB Environmental Management staff to this date through prescribed burning, mowing and removal of invasive and weedy species. In 2012, a project to remove buckthorn and invasive species and replant the shoreline with native plantings occurred in the Shingle Creek corridor from 46th to 50th Street North. This work was done by Conservation Corps of Minnesota through a Clean Water Fund grant and the support of the MPRB.

5.8.2 Plant Communities of Shingle Creek Park

Most of Shingle Creek Park consists of maintained turf, ornamental plantings, and developed parkland. Linear bands of natural to semi-natural vegetation exist along Shingle Creek. Figure 21 (above) illustrates the Park's plant communities addressed in this Phase II plan, and Table 14 presents the acres of each plant community type (including their quality ranks).

Table 14. Shingle Creek Park Phase II Plant Communities

PLANT COMMUNITIES[1]	ACRES	PERCENT OF STUDY AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**10.9**	**68.0**	**C-NN**
Forest/Woodland	**9.8**	**61.3**	**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)	**9.8**	**61.3**	**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	**1.1**	**6.8**	**C**
Prairie (6)	1.1	6.8	C
Non-Native Grassland (7)	0.0	0.0	N/A
Lowland Communities	**5.1**	**32.0**	**D**
Lowland Forest/Woodland	**5.1**	**32.0**	**D**
Floodplain Forest (8)	5.1	32.0	D
Wet Forest/Swamp (9)	0.0	0.0	N/A
Forested Peatland (10)	0.0	0.0	N/A
Lowland Shrub/Scrub	**0.0**	**0.0**	**N/A**
Lowland Shrub/Scrub (11)	0.0	0.0	N/A
Lowland Herbaceous	**0.0**	**0.0**	**N/A**
Wet Meadow (12)	0.0	0.0	N/A
Marsh (13)	0.0	0.0	N/A
TOTALS (Uplands + Lowlands)[3]	**16.0**	**100.0**	

[1] See Table 1 for descriptions
[2] See Section 3.3 for Ecological Quality Rank definitions; NN = Not a natural community; N/A = not applicable
[3] Rounding of values may make totals appear inaccurate

Shingle Creek Park's natural areas consist primarily of narrow bands of Altered Forest/Woodland and Floodplain Forest along the Creek (Figure 21). These natural areas range in quality from C to NN, primarily due to relatively poor native cover, invasive vegetation, and/or their species composition as a result of past human disturbances and other land use practices.

5.8.3 Managed Natural Areas of Shingle Creek Park

Shingle Creek Park contains a variety of native plant communities consisting of natural forests as well as planted natural areas. Some of these areas have been managed over the years by MPRB staff, primarily by controlling invasive plants. A management brief (Appendix A) was developed for the Park's following Managed Natural Area (Figure 21).

- **Shingle Creek Prairie** (1.1 acres) – This prairie was planted in 1996, and has since been managed by the MPRB. It has a quality rank of C due to relatively low native diversity and the presence of invasive and weedy species.

Ecological management is not routinely conducted in portions of Shingle Creek Park outside of the planted prairie. See individual plant community management briefs (Appendix A) for details on improving ecological quality for other plant community types found in the Park.

5.8.4 Issues & Opportunities at Shingle Creek Park

Issues

- Invasive vegetation:
    - Dominant or common invasive species: Common buckthorn and Siberian elm (in Floodplain Forest).
    - Additional invasive species: Butter and eggs, Common mullein, Hoary alyssum, Lamb's quarters, Red clover, Bladder campion, Crown vetch, Motherwort, Curly dock, Yellow foxtail, Quackgrass, Smooth brome, Reed canary grass, and Kentucky bluegrass.
- Erosion of creek banks and at stormwater outfalls.

Opportunities

- Improve higher quality native plant communities (e.g., Shingle Creek Prairie).
- Expand restoration, management, and enhancement of other Park natural areas to improve quality and connectivity.
- Expand interpretive opportunities (e.g., signage).
- Engage volunteers in restoration and management of natural areas

5.8.5 Goals of Shingle Creek Park

1. Improve quality rank of Shingle Creek Prairie from C to a rank of at least B by rotational, prescribed burning and spot management of invasive species. See management brief for details (Appendix A).

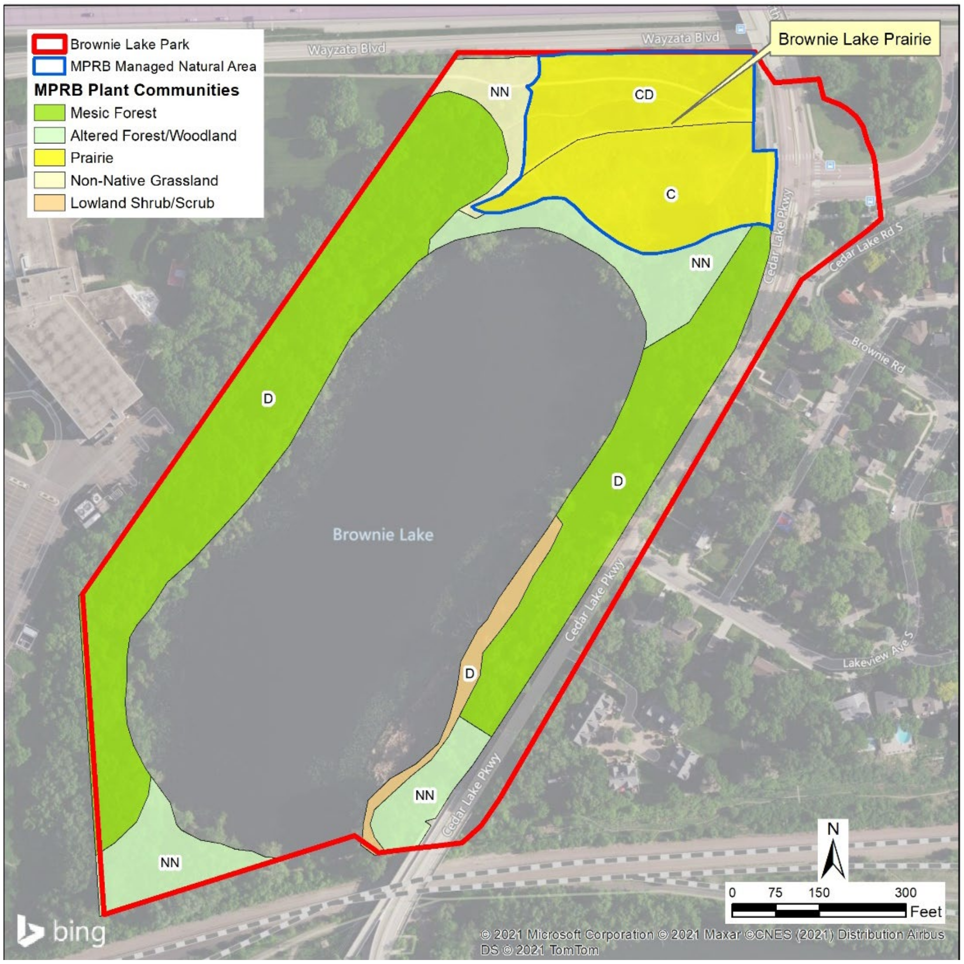
2. Maintain other natural areas, beginning with the next highest quality areas. This will generally entail the following considerations and tasks. Restoration and management tasks and methods are described in greater detail in Section 6.7.
    a. Restore natural disturbance regimes as appropriate (e.g., prescribed burning in prairies, savannas, and some forests and wetlands).
    b. Use biocontrols for invasive species management, when feasible; however, Leafy spurge, Spotted knapweed, and Purple loosestrife (i.e., species for which there are effective biocontrols) are not common in Shingle Creek Park.
    c. Removal of invasive Common buckthorn and other invasive brush.
    d. Remove invasive herbaceous vegetation.
    e. Install diverse native plantings—trees, shrubs, grasses, sedges, forbs, etc.
3. Install ecologically-appropriate herbaceous vegetation and shrubs following stormwater outfall and infrastructure rehabilitation projects. Appropriate native species can be selected from the MNDNR species list (Appendix J) that matches the plant community mapped in the outfall/infrastructure location. Trees should not be planted near infrastructure to prevent damage. If planned well, this native revegetation has the potential to buffer and connect adjacent natural areas.
4. Expand and connect natural areas with vegetation wherever possible to reduce the effects of habitat fragmentation (see Section 2.3.1). This could entail conversion of existing turf to native prairie/savanna, native plant gardens, or bee lawns.
5. Develop a more detailed park-specific Natural Resource Management Plan (NRMP) and implement recommendations.
6. Engage volunteers in restoration and management of the park's natural areas.

5.9 Brownie Lake Park

5.9.1 Overview of Brownie Lake Park

Brownie Lake Park consists of approximately 26.8 acres of land around Brownie Lake. The 11.7-acre Lake is the northernmost waterbody in the Minneapolis Chain of Lakes; Brownie Lake is connected to Cedar Lake via a constructed tunnel (under a railroad corridor and the Cedar Lake Regional Trail, Figure 22).

Figure 22. Brownie Lake Park Location and Phase II Plant Communities



About 12,000 years ago glaciers receded from the region, leaving behind a variety of landforms ranging from flat to rolling to hilly landscapes. In areas, glaciers deposited large mounds of soil called moraines, and melting blocks of ice left behind obvious depressions in the landscape. These glacial processes created the hilly topography seen in the Park today and formed Brownie Lake. Today, the Park is enjoyed by walkers and mountain bikers that use the trails, fisherman and personal watercraft enjoy access to the lake.

The planted prairie on the north side of the park was planted in 1995 as part of MPRB efforts to convert turf areas into native prairie and reduce mowing costs. Since 2004, the Loppet ski trail, which bisects the planted prairie, has been maintained for winter use by annual mowing. Ski trails and increasing mountain bike traffic began to impact the use of this park. In 2012, trails were developed in the forested area on the West side of Brownie Lake Park to provide mountain bike trail access to Theodore Wirth Park, at this time buckthorn was removed from this area for trail development. Brownie Lake Park's forested east side was cleared of buckthorn in 2005 by MPRB and neighborhood volunteers. Bryn Mawr neighborhood funds paid for the removal and replanting of native plants.

5.9.2 Plant Communities of Brownie Lake Park

Almost all of Brownie Lake Park consists of natural to semi-natural vegetation, dominated by Mesic Forest and planted prairie. Figure 22 (above) illustrates the Park's plant communities addressed in this Phase II plan, and Table 15 presents the acres of each plant community type (including their quality ranks).

Table 15. Brownie Lake Park Phase II Plant Communities

PLANT COMMUNITIES[1]	ACRES	PERCENT OF STUDY AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**11.8**	**97.0**	**C-NN**
Forest/Woodland	**8.4**	**69.3**	**D-NN**
Mature Forest/Woodland	**6.4**	**53.1**	**D**
Dry-Mesic Forest/Woodland (1)	0.0	0.0	N/A
Mesic Forest (2)	6.4	53.1	D
Altered Forest/Woodland (3)	**2.0**	**16.2**	**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	**3.4**	**27.8**	**C-NN**
Prairie (6)	2.9	24.0	C-CD
Non-Native Grassland (7)	0.5	3.7	NN
Lowland Communities	**0.4**	**3.0**	**D**
Lowland Forest/Woodland	**0.0**	**0.0**	**N/A**
Floodplain Forest (8)	0.0	0.0	N/A
Wet Forest/Swamp (9)	0.0	0.0	N/A
Forested Peatland (10)	0.0	0.0	N/A
Lowland Shrub/Scrub	**0.4**	**3.0**	**D**
Lowland Shrub/Scrub (11)	0.4	3.0	D
Lowland Herbaceous	**0.0**	**0.0**	**N/A**
Wet Meadow (12)	0.0	0.0	N/A
Marsh (13)	0.0	0.0	N/A
TOTALS (Uplands + Lowlands)[3]	**12.1**	**100.0**	

[1] See Table 1 for descriptions
[2] See Section 3.3 for Ecological Quality Rank definitions; NN = Not a natural community; N/A = not applicable
[3] Rounding of values may make totals appear inaccurate

The Park's highest quality natural areas have ranks of C to D. However, the majority of the Park's natural areas are ranked as C, CD or D quality (Figure 22), primarily due to relatively poor native cover, invasive vegetation, and/or their species composition as a result of past human disturbances and other land use practices.

5.9.3 Managed Natural Areas of Brownie Lake Park

Brownie Lake Park has remnant native plant communities as well as planted natural areas. Some of these areas have been managed over the years by MPRB staff, contractors, and volunteers, primarily by controlling invasive plants (e.g., Common buckthorn). Improvements were made to the Park in 2011, which included trail re-design and removal of common buckthorn from the western forest and re planting of the prairie area. Currently, MPRB is currently managing the planted prairie in the north portion of the Park by mowing and removal of woody species. The Park contains one Managed Natural Area (Figure 22), which is described briefly below and in greater detail in its own management brief (Appendix A).

- **Brownie Lake Prairie** (2.9 acres) – This prairie was planted in 1995. It has a quality rank of C to CD, largely due to woody invasion and other invasive plants.

Ecological management is not routinely conducted in portions of Brownie Lake Park outside of the planted prairie. See individual plant community management briefs (Appendix A) for details on improving ecological quality for other plant community types found in the Park.

5.9.4 Issues & Opportunities at Brownie Lake Park

Issues

- Invasive vegetation:
  - Dominant or common invasive species: none, due to recent management
  - Additional invasive species: White mulberry, invasive honeysuckles, Common buckthorn, Canada thistle, Common Burdock, Wormwood, Leafy spurge, Crown vetch, Birds-foot trefoil, Garlic mustard, Catnip, Motherwort, Curly dock, Purple loosestrife, and Reed canary grass.
- Presence of Oak wilt and Emerald ash borer.

Opportunities

- Improve native plant communities (e.g., Brownie Lake Prairie).
- Conduct strategic restoration and management at other unique natural areas (e.g., oak woodlands).
- Expand restoration, management, and enhancement of other Park natural areas to improve quality and connectivity.
- Expand interpretive opportunities (e.g., signage).
- Engage volunteers in restoration and management of the park's natural areas.

5.9.5 Goals of Brownie Lake Park

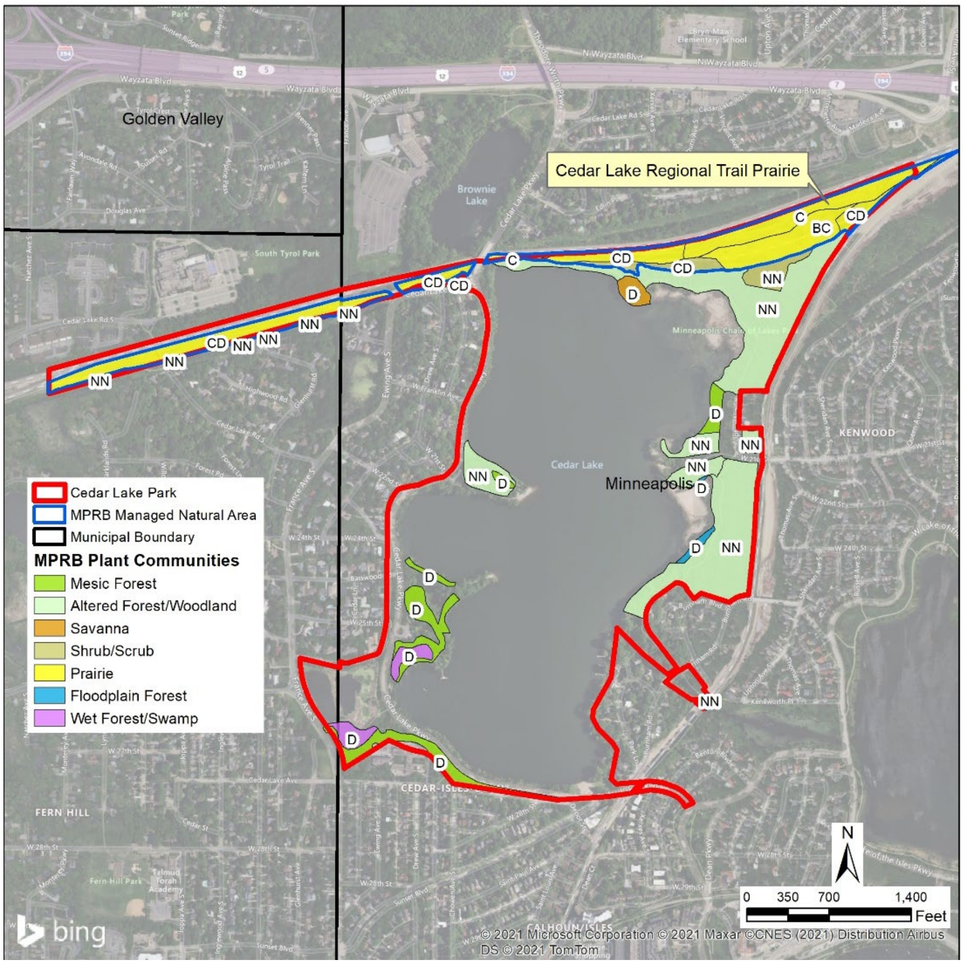
1. Improve quality rank of Brownie Lake Prairie from C/CD to at least C by rotational, prescribed burning and spot management of invasive species. See management brief for details (Appendix A).
2. Maintain other natural areas, beginning with the next highest quality areas. This will generally entail the following considerations and tasks. Restoration and management tasks and methods are described in greater detail in Section 6.7.
    a. Restore natural disturbance regimes as appropriate (e.g., prescribed burning in prairies, savannas, and some forests and wetlands).
    b. Use biocontrols for invasive species management; Leafy spurge and Purple loosestrife are present in Brownie Lake Park, but may not be sufficient to support colonies of beetles.
    c. Removal of invasive Common buckthorn and other invasive brush.
    d. Remove invasive herbaceous vegetation.
    e. Install diverse native plantings—trees, shrubs, grasses, sedges, forbs, etc.
3. Install ecologically-appropriate herbaceous vegetation and shrubs following stormwater outfall and infrastructure rehabilitation projects. Appropriate native species can be selected from the MNDNR species list (Appendix J) that matches the plant community mapped in the outfall/infrastructure location. Trees should not be planted near infrastructure to prevent damage. If planned well, this native revegetation has the potential to buffer and connect adjacent natural areas.
4. Expand and connect natural areas with vegetation wherever possible to reduce the effects of habitat fragmentation (see Section 2.3.1).
5. Develop a more detailed park-specific Natural Resource Management Plan (NRMP) and implement recommendations
6. Engage volunteers to assist with management of Brownie Lake Park's natural areas.

5.10 Cedar Lake Park

5.10.1 Overview of Cedar Lake Park

Cedar Lake Park consists of approximately 305 acres of land around Cedar Lake. The 166.3-acre Lake is part of the Minneapolis Chain of Lakes, connected to Brownie Lake to the north (via a constructed tunnel under a railroad corridor and the Cedar Lake Regional Trail) and to Lake of the Isles to the east (via the constructed Kenilworth Channel, Figure 23).

Figure 23. Cedar Lake Park Location and Phase II Plant Communities



About 12,000 years ago glaciers receded from the region, leaving behind a variety of landforms ranging from flat to rolling to hilly landscapes. In areas, glaciers deposited large mounds of soil called moraines, and melting blocks of ice left behind obvious depressions in the landscape. These glacial processes created the topography seen in the Park today and formed Cedar Lake.

The Park is enjoyed by personal watercraft users paddling the Lake, walkers and cyclists that use the trails, fisherman fish in the land and along its shoreline. Three beaches provide swimming access. Master planning for Cedar Lake and Lake of the Isles began in late 2019.

In the 1990s, former railroad property was turned into a regional bike trail. This initiative was funded through Federal Transportation Funds and supported by the MPRB and Cedar Lake Park Association. Volunteers associated with the Cedar Lake Park Association have been active for many years removing invasive vegetation from the Park forests and re-planting native species. In 2020 volunteers began participation in the Cover it Up project, planting native seed after buckthorn removal.

5.10.2 Plant Communities of Cedar Lake Park

Most of Cedar Lake Park consists of natural to semi-natural vegetation, dominated by Altered Forest/Woodland and the planted prairie. Most of the Park's maintained turf areas, ornamental plantings, and developed parkland are associated with the beaches and trails around the lake. Figure 23 (above) illustrates the Park's plant communities, and Table 16 presents the acres of each plant community type (including their quality ranks).

Table 16. Cedar Lake Park Phase II Plant Communities

PLANT COMMUNITIES[1]	ACRES	PERCENT OF STUDY AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**77.5**	**96.4**	**BC-NN**
Forest/Woodland	**45.8**	**57.0**	**D-NN**
Mature Forest/Woodland	**8.6**	**10.7**	**D**
Dry-Mesic Forest/Woodland (1)	0.0	0.0	N/A
Mesic Forest (2)	8.6	10.7	D
Altered Forest/Woodland (3)	**37.2**	**46.3**	**NN**
Savanna/Brushland	**5.3**	**6.7**	**CD-NN**
Savanna (4)	1.2	1.4	D
Shrub/Scrub (5)	4.2	5.2	NN - CD
Grassland	**26.3**	**32.8**	**BC - CD**
Prairie (6)	26.3	32.8	BC-CD
Non-Native Grassland (7)	0.0	0.0	N/A
Lowland Communities	**2.9**	**3.6**	**D**
Lowland Forest/Woodland	**2.9**	**3.6**	**D**
Floodplain Forest (8)	0.6	0.7	D
Wet Forest/Swamp (9)	2.3	2.8	D
Forested Peatland (10)	0.0	0.0	N/A
Lowland Shrub/Scrub	**0.0**	**0.0**	**N/A**
Lowland Shrub/Scrub (11)	0.0	0.0	N/A
Lowland Herbaceous	**0.0**	**0.0**	**N/A**
Wet Meadow (12)	0.0	0.0	N/A
Marsh (13)	0.0	0.0	N/A
TOTALS (Uplands + Lowlands)[3]	**80.3**	**100.0**	

[1] See Table 1 for descriptions
[2] See Section 3.3 for Ecological Quality Rank definitions; NN = Not a natural community; N/A = not applicable
[3] Rounding of values may make totals appear inaccurate

The Park's highest quality natural areas have ranks of BC to D. However, the majority of the Park's natural areas are ranked as C, CD or D quality (Figure 23), primarily due to relatively poor native cover, invasive vegetation, and/or their species composition as a result of past human disturbances and other land use practices.

5.10.3 Managed Natural Areas of Cedar Lake Park

Currently, MPRB Environmental Management manages only the planted prairie along the Cedar Lake Regional Bike Trail (Figure 23). A management brief (Appendix A) was developed for this Managed Natural Area.

- **Cedar Lake Regional Trail Prairie** (28.2 acres) – This prairie was planted in 1995 and has been maintained by staff contractors and volunteers since that time. Due to the area's history of previously being a railroad yard, invasive species and poor soils present a challenge. At present the MPRB has a goal of implementing prescribed burns of the prairie on a 3 year rotational basis. Aggressive native willows and sumac are controlled by mowing or prescribed burns. Biological controls have been in place since 2003 to control Leafy spurge and Spotted knapweed. The prairie's quality rank ranges from BC to CD, primarily due to differences in native and invasive cover.

Ecological management is not routinely conducted by MPRB in portions of the Cedar Lake Park outside of the planted prairie; however, volunteers have been active removing buckthorn and other invasive species from around the lake. See individual plant community management briefs (Appendix A) for details on improving ecological quality for other plant community types found in the Park.

5.10.4 Issues & Opportunities at Cedar Lake Park

Issues

- Invasive vegetation:
    - o Dominant or common invasive species: Common buckthorn (in Mesic Forest and Altered Forest/ Woodland), Kentucky bluegrass (in Shrub/Scrub), and Reed canary grass (in Wet Meadow).
    - o Additional invasive species: Siberian elm, White mulberry, invasive honeysuckles, Common buckthorn, Canada thistle, Common mullein, White and Yellow sweet clovers, Lamb's quarters, Common Burdock, Wormwood, Leafy spurge, Black nightshade, Crown vetch, Birds-foot trefoil, Hoary alyssum, Creeping bellflower, Garlic mustard, Catnip, St John's wort, Creeping Charlie, Motherwort, Field bindweed, and Curly dock

Opportunities

- Improve native plant communities (e.g., the relatively large, high-visibility Cedar Lake Regional Trail Prairie).
- Conduct strategic restoration and management at other unique natural areas (e.g., oak woodlands).
- Expand restoration, management, and enhancement of other Park natural areas to improve quality and connectivity.
- Sustain volunteer engagement in restoration and management.

5.10.5 Goals of Cedar Lake Park

1. Improve quality rank of Cedar Lake Regional Trail Prairie so all areas are at least C quality by rotational, prescribed burning and spot management of invasive species. See management brief for details (Appendix A).
2. Maintain other natural areas, beginning with the next highest quality areas. This will generally entail the following considerations and tasks. Restoration and management tasks and methods are described in greater detail in Section 6.7.
    a. Restore natural disturbance regimes as appropriate (e.g., prescribed burning in prairies, savannas, and some forests and wetlands).
    b. Continue to use biocontrols for management of invasive Leafy spurge and Spotted knapweed, as feasible.
    c. Removal of invasive Common buckthorn and other invasive brush.
    d. Remove invasive herbaceous vegetation.
    e. Install diverse native plantings—trees, shrubs, grasses, sedges, forbs, etc.
3. Install ecologically-appropriate herbaceous vegetation and shrubs following stormwater outfall and infrastructure rehabilitation projects. Appropriate native species can be selected from the MNDNR species list (Appendix J) that matches the plant community mapped in the outfall/infrastructure location. Trees should not be planted near infrastructure to prevent damage. If planned well, this native revegetation has the potential to buffer and connect adjacent natural areas.
4. Expand and connect natural areas with vegetation wherever possible to reduce the effects of habitat fragmentation (see Section 2.3.1). This could entail conversion of existing turf to native prairie/savanna, native plant gardens, or bee lawns.
5. Develop a more detailed park-specific Natural Resource Management Plan (NRMP) and implement recommendations
6. Sustain the legacy of volunteerism in Cedar Lake Park's natural areas

5.11 Lake of the Isles Park

5.11.1 Overview of Lake of the Isles Park

Lake of the Isles Park consists of approximately 211.5 acres of land and the Lake. The 110.8-acre Lake is part of the Minneapolis Chain of Lakes, connected to Cedar Lake to the west (via the constructed Kenilworth Channel) and to Bde Maka Ska to the south (via the constructed Lake of the Isles Lagoon and Canal, Figure 24). The Park is enjoyed by personal watercraft users in the Lake, walkers and cyclists that use the trails, and fisherman in boats and along the shoreline. There are no beaches around the lake, and an off-leash dog park exists in the southern portion of the Park. Master planning for Lake of the Isles and Cedar Lake began in late 2019.

Figure 24. Lake of the Isles Park Location and Phase II Plant Communities

About 12,000 years ago glaciers receded from the region, leaving behind a variety of landforms ranging from flat to rolling to hilly landscapes. In areas, glaciers deposited large mounds of soil called moraines, and melting blocks of ice left behind obvious depressions in the landscape. These glacial processes created the topography seen in the Park today

Historically, Lake of the Isles was originally a wetland complex, with high points of land (islands), wetland vegetation, and open water. Dredging of the wetland to create the lake took place in various phases between 1889 and 1911. Some of the dredged materials were deposited on the islands, particularly Raspberry Island, creating significant changes to the natural ecosystems. The result is that today the vegetation on Raspberry island is dominated by species that colonize disturbed habitats: Box-elder, Common buckthorn, Green ash, and others. Mike's Island, on the other hand, is representative of a historical "high point", and therefore consists of less dredged soil and has more intact native plant communities, including a maple-basswood-oak forest. Buckthorn is prevalent on both islands, as are fallen trees from storms that have damaged the mature tree canopy. The two islands are designated as wildlife refuges and are not accessible to the public. Buckthorn and invasive woody plant removals were done on both islands by MPRB Forestry and Environmental Management staff the winter of 2007-2008.

5.11.2 Plant Communities of Lake of the Isles Park

Most of Lake of the Isles Park consists of maintained turf, ornamental plantings, and developed parkland. Patches of natural to semi-natural vegetation exist throughout the Park, most notably on its two constructed islands and along the south edge of the Park. Figure 24 (above) illustrates the Park's plant communities, and Table 17 presents the acres of each plant community type (including their quality ranks).

Table 17. Lake of the Isles Park Phase II Plant Communities

PLANT COMMUNITIES[1]	ACRES	PERCENT OF STUDY AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**17.3**	**100.0**	**D-NN**
Forest/Woodland	**17.3**	**100.0**	**D**
Mature Forest/Woodland	**6.3**	**36.4**	**D**
Dry-Mesic Forest/Woodland (1)	0.0	0.0	N/A
Mesic Forest (2)	6.3	36.4	D
Altered Forest/Woodland (3)	**11.0**	**63.6**	**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	**0.0**	**0.0**	**N/A**
Lowland Forest/Woodland	**0.0**	**0.0**	**N/A**
Floodplain Forest (8)	0.0	0.0	N/A
Wet Forest/Swamp (9)	0.0	0.0	N/A
Forested Peatland (10)	0.0	0.0	N/A
Lowland Shrub/Scrub	**0.0**	**0.0**	**N/A**
Lowland Shrub/Scrub (11)	0.0	0.0	N/A
Lowland Herbaceous	**0.0**	**0.0**	**N/A**
Wet Meadow (12)	0.0	0.0	N/A
Marsh (13)	0.0	0.0	N/A
TOTALS (Uplands + Lowlands)[3]	**17.3**	**100.0**	

[1] See Table 1 for descriptions
[2] See Section 3.3 for Ecological Quality Rank definitions; NN = Not a natural community; N/A = not applicable
[3] Rounding of values may make totals appear inaccurate

The Park's highest quality natural areas have a rank of D, primarily due to the presence of invasive species and past human disturbances and other land use practices.

5.11.3 Managed Natural Areas of Lake of the Isles Park

Lake of the Isles Park is largely an altered landscape of parklands developed by dredging and filling of the lake and surrounding wetlands. Management briefs (Appendix A) were developed for the Park's following Managed Natural Areas (Figure 24).

- **Mike's Island** (3.8 acres) – The smaller of the Lake's two constructed islands, this island lies just northwest of Raspberry Island. The island's forest contains mature native trees (e.g., oaks and sugar maples) and a variety of native shrubs and wildflowers. However, due to dredge spoil placement in areas and abundant invasive vegetation, it nonetheless has a quality rank of D. The island is a designated wildlife refuge and access is prohibited.
- **Raspberry Island** (7.3 acres) – This is the larger of the two islands, constructed with dredge spoils from excavating the Lake. While the site contains some mature native trees, most of the

vegetation consists of volunteer woody species. This fact, coupled with abundant invasive vegetation (including Common buckthorn), resulted in a quality rank of NN. As with Mike's Island, Raspberry Island is a designated wildlife refuge and access is prohibited.

Ecological management is not routinely conducted in portions of Lake of the Isles Park outside of the islands. See individual plant community management briefs (Appendix A) for details on improving ecological quality for other plant community types found in the Park.

5.11.4 Issues & Opportunities at Lake of the Isles Park

Issues

- Invasive vegetation:
    - Dominant or common invasive species: Siberian elm, Common buckthorn, and White mulberry (in Altered Forest/Woodland and Mesic Forest).
    - Additional invasive species: Glossy buckthorn, Bittersweet nightshade, Oriental bittersweet, invasive honeysuckles, Canada thistle, Motherwort, Day lily, Garlic mustard, Lily-of-the-valley, and Purple loosestrife.
- Presence of emerald ash borer and Dutch elm disease.

Opportunities

- Improve native plant communities (e.g., Raspberry Island and Mike's Island)
- Engage volunteers in restoration and management

5.11.5 Goals of Lake of the Isles Park

1. Improve quality rank of Mike's Island from D to at least C and Raspberry Island from NN to at least C. This would entail controlling invasive species and re-planting with diverse, native vegetation. Timing and methods of restoration and management work should be executed sensitively on these wildlife refuge islands. See management brief for details (Appendix A).
2. Maintain natural areas, which will generally entail the following considerations and tasks. Restoration and management tasks and methods are described in greater detail in Section 6.7.
    a. Restore natural disturbance regimes as appropriate (e.g., prescribed burning in prairies, savannas, and some forests and wetlands).
    b. Biocontrols are in place for purple loosestrife; expand their use for other invasive species management when feasible.
    c. Removal of invasive Common buckthorn and other invasive woody plants.
    d. Remove invasive herbaceous vegetation.
    e. Install diverse native plantings—trees, shrubs, grasses, sedges, forbs, etc.
3. Install ecologically-appropriate herbaceous vegetation and shrubs following stormwater outfall and infrastructure rehabilitation projects. Appropriate native species can be selected from the MNDNR species list (Appendix J) that matches the plant community mapped in the outfall/infrastructure location. Trees should not be planted near infrastructure to prevent

damage. If planned well, this native revegetation has the potential to buffer and connect adjacent natural areas.

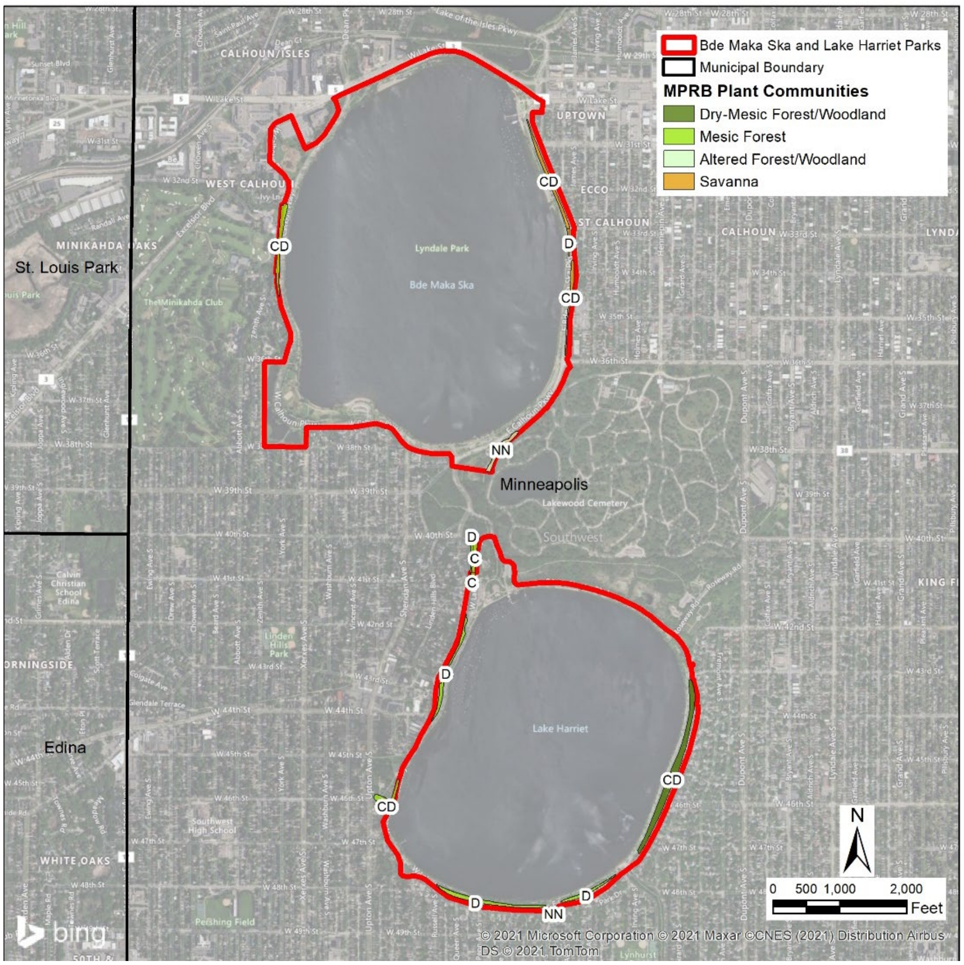
4. Engage volunteers to assist with management of Lake of the Isles Park's natural areas.

5.12 Bde Maka Ska and Lake Harriet Parks

5.12.1 Overview of Bde Maka Ska and Lake Harriet Parks

Bde Maka Ska and Lake Harriet Parks consist of approximately 918 acres of land including the two lakes (Figure 25). The 418.1-acre Bde Maka Ska and 343.8-acre Lake Harriet are part of the Minneapolis Chain of Lakes. Bde Maka Ska is connected to Lake of the Isles to the north, via the constructed Lake of the Isles Lagoon and Canal. Water flows south from Bde Maka Ska, through an open channel and underground pipe into Lake Harriet. Water exits Lake Harriet via a channel on the Lake's southeast shoreline which flows into Minnehaha Creek.

Figure 25. Bde Maka Ska and Lake Harriet Park Location and Phase II Plant Communities



About 12,000 years ago glaciers receded from the region, leaving behind a variety of landforms ranging from flat to rolling to hilly landscapes. In areas, glaciers deposited large mounds of soil called moraines, and melting blocks of ice left behind obvious depressions in the landscape. These glacial processes created the topography seen in the Park today and formed Bde Maka Ska and Lake Harriet.

A gathering space and public artwork on the southeast shore of Bde Maka Ska acknowledges and celebrates the presence and history of the native Dakota people and Chief Cloudman's village that was located near the lake.

Notable physical changes that have occurred to these parks including construction of the channel connecting Bde Maka Ska to Lake of the Isles, dredging and reshaping shorelines, and filling low areas and wetlands to create space for parkland (MPRB 2017). Today, Bde Maka Ska and Lake Harriet are two of the most visited parks in the entire park system. More about the Parks (their natural and cultural history, existing visitor uses, and recommended improvements) can be found in the Minneapolis Chain of Lakes Regional Park – Calhoun/Bde Maka Ska – Harriet Master Plan (MPRB 2017a).

5.12.2 Plant Communities of Bde Maka Ska and Lake Harriet Parks

Most of Bde Maka Ska and Lake Harriet Parks consist of maintained turf, ornamental plantings, and developed parkland. Patches and linear bands of natural to semi-natural vegetation exist in the Parks, mostly along slopes leading down to the lakes. Figure 25 (above) illustrates the Park's plant communities, and Table 18 presents the acres of each plant community type (including their quality ranks).

Table 18. Bde Maka Ska and Lake Harriet Park Phase II Plant Communities

PLANT COMMUNITIES[1]	ACRES	PERCENT OF STUDY AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**16.8**	**100.0**	**C-NN**
Forest/Woodland	**14.1**	**84.1**	**C-NN**
Mature Forest/Woodland	**12.8**	**76.0**	**C-CD**
Dry-Mesic Forest/Woodland (1)	4.8	28.6	CD
Mesic Forest (2)	8.0	47.4	C-CD
Altered Forest/Woodland (3)	**1.4**	**8.0**	**NN**
Savanna/Brushland	**2.7**	**15.9**	**CD - D**
Savanna (4)	2.7	15.9	CD - D
Shrub/Scrub (5)	0.0	0.0	N/A
Grassland	**0.0**	**0.0**	**C**
Prairie (6)	0.0	0.0	C
Non-Native Grassland (7)	0.0	0.0	N/A
Lowland Communities	**0.0**	**0.0**	**N/A**
Lowland Forest/Woodland	**0.0**	**0.0**	**N/A**
Floodplain Forest (8)	0.0	0.0	N/A
Wet Forest/Swamp (9)	0.0	0.0	N/A
Forested Peatland (10)	0.0	0.0	N/A
Lowland Shrub/Scrub	**0.0**	**0.0**	**N/A**
Lowland Shrub/Scrub (11)	0.0	0.0	N/A
Lowland Herbaceous	**0.0**	**0.0**	**N/A**
Wet Meadow (12)	0.0	0.0	N/A
Marsh (13)	0.0	0.0	N/A
TOTALS (Uplands + Lowlands)[3]	**16.8**	**100.0**	

[1] See Table 1 for descriptions
[2] See Section 3.3 for Ecological Quality Rank definitions; NN = Not a natural community; N/A = not applicable
[3] Rounding of values may make totals appear inaccurate

The Park's highest quality natural areas have ranks of C to CD (Figure 25), primarily due to the presence of invasive species.

5.12.3 Managed Natural Areas of Bde Maka Ska and Lake Harriet Parks

Bde Maka Ska and Lake Harriet Parks have woodland plant communities mostly along slopes leading down to the lakes. These linear bands of natural to semi-natural forest exist throughout the Parks. Woodland areas around Lake Harriet and Bde Maka Ska. Through a USDA grant, initial buckthorn removals were done in the early 2000s by MPRB staff. Control of buckthorn in these forested areas has continued sporadically over the years by MPRB staff and volunteers, primarily to allow for visibility to the lake and for safety concerns. Currently, MPRB is not consistently managing these areas within these Parks. See individual plant community management briefs (Appendix A) for details on improving ecological quality for plant community types found in the Park,

5.12.4 Issues & Opportunities at Bde Maka Ska and Lake Harriet Parks

Issues

- Invasive vegetation:
  - Dominant or common invasive species: Common buckthorn (in Dry-Mesic Forest/Woodland, Mesic Forest, and Savanna).
  - Additional invasive species: White mulberry, invasive honeysuckles, Canada thistle, Garlic mustard, Creeping Charlie, Lamb's quarters, Day lily, and Smooth brome.

Opportunities

- Improve native plant communities (e.g., Mesic Forests around lakes).
- Conduct strategic restoration and management at other unique natural areas.
- Expand restoration, management, and enhancement of other Park natural areas to improve quality and connectivity.
- Expand interpretive opportunities (e.g., signage).
- Sustain and expand volunteer engagement in restoration and management.

5.12.5 Goals of Bde Maka Ska and Lake Harriet Parks

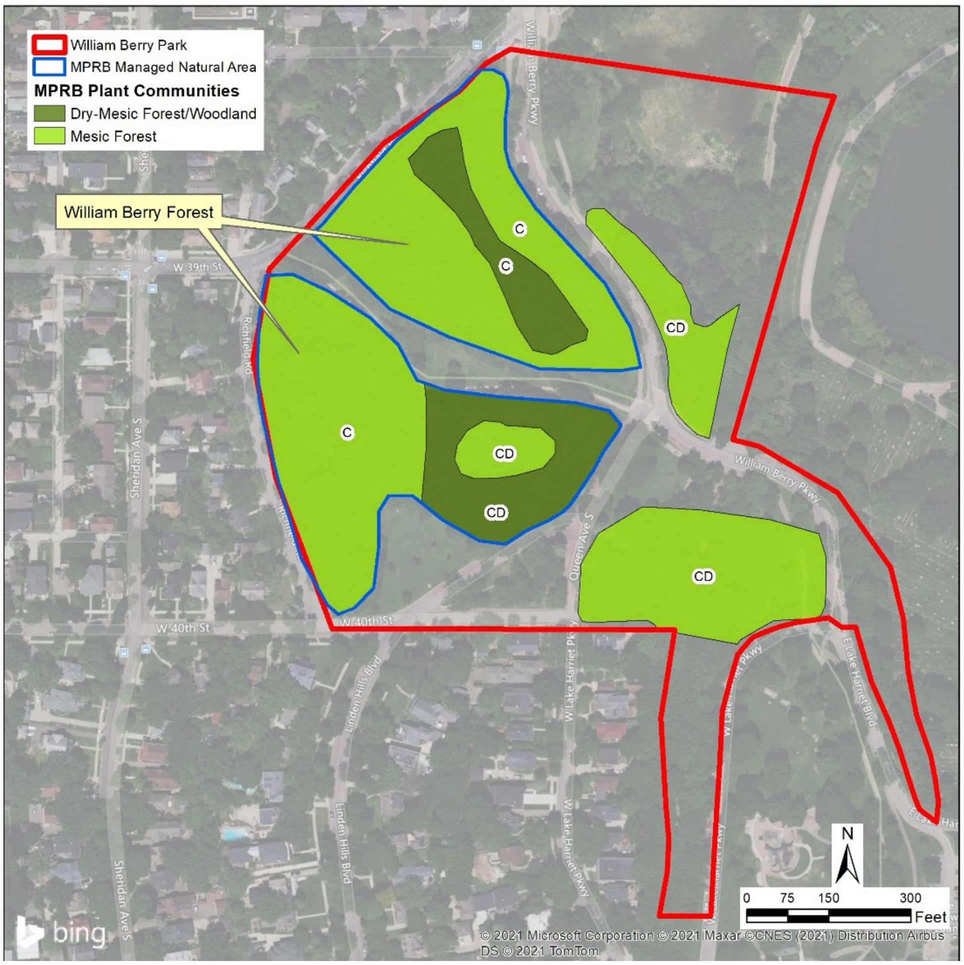
1. Improve quality ranks of the highest quality natural areas in Bde Maka Ska and Lake Harriet Parks to at least C. This will generally entail the following considerations and tasks. Restoration and management tasks and methods are described in greater detail in Section 6.7.
   a. Restore natural disturbance regimes as appropriate (e.g., prescribed burning in prairies, savannas, and some forests and wetlands).
   b. Use biocontrols for invasive species management, when feasible; however, Leafy spurge, Spotted knapweed, and Purple loosestrife (i.e., species for which there are effective biocontrols) are not common in Bde Maka Ska and Lake Harriet Parks.
   c. Removal of invasive Common buckthorn and other invasive brush.
   d. Remove invasive herbaceous vegetation.
   e. Install diverse native plantings—trees, shrubs, grasses, sedges, forbs, etc.
2. Install ecologically-appropriate herbaceous vegetation and shrubs following stormwater outfall and infrastructure rehabilitation projects. Appropriate native species can be selected from the MNDNR species list (Appendix J) that matches the plant community mapped in the outfall/infrastructure location. Trees should not be planted near infrastructure to prevent damage. If planned well, this native revegetation has the potential to buffer and connect adjacent natural areas.
3. Expand and connect natural areas with vegetation wherever possible to reduce the effects of habitat fragmentation (see Section 2.3.1). This could entail conversion of existing turf to native prairie/savanna, native plant gardens, or bee lawns.
4. Develop a more detailed park-specific Natural Resource Management Plan (NRMP) and implement recommendations.
5. Foster volunteerism in Bde Maka Ska and Lake Harriet Parks' natural areas.

5.13 William Berry Park

5.13.1 Overview of William Berry Park

William Berry Park consists of approximately 23.1 acres of land area located between Bde Maka Ska (to the north) and Lake Harriet (to the south) in the eastern portion of the Linden Hills Neighborhood (Figure 26). The Park is named in honor of William Morse Berry, who served as the first Superintendent of the Minneapolis park system from 1885 to 1906.

Figure 26. William Berry Park Location and Phase II Plant Communities



About 12,000 years ago glaciers receded from the region, leaving behind a variety of landforms ranging from flat to rolling to hilly landscapes. In areas, glaciers deposited large mounds of soil called moraines, and melting blocks of ice left behind obvious depressions in the landscape. These glacial processes and fill soils brought into the area as the parks were being developed in the 1900s created the hilly topography of William Berry Park. The Park is enjoyed for its natural beauty, including mature maple and oak forests. Nature lovers enjoy this natural area with its bird life and native wildflowers.

Grant and neighborhood funds in the early 2000s allowed MPRB staff and volunteers to remove mature buckthorn. Volunteers continue buckthorn control efforts to this day in the William Berry Forest, the two larger forested areas off Richfield Road. Native shrubs and wildflowers have been replanted into the William Berry Forest using neighborhood and MPRB funds.

5.13.2 Plant Communities of William Berry Park

William Berry Park contains native Mesic Forest and Dry-Mesic Forest/Woodland. Table 19 presents the acres of each plant community type (including their quality ranks).

Table 19. William Berry Park Phase II Plant Communities

PLANT COMMUNITIES[1]	ACRES	PERCENT OF STUDY AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**11.3**	**100.0**	**C-CD**
Forest/Woodland	**11.3**	**100.0**	**C-CD**
Mature Forest/Woodland	**11.3**	**100.0**	**C-CD**
Dry-Mesic Forest/Woodland (1)	2.1	18.9	C-CD
Mesic Forest (2)	9.2	81.1	C-CD
Altered Forest/Woodland (3)	**0.0**	**0.0**	**N/A**
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	**0.0**	**0.0**	**N/A**
Lowland Forest/Woodland	**0.0**	**0.0**	**N/A**
Floodplain Forest (8)	0.0	0.0	N/A
Wet Forest/Swamp (9)	0.0	0.0	N/A
Forested Peatland (10)	0.0	0.0	N/A
Lowland Shrub/Scrub	**0.0**	**0.0**	**N/A**
Lowland Shrub/Scrub (11)	0.0	0.0	N/A
Lowland Herbaceous	**0.0**	**0.0**	**N/A**
Wet Meadow (12)	0.0	0.0	N/A
Marsh (13)	0.0	0.0	N/A
TOTALS (Uplands + Lowlands)[3]	**11.3**	**100**	

[1] See Table 1 for descriptions
[2] See Section 3.3 for Ecological Quality Rank definitions; NN = Not a natural community; N/A = not applicable
[3] Rounding of values may make totals appear inaccurate

The Park's highest quality natural areas are those that have been actively managed by MPRB staff and volunteers; these have ranks of CD (having characteristics of both C and D quality natural areas). However, the majority of the Park's natural areas are ranked as C, CD or D quality (Figure 26), primarily due to the presence of invasive species.

