CITY OF MINNETONKA

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Natural Resources Master Plan

2021

City of Minnetonka
Natural Resources Master Plan

Restored native prairie in Tower Hill Park

Developed by

City of Minnetonka

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1 Introduction

The purpose of this plan is to set direction and priorities for Minnetonka's Natural Resources Division. To that end, the plan presents opportunities for ecosystem regeneration and capitalizes on the holistic benefits (ecological, societal, and economic) of improving and maintaining natural resources in the city. The plan addresses climate adaption and resilience, but not climate mitigation or reducing carbon footprint. It also addresses goals and strategies to protect and improve natural resources on public property, and ways to encourage such action on private property.

This plan focuses on aspects of natural resources management under the purview of the Natural Resources Division within Minnetonka City government. Issues such as environmental contamination, air quality, and public health are overseen by the Community Development's Environmental Health Division and not addressed in this document. Flooding, surface waters (lakes, wetlands, and streams), and stormwater management are addressed in the 2019 Water Resources Management Plan for Minnetonka. The 2021 Parks Open Space and Trail (POST) plan addresses park master planning, park classification, intensity of use, land acquisition and park amenities for City-owned property.

Minnetonka addresses natural resources protection and management through this plan, the POST plan, and the Water Resources Management Plan. Topics addressed include:

Protection & Management Topics	Natural Resources Master Plan	Parks, Open Space & Trail (POST) Plan	Water Resources Management Plan
Climate adaptation, resilience, sustainability	✔	✔	✔
Invasive species control	✔		✔
Ecological communities' restoration and maintenance planning	✔		
Community forest management and planning	✔		
Wildlife guidance	✔		
Stormwater infrastructure and flood management			✔
Stormwater Utility fees			✔
Lake, wetland, and groundwater protection (e.g. projects, ordinances, regulation)			✔
Individual park mater planning guidance		✔	
Park classifications		✔	
Open space acquisition		✔	
Recreational amenities		✔	
Determining park intensity of use		✔	
Education/outreach/engagement	✔	✔	✔

1.1 Goals and Objectives

There is broad community understanding that having healthy and high quality natural resources is essential to supporting a healthy and thriving community. This sentiment is expressed in the city's 2040 Comprehensive Plan, the council's Strategic Profile, the Parks, Open Space, and Trail Plan, and input received via the annual community survey. To that end, goals and objectives related to natural resources management and protection were identified for this plan to guide future priorities and allocation of resources for the Natural Resources Division and the city. The goals and objectives are:

A. Improve the quality of habitat in Minnetonka parks and open spaces, creating more resilient and sustainable ecological systems while providing multiple benefits to the community.

- Identify current conditions, prioritize areas, and describe restoration and management strategies, including required resources
- Identify and implement strategies to address known stressors that inhibit restoration and preservation of sustainable ecological systems, such as pests and disease, invasive species, herbivory, extreme storm events and climate change
- Promote habitat diversity, plant biodiversity, and healthy soil systems in natural areas to increase resilience and adaptation to Minnesota's changing climate
- Engage in collaborative partnerships with local organizations and groups to facilitate restoration of natural areas
- Monitor ecosystem health
- Revisit habitat quality assessments and prioritization of parks and other natural areas every five years as necessary to determine progress on meeting restoration goals, and realign resources where necessary

B. Manage and improve the community forest ecosystem on both public and private lands, including natural woodlands and the altered ecosystem of the traditional managed landscape.

- Implement strategies to increase species diversity, facilitate natural regeneration, reduce the impacts of pests and disease, and mitigate climate change
- Identify opportunities to increase tree canopy cover to mitigate the urban heat island effect
- Identify strategies to manage stormwater and soil in open spaces to adapt to changing precipitation patterns and increasing storm intensities
- Promote tree species diversification in lawns and other managed spaces
- Promote the regeneration of the entire community forest structure including soils, ground plain herbaceous vegetation, shrubs, midstory, and tree canopy

C. Engage the public to support ecological restoration and management on public property, and promote voluntary application of practices on private property.

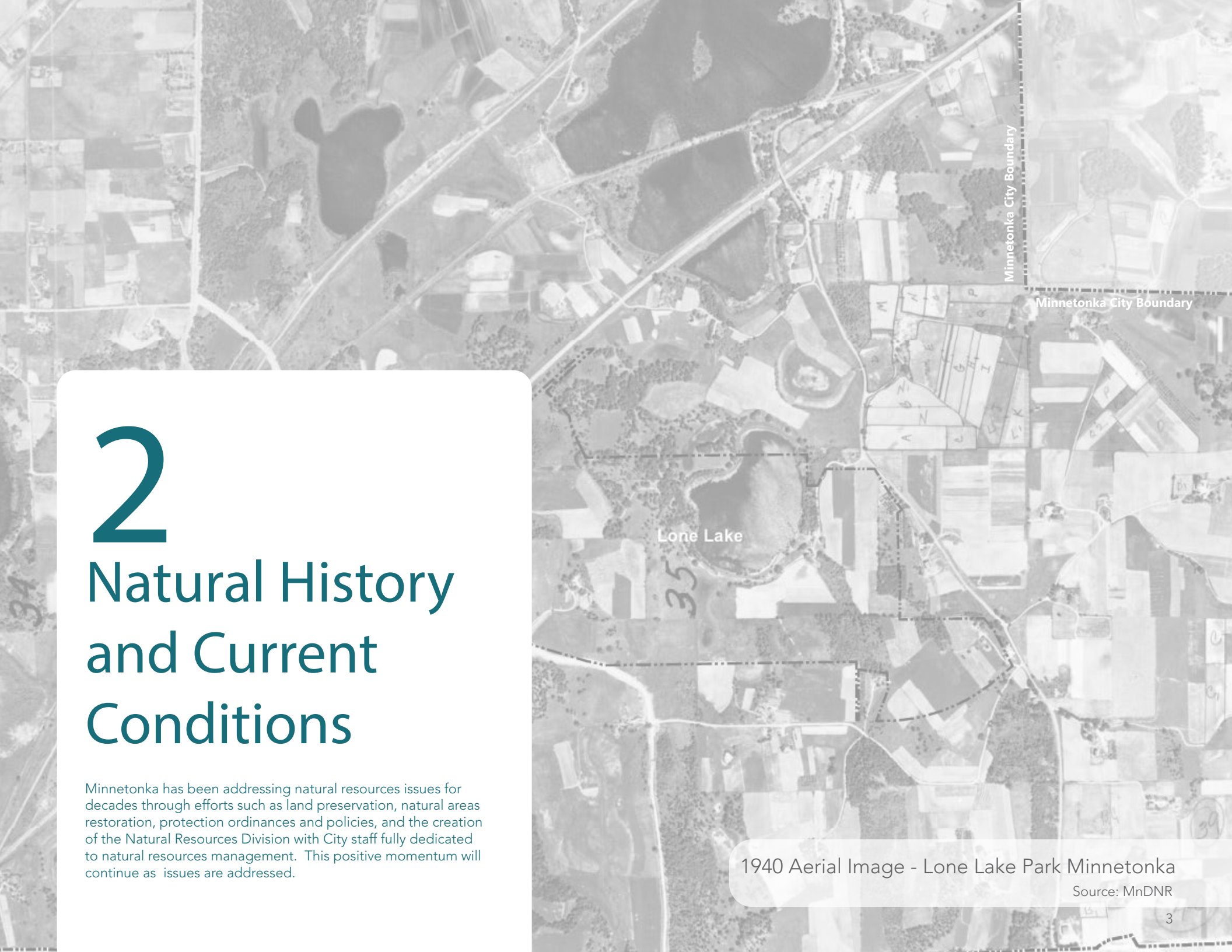
- Through education and outreach, increase Minnetonka residents' knowledge and understanding of natural resource management principles, practices, and benefits to the community
- Engage citizens and community-based organizations in habitat restoration and management activities on public property through volunteerism
- Implement programs that facilitate citizen involvement in habitat restoration and management on private property, including workshops, trainings, technical assistance, and incentives

Jidana Park - Minnetonka, Minnesota

2

Natural History and Current Conditions

Minnetonka has been addressing natural resources issues for decades through efforts such as land preservation, natural areas restoration, protection ordinances and policies, and the creation of the Natural Resources Division with City staff fully dedicated to natural resources management. This positive momentum will continue as issues are addressed.



1940 Aerial Image - Lone Lake Park Minnetonka

Source: MnDNR

2.1 Historic Ecological Communities

This map was developed from the original 1846–1848 land survey of Minnesota. It depicts ecological communities encountered by surveyors at that time. Note that oak openings were the dominant ecological community. Minnetonka was not forested as it is today.

Oak openings, also referred to as oak savanna and oak barrens, are described as grasslands having from one tree per acre to 50-percent tree canopy cover. The ground layer receives sun and shade, which permits growth of diverse grasses and flowering plants. Usually, enough sun reaches the ground to permit the growth of typical prairie species, such as big and little bluestem grasses and many wildflowers.

Understanding the historic ecological communities of the region is helpful in planning for climate change. Oak savanna was present just prior to Euro-American settlement. It could have a greater role in future Minnetonka natural areas.

Oak savanna was present and extremely common in the area we now call Minnetonka prior to Euro-American settlement.

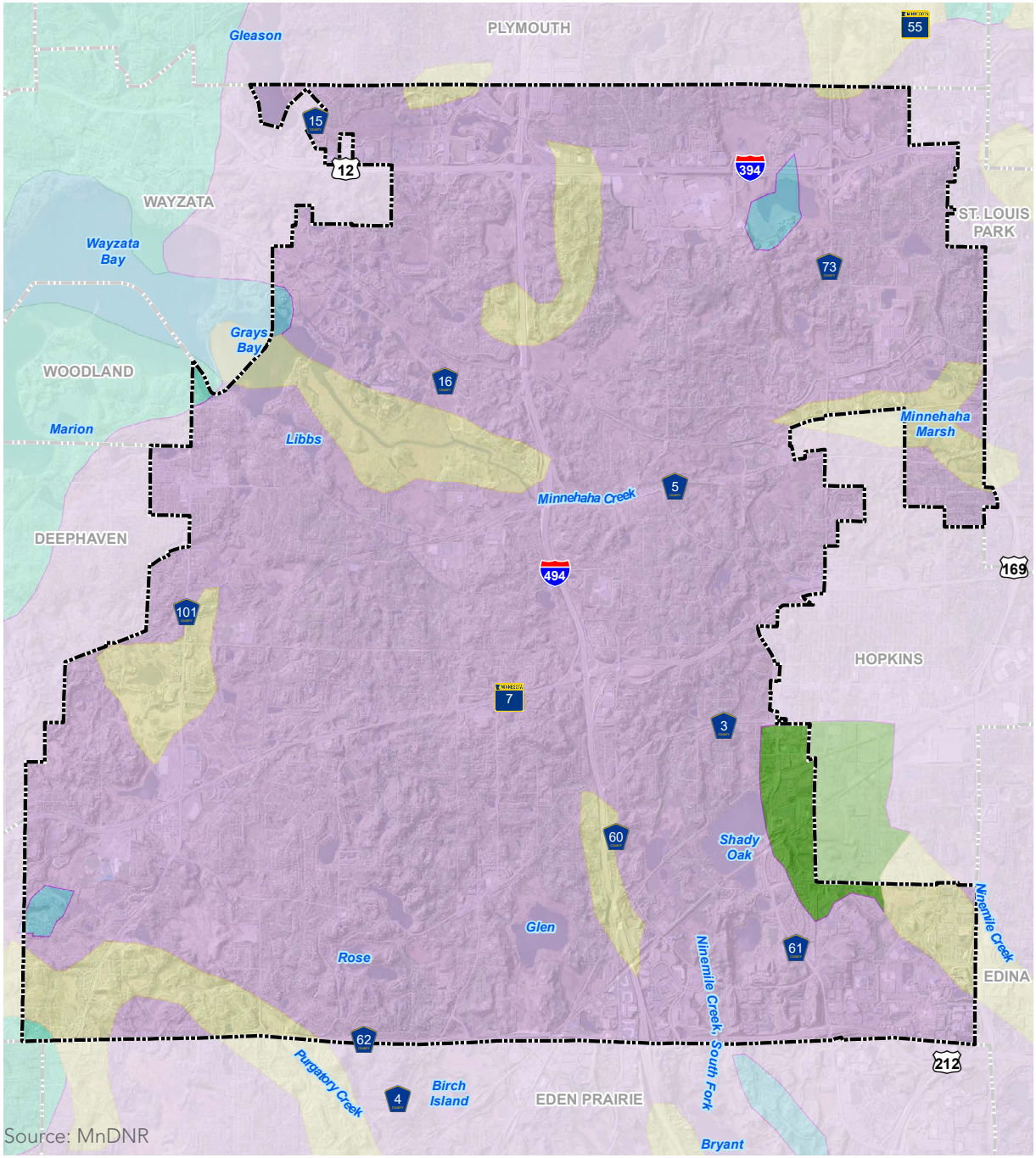


Figure 2.1 - Marschner Presettlement Vegetation Types (1846-1848)

Key

- Wet Prairie
- Oak Savanna
- Big Woods/Hardwoods (Oak, Maple, Basswood, Hickory)
- Conifer Bogs & Swamps
- Lakes (Open Water)
- Minnetonka City Boundary
- Other Municipal Boundary

N

0 2,250 4,500
Feet

2.2 Current Conditions

Figure 2.2 depicts present-day publicly owned natural areas in proximity to Minnetonka Boulevard. Only intentionally preserved landscapes reflect our natural heritage. It is important to preserve remaining natural areas and old-growth trees as places to learn about the natural landscape. Building from these landscapes we can further restore the urban fabric to enhance ecological quality and improve our quality of life.

The 1940 aerial photograph shows the agricultural landscape of the time. Open fields are visible as well as areas of scattered trees. These areas were often grazed. By this time agriculture had significantly impacted native plant communities.

The 2020 aerial photograph shows the current suburban landscape in the areas around Big Willow Park. Note the density of urban forest, which has greatly expanded since the end of agriculture.

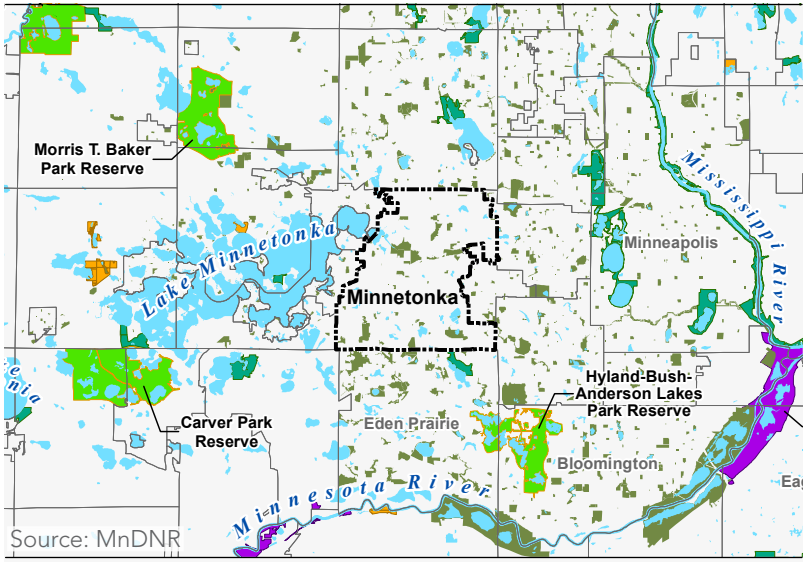


Figure 2.2 - Regional Natural Areas in Proximity to Minnetonka

Park Reserve
Regional Park
Special Recreation Area
Wildlife Refuge
Municipal Park
State Park
Minnetonka City Boundary
Municipal Boundary
N
0 3 6
Miles

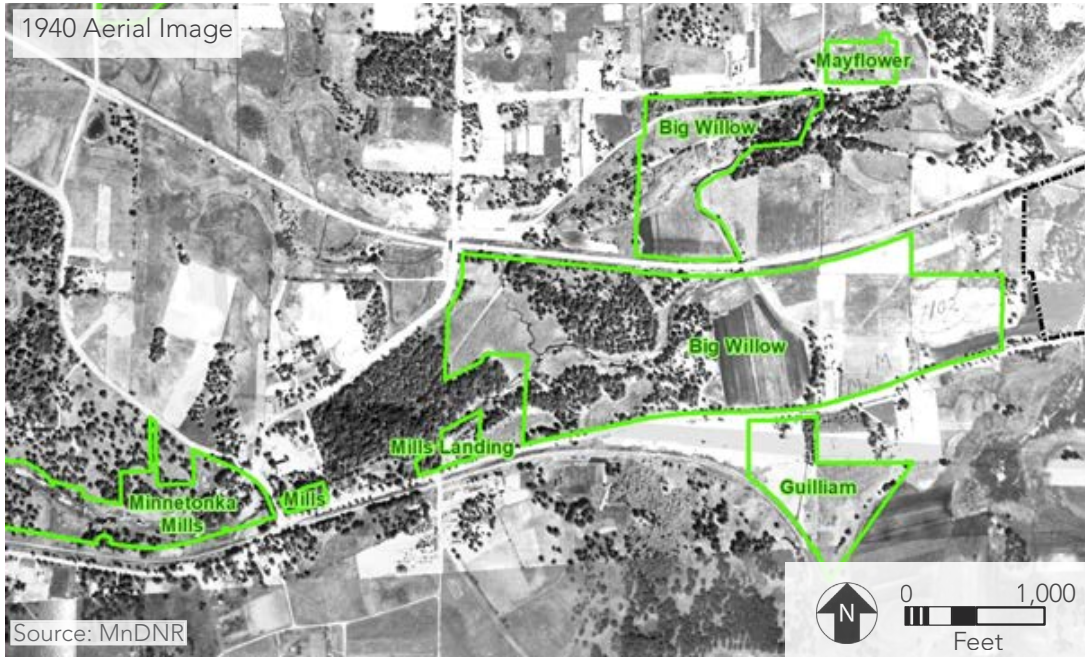


Figure 2.3 - Land Use Change

Minnetonka Park Boundary

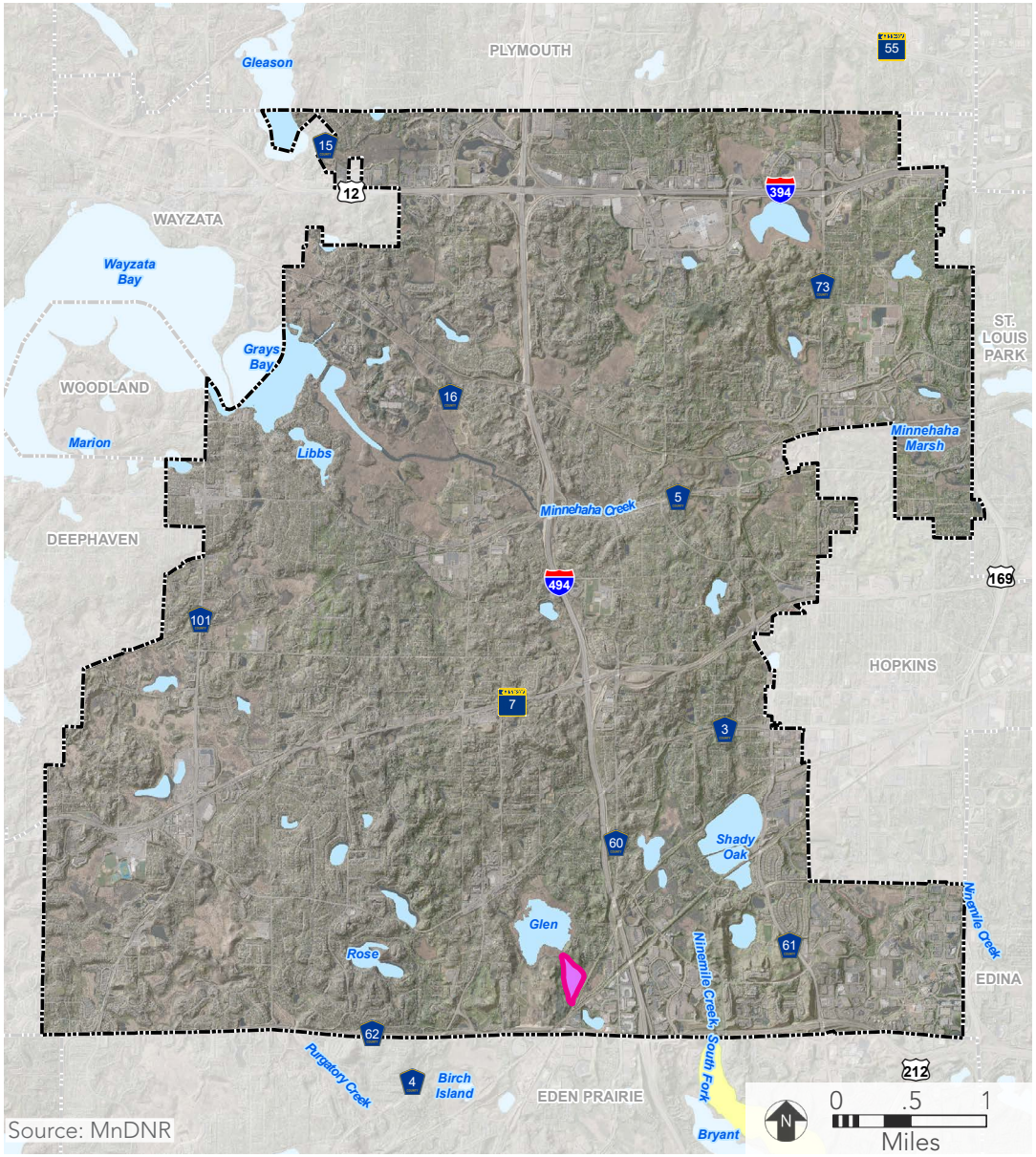


Figure 2.4 - Sites of Biodiversity Significance

Moderate Biodiversity Significance
Below Minimum Biodiversity Significance Threshold
Lakes, Ponds, and Rivers
Minnetonka City Boundary

Sites of Biodiversity Significance is a designation given by ecologists to rank biodiversity significance throughout the state of Minnesota. Assessment rankings are used to identify areas of native biological diversity significance to guide conservation and management practices. (Source: MnDNR)

Sites of Biodiversity Significance designations:

Outstanding - sites contain the best occurrences of the rarest species, the most outstanding examples of the rarest native plant communities, and/or the largest, most ecologically intact or functional landscapes.