5.13.3 Managed Natural Areas of William Berry Park

William Berry Park consists primarily of remnant upland forests (Figure 26). These areas have been managed over the years by MPRB staff and volunteers, primarily by controlling invasive plants and replanting with native shrubs and wildflowers. The Park contains one Managed Natural Area (Figure 26), which is described briefly below and in greater detail in its own management brief (Appendix A).

- **William Berry Forest** (8.4 acres) – This forest consists of Mesic Forest and Dry-Mesic Forest/Woodland. Patches of native wildflowers persist in this remnant forest. The area was assigned quality ranks ranging from C to CD, primarily due to relatively low native diversity and the presence of invasive and weedy species.

5.13.4 Issues & Opportunities at William Berry Park

Issues

- Invasive vegetation:
  - Dominant or common invasive species: none.
  - Additional invasive species: White poplar, Common buckthorn, Glossy buckthorn, Canada thistle, Purple loosestrife, and Reed canary grass.

Opportunities

- Improve quality of forested plant community
- Expand restoration, management, and enhancement of other Park areas
- Sustain volunteer engagement in restoration and management

5.13.5 Goals of William Berry Park

1. Improve quality rank of William Berry Forest to at least a C by removing Common buckthorn and spot treatment of persistent invasive vegetation (e.g., pulling, mowing, spot herbicide). See management brief for details (Appendix A).
2. Begin management in highest quality areas. This will generally entail the following considerations and tasks. Restoration and management tasks and methods are described in greater detail in Section 6.7.
   a. Restore natural disturbance regimes as appropriate (e.g., prescribed burning in prairies, savannas, and some forests and wetlands).
   b. Use biocontrols for invasive species management, when feasible; however, Leafy spurge, Spotted knapweed, and Purple loosestrife (i.e., species for which there are effective biocontrols) are not known to be present in William Berry Park.
   c. Removal of invasive Common buckthorn and other invasive woody plants.
   d. Remove invasive herbaceous vegetation.
   e. Install diverse native plantings—trees, shrubs, grasses, sedges, forbs, etc.
3. Expand and connect natural areas with vegetation wherever possible to reduce the effects of habitat fragmentation (see Section 2.3.1). This could entail conversion of existing turf to native prairie/savanna, native gardens or bee lawn.

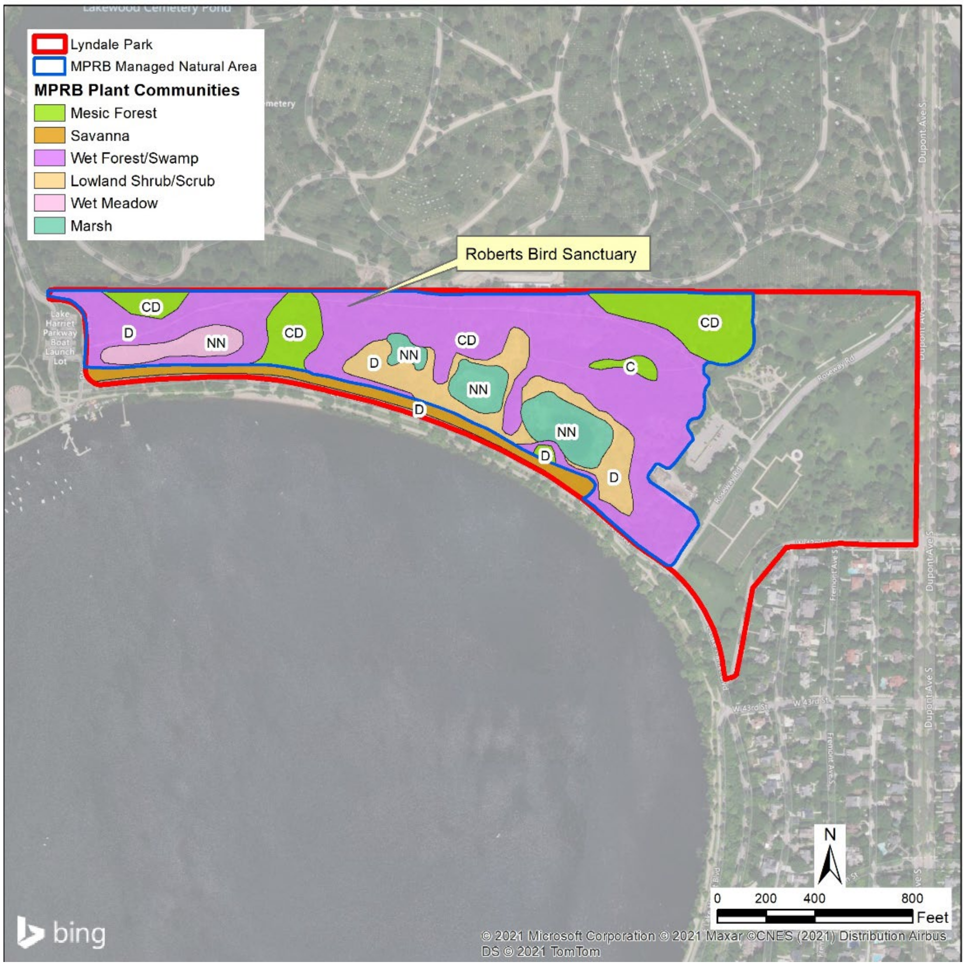
4. Develop a more detailed park-specific Natural Resource Management Plan (NRMP) and implement recommendations.
5. Sustain the legacy of volunteerism in William Berry Park's natural areas.

5.14 Lyndale Park

5.14.1 Overview of Lyndale Park

Lyndale Park consists of approximately 57.9 acres of land area located just north of Lake Harriet and south of Lakewood Cemetery in the East Harriet neighborhood (Figure 27). The Park is named after Lyndale Farm, which once surrounded Lake Harriet.

Figure 27. Lyndale Park Location and Phase II Plant Communities



About 12,000 years ago glaciers receded from the region, leaving behind a variety of landforms ranging from flat to rolling to hilly landscapes. In areas, glaciers deposited large mounds of soil called moraines, and melting blocks of ice left behind obvious depressions in the landscape. These glacial processes created the rolling topography and lakes found in the Park today. The Park is enjoyed for its gardens, maintained lawns, and large landscape trees. The Park's gardens include the Rose Garden, Annual-Perennial Gardens, and Peace Garden.

The Roberts Bird Sanctuary, named in 1947 for Thomas Sadler Roberts, a retired doctor and professor of ornithology at the University of Minnesota, is a 31-acre natural area within the park (MPRB 2013 draft and 2015). The Sanctuary was initially an access road to Lake Harriet and the easement for the first sanitary sewer line that has served the neighborhood since 1918. Ditching, filling, and dredging of ponds have greatly altered the hydrology and vegetation of the Sanctuary over the years. Additionally, a tornado in the 1980s caused significant damage to the Lake Harriet area and the Bird Sanctuary in particular. Restoration activities to rehabilitate the Sanctuary were initiated after the tornado with grant, MPRB, and neighborhood funds. These activities included development of waterfowl ponds, buckthorn removal, native plantings, and construction of an interpretive shelter at the Sanctuary entrance. The Sanctuary continues to be a valuable natural area, providing habitat for migrating birds and a place for nature observation in the heart of the city. At present Friends of Roberts Bird Sanctuary and Audubon Chapter of Minneapolis continue invasive species removals and native plant enhancements to the Sanctuary, through their MPRB Park Stewardship Agreement.

In late 2019, MPRB Forestry staff cleared Lyndale Park's northeastern Mesic Forest of ash trees (due to Emerald ash borer), dramatically altering the forest structure and composition. Native tree plantings have been installed in these areas, and over time they will fill canopy gaps and restore a more natural forest community.

5.14.2 Plant Communities of Lyndale Park

The eastern portion of Lyndale Park is dominated by gardens and lawn, proving space for picnicking and lawn games. The western portion of the Park is dominated by wooded wetlands (i.e., Wet Forest/Swamp and Lowland Shrub/Scrub) of Roberts Bird Sanctuary. Several other natural and semi-natural habitats exist in the Sanctuary, most notably, small remnant stands of Mesic Forest. Figure 27 (above) illustrates the Park's plant communities, and Table 20 presents the acres of each plant community type (including their quality ranks).

Table 20. Lyndale Park Phase II Plant Communities

PLANT COMMUNITIES[1]	ACRES	PERCENT OF STUDY AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**7.4**	**22.1**	**C-D**
Forest/Woodland	**5.3**	**15.7**	**C-D**
Mature Forest/Woodland	**5.3**	**15.7**	**C-D**
Dry-Mesic Forest/Woodland (1)	0.0	0.0	N/A
Mesic Forest (2)	5.3	15.7	C-D
Altered Forest/Woodland (3)	**0.0**	**0.0**	**N/A**
Savanna/Brushland	**2.1**	**6.4**	**D**
Savanna (4)	2.1	6.4	D
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	**26.1**	**77.9**	**CD-NN**
Lowland Forest/Woodland	**18.2**	**54.3**	**CD-D**
Floodplain Forest (8)	0.0	0.0	N/A
Wet Forest/Swamp (9)	18.2	54.3	CD-D
Forested Peatland (10)	0.0	0.0	N/A
Lowland Shrub/Scrub	**3.8**	**11.5**	**D**
Lowland Shrub/Scrub (11)	3.8	11.5	D
Lowland Herbaceous	**4.1**	**12.1**	**NN**
Wet Meadow (12)	1.2	3.5	NN
Marsh (13)	2.9	8.7	NN
TOTALS (Uplands + Lowlands)[3]	**33.5**	**100.0**	

[1] See Table 1 for descriptions
[2] See Section 3.3 for Ecological Quality Rank definitions; NN = Not a natural community; N/A = not applicable
[3] Rounding of values may make totals appear inaccurate

Mesic Forests in Roberts Bird Sanctuary were identified as the Park's highest quality natural areas (C to CD quality), due to the presence of some mature native trees and limited native ground cover. However, recent restoration and management work (especially removal of buckthorn) has improved the quality of many of the Park's lowland areas, including the Sanctuary's wooded wetlands (discussed below).

5.14.3 Managed Natural Areas of Lyndale Park

Lyndale Park's natural areas are generally confined to Roberts Bird Sanctuary (Figure 27). MPRB staff and the community developed management plans for the Sanctuary (MPRB 2013 draft and 2015), which is described briefly below and in greater detail in its own management brief (Appendix A).

- **Roberts Bird Sanctuary** (31.3 acres) – This natural area consists of a mosaic of upland and mostly wetland plant communities. Quality ranks range from C to NN due to invasive vegetation and as a result of past human disturbances and other land use practices.

Ecological management is not routinely conducted by MPRB in portions of Lyndale Park outside of the Sanctuary. See individual plant community management briefs (Appendix A) for details on improving ecological quality for other plant community types found in the Park.

5.14.4 Issues & Opportunities at Lyndale Park

Issues

- Invasive vegetation:
    - Dominant and common invasive species: Norway maple (in Altered Forest/Woodland) and Common buckthorn (in Mesic Forest).
    - Additional invasive species: White mulberry, White poplar, Glossy buckthorn, Wayfaring tree, invasive honeysuckles, European high bush cranberry, Garlic mustard, Creeping Charlie, Purple loosestrife, Canada thistle, and Reed canary grass.
- Presence of Dutch elm disease and Emerald ash borer (many ash were removed in 2019).
- Hydrologic alterations, which have affected soils and plant communities through the years.

Opportunities

- Improve quality of natural areas in high public use parks.
- Expand restoration, management, and enhancement of other Park areas to improve quality and connectivity.
- Sustain and expand volunteer engagement in restoration and management of the Park's natural areas.

5.14.5 Goals of Lyndale Park

1. Continue to improve quality ranks of forests and wetlands by removing Common buckthorn and spot treatment of persistent invasive vegetation (e.g., pulling, mowing, spot herbicide). Quality ranks have recently been improved in some areas. The Park's wooded wetlands should be restored to at least C quality, and the Park's upland Mesic Forests should be restored to at least C quality. See management brief for details (Appendix A).
2. Maintain other natural areas, beginning with the next highest quality areas. This will generally entail the following considerations and tasks. Restoration and management tasks and methods are described in greater detail in Section 6.7.
    a. Restore natural disturbance regimes as appropriate (e.g., prescribed burning in prairies, savannas, and some forests and wetlands).
    b. Use biocontrols for invasive species management, when feasible. Purple loosestrife biocontrols were released in the Sanctuary wetlands in the 1990s and are present today.
    c. Removal of invasive Common buckthorn and other invasive woody plants.
    d. Remove invasive herbaceous vegetation.
    e. Install diverse native plantings—trees, shrubs, grasses, sedges, forbs, etc.

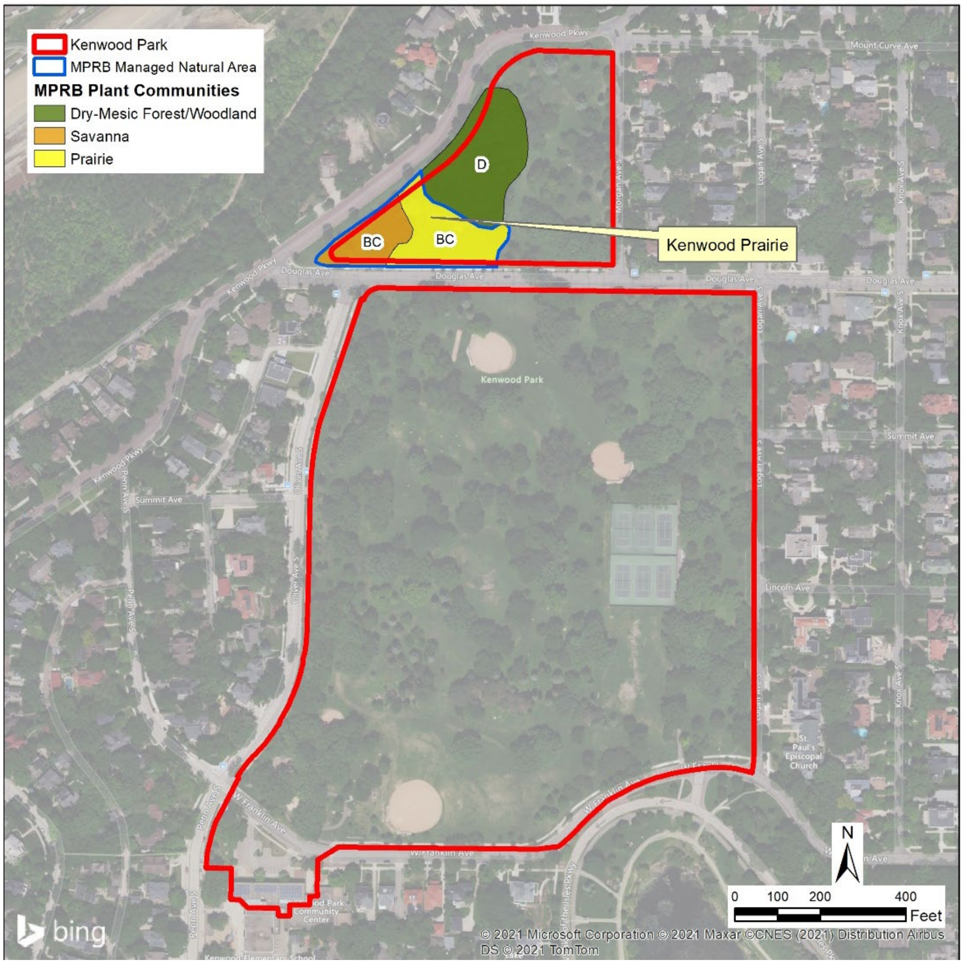
3. Expand and connect natural areas with vegetation wherever possible to reduce the effects of habitat fragmentation (see Section 2.3.1). This could entail conversion of existing turf to native prairie/savanna or native gardens (e.g., butterfly gardens).
4. Develop a more detailed park-specific Natural Resource Management Plan (NRMP) and implement recommendations.
5. Sustain the legacy of volunteerism in Lyndale Park's natural areas.

5.15 Kenwood Park

5.15.1 Overview of Kenwood Park

Kenwood Park is a Neighborhood Park that consists of approximately 33 acres of parkland just north of Lake of the Isles (Figure 28). When glaciers receded from the region, they left behind the rolling topography seen in the Park today. Kenwood Park's, ballfields, tennis courts, extensive lawn areas and a Community Center afford park users both active and passive recreation opportunities.

Figure 28. Kenwood Park Location and Phase II Plant Communities



The prairie planted in the northwest section of the park was planted in 1997 as part of MPRB turf conversion efforts to re-introduce native prairie plants into the parks and reduce mowing costs. The prairie has been maintained by MPRB staff through prescribed burning, mowing, and removal of invasive woody plants. The small 1-acre oak woodland, near the prairie, has been managed intermittently by MPRB staff and volunteers to remove buckthorn and other invasive plants.

5.15.2 Plant Communities of Kenwood Park

Most of Kenwood Park consists of maintained turf with scattered trees. The hill in the northern portion of the Park contains the planted prairie and small woodland. Figure 28 (above) illustrates the Park's plant communities, and Table 21 presents the acres of each plant community type (including their quality ranks).

Table 21. Kenwood Park Phase II Plant Communities

PLANT COMMUNITIES[1]	ACRES	PERCENT OF STUDY AREA	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**2.4**	**100.0**	**BC-D**
Forest/Woodland	**1.2**	**48.9**	**D**
Mature Forest/Woodland	**1.2**	**48.9**	**D**
Dry-Mesic Forest/Woodland (1)	1.2	48.9	D
Mesic Forest (2)	0.0	0.0	N/A
Altered Forest/Woodland (3)	0.0	0.0	N/A
Savanna/Brushland	**0.5**	**19.2**	**BC**
Savanna (4)	0.5	19.2	BC
Shrub/Scrub (5)	0.0	0.0	N/A
Grassland	**0.8**	**31.9**	**BC**
Prairie (6)	0.8	31.9	BC
Non-Native Grassland (7)	0.0	0.0	N/A
Lowland Communities	**0.0**	**0.0**	**N/A**
Lowland Forest/Woodland	**0.0**	**0.0**	**N/A**
Floodplain Forest (8)	0.0	0.0	N/A
Wet Forest/Swamp (9)	0.0	0.0	N/A
Forested Peatland (10)	0.0	0.0	N/A
Lowland Shrub/Scrub	**0.0**	**0.0**	**N/A**
Lowland Shrub/Scrub (11)	0.0	0.0	N/A
Lowland Herbaceous	**0.0**	**0.0**	**N/A**
Wet Meadow (12)	0.0	0.0	N/A
Marsh (13)	0.0	0.0	N/A
TOTALS (Uplands + Lowlands)[3]	**2.4**	**100.0**	

[1] See Table 1 for descriptions
[2] See Section 3.3 for Ecological Quality Rank definitions; NN = Not a natural community; N/A = not applicable
[3] Rounding of values may make totals appear inaccurate

The Park's planted Prairie and Savanna are quite healthy and diverse (see below); however, the adjacent Dry-Mesic Forest/Woodland is D quality (Figure 28), primarily due to the abundance of invasive species (e.g., Common buckthorn).

5.15.3 Managed Natural Areas of Kenwood Park

Currently, the planted prairie is the only Managed Natural Area in Kenwood Park (Figure 28). This area has been managed over the years by MPRB staff primarily by controlling invasive plants and occasional burning and mowing. A management brief (Appendix A) was developed for the Park's Managed Natural Area.

- **Kenwood Prairie** (1.2 acres) – The Park's planted Prairie/Savanna (referred to as the Kenwood Prairie) have ranks of BC due to moderate native diversity and cover, but presence of some invasive vegetation. These are some of the highest ecological quality ranks in the MPRB park system, due to the consistent efforts to maintain these areas.

5.15.4 Issues & Opportunities at Kenwood Park

Issues

- Invasive vegetation:
  - Dominant and common invasive species: Common buckthorn (in Dry-Mesic Forest/Woodland).
  - Additional invasive species: White mulberry, invasive honeysuckles, Canada thistle, Spotted knapweed, White sweet clover, Hoary alyssum, Crown vetch, Quackgrass, Smooth brome, Garlic mustard, and Burdock.
- Informal paths created by park users through the prairie.

Opportunities

- Maintain or improve high-visibility native plant communities.
- Expand restoration, management, and enhancement of other Park natural areas (e.g., adjacent forest/woodland) to improve quality and connectivity.
- Expand interpretive opportunities (e.g., signage)
- Engage volunteers in restoration and management of Park natural areas.

5.15.5 Goals of Kenwood Park

1. Maintain or improve BC quality rank of the prairie. This should entail continued management including regular, rotational, prescribed burning and spot treatment of persistent invasive vegetation (e.g., pulling, mowing, spot herbicide).
2. Maintain other natural areas, beginning with the next highest quality areas. This will generally entail the following considerations and tasks. Restoration and management tasks and methods are described in greater detail in Section 6.7.
   a. Restore natural disturbance regimes as appropriate (e.g., prescribed burning in prairies, savannas, and some forests and wetlands).
   b. Use biocontrols for invasive species management, when feasible. Spotted knapweed is present in Kenwood Prairie, but may not be sufficient to support a colony of beetles.
   c. Removal of invasive Common buckthorn and other invasive brush.
   d. Remove invasive herbaceous vegetation.
   e. Install diverse native plantings—trees, shrubs, grasses, sedges, forbs, etc.
3. Expand and connect natural areas with vegetation wherever possible to reduce the effects of habitat fragmentation (see Section 2.3.1). This could entail expansion of the prairie/savanna area, installing bee lawn or native plant gardens to the park.
4. Engage volunteers to assist with management of the Park's natural areas.

6. NATURAL AREAS RESTORATION AND MANAGEMENT

As described in preceding sections of this Natural Areas Plan, most natural areas within the MPRB park system are highly disturbed environments. The historical ecological structures and processes that used to sustain the health, productivity, and resilience of native plant communities and their ecosystems have been disrupted by lack of natural disturbances (e.g., historical ground fires, large herbivore grazing and browsing), invasive vegetation, climate change, and direct alteration of land for farming or development. These impacts have resulted in the loss of many elements of the former ecosystems and introduction of new elements that slow or prevent their natural recovery.

In developing this Natural Areas Plan, MPRB made a commitment to better understand and more proactively restore and maintain its natural areas. Overall goals are to: 1) protect and improve Managed Natural Areas, and 2) to improve extremely disturbed areas, wildlife habitat, and ecosystem services in the remainder of the MPRB park system. Exploring likely outcomes using two possible scenarios—with and without intervention—MPRB will be able to better understand the importance of strategic investments in natural resources

6.1 What Happens When Natural Areas 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 use of limited staff and financial resources. While these are valid perspectives, they are not the whole story.

Studies over the last half century clearly demonstrate that, without management, 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 of the unmanaged forests and woodlands of the Twin Cities is invasion by non-native Common buckthorn (*Rhamnus cathartica*) and invasive honeysuckle shrubs (*Lonicera* spp.). When these non-native shrubs invade natural areas, a cascade of negative effects follows. Oak regeneration is suppressed, native shrubs decline, soil chemistry and composition is changed, and ground vegetation is shaded, leading to the loss of soil-anchoring plants and increasing erosion. Flower resources for pollinators are eliminated, reducing the amount and variety of food for other wildlife, further depressing wildlife populations.

Many natural areas have experienced past land disturbance (e.g., grading) and vegetation alteration (e.g., clearing). Some areas were left to passively revegetate by natural processes, often resulting in a weedy, invasive plant-dominated landscape. Other areas may have been seeded or planted with soil-stabilizing grasses or other plants, often resulting in low plant diversity and habitat value. Over time, in the absence of mowing, regular ground fires, or grazing/browsing herbivores, light-seeded tree species such as Boxelder, Green ash, and elms often invade these areas creating “novel ecosystems” or the semi-natural forests and woodlands assigned a quality rank of “NN” for non-native/non-natural.

Large and ecologically complex regions may resist these negative trends, but without proper management natural resource quality generally declines over time. This is especially true in small and scattered natural areas, which is the situation in most of the MPRB park system. 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 Natural Areas Plan identifies and prioritizes the management actions that MPRB can take to improve the health and resilience of its natural areas and the ecosystem services and recreational benefits therein.

6.2 What Happens When Natural Areas Are Managed?

To restore native plants and animals to these disturbed ecosystems requires purposeful intervention and effort. However, once ecological restoration and management actions are taken, nature can be self-healing and self-replicating, requiring limited long-term management. Strategic interventions enable native plants and animals to rebound despite past environmentally damaging use. Typical restoration and management actions include:

- Restore natural disturbance regimes
- Introduce biocontrols (when available/feasible)
- Remove invasive shrubs
- Plant native trees/shrubs
- Remove invasive herbs
- Install herbaceous seeds/plants
- Practice adaptive management, including continued control of invasive species

Increasing the quality and size of habitat will encourage resettlement and persistence of native species, reduce per-acre management effort/costs, and increase the ecosystem's health and resilience.

Fortunately, some of MPRB's natural areas are higher ecological quality and contain plant communities that already possess a significant proportion of native vegetation. This considerably reduces the effort required to restore and manage these habitats; this lighter management touch is called "enhancement", and this constitutes where MPRB staff have focused management efforts. 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.

MPRB Natural Resources has been restoring, enhancing, and managing native plant communities in select areas of parkland for many years. Most of these efforts have been focused on MPRB's remnant native plant communities. Native oak savanna, once the dominant plant community in the area, is quite uncommon in the MPRB park system. Savanna restoration should be a priority because it supports a variety of uncommon plant and animal species that thrive in these habitats, and presents an attractive, park-like landscape.

6.3 Proposed Native Plant Communities

Given the current degraded condition of most MPRB natural areas, we recommend that all native or semi-natural plant communities be restored or enhanced to establish more ecologically healthy conditions

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. 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 ecological *enhancement* would diversify the canopy, understory, and ground layer vegetation and improve wildlife habitat, including for pollinators. More aggressive vegetation replacement (often to a native plant community similar to that found in the area circa 1850) would occur where turf grass is replaced by native prairie or savanna grasses and wildflowers under trees; this is ecological *restoration*.

Native plant species lists appropriate for restoring or enhancing MPRB's specific plant community types can be derived from MNDNR's *Native Plant Communities of Minnesota – The Eastern Broadleaf Forest Province* (MNDNR 2005). Management briefs for MPRB natural areas (Appendix A) reference appropriate target plant communities to restore/enhance, and Appendix J provides the actual MNDNR species lists for each plant community and associated data. Appendix K provides a list of tree species expected to be resilient to climate change in the Twin Cities.

Whenever possible, native plant materials (seed and live plants) used in ecological restorations should have a source-origin from within 200 miles of the project area, and 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 6.7 of this Plan discusses the restoration and management tasks needed to establish healthier native plant communities in MPRB's natural areas.

6.4 Management Units

At an individual park 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. Defining management units in larger parks should be done after more detailed site-specific Natural Resource Management Plans are completed.

Management can also be also used to phase projects over time, often necessitated by annual budgets or to provide refuges for invertebrates during and after prescribed fires (see Section 8.9.2 for further discussion of implementation phasing). 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. Small, detailed, management units have not been defined in this Plan for MPRB parks, but many of the smaller natural areas could be managed easily as a single unit.

6.5 Improving Natural Areas for Wildlife

This Natural Areas Plan is first and foremost a guide for managing native plant communities. This focus on the native flora of the MPRB park system simultaneously benefits native fauna and wildlife. Ecological restoration and management improves habitat for wildlife by increasing the variety and quality of habitat to meet the life-cycle needs of many native animal species. The adage "If you build it, they will come" often rings true with ecological restoration and management. It is often the case that a larger number of wildlife species and individuals—sometimes uncommon or specialist species—use a natural area after it is restored or enhanced.

Key elements to increase the variety and quality of wildlife habitat are:

- The right plant density and vegetation height—called "structure"—for the targeted wildlife habitat. Vegetation structure supports the nesting, sheltering, overwintering, and concealment needs of wildlife.
- A diversity of native plant species, especially those that produce flowers, berries, nuts, seeds and other food for all seasons and stages of life cycles. For instance, pollinators require nectar and pollen for much of the growing season, so plantings early-, mid-, and late-bloomers greatly helps this wildlife group.
- Special habitat resources for specific wildlife species, such as milkweeds for Monarch butterflies, nesting boxes for birds and bats, and sunning logs for turtles.
- Large, circular habitat cores with connections to other nearby habitats. While reducing habitat fragmentation is challenging in urban settings, there are many small ways to "round out" the edges of habitat and connect habitat patches (see Section 2.3.1 for related discussion). For example, turf that penetrates a forest on public land can be planted to trees to eliminate a source of edge effects. Unused or disturbed land next to planted prairies and restored savannas can be planted to prairie vegetation to enlarge habitat for small mammals and insects that inhabit prairies and savannas.
- Vegetation screening and other means of reducing the visual impact of people, bikes, and cars passing by natural areas. Secretive and easily-disturbed species will benefit.
- No off-leash pets will minimize disturbance and death of wild animal species.

6.6 Improving Ecosystem Services

A growing body of research supports the idea that restoring and managing natural areas improves ecosystem services—the free benefits people receive from functioning ecosystems. A simple example is the activity of burning a prairie every three or four years. This common and beneficial management practice replicates the region's historical surface fires. It removes accumulated dead leaf litter or duff that can cool or alter nutrient regimes in the soil, a condition that encourages invasive and weedy species. It stimulates the growth of native prairie plants and stimulates their flowering, while diminishing invasive and weedy plants. Lastly, prescribed burning improves a prairie's ecosystem services by creating quality wildlife habitat for many native animal species and increasing carbon sequestration rates in soil via the transfer of atmospheric carbon to plant roots. Appendix C provides a more comprehensive review of documented improvements in ecosystem services as a result of ecological management.

6.7 Initial Restoration & Short-Term Management Tasks

As outlined in the previous sections, 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. The initial restoration and short-term phase of a project typically occurs over the first three years or so, followed by long-term management. MPRB has adopted Integrated Pest Management (IPM) as a strategy that influences both phases of restoration and management but focuses on long-term prevention or suppression of pest problems with minimum impact on human health, the environment, and non-target organisms (MPRB Policy IX-B-9, 2008). The IPM approach provides important guiding principles when considering restoration and management of park natural areas because invasive species control species is a common and often major task. IPM considers the pest species you are attempting to control, its life cycle, and potential weaknesses or vulnerabilities that can be capitalized on in the most environmentally benign way.

Initial restoration and short-term management generally includes site preparation, brushing and thinning (in wooded communities), initial weed control, native seeding and planting, and ecological monitoring and reporting. Specific tasks to accomplish this work are described below. Some of these tasks may be applied during long-term management as well, which is addressed in Section 6.14.

6.7.1 Prescribed Burning

Prescribed burning is an important and cost-effective ecological restoration and management tool. While prescribed burning one of the primary long-term management tasks, it is presented here because it can be a very effective tool in site preparation, and one that reduces the use of and reliance on herbicide[3]. One such example is converting an old field to native prairie. Beginning restoration with a dormant season burn can damage these plant species, which are not adapted to fire. Burning removes accumulated thatch and exposes the blackened soil to the sun, which warms the soil and promotes germination of weed seeds. Burning, sometimes followed by tillage and/or spraying with herbicide, can provide good weed control as the site is prepared for native seeding.

Prescribed burning can be challenging, especially in an urban setting, there are many rules and considerations in implementing a prescribed burn. Several compliance procedures need to be met prior to burning including: MNPCA air quality alerts, MNDNR fire regulations, as well as procedures determined by various fire agencies. Burn plans need to be developed and plans are submitted to MNDNR and/or fire departments. Notifications of neighboring private properties (e.g., residences, businesses, hospitals,) are done weeks in advance of the burn. When developing a thorough and safe "burn plan" for a given site all of these elements need to be met.

Prior to any burning, the MPRB or its appointed contractor secures the necessary permissions and takes appropriate precautions to protect desired vegetation, infrastructure and secure the area from park users while burning. MPRB's "Contractor Procedures for Prescribes Burns" is provided in Appendix L.

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[3] *A Note About Herbicides. Ecological restoration and management often involves the use of herbicide. Some undesirable plant species can be managed with mowing or hand-pulling, but many perennial weeds are most effectively (and often most cost-effectively) managed using targeted herbicide treatments to achieve the best control.*

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. 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.

Policing may be necessary in high traffic areas. Due to fixed costs associated with burn coordination, site preparation, and execution, small burns (e.g., those less than three acres) are more expensive on a per-acre basis. Fixed costs include mowing burn unit breaks, other burn preparation work, training, and mobilization of a burn crew.

6.7.2 Biocontrol Options

Biocontrol is the use of natural enemies to reduce invasive species populations. As with prescribed burning, biocontrols are often used for long-term management; however, their application early in the restoration process can help reduce the use of and reliance on herbicides.

There are several approved biocontrol agents available for controlling invasive species in Minnesota. MPRB staff have used biocontrol agents in the park system's natural areas since the 1990s partnering with both MNDNR and the Minnesota Department of Agriculture (MDA). Biological control does have requirements for success, and as a control strategy it does not necessarily mean complete eradication of the plant. For example, Leafy spurge beetles require at least one-half acre of Leafy spurge to sustain the beetle population, and this area cannot be mowed, burned, or otherwise disturbed (https://www.mda.state.mn.us/plants/pestmanagement/weedcontrol/noxiouslist/leafyspurge/leafyspurge).

Biocontrols applicable to MPRB parklands (and used by MPRB) currently address Purple loosestrife, Spotted knapweed, and Leafy spurge. Additional information on biocontrols is provided in Appendix M.

6.7.3 Diseased Tree Removals

Tree disease management is conducted by the MPRB Forestry Department per their policies to control Oak wilt, Dutch elm disease, and Emerald ash borer. As diseased trees are removed from MPRB forests and woodlands, native species from Appendix J may be planted using either: 1) appropriate tree species (to fill canopy gaps where contiguous forest/woodland is desired), or 2) native grasses, sedges, and wildflowers (where prairie openings or savanna are desired).

6.7.4 Invasive Tree & Shrub Removal

Many native plant communities can be enhanced by removing invasive woody vegetation. Non-native Common buckthorn (*Rhamnus cathartica*), Glossy buckthorn (*Frangula alnus*), non-native honeysuckles (e.g., *Lonicera tatarica*), and White mulberry (*Morus alba*) are primary targets in the MPRB park system. Native species such as Boxelder (*Acer negundo*), Green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), Common hackberry (*Celtis occidentalis*), Eastern red cedar (*Juniperus virginiana*), and Chokecherry (*Prunus virginiana*) can also be aggressive and detrimental to restoration of healthy native plant communities. Selectively thinning dense or aggressive native woody species in the understory may be warranted, depending on restoration goals.

Removing invasive and aggressive woody vegetation opens opportunities to plant native trees and shrubs and forbs, which increase the variety of food and improve habitat quality for wildlife. At present MPRB has focused their work on the highest quality natural areas and areas with the rarest natural features (e.g., Theodore Wirth's Tamarack bog and Minnehaha Park's Black ash seepage swamp) due to limited resources. Future restoration areas should first focus on areas with light invasive species infestations. These areas would be treated first, as early or light infestations are more easily controlled than dense infestations. Removal of invasive woody vegetation typically includes the following tasks.

- Where erosion is not a concern (i.e., relatively flat, stable soils), seedlings can be hand pulled and relatively young invasive shrubs (i.e., up to ~3" diameter near the base) can be extracted using a Weed Wrench or similar tool. If removals can be conducted over the course of a year or two, buckthorn can be removed from some sites by cutting the stem at a height of ~3 feet (which reduces suckering). If these stems do "sucker" or "re-sprout", they can be re-cut, leveraged out, or dug out the following year.

- When the above methods are not feasible, cut and stump-treat all invasive non-native woody vegetation using an approved contact herbicide. The Minneapolis Code of Ordinances, Chapter 230 dealing with Pesticide Control and the MPRB policy on glyphosate is provided in Appendix N. Cut vegetation may be left lying on the ground to decompose over time (several years), piled and burned on site (in approved locations), chipped and thin spread on site (so it does not smother vegetation), or removed from the site. If limited resources require a less expensive method, basal bark application of herbicide can be used and shrubs and trees left standing. Herbicides should always be selected and applied carefully so desirable native vegetation is not affected adversely. Mechanized forestry mowing may be appropriate in areas, but care should be taken to not: 1) remove/damage desirable native vegetation, 2) encourage soil erosion, or 3) compact soil (e.g., conduct during frozen soil conditions and/or use tracked or wide-tired machinery). Forestry mowing also makes herbicide application of stumps challenging, so resprouts are common.

- As appropriate to achieve restoration goals, conduct selective thinning of remaining aggressive woody vegetation in the understory. Typically, forest canopy should be maintained to reduce subsequent invasion and growth of invasive shrubs (e.g., Common buckthorn), but thinning the understory and occasional canopy gaps will allow filtered sunlight to reach the ground and promote native plant and pollinator-habitat diversity. Many historical oak savannas have become overgrown with woody vegetation due to fire suppression, resulting in dense woodlands with an understory dominated by invasive plants (often buckthorn). Where savanna restoration is a goal, more aggressive thinning of native trees and shrubs may be warranted. Invasive removals in forested areas such as those in Theodore Wirth Park which are on the prairie- forest border provide an opportunity to re-introduce savanna prairie grassland species to further provide diversity of habitats for the park ecosystem.

- Woody plant clearing should be done when the ground is frozen to minimize soil disturbance. When feasible, remove large cut trees or shrubs from forests where removals are dense. In less densely cut areas, trim branches so the trunk lies near the ground surface to promote decay and provide habitat.

- Cut material will usually be transported off-site for utilization in biomass-to-energy burning. Care should be taken to not spread invasive plant propagules (e.g., buckthorn berries) during removal. Handling and transport of cut wood should follow all state and federal recommendations to minimize the potential transfer of pests such as Emerald ash borer, Gypsy moth, etc. Following MNDNR regulations and with City of Minneapolis Fire Department permitting, cut material may be stacked and burned in place.

- Retain and protect existing desirable native woody and herbaceous vegetation; this may require avoiding the use of forestry mowers and other general removal machinery. Steep slopes may prevent the use of mechanized woody plant removal, and special field techniques may be warranted (e.g., use of safety harnesses by workers).
- Treat invasive woody vegetation seedlings and re-sprouts with approved foliar herbicide in the growing season following cutting, preferably late in the summer or early fall (to avoid collateral damage to native vegetation). Due to the seedbank that accumulates in well-established stands of buckthorn, continued treatment of buckthorn seedlings may be needed for up to seven years following initial removal.
- Goats may be used to control woody vegetation through browsing. Goat browsing is discussed further under Section 6.14.3.

6.7.5 Invasive Herbaceous Vegetation Control

- Use a combination of manual pulling (where erosion is not a concern), spot application of herbicide, mowing, and/or prescribed burning to remove and control invasive herbaceous vegetation. The Minneapolis Code of Ordinances, Chapter 230 dealing with Pesticide Control and the MPRB's policy on glyphosate is provided in Appendix N. Mowing is discussed under Section 6.14.2, and prescribed burning is discussed under Sections 6.7.1 and 6.14.1.
- Retain and protect existing desirable native woody and herbaceous vegetation. Protecting desirable vegetation includes avoiding direct damage, appropriate timing for prescribed burning and mowing, and thoughtful and purposeful use of herbicides.
- If herbicides are used appropriate herbicide selection, application method and timing will help to protect desirable plants. Skilled applicators who are knowledgeable with plant identification and herbicide application methods are critical in assuring desirable plants are protected and herbicides applied correctly according to label directions. A minimum of two (and possibly three) herbicide treatments maybe required to control established perennial weeds such as Smooth brome (*Bromus inermis*), Kentucky bluegrass (*Poa pratensis*), and Canada thistle (*Cirsium arvense*), primarily due to their resistant and persistent root system.
- As these invasive plants have created a seedbank which could produce seedlings for many years, increasing the coverage of competing native vegetation is the most effective way in the long term to reduce invasive plant germination.

6.7.6 Herbaceous Vegetation Installation

- Following initial removal of invasive species, and if the native seedbank does not respond sufficiently in variety or coverage, seed with local ecotype native plants. Weed-free straw mulch is typically crimped into newly tilled and seeded areas to provide erosion protection until the seed germinates. Sloped areas and drainage swales often warrant installation of rolled erosion control product (e.g., erosion control blankets) after seeding. At a minimum, a native grassy cover crop is often recommended to create competition with invasive seedlings to give the existing native plants time to expand. Such native grass seedings can also provide fine fuel to help carry a prescribed burn, if wanted. Areas can later be overseeded with other forb species to increase diversity and habitat quality. In addition, volunteers can collect native seed and hand sow them in sparse or low diversity areas. Over time, as the ground layer develops, it will help stabilize soils, prevent new invasion by invasive and weedy plants, and restore the site's ecological composition, structure, and function.

- Seeding is less expensive than installing live plant plugs ("plugging"), but seeding requires more time for establishment. Enhancement plugging can be conducted in select areas if quick establishment and/or additional species diversity is desired (some native species do not germinate well or take several years to become established and flower). Protective fencing and signage informing the public of ongoing restoration can prevent damage to seeding and planting areas as well as provide education.

6.7.7 Tree & Shrub Installation

- Install ecologically appropriate and local ecotype native trees and shrubs. Appropriate native species can be selected from the MNDNR species list (Appendix J) that matches the plant community mapped in the planting location. Protection from deer and/or rodent browsing may be necessary. Native woody plantings can help stabilize and diversify forests, woodlands, and savannas, provide vegetative screening for sensitive wildlife, and initiate a trajectory towards a more natural structure and healthier ecological community.
- Direct seeding (e.g., acorns, walnuts, hickory nuts, and seeds of elm) may be effective in certain areas, but appropriate species selection and proper installation and care of bare root woody stock or saplings will usually result in faster/better establishment.
- Often it is best to not install woody vegetation in the first year or two of restoration and management. Native trees and shrubs can be added after invasive management is completed, if this is needed to create the desired habitat or establish vegetative screening.

6.7.8 Ecological Monitoring & Reporting

- Monitor natural areas during and in response to restoration/enhancement activities so management activities are adjusted accordingly. Monitoring the initial restoration and short-term management activities at a site will help define the best management schedule and techniques. Monitoring can range from more rapid/simple assessments to more quantitative surveys with detailed reporting. A more detailed discussion of ecological monitoring, including long-term monitoring, is provided in Section 6.16 of this Plan.

6.8 Special Restoration & Management Tasks

6.8.1 Infrastructure-Related Vegetation Management

Vegetation management around park infrastructure (e.g., trails, stormwater outfalls, historical features) entails special considerations and techniques.

- **Trail Edges** – Vegetation along trail edges can be challenging to maintain. Turf can simply be mowed, but when natural vegetation (e.g., prairie, woodlands) abuts trails, special edge management is warranted. Woody encroachment into the trail or adjacent “clear zone” must be controlled to provide safe use. Recommended management of non-turf trail edges is provided for areas with native vegetation (e.g., prairie) and woodland edges:
    - *Native herbaceous vegetation (e.g., prairie)* - mow 2x/yr, 6-8” height, 2-3 ft wide. Mowing typically done in June & August or early July & early September, depending on plant species present and growth rate. Mowing regime should be executed in a manner than allows for natives to self-seed, prevents plants from growing too tall and lodging (i.e., falling over), and avoids long, unsightly clippings.
    - *Turf/Woodland edge* - forestry mow 2x/yr, 4-6” height, at least 3 ft wide from the trail edge (in June & August or early July & early September); potential to overseed with shorter native species appropriate for site-specific condition, which may include species such as Little bluestem (*Schizachyrium scoparium*), Buffalo grass (*Buchloe dactyloides*), or Canada anemone (*Anemone canadensis*) in full sun to partial shade or Virginia waterleaf (*Hydrophyllum virginianum*) in more shaded areas. Trees should not be planted into this cleared management zone, and the area should be sufficient for snow storage from trail plowing.
- **Stormwater Outfalls and other Infrastructure** – Stormwater infrastructure, such as outfalls, can be damaged by woody vegetation. Roots of trees and shrubs can grow into and around these engineered features, causing damage or promoting failure. Many stormwater outfalls and other infrastructure exists in MPRB natural areas. Each outfall may exhibit a variety of conditions; therefore, an assessment should be made if woody vegetation roots are compromising or likely to compromise stormwater infrastructure. If roots are a concern, shrubs and young/small trees should be cut and removed and herbicide applied to the stump to prevent re-growth and future degradation or damage to the infrastructure. Larger trees may be root-trimmed or the entire tree may warrant removal, depending on the situation and in consultation with MPRB forestry and City of Minneapolis Public Works or the agency responsible for pipe maintenance.
- **Historical Features** – Historical features, such as Works Progress Administration (WPA) walls, found in several MPRB parks, are recognized and protected as cultural resources. As with stormwater outfalls, these features can be damaged by the roots of woody vegetation and interventions such as those recommended for stormwater outfalls (above) should be followed.

6.8.2 Establishing New Native Plantings/Conversions

The MPRB has converted former turf areas into planted prairies throughout the park system in the 1990s with mixed results. If this type of planting is desired for a park area the following recommendations need to be followed:

- Retain and protect existing desirable vegetation, especially mature native trees.
- Kill existing turf and other undesired vegetation by either:
    - Herbicide treatments. A minimum of two herbicide treatments is often required to control turf species and achieve desired results. Mowing prior to or in between treatments may improve kill of vegetation.
    - Solarization. Installation of black plastic during the summer months will kill existing vegetation without the use of herbicides. However, this process requires plastic sheeting (which may be vandalized), the plastic must be installed to not cause runoff/erosion problems, it may require several months for vegetation to die, soil-dwelling biota will also be killed, and the plastic requires disposal (i.e., waste).
    - Sod-cutting. This is another turf removal method; however, this procedure also removes topsoil from the site, which then requires transport and disposal and incurs associated costs.
- 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. Therefore, some species are best installed as live plants. If more rapid establishment and/or additional species diversity is desired, enhancement plugging can be conducted in select areas, such as along roads and paths, and near buildings, signage, and other park amenities.
- Protect seeding and planting areas with fencing and install signage to inform the public of the restoration in progress.

Unit costs for restoration and management tasks (provided in Appendix O) can be used for estimating the price of these conversions at the level of individual sites.

6.9 Initial Restoration and Short-Term Management Scheduling

Table 22 illustrates a schedule for a typical restoration project that requires significant site preparation followed by short-term management. Laying out restoration tasks for an individual project area requires a detailed scope, often with a different schedule. Special consideration should be given to the timing of different restoration and management tasks, as certain activities can harm (or benefit) particular wildlife species.

Table 22. Generalized Schedule for Initial Restoration & Short-Term Management Tasks

Task	Description/Subtask	Year 1				Year 2				Year 3			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Site Preparation	Herbicide, till, mow and/or preparation burn												
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 burn												
	Spot herbicide and/or spot mow												
	Foliar herbicide 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 monitoring report												

6.10 Management Briefs for Ecological Restoration & Management

Management briefs are short management plans for a particular natural area or type of native plant community. They provide a:

- basic description of plant communities;
- existing condition of plant communities;
- summary of issues, goals, and strategies; and
- simple schedule of tasks, describing frequency of occurrence and responsible parties.

Management briefs give enough information for general planning and budgeting; however, larger and more complex sites warrant a detailed Natural Resources Management Plan (NRMP), discussed in Section 8.10.

6.10.1 Management Briefs for Managed Natural Areas

Managed Natural Areas within the MPRB park system represent native plant communities of higher ecological quality and/or significance in the MPRB park system, as well as planted prairies. Over the past 20 years, the MPRB has used their Vegetation Database to develop work plans and document actions accomplished for the natural areas that they manage. Managed Natural Areas is a term used in MPRB's new (2018) asset management software program, Vue Works, to designate the areas MPRB Natural Resources staff and contractors manage, with assistance from community partnerships and volunteers. Building upon the work documented in the Vegetation Database and VueWorks, management briefs were developed for 19 Managed Natural Areas currently managed by MPRB Natural Resources staff (Appendix A)

6.10.2 Management Briefs for MPRB Plant Communities

Other natural areas within the MPRB park system that are not currently managed by staff may also be managed to sustain or enhance the existing plant community. A degraded Savanna located outside of a Managed Natural Area may warrant enhancement, or an Altered Forest/Woodland (a non-natural/non-native community, which receives an ecological quality rank of “NN”) may warrant ecological restoration and enhancement. Nine management briefs, each addressing a particular plant community type, are provided in Appendix A. These management briefs provide management strategies on how to improve the ecological quality of a degraded natural community or how to convert a highly altered plant community (e.g., Altered Forest/Woodland) to a target native plant community (e.g., Mesic Forest).

6.11 Initial Restoration & Short-Term Management Costs

Natural areas restoration and management requires an investment. A Natural Areas Plan 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. Appendix O provides unit costs for the following restoration and short-term management tasks, assuming a professional natural resource contracting firm does the work. Some of the costs apply to long-term management, too, as discussed in Section 6.14.

- Prescribed burning
- Brushing – various methods
- Mowing
- Herbicide application – various methods
- Tilling
- Seeding
- Planting – plugs
- Planting – potted materials

Costs can often be reduced by using MPRB 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 and enhancement goals are achieved.

6.12 MPRB Park System Initial Restoration & Short-Term Management Costs

Unit costs can be multiplied by acres needing restoration and management in order to arrive at a total cost for ecological restoration and management in MPRB’s natural areas. In this exercise, opinions of probable cost are developed for each different plant community present in the park system (Table 23), anticipating the restoration and management tasks (described in Section 6.7) needed in each plant community, and assigning average unit costs for each task (similar to those found in Appendix O). 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 natural areas addressed in this Phase II study.

Table 23. Preliminary Opinions of Probable Cost for MPRB Park System

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	**805.7**	**-**	**$ 4,985,310**
Forest/Woodland	**665.2**	**-**	**$ 4,276,746**
Mature Forest/Woodland	**412.1**	**-**	**$ 2,378,374**
Dry-Mesic Forest/Woodland (1)	152.4	$ 6,150	$ 937,131
Mesic Forest (2)	259.7	$ 5,550	$ 1,441,243
Altered Forest/Woodland (3)	**253.1**	$ 7,500	$ 1,898,372
Savanna/Brushland	**54.4**	**-**	**$ 396,353**
Savanna (4)	40.9	$ 7,200	$ 294,340
Shrub/Scrub (5)	13.5	$ 7,550	$ 102,012
Grassland	**86.1**	**-**	**$ 312,211**
Prairie (6)	75.7	$ 3,250	$ 246,066
Non-Native Grassland (7)	10.4	$ 6,350	$ 66,144
Lowland Communities	**147.8**	**-**	**$ 743,626**
Lowland Forest/Woodland	**113.8**	**-**	**$ 639,330**
Floodplain Forest (8)	80.6	$ 5,400	$ 435,259
Wet Forest/Swamp (9)	30.3	$ 6,200	$ 187,818
Forested Peatland (10)	2.9	$ 5,600	$ 16,253
Lowland Shrub/Scrub	**14.5**	**-**	**$ 104,295**
Lowland Shrub/Scrub (11)	14.5	$ 7,200	$ 104,295
Lowland Herbaceous	**19.5**	**Not estimated**	**Not estimated**
Wet Meadow (12)	6.5	Not estimated	Not estimated
Marsh (13)	13.0	Not estimated	Not estimated
TOTALS (Uplands + Lowlands)[3]	**953.5**		**$ 5,728,935**

[1] See Table 1 for descriptions

[2] Includes all areas addressed in this Phase II study; assumes initial restoration and short-term management (usually first 3 years) conducted by professional ecological contractors; costs assume use of non-glyphosate herbicides; 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 MPRB's extensive 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 park districts having similar land holdings. It is clear that MPRB'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.

6.13 MPRB Managed Natural Areas Restoration & Management Costs

Similar to the approach used in Section 6.12, units costs can be multiplied by acres needing restoration so that opinions of probable cost for ecological restoration and management can be developed for individual project areas. The following table summarizes preliminary opinions of probable cost for carrying out the necessary restoration and management tasks to improve the ecological health of each Managed Natural Area addressed in this Plan (a subset of the 400 acres of Managed Natural Areas). Note that active management has occurred in most of these Managed Natural Areas over recent years, so the effort and associated costs of restoration and short-term management are less than would be expected in other unmanaged areas.

Table 24. Preliminary Opinions of Probable Cost for Managed Natural Areas

MANAGED NATURAL AREA	NATURAL AREA INVESTMENTS (AC)[1]	ESTIMATED RESTORATION & SHORT-TERM MANAGEMENT COSTS[1]
1. North Mississippi Prairie	19.0	$ 75,345
2. 36th Street Savanna	3.5	$ 18,550
3. 44th Street Forest	6.2	$ 42,160
4. Edmund Boulevard Savanna	1.1	$ 5,115
5. Black Ash Seepage Swamp	1.4	$ 8,540
6. Morley's Prairie	1.4	$ 8,400
7. Longfellow Gardens Prairie	3.4	$ 15,300
8. 17th Avenue Prairie	0.6	$ 3,210
9. Nokomis Prairie	1.9	$ 9,880
10. Tamarack Bog	2.9	$ 12,760
11. JD Rivers Prairie	0.8	$ 3,320
12. Shingle Creek Prairie	1.1	$ 5,005
13. Brownie Lake Prairie	2.9	$ 12,035
14. Cedar Lake Regional Trail Prairie	28.2	$ 76,770
15. Mike's Island	3.8	$ 25,080
16. Raspberry Island	7.3	$ 50,005
17. William Berry Forest	8.5	$ 49,560
18. Roberts Bird Sanctuary	31.3	$ 149,220
19. Kenwood Prairie	1.2	$ 6,080
Totals[2]	**126.5**	**$ 576,335**

[1] Includes Managed Natural Areas addressed in this Phase II study; assumes initial restoration and short-term management (usually first 3 years) conducted by professional ecological contractors; costs assume use of non-glyphosate herbicides; costs do not address long-term management

[2] Rounding of values may make totals appear inaccurate

6.14 Long-Term Management

Once initial restoration and short-term management is completed, the site transitions to a less-intensive phase of long-term (or perpetual) management. Depending on the plant communities and stressors present, regular ecological monitoring (discussed in Section 6.16) will identify where and what interventions are warranted, but planning and budgeting should assume some long-term management action is warranted each year. Typical long-term management tasks are described in the following sections.

6.14.1 Prescribed Burning

Prescribed burning is discussed in Section 6.7.1 as a tool in site preparation; however, it is most often used as one of the primary long-term management tasks. Many of MPRB's natural areas are fire-dependent ecosystems – prairie, savanna, wet meadow – and these areas are most cost-effectively managed with well-planned and well-executed prescribed burns.

Prairies should typically be burned approximately every three years in order to mimic natural fire regimes, but this may vary depending on management needs. When feasible, burns should extend across habitat gradients (e.g., burning from prairies into adjacent wetlands). Varying burn units and burn seasons will help maintain the natural heterogeneity of the landscape – patches of light and shade, areas free of brush, and other microhabitats. Patchy burns help maintain this heterogeneity and provide refugia for wildlife during and after fire.

Prairies in MPRB parks contain many species of invertebrates (including pollinators) and may contain reptiles (e.g., Garter snake), ground-nesting birds (e.g., Field sparrow) and small mammals (e.g., Meadow vole). While many species are able to escape harm during ground fires, prescribed burns should be designed, timed, and executed to minimize negative impacts to vulnerable wildlife. Impact minimization strategies include rotational burning of burn units, such that an entire plant community is not burned at any given time; this provides refugia for wildlife. The USDA/NRCS recommends that most prescribed burning be done in the early spring (March-April, depending on the region) before the grassland bird nesting season. However, late-summer and fall burns may also be appropriate in some circumstances (USDA/NRCS 1999), and varying the seasonal burn time can help maintain greater habitat heterogeneity and biodiversity. Wet meadows are typically burned every three to five years, but more or less frequent burns may be appropriate to achieve management goals. Again, burns should be conducted in a manner that minimizes wildlife impacts (e.g., burning in the early spring to avoid harm to ground-nesting waterfowl).

Savanna, Dry-Mesic Forest/Woodland, and portions of Mesic Forest are also fire-dependent systems. Many of these wooded areas have abundant oak leaf litter that will carry a low-intensity surface fire, generally only two to three feet in height. These surface fires help remove excess leaf litter and organic duff, control invasive plants not adapted to fire, and stimulate the growth of a multi-functional assemblage of native plants. All together this creates high quality wildlife habitat for pollinators, reptiles, amphibians, and birds to name a few groups that benefit. MPRB's Dry-Mesic Forest/Woodland should be burned every two to four years, depending on the vegetation and wildlife response to restoration and management. A longer rotation may be possible after the initial restoration work is done. MPRB's Mesic Forest and Altered Forest/Woodland would benefit from infrequent low-intensity surface fires. However, burning these areas is more challenging due to less fine fuel and steeper slopes, and fire is less important in the short-term because the denser shade in these areas helps to exclude invasive plants. As with prairies and wet meadows, care should be taken to minimize wildlife impacts (e.g., burning in the early spring to avoid harm to ground-nesting woodland birds, such as thrushes and juncoes).

6.14.2 Mowing

Native plant communities benefit from a variety of long-term management techniques; therefore, areas proposed for prairie restoration should also employ mowing—especially if prescribed burning is not feasible in a given area. Mowing can help control invasion by weedy species, which are typically not adapted to being cut. Mowing of prairies should be done to a height of no less than 6 inches. The optimal time of year for mowing is typically late-summer, which produces usable hay while limiting impacts on wildlife. Mowing however, does not remove plant material and over time the accumulated organic matter results in nutrient enrichment, which can favor invasive plants. When feasible, periodic prescribed burns are recommended to burn organic matter and reduce nutrient accumulation in the soil.

6.14.3 Grazing & Browsing

Both open prairies and wooded native plant communities have benefited from managed grazing by cattle or bison, or browsing by goats, in rural settings in Minnesota; however, only goats are practical in the MPRB park system. It is important to understand and consider restoration/management goals, existing desirable vegetation, browsing preferences (i.e., which plant species are preferred by the animals), and appropriate stocking rates before prescribing a browsing regime. Close monitoring and appropriate rotation of browsing operations can help ensure the desired results are being achieved.

Goats have been used by the MPRB since 2017 in two small areas of Theodore Wirth Park that previously cleared of mature buckthorn. It has been found to be costly and has not to date resulted in a reduction of target invasive species. City of Minneapolis and City of Golden Valley (as part of Wirth park is in Golden Valley) ordinances both prohibit farm animals and electric fencing. The MPRB has required steel posts with woven wire fencing and full-time monitoring of the goats by contractor’s staff, this has added to the cost and complexity of this project.

6.14.4 Other Invasive Vegetation Control

Assuming proper site preparation and short-term management, and especially if prescribed fire is used, most restored or enhanced ecosystems will require limited but perpetual control of invasive vegetation. Manual pulling (where erosion is not a concern), spot application of herbicide, spot mowing, and/or prescribed burning (discussed above) will typically provide good control of invasive plants. The same cautions described in preceding sections should be followed regarding protecting desirable vegetation, minimizing the use of herbicide, and protecting wildlife.

6.15 Long-Term Management Schedule

Long-term management tasks are repeated at different intervals for different plant communities to ensure that healthy restored plant communities are maintained over the long term. The following table provides general guidelines regarding the frequency of different management tasks in different plant communities.

Table 25. Long-Term Management Schedule

Plant Community	Task Frequency (once every X years)			
	Prescribed Burning	Weed Control	Remedial Seeding/Planting	Monitoring & Reporting
Dry-Mesic Forest/Woodland	3-5	3-4	5	1
Mesic Forest, Altered Forest/Woodland	N/A	1-3	5	1
Lowland Forest/Woodland	N/A	1-3	5	1
Savanna/Prairie	3	2-3	3-5	1

N/A = not applicable
Schedule assumes that prescribed burning will be employed as a restoration and management technique. If prescribed burning is not employed, haying should be used in accessible prairie and savanna areas to remove accumulating plant material and to cut back woody seedlings.

6.16 Ecological Monitoring & Adaptive Management

The most successful natural resource restoration and management programs collect pre- and post-management data to establish a baseline and measure subsequent positive, negative, and neutral trends in natural resources. Monitoring of vegetation, wildlife, and areas prone to erosion provides information to evaluate and justify proposed changes to the restoration and enhancement program, including implementation of stormwater BMPs. As discussed previously, this “adaptive management” sets in motion a cycle of evaluation, adjustment, and refinement to make maintenance activities most effective. It is important that adaptive management begins when restoration and enhancement projects begin. It requires upfront planning and baseline data collection. Monitoring should be simple and relatively easy to implement, although plant or animal identification skills are usually required. Ecological monitoring provides an objective measurement of project-specific performance standards. It feeds data into the adaptive management plan for the site. Monitoring and reporting should be done more frequently at the onset of project implementation, after which frequency can be reduced over time to an intermittent level.

For the MPRB park system, we recommend the following monitoring protocols.

1. **Managed Natural Areas** (large intact natural areas, other natural communities with a quality rank of BC or better (quality rank definitions discussed below), and all prairie remnants).
    a. The Natural Resources Coordinator or other qualified ecologist conducts a baseline field assessment of 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 the Natural Resources Coordinator or other qualified ecologist. Any concerns should be conveyed to the Natural Resources Coordinator and interventions should be scheduled promptly.

2. **New Restoration Areas**
    a. Prior to initiating restoration activities, the Natural Resources Coordinator or other 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, the Natural Resources Coordinator or other qualified ecologist should inspect the entire project area confirming site preparation was done properly before installation of plant materials.
    c. During restoration activities, the Natural Resources Coordinator or other qualified ecologist should oversee contractors, MPRB staff, and volunteers at a frequency pursuant to their skill levels.
3. **Other Natural Areas**
    a. Conduct walkabout surveys as time and resources allow and report issues to MPRB Natural Resources Coordinator.

7. EXISTING IMPLEMENTATION RESOURCES

Securing financial resources – both for initial restoration efforts and long-term management – is critical to the long-term success of any management plan. Funding typically comes from internal budgets and external sources such as grants (discussed under Section 8.8). Currently, MPRB's Environmental Management Department budget is $520,000 per year (for staffing, contractors, etc.) plus an additional $100,000 per year from the Metropolitan Council for regional park maintenance.

Internal staffing is also critical to efficient management of natural areas. Currently Environmental Management Natural Resources and Volunteer Stewardship work groups work collaboratively to manage natural areas and engage community partnerships. Natural areas work done with staff or volunteers rely heavily on assistance from Forestry, Asset Management staff and their mobile equipment operators. These departments help to haul brush, mow, deliver mulch, and larger quantities of plant materials for planting in restoration and volunteer projects.

Environmental Stewardship Division consists of the following departments and staffing:

- **Environmental Management Department**
    - **Natural Resources –** 2 full-time staff: Natural Resources Supervisor and Natural Resources Technician. Natural Resources staff work with contractors and volunteers to maintain natural areas that have high ecological quality.
    - **Water Resources –** 4 full-time staff: Water Resources Supervisor, Water Quality Lead, and Water Resources Technicians (2). One certified part-time Environmental Program Specialist and seasonal staff hired for summer water quality and stormwater monitoring.
    - **Environmental Education –** 5 full-time staff: Environmental Education Manager, Environmental Education Supervisor, Aquatic Invasive Species Program Administrator, Gardener Curator, Nature Center and Outdoor Educator. Part-time staff includes naturalists, AIS inspectors, and youth workers.
    - **Environmental Stewardship Volunteer and Community Gardens**
      2 full-time staff; one Volunteer Coordinator implementing and one Community Garden Program Coordinator. These 2 staff are dedicated to implementing environmentally based volunteer and community garden programming.
- **Forestry Department consists of the following full-time staff:** 5 Forestry Foremen, 13 crew leaders, 43 Arborists, 9 Mobile Equipment Operators and 7 Administrative staff. Forestry Department Arborists plant, prune and remove trees on the City's boulevards and in park lands. The Forestry Department budget also supports monitoring for invasive tree pests specifically Emerald ash borer and Dutch elm disease, storm damage clean-up and hazardous tree removals.
- **Asset Management Department -** 171 FT staff including 6 Park Operation Managers, 23 Crew leaders, 113 Parkkeepers, 21 Mobile Equipment Operators, 8 Administrative staff and 70 – 90 Seasonal Park Maintenance workers hired for summer maintenance. Asset Management staff keep all grounds and facilities in the park system safe and in good repair. Asset Management crews maintain athletic fields, park buildings, wading pools, beaches, sport courts, trails, rinks, cross-county ski trails, and more.

8. IMPLEMENTATION RECOMMENDATIONS

8.1 Augment Budget, Technical Staff & Administrative Support

The current MPRB Natural Resources budget and staffing are inadequate to steward the park system's natural areas. Based on MPRB's existing natural areas, current natural resources staffing, and MPRB's goals for natural areas management, we recommend the following over the coming three to five years:

1. Increase MPRB's Natural Resources budget to allow better stewardship of the park system's natural areas. Budgeting must be sufficient to accomplish desired restoration projects as well as carry out long-term management in areas where an investment in restoration and management has occurred—sites that have transitioned from initial restoration to long term management. A specific annual budget increase recommendation cannot be provided at this time, because there are many ways MPRB may choose to meet the needs of its program, including using internal staff, hiring out tasks, securing grants, etc. These recommendations are discussed below and in the following sections.
2. Over the coming three to five years, hire an additional full-time Natural Resources Technician, bringing staffing levels in Environmental Stewardship/Natural Resources to 2 full-time equivalent Natural Resources Technicians. Assistant should: 1) be familiar with Minnesota's native plant communities and their restoration and management, 2) have strong native and invasive plant identification skills, 3) have training and certification in herbicide application and prescribed burning, and 4) have the ability to manage and contractors. This hire will enable Environmental Management to better maintain natural areas within the MPRB park system.
3. Restore funding for Seasonal Environmental Workers and add funds to equal 3 full-time-equivalents.
4. Over the coming three to five years, hire a part-time Natural Resource Technician-Volunteer Coordinator
5. Over the coming three to five years, hire an Administrative Assistant for Natural Resources to assist with contract development, financial tracking, and related support services.

8.2 Provide Specialized Training

Many restoration and management activities warrant oversight, specialized training, or licensing/certification where required by local, state, or federal law. Personnel involved in ecological restoration and management, especially prescribed burning, herbicide application, brush control, seed collection, erosion control, and ecological monitoring should receive training commensurate with the activity in which they would be involved. Training is especially important for those activities that may have risk and safety implications to people, property, and sensitive cultural resources. Most ecological restoration work involving herbicides is regulated by the Minnesota Department of Agriculture (MDA) and requires herbicide applicator licensing under Categories A&J. MPRB prefers that prescribed burning be conducted by contractors with S-130 and S-190 certification.

While useful data can be collected by amateurs, ecological monitoring protocols often require a moderate level of expertise to implement accurately and consistently. Implementing monitoring programs may require expertise in plant and wildlife identification, as well as a working understanding of erosion processes and potential solutions. The MPRB may wish to partner with local universities, other educational institutions, federal and state agencies (e.g., U.S. Fish & Wildlife Service), conservation non-profits (e.g., Friends of the Mississippi River staff), Minnesota Native Plant Society, Audubon Society, or other partners to assist with monitoring and reporting, as well as appropriate restoration and management tasks. Professional ecological consultants and contractors can also be used to provide these services.

8.3 Secure Work Space & Acquire Equipment

Currently there is a lack of adequate designated work space necessary to store and do light maintenance on tools and equipment. Storage of small tools, equipment, plant materials, and other supplies are scattered in locations near the South Side Service Center at 38^{th} and Bryant. There is not adequate meeting and work space for contracted CCMI crews and/ or seasonal crews.

In addition to personnel, natural resource management requires equipment. MPRB Environmental Management Natural Resources has no equipment dedicated to natural resources - based work., limited staff support and associated equipment is provided by MPRB's Forestry and Asset Management departments. Based on MPRB's existing natural areas, we recommend the following:

Develop work space that will meet the needs of field staff:

- Indoor storage area for tools, maintenance, and seed
- Indoor herbicide storage area with secondary containment
- Flammable liquid storage cabinet (for gasoline and other fuels)
- Designated herbicide container rinse/disposal area
- Outdoor staging area for plants

Purchase equipment to haul materials and implement mowing and other management tasks:

- Trailer for hauling equipment
- Deck mower (for turf)
- Brush or flail mower (for prairie)
- Forestry cutter or hand brush saws (for brush)

8.4 Increase Volunteer Engagement

As mentioned under Staffing Recommendations above, it is recommended that MPRB hire a part-time Natural Resource Technician-Volunteer Coordinator

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 MPRB parks.

Currently, MPRB has one Environmental Stewardship Volunteer Coordinators who support all Environmental Stewardship workgroups (i.e., Environmental Management, Asset Management, and Forestry) and also coordinates the Community Garden 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.

Current volunteer efforts in MPRB natural areas involve 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). Many volunteer activities require oversight by MPRB staff trained volunteers, MPRB staff, or partners (e.g., FMR MS Park Connection staff). Volunteer monitoring/research advances knowledge and builds public support for natural resource programs.

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 26 summarizes natural resource management tasks for which volunteers can provide assistance, as well as what tasks are appropriate for MPRB staff or professional restoration contractors (discussed below).

Table 26. Using MPRB Staff/CCM, Youth/Volunteers & Private Contractors

Ecological Task	MPRB Staff	Youth/Volunteer Role			Contractors	
		Generally Appropriate	Appropriate with Training & Oversight	Generally Not Appropriate	Conservation Corps of Minnesota and Iowa	Restoration Contractor
Native seed collection & sowing		X			X	
Installation of native plants and seeds	X	X			X	X
Hand-pulling invasive plants	X	X			X	
Dragging cut brush	X	X			X	X
Cutting brush	X		X		X	X
Simple ecological monitoring	X		X		With training	
Herbicide application	X		X		X	X
Slope stabilization						X
Prescribed burning				X		X
Management mowing	X			X		X
Technical ecological monitoring	X			X		X

Although assistance by volunteers has no direct monetary cost, the staff time or contracted time for organizing, training, equipping, and supervising volunteer events is a cost, as are materials (e.g., tools, safety equipment, recognition programs). Thoughtfully planned and executed volunteer programs will help reach the desired audience of potential volunteers, engage them in safe and meaningful work, and have them return to volunteer with the MPRB again.

8.5 Hire 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 MPRB goals are met. Solicitation, assessment, and selection of bids, as well as contractor oversight and contract administration takes expertise and time and need to follow City of Minneapolis and State of Minnesota Procurement and Purchasing procedures.

8.6 Explore 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. MPRB already has partnered with the following entities on natural resource-related projects or initiatives.

- Minnesota Department of Natural Resources (MNDNR)
- Minnehaha Creek Watershed District (MCWD)
- Mississippi Watershed Management Organization (MWMO)
- Bassett’s Creek and Shingle Creek
- Friends of the Mississippi River (FMR)
- National Park Service (NPS) and Mississippi Park Connection
- Conservation Corps of Minnesota and Iowa
- Audubon Society – Minneapolis Chapter

- Master Gardeners, Master Tree Stewards, and Master Naturalists
- University of Minnesota (supports forestry and volunteer projects, including new "Cover It Up" buckthorn removal project)
- Minneapolis neighborhoods

It is recommended that MPRB establish agreements or contracts with partner organizations to help implement ecological restoration and management projects, especially long-term management. For instance, MPRB has a agreements with FMR, Mississippi Park Connection, and Park Stewards groups to coordinate natural areas management efforts.

8.7 Increase Public Education & Outreach

Many of MPRB's parks provide important opportunities to capitalize on public outreach and interpretation. A variety of strategies can be used to educate and inspire the public regarding MPRB's natural resources. Some strategies that have been used effectively in similar communities follow.

- **Bioblitz.** Many communities have collected valuable data by sponsoring a bioblitz. A bioblitz is typically a 24-hour period when all living species within a given area, such as a public park are documented. A bioblitz helps to gather important baseline and ongoing monitoring data on plants and animals in a specific area, while also engaging people in discovery of the natural world and scientific research in the company of experts. A bioblitz could be organized and held by MPRB naturalists who staff environmental education centers such as North Mississippi and the Eloise Butler Wildflower Garden in the MPRB park system. Perhaps rotating through parks over time or repeated for ongoing monitoring could be done once the program is established. This could be an effective way of engaging the community and collecting valuable baseline and subsequent data for comparison with post-restoration data.
- **Internet.** MPRB currently has an interactive web map on its Natural Areas page, allowing the public to review plant community mapping and related data. MPRB could expand its parks web page to include more, and regularly-updated, content (e.g., "What's blooming at Theodore Wirth Regional Park this week").
- **Interpretive signage/kiosks addressing topics such as:**
  - Regional natural history: glacial history of the region, formation of Mississippi Gorge, and watersheds;
  - Native ecosystems: Specifically those being restored to the site—forest, woodland, savanna, prairie, wetland, etc.;
  - Ecological restoration and management practices;
  - Wildlife and their habitats; and
  - Naturalized stormwater treatment.

8.8 Pursue Grant Funding

As discussed above under budgeting, securing financial resources is critical to the long-term success of any management plan. Funding typically comes from internal budgets and external sources such as grants. While grants have secured by other entities have been used to restore MPRB parklands, MPRB Natural Resources staff have not pursued grants due to limited staff capacity to apply for, implement the project, and administer such funds. Additional staffing time and expertise is required to pursue, implement, and administer such funds, if awarded. Without additional staff support, these grants cannot be pursued. In addition, most grants must be used for initial restoration and short-term management – not long-term management. Therefore, MPRB needs to increase its annual Natural Resources budget so funds are available for long-term stewardship following restoration projects.

To augment MPRB's existing internal budget allocation, the following entities or programs may provide funds to help MPRB implement this Plan.

County Programs

- **Hennepin County Natural Resources Project Funding and Assistance Grants.** Hennepin County offers a variety of programs that provide funding and expert assistance in implementing projects that protect natural resources. More information is available at: https://www.hennepin.us/residents/environment/natural-resources-funding

State Programs

- **Outdoor Heritage Fund**. 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 "may be spent only to restore, protect, and enhance wetlands, prairies, forest and habitat for fish, game, and wildlife."
- **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. 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."

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/fivestar/Pages/home.aspx
- **Pulling Together Initiative.** Modest grants to help local communities effectively manage invasive vegetation. More information is available at: https://www.nfwf.org/pti/Pages/home.aspx
- **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: http://www.nfwf.org/monarch/Pages/home.aspx

8.9 Prioritize Projects & Develop Phasing Plan

8.9.1 Project Prioritization

Due to limited budgets, staffing, and related resources, phasing in of system-wide ecological restoration and management in MPRB'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. MPRB's has established a Criteria Based System for MPRB Regional Park and Trail Capital Project Scheduling (MPRB 2017), which outlines the following prioritization criteria:

- Community Factors
  - Racially Concentrated Areas of Poverty
  - Park Access
  - Park Safety

- Park Characteristics
  - Historic Investment
  - Use Intensity
  - Asset Condition: ADA Considerations
  - Asset Condition: Natural Resources
  - Asset Condition: Trail Quality

Continued management of the MPRB park system's highest ecological quality natural areas (including the Managed Natural Areas currently maintained by MPRB staff, volunteers, partners, and contracted services) will remain the highest priority. This will protect prior investments by MPRB and volunteers. Additionally, due to past management, these areas will require smaller investments to achieve conservation goals compared with the greater efforts/costs associated with undertaking new restoration and management projects.

Developing priorities beyond existing Managed Natural Areas will entail development of a prioritization matrix similar to that used for MPRB's capital funding. This matrix will help consider and weigh the MPRB Regional Park and Trail Capital Project Scheduling prioritization criteria listed above as well as a variety of additional factors when prioritizing natural areas restoration and management. After considering the Community Factors and Park Characteristics (above), sites with the following characteristics would be scored/prioritized higher than other sites:

- Has high public visibility
- Has a high quality plant community
- Is a large area supporting more sensitive wildlife
- Has a light/early infestation of a highly-invasive plant (requiring less effort to control)
- Has a dense/mature infestation of a highly-invasive plant (which provides a seed source for continued invasion pressure)
- Is next to another restoration project (providing opportunity for enlargement, ecological buffering, and/or improved habitat connectivity)
- Has potential to improve downstream water quality (e.g., through soil stabilization)
- Has potential to improve downstream surface water stability (e.g., through increased infiltration and groundwater recharge)

As MPRB natural areas are mostly associated with the Minneapolis Chain of Lakes, Mississippi River Corridor, and creek corridors (which are primarily in the southern portion of the city), emphasis in the future should focus on underutilized areas where little restoration or enhancement has occurred, such as the Shingle Creek Corridor.

8.9.2 Implementation Phasing

Following project prioritization, currently available and projected funds (i.e., budgets, grants) can be used to phase in ecological restoration and management projects over a given period of time, such as ten years. Projects are ordered so that the first year's available funds are dedicated to initiating restoration at the top priority projects. Available funds are spread over all projects that can be initiated in a given year; however, subsequent years' funds must be adequate to ensure short-term management (usually complete after year three) and long-term management can be afforded (i.e., you should not begin restoration if you lack the funds to see it through and continue long-term management). The following table shows a ten-year phasing and budgeting plan for restoration and management of priority natural resource projects in Johnson County, Kansas (AES et al 2019).

Table 27. Ten-Year Phasing Plan for Priority Projects (Johnson County, KS)

Table 18. 10-Year Phasing of Priority Terrestrial Projects (2020-2029)

Prioritization Rationale and Natural Areas/Parks	Natural Area Investments (ac)	Estimated Initial Resto & Mgmt Costs for Project	Year										Total Cost
			2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	
Prioritized Terrestrial Restoration & Management Projects													
SMP-Orange Violet Trail honeysuckle removal	200	$400,000	★ $133,200	★ $135,864	★ $138,581	● $63,672	● $64,946	● $66,245	◆ $33,785	◆ $34,461	◆ $35,150	◆ $35,853	**$741,757**
EM-Honeysuckle removal	70	$175,000	★ $58,275	★ $59,441	★ $60,629	● $22,285	● $22,731	● $23,186	◆ $11,825	◆ $12,061	◆ $12,302	◆ $12,548	**$295,284**
BBC-Large scale tree removals	140	$280,000	★ $93,240	★ $95,105	★ $97,007	● $44,571	● $45,462	● $46,371	◆ $23,649	◆ $24,122	◆ $24,605	◆ $25,097	**$519,230**
BBC-Prairie restoration	500	$1,300,000	★ $260,000	★ $265,200	★ $270,504	★ $275,914	★ $281,432	● $165,612	● $168,924	● $172,303	◆ $87,874	◆ $89,632	**$2,037,396**
CN-Honeysuckle removal	140	$350,000	★ $35,000	★ $35,700	★ $72,828	★ $222,854	● $45,462	● $46,371	● $47,299	◆ $24,122	◆ $24,605	◆ $25,097	**$579,338**
CB-Mission Road Property prairie restoration	80	$208,000				★ $44,146	★ $180,117	● $26,498	● $27,028	● $27,568	◆ $14,060	◆ $14,341	**$333,758**
SMP-Oakridge Hills prairie restoration	90	$234,000						★ $258,355	● $30,406	● $31,015	● $31,635	◆ $16,134	**$367,544**
KCP-Prairie restoration north of remnant	60	$156,000						★ $34,447	★ $140,545	● $20,676	● $21,090	● $21,512	**$238,270**
SMP-South Shore honeysuckle	240	$480,000							★ $180,006	★ $183,606	★ $187,278	● $86,047	**$636,936**
BBC-North savanna restoration	40	$220,000							★ $24,776	★ $126,355	★ $103,106	● $14,341	**$268,578**
KCP-Prairie restoration	18	$46,800								★ $16,128	★ $38,384	● $6,453	**$60,965**
SC-Wet prairie restoration	15	$39,000									★ $45,695	● $5,378	**$51,073**
MCS-Craig's Crossing woody removal	6	$10,800									★ $12,654	● $2,151	**$14,805**
CN-Cedar removal	70	$210,000									★ $49,210	★ $200,776	**$249,985**
CCS-Multiple small prairie restorations along streamway	37	$104,440										★ $124,815	**$124,815**
Total	**1,706.3**	**$4,214,040**	**$579,715**	**$591,309**	**$639,549**	**$673,443**	**$640,150**	**$667,086**	**$688,243**	**$672,418**	**$687,647**	**$680,175**	**$6,519,735**

★ orange cells = Initial Restoration; ● green cells = Establishment Management (avg. $300/ac/yr); ◆ purple cells = Long-term Management (avg. $150/ac/yr); costs assume 2 percent annual inflation

8.10 Prepare Site-Specific Natural Resources Management Plans

The management briefs provided in Appendix A give enough information for general planning and budgeting. However, larger and more complex sites warrant a detailed Natural Resources Management Plan (NRMP). 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, MPRB should consider and budget for natural resource planning. It is recommended this be done in conjunction with master planning efforts and collaboration between MPRB divisions, so park's natural resources are well understood, considered, and integrated into the master plan. NRMPs can vary in terms of content and detail, but Appendix P presents a general outline of such a plan.

9. NEXT STEPS

MPRB is fortunate to have over 2,800 acres of natural areas, harboring several high-quality examples of ecosystems native to east-central Minnesota. City residents use and enjoy these parks and natural areas, which also support them with ecosystem services. On the other hand, over a century of land alteration, soil erosion, and colonization by invasive species have compromised the functions and value of MPRB's natural resources. Implementing this Natural Areas Plan can reverse that situation and help achieve MPRB's conservation goals.

Continue Stewardship of Managed Natural Areas

- Implement management recommendations provided in this Natural Areas Plan to achieve the goals for Managed Natural Areas

Secure Resources & Finalize Internal Organization

- Incorporate the planning principles and goals of this Natural Areas Plan into MPRB operating procedures
- Communicate funding needs
- Augment staffing, technical capacity and equipment
- Secure commitments from partner organizations
- Develop prioritized phasing plan of specific restoration/management projects
- Develop project prioritization matrix
- Incorporate priority restoration and management projects into annual MPRB budgets
- Organize delivery of priority restoration and management projects
- Anticipate future funding needs (including long-term management) in Capital Improvement Plan process
- Increase and effectively use volunteer labor

Generate External Support

- Tailor outreach activities for restoration and management program
- Collaborate with partner organizations
- Identify and promote at least one high-visibility demonstration project, possibly related to a priority project, to illustrate the benefits of ecological restoration and management
- Hold a celebration of progress and initial success

Measure Progress

- Establish low-cost tracking of projects using ArcGIS Online, MPRB's VueWorks asset management software and department documents.
- Carry out long-term, low-cost monitoring of progress
- Continue quarterly progress reporting of completed work

Plan and Adaptively Manage

- Incorporate an ecosystem perspective in land and water management

- Refine and update Management Briefs for all natural areas
- Complete a work plan for the coming year at the end of each calendar year

In closing, well-trained MPRB staff—helped by volunteers, private contractors, and partners—will carry out this Natural Areas Plan over the coming decades. Staff will adapt the plan to meet changing circumstances, and residents and MPRB 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 MPRB's parklands will help other natural open space in the region, and over time will raise Minneapolis to a higher level of ecological health and resilience, to the benefit of all residents and visitors.

10. REFERENCES & RESOURCES

Alstad, A. O., E. I. Damschen, T. J. Givnish, J. A. Harrington, M. K. Leach, D. A. Rogers, D. M. Waller. 2016. The pace of plant community change is accelerating in remnant prairies. Sci. Adv. 2, e1500975.

Applied Ecological Services, Inc. (AES), Vireo, and Norman Ecological Consulting. 2019. JCPRD Natural Resource Plan. Prepared for Johnson County Park & Recreation District. Shawnee Mission, KS.

Applied Ecological Services, Inc. (AES) and SRF Consulting Group, Inc. (SRF). 2017. Natural Areas Plan – Phase 1. Prepared for Minneapolis Park & Recreation Board. Minneapolis, MN.

Barr Engineering Company. 2007. Mississippi River Gorge Slope Stabilization Inventory and Analysis. Prepared for Minneapolis Park and Recreation Board. Minneapolis, MN.

Barr Engineering Company. 2011. Minnehaha Park Lower Glen Restoration Project Report. Prepared for Minneapolis Park and Recreation Board. Minneapolis, MN

Bentrup, G. 2008. Conservation buffers: design guidelines for buffers, corridors, and greenways. Gen. Tech. Rep. SRS-109. Asheville, NC: Department of Agriculture, Forest Service, Southern Research Station. 110 p.

Cairn, S. and R. Cairn. 2003. History of Minnehaha Creek Watershed. Minnehaha Creek and Watershed District. Minneapolis, MN. City of Minneapolis. 2006. Mississippi River Critical Area Plan. Minneapolis, MN.

Chen, I-C., J.K. Hill, R. Ohlemüller, D.B. Roy and C.D. Thomas. 2011. Rapid range shifts of species associated with high levels of climate warming. Science 333:1024-1026.

Crompton, J.L. 2001. The Impact of Parks on Property Values: A Review of the Empirical Evidence. Journal of Leisure Research 33, 1:1-31.

Early Detection and Distribution Mapping System (EDD MapS). 2020. https://www.eddmaps.org/ (Accessed April 2020).

Galatowitsch, S., L. Frelich, and L. Phillips-Mao. 2009. Regional climate change adaptation strategies for biodiversity conservation in a midcontinental region of North America. Biological Conservation 142: 2012–22.

Hage, C and R.F. Hage. 2010. Nicollet Island. Arcadia Publishing, SC.

Hassan, R., R. Scholes, and N. Ash. (Eds.) 2005. Ecosystems and Human Well-being: Current State and Trends, Volume 1 - Findings of the Condition and Trends Working Group of the Millennium Ecosystem Assessment. Island Press, Washington, Covelo, London. https://www.millenniumassessment.org/documents/document.766.aspx.pdf (Accessed March 2019).

The Kestrel Design Group. 2000. Theodore Wirth Park & Minnehaha Creek Corridor Land Cover Classification and Management Plan. Prepared for Minneapolis Park & Recreation Board. Minneapolis, MN.

Le Maitre, D.C., B. W. Van Wilgen, R. A. Chapman and D. H. McKelly. 1996. Invasive plants and water resources in the Western Cape Province, South Africa: modeling the consequences of a lack of management. Journal of Applied Ecology. Vol. 33, No. 1 (Feb 1996), pp. 161-172

Leach, M.K. and T.J. Givnish. 1996. Ecological determinants of species loss in remnant prairies. Science. New Series, Volume 273, Issue 5281 (Sep. 13, 1996), 1555-1558.

Marschner, F.J. 1974. The Original Vegetation of Minnesota (map, scale 1:500,000). USDA Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota (redraft of the original 1930 edition).

Metropolitan Council. 2018. 2040 Regional Parks Policy Plan. St. Paul, MN.

Meyer, M., D.L. Brown and M. Zins. 2007. The best plants for thirty tough sites. University of Minnesota Extension, St. Paul MN. Accessed at University of Minnesota Digital Conservancy, https://hdl.handle.net/11299/51549.

Minneapolis Park & Recreation Board (MPRB). 2020. Ecological Systems Plan. Minneapolis Park & Recreation Board. Minneapolis, MN. https://www.minneapolisparks.org/park_care__improvements/park_projects/current_projects/ecological_system_plan/

Minneapolis Park & Recreation Board. 2019a. Mississippi Gorge Regional Park Master Plan. Minneapolis Park & Recreation Board. Minneapolis, MN. https://www.minneapolisparks.org/park_care__improvements/park_projects/current_projects/mississippi_gorge_regional_park_master_plan/

Minneapolis Park & Recreation Board. 2019b. Draft Minnehaha Parkway Regional Trail Master Plan. Minneapolis Park & Recreation Board. Minneapolis, MN. https://www.minneapolisparks.org/park_care__improvements/park_projects/current_projects/minnehaha_parkway_regional_trail_master_plan/

Minneapolis Park & Recreation Board. 2019c. Roberts Bird Sanctuary Avian Habitat Study and Improvements Plan. Prepared by Aune Fernandez Landscape Architects and Dr. David Zumeta. Minneapolis Park & Recreation Board. Minneapolis, MN.

Minneapolis Park & Recreation Board. 2017a. Minneapolis Chain of Lakes Regional Park – Calhoun/Bde Maka Ska – Harriet Master Plan. Minneapolis Park & Recreation Board. Minneapolis, MN. https://www.minneapolisparks.org/park_care__improvements/park_projects/master_plans/

Minneapolis Park & Recreation Board. 2017b. Criteria Based System for MPRB Regional Park and Trails Capital Projects (Board Resolution # 2017-244). Minneapolis Park & Recreation Board. Minneapolis, MN.

Minneapolis Park & Recreation Board. 2017c. Approved Thomas Sadler Roberts Bird Sanctuary Management Plan. Minneapolis Park & Recreation Board. Minneapolis, MN.

Minneapolis Park & Recreation Board. 2016. Central Mississippi Riverfront Regional Park Master Plan. Minneapolis Park & Recreation Board. Minneapolis, MN. https://www.minneapolisparks.org/wp-content/uploads/2018/11/central_riverfront_masterplan_approved.pdf

Minneapolis Park & Recreation Board. 2015a. Nokomis-Hiawatha Regional Park Master Plan. Minneapolis Park & Recreation Board. Minneapolis, MN. https://www.minneapolisparks.org/_asset/1dg1fv/nok_hia_masterplan.pdf

Minneapolis Park & Recreation Board. 2015b. Theodore Wirth Regional Park Master Plan. Minneapolis Park & Recreation Board. Minneapolis, MN. https://www.minneapolisparks.org/_asset/8l8tqk/wirth_park_masterplan_revised_w_appendices.pdf (Accessed April 2020).

Minneapolis Park & Recreation Board. 2013. Emerald Ash Borer Preparedness Plan. Minneapolis Park & Recreation Board. Minneapolis, MN

Minneapolis Park & Recreation Board. 2008. Integrated Pest Management (IPM) Policy (Policy IX-B-9). Minneapolis Park & Recreation Board. Minneapolis, MN.

Minneapolis Park & Recreation Board. 2004. Draft Management Plan for Upper Mississippi River Gorge – Below the Falls to 29th Street. Minneapolis Park & Recreation Board. Minneapolis, MN.

Minnesota Department of Natural Resources. 2019. Ecological Classification System (ECS). https://www.dnr.state.mn.us/ecs/index.html. (Accessed April 2019).

Minnesota Department of Natural Resources. 2018. Natural Heritage Information System (NHIS) data.

Minnesota Department of Natural Resources. 2016. Minnesota's Wildlife Action Plan 2015-2025. Division of Ecological and Water Resources, Minnesota Department of Natural Resources. https://www.dnr.state.mn.us/mnwap/index.html. (Accessed April 2019).

Minnesota Department of Natural Resources. 2009. Conservation Status Ranks for Native Plant Community Types and Subtypes.

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

Minnesota Department of Natural Resources. 2004. Minnesota Land Cover Classification System User Manual, Version 5.4. DNR Central Region, St. Paul, Minnesota.

Minnesota Department of Natural Resources. 2001. MNDNR Natural Community Element Occurrence Ranking Guidelines. Minnesota Natural Heritage Program. St. Paul, Minnesota.

National Fish, Wildlife and Plants Climate Adaptation Partnership. 2012. National Fish, Wildlife and Plants Climate Adaptation Strategy. Association of Fish and Wildlife Agencies, Council on Environmental Quality, Great Lakes Indian Fish and Wildlife Commission, National Oceanic and Atmospheric Administration, and U.S. Fish and Wildlife Service. Washington, DC. https://www.wildlifeadaptationstrategy.gov/pdf/NFWPCAS-Final.pdf

Pyne, S.J. 1982. Fire in America: A cultural history of wildland and rural fire. Princeton: Princeton University Press. Princeton, NJ.

Staudinger, Michelle D., N.B. Grimm, A. Staudt, S.L. Carter, F.S. Chapin III, P. Kareiva, M. Ruckelshaus, B.A. Stein. 2012. Impacts of Climate Change on Biodiversity, Ecosystems, and Ecosystem Services: Technical Input to the 2013 National Climate Assessment. Cooperative Report to the 2013 National Climate Assessment. 296 p. http://assessment.globalchange.gov

Stewart, O.C. 2002. Forgotten Fires – Native Americans and the transient wilderness. University of Oklahoma Press: Norman, OK.

Terrell, E.B., and M.M. Terrell. 2016. Native American context statement and reconnaissance level survey supplement. The City of Minneapolis Department of Community Planning & Economic Development. Minneapolis, MN.

U.S. Department of Agriculture (USDA)/Natural Resources Conservation Service (NRCS). 1999. Grassland Bird - Fish and Wildlife Habitat Management Leaflet Number 8. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_054067.pdf

U.S. Fish & Wildlife Service (USFWS). 2020. Information for Planning and Consultation (IPaC) website. https://ecos.fws.gov/ipac/location/index. (Accessed September 2020).

USFWS. 2019. Range-wide Indiana bat summer survey guidelines. https://www.fws.gov/midwest/endangered/mammals/inba/surveys/pdf/2019_Rangewide_IBat_Survey_Guidelines.pdf. (Accessed April 2020).

USFWS. 2016. Final 4(d) Rule for the Northern Long-Eared Bat. U.S. Fish and Wildlife Service, Washington, DC.

University of Minnesota Extension. 2019. Managing ash woodlands: recommendations from Minnesota woodland owners. University of Minnesota Extension, St. Paul, MN. Accessed at Minnesota Digital Conservancy, https://hdl.handle.net/11299/205052.

White-nose Syndrome spread maps. 2020. Data Last Updated: 8/30/2019. https://www.whitenosesyndrome.org/resources/map (Accessed April 2020).

Zumeta, David. 2019. Roberts Bird Sanctuary Avian Habitat Study and Improvements Plan. Report prepared for Aune and Fernandez Landscape Architects and the Minneapolis Park and Recreation Board.

Appendix A. Management Briefs for Managed Natural Areas and General Plant Communities

MANAGED NATURAL AREAS
1. North Mississippi Prairie
2. 36th Street Savanna
3. 44th Street Forest
4. Edmund Boulevard Savanna
5. Black Ash Seepage Swamp
6. Morley’s Prairie
7. Longfellow Gardens Prairie
8. 17th Avenue Prairie
9. Nokomis Prairie
10. Tamarack Bog
11. JD Rivers Prairie
12. Shingle Creek Prairie
13. Brownie Lake Prairie
14. Cedar Lake Regional Trail Prairie
15. Mike’s Island
16. Raspberry Island
17. William Berry Forest
18. Roberts Bird Sanctuary
19. Kenwood Prairie

GENERAL PLANT COMMUNITIES
1. Dry-Mesic Forest/Woodland
2. Mesic Forest
3. Altered Forest/Woodland
4. Savanna
5. Shrub/Scrub
6. Prairie
7. Non-Native Grassland
8. Floodplain Forest
9. Wet Forest/Swamp

NORTH MISSISSIPPI PRAIRIE – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park: North Mississippi Park
MPRB Vegetation: Prairie, Sav., Non-Nat. Grassl., Lowl. Shrub/Scrub
Natural Area Acres: 19.0
MLCCS Classification: Dry Prairie

ASSESSMENT OF CURRENT CONDITIONS

Site History: Restoration activities began in 2001, including planted prairie.

Current Condition (2018): Dominated by native grasses, with patches and scattered native forbs and invasive species.