High - sites contain very good quality occurrences of the rarest species, high-quality examples of rare native plant communities, and/or important functional landscapes.

Moderate - sites contain occurrences of rare species, moderately disturbed native plant communities, and/or landscapes that have strong potential for recovery of native plant communities and characteristic ecological processes.

Below - sites lack occurrences of rare species and natural features or do not meet MBS standards for outstanding, high, or moderate rank. These sites may include areas of conservation value at the local level, such as habitat for native plants and animals, corridors for animal movement, buffers surrounding higher-quality natural areas, areas with high potential for restoration of native habitat, or open space.

As depicted in this map, like other suburban communities, Minnetonka has only one site of biodiversity significance. This is the case because of land development since European settlement. First through the process of establishing agriculture and then urbanization, people have greatly altered Minnetonka, eliminating plant and animal species and degrading habitats. This has occurred throughout Minnesota and the United States. Minnetonka is now at a point of understanding how this effects our quality of life. We may choose to restore some of the original biodiversity, that requires consistent funding. It must be understood that continual management is necessary to restore biodiversity because of consistent degrading forces – from invasive species, to over browsing, to soil alterations, to climate change.

This document sets a framework for restoring biodiversity in Minnetonka. The success of this effort is up to the citizens of Minnetonka to support City leadership in directing financial resources to natural resources management.

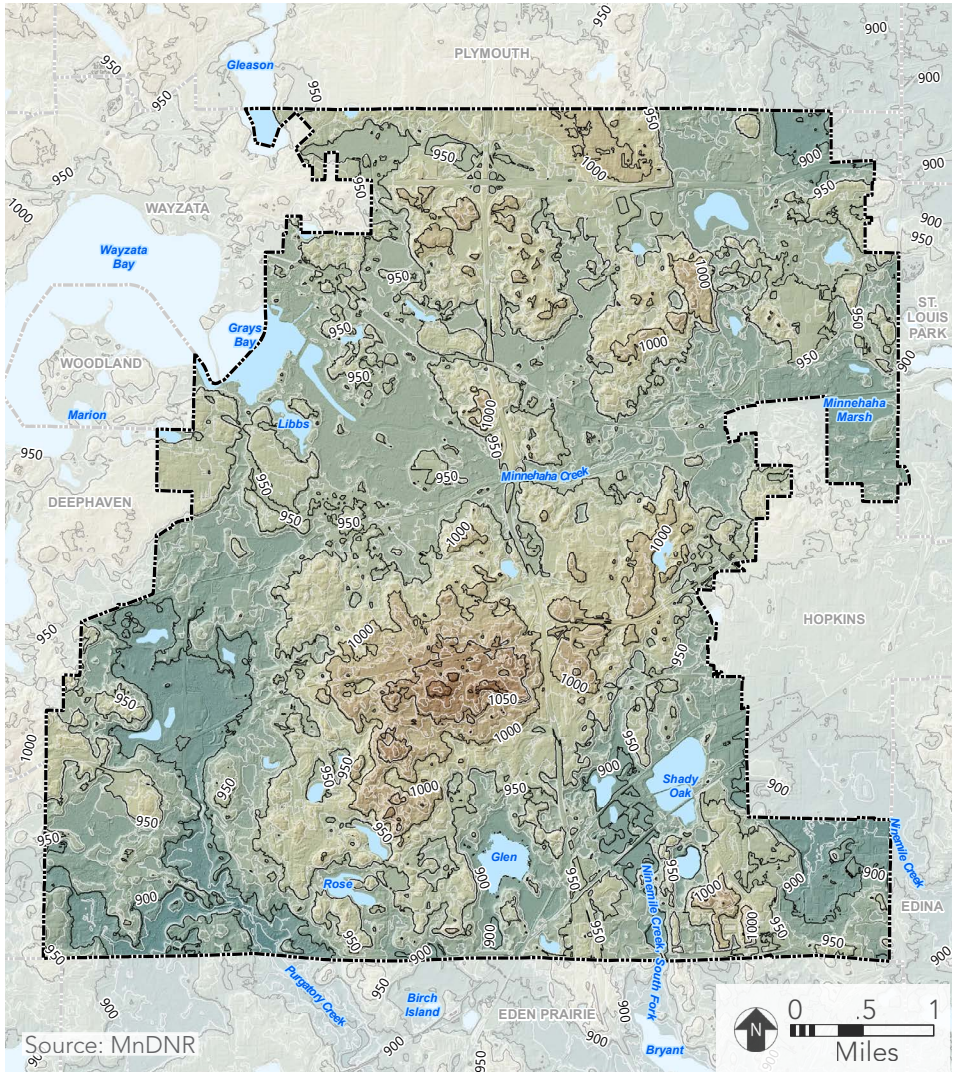


Figure 2.5 - Topography

- 50-ft Contours
- 20-ft Contours
- Lakes, Ponds, & Rivers
- High: 1130
- Low: 830
- Minnetonka City Boundary
- Municipal Boundary

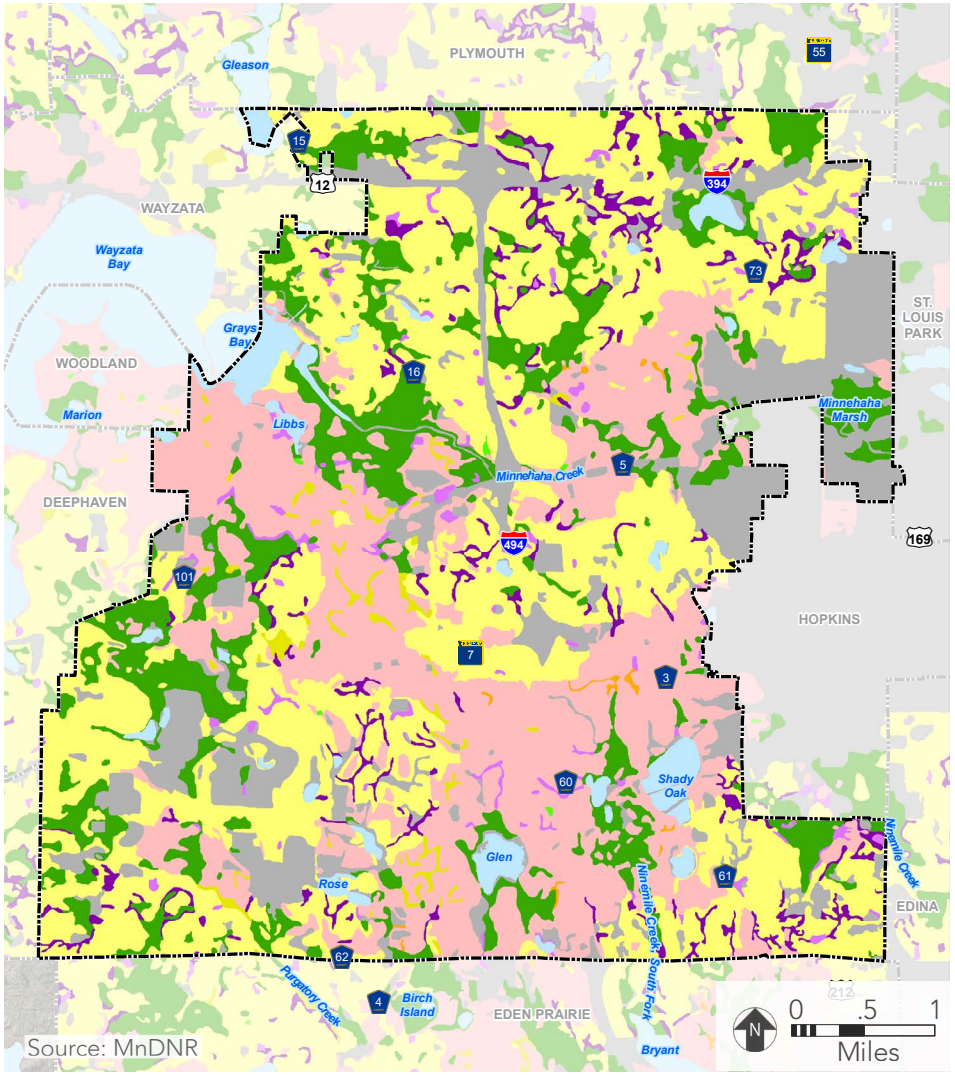


Figure 2.6 - USCS Soil Texture USCS (Unified Soil Classification System)

- CL (clay of low plasticity, lean clay)
- CL-ML (clay of low plasticity, lean clay-silt)
- MH (silt of high plasticity, elastic silt)
- ML (silt)
- OH (organic clay, organic silt)
- PT (peat)
- SM (silty sand)
- Not rated or not available
- Lakes, Ponds, & Rivers
- Minnetonka City Boundary
- Municipal Boundary

Topography and Soil Texture

These maps illustrate broad patterns of soil moisture and drainage. Areas that are high and dry contrast with low, wet areas of Minnetonka. Generally, silty and sandy soils are well drained, whereas soils containing clay hold water longer. Differing soil types and moisture levels support differing ecological communities.

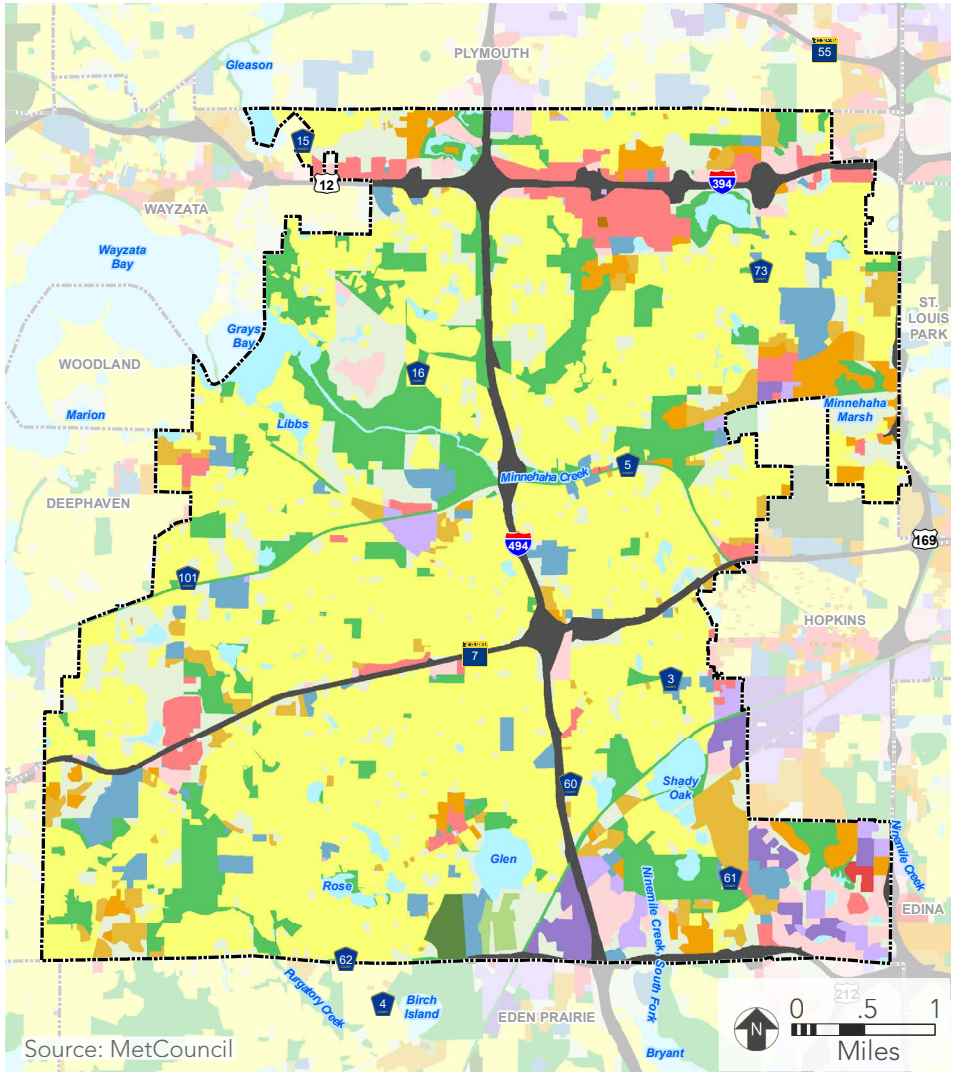


Figure 2.7 - Land Use (2016)

- Seasonal/Vacation
- Single Family Detached
- Manufactured Housing Park
- Single Family Attached
- Multifamily
- Retail & Other Commercial
- Office
- Mixed Use Residential
- Mixed Use Industrial
- Mixed Use Commercial
- Industrial & Utility
- Institutional
- Park, Recreational or Preserve
- Golf Course
- Major Highway
- Railway
- Agricultural
- Undeveloped
- Water

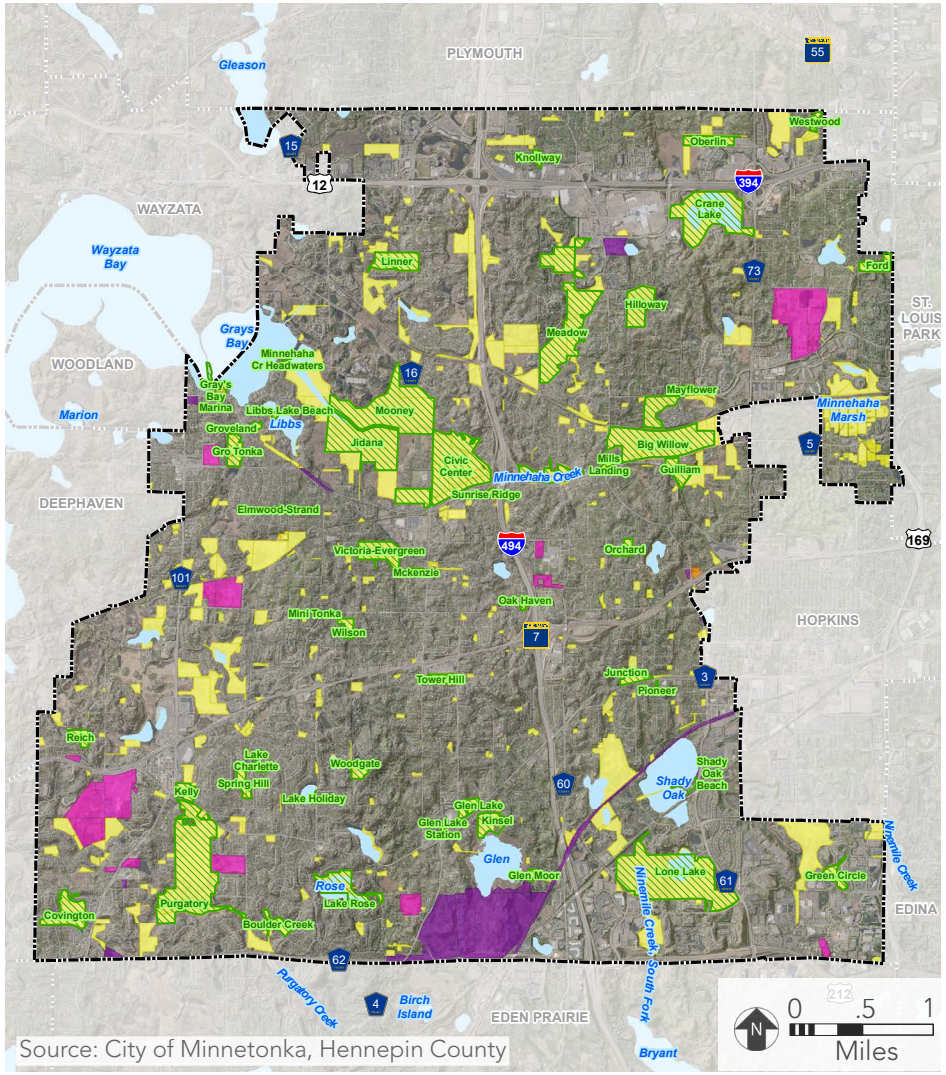


Figure 2.8 - Land Ownership

- City-Owned Parcel
- County-Owned Parcel
- School District-Owned Parcel
- Minnetonka Park
- Lakes, Ponds, & Rivers
- Minnetonka City Boundary
- Municipal Boundary

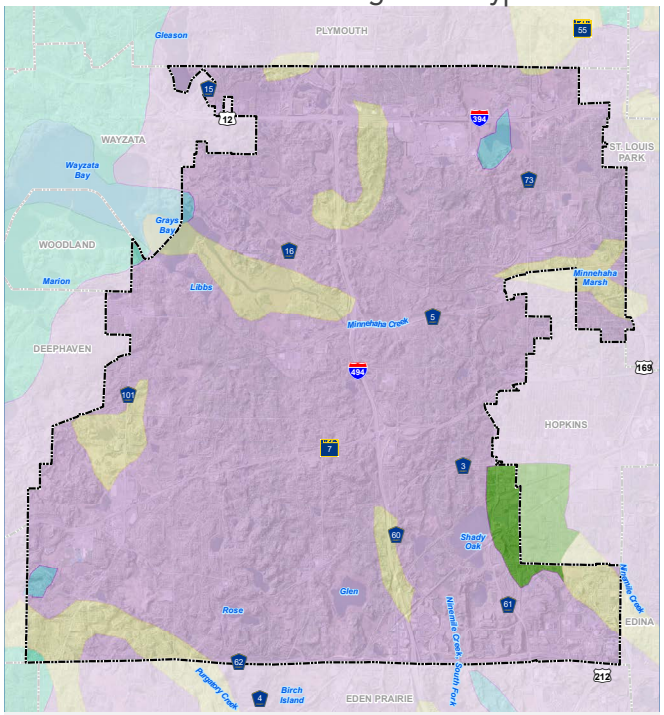
Land Use (2016) and Land Ownership

A majority of Minnetonka's land use is residential. Intensive commercial development exists along the I-394 corridor and in the southeast corner of the city. These land-use patterns present two opportunities for natural resources development: 1) to work with residential landowners to promote ecological improvement and 2) to further implement stormwater management facilities and expand the tree canopy in areas of intensive commercial development.

Impervious Surface with Natural Water Bodies

The hydrology of Minnetonka has changed since the time of European settlement through suburban development and the construction of impervious surfaces. Today, nearly 28% of landcover in Minnetoka is impervious surface (Figure 2.9). The wet prairies identified on Figure 2.1 have, over time, received greater stormwater runoff - converting them to permanent wetlands holding larger volumes of water. Today, Minnetonka's wetland plant communities are degraded and invasive species of narrowleaf cattail and reed canary grass have greatly reduced biodiversity.

Manrschner Presettlement Vegetation Types



'Manrschner Presettlement Vegetation Types

Wet Prairie

Oak Openings and Barrens

Impervious Surface & Natural Water Bodies

Impervious Surface

Wetland

Lake, Pond, River

Minnetonka City Boundary

Municipal Boundary

N

0 .5 1

Miles

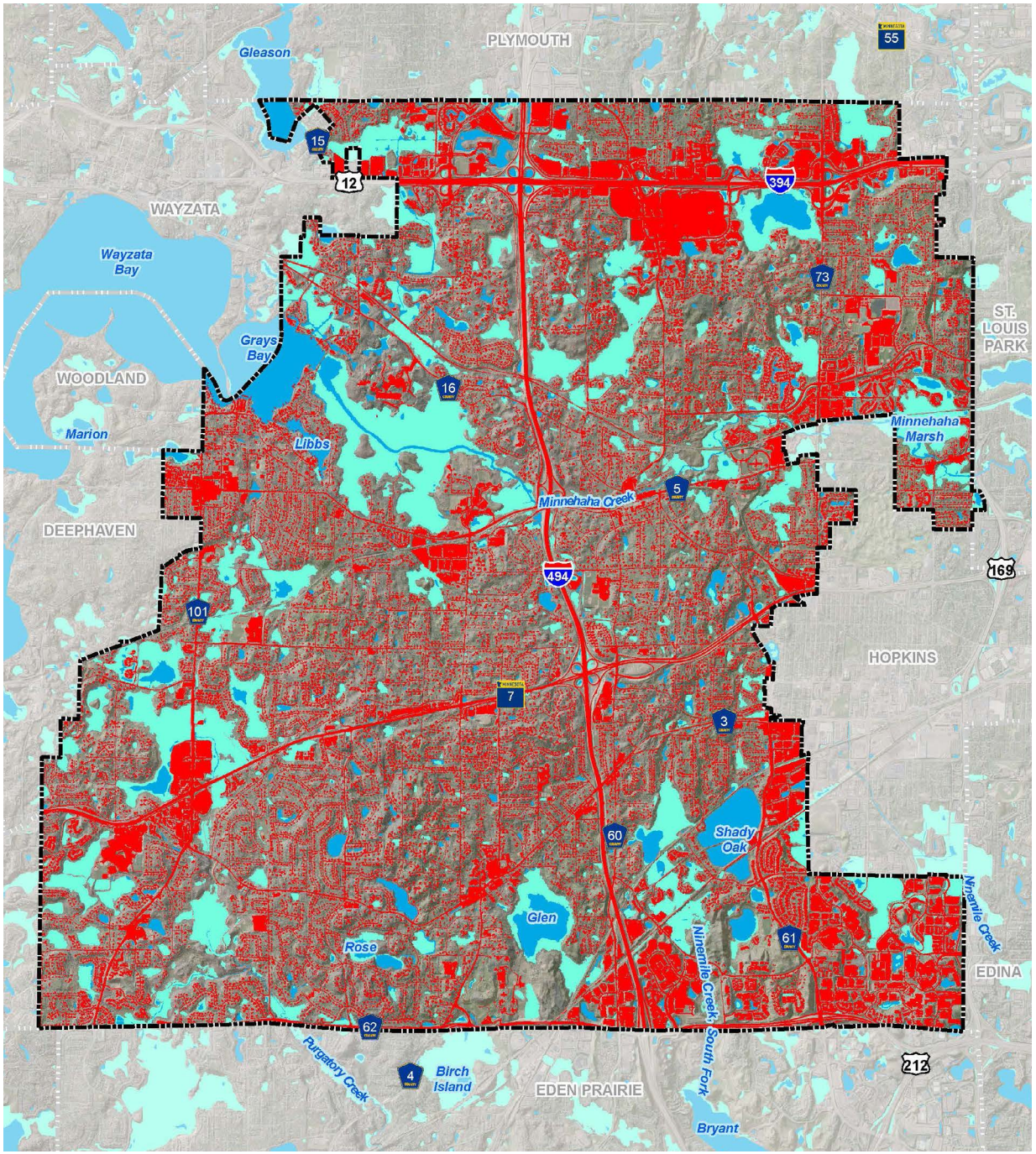


Figure 2.9 - Impervious Surface with Natural Water Bodies

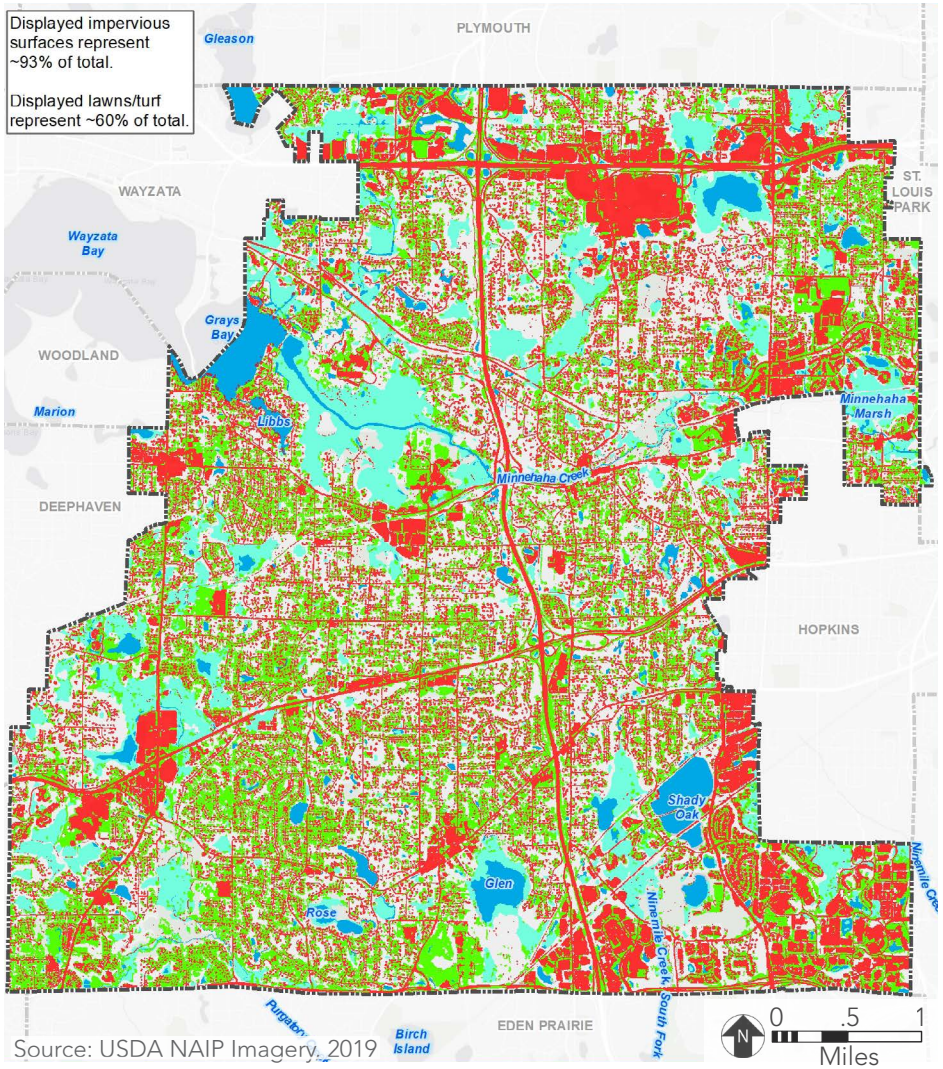


Figure 2.10 - Land Cover: Impervious, Turf, & Wetlands/Water

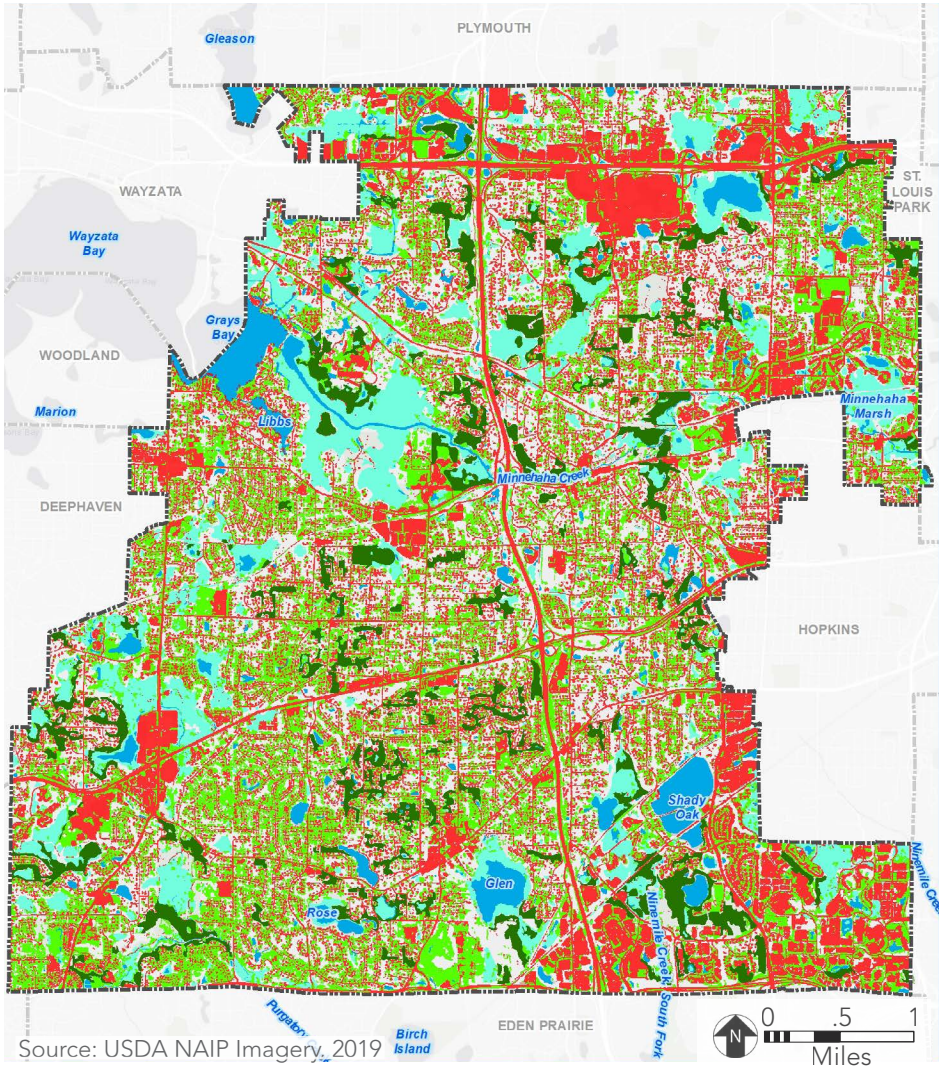


Figure 2.11 - Land Cover: Impervious, Turf, Woodlands, & Wetlands/Water

Impervious
Lawn/Turf
Wetland
Lake, Pond, River
Minnetonka City Boundary
Municipal Boundary

Impervious
Woodlands
Lawn/Turf
Wetland
Lake, Pond, River
Minnetonka City Boundary
Municipal Boundary

Land Cover (Impervious, Lawns/Turf, and Natural Water Bodies)

These maps were developed from aerial imagery. The extent of lawn and impervious surface is underestimated because trees extend over houses, streets, driveways, and lawns obscuring land cover beneath. It is thought that lawn is underestimated by as much as 30% (confirmed through small-area ground truthing) and impervious surface is underestimated by approximately 10%.

Figure 2.10 shows the extent of lawn in comparison to natural woodlands. See Figure 2.12 for the extend of the entire urban forest. Although Minnetonka has a significant urban forest, most trees do not exist within a naturally reproducing woodland ecosystem. Most trees in lawns do not naturally reproduce but are intentionally planted. This has huge implications for Minnetonka's future forest.

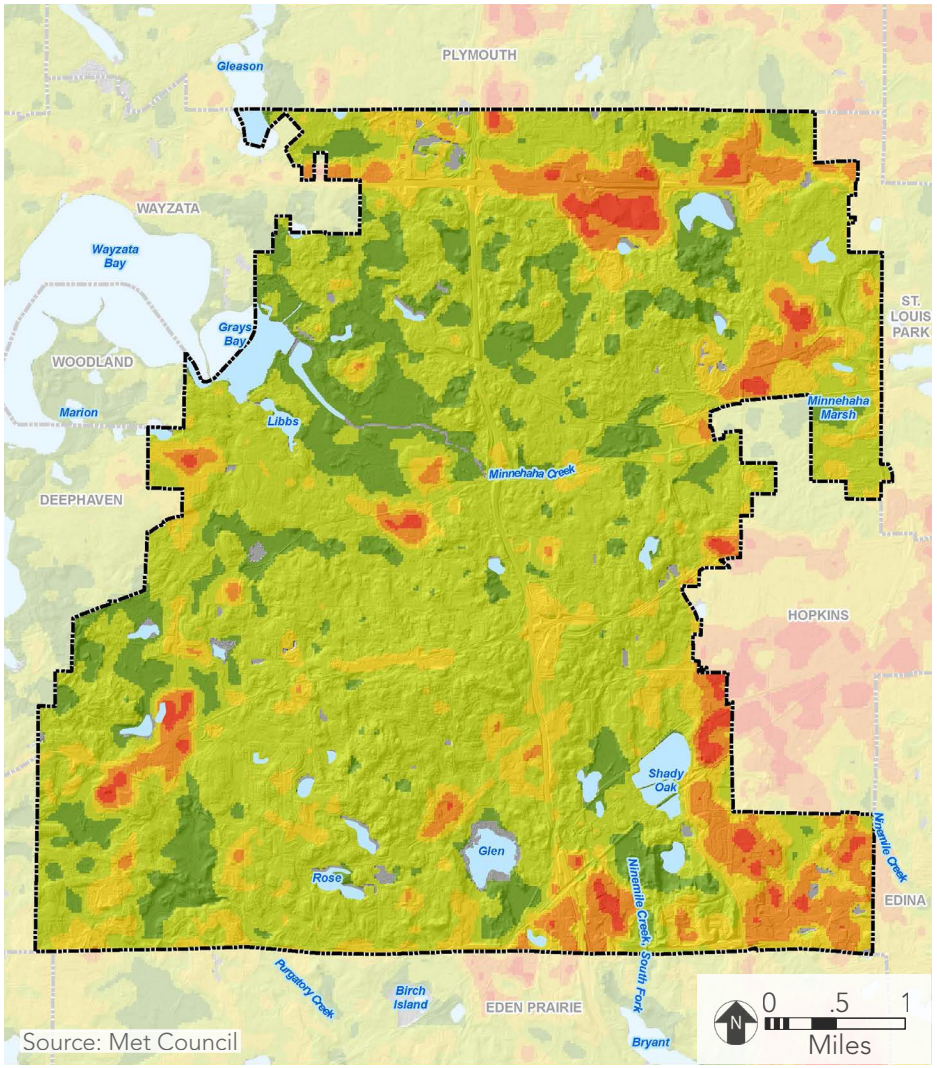


Figure 2.12 - Heat Island

> 100 °
95 -100 °
90-95 °
85-90 °
80-85 °
<80 °
Lakes, Ponds, & Rivers
Minnetonka City Boundary
Municipal Boundary

*Land Surface Temperature satellite image taken at noon on July 22, 2016. Air temperature at MSP was 90 ° F.

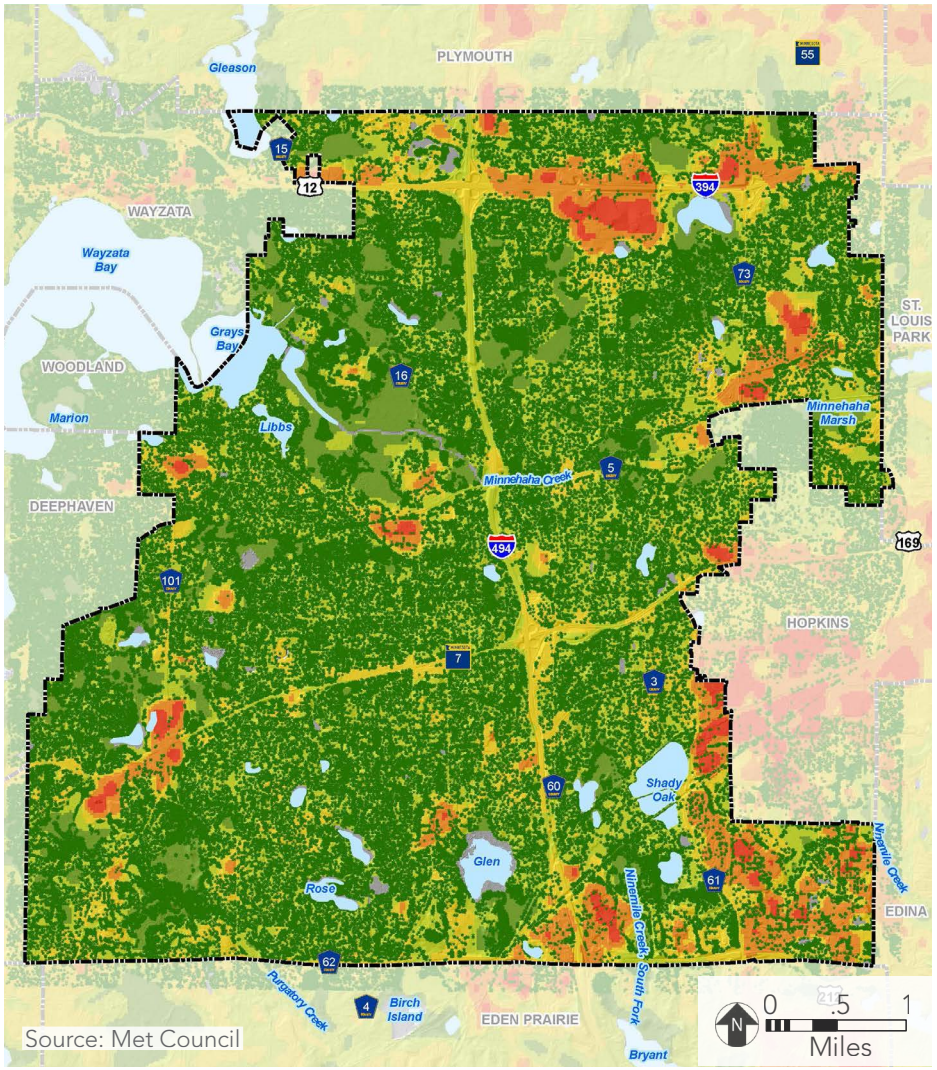


Figure 2.13- Heat Island & Tree Canopy

> 100 °
95 -100 °
90-95 °
85-90 °
80-85 °
<80 °
Lakes, Ponds, & Rivers
Minnetonka City Boundary
Municipal Boundary

*Land Surface Temperature satellite image taken at noon on July 22, 2016. Air temperature at MSP was 90 ° F.

Heat Island and Tree Canopy

These heat island maps were developed by the Metropolitan Council by recording and mapping land surface temperatures at a single point in time (July 22, 2016, 12pm) when the air temperature was 90 degrees. Red and orange areas depict greater heat accumulation. Higher surface temperatures correlate with greater impervious surface due to the capacity of hard surfaces to accumulate heat and the lack of trees. This can be mitigated by reducing impervious surfaces and by shading hard surfaces with trees. The payoff is reduced air conditioning, lower energy bills, less energy generation, and increased human comfort.

2.3 Natural Resources Inventory & Assessment of City Owned Property

Plant Community Inventory

In 2020, natural resources investigations were conducted as part of this planning process. The goals of the assessment were to review the existing land cover classification data, assess ecological quality, and inspect for other environmental issues such as erosion, soil degradation and invasive species.

Fist, all City owned natural areas were identified and assessed through desktop analysis. Analysis consisted of reviewing GIS data related to land cover type, habitat quality, hydrology, soil type, topography, and historical vegetation. Specific data reviewed included but was not limited to the 2003 Minnesota Land Cover Classification (MLCCS) survey, the National Wetlands Inventory, the Soil Survey Geographic Database (SSURGO), and the DNR's Natural Heritage Information System (NHIS).

Following the desktop analysis, field investigations were conducted by professional landscape architects who observed all the City-owned natural areas. While in the field, notes, photographs, and plant community boundaries were recorded on tablet computers using GIS mapping software. Investigators recorded information related to plant community type, species observed, percent of species cover, plant community quality, and environmental issues. During field checking, the MLCCS methodology, Version 5.4, and Minnetonka Ecological Communities Quality Ranking Description (Table 2.1) was utilized to classify existing land cover and determine habitat quality. The results of the field investigations were then compiled, analyzed, and mapped.

Table 2.1 - Ecological Communities Quality Ranking Description

Quality Ranking	Priority	Ground Plane Species Diversity
A	Preserve and Restore	Remnant natural communities of high ecological value with unique or rare species compared to other Minnetonka and metro area parks. Minnesota Land Cover Classification System (MLCCS) designation or City-purchased land for the purpose of preservation based on MLCCS recommendations.
	Continue Restoration	Remnant natural communities with species richness and/or abundance, with minimal signs of disturbance or have recovered since the time of Euro-American settlement and subsequent superficial disturbances; with natural contours, without grading or topsoil removal and still clearly recognizable as native plant communities as identified in MLCCS. Invasive species composition is lower (5-40%) due to restoration management.
B	Restore with Conditions	Natural communities or potential green corridors with variable diversity and variable signs of disturbance or past use (such as grading, soil removal, fill) and/or invasive plants, which may be priority for restoration. Continue restoration if reasonable long-term invasive species control measures are effective.
C	Lower Priority Restoration	Natural communities that may have been disturbed through actions such as clearing, fragmentation, grading, soil removal, dumping and/or the shrub and/or groundcover layers are dominated by invasive species (>50%). These communities generally have a low diversity of native plant species, although a native tree canopy may be intact. These communities are restorable, but a considerable effort and cost is required to restore and maintain native plant diversity.

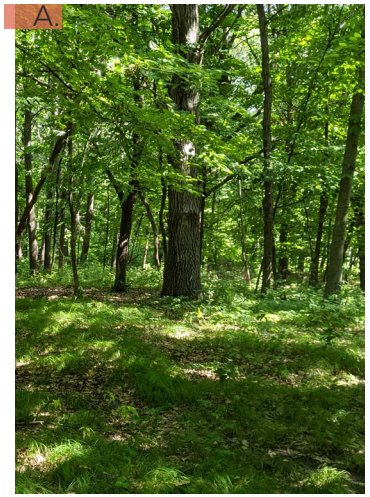
* Disturbance within Minnetonka historically may have occurred through partial logging, clear cutting, plowing to create agricultural fields, or livestock grazing among other forms of disturbance.