Existing Vegetation, Area & Quality Rank: Prairie (16.4 ac, mostly CD quality, some C and D quality); Savanna (1.4 ac, C and D quality); Non-Native Grassland (0.7 ac, NN); Lowland Shrub/Scrub (0.4 ac, CD quality)

Notable Native Plant Species: None identified

Notable Animal Species: None identified

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive herbaceous species, including Smooth brome, foxtails, Leafy spurge, White sweetclover, Canada thistle, Crown vetch, Birds-foot trefoil, Motherwort, Common burdock, Garlic mustard, Reed canary grass, invasive cattails
- Woody invasion by Common buckthorn, non-native honeysuckle, White mulberry, Black locust, Siberian elm, and native woody species such as Box elder, Eastern cottonwood, Green ash, sumacs, Riverbank grape
- Much of prairie dominated by aggressive native Big bluestem and patches of aggressive native Canada goldenrod

Restoration Goals (increase biodiversity and improve ecological quality rank to BC or better by implementing the following)

- Maintain <5% tree and shrub canopy cover in Prairie; maintain <50% tree canopy in Savanna
- Control invasive species, including woody invasion of Prairie and all listed MDA noxious weeds (e.g., Canada thistle)
- Increase cover and diversity of native forbs in Prairie
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

Management Strategies

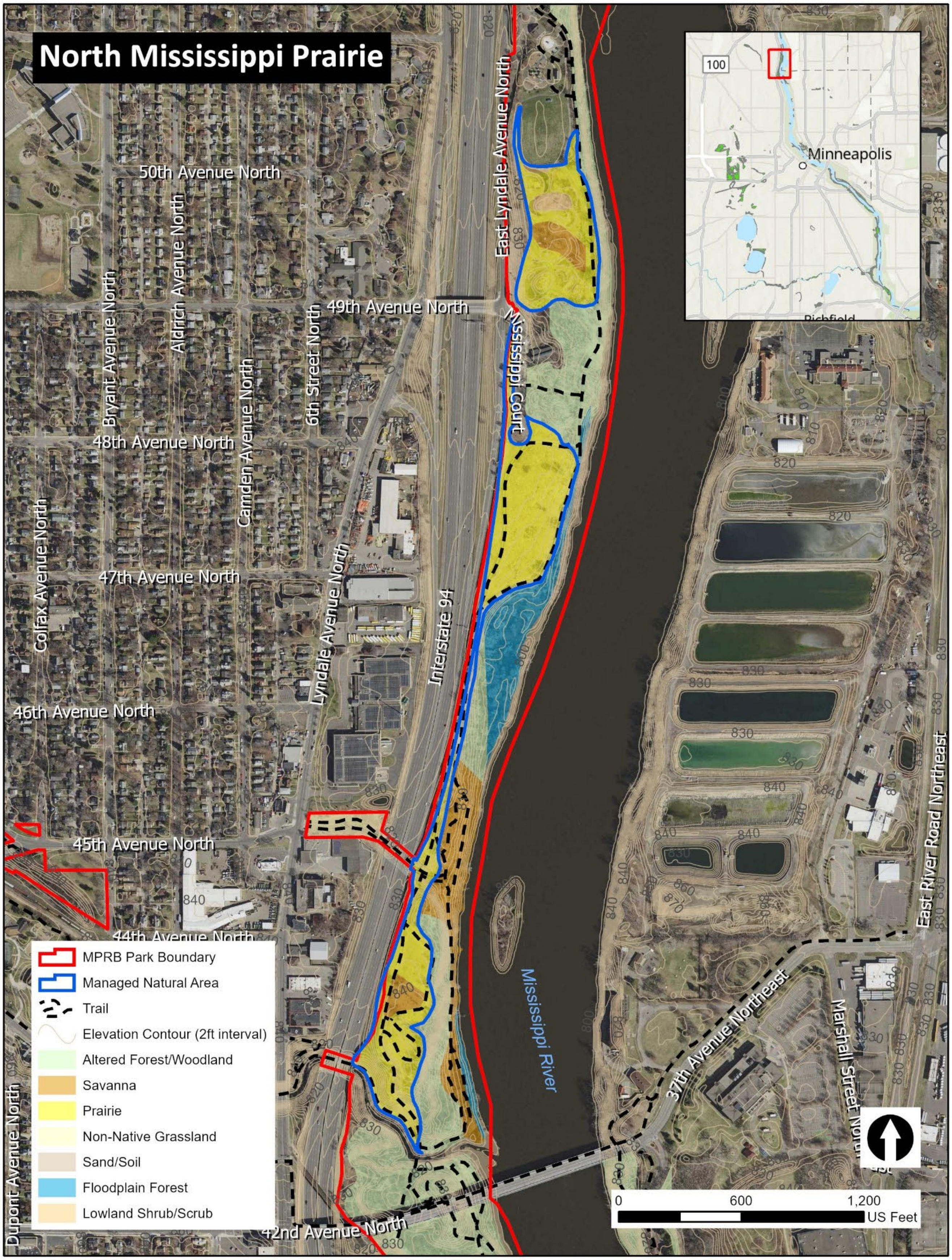
- Manually remove invasive vegetation where safe and feasible (as needed)
- Assess if biocontrols are feasible for the site's small populations of Leafy spurge and Purple loosestrife
- Conduct prescribed burn (rotational burn of 1/3 of prairie each year)
- Mow and brush saw as necessary to control woody invasion (burns should limit need for this task)
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Overseed to diversify ground layer (as needed)

Native Species to Plant & Perpetuate

See MNDNR's species list for UPs23 (Southern Mesic Prairie).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Prescribed burn	Annually burn 1/3 of prairie on rotation, varying spring & fall	Mar-Apr		Sep-Oct	Nov
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Prairie mowing	Annually if burns are not possible		Jun-Aug		
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		



North Mississippi Prairie
50th Avenue North
49th Avenue North
48th Avenue North
47th Avenue North
46th Avenue North
45th Avenue North
44th Avenue North
42nd Avenue North
37th Avenue Northeast
Bryant Avenue North
Aldrich Avenue North
Camden Avenue North
6th Street North
Colfax Avenue North
Lyndale Avenue North
Interstate 94
East Lyndale Avenue North
Mississippi Court
Dupont Avenue North
Marshall Street North
East River Road Northeast
Mississippi River
Minneapolis
Richfield
100
MPRB Park Boundary
Managed Natural Area
Trail
Elevation Contour (2ft interval)
Altered Forest/Woodland
Savanna
Prairie
Non-Native Grassland
Sand/Soil
Floodplain Forest
Lowland Shrub/Scrub
0
600
1,200
US Feet

36^{TH} ST SAVANNA – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park: Mississippi Gorge Park

MPRB Vegetation: Savanna

Acres: 3.5

MLCCS Classification: Mesic Oak Savanna

ASSESSMENT OF CURRENT CONDITIONS

Site History: Remnant native oak savanna. Significant restoration efforts have occurred since 1998.

Current Condition (2018): The area has scattered trees (~50% canopy cover), and the ground layer is predominantly native forbs, grasses and sedges. Raspberries and young woody growth are present.

Existing Vegetation, Area & Quality Rank: Savanna (3.5 acres, B quality)

Notable Native Plant Species

- Dominant trees: mature Bur oak, 24-32” dbh (estimated)
- Other species: Glade mallow – state threatened; likely planted

Notable Animal Species: None identified

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Park patrons use area as off-leash area spreading seeds of invasive plants and creating network of informal paths
- Poison ivy heavy in areas and concern during management, especially prescribed burning (smoke is hazardous)
- Oriental bittersweet and invasive honeysuckle are present

Restoration Goals (increase biodiversity and maintain ecological quality rank of B or better by implementing the following)

- Maintain <50% canopy cover
- Control invasive species, including Oriental bittersweet and Poison ivy, both listed by MDA as noxious weeds
- Increase abundance and diversity of native flora and fauna
- Abandon select trails; install signage or barriers (e.g., shrubs) to discourage trail creation and off-leash dogs
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

Management Strategies

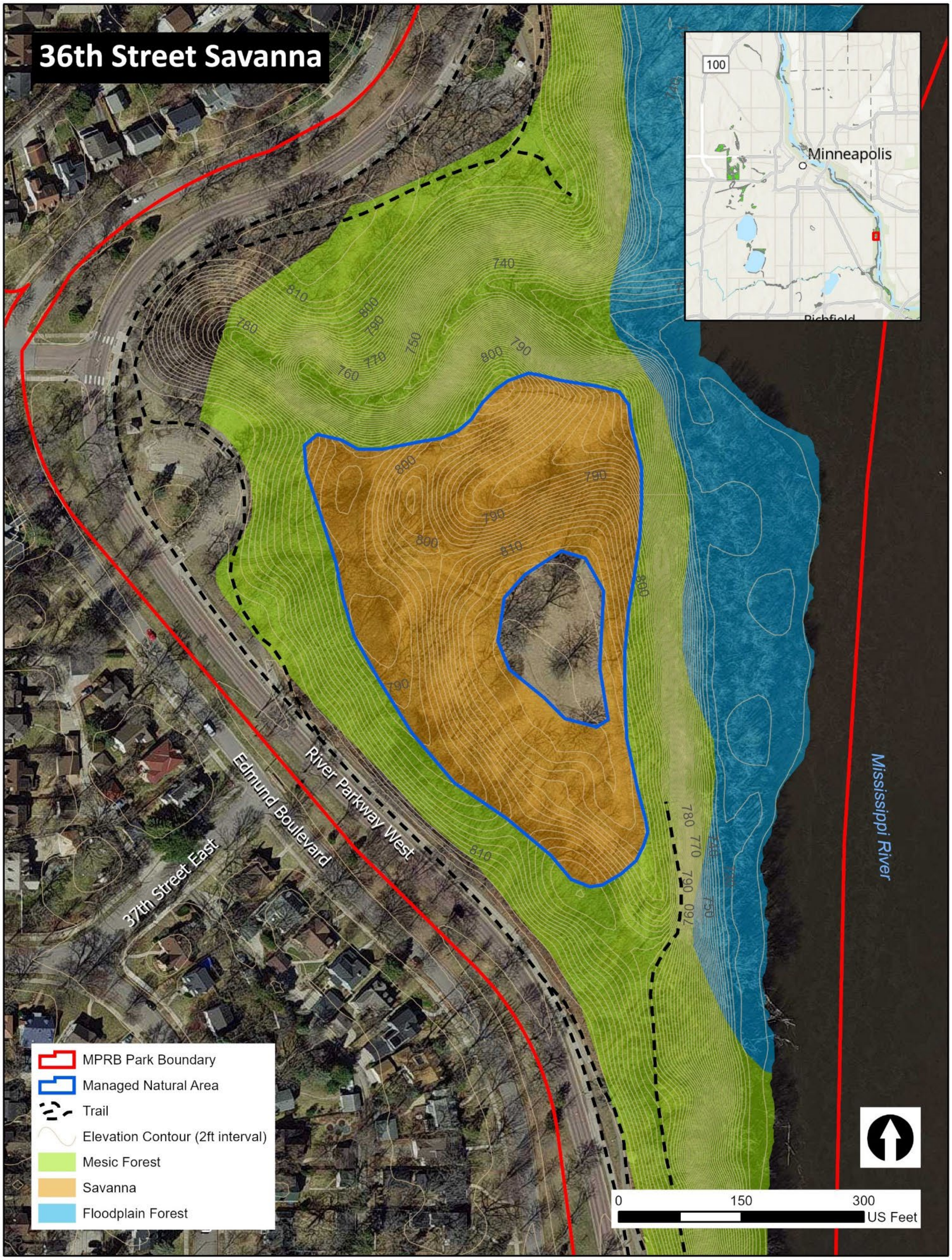
- Manually remove invasive vegetation where safe and feasible (as needed)
- Control Oriental bittersweet and Poison ivy near trails and larger patches in the savanna interior (annual)
- Conduct prescribed burn (rotational burn of ½ of savanna each time, such that each unit is burned every 3-4 years)
- Mow and brush saw as necessary to control woody invasion (burns should limit need for this task)
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Manually remove invasive woody species where cannot mow due to rocks and cement footings (as necessary)
- Overseed to diversify ground layer (as needed)

Native Species to Plant & Perpetuate

See MNDNR’s narrative description for UPs24 (Southern Mesic Savanna) and species lists for UPs23 (understory species generally appropriate for mesic savannas). Appropriate tree species include Bur oak and Northern pin oak.

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1” caliper)	Ongoing, as needed				Nov-Feb
Oriental bittersweet cut and treatment	Ongoing, as needed	Mar	Jul-Aug	Sep-Oct	Nov-Feb
Poison ivy foliar treatment in prescribed burn areas	Ongoing, as needed	May	Jun-Aug	Sep	
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Prescribed burn (vary spring & fall when feasible)	Every year or two (rotational), varying spring & fall	Mar-Apr		Sep-Oct	Nov
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native woody and herbaceous vegetation	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		


36th Street Savanna
Minneapolis
100
Richfield
740
810
800
790
780
770
750
760
River Parkway West
Edmund Boulevard
37th Street East
Mississippi River
MPRB Park Boundary
Managed Natural Area
Trail
Elevation Contour (2ft interval)
Mesic Forest
Savanna
Floodplain Forest
0
150
300
US Feet

44TH ST MESIC FOREST – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park: Mississippi Gorge Park

MPRB Vegetation: Mesic Forest

Acres: 6.2

MLCCS Classification: Oak Forest Mesic Subtype

ASSESSMENT OF CURRENT CONDITIONS

Site History: Remnant mesic oak forest. Significant restoration efforts have occurred since 2002.

Current Condition (2018): The area has scattered native trees and shrubs, and the ground layer is predominantly native forbs, grasses and sedges (moderate to high diversity).

Existing Vegetation, Area & Quality Rank: Mesic oak forest transitioning to maple-basswood forest (6.2 acres, B quality in northern portion to D quality in ravine)

Notable Native Plant Species

- Dominant trees: Mature Red oak, Sugar maple and Bur oak
- Other species: Bladdernut – native, but somewhat aggressive

Notable Animal Species: None identified

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive herbaceous species, including Day lily and Garlic mustard
- Woody invasion by Common buckthorn (most dense E and S of observation area) and Norway Maple (mostly in and near ravine)

Restoration Goals (increase biodiversity and maintain or improve ecological quality rank to C or better by implementing the following)

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

Management Strategies

- Manually remove invasive vegetation where safe and feasible (as needed)
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Install native shrubs, live plant plugs and seed to diversify ground layer and shrub stratum

Native Species to Plant & Perpetuate

See MNDNR's species lists for MHs37 (Southern Dry-Mesic Oak Forest), MHs38 (Southern Mesic Oak-Basswood Forest), and MHs39 (Southern Mesic Maple-Basswood Forest).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Removal of large Norway maples	As soon as resources available				Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native woody and herbaceous vegetation	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		

44th Street Forest
100
Minneapolis
44th Street East
River Parkway West
Edmund Boulevard
Mississippi River
800
790
780
770
760
750
740
760
MPRB Park Boundary
Managed Natural Area
Trail
Elevation Contour (2ft interval)
Mesic Forest
Floodplain Forest
0
150
300
US Feet

EDMUND BLVD SAVANNA – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park: Mississippi Gorge Park
MPRB Vegetation: Savanna
Natural Area Acres: 1.1
MLCCS Classification: Short grasses with sparse tree cover on upland soils

ASSESSMENT OF CURRENT CONDITIONS

Site History: Former native oak savanna. The southern portion of this area was seeded with natives and managed as savanna.

Current Condition (2018): The area has scattered trees (~50% canopy cover), and the ground layer is a mixture of native and non-native herbaceous species with oak seedlings (southern half) and predominantly turf grass (northern half).

Existing Vegetation, Area & Quality Rank: Savanna (1.1 acres, NN quality – not a natural community)

Notable Native Plant Species: Dominant trees: Mature Bur oak and numerous Bur oak seedlings

Notable Animal Species: None identified

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Historical seeding to turf grass and regular mowing has compromised the southern portion, and mowing continues in the northern portion.
- Variety of non-native and weedy species present throughout (mostly in northern half, e.g., Kentucky bluegrass and Dandelion)

Restoration Goals (increase biodiversity and improve ecological quality rank to C or better by implementing the following)

- Maintain <50% canopy cover
- Replace non-native and weedy groundcover in northern portion with native savanna herbaceous vegetation; manage southern portion to facilitate savanna restoration
- Control invasive species, including those listed above
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

Management Strategies

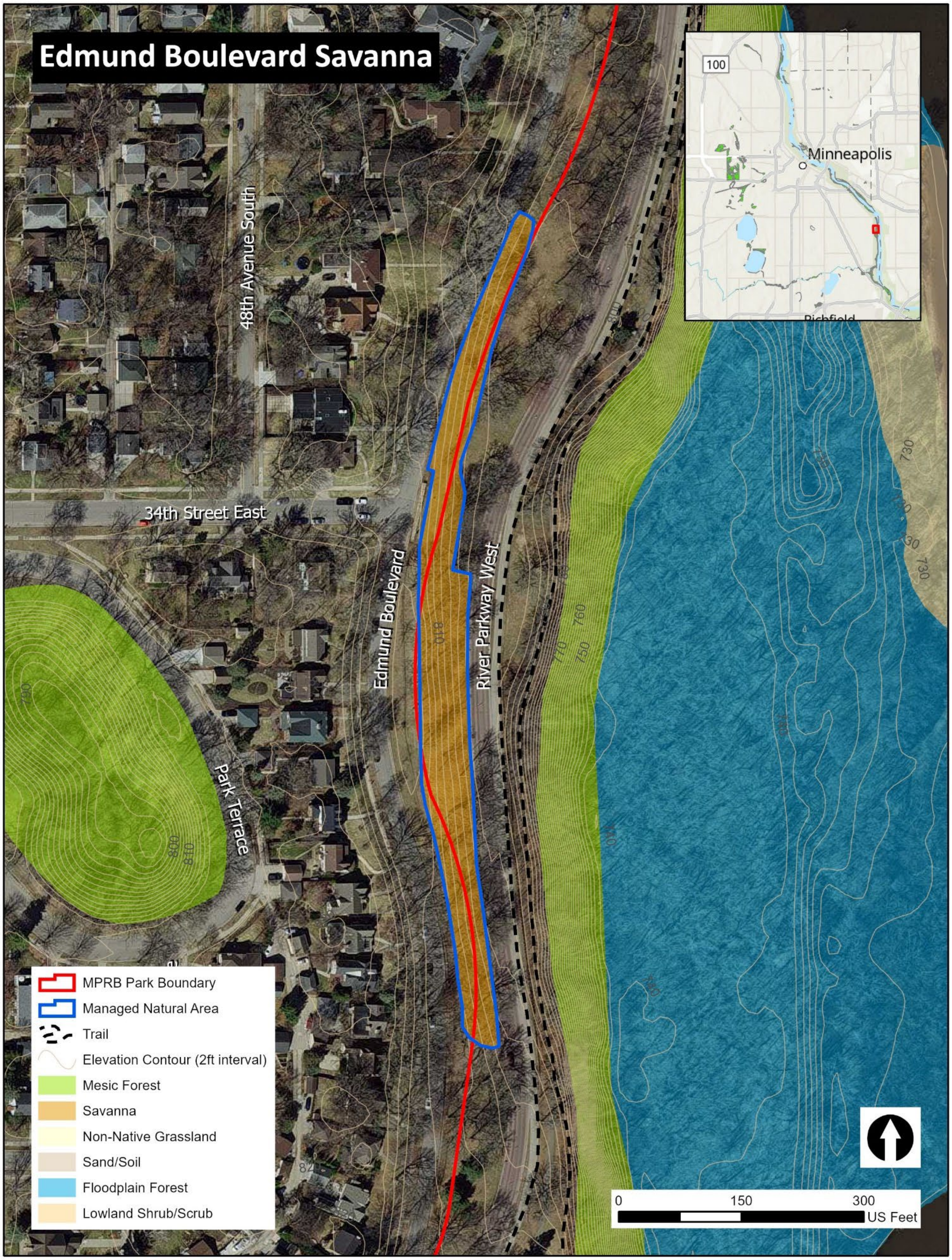
- Manually remove invasive vegetation where safe and feasible (as needed)
- Selectively treat turf grass and spot spray with MPRB-approved herbicide (as necessary)
- Conduct prescribed burn (rotational burn of ½ of savanna each time, such that each unit is burned every 3-4 years), protecting oak seedlings and saplings
- Mow and brush saw as necessary to control woody invasion (burns should limit need for this task)
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Overseed to diversify ground layer (as needed)

Native Species to Plant & Perpetuate

See MNDNR's narrative description for UPs24 (Southern Mesic Savanna) and species list for UPs23 (understory species generally appropriate for mesic savannas). Appropriate tree species include Bur oak and Northern Pin Oak.

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Prescribed burn	Every year or two (rotational), varying spring & fall	Mar-Apr		Sep-Oct	Nov
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		



Edmund Boulevard Savanna
48th Avenue South
34th Street East
Edmund Boulevard
River Parkway West
Park Terrace
Minneapolis
100
MPRB Park Boundary
Managed Natural Area
Trail
Elevation Contour (2ft interval)
Mesic Forest
Savanna
Non-Native Grassland
Sand/Soil
Floodplain Forest
Lowland Shrub/Scrub
0
150
300
US Feet

BLACK ASH SEEPAGE SWAMP – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park: Minnehaha Park

MPRB Vegetation: Wet Forest/Swamp

Natural Area Acres: 1.4

MLCCS Classification: Black Ash Swamp Seepage

ASSESSMENT OF CURRENT CONDITIONS

Site History: Remnant native seepage swamp. Limited restoration efforts have occurred, but Black ash trees were removed by MPRB Forestry in 2019 due to Emerald ash borer.

Current Condition (2019): The area has scattered native trees and shrubs, and the ground layer is predominantly native forbs, grasses and sedges (moderate diversity). A boardwalk provides public access to this wetland.

Existing Vegetation, Area & Quality Rank: Wet Forest/Swamp (1.4 acres, C quality)

Notable Native Plant Species

- Dominant trees: Black ash, Black willow and American elm
- Other species: Marsh marigold, Skunk cabbage, various sedges

Notable Animal Species: None identified

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive herbaceous species, including Reed canary grass, True forget-me-not, and Narrow-leaf bittercress
- Woody invasion by Common buckthorn and Glossy buckthorn

Restoration Goals (increase biodiversity and improve ecological quality rank to BC or better by implementing the following)

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

Management Strategies

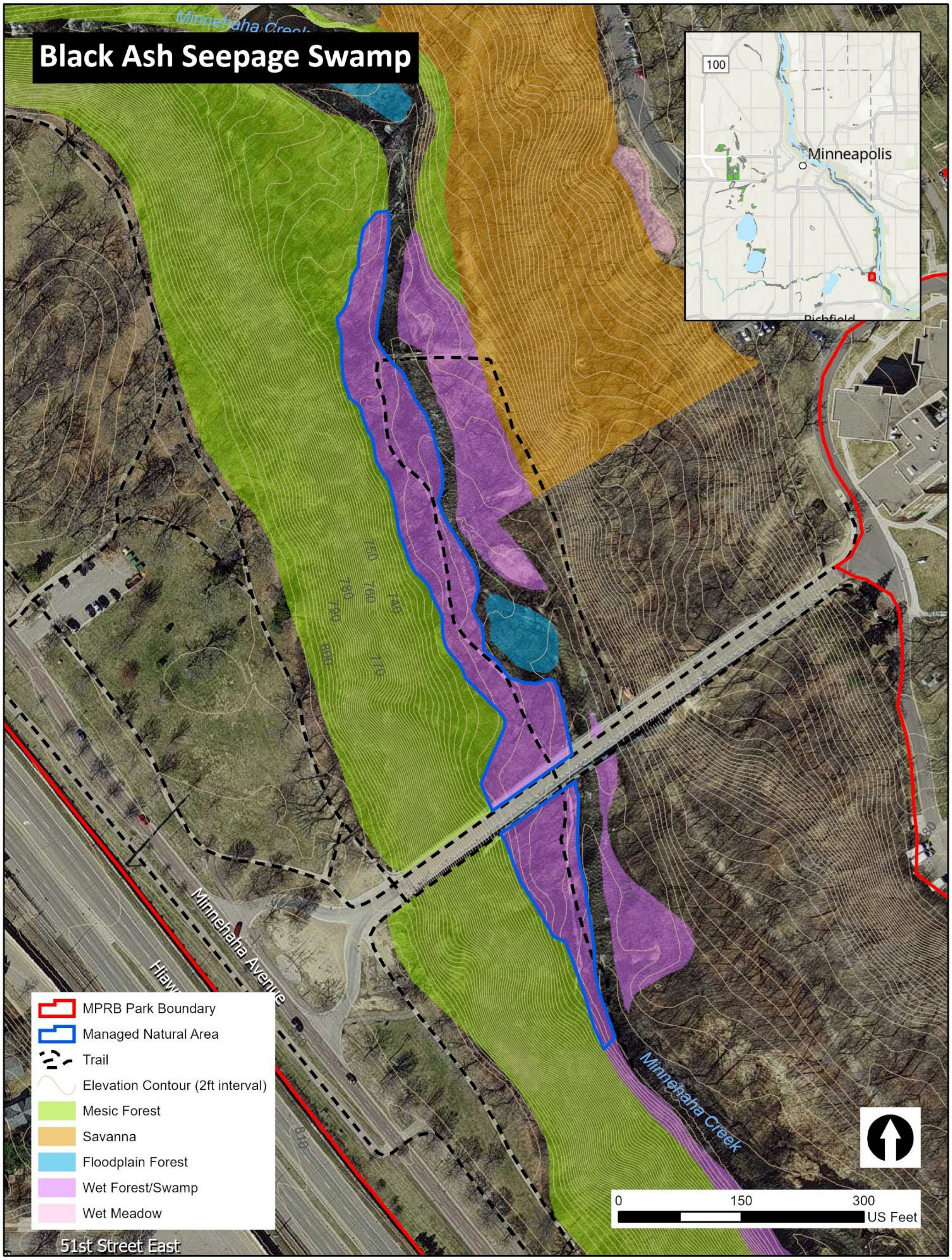
- Install native trees (e.g., Black willow, Dutch elm disease-resistant American elm, Red maple) to replace the Black ash canopy that was removed
- Manually remove invasive vegetation where safe and feasible (as needed)
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Overseed to diversify ground layer (as needed)

Native Species to Plant & Perpetuate

See MNDNR's species list for WFs57 (Southern Wet Ash Swamp).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native woody and herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		


Black Ash Seepage Swamp
Minnehaha Creek
Minneapolis
100
Richfield
750
780
760
740
790
800
770
Minnehaha Avenue
Minnehaha Creek
51st Street East
MPRB Park Boundary
Managed Natural Area
Trail
Elevation Contour (2ft interval)
Mesic Forest
Savanna
Floodplain Forest
Wet Forest/Swamp
Wet Meadow
0
150
300
US Feet

MORLEY'S PRAIRIE – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park Unit: Minnehaha Park
MPRB Vegetation: Prairie
Natural Area Acres: 1.4
MLCCS Classification: Mesic Prairie

ASSESSMENT OF CURRENT CONDITIONS

Site History: Remnant native prairie.

Current Condition (2019): Lack of management had led to brush encroachment; however, brushing was conducted in 2020.

Existing Vegetation, Area & Quality Rank: Prairie (1.4 acres, D quality), but quality assessed before recent brushing

Notable Native Plant Species: Dominant trees: Eastern cottonwood and Northern pin oak scattered in Prairie

Notable Animal Species: None identified

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Lack of regular prescribed fire led to significant woody encroachment and shading of native prairie vegetation; much of this invasive woody vegetation was recently removed
- Invasive herbaceous species, including Common burdock, Canada thistle, Motherwort, Curly dock, White campion, Catnip
- Woody invasion (much recently removed) consisted of Common buckthorn, non-native honeysuckle, Oriental bittersweet, and native woody species such as Box elder, Gray dogwood, Eastern cottonwood, Green ash, Smooth sumac, Staghorn sumac, and Poison ivy
- Low native plant diversity

Restoration Goals (increase biodiversity and improve ecological quality rank to BC or better by implementing the following)

- Maintain <5% tree and shrub canopy cover
- Control invasive species, including those listed above and all listed MDA noxious weeds (e.g., Canada thistle)
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

Management Strategies

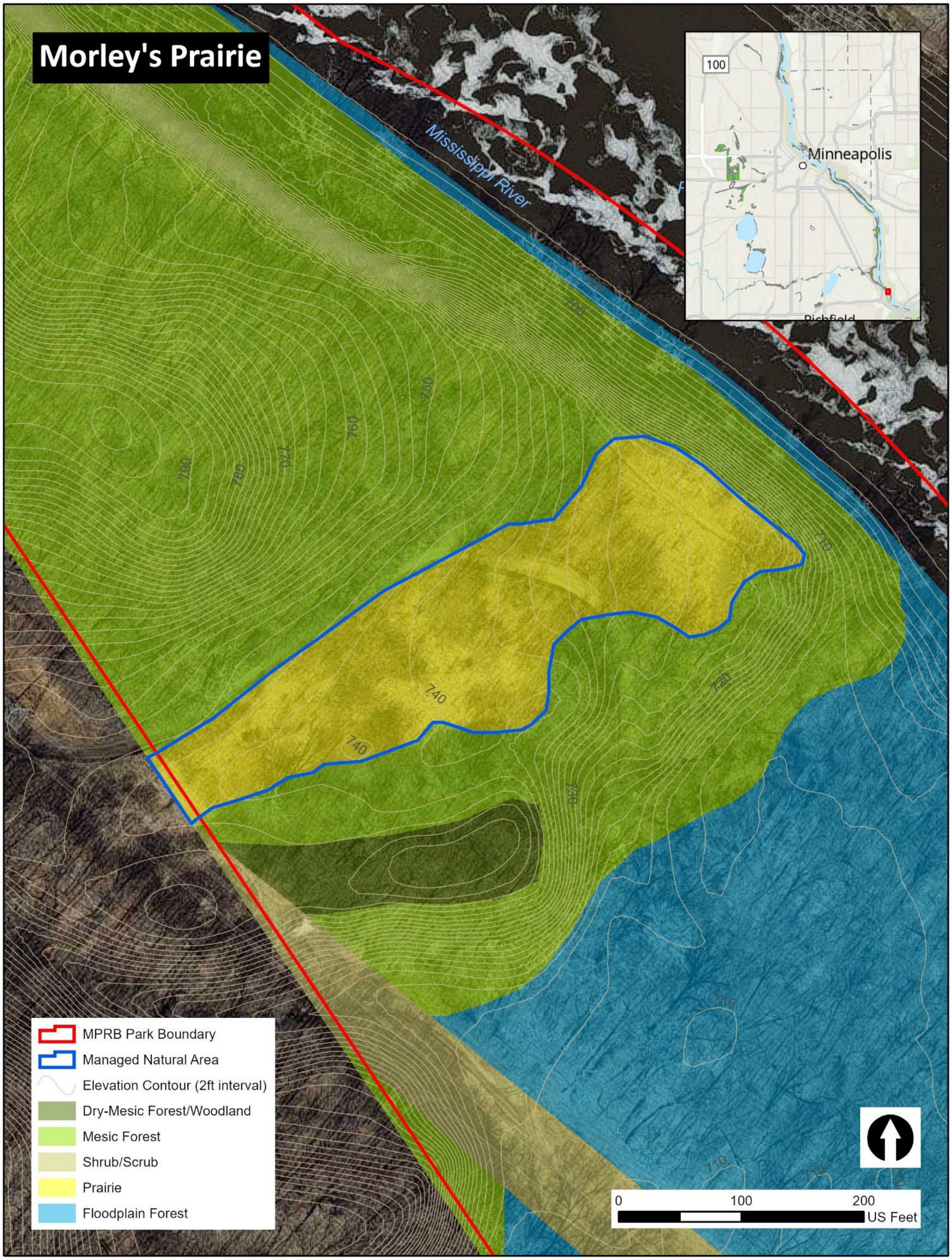
- Manually remove invasive vegetation where safe and feasible (as needed)
- Conduct prescribed burn (rotational burn of ½ of prairie each time, such that each unit is burned every 3-4 years)
- Mow and brush saw as necessary to control woody invasion (burns should limit need for this task)
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Overseed to diversify ground layer (as needed)

Native Species to Plant & Perpetuate

See MNDNR's species list for UPs23 (Southern Mesic Prairie).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Prescribed burn	Every year or two (rotational), varying spring & fall	Mar-Apr		Sep-Oct	Nov
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Prairie mowing	Annually if burns are not possible		Jun-Aug		
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		


Morley's Prairie
Mississippi River
100
Minneapolis
Richfield
790
780
770
760
750
740
740
730
720
710
700
710
710
710
MPRB Park Boundary
Managed Natural Area
Elevation Contour (2ft interval)
Dry-Mesic Forest/Woodland
Mesic Forest
Shrub/Scrub
Prairie
Floodplain Forest
0
100
200
US Feet

LONGFELLOW GARDENS PRAIRIE – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park Unit: Minnehaha Park

MPRB Vegetation: Prairie

Natural Area Acres: 3.4

MLCCS Classification: Mesic Prairie

ASSESSMENT OF CURRENT CONDITIONS

Site History: Planted prairie, established as part of park renovation in 2005.

Current Condition (2019): Dominated by low diversity of native forbs, grasses and sedges. Metropolitan Council utility work during 2020 affected portions of the Prairie.

Existing Vegetation, Area & Quality Rank: Prairie (3.4 acres, D quality)

Notable Native Plant Species: None identified

Notable Animal Species: None identified

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Disturbance to Prairie from utility work (which Metropolitan Council will restore with native vegetation)
- Invasive herbaceous species, including Hoary alyssum, Smooth brome, Birdsfoot trefoil, Black medick, Alfalfa, Yellow sweet clover, Reed canary grass, Kentucky bluegrass and Common mullein
- Woody invasion by Siberian elm and White mulberry
- Low native plant cover and diversity

Restoration Goals (increase biodiversity and improve ecological quality rank to BC or better by implementing the following)

- Maintain <5% tree and shrub canopy cover
- Control invasive species, including those listed above
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

Management Strategies

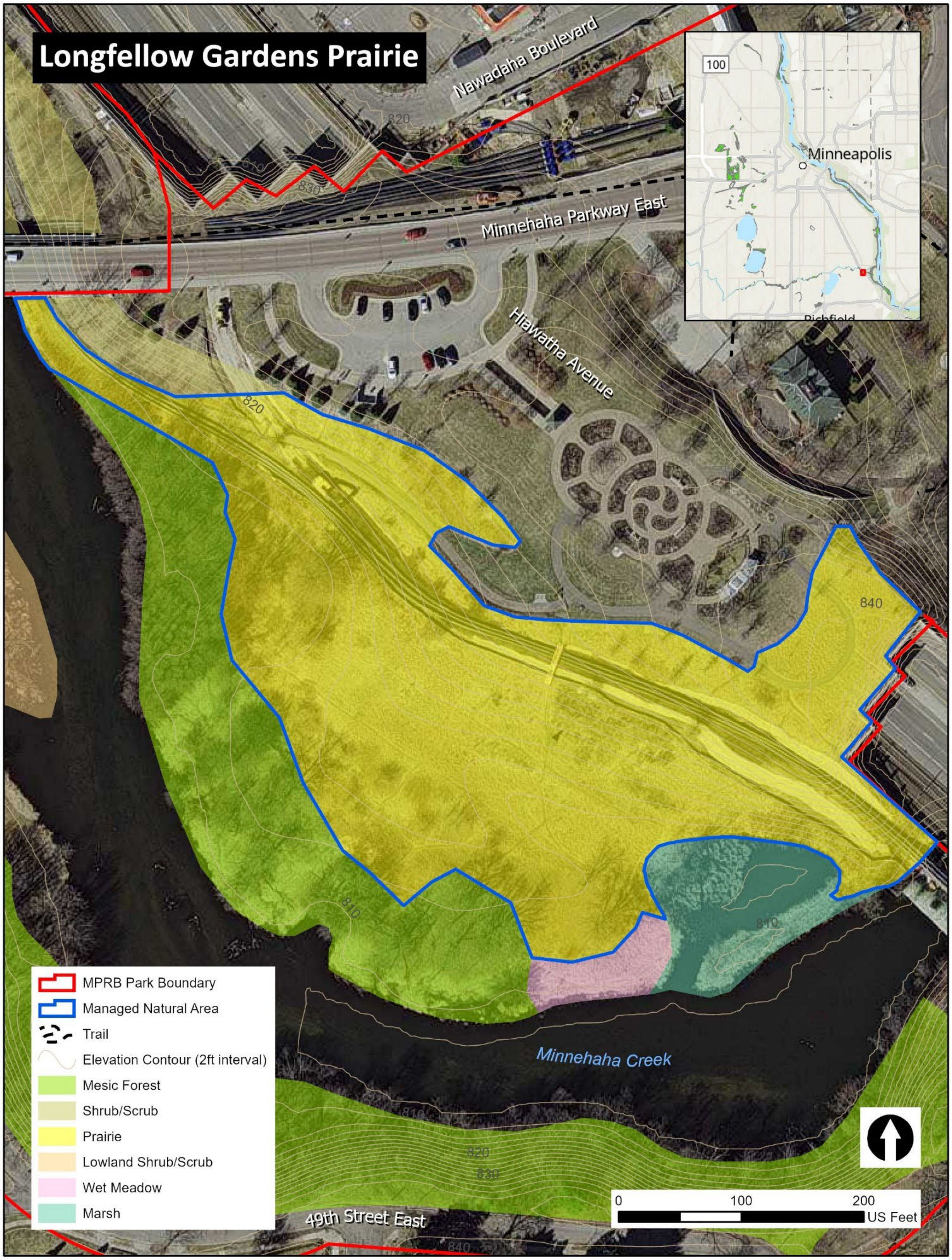
- Manually remove invasive vegetation where safe and feasible (as needed)
- Conduct prescribed burn (rotational burn of ½ of prairie each time, such that each unit is burned every 3-4 years)
- Mow and brush saw as necessary to control woody invasion (burns should limit need for this task)
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Overseed to diversify ground layer (as needed)

Native Species to Plant & Perpetuate

See MNDNR's species list for UPs23 (Southern Mesic Prairie).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Prescribed burn	Every year or two (rotational), varying spring & fall	Mar-Apr		Sep-Oct	Nov
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Prairie mowing	Annually if burns are not possible		Jun-Aug		
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		


Longfellow Gardens Prairie
Nawadaha Boulevard
Minnehaha Parkway East
Hiawatha Avenue
Minnehaha Creek
49th Street East
Minneapolis
100
820
830
840
810
MPRB Park Boundary
Managed Natural Area
Trail
Elevation Contour (2ft interval)
Mesic Forest
Shrub/Scrub
Prairie
Lowland Shrub/Scrub
Wet Meadow
Marsh
0
100
200
US Feet

17TH AVE PRAIRIE – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park Unit: Minnehaha Creek Park

MPRB Vegetation: Prairie

Natural Area Acres: 0.6

MLCCS Classification: Mesic Prairie

ASSESSMENT OF CURRENT CONDITIONS

Site History: Planted prairie, established in 1997.

Current Condition (2019): Dominated by native forbs, grasses and sedges.

Existing Vegetation, Area & Quality Rank: Prairie (0.6 acres, C quality)

Notable Native Plant Species: Dense patch of Cup plant at bottom of hill

Notable Animal Species: None identified

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Park patrons use the prairie slope for sledding in the winter; however, damage was not apparent
- Invasive herbaceous species, including Smooth brome, Reed canary grass, and Kentucky bluegrass
- Relatively low native plant cover and diversity
- Much of lower area dominated by aggressive native Cup plant

Restoration Goals (increase biodiversity and improve ecological quality rank to BC or better by implementing the following)

- Maintain <5% tree and shrub canopy cover
- Control invasive species, including those listed above
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

Management Strategies

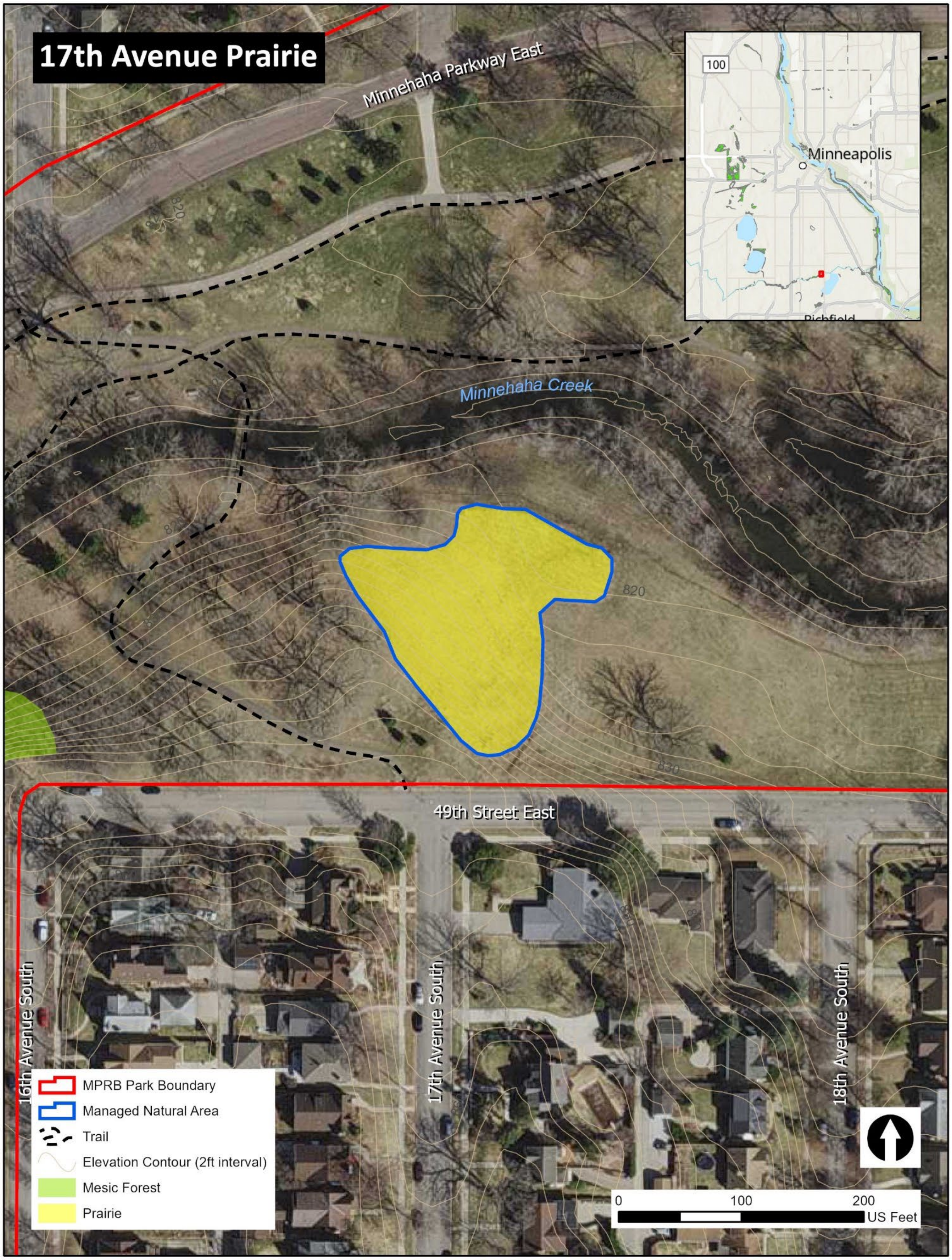
- Manually remove invasive vegetation where safe and feasible (as needed)
- Conduct prescribed burn (rotational burn of ½ of prairie each time, such that each unit is burned every 3-4 years)
- Mow and brush saw as necessary to control woody invasion (burns should limit need for this task)
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Overseed to diversify ground layer (as needed)

Native Species to Plant & Perpetuate

See MNDNR's species list for UPs23 (Southern Mesic Prairie).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Prescribed burn	Every year or two (rotational), varying spring & fall	Mar-Apr		Sep-Oct	Nov
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Prairie mowing	Annually if burns are not possible		Jun-Aug		
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		



17th Avenue Prairie
Minnehaha Parkway East
Minnehaha Creek
820
49th Street East
16th Avenue South
17th Avenue South
18th Avenue South
100
Minneapolis
MPRB Park Boundary
Managed Natural Area
Trail
Elevation Contour (2ft interval)
Mesic Forest
Prairie
0
100
200
US Feet

NOKOMIS PRAIRIE – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park Unit: Nokomis and Hiawatha Parks
MPRB Vegetation: Prairie
Natural Area Acres: 1.9
MLCCS Classification: Mesic Prairie

ASSESSMENT OF CURRENT CONDITIONS

Site History: Planted prairie, established in 2002.
Current Condition (2019): The ground layer is predominantly native forbs, grasses and sedges
Existing Vegetation, Area & Quality Rank: Prairie (1.9 acres, CD quality)
Notable Native Plant Species: None identified
Notable Animal Species: None identified

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive herbaceous species, including Canada thistle and cool-season (turf) grasses
- Woody invasion by native trees such as Green ash, native shrubs, and non-native woody species

Restoration Goals (increase biodiversity and improve ecological quality rank to C or better by implementing the following)

- Maintain <5% tree and shrub canopy cover
- Control invasive species, including woody invasion of Prairie and all listed MDA noxious weeds (e.g., Canada thistle)
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

Management Strategies

- Manually remove invasive vegetation where safe and feasible (as needed)
- Conduct prescribed burn (rotational burn of ½ of prairie each time, such that each unit is burned every 3-4 years)
- Mow and brush saw as necessary to control woody invasion (burns should limit need for this task)
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Overseed to diversify ground layer (as needed)

Native Species to Plant & Perpetuate:
See MNDNR's species list for UPs23 (Southern Mesic Prairie).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually	Mar-May	Jun-Aug	Sep-Oct	Nov-Feb
Prescribed burn	Every year or two (rotational), varying spring & fall	Mar-Apr		Sep-Oct	Nov
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Prairie mowing	Annually if burns are not possible		Jun-Aug		
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		

Nokomis Prairie
Minneapolis
100
Richfield
49th Street East
Woodlawn Boulevard
Minnehaha Parkway East
50th Street East
Lake Nokomis
850
840
830
MPRB Park Boundary
Managed Natural Area
Trail
Elevation Contour (2ft interval)
Prairie
0
100
200
US Feet

TAMARACK BOG – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park: Theodore Wirth Park

MPRB Vegetation: Forested Peatland

Natural Area Acres: 2.9

MLCCS Classification: Tamarack Swamp Sphagnum Subtype

ASSESSMENT OF CURRENT CONDITIONS

Site History: Remnant native tamarack bog. Intermittent restoration efforts have occurred since the 1990s.

Current Condition (2020): Recent Glossy buckthorn removal efforts have improved quality of bog.

Existing Vegetation, Area & Quality Rank: Forested Peatland (2.9 ac, BC quality)

Notable Native Plant Species

- Dominant trees: Tamarack
- Other species: Leather-leaf, Wild calla, numerous sedges, Sphagnum moss

Notable Animal Species: None identified

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Woody invasion by Glossy buckthorn and native maple and birch
- Invasive herbaceous species, including Purple loosestrife and Blue cattail

Restoration Goals (increase biodiversity and improve ecological quality rank to B or better by implementing the following)

- Maintain >75% canopy cover (mostly by Tamarack)
- Control invasive species, including those listed above
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

Management Strategies

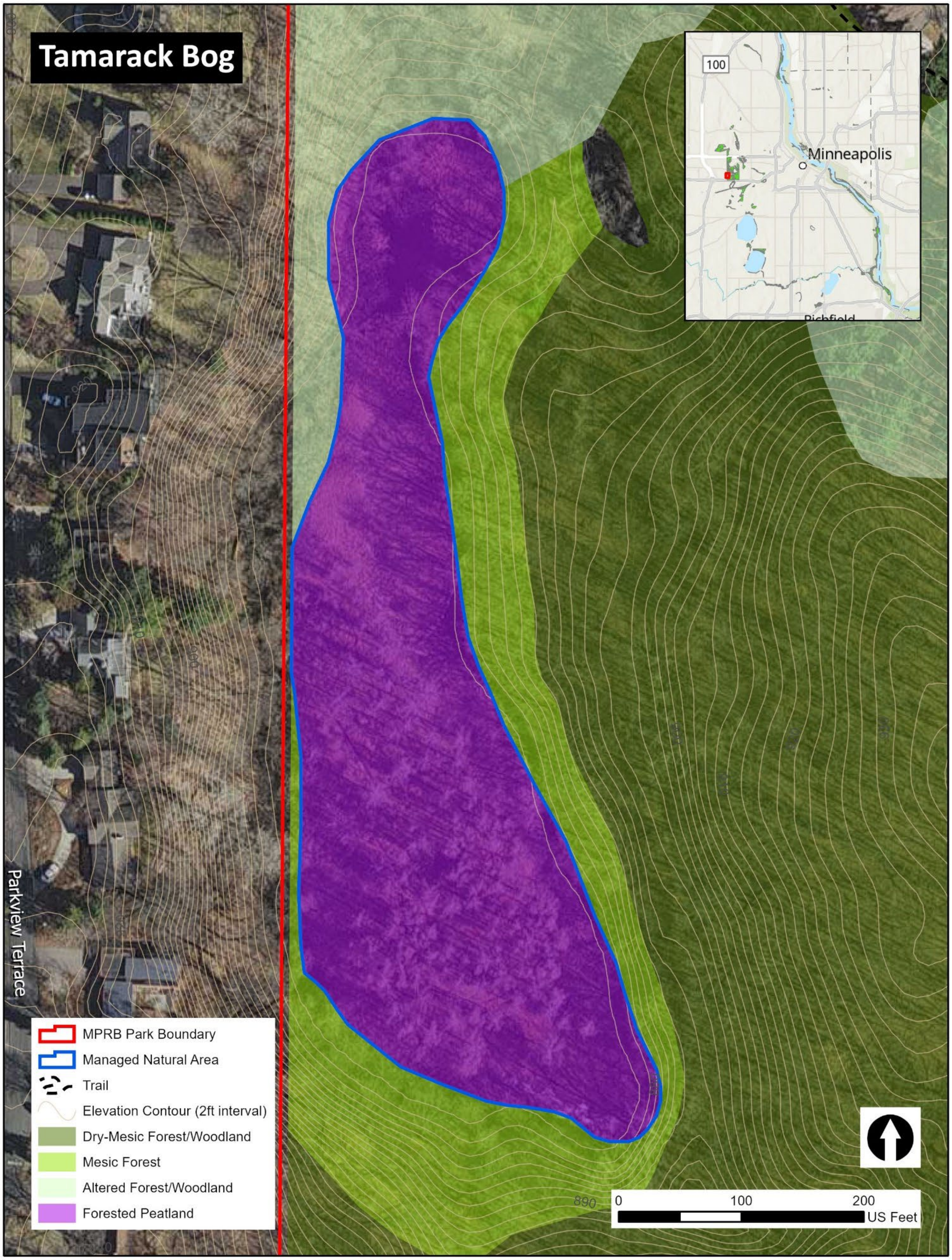
- Manually remove invasive vegetation where safe and feasible (as needed)
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Install Tamarack seedlings or saplings

Native Species to Plant & Perpetuate

See MNDNR's species list for FPs63 (Southern Rich Conifer Swamp).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually	Mar-May	Jun-Aug	Sep-Oct	Nov-Feb
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		



Tamarack Bog
100
Minneapolis
Richfield
Parkview Terrace
MPRB Park Boundary
Managed Natural Area
Trail
Elevation Contour (2ft interval)
Dry-Mesic Forest/Woodland
Mesic Forest
Altered Forest/Woodland
Forested Peatland
890
0
100
200
US Feet

JD RIVERS PRAIRIE – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park: Theodore Wirth Park

MPRB Vegetation: Prairie

Natural Area Acres: 0.8

MLCCS Classification: Other vegetable and truck crops

ASSESSMENT OF CURRENT CONDITIONS

Site History: Former park garden was planted into prairie in 1997.

Current Condition (2019): Dominated by native grasses, with patches and scattered native forbs and a few invasive species.