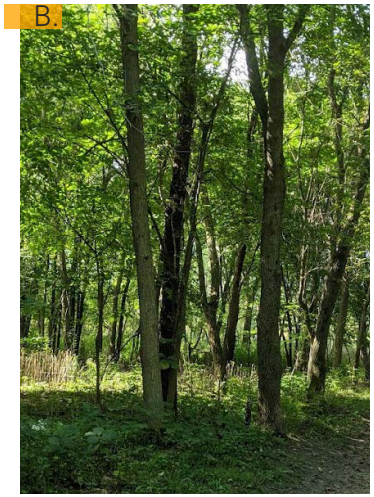
Minnetonka Ecological Communities Quality Ranking Inventory Examples

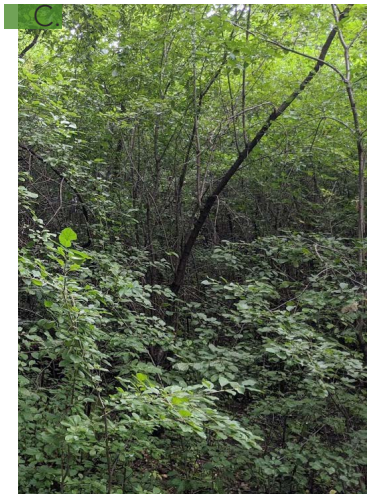
A. Jidana Park's remnant native woodland contains a valuable stand of oaks, hickory, ironwood, and other hardwood trees. The ground plane is mostly Pennsylvania sedge and contains little to no invasive species.

B. Ongoing buckthorn management has been occurring within Purgatory Park's woodland areas. Removing buckthorn allows for more sunlight and less competition for resources. This benefits tough and deer-resistant native woodland species. Bare soils, resprouting buckthorn and garlic mustard will be issues without ongoing management.

C. Previous land disturbance that occurred throughout Minnetonka has resulted in woodland understories dominated by buckthorn. These low-diversity woodlands provide very little forage and poor habitat for wildlife.







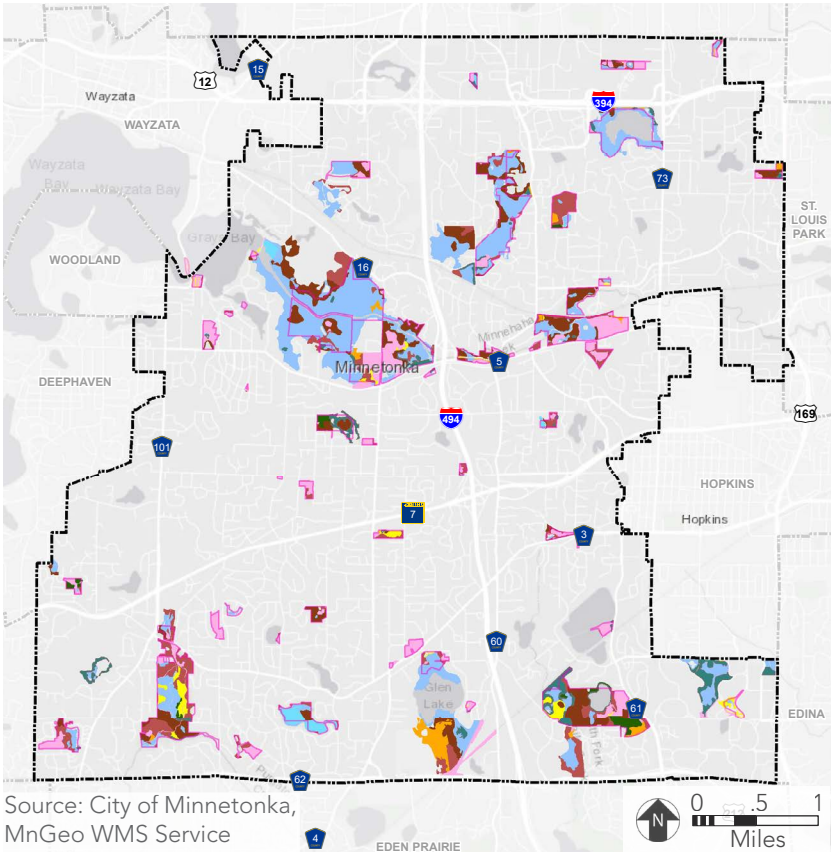


Figure 2.14 - Existing Plant Communities

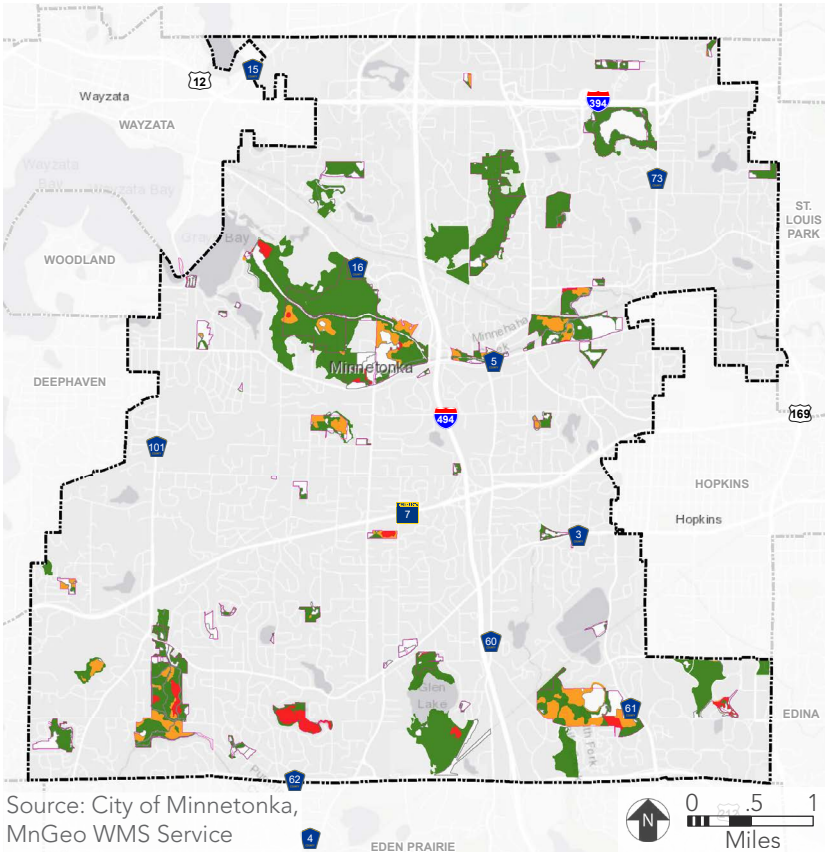


Figure 2.15 - Existing Plant Ecological Quality

- Altered/Non-Native Forest
- Cultural
- Deciduous Forest
- Floodplain Forest
- Grassland - Native
- Grassland - Non-Native
- Oak Forest
- Wetland - Native
- Wetland - Non-Native
- Minnetonka City Boundary
- Municipal Boundary
- Minnetonka Park

- A
- B
- C
- NA (Cultural & Open Water)
- Minnetonka City Boundary
- Municipal Boundary
- Minnetonka Park

Existing Plant Communities and Ecological Quality

A 2020 inventory of native plant communities and a ranking of the ecological quality of those communities on City of Minnetonka land is depicted here. Ecological quality rankings are defined as follows:

A. Natural communities of high ecological quality. Human disturbance and invasive species are limited (invasive species <5%). Habitat structure is intact and native plant species diversity is high, but some areas may have slightly limited diversity. These communities should be protected, and disturbance should be minimized or undertaken with extreme care. Monitor these areas for invasive species and control as they establish.

B. Natural communities that show signs of disturbance since the time of Euro-American settlement but are still clearly recognizable as native plant communities. Invasive species encroachment is somewhat low (5–50%). These areas could be enhanced, or at least be managed to avoid further damage. Native plant community restoration is highly feasible.

C. Natural communities that have been disturbed through actions in the past, such as such as clearing or grazing. The shrub and/or groundcover layers are dominated by invasive species (>50%). These communities generally have a low diversity of native plant species, although a native tree canopy may be intact. These communities are restorable, but a greater effort is required.

2.4 Wildlife

Current Status of Wildlife in Minnetonka

While no official survey data was used to determine the current status of wildlife in Minnetonka, it is assumed that wildlife populations are similar to those of typical urban, developed landscapes, and that restoring habitat will attract those wildlife species that depend on it for survival. Wildlife often found within the Minnesota River Valley and nearby urban areas include residential and migratory birds (Canada goose, mallard, blue-winged teal, etc.), reptiles (common garter snake, red-eared slider, snapping turtle, etc.), mammals (white-tailed deer, coyote, raccoon, opossum, bats, etc.), and amphibians (salamanders, frogs, and toads). These species are often generalists that can adapt to densely populated human areas with fragmented habitats.

The Minnesota Department of Natural Resource (MnDNR) National Heritage Information System (NHIS) database identified four threatened or endangered species within Minnetonka: the rusty patched bumble bee, eastern spotted skunk, red-shouldered hawk, and the Blanding's turtle. The United States Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) tool is used for project planning by streamlining the environmental review process. The tool identifies listed species found within the county of a proposed project; therefore, the species are found within Hennepin County and may be found in Minnetonka as well. Three terrestrial species were identified by the IPaC tool: the northern long-eared bat (threatened), monarch butterfly (candidate for listing), and rusty-patched bumble bee (federally endangered).The USFWS classified land south of Minnetonka Boulevard as high potential zones where rusty-patched bumble bees are likely present, and low potential zones to the north.

Publicly sourced data, through eBird, were analyzed to identify areas with a high density of bird species. Six scattered hotspots, ranging from 29 to 89 species, were found along Interstate 494 and Minnetonka Boulevard. Locations with the highest bird diversity were Purgatory Park, Lone Lake Park, and Big Willow Park—with counts ranging from 100 to 133 different species. Minnetonka is within the Mississippi Flyway, used by 325 different bird species. Approximately 40% of shorebirds and waterfowl in North America (Three Rivers Park District 2020) and nearly 50% of the bird species in North America spend part of their lives in the flyway (National Audubon Society). The birds use Minnetonka waterbodies, from shallow marsh wetlands to open water lakes. Invasive aquatic vegetation, like hybrid cattails and purple loosestrife, reduce available habitat for water birds by choking out wetlands.

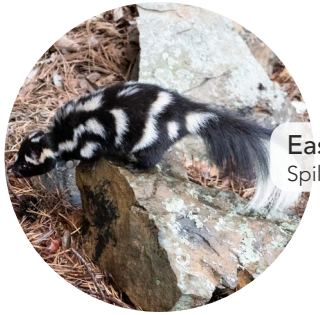
Data from iNaturalist, a publicly sourced database, and City survey efforts related to the rusty patched bumble bee includes 1,741 species observations since January 1, 2020. These observations identified 576 species in Minnetonka, and are comprised of the following:

- Birds – 230 observations of 65 different species, including wild turkeys, house finches, northern cardinals, and American robins.
- Amphibians – 85 observations of nine different species, including the American toad, tiger salamander, and northern leopard frog
- Reptiles – 41 observations of six different species, including the common garter snake, painted turtle, and common snapping turtle
- Mammals – 67 observations of 17 different species, including raccoon, white-tailed deer, eastern gray squirrel, and eastern chipmunk
- Insects and arachnids – 3,488 observations of 479 different species, including various bee, butterfly, and beetle species

Minnesota Department of Natural Resources

Threatened or Endangered Species

Rusty Patched Bumble Bee
Bombus affinis



Eastern Spotted Skunk
Spilogale putorius

Red-shouldered Hawk
Buteo lineatus

Blanding's Turtle
Emydoidea blandingii

Image Sources: All images are from USFWS - fws.gov
Rusty-patched bumblebee -USFWS (Midwest Region)
Eastern spotted skunk - Grayson Smith/USFWS
Red-shouldered hawk - Lamar Gore/USFWS (Northeast Region)
Blanding's Turtle - Courtney Celley/USFWS

The iNaturalist data also identified multiple species found in the NHIS and IPaC databases: 10 observations of the rusty-patched bumble bee, 13 observations of the monarch butterfly, and one observation a red-shouldered hawk. Considerations should be made before utilizing this data for management strategies because the data was not professionally obtained, which may lead to misidentification, favoritism for desirable species, and lack of data on elusive species.

Pollinators and other beneficial insects have been an area of concern; threats to these species are primarily due to loss of habitat and habitat fragmentation. Native prairies and oak savannas, once full of rich nectar and pollen-producing plants, have been replaced with buildings, pavement, and lawns. In the current residential landscape manicured lawns, often consisting of turfgrasses, have replaced native plants that support pollinators. Minnetonka's natural areas help support pollinator populations, but habitat fragmentation limits the resources required to support an abundance of these species. Since Minnetonka is located within high and low potential zones for the rusty-patched bumble bee, additional considerations should be taken prior to development projects to minimize impacts to the species, while the replacement of lawns (or portions of lawns) with native plants could replace destroyed habitat.

The increase in human growth and urban development has caused wildlife populations to differ greatly from the species that would historically have been found in Minnetonka. Natural disturbances, such as fire, have often been eliminated from urban settings, negatively impacting habitats dependent on these disturbances. Additionally, human encroachment and habitat destruction increase the potential for human-wildlife conflict and the labeling of certain species as nuisance animals or pests. These include white-tailed deer, raccoons, skunks, bats, and squirrels. Due to the local extinction of many predator species in the area, these populations often grow unchecked, resulting in more human-wildlife conflicts. For example, white-tailed deer in Minnetonka lack a natural predator, and populations are difficult to control. This leads to an increase in damages caused by herbivory and vehicle collisions. Additionally, geese are often viewed as pests, resulting in cities developing goose management plans. The highest number of human-goose conflicts are often seen near waterbodies with no natural buffer along the shore. The reduction in suitable habitat and habitat fragmentation has led to many species experiencing a lower carry capacity, limiting how many individuals or species can be supported within the region.

Other threats to urban wildlife include pets, such as cats and dogs, that can wreak havoc on local wildlife populations. Dogs primarily impact mammalian populations, such as raccoons and squirrels, while free-ranging cats decimate small mammal and bird populations due to their instinct and drive to hunt. A study conducted by the Smithsonian Institution and the USFWS estimated that domestic cats kill approximately 2.4 billion birds and 12.3 billion small mammals each year (S. Loss, T. Will, and P. Marra 2013). Additionally, threats to wildlife populations from human encroachment and development include collisions with buildings and vehicles, pollution (including light and noise), and lack of resources leading to inconsistent diets.

Guidelines for Wildlife Management

- Do not intentionally feed deer and other wildlife.
  - » Feeding wildlife increases the chance of human-wildlife conflict because it causes wildlife to become more acclimated to humans. This includes leaving trash cans open and hand-feeding or leaving feed out for animals. Additionally, allowing fallen fruits from trees and shrubs to remain in yards increases the chances of conflict with nuisance or pest species.
  - » While bird feeders are the exception, careful considerations should be made to minimize negative impacts. These include regular cleaning and maintenance of feeders and baths, placing feeders away from windows and reflective surfaces, and removing feeders if regularly visited by potentially sick or diseased individuals. Landowners may also consider adding native plants that host insects and produce seeds, which are key sources of food for wildlife.
- Create habitat by planting a diversity of species, including trees, shrubs and other insect host plants.
  - » Care should be taken to ensure that habitat does not increase human-wildlife conflicts. For example, planting mast-producing tree species along busy roadways could potentially increase traffic accidents caused by deer.
- Transition from manicured lawns to native landscapes.
  - » Replacing lawns with native vegetation will provide additional habitat for insects and birds and create natural corridors for wildlife.
- Minimize habitat fragmentation.
  - » Reducing habitat fragmentation by creating wildlife corridors will allow wildlife to access additional resources and reduce the potential for human-wildlife conflict.
- Refer to the city's goose and deer management plans for addressing nuisance populations.
- Tree removal is recommended between November 1 and March 31 to ensure minimal impacts to the northern long-eared bat during roosting season.

United States Fish and Wildlife Service

Threatened or Candidate for Listing

Monarch Butterfly
Danaus plexippus

Northern Long-eared Bat
Myotis septentrionalis

The United States Fish and Wildlife Service (USFWS) has identified two additional species of note that may be found in Minnetonka. The northern long-eared bat (threatened) and monarch butterfly (candidate for listing) are both found within Hennepin County.

Image Sources: All images are from USFWS - fws.gov
Monarch Butterfly - City of Minnetonka
Northern Long-eared Bat - USFWS - fws.gov (NPS/Steven Thomas)

2.5 Cultural Resources

People and nature are inseparable. Nature provides materials we use, services that sustain human communities and the planet, and experiences that restore our spirits.

Among small cities in Minnesota, the City of Minnetonka is unique in having a dedicated Natural Resources division. Nine full time staff members, with the support of seasonal interns, provide leadership and expertise in:

- Forestry
- Wetlands and water quality management
- Habitat restoration and invasive species control
- Construction review, monitoring, and compliance
- Outreach, education and community engagement

The Natural Resources division has a $1.8 million annual budget that supports policy development, partnerships, and implementation of strategies to protect natural resources on public lands. This work includes identifying and planning for future challenges – such as climate change and emerging invasive species – and identifying opportunities to prevent or reduce them. Because a large proportion of the city's natural areas are on private property, the Natural Resources division also emphasizes programs that inform and empower residents to take action.

Through Minnetonka's annual community survey and the 2021 Parks & Open Space planning process, residents shared these perceptions of Minnetonka's natural environment and their priorities to maintain or improve it. Below are common perceptions identified from surveys:

- Natural areas are important to the overall quality of life in Minnetonka; many residents regularly visit parks, trails and open spaces.
- Minnetonka's open spaces offer a restorative connection to nature, nature-focused activities such as hiking and birdwatching, outdoor exercise, and places to enjoy with family and friends.
- Most of Minnetonka's natural areas are in good or excellent condition.
- The City is doing just the right amount to protect the environment – but we must continue to focus on (1) trees and the community forest; (2) invasive species; and (3) water quality and stormwater management. Many residents are also concerned about native plant diversity, wildlife habitat, planning for climate resilience, and expanding the amount of restored area (including connectivity between parcels).
- Residents are divided about the best use of Minnetonka's natural areas. About 46 percent feel that natural areas should be protected, with low-impact activities allowed in designated areas, while 42 percent want a balance between protection and recreational uses. Smaller numbers of residents want either full preservation (with no recreational access) or no preservation to allow wider recreational access.
- The top suggestions to involve residents in natural resources management include more volunteer opportunities for groups and individuals, improved access to programs for underserved areas of the community, and educational programs on tree selection, planting and maintenance.

City of Minnetonka is unique in having nine full time staff members in its Natural Resources division with an annual budget of $1.8 million that supports policy development, partnerships, and implementation of strategies to protect natural resources on public lands. Above are few of the many species Minnetonka's Natural Resource division is working to support.

Image Source: City of Minnetonka

3

Natural Resources Issues and Opportunities

Minnetonka has addressed natural resources issues for decades through land preservation, natural area restoration, and protection ordinances and policies. The City also created a Natural Resources division with staff fully dedicated to natural resources management. This positive momentum will continue as the City addresses further impacts to natural resources. Current issues of concern and opportunities for improvement are discussed throughout this chapter.

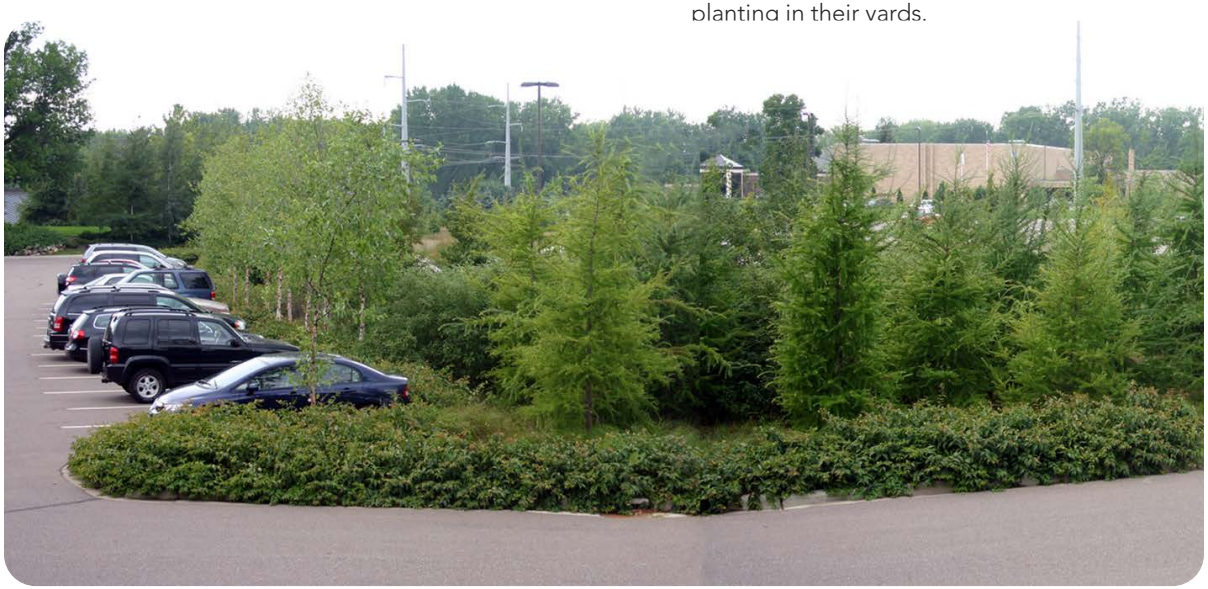
3.1 Habitat Fragmentation

In every city, original landscapes have been impacted by highways, homes, industrial and commercial buildings, and parking lots. It is important to recognize that this supports our lifestyles and economies. Human impacts have greatly diminished habitat. The results are negative impacts to clean water, clean air, natural heritage, and beautiful vistas. The process of bisecting and isolating habitats is called habitat fragmentation and results in isolated "islands" of habitat that are highly vulnerable to disturbances and stressors.

As our climate changes, the stresses of heat, heavier precipitation and drought impact the remaining habitat islands of Minnetonka's natural areas. This will force some species out of the region and cause new species to colonize. A solution to recolonization is to create corridors of habitat that connect islands of remnant natural areas. Making this happen in Minnetonka is tremendously difficult because it means removing portions of the urban fabric. A viable alternative is to introduce new species to islands of habitats (parks), especially plant species, to facilitate ecological changes in response to climate change.

Opportunities:

- Protect existing Minnetonka habitats.
- Expand native plant community restoration efforts on City properties. Prioritize high-quality areas and areas with previous restoration efforts. Focus on expanding core habitat (natural areas away from roads/structures) and corridors (along waterways).
- Control invasive species that will likely fill niches left open as native species no longer tolerate changing growing conditions.
- Monitor for species that may be disappearing from Minnetonka natural areas.
- Determine which species native to regions beyond Minnetonka, particularly from warmer climates, might best colonize Minnetonka natural areas to improve biodiversity as the climate continues to change.
- Develop plans to assist the migration of plant species through planting into Minnetonka natural areas. Trees and herbaceous plants are a good place to begin because they are the basis for wildlife habitats.
- Increase public awareness of habitat fragmentation through education and outreach. Encourage residents to create habitat through planting in their yards.



Thoughtful development and upgrading of existing City infrastructure can reduce habitat fragmentation through the creation of corridors that can start to relink habitat islands.

Figure 3.1 - Habitat Fragmentation

Habitat Boundary

Bisecting and isolating habitats through the process of suburban development is called habitat fragmentation. The diagram above does not represent a physical location but rather Illustrates how habitat fragmentation can occur through development over time. Habitat fragmentation results in isolated "islands" of habitat that are highly vulnerable to disturbances and stressors.

3.2 Reduced Native Plant Diversity

Native plant diversity and abundance have greatly declined from historical levels and are on a trajectory to continue to diminish in Minnetonka. Most local extinctions have occurred in the last half of the 19th century as the land was converted to agriculture and then to residential development in the 20th century. Today, populations are declining due to invasive species encroachment, predation, new development within remaining natural areas, competing priorities for people, and climate change (as described below).

Of note, in Minnetonka, the forest floors of park woodlands were once covered in an abundance of wildflowers, ferns, and sedges. Today, much of the herbaceous layer has been impacted by many forces resulting in limited cover. Highly diverse stands of herbaceous plants exist only minimally in Minnetonka parks today (see Figure 2.15).

Opportunities:

- Minimize soil disturbance when developing parks and other City lands. Prioritize soil protection and restoration as part of all City development projects.
- Restore a variety of native habitats. Oak savanna was the dominant presettlement habitat of Minnetonka, yet today, almost none remains. This and other habitat types could be restored to increase ecological diversity and complexity.
- Continue to work with organizations and community members to achieve natural resources goals presented in Section 1.1 and support natural resources protection efforts in the surrounding ecoregion.
- Allocate additional resources to support natural resources management on City properties to build on past restoration successes. Leverage grant opportunities whenever applicable.
- Increasingly implement fire as a management tool, especially in woodlands and savannas.
- More aggressively manage existing invasive species.
- Monitor and aggressively control new invasive species. For example, oriental bittersweet is just establishing in the region.
- Develop a "pest detector" program for volunteers to scout new invasive species and report to the MnDNR and Minnetonka natural resources staff.
- Use integrated pest management (IPM) principles to guide thoughtful and limited pesticide use.
- Identify and re-introduce locally extinct plants as appropriate to increase species diversity.
- Provide incentives for private landowners to control invasive vegetation on their property. Introduce cost-share programs for landowners who plant native plants.
- Continue managing white-tail deer populations to protect plant communities from over-browsing.

Land dominated by invasive plant species loses native plant diversity, such as in this dense stand of common buckthorn. Besides a lack of native tree species, notice the lack of herbaceous diversity covering the ground.

3.3 Soil Degradation

Soil in its natural state is loose, easily crumbled, and contains a contains healthy populations of microbes and fungi that, in turn, support diverse native plants. Ideally, soils comprise approximately 25 percent air, 25 percent water, 47 percent minerals and 3 percent organic matter. Healthy soils readily infiltrate precipitation and circulate air which supports vigorous plant growth.

With urban development, much of our urban soils have been bulldozed, driven upon (compacted), or scraped away. The damaged and compacted soil left behind lacks oxygen, sheds precipitation, lacks healthy populations of microbes, and struggles to support plants. Pesticides and fertilizers spread on landscapes further damage soil life, which also results in soil compaction. In addition, the soils of natural areas are impacted by earthworms (see section 3.7, below), resulting in compaction and erosion.

Soil degradation is common throughout the U.S., but measures can be taken to reduce impacts and regenerate soils. Many benefits and cost savings result from improving soil quality. These benefits include healthier trees, reduced tree-maintenance costs, better pavement shading (cooling cost savings), and deeper root systems for drought tolerance and carbon sequestration. Improved soil quality also results in cleaner water bodies due to reduced pollutant runoff and erosion, and healthier vegetation resistant to disease and pests. Healthy soils also improve groundwater recharge because porous soils increase stormwater infiltration.

Opportunities:

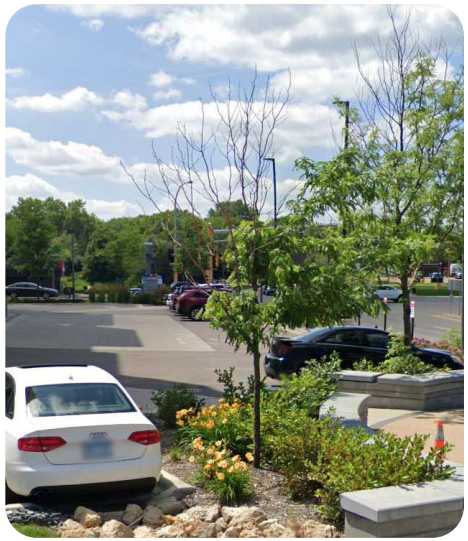
- Continue to promote soil protection/ improvement.
- Continue with City efforts to reduce pesticide and fertilizer use on public properties and right of ways.
- Initiate soil regeneration practices on city-sponsored construction projects.
- Educate private property owners on the importance of soil regeneration and low-input lawn maintenance.
- Educate private property owners about planting lawn alternatives that can sequester carbon, reduce fossil fuel use, build soil and add pollinator habitat.

3.4 Community Forest Alterations

The term community forest ecosystem includes not only Minnetonka's trees but the entire environment from which trees grow: water, air, soil, microbes, insects, wildlife, shrubs, tree seedlings, ferns, and wildflowers. Both growing situations require management to ensure a healthy tree canopy for Minnetonka. Trees within the built environment require active planting and soil management to nurture their health.

Minnetonka's community forest ecosystem is facing several challenges. Tree growth in developed areas, for example in parking lot islands, is challenged by limited rooting space. It is important to provide a significant volume of soil when planting these trees to support them to maturity. Insect damage, disease, and structural damage also negatively impact Minnetonka's community forest despite diligent efforts by Minnetonka's natural resources staff. Emerald ash borer and diseases on oaks are impacting the community forest, resulting in expensive removal costs. Property owners' and developers' limited knowledge can also limit tree diversity and proper care of existing trees and woodlands. Continue to provide tree management information to Minnetonka property owners would improve the quality of the community forest ecosystem.

These images compare a typical understory ground cover (left) with an earthworm infested ground cover (right). Earthworms are destructive to the soil structure as they consume vast amounts of ground surface organic matter. This results in soil moisture and nutrient loss and prevents the reproduction of native tree and wildflower species.



A parking island tree struggling with limited rooting space becomes susceptible to insect damage, disease, structural damage, and drought.

Our changing climate is presenting conditions that challenge the health of individual trees and woodland systems. We rely on trees to shade streets and buildings to mitigate the urban heat island effect. Areas of the City most affected by urban heat islands are sparsely covered by trees (see Urban Heat Island below). This could be a primary focus of new tree plantings.

Native woodlands are also facing challenges. Woodlands naturally go through a progression of change as they mature, called succession, where a series of tree species establish, mature, die, and are replaced with other species. This natural process is inhibited in Minnetonka (as throughout the metro area) by several factors. The problem is with native plant re-establishment. Minnetonka's oak woodlands are not regenerating. Oak seedlings are eliminated or out-competed in a variety of ways. Herbivory by deer, rabbits, and rodents has a significant impact. Earthworms voraciously consume duff (decomposing leaf litter) on the forest floor, which is necessary for the reproduction of many species of trees and woodland wildflowers. Invasive species out-compete young native species or prevent their germination through allelopathic processes (a common biological phenomenon by which one organism produces biochemicals that influence the growth, survival, development, and reproduction of other organisms).

Opportunities:

- Make Minnetonka's heat islands (see Figure 2.12 & Figure 2.13) priority tree-planting areas. Open pavements where possible and develop appropriate soil volumes.
- Restore woodlands and other native plant communities as per the Park Restoration Plans presented in Appendix A.
- Further fund disease management programs.
- Further fund and systematize tree pruning efforts.
- Continue planting trees on public land.
  - » Consider altering policies to allow tree planting within 15–20 feet of streets.
  - » Continue to increase species diversity.
- Continue and expand the replacement of trees lost insects, flooding and drought.
- Increase volunteer tree-planting events.
- Expand the city's annual tree sale to increase tree planting on private property.
- Grow trees less commonly planted in the city's new gravel bed nursery, such as native oaks or climate-adaptive species.
- Develop a climate-adapted tree list.
- Continue the deer management program to protect young trees.
- Develop a tree auditing program (analogues to an energy audit) to instruct property owners on the first steps for improving tree growth.
- Expand the community forest ecosystem education initiative.
  - » Advocate for planting and preservation of the right tree in the right place.
  - » Advocate for increased species diversity and the planting of appropriate native trees.
- Continue to support research to inform urban forestry best practices.
  - » Support the conservation arboriculture study to preserve heritage trees.
  - » Support field studies such as practices to protect bur oaks from bur oak blight (BOB), street tree protection, and wood utilization.
- Enhance the urban forest monitoring initiative.
  - » Monitor for new pests and evaluate current insect and disease levels.
  - » Monitor the species planted on public and private properties.
  - » Look for shifts in species composition in select Minnetonka woodlands.

Parking lots like these in Minnetonka are an opportunity for pavement reduction and the introduction of trees in parking lot islands.

The parking lot islands at Minnetonka Civic Center demonstrate the benefits of shading pavement, collecting stormwater, and providing a pleasant environment.

The Minnetonka Community Forest Ecosystem includes not only Minnetonka's tree canopy but the entire above and below ground urban forest environment (water, air, soil, humus, microbes, insects, wildlife, midstory trees, shrubs, tree seedlings, ferns, and wildflowers). The community forest reaches across the City from highly developed commercial areas, through residential neighborhoods, to natural woodlands.

3.5 Pollinator Species

Across the U.S., habitat for many pollinator species has been degraded or eliminated; with our growing population, this trend is increasing. Pollinators are an important set of species whose habitat can expand within Minnetonka. Native plant community restoration provides habitat for wild bees, butterflies and moths, beetles, wasps and ants, hummingbirds and other species that pollinate flowers. Planting food sources in the landscape and preserving or creating nesting and overwintering habitats for these species will support their survival and maintain their diversity.

Opportunities:

- Continue to enforce the native plant requirement within the landscape ordinance.
- Include a diversity of pollinator plant species in all City landscape projects, including trees and shrubs.
- Continue working to restore native plant communities in Minnetonka parks and eliminate invasive species that displace pollinator host plants.
- Formalize an annual native plant sale, offering native wildflowers, grasses and sedges that provide food for pollinators.
- Ensure that the annual tree sale includes trees and shrubs that are nectar sources and host plants for pollinators.
- Continue to educate residents on the value of pollinator species and how to enhance and restore pollinator habitat on their properties.
- Provide an incentive program for property owners to plant to plant nectar sources and host plants on their property.

3.6 Invasive Species

An invasive species is an organism introduced to a new region, accidentally or intentionally, which negatively impacts the economy, environment or human health. Invasive plants displace native plants and degrade wildlife habitat by eliminating or displacing cover and food sources. Invasive species can also cause topsoil erosion, leading to the degradation of water quality in lakes and streams. They often establish in previously disturbed areas and form single-species stands that limit movement through dense or thorny growth. Invasive species that have colonized in Minnetonka include (but are not limited to):

Upland: garlic mustard, black locust, Siberian elm, common buckthorn, Tartarian honeysuckle, oriental bittersweet, Amur maple, Norway maple, yellow and white sweet clover, Japanese hedge parsley, common burdock, wild parsnip, leafy spurge, spotted knapweed, Canada thistle, creeping Charlie, Japanese barberry, Japanese knotweed, crown vetch, alfalfa, and smooth brome.

Wetland and Lakeshores: narrowleaf cattail, yellow iris, purple loosestrife, common reed, and reed canary grass.

Minnetonka natural resources staff diligently control invasive plant species, especially common buckthorn, Tartarian honeysuckle, and garlic mustard in parks. It is important to watch for newly arriving invasive species identified on the MN DNR Early Detection Watch List. Species on this list have limited distribution in Minnesota but have been identified as high risk for broad establishment. Some species on the list include black swallow-wort, British yellowhead, Dalmatian toadflax, giant hogweed, Grecian foxglove, tree of heaven, teasel, Japanese hops, and multiflora rose. This list is dynamic. As of the summer of 2020, these species were not observed in Minnetonka parks.

Opportunities:

- Further fund a comprehensive invasive species management program. Pursue grants to supplement funding.
- Minimize the extent of soil disturbance when developing in parks and on other City property. Prioritize soil protection and restoration as part of all City development projects.
- Continue restoring native plant communities to promote native plant diversity and potentially out-compete some invasive plants.
- Continue to use volunteers to control invasive species within parks.
- Monitor and aggressively control new invasive species. For example, oriental bittersweet is just establishing in the region. Now is the time to get ahead of this newly introduced invasive species with diligent monitoring and immediate control upon discovery.
- Develop a Pest Detector Program, using volunteers to scout for new invasive species and report to the MNDNR and Minnetonka natural resources staff.
- Use integrated pest management (IPM) principles to guide thoughtful and limited pesticide use.
- Provide incentives for private landowners to control invasive vegetation on their property.
- Teach park users about the impacts of invasive species and show them how they can be identified and controlled.

Garlic Mustard
Celastrus orbiculatus Thunb

Purple Loosestrife
Lythrum salicaria

Spotted Knapweed
Centaurea stoebe

Oriental Bittersweet
Celastrus orbiculatus

Canada Thistle
Cirsium arvense

Image Sources:
USDA Forest Service - fs.usda.gov
iNaturalist - inaturalist.org
Washington State Noxious Weed Control Board - nwcb.wa.gov
Minnesota Wildflowers - minnesotawildflowers.info
Invasive Species Council of British Columbia - bcinvasives.ca

3.7 Native Plant Herbivory

Herbivory and overbrowsing are impacting Minnetonka's natural areas in many ways. Overbrowsing occurs because of an imbalance between predators and prey. There is a lack of predators (for good reason) in Minnetonka, and an overabundance of native herbivores such as deer, rabbits, rodents, and invasive earthworms results in overgrazing.

Deer overabundance is an issue throughout the region. Deer are significantly impacting native tree, shrub, and wildflower populations with their voracious appetites. Overbrowsing prevents these plants from regenerating; we lose the beauty of woodland wildflowers, lose native tree reproduction, and have reduced food sources for pollinators.

Deer herbivory is compounded by earthworm activity that limits vegetation regeneration. Earthworms are an invasive species not native to the Midwest. Our forests did not evolve in the presence of earthworms, which rapidly consume the decomposing leaf litter (duff) on the forest floor, leaving it bare by mid-summer. This results in soil moisture and nutrient loss and prevents the reproduction of native tree and wildflower species that require the protection of the duff to regenerate. Forests colonized by earthworms lack wildflowers, ferns, and young native trees. Unfortunately, there are no effective earthworm management techniques. It is important to keep deer populations low to keep them from further stressing a forest already weakened by earthworms. Deer also impact ornamental landscape plants. Minnetonka staff currently monitor and manage deer populations in collaboration with the Minnetonka Police Department.

Jumping worms have recently arrived in Minnetonka. These unusually active earthworms were unintentionally released from worm composting bins and are powerfully destructive to the soil structure. They consume vast amounts of ground surface organic matter, leaving the top six inches of soil the consistency of coffee grounds. Because leaf litter and landscape mulch are quickly devoured, soil infested by jumping worms is vulnerable to erosion. Once washed off, this leads to contamination of natural water bodies. There is no known control for jumping worms, which have been found in Minnetonka.

Opportunities:

- Continue the existing deer monitoring and management program.
- Work with neighboring communities to synchronize deer management programs to reduce the number of deer moving into Minnetonka through these communities.
- Educate Minnetonka citizens about the natural role of deer and how people can best nurture balanced populations of plants and animals.
- Establish a jumping worm awareness program to alert residents to the hazard of importing potentially infested soil and plants into their landscapes.
- Plant native forest species that can tolerate the presence of earthworms such as Pennsylvania sedge, zig-zag goldenrod, columbine, and jack-in-the-pulpit.
- Educate park users about the impact of earthworms and how they affect Minnesota forests.

Overbrowsing by deer prevents native plants from regenerating, directly impacting the quantity and quality of herbaceous plants.
Image Source: MnDNR - www.dnr.state.mn.us/mammals/deer/management

Invasive Worm Comparison

Nightcrawler Worm (Lumbricus terrestris)
Image Source: PetSmart LLC - petsmart.com

Jumping Worm (Amynthas agrestis)
Image Source: The Oregonian - oregonlive.com

Nightcrawler Worm (Lumbricus terrestris)	
Color:	Pink/Reddish
Body:	Thick, Slimy, Floppy
Size:	6-8 inches long
Clitellum:	Slightly raised from body, partially encircles body, and red/pink in color

Jumping Worm (Amynthas agrestis)	
Color:	Brown/Gray
Body:	Sleek, dry, smooth, and firm
Size:	4-5 inches long
Clitellum:	Flush with body, relatively close to head, encircles body, and light (compared to body) in color

3.8 Urban Heat Island Effect

Hard surfaces (such as streets, parking lots and rooftops) are necessary for urban life. However, these hard surfaces cannot absorb water and they increase the volume and rate of stormwater that carries pollutants into lakes, streams and wetlands. These impervious surfaces also accumulate heat that stresses people and the urban environment. Accumulated summer heat impacts outdoor workers and increases energy use through extended air conditioning. High summer temperatures also facilitate the formation of air pollutants such as ozone. Warmer winter temperatures allow the overwintering of tree pathogens and pests that host pathogens such as ticks and mosquitoes.

The urban heat island effect can be reduced, and Minnetonka's quality of life can be improved by limiting the amount of new impervious surface constructed, reducing unnecessary impervious surface, and creating green space with trees in its place. In the near future, opportunities to remove pavement may occur as people increasingly work from home, resulting in fewer cars on the streets. The imminent advances in the autonomous car will also reduce traffic and the need for parking spaces.