Existing Vegetation, Area & Quality Rank: Prairie (0.8 ac, B quality)

Notable Native Plant Species: None identified

Notable Animal Species: None identified

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive herbaceous species, including Curly dock, Purple loosestrife, Canada thistle and Birdsfoot trefoil
- Woody invasion by native Staghorn sumac

Restoration Goals (increase biodiversity and maintain ecological quality rank of B or better by implementing the following)

- Maintain <5% tree and shrub canopy cover
- Control invasive species, including those listed above and all listed by MDA as noxious weeds (e.g., Canada thistle and Purple loosestrife)
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

Management Strategies

- Manually remove invasive vegetation where safe and feasible (as needed)
- Conduct prescribed burn (rotational burn of ½ of prairie each time, such that each unit is burned every 3-4 years)
- Mow and brush saw as necessary to control woody invasion (burns should limit need for this task)
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Overseed to diversify ground layer (as needed)

Native Species to Plant & Perpetuate

See MNDNR's species list for UPs23 (Southern Mesic Prairie).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually	Mar-May	Jun-Aug	Sep-Oct	Nov-Feb
Prescribed burn	Every year or two (rotational), varying spring & fall	Mar-Apr		Sep-Oct	Nov
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Prairie mowing	Annually if burns are not possible		Jun-Aug		
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		

JD Rivers Prairie
Bassett Creek
Minneapolis
100
Glenwood Avenue North
MPRB Park Boundary
Managed Natural Area
Trail
Elevation Contour (2ft interval)
Mesic Forest
Altered Forest/Woodland
Savanna
Shrub/Scrub
Prairie
Sand/Soil
Floodplain Forest
0
100
200
US Feet

SHINGLE CREEK PRAIRIE – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park: Shingle Creek Park
MPRB Vegetation: Prairie
Natural Area Acres: 1.1
MLCCS Classification: Mesic Prairie

ASSESSMENT OF CURRENT CONDITIONS

Site History: Planted prairie, established in 1996.

Current Condition (2018): Dominated by native grasses, with patches and scattered native forbs and invasive species.

Existing Land Cover, Area & Quality Rank: Prairie (1.1 acres, C quality)

Notable Native Plant Species: None identified

Notable Animal Species: None identified

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date
- Invasive herbaceous species, including Kentucky bluegrass, Common mullein, Curly dock, Quackgrass, Butter and eggs
- Woody invasion by Siberian elm
- Relatively low native plant cover and diversity

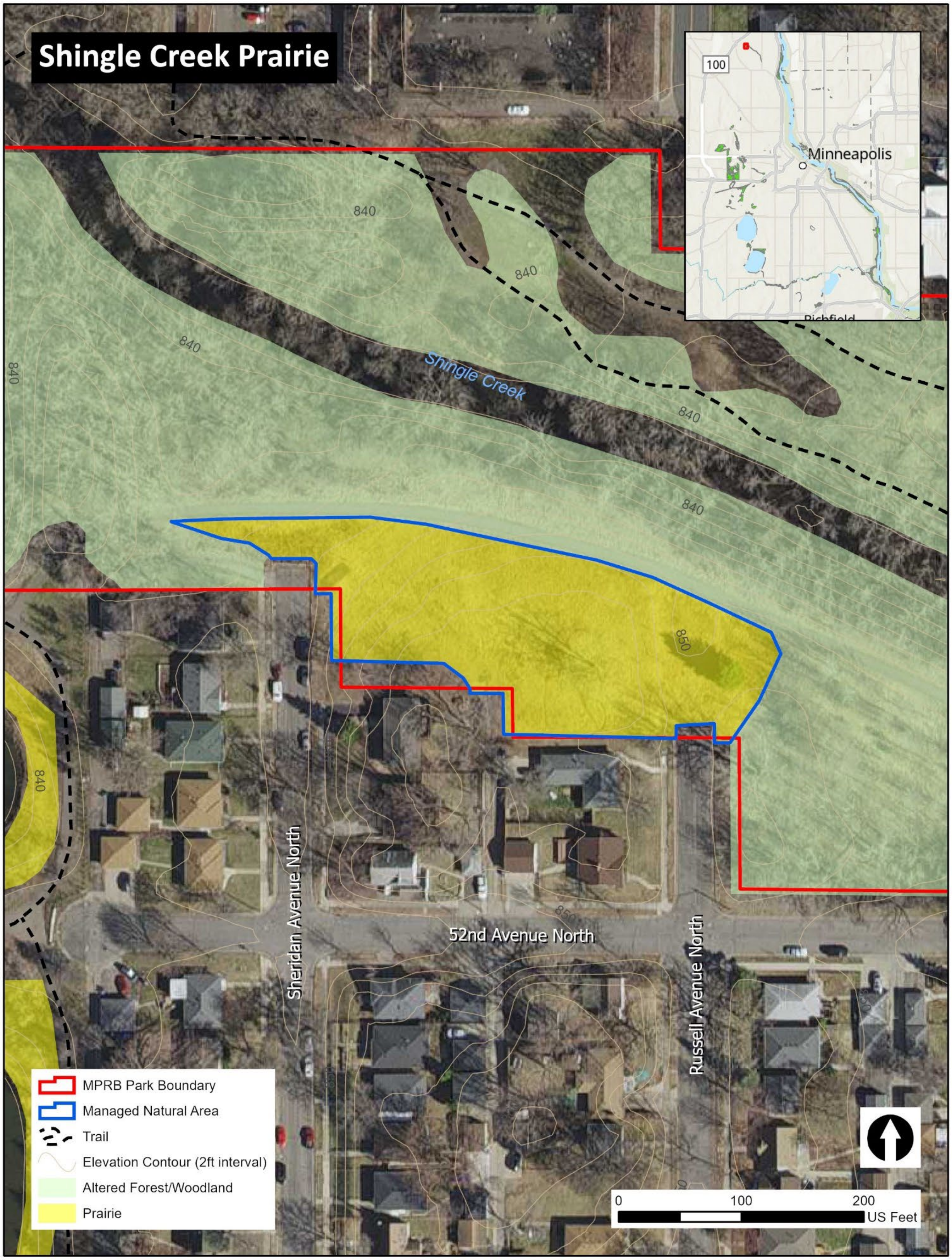
Restoration Goals (increase biodiversity and improve ecological quality rank to B or better by implementing the following)
- Maintain <5% tree and shrub canopy cover
- Control invasive species, including those listed above and woody invasion, as well as all listed MDA noxious weeds (e.g., Canada thistle)
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

Management Strategies
- Manually remove invasive vegetation where safe and feasible (as needed)
- Conduct prescribed burn (rotational burn of ½ of prairie each time, such that each unit is burned every 3-4 years)
- Mow and brush saw as necessary to control woody invasion (burns should limit need for this task)
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Overseed to diversify ground layer (as needed)

Native Species to Plant & Perpetuate:
See MNDNR's species list for UPs23 (Southern Mesic Prairie).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually	Mar-May	Jun-Aug	Sep-Oct	Nov-Feb
Prescribed burn	Every year or two (rotational), varying spring & fall	Mar-Apr		Sep-Oct	Nov
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Prairie mowing	Annually if burns are not possible		Jun-Aug		
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		


Shingle Creek Prairie
100
Minneapolis
Richfield
840
840
840
840
840
840
850
840
Shingle Creek
Sheridan Avenue North
52nd Avenue North
Russell Avenue North
MPRB Park Boundary
Managed Natural Area
Trail
Elevation Contour (2ft interval)
Altered Forest/Woodland
Prairie
0
100
200
US Feet

BROWNIE LAKE PRAIRIE – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park: Brownie Lake Park
MPRB Vegetation: Prairie
Natural Area Acres: 2.9
MLCCS Classification: Medium-tall grass altered/non-native dominated grassland

ASSESSMENT OF CURRENT CONDITIONS

Site History: Planted prairie, established in 1995.
Current Condition (2019): Dominated by native forbs and grasses, with patches of invasive species.
Existing Land Cover, Area & Quality Rank: Prairie (2.9 acres, C-CD quality)
Notable Native Plant Species: None identified
Notable Animal Species: None identified

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date
- Park patrons use prairie as off-leash dog run, spreading seeds of invasive plants and creating network of informal paths
- Park patrons use the prairie slope for sledding in the winter; however, damage was not apparent
- Invasive herbaceous species, including Reed canary grass, Birdsfoot trefoil, Crown vetch, Absinthe wormwood, Leafy spurge, Smooth brome and Kentucky bluegrass
- Patches of aggressive native Canada goldenrod
- Woody invasion by native species such as Smooth sumac and Boxelder

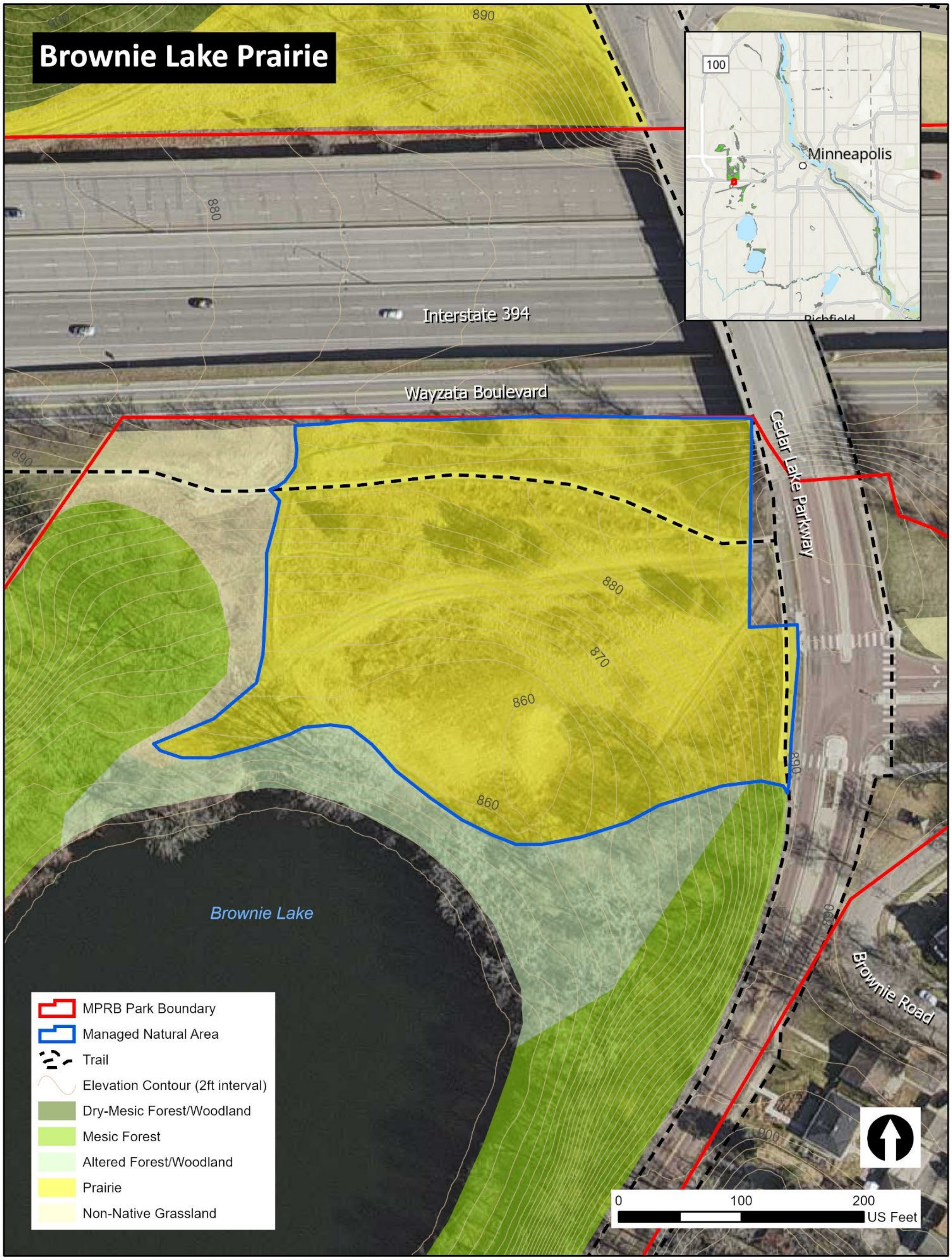
Restoration Goals (increase biodiversity and improve ecological quality rank to BC or better by implementing the following)
- Abandon select trails; install signage or barriers (e.g., shrubs) to discourage trail creation and off-leash dogs
- Maintain <5% tree and shrub canopy cover
- Control invasive species, including those listed above
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

Management Strategies
- Manually remove invasive vegetation where safe and feasible (as needed)
- Conduct prescribed burn (rotational burn of ½ of prairie each time, such that each unit is burned every 3-4 years)
- Mow and brush saw as necessary to control woody invasion (burns should limit need for this task)
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Overseed to diversify ground layer (as needed)

Native Species to Plant & Perpetuate
See MNDNR's narrative description and species lists for UPs23 (Southern Mesic Prairie).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually	Mar-May	Jun-Aug	Sep-Oct	Nov-Feb
Prescribed burn	Every year or two (rotational), varying spring & fall	Mar-Apr		Sep-Oct	Nov
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Prairie mowing	Annually if burns are not possible		Jun-Aug		
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		



Brownie Lake Prairie
Interstate 394
Wayzata Boulevard
Cedar Lake Parkway
Brownie Lake
Brownie Road
Minneapolis
100
890
880
870
860
MPRB Park Boundary
Managed Natural Area
Trail
Elevation Contour (2ft interval)
Dry-Mesic Forest/Woodland
Mesic Forest
Altered Forest/Woodland
Prairie
Non-Native Grassland
0
100
200
US Feet

CEDAR LAKE REGIONAL TRIAL PRAIRIE – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park: Cedar Lake Park

Natural Area Acres: 28.2

MPRB Vegetation: Prairie, Shrub/Scrub

MLCCS Classification: Mesic Prairie

ASSESSMENT OF CURRENT CONDITIONS

General History: Planted prairie, established in 1995.

General Conditions (2019): Prairie exhibits a variety of quality ranks, with patches and scattered invasive species.

Existing Vegetation, Area & Quality Rank Range: Planted Prairie (26.3 acres, BC-C quality); Shrub/Scrub (1.9 acres, CD quality)

Notable Native Plant Species: None identified

Notable Animal Species: None identified

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive herbaceous species, including Smooth brome, Kentucky bluegrass, Leafy spurge, Spotted knapweed, Crown vetch, Yellow & White sweet clover
- Woody invasion by sumac, willows, and Gray dogwood

Restoration Goals (increase biodiversity and maintain or improve ecological quality rank to BC or better by implementing the following)

- Maintain <5% tree and shrub canopy cover
- Control invasive species, including those listed above
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

Management Strategies

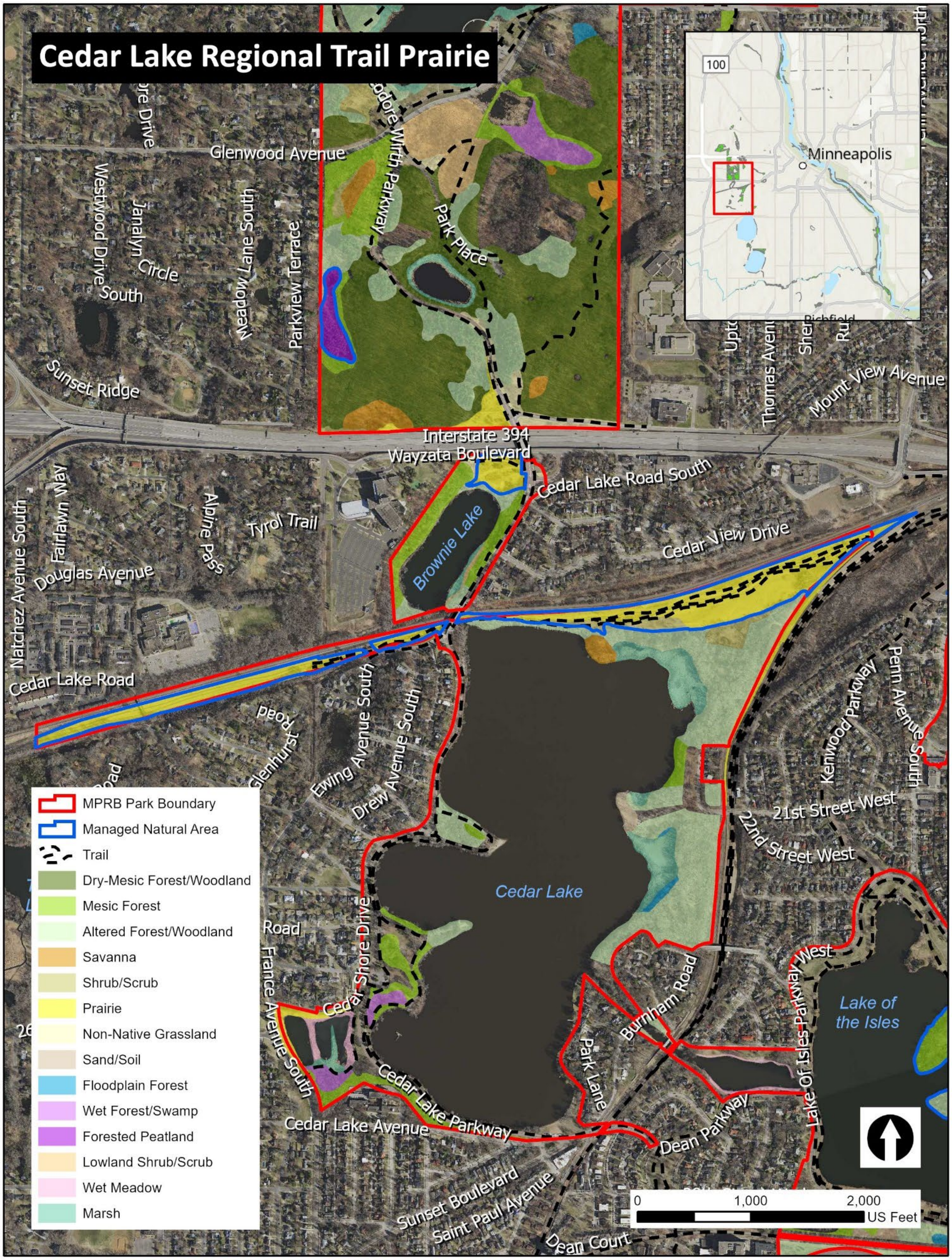
- Manually remove invasive trees and shrubs (except Oak species)
- Assess effectiveness of biological controls (in place since 2003) to control Leafy spurge and Spotted knapweed
- Conduct prescribed burn (rotational burn of 1/3 of prairie each year)
- Mow and brush saw as necessary to control woody invasion (burns should limit need for this task)
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Overseed to diversify ground layer (as needed)

Native Species to Plant & Perpetuate

See MNDNR's species list for UPs23 (Southern Mesic Prairie).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Prescribed burn	Annually burn 1/3 of prairie on rotation, varying spring & fall	Mar-Apr		Sep-Oct	Nov
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Prairie mowing	Annually if burns are not possible		Jun-Aug		
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		



Cedar Lake Regional Trail Prairie
Glenwood Avenue
Westwood Drive South
Janalyn Circle
Meadow Lane South
Parkview Terrace
Theodore Wirth Parkway
Park Place
Sunset Ridge
Interstate 394
Wayzata Boulevard
Cedar Lake Road South
Cedar View Drive
Brownie Lake
Tyrol Trail
Alpine Pass
Fairlawn Way
Douglas Avenue
Natchez Avenue South
Cedar Lake Road
Glenhurst Road
Ewing Avenue South
Drew Avenue South
Thomas Avenue
Mount View Avenue
Kenwood Parkway
Penn Avenue South
21st Street West
22nd Street West
Cedar Lake
Cedar Shore Drive
France Avenue South
Cedar Lake Parkway
Cedar Lake Avenue
Burnham Road
Park Lane
Dean Parkway
Lake of Isles Parkway West
Lake of the Isles
Sunset Boulevard
Saint Paul Avenue
Dean Court
Minneapolis
100
MPRB Park Boundary
Managed Natural Area
Trail
Dry-Mesic Forest/Woodland
Mesic Forest
Altered Forest/Woodland
Savanna
Shrub/Scrub
Prairie
Non-Native Grassland
Sand/Soil
Floodplain Forest
Wet Forest/Swamp
Forested Peatland
Lowland Shrub/Scrub
Wet Meadow
Marsh
0
1,000
2,000
US Feet

MIKE'S ISLAND – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park: Lake of the Isles Park
MPRB Vegetation: Mesic Forest
Natural Area Acres: 3.8
MLCCS Classification: Altered/non-native deciduous woodland

ASSESSMENT OF CURRENT CONDITIONS

Site History: The smaller of the Lake's two constructed islands; consists of historical upland forest and forested dredge spoils from construction of the lake; the island is a wildlife refuge.

Current Condition (2019): The island has scattered native trees and shrubs, with patches of native ground cover (forbs, grasses and sedges).

Existing Vegetation, Area & Quality Rank: Mesic Forest (3.8 ac, D quality)

Notable Native Plant Species: Dominant trees: Green ash, Common hackberry and Bur oak (22"-28" dbh)

Notable Animal Species: Eastern kingbird

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive herbaceous species, including Lily of the valley, Purple loosestrife
- Woody invasion by Common buckthorn, non-native honeysuckle and White mulberry
- Sparse understory and ground layer in areas, presumably due to non-native earthworms, sheet erosion, etc.

Restoration Goals (increase biodiversity and improve ecological quality rank to C or better by implementing the following)

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

Management Strategies

- Manually remove invasive vegetation where safe and feasible (as needed)
- Assess if biocontrol is feasible for the site's small population of Purple loosestrife
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Install native trees, shrubs, live plant plugs, and seed to maintain forest structure and add native diversity

Native Species to Plant & Perpetuate

See MNDNR's species lists for MHs37 (Southern Dry-Mesic Oak Forest), MHs38 (Southern Mesic Oak-Basswood Forest), and MHs39 (Southern Mesic Maple-Basswood Forest).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native woody and herbaceous vegetation	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		

Mike's Island
Lake of
the Isles
860
870
100
Minneapolis
MPRB Park Boundary
Managed Natural Area
Trail
Elevation Contour (2ft interval)
Mesic Forest
Altered Forest/Woodland
860
0
100
200
US Feet
860

RASPBERRY ISLAND – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park: Lake of the Isles Park

Natural Area Acres: 7.3

MPRB Vegetation: Altered Forest/Woodland

MLCCS Classification: Altered/non-native deciduous woodland

ASSESSMENT OF CURRENT CONDITIONS

Site History: The larger of the Lake's two constructed islands; consists of forested dredge spoils from construction of the lake; the island is a wildlife refuge.

Current Condition (2019): Variable, but generally degraded, especially the edges of the island.

Existing Vegetation, Area & Quality Rank: Altered Forest/Woodland (7.3 ac, NN quality - not a natural community)

Notable Native Plant Species: Dominant trees: Green ash, Common hackberry and American basswood

Notable Animal Species: Wood duck, Great blue heron, Downy woodpecker

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive herbaceous species, including Oriental bittersweet
- Woody invasion by Common and Glossy buckthorn, non-native honeysuckle and White mulberry
- Sparse understory and ground layer, presumably due to non-native earthworms, etc.
- Human encampment

Restoration Goals (increase biodiversity and improve ecological quality rank to C or better by implementing the following)

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

Management Strategies

- Manually remove invasive vegetation where safe and feasible (as needed)
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Install native trees, shrubs, live plant plugs, and seed to maintain forest structure and add native diversity

Native Species to Plant & Perpetuate

See MNDNR's species lists for MHs37 (Southern Dry-Mesic Oak Forest), MHs38 (Southern Mesic Oak-Basswood Forest), and MHs39 (Southern Mesic Maple-Basswood Forest).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native woody and herbaceous vegetation	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		

Raspberry Island
Lake Of Isles Parkway West
860
870
860
860
100
Minneapolis
Richfield
Lake of the Isles
MPRB Park Boundary
Managed Natural Area
Trail
Elevation Contour (2ft interval)
Mesic Forest
Altered Forest/Woodland
0
200
400
US Feet

WILLIAM BERRY FOREST – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park: William Berry Park

Natural Area Acres: 8.4

MPRB Vegetation: Mesic Forest, Dry-Mesic Forest/Woodland

MLCCS Classification: Oak woodland-brushland

ASSESSMENT OF CURRENT CONDITIONS

Site History: This wooded area represents one of the few remnant forests in the MPRB park system.

Current Condition (2019): Generally degraded, with patches of native wildflowers.

Existing Vegetation, Area & Quality Rank: Mesic Forest (6.3 ac, C-CD quality); Dry-Mesic Forest/Woodland (2.1 ac, C-CD quality)

Notable Native Plant Species

- Dominant trees: Mature Red oak, Bur oak, American basswood, and Common hackberry
- Other species: abundant Virginia waterleaf; also patches of sedges and various spring wildflowers

Notable Animal Species: None identified

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive herbaceous species, including Creeping bellflower, Day lily, and Siberian squill
- Woody invasion by Common buckthorn and non-native honeysuckle; recent brushing by volunteers (post assessment) has removed some invasive brush
- Sparse understory and ground layer in areas, presumably due to non-native earthworms, sheet erosion, etc.

Restoration Goals (increase biodiversity and improve ecological quality rank to BC or better by implementing the following)

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

Management Strategies

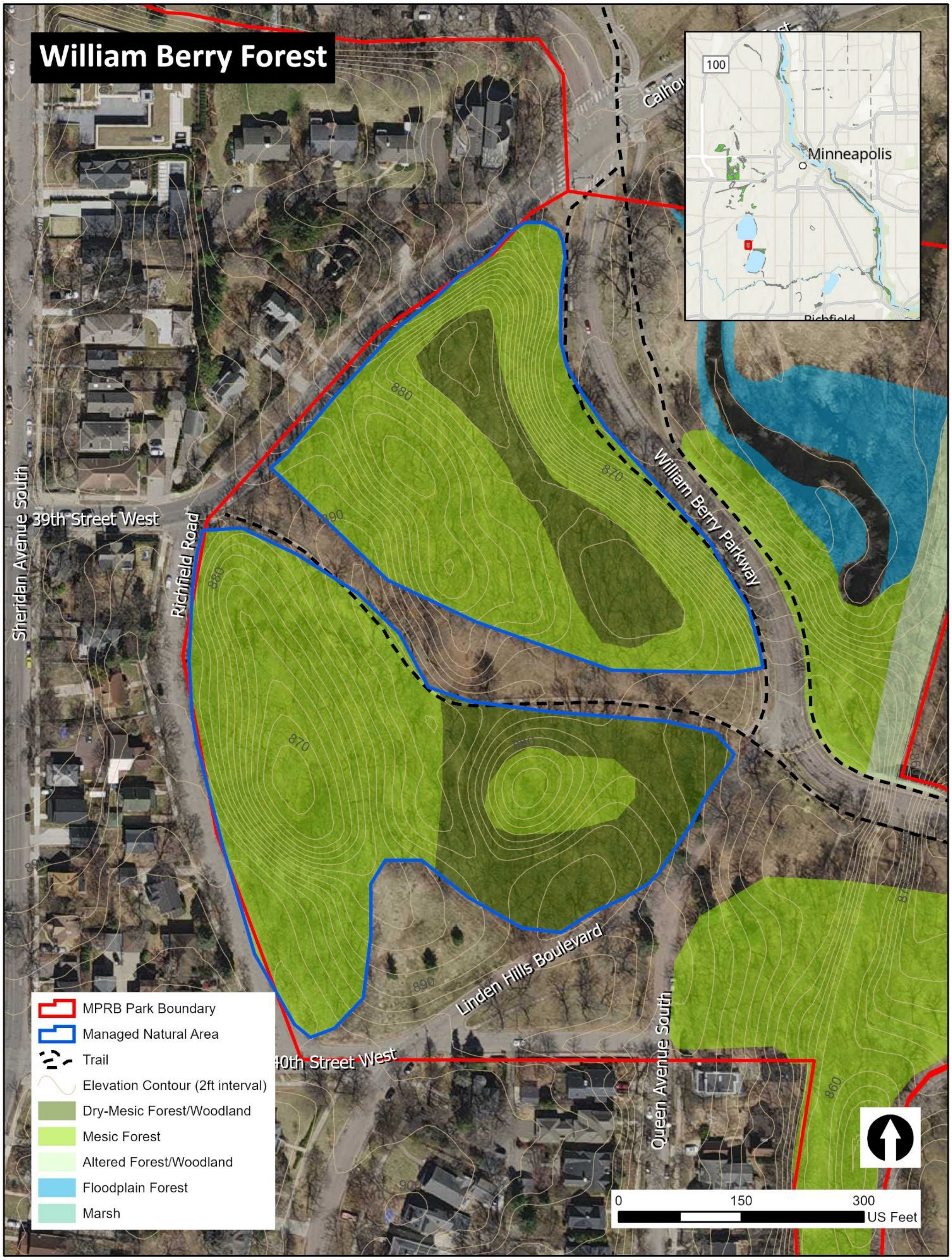
- Manually remove invasive vegetation where safe and feasible (as needed)
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Install native trees, shrubs, live plant plugs and seed to diversify plant community

Native Species to Plant & Perpetuate

See MNDNR's species lists for MHs37 (Southern Dry-Mesic Oak Forest), MHs38 (Southern Mesic Oak-Basswood Forest), and MHs39 (Southern Mesic Maple-Basswood Forest).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native woody and herbaceous vegetation	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		


William Berry Forest
Minneapolis
100
Sheridan Avenue South
39th Street West
Richfield Road
William Berry Parkway
Linden Hills Boulevard
40th Street West
Queen Avenue South
880
870
890
860
MPRB Park Boundary
Managed Natural Area
Trail
Elevation Contour (2ft interval)
Dry-Mesic Forest/Woodland
Mesic Forest
Altered Forest/Woodland
Floodplain Forest
Marsh
0
150
300
US Feet

ROBERTS BIRD SANCTUARY – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park: Lyndale Park

Natural Area Acres: 31.3

MPRB Vegetation: Various upland and wetland types (see below)

MLCCS Classification: Various

ASSESSMENT OF CURRENT CONDITIONS

Site History: While portions of the site represent remnant upland forest, the majority consists of lowlands/wetlands that have been altered by sewer utility construction and replacement, excavation of ponds and hydrologic modifications.

Current Condition (2019): Variable, but generally degraded; recent invasive removals and native plantings

Existing Vegetation, Area & Quality Rank: Lowland Shrub/ Scrub (3.8 ac, D quality); Marsh (2.9 ac, NN – not a natural community); Mesic Forest (5.3 ac, C to D quality); Wet Forest/Swamp (18.2 ac, CD quality); Wet Meadow (1.2 ac, NN)

Notable Native Plant Species: None identified

Notable Animal Species: Used by a diversity of waterfowl, forest birds, raptors (e.g., owls, hawks) and deer

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive herbaceous species, including invasive cattails and Reed canary grass (both abundant in wetlands), Purple loosestrife and Garlic mustard
- Woody invasion by Common and Glossy buckthorn, invasive honeysuckle, Norway maple and White mulberry; recent brushing by volunteers (post assessment) has removed much invasive brush
- Sparse ground layer in uplands, presumably due to invasive earthworms

Restoration Goals (increase biodiversity and improve ecological quality rank to C in most areas by implementing the following)

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

Management Strategies

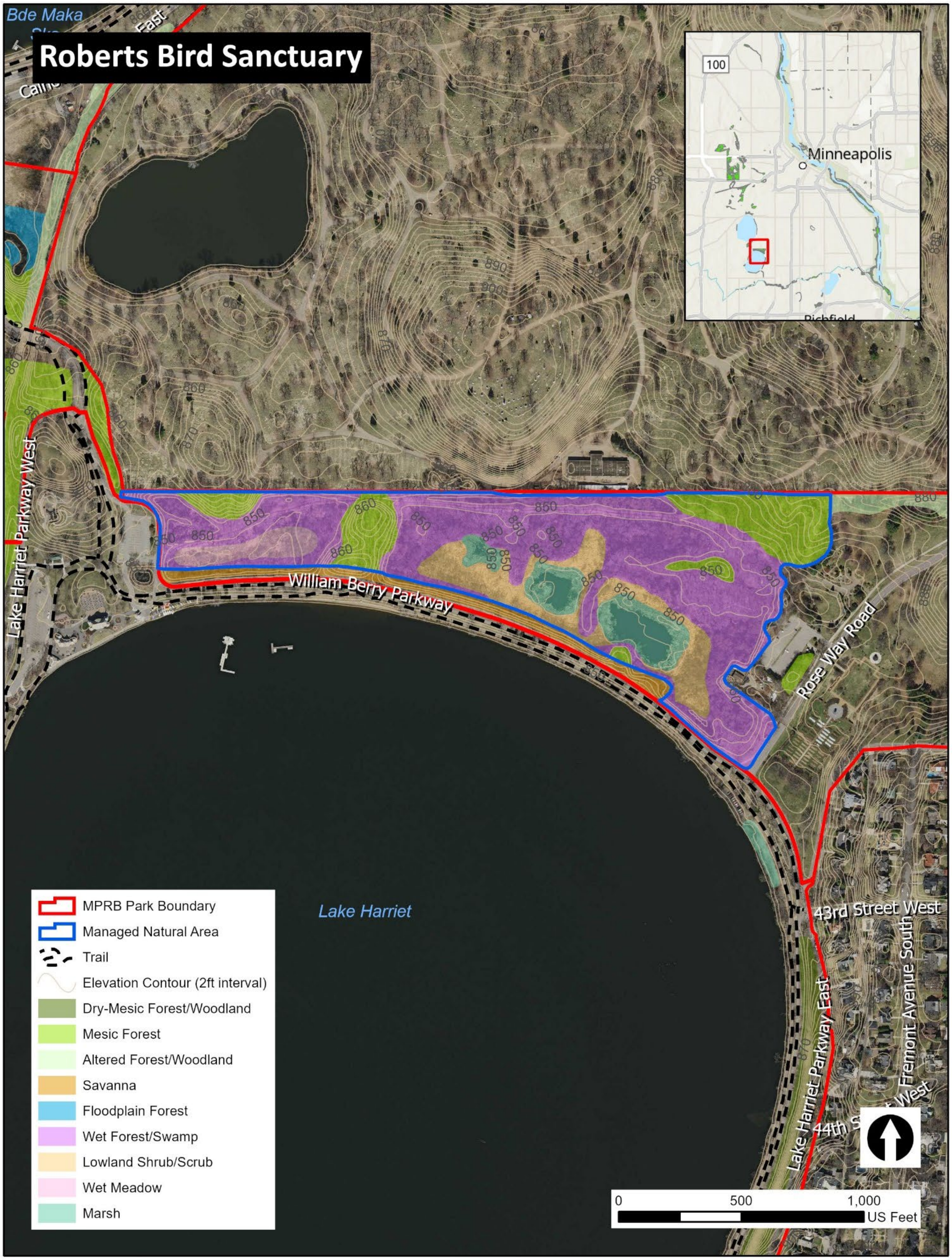
- Manually remove invasive vegetation where safe and feasible (as needed)
- Monitor and maintain existing biocontrol of Purple loosestrife
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Install native trees, shrubs, live plant plugs, and seed to diversify plant community

Native Species to Plant & Perpetuate

See species lists for MnDNR's MHs37 (Southern Dry-Mesic Oak Forest), MHs38 (Southern Mesic Oak-Basswood Forest), MHs39 (Southern Mesic Maple-Basswood Forest) and various wetland communities if wetlands are also being restored/enhanced.

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native woody and herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		



Roberts Bird Sanctuary
Bde Maka Ska
Minneapolis
100
Richfield
William Berry Parkway
Lake Harriet Parkway West
Rose Way Road
Lake Harriet
43rd Street West
Lake Harriet Parkway East
Fremont Avenue South
MPRB Park Boundary
Managed Natural Area
Trail
Elevation Contour (2ft interval)
Dry-Mesic Forest/Woodland
Mesic Forest
Altered Forest/Woodland
Savanna
Floodplain Forest
Wet Forest/Swamp
Lowland Shrub/Scrub
Wet Meadow
Marsh
0
500
1,000
US Feet

KENWOOD PRAIRIE – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

MPRB Park: Kenwood Park
MPRB Vegetation: Prairie, Savanna
Natural Area Acres: 1.2
MLCCS Classification: Oak woodland-brushland

ASSESSMENT OF CURRENT CONDITIONS

Site History: Planted prairie, established in 1997. Several trees (including spruce) in western "savanna" portion of site.
Current Condition (2019): Prairie is dominated by native grasses and forbs, with scattered invasive species.
Existing Vegetation, Area & Quality Rank: Prairie (0.8 ac, BC quality); Savanna (0.5 ac, BC quality)
Notable Native Plant Species: None identified
Notable Animal Species: None identified

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive herbaceous species, including Canada thistle, Spotted knapweed, White sweet clover, Crown vetch, Quackgrass and Smooth brome
- Woody invasion by native White mulberry, Common buckthorn and non-native honeysuckles

Restoration Goals (increase biodiversity and maintain ecological quality rank of B or better by implementing the following)

- Maintain <5% tree and shrub canopy cover in Prairie; maintain <50% canopy cover in Savanna
- Control invasive species, including those listed above and all listed by MDA as noxious weeds (e.g., Canada thistle)
- Improve biodiversity by increasing abundance and diversity of native plants throughout area

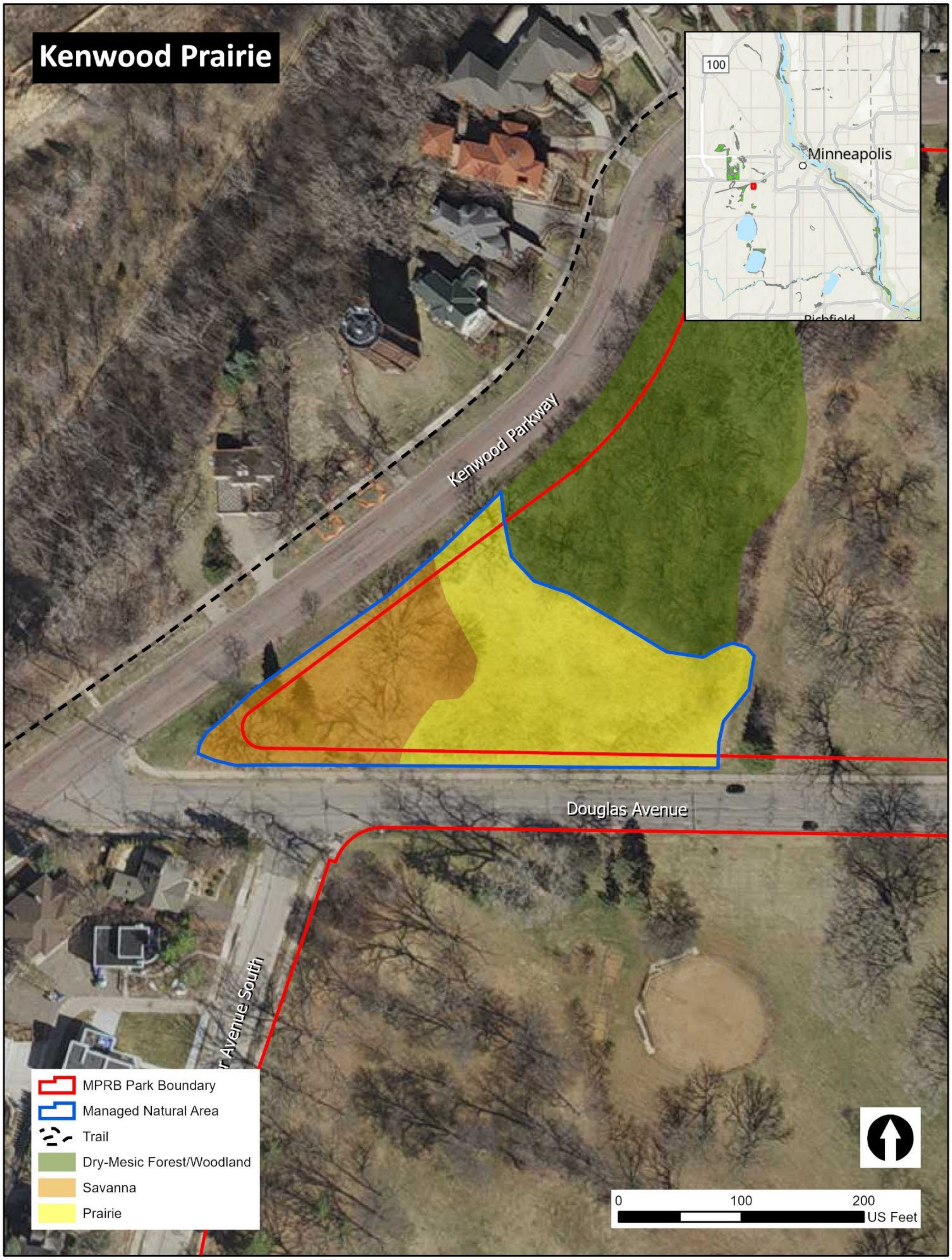
Management Strategies

- Manually remove invasive vegetation where safe and feasible (as needed)
- Conduct prescribed burn (rotational burn of ½ of site each time, such that each unit is burned every 3-4 years)
- Mow and brush saw as necessary to control woody invasion (burns should limit need for this task)
- Conduct stump and foliar spray treatments with MPRB-approved herbicide (as necessary)
- Overseed to diversify ground layer (as needed)

Native Species to Plant & Perpetuate
See MNDNR's species list for UPs23 (Southern Mesic Prairie).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually	Mar-May	Jun-Aug	Sep-Oct	Nov-Feb
Prescribed burn	Every year or two (rotational), varying spring & fall	Mar-Apr		Sep-Oct	Nov
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Prairie mowing	Annually if burns are not possible		Jun-Aug		
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		



Kenwood Prairie
Minneapolis
100
Kenwood Parkway
Douglas Avenue
Avenue South
MPRB Park Boundary
Managed Natural Area
Trail
Dry-Mesic Forest/Woodland
Savanna
Prairie
0
100
200
US Feet

DRY- MESIC FOREST/WOODLAND – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

Location: Relatively common in the MPRB park system; vast majority is within Theodore Wirth Park
Acres in MPRB Phase II Study: 152

MLCCS Classification(s): "Oak forest", "Oak woodland-brushland"
MNDNR Classification(s): Southern Dry-Mesic Oak (Maple) Woodland (FDs37)

ASSESSMENT OF CURRENT CONDITIONS

General History: Low-intensity surface fires were important for maintaining plant community structure and species composition. Without fire, woody plant invasion occurs and sun-requiring species disappear, reducing the variety of plants and insects in the community.

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

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive vegetation is common, especially Common buckthorn
- Invasive earthworms are often present, which reduces the surface forest duff layer, increases erosion, and changes soil structure to the detriment of many native species

Restoration Goals (increase biodiversity and improve quality rank by implementing the following):

- Maintain >80% canopy cover
- Remove and control invasive vegetation
- Improve biodiversity by increasing abundance and diversity of native plants throughout

Management Strategies

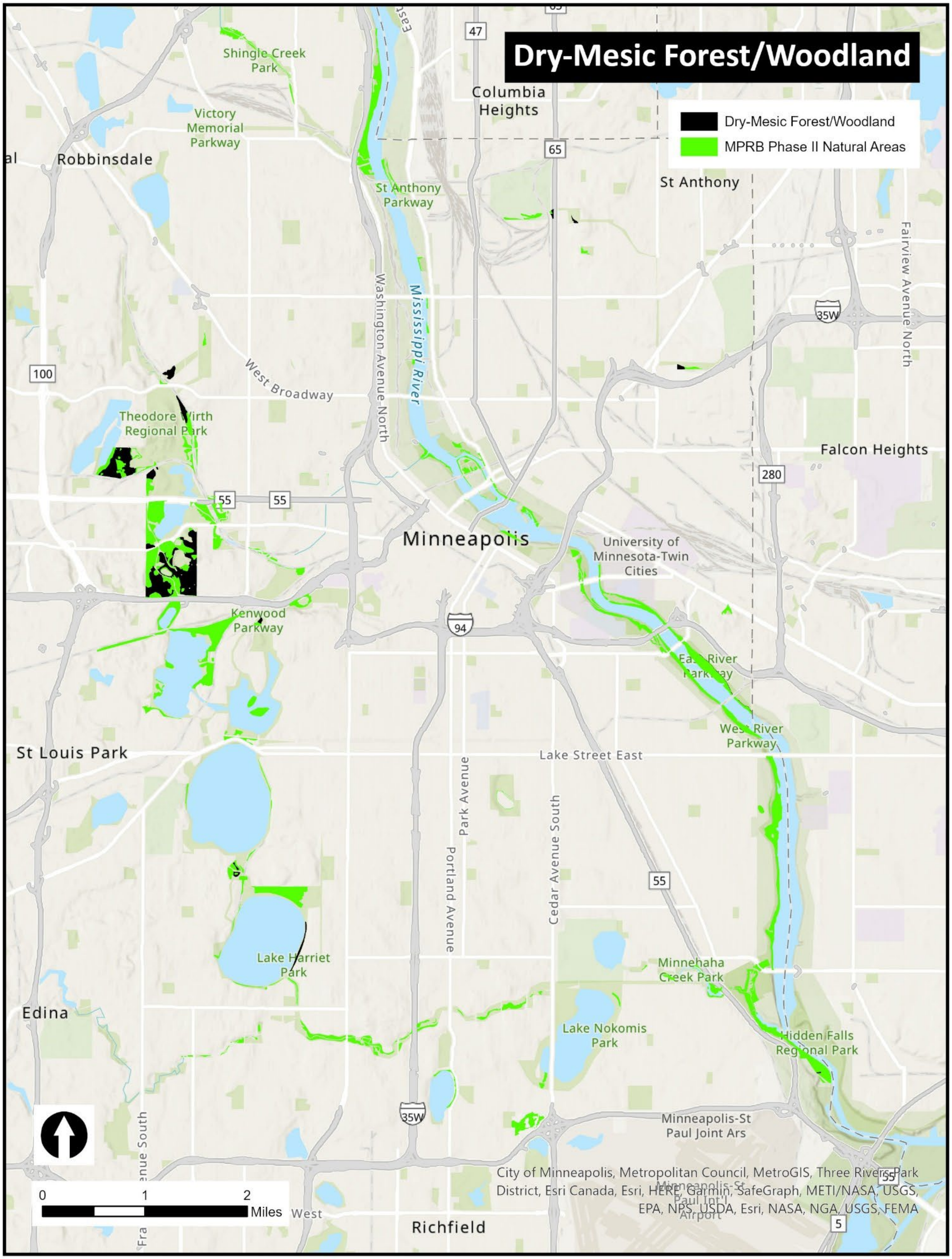
- Assess if fine fuel of oak leaf litter and dense graminoids will carry a prescribed surface fire, and establish if lacking. Fine fuel is essential for management using fire.
- Remove and control invasive woody and herbaceous species using Integrated Pest Management (IPM) practices, and protect desirable vegetation. Start with mechanical and biocontrol means; use herbicides sparingly as a last resort.
- Conduct selective thinning of aggressive native woody species (e.g., Box elder, Green ash) when inhibiting growth of native groundcover and regeneration of desirable canopy trees, especially oaks.
- Identify opportunities to expand and connect to adjacent natural areas.
- Install native trees, shrubs, live plant plugs, and seed to diversify ground, shrub, and canopy layers.
- Conduct annual walkabout to inspect and identify tasks to complete in the next growing season.

Native Species to Plant & Perpetuate

See species lists for MNDNR's Southern Dry-Mesic Oak (Maple) Woodland (FDs37).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection & removal		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Prescribed burn (where feasible)	When fine fuel is sufficient & helps achieve goals; typically, every ~10 yrs	May	Jun-Aug	Sep	
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native woody and herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		


Dry-Mesic Forest/Woodland
Dry-Mesic Forest/Woodland
MPRB Phase II Natural Areas
Shingle Creek Park
Victory Memorial Parkway
Robbinsdale
Columbia Heights
St Anthony
St Anthony Parkway
Mississippi River
Washington Avenue North
West Broadway
Fairview Avenue North
Theodore Wirth Regional Park
Falcon Heights
Minneapolis
University of Minnesota-Twin Cities
Kenwood Parkway
East River Parkway
West River Parkway
St Louis Park
Lake Street East
Park Avenue
Portland Avenue
Cedar Avenue South
Lake Harriet Park
Minnehaha Creek Park
Edina
Lake Nokomis Park
Hidden Falls Regional Park
Minneapolis-St Paul Joint Ars
Richfield
0
1
2
Miles
City of Minneapolis, Metropolitan Council, MetroGIS, Three Rivers Park District, Esri Canada, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, Esri, NASA, NGA, USGS, FEMA

MESIC FOREST – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

Location: Found throughout much of the MPRB park system, with most along the Mississippi Gorge and Minnehaha Creek

Acres in MPRB Phase II Study: 260

MLCCS Classification(s): "Maple-basswood forest", "Oak forest mesic subtype"

MNDNR Classification(s): Southern Dry-Mesic Oak Forest (MHs37), Southern Mesic Oak-Basswood Forest (MHs38), Southern Mesic Maple-Basswood Forest (MHs39)

ASSESSMENT OF CURRENT CONDITIONS

General History: Absence of natural disturbances (e.g., tree death, blowdown, rare surface fire) tends to result in eventual dominance by maple.