Opportunities:

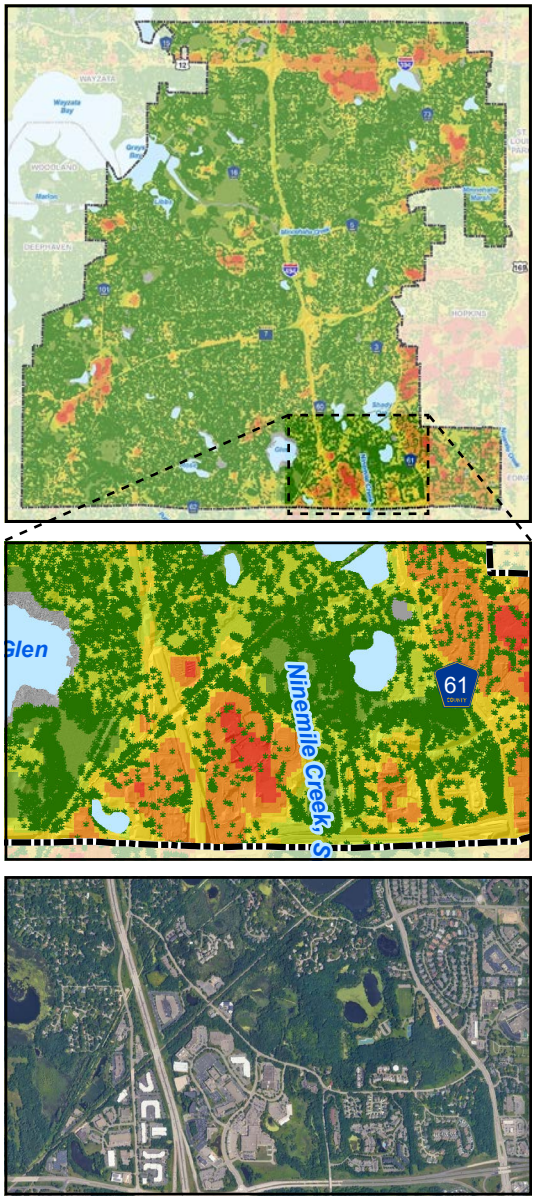
- Plant trees along streets and in parking lots. This may require changes in Minnetonka policy to allow street trees to be planted closer than 15 feet to curbs.
- Assess City parking requirements for commercial/office developments and determine how many stalls are required. The City has relaxed its parking requirements (per project) over the last several years, and should continue to explore even more definitive ordinance requirements that further that effort.
- Consider white or green roofs on all City building projects in Minnetonka. Plant more than the required number of trees on City construction projects. Plant trees with each street reconstruction project.
- Consider the use of light colored pavement in City construction projects to reflect light.
- Ensure the longevity of street and parking lot trees by providing adequate soil volumes in highly paved areas.
- Further fund the community forest management program and plant more trees.
- Continue to educate private property owners on the advantages of planting trees and their ideal locations for energy savings and pavement shading.
- Continue to amplify the City tree sale. Further fund the city's gravel bed nursery as a healthy source of trees for planting on City property.
- Consider developing a heat-island-mitigation bank for projects where there is not enough space to replace pre-existing trees. Funds deposited in the heat-island-mitigation bank would be used for planting trees in difficult areas that are highly paved.

Growing trees in a gravel-bed nursery (rather than a soil-based nursery) can triple the density of roots (image to the left). This allows gravel-bed nurseries (image to the right) to grow larger, healthier, and more resilient trees in a shorter time.

Image Source: Mississippi Watershed Management Organization - mwmo.org

Urban Heat Island Diagram

The imagery below shows an enlargement of Figure 1.4.7 - Heat Island & Tree Canopy. Impervious surfaces directly resulting in higher temperature values can be seen in the third image below.



3.9 Climate Change

Climate change is impacting Minnetonka and will increasingly negatively affect the region. In Minnesota, climate change manifests with warmer winters (especially increasing nighttime lows), increasing precipitation and storm intensity (more heavy rains and fewer slow soaking events), and greater snow events. According to the DNR State Climatologist office, increased summer daytime temperatures and increased occurrence of drought have not yet been experienced in Minnesota (although nighttime lows throughout the year have been increasing). However, drought and summer daytime temperatures are predicted to increase within the next 10 to 20 years.

Climate change exacerbates all the ecological issues discussed above. As the City experiences greater swings in temperature and precipitation, living organisms, including people, insects, birds, trees, wildflowers, and soil microorganisms, are forced to tolerate conditions beyond those through which they have evolved. Stressed plants and animals are more vulnerable to disease. As a result, some native plant species are predicted to die out, with invasive species taking their place. Thus, we lose our rich natural heritage. Degraded air and water quality as a result of climate change also affect human health.

Native plant communities serve to mitigate climate change through carbon sequestration. This occurs through the process of photosynthesis as CO_2 is sequestered from the atmosphere to build plant tissues; leaves, stems, trunks, roots, etc. This material, especially roots, over time dies and decays leaving behind a portion of this carbon in the soils in the form of organic matter. This is the 'black' of black dirt. Native plant communities are efficient at sequestering carbon from the atmosphere through photosynthesis.

Greenhouse gas emissions are prevented in native plant communities in comparison to lawns which require intensive maintenance. Considerable greenhouse gas is released through the pumping of water for irrigation, the production of fertilizers and pesticides, the manufacturing of mowers and other equipment, as well as the fuel burned in the operation of lawn equipment. In comparison, native plant communities are not watered or fertilized, and only occasionally require mowing (in urban landscapes). They may be burned which releases greenhouse gasses, but below-ground plant organic matter stays in place and carbon is sequestered. Prairies and savannas are also much less expensive to maintain than lawn once they are established. Lawns are a cultural asset where they are actively used, but unused lawns could be converted to more diverse and ecologically productive native plant communities.

Minnetonka residents and managers must be alert to the effects of climate change and take proactive action to address negative impacts.

Oak savannas are resilient plant communities that can withstand extremes in wet and dry conditions. They must be burned regularly.

Opportunities:

- Work with Minnetonka's Sustainability Commission to develop a climate action and adaptation plan for the city.
- Carefully balance growth and development with preservation efforts that protect our community's highly valued water and woodland resources. Develop a plant and animal monitoring program to track changes in species. Appropriate measures can be taken as changes occur. Evaluate the monitoring program periodically for fit and efficiency along with staffing capacity.
- Increase plant and habitat diversity in natural areas. Increasing species diversity establishes resilient plant communities because different species are adapted to different niches and will tolerate different stresses. For example, some prairie species can handle cool, wet conditions better than hot, dry conditions, while others tolerate the opposite. In a diverse ecosystem, species alternate in dominance as environmental conditions shift. They go dormant or store in the soil seed bank when the conditions they prefer are not present.
- Convert select woodlands to savanna. Oak savannas are more resilient to over-browsing, invasive species, heat, drought, and wind. Since oak savannas were the dominant plant community in Minnetonka before European settlement, it makes sense to restore them here.
- Teach residents about the impacts of climate change and instruct them on how they can act through volunteer activities.
- Implement the recommendations to mitigate the urban heat island effects described above.
- Monitor vectors for human diseases, such as mosquitoes and ticks. Educate the public on the connection between the increase of these illnesses and climate change.
- Continue to protect City staff from extreme heat and storm events.

3.10 Altered Hydrology of Natural Areas & Landscaped Greenspaces

Impacts to our green spaces—from past agriculture to suburban development and earthworm action to lawn management—have fundamentally changed how water flows in and through our landscapes. This affects our forests and grasslands as well as lakes, streams and wetlands. Therefore, we must adjust the management of our natural areas and landscaped greenspaces.

In 2019, a Minnetonka Water Resources Management Plan was developed that focused on stormwater management infrastructure and development for the built environment. However, the plan did not address issues of stormwater interaction within green spaces. The topic of managing stormwater within green spaces has not been considered because it was assumed that hydrologic management within greenspaces was unnecessary. After all, it has been raining and snowing on natural areas throughout history without human intervention. But people have directly and indirectly altered the hydrologic conditions of our green spaces (both natural areas and traditional landscapes). They have disturbed natural areas through past logging and grazing, eliminating healthy plant communities. The introduction of invasive plant and animal species (such as buckthorn and earthworms) has compacted the soil and inhibited plant growth, and soil structure has been degraded through crusting, erosion, and compaction. A reduction in soil organic matter results in increased water runoff and decreased water infiltration and storage in the ground. Healthy soils and plant communities are essential for efficient hydrologic cycling within both landscaped and natural areas.

A complicating factor altering greenspace hydrology is climate change. Minnesota's annual precipitation is increasing, and the intensity of storms is amplifying, with heavy downpours occurring more frequently. Intense downpours impact uncovered soil (lacking plants, mulch, or duff to break the force of raindrops), causing erosion and soil crusting, which allow precious topsoil to be washed away leaving the soil surface crusted by fine materials. Crusting prevents air circulation and rainwater infiltration into the soil which is essential for plant growth. Our goals for greenspace hydrology are to:

- Support healthy vegetation
  - » Plants improve soil structure by keeping soil porous through root action and supporting robust populations of essential soil microbes.
  - » Plants intercept the heavy force of raindrops that can erode, crust, and compact soil.

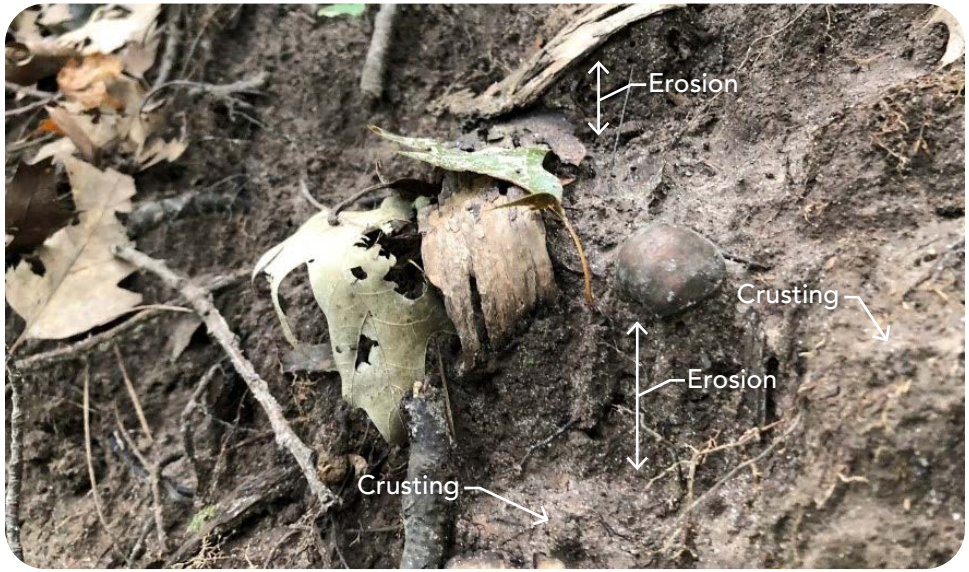
- Protect soils from erosion
  - » With healthy plant growth.
  - » With coverings of mulch, duff, or thatch.

- Support open soil structure
  - » With good air circulation and water infiltration.
  - » With a healthy soil food web (microbes, invertebrates, insects, mammals).

Lawns and traditional landscaped areas are typically composed of altered and compacted soils due to the construction process. We then compensate by fertilizing, applying pesticides, and irrigating to maintain healthy-appearing landscapes. The negative impacts of this type of management are evident.

Opportunities:

- Nurture soils in traditional landscapes and natural areas (see Soils section above) to support stable plant communities and healthy soil structure.
- Control invasive species in natural areas, such as common buckthorn, that negatively impact herbaceous vegetation.
- Transition degraded forests to open plant communities with light reaching the ground plain to nurture a complete vegetative soil cover (this compensates for the earthworm issues). Thin trees to establish a savanna plant community structure. Plant appropriate native herbaceous plants to develop a complete ground cover and restore native hydrology.
- Continue to manage deer populations to prevent overgrazing and the destruction of native vegetation.
- Strive to rectify eroding footpaths within parks to reduce soil erosion.
- Nurture healthy lawns through low-input management techniques. For instance, this can be done by diversifying lawn species to include low-growing perennials and limiting fertilizer use. Mowing high at 3-3.5 inches also supports healthier lawns.
- Manage landscape beds for dense vegetative cover and keep beds mulched to protect soils.
- Educate property owners on both low-input landscape management and the management of natural areas they may own. Encourage the restoration of vegetation, the regeneration of soil, and the restoration of hydrologic function.
- Continue partnerships with local organizations to share education efforts and obtain funding for initiatives.



This image of forest soil in Lone Lake Park shows a lack of duff and the resulting soil erosion and soil surface crusting that occurs with large storm events.

3.11 Human Perception of Natural Resources

Minnetonka is fortunate to have strong citizen support for its natural resources. Polls consistently show that natural resources protection ranks high among the community's list of priorities. Leadership is also supportive, as evidenced by a long history of natural resources funding, planning, and project implementation. And, the City has been able to take advantage of partnerships with governmental agencies such as Hennepin County, and watershed districts that share goals to protect natural resources.

One question is whether Minnetonka's efforts to protect and restore natural resources have led to complacency. Has the community taken natural resources for granted, assuming that they will keep giving life-essential benefits? Currently, we see very few diverse ecological communities, limited naturally regenerating urban forests, and almost no high-functioning wetlands in Minnetonka.

The topic of natural resources is complex and, therefore, often misunderstood. Natural resources involve the entire ecosystem that surrounds us. We use them to support our lifestyles, but the supply of Minnetonka's natural resources is not limitless. When we negatively impact soil, water, forests, wildlife, etc., we deplete natural resources and often prevent them from regenerating.

The citizens of Minnetonka perceive the condition of natural resources differently. Some see streets and buildings woven between a matrix of wetlands and beneath a beautiful forest. In contrast, others see a degraded and fragmented ecosystem infested by invasive species and diminishing species diversity. These competing perceptions often lead to inaction and can create a sense that natural resources are lower priority.

Misperceptions observed in Minnetonka are not unique, and apply to most areas of the U.S. They include:

Table 4.3 Common Natural Resource Misperceptions

Misperception	Results
A lack of understanding about the function of ecosystems; people don't know the difference between a healthy environment and one that is degraded/nonfunctioning.	• People believe that everything is ok in the environment and see no need to support additional funding to protect or regenerate natural resources. • People negatively impact natural resources without awareness. • There is a misunderstanding of the role of wildlife in ecosystems that leads to populations that are out of balance, with negative impacts to natural resources.
Green is good.	• Degraded ecological communities infested with invasive species are sometimes perceived as natural and not in need of regeneration. • There is a belief that every tree is sacred—seeing tree harvesting efforts that benefit forest regeneration as an irreplaceable loss.
An attitude that "I can do what I want", resulting in people-centric structures and activities that take priority over natural resources protection.	• Degraded forests, effaced soil, degraded wetlands, and poor ecosystem function are outcomes of this attitude. • Buildings and pavement are interspersed with degraded natural areas. • Altered natural areas cannot regenerate.

Opportunities/Recommendations:

- Build on current education efforts to deepen the understanding of ecosystems and natural resources in Minnetonka.
- Continue to demonstrate good stewardship through regeneration of ecological communities, urban forest management, clean water efforts, soil improvement projects, and wildlife management.
- Use multiple approaches to encourage citizen participation in activities that allow them to learn about the environment.
- Engage leadership in educational programs and on-the-ground efforts that benefit natural resources.

Section 2 of this report (Current Conditions) documents past impacts on Minnetonka's natural resources. Section 5 sets forth a plan to protect and replenish natural resources through the powers available to City government.

A public bench in Jidana Park slowly being swallowed by the invasive species, buckthorn.

4

Natural Resources Management Strategies

This section describes possible strategies for the management of natural resources in Minnetonka for the near future. This is an extensive list of strategies and not all can be accomplished due to limited budgets and staffing. Priorities for implementation will be determined at the time of annual budgeting and as needs arise.

4.1 Public Properties Natural Resource Management

This section presents management strategies and management priorities for city-owned natural areas, most of which are in parks. Implementation of these strategies will allow managers to effectively utilize funds and to focus on the protection of the most ecologically significant sites first. This will serve to preserve Minnetonka's natural heritage and build upon past ecological communities' regeneration successes.

Vegetation Management Prioritization

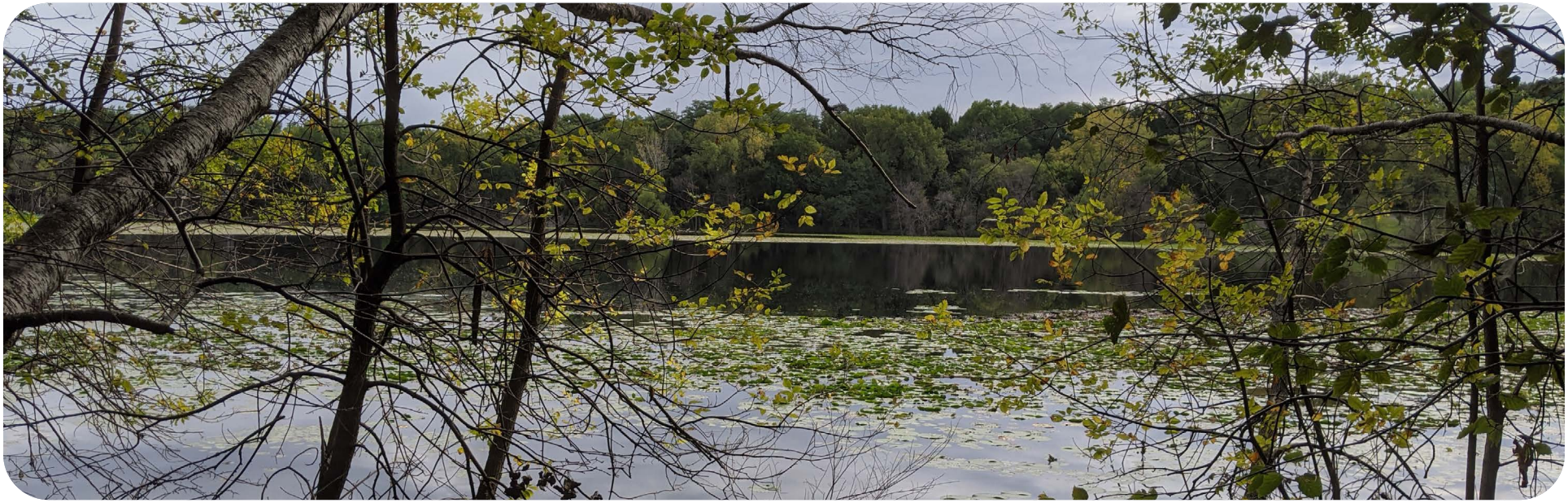
The prioritization of management activities on city-owned properties is essential to efficiently direct work. Given the amount of public natural areas within the city, a method for resource prioritization was developed to be strategic with restoration and management efforts. Eight criteria were developed to rank priorities. Table 4.1 scores and ranks management priorities for individual Minnetonka public properties. Table 4.2 shows the ranking scores for individual city-owned properties, and Figure 4.1 maps priority properties. All rankings were based on the conditions of properties ad ecological communities at the time of this report. Each property was ranked with the following eight criteria:

Table 4.1 Prioritization & Ranking Criteria

Criteria	Prioritizations	Ranking	Description
1	*Current Ecological Quality of Natural Community* Sites of higher ecological quality are ranked higher for protection and management. Quality was defined based on field assessments (see section 2.3, Table 2.1 for quality ranking criteria).	0 1 2	Dominated by altered/non-native plant community (Nothing higher than ecological quality C within the site) Moderate natural communities present (ecological quality B found within the site) High ecological quality (ecological quality A found within the site)
2	*Current Management Efforts:* Areas with recent or on-going restoration/management are prioritized to build upon past success.	0 1 2	No current restoration efforts Evidence of previous restoration efforts but no current restoration activities Restoration ongoing or detailed plans for restoration exist for the site
3	*Public Access and Use:* Sites that are highly utilized are given higher rank.	0 1 2	Natural areas not easily visible or accessible to the public Natural areas accessible but are not highly visited or park is dominated by lawn or recreational land cover Natural areas are highly visited
4	*Located within Conservation Corridor:* The MN DNR has designated potential conservation corridors that identifies lands that could be protected or restored to unify a connected habitat network within the Twin Cities Metropolitan area. Minnetonka natural areas within these corridors are prioritized.	0 1	Site not located within a MN DNR Metro Conservation Corridor Site is located within a Metro Conservation Corridor
5	*Size of Natural Area within a Site (Not including open water or cattail wetland):* Large natural areas are prioritized because restoration efforts are cost effective and because large habitat areas provide greater ecological value.	0 1 2	0 - 1 acres 1 - 10 acres 10+ acres

Table 4.1 Prioritization & Ranking Classifications (Continued)

Criteria	Prioritizations	Ranking	Description
6	*Priority for Restoration per City Council Open Space Policy (Policy Number 11.11):* The City Council has prioritized park improvements through this policy to ensure that changes and investments to parks, trails and open space fit into the bigger picture of serving the needs of the entire community.	0 1	No Yes
7	*Presence of significant, sensitive species or special plant community:* Rare and unique ecological communities within Minnetonka are prioritized for management to ensure their long-term viability.	0 1 2 3	No presence Remnant native herbaceous plant populations (example: bloodroot, trillium) Unique, intact Minnetonka ecological plant community (Example: bog, fen, tamarack swamp, sugar maple/basswood forest) Species uncommon or rare to City of Minnetonka (Management required to prevent species loss or habitat degradation, (for example orchids, heritage tree, hickory island))
8	*Volunteer participation within park:* Sites with active volunteer participation are prioritized	0 1 2	No active participation Periodic involvement Consistent volunteer work



Lone Lake Park ranks highest in the prioritization and ranking of select Minnetonka parks and natural areas. This park receives higher rankings than Jidana Park and Big Willow Park due to it's high quality natural areas, active volunteer engagement, and priority restoration per council open space policy (see Table 4.2).