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

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive vegetation is common, especially Common buckthorn and Garlic mustard
- Invasive earthworms are often present, which reduces the surface forest duff layer, increases erosion, and changes soil structure to the detriment of many native species

Restoration Goals (increase biodiversity and improve quality rank by implementing the following):

- Maintain >90% canopy cover
- Remove and control invasive vegetation
- Improve biodiversity by increasing abundance and diversity of native plants throughout

Management Strategies

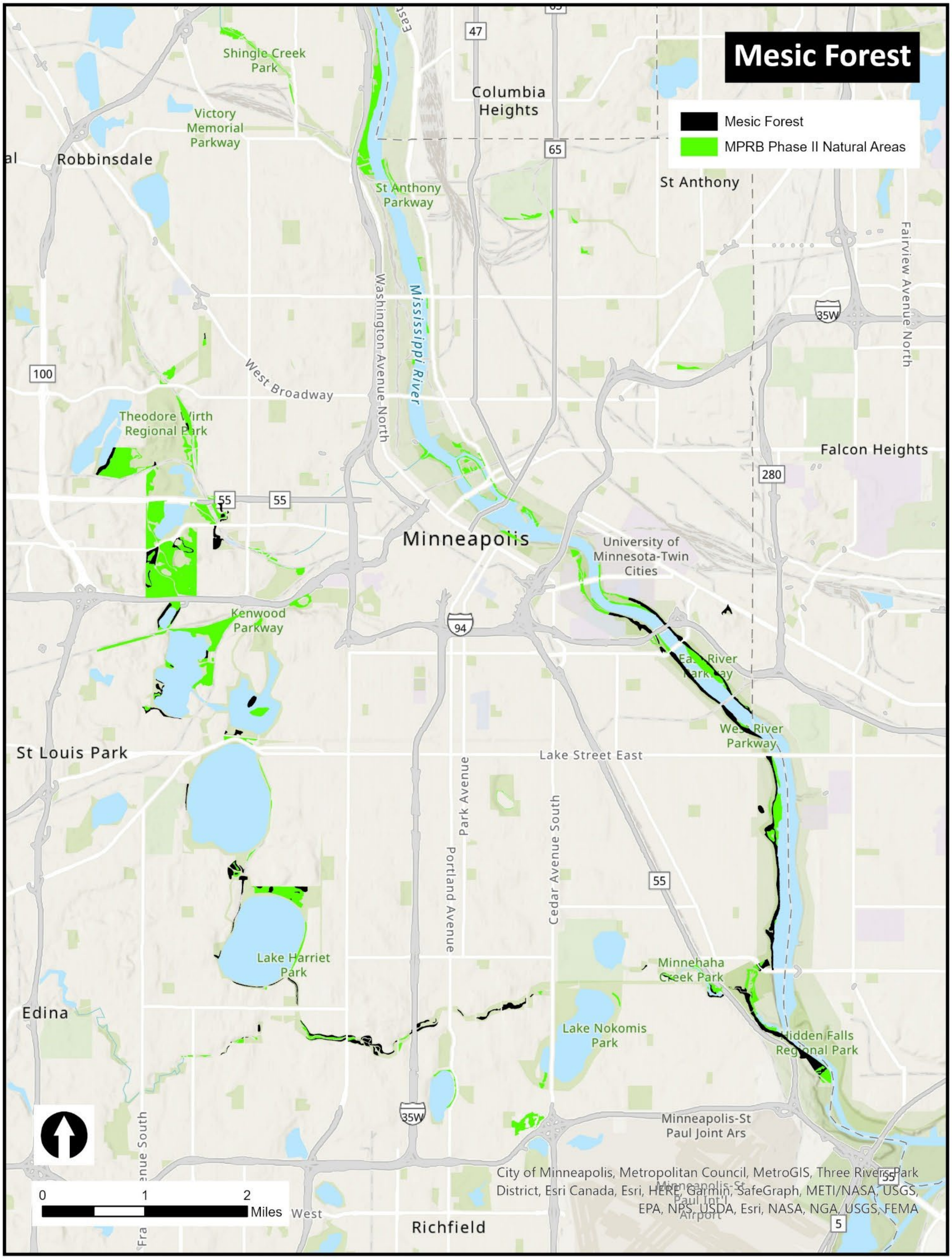
- Determine target native plant community; forest canopy composition and nearby reference sites will indicate the most appropriate type for the site.
- Remove and control invasive woody and herbaceous species using Integrated Pest Management (IPM) practices, and protect desirable vegetation. Start with mechanical and biocontrol means; use herbicides sparingly as a last resort.
- Conduct selective thinning of aggressive native woody species (e.g., Box elder, Green ash) when inhibiting growth of native groundcover and regeneration of desirable canopy trees.
- Identify opportunities to expand and connect forest with adjacent natural areas.
- Install native trees, shrubs, live plant plugs, and seed to diversify ground, shrub, subcanopy, and canopy layers.
- Conduct annual walkabout to inspect and identify tasks to complete in the next growing season.

Native Species to Plant & Perpetuate

See species lists for MNDNR's Southern Dry-Mesic Oak Forest (MHs37), Southern Mesic Oak-Basswood Forest (MHs38), Southern Mesic Maple-Basswood Forest (MHs39).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection & removal		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Prescribed burn (where feasible)	When fine fuel is sufficient & helps achieve goals	Mar-Apr		Oct	Nov-Dec
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native woody and herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		



Mesic Forest
Mesic Forest
MPRB Phase II Natural Areas
Shingle Creek Park
Victory Memorial Parkway
Robbinsdale
Columbia Heights
St Anthony
St Anthony Parkway
Mississippi River
Washington Avenue North
West Broadway
Theodore Wirth Regional Park
Falcon Heights
Fairview Avenue North
Minneapolis
University of Minnesota-Twin Cities
Kenwood Parkway
East River Parkway
West River Parkway
St Louis Park
Lake Street East
Park Avenue
Portland Avenue
Cedar Avenue South
Lake Harriet Park
Minnehaha Creek Park
Lake Nokomis Park
Hidden Falls Regional Park
Edina
Minneapolis-St Paul Joint Ars
Richfield
0 1 2 Miles
City of Minneapolis, Metropolitan Council, MetroGIS, Three Rivers Park District, Esri Canada, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, Esri, NASA, NGA, USGS, FEMA

ALTERED FOREST/WOODLAND – MANAGEMENT BRIEF

Minneapolis Park & Recreation Board

IDENTIFIERS & BASIC INFORMATION

Location: Found throughout much of the MPRB park system

MLCCS Classification(s): Most often "Altered/non-native deciduous forest" or "Boxelder-green ash (forest)"

Acres in MPRB Phase II Study: 253

MNDNR Classification(s): Not considered a natural community

ASSESSMENT OF CURRENT CONDITIONS

General History: A forested plant community on disturbed land (e.g., fill areas, former building/industrial sites, dump sites or unmanaged parkland).

General Conditions: Dominated by light-seeded trees and shrubs, most of which originated in lowland settings (e.g., Box elder, Green ash, American and Slippery elms, Eastern cottonwood, Hackberry).

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- While these forests/woodlands may be dominated by native species, they are not a natural community
- Invasive vegetation is common

Restoration Goals (increase biodiversity and improve quality rank by implementing the following):

- Transition to a natural community: typically Mesic Forest or Dry-Mesic Forest/Woodland
- Maintain >80% canopy cover
- Remove and control invasive vegetation
- Improve biodiversity by increasing abundance and diversity of native plants throughout

Management Strategies

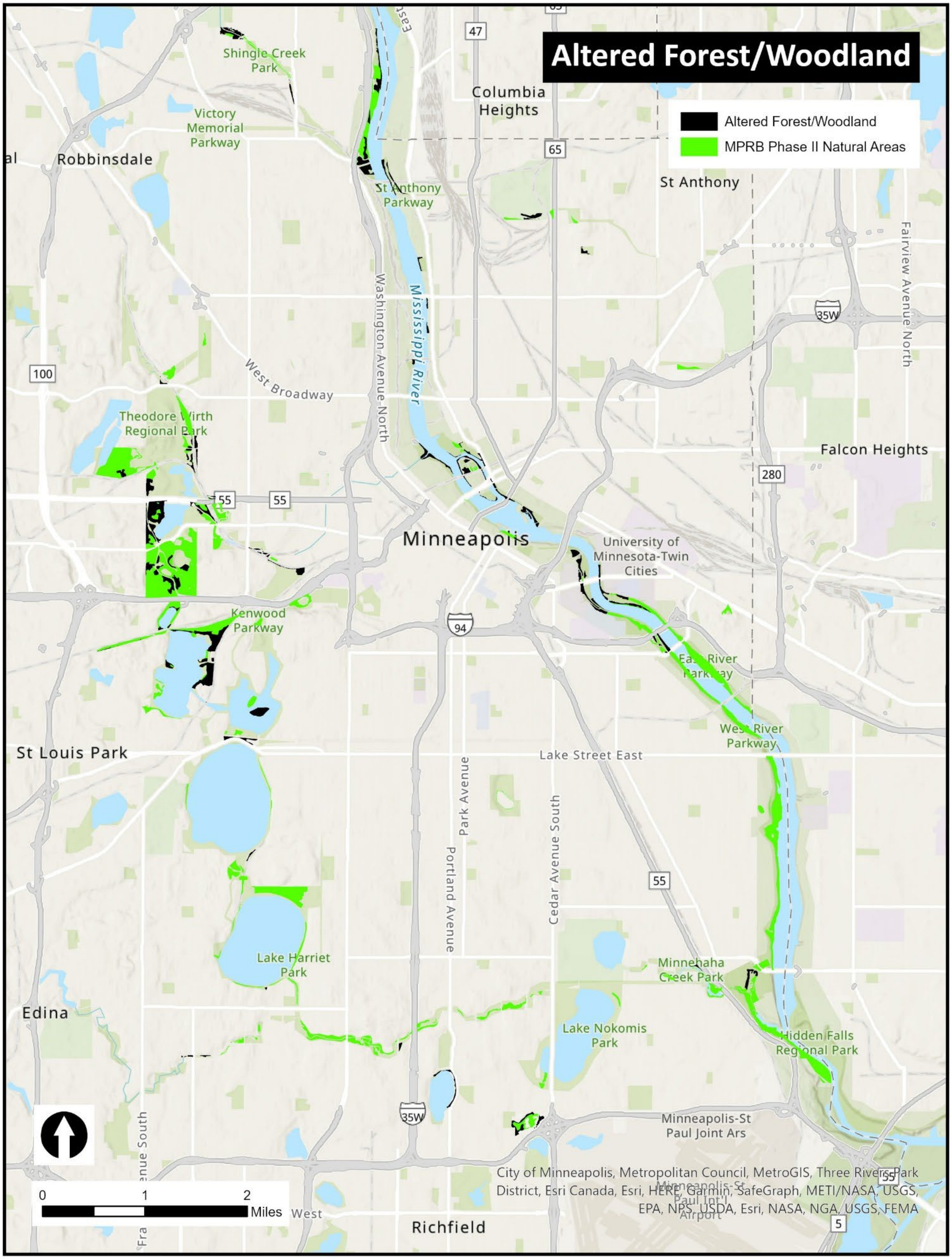
- Determine target native plant community. Forest and woodland with well-drained soil, especially on south- to west-facing slopes and lacking seepage, are best transitioned to fire-dependent Dry-Mesic Forest/Woodland; moister, mesic sites are best transitioned to Mesic Forest.
- If target is Dry-Mesic Forest/Woodland, assess if fine fuel of oak leaf litter and dense graminoids will carry a prescribed surface fire, and establish if lacking. Fine fuel is essential for management using fire.
- Remove and control invasive woody and herbaceous species using Integrated Pest Management (IPM) practices, and protect desirable vegetation. Start with mechanical and biocontrol means; use herbicides sparingly as a last resort.
- Conduct selective thinning of aggressive native woody species (e.g., Box elder, Green ash) when inhibiting growth of native groundcover and regeneration of desirable canopy trees, especially oaks.
- Identify opportunities to expand and connect to adjacent natural areas.
- Install native trees, shrubs, live plant plugs, and seed to diversify ground, shrub, and canopy layers.
- Conduct annual walkabout to inspect and identify tasks to complete in the next growing season.

Native Species to Plant & Perpetuate

For Dry-Mesic Forest/Woodland restorations, see species lists for MNDNR's Southern Dry-Mesic Oak (Maple) Woodland (FDs37); for Mesic Forest, see species lists for Southern Dry-Mesic Oak Forest (MHs37), Southern Mesic Oak-Basswood Forest (MHs38), or Southern Mesic Maple-Basswood Forest (MHs39).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection & removal		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Prescribed burn (where feasible)	When fine fuel is sufficient & helps achieve goals	May	Jun-Aug	Sep	
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native woody and herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		



Altered Forest/Woodland
Altered Forest/Woodland
MPRB Phase II Natural Areas
Shingle Creek Park
Victory Memorial Parkway
Robbinsdale
Columbia Heights
St Anthony Parkway
St Anthony
Mississippi River
Washington Avenue North
West Broadway
Fairview Avenue North
Theodore Wirth Regional Park
Falcon Heights
Minneapolis
University of Minnesota-Twin Cities
Kenwood Parkway
East River Parkway
West River Parkway
St Louis Park
Lake Street East
Park Avenue
Portland Avenue
Cedar Avenue South
Lake Harriet Park
Minnehaha Creek Park
Edina
Lake Nokomis Park
Hidden Falls Regional Park
Minneapolis-St Paul Joint Ars
Richfield
0 1 2 Miles
City of Minneapolis, Metropolitan Council, MetroGIS, Three Rivers Park District, Esri Canada, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, Esri, NASA, NGA, USGS, FEMA

SAVANNA – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

Location: Relatively uncommon in the MPRB park system

Acres in MPRB Phase II Study: 41

MLCCS Classification(s): "Mesic oak savanna", "Dry oak savanna", various cover types "with sparse trees"

MNDNR Classification(s): Native savannas: Southern Mesic Savanna (Ups24), Southern Dry Savanna (UPs14); if dominated by non-native plants, it is a "structural savanna", not a natural community

ASSESSMENT OF CURRENT CONDITIONS

General History: Frequent surface fires (every 2-4 yrs) helped maintain plant community structure and species composition. Without fire, woody plant invasion occurs, resulting in oak woodland-brushland or closed canopy forests; sun-requiring species disappear, reducing the variety of plants and insects in the community. Grazing and browsing animals also affected woody plant development but were less influential than fire.

General Conditions: 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.

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive vegetation is common, especially Common buckthorn and species that invade prairies

Restoration Goals (increase biodiversity and improve quality rank by implementing the following):

- Maintain 5-50% canopy cover
- Remove and control invasive vegetation
- Improve biodiversity by increasing abundance and diversity of native plants throughout Savanna

Management Strategies

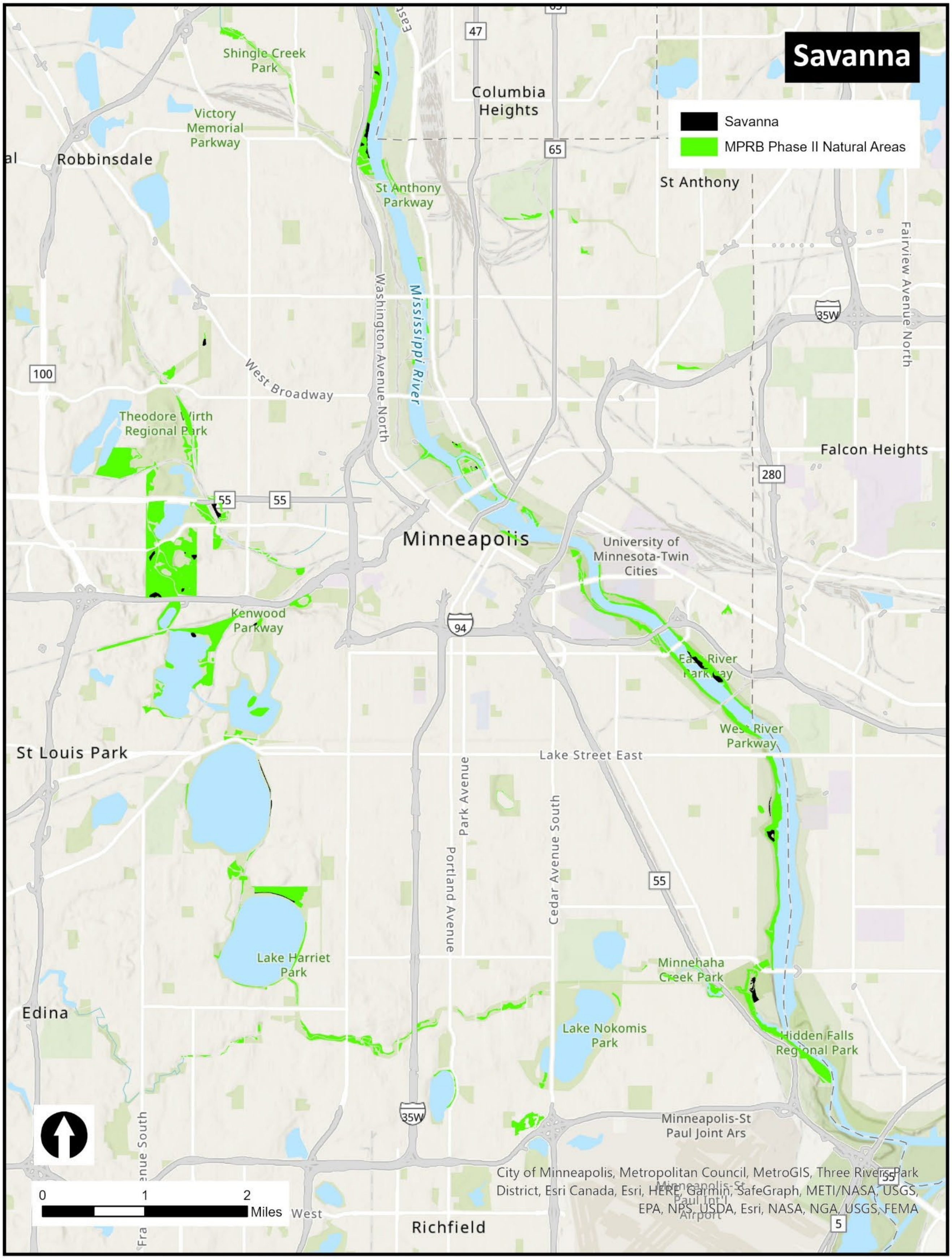
- Assess if fine fuel of oak leaf litter and dense graminoids will carry a prescribed surface fire, and establish if lacking. Fine fuel is essential for management using fire.
- Remove and control invasive woody and herbaceous species using Integrated Pest Management (IPM) practices, and protect desirable vegetation. Start with prescribed fire, mechanical and biocontrol means; use herbicides sparingly as a last resort.
- Divide area into two or three units and burn in alternating years.
- Conduct selective thinning of aggressive native woody species (e.g., Box elder, Green ash) when inhibiting growth of native groundcover and regeneration of desirable canopy trees, especially oaks.
- Identify opportunities to expand and connect to adjacent natural areas.
- Install native trees, shrubs, live plant plugs, and seed to diversify ground, shrub, and canopy layers.
- Conduct annual walkabout to inspect and identify tasks to complete in the next growing season.

Native Species to Plant & Perpetuate

See species lists for MNDNR's Southern Mesic Savanna (Ups24) or Southern Dry Savanna (UPs14).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection & removal		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Prescribed burn (where feasible)	When fine fuel is sufficient & helps achieve goals; typically every ~2-4 yrs	May	Jun-Aug	Sep	
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native woody and herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		



Savanna
Savanna
MPRB Phase II Natural Areas
Shingle Creek Park
Victory Memorial Parkway
Robbinsdale
Columbia Heights
St Anthony
St Anthony Parkway
Mississippi River
Washington Avenue North
West Broadway
Theodore Wirth Regional Park
Falcon Heights
Fairview Avenue North
Minneapolis
University of Minnesota-Twin Cities
Kenwood Parkway
East River Parkway
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Richfield
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SHRUB/SCRUB – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

Location: Uncommon in the MPRB park system

MLCCS Classification(s): Upland shrublands and various cover types "with sparse trees"

Acres in MPRB Phase II Study: 16

MNDNR Classification(s): Not considered a natural community

ASSESSMENT OF CURRENT CONDITIONS

General History: Most examples are former turf or other grassland areas that became overgrown with shrubs and scattered trees (including areas where MPRB has practiced reduced mowing).

General Conditions: A non-forested, upland plant community where shrubs and scrubby trees cover up to half the ground.

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive vegetation is common, including species of Non-Native Grasslands

Restoration Goals (increase biodiversity and improve quality rank by implementing the following):

- Transition to a natural community: typically Prairie, Savanna, Mesic Forest or Dry-Mesic Forest/Woodland
- Remove and control invasive vegetation
- Improve biodiversity by increasing abundance and diversity of native plants throughout

Management Strategies

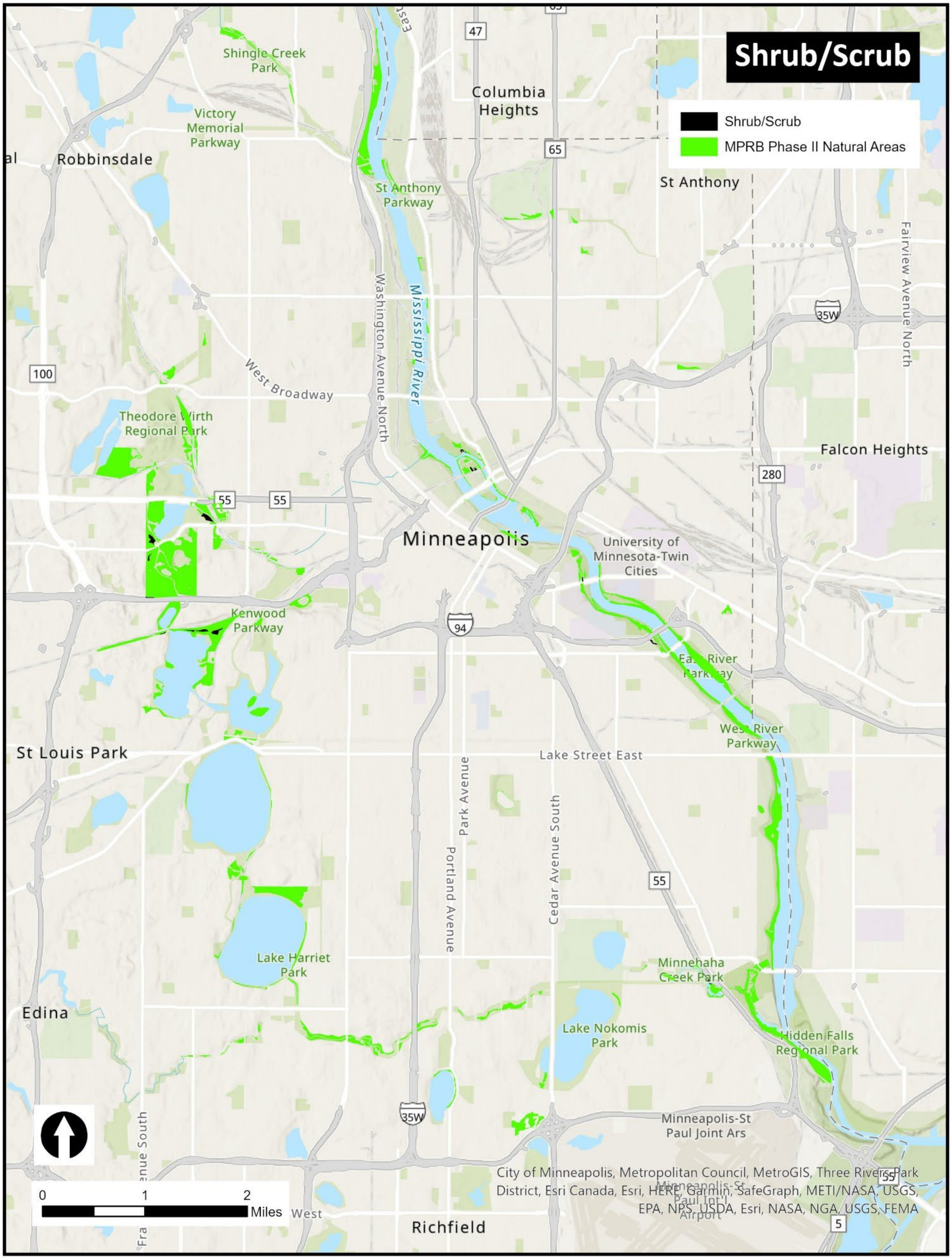
- Determine target native plant community based on the site's conservation goals. Goals may include establishing a habitat type to benefit particular plant or wildlife species, managing invasive vegetation to prevent its spread, or simply filling tree canopy gaps to convert quickly to forest or woodland.
- If restoring to a fire-dependent community, assess if fine fuel of oak leaf litter and dense graminoids will carry a prescribed surface fire, and establish if lacking. Fine fuel is essential for management using fire.
- Remove and control invasive woody and herbaceous species using Integrated Pest Management (IPM) practices, and protect desirable vegetation. Start with mechanical and biocontrol means; use herbicides sparingly as a last resort.
- Conduct selective thinning of aggressive native woody species (e.g., Box elder, Green ash) if they are inhibiting conservation goals.
- Identify opportunities to expand and connect to adjacent natural areas.
- Install native trees, shrubs, live plant plugs, and seed (as appropriate to the target plant community) to diversify ground, shrub, and canopy layers.
- Conduct annual walkabout to inspect and identify tasks to complete in the next growing season.

Native Species to Plant & Perpetuate

See species lists for the target native plant community.

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection & removal		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Prescribed burn (where feasible)	When fine fuel is sufficient & helps achieve goals; frequency depends on target plant community	May	Jun-Aug	Sep	
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native woody and herbaceous plants (when appropriate for target plant community)	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		



Shrub/Scrub
Shrub/Scrub
MPRB Phase II Natural Areas
Shingle Creek Park
Victory Memorial Parkway
Robbinsdale
Columbia Heights
St Anthony
St Anthony Parkway
Mississippi River
Washington Avenue North
West Broadway
Theodore Wirth Regional Park
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University of Minnesota-Twin Cities
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Hidden Falls Regional Park
Minneapolis-St Paul Joint Ars
Richfield
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PRAIRIE – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

Location: Relatively common in the MPRB park system; most are planted prairies

Acres in MPRB Phase II Study: 76

MLCCS Classification(s): Mesic prairie", "Dry prairie", "Wet prairie"

MNDNR Classification(s): Southern Mesic Prairie (Ups23), Southern Dry Prairie (Ups13), Southern Wet Prairie (WPs54)

ASSESSMENT OF CURRENT CONDITIONS

General History: All but Morley's Prairie in Minnehaha Park (addressed in a separate management brief) are planted prairies. Frequent surface fires (every 2-4 years) helped maintain plant community structure and species composition. Grazing and burrowing animals were also influential.

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

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive vegetation is common, including species of Non-Native Grasslands such as Smooth brome grass

Restoration Goals (increase biodiversity and improve quality rank by implementing the following):

- Maintain <5% canopy cover
- Remove and control invasive vegetation, including woody plant invasion
- Improve biodiversity by increasing abundance and diversity of native plants throughout

Management Strategies

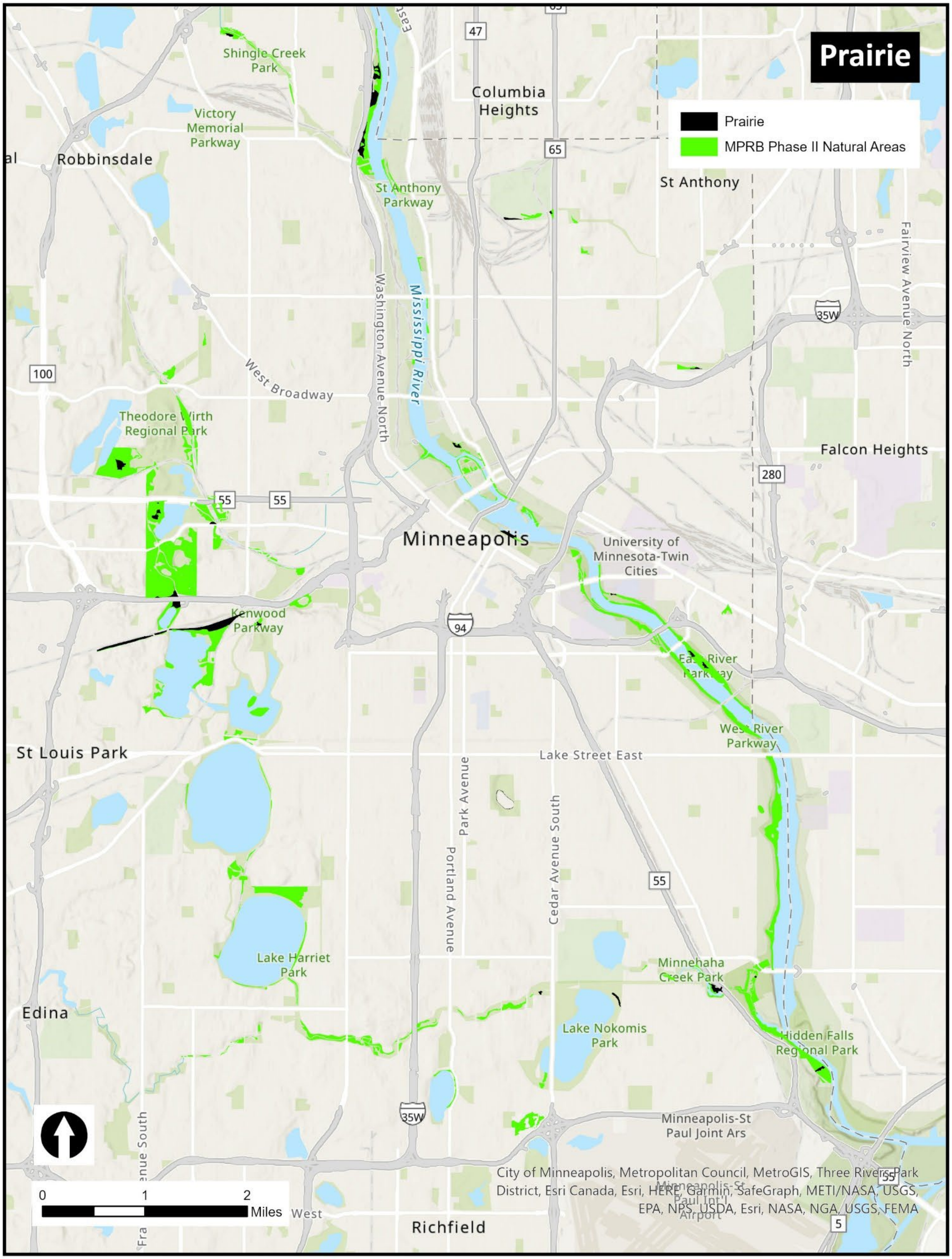
- Remove and control invasive woody and herbaceous species using Integrated Pest Management (IPM) practices, and protect desirable vegetation. Start with prescribed fire, mechanical and biocontrol means; use herbicides sparingly as a last resort.
- Divide area into two or three units and burn in alternating years.
- Identify opportunities to expand and connect to adjacent natural areas.
- Install native prairie shrubs, live plant plugs, and seed to diversify vegetation.
- Conduct annual walkabout to inspect and identify tasks to complete in the next growing season.

Native Species to Plant & Perpetuate

See species lists MNDNR's Southern Mesic Prairie (Ups23), Southern Dry Prairie (Ups13), Southern Wet Prairie (WPs54).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs); often not needed in Prairies	Annual inspection & removal		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Prescribed burn	Typically every 2-4 yrs	May	Jun-Aug	Sep	
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native prairie shrubs and herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		


Prairie
Prairie
MPRB Phase II Natural Areas
Shingle Creek Park
Victory Memorial Parkway
Robbinsdale
Columbia Heights
St Anthony
St Anthony Parkway
Mississippi River
Washington Avenue North
West Broadway
Theodore Wirth Regional Park
Minneapolis
University of Minnesota-Twin Cities
Falcon Heights
Fairview Avenue North
Kenwood Parkway
East River Parkway
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St Louis Park
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NON-NATIVE GRASSLAND – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

Location: Uncommon in the MPRB park system

MLCCS Classification(s): Various cover types with “altered/non-native dominated grassland”

Acres in MPRB Phase II Study: 10

MNDNR Classification(s): Not considered a natural community

ASSESSMENT OF CURRENT CONDITIONS

General History: Often previously farmed or grazed long ago; in Minneapolis parks these areas frequently occur where reduced mowing has been practiced.

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

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive vegetation is common, including trees and shrubs

Restoration Goals (increase biodiversity and improve quality rank by implementing the following):

- Transition to a natural community, typically Prairie or Savanna
- Remove and control invasive vegetation
- Improve biodiversity by increasing abundance and diversity of native plants throughout

Management Strategies

- Determine target native plant community based on the site’s conservation goals. Goals may include establishing a habitat type to benefit particular plant or wildlife species and managing invasive vegetation to prevent its spread.
- If restoring to a fire-dependent community, assess if fine fuel of oak leaf litter and dense graminoids will carry a prescribed surface fire, and establish if lacking. Fine fuel is essential for management using fire.
- Remove and control invasive woody and herbaceous species using Integrated Pest Management (IPM) practices, and protect desirable vegetation. Start with mechanical and biocontrol means; use herbicides sparingly as a last resort.
- Conduct selective thinning of aggressive native woody species (e.g., Box elder, Green ash) when inhibiting growth of native groundcover and regeneration of desirable trees.
- Identify opportunities to expand and connect to adjacent natural areas.
- Install native trees, shrubs, live plant plugs, and seed (as appropriate to the target plant community) to diversify ground, shrub, and canopy layers.
- Conduct annual walkabout to inspect and identify tasks to complete in the next growing season.

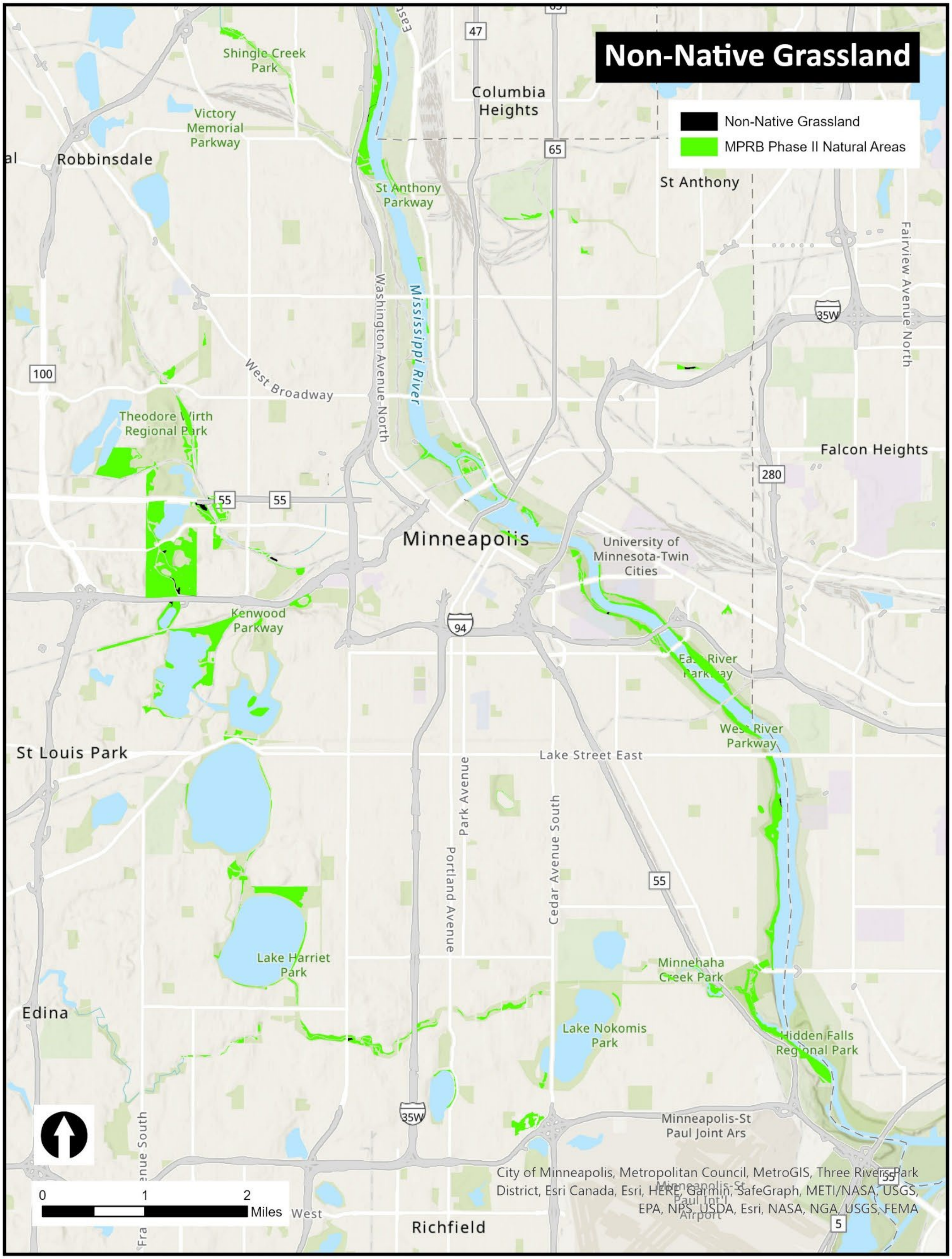
Native Species to Plant & Perpetuate

See species lists for the target native plant community.

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection & removal		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1” caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Prescribed burn (where feasible/appropriate)	When fine fuel is sufficient & helps achieve goals; frequency depends on target plant community	May	Jun-Aug	Sep	
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native woody and herbaceous plants (when appropriate for target plant community)	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		

Non-Native Grassland



FLOODPLAIN FOREST – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

Location: Relatively common in the MPRB park system, with most along the Mississippi River

MLCCS Classification(s): "Floodplain Forest System"

Acres in MPRB Phase II Study: 81

MNDNR Classification(s): Southern Floodplain Forest (FFs68)

ASSESSMENT OF CURRENT CONDITIONS

General History: Some Floodplain Forests still experience an unaltered annual flood-drawdown cycle and resemble historical forests, but others have changed due to dams, levees and other hydrological changes.

General Conditions: Low-lying woodlands, typically with mineral soils, that experience flooding or shallow water tables for a period of time; these floods often occur annually or at least once every few years.

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Hydrological alterations (e.g., watershed development, Ford Dam) have produced an unnatural flood regime
- Invasive vegetation is common, including Common buckthorn and Reed canary grass

Restoration Goals (increase biodiversity and improve quality rank by implementing the following):

- Maintain 70-100% canopy cover
- Remove and control invasive vegetation
- Improve biodiversity by increasing abundance and diversity of native plants throughout

Management Strategies

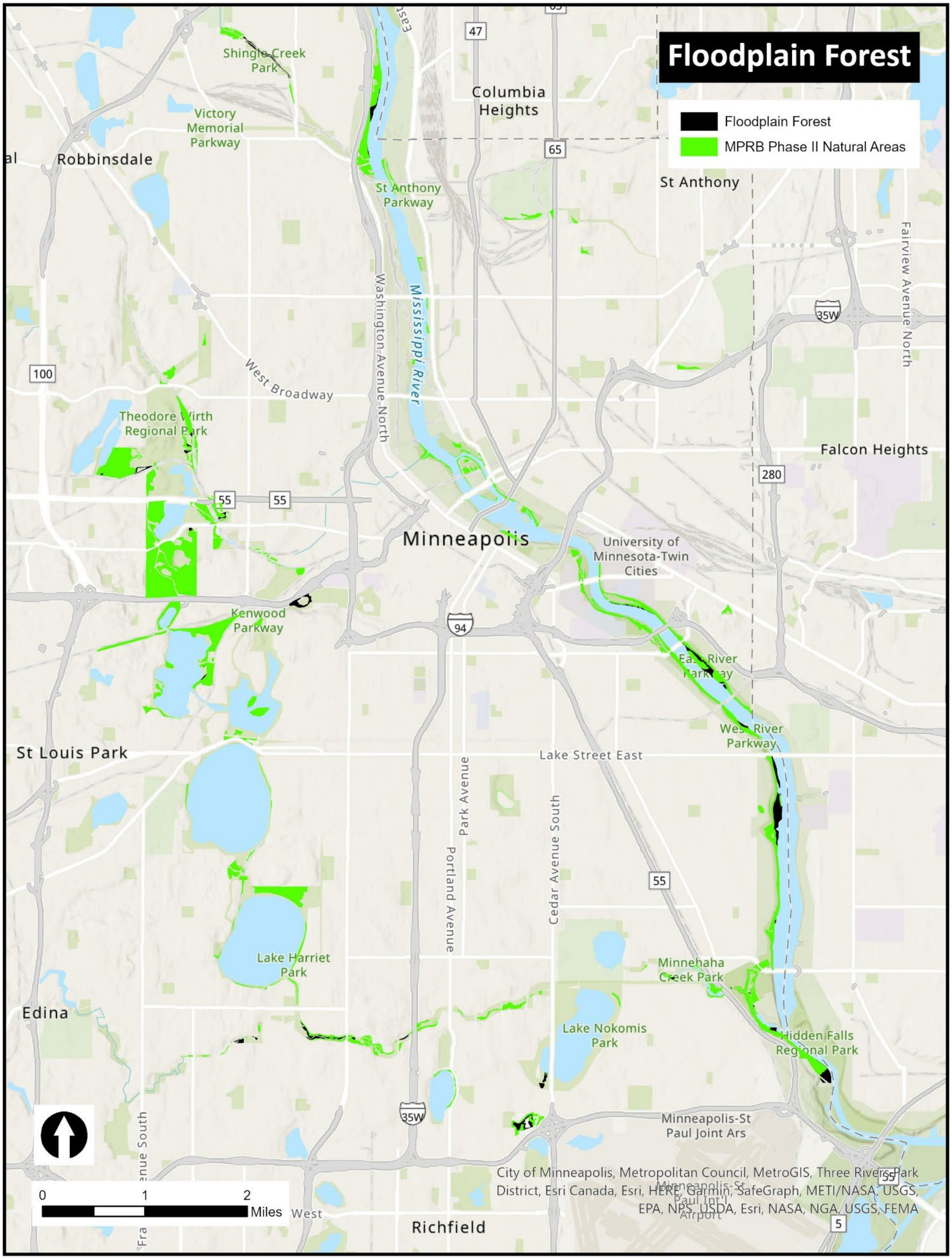
- Remove and control invasive woody and herbaceous species using Integrated Pest Management (IPM) practices, and protect desirable vegetation. Start with mechanical and biocontrol means; use herbicides sparingly as a last resort.
- Conduct selective thinning of aggressive native woody species (e.g., Box elder, Green ash) when inhibiting growth of native groundcover and regeneration of desirable canopy trees.
- Identify opportunities to expand and connect Floodplain Forest with adjacent natural areas.
- Install native trees, shrubs, live plant plugs, and seed to diversify ground, shrub, and canopy layers.
- Conduct annual walkabout to inspect and identify tasks to complete in the next growing season.

Native Species to Plant & Perpetuate

See species lists for MNDNR's FFs68 (Southern Floodplain Forest).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection & removal		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native woody and herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		


Floodplain Forest
Floodplain Forest
MPRB Phase II Natural Areas
Shingle Creek Park
Victory Memorial Parkway
Robbinsdale
Columbia Heights
St Anthony
St Anthony Parkway
Mississippi River
Washington Avenue North
West Broadway
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Cedar Avenue South
Lake Harriet Park
Minnehaha Creek Park
Lake Nokomis Park
Hidden Falls Regional Park
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Minneapolis-St Paul Joint Ars
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City of Minneapolis, Metropolitan Council, MetroGIS, Three Rivers Park District, Esri Canada, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, Esri, NASA, NGA, USGS, FEMA

WET FOREST/SWAMP – MANAGEMENT BRIEF

IDENTIFIERS & BASIC INFORMATION

Location: Relatively uncommon in the MPRB park system

Acres in MPRB Phase II Study: 30

MLCCS Classification(s): "Wet Forest System"

MNDNR Classification(s): Wet Ash Swamp (WFs57a)

ASSESSMENT OF CURRENT CONDITIONS

General History: Some Wet Forest/Swamp areas represent historical conditions of continuously saturated soil, while others have experienced partial drying due to ditching and other hydrological modifications.

General Conditions: Limited to saturated or inundated, typically organic soils, which were formed by plants that died but did not fully decompose.

RESTORATION & MANAGEMENT ISSUES, GOALS & STRATEGIES

Issues to Date

- Invasive vegetation is common, especially Reed canary grass in locations where the forest canopy is open. The ash borer will likely decimate black ash, a common canopy constituent.

Restoration Goals (increase biodiversity and improve quality rank by implementing the following)

- Maintain <75% canopy cover
- Remove and control invasive vegetation
- Improve biodiversity by increasing abundance and diversity of native plants throughout

Management Strategies

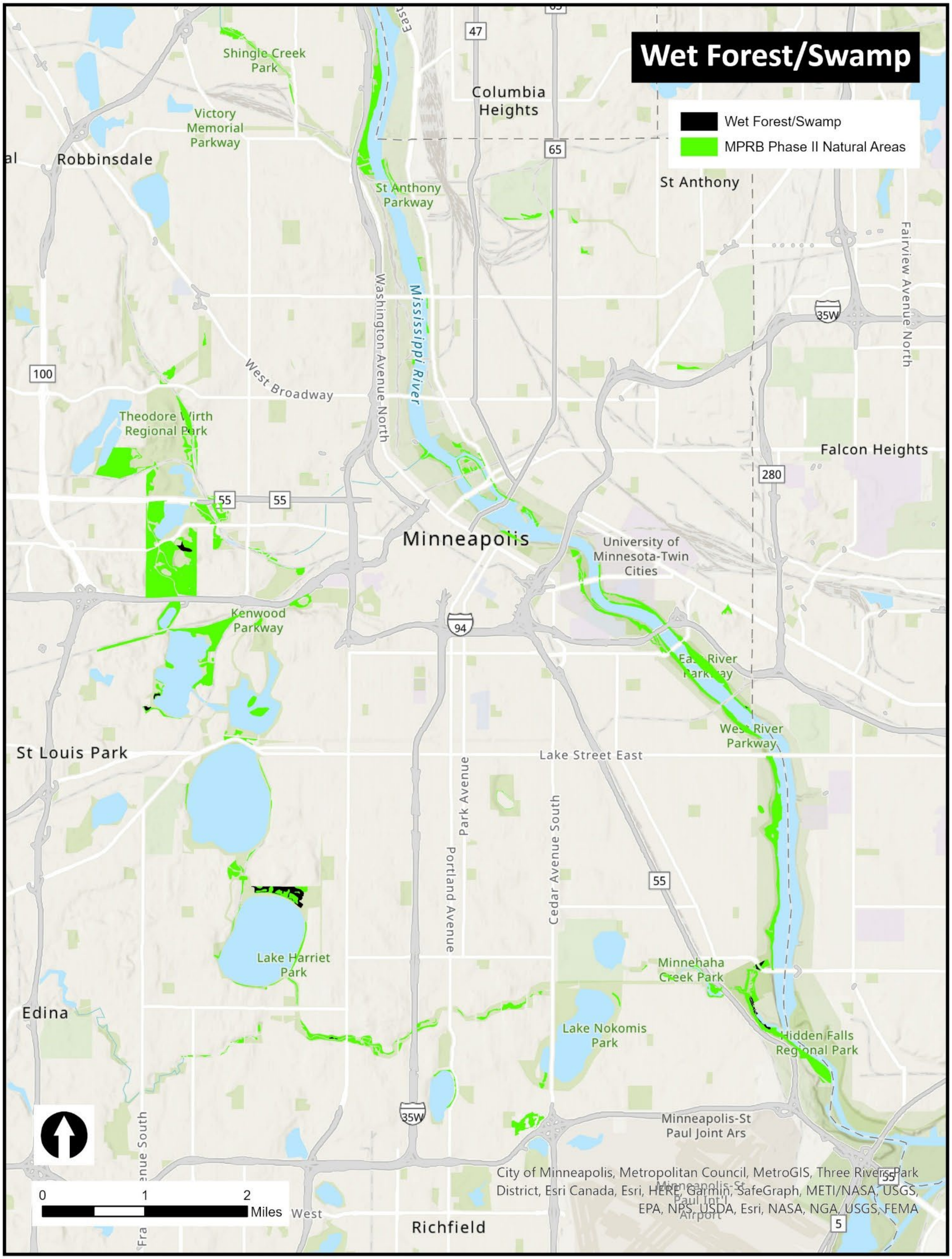
- Remove and control invasive woody and herbaceous species using Integrated Pest Management (IPM) practices, and protect desirable vegetation. Start with hydrological restoration, mechanical and biocontrol means; use herbicides sparingly as a last resort.
- Conduct selective thinning of aggressive native woody species (e.g., Box elder, Green ash) when they are inhibiting growth of native groundcover and regeneration of desirable canopy trees.
- Identify opportunities to expand and connect Wet Forest/Swamp with adjacent natural areas.
- Install native trees, shrubs, live plant plugs, and seed to diversify ground, shrub, and canopy layers.
- Conduct annual walkabout to inspect and identify tasks to complete in the next growing season.