Table 4.2 Prioritization and Ranking of Select Minnetonka Parks and Natural Areas

Park or Natural Area	Current Ecological Quality of Natural Community	Current Restoration Efforts	Public Access & Use	Located within Conservation Corridor	Size of Natural Area within Park Site (Not including open water or cattail wetland)	Priority Restoration per Council Open Space Policy	Presence of Significant/ Sensitive Plants or Community	Volunteer Involvement within Park	Total*
Lone Lake Park	2	2	2	1	2	1	3	2	15
Jidana Park	2	2	2	1	2	0	3	1	13
Big Willow Park	2	2	2	1	2	1	1	2	13
Purgatory Park	2	2	2	1	2	1	1	2	13
Cullen Nature Preserve	1	2	0	1	2	1	3	2	12
Minnetonka Mills Park	2	2	2	1	1	0	1	2	11
Civic Center	2	2	2	1	2	1	1	0	11
Hilloway Park	1	2	1	1	2	0	3	1	11
Meadow Park	1	1	2	1	2	1	1	1	10
Victoria Evergreen Park	2	2	2	1	1	0	1	1	10
Kinsel Park	2	1	2	1	1	0	0	2	9
Orchard Park	1	2	1	0	1	0	3	1	9
Lake Rose Park	2	2	0	1	1	0	1	2	9
Tamarack swamp south of Mtka HS	1	1	1	1	1	0	3	0	8
Reich Park	1	2	1	1	1	0	2	0	8
Tower Hill Park	2	2	1	1	1	0	1	0	8
Green Circle Park	2	2	2	0	1	0	0	0	7
Kelly Park	0	1	1	0	2	0	3	0	7
Headwaters, Minnehaha Creek	2	2	2	1	0	0	0	0	7
Oberlin Park	1	1	1	1	1	0	0	1	6
Gray's Bay Marina	2	2	1	1	0	0	0	0	6
Woodgate Park	0	1	1	0	1	0	0	1	4
Linner Park	0	1	1	1	1	0	0	0	4
Mooney Park	0	1	0	1	1	0	0	1	4
Covington Park	0	0	1	1	2	0	0	0	4
Whited Marsh - 5639 Whited Ave.	2	0	0	0	0	0	2	0	4
Ford Park	0	0	1	0	1	0	0	0	2
Crane Lake	0	0	0	1	1	0	0	0	2

Only community parks, preserves, and some neighborhood parks have been ranked for prioritization. Some neighborhood parks and mini parks with little to no natural areas were excluded from prioritization.
*Refer to Table 4.3 (Management Prioritization for Public Properties).

Table 4.3 Management Prioritization for Public Properties

Designation Descriptions	Overall Score
High priority for restoration; active restoration occurring; high volunteer interest and involvement; continue restoration work	10+
Medium priority; intermittent restoration occurring; intermittent volunteer involvement but opportunities exist	6-9
Lower priority for restoration; little to no restoration occurring but opportunities exist for more; little to no volunteer involvement	1-5

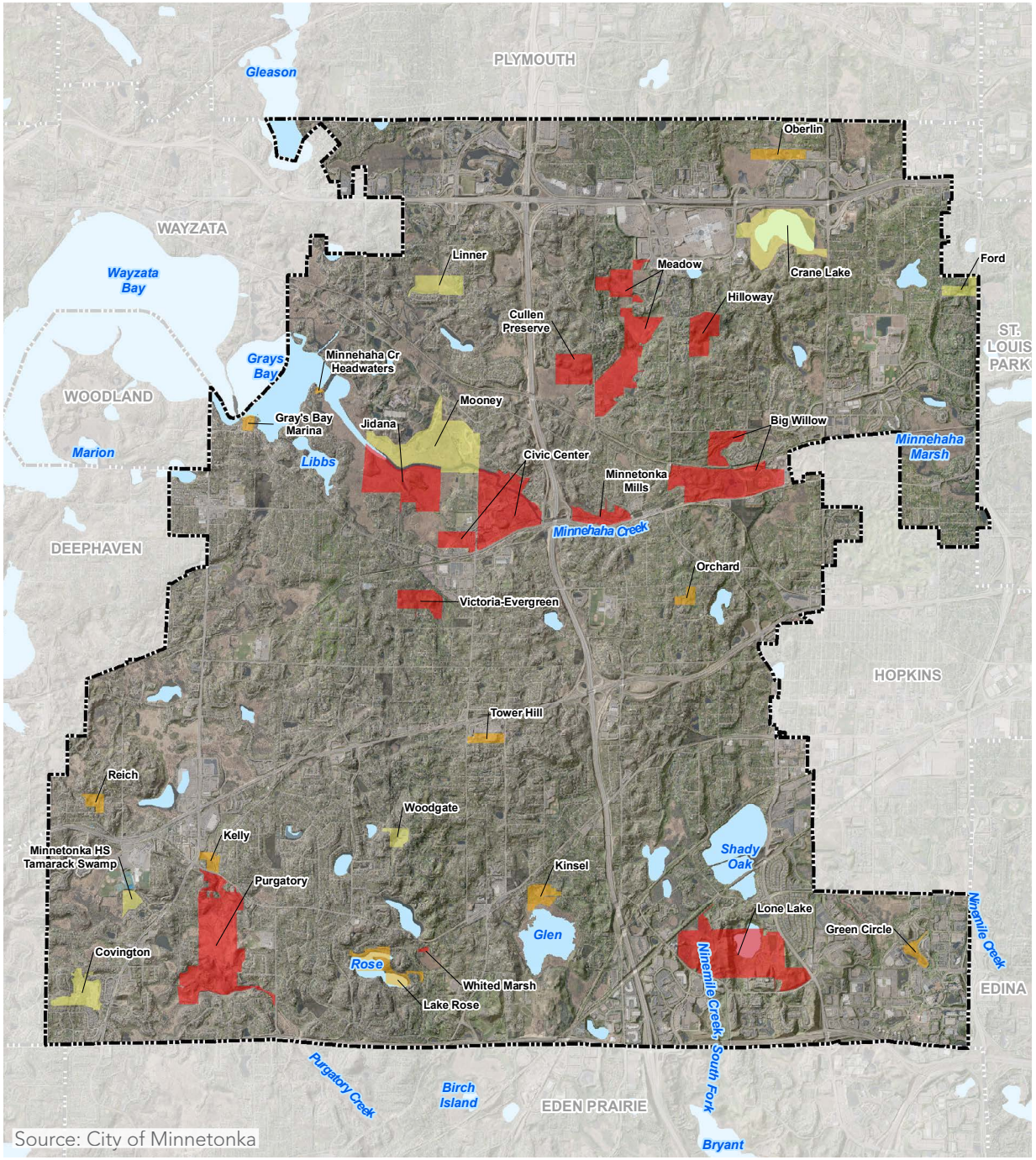


Figure 4.1 - Public Land Priority Ranking for Resource Allocation

Natural Area Management Priority of Minnetonka Parks

- High
- Medium
- Low
- Lakes, Ponds, and Rivers
- Minnetonka City Boundary

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Natural Resources Management Approach

Management strategies for individual sites with a priority score of 10 or greater (Table 4.2) have been developed and are presented in Appendix A. The intention of the individual site strategies is to guide the natural areas to increase species diversity and to be more resilient.

The management strategies presented in Appendix A are guided by the following:

1 ***The protection, diversification, and expansion of existing high quality ecological communities***:

Within each public property the management strategy is to first protect the highest ecological quality areas (areas of greatest native plant diversity) and then to move management efforts out to lower diversity areas as indicated within the management maps (Appendix A). The management effort required in the highest ecological areas might be minimal since invasive species presence is often low. Moving away from the areas into degraded habitats will likely require more intensive efforts.

Eventually an entire property may be restored and transition to a maintenance phase where burning, supplemental planting, and other management activities will encourage native plant proliferation and discourage invasive plant establishment. The speed at which ecological community restoration may be implemented will depend upon funding, volunteer engagement, and City staff capacity to oversee the process. It is critical that these activities be conducted concurrent with deer management to avoid damage to regenerating vegetation.

2 ***Monitoring to evaluate management success:***

Long term monitoring and the use of an adaptive management approach to steward Minnetonka's natural areas will institutionalize management resilience by allowing adjustment to changes seen on the ground.

Adaptive management is the process of testing a management technique in each unique landscape, monitoring its effectiveness, and then adjusting management in response. This iterative process takes time and results in long term success. Adaptive management involves observations of:

- Weed control and eradication success
- Native plant establishment failure and success
- Disturbance by people and wildlife
- Climate impacts

An adaptive management approach will continue for Minnetonka's public lands to preserve and enhance natural resources.

3 ***The evolution of highly degraded woodlands (such as buckthorn thickets) to communities that are resilient and economical to manage such as oak savanna:***

Once buckthorn is removed from degraded woodlands, it is an ongoing and expensive process to establish native woodland plants and keep buckthorn at bay. Using burn management as a tool to control invasive species is a viable solution. Historically in oak savannas and open woodlands, fire was the force that kept the tree canopy open and allowed light to hit the ground plain. This builds herbaceous fuel to carry fire which is an economical tool for managing buckthorn. Converting Minnetonka's severely degraded woodlands to open native plant communities is a sustainable long-term solution. This is because oak savannas are quick to establish (compared to woodlands) and more resilient to the degrading forces of herbivory, heat, drought, and wind. Also, regenerating oak savanna restores Minnetonka's natural heritage because oak savanna was the predominant ecological community in Minnetonka prior to European settlement (see Figure 2.1).

Degraded Woodland Restoration Sequence

The top image (#1) is an example of a Minnetonka park undergoing buckthorn removal. The second image (#2) shows an open understory after buckthron removal that can allow for native vegetation to establish. In the third image (#3), an additional thinning of trees, allows more light to reach the ground which in turn allows for native vegetation growth and burning as a management tool. In this situation herbaceous plant seeding is typically necessary.

Community Forest Management

Minnetonka holds the most extensive tree canopy of any Minneapolis/St. Paul metro community, which provides great benefits. This advantage, however, requires a proportional impetus of funding to properly manage our community forest.

The community forest can be sorted by three primary growing situations:

- Natural areas: somewhat undisturbed woodlands where trees and other vegetation can reproduce naturally
- Traditional landscaped areas: where trees grow in lawns and must be planted and maintained
- Urban plantings: where trees grow in constricted spaces in urbanized areas with significant amounts of pavement (above 85%) and typically poor soils

Each of these sectors of the community forest require management to maintain forest health and resilience to natural aging and the effects of climate change. Sector management strategies are listed below.

Natural Areas Forest

As discussed throughout Section 3, forests in natural areas are facing many challenges including disease and insect infestations, invasive species competition, degraded soil conditions, extremes of wet and dry weather, as well as limited economic resources for active forest management. Minnetonka forest management strategies include:

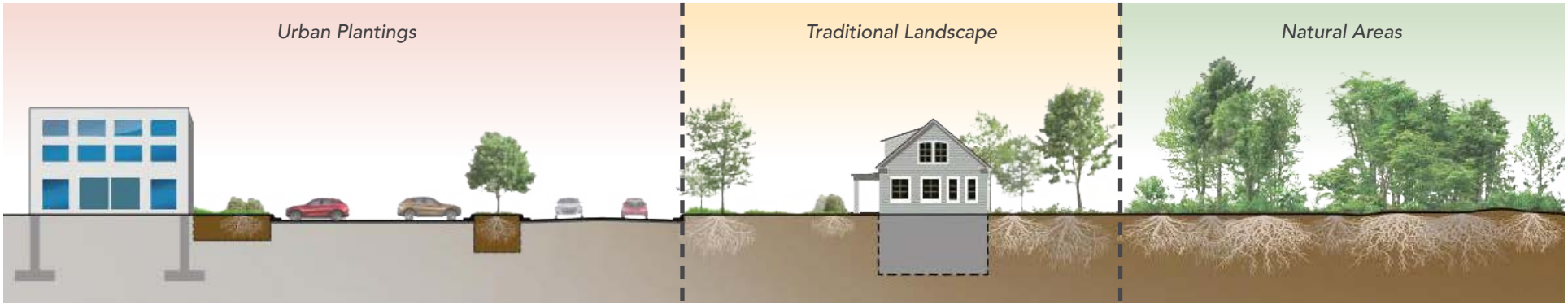
On public property:

- Working with City leadership and the citizens of Minnetonka to promote the value of our community forest and discuss the need for adequate funding to maintain this great asset.
- Developing a community forest inventory and management plan to identify forest composition and to direct future management activities.
- Regularly inspecting and monitoring for tree issues (structural, insect infestations, disease, etc.).
- Managing deer populations to reduce browse damage.
- Controlling tree insect infestations and disease.
- Regular pruning and the removal of hazardous trees. Good tree structure can reduce ice and wind damage which may become more prevalent with climate change.
- Planting of new trees:
  - » Lead volunteer efforts to plant trees.
  - » Strategically place trees to shade paved areas and buildings.
  - » Select species and cultivars that are less susceptible to insects, disease and climate change.
- Managing invasive species:
  - » Lead volunteer efforts to manage invasive species.
  - » Follow strategies for individual properties outlined in Section 4.
- Provide research and experimentation on pertinent forestry topics.

On private property:

- Expanding the City tree sale to increase tree planting. Provide species that are more resistant to insects and disease as well as climate adaptive species.
- Developing a tree auditing program (analogous to an energy audit) that serves to instruct property owners through an in-person site visit on the first steps recommended for improving tree growth on their properties. This may result in a recommendation for professionals to continue to advise the property owner and develop an in-depth tree management plan for the property.
- Providing educational programs and materials to Minnetonka citizens pertaining to the status and importance of trees in Minnetonka and the need/techniques for management.

Forest Management Primary Growing Groups



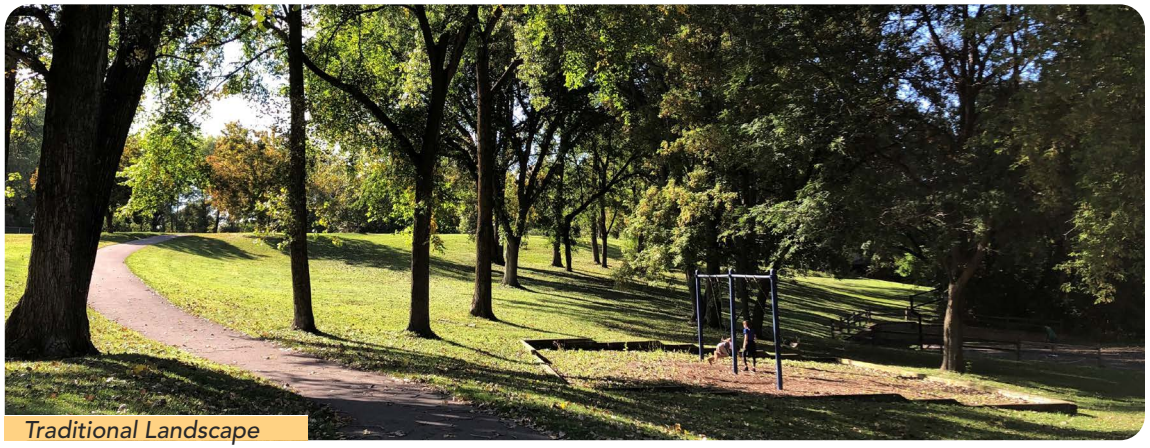
The diagram above shows example locations of the three community forest growing types. Urban plantings are defined as areas with 85% or greater coverage of pavement, typically have poor soils, and small and restricted rooting zones. The traditional landscape are environments where trees are planted and maintained within in lawns. Natural areas are somewhat undisturbed environments where vegetation can naturally reproduce.

Trees in Traditional Landscaped Areas

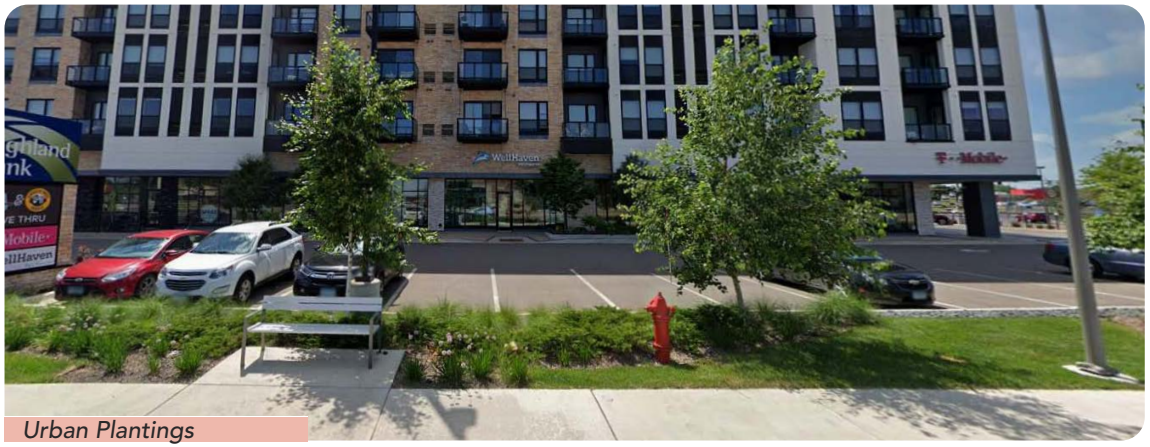
- Enforcing soil management and improvement ordinances through the development process to establish an adequate soil profile for tree growth.
- Managing lawns using organic methods that improve the soil biome/soil structure. This will greatly benefit trees.
- Planting a diversity of tree species and introducing climate adaptive species that will tolerate changing growing conditions.
- Expand the City tree sale.
- Managing stormwater to direct runoff to water trees. For example, runoff from driveways and streets can be directed to bioretention facilities where trees are planted.
- Regularly inspecting trees for insect infestations and disease so that proactive treatment can occur.
- Regularly pruning trees especially during the first 15 years after planting to develop a structure resilient to wind and disease.
- Providing educational programs and materials about tree protection, planting, and maintenance.

Trees in Urban Areas

- Focusing new tree planting in areas indicated as red in the Urban Heat Island map, Figure 2.12 & 2.13.
- Developing a heat island mitigation program to collect fees for trees impacted during building development projects to provide funds for planting in urbanized areas of impervious surfaces greater than 85%.
- Locating new tree plantings in areas that will shade pavement such as the south and west sides of streets, drives and parking lots. Shade the east and west sides of buildings for best energy savings.
- Designing planting islands in highly urbanized areas to ensure adequate rooting volume. A general guideline is to provide two cubic feet of soil per one square foot of tree crown area at maturity.
- Manage stormwater to direct runoff to islands with tree plantings. Salt tolerant tree species should be planted in these situations.
- Selecting tree species that tolerate tough growing conditions. Irrigation may be necessary in some situations.
- Regularly pruning trees especially during the first 15 years after planting to develop a structure resilient to wind and disease.
- Inspecting trees for insect infestations and disease so that proactive treatment can occur.



Traditional Landscape



Urban Plantings

Natural Areas

Above are examples of the three primary community forest growing situations within Minnetonka: traditional landscaped areas (trees within a lawn - Covington Park), urban plantings (treelawn in a streetscape - Plymouth road near interstate 394), and natural areas (Jidana Park).

4.2 Private Properties Natural Resource Management

Strategies for Managing Natural Resources on Private Properties

Most land in Minnetonka is privately owned. Therefore, many different individuals are stewards of Minnetonka's natural resources, whether they know it or not. City government can coax, motivate, and mandate individuals to protect natural resources by implementing incentive programs, cost-share programs, education programs, and establishing policies and ordinances. Below is a list of opportunities for Minnetonka to address natural resources on private properties. Policies and ordinances are discussed in section 4.4.

Municipalities can guide individuals to protect natural resources through incentive programs, cost-share programs, education programs, and establishing policies and ordinances. The image of a rain garden above is an example of private and public partnership created to enhance natural resource quality.

Table 4.4 Opportunities for Private Property Natural Resource Management

Topic	Education & Outreach	Technical Assistance & Incentives/Cost-Share
Habitat Fragmentation	• Increase public awareness of habitat fragmentation through education and outreach. Encourage residents to help create habitat in their yards. • Increase awareness of Hennepin County's conservation easement program and its benefits	• Develop a landscape auditing program (analogous to an energy audit) to instruct property owners on the first steps for controlling invasive species and planting natives on their properties. • Develop cost share opportunities for restoration in targeted spaces that connect fragmented habitats. Include technical assistance. • Promote similar resources available through partners, such as local watershed districts and the state Lawns to Legumes program.
Reduced Native Plant Diversity	• Use vehicles such as the Minnetonka print newsletter, natural resources e-newsletter, Minnetonka Matters, and in-person classes to teach property owners about the advantages of native plants and how to plant and maintain them. • Identify and promote native species that thrive in areas where buckthorn has been removed.	• Provide incentives for private landowners to control invasive vegetation on their property. • Introduce cost-share programs for landowners who plant native plants in conjunction with technical assistance. • Develop a landscape auditing program (analogous to an energy audit) to instruct property owners about the first steps for controlling invasive species and planting natives on their properties.
Soil Degradation	• Educate private property owners on the importance of soil regeneration and low-impact lawn maintenance. • Teach landowners about soil structure and the soil food web, along with techniques for regenerating soil. • Teach landowners about planting alternatives to lawns; these alternatives can serve many purposes, including carbon sequestration, reducing fossil fuel consumption, soil building, and providing pollinator habitat.	• As part of a tree auditing program (described in the cell below), instruct property owners on the first steps for improving soils on their properties. • As part of a landscape auditing program (analogous to an energy audit), instruct property owners on the first steps for improving soils on their properties. • Offer technical assistance for soil erosion mitigation.
Community Forest	• Expand the community forest ecosystem education initiative. • Advocate for planting the right tree in the right place. • Advocate for increased species diversity and the planting of appropriate native trees. • Teach about tree maintenance.	• Expand the City tree sale to increase tree planting on private property. • Develop a tree auditing program (analogous to an energy audit) to instruct property owners on the first steps for improving the tree canopy on their properties.

Table 4.4 Opportunities for Private Property Natural Resource Management (Continued)

Topic	Education & Outreach	Technical Assistance & Incentives/Cost-Share
Pollinator Species	• Educate citizens on the value of pollinator species and how to enhance and restore habitat on their properties.	• Provide an incentive or cost-share program for property owners to plant pollinator species on their property.
Invasive Species	• Teach about the impacts of invasive species and how they can be identified and controlled.	• Provide incentives for private landowners to control invasive vegetation on their property. • Develop a landscape auditing program (analogous to an energy audit) to instruct property owners on the first steps for controlling invasive species and planting natives on their properties.
Herbivory	• Educate Minnetonka citizens on the natural role of deer and how to nurture balanced populations of plants and animals. • Promote the state's jumping worm alert program to alert residents to the hazard of importing potentially infested mulch, soil, and plants into their landscapes. • Teach about the impact of earthworms and how they affect Minnesota forests.	• Promote tree protection measures within the tree sale, including the sale of tree protection items.
Urban Heat Island Effect	• Educate private property owners about the advantages of planting trees and the ideal tree-planting locations for energy savings and pavement shading. • Teach about the best roofing and pavement materials to reduce heat accumulation.	• Develop a heat island mitigation program to collect fees for trees impacted during building development projects. Funds would be used to plant trees in urbanized areas with greater than 85% impervious surfaces. • Develop incentive/cost share programs for properties reducing total pervious surface footprint. Continue and amplify the City tree sale. • Develop an urban heat island plan. Investigate appropriate pavements and roofing materials for City projects.
Climate Change	• Teach citizens about the impacts of climate change and instruct them on how they can act to prevent issues on their properties and through volunteer activities. • Raise awareness on innovative practices/adaptations that both Minnetonka and other communities have been exploring to combat and adapt to climate change	• Develop a climate adaptation and mitigation plan for Minnetonka. • Amplify the City tree sale and native plant sale. • Develop an urban heat island plan. Investigate appropriate pavements and roofing materials for City projects.
Altered Hydrology within Green Spaces	• Educate property owners about low-input landscape management. • Teach about the management of natural areas within private properties. Encourage the restoration of native plant communities, the regeneration of soil, and the restoration of hydrologic function.	• As part of a tree auditing program, instruct landowners on the first steps for improving soils on their properties. • As part of a landscape auditing program (analogous to an energy audit), instruct property owners on the first steps for green space improvements and maintenance on their properties.

4.3 Climate Change

Climate Adaptation Strategies

The Issues and Opportunities section (Section3) presents climate adaptation opportunities. Much of what we can do to protect our existing natural resources also helps these resources adapt to climate change. By improving the health of ecological communities, they become more resilient to the stresses of climate change.

Here's what we can do in Minnetonka:

Watch for Changes

Be aware of changes to natural resources so we can proactively address unwanted impacts of climate change.

- Monitor and aggressively control new invasive species to reduce competition and allow for reproduction and perpetuation of native plant communities.
- Scout new invasive species by developing a volunteer pest-detector program.
- Develop an urban forest monitoring initiative to be conducted by City staff.
  - » Monitor for new pests and evaluate current insect and disease levels.
  - » Monitor changes in tree species on public and private properties due to flooding, temperatures, and drought.
  - » Look for shifts in species composition in select Minnetonka woodlands.
- Monitor human pests and diseases such as mosquito and tick-borne illness.

Reduce Stress on Natural Resources

Reducing stress on natural resources will allow for vigor and resilience in the face of degrading forces of climate change.

- Restore a diversity of native habitats to meet the lifecycle requirements of diverse plant, pollinator and wildlife species.
- Work to rejuvenate soils in urban and natural areas to support resilient plant communities, build healthy soil structure, allow for stormwater infiltration, and prevent erosion.
- Allocate additional funding to support natural resources management on City properties, focusing on high priority areas and building on past restoration successes.
- Increase the use of fire as a management tool, especially in woodlands and savannas. Fire is a natural disturbance that builds community resilience.
- Manage existing invasive species and control new invasive species more aggressively to allow native species to proliferate.
- Promote the state's jumping worm alert program to alert residents to the hazard of importing potentially infested soil and plants into their landscapes.
- Continue managing white-tail deer populations to protect plant communities from herbivory.
- Provide incentives for private landowners to control invasive vegetation on their property. Introduce cost-share programs for landowners who plant native plants.
- Continue planting a diversity of tree species on public land and offer a diversity of species for planting on private property via the tree sale and other incentive programs.
- Manage landscape beds for dense vegetative cover and keep beds mulched to protect soils.

Increasing the use of fire as a management tool can build community resilience and help to reduce stress on Minnetonka's natural resources.

Allow and Facilitate Species Movement

Plant and animal species need to shift their natural range. Nurturing appropriate habitats will accommodate their lifecycle needs.

- Develop plans to assist the migration of plant species through plantings in Minnetonka natural areas. Trees and herbaceous plants are the structure for wildlife habitat and will accommodate shifting wildlife movement.
- Develop a climate-adapted tree list and make available to the public, developers, and project managers.
- Purchase or grow climate-adaptive tree species in the city's gravel-bed nursery and make available for planting in public and private property.
- Replace unused lawn with alternative plantings that provide habitat.
- Promote conservation easements to preserve habitats.

Protect Ourselves

The health and wellbeing of Minnetonka citizens are in jeopardy from intense storms, weather extremes and prolonged stresses on our immediate environment.

- Prioritize planting trees in Minnetonka's heat islands map (see Figure 2.12 & 2.13). Remove unused pavements wherever possible and develop appropriate soil volumes to allow for full tree growth.
- Plant trees to shade pavement along streets and in parking lots.
- Ensure the longevity of trees on streets and in parking lots by providing adequate soil volumes in highly paved areas.
- Assess City parking requirements for commercial/office developments and determine how many parking spaces are required. Consider changes to Minnetonka development requirements that reduce required parking spaces.
- Provide additional funding for the community forest management program to maintain the significant number of trees in Minnetonka.
- Continue to protect City staff from extreme heat and storm events.

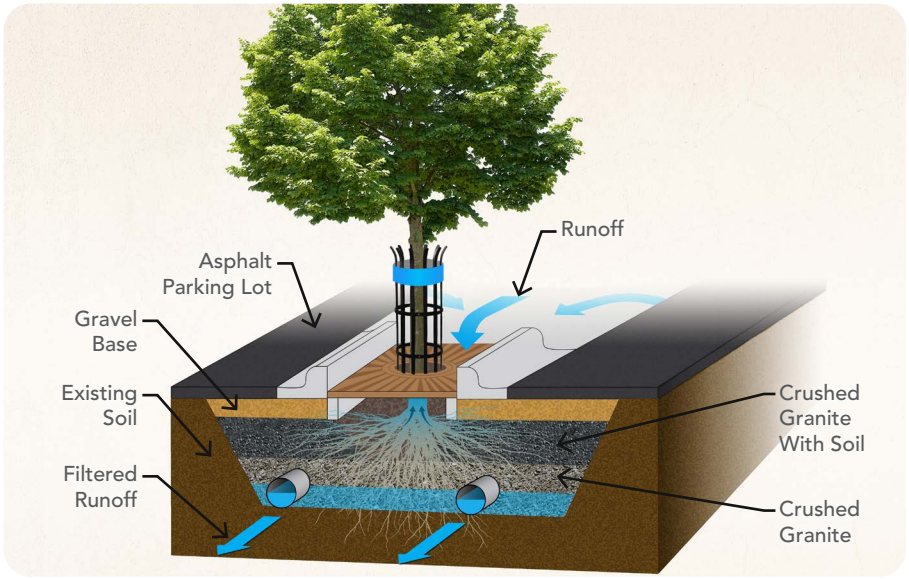
Educate Ourselves

- Educate citizens about the impacts of climate change and instruct them on how to take action.
- Plant lawn alternatives to reduce greenhouse gas emissions (through reduced maintenance requirements) and facilitate the growth of plants that sequester carbon. Teach about planting alternatives to lawns which can serve many purposes, including carbon sequestration, reduced fossil fuel consumption, soil building, and pollinator-habitat creation.
- Educate the public on the importance of soil regeneration to promote vegetation health and resilience.
- Educate citizens about low-input lawn maintenance, organic landscape care, and managing natural areas on private property. Encourage the restoration of vegetation, the regeneration of soil, and the restoration of hydrologic function.
- Educate the public about invasive species and out-of-balance native species and how they affect Minnesota forests.
- Educate property owners on both low-input landscape management and the management of natural areas they may own.

Lead by Example

Show how citizens of Minnetonka can address climate adaptation.

- Alter development ordinances to reduce carbon footprint and better protect natural resources.
- Restore and manage city-owned natural areas.
- Demonstrate alternative landscape design and practices on City properties.
- Reduce the amount of pavement on City projects.
- Capture stormwater in landscapes and regenerate soil on all City projects.



To mitigate the accumulation of heat in paved areas tree trench technology can be implemented to provide structural support of the pavement while providing adequate rooting volume for trees.

The photo above is native plantings on the Minnetonka City Hall campus. The image illustrates how Minnetonka can continue to demonstrate environmentally sound landscape practices and lead by example.

4.4 Natural Resources Policies and Ordinances

The following are the policies and ordinances that regulate the management of natural resources in the City of Minnetonka. Some of these policies are implemented by the city's Natural Resources Division staff while others are a collaboration with other City divisions. Many of them have recently been updated.

Policies

- Plant Pest Program, Council Policy 8.3 amended June 18, 2018
- Private Uses of Public Easement Areas, Council Policy 11.3 amended April 16, 2018
- Open Space Preservation Program, and the Management of Natural Resources, Council Policy 11.11 amended August 25, 2003
- Lake and Pond, Council Policy 12.11 amended Nov. 5, 2018
- Deer Population, Council Policy 9.3 amended May 19, 2014

Ordinances

- Tree Protection, Section 300.28.19 amended October 18, 2021
- Wetland Protection, Section 300.23 amended March 24, 2008
- Shoreland District, Section 300.25 amended June 25, 2012
- Landscaping, Section 300.27 amended July 22, 2019
- Special Provisions – Lawn Maintenance, Section 845.03 amended June 8, 2020

Opportunities for the Development and Improvement of Policies and Ordinances

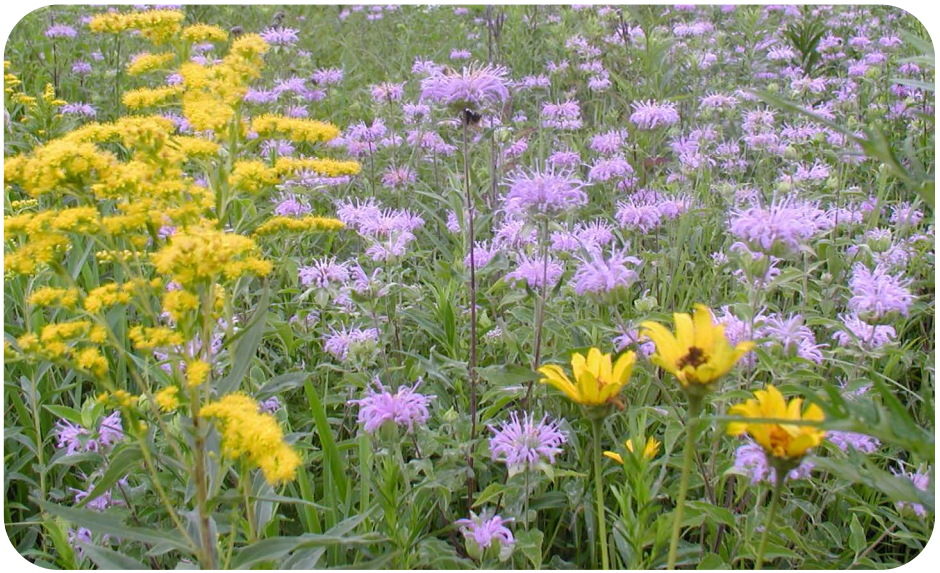
Develop a Soil Protection and Regeneration Ordinance
Soils are a foundation for natural resources. When managed well, they facilitate climate resilience for both the planted and natural landscape. Conditioning healthy soils also reduces maintenance costs because the soils are more fertile and hold more water and oxygen. Plants are healthier and more disease/insect resistant in healthy soils. Minnetonka may consider both an ordinance and a policy:

- Ordinance—An ordinance to address soils improvement should focus on construction projects, but could be explored to be broader. Such an ordinance could address site-design considerations to reduce impacts to soil and address actions necessary to regenerate damaged soil after construction.
- Policy—From buildings to roads, the City could develop a policy to reduce soil impacts and regenerate soils on city-sponsored construction projects.

Amend the Private Uses of Public Easement Areas Policy
This policy restricts the planting of trees within 15 feet of streets, limiting the opportunities to use trees for shade and address the urban heat island effect. Consider changing this policy to allow trees to be planted closer to streets.

Revise Parking Stall and Street Width Policies
Impervious surfaces impact our urban ecology in many ways, and limiting the extent of new pavement will prevent conditions such as heat accumulation. As cultural changes influence our need for driving and parking—for example, more people working from home and more online shopping—less pavement may be necessary. Consider reducing the number of parking stalls required in new developments and consider developing a "complete streets" policy that may reduce the size of streets.

Consider Setting a "Do-Not-Exceed" Turf Percentage in the Landscaping Ordinance
When actively used, turf is a great groundcover. However, much lawn is never used and could be replaced with alternative plantings that sequester carbon, reduce the use of gas-burning mowers, eliminate the need for irrigation and pesticides, and provide habitat. The City could amend its Landscaping Ordinance to limit the planting of resource-consumptive lawns.



Adopting an ordinance that limits the amount of unused turf would provide essential habitat for many species, especially birds, bees, and butterflies.

Image Source: City of Minnetonka

4.5 Engagement with People

Partnerships

Minnetonka's extensive natural resources goals are made more achievable by partnering with agencies and organizations that share similar goals. The City should continue partnerships with the following, and foster additional partnerships as warranted:

Local/Nonprofit: Friends of Minnetonka Parks and other community Friends groups, Minnetonka and Hopkins school districts, geocache enthusiasts, Minnesota Off Road Cyclists (MORC), neighboring municipalities, Metro Watershed Partners, GreenStep Cities, Metro Blooms/Blue Thumb

County: Hennepin County Environmental Services, Three Rivers Park District

Watershed: Nine Mile Creek Watershed District, Riley Purgatory Bluff Creek Watershed District, Minnehaha Creek Watershed District, Basset Creek Watershed Management Commission, Watershed Partners

State: Minnesota Department of Natural Resources, Minnesota Pollution Control Agency, Minnesota Department of Public Health, Minnesota Board of Water and Soil Resources

Federal: U.S. Fish and Wildlife Service

Outreach, Education and Engagement

Minnetonka's Natural Resources division works with other City departments and partner agencies and organizations to enact programs that protect and enhance the city's natural resources. Because most of Minnetonka's undeveloped and natural spaces are on private property, residents, businesses, and industries are also key partners in natural resource protection.

Outreach

Outreach is the creation of public awareness of City policies, programs, goals and opportunities, such as special events, volunteer programs, trainings, and grants. Outreach is also conducted through publication in the city's monthly print newsletter, the Minnetonka Memo, which is mailed to households citywide. Electronic and virtual forms of outreach, including monthly e-newsletters, social media, highway billboards, and the City website are also used to reach out to Minnetonka residents.

Minnetonka's natural resources goals are made more achievable through partnering. The top shows volunteers planting trees in Green Circle Park. The bottom image is a group of Nature Works volunteers that removed garlic mustard at Purgatory Park.

Image Sources: City of Minnetonka

Education

Natural Resources staff strive to offer diverse educational experiences – from workshops and webinars to handouts, story maps, videos and interpretive signage – and will continue to explore new approaches, technologies, audiences, and partnerships. Developing an Education and Outreach Plan soon can deepen this process.

Teaching provides information and skills to residents to better understand and take action on behalf of natural resources. Topics the Natural Resources division addresses include:

- community resilience
- stormwater runoff reduction and surface water protection
- water use efficiency
- soil health
- tree diversity, planting and maintenance
- planning for emerald ash borer and other pests and diseases
- habitat creation, restoration and preservation
- invasive species control
- pollinator and wildlife protection
- other emerging issues.

Engagement

Engagement takes education and outreach to the next level. It transforms awareness into action, and creates partnerships between the City government, residents and other stakeholders invested in natural resources protection. Natural Resources engagement currently includes events (such as the annual tree sale, native plant sale, and the Pollinator Field Day), cost-share grants, and a robust volunteer program. This aspect of natural resources programming will continue to grow.

Volunteerism is an especially crucial form of engagement in Minnetonka. Volunteers bring their enthusiasm, energy, and time to City projects. In turn, they enjoy social connection, gain new skills (or apply prior skills and experience), and a way to create change in the community.

Generally, natural resources volunteers can serve individually or in groups, and choose from a variety of roles, including:

- Habitat restoration – invasive species control, planting and maintenance
- Adopt-a-Spot – year-round restoration work in a particular park
- Wildlife steward - build and/or maintain habitat boxes, monitor species as determined by Natural Resources staff, and related tasks
- Forestry – tree planting and maintenance

In 2021, volunteer work was valued at $28.54 per hour. Several hundred people collectively contribute about 1,600 hours per year. Volunteers significantly extend the Natural Resources division's capacity and potential impact in the community. Individuals and groups, including park Friends groups, girl scouts and boy scouts, geocachers, local business groups, City elected and appointed officials, church groups and others regularly participate in volunteer events.

A robust volunteer engagement program recognizes the importance of recruiting, training, and empowering volunteers to achieve their goals while providing a benefit to the community. A program Logic Model (Appendix E) outlines the necessary components of the further developing Minnetonka natural resources volunteer program to enhance volunteer engagement.

Evaluation

Program evaluation is an important process to determine if engagement strategies are meeting intended goals. Routine evaluation should be conducted (e.g surveys, interviews) to inform future programs and activities.

Technical Assistance and Incentives

One significant way to engage property owners in natural resource protection on private property is by providing technical assistance to those who seek it, along with incentivizing protection activities. The City should consider several strategies for accomplishing this, including:

- Utilize staff technical expertise by providing technical training events and on-site consultations related to tree protection and landscaping projects that promote natural resource enhancement and protection, as staffing allows.
- Pilot a Minnetonka cost-share grant program to provide an incentive to landowners wanting to incorporate natural resources management practices on private property.
- Continue to make trees and native plants available and promote similar programs offered by local watershed districts, the state, and other partners.
- Specific technical assistance an incentive programs are described in Table 4.4 Opportunities for Private Property Natural Resources Management.

A critical form of engagement is volunteerism. Above are volunteer groups (Geocachers and Girl Scouts). These groups provide enthusiasm and energy, and are an effective way to create a positive change in the community.

Image Source: City of Minnetonka

4.6 Future Planning, Research, and Monitoring

Additional planning is recommended to develop more comprehensive strategies for protecting and improving Minnetonka's natural resources. Further planning may include:

- Develop maintenance plans for priority public properties ((Table 4.2 Prioritization and Ranking of Select Minnetonka Parks and Natural Areas) that include specific action plans (e.g. contracted services, volunteer efforts) and annual budgets.
- Update the Parks Management Prioritization table (Table 4.2) every 2-3 years to incorporate accomplishments and reconfigure prioritizations.
- Develop a Community Forest Inventory and Management Plan that focuses on threats to forest health, increasing tree diversity, increasing tree canopy in heat-island areas, and the impacts of climate change.
- Develop a natural resources climate adaptation and mitigation plan that prioritizes natural resources protection.
- Develop an urban heat island mitigation plan that includes strategies and funding for heat dissipation in priority areas.
- Develop a soils management plan that will identify actions to regenerate soils throughout Minnetonka.

Understanding the condition of natural resources and developing action plans that address the threats to those resources requires the collection of data. Potential research and monitoring initiatives include:

- Develop an urban forest monitoring initiative.
  - » Monitor for new pests and evaluate current insect and disease levels.
  - » Monitor the species planted on public and private properties.
  - » Look for shifts in species composition in select Minnetonka woodlands.
- Update the park prioritization and ranking rubric for select Minnetonka parks every two to three years.
- Provide research and experimentation on pertinent forestry topics.
- Continue monitoring deer populations.
- Monitor for new invasive species, including through a volunteer pest-detector program.
- Monitor vectors of human disease, including mosquitoes and ticks.
- Work with volunteer naturalists to monitor bird and wildlife populations.

Planning, research, and monitoring provide intention, critical information and momentum to protect and restore Minnetonka's natural resources.

Image Source: City of Minnetonka