Native Species to Plant & Perpetuate

See species lists for MNDNR's WFs57a (Wet Ash Swamp).

MANAGEMENT TASKS & SCHEDULE

Management Task	Occurrence	Season/Month(s) of Activity			
		Spring	Summer	Fall	Winter
Hazard tree inspection and removal (diseased and dead trees, or trees with damaged limbs)	Annual inspection & removal		Jun-Aug	Sep-Oct	Nov-Feb
Invasive/aggressive tree and shrub removal and treatment (specimens >1" caliper)	Ongoing, as needed				Nov-Feb
Monitor overall improvement of biodiversity	Annually		Jun-Aug		
Foliar treatment of invasive vegetation	Ongoing, as needed	Apr-May	Jun-Aug	Sep-Oct	
Planting and seeding of native woody and herbaceous plants	Ongoing, as needed	Mar-May		Sep-Oct	Nov
Invasive pulling events (volunteers)	Ongoing, as needed	May	Jun-Aug		


Wet Forest/Swamp
Wet Forest/Swamp
MPRB Phase II Natural Areas
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St Anthony
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Richfield
0 1 2 Miles
City of Minneapolis, Metropolitan Council, MetroGIS, Three Rivers Park District, Esri Canada, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, Esri, NASA, NGA, USGS, FEMA

Appendix B. MPRB Forestry Procedures

The Minneapolis Public Urban Forest

The Minneapolis Park & Recreation Board – Forestry Department manages all public trees within Minneapolis and within parks managed by the Minneapolis Park & Recreation Board. Public trees are categorized as street trees, parkland trees, and woodland trees. Street trees are public trees that are within the public right of way along Minneapolis roadways. Parkland trees are public trees within parks and other city owned property where trees are scattered across the landscape in a relatively open setting. Parkland trees are typically growing above and around turf grass, paths, and other infrastructure. Woodland trees are public trees that are typically within park property and are growing in a relatively dense configuration as part of a forest stand.

Forest Canopy Gap Management in Woodland Areas

Management of the Minneapolis public urban forest within woodland areas is mainly achieved at the scale of a forest canopy gap. Trees are pruned and removed in woodland areas to either control an urban forest pest or to mitigate a public hazard.

Currently the most impactful urban forest pests in Minneapolis include Dutch elm disease and emerald ash borer. Dead elm trees and elm trees infected with Dutch elm disease are removed in woodland areas to reduce vector breeding sites of elm bark beetles. Ash trees are removed in woodland areas where ash trees would become hazardous if no action were taken. Potentially hazardous ash trees that are symptomatic and not yet symptomatic of emerald ash borer infestation are removed. Ash trees in woodland areas that are not likely to present a risk to a target are left to provide habitat and nutrient cycling as they decline. Dutch elm disease and emerald ash borer inspection and management is ongoing across the entire Minneapolis Urban Forest.

While routine inspections for oak wilt take place across the entire Minneapolis Public Urban Forest, there are few active oak wilt centers in Minneapolis woodland areas. Oak wilt is currently being monitored and managed at three sites within woodland areas including Eloise Butler Wildflower Garden and Bird Sanctuary, the 26th Avenue North overlook along Theodore Wirth Parkway, and within the Mississippi Gorge Regional Park east of the intersection of West River Parkway and East 36th Street. Oak wilt management consists of root graft interruption using a vibratory plow where feasible and also removal of infested oak trees.

Removing individual trees in woodlands can lead to the formation of gaps in the forest canopy. If a gap is created when a tree is removed, the canopy gap is assessed for existing tree regeneration to determine the direction succession will progress with no further action. If the probable course of succession is not in alignment with the desired cover type, tree planting sites are placed and appropriate species selections are made to guide stand improvements. The Grow Tube Method is the most common technique for tree planting in woodland areas. This method utilizes quick to establish small planting stock that is sheltered by a plastic tube which provides favorable growing conditions in addition to protection.

Appendix C. Studies of Ecosystem Services Response to Restoration and Management[1]

Management Activity & Land Cover Type	*Water*			*Soils & Plants*		*Species*			*Atmosphere*		*Human Focus*			
	Water Flow Regula-tion	Water Purifi-cation	Ground-water Recharge	Erosion Control	Carbon Storage	Wildlife Popula-tion Stabili-zation	Pollina-tion	Rare Species and Habitat	Air Purfica-tion	Micro Climate Modera-tion	Pest & Disease Control	Game & Fish Produc-tion	Genetic & Wild Materials	Recrea-tion, Tourism, Spiritual, Aesthetic
A. Remove Invasive Plants (numbers refer to citation in end section of References and Resources)														
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 & Groundlayer 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 citation in end section of References and Resources)														
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 citation in end section of References and Resources)														
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

[1]green = positive effect; yellow = neutral effect

Ecosystem Services References

A. Remove Invasive Species

1. Hudson, J.R., J.L. Hanula and S. Horn. 2013. Removing Chinese privet from riparian forests still benefits pollinators five years later. *Biological Conservation* 167:355–362.
2. Madritch, M.D. and R.L. Lindroth. 2009. Removal of invasive shrubs reduces exotic earthworm populations. *Biological Invasions* 11:663-671.
3. McNeish, R.E., M.E. Benbow and R.W. McEwan. 2017. Removal of the invasive shrub, *Lonicera maackii* (Amur Honeysuckle), from a headwater stream riparian zone shifts taxonomic and functional composition of the aquatic biota. *Invasive Plant Science and Management* 10:232–246.
4. Larkin, D.J., J.F. Steffen., R.M Gentile and C.R. Zirbel. 2014. Ecosystem changes following restoration of a buckthorn-invaded woodland. *Restoration Ecology* 22:89–97.
5. Hopfensperger, K.N., R.L. Boyce and D. Schenk. 2017. Removing invasive *Lonicera maackii* and seeding native plants alters riparian ecosystem function. *Ecological Restoration* 35:320-327.
6. MNDNR (Minnesota Department of Natural Resources). 2011. Ruffed Grouse in Minnesota: A Long-Range Plan for Management. Division of Fish and Wildlife, St. Paul MN.
7. Tonietto, R.K. and D.J. Larkin. 2018. Habitat restoration benefits wild bees: A meta-analysis. *Journal of Applied Ecology* 55:582–590.
8. Roth, A.M. 2015. Common buckthorn (*Rhamnus cathartica*), European earthworms, and ecosystem management: invasion and restoration in Minnesota's deciduous forests. Dissertation, University of Minnesota, Minneapolis MN.
9. Fiedler, A.K., D.A. Landis and M. Arduser. 2011. Rapid shift in pollinator communities following invasive species removal. *Restoration Ecology* 20: 593-602.
10. Allan, B.F., H.P. Dutra., L.S. Goessling., K. Barnett., J.M Chase., R.J. Marquis., G. Pang., G.A. Storch., R.E. Thach and J.L. Orrock. 2010. Invasive honeysuckle eradication reduces tick-borne disease risk by altering host dynamics. *Proceedings of The National Academy of Sciences* 107: 18523-18527.
11. DeMeester, J.E. and D.B. Richter. 2009. Restoring restoration: removal of the invasive plant *Microstegium vimineum* from a North Carolina wetland. *Biological Invasions* 12: 781–793.
12. Hanula, J. L. and S. Horn. 2011. Removing an exotic shrub from riparian forests increases butterfly abundance and diversity. *Forest Ecology and Management* 262:674–680.
13. Hanula, J. L. and S. Horn. 2011. Removing an invasive shrub (Chinese privet) increases native bee diversity and abundance in riparian forests of the southeastern United States. *Insect Conservation and Diversity* 4:275-283.
14. Martin, P.A., A.C. Newton and J.M Bullock. 2017. Impacts of invasive plants on carbon pools depend on both species' traits and local climate. *Ecology* 98:1026-1035.
15. Newman, R.M., M. Dunne and T. Ostendorf. 2018. Aquatic plant community of lakes Lucy, Mitchell, Susan, Riley and Staring within the Riley Purgatory Bluff Creek Watershed: final report for 2015-2017. University of Minnesota, Minneapolis MN.

B. Plant Native Species

1. Borsari, B., N. Mundahl., M. F. Vidrine and M. Pastorek. 2014. The significance of micro-prairie reconstruction in urban environments. *The Prairie Naturalist* 23:70–77.
2. Harmon-Threatt, A. N. and S.P. Hendrix. 2015. Prairie restorations and bees: the potential ability of seed mixes to foster native bee communities. *Basic and Applied Ecology* 16:64–72.
3. Von Haden, A.C. and M.E. Dornbush. 2017. Ecosystem carbon pools, fluxes, and balances within mature tallgrass prairie restorations. *Restoration Ecology* 4:549–558.
4. Gascoigne, W.R., D. Hoag., L.Koontz., B.A. Tangen., T.L. Shaffer and R.A. Gleason. 2011. Valuing ecosystem and economic services across land-use scenarios in the Prairie Pothole Region of the Dakotas, USA. *Ecological Economics* 70:1715–1725.
5. USFS (U.S Forest Service). 2019. Ecosystem services from national grasslands. Accessed 2/20/2019 at https://www.fs.fed.us/grasslands/ecoservices/index.shtml.
6. Schulte, L. A., J. Niemi, M. J. Helmers, M. Liebman, J. G. Arbuckle, D. E. James, K. Randall, M. E. O. Neal, M. D. Tomer, J. C. Tyndall, P. Drobney, J. Neal, G. Van Ryswyk, L. A. Schulte, J. Niemi, M. J. Helmers, M. Liebman, J. G. Arbuckle and D. E. James. 2017. Prairie strips improve biodiversity and the delivery of multiple ecosystem services from corn–soybean croplands. *Proceedings of the National Academy of Sciences* 114:11247–11252.
7. Nowak, D.J. 2017. Assessing the benefits and economic values of trees. *In* Ferrini, Francesco; van den Bosch, Cecil C.K., A. Fini (eds.), Chapter 11, pp. 152-163. Routledge handbook of urban forestry. New York, NY.
8. Mc Pherson, E.G. 2014. Monitoring Million Trees LA: tree performance during the early years and future benefits. *Arboriculture & Urban Forestry* 40:285-300.
9. Aerts, R. and O. Honnay. 2011. Forest restoration, biodiversity and ecosystem functioning. *BMC Ecology* 29:1-10.
10. S.J. Livesley, E.G. McPherson, and C. Calfapietra. 2016. The urban forest and ecosystem services: impacts on urban water, heat, and pollution cycles at the tree, street, and city scale. *Journal of Environmental Quality 45:119*–124.
11. Helmers, M.J., X. Zhou., H. Asbjornsen., R. Kolka., M. D. Tomer and R. M. Cruse. 2012. Sediment removal by prairie filter strips in row-cropped ephemeral watersheds. *Journal of Environmental Quality* 41:1531–1539.
12. Zhou, X., M.J. Helmers., H. Asbjornsen., R. Kolka and M.D. Tomer. 2010. Perennial filter strips reduce nitrate levels in soil and shallow groundwater after grassland-to-cropland conversion. *Journal of Environmental Quality* 39:2006–2015.
13. Nowak, D.J. and G.M. Heisler. 2010. Air quality effects of trees and parks. National Recreation and Park Association, Ashburn, VA.
14. Feltham, H. K. Park., J. Minderman and D Goulson. 2015. Experimental evidence that wildflower strips increase pollinator visits to crops. *Ecology and Evolution* 5:3523–3530.
15. Elmqvist, T., H.Setala., S.N. Handel., S. der Ploeg., J. Aronson., J.N. Blignaut., E. Gomez-Baggethun., D.J. Nowak., J.Kronenberg and R.Groot. 2015. Benefits of restoring ecosystem services in urban areas. *Current Opinion in Environmental Sustainability* 14:101-108.

C. Restore Natural Processes (Fire, Hydrology, Erosion Rate, etc.)

1. Moorman, C., T. Sharpe., J. Evans and L. Thomas. 2016. Using fire to improve wildlife habitat. North Carolina State University, Raleigh NC.
2. USFS (U.S Forest Service). 2019. Controlled burning. Accessed 2/20/2019 at https://www.fs.usda.gov/detail/dbnf/home/?cid=stelprdb5281464.
3. Walkingstick, T. and H. Liechty. 2004. Why we burn: prescribed burning as a management tool. University of Arkansas, Fayetteville AR.
4. Sommers, W.T., R.A Loehman and C.C Hardy. 2014. Wildland fire emissions, carbon, and climate: science overview and knowledge needs. *Forest Ecology and Management* 317: 1-8.
5. Cawson, J.G., G.J. Sheridan., H.G. Smith and P.N.J. Lane. 2012. Surface runoff and erosion after prescribed burning and the effect of different fire regimes in forests and shrublands. *International Journal of Wildland Fire* 12:857-872.
6. Cluer, B. and C. Thorne. 2013. A stream evolution model integrating habitat and ecosystem benefits. *River Research and Applications* 30:135–154.
7. Strayer, D.L. and S.E.G. Findlay. 2010. Ecology of freshwater shore zones. *Aquatic Sciences* 72:127–163.
8. Raitif, J., J.M. Roussel and M. Plantegenest. 2019. From stream to land: ecosystem services provided by stream insects to agriculture. *Agriculture Ecosystems & Environment* 270-271:32-40.
9. Hanula, J.L., M. D. Ulyshen and S. Horn. 2016. Conserving pollinators in North American forests: a review. *Natural Area Journal* 36:427-439.
10. Ryan, K.C., E. E. Knapp and J. M. Varner. 2013. Prescribed fire in North American forests and woodlands: history, current practice, and challenges. *The Ecological Society of America* 1:15-24.
11. Rieman, B. E., P. F. Hessburg, C. Luce and M. R. Dare. 2010. Wildfire and management of forests and native fishes: conflict or opportunity for convergent solutions? *BioScience* 60:460–468.
12. Smiley P. C. and E. D. Dibble. 2007. Influence of spatial resolution on assessing channelization impacts on fish and macroinvertebrate communities in a warmwater stream in the southeastern United States. *Environmental Monitoring and Assessment* 138:17-29
13. Pracheil, C.M. 2010. Ecological impacts of stream bank stabilization in a Great Plains river. Thesis, University of Nebraska, Lincoln NE.
14. Cowdery, T.K., Christenson, C.A., and Ziegeweid, J.R., 2019, The hydrologic benefits of wetland and prairie restoration in western Minnesota—Lessons learned at the Glacial Ridge National Wildlife Refuge, 2002–15: U.S. Geological Survey Scientific Investigations Report 2019–5041, 81 p., https://doi.org/10.3133/sir20195041.

Appendix D. Practices to Avoid Introducing & Moving Invasive Species (MN Dept. Nat. Resources)

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 E. MPRB Invasive Vegetation to Control & Monitor

Table E.1 Lists of Invasive Plant Species Known to Exist and/or Managed in MPRB Park System

Common Name	Scientific Name	MPRB Location & Management Notes	2020 MDA Noxious Weed List Status
UPLAND FORBS			
Bird's-foot trefoil	*Lotus corniculatus*	N Miss Prairie Plantings	N/A
Canada thistle	*Cirsium arvense*	Throughout park system. Problematic in North Mississippi Regional Park.	MDA Control
Common burdock	*Arctium minus*	Throughout park system Very large populations at Minnehaha Park and in areas of Wirth Park.	N/A
Common teasel	*Dipsacus fullonum L.*	Found along St. Anthony Parkway in NE Minneapolis. Listed on EDD Maps.	MDA Eradicate
Common tansy	*Tanacetum vulgare*	Near JD Rivers is being monitored and controlled.	MDA Control
Crown vetch	*Securigera varia*	Mill Ruins, Wirth Park, Ridgway Pkwy prairie. Have done foliar treatments and mechanical removals.	MDA Restricted
Dame's rocket	*Hesperis matronalis*	Throughout park system, heavily present near Bde Maka Ska. Annual mowing has significantly reduced population size.	N/A
Garlic mustard	*Alliaria petiolata*	Throughout park system.	MDA Restricted
Grecian foxglove	*Digitalis lanata*	Found in Eloise Wildflower Garden. Listed on EDD Maps.	MDA Eradicate
Hoary alyssum	*Berteroa icana*	Shingle creek prairie.	N/A
Japanese hedge parsley	*Torilis japonica*	Observed by RES along Cedar Lake Trail, just northwest of Cedar Lake.	N/A
Japanese knotweed	*Polygonum cuspidatum*	Patches found along Minnehaha Creek, Nicollet Island, and Solomon Park. Listed on EDD Maps.	MDA Control
Japanese barberry	*Berberis thunbergii*	Found sporadically throughout system. Notably found in South Wirth Listed on EDD maps.	MDA Restricted
Leafy spurge	*Euphorbia esula*	Cedar Lake Regional bike trail, Brownie Lake and N. Mississippi Prairies. Biocontrols released on Cedar Lake Trail.	MDA Control
Mugwort/Wormwood	*Artemesia vulgaris*	Found in Mississippi River Gorge Prairie at 36th St. Listed on EDD Maps.	N/A
Narrowleaf bittercress	*Cardamine impatiens*	Minnehaha Lower glen along the creek and most likely the MS River. Hand pulling when possible.	MDA Control
Purple loosestrife	*Lythrum salicaria*	Biological control agents released in early 1990s. Present in populations at the Bog.	MDA Control

Common Name	Scientific Name	MPRB Location & Management Notes	2020 MDA Noxious Weed List Status
Spotted knapweed	*Centaurea stoebe* ssp *micranthos*	Cedar Lake Regional Bike trail Osseo Rd / Victory dog park and prairie Biological controls released on Cedar Lake trail. Biocontrol present also at Osseo Rd.	MDA Control
White/Yellow sweet clovers	*Melilotus alba* *Melilotus officianalis*	Controlled in prairie plantings when necessary.	N/A
Wild parsnip	*Pastinaca sativa*	Wirth Park near Hwy 55 and also near Bassett's Creek & JD Rivers garden.	MDA Control
GRASSES			
Common reed	*Phragmites australis*	Lake of the Isles south end large patch that is on the shoreline; not increasing in size.	MDA Restricted
WOODY VINES			
Oriental bittersweet	*Celastrus orbiculatus*	Found in River Road and Minnehaha Parkway, Minnehaha Park, Diamond Lake, and Theodore Wirth. Park Locations Listed on EDD Maps.	MDA Eradicate
Poison ivies	*Toxicodendron rydbergii* and *T. radicans*	Treated only if near walking path or in prairie areas that will be burned.	MDA Specially Regulated
SHRUBS/ TREES			
Amur maple	*Acer ginnala Maxim*	Was present then removed from South Theodore Wirth.	MDA Specially Regulated
Black locust	*Robinia pseudacacia*	MS River Gorge- pockets of trees not removed or controlled.	MDA Restricted
Buckthorn, common	*Rhamnus cathartica*	Throughout woodlands.	MDA Restricted
Buckthorn, glossy	*Frangula alnus*	Wirth Tamarack Bog and wetlands. Spring lake area.	MDA Restricted
Honeysuckle	*Lonicera tatarica*	Throughout park system.	MDA Restricted
White/Russian Mulberry	*Morus alba*	Throughout park system.	N/A
Siberian elm	*Ulmus pumila L.*	Throughout particularly problematic along Shingle Creek near the planted prairie.	N/A

MDA Key:

Prohibited Noxious Weeds: Attempts must be made by ALL landowners to control or eradicate species on these lists. These species cannot be transported illegally or sold in Minnesota.
Eradicate: Must be eradicated by killing the above and belowground parts of the plant.
Control: Must be controlled, preventing the maturation and spread of propagating parts.
Restricted: May not be sold, transported illegally, or intentionally planted in Minnesota.
Specially Regulated: Shall be handled, controlled or eradicated according to specified regulations.
N/A: Not regulated by MDA.

Table E2. Invasive Landscaping Plant Species to Control & Monitor

The following table presents undesirable plant species that are known to escape planting areas and invade natural areas, often with adverse ecological effects.

Common Name	Scientific Name
TREES, SHRUBS & VINES	
Barberry	*Berberis thunbergii* (or related)
Multiflora rose	*Rosa multiflora*
Norway maple	*Acer platanoides*
Russian olive	*Eleagnus angustifolia*
Siberian peashrub	*Caragana arborescens*
White or European poplar	*Populus alba*
GRASSES & FLOWERING PLANTS	
Common St. John's wort	*Hypericum perforatum*
Flowering rush	*Butomus umbellatus*
Mullein	*Verbascum thapsus*
Ornamental water lilies	various species
Queen Anne's lace	*Daucus carota*
Reed canary grass	*Phalaris arundinacea*
Silver banner grass	*Miscanthus sinensis*
Smooth brome	*Bromus inermis*
Yellow water iris	*Iris pseudacorus*

Appendix F. Plans and Data Reviewed During Development of Natural Areas Plan

MPRB Plans/Documents

- Ecological System Plan (MPRB 2020)
- Mississippi Gorge Regional Park Master Plan (MPRB 2019a)
- Minnehaha Parkway Regional Trail Master Plan (MPRB 2019b)
- Roberts Bird Sanctuary Avian Habitat Study and Improvements Plan (MPRB 2019c)
- Minneapolis Chain of Lakes Regional Park – Calhoun/Bde Maka Ska – Harriet Master Plan (MPRB 2017a)
- Criteria Based System for MPRB Regional Parks and Trails Capital Projects, Board Resolution # 2017-244 (MPRB 2017b)
- Thomas Sadler Roberts Bird Sanctuary Management Plans (MPRB 2017c)
- Central Mississippi Riverfront Regional Park Master Plan (MPRB 2016)
- Nokomis-Hiawatha Regional Park Master Plan (MPRB 2015a)
- Theodore Wirth Regional Park Master Plan (MPRB 2015b)
- Emerald Ash Borer Preparedness Plan (MPRB 2013)
- Integrated Pest Management (IPM) Policy, Policy IX-B-9 (MPRB 2008)
- Draft Management Plan for Upper Mississippi River Gorge – Below the Falls to 29th Street (MPRB 2004)
- MPRB Vegetation Database reports for Managed Natural Areas – addressing 1990s to present

MPRB Geographic Information System (GIS) Data

- Park boundaries
- Managed natural areas
- Reduced mow areas
- Stormwater Best Management Practices (BMPs)

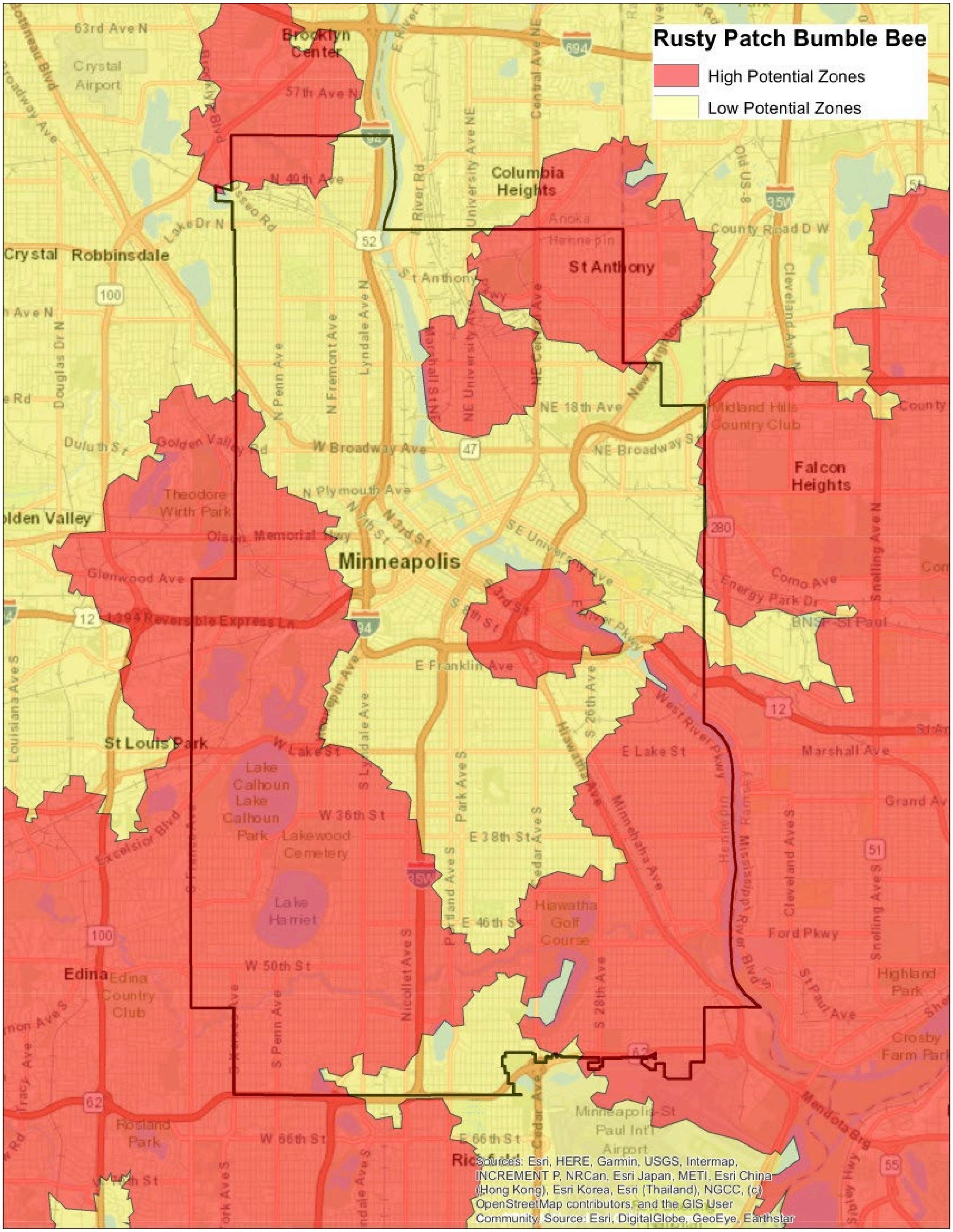
Other Reports/Data

- City of Minneapolis – Mississippi River Critical Area Plan (City of Minneapolis 2016)
- 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)

Public GIS/Mapping Data

- Hennepin County parcel data
- City of Minneapolis city boundary
- Minnesota Land Cover Classification System (MLCCS) data (MNDNR 2004)
- MNDNR National Wetlands Inventory (NWI) Central Minnesota Update
- MNDNR County Biological Survey data (Sites of Biological Significance and Native Plant Communities)
- MNDNR Regionally Significant Terrestrial and Wetland Ecological Areas
- MNDNR Natural Heritage Information System (NHIS) – rare natural features
- Hennepin County Open Space Corridors and Priority Natural Resource Corridors
- Original Vegetation of Minnesota (Marschner 1974)
- Elevation data from LiDAR (MnTOPO)
- Aerial photography (historical and recent, from Metropolitan Council/MnGeo and Hennepin County)

Appendix G. Rusty Patched Bumble Bee – Minneapolis Distribution Map



Appendix H. Management Recommendations for Select Federally-Protected Species

General Guidelines for Wildlife Species Protection

1. Identify locations of presence.
2. Read USFWS management guidelines.
3. Modify management plans for locations with these species.
4. Implement management.
5. Confirm continued presence of species after management implementation and before next management activity is implemented.
6. Adjust management activity if species is found to not be present.

Rusty Patched Bumble Bee Protection Strategies

- Install diverse native flowering plants known to be beneficial to Rusty patched bumble bee (see USFWS Plant Guide later in this appendix).
- Remove/control invasive vegetation to provide diverse, full life-cycle habitat.
- Preserve native landscape areas, where lack of mowing and soil disturbance will provide potential habitat.
- Do not use insect pesticides (especially those containing neonicotinoids) or chemical fertilizers.
- When herbicides are necessary, use products with low insect toxicity and apply them in the smallest quantities to specific plant parts, such as painting an herbicide on a cut buckthorn stump.

USFWS (U.S. Fish and Wildlife Service) - Conservation Management Guidelines for the Rusty Patched Bumble Bee (*Bombus affinis*), version 1.6 (USFWS 2018);
https://www.fws.gov/midwest/endangered/insects/rpbb/pdf/ConservationGuidanceRPBBv1_27Feb2018.pdf

Access to diverse and abundant floral resources is essential for the rusty patched bumble bee during its active season, which is typically long compared to most other bumble bee species. The species is active and reliant on flowers during the entire growing season (mid-March through mid-October).

Prescribed Fire Timing Considerations

- Only burn from **mid-October through mid- March**, if possible, so that floral resources are not reduced when the species is feeding. If feasible to achieve your management objectives, conduct spring burns as early as is feasible or late fall burns. Late spring burns may reduce the nectar and pollen sources for newly emerged queens that are gathering food to establish their colonies.

Mowing Timing Considerations

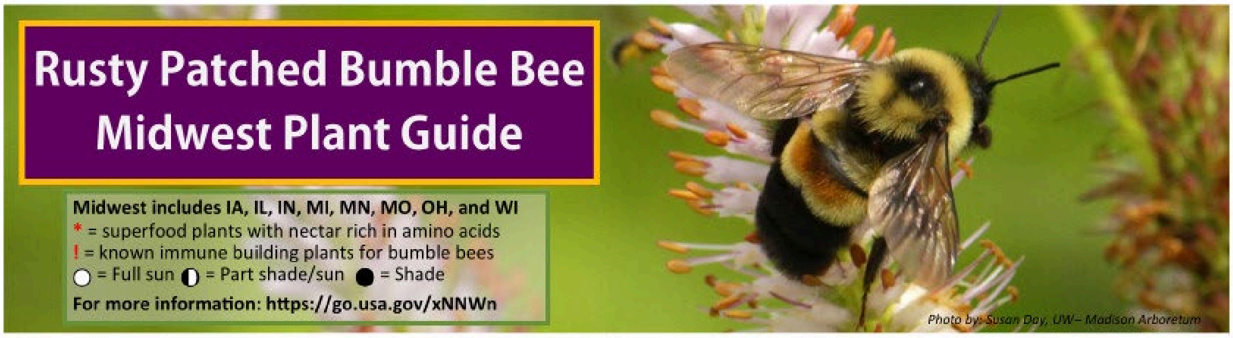
- Mow outside of the active season **(i.e., mid-October through mid-March**), if possible, in areas that provide summer foraging habitat. If mowing must occur during the active flight season(**mid-March through mid- October**), attempt to create a mosaic of structurally different habitat patches or ensure that the extent of the area mowed is not likely to affect more than one-third of the foraging habitat that is available on site or within the larger landscape [within 1 km (0.6mi)] of the site boundary.

- Mow at the highest cutting height possible, ideally **12-16 inches (30 - 40 cm),** or a minimum of **8-10 inches (20 - 25cm)** if possible. Mowing at this height will reduce disturbance of established nests or overwintering queens.
- Mow no more than **1/2** of the open, non-forested foraging habitat within your management area per year, if possible

Herbicide Timing Considerations

- If feasible to ensure effective control of target plant species, apply herbicides pesticides when at times when bumble bees are less active **(late at night, or late fall and winter).** Bumble bees can fly at relatively cold temperatures and are active in early spring **(e.g., mid-March)** and in the **morning and evening hours.**

USFWS Rusty Patched Bumble Bee - Midwest Plant Guide



Bloom Period	Common Name	Scientific Name	Shade	Habitat type
Forbs/Wildflowers				
EARLY (March-April)	Anemones	*Anemone* spp.	◐ ●	Species dependent
	Ground plum	*Astragalus crassicarpus*	○	Dry prairies
	Virginia bluebells	*Mertensia virginica*	◐ ●	Moist woods, wooded edges
	Shooting star	*Primula* spp.	○ ◐	Savanna, open woods
	Wild geranium	*Geranium maculatum*	◐ ●	Woodlands, open woods
	Virginia waterleaf	*Hydrophyllum virginianum*	◐ ●	Moist woodlands
	Wild lupine	*Lupinus perennis*	○ ◐	Savanna, open woods
	Wood betony	*Pedicularis canadensis*	○ ◐	Prairies, open woods
MID (May-August)	Native giant hyssop* ***1***	*Agastache* spp.	○ ◐	Fields to deciduous woods
	Milkweed ***2***	*Asclepias* spp.	○ ◐	Species dependent
	Wild white indigo or cream indigo	*Baptisia* spp.	○ ◐	Prairie, open woodland
	White and purple prairie clover *	*Dalea candida* and *purpurea*	○	Prairies, dry fields
	Coneflower* ***3***	*Echinacea* spp.	○	Dry prairies
	Joe pye weed* ***4***	*Eutrochium* spp.	○	Wet meadows, open woods
	Jewelweed	*Impatiens capensis*	○ ◐	Moist thickets, forested edges
	Blazing-star	*Liatris* spp.	○ ◐	Prairies
	Bee balm/wild bergamot*! ***5***	*Monarda fistulosa*	○ ◐	Dry fields, prairies
	Penstemon spp.	*Penstemon* spp.	○ ◐	Prairie, fields, wooded edges
	Mountain mint	*Pycanthemum virginianum*	○ ◐	Fields, prairies, fens
	Culver's root ***6***	*Veronicastrum virginicum*	○ ◐	Fields, prairie, wooded edges
LATE (Sept.-October)	Native field thistle	*Cirsium discolor*	○	Fields, open woods
	Native swamp thistle	*Cirsium muticum*	○ ◐	Swamps, wet meadows
	Gentian	*Gentiana* spp.	○ ◐	Moist fields, wooded edges
	Showy goldenrod* **(also MID in IA, MN, MO)** ***7***	*Solidago speciosa*	○	Fields, prairies, savannas
	Goldenrod* **(also MID in IA, MN, MO)**	*Solidago* spp.	○ ◐ ●	Species dependent
	New England aster* **(also MID in IA, MN, MO)** ***8***	*Symphyotrichum novae-angliae*	○ ◐	Moist fields, wooded edges
	White turtlehead!	*Chelone glabra*	○ ◐	Wet meadows, wetlands
Trees and Shrubs				
EARLY (March-April)	Serviceberry	*Amelanchier* spp.	○ ◐	Forest understory, woods edge
	Plums and cherries	*Prunus* spp.	○ ◐	Species dependent
	Gooseberry and currants	*Ribes* spp.	○ ◐	Species dependent
	Willows	*Salix* spp.	○ ◐	Meadows, wetlands
MID (May-August)	Leadplant *	*Amorpha canescens*	○	Dry prairie, open woods
	New Jersey tea	*Ceanothus americanus*	○ ◐	Fields, prairies, open woods
	Buttonbush	*Cephalanthus occidentalis*	○ ◐	Riverbanks, marshes, shores
	Dwarf bush honeysuckle	*Diervilla lonicera*	◐	Woodland edges, thickets
	Wild roses	*Rosa* spp.	○ ◐	Prairies, wooded edges
	American basswood	*Tilia americana*	○ ◐	Deciduous forest
	Large cranberry!	*Vaccinium macrocarpon*	○	Wetlands

Northern Long-Eared Bat Protection Strategies

- Do not remove potential roost trees. The USFWS (https://www.fws.gov/midwest/endangered/mammals/inba/surveys/pdf/2019_Rangewide_IBat_Survey_Guidelines.pdf) defines roost trees (for Indiana and Northern long-eared bat) as:

  [24] While trees <5 inches (<12.7 cm) dbh that have exfoliating bark, cracks, crevices, and/or hollows may have some potential to be male Indiana bat summer roosting habitat, the USFWS does not consider early-successional, even-aged stands of trees <5 inches dbh to be suitable roosting habitat for the purposes of this guidance. Suitable *roosting* habitat is defined as forest patches with trees of 5-inch (12.7 cm) dbh or larger. However, early successional habitat with small diameter trees may be used as foraging habitat by Indiana bats. Therefore, a project that would remove or otherwise adversely affect ≥20 acres of early successional habitat containing trees between 3 and 5 inches (7.6-12.7 cm) dbh would require coordination/consultation with the USFWS FO to ensure that associated impacts would not rise to the level of take. The USFWS may request P/A surveys if >20 acres of early successional habitat were proposed for removal.

- Do not remove 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.

USFWS (U.S. Fish and Wildlife Service) - Bald Eagle Protection Strategies

Adapted from:

https://www.fws.gov/midwest/eagle/avoid_conflicts/recreation.html#:~:text=Bald%20Eagle%20Conservation&text=In%20the%20upper%20Midwest%20(Illinois,from%20August%20through%20mid%2DJanuary

and

https://www.fws.gov/midwest/eagle/Nhistory/humanact.html

In Minnesota the nesting season is generally from late January through late July and the non-nesting season is from August through mid-January.

Avoid Disturbing Nesting Bald Eagles

To avoid disturbing nesting bald eagles, we recommend that you (1) maintain natural forested (or vegetative) buffers around nest trees, and (2) avoid certain activities during the nesting season. The buffer areas serve to minimize visual and auditory impacts associated with human activities near nest sites.

The impact that a new human activity has on a pair of nesting eagles depends on whether the eagles can see the activity from their nest and on how tolerant the birds are to human activity, which may be evidenced by the presence of ongoing human activity near the nest. Visibility is a factor because eagles are more prone to disturbance when an activity occurs in full view. For this reason, we recommend that people locate activities farther from the nest in areas with open vistas than in areas where the view is shielded by rolling topography, trees, or other screening factors. Also, vegetative buffers should be large enough to protect existing nest trees and provide for alternative or replacement nest trees. The size and shape of effective buffers depends on topography and other characteristics surrounding the nest site. For example, in open areas where there are little or no natural forested buffers, the distance alone will serve as the buffer. Consequently, the buffers in open areas may need to be larger than for areas with denser vegetation or other natural screening.

In addition to the physical features of the landscape, appropriate buffer size may vary according to the historical tolerances of eagles to human activities in particular localities, and may also depend on the location of the nest in relation to feeding and roosting areas used by the eagles. The continued presence of nesting bald eagles in the vicinity of the existing activities indicates that eagles in that area can tolerate a greater degree of human activity than we expect from eagles in areas that experience fewer human impacts.

We recommend seasonal restriction for many temporary activities that do not involve habitat alterations (e.g. fireworks, outdoor concerts). Potential negative impacts can be avoided by restricting these kinds of activities to the non-nesting period.

For activities that include both temporary and permanent habitat disturbance (e.g., building construction), we recommend a combination of landscape buffers and seasonal restrictions.

For specific guidance on establishing appropriate buffers and seasonal restrictions and determining whether a permit is necessary, go to the Eagle Incidental Take Permit: Step-by-Step Guidance.

Avoid Disturbing Bald Eagles During the Non-nesting Period

Bald eagles are not as sensitive to human disturbance during migration and the winter period as they are during the nesting period. However, wintering bald eagles congregate at specific sites year-after-year for purposes of feeding and sheltering. Bald eagles rely on these established roost sites because of their proximity to sufficient food sources. Permanent landscape changes may eliminate these "relied upon" areas and force bald eagles to seek out other wintering roost and foraging areas. Depending on the proximity of other suitable roost or foraging areas and the condition of the affected eagles, loss of these areas can harm bald eagles. In addition, human activities near or within communal roost sites may—although not physically alter the habitat--prevent eagles from feeding or taking shelter. In either case, the action may violate the Eagle Act and a permit may be needed. If your activities may disturb roosting or foraging eagles, you should contact your local U.S. Fish and Wildlife Service eagle biologist for advice and recommendations for how to avoid disturbance or harm and whether a permit is necessary.

More detailed Bald eagle management guidelines are described in the National Bald Eagle Management Guidelines (2007):
https://www.fws.gov/midwest/eagle/pdf/NationalBaldEagleManagementGuidelines.pdf

Appendix I. MPRB Natural Area Plant Communities for Parks Addressed by this Plan

Plant Communities[1]	North Miss. Park (acres)	Central Miss. Riverfront Park (acres)	Miss. Gorge Park (acres)	Minnehaha Park (acres)	Minnehaha Creek Park (acres)	Nokomis & Lake Hiawatha (acres)	Theodore Wirth Park (acres)	Shingle Creek Park (acres)	Brownie Lake Park (acres)	Cedar Lake Park (acres)	Lake of the Isles Park (acres)	Bde Maka Ska & Lake Harriet (acres)	William Berry Park (acres)	Lyndale Park (acres)	Kenwood Park (acres)	Total (acres)	Ecological Quality Ranks in MPRB Park System (range)
Upland Communities	**45.4**	**36.4**	**142.4**	**56.7**	**46.5**	**1.9**	**255.2**	**10.9**	**11.8**	**77.5**	**17.3**	**16.8**	**11.3**	**7.4**	**2.4**	**739.7**	**B-NN**
Forest/Woodland	**22.6**	**30.0**	**125.6**	**45.8**	**44.8**	**0.0**	**225.4**	**9.8**	**8.4**	**45.8**	**17.3**	**14.1**	**11.3**	**5.3**	**1.2**	**607.3**	**B-NN**
Mature Forest/Woodland	**0.0**	**0.0**	**99.1**	**40.9**	**41.7**	**0.0**	**156.2**	**0.0**	**6.4**	**8.6**	**6.3**	**12.8**	**11.3**	**5.3**	**1.2**	**389.8**	
Dry-Mesic Forest/Woodland (1)	0.0	0.0	1.5	0.3	0.0	0.0	133.0	0.0	0.0	0.0	0.0	4.8	2.1	0.0	1.2	142.9	C-D
Mesic Forest (2)	0.0	0.0	97.6	40.6	41.7	0.0	23.2	0.0	6.4	8.6	6.3	8.0	9.2	5.3	0.0	246.8	B-D
Altered Forest/Woodland (3)	22.6	30.0	26.5	4.8	3.2	0	69.1	9.8	2.0	37.2	11.0	1.4	0.0	0.0	0.0	217.5	NN
Savanna/Brushland	**5.5**	**2.2**	**13.1**	**6.0**	**0.5**	**0.0**	**15.3**	**0.0**	**0.0**	**5.3**	**0.0**	**2.7**	**0.0**	**2.1**	**0.5**	**53.2**	**B-D**
Savanna (4)	5.5	0.7	12.1	5.8	0.0	0.0	9.1	0.0	0.0	1.2	0.0	2.7	0.0	2.1	0.5	39.7	B-D
Shrub/Scrub (5)	0.0	1.5	1.0	0.1	0.5	0.0	6.2	0.0	0.0	4.2	0.0	0.0	0.0	0.0	0.0	13.5	CD-D
Grassland	**17.3**	**4.3**	**3.6**	**4.9**	**1.2**	**1.9**	**14.5**	**1.1**	**3.4**	**26.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**79.2**	**B-NN**
Prairie (6)	16.4	4.1	2.7	4.9	0.6	1.9	9.7	1.1	2.9	26.3	0.0	0.0	0.0	0.0	0.8	71.4	B-D
Non-Native Grassland (7)	0.9	0.2	0.9	0.0	0.6	0.0	4.8	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	7.8	NN
Lowland Communities	**4.6**	**0.0**	**31.8**	**14.4**	**11.2**	**3.1**	**32.2**	**5.1**	**0.4**	**2.9**	**0.0**	**0.0**	**0.0**	**26.1**	**0.0**	**131.6**	**BC-D**
Lowland Forest/Woodland	**4.1**	**0.0**	**31.5**	**13.6**	**9.9**	**2.9**	**12.8**	**5.1**	**0.0**	**2.9**	**0.0**	**0.0**	**0.0**	**18.2**	**0.0**	**100.9**	**BC-D**
Floodplain Forest (8)	4.1	0.0	31.3	8.4	9.3	2.9	5.8	5.1	0.0	0.6	0.0	0.0	0.0	0.0	0.0	67.7	C-D
Wet Forest/Swamp (9)	0.0	0.0	0.1	5.1	0.5	0.0	4.1	0.0	0.0	2.3	0.0	0.0	0.0	18.2	0.0	30.3	C-D
Forested Peatland (10)	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	BC
Lowland Shrub/Scrub	**0.4**	**0.0**	**0.3**	**0.2**	**0.0**	**0.0**	**9.3**	**0.0**	**0.4**	**0.0**	**0.0**	**0.0**	**0.0**	**3.8**	**0.0**	**14.5**	**C-D**
Lowland Shrub/Scrub (11)	0.4	0.0	0.3	0.2	0.0	0.0	9.3	0.0	0.4	0.0	0.0	0.0	0.0	3.8	0.0	14.5	C-D
Lowland Herbaceous	**0**	**0.0**	**0**	**0.6**	**1.4**	**0.1**	**10.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.00**	**0.00**	**4.1**	**0.0**	**16.3**	**C-D**
Wet Meadow (12)	0.0	0.0	0.0	0.6	0.9	0.0	3.8	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	6.5	CD
Marsh (13)	0.0	0.0	0.0	0.0	0.5	0.1	6.3	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	9.8	BC-NN
Totals[2]	**49.9**	**36.4**	**174.2**	**71.0**	**57.8**	**4.9**	**287.4**	**16.0**	**12.1**	**80.3**	**17.3**	**16.8**	**11.3**	**33.5**	**2.4**	**871.4**	

NN = Not a natural community; N/A = Not Applicable

[1] See Table 1 for descriptions

[2] Rounding of values may make totals appear inaccurate

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Appendix J. MNDNR Species Lists for MPRB Native Plant Communities

MPRB NATIVE PLANT COMMUNITIES
1. Southern Dry-Mesic Oak (Maple) Woodland (FDs37)
2. Southern Dry-Mesic Oak Forest (MHs37)
3. Southern Mesic Oak-Basswood Forest (MHs38)
4. Southern Mesic Maple-Basswood Forest (MHs39)
5. Southern Dry Savanna (UPs14)
6. Southern Dry Prairie (UPs13)
7. Southern Mesic Prairie (UPs23)
8. Southern Wet Prairie (WPs54)
9. Southern Floodplain Forest (FFs68)
10. Southern Wet Ash Swamp (WFs57)
11. Southern Rich Conifer Swamp (FPs63)
12. Northern Wet Meadow/Carr (WMn82)
13. Southern Seepage Meadow/Carr (WMs83)
14. Northern Mixed Cattail Marsh (MRn83)
15. Northern Bulrush-Spikerush Marsh (MRn93)

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FDs37 Southern Dry-Mesic Oak (Maple) Woodland — Species Frequency and Cover

Species	freq%	cover
Forbs, Ferns & Fern Allies		
Clayton's sweet cicely *(Osmorhiza claytonii)*	78	●●
Pointed-leaved tick trefoil *(Desmodium glutinosum)*	78	●●
Hog peanut *(Amphicarpaea bracteata)*	76	●●
Canada mayflower *(Maianthemum canadense)*	73	●
Wild geranium *(Geranium maculatum)*	69	●●
Common enchanter's nightshade *(Circaea lutetiana)*	60	●
Wild sarsaparilla *(Aralia nudicaulis)*	60	●
Lopseed *(Phryma leptostachya)*	60	●
Common false Solomon's seal *(Smilacina racemosa)*	60	●
Pale bellwort *(Uvularia sessilifolia)*	60	●●
Lady fern *(Athyrium filix-femina)*	51	●
Bracken *(Pteridium aquilinum)*	51	●●
Sweet-scented bedstraw *(Galium triflorum)*	51	●
Large-leaved aster *(Aster macrophyllus)*	49	●●
Columbine *(Aquilegia canadensis)*	40	●
Northern bedstraw *(Galium boreale)*	40	●
Wood anemone *(Anemone quinquefolia)*	40	●
Spreading dogbane *(Apocynum androsaemifolium)*	38	●
Maryland black snakeroot *(Sanicula marilandica)*	36	●
Early meadow-rue *(Thalictrum dioicum)*	31	●
Giant Solomon's seal *(Polygonatum biflorum)*	27	●
Starry false Solomon's seal *(Smilacina stellata)*	22	●
Starflower *(Trientalis borealis)*	20	●
Interrupted fern *(Osmunda claytoniana)*	20	●●
Large-flowered bellwort *(Uvularia grandiflora)*	20	●●
Elliptic shinleaf *(Pyrola elliptica)*	20	●
Tail-leaved aster *(Aster sagittifolius)*	18	●
Grasses & Sedges		
Pennsylvania sedge *(Carex pensylvanica)*	84	●●●
Moutain rice grass *(Oryzopsis asperifolia)*	40	●
Nodding fescue *(Festuca subverticillata)*	11	●
Bottlebrush grass *(Elymus hystrix)*	11	●
Woody Vines		
Virginia creeper *(Parthenocissus spp.)*	91	●
Wild grape *(Vitis riparia)*	62	●
Low Shrubs		
Red raspberry *(Rubus idaeus)*	64	●
Tall blackberries *(Rubus allegheniensis and similar Rubus spp.)*	47	●
Tall Shrubs		
Chokecherry *(Prunus virginiana)*	82	●●
American hazelnut *(Corylus americana)*	80	●●●
Gray dogwood *(Cornus racemosa)*	67	●●●
Prickly ash *(Zanthoxylum americanum)*	67	●●
Poison ivy *(Toxicodendron rydbergii)*	64	●
Prickly gooseberry *(Ribes cynosbati)*	49	●
Downy arrowwood *(Viburnum rafinesquianum)*	49	●●
Juneberries *(Amelanchier spp.)*	47	●
Nannyberry *(Viburnum lentago)*	42	●
Bush honeysuckle *(Diervilla lonicera)*	33	●
Missouri gooseberry *(Ribes missouriense)*	24	●
Beaked hazelnut *(Corylus cornuta)*	22	●●●
Snowberry or Wolfberry *(Symphoricarpos albus or S. occidentalis)*	20	●
Red-berried elder *(Sambucus racemosa)*	20	●
Round-leaved dogwood *(Cornus rugosa)*	16	●

Trees	Canopy		Subcanopy		Shrub Layer	
	freq%	cover	freq%	cover	freq%	cover
Bur oak	67	●●●	58	●●	33	●
Northern pin oak	60	●●●●	33	●●●	38	●
Northern red oak	33	●●●●	13	●●●	22	●
White oak	29	●●●	9	●●	18	●
Black cherry	29	●	58	●●	69	●
Quaking aspen	27	●●	18	●●	18	●
Red maple	27	●●	56	●●●	53	●
Paper birch	20	●●	-	-	-	-
Big-toothed aspen	11	●●●	-	-	-	-
Green ash	9	●●●	31	●●	36	●
American elm	-	-	31	●●	33	●
Ironwood	-	-	29	●●●	18	●●

MHs37 Southern Dry-Mesic Oak Forest – Species Frequency & Cover

Forbs, Ferns & Fern Allies	freq%	cover
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	●

* Erect, Smooth, or Illinois carrion-flower *(Smilax ecirrata, S. herbacea,* or *S. illinoensis)*

Climbing Plants	freq%	cover
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	●

MHs37 - continued -

MESIC HARDWOOD FOREST SYSTEM
Southern Floristic Region

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	●
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

Forbs, Ferns & Fern Allies	freq%	cover
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	●

*Erect, Smooth, or Illinois carrion-flower *(Smilax ecirrata, S. herbacea*, or *S. illinoensis)*

Trees	Canopy		Subcanopy		Shrub Layer	
	freq%	cover	freq%	cover	freq%	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	●●

UPs14 Southern Dry Savanna — Species Frequency & Cover

Forbs, Ferns & Fern Allies	*freq%*	*cover*
Western ragweed *(Ambrosia psilostachya)*	80	●●
Virginia ground cherry *(Physalis virginiana)*	73	●
Hairy puccoon *(Lithospermum caroliniense)*	70	●
Gray goldenrod *(Solidago nemoralis)*	67	●
Hoary frostweed *(Helianthemum bicknellii)*	67	●
Horseweed *(Conyza canadensis)*	60	●
White sage *(Artemisia ludoviciana)*	53	●
Bearded birdfoot violet *(Viola palmata)*	53	●
Starry false Solomon's seal *(Smilacina stellata)*	47	●
Purple prairie clover *(Dalea purpurea)*	47	●
Common milkweed *(Asclepias syriaca)*	40	●
Long-headed thimbleweed *(Anemone cylindrica)*	40	●
Hoary puccoon *(Lithospermum canescens)*	40	●
Prairie pinweed *(Lechea stricta)*	33	●
Round-headed bush clover *(Lespedeza capitata)*	33	●
Skyblue aster *(Aster oolentangiensis)*	33	●
Rough blazing star *(Liatris aspera)*	33	●
Rock spikemoss *(Selaginella rupestris)*	30	●
Missouri goldenrod *(Solidago missouriensis)*	30	●
Bird's foot coreopsis *(Coreopsis palmata)*	30	●
Harebell *(Campanula rotundifolia)*	30	●
Hairy golden aster *(Chrysopsis villosa)*	30	●
Bastard toad-flax *(Comandra umbellata)*	30	●
Heath aster *(Aster ericoides)*	27	●
Showy goldenrod *(Solidago speciosa)*	27	●
Flowering spurge *(Euphorbia corollata)*	23	●
Mock pennyroyal *(Hedeoma hispida)*	23	●
Large-flowered beard tongue *(Penstemon grandiflorus)*	23	●
Erect, Smooth, or Illinois carrion-flower*	23	●
Tall cinquefoil *(Potentilla arguta)*	23	●
Stiff sunflower *(Helianthus pauciflorus)*	20	●●
Horsemint *(Monarda punctata)*	20	●●
Tall wormwood or Tarragon**	20	●
Silky prairie clover *(Dalea villosa)*	17	●

	freq%	*cover*
Grasses & Sedges		
Junegrass *(Koeleria pyramidata)*	80	●
Porcupine grass *(Stipa spartea)*	73	●●●
Little bluestem *(Schizachyrium scoparium)*	70	●●●
Big bluestem *(Andropogon gerardii)*	67	●●
Hay sedge *(Carex foenea)*	53	●●
Purple lovegrass *(Eragrostis spectabilis)*	53	●
Indian grass *(Sorghastrum nutans)*	40	●●●
Muhlenberg's sedge *(Carex muhlenbergia)*	37	●●
Pennsylvania sedge *(Carex pensylvanica* var. *pensylvanica)*	37	●●
Sand reed-grass *(Calamovilfa longifolia)*	37	●
Switchgrass *(Panicum virgatum)*	37	●
Prairie dropseed *(Sporobolus heterolepis)*	37	●●
Long-leaved panic grass *(Panicum perlongum)*	37	●
Scribner's panic grass *(Panicum oligosanthes)*	30	●●
Hairy grama *(Bouteloua hirsuta)*	30	●
Side-oats grama *(Bouteloua curtipendula)*	23	●●●
Fall witch grass *(Leptoloma cognatum)*	23	●
Woody Vines		
Virginia creeper *(Parthenocissus vitacea* or *P. quinquefolia)*	47	●
Semi-Shrubs		
Leadplant *(Amorpha canescens)*	53	●●
Prairie rose *(Rosa arkansana)*	43	●
Shrubs		
Chokecherry *(Prunus virginiana)*	50	●
American hazelnut *(Corylus americana)*	43	●
Smooth sumac *(Rhus glabra)*	40	●●
Low or Saskatoon juneberry *(Amelanchier humilis* or *A. alnifolia)*	37	●

Trees	**Canopy**		**Shrub Layer**	
	freq%	*cover*	*freq%*	*cover*
Bur oak	43	●●●	67	●
Northern pin oak	27	●●●	37	●
Black oak	23	●●●	23	●●
Jack Pine	17	●●●	17	●

*Erect, Smooth, or Illinois carrion-flower *(Smilax ecirrata, S. herbacea,* or *S. illinoensis)* **Tall wormwood or Tarragon *(Artemisia dracunculus* or *A. campestris)*

UPs13 Southern Dry Prairie — Species Frequency & Cover

Species	freq%	cover
Forbs, Ferns & Fern Allies		
Purple prairie clover *(Dalea purpurea)*	72	●
Gray goldenrod *(Solidago nemoralis)*	61	●
Silky aster *(Aster sericeus)*	61	●
Heath aster *(Aster ericoides)*	60	●●
Stiff goldenrod *(Solidago rigida)*	53	●
Long-headed thimbleweed *(Anemone cylindrica)*	53	●
Bearded birdfoot violet *(Viola pedatifida)*	47	●
Rough blazing star *(Liatris aspera)*	45	●
Daisy fleabane *(Erigeron strigosus)*	43	●
Pasque-flower *(Anemone patens)*	42	●
Stiff sunflower *(Helianthus pauciflorus)*	41	●●
Narrow-leaved purple coneflower *(Echinacea angustifolia)*	40	●
Tall cinquefoil *(Potentilla arguta)*	40	●
Bastard toad-flax *(Comandra umbellata)*	37	●
Prairie turnip *(Pediomelum esculentum)*	37	●
Prairie wild onion *(Allium stellatum)*	36	●
Dotted blazing star *(Liatris punctata)*	34	●
Hoary puccoon *(Lithospermum canescens)*	32	●
Aromatic aster *(Aster oblongifolius)*	30	●
Virginia ground cherry *(Physalis virginiana)*	30	●
Flodman's thistle *(Cirsium flodmanii)*	29	●
Bird's foot coreopsis *(Coreopsis palmata)*	28	●●
Grooved yellow flax *(Linum sulcatum)*	28	●
Western ragweed *(Ambrosia psilostachya)*	26	●●
Canada goldenrod *(Solidago canadensis)*	25	●
Heart-leaved alexanders *(Zizia aptera)*	25	●
Wild bergamot *(Monarda fistulosa)*	25	●
Harebell *(Campanula rotundifolia)*	25	●
Toothed evening primrose *(Calylophus serrulatus)*	25	●
Missouri goldenrod *(Solidago missouriensis)*	24	●
Skyblue aster *(Aster oolentangiensis)*	24	●
Mock pennyroyal *(Hedeoma hispida)*	24	●
Prairie sagewort *(Artemisia frigida)*	23	●●
Hoary vervain *(Verbena stricta)*	23	●
Flowering spurge *(Euphorbia corollata)*	22	●
White sage *(Artemisia ludoviciana)*	22	●
Whorled milkweed *(Asclepias verticillata)*	21	●
Field blue-eyed grass *(Sisyrinchium campestre)*	21	●
Tall wormwood or Tarragon*	20	●
Hairy golden aster *(Chrysopsis villosa)*	20	●
Prairie or Balsam ragwort *(Senecio plattensis* or *S. pauperculus)*	20	●
False boneset *(Kuhnia eupatorioides)*	19	●
False gromwell *(Onosmodium molle)*	19	●
Green milkweed *(Asclepias viridiflora)*	19	●
Narrow-leaved puccoon *(Lithospermum incisum)*	17	●
Plantain-leaved pussytoes *(Antennaria plantaginifolia)*	16	●
Hairy puccoon *(Lithospermum caroliniense)*	13	●
Silky prairie clover *(Dalea villosa)*	6	●●
Grasses & Sedges		
Little bluestem *(Schizachyrium scoparium)*	88	●●●
Side-oats grama *(Bouteloua curtipendula)*	79	●●●
Big bluestem *(Andropogon gerardii)*	73	●●●
Prairie dropseed *(Sporobolus heterolepis)*	58	●●●
Porcupine grass *(Stipa spartea)*	57	●●●
Plains muhly *(Muhlenbergia cuspidata)*	56	●●
Indian grass *(Sorghastrum nutans)*	45	●●●
Junegrass *(Koeleria pyramidata)*	43	●●
Hairy grama *(Bouteloua hirsuta)*	30	●●
Scribner's panic grass *(Panicum oligosanthes)*	26	●
Wilcox's panic grass *(Panicum wilcoxianum)*	22	●
Blue grama *(Bouteloua gracilis)*	16	●●●
Sand reed-grass *(Calamovilfa longifolia)*	16	●●
Needle-and-thread grass *(Stipa comata)*	13	●●●
Semi-Shrubs		
Leadplant *(Amorpha canescens)*	71	●●
Prairie rose *(Rosa arkansana)*	40	●
Shrubs		
Smooth sumac *(Rhus glabra)*	29	●●
Wolfberry *(Symphoricarpos occidentalis)*	15	●

*Tall wormwood or Tarragon *(Artemisia dracunculus* or *A. campestris)*

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	●●

	freq%	cover
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

Species	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)*

FFs68 *Southern Floodplain Forest* – Species Frequency & Cover

	freq%	cover
Forbs, Ferns & Fern Allies		
Wood nettle *(Laportea canadensis)*	93	●●●●
Ontario aster *(Aster ontarionis)*	56	●
Mad dog skullcap *(Scutellaria lateriflora)*	56	●
Clearweed *(Pilea* spp.)	52	●●●
Bur marigold and Beggarticks *(Bidens* spp.)	44	●
Touch-me-not *(Impatiens* spp.)	41	●
Tall coneflower *(Rudbeckia laciniata)*	41	●●
Stinging nettle *(Urtica dioica)*	37	●
Kidney-leaved buttercup *(Ranunculus abortivus)*	33	●
Narrow-leaved hedge nettle *(Stachys tenuifolia)*	33	●
Honewort *(Cryptotaenia canadensis)*	26	●
False nettle *(Boehmeria cylindrica)*	26	●●
Wild cucumber *(Echinocystis lobata)*	19	●
Nodding or Virginia stickseed *(Hackelia deflexa* or *H. virginiana)*	19	●
Northern bugleweed *(Lycopus uniflorus)*	19	●
Side-flowering aster *(Aster lateriflorus)*	15	●
Dodder *(Cuscuta* spp.)	15	●
Tall bellflower *(Campanula americana)*	15	●
Virginia knotweed *(Polygonum virginianum)*	15	●●
Germander *(Teucrium canadense)*	15	●
Bur cucumber *(Sicyos angulatus)*	15	●●
Woundwort *(Stachys palustris)*	15	●
Cut-leaved bugleweed *(Lycopus americanus)*	15	●
Eastern panicled aster *(Aster lanceolatus)*	11	●●●●
Green dragon *(Arisaema dracontium)*	11	●
White snakeroot *(Eupatorium rugosum)*	11	●
Stemless blue violets *(Viola sororia* and similar *Viola* spp.)	11	●
Erect, Smooth, or Illinois carrion-flower*	11	●
Common mint *(Mentha arvensis)*	11	●
Three-seeded mercury *(Acalypha rhomboidea)*	11	●
Southern blue flag *(Iris virginica)*	11	●
Grasses & Sedges		
Virginia wild rye *(Elymus virginicus)*	52	●●
White grass *(Leersia virginica)*	44	●●●
Rice cut grass *(Leersia oryzoides)*	30	●●
Hop umbrella sedge *(Carex lupulina)*	22	●●
Cattail sedge *(Carex typhina)*	15	●●●
Ambiguous sedge *(Carex amphibola)*	15	●●
Bladder sedge *(Carex intumescens)*	11	●
Stout woodreed *(Cinna arundinacea)*	11	●
Gray's sedge *(Carex grayi)*	11	●●
Climbing Plants		
Wild grape *(Vitis riparia)*	81	●
Canada moonseed *(Menispermum canadense)*	56	●
Greenbrier *(Smilax tamnoides)*	33	●
Virginia creeper *(Parthenocissus* spp.)	26	●
Climbing poison ivy *(Toxicodendron rydbergii)*	**	**
Shrubs		
Climbing poison ivy *(Toxicodendron rydbergii)*	33	●●
Black willow *(Salix nigra)*	11	●●●●

Trees	Canopy freq%	Canopy cover	Subcanopy freq%	Subcanopy cover	Shrub Layer freq%	Shrub Layer cover
Silver maple	96	●●●●●	56	●●●	63	●●●
Green ash	67	●●●	48	●●	74	●
American elm	41	●●	56	●●●	56	●
Cottonwood	30	●●●●	-	-	-	-
Hackberry	22	●	19	●●	33	●
Box elder	11	●●●	22	●●	22	●
Swamp white oak	11	●●●	-	-	-	-
Red elm	-	-	-	-	26	●

* Erect, Smooth, or Illinois carrion-flower *(Smilax ecirrata, S. herbacea,* or *S. illinoensis)* **Climbing poison ivy is important in both the shrub and climbing plant layers, but all records from plot samples were universally assigned to the shrub layer.

WFs57 Southern Wet Ash Swamp – Species Frequency & Cover

Forbs, Ferns & Fern Allies	freq%	cover
Touch-me-not *(Impatiens* spp.)	97	●●●
Jack-in-the-pulpit *(Arisaema triphyllum)*	90	●
Wood nettle *(Laportea canadensis)*	81	●●●
Common marsh marigold *(Caltha palustris)*	68	●●●
Wild geranium *(Geranium maculatum)*	65	●
Common enchanter's nightshade *(Circaea lutetiana)*	61	●
Tall coneflower *(Rudbeckia laciniata)*	61	●
Lady fern *(Athyrium filix-femina)*	58	●●
White avens *(Geum canadense)*	55	●
Sensitive fern *(Onoclea sensibilis)*	48	●
Clayton's sweet cicely *(Osmorhiza claytonii)*	48	●
Two-leaved miterwort *(Mitella diphylla)*	48	●
Wild ginger *(Asarum canadense)*	45	●●
Sweet-scented bedstraw *(Galium triflorum)*	45	●
Cleavers *(Galium aparine)*	45	●
Hog peanut *(Amphicarpaea bracteata)*	45	●
Honewort *(Cryptotaenia canadensis)*	45	●
Early meadow-rue *(Thalictrum dioicum)*	42	●
Canada mayflower *(Maianthemum canadense)*	42	●
Ostrich fern *(Matteuccia struthiopteris)*	39	●●●
Zigzag goldenrod *(Solidago flexicaulis)*	39	●
Stinging nettle *(Urtica dioica)*	39	●
Michigan lily *(Lilium michiganense)*	39	●
Hispid buttercup *(Ranunculus hispidus)*	39	●
Virginia waterleaf *(Hydrophyllum virginianum)*	39	●
Dwarf raspberry *(Rubus pubescens)*	39	●
Hooked crowfoot *(Ranunculus recurvatus)*	35	●
Skunk cabbage *(Symplocarpus foetidus)*	35	●●●●●
Bulblet fern *(Cystopteris bulbifera)*	35	●
Field horsetail *(Equisetum arvense)*	32	●
Clearweed *(Pilea* spp.)	29	●●
Crooked aster *(Aster prenanthoides)*	29	●●
Tall scouring rush *(Equisetum hyemale)*	23	●●
False mermaid *(Floerkea proserpinacoides)*	19	●●●●

	freq%	cover
Small-leaved water cress *(Rorippa nasturtium-aquaticum)*	10	●●●
Grasses & Sedges		
Fowl manna grass *(Glyceria striata)*	69	●●
Awl-fruited sedge *(Carex stipata)*	52	●
Starry sedge *(Carex rosea* or *C. radiata)*	39	●●
Bland sedge *(Carex blanda)*	32	●
Graceful sedge *(Carex gracillima)*	32	●
Lake sedge *(Carex lacustris)*	29	●●●
Brome-like sedge *(Carex bromoides)*	23	●●●
Smooth-sheathed sedge *(Carex laevivaginata)*	16	●
Interior sedge *(Carex interior)*	13	●●●
Climbing Plants		
Virginia creeper *(Parthenocissus* spp.)	94	●
Shrubs		
Wild black currant *(Ribes americanum)*	52	●
Chokecherry *(Prunus virginiana)*	45	●
Nannyberry *(Viburnum lentago)*	45	●●
Pagoda dogwood *(Cornus alternifolia)*	35	●
Poison ivy *(Toxicodendron rydbergii)*	32	●
Prickly gooseberry *(Ribes cynosbati)*	29	●
Speckled alder *(Alnus incana)*	26	●●●
Missouri gooseberry *(Ribes missouriense)*	23	●●

Trees	Canopy		Subcanopy		Shrub Layer	
	freq%	cover	freq%	cover	freq%	cover
Black ash	97	●●●●	90	●●●	90	●●
Basswood	58	●●	52	●●	42	●
Sugar maple	39	●●●	39	●●	42	●
American elm	32	●●	45	●	48	●
Bur oak	23	●	-	-	26	●
Yellow birch	19	●●●	19	●●●	16	●
Paper birch	16	●●●	-	-	-	-
Green ash	16	●●●	13	●●	13	●
Blue beech	13	●	23	●●	23	●
Northern red oak	-	-	-	-	32	●

FPs63 Southern Rich Conifer Swamp — Species Frequency & Cover

	freq%	cover
Forbs, Ferns & Fern Allies		
Dwarf raspberry *(Rubus pubescens)*	87	●●●
Common marsh marigold *(Caltha palustris)*	77	●
Touch-me-not *(Impatiens* spp.)	70	●●
Northern marsh fern *(Thelypteris palustris)*	70	●●●
Sweet-scented bedstraw *(Galium triflorum)*	63	●
Starflower *(Trientalis borealis)*	63	●
Tufted loosestrife *(Lysimachia thyrsiflora)*	63	●●
Canada mayflower *(Maianthemum canadense)*	57	●●
Great water dock *(Rumex orbiculatus)*	53	●
Three-leaved false Solomon's seal *(Smilacina trifolia)*	53	●
Bulb-bearing water hemlock *(Cicuta bulbifera)*	47	●
Bog aster *(Aster borealis)*	47	●
Northern bugleweed *(Lycopus uniflorus)*	47	●
Red-stemmed aster *(Aster puniceus)*	47	●
Marsh bellflower *(Campanula aparinoides)*	47	●
Spinulose shield fern or Glandular wood fern*	47	●
Spotted Joe pye weed *(Eupatorium maculatum)*	43	●
Water horsetail *(Equisetum fluviatile)*	43	●●
Crested fern *(Dryopteris cristata)*	40	●
Bunchberry *(Cornus canadensis)*	40	●
Tall Northern bog orchid *(Platanthera hyperborea)*	40	●
Pink shinleaf *(Pyrola asarifolia)*	40	●
Big-leaf white violet or Northern white violet**	37	●
Alpine enchanter's nightshade *(Circaea alpina)*	37	●
Bur marigold and Beggarticks *(Bidens* spp.)	37	●●
Common strawberry *(Fragaria virginiana)*	33	●
Clearweed *(Pilea* spp.)	33	●
Showy lady's slipper *(Cypripedium reginae)*	33	●
Marsh skullcap *(Scutellaria galericulata)*	33	●
Swamp saxifrage *(Saxifraga pensylvanica)*	33	●
Naked miterwort *(Mitella nuda)*	33	●●
Mad dog skullcap *(Scutellaria lateriflora)*	30	●
Grasses & Sedges		
Bristle-stalked sedge *(Carex leptalea)*	70	●●●
Soft-leaved sedge *(Carex disperma)*	47	●●●
Bluejoint *(Calamagrostis canadensis)*	43	●
Fowl manna grass *(Glyceria striata)*	43	●
Fringed brome *(Bromus ciliatus)*	33	●
Interior sedge *(Carex interior)*	33	●●●
Fen wiregrass sedge *(Carex lasiocarpa)*	30	●●●
Climbing Plants		
Virginia creeper *(Parthenocissus* spp.)	60	●
Wild grape *(Vitis riparia)*	40	●
Wild honeysuckle *(Lonicera dioica)*	37	●
Low Shrubs		
Poison ivy *(Toxicodendron rydbergii)*	57	●
Red raspberry *(Rubus idaeus)*	43	●
Mountain fly honeysuckle *(Lonicera villosa)*	37	●
Labrador tea *(Ledum groenlandicum)*	30	●●
Tall Shrubs		
Red-osier dogwood *(Cornus sericea)*	77	●●
Bog birch *(Betula pumila)*	77	●●
Swamp gooseberry *(Ribes hirtellum)*	60	●
Dwarf alder *(Rhamnus alnifolia)*	50	●
Speckled alder *(Alnus incana)*	50	●●●
Swamp red currant *(Ribes triste)*	47	●
Juneberries *(Amelanchier* spp.)	43	●
Pussy willow *(Salix discolor)*	30	●●

Trees	Canopy		Understory	
	freq%	cover	freq%	cover
Tamarack	93	●●●●	60	●●●
Paper birch	37	●	30	●
American elm	23	●●●	57	●●
Black spruce	17	●	17	●
Red maple	13	●	37	●
Black ash	13	●	37	●
Northern red oak	-	-	30	●
Box elder	-	-	27	●

*Spinulose shield fern or Glandular wood fern *(Dryopteris carthusiana* or *D. intermedia)* **Big-leaf white violet or Northern white violet *(Viola blanda* or *V. macloskeyi)*

WMn82 Northern Wet Meadow/Carr — Species Frequency & Cover

	freq%	cover
Grasses & Sedges		
Bluejoint *(Calamagrostis canadensis)*	80	●●●●
Lake sedge *(Carex lacustris)*	72	●●●●
Tussock sedge *(Carex stricta)*	41	●●●●
Beaked sedge *(Carex utriculata)*	33	●●●
Fen wiregrass sedge *(Carex lasiocarpa)*	29	●●●
Woolgrass *(Scirpus cyperinus)*	22	●●
Aquatic sedge *(Carex aquatilis)*	11	●●●
Forbs, Ferns & Fern Allies		
Tufted loosestrife *(Lysimachia thyrsiflora)*	59	●
Marsh bellflower *(Campanula aparinoides)*	58	●
Marsh skullcap *(Scutellaria galericulata)*	53	●
Great water dock *(Rumex orbiculatus)*	52	●
Three-cleft or small bedstraw *(Galium trifidum* or *G. tinctorium)*	46	●
Bulb-bearing water hemlock *(Cicuta bulbifera)*	46	●
Northern bugleweed *(Lycopus uniflorus)*	45	●
Linear-leaved, Marsh, or Downy willow-herb*	44	●
Water smartweed *(Polygonum amphibium)*	42	●
Northern marsh fern *(Thelypteris palustris)*	40	●●
Touch-me-not *(Impatiens* spp.)	39	●●
Marsh cinquefoil *(Potentilla palustris)*	38	●
Spotted Joe pye weed *(Eupatorium maculatum)*	34	●
Broad-leaved cattail *(Typha latifolia)*	32	●●
Arrow-leaved tearthumb *(Polygonum sagittatum)*	28	●
Crested fern *(Dryopteris cristata)*	24	●
Marsh St. John's wort *(Triadenum fraseri)*	23	●
Swamp milkweed *(Asclepias incarnata)*	22	●
Northern blue flag *(Iris versicolor)*	22	●
Broad-leaved arrowhead *(Sagittaria latifolia)*	22	●●
Labrador bedstraw *(Galium labradoricum)*	21	●
Bur marigold and Beggarticks *(Bidens* spp.)	21	●●

	freq%	cover
Sensitive fern *(Onoclea sensibilis)*	20	●
Common mint *(Mentha arvensis)*	19	●
Red-stemmed aster *(Aster puniceus)*	19	●
Marsh vetchling *(Lathyrus palustris)*	17	●
Common marsh marigold *(Caltha palustris)*	17	●
Cut-leaved bugleweed *(Lycopus americanus)*	17	●
Long-leaved chickweed *(Stellaria longifolia)*	13	●
Bog aster *(Aster borealis)*	12	●
Mad dog skullcap *(Scutellaria lateriflora)*	12	●
Giant goldenrod *(Solidago gigantea)*	12	●
Big-leaf white violet or Northern white violet**	12	●
Lesser-duckweed *(Lemna minor)*	12	●
Dwarf raspberry *(Rubus pubescens)*	11	●
Sweet flag *(Acorus calamus)*	11	●●
Rough cinquefoil *(Potentilla norvegica)*	11	●
Common boneset *(Eupatorium perfoliatum)*	11	●
Water horsetail *(Equisetum fluviatile)*	10	●
Low Shrubs		
Red raspberry *(Rubus idaeus)*	13	●
Tall Shrubs		
Slender willow *(Salix petiolaris)*	42	●●●
Pussy willow *(Salix discolor)*	29	●●
Red-osier dogwood *(Cornus sericea)*	24	●●
Speckled alder *(Alnus incana)*	24	●●●
Meadowsweet *(Spiraea alba)*	23	●
Bebb's willow *(Salix bebbiana)*	20	●●
Bog birch *(Betula pumila)*	14	●●
Tree Seedlings & Saplings (< 16ft)		
Paper birch	8	●
Black ash	7	●
Red maple	5	●

*Linear-leaved, Marsh, or Downy willow-herb *(Epilobium leptophyllum*, *E. palustre*, or *E. strictum)* **Big-leaf white violet or Northern white violet *(Viola blanda* or *V. macloskeyi)*

WMs83 Southern Seepage Meadow/Carr — Species Frequency & Cover

	freq%	cover
Grasses & Sedges		
Tussock sedge *(Carex stricta)*	58	●●●●
Bluejoint *(Calamagrostis canadensis)*	45	●●●
Fowl bluegrass *(Poa palustris)*	36	●
Lake sedge *(Carex lacustris)*	33	●●
Prairie sedge *(Carex prairea)*	33	●●●
Fowl manna grass *(Glyceria striata)*	31	●
Woolly sedge *(Carex pellita)*	28	●●
Aquatic sedge *(Carex aquatilis)*	25	●●●●
Porcupine sedge *(Carex hystericina)*	25	●●
Redtop *(Agrostis stolonifera)*	23	●
Fringed brome *(Bromus ciliatus)*	23	●
Red-stalked spikerush *(Eleocharis palustris)*	22	●
Interior sedge *(Carex interior)*	22	●
Dark green or Pale bulrush *(Scirpus atrovirens* or *S. pallidus)*	19	●
Sartwell's sedge *(Carex sartwellii)*	17	●●●
Prairie cordgrass *(Spartina pectinata)*	17	●●●
Clustered muhly grass *(Muhlenbergia glomerata)*	16	●
Awl-fruited sedge *(Carex stipata)*	16	●
Narrow reedgrass *(Calamagrostis stricta)*	16	●●●
Forbs, Ferns & Fern Allies		
Spotted Joe pye weed *(Eupatorium maculatum)*	83	●●
Great water dock *(Rumex orbiculatus)*	59	●
Marsh bellflower *(Campanula aparinoides)*	56	●
Red-stemmed aster *(Aster puniceus)*	50	●●
Common boneset *(Eupatorium perfoliatum)*	50	●
Swamp milkweed *(Asclepias incarnata)*	48	●
Giant goldenrod *(Solidago gigantea)*	47	●
Northern bugleweed *(Lycopus uniflorus)*	44	●
Touch-me-not *(Impatiens* spp.)	42	●●●
Common marsh marigold *(Caltha palustris)*	41	●●
Sunflower *(Helianthus giganteus, H. grosseserratus,* or *H. nuttallii)*	39	●●
Cut-leaved bugleweed *(Lycopus americanus)*	38	●
Marsh vetchling *(Lathyrus palustris)*	38	●
Broad-leaved cattail *(Typha latifolia)*	36	●●●
Linear-leaved, Marsh, or Downy willow-herb*	34	●
Northern bog violet *(Viola nephrophylla)*	33	●
Tall meadow-rue *(Thalictrum dasycarpum)*	33	●
Canada goldenrod *(Solidago canadensis)*	33	●
Tufted loosestrife *(Lysimachia thyrsiflora)*	31	●
Bog aster *(Aster borealis)*	31	●
Flat-topped aster *(Aster umbellatus)*	31	●
Virginia mountain mint *(Pycnanthemum virginianum)*	30	●
Northern marsh fern *(Thelypteris palustris)*	30	●●
Common mint *(Mentha arvensis)*	28	●
Marsh skullcap *(Scutellaria galericulata)*	27	●
Dwarf raspberry *(Rubus pubescens)*	27	●●●
Swamp thistle *(Cirsium muticum)*	25	●
Eastern panicled aster *(Aster lanceolatus)*	23	●
Water smartweed *(Polygonum amphibium)*	22	●●
Spotted water hemlock *(Cicuta maculata)*	20	●
American, Purple-leaved, or Northern willow-herb**	20	●
Labrador bedstraw *(Galium labradoricum)*	20	●
Clearweed *(Pilea* spp.)	20	●●
Swamp lousewort *(Pedicularis lanceolata)*	20	●
White turtlehead *(Chelone glabra)*	19	●
Woundwort *(Stachys palustris)*	19	●
Rough bugleweed *(Lycopus asper)*	17	●●●
Bulb-bearing water hemlock *(Cicuta bulbifera)*	16	●
Blue vervain *(Verbena hastata)*	14	●
Starry false Solomon's seal *(Smilacina stellata)*	14	●
Sensitive fern *(Onoclea sensibilis)*	14	●●
Shrubs		
Red-osier dogwood *(Cornus sericea)*	48	●●●
Pussy willow *(Salix discolor)*	39	●●
Slender willow *(Salix petiolaris)*	27	●●
Bebb's willow *(Salix bebbiana)*	19	●
Sage-leaved willow *(Salix candida)*	17	●
Bog birch *(Betula pumila)*	16	●●●
Heart-leaved willow *(Salix eriocephala)*	14	●●

*Linear-leaved, Marsh, or Downy willow-herb *(Epilobium leptophyllum, E. palustre,* or *E. strictum)* **American, Purple-leaved, or Northern willow-herb *(Epilobium ciliatum, E. coloratum,* or *E. glandulosum)*

MRn83 Northern Mixed Cattail Marsh — Species Frequency & Cover

Species	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	●

Species	freq%	cover
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	●●●●

	freq%	cover
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 K. Climate-Adapted Trees to Plant in the Twin Cities Region

To provide the Minneapolis Park and Recreation Board (MPRB) with a robust framework for restoring and managing natural resources, Resource Environmental Solutions, LLC. (RES) analyzed data and selected climate-adapted tree species for planting in the natural areas of the MPRB park system. RES ecologists used their field experience and scientific information to identify tree species having the greatest chance of persisting in the Twin Cities region over the coming decades, despite predicted changes in local climate. RES used the following approach.

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

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

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

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

Trees 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, RES 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 RES ecologists based on extensive field experience throughout the Midwest and in particular work in MPRB's parklands as part of the ongoing natural areas planning effort.

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 K.1. Climate-Adapted Trees to Plant in the Twin Cities Region

Species Name [1, 2]	Common Name [1, 2]	Family [1, 2]	MPRB Plant Community Suitable for Planting [3]	Wet Soil Tolerant [4, 5]	Dry Soil Tolerant [4, 5]	Potential Diseases, Pests & Problems [6, 7, &]
Acer rubrum	Red maple	Aceraceae	MFW, WFS	Yes		Susceptible to storm damage, inviting fungi and insect pest; leaf chlorosis
Acer saccharinum	Silver maple	Aceraceae	WFS, FF	Yes	Yes	Storm damage; verticillium wilt
Acer saccharum	Sugar maple	Aceraceae	MFW		Yes	Verticillium wilt
Aesculus glabra	Ohio buckeye	Sapindaceae	DMFW, WFS	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	FF	Yes		Bronze birch borer, chlorosis, Asian long-horned beetle host
Carpinus caroliniana	Blue beech, Musclewood, Hornbeam	Betulaceae	MFW, FF	Yes		Fire
Carya cordiformis	Bitternut hickory	Juglandaceae	MFW	Yes	Yes	Hickory bark beetles, pecan weevils, anthracnose, and powdery mildew
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

Species Name [1, 2]	Common Name [1, 2]	Family [1, 2]	MPRB Plant Community Suitable for Planting [3]	Wet Soil Tolerant [4, 5]	Dry Soil Tolerant [4, 5]	Potential Diseases, Pests & Problems [6, 7, &]
Celtis occidentalis	Common hackberry	Cannabaceae	MFW, FF		Yes	Nipple gall and witches broom gall
Cercis canadensis [8]	Eastern redbud	Fabaceae	MFW, S	Yes		Leaf anthracnose; *Botryosphaeria* canker; verticillium wilt
Cornus alternifolia	Pagoda dogwood	Cornaceae	MFW, SS	Yes		Anthracnose, crown canker
Fraxinus americana	White ash	Oleaceae	MFW	Yes	Yes	Emerald ash borer, ash dieback, environmental pollutants
Gleditsia triacanthos	Honeylocust	Fabaceae	WFS, FF	Yes	Yes	*Nectria* canker
Gymnocladus dioicus	Kentucky coffee tree	Fabaceae	FF		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	FF	Yes		Hybridizes with invasive white mulberry
Ostrya virginiana	Ironwood, Eastern hophornbeam	Betulaceae	DMFW, MFW		Yes	Trunk and butt rots

Species Name [1, 2]	Common Name [1, 2]	Family [1, 2]	MPRB Plant Community Suitable for Planting [3]	Wet Soil Tolerant [4, 5]	Dry Soil Tolerant [4, 5]	Potential Diseases, Pests & Problems [6, 7, &]
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	FF	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	WFS, FF	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, MFW, S, FF	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

Species Name [1, 2]	Common Name [1, 2]	Family [1, 2]	MPRB Plant Community Suitable for Planting [3]	Wet Soil Tolerant [4, 5]	Dry Soil Tolerant [4, 5]	Potential Diseases, Pests & Problems [6, 7, &]
						chestnut borer
Quercus palustris [8]	Pin oak	Fagaceae	DMFW	Yes		Oak wilt, gypsy moth
Quercus rubra	Northern red oak	Fagaceae	DMFW, MFW		Yes	Oak wilt
Quercus velutina	Black oak	Fagaceae	DMFW, S		Yes	Oak wilt
Salix amygdaloides	Peachleaf willow	Salicaceae	WFS, FF	Yes		Willow rust, aphids, Asian long-horned beetle host
Salix nigra	Black willow	Salicaceae	WFS, FF	Yes		Willow rust, aphids, Asian long-horned beetle
Sassafras albidum[8]	Sassafras	Lauraceae	DMFW	Yes		Laurel wilt
Tilia americana	American basswood	Tiliaceae	DMFW, MFW		Yes	Borers, beetles, lacebugs, caterpillars, scale, spider mites
Ulmus americana	American elm	Ulmaceae	MFW, FF	Yes	Yes	Dutch elm disease, Asian long-horned beetle host
Ulmus rubra	Slippery elm	Ulmaceae	MFW, FF, WFS	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; S = Savanna; SS = Shrub/Scrub; MFW = Mesic Forest; FF = Floodplain Forest; WFS = Wet Forest/Swamp
[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 L. MPRB – Contractor Procedures for Prescribed Burns

Minneapolis
Park & Recreation Board

Contractor Procedures for Prescribed Burns

Prior to the burn Season:

- Spring Burns - notify MPRB Contract Manager by March 1st what sites are planned for burning
- Fall Burns – notify MPRB Contract Manager by August 1st what sites are planned for burning
- Provide MPRB Contract Manager a contact name and phone number, which will be included on the notification postcard for resident questions and concerns.

Three weeks prior to planned burn date:

- Request and fill out permit applications in accordance with City of Minneapolis Fire Prevention Bureau at (612) 673-2546 and the Minnesota Department of Natural Resources Forestry Division (651) 259-5926.
- Sites require: a DNR permit, a burn plan, a Minneapolis Fire permit and also notification of fire departments in the appropriate adjacent municipalities and State Highway Patrol if near a major highway.
- For all sites submit the DNR burn plan to both the DNR and MPRB's Natural Resources Coordinator/Contract Manager.

Two weeks prior:

- MPRB will send out social media and eGOV notifications indicating the burn time frame and that the burn is weather dependent.
- MPRB will send contractor a phone contact list, for people/agencies that need to be called prior to the burn.

One day prior to the burn:

- Contractor must notify MPRB Contract Manager of site(s) to be burned the following day.
- MPRB Contract Manager will notify the MPRB staff of sites that will be burned.
- Contractor is responsible for making calls to residents/businesses who have requested notification.

Morning of the prescribed burn:

- Contractor must check with MPCA regarding the Air Quality Index (AQI) for the Twin Cities. Burning cannot occur if indexes exceed 100 in value. AQI values can be checked daily by dialing (651)297-1630, through their website at www.pca.state.mn.us or mobile app.
- Contractor will consult DNR website to determine whether or not a Red Flag warning has been issued. No burning is permitted when DNR has issued a Red Flag warning.
- Contractor must notify MPRB Contract Manager as to whether or not the burn is on for the day and the approximate timeline for the burn (start and stop times)
- Contractor will make calls to residents/businesses who have requested notification of the burn

Before burning:

- Post warning signs on trails and / or adjacent areas to the burn area, to notify park users.
- Prior to burn: Contact appropriate fire dispatcher (DNR and/or 911) and others on the phone contact list and inform them:
    (1) that the burn is beginning,
    (2) give fire dispatch a cell phone number for a person supervising at the burn site

After burn:

- MOP-UP, Make sure all embers are watered down and all smoke is extinguished before leaving site.
- Call fire dispatchers MNDNR, 911 and MPRB Police, (State patrol if required) to notify them that the burn is completed and extinguished.

MPRB requires prior burn experience by contractor and S-130 and S-190 training for burn crew is preferred. Water source must be on site and minimum of four person burn crew is preferred.

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Appendix M. Potential Biocontrol Options for the MPRB Park System

Plant Community	Invasive Plant Species	Biocontrol Agent	Mechanism	Application to Site	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 throughout the winter and early spring.	Biocontrol agent currently not available in the United States but undergoing further testing.	Becker et al. 2020
Upland Grasslands	Leafy spurge (*Euphorbia esula*)	Leafy spurge beetle (*Aphthona lacertosa*) Black dot Leafy spurge flea beetle (*Aphthona nigriscutis*)	Adult Stage: Herbivory of foliage and lay their eggs at the base of spurge plants. Larval Stage: The eggs hatch and larvae feed on the roots over the winter until they pupate and emerge as adults the following summer.	Leafy spurge is known to exist in the MPRB park system. In cooperation with MDA, biocontrol beetles were introduced at the Cedar Lake Regional Trail prairie in 2004. Other park system populations of leafy spurge are too small to support biocontrol.	Chandler et al. 2012
	Spotted knapweed (*Centaurea stoebe*)	Seedhead weevils (*Larinus minutus* and *L. obtusus*)	Adult stage: Herbivory of foliage. Larval stage: Consume the developing spotted knapweed seed.	Spotted knapweed is known to exist in the MPRB park system. In cooperation with MDA, both Spotted knapweed biocontrol agents were introduced at Cedar Lake Regional Trail prairie in 2004 and are well established.	Chandler 2020
		A root-boring weevil (*Cyphocleonus achates*)	Larval Stage: Develop in the roots consuming plant resources and physically damaging the roots.		
Wetlands	Purple loosestrife (*Lythrum salicaria, L. virgatum*)	Black-margined loosestrife beetle (*Galerucella calmariensis*) Purple loosestrife leaf beetle (*Galerucella pusilla*)	Adult Stage: Herbivory of foliage. Larval Stage: First instar larvae feed concealed within leaf or flower buds; later instars feed openly on all aboveground plant parts.	Purple loosestrife is known to exist in the MPRB park system. MPRB started a biological control program in cooperation with MNDNR in 1987, which is now well established.	MNDNR 2020
		Loosestrife root weevil *(Hylobius transversovittatus)*	Adult Stage: Herbivory of foliage. Larval Stage: Feed within the roots.		

References

Becker, R. and E. Katovich. 2020. Garlic mustard biocontrol: ecological host range of biocontrol agents. University of Minnesota. Available at: https://mitppc.umn.edu/project/biocontrol-garlic-mustard. (Accessed May 2020).

Chandler, M. 2020. Spotted Knapweed Biocontrol. Minnesota Department of Agriculture. Available at: https://www.mda.state.mn.us/plants/pestmanagement/weedcontrol/noxiouslist/spottedknapweed/knapweed. (Accessed May 2020).

Chandler, M.A., L.C. Skinner and L.C. Van Piper. 2012. Biological control of invasive plants in Minnesota. Available at: https://files.dnr.state.mn.us/natural_resources/invasives/biocontrolofplants.pdf. (Accessed May 2020).

Minnesota Department of Natural Resources (MNDNR). 2020. Purple loosestrife control: Biological. Available at: https://www.dnr.state.mn.us/invasives/aquaticplants/purpleloosestrife/biocontrol.html. (Accessed: May 2020).

Appendix N. MPRB Glyphosate Moratorium and City of Minneapolis Pesticide Ordinance (230)

MPRB OCTOBER 2018 – BOARD RESOLUTION #2018-303

Resolution Approving the Minneapolis Park and Recreation Board Establishing a Moratorium on the Use of Glyphosate in All Land and Water Resource Management Activities Starting January 1, 2019, and Creating a Technical and Community Advisory Committee to Recommend Alternatives to Glyphosate and Other Toxic Pesticides establishing a moratorium on the use of glyphosate.

CITY OF MINNEAPOLIS CODE OF ORDINANCES - CHAPTER 230. PESTICIDE CONTROL

230.10. Definitions. The following words and phrases when used herein shall have the meanings respectively ascribed to them in this section.

Lawn. Any yard, lawn, park golf course, athletic field, landscaped area containing grass, plants, trees or other vegetation, or other similar property whether privately or publicly owned.

Person. Any firm, corporation, business, governmental unit or agency thereof, or any educational institution of any kind whether public or private, and any employee thereof.

Pest. Any insect, rodent, nematode, fungus, weed, terrestrial or aquatic plant, animal life, or other organism declared to be a pest by the Minnesota Commission of Agriculture.

Pesticide. Any dry or liquid substance or mixture of substances available from any source whatever, including but not limited to wholesale or retail purchase by any person as defined by this section, intended to prevent , destroy, or repel any pest or intended for use as a plant regulator, defoliant of desiccant; or any chemical, mixture, or combination of chemicals registered or required to be registered as a pesticide with the U.S. Environmental Protection Agency, EPA, or successor in interest, the State of Minnesota Department of Agriculture, or any government agency of the State of Minnesota. (87-Or-078, § 1, 5-8-87)

230.20. Licensing. All persons and employees of a person engaged in the business of pesticide application shall be trained and qualified in the methods of handling and applying pesticides. All such persons and employees shall be licensed by the State of Minnesota pursuant to the applicable requirements of Minnesota Statute Chapter 18A and rules promulgated thereunder by the commissioner of agriculture, and further must comply with the applicable licensing requirements of Chapter 325 of this Code. All pesticides shall be applied pursuant to the applicable requirements of Minnesota Statute Chapter 18A and rules promulgated thereunder by the commissioner of agriculture. (87-Or-078, § 1, 5-8-87)

230.30. Warning flags required for pesticide application.

(a) All persons who apply pesticides outdoors are required to post or affix warning flags on the street frontage of the property so treated. Persons who apply pesticides in parks, golf courses, playgrounds, athletic fields or other similar property must, in addition, post or affix warning flags at or near the entrances to such property.

(b) Warning flags must project a minimum of eighteen (18) inches above the top of the grass line. The warning flags must be of a material rain-resistant for at least a forty-eight hour period and must remain in place forty-eight (48) hours from the time of initial application.

(c) The following information must be printed on the flag in contrasting colors in capitalized letter measuring at least one-half (1/2) inch, or in such other format as may be approved by the commissioner of health. The flag shall provide the following information:

(1) The name of the company applying the pesticide; if not applied by a company, the name of the person, firm, corporation, business, governmental unit or agency thereof, or educational institution.

(2) The date of application.

(3) The following language: “This lawn chemically treated. Keep children and pets off for forty-eight (48) hours,” or a universally accepted symbol approved by the commissioner of health which is recognized as having the same meaning or intent. In addition, the flag may include the name of the pesticide used.
(4) The flag shall be posted on the lawn or yard no closer than two (2) feet from the sidewalk or right-of-way and no further than five (5) feet from the sidewalk or right-of-way. In the case of parks, golf courses, playgrounds, athletic fields or other similar property, such warning flags shall also be posted immediately adjacent to areas within such property where pesticides have been applied. (87-Or-078, §, 1, 5-8-87)

230.40. Violation. A violation of this chapter is a misdemeanor. (87-Or-078, §, 1, 5-8-87)

230.50. Enforcement. This chapter shall be enforced jointly by agents of the health department and department of inspections pursuant to rules and administrative procedures for such enforcement promulgated under the authority of the city council. (87-Or-078, §, 1, 5-8-87)

230.60. Severability. If any provision of this chapter is held to be invalid, the remaining portions shall not be invalidated. (87-Or-078, §, 1, 5-8-87)

Appendix O. Generalized Professional Contractor Unit Costs for Ecological Services

Task	Plan Section	Unit	Unit Cost Range
Invasive/Aggressive Tree & Shrub Removal Tasks			
Tree removal (size, access, and disposal method influence cost)	6.7.3 & 6.7.4	each	$180-$600
Brushing (non-steep slopes; cut and stump treat)	6.7.4	acre	$1,500-$3,500
Brushing (steep slopes; cut and stump treat)	6.7.4	acre	$3,000-$6,000
Brushing (forestry mower)	6.7.4	acre	$800-$2,000
Brushing (goat browsing)	6.14.3	acre	$3,000-$4,000
Foliar spray young woody brush	6.7.4	acre	$200-400
Invasive/Aggressive Herbaceous Species Removal Tasks			
Broadcast herbicide	6.7.5	acre/trip	$175-300
Spot herbicide	6.7.5	acre/trip	$200-400
Mowing	6.14.2	acre/trip	$150-350
Prescribed burn (minimum 3 acres)	6.7.1 & 6.14.1	acre	$300-700
Tilling	6.8.2	acre	$150-350
Native Seeding & Planting Tasks			
Native seed (material only)	6.7.6	acre	$200-$1,100
Native seeding (no-till drill, labor only)	6.7.6	acre	$200-500
Native seeding (hand-broadcast, labor only)	6.7.6	acre	$300-600
Straw mulch (spread and crimp)	6.7.6	acre	$600-900
Installed live herbaceous plant plug	6.7.6	each	$3-7
Installed shrub (2-gallon pot)	6.7.7	each	$25-40
Installed shrub (5-gallon pot)	6.7.7	each	$50-75
Installed tree (10-gallon pot)	6.7.7	each	$150-250
Installed tree (2” ball & burlap)	6.7.7	each	$300-600

Appendix P. 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
  - 5.2.2. Goal 2

5.2.3. Goal 3

6. PARK MANAGEMENT UNITS
6.1. Management Unit 1
6.1.1. Description
6.1.2. Amenities
6.1.3. Plant Communities
6.1.4. Invasive Species
6.1.5. Wildlife
6.1.6. Water
6.1.7. Additional Management Recommendations
6.2. Management Unit 2

7. MONITORING AND REPORTING
7.1. Monitoring
7.2. Reporting

8. PRIORITIZATION, SCHEDULING AND COSTS
8.1. Prioritization
8.2. Initial Implementation Schedule and Costs

9. REFERENCES

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Appendix B. Wildlife Species Inventory (including invasives)
Appendix C. Acceptable Source Location for Native Species Seed